STORMWATER REPORT

FOR

BRITE EXCAVATING

4 SPECTACLE POND ROAD

IN

LITTLETON,
MASSACHUSETTS

PREPARED BY: DILLIS & ROY
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PREPARED FOR: BRITE EXCAVATING
14 PATRICIA DRIVE
AYER, MASSACHUSETTS

MARCH 11TH, 2024
REVISED JULY 16TH, 2024
CDG PROJECT #6233

COMMONWEALTH OF MASSACHUSETTS
FRANCIS M
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REGISTERED
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7/16/2024

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1.0 Project Narrative

1.1 Project Type

The proposed project consists of a 6,000 square foot (60’x100’), single-story building with a paved parking lot. The proposed project will include new utility service connections and the installation of a private well & on-site sewage disposal system to service the new building.

1.2 Purpose and Scope

This report has been prepared to comply with the requirements of the Stormwater Management Standards incorporated in the Massachusetts Wetlands Protection Act Regulations, 310 CMR 10.00 and the Town of Littleton Stormwater Management Regulations. These standards are intended to promote increased groundwater recharge and prevent stormwater discharges from causing or contributing to the pollution of surface waters and ground waters of the Commonwealth. The standards aim to accomplish these goals by encouraging the greater use of low impact development techniques and improving the operation and maintenance of stormwater best management practices.

This report addresses compliance of the proposed development with each of the ten stormwater standards, provides calculations to support the compliance information, and provides an Operation and Maintenance Plan and Long-Term Pollution Prevention Plan for the stormwater management system.

1.3 Proposed Development

As mentioned, the proposed project consists of a 6,000 square foot commercial building, paved parking lot, access driveway, and private septic system to serve the new building. The building will consist of an open floor slab which will be divided into five (5) units, each with 1,200 square feet of warehouse space. Parking for the proposed building will be in front of each bay, which will have pedestrian & vehicular access doors.

Prior approval has been granted for the installation of the well and septic system shown on the attached plans. The proposed septic system has been designed in accordance with 310 CMR 15.00 (Title V) regulations as well as the Town of Littleton Board of Health regulations. The remainder of the site will remain as gravel/dirt, except for the grassed and paved areas adjacent to the building.

1.4 LID Measures

Care has been taken to lay out the proposed site in a manner that respects the existing topography. BMPs such as stormceptor treatment units, deep sump hooded catch basins, and subsurface infiltration systems are used to manage the stormwater runoff associated with the proposed development. Runoff from the proposed roof will be routed via roof headers to the subsurface infiltration system. The subsurface system will be used to promote groundwater recharge and limit the runoff leaving the site.

1.5 Site Description

The existing site is approximately 6 acres and lies on the north side of Spectacle Pond Road and is bound by Bennet's Brook. The site is currently used as a material stockpile yard with stone, ledge, & mulch stockpiles. The remainder of the site is vacant with respect to pavement and buildings, with the existing landcover being best described as gravel/dirt.

The site is surrounded by bordering vegetated wetlands, with Bennett's Brook also along the northwest side of the property. The entire property falls within a MassWildlife Natural Heritage & Endangered Species Program Priority Habitat of Rare Species Map (indicated on MassMapper). The existing limit of disturbance on the site is a short berm that wraps around the entire disturbed portion of the site which runs approximately parallel with the bordering vegetated wetland line.

The site is comprised primarily of Quonset loamy sand which falls within Hydrologic Soils Group (HSG) A. On-site soil testing confirmed that a majority of the site contains 2-4 feet of fill material over the coarse sand and gravel. The proposed development area is located on a portion of the site that belongs to HSG A. Soils belonging to HSG A have a high rate of water transmission (low runoff potential).

1.6 Proposed Stormwater Management System

Runoff from the proposed impervious areas will be conveyed and treated through a combination of BMP's and infiltrated to the groundwater. The infiltration will help to recharge the groundwater and ensure that the proposed development will not cause any off-site flooding. The following is a brief discussion of each conveyance and treatment BMP proposed.

<u>Subsurface Infiltration System</u>

A subsurface infiltration system is proposed at a low point adjacent to the proposed pavement. The infiltration system will collect runoff from a majority of the proposed pavement and the proposed roof area and has been designed to store and infiltrate the stormwater runoff associated with the 100-year storm event. The infiltration system will consist of 9 precast concrete galleys embedded in crushed stone as detailed on the attached site plan.

Deep Sump & Hooded Catch Basin

A deep sump & hooded catch basin will be installed to capture stormwater runoff from the proposed pavement. Stormwater will discharge via culvert to a pre-treatment unit (Stormceptor) before ultimately discharging to the subsurface infiltrations system described above. The catch basin & outlet culvert have been designed to accommodate flows associated with the 100-year storm event.

Swale & Detention Pond

A swale & detention pond will be installed to capture stormwater runoff from the proposed driveway. Stormwater will discharge to a layer of riprap to be installed at the high end of the swale on its way toward the detention pond at the left side of the site and will enter a sedimentation forebay before entering the detention pond itself. The swale & pond have been designed to accommodate flows associated with the 100-year storm event. The pond itself is located at an existing low spot bounded by soil berms.

1.7 Methods of Analysis

United States Department of Agriculture Natural Resources Conservation Service (NRCS) soil cover complex methods (TR-20) were employed to compute runoff quantities for the subject property and, where appropriate, adjacent property that drains toward a common discharge point with runoff from the subject site. HydroCAD 10.10 computer software was employed in this hydrologic analysis.

Due to the existing topography of the site, all runoff from the proposed project collects at one of two low points on the site. A pre- and post- development analysis were performed to determine that there will be no flooding during the 2-, 10-, 25-, 50-, and 100-year return frequencies. Watershed boundaries for existing conditions are depicted on the attached pre-development watershed plan. Post-developed watershed boundaries are indicated on the post-development watershed plan.

2.0 Stormwater Standards Compliance

2.1 Standard 1 – Untreated Discharges

The stormwater management system for the proposed development will not result in any new discharges of untreated stormwater to wetland resource areas. Stormwater management structures have been designed such that there is no erosion or scour to wetland resource areas or waters of the Commonwealth.

2.2 Standard 2 – Peak Rate Attenuation

The stormwater management system for the proposed development will employ a subsurface infiltration system consisting of galley style chambers that have been sized to capture and infiltrate the stormwater runoff associated with the 100-year, 24-hour rainfall event.

Hydrologic calculations for existing and proposed site conditions are included in appendices D & E, respectively. Calculations for 24-hour rainfall events of 2-, 10-, 25-, 50-, and 100-year return frequencies are provided. For all rainfall events considered, the proposed stormwater management system will control runoff from the development such that the corresponding water levels at the existing low points will not cause any on or off-site flooding. Refer to the table below for a comparison of pre- & post- development stormwater runoff.

	Pre-Developed (cfs)	**Post-Developed (cfs)**	**Delta (cfs)**
Design Point "A"			
2-Year	2.21	1.16	-1.05
10-Year	5.47	3.44	-2.03
25-Year	7.73	5.09	-2.64
50-Year	9.47	6.39	-3.08
100-Year	11.39	7.84	-3.55

Design Point "B"			
2-Year	0.15	0.00	-0.15
10-Year	0.36	0.00	-0.36
25-Year	0.51	0.01	-0.50
50-Year	0.62	0.02	-0.60
100-Year	0.75	0.05	-0.70

2.3 Standard 3 – Recharge

As discussed in the Introduction, NRCS data indicates that the areas within the proposed development consist of soils from HSG A. A subsurface infiltration system is proposed to provide infiltration of runoff from pavement & roof areas. Recharge calculations can be found in Appendix F.

2.4 Standard 4 – Water Quality

A total of 98% TSS removal is provided using the specified BMPs. 89% TSS removal is provided prior to discharge to the leaching chambers. See Appendix F for TSS removal calculations. An 8.27 in/hr Rawls Rate was used for exfiltration for the proposed soil. On-site soil testing discovered that the existing soils are well drained sand and gravel, however this is inconsistent with the soil maps provided by the NRCS. The parking area will be raised using screened sand from the site, providing a similar infiltration rate to the existing soil on the property.

2.5 Standard 5 – Land Uses with Higher Pollutant Loads

The current and proposed uses of the subject site do not constitute land use with higher potential pollutant load, thus Standard 5 does not apply to the proposed project.

2.6 Standard 6 – Critical Areas

The proposed project does not involve a stormwater discharge within or near to any of the areas defined as “Critical Areas” at 314 CMR 9.02 and 310 CMR 10.04.

2.7 Standard 7 – Redevelopment

The project does not qualify for redevelopment provisions.

2.8 Standard 8 – Construction Period Pollution Prevention and Erosion and Sediment Control

The project is subject to the filing of an Environmental Protection Agency Notice of Intent (EPA NOI), the Stormwater Pollution Prevention Plan (SWPPP) will be prepared prior to construction. This document will be prepared to satisfy the requirements of the EPA NOI and the Standard 8 Construction Period Pollution prevention and Erosion and Sedimentation Control Plan.

2.9 Standard 9 – Operation and Maintenance Plan

Refer to Appendix G for a complete copy of the Stormwater Operation and Maintenance Plan.

2.10 Standard 10 – Prohibition of Illicit Discharges

An illicit discharge statement will be prepared after approvals are received and prior to construction.

APPENDIX A

Locus Map

LOCUS MAP

1"=1,500'

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References: 1988 USGS Fitchburg & Ayer Massachusetts Topographic Map

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APPENDIX B

Checklist for Stormwater Report

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.

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

COMMONWEALTH OF MASSACHUSETTS
FRANCIS M
McPARTLAN
CIVIL
No. 49572
REGISTERED
PROFESSIONAL ENGINEER

7/16/2024

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): Subsurface Infiltration System, Stormceptor Treatment Unit

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 (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 (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 (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 (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

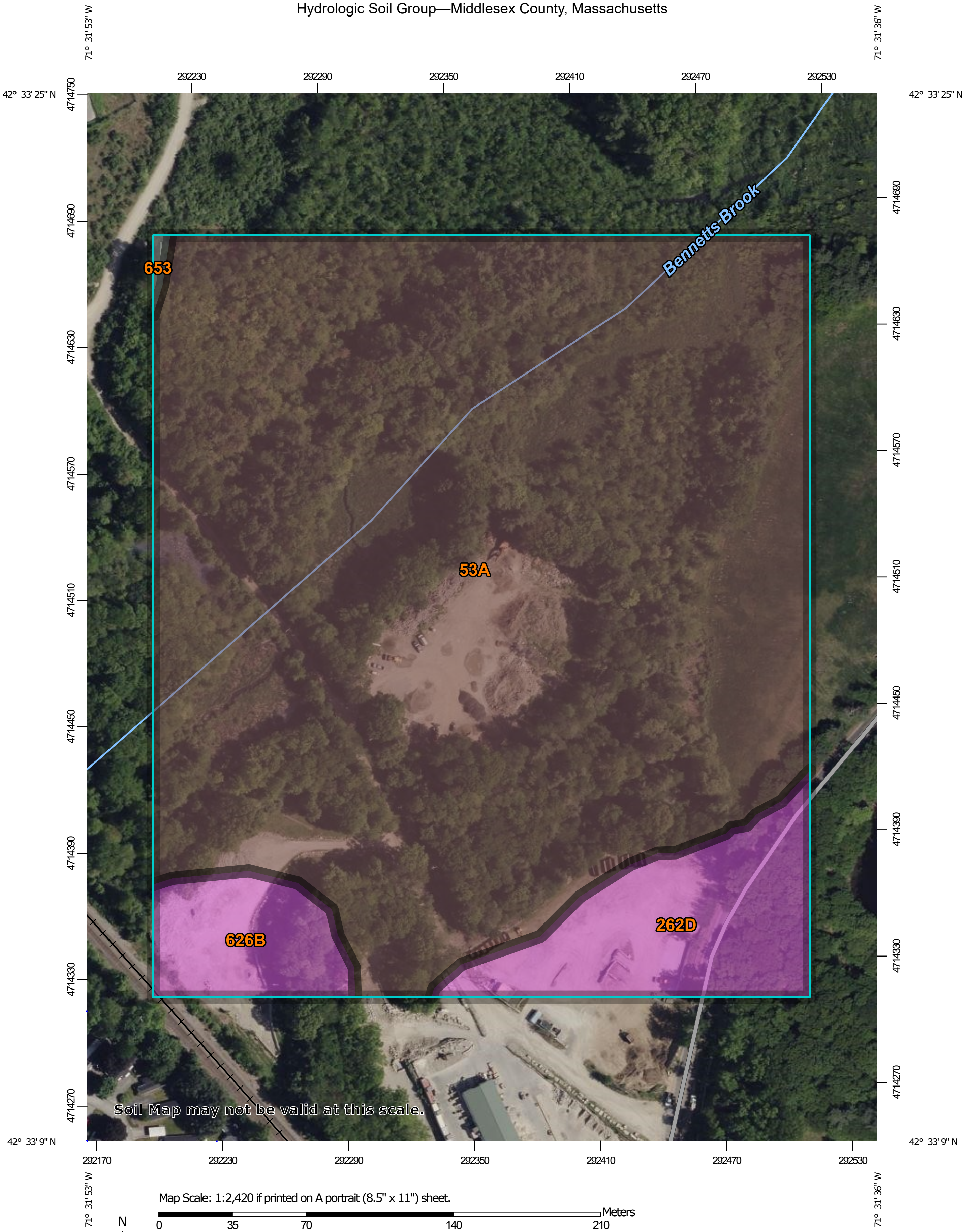
☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☐ An Illicit Discharge Compliance Statement is attached;

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

APPENDIX C

NRCS Soils Data



Map Scale: 1:2,420 if printed on A portrait (8.5" x 11") sheet.

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 1:24,000.

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 23, Sep 12, 2023

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
53A	Freetown muck, ponded, 0 to 1 percent slopes	B/D	24.3	86.7%
262D	Quonset sandy loam, 15 to 25 percent slopes	A	2.4	8.7%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	A	1.2	4.4%
653	Udorthents, sandy		0.0	0.2%
Totals for Area of Interest			**28.0**	**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

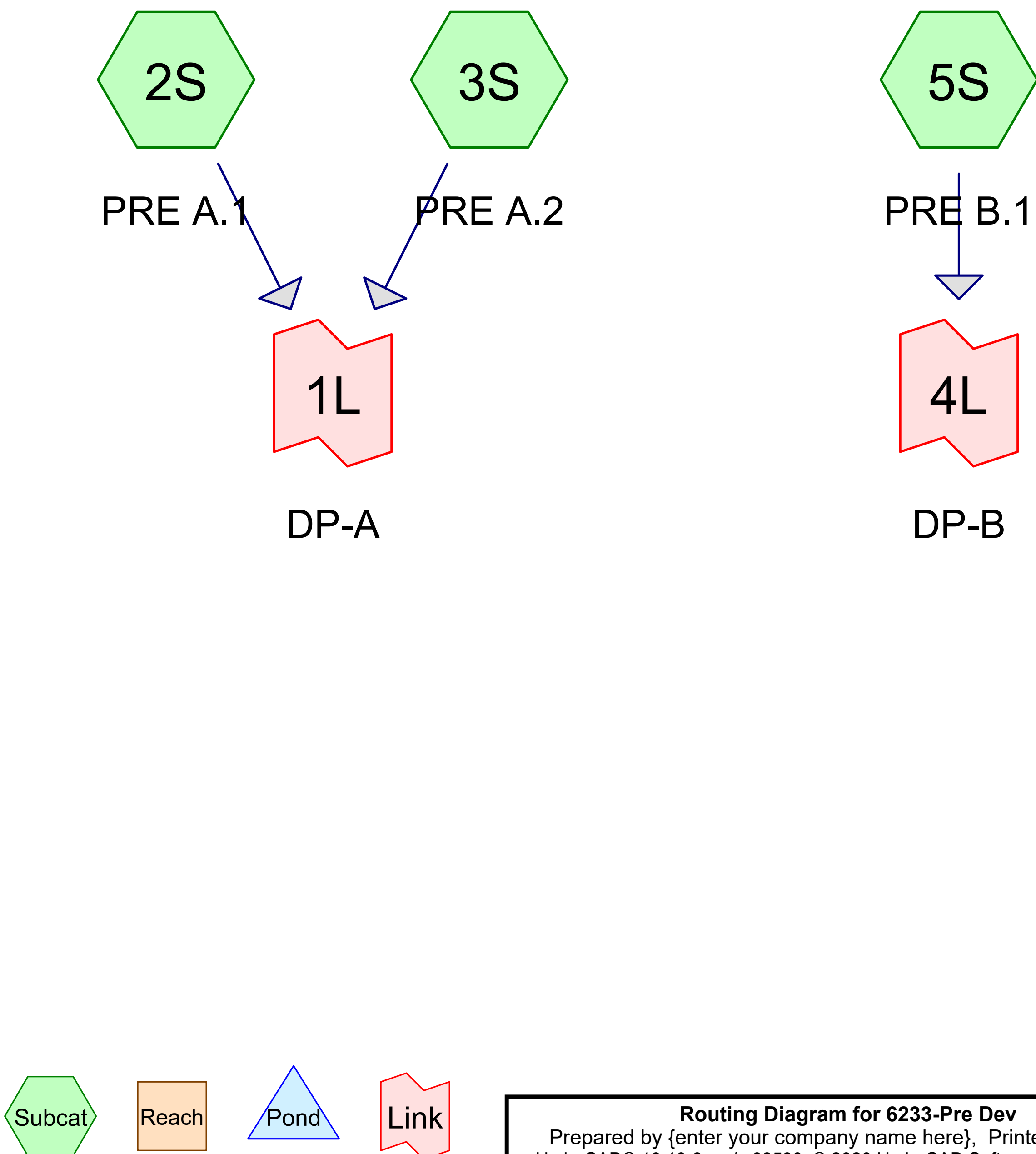
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX D

Existing Conditions – Hydrologic Calculations



Routing Diagram for 6233-Pre Dev
Prepared by {enter your company name here}, Printed 7/5/2024

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type III 24-hr		Default	24.00	1	3.16	2
2	10-Year	Type III 24-hr		Default	24.00	1	4.86	2
3	25-Year	Type III 24-hr		Default	24.00	1	5.92	2
4	50-Year	Type III 24-hr		Default	24.00	1	6.71	2
5	100-Year	Type III 24-hr		Default	24.00	1	7.56	2

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

Subcatchment2S: PRE A.1 Runoff Area=78,006 sf 0.00% Impervious Runoff Depth=0.90"
Tc=6.0 min CN=72 Runoff=1.72 cfs 0.135 af

Subcatchment3S: PRE A.2 Runoff Area=22,176 sf 0.00% Impervious Runoff Depth=0.90"
Tc=6.0 min CN=72 Runoff=0.49 cfs 0.038 af

Subcatchment5S: PRE B.1 Runoff Area=6,571 sf 0.00% Impervious Runoff Depth=0.90"
Tc=6.0 min CN=72 Runoff=0.15 cfs 0.011 af

Link 1L: DP-A Inflow=2.21 cfs 0.173 af
Primary=2.21 cfs 0.173 af

Link 4L: DP-B Inflow=0.15 cfs 0.011 af
Primary=0.15 cfs 0.011 af

Total Runoff Area = 2.451 ac Runoff Volume = 0.185 af Average Runoff Depth = 0.90"
100.00% Pervious = 2.451 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2S: PRE A.1

Runoff = 1.72 cfs @ 12.10 hrs, Volume= 0.135 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.16"

Area (sf)	CN	Description
78,006	72	Dirt roads, HSG A
78,006		100.00% Pervious Area

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

Summary for Subcatchment 3S: PRE A.2

Runoff = 0.49 cfs @ 12.10 hrs, Volume= 0.038 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.16"

Area (sf)	CN	Description
22,176	72	Dirt roads, HSG A
22,176		100.00% Pervious Area

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

Summary for Subcatchment 5S: PRE B.1

Runoff = 0.15 cfs @ 12.10 hrs, Volume= 0.011 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.16"

