# STORMWATER REPORT

## 157-165 Lowland Street
Holliston, MA

October 14, 2022

PREPARED BY:
Connorstone Engineering, Inc.
10 Southwest Cutoff, Suite 7
Northborough, MA 01532
Ph: (508) 393-9727 F: (508) 393-5242

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# Project Summary

The purpose of this analysis is to summarize the design calculations, and design a stormwater management system in accordance with the Mass Department of Environmental Protection Stormwater Standards.

## Site Description

Location: 157-165 Lowland Street

Assessors Map / Parcel: Map 4 Parcel 34 and Map 3 Parcel 16

Project Area: Approximately 7.1 acres

Zoning District: Industrial and Groundwater Protection Overlay District (Zone II)

Existing Site Conditions: The site is currently occupied as a material yard with multiple structures toward the rear of the site. the remainder of the yard includes stockpile areas and a compacted gravel surface.

Site Topography: The site is generally flat with the exception of the stockpile areas and screening berm.

Wetland Resource Areas: Wetland resource areas exist along the westerly side of the site associated with a perennial stream (Bogastow Brook). The stream would have the associated resources areas of Bank, Riverfront Area, and Bordering Land Subject to Flooding (BLSF). The limits of the flood plain and BLSF have been delineated as the 157 contour elevation based upon the most recent FEMA flood insurance rate mapping and flood insurance study.

Soil Mapping: The Natural Resource Conservation Service has mapped the soils on site as Udorthents, which is currently developed land. This soil classification does not have a soil group rating or description. Surrounding areas are Merrimac and Hinckley soils, which are sandy well drained soils within soil group A. The USGS mapping also shows this area as a previous gravel pit.

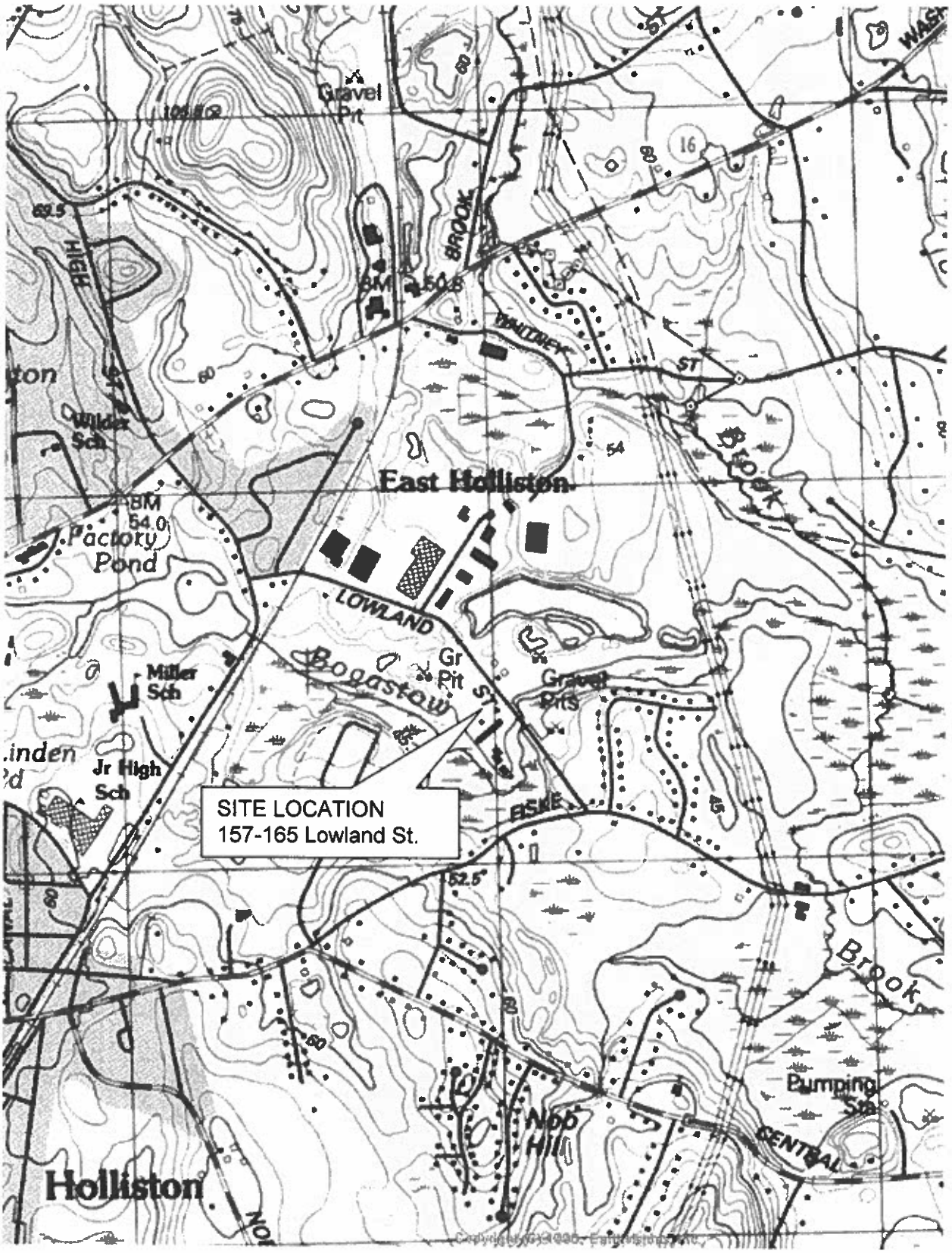
Soil testing has been performed throughout the site, and the results have shown a deep layer of fill ranging from 86 inches to greater than 132 inches. When soils were encountered below the fill layer the texture ranged from sandy loam to medium sand.

## Proposed Project Summary

Proposed Use: The proposed project includes the construction of a 7,200 square foot contractor garage building, 180'x260' paved pad around the building, new septic system, utility connections, a stormwater management system, and related site work.

The project will create 46,700 square feet of impervious surfaces for the new building and paved areas. Stormwater runoff from all of the new paved areas and roof areas will be collected and conveyed to a proposed infiltration basin for treatment and recharge, the basin has been sized to fully infiltrate the 100 year storm event. Pretreatment has been provided through proprietary separators (Stormceptors). The overall system exceeds MassDEP standards for groundwater recharge and treatment. The remaining portions of the site will remain to match the current existing conditions.

# LOCUS MAP – USGS Mapping



**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.

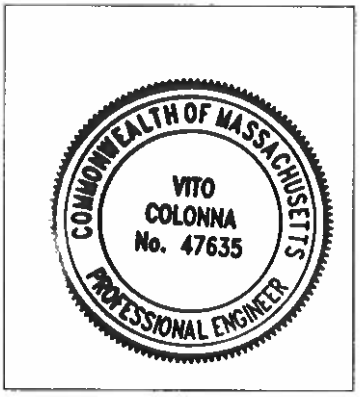
*Note:* Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that 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




10/14/22
Signature and Date

## Checklist

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

☐ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

# Checklist for Stormwater Report

## Checklist (continued)

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

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

**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; - Site Plan
- ☐ 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.

