STORMWATER MANAGEMENT REPORT

FOR: F & D REALTY LLC

PROPOSED SITE IMPROVEMENTS

163 ELM STREET

SALISBURY, MA

TAX MAP 9 LOT No. 31

PREPARED BY:

MILLENNIUM ENGINEERING, INC.
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(978) 463-8980

JUNE 21, 2022

COMMONWEALTH OF MASSACHUSETTS
CHRISTOPHER M.
YORK
CIVIL
No. 49181
REGISTERED
PROFESSIONAL ENGINEER

Christ M. Yo
6-21-22

1.0 INTRODUCTION

1.1 Project Description

F & D Realty LLC proposes to construct two buildings with associated gravel storage areas. Approximately 796 feet of paved driveway, a public water & sewer distribution network, and a stormwater management system will be constructed to support the development. Private utilities including gas, electric, telephone, and cable will also support the development. Access to the site will continue to be provided via Elm Street.

1.2 Existing Site Characteristics

The subject parcel is described as Tax Map 9, Lot No. 31 on the Town of Salisbury, MA Assessor's Map and is bordered by Elm Street to the north. The property is located in the C and C-3 Commercial Zoning Districts. Elevations within the project site range from 52.00' along Elm Street to 8.00' in the wetlands at the rear of the site. These elevations are based upon 1988 NAVD.

The existing parcel is mostly hard packed gravel and is used for storage of materials and vehicles. Up until around 2007, the site was mostly undeveloped woodland with a single-family dwelling at the front of the property. Development of the parcel began with the removal of the dwelling and continued with clearing of a large portion of the site. The remainder of the site is undeveloped woodland. Stormwater runoff patterns generally flow from north to south across the property, feeding the bordering vegetated wetlands. See the accompanying plan for a more detailed description of the existing site conditions and topography.

The lot consists of several soil groups: Windsor loamy sand, 255A (Hydrologic Soil Group A); Deerfield loamy fine sand, 256A (Hydrologic Soil Group A); Hinckley and Windsor soils, 257E (Hydrologic Soil Group A); Ipswich and Westbrook mucky peats, 712A (Hydrologic Soil Group A/D); and Windsor-Rock outcrop complex, 721D (Hydrologic Soil Group A). See Appendix E for the NRCS soil map. In addition, soil evaluations were performed onsite to assist in the design of the stormwater treatment facilities. 19 test pits were performed in March and May 2022 which indicated sandy soils throughout most of the site. Silty loam soils were encountered at the rear of the site.

1.3 Proposed Site Features

The proposed development consists of 2 proposed buildings along nearly 800 linear feet of 24' wide paved driveway. Driveway profiles throughout the development are 1.0%. Access into the development is from Elm Street.

The development will include the installation of public and private utilities. The development will tie into the existing water distribution system and the existing wastewater collection system to provide service to the two buildings. Natural gas, electrical, telephone and cable service will be provided.

The storm water management system for the proposed development will consist of vertical granite curbing to direct the runoff to the low points of the driveway. A standard catch basin/manhole and piping system is proposed for the driveway network. From the low point, the runoff will be piped to an infiltration basin.

The paved and gravel areas around the buildings will connect to the drainage network. The gravel storage area located at the end of the paved driveway will be graded towards a drainage swale before discharging into the infiltration basin. The gravel storage area at the rear of the site will drain to a constructed wetland.

2.0 WATERSHED ANALYSIS AND METHODOLOGY

The proposed site is located within Land Subject to Coastal Storm Flowage; therefore, the site does not have to meet Stormwater Management Standard No.2 – Post-development peak discharge rates. However, all impervious areas will be directed to the roadway drainage system and a Stormceptor treatment device as well as a constructed wetland at the rear of the site. The Stormceptor device will remove the required 80% TSS from the runoff prior to leaving the site.

The stormwater runoff management system was analyzed using the storm events of the 2-year, 10-year and 100-year frequency. The analysis was performed using HydroCAD, version 10.00. Using USDA NRCS TR-20 and TR-55 methods of estimating runoff, the program uses the measured characteristics of the site and computes runoff produced by simulated rainfall events. The results are then used to design runoff control structures.

3.0 STORMWATER STANDARDS CALCULATIONS

The Stormwater Management Plan developed for this project incorporates water quantity and quality controls that will protect surface and groundwater resources and adjacent properties from potential impacts due to increased impervious areas on the site. The following provides a brief discussion on how the proposed project will meet the ten established performance standards of the DEP Stormwater Management Policy.

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

No proposed site stormwater conveyance systems will discharge untreated stormwater directly to wetlands or surrounding areas. Stormwater runoff from the proposed driveway and gravel areas will discharge into the proposed infiltration basin and constructed wetland.

2. Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may *be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.*

The proposed site is located within Land Subject to Coastal Storm Flowage; therefore, the site does not have to meet Stormwater Management Standard No.2 – Post-development peak discharge rates.

3. Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best 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 type. 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.

Required Recharge volume, Rv (A soil) = F * impervious area
= 0.60 in * 207,000 s.f.
= 10,363 c.f.

Total Recharge provided = 11,516 c.f.

Drawdown Calculations

Underground Infiltration System

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

Rv=Storage Volume=1,111 c.f.
K=Saturated Hydraulic Conductivity=8.27 in./hr
Bottom Area=830 s.f.

$$\text{Drawdown Time} = \frac{\text{1,111 c.f.}}{\text{(8.27 in/hr)(1ft/12in)(830 s.f.)}}$$

Drawdown Time = 1.9 hours

Infiltration Basin

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

Rv=Storage Volume=10,680 c.f.
K=Saturated Hydraulic Conductivity=8.27 in./hr
Bottom Area=1,825 s.f.

$$\text{Drawdown Time} = \frac{10{,}680 \text{ c.f.}}{(8.27 \text{ in/hr})(1\text{ft}/12\text{in})(1{,}825 \text{ s.f.})}$$

Drawdown Time = 8.5 hours

4. Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when:

a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;
b. Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and
c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

The Massachusetts DEP requires water quality calculations based on 0.5 inch of runoff for the total impervious area associated with the proposed development. The following calculation identifies the water quality volume required.

Total Impervious Area = 207,000 s.f.
207,000 s.f. x 0.5" / 12 (to convert to ft) = 8,625 c.f. of runoff to be treated for water quality.

The proposed development's drainage system must meet the MA Office of Coastal Zone management (CZM)/MA Department of Environmental Protection (DEP) Stormwater Management policy standard of removing 80% of the average annual load of Total Suspended Solids (TSS). The stormwater management system for this development will include the use of a Contech CDS unit for treatment prior to discharge into the drainage system. The following demonstrates that the proposed storm water management system for the development satisfies the requirement for treatment of 80% of total Suspended Solids:

Contech CDS2015-4	83%
Constructed Wetland	80%

5. For land uses with higher potential pollutant loads, 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. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the *regulations promulgated there under at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.*

This project does not qualify as a land use with higher potential pollutant loads.

6. Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.

This project does not fall within a critical area.

7. A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

The proposed development is not considered a redevelopment project and does not meet the requirements of definition for this standard.

8. A plan to control construction-related impacts including 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.

The proposed development design includes erosion and sediment controls to minimize the potential for sedimentation in down gradient resource areas. Reference is made to the project plans for additional information.

9. A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.

An O&M plan has been developed and is included in this report.

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

No illicit discharges exist on the site.

4.0 CONCLUSIONS

The results of this report indicate the proposed stormwater management system for the proposed development is capable of treating the runoff for the 2-year, 10-year and 100-year storm events.

The peak flow rates in this analysis have been conservatively estimated for both the pre- and post-development conditions. Based on the results of the analyses described herein, the proposed development will not increase the runoff rate leaving the site. The proposed storm water management facilities shown on the Site Plan will produce no adverse storm water runoff impacts under the storms analyzed.

5.0 APPENDIX A – STORMWATER REPORT CHECKLIST

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.

[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.

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

COMMONWEALTH OF MASSACHUSETTS
CHRISTOPHER M. YORK
CIVIL
No. 49181
REGISTERED
PROFESSIONAL ENGINEER

Chris M. Y- 6-21-22

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist (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

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

Standard 1: No New Untreated Discharges

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

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

  ☐ is within the Zone II or Interim Wellhead Protection Area

  ☐ is near or to other critical areas

  ☒ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)

  ☐ involves runoff from land uses with higher potential pollutant loads.

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

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

Checklist (continued)

Standard 4: Water Quality (continued)

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

☒ The ½" or 1" Water Quality Volume or

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist (continued)

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

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

☐ Limited Project

☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.

☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area

☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff

☐ Bike Path and/or Foot Path

☐ Redevelopment Project

☐ Redevelopment portion of mix of new and redevelopment.

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

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

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

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

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

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

Checklist (continued)

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

Checklist for Stormwater Report

☐ 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.

6.0 APPENDIX B – LONG-TERM POLLUTION PREVENTION PLAN AND OPERATION & MAINTENANCE PLAN

LONG-TERM POLLUTION PREVENTION PLAN
AND
OPERATION & MAINTENANCE PLAN

For

F & D REALTY LLC
1 MELVIN STREET SUITE D
WAKEFIELD, MA 01880

PROPOSED SITE IMPROVEMENTS
AT 163 ELM STREET

PREPARED BY:

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62 ELM STREET
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JUNE 21, 2022

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This long-term Stormwater Management System Operations and Maintenance (O&M) Plan, filed with the Town of Salisbury, shall be implemented at 163 Elm Street to ensure that the stormwater management system functions as designed. The Owner holds the primary responsibility for overseeing and implementing the O&M Plan and assigning a Property Manager who will be responsible for the proper operation and maintenance of the stormwater structures. In case of transfer of property ownership, future property owners shall be notified of the presence of the stormwater management system and the requirements for proper implementation of the O&M Plan. Included in the manual is a Stormwater Management O&M Plan identifying the key components of the stormwater system and a log for tracking inspections and maintenance.

The stormwater management system protects and enhances the stormwater runoff water quality through the removal of sediment and pollutants, and source control significantly reduces the amount of pollutants entering the system. Preventive maintenance of the system will include a comprehensive source reduction program of regular vacuuming and litter removal, and prohibitions on the use of pesticides.

The purpose of the Stormwater Operations and Maintenance (O&M) plan is to ensure inspection of the system, removal of accumulated sediments, oils, and debris, and implementation of corrective action and record keeping activities.

The ongoing responsibility is the Owner, its successors and assigns. Adequate maintenance is defined in this document as good working condition.

Contact information is provided below:

Responsibility for Operations and Maintenance During Construction
Mark Cardillo
1 Melvin Street Suite D
Wakefield, MA 01880
(617) 719-2238

EROSION AND SEDIMENT CONTROL BMPs

Minimize Disturbed Area and Protect Natural Features and Soil

Topsoil

Topsoil stripped from the immediate construction area can be temporarily stockpiled on site providing that the perimeter of the stockpiles is properly staked with silt fence at the toe of slope. The stockpiles shall be in areas that will not interfere with construction and at least 15 feet away from areas of concentrated flows or pavement. The area shall be inspected weekly for erosion and immediately after storm events. Areas on or around the stockpile that have eroded shall be stabilized immediately with erosion controls.

Stabilize Soils

Temporary Stabilization

- All vegetated areas which do not exhibit a minimum of 85% vegetative growth by Oct. 15th, or which are disturbed after Oct. 15th, shall be stabilized by seeding and installing erosion control blankets on slopes greater than 3:1, and seeding and placing 3 to 4 tons of mulch per acre, secured with anchored netting, elsewhere. The placement of erosion control blankets or mulch and netting shall not occur over accumulated snow or on frozen ground and shall be completed in advance of thaw or spring melt events.
- All ditches or swales which do not exhibit a minimum of 85% vegetative growth by Oct. 15th, or which are disturbed after Oct. 15th, shall be stabilized with stone or erosion control blankets appropriate for the design flow conditions.
- After November 15th, incomplete road surfaces, where work has stopped for the winter season, shall be protected with a minimum of 3 inches of crushed gravel.

Protect Slopes

Geotextile erosion control blankets shall be used to provide stabilization for slopes exceeding 3:1. Prepare soil before installing erosion control blanket, including any necessary application of lime, fertilizer, and seed. Begin at the top of the slope by anchoring the blanket in a 6" deep x 6" wide trench with approximately 12" extended beyond the upslope portion of the trench. Anchor the blanket with a row of staples/stakes approximately 12" apart in the bottom of the trench. Backfill and compact the trench after stapling. Apply seed to compacted soil and fold remaining 12" portion of back over seed and compacted soil. Secure over compacted soil with a row of staples/stakes spaced approximately 12" apart across the width of the blanket. Roll erosion control blanket either down or horizontally across the slope. Blanket will unroll with appropriate side against the soil surface. All blankets must be securely fastened to soil surface by placing staples/stakes in appropriate locations as shown in the staple pattern guide. When using the dot system, staples/stakes should be placed through each of the colored dots corresponding to the appropriate staple pattern. The edges of parallel blankets must be stapled with approximately 2"-5" overlap. Consecutive blankets spliced down the slope must be placed end over end (shingle style) with an approximate 3" overlap. Staple through overlapped area, approximately 12" apart across entire blanket's width. In loose soil conditions, the use of staple or stake lengths greater than 6" may be necessary to properly anchor the blanket.

Establish Perimeter Controls and Sediment Barriers

Silt fence shall be installed along the limit of work. The silt fence shall be installed before construction begins. Wooden posts shall be doubled and coupled at filter cloth seams. Filter cloth shall be fastened securely to support netting with ties spaced every 24" at top, midsection, and bottom. When two sections of filter cloth adjoin each other, they shall be overlapped by 6 inches, folded and stapled. Woodchips shall be installed at downslope side of silt fence and shall remain after silt fence is removed. Silt fence shall be removed upon completion of the project and stabilization of all soil.

Maintenance:
1. Silt fence shall be inspected immediately after each rainfall and at least daily during prolonged rainfall. Any repairs that are required shall be made immediately.
2. If the fabric on the silt fence shall decompose or become ineffective during the expected life of the fence, the fabric shall be replaced promptly.
3. Sediment deposits shall be inspected after every storm event. The deposits shall be removed when they reach approximately one-half the height of the barrier.
4. Sediment deposits that are removed or left in place after the fabric has been removed shall be graded to conform with the existing topography and vegetated.

Establish Stabilized Construction Entrance

A stabilized construction entrance shall be installed before construction begins on the site. The stone anti-tracking pad shall remain in place until the subgrade of pavement is installed.

1. Stone shall be 4-6" stone, reclaimed stone, or recycled concrete equivalent.
2. The length of the stabilized entrance shall not be less than 50'.
3. The thickness of the stone for the stabilized entrance shall not be less than 12".
4. Geotextile filter cloth shall be placed over the entire area prior to placing the stone.
5. All surface water that is flowing to or diverted toward the construction entrance shall be piped beneath the entrance. If piping is impractical, a berm with 5:1 slopes that can be crossed by vehicles may be substituted for the pipe.
6. The entrance shall be maintained in a condition that will prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic top-dressing with additional stone as conditions demand and repair and/or cleanout of any measures used to trap sediment. All sediment spilled, washed, or tracked onto public rights-of-way must be removed promptly.
7. Wheels shall be cleaned to remove mud prior to entrance onto public rights-of way. When washing is required, it shall be done on an area stabilized with stone which drains into an approved sediment trapping device.

Catch Basin Inlet Protection

Inlet protection devices intercept and/or filter sediment before it can be transported from a site into the storm drain system and discharged into a lake, river, stream, wetland, or other waterbody. These devices also keep sediment from filling or clogging storm drain pipes, ditches, and downgradient sediment traps or ponds. A siltsack or approved equal shall be used for catch basin inlet protection. It should be inspected weekly. When the restraint cord is no longer visible, siltsack is full and shall be emptied.

<u>POST-CONSTRUCTION BMPs</u>

Snow and Snow Melt Management

Proper management of snow and snow melt, snow removal and storage, use of deicing compounds, and other practices can minimize major runoff and pollutant loading impacts. Snow will be stored in the areas shown on the site plan. Snow is not to be plowed or piled within the wetlands, wetland buffer, or constructed wetland. Use of alternative deicing compounds, such as calcium chloride and calcium magnesium acetate, will be investigated for use. Professional services will be used for snow management.

Catch Basins

Catch basins are incorporated in the proposed development's stormwater management plan. The sump provides for settlement of suspended solids and a hood is provided to remove floatables and trapped hydrocarbons. It is not anticipated that the proposed paved areas will become an area of high sediment loading. The sump should be inspected and cleaned at least four times per year; the more frequent the cleaning, the less likely sediment will be resuspended and subsequently discharged. Catch basin sediments and debris shall be disposed of at an approved DEP landfill. The Owner shall be responsible for the catch basin cleaning operations.

CDS System

A CDS2015-4 is incorporated into the site design for treatment for the proposed Drainage system. At a minimum, the unit shall be inspected twice per year (spring and fall). The CDS unit should be vacuum cleaned when the level of sediment has reached 75% of capacity in the isolated sump. Sediments and debris shall be disposed of at an approved DEP landfill. The Homeowner's Association shall be responsible for the CDS cleaning operations.

Sediment Forebay

A sediment forebay is included in the stormwater management plan as pretreatment for the constructed wetland. The forebay shall be inspected two times per year by a landscaping contractor hired by the Owner. Sediments removed during cleaning shall be disposed of at an approved DEP landfill.

Infiltration Basin

An infiltration basin is included in the stormwater management plan design for the proposed development. The applicant of the project, through his contractor, will incorporate this sediment control feature into the project during construction activities. The basin shall be protected and shall not be used for sedimentation during construction. The basin shall be inspected monthly during construction and cleaned upon completion of the project. Upon completion of the development, the Owner will be responsible for proper maintenance of the basin. Infiltration basins are prone to clogging and failure, so to ensure proper performance and system longevity, it is imperative the following maintenance schedule is recommended:

a. Mowing: Basin should be mowed periodically; at least once per month in the spring, summer and fall. The vegetation must not be cut shorter than four inches. All grass clippings should be removed and properly disposed of;
b. Sediment and debris removal: Once the basin is in use, it shall be inspected for the first few months after every rainfall event exceeding 2.5 inches over a 24-hour period to endure it is stabilized and functioning properly. If water remains standing in the basin 48-72 hours after the storm, check for clogging. Reasons for clogging include upland sediment erosion, excessive compaction of soils or low spots. Basin should be inspected at least four times per year and after every time drainage flows through the high outlet orifice. Any sediment and debris should be removed manually before the vegetation is adversely impacted. At a minimum, accumulated debris should be removed at least once per year to ensure sediments are not re-suspended. Use deep tilling to break up any clogged surfaces and revegetate immediately. Items to look for during inspection include: signs of settlement, crackling, erosion, leakage in the embankments, tree growth in the embankments, condition of riprap, sediment accumulation and the health of the turf.
c. Basin protection: Efforts should be made, through snow and snow melt management, local bylaws and public education, to protect the basin from damages of snow removal and off-street parking.

Constructed Wetland

A constructed wetland is included in the stormwater management plan design for the proposed development. The Owner shall be responsible for proper maintenance and upkeep of the wetlands. To ensure proper performance and system longevity, the following maintenance schedule is recommended:

a.) Sediment and debris removal: Wetlands should be inspected twice a year by a certified wetland scientist, during both growing and non-growing seasons, in the first 3 years after construction. Observations during the inspections should include:
    i.) Types and distribution of dominant wetland plants in the wetlands;
    ii.) The presence and distribution of planted wetland species versus the presence and distribution of natural wetland species and any signs that natural species are overtaking planted species;

iii.) Accumulation of sediment in the forebay and micropool. Any sediment and debris should be removed manually before the vegetation is adversely impacted;

Wetland protection: Efforts should be made, through snow and snow melt management, local bylaws and public education, to protect the wetlands from damages of snow removal and off street parking.

FINAL STABILIZATION

Permanent Seeding

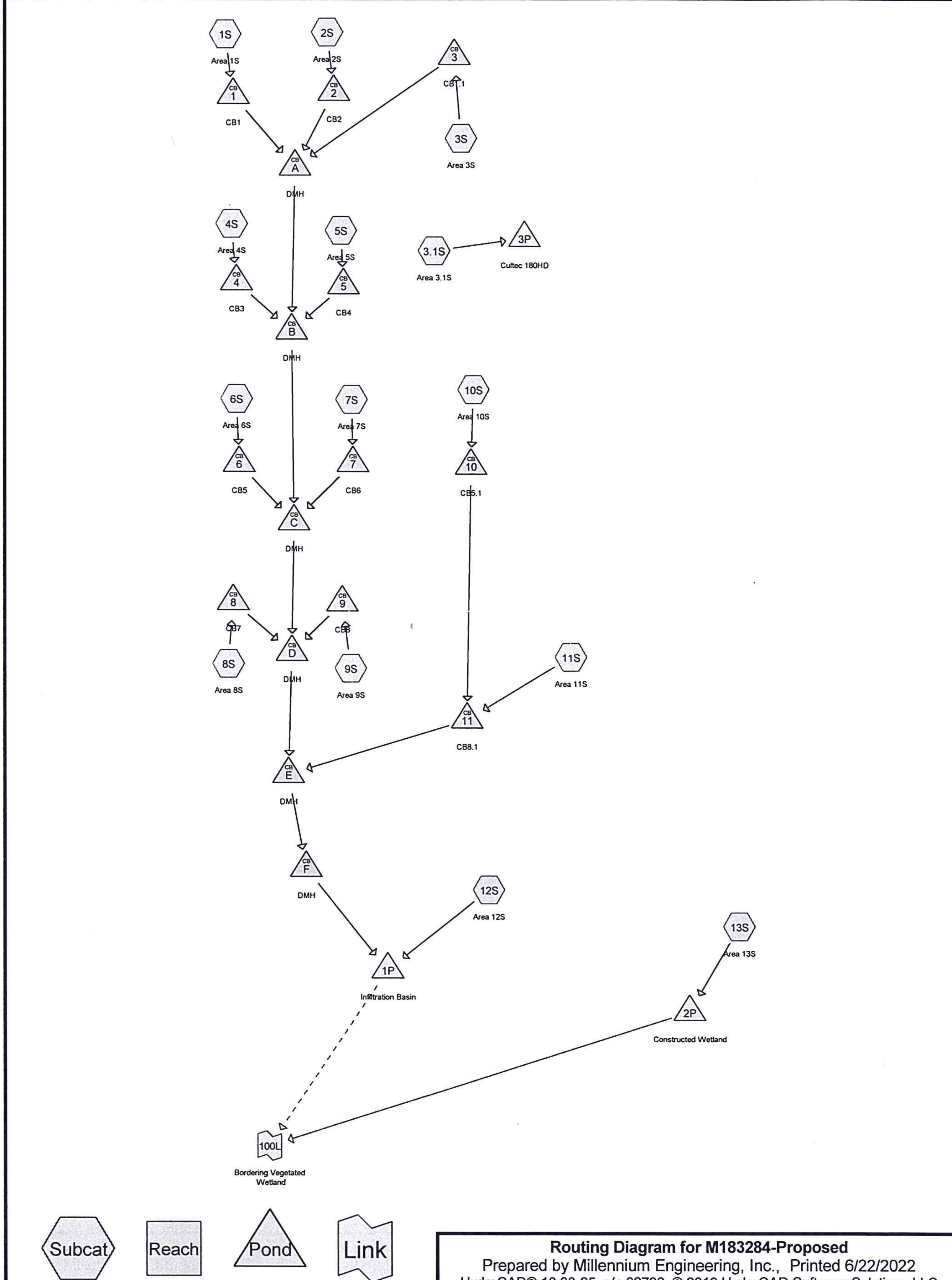
Loam and hydroseed any disturbed surfaces after the final design grades have been achieved. A minimum of 6" of loam shall be installed. Seed mix shall be MA State Slope Mixture (50% creeping red fescue, 30% Kentucky 31 tall fescue, 10% annual ryegrass, 5% red top, 5% ladino clover) and MA State Plot Mixture (50% creeping red fescue, 25% 85/80 Kentucky bluegrass, 10% annual ryegrass, 10% red top, 5% ladino clover).

Construction debris, trash and temporary BMPs (including silt fences, material storage areas, and inlet protection) will also be removed and any areas disturbed during removal will be seeded immediately.

