Stormwater Report

Birch Meadow Park Phase 1

Birch Meadow Drive
Reading, MA 01867

11/29/2022

Owner:
Town of Reading
16 Lowell Street
Reading, MA01867
(781) 942-9001

Civil Engineer/ Landscape Architect:
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Submitted To:
Town of Reading
16 Lowell Street
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November 29, 2022

Executive Summary

The Town of Reading is proposing ADA walkway and parking improvements at Birch Meadow Park. The project will include renovating the existing the hard-packed gravel parking lot to the northwest of the existing track and field to a paved asphalt lot with formalized parking, accessible parking spots, and walkways leading to the track and field area. In addition, the Town is proposing to renovate and formalize existing (formal and informal) walkways located to the southwest of the high school to traverse northwest to southeast from Birch Meadow Drive south of the softball field to the existing driveway and parking area at the high school. This will allow for ADA accessibility from the parking area to various areas of Birch Meadow Park.

Construction of the proposed project is subject to regulation under the following:

- MA Wetlands Protection Act
- MA DEP's Stormwater Management Policy (January 2008)
- Town of Reading Wetlands Protection Bylaw and Regulation
- Town of Reading Stormwater Management and Erosion Control Regulations

The majority of Birch Meadow Park and the high school and athletic site flows to the existing culvert that runs beneath the park. As such, while the proposed work is a small portion of the park, it is important to review the overall implications of the runoff flowing to the discharge point which is essentially the culvert (DP-1). As shown on the drainage maps within, the Area of Analysis is 21.24-acres while the actual proposed limit of work is only 2.54-acres.

As shown in the Report, the proposed design meets all mitigation, treatment, and recharge requirements within the documents listed above.

The following report was created in accordance with the documents listed above and is organized into sections that correspond to the categories listed in the "Massachusetts Stormwater Report Checklist".

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Birch Meadow

Town of Reading, MA

Locus Map

PROJECT NO.: 22014.00
REFERENCE SHEET:
PHASE: PERMITTING
DATE: NOVEMBER 28, 2022
SCALE: 1" = 200'-0"

Figure No. 1

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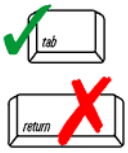
Massachusetts Stormwater Report Checklist

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

11/29/2022

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:

- [X] 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
- [X] Use of "country drainage" versus curb and gutter conveyance and pipe
- [X] 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

- [X] 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.

1.0 Project Type

The area to be renovated is located at a series of parcels at Birch Meadow Park, which includes the High School campus, in the Town of Reading, MA. The proposed area of disturbance is approximately 110,439sf (2.54-acres). The proposed construction consists of:

- Renovating an existing hard-packed gravel lot to an asphalt lot with improved accessibility;
- Renovating and extending accessible walkways from the High School parking area to the various athletic fields on-site and to Birch Meadow Drive.

The project is considered a mix of new development and redevelopment and has been designed in accordance with the "Massachusetts Stormwater Handbook" dated January 2008 and the Town of Readings Wetlands Protection Regulations and Town of Reading's Stormwater Management and Erosion Control Regulations.

2.0 LID Measures

Key features of Low Impact Development (LID) stormwater management systems include implementing practices that maintain a site's existing hydrology, using decentralized practices to manage stormwater close to the source of generation, and maximizing onsite infiltration to reduce runoff and landscape watering requirements.

The following LID techniques Best Management Practices are specified in the proposed development program to mitigate the increase in stormwater runoff from the site.

BMPs Used:

- Use of "country drainage" and overland flow in areas of the site
- Using on-site infiltration to extent possible

3.0 Standard 1 – No New Untreated Discharges

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

The computations and strategies for Standards 4 through 6 in this report demonstrate that there will be no new untreated discharges from the site.

4.0 Standard 2 – Peak Rate Attenuation

Standard 2 requires that peak rates of flow be attenuated for the proposed condition. The following section outlines the procedure for determining the peak rates for the existing and proposed conditions.

4.1 Methodology and Design Criteria

4.1.1 Hydrologic Model Description

The drainage analysis was performed using the Soil Conservation Service (SCS) TR-55 and TR-20 methodologies and the computer program HydroCAD 10.00-22 by HydroCAD software Solutions, LLC.

4.1.2 Design Storms

The analysis was performed on the 2-, 10-, and 100-year frequency rainfall events. The events were based on the 24-hour Type-III duration storm.

4.1.3 Time of Concentration

Time of concentration (Tc) values were calculated using Average Velocities for Overland Flow, found in SCS TR-55 Urban Hydrology for Small Watersheds. The minimum Tc used was six (6) minutes. Tc flows can be found on Figures 2 and 3.

4.1.4 Curve Numbers

Curve numbers were developed for each of the different use categories and hydrologic soil group types within each sub-area. The curve numbers were based on the SCS TR-55 methodology and are included in the HydroCAD input and output found in the Attachments Section.

4.1.5 Rainfall Depth

Rainfall depths are per the Rainfall Frequency Atlas of the United States (TP-40). Rainfall events for the 2-, 10-, and 100-year storms were analyzed.

The following rainfall depths were used in the calculations:

Storm Event	**Rainfall Depth**
2-Year	3.10 inches
10-Year	4.50 inches
100-Year	6.50 inches

4.2 Soil Conditions

The NRCS Web Soil Survey report shows that the project area is located within an area with map unit/name 655/Udorthents, wet substratum which is not given a hydrologic rating. In reviewing surrounding areas to the site, the hydrologic ratings vary from A to B. To be conservative, a B hydrologic rating has been carried throughout the hydrologic analysis. The Web Soil Survey Report can be found in the Appendix.

Table 1: NRCS Soil Types

Map Designation	Soil Name	Soil Group
655	Udorthents – wet substratum	B*

*Soil Group based on findings from the NRCS Soil Report for surrounding soils

4.3 Existing Conditions

4.3.1 Existing Conditions Drainage Areas and Discharge Points

As noted previously the disturbance for the project areas is limited to about 2.54-acres. This is broken up into 1.0-acres at the parking lot area and 1.54-acres for the accessible walkway work. However, for the drainage analysis a larger Area of Analysis (AOA) is used to more adequately quantify and compare the runoff in the existing and proposed conditions. The Area of Analysis (AOA) includes Birch Meadow Park and the accompanying High School campus and is approximately 925,402 sf or 21.24 acres. The site is comprised of impervious surfaces associated with the various buildings, parking lots, and drives; impervious walkways through the park; synthetic turf athletic surfaces; natural grass athletic surfaces with skinned infield areas; wooded areas; wetlands areas; and the hard packed gravel lot adjacent to the track and field facility. Runoff from these various areas all flow to the existing wetland areas and the culvert that runs below grade through the site either via surface flow or through the site's existing drainage system. The wetland system and culvert outlet to the south of the softball fields is considered the Discharge Point for the Area of Analysis (DP-1).