Area (sf)	CN	Description
6,571	72	Dirt roads, HSG A
6,571		100.00% Pervious Area

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

Summary for Link 1L: DP-A

Inflow Area = 2.300 ac, 0.00% Impervious, Inflow Depth = 0.90" for 2-Year event
Inflow = 2.21 cfs @ 12.10 hrs, Volume= 0.173 af
Primary = 2.21 cfs @ 12.10 hrs, Volume= 0.173 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Link 4L: DP-B

Inflow Area = 0.151 ac, 0.00% Impervious, Inflow Depth = 0.90" for 2-Year event
Inflow = 0.15 cfs @ 12.10 hrs, Volume= 0.011 af
Primary = 0.15 cfs @ 12.10 hrs, Volume= 0.011 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

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

Subcatchment2S: PRE A.1 Runoff Area=78,006 sf 0.00% Impervious Runoff Depth=2.09"
Tc=6.0 min CN=72 Runoff=4.26 cfs 0.312 af

Subcatchment3S: PRE A.2 Runoff Area=22,176 sf 0.00% Impervious Runoff Depth=2.09"
Tc=6.0 min CN=72 Runoff=1.21 cfs 0.089 af

Subcatchment5S: PRE B.1 Runoff Area=6,571 sf 0.00% Impervious Runoff Depth=2.09"
Tc=6.0 min CN=72 Runoff=0.36 cfs 0.026 af

Link 1L: DP-A Inflow=5.47 cfs 0.401 af
Primary=5.47 cfs 0.401 af

Link 4L: DP-B Inflow=0.36 cfs 0.026 af
Primary=0.36 cfs 0.026 af

Total Runoff Area = 2.451 ac Runoff Volume = 0.427 af Average Runoff Depth = 2.09"
100.00% Pervious = 2.451 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2S: PRE A.1

Runoff = 4.26 cfs @ 12.10 hrs, Volume= 0.312 af, Depth= 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.86"

Area (sf)	CN	Description
78,006	72	Dirt roads, HSG A
78,006		100.00% Pervious Area

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

Summary for Subcatchment 3S: PRE A.2

Runoff = 1.21 cfs @ 12.10 hrs, Volume= 0.089 af, Depth= 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.86"

Area (sf)	CN	Description
22,176	72	Dirt roads, HSG A
22,176		100.00% Pervious Area

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

Summary for Subcatchment 5S: PRE B.1

Runoff = 0.36 cfs @ 12.10 hrs, Volume= 0.026 af, Depth= 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.86"

Area (sf)	CN	Description
6,571	72	Dirt roads, HSG A
6,571		100.00% Pervious Area

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

Summary for Link 1L: DP-A

Inflow Area = 2.300 ac, 0.00% Impervious, Inflow Depth = 2.09" for 10-Year event
Inflow = 5.47 cfs @ 12.10 hrs, Volume= 0.401 af
Primary = 5.47 cfs @ 12.10 hrs, Volume= 0.401 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Link 4L: DP-B

Inflow Area = 0.151 ac, 0.00% Impervious, Inflow Depth = 2.09" for 10-Year event
Inflow = 0.36 cfs @ 12.10 hrs, Volume= 0.026 af
Primary = 0.36 cfs @ 12.10 hrs, Volume= 0.026 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

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

Subcatchment2S: PRE A.1 Runoff Area=78,006 sf 0.00% Impervious Runoff Depth=2.93"
Tc=6.0 min CN=72 Runoff=6.02 cfs 0.437 af

Subcatchment3S: PRE A.2 Runoff Area=22,176 sf 0.00% Impervious Runoff Depth=2.93"
Tc=6.0 min CN=72 Runoff=1.71 cfs 0.124 af

Subcatchment5S: PRE B.1 Runoff Area=6,571 sf 0.00% Impervious Runoff Depth=2.93"
Tc=6.0 min CN=72 Runoff=0.51 cfs 0.037 af

Link 1L: DP-A Inflow=7.73 cfs 0.561 af
Primary=7.73 cfs 0.561 af

Link 4L: DP-B Inflow=0.51 cfs 0.037 af
Primary=0.51 cfs 0.037 af

Total Runoff Area = 2.451 ac Runoff Volume = 0.598 af Average Runoff Depth = 2.93"
100.00% Pervious = 2.451 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2S: PRE A.1

Runoff = 6.02 cfs @ 12.09 hrs, Volume= 0.437 af, Depth= 2.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.92"

Area (sf)	CN	Description
78,006	72	Dirt roads, HSG A
78,006		100.00% Pervious Area

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

Summary for Subcatchment 3S: PRE A.2

Runoff = 1.71 cfs @ 12.09 hrs, Volume= 0.124 af, Depth= 2.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.92"

Area (sf)	CN	Description
22,176	72	Dirt roads, HSG A
22,176		100.00% Pervious Area

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

Summary for Subcatchment 5S: PRE B.1

Runoff = 0.51 cfs @ 12.09 hrs, Volume= 0.037 af, Depth= 2.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.92"

Area (sf)	CN	Description
6,571	72	Dirt roads, HSG A
6,571		100.00% Pervious Area

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

Summary for Link 1L: DP-A

Inflow Area = 2.300 ac, 0.00% Impervious, Inflow Depth = 2.93" for 25-Year event
Inflow = 7.73 cfs @ 12.09 hrs, Volume= 0.561 af
Primary = 7.73 cfs @ 12.09 hrs, Volume= 0.561 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Link 4L: DP-B

Inflow Area = 0.151 ac, 0.00% Impervious, Inflow Depth = 2.93" for 25-Year event
Inflow = 0.51 cfs @ 12.09 hrs, Volume= 0.037 af
Primary = 0.51 cfs @ 12.09 hrs, Volume= 0.037 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

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

Subcatchment2S: PRE A.1 Runoff Area=78,006 sf 0.00% Impervious Runoff Depth=3.58"
Tc=6.0 min CN=72 Runoff=7.38 cfs 0.535 af

Subcatchment3S: PRE A.2 Runoff Area=22,176 sf 0.00% Impervious Runoff Depth=3.58"
Tc=6.0 min CN=72 Runoff=2.10 cfs 0.152 af

Subcatchment5S: PRE B.1 Runoff Area=6,571 sf 0.00% Impervious Runoff Depth=3.58"
Tc=6.0 min CN=72 Runoff=0.62 cfs 0.045 af

Link 1L: DP-A Inflow=9.47 cfs 0.687 af
Primary=9.47 cfs 0.687 af

Link 4L: DP-B Inflow=0.62 cfs 0.045 af
Primary=0.62 cfs 0.045 af

Total Runoff Area = 2.451 ac Runoff Volume = 0.732 af Average Runoff Depth = 3.58"
100.00% Pervious = 2.451 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2S: PRE A.1

Runoff = 7.38 cfs @ 12.09 hrs, Volume= 0.535 af, Depth= 3.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.71"

Area (sf)	CN	Description
78,006	72	Dirt roads, HSG A
78,006		100.00% Pervious Area

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

Summary for Subcatchment 3S: PRE A.2

Runoff = 2.10 cfs @ 12.09 hrs, Volume= 0.152 af, Depth= 3.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.71"

Area (sf)	CN	Description
22,176	72	Dirt roads, HSG A
22,176		100.00% Pervious Area

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

Summary for Subcatchment 5S: PRE B.1

Runoff = 0.62 cfs @ 12.09 hrs, Volume= 0.045 af, Depth= 3.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.71"

Area (sf)	CN	Description
6,571	72	Dirt roads, HSG A
6,571		100.00% Pervious Area

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

Summary for Link 1L: DP-A

Inflow Area = 2.300 ac, 0.00% Impervious, Inflow Depth = 3.58" for 50-Year event
Inflow = 9.47 cfs @ 12.09 hrs, Volume= 0.687 af
Primary = 9.47 cfs @ 12.09 hrs, Volume= 0.687 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Link 4L: DP-B

Inflow Area = 0.151 ac, 0.00% Impervious, Inflow Depth = 3.58" for 50-Year event
Inflow = 0.62 cfs @ 12.09 hrs, Volume= 0.045 af
Primary = 0.62 cfs @ 12.09 hrs, Volume= 0.045 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

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

Subcatchment2S: PRE A.1 Runoff Area=78,006 sf 0.00% Impervious Runoff Depth=4.31"
Tc=6.0 min CN=72 Runoff=8.87 cfs 0.643 af

Subcatchment3S: PRE A.2 Runoff Area=22,176 sf 0.00% Impervious Runoff Depth=4.31"
Tc=6.0 min CN=72 Runoff=2.52 cfs 0.183 af

Subcatchment5S: PRE B.1 Runoff Area=6,571 sf 0.00% Impervious Runoff Depth=4.31"
Tc=6.0 min CN=72 Runoff=0.75 cfs 0.054 af

Link 1L: DP-A Inflow=11.39 cfs 0.826 af
Primary=11.39 cfs 0.826 af

Link 4L: DP-B Inflow=0.75 cfs 0.054 af
Primary=0.75 cfs 0.054 af

Total Runoff Area = 2.451 ac Runoff Volume = 0.880 af Average Runoff Depth = 4.31"
100.00% Pervious = 2.451 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 2S: PRE A.1

Runoff = 8.87 cfs @ 12.09 hrs, Volume= 0.643 af, Depth= 4.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.56"

Area (sf)	CN	Description
78,006	72	Dirt roads, HSG A
78,006		100.00% Pervious Area

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

Summary for Subcatchment 3S: PRE A.2

Runoff = 2.52 cfs @ 12.09 hrs, Volume= 0.183 af, Depth= 4.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.56"

Area (sf)	CN	Description
22,176	72	Dirt roads, HSG A
22,176		100.00% Pervious Area

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

Summary for Subcatchment 5S: PRE B.1

Runoff = 0.75 cfs @ 12.09 hrs, Volume= 0.054 af, Depth= 4.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.56"

Area (sf)	CN	Description
6,571	72	Dirt roads, HSG A
6,571		100.00% Pervious Area

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

Summary for Link 1L: DP-A

Inflow Area =	2.300 ac,	0.00% Impervious,	Inflow Depth = 4.31"	for 100-Year event
Inflow =	11.39 cfs @	12.09 hrs, Volume=	0.826 af	
Primary =	11.39 cfs @	12.09 hrs, Volume=	0.826 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

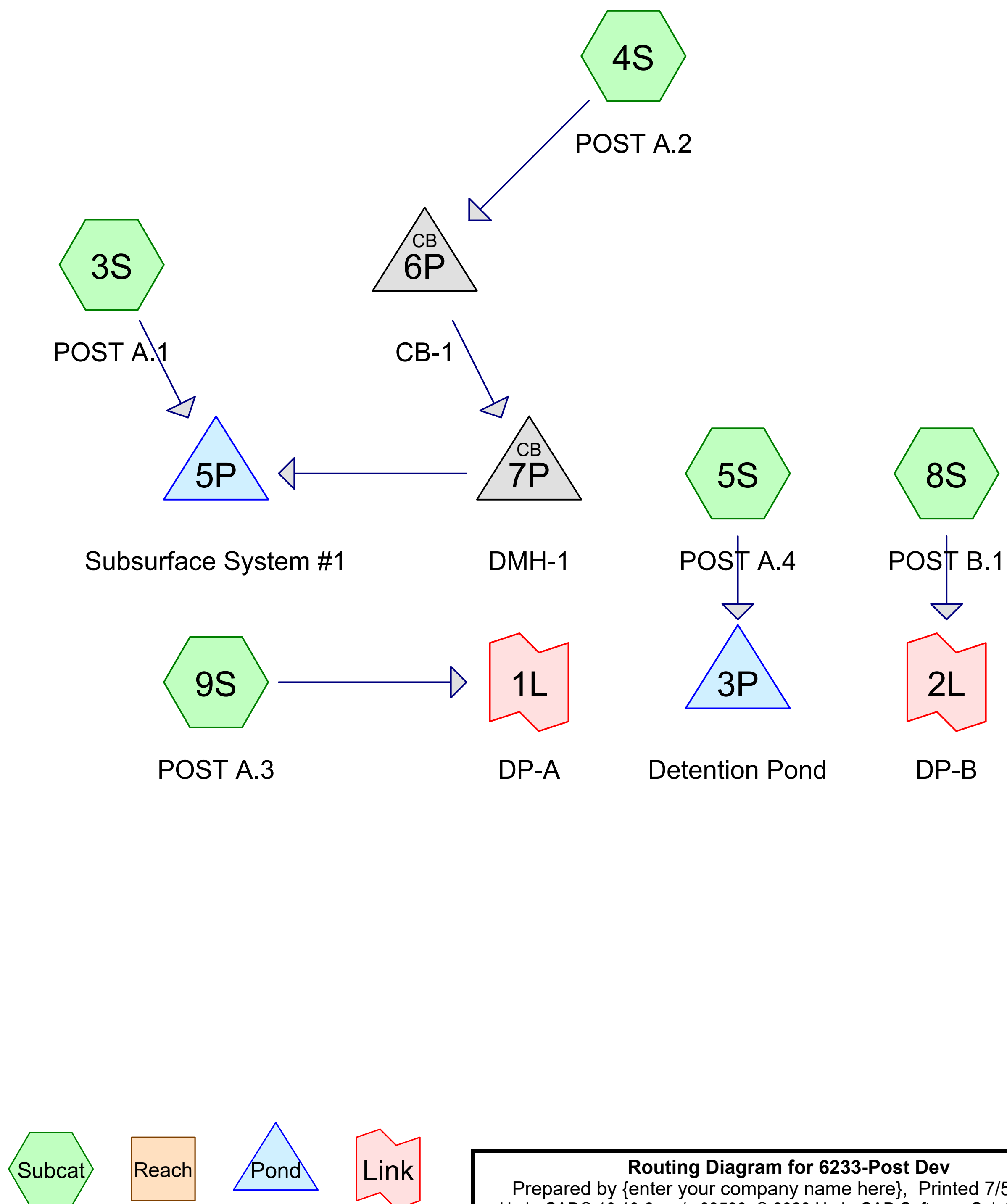
Summary for Link 4L: DP-B

Inflow Area =	0.151 ac,	0.00% Impervious,	Inflow Depth = 4.31"	for 100-Year event
Inflow =	0.75 cfs @	12.09 hrs, Volume=	0.054 af	
Primary =	0.75 cfs @	12.09 hrs, Volume=	0.054 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

APPENDIX E

Proposed Conditions – Hydrologic Calculations



Routing Diagram for 6233-Post Dev
Prepared by {enter your company name here}, Printed 7/5/2024
HydroCAD® 10.10-3a s/n 03590 © 2020 HydroCAD Software Solutions LLC

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type III 24-hr		Default	24.00	1	3.16	2
2	10-Year	Type III 24-hr		Default	24.00	1	4.86	2
3	25-Year	Type III 24-hr		Default	24.00	1	5.92	2
4	50-Year	Type III 24-hr		Default	24.00	1	6.71	2
5	100-Year	Type III 24-hr		Default	24.00	1	7.56	2

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

Subcatchment3S: POST A.1 Runoff Area=6,000 sf 100.00% Impervious Runoff Depth=2.93"
Tc=6.0 min CN=98 Runoff=0.41 cfs 0.034 af

Subcatchment4S: POST A.2 Runoff Area=10,195 sf 100.00% Impervious Runoff Depth=2.93"
Tc=6.0 min CN=98 Runoff=0.70 cfs 0.057 af

Subcatchment5S: POST A.4 Runoff Area=7,501 sf 21.97% Impervious Runoff Depth=0.16"
Tc=6.0 min CN=52 Runoff=0.01 cfs 0.002 af

Subcatchment8S: POST B.1 Runoff Area=3,596 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=39 Runoff=0.00 cfs 0.000 af

Subcatchment9S: POST A.3 Runoff Area=79,466 sf 0.00% Impervious Runoff Depth=0.67"
Tc=6.0 min CN=67 Runoff=1.17 cfs 0.101 af

Pond 3P: Detention Pond Peak Elev=218.00' Storage=0 cf Inflow=0.01 cfs 0.002 af
Outflow=0.01 cfs 0.002 af

Pond 5P: Subsurface System #1 Peak Elev=217.32' Storage=891 cf Inflow=1.11 cfs 0.091 af
Outflow=0.29 cfs 0.091 af

Pond 6P: CB-1 Peak Elev=218.98' Inflow=0.70 cfs 0.057 af
12.0" Round Culvert n=0.013 L=30.0' S=0.0200 '/' Outflow=0.70 cfs 0.057 af

Pond 7P: DMH-1 Peak Elev=218.14' Inflow=0.70 cfs 0.057 af
12.0" Round Culvert n=0.013 L=6.0' S=0.0200 '/' Outflow=0.70 cfs 0.057 af

Link 1L: DP-A Inflow=1.17 cfs 0.101 af
Primary=1.17 cfs 0.101 af

Link 2L: DP-B Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af

Total Runoff Area = 2.451 ac Runoff Volume = 0.194 af Average Runoff Depth = 0.95"
83.29% Pervious = 2.041 ac 16.71% Impervious = 0.410 ac

Summary for Subcatchment 3S: POST A.1

Runoff = 0.41 cfs @ 12.09 hrs, Volume= 0.034 af, Depth= 2.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.16"

Area (sf)	CN	Description
6,000	98	Roofs, HSG A
6,000		100.00% Impervious Area

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

Summary for Subcatchment 4S: POST A.2

Runoff = 0.70 cfs @ 12.09 hrs, Volume= 0.057 af, Depth= 2.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.16"

Area (sf)	CN	Description
10,195	98	Paved parking, HSG A
10,195		100.00% Impervious Area

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

Summary for Subcatchment 5S: POST A.4

Runoff = 0.01 cfs @ 12.42 hrs, Volume= 0.002 af, Depth= 0.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.16"

	Area (sf)	CN	Description
*	1,648	98	Paved parking, HSG A
	5,853	39	>75% Grass cover, Good, HSG A
	7,501	52	Weighted Average
	5,853		78.03% Pervious Area
	1,648		21.97% Impervious Area

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

Summary for Subcatchment 8S: POST B.1

Runoff = 0.00 cfs @ 23.99 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.16"

Area (sf)	CN	Description
3,596	39	>75% Grass cover, Good, HSG A
3,596		100.00% Pervious Area

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

Summary for Subcatchment 9S: POST A.3

Runoff = 1.17 cfs @ 12.11 hrs, Volume= 0.101 af, Depth= 0.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.16"

Area (sf)	CN	Description
67,202	72	Dirt roads, HSG A
12,264	39	>75% Grass cover, Good, HSG A
79,466	67	Weighted Average
79,466		100.00% Pervious Area

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

Summary for Pond 3P: Detention Pond

Inflow Area = 0.172 ac, 21.97% Impervious, Inflow Depth = 0.16" for 2-Year event
Inflow = 0.01 cfs @ 12.42 hrs, Volume= 0.002 af
Outflow = 0.01 cfs @ 12.43 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.9 min
Discarded = 0.01 cfs @ 12.43 hrs, Volume= 0.002 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.00' @ 12.43 hrs Surf.Area= 404 sf Storage= 0 cf

Plug-Flow detention time= 0.9 min calculated for 0.002 af (100% of inflow)
Center-of-Mass det. time= 0.9 min (989.3 - 988.4)

Volume	Invert	Avail.Storage	Storage Description
#1	218.00'	553 cf	**Irregular pond (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
218.00	404	82.4	0	0	404
219.00	717	126.5	553	553	1,145

Device	Routing	Invert	Outlet Devices
#1	Discarded	218.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.08 cfs @ 12.43 hrs HW=218.00' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Summary for Pond 5P: Subsurface System #1

Inflow Area = 0.372 ac,100.00% Impervious, Inflow Depth = 2.93" for 2-Year event
Inflow = 1.11 cfs @ 12.09 hrs, Volume= 0.091 af
Outflow = 0.29 cfs @ 12.45 hrs, Volume= 0.091 af, Atten= 74%, Lag= 21.8 min
Discarded = 0.29 cfs @ 12.45 hrs, Volume= 0.091 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 217.32' @ 12.45 hrs Surf.Area= 1,008 sf Storage= 891 cf
Flood Elev= 221.50' Surf.Area= 1,008 sf Storage= 3,600 cf

