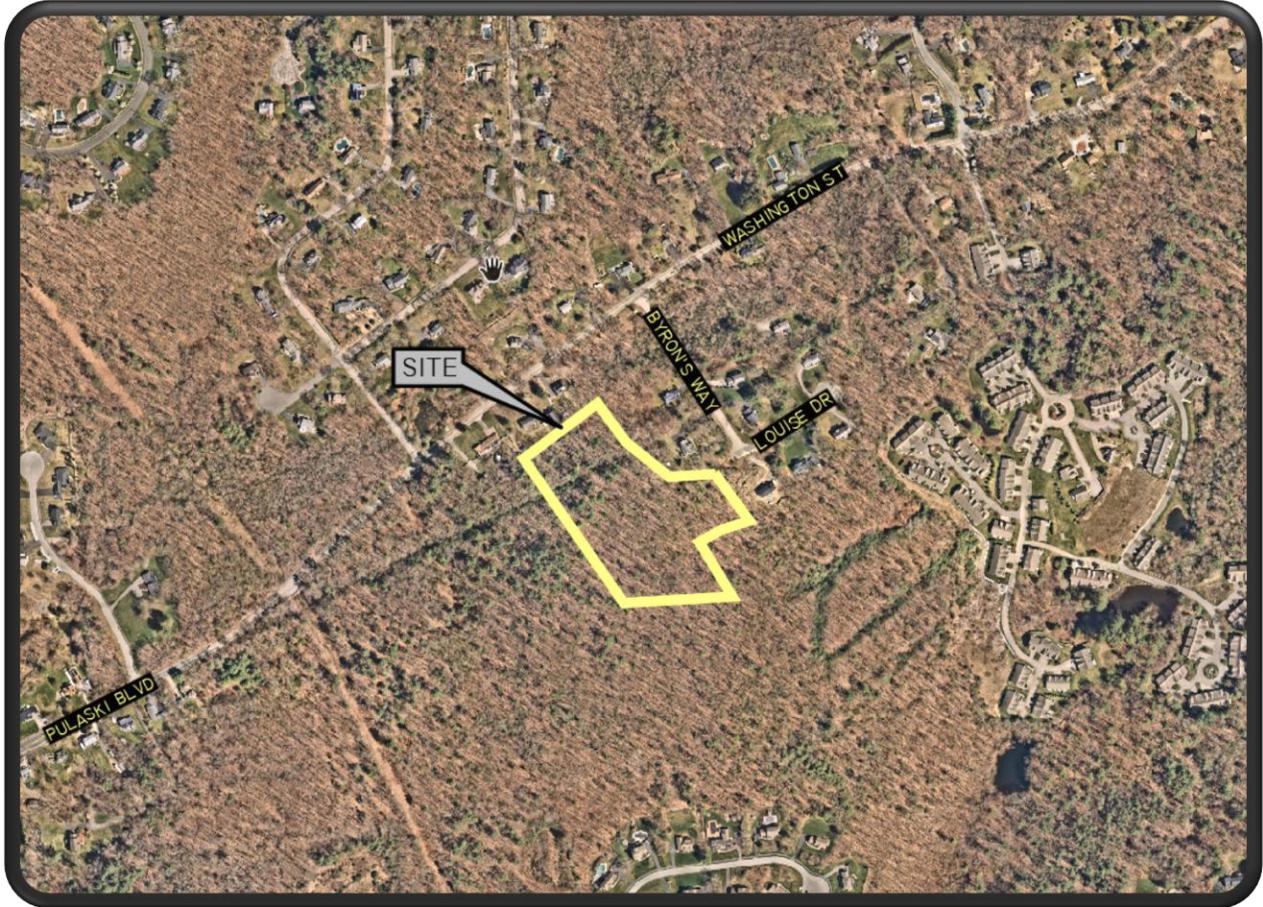




Stormwater Management Report



Louise Drive

Located in Franklin, MA
Applicant: Paul Longobardi
9-18-2024

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Executive Summary

On behalf of the Client, we are submitting drainage calculations for the proposed development on Louise Drive. The site is located on Assessors' Plat 339 Lots 13-16 & Assessors' Plat 349 Lot 2 . The site exists today as almost entirely wooded area. The client proposes to construct a new roadway for four new homes and associated parking that will extend from the current Louise Drive. The post development stormwater will be treated for water quality using Best Management Practices (BMPs). The Site has been designed to the Massachusetts Stormwater Management Standards (MASWMS). Site constraints included a high groundwater table and crossing of a wetland.

To treat and mitigate post development flows on site, a proprietary treatment device, a series of catch basins, a sediment forebay, a sand filter, and a detention pond are utilized. The treatment train will remove TSS (total suspended solids) in accordance with the MASWMS. The infiltration / detention systems are designed to control runoff for the 2 through 100-year storm events.

This report details how the site will show no net increase in stormwater runoff from pre development to post development conditions, and how the proposed BMPs will meet the Massachusetts Stormwater Management Standards (MASWMS) and the Town of Franklin Stormwater Management Bylaw.

Pre development Conditions versus Post Development Conditions are summarized below:

Pre Development vs. Post Development Mitigated

Watershed 1: (DP-1)

Conditions – Peak Flow	2-Year	10-Year	25-Year	100-Year
Pre Dev Summation	11.00	24.50	36.18	61.50
Post Dev Summation	10.29	23.48	34.23	53.51
Net Change	-0.71	-1.02	-1.95	-7.99

All flows in cubic feet per second (cfs)

Conditions – Volume	2-Year	10-Year	25-Year	100-Year
Pre Dev Summation	1.207	2.568	3.768	6.426
Post Dev Summation	1.088	2.358	3.469	5.921
Net Change	-0.119	-0.210	-0.299	-0.505

All volumes in acre-feet (ac-ft)



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 8²
- Operation and Maintenance Plan required by Standard 9

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

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

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

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

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



Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Signature and Date

Checklist

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

- New development
- Redevelopment
- Mix of New Development and Redevelopment



Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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



Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

- Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.
- Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

- Soil Analysis provided.
- Required Recharge Volume calculation provided.
- Required Recharge volume reduced through use of the LID site Design Credits.
- Sizing the infiltration, BMPs is based on the following method: Check the method used.
 - Static
 - Simple Dynamic
 - Dynamic Field¹
- 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.

N/A

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

- The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted **prior to** the discharge of stormwater to the post-construction stormwater BMPs.
- The NPDES Multi-Sector General Permit does **not** cover the land use.
- LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- All exposure has been eliminated.
- All exposure has **not** been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

- The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- Critical areas and BMPs are identified in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

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

- The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:
 - Limited Project
 - Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
 - Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
 - Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
 - Bike Path and/or Foot Path
 - Redevelopment Project
 - Redevelopment portion of mix of new and redevelopment.
- Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.
- The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

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

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

- Narrative;
 - Construction Period Operation and Maintenance Plan;
 - Names of Persons or Entity Responsible for Plan Compliance;
 - Construction Period Pollution Prevention Measures;
 - Erosion and Sedimentation Control Plan Drawings;
 - Detail drawings and specifications for erosion control BMPs, including sizing calculations;
 - Vegetation Planning;
 - Site Development Plan;
 - Construction Sequencing Plan;
 - Sequencing of Erosion and Sedimentation Controls;
 - Operation and Maintenance of Erosion and Sedimentation Controls;
 - Inspection Schedule;
 - Maintenance Schedule;
 - Inspection and Maintenance Log Form.
- A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

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

- The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- The project is **not** covered by a NPDES Construction General Permit.
- The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

- The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
 - Name of the stormwater management system owners;
 - Party responsible for operation and maintenance;
 - Schedule for implementation of routine and non-routine maintenance tasks;
 - Plan showing the location of all stormwater BMPs maintenance access areas;
 - Description and delineation of public safety features;
 - Estimated operation and maintenance budget; and
 - Operation and Maintenance Log Form.
- The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
 - A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
 - A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

- The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- An Illicit Discharge Compliance Statement is attached;
- NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.

1.0 Project Description

The purpose of this report is to specify a Storm Water Management System for the proposed development at 0 Louise Drive. A Stormwater System Operations and Maintenance Plan (O&M) has been prepared by DiPrete Engineering as a separate document.

The proposed development is located on Assessors' Plat 339 Lots 13-16 & Assessors' Plat 349 Lot 2 in Franklin, Massachusetts. The site is located on Louise Drive starting where it intersects with Byron's Way. The first watercourse that receives stormwater runoff downstream of the site is the Miscoe Brook.

The proposed development will include a paved roadway with provision for a future four new home subdivision and associated driveways. The future site will be serviced by private wells and private septic tanks.

Stormwater treatment and mitigation will be provided by utilizing Best Management Practices (BMPs) as established by the Massachusetts Stormwater Handbook. BMPs will consist of a proprietary treatment device, a series of catch basins, a sediment forebay, a sand filter, and a detention pond. The system has been designed to meet the MADEP Stormwater Handbook, otherwise known as the Massachusetts Stormwater Management Standards (MASWMS), and the Town of Franklin Stormwater Management Bylaws.

2.0 Site Conditions

2.1 SOILS

There are the following soil types within the analyzed area of the Site as mapped by the NRCS USDA Soil Conservation service:

Soil Symbol	Description	Hydrologic Group
103D	Charlton-Hollis-Rock outcrop complex, 15 to 20 percent slopes	D
104C	Hollis-Rock outcrop-Charlton complex, 3 to 15 percent slopes	D
302C	Montauk fine sandy loam, 8 to 15 percent slopes, extremely stony	C

The onsite soil includes 103D - Charlton-Hollis-Rock outcrop complex which does not have a Hydrologic Group. Other soils in and around the site include 104C – Hollis-Rock outcrop-Charlton complex, which is Hydrologic Group D soil, and 302C – Montauk fine sandy loam, which is Hydrologic Group C soil. Therefore, Hydrologic Group D has been used for modeling the 103D soil.

Site specific soil evaluations can be found in Appendix A2.1.

2.2 EXISTING SITE CONDITIONS

Currently the site is wooded. Stormwater runoff from the majority of the site flows overland and discharges to the existing wetland complex to the northeast of the site.

Stormwater from the site ultimately discharges to the Miscoe Brook. None of the stormwater discharging from the site is currently treated or detained before ultimately discharging to Miscoe Brook.

Design Point 1 (DP-1) represents the existing northeast wetland complex.

2.3 POST SITE CONDITIONS

The proposed drainage analysis uses stormwater management systems to control and treat runoff from the proposed development. The following BMP's are proposed and have been designed to include the following elements:

- Proprietary Separator (Downstream Defender)
 - Phosphorus removal capabilities
 - 3rd party testing demonstrates over 80% removal efficiency of TSS
 - 3rd party testing demonstrates over 80% removal efficiency of oils
- Sediment Forebay
 - Pretreatment of impervious areas.
 - 2.0'-4.0' forebay depth with proposed 2:1 reinforced slopes.
 - Acts as a stormwater bypass system. The water quality storm is directed to the water quality device while other storms are bypassed.
 - Equipped with Water quality stormwater event by-pass to the water quality BMP.
 - Sandy-loam or other slower infiltrating soil to be placed under the sediment forebays to inhibit infiltration within sediment forebay in areas with high in situ infiltration rates.
- Sand Filter
 - Fully infiltrates the water quality stormwater event.
 - 2.0' of sand media mix including 6" of top soil and 1.5' of filter sand for stormwater infiltration.
- Conveyance Swale
 - Diverts water around the pond complex to not impede on the abutters
- Detention pond
 - Provides a subdrain for high water table

The above elements will be used to meet the MASWMS.

3.0 Minimum Standards

The site has been designed to meet the MASWMS. The following sections outline how the site meets or exceeds the minimum required standards.

3.1 Minimum Standard 1: No New Untreated Discharges

There are no new untreated discharges from the proposed development.

3.2 Minimum Standard 2: Peak Rate Attenuation

3.2.1 Method of Analysis

USDA Soil Conservation Service Method as defined by Technical Release No. 20 (TR-20) determines Stormwater runoff rate and volume. Type III rainfall distribution is utilized. Time of concentration is determined using Technical Release No 55 (TR-55) methodology, through the computer program *HydroCAD ver. 10* by HydroCAD Software Solutions LLC.

Infiltration rates have been determined based on onsite soil evaluations. The soil evaluations were used to develop a texture class. Infiltration rates are based on Rawl's Rates. See table 2.3.3 of the Massachusetts Stormwater Handbook.

Based on the sandy loamy soil at the surface of the existing natural depression on site, an infiltration rate of 1.02 in/hr would have been used under existing conditions. Under proposed conditions, the A and B soil horizons are to be removed for the Sand filter so that the pond bottom can be set within the C soil horizon. An infiltration rate of 8.27 in/hr is used in the sand filter as proposed conditions.

The 'bottom of pond' areas for open air infiltration BMPs have been modeled as CN 98, since the direct rainfall that hits the pond bottom enters the pond instantaneously without any appreciable losses.

The drainage system has been designed to mitigate all stormwater flows for the 2 through 100 year storm events. The outlets have been sized to handle the 100-year storm event and minimize potential erosion.

Drainage Network Design Parameters:

A. PIPES

- All drainage pipes are HDPE or equivalent unless otherwise noted.
- Manning's coefficient = 0.012 for HDPE Pipe
- Diameters & lengths as specified
- The 50-year design storm is utilized for the drainage pipe design and overland flow design to ensure that the drainage system contains and channels water to the BMP areas as shown on the plans.
- The rational method has been used for the closed drainage system.

B. STRUCTURES

- Catch basins – Pre-cast concrete with 4' sump unless otherwise noted, with inverts as specified
- Manholes – Pre-cast concrete with inverts as specified.

C. OPEN CHANNELS SYSTEMS (SWALES)

- All open channels systems shall be grassed channels unless otherwise noted.

- Manning's coefficient = 0.030 for grass
- Width, depth, slope and side slopes as noted on plans.
- The 100-year design storm is utilized for the open channel design to ensure that the drainage system contains and channels water to the BMP areas as shown on the plans.
- HydroCAD has been used to model the open channels/ swales. See Appendix A5.1.

3.2.2 Design Storm

Analysis of 2-year, 10-year, 25-year and 100-year frequency storms are included. The following 24-hour rainfall intensities are obtained from the Cornell Extreme Precipitation in New York & New England (<http://precip.eas.cornell.edu/>). Note: For design storms where the Hydrology Handbook for Conservation Commissioners (Table F-1) lists a higher intensity than the Cornell data, that intensity has been adopted in lieu of the Cornell figure.

Norfolk County.

2 year =	3.27 inches
10 year =	4.94 inches
25 year =	6.26 inches
100 year=	8.99 inches

3.2.3 Design Point Breakdown

The site is analyzed as 1 watershed area. In the pre development stage there are 2 sub-catchments. In the post development stage, there are 7 sub-catchments. Each watershed will demonstrate zero increase of runoff due to the proposed development. A description of each watershed and associated sub-catchments are summarized as follows, for cover types see color watershed maps located in back of this report. Numbers in parentheses () indicate the HydroCAD Node Number.

Design Point 1:

Watershed #1 flows to Design Point 1 (DP-1)(12/119). This watershed consists of the entire site, plus upstream run on as shown on the Watershed Maps at the back of this report. The design point is the existing northeast wetland complex (12/119).

In pre development conditions there are 2 sub-catchments tributary to Design Point 1.

Pre-01 (10) collects stormwater runoff from the southeast section of the site. Water flows overland and discharges onto the neighboring abutter, which ultimately continues downstream to the existing MassDOT drainage network.

Pre-02 (11) collects stormwater runoff from the majority of the site flows overland and discharges to the existing wetland complex to the northeast of the site.

In post development conditions there are 7 sub-catchments tributary to Design Point 1.

Post-01 (100) collects runoff from the existing upland in the western central southern portion of the site, through a series of pipe network drainage structures (101, 104, 110, 111) which directs the stormwater to Pond Complex A (113, 114, 115) before being discharged to DP-1 (119) via overland flow.

Post-02 (102) collects runoff from a proposed home site and portion of the proposed roadway, through a series of pipe network drainage structures (103, 104, 110, 111) which directs the stormwater to Pond Complex A (113, 114, 115) before being discharged to DP-1 (119) via overland flow.

Post-03 (105) collects runoff from the existing upland in the western southern portion of the site, a proposed home site and southern portion of the proposed cul-de-sac through a series of pipe network drainage structures (106, 109, 110, 111) which directs the stormwater to Pond Complex A (113, 114, 115) before being discharged to DP-1 (119) via overland flow.

Post-04 (107) collects runoff from a proposed home and northern portion of the proposed cul-de-sac, through a series of pipe network drainage structures (108, 109, 110, 111) which directs the stormwater to Pond Complex A (113, 114, 115) before being discharged to DP-1 (119) via overland flow.

Post-05 (112) contains Pond Complex A. It collects runoff from a northern portion of the site and directs it via overland flow to Pond Complex A (113, 114, 115) before being discharged to DP-1 (119) via overland flow.

Post-06 (116) collects runoff from the existing upland in the eastern central southern portion of the site and directs via overland flow it through a Box Arch Culvert (117) into DP-1 (119).

Post-07 (118) contains the undetained area downgradient of Box Arch Culvert (113P). Stormwater discharges to DP-1 (119) via overland flow.

Post-08 (120) collects runoff from the existing upland in the eastern central southern portion of the site and directs via overland flow to a proprietary device (121) before reaching the existing detention pond off of Byron's Way (122).

Below is a summary of the hydrologic parameters for the pre and post development sub-catchments in Design Point-1 (119).

*Flowing to existing detention basin

	Area (acres)	CN	Tc (min)
Pre-01	1.145	77	17.4
Pre-02	12.075	74	19.5
Post-01	2.915	75	13.3
Post-02	0.431	87	6.0
Post-03	3.008	73	17.7
Post-04	0.350	91	6.0
Post-05	0.815	77	6.5
Post-06	1.646	77	12.8
Post-07	2.896	74	12.6
Post-08*	2.409	80	17.5

3.2.4 Outlet Protection

The proposed BMPs and drainage systems have been designed to minimize erosion from the proposed development. Outlet structures include rip rap where specified, to encourage non erosive velocities. Per the Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas (Part III), design criteria for outlet protection should address peak runoff from the 10 year storm. Exit velocities equal to or less than 3.0 ft/s are considered non erosive.

Pipe Outlet Protection Calculations

In the absence of specific design data in the Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas (Part III), the design equation listed in both the Rhode Island and Connecticut SESC manuals has been used to estimate exit velocity from the riprap pads, as follows:

$$L_a = \frac{1.7Q}{D_o^{3/2}} + 8D_o$$

Where:

La = required length of riprap apron (ft)

Q = outlet pipe discharge (cfs)

Do = outlet pipe diameter (ft)

For discharges where tailwater (TW) is > 0.5 Do, the width of distant end of riprap is:

$$W = 3*Do + 0.4*La$$

For stone size, d₅₀ is determined by the following formula:

$$d_{50} = \left(\frac{0.02}{TW}\right) \left(\frac{Q}{D_o}\right)^{4/3}$$

Source: Rhode Island Soil Erosion and Sediment Control Handbook; Connecticut Guidelines for Soil Erosion and Sediment Control Handbook

The above equations are used to generate outlet protection parameters to promote non-erosive discharge. The table below shows a summary of the required and provided riprap pads. Note the 100 year discharges have been used, instead of the 10 year discharge. Therefore, the outlet protection pads are conservative:

Outlet Protection

Outlet	Do (ft)	100 Year Q (cfs)	La (ft) Required	W (ft) Required	d-50 (in)
FES-11	2.00	30.39	35	41	11

It should be noted that the 10 year storm is typically used for determining the above parameters, however the 100 year flow data has been used in this instance to be conservative.

Based on the equations, all proposed stone pad lengths will adequately reduce the exit velocities.

3.2.5 Standard 2 Conclusion

The tables below present a summary of the pre development flows vs. the mitigated post development flows. The tables show a decrease in the rate of runoff and volume for all storms included in the analysis.

Pre Development vs. Post Development Mitigated

Watershed 1: (DP-1)

Conditions – Peak Flow	2-Year	10-Year	25-Year	100-Year
Pre Dev Summation	11.00	24.50	36.18	61.50
Post Dev Summation	10.29	23.48	34.23	53.51
Net Change	-0.71	-1.02	-1.95	-7.99

All flows in cubic feet per second (cfs)

Conditions – Volume	2-Year	10-Year	25-Year	100-Year
Pre Dev Summation	1.207	2.568	3.768	6.426
Post Dev Summation	1.088	2.358	3.469	5.921
Net Change	-0.119	-0.210	-0.299	-0.505

All volumes in acre-feet (ac-ft)

As shown above, there will be no increase in stormwater runoff peak rate or volume following the proposed construction during the 2 through 100 year storm events. The stormwater system has been designed to provide appropriate peak rate attenuation for all storm events.

