STORMWATER MANAGEMENT REPORT

FOR: DANIEL S. DESTEFANO

PROPOSED 9-LOT SUBDIVISION

9 GERRISH ROAD

SALISBURY, MA

TAX MAP 22 LOT No. 19

PREPARED BY:

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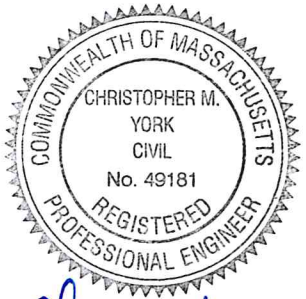
JUNE 18, 2020

REV: SEPT. 1, 2020



Christ M.Y. 9-1-20

1.0 INTRODUCTION

1.1 Project Description

Daniel Destefano proposes to construct a 9-unit subdivision. Approximately 683 feet of roadway, 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 Gerrish Road.

1.2 Existing Site Characteristics

The subject parcel is described as Tax Map 22, Lot No. 19 on the Town of Salisbury, MA Assessor's Map and is bordered by Gerrish Road to the south. The property is located in the R-1 and R-2 Zoning Districts. Elevations within the project site range from 40.00' near the existing dwelling to 20.00' in the wetlands. These elevations are based upon 1988 NAVD.

The existing parcel contains a single-family dwelling. The remainder of the site is undeveloped woodland and lawn area with pockets of ledge outcrops. Stormwater runoff patterns generally flow from east to west across the property, feeding the bordering vegetated wetlands. The front portion of the site drains towards Gerrish Road. See the accompanying plan for a more detailed description of the existing site conditions and topography.

The lot consists of several soil groups: Walpole variant fine sandy loam, 21A (Hydrologic Soil Group C/D); Raynham silt loam, 30A (Hydrologic Soil Group C/D); Belgrade very fine sandy loam, 225A (Hydrologic Soil Group C); Amostown fine sandy loam, 258B (Hydrologic Soil Group C/D); Ninigret fine sandy loam, 276A (Hydrologic Soil Group C) and Windsor-Rock outcrop complex, 721C (Hydrologic Soil Group A). See Appendix F for the NRCS soil map. In addition, soil evaluations were performed onsite to assist in the design of the stormwater treatment facilities. 9 test pits were performed in March 2020 which indicated silty loam soils throughout the site.

1.3 Proposed Site Features

The proposed development will service 9 single-family homes. 683 linear feet of 26' wide paved roadway with a cul-de-sac is proposed. Roadway profiles throughout the development range from 1.0% to 4.5%. Access into the development is from Gerrish Road.

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

The storm water management system for the proposed development will consist of granite curbing to direct the runoff to the low points of the road. Standard catch basin/manhole and piping systems are proposed for the roadway network and will also service portions of the surrounding lawn/landscaped areas sloping towards the roadway. From the low point, the runoff will be piped to a constructed wetland at the rear of the site and a constructed wetland at the rear of Lot 1.

2.0 WATERSHED ANALYSIS AND METHODOLOGY

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.

Existing drainage area boundaries were developed using an onsite topographic survey performed by Millennium Engineering, Inc. Proposed site development boundaries were developed from proposed grades and ground cover designed to minimize site storm water management structure requirements.

Hydrologic soil groups and curve numbers were estimated for existing and proposed developed conditions using available NRCS Soil Maps, current vegetation, and terrain.

3.0 DRAINAGE ANALYSIS

The purpose of the drainage analysis is two-fold. The first is to analyze and quantify the pre-development runoff flows through the site. The second purpose is to evaluate the impact of the proposed development on drainage patterns and flows, both within and outside the site, and to design a stormwater management system to adequately convey post-development runoff.

The design of the stormwater management system has the following goals:

1.) Minimize or eliminate erosion and sedimentation during construction as well as after development.

2.) To ensure that post-development flows do not have an adverse affect on downstream drainage structures and landowners.

3.) To design a stormwater and treatment system which will carry the surface runoff and satisfy goals one and two.

