DRAINAGE REPORT

For

1165R MASS MA PROPERTY LLC

PROPOSED

Residential Development

1165R Massachusetts Avenue
Arlington, Massachusetts
Middlesex County

Prepared by:

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

Joshua G. Swerling
Massachusetts P.E. Lic. #41697

BOHLER

March 4, 2021
Revised May 5, 2021

#W191330

BOHLER

TABLE OF CONTENTS

LIST OF TABLES

APPENDICES

I. EXECUTIVE SUMMARY

This report examines the changes in drainage that can be expected as the result of the development of a proposed residential development at 1165R Massachusetts Avenue in the Town of Arlington, Massachusetts. The site is approximately 2.3 acres in area and contains mill buildings that have been converted to commercial uses. Approximately 93% of the site has impervious cover either from the mill building roofs or paved parking. Mill Brook bisects the site into east and west parts and Ryder Brook enters the site from the north through a man-made swale where it enters a culvert that discharges into Mill Brook. Mill Brook is channelized through the entire site with concrete masonry channel sides and a concrete channel bottom.

The proposed project includes the construction of two new residential buildings totaling approximately 130 units. The project will result in a decrease in impervious area and therefore mitigation of post-development flows is not necessary. The project will also require the relocation of Ryder Brook around the proposed building. This report addresses a comparative analysis of the pre- and post-development site runoff conditions. Additionally, this report provides calculations documenting the design of the proposed stormwater conveyance/management system as illustrated within the accompanying Site Development Plans prepared by Bohler. The project will also provide erosion and sedimentation controls during the demolition and construction periods, as well as long term stabilization of the site.

For the purposes of this analysis the pre- and post-development drainage conditions were analyzed at a design point at Mill Brook, which is where all of the stormwater runoff from the site currently drains to. A summary of the existing and proposed conditions peak runoff rates and volumes for the 2-, 10-, 25-, and 100-year storms can be found in **Table 1.1** and **Table 1.2** below. In addition, the project has been designed to meet or exceed the Stormwater Management Standards as detailed herein.

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	6.61	4.92	**-1.69**	10.92	9.28	**-1.64**	14.28	12.75	**-1.53**	19.92	18.57	**-1.35**

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

Table 1.2: Design Point Volume 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	0.511	0.361	**-0.150**	0.868	0.691	**-0.177**	1.153	0.963	**-0.190**	1.634	1.429	**-0.205**

**Volumes are represented in acre-feet (ac-ft)*

II. EXISTING SITE CONDITIONS

Existing Site Description

The site is approximately 2.3 acres in area and contains mill buildings that have been converted to commercial uses. The majority of the site has impervious cover either from the mill building roofs or paved parking. Mill Brook bisects the site and Ryder Brook also enters the site from the north through a man-made swale where it enters a culvert that discharges into Mill Brook. Mill Brook is channelized through the entire site with concrete masonry channel sides and a concrete channel bottom.

On-Site Soil Information

The majority of the soils at the site are mapped as Urban land, Udorthents, and Merrimac-Urban land. The Merrimac-Urban soil is classified by the Natural Resource Conservation Service (NRCS) as Hydrologic Soil Group (HSG) "A". On-site geotechnical testing performed on the site supports the HSG "A" rating and that is what has been used in this analysis. Refer to **Appendix C** for additional information.

Existing Collection and Conveyance

Almost the entire site drains by sheet flow to Ryder Brook or directly to Mill Brook. Ryder Brook flows through a 24 inch reinforced concrete pipe to Mill Brook. There is one catch basin behind the building in the southeast corner of the site. It is believed that this catch basin discharges through a pipe under the building to Mill Brook.

Runoff from properties northwest of the site currently drain onto the site. That runoff sheet flows across the site to Ryder Brook.

Existing Watersheds and Design Point Information

The site was subdivided into two (2) separate sub catchments for the existing conditions as described below to analyze existing and proposed flow rates at each design point. The minimum time of concentration for all areas is calculated as 6 minutes (0.1 hr).

Subcatchment E1 is 0.34 acres of pavement and rooftop with a small area of lawn. This area flows overland from high points at Massachusetts Avenue to the southwest down to

Mill Brook. Due to the mostly impervious nature of the drainage area and steep slopes, the time of concentration is the minimum allowable six (6) minutes.

Subcatchment E2 is 1.69 acres of pavement and rooftop with small areas of lawn. This area flows overland from high points at the north and east side of the site down to Mill Brook. Due to the mostly impervious nature of the drainage area, the time of concentration is the minimum allowable six (6) minutes.

Design Point #1 (DP1) is Mill Brook at the south property line where all of the runoff from the site currently drains.

Refer to **Tables 1.1, 1.2, 6.1, and 6.2** for the calculated existing conditions peak rates of runoff and volumes. For additional hydrologic information, refer to **Appendix D** and the Drainage Area Maps in the appendices of this report for a graphical representation of the existing drainage areas.

III. PROPOSED SITE CONDITIONS

Proposed Development Description

The proposed project consists of the construction of two new residential buildings. The larger building will be located on the northeast side of Mill Brook and the other building will be located on the southwest side of the brook. The existing driveways will remain but a new storm sewer system is proposed to capture and treat stormwater runoff for water quality. Pretreatment of stormwater runoff will be provided by deep-sump, hooded catch basins prior to discharging to a water quality unit for final treatment.

Proposed Development Collection and Conveyance

Deep sump hooded catch basins are proposed to collect and route runoff from the proposed paved parking areas to a water quality unit. Pipes have been designed for the 25-year storm using the Rational Method. Pipe sizing calculations are included in **Appendix F**.

The runoff from the off-site properties to the north draining into the site will continue to flow into the site. The majority of that runoff will sheet flow to the open swale proposed for the relocation of Ryder Brook. Some of the runoff will enter the proposed storm sewer system where it will be collected and routed through the proposed water quality unit.

The best management practices (BMPs) incorporated into the proposed stormwater management system have been designed to meet the total suspended solid (TSS) removal requirements as set forth in the Massachusetts Department of Environmental Protection Stormwater Handbook standards. Refer to **Appendix F** for calculations. In addition, a Stormwater Operation and Maintenance (O&M) Plan, attached in **Appendix G**, has been developed which includes scheduled maintenance and periodic inspections of stormwater management structures.

Proposed Watersheds and Design Point Information

The project has been designed to maintain existing drainage watersheds to the greatest extent possible, with the same design points described in **Section II** above. The site was subdivided into two (2) separate sub catchments for the proposed conditions as described

below. The minimum time of concentration for all proposed areas is calculated as 6 minutes (0.1 hr).

Proposed drainage areas are similar to existing and have been divided into two areas, one north of Mill Brook and the other south of Mill Brook. Subcatchment P1 consists of 0.34 acres of mostly impervious area with a CN of 94 and time of concentration of 6 minutes. This is the area on the south side of the site draining to Mill Brook.

Subcatchment P2 consists of 1.69 acres of mostly impervious area with some areas of lawn with a CN of 83 and time of concentration of 6 minutes. This is the area on the north side of the site draining to Mill Brook.

Refer to **Tables 1.1 and 6.1** for the calculated proposed conditions peak rates of runoff. For additional hydrologic information, refer to **Appendix D** and the Drainage Area Maps in the appendices of this report for a graphical representation of the proposed drainage areas.

IV. METHODOLOGY

Peak Flow Calculations

Methodology utilized to design the proposed stormwater management system includes compliance with the guidelines set forth in the latest edition of the Massachusetts DEP Stormwater Handbook. The pre- and post-development runoff rates being discharged from the site were computed using the HydroCAD computer program. The drainage area and outlet information were entered into the program, which routes storm flows based on NRCS TR-20 and TR-55 methods. The other components of the model were determined following standard NRCS procedures for Curve Numbers (CNs) and times of concentrations documented in the appendices of this report. The rainfall data utilized and listed below in table 4.1 below for stormwater calculations is based on NOAA 14+. Refer to **Appendix F** for more information.

Table 4.1: NOAA 14+ Rainfall Intensities

Frequency	2 year	10 year	25 year	100 year
Rainfall* (inches)	3.64	5.79	7.49	10.35

The proposed stormwater management as designed will provide a decrease in peak rates of runoff from the proposed facility for the 2-, 10-, 25- and 100-year design storm events. Additionally, the proposed project meets, or exceeds, the MADEP Stormwater Management standards. Compliance with these standards is described further below.

Ryder Brook Relocation

Analysis of the Ryder Brook watershed is difficult due to the number of streets within the watershed. Each road has a storm sewer system that may divert runoff out of the watershed. Rather than attempting to analyze the watershed and making assumptions about where each road drains to, the proposed pipe was sized based on the 24-inch existing concrete pipe.

The proposed pipe is 30 inches in diameter and will have double the capacity of the existing 24-inch pipe, based on the Mannings Formula for pipe capacity. There are no known flooding issues at the site, and based on the increase in capacity and decrease in impervious area and peak flows resulting from this project, the proposed 30-inch pipe should be sufficient to adequately convey flows. Calculations documenting swale and pipe capacities are included in Appendix F.

V. DEP STORMWATER MANAGEMENT STANDARDS

Standard #1: No New Untreated Discharges

The project has been designed so that proposed areas of vehicular traffic will be collected and passed through the proposed drainage system for treatment prior to discharge. The proposed system will discharge at an existing outfall point at Mill Brook.

Standard #2: Peak Rate Attenuation

The proposed decrease in impervious area will result in a decrease in post-development peak rates of runoff from pre-development conditions for the 2-, 10-, 25- and 100-year storm events.

Standard #3: Recharge

The proposed decrease in impervious area will result in an increase in groundwater recharge. No additional stormwater infiltration measures are necessary.

Standard #4: Water Quality

Runoff from exterior parking areas and driveways will be collected in the proposed storm sewer system. Water quality treatment will be provided via deep sump catch basins and a proprietary water quality unit.

Standard #5: Land Use with Higher Potential Pollutant Loads

Not Applicable for this project.

Standard #6: Critical Areas

Not Applicable for this project.

Standard #7: Redevelopment

The site is a redevelopment, and all applicable stormwater standards will be met to the maximum extent practicable.

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

The proposed project will provide construction period erosion and sedimentation controls to be designed in the final site plan set for this project. This will include a proposed construction exit, protection for stormwater inlets, protection around temporary material stock piles 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 will be prepared outlining procedures and time tables for the long term operation and maintenance of the proposed site stormwater management system, including initial inspections upon completion of construction, and periodic monitoring of the system components, in accordance with established practices and the manufacturer's recommendations. The O&M Plan will include a list of responsible parties and an estimated budget for inspections and maintenance.

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.

VI. SUMMARY

In summary, the proposed stormwater management system illustrated on the drawings prepared by Bohler results in a reduction in peak rates of runoff from the subject site when compared to pre-development conditions for the 2-, 10-, 25- and 100-year storm frequencies. In addition, the proposed best management practices will result in an effective removal of total suspended solids from the post-development runoff. The pre-development versus post-development stormwater discharge comparisons are contained in **Table 6.1** below:

Table 6.1: 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	6.61	4.92	**-1.69**	10.92	9.28	**-1.64**	14.28	12.75	**-1.53**	19.92	18.57	**-1.35**

Table 6.2: Design Point Volume 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	0.511	0.361	**-0.150**	0.868	0.691	**-0.177**	1.153	0.963	**-0.190**	1.634	1.429	**-0.205**

**Volumes are represented in acre-feet (ac-ft)*

As outlined in the tables above, the proposed stormwater management system as designed will provide a decrease in peak rates of runoff from the proposed facility for the 2-, 10-, 25- and 100-year storm events. Additionally, the project meets, or exceeds the MADEP Stormwater Management Standards as described further herein.

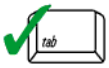
APPENDIX A: MASSACHUSETTS STORMWATER MANAGEMENT CHECKLIST

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

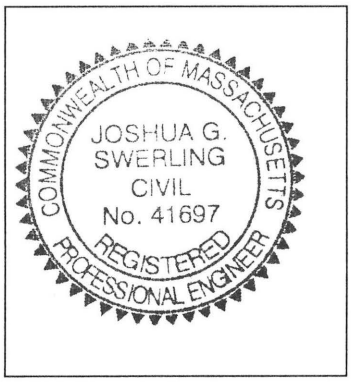
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



Joshua G Swerling April 1, 2021

Signature and Date

Checklist

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

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☐ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

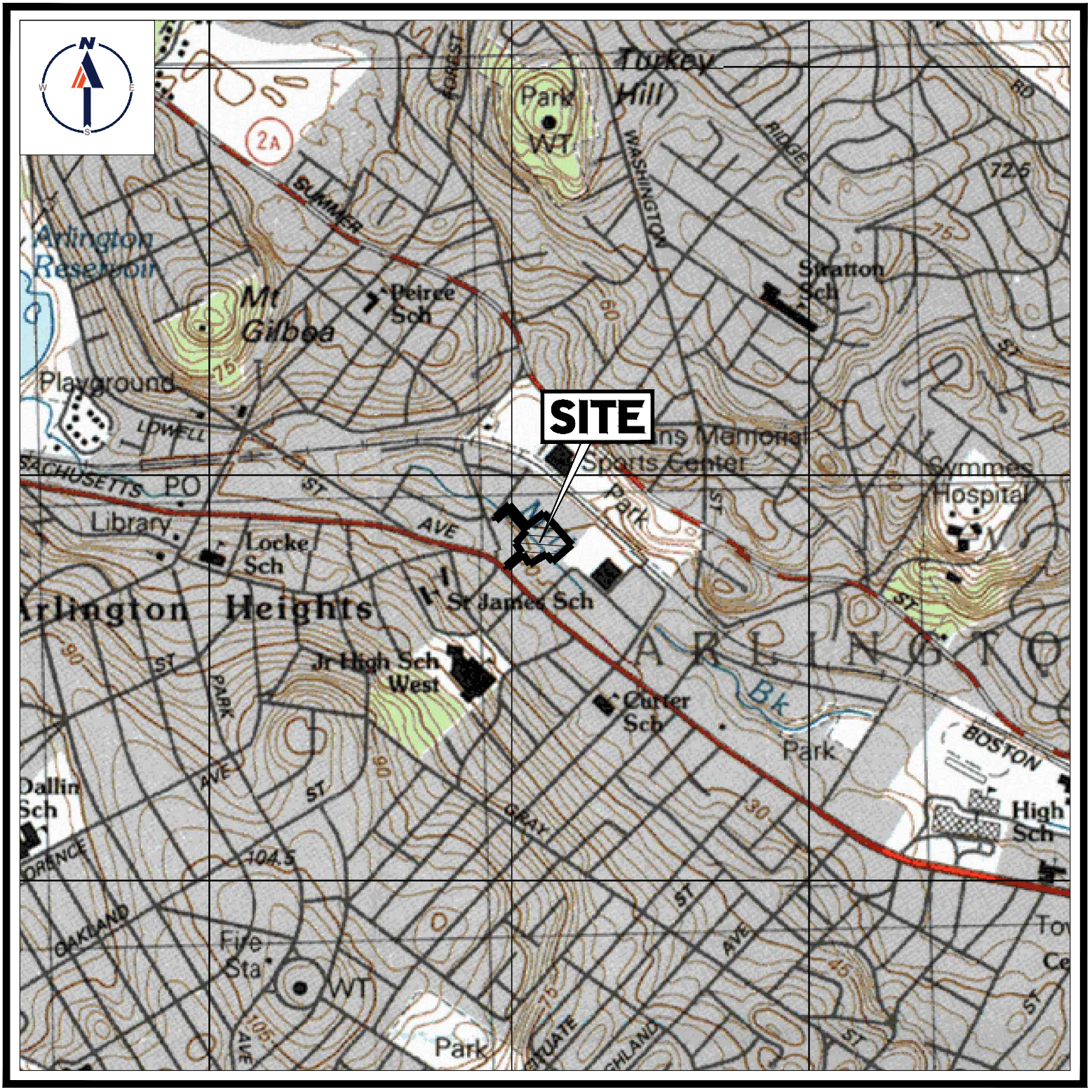
☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