3.3 Minimum Standard 3: Recharge

Recharge is analyzed per watershed based on impervious area coverage in accordance with Standard 3. Groundwater recharge is determined from the following equation:

$$R_v = F * \text{impervious area}$$

Where: R_v = Required Recharge Volume (ac-ft)

F = Target Depth Factor based on Hydrologic Soil Group Recharge (see table below)

I = Impervious Area (acres)

HSG	Target Depth Factor (F) (inch)
A	0.60
B	0.35
C	0.25
D	0.10

Due to the presence of Hydraulic Group D soils, the Target Depth Factor for this project is 0.10 inches for the Recharge Volume.

For each treatment system, one practice is being used to meet both Standards 3 & 4. Town requirements specify a water quality/ recharge volume of 1", which is equal to or larger than both the recharge and water quality volumes required by the MASWMS. Therefore, the town requirements overrule and 1" has been used for both recharge and water quality volumes in this analysis.

Recharge requirements will be met through the use of a sand filter(infiltrating).

Recharge has been analyzed using the Simple Dynamic (Computer Model) Method per the Massachusetts Stormwater Handbook Volume 3 Chapter 1, using HydroCAD.

The table below summarizes the required Recharge Volume for each BMP:

BMP	HSG	F	I (Acres)	R_v Required (ac-ft)
A	D	1	0.669	0.0558

A hydrocad model was created for each applicable BMP system using contributing impervious area (only) and calibrating the rainfall data to produce a runoff volume equal to the Required Recharge (R_v) volume per the table above, during the peak 2 hours of the storm. Exfiltration was set to apply to "horizontal area only".

As shown in the reported results, all stormwater is recharged without exiting the pond.

See Appendix 3.3 for all HydroCAD results.

Drawdown

All infiltration BMPs are required to drain down the required recharge volume completely within 72 hours, using the following formula:

$$Time_{drawdown} = \frac{Rv}{(K)(Bottom\ Area)}$$

Where:

Rv = Required Storage Volume

K = Saturated Hydraulic Conductivity for "Static" and "Simple Dynamic" Methods (Rawls Rate)

Bottom Area = Bottom Area of Recharge Structure

The table below summarizes the drawdown results for each BMP:

BMP	R_v (cu-ft)	K (in/hr)	Bottom Area (sf)	Drawdown (hr)
A	2428	8.27	735	4.8

3.4 Minimum Standard 4: Water Quality

The proposed treatment train has been designed to meet or exceed water quality requirements per Standard 4.

The stormwater management system is required to provide a minimum of 80% TSS removal per Standard 4. See Appendix A3.4 for TSS Removal Calculation Worksheets.

For water quality volume requirements, per the Massachusetts Stormwater Handbook:

The required water quality volume equals 1.0 inch of runoff times the total impervious area of the post development project site for a discharge –

- From a land use with a higher potential pollutant load
- Within an area with a rapid infiltration rate (greater than 2.4 inches per hour)
- Within a Zone II or Interim Wellhead Protection Area
- Near or to the following critical areas:
 - Outstanding Resource Waters
 - Special Resource Waters
 - Bathing beaches
 - Shellfish growing areas
 - Cold-water fisheries

For all other discharges the required water quality volume equals 0.5 inches of runoff times the total impervious area of the post development site.

However, Town/ City requirements specify a water quality/ recharge volume of 1", which is equal to or larger than both the recharge and water quality volumes required by the MASWMS. Therefore, the Town/ City requirements overrule and 1" has been adopted.

For each treatment system, one practice is being used to meet both Standards 3 &4. Therefore, the BMPs have been sized for the larger of the Recharge/ Water Quality Volume. See Section 3.3 for more details.

The stormwater management system is also required to provide a minimum of 80% TSS removal per Standard 4.

See Appendix 3.4 for TSS removal worksheet.

3.4.1 Individual BMP Water Quality Requirements

Each BMP has been designed per the Massachusetts Stormwater Handbook to provide water quality treatment to the maximum extent practical.

Downstream Defender™ (121)

The Downstream Defender™ is a proprietary device which removes stormwater runoff sediment before stormwater is then discharged. The device also provides TP removal and was sized per the manufacturer's requirements.

Sand Filter Sizing

Name of Sand Filter: WQ-A

Water Quality Calculations

WQ_v = 1 inch x Impervious Area
WQ_v = 2,428 (Cubic Feet)

Minimum Size of Sand Filter Filter Area

$A_f = (WQ_v) \times (d_f) / [(k) \times (h_f + d_f) \times (t_f)]$
Required A_f = 455 (Square Feet) Where A_f is the required filter bed area
Provided A_f = 735 (Square Feet)

<u>Sand Filter Parameters</u>	
At, Total Area to Sand Filter	1.931 (Acres)
Impervious Area To Sand Filter	0.669 (Acres)
d _f , Filter Bed Depth	1.50 (feet)
k, Coefficient of Permeability	4.0 (ft/day)
h _f , Average Height of Water	0.50 (ft)
t _f , Design Filter Bed Drain Time	1.00 (days)
Ponding Depth	12 (in)
Loam Depth	6 (in)

Sand Filter Pre Treatment

Type of Pre Treatment: Sediment Forebay

As = 5,750 * Q Q = %WQ_v / 86,400 %WQ_v = 25%
Required As = 40 (Square Feet), where As is the required forebay Area
Provided As = 117 (Square Feet)

25% of Water Quality Volume must be provided in Forebay
Required Volume = 607 (Cubic Feet)
Provided Volume = 1,023 (Cubic Feet)

Required Water Quality Volume

75% of the WQ_v must be held within system (including forebay)
Required WQ_v = 1,821 (Cubic Feet)

Volume of Loam 121 (Cubic Feet)
Volume of Forebay 1,023 (Cubic Feet)
Volume of Ponding 1,000 (Cubic Feet)
Volume of Voids in Filter Bed 364 (Cubic Feet)

Total 2,508 (Cubic Feet)

3.4.2 TMDL

The proposed development site ultimately discharges stormwater to the Miscoe Brook (USGS-01103220), which has no listed impairments. Therefore, no TMDL applies to this site.

3.5 Minimum Standard 5: Land Uses with Higher Potential Pollutant Loads (LUHPPLs)

The site is not considered a LUHPPL.

3.6 Minimum Standard 6: Critical Areas

The site is not located within a critical resource area.

3.7 Minimum Standard 7: Redevelopments

The site is not classified as a redevelopment site.

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

See the plan set and Stormwater Pollution Prevention Plan (SWPPP) for this development prepared by DiPrete Engineering.

3.9 Minimum Standard 9: Operation and Maintenance Plan

See the Stormwater System Operations and Maintenance Plan prepared by DiPrete Engineering.

3.10 Minimum Standard 10: Prohibition of Illicit Discharges

There are no existing or proposed illicit discharges on site. As this project is within Wetlands jurisdiction, an Illicit Discharge Compliance Statement will be submitted to the issuing authority prior to the discharge of any stormwater to post-construction BMPs.

4.0 City of Franklin Stormwater Management Ordinance

This section is intended to address any additional requirements of the Town of Franklin Stormwater Management and Erosion Control Bylaw and Town of Franklin Rules and Regulations Governing the Subdivision of Land that were not covered by the MASWMS. The following sections outline how the site meets or exceeds the minimum required standards.

4.1 Stormwater Conveyance System

Drainage Network Design Parameters:

A. PIPES

- *All Drainpipes shall be reinforced concrete pipe (RCP) having a minimum diameter of 12 inches.*
 - DiPrete Engineering is requesting a waiver to use HDPE in lieu of RCP.
 - All proposed pipes have a diameter of 12 inches or greater.
- *The designed culverts shall be of adequate capacity to accommodate flows from a fifty (50) year storm at a minimum. The closed storm drain system shall be of adequate capacity to accommodate flows from a twenty five (25) year storm at a minimum.*
 - The 100-year design storm has been utilized for the drainage pipe design to ensure that the drainage system captures and conveys stormwater to the BMP areas as shown on the plans.

B. STRUCTURES

- *All catch basins are to be constructed with sumps having a minimum depth of four (4) feet.*
 - Proposed catch basins have sumps of 4 foot depth.

C. STANDARDS

For new development sites

- *Retain the volume of runoff equivalent to, or greater than, 1.0 inch multiplied by the total post construction impervious surface area on the site.*
- *Remove 90% of the average annual load of total suspended solids (TSS) generated from the total post-construction impervious area on the site and 60% of the average annual load of total phosphorus (TP) generated from the total post-construction impervious surface area on the site.*

See Plan Set prepared by DiPrete Engineering and HydroCAD™ calculations to follow for Drainage Network Calculations.

Appendix A

A2.1 Soil Evaluations

Massachusetts Soil Evaluation Form

 DE Project Number 3343-001

 Property Owner: Pam Longobardi

 Property Location: Louise Drive, Franklin

 Date of Test Hole: 05/23/2024

 Soil Evaluator: Tim Twohig

 License Number: SE14783

 Weather: Sunny to thunderstorms

 Time: 8:00

TH ^{dth 24-1} Horizon	Depth	Coarse Fragment % by Vol.		Soil Colors - Moist (Munsell)		Re-Dox	Soil Texture (USDA)	Soil Structure	Soil Consistence (Moist)	Other
		Gravel	Cobbles & Stones	Matrix	Re-Dox Features	Depth, Percent				
A	0-4"	-	-	10YR 2/1	-	-	fsl	1 Gr	Fr	
Bw	4-36"	-	-	10YR 5/4	7.5YR 5/6	22", 5%	fsl	1 SBK	Fr	
Cd1	36-48"	5	5	2.5Y 5/2	7.5YR 5/8	36", 10%	lfs	1 PI	Fi	
Cd2	48-96"	15	15	Gley 1 5/10GY	-	-	Cb Gr lfs	1 PI	Fi	
TH ^{dth 24-2} Horizon	Depth	Coarse Fragment % by Vol.		Soil Colors - Moist (Munsell)		Re-Dox	Soil Texture (USDA)	Soil Structure	Soil Consistence (Moist)	Other
		Gravel	Cobbles & Stones	Matrix	Re-Dox Features	Depth, Percent				
A	0-6"	-	-	10YR 2/1	-	-	fsl	1 Gr	Fr	
Bw1	6-25"	-	-	10YR 5/4	-	-	fsl	1 SBK	Fr	
Bw2	25-32"	5	-	10YR 5/4	7.5YR 5/8	28", 5%	fsl	1 SBK	Fr	
Cd1	32-60"	5	-	2.5Y 5/2	7.5YR 5/8	32", 10%	lfs	1 PI	Fi	
Cd2	60-96"	15	15	2.5Y 5/2	-	-	Cb Gr lfs	1 PI	Fi	

 TH^{dth 24-1} Fill Depth - Total Depth 96" Impervious/Limiting Layer Depth - GW Seepage Depth 26" SHWT 22"

 TH^{dth 24-2} Fill Depth - Total Depth 96" Impervious/Limiting Layer Depth - GW Seepage Depth 36" SHWT 28"

Comments: _____

Massachusetts Soil Evaluation Form

 DE Project Number 3343-001

 Property Owner: Pam Longobardi

 Property Location: Louise Drive, Franklin

 Date of Test Hole: 05/23/2024

 Soil Evaluator: Tim Twohig

 License Number: SE14783

 Weather: Sunny to thunderstorms

 Time: 8:00

TH _{dth 24-3} Horizon	Depth	Coarse Fragment % by Vol.		Soil Colors - Moist (Munsell)		Re-Dox	Soil Texture (USDA)	Soil Structure	Soil Consistence (Moist)	Other
		Gravel	Cobbles & Stones	Matrix	Re-Dox Features	Depth, Percent				
A	0-5"	-	-	10YR 2/1	-	-	fsl	1 Gr	Fr	
Bw	5-28"	-	-	10YR 4/4	7.5YR 5/6	22", 15%	fsl	1 SBK	Fr	
Cd1	28-35"	-	-	2.5Y 5/3	7.5YR 5/8	28", 15%	lfs	1 PI	Fi	
Cd2	35-96"	15	15	5Y 4/3	-	-	Cb Gr fsl	1 PI	Fi	
TH _{dth 24-4} Horizon	Depth	Coarse Fragment % by Vol.		Soil Colors - Moist (Munsell)		Re-Dox	Soil Texture (USDA)	Soil Structure	Soil Consistence (Moist)	Other
		Gravel	Cobbles & Stones	Matrix	Re-Dox Features	Depth, Percent				
A	0-8"	-	-	10YR 2/2	-	-	fsl	1 Gr	Fr	
Bw	8-32"	-	-	10YR 4/4	7.5YR 5/6	25", 5%	fsl	1 SBK	Fr	
Cd1	32-60"	5	-	2.5Y 5/3	7.5YR 5/8	32", 10%	fsl	1 PI	Fi	
Cd2	60-96"	15	15	2.5Y 5/3	7.5YR 5/8	60", 10%	Cb Gr lfs	1 PI	Fi	

 TH_{dth 24-3} Fill Depth _____ Total Depth 96" Impervious/Limiting Layer Depth _____ GW Seepage Depth 28" SHWT 22"

 TH_{dth 24-4} Fill Depth _____ Total Depth 96" Impervious/Limiting Layer Depth _____ GW Seepage Depth 28" SHWT 25"

 Comments: dth 24-4: Both Cd horizons have pockets of lfs and fsl

Massachusetts Soil Evaluation Form

 DE Project Number 3343-001

 Property Owner: Pam Longobardi

 Property Location: Louise Drive, Franklin

 Date of Test Hole: 05/23/2024

 Soil Evaluator: Tim Twohig

 License Number: SE14783

 Weather: Sunny to thunderstorms

 Time: 8:00

TH ^{dth 24-5} Horizon	Depth	Coarse Fragment % by Vol.		Soil Colors - Moist (Munsell)		Re-Dox	Soil Texture (USDA)	Soil Structure	Soil Consistence (Moist)	Other
		Gravel	Cobbles & Stones	Matrix	Re-Dox Features	Depth, Percent				
A	0-10"	-	-	10YR 2/2	-	-	fsl	1 Gr	Fr	
Bw	10-24"	-	-	10YR 4/4	-	-	fsl	1 SBK	Fr	
Cd	24-96"	15	15	2.5Y 5/3	7.5YR 5/6	27", 5%	fsl	1 PI	Fi	
TH ^{dth 24-6} Horizon	Depth	Coarse Fragment % by Vol.		Soil Colors - Moist (Munsell)		Re-Dox	Soil Texture (USDA)	Soil Structure	Soil Consistence (Moist)	Other
		Gravel	Cobbles & Stones	Matrix	Re-Dox Features	Depth, Percent				
A	0-2"	-	-	10YR 2/2	-	-	fsl	1 Gr	Fr	
AB	2-8"	-	-	10YR 3/3	-	-	fsl	1 SBK	Fr	
Bw	8-31"	-	-	10YR 5/4	-	-	fsl	1 SBK	Fr	
Cd1	31-60"	-	-	10YR 5/3	7.5YR 5/6	31", 5%	lfs	1 PI	Fi	
Cd2	60-84"	20	20	10YR 5/3	-	-	Cb Gr lfs	1 PI	Fi	
2C	84-96"	15	-	2.5Y 5/3	-	-	Gr cos	0 SGR	Lo	

 TH^{dth 24-5} Fill Depth - Total Depth 96" Impervious/Limiting Layer Depth - GW Seepage Depth 36" SHWT 27"

 TH^{dth 24-6} Fill Depth - Total Depth 96" Impervious/Limiting Layer Depth - GW Seepage Depth 77" SHWT 31"

Comments: _____

Massachusetts Soil Evaluation Form

 DE Project Number 3343-001

 Property Owner: Pam Longobardi

 Property Location: Louise Drive, Franklin

 Date of Test Hole: 05/23/2024

 Soil Evaluator: Tim Twohig

 License Number: SE14783

 Weather: Sunny to thunderstorms

 Time: 8:00

TH ^{dth 24-7} Horizon	Depth	Coarse Fragment % by Vol.		Soil Colors - Moist (Munsell)		Re-Dox	Soil Texture (USDA)	Soil Structure	Soil Consistence (Moist)	Other
		Gravel	Cobbles & Stones	Matrix	Re-Dox Features	Depth, Percent				
A	0-10"	-	-	10YR 2/2	-	-	fsl	1 Gr	Fr	
Bw	10-34"	-	-	10YR 5/4	-	-	fsl	1 SBK	Fr	
Cd	34-96"	10	10	2.5Y 5/3	7.5YR 5/6	34", 5%	lfs	0 M	Fi	
TH ^{dth 24-8} Horizon	Depth	Coarse Fragment % by Vol.		Soil Colors - Moist (Munsell)		Re-Dox	Soil Texture (USDA)	Soil Structure	Soil Consistence (Moist)	Other
		Gravel	Cobbles & Stones	Matrix	Re-Dox Features	Depth, Percent				
A	0-8"	-	-	10YR 2/2	-	-	fsl	1 Gr	Fr	
Bw	8-24"	-	-	10YR 5/4	-	-	fsl	1 SBK	Fr	
Cd	24-72"	-	-	2.5Y 5/3	7.5YR 5/6	24", 5%	lfs	0 M	Fi	
2C	72-96"	-	-	2.5Y 4/3	7.5YR 5/6	-	s	0 SGR	Lo	

 TH^{dth 24-7} Fill Depth - Total Depth 96" Impervious/Limiting Layer Depth - GW Seepage Depth 41" SHWT 34"

 TH^{dth 24-8} Fill Depth - Total Depth 96" Impervious/Limiting Layer Depth - GW Seepage Depth 48" SHWT 24"

Comments: _____

Massachusetts Soil Evaluation Form

 DE Project Number 3343-001

 Property Owner: Pam Longobardi

 Property Location: Louise Drive, Franklin

 Date of Test Hole: 05/23/2024

 Soil Evaluator: Tim Twohig

 License Number: SE14783

 Weather: Sunny to thunderstorms

 Time: 8:00

TH ^{dth 24-9} Horizon	Depth	Coarse Fragment % by Vol.		Soil Colors - Moist (Munsell)		Re-Dox	Soil Texture (USDA)	Soil Structure	Soil Consistence (Moist)	Other
		Gravel	Cobbles & Stones	Matrix	Re-Dox Features	Depth, Percent				
A	0-7"	-	-	10YR 2/2	-	-	fsl	1 Gr	Fr	
Bw	7-32"	-	-	10YR 5/4	7.5YR 5/6	28", 5%	fsl	1 SBK	Fr	
Cd	32-69"	10	10	2.5Y 5/3	2.5Y 5/2	32", 5%	fsl	0 M	Fr --> Fi	
2C	69-96"			2.5Y 5/3	-	-	ls	0 M	Fr	
TH ^{dth 24-10} Horizon	Depth	Coarse Fragment % by Vol.		Soil Colors - Moist (Munsell)		Re-Dox	Soil Texture (USDA)	Soil Structure	Soil Consistence (Moist)	Other
		Gravel	Cobbles & Stones	Matrix	Re-Dox Features	Depth, Percent				
A	0-6"	-	-	10YR 2/2	-	-	fsl	1 Gr	Fr	
Bw	6-27"	-	-	10YR 5/4	-	-	fsl	1 SBK	Fr	
Cd1	27-67"	-	-	2.5Y 5/3	7.5YR 5/8	29", 5%	fsl	0 M	Fi	
Cd2	67-96"	15	15	2.5Y 5/3	-	-	Cb Gr fsl	0 M	Fi	

 TH^{dth 24-9} Fill Depth - Total Depth 96" Impervious/Limiting Layer Depth - GW Seepage Depth - SHWT 28"

 TH^{dth 24-10} Fill Depth - Total Depth 96" Impervious/Limiting Layer Depth - GW Seepage Depth 34" SHWT 29"

