DRAINAGE REPORT

For

MARCUS PARTNERS

PROPOSED
"RESIDENTIAL DEVELOPMENT"

582 Kelley Boulevard Rear
North Attleborough, Massachusetts
Bristol County

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I. EXECUTIVE SUMMARY

This report examines the changes in drainage that can be expected as the result of the proposed residential development located on the South and West side of Kelley Blvd near the intersection with Plain Street. The site, which contains approximately 13.679 acres of land, contains an existing fun center with driving range, mini golf, and batting cages with surface parking lots.

The proposed project includes the construction of new residential apartment buildings and amenities with new paved parking areas, landscaping, storm water management components and associated utilities. This report addresses a comparative analysis of the pre- and post-development site runoff conditions. Additionally, this report provides calculations documenting the design of the proposed stormwater conveyance/management system as illustrated within the accompanying Site Development Plans prepared by Bohler. The project will also provide erosion and sedimentation controls during the demolition and construction periods, as well as long term stabilization of the site.

For the purposes of this analysis the pre- and post-development drainage conditions were analyzed at four (4) "design points" where stormwater runoff currently drains to under existing conditions. These design points are described in further detail in **Section II** below. A summary of the existing and proposed conditions peak runoff rates and volumes for the 2-, 10-, 25-, and 100-year storms can be found in **Table 1.1** and **Table 1.2** below. In addition, the project has been designed to meet or exceed the Stormwater Management Standards as detailed herein.

Table 1.1: Design Point Peak Runoff Rate Summary

Peak Flow Discharge in cubic feet per second (cfs)												
	2-year			10-year			25-year			100-year		
	Pre-	Post-	Delta	Pre-	Post-	Delta	Pre-	Post-	Delta	Pre-	Post-	Delta
DP1	1.47	0.00	-1.47	2.35	0.01	-2.34	3.74	0.05	-3.69	7.37	0.17	-7.20
DP2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DP3	0.19	0.02	-0.17	0.30	0.03	-0.27	0.39	0.17	-0.22	0.73	0.49	-0.24
DP4	0.10	0.00	-0.10	0.16	0.00	-0.16	0.20	0.02	-0.18	0.28	0.07	-0.21

Table 1.2: Design Point Volume Summary

Volume Discharge in acre-ft (ac-ft) from 72-hr Time Span												
	2-year			10-year			25-year			100-year		
	Pre-	Post-	Delta	Pre-	Post-	Delta	Pre-	Post-	Delta	Pre-	Post-	Delta
DP1	0.250	0.000	-0.250	0.567	0.004	-0.563	0.887	0.009	-0.878	1.521	0.019	-1.502
DP2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DP3	0.015	0.002	-0.013	0.030	0.007	-0.023	0.044	0.017	-0.027	0.069	0.077	0.008
DP4	0.008	0.000	-0.008	0.014	0.002	-0.012	0.022	0.005	-0.017	0.042	0.016	-0.026

II. EXISTING SITE CONDITIONS

Existing Site Description

The site consists of approximately 13.679 acres of land located on the South and West side of Kelley Blvd near the intersection with Plain Street in North Attleborough. Most of the site is cleared for the existing driving range use. Other areas of the site are developed by parking and vehicular access. Near the western property line is a densely wooded area with delineated wetlands. Slopes on the site range from 1%-15% with a mean slope of 4% and on-site elevations ranging from 194 to 207.

On-Site Soil Information

The Natural Resource Conservation Service (NRCS) maps multiple on-site soils classified as Hydrologic Soil Group (HSG) 'A'. On-site test pits and monitoring wells at the locations of the proposed stormwater management basins were performed by Whitestone Associates, Inc. on several visits as documented in the *Comprehensive Stormwater Management Area Evaluation*. Refer to **Appendix C** for additional information.

Wetlands exist along the western property line per the Order of Resource Area Delineation DEP File No SE 243-0963.

Existing Collection and Conveyance

Throughout the parking and access areas there are few catch basins that discharge into unknown sized drywells. Existing municipal storm drainage infrastructure exists within Kelley Blvd and George Leven Road, but none of the existing site drains to the municipal system.

Existing Watersheds and Design Point Information

For the purposes of this analysis, the pre- and post-development drainage conditions were analyzed at four (4) "design points" as described below where stormwater runoff currently drains to under existing conditions. The existing site was subdivided into seven (7) separate sub catchments to analyze existing and proposed flow rates at each design point. Refer to **Appendix D** and the Drainage Area Maps in the appendices of this report for a graphical representation of the existing drainage areas.

Design Point #1 (DP1) represents the flow to the southern abutters at Map Lots 35-217 and 35-3A. Stormwater runoff from the lots fronting on Kelley Blvd is captured by catch basins and infiltrated into drywells therefore the flow and volume is discarded and not realized at DP1.

Design Point #2 (DP2) represents area directed to a drywell in the access drive south of the batting cages. This point assumes no offsite runoff to the abutter and that all stormwater runoff volume infiltrates.

Design Point #3 (DP3) represents the flow to George Leven Drive.

Design Point #4 (DP4) represents the flow to the Map Lot 35-218 and the existing wetland near the west property line. The wetlands receive offsite flow from the west which flows overland to the south adjacent to Map 35-218.

Refer to **Table 1.1 and 1.2** for the existing conditions peak rates of runoff and volumes.

III. PROPOSED SITE CONDITIONS

Proposed Development Description

The proposed project consists of the construction of new residential apartments with associated paved parking areas, landscaping, utilities, and stormwater management systems. The site has been designed to drain to deep-sump, hooded catch basins and/or filtering bioretention areas before entering either an underground infiltration basin or one of two above ground infiltration basins. Pretreatment of stormwater runoff prior to infiltration is achieved by combination of the deep-sump, hooded catch basins, filtered bioretention, and/or proprietary water quality units.

Proposed Development Collection and Conveyance

Deep sump hooded catch basins are proposed to collect and route runoff from the paved parking areas to the existing surface basins. Pipes have been designed for the 25-year storm using Storm Sewers by Hydraflow Software/Rational Method. Pipe, inlet, and outlet protection sizing calculations are included in **Appendix F**.

The best management practices (BMPs) incorporated into the proposed stormwater management system have been designed to meet, or exceed, the standards set forth in the Massachusetts Department of Environmental Protection Stormwater Handbook standards. Refer to **Section V** for additional information.

Proposed Watersheds and Design Point Information

The project has been designed to maintain existing drainage watersheds to the greatest extent possible, with the same design points described in **Section II** above. The site was subdivided

into sixteen (16) separate sub catchments for the proposed conditions as described below. The minimum time of concentration for all proposed areas is calculated as 6 minutes (0.1 hr).

Under proposed conditions DP1 receives stormwater flows from watershed “PD1.0” representing grassed areas that are not captured by the stormwater management system.

Under proposed conditions DP2 ends at the above ground infiltration basin “P2.1” which receives stormwater flows from the lots fronting on Kelley Blvd and the access drive from George Leven Road. The emergency overflow for P2.1 is directed to the same existing condition drywell. Matching existing conditions, this point assumes no offsite runoff to the abutter and that all stormwater runoff volume infiltrates.

Under proposed conditions DP3 receives stormwater flows from basin P1.10 and a portion of the southern access drive that cannot be directed to the stormwater management system.

Under proposed conditions DP4 receives stormwater flows from watershed “PD4” representing grassed and wooded areas that are not captured by the stormwater management system.

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

IV. METHODOLOGY

Peak Flow Calculations

Methodology utilized to design the proposed stormwater management system includes compliance with the guidelines set forth in the latest edition of the Massachusetts DEP Stormwater Handbook. The pre- and post-development runoff rates being discharged from the site were computed using the HydroCAD computer program. The drainage area and outlet information were entered into the program, which routes storm flows based on NRCS TR-20 and TR-55 methods. The other components of the model were determined following standard NRCS procedures for Curve Numbers (CNs) and times of concentrations documented in the appendices of this report. The rainfall data utilized and listed below in table 4.1 below for stormwater calculations is based on NOAA Atlas 14, Volume 10, Version 3 from July 16, 2024 at the site location. Refer to **Appendix F** for more information.

Table 4.1: Rainfall Depths

Frequency	2 year	10 year	25 year	100 year
Rainfall (inches)	3.40	5.19	6.31	8.03

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

V. STORMWATER MANAGEMENT STANDARDS

Standard #1: No New Untreated Discharges

The project has been designed so that proposed impervious areas (including the building roof and paved parking/driveway areas) shall be collected and passed through the proposed drainage system for treatment prior to discharge.

Standard #2: Peak Rate Attenuation

As outlined in **Table 1.1** and **Table 6.1**, the development of the site and the proposed stormwater management system, have been designed so that post-development peak rates of runoff are below pre-development conditions for the 2-, 10-, 25- and 100-year storm events at all design points.

Standard #3: Recharge

The stormwater runoff from the project will be collected and diverted to either above or below ground infiltration basins. The project as proposed will involve the creation of 5.583 acres of new impervious area and is required to infiltrate 12,160 cubic feet of stormwater as defined in Stormwater Standard 3. The proposed infiltration basins will collectively provide 82,453 cubic feet of volume below the respective lowest outlets for groundwater recharge. Refer to **Appendix F** of this report for calculations documenting required and provided recharge volumes.

The DEP Stormwater Standards require that the infiltration BMP drains completely within 72 hours of the end of the storm event. Calculations showing adequate drawdown are included in **Appendix F** of this report.

A groundwater mounding analysis has been provided in **Appendix F** of this report. The analysis shows that the groundwater mound will have no effect on the proposed system.

Standard #4: Water Quality

Water quality treatment is provided via a combination of some or all of the following: deep sump catch basins, water quality units, filtered bioretention, and infiltration basin. TSS removal calculations are included in **Appendix F** of this report. The project as proposed will involve the creation of new impervious area (see Standard #3) and is required to treat 39,647 cubic feet of water quality volume as defined in Stormwater Standard 4. The proposed infiltration basins and bioretention collectively provide 88,592 cubic feet of water quality volume below the respective lowest outlets for water quality treatment. Refer to **Appendix F** of this report for calculations documenting required and provided water quality volumes.

Standard #5: Land Use with Higher Potential Pollutant Loads

The proposed project involves “Land Uses with Higher Potential Pollutant Loads”. Accordingly, the stormwater management system includes water quality units in lieu of an oil/grit separators and filtered bioretention prior to discharge. In addition, the project will provide 44% TSS removal prior to infiltration and treat the 1.0 in water quality depth, as further illustrated in **Appendix E** of this report.

Standard #6: Critical Areas

A Zone II and interim wellhead protection area has been established covers the development. The proposed stormwater management system has been designed to provide at least eighty percent (80%) removal of Total Suspended Solids (TSS) through the use of several Best Management Practices (BMPs), including deep-sump hooded catch basins, filtering bioretention areas, water quality units, and infiltration basins. The deep-sump hooded catch basins, filtering bioretention, and water quality units will provide a minimum of 44% TSS removal prior to all infiltration basins. Refer to **Appendix F** for TSS removal calculations.

Standard #7: Redevelopment

This project is a partial redevelopment but is treated as a new development.

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

The proposed project will provide construction period erosion and sedimentation controls as indicated within the site plan set provided for this project. This includes a proposed construction exit, protection for stormwater inlets, protection around temporary material stock piles and various

other techniques as outlined on the erosion and sediment control sheets. Additionally, the project is required to file a Notice of Intent with the US EPA and implement a Stormwater Pollution Prevention Plan (SWPPP) during the construction period. The SWPPP will be prepared prior to the start of construction and will be implemented by the site contractor under the guidance and responsibility of the project's proponent. Refer to **Appendix H**.

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

An Operation and Maintenance (O&M) Plan for this site has been prepared and is included in **Appendix G** of this report. The O&M Plan outlines procedures and time tables for the long term operation and maintenance of the proposed site stormwater management system, including initial inspections upon completion of construction, and periodic monitoring of the system components, in accordance with established practices and the manufacturer's recommendations. The O&M Plan includes a list of responsible parties.

Standard #10: Prohibition of Illicit Discharges

The proposed stormwater system will only convey allowable non-stormwater discharges (firefighting waters, irrigation, air conditioning condensates, etc.) and will not contain any illicit discharges from prohibited sources. An Illicit Discharge Statement is included in **Appendix G** of this report.

VI. SUMMARY

In summary, the proposed stormwater management system illustrated on the drawings prepared by Bohler results in a reduction in peak rates of runoff from the subject site when compared to pre-development conditions for the 2-, 10-, 25- and 100-year storm frequencies. In addition, the proposed best management practices will result in an effective removal of total suspended solids from the post-development runoff. The pre-development versus post-development stormwater discharge comparisons are contained in **Table 6.1** and **Table 6.2** below.

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

Table 6.1: Design Point Peak Runoff Rate Summary

Peak Flow Discharge in cubic feet per second (cfs)												
	2-year			10-year			25-year			100-year		
	Pre-	Post-	Delta	Pre-	Post-	Delta	Pre-	Post-	Delta	Pre-	Post-	Delta
DP1	1.47	0.00	-1.47	2.35	0.01	-2.34	3.74	0.05	-3.69	7.37	0.17	-7.20
DP2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DP3	0.19	0.02	-0.17	0.30	0.03	-0.27	0.39	0.17	-0.22	0.73	0.49	-0.24
DP4	0.10	0.00	-0.10	0.16	0.00	-0.16	0.20	0.02	-0.18	0.28	0.07	-0.21

Table 6.2: Design Point Volume Summary

Volume Discharge in acre-ft (ac-ft) from 72-hr Time Span												
	2-year			10-year			25-year			100-year		
	Pre-	Post-	Delta	Pre-	Post-	Delta	Pre-	Post-	Delta	Pre-	Post-	Delta
DP1	0.250	0.000	-0.250	0.567	0.004	-0.563	0.887	0.009	-0.878	1.521	0.019	-1.502
DP2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DP3	0.015	0.002	-0.013	0.030	0.007	-0.023	0.044	0.017	-0.027	0.069	0.077	0.008
DP4	0.008	0.000	-0.008	0.014	0.002	-0.012	0.022	0.005	-0.017	0.042	0.016	-0.026

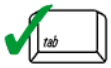
APPENDIX A: MASSACHUSETTS STORMWATER MANAGEMENT CHECKLIST

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

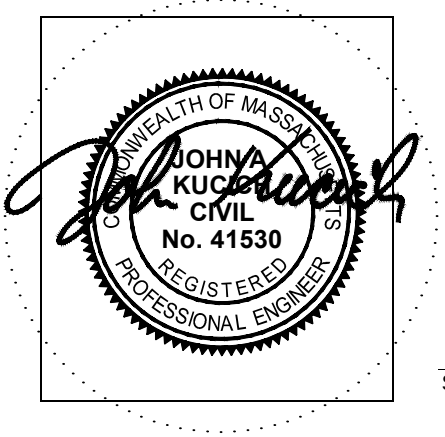
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



11/21/2024

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): Infiltration practices

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

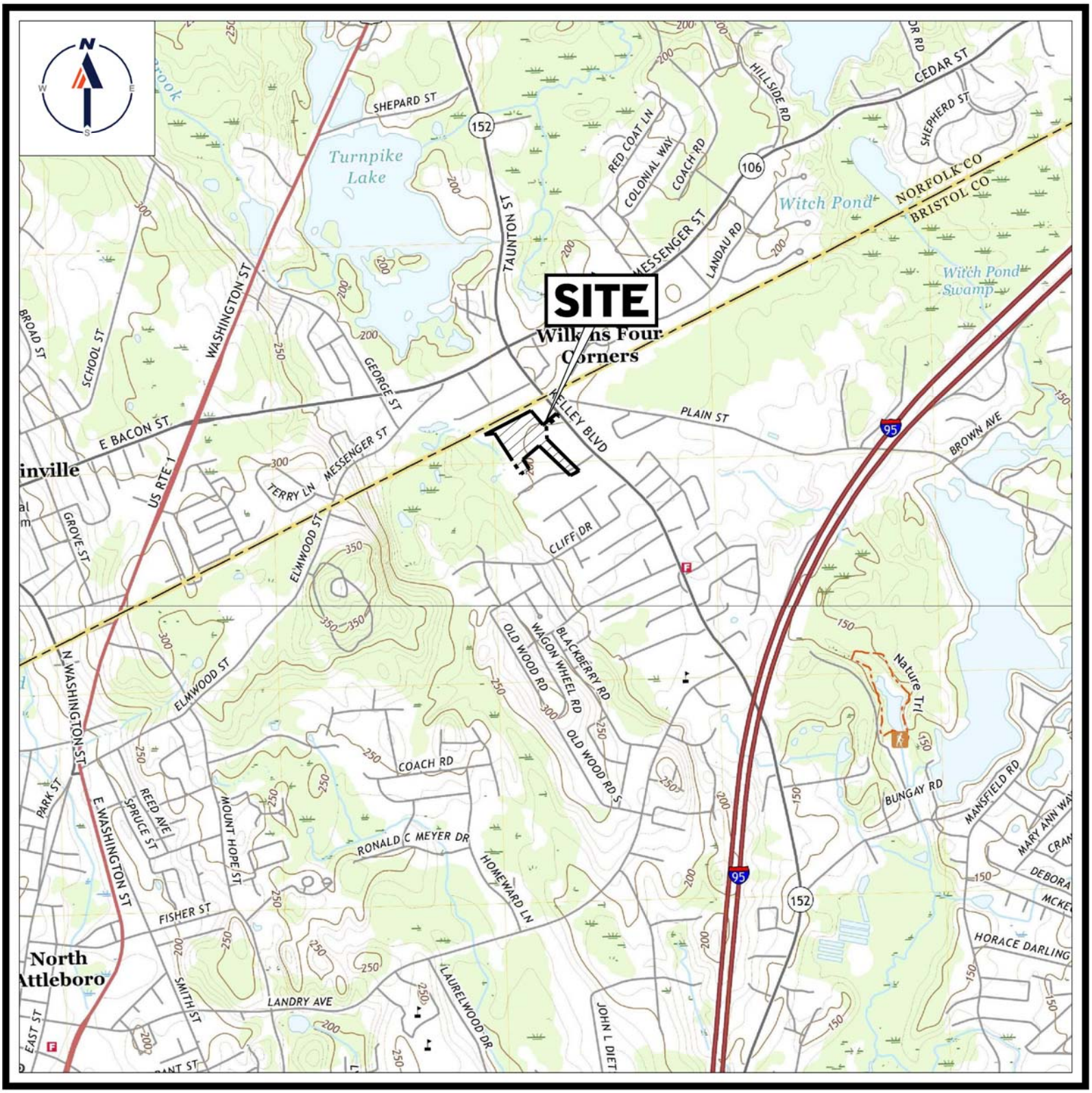
☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

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

APPENDIX B: PROJECT LOCATION MAPS

- *USGS MAP*
- *FEMA FIRMETTE*
- *NORTH ATTLEBOROUGH GIS – WELLHEAD ZONE II*



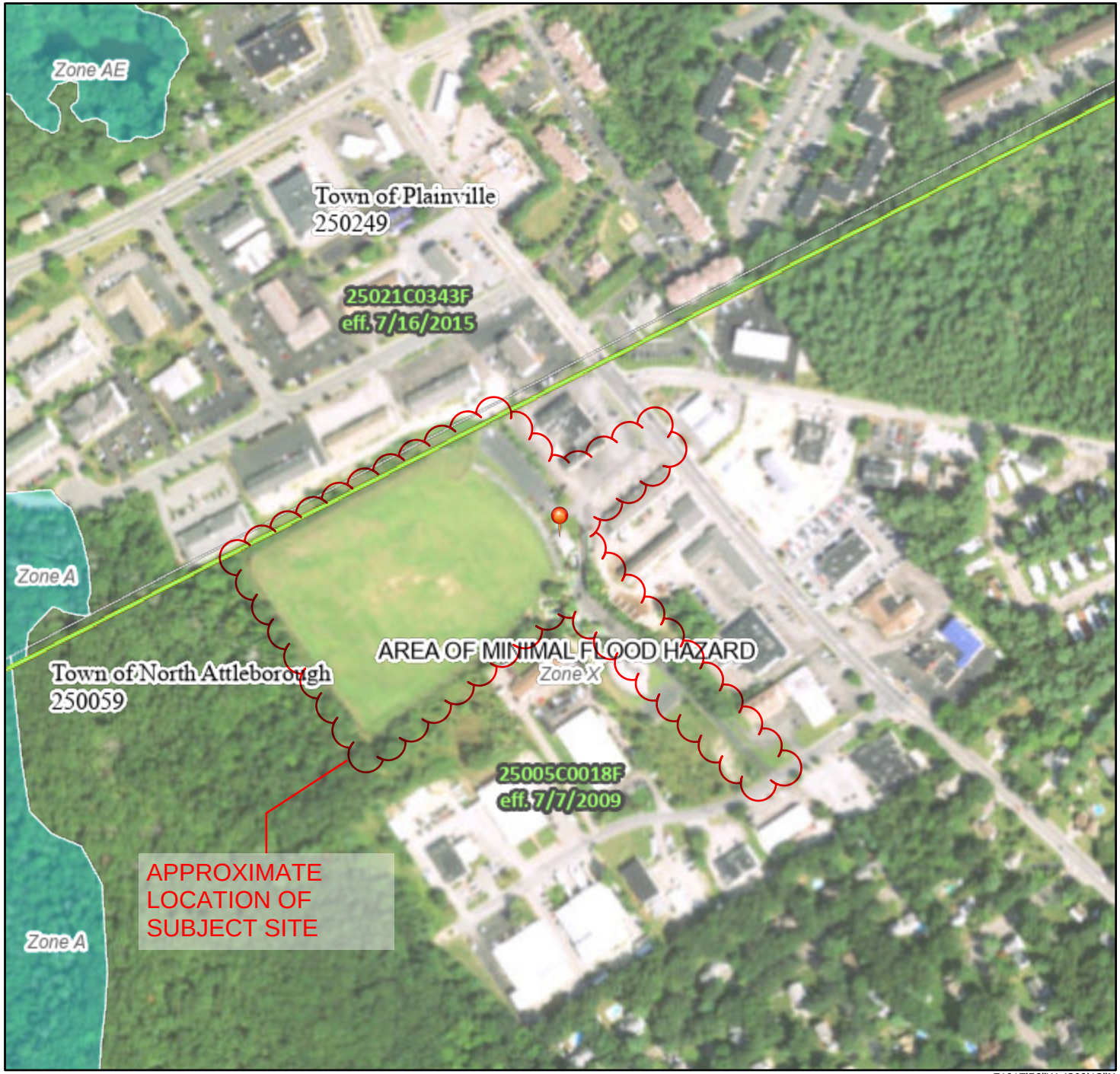
USGS MAP

SCALE: 1" = 2,000'
SOURCE: WRENTHAM AND ATTLEBORO MASSACHUSETTS USGS QUADRANGLE

National Flood Hazard Layer FIRMette

FEMA

71°18'33"W 42°0'40"N



71°17'56"W 42°0'13"N

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

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

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

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

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

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

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

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

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

N

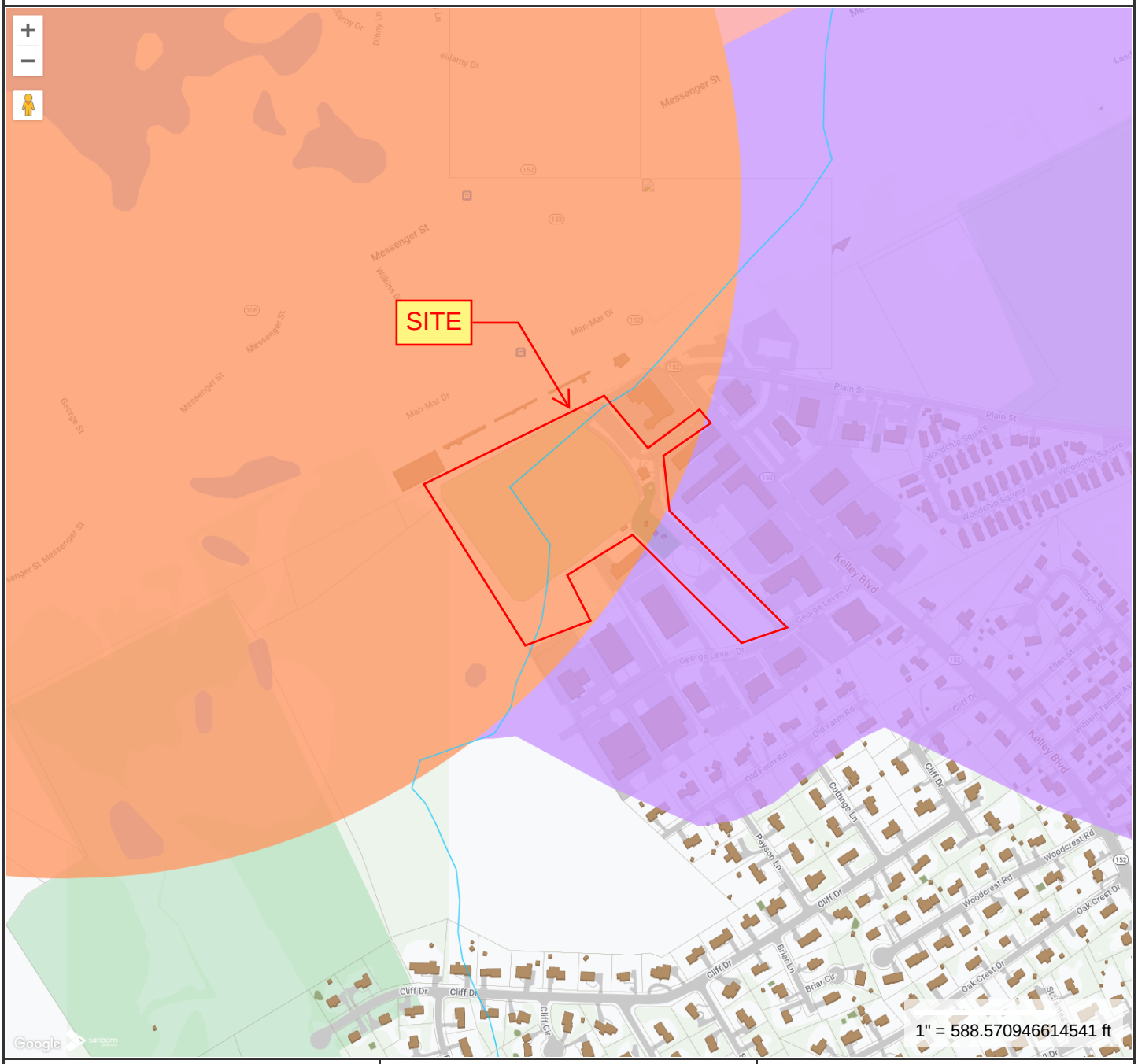
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/11/2022 at 2:43 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

Water Resource Protection



MAP FOR REFERENCE ONLY
NOT A LEGAL DOCUMENT

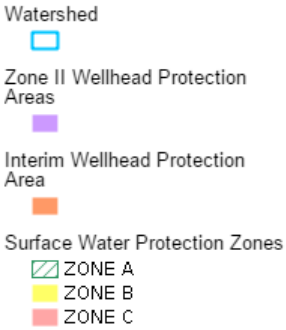
Town of North Attleborough, MA makes no claims and no warranties, expressed or implied, concerning the validity or accuracy of the GIS data presented on this map.

Geometry updated 07/01/2024
Data updated 07/01/2024

Print map scale is approximate. Critical layout or measurement activities should not be done using this resource.

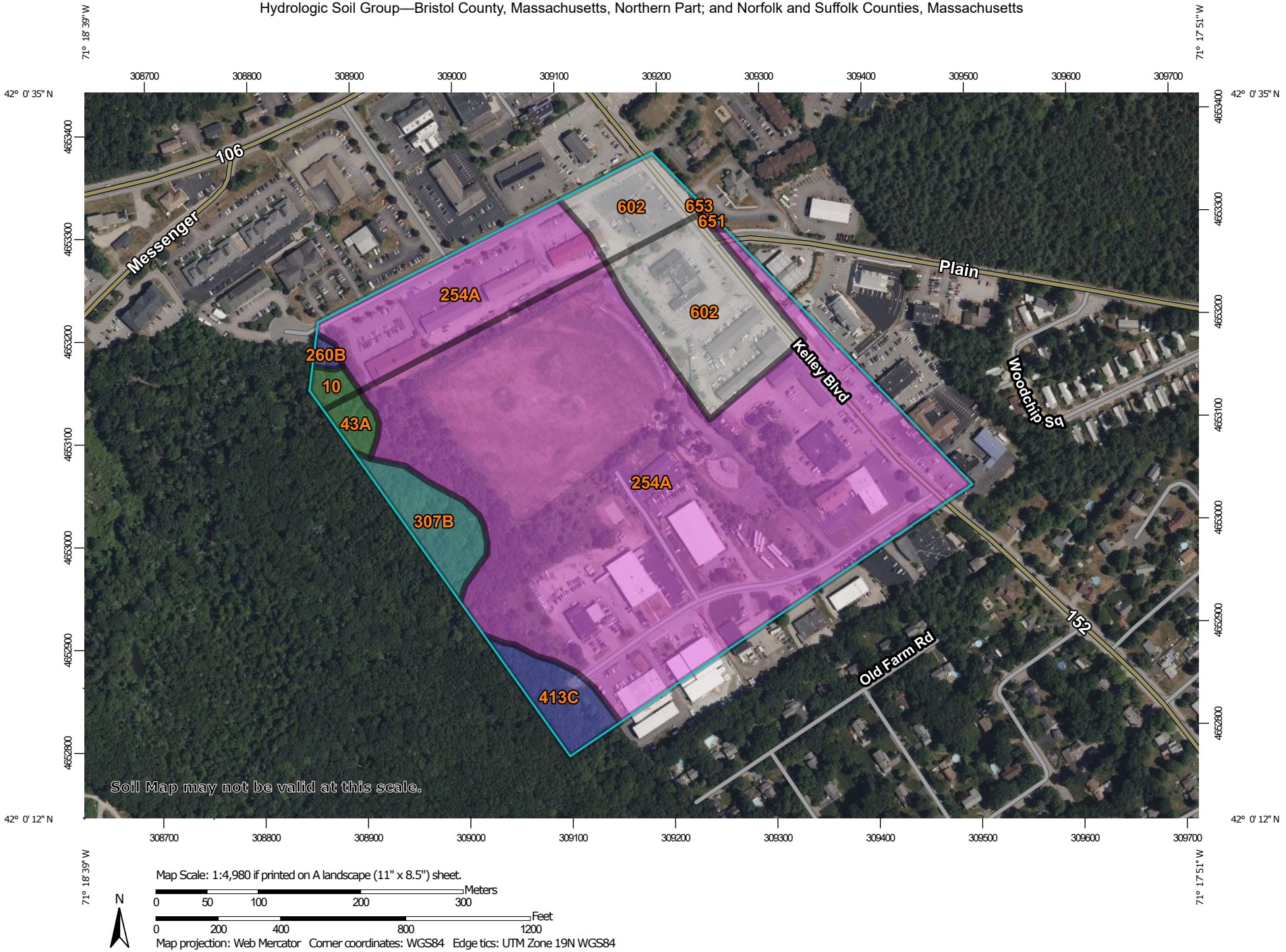
Map Theme Legends

Water Resource Protection



APPENDIX C: SOIL AND WETLAND INFORMATION

- *NCRS CUSTOM SOIL RESOURCE REPORT*
- *REPORT OF GEOTECHNICAL INVESTIGATION - COMPREHENSIVE STORMWATER MANAGEMENT AREA EVALUATION*



Map Scale: 1:4,980 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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 scales ranging from 1:20,000 to 1:25,000.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Bristol County, Massachusetts, Northern Part
Survey Area Data: Version 16, Sep 10, 2023

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 19, Sep 10, 2023

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Jun 14, 2022—Jul 1, 2022

MAP LEGEND

MAP INFORMATION

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
43A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	A/D	0.5	1.0%
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	A	34.4	68.0%
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	C	1.8	3.5%
413C	Charlton-Paxton fine sandy loams, 8 to 15 percent slopes, very stony	B	1.5	2.9%
602	Urban land		4.8	9.5%
651	Udorthents, smoothed	A	0.0	0.1%
Subtotals for Soil Survey Area			**43.0**	**85.0%**
Totals for Area of Interest			**50.6**	**100.0%**

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10	Scarboro and Birdsall soils, 0 to 3 percent slopes	A/D	0.3	0.7%
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	A	5.2	10.2%
260B	Sudbury fine sandy loam, 2 to 8 percent slopes	B	0.2	0.3%
602	Urban land, 0 to 15 percent slopes		1.9	3.8%
653	Udorthents, sandy	A	0.0	0.0%
Subtotals for Soil Survey Area			**7.6**	**15.0%**
Totals for Area of Interest			**50.6**	**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

WHITESTONE
An Employee-Owned Company

352 TURNPIKE ROAD
SUITE 105
SOUTHBOROUGH, MA 01772
508.485.0755
whitestoneassoc.com

August 21, 2024

via email

MCP 582 KELLEY, LLC
3401 Columbia Pike
Suite 410
Arlington, Virginia 22204

Attention: Ms. Caitlin Walker
Senior Development Manager

Regarding: COMPREHENSIVE STORMWATER MANAGEMENT AREA EVALUATION
PROPOSED RESIDENTIAL DEVELOPMENT
582 KELLEY BOULEVARD
MAP 35, LOT 3
NORTH ATTLEBOROUGH, BRISTOL COUNTY, MASSACHUSETTS
WHITESTONE PROJECT NO.: GM2118635.002

Dear Ms. Walker:

Whitestone Associates, Inc. (Whitestone) has completed a comprehensive stormwater management (SWM) area evaluation at the above-referenced site. Whitestone previously completed March 23, May 23, and November 29, 2022 *Limited SWM Area Evaluation* reports for the site. The purpose of these evaluations were to assess subsurface conditions, groundwater depths, estimate seasonal groundwater high (SGWH), and water infiltration rates at the site. Multiple evaluations were completed at the client's request to further assess subsurface conditions including in areas that could not be accessed during previous investigations.

1.0 PROJECT DESCRIPTION

1.1 Site Location & Existing Conditions

The approximately 18-acre subject property is located at 582 Kelley Boulevard in North Attleborough, Bristol County, Massachusetts. The site is developed with the *Stix Fun Center* golf driving range and associated structures. Wetlands and a shallow stream are located at the southwest site property boundary.

1.2 Site Geology

Based on a review of the U.S. Geological Survey *Surficial Geologic Map of the Wrentham Quadrangle, Massachusetts (2008)*, the site is underlain by coarse glacial stratified (glaciofluvial) deposits. The *Geologic Map of Massachusetts*, prepared by U.S. Geological Survey, indicates that the subject property is underlain by the Upper and Middle Pennsylvanian-aged Rhode Island Formation, consisting of sandstone and graywacke, with minor conglomerate, shale, and anthracite, part of the Milford-Dedham Zone.

