Stormwater Management Report

LACKEY DAM LOGISTICS CENTER

Lackey Dam Road
Sutton and Uxbridge, Massachusetts

Prepared for:
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LIST OF ATTACHMENTS

1.0 INTRODUCTION

The proposed Lackey Dam Logistics Center development consists of an approximately 212,350 square feet warehouse building including associated improvements (the Project). The proposed Project includes a stormwater management system designed to mitigate potential impacts the proposed Project could have on the existing watershed. Stormwater controls have been proposed to control peak runoff rates, provide water quality treatment and sediment removal, and promote groundwater recharge. The proposed system has been designed to comply with:

- The 2008 Massachusetts Department of Environmental Protection (DEP) Stormwater Management Handbook,
- The Massachusetts Wetland Protection Act (310 CMR 10.00), and
- Local Wetland Regulations

The pre- and post-development hydrologic conditions were modeled using HydroCAD™ version 10.10 to demonstrate that post-development stormwater runoff rates will be less than or equal to the pre-development rates. Watershed maps with soil types as well as a detailed analysis of the model results are also included. The following table summarizes the peak runoff rates for the pre- and post-development conditions.

Table 1: Pre- & Post-development Peak Runoff Rate Comparison, units are in cubic feet per second (cfs).

Storm Event	2 Year		10 Year		100 Year	
	Pre	Post	*Pre*	Post	*Pre*	Post
Design Point 1	*0.28*	0.55	*3.80*	3.10	*24.00*	22.66
Design Point 2	*0.95*	0.43	*7.17*	1.89	*30.39*	10.07
Design Point 3	*0.00*	0.00	*0.01*	0.00	*0.37*	0.01

2.0 PRE-DEVELOPMENT CONDITIONS

2.1 Site Conditions

The proposed development is located off Lackey Dam Road in the towns of Sutton and Uxbridge, Massachusetts. The site is largely undeveloped and contains wooded areas interspersed with forested wetlands. The Project site is bounded by Lackey Dam Road to the south and east, Oakhurst Road to the north, wetlands to the east and southwest, and abutting residential and industrial properties to the northwest. The existing #100 Lackey Dam Road single-family residence is located at the south end of the proposed development. The southern portion of the site slopes toward Lackey Dam Road and toward the wetland system located along the southwestern perimeter of the site. There is a high point located along the northwestern perimeter of site. The northern portion of the site slopes toward the eastern wetland system with a minor, northern area first draining directly to Oakhurst Road. The southwestern and eastern wetland systems drain to the eastern side of Lackey Dam Road via existing culvert pipes.

Runoff from the site currently drains to three primary locations:

DP-1: Wetland system located along the southwestern portion of the site.
DP-2: Wetland system located along the northeastern portion of the site.
DP-3: Oakhurst Road along the northern portion of the site.

These design points have been named correspondingly in the hydrologic analyses.

2.1.1 Critical Areas

Critical Areas as defined by Standard 6 of the 2008 MassDEP Stormwater Management Handbook are areas where high levels of stormwater treatment is required; typically the first inch of runoff is treated using specific best management practices (BMPs) and pre-treatment methods. Specific source control and pollution prevention measures are also required.

The site does not contain, nor is it tributary to any Critical Areas.

2.1.2 Total Maximum Daily Loads (TMDL)

A TMDL is the greatest amount of a pollutant that a waterbody can accept and still meet water quality standards for protecting public health and maintaining the designated beneficial uses of those waters for drinking, swimming, recreation, and fishing. A TMDL is implemented by specifying how much of that pollutant can come from point, nonpoint, and natural sources.

The site is not within a watershed with a TMDL or draft TMDL.

2.2 Soil Description

The Natural Resources Conservation Service (NRCS) lists the on-site soils as Hydrologic Soil Group A & B (for the upland site areas).

A representative from McArdle Gannon Associates, Inc. (MGA), the project geotechnical engineer, conducted site wide soil testing that verify the NRCS classification. This testing informed elevations of estimated seasonal high groundwater and refusal.

Refer to Attachment 1: Soil Data for additional information.

2.3 Hydrologic Analysis

Sub-catchment areas were delineated based on existing runoff patterns and topographic information. This information is shown on the *Pre-Development Conditions Hydrologic Areas Map* included in Attachment 2. Summaries of each area with respect to Curve Number and Time of Concentration calculations can be found in the model results also in Attachment 2.

3.0 POST-DEVELOPMENT CONDITIONS

3.1 Design Strategy

The proposed development includes a 212,350 square foot warehouse building with associated loading bays, parking areas and access drives. Significant earthwork will be required for the project. During the preliminary design phase of the site layout, consideration was given to conserving environmentally sensitive features and minimizing impacts on the existing hydrology. However, based on the constraints set forth by the proposed site's usage, the Bordering Vegetated Wetland present on the eastern portion of the site is impacted by the design. As a result, approximately 3,840 square feet of wetland fill is proposed. To mitigate this impact, a wetland replication area of approximately 5,860 square feet is proposed.

Stormwater runoff from the proposed parking areas and roadways will be collected in deep sump hooded catch basins and subsequently conveyed through a drain pipe network and proprietary stormwater quality treatment units prior to discharging to three infiltration basins located throughout the site for peak rate attenuation and recharge to groundwater. Runoff from the proposed rooftop will be collected in a subsurface roof drain network and will also discharge to two of the three infiltration basins. The basins will discharge upland of the on-site wetland systems, consistent with the existing hydrology of the site.

All stormwater BMPs were designed to treat a minimum of the first 0.5 inch of runoff generated by the on-site impervious areas. Stormwater BMP sizing worksheets and water quality sizing calculations are included in Attachment 4 of this report.

Infiltration basins were selected as the primary best management practices for peak rate attenuation due to the mapped NRCS soils onsite as well as the depths to groundwater as confirmed by the soil testing. The site is comprised of Hydrologic Soil Group A and B soils, with the exception of the on-site wetlands.

3.2 Hydrologic Analysis

The design points established for the pre-development conditions analysis were used in the post-development analysis for direct comparison. The tributary areas and flow paths were modified to reflect post-development conditions. See Attachment 3 for the *Post-Development Conditions Hydrologic Areas Map*. Summaries of each area with respect to Curve Number and Time of Concentration calculations can be found in the model results in Attachment 3.

3.3 Stormwater Management Controls Sizing

Infiltration Basins

The three infiltration basins have been designed to reduce post-development peak rates of runoff up to the 100-year storm event. In order to reduce sediment and meet treatment requirements, runoff will be conveyed to proprietary treatment structures prior to discharging into each of the three infiltration basins. The outlet control structures have been designed as a multi-stage outlet with low-flow orifices proposed above the bottom of the basin to infiltrate retained runoff and control the discharge rates for a variety of storm events. The outlets consist of precast structures with circular orifices and/or rectangular weirs routed to pipe outfalls with flared ends and riprap pads at the discharge points. direct stormwater towards the bordering vegetated wetlands (BVW). To prevent overtopping, an emergency spillway has been provided (in addition to open grates at the top of the outlet control structures) to direct the excess flow towards the BVW, consistent with the existing drainage pattern. The basins have been designed so that they will provide the required offset to groundwater.

The infiltration basins were sized using the static method, as described in Chapter 3 of the Massachusetts Stormwater Handbook, using a Rawls exfiltration rate of 0.52 inches per hour (for HSG B soils). The system has been designed to meet the required recharge volume, and will fully dewater within 72 hours.

3.4 Hydraulic Calculations

In compliance with local requirements, the proposed stormwater collection and conveyance system will be designed to convey the 25-year rational storm event as well as to not surcharge structure grates and covers during the 100-year rational storm event. Hydraulic calculations are forthcoming.

3.5 Compliance with DEP Stormwater Management Standards

The proposed stormwater management system was designed in compliance with the ten (10) DEP Stormwater Management Standards. The following summary provides key information related to the proposed stormwater management system, its design elements, and mitigation measures for potential impacts.

STANDARD 1: **No new stormwater conveyance (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.**

There will be no direct discharge of untreated stormwater to nearby wetlands or waters of the Commonwealth. Runoff from impervious areas of the site will be conveyed to stormwater management controls for water quality treatment, runoff rate attenuation and groundwater recharge prior to discharge to adjacent wetlands.

STANDARD 2: **Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.**

The stormwater management design will generally control post-development peak discharge rates for the 2, 10, & 100-year, 24-hour storms so as to maintain pre-development peak discharge rates. There is a de minimis increase in the peak rate of runoff at DP-1 during the 2-year storm. This is due to elevation constraints (not being able to route all of the post-development subcatchment adjacent to Lackey Dam Road to Basin #1, given the proposed bottom elevation). Refer to Section 1.0 Introduction for a summary of the peak rates of runoff.

STANDARD 3: **Loss of annual recharge to groundwater shall be eliminated or minimized through the use of environmentally sensitive site design, low impact development techniques, stormwater management practices and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil types. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.**

The stormwater management system includes three infiltration basins that will effectively recharge groundwater on-site. The infiltration basins were sized using the static method based on the required recharge volume for the post-development site. As a result, annual recharge from the post-development site is designed to exceed the annual recharge from the site under pre-development conditions. See Attachment 4 for the Groundwater Recharge Calculation.

STANDARD 4: **Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS).**

The proposed project will meet the water quality requirements of Standard 4 using on-site treatment trains that achieve 80% TSS removal. TSS removal worksheets are forthcoming. Structural BMPs include deep sump hooded catch basins and proprietary water quality structures for treatment of stormwater runoff prior to infiltration in the basins. All BMPs designed for water quality treatment will be sized to capture and treat the flow rate associated with the first 0.5-inch of runoff from proposed impervious surfaces. All proposed stormwater management BMPs will be operated and maintained to ensure continued water quality treatment of runoff. The Site Owner's Manual complies with the Long-Term Pollution Prevention Plan (Standard 4) and the Long-Term Operation and Maintenance Plan (Standard 9) requirements of the 2008 Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards. The Manual outlines source control and pollution prevention measures and maintenance requirements of stormwater best management practices (BMPs) associated with the proposed development.

STANDARD 5: **For land uses with higher potential pollutant loads (LUHPPLs), source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.**

The proposed project is not associated with stormwater discharges from land uses with higher potential pollutant loads.

STANDARD 6: **Stormwater discharges to critical areas must utilize certain stormwater management BMPs approved for critical areas. Critical areas are Outstanding Resource Waters, shellfish beds, swimming beaches, coldwater fisheries and recharge areas for public water supplies.**

There are no stormwater discharges to critical areas associated with this project. The proposed site improvements will drain to Lackey Pond, which is not identified as a critical area.

STANDARD 7: **Redevelopment of previously developed sites must meet the Stormwater Management Standards to the maximum extent practicable. However, if it is not practicable to meet all the Standards,**

new (retrofitted or expanded) stormwater management systems must be designed to improve existing conditions.

The proposed project is new development, and therefore this standard does not apply.

STANDARD 8: **A plan to control construction-related impacts during erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.**

A Stormwater Pollution Prevention Plan (SWPPP) will be developed prior to construction to comply with Section 3 of the NPDES Construction General Permit for Stormwater Discharges; therefore the requirements of Standard 8 are fulfilled.

STANDARD 9: **A Long-Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed.**

The Site Owner's Manual complies with the Long-Term Pollution Prevention Plan (Standard 4) and the Long-Term Operation and Maintenance Plan (Standard 9) requirements of the 2008 Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards. The Manual outlines source control and pollution prevention measures and maintenance requirements of the stormwater best management practices (BMPs) associated with the proposed development. See Attachment 5 for the Site Owner's Manual.

STANDARD 10: **All illicit discharges to the stormwater management system are prohibited.**

There will be no illicit discharges to the proposed stormwater management system associated with the proposed project. An Illicit Discharge Compliance Statement is provided on the following page.

3.6 Illicit Discharge Compliance Statement

An illicit discharge is any discharge to a stormwater management system that is not comprised entirely of stormwater, discharges from fire-fighting activities, and certain non-designated non-stormwater discharges.

To the best of my knowledge, no detectable illicit discharge exists on site. The site plans included with this report detail the storm sewers that convey stormwater on the site and demonstrate that these systems do not include the entry of an illicit discharge. A Site Owner's Manual is also included, which contains the Long Term Pollution Plan that outlines measures to prevent future illicit discharges. As the Site Owner, I will ultimately be responsible for implementing the Long Term Pollution Prevention Plan.

Signature: _____

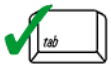
Owner

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

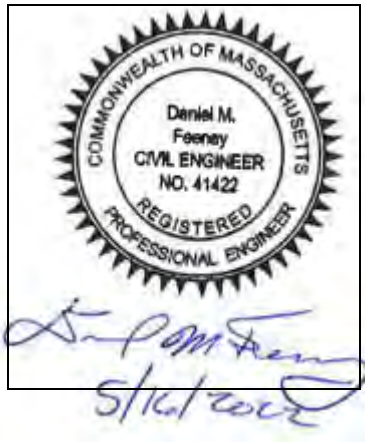
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☒ 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.

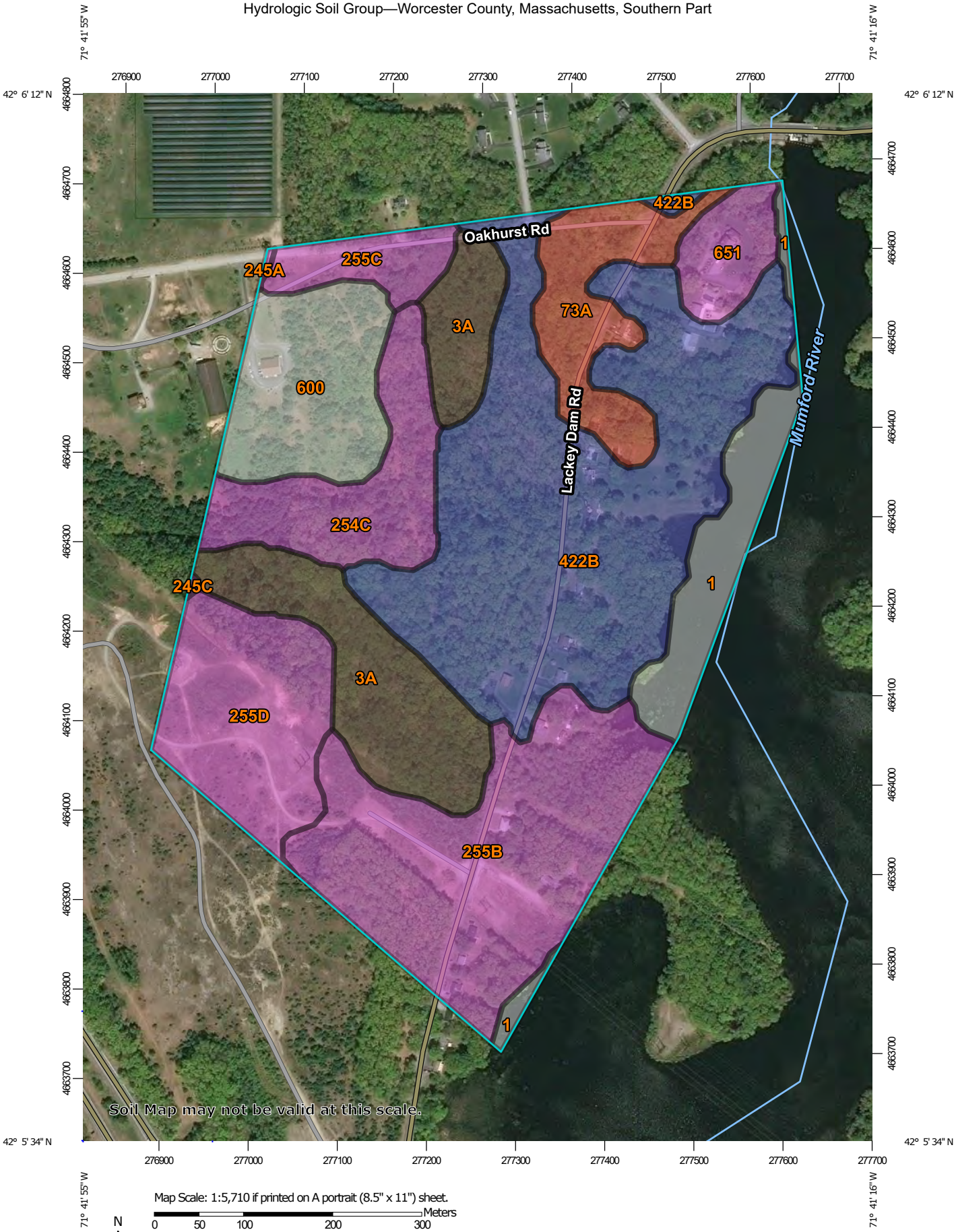
Standard 10: Prohibition of Illicit Discharges

☒ 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.

Attachment 1
Soil Data



Map Scale: 1:5,710 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Lines

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Points

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Water Features

Streams and Canals

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 13, Jun 11, 2020

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

Date(s) aerial images were photographed: May 18, 2019—Jul 9, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		6.6	5.7%
3A	Scarboro and Walpole soils, 0 to 3 percent slopes	B/D	13.0	11.3%
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	D	6.9	6.0%
245A	Hinckley loamy sand, 0 to 3 percent slopes	A	0.1	0.1%
245C	Hinckley loamy sand, 8 to 15 percent slopes	A	0.0	0.0%
254C	Merrimac fine sandy loam, 8 to 15 percent slopes	A	8.2	7.1%
255B	Windsor loamy sand, 3 to 8 percent slopes	A	20.9	18.1%
255C	Windsor loamy sand, 8 to 15 percent slopes	A	3.1	2.7%
255D	Windsor loamy sand, 15 to 25 percent slopes	A	10.4	9.0%
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	B	34.1	29.6%
600	Pits, gravel		8.8	7.7%
651	Udorthents, smoothed	A	3.2	2.8%
Totals for Area of Interest			**115.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

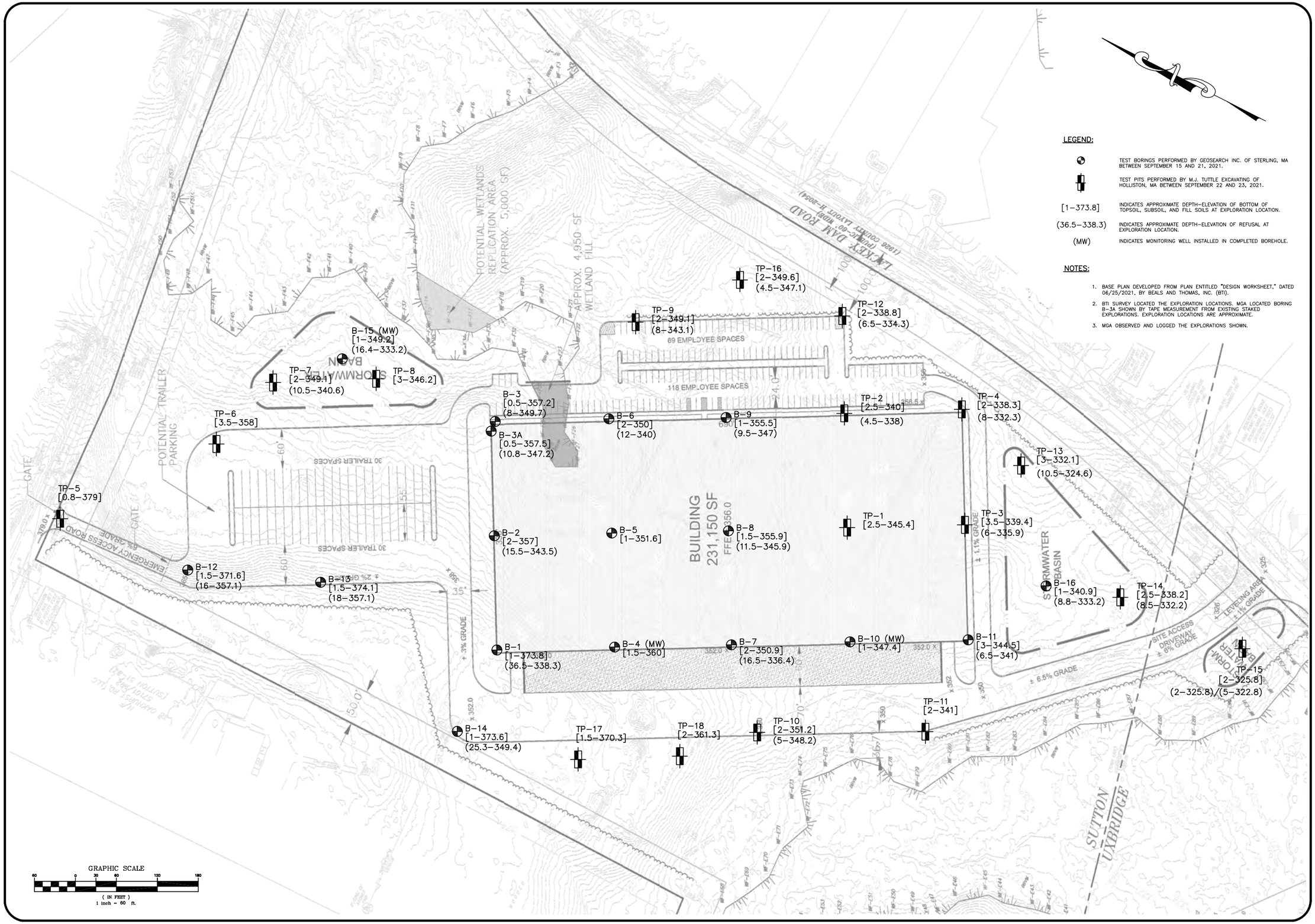
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



REDUCED COPY

REVISIONS

DRAWN BY: RED

DESIGNED BY: RED

CHECKED BY: JJG

McArdle Gannon Associates, Inc.
Engineers & Consultants
300 Oak Street, Suite 460 Pembroke, MA 02359
781.826.0040 phone 781.735.0418 fax

EXPLORATION LOCATION PLAN
PROPOSED BLACKSTONE LOGISTICS CENTER
LOT 2 - LACKEY DAM ROAD
UXBRIDGE AND SUTTON, MASSACHUSETTS

NOVEMBER 2021

SCALE: 1" = 60'

JOB No. G0875

FIG No. 2

SHEET 1 OF 1

McArdle Gannon Associates, Inc.
Engineers & Consultants

TABLE 1
SUBSURFACE EXPLORATION SUMMARY
Page 1 of 2

Project: Proposed Blackstone Logistics Center - Lot 2
Location: Lackey Dam Rd, Uxbridge and Sutton, MA
MGA Job No.: G0875

Exploration No.	Ground Surface Elevation (feet) [1]	Thickness of Existing Fill (feet)	Thickness of Topsoil /Subsoil (feet)	Depth to Top of Natural (feet)	Elevation of Top of Natural (feet)	Depth to Refusal (feet)	Elevation of Refusal (feet)	Depth to Groundwater (feet)	Elevation of Groundwater (feet)
B-1	374.8	0.0	1.0	1.0	373.8	36.5	338.3	20.0	354.8
B-2	359.0	0.0	2.0	2.0	357.0	15.9	343.1	12.0	347.0
B-3	357.7	0.0	0.5	0.5	357.2	8.0	349.7	NE	NE
B-3A	358.0	0.0	0.5	0.5	357.5	10.8	347.3	NE	NE
B-4 (MW)	361.5	0.0	1.5	1.5	360.0	NE	NE	11.7	349.8
B-5	352.6	0.0	1.0	1.0	351.6	NE	NE	7.6	345.0
B-6	352.0	0.0	2.0	2.0	350.0	NE	NE	4.5	347.5
B-7	352.9	0.0	2.0	2.0	350.9	16.5	336.4	8.5	344.4
B-8	357.4	0.0	1.5	1.5	355.9	11.5	345.9	NE	NE
B-9	356.5	0.0	1.0	1.0	355.5	9.5	347.0	NE	NE
B-10 (MW)	348.4	1.0	0.0	1.0	347.4	NE	NE	9.1	339.3
B-11	347.5	0.0	1.0	1.0	346.5	6.5	341.0	NE	NE
B-12	373.1	0.0	1.5	1.5	371.6	16.0	357.1	15.0	358.1
B-13	375.1	0.0	1.0	1.0	374.1	18.0	357.1	NE	NE
B-14	374.6	0.0	1.0	1.0	373.6	25.3	349.4	20.0	354.6
B-15 (MW)	350.2	0.0	1.0	1.0	349.2	16.4	333.8	5.5	344.7
B-16	341.9	0.0	1.0	1.0	340.9	8.8	333.2	NE	NE

Notes:

(1) Ground surface elevations for the explorations were determined by survey performed by Beals and Thomas, Inc. Elevations should be considered approximate.
NE = Not Encountered
NA = Not Available

McArdle Gannon Associates, Inc.
Engineers & Consultants

TABLE 1
SUBSURFACE EXPLORATION SUMMARY
Page 2 of 2

Project: Proposed Blackstone Logistics Center - Lot 2
Location: Lackey Dam Rd, Uxbridge and Sutton, MA
MGA Job No.: G0875

Exploration No.	Ground Surface Elevation (feet) [(1)]	Thickness of Existing Fill (feet)	Thickness of Topsoil /Subsoil (feet)	Depth to Top of Natural (feet)	Elevation of Top of Natural (feet)	Depth to Refusal (feet)	Elevation of Refusal (feet)	Depth to Groundwater (feet)	Elevation of Groundwater (feet)
TP-1	347.9	0.0	2.5	2.5	345.4	NE	NE	NE	NE
TP-2	342.5	0.0	2.5	2.5	340.0	4.5	338.0	NE	NE
TP-3	341.9	0.0	2.5	2.5	339.4	6.0	335.9	NE	NE
TP-4	340.3	0.0	2.0	2.0	338.3	8.0	332.3	NE	NE
TP-5	379.7	0.0	0.8	0.8	378.9	NE	NE	NE	NE
TP-6	361.5	2.0	1.5	3.5	358.0	NE	NE	NE	NE
TP-7	351.1	0.0	2.0	2.0	349.1	10.5	340.6	8.0	343.1
TP-8	349.2	0.0	3.0	3.0	346.2	NE	NE	7.0	342.2
TP-9	351.1	0.0	2.0	2.0	349.1	8.0	343.1	NE	NE
TP-10	353.2	0.0	2.0	2.0	351.2	NE	NE	NE	NE
TP-11	343.0	0.0	2.0	2.0	341.0	NE	NE	NE	NE
TP-12	340.8	0.0	2.0	2.0	338.8	6.5	334.3	NE	NE
TP-13	335.1	0.0	3.0	3.0	332.1	10.5	324.6	NE	NE
TP-14	340.7	0.0	2.5	2.5	338.2	8.5	332.2	NE	NE
TP-15	327.8	0.0	2.0	2.0	325.8	5.0	322.8	NE	NE
TP-16	351.6	0.0	2.0	2.0	349.6	4.5	347.1	NE	NE
TP-17	371.8	1.5	0.0	1.5	370.3	NE	NE	7.0	364.8
TP-18	363.3	0.0	2.0	2.0	361.3	NE	NE	NE	NE

Notes:

(1) Ground surface elevations for the explorations were determined by survey performed by Beals and Thomas, Inc. Elevations should be considered approximate.
NE = Not Encountered
NA = Not Available

McArdle Gannon Associates, Inc.
Engineers & Consultants

TEST BORING LOG

BORING B-15 (MW)

PROJECT: Blackstone Logistics Center - Lot 2, Sutton & Uxbridge, MA
CLIENT: Scannell Properties
CONTRACTOR: Geosearch, Inc.

MGA NO. : G0875
SHEET NO. : 1 of 1
LOCATION N : See Plan
E :
ELEVATION : 350.2'±
DATE START : 9/16/21
END : 9/16/21
DRILLER : Sean Preston
ENGINEER : Robert Bosselman

GROUNDWATER		DEPTH (ft) OF:			EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Hole	Type	HSA	Split Spoon	---
9/16/21	12:00	6'	10'	12'	Size I.D.	4-1/4"	1-3/8"	---
9/23/21	12:40	5.5'	MW	OUT	Hammer Wt.	---	140#	- - - -
					Hammer Fall	---	30"	- - - -

Depth in Feet	Strata Change	Case BPF (Drill) (min/ft)	Sampler Blows Per 6" (RQD%)	Sample Number/ Type	Sample Depth Range (ft)	Sample Recov-ery (in)	Elev-ation/ Depth (ft)	FIELD CLASSIFICATION AND REMARKS	Well Schematic
0			2	S-1	0.0	4	349.7		
			4	S-1A	0.5	4	0.5	Dark brown, fine to medium SAND, some Silt, trace fine Gravel.	
			15	S-1B	0.5	8	349.2	-TOPSOIL-	
			70/3"		1.0		1.0	Orange-brown, fine to coarse SAND, some fine to coarse Gravel, litte (+) Silt.	
					1.0			-SUBSOIL-	
4					2.0			Gray to olive, fine to coarse SAND, some fine to coarse Gravel, little (+) Silt. (possible Cobble/Boulder Fragments)	
			11	S-2	5.0	22		Very dense, Light brown, fine to coarse SAND, some fine Gravel, little (-) Silt.	
			19		7.0				
			34					-SAND AND GRAVEL-	
8			37						
			15	S-3	10.0	20		Dense, Gray to beige, fine to coarse SAND, some fine to coarse Gravel, little (+) Silt.	
			20		12.0				
			15						
12			14						
							335.2		
			11	S-4	15.0	8	15.0	Light Brown, fine to coarse SAND, little fine Gravel, trace (-) Silt.	
			17		16.0		334.2	-SAND-	
16			80/5"	S-4A	16.0	5	16.0		
					16.4	-	333.2	Light Brown, fine to medium SAND and SILT.	
							17.0	-SAND AND SILT-	
								Bottom of Boring, Split Spoon Refusal at 16.4 Feet	
20									

BLOWS/FT.	DENSITY
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
50 +	Very Dense

BLOWS/FT.	CONSISTENCY
0 - 2	Very Soft
2 - 4	Soft
4 - 8	Medium Stiff
8 - 15	Stiff
15 - 30	Very Stiff
30+	Hard

SAMPLE IDENTIFICATION
- S - Split Spoon
- T - Thin Wall Tube
- U - Undisturbed Piston
- C - Diamond Core
- W - Wash Sample

SUMMARY
Overburden:
Rock:
Samples:

BORING B-15 (MW)

300 Oak Street, Suite 460 Pembroke, MA 02359 | Telephone 781.826.0040 | Fax 781.735.0418 | mcardlegannon.com

McArdle Gannon Associates, Inc.
Engineers & Consultants

TEST BORING LOG

BORING B-16

PROJECT: Blackstone Logistics Center - Lot 2, Sutton & Uxbridge, MA
CLIENT: Scannell Properties
CONTRACTOR: Geosearch, Inc.