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

APPENDIX B: PROJECT LOCATION MAPS

- *USGS MAP*
- *FEMA FIRMETTE*



USGS MAP

SCALE: 1" = 1,000'
SOURCE: BOSTON NORTH MASSACHUSETTS USGS QUADRANGLE

National Flood Hazard Layer FIRMette

FEMA

Feet

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

1:6,000

Legend

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

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

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

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

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

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

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

N

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

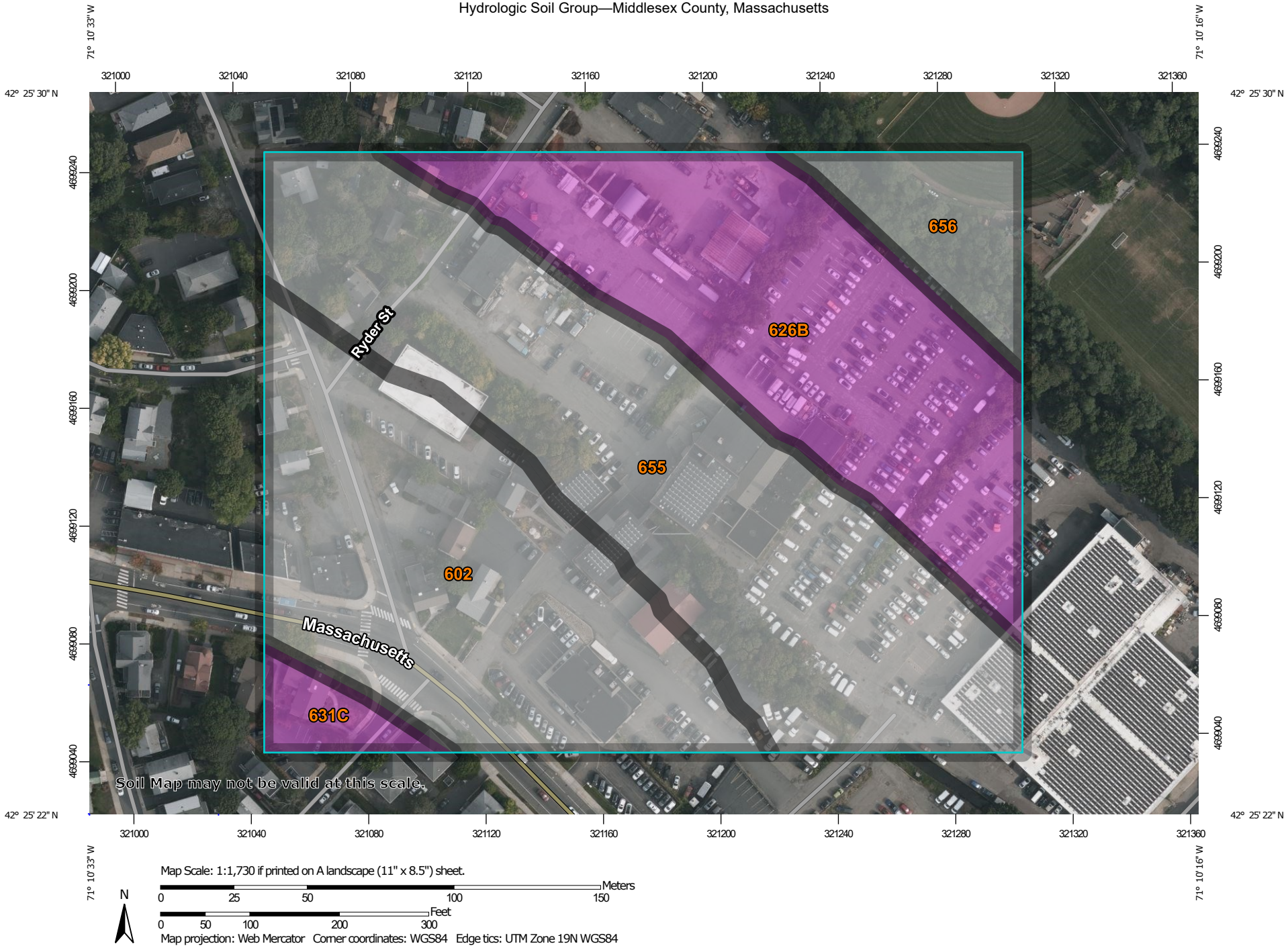
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/11/2019 at 8:51:54 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

APPENDIX C: SOIL AND WETLAND INFORMATION

- *NCRS CUSTOM SOIL RESOURCE REPORT*
- *SOIL BORING LOGS*



Map Scale: 1:1,730 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 25 50 100 150

Feet: 0 50 100 200 300

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Lines

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Points

A
A/D
B
B/D
C
C/D
D
Not rated or not available

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: Middlesex County, Massachusetts
Survey Area Data: Version 19, Sep 12, 2019

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

Date(s) aerial images were photographed: Sep 11, 2019—Oct 5, 2019

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
602	Urban land		3.6	27.9%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	A	3.5	26.5%
631C	Charlton-Urban land-Hollis complex, 3 to 15 percent slopes, rocky	A	0.3	2.4%
655	Udorthents, wet substratum		4.9	37.4%
656	Udorthents-Urban land complex		0.8	5.8%
Totals for Area of Interest			**13.1**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

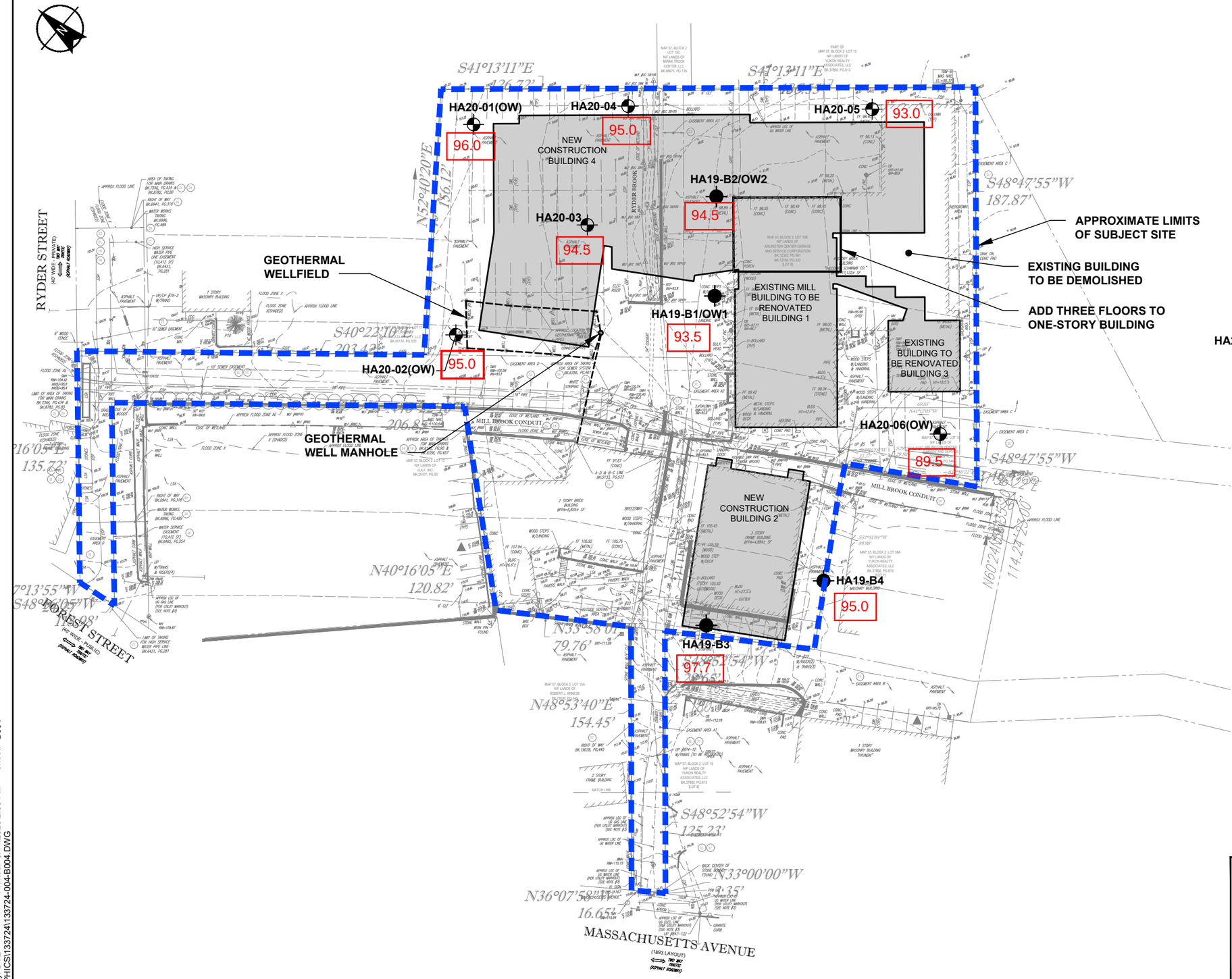
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



LEGEND

HA20-01(OW)	DESIGNATED AND APPROXIMATE LOCATION OF TEST BORING DRILLED BY NEW ENGLAND BORING CONTRACTORS FROM 13 TO 17 AUGUST 2020 AND OBSERVED BY HALEY & ALDRICH STAFF
HA19-B-1/ OW-1	DESIGNATION AND APPROXIMATE LOCATION OF TEST BORING/ OBSERVATION WELL DRILLED BY NORTHERN DRILL SERVICES, INC. OF NORTHBOROUGH, MASSACHUSETTS DURING THE PERIOD 5 TO 6 DECEMBER 2019 AND MONITORED BY HALEY & ALDRICH, INC. PERSONNEL
(OW)	INDICATES OBSERVATION WELL INSTALLED IN COMPLETED BOREHOLE
94.5	TOP OF GLACIAL SOILS (EL. IN FEET)

NOTE

1. BASE PLAN TAKEN FROM A DRAWING TITLED "ALTA/NSPS LAND TITLE SURVEY, SPAULDING & SLYE INVESTMENTS", PREPARED BY CONTROL POINT ASSOCIATES, INC., DATED 16 MARCH 2020.

HALEY ALDRICH

1165R MASSACHUSETTS AVENUE
ARLINGTON, MASSACHUSETTS

SITE AND SUBSURFACE EXPLORATION LOCATION PLAN

SCALE: AS SHOWN
SEPTEMBER 2020

FIGURE 2

Saved by: DTE Printed: 9/11/2020 2:50 PM Sheet: B004
J:\GRAPHICS\133724\133724-004-B004.DWG

TEST BORING REPORT

Boring No. HA19-B1 (OW)

Project	MIRAK MILL, 1165 MASSACHUSETTS AVE
Client	551 FUND AQUSITIONS LLC
Contractor	NORTHERN DRILL SERVICE, INC.

File No. 133724-002
Sheet No. 1 of 1
Start December 5, 2019
Finish December 5, 2019
Driller Z. Nader, J. Stevens
H&A Rep. N. Lescalleet
Elevation 98.0
Datum
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: Diedrich D-25, ATV
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: Driven to 14.0 ft
				Hoist/Hammer: Automatic Hammer
				PID Make & Model: Tiger

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	PID Readings (ppm)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	4 2 3	S1 1	0.0 2.0	ND	SP		97.5 0.5	-BITUMINOUS CONCRETE- Very loose gray poorly graded SAND (SP), mps 0.1 in., no structure, no odor, dry			10	80	10					
	4 5 5 45	S2 14	2.0 4.0	0.1	SM			-FILL- Medium dense light brown silty SAND with gravel (SM), mps 1.7 in., no structure, no odor, moist	5	10	10	20	20	35				
5	16 22 29 46	S3 12	4.0 6.0	ND	SW-SM		93.5 4.5	Dense light brown to gray brown well graded SAND with silt and gravel (SW-SM), mps 1.7 in., no structure, no odor, moist	10	15	10	50	5	10				
	30 25 29 23	S4 20	6.0 8.0	ND	SW-SM			Similar to above, except very dense, wet -GLACIOFLUVIAL DEPOSITS-	10	15	10	50	5	10				
	26 42 32 37	S5 10	8.0 10.0	ND	SW-SM			Similar to above, except MPS 6.0 in. Note: Drove casing through ~6.0 in. cobble blew ~9.5-10.0 ft.	10	15	10	50	5	10				
10	20 30 22 26	S6 10	10.0 12.0	ND	SW-SM			Very dense light brown to gray brown well graded SAND with silt and gravel (SW-SM), mps 3.0 in.,no structure, no odor, wet	10	15	10	50	5	10				
	28 22 48 50/2"	S7 24	12.0 13.6					Similar to above										
15	27 37 50 52	S8 8	14.0 16.0	ND	SW-SM			Similar to above, except pocket of suspected weathered gravel from 14.0-14.5 ft	15	10	10	25	30	10				
							82.0 16.0	-BOTTOM OF EXPLORATION 16.0 FT-										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/5/2019					~7.0

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

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

Summary
Overburden (ft) 16.0
Rock Cored (ft) -
Samples S8

Boring No. HA19-B1 (OW)

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

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

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

TEST BORING REPORT

Boring No. HA19-B2 (OW)

Project	MIRAK MILL, 1165 MASSACHUSETTS AVE
Client	551 FUND AQUSITIONS LLC
Contractor	NORTHERN DRILL SERVICE, INC.

File No. 133724-002
Sheet No. 1 of 1
Start December 5, 2019
Finish December 6, 2019
Driller Z. Nader, J. Stevens
H&A Rep. N. Lescalleet
Elevation Datum 98.5
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: Diedrich D-25, ATV
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: Driven to 14.0 ft
				Hoist/Hammer: Automatic Hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	PID Readings (ppm)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							98.0	-BITUMINOUS CONCRETE-										
	5 3 3	S1 12	0.0 2.0	NP	SM		0.5	Loose dark gray silty SAND with gravel (SM), mps 1.0 in., no structure, no odor, dry, trace brick -FILL-	5	10	10	15	30	30				
	6 8 6 16	S2 4	2.0 4.0	0.1	SM		96.0 2.5 94.5	Medium dense light brown to orange brown poorly graded SAND (SP), mps 0.1 in., no structure, no odor, dry -FILL-			10	80	10					
	22 64 33 32	S3 14	4.0 6.0	0.1	SM		4.0	Very dense light brown to gray brown silty SAND with gravel (SM), mps 1.7 in., no structure, no odor, dry	10	10	15	20	20	25				
5	8 12 38 52	S4 16	6.0 8.0	0.1	SW-SM			Very dense well graded SAND with silt and gravel (SW-SM), mps 1.5 in., no structure, no odor, wet, pockets of light brown to dark gray fine sand -GLACIOFLUVIAL DEPOSITS-	10	15	10	50	5	10				
	12 34 24 22	S5 16	8.0 10.0															
10	22 34 38 56	S6 14	10.0 12.0	ND	SM		88.5 10.0	Very dense silty SAND with gravel (SM), mps 1.7 in., no structure, no odor, wet	10	10	15	20	20	25				
	50 44 55 54	S7 18	12.0 14.0	ND	SM			Similar to above -GLACIOFLUVIAL DEPOSITS-	10	10	15	20	20	25				
15	29 38 85/4"	S8 10	14.0 15.4	ND	SM			Similar to above, piece of coarse gravel lodged in tip of spoon. Hit cobble at about 15.2 ft.	10	10	15	20	20	25				
							83.1 15.4	-BOTTOM OF EXPLORATION 15.4 FT-										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/6/2019					~6.0

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

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

Summary
Overburden (ft) 15.4
Rock Cored (ft) -
Samples S8
Boring No. HA19-B2 (OW)

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

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

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

TEST BORING REPORT

Boring No. HA19-B3

Project	MIRAK MILL, 1165 MASSACHUSETTS AVE
Client	551 FUND AQUSITIONS LLC
Contractor	NORTHERN DRILL SERVICE, INC.

File No. 133724-002
Sheet No. 1 of 1
Start December 6, 2019
Finish December 6, 2019
Driller Z. Nader, J. Stevens
H&A Rep. N. Lescalleet
Elevation 105.0
Datum
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: Diedrich D-25, ATV
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: Driven to 12.0 ft
				Hoist/Hammer: Automatic Hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	PID Readings (ppm)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	4 5 6 8	S1 NR	0.0 2.0	0.1		104.5 0.5	-BITUMINOUS CONCRETE- Note: No recovery for 0-2.0 ft and 2.0-4.0 ft with 2 in. spoon. Overdrove 3 in. spoon 0-4.0 ft for sample.										
	10 12 4 3	S2 NR	2.0 4.0	0.1	ML		Medium dense light brown SILT with sand (ML), mps 0.1 in., no structure, no odor, dry -FILL-					20	80				
	2 3 4 6	S3 14	4.0 6.0	0.2	ML	101.0 4.0	Similar to above, except loose					20	80				
5	8 12 11 17	S4 22	6.0 8.0	0.2	ML	99.0 6.0 97.7 7.3	Similar to above, except medium dense -FILL-					20	80				
	12 12 16 18	S5 8	8.0 10.0	0.1 ND	SW-SM	95.0	Medium dense light brown to gray brown well graded SAND with silt and gravel (SW-SM), mps 1.0 in., no structure, no odor, dry -GLACIOFLUVIAL DEPOSITS- Similar to above	10 10	10 10	20 20	25 25	25 25	10 10				
10	22 24 30 32	S6 14	10.0 12.0	ND	SW	10.0	Very dense light brown to gray brown well graded SAND with gravel (SW), mps 1.7 in., no structure, no odor, dry -GLACIOFLUVIAL DEPOSITS-	10	10	25	25	25	5				
	22 50 36 52	S7 10	12.0 14.0	ND	SW		Similar to above	10	10	25	25	25	5				
	55 20 18 22	S8 NR	14.0 16.0	ND	SW	91.0 14.0 89.0	Similar to above, except dense	10	10	25	25	25	5				
15						16.0	-BOTTOM OF EXPLORATION 16.0 FT-										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/6/2019					~14.0

Sample ID

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

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 16.0
Rock Cored (ft) -
Samples S8

Boring No. HA19-B3

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

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

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

TEST BORING REPORT

Boring No. HA19-B4

Project	MIRAK MILL, 1165 MASSACHUSETTS AVE
Client	551 FUND AQUSITIONS LLC
Contractor	NORTHERN DRILL SERVICE, INC.