Drainage Area EX-1 in the HydroCAD model encompasses the entire Area of Analysis and is approximately 21.24-acres. Runoff flows either via surface flow or through the site's existing drainage system to DP-1.

4.3.2 Existing Drainage Area Summary

Figure 2 shows a map of the existing drainage area.

Table 2 summarizes the existing drainage areas, materials, and the pertinent information used for hydrologic analysis.

Table 2: Existing Conditions Drainage Area Characteristics Summary

EX-1		
Area Types	Curve Number	Area (sf)
Impervious	98	296,098
Wooded	58	91,227
Infield Mix	86	35,545
Synthetic Turf	61	157,014
Grass	61	345,518
TOTAL	74	925,402

*Reference Attachment Section 13: HydroCAD Data – Existing Conditions, CN of each drainage area.
**Reference Attachment Section 13: HydroCAD Data – Existing Conditions, Tc of each drainage area.

LEGEND

DRAINAGE AREA EX-1

DISCHARGE POINT DP-X

0' 100' 200' 400' 600'

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Pre-Development Plan

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Figure No. 2

4.4 Proposed Conditions

The proposed project consists of renovating the existing hard-packed gravel parking lot to the northwest of the track and field to a paved asphalt parking lot with associated ADA parking and walkways to the track and field facility. New landscape areas are proposed within and adjacent to the parking lot area.

4.4.1 Proposed Conditions Drainage Areas and Discharge Points

In the proposed conditions the Area of Analysis remains the same with one (1) discharge point (DP-1). However, the drainage area has been divided into two sub-areas for analysis.

PR-1A is approximately 20.48-acres and includes the majority of the site that is not renovated as part of the project and the accessible walkway to the southwest of the site that provides an accessible connection between the High School parking area and Birch Meadow Drive. Runoff from these areas flow to DP-1 either via surface flow or through the existing drainage infrastructure on-site.

PR-1B is approximately 0.77-acres and consists of the paved areas within the parking lot and associated walkways that flow to the internal catchment areas and/or to the bioretention area to the northeast of the parking area. Runoff that is collected in the area drain and catch basin flow to a leaching basin next to the bioretention area. Due to the shallow nature of the site, the runoff flowing to the leaching basin at the infiltration basin will overtop the grate and then flow to the infiltration basin. For modelling purposes the leaching basin is considered part of "Pond 8P". The infiltration basin is designed to infiltrate and then whatever does not infiltrate will outlet through the subsurface drains to the existing storm drain system in the roadway which then flows to the wetland area (DP-1).

Exfiltration is accounted for in the model at the infiltration basin. Based on the soils being B-soils and using the associated Rawl's Rate, the exfiltration at the bottom of the infiltration area is:

$$Exfiltration\ Rate\ (cfs) = (Infiltration\ Rate\ )(Available\ Area\ for\ Infiltration)$$

$$Exfiltration\ Rate\ (cfs) = \left(\frac{1.02\ in}{hr}\right)\left(\frac{1\ ft}{12\ in}\right)\left(\frac{1\ hr}{3600\ sec}\right)(809sf)$$

$$Exfiltration\ Rate\ (cfs) = 0.02cfs$$

4.4.2 Proposed Drainage Area Summary

Figure 3 shows a map of the proposed drainage areas and respective discharge points.

Table 3 summarizes the proposed drainage areas, including the pertinent information used for hydrologic analysis.

Table 3: Proposed Conditions Drainage Area Characteristics Summary

PR-1A		
Area Types	Curve Number	Area (sf)
Impervious	98	285,893
Wooded	58	78,915
Infield Mix	86	35,545
Synthetic Turf	61	157,014
Grass	61	334,616
SUBTOTAL	74	891,983

PR-1B		
Area Types	Curve Number	Area (sf)
Impervious	98	24,778
Grass	61	8,641
SUBTOTAL	88	33,419

TOTAL		925,402

*Reference Attachment Section 13: HydroCAD Data – Proposed Conditions, CN of each drainage area.

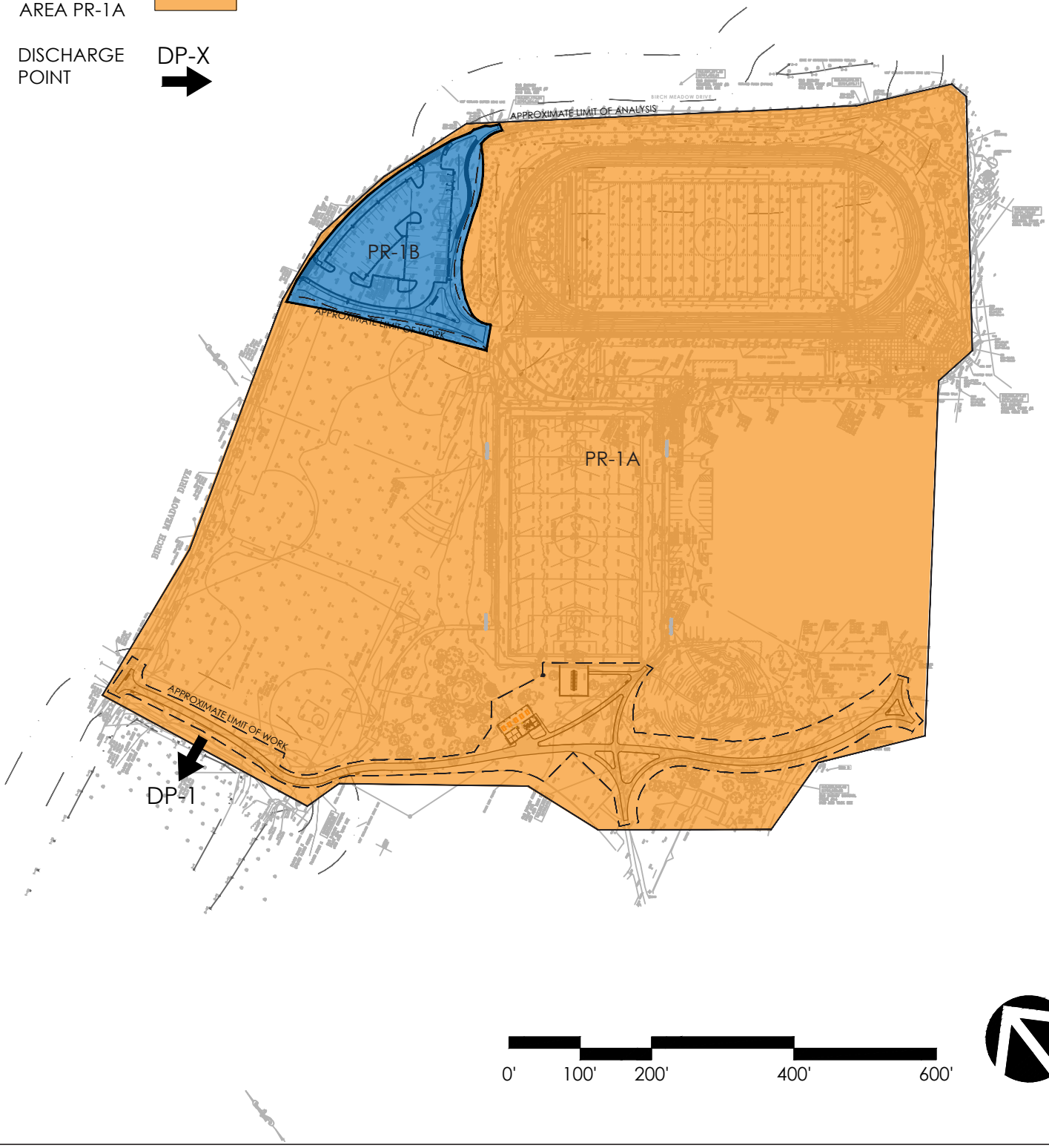
**Reference Attachment Section 13: HydroCAD Data – Proposed Conditions, Tc of each drainage area.