MGA NO. : G0875
SHEET NO. : 1 of 1
LOCATION N : See Plan
E :
ELEVATION : 341.9'±
DATE START : 9/20/21
END : 9/20/21
DRILLER : Sean Preston
ENGINEER : Robert Drown

GROUNDWATER		DEPTH (ft) OF:			EQUIPMENT	CASING	SAMPLER	CORE
Date	Time	Water	Casing	Hole	Type	HSA	Split Spoon	---
9/20/21	12:50	NE	8.75'	8.75'	Size I.D.	4-1/4"	1-3/8"	---
					Hammer Wt.	---	140#	- - - -
					Hammer Fall	---	30"	- - - -

Depth in Feet	Strata Change	Case BPF (Drill) (min/ft)	Sampler Blows Per 6" (RQD%)	Sample Number/ Type	Sample Depth Range (ft)	Sample Recovery (in)	Elevation/ Depth (ft)	FIELD CLASSIFICATION AND REMARKS
0			1	S-1	0.0	6	341.4	Dark brown, fine to medium SAND, some Silt, little Roots.
			1	S-1A	0.5	6	0.5	-TOPSOIL-
			1	S-1B	0.5	12	340.9	Orange-brown, fine to medium SAND, some (-) Silt, trace (-) Roots.
			1		1.0		1.0	-SUBSOIL-
					1.0			Olive-brown, fine to medium SAND, trace (+) Silt.
4					2.0			-SAND-
			5	S-2	5.0	24	336.9 5.0	Moist, Medium Dense, Olive/Brown, SILT and fine SAND.
			5		7.0			
			6					-SAND AND SILT-
			5					
8							333.2	
						-	8.8	Bottom of Boring, Auger Refusal at 8.75 Feet.
12								
16								
20								

BLOWS/FT.	DENSITY
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
50 +	Very Dense

BLOWS/FT.	CONSISTENCY
0 - 2	Very Soft
2 - 4	Soft
4 - 8	Medium Stiff
8 - 15	Stiff
15 - 30	Very Stiff
30+	Hard

SAMPLE IDENTIFICATION
- S - Split Spoon
- T - Thin Wall Tube
- U - Undisturbed Piston
- C - Diamond Core
- B - Bulk/Grab Sample

SUMMARY
Station:
Rock:
Samples:

BORING B-16

300 Oak Street, Suite 460 Pembroke, MA 02359 | Telephone 781.826.0040 | Fax 781.735.0418 | mcardlegannon.com

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
	Topsoil
	Sand
	Sand and Silt
	Silt
	Glacial Till
	Subsoil
	Sand and Gravel
	Weathered Rock
	Fill

Symbol	Description
	Granite
Soil Samplers	
	Split Spoon
Monitor Well Details	
	assorted cuttings
	bentonite pellets
	silica sand, blank PVC
	slotted pipe w/ sand
	endcap on pipe packed in sand
	no pipe, filler material

Notes:

1. Geosearch, Inc. performed the test borings with a all terrain vehicle mounted drill rig equipped with an automatic safety hammer on September 15 through 21, 2021.

2. Beals and Thomas, Inc. (BTI) survey located the test borings and provided ground surface elevations indicated on the logs. MGA located boring B-3A by tape measurement from surveyed locations by BTI. MGA estimated the ground surface elevation for B-3A based on contours on the referanced plans. Elevations are approximate.

3. MGA observed and logged the borings.

4. 'NE' = Not Encountered

5. It should be noted that groundwater level at the site will fluctuate due to varying climatic, surface, and subsurface conditions. Therefore, groundwater levels encountered during construction and thereafter may differ from those reported herein.

Commonwealth of Massachusetts
City/Town of Sutton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-7 (Hole #) | 09/22/21 (Date) | 10:30 (Time) | Sunny (Weather) | 42.099361 (Latitude) | -71.693624 (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Young growth Forest (Vegetation) | Few Boulders (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5 (Slope (%))

Description of Location: Wooded Area in undeveloped area.

2. Soil Parent Material: Glaciofluvial Deposits | Outwash (Landform) | Toe Slope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >200 feet | Drainage Way >50 feet | Wetlands >50 feet
Property Line >50 feet | Drinking Water Well >50 feet | Other >50 feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☒ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 96 Depth Weeping from Pit | 96 Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-12	Ap	Loamy Sand	10YR 4/1				0-5	0	Massive	Very Friable	
12-24	Bw	Loamy Sand	10YR 6/8				0-5	0	Massive	Very Friable	
24-48	C1	Loamy Sand	10YR 6/1				5-10	0	Massive	Very Friable	
48-126	C2	Loamy Sand	10YR 5/1	84	7.5YR 6/8	30	25-30	5-10	Massive	Friable	
126	R										

Additional Notes:

Commonwealth of Massachusetts
City/Town of Sutton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-8 (Hole #) | 09/22/21 (Date) | 11:15 (Time) | Sunny (Weather) | 42.099361 (Latitude) | -71.693624 (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Young growth Forest (Vegetation) | Few Boulders (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5 (Slope (%))

Description of Location: Wooded Area in undeveloped area.

2. Soil Parent Material: Glaciofluvial Deposits | Outwash (Landform) | Toe Slope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >200 feet | Drainage Way >50 feet | Wetlands >50 feet
Property Line >50 feet | Drinking Water Well >50 feet | Other >50 feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 84 Depth Weeping from Pit | 84 Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-18	Ap	Loamy Sand	10YR 3/1				0-5	0	Massive	Very Friable	
18-36	Bw	Loamy Sand	10YR 6/8				0-5	0	Massive	Very Friable	
36-120	C1	Loamy Sand	10YR 5/1	72	7.5YR 6/8	50	10-15	0-5	Massive	Very Friable	

Additional Notes:

Commonwealth of Massachusetts
City/Town of Sutton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-13 (Hole #) | 09/23/21 (Date) | 8:55 (Time) | Sunny (Weather) | 42.099361 (Latitude) | -71.693624 (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Young growth Forest (Vegetation) | Few Boulders (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5 (Slope (%))

Description of Location: Wooded Area in undeveloped area.

2. Soil Parent Material: Glaciofluvial Deposits | Outwash (Landform) | Toe Slope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >200 feet | Drainage Way >50 feet | Wetlands >50 feet
Property Line >50 feet | Drinking Water Well >50 feet | Other >50 feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☒ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-24	Ap	Sandy Loam	10YR 4/3				0	0	Massive	Very Friable	
24-36	Bw	Sandy Loam	10YR 6/8				0-5	0	Massive	Very Friable	
36-126	C1	Sandy Loam	10YR 5/1				25-30	10-15	Massive	(1)	
126	R										

Additional Notes:
(1) Firm in Place, Very Friable in hand.

Commonwealth of Massachusetts
City/Town of Sutton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-14 (Hole #) | 09/22/21 (Date) | 3:00 (Time) | Sunny (Weather) | 42.099361 (Latitude) | -71.693624 (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Young growth Forest (Vegetation) | Few Boulders (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5 (Slope (%))

Description of Location: Wooded Area in undeveloped area.

2. Soil Parent Material: Glaciofluvial Deposits | Outwash (Landform) | Toe Slope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >200 feet | Drainage Way >50 feet | Wetlands >50 feet
Property Line >50 feet | Drinking Water Well >50 feet | Other >50 feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☒ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-12	Ap	Sandy Loam	10YR 3/1				0	0	Massive	Very Friable	
12-30	Bw	Sandy Loam	10YR 6/8				0-5	0	Massive	Very Friable	
30-60	C1	Loamy Sand	10YR 6/1				5-15	5	Massive	Very Friable	
60-102	C2	Sandy Loam	10YR 5/1				20-30	10	Massive	(1)	
102	R										

Additional Notes:
(1) Firm in Place, Very Friable in hand.

Commonwealth of Massachusetts
City/Town of Sutton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-15 (Hole #) | 09/22/21 (Date) | 3:10 (Time) | Sunny (Weather) | 42.099361 (Latitude) | -71.693624 (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Young growth Forest (Vegetation) | Few Boulders (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 5 (Slope (%))

Description of Location: Wooded Area in undeveloped area.

2. Soil Parent Material: Glaciofluvial Deposits | Outwash (Landform) | Toe Slope (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >200 feet | Drainage Way >50 feet | Wetlands >50 feet
Property Line >50 feet | Drinking Water Well >50 feet | Other >50 feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☒ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-6	Ap	Sandy Loam	10YR 3/4				0-5	0	Massive	Very Friable	
6-24	Bw	Sandy Loam	10YR 6/8				5-10	10	Massive	Very Friable	
24-60	C1	Sandy Loam	10YR 5/1				15-20	5-10	Massive	(1)	
24	R										Refusal North side of TP
60	R										Refusal South side of TP

Additional Notes:
(1) Firm in Place, Very Friable in hand.

Attachment 2
Pre-Development Hydrologic Analysis

BEALS + THOMAS

PRE-DEVELOPMENT HYDROLOGIC ANALYSIS

OBJECTIVE

To determine the pre-development peak runoff rates for the site for the 2-, 10-, and 100-year storm events.

CONCLUSION(S)

Peak Runoff Rates

The following numbers represent the peak rates of runoff from the site under pre-development conditions:

Storm Event	Design Point 1 (cfs)	Design Point 2 (cfs)	Design Point 3 (cfs)
2-year	0.28	0.95	0.00
10-year	3.80	7.17	0.01
100-year	24.00	30.39	0.37

CALCULATION METHODS

1. CN and Tc determined based on TR-55 methodology.
2. Runoff rates and volumes were computed using HydroCAD version 10.10-6a.
3. Area take-offs performed using Civil 3D.

ASSUMPTIONS

1. Hydrologic group of on-site soils was determined based on the United States Department of Agriculture, NRCS Soil Survey information.
2. Per TR-55, a minimum time of concentration of 6 minutes was used.
3. Surface cover types and boundaries have been estimated based upon B+T Topographic Plan information.
4. The area of analysis is limited to the area affected by the proposed development.
5. The wetland area that is proposed to be filled was modeled as Woods, Good, HSG D.

SOURCES OF DATA/ EQUATIONS

1. Pre-Development Conditions Watershed Map, dated 4/14/2022, prepared by Beals and Thomas, Inc. (307706P037B-001).
2. TR-55 Urban Hydrology for Small Watersheds, SCS, 1986.
3. Storm data for rainfall sourced from NOAA Atlas 14 for the site area. See the attached Point Precipitation Frequency Estimates table.
4. NRCS Soil Survey for Worcester County, downloaded from Web Soil Survey 2.0 on 3/4/2021.
5. Beals and Thomas, Inc. Topographic Plans, B+T plan numbers 307704B005A and 307704B003H.
6. Massachusetts DEP Stormwater Handbook, February 2008.

LIST OF ATTACHMENTS

REV	CALC. BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
0	M. Bruckman	3/4/2021				
1	M. Bruckman	7/22/2021				
2	T. Michalak	5/9/2022				

307706CS001C

Corporate Office
144 Turnpike Road
Southborough, MA 01772

T 508.366.0560 | www.bealsandthomas.com | F 508.366.4391

Regional Office
32 Court Street
Plymouth, MA 02360

1. Pre-Development Conditions Watershed Map, dated 4/14/2022, prepared by Beals and Thomas, Inc.
2. Pre-Development Conditions Hydrology Report from HydroCAD file 307706HC001B, dated 4/14/2022.
3. NOAA Atlas 14 – Point Precipitation Frequency Estimates

REV	CALC. BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
0	M. Bruckman	3/4/2021				
1	M. Bruckman	7/22/2021				
2	T. Michalak	5/9/2022				

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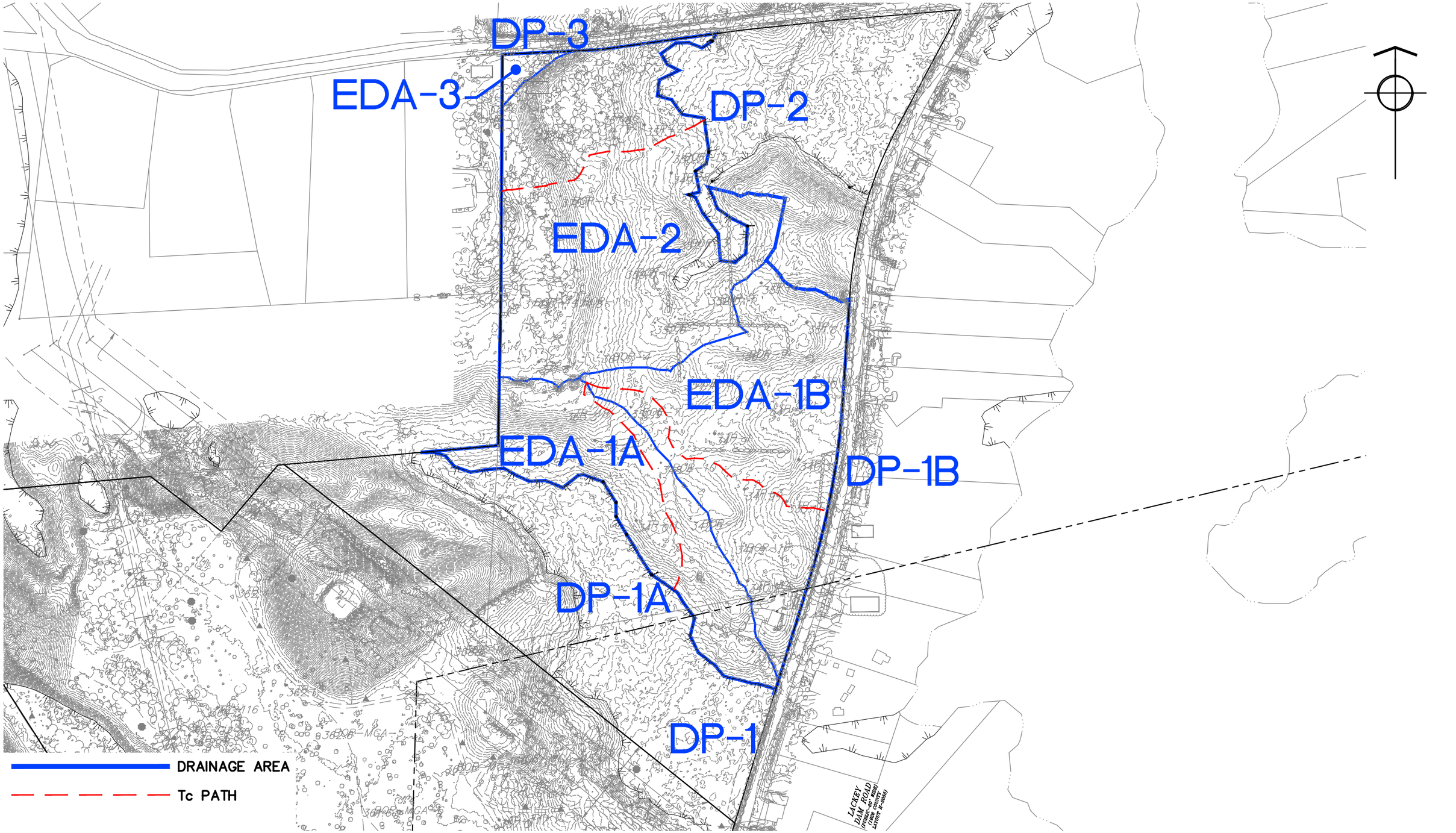


METERS
0 50 125 200
0 125 250 500 750
FEET

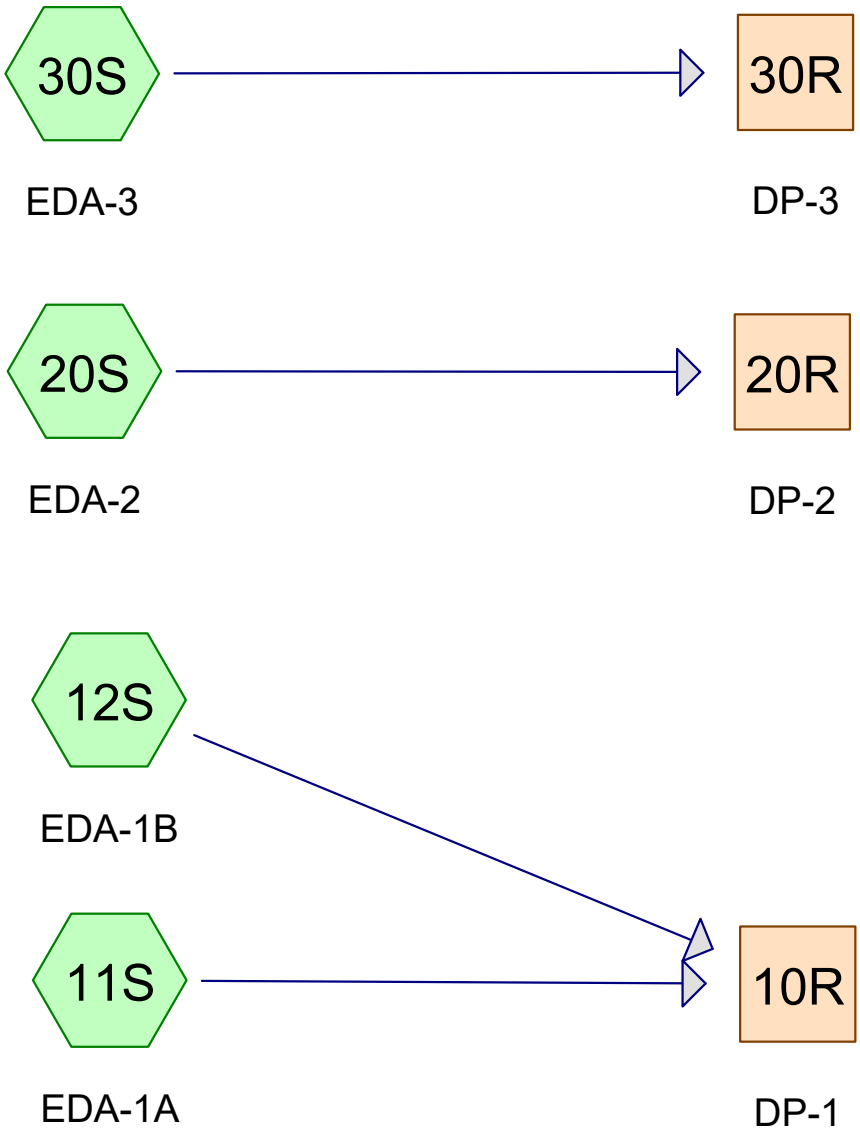
BEALS + THOMAS

B+T Drawing No. 307706P037B-001 Date: 05/09/2022 Scale: 1" = 250'

Existing Conditions

Watershed Map

Figure 1



EXISTING CONDITIONS

Subcat Reach Pond Link

Routing Diagram for 307706HC001B
Prepared by Beals and Thomas, Inc., Printed 5/9/2022

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NRCC 24-hr	D	Default	24.00	1	3.23	2
2	10-Year	NRCC 24-hr	D	Default	24.00	1	4.85	2
3	100-Year	NRCC 24-hr	D	Default	24.00	1	8.71	2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.954	39	>75% Grass cover, Good, HSG A (11S, 12S, 20S, 30S)
0.473	61	>75% Grass cover, Good, HSG B (11S, 12S)
1.964	80	>75% Grass cover, Good, HSG D (20S, 30S)
0.094	98	Paved parking, HSG B (11S, 12S)
0.030	98	Roofs, HSG B (12S)
6.596	30	Woods, Good, HSG A (11S, 12S, 20S, 30S)
12.184	55	Woods, Good, HSG B (11S, 12S, 20S)
3.193	77	Woods, Good, HSG D (20S, 30S)
25.488	**53**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
7.550	HSG A	11S, 12S, 20S, 30S
12.781	HSG B	11S, 12S, 20S
0.000	HSG C	
5.157	HSG D	20S, 30S
0.000	Other	
25.488		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.954	0.473	0.000	1.964	0.000	3.391	>75% Grass cover, Good	11S, 12S, 20S, 30S
0.000	0.094	0.000	0.000	0.000	0.094	Paved parking	11S, 12S
0.000	0.030	0.000	0.000	0.000	0.030	Roofs	12S
6.596	12.184	0.000	3.193	0.000	21.973	Woods, Good	11S, 12S, 20S, 30S
7.550	**12.781**	**0.000**	**5.157**	**0.000**	**25.488**	**TOTAL AREA**	

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 11S: EDA-1A Runoff Area=5.162 ac 0.85% Impervious Runoff Depth=0.06"
Flow Length=669' Tc=20.4 min CN=46 Runoff=0.03 cfs 0.027 af

Subcatchment 12S: EDA-1B Runoff Area=8.350 ac 0.96% Impervious Runoff Depth=0.21"
Flow Length=815' Tc=20.9 min CN=53 Runoff=0.28 cfs 0.143 af

Subcatchment 20S: EDA-2 Runoff Area=11.712 ac 0.00% Impervious Runoff Depth=0.29"
Flow Length=620' Tc=15.9 min CN=56 Runoff=0.95 cfs 0.282 af

Subcatchment 30S: EDA-3 Runoff Area=0.264 ac 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=40 Runoff=0.00 cfs 0.000 af

Reach 10R: DP-1 Inflow=0.28 cfs 0.169 af
Outflow=0.28 cfs 0.169 af

Reach 20R: DP-2 Inflow=0.95 cfs 0.282 af
Outflow=0.95 cfs 0.282 af

Reach 30R: DP-3 Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 25.488 ac Runoff Volume = 0.452 af Average Runoff Depth = 0.21"
99.51% Pervious = 25.364 ac 0.49% Impervious = 0.124 ac

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 11S: EDA-1A Runoff Area=5.162 ac 0.85% Impervious Runoff Depth=0.44"
Flow Length=669' Tc=20.4 min CN=46 Runoff=0.59 cfs 0.189 af

Subcatchment 12S: EDA-1B Runoff Area=8.350 ac 0.96% Impervious Runoff Depth=0.79"
Flow Length=815' Tc=20.9 min CN=53 Runoff=3.25 cfs 0.551 af

Subcatchment 20S: EDA-2 Runoff Area=11.712 ac 0.00% Impervious Runoff Depth=0.97"
Flow Length=620' Tc=15.9 min CN=56 Runoff=7.17 cfs 0.942 af

Subcatchment 30S: EDA-3 Runoff Area=0.264 ac 0.00% Impervious Runoff Depth=0.20"
Tc=6.0 min CN=40 Runoff=0.01 cfs 0.004 af

Reach 10R: DP-1 Inflow=3.80 cfs 0.740 af
Outflow=3.80 cfs 0.740 af

Reach 20R: DP-2 Inflow=7.17 cfs 0.942 af
Outflow=7.17 cfs 0.942 af

Reach 30R: DP-3 Inflow=0.01 cfs 0.004 af
Outflow=0.01 cfs 0.004 af

Total Runoff Area = 25.488 ac Runoff Volume = 1.687 af Average Runoff Depth = 0.79"
99.51% Pervious = 25.364 ac 0.49% Impervious = 0.124 ac

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 11S: EDA-1A Runoff Area=5.162 ac 0.85% Impervious Runoff Depth=2.24"
Flow Length=669' Tc=20.4 min CN=46 Runoff=7.19 cfs 0.962 af

Subcatchment 12S: EDA-1B Runoff Area=8.350 ac 0.96% Impervious Runoff Depth=3.04"
Flow Length=815' Tc=20.9 min CN=53 Runoff=16.80 cfs 2.118 af

Subcatchment 20S: EDA-2 Runoff Area=11.712 ac 0.00% Impervious Runoff Depth=3.40"
Flow Length=620' Tc=15.9 min CN=56 Runoff=30.39 cfs 3.317 af

Subcatchment 30S: EDA-3 Runoff Area=0.264 ac 0.00% Impervious Runoff Depth=1.57"
Tc=6.0 min CN=40 Runoff=0.37 cfs 0.035 af

Reach 10R: DP-1 Inflow=24.00 cfs 3.080 af
Outflow=24.00 cfs 3.080 af

Reach 20R: DP-2 Inflow=30.39 cfs 3.317 af
Outflow=30.39 cfs 3.317 af

Reach 30R: DP-3 Inflow=0.37 cfs 0.035 af
Outflow=0.37 cfs 0.035 af

Total Runoff Area = 25.488 ac Runoff Volume = 6.432 af Average Runoff Depth = 3.03"
99.51% Pervious = 25.364 ac 0.49% Impervious = 0.124 ac

Summary for Subcatchment 11S: EDA-1A

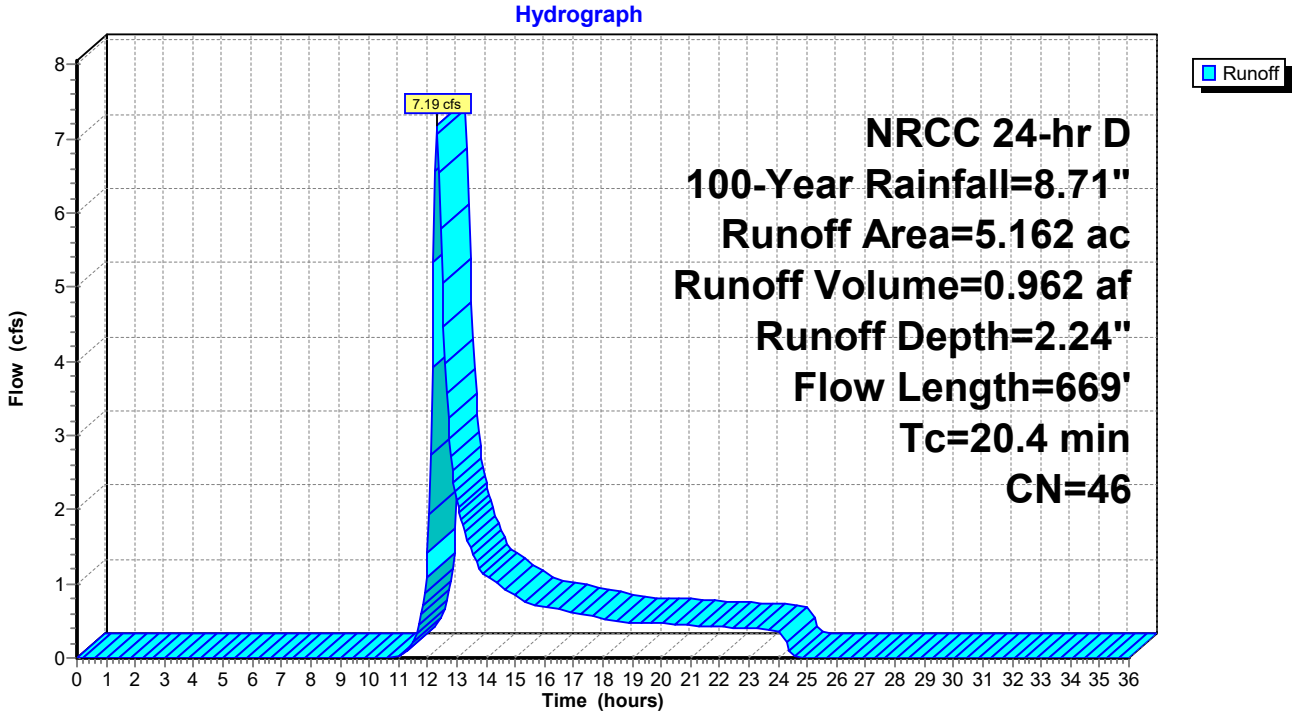
Runoff = 7.19 cfs @ 12.32 hrs, Volume= 0.962 af, Depth= 2.24"
Routed to Reach 10R : DP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.71"

Area (ac)	CN	Description
1.945	30	Woods, Good, HSG A
3.072	55	Woods, Good, HSG B
0.003	39	>75% Grass cover, Good, HSG A
0.098	61	>75% Grass cover, Good, HSG B
0.044	98	Paved parking, HSG B
5.162	46	Weighted Average
5.118		99.15% Pervious Area
0.044		0.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.3	50	0.0300	0.08		**Sheet Flow, SHT** Woods: Light underbrush n= 0.400 P2= 3.32"
1.3	114	0.0833	1.44		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
0.9	101	0.1485	1.93		**Shallow Concentrated Flow, SCF-2** Woodland Kv= 5.0 fps
3.3	99	0.0101	0.50		**Shallow Concentrated Flow, SCF-3** Woodland Kv= 5.0 fps
4.1	248	0.0403	1.00		**Shallow Concentrated Flow, SCF-4** Woodland Kv= 5.0 fps
0.5	57	0.1316	1.81		**Shallow Concentrated Flow, SCF-5** Woodland Kv= 5.0 fps
20.4	669	Total			