Plug-Flow detention time= 19.0 min calculated for 0.091 af (100% of inflow)
Center-of-Mass det. time= 19.0 min (775.7 - 756.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	216.33'	0 cf	**24.00'W x 42.00'L x 4.67'H Field A** 4,707 cf Overall - 4,707 cf Embedded = 0 cf x 40.0% Voids
#2A	216.33'	3,600 cf	**Shea Leaching Chamber 8x14x4.7**x 9 Inside #1 Inside= 84.0"W x 48.0"H => 30.77 sf x 13.00'L = 400.0 cf Outside= 96.0"W x 56.0"H => 37.36 sf x 14.00'L = 523.0 cf 9 Chambers in 3 Rows
		3,600 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	216.33'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 214.33'

Discarded OutFlow Max=0.29 cfs @ 12.45 hrs HW=217.32' (Free Discharge)
└─**1=Exfiltration** (Controls 0.29 cfs)

Summary for Pond 6P: CB-1

Inflow Area = 0.234 ac,100.00% Impervious, Inflow Depth = 2.93" for 2-Year event
Inflow = 0.70 cfs @ 12.09 hrs, Volume= 0.057 af
Outflow = 0.70 cfs @ 12.09 hrs, Volume= 0.057 af, Atten= 0%, Lag= 0.0 min
Primary = 0.70 cfs @ 12.09 hrs, Volume= 0.057 af

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

Peak Elev= 218.98' @ 12.09 hrs
Flood Elev= 221.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	218.50'	**12.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 218.50' / 217.90' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.68 cfs @ 12.09 hrs HW=218.98' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.68 cfs @ 1.85 fps)

Summary for Pond 7P: DMH-1

Inflow Area = 0.234 ac,100.00% Impervious, Inflow Depth = 2.93" for 2-Year event
Inflow = 0.70 cfs @ 12.09 hrs, Volume= 0.057 af
Outflow = 0.70 cfs @ 12.09 hrs, Volume= 0.057 af, Atten= 0%, Lag= 0.0 min
Primary = 0.70 cfs @ 12.09 hrs, Volume= 0.057 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.14' @ 12.09 hrs
Flood Elev= 221.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	217.65'	**12.0" Round Culvert** L= 6.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 217.65' / 217.53' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.68 cfs @ 12.09 hrs HW=218.13' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.68 cfs @ 2.68 fps)

Summary for Link 1L: DP-A

Inflow Area = 1.824 ac, 0.00% Impervious, Inflow Depth = 0.67" for 2-Year event
Inflow = 1.17 cfs @ 12.11 hrs, Volume= 0.101 af
Primary = 1.17 cfs @ 12.11 hrs, Volume= 0.101 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Link 2L: DP-B

Inflow Area = 0.083 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 23.99 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 23.99 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

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

Subcatchment3S: POST A.1 Runoff Area=6,000 sf 100.00% Impervious Runoff Depth=4.62"
Tc=6.0 min CN=98 Runoff=0.64 cfs 0.053 af

Subcatchment4S: POST A.2 Runoff Area=10,195 sf 100.00% Impervious Runoff Depth=4.62"
Tc=6.0 min CN=98 Runoff=1.09 cfs 0.090 af

Subcatchment5S: POST A.4 Runoff Area=7,501 sf 21.97% Impervious Runoff Depth=0.74"
Tc=6.0 min CN=52 Runoff=0.10 cfs 0.011 af

Subcatchment8S: POST B.1 Runoff Area=3,596 sf 0.00% Impervious Runoff Depth=0.17"
Tc=6.0 min CN=39 Runoff=0.00 cfs 0.001 af

Subcatchment9S: POST A.3 Runoff Area=79,466 sf 0.00% Impervious Runoff Depth=1.71"
Tc=6.0 min CN=67 Runoff=3.45 cfs 0.259 af

Pond 3P: Detention Pond Peak Elev=218.03' Storage=11 cf Inflow=0.10 cfs 0.011 af
Outflow=0.08 cfs 0.011 af

Pond 5P: Subsurface System #1 Peak Elev=218.17' Storage=1,652 cf Inflow=1.73 cfs 0.143 af
Outflow=0.37 cfs 0.143 af

Pond 6P: CB-1 Peak Elev=219.12' Inflow=1.09 cfs 0.090 af
12.0" Round Culvert n=0.013 L=30.0' S=0.0200 '/' Outflow=1.09 cfs 0.090 af

Pond 7P: DMH-1 Peak Elev=218.29' Inflow=1.09 cfs 0.090 af
12.0" Round Culvert n=0.013 L=6.0' S=0.0200 '/' Outflow=1.09 cfs 0.090 af

Link 1L: DP-A Inflow=3.45 cfs 0.259 af
Primary=3.45 cfs 0.259 af

Link 2L: DP-B Inflow=0.00 cfs 0.001 af
Primary=0.00 cfs 0.001 af

Total Runoff Area = 2.451 ac Runoff Volume = 0.414 af Average Runoff Depth = 2.03"
83.29% Pervious = 2.041 ac 16.71% Impervious = 0.410 ac

Summary for Subcatchment 3S: POST A.1

Runoff = 0.64 cfs @ 12.09 hrs, Volume= 0.053 af, Depth= 4.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.86"

Area (sf)	CN	Description
6,000	98	Roofs, HSG A
6,000		100.00% Impervious Area

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

Summary for Subcatchment 4S: POST A.2

Runoff = 1.09 cfs @ 12.09 hrs, Volume= 0.090 af, Depth= 4.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.86"

Area (sf)	CN	Description
10,195	98	Paved parking, HSG A
10,195		100.00% Impervious Area

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

Summary for Subcatchment 5S: POST A.4

Runoff = 0.10 cfs @ 12.12 hrs, Volume= 0.011 af, Depth= 0.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.86"

	Area (sf)	CN	Description
*	1,648	98	Paved parking, HSG A
	5,853	39	>75% Grass cover, Good, HSG A
	7,501	52	Weighted Average
	5,853		78.03% Pervious Area
	1,648		21.97% Impervious Area

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

Summary for Subcatchment 8S: POST B.1

Runoff = 0.00 cfs @ 13.62 hrs, Volume= 0.001 af, Depth= 0.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.86"

Area (sf)	CN	Description
3,596	39	>75% Grass cover, Good, HSG A
3,596		100.00% Pervious Area

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

Summary for Subcatchment 9S: POST A.3

Runoff = 3.45 cfs @ 12.10 hrs, Volume= 0.259 af, Depth= 1.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.86"

Area (sf)	CN	Description
67,202	72	Dirt roads, HSG A
12,264	39	>75% Grass cover, Good, HSG A
79,466	67	Weighted Average
79,466		100.00% Pervious Area

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

Summary for Pond 3P: Detention Pond

Inflow Area = 0.172 ac, 21.97% Impervious, Inflow Depth = 0.74" for 10-Year event
Inflow = 0.10 cfs @ 12.12 hrs, Volume= 0.011 af
Outflow = 0.08 cfs @ 12.22 hrs, Volume= 0.011 af, Atten= 22%, Lag= 5.9 min
Discarded = 0.08 cfs @ 12.22 hrs, Volume= 0.011 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.03' @ 12.22 hrs Surf.Area= 411 sf Storage= 11 cf

Plug-Flow detention time= 1.0 min calculated for 0.011 af (100% of inflow)
Center-of-Mass det. time= 1.0 min (909.5 - 908.5)

Volume	Invert	Avail.Storage	Storage Description
#1	218.00'	553 cf	**Irregular pond (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
218.00	404	82.4	0	0	404
219.00	717	126.5	553	553	1,145

Device	Routing	Invert	Outlet Devices
#1	Discarded	218.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.08 cfs @ 12.22 hrs HW=218.03' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Summary for Pond 5P: Subsurface System #1

Inflow Area = 0.372 ac,100.00% Impervious, Inflow Depth = 4.62" for 10-Year event
Inflow = 1.73 cfs @ 12.09 hrs, Volume= 0.143 af
Outflow = 0.37 cfs @ 12.50 hrs, Volume= 0.143 af, Atten= 79%, Lag= 24.6 min
Discarded = 0.37 cfs @ 12.50 hrs, Volume= 0.143 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.17' @ 12.50 hrs Surf.Area= 1,008 sf Storage= 1,652 cf
Flood Elev= 221.50' Surf.Area= 1,008 sf Storage= 3,600 cf

Plug-Flow detention time= 30.3 min calculated for 0.143 af (100% of inflow)
Center-of-Mass det. time= 30.3 min (778.8 - 748.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	216.33'	0 cf	**24.00'W x 42.00'L x 4.67'H Field A** 4,707 cf Overall - 4,707 cf Embedded = 0 cf x 40.0% Voids
#2A	216.33'	3,600 cf	**Shea Leaching Chamber 8x14x4.7**x 9 Inside #1 Inside= 84.0"W x 48.0"H => 30.77 sf x 13.00'L = 400.0 cf Outside= 96.0"W x 56.0"H => 37.36 sf x 14.00'L = 523.0 cf 9 Chambers in 3 Rows
		3,600 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	216.33'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 214.33'

Discarded OutFlow Max=0.37 cfs @ 12.50 hrs HW=218.17' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.37 cfs)

Summary for Pond 6P: CB-1

Inflow Area = 0.234 ac,100.00% Impervious, Inflow Depth = 4.62" for 10-Year event
Inflow = 1.09 cfs @ 12.09 hrs, Volume= 0.090 af
Outflow = 1.09 cfs @ 12.09 hrs, Volume= 0.090 af, Atten= 0%, Lag= 0.0 min
Primary = 1.09 cfs @ 12.09 hrs, Volume= 0.090 af

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

Peak Elev= 219.12' @ 12.09 hrs
Flood Elev= 221.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	218.50'	**12.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 218.50' / 217.90' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.06 cfs @ 12.09 hrs HW=219.11' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.06 cfs @ 2.10 fps)

Summary for Pond 7P: DMH-1

Inflow Area = 0.234 ac,100.00% Impervious, Inflow Depth = 4.62" for 10-Year event
Inflow = 1.09 cfs @ 12.09 hrs, Volume= 0.090 af
Outflow = 1.09 cfs @ 12.09 hrs, Volume= 0.090 af, Atten= 0%, Lag= 0.0 min
Primary = 1.09 cfs @ 12.09 hrs, Volume= 0.090 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.29' @ 12.09 hrs
Flood Elev= 221.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	217.65'	**12.0" Round Culvert** L= 6.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 217.65' / 217.53' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.06 cfs @ 12.09 hrs HW=218.28' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 1.06 cfs @ 2.91 fps)

Summary for Link 1L: DP-A

Inflow Area = 1.824 ac, 0.00% Impervious, Inflow Depth = 1.71" for 10-Year event
Inflow = 3.45 cfs @ 12.10 hrs, Volume= 0.259 af
Primary = 3.45 cfs @ 12.10 hrs, Volume= 0.259 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Link 2L: DP-B

Inflow Area = 0.083 ac, 0.00% Impervious, Inflow Depth = 0.17" for 10-Year event
Inflow = 0.00 cfs @ 13.62 hrs, Volume= 0.001 af
Primary = 0.00 cfs @ 13.62 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

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

Subcatchment3S: POST A.1 Runoff Area=6,000 sf 100.00% Impervious Runoff Depth=5.68"
Tc=6.0 min CN=98 Runoff=0.78 cfs 0.065 af

Subcatchment4S: POST A.2 Runoff Area=10,195 sf 100.00% Impervious Runoff Depth=5.68"
Tc=6.0 min CN=98 Runoff=1.33 cfs 0.111 af

Subcatchment5S: POST A.4 Runoff Area=7,501 sf 21.97% Impervious Runoff Depth=1.25"
Tc=6.0 min CN=52 Runoff=0.21 cfs 0.018 af

Subcatchment8S: POST B.1 Runoff Area=3,596 sf 0.00% Impervious Runoff Depth=0.42"
Tc=6.0 min CN=39 Runoff=0.01 cfs 0.003 af

Subcatchment9S: POST A.3 Runoff Area=79,466 sf 0.00% Impervious Runoff Depth=2.47"
Tc=6.0 min CN=67 Runoff=5.11 cfs 0.375 af

Pond 3P: Detention Pond Peak Elev=218.21' Storage=91 cf Inflow=0.21 cfs 0.018 af
Outflow=0.09 cfs 0.018 af

Pond 5P: Subsurface System #1 Peak Elev=218.72' Storage=2,149 cf Inflow=2.11 cfs 0.176 af
Outflow=0.42 cfs 0.176 af

Pond 6P: CB-1 Peak Elev=219.20' Inflow=1.33 cfs 0.111 af
12.0" Round Culvert n=0.013 L=30.0' S=0.0200 '/' Outflow=1.33 cfs 0.111 af

Pond 7P: DMH-1 Peak Elev=218.37' Inflow=1.33 cfs 0.111 af
12.0" Round Culvert n=0.013 L=6.0' S=0.0200 '/' Outflow=1.33 cfs 0.111 af

Link 1L: DP-A Inflow=5.11 cfs 0.375 af
Primary=5.11 cfs 0.375 af

Link 2L: DP-B Inflow=0.01 cfs 0.003 af
Primary=0.01 cfs 0.003 af

Total Runoff Area = 2.451 ac Runoff Volume = 0.572 af Average Runoff Depth = 2.80"
83.29% Pervious = 2.041 ac 16.71% Impervious = 0.410 ac

Summary for Subcatchment 3S: POST A.1

Runoff = 0.78 cfs @ 12.09 hrs, Volume= 0.065 af, Depth= 5.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.92"

Area (sf)	CN	Description
6,000	98	Roofs, HSG A
6,000		100.00% Impervious Area

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

Summary for Subcatchment 4S: POST A.2

Runoff = 1.33 cfs @ 12.09 hrs, Volume= 0.111 af, Depth= 5.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.92"

Area (sf)	CN	Description
10,195	98	Paved parking, HSG A
10,195		100.00% Impervious Area

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

Summary for Subcatchment 5S: POST A.4

Runoff = 0.21 cfs @ 12.11 hrs, Volume= 0.018 af, Depth= 1.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.92"

	Area (sf)	CN	Description
*	1,648	98	Paved parking, HSG A
	5,853	39	>75% Grass cover, Good, HSG A
	7,501	52	Weighted Average
	5,853		78.03% Pervious Area
	1,648		21.97% Impervious Area

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

Summary for Subcatchment 8S: POST B.1

Runoff = 0.01 cfs @ 12.35 hrs, Volume= 0.003 af, Depth= 0.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.92"

Area (sf)	CN	Description
3,596	39	>75% Grass cover, Good, HSG A
3,596		100.00% Pervious Area

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

Summary for Subcatchment 9S: POST A.3

Runoff = 5.11 cfs @ 12.10 hrs, Volume= 0.375 af, Depth= 2.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=5.92"

Area (sf)	CN	Description
67,202	72	Dirt roads, HSG A
12,264	39	>75% Grass cover, Good, HSG A
79,466	67	Weighted Average
79,466		100.00% Pervious Area

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

Summary for Pond 3P: Detention Pond

Inflow Area = 0.172 ac, 21.97% Impervious, Inflow Depth = 1.25" for 25-Year event
Inflow = 0.21 cfs @ 12.11 hrs, Volume= 0.018 af
Outflow = 0.09 cfs @ 12.44 hrs, Volume= 0.018 af, Atten= 57%, Lag= 19.8 min
Discarded = 0.09 cfs @ 12.44 hrs, Volume= 0.018 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.21' @ 12.44 hrs Surf.Area= 462 sf Storage= 91 cf

Plug-Flow detention time= 5.1 min calculated for 0.018 af (100% of inflow)
Center-of-Mass det. time= 5.1 min (893.3 - 888.2)

Volume	Invert	Avail.Storage	Storage Description
#1	218.00'	553 cf	**Irregular pond (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
218.00	404	82.4	0	0	404
219.00	717	126.5	553	553	1,145

Device	Routing	Invert	Outlet Devices
#1	Discarded	218.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.09 cfs @ 12.44 hrs HW=218.21' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Summary for Pond 5P: Subsurface System #1

Inflow Area = 0.372 ac,100.00% Impervious, Inflow Depth = 5.68" for 25-Year event
Inflow = 2.11 cfs @ 12.09 hrs, Volume= 0.176 af
Outflow = 0.42 cfs @ 12.51 hrs, Volume= 0.176 af, Atten= 80%, Lag= 25.5 min
Discarded = 0.42 cfs @ 12.51 hrs, Volume= 0.176 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.72' @ 12.51 hrs Surf.Area= 1,008 sf Storage= 2,149 cf
Flood Elev= 221.50' Surf.Area= 1,008 sf Storage= 3,600 cf

Plug-Flow detention time= 36.5 min calculated for 0.176 af (100% of inflow)
Center-of-Mass det. time= 36.5 min (781.8 - 745.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	216.33'	0 cf	**24.00'W x 42.00'L x 4.67'H Field A** 4,707 cf Overall - 4,707 cf Embedded = 0 cf x 40.0% Voids
#2A	216.33'	3,600 cf	**Shea Leaching Chamber 8x14x4.7**x 9 Inside #1 Inside= 84.0"W x 48.0"H => 30.77 sf x 13.00'L = 400.0 cf Outside= 96.0"W x 56.0"H => 37.36 sf x 14.00'L = 523.0 cf 9 Chambers in 3 Rows
		3,600 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	216.33'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 214.33'

Discarded OutFlow Max=0.42 cfs @ 12.51 hrs HW=218.72' (Free Discharge)
└─**1=Exfiltration** (Controls 0.42 cfs)

Summary for Pond 6P: CB-1

Inflow Area = 0.234 ac,100.00% Impervious, Inflow Depth = 5.68" for 25-Year event
Inflow = 1.33 cfs @ 12.09 hrs, Volume= 0.111 af
Outflow = 1.33 cfs @ 12.09 hrs, Volume= 0.111 af, Atten= 0%, Lag= 0.0 min
Primary = 1.33 cfs @ 12.09 hrs, Volume= 0.111 af

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

Peak Elev= 219.20' @ 12.09 hrs
Flood Elev= 221.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	218.50'	**12.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 218.50' / 217.90' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.29 cfs @ 12.09 hrs HW=219.19' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.29 cfs @ 2.23 fps)

Summary for Pond 7P: DMH-1

Inflow Area = 0.234 ac,100.00% Impervious, Inflow Depth = 5.68" for 25-Year event
Inflow = 1.33 cfs @ 12.09 hrs, Volume= 0.111 af
Outflow = 1.33 cfs @ 12.09 hrs, Volume= 0.111 af, Atten= 0%, Lag= 0.0 min
Primary = 1.33 cfs @ 12.09 hrs, Volume= 0.111 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.37' @ 12.09 hrs
Flood Elev= 221.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	217.65'	**12.0" Round Culvert** L= 6.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 217.65' / 217.53' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.29 cfs @ 12.09 hrs HW=218.36' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 1.29 cfs @ 3.04 fps)

Summary for Link 1L: DP-A

Inflow Area = 1.824 ac, 0.00% Impervious, Inflow Depth = 2.47" for 25-Year event
Inflow = 5.11 cfs @ 12.10 hrs, Volume= 0.375 af
Primary = 5.11 cfs @ 12.10 hrs, Volume= 0.375 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Link 2L: DP-B

Inflow Area = 0.083 ac, 0.00% Impervious, Inflow Depth = 0.42" for 25-Year event
Inflow = 0.01 cfs @ 12.35 hrs, Volume= 0.003 af
Primary = 0.01 cfs @ 12.35 hrs, Volume= 0.003 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