1.3 Proposed Construction

Based on the February 23, 2022 *Grading and Drainage Plan* prepared by Bohler Engineering MA, LLC, the proposed redevelopment will include removal of the *Stix Fun Center* facility and construction of approximately 300 residential units, including three multi-story apartment buildings with footprints ranging

from approximately 24,210 square feet to 31,025 square feet, a pool, associated paved parking and landscaped areas. Stormwater management is proposed to consist of an infiltration system in the northwestern portion of the site and three detention ponds in the eastern portion of the site.

2.0 FIELD EXPLORATION & TESTING

2.1 Field Exploration

Field exploration at the project site consisted of advancing 24 test pits (identified as TP-1 through TP-10, TP-101 through TP-105, and TP-201 through TP-209) and three borings (identified as B-101/MW through B-103/MW. Groundwater monitoring wells were installed in the boring locations. Whitestone representatives including a Title 5 System Inspector and Soil Evaluator (SE #14233) and a Professional Engineer licensed in the Commonwealth of Massachusetts (PE# 477440 evaluated soil and groundwater conditions within the test pits. The test pits and borings subsequently were backfilled to the surface with excavated soils from the investigation after conducting percolation testing. The locations of the explorations are shown on the accompanying *Test Location Plan* included as Figure 1. *Records of Subsurface Exploration* are provided in Appendix A.

The subsurface tests were conducted in the presence of a Whitestone engineer, who conducted field tests, recorded visual classifications, and collected samples of the various strata encountered. Test locations were established in the field by taping from existing site features noted on the plan. These locations are presumed to be accurate to the degree implied by the method used.

Groundwater level observations, where encountered, were recorded during and immediately after the completion of field operations prior to backfilling the test pits. Seasonal variations, temperature effects, man-made effects, and recent rainfall conditions may influence the levels of the groundwater, and the observed levels will depend on the permeability of the soils. Groundwater elevations derived from sources other than seasonally observed groundwater monitor wells may not be representative of true groundwater levels.

2.2 Infiltration/Percolation Testing

March 23, 2022 Infiltration Testing

Field infiltration testing was conducted in the test pits and is summarized in the following table.

SUMMARY OF INFILTRATION TESTING					
Location	**Ground Elevation (feet above NAVD)***	**Groundwater Depth/Elevation (fbgs/feet NAVD)****	**Test Depth/Elevation (fbgs/feet NAVD)****	**Estimated SGWH/ Elevation (fbgs/feet NAVD)****	**Infiltration Rate (in/hr)**
TP-1	198	5.4 / 192.6	2 / 196	3.2 / 194.8	>30
TP-2	204	NE	4 / 200	-	>30
TP-3	202	4.75 / 197.25	2 / 200	2 / 200	2
TP-4	203	6.8 / 196.2	2 / 201	3.3 / 199.7	5
TP-5	204	NE	4 / 200	5 / 199	>30

*Elevations are interpolated based on the contour lines on the February 23, 2022 *Grading and Drainage Plan* prepared by Bohler Engineering MA, LLC
**NE: Not encountered; fbgs: feet below ground surface

May 23, 2022 Guelph Permeameter Infiltration Testing

Field infiltration testing was conducted with a Guelph permeameter, which has an applicable permeability range of about 0.01 inches per hour (in/hr) to 15 in/hr. Hydraulic conductivities, k_{fs}, documented by the Guelph are tabulated below and ranged from 11.5 in/hr to greater than 30 in/hr. The measured hydraulic conductivities, except for infiltration test I-9, are outside the applicable range for the Guelph permeameter. However, the measured hydraulic conductivities in infiltration tests I-6, I-7, I-8, and I-10 are still considered indicative of the higher permeability of the soil tested.

SUMMARY OF GUELPH PERMEAMETER TESTING					
Location	**Ground Elevation (feet above NAVD)***	**Groundwater Depth/Elevation (fbgs/feet NAVD)****	**Test Depth/Elevation (fbgs/feet NAVD)****	**Estimated SGWH/ Elevation (fbgs/feet NAVD)****	**Field Saturated Hydraulic Conductivity, k_{fs} (in/hr)**
I-6 (TP-6)	203	NE	2.7 / 200.3	4.8 / 198.2	25.1
I-7 (TP-7)	200	NE	2 / 198	4 / 196	>30
I-8 (TP-8)	201	NE	2 / 199	4.2 / 196.8	>30
I-9 (TP-9)	203	NE	2 / 201	3.7 / 199.3	11.5
I-10 (TP-10)	202	NE	2 / 200	3.7 / 198.3	>30

*Elevations are interpolated based on contour lines on Bohler February 23, 2022 *Grading and Drainage Plan*
**NE: Not encountered; fbgs: feet below ground surface

Typically, Whitestone recommends at least a Factor of Safety (FoS) of two be applied to field infiltration rates to account for siltation and consolidation of systems over time. Safety factors are dependent on how critical the systems are to the development. If the system is critical, a greater FoS should be applied. Infiltration rates are variable and dependent on test depth and stratification. An appropriate Factor of Safety should be selected and applied to the values above based on how critical the functionality of the systems will be.

November 29, 2022 Percolation Testing

Percolation tests were conducted in approximate 12-inch diameter and 12-inch deep holes excavated from a shelf at the side of the test pits. Water infiltrated at a rate greater than 15 inches per hour.

SUMMARY OF PERCOLATION TESTING					
Location	**Ground Elevation (ft NAVD)***	**Groundwater Depth/Elevation (fbgs/ft NAVD)***	**Test Depth/Elevation (fbgs/ft NAVD)***	**Estimated SGWH/ Elevation (fbgs/ft NAVD)***	**Percolation Rate (in/hr)**
PERC-1 (TP-101)	197	NE	3.5 / 193.5	4.8 / 191.2	>15
PERC-5 (TP-102)	198	NE	3 / 195	3.9 / 194.1	>15
PERC-2 (TP-103)	201	NE	4.5 / 196.5	7.8 / 193.2	>15

SUMMARY OF PERCOLATION TESTING					
Location	**Ground Elevation (ft NAVD)***	**Groundwater Depth/Elevation (fbgs/ft NAVD)***	**Test Depth/Elevation (fbgs/ft NAVD)***	**Estimated SGWH/ Elevation (fbgs/ft NAVD)***	**Percolation Rate (in/hr)**
PERC-3 (TP-104)	201.5	NE	4 / 197.5	4.5 / 197	>15
PERC-4 (TP-105)	198	NE	3 / 195	4.8 / 191.3	>15

*Elevations are interpolated based on contour lines on Bohler February 23, 2022 *Grading and Drainage Plan*
NE: Not encountered; fbgs: feet below ground surface

August 5, 2024 Groundwater Data

On July 31, 2024,Whitestone installed monitoring wells within borings B-101/MW through B-103/MW. Where encountered, groundwater readings were recorded immediately following well installation. Whitestone returned to the site on August 5, 2024 to record stabilized groundwater within wells. Stabilized groundwater readings can be found below.

SUMMARY OF GROUNDWATER DEPTH		
Location	**Ground Elevation (feet above NAVD)**	**Stabilized Groundwater Depth/Elevation (fbgs/feet NAVD)**
B-101/MW	203	14 / 189
B-102/MW	200	18 / 182
B-103/MW	199	17 / 182

NE: Not encountered; fbgs: feet below ground surface

3.0 SUBSURFACE CONDITIONS

The subsurface soil conditions encountered within the subsurface test locations conducted by Whitestone consisted of the following generalized strata in order of increasing depth. *Records of Subsurface Exploration* are provided in Appendix A.

Surface Cover Materials The test pits encountered 10 inches to 24 inches of topsoil at the ground surface, typically underlain by six inches to 12 inches of subsoil.

Alluvial Deposit (Intermittent): Beneath the topsoil and subsoil layers in TP-3 the former subsoil layer in TP-7 a three-inch to six inch-thick layer of an alluvial deposit was encountered which included organics. The alluvial deposit is likely associated with a historic stream to the southwest where the low-flow intermittent stream was observed.

Existing Fill (Intermittent): At the ground surface, test pits TP-101, TP-102, and TP-103 encountered existing fill, consisting of brown to dark brown, silty sand with gravel, brick and asphalt pieces. The existing fill extended to depths of 1.8 fbgs to 4.1 fbgs. In test pit TP-101, a former subsoil layer seven inches thick was encountered directly under the existing fill. In test pit TP-102, three inches of former topsoil and five inches of former subsoil were encountered directly under the existing fill.

Glaciofluvial Deposit: Beneath the surface cover materials, former topsoil/subsoil, or existing fill, the test pits encountered a glaciofluvial deposit, generally consisting of brown to gray, coarse to fine sand, some gravel, trace silt with cobbles. This stratum has significant amounts of gravel and cobbles. The test pits terminated in this stratum at depths of 5.7 fbgs to 8.7 fbgs.

Groundwater: Groundwater was encountered during the test pits at depth ranging from 4.8 fbgs to 6.8 fbgs and in the monitoring wells in the borings from 14.0 fbgs to 18.5 fbgs. Indications of the seasonal high-water level were noted Indications of the seasonal high-water level were noted in the test pits at depths ranging from two fbgs to greater than 10 fbgs. Groundwater levels should be expected to fluctuate seasonally and following periods of precipitation.

4.0 CONCLUSION

The site hydrogeological conditions are complex as result of both natural and existing development-related conditions. These complex conditions include pervious corridors of gravel, pavement surface runoff, existing infiltration systems, and the water course to the north of the site. This has caused irregular mottling and resulted in observed seasonal groundwater high elevations that vary across the site. As such, Whitestone considers that not all seasonal groundwater high elevations identified during the investigations are appropriate for use when considering the final condition of the site following redevelopment. The stratification of gravel at the site and pervious corridors result in the temporarily surge of groundwater that may change on the order of 10 feet for brief periods of time following heavy precipitation. This is demonstrated empirically through the periodic and static groundwater readings within some of the wells compared to the observed seasonal groundwater high elevations.

Locations at the site are expected to have artificial seasonal groundwater high elevations or conditions resulting in seasonal groundwater high elevations that are not relevant for the proposed development. These locations are described below:

- TP-9 and TP-10 – These locations have been influenced by a stratified soil layer within the grass area of the driving range where water is very briefly delayed during infiltration. Because of this brief delay in infiltration slight mottling occurs. The seasonal groundwater high in this area can easily be mistaken to be at a higher elevation and should not be relied upon for design.

- TP-1. TP-6, and TP-104 – Observed seasonal groundwater high in these areas is artificially high as a result of significant surface water infiltration and temporary mounding condition associated with sheet flow from impervious surfaces. This condition will change following redevelopment and likely be several feet lower at these locations.

During the latest round of investigation Whitestone carefully examined the locations of previous explorations in the field. Some locations of the site were found to not be accurately represented on the survey that was previously used to establish ground surface elevations at test locations. Discrepancies were identified at TP-101. TP-102, and TP-105 where actual ground surfaces are about one foot to two feet lower than originally shown on plans. The ground surface and estimated seasonal groundwater high elevations have been adjusted on Whitestone's logs, plan, and herein to be representative of actual conditions.

4.0 CLOSING

Whitestone's Geotechnical Division appreciates the opportunity to be of continuing service to MCP 582 Kelley, LLC. Please contact us with any questions regarding this report.

Sincerely,

WHITESTONE ASSOCIATES, INC.

Jason R. Landry
Senior Project Manager

Ryan R. Roy, P.E.
Vice President

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FIGURE 1
Test Location Plan

LEGEND

- TEST PIT
- GUELPH INFILTRATION TEST
- SOIL BORING/ MONITORING WELL
- PERC TEST

GSE — GROUND SURFACE ELEVATION
ESGWH — ESTIMATED SEASONAL GROUNDWATER HIGH

NOTE: ALL LOCATIONS ARE APPROXIMATE.

REFERENCE

THIS PLAN IS BASED UPON A 2/23/22 GRADING & DRAINAGE PLAN PREPARED BY BOHLER ENGINEERING.

WHITESTONE
An Employee-Owned Company
352 TURNPIKE ROAD, SUITE 320, SOUTHBOROUGH, MA 01772
508.485.0755 WHITESTONEASSOC.COM

DRAWING TITLE: **TEST LOCATION PLAN**

CLIENT: **MARCUS PARTNERS, INC.**

PROJECT: **PROPOSED RESIDENTIAL DEVELOPMENT**
582 KELLEY BOULEVARD
NORTH ATTLEBOROUGH, BRISTOL COUNTY, MASSACHUSETTS

PROJECT #: GM2118635.000	
DESIGNED BY: MR	PROJ. MGR.: RR
DATE: 8/20/24	FIGURE: 1
SCALE: 1" = 100'	

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APPENDIX A
Records of Subsurface Exploration

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-2

Page 1 of 1

Project:	Proposed Residential Development	**WAI Project No.:**	GM2118635.001
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

Surface Elevation:	± 204.0 feet NAVD88	**Date Started:**	3/17/2022		**Water Depth (feet bgs) | Elevation (ft NAVD88)**	**Cave-In Depth (feet bgs) | Elevation (ft NAVD88)**	
Termination Depth:	8.0 feet bgs	**Date Completed:**	3/17/2022				
Location:		**Logged By:**	JR	**During:**	-- | --		
Excavating Method:	Compact Excavator	**Contractor:**	BC	**At Completion:**	-- | --	**At Completion:**	-- | --
Test Method:	Visual Observation	**Rig Type:**	Mini Excavator	**24 Hours:**	-- | --		

SAMPLE INFORMATION			DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)				
			0.0				
				TS		12" Topsoil - Dark Brown, Medium to Fine Sand, Some Silt with Trace Organics	
			1.0				
				SUBSOIL		Orange-Brown, Medium to Fine Sand, Some Silt, Little Gravel	
			2.0				
				GLACIO-FLUVIAL DEPOSIT		Tan, Coarse to Fine Sand and Gravel, Trace Silt with Cobbles and occasional Boulders	
			5.0				
			8.0				
						Test Pit TP-2 Terminated at Depth of 8.0 Feet Below Ground Surface.	
			10.0				
			15.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-3

Page 1 of 1

Project:	Proposed Residential Development	**WAI Project No.:**	GM2118635.001
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

Surface Elevation:	± 202.0 feet NAVD88	**Date Started:**	3/17/2022		**Water Depth (feet bgs)**	**Elevation (ft NAVD88)**	**Cave-In Depth (feet bgs)** / **Elevation (ft NAVD88)**
Termination Depth:	6.5 feet bgs	**Date Completed:**	3/17/2022				
Location:		**Logged By:**	JR	**During:**	4.8	--	
Excavating Method:	Compact Excavator	**Contractor:**	BC	**At Completion:**	--	--	**At Completion:** -- / --
Test Method:	Visual Observation	**Rig Type:**	Mini Excavator	**24 Hours:**	--	--	

SAMPLE INFORMATION			DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)				
			0.0				
				TS		10" Topsoil - Dark Brown, Medium to Fine Sand, Some Silt with Trace Organics	
			0.8				
				SUBSOIL		Subsoil, Orange-Brown, Medium to Fine Sand, Some Silt, Little Gravel	
			1.8				
			2.1	ALLUVIAL		Grey, Fine Sand and Silt, Trace Gravel	Estimated SGWH = 2'
				GLACIO-FLUVIAL DEPOSIT		Brown, Coarse to Fine Sand, Some Gravel, Little Silt with Cobbles and occasional Boulders	
			5.0				
			6.5				
						Test Pit TP-3 Terminated at Depth of 6.5 Feet Below Ground Surface.	
			10.0				
			15.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-4

Page 1 of 1

Project:	Proposed Residential Development	**WAI Project No.:**	GM2118635.001
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

Surface Elevation:	± 203.0 feet NAVD88	**Date Started:**	3/17/2022		**Water Depth (feet bgs) | Elevation (ft NAVD88)**		**Cave-In Depth (feet bgs) | Elevation (ft NAVD88)**
Termination Depth:	8.0 feet bgs	**Date Completed:**	3/17/2022				
Location:		**Logged By:**	JR	**During:**	6.8 | --		
Excavating Method:	Compact Excavator	**Contractor:**	BC	**At Completion:**	-- | --	**At Completion:**	-- | --
Test Method:	Visual Observation	**Rig Type:**	Mini Excavator	**24 Hours:**	-- | --		

SAMPLE INFORMATION			DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)				
			0.0				
				TS		12" Topsoil - Dark Brown, Medium to Fine Sand, Some Silt with Trace Organics	
			1.0				
			1.5	SUBSOIL		Orange-Brown, Medium to Fine Sand, Some Silt, Little Gravel	
				GLACIO-FLUVIAL DEPOSIT		Brown, Coarse to Fine Sand, Some Gravel, Little Silt with Cobbles and occasional Boulders	Estimated SGWH = 3.3'
			5.0				
			8.0			Test Pit TP-4 Terminated at Depth of 8.0 Feet Below Ground Surface.	
			10.0				
			15.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-5

Page 1 of 1

Project:	Proposed Residential Development	**WAI Project No.:**	GM2118635.001
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

Surface Elevation:	± 204.0 feet NAVD88	**Date Started:**	3/17/2022		**Water Depth (feet bgs) | Elevation (ft NAVD88)**	**Cave-In Depth (feet bgs) | Elevation (ft NAVD88)**	
Termination Depth:	8.0 feet bgs	**Date Completed:**	3/17/2022				
Location:		**Logged By:**	JR	**During:**	-- | --		
Excavating Method:	Compact Excavator	**Contractor:**	BC	**At Completion:**	-- | --	**At Completion:**	-- | --
Test Method:	Visual Observation	**Rig Type:**	Mini Excavator	**24 Hours:**	-- | --		

SAMPLE INFORMATION			DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)				
			0.0				
				TS		12" Topsoil - Dark Brown, Medium to Fine Sand, Some Silt with Trace Organics	
			1.0				
				SUBSOIL		Orange-Brown, Medium to Fine Sand, Little Gravel and Silt with Cobbles	
			2.0				
				GLACIO-FLUVIAL DEPOSIT		Brown, Coarse to Fine Sand and Gravel, Trace Silt with Cobbles and occasional Boulders	Estimated SGWH = 5'
			5.0				
			8.0				
						Test Pit TP-5 Terminated at Depth of 8.0 Feet Below Ground Surface.	
			10.0				
			15.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-7

Page 1 of 1

Project:	Proposed Residential Development	**WAI Project No.:**	GM2118635.002
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

Surface Elevation:	± 200.0 feet NAVD88	**Date Started:**	5/20/2022		**Water Depth (feet bgs) | Elevation (ft NAVD88)**		**Cave-In Depth (feet bgs) | Elevation (ft NAVD88)**
Termination Depth:	7.0 feet bgs	**Date Completed:**	5/20/2022				
Location:	SWM Area	**Logged By:**	RK	**During:**	-- | --		
Excavating Method:	Excavator	**Contractor:**	AM	**At Completion:**	-- | --	**At Completion:**	-- | --
Test Method:	Visual Observation	**Rig Type:**	Caterpillar 375	**24 Hours:**	-- | --		

SAMPLE INFORMATION			DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)				
			0.0				
				EXISTING FILL		10" Existing Fill (Brown, Silty Sand with Gravel)	
				TOPSOIL		5" Former Topsoil	
				SUBSOIL		13" Former Subsoil, Roots	Guelph Infiltration Test @ 2 fbgs
			3.0	ALLUVIAL		Orange to Gray, Sand, Little Silt, Little Gravel	
				GLACIO-FLUVIAL DEPOSIT		Tan, Coarse to Fine Sand and Gravel, Trace Silt with Cobbles and occasional Boulders	Estimated SGWH = 4'
			5.0			Test Pit TP-7 Terminated at Depth of 7.0 Feet Below Ground Surface.	
			10.0				
			15.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-8

Page 1 of 1

Project:	Proposed Residential Development	**WAI Project No.:**	GM2118635.002
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

Surface Elevation:	± 201.0 feet NAVD88	**Date Started:**	5/20/2022		**Water Depth (feet bgs) | Elevation (ft NAVD88)**		**Cave-In Depth (feet bgs) | Elevation (ft NAVD88)**
Termination Depth:	7.0 feet bgs	**Date Completed:**	5/20/2022				
Location:	SWM Area	**Logged By:**	RK	**During:**	-- | --		
Excavating Method:	Excavator	**Contractor:**	AM	**At Completion:**	-- | --	**At Completion:**	-- | --
Test Method:	Visual Observation	**Rig Type:**	Caterpillar 375	**24 Hours:**	-- | --		

SAMPLE INFORMATION			DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)				
			0.0				
				TS		6" Topsoil	
				SUBSOIL		10" Subsoil, Roots	
				GLACIO-FLUVIAL DEPOSIT		Brown, Coarse to Fine Sand, Some Gravel, Little Silt with Cobbles and occasional Boulders	Guelph Infiltration Test @ 2 fbgs Estimated SGWH = 4.2'
			5.0				
						Test Pit TP-8 Terminated at Depth of 7.0 Feet Below Ground Surface.	
			10.0				
			15.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-101

Page 1 of 1

Project:	Proposed Residential Development	**WAI Project No.:**	GM2118635.002
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

Surface Elevation:	± 196.0 feet NAVD88	**Date Started:**	10/31/2022		**Water Depth (feet bgs)**	**Elevation (ft NAVD88)**	**Cave-In Depth (feet bgs)** / **Elevation (feet bgs)**
Termination Depth:	6.5 feet bgs	**Date Completed:**	10/31/2022				
Location:	SWM Area	**Logged By:**	RK	**During:**	--	--	
Excavating Method:	Compact Excavator	**Contractor:**	DE	**At Completion:**	--	--	**At Completion:** -- / --
Test Method:	Visual Observation	**Rig Type:**	Bobcat E35	**24 Hours:**	--	--	

SAMPLE INFORMATION			DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)				
			0.0				
				EXISTING FILL		Brown, Silty Sand with Gravel (FILL)	
			2.2				
			2.8	SUBSOIL		7" Former Subsoil, Roots	
				GLACIO-FLUVIAL DEPOSIT		Brown, Coarse to Fine Sand and Gravel, Trace Silt with Cobbles	Percolation Test @ 3.5 fbgs Estimated SGWH = 4.8 fbgs
			5.0				
						Test Pit TP-101 Terminated at Depth of 6.5 Feet Below Ground Surface.	
			10.0				
			15.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-102

Page 1 of 1

Project:	Proposed Residential Development	**WAI Project No.:**	GM2118635.002
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

				Water Depth (feet bgs) | Elevation (ft NAVD88)	Cave-In Depth (feet bgs) | Elevation (ft NAVD88)
Surface Elevation:	± 197.0 feet NAVD88	**Date Started:**	10/31/2022		
Termination Depth:	6.4 feet bgs	**Date Completed:**	10/31/2022		
Location:	SWM Area	**Logged By:**	RK	**During:** -- | --	
Excavating Method:	Compact Excavator	**Contractor:**	DE	**At Completion:** -- | --	**At Completion:** -- | --
Test Method:	Visual Observation	**Rig Type:**	Bobcat E35	**24 Hours:** -- | --	

SAMPLE INFORMATION			DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)				
			0.0				
				EXISTING FILL		Dark Brown, Silty Sand with Gravel (FILL)	
			1.8				
			2.1	TOPSOIL		3" Former Topsoil	
			2.5	SUBSOIL		5" Former Subsoil	
				GLACIO-FLUVIAL DEPOSIT		Tan, Coarse to Fine Sand and Gravel, Trace Silt with Cobbles	Estimated SGWH = 3.9 fbgs
			5.0				
			10.0			Test Pit TP-102 Terminated at Depth of 6.4 Feet Below Ground Surface.	
			15.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-103

Page 1 of 1

Project:	Proposed Residential Development	**WAI Project No.:**	GM2118635.002
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

Surface Elevation:	± 201.0 feet NAVD88	**Date Started:**	10/31/2022		**Water Depth (feet bgs) | Elevation (ft NAVD88)**		**Cave-In Depth (feet bgs) | Elevation (ft NAVD88)**
Termination Depth:	8.7 feet bgs	**Date Completed:**	10/31/2022				
Location:	SWM Area	**Logged By:**	RK	**During:**	-- | --		
Excavating Method:	Compact Excavator	**Contractor:**	DE	**At Completion:**	-- | --	**At Completion:**	-- | --
Test Method:	Visual Observation	**Rig Type:**	Bobcat E35	**24 Hours:**	-- | --		

SAMPLE INFORMATION			DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)				
			0.0				
				EXISTING FILL		Dark Brown, Silty Sand with Gravel, Brick and Asphalt Pieces (FILL)	
			4.1				
				GLACIO-FLUVIAL DEPOSIT		Gray, Coarse to Fine Sand, Some Gravel, Trace Silt with Cobbles	Percolation Test @ 4.5 fbgs Estimated SGWH = 7.8 fbgs
			5.0				
			10.0			Test Pit TP-103 Terminated at Depth of 8.7 Feet Below Ground Surface.	
			15.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-105

Page 1 of 1

Project:	Proposed Residential Development	**WAI Project No.:**	GM2118635.002
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

Surface Elevation:	± 198.0 feet NAVD88	**Date Started:**	10/31/2022		**Water Depth (feet bgs) | Elevation (ft NAVD88)**		**Cave-In Depth (feet bgs) | Elevation (ft NAVD88)**
Termination Depth:	7.5 feet bgs	**Date Completed:**	10/31/2022				
Location:	SWM Area	**Logged By:**	RK	**During:**	-- | --		
Excavating Method:	Compact Excavator	**Contractor:**	DE	**At Completion:**	-- | --	**At Completion:**	-- | --
Test Method:	Visual Observation	**Rig Type:**	Bobcat E35	**24 Hours:**	-- | --		

SAMPLE INFORMATION			DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)				
			0.0				
				TOPSOIL		12" Topsoil	
				SUBSOIL		9" Subsoil, Roots	
				GLACIO-FLUVIAL DEPOSIT		Brown, Coarse to Fine Sand, Some Gravel, Trace Silt with Cobbles	Percolation Test @ 3 fbgs Estimated SGWH = 4.8 fbgs
			5.0				
			10.0			Test Pit TP-105 Terminated at Depth of 7.5 Feet Below Ground Surface.	
			15.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-201

Page 1 of 1

Project:	Proposed Retail Development	**WAI Project No.:**	GM2118635.003
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

				Water Depth (feet bgs)	Elevation (ft NAVD88)	Cave-In Depth (feet bgs)	Elevation (ft NAVD88)
Surface Elevation:	± 204.0 feet NAVD88	**Date Started:**	8/2/2024				
Termination Depth:	9.7 feet bgs	**Date Completed:**	8/2/2024				
Proposed Location:	SWM Area	**Logged By:**	TG	**During:**	-- |		
Excavating Method:	Excavator	**Contractor:**	Earthwork Ind.	**At Completion:**	-- | --	**At Completion:**	-- | --
Test Method:	Visual Observation	**Rig Type:**	DX 85R	**24 Hours:**	-- | --		

SAMPLE INFORMATION			DEPTH	STRATA	DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)			
			0.0			
			0.5		Topsoil	
			1.8		Subsoil	
			5.0		Well Graded Sand with Gravel, Occasional Cobbles and Boulders	Estimeated Seasonal Groundwater High at 6.0 Feet
			6.0			
			10.0		Test Pit TP-201 Terminated at a depth of 9.7 Feet Below Ground Surface.	
			15.0			

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-202

Page 1 of 1

Project:	Proposed Retail Development	**WAI Project No.:**	GM2118635.003
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

				Water Depth (feet bgs)	Elevation (ft NAVD88)	Cave-In Depth (feet bgs)	Elevation (ft NAVD88)
Surface Elevation:	± 202.0 feet NAVD88	**Date Started:**	8/2/2024				
Termination Depth:	10.0 feet bgs	**Date Completed:**	8/2/2024				
Proposed Location:	SWM Area	**Logged By:**	TG	**During:**	-- |		
Excavating Method:	Excavator	**Contractor:**	Earthwork Ind.	**At Completion:**	-- | --	**At Completion:**	-- | --
Test Method:	Visual Observation	**Rig Type:**	DX 85R	**24 Hours:**	-- | --		

SAMPLE INFORMATION			DEPTH	STRATA	DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)			
			0.0			
			0.7		Topsoil	
			2.0		Subsoil	
			5.0		Well Graded Sand with Gravel, Occasional Cobbles and Boulders	
			10.0		Test Pit TP-202 Terminated at a depth of 10 Feet Below Ground Surface.	Estimeated Seasonal Groundwater High at 10 Feet
			15.0			

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-203

Page 1 of 1

Project:	Proposed Retail Development	**WAI Project No.:**	GM2118635.003
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

				Water Depth (feet bgs)	Elevation (ft NAVD88)	Cave-In Depth (feet bgs)	Elevation (ft NAVD88)
Surface Elevation:	± 201.0 feet NAVD88	**Date Started:**	8/2/2024				
Termination Depth:	10.0 feet bgs	**Date Completed:**	8/2/2024				
Proposed Location:	SWM Area	**Logged By:**	TG	**During:**	-- | --		
Excavating Method:	Excavator	**Contractor:**	Earthwork Ind.	**At Completion:**	-- | --	**At Completion:**	-- | --
Test Method:	Visual Observation	**Rig Type:**	DX 85R	**24 Hours:**	-- | --		

SAMPLE INFORMATION			DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)				
			0.0				
			0.5			Topsoil	
			1.5			Subsoil	
			5.0			Well Graded Sand with Gravel, Occasional Cobbles and Boulders	Estimeated Seasonal Groundwater High Not Encountered
			10.0			Test Pit TP-203 Terminated at a depth of 10 Feet Below Ground Surface.	
			15.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-204

Page 1 of 1

Project:	Proposed Retail Development	**WAI Project No.:**	GM2118635.003
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

Surface Elevation:	± 200.0 feet NAVD88	**Date Started:**	8/2/2024		**Water Depth (feet bgs) | Elevation (ft NAVD88)**		**Cave-In Depth (feet bgs) | Elevation (ft NAVD88)**
Termination Depth:	10.0 feet bgs	**Date Completed:**	8/2/2024				
Proposed Location:	SWM Area	**Logged By:**	TG	**During:**	-- |		
Excavating Method:	Excavator	**Contractor:**	Earthwork Ind.	**At Completion:**	-- | --	**At Completion:**	-- | --
Test Method:	Visual Observation	**Rig Type:**	DX 85R	**24 Hours:**	-- | --		

SAMPLE INFORMATION			DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)				
			0.0				
			0.5			Topsoil	
						Silty Sand with Gravel, Occasional Cobbles and Boulders	
			3.5				
						Well Graded Sand with Gravel, Occasional Cobbles and Boulders	
			5.0				
			7.0				Estimeated Seasonal Groundwater High at 7 Feet
			10.0			Test Pit TP-204 Terminated at a depth of 10 Feet Below Ground Surface.	
			15.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-205/TP-205A

Project:	Proposed Retail Development	**WAI Project No.:**	GM2118635.003
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

Surface Elevation:	± 199.0 feet NAVD88	**Date Started:**	8/5/2024		**Water Depth (feet bgs)**	**Elevation (ft NAVD88)**	**Cave-In Depth (feet bgs) / Elevation (ft NAVD88)**
Termination Depth:	3.0 feet bgs	**Date Completed:**	8/5/2024				
Proposed Location:	SWM Area	**Logged By:**	RR	**During:**	--	--	
Excavating Method:	Excavator	**Contractor:**	Earthwork Ind.	**At Completion:**	--	--	**At Completion:** -- / --
Test Method:	Visual Observation	**Rig Type:**	DX 85R	**24 Hours:**	--	--	

SAMPLE INFORMATION			DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)				
			0.0				
			0.25			Topsoil	
			0.75			Subsoil	
						Well Graded Sand and Gravel, Little Silt	
			3.0				Possible Leach Field Stone Encountered
						Test Pit TP-205 Terminated at a depth of 3.0 Feet Below Ground Surface.	
			5.0				
			10.0				
			15.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-206

Page 1 of 1

Project:	Proposed Retail Development	**WAI Project No.:**	GM2118635.003
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

				Water Depth | Elevation (feet bgs) | (ft NAVD88)	Cave-In Depth | Elevation (feet bgs) | (ft NAVD88)
Surface Elevation:	± 199.0 feet NAVD88	**Date Started:**	8/5/2024		
Termination Depth:	10.5 feet bgs	**Date Completed:**	8/5/2024		
Proposed Location:	SWM Area	**Logged By:**	RR	**During:** -- |	
Excavating Method:	Excavator	**Contractor:**	Earthwork Ind.	**At Completion:** -- | --	**At Completion:** -- | --
Test Method:	Visual Observation	**Rig Type:**	DX 85R	**24 Hours:** -- | --	

SAMPLE INFORMATION			DEPTH	STRATA	DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)			
			0.0			
			0.25		Topsoil	
			0.75		Subsoil	
					Silty Sand with Gravel, Occasional Cobbles	
			4.0			
					Well Graded Sand and Gravel, Trace Silt, Occasional Cobbles	
			5.0			
			8.0			Estimeated Seasonal Groundwater High at 8.0 Feet
			10.0			
			10.5			
					Test Pit TP-206 Terminated at a depth of10.5 Feet Below Ground Surface.	
			15.0			

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-207

Page 1 of 1

Project:	Proposed Retail Development	**WAI Project No.:**	GM2118635.003
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

				Water Depth | Elevation (feet bgs) | (ft NAVD88)	Cave-In Depth | Elevation (feet bgs) | (ft NAVD88)
Surface Elevation:	± 198.0 feet NAVD88	**Date Started:**	8/5/2024		
Termination Depth:	10.5 feet bgs	**Date Completed:**	8/5/2024		
Proposed Location:	SWM Area	**Logged By:**	RR	**During:** -- |	
Excavating Method:	Excavator	**Contractor:**	Earthwork Ind.	**At Completion:** -- | --	**At Completion:** -- | --
Test Method:	Visual Observation	**Rig Type:**	DX 85R	**24 Hours:** -- | --	

SAMPLE INFORMATION			DEPTH	STRATA	DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)			
			0.0			
			0.25		Topsoil	
			0.75		Subsoil	
			5.0		Well Graded Sand with Gravel, Occasional Cobbles	
			6.0			Estimeated Seasonal Groundwater High at 5.8 Feet
			7.5		Poorly Graded Sand With Gravel	
			8.0		Well Graded Sand with Gravel, Occasional Cobbles	
			10.0			
			10.5		Test Pit TP-207 Terminated at a depth of10.5 Feet Below Ground Surface.	
			15.0			

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-208

Page 1 of 1

Project:	Proposed Retail Development	**WAI Project No.:**	GM2118635.003
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

				Water Depth (feet bgs)	Water Elevation (ft NAVD88)	Cave-In Depth (feet bgs)	Cave-In Elevation (ft NAVD88)
Surface Elevation:	± 198.0 feet NAVD88	**Date Started:**	8/5/2024				
Termination Depth:	10.0 feet bgs	**Date Completed:**	8/5/2024				
Proposed Location:	SWM Area	**Logged By:**	RR	**During:**	--		
Excavating Method:	Excavator	**Contractor:**	Earthwork Ind.	**At Completion:**	--	**At Completion:**	--
Test Method:	Visual Observation	**Rig Type:**	DX 85R	**24 Hours:**	--		

SAMPLE INFORMATION			DEPTH	STRATA	DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)			
			0.0			
			0.25		Topsoil	
			1.0		Subsoil	
			5.0		Well Graded Sand with Gravel, Occasional Cobbles	
			9.0			Estimeated Seasonal Groundwater High at 9.0 Feet
			10.0			
					Test Pit TP-208 Terminated at a depth of10.0 Feet Below Ground Surface.	
			15.0			

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Test Pit No.: TP-209

Page 1 of 1

Project:	Proposed Retail Development	**WAI Project No.:**	GM2118635.003
Location:	582 Kelley Boulevard, North Attleborough, Bristol County, Massachusetts	**Client:**	MCP 582 Kelley, LLC

				Water Depth | Elevation	Cave-In Depth | Elevation
				(feet bgs) | (ft NAVD88)	(feet bgs) | (ft NAVD88)
Surface Elevation:	± 198.0 feet NAVD88	**Date Started:**	8/5/2024		
Termination Depth:	10.0 feet bgs	**Date Completed:**	8/5/2024		
Proposed Location:	SWM Area	**Logged By:**	RR	**During:** -- |	
Excavating Method:	Excavator	**Contractor:**	Earthwork Ind.	**At Completion:** -- | --	**At Completion:** -- | --
Test Method:	Visual Observation	**Rig Type:**	DX 85R	**24 Hours:** -- | --	

SAMPLE INFORMATION			DEPTH	STRATA	DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (ft.)	Number	Type	(feet)			
			0.0			
			0.25		Topsoil	
			1.0		Subsoil	
					Well Graded Sand with Gravel, Occasional Cobbles	
			4.0		Well Graded Gravel	
			5.0			
			5.5		Well Graded Sand with Gravel, Occasional Cobbles	
			7.0		Well Graded Sand with Gravel, Occasional Cobbles and Boulders	
			9.0			
			10.0		Test Pit TP-209 Terminated at a depth of 10.0 Feet Below Ground Surface.	
			15.0			

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-101/MW

Project:	Proposed Residential Development	**WAI Project No.:**	GM2118635.000
Location:	582 Kelley Boulevard Rear, North Attleborough, Bristol County, Massachusetts	**Client:**	MP Properties III, LLC
Surface Elevation:	± 203.0 feet above NAVD88	**Date Started:**	7/31/2024
Termination Depth:	21.0 feet bgs	**Date Completed:**	7/31/2024
Proposed Location:	Stormwater Area	**Logged By:**	TG
Drill / Test Method:	HSA / SPT (Autohammer)	**Contractor:**	GL
	4" FWC & Roller Bit	**Equipment:**	CME 55

Water Depth | Elevation (feet bgs) | (ft NAVD88)		Cave-In Depth | Elevation (feet bgs) | (ft NAVD88)	
During:	14.0 | --		
At Completion:	-- | --	**At Completion:**	-- | --
24 Hours:	14.0 | --	**24 Hours:**	-- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0				
0 - 2	S-1		3 - 7 - 13 - 26	12	20		TS		12" Topsoil	
						2.0	SUBSOIL		12" Subsoil	Cobbles and boulders throughout boring
2 - 3	S-2		49 - 70	9	-				Brown, Very Dense, Well-Graded Gravel with Silt and Sand (GW-GM)	
						5.0				
5 - 5.8	S-3		73 - 56/3"	6	-				As Above (GW-GM)	
7 - 7.7	S-4		53 - 70/2"	3	-				As Above (GW-GM)	
						10.0	GLACIO-FLUVIAL DEPOSIT			
10 - 10.5	S-5		90	2	-				As Above (GW-GM)	Hollow Stem Auger Refusal at depth of 10 fbgs.
14 - 16	S-6		17 - 13 - 11 - 53	7	24	15.0			As Above, Medium Dense (GW-GM)	
19 - 21	S-7		31 - 38 - 41 - 28	8	79	20.0			As Above (GW-GM)	Installed Groundwater Monitoring Well in Borehole
						25.0			Boring Log B-101 Terminated at Depth of 21.0 feet below ground surface.	