# MA D.E.P. STORMWATER STANDARDS

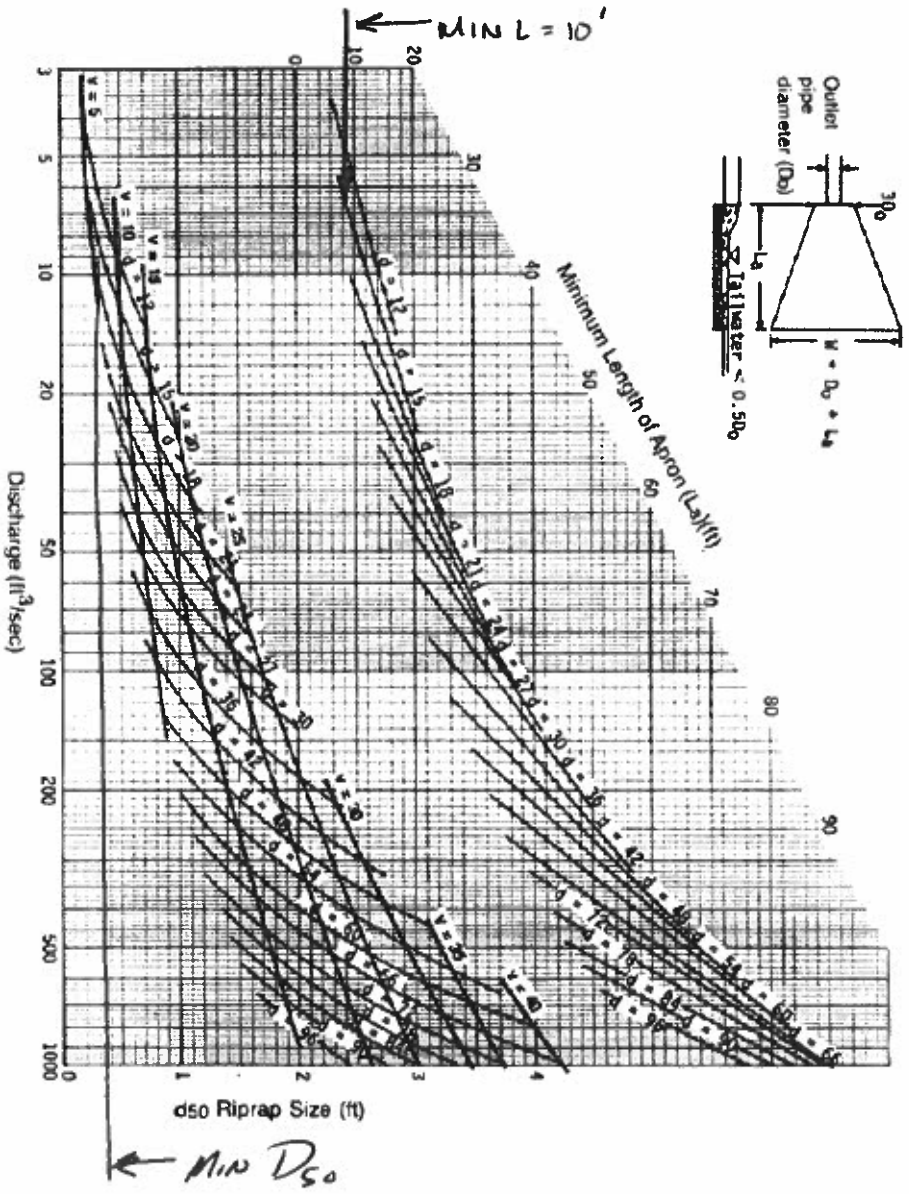
**Standard 1: No New Untreated Discharges**

There are no new untreated discharges to any wetland resource area or related buffer zones. All stormwater from the current development portion of the site will be fully contained through the 100-year storm event.

Pipe Point Discharge Design:

1. Stormwater Discharge Velocity:
   15" FE: $Q_{FULL\ FLOW}$= 6.3 cfs / $V_{FULL\ FLOW}$ = 5.1 fps (15" HDPE @ 0.8% slope)

2. Riprap sizing: Use: Riprap Size = 4" $D_{50}$ Minimum... Use 6-12"
   Length= = 10 feet



## Standard 2: Peak Rate Attenuation

The proposed project has been design to fully contain and infiltrate the entire development area through the 100 year storm event. A large infiltration basin has been proposed along the rear of the proposed building and parking area. This design will control the rate of runoff leaving the site and provide an increase the groundwater recharge.

The pre- and post-development stormwater runoff has been analyzed using HydroCAD 9.10, which is a stormwater modeling computer program utilizing a collection of techniques for the generation and routing of hydrographs, including Soil Conservation Service (SCS) Technical Release No. 20 (TR-20) and SCS Technical Release 55 (TR-55), *Urban Hydrology for Small Watersheds*. Rainfall intensities were determined from the most recent NOAA Atlas 14 data.

Runoff would have the potential to leave the site toward the stream to the west of the site. However, all of the developed areas will be fully contained on-site with zero runoff up to, and including, the 100-year storm event.

***Analysis Point 1 – Flow to the West from development area***

| Storm Event | Peak Rate of Runoff<br>Proposed | Volume of Runoff<br>Proposed |
|---|---|---|
| 2-year<br>(3.36 inches) | 0.0 cfs | 0.0 ac-ft |
| 10-year<br>(5.25 inches) | 0.0 cfs | 0.0 ac-ft |
| 100-year<br>(8.26 inches) | 0.0 cfs | 0.0 ac-ft |

**Standard 3: Stormwater Recharge**

The proposed site plan has not proposed any increase to the impervious surfaces. Therefore, recharge is not required for the proposed project. Although not required, recharge has been provided through the proposed stormwater basin.

Recharge Volume Summary:

Post development increased impervious area = 46,700 S.F. (net reduction)
Recharge volume required = 46,700 s.f. x 0.6 inches / 12 = 2,335
Recharge volume proposed = 29,500 C.F. volume proposed (up to overflow spillway)

Soil Conditions:

Soil mapping has shown the work area as Udorthents, which is developed area without a Hydrologic Soil Group. Soil testing has been performed throughout the site, and the results have shown a deep layer of fill ranging from 86 inches to greater than 132 inches. When soils were encountered below the fill layer the texture ranged from sandy loam closer to Lowland Street to a loamy sand and medium in the rear portions of the site. Areas nearest to the septic system and infiltration basin included fine sand and medium sand. All fill below the limits of the infiltration basin would be removed and replaced with clean free draining fill as noted on the plans.

Groundwater was encountered with evidence of seasonal high groundwater (mottles) in the infiltration basin area at elevation 151.8. This would provide a minimum four (4) foot separation from the bottom of basin.