Comments: _____

Massachusetts Soil Evaluation Form

 DE Project Number 3343-001

 Property Owner: Pam Longobardi

 Property Location: Louise Drive, Franklin

 Date of Test Hole: 05/23/2024

 Soil Evaluator: Tim Twohig

 License Number: SE14783

 Weather: Sunny to thunderstorms

 Time: 8:00

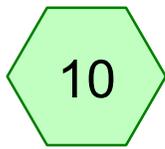
TH ^{dth 24-11} Horizon	Depth	Coarse Fragment % by Vol.		Soil Colors - Moist (Munsell)		Re-Dox	Soil Texture (USDA)	Soil Structure	Soil Consistence (Moist)	Other
		Gravel	Cobbles & Stones	Matrix	Re-Dox Features	Depth, Percent				
A	0-5"	-	-	10YR 3/2	-	-	fsl	1 Gr	Fr	
Bw	5-27"	-	-	10YR 5/4	-	-	fsl	1 SBK	Fr	
Cd1	27-48"	-		2.5Y 5/3	7.5YR 5/6	27", 5%	fsl	0 M	Fi	
Cd2	48-96"	10	10	5Y 4/1	-	-	fsl	1 PI	Fi	
TH Horizon	Depth	Coarse Fragment % by Vol.		Soil Colors - Moist (Munsell)		Re-Dox	Soil Texture (USDA)	Soil Structure	Soil Consistence (Moist)	Other
		Gravel	Cobbles & Stones	Matrix	Re-Dox Features	Depth, Percent				

 TH^{dth 24-11} Fill Depth _____ Total Depth 96" Impervious/Limiting Layer Depth _____ GW Seepage Depth _____ SHWT 27"

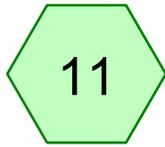
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Comments: _____

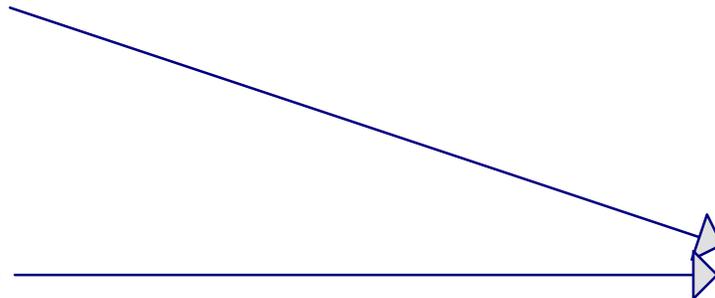
A3.2.1 HydroCAD Node Diagram



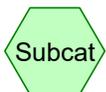
WPre-01



WPre-02



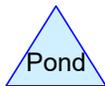
DP-1 Northeast Wetland



Subcat



Reach



Pond



Link

Routing Diagram for 3343-001-ALLS-EHCD-INHS
Prepared by DiPrete Engineering, Printed 9/10/2024
HydroCAD® 10.20-3c s/n 01125 © 2023 HydroCAD Software Solutions LLC

3343-001-ALLS-EHCD-INHS

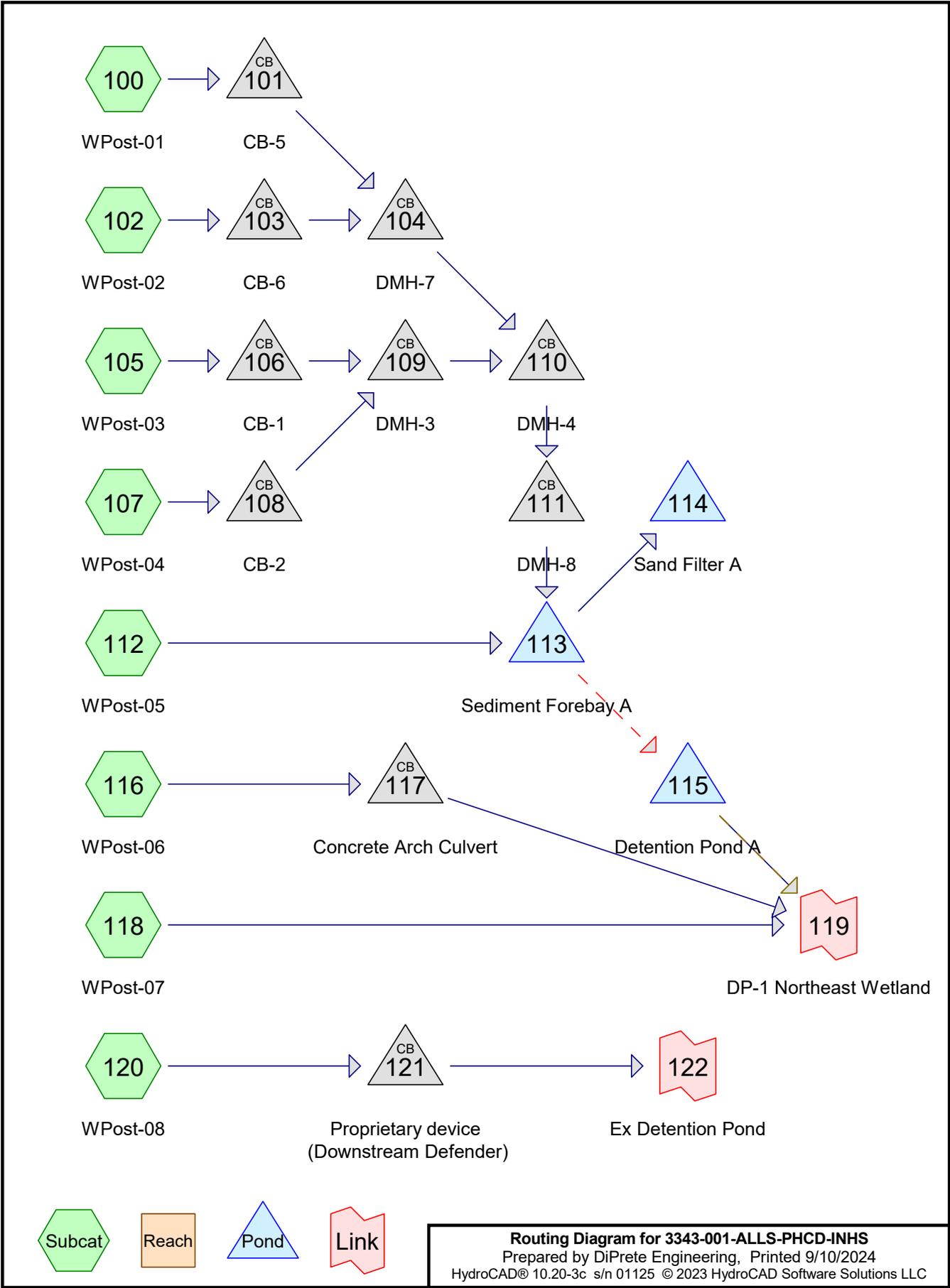
Prepared by DiPrete Engineering

Printed 9/10/2024

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Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.143	74	>75% Grass cover, Good, HSG C (11)
5.227	70	Woods, Good, HSG C (10, 11)
7.850	77	Woods, Good, HSG D (10, 11)
13.220	74	TOTAL AREA



3343-001-ALLS-PHCD-INHS

Prepared by DiPrete Engineering

Printed 9/10/2024

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Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.593	74	>75% Grass cover, Good, HSG C (105, 112, 118)
1.709	80	>75% Grass cover, Good, HSG D (100, 102, 105, 107, 112, 116, 118, 120)
0.693	98	Impervious, HSG D (100, 102, 105, 107, 120)
0.220	98	Roofs, HSG D (102, 105, 107, 120)
4.776	70	Woods, Good, HSG C (100, 105, 112, 118, 120)
6.480	77	Woods, Good, HSG D (100, 105, 107, 112, 116, 118, 120)
14.471	76	TOTAL AREA

A3.2.2 HydroCAD 2-Year Storm Analysis

3343-001-ALLS-EHCD-INHS

Type III 24-hr 2-Year Rainfall=3.27"

Prepared by DiPrete Engineering

HydroCAD® 10.20-3c s/n 01125 © 2023 HydroCAD Software Solutions LLC

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

Subcatchment 10: WPre-01

Runoff Area=1.145 ac 0.00% Impervious Runoff Depth=1.26"
Flow Length=1,097' Tc=17.4 min CN=77 Runoff=1.17 cfs 0.120 af

Subcatchment 11: WPre-02

Runoff Area=12.075 ac 0.00% Impervious Runoff Depth=1.08"
Flow Length=1,700' Tc=19.5 min CN=74 Runoff=9.88 cfs 1.091 af

Link 12: DP-1 Northeast Wetland

Inflow=11.03 cfs 1.211 af
Primary=11.03 cfs 1.211 af

Total Runoff Area = 13.220 ac Runoff Volume = 1.211 af Average Runoff Depth = 1.10"
100.00% Pervious = 13.220 ac 0.00% Impervious = 0.000 ac

3343-001-ALLS-PHCD-INHS

Type III 24-hr 2-Year Rainfall=3.27"

Prepared by DiPrete Engineering

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

Subcatchment 100: WPost-01	Runoff Area=2.915 ac 2.56% Impervious Runoff Depth=1.14" Flow Length=818' Tc=13.3 min CN=75 Runoff=2.95 cfs 0.277 af
Subcatchment 102: WPost-02	Runoff Area=0.431 ac 38.14% Impervious Runoff Depth=1.98" Tc=6.0 min CN=87 Runoff=1.00 cfs 0.071 af
Subcatchment 105: WPost-03	Runoff Area=3.008 ac 7.15% Impervious Runoff Depth=1.03" Flow Length=1,237' Tc=17.7 min CN=73 Runoff=2.40 cfs 0.258 af
Subcatchment 107: WPost-04	Runoff Area=0.350 ac 61.18% Impervious Runoff Depth=2.32" Tc=6.0 min CN=91 Runoff=0.94 cfs 0.068 af
Subcatchment 112: WPost-05	Runoff Area=0.815 ac 0.00% Impervious Runoff Depth=1.26" Flow Length=160' Tc=6.5 min CN=77 Runoff=1.16 cfs 0.086 af
Subcatchment 116: WPost-06	Runoff Area=1.646 ac 0.00% Impervious Runoff Depth=1.26" Flow Length=786' Tc=12.8 min CN=77 Runoff=1.90 cfs 0.173 af
Subcatchment 118: WPost-07	Runoff Area=2.896 ac 0.00% Impervious Runoff Depth=1.08" Flow Length=434' Tc=12.6 min CN=74 Runoff=2.81 cfs 0.262 af
Subcatchment 118x: WPost-07 Node	Runoff Area=2.896 ac 0.00% Impervious Runoff Depth=1.08" Flow Length=434' Tc=12.6 min CN=74 Runoff=2.81 cfs 0.262 af
Subcatchment 120: WPost-08	Runoff Area=2.409 ac 10.14% Impervious Runoff Depth=1.46" Flow Length=1,156' Tc=17.5 min CN=80 Runoff=2.89 cfs 0.292 af
Reach 118.2: swale north of pond	Avg. Flow Depth=0.30' Max Vel=4.89 fps Inflow=2.81 cfs 0.262 af n=0.025 L=238.0' S=0.0588 '/ Capacity=38.53 cfs Outflow=2.80 cfs 0.262 af
Pond 101: CB-5	Peak Elev=376.00' Inflow=2.95 cfs 0.277 af 18.00" Round Culvert n=0.012 L=18.0' S=0.0050 '/ Outflow=2.95 cfs 0.277 af
Pond 103: CB-6	Peak Elev=375.82' Inflow=1.00 cfs 0.071 af 15.00" Round Culvert n=0.012 L=18.0' S=0.0050 '/ Outflow=1.00 cfs 0.071 af
Pond 104: DMH-7	Peak Elev=375.29' Inflow=3.59 cfs 0.348 af 24.00" Round Culvert n=0.012 L=48.0' S=0.0100 '/ Outflow=3.59 cfs 0.348 af
Pond 106: CB-1	Peak Elev=376.01' Inflow=2.40 cfs 0.258 af 24.00" Round Culvert n=0.012 L=21.0' S=0.0100 '/ Outflow=2.40 cfs 0.258 af
Pond 108: CB-2	Peak Elev=377.21' Inflow=0.94 cfs 0.068 af 10.00" Round Culvert n=0.012 L=201.0' S=0.0010 '/ Outflow=0.94 cfs 0.068 af
Pond 109: DMH-3	Peak Elev=375.74' Inflow=2.84 cfs 0.325 af 24.00" Round Culvert n=0.012 L=52.0' S=0.0200 '/ Outflow=2.84 cfs 0.325 af

3343-001-ALLS-PHCD-INHS

Type III 24-hr 2-Year Rainfall=3.27"

Prepared by DiPrete Engineering

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Pond 110: DMH-4 Peak Elev=373.91' Inflow=6.29 cfs 0.674 af
36.00" Round Culvert n=0.013 L=227.0' S=0.0758 '/ Outflow=6.29 cfs 0.674 af

Pond 111: DMH-8 Peak Elev=359.45' Inflow=6.29 cfs 0.674 af
36.00" Round Culvert n=0.013 L=17.6' S=0.0114 '/ Outflow=6.35 cfs 0.674 af

Pond 113: Sediment Forebay A Peak Elev=359.40' Storage=1,351 cf Inflow=7.19 cfs 0.759 af
Primary=0.83 cfs 0.106 af Secondary=6.52 cfs 0.653 af Outflow=7.11 cfs 0.759 af

Pond 114: Sand Filter A Peak Elev=359.29' Storage=2,235 cf Inflow=0.83 cfs 0.106 af
Outflow=0.04 cfs 0.106 af

Pond 115: Detention Pond A Peak Elev=349.23' Storage=2,105 cf Inflow=6.52 cfs 0.653 af
Primary=6.02 cfs 0.653 af Secondary=0.00 cfs 0.000 af Outflow=6.02 cfs 0.653 af

Pond 117: Concrete Arch Culvert Peak Elev=377.84' Inflow=1.90 cfs 0.173 af
174.00" x 36.00", R=150.00" Arch Culvert n=0.012 L=40.5' S=0.0968 '/ Outflow=1.90 cfs 0.173 af

Pond 121: Proprietary device (Downstream Defender) Peak Elev=362.94' Inflow=2.89 cfs 0.292 af
15.00" Round Culvert n=0.012 L=100.0' S=0.1200 '/ Outflow=2.89 cfs 0.292 af

Link 119: DP-1 Northeast Wetland Inflow=10.29 cfs 1.088 af
Primary=10.29 cfs 1.088 af

Link 122: Ex Detention Pond Inflow=2.89 cfs 0.292 af
Primary=2.89 cfs 0.292 af

Total Runoff Area = 17.367 ac Runoff Volume = 1.748 af Average Runoff Depth = 1.21"
94.74% Pervious = 16.455 ac 5.26% Impervious = 0.913 ac

A3.2.3 HydroCAD 10-Year Storm Analysis

3343-001-ALLS-EHCD-INHS

Type III 24-hr 10-Year Rainfall=4.94"

Prepared by DiPrete Engineering

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

Subcatchment 10: WPre-01

Runoff Area=1.145 ac 0.00% Impervious Runoff Depth=2.57"
Flow Length=1,097' Tc=17.4 min CN=77 Runoff=2.46 cfs 0.245 af

Subcatchment 11: WPre-02

Runoff Area=12.075 ac 0.00% Impervious Runoff Depth=2.32"
Flow Length=1,700' Tc=19.5 min CN=74 Runoff=22.17 cfs 2.331 af

Link 12: DP-1 Northeast Wetland

Inflow=24.58 cfs 2.576 af
Primary=24.58 cfs 2.576 af

Total Runoff Area = 13.220 ac Runoff Volume = 2.576 af Average Runoff Depth = 2.34"
100.00% Pervious = 13.220 ac 0.00% Impervious = 0.000 ac

3343-001-ALLS-PHCD-INHS

Type III 24-hr 10-Year Rainfall=4.94"

Prepared by DiPrete Engineering

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

Subcatchment 100: WPost-01	Runoff Area=2.915 ac 2.56% Impervious Runoff Depth=2.40" Flow Length=818' Tc=13.3 min CN=75 Runoff=6.47 cfs 0.583 af
Subcatchment 102: WPost-02	Runoff Area=0.431 ac 38.14% Impervious Runoff Depth=3.51" Tc=6.0 min CN=87 Runoff=1.74 cfs 0.126 af
Subcatchment 105: WPost-03	Runoff Area=3.008 ac 7.15% Impervious Runoff Depth=2.23" Flow Length=1,237' Tc=17.7 min CN=73 Runoff=5.52 cfs 0.560 af
Subcatchment 107: WPost-04	Runoff Area=0.350 ac 61.18% Impervious Runoff Depth=3.92" Tc=6.0 min CN=91 Runoff=1.54 cfs 0.115 af
Subcatchment 112: WPost-05	Runoff Area=0.815 ac 0.00% Impervious Runoff Depth=2.57" Flow Length=160' Tc=6.5 min CN=77 Runoff=2.42 cfs 0.175 af
Subcatchment 116: WPost-06	Runoff Area=1.646 ac 0.00% Impervious Runoff Depth=2.57" Flow Length=786' Tc=12.8 min CN=77 Runoff=3.98 cfs 0.353 af
Subcatchment 118: WPost-07	Runoff Area=2.896 ac 0.00% Impervious Runoff Depth=2.32" Flow Length=434' Tc=12.6 min CN=74 Runoff=6.30 cfs 0.559 af
Subcatchment 118x: WPost-07 Node	Runoff Area=2.896 ac 0.00% Impervious Runoff Depth=2.32" Flow Length=434' Tc=12.6 min CN=74 Runoff=6.30 cfs 0.559 af
Subcatchment 120: WPost-08	Runoff Area=2.409 ac 10.14% Impervious Runoff Depth=2.84" Flow Length=1,156' Tc=17.5 min CN=80 Runoff=5.72 cfs 0.570 af
Reach 118.2: swale north of pond	Avg. Flow Depth=0.44' Max Vel=6.06 fps Inflow=6.30 cfs 0.559 af n=0.025 L=238.0' S=0.0588 '/ Capacity=38.53 cfs Outflow=6.29 cfs 0.559 af
Pond 101: CB-5	Peak Elev=376.72' Inflow=6.47 cfs 0.583 af 18.00" Round Culvert n=0.012 L=18.0' S=0.0050 '/ Outflow=6.47 cfs 0.583 af
Pond 103: CB-6	Peak Elev=376.04' Inflow=1.74 cfs 0.126 af 15.00" Round Culvert n=0.012 L=18.0' S=0.0050 '/ Outflow=1.74 cfs 0.126 af
Pond 104: DMH-7	Peak Elev=375.80' Inflow=7.60 cfs 0.709 af 24.00" Round Culvert n=0.012 L=48.0' S=0.0100 '/ Outflow=7.60 cfs 0.709 af
Pond 106: CB-1	Peak Elev=376.57' Inflow=5.52 cfs 0.560 af 24.00" Round Culvert n=0.012 L=21.0' S=0.0100 '/ Outflow=5.52 cfs 0.560 af
Pond 108: CB-2	Peak Elev=378.02' Inflow=1.54 cfs 0.115 af 10.00" Round Culvert n=0.012 L=201.0' S=0.0010 '/ Outflow=1.54 cfs 0.115 af
Pond 109: DMH-3	Peak Elev=376.19' Inflow=6.25 cfs 0.674 af 24.00" Round Culvert n=0.012 L=52.0' S=0.0200 '/ Outflow=6.25 cfs 0.674 af

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Type III 24-hr 10-Year Rainfall=4.94"

Prepared by DiPrete Engineering

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Pond 110: DMH-4 Peak Elev=374.44' Inflow=13.58 cfs 1.384 af
36.00" Round Culvert n=0.013 L=227.0' S=0.0758 '/ Outflow=13.58 cfs 1.384 af

Pond 111: DMH-8 Peak Elev=359.88' Inflow=13.58 cfs 1.384 af
36.00" Round Culvert n=0.013 L=17.6' S=0.0114 '/ Outflow=13.64 cfs 1.384 af

Pond 113: Sediment Forebay A Peak Elev=359.67' Storage=1,529 cf Inflow=15.34 cfs 1.559 af
Primary=0.46 cfs 0.112 af Secondary=14.85 cfs 1.446 af Outflow=15.27 cfs 1.559 af

Pond 114: Sand Filter A Peak Elev=359.58' Storage=2,650 cf Inflow=0.46 cfs 0.112 af
Outflow=0.04 cfs 0.112 af

Pond 115: Detention Pond A Peak Elev=350.40' Storage=4,166 cf Inflow=14.85 cfs 1.446 af
Primary=13.86 cfs 1.446 af Secondary=0.00 cfs 0.000 af Outflow=13.86 cfs 1.446 af