File No. 133724-002
Sheet No. 1 of 1
Start December 6, 2019
Finish December 6, 2019
Driller Z. Nader, J. Stevens
H&A Rep. N. Lescalleet
Elevation 99.0
Datum
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: Diedrich D-25, ATV
Inside Diameter (in.)	4	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	140	140	-	Drill Mud: None
Hammer Fall (in.)	30	30	-	Casing: Driven to 12.0 ft
				Hoist/Hammer: Automatic Hammer
				PID Make & Model:

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	PID Readings (ppm)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0	6 12 15	S1 10	0.0 2.0	0.2	SM	98.5 0.5	-BITUMINOUS CONCRETE- Medium dense light brown silty SAND with gravel (SM), mps 1.6 in., no structure, no odor, dry	5	10	20	25	20	20				
	19 8 19 22	S2 12	2.0 4.0	0.3 0.3	SM SW-SM	96.0 3.0	Similar to above Medium dense light brown to gray brown well graded SAND with gravel and silt (SW-SM), mps 1.7 in., no structure, no odor, dry	5 10	10 10	20 20	25 30	20 20	20 10				
5	15 17 23 42	S3 10	4.0 6.0	0.2	SW-SM	95.0 4.0	Similar to above, except dense	10	10	20	30	20	10				
	29 36 42 50	S4 12	6.0 8.0	ND	SW-SM		Similar to above, except very dense -GLACIOFLUVIAL DEPOSITS-	10	10	20	30	20	10				
	24 32 55 40	S5 12	8.0 10.0														
10	40 50/2"	S6 10	10.0 10.7	ND ND	SW		Very dense light brown to gray brown well graded SAND with gravel (SW), mps 1.7 in., no structure, no odor, wet. Split spoon bouncing at ~10.5 ft refusal at 10.7 ft. Note: Rig chatter and cuttings indicate drilling through ~1.0-1.5 ft boulder starting at about 10.5 bgs.	10	15	20	30	20	5				
				ND	GW	85.0 14.0	Very dense light brown to gray brown well graded GRAVEL with sand (GW), mps 3.0 in., no structure, no odor, wet -GLACIOFLUVIAL DEPOSITS-	30	40	10	10	10					
15						83.0 16.0	-BOTTOM OF EXPLORATION 16.0 FT-										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
12/6/2019					~9.0

Sample ID

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

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 16.0
Rock Cored (ft) -
Samples S8

Boring No. HA19-B4

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

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

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

TEST BORING REPORT

Boring No.HA20-01(OW)

Project	1165R MASSACHUSETTS AVENUE, ARLINGTON, MA
Client	1165R MASS MA VENTURES LLC
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 133724-004
Sheet No. 1 of 1
Start August 13, 2020
Finish August 13, 2020
Driller M. Soucy
H&A Rep. S.Shay
Elevation 101.0 (est.)
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: Tracked, Mobile Drill B53
Inside Diameter (in.)	4.0	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	300	140	-	Drill Mud: None
Hammer Fall (in.)	24	30	-	Casing: HW Drive to 14.0 ft
				Hoist/Hammer: Winch Automatic Hammer
				PID Make & Model: Tiger PhoCheck (10.6 eV)

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	PID Readings (ppm)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0				2.3	SP		100.7 0.3	-ASPHALT- Medium dense light brown poorly-graded SAND, mps 3 cm, no structure although appears to be disturbed, no odor, dry	10	20	20	20	30					
	5 10 15 19	S1 14	1.0 3.0					-FILL-										
	55 46 44 39	S2 18	3.0 5.0	1.8				Similar to above, except very dense	10	20	15	15	35	5				
5	20 27 40 63	S3 14	5.0 7.0		GP		96.0 5.0	Very dense gray brown poorly graded GRAVEL with sand (GP), mps 3 cm, no structure, no odor, wet	20	40	20	10	10					
							93.0 8.0											
	40 49 45	S4 12	9.0 10.5	0.7	SP-SM			Very dense olive brown poorly graded SAND with silt and gravel, mps 3 cm, no structure, no odor, wet	5	15	15	30	25	10				
10								-GLACIOFLUVIAL DEPOSITS-										
	21 73 53 70	S5 14	14.0 16.0	0.5	SP-SM			Very dense olive brown poorly graded SAND with silt and gravel (SP-SM), mps 3 cm, no structure, no odor, wet	5	10	20	20	35	10				
15							85.0 16.0	BOTTOM OF EXPLORATION 16.0 FT										
								Note: Advanced borehole with roller bit to 15.3 ft. for observation well installation. See "Observation Well Installation Report HA20-01 (OW)" for well construction details.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
8/14/2020	7:15	20.0	Well	16.0	9.5

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

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

Summary
Overburden (ft) 16.0
Rock Cored (ft) -
Samples S5

Boring No. HA20-01(OW)

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

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

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

TEST BORING REPORT

Boring No.HA20-02(OW)

Project	1165R MASSACHUSETTS AVENUE, ARLINGTON, MA
Client	1165R MASS MA VENTURES LLC
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 133724-004
Sheet No. 1 of 1
Start August 13, 2020
Finish August 13, 2020
Driller M. Soucy
H&A Rep. S.Shay
Elevation 100.5 (est.)
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: Tracked, Mobile Drill B53
Inside Diameter (in.)	4.0	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	300	140	-	Drill Mud: None
Hammer Fall (in.)	24	30	-	Casing: HW Drive to 14.0 ft
				Hoist/Hammer: Winch Automatic Hammer
				PID Make & Model: Tiger PhoCheck (10.6 eV)

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	PID Readings (ppm)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							100.2 0.3	-ASPHALT (PARKING LOT)-										
	6 6 7 6	S1 12	1.0 3.0	0.9	SP-SM		98.0	Medium dense brown poorly graded SAND with silt and gravel (SP-SM), mps 3 cm, no structure, no odor, dry	5	10	15	40	20	10				
	3 5 5 8	S2 14	3.0 5.0	0.9	OL/OH		2.5	Stiff dark brown ORGANIC SOIL (OL/OH), mps 1.5 cm, appears to be reworked material, no odor, moist		5			5	90				
							96.5 4.0	-FILL-										
5	14 21 100	S3 10	5.0 6.5	0.3	SP-SM		95.0 5.5	Very dense brown poorly graded SAND with silt (SP-SM), mps 3 cm, no structure, no odor, moist Note: Difficult casing advancement from 5.5 ft.	5	5	15	30	35	10				
10	23 21 24 26	S4 16	9.0 11.0	0.1	SM			Dense dark olive brown silty SAND with gravel (SM), mps 3 cm, no structure no odor, wet	5	10	15	20	35	15				
								-GLACIOFLUVIAL DEPOSITS-										
15	15 15 22 17	S5 8	14.0 16.0	0.3	SM			Dense dark olive brown silty SAND with gravel (SM), mps 3 cm, no structure no odor, wet	5	10	15	20	35	15				
							84.5 16.0	BOTTOM OF EXPLORATION 16.0 FT Note: Advanced borehole with roller bit to 15.3 ft. for observation well installation. See "Observation Well Installation Report HA20-02 (OW)" for well construction details.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
8/13/2020	14:30	None	14.0	16.0	8.9

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

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

Summary
Overburden (ft) 16.0
Rock Cored (ft) -
Samples S5

Boring No. HA20-02(OW)

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

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

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

TEST BORING REPORT

Boring No. HA20-03

Project	1165R MASSACHUSETTS AVENUE, ARLINGTON, MA
Client	1165R MASS MA VENTURES LLC
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 133724-004
Sheet No. 1 of 1
Start August 14, 2020
Finish August 14, 2020
Driller M. Soucy
H&A Rep. S.Shay
Elevation 99.5 (est.)
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: Tracked, Mobile Drill B53
Inside Diameter (in.)	4.0	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	300	140	-	Drill Mud: None
Hammer Fall (in.)	24	30	-	Casing: HW Drive to 14.0 ft
				Hoist/Hammer: Winch Automatic Hammer
				PID Make & Model: Tiger PhoCheck (10.6 eV)

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	PID Readings (ppm)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						99.2 0.3	-ASPHALT (PARKING LOT)-										
	8 6 3 5	S1 8	1.0 3.0	2.7	OL/ OH		Stiff dark brown ORGANIC SOIL with sand (OL/OH), mps 3 cm, re-worked material, no odor, moist	5	5	5	5	5	75				
	12 22 15 18	S2 10	3.0 5.0	6.3	OL/ OH		Stiff dark brown sandy ORGANIC SOIL (OL/OH), mps 3 cm, re-worked material, no odor, moist	5		5	20	20	50				
							-FILL-										
5	26 30 28 37	S3 17	5.0 7.0	2.4	SM	94.5 5.0	Very dense brown to gray brown silty SAND with gravel (SM), mps 2.8 cm, no structure, no odor, dry	5	15	15	15	35	15				
				1.0	SP- SM	91.5 8.0	Very dense gray brown with dark brown weathering poorly graded SAND with silt and gravel (SP-SM), mps 3 cm, no structure, no odor, wet	10	15	15	15	35	10				
10	23 30 25 36	S4 13	9.0 11.0														
							-GLACIOFLUVIAL DEPOSITS-										
	38 70 110	S5 9	14.0 15.5	0.8	SP- SM		Similar to above, including weathered gravel materials	10	15	15	15	35	10				
15						83.5 16.0	BOTTOM OF EXPLORATION 16.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
8/14/2020	10:10	None	14.0	16.0	7.8

Sample ID

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

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 16.0
Rock Cored (ft) -
Samples S5

Boring No. HA20-03

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

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

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

TEST BORING REPORT

Boring No. HA20-04

Project	1165R MASSACHUSETTS AVENUE, ARLINGTON, MA
Client	1165R MASS MA VENTURES LLC
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 133724-004
Sheet No. 1 of 1
Start August 14, 2020
Finish August 14, 2020
Driller M. Soucy
H&A Rep. S.Shay
Elevation 100.0 (est.)
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: Tracked, Mobile Drill B53
Inside Diameter (in.)	4.0	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	300	140	-	Drill Mud: None
Hammer Fall (in.)	24	30	-	Casing: HW Drive to 12.0 ft
				Hoist/Hammer: Winch Automatic Hammer
				PID Make & Model: Tiger PhoCheck (10.6 eV)

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	PID Readings (ppm)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						99.7 0.3	-ASPHALT (PARKING LOT)-										
	4 3 2 3	S1 12	1.0 3.0	84.0	OL/ OH		Loose dark brown ORGANIC SOIL with sand (OL/OH), mps 2.5 cm, no structure, strong gasoline-like odor, moist	5				35	60				
						97.0											
	10 17 26 42	S2 10	3.0 5.0	13.5	SM	3.0	Dense dark brown poorly graded SAND (SM), mps 1.5 cm, no structure, slight gasoline-like odor, moist, 10% organic soil mixed -FILL-		10	20	20	30	20				
5						95.0											
	18 25 36 20	S3 8	5.0 7.0	2.8	SP	5.0	Very dense yellow brown to olive brown poorly graded SAND, mps 2 mm, well-defined stratification, no odor, moist -GLACIOFLUVIAL DEPOSITS-			20	30	50					
	13 10 11 12	S4 10	9.0 11.0	1.6	SW		Medium dense olive brown well graded SAND (SW), mps 4 mm, single-grain structure, no odor, wet			30	35	35					
10						88.0 12.0	Note: Abrupt change in effort to advance casing at 12.0 ft. Possible boulder indicated by drilling effort 12.0-14.5 ft. Advanced borehole to 15.0 ft, except roller bit broke off (unable to extract, remains in subsurface). Unsampled footage 12.0-15.0 ft.										
15						85.0 15.0	BOTTOM OF EXPLORATION 15.0 FT										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
8/14/2020	14:05	None	12.0	15.0	6.0*

*Obstruction bottom of borehole

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

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

Summary

Overburden (ft)	15.0
Rock Cored (ft)	-
Samples	S4

Boring No. HA20-04

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

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

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

TEST BORING REPORT

Boring No. HA20-05

Project	1165R MASSACHUSETTS AVENUE, ARLINGTON, MA
Client	1165R MASS MA VENTURES LLC
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 133724-004
Sheet No. 1 of 1
Start August 17, 2020
Finish August 17, 2020
Driller M. Soucy
H&A Rep. S.Shay
Elevation 99.0 (est.)
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: Truck, GEFCO StrataStarF15
Inside Diameter (in.)	4.0	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	300	140	-	Drill Mud: None
Hammer Fall (in.)	24	30	-	Casing: HW Drive to 14.0 ft
				Hoist/Hammer: Winch Automatic Hammer
				PID Make & Model: Tiger PhoCheck (10.6 eV)

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	PID Readings (ppm)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0						98.7	-ASPHALT (PARKING LOT)-										
						0.3											
	10 21 55 20	S1 12	1.0 3.0	1.3	SP		S1, top 6 in.: Medium dense brown poorly graded SAND, mps 5 mm, single-grain structure, no odor, dry				75	25					
						97.0											
					SP	2.0	S1, bottom 6 in.: Very dense black poorly graded SAND with gravel, mps 1 cm, mixed with up to 50% cinders, no odor, dry, trace concrete		15	35	25	20	5				
	23 40 23 22	S2 16	3.0 5.0	0.6	SP		Very dense brown poorly graded SAND with gravel, mps 3 cm, no structure, no odor, moist	5	20	20	20	35					
						94.5	-FILL-										
5						4.5											
	45 78 78	S3 3	5.0 6.5	0.3	GP		Very dense brown poorly graded GRAVEL, mps 2.2 cm, no structure, no odor, wet	10	25	35	15	15					
						93.0											
						6.0											
	50 72 83 66	S4 6	9.0 11.0	0.2	SP		Very dense olive brown poorly graded SAND with silt and gravel, mps 1.5 cm, no structure, no odor, wet		15	15	40	20	10				
10							-GLACIOFLUVIAL DEPOSITS-										
						86.5											
						12.5											
	39 34 34 47	S5 10	14.0 16.0	0.2	SM		Very dense olive gray silty SAND with gravel, mps 3 cm, moderately well bonded, no odor, wet	5	15	15	20	30	15				
15						83.0											
						16.0	BOTTOM OF EXPLORATION 16.0 FT										

Water Level Data					
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
8/17/2020	9:40	None	14.0	16.0	7.5

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

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

Summary
- Overburden (ft) 16.0
- Rock Cored (ft) -
- Samples S5

Boring No. HA20-05

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

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

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

TEST BORING REPORT

Boring No.HA20-06(OW)

Project	1165R MASSACHUSETTS AVENUE, ARLINGTON, MA
Client	1165R MASS MA VENTURES LLC
Contractor	NEW ENGLAND BORING CONTRACTORS

File No. 133724-004
Sheet No. 1 of 1
Start August 17, 2020
Finish August 17, 2020
Driller K. Smith
H&A Rep. S.Shay
Elevation 94.5 (est.)
Datum NAVD88
Location See Plan

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HW	S	--	Rig Make & Model: Truck, GEFCO StrataStarF15
Inside Diameter (in.)	4.0	1 3/8	--	Bit Type: Roller Bit
Hammer Weight (lb)	300	140	-	Drill Mud: None
Hammer Fall (in.)	24	30	-	Casing: HW Drive to 15.0 ft
				Hoist/Hammer: Winch Automatic Hammer
				PID Make & Model: Tiger PhoCheck (10.6 eV)

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	PID Readings (ppm)	USCS Symbol	Well Diagram	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Field Test Toughness	Field Test Plasticity	Field Test Strength
0							94.2 0.3	-ASPHALT (PARKING LOT)-										
	9 9 19 19	S1 10	1.0 3.0	0.8	SM			Medium dense dark brown silty SAND (SM), mps 3 cm, no structure, no odor, moist, trace cinders, up to 20% organic soil mixed	5	5	10	15	25	40				
								-FILL-										
	11 21 18 12	S2 10	3.0 5.0	0.4	SM			Similar to above, except dense	5	5	10	15	25	40				
5	38 100/4"	S3 8	5.0 5.9	0.2	GP		89.5 5.0	Very dense orange brown poorly graded GRAVEL with sand (GP), mps 3 cm, no structure, no odor, wet	15	35	25	15	10					
								-GLACIOFLUVIAL DEPOSITS-										
							86.5 8.0											
	37 32 25 31	S4 6	9.0 11.0	0.1	SP-SM			Very dense brown poorly-graded SAND with silt and gravel (SP-SM), mps 3 cm, no structure, no odor, wet	10	10	10	30	30	10				
10							82.5 12.0											
								-GLACIOFLUVIAL DEPOSITS-										
15	30 39 48	S5 10	15.0 16.5	0.2	SM			Very dense olive gray silty SAND with gravel (SM), mps 3 cm, moderately bonded, no odor, wet	10	10	20	20	25	15				
							78.0 16.5	BOTTOM OF EXPLORATION 16.5 FT Note: See "Observation Well Installation Report HA20-06 (OW)" for well construction details.										