INSPECTION & MAINTENANCE LOG

Activity	*Date*	*Inspected By*	*Findings*
Deep Sump Catch Basin (4x per year)			
CDS2015-4 Cleaning (2x per year)			
Forebay, Infiltration Basin Mowing (1x per month in spring, summer & fall)			
Forebay, Infiltration Basin Inspection & Sediment Removal (4x per year)			
Constructed Wetland Cleaning (2x per year min.)			
Rip-rap Outlets & Emergency Spillway Protection (2x per year)			
Roof Drain Cleanouts (2x per year)			
Vegetation and Landscaping (2x per year)			

7.0 APPENDIX C – POST-DEVELOPMENT DRAINAGE CALCULATIONS



Routing Diagram for M183284-Proposed
Prepared by Millennium Engineering, Inc., Printed 6/22/2022
HydroCAD® 10.00-25 s/n 02736 © 2019 HydroCAD Software Solutions LLC

Summary for Subcatchment 1S: Area 1S

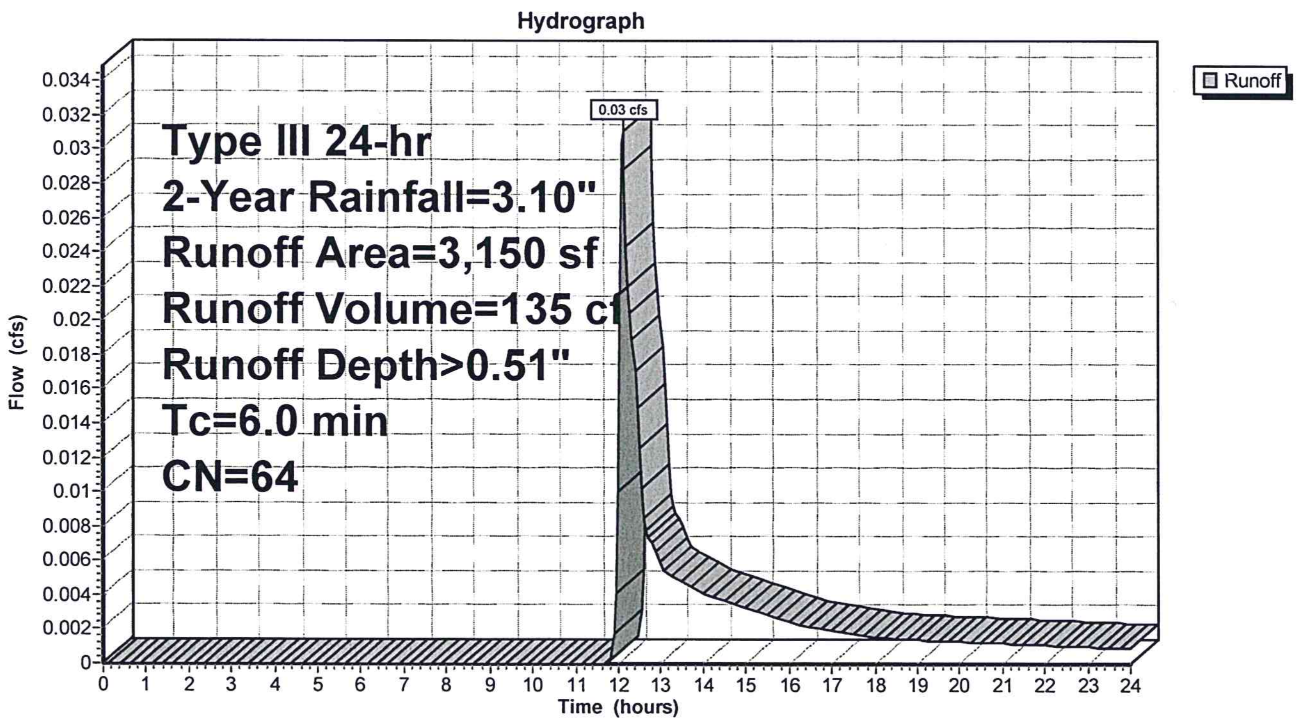
Runoff = 0.03 cfs @ 12.12 hrs, Volume= 135 cf, Depth> 0.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
1,360	98	Paved parking, HSG A
1,790	39	>75% Grass cover, Good, HSG A
3,150	64	Weighted Average
1,790		56.83% Pervious Area
1,360		43.17% Impervious Area

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

Subcatchment 1S: Area 1S



Summary for Pond 1: CB1

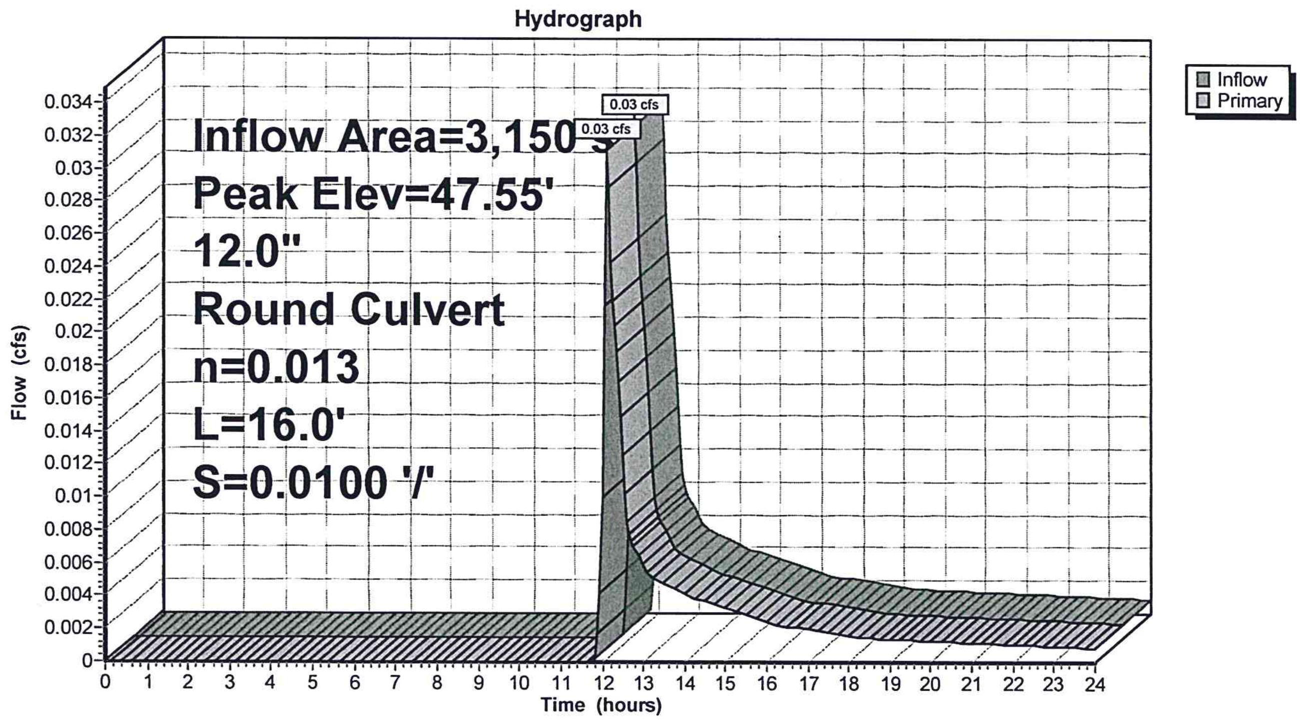
Inflow Area = 3,150 sf, 43.17% Impervious, Inflow Depth > 0.51" for 2-Year event
Inflow = 0.03 cfs @ 12.12 hrs, Volume= 135 cf
Outflow = 0.03 cfs @ 12.12 hrs, Volume= 135 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.03 cfs @ 12.12 hrs, Volume= 135 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 47.55' @ 12.12 hrs
Flood Elev= 50.86'

Device	Routing	Invert	Outlet Devices
#1	Primary	47.46'	**12.0" Round Culvert** L= 16.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 47.46' / 47.30' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.03 cfs @ 12.12 hrs HW=47.55' TW=45.97' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 0.03 cfs @ 1.32 fps)

Pond 1: CB1



Summary for Subcatchment 2S: Area 2S

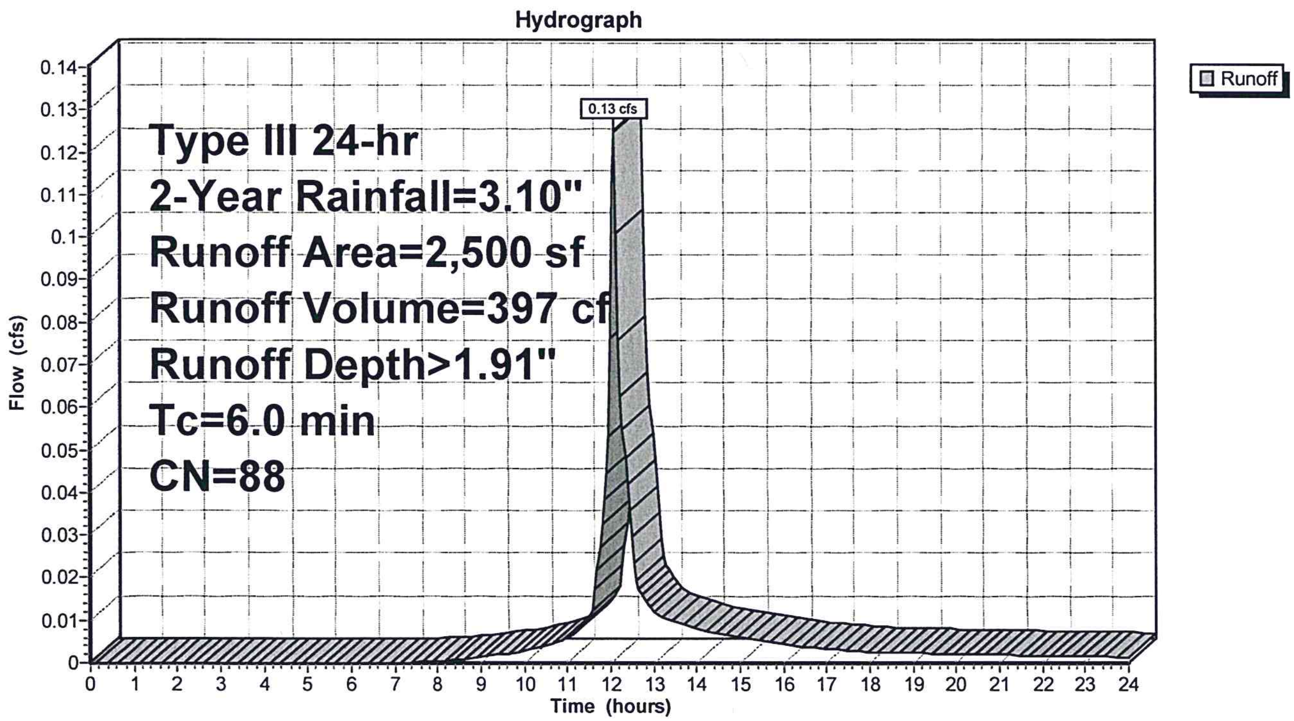
Runoff = 0.13 cfs @ 12.09 hrs, Volume= 397 cf, Depth> 1.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
2,070	98	Paved parking, HSG A
430	39	>75% Grass cover, Good, HSG A
2,500	88	Weighted Average
430		17.20% Pervious Area
2,070		82.80% Impervious Area

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

Subcatchment 2S: Area 2S



Summary for Pond 2: CB2

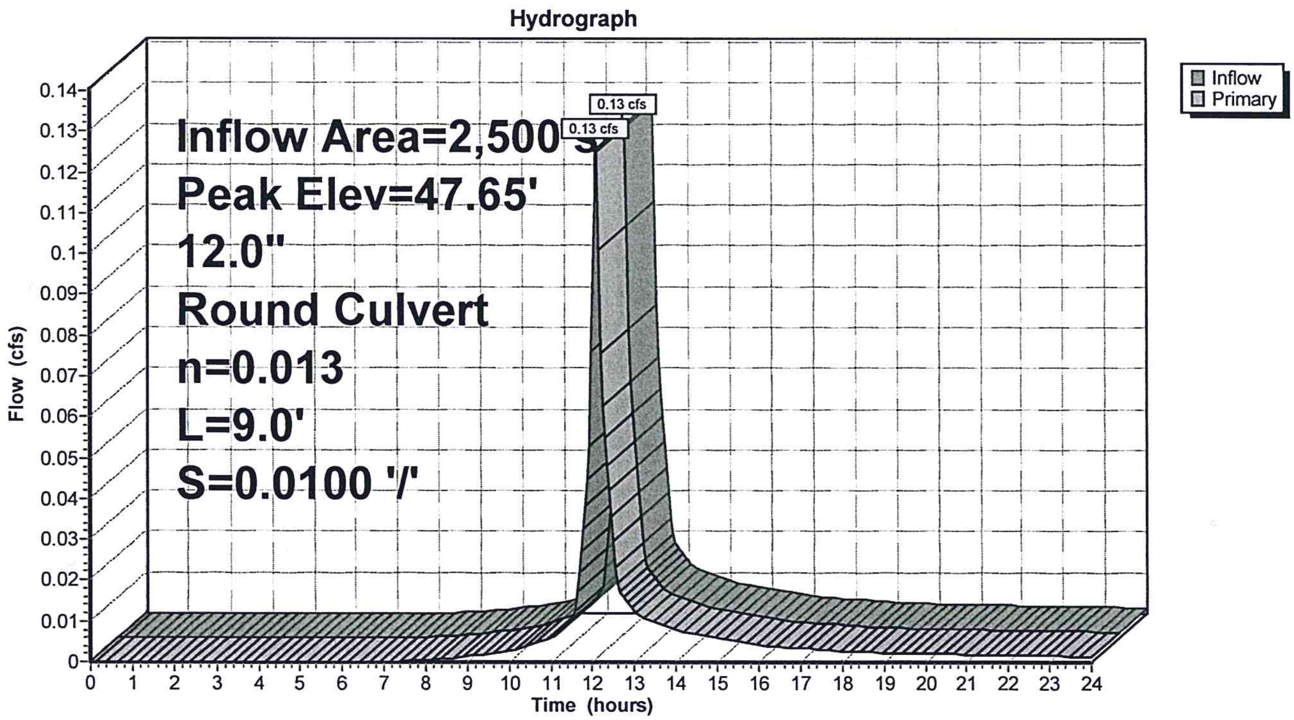
Inflow Area =	2,500 sf,	82.80% Impervious,	Inflow Depth > 1.91"	for 2-Year event
Inflow =	0.13 cfs @	12.09 hrs, Volume=	397 cf	
Outflow =	0.13 cfs @	12.09 hrs, Volume=	397 cf, Atten= 0%, Lag= 0.0 min	
Primary =	0.13 cfs @	12.09 hrs, Volume=	397 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 47.65' @ 12.09 hrs
Flood Elev= 50.86'

Device	Routing	Invert	Outlet Devices
#1	Primary	47.46'	**12.0" Round Culvert** L= 9.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 47.46' / 47.37' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.12 cfs @ 12.09 hrs HW=47.65' TW=45.97' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 0.12 cfs @ 1.83 fps)

Pond 2: CB2



Summary for Subcatchment 3S: Area 3S

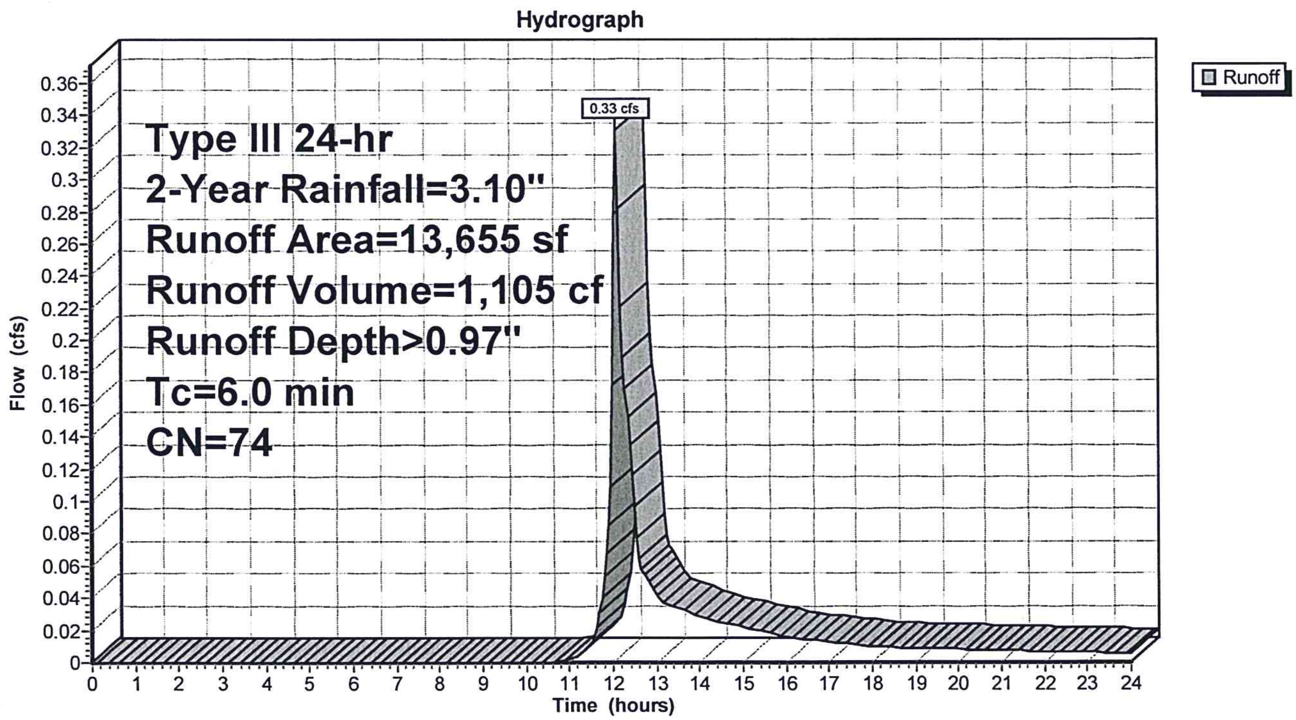
Runoff = 0.33 cfs @ 12.10 hrs, Volume= 1,105 cf, Depth> 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
8,120	98	Paved parking, HSG A
5,535	39	>75% Grass cover, Good, HSG A
13,655	74	Weighted Average
5,535		40.53% Pervious Area
8,120		59.47% Impervious Area

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

Subcatchment 3S: Area 3S



Summary for Pond 3: CB1.1

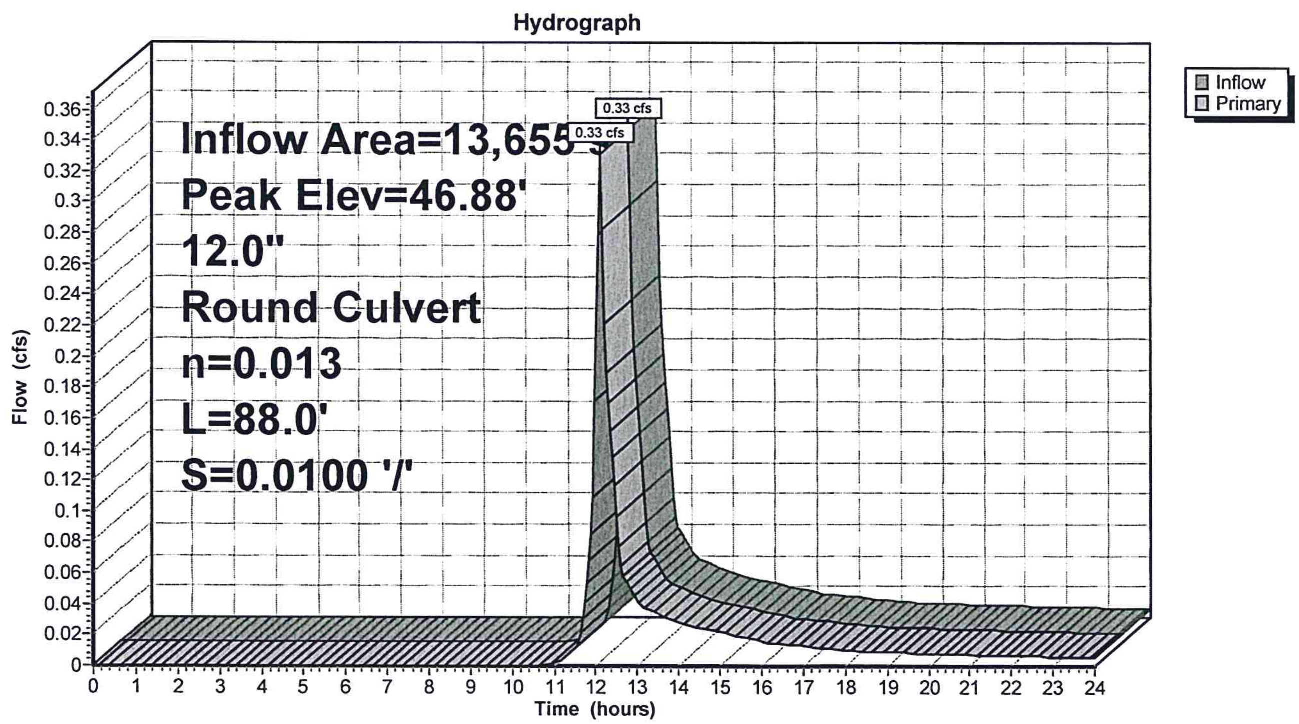
Inflow Area =	13,655 sf,	59.47% Impervious,	Inflow Depth > 0.97"	for 2-Year event
Inflow =	0.33 cfs @	12.10 hrs, Volume=	1,105 cf	
Outflow =	0.33 cfs @	12.10 hrs, Volume=	1,105 cf,	Atten= 0%, Lag= 0.0 min
Primary =	0.33 cfs @	12.10 hrs, Volume=	1,105 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 46.88' @ 12.10 hrs
Flood Elev= 49.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	46.60'	**12.0" Round Culvert** L= 88.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 46.60' / 45.72' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.32 cfs @ 12.10 hrs HW=46.88' TW=45.97' (Dynamic Tailwater)
↑**1=Culvert** (Outlet Controls 0.32 cfs @ 2.66 fps)

Pond 3: CB1.1



Summary for Pond A: DMH

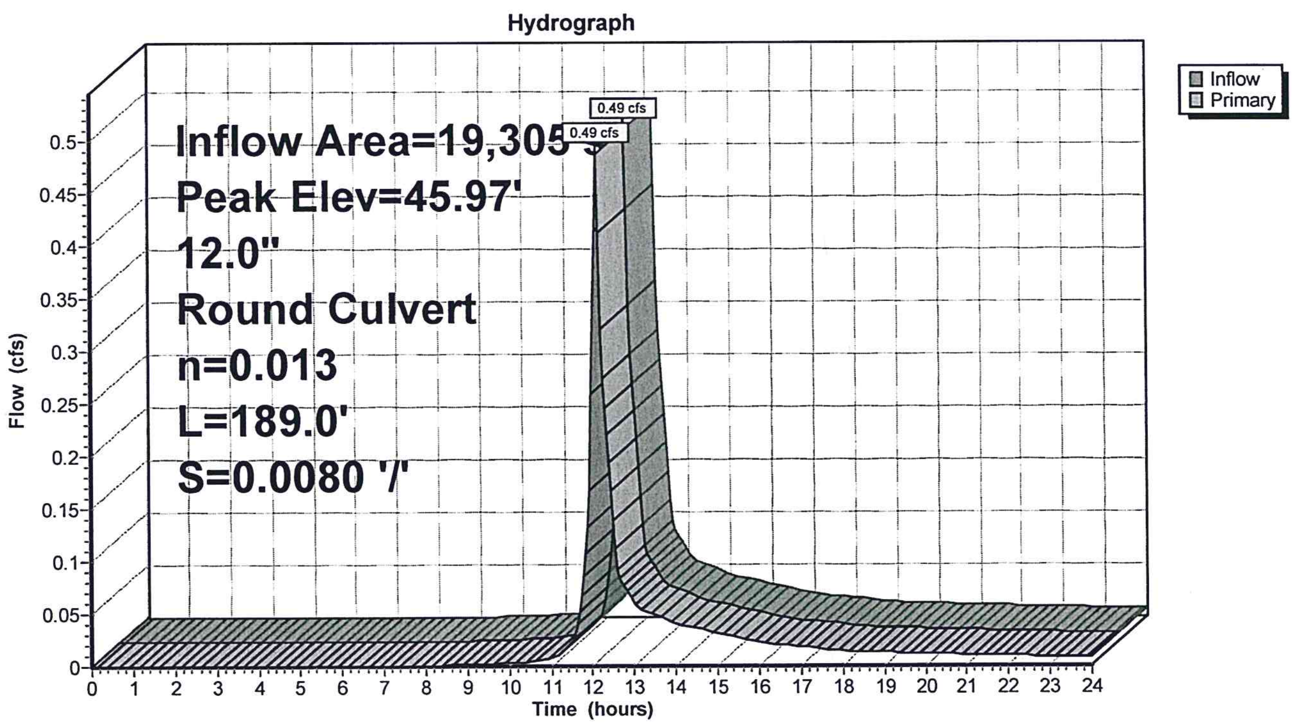
Inflow Area = 19,305 sf, 59.83% Impervious, Inflow Depth > 1.02" for 2-Year event
Inflow = 0.49 cfs @ 12.10 hrs, Volume= 1,637 cf
Outflow = 0.49 cfs @ 12.10 hrs, Volume= 1,637 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.49 cfs @ 12.10 hrs, Volume= 1,637 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 45.97' @ 12.10 hrs
Flood Elev= 51.03'

Device	Routing	Invert	Outlet Devices
#1	Primary	45.60'	**12.0" Round Culvert** L= 189.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 45.60' / 44.09' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.47 cfs @ 12.10 hrs HW=45.97' TW=44.67' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 0.47 cfs @ 2.63 fps)

Pond A: DMH



Summary for Subcatchment 4S: Area 4S

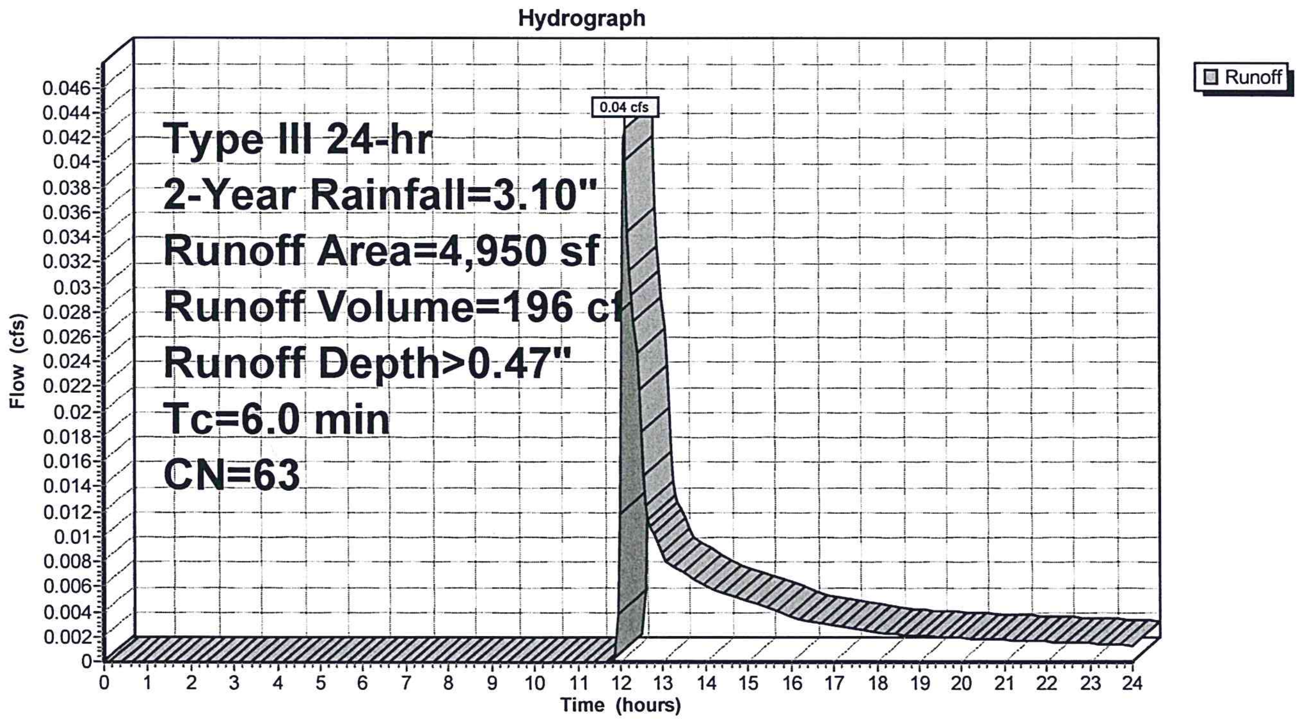
Runoff = 0.04 cfs @ 12.12 hrs, Volume= 196 cf, Depth> 0.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
2,050	98	Paved parking, HSG A
2,900	39	>75% Grass cover, Good, HSG A
4,950	63	Weighted Average
2,900		58.59% Pervious Area
2,050		41.41% Impervious Area