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

Subcatchment3S: POST A.1	Runoff Area=6,000 sf 100.00% Impervious Runoff Depth=6.47" Tc=6.0 min CN=98 Runoff=0.89 cfs 0.074 af
Subcatchment4S: POST A.2	Runoff Area=10,195 sf 100.00% Impervious Runoff Depth=6.47" Tc=6.0 min CN=98 Runoff=1.50 cfs 0.126 af
Subcatchment5S: POST A.4	Runoff Area=7,501 sf 21.97% Impervious Runoff Depth=1.68" Tc=6.0 min CN=52 Runoff=0.30 cfs 0.024 af
Subcatchment8S: POST B.1	Runoff Area=3,596 sf 0.00% Impervious Runoff Depth=0.67" Tc=6.0 min CN=39 Runoff=0.03 cfs 0.005 af
Subcatchment9S: POST A.3	Runoff Area=79,466 sf 0.00% Impervious Runoff Depth=3.08" Tc=6.0 min CN=67 Runoff=6.42 cfs 0.468 af
Pond 3P: Detention Pond	Peak Elev=218.39' Storage=178 cf Inflow=0.30 cfs 0.024 af Outflow=0.10 cfs 0.024 af
Pond 5P: Subsurface System #1	Peak Elev=219.14' Storage=2,531 cf Inflow=2.39 cfs 0.200 af Outflow=0.46 cfs 0.200 af
Pond 6P: CB-1	Peak Elev=219.26' Inflow=1.50 cfs 0.126 af 12.0" Round Culvert n=0.013 L=30.0' S=0.0200 '/' Outflow=1.50 cfs 0.126 af
Pond 7P: DMH-1	Peak Elev=218.43' Inflow=1.50 cfs 0.126 af 12.0" Round Culvert n=0.013 L=6.0' S=0.0200 '/' Outflow=1.50 cfs 0.126 af
Link 1L: DP-A	Inflow=6.42 cfs 0.468 af Primary=6.42 cfs 0.468 af
Link 2L: DP-B	Inflow=0.03 cfs 0.005 af Primary=0.03 cfs 0.005 af

Total Runoff Area = 2.451 ac Runoff Volume = 0.697 af Average Runoff Depth = 3.41"
83.29% Pervious = 2.041 ac 16.71% Impervious = 0.410 ac

Summary for Subcatchment 3S: POST A.1

Runoff = 0.89 cfs @ 12.09 hrs, Volume= 0.074 af, Depth= 6.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.71"

	Area (sf)	CN	Description
	6,000	98	Roofs, HSG A
	6,000		100.00% Impervious Area

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

Summary for Subcatchment 4S: POST A.2

Runoff = 1.50 cfs @ 12.09 hrs, Volume= 0.126 af, Depth= 6.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.71"

	Area (sf)	CN	Description
	10,195	98	Paved parking, HSG A
	10,195		100.00% Impervious Area

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

Summary for Subcatchment 5S: POST A.4

Runoff = 0.30 cfs @ 12.11 hrs, Volume= 0.024 af, Depth= 1.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.71"

	Area (sf)	CN	Description
*	1,648	98	Paved parking, HSG A
	5,853	39	>75% Grass cover, Good, HSG A
	7,501	52	Weighted Average
	5,853		78.03% Pervious Area
	1,648		21.97% Impervious Area

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

Summary for Subcatchment 8S: POST B.1

Runoff = 0.03 cfs @ 12.25 hrs, Volume= 0.005 af, Depth= 0.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.71"

Area (sf)	CN	Description
3,596	39	>75% Grass cover, Good, HSG A
3,596		100.00% Pervious Area

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

Summary for Subcatchment 9S: POST A.3

Runoff = 6.42 cfs @ 12.10 hrs, Volume= 0.468 af, Depth= 3.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-Year Rainfall=6.71"

Area (sf)	CN	Description
67,202	72	Dirt roads, HSG A
12,264	39	>75% Grass cover, Good, HSG A
79,466	67	Weighted Average
79,466		100.00% Pervious Area

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

Summary for Pond 3P: Detention Pond

Inflow Area = 0.172 ac, 21.97% Impervious, Inflow Depth = 1.68" for 50-Year event
Inflow = 0.30 cfs @ 12.11 hrs, Volume= 0.024 af
Outflow = 0.10 cfs @ 12.49 hrs, Volume= 0.024 af, Atten= 67%, Lag= 23.1 min
Discarded = 0.10 cfs @ 12.49 hrs, Volume= 0.024 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.39' @ 12.49 hrs Surf.Area= 515 sf Storage= 178 cf

Plug-Flow detention time= 10.0 min calculated for 0.024 af (100% of inflow)
Center-of-Mass det. time= 10.0 min (887.8 - 877.8)

Volume	Invert	Avail.Storage	Storage Description
#1	218.00'	553 cf	**Irregular pond (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
218.00	404	82.4	0	0	404
219.00	717	126.5	553	553	1,145

Device	Routing	Invert	Outlet Devices
#1	Discarded	218.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.10 cfs @ 12.49 hrs HW=218.39' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.10 cfs)

Summary for Pond 5P: Subsurface System #1

Inflow Area = 0.372 ac,100.00% Impervious, Inflow Depth = 6.47" for 50-Year event
Inflow = 2.39 cfs @ 12.09 hrs, Volume= 0.200 af
Outflow = 0.46 cfs @ 12.52 hrs, Volume= 0.200 af, Atten= 81%, Lag= 26.0 min
Discarded = 0.46 cfs @ 12.52 hrs, Volume= 0.200 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 219.14' @ 12.52 hrs Surf.Area= 1,008 sf Storage= 2,531 cf
Flood Elev= 221.50' Surf.Area= 1,008 sf Storage= 3,600 cf

Plug-Flow detention time= 40.7 min calculated for 0.200 af (100% of inflow)
Center-of-Mass det. time= 40.7 min (784.2 - 743.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	216.33'	0 cf	**24.00'W x 42.00'L x 4.67'H Field A** 4,707 cf Overall - 4,707 cf Embedded = 0 cf x 40.0% Voids
#2A	216.33'	3,600 cf	**Shea Leaching Chamber 8x14x4.7**x 9 Inside #1 Inside= 84.0"W x 48.0"H => 30.77 sf x 13.00'L = 400.0 cf Outside= 96.0"W x 56.0"H => 37.36 sf x 14.00'L = 523.0 cf 9 Chambers in 3 Rows
		3,600 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	216.33'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 214.33'

Discarded OutFlow Max=0.46 cfs @ 12.52 hrs HW=219.14' (Free Discharge)
└─**1=Exfiltration** (Controls 0.46 cfs)

Summary for Pond 6P: CB-1

Inflow Area = 0.234 ac,100.00% Impervious, Inflow Depth = 6.47" for 50-Year event
Inflow = 1.50 cfs @ 12.09 hrs, Volume= 0.126 af
Outflow = 1.50 cfs @ 12.09 hrs, Volume= 0.126 af, Atten= 0%, Lag= 0.0 min
Primary = 1.50 cfs @ 12.09 hrs, Volume= 0.126 af

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

Peak Elev= 219.26' @ 12.09 hrs
Flood Elev= 221.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	218.50'	**12.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 218.50' / 217.90' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.46 cfs @ 12.09 hrs HW=219.25' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.46 cfs @ 2.32 fps)

Summary for Pond 7P: DMH-1

Inflow Area = 0.234 ac,100.00% Impervious, Inflow Depth = 6.47" for 50-Year event
Inflow = 1.50 cfs @ 12.09 hrs, Volume= 0.126 af
Outflow = 1.50 cfs @ 12.09 hrs, Volume= 0.126 af, Atten= 0%, Lag= 0.0 min
Primary = 1.50 cfs @ 12.09 hrs, Volume= 0.126 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.43' @ 12.09 hrs
Flood Elev= 221.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	217.65'	**12.0" Round Culvert** L= 6.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 217.65' / 217.53' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.46 cfs @ 12.09 hrs HW=218.42' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.46 cfs @ 3.12 fps)

Summary for Link 1L: DP-A

Inflow Area = 1.824 ac, 0.00% Impervious, Inflow Depth = 3.08" for 50-Year event
Inflow = 6.42 cfs @ 12.10 hrs, Volume= 0.468 af
Primary = 6.42 cfs @ 12.10 hrs, Volume= 0.468 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Link 2L: DP-B

Inflow Area = 0.083 ac, 0.00% Impervious, Inflow Depth = 0.67" for 50-Year event
Inflow = 0.03 cfs @ 12.25 hrs, Volume= 0.005 af
Primary = 0.03 cfs @ 12.25 hrs, Volume= 0.005 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

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

Subcatchment3S: POST A.1 Runoff Area=6,000 sf 100.00% Impervious Runoff Depth=7.32"
Tc=6.0 min CN=98 Runoff=1.00 cfs 0.084 af

Subcatchment4S: POST A.2 Runoff Area=10,195 sf 100.00% Impervious Runoff Depth=7.32"
Tc=6.0 min CN=98 Runoff=1.70 cfs 0.143 af

Subcatchment5S: POST A.4 Runoff Area=7,501 sf 21.97% Impervious Runoff Depth=2.18"
Tc=6.0 min CN=52 Runoff=0.40 cfs 0.031 af

Subcatchment8S: POST B.1 Runoff Area=3,596 sf 0.00% Impervious Runoff Depth=0.98"
Tc=6.0 min CN=39 Runoff=0.05 cfs 0.007 af

Subcatchment9S: POST A.3 Runoff Area=79,466 sf 0.00% Impervious Runoff Depth=3.76"
Tc=6.0 min CN=67 Runoff=7.87 cfs 0.571 af

Pond 3P: Detention Pond Peak Elev=218.59' Storage=289 cf Inflow=0.40 cfs 0.031 af
Outflow=0.11 cfs 0.031 af

Pond 5P: Subsurface System #1 Peak Elev=219.61' Storage=2,948 cf Inflow=2.69 cfs 0.227 af
Outflow=0.51 cfs 0.227 af

Pond 6P: CB-1 Peak Elev=219.33' Inflow=1.70 cfs 0.143 af
12.0" Round Culvert n=0.013 L=30.0' S=0.0200 '/' Outflow=1.70 cfs 0.143 af

Pond 7P: DMH-1 Peak Elev=218.50' Inflow=1.70 cfs 0.143 af
12.0" Round Culvert n=0.013 L=6.0' S=0.0200 '/' Outflow=1.70 cfs 0.143 af

Link 1L: DP-A Inflow=7.87 cfs 0.571 af
Primary=7.87 cfs 0.571 af

Link 2L: DP-B Inflow=0.05 cfs 0.007 af
Primary=0.05 cfs 0.007 af

Total Runoff Area = 2.451 ac Runoff Volume = 0.836 af Average Runoff Depth = 4.09"
83.29% Pervious = 2.041 ac 16.71% Impervious = 0.410 ac

Summary for Subcatchment 3S: POST A.1

Runoff = 1.00 cfs @ 12.09 hrs, Volume= 0.084 af, Depth= 7.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.56"

Area (sf)	CN	Description
6,000	98	Roofs, HSG A
6,000		100.00% Impervious Area

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

Summary for Subcatchment 4S: POST A.2

Runoff = 1.70 cfs @ 12.09 hrs, Volume= 0.143 af, Depth= 7.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.56"

Area (sf)	CN	Description
10,195	98	Paved parking, HSG A
10,195		100.00% Impervious Area

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

Summary for Subcatchment 5S: POST A.4

Runoff = 0.40 cfs @ 12.10 hrs, Volume= 0.031 af, Depth= 2.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.56"

	Area (sf)	CN	Description
*	1,648	98	Paved parking, HSG A
	5,853	39	>75% Grass cover, Good, HSG A
	7,501	52	Weighted Average
	5,853		78.03% Pervious Area
	1,648		21.97% Impervious Area

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

Summary for Subcatchment 8S: POST B.1

Runoff = 0.05 cfs @ 12.14 hrs, Volume= 0.007 af, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.56"

Area (sf)	CN	Description
3,596	39	>75% Grass cover, Good, HSG A
3,596		100.00% Pervious Area

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

Summary for Subcatchment 9S: POST A.3

Runoff = 7.87 cfs @ 12.09 hrs, Volume= 0.571 af, Depth= 3.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=7.56"

Area (sf)	CN	Description
67,202	72	Dirt roads, HSG A
12,264	39	>75% Grass cover, Good, HSG A
79,466	67	Weighted Average
79,466		100.00% Pervious Area

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

Summary for Pond 3P: Detention Pond

Inflow Area = 0.172 ac, 21.97% Impervious, Inflow Depth = 2.18" for 100-Year event
Inflow = 0.40 cfs @ 12.10 hrs, Volume= 0.031 af
Outflow = 0.11 cfs @ 12.52 hrs, Volume= 0.031 af, Atten= 72%, Lag= 25.2 min
Discarded = 0.11 cfs @ 12.52 hrs, Volume= 0.031 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.59' @ 12.52 hrs Surf.Area= 578 sf Storage= 289 cf

Plug-Flow detention time= 16.5 min calculated for 0.031 af (100% of inflow)
Center-of-Mass det. time= 16.5 min (885.6 - 869.1)

Volume	Invert	Avail.Storage	Storage Description
#1	218.00'	553 cf	**Irregular pond (Irregular)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
218.00	404	82.4	0	0	404
219.00	717	126.5	553	553	1,145

Device	Routing	Invert	Outlet Devices
#1	Discarded	218.00'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.11 cfs @ 12.52 hrs HW=218.59' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Summary for Pond 5P: Subsurface System #1

Inflow Area = 0.372 ac,100.00% Impervious, Inflow Depth = 7.32" for 100-Year event
Inflow = 2.69 cfs @ 12.09 hrs, Volume= 0.227 af
Outflow = 0.51 cfs @ 12.52 hrs, Volume= 0.227 af, Atten= 81%, Lag= 26.3 min
Discarded = 0.51 cfs @ 12.52 hrs, Volume= 0.227 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 219.61' @ 12.52 hrs Surf.Area= 1,008 sf Storage= 2,948 cf
Flood Elev= 221.50' Surf.Area= 1,008 sf Storage= 3,600 cf

Plug-Flow detention time= 44.8 min calculated for 0.227 af (100% of inflow)
Center-of-Mass det. time= 44.8 min (786.7 - 741.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	216.33'	0 cf	**24.00'W x 42.00'L x 4.67'H Field A** 4,707 cf Overall - 4,707 cf Embedded = 0 cf x 40.0% Voids
#2A	216.33'	3,600 cf	**Shea Leaching Chamber 8x14x4.7**x 9 Inside #1 Inside= 84.0"W x 48.0"H => 30.77 sf x 13.00'L = 400.0 cf Outside= 96.0"W x 56.0"H => 37.36 sf x 14.00'L = 523.0 cf 9 Chambers in 3 Rows
		3,600 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	216.33'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 214.33'

Discarded OutFlow Max=0.51 cfs @ 12.52 hrs HW=219.60' (Free Discharge)
└─**1=Exfiltration** (Controls 0.51 cfs)

Summary for Pond 6P: CB-1

Inflow Area = 0.234 ac,100.00% Impervious, Inflow Depth = 7.32" for 100-Year event
Inflow = 1.70 cfs @ 12.09 hrs, Volume= 0.143 af
Outflow = 1.70 cfs @ 12.09 hrs, Volume= 0.143 af, Atten= 0%, Lag= 0.0 min
Primary = 1.70 cfs @ 12.09 hrs, Volume= 0.143 af

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

Peak Elev= 219.33' @ 12.09 hrs
Flood Elev= 221.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	218.50'	**12.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 218.50' / 217.90' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.65 cfs @ 12.09 hrs HW=219.31' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.65 cfs @ 2.42 fps)

Summary for Pond 7P: DMH-1

Inflow Area = 0.234 ac,100.00% Impervious, Inflow Depth = 7.32" for 100-Year event
Inflow = 1.70 cfs @ 12.09 hrs, Volume= 0.143 af
Outflow = 1.70 cfs @ 12.09 hrs, Volume= 0.143 af, Atten= 0%, Lag= 0.0 min
Primary = 1.70 cfs @ 12.09 hrs, Volume= 0.143 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 218.50' @ 12.09 hrs
Flood Elev= 221.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	217.65'	**12.0" Round Culvert** L= 6.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 217.65' / 217.53' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.65 cfs @ 12.09 hrs HW=218.48' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.65 cfs @ 3.20 fps)

Summary for Link 1L: DP-A

Inflow Area = 1.824 ac, 0.00% Impervious, Inflow Depth = 3.76" for 100-Year event
Inflow = 7.87 cfs @ 12.09 hrs, Volume= 0.571 af
Primary = 7.87 cfs @ 12.09 hrs, Volume= 0.571 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

Summary for Link 2L: DP-B

Inflow Area = 0.083 ac, 0.00% Impervious, Inflow Depth = 0.98" for 100-Year event
Inflow = 0.05 cfs @ 12.14 hrs, Volume= 0.007 af
Primary = 0.05 cfs @ 12.14 hrs, Volume= 0.007 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

APPENDIX F

Recharge Volume / Water Quality Volume / TSS Removal / Mounding Calculations

Subsurface Infiltration System

Stormwater Recharge Calculations

CALCULATIONS

Recharge Volume, Rv:

$R_v = A_C x F$

Hydrologic Soil Group	Impervious Area (Ac) [1]	Target Depth (F)	Recharge Volume (Rv) Ac-feet
A	0.369	0.6	0.018
Total	**0.369**		**0.018**

Total Recharge Volume Required = 0.018 Ac-ft
Total Recharge Volume Required (Rv) = 804 C.ft
Recharge Vol. Provided (from Infil. Structure) = 2,861.0

REFERENCES

Table 2.3.2: Recharge Target Depth by Hydrologic Soil Group

NRCS Hydrologic Soil Group	Approx. Soil Texture	Target Depth Factor (F)
A	sand	0.6 inch
B	loam	0.35 inch
C	silty loam	0.25 inch
D	clay	0.1 inch

Required Sediment Forebay vol, Fv:

$F_v = A_C(cu.ft)x0.1inch$ of impervious area

[1] Imp. area captured by ponds, Ap = 0.369 Ac
Required Sediment Forebay vol, Fv= 134 C.ft

Sediment Volume Provided = 0 **C.ft** **(Pretreatment provided with Stormceptor unit)**

Drawdown Calculations

CALCULATIONS

Proposed Infiltration Area Calculations:

$$Drawdown = \frac{R_V}{(Rawls\ Rate)(Bottom\ Area)}$$

Drawdown Calculations:

Soil Texture: 1 Sand

Bottom Surface Area (A): 1,008 SF
Rawls Rate: 8.27 in/hr
Total Recharge Volume Provided= 2,861 C.ft
Drawdown: 4.12 hr
Drawdown is less than 72 Hours as Required

REFERENCES

Table 2.3.3: 1982 Rawls Rates

Texture Class	NRCS Hydrologic Soil Group	Infiltration Rate
1 Sand	A	8.27 in/hr
2 Loamy Sand	A	2.41 in/hr
3 Sandy Loam	B	1.02 in/hr
4 Loam	B	0.52 in/hr
5 Silt Loam	C	0.27 in/hr
6 Sandy Clay Loam	C	0.17 in/hr
7 Clay Loam	D	0.09 in/hr
8 Silty Clay Loam	D	0.06 in/hr
9 Sandy Clay	D	0.05 in/hr
10 Silty Clay	D	0.04 in/hr
11 Clay	D	0.02 in/hr

NOTES:
Input Values
[1] = Refer to Proposed Conditions HydroCAD modeling report

Adjusted Recharge/WQV Calcs

Stormwater Recharge Calculations

Capture Area Adjustment, Rvadj:

$$R_v adj = \frac{A_t}{A_p} x R_v$$

[1] Imp. area captured by ponds, Ap =	0.369	Ac
[1] Total proposed impervious area on site, A_T =	0.403	Ac
Recharge volume required, Rv =	878	C.ft
Capture Rate=	**92%**	OK
Capture Area Adjustment Factor=	**1.09**	
Adjusted Recharge Volume Required Rvadj =	**959**	**C.ft**
[1] Total Recharge Volume Provided =	2,861.0	**C.ft**

NOTES:

Input Values

[1] = Sum of Recharge Vol. Provided from Infil. Area 1, Infil. Area 2, Infil. Area 3 and Infil. Basin

Water Quality Calculations

CALCULATIONS

Water Quality Calculation:

$$V_{WQ} = D_{WQ}(ft) x\, A_T(ft^2)$$

Water Quality Depth =	1	in
Water Quality Depth , D_{WQ} =	**0.08**	**ft.**
Total impervious area on site, A_T =	0.403	Ac.
A_T =	**17,555**	**ft^2**
Required Water Quality Volume, V_{WQ} =	**1,463**	**C.ft.**