LEGEND

DRAINAGE AREA PR-1B

DRAINAGE AREA PR-1A

DISCHARGE POINT DP-X



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Birch Meadow

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Figure No. 3

4.5 Peak Discharge Runoff Rates

The peak flows were calculated for the 2-, 10-, and 100-year storm events under proposed conditions to compare to the existing runoff rates. As shown all proposed rates are below the existing conditions therefore meeting this Standard.

Table 4: Existing and Proposed Peak Rates of Runoff

Discharge Point	2 Year Storm		10 Year Storm		100 Year Storm	
	Existing (cfs)	Proposed (cfs)	Existing (cfs)	Proposed (cfs)	Existing (cfs)	Proposed (cfs)
DP-1	11.24	11.08	23.99	23.55	44.45	43.55

cfs- Cubic feet per second

5.0 Standard 3 – Recharge

The intent of this standard is to ensure that the infiltration volume of precipitation into the ground under post-development conditions is at least as much as the infiltration volume under pre-development conditions. Standard 3 requires the restoration of recharge, using infiltration measures and careful site design. Through judicious use of low impact development techniques and other approaches that minimize impervious surfaces and mimic natural conditions, new developments can approximate pre-development recharge for most storms.

As noted previously, the site soils are considered Hydrologic Soil B.

Calculations used to demonstrate compliance with Standard 3 used the Static method as outlined in the MA DEP Stormwater Management Handbook. The required recharge volume is determined by:

$$R_v = F * impervious\ area$$

Where:

F = Target Depth Factor associated with each Hydrologic Soil Group (0.35-inch for Soil Type B)

5.1 Recharge of Areas within LOW

Recharge at the site will occur at Infiltration Basin 1 (Pond 8P). As the proposed project is a mix of new and redevelopment, for recharge the increase in impervious area will be considered for infiltration. The increase in impervious surface due to the proposed project is 14,573sf.

Recharge Calculation:

$$Total\ R_v = \left(0.35\ in\ x\ \frac{1ft}{12in}\ x\ 14{,}573\ sf\right)$$

$$R_v = 425\ cf$$

Since the proposed parking lot area has an impervious coverage of 24,778sf (refer to PR-1B) the runoff from the parking lot will generate enough runoff to account for the increase in impervious and therefore an adjustment factor is not required for this calculation even though the runoff from the ADA walkway to the south of the softball field is not being collected.

As noted in the HydroCAD model, Pond-8P in the 2-year storm the pond discards, or infiltrates, 1,136cf exceeding the required recharge volume, therefore meeting this Standard.

5.2 Drawdown Time

The Massachusetts Stormwater Handbook requires that recharge volume have a drawdown time of 72 hours or less. The drawdown time is determined by:

$$Time_{drawdown} = \frac{R_v\ cf}{(K)\ x\ (Bottom\ Area)}$$

Where:

K= Rawls Rate (1.02 in/hr for Type B Sandy Loam)

5.2.1 Drawdown Time of Pond 8P

The drawdown time for the detention system associated with Infiltration Basin 1 (Pond 8P)

$$Time_{drawdown} = \frac{425\ cf}{\left(\frac{1.02\ in}{hr}\right)x\ (809sf)}$$

$$Time_{drawdown} = \frac{425\ cf}{\left(\frac{1.02\ in}{hr}\right) x\ \left(\frac{1\ ft}{12\ in}\right) x\ \left(\frac{1\ hr}{60\ mins}\right) x\ (809\ sf)}$$

$$Time_{drawdown} = 370.8\ mins = 6.18\ hrs$$

The infiltration basin meets the drawdown time requirement.

6.0 Standard 4 – Water Quality

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

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

The MA Stormwater Handbook requires a water quality volume equal to 0.5-inch of runoff times the total impervious areas requiring treatment.

The accessible walkway connecting Birch Meadow Drive to the High School parking area will not generate TSS like a parking lot or roadway. However the Stormwater Handbook does not provide a distinction between the level of TSS generated from a parking lot / roadway with that of a paved pedestrian walkway. Runoff from the walkway will flow into the adjacent grass areas and eventually flow towards existing drainage infrastructure or via surface flow to the wetland/culvert areas. The case can be made that with the low amount of TSS produced from a pedestrian walkway (similar to runoff from pavement that has gone through BMPs such as street sweeping, deep sump catch basins, oil grit separator, and a sediment forebay) in addition to the runoff flowing over large areas of grass (similar to a Vegetated Filter Strip), the treatment train calculation shows a TSS Removal rate of 79%, just below the 80% dictated by the Standards. As this is a portion of redevelopment we ask for relief of meeting the 80% TSS removal for this portion of the work.