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

Subcatchment 4S: Area 4S



Summary for Pond 4: CB3

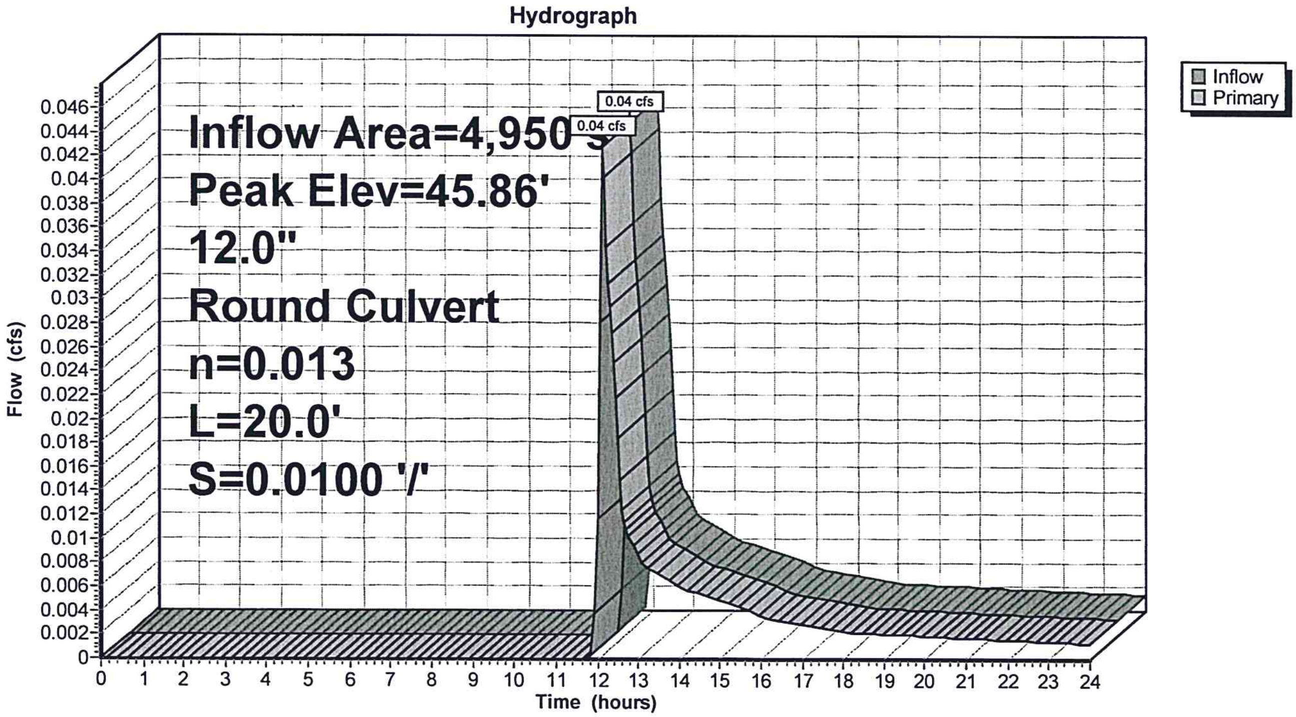
Inflow Area =	4,950 sf,	41.41% Impervious,	Inflow Depth > 0.47"	for 2-Year event
Inflow =	0.04 cfs @	12.12 hrs, Volume=	196 cf	
Outflow =	0.04 cfs @	12.12 hrs, Volume=	196 cf,	Atten= 0%, Lag= 0.0 min
Primary =	0.04 cfs @	12.12 hrs, Volume=	196 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 45.86' @ 12.12 hrs
Flood Elev= 49.15'

Device	Routing	Invert	Outlet Devices
#1	Primary	45.75'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 45.75' / 45.55' S= 0.0100 '/' Cc= 0.900 n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf

Primary OutFlow Max=0.04 cfs @ 12.12 hrs HW=45.85' TW=44.65' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 0.04 cfs @ 1.45 fps)

Pond 4: CB3



Summary for Subcatchment 5S: Area 5S

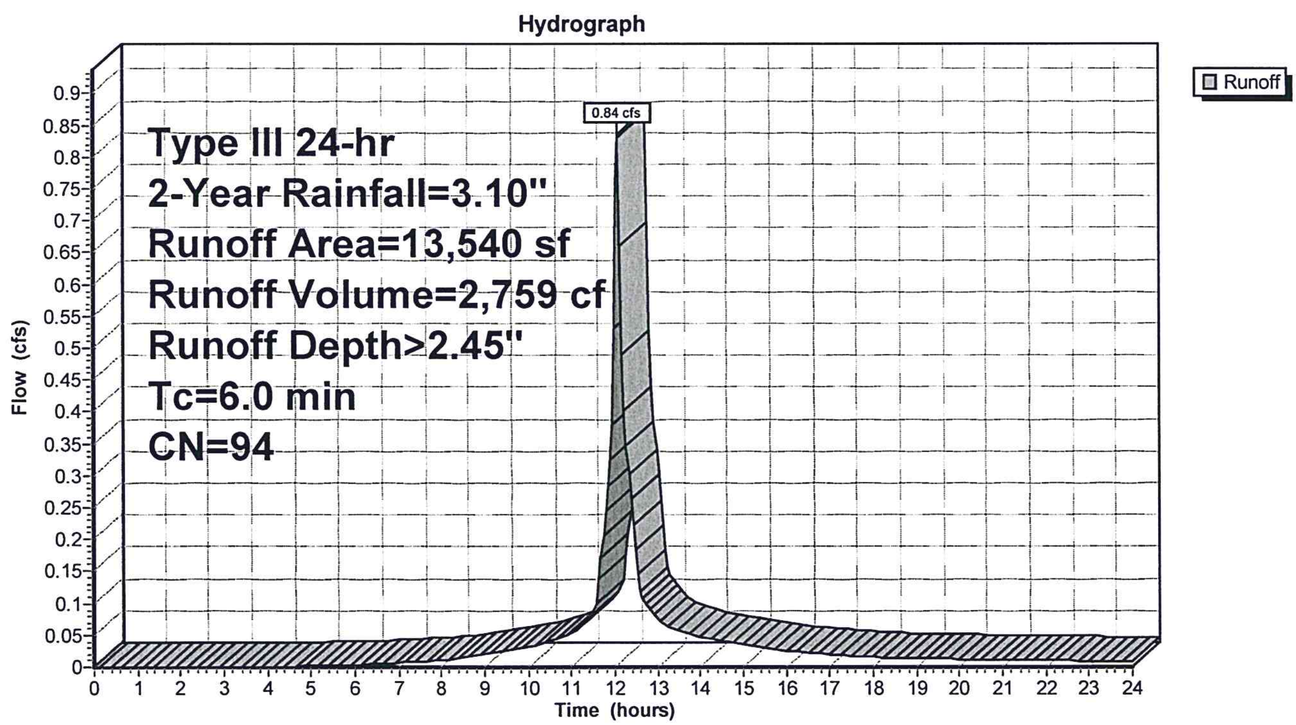
Runoff = 0.84 cfs @ 12.09 hrs, Volume= 2,759 cf, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
12,560	98	Paved parking, HSG A
980	39	>75% Grass cover, Good, HSG A
13,540	94	Weighted Average
980		7.24% Pervious Area
12,560		92.76% Impervious Area

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

Subcatchment 5S: Area 5S



Summary for Pond 5: CB4

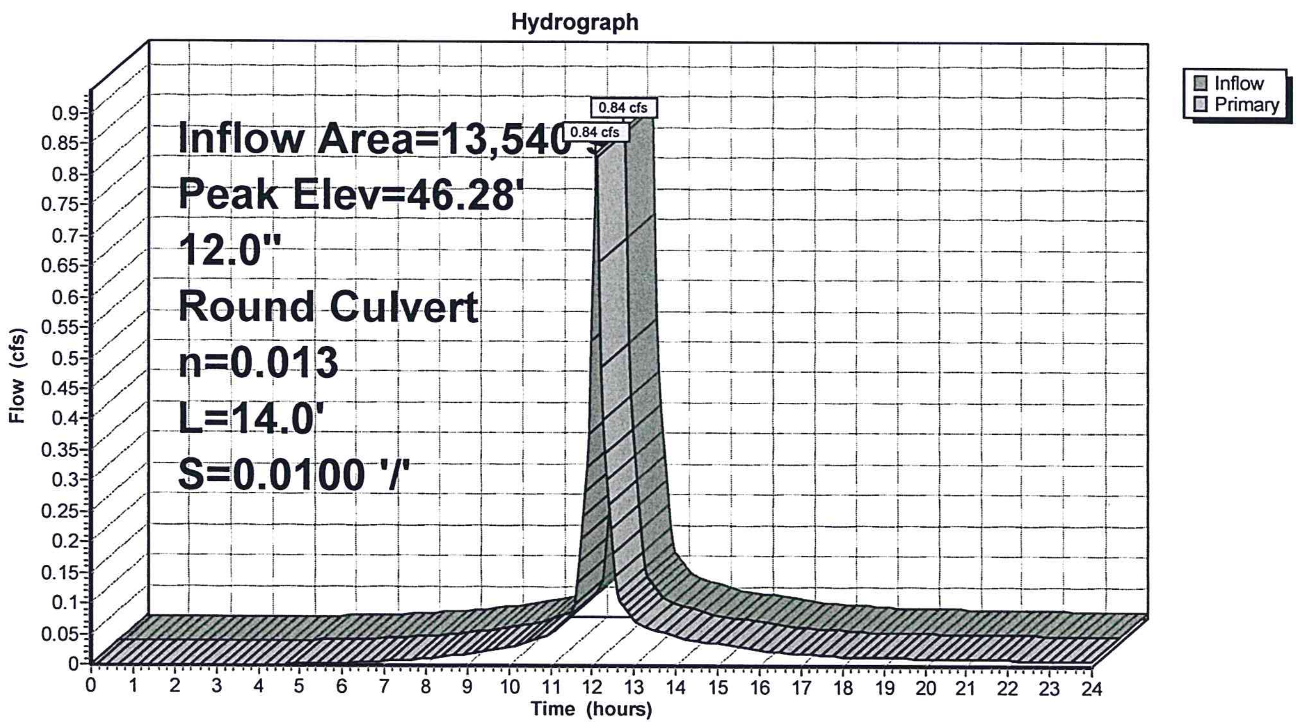
Inflow Area = 13,540 sf, 92.76% Impervious, Inflow Depth > 2.45" for 2-Year event
Inflow = 0.84 cfs @ 12.09 hrs, Volume= 2,759 cf
Outflow = 0.84 cfs @ 12.09 hrs, Volume= 2,759 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.84 cfs @ 12.09 hrs, Volume= 2,759 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 46.28' @ 12.09 hrs
Flood Elev= 49.16'

Device	Routing	Invert	Outlet Devices
#1	Primary	45.76'	**12.0" Round Culvert** L= 14.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 45.76' / 45.62' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.82 cfs @ 12.09 hrs HW=46.28' TW=44.66' (Dynamic Tailwater)
1=Culvert (Barrel Controls 0.82 cfs @ 2.90 fps)

Pond 5: CB4



Summary for Pond B: DMH

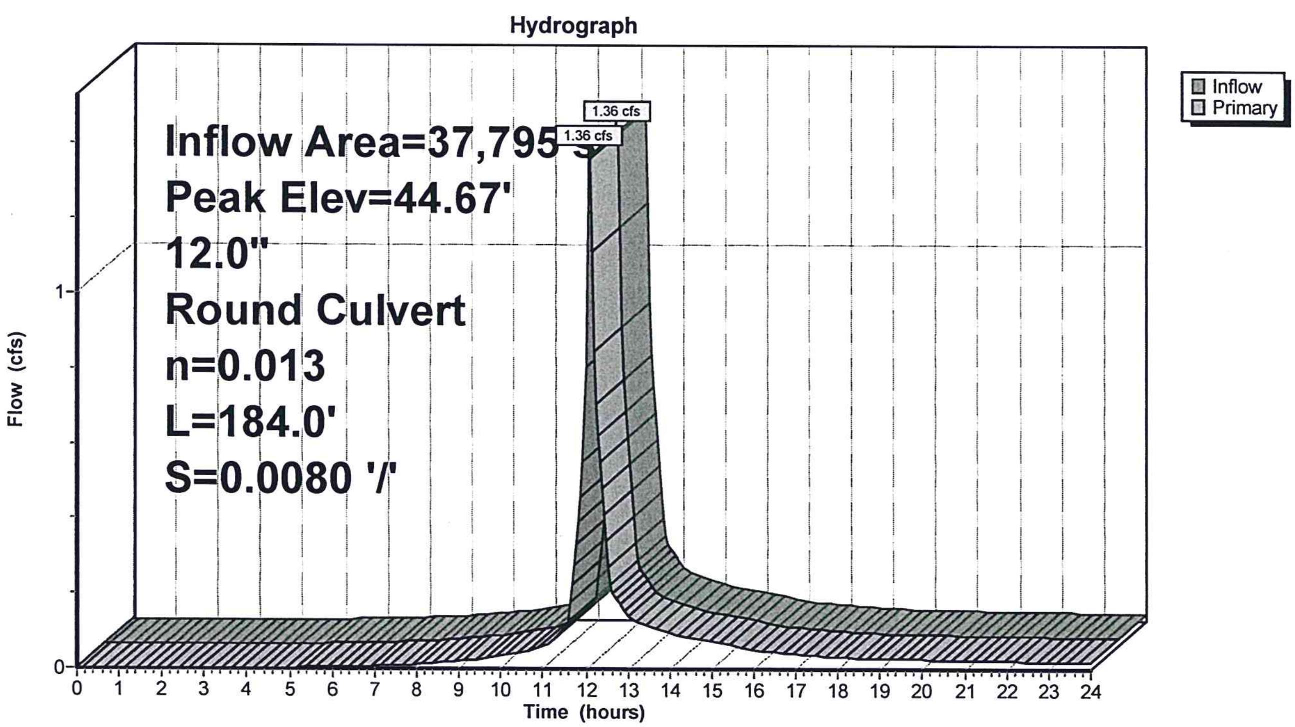
Inflow Area =	37,795 sf, 69.22% Impervious,	Inflow Depth > 1.46"	for 2-Year event	
Inflow =	1.36 cfs @	12.09 hrs, Volume=	4,591 cf	
Outflow =	1.36 cfs @	12.09 hrs, Volume=	4,591 cf,	Atten= 0%, Lag= 0.0 min
Primary =	1.36 cfs @	12.09 hrs, Volume=	4,591 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 44.67' @ 12.10 hrs
Flood Elev= 49.12'

Device	Routing	Invert	Outlet Devices
#1	Primary	43.99'	**12.0" Round Culvert** L= 184.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 43.99' / 42.52' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.28 cfs @ 12.09 hrs HW=44.66' TW=43.51' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 1.28 cfs @ 3.21 fps)

Pond B: DMH



Summary for Subcatchment 6S: Area 6S

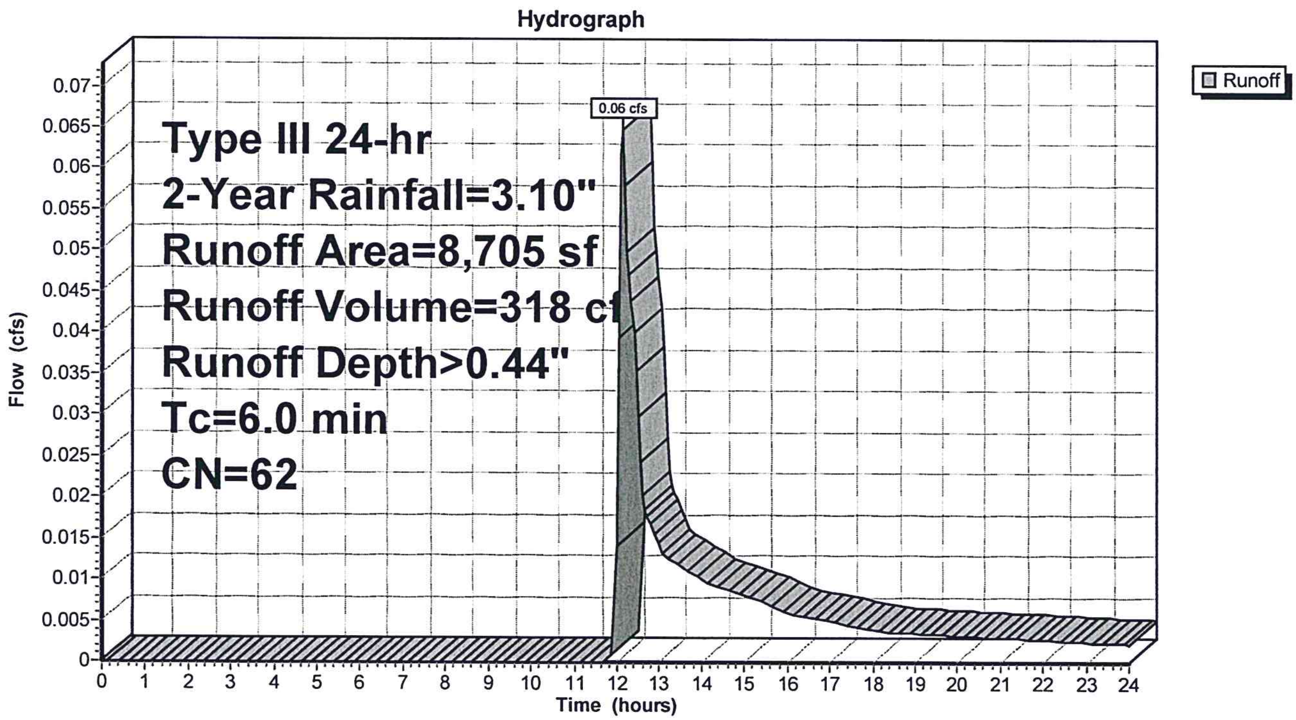
Runoff = 0.06 cfs @ 12.12 hrs, Volume= 318 cf, Depth> 0.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
3,395	98	Paved parking, HSG A
5,310	39	>75% Grass cover, Good, HSG A
8,705	62	Weighted Average
5,310		61.00% Pervious Area
3,395		39.00% Impervious Area

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

Subcatchment 6S: Area 6S



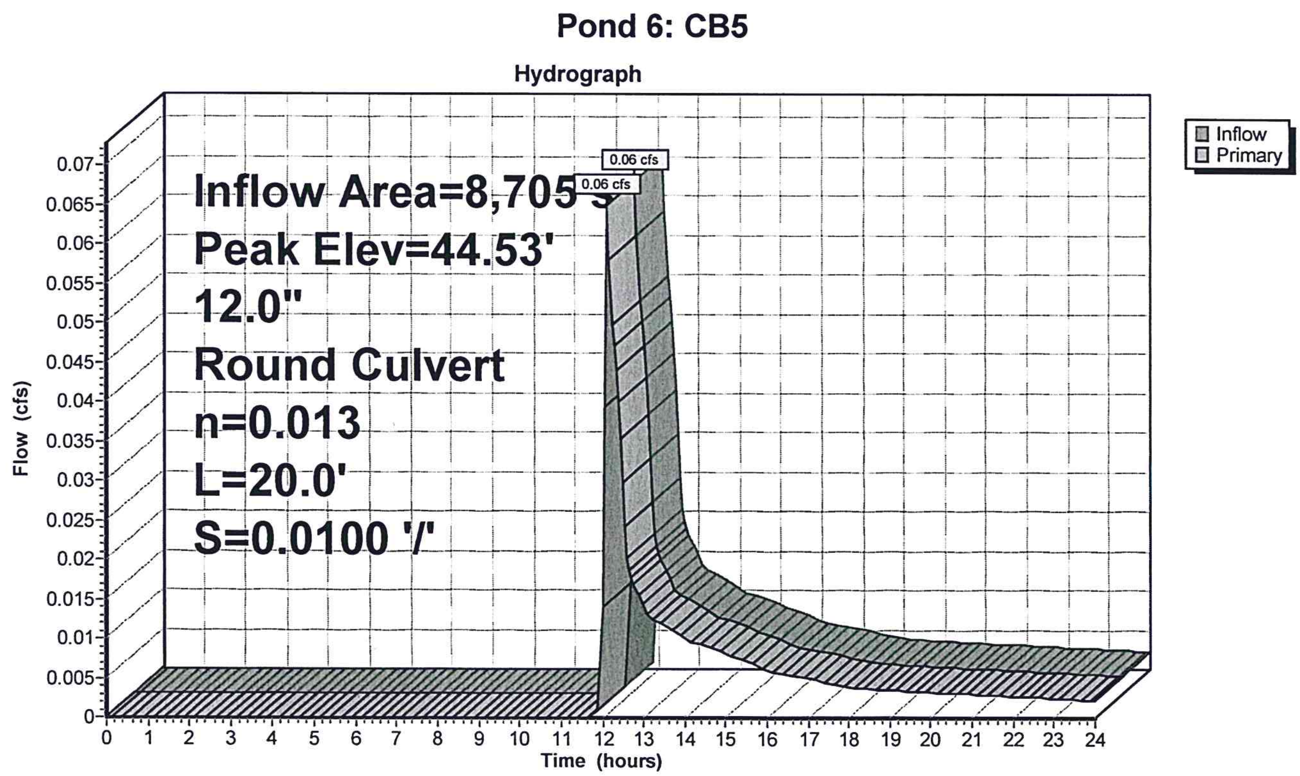
Summary for Pond 6: CB5

Inflow Area =	8,705 sf,	39.00% Impervious,	Inflow Depth > 0.44"	for 2-Year event	
Inflow =	0.06 cfs @	12.12 hrs,	Volume=	318 cf	
Outflow =	0.06 cfs @	12.12 hrs,	Volume=	318 cf,	Atten= 0%, Lag= 0.0 min
Primary =	0.06 cfs @	12.12 hrs,	Volume=	318 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 44.53' @ 12.12 hrs
Flood Elev= 47.80'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.40'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 44.40' / 44.20' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.06 cfs @ 12.12 hrs HW=44.53' TW=43.46' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 0.06 cfs @ 1.63 fps)



Summary for Subcatchment 7S: Area 7S

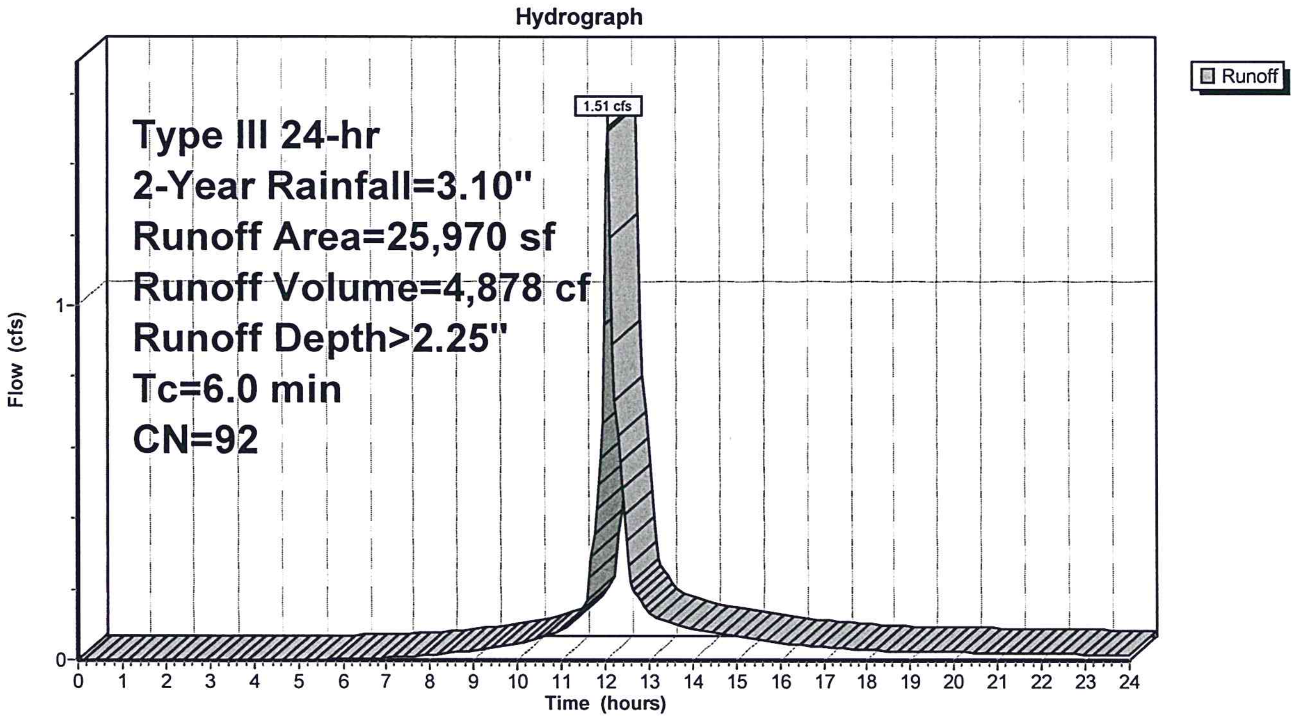
Runoff = 1.51 cfs @ 12.09 hrs, Volume= 4,878 cf, Depth> 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
6,470	98	Paved parking, HSG A
17,620	96	Gravel surface, HSG A
1,880	39	>75% Grass cover, Good, HSG A
25,970	92	Weighted Average
19,500		75.09% Pervious Area
6,470		24.91% Impervious Area