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
8/17/2020	13:00	0.5	15.0	16.5	6.7

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

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

Summary
Overburden (ft) 16.5
Rock Cored (ft) -
Samples S5

Boring No. HA20-06(OW)

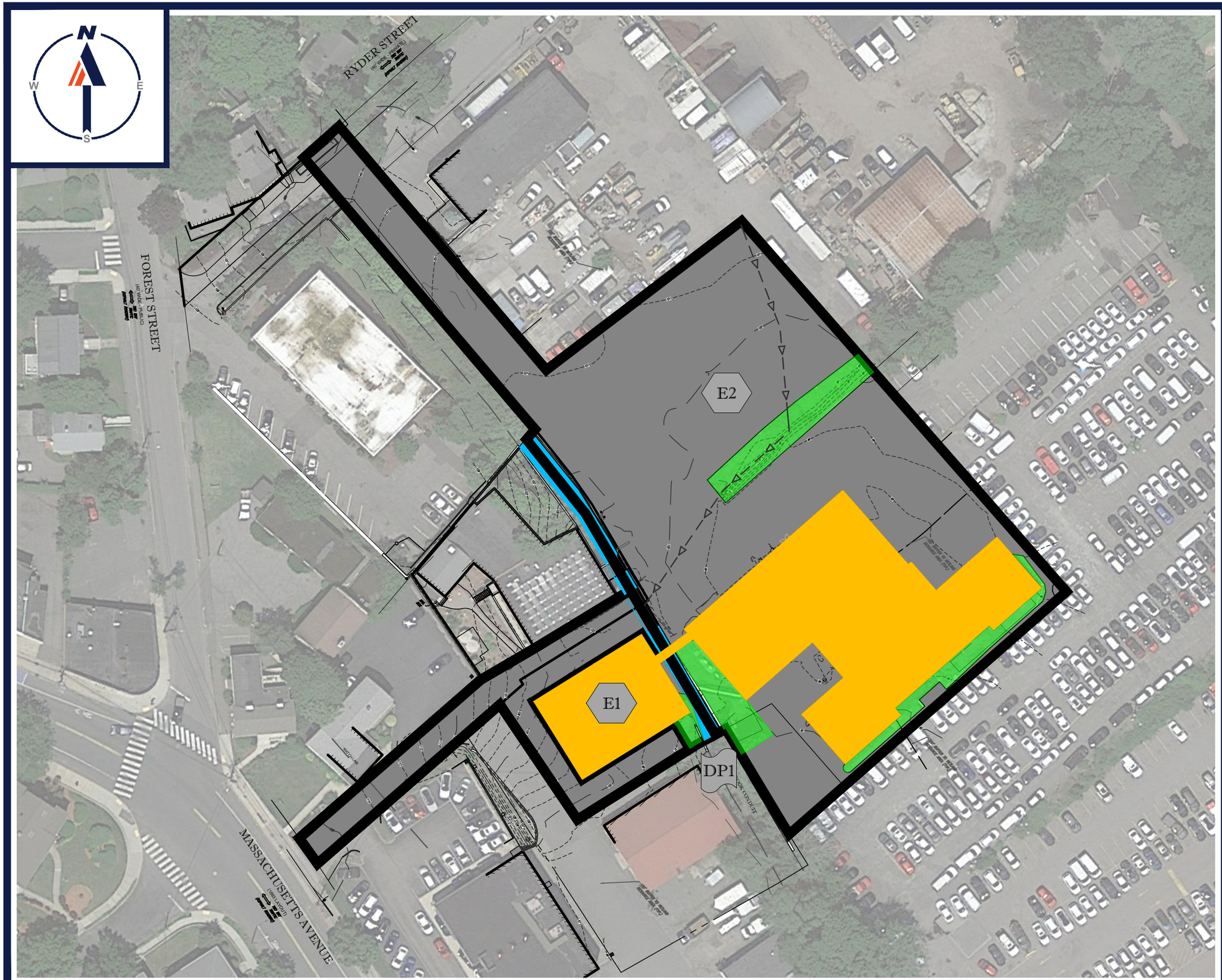
Field Tests: **Dilatancy**: R - Rapid S - Slow N - None
Toughness: L - Low M - Medium H - High
Plasticity: N - Nonplastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High V - Very High

†**Note: Maximum particle size is determined by direct observation within the limitations of sampler size.**

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

APPENDIX D: EXISTING CONDITIONS HYDROLOGIC ANALYSIS

- *EXISTING CONDITIONS DRAINAGE MAP*
- *EXISTING CONDITIONS HYDROCAD COMPUTATIONS*



LEGEND

- WATERSHED BOUNDARY
- DP# — DESIGN POINT
- TIME OF CONCENTRATION
- X#.# — SUBCATCHMENT
- CONCRETE/ PAVEMENT
- ROOF
- LANDSCAPE/ LAWN

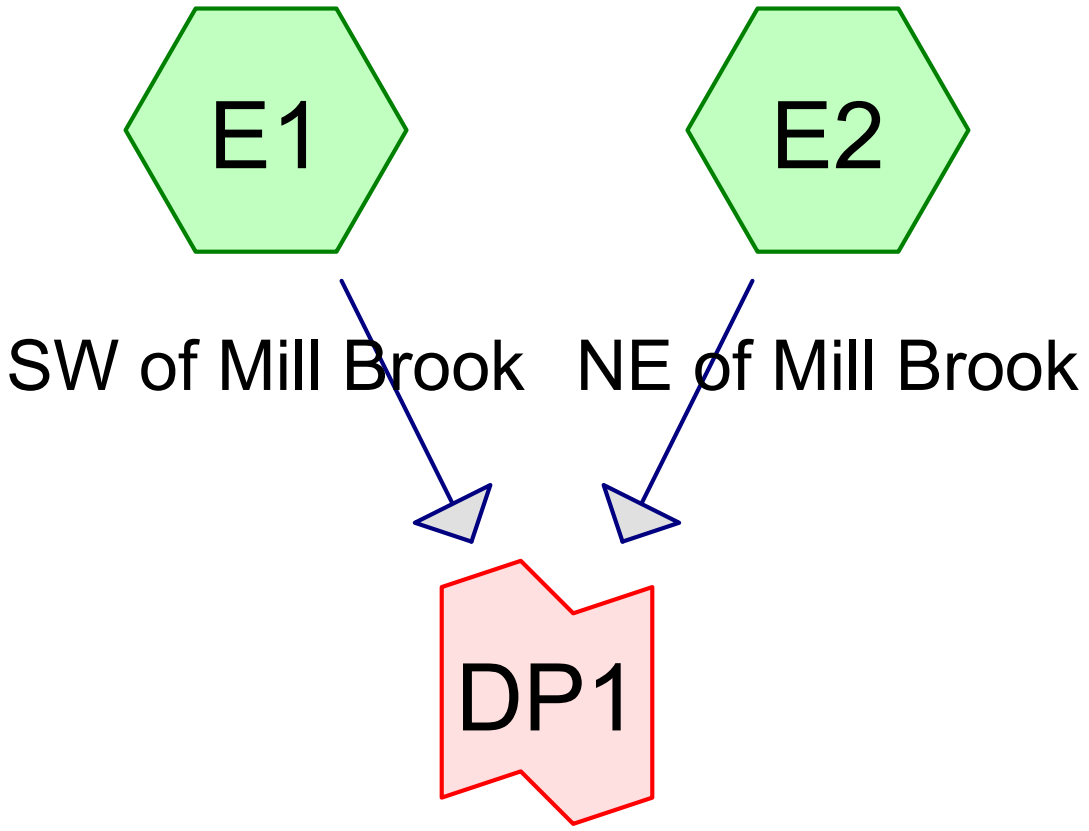
EXISTING DRAINAGE WATERSHED MAP

1165R MASSACHUSETTS AVE
ARLINGTON, MA

PREPARED BY

BOHLER

SCALE: 1"=60'
DATE: 03/04/2021



Design Pt 1 - Mill Brook

Subcat Reach Pond Link

Routing Diagram for W191330 EXISTING
Prepared by Bohler, Printed 4/1/2021

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 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: SW of Mill Brook Runoff Area=0.336 ac 97.92% Impervious Runoff Depth=3.29"
Tc=6.0 min CN=97 Runoff=1.15 cfs 0.092 af

Subcatchment E2: NE of Mill Brook Runoff Area=1.689 ac 92.60% Impervious Runoff Depth=2.97"
Flow Length=270' Tc=6.0 min CN=94 Runoff=5.46 cfs 0.418 af

Link DP1: Design Pt 1 - Mill Brook Inflow=6.61 cfs 0.511 af
Primary=6.61 cfs 0.511 af

Summary for Subcatchment E1: SW of Mill Brook

Runoff = 1.15 cfs @ 12.09 hrs, Volume= 0.092 af, Depth= 3.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.64"

Area (ac)	CN	Description
0.007	39	>75% Grass cover, Good, HSG A
0.206	98	Paved parking, HSG A
0.110	98	Roofs, HSG A
0.013	98	Water Surface, HSG A
0.336	97	Weighted Average
0.007		2.08% Pervious Area
0.329		97.92% Impervious Area

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

Summary for Subcatchment E2: NE of Mill Brook

Runoff = 5.46 cfs @ 12.09 hrs, Volume= 0.418 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.64"

Area (ac)	CN	Description
0.125	39	>75% Grass cover, Good, HSG A
1.126	98	Paved parking, HSG A
0.416	98	Roofs, HSG A
0.022	98	Water Surface, HSG A
1.689	94	Weighted Average
0.125		7.40% Pervious Area
1.564		92.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	130	0.0180	1.40		**Sheet Flow, Parking Lot** Smooth surfaces n= 0.011 P2= 3.27"
0.4	60	0.0300	2.77	11.09	**Channel Flow, Ryder Brook Ditch** Area= 4.0 sf Perim= 5.0' r= 0.80' n= 0.080 Earth, long dense weeds
0.2	80	0.0150	8.82	27.71	**Pipe Channel, Pipe to Mill Brook** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
3.9					**Direct Entry, To Make Min. Allowable**
6.0	270	Total			

Summary for Link DP1: Design Pt 1 - Mill Brook

Inflow Area = 2.025 ac, 93.48% Impervious, Inflow Depth = 3.03" for 2 yr event
Inflow = 6.61 cfs @ 12.09 hrs, Volume= 0.511 af
Primary = 6.61 cfs @ 12.09 hrs, Volume= 0.511 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 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: SW of Mill Brook Runoff Area=0.336 ac 97.92% Impervious Runoff Depth=5.43"
Tc=6.0 min CN=97 Runoff=1.85 cfs 0.152 af

Subcatchment E2: NE of Mill Brook Runoff Area=1.689 ac 92.60% Impervious Runoff Depth=5.09"
Flow Length=270' Tc=6.0 min CN=94 Runoff=9.06 cfs 0.716 af

Link DP1: Design Pt 1 - Mill Brook Inflow=10.92 cfs 0.868 af
Primary=10.92 cfs 0.868 af

Summary for Subcatchment E1: SW of Mill Brook

Runoff = 1.85 cfs @ 12.09 hrs, Volume= 0.152 af, Depth= 5.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=5.79"

Area (ac)	CN	Description
0.007	39	>75% Grass cover, Good, HSG A
0.206	98	Paved parking, HSG A
0.110	98	Roofs, HSG A
0.013	98	Water Surface, HSG A
0.336	97	Weighted Average
0.007		2.08% Pervious Area
0.329		97.92% Impervious Area

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

Summary for Subcatchment E2: NE of Mill Brook

Runoff = 9.06 cfs @ 12.09 hrs, Volume= 0.716 af, Depth= 5.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=5.79"

Area (ac)	CN	Description
0.125	39	>75% Grass cover, Good, HSG A
1.126	98	Paved parking, HSG A
0.416	98	Roofs, HSG A
0.022	98	Water Surface, HSG A
1.689	94	Weighted Average
0.125		7.40% Pervious Area
1.564		92.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	130	0.0180	1.40		**Sheet Flow, Parking Lot** Smooth surfaces n= 0.011 P2= 3.27"
0.4	60	0.0300	2.77	11.09	**Channel Flow, Ryder Brook Ditch** Area= 4.0 sf Perim= 5.0' r= 0.80' n= 0.080 Earth, long dense weeds
0.2	80	0.0150	8.82	27.71	**Pipe Channel, Pipe to Mill Brook** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
3.9					**Direct Entry, To Make Min. Allowable**
6.0	270	Total			

Summary for Link DP1: Design Pt 1 - Mill Brook

Inflow Area = 2.025 ac, 93.48% Impervious, Inflow Depth = 5.15" for 10 yr event
Inflow = 10.92 cfs @ 12.09 hrs, Volume= 0.868 af
Primary = 10.92 cfs @ 12.09 hrs, Volume= 0.868 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 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: SW of Mill Brook Runoff Area=0.336 ac 97.92% Impervious Runoff Depth=7.13"
Tc=6.0 min CN=97 Runoff=2.40 cfs 0.200 af

Subcatchment E2: NE of Mill Brook Runoff Area=1.689 ac 92.60% Impervious Runoff Depth=6.77"
Flow Length=270' Tc=6.0 min CN=94 Runoff=11.88 cfs 0.954 af

Link DP1: Design Pt 1 - Mill Brook Inflow=14.28 cfs 1.153 af
Primary=14.28 cfs 1.153 af

Summary for Subcatchment E1: SW of Mill Brook

Runoff = 2.40 cfs @ 12.09 hrs, Volume= 0.200 af, Depth= 7.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=7.49"

Area (ac)	CN	Description
0.007	39	>75% Grass cover, Good, HSG A
0.206	98	Paved parking, HSG A
0.110	98	Roofs, HSG A
0.013	98	Water Surface, HSG A
0.336	97	Weighted Average
0.007		2.08% Pervious Area
0.329		97.92% Impervious Area

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

Summary for Subcatchment E2: NE of Mill Brook

Runoff = 11.88 cfs @ 12.09 hrs, Volume= 0.954 af, Depth= 6.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=7.49"

Area (ac)	CN	Description
0.125	39	>75% Grass cover, Good, HSG A
1.126	98	Paved parking, HSG A
0.416	98	Roofs, HSG A
0.022	98	Water Surface, HSG A
1.689	94	Weighted Average
0.125		7.40% Pervious Area
1.564		92.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	130	0.0180	1.40		**Sheet Flow, Parking Lot** Smooth surfaces n= 0.011 P2= 3.27"
0.4	60	0.0300	2.77	11.09	**Channel Flow, Ryder Brook Ditch** Area= 4.0 sf Perim= 5.0' r= 0.80' n= 0.080 Earth, long dense weeds
0.2	80	0.0150	8.82	27.71	**Pipe Channel, Pipe to Mill Brook** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
3.9					**Direct Entry, To Make Min. Allowable**
6.0	270	Total			

Summary for Link DP1: Design Pt 1 - Mill Brook

Inflow Area = 2.025 ac, 93.48% Impervious, Inflow Depth = 6.83" for 25 yr event
Inflow = 14.28 cfs @ 12.09 hrs, Volume= 1.153 af
Primary = 14.28 cfs @ 12.09 hrs, Volume= 1.153 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 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: SW of Mill Brook Runoff Area=0.336 ac 97.92% Impervious Runoff Depth=9.99"
Tc=6.0 min CN=97 Runoff=3.33 cfs 0.280 af

Subcatchment E2: NE of Mill Brook Runoff Area=1.689 ac 92.60% Impervious Runoff Depth=9.62"
Flow Length=270' Tc=6.0 min CN=94 Runoff=16.59 cfs 1.354 af

Link DP1: Design Pt 1 - Mill Brook Inflow=19.92 cfs 1.634 af
Primary=19.92 cfs 1.634 af

Summary for Subcatchment E1: SW of Mill Brook

Runoff = 3.33 cfs @ 12.09 hrs, Volume= 0.280 af, Depth= 9.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=10.35"

Area (ac)	CN	Description
0.007	39	>75% Grass cover, Good, HSG A
0.206	98	Paved parking, HSG A
0.110	98	Roofs, HSG A
0.013	98	Water Surface, HSG A
0.336	97	Weighted Average
0.007		2.08% Pervious Area
0.329		97.92% Impervious Area