Draw down Time (maximum 72 hours allowable):

(WQV) / (infiltration rate x bottom area) = drawdown time
(29,500 cubic feet WQV) / (2.42 in/hr * 1/12 * 6,400 sq. ft. bottom area) = 23 hours
2.42 in/hr = rawles rate for underlying native soil

Mounding Analysis

The bottom of infiltration basin has been maintained at least 4-feet above estimated seasonal high groundwater. In accordance with the Massachusetts Stormwater Handbook a mounding analysis would not be required.

**Standard 4: Water Quality**

All new impervious surfaces have been collected and treated through proprietary separators and an infiltration basin designed to meet MassDEP's Stormwater Handbook.

| 1<br>**BMP** | 2<br>**TSS removal** | 3<br>**Starting TSS**<br>(5 from previous BMP) | 4<br>**TSS Removal**<br>**( 2 * 3 )** | 5<br>**Remaining TSS**<br>**( 3 - 4 )** |
|---|---|---|---|---|
| Stormceptor | 83% | 100% | 83% | 20% |
| Infiltration Basin | 80% | 17% | 14% | 3% |
| | | **Total TSS Removal =** | **97%** | |

1. Infiltration Basin:
   Required WQV: (1 inch) x (Impervious Area 46,700 s.f.) = 3,892 C.F.
   Provided WQV: Available volume below spillway = 29,500 C.F

   Forebay sizing required = 0.1 inch x 46,700 s.f. = 390 c.f.
   forebay sizing proposed = 400 c.f.

   Pretreatment prior to infiltration basin = >80% TSS removal
   (minimum 44% TSS required).

2. Stormceptor = 83% TSS Removal

   Water Quality Flow Rate Conversion
   WQF = qu x A x WQV = 0.7 cfs
   Where
   qu=835 csm/in
   A = impervious area = 23,800 s.f. or 0.00086 sq. mi
   WQV = 1-inch

**Standard 5: Land uses with higher pollutant Loads**

The proposed use may include a fleet of vehicles. Appropriate BMP's and pretreatment have been provided. Water Quality Structures have been proposed to provide enhanced oil/gas separation and containment.

**Standard 6: Critical Areas**

The project is located within a MassDEP approved Zone II. The infiltration basin has been sized for a 1-inch WQV and appropriate pretreatment BMP's have also been included.

**Standard 7: Redevelopment**

The proposed project may qualify as a redevelopment project. However, all of the MassDEP standards have been met.

**Standard 8: Construction Period Controls**

Erosion controls have been provided on the plans including perimeter erosion barriers down-gradient of all proposed work, and sedimentation and erosion control notes are provided on the plans. A project Stormwater Pollution Prevention Plan (SWPPP) has been prepared for the project and is attached with this report.

**Standard 9: Operation and Maintenance Plan**

The owner will be responsible for all future operation and maintenance of the proposed stormwater management system. A recommended Operation and Maintenance Plan has been provided with this report.

**Standard 10: Illicit Discharges**

Based upon site observations and review of the design plans, no illicit discharges would be allowed or proposed on-site. The proposed building would be serviced by a new on-site septic system, and Illicit discharges are prohibited.

## STORMWATER DRAINAGE SYSTEM DESIGN

The street drainage system has been designed from calculations based upon the 25-year design storm to ensure capacity to convey stormwater.

Storm intensities were determined from exhibit 8-14 "*Intensity – Duration – Frequency Curve for Worcester, MA*" from the MassHighway Design Manual. The resulting analysis was performed using the Rational Method of determining peak storm flows. All storm sewer pipe sizes were determined using Manning's Equation for pipes flowing full.

The following table presents the hydraulic calculations performed for sizing the site drainage system. The structure references refer to those as shown on the site plan submitted with this report.

# DRAIN PIPE SIZING CALCULATIONS

PROJECT 157-165 Lowland Street LOCATION Holliston, MA BY: VC n= 0.012
CLIENT SHEET 1 OF 1 DATE: 10/17/2022 RETURN PERIOD **25 YEAR**

| Line | | Area | C | Ca | Tc | rain | Inlet flow Q | Pipe flow Qd | Pipe Size | Pipe Length | Slope | flowing full | | Rim (feet) | | Inv. El. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FROM | TO | ac | | | min. | in/hr | cfs | cfs | in | ft | ft/ft | Qf | Vf | Upper | Lower | Upper | Lower |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| DI-1 | DMH-1 | 0.25 | 0.75 | 1.1 | 5 | 6.5 | 1.34 | **1.34** | 12 | 175 | 0.008 | **3.45** | 4.40 | 161.50 | 161.60 | 159.00 | 157.60 |
| CB-1 | DMH-1 | 0.14 | 0.75 | 1.1 | 5 | 6.5 | 0.75 | **0.75** | 12 | 10 | 0.030 | **6.69** | 8.52 | 161.50 | 161.60 | 158.00 | 157.70 |
| DMH-1 | STC-1 | | | | | | | **2.09** | 15 | 75 | 0.005 | **5.11** | 4.17 | 161.60 | 160.75 | 157.50 | 157.10 |
| CB-2 | STC-1 | 0.36 | 0.8 | 1.1 | 5 | 6.5 | 2.06 | **2.06** | 12 | 10 | 0.020 | **5.46** | 6.95 | 160.5 | 16.75 | 157.30 | 157.10 |
| STC-1 | FE-1 | | | | | | | **4.15** | 15 | 25 | 0.008 | **6.26** | 5.10 | 160.75 | --- | 156.85 | 156.65 |
| | | | | | | | | | | | | | | | | | |
| DI-2 | DI-3 | 0.1 | 0.95 | 1.1 | 5 | 6.5 | 0.68 | **0.68** | 8 | 20 | 0.010 | **1.31** | 3.75 | 161.50 | 161.50 | 159.30 | 159.10 |
| DI-2 | DMH-2 | 0.08 | 0.95 | 1.1 | 5 | 6.5 | 0.54 | **1.22** | 12 | 160 | 0.009 | **3.61** | 4.60 | 161.50 | 161.60 | 159.00 | 157.60 |
| CB-3 | DMH-2 | 0.06 | 0.95 | 1.1 | 5 | 6.5 | 0.41 | **0.41** | 12 | 10 | 0.030 | **6.69** | 8.52 | 161.50 | 161.60 | 158.00 | 157.70 |
| DMH-2 | STC-2 | | | | | | | **1.63** | 15 | 75 | 0.005 | **5.11** | 4.17 | 161.60 | 160.75 | 157.50 | 157.10 |
| CB-4 | STC-2 | 0.3 | 0.95 | 1.1 | 5 | 6.5 | 2.04 | **2.04** | 12 | 10 | 0.020 | **5.46** | 6.95 | 160.5 | 160.75 | 157.30 | 157.10 |
| STC-2 | FE-2 | | | | | | | **3.67** | 15 | 25 | 0.008 | **6.26** | 5.10 | 160.75 | --- | 156.85 | 156.65 |
| | | | | | | | | | | | | | | | | | |
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# WATER QUALITY STRUCTURE (STORMCEPTOR) SIZING DATA

157-165 Lowland Street, Holliston, MA

Stormceptor®

# Stormceptor Design Summary

**PCSWMM for Stormceptor**

## Project Information

| | |
|---|---|
| Date | 10/14/2022 |
| Project Name | Lowland Street |
| Project Number | N/A |
| Location | Holliston |

## Designer Information

| | |
|---|---|
| Company | N/A |
| Contact | N/A |

## Notes

STC-2

## Drainage Area

| | |
|---|---|
| Total Area (ac) | 0.54 |
| Imperviousness (%) | 100 |

The Stormceptor System model STC 450i achieves the water quality objective removing 83% TSS for a Fine (organics, silts and sand) particle size distribution; providing continuous positive treatment for a stormwater quality flow rate of 0.7 cfs.