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

Subcatchment 7S: Area 7S



Summary for Pond 7: CB6

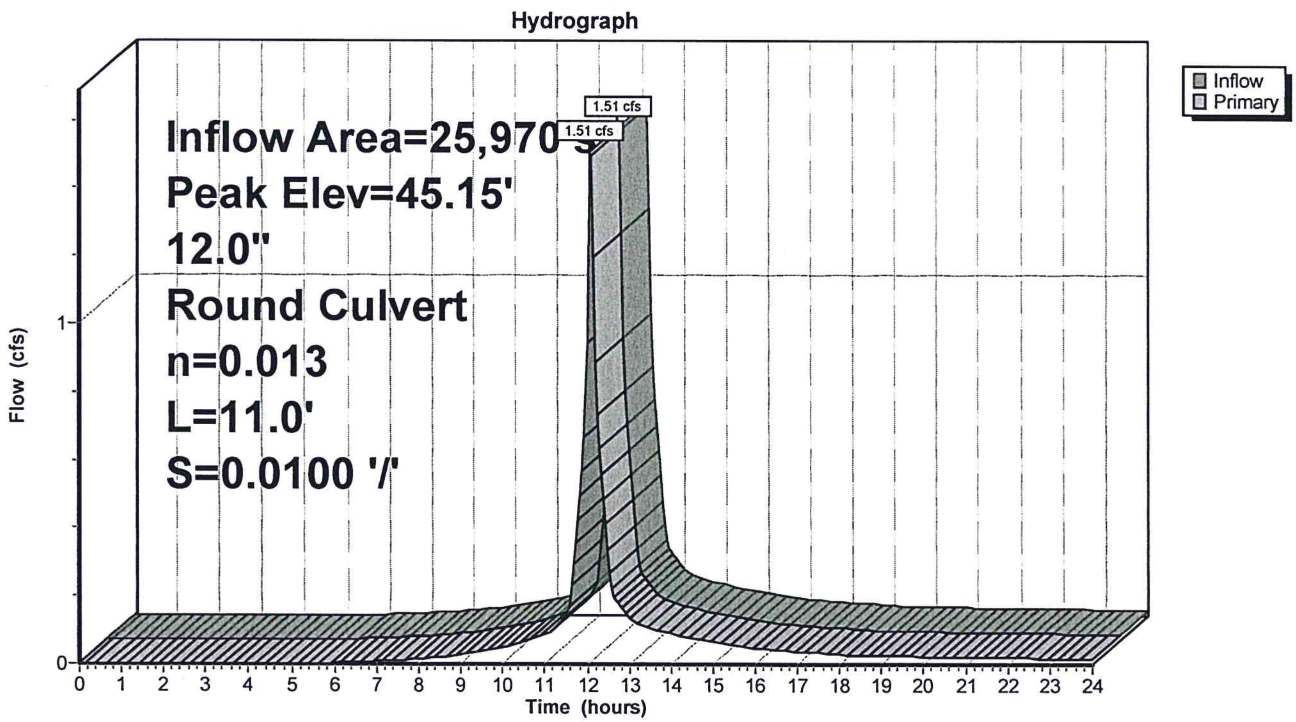
Inflow Area = 25,970 sf, 24.91% Impervious, Inflow Depth > 2.25" for 2-Year event
Inflow = 1.51 cfs @ 12.09 hrs, Volume= 4,878 cf
Outflow = 1.51 cfs @ 12.09 hrs, Volume= 4,878 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.51 cfs @ 12.09 hrs, Volume= 4,878 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 45.15' @ 12.09 hrs
Flood Elev= 47.79'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.39'	**12.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 44.39' / 44.28' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.47 cfs @ 12.09 hrs HW=45.14' TW=43.50' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 1.47 cfs @ 3.25 fps)

Pond 7: CB6



Summary for Pond C: DMH

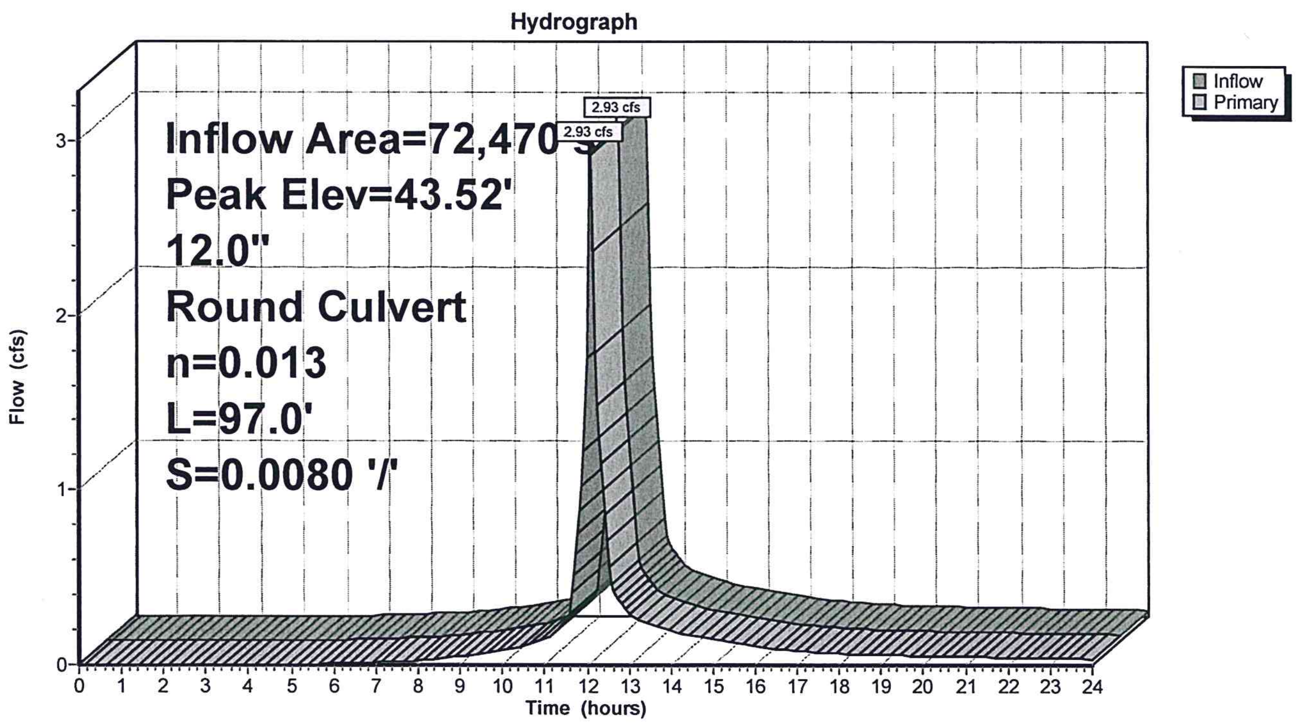
Inflow Area = 72,470 sf, 49.71% Impervious, Inflow Depth > 1.62" for 2-Year event
Inflow = 2.93 cfs @ 12.09 hrs, Volume= 9,787 cf
Outflow = 2.93 cfs @ 12.09 hrs, Volume= 9,787 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.93 cfs @ 12.09 hrs, Volume= 9,787 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 43.52' @ 12.10 hrs
Flood Elev= 47.88'

Device	Routing	Invert	Outlet Devices
#1	Primary	42.42'	**12.0" Round Culvert** L= 97.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 42.42' / 41.64' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.83 cfs @ 12.09 hrs HW=43.51' TW=42.49' (Dynamic Tailwater)
↑**1=Culvert** (Outlet Controls 2.83 cfs @ 4.13 fps)

Pond C: DMH



Summary for Subcatchment 8S: Area 8S

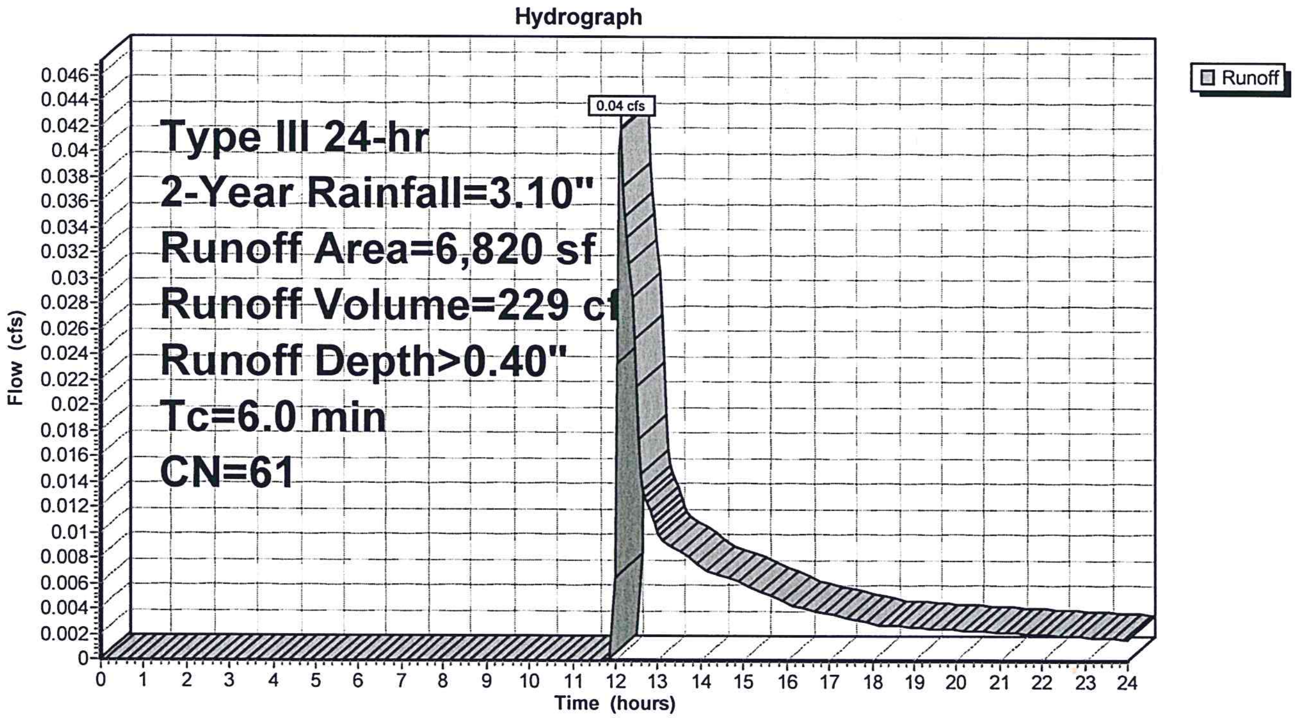
Runoff = 0.04 cfs @ 12.14 hrs, Volume= 229 cf, Depth> 0.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
2,500	98	Paved parking, HSG A
4,320	39	>75% Grass cover, Good, HSG A
6,820	61	Weighted Average
4,320		63.34% Pervious Area
2,500		36.66% Impervious Area

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

Subcatchment 8S: Area 8S



Summary for Pond 8: CB7

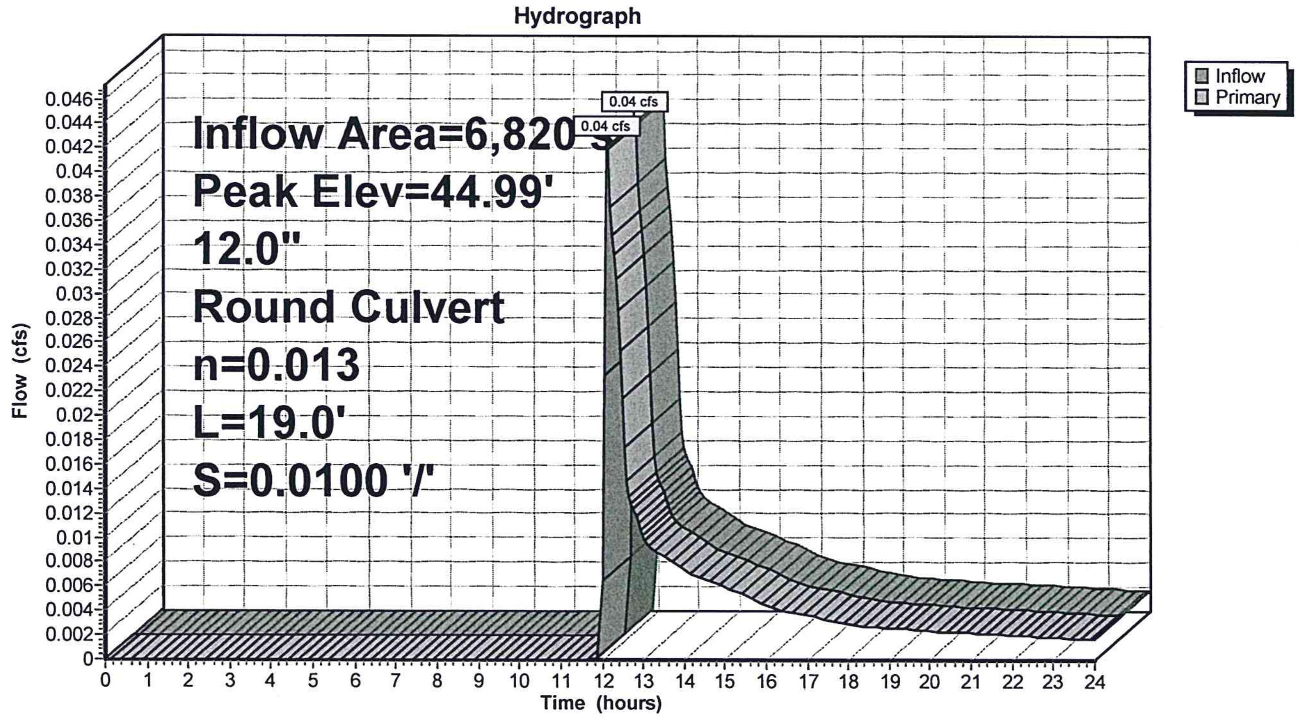
Inflow Area = 6,820 sf, 36.66% Impervious, Inflow Depth > 0.40" for 2-Year event
Inflow = 0.04 cfs @ 12.14 hrs, Volume= 229 cf
Outflow = 0.04 cfs @ 12.14 hrs, Volume= 229 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.04 cfs @ 12.14 hrs, Volume= 229 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 44.99' @ 12.14 hrs
Flood Elev= 48.28'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.88'	**12.0" Round Culvert** L= 19.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 44.88' / 44.69' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.04 cfs @ 12.14 hrs HW=44.98' TW=42.44' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 0.04 cfs @ 1.46 fps)

Pond 8: CB7



Summary for Subcatchment 9S: Area 9S

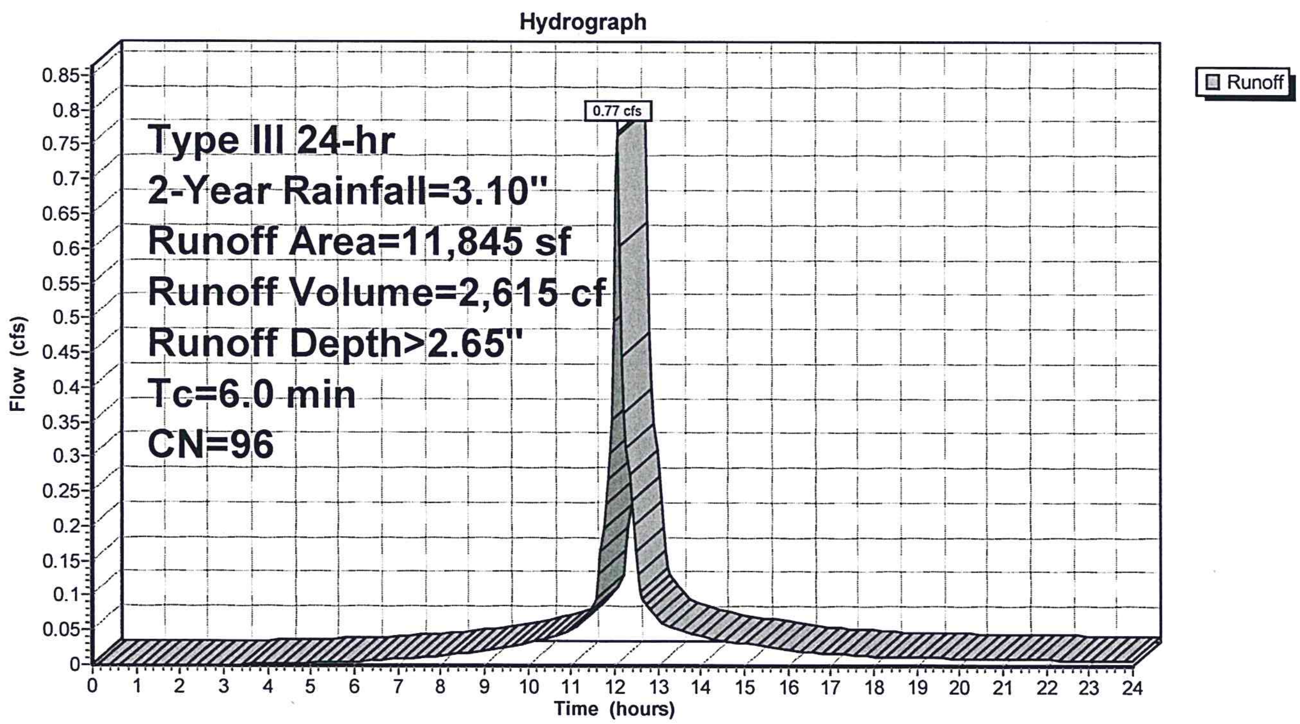
Runoff = 0.77 cfs @ 12.09 hrs, Volume= 2,615 cf, Depth> 2.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
5,280	98	Roofs, HSG A
4,965	98	Paved parking, HSG A
1,200	96	Gravel surface, HSG A
400	39	>75% Grass cover, Good, HSG A
11,845	96	Weighted Average
1,600		13.51% Pervious Area
10,245		86.49% Impervious Area

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

Subcatchment 9S: Area 9S



Summary for Pond 9: CB8

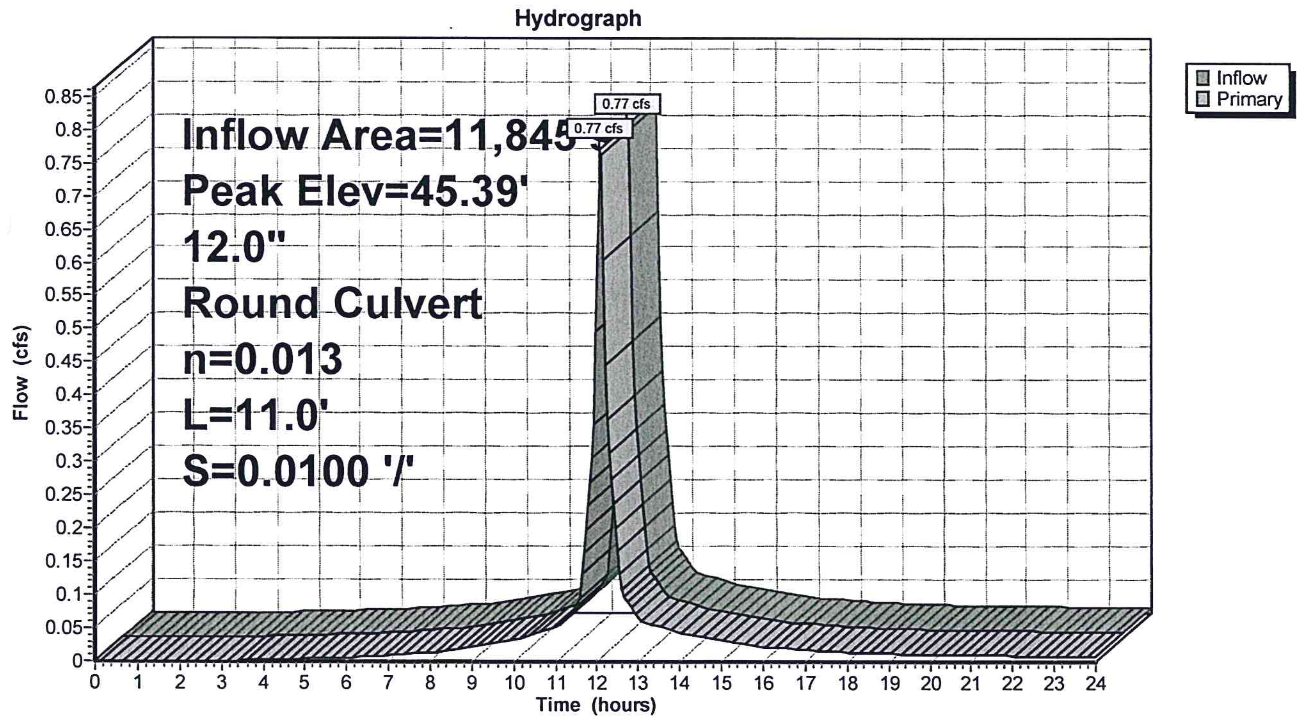
Inflow Area =	11,845 sf,	86.49% Impervious,	Inflow Depth > 2.65"	for 2-Year event
Inflow =	0.77 cfs @	12.09 hrs, Volume=	2,615 cf	
Outflow =	0.77 cfs @	12.09 hrs, Volume=	2,615 cf, Atten= 0%, Lag= 0.0 min	
Primary =	0.77 cfs @	12.09 hrs, Volume=	2,615 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 45.39' @ 12.09 hrs
Flood Elev= 48.28'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.88'	**12.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 44.88' / 44.77' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.75 cfs @ 12.09 hrs HW=45.38' TW=42.48' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 0.75 cfs @ 2.78 fps)

Pond 9: CB8



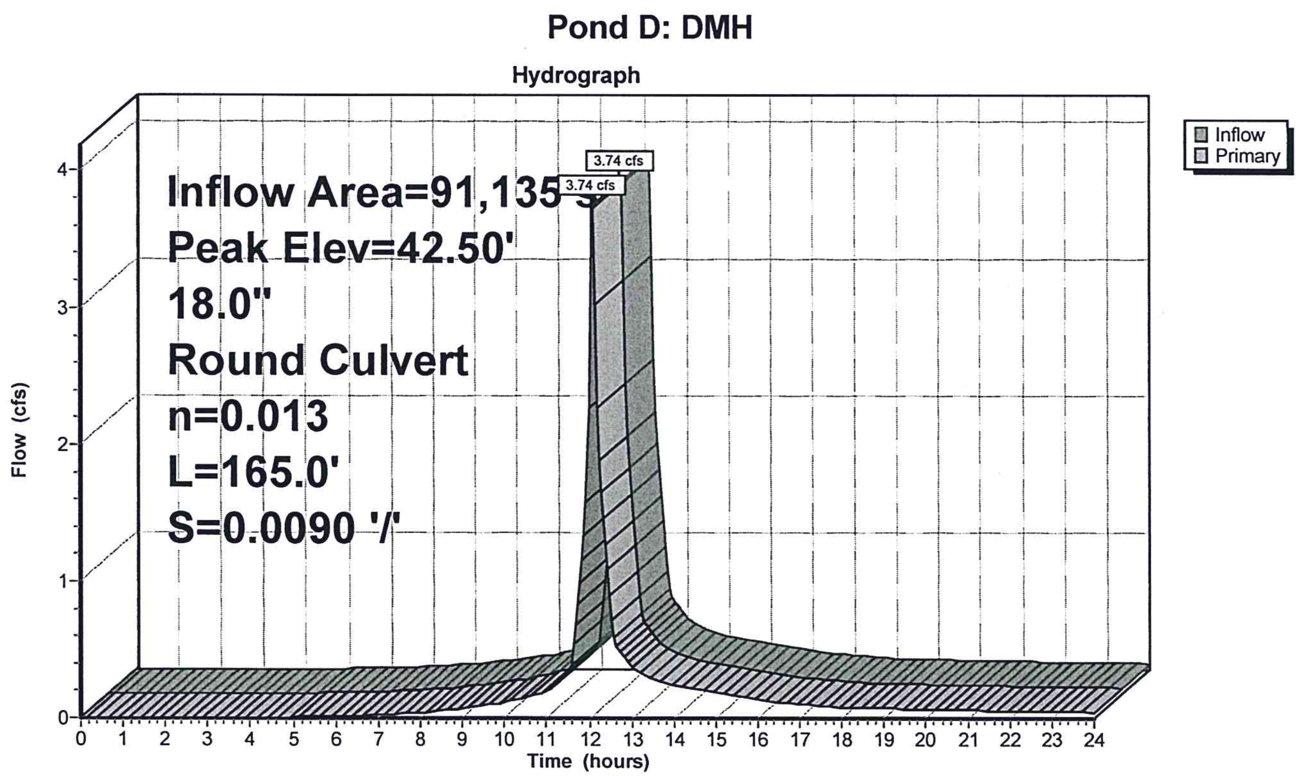
Summary for Pond D: DMH

Inflow Area =	91,135 sf,	53.51% Impervious,	Inflow Depth > 1.66"	for 2-Year event
Inflow =	3.74 cfs @	12.09 hrs, Volume=	12,631 cf	
Outflow =	3.74 cfs @	12.09 hrs, Volume=	12,631 cf,	Atten= 0%, Lag= 0.0 min
Primary =	3.74 cfs @	12.09 hrs, Volume=	12,631 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 42.50' @ 12.10 hrs
Flood Elev= 48.47'

Device	Routing	Invert	Outlet Devices
#1	Primary	41.54'	**18.0" Round Culvert** L= 165.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 41.54' / 40.06' S= 0.0090 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=3.54 cfs @ 12.09 hrs HW=42.49' TW=41.16' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 3.54 cfs @ 4.29 fps)