REFERENCES

1 inch depth
Zone II discharges
IWPA discharges
Critical Area
Runoff from LUHPPL
Infiltration rate >2.4 inches/hour
1/2 inch depth
Discharge to other ares
8 inch
9 inch
10 inch
11 inch

Subsurface Infiltration System - 100-yr Storm Event

Stormwater Recharge Calculations

CALCULATIONS

Recharge Volume, Rv:

$R_v = A_C x F$

Hydrologic Soil Group	Impervious Area (Ac) [1]	Target Depth (F)	Recharge Volume (Rv) Ac-feet
A	0.369	0.6	0.018
Total	**0.369**		**0.018**

Total Recharge Volume Required = 0.018 Ac-ft
Total Recharge Volume Required (Rv) = 804 C.ft
Recharge Vol. Provided (from Infil. Structure) = 9,801.0

REFERENCES

Table 2.3.2: Recharge Target Depth by Hydrologic Soil Group

NRCS Hydrologic Soil Group	Approx. Soil Texture	Target Depth Factor (F)
A	sand	0.6 inch
B	loam	0.35 inch
C	silty loam	0.25 inch
D	clay	0.1 inch

Required Sediment Forebay vol, Fv:

$F_v = A_C(cu.ft)x0.1inch$ of impervious area

[1] Imp. area captured by ponds, Ap = 0.369 Ac
Required Sediment Forebay vol, Fv= 134 C.ft

Sediment Volume Provided = 0 C.ft **(Pretreatment provided with Stormceptor unit)**

Drawdown Calculations

CALCULATIONS

Proposed Infiltration Area Calculations:

$$Drawdown = \frac{R_V}{(Rawls\ Rate)(Bottom\ Area)}$$

Drawdown Calculations:

Soil Texture: 1 Sand

Bottom Surface Area (A): 1,008 SF
Rawls Rate: 8.27 in/hr
Total Recharge Volume Provided= 9,801 C.ft
Drawdown: 14.11 hr
Drawdown is less than 72 Hours as Required

REFERENCES

Table 2.3.3: 1982 Rawls Rates

Texture Class	NRCS Hydrologic Soil Group	Infiltration Rate
1 Sand	A	8.27 in/hr
2 Loamy Sand	A	2.41 in/hr
3 Sandy Loam	B	1.02 in/hr
4 Loam	B	0.52 in/hr
5 Silt Loam	C	0.27 in/hr
6 Sandy Clay Loam	C	0.17 in/hr
7 Clay Loam	D	0.09 in/hr
8 Silty Clay Loam	D	0.06 in/hr
9 Sandy Clay	D	0.05 in/hr
10 Silty Clay	D	0.04 in/hr
11 Clay	D	0.02 in/hr

NOTES:

Input Values

[1] = Refer to Proposed Conditions HydroCAD modeling report

Adjusted Recharge/WQV Calcs - 100-yr Storm Event

Stormwater Recharge Calculations

Capture Area Adjustment, Rvadj:

$$R_v adj = \frac{A_t}{A_p} x R_v$$

[1] Imp. area captured by ponds, Ap =	0.369	Ac
[1] Total proposed impervious area on site, AT =	0.403	Ac
Recharge volume required, Rv =	878	C.ft
Capture Rate=	**92%**	OK
Capture Area Adjustment Factor=	**1.09**	
Adjusted Recharge Volume Required Rvadj =	**959**	**C.ft**
[1] Total Recharge Volume Provided =	9,801.0	**C.ft**

NOTES:

Input Values

[1] = Sum of Recharge Vol. Provided from Infil. Area 1, Infil. Area 2, Infil. Area 3 and Infil. Basin

Water Quality Calculations

CALCULATIONS

Water Quality Calculation:

$$V_{WQ} = D_{WQ}(ft) x A_T(ft^2)$$

Water Quality Depth =	1	in
Water Quality Depth , DWQ =	**0.08**	**ft.**
Total impervious area on site, AT =	0.403	Ac.
A_T =	**17,555**	**ft^2**
Required Water Quality Volume, VWQ =	**1,463**	**C.ft.**

REFERENCES

1 inch depth
Zone II discharges
IWPA discharges
Critical Area
Runoff from LUHPPL
Infiltration rate >2.4 inches/hour
1/2 inch depth
Discharge to other ares
8 inch
9 inch
10 inch
11 inch

Detention Pond

Stormwater Recharge Calculations

CALCULATIONS

Recharge Volume, Rv:

$R_v = A_C x F$

Hydrologic Soil Group	Impervious Area (Ac) [1]	Target Depth (F)	Recharge Volume (Rv) Ac-feet
A	0.038	0.6	0.002
Total	**0.038**		**0.002**

Total Recharge Volume Required = 0.002 Ac-ft
Total Recharge Volume Required (Rv) = 83 C.ft
Recharge Vol. Provided (from Infil. Structure) = 553.3

Required Sediment Forebay vol, Fv:

$F_v = A_C(cu.ft)x0.1inch$ of impervious area

[1] Imp. area captured by ponds, Ap = 0.038 Ac
Required Sediment Forebay vol, Fv= 14 C.ft

Sediment Volume Provided = 68.8 **C.ft**

REFERENCES

Table 2.3.2: Recharge Target Depth by Hydrologic Soil Group

NRCS Hydrologic Soil Group	Approx. Soil Texture	Target Depth Factor (F)
A	sand	0.6 inch
B	loam	0.35 inch
C	silty loam	0.25 inch
D	clay	0.1 inch

Drawdown Calculations

CALCULATIONS

Proposed Infiltration Area Calculations:

$$Drawdown = \frac{R_V}{(Rawls\ Rate)(Bottom\ Area)}$$

Drawdown Calculations:

Soil Texture: 1 Sand

Bottom Surface Area (A): 404 SF
Rawls Rate: 8.27 in/hr
Total Recharge Volume Provided= 553 C.ft
Drawdown: 1.99 hr
Drawdown is less than 72 Hours as Required

REFERENCES

Table 2.3.3: 1982 Rawls Rates

Texture Class	NRCS Hydrologic Soil Group	Infiltration Rate
1 Sand	A	8.27 in/hr
2 Loamy Sand	A	2.41 in/hr
3 Sandy Loam	B	1.02 in/hr
4 Loam	B	0.52 in/hr
5 Silt Loam	C	0.27 in/hr
6 Sandy Clay Loam	C	0.17 in/hr
7 Clay Loam	D	0.09 in/hr
8 Silty Clay Loam	D	0.06 in/hr
9 Sandy Clay	D	0.05 in/hr
10 Silty Clay	D	0.04 in/hr
11 Clay	D	0.02 in/hr

NOTES:

Input Values

[1] = Refer to Proposed Conditions HydroCAD modeling report

4 Spectacle Pond Road
Littleton, MA

July 5, 2024
6233

Adjusted Recharge/WQV Calcs

Stormwater Recharge Calculations

Capture Area Adjustment, Rvadj:

$$R_v adj = \frac{A_t}{A_p} x R_v$$

[1] Imp. area captured by ponds, Ap =	0.038	Ac
[1] Total proposed impervious area on site, AT =	0.038	Ac
Recharge volume required, Rv =	83	C.ft
Capture Rate=	**100%**	OK
Capture Area Adjustment Factor=	**1.00**	
Adjusted Recharge Volume Required Rvadj =	**83**	**C.ft**
[1] Total Recharge Volume Provided =	553.3	**C.ft**

NOTES:

Input Values

[1] = Sum of Recharge Vol. Provided from Infil. Area 1, Infil. Area 2, Infil. Area 3 and Infil. Basin

Water Quality Calculations

CALCULATIONS

Water Quality Calculation:

$$V_{WQ} = D_{WQ}(ft) x\ A_T(ft^2)$$

Water Quality Depth =	1	in
Water Quality Depth , DWQ =	**0.08**	**ft.**
Total impervious area on site, AT =	0.038	Ac.
A_T =	**1,655**	ft^2
Required Water Quality Volume, VWQ =	**138**	**C.ft.**

REFERENCES

1 inch depth
Zone II discharges
IWPA discharges
Critical Area
Runoff from LUHPPL
Infiltration rate >2.4 inches/hour
1/2 inch depth
Discharge to other ares
8 inch
9 inch
10 inch
11 inch

DILLIS & ROY CIVIL DESIGN GROUP
CIVIL ENGINEERS LAND SURVEYORS WETLAND CONSULTANTS

1" Calculation Sheet

DDCDG Job # 6233 - 4 Spectacle Pond Rd, Littleton
Calc: CRL
Date: 7/3/2024

This spreadsheet should be used to convert water quality volume to an equivilent water quality peak flow rate as outlined in the new MA DEP guidelines that take effect on October 15, 2013.

Glossary

Water Quality Flow Rate =	WQF
Water Quality Volume =	WQV*
unit peak discharge (csm/in) =	qu**
Impervious Area in watershed (square miles) =	Ai

*WQV is expressed in watershed inches (you must use 1.0-inches in all cases with this method and not 0.5-inches)
** calculate the qu based on the time of concentration (see 1" - qu Table)

Compute Water Quality Flow with the following Equation

WQF = (qu)(A)(WQV)

Input Information (in colored cells only)

Site Plan Callout		Enter qu (from 1" - qu Table)	Enter Impervious Area (SF)	Ai (sq/mi)	WQV		WQF	
Infil. System	=	774	16075	0.000577	1	=	0.45	cfs
Detention Pond	=	774	1648	0.000059	1	=	0.05	cfs
	=			0.000000	1	=	0.00	cfs
	=			0.000000	1	=	0.00	cfs
	=			0.000000	1	=	0.00	cfs
	=			0.000000	1	=	0.00	cfs
	=			0.000000	1	=	0.00	cfs
	=			0.000000	1	=	0.00	cfs
	=			0.000000	1	=	0.00	cfs
	=			0.000000	1	=	0.00	cfs

1" qu Sheet

Sheet 2

	Tc (hours)	qu (csm/in)	
	0.01	835	
	0.03	835	
	0.05	831	
	0.067	814	
5 Minutes	0.083	795	
	0.1	774	<—
	0.116	755	
	0.133	736	
	0.15	717	
10 minutes	0.167	700	
	0.183	685	
	0.2	669	
	0.217	654	
	0.233	641	
15 minutes	0.25	628	
	0.3	593	
	0.333	572	
	0.35	563	
	0.4	536	
	0.416	528	
	0.5	491	
	0.583	460	
	0.6	454	
	0.667	433	
	0.7	424	
	0.8	398	
	0.9	376	
	1	356	
	1.1	339	
	1.2	323	
	1.3	309	
	1.4	296	
	1.5	285	
	1.6	274	
	1.7	264	
	1.8	255	
	1.9	247	
	2	239	
	2.1	232	
	2.2	225	
	2.3	219	
	2.4	213	
	2.5	207	
	2.6	202	

Tc (hours)	qu (csm/in)
2.7	197
2.8	192
2.9	187
3	183
3.1	179
3.2	175
3.3	171
3.4	168
3.5	164
3.6	161
3.7	158
3.8	155
3.9	152
4	149
4.1	146
4.2	144
4.3	141
4.4	139
4.5	137
4.6	134
4.7	132
4.8	130
4.9	128
5	126
5.1	124
5.2	122
5.3	120
5.4	119
5.5	117
5.6	115
5.7	114
5.8	112
5.9	111
6	109
6.1	108
6.2	106
6.3	105
6.4	104
6.5	102
6.6	101
6.7	100
6.8	99
6.9	98
7	96

Tc (hours)	qu (csm/in)
7.1	95
7.2	94
7.3	93
7.4	92
7.5	91
7.6	90
7.7	89
7.8	88
7.9	87
8	86
8.1	85
8.2	84
8.3	84
8.4	83
8.5	82
8.6	81
8.7	80
8.8	79
8.9	79
9	78
9.1	77
9.2	76
9.3	76
9.4	75
9.5	74
9.6	74
9.7	73
9.8	72
9.9	72
10	71

*Table of qu values for Ia/P Curve =0.034, listed by Tc, for Type III Storm Distribution
http://www.mass.gov/eea/docs/dep/water/resources/07v5/13wqvwqf.pdf

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: 4 Spectacle Pond Road - Littleton, MA - Pre-treatment Worksheet

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)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Proprietary Treatment Practice	**0.89**	**0.75**	**0.67**	**0.08**
	0.00	**0.08**	**0.00**	**0.08**
	0.00	**0.08**	**0.00**	**0.08**
	0.00	**0.08**	**0.00**	**0.08**

Total TSS Removal = 92%

Project: **Brite Excavating**
Prepared By: **RWP**
Date: **11-Mar-24**

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

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: 4 Spectacle Pond Road - Littleton, MA - Post-Treatement Worksheet

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)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Proprietary Treatment Practice	**0.89**	**0.75**	**0.67**	**0.08**
Subsurface Infiltration Structure	**0.80**	**0.08**	**0.07**	**0.02**
	0.00	**0.02**	**0.00**	**0.02**
	0.00	**0.02**	**0.00**	**0.02**

Total TSS Removal = **98%**

Project: **Brite Excavating**
Prepared By: **RWP**
Date: **11-Mar-24**

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

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: 4 Spectacle Pond Road - Littleton, MA - Detention pond worksheet

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)
Grass Channel	**0.50**	**1.00**	**0.50**	**0.50**
Sediment Forebay	**0.25**	**0.50**	**0.13**	**0.38**
	0.00	**0.38**	**0.00**	**0.38**
	0.00	**0.38**	**0.00**	**0.38**
	0.00	**0.38**	**0.00**	**0.38**

Total TSS Removal = 63%

Project: **Brite Excavating**
Prepared By: **CRL**
Date: **3-Jul-24**

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

MOUNDSOLV
GROUNDWATER MOUNDING ANALYSIS FOR A SLOPING WATER-TABLE AQUIFER
ZLOTNIK ET AL. (2017) SOLUTION

Solution Method

Zlotnik et al. (2017) transient solution for a rectangular source (linearization method 1)

Site Description

Aquifer Data

Property	Value
Horizontal hydraulic conductivity, *K* (ft/d)	20.4
Specific yield, *Sy*	0.25
Initial saturated thickness, h_0 (ft)	10
Maximum allowable water-table rise, *σ* (ft)	5
Dip, *i* (ft/ft)	0
Slope rotation from x axis, *γ* (°)	0

Recharge Sources

Property	Source 1
X coordinate at center, *X* (ft)	0
Y coordinate at center, *Y* (ft)	0
Dimension along x* axis, *L* (ft)	24
Dimension along y* axis, *W* (ft)	42
Rotation from slope direction, *ϕ* (°)	0
Recharge rate, *Q* (ft^3/d)	8336.16
Infiltration rate, *q* (ft/d)	8.27
Recharge duration, t_0 (d)	1.01

Monitoring Points

Elapsed Time, t = 3 d

Name	x (ft)	y (ft)	s (ft)	h (ft)	z (ft)
Source 1	0	0	1.303	11.3	0

APPENDIX G

Operation and Maintenance Plan

STORMWATER OPERATION & MAINTENANCE MANUAL

FOR

BRITE EXCAVATING

4 SPECTACLE POND ROAD

IN

LITTLETON,
MASSACHUSETTS

PREPARED BY: DILLIS & ROY
CIVIL DESIGN GROUP, INC.
1 Main Street, Suite #1
Lunenburg, MA 01462

PREPARED FOR: BRITE EXCAVATING
4 SPECTACLE POND ROAD
LITTLETON, MASSACHUSETTS

MARCH 11TH, 2024
REVISED JULY 16TH, 2024

CDG PROJECT #6233

DILLIS & ROY
CIVIL DESIGN GROUP
CIVIL ENGINEERS LAND SURVEYORS WETLAND CONSULTANTS

TABLE OF CONTENTS:

1.0 Project Narrative

1.1 Proposed Stormwater Management System

Runoff from the proposed development will be conveyed and treated through a combination of Best Management Practices (BMP's). The following is a brief discussion of each conveyance and treatment BMP proposed.

Subsurface Infiltration System

A subsurface infiltration system is proposed to capture runoff associated with proposed pavement and roof areas. The stormwater management area has been designed to accommodate the runoff associated with the 2-, 10-, 25-, 50-, & 100-year storm event, with no flooding during the 100-year storm event. Pretreatment is provided using a deep-sump hooded catch basin and Stormceptor treatment unit. Stormwater will be routed into the subsurface system through a deep sump hooded catch basin and into a drain manhole with a Stormceptor treatment unit installed within before discharging into the subsurface infiltration system. The catch basin & Stormceptor unit will increase the settlement of heavy solids before emptying into the infiltration basin.

Stormceptor (Model STC 450i)

A Stormceptor treatment unit is proposed upstream of the subsurface infiltration system to provide pretreatment of stormwater runoff. Runoff captured from the proposed catch basin will route stormwater runoff through the treatment unit via a pipe culvert before ultimately discharging to the subsurface system.

Swale and Detention Pond

A swale and detention pond is proposed adjacent to the proposed access driveway to capture and provide infiltration of stormwater associated with the access driveway. The swale will have approximately 130 sq. ft. of riprap installed to a depth of 6" at its start near the driveway and shall lead toward a sedimentation forebay before entering the detention pond on the left side of the site. The pond itself will be approximately 1000 sq. ft. in size and shall have a maximum depth of about 1.5 feet giving it a capacity of about 1,500 cu. ft.

1.2 Operation & Maintenance Tasks

The following activities shall be performed routinely to allow for proper functioning of the stormwater system. The following are guidelines referring to each major component of the stormwater management system.

1.2.1 *Street Sweeping*

Street sweeping shall be performed at least twice a year; once in fall, and once in spring, and as required. For most effective results, sweeping shall be performed by a vacuum-style truck in the early spring before spring rain events can wash silt and sediment from snow removal activities into the stormwater system, and in mid-late fall so that organic debris can be intercepted prior to clogging the infiltration system. Silt and sediment shall be disposed of in accordance with local, state, and federal guidelines for hazardous waste.

1.2.2 *Storm Drain lines*

Storm drain inlets and outlets shall be inspected incidentally with all structure inspections. Evidence of debris intrusion or excessive siltation or sedimentation could result in the need to clean a storm drain line. Flushing or jetting shall be performed as required. All flushing and jetting shall be performed in the direction away from any outlet devices. A vacuum truck shall be used at the opposite end of the flushing or jetting to remove any silt or sediment that is cleaned from the storm drain.

1.2.3 *Deep Sump Catch Basin*

Deep sump catch basins shall be inspected at least semi-annually for signs of wear, settling, cracking, or other fatigue. Catch basin castings shall be inspected for signs of root intrusion or significant water infiltration. Catch basin sumps shall be checked for silt/sediment buildup and cleaned as necessary. Cleaning shall be performed by a vacuum truck. Catch basins shall be resealed as required and outlets shall be inspected incidentally with all structure inspections.

1.2.4 *Subsurface Infiltration System (Leaching Galleys)*

The subsurface infiltration system shall be monitored and maintained regularly to ensure no obstructions in the systems are present. Any depressions in the area could indicate that the system has collapsed and shall be inspected immediately. The system is equipped with multiple inspection ports to monitor the buildup of sedimentation. If the depth of sedimentation is in excess of the manufacturer's guidelines, the system will need to be cleaned out with high pressure water. The high-pressure water shall be used on one end, a vacuum truck will be used on the opposite end to remove any silt or sediment that is cleaned from the chambers. Other maintenance will include checking the inlets for debris, survey the surrounding area for depressions and confirm no unauthorized modifications have been performed to the system.

1.2.5 Stormceptor Treatment Unit

The proposed Stormceptor treatment unit shall be inspected at least semi-annually for signs of wear, settling, cracking, or other fatigue. The treatment unit should be monitored for the accumulation of sediment and oil, both of which can be easily measured through the access manhole. When the sediment depth reaches 8-inches, it shall be removed via vacuum truck. Accumulated oil shall be removed with a portable pump and contained in a secondary containment tank.

1.2.6 Swale and Detention Pond

The grass channel swale and detention pond shall be inspected after every major storm for the first three months following construction and then periodically for signs of sediment build up and to ensure stabilization. The detention pond shall be reconstructed, or the grass channel swale regraded and reseeded, if either is not stabilized following major storms after the first three months. Organic materials (sticks, leaves, etc.) found in the riprap shall be removed immediately. If the riprap or forebay are clogged with debris, sediment, or organic matter, the stone shall be replaced as necessary.