Subcatchment 11S: EDA-1A



Summary for Subcatchment 12S: EDA-1B

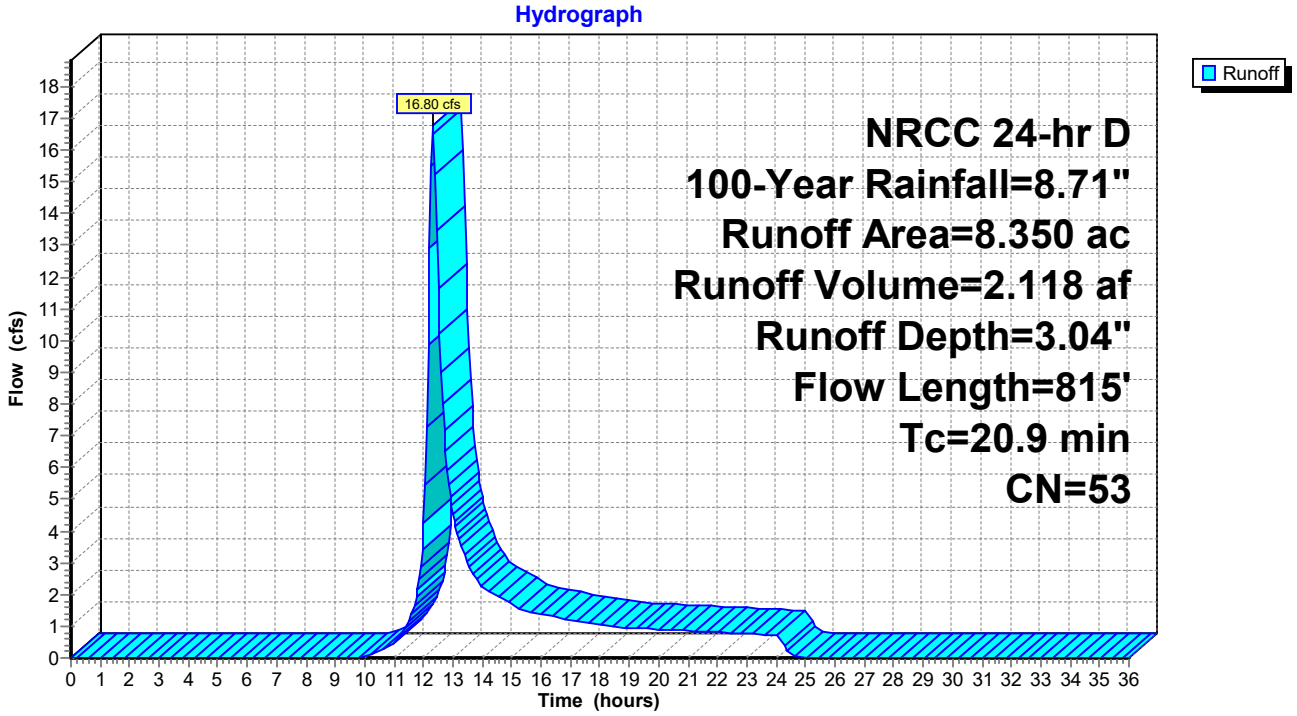
Runoff = 16.80 cfs @ 12.32 hrs, Volume= 2.118 af, Depth= 3.04"
Routed to Reach 10R : DP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.71"

Area (ac)	CN	Description
0.914	30	Woods, Good, HSG A
6.980	55	Woods, Good, HSG B
0.001	39	>75% Grass cover, Good, HSG A
0.375	61	>75% Grass cover, Good, HSG B
0.030	98	Roofs, HSG B
0.050	98	Paved parking, HSG B
8.350	53	Weighted Average
8.270		99.04% Pervious Area
0.080		0.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	50	0.0600	0.11		**Sheet Flow, SHT** Woods: Light underbrush n= 0.400 P2= 3.32"
0.7	65	0.0923	1.52		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
3.5	198	0.0354	0.94		**Shallow Concentrated Flow, SCF-2** Woodland Kv= 5.0 fps
6.0	297	0.0269	0.82		**Shallow Concentrated Flow, SCF-3** Woodland Kv= 5.0 fps
2.9	205	0.0561	1.18		**Shallow Concentrated Flow, SCF-4** Woodland Kv= 5.0 fps
20.9	815	Total			

Subcatchment 12S: EDA-1B



Summary for Subcatchment 20S: EDA-2

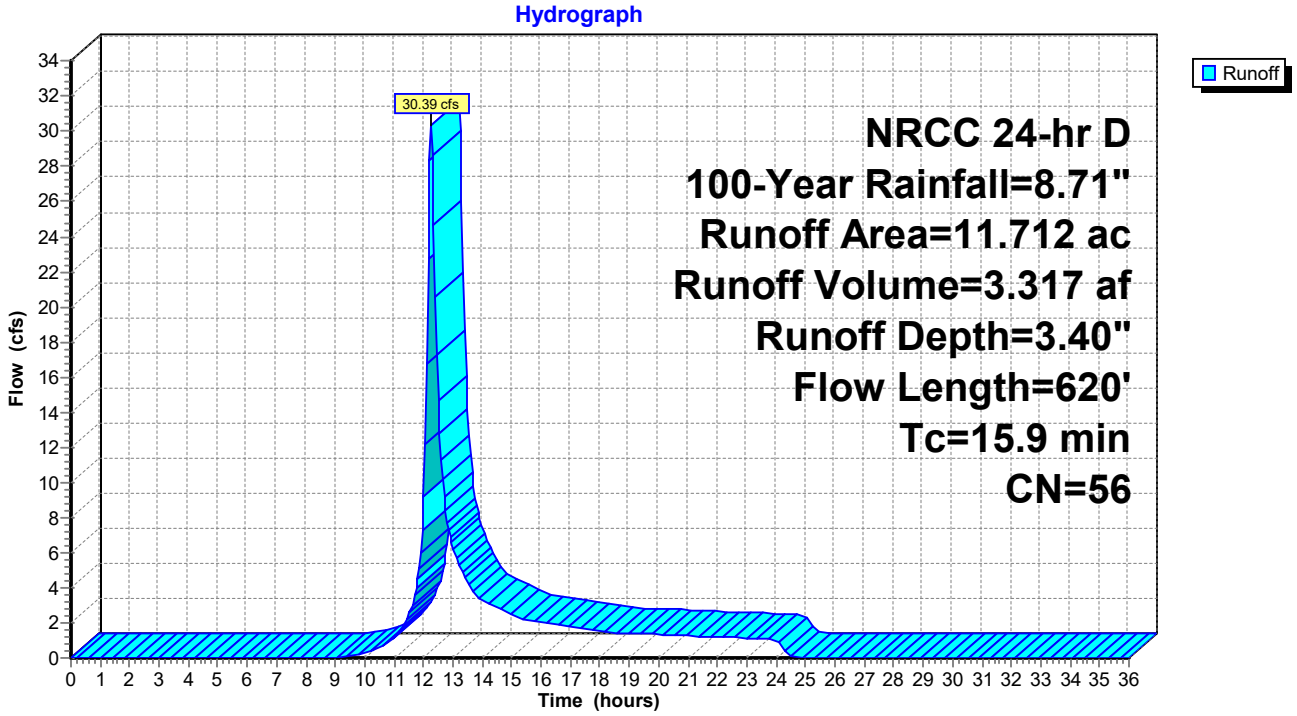
Runoff = 30.39 cfs @ 12.25 hrs, Volume= 3.317 af, Depth= 3.40"
Routed to Reach 20R : DP-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.71"

Area (ac)	CN	Description
0.709	39	>75% Grass cover, Good, HSG A
1.961	80	>75% Grass cover, Good, HSG D
3.723	30	Woods, Good, HSG A
2.132	55	Woods, Good, HSG B
3.187	77	Woods, Good, HSG D
11.712	56	Weighted Average
11.712		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	50	0.0600	0.11		**Sheet Flow, SHT** Woods: Light underbrush n= 0.400 P2= 3.32"
1.5	74	0.0270	0.82		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
0.9	101	0.1485	1.93		**Shallow Concentrated Flow, SCF-2** Woodland Kv= 5.0 fps
5.7	395	0.0532	1.15		**Shallow Concentrated Flow, SCF-3** Woodland Kv= 5.0 fps
15.9	620	Total			

Subcatchment 20S: EDA-2



Summary for Subcatchment 30S: EDA-3

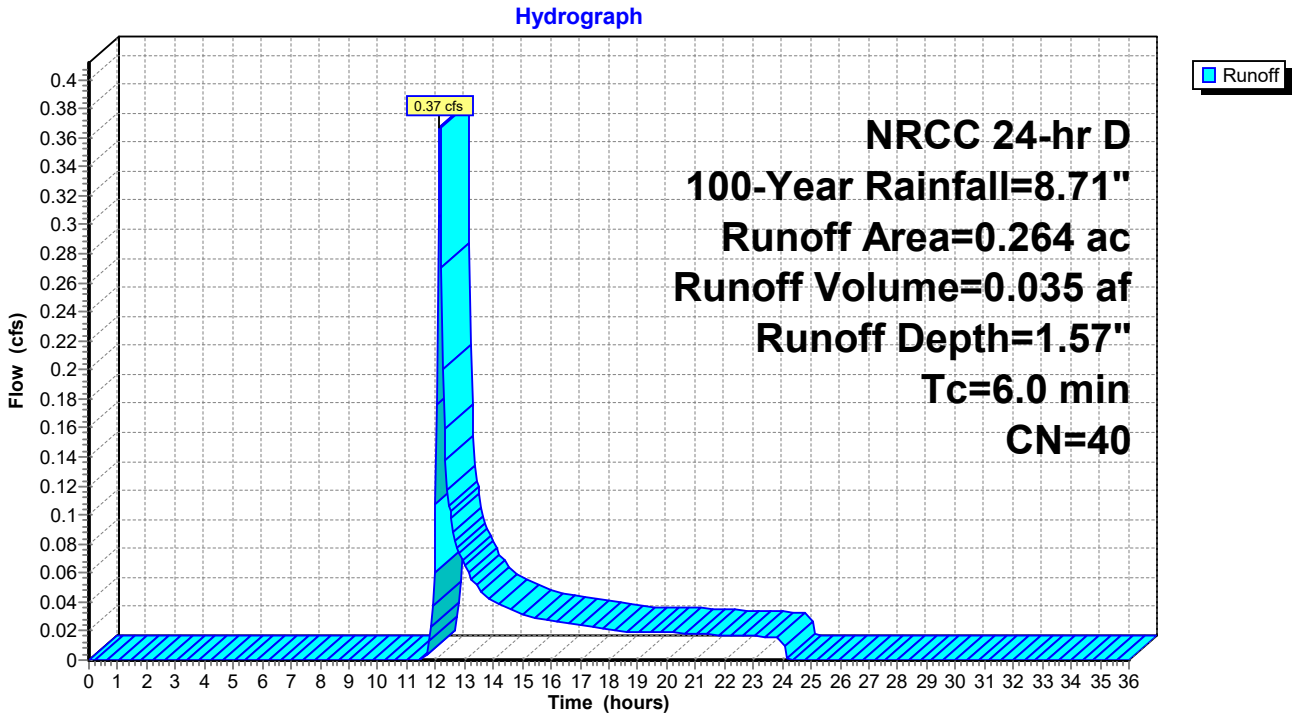
Runoff = 0.37 cfs @ 12.14 hrs, Volume= 0.035 af, Depth= 1.57"
Routed to Reach 30R : DP-3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.71"

Area (ac)	CN	Description
0.241	39	>75% Grass cover, Good, HSG A
0.003	80	>75% Grass cover, Good, HSG D
0.014	30	Woods, Good, HSG A
0.006	77	Woods, Good, HSG D
0.264	40	Weighted Average
0.264		100.00% Pervious Area

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

Subcatchment 30S: EDA-3

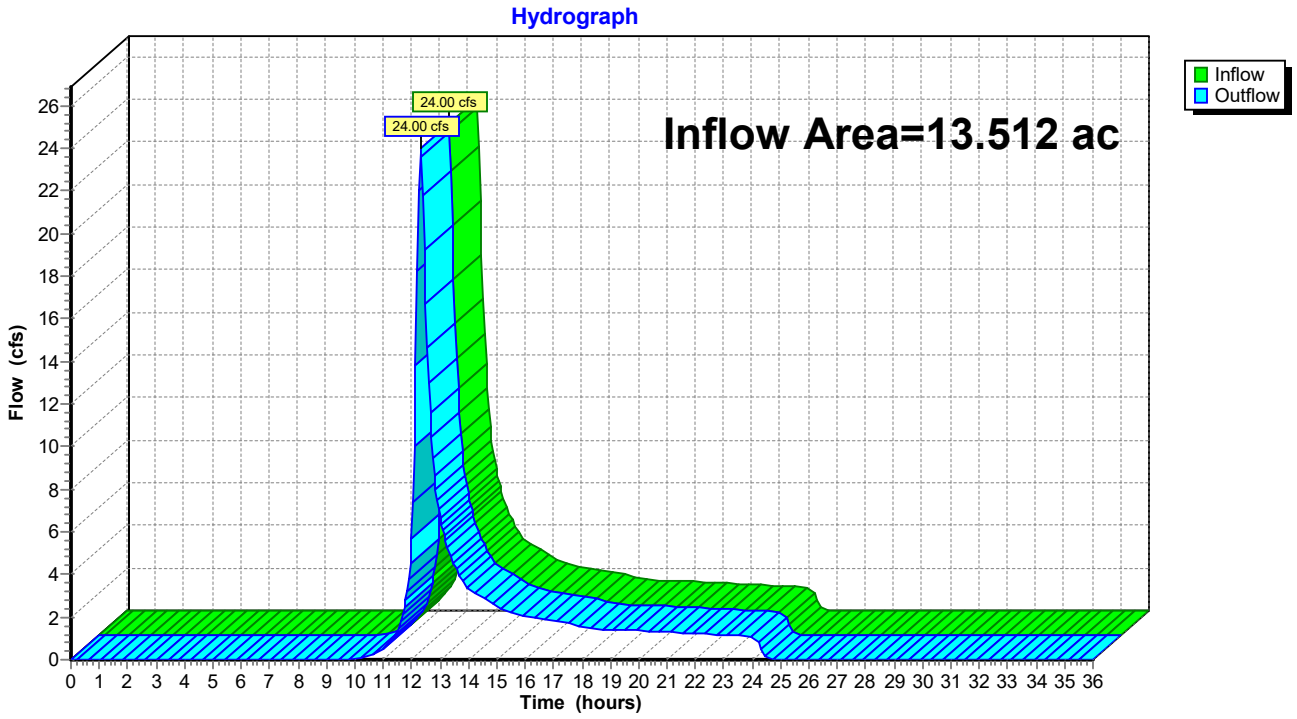


Summary for Reach 10R: DP-1

Inflow Area = 13.512 ac, 0.92% Impervious, Inflow Depth = 2.74" for 100-Year event
Inflow = 24.00 cfs @ 12.32 hrs, Volume= 3.080 af
Outflow = 24.00 cfs @ 12.32 hrs, Volume= 3.080 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Reach 10R: DP-1

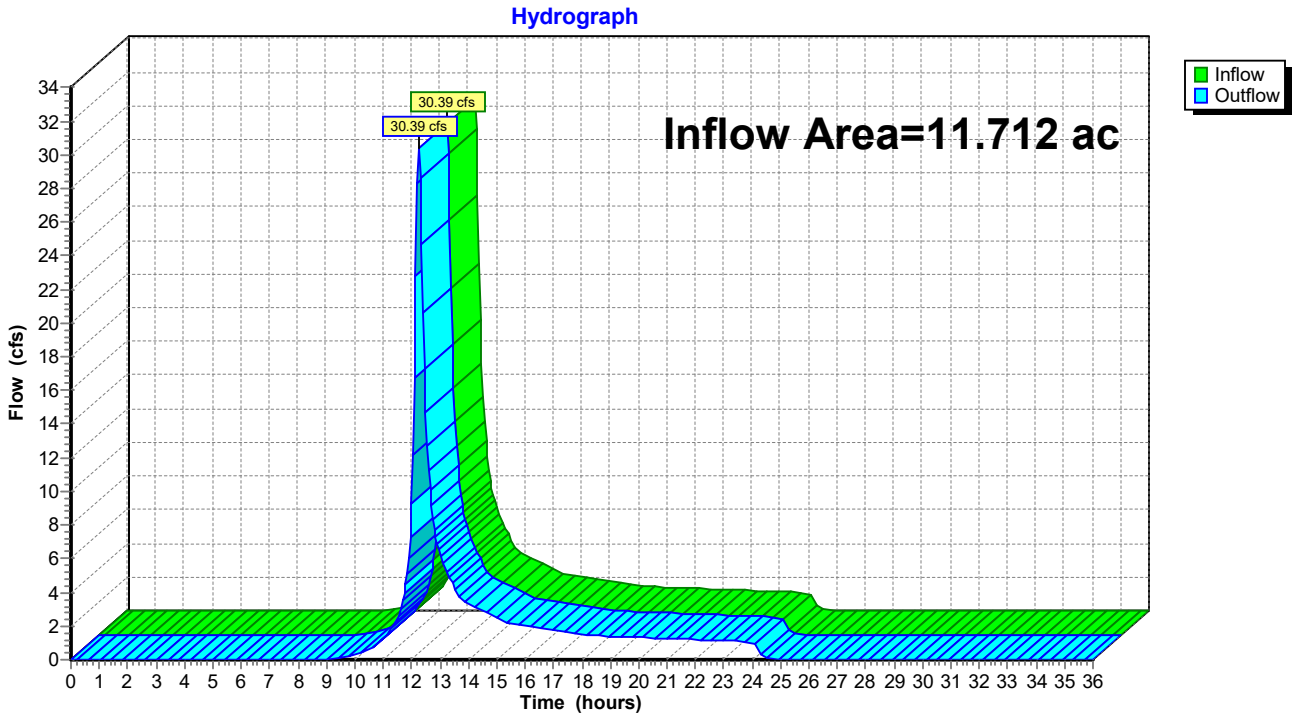


Summary for Reach 20R: DP-2

Inflow Area = 11.712 ac, 0.00% Impervious, Inflow Depth = 3.40" for 100-Year event
Inflow = 30.39 cfs @ 12.25 hrs, Volume= 3.317 af
Outflow = 30.39 cfs @ 12.25 hrs, Volume= 3.317 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Reach 20R: DP-2

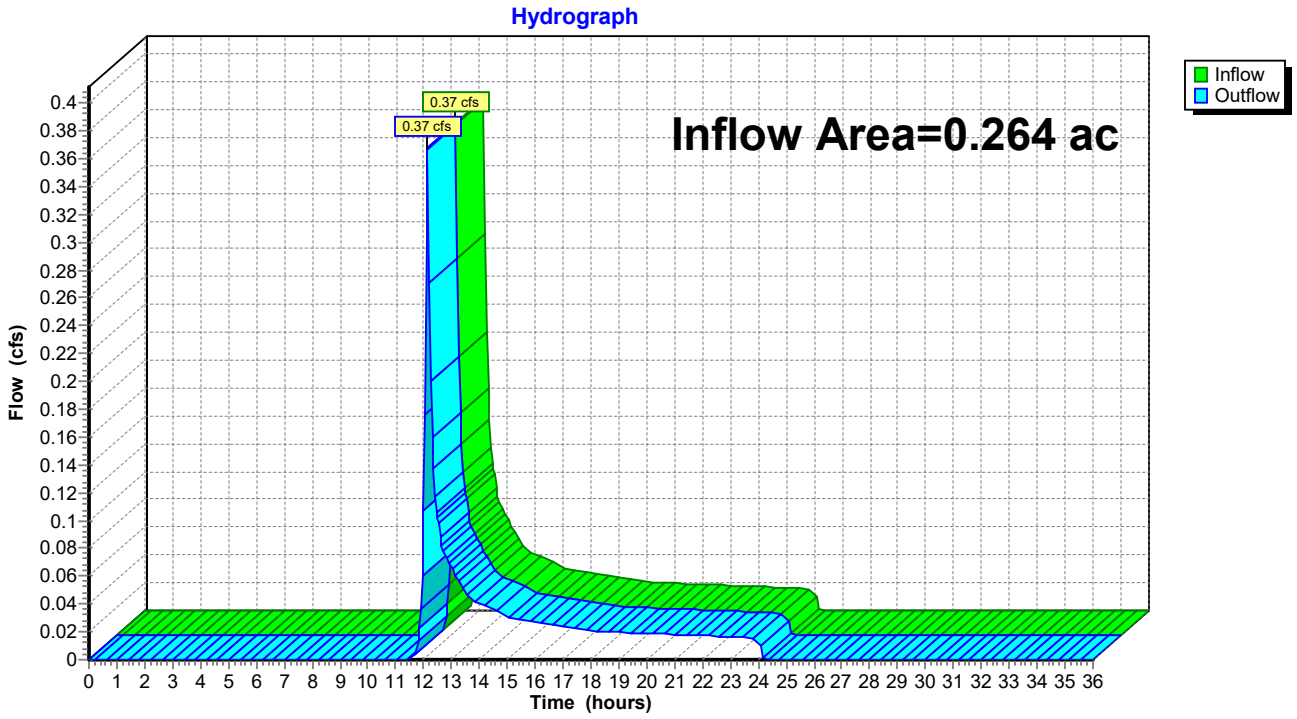


Summary for Reach 30R: DP-3

Inflow Area = 0.264 ac, 0.00% Impervious, Inflow Depth = 1.57" for 100-Year event
Inflow = 0.37 cfs @ 12.14 hrs, Volume= 0.035 af
Outflow = 0.37 cfs @ 12.14 hrs, Volume= 0.035 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Reach 30R: DP-3



Attachment 3
Post-Development Hydrologic Analysis

POST-DEVELOPMENT HYDROLOGIC CALCULATIONS

OBJECTIVE

To determine the post-development peak runoff rates for the site for the 2-, 10-, and 100-year storm events.

CONCLUSION(S)

Peak Runoff Rates

The following numbers represent the peak rates of runoff from the site under post-development conditions:

Storm Event	Design Point 1 (cfs)	Design Point 2 (cfs)	Design Point 3 (cfs)
2-year	0.55	0.43	0.00
10-year	3.10	1.89	0.00
100-year	22.66	10.07	0.01

CALCULATION METHODS

1. CN and Tc determined based on TR-55 methodology.
2. Runoff rates and volumes were computed using HydroCAD version 10.10-6a.
3. Area take-offs performed using Civil 3D.

ASSUMPTIONS

1. Hydrologic group of on-site soils was determined based on the United States Department of Agriculture, NRCS Soil Survey information.
2. Per TR-55, a minimum time of concentration of 6 minutes was used.
3. Surface cover types and watershed boundaries have been estimated based upon B+T Topographic Plan information.
4. The area of analysis is limited to the area affected by the proposed development.
5. The proposed replicated wetland was modeled as Woods, Good, HSG D.
6. Based on information from Table 2.3.3 in Volume 3, Chapter 1 of the Massachusetts Stormwater Handbook, the on-site soils are assumed to have an infiltration rate of 1.02 in/hr for “Sandy Loam” (HSG B).

SOURCES OF DATA/ EQUATIONS

1. Post-Development Conditions Watershed Map, dated 5/13/2022, prepared by Beals and Thomas, Inc. (307706P037B-002).
2. TR-55 Urban Hydrology for Small Watersheds, SCS, 1986.
3. Storm data for rainfall sourced from NOAA Atlas 14 for the site area. See the attached Point Precipitation Frequency Estimates table.
4. NRCS Soil Survey for Worcester County downloaded from Web Soil Survey 2.0 on 3/4/2021.

REV	CALC. BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
0	T. Michalak	5/13/2022				

307706CS002A

Corporate Office
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T 508.366.0560 | www.bealsandthomas.com | F 508.366.4391

Regional Office
32 Court Street
Plymouth, MA 02360

5. Beals and Thomas, Inc. Topographic Plans, B+T plan numbers 307704B005A and 307704B003H.
6. Massachusetts DEP Stormwater Handbook, February 2008.

LIST OF ATTACHMENTS

1. Post-Development Conditions Watershed Map, dated 5/13/2022, prepared by Beals and Thomas, Inc.
2. Post-Development Conditions Hydrology Report from HydroCAD file 307706HC002A, dated 5/13/2022.
3. NOAA Atlas 14 – Point Precipitation Frequency Estimates

REV	CALC. BY	DATE	CHECKED BY	DATE	APPROVED BY	DATE
0	T. Michalak	5/13/2022				

Civil Engineering ▪ Land Surveying ▪ Landscape Architecture ▪ Land Use Permitting ▪ Environmental Planning ▪ Wetland Science

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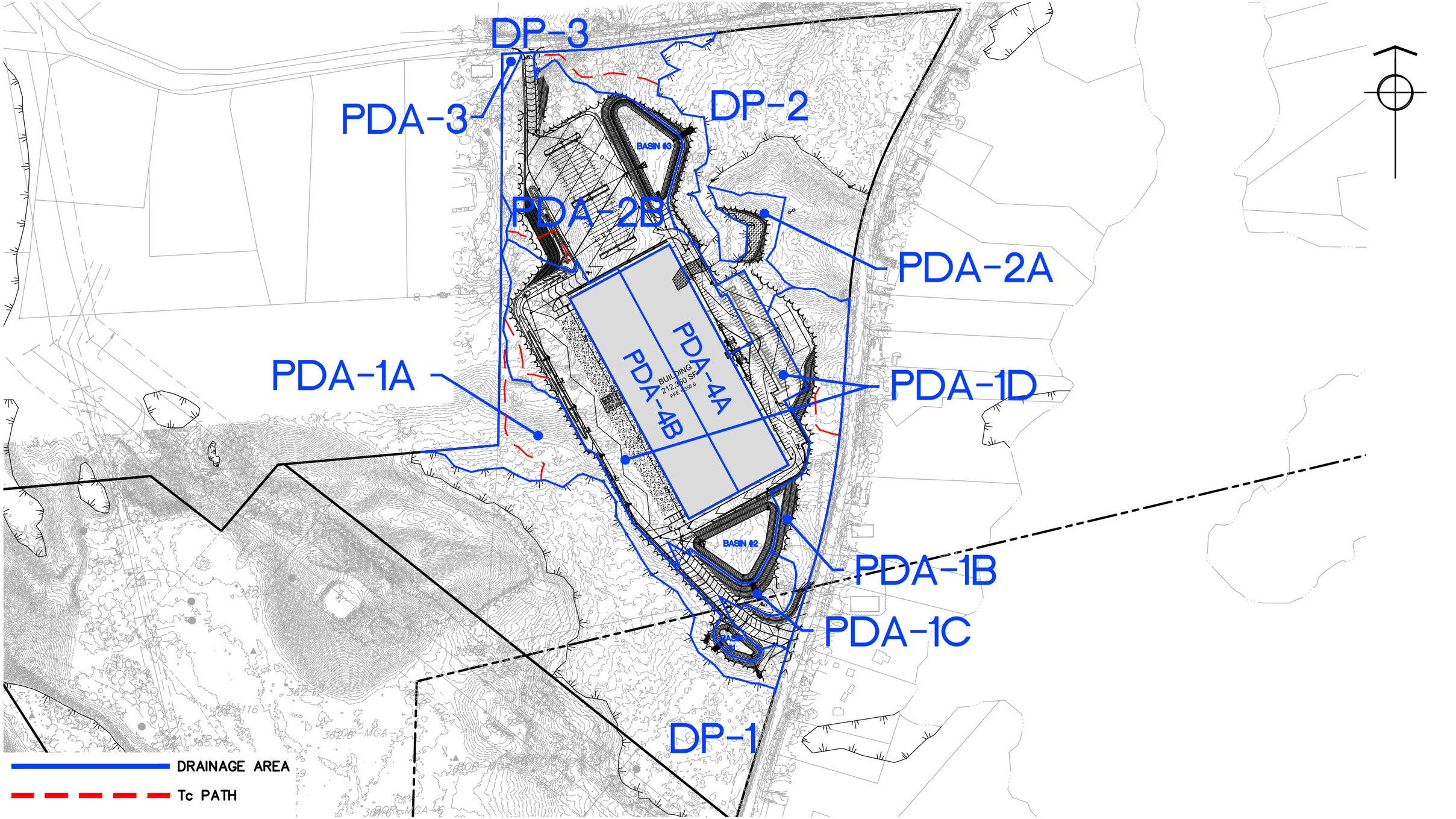


BEALS+THOMAS

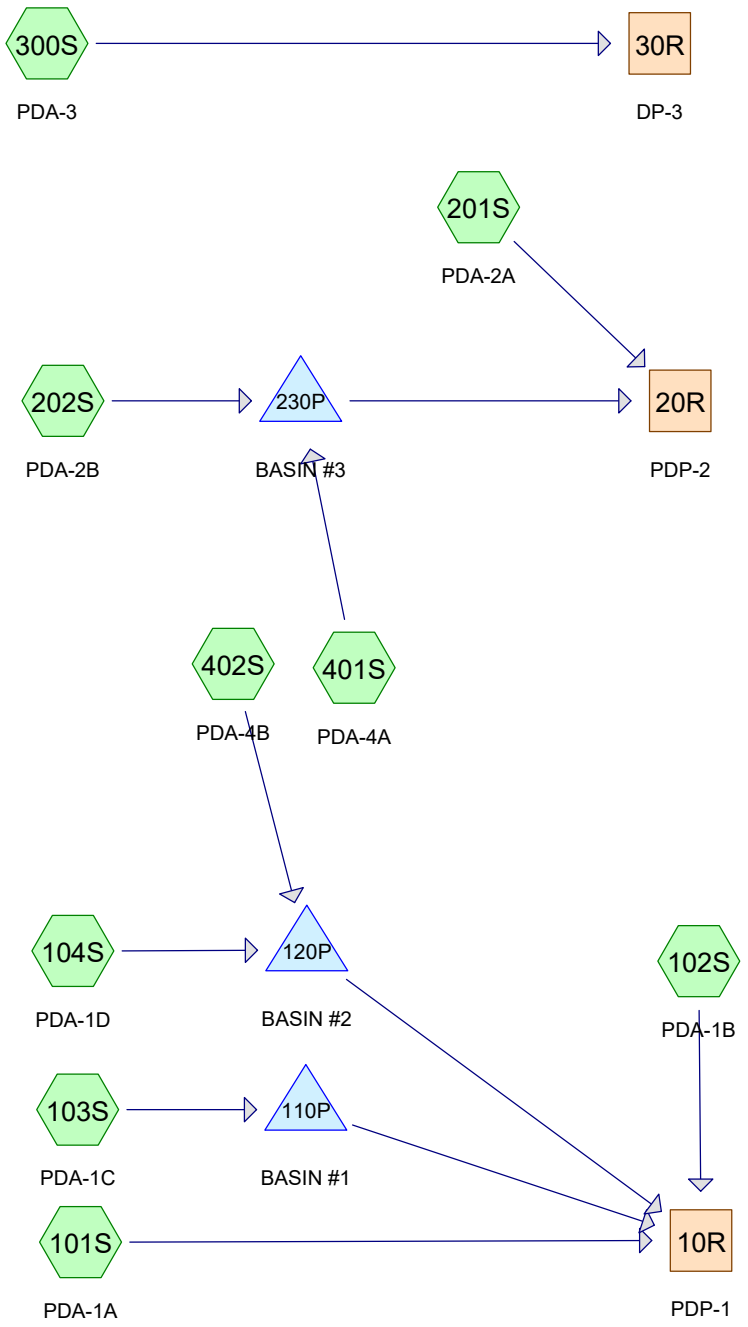
B+T Drawing No. 307706P037B-002 Date: 05/13/2022 Scale: 1" = 250'

METERS
0 50 125 200
0 125 250 500 750
FEET

IN PROGRESS
5/13/2022

Proposed Conditions
Watershed Map

Figure
2



PROPOSED CONDITIONS

Subcat Reach Pond Link

Routing Diagram for 307706HC002A
Prepared by Beals and Thomas, Inc., Printed 5/13/2022