Summary for Subcatchment 10S: Area 10S

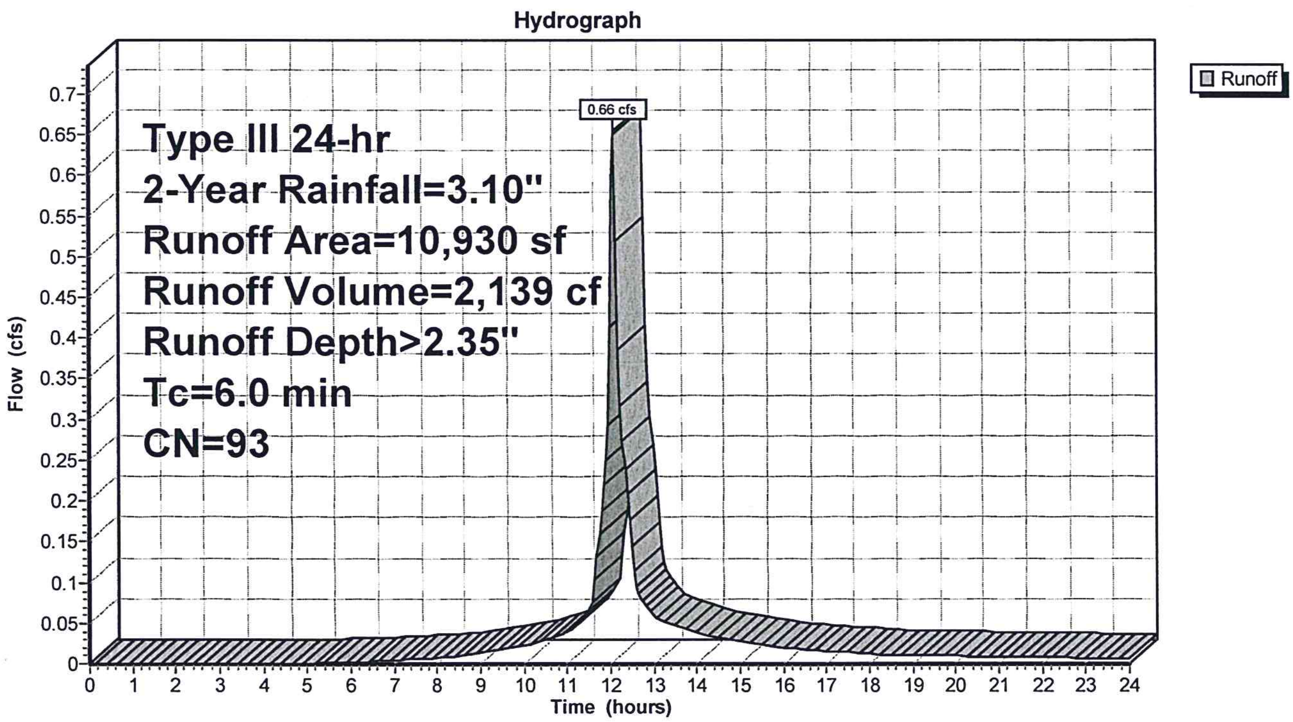
Runoff = 0.66 cfs @ 12.09 hrs, Volume= 2,139 cf, Depth> 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
8,735	98	Paved parking, HSG A
1,325	96	Gravel surface, HSG A
870	39	>75% Grass cover, Good, HSG A
10,930	93	Weighted Average
2,195		20.08% Pervious Area
8,735		79.92% Impervious Area

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

Subcatchment 10S: Area 10S



Summary for Pond 10: CB5.1

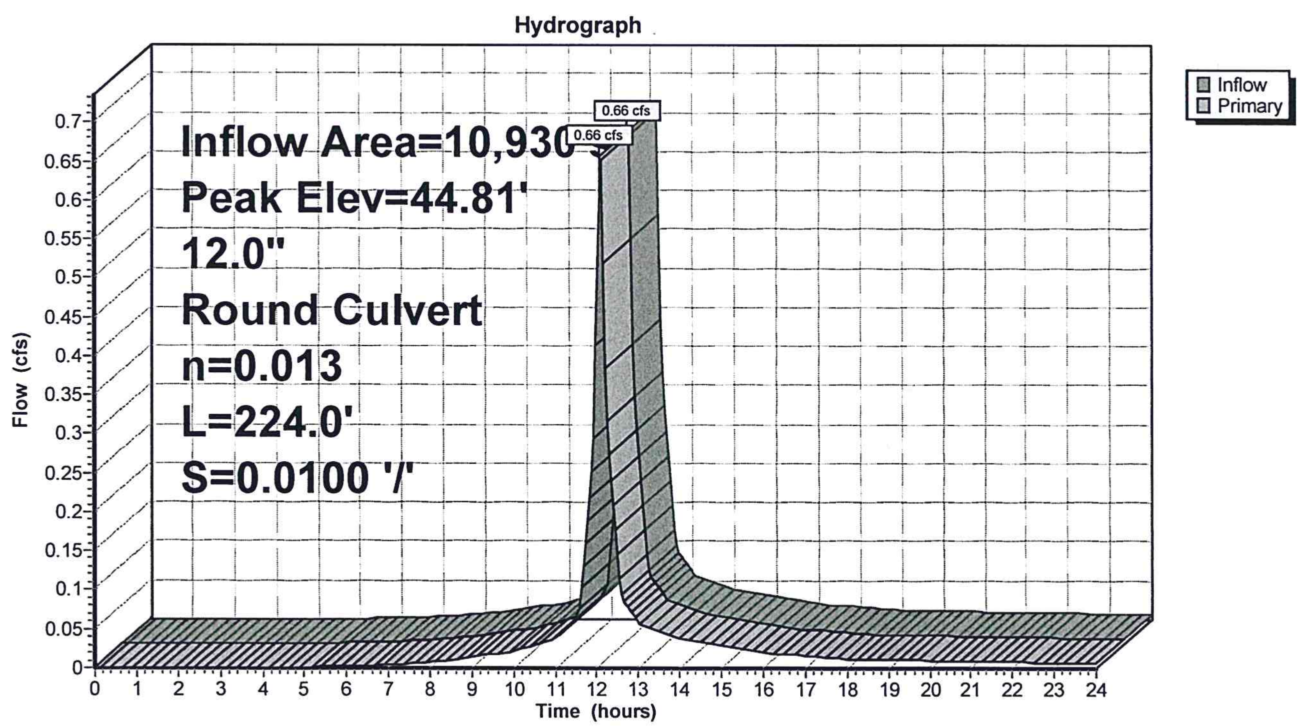
Inflow Area = 10,930 sf, 79.92% Impervious, Inflow Depth > 2.35" for 2-Year event
Inflow = 0.66 cfs @ 12.09 hrs, Volume= 2,139 cf
Outflow = 0.66 cfs @ 12.09 hrs, Volume= 2,139 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.66 cfs @ 12.09 hrs, Volume= 2,139 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 44.81' @ 12.09 hrs
Flood Elev= 47.80'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.40'	**12.0" Round Culvert** L= 224.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 44.40' / 42.16' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.63 cfs @ 12.09 hrs HW=44.81' TW=42.83' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 0.63 cfs @ 3.13 fps)

Pond 10: CB5.1



Summary for Subcatchment 11S: Area 11S

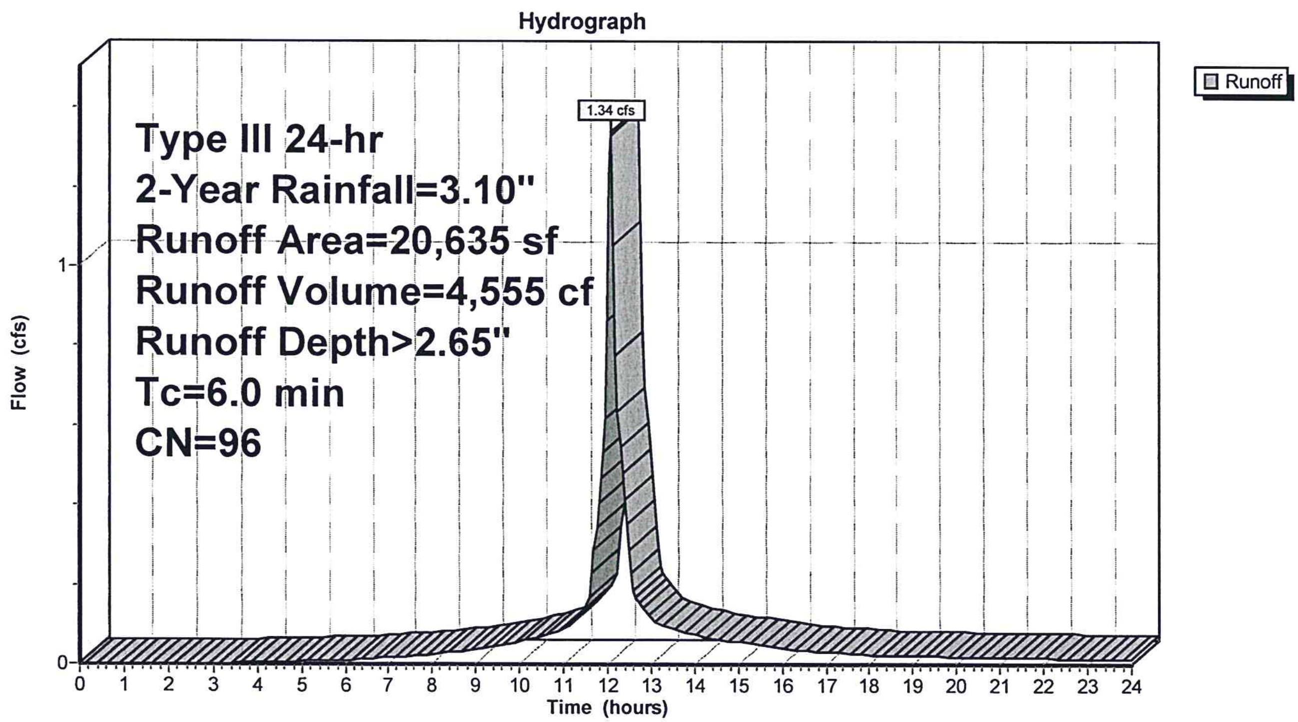
Runoff = 1.34 cfs @ 12.09 hrs, Volume= 4,555 cf, Depth> 2.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
5,280	98	Roofs, HSG A
8,700	98	Paved parking, HSG A
6,190	96	Gravel surface, HSG A
465	39	>75% Grass cover, Good, HSG A
20,635	96	Weighted Average
6,655		32.25% Pervious Area
13,980		67.75% Impervious Area

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

Subcatchment 11S: Area 11S



Summary for Pond 11: CB8.1

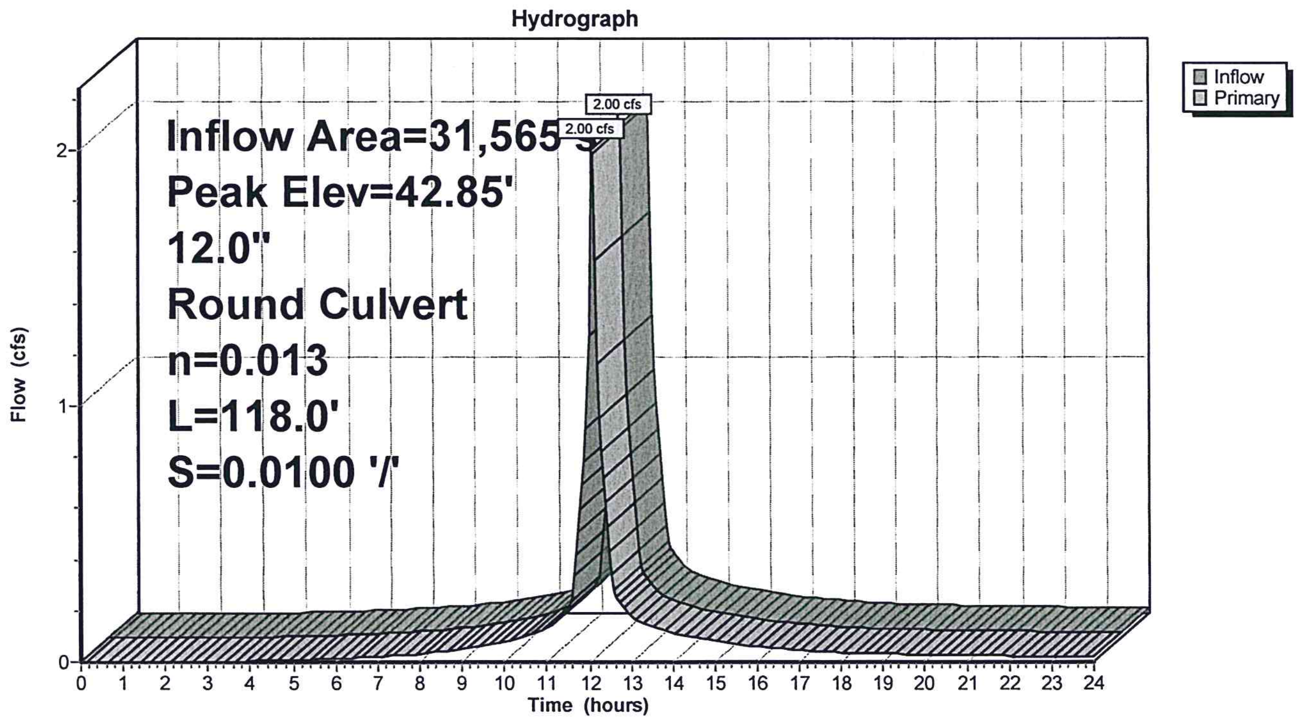
Inflow Area = 31,565 sf, 71.96% Impervious, Inflow Depth > 2.54" for 2-Year event
Inflow = 2.00 cfs @ 12.09 hrs, Volume= 6,694 cf
Outflow = 2.00 cfs @ 12.09 hrs, Volume= 6,694 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.00 cfs @ 12.09 hrs, Volume= 6,694 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 42.85' @ 12.09 hrs
Flood Elev= 48.20'

Device	Routing	Invert	Outlet Devices
#1	Primary	42.06'	**12.0" Round Culvert** L= 118.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 42.06' / 40.88' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.95 cfs @ 12.09 hrs HW=42.83' TW=41.15' (Dynamic Tailwater)
1=Culvert (Inlet Controls 1.95 cfs @ 2.99 fps)

Pond 11: CB8.1



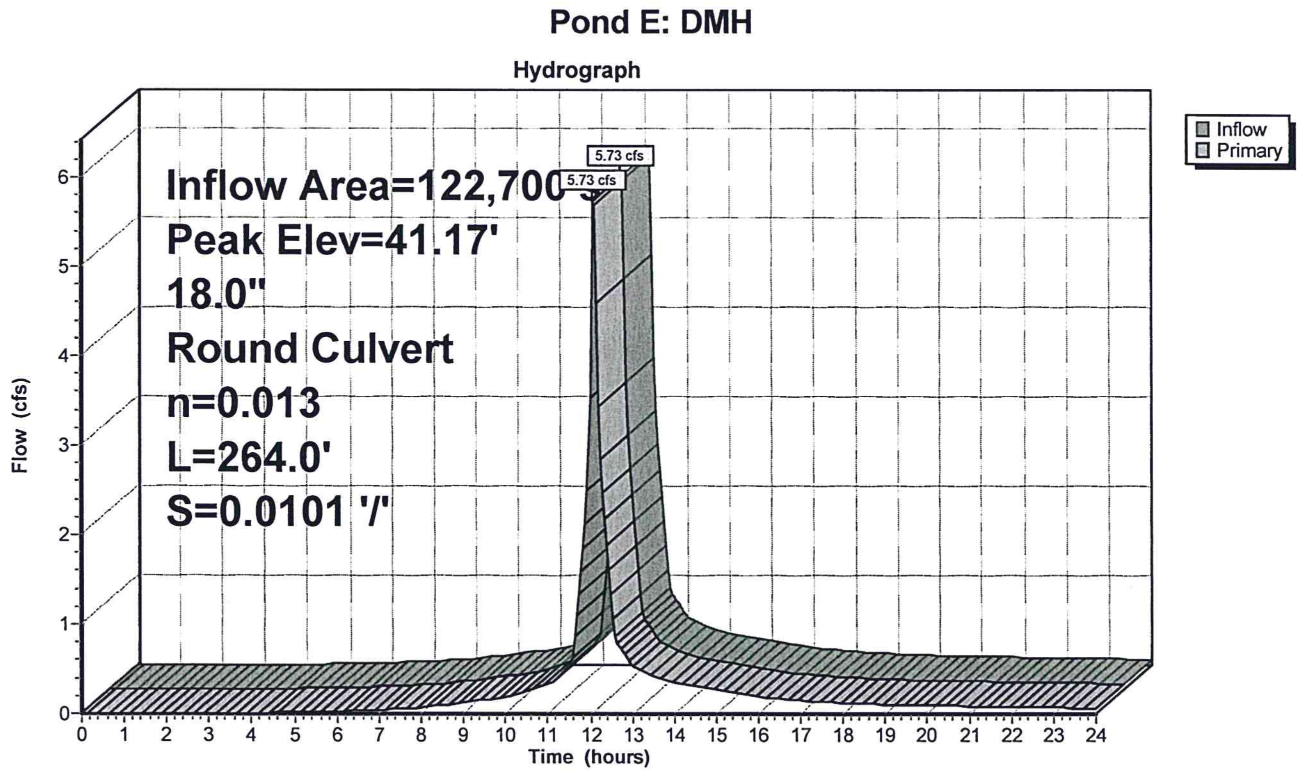
Summary for Pond E: DMH

Inflow Area =	122,700 sf,	58.26% Impervious,	Inflow Depth > 1.89"	for 2-Year event
Inflow =	5.73 cfs @	12.09 hrs, Volume=	19,324 cf	
Outflow =	5.73 cfs @	12.09 hrs, Volume=	19,324 cf, Atten= 0%, Lag= 0.0 min	
Primary =	5.73 cfs @	12.09 hrs, Volume=	19,324 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 41.17' @ 12.09 hrs
Flood Elev= 50.16'

Device	Routing	Invert	Outlet Devices
#1	Primary	39.96'	**18.0" Round Culvert** L= 264.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 39.96' / 37.30' S= 0.0101 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=5.61 cfs @ 12.09 hrs HW=41.15' TW=38.23' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 5.61 cfs @ 3.72 fps)



Summary for Pond F: DMH

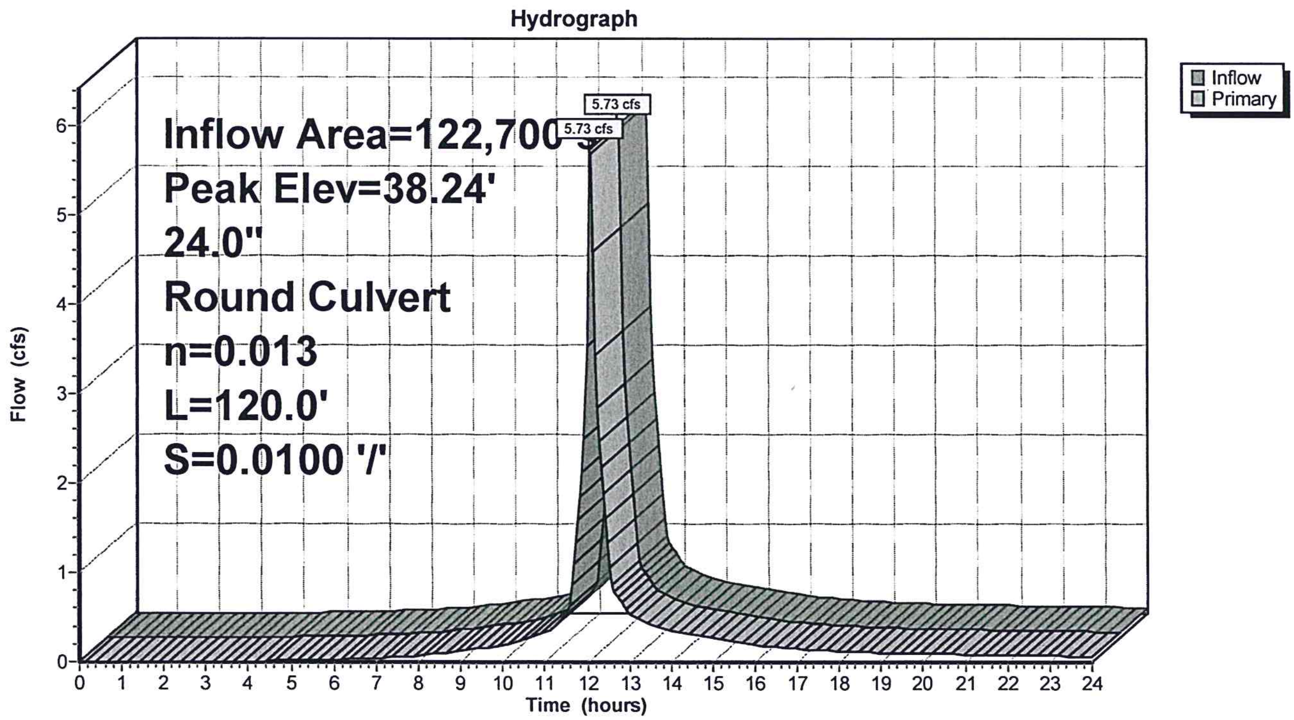
Inflow Area = 122,700 sf, 58.26% Impervious, Inflow Depth > 1.89" for 2-Year event
Inflow = 5.73 cfs @ 12.09 hrs, Volume= 19,324 cf
Outflow = 5.73 cfs @ 12.09 hrs, Volume= 19,324 cf, Atten= 0%, Lag= 0.0 min
Primary = 5.73 cfs @ 12.09 hrs, Volume= 19,324 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 38.24' @ 12.09 hrs
Flood Elev= 49.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	37.20'	**24.0" Round Culvert** L= 120.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 37.20' / 36.00' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=5.61 cfs @ 12.09 hrs HW=38.23' TW=35.53' (Dynamic Tailwater)
└—**1=Culvert** (Inlet Controls 5.61 cfs @ 3.45 fps)

Pond F: DMH



Summary for Subcatchment 12S: Area 12S

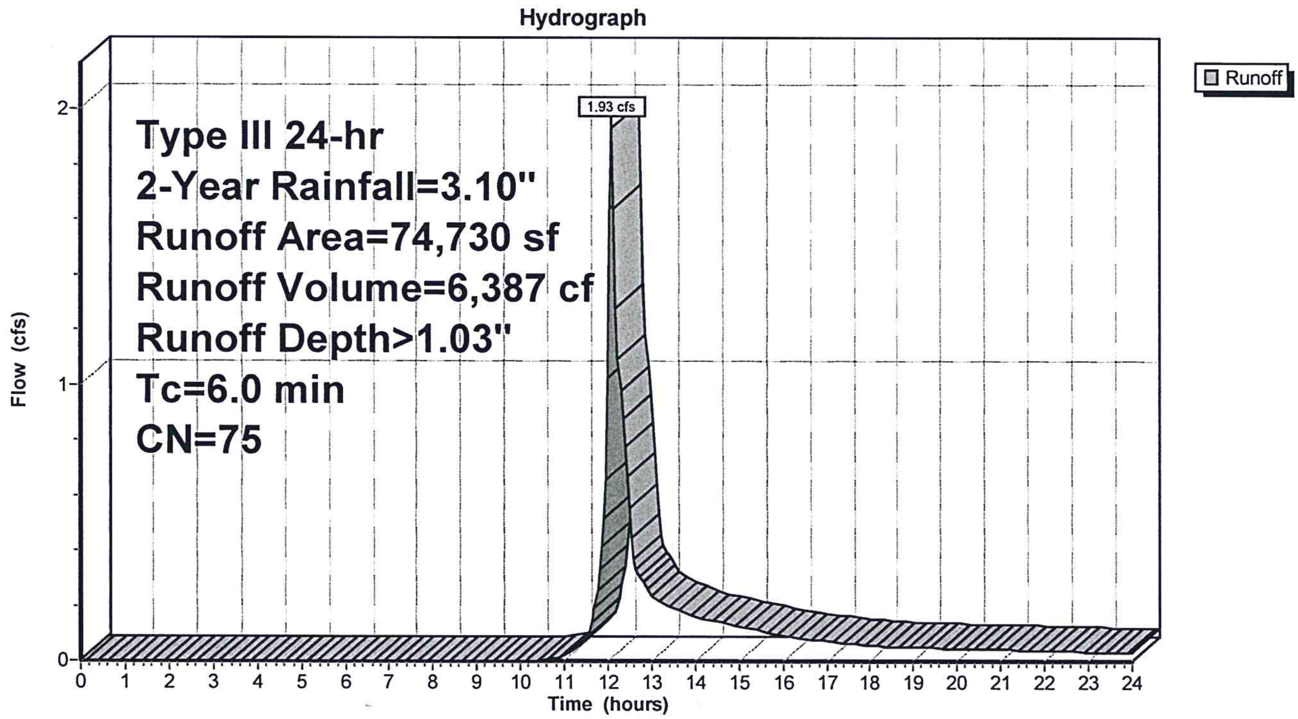
Runoff = 1.93 cfs @ 12.10 hrs, Volume= 6,387 cf, Depth> 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
47,830	96	Gravel surface, HSG A
26,900	39	>75% Grass cover, Good, HSG A
74,730	75	Weighted Average
74,730		100.00% Pervious Area

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

Subcatchment 12S: Area 12S



Summary for Pond 1P: Infiltration Basin

Inflow Area = 197,430 sf, 36.21% Impervious, Inflow Depth > 1.56" for 2-Year event
Inflow = 7.66 cfs @ 12.09 hrs, Volume= 25,711 cf
Outflow = 2.87 cfs @ 12.38 hrs, Volume= 25,713 cf, Atten= 63%, Lag= 17.2 min
Discarded = 0.76 cfs @ 12.38 hrs, Volume= 23,217 cf
Secondary = 2.10 cfs @ 12.38 hrs, Volume= 2,496 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 36.50' @ 12.38 hrs Surf.Area= 3,991 sf Storage= 8,559 cf
Flood Elev= 37.00' Surf.Area= 4,460 sf Storage= 10,680 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 104.8 min (917.2 - 812.4)

Volume	Invert	Avail.Storage	Storage Description
#1	33.00'	10,680 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