Pond 117: Concrete Arch Culvert Peak Elev=377.91' Inflow=3.98 cfs 0.353 af
174.00" x 36.00", R=150.00" Arch Culvert n=0.012 L=40.5' S=0.0968 '/ Outflow=3.98 cfs 0.353 af

Pond 121: Proprietary device (Downstream Defender) Peak Elev=363.83' Inflow=5.72 cfs 0.570 af
15.00" Round Culvert n=0.012 L=100.0' S=0.1200 '/ Outflow=5.72 cfs 0.570 af

Link 119: DP-1 Northeast Wetland Inflow=23.48 cfs 2.358 af
Primary=23.48 cfs 2.358 af

Link 122: Ex Detention Pond Inflow=5.72 cfs 0.570 af
Primary=5.72 cfs 0.570 af

Total Runoff Area = 17.367 ac Runoff Volume = 3.600 af Average Runoff Depth = 2.49"
94.74% Pervious = 16.455 ac 5.26% Impervious = 0.913 ac

A3.2.4 HydroCAD 25-Year Storm Analysis

3343-001-ALLS-EHCD-INHS

Type III 24-hr 25-Year Rainfall=6.26"

Prepared by DiPrete Engineering

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

Subcatchment 10: WPre-01

Runoff Area=1.145 ac 0.00% Impervious Runoff Depth=3.71"
Flow Length=1,097' Tc=17.4 min CN=77 Runoff=3.56 cfs 0.354 af

Subcatchment 11: WPre-02

Runoff Area=12.075 ac 0.00% Impervious Runoff Depth=3.40"
Flow Length=1,700' Tc=19.5 min CN=74 Runoff=32.81 cfs 3.426 af

Link 12: DP-1 Northeast Wetland

Inflow=36.30 cfs 3.780 af
Primary=36.30 cfs 3.780 af

Total Runoff Area = 13.220 ac Runoff Volume = 3.780 af Average Runoff Depth = 3.43"
100.00% Pervious = 13.220 ac 0.00% Impervious = 0.000 ac

3343-001-ALLS-PHCD-INHS

Type III 24-hr 25-Year Rainfall=6.26"

Prepared by DiPrete Engineering

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

Subcatchment 100: WPost-01	Runoff Area=2.915 ac 2.56% Impervious Runoff Depth=3.50" Flow Length=818' Tc=13.3 min CN=75 Runoff=9.49 cfs 0.851 af
Subcatchment 102: WPost-02	Runoff Area=0.431 ac 38.14% Impervious Runoff Depth=4.77" Tc=6.0 min CN=87 Runoff=2.34 cfs 0.171 af
Subcatchment 105: WPost-03	Runoff Area=3.008 ac 7.15% Impervious Runoff Depth=3.31" Flow Length=1,237' Tc=17.7 min CN=73 Runoff=8.26 cfs 0.828 af
Subcatchment 107: WPost-04	Runoff Area=0.350 ac 61.18% Impervious Runoff Depth=5.21" Tc=6.0 min CN=91 Runoff=2.02 cfs 0.152 af
Subcatchment 112: WPost-05	Runoff Area=0.815 ac 0.00% Impervious Runoff Depth=3.71" Flow Length=160' Tc=6.5 min CN=77 Runoff=3.48 cfs 0.252 af
Subcatchment 116: WPost-06	Runoff Area=1.646 ac 0.00% Impervious Runoff Depth=3.71" Flow Length=786' Tc=12.8 min CN=77 Runoff=5.74 cfs 0.509 af
Subcatchment 118: WPost-07	Runoff Area=2.896 ac 0.00% Impervious Runoff Depth=3.40" Flow Length=434' Tc=12.6 min CN=74 Runoff=9.34 cfs 0.822 af
Subcatchment 118x: WPost-07 Node	Runoff Area=2.896 ac 0.00% Impervious Runoff Depth=3.40" Flow Length=434' Tc=12.6 min CN=74 Runoff=9.34 cfs 0.822 af
Subcatchment 120: WPost-08	Runoff Area=2.409 ac 10.14% Impervious Runoff Depth=4.02" Flow Length=1,156' Tc=17.5 min CN=80 Runoff=8.07 cfs 0.806 af
Reach 118.2: swale north of pond	Avg. Flow Depth=0.53' Max Vel=6.71 fps Inflow=9.34 cfs 0.822 af n=0.025 L=238.0' S=0.0588 '/ Capacity=38.53 cfs Outflow=9.32 cfs 0.822 af
Pond 101: CB-5	Peak Elev=378.21' Inflow=9.49 cfs 0.851 af 18.00" Round Culvert n=0.012 L=18.0' S=0.0050 '/ Outflow=9.49 cfs 0.851 af
Pond 103: CB-6	Peak Elev=376.36' Inflow=2.34 cfs 0.171 af 15.00" Round Culvert n=0.012 L=18.0' S=0.0050 '/ Outflow=2.34 cfs 0.171 af
Pond 104: DMH-7	Peak Elev=376.22' Inflow=11.02 cfs 1.023 af 24.00" Round Culvert n=0.012 L=48.0' S=0.0100 '/ Outflow=11.02 cfs 1.023 af
Pond 106: CB-1	Peak Elev=377.04' Inflow=8.26 cfs 0.828 af 24.00" Round Culvert n=0.012 L=21.0' S=0.0100 '/ Outflow=8.26 cfs 0.828 af
Pond 108: CB-2	Peak Elev=378.80' Inflow=2.02 cfs 0.152 af 10.00" Round Culvert n=0.012 L=201.0' S=0.0010 '/ Outflow=2.02 cfs 0.152 af
Pond 109: DMH-3	Peak Elev=376.55' Inflow=9.21 cfs 0.981 af 24.00" Round Culvert n=0.012 L=52.0' S=0.0200 '/ Outflow=9.21 cfs 0.981 af

3343-001-ALLS-PHCD-INHS*Type III 24-hr 25-Year Rainfall=6.26"*

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Pond 110: DMH-4 Peak Elev=374.82' Inflow=19.84 cfs 2.003 af
 36.00" Round Culvert n=0.013 L=227.0' S=0.0758 '/ Outflow=19.84 cfs 2.003 af

Pond 111: DMH-8 Peak Elev=360.32' Inflow=19.84 cfs 2.003 af
 36.00" Round Culvert n=0.013 L=17.6' S=0.0114 '/ Outflow=20.08 cfs 2.003 af

Pond 113: Sediment Forebay A Peak Elev=359.87' Storage=1,669 cf Inflow=22.52 cfs 2.255 af
 Primary=0.53 cfs 0.116 af Secondary=21.77 cfs 2.139 af Outflow=22.27 cfs 2.255 af

Pond 114: Sand Filter A Peak Elev=359.72' Storage=2,868 cf Inflow=0.53 cfs 0.116 af
 Outflow=0.04 cfs 0.116 af

Pond 115: Detention Pond A Peak Elev=351.16' Storage=5,948 cf Inflow=21.77 cfs 2.139 af
 Primary=20.17 cfs 2.139 af Secondary=0.00 cfs 0.000 af Outflow=20.17 cfs 2.139 af

Pond 117: Concrete Arch Culvert Peak Elev=377.97' Inflow=5.74 cfs 0.509 af
 174.00" x 36.00", R=150.00" Arch Culvert n=0.012 L=40.5' S=0.0968 '/ Outflow=5.74 cfs 0.509 af

Pond 121: Proprietary device (Downstream Defender) Peak Elev=365.02' Inflow=8.07 cfs 0.806 af
 15.00" Round Culvert n=0.012 L=100.0' S=0.1200 '/ Outflow=8.07 cfs 0.806 af

Link 119: DP-1 Northeast Wetland Inflow=34.23 cfs 3.469 af
 Primary=34.23 cfs 3.469 af

Link 122: Ex Detention Pond Inflow=8.07 cfs 0.806 af
 Primary=8.07 cfs 0.806 af

Total Runoff Area = 17.367 ac Runoff Volume = 5.214 af Average Runoff Depth = 3.60"
94.74% Pervious = 16.455 ac 5.26% Impervious = 0.913 ac

A3.2.5 HydroCAD 100-Year Storm Analysis

3343-001-ALLS-EHCD-INHS

Type III 24-hr 25-Year Rainfall=6.26"

Prepared by DiPrete Engineering

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

Subcatchment 10: WPre-01

Runoff Area=1.145 ac 0.00% Impervious Runoff Depth=3.71"
Flow Length=1,097' Tc=17.4 min CN=77 Runoff=3.56 cfs 0.354 af

Subcatchment 11: WPre-02

Runoff Area=12.075 ac 0.00% Impervious Runoff Depth=3.40"
Flow Length=1,700' Tc=19.5 min CN=74 Runoff=32.81 cfs 3.426 af

Link 12: DP-1 Northeast Wetland

Inflow=36.30 cfs 3.780 af
Primary=36.30 cfs 3.780 af

Total Runoff Area = 13.220 ac Runoff Volume = 3.780 af Average Runoff Depth = 3.43"
100.00% Pervious = 13.220 ac 0.00% Impervious = 0.000 ac

3343-001-ALLS-EHCD-INHS

Type III 24-hr 25-Year Rainfall=6.26"

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Summary for Subcatchment 10: WPre-01

Runoff = 3.56 cfs @ 12.24 hrs, Volume= 0.354 af, Depth= 3.71"
 Routed to Link 12 : DP-1 Northeast Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 25-Year Rainfall=6.26"

Area (ac)	CN	Description
0.002	70	Woods, Good, HSG C
1.143	77	Woods, Good, HSG D
1.145	77	Weighted Average
1.145		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.9	100	0.0580	0.12		Sheet Flow, A
					Woods: Light underbrush n= 0.400 P2= 3.27"
3.5	997	0.0868	4.74		Shallow Concentrated Flow, B
					Unpaved Kv= 16.1 fps
17.4	1,097	Total			

Summary for Subcatchment 11: WPre-02

Runoff = 32.81 cfs @ 12.27 hrs, Volume= 3.426 af, Depth= 3.40"
 Routed to Link 12 : DP-1 Northeast Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 25-Year Rainfall=6.26"

Area (ac)	CN	Description
0.143	74	>75% Grass cover, Good, HSG C
5.225	70	Woods, Good, HSG C
6.708	77	Woods, Good, HSG D
12.075	74	Weighted Average
12.075		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	100	0.0630	0.12		Sheet Flow, A
					Woods: Light underbrush n= 0.400 P2= 3.27"
6.1	1,600	0.0738	4.37		Shallow Concentrated Flow, B
					Unpaved Kv= 16.1 fps
19.5	1,700	Total			

Summary for Link 12: DP-1 Northeast Wetland

Inflow Area = 13.220 ac, 0.00% Impervious, Inflow Depth = 3.43" for 25-Year event
Inflow = 36.30 cfs @ 12.27 hrs, Volume= 3.780 af
Primary = 36.30 cfs @ 12.27 hrs, Volume= 3.780 af, Atten= 0%, Lag= 0.0 min

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

3343-001-ALLS-PHCD-INHS

Type III 24-hr 100-Year Rainfall=8.99"

Prepared by DiPrete Engineering

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

Subcatchment 100: WPost-01	Runoff Area=2.915 ac 2.56% Impervious Runoff Depth=5.94" Flow Length=818' Tc=13.3 min CN=75 Runoff=15.99 cfs 1.444 af
Subcatchment 102: WPost-02	Runoff Area=0.431 ac 38.14% Impervious Runoff Depth=7.42" Tc=6.0 min CN=87 Runoff=3.55 cfs 0.267 af
Subcatchment 105: WPost-03	Runoff Area=3.008 ac 7.15% Impervious Runoff Depth=5.70" Flow Length=1,237' Tc=17.7 min CN=73 Runoff=14.20 cfs 1.428 af
Subcatchment 107: WPost-04	Runoff Area=0.350 ac 61.18% Impervious Runoff Depth=7.90" Tc=6.0 min CN=91 Runoff=2.99 cfs 0.231 af
Subcatchment 112: WPost-05	Runoff Area=0.815 ac 0.00% Impervious Runoff Depth=6.19" Flow Length=160' Tc=6.5 min CN=77 Runoff=5.74 cfs 0.420 af
Subcatchment 116: WPost-06	Runoff Area=1.646 ac 0.00% Impervious Runoff Depth=6.19" Flow Length=786' Tc=12.8 min CN=77 Runoff=9.49 cfs 0.849 af
Subcatchment 118: WPost-07	Runoff Area=2.896 ac 0.00% Impervious Runoff Depth=5.82" Flow Length=434' Tc=12.6 min CN=74 Runoff=15.90 cfs 1.405 af
Subcatchment 118x: WPost-07 Node	Runoff Area=2.896 ac 0.00% Impervious Runoff Depth=5.82" Flow Length=434' Tc=12.6 min CN=74 Runoff=15.90 cfs 1.405 af
Subcatchment 120: WPost-08	Runoff Area=2.409 ac 10.14% Impervious Runoff Depth=6.56" Flow Length=1,156' Tc=17.5 min CN=80 Runoff=12.99 cfs 1.317 af
Reach 118.2: swale north of pond	Avg. Flow Depth=0.68' Max Vel=7.69 fps Inflow=15.90 cfs 1.405 af n=0.025 L=238.0' S=0.0588 '/ Capacity=38.53 cfs Outflow=15.87 cfs 1.405 af
Pond 101: CB-5	Peak Elev=383.61' Inflow=15.99 cfs 1.444 af 18.00" Round Culvert n=0.012 L=18.0' S=0.0050 '/ Outflow=15.99 cfs 1.444 af
Pond 103: CB-6	Peak Elev=378.18' Inflow=3.55 cfs 0.267 af 15.00" Round Culvert n=0.012 L=18.0' S=0.0050 '/ Outflow=3.55 cfs 0.267 af
Pond 104: DMH-7	Peak Elev=377.94' Inflow=18.35 cfs 1.710 af 24.00" Round Culvert n=0.012 L=48.0' S=0.0100 '/ Outflow=18.35 cfs 1.710 af
Pond 106: CB-1	Peak Elev=379.07' Inflow=14.20 cfs 1.428 af 24.00" Round Culvert n=0.012 L=21.0' S=0.0100 '/ Outflow=14.20 cfs 1.428 af
Pond 108: CB-2	Peak Elev=381.02' Inflow=2.99 cfs 0.231 af 10.00" Round Culvert n=0.012 L=201.0' S=0.0010 '/ Outflow=2.99 cfs 0.231 af
Pond 109: DMH-3	Peak Elev=377.66' Inflow=15.64 cfs 1.658 af 24.00" Round Culvert n=0.012 L=52.0' S=0.0200 '/ Outflow=15.64 cfs 1.658 af

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Pond 110: DMH-4 Peak Elev=375.62' Inflow=33.34 cfs 3.369 af
 36.00" Round Culvert n=0.013 L=227.0' S=0.0758 '/ Outflow=33.34 cfs 3.369 af

Pond 111: DMH-8 Peak Elev=361.46' Inflow=33.34 cfs 3.369 af
 36.00" Round Culvert n=0.013 L=17.6' S=0.0114 '/ Outflow=33.35 cfs 3.369 af

Pond 113: Sediment Forebay A Peak Elev=360.23' Storage=1,945 cf Inflow=37.39 cfs 3.789 af
 Primary=0.66 cfs 0.122 af Secondary=36.70 cfs 3.667 af Outflow=37.34 cfs 3.789 af

Pond 114: Sand Filter A Peak Elev=359.96' Storage=3,262 cf Inflow=0.66 cfs 0.122 af
 Outflow=0.04 cfs 0.122 af

Pond 115: Detention Pond A Peak Elev=353.01' Storage=12,059 cf Inflow=36.70 cfs 3.667 af
 Primary=30.41 cfs 3.667 af Secondary=0.00 cfs 0.000 af Outflow=30.41 cfs 3.667 af

Pond 117: Concrete Arch Culvert Peak Elev=378.07' Inflow=9.49 cfs 0.849 af
 174.00" x 36.00", R=150.00" Arch Culvert n=0.012 L=40.5' S=0.0968 '/ Outflow=9.49 cfs 0.849 af

Pond 121: Proprietary device (Downstream Defender) Peak Elev=368.83' Inflow=12.99 cfs 1.317 af
 15.00" Round Culvert n=0.012 L=100.0' S=0.1200 '/ Outflow=12.99 cfs 1.317 af

Link 119: DP-1 Northeast Wetland Inflow=53.51 cfs 5.921 af
 Primary=53.51 cfs 5.921 af

Link 122: Ex Detention Pond Inflow=12.99 cfs 1.317 af
 Primary=12.99 cfs 1.317 af

Total Runoff Area = 17.367 ac Runoff Volume = 8.764 af Average Runoff Depth = 6.06"
94.74% Pervious = 16.455 ac 5.26% Impervious = 0.913 ac

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Summary for Subcatchment 100: WPost-01

Runoff = 15.99 cfs @ 12.18 hrs, Volume= 1.444 af, Depth= 5.94"
 Routed to Pond 101 : CB-5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-Year Rainfall=8.99"

Area (ac)	CN	Description
0.078	80	>75% Grass cover, Good, HSG D
0.075	98	Impervious, HSG D
1.080	70	Woods, Good, HSG C
1.682	77	Woods, Good, HSG D
2.915	75	Weighted Average
2.841	74	97.44% Pervious Area
0.075	98	2.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	100	0.1130	0.16		Sheet Flow, A
					Woods: Light underbrush n= 0.400 P2= 3.27"
2.4	677	0.0852	4.70		Shallow Concentrated Flow, B
					Unpaved Kv= 16.1 fps
0.3	41	0.0170	2.65		Shallow Concentrated Flow, C - Paved
					Paved Kv= 20.3 fps
13.3	818	Total			

Summary for Subcatchment 102: WPost-02

Runoff = 3.55 cfs @ 12.08 hrs, Volume= 0.267 af, Depth= 7.42"
 Routed to Pond 103 : CB-6

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-Year Rainfall=8.99"

Area (ac)	CN	Description
0.267	80	>75% Grass cover, Good, HSG D
0.104	98	Impervious, HSG D
0.060	98	Roofs, HSG D
0.431	87	Weighted Average
0.267	80	61.86% Pervious Area
0.164	98	38.14% Impervious Area

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

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Summary for Subcatchment 105: WPost-03

Runoff = 14.20 cfs @ 12.24 hrs, Volume= 1.428 af, Depth= 5.70"
 Routed to Pond 106 : CB-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-Year Rainfall=8.99"

Area (ac)	CN	Description
0.021	74	>75% Grass cover, Good, HSG C
0.271	80	>75% Grass cover, Good, HSG D
0.165	98	Impervious, HSG D
0.050	98	Roofs, HSG D
2.421	70	Woods, Good, HSG C
0.080	77	Woods, Good, HSG D
3.008	73	Weighted Average
2.793	71	92.85% Pervious Area
0.215	98	7.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	100	0.0630	0.12		Sheet Flow, A
					Woods: Light underbrush n= 0.400 P2= 3.27"
3.5	898	0.0697	4.25		Shallow Concentrated Flow, B
					Unpaved Kv= 16.1 fps
0.8	239	0.0623	5.07		Shallow Concentrated Flow, C - Paved
					Paved Kv= 20.3 fps
17.7	1,237	Total			

Summary for Subcatchment 107: WPost-04

Runoff = 2.99 cfs @ 12.08 hrs, Volume= 0.231 af, Depth= 7.90"
 Routed to Pond 108 : CB-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-Year Rainfall=8.99"

Area (ac)	CN	Description
0.134	80	>75% Grass cover, Good, HSG D
0.154	98	Impervious, HSG D
0.060	98	Roofs, HSG D
0.002	77	Woods, Good, HSG D
0.350	91	Weighted Average
0.136	80	38.82% Pervious Area
0.214	98	61.18% Impervious Area

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

Summary for Subcatchment 112: WPost-05

Runoff = 5.74 cfs @ 12.09 hrs, Volume= 0.420 af, Depth= 6.19"
 Routed to Pond 113 : Sediment Forebay A

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-Year Rainfall=8.99"

Area (ac)	CN	Description
0.274	74	>75% Grass cover, Good, HSG C
0.236	80	>75% Grass cover, Good, HSG D
0.013	70	Woods, Good, HSG C
0.292	77	Woods, Good, HSG D
0.815	77	Weighted Average
0.815	77	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	100	0.1520	0.27		Sheet Flow, A
					Grass: Dense n= 0.240 P2= 3.27"
0.2	60	0.0716	4.31		Shallow Concentrated Flow, B
					Unpaved Kv= 16.1 fps
6.5	160	Total			