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NRCC 24-hr	D	Default	24.00	1	3.23	2
2	10-Year	NRCC 24-hr	D	Default	24.00	1	4.85	2
3	100-Year	NRCC 24-hr	D	Default	24.00	1	8.71	2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.208	39	>75% Grass cover, Good, HSG A (101S, 104S, 201S, 202S, 300S)
4.660	61	>75% Grass cover, Good, HSG B (101S, 102S, 103S, 104S, 201S, 202S)
1.878	98	Paved parking, HSG A (104S, 202S)
5.387	98	Paved parking, HSG B (102S, 103S, 104S, 202S)
2.155	98	Roofs, HSG A (401S, 402S)
2.720	98	Roofs, HSG B (401S, 402S)
0.029	98	Unconnected pavement, HSG A (104S, 202S)
0.110	98	Unconnected pavement, HSG B (103S, 104S, 202S)
2.298	30	Woods, Good, HSG A (101S, 104S, 201S, 202S, 300S)
5.044	55	Woods, Good, HSG B (101S, 102S, 103S, 104S, 201S, 202S)
25.488	**74**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
7.567	HSG A	101S, 104S, 201S, 202S, 300S, 401S, 402S
17.921	HSG B	101S, 102S, 103S, 104S, 201S, 202S, 401S, 402S
0.000	HSG C	
0.000	HSG D	
0.000	Other	
25.488		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
1.208	4.660	0.000	0.000	0.000	5.869	>75% Grass cover, Good	101S, 102S, 103S, 104S, 201S, 202S, 300S
1.878	5.387	0.000	0.000	0.000	7.264	Paved parking	102S, 103S, 104S, 202S
2.155	2.720	0.000	0.000	0.000	4.875	Roofs	401S, 402S
0.029	0.110	0.000	0.000	0.000	0.139	Unconnected pavement	103S, 104S, 202S
2.298	5.044	0.000	0.000	0.000	7.342	Woods, Good	101S, 102S, 103S, 104S, 201S, 202S, 300S
7.567	**17.921**	**0.000**	**0.000**	**0.000**	**25.488**	**TOTAL AREA**	

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 101S: PDA-1A Runoff Area=2.614 ac 0.00% Impervious Runoff Depth=0.06"
Flow Length=415' Tc=14.1 min CN=46 Runoff=0.02 cfs 0.013 af

Subcatchment 102S: PDA-1B Runoff Area=2.786 ac 7.68% Impervious Runoff Depth=0.42"
Flow Length=182' Tc=15.0 min CN=60 Runoff=0.55 cfs 0.098 af

Subcatchment 103S: PDA-1C Runoff Area=0.979 ac 23.92% Impervious Runoff Depth=0.80"
Tc=6.0 min CN=69 Runoff=0.77 cfs 0.065 af

Subcatchment 104S: PDA-1D Runoff Area=5.928 ac 67.29% Impervious Runoff Depth=1.71"
Flow Length=235' Tc=19.4 min CN=84 Runoff=7.21 cfs 0.843 af

Subcatchment 201S: PDA-2A Runoff Area=2.572 ac 0.00% Impervious Runoff Depth=0.08"
Flow Length=344' Tc=11.1 min CN=47 Runoff=0.02 cfs 0.017 af

Subcatchment 202S: PDA-2B Runoff Area=5.663 ac 52.38% Impervious Runoff Depth=1.17"
Flow Length=239' Tc=10.3 min CN=76 Runoff=5.98 cfs 0.554 af

Subcatchment 300S: PDA-3 Runoff Area=0.071 ac 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=31 Runoff=0.00 cfs 0.000 af

Subcatchment 401S: PDA-4A Runoff Area=2.437 ac 100.00% Impervious Runoff Depth=3.00"
Tc=6.0 min CN=98 Runoff=6.84 cfs 0.609 af

Subcatchment 402S: PDA-4B Runoff Area=2.437 ac 100.00% Impervious Runoff Depth=3.00"
Tc=6.0 min CN=98 Runoff=6.84 cfs 0.609 af

Reach 10R: PDP-1 Inflow=0.55 cfs 0.774 af
Outflow=0.55 cfs 0.774 af

Reach 20R: PDP-2 Inflow=0.43 cfs 0.708 af
Outflow=0.43 cfs 0.708 af

Reach 30R: DP-3 Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Pond 110P: BASIN #1 Peak Elev=325.97' Storage=2,830 cf Inflow=0.77 cfs 0.065 af
Outflow=0.00 cfs 0.000 af

Pond 120P: BASIN #2 Peak Elev=342.47' Storage=47,699 cf Inflow=11.48 cfs 1.452 af
Outflow=0.40 cfs 0.663 af

Pond 230P: BASIN #3 Peak Elev=348.39' Storage=34,787 cf Inflow=12.27 cfs 1.162 af
Outflow=0.41 cfs 0.692 af

Total Runoff Area = 25.488 ac Runoff Volume = 2.807 af Average Runoff Depth = 1.32"
51.83% Pervious = 13.210 ac 48.17% Impervious = 12.278 ac

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 101S: PDA-1A Runoff Area=2.614 ac 0.00% Impervious Runoff Depth=0.44"
Flow Length=415' Tc=14.1 min CN=46 Runoff=0.34 cfs 0.096 af

Subcatchment 102S: PDA-1B Runoff Area=2.786 ac 7.68% Impervious Runoff Depth=1.21"
Flow Length=182' Tc=15.0 min CN=60 Runoff=2.43 cfs 0.282 af

Subcatchment 103S: PDA-1C Runoff Area=0.979 ac 23.92% Impervious Runoff Depth=1.85"
Tc=6.0 min CN=69 Runoff=1.93 cfs 0.151 af

Subcatchment 104S: PDA-1D Runoff Area=5.928 ac 67.29% Impervious Runoff Depth=3.13"
Flow Length=235' Tc=19.4 min CN=84 Runoff=13.14 cfs 1.548 af

Subcatchment 201S: PDA-2A Runoff Area=2.572 ac 0.00% Impervious Runoff Depth=0.49"
Flow Length=344' Tc=11.1 min CN=47 Runoff=0.48 cfs 0.104 af

Subcatchment 202S: PDA-2B Runoff Area=5.663 ac 52.38% Impervious Runoff Depth=2.41"
Flow Length=239' Tc=10.3 min CN=76 Runoff=12.58 cfs 1.139 af

Subcatchment 300S: PDA-3 Runoff Area=0.071 ac 0.00% Impervious Runoff Depth=0.01"
Tc=6.0 min CN=31 Runoff=0.00 cfs 0.000 af

Subcatchment 401S: PDA-4A Runoff Area=2.437 ac 100.00% Impervious Runoff Depth=4.61"
Tc=6.0 min CN=98 Runoff=10.34 cfs 0.937 af

Subcatchment 402S: PDA-4B Runoff Area=2.437 ac 100.00% Impervious Runoff Depth=4.61"
Tc=6.0 min CN=98 Runoff=10.34 cfs 0.937 af

Reach 10R: PDP-1 Inflow=3.10 cfs 2.044 af
Outflow=3.10 cfs 2.044 af

Reach 20R: PDP-2 Inflow=1.89 cfs 1.568 af
Outflow=1.89 cfs 1.568 af

Reach 30R: DP-3 Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Pond 110P: BASIN #1 Peak Elev=326.28' Storage=3,897 cf Inflow=1.93 cfs 0.151 af
Outflow=0.09 cfs 0.081 af

Pond 120P: BASIN #2 Peak Elev=343.32' Storage=66,513 cf Inflow=19.18 cfs 2.485 af
Outflow=2.00 cfs 1.586 af

Pond 230P: BASIN #3 Peak Elev=349.27' Storage=53,088 cf Inflow=22.06 cfs 2.076 af
Outflow=1.75 cfs 1.464 af

Total Runoff Area = 25.488 ac Runoff Volume = 5.193 af Average Runoff Depth = 2.45"
51.83% Pervious = 13.210 ac 48.17% Impervious = 12.278 ac

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 101S: PDA-1A Runoff Area=2.614 ac 0.00% Impervious Runoff Depth=2.24"
Flow Length=415' Tc=14.1 min CN=46 Runoff=4.32 cfs 0.487 af

Subcatchment 102S: PDA-1B Runoff Area=2.786 ac 7.68% Impervious Runoff Depth=3.87"
Flow Length=182' Tc=15.0 min CN=60 Runoff=8.61 cfs 0.900 af

Subcatchment 103S: PDA-1C Runoff Area=0.979 ac 23.92% Impervious Runoff Depth=4.96"
Tc=6.0 min CN=69 Runoff=5.21 cfs 0.405 af

Subcatchment 104S: PDA-1D Runoff Area=5.928 ac 67.29% Impervious Runoff Depth=6.78"
Flow Length=235' Tc=19.4 min CN=84 Runoff=27.56 cfs 3.349 af

Subcatchment 201S: PDA-2A Runoff Area=2.572 ac 0.00% Impervious Runoff Depth=2.35"
Flow Length=344' Tc=11.1 min CN=47 Runoff=5.02 cfs 0.504 af

Subcatchment 202S: PDA-2B Runoff Area=5.663 ac 52.38% Impervious Runoff Depth=5.81"
Flow Length=239' Tc=10.3 min CN=76 Runoff=29.82 cfs 2.741 af

Subcatchment 300S: PDA-3 Runoff Area=0.071 ac 0.00% Impervious Runoff Depth=0.68"
Tc=6.0 min CN=31 Runoff=0.01 cfs 0.004 af

Subcatchment 401S: PDA-4A Runoff Area=2.437 ac 100.00% Impervious Runoff Depth=8.47"
Tc=6.0 min CN=98 Runoff=18.64 cfs 1.720 af

Subcatchment 402S: PDA-4B Runoff Area=2.437 ac 100.00% Impervious Runoff Depth=8.47"
Tc=6.0 min CN=98 Runoff=18.64 cfs 1.720 af

Reach 10R: PDP-1 Inflow=22.66 cfs 5.854 af
Outflow=22.66 cfs 5.854 af

Reach 20R: PDP-2 Inflow=10.07 cfs 4.311 af
Outflow=10.07 cfs 4.311 af

Reach 30R: DP-3 Inflow=0.01 cfs 0.004 af
Outflow=0.01 cfs 0.004 af

Pond 110P: BASIN #1 Peak Elev=327.23' Storage=7,599 cf Inflow=5.21 cfs 0.405 af
Outflow=0.90 cfs 0.334 af

Pond 120P: BASIN #2 Peak Elev=344.96' Storage=105,595 cf Inflow=37.87 cfs 5.069 af
Outflow=14.12 cfs 4.133 af

Pond 230P: BASIN #3 Peak Elev=351.25' Storage=100,028 cf Inflow=46.95 cfs 4.461 af
Outflow=6.24 cfs 3.807 af

Total Runoff Area = 25.488 ac Runoff Volume = 11.830 af Average Runoff Depth = 5.57"
51.83% Pervious = 13.210 ac 48.17% Impervious = 12.278 ac

Summary for Subcatchment 101S: PDA-1A

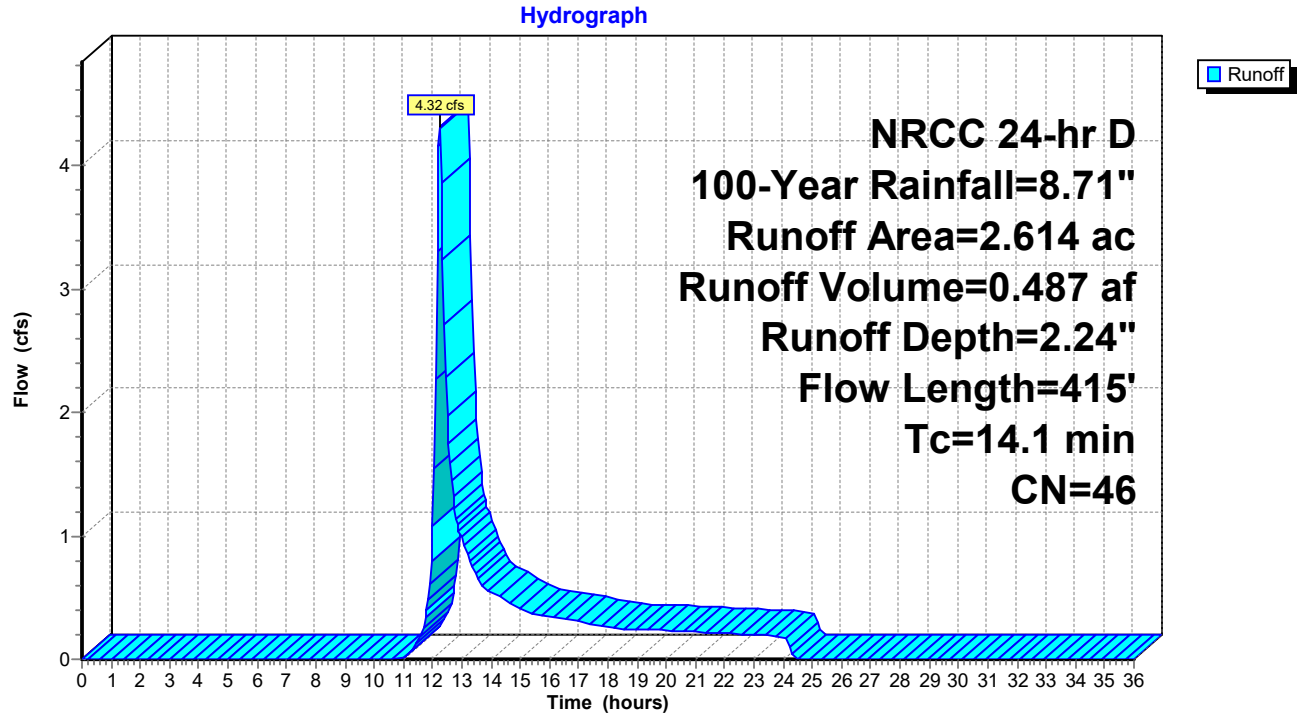
Runoff = 4.32 cfs @ 12.24 hrs, Volume= 0.487 af, Depth= 2.24"
Routed to Reach 10R : PDP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.71"

Area (ac)	CN	Description
0.334	61	>75% Grass cover, Good, HSG B
1.212	55	Woods, Good, HSG B
1.016	30	Woods, Good, HSG A
0.051	39	>75% Grass cover, Good, HSG A
2.614	46	Weighted Average
2.614		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0400	0.09		**Sheet Flow, SHT** Woods: Light underbrush n= 0.400 P2= 3.32"
2.1	214	0.1168	1.71		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
2.8	151	0.0331	0.91		**Shallow Concentrated Flow, SCF-2** Woodland Kv= 5.0 fps
14.1	415	Total			

Subcatchment 101S: PDA-1A



Summary for Subcatchment 102S: PDA-1B

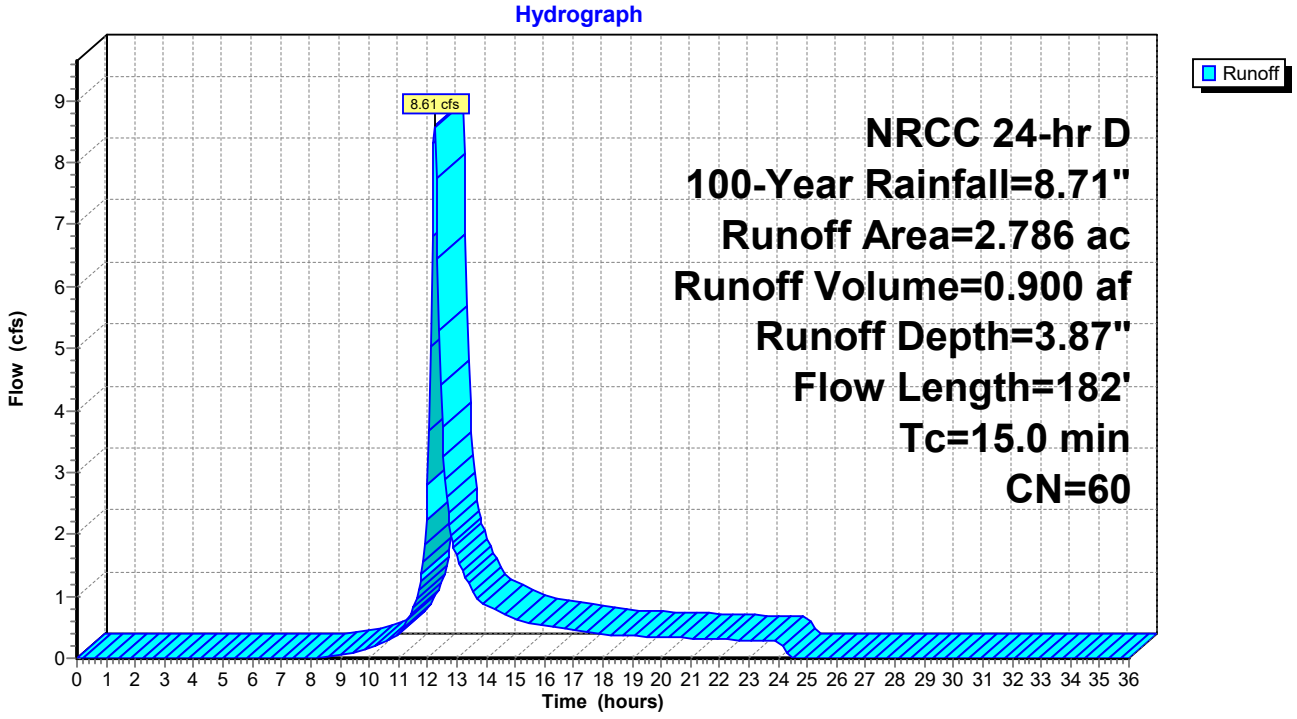
Runoff = 8.61 cfs @ 12.24 hrs, Volume= 0.900 af, Depth= 3.87"
Routed to Reach 10R : PDP-1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.71"

Area (ac)	CN	Description
0.214	98	Paved parking, HSG B
1.000	61	>75% Grass cover, Good, HSG B
1.572	55	Woods, Good, HSG B
2.786	60	Weighted Average
2.572		92.32% Pervious Area
0.214		7.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.1	50	0.0200	0.07		**Sheet Flow, SHT** Woods: Light underbrush n= 0.400 P2= 3.32"
2.9	132	0.0227	0.75		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
15.0	182	Total			

Subcatchment 102S: PDA-1B



Summary for Subcatchment 103S: PDA-1C

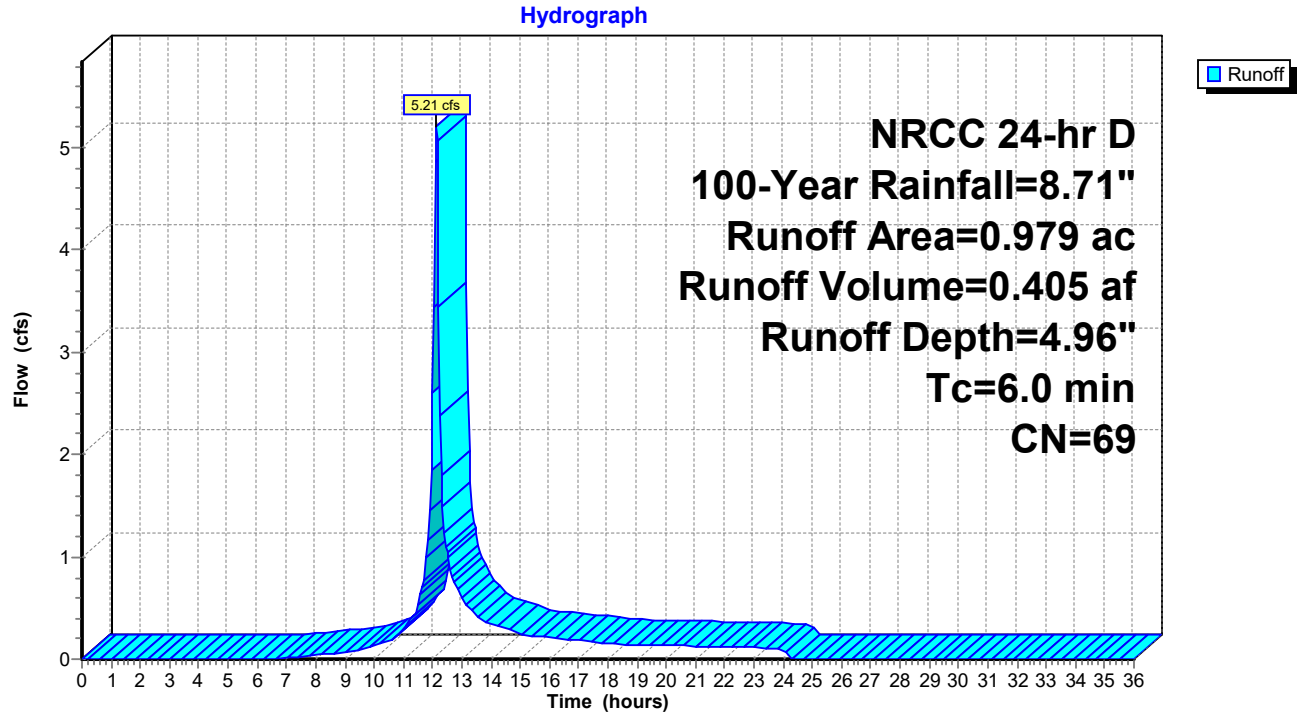
Runoff = 5.21 cfs @ 12.13 hrs, Volume= 0.405 af, Depth= 4.96"
Routed to Pond 110P : BASIN #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.71"

Area (ac)	CN	Description
0.671	61	>75% Grass cover, Good, HSG B
0.220	98	Paved parking, HSG B
0.073	55	Woods, Good, HSG B
0.014	98	Unconnected pavement, HSG B
0.979	69	Weighted Average
0.745		76.08% Pervious Area
0.234		23.92% Impervious Area
0.014		6.10% Unconnected

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

Subcatchment 103S: PDA-1C



Summary for Subcatchment 104S: PDA-1D

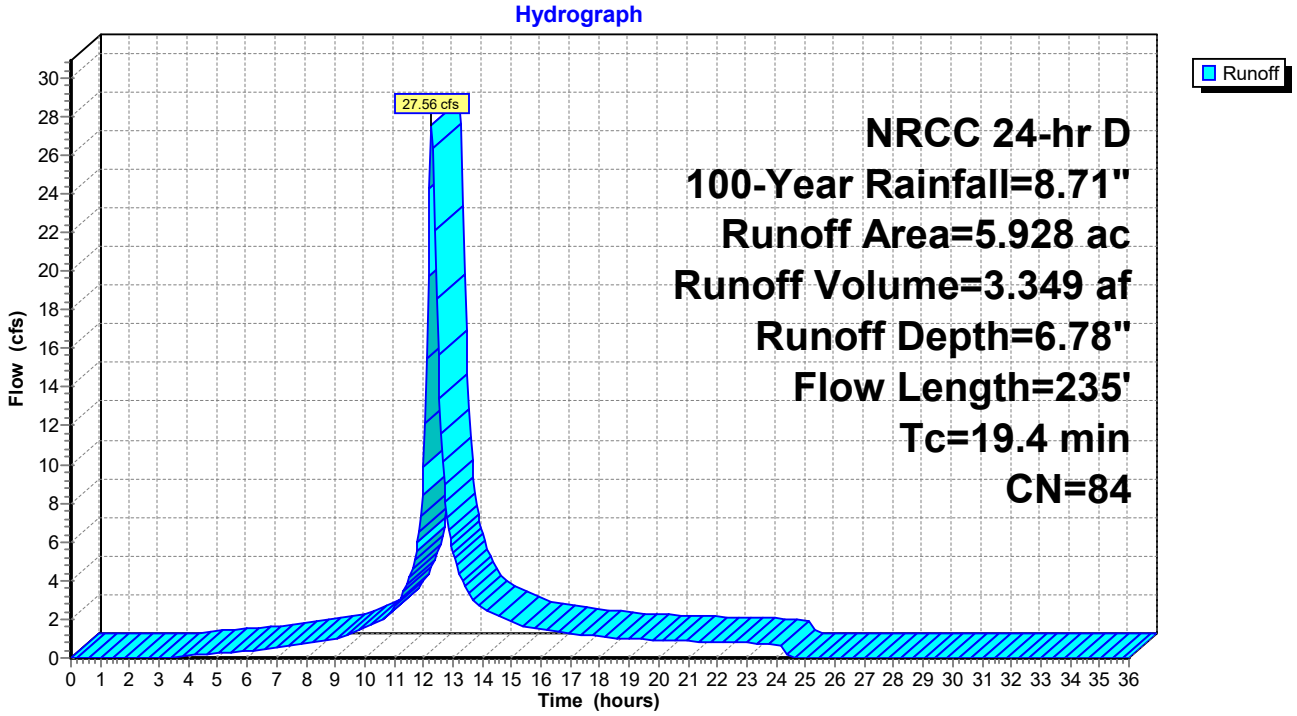
Runoff = 27.56 cfs @ 12.28 hrs, Volume= 3.349 af, Depth= 6.78"
Routed to Pond 120P : BASIN #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.71"

Area (ac)	CN	Description
1.275	61	>75% Grass cover, Good, HSG B
0.064	98	Unconnected pavement, HSG B
2.825	98	Paved parking, HSG B
0.023	98	Unconnected pavement, HSG A
0.192	30	Woods, Good, HSG A
0.213	39	>75% Grass cover, Good, HSG A
1.077	98	Paved parking, HSG A
0.259	55	Woods, Good, HSG B
5.928	84	Weighted Average
1.939		32.71% Pervious Area
3.989		67.29% Impervious Area
0.087		2.18% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	50	0.0100	0.05		**Sheet Flow, SHT** Woods: Light underbrush n= 0.400 P2= 3.32"
3.4	185	0.0324	0.90		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
19.4	235	Total			

Subcatchment 104S: PDA-1D



Summary for Subcatchment 201S: PDA-2A

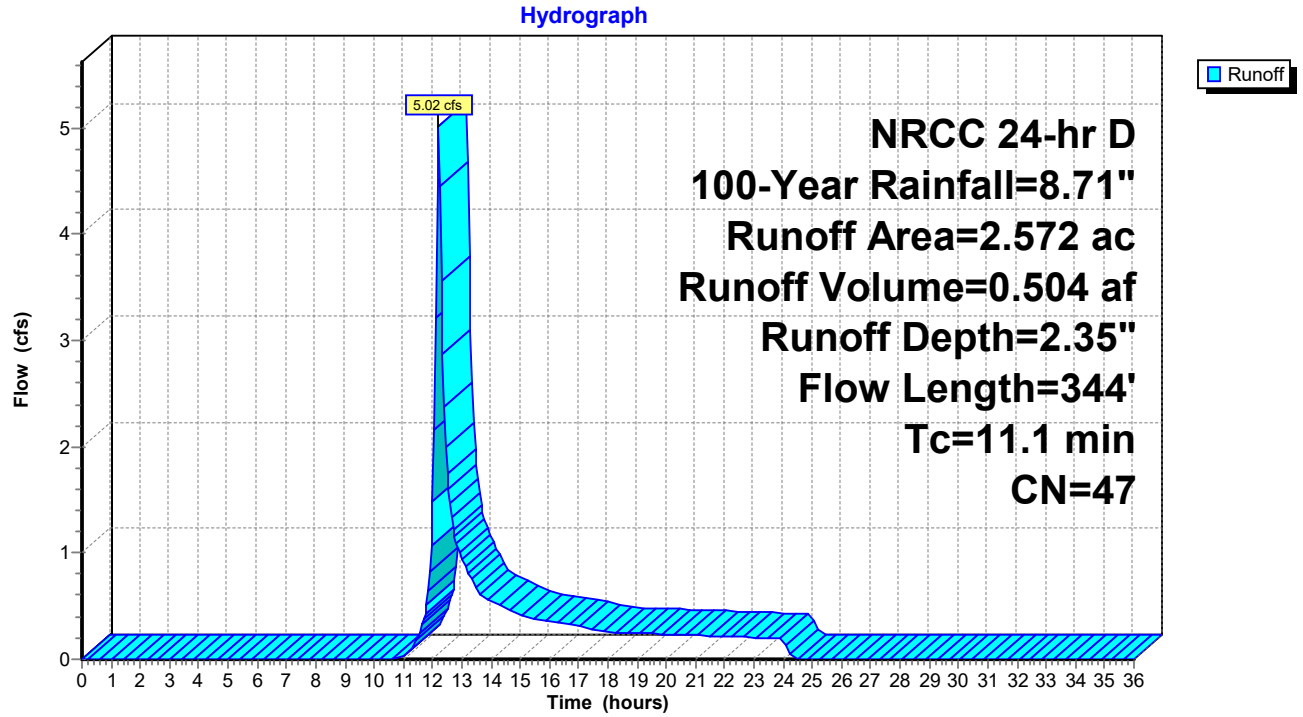
Runoff = 5.02 cfs @ 12.20 hrs, Volume= 0.504 af, Depth= 2.35"
Routed to Reach 20R : PDP-2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.71"

Area (ac)	CN	Description
0.360	61	>75% Grass cover, Good, HSG B
1.223	55	Woods, Good, HSG B
0.085	39	>75% Grass cover, Good, HSG A
0.904	30	Woods, Good, HSG A
2.572	47	Weighted Average
2.572		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0700	0.11		**Sheet Flow, SHT** Woods: Light underbrush n= 0.400 P2= 3.32"
0.3	43	0.3023	2.75		**Shallow Concentrated Flow, SCF-1** Woodland Kv= 5.0 fps
3.5	251	0.0558	1.18		**Shallow Concentrated Flow, SCF-2** Woodland Kv= 5.0 fps
11.1	344	Total			