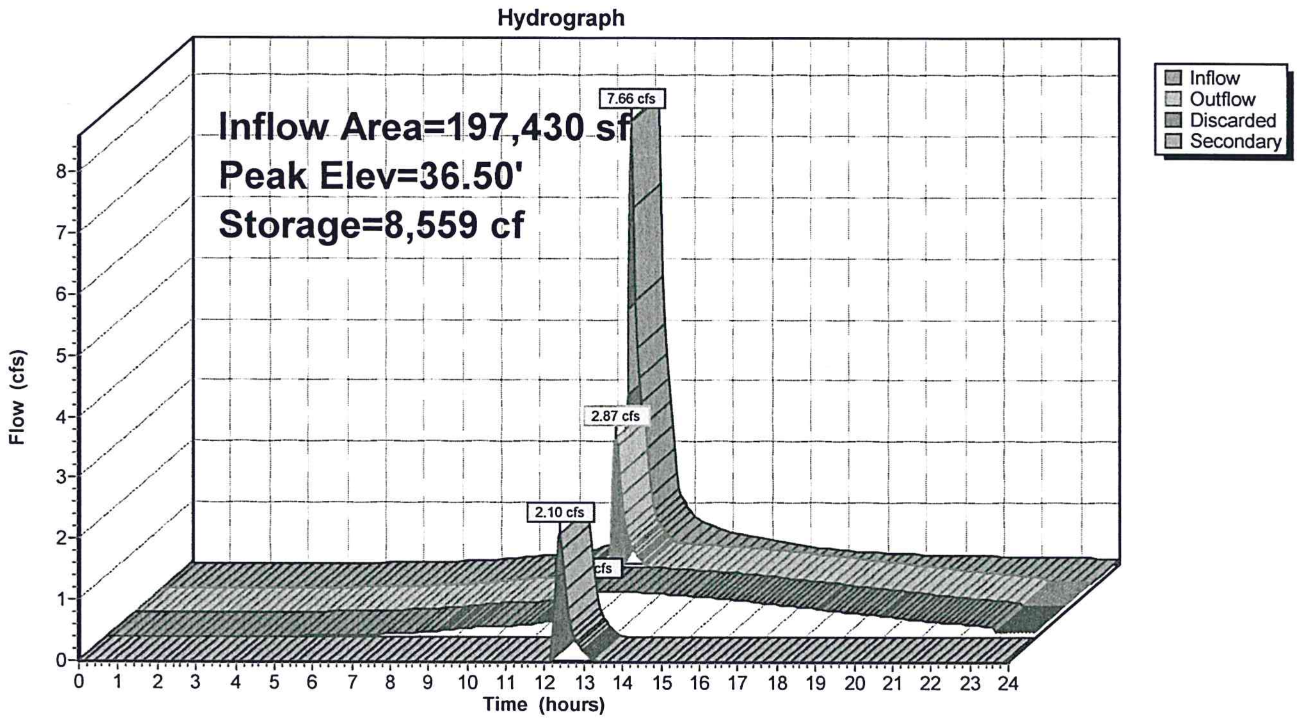
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
33.00	900	0	0
34.00	1,825	1,363	1,363
35.00	2,650	2,238	3,600
36.00	3,525	3,088	6,688
37.00	4,460	3,993	10,680

Device	Routing	Invert	Outlet Devices
#1	Discarded	33.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Secondary	36.35'	**15.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

Discarded OutFlow Max=0.76 cfs @ 12.38 hrs HW=36.50' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.76 cfs)

Secondary OutFlow Max=2.07 cfs @ 12.38 hrs HW=36.50' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 2.07 cfs @ 0.94 fps)

Pond 1P: Infiltration Basin



Summary for Subcatchment 13S: Area 13S

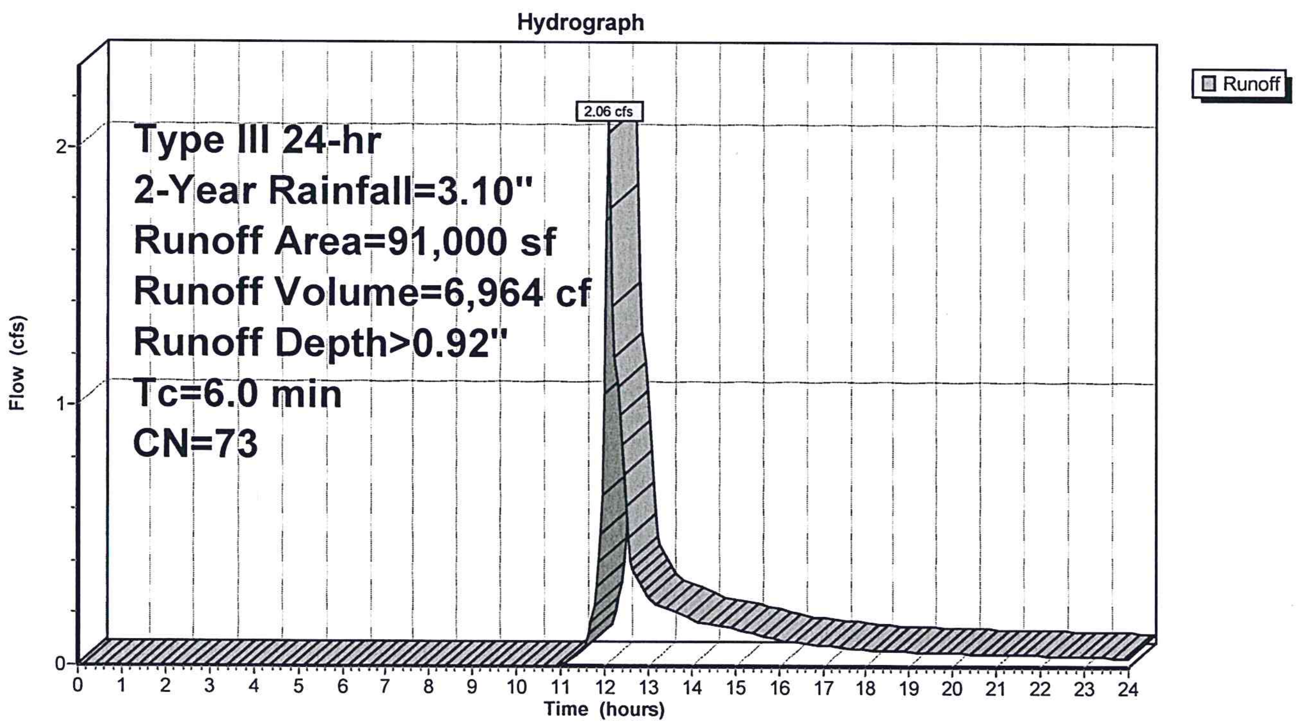
Runoff = 2.06 cfs @ 12.10 hrs, Volume= 6,964 cf, Depth> 0.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
55,000	96	Gravel surface, HSG A
36,000	39	>75% Grass cover, Good, HSG A
91,000	73	Weighted Average
91,000		100.00% Pervious Area

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

Subcatchment 13S: Area 13S



Summary for Pond 2P: Constructed Wetland

Inflow Area = 91,000 sf, 0.00% Impervious, Inflow Depth > 0.92" for 2-Year event
Inflow = 2.06 cfs @ 12.10 hrs, Volume= 6,964 cf
Outflow = 0.72 cfs @ 12.46 hrs, Volume= 6,919 cf, Atten= 65%, Lag= 21.2 min
Primary = 0.72 cfs @ 12.46 hrs, Volume= 6,919 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 10.00' @ 12.46 hrs Surf.Area= 2,703 sf Storage= 1,477 cf
Flood Elev= 11.00' Surf.Area= 3,400 sf Storage= 4,515 cf

Plug-Flow detention time= 21.9 min calculated for 6,919 cf (99% of inflow)
Center-of-Mass det. time= 18.2 min (885.0 - 866.8)

Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	4,515 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

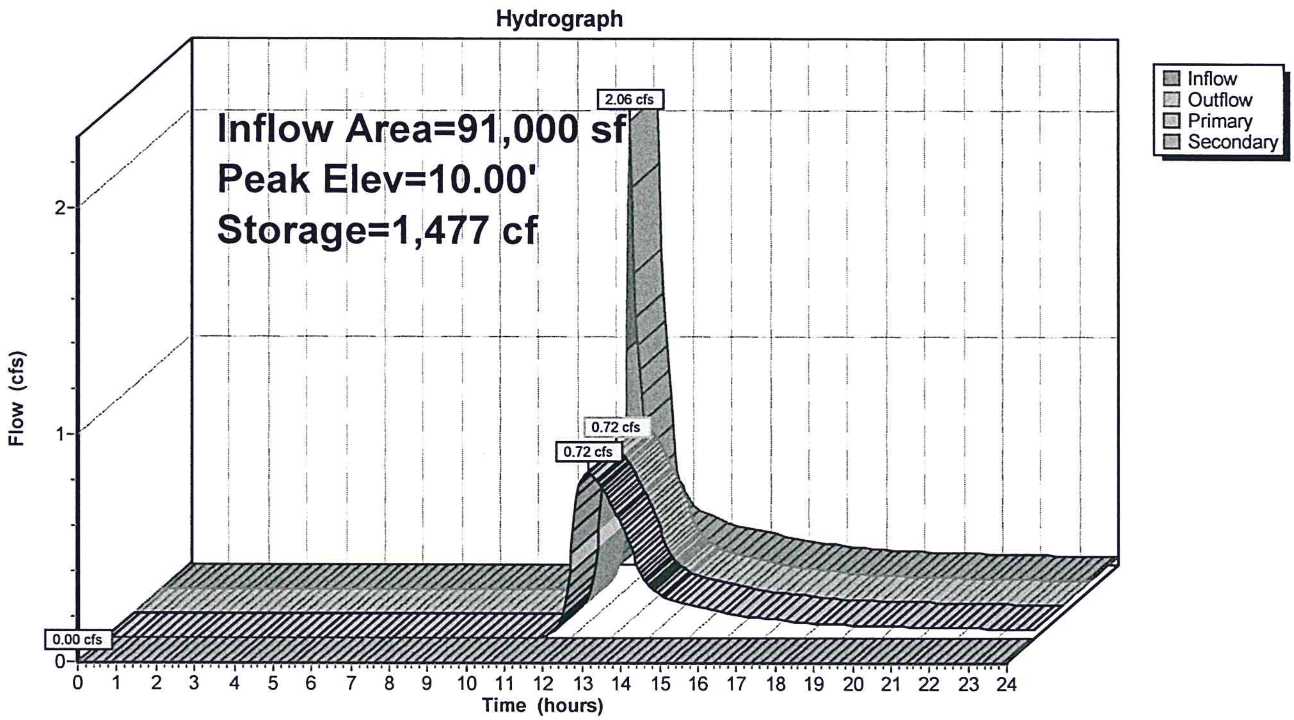
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
9.00	230	0	0
10.00	2,700	1,465	1,465
11.00	3,400	3,050	4,515

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**6.0" Round Culvert** L= 20.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 9.00' / 8.80' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Secondary	10.50'	**9.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.72 cfs @ 12.46 hrs HW=10.00' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 0.72 cfs @ 3.69 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=9.00' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Constructed Wetland

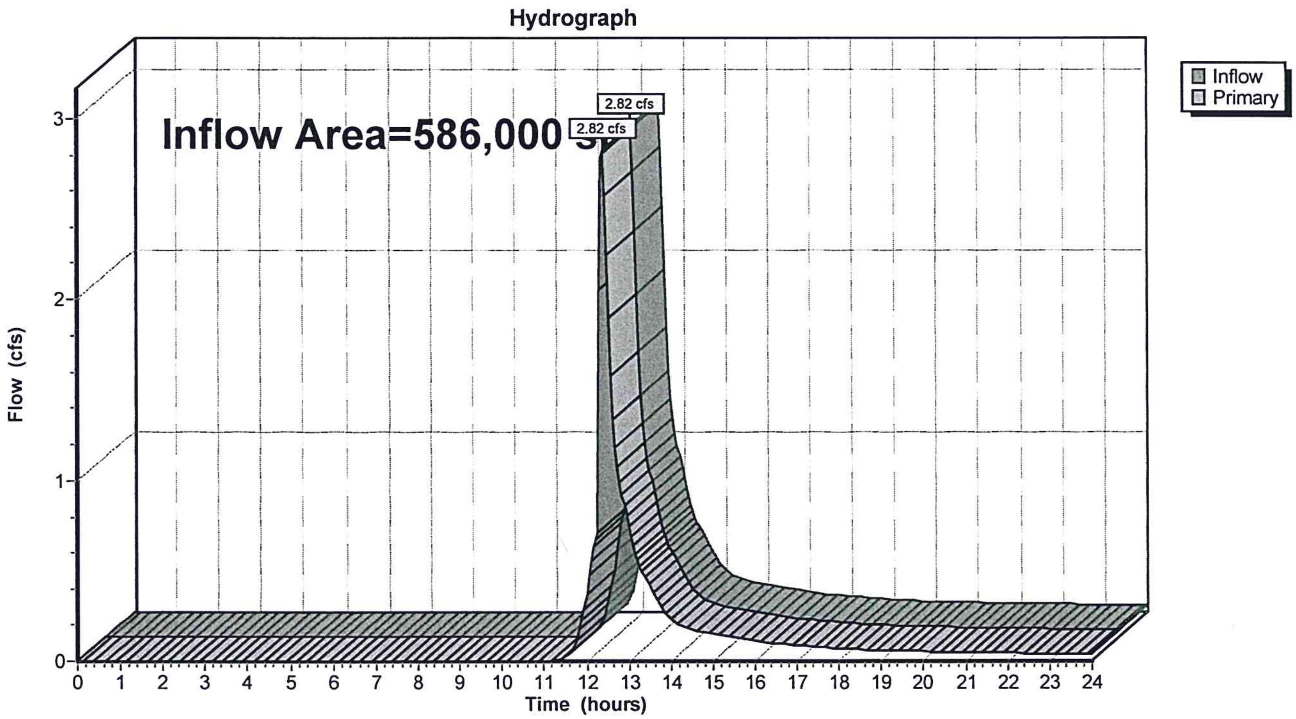


Summary for Link 100L: Bordering Vegetated Wetland

Inflow Area =	586,000 sf,	0.00% Impervious,	Inflow Depth > 0.19"	for 2-Year event
Inflow =	2.82 cfs @	12.38 hrs, Volume=	9,415 cf	
Primary =	2.82 cfs @	12.38 hrs, Volume=	9,415 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 100L: Bordering Vegetated Wetland



Summary for Subcatchment 3.1S: Area 3.1S

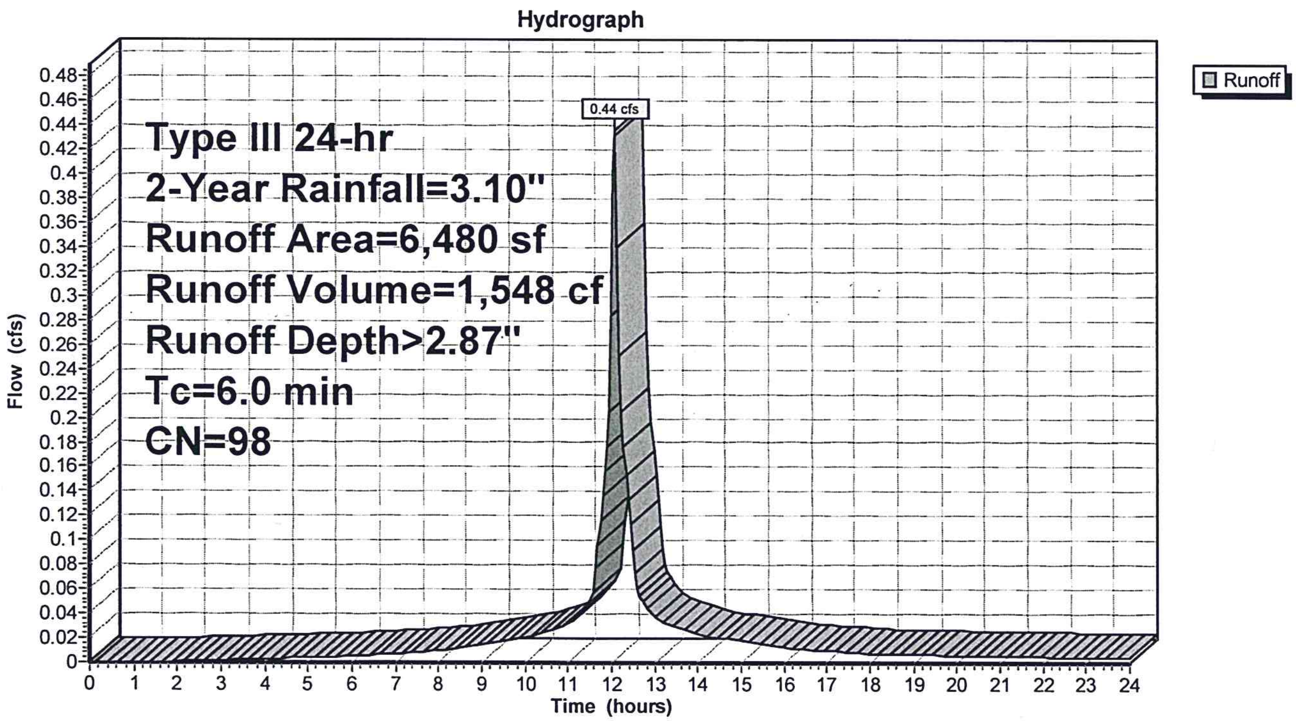
Runoff = 0.44 cfs @ 12.09 hrs, Volume= 1,548 cf, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
6,480	98	Roofs, HSG A
6,480		100.00% Impervious Area

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

Subcatchment 3.1S: Area 3.1S



Summary for Pond 3P: Cultec 180HD

Inflow Area = 6,480 sf,100.00% Impervious, Inflow Depth > 2.87" for 2-Year event
Inflow = 0.44 cfs @ 12.09 hrs, Volume= 1,548 cf
Outflow = 0.16 cfs @ 12.00 hrs, Volume= 1,557 cf, Atten= 64%, Lag= 0.0 min
Discarded = 0.16 cfs @ 12.00 hrs, Volume= 1,557 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 47.94' @ 12.34 hrs Surf.Area= 830 sf Storage= 188 cf
Flood Elev= 49.44' Surf.Area= 830 sf Storage= 889 cf

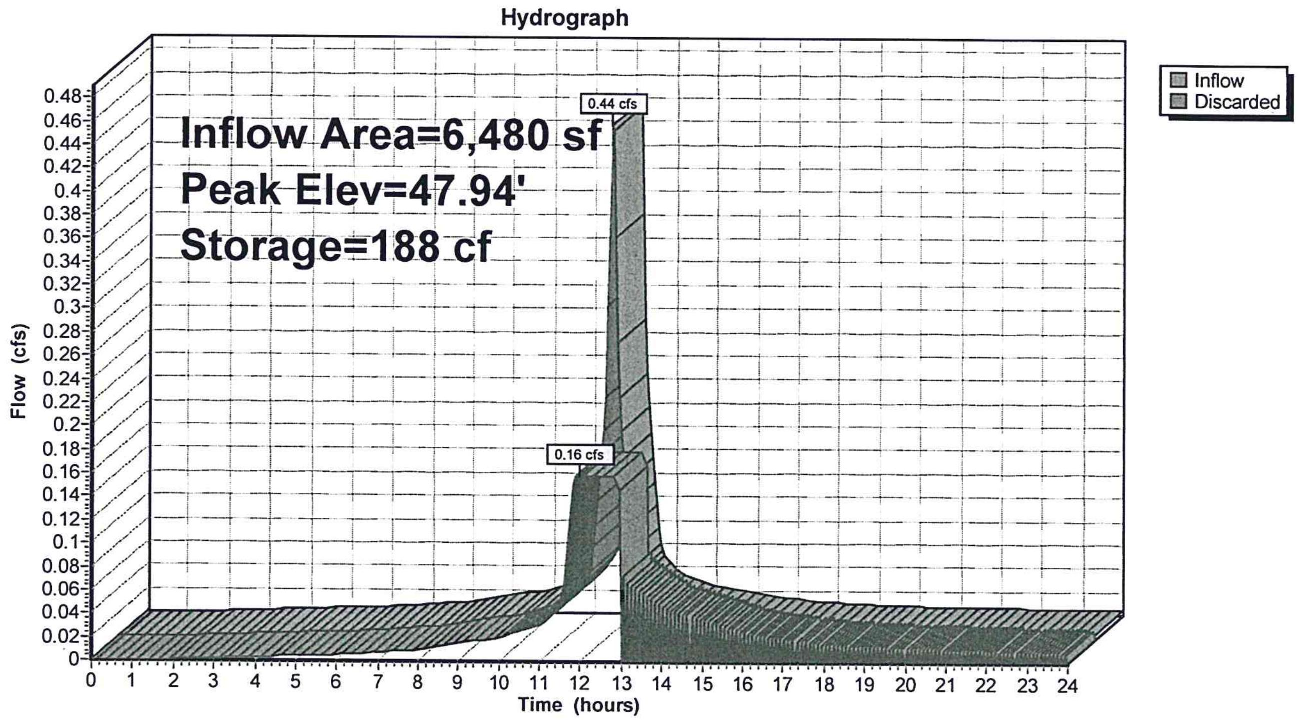
Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 4.7 min (761.4 - 756.6)

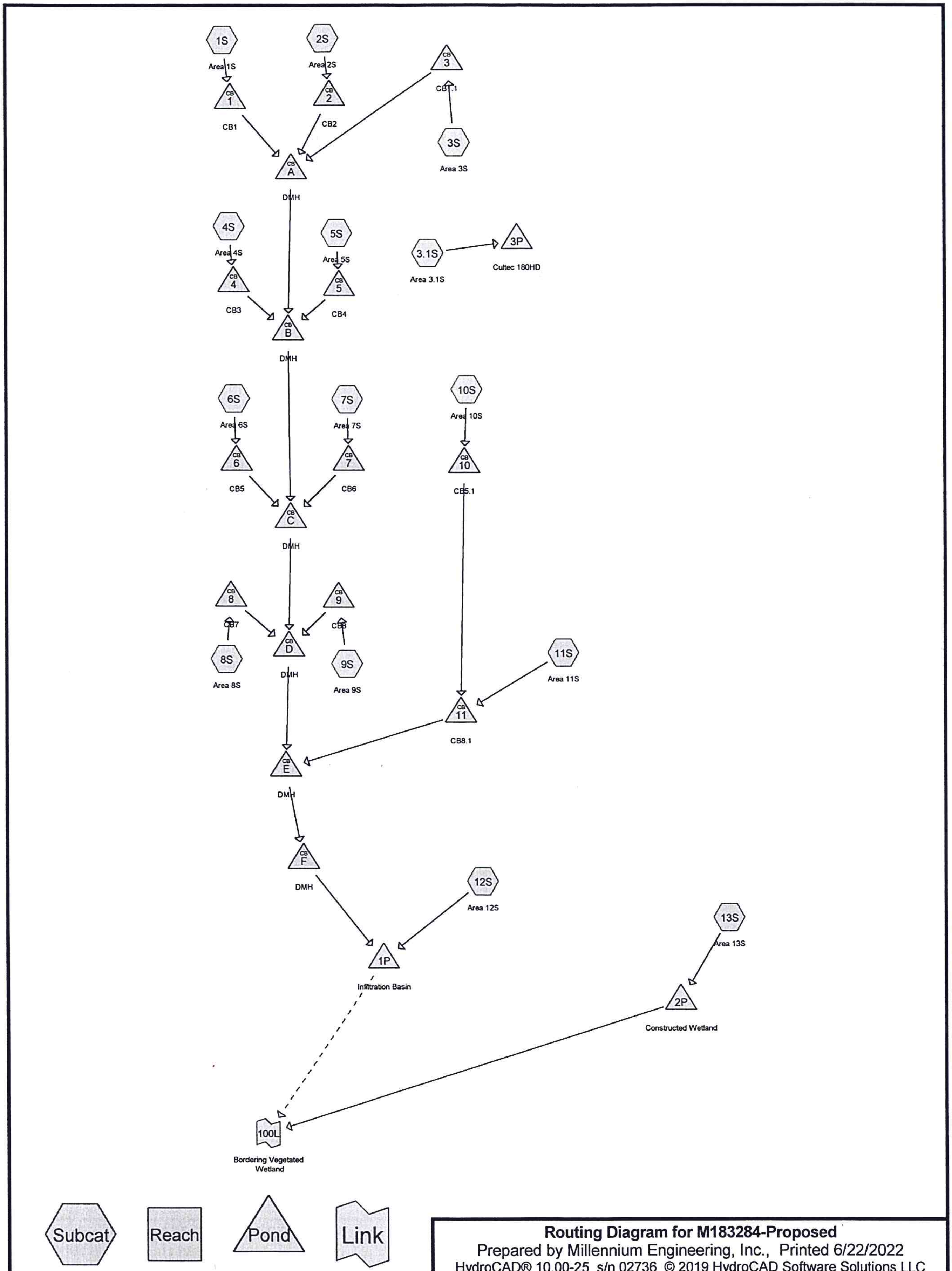
Volume	Invert	Avail.Storage	Storage Description
#1	47.90'	354 cf	**Cultec C-100HD** x 25 Inside #2 Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap Row Length Adjustment= +0.50' x 1.86 sf x 5 rows
#2	47.40'	758 cf	**21.00'W x 39.50'L x 2.71'H Prismatoid** 2,248 cf Overall - 354 cf Embedded = 1,894 cf x 40.0% Voids
		1,111 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	47.40'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.16 cfs @ 12.00 hrs HW=47.47' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

Pond 3P: Cultec 180HD





Routing Diagram for M183284-Proposed
Prepared by Millennium Engineering, Inc., Printed 6/22/2022
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Summary for Subcatchment 1S: Area 1S

Runoff = 0.10 cfs @ 12.10 hrs, Volume= 332 cf, Depth> 1.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
1,360	98	Paved parking, HSG A
1,790	39	>75% Grass cover, Good, HSG A
3,150	64	Weighted Average
1,790		56.83% Pervious Area
1,360		43.17% Impervious Area

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

Summary for Subcatchment 2S: Area 2S

Runoff = 0.21 cfs @ 12.09 hrs, Volume= 665 cf, Depth> 3.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
2,070	98	Paved parking, HSG A
430	39	>75% Grass cover, Good, HSG A
2,500	88	Weighted Average
430		17.20% Pervious Area
2,070		82.80% Impervious Area