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-102/MW

Project:	Proposed Residential Development	**WAI Project No.:**	GM2118635.000
Location:	582 Kelley Boulevard Rear, North Attleborough, Bristol County, Massachusetts	**Client:**	MP Properties III, LLC
Surface Elevation:	± 200.0 feet above NAVD88	**Date Started:**	8/1/2024
Termination Depth:	29.0 feet bgs	**Date Completed:**	8/1/2024
Proposed Location:	Stormwater Area	**Logged By:**	TG
Drill / Test Method:	4" FWC & Roller Bit	**Contractor:**	GL
	SPT (Autohammer)	**Equipment:**	CME 55

	Water Depth (feet bgs)	Elevation (ft NAVD88)	Cave-In Depth (feet bgs)	Elevation (ft NAVD88)
During:	18.0	--		
At Completion:	--	--	**At Completion:**	-- / --
24 Hours:	18.5	--	**24 Hours:**	-- / --

Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	DEPTH (feet)	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
						0.0				
							Subbase		8" Granular Subbase	Cobbles and boulders throughout boring
0 - 2	S-1	X	16 - 18 - 15 - 10	13	33		FILL		Brown, Dense, Silty Sand with Gravel (FILL)	
2 - 4	S-2	X	18 - 13 - 20 - 28	16	33	4.0			As Above (FILL)	
5 - 5.4	S-3	X	23 - 36 - 50/5"	10	72	5.0	GLACIO-FLUVIAL DEPOSIT		Brown, Very Dense, Poorly Graded Sand with Silt and Gravel (SP-SM)	
9 - 11	S-4	X	23 - 27 - 29 - 22	10	56	10.0			As Above (S{-SM)	
14 - 16	S-5	X	21 - 23 - 28 - 41	0	51	15.0			Very Dense, No Recovery	
19 - 21	S-6	X	13 - 10 - 8 - 9	12	18	20.0			Brown, Medium Dense, Well-Graded Gravel with Silt and Sand (GW-GM)	
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-102/MW

Project:	Proposed Residential Development	**WAI Project No.:**	GM2118635.000
Location:	582 Kelley Boulevard Rear, North Attleborough, Bristol County, Massachusetts	**Client:**	MP Properties III, LLC

Surface Elevation:	± 200.0 feet above NAVD88	**Date Started:**	8/1/2024		**Water Depth | Elevation** (feet bgs) | (ft NAVD88)	**Cave-In Depth | Elevation** (feet bgs) | (ft NAVD88)
Termination Depth:	29.0 feet bgs	**Date Completed:**	8/1/2024			
Proposed Location:	Stormwater Area	**Logged By:**	TG	**During:**	18.0 | --	
Drill / Test Method:	4" FWC & Roller Bit	**Contractor:**	GL	**At Completion:**	-- | --	**At Completion:** -- | --
	SPT (Autohammer)	**Equipment:**	CME 55	**24 Hours:**	18.5 | --	**24 Hours:** -- | --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						25.0	GLACIO-FLUVIAL DEPOSIT			Installed Groundwater Monitoring Well in Borehole
						30.0			Boring Log B-102 Terminated at Depth of 29.0 feet below ground surface.	
						35.0				
						40.0				
						45.0				
						50.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

RECORD OF SUBSURFACE EXPLORATION

Boring No.: B-103/MW

Project:	Proposed Residential Development	**WAI Project No.:**	GM2118635.000
Location:	582 Kelley Boulevard Rear, North Attleborough, Bristol County, Massachusetts	**Client:**	MP Properties III, LLC
Surface Elevation:	± 199.0 feet above NAVD88	**Date Started:**	8/1/2024
Termination Depth:	19.0 feet bgs	**Date Completed:**	8/1/2024
Proposed Location:	Stormwater Area	**Logged By:**	TG
Drill / Test Method:	4" FWC & Roller Bit	**Contractor:**	GL
	SPT (Autohammer)	**Equipment:**	CME 55

	Water Depth (feet bgs)	Elevation (ft NAVD88)	Cave-In Depth (feet bgs)	Elevation (ft NAVD88)
During:	--	--		
At Completion:	--	--	**At Completion:**	-- / --
24 Hours:	17.5	--	**24 Hours:**	-- / --

SAMPLE INFORMATION						DEPTH	STRATA		DESCRIPTION OF MATERIALS (Classification)	REMARKS
Depth (feet)	No	Type	Blows Per 6"	Rec. (in.)	N	(feet)				
						0.0				
							TS		5" Topsoil	
0 - 2	S-1		9 - 21 - 18 - 23	16	39				Brown, Medium Dense, Silty Sand with Gravel (FILL)	Cobbles and boulders throughout boring
2 - 2.9	S-2		72 - 45/5"	7	-		FILL		As Above (FILL)	
						4.0				
4 - 6	S-3		26 - 39 - 60 - 58	18	99	5.0			Brown, Very Dense, Poorly Graded Sand with Silt and Gravel (SP-SM)	
						10.0	GLACIO-FLUVIAL DEPOSIT			
						15.0				Installed Groundwater Monitoring Well in Borehole
						20.0			Boring Log B-103 Terminated at Depth of 19.0 feet below ground surface.	
						25.0				

NOTES: bgs = below ground surface, msl = mean sea level, NA = Not Applicable, NE = Not Encountered, NS = Not Surveyed, P = Perched

WHITESTONE

APPENDIX B
Supplemental Information (USCS, Terms & Symbols)

WHITESTONE
An Employee-Owned Company

16 Old Forge Road
Suite A
Rocky Hill, CT 06067
860.726.7889
whitestoneassoc.com

UNIFIED SOIL CLASSIFICATION SYSTEM

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMITS LESS THAN 50	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMITS GREATER THAN 50	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS FOR SAMPLES WITH 5% TO 12% FINES

GRADATION*

% FINER BY WEIGHT

TRACE..... 1% TO 10%
LITTLE..... 10% TO 20%
SOME..... 20% TO 35%
AND..... 35% TO 50%

COMPACTNESS*
Sand and/or Gravel

RELATIVE DENSITY

LOOSE. ..... 0% TO 40%
MEDIUM DENSE.... 40% TO 70%
DENSE..... 70% TO 90%
VERY DENSE..... 90% TO 100%

CONSISTENCY*
Clay and/or Silt

RANGE OF SHEARING STRENGTH IN POUNDS PER SQUARE FOOT

VERY SOFT..... LESS THAN 250
SOFT..... ..... 250 TO 500
MEDIUM..... 500 TO 1000
STIFF..... 1000 TO 2000
VERY STIFF..... 2000 TO 4000
HARD..... GREATER THAN 4000

** VALUES ARE FROM LABORATORY OR FIELD TEST DATA, WHERE APPLICABLE. WHEN NO TESTING WAS PERFORMED, VALUES ARE ESTIMATED.*

L:\Geotechnical Forms and References\Reports\USCSTRMSSYM CT.docx

WHITESTONE
An Employee-Owned Company

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Rocky Hill, CT 06067
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GEOTECHNICAL TERMS AND SYMBOLS

SAMPLE IDENTIFICATION

The Unified Soil Classification System is used to identify the soil unless otherwise noted.

SOIL PROPERTY SYMBOLS

N: Standard Penetration Value: Blows per ft. of a 140 lb. hammer falling 30" on a 2" O.D. split-spoon.
Qu: Unconfined compressive strength, TSF.
Qp: Penetrometer value, unconfined compressive strength, TSF.
Mc: Moisture content, %.
LL: Liquid limit, %.
PI: Plasticity index, %.
δd: Natural dry density, PCF.
▼: Apparent groundwater level at time noted after completion of boring.

DRILLING AND SAMPLING SYMBOLS

NE: Not Encountered (Groundwater was not encountered).
SS: Split-Spoon - 1 ⅜" I.D., 2" O.D., except where noted.
ST: Shelby Tube - 3" O.D., except where noted.
AU: Auger Sample.
OB: Diamond Bit.
CB: Carbide Bit
WS: Washed Sample.

RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

Term (Non-Cohesive Soils)	Standard Penetration Resistance
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

Term (Cohesive Soils)	Qu (TSF)
Very Soft	0 - 0.25
Soft	0.25 - 0.50
Firm (Medium)	0.50 - 1.00
Stiff	1.00 - 2.00
Very Stiff	2.00 - 4.00
Hard	4.00+

PARTICLE SIZE

Boulders	8 in.+	Coarse Sand	5mm-0.6mm	Silt	0.074mm-0.005mm
Cobbles	8 in.-3 in.	Medium Sand	0.6mm-0.2mm	Clay	-0.005mm
Gravel	3 in.-5mm	Fine Sand	0.2mm-0.074mm		

Other Office Locations:

Warren, NJ 908.668.7777 | Chalfont, PA 215.712.2700 | Southborough, MA 508.485.0755 | Wall, NJ 732.592.2101 | Philadelphia, PA 215.848.2323 | Bedford, NH 603.514.2230 | Tampa, FL 813.851.0690

Environmental & Geotechnical Engineers & Consultants

APPENDIX D: EXISTING CONDITIONS HYDROLOGIC ANALYSIS

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

LEGEND

- WATERSHED BOUNDARY
- TIME OF CONCENTRATION
- DP# — DESIGN POINT
- # — SUBCATCHMENT

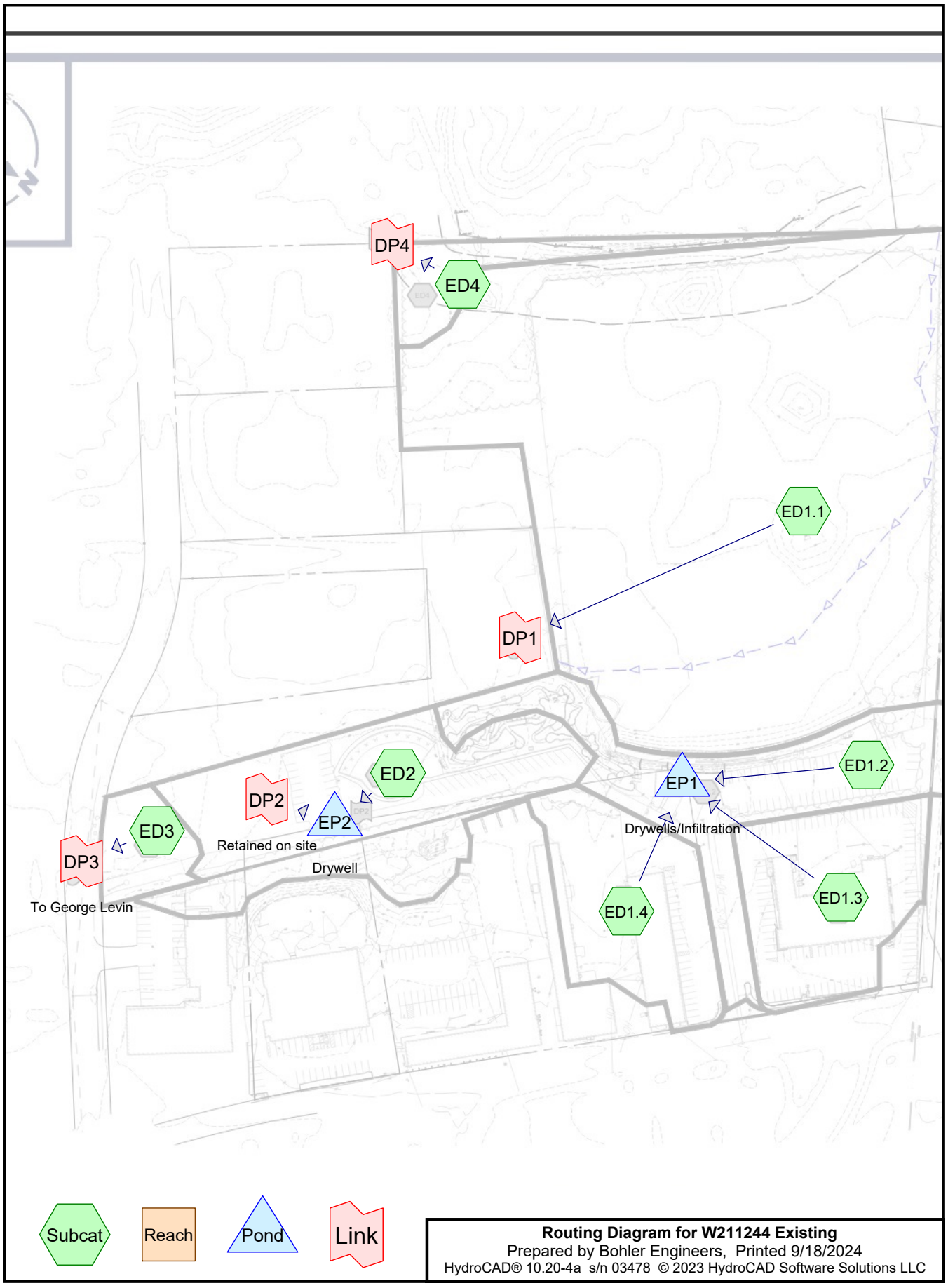
EXISTING CONDITIONS WATERSHED MAP

582 KELLEY BOULEVARD,
NORTH ATTELBOROUGH, MA

PREPARED BY

BOHLER

SCALE: 1"=150'
DATE: 9/17/2024



Routing Diagram for W211244 Existing
Prepared by Bohler Engineers, Printed 9/18/2024

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
11.237	39	>75% Grass cover, Good, HSG A (ED1.1, ED1.2, ED1.3, ED1.4, ED2, ED3, ED4)
0.795	96	Gravel surface, HSG A (ED1.2, ED1.4, ED2)
4.289	98	Paved parking, HSG A (ED1.1, ED1.2, ED1.3, ED1.4, ED2, ED3, ED4)
1.055	98	Roofs, HSG A (ED1.1, ED1.2, ED1.3, ED1.4)
1.363	30	Woods, Good, HSG A (ED1.1, ED4)
18.739	**58**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
18.739	HSG A	ED1.1, ED1.2, ED1.3, ED1.4, ED2, ED3, ED4
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
18.739		**TOTAL AREA**

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment ED1.1: Runoff Area=10.885 ac 8.57% Impervious Runoff Depth=0.28"
Flow Length=970' Tc=44.0 min CN=WQ Runoff=1.47 cfs 0.250 af

Subcatchment ED1.2: Runoff Area=2.054 ac 69.28% Impervious Runoff Depth=2.37"
Tc=6.0 min CN=WQ Runoff=5.09 cfs 0.405 af

Subcatchment ED1.3: Runoff Area=1.326 ac 92.99% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=WQ Runoff=4.07 cfs 0.325 af

Subcatchment ED1.4: Runoff Area=1.271 ac 54.62% Impervious Runoff Depth=2.92"
Tc=6.0 min CN=WQ Runoff=3.94 cfs 0.309 af

Subcatchment ED2: Runoff Area=2.272 ac 42.76% Impervious Runoff Depth=1.57"
Tc=6.0 min CN=WQ Runoff=3.73 cfs 0.297 af

Subcatchment ED3: Runoff Area=0.379 ac 15.37% Impervious Runoff Depth=0.49"
Tc=6.0 min CN=WQ Runoff=0.19 cfs 0.015 af

Subcatchment ED4: Runoff Area=0.554 ac 5.69% Impervious Runoff Depth=0.18"
Tc=6.0 min CN=WQ Runoff=0.10 cfs 0.008 af

Pond EP1: Drywells/Infiltration Inflow=13.10 cfs 1.040 af
Primary=13.10 cfs 1.040 af

Pond EP2: Drywell Inflow=3.73 cfs 0.297 af
Primary=3.73 cfs 0.297 af

Link DP1: Inflow=1.47 cfs 0.250 af
Primary=1.47 cfs 0.250 af

Link DP2: Retained on site Inflow=3.73 cfs 0.297 af
Primary=3.73 cfs 0.297 af

Link DP3: To George Levin Inflow=0.19 cfs 0.015 af
Primary=0.19 cfs 0.015 af

Link DP4: Inflow=0.10 cfs 0.008 af
Primary=0.10 cfs 0.008 af

Total Runoff Area = 18.739 ac Runoff Volume = 1.610 af Average Runoff Depth = 1.03"
71.48% Pervious = 13.395 ac 28.52% Impervious = 5.344 ac

Summary for Subcatchment ED1.1:

Runoff = 1.47 cfs @ 12.57 hrs, Volume= 0.250 af, Depth= 0.28"
Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
9.068	39	>75% Grass cover, Good, HSG A
0.586	98	Paved parking, HSG A
0.347	98	Roofs, HSG A
0.884	30	Woods, Good, HSG A
10.885		Weighted Average
9.952		91.43% Pervious Area
0.933		8.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	20	0.0300	0.04		**Sheet Flow, A-B** Woods: Dense underbrush n= 0.800 P2= 3.40"
4.5	30	0.0300	0.11		**Sheet Flow, B-C** Grass: Dense n= 0.240 P2= 3.40"
31.0	920	0.0050	0.49		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
44.0	970	Total			

Summary for Subcatchment ED1.2:

Runoff = 5.09 cfs @ 12.08 hrs, Volume= 0.405 af, Depth= 2.37"
Routed to Pond EP1 : Drywells/Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.511	39	>75% Grass cover, Good, HSG A
0.120	96	Gravel surface, HSG A
1.313	98	Paved parking, HSG A
0.110	98	Roofs, HSG A
2.054		Weighted Average
0.631		30.72% Pervious Area
1.423		69.28% Impervious Area

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

Summary for Subcatchment ED1.3:

Runoff = 4.07 cfs @ 12.08 hrs, Volume= 0.325 af, Depth= 2.94"
Routed to Pond EP1 : Drywells/Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.093	39	>75% Grass cover, Good, HSG A
0.921	98	Paved parking, HSG A
0.312	98	Roofs, HSG A
1.326		Weighted Average
0.093		7.01% Pervious Area
1.233		92.99% Impervious Area

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

Summary for Subcatchment ED1.4:

Runoff = 3.94 cfs @ 12.08 hrs, Volume= 0.309 af, Depth= 2.92"
Routed to Pond EP1 : Drywells/Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.063	39	>75% Grass cover, Good, HSG A
0.514	96	Gravel surface, HSG A
0.408	98	Paved parking, HSG A
0.286	98	Roofs, HSG A
1.271		Weighted Average
0.577		45.38% Pervious Area
0.694		54.62% Impervious Area

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

Summary for Subcatchment ED2:

Runoff = 3.73 cfs @ 12.08 hrs, Volume= 0.297 af, Depth= 1.57"
Routed to Pond EP2 : Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
1.138	39	>75% Grass cover, Good, HSG A
0.162	96	Gravel surface, HSG A
0.971	98	Paved parking, HSG A
2.272		Weighted Average
1.300		57.24% Pervious Area
0.971		42.76% Impervious Area

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

Summary for Subcatchment ED3:

Runoff = 0.19 cfs @ 12.08 hrs, Volume= 0.015 af, Depth= 0.49"
Routed to Link DP3 : To George Levin

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.321	39	>75% Grass cover, Good, HSG A
0.058	98	Paved parking, HSG A
0.379		Weighted Average
0.321		84.63% Pervious Area
0.058		15.37% Impervious Area

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

Summary for Subcatchment ED4:

Runoff = 0.10 cfs @ 12.08 hrs, Volume= 0.008 af, Depth= 0.18"
Routed to Link DP4 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.043	39	>75% Grass cover, Good, HSG A
0.032	98	Paved parking, HSG A
0.479	30	Woods, Good, HSG A
0.554		Weighted Average
0.522		94.31% Pervious Area
0.032		5.69% Impervious Area

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

Summary for Pond EP1: Drywells/Infiltration

Inflow Area = 4.650 ac, 72.04% Impervious, Inflow Depth = 2.68" for 2-Year event
Inflow = 13.10 cfs @ 12.08 hrs, Volume= 1.040 af
Primary = 13.10 cfs @ 12.08 hrs, Volume= 1.040 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond EP2: Drywell

Inflow Area = 2.272 ac, 42.76% Impervious, Inflow Depth = 1.57" for 2-Year event
Inflow = 3.73 cfs @ 12.08 hrs, Volume= 0.297 af
Primary = 3.73 cfs @ 12.08 hrs, Volume= 0.297 af, Atten= 0%, Lag= 0.0 min
Routed to Link DP2 : Retained on site

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP1:

Inflow Area = 10.885 ac, 8.57% Impervious, Inflow Depth = 0.28" for 2-Year event
Inflow = 1.47 cfs @ 12.57 hrs, Volume= 0.250 af
Primary = 1.47 cfs @ 12.57 hrs, Volume= 0.250 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP2: Retained on site

Inflow Area = 2.272 ac, 42.76% Impervious, Inflow Depth = 1.57" for 2-Year event
Inflow = 3.73 cfs @ 12.08 hrs, Volume= 0.297 af
Primary = 3.73 cfs @ 12.08 hrs, Volume= 0.297 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP3: To George Levin

Inflow Area = 0.379 ac, 15.37% Impervious, Inflow Depth = 0.49" for 2-Year event
Inflow = 0.19 cfs @ 12.08 hrs, Volume= 0.015 af
Primary = 0.19 cfs @ 12.08 hrs, Volume= 0.015 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP4:

Inflow Area = 0.554 ac, 5.69% Impervious, Inflow Depth = 0.18" for 2-Year event
Inflow = 0.10 cfs @ 12.08 hrs, Volume= 0.008 af
Primary = 0.10 cfs @ 12.08 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment ED1.1: Runoff Area=10.885 ac 8.57% Impervious Runoff Depth=0.63"
Flow Length=970' Tc=44.0 min CN=WQ Runoff=2.35 cfs 0.567 af

Subcatchment ED1.2: Runoff Area=2.054 ac 69.28% Impervious Runoff Depth=3.77"
Tc=6.0 min CN=WQ Runoff=7.83 cfs 0.645 af

Subcatchment ED1.3: Runoff Area=1.326 ac 92.99% Impervious Runoff Depth=4.62"
Tc=6.0 min CN=WQ Runoff=6.26 cfs 0.511 af

Subcatchment ED1.4: Runoff Area=1.271 ac 54.62% Impervious Runoff Depth=4.63"
Tc=6.0 min CN=WQ Runoff=6.10 cfs 0.490 af

Subcatchment ED2: Runoff Area=2.272 ac 42.76% Impervious Runoff Depth=2.57"
Tc=6.0 min CN=WQ Runoff=5.74 cfs 0.487 af

Subcatchment ED3: Runoff Area=0.379 ac 15.37% Impervious Runoff Depth=0.96"
Tc=6.0 min CN=WQ Runoff=0.30 cfs 0.030 af

Subcatchment ED4: Runoff Area=0.554 ac 5.69% Impervious Runoff Depth=0.31"
Tc=6.0 min CN=WQ Runoff=0.16 cfs 0.014 af

Pond EP1: Drywells/Infiltration Inflow=20.18 cfs 1.645 af
Primary=20.18 cfs 1.645 af

Pond EP2: Drywell Inflow=5.74 cfs 0.487 af
Primary=5.74 cfs 0.487 af

Link DP1: Inflow=2.35 cfs 0.567 af
Primary=2.35 cfs 0.567 af

Link DP2: Retained on site Inflow=5.74 cfs 0.487 af
Primary=5.74 cfs 0.487 af

Link DP3: To George Levin Inflow=0.30 cfs 0.030 af
Primary=0.30 cfs 0.030 af

Link DP4: Inflow=0.16 cfs 0.014 af
Primary=0.16 cfs 0.014 af

Total Runoff Area = 18.739 ac Runoff Volume = 2.745 af Average Runoff Depth = 1.76"
71.48% Pervious = 13.395 ac 28.52% Impervious = 5.344 ac

Summary for Subcatchment ED1.1:

Runoff = 2.35 cfs @ 12.61 hrs, Volume= 0.567 af, Depth= 0.63"
Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
9.068	39	>75% Grass cover, Good, HSG A
0.586	98	Paved parking, HSG A
0.347	98	Roofs, HSG A
0.884	30	Woods, Good, HSG A
10.885		Weighted Average
9.952		91.43% Pervious Area
0.933		8.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	20	0.0300	0.04		**Sheet Flow, A-B** Woods: Dense underbrush n= 0.800 P2= 3.40"
4.5	30	0.0300	0.11		**Sheet Flow, B-C** Grass: Dense n= 0.240 P2= 3.40"
31.0	920	0.0050	0.49		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
44.0	970	Total			

Summary for Subcatchment ED1.2:

Runoff = 7.83 cfs @ 12.08 hrs, Volume= 0.645 af, Depth= 3.77"
Routed to Pond EP1 : Drywells/Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
0.511	39	>75% Grass cover, Good, HSG A
0.120	96	Gravel surface, HSG A
1.313	98	Paved parking, HSG A
0.110	98	Roofs, HSG A
2.054		Weighted Average
0.631		30.72% Pervious Area
1.423		69.28% Impervious Area

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

Summary for Subcatchment ED1.3:

Runoff = 6.26 cfs @ 12.08 hrs, Volume= 0.511 af, Depth= 4.62"
Routed to Pond EP1 : Drywells/Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
0.093	39	>75% Grass cover, Good, HSG A
0.921	98	Paved parking, HSG A
0.312	98	Roofs, HSG A
1.326		Weighted Average
0.093		7.01% Pervious Area
1.233		92.99% Impervious Area

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

Summary for Subcatchment ED1.4:

Runoff = 6.10 cfs @ 12.08 hrs, Volume= 0.490 af, Depth= 4.63"
Routed to Pond EP1 : Drywells/Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
0.063	39	>75% Grass cover, Good, HSG A
0.514	96	Gravel surface, HSG A
0.408	98	Paved parking, HSG A
0.286	98	Roofs, HSG A
1.271		Weighted Average
0.577		45.38% Pervious Area
0.694		54.62% Impervious Area

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

Summary for Subcatchment ED2:

Runoff = 5.74 cfs @ 12.08 hrs, Volume= 0.487 af, Depth= 2.57"
Routed to Pond EP2 : Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
1.138	39	>75% Grass cover, Good, HSG A
0.162	96	Gravel surface, HSG A
0.971	98	Paved parking, HSG A
2.272		Weighted Average
1.300		57.24% Pervious Area
0.971		42.76% Impervious Area

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

Summary for Subcatchment ED3:

Runoff = 0.30 cfs @ 12.08 hrs, Volume= 0.030 af, Depth= 0.96"
Routed to Link DP3 : To George Levin

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
0.321	39	>75% Grass cover, Good, HSG A
0.058	98	Paved parking, HSG A
0.379		Weighted Average
0.321		84.63% Pervious Area
0.058		15.37% Impervious Area

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

Summary for Subcatchment ED4:

Runoff = 0.16 cfs @ 12.08 hrs, Volume= 0.014 af, Depth= 0.31"
Routed to Link DP4 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
0.043	39	>75% Grass cover, Good, HSG A
0.032	98	Paved parking, HSG A
0.479	30	Woods, Good, HSG A
0.554		Weighted Average
0.522		94.31% Pervious Area
0.032		5.69% Impervious Area

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

Summary for Pond EP1: Drywells/Infiltration

Inflow Area = 4.650 ac, 72.04% Impervious, Inflow Depth = 4.25" for 10-Year event
Inflow = 20.18 cfs @ 12.08 hrs, Volume= 1.645 af
Primary = 20.18 cfs @ 12.08 hrs, Volume= 1.645 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond EP2: Drywell

Inflow Area = 2.272 ac, 42.76% Impervious, Inflow Depth = 2.57" for 10-Year event
Inflow = 5.74 cfs @ 12.08 hrs, Volume= 0.487 af
Primary = 5.74 cfs @ 12.08 hrs, Volume= 0.487 af, Atten= 0%, Lag= 0.0 min
Routed to Link DP2 : Retained on site

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP1:

Inflow Area = 10.885 ac, 8.57% Impervious, Inflow Depth = 0.63" for 10-Year event
Inflow = 2.35 cfs @ 12.61 hrs, Volume= 0.567 af
Primary = 2.35 cfs @ 12.61 hrs, Volume= 0.567 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP2: Retained on site

Inflow Area = 2.272 ac, 42.76% Impervious, Inflow Depth = 2.57" for 10-Year event
Inflow = 5.74 cfs @ 12.08 hrs, Volume= 0.487 af
Primary = 5.74 cfs @ 12.08 hrs, Volume= 0.487 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP3: To George Levin

Inflow Area = 0.379 ac, 15.37% Impervious, Inflow Depth = 0.96" for 10-Year event
Inflow = 0.30 cfs @ 12.08 hrs, Volume= 0.030 af
Primary = 0.30 cfs @ 12.08 hrs, Volume= 0.030 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP4:

Inflow Area = 0.554 ac, 5.69% Impervious, Inflow Depth = 0.31" for 10-Year event
Inflow = 0.16 cfs @ 12.08 hrs, Volume= 0.014 af
Primary = 0.16 cfs @ 12.08 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment ED1.1: Runoff Area=10.885 ac 8.57% Impervious Runoff Depth=0.98"
Flow Length=970' Tc=44.0 min CN=WQ Runoff=3.74 cfs 0.887 af

Subcatchment ED1.2: Runoff Area=2.054 ac 69.28% Impervious Runoff Depth=4.68"
Tc=6.0 min CN=WQ Runoff=9.57 cfs 0.801 af

Subcatchment ED1.3: Runoff Area=1.326 ac 92.99% Impervious Runoff Depth=5.68"
Tc=6.0 min CN=WQ Runoff=7.63 cfs 0.628 af

Subcatchment ED1.4: Runoff Area=1.271 ac 54.62% Impervious Runoff Depth=5.70"
Tc=6.0 min CN=WQ Runoff=7.44 cfs 0.604 af

Subcatchment ED2: Runoff Area=2.272 ac 42.76% Impervious Runoff Depth=3.28"
Tc=6.0 min CN=WQ Runoff=7.09 cfs 0.621 af

Subcatchment ED3: Runoff Area=0.379 ac 15.37% Impervious Runoff Depth=1.39"
Tc=6.0 min CN=WQ Runoff=0.39 cfs 0.044 af

Subcatchment ED4: Runoff Area=0.554 ac 5.69% Impervious Runoff Depth=0.48"
Tc=6.0 min CN=WQ Runoff=0.20 cfs 0.022 af

Pond EP1: Drywells/Infiltration Inflow=24.65 cfs 2.033 af
Primary=24.65 cfs 2.033 af

Pond EP2: Drywell Inflow=7.09 cfs 0.621 af
Primary=7.09 cfs 0.621 af

Link DP1: Inflow=3.74 cfs 0.887 af
Primary=3.74 cfs 0.887 af

Link DP2: Retained on site Inflow=7.09 cfs 0.621 af
Primary=7.09 cfs 0.621 af

Link DP3: To George Levin Inflow=0.39 cfs 0.044 af
Primary=0.39 cfs 0.044 af

Link DP4: Inflow=0.20 cfs 0.022 af
Primary=0.20 cfs 0.022 af

Total Runoff Area = 18.739 ac Runoff Volume = 3.607 af Average Runoff Depth = 2.31"
71.48% Pervious = 13.395 ac 28.52% Impervious = 5.344 ac

Summary for Subcatchment ED1.1:

Runoff = 3.74 cfs @ 12.67 hrs, Volume= 0.887 af, Depth= 0.98"
Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
9.068	39	>75% Grass cover, Good, HSG A
0.586	98	Paved parking, HSG A
0.347	98	Roofs, HSG A
0.884	30	Woods, Good, HSG A
10.885		Weighted Average
9.952		91.43% Pervious Area
0.933		8.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	20	0.0300	0.04		**Sheet Flow, A-B** Woods: Dense underbrush n= 0.800 P2= 3.40"
4.5	30	0.0300	0.11		**Sheet Flow, B-C** Grass: Dense n= 0.240 P2= 3.40"
31.0	920	0.0050	0.49		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
44.0	970	Total			

Summary for Subcatchment ED1.2:

Runoff = 9.57 cfs @ 12.08 hrs, Volume= 0.801 af, Depth= 4.68"
Routed to Pond EP1 : Drywells/Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
0.511	39	>75% Grass cover, Good, HSG A
0.120	96	Gravel surface, HSG A
1.313	98	Paved parking, HSG A
0.110	98	Roofs, HSG A
2.054		Weighted Average
0.631		30.72% Pervious Area
1.423		69.28% Impervious Area

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

Summary for Subcatchment ED1.3:

Runoff = 7.63 cfs @ 12.08 hrs, Volume= 0.628 af, Depth= 5.68"
Routed to Pond EP1 : Drywells/Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
0.093	39	>75% Grass cover, Good, HSG A
0.921	98	Paved parking, HSG A
0.312	98	Roofs, HSG A
1.326		Weighted Average
0.093		7.01% Pervious Area
1.233		92.99% Impervious Area

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

Summary for Subcatchment ED1.4:

Runoff = 7.44 cfs @ 12.08 hrs, Volume= 0.604 af, Depth= 5.70"
Routed to Pond EP1 : Drywells/Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
0.063	39	>75% Grass cover, Good, HSG A
0.514	96	Gravel surface, HSG A
0.408	98	Paved parking, HSG A
0.286	98	Roofs, HSG A
1.271		Weighted Average
0.577		45.38% Pervious Area
0.694		54.62% Impervious Area

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

Summary for Subcatchment ED2:

Runoff = 7.09 cfs @ 12.09 hrs, Volume= 0.621 af, Depth= 3.28"
Routed to Pond EP2 : Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
1.138	39	>75% Grass cover, Good, HSG A
0.162	96	Gravel surface, HSG A
0.971	98	Paved parking, HSG A
2.272		Weighted Average
1.300		57.24% Pervious Area
0.971		42.76% Impervious Area

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

Summary for Subcatchment ED3:

Runoff = 0.39 cfs @ 12.10 hrs, Volume= 0.044 af, Depth= 1.39"
Routed to Link DP3 : To George Levin

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
0.321	39	>75% Grass cover, Good, HSG A
0.058	98	Paved parking, HSG A
0.379		Weighted Average
0.321		84.63% Pervious Area
0.058		15.37% Impervious Area

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

Summary for Subcatchment ED4:

Runoff = 0.20 cfs @ 12.09 hrs, Volume= 0.022 af, Depth= 0.48"
Routed to Link DP4 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
0.043	39	>75% Grass cover, Good, HSG A
0.032	98	Paved parking, HSG A
0.479	30	Woods, Good, HSG A
0.554		Weighted Average
0.522		94.31% Pervious Area
0.032		5.69% Impervious Area

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

Summary for Pond EP1: Drywells/Infiltration

Inflow Area = 4.650 ac, 72.04% Impervious, Inflow Depth = 5.25" for 25-Year event
Inflow = 24.65 cfs @ 12.08 hrs, Volume= 2.033 af
Primary = 24.65 cfs @ 12.08 hrs, Volume= 2.033 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond EP2: Drywell

Inflow Area = 2.272 ac, 42.76% Impervious, Inflow Depth = 3.28" for 25-Year event
Inflow = 7.09 cfs @ 12.09 hrs, Volume= 0.621 af
Primary = 7.09 cfs @ 12.09 hrs, Volume= 0.621 af, Atten= 0%, Lag= 0.0 min
Routed to Link DP2 : Retained on site

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP1:

Inflow Area = 10.885 ac, 8.57% Impervious, Inflow Depth = 0.98" for 25-Year event
Inflow = 3.74 cfs @ 12.67 hrs, Volume= 0.887 af
Primary = 3.74 cfs @ 12.67 hrs, Volume= 0.887 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP2: Retained on site

Inflow Area = 2.272 ac, 42.76% Impervious, Inflow Depth = 3.28" for 25-Year event
Inflow = 7.09 cfs @ 12.09 hrs, Volume= 0.621 af
Primary = 7.09 cfs @ 12.09 hrs, Volume= 0.621 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP3: To George Levin

Inflow Area = 0.379 ac, 15.37% Impervious, Inflow Depth = 1.39" for 25-Year event
Inflow = 0.39 cfs @ 12.10 hrs, Volume= 0.044 af
Primary = 0.39 cfs @ 12.10 hrs, Volume= 0.044 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP4:

Inflow Area = 0.554 ac, 5.69% Impervious, Inflow Depth = 0.48" for 25-Year event
Inflow = 0.20 cfs @ 12.09 hrs, Volume= 0.022 af
Primary = 0.20 cfs @ 12.09 hrs, Volume= 0.022 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment ED1.1: Runoff Area=10.885 ac 8.57% Impervious Runoff Depth=1.68"
Flow Length=970' Tc=44.0 min CN=WQ Runoff=7.37 cfs 1.521 af

Subcatchment ED1.2: Runoff Area=2.054 ac 69.28% Impervious Runoff Depth=6.13"
Tc=6.0 min CN=WQ Runoff=12.57 cfs 1.049 af

Subcatchment ED1.3: Runoff Area=1.326 ac 92.99% Impervious Runoff Depth=7.33"
Tc=6.0 min CN=WQ Runoff=9.79 cfs 0.809 af

Subcatchment ED1.4: Runoff Area=1.271 ac 54.62% Impervious Runoff Depth=7.37"
Tc=6.0 min CN=WQ Runoff=9.54 cfs 0.780 af

Subcatchment ED2: Runoff Area=2.272 ac 42.76% Impervious Runoff Depth=4.46"
Tc=6.0 min CN=WQ Runoff=9.85 cfs 0.843 af

Subcatchment ED3: Runoff Area=0.379 ac 15.37% Impervious Runoff Depth=2.19"
Tc=6.0 min CN=WQ Runoff=0.73 cfs 0.069 af

Subcatchment ED4: Runoff Area=0.554 ac 5.69% Impervious Runoff Depth=0.90"
Tc=6.0 min CN=WQ Runoff=0.28 cfs 0.042 af

Pond EP1: Drywells/Infiltration Inflow=31.90 cfs 2.638 af
Primary=31.90 cfs 2.638 af

Pond EP2: Drywell Inflow=9.85 cfs 0.843 af
Primary=9.85 cfs 0.843 af

Link DP1: Inflow=7.37 cfs 1.521 af
Primary=7.37 cfs 1.521 af

Link DP2: Retained on site Inflow=9.85 cfs 0.843 af
Primary=9.85 cfs 0.843 af

Link DP3: To George Levin Inflow=0.73 cfs 0.069 af
Primary=0.73 cfs 0.069 af

Link DP4: Inflow=0.28 cfs 0.042 af
Primary=0.28 cfs 0.042 af

Total Runoff Area = 18.739 ac Runoff Volume = 5.113 af Average Runoff Depth = 3.27"
71.48% Pervious = 13.395 ac 28.52% Impervious = 5.344 ac

Summary for Subcatchment ED1.1:

Runoff = 7.37 cfs @ 12.67 hrs, Volume= 1.521 af, Depth= 1.68"
Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
9.068	39	>75% Grass cover, Good, HSG A
0.586	98	Paved parking, HSG A
0.347	98	Roofs, HSG A
0.884	30	Woods, Good, HSG A
10.885		Weighted Average
9.952		91.43% Pervious Area
0.933		8.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	20	0.0300	0.04		**Sheet Flow, A-B** Woods: Dense underbrush n= 0.800 P2= 3.40"
4.5	30	0.0300	0.11		**Sheet Flow, B-C** Grass: Dense n= 0.240 P2= 3.40"
31.0	920	0.0050	0.49		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
44.0	970	Total			

Summary for Subcatchment ED1.2:

Runoff = 12.57 cfs @ 12.08 hrs, Volume= 1.049 af, Depth= 6.13"
Routed to Pond EP1 : Drywells/Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.511	39	>75% Grass cover, Good, HSG A
0.120	96	Gravel surface, HSG A
1.313	98	Paved parking, HSG A
0.110	98	Roofs, HSG A
2.054		Weighted Average
0.631		30.72% Pervious Area
1.423		69.28% Impervious Area

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

Summary for Subcatchment ED1.3:

Runoff = 9.79 cfs @ 12.08 hrs, Volume= 0.809 af, Depth= 7.33"
Routed to Pond EP1 : Drywells/Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.093	39	>75% Grass cover, Good, HSG A
0.921	98	Paved parking, HSG A
0.312	98	Roofs, HSG A
1.326		Weighted Average
0.093		7.01% Pervious Area
1.233		92.99% Impervious Area

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

Summary for Subcatchment ED1.4:

Runoff = 9.54 cfs @ 12.08 hrs, Volume= 0.780 af, Depth= 7.37"
Routed to Pond EP1 : Drywells/Infiltration

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.063	39	>75% Grass cover, Good, HSG A
0.514	96	Gravel surface, HSG A
0.408	98	Paved parking, HSG A
0.286	98	Roofs, HSG A
1.271		Weighted Average
0.577		45.38% Pervious Area
0.694		54.62% Impervious Area

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

Summary for Subcatchment ED2:

Runoff = 9.85 cfs @ 12.09 hrs, Volume= 0.843 af, Depth= 4.46"
Routed to Pond EP2 : Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
1.138	39	>75% Grass cover, Good, HSG A
0.162	96	Gravel surface, HSG A
0.971	98	Paved parking, HSG A
2.272		Weighted Average
1.300		57.24% Pervious Area
0.971		42.76% Impervious Area

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

Summary for Subcatchment ED3:

Runoff = 0.73 cfs @ 12.10 hrs, Volume= 0.069 af, Depth= 2.19"
Routed to Link DP3 : To George Levin

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.321	39	>75% Grass cover, Good, HSG A
0.058	98	Paved parking, HSG A
0.379		Weighted Average
0.321		84.63% Pervious Area
0.058		15.37% Impervious Area

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

Summary for Subcatchment ED4:

Runoff = 0.28 cfs @ 12.09 hrs, Volume= 0.042 af, Depth= 0.90"
Routed to Link DP4 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.043	39	>75% Grass cover, Good, HSG A
0.032	98	Paved parking, HSG A
0.479	30	Woods, Good, HSG A
0.554		Weighted Average
0.522		94.31% Pervious Area
0.032		5.69% Impervious Area

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

Summary for Pond EP1: Drywells/Infiltration

Inflow Area = 4.650 ac, 72.04% Impervious, Inflow Depth = 6.81" for 100-Year event
Inflow = 31.90 cfs @ 12.08 hrs, Volume= 2.638 af
Primary = 31.90 cfs @ 12.08 hrs, Volume= 2.638 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond EP2: Drywell

Inflow Area = 2.272 ac, 42.76% Impervious, Inflow Depth = 4.46" for 100-Year event
Inflow = 9.85 cfs @ 12.09 hrs, Volume= 0.843 af
Primary = 9.85 cfs @ 12.09 hrs, Volume= 0.843 af, Atten= 0%, Lag= 0.0 min
Routed to Link DP2 : Retained on site

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP1:

Inflow Area = 10.885 ac, 8.57% Impervious, Inflow Depth = 1.68" for 100-Year event
Inflow = 7.37 cfs @ 12.67 hrs, Volume= 1.521 af
Primary = 7.37 cfs @ 12.67 hrs, Volume= 1.521 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP2: Retained on site

Inflow Area = 2.272 ac, 42.76% Impervious, Inflow Depth = 4.46" for 100-Year event
Inflow = 9.85 cfs @ 12.09 hrs, Volume= 0.843 af
Primary = 9.85 cfs @ 12.09 hrs, Volume= 0.843 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP3: To George Levin

Inflow Area = 0.379 ac, 15.37% Impervious, Inflow Depth = 2.19" for 100-Year event
Inflow = 0.73 cfs @ 12.10 hrs, Volume= 0.069 af
Primary = 0.73 cfs @ 12.10 hrs, Volume= 0.069 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP4:

Inflow Area = 0.554 ac, 5.69% Impervious, Inflow Depth = 0.90" for 100-Year event
Inflow = 0.28 cfs @ 12.09 hrs, Volume= 0.042 af
Primary = 0.28 cfs @ 12.09 hrs, Volume= 0.042 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

APPENDIX E: PROPOSED CONDITIONS HYDROLOGIC ANALYSIS

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

LEGEND

WATERSHED BOUNDARY

DP# DESIGN POINT

WQU WATER QUALITY UNIT

P1.1 SUBCATCHMENT

PROPOSED CONDITIONS WATERSHED MAP

582 KELLEY BOULEVARD, NORTH ATTELBOROUGH, MA

PREPARED BY

BOHLER

SCALE: 1"=150'

DATE: 9/17/2024, REV 11/21/2024

Routing Diagram for W211244 Proposed-rev1
Prepared by Bohler, Printed 11/21/2024

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
6.804	39	>75% Grass cover, Good, HSG A (PD1.0, PD1.10, PD1.11, PD1.12, PD1.13, PD1.13.1, PD1.15, PD1.2, PD1.3, PD1.4, PD2.1, PD2.1.1, PD2.1.2, PD3.0, PD3.1, PD4)
0.572	96	Gravel surface, HSG A (PD1.2, PD1.4)
7.631	98	Paved parking, HSG A (PD1.10, PD1.11, PD1.12, PD1.13, PD1.13.1, PD1.15, PD1.2, PD1.3, PD1.4, PD2.1, PD2.1.1, PD2.1.2, PD3.0)
3.291	98	Roofs, HSG A (PD1.0, PD1.10, PD1.11, PD1.12, PD1.13, PD1.13.1, PD1.15, PD1.3, PD1.4)
0.440	30	Woods, Good, HSG A (PD1.12, PD4)
18.740	**75**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
18.740	HSG A	PD1.0, PD1.10, PD1.11, PD1.12, PD1.13, PD1.13.1, PD1.15, PD1.2, PD1.3, PD1.4, PD2.1, PD2.1.1, PD2.1.2, PD3.0, PD3.1, PD4
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
18.740		**TOTAL AREA**

Summary for Subcatchment PD1.0:

Runoff = 0.00 cfs @ 12.08 hrs, Volume= 0.000 af, Depth= 0.02"
Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.188	39	>75% Grass cover, Good, HSG A
0.001	98	Roofs, HSG A
0.189		Weighted Average
0.188		99.56% Pervious Area
0.001		0.44% Impervious Area

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

Summary for Subcatchment PD1.10:

Runoff = 0.11 cfs @ 12.08 hrs, Volume= 0.009 af, Depth= 0.12"
Routed to Pond P1.10 : AG infiltration basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.838	39	>75% Grass cover, Good, HSG A
0.007	98	Paved parking, HSG A
0.025	98	Roofs, HSG A
0.871		Weighted Average
0.838		96.23% Pervious Area
0.033		3.77% Impervious Area

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

Summary for Subcatchment PD1.11:

Runoff = 14.17 cfs @ 12.08 hrs, Volume= 1.132 af, Depth= 2.36"
Routed to Reach WQU1.11 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
1.457	39	>75% Grass cover, Good, HSG A
2.972	98	Paved parking, HSG A
1.315	98	Roofs, HSG A
5.745		Weighted Average
1.457		25.36% Pervious Area
4.288		74.64% Impervious Area

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

Summary for Subcatchment PD1.12:

Runoff = 2.79 cfs @ 12.08 hrs, Volume= 0.223 af, Depth= 1.49"
Routed to Pond p1.12 : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.776	39	>75% Grass cover, Good, HSG A
0.790	98	Paved parking, HSG A
0.055	98	Roofs, HSG A
0.183	30	Woods, Good, HSG A
1.803		Weighted Average
0.959		53.16% Pervious Area
0.845		46.84% Impervious Area

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

Summary for Subcatchment PD1.13:

Runoff = 5.50 cfs @ 12.08 hrs, Volume= 0.439 af, Depth= 1.96"
Routed to Reach WQU1.13 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
1.021	39	>75% Grass cover, Good, HSG A
1.157	98	Paved parking, HSG A
0.506	98	Roofs, HSG A
2.685		Weighted Average
1.021		38.04% Pervious Area
1.663		61.96% Impervious Area

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

Summary for Subcatchment PD1.13.1:

Runoff = 2.14 cfs @ 12.08 hrs, Volume= 0.171 af, Depth= 2.76"
Routed to Pond P1.13 : Stormtrap

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.095	39	>75% Grass cover, Good, HSG A
0.023	98	Paved parking, HSG A
0.624	98	Roofs, HSG A
0.742		Weighted Average
0.095		12.79% Pervious Area
0.647		87.21% Impervious Area

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

Summary for Subcatchment PD1.15:

Runoff = 2.23 cfs @ 12.08 hrs, Volume= 0.178 af, Depth= 2.21"
Routed to Reach WQU1.15 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.293	39	>75% Grass cover, Good, HSG A
0.509	98	Paved parking, HSG A
0.166	98	Roofs, HSG A
0.969		Weighted Average
0.293		30.27% Pervious Area
0.676		69.73% Impervious Area

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

Summary for Subcatchment PD1.2:

Runoff = 1.98 cfs @ 12.08 hrs, Volume= 0.158 af, Depth= 1.60"
Routed to Pond P1.4 : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.584	39	>75% Grass cover, Good, HSG A
0.059	96	Gravel surface, HSG A
0.542	98	Paved parking, HSG A
1.184		Weighted Average
0.643		54.28% Pervious Area
0.542		45.72% Impervious Area

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

Summary for Subcatchment PD1.3:

Runoff = 4.08 cfs @ 12.08 hrs, Volume= 0.325 af, Depth= 2.95"
Routed to Pond D1.3 : Replaced CB pretreatment

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.093	39	>75% Grass cover, Good, HSG A
0.921	98	Paved parking, HSG A
0.312	98	Roofs, HSG A
1.326		Weighted Average
0.093		7.01% Pervious Area
1.233		92.99% Impervious Area

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

Summary for Subcatchment PD1.4:

Runoff = 3.91 cfs @ 12.08 hrs, Volume= 0.307 af, Depth= 2.90"
Routed to Pond D1.4 : Exist CB pretreatment

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.071	39	>75% Grass cover, Good, HSG A
0.514	96	Gravel surface, HSG A
0.400	98	Paved parking, HSG A
0.286	98	Roofs, HSG A
1.271		Weighted Average
0.584		46.00% Pervious Area
0.686		54.00% Impervious Area

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

Summary for Subcatchment PD2.1:

Runoff = 0.16 cfs @ 12.08 hrs, Volume= 0.013 af, Depth= 0.14"
Routed to Pond P2.1 : DP2 AG infiltration basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
1.042	39	>75% Grass cover, Good, HSG A
0.048	98	Paved parking, HSG A
1.090		Weighted Average
1.042		95.61% Pervious Area
0.048		4.39% Impervious Area

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

Summary for Subcatchment PD2.1.1:

Runoff = 0.24 cfs @ 12.08 hrs, Volume= 0.019 af, Depth= 2.55"
Routed to Reach WQU2.1.1 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.018	39	>75% Grass cover, Good, HSG A
0.073	98	Paved parking, HSG A
0.091		Weighted Average
0.018		19.60% Pervious Area
0.073		80.40% Impervious Area

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

Summary for Subcatchment PD2.1.2:

Runoff = 0.60 cfs @ 12.08 hrs, Volume= 0.048 af, Depth= 2.59"
Routed to Reach WQU2.1.2 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.040	39	>75% Grass cover, Good, HSG A
0.182	98	Paved parking, HSG A
0.223		Weighted Average
0.040		18.11% Pervious Area
0.182		81.89% Impervious Area

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

Summary for Subcatchment PD3.0:

Runoff = 0.02 cfs @ 12.08 hrs, Volume= 0.002 af, Depth= 0.79"
Routed to Link DP3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.019	39	>75% Grass cover, Good, HSG A
0.006	98	Paved parking, HSG A
0.025		Weighted Average
0.019		75.15% Pervious Area
0.006		24.85% Impervious Area

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

Summary for Subcatchment PD3.1:

Runoff = 0.00 cfs @ 23.42 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Link DP3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.210	39	>75% Grass cover, Good, HSG A
0.210		100.00% Pervious Area

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

Summary for Subcatchment PD4:

Runoff = 0.00 cfs @ 23.42 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Link DP4 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.059	39	>75% Grass cover, Good, HSG A
0.257	30	Woods, Good, HSG A
0.316		Weighted Average
0.316		100.00% Pervious Area

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

Summary for Reach WQU1.11: WQU

Inflow Area = 10.975 ac, 67.82% Impervious, Inflow Depth = 1.48" for 2-Year event
Inflow = 14.80 cfs @ 12.08 hrs, Volume= 1.355 af
Outflow = 14.80 cfs @ 12.08 hrs, Volume= 1.355 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.10 : AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach WQU1.13: WQU

Inflow Area = 2.685 ac, 61.96% Impervious, Inflow Depth = 1.96" for 2-Year event
Inflow = 5.50 cfs @ 12.08 hrs, Volume= 0.439 af
Outflow = 5.50 cfs @ 12.08 hrs, Volume= 0.439 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.13 : Stormtrap

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach WQU1.15: WQU

Inflow Area = 0.969 ac, 69.73% Impervious, Inflow Depth = 2.21" for 2-Year event
Inflow = 2.23 cfs @ 12.08 hrs, Volume= 0.178 af
Outflow = 2.23 cfs @ 12.08 hrs, Volume= 0.178 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.10 : AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach WQU2.1.1: WQU

Inflow Area = 0.091 ac, 80.40% Impervious, Inflow Depth = 2.55" for 2-Year event
Inflow = 0.24 cfs @ 12.08 hrs, Volume= 0.019 af
Outflow = 0.24 cfs @ 12.08 hrs, Volume= 0.019 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P2.1 : DP2 AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach WQU2.1.2: WQU

Inflow Area = 0.223 ac, 81.89% Impervious, Inflow Depth = 2.59" for 2-Year event
Inflow = 0.60 cfs @ 12.08 hrs, Volume= 0.048 af
Outflow = 0.60 cfs @ 12.08 hrs, Volume= 0.048 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P2.1 : DP2 AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond D1.3: Replaced CB pretreatment

Inflow Area = 1.326 ac, 92.99% Impervious, Inflow Depth = 2.95" for 2-Year event
Inflow = 4.08 cfs @ 12.08 hrs, Volume= 0.325 af
Primary = 4.08 cfs @ 12.08 hrs, Volume= 0.325 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.4 : Bioretention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond D1.4: Exist CB pretreatment

Inflow Area = 1.271 ac, 54.00% Impervious, Inflow Depth = 2.90" for 2-Year event
Inflow = 3.91 cfs @ 12.08 hrs, Volume= 0.307 af
Primary = 3.91 cfs @ 12.08 hrs, Volume= 0.307 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.4 : Bioretention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond P1.10: AG infiltration basin

Inflow Area = 12.815 ac, 63.61% Impervious, Inflow Depth = 1.44" for 2-Year event
Inflow = 17.14 cfs @ 12.08 hrs, Volume= 1.543 af
Outflow = 4.42 cfs @ 12.48 hrs, Volume= 1.543 af, Atten= 74%, Lag= 23.9 min
Discarded = 4.42 cfs @ 12.48 hrs, Volume= 1.543 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link DP3 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 196.83' @ 12.48 hrs Surf.Area= 18,884 sf Storage= 13,180 cf

Plug-Flow detention time= 16.5 min calculated for 1.542 af (100% of inflow)
Center-of-Mass det. time= 16.5 min (780.1 - 763.6)

Volume	Invert	Avail.Storage	Storage Description
#1	196.10'	74,881 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
196.10	17,075	0	0
199.60	25,714	74,881	74,881

Device	Routing	Invert	Outlet Devices
#1	Primary	198.65'	**10.0' long + 3.0 '/' SideZ x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Discarded	196.10'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 193.00' Phase-In= 0.01'
#3	Primary	197.80'	**4.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=4.42 cfs @ 12.48 hrs HW=196.83' (Free Discharge)
└**2=Exfiltration** (Controls 4.42 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=196.10' TW=0.00' (Dynamic Tailwater)
├**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└**3=Grate** (Controls 0.00 cfs)

Summary for Pond P1.12: Bioretention

Inflow Area = 1.803 ac, 46.84% Impervious, Inflow Depth = 1.49" for 2-Year event
Inflow = 2.79 cfs @ 12.08 hrs, Volume= 0.223 af
Outflow = 0.74 cfs @ 12.44 hrs, Volume= 0.223 af, Atten= 74%, Lag= 21.1 min
Primary = 0.74 cfs @ 12.44 hrs, Volume= 0.223 af
Routed to Reach WQU1.11 : WQU

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 202.12' @ 12.44 hrs Surf.Area= 8,064 sf Storage= 2,760 cf

Plug-Flow detention time= 54.9 min calculated for 0.223 af (100% of inflow)
Center-of-Mass det. time= 55.1 min (811.0 - 755.9)

Volume	Invert	Avail.Storage	Storage Description
#1	202.00'	4,112 cf	**Surface V (Prismatic)**Listed below (Recalc)
#2	200.01'	2,296 cf	**Media (Prismatic)**Listed below (Recalc) 7,654 cf Overall x 30.0% Voids
		6,408 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
202.00	3,846	0	0
202.80	6,433	4,112	4,112

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
200.01	3,846	0	0
202.00	3,846	7,654	7,654

Device	Routing	Invert	Outlet Devices
#1	Primary	199.80'	**15.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 199.80' / 199.75' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	202.30'	**24.0" x 24.0" Horiz. Rim** C= 0.600 Limited to weir flow at low heads
#3	Device 1	200.00'	**6.0" Round Underdrain** L= 100.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 200.00' / 199.80' S= 0.0020 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#4	Device 3	200.01'	**0.500 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 200.00' Phase-In= 0.01'

Primary OutFlow Max=0.74 cfs @ 12.44 hrs HW=202.12' TW=0.00' (Dynamic Tailwater)
- **1=Culvert** (Passes 0.74 cfs of 7.68 cfs potential flow)
- **2=Rim** (Controls 0.00 cfs)
- **3=Underdrain** (Barrel Controls 0.74 cfs @ 3.77 fps)
  - **4=Exfiltration** (Passes 0.74 cfs of 9.47 cfs potential flow)

Summary for Pond P1.13: Stormtrap

Inflow Area = 3.427 ac, 67.42% Impervious, Inflow Depth = 2.14" for 2-Year event
Inflow = 7.64 cfs @ 12.08 hrs, Volume= 0.610 af
Outflow = 1.40 cfs @ 12.53 hrs, Volume= 0.610 af, Atten= 82%, Lag= 26.6 min
Discarded = 1.40 cfs @ 12.53 hrs, Volume= 0.610 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach WQU1.11 : WQU

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 198.21' @ 12.53 hrs Surf.Area= 7,860 sf Storage= 7,025 cf

Plug-Flow detention time= 29.8 min calculated for 0.610 af (100% of inflow)
Center-of-Mass det. time= 29.8 min (785.3 - 755.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	197.20'	0 cf	**30.27'W x 259.65'L x 4.00'H Field A** 31,439 cf Overall - 31,439 cf Embedded = 0 cf x 40.0% Voids
#2A	197.20'	24,340 cf	**StormTrap ST2 SingleTrap 3-6** x 32 Inside #1 Inside= 101.7"W x 42.0"H => 26.77 sf x 15.40'L = 412.1 cf Outside= 101.7"W x 48.0"H => 33.92 sf x 15.40'L = 522.2 cf 32 Chambers in 2 Rows 16.96' x 246.33' Core + 6.66' Border = 30.27' x 259.65' System
		24,340 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	197.20'	**5.750 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 194.20' Phase-In= 0.01'
#2	Primary	198.60'	**12.0" Round Culvert** L= 29.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 198.60' / 198.42' S= 0.0062 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#3	Device 2	200.50'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=1.40 cfs @ 12.53 hrs HW=198.21' (Free Discharge)
↑—**1=Exfiltration** (Controls 1.40 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=197.20' TW=0.00' (Dynamic Tailwater)
↑—**2=Culvert** (Controls 0.00 cfs)
↑—**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond P1.4: Bioretention

Inflow Area = 3.781 ac, 65.08% Impervious, Inflow Depth = 2.51" for 2-Year event
Inflow = 9.97 cfs @ 12.08 hrs, Volume= 0.790 af
Outflow = 9.67 cfs @ 12.10 hrs, Volume= 0.790 af, Atten= 3%, Lag= 1.2 min
Primary = 9.67 cfs @ 12.10 hrs, Volume= 0.790 af
Routed to Pond P2.1 : DP2 AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 198.75' @ 12.10 hrs Surf.Area= 4,211 sf Storage= 3,556 cf

Plug-Flow detention time= 112.1 min calculated for 0.790 af (100% of inflow)
Center-of-Mass det. time= 112.3 min (870.7 - 758.4)

Volume	Invert	Avail.Storage	Storage Description
#1	197.30'	3,952 cf	**Surface V (Prismatic)** Listed below (Recalc)
#2	195.30'	510 cf	**Media (Prismatic)** Listed below (Recalc) 1,700 cf Overall x 30.0% Voids
		4,462 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
197.30	850	0	0
199.00	3,800	3,952	3,952

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
195.30	850	0	0
197.30	850	1,700	1,700

Device	Routing	Invert	Outlet Devices
#1	Primary	195.30'	**4.0" Round Underdrain** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 195.30' / 195.00' S= 0.0300 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Device 1	195.30'	**0.500 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 193.00' Phase-In= 0.01'
#3	Primary	198.40'	**18.0' long + 3.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=9.66 cfs @ 12.10 hrs HW=198.75' TW=195.21' (Dynamic Tailwater)
- **1=Underdrain** (Passes 0.07 cfs of 0.76 cfs potential flow)
  - **2=Exfiltration** (Controls 0.07 cfs)
- **3=Broad-Crested Rectangular Weir** (Weir Controls 9.59 cfs @ 1.45 fps)

Summary for Pond P2.1: DP2 AG infiltration basin

Inflow Area = 5.184 ac, 53.31% Impervious, Inflow Depth = 2.02" for 2-Year event
Inflow = 10.65 cfs @ 12.10 hrs, Volume= 0.871 af
Outflow = 3.43 cfs @ 12.41 hrs, Volume= 0.871 af, Atten= 68%, Lag= 18.6 min
Discarded = 3.43 cfs @ 12.41 hrs, Volume= 0.871 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 195.40' @ 12.41 hrs Surf.Area= 15,853 sf Storage= 6,218 cf

Plug-Flow detention time= 8.8 min calculated for 0.871 af (100% of inflow)
Center-of-Mass det. time= 8.8 min (869.1 - 860.3)

Volume	Invert	Avail.Storage	Storage Description
#1	195.00'	34,616 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
195.00	14,863	0	0
197.00	19,753	34,616	34,616

Device	Routing	Invert	Outlet Devices
#1	Discarded	195.00'	**8.270 in/hr Exfiltration over Surface area**

Conductivity to Groundwater Elevation = 192.00' Phase-In= 0.01'

Discarded OutFlow Max=3.43 cfs @ 12.41 hrs HW=195.40' (Free Discharge)
1=Exfiltration (Controls 3.43 cfs)

Summary for Link DP1:

Inflow Area = 0.189 ac, 0.44% Impervious, Inflow Depth = 0.02" for 2-Year event
Inflow = 0.00 cfs @ 12.08 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 12.08 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP3:

Inflow Area = 13.050 ac, 62.51% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.02 cfs @ 12.08 hrs, Volume= 0.002 af
Primary = 0.02 cfs @ 12.08 hrs, Volume= 0.002 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP4:

Inflow Area = 0.316 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 23.42 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 23.42 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Subcatchment PD1.0:

Runoff = 0.01 cfs @ 12.43 hrs, Volume= 0.004 af, Depth= 0.26"
Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
0.188	39	>75% Grass cover, Good, HSG A
0.001	98	Roofs, HSG A
0.189		Weighted Average
0.188		99.56% Pervious Area
0.001		0.44% Impervious Area

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

Summary for Subcatchment PD1.10:

Runoff = 0.17 cfs @ 12.08 hrs, Volume= 0.030 af, Depth= 0.42"
Routed to Pond P1.10 : AG infiltration basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
0.838	39	>75% Grass cover, Good, HSG A
0.007	98	Paved parking, HSG A
0.025	98	Roofs, HSG A
0.871		Weighted Average
0.838		96.23% Pervious Area
0.033		3.77% Impervious Area

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

Summary for Subcatchment PD1.11:

Runoff = 21.78 cfs @ 12.08 hrs, Volume= 1.799 af, Depth= 3.76"
Routed to Reach WQU1.11 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
1.457	39	>75% Grass cover, Good, HSG A
2.972	98	Paved parking, HSG A
1.315	98	Roofs, HSG A
5.745		Weighted Average
1.457		25.36% Pervious Area
4.288		74.64% Impervious Area

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

Summary for Subcatchment PD1.12:

Runoff = 4.29 cfs @ 12.08 hrs, Volume= 0.364 af, Depth= 2.42"
Routed to Pond p1.12 : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
0.776	39	>75% Grass cover, Good, HSG A
0.790	98	Paved parking, HSG A
0.055	98	Roofs, HSG A
0.183	30	Woods, Good, HSG A
1.803		Weighted Average
0.959		53.16% Pervious Area
0.845		46.84% Impervious Area

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

Summary for Subcatchment PD1.13:

Runoff = 8.45 cfs @ 12.08 hrs, Volume= 0.707 af, Depth= 3.16"
Routed to Reach WQU1.13 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
1.021	39	>75% Grass cover, Good, HSG A
1.157	98	Paved parking, HSG A
0.506	98	Roofs, HSG A
2.685		Weighted Average
1.021		38.04% Pervious Area
1.663		61.96% Impervious Area

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

Summary for Subcatchment PD1.13.1:

Runoff = 3.29 cfs @ 12.08 hrs, Volume= 0.269 af, Depth= 4.35"
Routed to Pond P1.13 : Stormtrap

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
0.095	39	>75% Grass cover, Good, HSG A
0.023	98	Paved parking, HSG A
0.624	98	Roofs, HSG A
0.742		Weighted Average
0.095		12.79% Pervious Area
0.647		87.21% Impervious Area

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

Summary for Subcatchment PD1.15:

Runoff = 3.43 cfs @ 12.08 hrs, Volume= 0.285 af, Depth= 3.53"
Routed to Reach WQU1.15 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
0.293	39	>75% Grass cover, Good, HSG A
0.509	98	Paved parking, HSG A
0.166	98	Roofs, HSG A
0.969		Weighted Average
0.293		30.27% Pervious Area
0.676		69.73% Impervious Area

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

Summary for Subcatchment PD1.2:

Runoff = 3.04 cfs @ 12.08 hrs, Volume= 0.258 af, Depth= 2.62"
Routed to Pond P1.4 : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
0.584	39	>75% Grass cover, Good, HSG A
0.059	96	Gravel surface, HSG A
0.542	98	Paved parking, HSG A
1.184		Weighted Average
0.643		54.28% Pervious Area
0.542		45.72% Impervious Area

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

Summary for Subcatchment PD1.3:

Runoff = 6.26 cfs @ 12.08 hrs, Volume= 0.511 af, Depth= 4.62"
Routed to Pond D1.3 : Replaced CB pretreatment

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
0.093	39	>75% Grass cover, Good, HSG A
0.921	98	Paved parking, HSG A
0.312	98	Roofs, HSG A
1.326		Weighted Average
0.093		7.01% Pervious Area
1.233		92.99% Impervious Area

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

Summary for Subcatchment PD1.4:

Runoff = 6.06 cfs @ 12.08 hrs, Volume= 0.487 af, Depth= 4.60"
Routed to Pond D1.4 : Exist CB pretreatment

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
0.071	39	>75% Grass cover, Good, HSG A
0.514	96	Gravel surface, HSG A
0.400	98	Paved parking, HSG A
0.286	98	Roofs, HSG A
1.271		Weighted Average
0.584		46.00% Pervious Area
0.686		54.00% Impervious Area

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

Summary for Subcatchment PD2.1:

Runoff = 0.24 cfs @ 12.08 hrs, Volume= 0.041 af, Depth= 0.45"
Routed to Pond P2.1 : DP2 AG infiltration basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
1.042	39	>75% Grass cover, Good, HSG A
0.048	98	Paved parking, HSG A
1.090		Weighted Average
1.042		95.61% Pervious Area
0.048		4.39% Impervious Area

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

Summary for Subcatchment PD2.1.1:

Runoff = 0.37 cfs @ 12.08 hrs, Volume= 0.031 af, Depth= 4.03"
Routed to Reach WQU2.1.1 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
0.018	39	>75% Grass cover, Good, HSG A
0.073	98	Paved parking, HSG A
0.091		Weighted Average
0.018		19.60% Pervious Area
0.073		80.40% Impervious Area

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

Summary for Subcatchment PD2.1.2:

Runoff = 0.93 cfs @ 12.08 hrs, Volume= 0.076 af, Depth= 4.10"
Routed to Reach WQU2.1.2 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
0.040	39	>75% Grass cover, Good, HSG A
0.182	98	Paved parking, HSG A
0.223		Weighted Average
0.040		18.11% Pervious Area
0.182		81.89% Impervious Area

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

Summary for Subcatchment PD3.0:

Runoff = 0.03 cfs @ 12.08 hrs, Volume= 0.003 af, Depth= 1.41"
Routed to Link DP3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
0.019	39	>75% Grass cover, Good, HSG A
0.006	98	Paved parking, HSG A
0.025		Weighted Average
0.019		75.15% Pervious Area
0.006		24.85% Impervious Area

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

Summary for Subcatchment PD3.1:

Runoff = 0.01 cfs @ 12.44 hrs, Volume= 0.004 af, Depth= 0.24"
Routed to Link DP3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
0.210	39	>75% Grass cover, Good, HSG A
0.210		100.00% Pervious Area

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

Summary for Subcatchment PD4:

Runoff = 0.00 cfs @ 12.44 hrs, Volume= 0.001 af, Depth= 0.05"
Routed to Link DP4 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=5.19"

Area (ac)	CN	Description
0.059	39	>75% Grass cover, Good, HSG A
0.257	30	Woods, Good, HSG A
0.316		Weighted Average
0.316		100.00% Pervious Area

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

Summary for Reach WQU1.11: WQU

Inflow Area = 10.975 ac, 67.82% Impervious, Inflow Depth = 2.37" for 10-Year event
Inflow = 22.53 cfs @ 12.08 hrs, Volume= 2.163 af
Outflow = 22.53 cfs @ 12.08 hrs, Volume= 2.163 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.10 : AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach WQU1.13: WQU

Inflow Area = 2.685 ac, 61.96% Impervious, Inflow Depth = 3.16" for 10-Year event
Inflow = 8.45 cfs @ 12.08 hrs, Volume= 0.707 af
Outflow = 8.45 cfs @ 12.08 hrs, Volume= 0.707 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.13 : Stormtrap

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach WQU1.15: WQU

Inflow Area = 0.969 ac, 69.73% Impervious, Inflow Depth = 3.53" for 10-Year event
Inflow = 3.43 cfs @ 12.08 hrs, Volume= 0.285 af
Outflow = 3.43 cfs @ 12.08 hrs, Volume= 0.285 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.10 : AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach WQU2.1.1: WQU

Inflow Area = 0.091 ac, 80.40% Impervious, Inflow Depth = 4.03" for 10-Year event
Inflow = 0.37 cfs @ 12.08 hrs, Volume= 0.031 af
Outflow = 0.37 cfs @ 12.08 hrs, Volume= 0.031 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P2.1 : DP2 AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach WQU2.1.2: WQU

Inflow Area = 0.223 ac, 81.89% Impervious, Inflow Depth = 4.10" for 10-Year event
Inflow = 0.93 cfs @ 12.08 hrs, Volume= 0.076 af
Outflow = 0.93 cfs @ 12.08 hrs, Volume= 0.076 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P2.1 : DP2 AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond D1.3: Replaced CB pretreatment

Inflow Area = 1.326 ac, 92.99% Impervious, Inflow Depth = 4.62" for 10-Year event
Inflow = 6.26 cfs @ 12.08 hrs, Volume= 0.511 af
Primary = 6.26 cfs @ 12.08 hrs, Volume= 0.511 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.4 : Bioretention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond D1.4: Exist CB pretreatment

Inflow Area = 1.271 ac, 54.00% Impervious, Inflow Depth = 4.60" for 10-Year event
Inflow = 6.06 cfs @ 12.08 hrs, Volume= 0.487 af
Primary = 6.06 cfs @ 12.08 hrs, Volume= 0.487 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.4 : Bioretention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond P1.10: AG infiltration basin

Inflow Area = 12.815 ac, 63.61% Impervious, Inflow Depth = 2.32" for 10-Year event
Inflow = 26.12 cfs @ 12.08 hrs, Volume= 2.478 af
Outflow = 5.47 cfs @ 12.55 hrs, Volume= 2.478 af, Atten= 79%, Lag= 27.8 min
Discarded = 5.47 cfs @ 12.55 hrs, Volume= 2.478 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Link DP3 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 197.46' @ 12.55 hrs Surf.Area= 20,442 sf Storage= 25,585 cf

Plug-Flow detention time= 30.0 min calculated for 2.478 af (100% of inflow)
Center-of-Mass det. time= 30.0 min (792.0 - 762.0)

Volume	Invert	Avail.Storage	Storage Description
#1	196.10'	74,881 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
196.10	17,075	0	0
199.60	25,714	74,881	74,881

Device	Routing	Invert	Outlet Devices
#1	Primary	198.65'	**10.0' long + 3.0 '/' SideZ x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Discarded	196.10'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 193.00' Phase-In= 0.01'
#3	Primary	197.80'	**4.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=5.47 cfs @ 12.55 hrs HW=197.46' (Free Discharge)
└**2=Exfiltration** (Controls 5.47 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=196.10' TW=0.00' (Dynamic Tailwater)
├**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└**3=Grate** (Controls 0.00 cfs)

Summary for Pond P1.12: Bioretention

Inflow Area = 1.803 ac, 46.84% Impervious, Inflow Depth = 2.42" for 10-Year event
Inflow = 4.29 cfs @ 12.08 hrs, Volume= 0.364 af
Outflow = 1.69 cfs @ 12.31 hrs, Volume= 0.364 af, Atten= 61%, Lag= 13.4 min
Primary = 1.69 cfs @ 12.31 hrs, Volume= 0.364 af
Routed to Reach WQU1.11 : WQU

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 202.40' @ 12.31 hrs Surf.Area= 9,001 sf Storage= 4,118 cf

Plug-Flow detention time= 52.7 min calculated for 0.364 af (100% of inflow)
Center-of-Mass det. time= 52.9 min (811.2 - 758.3)

Volume	Invert	Avail.Storage	Storage Description
#1	202.00'	4,112 cf	**Surface V (Prismatic)**Listed below (Recalc)
#2	200.01'	2,296 cf	**Media (Prismatic)**Listed below (Recalc) 7,654 cf Overall x 30.0% Voids
		6,408 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
202.00	3,846	0	0
202.80	6,433	4,112	4,112

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
200.01	3,846	0	0
202.00	3,846	7,654	7,654

Device	Routing	Invert	Outlet Devices
#1	Primary	199.80'	**15.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 199.80' / 199.75' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	202.30'	**24.0" x 24.0" Horiz. Rim** C= 0.600 Limited to weir flow at low heads
#3	Device 1	200.00'	**6.0" Round Underdrain** L= 100.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 200.00' / 199.80' S= 0.0020 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#4	Device 3	200.01'	**0.500 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 200.00' Phase-In= 0.01'

Primary OutFlow Max=1.68 cfs @ 12.31 hrs HW=202.40' TW=0.00' (Dynamic Tailwater)
- **1=Culvert** (Passes 1.68 cfs of 8.31 cfs potential flow)
- **2=Rim** (Weir Controls 0.89 cfs @ 1.06 fps)
- **3=Underdrain** (Barrel Controls 0.80 cfs @ 4.06 fps)
  - **4=Exfiltration** (Passes 0.80 cfs of 10.77 cfs potential flow)

Summary for Pond P1.13: Stormtrap

Inflow Area = 3.427 ac, 67.42% Impervious, Inflow Depth = 3.42" for 10-Year event
Inflow = 11.74 cfs @ 12.08 hrs, Volume= 0.976 af
Outflow = 1.69 cfs @ 12.58 hrs, Volume= 0.976 af, Atten= 86%, Lag= 30.1 min
Discarded = 1.69 cfs @ 12.58 hrs, Volume= 0.976 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach WQU1.11 : WQU

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 199.04' @ 12.58 hrs Surf.Area= 7,860 sf Storage= 12,809 cf

Plug-Flow detention time= 52.6 min calculated for 0.976 af (100% of inflow)
Center-of-Mass det. time= 52.6 min (805.7 - 753.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	197.20'	0 cf	**30.27'W x 259.65'L x 4.00'H Field A** 31,439 cf Overall - 31,439 cf Embedded = 0 cf x 40.0% Voids
#2A	197.20'	24,340 cf	**StormTrap ST2 SingleTrap 3-6** x 32 Inside #1 Inside= 101.7"W x 42.0"H => 26.77 sf x 15.40'L = 412.1 cf Outside= 101.7"W x 48.0"H => 33.92 sf x 15.40'L = 522.2 cf 32 Chambers in 2 Rows 16.96' x 246.33' Core + 6.66' Border = 30.27' x 259.65' System
		24,340 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	197.20'	**5.750 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 194.20' Phase-In= 0.01'
#2	Primary	198.60'	**12.0" Round Culvert** L= 29.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 198.60' / 198.42' S= 0.0062 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#3	Device 2	200.50'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=1.69 cfs @ 12.58 hrs HW=199.04' (Free Discharge)
↑—**1=Exfiltration** (Controls 1.69 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=197.20' TW=0.00' (Dynamic Tailwater)
↑—**2=Culvert** (Controls 0.00 cfs)
↑—**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond P1.4: Bioretention

Inflow Area = 3.781 ac, 65.08% Impervious, Inflow Depth = 3.99" for 10-Year event
Inflow = 15.36 cfs @ 12.08 hrs, Volume= 1.256 af
Outflow = 15.02 cfs @ 12.10 hrs, Volume= 1.256 af, Atten= 2%, Lag= 1.1 min
Primary = 15.02 cfs @ 12.10 hrs, Volume= 1.256 af
Routed to Pond P2.1 : DP2 AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 198.85' @ 12.10 hrs Surf.Area= 4,393 sf Storage= 3,918 cf

Plug-Flow detention time= 76.8 min calculated for 1.256 af (100% of inflow)
Center-of-Mass det. time= 76.7 min (829.6 - 752.9)

Volume	Invert	Avail.Storage	Storage Description
#1	197.30'	3,952 cf	**Surface V (Prismatic)** Listed below (Recalc)
#2	195.30'	510 cf	**Media (Prismatic)** Listed below (Recalc) 1,700 cf Overall x 30.0% Voids
		4,462 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
197.30	850	0	0
199.00	3,800	3,952	3,952

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
195.30	850	0	0
197.30	850	1,700	1,700

Device	Routing	Invert	Outlet Devices
#1	Primary	195.30'	**4.0" Round Underdrain** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 195.30' / 195.00' S= 0.0300 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Device 1	195.30'	**0.500 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 193.00' Phase-In= 0.01'
#3	Primary	198.40'	**18.0' long + 3.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=15.01 cfs @ 12.10 hrs HW=198.85' TW=195.44' (Dynamic Tailwater)
- **1=Underdrain** (Passes 0.07 cfs of 0.77 cfs potential flow)
  - **2=Exfiltration** (Controls 0.07 cfs)
- **3=Broad-Crested Rectangular Weir** (Weir Controls 14.93 cfs @ 1.71 fps)

Summary for Pond P2.1: DP2 AG infiltration basin

Inflow Area = 5.184 ac, 53.31% Impervious, Inflow Depth = 3.25" for 10-Year event
Inflow = 16.52 cfs @ 12.10 hrs, Volume= 1.403 af
Outflow = 4.07 cfs @ 12.49 hrs, Volume= 1.403 af, Atten= 75%, Lag= 23.7 min
Discarded = 4.07 cfs @ 12.49 hrs, Volume= 1.403 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 195.83' @ 12.49 hrs Surf.Area= 16,893 sf Storage= 13,180 cf

Plug-Flow detention time= 17.7 min calculated for 1.403 af (100% of inflow)
Center-of-Mass det. time= 17.7 min (842.6 - 824.9)

Volume	Invert	Avail.Storage	Storage Description
#1	195.00'	34,616 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
195.00	14,863	0	0
197.00	19,753	34,616	34,616

Device	Routing	Invert	Outlet Devices
#1	Discarded	195.00'	**8.270 in/hr Exfiltration over Surface area**

Conductivity to Groundwater Elevation = 192.00' Phase-In= 0.01'

Discarded OutFlow Max=4.07 cfs @ 12.49 hrs HW=195.83' (Free Discharge)
↑—**1=Exfiltration** (Controls 4.07 cfs)

Summary for Link DP1:

Inflow Area = 0.189 ac, 0.44% Impervious, Inflow Depth = 0.26" for 10-Year event
Inflow = 0.01 cfs @ 12.43 hrs, Volume= 0.004 af
Primary = 0.01 cfs @ 12.43 hrs, Volume= 0.004 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP3:

Inflow Area = 13.050 ac, 62.51% Impervious, Inflow Depth = 0.01" for 10-Year event
Inflow = 0.03 cfs @ 12.08 hrs, Volume= 0.007 af
Primary = 0.03 cfs @ 12.08 hrs, Volume= 0.007 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP4:

Inflow Area = 0.316 ac, 0.00% Impervious, Inflow Depth = 0.05" for 10-Year event
Inflow = 0.00 cfs @ 12.44 hrs, Volume= 0.001 af
Primary = 0.00 cfs @ 12.44 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Subcatchment PD1.0:

Runoff = 0.05 cfs @ 12.31 hrs, Volume= 0.009 af, Depth= 0.56"
Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
0.188	39	>75% Grass cover, Good, HSG A
0.001	98	Roofs, HSG A
0.189		Weighted Average
0.188		99.56% Pervious Area
0.001		0.44% Impervious Area

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

Summary for Subcatchment PD1.10:

Runoff = 0.32 cfs @ 12.13 hrs, Volume= 0.054 af, Depth= 0.75"
Routed to Pond P1.10 : AG infiltration basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
0.838	39	>75% Grass cover, Good, HSG A
0.007	98	Paved parking, HSG A
0.025	98	Roofs, HSG A
0.871		Weighted Average
0.838		96.23% Pervious Area
0.033		3.77% Impervious Area

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

Summary for Subcatchment PD1.11:

Runoff = 26.63 cfs @ 12.08 hrs, Volume= 2.235 af, Depth= 4.67"
Routed to Reach WQU1.11 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
1.457	39	>75% Grass cover, Good, HSG A
2.972	98	Paved parking, HSG A
1.315	98	Roofs, HSG A
5.745		Weighted Average
1.457		25.36% Pervious Area
4.288		74.64% Impervious Area

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

Summary for Subcatchment PD1.12:

Runoff = 5.28 cfs @ 12.09 hrs, Volume= 0.464 af, Depth= 3.09"
Routed to Pond p1.12 : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
0.776	39	>75% Grass cover, Good, HSG A
0.790	98	Paved parking, HSG A
0.055	98	Roofs, HSG A
0.183	30	Woods, Good, HSG A
1.803		Weighted Average
0.959		53.16% Pervious Area
0.845		46.84% Impervious Area

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

Summary for Subcatchment PD1.13:

Runoff = 10.37 cfs @ 12.08 hrs, Volume= 0.887 af, Depth= 3.97"
Routed to Reach WQU1.13 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
1.021	39	>75% Grass cover, Good, HSG A
1.157	98	Paved parking, HSG A
0.506	98	Roofs, HSG A
2.685		Weighted Average
1.021		38.04% Pervious Area
1.663		61.96% Impervious Area

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

Summary for Subcatchment PD1.13.1:

Runoff = 4.01 cfs @ 12.08 hrs, Volume= 0.332 af, Depth= 5.36"
Routed to Pond P1.13 : Stormtrap

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
0.095	39	>75% Grass cover, Good, HSG A
0.023	98	Paved parking, HSG A
0.624	98	Roofs, HSG A
0.742		Weighted Average
0.095		12.79% Pervious Area
0.647		87.21% Impervious Area

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

Summary for Subcatchment PD1.15:

Runoff = 4.20 cfs @ 12.08 hrs, Volume= 0.355 af, Depth= 4.40"
Routed to Reach WQU1.15 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
0.293	39	>75% Grass cover, Good, HSG A
0.509	98	Paved parking, HSG A
0.166	98	Roofs, HSG A
0.969		Weighted Average
0.293		30.27% Pervious Area
0.676		69.73% Impervious Area

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

Summary for Subcatchment PD1.2:

Runoff = 3.75 cfs @ 12.09 hrs, Volume= 0.329 af, Depth= 3.33"
Routed to Pond P1.4 : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
0.584	39	>75% Grass cover, Good, HSG A
0.059	96	Gravel surface, HSG A
0.542	98	Paved parking, HSG A
1.184		Weighted Average
0.643		54.28% Pervious Area
0.542		45.72% Impervious Area

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

Summary for Subcatchment PD1.3:

Runoff = 7.63 cfs @ 12.08 hrs, Volume= 0.628 af, Depth= 5.68"
Routed to Pond D1.3 : Replaced CB pretreatment

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
0.093	39	>75% Grass cover, Good, HSG A
0.921	98	Paved parking, HSG A
0.312	98	Roofs, HSG A
1.326		Weighted Average
0.093		7.01% Pervious Area
1.233		92.99% Impervious Area

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

Summary for Subcatchment PD1.4:

Runoff = 7.39 cfs @ 12.08 hrs, Volume= 0.600 af, Depth= 5.67"
Routed to Pond D1.4 : Exist CB pretreatment

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
0.071	39	>75% Grass cover, Good, HSG A
0.514	96	Gravel surface, HSG A
0.400	98	Paved parking, HSG A
0.286	98	Roofs, HSG A
1.271		Weighted Average
0.584		46.00% Pervious Area
0.686		54.00% Impervious Area

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

Summary for Subcatchment PD2.1:

Runoff = 0.43 cfs @ 12.13 hrs, Volume= 0.071 af, Depth= 0.78"
Routed to Pond P2.1 : DP2 AG infiltration basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
1.042	39	>75% Grass cover, Good, HSG A
0.048	98	Paved parking, HSG A
1.090		Weighted Average
1.042		95.61% Pervious Area
0.048		4.39% Impervious Area

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

Summary for Subcatchment PD2.1.1:

Runoff = 0.45 cfs @ 12.08 hrs, Volume= 0.038 af, Depth= 4.99"
Routed to Reach WQU2.1.1 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
0.018	39	>75% Grass cover, Good, HSG A
0.073	98	Paved parking, HSG A
0.091		Weighted Average
0.018		19.60% Pervious Area
0.073		80.40% Impervious Area

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

Summary for Subcatchment PD2.1.2:

Runoff = 1.13 cfs @ 12.08 hrs, Volume= 0.094 af, Depth= 5.07"
Routed to Reach WQU2.1.2 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
0.040	39	>75% Grass cover, Good, HSG A
0.182	98	Paved parking, HSG A
0.223		Weighted Average
0.040		18.11% Pervious Area
0.182		81.89% Impervious Area

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

Summary for Subcatchment PD3.0:

Runoff = 0.04 cfs @ 12.09 hrs, Volume= 0.004 af, Depth= 1.91"
Routed to Link DP3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
0.019	39	>75% Grass cover, Good, HSG A
0.006	98	Paved parking, HSG A
0.025		Weighted Average
0.019		75.15% Pervious Area
0.006		24.85% Impervious Area

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

Summary for Subcatchment PD3.1:

Runoff = 0.05 cfs @ 12.31 hrs, Volume= 0.009 af, Depth= 0.54"
Routed to Link DP3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
0.210	39	>75% Grass cover, Good, HSG A
0.210		100.00% Pervious Area

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

Summary for Subcatchment PD4:

Runoff = 0.01 cfs @ 12.31 hrs, Volume= 0.005 af, Depth= 0.19"
Routed to Link DP4 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.31"

Area (ac)	CN	Description
0.059	39	>75% Grass cover, Good, HSG A
0.257	30	Woods, Good, HSG A
0.316		Weighted Average
0.316		100.00% Pervious Area

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

Summary for Reach WQU1.11: WQU

Inflow Area = 10.975 ac, 67.82% Impervious, Inflow Depth = 2.95" for 25-Year event
Inflow = 27.52 cfs @ 12.09 hrs, Volume= 2.699 af
Outflow = 27.52 cfs @ 12.09 hrs, Volume= 2.699 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.10 : AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach WQU1.13: WQU

Inflow Area = 2.685 ac, 61.96% Impervious, Inflow Depth = 3.97" for 25-Year event
Inflow = 10.37 cfs @ 12.08 hrs, Volume= 0.887 af
Outflow = 10.37 cfs @ 12.08 hrs, Volume= 0.887 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.13 : Stormtrap

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach WQU1.15: WQU

Inflow Area = 0.969 ac, 69.73% Impervious, Inflow Depth = 4.40" for 25-Year event
Inflow = 4.20 cfs @ 12.08 hrs, Volume= 0.355 af
Outflow = 4.20 cfs @ 12.08 hrs, Volume= 0.355 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.10 : AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach WQU2.1.1: WQU

Inflow Area = 0.091 ac, 80.40% Impervious, Inflow Depth = 4.99" for 25-Year event
Inflow = 0.45 cfs @ 12.08 hrs, Volume= 0.038 af
Outflow = 0.45 cfs @ 12.08 hrs, Volume= 0.038 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P2.1 : DP2 AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach WQU2.1.2: WQU

Inflow Area = 0.223 ac, 81.89% Impervious, Inflow Depth = 5.07" for 25-Year event
Inflow = 1.13 cfs @ 12.08 hrs, Volume= 0.094 af
Outflow = 1.13 cfs @ 12.08 hrs, Volume= 0.094 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P2.1 : DP2 AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond D1.3: Replaced CB pretreatment

Inflow Area = 1.326 ac, 92.99% Impervious, Inflow Depth = 5.68" for 25-Year event
Inflow = 7.63 cfs @ 12.08 hrs, Volume= 0.628 af
Primary = 7.63 cfs @ 12.08 hrs, Volume= 0.628 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.4 : Bioretention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond D1.4: Exist CB pretreatment

Inflow Area = 1.271 ac, 54.00% Impervious, Inflow Depth = 5.67" for 25-Year event
Inflow = 7.39 cfs @ 12.08 hrs, Volume= 0.600 af
Primary = 7.39 cfs @ 12.08 hrs, Volume= 0.600 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.4 : Bioretention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond P1.10: AG infiltration basin

Inflow Area = 12.815 ac, 63.61% Impervious, Inflow Depth = 2.91" for 25-Year event
Inflow = 31.99 cfs @ 12.09 hrs, Volume= 3.108 af
Outflow = 6.39 cfs @ 12.57 hrs, Volume= 3.108 af, Atten= 80%, Lag= 28.7 min
Discarded = 6.25 cfs @ 12.57 hrs, Volume= 3.104 af
Primary = 0.14 cfs @ 12.57 hrs, Volume= 0.004 af
Routed to Link DP3 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 197.92' @ 12.57 hrs Surf.Area= 21,558 sf Storage= 35,085 cf

Plug-Flow detention time= 39.0 min calculated for 3.108 af (100% of inflow)
Center-of-Mass det. time= 39.0 min (800.8 - 761.8)

Volume	Invert	Avail.Storage	Storage Description
#1	196.10'	74,881 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
196.10	17,075	0	0
199.60	25,714	74,881	74,881

Device	Routing	Invert	Outlet Devices
#1	Primary	198.65'	**10.0' long + 3.0 '/' SideZ x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Discarded	196.10'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 193.00' Phase-In= 0.01'
#3	Primary	197.80'	**4.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=6.25 cfs @ 12.57 hrs HW=197.92' (Free Discharge)
└**2=Exfiltration** (Controls 6.25 cfs)

Primary OutFlow Max=0.14 cfs @ 12.57 hrs HW=197.92' TW=0.00' (Dynamic Tailwater)
├**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└**3=Grate** (Weir Controls 0.14 cfs @ 1.11 fps)

Summary for Pond P1.12: Bioretention

Inflow Area = 1.803 ac, 46.84% Impervious, Inflow Depth = 3.09" for 25-Year event
Inflow = 5.28 cfs @ 12.09 hrs, Volume= 0.464 af
Outflow = 2.94 cfs @ 12.21 hrs, Volume= 0.464 af, Atten= 44%, Lag= 7.5 min
Primary = 2.94 cfs @ 12.21 hrs, Volume= 0.464 af
Routed to Reach WQU1.11 : WQU

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 202.49' @ 12.21 hrs Surf.Area= 9,269 sf Storage= 4,556 cf

Plug-Flow detention time= 48.4 min calculated for 0.464 af (100% of inflow)
Center-of-Mass det. time= 48.6 min (809.6 - 761.0)

Volume	Invert	Avail.Storage	Storage Description
#1	202.00'	4,112 cf	**Surface V (Prismatic)**Listed below (Recalc)
#2	200.01'	2,296 cf	**Media (Prismatic)**Listed below (Recalc) 7,654 cf Overall x 30.0% Voids
		6,408 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
202.00	3,846	0	0
202.80	6,433	4,112	4,112

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
200.01	3,846	0	0
202.00	3,846	7,654	7,654

Device	Routing	Invert	Outlet Devices
#1	Primary	199.80'	**15.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 199.80' / 199.75' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	202.30'	**24.0" x 24.0" Horiz. Rim** C= 0.600 Limited to weir flow at low heads
#3	Device 1	200.00'	**6.0" Round Underdrain** L= 100.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 200.00' / 199.80' S= 0.0020 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#4	Device 3	200.01'	**0.500 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 200.00' Phase-In= 0.01'

Primary OutFlow Max=2.94 cfs @ 12.21 hrs HW=202.49' TW=0.00' (Dynamic Tailwater)
- **1=Culvert** (Passes 2.94 cfs of 8.49 cfs potential flow)
  - **2=Rim** (Weir Controls 2.13 cfs @ 1.42 fps)
  - **3=Underdrain** (Barrel Controls 0.81 cfs @ 4.13 fps)
    - **4=Exfiltration** (Passes 0.81 cfs of 11.15 cfs potential flow)

Summary for Pond P1.13: Stormtrap

Inflow Area = 3.427 ac, 67.42% Impervious, Inflow Depth = 4.27" for 25-Year event
Inflow = 14.38 cfs @ 12.08 hrs, Volume= 1.219 af
Outflow = 1.90 cfs @ 12.63 hrs, Volume= 1.219 af, Atten= 87%, Lag= 32.8 min
Discarded = 1.90 cfs @ 12.63 hrs, Volume= 1.219 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach WQU1.11 : WQU

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 199.64' @ 12.63 hrs Surf.Area= 7,860 sf Storage= 16,946 cf

Plug-Flow detention time= 67.4 min calculated for 1.219 af (100% of inflow)
Center-of-Mass det. time= 67.4 min (820.2 - 752.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	197.20'	0 cf	**30.27'W x 259.65'L x 4.00'H Field A** 31,439 cf Overall - 31,439 cf Embedded = 0 cf x 40.0% Voids
#2A	197.20'	24,340 cf	**StormTrap ST2 SingleTrap 3-6** x 32 Inside #1 Inside= 101.7"W x 42.0"H => 26.77 sf x 15.40'L = 412.1 cf Outside= 101.7"W x 48.0"H => 33.92 sf x 15.40'L = 522.2 cf 32 Chambers in 2 Rows 16.96' x 246.33' Core + 6.66' Border = 30.27' x 259.65' System
		24,340 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	197.20'	**5.750 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 194.20' Phase-In= 0.01'
#2	Primary	198.60'	**12.0" Round Culvert** L= 29.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 198.60' / 198.42' S= 0.0062 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#3	Device 2	200.50'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=1.90 cfs @ 12.63 hrs HW=199.64' (Free Discharge)
↑—**1=Exfiltration** (Controls 1.90 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=197.20' TW=0.00' (Dynamic Tailwater)
↑—**2=Culvert** (Controls 0.00 cfs)
↑—**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond P1.4: Bioretention

Inflow Area = 3.781 ac, 65.08% Impervious, Inflow Depth = 4.94" for 25-Year event
Inflow = 18.78 cfs @ 12.08 hrs, Volume= 1.557 af
Outflow = 18.41 cfs @ 12.10 hrs, Volume= 1.557 af, Atten= 2%, Lag= 1.0 min
Primary = 18.41 cfs @ 12.10 hrs, Volume= 1.557 af
Routed to Pond P2.1 : DP2 AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 198.91' @ 12.10 hrs Surf.Area= 4,493 sf Storage= 4,126 cf

Plug-Flow detention time= 64.2 min calculated for 1.557 af (100% of inflow)
Center-of-Mass det. time= 64.1 min (815.2 - 751.1)

Volume	Invert	Avail.Storage	Storage Description
#1	197.30'	3,952 cf	**Surface V (Prismatic)** Listed below (Recalc)
#2	195.30'	510 cf	**Media (Prismatic)** Listed below (Recalc) 1,700 cf Overall x 30.0% Voids
		4,462 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
197.30	850	0	0
199.00	3,800	3,952	3,952

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
195.30	850	0	0
197.30	850	1,700	1,700

Device	Routing	Invert	Outlet Devices
#1	Primary	195.30'	**4.0" Round Underdrain** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 195.30' / 195.00' S= 0.0300 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Device 1	195.30'	**0.500 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 193.00' Phase-In= 0.01'
#3	Primary	198.40'	**18.0' long + 3.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=18.40 cfs @ 12.10 hrs HW=198.91' TW=195.60' (Dynamic Tailwater)
- **1=Underdrain** (Passes 0.08 cfs of 0.76 cfs potential flow)
  - **2=Exfiltration** (Controls 0.08 cfs)
- **3=Broad-Crested Rectangular Weir** (Weir Controls 18.33 cfs @ 1.84 fps)

Summary for Pond P2.1: DP2 AG infiltration basin

Inflow Area = 5.184 ac, 53.31% Impervious, Inflow Depth = 4.07" for 25-Year event
Inflow = 20.37 cfs @ 12.10 hrs, Volume= 1.760 af
Outflow = 4.52 cfs @ 12.53 hrs, Volume= 1.760 af, Atten= 78%, Lag= 25.6 min
Discarded = 4.52 cfs @ 12.53 hrs, Volume= 1.760 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 196.12' @ 12.53 hrs Surf.Area= 17,603 sf Storage= 18,193 cf

Plug-Flow detention time= 23.8 min calculated for 1.760 af (100% of inflow)
Center-of-Mass det. time= 23.8 min (836.5 - 812.8)

Volume	Invert	Avail.Storage	Storage Description
#1	195.00'	34,616 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
195.00	14,863	0	0
197.00	19,753	34,616	34,616

Device	Routing	Invert	Outlet Devices
#1	Discarded	195.00'	**8.270 in/hr Exfiltration over Surface area**

Conductivity to Groundwater Elevation = 192.00' Phase-In= 0.01'

Discarded OutFlow Max=4.52 cfs @ 12.53 hrs HW=196.12' (Free Discharge)
↑—**1=Exfiltration** (Controls 4.52 cfs)

Summary for Link DP1:

Inflow Area = 0.189 ac, 0.44% Impervious, Inflow Depth = 0.56" for 25-Year event
Inflow = 0.05 cfs @ 12.31 hrs, Volume= 0.009 af
Primary = 0.05 cfs @ 12.31 hrs, Volume= 0.009 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP3:

Inflow Area = 13.050 ac, 62.51% Impervious, Inflow Depth = 0.02" for 25-Year event
Inflow = 0.17 cfs @ 12.55 hrs, Volume= 0.017 af
Primary = 0.17 cfs @ 12.55 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP4:

Inflow Area = 0.316 ac, 0.00% Impervious, Inflow Depth = 0.19" for 25-Year event
Inflow = 0.01 cfs @ 12.31 hrs, Volume= 0.005 af
Primary = 0.01 cfs @ 12.31 hrs, Volume= 0.005 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Subcatchment PD1.0:

Runoff = 0.17 cfs @ 12.12 hrs, Volume= 0.019 af, Depth= 1.20"
Routed to Link DP1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.188	39	>75% Grass cover, Good, HSG A
0.001	98	Roofs, HSG A
0.189		Weighted Average
0.188		99.56% Pervious Area
0.001		0.44% Impervious Area

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

Summary for Subcatchment PD1.10:

Runoff = 0.99 cfs @ 12.11 hrs, Volume= 0.103 af, Depth= 1.42"
Routed to Pond P1.10 : AG infiltration basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.838	39	>75% Grass cover, Good, HSG A
0.007	98	Paved parking, HSG A
0.025	98	Roofs, HSG A
0.871		Weighted Average
0.838		96.23% Pervious Area
0.033		3.77% Impervious Area

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

Summary for Subcatchment PD1.11:

Runoff = 34.97 cfs @ 12.08 hrs, Volume= 2.926 af, Depth= 6.11"
Routed to Reach WQU1.11 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
1.457	39	>75% Grass cover, Good, HSG A
2.972	98	Paved parking, HSG A
1.315	98	Roofs, HSG A
5.745		Weighted Average
1.457		25.36% Pervious Area
4.288		74.64% Impervious Area

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

Summary for Subcatchment PD1.12:

Runoff = 7.29 cfs @ 12.09 hrs, Volume= 0.630 af, Depth= 4.19"
Routed to Pond p1.12 : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.776	39	>75% Grass cover, Good, HSG A
0.790	98	Paved parking, HSG A
0.055	98	Roofs, HSG A
0.183	30	Woods, Good, HSG A
1.803		Weighted Average
0.959		53.16% Pervious Area
0.845		46.84% Impervious Area

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

Summary for Subcatchment PD1.13:

Runoff = 13.94 cfs @ 12.09 hrs, Volume= 1.179 af, Depth= 5.27"
Routed to Reach WQU1.13 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
1.021	39	>75% Grass cover, Good, HSG A
1.157	98	Paved parking, HSG A
0.506	98	Roofs, HSG A
2.685		Weighted Average
1.021		38.04% Pervious Area
1.663		61.96% Impervious Area

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

Summary for Subcatchment PD1.13.1:

Runoff = 5.18 cfs @ 12.08 hrs, Volume= 0.429 af, Depth= 6.94"
Routed to Pond P1.13 : Stormtrap

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.095	39	>75% Grass cover, Good, HSG A
0.023	98	Paved parking, HSG A
0.624	98	Roofs, HSG A
0.742		Weighted Average
0.095		12.79% Pervious Area
0.647		87.21% Impervious Area

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

Summary for Subcatchment PD1.15:

Runoff = 5.56 cfs @ 12.09 hrs, Volume= 0.467 af, Depth= 5.79"
Routed to Reach WQU1.15 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.293	39	>75% Grass cover, Good, HSG A
0.509	98	Paved parking, HSG A
0.166	98	Roofs, HSG A
0.969		Weighted Average
0.293		30.27% Pervious Area
0.676		69.73% Impervious Area

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

Summary for Subcatchment PD1.2:

Runoff = 5.20 cfs @ 12.09 hrs, Volume= 0.445 af, Depth= 4.51"
Routed to Pond P1.4 : Bioretention

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.584	39	>75% Grass cover, Good, HSG A
0.059	96	Gravel surface, HSG A
0.542	98	Paved parking, HSG A
1.184		Weighted Average
0.643		54.28% Pervious Area
0.542		45.72% Impervious Area

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

Summary for Subcatchment PD1.3:

Runoff = 9.79 cfs @ 12.08 hrs, Volume= 0.809 af, Depth= 7.33"
Routed to Pond D1.3 : Replaced CB pretreatment

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.093	39	>75% Grass cover, Good, HSG A
0.921	98	Paved parking, HSG A
0.312	98	Roofs, HSG A
1.326		Weighted Average
0.093		7.01% Pervious Area
1.233		92.99% Impervious Area

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

Summary for Subcatchment PD1.4:

Runoff = 9.49 cfs @ 12.08 hrs, Volume= 0.776 af, Depth= 7.33"
Routed to Pond D1.4 : Exist CB pretreatment

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.071	39	>75% Grass cover, Good, HSG A
0.514	96	Gravel surface, HSG A
0.400	98	Paved parking, HSG A
0.286	98	Roofs, HSG A
1.271		Weighted Average
0.584		46.00% Pervious Area
0.686		54.00% Impervious Area

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

Summary for Subcatchment PD2.1:

Runoff = 1.29 cfs @ 12.11 hrs, Volume= 0.133 af, Depth= 1.46"
Routed to Pond P2.1 : DP2 AG infiltration basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
1.042	39	>75% Grass cover, Good, HSG A
0.048	98	Paved parking, HSG A
1.090		Weighted Average
1.042		95.61% Pervious Area
0.048		4.39% Impervious Area

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

Summary for Subcatchment PD2.1.1:

Runoff = 0.59 cfs @ 12.08 hrs, Volume= 0.049 af, Depth= 6.49"
Routed to Reach WQU2.1.1 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.018	39	>75% Grass cover, Good, HSG A
0.073	98	Paved parking, HSG A
0.091		Weighted Average
0.018		19.60% Pervious Area
0.073		80.40% Impervious Area

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

Summary for Subcatchment PD2.1.2:

Runoff = 1.47 cfs @ 12.08 hrs, Volume= 0.122 af, Depth= 6.59"
Routed to Reach WQU2.1.2 : WQU

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.040	39	>75% Grass cover, Good, HSG A
0.182	98	Paved parking, HSG A
0.223		Weighted Average
0.040		18.11% Pervious Area
0.182		81.89% Impervious Area

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

Summary for Subcatchment PD3.0:

Runoff = 0.06 cfs @ 12.09 hrs, Volume= 0.006 af, Depth= 2.81"
Routed to Link DP3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.019	39	>75% Grass cover, Good, HSG A
0.006	98	Paved parking, HSG A
0.025		Weighted Average
0.019		75.15% Pervious Area
0.006		24.85% Impervious Area

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

Summary for Subcatchment PD3.1:

Runoff = 0.19 cfs @ 12.12 hrs, Volume= 0.021 af, Depth= 1.17"
Routed to Link DP3 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.210	39	>75% Grass cover, Good, HSG A
0.210		100.00% Pervious Area

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

Summary for Subcatchment PD4:

Runoff = 0.06 cfs @ 12.36 hrs, Volume= 0.015 af, Depth= 0.56"
Routed to Link DP4 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.03"

Area (ac)	CN	Description
0.059	39	>75% Grass cover, Good, HSG A
0.257	30	Woods, Good, HSG A
0.316		Weighted Average
0.316		100.00% Pervious Area

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

Summary for Reach WQU1.11: WQU

Inflow Area = 10.975 ac, 67.82% Impervious, Inflow Depth = 3.91" for 100-Year event
Inflow = 38.70 cfs @ 12.09 hrs, Volume= 3.574 af
Outflow = 38.70 cfs @ 12.09 hrs, Volume= 3.574 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.10 : AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach WQU1.13: WQU

Inflow Area = 2.685 ac, 61.96% Impervious, Inflow Depth = 5.27" for 100-Year event
Inflow = 13.94 cfs @ 12.09 hrs, Volume= 1.179 af
Outflow = 13.94 cfs @ 12.09 hrs, Volume= 1.179 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.13 : Stormtrap

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach WQU1.15: WQU

Inflow Area = 0.969 ac, 69.73% Impervious, Inflow Depth = 5.79" for 100-Year event
Inflow = 5.56 cfs @ 12.09 hrs, Volume= 0.467 af
Outflow = 5.56 cfs @ 12.09 hrs, Volume= 0.467 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.10 : AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach WQU2.1.1: WQU

Inflow Area = 0.091 ac, 80.40% Impervious, Inflow Depth = 6.49" for 100-Year event
Inflow = 0.59 cfs @ 12.08 hrs, Volume= 0.049 af
Outflow = 0.59 cfs @ 12.08 hrs, Volume= 0.049 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P2.1 : DP2 AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach WQU2.1.2: WQU

Inflow Area = 0.223 ac, 81.89% Impervious, Inflow Depth = 6.59" for 100-Year event
Inflow = 1.47 cfs @ 12.08 hrs, Volume= 0.122 af
Outflow = 1.47 cfs @ 12.08 hrs, Volume= 0.122 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P2.1 : DP2 AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond D1.3: Replaced CB pretreatment

Inflow Area = 1.326 ac, 92.99% Impervious, Inflow Depth = 7.33" for 100-Year event
Inflow = 9.79 cfs @ 12.08 hrs, Volume= 0.809 af
Primary = 9.79 cfs @ 12.08 hrs, Volume= 0.809 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.4 : Bioretention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond D1.4: Exist CB pretreatment

Inflow Area = 1.271 ac, 54.00% Impervious, Inflow Depth = 7.33" for 100-Year event
Inflow = 9.49 cfs @ 12.08 hrs, Volume= 0.776 af
Primary = 9.49 cfs @ 12.08 hrs, Volume= 0.776 af, Atten= 0%, Lag= 0.0 min
Routed to Pond P1.4 : Bioretention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond P1.10: AG infiltration basin

Inflow Area = 12.815 ac, 63.61% Impervious, Inflow Depth = 3.88" for 100-Year event
Inflow = 45.21 cfs @ 12.09 hrs, Volume= 4.144 af
Outflow = 7.94 cfs @ 12.62 hrs, Volume= 4.144 af, Atten= 82%, Lag= 31.5 min
Discarded = 7.56 cfs @ 12.62 hrs, Volume= 4.094 af
Primary = 0.39 cfs @ 12.62 hrs, Volume= 0.051 af
Routed to Link DP3 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 198.65' @ 12.62 hrs Surf.Area= 23,372 sf Storage= 51,596 cf

Plug-Flow detention time= 51.5 min calculated for 4.144 af (100% of inflow)
Center-of-Mass det. time= 51.5 min (813.3 - 761.8)

Volume	Invert	Avail.Storage	Storage Description
#1	196.10'	74,881 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
196.10	17,075	0	0
199.60	25,714	74,881	74,881

Device	Routing	Invert	Outlet Devices
#1	Primary	198.65'	**10.0' long + 3.0 '/' SideZ x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Discarded	196.10'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 193.00' Phase-In= 0.01'
#3	Primary	197.80'	**4.0" Horiz. Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=7.56 cfs @ 12.62 hrs HW=198.65' (Free Discharge)
└**2=Exfiltration** (Controls 7.56 cfs)

Primary OutFlow Max=0.39 cfs @ 12.62 hrs HW=198.65' TW=0.00' (Dynamic Tailwater)
├**1=Broad-Crested Rectangular Weir** (Weir Controls 0.00 cfs @ 0.09 fps)
└**3=Grate** (Orifice Controls 0.39 cfs @ 4.44 fps)

Summary for Pond P1.12: Bioretention

Inflow Area = 1.803 ac, 46.84% Impervious, Inflow Depth = 4.19" for 100-Year event
Inflow = 7.29 cfs @ 12.09 hrs, Volume= 0.630 af
Outflow = 5.32 cfs @ 12.16 hrs, Volume= 0.630 af, Atten= 27%, Lag= 4.5 min
Primary = 5.32 cfs @ 12.16 hrs, Volume= 0.630 af
Routed to Reach WQU1.11 : WQU

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 202.61' @ 12.16 hrs Surf.Area= 9,660 sf Storage= 5,236 cf

Plug-Flow detention time= 44.0 min calculated for 0.630 af (100% of inflow)
Center-of-Mass det. time= 44.2 min (808.3 - 764.1)

Volume	Invert	Avail.Storage	Storage Description
#1	202.00'	4,112 cf	**Surface V (Prismatic)**Listed below (Recalc)
#2	200.01'	2,296 cf	**Media (Prismatic)**Listed below (Recalc) 7,654 cf Overall x 30.0% Voids
		6,408 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
202.00	3,846	0	0
202.80	6,433	4,112	4,112

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
200.01	3,846	0	0
202.00	3,846	7,654	7,654

Device	Routing	Invert	Outlet Devices
#1	Primary	199.80'	**15.0" Round Culvert** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 199.80' / 199.75' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 1.23 sf
#2	Device 1	202.30'	**24.0" x 24.0" Horiz. Rim** C= 0.600 Limited to weir flow at low heads
#3	Device 1	200.00'	**6.0" Round Underdrain** L= 100.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 200.00' / 199.80' S= 0.0020 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#4	Device 3	200.01'	**0.500 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 200.00' Phase-In= 0.01'

Primary OutFlow Max=5.32 cfs @ 12.16 hrs HW=202.61' TW=0.00' (Dynamic Tailwater)
- **1=Culvert** (Passes 5.32 cfs of 8.73 cfs potential flow)
  - **2=Rim** (Weir Controls 4.48 cfs @ 1.82 fps)
  - **3=Underdrain** (Barrel Controls 0.83 cfs @ 4.25 fps)
    - **4=Exfiltration** (Passes 0.83 cfs of 11.69 cfs potential flow)

Summary for Pond P1.13: Stormtrap

Inflow Area = 3.427 ac, 67.42% Impervious, Inflow Depth = 5.63" for 100-Year event
Inflow = 19.12 cfs @ 12.09 hrs, Volume= 1.609 af
Outflow = 2.91 cfs @ 12.58 hrs, Volume= 1.609 af, Atten= 85%, Lag= 29.7 min
Discarded = 2.24 cfs @ 12.58 hrs, Volume= 1.590 af
Primary = 0.67 cfs @ 12.58 hrs, Volume= 0.018 af
Routed to Reach WQU1.11 : WQU

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 200.62' @ 12.58 hrs Surf.Area= 7,860 sf Storage= 23,781 cf

Plug-Flow detention time= 86.8 min calculated for 1.609 af (100% of inflow)
Center-of-Mass det. time= 86.8 min (839.5 - 752.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	197.20'	0 cf	**30.27'W x 259.65'L x 4.00'H Field A** 31,439 cf Overall - 31,439 cf Embedded = 0 cf x 40.0% Voids
#2A	197.20'	24,340 cf	**StormTrap ST2 SingleTrap 3-6** x 32 Inside #1 Inside= 101.7"W x 42.0"H => 26.77 sf x 15.40'L = 412.1 cf Outside= 101.7"W x 48.0"H => 33.92 sf x 15.40'L = 522.2 cf 32 Chambers in 2 Rows 16.96' x 246.33' Core + 6.66' Border = 30.27' x 259.65' System
		24,340 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	197.20'	**5.750 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 194.20' Phase-In= 0.01'
#2	Primary	198.60'	**12.0" Round Culvert** L= 29.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 198.60' / 198.42' S= 0.0062 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#3	Device 2	200.50'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=2.24 cfs @ 12.58 hrs HW=200.62' (Free Discharge)
↑—**1=Exfiltration** (Controls 2.24 cfs)

Primary OutFlow Max=0.67 cfs @ 12.58 hrs HW=200.62' TW=0.00' (Dynamic Tailwater)
↑—**2=Culvert** (Passes 0.67 cfs of 4.58 cfs potential flow)
↑—**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.67 cfs @ 1.13 fps)

Summary for Pond P1.4: Bioretention

Inflow Area = 3.781 ac, 65.08% Impervious, Inflow Depth = 6.44" for 100-Year event
Inflow = 24.48 cfs @ 12.08 hrs, Volume= 2.030 af
Outflow = 24.07 cfs @ 12.10 hrs, Volume= 2.030 af, Atten= 2%, Lag= 0.9 min
Primary = 24.07 cfs @ 12.10 hrs, Volume= 2.030 af
Routed to Pond P2.1 : DP2 AG infiltration basin

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 199.00' @ 12.10 hrs Surf.Area= 4,642 sf Storage= 4,446 cf

Plug-Flow detention time= 50.9 min calculated for 2.030 af (100% of inflow)
Center-of-Mass det. time= 51.1 min (800.4 - 749.3)

Volume	Invert	Avail.Storage	Storage Description
#1	197.30'	3,952 cf	**Surface V (Prismatic)** Listed below (Recalc)
#2	195.30'	510 cf	**Media (Prismatic)** Listed below (Recalc) 1,700 cf Overall x 30.0% Voids
		4,462 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
197.30	850	0	0
199.00	3,800	3,952	3,952

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
195.30	850	0	0
197.30	850	1,700	1,700

Device	Routing	Invert	Outlet Devices
#1	Primary	195.30'	**4.0" Round Underdrain** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 195.30' / 195.00' S= 0.0300 '/' Cc= 0.900 n= 0.012, Flow Area= 0.09 sf
#2	Device 1	195.30'	**0.500 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 193.00' Phase-In= 0.01'
#3	Primary	198.40'	**18.0' long + 3.0 '/' SideZ x 4.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=24.06 cfs @ 12.10 hrs HW=199.00' TW=195.86' (Dynamic Tailwater)
- **1=Underdrain** (Passes 0.08 cfs of 0.74 cfs potential flow)
  - **2=Exfiltration** (Controls 0.08 cfs)
- **3=Broad-Crested Rectangular Weir** (Weir Controls 23.98 cfs @ 2.04 fps)

Summary for Pond P2.1: DP2 AG infiltration basin

Inflow Area = 5.184 ac, 53.31% Impervious, Inflow Depth = 5.40" for 100-Year event
Inflow = 27.37 cfs @ 12.10 hrs, Volume= 2.335 af
Outflow = 5.27 cfs @ 12.56 hrs, Volume= 2.335 af, Atten= 81%, Lag= 27.4 min
Discarded = 5.27 cfs @ 12.56 hrs, Volume= 2.335 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 196.60' @ 12.56 hrs Surf.Area= 18,763 sf Storage= 26,819 cf

Plug-Flow detention time= 33.4 min calculated for 2.335 af (100% of inflow)
Center-of-Mass det. time= 33.4 min (833.9 - 800.5)

Volume	Invert	Avail.Storage	Storage Description
#1	195.00'	34,616 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
195.00	14,863	0	0
197.00	19,753	34,616	34,616

Device	Routing	Invert	Outlet Devices
#1	Discarded	195.00'	**8.270 in/hr Exfiltration over Surface area**

Conductivity to Groundwater Elevation = 192.00' Phase-In= 0.01'

Discarded OutFlow Max=5.27 cfs @ 12.56 hrs HW=196.60' (Free Discharge)
↑—**1=Exfiltration** (Controls 5.27 cfs)

Summary for Link DP1:

Inflow Area = 0.189 ac, 0.44% Impervious, Inflow Depth = 1.20" for 100-Year event
Inflow = 0.17 cfs @ 12.12 hrs, Volume= 0.019 af
Primary = 0.17 cfs @ 12.12 hrs, Volume= 0.019 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP3:

Inflow Area = 13.050 ac, 62.51% Impervious, Inflow Depth = 0.07" for 100-Year event
Inflow = 0.49 cfs @ 12.40 hrs, Volume= 0.077 af
Primary = 0.49 cfs @ 12.40 hrs, Volume= 0.077 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Link DP4:

Inflow Area = 0.316 ac, 0.00% Impervious, Inflow Depth = 0.56" for 100-Year event
Inflow = 0.06 cfs @ 12.36 hrs, Volume= 0.015 af
Primary = 0.06 cfs @ 12.36 hrs, Volume= 0.015 af, Atten= 0%, Lag= 0.0 min
Routed to nonexistent node POA-3

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Stage-Area-Storage for Pond P1.10: AG infiltration basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
196.10	17,075	0
196.15	17,198	857
196.20	17,322	1,720
196.25	17,445	2,589
196.30	17,569	3,464
196.35	17,692	4,346
196.40	17,815	5,234
196.45	17,939	6,127
196.50	18,062	7,027
196.55	18,186	7,934
196.60	18,309	8,846
196.65	18,433	9,765
196.70	18,556	10,689
196.75	18,679	11,620
196.80	18,803	12,557
196.85	18,926	13,500
196.90	19,050	14,450
196.95	19,173	15,405
197.00	19,296	16,367
197.05	19,420	17,335
197.10	19,543	18,309
197.15	19,667	19,289
197.20	19,790	20,276
197.25	19,914	21,268
197.30	20,037	22,267
197.35	20,160	23,272
197.40	20,284	24,283
197.45	20,407	25,300
197.50	20,531	26,324
197.55	20,654	27,354
197.60	20,777	28,389
197.65	20,901	29,431
197.70	21,024	30,479
197.75	21,148	31,534
197.80	21,271	32,594
197.85	21,395	33,661
197.90	21,518	34,734
197.95	21,641	35,813
198.00	21,765	36,898
198.05	21,888	37,989
198.10	22,012	39,087
198.15	22,135	40,190
198.20	22,258	41,300
198.25	22,382	42,416
198.30	22,505	43,538
198.35	22,629	44,667
198.40	22,752	45,801
198.45	22,875	46,942
198.50	22,999	48,089
198.55	23,122	49,242
198.60	23,246	50,401
198.65	23,369	51,566
198.70	23,493	52,738
198.75	23,616	53,916
198.80	23,739	55,099
198.85	23,863	56,289
198.90	23,986	57,486
198.95	24,110	58,688
199.00	24,233	59,897
199.05	24,356	61,111
199.10	24,480	62,332
199.15	24,603	63,559
199.20	24,727	64,793
199.25	24,850	66,032
199.30	24,974	67,278
199.35	25,097	68,529
199.40	25,220	69,787
199.45	25,344	71,051
199.50	25,467	72,322
199.55	25,591	73,598
199.60	**25,714**	**74,881**

Stage-Area-Storage for Pond P1.12: Bioretention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
200.01	3,846	0
200.06	3,846	58
200.11	3,846	115
200.16	3,846	173
200.21	3,846	231
200.26	3,846	288
200.31	3,846	346
200.36	3,846	404
200.41	3,846	462
200.46	3,846	519
200.51	3,846	577
200.56	3,846	635
200.61	3,846	692
200.66	3,846	750
200.71	3,846	808
200.76	3,846	865
200.81	3,846	923
200.86	3,846	981
200.91	3,846	1,038
200.96	3,846	1,096
201.01	3,846	1,154
201.06	3,846	1,211
201.11	3,846	1,269
201.16	3,846	1,327
201.21	3,846	1,385
201.26	3,846	1,442
201.31	3,846	1,500
201.36	3,846	1,558
201.41	3,846	1,615
201.46	3,846	1,673
201.51	3,846	1,731
201.56	3,846	1,788
201.61	3,846	1,846
201.66	3,846	1,904
201.71	3,846	1,961
201.76	3,846	2,019
201.81	3,846	2,077
201.86	3,846	2,135
201.91	3,846	2,192
201.96	3,846	2,250
202.01	7,724	2,335
202.06	7,886	2,533
202.11	8,048	2,739
202.16	8,209	2,953
202.21	8,371	3,175
202.26	8,533	3,405
202.31	8,694	3,644
202.36	8,856	3,890
202.41	9,018	4,145
202.46	9,180	4,407
202.51	9,341	4,678
202.56	9,503	4,957
202.61	9,665	5,244
202.66	9,826	5,539
202.71	9,988	5,842
202.76	**10,150**	**6,153**

Pond P1.13: Stormtrap - Chamber Wizard Field A

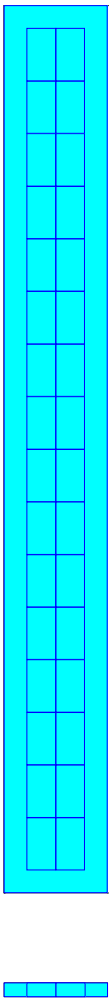
Chamber Model = StormTrap ST2 SingleTrap 3-6 (StormTrap ST2 SingleTrap® Type II+IV)
Inside= 101.7"W x 42.0"H => 26.77 sf x 15.40'L = 412.1 cf
Outside= 101.7"W x 48.0"H => 33.92 sf x 15.40'L = 522.2 cf

16 Chambers/Row x 15.40' Long = 246.33' Row Length +79.9" Border x 2 = 259.65' Base Length
2 Rows x 101.7" Wide + 79.9" Side Border x 2 = 30.27' Base Width
48.0" Chamber Height = 4.00' Field Height

32 Chambers x 412.1 cf + 11,152.0 cf Border = 24,340.2 cf Chamber Storage
32 Chambers x 522.2 cf + 14,729.2 cf Border = 31,438.8 cf Displacement

Chamber Storage = 24,340.2 cf = 0.559 af
Overall Storage Efficiency = 77.4%
Overall System Size = 259.65' x 30.27' x 4.00'

32 Chambers (plus border)
1,164.4 cy Field



Stage-Area-Storage for Pond P1.13: Stormtrap

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
197.20	**7,860**	0
197.25	7,860	348
197.30	7,860	695
197.35	7,860	1,043
197.40	7,860	1,391
197.45	7,860	1,739
197.50	7,860	2,086
197.55	7,860	2,434
197.60	7,860	2,782
197.65	7,860	3,129
197.70	7,860	3,477
197.75	7,860	3,825
197.80	7,860	4,173
197.85	7,860	4,520
197.90	7,860	4,868
197.95	7,860	5,216
198.00	7,860	5,563
198.05	7,860	5,911
198.10	7,860	6,259
198.15	7,860	6,607
198.20	7,860	6,954
198.25	7,860	7,302
198.30	7,860	7,650
198.35	7,860	7,997
198.40	7,860	8,345
198.45	7,860	8,693
198.50	7,860	9,041
198.55	7,860	9,388
198.60	7,860	9,736
198.65	7,860	10,084
198.70	7,860	10,432
198.75	7,860	10,779
198.80	7,860	11,127
198.85	7,860	11,475
198.90	7,860	11,822
198.95	7,860	12,170
199.00	7,860	12,518
199.05	7,860	12,866
199.10	7,860	13,213
199.15	7,860	13,561
199.20	7,860	13,909
199.25	7,860	14,256
199.30	7,860	14,604
199.35	7,860	14,952
199.40	7,860	15,300
199.45	7,860	15,647
199.50	7,860	15,995
199.55	7,860	16,343
199.60	7,860	16,690
199.65	7,860	17,038
199.70	7,860	17,386
199.75	7,860	17,734
199.80	7,860	18,081
199.85	7,860	18,429
199.90	7,860	18,777
199.95	7,860	19,124
200.00	7,860	19,472
200.05	7,860	19,820
200.10	7,860	20,168
200.15	7,860	20,515
200.20	7,860	20,863
200.25	7,860	21,211
200.30	7,860	21,558
200.35	7,860	21,906
200.40	7,860	22,254
200.45	7,860	22,602
200.50	7,860	22,949
200.55	7,860	23,297
200.60	7,860	23,645
200.65	7,860	23,992
200.70	7,860	24,340
200.75	7,860	24,340
200.80	7,860	24,340
200.85	7,860	24,340
200.90	7,860	24,340
200.95	7,860	24,340
201.00	7,860	24,340
201.05	7,860	24,340
201.10	7,860	**24,340**
201.15	7,860	**24,340**
201.20	7,860	24,340

Stage-Area-Storage for Pond P1.4: Bioretention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
195.30	850	0
195.35	850	13
195.40	850	25
195.45	850	38
195.50	850	51
195.55	850	64
195.60	850	77
195.65	850	89
195.70	850	102
195.75	850	115
195.80	850	128
195.85	850	140
195.90	850	153
195.95	850	166
196.00	850	178
196.05	850	191
196.10	850	204
196.15	850	217
196.20	850	230
196.25	850	242
196.30	850	255
196.35	850	268
196.40	850	280
196.45	850	293
196.50	850	306
196.55	850	319
196.60	850	332
196.65	850	344
196.70	850	357
196.75	850	370
196.80	850	383
196.85	850	395
196.90	850	408
196.95	850	421
197.00	850	433
197.05	850	446
197.10	850	459
197.15	850	472
197.20	850	485
197.25	850	497
197.30	1,700	510
197.35	1,787	555
197.40	1,874	604
197.45	1,960	657
197.50	2,047	715
197.55	2,134	777
197.60	2,221	843
197.65	2,307	914
197.70	2,394	989
197.75	2,481	1,068
197.80	2,568	1,152
197.85	2,654	1,240
197.90	2,741	1,332
197.95	2,828	1,429
198.00	2,915	1,530
198.05	3,001	1,636
198.10	3,088	1,745
198.15	3,175	1,859
198.20	3,262	1,978
198.25	3,349	2,101
198.30	3,435	2,228
198.35	3,522	2,359
198.40	3,609	2,495
198.45	3,696	2,635
198.50	3,782	2,779
198.55	3,869	2,928
198.60	3,956	3,081
198.65	4,043	3,239
198.70	4,129	3,401
198.75	4,216	3,567
198.80	4,303	3,737
198.85	4,390	3,912
198.90	4,476	4,091
198.95	4,563	4,275
199.00	**4,650**	**4,462**

Stage-Area-Storage for Pond P2.1: DP2 AG infiltration basin

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
195.00	14,863	0
195.02	14,912	298
195.04	14,961	596
195.06	15,010	896
195.08	15,059	1,197
195.10	15,107	1,499
195.12	15,156	1,801
195.14	15,205	2,105
195.16	15,254	2,409
195.18	15,303	2,715
195.20	15,352	3,021
195.22	15,401	3,329
195.24	15,450	3,638
195.26	15,499	3,947
195.28	15,548	4,257
195.30	15,597	4,569
195.32	15,645	4,881
195.34	15,694	5,195
195.36	15,743	5,509
195.38	15,792	5,824
195.40	15,841	6,141
195.42	15,890	6,458
195.44	15,939	6,776
195.46	15,988	7,096
195.48	16,037	7,416
195.50	16,086	7,737
195.52	16,134	8,059
195.54	16,183	8,383
195.56	16,232	8,707
195.58	16,281	9,032
195.60	16,330	9,358
195.62	16,379	9,685
195.64	16,428	10,013
195.66	16,477	10,342
195.68	16,526	10,672
195.70	16,574	11,003
195.72	16,623	11,335
195.74	16,672	11,668
195.76	16,721	12,002
195.78	16,770	12,337
195.80	16,819	12,673
195.82	16,868	13,010
195.84	16,917	13,348
195.86	16,966	13,686
195.88	17,015	14,026
195.90	17,064	14,367
195.92	17,112	14,709
195.94	17,161	15,051
195.96	17,210	15,395
195.98	17,259	15,740
196.00	17,308	16,086
196.02	17,357	16,432
196.04	17,406	16,780
196.06	17,455	17,128
196.08	17,504	17,478
196.10	17,552	17,829
196.12	17,601	18,180
196.14	17,650	18,533
196.16	17,699	18,886
196.18	17,748	19,241
196.20	17,797	19,596
196.22	17,846	19,952
196.24	17,895	20,310
196.26	17,944	20,668
196.28	17,993	21,028
196.30	18,042	21,388
196.32	18,090	21,749
196.34	18,139	22,112
196.36	18,188	22,475
196.38	18,237	22,839
196.40	18,286	23,204
196.42	18,335	23,571
196.44	18,384	23,938
196.46	18,433	24,306
196.48	18,482	24,675
196.50	18,531	25,045
196.52	18,579	25,416
196.54	18,628	25,788
196.56	18,677	26,161
196.58	18,726	26,535
196.60	18,775	26,910
196.62	18,824	27,286
196.64	18,873	27,663
196.66	18,922	28,041
196.68	18,971	28,420
196.70	19,019	28,800
196.72	19,068	29,181
196.74	19,117	29,563
196.76	19,166	29,946
196.78	19,215	30,330
196.80	19,264	30,714
196.82	19,313	31,100
196.84	19,362	31,487
196.86	19,411	31,875
196.88	19,460	32,263
196.90	19,509	32,653
196.92	19,557	33,044
196.94	19,606	33,435
196.96	19,655	33,828
196.98	19,704	34,221
197.00	**19,753**	**34,616**

APPENDIX F: STORMWATER CALCULATIONS

- *NOAA RAINFALL DATA*
- *MA STANDARD #3 – RECHARGE AND DRAWDOWN TIME*
- *MA STANDARD #4 – WATER QUALITY AND TSS REMOVAL*
- *OUTLET PROTECTION SIZING*
- *MOUNDING ANALYSIS AND NARRATIVE*