Subcatchment 201S: PDA-2A



Summary for Subcatchment 202S: PDA-2B

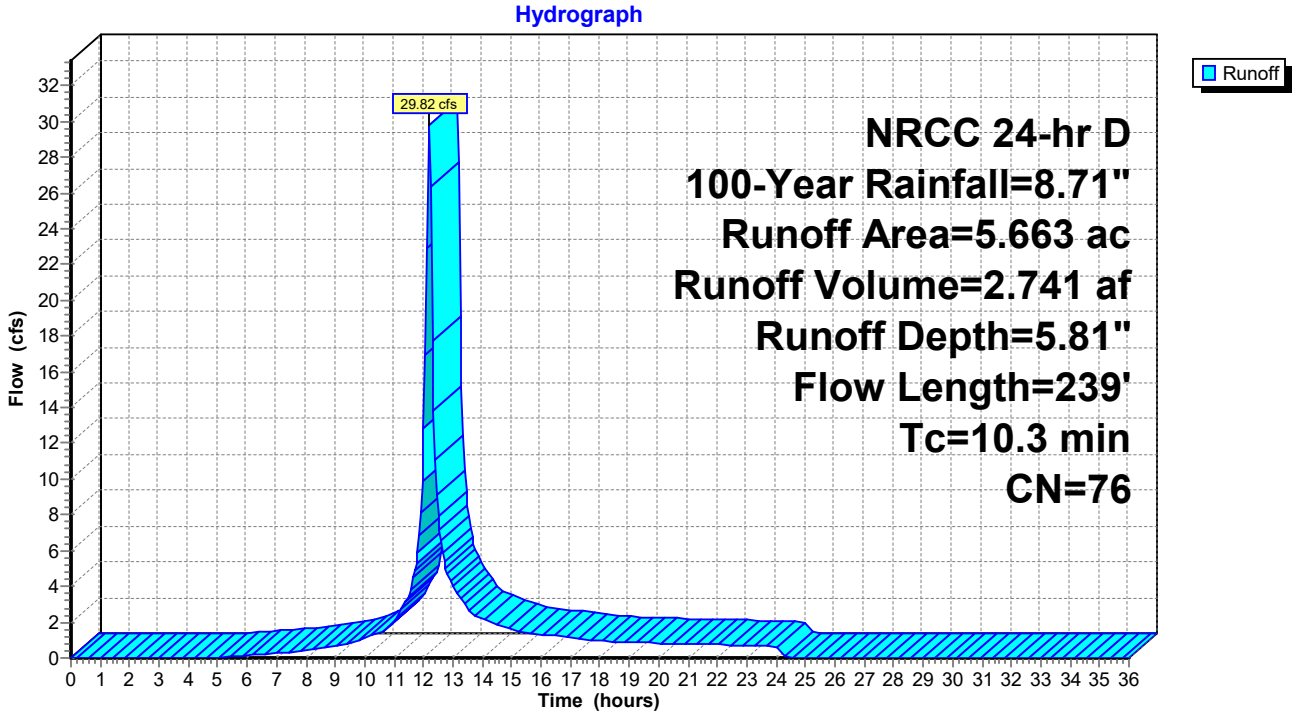
Runoff = 29.82 cfs @ 12.18 hrs, Volume= 2.741 af, Depth= 5.81"
Routed to Pond 230P : BASIN #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.71"

Area (ac)	CN	Description
0.031	98	Unconnected pavement, HSG B
1.019	61	>75% Grass cover, Good, HSG B
2.128	98	Paved parking, HSG B
0.854	39	>75% Grass cover, Good, HSG A
0.801	98	Paved parking, HSG A
0.703	55	Woods, Good, HSG B
0.120	30	Woods, Good, HSG A
0.006	98	Unconnected pavement, HSG A
5.663	76	Weighted Average
2.697		47.62% Pervious Area
2.966		52.38% Impervious Area
0.037		1.26% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	50	0.0600	0.11		**Sheet Flow, SHT** Woods: Light underbrush n= 0.400 P2= 3.32"
0.5	50	0.0600	1.71		**Shallow Concentrated Flow, SCF-1** Short Grass Pasture Kv= 7.0 fps
0.2	50	0.4000	4.43		**Shallow Concentrated Flow, SCF-2** Short Grass Pasture Kv= 7.0 fps
1.8	89	0.0281	0.84		**Shallow Concentrated Flow, SCF-3** Woodland Kv= 5.0 fps
10.3	239	Total			

Subcatchment 202S: PDA-2B



Summary for Subcatchment 300S: PDA-3

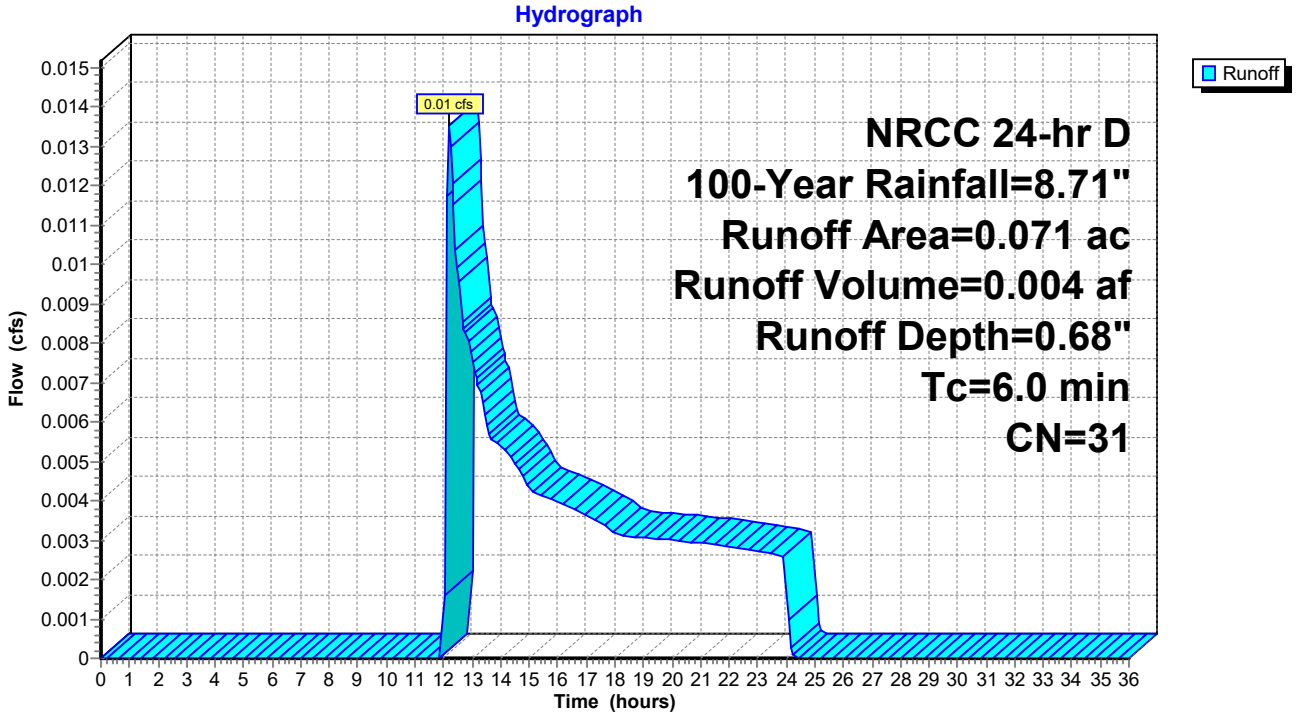
Runoff = 0.01 cfs @ 12.21 hrs, Volume= 0.004 af, Depth= 0.68"
Routed to Reach 30R : DP-3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.71"

Area (ac)	CN	Description
0.005	39	>75% Grass cover, Good, HSG A
0.066	30	Woods, Good, HSG A
0.071	31	Weighted Average
0.071		100.00% Pervious Area

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

Subcatchment 300S: PDA-3



Summary for Subcatchment 401S: PDA-4A

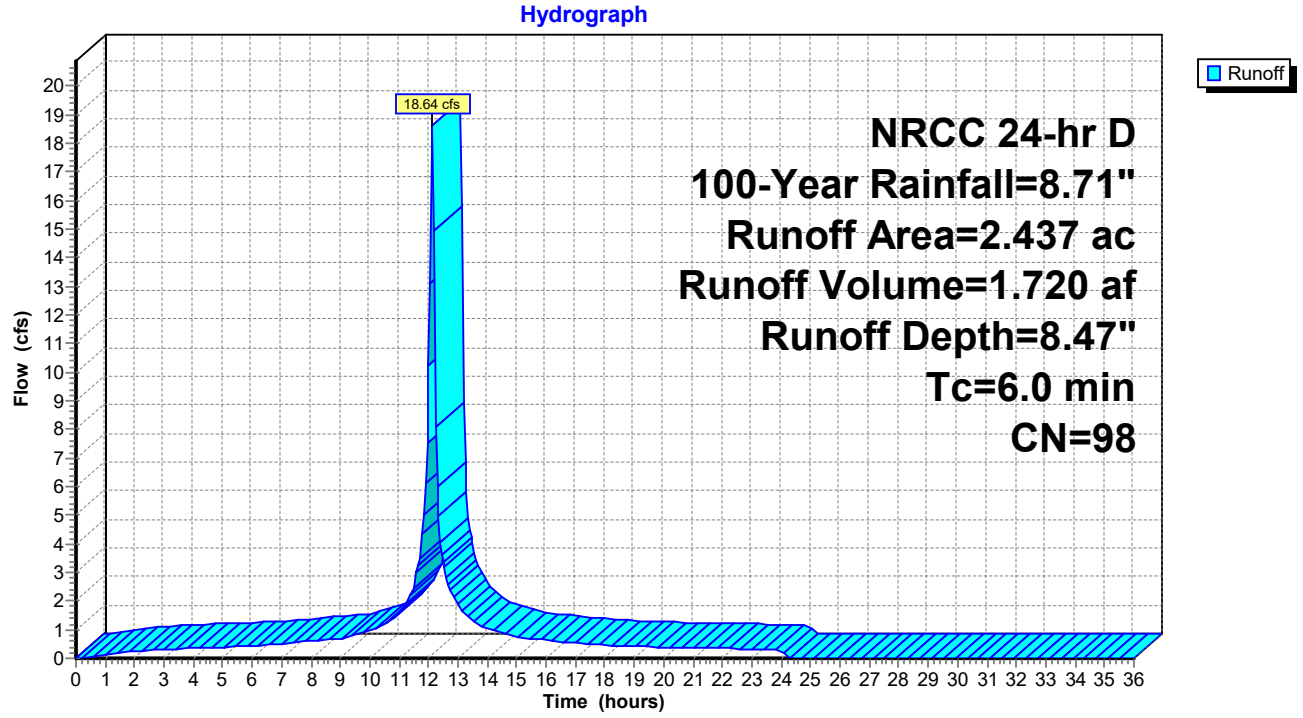
Runoff = 18.64 cfs @ 12.13 hrs, Volume= 1.720 af, Depth= 8.47"
Routed to Pond 230P : BASIN #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.71"

Area (ac)	CN	Description
1.646	98	Roofs, HSG B
0.791	98	Roofs, HSG A
2.437	98	Weighted Average
2.437		100.00% Impervious Area

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

Subcatchment 401S: PDA-4A



Summary for Subcatchment 402S: PDA-4B

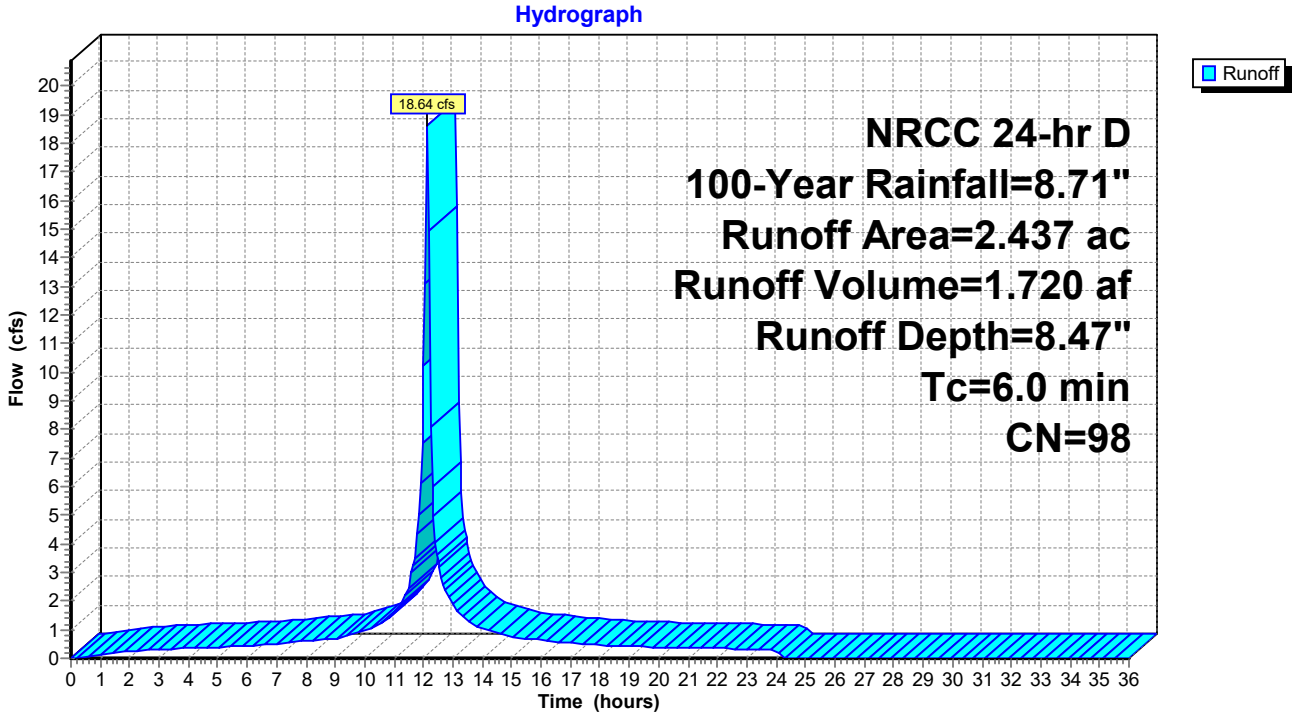
Runoff = 18.64 cfs @ 12.13 hrs, Volume= 1.720 af, Depth= 8.47"
Routed to Pond 120P : BASIN #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-Year Rainfall=8.71"

Area (ac)	CN	Description
1.074	98	Roofs, HSG B
1.363	98	Roofs, HSG A
2.437	98	Weighted Average
2.437		100.00% Impervious Area

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

Subcatchment 402S: PDA-4B

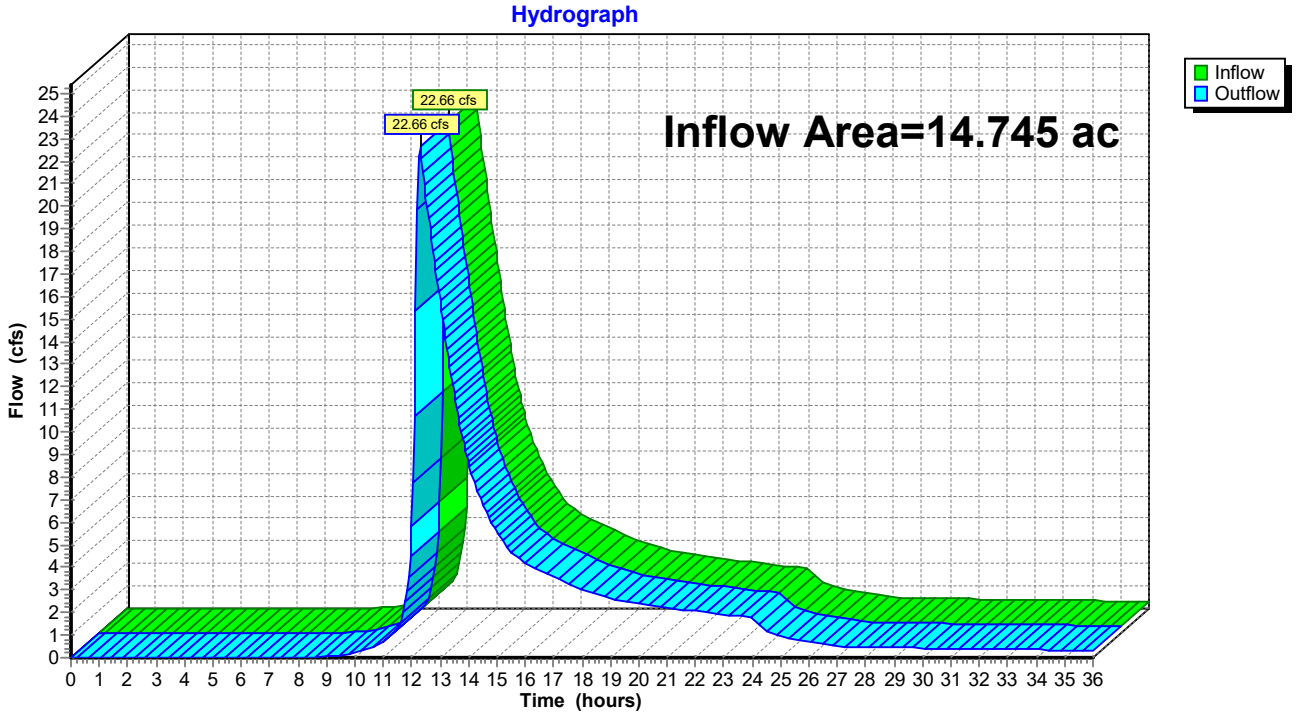


Summary for Reach 10R: PDP-1

Inflow Area = 14.745 ac, 46.62% Impervious, Inflow Depth > 4.76" for 100-Year event
Inflow = 22.66 cfs @ 12.30 hrs, Volume= 5.854 af
Outflow = 22.66 cfs @ 12.30 hrs, Volume= 5.854 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Reach 10R: PDP-1

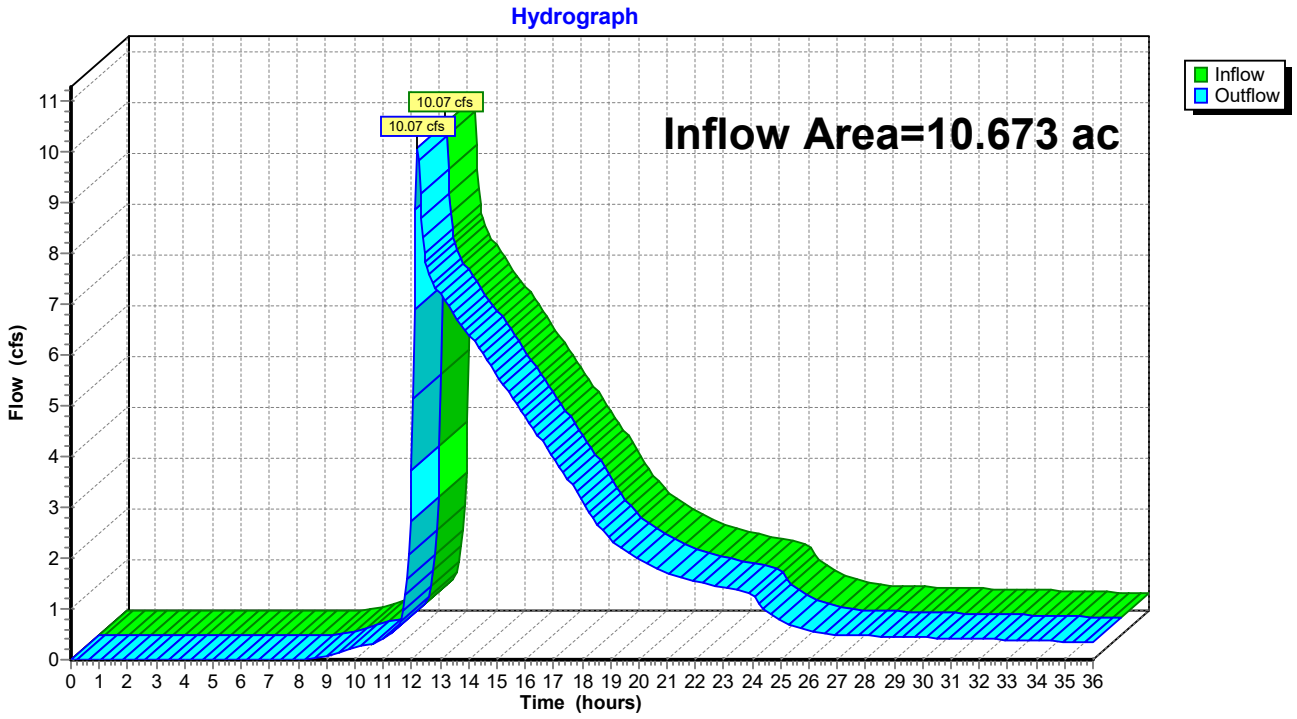


Summary for Reach 20R: PDP-2

Inflow Area = 10.673 ac, 50.63% Impervious, Inflow Depth > 4.85" for 100-Year event
Inflow = 10.07 cfs @ 12.22 hrs, Volume= 4.311 af
Outflow = 10.07 cfs @ 12.22 hrs, Volume= 4.311 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Reach 20R: PDP-2

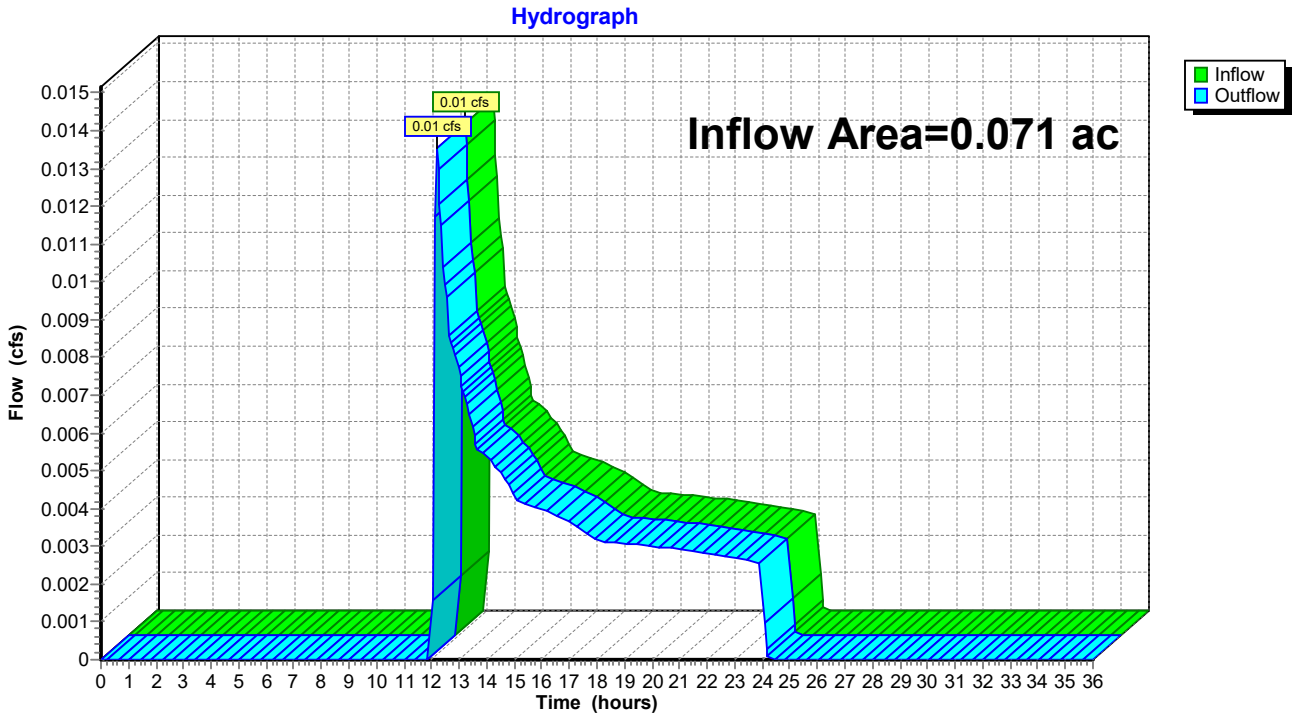


Summary for Reach 30R: DP-3

Inflow Area = 0.071 ac, 0.00% Impervious, Inflow Depth = 0.68" for 100-Year event
Inflow = 0.01 cfs @ 12.21 hrs, Volume= 0.004 af
Outflow = 0.01 cfs @ 12.21 hrs, Volume= 0.004 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Reach 30R: DP-3



Summary for Pond 110P: BASIN #1

Inflow Area = 0.979 ac, 23.92% Impervious, Inflow Depth = 4.96" for 100-Year event
Inflow = 5.21 cfs @ 12.13 hrs, Volume= 0.405 af
Outflow = 0.90 cfs @ 12.59 hrs, Volume= 0.334 af, Atten= 83%, Lag= 27.5 min
Primary = 0.90 cfs @ 12.59 hrs, Volume= 0.334 af
Routed to Reach 10R : PDP-1

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 327.23' @ 12.59 hrs Surf.Area= 4,276 sf Storage= 7,599 cf

Plug-Flow detention time= 252.0 min calculated for 0.334 af (82% of inflow)
Center-of-Mass det. time= 171.2 min (1,016.6 - 845.3)

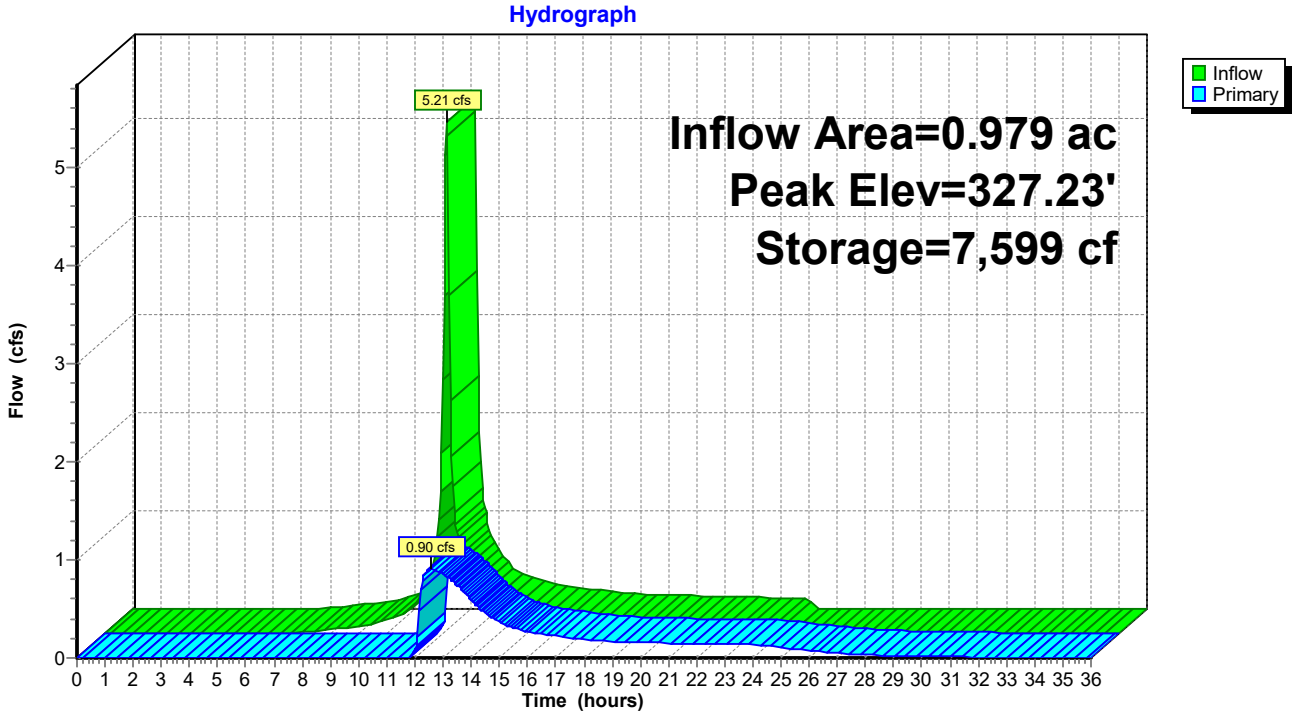
Volume	Invert	Avail.Storage	Storage Description
#1	325.00'	16,506 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
325.00	2,583	0	0
326.00	3,308	2,946	2,946
327.00	4,086	3,697	6,643
328.00	4,918	4,502	11,145
329.00	5,805	5,362	16,506

Device	Routing	Invert	Outlet Devices
#1	Primary	323.00'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 323.00' / 322.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Device 1	326.00'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	326.50'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.90 cfs @ 12.59 hrs HW=327.23' (Free Discharge)
└**1=Culvert** (Passes 0.90 cfs of 7.30 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.25 cfs @ 5.06 fps)
  └**3=Orifice/Grate** (Orifice Controls 0.65 cfs @ 3.33 fps)

Pond 110P: BASIN #1



Summary for Pond 120P: BASIN #2

Inflow Area = 8.365 ac, 76.82% Impervious, Inflow Depth = 7.27" for 100-Year event
Inflow = 37.87 cfs @ 12.16 hrs, Volume= 5.069 af
Outflow = 14.12 cfs @ 12.61 hrs, Volume= 4.133 af, Atten= 63%, Lag= 26.9 min
Primary = 14.12 cfs @ 12.61 hrs, Volume= 4.133 af
Routed to Reach 10R : PDP-1

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 344.96' @ 12.61 hrs Surf.Area= 25,931 sf Storage= 105,595 cf

Plug-Flow detention time= 317.5 min calculated for 4.133 af (82% of inflow)
Center-of-Mass det. time= 229.6 min (1,019.7 - 790.1)