1.2.7 Snow Storage

Snow shall be cleared from traveled ways and stockpiled in the locations indicated on the Site Plans. Snow stockpiles shall be stored outside the wetland buffer zone to the maximum extent practicable. Additionally, the berm around the parking area shall be regularly inspected following snow events to ensure that is in good condition and shall be repaired or replaced if damage occurs due to plowing of snow.

O&M Schedule

O&M Task		**Monthly**	**Quarterly**	**Spring**	**Fall**	**2-years**	**As required**
1.	**Street Sweeping**			x	x		x
2.	**Subsurface Infiltration System**						
	Inspection			x	x		
	Remove Sediment					x	x
	Inspect interior inlet pipes					x	
	Remove Debris						x
3.	**Catch Basins**						
	Inspect Rims			x	x		
	Inspect inside/inlet and outlet pipes					x	
	Remove sediment					x	x
4.	**Drain Manholes**						
	Inspect rims			x	x		
	Inspect inside/inlet and outlet pipes					x	
	Remove sediment					x	x
5.	**Storm Drain Lines**						
	Inspection			x			x
	Clean						x
6.	**Stormceptor Treatment Unit**						
	Inspection			x		x	
	Inspect inside/inlet and outlet pipes					x	x
	Remove sediment & oil						x
7.	**Swale and Detention Pond**						
	Inspection			x	x		
	Remove Sediment						x
	Replace Stone						x
7.	**Snow Removal**						
	Snow Plowing						x
	Berm Inspection			x			x

APPENDIX A

Stormceptor STC Maintenance & Operation Guide

CONTECH®
ENGINEERED SOLUTIONS

Stormceptor® STC
Operation and Maintenance Guide

Stormceptor® STC

Stormceptor Design Notes

- Only the STC 450i is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 450i to STC 7200 may accommodate multiple inlet pipes.

Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences			
Inlet Pipe Configuration	STC 450i	STC 900 to STC 7200	STC 11000 to STC 16000
Single inlet pipe	3 in. (75 mm)	1 in. (25 mm)	3 in. (75 mm)
Multiple inlet pipes	3 in. (75 mm)	3 in. (75 mm)	Only one inlet pipe.

Maximum inlet and outlet pipe diameters:

Inlet/Outlet Configuration	Inlet Unit STC 450i	In-Line Unit STC 900 to STC 7200	Series* STC 11000 to STC 16000
Straight Through	24 inch (600 mm)	42 inch (1050 mm)	60 inch (1500 mm)
Bend (90 degrees)	18 inch (450 mm)	33 inch (825 mm)	33 inch (825 mm)

- The inlet and in-line Stormceptor units can accommodate turns to a maximum of 90 degrees.
- Minimum distance from top of grade to crown is 2 feet (0.6 m)
- Submerged conditions. A unit is submerged when the standing water elevation at the proposed location of the Stormceptor unit is greater than the outlet invert elevation during zero flow conditions. In these cases, please contact your local Stormceptor representative and provide the following information:
- Top of grade elevation
- Stormceptor inlet and outlet pipe diameters and invert elevations
- Standing water elevation
- Stormceptor head loss, K = 1.3 (for submerged condition, K = 4)

Stormceptor® STC

OPERATION AND MAINTENANCE GUIDE
Table of Content

1. About Stormceptor

The Stormceptor® STC (Standard Treatment Cell) was developed by Imbrium™ Systems to address the growing need to remove and isolate pollution from the storm drain system before it enters the environment. The Stormceptor STC targets hydrocarbons and total suspended solids (TSS) in stormwater runoff. It improves water quality by removing contaminants through the gravitational settling of fine sediments and floatation of hydrocarbons while preventing the re-suspension or scour of previously captured pollutants.

The development of the Stormceptor STC revolutionized stormwater treatment, and created an entirely new category of environmental technology. Protecting thousands of waterways around the world, the Stormceptor System has set the standard for effective stormwater treatment.

1.1. Patent Information

The Stormceptor technology is protected by the following patents:

- Australia Patent No. 693,164 • 693,164 • 707,133 • 729,096 • 779401
- Austrian Patent No. 289647
- Canadian Patent No 2,009,208 •2,137,942 • 2,175,277 • 2,180,305 • 2,180,383 • 2,206,338 • 2,327,768 (Pending)
- China Patent No 1168439
- Denmark DK 711879
- German DE 69534021
- Indonesian Patent No 16688
- Japan Patent No 9-11476 (Pending)
- Korea 10-2000-0026101 (Pending)
- Malaysia Patent No PI9701737 (Pending)
- New Zealand Patent No 314646
- United States Patent No 4,985,148 • 5,498,331 • 5,725,760 • 5,753,115 • 5,849,181 • 6,068,765 • 6,371,690
- Stormceptor OSR Patent Pending • Stormceptor LCS Patent Pending

2. Stormceptor Design Overview

2.1. Design Philosophy

The patented Stormceptor System has been designed to focus on the environmental objective of providing long-term pollution control. The unique and innovative Stormceptor design allows for continuous positive treatment of runoff during all rainfall events, while ensuring that all captured pollutants are retained within the system, even during intense storm events.

An integral part of the Stormceptor design is PCSWMM for Stormceptor - sizing software developed in conjunction with Computational Hydraulics Inc. (CHI) and internationally acclaimed expert, Dr. Bill James. Using local historical rainfall data and continuous simulation modeling, this software allows a Stormceptor unit to be designed for each individual site and the corresponding water quality objectives.

By using PCSWMM for Stormceptor, the Stormceptor System can be designed to remove a wide range of particles (typically from 20 to 2,000 microns), and can also be customized to remove a specific particle size distribution (PSD). The specified PSD should accurately reflect what is in the stormwater runoff to ensure the device is achieving the desired water quality objective. Since stormwater runoff contains small particles (less than 75 microns), it is important to design a treatment system to remove smaller particles in addition to coarse particles.

2.2. Benefits

The Stormceptor System removes free oil and suspended solids from stormwater, preventing spills and non-point source pollution from entering downstream lakes and rivers. The key benefits, capabilities and applications of the Stormceptor System are as follows:

- Provides continuous positive treatment during all rainfall events
- Can be designed to remove over 80% of the annual sediment load
- Removes a wide range of particles
- Can be designed to remove a specific particle size distribution (PSD)
- Captures free oil from stormwater
- Prevents scouring or re-suspension of trapped pollutants
- Pre-treatment to reduce maintenance costs for downstream treatment measures (ponds, swales, detention basins, filters)
- Groundwater recharge protection
- Spills capture and mitigation
- Simple to design and specify
- Designed to your local watershed conditions
- Small footprint to allow for easy retrofit installations
- Easy to maintain (vacuum truck)
- Multiple inlets can connect to a single unit
- Suitable as a bend structure
- Pre-engineered for traffic loading (minimum AASHTO HS-20)
- Minimal elevation drop between inlet and outlet pipes
- Small head loss
- Additional protection provided by an 18" (457 mm) fiberglass skirt below the top of the insert, for the containment of hydrocarbons in the event of a spill.

2.3. Environmental Benefit

Freshwater resources are vital to the health and welfare of their surrounding communities. There is increasing public awareness, government regulations and corporate commitment to reducing the pollution entering our waterways. A major source of this pollution originates from stormwater runoff from urban areas. Rainfall runoff carries oils, sediment and other contaminants from roads and parking lots discharging directly into our streams, lakes and coastal waterways.

The Stormceptor System is designed to isolate contaminants from getting into the natural environment. The Stormceptor technology provides protection for the environment from spills that occur at service stations and vehicle accident sites, while also removing contaminated sediment in runoff that washes from roads and parking lots.

3. Key Operation Features

3.1. Scour Prevention

A key feature of the Stormceptor System is its patented scour prevention technology. This innovation ensures pollutants are captured and retained during all rainfall events, even extreme storms. The Stormceptor System provides continuous positive treatment for all rainfall events, including intense storms. Stormceptor slows incoming runoff, controlling and reducing velocities in the lower chamber to create a non-turbulent environment that promotes free oils and floatable debris to rise and sediment to settle.

The patented scour prevention technology, the fiberglass insert, regulates flows into the lower chamber through a combination of a weir and orifice while diverting high energy flows away through the upper chamber to prevent scouring. Laboratory testing demonstrated no scouring when tested up to 125% of the unit's operating rate, with the unit loaded to 100% sediment capacity (NJDEP, 2005). Second, the depth of the lower chamber ensures the sediment storage zone is adequately separated from the path of flow in the lower chamber to prevent scouring.

3.2. Operational Hydraulic Loading Rate

Designers and regulators need to evaluate the treatment capacity and performance of manufactured stormwater treatment systems. A commonly used parameter is the "operational hydraulic loading rate" which originated as a design methodology for wastewater treatment devices.

Operational hydraulic loading rate may be calculated by dividing the flow rate into a device by its settling area. This represents the critical settling velocity that is the prime determinant to quantify the influent particle size and density captured by the device. PCSWMM for Stormceptor uses a similar parameter that is calculated by dividing the hydraulic detention time in the device by the fall distance of the sediment.

$$v_{SC} = \frac{H}{6_H} = \frac{Q}{A_S}$$

Where:

v_{SC} = critical settling velocity, ft/s (m/s)

H = tank depth, ft (m)

$Ø_H$ = hydraulic detention time, ft/s (m/s)

Q = volumetric flow rate, ft3/s (m3/s)

A_S = surface area, ft^2 (m^2)

(Tchobanoglous, G. and Schroeder, E.D. 1987. Water Quality. Addison Wesley.)

Unlike designing typical wastewater devices, stormwater systems are designed for highly variable flow rates including intense peak flows. PCSWMM for Stormceptor incorporates all of the flows into its calculations, ensuring that the operational hydraulic loading rate is considered not only for one flow rate, but for all flows including extreme events.

3.3. Double Wall Containment

The Stormceptor System was conceived as a pollution identifier to assist with identifying illicit discharges. The fiberglass insert has a continuous skirt that lines the concrete barrel wall for a depth of 18 inches (457 mm) that provides double wall containment for hydrocarbons storage. This protective barrier ensures that toxic floatables do not migrate through the concrete wall into the surrounding soils.

4. Stormceptor Product Line

4.1. Stormceptor Models

A summary of Stormceptor models and capacities are listed in Table 1.

Table 1. Stormceptor Models

Stormceptor Model	Total Storage Volume U.S. Gal (L)	Hydrocarbon Storage Capacity U.S. Gal (L)	Maximum Sediment Capacity ft^3 (L)
STC 450i	470 (1,780)	86 (330)	46 (1,302)
STC 900	952 (3,600)	251 (950)	89 (2,520)
STC 1200	1,234 (4,670)	251 (950)	127 (3,596)
STC 1800	1,833 (6,940)	251 (950)	207 (5,861)
STC 2400	2,462 (9,320)	840 (3,180)	205 (5,805)
STC 3600	3,715 (1,406)	840 (3,180)	373 (10,562)
STC 4800	5,059 (1,950)	909 (3,440)	543 (15,376)
STC 6000	6,136 (23,230)	909 (3,440)	687 (19,453)
STC 7200	7,420 (28,090)	1,059 (4,010)	839 (23,757)
STC 11000	11,194 (42,370)	2,797 (10, 590)	1,086 (30,752)
STC 13000	13,348 (50,530)	2,797 (10, 590)	1,374 (38,907)
STC 16000	15,918 (60,260)	3,055 (11, 560)	1,677 (47,487)

NOTE: Storage volumes may vary slightly from region to region. For detailed information, contact your local Stormceptor representative.

4.2. Inline Stormceptor

The Inline Stormceptor, Figure 1, is the standard design for most stormwater treatment applications. The patented Stormceptor design allows the Inline unit to maintain continuous positive treatment of total suspended solids (TSS) year-round, regardless of flow rate. The Inline Stormceptor is composed of a precast concrete tank with a fiberglass insert situated at the invert of the storm sewer pipe, creating an upper chamber above the insert and a lower chamber below the insert.

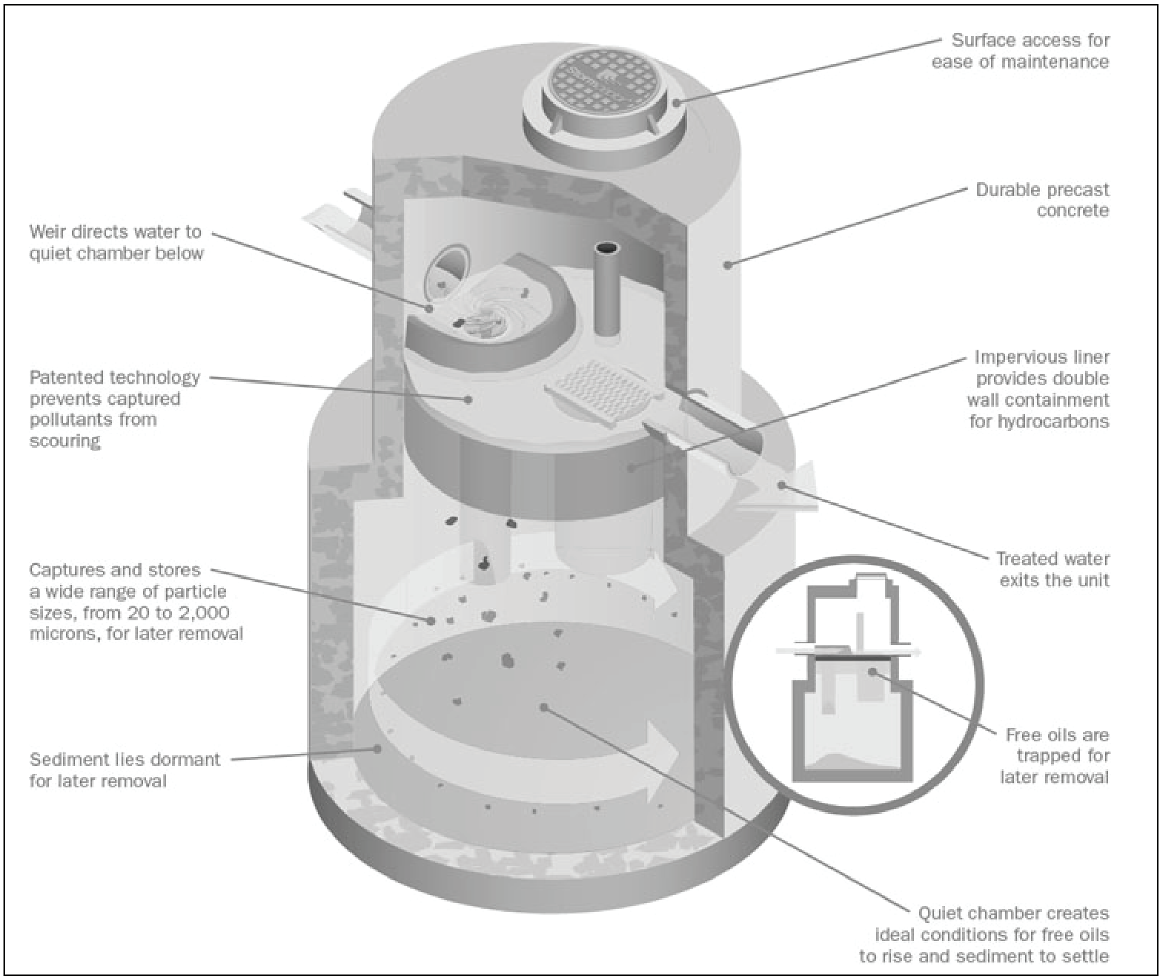


Figure 1. Inline Stormceptor

Operation

As water flows into the Stormceptor unit, it is slowed and directed to the lower chamber by a weir and drop tee. The stormwater enters the lower chamber, a non-turbulent environment, allowing free oils to rise and sediment to settle. The oil is captured underneath the fiberglass insert and shielded from exposure to the concrete walls by a fiberglass skirt. After the pollutants separate, treated water continues up a riser pipe, and exits the lower chamber on the downstream side of the weir before leaving the unit. During high flow events, the Stormceptor System's patented scour prevention technology ensures continuous pollutant removal and prevents re-suspension of previously captured pollutants.

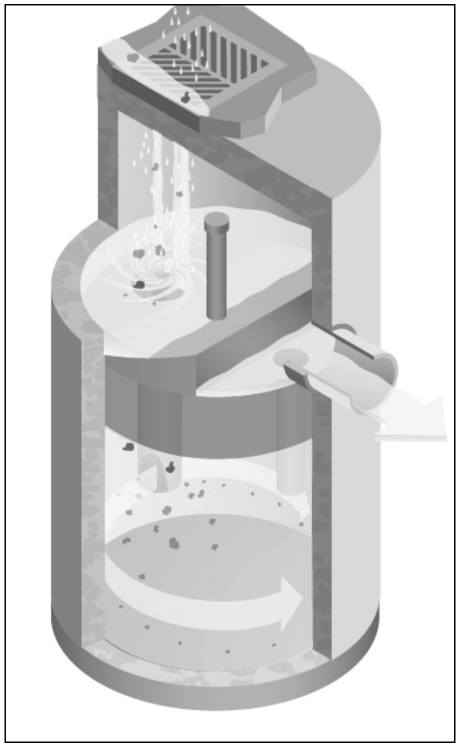


Figure 2. Inlet Stormceptor

4.3. Inlet Stormceptor

The Inlet Stormceptor System, Figure 2, was designed to provide protection for parking lots, loading bays, gas stations and other spill-prone areas. The Inlet Stormceptor is designed to remove sediment from stormwater introduced through a grated inlet, a storm sewer pipe, or both.

The Inlet Stormceptor design operates in the same manner as the Inline unit, providing continuous positive treatment, and ensuring that captured material is not re-suspended.

4.4. Series Stormceptor

Designed to treat larger drainage areas, the Series Stormceptor System, Figure 3, consists of two adjacent Stormceptor models that function in parallel. This design eliminates the need for additional structures and piping to reduce installation costs.

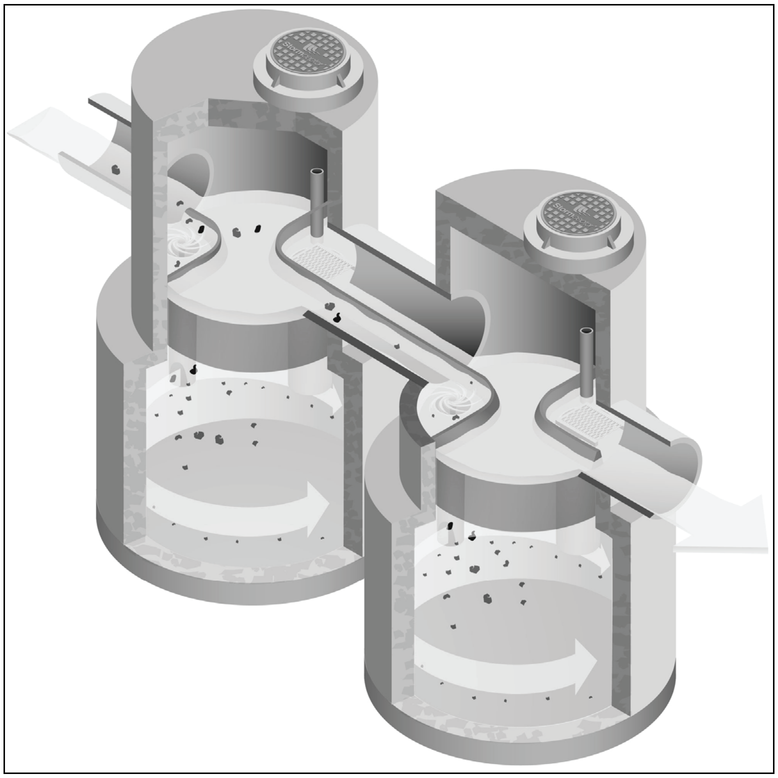


Figure 3. Series System

The Series Stormceptor design operates in the same manner as the Inline unit, providing continuous positive treatment, and ensuring that captured material is not re-suspended.