NOAA Atlas 14, Volume 10, Version 3
Location name: North Attleboro, Massachusetts, USA*
Latitude: 42.0074°, Longitude: -71.304°
Elevation: 201 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.313** (0.248-0.391)	**0.385** (0.305-0.481)	**0.502** (0.397-0.630)	**0.599** (0.470-0.756)	**0.733** (0.556-0.969)	**0.833** (0.619-1.12)	**0.940** (0.678-1.32)	**1.06** (0.720-1.52)	**1.25** (0.811-1.84)	**1.40** (0.889-2.11)
10-min	**0.443** (0.352-0.554)	**0.545** (0.432-0.682)	**0.711** (0.562-0.893)	**0.849** (0.666-1.07)	**1.04** (0.788-1.37)	**1.18** (0.876-1.59)	**1.33** (0.960-1.87)	**1.51** (1.02-2.15)	**1.77** (1.15-2.61)	**1.99** (1.26-2.99)
15-min	**0.521** (0.414-0.652)	**0.641** (0.508-0.802)	**0.837** (0.661-1.05)	**0.999** (0.784-1.26)	**1.22** (0.927-1.62)	**1.39** (1.03-1.88)	**1.57** (1.13-2.20)	**1.77** (1.20-2.53)	**2.08** (1.35-3.07)	**2.34** (1.48-3.52)
30-min	**0.721** (0.573-0.901)	**0.890** (0.706-1.11)	**1.17** (0.921-1.46)	**1.40** (1.10-1.76)	**1.71** (1.30-2.26)	**1.94** (1.44-2.63)	**2.20** (1.58-3.08)	**2.49** (1.68-3.55)	**2.93** (1.90-4.31)	**3.29** (2.08-4.95)
60-min	**0.921** (0.731-1.15)	**1.14** (0.903-1.42)	**1.50** (1.18-1.88)	**1.79** (1.41-2.26)	**2.20** (1.67-2.90)	**2.50** (1.86-3.38)	**2.82** (2.04-3.97)	**3.20** (2.17-4.57)	**3.77** (2.45-5.56)	**4.25** (2.69-6.38)
2-hr	**1.18** (0.941-1.46)	**1.47** (1.18-1.83)	**1.96** (1.56-2.44)	**2.36** (1.87-2.96)	**2.92** (2.23-3.83)	**3.33** (2.50-4.47)	**3.78** (2.75-5.28)	**4.31** (2.93-6.09)	**5.13** (3.34-7.49)	**5.82** (3.70-8.66)
3-hr	**1.36** (1.10-1.68)	**1.71** (1.37-2.11)	**2.28** (1.82-2.82)	**2.75** (2.18-3.42)	**3.40** (2.61-4.44)	**3.87** (2.92-5.18)	**4.39** (3.22-6.12)	**5.02** (3.43-7.06)	**5.98** (3.91-8.69)	**6.81** (4.34-10.1)
6-hr	**1.78** (1.44-2.18)	**2.21** (1.79-2.70)	**2.91** (2.34-3.57)	**3.49** (2.79-4.30)	**4.28** (3.32-5.55)	**4.87** (3.69-6.45)	**5.51** (4.06-7.60)	**6.28** (4.31-8.74)	**7.44** (4.90-10.7)	**8.44** (5.41-12.4)
12-hr	**2.32** (1.89-2.81)	**2.82** (2.30-3.42)	**3.63** (2.95-4.43)	**4.31** (3.48-5.28)	**5.25** (4.09-6.72)	**5.94** (4.53-7.78)	**6.69** (4.94-9.09)	**7.56** (5.23-10.4)	**8.87** (5.87-12.6)	**9.97** (6.43-14.5)
24-hr	**2.81** (2.31-3.38)	**3.40** (2.80-4.10)	**4.38** (3.59-5.29)	**5.19** (4.23-6.31)	**6.31** (4.96-8.01)	**7.14** (5.48-9.27)	**8.03** (5.98-10.8)	**9.09** (6.32-12.4)	**10.7** (7.09-15.0)	**12.0** (7.77-17.2)
2-day	**3.17** (2.63-3.78)	**3.90** (3.23-4.65)	**5.09** (4.20-6.09)	**6.08** (4.98-7.32)	**7.44** (5.89-9.38)	**8.44** (6.54-10.9)	**9.53** (7.17-12.8)	**10.9** (7.59-14.7)	**12.9** (8.63-18.0)	**14.7** (9.55-20.9)
3-day	**3.45** (2.88-4.09)	**4.23** (3.52-5.02)	**5.51** (4.57-6.56)	**6.57** (5.41-7.87)	**8.02** (6.39-10.1)	**9.10** (7.09-11.7)	**10.3** (7.76-13.7)	**11.7** (8.21-15.8)	**13.9** (9.33-19.3)	**15.8** (10.3-22.4)
4-day	**3.71** (3.11-4.39)	**4.52** (3.78-5.35)	**5.84** (4.86-6.94)	**6.94** (5.74-8.28)	**8.44** (6.74-10.6)	**9.56** (7.46-12.2)	**10.8** (8.15-14.3)	**12.2** (8.61-16.4)	**14.5** (9.75-20.1)	**16.4** (10.8-23.2)
7-day	**4.45** (3.75-5.22)	**5.30** (4.46-6.23)	**6.68** (5.60-7.88)	**7.84** (6.52-9.29)	**9.42** (7.56-11.7)	**10.6** (8.31-13.4)	**11.9** (9.00-15.6)	**13.4** (9.45-17.8)	**15.6** (10.6-21.4)	**17.5** (11.5-24.5)
10-day	**5.16** (4.36-6.03)	**6.03** (5.10-7.06)	**7.46** (6.28-8.76)	**8.65** (7.23-10.2)	**10.3** (8.28-12.6)	**11.5** (9.04-14.4)	**12.8** (9.70-16.6)	**14.3** (10.2-18.9)	**16.5** (11.2-22.5)	**18.3** (12.1-25.4)
20-day	**7.29** (6.22-8.45)	**8.23** (7.02-9.55)	**9.77** (8.30-11.4)	**11.0** (9.31-12.9)	**12.8** (10.4-15.5)	**14.2** (11.1-17.4)	**15.5** (11.7-19.7)	**16.9** (12.1-22.1)	**18.9** (12.9-25.5)	**20.4** (13.5-28.1)
30-day	**9.06** (7.77-10.5)	**10.1** (8.61-11.6)	**11.7** (9.96-13.5)	**13.0** (11.0-15.2)	**14.9** (12.1-17.9)	**16.3** (12.9-19.9)	**17.7** (13.4-22.2)	**19.1** (13.8-24.8)	**20.9** (14.4-28.0)	**22.2** (14.8-30.4)
45-day	**11.3** (9.70-12.9)	**12.3** (10.6-14.1)	**14.0** (12.0-16.2)	**15.5** (13.2-17.9)	**17.4** (14.2-20.8)	**19.0** (15.0-23.0)	**20.5** (15.5-25.4)	**21.8** (15.8-28.1)	**23.5** (16.2-31.3)	**24.6** (16.4-33.4)
60-day	**13.1** (11.3-15.0)	**14.2** (12.3-16.2)	**16.0** (13.8-18.4)	**17.5** (15.0-20.2)	**19.6** (16.0-23.2)	**21.2** (16.9-25.6)	**22.8** (17.2-28.1)	**24.1** (17.5-30.9)	**25.7** (17.8-34.0)	**26.7** (17.9-36.1)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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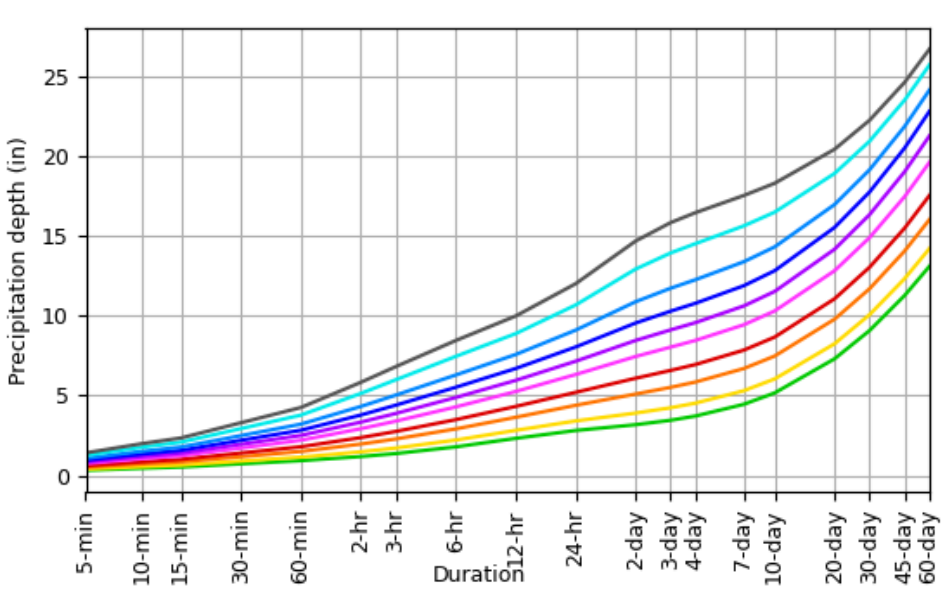
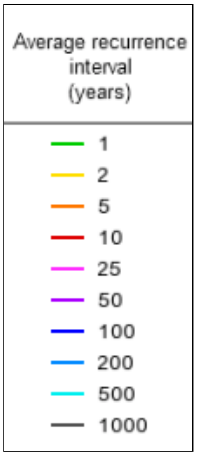
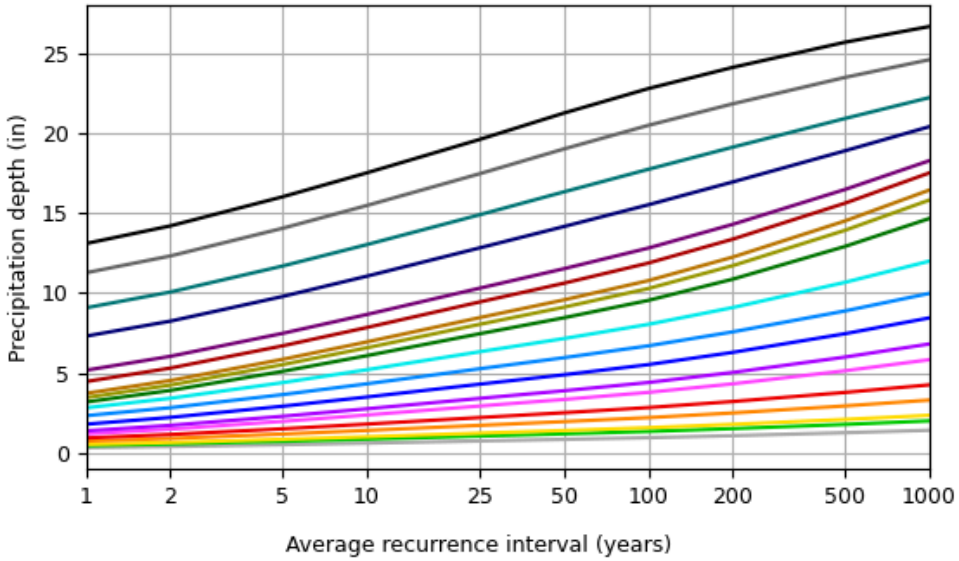
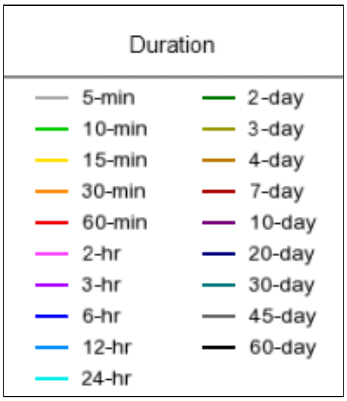
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 42.0074°, Longitude: -71.3040°









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Created (GMT): Tue Jul 16 17:07:10 2024

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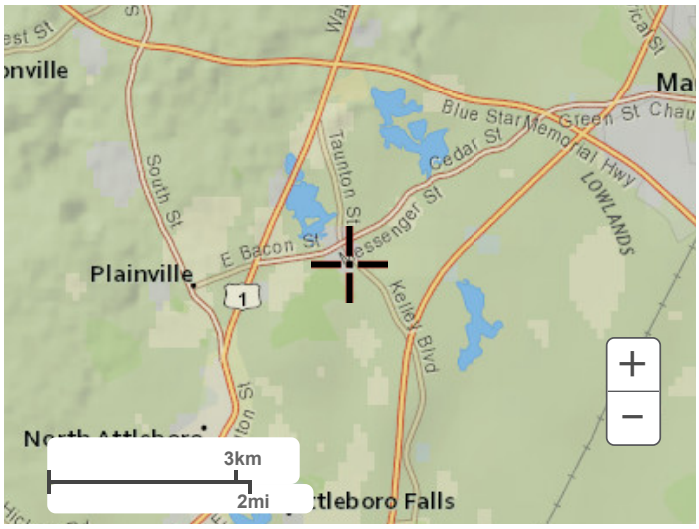
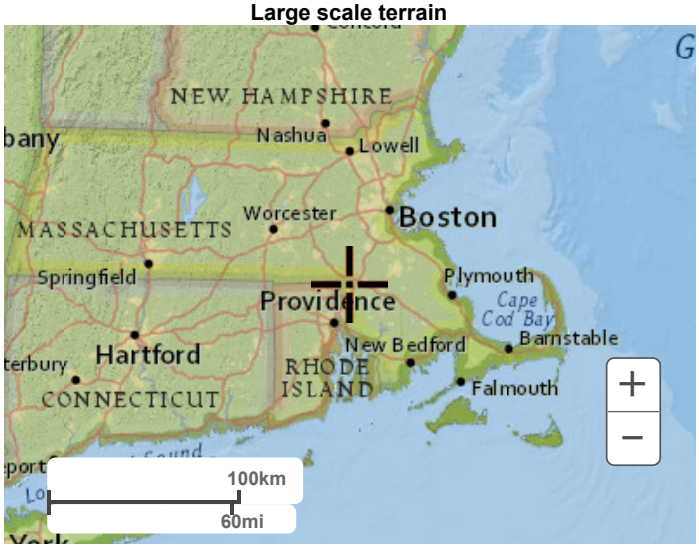
Maps & aerials

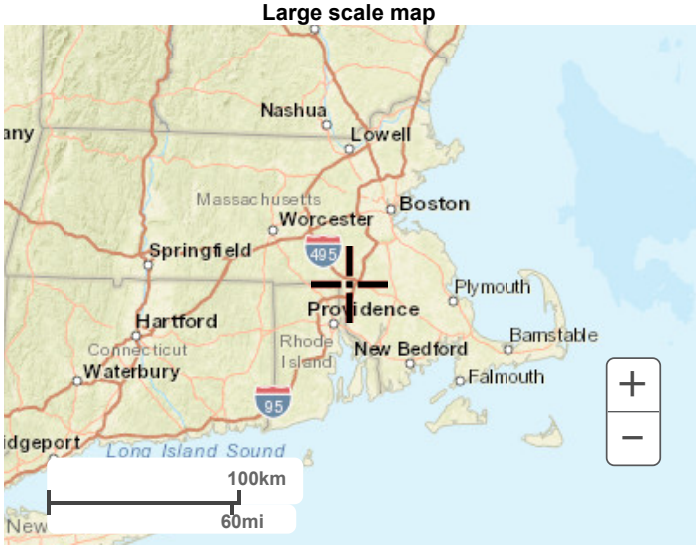
Small scale terrain



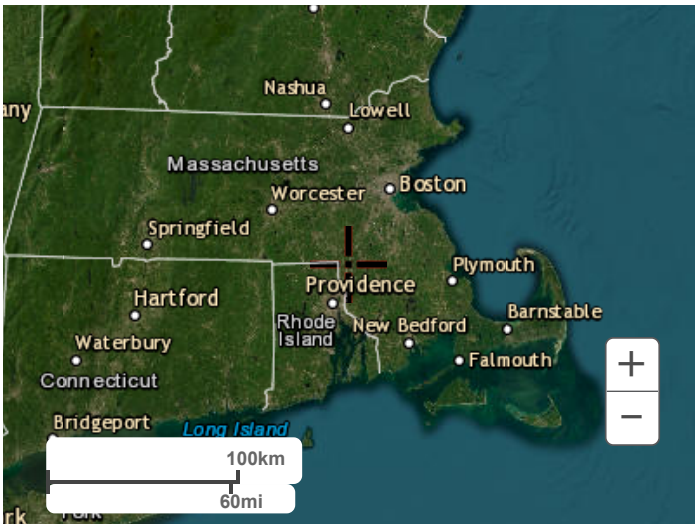
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Proposed Residential Development
582 Kelley Blvd Rear
Town of North Attleborough, MA
Bohler Job Number: W211244
9/19/2024, revised 11/21/2024

MA DEP Standard 3: Recharge Volume Calculations

Required Recharge Volume - A Soils (0.60 in.)	
Existing Site Impervious Area (ac)*	5.339
Proposed Site Impervious Area (ac)*	10.922
Proposed Increase in Site Impervious Area (ac)*	5.583
Recharge Volume Required (cf)	**12,160**

Required Recharge Volume - B Soils (0.35 in.)	
Existing Site Impervious Area (ac)	0.000
Proposed Site Impervious Area (ac)	0.000
Proposed Increase in Site Impervious Area (ac)	0.000
Recharge Volume Required (cf)	**0**

Required Recharge Volume - C Soils (0.25 in.)	
Existing Site Impervious Area (ac)	0.000
Proposed Site Impervious Area (ac)	0.000
Proposed Increase in Site Impervious Area (ac)	0.000
Recharge Volume Required (cf)	**0**

Required Recharge Volume - D Soils (0.10 in.)	
Existing Site Impervious Area (ac)	0.000
Proposed Site Impervious Area (ac)	0.000
Proposed Increase in Site Impervious Area (ac)	0.000
Recharge Volume Required (cf)	**0**

*Within analysis area

Total Recharge Volume Required (cf)	**12,160**

Recharge Volume Adjustment Factor	
Impervious Area Directed to Infiltration BMP (ac)	**10.922**
%Impervious Directed to Infiltration BMP	100%
Adjustment Factor	1.00
Adjusted Total Recharge Volume Required (cf)	**12,160**

Provided Recharge Volume**	
P1.10	32,594
P1.13	22,949
P2.1	26,910
Total Recharge Volume Provided (cf)	**82,453**

Provided greater than or Equal to Required

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

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MA DEP Standard 3: Drawdown Time Calculations

P1.10	
Volume below outlet pipe (Rv) (cf)	32,594
Soil Type	Sand - A
Infiltration rate (K)*	8.27
Bottom Area (sf)	17,075
Drawdown time (Hours)*	**2.8**
P1.13	
Volume below outlet pipe (Rv) (cf)	22,949
Soil Type	Sand - A
Infiltration rate (K)*	5.75
Bottom Area (sf)	7,860
Drawdown time (Hours)**	**6.1**
P2.1	
Volume below outlet pipe (Rv) (cf)	26,910
Soil Type	Sand - A
Infiltration rate (K)*	8.27
Bottom Area (sf)	3,062
Drawdown time (Hours)**	**12.8**

*Infiltration Rates from lesser of (1) in-situ tests with FS of 2 applied or (2) Rawls rate
**Drawdown time = Rv / (K) x (bottom area)

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MA DEP Standard 4: Water Quality Volume Calculations

Water Quality Volume Required	
Water Quality Volume runoff (in.)*	1.0
Total Post Development Impervious Area (sf)	475,762
Required Water Quality Volume (cf)	**39,647**
*Water Quality volume runoff is equal to 1.0 inches of runoff times the total impervious area of the post development project site.	

Water Quality Volume Provided*	
P1.10	32,594
P1.13	22,949
P2.1	26,910
P1.12	3,644
P1.4	2,495
Total Provided Water Quality Volume (cf)	**88,592**

Required WQV Provided

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

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Proposed Residential Development
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1" Water Quality Volume to Flow Rate Calculation Sheet

Compute Water Quality Flow with the following Equation

WQF = (qu)(A)(WQV)

Site Plan Callout		qu (from 1" - qu Table)	Impervious Area (SF)	Ai (sq/mi)	WQV (inches)		WQF (cfs)	Unit provided	Configuration	WQF treatment rate (cfs)
WQU1.11	=	774	186788	0.006700	1	=	**5.19**	**CS-6**	**Offline**	**5.60**
WQU1.13	=	774	72468	0.002599	1	=	**2.01**	**CS-5**	**Online**	**3.50**
WQU1.15	=	774	29433	0.001056	1	=	**0.82**	**CDS1515**	**Online**	**1.00**
WQU2.1.1	=	774	3187	0.000114	1	=	**0.09**	**CDS1515**	**Online**	**1.00**
WQU2.1.2	=	774	7955	0.000285	1	=	**0.22**	**CDS1515**	**Online**	**1.00**

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)

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MA DEP Standard 4: TSS Removal Calculation Worksheet

BMP Treatment Train: Pretreatment train for 44% - Deep Sump CBs to Oil/Grit separator

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump CBs	**0.25**	**1.00**	**0.25**	**0.75**
Water Quality Unit	**0.80**	**0.75**	**0.60**	**0.15**
		Total TSS Removal =	**85%**	

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

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Proposed Residential Development
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MA DEP Standard 4: TSS Removal Calculation Worksheet

BMP Treatment Train: Pretreatment train for 44% - Filtered Bioretention

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Filtered Bioretention	**0.80**	**1.00**	**0.80**	**0.20**
		Total TSS Removal =	**80%**	

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

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9/19/2024, revised 11/21/2024

MA DEP Standard 4: TSS Removal Calculation Worksheet

BMP Treatment Train: Offline Deep Sump CBs to Oil/Grit separator to Infiltration Basin

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump CBs	**0.25**	**1.00**	**0.25**	**0.75**
Water Quality Unit	**0.80**	**0.75**	**0.60**	**0.15**
Infiltration Basin	**0.80**	**0.15**	**0.12**	**0.03**
		Total TSS Removal =	**97%**	

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

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Proposed Residential Development
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Bohler Job Number: W211244
9/19/2024, revised 11/21/2024

MA DEP Standard 4: TSS Removal Calculation Worksheet

BMP Treatment Train: Filtered Bioretention to Infiltration Basin

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Filtered Bioretention	**0.80**	**1.00**	**0.80**	**0.20**
Infiltration Basin	**0.80**	**0.20**	**0.16**	**0.04**
		Total TSS Removal =	**96%**	

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

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Product Flow Rates

CASCADE

Model	Treatment Rate (cfs)	Sediment Capacity[1] (CF)
CS-4	2.00	19
CS-5	3.50	29
CS-6	5.60	42
CS-8	12.00	75
CS-10	18.00	118

CDS

Model	Treatment Rate[2] (cfs)	Sediment Capacity[1] (CF)
1515-3	1.00	14
2015-4	1.40	25
2015-5	1.40	39
2015-6	1.40	57
2020-5	2.20	39
2020-6	2.20	57
2025-5	3.20	39
2025-6	3.20	57
3020-6	3.90	57
3025-6	5.00	57
3030-6	5.70	57
3035-6	6.50	57
4030-8	7.50	151
4040-8	9.50	151

VORTECHS

Model	Treatment Rate (cfs)	Sediment Capacity[3] (CF)
1000	1.60	16
2000	2.80	32
3000	4.50	49
4000	6.00	65
5000	8.50	86
7000	11.00	108
9000	14.00	130
11000	17.5	151
16000	25	192

STORMCEPTOR STC

Model	Treatment Rate (cfs)	Sediment Capacity[1] (CF)
STC 450i	0.40	46
STC 900	0.89	89
STC 2400	1.58	205
STC 4800	2.47	543
STC 7200	3.56	839
STC 11000	4.94	1086
STC 16000	7.12	1677

1 Additional sediment storage capacity available – Check with your local representative for information.

2 Treatment Capacity is based on laboratory testing using OK-110 (average D50 particle size of approximately 100 microns) and a 2400 micron screen.

3 Maintenance recommended when sediment depth has accumulated to within 12-18 inches of the dry weather water surface elevation.

STORMWATER SOLUTIONS

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STRUCTURES SOLUTIONS

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Proposed Residential Development
582 Kelley Blvd Rear
Town of North Attleborough, MA
Bohler Job Number: W211244
9/19/2024, revised 11/21/2024

Rip Rap Sizing Calculations

Design Period Storm: 25 **Year**

Rip Rap Apron Sizing Calculations

Location	Pipe Size (in.)	Pipe Size (ft.)	Q (cfs)	TW (ft.)	V (fps)	W1 (ft.)	La (ft.)	W2 (ft.)	W3 (ft.)	Apron Type	Rip Rap Type
From WQU1.15	15	1.3	4.20	1.82	5.41	3.75	10	8	NA	B	Modified
From WQU2.1.1	12	1.0	0.49	1.12	2.63	3.00	10	7	NA	B	Modified
From WQU2.1.2	12	1.0	1.21	1.12	3.38	3.00	10	7	NA	B	Modified

Based ConnDOT Drainage Manual - Type A, B, and C Riprap Aprons

Outlet Velocity (fps)
0-8 - Modified
8-10 - Intermediate
10-14 - Standard

Scour Hole Sizing Calculations

Location	Pipe Size/ Span (in)	Pipe Size/ Span (ft)	Q (cfs)	TW (ft.)	Scour Hole Type	D_{50} (ft)	F (ft)	C (ft)	B (ft)	Rip Rap Type
From WQU1.11	30	2.5	27.52	1.82	Type 1	0.17	1.25	15	13	Modified

Based on ConnDOT Drainage Manual - Type 1 and 2 Scour Holes

D_{50} < 0.42 ft - Modified
0.42 ft < D_{50} < 0.67 ft - Intermediate
0.67 ft < D_{50} < 1.25 ft - Standard
1.25 ft < D_{50} - Special Design

Riprap Type D_{50} (inches)
Modified - 5
Intermediate - 8
Standard - 15

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

GROUNDWATER MOUNDING CALCULATIONS

"Proposed Residential Development"
582 Kelley Boulevard Rear
North Attleborough, MA
Bohler Job Number: W211244
9/19/2024, revised 11/21/2024

Methodology

Basins P1.10, P1.13, and P2.1 for this project are designed with less than 4 feet of groundwater separation. They are also designed to attenuate the 10-year storm event or larger. Therefore, groundwater mounding calculations are required according to MA DEP Stormwater Management Guidelines. The purpose of the calculations is to ensure that the mound will not prevent the full draining of the basin. The mounding analysis must show that the recharge volume will exfiltrate within seventy-two (72) hours. Additionally, it should be verified that the mounding effect will not cause stormwater to surge above the lowest discharge point out of a basin (during the 72-hour period) or raise the water elevation in a nearby resource area.

The groundwater mounding analysis was performed by a proprietary program using the Hantush Method with Glover's Solution. Input parameters are site specific and determined based on existing and proposed conditions. The required input parameters are the following: application rate; duration of application; fillable porosity; hydraulic conductivity; initial saturated thickness; length of application area; width of application area; and distance to closest resource area (constant head boundary).

Calculations using the Hantush Method are considered conservative due to the fact that the unsaturated soil zone is not incorporated. In practice, this zone will have a significant positive effect on reducing the groundwater mounding under an infiltration basin by allowing horizontal migration. Please refer to the table below where all values are in feet:

Stormwater Basin	(A) Unsaturated Zone (Basin bottom to ESHGW)	(B) Depth Below Lowest Outlet to Basin Bottom	(C) Mounding Storage Provided (A)+(B)	(D) Groundwater Mounding - Δh (D must be <C)	(E) Groundwater Mounding at 72 hrs. (E must be <A)
P1.10	**3.1**	**1.7**	**4.8**	**4.698**	**0.778**
P1.13	**3.0**	**3.3**	**6.3**	**3.578**	**0.797**
P2.1	**3.0**	**1.6**	**4.6**	**3.852**	**0.645**

Additionally, if the mound exceeds the unsaturated zone thickness, we must check the mound after 72 hours to verify that it is less than the unsaturated zone thickness to ensure that the basin can exfiltrate within that period of time.

The application rate used is converted from the Rawls value selected for an exfiltration rate in HydroCAD. The duration of application used for the analysis is the 24-hour based duration of the storm event. The fillable porosity, hydraulic conductivity, and initial saturated thickness used for the analysis are based on the existing soil conditions.

Results

Based on the criteria mentioned above, the analysis (see attached) indicates the mound in each stormwater basin falls below the mounding storage provided. Additionally, the mounding effect at the end of Day 3 is less than the unsaturated zone thickness for all basins. Given these results, we feel as though the basins recharge the stormwater volume within 72 hours as required.

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
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use consistent units (e.g. feet & days **or** inches & hours)

Input Values		
16.5400	***R***	**Recharge (infiltration) rate (feet/day)**
0.200	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
165.40	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
160.000	**x**	**1/2 length of basin (x direction, in feet)**
31.000	**y**	**1/2 width of basin (y direction, in feet)**
0.099	**t**	**duration of infiltration period (days)**
22.000	**hi(0)**	**initial thickness of saturated zone (feet)**

Conversion Table

inch/hour	feet/day
0.67	1.33
2.00	4.00

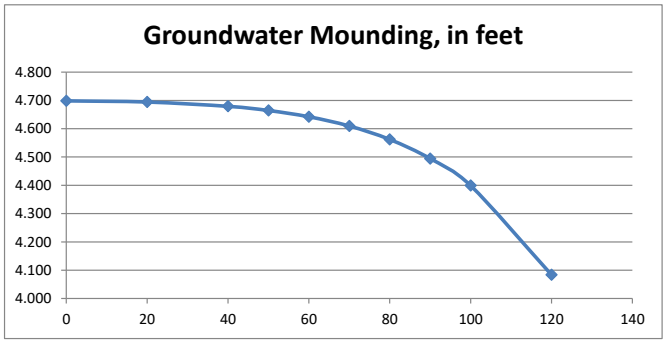
hours	days
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

26.698	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
4.698	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
4.698	**0**
4.694	**20**
4.679	**40**
4.664	**50**
4.642	**60**
4.609	**70**
4.562	**80**
4.494	**90**
4.399	**100**
4.084	**120**

Re-Calculate Now



Disclaimer

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P1.10-72 hr

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The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
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use consistent units (e.g. feet & days **or** inches & hours)

Conversion Table

inch/hour	feet/day
0.67	1.33
2.00	4.00

hours	days
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

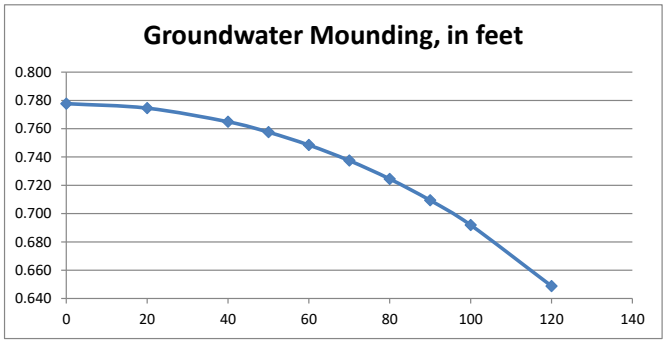
Input Values

0.5476	***R***	**Recharge (infiltration) rate (feet/day)**
0.200	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
165.40	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
160.000	**x**	**1/2 length of basin (x direction, in feet)**
31.000	**y**	**1/2 width of basin (y direction, in feet)**
3.000	**t**	**duration of infiltration period (days)**
22.000	**hi(0)**	**initial thickness of saturated zone (feet)**

22.778	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
0.778	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
0.778	0
0.775	20
0.765	40
0.758	50
0.748	60
0.737	70
0.724	80
0.709	90
0.692	100
0.649	120

Re-Calculate Now



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use consistent units (e.g. feet & days **or** inches & hours)

Conversion Table

inch/hour	feet/day
0.67	1.33
2.00	4.00

hours	days
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

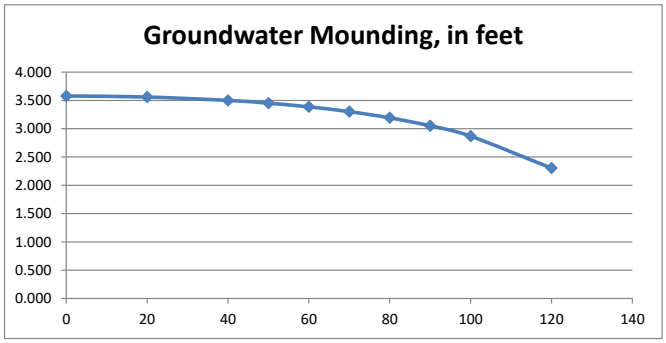
Input Values

11.5000	R	Recharge (infiltration) rate (feet/day)
0.200	Sy	Specific yield, Sy (dimensionless, between 0 and 1)
115.00	K	Horizontal hydraulic conductivity, Kh (feet/day)*
129.500	x	1/2 length of basin (x direction, in feet)
15.000	y	1/2 width of basin (y direction, in feet)
0.257	t	duration of infiltration period (days)
23.200	hi(0)	initial thickness of saturated zone (feet)

26.778	h(max)	maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
3.578	Δh(max)	maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
3.578	0
3.560	20
3.500	40
3.451	50
3.386	60
3.301	70
3.192	80
3.051	90
2.868	100
2.303	120

Re-Calculate Now



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P1.13-72 hr

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
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use consistent units (e.g. feet & days **or** inches & hours)

Conversion Table

inch/hour	feet/day
0.67	1.33
2.00	4.00

hours	days
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

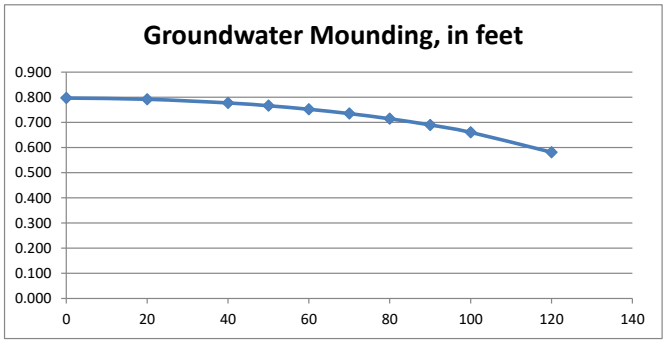
Input Values

0.9845	***R***	**Recharge (infiltration) rate (feet/day)**
0.200	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
115.00	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
129.500	**x**	**1/2 length of basin (x direction, in feet)**
15.000	**y**	**1/2 width of basin (y direction, in feet)**
3.000	**t**	**duration of infiltration period (days)**
23.200	**hi(0)**	**initial thickness of saturated zone (feet)**

23.997	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
0.797	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
0.797	0
0.792	20
0.777	40
0.766	50
0.752	60
0.735	70
0.714	80
0.690	90
0.661	100
0.581	120

Re-Calculate Now



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use consistent units (e.g. feet & days **or** inches & hours)

Input Values		
16.5400	***R***	**Recharge (infiltration) rate (feet/day)**
0.200	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
165.40	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
177.500	**x**	**1/2 length of basin (x direction, in feet)**
22.000	**y**	**1/2 width of basin (y direction, in feet)**
0.104	**t**	**duration of infiltration period (days)**
21.000	**hi(0)**	**initial thickness of saturated zone (feet)**

Conversion Table

inch/hour	feet/day
0.67	1.33
2.00	4.00

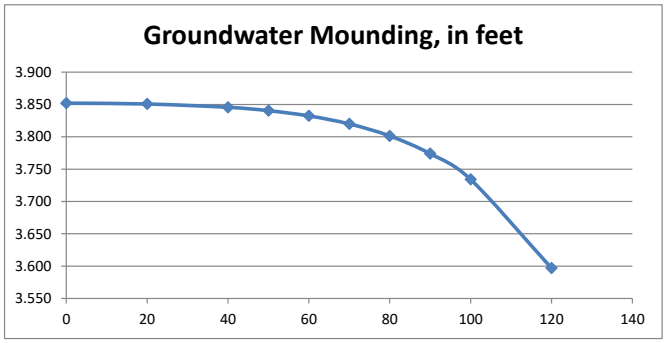
hours	days
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

24.852	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
3.852	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
3.852	0
3.851	20
3.846	40
3.840	50
3.832	60
3.820	70
3.801	80
3.774	90
3.734	100
3.597	120

Re-Calculate Now



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P2.1-72 hr

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use consistent units (e.g. feet & days **or** inches & hours)

Conversion Table

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0.67	1.33
2.00	4.00

hours	days
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

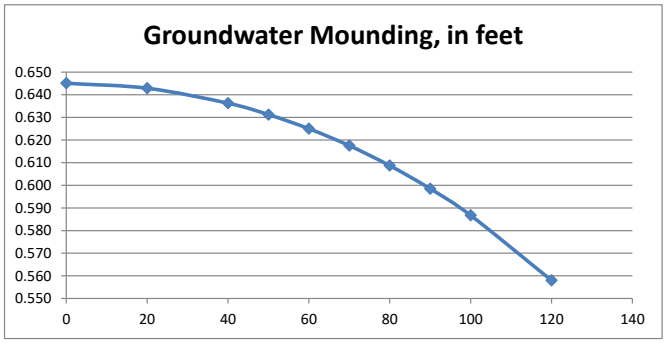
Input Values

0.5743	***R***	**Recharge (infiltration) rate (feet/day)**
0.200	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
165.40	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
177.500	**x**	**1/2 length of basin (x direction, in feet)**
22.000	**y**	**1/2 width of basin (y direction, in feet)**
3.000	**t**	**duration of infiltration period (days)**
21.000	**hi(0)**	**initial thickness of saturated zone (feet)**

21.645	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
0.645	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
0.645	0
0.643	20
0.636	40
0.631	50
0.625	60
0.618	70
0.609	80
0.598	90
0.587	100
0.558	120

Re-Calculate Now



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APPENDIX G: OPERATION AND MAINTENANCE

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

STORMWATER OPERATION AND MAINTENANCE PLAN

Proposed Residential Development
582 Kelley Boulevard Rear
North Attleborough, Massachusetts

RESPONSIBLE PARTY DURING CONSTRUCTION:

Contractor - TBD

RESPONSIBLE PARTY POST CONSTRUCTION:

Owner

Construction Phase

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

Post Development Controls

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

1. Parking lots and Roadways: Sweep at least two (2) times per year and on a more frequent basis depending on sanding operations. Swept areas shall include all parking, drive aisles, and access aisles. All resulting sweepings shall be collected and properly disposed of offsite in accordance with MADEP and other applicable requirements.

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

3. Riprap apron / Scour Hole: Riprap and scour holes should be checked at least annually and after every major storm event (generally equal or greater to 3.0 inches in 24 hours) for displaced stones, slumping, and erosion at edges, especially downstream or downslope. If the riprap is damaged, it should be repaired before further damage can take place. Note and

repair any erosion, stone displacement or low spots in the areas. Woody vegetation should be removed from the riprap annually.

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

5. Infiltration Basin: Preventative maintenance after every major storm event during the first three (3) months of operation and at least twice per year thereafter. Inspect structure and pretreatment BMP to ensure proper operation after every major storm event (generally equal or greater to 3.0 inches in 24 hours) for the first three months. Mow the buffer area, side slopes and basin bottom if grassed floor, rake if stone or sand bottom, remove trash and debris, remove grass clippings and accumulated organic matter. Any sediment removed shall be disposed of in accordance with MADEP and other applicable requirements.