## Rainfall

| | |
|---|---|
| Name | WORCESTER WSO AP |
| State | MA |
| ID | 9923 |
| Years of Records | 1948 to 2005 |
| Latitude | 42°16'2"N |
| Longitude | 71°52'34"W |

## Water Quality Objective

| | |
|---|---|
| TSS Removal (%) | 44 |
| WQ Flow Rate (cfs) | 0.7 |

## Upstream Storage

| Storage (ac-ft) | Discharge (cfs) |
|---|---|
| 0 | 0 |

## Stormceptor Sizing Summary

| Stormceptor Model | TSS Removal % |
|---|---|
| STC 450i | 83 |
| STC 900 | 89 |
| STC 1200 | 89 |
| STC 1800 | 90 |
| STC 2400 | 92 |
| STC 3600 | 92 |
| STC 4800 | 94 |
| STC 6000 | 94 |
| STC 7200 | 95 |
| STC 11000 | 97 |
| STC 13000 | 97 |
| STC 16000 | 97 |



Rinker MATERIALS™

Stormceptor®

# Stormceptor Design Summary

**PCSWMM for Stormceptor**

## Project Information

| | |
|---|---|
| Date | 10/14/2022 |
| Project Name | Lowland Street |
| Project Number | N/A |
| Location | Holliston |

## Designer Information

| | |
|---|---|
| Company | N/A |
| Contact | N/A |

## Notes

STC-1

## Drainage Area

| | |
|---|---|
| Total Area (ac) | 0.7 |
| Imperviousness (%) | 75 |

The Stormceptor System model STC 450i achieves the water quality objective removing 84% TSS for a Fine (organics, silts and sand) particle size distribution; providing continuous positive treatment for a stormwater quality flow rate of 0.7 cfs.

## Rainfall

| | |
|---|---|
| Name | WORCESTER WSO AP |
| State | MA |
| ID | 9923 |
| Years of Records | 1948 to 2005 |
| Latitude | 42°16'2"N |
| Longitude | 71°52'34"W |

## Water Quality Objective

| | |
|---|---|
| TSS Removal (%) | 44 |
| WQ Flow Rate (cfs) | 0.7 |

## Upstream Storage

| Storage (ac-ft) | Discharge (cfs) |
|---|---|
| 0 | 0 |

## Stormceptor Sizing Summary

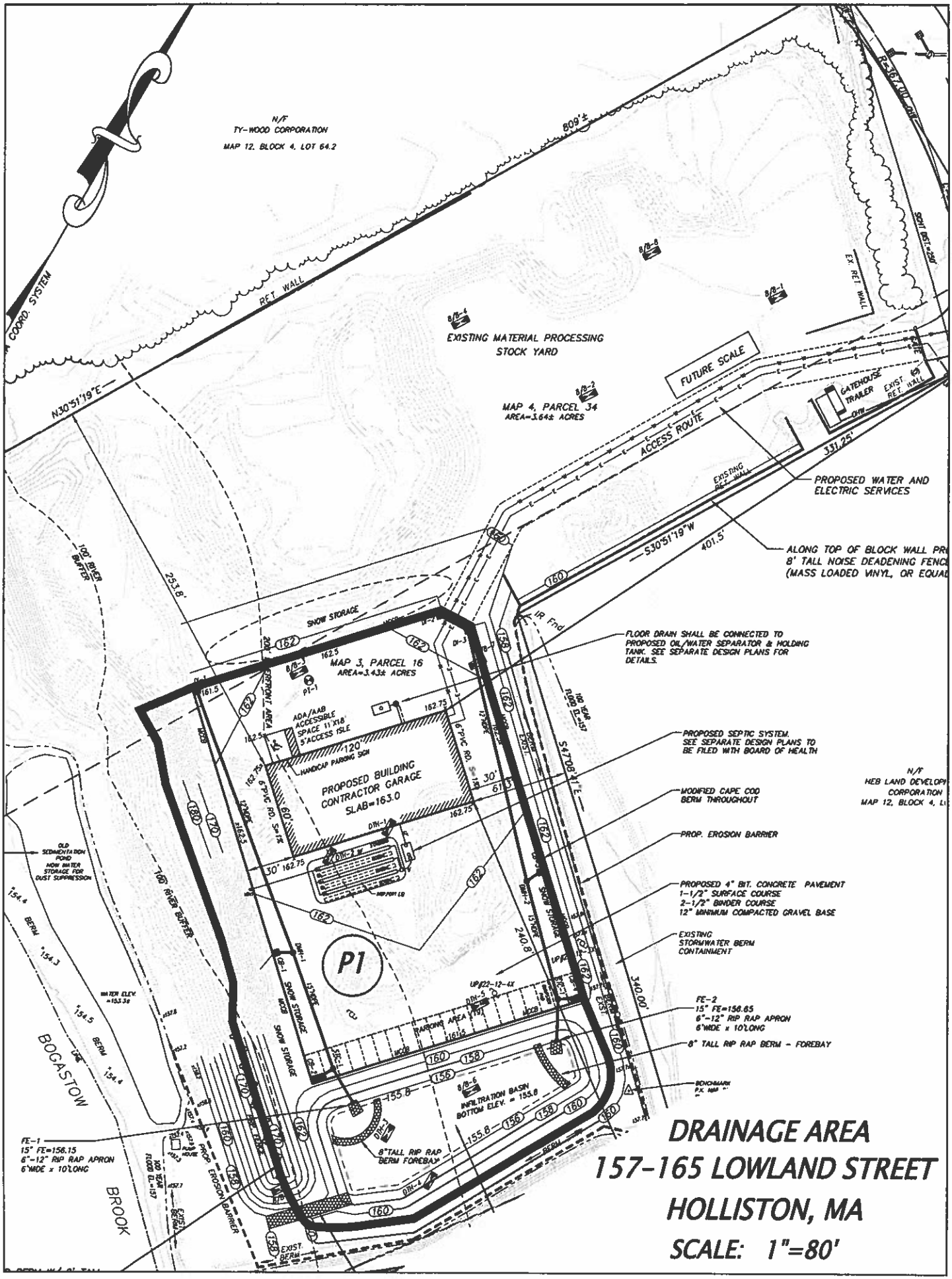
| Stormceptor Model | TSS Removal % |
|---|---|
| STC 450i | 84 |
| STC 900 | 90 |
| STC 1200 | 90 |
| STC 1800 | 90 |
| STC 2400 | 92 |
| STC 3600 | 93 |
| STC 4800 | 94 |
| STC 6000 | 94 |
| STC 7200 | 96 |
| STC 11000 | 97 |
| STC 13000 | 97 |
| STC 16000 | 98 |