At the parking lot area the project will meet the TSS removal rate requirement. The majority of the parking lot and adjacent walkways will be collected and run through a deep sump catch basin and flow to a leaching basin. This runoff will either infiltrate into the ground or overflow to the rain garden / infiltration basin. This treatment train provides 86% TSS removal.

At the remaining parking lot area, runoff will surface flow towards the bioretention area. Runoff flowing off the parking lot area will flow through a pretreatment of 12" of gravel followed by a 5' sod strip (as defined in V2C2 of the SWH) before flowing into the bioretention area. Use of the bioretention area with pretreatment provides 90% TSS removal.

The impervious area in PR-1B, which is the parking lot area, is 24,778sf. The SWH requires treatment of 0.5-inches over this area. The Required Water Quality Volume is:

$$Total\ Impervious\ Area = 24{,}778\ \text{sf}$$

$$R_v = \left(0.5\ in\ x\ \frac{1ft}{12in}\ x\ 24{,}778\ sf\right)$$

$$R_v = 1{,}032\ cf$$

As shown in the HydroCAD model, Pond 8P has adequate storage to treat this volume and therefore the TSS removal standard is met for the parking lot area.

7.0 Standard 5 – Land Uses with Higher Potential Pollutant Loads

This project site is not considered a land use with Higher Potential Pollutant loads and therefore Standard 5 is not applicable to this project.

8.0 Standard 6 – Critical Areas

Stormwater discharges within critical areas require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such area, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors.

The proposed project is not within a Critical Area.

9.0 Standard 7 – Redevelopment

The project site is considered a mix of new and redevelopment project per the MA Stormwater handbook criteria. However, the project applicant and the design team are implementing a stormwater management system in full compliance with all of the standards outlined in the Massachusetts Stormwater Handbook to the extent practicable. Relief has been requested for TSS removal along the pedestrian walkway portion of the project.

10.0 Standard 8 – Construction Period Pollution Prevention and Erosion & Sedimentation Control

Construction period pollution prevention and erosion and sedimentation control measures will be implemented at the project site to control construction related impacts during construction and land disturbance activities.

The general contractor for the project will be responsible for the implementation of the construction period controls.

The project scope will disturb approximately 2.54-acres acres of land during the construction process and will require a NPDES Construction General Permit issued by the Environmental Protection Agency. As a result, a stormwater pollution prevention plan (SWPPP) will be required. The SWPPP document will satisfy the requirements of the Construction General Permit and the construction period erosion, sedimentation and pollution prevention plan requirements outlined in Standard 9 of the Massachusetts Stormwater Handbook. A SWPPP will be developed by the awarded General Contractor and a copy will be kept on-site during project construction. A copy can be provided to the Conservation Commission if requested.

11.0 Standard 9 – Operation and Maintenance Plan

The goal of the Operation and Maintenance Plan is not only to protect resources on-site or nearby, but also to protect resources in the region that may be affected by the activities at the site. For the proposed water quality treatment measures and the implementation of Best Management Practices (BMPs) refer to Section 6.0, Standard 4. The Town of Reading will own the stormwater management system and they will be responsible for operation and maintenance.

The Post Construction Operation and Maintenance Plan is included in the Attachments Section.

12.0 Standard 10 – Prohibition of Illicit Discharges

Standard 10 of the Massachusetts Stormwater Handbook prohibits illicit discharges to stormwater management systems. As stated in the handbook, "The stormwater management system is the system for conveying, treating, and infiltrating stormwater on-site, including stormwater best management practices and any pipes intended to transport

stormwater to the groundwater, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater."

It is fully understood that the Storm Water Pollution Prevention Plan (SWPPP) will include procedures to prevent illicit discharges to the stormwater management system.

Standard 10 also states that "The Illicit Discharge Compliance Statement must be accompanied by a site map that is drawn to scale and that identifies the location of any systems for conveying stormwater on the site and shows that these systems do not allow the entry of any illicit discharges into the stormwater management system. The site map shall identify the location of any systems for conveying wastewater and/or groundwater on the site and show that there are no connections between the stormwater and wastewater management systems and the location of any measures taken to prevent the entry of illicit discharges into the stormwater management system." Included with the Stormwater Report is a Drainage and Utility Plan that displays the location of all of the stormwater management components as well as other utilities (existing and proposed) on the project site and conforms to requirements of a "site map" to accompany the Illicit Discharge Compliance Statement.