Summary for Subcatchment 116: WPost-06

Runoff = 9.49 cfs @ 12.17 hrs, Volume= 0.849 af, Depth= 6.19"
 Routed to Pond 117 : Concrete Arch Culvert

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-Year Rainfall=8.99"

Area (ac)	CN	Description
0.012	80	>75% Grass cover, Good, HSG D
1.634	77	Woods, Good, HSG D
1.646	77	Weighted Average
1.646	77	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.3	100	0.1230	0.16		Sheet Flow, A
					Woods: Light underbrush n= 0.400 P2= 3.27"
2.5	686	0.0833	4.65		Shallow Concentrated Flow, B
					Unpaved Kv= 16.1 fps
12.8	786	Total			

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Summary for Subcatchment 118: WPost-07

Runoff = 15.90 cfs @ 12.17 hrs, Volume= 1.405 af, Depth= 5.82"
 Routed to Link 119 : DP-1 Northeast Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-Year Rainfall=8.99"

Area (ac)	CN	Description
0.298	74	>75% Grass cover, Good, HSG C
0.244	80	>75% Grass cover, Good, HSG D
0.000	98	Impervious, HSG D
0.000	98	Roofs, HSG D
1.260	70	Woods, Good, HSG C
1.094	77	Woods, Good, HSG D
2.896	74	Weighted Average
2.896	74	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0900	0.14		Sheet Flow, A
					Woods: Light underbrush n= 0.400 P2= 3.27"
1.0	334	0.1107	5.36		Shallow Concentrated Flow, B
					Unpaved Kv= 16.1 fps
12.6	434	Total			

Summary for Subcatchment 118x: WPost-07 Node

Runoff = 15.90 cfs @ 12.17 hrs, Volume= 1.405 af, Depth= 5.82"
 Routed to Reach 118.2 : swale north of pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-Year Rainfall=8.99"

Area (ac)	CN	Description
0.298	74	>75% Grass cover, Good, HSG C
0.244	80	>75% Grass cover, Good, HSG D
0.000	98	Impervious, HSG D
0.000	98	Roofs, HSG D
1.260	70	Woods, Good, HSG C
1.094	77	Woods, Good, HSG D
2.896	74	Weighted Average
2.896	74	100.00% Pervious Area

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0900	0.14		Sheet Flow, A
					Woods: Light underbrush n= 0.400 P2= 3.27"
1.0	334	0.1107	5.36		Shallow Concentrated Flow, B
					Unpaved Kv= 16.1 fps
12.6	434	Total			

Summary for Subcatchment 120: WPost-08

Runoff = 12.99 cfs @ 12.23 hrs, Volume= 1.317 af, Depth= 6.56"
 Routed to Pond 121 : Proprietary device (Downstream Defender)

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-Year Rainfall=8.99"

Area (ac)	CN	Description
0.467	80	>75% Grass cover, Good, HSG D
0.195	98	Impervious, HSG D
0.050	98	Roofs, HSG D
0.002	70	Woods, Good, HSG C
1.696	77	Woods, Good, HSG D
2.409	80	Weighted Average
2.165	78	89.86% Pervious Area
0.244	98	10.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.9	100	0.0580	0.12		Sheet Flow, A
					Woods: Light underbrush n= 0.400 P2= 3.27"
2.9	824	0.0856	4.71		Shallow Concentrated Flow, B
					Unpaved Kv= 16.1 fps
0.7	232	0.0849	5.91		Shallow Concentrated Flow, C
					Paved Kv= 20.3 fps
17.5	1,156	Total			

Summary for Reach 118.2: swale north of pond

Inflow Area = 2.896 ac, 0.00% Impervious, Inflow Depth = 5.82" for 100-Year event
 Inflow = 15.90 cfs @ 12.17 hrs, Volume= 1.405 af
 Outflow = 15.87 cfs @ 12.18 hrs, Volume= 1.405 af, Atten= 0%, Lag= 0.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Max. Velocity= 7.69 fps, Min. Travel Time= 0.5 min
 Avg. Velocity= 2.90 fps, Avg. Travel Time= 1.4 min

Peak Storage= 491 cf @ 12.18 hrs
 Average Depth at Peak Storage= 0.68' , Surface Width= 5.08'
 Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 38.53 cfs

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1.00' x 1.00' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 3.0 '/' Top Width= 7.00'
Length= 238.0' Slope= 0.0588 '/'
Inlet Invert= 352.00', Outlet Invert= 338.00'



Summary for Pond 101: CB-5

Inflow Area = 2.915 ac, 2.56% Impervious, Inflow Depth = 5.94" for 100-Year event
Inflow = 15.99 cfs @ 12.18 hrs, Volume= 1.444 af
Outflow = 15.99 cfs @ 12.18 hrs, Volume= 1.444 af, Atten= 0%, Lag= 0.0 min
Primary = 15.99 cfs @ 12.18 hrs, Volume= 1.444 af
Routed to Pond 104 : DMH-7

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 383.61' @ 12.18 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	374.97'	18.00" Round Pipe L= 18.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 374.97' / 374.88' S= 0.0050 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=16.00 cfs @ 12.18 hrs HW=383.60' TW=377.93' (Dynamic Tailwater)
↑**1=Pipe** (Inlet Controls 16.00 cfs @ 9.05 fps)

Summary for Pond 103: CB-6

Inflow Area = 0.431 ac, 38.14% Impervious, Inflow Depth = 7.42" for 100-Year event
Inflow = 3.55 cfs @ 12.08 hrs, Volume= 0.267 af
Outflow = 3.55 cfs @ 12.08 hrs, Volume= 0.267 af, Atten= 0%, Lag= 0.0 min
Primary = 3.55 cfs @ 12.08 hrs, Volume= 0.267 af
Routed to Pond 104 : DMH-7

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 378.18' @ 12.17 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	375.22'	15.00" Round Pipe L= 18.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 375.22' / 375.13' S= 0.0050 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=3.05 cfs @ 12.08 hrs HW=377.46' TW=377.04' (Dynamic Tailwater)
↑**1=Pipe** (Inlet Controls 3.05 cfs @ 2.48 fps)

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Summary for Pond 104: DMH-7

Inflow Area = 3.347 ac, 7.15% Impervious, Inflow Depth = 6.13" for 100-Year event
 Inflow = 18.35 cfs @ 12.16 hrs, Volume= 1.710 af
 Outflow = 18.35 cfs @ 12.16 hrs, Volume= 1.710 af, Atten= 0%, Lag= 0.0 min
 Primary = 18.35 cfs @ 12.16 hrs, Volume= 1.710 af
 Routed to Pond 110 : DMH-4

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 377.94' @ 12.17 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	374.38'	24.00" Round Pipe L= 48.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 374.38' / 373.90' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=18.25 cfs @ 12.16 hrs HW=377.93' TW=375.59' (Dynamic Tailwater)
 ↑**1=Pipe** (Inlet Controls 18.25 cfs @ 5.81 fps)

Summary for Pond 106: CB-1

Inflow Area = 3.008 ac, 7.15% Impervious, Inflow Depth = 5.70" for 100-Year event
 Inflow = 14.20 cfs @ 12.24 hrs, Volume= 1.428 af
 Outflow = 14.20 cfs @ 12.24 hrs, Volume= 1.428 af, Atten= 0%, Lag= 0.0 min
 Primary = 14.20 cfs @ 12.24 hrs, Volume= 1.428 af
 Routed to Pond 109 : DMH-3

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 379.07' @ 12.24 hrs
 Flood Elev= 381.95'

Device	Routing	Invert	Outlet Devices
#1	Primary	375.15'	24.00" Round Pipe L= 21.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 375.15' / 374.94' S= 0.0100 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=14.23 cfs @ 12.24 hrs HW=379.07' TW=377.64' (Dynamic Tailwater)
 ↑**1=Pipe** (Inlet Controls 14.23 cfs @ 4.53 fps)

Summary for Pond 108: CB-2

Inflow Area = 0.350 ac, 61.18% Impervious, Inflow Depth = 7.90" for 100-Year event
 Inflow = 2.99 cfs @ 12.08 hrs, Volume= 0.231 af
 Outflow = 2.99 cfs @ 12.08 hrs, Volume= 0.231 af, Atten= 0%, Lag= 0.0 min
 Primary = 2.99 cfs @ 12.08 hrs, Volume= 0.231 af
 Routed to Pond 109 : DMH-3

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 381.02' @ 12.08 hrs
 Flood Elev= 381.86'

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Device	Routing	Invert	Outlet Devices
#1	Primary	376.31'	10.00" Round Pipe L= 201.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 376.31' / 376.10' S= 0.0010 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.55 sf

Primary OutFlow Max=2.98 cfs @ 12.08 hrs HW=381.00' TW=376.89' (Dynamic Tailwater)↑**1=Pipe** (Barrel Controls 2.98 cfs @ 5.47 fps)**Summary for Pond 109: DMH-3**

Inflow Area = 3.358 ac, 12.79% Impervious, Inflow Depth = 5.93" for 100-Year event
 Inflow = 15.64 cfs @ 12.23 hrs, Volume= 1.658 af
 Outflow = 15.64 cfs @ 12.23 hrs, Volume= 1.658 af, Atten= 0%, Lag= 0.0 min
 Primary = 15.64 cfs @ 12.23 hrs, Volume= 1.658 af
 Routed to Pond 110 : DMH-4

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

Peak Elev= 377.66' @ 12.23 hrs

Flood Elev= 381.55'

Device	Routing	Invert	Outlet Devices
#1	Primary	374.94'	24.00" Round Pipe L= 52.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 374.94' / 373.90' S= 0.0200 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=15.64 cfs @ 12.23 hrs HW=377.65' TW=375.56' (Dynamic Tailwater)↑**1=Pipe** (Inlet Controls 15.64 cfs @ 4.98 fps)**Summary for Pond 110: DMH-4**

Inflow Area = 6.705 ac, 9.97% Impervious, Inflow Depth = 6.03" for 100-Year event
 Inflow = 33.34 cfs @ 12.19 hrs, Volume= 3.369 af
 Outflow = 33.34 cfs @ 12.19 hrs, Volume= 3.369 af, Atten= 0%, Lag= 0.0 min
 Primary = 33.34 cfs @ 12.19 hrs, Volume= 3.369 af
 Routed to Pond 111 : DMH-8

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

Peak Elev= 375.62' @ 12.19 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	372.90'	36.00" Round Culvert L= 227.0' RCP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 372.90' / 355.70' S= 0.0758 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 7.07 sf

Primary OutFlow Max=33.33 cfs @ 12.19 hrs HW=375.62' TW=361.46' (Dynamic Tailwater)↑**1=Culvert** (Inlet Controls 33.33 cfs @ 4.95 fps)

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Type III 24-hr 100-Year Rainfall=8.99"

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Summary for Pond 111: DMH-8

Inflow Area = 6.705 ac, 9.97% Impervious, Inflow Depth = 6.03" for 100-Year event
 Inflow = 33.34 cfs @ 12.19 hrs, Volume= 3.369 af
 Outflow = 33.35 cfs @ 12.18 hrs, Volume= 3.369 af, Atten= 0%, Lag= 0.0 min
 Primary = 33.35 cfs @ 12.18 hrs, Volume= 3.369 af
 Routed to Pond 113 : Sediment Forebay A

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 361.46' @ 12.18 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	355.70'	36.00" Round Culvert L= 17.6' RCP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 355.70' / 355.50' S= 0.0114 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 7.07 sf

Primary OutFlow Max=33.35 cfs @ 12.18 hrs HW=361.46' TW=360.23' (Dynamic Tailwater)
 ↑**1=Culvert** (Inlet Controls 33.35 cfs @ 4.72 fps)

Summary for Pond 113: Sediment Forebay A

Inflow Area = 7.520 ac, 8.89% Impervious, Inflow Depth = 6.05" for 100-Year event
 Inflow = 37.39 cfs @ 12.16 hrs, Volume= 3.789 af
 Outflow = 37.34 cfs @ 12.17 hrs, Volume= 3.789 af, Atten= 0%, Lag= 0.5 min
 Primary = 0.66 cfs @ 12.12 hrs, Volume= 0.122 af
 Routed to Pond 114 : Sand Filter A
 Secondary = 36.70 cfs @ 12.17 hrs, Volume= 3.667 af
 Routed to Pond 115 : Detention Pond A

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Automatic Starting Elev= 358.00' Surf.Area= 405 sf Storage= 624 cf
 Peak Elev= 360.23' @ 12.17 hrs Surf.Area= 798 sf Storage= 1,945 cf (1,320 cf above start)

Plug-Flow detention time= 8.6 min calculated for 3.774 af (100% of inflow)
 Center-of-Mass det. time= 4.6 min (817.5 - 812.9)

Volume	Invert	Avail.Storage	Storage Description
#1	355.50'	2,866 cf	Ponding Storage (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
355.50	117	0	0
356.00	162	70	70
357.00	271	217	286
358.00	405	338	624
359.00	565	485	1,109
359.50	654	305	1,414
360.50	851	753	2,167
361.00	959	453	2,619
361.25	1,015	247	2,866

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Device	Routing	Invert	Outlet Devices
#1	Primary	358.00'	6.00" Round Culvert L= 24.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 358.00' / 357.80' S= 0.0083 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#2	Secondary	359.00'	10.0' long 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

Primary OutFlow Max=0.65 cfs @ 12.12 hrs HW=360.20' TW=359.72' (Dynamic Tailwater)

↑**1=Culvert** (Outlet Controls 0.65 cfs @ 3.31 fps)

Secondary OutFlow Max=36.70 cfs @ 12.17 hrs HW=360.23' TW=352.39' (Dynamic Tailwater)

↑**2=Broad-Crested Rectangular Weir** (Weir Controls 36.70 cfs @ 2.98 fps)

Summary for Pond 114: Sand Filter A

Inflow Area = 7.520 ac, 8.89% Impervious, Inflow Depth = 0.19" for 100-Year event
 Inflow = 0.66 cfs @ 12.12 hrs, Volume= 0.122 af
 Outflow = 0.04 cfs @ 6.33 hrs, Volume= 0.122 af, Atten= 94%, Lag= 0.0 min
 Discarded = 0.04 cfs @ 6.33 hrs, Volume= 0.122 af

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

Peak Elev= 359.96' @ 12.38 hrs Surf.Area= 735 sf Storage= 3,262 cf

Plug-Flow detention time= 619.7 min calculated for 0.122 af (100% of inflow)

Center-of-Mass det. time= 619.7 min (1,353.3 - 733.6)

Volume	Invert	Avail.Storage	Storage Description
#1	357.50'	4,886 cf	Ponding Storage (Prismatic) Listed below (Recalc) -Impervious
#2	355.50'	364 cf	Sand/Loam (Prismatic) Listed below (Recalc)
			1,103 cf Overall x 33.0% Voids
		5,250 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
357.50	735	0	0
357.80	831	235	235
358.00	898	173	408
358.50	1,074	493	901
359.00	1,264	585	1,485
360.00	1,688	1,476	2,961
360.50	1,921	902	3,864
361.00	2,168	1,022	4,886

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
355.50	735	0	0
357.00	735	1,103	1,103

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Type III 24-hr 100-Year Rainfall=8.99"

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Device	Routing	Invert	Outlet Devices
#1	Discarded	355.50'	2.410 in/hr Exfiltration over Surface area Phase-In= 0.01'

Discarded OutFlow Max=0.04 cfs @ 6.33 hrs HW=355.56' (Free Discharge)

↳ **1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Summary for Pond 115: Detention Pond A

Inflow = 36.70 cfs @ 12.17 hrs, Volume= 3.667 af
 Outflow = 30.41 cfs @ 12.30 hrs, Volume= 3.667 af, Atten= 17%, Lag= 8.0 min
 Primary = 30.41 cfs @ 12.30 hrs, Volume= 3.667 af
 Routed to Link 119 : DP-1 Northeast Wetland
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Link 119 : DP-1 Northeast Wetland

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 353.01' @ 12.30 hrs Surf.Area= 4,044 sf Storage= 12,059 cf

Plug-Flow detention time= 5.9 min calculated for 3.667 af (100% of inflow)
 Center-of-Mass det. time= 5.9 min (826.1 - 820.3)

Volume	Invert	Avail.Storage	Storage Description
#1	347.00'	16,583 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
347.00	520	0	0
348.00	881	701	701
349.00	1,298	1,090	1,790
350.00	1,867	1,583	3,373
351.00	2,455	2,161	5,534
352.00	3,248	2,852	8,385
353.00	4,036	3,642	12,027
354.00	5,076	4,556	16,583

Device	Routing	Invert	Outlet Devices
#1	Primary	342.50'	24.00" Round Culvert L= 56.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 342.50' / 338.00' S= 0.0804 '/ Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	346.00'	6.00" Vert. Low Flow 6" C= 0.600 Limited to weir flow at low heads
#3	Device 1	348.00'	12.00" W x 38.00" H Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Secondary	353.10'	30.0' long x 14.0' 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) 2.64 2.67 2.70 2.65 2.64 2.65 2.65 2.63

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Type III 24-hr 100-Year Rainfall=8.99"

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Primary OutFlow Max=30.41 cfs @ 12.30 hrs HW=353.01' TW=0.00' (Dynamic Tailwater)

- ↑ **1=Culvert** (Passes 30.41 cfs of 41.15 cfs potential flow)
 - ↑ **2=Low Flow 6"** (Orifice Controls 2.46 cfs @ 12.52 fps)
 - ↑ **3=Orifice/Grate** (Orifice Controls 27.95 cfs @ 8.83 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=347.00' TW=0.00' (Dynamic Tailwater)

- ↑ **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 117: Concrete Arch Culvert

Inflow Area = 1.646 ac, 0.00% Impervious, Inflow Depth = 6.19" for 100-Year event
 Inflow = 9.49 cfs @ 12.17 hrs, Volume= 0.849 af
 Outflow = 9.49 cfs @ 12.17 hrs, Volume= 0.849 af, Atten= 0%, Lag= 0.0 min
 Primary = 9.49 cfs @ 12.17 hrs, Volume= 0.849 af
 Routed to Link 119 : DP-1 Northeast Wetland

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 378.07' @ 12.17 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	377.72'	174.00" W x 36.00" H, R=150.00" Arch Culvert L= 40.5' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 377.72' / 373.80' S= 0.0968 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 32.75 sf

Primary OutFlow Max=9.49 cfs @ 12.17 hrs HW=378.07' TW=0.00' (Dynamic Tailwater)

- ↑ **1=Culvert** (Inlet Controls 9.49 cfs @ 1.89 fps)

Summary for Pond 121: Proprietary device (Downstream Defender)

Inflow Area = 2.409 ac, 10.14% Impervious, Inflow Depth = 6.56" for 100-Year event
 Inflow = 12.99 cfs @ 12.23 hrs, Volume= 1.317 af
 Outflow = 12.99 cfs @ 12.23 hrs, Volume= 1.317 af, Atten= 0%, Lag= 0.0 min
 Primary = 12.99 cfs @ 12.23 hrs, Volume= 1.317 af
 Routed to Link 122 : Ex Detention Pond

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 368.83' @ 12.23 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	362.00'	15.00" Round Culvert L= 100.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 362.00' / 350.00' S= 0.1200 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.23 sf

Primary OutFlow Max=12.98 cfs @ 12.23 hrs HW=368.83' TW=0.00' (Dynamic Tailwater)

- ↑ **1=Culvert** (Inlet Controls 12.98 cfs @ 10.58 fps)

Summary for Link 119: DP-1 Northeast Wetland

Inflow Area = 4.542 ac, 0.00% Impervious, Inflow Depth = 15.64" for 100-Year event
Inflow = 53.51 cfs @ 12.19 hrs, Volume= 5.921 af
Primary = 53.51 cfs @ 12.19 hrs, Volume= 5.921 af, Atten= 0%, Lag= 0.0 min

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

Summary for Link 122: Ex Detention Pond

Inflow Area = 2.409 ac, 10.14% Impervious, Inflow Depth = 6.56" for 100-Year event
Inflow = 12.99 cfs @ 12.23 hrs, Volume= 1.317 af
Primary = 12.99 cfs @ 12.23 hrs, Volume= 1.317 af, Atten= 0%, Lag= 0.0 min

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

A3.3 Water Quality Storm Analysis

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Type III 24-hr WQ Storm Rainfall=1.20"