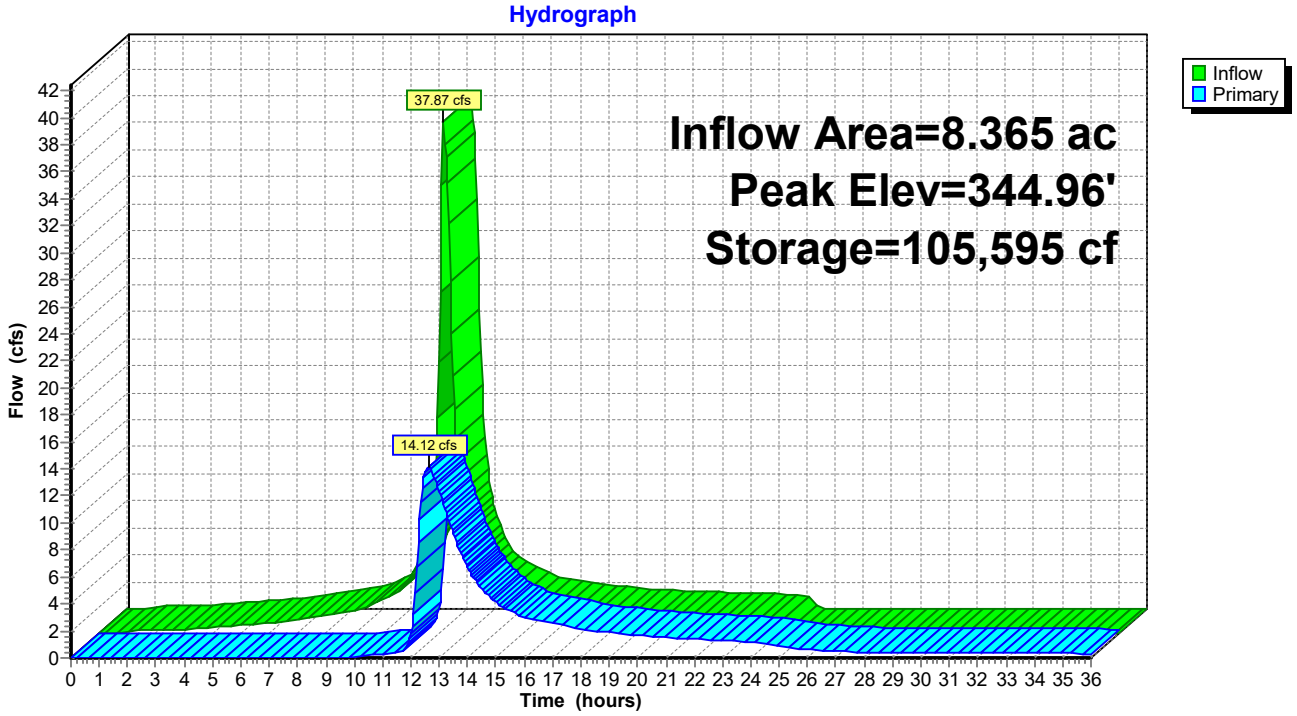
Volume	Invert	Avail.Storage	Storage Description
#1	340.00'	133,731 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
340.00	17,228	0	0
341.00	18,886	18,057	18,057
342.00	20,597	19,742	37,799
343.00	22,362	21,480	59,278
344.00	23,230	22,796	82,074
345.00	26,053	24,642	106,716
346.00	27,978	27,016	133,731

Device	Routing	Invert	Outlet Devices
#1	Primary	338.00'	**18.0" Round Culvert** L= 200.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 338.00' / 334.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 1.77 sf
#2	Device 1	341.40'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	342.70'	**1.0' long x 2.30' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 2.7' Crest Height
#4	Device 1	343.60'	**1.5' long x 1.40' rise Sharp-Crested Rectangular Weir** 2 End Contraction(s) 3.6' Crest Height

Primary OutFlow Max=14.11 cfs @ 12.61 hrs HW=344.96' (Free Discharge)
└**1=Culvert** (Passes 14.11 cfs of 19.20 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.77 cfs @ 8.86 fps)
  ├**3=Sharp-Crested Rectangular Weir** (Weir Controls 6.70 cfs @ 5.41 fps)
  └**4=Sharp-Crested Rectangular Weir** (Weir Controls 6.64 cfs @ 3.98 fps)

Pond 120P: BASIN #2



Summary for Pond 230P: BASIN #3

Inflow Area = 8.101 ac, 66.71% Impervious, Inflow Depth = 6.61" for 100-Year event
Inflow = 46.95 cfs @ 12.15 hrs, Volume= 4.461 af
Outflow = 6.24 cfs @ 12.95 hrs, Volume= 3.807 af, Atten= 87%, Lag= 48.1 min
Primary = 6.24 cfs @ 12.95 hrs, Volume= 3.807 af
Routed to Reach 20R : PDP-2

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 351.25' @ 12.95 hrs Surf.Area= 25,557 sf Storage= 100,028 cf

Plug-Flow detention time= 338.1 min calculated for 3.802 af (85% of inflow)
Center-of-Mass det. time= 264.5 min (1,060.6 - 796.1)

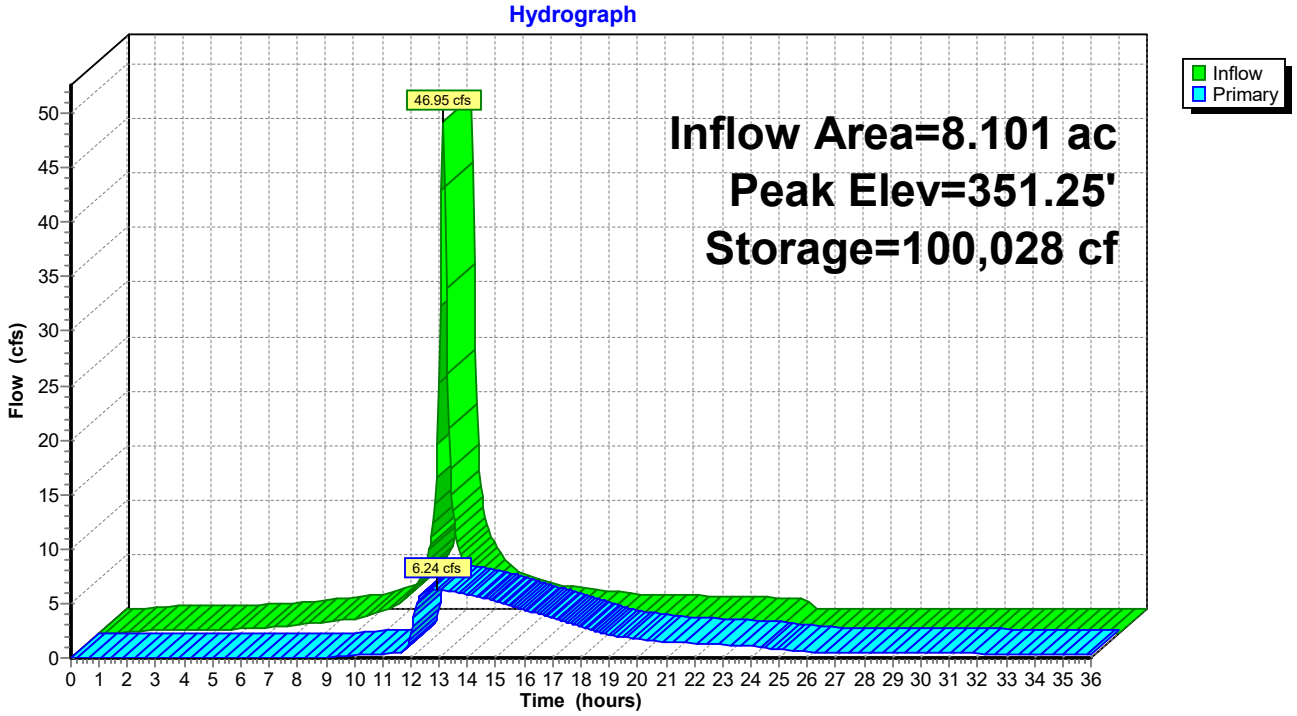
Volume	Invert	Avail.Storage	Storage Description
#1	346.50'	133,455 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
346.50	16,731	0	0
347.00	17,603	8,584	8,584
348.00	19,384	18,494	27,077
349.00	21,220	20,302	47,379
350.00	23,110	22,165	69,544
351.00	25,052	24,081	93,625
352.00	27,049	26,051	119,676
352.50	28,069	13,780	133,455

Device	Routing	Invert	Outlet Devices
#1	Primary	344.50'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 344.50' / 343.50' S= 0.0200 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf
#2	Device 1	347.25'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	348.70'	**12.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=6.24 cfs @ 12.95 hrs HW=351.25' (Free Discharge)
↑**1=Culvert** (Passes 6.24 cfs of 9.35 cfs potential flow)
↑**2=Orifice/Grate** (Orifice Controls 0.82 cfs @ 9.43 fps)
3=Orifice/Grate (Orifice Controls 5.42 cfs @ 6.90 fps)

Pond 230P: BASIN #3



Attachment 4
Groundwater Recharge, Water Quality Volume, and Riprap Apron Sizing Calculations

BEALS + THOMAS

B E A L S + T H O M A S

Standard 3: Groundwater Recharge

Groundwater Recharge Volume Required:

Rv = F x Impervious Area, where:

Rv = Required Recharge Volume [Ac-ft]

F = Target Depth Factor associated with each Hydrologic Soil Group (HSG) [in]

Impervious Area = Total Pavement and Rooftop Area under Post-development Conditions [Ac]

			Impervious Area [Acres]	Required Recharge Volume [Ac-ft]	
HSG "A", use F =	0.6	in	4.062	0.203	
HSG "B", use F =	0.35	in	8.217	0.240	
HSG "C", use F =	0.25	in	0.000	0.000	
HSG "D", use F =	0.1	in	0.000	0.000	
Total Required Recharge Volume (Rv) =				**0.443**	**Ac-ft**

Capture Area Adjustment: (Ref: DEP Handbook V.3 Ch.1 P.27-28)

Total Site Impervious Area (Total)=	12.279	Acres
Impervious Area Draining to Infiltrative BMPs (infil) =	12.06	Acres
Percent Imp. Area Draining to Infiltrative BMPs =	98.3%	
Capture Area Adjustment Factor = (Total)/(Infil) = Ca =	1.02	
Adjusted Required Recharge Volume = Ca x Rv	**0.451**	**Ac-ft**

Groundwater Recharge Volume Provided :

BMP	Provided Recharge Volume [Ac-ft]	
Infiltration Basin 1 =	0.068	
Infiltration Basin 2 =	0.591	
Infiltration Basin 3 =	0.299	
Total Provided Recharge Volume =	**0.958**	**Ac-ft**

PROVIDED GROUNDWATER RECHARGE VOLUME IS GREATER THAN OR EQUAL TO THE REQUIRED RECHAR
THEREFORE PROPOSED STORMWATER MANAGEMENT DESIGN IS IN COMPLIANCE WITH STANDAI

JOB NO. 3077.06 COMPUTED BY: RFK CHECKED BY:

JOB: Lackey Dam Logistics Center DATE: 05/13/22 DATE:

B E A L S + T H O M A S

Standard 3: Drawdown

$$\text{Drawdown Time} = \frac{Rv}{(K)\,(\text{Bottom Area})}$$

where:

Rv = Storage Volume Below Outlet [Ac-ft]
K= Infiltration Rate [in/hr]
Bottom Area= Bottom Area of Recharge System [Ac]

Infiltration Basin 1

Rv =	0.068	Ac-ft	
K =	0.520	in/hr	
Bottom Area =	0.059	Acres	
Drawdown Time =	**26.320**	**Hours**	*< 72 Hours, Design is in compliance with the standard.*

Infiltration Basin 2

Rv =	0.591	Ac-ft	
K =	0.520	in/hr	
Bottom Area =	0.396	Acres	
Drawdown Time =	**34.489**	**Hours**	*< 72 Hours, Design is in compliance with the standard.*

Infiltration Basin 3

Rv =	0.299	Ac-ft	
K =	0.520	in/hr	
Bottom Area =	0.384	Acres	
Drawdown Time =	**17.986**	**Hours**	*< 72 Hours, Design is in compliance with the standard.*

Note:

1. The infiltration BMPs have been designed to fully drain within 72 hours, therefore the proposed stormwater management design is in compliance with Standard 3 .

2. Infiltration Rate based on Volume 3, Chapter 1, Table 2.3.3 *Rawls Rates* from the 2008 MA DEP Stormwater Management Handbook.

JOB NO.	3077.06	COMPUTED BY:	RFK	CHECKED BY:	TJM
JOB:	Lackey Dam Logistics Center	DATE:	05/13/22	DATE:	5/16/22

Stage-Area-Storage for Pond 110P: BASIN #1

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
325.00	2,583	0	325.51	2,953	1,412
325.01	2,590	26	325.52	2,960	1,441
325.02	2,597	52	325.53	2,967	1,471
325.03	2,605	78	325.54	2,975	1,501
325.04	2,612	104	325.55	2,982	1,530
325.05	2,619	130	325.56	2,989	1,560
325.06	2,627	156	325.57	2,996	1,590
325.07	2,634	183	325.58	3,003	1,620
325.08	2,641	209	325.59	3,011	1,650
325.09	2,648	235	325.60	3,018	1,680
325.10	2,656	262	325.61	3,025	1,711
325.11	2,663	289	325.62	3,033	1,741
325.12	2,670	315	325.63	3,040	1,771
325.13	2,677	342	325.64	3,047	1,802
325.14	2,684	369	325.65	3,054	1,832
325.15	2,692	396	325.66	3,062	1,863
325.16	2,699	423	325.67	3,069	1,893
325.17	2,706	450	325.68	3,076	1,924
325.18	2,714	477	325.69	3,083	1,955
325.19	2,721	504	325.70	3,090	1,986
325.20	2,728	531	325.71	3,098	2,017
325.21	2,735	558	325.72	3,105	2,048
325.22	2,743	586	325.73	3,112	2,079
325.23	2,750	613	325.74	3,120	2,110
325.24	2,757	641	325.75	3,127	2,141
325.25	2,764	668	325.76	3,134	2,172
325.26	2,771	696	325.77	3,141	2,204
325.27	2,779	724	325.78	3,148	2,235
325.28	2,786	752	325.79	3,156	2,267
325.29	2,793	780	325.80	3,163	2,298
325.30	2,801	808	325.81	3,170	2,330
325.31	2,808	836	325.82	3,177	2,362
325.32	2,815	864	325.83	3,185	2,394
325.33	2,822	892	325.84	3,192	2,425
325.34	2,829	920	325.85	3,199	2,457
325.35	2,837	948	325.86	3,207	2,489
325.36	2,844	977	325.87	3,214	2,522
325.37	2,851	1,005	325.88	3,221	2,554
325.38	2,858	1,034	325.89	3,228	2,586
325.39	2,866	1,063	325.90	3,235	2,618
325.40	2,873	1,091	325.91	3,243	2,651
325.41	2,880	1,120	325.92	3,250	2,683
325.42	2,888	1,149	325.93	3,257	2,716
325.43	2,895	1,178	325.94	3,264	2,748
325.44	2,902	1,207	325.95	3,272	2,781
325.45	2,909	1,236	325.96	3,279	2,814
325.46	2,916	1,265	325.97	3,286	2,847
325.47	2,924	1,294	325.98	3,294	2,879
325.48	2,931	1,323	325.99	3,301	2,912
325.49	2,938	1,353	326.00	3,308	2,946
325.50	2,946	1,382	326.01	3,316	2,979

Stage-Area-Storage for Pond 110P: BASIN #1 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
326.02	3,324	3,012	326.53	3,720	4,808
326.03	3,331	3,045	326.54	3,728	4,845
326.04	3,339	3,078	326.55	3,736	4,883
326.05	3,347	3,112	326.56	3,744	4,920
326.06	3,355	3,145	326.57	3,751	4,957
326.07	3,362	3,179	326.58	3,759	4,995
326.08	3,370	3,213	326.59	3,767	5,033
326.09	3,378	3,246	326.60	3,775	5,070
326.10	3,386	3,280	326.61	3,783	5,108
326.11	3,394	3,314	326.62	3,790	5,146
326.12	3,401	3,348	326.63	3,798	5,184
326.13	3,409	3,382	326.64	3,806	5,222
326.14	3,417	3,416	326.65	3,814	5,260
326.15	3,425	3,450	326.66	3,821	5,298
326.16	3,432	3,485	326.67	3,829	5,336
326.17	3,440	3,519	326.68	3,837	5,375
326.18	3,448	3,554	326.69	3,845	5,413
326.19	3,456	3,588	326.70	3,853	5,452
326.20	3,464	3,623	326.71	3,860	5,490
326.21	3,471	3,657	326.72	3,868	5,529
326.22	3,479	3,692	326.73	3,876	5,568
326.23	3,487	3,727	326.74	3,884	5,606
326.24	3,495	3,762	326.75	3,892	5,645
326.25	3,503	3,797	326.76	3,899	5,684
326.26	3,510	3,832	326.77	3,907	5,723
326.27	3,518	3,867	326.78	3,915	5,762
326.28	3,526	3,902	326.79	3,923	5,802
326.29	3,534	3,938	326.80	3,930	5,841
326.30	3,541	3,973	326.81	3,938	5,880
326.31	3,549	4,008	326.82	3,946	5,920
326.32	3,557	4,044	326.83	3,954	5,959
326.33	3,565	4,080	326.84	3,962	5,999
326.34	3,573	4,115	326.85	3,969	6,038
326.35	3,580	4,151	326.86	3,977	6,078
326.36	3,588	4,187	326.87	3,985	6,118
326.37	3,596	4,223	326.88	3,993	6,158
326.38	3,604	4,259	326.89	4,000	6,198
326.39	3,611	4,295	326.90	4,008	6,238
326.40	3,619	4,331	326.91	4,016	6,278
326.41	3,627	4,367	326.92	4,024	6,318
326.42	3,635	4,403	326.93	4,032	6,358
326.43	3,643	4,440	326.94	4,039	6,399
326.44	3,650	4,476	326.95	4,047	6,439
326.45	3,658	4,513	326.96	4,055	6,480
326.46	3,666	4,549	326.97	4,063	6,520
326.47	3,674	4,586	326.98	4,070	6,561
326.48	3,681	4,623	326.99	4,078	6,602
326.49	3,689	4,660	327.00	4,086	6,643
326.50	3,697	4,697	327.01	4,094	6,683
326.51	3,705	4,734	327.02	4,103	6,724
326.52	3,713	4,771	327.03	4,111	6,765

Stage-Area-Storage for Pond 110P: BASIN #1 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
327.04	4,119	6,807	327.55	4,544	9,016
327.05	4,128	6,848	327.56	4,552	9,061
327.06	4,136	6,889	327.57	4,560	9,107
327.07	4,144	6,931	327.58	4,569	9,152
327.08	4,153	6,972	327.59	4,577	9,198
327.09	4,161	7,014	327.60	4,585	9,244
327.10	4,169	7,055	327.61	4,594	9,290
327.11	4,178	7,097	327.62	4,602	9,336
327.12	4,186	7,139	327.63	4,610	9,382
327.13	4,194	7,181	327.64	4,618	9,428
327.14	4,202	7,223	327.65	4,627	9,474
327.15	4,211	7,265	327.66	4,635	9,520
327.16	4,219	7,307	327.67	4,643	9,567
327.17	4,227	7,349	327.68	4,652	9,613
327.18	4,236	7,391	327.69	4,660	9,660
327.19	4,244	7,434	327.70	4,668	9,707
327.20	4,252	7,476	327.71	4,677	9,753
327.21	4,261	7,519	327.72	4,685	9,800
327.22	4,269	7,562	327.73	4,693	9,847
327.23	4,277	7,604	327.74	4,702	9,894
327.24	4,286	7,647	327.75	4,710	9,941
327.25	4,294	7,690	327.76	4,718	9,988
327.26	4,302	7,733	327.77	4,727	10,035
327.27	4,311	7,776	327.78	4,735	10,083
327.28	4,319	7,819	327.79	4,743	10,130
327.29	4,327	7,862	327.80	4,752	10,178
327.30	4,336	7,906	327.81	4,760	10,225
327.31	4,344	7,949	327.82	4,768	10,273
327.32	4,352	7,993	327.83	4,777	10,320
327.33	4,361	8,036	327.84	4,785	10,368
327.34	4,369	8,080	327.85	4,793	10,416
327.35	4,377	8,124	327.86	4,802	10,464
327.36	4,386	8,167	327.87	4,810	10,512
327.37	4,394	8,211	327.88	4,818	10,560
327.38	4,402	8,255	327.89	4,826	10,609
327.39	4,410	8,299	327.90	4,835	10,657
327.40	4,419	8,343	327.91	4,843	10,705
327.41	4,427	8,388	327.92	4,851	10,754
327.42	4,435	8,432	327.93	4,860	10,802
327.43	4,444	8,476	327.94	4,868	10,851
327.44	4,452	8,521	327.95	4,876	10,900
327.45	4,460	8,565	327.96	4,885	10,948
327.46	4,469	8,610	327.97	4,893	10,997
327.47	4,477	8,655	327.98	4,901	11,046
327.48	4,485	8,700	327.99	4,910	11,095
327.49	4,494	8,745	328.00	4,918	11,145
327.50	4,502	8,790	328.01	4,927	11,194
327.51	4,510	8,835	328.02	4,936	11,243
327.52	4,519	8,880	328.03	4,945	11,292
327.53	4,527	8,925	328.04	4,953	11,342
327.54	4,535	8,970	328.05	4,962	11,392

Stage-Area-Storage for Pond 110P: BASIN #1 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
328.06	4,971	11,441
328.07	4,980	11,491
328.08	4,989	11,541
328.09	4,998	11,591
328.10	5,007	11,641
328.11	5,016	11,691
328.12	5,024	11,741
328.13	5,033	11,791
328.14	5,042	11,842
328.15	5,051	11,892
328.16	5,060	11,943
328.17	5,069	11,993
328.18	5,078	12,044
328.19	5,087	12,095
328.20	5,095	12,146
328.21	5,104	12,197
328.22	5,113	12,248
328.23	5,122	12,299
328.24	5,131	12,350
328.25	5,140	12,402
328.26	5,149	12,453
328.27	5,157	12,505
328.28	5,166	12,556
328.29	5,175	12,608
328.30	5,184	12,660
328.31	5,193	12,712
328.32	5,202	12,764
328.33	5,211	12,816
328.34	5,220	12,868
328.35	5,228	12,920
328.36	5,237	12,972
328.37	5,246	13,025
328.38	5,255	13,077
328.39	5,264	13,130
328.40	5,273	13,183
328.41	5,282	13,235
328.42	5,291	13,288
328.43	5,299	13,341
328.44	5,308	13,394
328.45	5,317	13,447
328.46	5,326	13,501
328.47	5,335	13,554
328.48	5,344	13,607
328.49	5,353	13,661
328.50	5,362	13,714
328.51	5,370	13,768
328.52	5,379	13,822
328.53	5,388	13,876
328.54	5,397	13,930
328.55	5,406	13,984
328.56	5,415	14,038
328.57	5,424	14,092
328.58	5,432	14,146
328.59	5,441	14,201
328.60	5,450	14,255
328.61	5,459	14,310
328.62	5,468	14,364
328.63	5,477	14,419
328.64	5,486	14,474
328.65	5,495	14,529
328.66	5,503	14,584
328.67	5,512	14,639
328.68	5,521	14,694
328.69	5,530	14,749
328.70	5,539	14,804
328.71	5,548	14,860
328.72	5,557	14,915
328.73	5,566	14,971
328.74	5,574	15,027
328.75	5,583	15,082
328.76	5,592	15,138
328.77	5,601	15,194
328.78	5,610	15,250
328.79	5,619	15,307
328.80	5,628	15,363
328.81	5,636	15,419
328.82	5,645	15,475
328.83	5,654	15,532
328.84	5,663	15,589
328.85	5,672	15,645
328.86	5,681	15,702
328.87	5,690	15,759
328.88	5,699	15,816
328.89	5,707	15,873
328.90	5,716	15,930
328.91	5,725	15,987
328.92	5,734	16,044
328.93	5,743	16,102
328.94	5,752	16,159
328.95	5,761	16,217
328.96	5,770	16,275
328.97	5,778	16,332
328.98	5,787	16,390
328.99	5,796	16,448
329.00	**5,805**	**16,506**

Stage-Area-Storage for Pond 120P: BASIN #2

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
340.00	17,228	0	340.51	18,074	9,002
340.01	17,245	172	340.52	18,090	9,183
340.02	17,261	345	340.53	18,107	9,364
340.03	17,278	518	340.54	18,123	9,545
340.04	17,294	690	340.55	18,140	9,726
340.05	17,311	863	340.56	18,156	9,908
340.06	17,327	1,037	340.57	18,173	10,089
340.07	17,344	1,210	340.58	18,190	10,271
340.08	17,361	1,384	340.59	18,206	10,453
340.09	17,377	1,557	340.60	18,223	10,635
340.10	17,394	1,731	340.61	18,239	10,818
340.11	17,410	1,905	340.62	18,256	11,000
340.12	17,427	2,079	340.63	18,273	11,183
340.13	17,444	2,254	340.64	18,289	11,365
340.14	17,460	2,428	340.65	18,306	11,548
340.15	17,477	2,603	340.66	18,322	11,732
340.16	17,493	2,778	340.67	18,339	11,915
340.17	17,510	2,953	340.68	18,355	12,098
340.18	17,526	3,128	340.69	18,372	12,282
340.19	17,543	3,303	340.70	18,389	12,466
340.20	17,560	3,479	340.71	18,405	12,650
340.21	17,576	3,654	340.72	18,422	12,834
340.22	17,593	3,830	340.73	18,438	13,018
340.23	17,609	4,006	340.74	18,455	13,203
340.24	17,626	4,182	340.75	18,472	13,387
340.25	17,643	4,359	340.76	18,488	13,572
340.26	17,659	4,535	340.77	18,505	13,757
340.27	17,676	4,712	340.78	18,521	13,942
340.28	17,692	4,889	340.79	18,538	14,127
340.29	17,709	5,066	340.80	18,554	14,313
340.30	17,725	5,243	340.81	18,571	14,499
340.31	17,742	5,420	340.82	18,588	14,684
340.32	17,759	5,598	340.83	18,604	14,870
340.33	17,775	5,776	340.84	18,621	15,056
340.34	17,792	5,953	340.85	18,637	15,243
340.35	17,808	6,131	340.86	18,654	15,429
340.36	17,825	6,310	340.87	18,670	15,616
340.37	17,841	6,488	340.88	18,687	15,803
340.38	17,858	6,666	340.89	18,704	15,990
340.39	17,875	6,845	340.90	18,720	16,177
340.40	17,891	7,024	340.91	18,737	16,364
340.41	17,908	7,203	340.92	18,753	16,551
340.42	17,924	7,382	340.93	18,770	16,739
340.43	17,941	7,561	340.94	18,787	16,927
340.44	17,958	7,741	340.95	18,803	17,115
340.45	17,974	7,920	340.96	18,820	17,303
340.46	17,991	8,100	340.97	18,836	17,491
340.47	18,007	8,280	340.98	18,853	17,680
340.48	18,024	8,460	340.99	18,869	17,868
340.49	18,040	8,641	341.00	18,886	18,057
340.50	18,057	8,821	341.01	18,903	18,246

Stage-Area-Storage for Pond 120P: BASIN #2 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
341.02	18,920	18,435	341.53	19,793	28,307
341.03	18,937	18,624	341.54	19,810	28,505
341.04	18,954	18,814	341.55	19,827	28,703
341.05	18,972	19,003	341.56	19,844	28,901
341.06	18,989	19,193	341.57	19,861	29,100
341.07	19,006	19,383	341.58	19,878	29,299
341.08	19,023	19,573	341.59	19,895	29,498
341.09	19,040	19,764	341.60	19,913	29,697
341.10	19,057	19,954	341.61	19,930	29,896
341.11	19,074	20,145	341.62	19,947	30,095
341.12	19,091	20,336	341.63	19,964	30,295
341.13	19,108	20,527	341.64	19,981	30,494
341.14	19,126	20,718	341.65	19,998	30,694
341.15	19,143	20,909	341.66	20,015	30,894
341.16	19,160	21,101	341.67	20,032	31,095
341.17	19,177	21,292	341.68	20,049	31,295
341.18	19,194	21,484	341.69	20,067	31,496
341.19	19,211	21,676	341.70	20,084	31,696
341.20	19,228	21,868	341.71	20,101	31,897
341.21	19,245	22,061	341.72	20,118	32,098
341.22	19,262	22,253	341.73	20,135	32,300
341.23	19,280	22,446	341.74	20,152	32,501
341.24	19,297	22,639	341.75	20,169	32,703
341.25	19,314	22,832	341.76	20,186	32,904
341.26	19,331	23,025	341.77	20,203	33,106
341.27	19,348	23,219	341.78	20,221	33,309
341.28	19,365	23,412	341.79	20,238	33,511
341.29	19,382	23,606	341.80	20,255	33,713
341.30	19,399	23,800	341.81	20,272	33,916
341.31	19,416	23,994	341.82	20,289	34,119
341.32	19,434	24,188	341.83	20,306	34,322
341.33	19,451	24,383	341.84	20,323	34,525
341.34	19,468	24,577	341.85	20,340	34,728
341.35	19,485	24,772	341.86	20,357	34,932
341.36	19,502	24,967	341.87	20,375	35,135
341.37	19,519	25,162	341.88	20,392	35,339
341.38	19,536	25,357	341.89	20,409	35,543
341.39	19,553	25,553	341.90	20,426	35,747
341.40	19,570	25,748	341.91	20,443	35,952
341.41	19,588	25,944	341.92	20,460	36,156
341.42	19,605	26,140	341.93	20,477	36,361
341.43	19,622	26,336	341.94	20,494	36,566
341.44	19,639	26,532	341.95	20,511	36,771
341.45	19,656	26,729	341.96	20,529	36,976
341.46	19,673	26,926	341.97	20,546	37,181
341.47	19,690	27,122	341.98	20,563	37,387
341.48	19,707	27,319	341.99	20,580	37,593
341.49	19,724	27,517	342.00	20,597	37,799
341.50	19,742	27,714	342.01	20,615	38,005
341.51	19,759	27,911	342.02	20,632	38,211
341.52	19,776	28,109	342.03	20,650	38,417