Illicit Discharge Compliance Statement

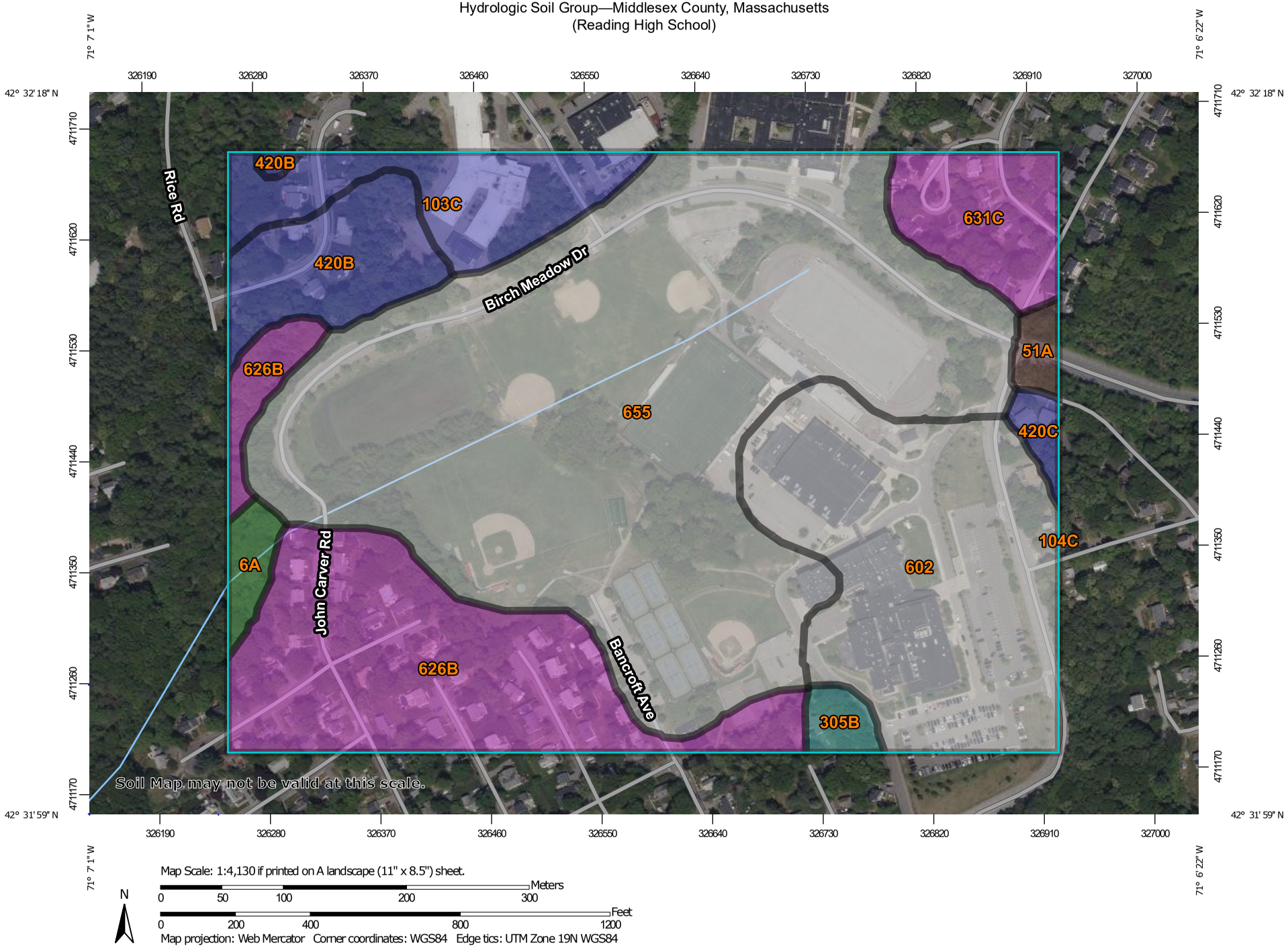
Per the requirements of Standard 10 of the Massachusetts Stormwater Management Standards it shall be stated that No Illicit Discharges exist on the Birch Meadow Park sites located at 0 Birch Meadow Drive.

13.0 Attachments

Soil Map and Info
HydroCAD Data 2, 10, 100 year Storms
TSS Removal Calculations
Operation and Maintenance Plan (Bound Separately)

Soil Map and Information

Hydrologic Soil Group—Middlesex County, Massachusetts
(Reading High School)



Map Scale: 1:4,130 if printed on A landscape (11" x 8.5") sheet.

N

0 50 100 200 300 Meters

0 200 400 800 1200 Feet

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 21, Sep 2, 2021

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

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

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background 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
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	A/D	0.9	1.1%
51A	Swansea muck, 0 to 1 percent slopes	B/D	0.6	0.8%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	B	4.6	5.6%
104C	Hollis-Rock outcrop-Charlton complex, 0 to 15 percent slopes	D	0.0	0.0%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	C	0.7	0.9%
420B	Canton fine sandy loam, 3 to 8 percent slopes	B	4.1	5.0%
420C	Canton fine sandy loam, 8 to 15 percent slopes	B	0.6	0.7%
602	Urban land		14.2	17.4%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	A	13.2	16.2%
631C	Charlton-Urban land-Hollis complex, 3 to 15 percent slopes, rocky	A	3.5	4.3%
655	Udorthents, wet substratum		39.4	48.2%
Totals for Area of Interest			**81.8**	**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.

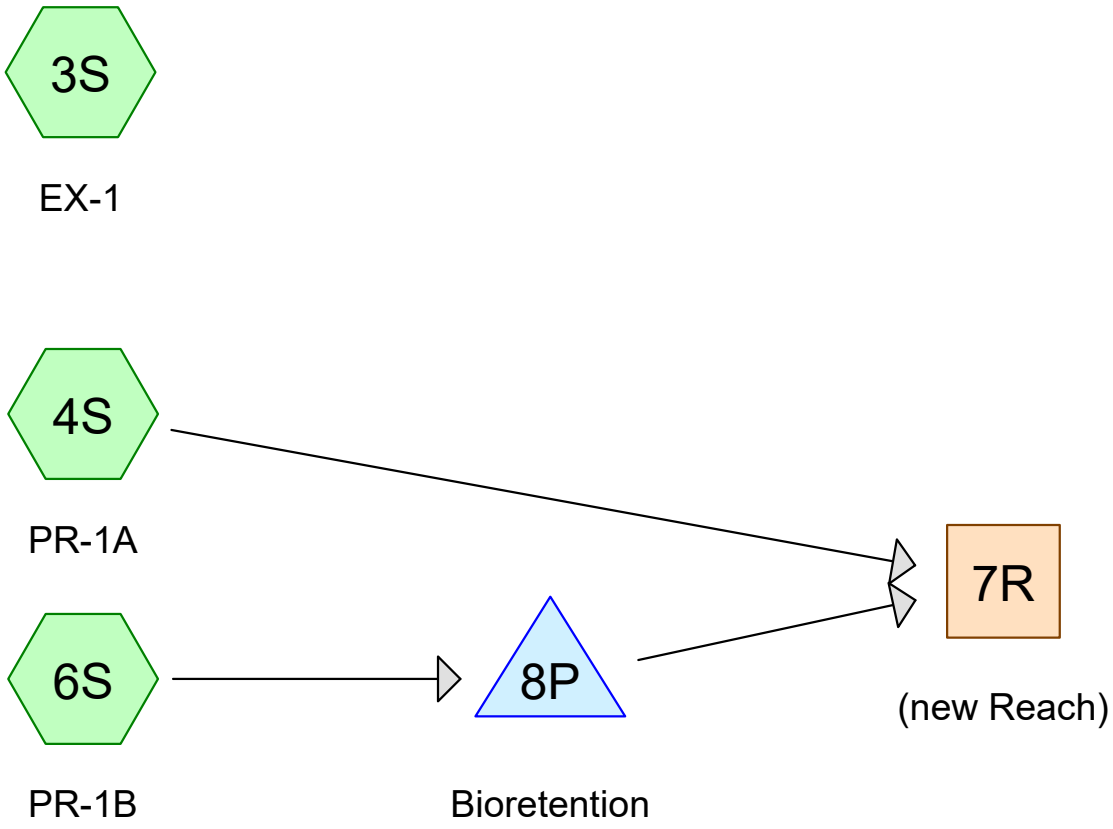
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