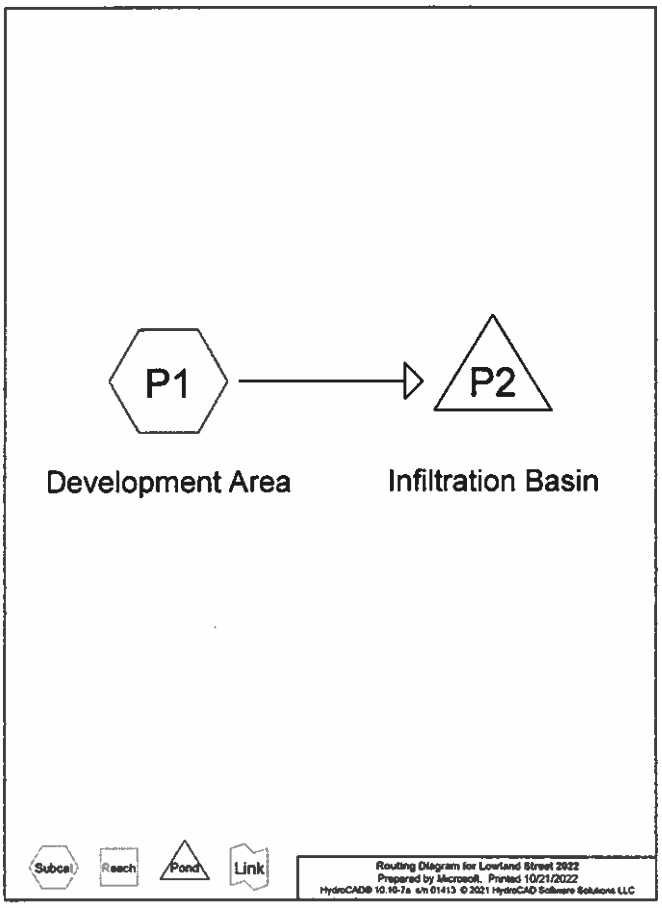


Rinker MATERIALS™

# HYDROCAD CALCULATIONS

2-, 10-, and 100-Year Storm
Calculation Sheets


N/F
TY-WOOD CORPORATION
MAP 12, BLOCK 4, LOT 64.2
809'±
R.E.T. WALL
EXISTING MATERIAL PROCESSING
STOCK YARD
FUTURE SCALE
GATEHOUSE TRAILER
EXIST R.E.T. WALL
ACCESS ROUTE
331.25'
PROPOSED WATER AND ELECTRIC SERVICES
EXISTING R.E.T. WALL
S30°51'19"W
401.5'
ALONG TOP OF BLOCK WALL PR
8' TALL NOISE DEADENING FENC
(MASS LOADED VINYL, OR EQUA
N30°51'19"E
MAP 4, PARCEL 34
AREA=3.64± ACRES
MAP 3, PARCEL 16
AREA=3.43± ACRES
PROPOSED BUILDING
CONTRACTOR GARAGE
SLAB=163.0
ADA/AAB ACCESSIBLE SPACE 11'X18' 5'ACCESS ISLE
HANDICAP PARKING SIGN
SNOW STORAGE
PARKING AREA
FLOOR DRAIN SHALL BE CONNECTED TO PROPOSED OIL/WATER SEPARATOR & HOLDING TANK. SEE SEPARATE DESIGN PLANS FOR DETAILS.
PROPOSED SEPTIC SYSTEM. SEE SEPARATE DESIGN PLANS TO BE FILED WITH BOARD OF HEALTH
MODIFIED CAPE COD BERM THROUGHOUT
PROP. EROSION BARRIER
PROPOSED 4" BIT. CONCRETE PAVEMENT
1-1/2" SURFACE COURSE
2-1/2" BINDER COURSE
12" MINIMUM COMPACTED GRAVEL BASE
EXISTING STORMWATER BERM CONTAINMENT
FE-2
15" FE=156.65
6"-12" RIP RAP APRON
6'WIDE x 10'LONG
8" TALL RIP RAP BERM - FOREBAY
INFILTRATION BASIN
BOTTOM ELEV. = 155.6
8"TALL RIP RAP BERM FOREBAY
FE-1
15" FE=156.15
6"-12" RIP RAP APRON
6'WIDE x 10'LONG
PROP. EROSION BARRIER
EXIST. BERM
OLD SEDIMENTATION POND NOW WATER STORAGE FOR DUST SUPPRESSION
100' RIVER BUFFER
BOGASTOW BROOK
P1
DRAINAGE AREA
157-165 LOWLAND STREET
HOLLISTON, MA
SCALE: 1"=80'





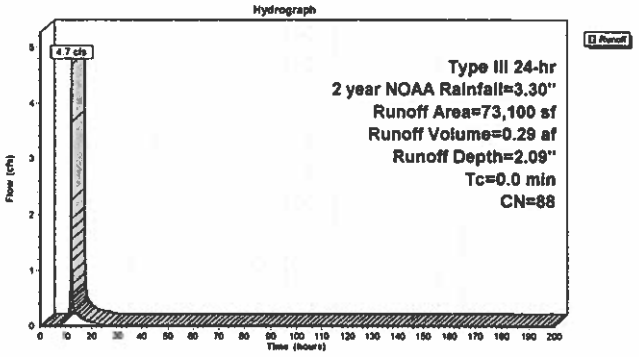

## Summary for Subcatchment P1: Development Area

Runoff = 4.7 cfs @ 12.00 hrs, Volume= 0.29 af, Depth= 2.09"
Routed to Pond P2 : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year NOAA Rainfall=3.30"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 39,000 | 98 | Paved parking |
| * | 7,200 | 98 | Roofs |
| | 20,700 | 61 | >75% Grass cover, Good, HSG B |
| * | 6,200 | 98 | pond bottom |
| | 73,100 | 88 | Weighted Average |
| | 20,700 | | 28.32% Pervious Area |
| | 52,400 | | 71.68% Impervious Area |

### Subcatchment P1: Development Area






## Summary for Pond P2: Infiltration Basin

Inflow Area = 1.678 ac, 71.68% Impervious, Inflow Depth = 2.09" for 2 year NOAA event
Inflow = 4.7 cfs @ 12.00 hrs, Volume= 0.29 af
Outflow = 0.5 cfs @ 12.60 hrs, Volume= 0.29 af, Atten= 89%, Lag= 36.1 min
Discarded = 0.5 cfs @ 12.60 hrs, Volume= 0.29 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.00 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 156.41' @ 12.60 hrs Surf.Area= 8,064 sf Storage= 4,599 cf