Stage-Area-Storage for Pond 120P: BASIN #2 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
342.04	20,668	38,624	342.55	21,568	49,394
342.05	20,685	38,831	342.56	21,585	49,610
342.06	20,703	39,037	342.57	21,603	49,826
342.07	20,721	39,245	342.58	21,621	50,042
342.08	20,738	39,452	342.59	21,638	50,258
342.09	20,756	39,659	342.60	21,656	50,474
342.10	20,774	39,867	342.61	21,674	50,691
342.11	20,791	40,075	342.62	21,691	50,908
342.12	20,809	40,283	342.63	21,709	51,125
342.13	20,826	40,491	342.64	21,727	51,342
342.14	20,844	40,699	342.65	21,744	51,559
342.15	20,862	40,908	342.66	21,762	51,777
342.16	20,879	41,117	342.67	21,780	51,995
342.17	20,897	41,325	342.68	21,797	52,213
342.18	20,915	41,535	342.69	21,815	52,431
342.19	20,932	41,744	342.70	21,832	52,649
342.20	20,950	41,953	342.71	21,850	52,867
342.21	20,968	42,163	342.72	21,868	53,086
342.22	20,985	42,373	342.73	21,885	53,305
342.23	21,003	42,582	342.74	21,903	53,524
342.24	21,021	42,793	342.75	21,921	53,743
342.25	21,038	43,003	342.76	21,938	53,962
342.26	21,056	43,213	342.77	21,956	54,181
342.27	21,074	43,424	342.78	21,974	54,401
342.28	21,091	43,635	342.79	21,991	54,621
342.29	21,109	43,846	342.80	22,009	54,841
342.30	21,127	44,057	342.81	22,027	55,061
342.31	21,144	44,268	342.82	22,044	55,281
342.32	21,162	44,480	342.83	22,062	55,502
342.33	21,179	44,692	342.84	22,080	55,723
342.34	21,197	44,903	342.85	22,097	55,944
342.35	21,215	45,116	342.86	22,115	56,165
342.36	21,232	45,328	342.87	22,133	56,386
342.37	21,250	45,540	342.88	22,150	56,607
342.38	21,268	45,753	342.89	22,168	56,829
342.39	21,285	45,966	342.90	22,185	57,051
342.40	21,303	46,178	342.91	22,203	57,273
342.41	21,321	46,392	342.92	22,221	57,495
342.42	21,338	46,605	342.93	22,238	57,717
342.43	21,356	46,818	342.94	22,256	57,939
342.44	21,374	47,032	342.95	22,274	58,162
342.45	21,391	47,246	342.96	22,291	58,385
342.46	21,409	47,460	342.97	22,309	58,608
342.47	21,427	47,674	342.98	22,327	58,831
342.48	21,444	47,888	342.99	22,344	59,054
342.49	21,462	48,103	343.00	22,362	59,278
342.50	21,480	48,318	343.01	22,371	59,502
342.51	21,497	48,533	343.02	22,379	59,725
342.52	21,515	48,748	343.03	22,388	59,949
342.53	21,532	48,963	343.04	22,397	60,173
342.54	21,550	49,178	343.05	22,405	60,397

Stage-Area-Storage for Pond 120P: BASIN #2 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
343.06	22,414	60,621	343.57	22,857	72,165
343.07	22,423	60,845	343.58	22,865	72,394
343.08	22,431	61,070	343.59	22,874	72,623
343.09	22,440	61,294	343.60	22,883	72,851
343.10	22,449	61,519	343.61	22,891	73,080
343.11	22,457	61,743	343.62	22,900	73,309
343.12	22,466	61,968	343.63	22,909	73,538
343.13	22,475	62,192	343.64	22,918	73,767
343.14	22,484	62,417	343.65	22,926	73,997
343.15	22,492	62,642	343.66	22,935	74,226
343.16	22,501	62,867	343.67	22,944	74,455
343.17	22,510	63,092	343.68	22,952	74,685
343.18	22,518	63,317	343.69	22,961	74,914
343.19	22,527	63,542	343.70	22,970	75,144
343.20	22,536	63,768	343.71	22,978	75,374
343.21	22,544	63,993	343.72	22,987	75,604
343.22	22,553	64,219	343.73	22,996	75,834
343.23	22,562	64,444	343.74	23,004	76,064
343.24	22,570	64,670	343.75	23,013	76,294
343.25	22,579	64,896	343.76	23,022	76,524
343.26	22,588	65,121	343.77	23,030	76,754
343.27	22,596	65,347	343.78	23,039	76,984
343.28	22,605	65,573	343.79	23,048	77,215
343.29	22,614	65,799	343.80	23,056	77,445
343.30	22,622	66,026	343.81	23,065	77,676
343.31	22,631	66,252	343.82	23,074	77,907
343.32	22,640	66,478	343.83	23,082	78,137
343.33	22,648	66,705	343.84	23,091	78,368
343.34	22,657	66,931	343.85	23,100	78,599
343.35	22,666	67,158	343.86	23,108	78,830
343.36	22,674	67,385	343.87	23,117	79,061
343.37	22,683	67,611	343.88	23,126	79,293
343.38	22,692	67,838	343.89	23,135	79,524
343.39	22,701	68,065	343.90	23,143	79,755
343.40	22,709	68,292	343.91	23,152	79,987
343.41	22,718	68,519	343.92	23,161	80,218
343.42	22,727	68,747	343.93	23,169	80,450
343.43	22,735	68,974	343.94	23,178	80,682
343.44	22,744	69,201	343.95	23,187	80,914
343.45	22,753	69,429	343.96	23,195	81,145
343.46	22,761	69,656	343.97	23,204	81,377
343.47	22,770	69,884	343.98	23,213	81,610
343.48	22,779	70,112	343.99	23,221	81,842
343.49	22,787	70,340	344.00	23,230	82,074
343.50	22,796	70,568	344.01	23,258	82,306
343.51	22,805	70,796	344.02	23,286	82,539
343.52	22,813	71,024	344.03	23,315	82,772
343.53	22,822	71,252	344.04	23,343	83,005
343.54	22,831	71,480	344.05	23,371	83,239
343.55	22,839	71,708	344.06	23,399	83,473
343.56	22,848	71,937	344.07	23,428	83,707

Stage-Area-Storage for Pond 120P: BASIN #2 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
344.08	23,456	83,941	344.59	24,896	96,271
344.09	23,484	84,176	344.60	24,924	96,520
344.10	23,512	84,411	344.61	24,952	96,770
344.11	23,541	84,646	344.62	24,980	97,019
344.12	23,569	84,882	344.63	25,008	97,269
344.13	23,597	85,118	344.64	25,037	97,519
344.14	23,625	85,354	344.65	25,065	97,770
344.15	23,653	85,590	344.66	25,093	98,021
344.16	23,682	85,827	344.67	25,121	98,272
344.17	23,710	86,064	344.68	25,150	98,523
344.18	23,738	86,301	344.69	25,178	98,775
344.19	23,766	86,539	344.70	25,206	99,027
344.20	23,795	86,776	344.71	25,234	99,279
344.21	23,823	87,015	344.72	25,263	99,531
344.22	23,851	87,253	344.73	25,291	99,784
344.23	23,879	87,492	344.74	25,319	100,037
344.24	23,908	87,731	344.75	25,347	100,290
344.25	23,936	87,970	344.76	25,375	100,544
344.26	23,964	88,209	344.77	25,404	100,798
344.27	23,992	88,449	344.78	25,432	101,052
344.28	24,020	88,689	344.79	25,460	101,307
344.29	24,049	88,929	344.80	25,488	101,561
344.30	24,077	89,170	344.81	25,517	101,816
344.31	24,105	89,411	344.82	25,545	102,072
344.32	24,133	89,652	344.83	25,573	102,327
344.33	24,162	89,894	344.84	25,601	102,583
344.34	24,190	90,135	344.85	25,630	102,839
344.35	24,218	90,377	344.86	25,658	103,096
344.36	24,246	90,620	344.87	25,686	103,352
344.37	24,275	90,862	344.88	25,714	103,609
344.38	24,303	91,105	344.89	25,742	103,867
344.39	24,331	91,348	344.90	25,771	104,124
344.40	24,359	91,592	344.91	25,799	104,382
344.41	24,387	91,836	344.92	25,827	104,640
344.42	24,416	92,080	344.93	25,855	104,899
344.43	24,444	92,324	344.94	25,884	105,157
344.44	24,472	92,568	344.95	25,912	105,416
344.45	24,500	92,813	344.96	25,940	105,676
344.46	24,529	93,058	344.97	25,968	105,935
344.47	24,557	93,304	344.98	25,997	106,195
344.48	24,585	93,550	344.99	26,025	106,455
344.49	24,613	93,796	345.00	26,053	106,716
344.50	24,642	94,042	345.01	26,072	106,976
344.51	24,670	94,288	345.02	26,091	107,237
344.52	24,698	94,535	345.03	26,111	107,498
344.53	24,726	94,782	345.04	26,130	107,759
344.54	24,754	95,030	345.05	26,149	108,021
344.55	24,783	95,277	345.06	26,169	108,282
344.56	24,811	95,525	345.07	26,188	108,544
344.57	24,839	95,774	345.08	26,207	108,806
344.58	24,867	96,022	345.09	26,226	109,068

Stage-Area-Storage for Pond 120P: BASIN #2 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
345.10	26,246	109,330
345.11	26,265	109,593
345.12	26,284	109,856
345.13	26,303	110,119
345.14	26,322	110,382
345.15	26,342	110,645
345.16	26,361	110,909
345.17	26,380	111,172
345.18	26,400	111,436
345.19	26,419	111,700
345.20	26,438	111,965
345.21	26,457	112,229
345.22	26,477	112,494
345.23	26,496	112,759
345.24	26,515	113,024
345.25	26,534	113,289
345.26	26,553	113,554
345.27	26,573	113,820
345.28	26,592	114,086
345.29	26,611	114,352
345.30	26,631	114,618
345.31	26,650	114,884
345.32	26,669	115,151
345.33	26,688	115,418
345.34	26,707	115,685
345.35	26,727	115,952
345.36	26,746	116,219
345.37	26,765	116,487
345.38	26,784	116,755
345.39	26,804	117,023
345.40	26,823	117,291
345.41	26,842	117,559
345.42	26,862	117,828
345.43	26,881	118,096
345.44	26,900	118,365
345.45	26,919	118,634
345.46	26,938	118,904
345.47	26,958	119,173
345.48	26,977	119,443
345.49	26,996	119,713
345.50	27,016	119,983
345.51	27,035	120,253
345.52	27,054	120,523
345.53	27,073	120,794
345.54	27,093	121,065
345.55	27,112	121,336
345.56	27,131	121,607
345.57	27,150	121,878
345.58	27,169	122,150
345.59	27,189	122,422
345.60	27,208	122,694
345.61	27,227	122,966
345.62	27,247	123,238
345.63	27,266	123,511
345.64	27,285	123,784
345.65	27,304	124,057
345.66	27,324	124,330
345.67	27,343	124,603
345.68	27,362	124,877
345.69	27,381	125,150
345.70	27,400	125,424
345.71	27,420	125,698
345.72	27,439	125,973
345.73	27,458	126,247
345.74	27,478	126,522
345.75	27,497	126,797
345.76	27,516	127,072
345.77	27,535	127,347
345.78	27,554	127,622
345.79	27,574	127,898
345.80	27,593	128,174
345.81	27,612	128,450
345.82	27,631	128,726
345.83	27,651	129,003
345.84	27,670	129,279
345.85	27,689	129,556
345.86	27,709	129,833
345.87	27,728	130,110
345.88	27,747	130,387
345.89	27,766	130,665
345.90	27,785	130,943
345.91	27,805	131,221
345.92	27,824	131,499
345.93	27,843	131,777
345.94	27,862	132,056
345.95	27,882	132,335
345.96	27,901	132,613
345.97	27,920	132,893
345.98	27,940	133,172
345.99	27,959	133,451
346.00	**27,978**	**133,731**

Stage-Area-Storage for Pond 230P: BASIN #3

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
346.50	16,731	0	347.01	17,621	8,760
346.51	16,748	167	347.02	17,639	8,936
346.52	16,766	335	347.03	17,656	9,112
346.53	16,783	503	347.04	17,674	9,289
346.54	16,801	671	347.05	17,692	9,466
346.55	16,818	839	347.06	17,710	9,643
346.56	16,836	1,007	347.07	17,728	9,820
346.57	16,853	1,175	347.08	17,745	9,997
346.58	16,871	1,344	347.09	17,763	10,175
346.59	16,888	1,513	347.10	17,781	10,353
346.60	16,905	1,682	347.11	17,799	10,531
346.61	16,923	1,851	347.12	17,817	10,709
346.62	16,940	2,020	347.13	17,835	10,887
346.63	16,958	2,190	347.14	17,852	11,065
346.64	16,975	2,359	347.15	17,870	11,244
346.65	16,993	2,529	347.16	17,888	11,423
346.66	17,010	2,699	347.17	17,906	11,602
346.67	17,027	2,869	347.18	17,924	11,781
346.68	17,045	3,040	347.19	17,941	11,960
346.69	17,062	3,210	347.20	17,959	12,140
346.70	17,080	3,381	347.21	17,977	12,319
346.71	17,097	3,552	347.22	17,995	12,499
346.72	17,115	3,723	347.23	18,013	12,679
346.73	17,132	3,894	347.24	18,030	12,860
346.74	17,150	4,066	347.25	18,048	13,040
346.75	17,167	4,237	347.26	18,066	13,220
346.76	17,184	4,409	347.27	18,084	13,401
346.77	17,202	4,581	347.28	18,102	13,582
346.78	17,219	4,753	347.29	18,119	13,763
346.79	17,237	4,925	347.30	18,137	13,945
346.80	17,254	5,098	347.31	18,155	14,126
346.81	17,272	5,270	347.32	18,173	14,308
346.82	17,289	5,443	347.33	18,191	14,489
346.83	17,307	5,616	347.34	18,209	14,671
346.84	17,324	5,789	347.35	18,226	14,854
346.85	17,341	5,963	347.36	18,244	15,036
346.86	17,359	6,136	347.37	18,262	15,219
346.87	17,376	6,310	347.38	18,280	15,401
346.88	17,394	6,484	347.39	18,298	15,584
346.89	17,411	6,658	347.40	18,315	15,767
346.90	17,429	6,832	347.41	18,333	15,950
346.91	17,446	7,006	347.42	18,351	16,134
346.92	17,463	7,181	347.43	18,369	16,317
346.93	17,481	7,356	347.44	18,387	16,501
346.94	17,498	7,530	347.45	18,404	16,685
346.95	17,516	7,706	347.46	18,422	16,869
346.96	17,533	7,881	347.47	18,440	17,054
346.97	17,551	8,056	347.48	18,458	17,238
346.98	17,568	8,232	347.49	18,476	17,423
346.99	17,586	8,408	347.50	18,494	17,608
347.00	17,603	8,584	347.51	18,511	17,793

Stage-Area-Storage for Pond 230P: BASIN #3 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
347.52	18,529	17,978	348.03	19,439	27,659
347.53	18,547	18,163	348.04	19,457	27,854
347.54	18,565	18,349	348.05	19,476	28,048
347.55	18,583	18,535	348.06	19,494	28,243
347.56	18,600	18,720	348.07	19,513	28,438
347.57	18,618	18,907	348.08	19,531	28,634
347.58	18,636	19,093	348.09	19,549	28,829
347.59	18,654	19,279	348.10	19,568	29,025
347.60	18,672	19,466	348.11	19,586	29,220
347.61	18,689	19,653	348.12	19,604	29,416
347.62	18,707	19,840	348.13	19,623	29,612
347.63	18,725	20,027	348.14	19,641	29,809
347.64	18,743	20,214	348.15	19,659	30,005
347.65	18,761	20,402	348.16	19,678	30,202
347.66	18,778	20,589	348.17	19,696	30,399
347.67	18,796	20,777	348.18	19,714	30,596
347.68	18,814	20,965	348.19	19,733	30,793
347.69	18,832	21,154	348.20	19,751	30,991
347.70	18,850	21,342	348.21	19,770	31,188
347.71	18,868	21,531	348.22	19,788	31,386
347.72	18,885	21,719	348.23	19,806	31,584
347.73	18,903	21,908	348.24	19,825	31,782
347.74	18,921	22,097	348.25	19,843	31,980
347.75	18,939	22,287	348.26	19,861	32,179
347.76	18,957	22,476	348.27	19,880	32,378
347.77	18,974	22,666	348.28	19,898	32,576
347.78	18,992	22,856	348.29	19,916	32,776
347.79	19,010	23,046	348.30	19,935	32,975
347.80	19,028	23,236	348.31	19,953	33,174
347.81	19,046	23,426	348.32	19,972	33,374
347.82	19,063	23,617	348.33	19,990	33,574
347.83	19,081	23,807	348.34	20,008	33,774
347.84	19,099	23,998	348.35	20,027	33,974
347.85	19,117	24,189	348.36	20,045	34,174
347.86	19,135	24,381	348.37	20,063	34,375
347.87	19,152	24,572	348.38	20,082	34,575
347.88	19,170	24,764	348.39	20,100	34,776
347.89	19,188	24,956	348.40	20,118	34,977
347.90	19,206	25,148	348.41	20,137	35,179
347.91	19,224	25,340	348.42	20,155	35,380
347.92	19,242	25,532	348.43	20,173	35,582
347.93	19,259	25,724	348.44	20,192	35,784
347.94	19,277	25,917	348.45	20,210	35,986
347.95	19,295	26,110	348.46	20,229	36,188
347.96	19,313	26,303	348.47	20,247	36,390
347.97	19,331	26,496	348.48	20,265	36,593
347.98	19,348	26,690	348.49	20,284	36,796
347.99	19,366	26,883	348.50	20,302	36,999
348.00	19,384	27,077	348.51	20,320	37,202
348.01	19,402	27,271	348.52	20,339	37,405
348.02	19,421	27,465	348.53	20,357	37,608

Stage-Area-Storage for Pond 230P: BASIN #3 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
348.54	20,375	37,812	349.05	21,315	48,442
348.55	20,394	38,016	349.06	21,333	48,656
348.56	20,412	38,220	349.07	21,352	48,869
348.57	20,431	38,424	349.08	21,371	49,083
348.58	20,449	38,629	349.09	21,390	49,296
348.59	20,467	38,833	349.10	21,409	49,510
348.60	20,486	39,038	349.11	21,428	49,725
348.61	20,504	39,243	349.12	21,447	49,939
348.62	20,522	39,448	349.13	21,466	50,154
348.63	20,541	39,653	349.14	21,485	50,368
348.64	20,559	39,859	349.15	21,503	50,583
348.65	20,577	40,064	349.16	21,522	50,798
348.66	20,596	40,270	349.17	21,541	51,014
348.67	20,614	40,476	349.18	21,560	51,229
348.68	20,632	40,683	349.19	21,579	51,445
348.69	20,651	40,889	349.20	21,598	51,661
348.70	20,669	41,096	349.21	21,617	51,877
348.71	20,688	41,302	349.22	21,636	52,093
348.72	20,706	41,509	349.23	21,655	52,310
348.73	20,724	41,717	349.24	21,674	52,526
348.74	20,743	41,924	349.25	21,693	52,743
348.75	20,761	42,131	349.26	21,711	52,960
348.76	20,779	42,339	349.27	21,730	53,177
348.77	20,798	42,547	349.28	21,749	53,395
348.78	20,816	42,755	349.29	21,768	53,612
348.79	20,834	42,963	349.30	21,787	53,830
348.80	20,853	43,172	349.31	21,806	54,048
348.81	20,871	43,380	349.32	21,825	54,266
348.82	20,890	43,589	349.33	21,844	54,485
348.83	20,908	43,798	349.34	21,863	54,703
348.84	20,926	44,007	349.35	21,882	54,922
348.85	20,945	44,217	349.36	21,900	55,141
348.86	20,963	44,426	349.37	21,919	55,360
348.87	20,981	44,636	349.38	21,938	55,579
348.88	21,000	44,846	349.39	21,957	55,799
348.89	21,018	45,056	349.40	21,976	56,018
348.90	21,036	45,266	349.41	21,995	56,238
348.91	21,055	45,477	349.42	22,014	56,458
348.92	21,073	45,687	349.43	22,033	56,678
348.93	21,091	45,898	349.44	22,052	56,899
348.94	21,110	46,109	349.45	22,070	57,119
348.95	21,128	46,320	349.46	22,089	57,340
348.96	21,147	46,532	349.47	22,108	57,561
348.97	21,165	46,743	349.48	22,127	57,782
348.98	21,183	46,955	349.49	22,146	58,004
348.99	21,202	47,167	349.50	22,165	58,225
349.00	21,220	47,379	349.51	22,184	58,447
349.01	21,239	47,591	349.52	22,203	58,669
349.02	21,258	47,804	349.53	22,222	58,891
349.03	21,277	48,016	349.54	22,241	59,113
349.04	21,296	48,229	349.55	22,260	59,336

Stage-Area-Storage for Pond 230P: BASIN #3 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
349.56	22,278	59,559	350.07	23,246	71,166
349.57	22,297	59,781	350.08	23,265	71,399
349.58	22,316	60,004	350.09	23,285	71,632
349.59	22,335	60,228	350.10	23,304	71,865
349.60	22,354	60,451	350.11	23,324	72,098
349.61	22,373	60,675	350.12	23,343	72,331
349.62	22,392	60,899	350.13	23,362	72,565
349.63	22,411	61,123	350.14	23,382	72,798
349.64	22,430	61,347	350.15	23,401	73,032
349.65	22,448	61,571	350.16	23,421	73,266
349.66	22,467	61,796	350.17	23,440	73,501
349.67	22,486	62,021	350.18	23,460	73,735
349.68	22,505	62,246	350.19	23,479	73,970
349.69	22,524	62,471	350.20	23,498	74,205
349.70	22,543	62,696	350.21	23,518	74,440
349.71	22,562	62,922	350.22	23,537	74,675
349.72	22,581	63,147	350.23	23,557	74,911
349.73	22,600	63,373	350.24	23,576	75,146
349.74	22,619	63,599	350.25	23,596	75,382
349.75	22,638	63,826	350.26	23,615	75,618
349.76	22,656	64,052	350.27	23,634	75,854
349.77	22,675	64,279	350.28	23,654	76,091
349.78	22,694	64,506	350.29	23,673	76,328
349.79	22,713	64,733	350.30	23,693	76,564
349.80	22,732	64,960	350.31	23,712	76,801
349.81	22,751	65,187	350.32	23,731	77,039
349.82	22,770	65,415	350.33	23,751	77,276
349.83	22,789	65,643	350.34	23,770	77,514
349.84	22,808	65,871	350.35	23,790	77,751
349.85	22,827	66,099	350.36	23,809	77,989
349.86	22,845	66,327	350.37	23,829	78,228
349.87	22,864	66,556	350.38	23,848	78,466
349.88	22,883	66,784	350.39	23,867	78,705
349.89	22,902	67,013	350.40	23,887	78,943
349.90	22,921	67,242	350.41	23,906	79,182
349.91	22,940	67,472	350.42	23,926	79,421
349.92	22,959	67,701	350.43	23,945	79,661
349.93	22,978	67,931	350.44	23,964	79,900
349.94	22,997	68,161	350.45	23,984	80,140
349.95	23,015	68,391	350.46	24,003	80,380
349.96	23,034	68,621	350.47	24,023	80,620
349.97	23,053	68,852	350.48	24,042	80,861
349.98	23,072	69,082	350.49	24,062	81,101
349.99	23,091	69,313	350.50	24,081	81,342
350.00	23,110	69,544	350.51	24,100	81,583
350.01	23,129	69,775	350.52	24,120	81,824
350.02	23,149	70,007	350.53	24,139	82,065
350.03	23,168	70,238	350.54	24,159	82,307
350.04	23,188	70,470	350.55	24,178	82,548
350.05	23,207	70,702	350.56	24,198	82,790
350.06	23,227	70,934	350.57	24,217	83,032

Stage-Area-Storage for Pond 230P: BASIN #3 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
350.58	24,236	83,274	351.09	25,232	95,888
350.59	24,256	83,517	351.10	25,252	96,140
350.60	24,275	83,760	351.11	25,272	96,393
350.61	24,295	84,002	351.12	25,292	96,646
350.62	24,314	84,245	351.13	25,312	96,899
350.63	24,333	84,489	351.14	25,332	97,152
350.64	24,353	84,732	351.15	25,352	97,405
350.65	24,372	84,976	351.16	25,372	97,659
350.66	24,392	85,220	351.17	25,391	97,913
350.67	24,411	85,464	351.18	25,411	98,167
350.68	24,431	85,708	351.19	25,431	98,421
350.69	24,450	85,952	351.20	25,451	98,675
350.70	24,469	86,197	351.21	25,471	98,930
350.71	24,489	86,442	351.22	25,491	99,185
350.72	24,508	86,687	351.23	25,511	99,440
350.73	24,528	86,932	351.24	25,531	99,695
350.74	24,547	87,177	351.25	25,551	99,950
350.75	24,567	87,423	351.26	25,571	100,206
350.76	24,586	87,668	351.27	25,591	100,462
350.77	24,605	87,914	351.28	25,611	100,718
350.78	24,625	88,161	351.29	25,631	100,974
350.79	24,644	88,407	351.30	25,651	101,230
350.80	24,664	88,653	351.31	25,671	101,487
350.81	24,683	88,900	351.32	25,691	101,744
350.82	24,702	89,147	351.33	25,711	102,001
350.83	24,722	89,394	351.34	25,731	102,258
350.84	24,741	89,642	351.35	25,751	102,516
350.85	24,761	89,889	351.36	25,771	102,773
350.86	24,780	90,137	351.37	25,791	103,031
350.87	24,800	90,385	351.38	25,811	103,289
350.88	24,819	90,633	351.39	25,831	103,547
350.89	24,838	90,881	351.40	25,851	103,806
350.90	24,858	91,130	351.41	25,871	104,064
350.91	24,877	91,378	351.42	25,891	104,323
350.92	24,897	91,627	351.43	25,911	104,582
350.93	24,916	91,876	351.44	25,931	104,841
350.94	24,935	92,125	351.45	25,951	105,101
350.95	24,955	92,375	351.46	25,971	105,360
350.96	24,974	92,624	351.47	25,991	105,620
350.97	24,994	92,874	351.48	26,011	105,880
350.98	25,013	93,124	351.49	26,031	106,140
350.99	25,033	93,375	351.50	26,051	106,401
351.00	25,052	93,625	351.51	26,070	106,661
351.01	25,072	93,876	351.52	26,090	106,922
351.02	25,092	94,126	351.53	26,110	107,183
351.03	25,112	94,377	351.54	26,130	107,444
351.04	25,132	94,629	351.55	26,150	107,706
351.05	25,152	94,880	351.56	26,170	107,967
351.06	25,172	95,132	351.57	26,190	108,229
351.07	25,192	95,384	351.58	26,210	108,491
351.08	25,212	95,636	351.59	26,230	108,753

Stage-Area-Storage for Pond 230P: BASIN #3 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
351.60	26,250	109,016
351.61	26,270	109,278
351.62	26,290	109,541
351.63	26,310	109,804
351.64	26,330	110,067
351.65	26,350	110,331
351.66	26,370	110,594
351.67	26,390	110,858
351.68	26,410	111,122
351.69	26,430	111,386
351.70	26,450	111,651
351.71	26,470	111,915
351.72	26,490	112,180
351.73	26,510	112,445
351.74	26,530	112,710
351.75	26,550	112,976
351.76	26,570	113,241
351.77	26,590	113,507
351.78	26,610	113,773
351.79	26,630	114,039
351.80	26,650	114,306
351.81	26,670	114,572
351.82	26,690	114,839
351.83	26,710	115,106
351.84	26,729	115,373
351.85	26,749	115,641
351.86	26,769	115,908
351.87	26,789	116,176
351.88	26,809	116,444
351.89	26,829	116,712
351.90	26,849	116,981
351.91	26,869	117,249
351.92	26,889	117,518
351.93	26,909	117,787
351.94	26,929	118,056
351.95	26,949	118,326
351.96	26,969	118,595
351.97	26,989	118,865
351.98	27,009	119,135
351.99	27,029	119,405
352.00	27,049	119,676
352.01	27,069	119,946
352.02	27,090	120,217
352.03	27,110	120,488
352.04	27,131	120,759
352.05	27,151	121,031
352.06	27,171	121,302
352.07	27,192	121,574
352.08	27,212	121,846
352.09	27,233	122,118
352.10	27,253	122,391
352.11	27,273	122,663
352.12	27,294	122,936
352.13	27,314	123,209
352.14	27,335	123,482
352.15	27,355	123,756
352.16	27,375	124,029
352.17	27,396	124,303
352.18	27,416	124,577
352.19	27,437	124,852
352.20	27,457	125,126
352.21	27,477	125,401
352.22	27,498	125,676
352.23	27,518	125,951
352.24	27,539	126,226
352.25	27,559	126,502
352.26	27,579	126,777
352.27	27,600	127,053
352.28	27,620	127,329
352.29	27,641	127,605
352.30	27,661	127,882
352.31	27,681	128,159
352.32	27,702	128,436
352.33	27,722	128,713
352.34	27,743	128,990
352.35	27,763	129,268
352.36	27,783	129,545
352.37	27,804	129,823
352.38	27,824	130,101
352.39	27,845	130,380
352.40	27,865	130,658
352.41	27,885	130,937
352.42	27,906	131,216
352.43	27,926	131,495
352.44	27,947	131,775
352.45	27,967	132,054
352.46	27,987	132,334
352.47	28,008	132,614
352.48	28,028	132,894
352.49	28,049	133,174
352.50	**28,069**	**133,455**

B E A L S + T H O M A S

Standard 4: Water Quality Volume Summary

$V_{WQ} = (D_{WQ} / 12\ in/ft) \times (A_{IMP} \times 43{,}560\ SF/Ac)$ **where:**

V_{WQ} = Required Water Quality Volume [CF]

D_{WQ} = Water Quality Depth : 1-inch for discharges within a Zone II or Interim Wellhead Protection Area, to or near critical areas, runoff from LUHPPL, or exfiltration to soil with infiltration rate 2.4 in/hr or greater; ½-inch for discharges to other areas.

A_{IMP} = Post-development Impervious Area; may exclude roof top areas [Ac]

Required Water Quality Volume:

Drainage Area/ Treatment Train	A_{IMP} [Ac]	D_{WQ} [in]	V_{WQ} Required [CF]	
WQI-1	2.204	0.5	4,000	
WQI-2	0.884	0.5	1,604	
WQI-3	3.673	0.5	6,667	
WQI-4	0.230	0.5	417	
WQI-5	0.230	0.5	417	
Total Required Water Quality Volume:			13,104	Cubic Feet

Provided Water Quality Volume:

Drainage Area/ Treatment Train	BMP	Water Quality Volume Provided [CF]	
WQI-1	Proprietary Unit	4,000	
WQI-2	Proprietary Unit	1,604	
WQI-3	Proprietary Unit	6,667	
WQI-4	Proprietary Unit	417	
WQI-5	Proprietary Unit	417	
Total Provided Water Quality Volume:		13,104	Cubic Feet

DOES NOT COMPLY WITH THE STANDARD

JOB NO. 3077.06 COMPUTED BY: RFK CHECKED BY: TJM

JOB: Lackey Dam Logistics Center DATE: 05/13/22 DATE: 5/16/22

B E A L S + T H O M A S

Proprietary Water Quality Inlet Sizing

Step 1: Define Minimum Flow Rate per Water Quality Inlet to Treat Desired Water Quality Volume

Water quality inlets are sized based on flow rate; therefore expressing Water Quality Volume as a flow rate based on the percentage of cumulative average volume captured ensures systems are sized to achieve the desired Water Quality treatment level.