HydroCAD Data – 2, 10, 100-year Storms



Subcat Reach Pond Link

Routing Diagram for 22014-HydroCAD-Calcs
Prepared by {enter your company name here}, Printed 11/28/2022

Time span=0.00-30.00 hrs, dt=0.02 hrs, 1501 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 3S: EX-1 Runoff Area=925,402 sf 32.00% Impervious Runoff Depth=0.97"
Flow Length=1,714' Tc=39.7 min CN=74 Runoff=11.24 cfs 74,980 cf

Subcatchment 4S: PR-1A Runoff Area=891,983 sf 32.05% Impervious Runoff Depth=0.97"
Flow Length=1,714' Tc=39.7 min CN=74 Runoff=10.83 cfs 72,272 cf

Subcatchment 6S: PR-1B Runoff Area=33,419 sf 74.14% Impervious Runoff Depth=1.91"
Tc=6.0 min CN=88 Runoff=1.71 cfs 5,312 cf

Reach 7R: (new Reach) Inflow=11.08 cfs 76,448 cf
Outflow=11.08 cfs 76,448 cf

Pond 8P: Bioretention Peak Elev=90.16' Storage=1 cf Inflow=1.71 cfs 5,312 cf
Discarded=0.02 cfs 1,136 cf Primary=1.69 cfs 4,176 cf Outflow=1.71 cfs 5,312 cf

Total Runoff Area = 1,850,804 sf Runoff Volume = 152,564 cf Average Runoff Depth = 0.99"
67.22% Pervious = 1,244,035 sf 32.78% Impervious = 606,769 sf

Summary for Subcatchment 3S: EX-1

Runoff = 11.24 cfs @ 12.59 hrs, Volume= 74,980 cf, Depth= 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	296,098	98	Impervious
	91,229	58	Woods/grass comb., Good, HSG B
*	35,545	86	Infield Mix, bare soil
*	157,014	61	Synthetic Turf
*	345,516	61	Grass
	925,402	74	Weighted Average
	629,304		68.00% Pervious Area
	296,098		32.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0460	0.09		**Sheet Flow, Flow 1.1 (50') Wooded** Woods: Light underbrush n= 0.400 P2= 3.10"
1.3	50	0.0046	0.65		**Sheet Flow, Flow 2.1(50') Impervious** Smooth surfaces n= 0.011 P2= 3.10"
19.0	952	0.0031	0.84		**Shallow Concentrated Flow, Flow 1.2 (952') Short Grass** Grassed Waterway Kv= 15.0 fps
10.4	662	0.0050	1.06		**Shallow Concentrated Flow, Flow 2.2 (662') Short Grass** Grassed Waterway Kv= 15.0 fps
39.7	1,714	Total			

Summary for Subcatchment 4S: PR-1A

Runoff = 10.83 cfs @ 12.59 hrs, Volume= 72,272 cf, Depth= 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	285,893	98	Impervious
*	78,917	58	Wooded, grass
*	35,545	86	Infield Mix
*	157,014	61	Synthetic Turf
*	334,614	61	Grass
	891,983	74	Weighted Average
	606,090		67.95% Pervious Area
	285,893		32.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0460	0.09		**Sheet Flow, Flow 1.1 (50') Wooded** Woods: Light underbrush n= 0.400 P2= 3.10"
1.3	50	0.0046	0.65		**Sheet Flow, Flow 2.1 (50') Paved** Smooth surfaces n= 0.011 P2= 3.10"
19.0	952	0.0031	0.84		**Shallow Concentrated Flow, Flow 1.2 (952') Grass** Grassed Waterway Kv= 15.0 fps
10.4	662	0.0050	1.06		**Shallow Concentrated Flow, Flow 2.2 (662') Grass** Grassed Waterway Kv= 15.0 fps
39.7	1,714	Total			

Summary for Subcatchment 6S: PR-1B

Runoff = 1.71 cfs @ 12.09 hrs, Volume= 5,312 cf, Depth= 1.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
24,778	98	Paved parking, HSG B
8,641	61	>75% Grass cover, Good, HSG B
33,419	88	Weighted Average
8,641		25.86% Pervious Area
24,778		74.14% Impervious Area

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

Summary for Reach 7R: (new Reach)

Inflow Area = 925,402 sf, 33.57% Impervious, Inflow Depth = 0.99" for 2-Year event
Inflow = 11.08 cfs @ 12.58 hrs, Volume= 76,448 cf
Outflow = 11.08 cfs @ 12.58 hrs, Volume= 76,448 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs

Summary for Pond 8P: Bioretention

Inflow Area = 33,419 sf, 74.14% Impervious, Inflow Depth = 1.91" for 2-Year event
Inflow = 1.71 cfs @ 12.09 hrs, Volume= 5,312 cf
Outflow = 1.71 cfs @ 12.09 hrs, Volume= 5,312 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.02 cfs @ 9.12 hrs, Volume= 1,136 cf
Primary = 1.69 cfs @ 12.09 hrs, Volume= 4,176 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Peak Elev= 90.16' @ 12.09 hrs Surf.Area= 1 sf Storage= 1 cf

Plug-Flow detention time= 0.1 min calculated for 5,308 cf (100% of inflow)

Center-of-Mass det. time= 0.1 min (816.4 - 816.4)

Volume	Invert	Avail.Storage	Storage Description
#1	89.10'	1,221 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
89.10	1	0	0
92.30	2	5	5
92.44	809	57	62
93.34	1,767	1,159	1,221

Device	Routing	Invert	Outlet Devices
#1	Discarded	89.10'	**0.02 cfs Exfiltration at all elevations**
#2	Primary	89.34'	**12.0" Round Culvert** L= 17.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 89.34' / 89.10' S= 0.0141 '/' Cc= 0.900 n= 0.015, Flow Area= 0.79 sf

Discarded OutFlow Max=0.02 cfs @ 9.12 hrs HW=89.15' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=1.68 cfs @ 12.09 hrs HW=90.16' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 1.68 cfs @ 2.43 fps)

Time span=0.00-30.00 hrs, dt=0.02 hrs, 1501 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 3S: EX-1 Runoff Area=925,402 sf 32.00% Impervious Runoff Depth=1.97"
Flow Length=1,714' Tc=39.7 min CN=74 Runoff=23.99 cfs 152,101 cf