Plug-Flow detention time= 75.3 min calculated for 0.29 af (100% of inflow)
Center-of-Mass det. time= 75.3 min ( 883.6 - 808.2 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 155.80' | 41,493 cf | Custom Stage Data (Conic) Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|
| 155.80 | 6,400 | 0 | 0 | 6,400 |
| 156.00 | 7,600 | 1,398 | 1,398 | 7,601 |
| 158.00 | 10,000 | 17,545 | 18,943 | 10,091 |
| 160.00 | 12,600 | 22,550 | 41,493 | 12,798 |

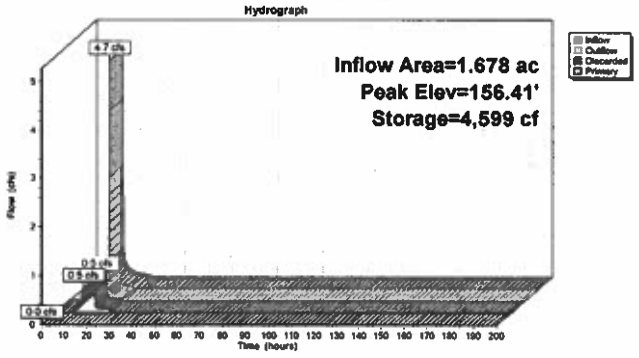
| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 155.80' | 2.420 in/hr Exfiltration over Surface area<br>Conductivity to Groundwater Elevation = 151.80' |
| #2 | Primary | 159.00' | 10.0' long + 3.0 '/' SideZ x 10.0' breadth Broad-Crested Rectangular Weir<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60<br>Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64 |

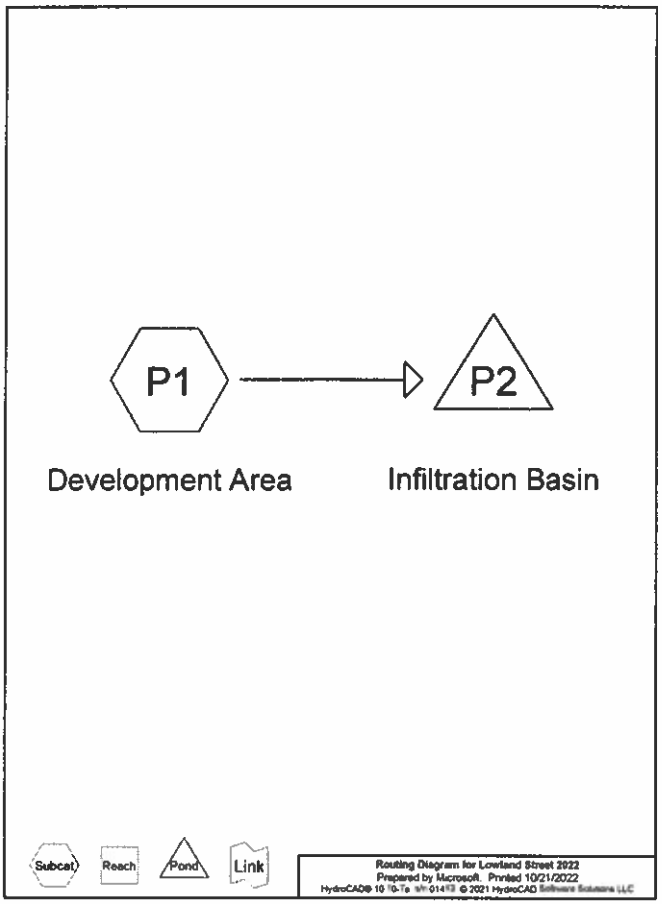
Discarded OutFlow Max=0.5 cfs @ 12.60 hrs HW=156.41' (Free Discharge)
└1=Exfiltration ( Controls 0.5 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=155.80' (Free Discharge)
└2=Broad-Crested Rectangular Weir ( Controls 0.0 cfs)



### Pond P2: Infiltration Basin







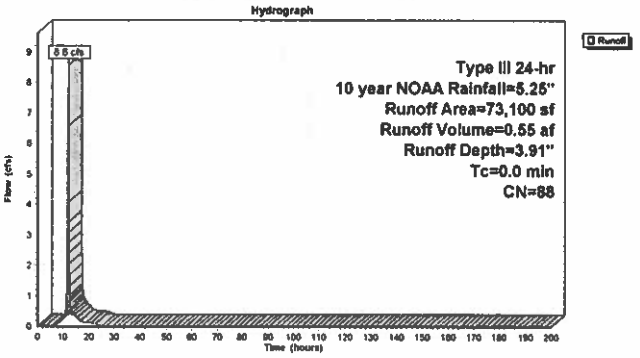

## Summary for Subcatchment P1: Development Area

Runoff = 8.6 cfs @ 12.00 hrs, Volume= 0.55 af, Depth= 3.91"
Routed to Pond P2 : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type 24-hr 10 year NOAA Rainfall=5.25"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 39,000 | 98 | Paved parking |
| * | 7,200 | 98 | Roofs |
| | 20,700 | 61 | >75% Grass cover, Good, HSG B |
| * | 6,200 | 98 | pond bottom |
| | 73,100 | 88 | Weighted Average |
| | 20,700 | | 28.32% Pervious Area |
| | 52,400 | | 71.68% Impervious Area |

### Subcatchment P1: Development Area






## Summary for Pond P2: Infiltration Basin

Inflow Area = 1.678 ac, 71.68% Impervious, Inflow Depth = 3.91" for 10 year NOAA event
Inflow = 8.6 cfs @ 12.00 hrs, Volume= 0.55 af
Outflow = 0.6 cfs @ 12.96 hrs, Volume= 0.55 af, Atten= 93%, Lag= 57.3 min
Discarded = 0.6 cfs @ 12.96 hrs, Volume= 0.55 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.00 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 157.06' @ 12.96 hrs Surf.Area= 8,832 sf Storage= 10,105 cf

Plug-Flow detention time= 151.0 min calculated for 0.55 af (100% of inflow)
Center-of-Mass det. time= 151.0 min ( 941.6 - 790.6 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 155.80' | 41,493 cf | **Custom Stage Data (Conic) Listed below (Recalc)** |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|
| 155.80 | 6,400 | 0 | 0 | 6,400 |
| 156.00 | 7,600 | 1,398 | 1,398 | 7,601 |
| 158.00 | 10,000 | 17,545 | 18,943 | 10,091 |
| 160.00 | 12,600 | 22,550 | 41,493 | 12,798 |