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Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
 Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv.
 Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 100: WPost-01	Runoff Area=2.915 ac 2.56% Impervious Runoff Depth=0.09" Flow Length=818' Tc=13.3 min CN=74/98 Runoff=0.07 cfs 0.021 af
Subcatchment 102: WPost-02	Runoff Area=0.431 ac 38.14% Impervious Runoff Depth=0.47" Tc=6.0 min CN=80/98 Runoff=0.20 cfs 0.017 af
Subcatchment 105: WPost-03	Runoff Area=3.008 ac 7.15% Impervious Runoff Depth=0.10" Flow Length=1,237' Tc=17.7 min CN=71/98 Runoff=0.17 cfs 0.025 af
Subcatchment 107: WPost-04	Runoff Area=0.350 ac 61.18% Impervious Runoff Depth=0.66" Tc=6.0 min CN=80/98 Runoff=0.25 cfs 0.019 af
Subcatchment 112: WPost-05	Runoff Area=0.815 ac 0.00% Impervious Runoff Depth=0.10" Flow Length=160' Tc=6.5 min CN=77/0 Runoff=0.04 cfs 0.007 af
Subcatchment 116: WPost-06	Runoff Area=1.646 ac 0.00% Impervious Runoff Depth=0.10" Flow Length=786' Tc=12.8 min CN=77/0 Runoff=0.07 cfs 0.014 af
Subcatchment 118: WPost-07	Runoff Area=2.896 ac 0.00% Impervious Runoff Depth=0.06" Flow Length=434' Tc=12.6 min CN=74/0 Runoff=0.04 cfs 0.015 af
Subcatchment 120: WPost-08	Runoff Area=2.409 ac 10.14% Impervious Runoff Depth=0.21" Flow Length=1,156' Tc=17.5 min CN=78/98 Runoff=0.26 cfs 0.041 af
Pond 101: CB-5	Peak Elev=375.11' Inflow=0.07 cfs 0.021 af 18.00" Round Culvert n=0.012 L=18.0' S=0.0050 '/ Outflow=0.07 cfs 0.021 af
Pond 103: CB-6	Peak Elev=375.47' Inflow=0.20 cfs 0.017 af 15.00" Round Culvert n=0.012 L=18.0' S=0.0050 '/ Outflow=0.20 cfs 0.017 af
Pond 104: DMH-7	Peak Elev=374.61' Inflow=0.26 cfs 0.038 af 24.00" Round Culvert n=0.012 L=48.0' S=0.0100 '/ Outflow=0.26 cfs 0.038 af
Pond 106: CB-1	Peak Elev=375.35' Inflow=0.17 cfs 0.025 af 24.00" Round Culvert n=0.012 L=21.0' S=0.0100 '/ Outflow=0.17 cfs 0.025 af
Pond 108: CB-2	Peak Elev=376.72' Inflow=0.25 cfs 0.019 af 10.00" Round Culvert n=0.012 L=201.0' S=0.0010 '/ Outflow=0.25 cfs 0.019 af
Pond 109: DMH-3	Peak Elev=375.21' Inflow=0.36 cfs 0.045 af 24.00" Round Culvert n=0.012 L=52.0' S=0.0200 '/ Outflow=0.36 cfs 0.045 af
Pond 110: DMH-4	Peak Elev=373.20' Inflow=0.62 cfs 0.082 af 36.00" Round Culvert n=0.013 L=227.0' S=0.0758 '/ Outflow=0.62 cfs 0.082 af
Pond 111: DMH-8	Peak Elev=358.75' Inflow=0.62 cfs 0.082 af 36.00" Round Culvert n=0.013 L=17.6' S=0.0114 '/ Outflow=0.77 cfs 0.082 af

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Type III 24-hr WQ Storm Rainfall=1.20"

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Pond 113: Sediment Forebay A Peak Elev=358.76' Storage=976 cf Inflow=0.79 cfs 0.089 af
Primary=0.52 cfs 0.089 af Secondary=0.00 cfs 0.000 af Outflow=0.52 cfs 0.089 af

Pond 114: Sand Filter A Peak Elev=358.75' Storage=1,549 cf Inflow=0.52 cfs 0.089 af
Outflow=0.04 cfs 0.089 af

Pond 115: Detention Pond A Peak Elev=347.00' Storage=0 cf Inflow=0.00 cfs 0.000 af
Primary=0.00 cfs 0.000 af Secondary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Pond 117: Concrete Arch Culvert Peak Elev=377.73' Inflow=0.07 cfs 0.014 af
174.00" x 36.00", R=150.00" Arch Culvert n=0.012 L=40.5' S=0.0968 '/ Outflow=0.07 cfs 0.014 af

Pond 121: Proprietary device (Downstream Defender) Peak Elev=362.25' Inflow=0.26 cfs 0.041 af
15.00" Round Culvert n=0.012 L=100.0' S=0.1200 '/ Outflow=0.26 cfs 0.041 af

Link 119: DP-1 Northeast Wetland Inflow=0.11 cfs 0.029 af
Primary=0.11 cfs 0.029 af

Link 122: Ex Detention Pond Inflow=0.26 cfs 0.041 af
Primary=0.26 cfs 0.041 af

Total Runoff Area = 14.471 ac Runoff Volume = 0.159 af Average Runoff Depth = 0.13"
93.69% Pervious = 13.559 ac 6.31% Impervious = 0.913 ac

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Type III 24-hr WQ Storm Rainfall=1.20"

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Summary for Subcatchment 100: WPost-01

Runoff = 0.07 cfs @ 12.46 hrs, Volume= 0.021 af, Depth= 0.09"
 Routed to Pond 101 : CB-5

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr WQ Storm Rainfall=1.20"

Area (ac)	CN	Description
0.078	80	>75% Grass cover, Good, HSG D
0.075	98	Impervious, HSG D
1.080	70	Woods, Good, HSG C
1.682	77	Woods, Good, HSG D
2.915	75	Weighted Average
2.841	74	97.44% Pervious Area
0.075	98	2.56% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	100	0.1130	0.16		Sheet Flow, A
					Woods: Light underbrush n= 0.400 P2= 3.27"
2.4	677	0.0852	4.70		Shallow Concentrated Flow, B
					Unpaved Kv= 16.1 fps
0.3	41	0.0170	2.65		Shallow Concentrated Flow, C - Paved
					Paved Kv= 20.3 fps
13.3	818	Total			

Summary for Subcatchment 102: WPost-02

Runoff = 0.20 cfs @ 12.09 hrs, Volume= 0.017 af, Depth= 0.47"
 Routed to Pond 103 : CB-6

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr WQ Storm Rainfall=1.20"

Area (ac)	CN	Description
0.267	80	>75% Grass cover, Good, HSG D
0.104	98	Impervious, HSG D
0.060	98	Roofs, HSG D
0.431	87	Weighted Average
0.267	80	61.86% Pervious Area
0.164	98	38.14% Impervious Area

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

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Type III 24-hr WQ Storm Rainfall=1.20"

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Summary for Subcatchment 105: WPost-03

Runoff = 0.17 cfs @ 12.23 hrs, Volume= 0.025 af, Depth= 0.10"
 Routed to Pond 106 : CB-1

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr WQ Storm Rainfall=1.20"

Area (ac)	CN	Description
0.021	74	>75% Grass cover, Good, HSG C
0.271	80	>75% Grass cover, Good, HSG D
0.165	98	Impervious, HSG D
0.050	98	Roofs, HSG D
2.421	70	Woods, Good, HSG C
0.080	77	Woods, Good, HSG D
3.008	73	Weighted Average
2.793	71	92.85% Pervious Area
0.215	98	7.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	100	0.0630	0.12		Sheet Flow, A
					Woods: Light underbrush n= 0.400 P2= 3.27"
3.5	898	0.0697	4.25		Shallow Concentrated Flow, B
					Unpaved Kv= 16.1 fps
0.8	239	0.0623	5.07		Shallow Concentrated Flow, C - Paved
					Paved Kv= 20.3 fps
17.7	1,237	Total			

Summary for Subcatchment 107: WPost-04

Runoff = 0.25 cfs @ 12.09 hrs, Volume= 0.019 af, Depth= 0.66"
 Routed to Pond 108 : CB-2

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr WQ Storm Rainfall=1.20"

Area (ac)	CN	Description
0.134	80	>75% Grass cover, Good, HSG D
0.154	98	Impervious, HSG D
0.060	98	Roofs, HSG D
0.002	77	Woods, Good, HSG D
0.350	91	Weighted Average
0.136	80	38.82% Pervious Area
0.214	98	61.18% Impervious Area

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Type III 24-hr WQ Storm Rainfall=1.20"

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

Summary for Subcatchment 112: WPost-05

Runoff = 0.04 cfs @ 12.33 hrs, Volume= 0.007 af, Depth= 0.10"
 Routed to Pond 113 : Sediment Forebay A

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr WQ Storm Rainfall=1.20"

Area (ac)	CN	Description
0.274	74	>75% Grass cover, Good, HSG C
0.236	80	>75% Grass cover, Good, HSG D
0.013	70	Woods, Good, HSG C
0.292	77	Woods, Good, HSG D
0.815	77	Weighted Average
0.815	77	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.3	100	0.1520	0.27		Sheet Flow, A
					Grass: Dense n= 0.240 P2= 3.27"
0.2	60	0.0716	4.31		Shallow Concentrated Flow, B
					Unpaved Kv= 16.1 fps
6.5	160	Total			

Summary for Subcatchment 116: WPost-06

Runoff = 0.07 cfs @ 12.42 hrs, Volume= 0.014 af, Depth= 0.10"
 Routed to Pond 117 : Concrete Arch Culvert

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr WQ Storm Rainfall=1.20"

Area (ac)	CN	Description
0.012	80	>75% Grass cover, Good, HSG D
1.634	77	Woods, Good, HSG D
1.646	77	Weighted Average
1.646	77	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.3	100	0.1230	0.16		Sheet Flow, A
					Woods: Light underbrush n= 0.400 P2= 3.27"
2.5	686	0.0833	4.65		Shallow Concentrated Flow, B
					Unpaved Kv= 16.1 fps
12.8	786	Total			

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Type III 24-hr WQ Storm Rainfall=1.20"

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Summary for Subcatchment 118: WPost-07

Runoff = 0.04 cfs @ 12.52 hrs, Volume= 0.015 af, Depth= 0.06"
 Routed to Link 119 : DP-1 Northeast Wetland

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr WQ Storm Rainfall=1.20"

Area (ac)	CN	Description
0.298	74	>75% Grass cover, Good, HSG C
0.244	80	>75% Grass cover, Good, HSG D
0.000	98	Impervious, HSG D
0.000	98	Roofs, HSG D
1.260	70	Woods, Good, HSG C
1.094	77	Woods, Good, HSG D
2.896	74	Weighted Average
2.896	74	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0900	0.14		Sheet Flow, A
					Woods: Light underbrush n= 0.400 P2= 3.27"
1.0	334	0.1107	5.36		Shallow Concentrated Flow, B
					Unpaved Kv= 16.1 fps
12.6	434	Total			

Summary for Subcatchment 120: WPost-08

Runoff = 0.26 cfs @ 12.29 hrs, Volume= 0.041 af, Depth= 0.21"
 Routed to Pond 121 : Proprietary device (Downstream Defender)

Runoff by SCS TR-20 method, UH=SCS, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Type III 24-hr WQ Storm Rainfall=1.20"

Area (ac)	CN	Description
0.467	80	>75% Grass cover, Good, HSG D
0.195	98	Impervious, HSG D
0.050	98	Roofs, HSG D
0.002	70	Woods, Good, HSG C
1.696	77	Woods, Good, HSG D
2.409	80	Weighted Average
2.165	78	89.86% Pervious Area
0.244	98	10.14% Impervious Area

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Type III 24-hr WQ Storm Rainfall=1.20"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.9	100	0.0580	0.12		Sheet Flow, A Woods: Light underbrush n= 0.400 P2= 3.27"
2.9	824	0.0856	4.71		Shallow Concentrated Flow, B Unpaved Kv= 16.1 fps
0.7	232	0.0849	5.91		Shallow Concentrated Flow, C Paved Kv= 20.3 fps
17.5	1,156	Total			

Summary for Pond 101: CB-5

Inflow Area = 2.915 ac, 2.56% Impervious, Inflow Depth = 0.09" for WQ Storm event
 Inflow = 0.07 cfs @ 12.46 hrs, Volume= 0.021 af
 Outflow = 0.07 cfs @ 12.46 hrs, Volume= 0.021 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.07 cfs @ 12.46 hrs, Volume= 0.021 af
 Routed to Pond 104 : DMH-7

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 375.11' @ 12.46 hrs

Device #	Routing	Invert	Outlet Devices
#1	Primary	374.97'	18.00" Round Pipe L= 18.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 374.97' / 374.88' S= 0.0050 '/ Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=0.07 cfs @ 12.46 hrs HW=375.11' TW=374.54' (Dynamic Tailwater)
 ↑**1=Pipe** (Barrel Controls 0.07 cfs @ 1.31 fps)

Summary for Pond 103: CB-6

Inflow Area = 0.431 ac, 38.14% Impervious, Inflow Depth = 0.47" for WQ Storm event
 Inflow = 0.20 cfs @ 12.09 hrs, Volume= 0.017 af
 Outflow = 0.20 cfs @ 12.09 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.20 cfs @ 12.09 hrs, Volume= 0.017 af
 Routed to Pond 104 : DMH-7

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 375.47' @ 12.09 hrs

Device #	Routing	Invert	Outlet Devices
#1	Primary	375.22'	15.00" Round Pipe L= 18.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 375.22' / 375.13' S= 0.0050 '/ Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=0.20 cfs @ 12.09 hrs HW=375.47' TW=374.61' (Dynamic Tailwater)
 ↑**1=Pipe** (Barrel Controls 0.20 cfs @ 1.75 fps)

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Type III 24-hr WQ Storm Rainfall=1.20"

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Summary for Pond 104: DMH-7

Inflow Area = 3.347 ac, 7.15% Impervious, Inflow Depth = 0.13" for WQ Storm event
 Inflow = 0.26 cfs @ 12.10 hrs, Volume= 0.038 af
 Outflow = 0.26 cfs @ 12.10 hrs, Volume= 0.038 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.26 cfs @ 12.10 hrs, Volume= 0.038 af
 Routed to Pond 110 : DMH-4

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 374.61' @ 12.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	374.38'	24.00" Round Pipe L= 48.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 374.38' / 373.90' S= 0.0100 '/ Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=0.26 cfs @ 12.10 hrs HW=374.61' TW=373.20' (Dynamic Tailwater)
 ↑**1=Pipe** (Inlet Controls 0.26 cfs @ 1.29 fps)

Summary for Pond 106: CB-1

Inflow Area = 3.008 ac, 7.15% Impervious, Inflow Depth = 0.10" for WQ Storm event
 Inflow = 0.17 cfs @ 12.23 hrs, Volume= 0.025 af
 Outflow = 0.17 cfs @ 12.23 hrs, Volume= 0.025 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.17 cfs @ 12.23 hrs, Volume= 0.025 af
 Routed to Pond 109 : DMH-3

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 375.35' @ 12.22 hrs
 Flood Elev= 381.95'

Device	Routing	Invert	Outlet Devices
#1	Primary	375.15'	24.00" Round Pipe L= 21.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 375.15' / 374.94' S= 0.0100 '/ Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=0.17 cfs @ 12.23 hrs HW=375.35' TW=375.19' (Dynamic Tailwater)
 ↑**1=Pipe** (Outlet Controls 0.17 cfs @ 1.62 fps)

Summary for Pond 108: CB-2

Inflow Area = 0.350 ac, 61.18% Impervious, Inflow Depth = 0.66" for WQ Storm event
 Inflow = 0.25 cfs @ 12.09 hrs, Volume= 0.019 af
 Outflow = 0.25 cfs @ 12.09 hrs, Volume= 0.019 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.25 cfs @ 12.09 hrs, Volume= 0.019 af
 Routed to Pond 109 : DMH-3

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 376.72' @ 12.09 hrs
 Flood Elev= 381.86'

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Type III 24-hr WQ Storm Rainfall=1.20"

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Device	Routing	Invert	Outlet Devices
#1	Primary	376.31'	10.00" Round Pipe L= 201.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 376.31' / 376.10' S= 0.0010 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.55 sf

Primary OutFlow Max=0.25 cfs @ 12.09 hrs HW=376.72' TW=375.21' (Dynamic Tailwater)↑**1=Pipe** (Barrel Controls 0.25 cfs @ 1.35 fps)**Summary for Pond 109: DMH-3**

Inflow Area = 3.358 ac, 12.79% Impervious, Inflow Depth = 0.16" for WQ Storm event
 Inflow = 0.36 cfs @ 12.10 hrs, Volume= 0.045 af
 Outflow = 0.36 cfs @ 12.10 hrs, Volume= 0.045 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.36 cfs @ 12.10 hrs, Volume= 0.045 af
 Routed to Pond 110 : DMH-4

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

Peak Elev= 375.21' @ 12.10 hrs

Flood Elev= 381.55'

Device	Routing	Invert	Outlet Devices
#1	Primary	374.94'	24.00" Round Pipe L= 52.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 374.94' / 373.90' S= 0.0200 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=0.36 cfs @ 12.10 hrs HW=375.21' TW=373.20' (Dynamic Tailwater)↑**1=Pipe** (Inlet Controls 0.36 cfs @ 1.40 fps)**Summary for Pond 110: DMH-4**

Inflow Area = 6.705 ac, 9.97% Impervious, Inflow Depth = 0.15" for WQ Storm event
 Inflow = 0.62 cfs @ 12.10 hrs, Volume= 0.082 af
 Outflow = 0.62 cfs @ 12.10 hrs, Volume= 0.082 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.62 cfs @ 12.10 hrs, Volume= 0.082 af
 Routed to Pond 111 : DMH-8

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

Peak Elev= 373.20' @ 12.10 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	372.90'	36.00" Round Culvert L= 227.0' RCP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 372.90' / 355.70' S= 0.0758 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 7.07 sf

Primary OutFlow Max=0.62 cfs @ 12.10 hrs HW=373.20' TW=358.46' (Dynamic Tailwater)↑**1=Culvert** (Inlet Controls 0.62 cfs @ 1.65 fps)

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Type III 24-hr WQ Storm Rainfall=1.20"

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Summary for Pond 111: DMH-8

Inflow Area = 6.705 ac, 9.97% Impervious, Inflow Depth = 0.15" for WQ Storm event
 Inflow = 0.62 cfs @ 12.10 hrs, Volume= 0.082 af
 Outflow = 0.77 cfs @ 12.11 hrs, Volume= 0.082 af, Atten= 0%, Lag= 0.5 min
 Primary = 0.77 cfs @ 12.11 hrs, Volume= 0.082 af
 Routed to Pond 113 : Sediment Forebay A

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 358.75' @ 17.79 hrs

Device #1	Routing	Invert	Outlet Devices
	Primary	355.70'	36.00" Round Culvert L= 17.6' RCP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 355.70' / 355.50' S= 0.0114 '/ Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 7.07 sf

Primary OutFlow Max=0.00 cfs @ 12.11 hrs HW=358.48' TW=358.49' (Dynamic Tailwater)
 ↑**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 113: Sediment Forebay A

Inflow Area = 7.520 ac, 8.89% Impervious, Inflow Depth = 0.14" for WQ Storm event
 Inflow = 0.79 cfs @ 12.11 hrs, Volume= 0.089 af
 Outflow = 0.52 cfs @ 12.21 hrs, Volume= 0.089 af, Atten= 34%, Lag= 6.2 min
 Primary = 0.52 cfs @ 12.21 hrs, Volume= 0.089 af
 Routed to Pond 114 : Sand Filter A
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Pond 115 : Detention Pond A

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Automatic Starting Elev= 358.00' Surf.Area= 405 sf Storage= 624 cf
 Peak Elev= 358.76' @ 17.85 hrs Surf.Area= 526 sf Storage= 976 cf (352 cf above start)

Plug-Flow detention time= 208.2 min calculated for 0.075 af (84% of inflow)
 Center-of-Mass det. time= 74.8 min (938.7 - 863.9)

Volume	Invert	Avail.Storage	Storage Description
#1	355.50'	2,866 cf	Ponding Storage (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
355.50	117	0	0
356.00	162	70	70
357.00	271	217	286
358.00	405	338	624
359.00	565	485	1,109
359.50	654	305	1,414
360.50	851	753	2,167
361.00	959	453	2,619
361.25	1,015	247	2,866

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Type III 24-hr WQ Storm Rainfall=1.20"

Prepared by DiPrete Engineering

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Device	Routing	Invert	Outlet Devices
#1	Primary	358.00'	6.00" Round Culvert L= 24.0' RCP, groove end w/headwall, Ke= 0.200 Inlet / Outlet Invert= 358.00' / 357.80' S= 0.0083 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#2	Secondary	359.00'	10.0' long 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