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

Summary for Subcatchment E2: NE of Mill Brook

Runoff = 16.59 cfs @ 12.09 hrs, Volume= 1.354 af, Depth= 9.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=10.35"

Area (ac)	CN	Description
0.125	39	>75% Grass cover, Good, HSG A
1.126	98	Paved parking, HSG A
0.416	98	Roofs, HSG A
0.022	98	Water Surface, HSG A
1.689	94	Weighted Average
0.125		7.40% Pervious Area
1.564		92.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	130	0.0180	1.40		**Sheet Flow, Parking Lot** Smooth surfaces n= 0.011 P2= 3.27"
0.4	60	0.0300	2.77	11.09	**Channel Flow, Ryder Brook Ditch** Area= 4.0 sf Perim= 5.0' r= 0.80' n= 0.080 Earth, long dense weeds
0.2	80	0.0150	8.82	27.71	**Pipe Channel, Pipe to Mill Brook** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
3.9					**Direct Entry, To Make Min. Allowable**
6.0	270	Total			

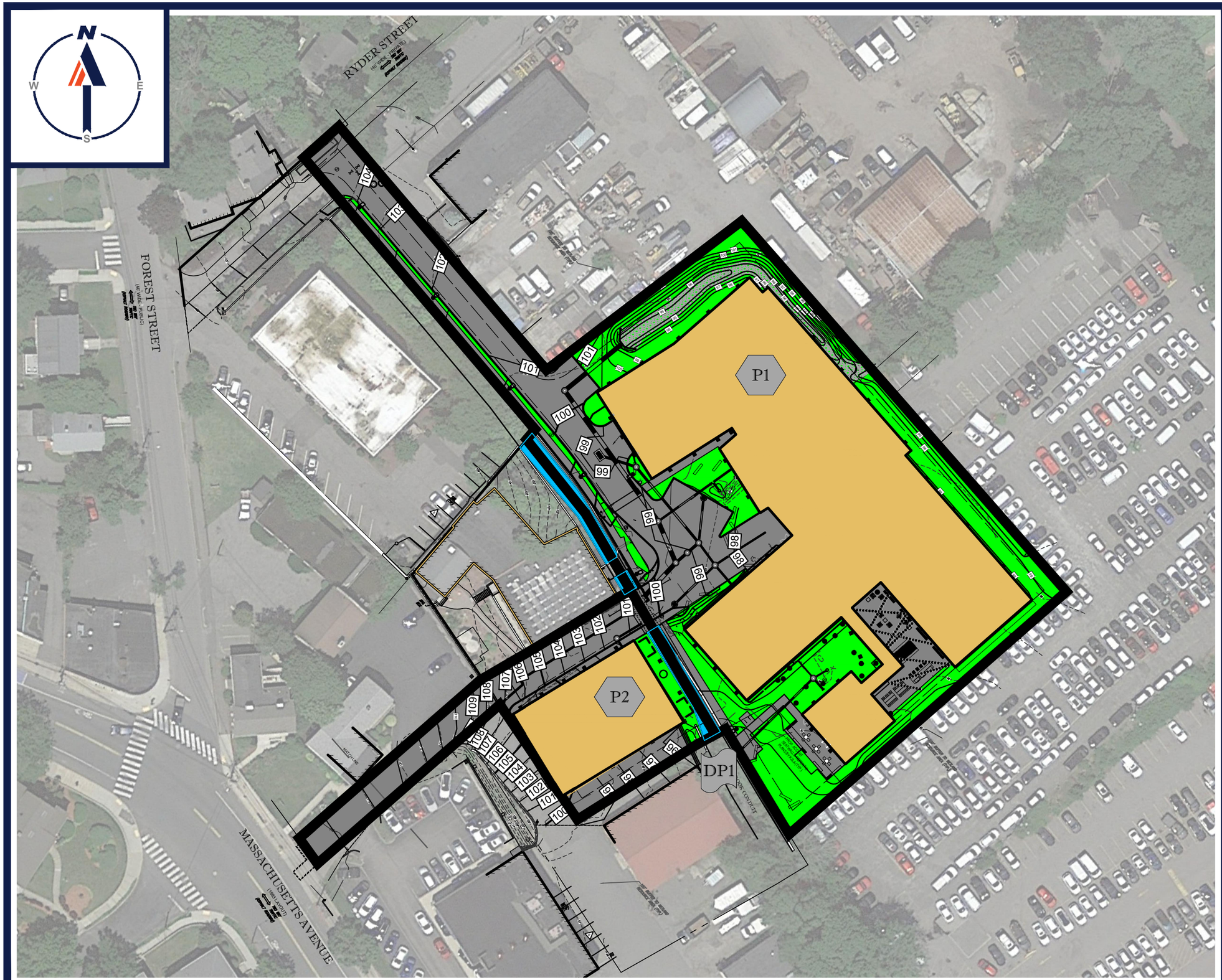
Summary for Link DP1: Design Pt 1 - Mill Brook

Inflow Area = 2.025 ac, 93.48% Impervious, Inflow Depth = 9.68" for 100 yr event
Inflow = 19.92 cfs @ 12.09 hrs, Volume= 1.634 af
Primary = 19.92 cfs @ 12.09 hrs, Volume= 1.634 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

APPENDIX E: PROPOSED CONDITIONS HYDROLOGIC ANALYSIS

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



LEGEND

- WATERSHED BOUNDARY
- DESIGN POINT (DP#)
- TIME OF CONCENTRATION
- SUBCATCHMENT (X#.#)
- CONCRETE/ PAVEMENT
- ROOF
- LANDSCAPE/ LAWN

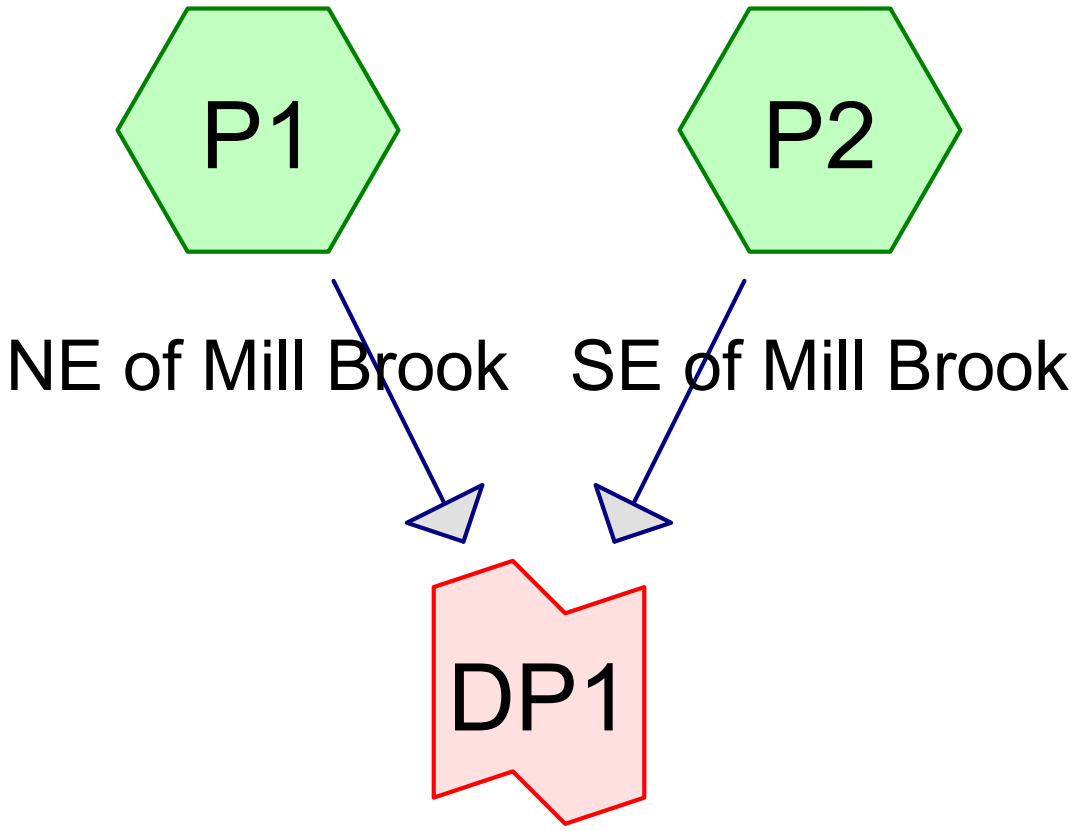
PROPOSED CONDITIONS WATERSHED MAP

1165R MASSACHUSETTS AVE
ARLINGTON, MA

PREPARED BY

BOHLER

SCALE: 1"=60'
DATE: 04/01/2021



DP1 - Mill Brook

Subcat Reach Pond Link

Routing Diagram for W191330 PROPOSED
Prepared by Bohler, Printed 4/1/2021

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 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 P1: NE of Mill Brook Runoff Area=0.336 ac 93.75% Impervious Runoff Depth=2.97"
Tc=6.0 min CN=94 Runoff=1.09 cfs 0.083 af

Subcatchment P2: SE of Mill Brook Runoff Area=1.689 ac 73.89% Impervious Runoff Depth=1.98"
Tc=6.0 min CN=83 Runoff=3.84 cfs 0.278 af

Link DP1: DP1 - Mill Brook Inflow=4.92 cfs 0.361 af
Primary=4.92 cfs 0.361 af

Summary for Subcatchment P1: NE of Mill Brook

Runoff = 1.09 cfs @ 12.09 hrs, Volume= 0.083 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.64"

Area (ac)	CN	Description
0.021	39	>75% Grass cover, Good, HSG A
0.176	98	Paved parking, HSG A
0.126	98	Roofs, HSG A
0.013	98	Water Surface, HSG A
0.336	94	Weighted Average
0.021		6.25% Pervious Area
0.315		93.75% Impervious Area

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

Summary for Subcatchment P2: SE of Mill Brook

Runoff = 3.84 cfs @ 12.09 hrs, Volume= 0.278 af, Depth= 1.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.64"

Area (ac)	CN	Description
0.441	39	>75% Grass cover, Good, HSG A
0.461	98	Paved parking, HSG A
0.765	98	Roofs, HSG A
0.022	98	Water Surface, HSG A
1.689	83	Weighted Average
0.441		26.11% Pervious Area
1.248		73.89% Impervious Area

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

Summary for Link DP1: DP1 - Mill Brook

Inflow Area = 2.025 ac, 77.19% Impervious, Inflow Depth = 2.14" for 2 yr event
Inflow = 4.92 cfs @ 12.09 hrs, Volume= 0.361 af
Primary = 4.92 cfs @ 12.09 hrs, Volume= 0.361 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 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 P1: NE of Mill Brook Runoff Area=0.336 ac 93.75% Impervious Runoff Depth=5.09"
Tc=6.0 min CN=94 Runoff=1.80 cfs 0.142 af

Subcatchment P2: SE of Mill Brook Runoff Area=1.689 ac 73.89% Impervious Runoff Depth=3.90"
Tc=6.0 min CN=83 Runoff=7.48 cfs 0.548 af

Link DP1: DP1 - Mill Brook Inflow=9.28 cfs 0.691 af
Primary=9.28 cfs 0.691 af

Summary for Subcatchment P1: NE of Mill Brook

Runoff = 1.80 cfs @ 12.09 hrs, Volume= 0.142 af, Depth= 5.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=5.79"

Area (ac)	CN	Description
0.021	39	>75% Grass cover, Good, HSG A
0.176	98	Paved parking, HSG A
0.126	98	Roofs, HSG A
0.013	98	Water Surface, HSG A
0.336	94	Weighted Average
0.021		6.25% Pervious Area
0.315		93.75% Impervious Area

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

Summary for Subcatchment P2: SE of Mill Brook

Runoff = 7.48 cfs @ 12.09 hrs, Volume= 0.548 af, Depth= 3.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=5.79"

Area (ac)	CN	Description
0.441	39	>75% Grass cover, Good, HSG A
0.461	98	Paved parking, HSG A
0.765	98	Roofs, HSG A
0.022	98	Water Surface, HSG A
1.689	83	Weighted Average
0.441		26.11% Pervious Area
1.248		73.89% Impervious Area

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

Summary for Link DP1: DP1 - Mill Brook

Inflow Area = 2.025 ac, 77.19% Impervious, Inflow Depth = 4.09" for 10 yr event
Inflow = 9.28 cfs @ 12.09 hrs, Volume= 0.691 af
Primary = 9.28 cfs @ 12.09 hrs, Volume= 0.691 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 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 P1: NE of Mill Brook Runoff Area=0.336 ac 93.75% Impervious Runoff Depth=6.77"
Tc=6.0 min CN=94 Runoff=2.36 cfs 0.190 af

Subcatchment P2: SE of Mill Brook Runoff Area=1.689 ac 73.89% Impervious Runoff Depth=5.49"
Tc=6.0 min CN=83 Runoff=10.39 cfs 0.773 af

Link DP1: DP1 - Mill Brook Inflow=12.75 cfs 0.963 af
Primary=12.75 cfs 0.963 af

Summary for Subcatchment P1: NE of Mill Brook

Runoff = 2.36 cfs @ 12.09 hrs, Volume= 0.190 af, Depth= 6.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=7.49"

Area (ac)	CN	Description
0.021	39	>75% Grass cover, Good, HSG A
0.176	98	Paved parking, HSG A
0.126	98	Roofs, HSG A
0.013	98	Water Surface, HSG A
0.336	94	Weighted Average
0.021		6.25% Pervious Area
0.315		93.75% Impervious Area

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

Summary for Subcatchment P2: SE of Mill Brook

Runoff = 10.39 cfs @ 12.09 hrs, Volume= 0.773 af, Depth= 5.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=7.49"

Area (ac)	CN	Description
0.441	39	>75% Grass cover, Good, HSG A
0.461	98	Paved parking, HSG A
0.765	98	Roofs, HSG A
0.022	98	Water Surface, HSG A
1.689	83	Weighted Average
0.441		26.11% Pervious Area
1.248		73.89% Impervious Area

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

Summary for Link DP1: DP1 - Mill Brook

Inflow Area = 2.025 ac, 77.19% Impervious, Inflow Depth = 5.70" for 25 yr event
Inflow = 12.75 cfs @ 12.09 hrs, Volume= 0.963 af
Primary = 12.75 cfs @ 12.09 hrs, Volume= 0.963 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 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 P1: NE of Mill Brook Runoff Area=0.336 ac 93.75% Impervious Runoff Depth=9.62"
Tc=6.0 min CN=94 Runoff=3.30 cfs 0.269 af

Subcatchment P2: SE of Mill Brook Runoff Area=1.689 ac 73.89% Impervious Runoff Depth=8.24"
Tc=6.0 min CN=83 Runoff=15.27 cfs 1.160 af

Link DP1: DP1 - Mill Brook Inflow=18.57 cfs 1.429 af
Primary=18.57 cfs 1.429 af

Summary for Subcatchment P1: NE of Mill Brook

Runoff = 3.30 cfs @ 12.09 hrs, Volume= 0.269 af, Depth= 9.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=10.35"

Area (ac)	CN	Description
0.021	39	>75% Grass cover, Good, HSG A
0.176	98	Paved parking, HSG A
0.126	98	Roofs, HSG A
0.013	98	Water Surface, HSG A
0.336	94	Weighted Average
0.021		6.25% Pervious Area
0.315		93.75% Impervious Area

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

Summary for Subcatchment P2: SE of Mill Brook

Runoff = 15.27 cfs @ 12.09 hrs, Volume= 1.160 af, Depth= 8.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=10.35"

Area (ac)	CN	Description
0.441	39	>75% Grass cover, Good, HSG A
0.461	98	Paved parking, HSG A
0.765	98	Roofs, HSG A
0.022	98	Water Surface, HSG A
1.689	83	Weighted Average
0.441		26.11% Pervious Area
1.248		73.89% Impervious Area

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

Summary for Link DP1: DP1 - Mill Brook

Inflow Area = 2.025 ac, 77.19% Impervious, Inflow Depth = 8.47" for 100 yr event
Inflow = 18.57 cfs @ 12.09 hrs, Volume= 1.429 af
Primary = 18.57 cfs @ 12.09 hrs, Volume= 1.429 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

APPENDIX F: STORMWATER CALCULATIONS

- *MA STANDARD #3 – RECHARGE CALCULATIONS*
- *MA STANDARD #4 – WATER QUALITY AND TSS REMOVAL*
- *WATER QUALITY UNIT SIZING*
- *PIPE SIZING*
- *RYDER BROOK RELOCATED SWALE CAPACITIES AND INLET CONTROL CALCULATIONS*

Proposed Development
1165R Massachusetts Avenue
Arlington, MA
Bohler Job Number: W191330
March 4, 2021

MA DEP Standard 3: Recharge Volume Calculations

Required Recharge Volume - A Soils (0.60 in.)	
Existing Site Impervious Area (ac)	1.920
Proposed Site Impervious Area (ac)	1.590
Proposed Increase in Site Impervious Area (ac)	-0.330
Recharge Volume Required (cf)	**0**
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)	**0**
Recharge Volume Adjustment Factor	
Impervious Area Directed to Infiltration BMP (ac)	**0.000**
%Impervious Directed to Infiltration BMP	
Adjustment Factor	
Adjusted Total Recharge Volume Required (cf)	
Provided Recharge Volume*	
N/A	0
Total Recharge Volume Provided (cf)	**0**
	Not Required

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

Prepared By:
Bohler Engineering
352 Turnpike Road
Southborough, MA 01772
(508) 480-9900

TSS Removal Calculation Worksheet

Location: CBs to Water Quality Unit

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump CBs	**0.25**	**1.00**	**0.25**	**0.75**
Water Quality Unit	**0.80**	**0.75**	**0.60**	**0.15**

Total TSS Removal = **85%**

Project: **1165R Mass Ave**
Prepared By: **Bohler**
Date: **3/4/2021**

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

Prepared By:
Bohler Engineering
352 Turnpike Road
Southborough, MA 01772
(508) 480-9900

TSS Removal Calculation Worksheet

Location: Trench Drains to Water Quality Unit

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Water Quality Unit	**0.80**	**1.00**	**0.80**	**0.20**
	0.00			

Total TSS Removal = **80%**

Project: **1165R Mass Ave**
Prepared By: **Bohler**
Date: **3/4/2021**

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

Prepared By:
Bohler Engineering
352 Turnpike Road
Southborough, MA 01772
(508) 480-9900

MassDEP Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Proprietary Stormwater Treatment Practices

Q= (qu)(A)(WQV)

WQV = 1/2”

qu=773 csm/in (time of concentration = 5 min. = 0.083 hr)

qu=677 csm/in (time of concentration = 10 min. = 0.167 hr)

conversion from acres to sq. mi.= 0.0015625 mi^2/acre

Stormwater Quality Unit WQU-1 (CDS 2015-4)

Impervious Area= 0.913 Ac.