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

Summary for Subcatchment 3.1S: Area 3.1S

Runoff = 0.64 cfs @ 12.09 hrs, Volume= 2,301 cf, Depth> 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
6,480	98	Roofs, HSG A
6,480		100.00% Impervious Area

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

Summary for Subcatchment 3S: Area 3S

Runoff = 0.70 cfs @ 12.10 hrs, Volume= 2,242 cf, Depth> 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
8,120	98	Paved parking, HSG A
5,535	39	>75% Grass cover, Good, HSG A
13,655	74	Weighted Average
5,535		40.53% Pervious Area
8,120		59.47% Impervious Area

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

Summary for Subcatchment 4S: Area 4S

Runoff = 0.14 cfs @ 12.10 hrs, Volume= 495 cf, Depth> 1.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
2,050	98	Paved parking, HSG A
2,900	39	>75% Grass cover, Good, HSG A
4,950	63	Weighted Average
2,900		58.59% Pervious Area
2,050		41.41% Impervious Area

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

Summary for Subcatchment 5S: Area 5S

Runoff = 1.27 cfs @ 12.09 hrs, Volume= 4,302 cf, Depth> 3.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
12,560	98	Paved parking, HSG A
980	39	>75% Grass cover, Good, HSG A
13,540	94	Weighted Average
980		7.24% Pervious Area
12,560		92.76% Impervious Area

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

Summary for Subcatchment 6S: Area 6S

Runoff = 0.23 cfs @ 12.10 hrs, Volume= 826 cf, Depth> 1.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
3,395	98	Paved parking, HSG A
5,310	39	>75% Grass cover, Good, HSG A
8,705	62	Weighted Average
5,310		61.00% Pervious Area
3,395		39.00% Impervious Area

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

Summary for Subcatchment 7S: Area 7S

Runoff = 2.35 cfs @ 12.09 hrs, Volume= 7,790 cf, Depth> 3.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
6,470	98	Paved parking, HSG A
17,620	96	Gravel surface, HSG A
1,880	39	>75% Grass cover, Good, HSG A
25,970	92	Weighted Average
19,500		75.09% Pervious Area
6,470		24.91% Impervious Area

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

Summary for Subcatchment 8S: Area 8S

Runoff = 0.17 cfs @ 12.11 hrs, Volume= 613 cf, Depth> 1.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
2,500	98	Paved parking, HSG A
4,320	39	>75% Grass cover, Good, HSG A
6,820	61	Weighted Average
4,320		63.34% Pervious Area
2,500		36.66% Impervious Area

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

Summary for Subcatchment 9S: Area 9S

Runoff = 1.15 cfs @ 12.09 hrs, Volume= 3,981 cf, Depth> 4.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
5,280	98	Roofs, HSG A
4,965	98	Paved parking, HSG A
1,200	96	Gravel surface, HSG A
400	39	>75% Grass cover, Good, HSG A
11,845	96	Weighted Average
1,600		13.51% Pervious Area
10,245		86.49% Impervious Area

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

Summary for Subcatchment 10S: Area 10S

Runoff = 1.01 cfs @ 12.09 hrs, Volume= 3,375 cf, Depth> 3.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
8,735	98	Paved parking, HSG A
1,325	96	Gravel surface, HSG A
870	39	>75% Grass cover, Good, HSG A
10,930	93	Weighted Average
2,195		20.08% Pervious Area
8,735		79.92% Impervious Area

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

Summary for Subcatchment 11S: Area 11S

Runoff = 1.99 cfs @ 12.09 hrs, Volume= 6,936 cf, Depth> 4.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
5,280	98	Roofs, HSG A
8,700	98	Paved parking, HSG A
6,190	96	Gravel surface, HSG A
465	39	>75% Grass cover, Good, HSG A
20,635	96	Weighted Average
6,655		32.25% Pervious Area
13,980		67.75% Impervious Area

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

Summary for Subcatchment 12S: Area 12S

Runoff = 4.02 cfs @ 12.10 hrs, Volume= 12,756 cf, Depth> 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
47,830	96	Gravel surface, HSG A
26,900	39	>75% Grass cover, Good, HSG A
74,730	75	Weighted Average
74,730		100.00% Pervious Area

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

Summary for Subcatchment 13S: Area 13S

Runoff = 4.50 cfs @ 12.10 hrs, Volume= 14,361 cf, Depth> 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
55,000	96	Gravel surface, HSG A
36,000	39	>75% Grass cover, Good, HSG A
91,000	73	Weighted Average
91,000		100.00% Pervious Area

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

Summary for Pond 1: CB1

Inflow Area = 3,150 sf, 43.17% Impervious, Inflow Depth > 1.26" for 10-Year event
Inflow = 0.10 cfs @ 12.10 hrs, Volume= 332 cf
Outflow = 0.10 cfs @ 12.10 hrs, Volume= 332 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.10 cfs @ 12.10 hrs, Volume= 332 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 47.62' @ 12.10 hrs
Flood Elev= 50.86'

Device	Routing	Invert	Outlet Devices
#1	Primary	47.46'	**12.0" Round Culvert** L= 16.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 47.46' / 47.30' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.10 cfs @ 12.10 hrs HW=47.62' TW=46.18' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.10 cfs @ 1.80 fps)

Summary for Pond 1P: Infiltration Basin

Inflow Area = 197,430 sf, 36.21% Impervious, Inflow Depth > 2.69" for 10-Year event
Inflow = 13.33 cfs @ 12.09 hrs, Volume= 44,313 cf
Outflow = 11.93 cfs @ 12.14 hrs, Volume= 43,780 cf, Atten= 10%, Lag= 3.1 min
Discarded = 0.82 cfs @ 12.14 hrs, Volume= 29,541 cf
Secondary = 11.12 cfs @ 12.14 hrs, Volume= 14,239 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 36.79' @ 12.14 hrs Surf.Area= 4,260 sf Storage= 9,746 cf
Flood Elev= 37.00' Surf.Area= 4,460 sf Storage= 10,680 cf

Plug-Flow detention time= 86.7 min calculated for 43,780 cf (99% of inflow)

Center-of-Mass det. time= 79.3 min (881.6 - 802.3)

Volume	Invert	Avail.Storage	Storage Description
#1	33.00'	10,680 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
33.00	900	0	0
34.00	1,825	1,363	1,363
35.00	2,650	2,238	3,600
36.00	3,525	3,088	6,688
37.00	4,460	3,993	10,680

Device	Routing	Invert	Outlet Devices
#1	Discarded	33.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Secondary	36.35'	**15.0' long x 9.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.46 2.55 2.70 2.69 2.68 2.68 2.67 2.64 2.64 2.64 2.65 2.64 2.65 2.65 2.66 2.67 2.69

Discarded OutFlow Max=0.81 cfs @ 12.14 hrs HW=36.78' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.81 cfs)

Secondary OutFlow Max=10.89 cfs @ 12.14 hrs HW=36.78' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 10.89 cfs @ 1.69 fps)

Summary for Pond 2: CB2

Inflow Area = 2,500 sf, 82.80% Impervious, Inflow Depth > 3.19" for 10-Year event
Inflow = 0.21 cfs @ 12.09 hrs, Volume= 665 cf
Outflow = 0.21 cfs @ 12.09 hrs, Volume= 665 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.21 cfs @ 12.09 hrs, Volume= 665 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 47.71' @ 12.09 hrs
Flood Elev= 50.86'

Device	Routing	Invert	Outlet Devices
#1	Primary	47.46'	**12.0" Round Culvert** L= 9.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 47.46' / 47.37' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.20 cfs @ 12.09 hrs HW=47.70' TW=46.16' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.20 cfs @ 2.04 fps)

Summary for Pond 2P: Constructed Wetland

Inflow Area = 91,000 sf, 0.00% Impervious, Inflow Depth > 1.89" for 10-Year event
Inflow = 4.50 cfs @ 12.10 hrs, Volume= 14,361 cf
Outflow = 2.19 cfs @ 12.30 hrs, Volume= 14,292 cf, Atten= 51%, Lag= 12.4 min
Primary = 0.98 cfs @ 12.30 hrs, Volume= 13,062 cf
Secondary = 1.20 cfs @ 12.30 hrs, Volume= 1,230 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 10.64' @ 12.30 hrs Surf.Area= 3,145 sf Storage= 3,322 cf
Flood Elev= 11.00' Surf.Area= 3,400 sf Storage= 4,515 cf

Plug-Flow detention time= 28.5 min calculated for 14,263 cf (99% of inflow)
Center-of-Mass det. time= 25.7 min (870.5 - 844.8)

Volume	Invert	Avail.Storage	Storage Description
#1	9.00'	4,515 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
9.00	230	0	0
10.00	2,700	1,465	1,465
11.00	3,400	3,050	4,515

Device	Routing	Invert	Outlet Devices
#1	Primary	9.00'	**6.0" Round Culvert** L= 20.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 9.00' / 8.80' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.20 sf
#2	Secondary	10.50'	**9.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.98 cfs @ 12.30 hrs HW=10.64' TW=0.00' (Dynamic Tailwater)
1=Culvert (Inlet Controls 0.98 cfs @ 5.00 fps)

Secondary OutFlow Max=1.20 cfs @ 12.30 hrs HW=10.64' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Weir Controls 1.20 cfs @ 0.99 fps)

Summary for Pond 3: CB1.1

Inflow Area = 13,655 sf, 59.47% Impervious, Inflow Depth > 1.97" for 10-Year event
Inflow = 0.70 cfs @ 12.10 hrs, Volume= 2,242 cf
Outflow = 0.70 cfs @ 12.10 hrs, Volume= 2,242 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.70 cfs @ 12.10 hrs, Volume= 2,242 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 47.03' @ 12.10 hrs
Flood Elev= 49.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	46.60'	**12.0" Round Culvert** L= 88.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 46.60' / 45.72' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.67 cfs @ 12.10 hrs HW=47.03' TW=46.17' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 0.67 cfs @ 3.10 fps)

Summary for Pond 3P: Cultec 180HD

Inflow Area = 6,480 sf,100.00% Impervious, Inflow Depth > 4.26" for 10-Year event
Inflow = 0.64 cfs @ 12.09 hrs, Volume= 2,301 cf
Outflow = 0.16 cfs @ 11.85 hrs, Volume= 2,311 cf, Atten= 75%, Lag= 0.0 min
Discarded = 0.16 cfs @ 11.85 hrs, Volume= 2,311 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 48.34' @ 12.46 hrs Surf.Area= 830 sf Storage= 436 cf
Flood Elev= 49.44' Surf.Area= 830 sf Storage= 889 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 12.7 min (762.1 - 749.4)

Volume	Invert	Avail.Storage	Storage Description
#1	47.90'	354 cf	**Cultec C-100HD** x 25 Inside #2 Effective Size= 32.1"W x 12.0"H => 1.86 sf x 7.50'L = 14.0 cf Overall Size= 36.0"W x 12.5"H x 8.00'L with 0.50' Overlap Row Length Adjustment= +0.50' x 1.86 sf x 5 rows
#2	47.40'	758 cf	**21.00'W x 39.50'L x 2.71'H Prismatoid** 2,248 cf Overall - 354 cf Embedded = 1,894 cf x 40.0% Voids
		1,111 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	47.40'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.16 cfs @ 11.85 hrs HW=47.45' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.16 cfs)

Summary for Pond 4: CB3

Inflow Area = 4,950 sf, 41.41% Impervious, Inflow Depth > 1.20" for 10-Year event
Inflow = 0.14 cfs @ 12.10 hrs, Volume= 495 cf
Outflow = 0.14 cfs @ 12.10 hrs, Volume= 495 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.14 cfs @ 12.10 hrs, Volume= 495 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 46.31' @ 12.19 hrs
Flood Elev= 49.15'

Device	Routing	Invert	Outlet Devices
#1	Primary	45.75'	**12.0" Round Culvert**

L= 20.0' CPP, square edge headwall, Ke= 0.500
Inlet / Outlet Invert= 45.75' / 45.55' S= 0.0100 '/' Cc= 0.900
n= 0.013 Concrete pipe, bends & connections, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.10 hrs HW=45.95' TW=46.07' (Dynamic Tailwater)
1=Culvert (Controls 0.00 cfs)

Summary for Pond 5: CB4

Inflow Area = 13,540 sf, 92.76% Impervious, Inflow Depth > 3.81" for 10-Year event
Inflow = 1.27 cfs @ 12.09 hrs, Volume= 4,302 cf
Outflow = 1.27 cfs @ 12.09 hrs, Volume= 4,302 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.27 cfs @ 12.09 hrs, Volume= 4,302 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 46.43' @ 12.09 hrs
Flood Elev= 49.16'

Device	Routing	Invert	Outlet Devices
#1	Primary	45.76'	**12.0" Round Culvert** L= 14.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 45.76' / 45.62' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.24 cfs @ 12.09 hrs HW=46.42' TW=45.76' (Dynamic Tailwater)
1=Culvert (Barrel Controls 1.24 cfs @ 3.18 fps)

Summary for Pond 6: CB5

Inflow Area = 8,705 sf, 39.00% Impervious, Inflow Depth > 1.14" for 10-Year event
Inflow = 0.23 cfs @ 12.10 hrs, Volume= 826 cf
Outflow = 0.23 cfs @ 12.10 hrs, Volume= 826 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.23 cfs @ 12.10 hrs, Volume= 826 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 45.61' @ 12.15 hrs
Flood Elev= 47.80'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.40'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 44.40' / 44.20' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.10 hrs HW=45.06' TW=45.53' (Dynamic Tailwater)
1=Culvert (Controls 0.00 cfs)

Summary for Pond 7: CB6

Inflow Area =	25,970 sf,	24.91% Impervious,	Inflow Depth > 3.60"	for 10-Year event	
Inflow =	2.35 cfs @	12.09 hrs,	Volume=	7,790 cf	
Outflow =	2.35 cfs @	12.09 hrs,	Volume=	7,790 cf,	Atten= 0%, Lag= 0.0 min
Primary =	2.35 cfs @	12.09 hrs,	Volume=	7,790 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 45.86' @ 12.14 hrs
Flood Elev= 47.79'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.39'	**12.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 44.39' / 44.28' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.09 hrs HW=45.39' TW=45.46' (Dynamic Tailwater)
↑—**1=Culvert** (Controls 0.00 cfs)

Summary for Pond 8: CB7

Inflow Area =	6,820 sf,	36.66% Impervious,	Inflow Depth > 1.08"	for 10-Year event	
Inflow =	0.17 cfs @	12.11 hrs,	Volume=	613 cf	
Outflow =	0.17 cfs @	12.11 hrs,	Volume=	613 cf,	Atten= 0%, Lag= 0.0 min
Primary =	0.17 cfs @	12.11 hrs,	Volume=	613 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 45.09' @ 12.11 hrs
Flood Elev= 48.28'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.88'	**12.0" Round Culvert** L= 19.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 44.88' / 44.69' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.17 cfs @ 12.11 hrs HW=45.09' TW=42.97' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.17 cfs @ 2.09 fps)

Summary for Pond 9: CB8

Inflow Area =	11,845 sf,	86.49% Impervious,	Inflow Depth > 4.03"	for 10-Year event	
Inflow =	1.15 cfs @	12.09 hrs,	Volume=	3,981 cf	
Outflow =	1.15 cfs @	12.09 hrs,	Volume=	3,981 cf,	Atten= 0%, Lag= 0.0 min
Primary =	1.15 cfs @	12.09 hrs,	Volume=	3,981 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 45.52' @ 12.09 hrs
Flood Elev= 48.28'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.88'	**12.0" Round Culvert** L= 11.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 44.88' / 44.77' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.11 cfs @ 12.09 hrs HW=45.51' TW=42.93' (Dynamic Tailwater)
1=Culvert (Barrel Controls 1.11 cfs @ 3.04 fps)

Summary for Pond 10: CB5.1

Inflow Area = 10,930 sf, 79.92% Impervious, Inflow Depth > 3.71" for 10-Year event
Inflow = 1.01 cfs @ 12.09 hrs, Volume= 3,375 cf
Outflow = 1.01 cfs @ 12.09 hrs, Volume= 3,375 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.01 cfs @ 12.09 hrs, Volume= 3,375 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 44.93' @ 12.10 hrs
Flood Elev= 47.80'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.40'	**12.0" Round Culvert** L= 224.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 44.40' / 42.16' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.95 cfs @ 12.09 hrs HW=44.92' TW=43.16' (Dynamic Tailwater)
1=Culvert (Outlet Controls 0.95 cfs @ 3.32 fps)

Summary for Pond 11: CB8.1

Inflow Area = 31,565 sf, 71.96% Impervious, Inflow Depth > 3.92" for 10-Year event
Inflow = 3.00 cfs @ 12.09 hrs, Volume= 10,311 cf
Outflow = 3.00 cfs @ 12.09 hrs, Volume= 10,311 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.00 cfs @ 12.09 hrs, Volume= 10,311 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 43.18' @ 12.09 hrs
Flood Elev= 48.20'

Device	Routing	Invert	Outlet Devices
#1	Primary	42.06'	**12.0" Round Culvert** L= 118.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 42.06' / 40.88' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.93 cfs @ 12.09 hrs HW=43.16' TW=41.85' (Dynamic Tailwater)
1=Culvert (Inlet Controls 2.93 cfs @ 3.73 fps)

Summary for Pond A: DMH

Inflow Area = 19,305 sf, 59.83% Impervious, Inflow Depth > 2.01" for 10-Year event
Inflow = 1.01 cfs @ 12.10 hrs, Volume= 3,239 cf
Outflow = 1.01 cfs @ 12.10 hrs, Volume= 3,239 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.01 cfs @ 12.10 hrs, Volume= 3,239 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 46.48' @ 12.18 hrs
Flood Elev= 51.03'

Device	Routing	Invert	Outlet Devices
#1	Primary	45.60'	**12.0" Round Culvert** L= 189.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 45.60' / 44.09' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.42 cfs @ 12.10 hrs HW=46.17' TW=45.94' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 0.42 cfs @ 1.31 fps)

Summary for Pond B: DMH

Inflow Area = 37,795 sf, 69.22% Impervious, Inflow Depth > 2.55" for 10-Year event
Inflow = 2.42 cfs @ 12.09 hrs, Volume= 8,037 cf
Outflow = 2.42 cfs @ 12.09 hrs, Volume= 8,037 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.42 cfs @ 12.09 hrs, Volume= 8,037 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 46.37' @ 12.13 hrs
Flood Elev= 49.12'

Device	Routing	Invert	Outlet Devices
#1	Primary	43.99'	**12.0" Round Culvert** L= 184.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 43.99' / 42.52' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.40 cfs @ 12.09 hrs HW=45.87' TW=45.51' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 1.40 cfs @ 1.78 fps)

Summary for Pond C: DMH

Inflow Area = 72,470 sf, 49.71% Impervious, Inflow Depth > 2.76" for 10-Year event
Inflow = 5.00 cfs @ 12.09 hrs, Volume= 16,653 cf
Outflow = 5.00 cfs @ 12.09 hrs, Volume= 16,653 cf, Atten= 0%, Lag= 0.0 min
Primary = 5.00 cfs @ 12.09 hrs, Volume= 16,653 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 45.61' @ 12.10 hrs
Flood Elev= 47.88'

Device	Routing	Invert	Outlet Devices
#1	Primary	42.42'	**12.0" Round Culvert** L= 97.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 42.42' / 41.64' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=4.72 cfs @ 12.09 hrs HW=45.49' TW=42.94' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 4.72 cfs @ 6.01 fps)

Summary for Pond D: DMH

Inflow Area =	91,135 sf,	53.51% Impervious,	Inflow Depth > 2.80"	for 10-Year event
Inflow =	6.31 cfs @	12.09 hrs, Volume=	21,246 cf	
Outflow =	6.31 cfs @	12.09 hrs, Volume=	21,246 cf,	Atten= 0%, Lag= 0.0 min
Primary =	6.31 cfs @	12.09 hrs, Volume=	21,246 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 42.99' @ 12.11 hrs
Flood Elev= 48.47'

Device	Routing	Invert	Outlet Devices
#1	Primary	41.54'	**18.0" Round Culvert** L= 165.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 41.54' / 40.06' S= 0.0090 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=5.60 cfs @ 12.09 hrs HW=42.94' TW=41.86' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 5.60 cfs @ 4.23 fps)

Summary for Pond E: DMH

Inflow Area =	122,700 sf,	58.26% Impervious,	Inflow Depth > 3.09"	for 10-Year event
Inflow =	9.31 cfs @	12.09 hrs, Volume=	31,557 cf	
Outflow =	9.31 cfs @	12.09 hrs, Volume=	31,557 cf,	Atten= 0%, Lag= 0.0 min
Primary =	9.31 cfs @	12.09 hrs, Volume=	31,557 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 41.91' @ 12.09 hrs
Flood Elev= 50.16'

Device	Routing	Invert	Outlet Devices
#1	Primary	39.96'	**18.0" Round Culvert** L= 264.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 39.96' / 37.30' S= 0.0101 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=9.10 cfs @ 12.09 hrs HW=41.85' TW=38.57' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 9.10 cfs @ 5.15 fps)

Summary for Pond F: DMH

Inflow Area = 122,700 sf, 58.26% Impervious, Inflow Depth > 3.09" for 10-Year event
Inflow = 9.31 cfs @ 12.09 hrs, Volume= 31,557 cf
Outflow = 9.31 cfs @ 12.09 hrs, Volume= 31,557 cf, Atten= 0%, Lag= 0.0 min
Primary = 9.31 cfs @ 12.09 hrs, Volume= 31,557 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 38.59' @ 12.09 hrs
Flood Elev= 49.00'

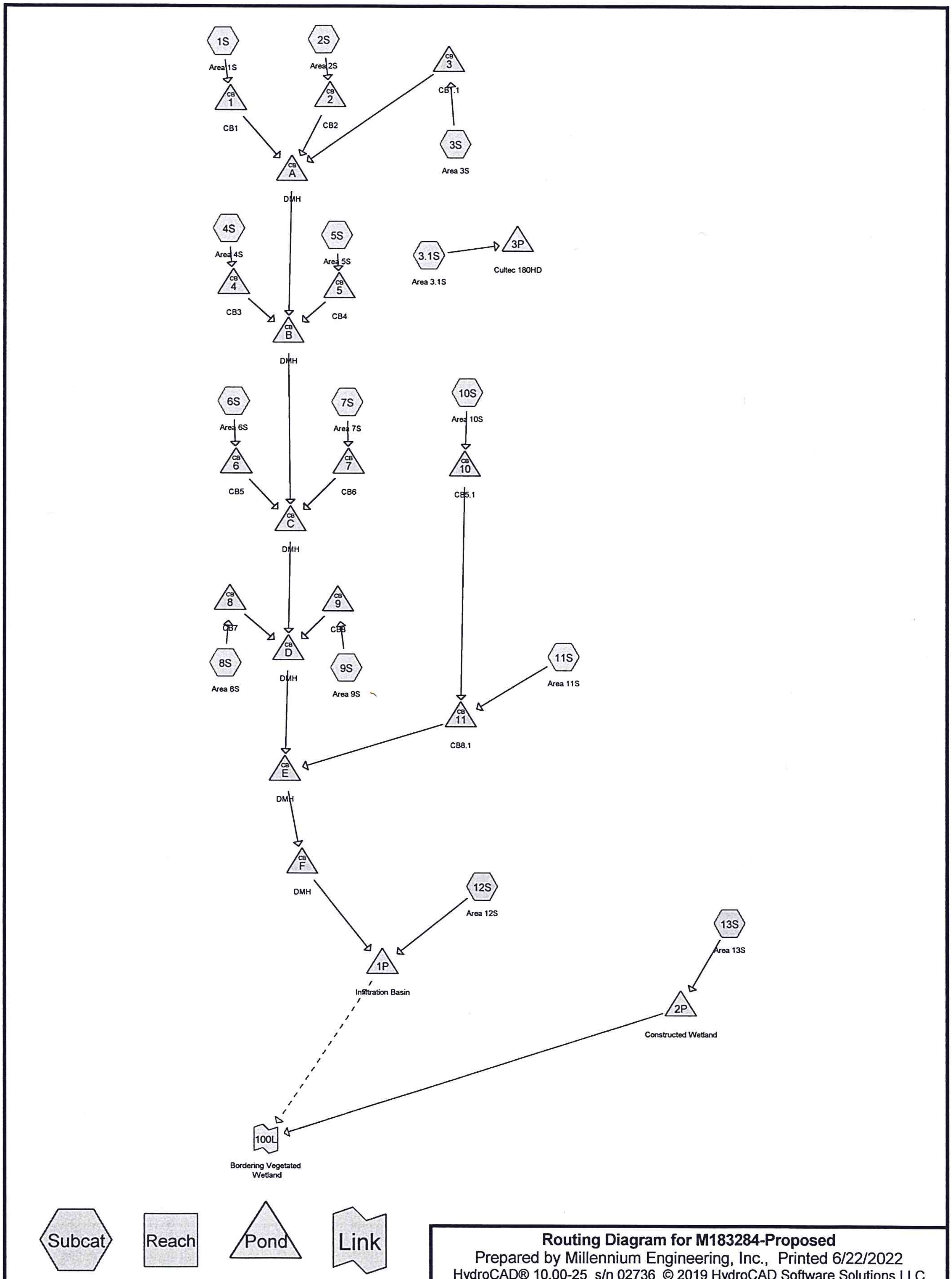
Device	Routing	Invert	Outlet Devices
#1	Primary	37.20'	**24.0" Round Culvert** L= 120.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 37.20' / 36.00' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=9.10 cfs @ 12.09 hrs HW=38.57' TW=36.70' (Dynamic Tailwater)
↑**1=Culvert** (Inlet Controls 9.10 cfs @ 3.98 fps)

Summary for Link 100L: Bordering Vegetated Wetland

Inflow Area = 586,000 sf, 0.00% Impervious, Inflow Depth > 0.58" for 10-Year event
Inflow = 12.00 cfs @ 12.15 hrs, Volume= 28,531 cf
Primary = 12.00 cfs @ 12.15 hrs, Volume= 28,531 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs



Routing Diagram for M183284-Proposed
Prepared by Millennium Engineering, Inc., Printed 6/22/2022
HydroCAD® 10.00-25 s/n 02736 © 2019 HydroCAD Software Solutions LLC

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Area 1S Runoff Area=3,150 sf 43.17% Impervious Runoff Depth>2.62"
Tc=6.0 min CN=64 Runoff=0.21 cfs 689 cf

Subcatchment 2S: Area 2S Runoff Area=2,500 sf 82.80% Impervious Runoff Depth>5.10"
Tc=6.0 min CN=88 Runoff=0.32 cfs 1,064 cf

Subcatchment 3.1S: Area 3.1S Runoff Area=6,480 sf 100.00% Impervious Runoff Depth>6.26"
Tc=6.0 min CN=98 Runoff=0.93 cfs 3,379 cf

Subcatchment 3S: Area 3S Runoff Area=13,655 sf 59.47% Impervious Runoff Depth>3.61"
Tc=6.0 min CN=74 Runoff=1.30 cfs 4,104 cf

Subcatchment 4S: Area 4S Runoff Area=4,950 sf 41.41% Impervious Runoff Depth>2.53"
Tc=6.0 min CN=63 Runoff=0.32 cfs 1,044 cf

Subcatchment 5S: Area 5S Runoff Area=13,540 sf 92.76% Impervious Runoff Depth>5.79"
Tc=6.0 min CN=94 Runoff=1.89 cfs 6,531 cf

Subcatchment 6S: Area 6S Runoff Area=8,705 sf 39.00% Impervious Runoff Depth>2.44"
Tc=6.0 min CN=62 Runoff=0.55 cfs 1,768 cf

Subcatchment 7S: Area 7S Runoff Area=25,970 sf 24.91% Impervious Runoff Depth>5.56"
Tc=6.0 min CN=92 Runoff=3.54 cfs 12,028 cf

Subcatchment 8S: Area 8S Runoff Area=6,820 sf 36.66% Impervious Runoff Depth>2.34"
Tc=6.0 min CN=61 Runoff=0.41 cfs 1,332 cf

Subcatchment 9S: Area 9S Runoff Area=11,845 sf 86.49% Impervious Runoff Depth>6.02"
Tc=6.0 min CN=96 Runoff=1.68 cfs 5,944 cf

Subcatchment 10S: Area 10S Runoff Area=10,930 sf 79.92% Impervious Runoff Depth>5.67"
Tc=6.0 min CN=93 Runoff=1.51 cfs 5,167 cf

Subcatchment 11S: Area 11S Runoff Area=20,635 sf 67.75% Impervious Runoff Depth>6.02"
Tc=6.0 min CN=96 Runoff=2.92 cfs 10,355 cf

Subcatchment 12S: Area 12S Runoff Area=74,730 sf 0.00% Impervious Runoff Depth>3.71"
Tc=6.0 min CN=75 Runoff=7.32 cfs 23,097 cf

Subcatchment 13S: Area 13S Runoff Area=91,000 sf 0.00% Impervious Runoff Depth>3.50"
Tc=6.0 min CN=73 Runoff=8.42 cfs 26,577 cf

Pond 1: CB1 Peak Elev=53.46' Inflow=0.21 cfs 689 cf
12.0" Round Culvert n=0.013 L=16.0' S=0.0100 '/' Outflow=0.21 cfs 689 cf

Pond 1P: Infiltration Basin Peak Elev=36.98' Storage=10,594 cf Inflow=21.95 cfs 73,122 cf
Discarded=0.85 cfs 35,559 cf Secondary=20.29 cfs 35,505 cf Outflow=21.14 cfs 71,064 cf

Pond 2: CB2 Peak Elev=53.46' Inflow=0.32 cfs 1,064 cf
12.0" Round Culvert n=0.013 L=9.0' S=0.0100 '/' Outflow=0.32 cfs 1,064 cf

Pond 2P: Constructed Wetland Peak Elev=10.91' Storage=4,202 cf Inflow=8.42 cfs 26,577 cf
Primary=1.07 cfs 19,385 cf Secondary=6.31 cfs 7,091 cf Outflow=7.39 cfs 26,476 cf

Pond 3: CB1.1 Peak Elev=53.51' Inflow=1.30 cfs 4,104 cf
12.0" Round Culvert n=0.013 L=88.0' S=0.0100 '/' Outflow=1.30 cfs 4,104 cf

Pond 3P: Cultec 180HD Peak Elev=49.30' Storage=842 cf Inflow=0.93 cfs 3,379 cf
Outflow=0.16 cfs 3,380 cf

Pond 4: CB3 Peak Elev=53.24' Inflow=0.32 cfs 1,044 cf
12.0" Round Culvert n=0.013 L=20.0' S=0.0100 '/' Outflow=0.32 cfs 1,044 cf

Pond 5: CB4 Peak Elev=53.32' Inflow=1.89 cfs 6,531 cf
12.0" Round Culvert n=0.013 L=14.0' S=0.0100 '/' Outflow=1.89 cfs 6,531 cf

Pond 6: CB5 Peak Elev=51.71' Inflow=0.55 cfs 1,768 cf
12.0" Round Culvert n=0.013 L=20.0' S=0.0100 '/' Outflow=0.55 cfs 1,768 cf

Pond 7: CB6 Peak Elev=52.08' Inflow=3.54 cfs 12,028 cf
12.0" Round Culvert n=0.013 L=11.0' S=0.0100 '/' Outflow=3.54 cfs 12,028 cf

Pond 8: CB7 Peak Elev=47.26' Inflow=0.41 cfs 1,332 cf
12.0" Round Culvert n=0.013 L=19.0' S=0.0100 '/' Outflow=0.41 cfs 1,332 cf

Pond 9: CB8 Peak Elev=47.30' Inflow=1.68 cfs 5,944 cf
12.0" Round Culvert n=0.013 L=11.0' S=0.0100 '/' Outflow=1.68 cfs 5,944 cf

Pond 10: CB5.1 Peak Elev=47.62' Inflow=1.51 cfs 5,167 cf
12.0" Round Culvert n=0.013 L=224.0' S=0.0100 '/' Outflow=1.51 cfs 5,167 cf

Pond 11: CB8.1 Peak Elev=47.49' Inflow=4.43 cfs 15,522 cf
12.0" Round Culvert n=0.013 L=118.0' S=0.0100 '/' Outflow=4.43 cfs 15,522 cf

Pond A: DMH Peak Elev=53.46' Inflow=1.84 cfs 5,856 cf
12.0" Round Culvert n=0.013 L=189.0' S=0.0080 '/' Outflow=1.84 cfs 5,856 cf

Pond B: DMH Peak Elev=53.24' Inflow=4.04 cfs 13,431 cf
12.0" Round Culvert n=0.013 L=184.0' S=0.0080 '/' Outflow=4.04 cfs 13,431 cf

Pond C: DMH Peak Elev=51.70' Inflow=8.13 cfs 27,227 cf
12.0" Round Culvert n=0.013 L=97.0' S=0.0080 '/' Outflow=8.13 cfs 27,227 cf

Pond D: DMH Peak Elev=47.37' Inflow=10.21 cfs 34,503 cf
18.0" Round Culvert n=0.013 L=165.0' S=0.0090 '/' Outflow=10.21 cfs 34,503 cf

Pond E: DMH Peak Elev=45.67' Inflow=14.63 cfs 50,025 cf
18.0" Round Culvert n=0.013 L=264.0' S=0.0101 '/' Outflow=14.63 cfs 50,025 cf

Pond F: DMH Peak Elev=39.12' Inflow=14.63 cfs 50,025 cf
24.0" Round Culvert n=0.013 L=120.0' S=0.0100 '/' Outflow=14.63 cfs 50,025 cf

Link 100L: Bordering Vegetated Wetland Inflow=27.46 cfs 67,331 cf
Primary=27.46 cfs 67,331 cf

Total Runoff Area = 294,910 sf Runoff Volume = 103,078 cf Average Runoff Depth = 4.19"
73.56% Pervious = 216,945 sf 26.44% Impervious = 77,965 sf

8.0 APPENDIX D – PROPRIETARY BMP DOCUMENTATION

Project:	163 Elm Street
Location:	Salisbury, MA
Prepared For:	Millennium Engineering

CONTECH ENGINEERED SOLUTIONS

Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1/2" of runoff from the contributing impervious surface.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Procedure: Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi^2/watershed inches (csm/in).

Compute Q Rate using the following equation:

Q = (qu) (A) (WQV)

where:

Q = flow rate associated with first 1/2" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1/2" in this case)

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)	qu (csm/in.)	Q (cfs)
CDS	1.42	0.0022188	6.0	0.100	0.50	752.00	0.83

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

163 ELM STREET
SALISBURY, MA

Area	1.42 ac	Unit Site Designation	CDS
Weighted C	0.9	Rainfall Station #	67
t_c	6 min		
CDS Model	2015-4	CDS Treatment Capacity	1.4 cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.08	41.0%	41.0%	0.10	0.10	37.9
0.16	23.9%	64.9%	0.20	0.20	20.8
0.24	11.5%	76.5%	0.31	0.31	9.5
0.32	7.4%	83.9%	0.41	0.41	5.7
0.40	4.4%	88.3%	0.51	0.51	3.2
0.48	2.9%	91.2%	0.61	0.61	2.0
0.56	1.8%	93.0%	0.72	0.72	1.1
0.64	1.2%	94.2%	0.82	0.82	0.7
0.72	1.6%	95.8%	0.92	0.92	0.8
0.80	0.8%	96.6%	1.02	1.02	0.4
1.00	0.6%	97.1%	1.28	1.28	0.2
1.40	1.4%	98.6%	1.79	1.40	0.3
1.80	0.9%	99.5%	2.30	1.40	0.2
2.20	0.5%	100.0%	2.81	1.40	0.1
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					82.9
				Removal Efficiency Adjustment[2] =	0.0%
				Predicted % Annual Rainfall Treated =	99.1%
				Predicted Net Annual Load Removal Efficiency =	**82.9%**

1 - Based on 7 years of data from NCDC station #3276, Groveland, Essex County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

9.0 APPENDIX E – NRCS SOIL DATA

USDA United States Department of Agriculture

NRCS Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Essex County, Massachusetts, Northern Part

163 Elm Street

April 4, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

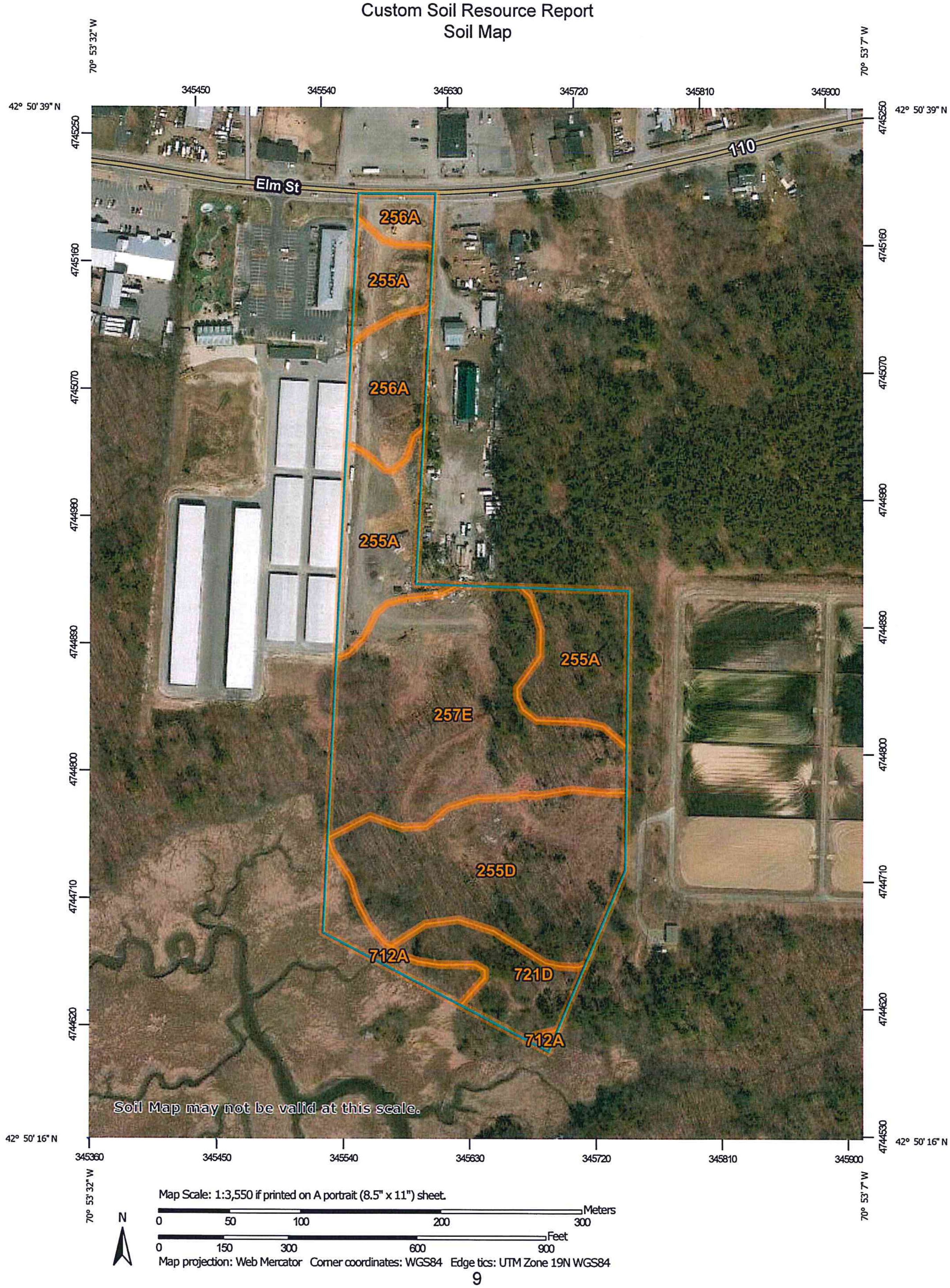
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map


70° 53' 32" W
70° 53' 7" W
42° 50' 39" N
42° 50' 16" N
345360
345450
345540
345630
345720
345810
345900
4745250
4745160
4745070
4744980
4744890
4744800
4744710
4744620
4744530
110
Elm St
256A
255A
256A
255A
255A
257E
255D
712A
721D
712A
Soil Map may not be valid at this scale.
Map Scale: 1:3,550 if printed on A portrait (8.5" x 11") sheet.
Meters
0 50 100 200 300
Feet
0 150 300 600 900
N
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 Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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 1:15,800.

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: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 17, Sep 2, 2021

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

Date(s) aerial images were photographed: Dec 31, 2009—Sep 12, 2016

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
255A	Windsor loamy sand, 0 to 3 percent slopes	4.1	22.2%
255D	Windsor loamy sand, 15 to 25 percent slopes	4.5	24.6%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	1.7	9.3%
257E	Hinckley and Windsor soils, 25 to 35 percent slopes	6.0	32.5%
712A	Ipswich and Westbrook mucky peats, 0 to 2 percent slopes, very frequently flooded	0.8	4.2%
721D	Windsor-Rock outcrop complex, 15 to 25 percent slopes	1.3	7.2%
Totals for Area of Interest		**18.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Essex County, Massachusetts, Northern Part

255A—Windsor loamy sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2svkg
Elevation: 0 to 990 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Windsor, loamy sand, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Windsor, Loamy Sand

Setting

Landform: Outwash plains, outwash terraces, deltas, dunes
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Parent material: Loose sandy glaciofluvial deposits derived from granite and/or loose sandy glaciofluvial deposits derived from schist and/or loose sandy glaciofluvial deposits derived from gneiss

Typical profile

O - 0 to 1 inches: moderately decomposed plant material
A - 1 to 3 inches: loamy sand
Bw - 3 to 25 inches: loamy sand
C - 25 to 65 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Deerfield, loamy sand

Percent of map unit: 10 percent
Landform: Deltas, terraces, outwash plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Hinckley, loamy sand

Percent of map unit: 5 percent
Landform: Deltas, kames, eskers, outwash plains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

255D—Windsor loamy sand, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 2svlb
Elevation: 0 to 1,290 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Windsor and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Windsor

Setting

Landform: Dunes, deltas, outwash terraces, outwash plains
Landform position (three-dimensional): Tread, riser
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Loose sandy glaciofluvial deposits derived from granite and/or loose sandy glaciofluvial deposits derived from schist and/or loose sandy glaciofluvial deposits derived from gneiss

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 3 inches: loamy sand

Bw - 3 to 25 inches: loamy sand
C - 25 to 65 inches: sand

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Hinckley

Percent of map unit: 5 percent
Landform: Deltas, kames, eskers, outwash plains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Landform: Outwash plains, outwash terraces, moraines, stream terraces, eskers, kames
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

256A—Deerfield loamy fine sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2xfg8
Elevation: 0 to 1,100 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F

Frost-free period: 145 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Deerfield and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Deerfield

Setting

Landform: Outwash terraces, outwash deltas, outwash plains, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Sandy outwash derived from granite, gneiss, and/or quartzite

Typical profile

Ap - 0 to 9 inches: loamy fine sand
Bw - 9 to 25 inches: loamy fine sand
BC - 25 to 33 inches: fine sand
Cg - 33 to 60 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: About 15 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum: 11.0
Available water supply, 0 to 60 inches: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: A
Ecological site: F144AY027MA - Moist Sandy Outwash
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 7 percent
Landform: Outwash terraces, kame terraces, outwash deltas, outwash plains
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Wareham

Percent of map unit: 5 percent
Landform: Drainageways, depressions

Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Sudbury

Percent of map unit: 2 percent
Landform: Outwash plains, kame terraces, outwash deltas, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Ninigret

Percent of map unit: 1 percent
Landform: Kame terraces, outwash plains, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex, linear
Across-slope shape: Convex, concave
Hydric soil rating: No

257E—Hinckley and Windsor soils, 25 to 35 percent slopes

Map Unit Setting

National map unit symbol: 2svm2
Elevation: 0 to 1,470 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Hinckley and similar soils: 50 percent
Windsor and similar soils: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Outwash deltas, outwash terraces, moraines, eskers, kames, outwash plains, kame terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material

A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 25 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Description of Windsor

Setting

Landform: Moraines, eskers, kames, outwash deltas, outwash terraces, outwash plains, kame terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Parent material: Loose sandy glaciofluvial deposits derived from granite and/or loose sandy glaciofluvial deposits derived from schist and/or loose sandy glaciofluvial deposits derived from gneiss

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 3 inches: loamy sand
Bw - 3 to 25 inches: loamy sand
C - 25 to 65 inches: sand

Properties and qualities

Slope: 25 to 35 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)

Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 10 percent
Landform: Kame terraces, outwash plains, kames, outwash terraces, moraines, eskers
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Nose slope, head slope, side slope, crest, riser
Down-slope shape: Concave, convex, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

712A—Ipswich and Westbrook mucky peats, 0 to 2 percent slopes, very frequently flooded

Map Unit Setting

National map unit symbol: 2tyqn
Elevation: 0 to 10 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Ipswich and similar soils: 55 percent
Westbrook and similar soils: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ipswich

Setting

Landform: Tidal marshes
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Partially- decomposed herbaceous organic material

Typical profile

Oe - 0 to 42 inches: mucky peat
Oa - 42 to 59 inches: muck

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.14 to 99.90 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to strongly saline (0.7 to 111.6 mmhos/cm)
Sodium adsorption ratio, maximum: 20.0
Available water supply, 0 to 60 inches: Very high (about 26.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: A/D
Ecological site: R144AY001CT - Tidal Salt Low Marsh mesic very frequently flooded, R144AY002CT - Tidal Salt High Marsh mesic very frequently flooded
Hydric soil rating: Yes

Description of Westbrook

Setting

Landform: Tidal marshes
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Partly-decomposed herbaceous organic material over loamy mineral material

Typical profile

Oe - 0 to 19 inches: mucky peat
Cg - 19 to 59 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Very low to high (0.00 to 14.17 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Very frequent
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to strongly saline (0.7 to 111.6 mmhos/cm)
Sodium adsorption ratio, maximum: 33.0
Available water supply, 0 to 60 inches: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: B/D
Ecological site: R144AY001CT - Tidal Salt Low Marsh mesic very frequently flooded, R144AY002CT - Tidal Salt High Marsh mesic very frequently flooded
Hydric soil rating: Yes

Minor Components

Pawcatuck

Percent of map unit: 15 percent
Landform: Tidal marshes
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R144AY001CT - Tidal Salt Low Marsh mesic very frequently flooded, R144AY002CT - Tidal Salt High Marsh mesic very frequently flooded
Hydric soil rating: Yes

721D—Windsor-Rock outcrop complex, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 2w2x7
Elevation: 90 to 350 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Windsor and similar soils: 55 percent
Rock outcrop: 30 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Windsor

Setting

Landform: Deltas, outwash terraces, dunes, outwash plains
Landform position (three-dimensional): Riser
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Parent material: Loose sandy glaciofluvial deposits derived from granite and/or schist and/or gneiss

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 3 inches: loamy sand

Bw - 3 to 25 inches: loamy sand
C - 25 to 65 inches: sand

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Ridges, hills
Parent material: Igneous and metamorphic rock

Typical profile

R - 0 to 79 inches: bedrock

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water supply, 0 to 60 inches: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Unranked

Minor Components

Wareham

Percent of map unit: 8 percent
Landform: Drainageways, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 7 percent
Landform: Depressions, drainageways
Down-slope shape: Concave

Across-slope shape: Concave
Hydric soil rating: Yes

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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.

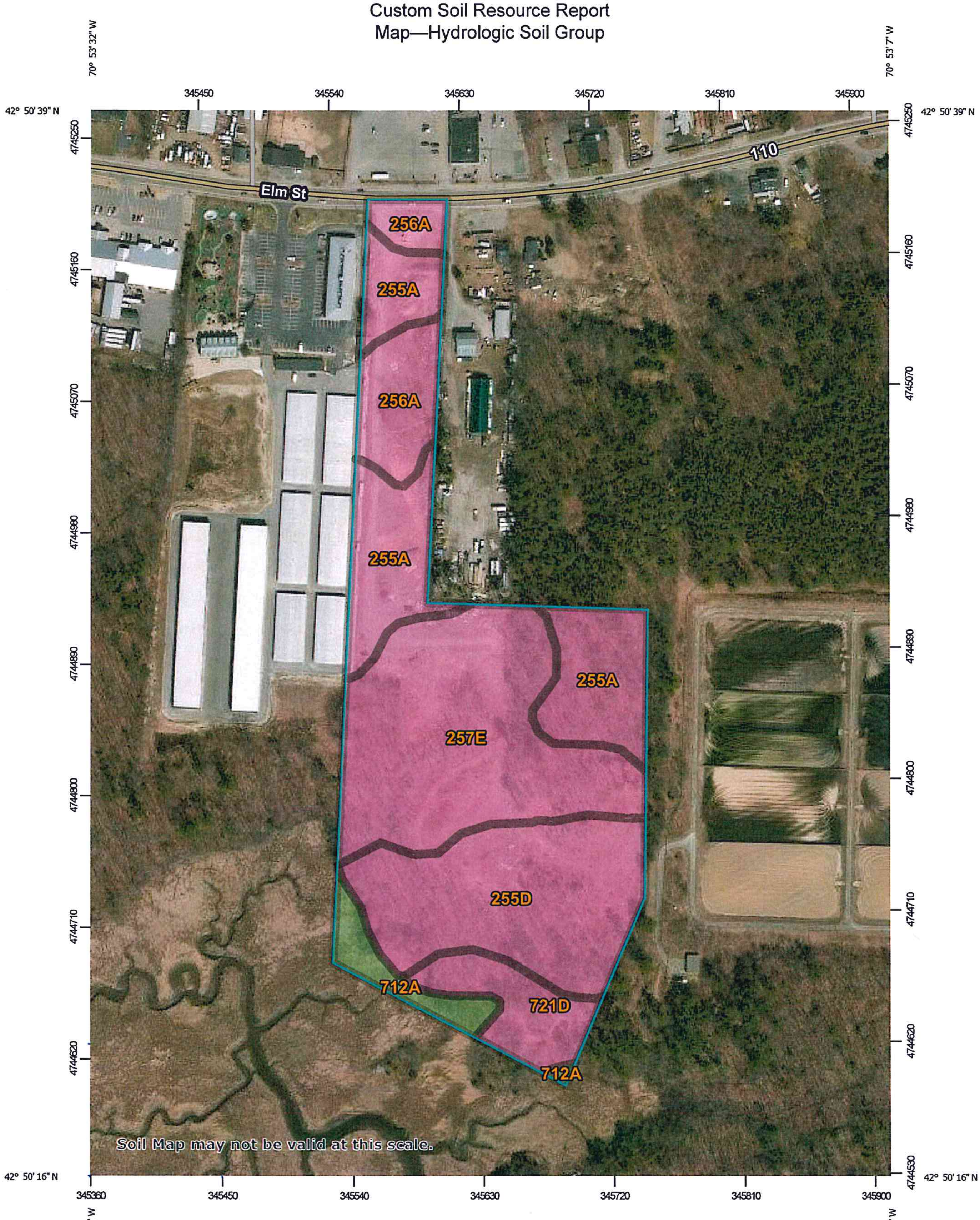
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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.

Map—Hydrologic Soil Group



Map Scale: 1:3,550 if printed on A portrait (8.5" x 11") sheet.

N

0 50 100 200 300 Meters

0 150 300 600 900 Feet

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 1:15,800.

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: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 17, Sep 2, 2021

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

Date(s) aerial images were photographed: Dec 31, 2009—Sep 12, 2016

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.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
255A	Windsor loamy sand, 0 to 3 percent slopes	A	4.1	22.2%
255D	Windsor loamy sand, 15 to 25 percent slopes	A	4.5	24.6%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	A	1.7	9.3%
257E	Hinckley and Windsor soils, 25 to 35 percent slopes	A	6.0	32.5%
712A	Ipswich and Westbrook mucky peats, 0 to 2 percent slopes, very frequently flooded	A/D	0.8	4.2%
721D	Windsor-Rock outcrop complex, 15 to 25 percent slopes	A	1.3	7.2%
Totals for Area of Interest			**18.5**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

10.0 APPENDIX F – WATERSHED PLANS