Primary OutFlow Max=0.52 cfs @ 12.21 hrs HW=358.55' TW=357.61' (Dynamic Tailwater)
 ↳1=Culvert (Barrel Controls 0.52 cfs @ 2.98 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=358.00' TW=347.00' (Dynamic Tailwater)
 ↳2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 114: Sand Filter A

Inflow Area = 7.520 ac, 8.89% Impervious, Inflow Depth = 0.14" for WQ Storm event
 Inflow = 0.52 cfs @ 12.21 hrs, Volume= 0.089 af
 Outflow = 0.04 cfs @ 11.48 hrs, Volume= 0.089 af, Atten= 92%, Lag= 0.0 min
 Discarded = 0.04 cfs @ 11.48 hrs, Volume= 0.089 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
 Peak Elev= 358.75' @ 17.87 hrs Surf.Area= 735 sf Storage= 1,549 cf

Plug-Flow detention time= 396.8 min calculated for 0.089 af (100% of inflow)
 Center-of-Mass det. time= 396.7 min (1,335.5 - 938.7)

Volume	Invert	Avail.Storage	Storage Description
#1	357.50'	4,886 cf	Ponding Storage (Prismatic) Listed below (Recalc) -Impervious
#2	355.50'	364 cf	Sand/Loam (Prismatic) Listed below (Recalc)
			1,103 cf Overall x 33.0% Voids
		5,250 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
357.50	735	0	0
357.80	831	235	235
358.00	898	173	408
358.50	1,074	493	901
359.00	1,264	585	1,485
360.00	1,688	1,476	2,961
360.50	1,921	902	3,864
361.00	2,168	1,022	4,886

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
355.50	735	0	0
357.00	735	1,103	1,103

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Type III 24-hr WQ Storm Rainfall=1.20"

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Device	Routing	Invert	Outlet Devices
#1	Discarded	355.50'	2.410 in/hr Exfiltration over Surface area Phase-In= 0.01'

Discarded OutFlow Max=0.04 cfs @ 11.48 hrs HW=355.56' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Summary for Pond 115: Detention Pond A

Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Link 119 : DP-1 Northeast Wetland
 Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Routed to Link 119 : DP-1 Northeast Wetland

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

Peak Elev= 347.00' @ 0.00 hrs Surf.Area= 520 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)

Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	347.00'	16,583 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
347.00	520	0	0
348.00	881	701	701
349.00	1,298	1,090	1,790
350.00	1,867	1,583	3,373
351.00	2,455	2,161	5,534
352.00	3,248	2,852	8,385
353.00	4,036	3,642	12,027
354.00	5,076	4,556	16,583

Device	Routing	Invert	Outlet Devices
#1	Primary	342.50'	24.00" Round Culvert L= 56.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 342.50' / 338.00' S= 0.0804 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	346.00'	6.00" Vert. Low Flow 6" C= 0.600 Limited to weir flow at low heads
#3	Device 1	348.00'	12.00" W x 38.00" H Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Secondary	353.10'	30.0' long x 14.0' 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) 2.64 2.67 2.70 2.65 2.64 2.65 2.65 2.63

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Type III 24-hr WQ Storm Rainfall=1.20"

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Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=347.00' TW=0.00' (Dynamic Tailwater)

↑**1=Culvert** (Passes 0.00 cfs of 24.97 cfs potential flow)

 ↑**2=Low Flow 6"** (Passes 0.00 cfs of 0.82 cfs potential flow)

 ↑**3=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=347.00' TW=0.00' (Dynamic Tailwater)

↑**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 117: Concrete Arch Culvert

Inflow Area = 1.646 ac, 0.00% Impervious, Inflow Depth = 0.10" for WQ Storm event
Inflow = 0.07 cfs @ 12.42 hrs, Volume= 0.014 af
Outflow = 0.07 cfs @ 12.42 hrs, Volume= 0.014 af, Atten= 0%, Lag= 0.0 min
Primary = 0.07 cfs @ 12.42 hrs, Volume= 0.014 af
Routed to Link 119 : DP-1 Northeast Wetland

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 377.73' @ 12.42 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	377.72'	174.00" W x 36.00" H, R=150.00" Arch Culvert L= 40.5' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 377.72' / 373.80' S= 0.0968 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 32.75 sf

Primary OutFlow Max=0.07 cfs @ 12.42 hrs HW=377.73' TW=0.00' (Dynamic Tailwater)

↑**1=Culvert** (Inlet Controls 0.07 cfs @ 0.38 fps)

Summary for Pond 121: Proprietary device (Downstream Defender)

Inflow Area = 2.409 ac, 10.14% Impervious, Inflow Depth = 0.21" for WQ Storm event
Inflow = 0.26 cfs @ 12.29 hrs, Volume= 0.041 af
Outflow = 0.26 cfs @ 12.29 hrs, Volume= 0.041 af, Atten= 0%, Lag= 0.0 min
Primary = 0.26 cfs @ 12.29 hrs, Volume= 0.041 af
Routed to Link 122 : Ex Detention Pond

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 362.25' @ 12.29 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	362.00'	15.00" Round Culvert L= 100.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 362.00' / 350.00' S= 0.1200 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.23 sf

Primary OutFlow Max=0.26 cfs @ 12.29 hrs HW=362.25' TW=0.00' (Dynamic Tailwater)

↑**1=Culvert** (Inlet Controls 0.26 cfs @ 1.50 fps)

Summary for Link 119: DP-1 Northeast Wetland

Inflow Area = 4.542 ac, 0.00% Impervious, Inflow Depth = 0.08" for WQ Storm event
Inflow = 0.11 cfs @ 12.48 hrs, Volume= 0.029 af
Primary = 0.11 cfs @ 12.48 hrs, Volume= 0.029 af, Atten= 0%, Lag= 0.0 min

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

Summary for Link 122: Ex Detention Pond

Inflow Area = 2.409 ac, 10.14% Impervious, Inflow Depth = 0.21" for WQ Storm event
Inflow = 0.26 cfs @ 12.29 hrs, Volume= 0.041 af
Primary = 0.26 cfs @ 12.29 hrs, Volume= 0.041 af, Atten= 0%, Lag= 0.0 min

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

A3.4 TSS Removal Calculations Worksheets

INSTRUCTIONS:

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

Version 1, Automated: Mar. 4, 2008

Location: Louise Dr, Franklin, MA

B	C	D	E	F
BMP ¹	TSS Removal Rate ¹	Starting TSS Load*	Amount Removed (C*D)	Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Sediment Forebay	0.25	0.75	0.19	0.56
Sand Filter	0.80	0.56	0.45	0.11
Extended Dry Detention Basin	0.50	0.11	0.06	0.06
	0.00	0.06	0.00	0.06

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

94%

Total TSS Removal =

Project: 3343-001
 Prepared By: BEG
 Date: 7/10/2024

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

TSS Removal Calculation Worksheet

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
 1. From MassDEP Stormwater Handbook Vol. 1

Louise Drive
 Pollutant Loading Calculations - Post Development - Total Phosphorus
 Annual RainFall

Watershed	Land Use	Pollutant Removal Efficiencies										Loading	
		Area (acres)	Impervious (%)	Runoff Coef., Rv	Concentration (lb/ac/yr)	Catch Basins	Sand Filter	Downstream Defender	Ext Dry Detention Basin	Overall Efficiency (%)	Resulant Conc. (mg/l)	Total Loading	lbs/year
North Watershed	Highway	1.45	58.2%	0.57	1.34	0%	50%	30%	68%	68%	84%	0.21	0.3
	Medium Density Res (MDR)	11.77	2.8%	0.08	1.96	0%	50%		68%	84%	0.31	3.7	
<div style="display: flex; justify-content: space-between;"> Pre Loading 20.09 </div> <div style="display: flex; justify-content: space-between;"> Difference (16.09) </div> <div style="display: flex; justify-content: space-between;"> % 80% </div>													

Louise Drive
 Pollutant Loading Calculations - Pre-Development - Total Phosphorus
 Annual RainFall

Watershed	Land Use	Area (acres)	Loading (lb/ac/yr)	Total Loading lbs/year
Site	Open Land/Agriculture	13.22	1.52	20.1
				20.1

Minimum Measure: Post Construction Stormwater Management in New Development and Redevelopment

Subcategory: Retention/Detention

Description

Dry detention ponds (also called dry ponds, extended detention basins, detention ponds and extended detention ponds) are basins that detain stormwater for some minimum time (e.g., 24 hours) to allow particles and pollutants to settle and reduce peak flow rates. They do not have large permanent pools of water—unlike wet ponds—though they often have small pools at the inlet and outlet of the basin. Although dry detention ponds were once popular for flood control, they are less so now, given their limited ability to provide water quality treatment.

Applicability

Dry detention ponds have traditionally been one of the most widely used stormwater controls. They are appropriate for detaining stormwater from large drainage areas (typically 10 or more acres). They require a large area to construct, so other stormwater controls are more appropriate for smaller sites (see [Grassed Swales](#), [Infiltration Basin](#), [Infiltration Trench](#), [Bioretention \(Rain Gardens\)](#), [Permeable Pavements](#), or [Green Roofs](#)). If pollutant removal efficiency is an important consideration, dry detention ponds may not be the most appropriate choice.



Dry detention pond with security fencing.
Credit: Jared Richardson for USEPA, 2012

Regional Applicability

Dry detention ponds can work in all regions of the United States. Design engineers might need to make minor changes in cold or arid climates or in regions with karst (i.e., limestone) topography.

Stormwater Hot Spots

Dry detention ponds can accept flow from stormwater hot spots, but to do so need a liner or significant separation from groundwater.

Stormwater Retrofit

As noted above, dry detention ponds were common stormwater controls in the past but have become less popular given their limited ability to address water quality concerns (see “Limitations” below). They can be useful stormwater retrofit options, though, given their existing prevalence and the fact that they already offer certain stormwater management benefits such as flood control. In retrofit scenarios, it is possible to modify these facilities to incorporate features that address additional objectives such as water quality treatment and channel protection. This could be a more cost-effective option than constructing an entirely new stormwater control—as could combining a dry detention basin with other

Common Terms

Stormwater hot spots are areas where land use or activities generate highly contaminated stormwater discharges, with pollutant concentrations exceeding those typically found in stormwater. Examples include gas stations, vehicle repair areas and waste storage areas.

A **stormwater retrofit** is a stormwater management practice (usually structural) put into place after development or construction of a stormwater control to improve water quality, protect downstream channels, reduce flooding or meet other specific objectives that did not exist at the time of original construction.

stormwater treatment options to address water quality impacts.

Cold Water (Trout) Streams

Dry detention ponds can increase the temperature of stormwater they receive (UNHSC, 2011). Generally, the only way to mitigate this effect is to decrease the detention time. Alternative stormwater controls may therefore be more appropriate in areas discharging to cold water streams.

Siting Considerations

Designers need to ensure that the dry detention pond is feasible at the site in question. This section provides basic guidelines for siting dry detention ponds.

Drainage Area

In general, dry detention ponds are appropriate for sites with a minimum area of 10 acres. On smaller sites, it can be challenging to provide proper discharge control because the orifice diameter at the outlet needed to control relatively small storms becomes very small and thus prone to clogging (City of Portland, 2016). For smaller sites, [green infrastructure](#) practices and [on-lot treatment controls](#) are better options given their smaller footprint and effectiveness.

Slope

Dry detention ponds can operate at sites with slopes up to about 15 percent. The local slope needs to be relatively flat: this allows the pond's side slopes to be reasonably flat, which keeps safety risks low.

There is no minimum slope requirement, though there needs to be enough elevation drop from the pond inlet to the pond outlet to ensure that flow can move through the system.

Soils

Dry detention ponds can function with almost all soils and geology, with minor design adjustments for karst areas or in rapidly percolating soils such as sand. In such areas, extended detention ponds need impermeable liners to prevent groundwater contamination or sinkhole formation.

Standing Water

To limit standing water, the base of the extended detention facility should not intersect the groundwater table. The persistence of standing water for more than 3 days in dry detention facilities makes them ideal breeding grounds for mosquitoes (Metzger et al., 2002).

Design Considerations

Specific designs may vary considerably, depending on site constraints, preferences of the designer or community, or local regulations. Common recommended features fall into five basic categories: pretreatment, treatment, conveyance, maintenance reduction and landscaping. For any project, design engineers should follow local requirements.

Pretreatment

Removing coarse sediment particles from stormwater before they reach the large permanent pool reduces a pond's maintenance burden. Pretreatment features help settle out these particles. For a pond, the appropriate pretreatment feature is a sediment forebay, a small pool at the entrance to the pond (typically about 10 percent of the volume of water that the pond will treat for pollutant removal).

Treatment

Treatment design features enhance a stormwater control's ability to remove pollutants. To allow for enough settling time, the pond should be large enough to detain the volume of stormwater it treats for between 12 and 48 hours. Designing dry ponds with a high length-to-width ratio (i.e., at least 1.5:1) and incorporating other design features to maximize the flow path effectively increases the detention time in the system by keeping flow from short-circuiting the pond. Designing ponds with relatively flat side slopes can also help to lengthen the effective flow path. Last, as dry detention ponds alone do not provide a high degree of pollutant removal, adding filtration at the outlet improves water quality before discharging to receiving waters.

Conveyance

The conveyance system should carry stormwater to and from dry ponds safely, in a manner that minimizes erosion potential. It is also important to stabilize the outfall of pond systems to prevent scouring. To convey

low flows through the system, designers should incorporate a small, shallow pilot channel, as well as an emergency spillway to safely convey water from large floods. To help mitigate the warming of water at the outlet channel, designers should provide shade around the channel at the pond outlet, if possible.

Maintenance Reduction

Stormwater controls need regular maintenance. Design features can ease this maintenance burden. In a dry detention pond, a micropool at the outlet can prevent resuspension of sediment and outlet clogging. A good design includes maintenance access to the forebay and micropool.

Another design feature that can reduce maintenance needs is a non-clogging outlet. Typical examples include a reverse-slope pipe or a weir outlet with a trash rack. A reverse-slope pipe draws from below the permanent pool, extending in a reverse angle up to the riser, and determines the water elevation of the micropool. Because these outlets draw water from below the level of the permanent pool, floating debris is less likely to clog them.

Landscaping

Designers should maintain a vegetated buffer around the dry detention pond and should select plants within the detention zone (i.e., the portion of the pond up to the elevation where it detains stormwater) that can withstand both wet and dry periods.

Storage Pipes and Tanks

Another variation of the dry detention pond design is the use of storage tanks, storage pipes or underground vaults. This approach is most common in urban environments on small sites with limited opportunity to provide flood control—where underground storage for a

large drainage area would generally be costly. Because the drainage area contributing to tank or pipe storage is typically small, the outlet diameter needed to reduce the flow from very small storms would be very small. A very small outlet diameter, along with the underground location of the tanks or pipes, creates the chance that debris will build up in the outlet and cause maintenance problems.

Arid or Semiarid Climates

In arid and semiarid regions, design engineers might need to make changes to conserve scarce water resources. Any landscaping plans should prescribe drought-tolerant vegetation wherever possible. In addition, the design engineer can replace the wet forebay with an alternative dry pretreatment, such as a detention cell. In regions with distinct wet and dry seasons—as in many arid regions—detention ponds can have recreation uses in the dry season (e.g., as ball fields).

Cold Climates

In cold climates, some additional design features can help to treat spring snowmelt. One such modification is to increase the volume available for detention to help treat this relatively large flow event. As well, it may be necessary to remove sediment from the forebay more often than in warmer climates (see “Maintenance Considerations” below for guidelines) to account for sedimentation due to road sanding.

Maintenance Considerations

In addition to incorporating features into the dry detention pond design to minimize maintenance, site operators will need to carry out some regular maintenance and inspection practices. Table 1 outlines some of these practices.

Table 1. Typical maintenance activities for dry ponds

Activity	Schedule
<ul style="list-style-type: none"> ■ Note erosion of pond banks or bottom 	Semiannual inspection
<ul style="list-style-type: none"> ■ Inspect for damage to the embankment ■ Monitor for sediment accumulation in the facility and forebay ■ Examine to ensure that inlet and outlet devices are free of debris and operational 	Annual inspection
<ul style="list-style-type: none"> ■ Repair undercut or eroded areas ■ Mow side slopes ■ Manage pesticide and nutrients ■ Remove litter and debris 	Standard maintenance
<ul style="list-style-type: none"> ■ Seed or sod to restore dead or damaged ground cover 	Annual maintenance (as needed)
<ul style="list-style-type: none"> ■ Monitor sediment accumulations in the forebay; remove sediment when the forebay capacity has been reduced by 50 percent 	2- to 7-year maintenance
<ul style="list-style-type: none"> ■ Monitor sediment accumulations; remove sediment when the pond volume has been reduced by 25 percent 	25- to 50-year maintenance

Source: Modified from MPCA, 2017

Limitations

Although dry detention ponds are widely applicable, they have some limitations that might make other stormwater controls preferable:

- Dry detention ponds have limited water quality treatment capacity compared to other structural stormwater controls and are ineffective at removing soluble pollutants (see “Effectiveness”).
- Dry extended detention ponds may become a nuisance due to mosquito breeding if improperly maintained or if shallow pools of water form for more than 3 days.
- Dry ponds may detract from the value of a home (see “Cost Considerations”).

Dry detention ponds on their own only provide peak flow reduction and do little to control stormwater volume, which could result in adverse downstream impacts.

Effectiveness

Structural stormwater controls can achieve four broad resource protection goals: flood control, channel protection, groundwater recharge and pollutant removal. Dry detention basins can provide flood control and channel protection, as well as some limited pollutant removal. They are not typically designed to provide groundwater recharge (for a similar control that does provide groundwater recharge, see [Infiltration Basin](#)). However, some infiltration to surrounding soils may occur, particularly in soils with high infiltration rates.

Flood Control

One objective of stormwater controls can be to reduce the flood hazard associated with large storm events by reducing the peak flow associated with these storms. One of the main purposes of dry detention basins is to slow stormwater and reduce peak flow rates. Dry detention ponds therefore provide effective flood control, especially in conjunction with other peak flow reduction controls throughout a watershed.

Channel Protection

One result of urbanization is the geomorphic changes that occur in response to modified hydrology. Traditionally, dry detention basins have provided control of the 2-year storm for channel protection. However, it appears that this control has been relatively ineffective for channel protection. Research suggests that control of a smaller storm, such as the 1-year storm, might be more appropriate (MacRae, 1996; Tillinghast et al., 2011). Most current channel protection standards are based on the 1-year storm event (e.g., MDE, 2009).

Pollutant Removal

Dry detention basins provide some pollutant removal, provided that the design features described in the “Siting Considerations” and “Design Considerations” sections are incorporated. Although they are effective at removing some pollutants through settling, they are less effective at removing soluble pollutants because of the absence of a permanent pool. Pollutant loading information for dry detention basins provided by the New Hampshire Department of Environmental Services allows for an assumed removal efficiency of 80 percent for total suspended solids, 55 percent for total nitrogen removal and 68 percent for total phosphorus removal (NHDES, 2011).

Cost Considerations¹

The construction costs associated with dry detention ponds can range considerably depending on the type of construction and size. Adjusted for inflation, a reported range for dry detention ponds and dry extended detention ponds is \$45,000 to \$80,000 per acre of impervious surface treated (King & Hagan, 2011). As with most other stormwater controls, economies of scale suggest that larger systems are at the lower end of this range.

Maintenance costs can be slightly higher than comparable wet ponds, mostly due to the greater area needing regular mowing. For ponds, the annual cost of routine maintenance is typically about 2 to 6 percent of the construction cost (King & Hagan, 2011). Alternatively, a community can estimate the cost of the maintenance activities outlined in the maintenance section.

Another economic concern associated with dry ponds is that they can detract from the value of adjacent properties, especially compared to wet ponds and mixed recreational use stormwater facilities (Lee & Li, 2009). One study found that dry ponds detract from the perceived value of adjacent homes by between 3 and 10 percent (Emmerling-Dinovo, 1995).

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

¹ Prices updated to 2019 dollars. Inflation rates obtained from the Bureau of Labor Statistics CPI Inflation Calculator website: <https://data.bls.gov/cgi-bin/cpicalc.pl>.

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Disclaimer

This fact sheet is intended to be used for informational purposes only. These examples and references are not intended to be comprehensive and do not preclude the use of other technically sound practices. State or local requirements may apply.