Subcatchment 4S: PR-1A Runoff Area=891,983 sf 32.05% Impervious Runoff Depth=1.97"
Flow Length=1,714' Tc=39.7 min CN=74 Runoff=23.12 cfs 146,608 cf

Subcatchment 6S: PR-1B Runoff Area=33,419 sf 74.14% Impervious Runoff Depth=3.20"
Tc=6.0 min CN=88 Runoff=2.82 cfs 8,901 cf

Reach 7R: (new Reach) Inflow=23.55 cfs 154,259 cf
Outflow=23.55 cfs 154,259 cf

Pond 8P: Bioretention Peak Elev=90.72' Storage=2 cf Inflow=2.82 cfs 8,901 cf
Discarded=0.02 cfs 1,250 cf Primary=2.80 cfs 7,651 cf Outflow=2.82 cfs 8,901 cf

Total Runoff Area = 1,850,804 sf Runoff Volume = 307,611 cf Average Runoff Depth = 1.99"
67.22% Pervious = 1,244,035 sf 32.78% Impervious = 606,769 sf

Summary for Subcatchment 3S: EX-1

Runoff = 23.99 cfs @ 12.57 hrs, Volume= 152,101 cf, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	296,098	98	Impervious
	91,229	58	Woods/grass comb., Good, HSG B
*	35,545	86	Infield Mix, bare soil
*	157,014	61	Synthetic Turf
*	345,516	61	Grass
	925,402	74	Weighted Average
	629,304		68.00% Pervious Area
	296,098		32.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0460	0.09		**Sheet Flow, Flow 1.1 (50') Wooded** Woods: Light underbrush n= 0.400 P2= 3.10"
1.3	50	0.0046	0.65		**Sheet Flow, Flow 2.1(50') Impervious** Smooth surfaces n= 0.011 P2= 3.10"
19.0	952	0.0031	0.84		**Shallow Concentrated Flow, Flow 1.2 (952') Short Grass** Grassed Waterway Kv= 15.0 fps
10.4	662	0.0050	1.06		**Shallow Concentrated Flow, Flow 2.2 (662') Short Grass** Grassed Waterway Kv= 15.0 fps
39.7	1,714	Total			

Summary for Subcatchment 4S: PR-1A

Runoff = 23.12 cfs @ 12.57 hrs, Volume= 146,608 cf, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	285,893	98	Impervious
*	78,917	58	Wooded, grass
*	35,545	86	Infield Mix
*	157,014	61	Synthetic Turf
*	334,614	61	Grass
	891,983	74	Weighted Average
	606,090		67.95% Pervious Area
	285,893		32.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0460	0.09		**Sheet Flow, Flow 1.1 (50') Wooded** Woods: Light underbrush n= 0.400 P2= 3.10"
1.3	50	0.0046	0.65		**Sheet Flow, Flow 2.1 (50') Paved** Smooth surfaces n= 0.011 P2= 3.10"
19.0	952	0.0031	0.84		**Shallow Concentrated Flow, Flow 1.2 (952') Grass** Grassed Waterway Kv= 15.0 fps
10.4	662	0.0050	1.06		**Shallow Concentrated Flow, Flow 2.2 (662') Grass** Grassed Waterway Kv= 15.0 fps
39.7	1,714	Total			

Summary for Subcatchment 6S: PR-1B

Runoff = 2.82 cfs @ 12.09 hrs, Volume= 8,901 cf, Depth= 3.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
24,778	98	Paved parking, HSG B
8,641	61	>75% Grass cover, Good, HSG B
33,419	88	Weighted Average
8,641		25.86% Pervious Area
24,778		74.14% Impervious Area

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

Summary for Reach 7R: (new Reach)

Inflow Area = 925,402 sf, 33.57% Impervious, Inflow Depth = 2.00" for 10-Year event
Inflow = 23.55 cfs @ 12.56 hrs, Volume= 154,259 cf
Outflow = 23.55 cfs @ 12.56 hrs, Volume= 154,259 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs

Summary for Pond 8P: Bioretention

Inflow Area = 33,419 sf, 74.14% Impervious, Inflow Depth = 3.20" for 10-Year event
Inflow = 2.82 cfs @ 12.09 hrs, Volume= 8,901 cf
Outflow = 2.82 cfs @ 12.09 hrs, Volume= 8,901 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.02 cfs @ 7.74 hrs, Volume= 1,250 cf
Primary = 2.80 cfs @ 12.09 hrs, Volume= 7,651 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Peak Elev= 90.72' @ 12.09 hrs Surf.Area= 2 sf Storage= 2 cf

Plug-Flow detention time= 0.0 min calculated for 8,895 cf (100% of inflow)

Center-of-Mass det. time= 0.0 min (801.8 - 801.7)

Volume	Invert	Avail.Storage	Storage Description
#1	89.10'	1,221 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
89.10	1	0	0
92.30	2	5	5
92.44	809	57	62
93.34	1,767	1,159	1,221

Device	Routing	Invert	Outlet Devices
#1	Discarded	89.10'	**0.02 cfs Exfiltration at all elevations**
#2	Primary	89.34'	**12.0" Round Culvert** L= 17.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 89.34' / 89.10' S= 0.0141 '/' Cc= 0.900 n= 0.015, Flow Area= 0.79 sf

Discarded OutFlow Max=0.02 cfs @ 7.74 hrs HW=89.15' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=2.78 cfs @ 12.09 hrs HW=90.71' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 2.78 cfs @ 3.54 fps)

Time span=0.00-30.00 hrs, dt=0.02 hrs, 1501 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 3S: EX-1 Runoff Area=925,402 sf 32.00% Impervious Runoff Depth=3.61"
Flow Length=1,714' Tc=39.7 min CN=74 Runoff=44.45 cfs 278,364 cf

Subcatchment 4S: PR-1A Runoff Area=891,983 sf 32.05% Impervious Runoff Depth=3.61"
Flow Length=1,714' Tc=39.7 min CN=74 Runoff=42.84 cfs 268,311 cf

Subcatchment 6S: PR-1B Runoff Area=33,419 sf 74.14% Impervious Runoff Depth=5.11"
Tc=6.0 min CN=88 Runoff=4.41 cfs 14,227 cf

Reach 7R: (new Reach) Inflow=43.55 cfs 281,172 cf
Outflow=43.55 cfs 281,172 cf

Pond 8P: Bioretention Peak Elev=92.00' Storage=4 cf Inflow=4.41 cfs 14,227 cf
Discarded=0.02 cfs 1,367 cf Primary=4.39 cfs 12,860 cf Outflow=4.41 cfs 14,227 cf