5. Sizing the Stormceptor System

The Stormceptor System is a versatile product that can be used for many different aspects of water quality improvement. While addressing these needs, there are conditions that the designer needs to be aware of in order to size the Stormceptor model to meet the demands of each individual site in an efficient and cost-effective manner.

PCSWMM for Stormceptor is the support tool used for identifying the appropriate Stormceptor model. In order to size a unit, it is recommended the user follow the seven design steps in the program. The steps are as follows:

STEP 1 – Project Details

The first step prior to sizing the Stormceptor System is to clearly identify the water quality objective for the development. It is recommended that a level of annual sediment (TSS) removal be identified and defined by a particle size distribution.

STEP 2 – Site Details

Identify the site development by the drainage area and the level of imperviousness. It is recommended that imperviousness be calculated based on the actual area of imperviousness based on paved surfaces, sidewalks and rooftops.

STEP 3 – Upstream Attenuation

The Stormceptor System is designed as a water quality device and is sometimes used in conjunction with onsite water quantity control devices such as ponds or underground detention systems. When possible, a greater benefit is typically achieved when installing a Stormceptor unit upstream of a detention facility. By placing the Stormceptor unit upstream of a detention structure, a benefit of less maintenance of the detention facility is realized.

STEP 4 – Particle Size Distribution

It is critical that the PSD be defined as part of the water quality objective. PSD is critical for the design of treatment system for a unit process of gravity settling and governs the size of a treatment system. A range of particle sizes has been provided and it is recommended that clays and silt-sized particles be considered in addition to sand and gravel-sized particles. Options and sample PSDs are provided in PCSWMM for Stormceptor. The default particle size distribution is the Fine Distribution, Table 2, option.

Table 2. Fine Distribution

Particle Size	Distribution	Specific Gravity
20	20%	1.3
60	20%	1.8
150	20%	2.2
400	20%	2.65
2000	20%	2.65

If the objective is the long-term removal of 80% of the total suspended solids on a given site, the PSD should be representative of the expected sediment on the site. For example, a system designed to remove 80% of coarse particles (greater than 75 microns) would provide relatively poor removal efficiency of finer particles that may be naturally prevalent in runoff from the site.

Since the small particle fraction contributes a disproportionately large amount of the total available particle surface area for pollutant adsorption, a system designed primarily for coarse particle capture will compromise water quality objectives.

STEP 5 – Rainfall Records

Local historical rainfall has been acquired from the U.S. National Oceanic and Atmospheric Administration, Environment Canada and regulatory agencies across North America. The rainfall data provided with PCSMM for Stormceptor provides an accurate estimation of small storm hydrology by modeling actual historical storm events including duration, intensities and peaks.

STEP 6 – Summary

At this point, the program may be executed to predict the level of TSS removal from the site. Once the simulation has completed, a table shall be generated identifying the TSS removal of each Stormceptor unit.

STEP 7 – Sizing Summary

Performance estimates of all Stormceptor units for the given site parameters will be displayed in a tabular format. The unit that meets the water quality objective, identified in Step 1, will be highlighted.

5.1. PCSWMM for Stormceptor

The Stormceptor System has been developed in conjunction with PCSWMM for Stormceptor as a technological solution to achieve water quality goals. Together, these two innovations model, simulate, predict and calculate the water quality objectives desired by a design engineer for TSS removal.

PCSWMM for Stormceptor is a proprietary sizing program which uses site specific inputs to a computer model to simulate sediment accumulation, hydrology and long-term total suspended solids removal. The model has been calibrated to field monitoring results from Stormceptor units that have been monitored in North America. The sizing methodology can be described by three processes:

1. Determination of real time hydrology
2. Buildup and wash off of TSS from impervious land areas
3. TSS transport through the Stormceptor (settling and discharge). The use of a calibrated model is the preferred method for sizing stormwater quality structures for the following reasons:
   » The hydrology of the local area is properly and accurately incorporated in the sizing (distribution of flows, flow rate ranges and peaks, back-to-back storms, inter-event times)
   » The distribution of TSS with the hydrology is properly and accurately considered in the sizing
   » Particle size distribution is properly considered in the sizing
   » The sizing can be optimized for TSS removal
   » The cost benefit of alternate TSS removal criteria can be easily assessed
   » The program assesses the performance of all Stormceptor models. Sizing may be selected based on a specific water quality outcome or based on the Maximum Extent Practicable

For more information regarding PCSWMM for Stormceptor, contact your local Stormceptor representative, or visit www.imbriumsystems.com to download a free copy of the program.

5.2. Sediment Loading Characteristics

The way in which sediment is transferred to stormwater can have a considerable effect on which type of system is implemented. On typical impervious surfaces (e.g. parking lots) sediment will build over time and wash off with the next rainfall. When rainfall patterns are examined, a short intense storm will have a higher concentration of sediment than a long slow drizzle. Together with rainfall data representing the site's typical rainfall patterns, sediment loading characteristics play a part in the correct sizing of a stormwater quality device.

Typical Sites

For standard site design of the Stormceptor System, PCSWMM for Stormceptor is utilized to accurately assess the unit's performance. As an integral part of the product's design, the program can be used to meet local requirements for total suspended solid removal. Typical installations of manufactured stormwater treatment devices would occur on areas such as paved parking lots or paved roads. These are considered "stable" surfaces which have non – erodible surfaces.

Unstable Sites

While standard sites consist of stable concrete or asphalt surfaces, sites such as gravel parking lots, or maintenance yards with stockpiles of sediment would be classified as "unstable". These types of sites do not exhibit first flush characteristics, are highly erodible and exhibit atypical sediment loading characteristics and must therefore be sized more carefully. Contact your local Stormceptor representative for assistance in selecting a proper unit sized for such unstable sites.

6. Spill Controls

When considering the removal of total petroleum hydrocarbons (TPH) from a storm sewer system there are two functions of the system: oil removal, and spill capture.

'Oil Removal' describes the capture of the minute volumes of free oil mobilized from impervious surfaces. In this instance relatively low concentrations, volumes and flow rates are considered. While the Stormceptor unit will still provide an appreciable oil removal function during higher flow events and/or with higher TPH concentrations, desired effluent limits may be exceeded under these conditions.

‘Spill Capture’ describes a manner of TPH removal more appropriate to recovery of a relatively high volume of a single phase deleterious liquid that is introduced to the storm sewer system over a relatively short duration. The two design criteria involved when considering this manner of introduction are overall volume and the specific gravity of the material. A standard Stormceptor unit will be able to capture and retain a maximum spill volume and a minimum specific gravity.

For spill characteristics that fall outside these limits, unit modifications are required. Contact your local Stormceptor Representative for more information.

One of the key features of the Stormceptor technology is its ability to capture and retain spills. While the standard Stormceptor System provides excellent protection for spill control, there are additional options to enhance spill protection if desired.

6.1. Oil Level Alarm

The oil level alarm is an electronic monitoring system designed to trigger a visual and audible alarm when a pre-set level of oil is reached within the lower chamber. As a standard, the oil

level alarm is designed to trigger at approximately 85% of the unit’s available depth level for oil capture. The feature acts as a safeguard against spills caused by exceeding the oil storage capacity of the separator and eliminates the need for manual oil level inspection.

The oil level alarm installed on the Stormceptor insert is illustrated in Figure 4.

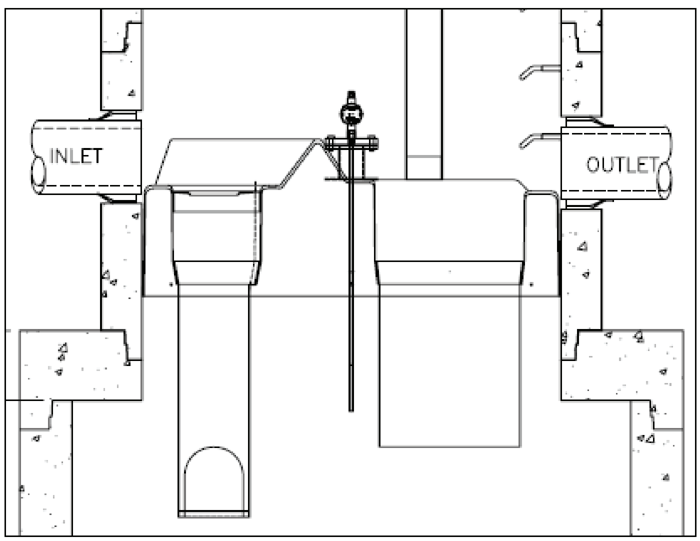


Figure 4. Oil level alarm

6.2. Increased Volume Storage Capacity

The Stormceptor unit may be modified to store a greater spill volume than is typically available. Under such a scenario, instead of installing a larger than required unit, modifications can be made to the recommended Stormceptor model to accommodate larger volumes. Contact your local Stormceptor representative for additional information and assistance for modifications.

7. Stormceptor Options

The Stormceptor System allows flexibility to incorporate to existing and new storm drainage infrastructure. The following section identifies considerations that should be reviewed when installing the system into a drainage network. For conditions that fall outside of the recommendations in this section, please contact your local Stormceptor representative for further guidance.

7.1. Installation Depth Minimum Cover

The minimum distance from the top of grade to the crown of the inlet pipe is 24 inches (600 mm). For situations that have a lower minimum distance, contact your local Stormceptor representative.

7.2. Maximum Inlet and Outlet Pipe Diameters

Maximum inlet and outlet pipe diameters are illustrated in Figure 5. Contact your local Stormceptor representative for larger pipe diameters

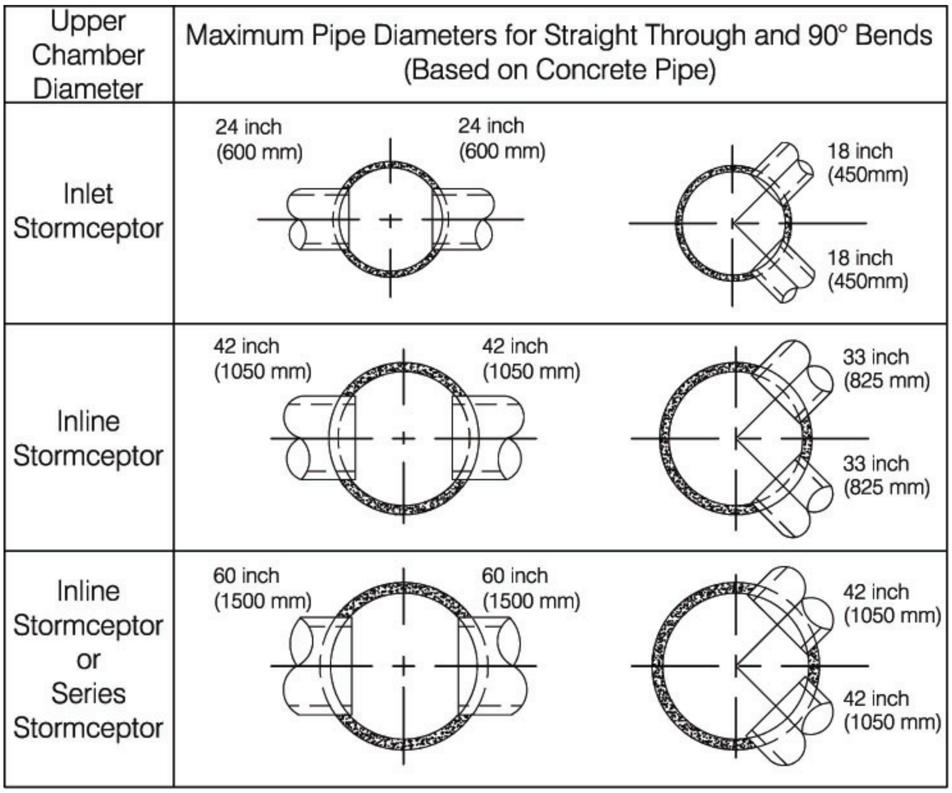


Figure 5. Maximum pipe diameters for straight through and bend applications

*The bend should only be incorporated into the second structure (downstream structure) of the Series Stormceptor System

7.3. Bends

The Stormceptor System can be used to change horizontal alignment in the storm drain network up to a maximum of 90 degrees. Figure 6 illustrates the typical bend situations of the Stormceptor System. Bends should only be applied to the second structure (downstream structure) of the Series Stormceptor System.

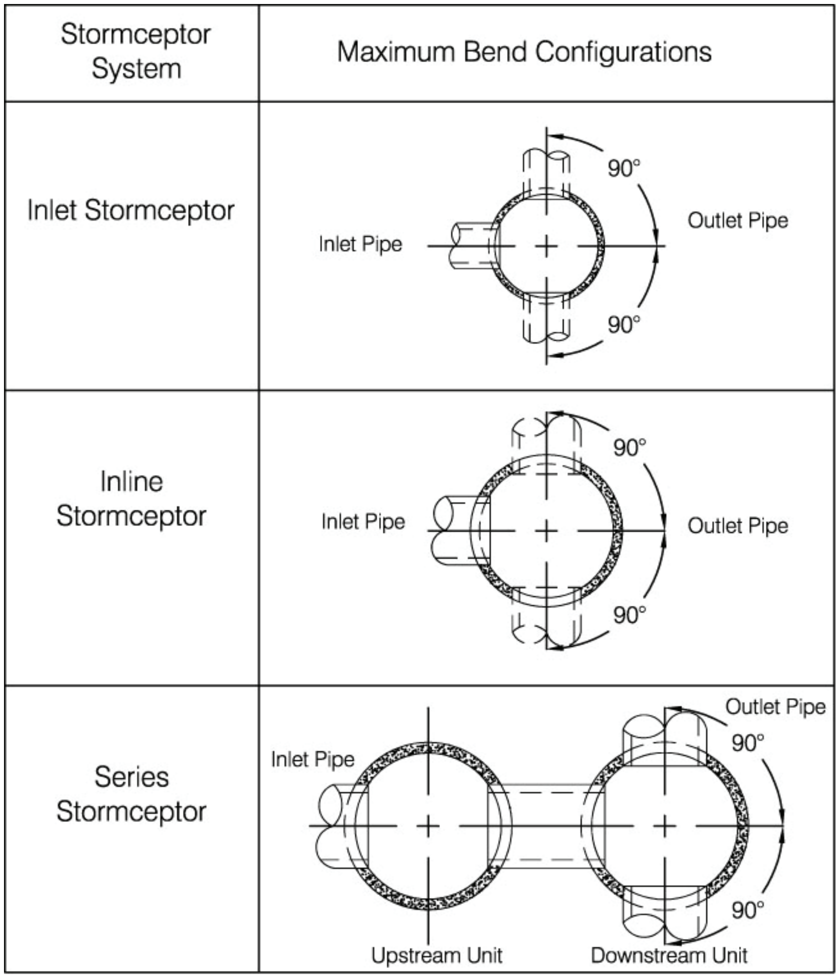


Figure 6. Maximum bend angles

7.4. Multiple Inlet Pipes

The Inlet and Inline Stormceptor System can accommodate two or more inlet pipes. The maximum number of inlet pipes that can be accommodated into a Stormceptor unit is a function of the number, alignment and diameter of the pipes and its effects on the structural integrity of the precast concrete. When multiple inlet pipes are used for new developments, each inlet pipe shall have an invert elevation 3 inches (75 mm) higher than the outlet pipe invert elevation.

7.5. Inlet/Outlet Pipe Invert Elevations

Recommended inlet and outlet pipe invert differences are listed in Table 3.

Table 3. Recommended Drops Between Inlet and Outlet Pipe Inverts

Number of Inlet Pipes	Inlet System	In-Line System	Series System
1	3 inches (75 mm)	1 inch (25 mm)	3 inches (75 mm)
>1	3 inches (75 mm)	3 inches (75 mm)	Not Applicable

7.6. Shallow Stormceptor

In cases where there may be restrictions to the depth of burial of storm sewer systems. In this situation, for selected Stormceptor models, the lower chamber components may be increased in diameter to reduce the overall depth of excavation required.

7.7. Customized Live Load

The Stormceptor system is typically designed for local highway truck loading (AASHTO HS- 20). When the project requires live loads greater than HS-20, the Stormceptor System may be customized structurally for a pre-specified live load. Contact your local Stormceptor representative for customized loading conditions.

7.8. Pre-treatment

The Stormceptor System may be sized to remove sediment and for spills control in conjunction with other stormwater BMPs to meet the water quality objective. For pretreatment applications, the Stormceptor System should be the first unit in a treatment train. The benefits of pre-treatment include the extension of the operational life (extension of maintenance frequency) of large stormwater management facilities, prevention of spills and lower total life- cycle maintenance cost.

7.9. Head loss

The head loss through the Stormceptor System is similar to a 60 degree bend at a manhole. The K value for calculating minor losses is approximately 1.3 (minor loss = k*1.3v2/2g).

However, when a Submerged modification is applied to a Stormceptor unit, the corresponding K value is 4.

7.10. Submerged

The Submerged modification, Figure 7, allows the Stormceptor System to operate in submerged or partially submerged storm sewers. This configuration can be installed on all models of the Stormceptor System by modifying the fiberglass insert. A customized weir height and a secondary drop tee are added.

Submerged instances are defined as standing water in the storm drain system during zero flow conditions. In these instances, the following information is necessary for the proper design and application of submerged modifications:

- Stormceptor top of grade elevation
- Stormceptor outlet pipe invert elevation
- Standing water elevation

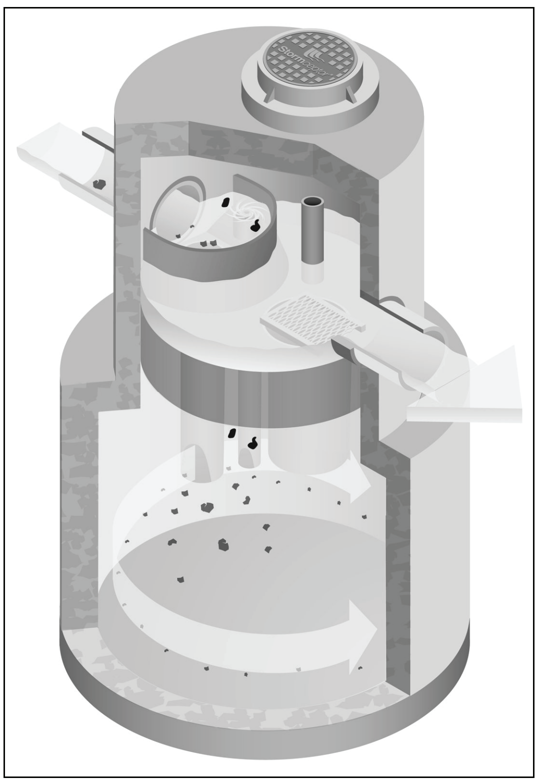


Figure 7. Submerged Stormceptor

8. Comparing Technologies

Designers have many choices available to achieve water quality goals in the treatment of stormwater runoff. Since many alternatives are available for use in stormwater quality treatment it is important to consider how to make an appropriate comparison between "approved alternatives". The following is a guide to assist with the accurate comparison of differing technologies and performance claims.

8.1. Particle Size Distribution (PSD)

The most sensitive parameter to the design of a stormwater quality device is the selection of the design particle size. While it is recommended that the actual particle size distribution (PSD) for sites be measured prior to sizing, alternative values for particle size should be selected to represent what is likely to occur naturally on the site. A reasonable estimate of a particle size distribution likely to be found on parking lots or other impervious surfaces should consist of a wide range of particles such as 20 microns to 2,000 microns (Ontario MOE, 1994).

There is no absolute right particle size distribution or specific gravity and the user is cautioned to review the site location, characteristics, material handling practices and regulatory requirements when selecting a particle size distribution. When comparing technologies, designs using different PSDs will result in incomparable TSS removal efficiencies. The PSD of the TSS removed needs to be standard between two products to allow for an accurate comparison.

8.2. Scour Prevention

In order to accurately predict the performance of a manufactured treatment device, there must be confidence that it will perform under all conditions. Since rainfall patterns cannot be predicted, stormwater quality devices placed in storm sewer systems must be able to withstand extreme events, and ensure that all pollutants previously captured are retained in the system.