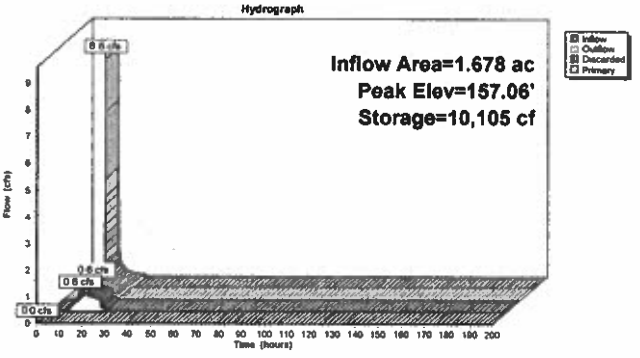
| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 155.80' | **2.420 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 151.80' |
| #2 | Primary | 159.00' | **10.0' long + 3.0 '/' SideZ x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64 |

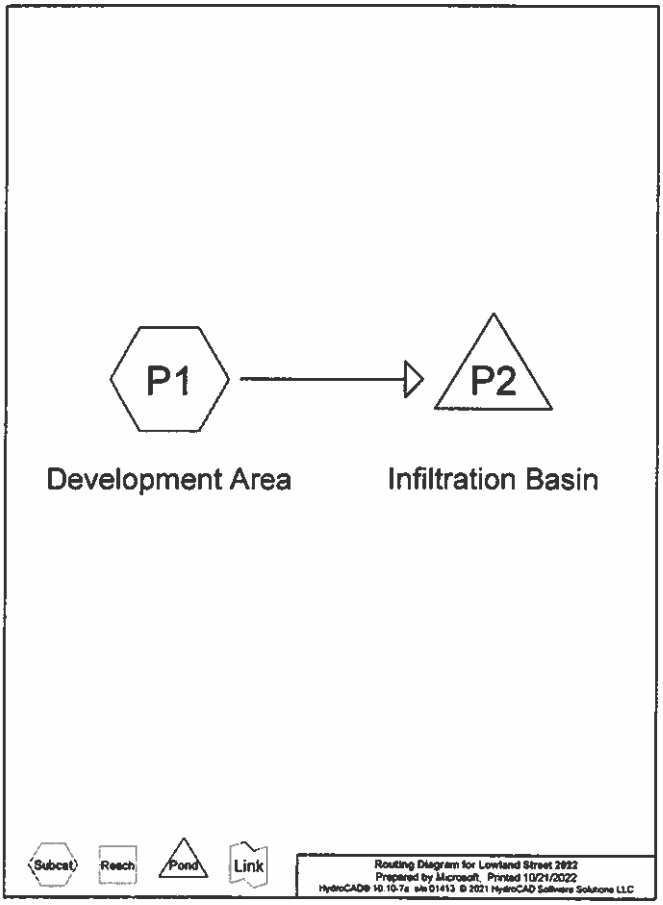
**Discarded OutFlow** Max=0.6 cfs @ 12.96 hrs HW=157.06' (Free Discharge)
**1=Exfiltration** ( Controls 0.6 cfs)

**Primary OutFlow** Max=0.0 cfs @ 0.00 hrs HW=155.80' (Free Discharge)
**2=Broad-Crested Rectangular Weir** ( Controls 0.0 cfs)



### Pond P2: Infiltration Basin







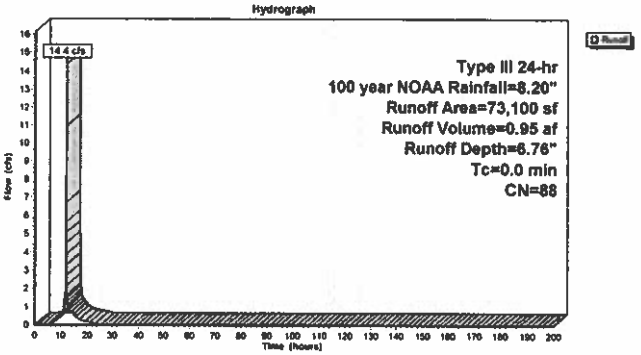

## Summary for Subcatchment P1: Development Area

Runoff = 14.4 cfs @ 12.00 hrs, Volume= 0.95 af, Depth= 6.76"
Routed to Pond P2 : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year NOAA Rainfall=8.20"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 39,000 | 98 | Paved parking |
| * | 7,200 | 98 | Roofs |
| | 20,700 | 61 | >75% Grass cover, Good, HSG B |
| * | 6,200 | 98 | pond bottom |
| | 73,100 | 88 | Weighted Average |
| | 20,700 | | 28.32% Pervious Area |
| | 52,400 | | 71.68% Impervious Area |

### Subcatchment P1: Development Area






## Summary for Pond P2: Infiltration Basin

Inflow Area = 1.678 ac, 71.68% Impervious, Inflow Depth = 6.76" for 100 year NOAA event
Inflow = 14.4 cfs @ 12.00 hrs, Volume= 0.95 af
Outflow = 0.8 cfs @ 13.45 hrs, Volume= 0.95 af, Atten= 94%, Lag= 87.1 min
Discarded = 0.8 cfs @ 13.45 hrs, Volume= 0.95 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.00 af

Routing by Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.05 hrs
Peak Elev= 158.08' @ 13.45 hrs Surf.Area= 10,098 sf Storage= 19,744 cf

Plug-Flow detention time= 248.4 min calculated for 0.95 af (100% of inflow)
Center-of-Mass det. time= 248.4 min ( 1,024.2 - 775.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 155.80' | 41,493 cf | Custom Stage Data (Conic) Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) | Wet.Area (sq-ft) |
|---|---|---|---|---|
| 155.80 | 6,400 | 0 | 0 | 6,400 |
| 156.00 | 7,600 | 1,398 | 1,398 | 7,601 |
| 158.00 | 10,000 | 17,545 | 18,943 | 10,091 |
| 160.00 | 12,600 | 22,550 | 41,493 | 12,798 |

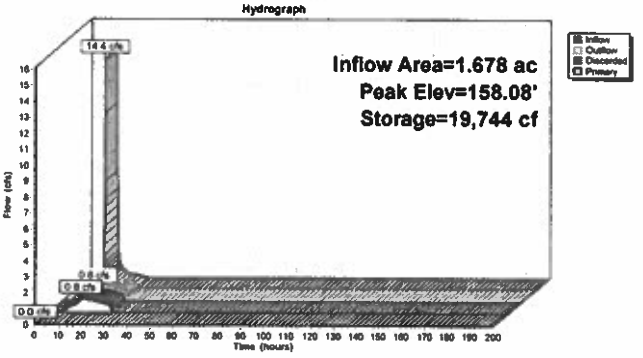
| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 155.80' | 2.420 in/hr Exfiltration over Surface area<br>Conductivity to Groundwater Elevation = 151.80' |
| #2 | Primary | 159.00' | 10.0' long + 3.0 '/' SideZ x 10.0' breadth Broad-Crested Rectangular Weir<br>Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60<br>Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64 |

Discarded OutFlow Max=0.8 cfs @ 13.45 hrs HW=158.08' (Free Discharge)
└1=Exfiltration ( Controls 0.8 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=155.80' (Free Discharge)
└2=Broad-Crested Rectangular Weir ( Controls 0.0 cfs)



### Pond P2: Infiltration Basin



# STORMWATER OPERATION & MAINENANCE PLAN

# STORMWATER OPERATION AND MAINTENANCE PLAN

## 157-165 Lowland Street
## Holliston, MA

***October 14, 2022***

Stormwater Management System Owner: and Responsible Party

Name:_____

_____

Signature:_____

This Operation and Maintenance Plan has been prepared in accordance with the recommendations outlined in the DEP stormwater handbook. This plan outlines the minimum efforts necessary to ensure that the stormwater collection and infiltration system for this site operates in accordance with the design. Efforts in addition to the minimum listed herein may be required to ensure adequate stormwater management.