6. Underground Infiltration Basins: Preventative maintenance after every major storm event during the first three (3) months of operation and at least twice per year thereafter. Inspect structure and pretreatment BMP to ensure proper operation after every major storm event (generally equal or greater to 3.0 inches in 24 hours) for the first three months. The outlet of the basin, if any, shall be inspected for erosion and sedimentation, and rip-rap shall be promptly repaired in the case of erosion. Sediment collecting in the bottom of the basin shall be inspected twice annually, and removal shall commence any time the sediment reaches a depth of six inches anywhere in the basin. Any sediment removed shall be disposed of in accordance with MADEP and other applicable requirements.

7. Bioretention Areas: shall be inspected and cleared of trashed monthly; mowed 2 to 12 times per year; mulched annually; fertilized annually; dead vegetation removed annually; pruned annually; replace entire media and all vegetation as needed. Any sediment removed shall be disposed of in accordance with MADEP and other applicable requirements.

8. Dry Well: Dry wells shall be inspected a minimum of once a year to ensure they are operating as intended and in working order. To determine if the dry well is functioning, measure the depth of water at 24 and 48 hour intervals after a storm. Calculate clearance rates by dividing the drop in water level (inches) by the time elapsed (hours). Inspections shall be by qualified personnel assigned by the property owner. Sediment collecting in the bottom of the basin shall be inspected once annually, and shall be removed any time the sediment reaches a depth of six inches. Any sediment removed shall be disposed of in accordance with MADEP and other applicable requirements.

STORMWATER MANAGEMENT SYSTEM

POST-CONSTRUCTION INSPECTION REPORT

LOCATION:

Proposed Residential Development
582 Kelley Boulevard Rear
North Attleborough, Massachusetts

RESPONSIBLE PARTY:

Owner

NAME OF INSPECTOR:	INSPECTION DATE:
Note Condition of the Following (sediment depth, debris, standing water, damage, etc.):	
Catch Basins:	
Discharge Points/ Flared End Sections / Rip Rap:	
Infiltration Basin:	
Water Quality Units:	
Other:	

Note Recommended Actions to be taken on the Following (sediment and/or debris removal, repairs, etc.):
Catch Basins:
Discharge Points / Flared End Sections / Rip Rap:
Infiltration Basin:
Water Quality Units:
Other:
Comments:

STORMWATER INSPECTION AND MAINTENANCE LOG FORM

Proposed Residential Development
582 Kelley Boulevard Rear
North Attleborough, Massachusetts

Stormwater Management Practice	Responsible Party	Date	Maintenance Activity Performed

LONG-TERM POLLUTION PREVENTION PLAN

Proposed Residential Development
582 Kelley Boulevard Rear
North Attleborough, Massachusetts

RESPONSIBLE PARTY DURING CONSTRUCTION:

Contractor - TBD

RESPONSIBLE PARTY POST CONSTRUCTION:

Owner

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

- The property owner shall be responsible for "good housekeeping" including proper periodic maintenance of building and pavement areas, curbing, landscaping, etc.
- Proper storage and removal of solid waste (dumpsters).
- Sweeping of parking lots, drive aisles and access aisles a minimum of twice per year with a commercial cleaning unit. Any sediment removed shall be disposed of in accordance with applicable local and state requirements.
- Sweeping of roadways a minimum of twice per year with a commercial cleaning unit. Any sediment removed shall be disposed of in accordance with applicable local and state requirements.
- Regular inspections and maintenance of Stormwater Management System as noted in the "O&M Plan".
- Snow removal shall be the responsibility of the property owner. Snow shall not be plowed, dumped and/or placed in forebays, infiltration basins or similar stormwater controls. Salting and/or sanding of pavement / walkway areas during winter conditions shall only be done in accordance with all state/local requirements and approvals.
- No outdoor maintenance or washing of vehicles allowed.
- Trash and other debris shall be removed from all areas of the site at least twice yearly.

- Reseed any bare areas as soon as they occur. Erosion control measures shall be installed in these areas to prevent deposits of sediment from entering the drainage system.

- Grass shall be maintained at a minimum blade height of two to three inches and only 1/3 of the plant height shall be removed at a time. Clippings shall not be disposed of within stormwater management areas or adjacent resource areas.

- Plants shall be pruned as necessary.

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

- Homeowners will be encouraged to implement the following methods when washing vehicles: Use soap sparingly, use a hose nozzle with a trigger to save water, and pour the bucket of soapy water down the sink when done and not in the street or when possible use a commercial car wash.

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

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

- In no case shall snow be disposed of or stored in the detention basins, infiltration basins or bioretention areas.

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

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

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

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

- The primary agents used for deicing at parking lots, sidewalks and the access roads shall consist of salt alternatives such as calcium carbonate ($CaCO_3$) or potassium chloride (KCl).

- Deliveries shall be monitored by owner or owner's representative to ensure proper delivery and in the event that a spillage occurs it shall be contained and cleaned up immediately in accordance with the spill prevention program for the project.

- Recycle materials whenever possible. Provide separate containers for recycle materials. Recycling products will be removed by a certified waste hauler.

OPERATON AND MAINTENANCE TRAINING PROGRAM

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

Discuss the Operations and Maintenance Plan

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

Discuss the Spill Prevention and Response Procedures

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

ILLICIT DISCHARGE STATEMENT

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

Duly Acknowledged:

_____

Name & Title Date

SPILL PREVENTION AND RESPONSE PROCEDURES (POST CONSTRUCTION)

In order to prevent or minimize the potential for a spill of Hazardous Substances or Oil or come into contact with stormwater, the following steps will be implemented:

1. All Hazardous Substances or Oil (such as pesticides, petroleum products, fertilizers, detergents, acids, paints, paint solvents, cleaning solvents, etc.) will be stored in a secure location, with their lids on, preferably under cover, when not in use.

2. The minimum practical quantity of all such materials will be kept on site.

3. A spill control and containment kit (containing, for example, absorbent materials, acid neutralizing powder, brooms, dust pans, mops, rags, gloves, goggles, plastic and metal trash containers, etc.) will be provided on site.

4. Manufacturer's recommended methods for spill cleanup will be clearly posted and site personnel will be trained regarding these procedures and the location of the information and cleanup supplies.

5. It is the OWNER's responsibility to ensure that all Hazardous Waste on site is disposed of properly by a licensed hazardous material disposal company. The OWNER is responsible for not exceeding Hazardous Waste storage requirements mandated by the EPA or state and local authorities.

In the event of a spill of Hazardous Substances or Oil, the following procedures should be followed:

1. All measures should be taken to contain and abate the spill and to prevent the discharge of the Hazardous Substance or Oil to stormwater or off-site. (The spill area should be kept well ventilated and personnel should wear appropriate protective clothing to prevent injury from contact with the Hazardous Substances.)

2. For spills of less than five (5) gallons of material, proceed with source control and containment, clean-up with absorbent materials or other applicable means unless an imminent hazard or other circumstances dictate that the spill should be treated by a professional emergency response contractor.

3. For spills greater than five (5) gallons of material immediately contact the MADEP at the toll-free 24-hour statewide emergency number: **1-888-304-1133**, the local fire department (**9-1-1**) and an approved emergency response contractor. Provide information on the type of material spilled, the location of the spill, the quantity spilled, and the time of the spill to the emergency response contractor or coordinator, and proceed with prevention, containment and/or clean-up if so desired. (Use the form provided, or similar).

4. If there is a Reportable Quantity (RQ) release, then the National Response Center should be notified immediately at (800) 424-8802; within 14 days a report should be submitted to the EPA regional office describing the release, the date and circumstances of the release and the steps taken to prevent another release. This Pollution Prevention Plan should be updated to reflect any such steps or actions taken and measures to prevent the same from reoccurring.

SPILL PREVENTION CONTROL AND COUNTERMEASURE FORM

Proposed Residential Development
582 Kelley Boulevard Rear
North Attleborough, Massachusetts

Where a release containing a hazardous substance occurs, the following steps shall be taken by the facility manager and/or supervisor:

1. Immediately notify The Town Fire Department (at **9-1-1**)

2. All measures must be taken to contain and abate the spill and to prevent the discharge of the pollutant(s) to off-site locations, receiving waters, wetlands and/or resource areas.

3. Notify the Town Health Department at 508-699-0100 Ext. 2560 and the Town Conservation Commission at 508-699-0100 Ext. 2584.

4. Provide documentation from licensed contractor showing disposal and cleanup procedures were completed as well as details on chemicals that were spilled to the Town Health Department and Conservation Commission.

Date of spill:_____ Time:_____ Reported By:_____

Weather Conditions:_____

Material Spilled	**Location of Spill**	**Approximate Quantity of Spill (in gallons)**	**Agency(s) Notified**	**Date of Notification**

Cause of Spill: _____

_____

Measures Taken to Clean up Spill: _____

_____

Type of equipment: _____ Make: _____ Size: _____

License or S/N: _____

Location and Method of Disposal _____

_____

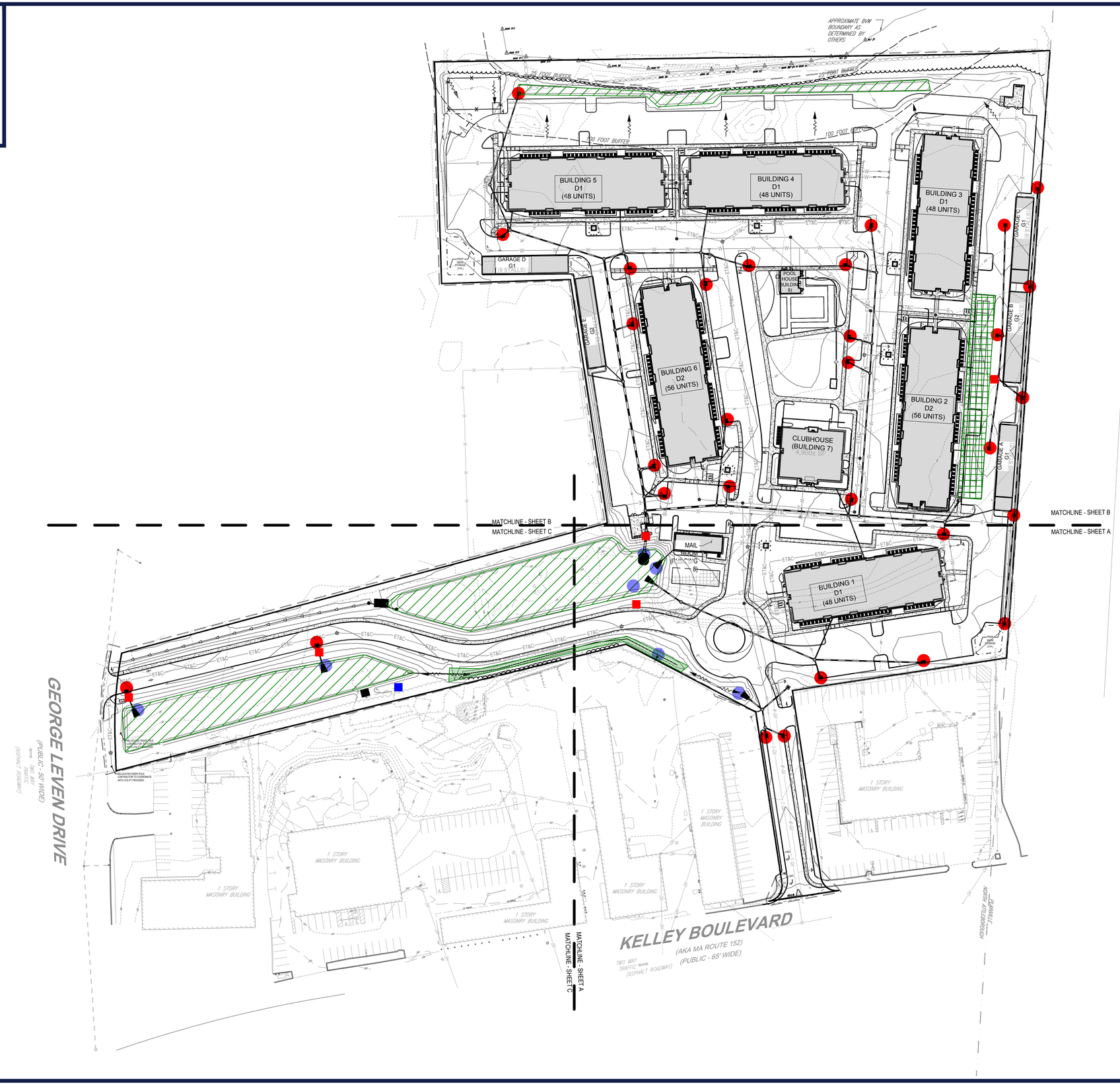
Procedures, method, and precautions instituted to prevent a similar occurrence from recurring: _____

_____

_____

Additional Contact Numbers:

- DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP) EMERGENCY PHONE: 1-888-304-1133
- NATIONAL RESPONSE CENTER PHONE: (800) 424-8802
- U.S. ENVIRONMENTAL PROTECTION AGENCY PHONE: (888) 372-7341



BOHLER

SITE CIVIL AND CONSULTING ENGINEERING
LAND SURVEYING
PROGRAM MANAGEMENT
LANDSCAPE ARCHITECTURE
SUSTAINABLE DESIGN
PERMITTING SERVICES
TRANSPORTATION SERVICES

REVISIONS

REV	DATE	COMMENT	DRAWN BY / CHECKED BY
1	10/29/2024	DD SET	AO / KWC
2	11/25/2024	CD SET	AO / KWC

811 Know what's below. Call before you dig.
ALWAYS CALL 811
It's fast. It's free. It's the law.

PERMIT SET

THIS DRAWING IS INTENDED FOR MUNICIPAL AND/OR AGENCY REVIEW AND APPROVAL. IT IS NOT INTENDED AS A CONSTRUCTION DOCUMENT UNLESS INDICATED OTHERWISE.

PROJECT No.:	W211244
DRAWN BY:	VEH/AO/DT
CHECKED BY:	KWC
DATE:	9/18/2024
CAD I.D.:	W211244-UTIL-1A

PROJECT:

PROPOSED SITE PLAN DOCUMENTS

FOR

MARCUS PARTNERS

PROPOSED DEVELOPMENT

MAP: 35 LOT: 3
582 KELLEY BOULEVARD REAR, TOWN OF NORTH ATTLEBOROUGH , BRISTOL COUNTY, MASSACHUSETTS

BOHLER
3 EXECUTIVE PARK DRIVE, FLOOR 2
BEDFORD, NH 03110
Phone: (603) 441-2900
www.BohlerEngineering.com

SHEET TITLE:
OPERATION AND MAINTENANCE PLAN

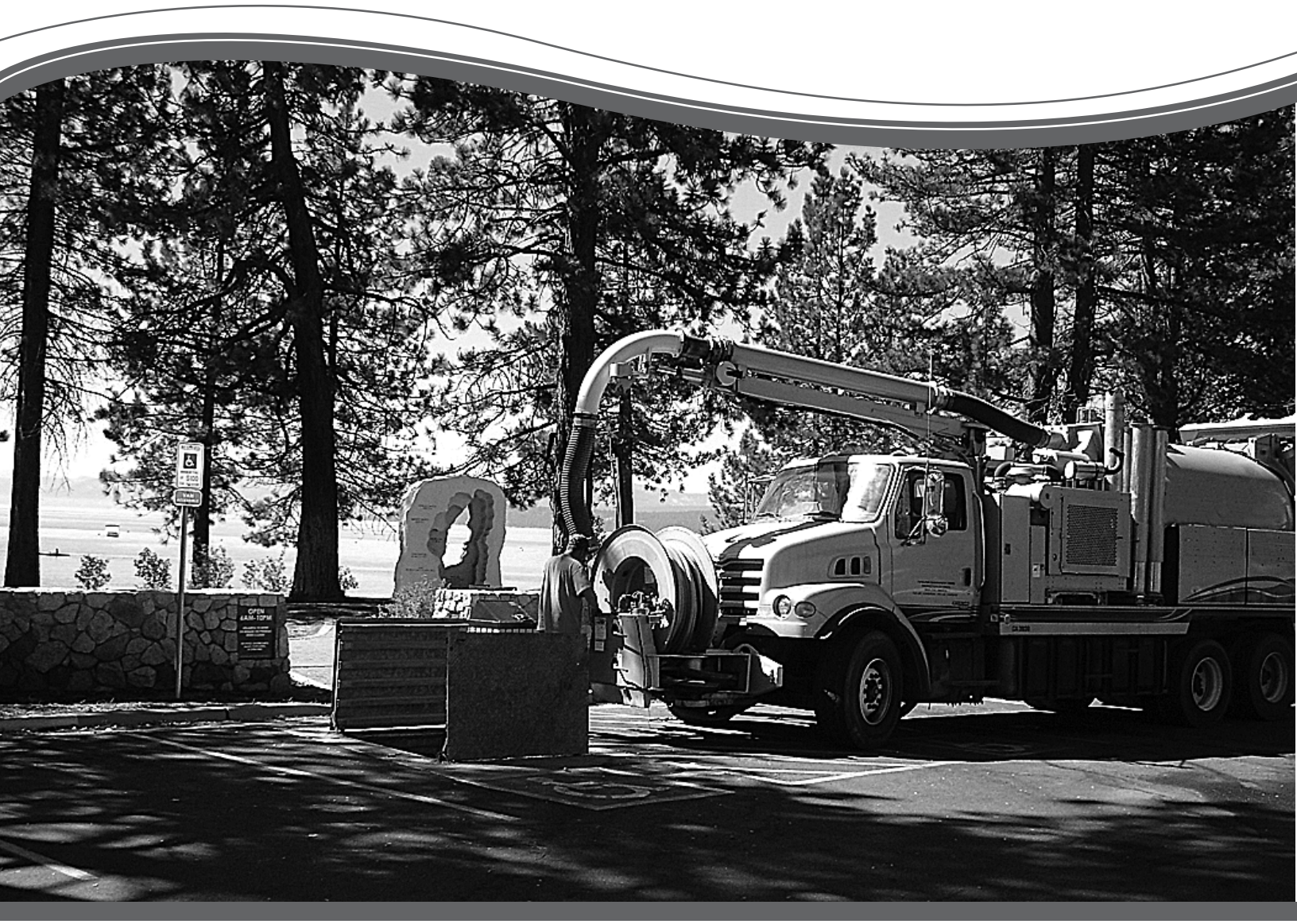
SHEET NUMBER:
OM-1

REVISION 2 - 9/17/2024

P:\211\W211244\CAD\DRAWINGS\PLAN SETS\CIVIL SITE PLANS\W211244-UTIL-1A-----LAYOUT C-651 DRAIN OVERALL

CONTECH®
ENGINEERED SOLUTIONS

Cascade Separator® Inspection and Maintenance Guide



CASCADE
separator®

Maintenance

The Cascade Separator® system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects sediment and debris will depend upon on-site activities and site pollutant characteristics. For example, unstable soils or heavy winter sanding will cause the sediment storage sump to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

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

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

Access to the Cascade Separator unit is typically achieved through one manhole access cover. The opening allows for inspection and cleanout of the center chamber (cylinder) and sediment storage sump, as well as inspection of the inlet chamber and slanted skirt. For large units, multiple manhole covers allow access to the chambers and sump.

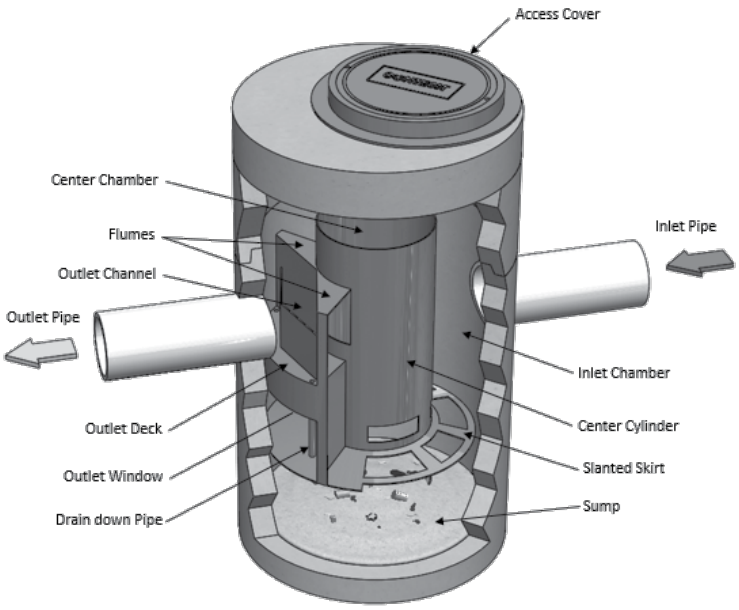
The Cascade Separator system should be cleaned before the level of sediment in the sump reaches the maximum sediment depth and/or when an appreciable level of hydrocarbons and trash has accumulated. If sorbent material is used, it must be replaced when significant discoloration has occurred. Performance may be impacted when maximum sediment storage capacity is exceeded. Contech recommends maintaining the system when sediment level reaches 50% of maximum storage volume. The level of sediment is easily determined by measuring the distance from the system outlet invert (standing water level) to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Finer, silty particles at the top of the pile typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the chart in this document to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% of the maximum sediment storage.

Cleaning

Cleaning of a Cascade Separator system should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole cover and insert the vacuum tube down through the center chamber and into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The areas outside the center chamber and the slanted skirt should also be washed off if pollutant build-up exists in these areas.

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

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and to ensure proper safety precautions. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the Cascade Separator system must be done in accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal. If any components are damaged, replacement parts can be ordered from the manufacturer.



Cascade Separator® Maintenance Indicators and Sediment Storage Capacities

Model Number	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CS-3	3	0.9	1.5	0.5	0.4	0.3
CS-4	4	1.2	2.5	0.8	0.7	0.5
CS-5	5	1.3	3	0.9	1.1	0.8
CS-6	6	1.8	3.5	1	1.6	1.2
CS-8	8	2.4	4.8	1.4	2.8	2.1
CS-10	10	3.0	6.2	1.9	4.4	3.3
CS-12	12	3.6	7.5	2.3	6.3	4.8

Note: The information in the chart is for standard units. Units may have been designed with non-standard sediment storage depth.

A Cascade Separator unit can be easily cleaned in less than 30 minutes.

A vacuum truck excavates pollutants from the systems.

Cascade Separator® Inspection & Maintenance Log

Cascade Model:			Location:		
Date	Depth Below Invert to Top of Sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The depth to sediment is determined by taking a measurement from the manhole outlet invert (standing water level) to the top of the sediment pile. Once this measurement is recorded, it should be compared to the chart in the maintenance guide to determine if the height of the sediment pile off the bottom of the sump floor exceeds 50% of the maximum sediment storage. Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.
2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SUPPORT

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

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

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CDS Guide
Operation, Design, Performance and Maintenance

CDS®

Using patented continuous deflective separation technology, the CDS system screens, separates and traps debris, sediment, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Inline units can treat up to 6 cfs, and internally bypass flows in excess of 50 cfs (1416 L/s). Available precast or cast-in-place, offline units can treat flows from 1 to 300 cfs (28.3 to 8495 L/s). The pollutant removal capacity of the CDS system has been proven in lab and field testing.

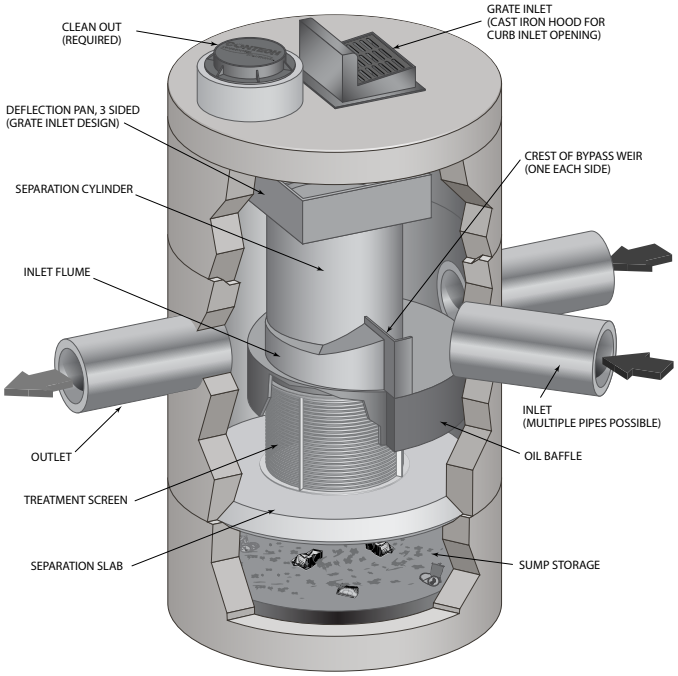
Operation Overview

Stormwater enters the diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed from the flow. All flows up to the system's treatment design capacity enter the separation chamber and are treated.

Swirl concentration and screen deflection force floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.

Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During the flow events exceeding the treatment design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants are retained in the separation cylinder.



Design Basics

There are three primary methods of sizing a CDS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow rate for a defined particle size. The Rational Rainfall Method™ or the and Probabilistic Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically in the Unites States, CDS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a gradation with an average particle size (d50) of 125 microns (μm). For some regulatory environments, CDS systems can also be designed to achieve an 80% annual solids load reduction based on an average particle size (d50) of 75 microns (μm) or 50 microns (μm).

Water Quality Flow Rate Method

In some cases, regulations require that a specific treatment rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval, e.g. the six-month storm, or a water quality depth, e.g. 1/2-inch (13 mm) of rainfall.

The CDS is designed to treat all flows up to the WQQ. At influent rates higher than the WQQ, the diversion weir will direct most flow exceeding the WQQ around the separation chamber. This allows removal efficiency to remain relatively constant in the separation chamber and eliminates the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the CDS will remove a specific gradation of sediment at a specific removal efficiency. Therefore the treatment flow rate is variable, based on the gradation and removal efficiency specified by the design engineer.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.

Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes, or hourly, and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS system are

determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Probabilistic Rational Method

The Probabilistic Rational Method is a sizing program Contech developed to estimate a net annual sediment load reduction for a particular CDS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics.

The Probabilistic Method is an extension of the Rational Method used to estimate peak discharge rates generated by storm events of varying statistical return frequencies (e.g. 2-year storm event). Under the Rational Method, an adjustment factor is used to adjust the runoff coefficient estimated for the 10-year event, correlating a known hydrologic parameter with the target storm event. The rainfall intensities vary depending on the return frequency of the storm event under consideration. In general, these two frequency dependent parameters (rainfall intensity and runoff coefficient) increase as the return frequency increases while the drainage area remains constant.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Method. Since most sites are relatively small and highly impervious, the Rational Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS are determined. Performance efficiency curve on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Treatment Flow Rate

The inlet throat area is sized to ensure that the WQQ passes through the separation chamber at a water surface elevation equal to the crest of the diversion weir. The diversion weir bypasses excessive flows around the separation chamber, thus preventing re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The hydraulic capacity of a CDS system is determined by the length and height of the diversion weir and by the maximum allowable head in the system. Typical configurations allow hydraulic capacities of up to ten times the treatment flow rate. The crest of the diversion weir may be lowered and the inlet throat may be widened to increase the capacity of the system at a given water surface elevation. The unit is designed to meet project specific hydraulic requirements.

Performance

Full-Scale Laboratory Test Results

A full-scale CDS system (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This CDS unit was evaluated under controlled laboratory conditions of influent flow rate and addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSDs) of the test materials were analyzed using standard method "Gradation ASTM D-422 "Standard Test Method for Particle-Size Analysis of Soils" by a certified laboratory.

UF Sediment is a mixture of three different products produced by the U.S. Silica Company: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation (d50 = 20 to 30 μm) covering a wide size range (Coefficient of Uniformity, C averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer d50 (d50 for NJDEP is approximately 50 μm) (NJDEP, 2003).

The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size (d50) of 106 microns. The PSDs for the test material are shown in Figure 1.

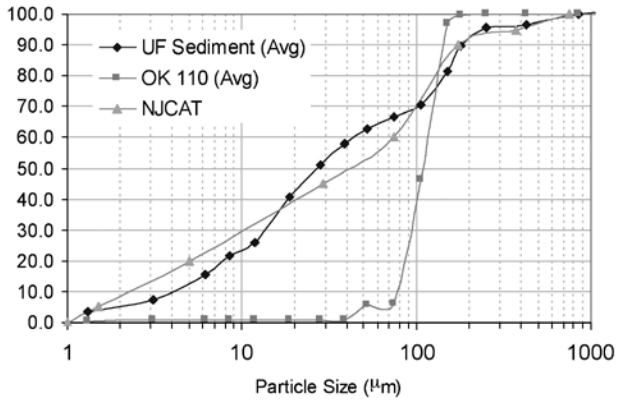


Figure 1. Particle size distributions

Tests were conducted to quantify the performance of a specific CDS unit (1.1 cfs (31.3-L/s) design capacity) at various flow rates, ranging from 1% up to 125% of the treatment design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations of approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC) testing using ASTM D3977-97 "Standard Test Methods for Determining Sediment Concentration in Water Samples", and particle size distribution analysis.

Results and Modeling

Based on the data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve representative of the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect

to SSC removal for any particle size gradation, assuming the particles are inorganic sandy-silt. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand) as a function of operating rate.

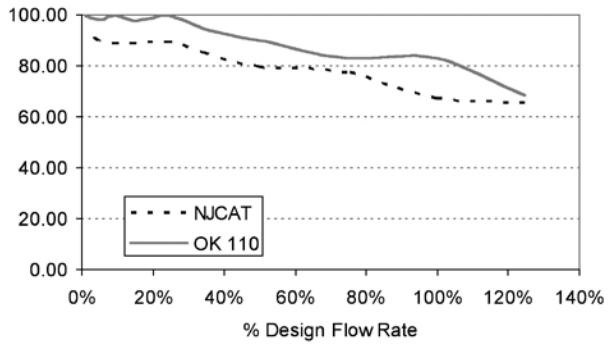


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size (d50) of 125 microns (e.g. Washington State Department of Ecology — WASDOE - 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). The model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at the design (100%) flow rate, for this particle size distribution (d50 = 125 μm).

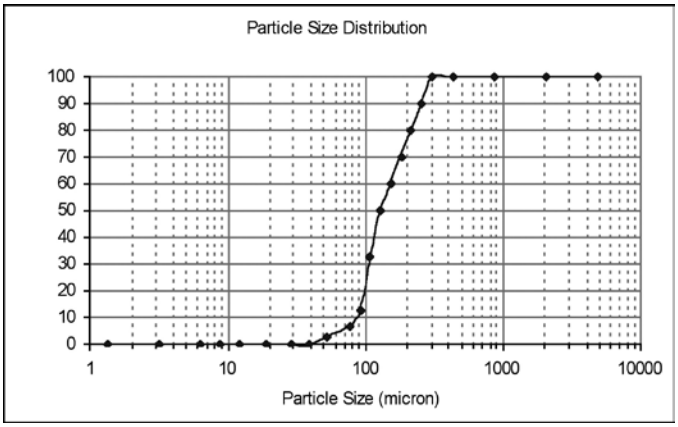


Figure 3. WASDOE PSD

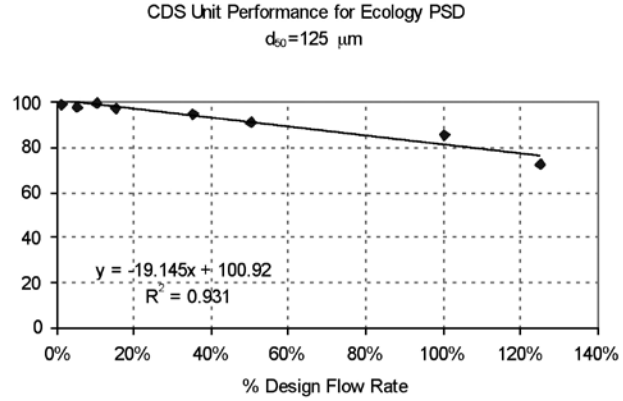


Figure 4. Modeled performance for WASDOE PSD.

Maintenance

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

Inspection

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

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified

during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

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

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

Cleaning

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

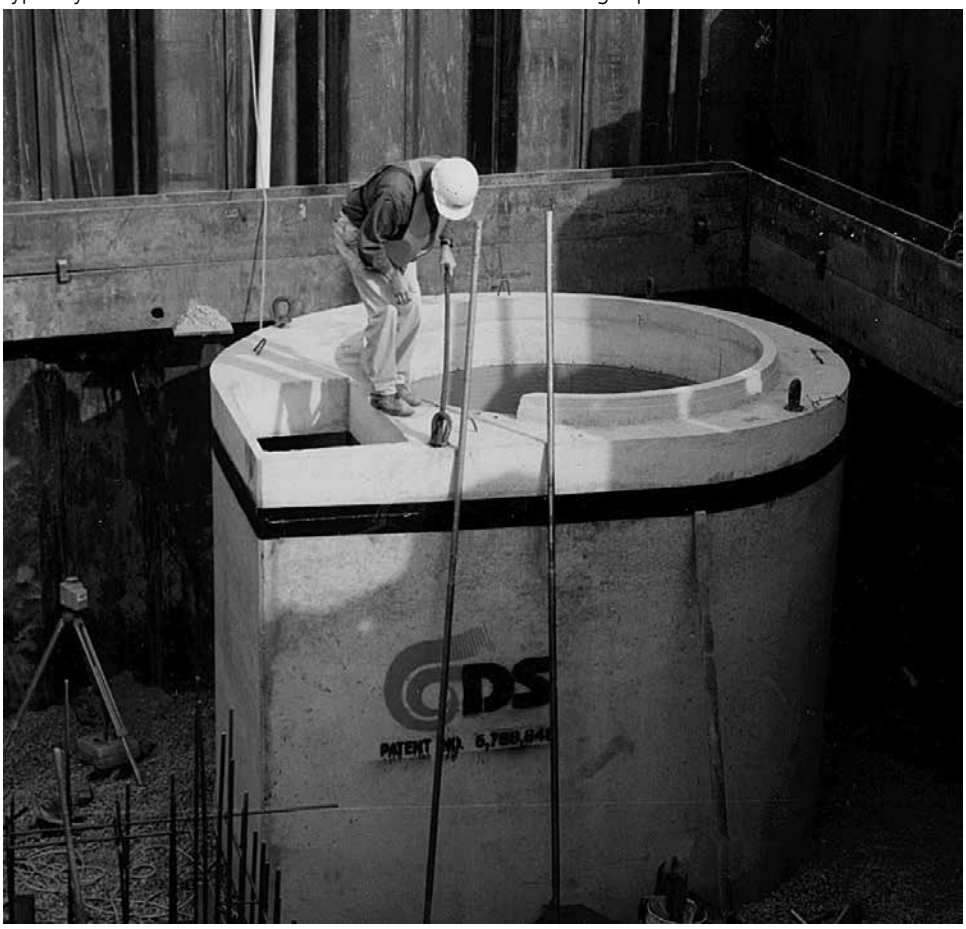
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should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

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

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

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Note: To avoid underestimating the volume of sediment in the chamber, carefully lower the measuring device to the top of the sediment pile. Finer silty particles at the top of the pile may be more difficult to feel with a measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.



CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

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

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

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

SUPPORT

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

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