$Q = (q_u)(A)(WQV)$ where:

Q = peak flow rate associated with first 1.0-inch of runoff [CFS]

q_u = The Peak Discharge [CFS/mi^2/in] Massachusetts DEP Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices

A = Contributing Drainage Area, Impervious Surface Only [Ac]

WQV = The Water Quality Treatment Depth [In]

WQI No.	A (Ac)	Tc (Min)	WQV (in)	q_u (csm/in)	Q (cfs)
WQI-1	2.20	6.0	1.0	774	2.67
WQI-2	0.88	6.0	1.0	774	1.07
WQI-3	3.67	6.0	1.0	774	4.44
WQI-4	0.23	6.0	1.0	774	0.28
WQI-5	0.23	6.0	1.0	774	0.28
Total	7.22	Acres			

Step 2: Size Water Quality Inlet as recommended by Manufacturer

See attached Sizing Report(s) for recommended model(s).

Step 3: Water Quality Volume Provided by WQI unit(s)

Total Impervious Area Treated by WQI unit(s):	7.22	Acres
	314,500	SF
Treated Water Quality Depth :	0.5	inches
(accounted for by Average Water Quality Flow Rate)		
Total Water Quality Volume provided by Water Quality Inlets	**13,104**	**CF**

JOB NO. 3077.06 COMPUTED BY: TJM CHECKED BY:

JOB: Lackey Dam Logistics Center DATE: 05/16/22 DATE:

B E A L S + T H O M A S

Riprap Apron Sizing

Median Stone Sizing:

$$D_{50} = 0.2 D_0 \left(\frac{Q}{\sqrt{g} D_0^{2.5}} \right)^{\frac{4}{3}} \left(\frac{D_0}{TW} \right)$$

Where:

D_0 = Maximum Inside Pipe Diameter (ft)

D_{50} = Median Riprap Diameter (ft)

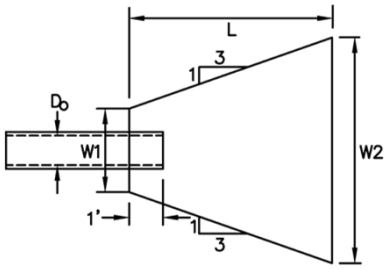
Q = Peak Discharge Rate from Hydraulic Design (cfs)

TW = Tailwater Depth (ft); (Use $0.4D_0$ if TW is unknown, max $1.0D_{o)}$

g = Gravitational Acceleration Constant = 32.2 ft/s^2

Apron Sizing:

D_{50} [In]	Apron Length (L) [ft}	Apron Depth [In]	Apron Width At Beginning	Apron Width At End
5	$4D_0$	$3.5D_{50}$	$3D_0$	$3D_0 + \frac{2}{3}L$
6	$4D_0$	$3.3D_{50}$	$3D_0$	$3D_0 + \frac{2}{3}L$
10	$5D_0$	$2.4D_{50}$	$3D_0$	$3D_0 + \frac{2}{3}L$
14	$6D_0$	$2.2D_{50}$	$3D_0$	$3D_0 + \frac{2}{3}L$
20	$7D_0$	$2.0D_{50}$	$3D_0$	$3D_0 + \frac{2}{3}L$
22	$8D_0$	$2.0D_{50}$	$3D_0$	$3D_0 + \frac{2}{3}L$



FLARED END SECTION	PIPE DIAMETER (D_0) (FEET)	100-YEAR STORM FLOW (Q) (CFS)	TAILWATER (TW) [ft]	MEDIAN STONE DIAMETER (D_{50}) (INCHES)	APRON LENGTH (L) (FEET)	APRON DEPTH [In]	APRON WIDTH AT BEGINING (W_1) [ft]	APRON WIDTH AT END (W_2) [ft]
FE-09	1.0	0.90	0.4	5	4.00	17.5	3.0	5.7
FE-11	1.5	14.12	0.6	10	7.50	24	4.5	9.5
FE-12	1.0	6.24	0.4	10	5.00	24	3	6.3

Notes

[1] Calculations performed in accordance with Hydraulic Engineering Circular No. 14, Third Edition; Hydraulic Design of Energy Dissipaters for Culverts and Channels, dated July 2006.

[2] Pipe shall extend 1 foot into riprap.

[3] For maximum pipe size of 60".

JOB NO. 3077.06 COMPUTED BY: TJM CHECKED BY:

JOB: Lackey Dam Logistics Center DATE: 05/16/22 DATE:

Attachment 5
Site Owner's Manual

BEALS + THOMAS

Site Owner's Manual

LACKEY DAM LOGISTICS CENTER

Lackey Dam Road
Sutton and Uxbridge, Massachusetts

Prepared for:
US MA Development, LLC
8801 River Crossing Boulevard, Suite 300
Indianapolis, IN, 46240

Prepared by:

BEALS + THOMAS

May 16, 2022

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FIGURES

APPENDICES

1.0 INTRODUCTION

The Site Owner's Manual complies with the Long-Term Pollution Prevention Plan (Standard 4) and the Long-Term Operation and Maintenance Plan (Standard 9) requirements of the 2008 Massachusetts Department of Environmental Protection (DEP) Stormwater Handbook. The Manual outlines source control and pollution prevention measures and maintenance requirements of stormwater best management practices (BMPs) associated with the proposed development.

2.0 SITE OWNER'S AGREEMENT

2.1 Operation and Maintenance Compliance Statement

Site Owner: US MA Development, LLC
8801 River Crossing Boulevard, Suite 300
Indianapolis, IN 46240

Responsible Party: US MA Development, LLC

US MA Development, LLC or their successors shall maintain ownership of the on-site stormwater management system as well as the responsibility for operation and maintenance during the post-development stages of the project. The site has been inspected for erosion and appropriate measures have been taken to permanently stabilize any eroded areas. All aspects of stormwater best management practices (BMPs) have been inspected for damage, wear and malfunction, and appropriate steps have been taken to repair or replace the system or portions of the system so that the stormwater at the site may be managed in accordance with the Stormwater Management Standards. Future responsible parties shall be notified of their continuing legal responsibility to operate and maintain the BMPs. The operation and maintenance plan for the stormwater BMPs is being implemented.

_____ _____
Responsible Party Signature Date

2.2 Stormwater Maintenance Easements

There are no off-site areas utilized for stormwater control, therefore no stormwater management easements are required. The Site Owner will have access to all stormwater practices for inspection and maintenance, including direct maintenance access by heavy equipment to structures requiring regular maintenance.

2.3 Record Keeping

The Site Owner shall maintain a rolling log in which all inspections and maintenance activities for the past three years shall be recorded. The Operation and Maintenance Log includes information pertaining to inspections, repairs, and disposal relevant to the project's stormwater management system. The Log is located in Appendix A.

The Operation and Maintenance Log shall be made available to the Conservation Commission and the DEP upon request. The Conservation Commission and the DEP shall be allowed to enter and inspect the premises to evaluate and ensure that the responsible party complies with the maintenance requirements for each BMP.

2.4 Training

Employees involved in grounds maintenance and emergency response will be educated on the general concepts of stormwater management and groundwater protection. The Site Owner's Manual will be reviewed with the maintenance staff. The staff will be trained on the proper course of action for specific events expected to be incurred during routine maintenance or emergency situations.

3.0 LONG-TERM POLLUTION PREVENTION PLAN

In compliance with Standard 4 of the 2008 DEP Stormwater Management Handbook, this section outlines source control and pollution prevention measures to be employed on-site after construction.

3.1 Storage of Materials and Waste

The site shall be kept clear of trash and debris at all times. Certain materials and waste products shall be stored inside or outside upon an impervious surface and covered, as required by local and state regulations.

3.2 Vehicle Washing

No commercial vehicle washing shall take place on site.

3.3 Routine Inspections and Maintenance of Stormwater BMPs

See Section 4.0 Long-Term Operation and Maintenance Plan, for routine inspection and maintenance requirements for all proposed stormwater BMPs.

3.4 Spill Prevention and Response

A contingency plan shall be implemented to address the spill or release of petroleum products and hazardous materials and will include the following measures:

1. Equipment necessary to quickly attend to inadvertent spills or leaks shall be stored on-site in a secure but accessible location. Such equipment shall include but not be limited to the following: safety goggles, chemically resistant gloves and overshoe boots, water and chemical fire extinguishers, sand and shovels, suitable absorbent materials, storage containers and first aid equipment (i.e. Indian Valley Industries, Inc. 55-gallon Spill Containment kit or approved equivalent).

2. Spills or leaks shall be treated properly according to material type, volume of spillage and location of spill. Mitigation shall include preventing further spillage, containing the spilled material in the smallest practical area, removing spilled material in a safe and environmentally-friendly manner, and remediation of any damage to the environment.

3. For large spills, Massachusetts DEP Hazardous Waste Incident Response Group shall be notified immediately at 888-304-1133 and an emergency response contractor shall be consulted.

3.5 Maintenance of Lawns, Gardens, and other Landscaped Areas

Lawns, gardens, and other landscaped areas shall be maintained regularly by the site owner. Vegetated and landscaped BMPs will be maintained as outlined in Section 4.0.

3.6 Storage and Use of Fertilizers, Herbicides, and Pesticides

All fertilizers, herbicides, and pesticides shall be stored in accordance with local, state, and federal regulations. The application rate and use of fertilizers, herbicides, and pesticides on the site shall at no time exceed local, state, or federal specifications.

3.7 Operation and Management of Septic Systems

The proposed development includes a septic system to treat wastewater. The septic system shall be operated and maintained in accordance with local and state regulations.

3.8 Snow and Deicing Chemical Management

Snow removal and use of deicing chemicals at the proposed development shall comply with the following requirements:

- Plowed snow shall be placed in the areas outside of wetland boundaries and stormwater best management practices. The following maintenance measures shall be undertaken at all snow disposal sites:
  - Debris shall be cleared from an area prior to using it for snow disposal.
  - Debris and accumulated sediments shall be cleared from the site and properly disposed of at the end of the snow season and no later than May 15.
- In accordance with the Massachusetts General Laws, Chapter 85, Section 7A, salt and other de-icing chemicals will be stored at an indoor location. Salt and other deicing chemicals shall be stored in accordance with Massachusetts General Law.
- Sand piles shall be contained and stabilized to prevent the discharge of sand to wetlands or water bodies, and, where feasible, covered.
- Salt storage piles shall be located outside of the 100-year floodplain.
- The application of salt on the proposed parking areas and driveway shall at no time exceed state or local requirements.

4.0 LONG-TERM OPERATION AND MAINTENANCE PLAN

This section outlines the stormwater best management practices (BMPs) associated with the proposed stormwater management system and identifies the long-term inspection and maintenance requirements for each BMP.

4.1 Stormwater Management System Components

The following table outlines the type and quantity of the BMPs and their general location. Please reference the site plans provided in the Figures section for exact location. All BMPs are accessible for maintenance from either the development driveway or parking areas.

BMP Type	Quantity	Location
Catch Basin	25	Throughout the paved parking area and access drives.
Area Drain	5	Along the western side of the site and adjacent to Infiltration Basin 2.
Water Quality Structure	6	Upstream of pipe outfalls into the infiltration basins.
Infiltration Basin	3	At the northeast and southern portions of the site.
Stormwater Outfalls	15	Flared end inlets into infiltration basins, at basin outfall pipes, and rip-rap overflow spillways.

4.2 Inspection and Maintenance Schedules

4.2.1 General Maintenance for Mosquito Control

If necessary to minimize mosquito breeding, a licensed pesticide applicator shall apply larvicides, such as Bacillus sphaericus (Bs) to all catch basins sumps, and water quality inlets. Larvicides shall be applied in compliance with all pesticide label requirements, and will be applied during or immediately after wet weather, unless the product used can withstand extended dry periods. Ensure all manhole covers, and inspection ports are secure to reduce the likelihood of mosquitoes laying eggs in standing water.

4.2.2 Deep Sump and Hooded Catch Basins

Catch basins shall be inspected four times per year, including after the foliage season. Other inspection and maintenance requirements include:

- Units shall be cleaned (organic material, sediment and hydrocarbons removed) four times per year or whenever the depth of deposits is

greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin.
    - Cleanout shall always occur after street sweeping.
- If any evidence of hydrocarbons is found during inspection, the material shall be immediately removed using absorbent pads or other suitable measures and disposed of legally.
- Remove other accumulated debris as necessary.
- Transport and disposal of accumulated sediment off-site shall be in accordance with applicable local, state and federal guidelines and regulations.

4.2.3 Area Drains

Area drains shall be inspected and/or cleaned at least once per year.

4.2.4 Water Quality Structure

Maintenance of water quality structures shall be performed according the recommendations set forth by the manufacturer (see Appendix C. Proprietary Water Quality Structure Technical Manual for complete installation, operation and maintenance procedures). Inspection and maintenance procedures for proprietary devices are provided below:

- Units shall be inspected post-construction, prior to being put into service.
- Units shall be inspected not less than twice per year following installation and no less than once per year thereafter.
- Units shall be inspected immediately after any oil, fuel or chemical spill.
- All inspections shall include checking the oil level and sediment depth in the unit.
- Removal of sediments/oils shall occur per manufacturer recommendations.
- A licensed waste management company shall remove captured petroleum waste products from any oil, chemical or fuel spills and dispose.
- OSHA confined space entry protocols shall be followed if entry into the unit is required.

4.2.5 Infiltration Basins

Infiltration basins shall be inspected and maintained after major storm events (rainfall totals greater than 2.5 inches in 24 hours) during the first three months of operation and twice a year and when there are discharges through the outlet control structure thereafter. Additionally, all pretreatment BMPs

shall be inspected in accordance with the minimal requirements specified for those practices and after all major storm events. Inspections shall include the following measures:

- During and after major storm events, the length of time standing water remains in the basin shall be recorded.
  - If the time is greater than 72 hours, thoroughly inspect the basin for signs of clogging.
  - A corrective action plan shall be developed by a qualified professional to restore infiltrative function. The Site Owner shall take immediate action to implement these corrective measures.
- Examine the outlet structure for evidence of clogging or outflow release velocities that are greater than the design velocity.
- Identify areas of sediment accumulation, differential settlement, cracking, and erosion within the basin.
- Inspect embankments for leakage and tree growth.
- Examine the health of the vegetation within the basin and on the embankments.

Corrective measures shall be taken immediately as warranted by the inspections. If any evidence of hydrocarbons is found during inspection, the material shall be immediately removed using absorbent pads or other suitable measures and legally disposed.

Preventative maintenance shall include the following activities:

- Mow the buffer area and basin bottom and side slopes, if vegetated.
- Remove trash, debris, and accumulated organic matter.
- Remove clippings after mowing.

4.2.6 Stormwater Outfalls

Flared end sections and associated riprap spillways shall be inspected at least once per year and after major storm events (rainfall totals greater than 2.5 inches in 24 hours) to ensure that the stability of the outlet area is maintained. The outfall area shall be kept clear of debris such as trash, branches, and sediment. Repairs shall be made immediately if riprap displacement or downstream channel scour is observed.

4.3 Estimated Operation and Maintenance Budget

An operations and maintenance budget was prepared to approximate the annual cost of the inspections required in compliance with the DEP Stormwater Management Policy. The table below estimates the annual cost to inspect and maintain each proposed BMP, based on the requirements in Section 4.2.

BMP Type	# of BMPS	Annual O&M Cost (per BMP)[1]	Total Cost
Mosquito Control	25	$50-$100	$1250-$2,500
Catch Basin	25	$200-$400	$5000-$10,000
Area Drain	5	$50-$100	$250-$500
Water Quality Structure	6	$100-$300	$600-$1,800
Infiltration Basin	3	$200 - $400	$600-$1,200
Stormwater Outfalls (Flared Ends & Spillways)	15	$50-$100	$750-$1,500
		Total	**$8,450-$17,500**

4.4 Public Safety Features

Multiple safety measures are proposed to protect the public and prevent pollutant contamination of the stormwater management system and other water resources. Guardrails along the access driveway will prevent cars from inadvertently detouring down steep side slopes and into adjacent stormwater basins. They will provide protection to the public and prevent pollutant contamination of the stormwater management system and the municipal drainage system.

[1] Annual maintenance cost is based on estimate of the cost to complete all inspection and maintenance measures outlined in Section 4.2. For BMPs that require sediment removal at regular intervals (i.e. every 5 or 10 years), the annual cost includes the annual percentage of that cost.

Figures

Figure 1: Site Plans
(Refer to the Issued Permitting Plans)

Appendices

Appendix A

Operation and Maintenance Log

OPERATION AND MAINTENANCE LOG

This template is intended to comply with the operation and maintenance log requirements of the 2008 DEP Stormwater Management Handbook. Copies of this log should be made for all inspections and kept on file for three years from the inspection date.

Name/Company of Inspector:
Date/Time of Inspection:
Weather Conditions: (Note current weather and any recent precipitation events)

Stormwater BMP	Inspection Observations	Actions Required

Appendix B

List of Emergency Contacts

List of Emergency Contacts:

Massachusetts DEP Hazardous Waste Incident Response Group
Tel: (617) 792-7653

Sutton Fire Department
Emergencies: Dial 911
4 Uxbridge Road
Sutton, MA 01590
Tel: (508) 865-8737

Sutton Police Department
Emergencies: Dial 911
489 Central Turnpike
Sutton, MA 01590
Tel: (508) 865-4449

Uxbridge Fire Department
Emergencies: Dial 911
31 South Main Street
Uxbridge, MA 01569
Tel: (508) 278-2787

Uxbridge Police Department
Emergencies: Dial 911
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Appendix C

Proprietary Separator Technical Manual

CONTECH®
ENGINEERED SOLUTIONS

CDS Guide
Operation, Design, Performance and Maintenance

CDS®

Using patented continuous deflective separation technology, the CDS system screens, separates and traps debris, sediment, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Inline units can treat up to 6 cfs, and internally bypass flows in excess of 50 cfs (1416 L/s). Available precast or cast-in-place, offline units can treat flows from 1 to 300 cfs (28.3 to 8495 L/s). The pollutant removal capacity of the CDS system has been proven in lab and field testing.

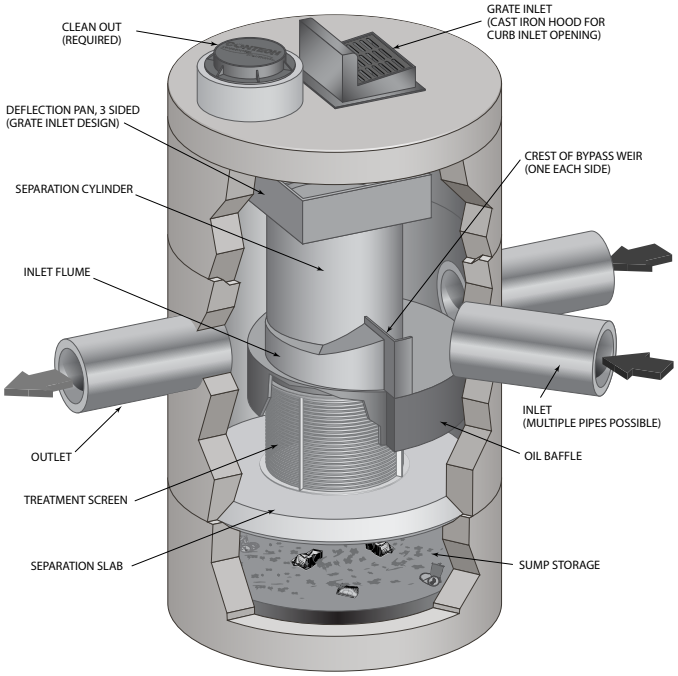
Operation Overview

Stormwater enters the diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed from the flow. All flows up to the system's treatment design capacity enter the separation chamber and are treated.

Swirl concentration and screen deflection force floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.

Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During the flow events exceeding the treatment design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants are retained in the separation cylinder.



Design Basics

There are three primary methods of sizing a CDS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow rate for a defined particle size. The Rational Rainfall Method™ or the and Probabilistic Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically in the Unites States, CDS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a gradation with an average particle size (d50) of 125 microns (μm). For some regulatory environments, CDS systems can also be designed to achieve an 80% annual solids load reduction based on an average particle size (d50) of 75 microns (μm) or 50 microns (μm).

Water Quality Flow Rate Method

In some cases, regulations require that a specific treatment rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval, e.g. the six-month storm, or a water quality depth, e.g. 1/2-inch (13 mm) of rainfall.

The CDS is designed to treat all flows up to the WQQ. At influent rates higher than the WQQ, the diversion weir will direct most flow exceeding the WQQ around the separation chamber. This allows removal efficiency to remain relatively constant in the separation chamber and eliminates the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the CDS will remove a specific gradation of sediment at a specific removal efficiency. Therefore the treatment flow rate is variable, based on the gradation and removal efficiency specified by the design engineer.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.

Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes, or hourly, and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS system are

determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Probabilistic Rational Method

The Probabilistic Rational Method is a sizing program Contech developed to estimate a net annual sediment load reduction for a particular CDS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics.

The Probabilistic Method is an extension of the Rational Method used to estimate peak discharge rates generated by storm events of varying statistical return frequencies (e.g. 2-year storm event). Under the Rational Method, an adjustment factor is used to adjust the runoff coefficient estimated for the 10-year event, correlating a known hydrologic parameter with the target storm event. The rainfall intensities vary depending on the return frequency of the storm event under consideration. In general, these two frequency dependent parameters (rainfall intensity and runoff coefficient) increase as the return frequency increases while the drainage area remains constant.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Method. Since most sites are relatively small and highly impervious, the Rational Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS are determined. Performance efficiency curve on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Treatment Flow Rate

The inlet throat area is sized to ensure that the WQQ passes through the separation chamber at a water surface elevation equal to the crest of the diversion weir. The diversion weir bypasses excessive flows around the separation chamber, thus preventing re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The hydraulic capacity of a CDS system is determined by the length and height of the diversion weir and by the maximum allowable head in the system. Typical configurations allow hydraulic capacities of up to ten times the treatment flow rate. The crest of the diversion weir may be lowered and the inlet throat may be widened to increase the capacity of the system at a given water surface elevation. The unit is designed to meet project specific hydraulic requirements.

Performance

Full-Scale Laboratory Test Results

A full-scale CDS system (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This CDS unit was evaluated under controlled laboratory conditions of influent flow rate and addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSDs) of the test materials were analyzed using standard method "Gradation ASTM D-422 "Standard Test Method for Particle-Size Analysis of Soils" by a certified laboratory.

UF Sediment is a mixture of three different products produced by the U.S. Silica Company: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation (d50 = 20 to 30 μm) covering a wide size range (Coefficient of Uniformity, C averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer d50 (d50 for NJDEP is approximately 50 μm) (NJDEP, 2003).

The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size (d50) of 106 microns. The PSDs for the test material are shown in Figure 1.

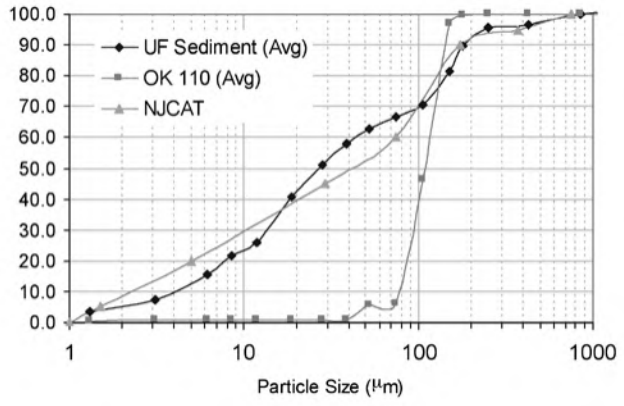


Figure 1. Particle size distributions

Tests were conducted to quantify the performance of a specific CDS unit (1.1 cfs (31.3-L/s) design capacity) at various flow rates, ranging from 1% up to 125% of the treatment design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations of approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC) testing using ASTM D3977-97 "Standard Test Methods for Determining Sediment Concentration in Water Samples", and particle size distribution analysis.

Results and Modeling

Based on the data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve representative of the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect

to SSC removal for any particle size gradation, assuming the particles are inorganic sandy-silt. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand) as a function of operating rate.

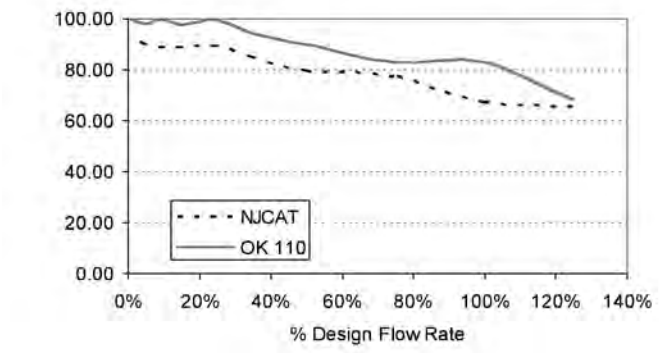


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size (d50) of 125 microns (e.g. Washington State Department of Ecology — WASDOE - 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). The model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at the design (100%) flow rate, for this particle size distribution (d50 = 125 μm).

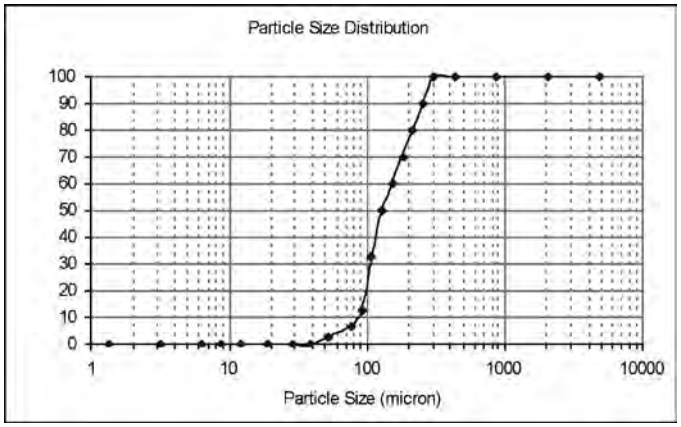


Figure 3. WASDOE PSD

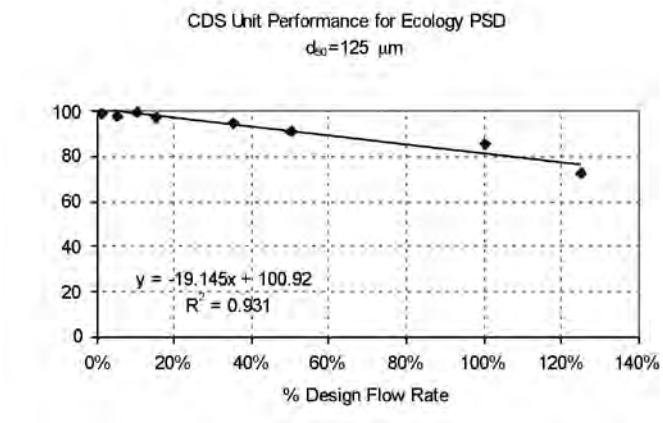


Figure 4. Modeled performance for WASDOE PSD.

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified

during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

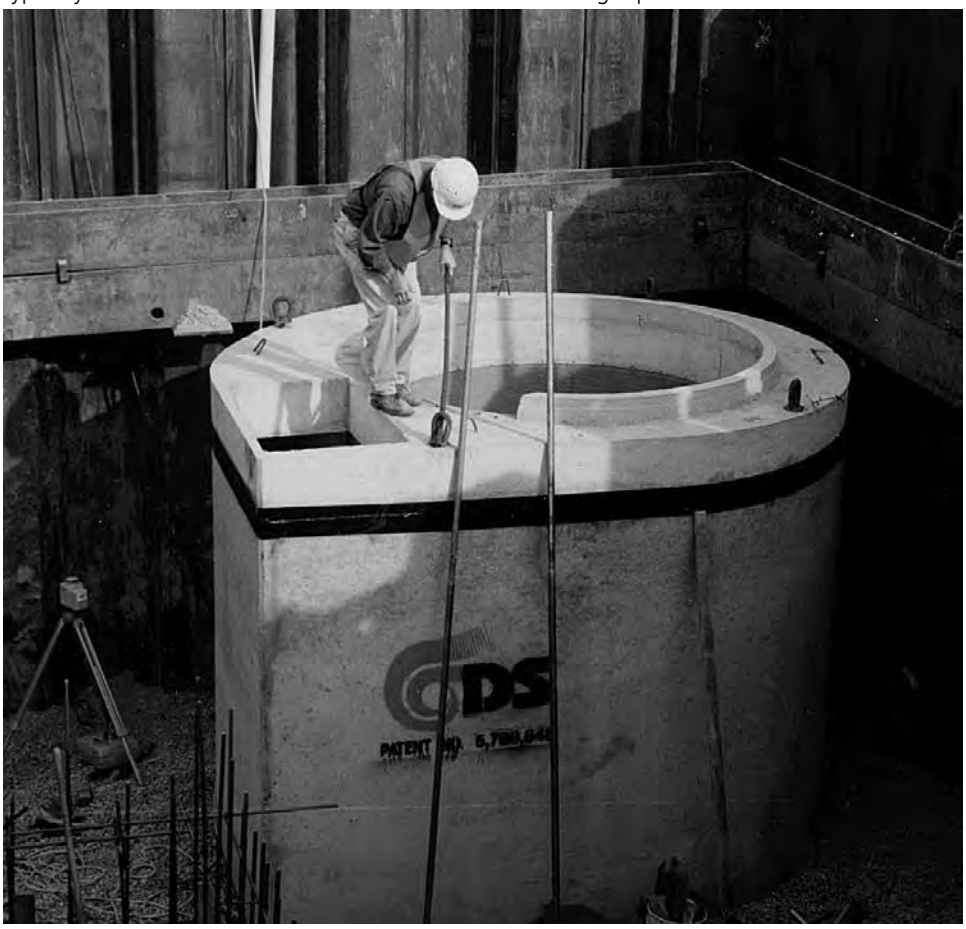
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be cleaned to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Note: To avoid underestimating the volume of sediment in the chamber, carefully lower the measuring device to the top of the sediment pile. Finer silty particles at the top of the pile may be more difficult to feel with a measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.



CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile**.

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SUPPORT

- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

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The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; related foreign patents or other patents pending.

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