Total Runoff Area = 1,850,804 sf Runoff Volume = 560,902 cf Average Runoff Depth = 3.64"
67.22% Pervious = 1,244,035 sf 32.78% Impervious = 606,769 sf

Summary for Subcatchment 3S: EX-1

Runoff = 44.45 cfs @ 12.56 hrs, Volume= 278,364 cf, Depth= 3.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	296,098	98	Impervious
	91,229	58	Woods/grass comb., Good, HSG B
*	35,545	86	Infield Mix, bare soil
*	157,014	61	Synthetic Turf
*	345,516	61	Grass
	925,402	74	Weighted Average
	629,304		68.00% Pervious Area
	296,098		32.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0460	0.09		**Sheet Flow, Flow 1.1 (50') Wooded** Woods: Light underbrush n= 0.400 P2= 3.10"
1.3	50	0.0046	0.65		**Sheet Flow, Flow 2.1(50') Impervious** Smooth surfaces n= 0.011 P2= 3.10"
19.0	952	0.0031	0.84		**Shallow Concentrated Flow, Flow 1.2 (952') Short Grass** Grassed Waterway Kv= 15.0 fps
10.4	662	0.0050	1.06		**Shallow Concentrated Flow, Flow 2.2 (662') Short Grass** Grassed Waterway Kv= 15.0 fps
39.7	1,714	Total			

Summary for Subcatchment 4S: PR-1A

Runoff = 42.84 cfs @ 12.56 hrs, Volume= 268,311 cf, Depth= 3.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	285,893	98	Impervious
*	78,917	58	Wooded, grass
*	35,545	86	Infield Mix
*	157,014	61	Synthetic Turf
*	334,614	61	Grass
	891,983	74	Weighted Average
	606,090		67.95% Pervious Area
	285,893		32.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	50	0.0460	0.09		**Sheet Flow, Flow 1.1 (50') Wooded** Woods: Light underbrush n= 0.400 P2= 3.10"
1.3	50	0.0046	0.65		**Sheet Flow, Flow 2.1 (50') Paved** Smooth surfaces n= 0.011 P2= 3.10"
19.0	952	0.0031	0.84		**Shallow Concentrated Flow, Flow 1.2 (952') Grass** Grassed Waterway Kv= 15.0 fps
10.4	662	0.0050	1.06		**Shallow Concentrated Flow, Flow 2.2 (662') Grass** Grassed Waterway Kv= 15.0 fps
39.7	1,714	Total			

Summary for Subcatchment 6S: PR-1B

Runoff = 4.41 cfs @ 12.08 hrs, Volume= 14,227 cf, Depth= 5.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
24,778	98	Paved parking, HSG B
8,641	61	>75% Grass cover, Good, HSG B
33,419	88	Weighted Average
8,641		25.86% Pervious Area
24,778		74.14% Impervious Area

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

Summary for Reach 7R: (new Reach)

Inflow Area = 925,402 sf, 33.57% Impervious, Inflow Depth = 3.65" for 100-Year event
Inflow = 43.55 cfs @ 12.55 hrs, Volume= 281,172 cf
Outflow = 43.55 cfs @ 12.55 hrs, Volume= 281,172 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs

Summary for Pond 8P: Bioretention

Inflow Area = 33,419 sf, 74.14% Impervious, Inflow Depth = 5.11" for 100-Year event
Inflow = 4.41 cfs @ 12.08 hrs, Volume= 14,227 cf
Outflow = 4.41 cfs @ 12.09 hrs, Volume= 14,227 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.02 cfs @ 6.18 hrs, Volume= 1,367 cf
Primary = 4.39 cfs @ 12.09 hrs, Volume= 12,860 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.02 hrs
Peak Elev= 92.00' @ 12.09 hrs Surf.Area= 2 sf Storage= 4 cf

Plug-Flow detention time= 0.0 min calculated for 14,218 cf (100% of inflow)

Center-of-Mass det. time= 0.0 min (788.8 - 788.8)

Volume	Invert	Avail.Storage	Storage Description
#1	89.10'	1,221 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
89.10	1	0	0
92.30	2	5	5
92.44	809	57	62
93.34	1,767	1,159	1,221

Device	Routing	Invert	Outlet Devices
#1	Discarded	89.10'	**0.02 cfs Exfiltration at all elevations**
#2	Primary	89.34'	**12.0" Round Culvert** L= 17.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 89.34' / 89.10' S= 0.0141 '/' Cc= 0.900 n= 0.015, Flow Area= 0.79 sf

Discarded OutFlow Max=0.02 cfs @ 6.18 hrs HW=89.15' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=4.36 cfs @ 12.09 hrs HW=91.98' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 4.36 cfs @ 5.56 fps)

TSS Removal Calculations

INSTRUCTIONS:

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

Version 1, Automated: Mar. 4, 2008

Location: Southwestern Walkway

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Street Sweeping - 9%	0.09	1.00	0.09	0.91
Deep Sump and Hooded Catch Basin	0.25	0.91	0.23	0.68
Oil Grit Separator	0.25	0.68	0.17	0.51
Sediment Forebay	0.25	0.51	0.13	0.38
Vegetated Filter Strip >50 feet	0.45	0.38	0.17	0.21

Total TSS Removal = 79%

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

Project: Birchmeadown Park

Prepared By: MEB

Date: 11/29/22

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

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

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

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

Version 1, Automated: Mar. 4, 2008

Location: Parking Area - CB-LC Collection

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Street Sweeping - 9%	0.09	1.00	0.09	0.91
Deep Sump and Hooded Catch Basin	0.25	0.91	0.23	0.68
Leaching Catch Basin	0.80	0.68	0.55	0.14
	0.00	0.14	0.00	0.14
	0.00	0.14	0.00	0.14

Total TSS Removal = 86%

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

Project: Birch Meadow

Prepared By: MEB

Date: 11/29/22

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

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

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

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

Location: Parking Area - Surface Flow to Bioretention

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Bioretention Area	0.90	1.00	0.90	0.10
	0.00	0.10	0.00	0.10
	0.00	0.10	0.00	0.10
	0.00	0.10	0.00	0.10
	0.00	0.10	0.00	0.10

Total TSS Removal = 90%

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

Project: Birch Meadow

Prepared By: MEB

Date: 11/29/22

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

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

1. From MassDEP Stormwater Handbook Vol. 1

Operation and Maintenance Plan

Bound Separately