Q = 773 x 0.913 x 0.0015625 x 0.5

Q= 0.55 cfs treatment rate required

The maximum treatment rate of the CDS 2015-4 is **1.4 cfs** and is thus adequate

Available Models

CDS Model	Treatment Capacity[3] (cfs)	Maximum Sediment Storage Capacity (CF)
1515	1.0	26
w/ 1' added sump	1.0	33
w/ 2' added sump	1.0	40
w/ 3' added sump	1.0	47
2015_4	1.4	50
w/ 1' added sump	1.4	63
w/ 2' added sump	1.4	75
w/ 3' added sump	1.4	88
2015	1.4	79
w/ 1' added sump	1.4	98
w/ 2' added sump	1.4	118
2020	2.2	90
w/ 1' added sump	2.2	110
w/ 2' added sump	2.2	129
2025	3.2	97
w/ 1' added sump	3.2	117
w/ 2' added sump	3.2	136
3020	3.9	134
w/ 1' added sump	3.9	163
w/ 2' added sump	3.9	191
3030	6.1	157
w/ 1' added sump	6.1	185
w/ 2' added sump	6.1	213
4030	7.9	329
w/ 1' added sump	7.9	379
w/ 2' added sump	7.9	429
4040	12.4	381
w/ 1' added sump	12.4	431
w/ 2' added sump	12.4	482

1. Structure diameter represents the typical inside dimension of the concrete structure. Offline systems will require additional concrete diversion components
2. Depth below pipe can vary to accommodate site specific design. Depth below pipe invert represents the depth from the pipe invert to the inside bottom of concrete structure.
3. Treatment Capacity is based on laboratory testing using OK-110 (average d50 particle size of approximately 100 microns) and a 2400 micron screen.

Sediment Depths Indicating Required Servicing*

CDS Model	Standard Sediment Depth (in.)	w/ 1' added Sump Sediment Depth (in.)	w/ 2' added Sump Sediment Depth (in.)
1515	18	27	36
2015_4	18	30	42
2015	18	30	42
2020	18	30	42
2025	18	30	42
3020	18	30	42
3030	18	39	42
4030	27	39	51
4040	27	39	51

* Based on 75% capacity of isolated sump.

UNIVERSITY OF MASSACHUSETTS
AT AMHERST
Water Resources Research Center
Blaisdell House, UMass
310 Hicks Way
Amherst, MA 01003

Massachusetts Stormwater Evaluation Project

(413) 545-5532
(413) 545-2304 FAX
www.mastep.net

MASTEP Technology Review

Technology Name: CDS (Continuous Deflective Separator) - Contech Stormwater Solutions, Inc.

Studies Reviewed:

- NJCAT Technology Verification High Efficiency Continuous Deflective Separators CDS Technologies Inc. January 2010.
- Independent Review of CDS 2015 Product Evaluation, FB Environmental Associates, 2009.
- NJCAT Technology Verification Addendum Report High Efficiency Continuous Deflective Separators CDS Technologies Inc. December 2004
- Continuous Deflection Separation (CDS) Unit For Sediment Control In Brevard County, Florida January, 2000

Date: 5/13/2011
Reviewer: Jerry Schoen

Rating: 2

Brief rationale for rating: MASTEP rating is based primarily on NJCAT 2010 field study and FB Environmental 2009 laboratory study. Both studies generally followed TARP field or NJDEP-recommended laboratory test protocols, with some exceptions. The 2010 field study sampled storms totaling 37% of average annual rainfall (50% is required), and experienced excessively large influent particles. This is discussed further below and in the MASTEP study description. In the FB lab study, no evidence of a Quality Assurance Project Plan, little discussion of quality control, higher than recommended particle size distribution, limited range of influent sediment concentration, sediments analyzed by SSC method but not TSS.

The Florida field study monitored 5 storm events and encountered sampling/equipment problems in four of them. The NJCAT lab study was conducted on a unit that was specially modified for testing in New Jersey, and is now being sold in NJ and NY.

Other Comments:

FB Environmental Associates study:

- OK-110 sediment mix used. This is recommended by Maine DEP, but produces sediments somewhat larger than those recommended by New Jersey DEP.
- Sediment analysis conducted with whole sample; essentially SSC method. SSC is generally regarded as more accurate than TSS method, but comparisons with other studies or products that use TSS data are problematic.
- Full range of flows were tested.
- Only one target sediment concentration was tested; average influent SSC was 313 mg/l, slightly outside of recommended 100-300 mg/l range.
- Scour test was performed; system produced no scour at flows up to 137% of capacity.

NJCAT 2010 Study

- Mean influent particle size was 500-600 microns, well above the TARP criteria of < 100 microns. To address this problem, the testing agency separated samples into

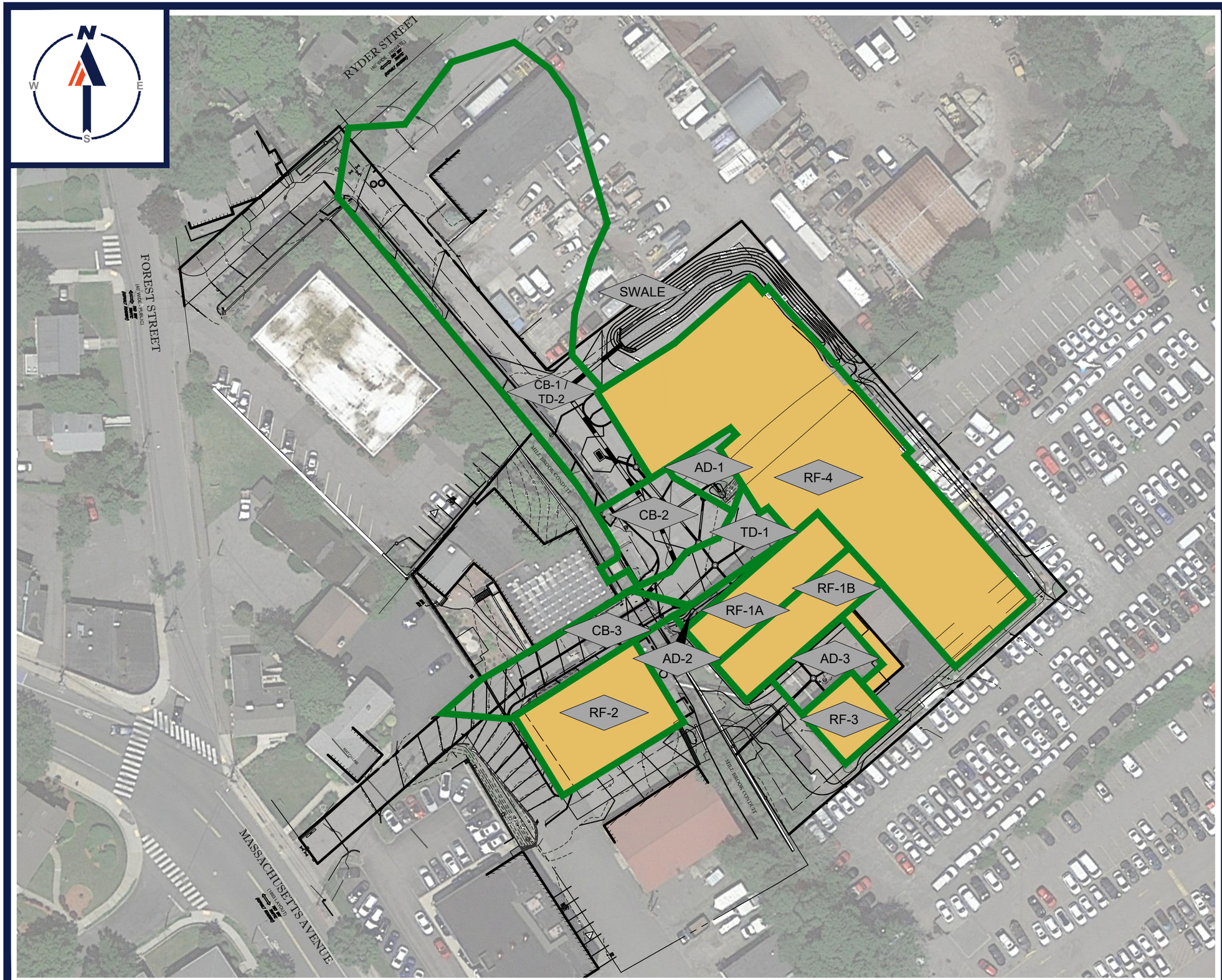
filtered subsamples of several size ranges (> 2000 microns, < 2000, < 500 and < 50). Removal efficiencies were calculated for each of these ranges, with results ranging from 64% (for <50 micron particles) to 99% (for > 2000 microns).
- TSS and SSC efficiencies were calculated by Event Mean Concentration and by Sum Of Loads methods.
- Study was well document. Other than issues of particle size and % annual rainfall, study closely followed TARP guidelines.

NJCAT 2004 Study

- Expectations of sediment removal performance comparable to this study should be confined to units that contain the sediment weir and a 2400 micron screen.
- The study did not include a scour test.
- A particularly fine sediment mix (Sil-Col-Sil 106, pre-washed to remove all particles > 100 microns), which makes sediment removal more difficult. Higher removal efficiencies may be obtained if sediment particle size range is larger.
- A narrow range of influent sediment (164 – 203 mg/l, average 184), was tested but this is within the NJDEP-recommended 100-300 mg/l range.
- TSS analysis appears to have been performed by a non- standardized method.
- No discussion of quality control.

Brevard County FL study

- This study was performed before release of the TARP Tier II Protocols and does not conform to them.
- The study states that "testing under higher flow conditions would be desirable."
- TSS, BOD, COD, pH, total phosphorus, and turbidity were monitored.



LEGEND

- INLET CATCHMENT BOUNDARY
- CB-# — PROPOSED CATCH BASIN
- TD-# — TRENCH DRAIN
- AD-# — AREA DRAIN

OFF-SITE TOPOGRAPHY FROM NOAA 2013-2014 LIDAR INFORMATION

PROPOSED INLET MAP

1165R MASSACHUSETTS AVE
ARLINGTON, MA

PREPARED BY

BOHLER

SCALE: 1"=60'
DATE: 04/01/2021

Results

Line No.	Line ID	Inlet Time (min)	Tc (min)	i Inlet (in/hr)	Drng Area (ac)	Runoff Coeff (C)	Incr Q (cfs)	Total CxA	Known Q (cfs)	Line Length (ft)	Line Slope (%)	Line Size (in)	Flow Rate (cfs)	Capac Full (cfs)	Vel Ave (ft/s)	Invert Up (ft)	Invert Dn (ft)	Gnd/Rim El Up (ft)	Cover Up (ft)	HGL Up (ft)	
1	MHC-BRK	0.0	14.1	0.00	0.00	0.00	0.00	1.34	0.00	31.00	1.61	30	31.82	56.43	6.48	91.00	90.50	98.75	5.25	94.66	
2	MHB-MHC	0.0	5.7	0.00	0.00	0.00	0.00	0.51	0.00	29.00	1.86	30	28.95	60.63	5.90	91.60	91.06	98.90	4.80	95.54	
3	MHA-MHB	0.0	0.1	0.00	0.00	0.00	0.00	0.00	0.00	102.00	1.90	30	26.00	61.27	5.30	93.60	91.66	100.50	4.40	96.53	
4	HW-MHA	0.0	0.0	0.00	0.00	0.00	26.00	0.00	26.00	47.00	1.89	30	26.00	61.14	5.30	94.50	93.61	99.00	2.00	97.13	
5	WQU1-MHC	0.0	14.0	0.00	0.00	0.00	0.00	0.83	0.00	10.00	1.00	18	3.62	11.38	2.05	94.20	94.10	98.95	3.25	95.90	
6	MHD-WQU1	0.0	14.0	0.00	0.00	0.00	0.00	0.83	0.00	10.00	1.00	18	3.63	11.38	2.05	94.40	94.30	98.90	3.00	95.92	
7	MHE-MHD	0.0	5.1	0.00	0.00	0.00	0.00	0.56	0.00	62.00	1.02	15	3.32	7.05	2.96	95.10	94.47	98.40	2.05	96.08	
8	CB1-MHE	5.0	5.0	6.00	0.64	0.87	3.34	0.56	0.00	24.00	1.00	15	3.34	7.00	3.77	95.44	95.20	98.80	2.11	96.17 j	
9	CB2-MHE	5.0	5.0	6.00	0.08	0.80	0.38	0.06	0.00	29.00	1.00	12	0.38	3.86	0.62	95.40	95.11	98.40	2.00	96.03	
10	TEE-MHB	0.0	5.5	0.00	0.00	0.00	0.00	0.51	0.00	43.00	2.00	12	2.97	5.46	3.79	93.36	92.50	99.00	4.64	96.65	
11	RF4-TEE	5.0	5.0	6.00	0.55	0.90	2.97	0.50	0.00	15.00	0.87	12	2.97	3.59	3.78	93.49	93.36	98.50	4.01	96.96	
12	MHF-MHD	0.0	13.8	0.00	0.00	0.00	0.00	0.21	0.00	18.00	1.00	12	0.92	3.86	1.18	94.68	94.50	98.50	2.82	96.04	
13	CB3-MHF	5.0	5.0	6.00	0.09	0.90	0.49	0.08	0.00	36.00	1.00	12	0.49	3.86	1.05	95.60	95.24	98.60	2.00	96.05	
14	TD1-MHF	5.0	5.0	6.00	0.06	0.90	0.32	0.05	0.00	18.00	5.06	12	0.32	8.67	1.32	96.00	95.09	97.75	0.75	96.24 j	
15	RF1A-MHF	5.0	13.3	6.00	0.08	0.90	0.43	0.08	0.00	16.00	1.00	12	0.34	3.86	0.43	95.00	94.84	98.00	2.00	96.08	
16	AD1-TEE	5.0	5.0	6.00	0.03	0.42	0.08	0.01	0.00	7.00	1.86	8	0.08	1.78	0.22	93.49	93.36	97.90	3.74	97.09	
17	AD2-RF1A	5.0	5.0	6.00	0.01	0.35	0.02	0.00	0.00	30.00	1.00	8	0.02	1.31	0.06	95.20	94.90	96.50	0.63	96.09	
18	MHK-BRK	0.0	5.8	0.00	0.00	0.00	0.00	0.15	0.00	68.00	3.07	15	0.84	12.26	0.69	93.09	91.00	96.50	2.16	94.51	
19	RF1B-MHK	5.0	5.0	6.00	0.08	0.90	0.43	0.07	0.00	15.00	1.93	12	0.43	5.36	0.55	93.50	93.21	98.00	3.50	94.52	
20	RF3-MHK	5.0	5.0	6.00	0.04	0.90	0.22	0.04	0.00	13.00	1.00	12	0.22	3.86	0.46	94.00	93.87	96.50	1.50	94.52	
21	AD3-MHK	5.0	5.0	6.00	0.05	0.75	0.22	0.04	0.00	10.00	2.00	8	0.22	1.85	2.23	94.50	94.30	96.00	0.83	94.72	