In order to have confidence in a system's performance under extreme conditions, independent validation of scour prevention is essential when examining different technologies. Lack of independent verification of scour prevention should make a designer wary of accepting any product's performance claims.

8.3. Hydraulics

Full scale laboratory testing has been used to confirm the hydraulics of the Stormceptor System. Results of lab testing have been used to physically design the Stormceptor System and the sewer pipes entering and leaving the unit. Key benefits of Stormceptor are:

- Low head loss (typical k value of 1.3)
- Minimal inlet/outlet invert elevation drop across the structure
- Use as a bend structure
- Accommodates multiple inlets

The adaptability of the treatment device to the storm sewer design infrastructure can affect the overall performance and cost of the site.

8.4. Hydrology

Stormwater quality treatment technologies need to perform under varying climatic conditions. These can vary from long low intensity rainfall to short duration, high intensity storms. Since a treatment device is expected to perform under all these conditions, it makes sense that any system's design should accommodate those conditions as well.

Long-term continuous simulation evaluates the performance of a technology under the varying conditions expected in the climate of the subject site. Single, peak event design does not provide this information and is not equivalent to long-term simulation. Designers should request long-term simulation performance to ensure the technology can meet the long-term water quality objective.

9. Testing

The Stormceptor System has been the most widely monitored stormwater treatment technology in the world. Performance verification and monitoring programs are completed to the strictest standards and integrity. Since its introduction in 1990, numerous independent field tests and studies detailing the effectiveness of the Stormceptor System have been completed.

- Coventry University, UK – 97% removal of oil, 83% removal of sand and 73% removal of peat
- National Water Research Institute, Canada, - scaled testing for the development of the Stormceptor System identifying both TSS removal and scour prevention.
- New Jersey TARP Program – full scale testing of an STC 900 demonstrating 75% TSS removal of particles from 1 to 1000 microns. Scour testing completed demonstrated that the system does not scour. The New Jersey Department of Environmental Protection was followed.
- City of Indianapolis – full scale testing of an STC 900 demonstrating over 80% TSS removal of particles from 50 microns to 300 microns at 130% of the unit's operating rate. Scour testing completed demonstrated that the system does not scour.
- Westwood Massachusetts (1997), demonstrated >80% TSS removal
- Como Park (1997), demonstrated 76% TSS removal
- Ontario MOE SWAMP Program – 57% removal of 1 to 25 micron particles
- Laval Quebec – 50% removal of 1 to 25 micron particles

10. Installation

The installation of the concrete Stormceptor should conform in general to state highway, or local specifications for the installation of manholes. Selected sections of a general specification that are applicable are summarized in the following sections.

10.1. Excavation

Excavation for the installation of the Stormceptor should conform to state highway, or local specifications. Topsoil removed during the excavation for the Stormceptor should be stockpiled in designated areas and should not be mixed with subsoil or other materials.

Topsoil stockpiles and the general site preparation for the installation of the Stormceptor should conform to state highway or local specifications.

The Stormceptor should not be installed on frozen ground. Excavation should extend a minimum of 12 inches (300 mm) from the precast concrete surfaces plus an allowance for shoring and bracing where required. If the bottom of the excavation provides an unsuitable foundation additional excavation may be required.

In areas with a high water table, continuous dewatering may be required to ensure that the excavation is stable and free of water.

10.2. Backfilling

Backfill material should conform to state highway or local specifications. Backfill material should be placed in uniform layers not exceeding 12 inches (300mm) in depth and compacted to state highway or local specifications.

11. Stormceptor Construction Sequence

The concrete Stormceptor is installed in sections in the following sequence:

1. Aggregate base
2. Base slab
3. Lower chamber sections
4. Upper chamber section with fiberglass insert
5. Connect inlet and outlet pipes
6. Assembly of fiberglass insert components (drop tee, riser pipe, oil cleanout port and orifice plate
7. Remainder of upper chamber
8. Frame and access cover

The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

Adjustment of the Stormceptor can be performed by lifting the upper sections free of the excavated area, re-leveling the base and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary. Once the Stormceptor has been constructed, any lift holes must be plugged with mortar.

12. Maintenance

12.1. Health and Safety

The Stormceptor System has been designed considering safety first. It is recommended that confined space entry protocols be followed if entry to the unit is required. In addition, the fiberglass insert has the following health and safety features:

- Designed to withstand the weight of personnel
- A safety grate is located over the 24 inch (600 mm) riser pipe opening
- Ladder rungs can be provided for entry into the unit, if required

12.2. Maintenance Procedures

Maintenance of the Stormceptor system is performed using vacuum trucks. No entry into the unit is required for maintenance (in most cases). The vacuum service industry is a well- established sector of the service industry that cleans underground tanks, sewers and catch basins. Costs to clean a Stormceptor will vary based on the size of unit and transportation distances.

The need for maintenance can be determined easily by inspecting the unit from the surface. The depth of oil in the unit can be determined by inserting a dipstick in the oil inspection/cleanout port.

Similarly, the depth of sediment can be measured from the surface without entry into the Stormceptor via a dipstick tube equipped with a ball valve. This tube would be inserted through the riser pipe. Maintenance should be performed once the sediment depth exceeds the guideline values provided in the Table 4.

Table 4. Sediment Depths Indicating Required Servicing*

Particle Size	Specific Gravity
Model	Sediment Depth inches (mm)
450i	8 (200)
900	8 (200)
1200	10 (250)
1800	15 (381)
2400	12 (300)
3600	17 (430)
4800	15 (380)
6000	18 (460)
7200	15 (381)
11000	17 (380)
13000	20 (500)
16000	17 (380)
* based on 15% of the Stormceptor unit's total storage	

Although annual servicing is recommended, the frequency of maintenance may need to be increased or reduced based on local conditions (i.e. if the unit is filling up with sediment more quickly than projected, maintenance may be required semi-annually; conversely once the site has stabilized maintenance may only be required every two or three years).

Oil is removed through the oil inspection/cleanout port and sediment is removed through the riser pipe. Alternatively oil could be removed from the 24 inches (600 mm) opening if water is removed from the lower chamber to lower the oil level below the drop pipes.

The following procedures should be taken when cleaning out Stormceptor:

1. Check for oil through the oil cleanout port
2. Remove any oil separately using a small portable pump
3. Decant the water from the unit to the sanitary sewer, if permitted by the local regulating authority, or into a separate containment tank
4. Remove the sludge from the bottom of the unit using the vacuum truck
5. Re-fill Stormceptor with water where required by the local jurisdiction

12.3. Submerged Stormceptor

Careful attention should be paid to maintenance of the Submerged Stormceptor System. In cases where the storm drain system is submerged, there is a requirement to plug both the inlet and outlet pipes to economically clean out the unit.

12.4. Hydrocarbon Spills

The Stormceptor is often installed in areas where the potential for spills is great. The Stormceptor System should be cleaned immediately after a spill occurs by a licensed liquid waste hauler.

12.5. Disposal

Requirements for the disposal of material from the Stormceptor System are similar to that of any other stormwater Best Management Practice (BMP) where permitted. Disposal options for the sediment may range from disposal in a sanitary trunk sewer upstream of a sewage treatment plant, to disposal in a sanitary landfill site. Petroleum waste products collected in the Stormceptor (free oil/chemical/fuel spills) should be removed by a licensed waste management company.

12.6. Oil Sheens

With a steady influx of water with high concentrations of oil, a sheen may be noticeable at the Stormceptor outlet. This may occur because a rainbow or sheen can be seen at very small oil concentrations (<10 mg/L). Stormceptor will remove over 98% of all free oil spills from storm sewer systems for dry weather or frequently occurring runoff events.

The appearance of a sheen at the outlet with high influent oil concentrations does not mean the unit is not working to this level of removal. In addition, if the influent oil is emulsified the Stormceptor will not be able to remove it. The Stormceptor is designed for free oil removal and not emulsified conditions.

SUPPORT

Drawings and specifications are available at www.ContechES.com.

Site-specific design support is available from our engineers.

CONTECH® ENGINEERED SOLUTIONS

800-925-5240
www.ContechES.com

APPENDIX B

Concrete Galley General Operation & Maintenance Guide

This manual contains guidelines and general recommendations to be used in conjunction with concrete galley subsurface infiltration areas, but not to supersede, local regulations or regulatory authorities. OSHA Guidelines must be followed when inspecting or cleaning any structure

Introduction

Concrete Galleys provide a Subsurface Stormwater Management System consisting of precast concrete chambers arranged in parallel rows surrounded by stone. The galleys create voids within the stone to provide stormwater detention, retention, infiltration, and reclamation. In order to minimize the amount of sediment which may enter the galley system, a sediment collection device (stormwater pretreatment device) is recommended upstream from the concrete galley system. Examples of pretreatment devices include, but are not limited to, an appropriately sized catch basin with sump, pretreatment catchment device, oil grit separator, or baffled distribution box. Manufactured pretreatment devices may also be used in accordance with concrete galleys. Installation, operation, and maintenance of these devices shall be in accordance with manufacturer's recommendations. Almost all of the sediment entering the stormwater management system will be collected within the pretreatment device.

Best Management Practices allow for the maintenance of the preliminary collection systems prior to feeding the concrete galleys chambers. The pretreatment structures shall be inspected for any debris that will restrict inlet flow rates. Outfall structures, if any, such as outlet control must also be inspected for any obstructions that would restrict outlet flow rates. OSHA Guidelines must be followed when inspecting or cleaning any structure.

Operation and Maintenance Requirements

Operation

The concrete galley stormwater management systems shall be operated to receive only stormwater run-off in accordance with applicable local regulations. Pretreatment of suspended solids is superior to treatment of solids once they have been introduced into the system. The use of pretreatment is adequate as long as the structure is maintained and the site remains stable with finished impervious surfaces such as parking lots, walkways, and pervious areas are properly maintained. If there is to be an unstable condition, such as improvements to buildings or parking areas, all proper silt control measures shall be implemented according to local regulations.

Inspection and Maintenance Options

A. The concrete galley system may be equipped with an inspection ports located on the ends of the system. The inspection port is a circular cast box placed in a rectangular concrete collar. When the lid is removed, a 6-inch (150 mm) pipe with a screw-in plug will be exposed. Remove the plug. This will provide access to the concrete galley below. From the surface, through this access, the sediment may be measured at this location. A stadia rod may be used to measure the depth of sediment if any in this row. If the depth of sediment is in excess of 3 inches (76 mm), then this row should be cleaned with high pressure water through culvert cleaning nozzle. This would be carried out through an upstream manhole or inspection port. CCTV inspection of this chamber can be deployed through this inspection port to determine if any sediment has accumulated.

Manhole Access (if equipped)

This inspection should only be carried out by persons trained in confined space entry and sewer inspection services. After the manhole cover has been removed a gas detector must be lowered into the manhole to ensure that there are not high concentrations of toxic gases present. The inspector should be lowered into the manhole with the proper safety equipment as per OSHA requirements. The inspector may be able to observe sediment from this location. If this is not possible, the inspector will need to deploy a CCTV robot to permit viewing of the sediment.

Maintenance Guidelines

The following guidelines shall be adhered to for the operation and maintenance of the concrete galley stormwater management system:

A. The owner shall keep a maintenance log which shall include details of any events which would have an effect on the system's operational capacity.

B. The operation and maintenance procedure shall be reviewed periodically and changed to meet site conditions.

C. Maintenance of the stormwater management system shall be performed by qualified workers and shall follow applicable occupational health and safety requirements.

D. Debris removed from the stormwater management system shall be disposed of in accordance with applicable laws and regulations.

Suggested Maintenance Schedules

Please refer to the O&M schedule within this manual for required maintenance and inspection frequencies.

APPENDIX C

Stormwater Management System Owners/Operators

Steve Breitmaier
Brite Excavating
14 Patricia Drive
Ayer, Massachusetts

I certify that I have read and agree to perform the operation & maintenance requirements detailed in this Operation & Maintenance Manual

Signature Date

APPENDIX H

Long Term Pollution Prevention Plan

LONG-TERM POLLUTION PREVENTION PLAN

FOR

BRITE EXCAVATING
4 SPECTACLE POND ROAD

IN

LITTLETON,
MASSACHUSETTS

PREPARED BY: DILLIS & ROY
CIVIL DESIGN GROUP, INC.
1 Main Street, Suite #1
Lunenburg, MA 01462

PREPARED FOR: BRITE EXCAVATING
14 PATRICIA DRIVE
AYER, MASSACHUSETTS

MARCH 11TH, 2024

CDG PROJECT #6233

DILLIS & ROY
CIVIL DESIGN GROUP
CIVIL ENGINEERS LAND SURVEYORS WETLAND CONSULTANTS

1.0 Summary

This Long-Term Pollution Prevention Plan (LTPPP) has been prepared by Dillis & Roy Civil Design Group, Inc. pursuant to the Massachusetts Stormwater Regulations. The proposed project includes the construction of a new building with a paved parking lot. The stormwater management system has been designed in accordance with the Massachusetts Stormwater Regulations as well as the Town of Littleton's Stormwater Rules and Regulations to provide pretreatment of the stormwater prior to discharge.

2.0 Spill Prevention Plan

No hazardous materials other than normal cleaning items are expected to be stored on site after the construction period has ended.

It is expected that normal DEP notification procedures would be triggered for major spills such as heating oil or propane and natural gas leaks.

3.0 Stormwater System O&M

A Stormwater Operation & Maintenance plan has been prepared for the proposed stormwater management system. Refer to this document for details pertaining to the required inspections, routine maintenance and operation details.

4.0 Fertilizers, herbicides, and pesticides

Application of fertilizer, herbicides and pesticides shall be performed in a manner consistent with the industry standards for the application.

No application of chemicals is to be performed within the stormwater management areas on the site.

5.0 Snow/Salt Management

5.1 Snow Plowing

It is expected that the site will be plowed by the owner or a private contractor.

5.2 Salt/Sand Usage

It is expected that sanding and salting will be performed on an infrequent basis during times when unusually icy conditions persist for periods of time.

6.0 Waste Management

6.1 Solid Waste

A dumpster will be located on the site during construction. This area will be the primary area for the on-site storage of solid waste prior to pick-up by a waste management company.

4.0 Plans

PREPARED BY:

DILLIS & ROY CIVIL DESIGN GROUP

CIVIL ENGINEERS · LAND SURVEYORS · WETLAND CONSULTANTS

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OWNER:
STEVEN BREITMAIER
4 SPECTACLE POND ROAD
LITTLETON, MASSACHUSETTS

APPLICANT:
BRITE EXCAVATING
14 PATRICIA DRIVE
AYER, MASSACHUSETTS

SCALE: 30 0 15 30 60 120 — 1 in. = 30 ft.

*SCALE: 1 IN. = 30 FT. WHEN PRINTED ON 24"X36"

DATE: 3/11/2024

DESIGN BY: RWP/SBD

DRAWN BY: RWP

CHECKED BY: GSR

PRE-DEVELOPMENT WATERSHED PLAN

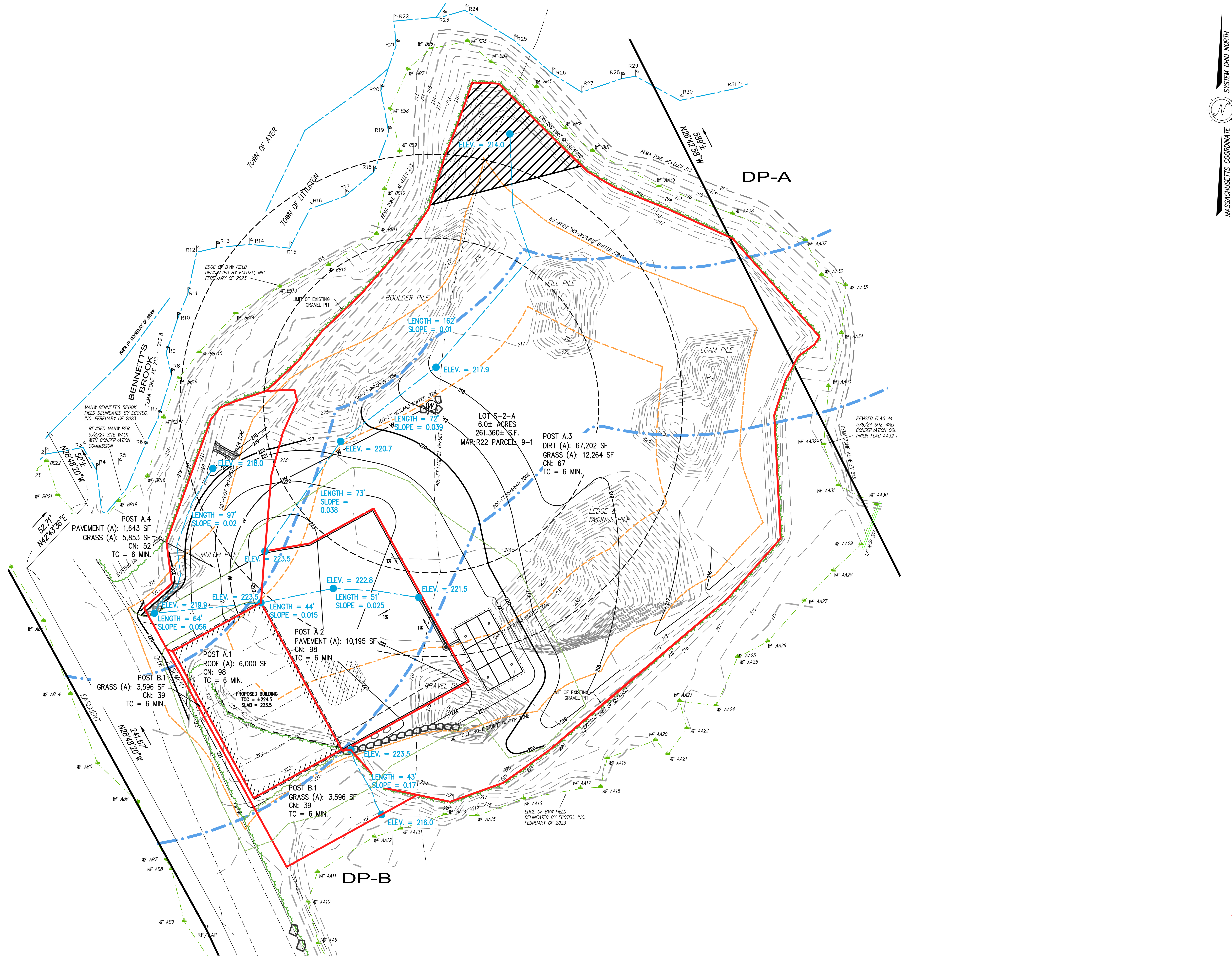
4 SPECTACLE POND ROAD
LITTLETON, MASSACHUSETTS

NO.	DATE	DESCRIPTION	BY
1.	5/21/24	GENERAL REVISIONS PER CLIENT COMMENTS	CRL
2.	6/14/24	GENERAL REVISIONS PER PEER REVIEW COMMENTS	CRL
3.	7/5/24	GENERAL REVISIONS PER PEER REVIEW COMMENTS	CRL

JOB NO. 6233

DRAWING NO. 6233-PRE

SHEET NO. 1



LEGEND

PROP. FEATURE	DESCRIPTION
(red line)	SUBCATCHMENT BOUNDARY
(blue line)	TIME OF CONCENTRATION PATH
(dashed line)	CHANGE IN SOIL CLASSIFICATION
(dotted line)	CHANGE IN LANDCOVER

PREPARED BY:

DILLIS & ROY CIVIL DESIGN GROUP

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DATE: 3/11/2024
DESIGN BY: RWP/SBD
DRAWN BY: RWP
CHECKED BY: GSR

POST-DEVELOPMENT WATERSHED PLAN
4 SPECTACLE POND ROAD
LITTLETON, MASSACHUSETTS

NO.	DATE	DESCRIPTION	BY
1.	5/21/24	GENERAL REVISIONS PER CLIENT COMMENTS	CRL
2.	6/14/24	GENERAL REVISIONS PER PEER REVIEW COMMENTS	CRL
3.	7/5/24	GENERAL REVISIONS PER PEER REVIEW COMMENTS	CRL

JOB NO. 6233
DRAWING NO. 6233-POST
SHEET NO. 1