Downstream Defender®

High-Level Treatment in a Small Footprint

Product Profile

The Downstream Defender® is an advanced vortex separator used to treat stormwater runoff in pretreatment or stand-alone applications. Its unique flow-modifying internal components distinguish the Downstream Defender® from conventional and simple swirl separators that typically bypass untreated peak flows to prevent washout of captured pollutants. Its wide treatment flow range, low headloss, small footprint and low-profile make it a compact and economical solution for capturing nonpoint source pollution.

Components

- | | |
|------------------------------------|--------------------------|
| 1. Inlet to Precast Vortex Chamber | 4. Outlet Pipe |
| 2. Cylindrical Baffle | 5. Sediment Storage Sump |
| 3. Center Shaft | 6. Access Lid |

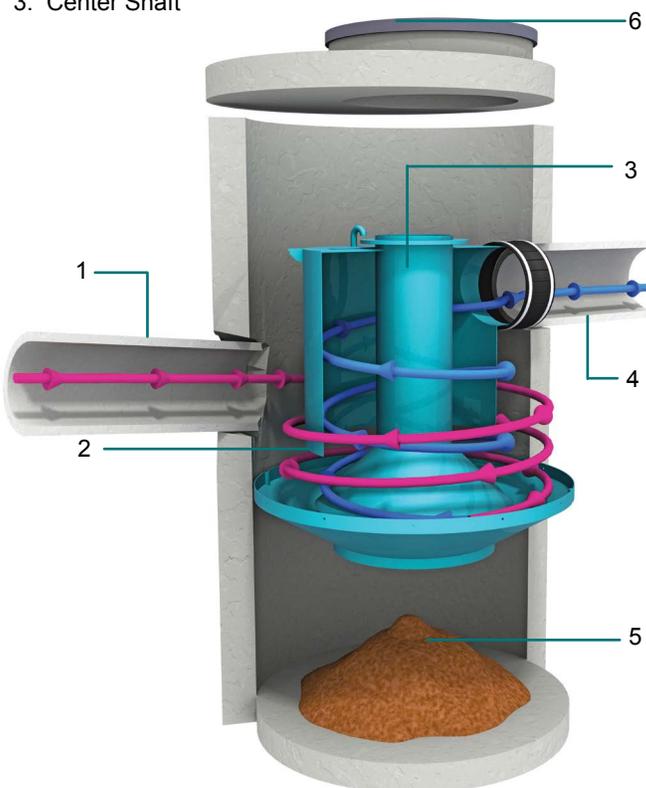


Fig.1 The Downstream Defender® has internal components designed to maximize pollutant capture and minimize pollutant washout.

Applications

- Removal of total suspended solids (TSS), floatable trash and petroleum products from stormwater runoff
- New construction or redevelopment of commercial and residential sites
- Pollutant hotspots such as maintenance yards, parking lots, gas stations, streets, highways, airports and transportation hubs
- Site constrained LID or green infrastructure based developments
- LEED® development projects

Advantages

- Special internal components maximize pollutant capture and minimize footprint, headloss and washout
- Captures and retains a wide range of TSS particles
- High peak treatment flow rates
- Treats the entire storm with no washout or untreated bypass flows
- Low maintenance requirements - no dredging required, and no screens or media to block
- Variable inlet/outlet angles for ease of site layout

How it Works

Advanced hydrodynamic vortex separation is a complex hydraulic process that augments gravity separation with low-energy rotary forces. The flow modifying internal components used in the Downstream Defender® harness the energy from vortex flow and maximize the time for separation to occur while deflecting high scour velocities (**Fig.1**).

Polluted stormwater is introduced tangentially into the side of the precast vortex chamber to establish rotational flow. A cylindrical baffle with an inner center shaft creates an outer (**magenta arrow**) and inner (**blue arrow**) spiraling column of flow and ensures maximum residence time for pollutant travel between the inlet and outlet.

Oil, trash and other floating pollutants are captured and stored on the surface of the outer spiraling column. Low energy vortex motion directs sediment into the protected sump region. Only after following a long three-dimensional flow path is the treated stormwater discharged from the outlet pipe. Maintenance ports at ground level provide access for easy inspection and clean-out.

Downstream Defender®

Drainage Profile

The Downstream Defender® is designed with a submerged tangential inlet to minimize turbulence within the device. Turbulence increases system headlosses and reduces performance by keeping pollutant particles in suspension.

The inlet elevation of the Downstream Defender® is located one inlet pipe diameter lower than the elevation of the outlet invert (**Fig.2**). This arrangement ensures that influent flows are introduced to the treatment chamber quiescently below the water surface elevation, minimizing turbulence.

The unique flow-modifying internal components also minimize hydraulic losses. There are no internal weirs or orifices; large clear openings ensure low headloss at peak flow rates with little risk of blockages that cause upstream flooding.

Sizing & Design

The Downstream Defender® can be used to meet a wide range of stormwater treatment objectives. It is available in 5 precast models that fit easily into the drainage network (**Table 1**). Selection and layout of the appropriate Downstream Defender® model depends on site hydraulics, site constraints and local regulations. Both online (**Fig.3a**) and offline (**Fig.3b**) configurations are common.

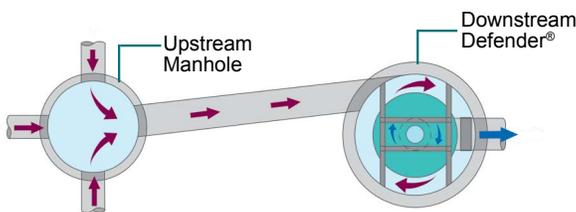


Fig.3a The Downstream Defender® in an online configuration.

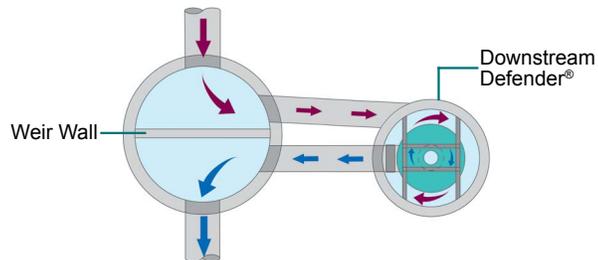


Fig.3b The Downstream Defender® in an offline configuration.

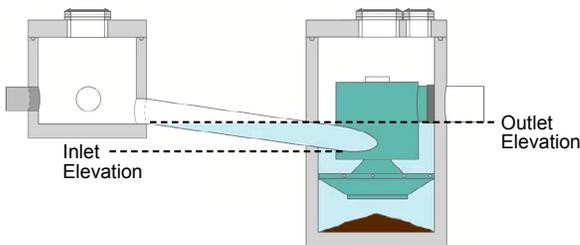


Fig.2 The Downstream Defender® has a submerged inlet that reduces headloss and improves efficiency of pollutant capture.

Table 1. Downstream Defender® Design Chart.

Model Number and Diameter		Peak Treatment Flow Rate		Maximum Pipe Diameter		Oil Storage Capacity		Sediment Storage Capacity		Minimum Distance from Outlet Invert to Top of Rim		Standard Height from Outlet Invert to Sump Floor	
(ft)	(m)	(cfs)	(L/s)	(in)	(mm)	(gal)	(L)	(yd ³)	(m ³)	(ft)	(m)	(ft)	(m)
4	1.2	3.0	85	12	300	70	265	0.70	0.53	2.8	0.85	4.1	1.25
6	1.8	8.0	227	18	450	216	818	2.10	1.61	3.2	0.98	5.9	1.80
8	2.4	15.0	425	24	600	540	2,044	4.65	3.56	4.2	1.28	7.7	2.35
10	3.0	25.0	708	30	750	1,050	3,975	8.70	6.65	5.0	1.52	9.4	2.85
12*	3.7	38.0	1,076	36	900	1,770	6,700	14.70	11.24	5.6	1.71	11.2	3.41

*Not available in all areas. Contact Hydro International for details.

Inspection and Maintenance

Nobody maintains our systems better than we do. To ensure optimal, ongoing device performance, be sure to recommend Hydro International as a preferred service and maintenance provider to your clients.



Call 1 (800) 848-2706 to schedule an inspection and cleanout or learn more at hydro-int.com/service

Free Stormwater Sizing Tool

This simple online tool will recommend the best separator, model size and online/offline arrangement based on site-specific data entered by the user.

Go to hydro-int.com/sizing to access the tool.



July 7, 2020

To Whom It May Concern:

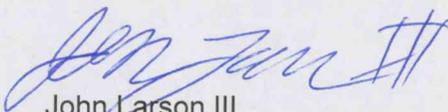
RE: Downstream Defender® Removal Efficiency

Regarding Downstream Defenders operating under submerged condition, I offer the following comments: A tail water condition in a detention system or pond will not adversely impact the operation of a Downstream Defender. An online Downstream Defender does not contain internal flow control devices (weirs or orifices) that will be bypassed by a rising tail water; consequently, any flow that passes through the Downstream Defender will be treated. In cases where there is the potential for a large reverse flow, such as a tidal condition in a large diameter main line pipe, we would recommend a back-flow preventer. In situations where the Downstream Defender is discharging to a submerged condition such as underground storage or a detention pond a backflow preventer is not required. This is because the water level in downstream storage tends to rise slowly and gradually submerge the upstream pipe network rather than generate large reverse flow rates.

For offline systems, we set the weir in the diversion structure to divert the first flush to an offline treatment unit under the assumption that the downstream storage is empty and available to accept the first flush. Alternatively, we can set the weir relative to a design tail water condition as required. In most cases, downstream storage is assumed to be empty and available to accept the first flush flow. After the first flush is diverted to downstream storage and as water levels start to rise and submerge the weir, the differential head across the treatment unit typically starts to decrease diverting less flow to an offline unit. The same thing occurs in treatment devices that may be placed online but have an internal bypass. Typically, by the time the weir is fully submerged the storage system is full and the first flush flow has already been adequately treated.

If you have any questions please do not hesitate to call us. We would be happy to assist you.

Signature,
Hydro International



John Larson III
Senior Project Engineer

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A 5.1 Open Channel Calculations HydroCAD 100-Year Storm Analysis

3343-001-ALLS-PHCD-INHS

Type III 24-hr 100-Year Rainfall=8.99"

Prepared by DiPrete Engineering

HydroCAD® 10.20-3c s/n 01125 © 2023 HydroCAD Software Solutions LLC

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

Subcatchment 118x: WPost-07 Node

Runoff Area=2.896 ac 0.00% Impervious Runoff Depth=5.82"
Flow Length=434' Tc=12.6 min CN=74 Runoff=15.90 cfs 1.405 af

Reach 118.2: swale north of pond

Avg. Flow Depth=0.68' Max Vel=7.69 fps Inflow=15.90 cfs 1.405 af
n=0.025 L=238.0' S=0.0588 '/ Capacity=38.53 cfs Outflow=15.87 cfs 1.405 af

Total Runoff Area = 2.896 ac Runoff Volume = 1.405 af Average Runoff Depth = 5.82"
100.00% Pervious = 2.896 ac 0.00% Impervious = 0.000 ac

3343-001-ALLS-PHCD-INHS

Type III 24-hr 100-Year Rainfall=8.99"

Prepared by DiPrete Engineering

HydroCAD® 10.20-3c s/n 01125 © 2023 HydroCAD Software Solutions LLC

Summary for Subcatchment 118x: WPost-07 Node

Runoff = 15.90 cfs @ 12.17 hrs, Volume= 1.405 af, Depth= 5.82"

Routed to Reach 118.2 : swale north of pond

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.99"

Area (ac)	CN	Description
0.298	74	>75% Grass cover, Good, HSG C
0.244	80	>75% Grass cover, Good, HSG D
0.000	98	Impervious, HSG D
0.000	98	Roofs, HSG D
1.260	70	Woods, Good, HSG C
1.094	77	Woods, Good, HSG D
2.896	74	Weighted Average
2.896	74	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	100	0.0900	0.14		Sheet Flow, A
					Woods: Light underbrush n= 0.400 P2= 3.27"
1.0	334	0.1107	5.36		Shallow Concentrated Flow, B
					Unpaved Kv= 16.1 fps
12.6	434	Total			

Summary for Reach 118.2: swale north of pond

Inflow Area = 2.896 ac, 0.00% Impervious, Inflow Depth = 5.82" for 100-Year event

Inflow = 15.90 cfs @ 12.17 hrs, Volume= 1.405 af

Outflow = 15.87 cfs @ 12.18 hrs, Volume= 1.405 af, Atten= 0%, Lag= 0.4 min

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

Max. Velocity= 7.69 fps, Min. Travel Time= 0.5 min

Avg. Velocity = 2.90 fps, Avg. Travel Time= 1.4 min

Peak Storage= 491 cf @ 12.18 hrs

Average Depth at Peak Storage= 0.68', Surface Width= 5.08'

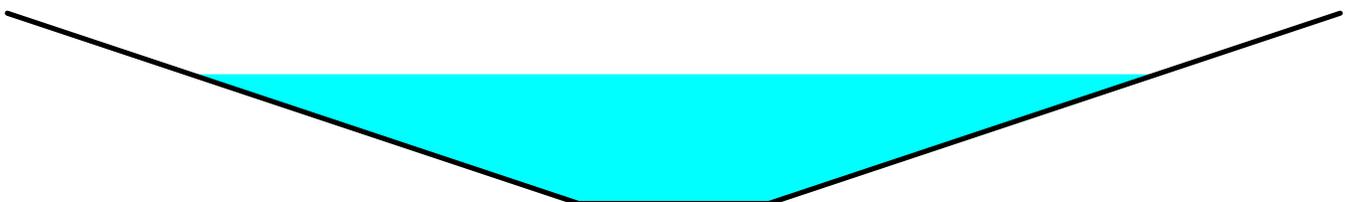
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 38.53 cfs

1.00' x 1.00' deep channel, n= 0.025 Earth, clean & winding

Side Slope Z-value= 3.0 ' Top Width= 7.00'

Length= 238.0' Slope= 0.0588 ' /'

Inlet Invert= 352.00', Outlet Invert= 338.00'



Watershed Maps

Z:\DEVELOPMENT\PROJECTS\1342-001 LOUISE DRIVE\AUTOCAD DRAWINGS\1342-001\WMP.DWG PLOTTED: 9/11/2024

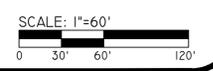


LEGEND

- WOODS - A SOILS
- WOODS - B SOILS
- WOODS - C SOILS
- WOODS - D SOILS
- GRASS - A SOILS
- GRASS - B SOILS
- GRASS - C SOILS
- GRASS - D SOILS
- GRAVEL - A SOILS
- GRAVEL - B SOILS
- GRAVEL - C SOILS
- GRAVEL - D SOILS
- IMPERVIOUS
- BRUSH - A SOILS
- BRUSH - B SOILS
- BRUSH - C SOILS
- BRUSH - D SOILS
- WATER

LEGEND

- TC LINE WITH ELEVATIONS
- SUBCATCHMENT AREA
- SOIL BOUNDARY
- REACH
- SUBCATCHMENT
- DRAINAGE POND/BIO RETENTION/SAND FILTER/INFILTRATING SWALE
- DRAINAGE STRUCTURE/POND WITH INSIGNIFICANT STORAGE
- REACH/SWALE
- DESIGN POINT

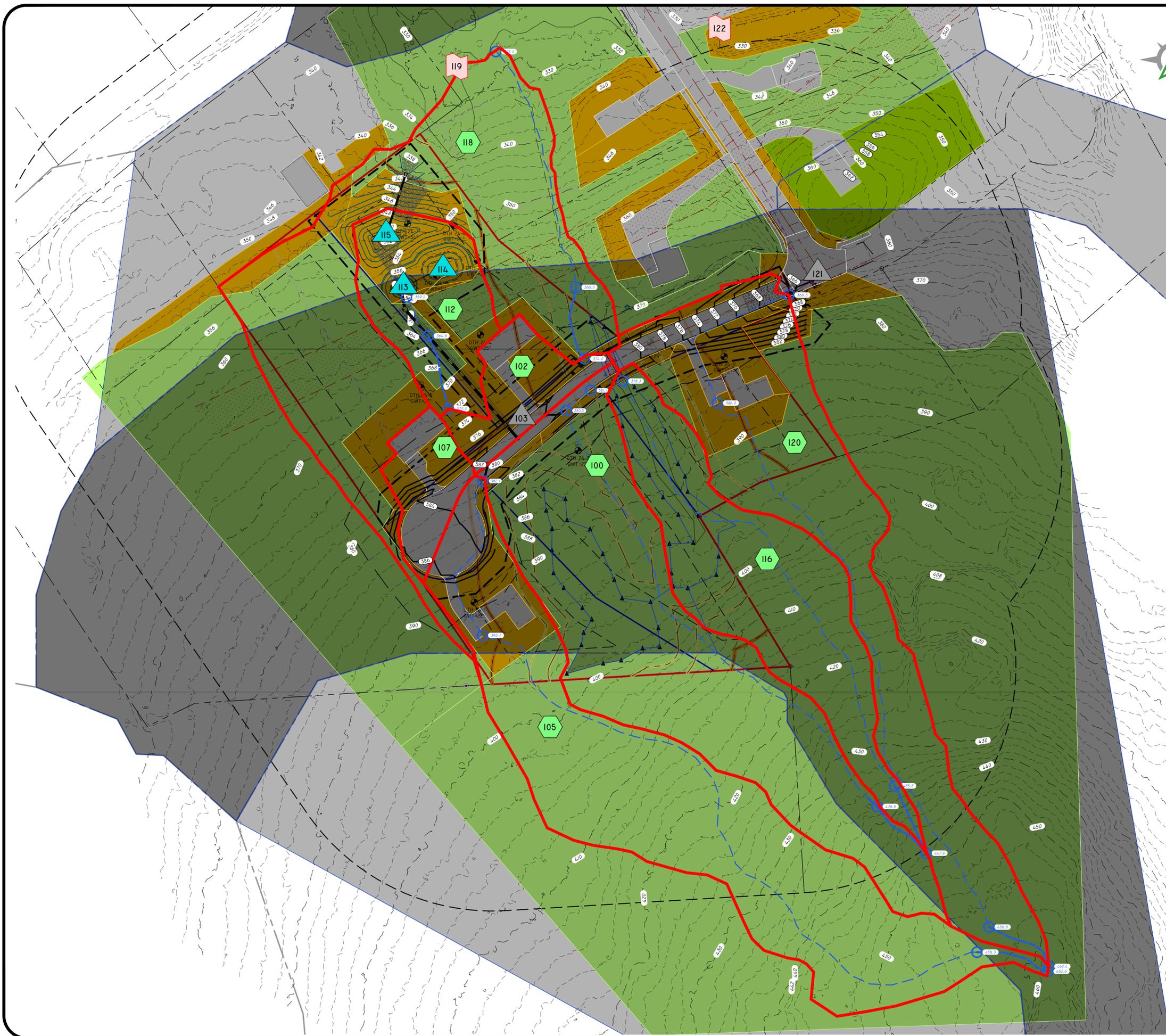


PRE-DEVELOPMENT WATERSHED MAP
LOUISE DRIVE



Two Stafford Court, Cranston, RI 02920
TEL: 401-943-1000 FAX: 401-464-6006 WWW.DIPRETE-ENG.COM
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Z:\DEVELOPMENT\PROJECTS\1342-001 LOUISE DRIVE\AUTOCAD DRAWINGS\1342-001-WMP-DWG.PLOTTER: 9/14/2024

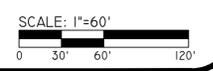


LEGEND

- WOODS - A SOILS
- WOODS - B SOILS
- WOODS - C SOILS
- WOODS - D SOILS
- GRASS - A SOILS
- GRASS - B SOILS
- GRASS - C SOILS
- GRASS - D SOILS
- GRAVEL - A SOILS
- GRAVEL - B SOILS
- GRAVEL - C SOILS
- GRAVEL - D SOILS
- IMPERVIOUS
- BRUSH - A SOILS
- BRUSH - B SOILS
- BRUSH - C SOILS
- BRUSH - D SOILS
- WATER

LEGEND

- TC LINE WITH ELEVATIONS 37.3A37.5B
- SUBCATCHMENT AREA
- SOIL BOUNDARY
- REACH
- SUBCATCHMENT 100
- DRAINAGE POND/BIO RETENTION/SAND FILTER/INFILTRATING SWALE 100
- DRAINAGE STRUCTURE/POND WITH INSIGNIFICANT STORAGE 100
- REACH/SWALE 100
- DESIGN POINT 100



POST-DEVELOPMENT WATERSHED MAP
LOUISE DRIVE



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