Project File: test3.stm | Number of lines: 21 | Date: 04-01-2021

NOTES: Intensity = 45.72 / (Inlet time + 11.30) ^ 0.73 -- Return period = 25 Yrs. ; ** Critical depth

Results

Line No.	Line ID	Inlet Time (min)	Tc (min)	i Inlet (in/hr)	Drng Area (ac)	Runoff Coeff (C)	Incr Q (cfs)	Total CxA	Known Q (cfs)	Line Length (ft)	Line Slope (%)	Line Size (in)	Flow Rate (cfs)	Capac Full (cfs)	Vel Ave (ft/s)	Invert Up (ft)	Invert Dn (ft)	Gnd/Rim El Up (ft)	Cover Up (ft)	HGL Up (ft)
1	MHC-BRK	0.0	12.4	0.00	0.00	0.00	0.00	1.34	0.00	31.00	1.61	30	33.64	56.43	6.85	91.00	90.50	98.75	5.25	94.68
2	MHB-MHC	0.0	5.6	0.00	0.00	0.00	0.00	0.51	0.00	29.00	1.86	30	29.66	60.63	6.04	91.60	91.06	98.90	4.80	95.69
3	MHA-MHB	0.0	0.1	0.00	0.00	0.00	0.00	0.00	0.00	102.00	1.90	30	26.00	61.27	5.30	93.60	91.66	100.50	4.40	96.73
4	HW-MHA	0.0	0.0	0.00	0.00	0.00	26.00	0.00	26.00	47.00	1.89	30	26.00	61.14	5.30	94.50	93.61	99.00	2.00	97.33
5	WQU1-MHC	0.0	12.3	0.00	0.00	0.00	0.00	0.83	0.00	10.00	1.00	18	4.75	11.38	2.69	94.20	94.10	98.95	3.25	96.03
6	MHD-WQU1	0.0	12.3	0.00	0.00	0.00	0.00	0.83	0.00	10.00	1.00	18	4.76	11.38	2.69	94.40	94.30	98.90	3.00	96.06
7	MHE-MHD	0.0	5.1	0.00	0.00	0.00	0.00	0.56	0.00	62.00	1.02	15	4.10	7.05	3.34	95.10	94.47	98.40	2.05	96.35
8	CB1-MHE	5.0	5.0	7.40	0.64	0.87	4.12	0.56	0.00	24.00	1.00	15	4.12	7.00	3.52	95.44	95.20	98.80	2.11	96.51
9	CB2-MHE	5.0	5.0	7.40	0.08	0.80	0.47	0.06	0.00	29.00	1.00	12	0.47	3.86	0.62	95.40	95.11	98.40	2.00	96.29
10	TEE-MHB	0.0	5.4	0.00	0.00	0.00	0.00	0.51	0.00	43.00	2.00	12	3.69	5.46	4.69	93.36	92.50	99.00	4.64	96.87
11	RF4-TEE	5.0	5.0	7.40	0.55	0.90	3.66	0.50	0.00	15.00	0.87	12	3.66	3.59	4.66	93.49	93.36	98.50	4.01	97.35
12	MHF-MHD	0.0	12.1	0.00	0.00	0.00	0.00	0.21	0.00	18.00	1.00	12	1.21	3.86	1.54	94.68	94.50	98.50	2.82	96.27
13	CB3-MHF	5.0	5.0	7.40	0.09	0.90	0.60	0.08	0.00	36.00	1.00	12	0.60	3.86	0.86	95.60	95.24	98.60	2.00	96.34
14	TD1-MHF	5.0	5.0	7.40	0.06	0.90	0.40	0.05	0.00	18.00	5.06	12	0.40	8.67	1.23	96.00	95.09	97.75	0.75	96.31
15	RF1A-MHF	5.0	11.7	7.40	0.08	0.90	0.53	0.08	0.00	16.00	1.00	12	0.44	3.86	0.56	95.00	94.84	98.00	2.00	96.34
16	AD1-TEE	5.0	5.0	7.40	0.03	0.42	0.09	0.01	0.00	7.00	1.86	8	0.09	1.78	0.27	93.49	93.36	97.90	3.74	97.55
17	AD2-RF1A	5.0	5.0	7.40	0.01	0.35	0.03	0.00	0.00	30.00	1.00	8	0.03	1.31	0.07	95.20	94.90	96.50	0.63	96.35
18	MHK-BRK	0.0	5.6	0.00	0.00	0.00	0.00	0.15	0.00	68.00	3.07	15	1.05	12.26	0.85	93.09	91.00	96.50	2.16	94.52
19	RF1B-MHK	5.0	5.0	7.40	0.08	0.90	0.53	0.07	0.00	15.00	1.93	12	0.53	5.36	0.68	93.50	93.21	98.00	3.50	94.53
20	RF3-MHK	5.0	5.0	7.40	0.04	0.90	0.27	0.04	0.00	13.00	1.00	12	0.27	3.86	0.56	94.00	93.87	96.50	1.50	94.53
21	AD3-MHK	5.0	5.0	7.40	0.05	0.75	0.28	0.04	0.00	10.00	2.00	8	0.28	1.85	2.49	94.50	94.30	96.00	0.83	94.75

Project File: W191330.stm | Number of lines: 21 | Date: 04-01-2021

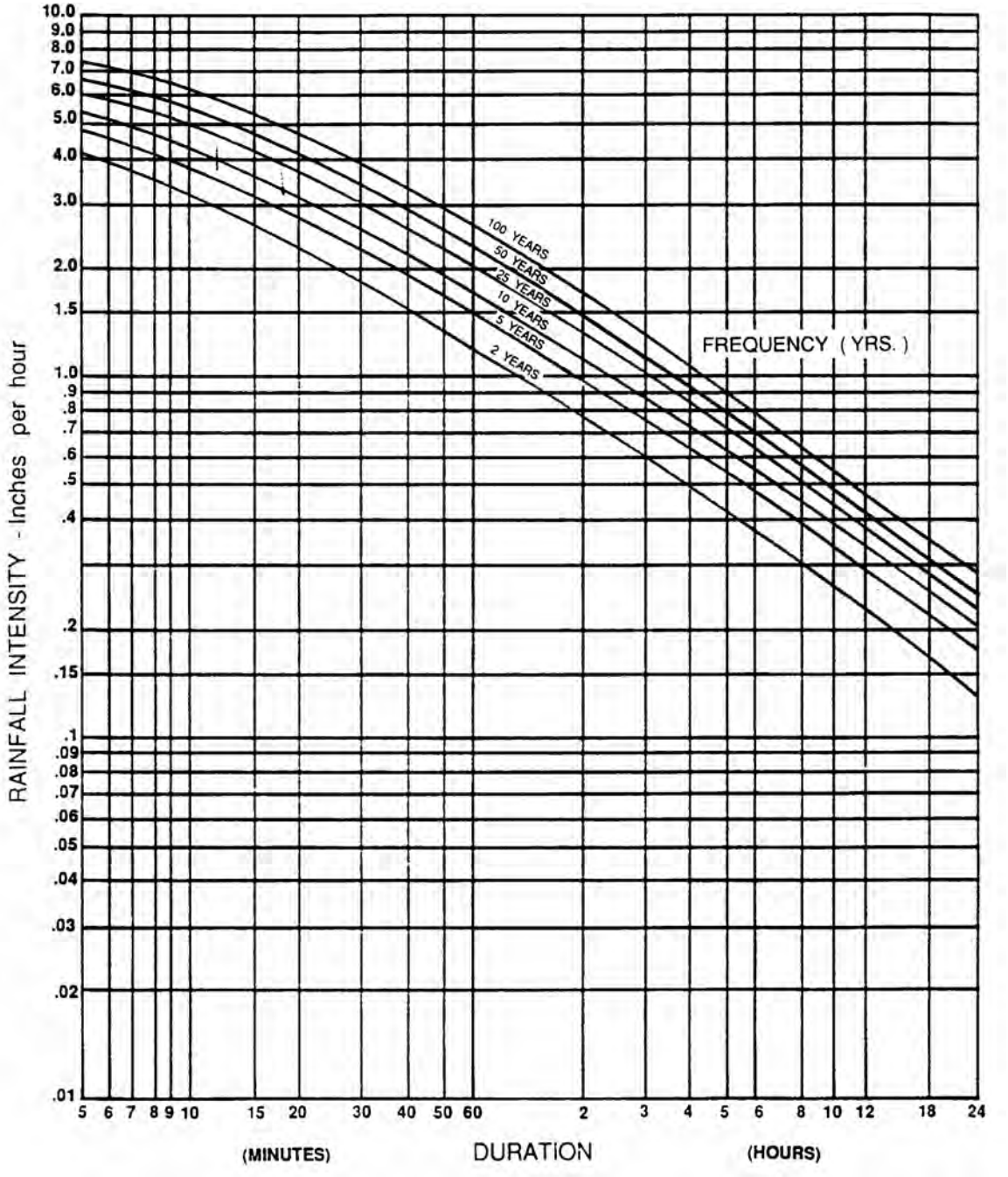
NOTES: Intensity = 44.87 / (Inlet time + 10.30) ^ 0.66 -- Return period = 100 Yrs. ; ** Critical depth

CATCH BASIN DRAINAGE AREA SUMMARY
1165R MASS AVE
ARLINGTON, MA

c coefficient, grass=	0.30
c coefficient, impervious=	0.90

Drainage Area Name	Total Area (sf)	Grassed Area (sf)	"C"	Total Area (Ac.)
CB-1	27,752	1,388	0.87	0.64
CB-2	3,660	640	0.80	0.08
CB-3	4,116	0	0.90	0.09
AD-1	1,188	950	0.42	0.03
AD-2	471	424	0.36	0.01
AD-3	1,966	492	0.75	0.05
TD-1	2,610	0	0.90	0.06
RF-1A	3,361	0	0.90	0.08
RF-1B	3,388	0	0.90	0.08
RF-2	5,398	0	0.90	0.12
RF-3	1,742	0	0.90	0.04
RF-4	24,160	0	0.90	0.55
			Total Area (ac.)=	1.83

Exhibit 8-12
Intensity – Duration – Frequency Curve for Boston, MA



Source: TR55 - Urban Hydrology for Small Wetlands, NRCS

Ryder Brook Relocation
Calculations Demonstrating
Increase in Pipe Capacity

Manning's Equation
For Circular Pipes

Existing 24" Pipe		
DIAMETER	2	ft
SLOPE	0.013	
n	0.013	
Area	3.14	sf
Perimeter	6.28	ft
Hyd. Radius	0.50	ft
Velocity	8.23	
Q (cfs)	**25.86**	
Proposed 30" Pipe		
DIAMETER	2.5	ft
SLOPE	0.016	
n	0.012	
Area	4.91	sf
Perimeter	7.85	ft
Hyd. Radius	0.63	ft
Velocity	11.48	
Q (cfs)	**56.36**	

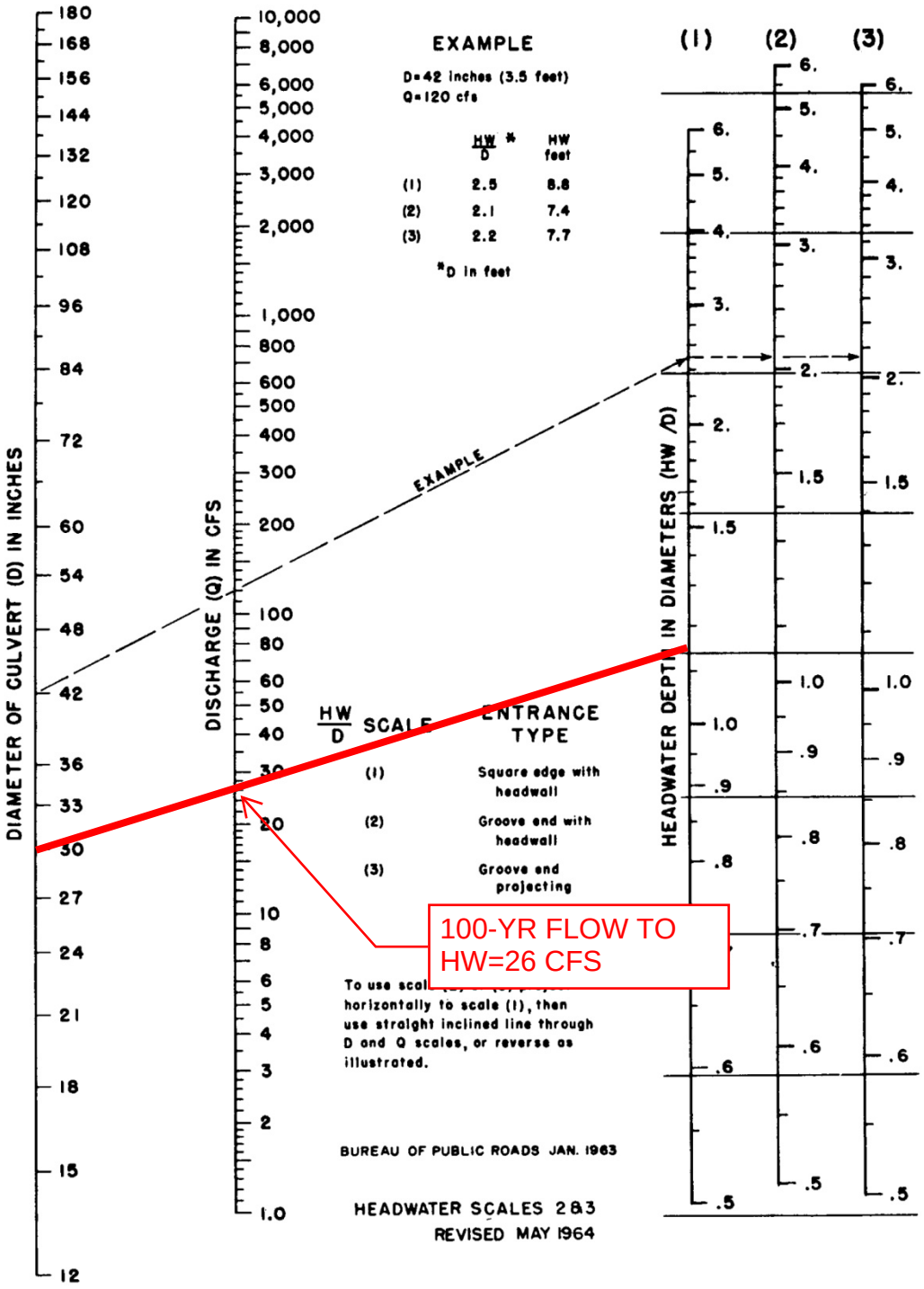


Figure 5C-5 Headwater Depth for Concrete Pipe Culverts with Inlet Control
Source: www.deldot.gov/information/pubs_forms/manuals/road_design/pdf/supp_figures_chap6.pdf

HEADWATER ELEV. = 1.15 x 2.5' (30") = 2.88 FT + CHANNEL BOTTOM ELEVATION OF 94.5 = **97.40 FT**

INLET CONTROL CALCULATION

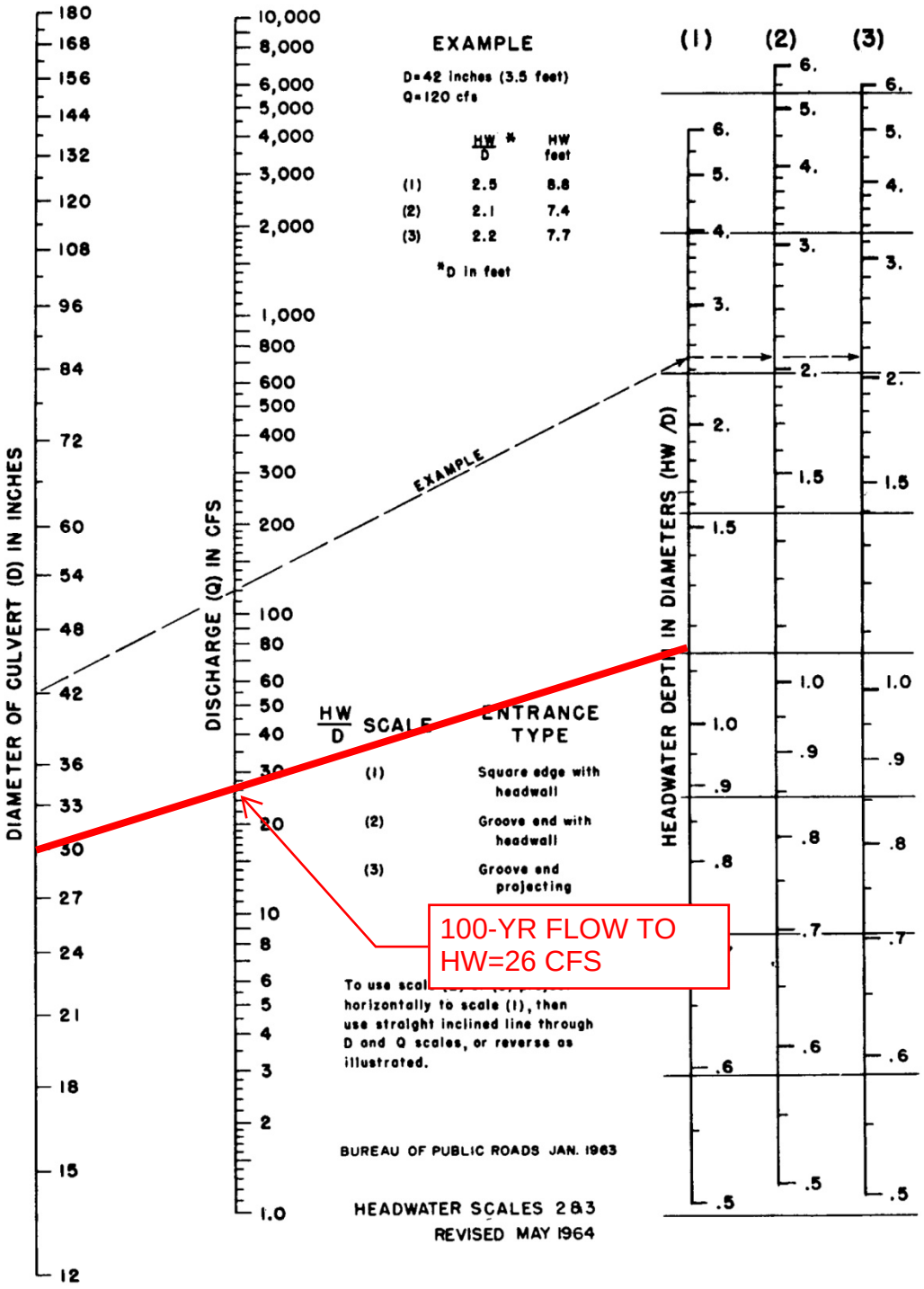


Figure 5C-5 Headwater Depth for Concrete Pipe Culverts with Inlet Control
Source: www.deldot.gov/information/pubs_forms/manuals/road_design/pdf/supp_figures_chap6.pdf