This plan includes general site restrictions, routing/non-routine operation and maintenance; reporting and record keeping; and an estimated budget.

**General Site Conditions**

The following conditions are imposed as part of this Plan.

- Illicit discharges into the site or any other stormwater management system are perpetually prohibited.
- Uncovered and/or uncontained road de-icing materials shall not be stored on-site.

**Operation and Maintenance:**

*Schedule*: The stormwater management system should be inspected at least four times per year during site operations.

Specific inspection and maintenance practices are listed under each component below. Upon completion of inspection, the inspector should specify any necessary corrective actions to be taken by ownership of the facility. The items to be inspected and maintained are described in the following sections.

Based on the observed conditions, the Responsible Party shall immediately schedule the appropriate maintenance. Some minor maintenance, such as the removal of blockages, debris and saplings in the basins may be conducted at the time of the inspection. More difficult maintenance activities, requiring special equipment, will have to be scheduled, such as the removal of excessive sediment or the repair of eroded areas.

*Estimated Budget:* Approximately $4,000 per year.

*Infiltration Basin*

After every major storm during the first 3 months of operation and at least four times per year thereafter, the inspector shall visually inspect the basin, noting each of the items listed below (Vegetation, Dewatering, Inlets, Outlets and Structural Stability). If any of the items are in need of attention, it shall be noted and the proper remedial action initiated, as described below, as soon as possible.

The inspector shall visit the site three to four days after the rainfall of a major storm has ended to ensure that the facility has drained to the appropriate level. If significant water remains ponded in the system three (3) days after the latest rainfall, sediment removal/blockage removal activities shall be investigated and/or performed. Sediment removal may require excavation of the soils. Areas shall be replaced to finish grade with either clean coarse sand or a highly permeable sand compost mix and then seeded.

The interior check dams and perimeter check dams should be inspected for sediment accumulation and overall condition. Sediment shall be removed whenever visible and any damaged sections shall be repaired. The perimeter check dam should be continuous along the entire top of basin with no breaks between the basin and operations yard.

At a minimum of twice per year, mow the buffer area, side slopes, and basin bottom (if grassed floor); remove trash and debris; remove grass clippings and accumulated organic matter. The embankment and side slopes of the basin should exhibit no visible signs of erosion, settlement, slope failure, wildlife damage, or vehicle damage. Damaged side slopes should be repaired using similar fill of adequate permeability. Damaged embankments should be filled and compacted with impermeable soils to prevent seepage. Eroded areas should be reseeded as discussed under "vegetation". Repeated repairs to side slopes may necessitate the flattening of the slopes to ensure structural stability. Signs of vehicle damage may necessitate the construction of fences around certain areas.

Vegetation should be dense (and aesthetically acceptable on all portions of the device, including the side slopes, basin floor, buffer strips and the embankments. The inspector shall determine: (1) whether fertilizing is required (2) the areas where grass should be mowed, and (3) the areas which should be protected against erosion. In addition, recently seeded areas should be inspected for failures. Grasses of the fescue family can be mowed a minimum of twice per year, in July and late September. In addition to grass maintenance, any other vegetation in the basin area or access areas which has reached nuisance levels, (e.g., bushes, trees and weeds) should be trimmed or removed.

Repairs to damaged or deteriorating structures shall be made as soon as possible. Materials that cannot be adequately repaired, must be replaced.

Outlet spillways should be inspected for settlement, debris and/or vegetation blockages, and evidence of flow. The basin is designed to infiltrate the entire 100 year storm and discharge through the spillway should not occur.

Catch Basins, and Stormceptors.
The actual removal of sediments and associated pollutants and trash occurs only when sumps are cleaned out; therefore, regular maintenance is required. The more frequent the cleaning, the less likely sediments will be resuspended and subsequently discharged. Frequent cleaning also results in more volume available for future storms and enhances the overall performance.

At a minimum, catch basins and Stormceptors should be inspected four times annually, and cleaned whenever sediment accumulation exceeds 12 inches in catch basins and 8 inches in Stormceptors. Disposal of the accumulated sediment and hydrocarbons must be in accordance with applicable local, state, and federal guidelines and regulations. At each inspection, inspect gas trap hoods and repair as necessary. Inspect outlet pipe and remove debris. Vacuum trucks shall be utilized for all cleanings.

**Reporting and Record Keeping**

The responsible party will be responsible for maintaining accurate Maintenance Logs for all maintenance, inspections, repairs, replacements, and disposal (for disposal, the log shall indicate the type of material and the disposal location). The logs shall be kept on site be available for inspection by the Town municipal departments or other auditing authority. This will be a perpetual requirement of the Owners or their Designated Party.

The Site Maintenance Log will be completed as described above, and at a minimum will include:

a. The date of inspection or activity;
b. Name of inspector;
c. The condition of each BMP, including components such as:
    i. Pretreatment devices
    ii. Vegetation
    iii. Inlets and outlets
    iv. Swales
    v. Underground drainage
    vi. Sediment and debris accumulation.
    vii. Any nonstructural practices
    viii. Pavement condition
    ix. Roof drains and gutter conditions
    ix. Any other item that could affect the proper function of the stormwater management system
d. Description of the need for maintenance; and
e. For disposal include type of material and the disposal location;

**Drainage Easements:**

No drainage easements are currently proposed or required.

**Changes to Operation and Maintenance Plans**

The owner(s) of the stormwater management system must notify the Stormwater Permitting Authority or its designated Reviewing Agent of changes in ownership or assignment of financial responsibility.

**Emergency Response Plan / Spill Control Practices**

On-site storage of hazardous materials shall not be allowed.

In the event of an accident in the driveway where a significant amount of gasoline or other petroleum product is released, the following procedure should be followed:

1. Immediately contact the following agencies:

| | |
|---|---|
| Holliston Fire Department | (508) 429-4631 |
| MassDEP Emergency response | (888) 304-1133 |

2. Provide support to agencies listed above, which may include contacting an outside contractor to provide clean-up or contacting a Licensed Site Professional (LSP) to lead the clean-up.

The drainage systems in the vicinity should be inspected. If there is evidence of discharge from the drainage system, additional corrective actions must be taken extending to the receiving water or beyond.