HEADWATER ELEV. = 1.15 x 2.5' (30") = 2.88 FT + CHANNEL BOTTOM ELEVATION OF 94.5 = **97.40 FT**

Manning's Eq for trap. Channels
Capacity of Relocated Ryder Brook Swale
At Headwall

Bottom Width	BW=	4.00
Side Slope	SS=	2.00
# of sides (1 for curb)		2.00
Depth of Flow	D=	2.90
Slope	S=	0.005
Manning's "n"	n=	0.040
Flow Area	A=	28.42
Wetted Perimeter	P=	16.97
Hydraulic Radius	R=	1.67
Spread	T=	8.48
Velocity (fps)	V=	3.71
Flow (cfs)	**Q=**	**105.57**

APPENDIX G: OPERATION AND MAINTENANCE

- *STORMWATER OPERATION AND MAINTENANCE PLAN*
- *INSPECTION REPORT*
- *INSPECTION AND MAINTENANCE LOG FORM*
- *LONG-TERM POLLUTION PREVENTION PLAN*
- *ILLICIT DISCHARGE STATEMENT*
- *SPILL PREVENTION*
- *PROPOSED OPERATION AND MAINTENANCE MAP*
- *MANUFACTURER'S INSPECTION AND MAINTENANCE MANUALS*

STORMWATER OPERATION AND MAINTENANCE PLAN

1165R Massachusetts Avenue
Arlington, MA

RESPONSIBLE PARTY DURING CONSTRUCTION:

1165R MASS MA PROPERTY LLC
1165R Massachusetts Avenue
Arlington, MA

RESPONSIBLE PARTY POST CONSTRUCTION:

1165R MASS MA PROPERTY LLC
1165R Massachusetts Avenue
Arlington, MA

Construction Phase

During the construction phase, all erosion control devices and measures shall be maintained in accordance with the final record plans, local/state approvals and conditions, the EPA Construction General Permit and the Stormwater Pollution Prevention Plan (SWPPP) if applicable. Additionally, the maintenance of all erosion / siltation control measures during construction shall be the responsibility of the general contractor. Contact information of the OWNER and CONTRACTOR shall be listed in the SWPPP for this site. The SWPPP also includes information regarding construction period allowable and illicit discharges, housekeeping and emergency response procedures. Upon proper notice to the property owner, the Town/City or its authorized designee shall be allowed to enter the property at a reasonable time and in a reasonable manner for the purposes of inspection.

Post Development Controls

Once construction is completed, the post development stormwater controls are to be operated and maintained in compliance with the following permanent procedures (note that the continued implementation of these procedures shall be the responsibility of the Owner or its assignee):

1. Parking lots and on-site driveways: Sweep at least two (2) times per year and on a more frequent basis depending on sanding operations. All resulting sweepings shall be collected and properly disposed of off site in accordance with MADEP and other applicable requirements.

   Approximate Maintenance Budget: $1,000/year

2. Catch basins, yard drains, trench drains, manholes and piping: Inspect two (2) times per year and at the end of foliage and snow-removal seasons. These features shall be cleaned two (2) times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the catch basin or underground system. Accumulated sediment and hydrocarbons present must be removed and properly disposed of off site in accordance with MADEP and other applicable requirements.

Approximate Maintenance Budget: $500/year per structure.

3. Water Quality Unit (Proprietary Separator): Follow manufacturer's recommendations (attached).

   Approximate Maintenance Budget: $1,000/year per unit.

4. Driveway perimeter peastone gravel infiltration trench: Preventative maintenance after every major storm event during the first three (3) months of operation and at least twice per year thereafter. Inspect trench to ensure proper operation after every major storm event (generally equal or greater to 3.0 inches in 24 hours) for the first three months. Remove trash and debris, remove grass clippings and accumulated organic matter. Any sediment removed shall be disposed of in accordance with MADEP and other applicable requirements.

   Approximate Maintenance Budget: $200/year.

5. Ryder Brook drainage swale: Inspect at least quarterly and after any rainfall of 3.0 or more inches occurring within a 24-hour period. Inspect the headwall and trash rack for debris or clogging. Remove any debris or clogs immediately. At least once per year, generally in the summer or early fall, the sideslopes of the channel shall be maintained by repairing any erosion, replacing vegetation that does not appear to be healthy, and removing any vegetation that has the potential to impair conveyance of water within the swale. Trees are not proposed within the swale and any naturally occurring trees shall be removed before they are large enough to cause significant disruption to the swale by their removal. The riprap stone channel bottom shall be inspected and repaired as necessary. Any accumulated sediment that could impair conveyance of water shall be removed. All materials removed from the swale including debris, sediment, or vegetative growth shall be disposed of in accordance with MADEP and other applicable requirements.

   Approximate Maintenance Budget: $2,000/year.

All components of the stormwater system will be accessible by the owner or their assignee.

STORMWATER MANAGEMENT SYSTEM

POST-CONSTRUCTION INSPECTION REPORT

LOCATION:

1165R Massachusetts Avenue
Arlington, MA

RESPONSIBLE PARTY:

1165R MASS MA PROPERTY LLC
1165R Massachusetts Avenue
Arlington, MA

NAME OF INSPECTOR:	INSPECTION DATE:
Note Condition of the Following (sediment depth, debris, standing water, damage, etc.):	
Catch Basins:	
Discharge Points:	
Water Quality Units:	
Driveway perimeter peastone gravel infiltration trench:	
Other:	

Note Recommended Actions to be taken on the Following (sediment and/or debris removal, repairs, etc.):
Catch Basins:
Discharge Points:
Water Quality Units:
Driveway perimeter peastone gravel infiltration trench:
Other:
Comments:

STORMWATER INSPECTION AND MAINTENANCE LOG FORM

1165R Massachusetts Ave.
Arlington, MA

Stormwater Management Practice	Responsible Party	Date	Maintenance Activity Performed

LONG-TERM POLLUTION PREVENTION PLAN

1165R Massachusetts Avenue
Arlington, MA

RESPONSIBLE PARTY DURING CONSTRUCTION:

1165R MASS MA PROPERTY LLC
1165R Massachusetts Avenue
Arlington, MA

RESPONSIBLE PARTY POST CONSTRUCTION:

1165R MASS MA PROPERTY LLC
1165R Massachusetts Avenue
Arlington, MA

For this site, the Long-Term Pollution Prevention Plan will consist of the following:

- The property owner shall be responsible for "good housekeeping" including proper periodic maintenance of building and pavement areas, curbing, landscaping, etc.
- Proper storage and removal of solid waste (dumpsters).
- Sweeping of driveways a minimum of twice per year with a commercial cleaning unit. Any sediment removed shall be disposed of in accordance with applicable local and state requirements.
- Regular inspections and maintenance of Stormwater Management System as noted in the "O&M Plan".
- Snow removal shall be the responsibility of the property owner. Snow shall not be plowed, dumped and/or placed in forebays, infiltration basins or similar stormwater controls. Salting and/or sanding of pavement / walkway areas during winter conditions shall only be done in accordance with all state/local requirements and approvals.

OPERATON AND MAINTENANCE TRAINING PROGRAM

The Owner will coordinate an annual in-house training session with staff to discuss the Operations and Maintenance Plan and the Long-Term Pollution Prevention Plan. Annual training will include the following:

Discuss the Operations and Maintenance Plan

- Explain the general operations of the stormwater management system and its BMPs
- Identify potential sources of stormwater pollution and measures / methods of reducing or eliminating that pollution
- Emphasize good housekeeping measures

Discuss Spill Prevention and Response Procedures

- Explain the process in the event of a spill
- Identify potential sources of spills and procedures for cleanup and /or reporting and notification
- Complete a yearly inventory or Materials Safety Data sheets of all tenants and confirm that no potentially harmful chemicals are in use.

Operation and Maintenance Measures

- Trash and other debris shall be removed from all areas of the site at least twice yearly.
- Reseed any bare areas as soon as they occur. Erosion control measures shall be installed in these areas to prevent deposits of sediment from entering the drainage system.
- Grass shall be maintained at a minimum blade height of two to three inches and only 1/3 of the plant height shall be removed at a time. Clippings shall not be disposed of within stormwater management areas or adjacent resource areas.
- Plants shall be pruned as necessary.
- The use of fertilizers will be kept at a level consistent with typical residential use. Fertilizer will be applied a maximum of once to twice per year during the initial planting and stabilization of landscaped areas. Once plants are established and growing well fertilizer will be applied judiciously.
- The use of pesticides will be kept at a level consistent with typical residential use. Where possible mechanical methods (i.e. pest traps) or biological methods (i.e.

beneficial insects) of pest control shall be implemented. If pesticides (insecticide, herbicide, and fungicide) are required to be used, a pesticide which poses the lowest risk to public health and the environment shall be used.

- Pet waste shall be disposed of in accordance with local regulations. Pet waste shall not be disposed of in a storm drain or catch basin.

- Snow piles shall be located adjacent to or on pervious surfaces in upland areas. This will allow snow melt water to filter in to the soil, leaving behind sand and debris which can be removed in the springtime.

- In no case shall snow be disposed of or stored in resource areas (wetlands, floodplain, streams or other water bodies).

- If necessary, stockpiled snow will be removed from the Site and disposed of at an off-site location in accordance with all local, state and federal regulations.

- The amount of sand and deicing chemicals shall be kept at the minimum amount required to provide safe pedestrian and vehicle travel.

- Deicing chemicals are recommended as a pretreatment to storm events to minimize the amount of applied sand.

- Sand and deicing chemicals should be stockpiled under covered storage facilities that prevent precipitation and adjacent runoff from coming in contact with the deicing materials. Stockpile areas shall be located outside resource areas.

ILLICIT DISCHARGE STATEMENT

Certain types of non-stormwater discharges are allowed under the U.S. Environmental Protection Agency Construction General Permit. These types of discharges will be allowed under the conditions that no pollutants will be allowed to come in contact with the water prior to or after its discharge. The control measures which have been outlined previously in this LTPPP will be strictly followed to ensure that no contamination of these non-storm water discharges takes place. Any existing illicit discharges, if discovered during the course of the work, will be reported to MassDEP and the local DPW, as applicable, to be addressed in accordance with their respective policies. No illicit discharges will be allowed in conjunction with the proposed improvements.

Duly Acknowledged:

_____

Name & Title

CONTECH®
ENGINEERED SOLUTIONS

CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.3	3.0	0.9	1.3	1.0
CDS2020	5	1.3	3.5	1.1	1.3	1.0
CDS2025	5	1.3	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, earth stabilization and wastewater treament products. For information, visit www.ContechES.com or call 800.338.1122

CONTECH®
ENGINEERED SOLUTIONS
800.925.5240
www.ContechES.com

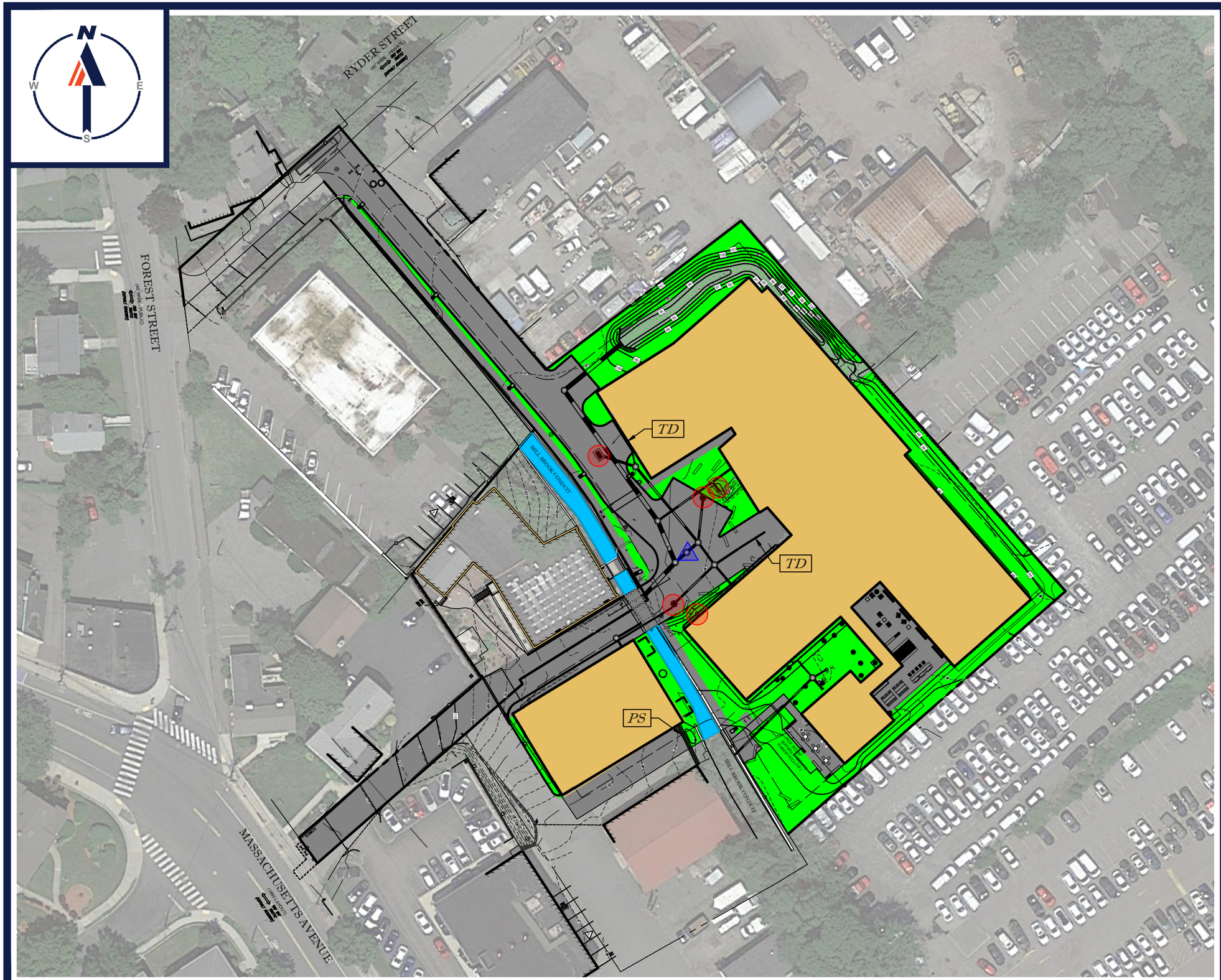
CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.



LEGEND

- CATCH BASIN (SINGLE AND DOUBLE)
- WATER QUALITY UNIT
- TD — TRENCH DRAIN
- PS — PEASTONE GRAVEL DIAPHRAGM

OPERATION & MAINTENANCE LOCATION MAP

1165R MASSACHUSETTS AVE
ARLINGTON, MA

PREPARED BY

BOHLER

SCALE: 1"=60'
DATE: 04/01/2021