To determine the hydrological effect of the proposed development on the watershed, the existing conditions must first be analyzed.

4.0 WATERSHED DESCRIPTION: EXISTING CONDITIONS

Depending on the soil classification, type of ground cover present and the direction of the flow of runoff, the existing site is divided into watershed areas. Watershed area 100 consists of the front of the site including the existing driveway and a portion of the existing dwelling and it flows towards Gerrish Road. Area 200S consists of the remainder of the site and it feeds the bordering vegetated wetlands. See the attached plans (Watersheds and HydroCad Data, sheet 1 of 2) for the watershed area boundaries and the pre-development time of concentration flow paths.

4.1 WATERSHED ANALYSIS: EXISTING CONDITIONS

The existing conditions were modeled using the tabular hydrograph method with a Type III synthetic storm distribution for the 2, 10 and 100-year storm recurrence intervals. Runoff hydrographs were produced to estimate existing peak discharge.

Flows for the three storm simulations are as follows:

Existing Peak Runoff Rates (c.f.s.)

Subcatchment	Size	2 Yr	10 Yr	100 Yr
	(Acres)	Storm	Storm	Storm
100	1.89	0.8	2.4	5.1
200	4.41	1.2	3.9	8.8
		2 Yr	10 Yr	100 Yr
Gerrish Road		0.8	2.4	5.1
Wetlands		1.2	3.9	8.8

The pre-development drainage calculations can be found in Appendix C.

5.0 WATERSHED DESCRIPTION: POST-DEVELOPMENT CONDITIONS

To determine the post development runoff, new watersheds, runoff curve numbers and times of concentration were generated reflecting the changes in the topography and surface cover. The post-development watersheds are shown on the attached plans (Watersheds and HydroCad Data, sheet 2 of 2). Watershed areas 1S and 2S consist of the first 75 feet of the proposed roadway and it connects to the existing drainage system on Gerrish Road. Areas 3S, 4S and 9S feed the proposed constructed wetland on Lot 1 before discharging to the bordering vegetated wetlands. Areas 5S-8S consist of the majority of the proposed roadway and they feed the constructed wetland behind Lot 5 prior to discharging into the bordering vegetated wetlands. Area 100 consists of the front of the site and it flows towards Gerrish Road. Area 200S consists of the remainder of the site and it feeds the bordering vegetated wetlands.

5.1 WATERSHED ANALYSIS: POST-DEVELOPMENT CONDITIONS

The proposed developed conditions were modeled using the tabular hydrograph method with a Type III synthetic storm distribution for the 2, 10 and 100-year storm recurrence intervals. Runoff hydrographs were produced to estimate the post-development peak discharge.

Flows for the three storm simulations are as follows:

Post-Developed Peak Runoff Rates (c.f.s.)

Subcatchment	Size (Acres)	2 Yr Storm	10 Yr Storm	100 Yr Storm
1S	0.04	0.1	0.2	0.3
2S	0.03	0.1	0.1	0.2
3S	0.25	0.5	0.8	1.3
4S	0.30	0.1	0.3	0.7
5S	0.33	0.8	1.2	1.9
6S	0.75	0.6	1.5	2.9
7S	0.07	0.2	0.3	0.4
8S	0.54	0.7	1.3	2.4
9S	0.14	0.0	0.1	0.3
100	1.69	0.6	2.0	4.4
200	2.17	1.0	2.6	5.5
		2 Yr	10 Yr	100 Yr
Gerrish Road		0.8	2.2	4.8
Wetlands		1.2	3.1	6.1

The post-development drainage calculations can be found in Appendix D.

6.0 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 road will discharge into the proposed constructed wetlands.

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.

Stormwater runoff peak discharge rates from the proposed development are less than existing conditions for the 2-yr, 10-yr, and 100-yr 24-hour Type III storm events.

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 (C soil) = F * impervious area
= 0.25 in * 43,200 s.f.
= 900 c.f.

Standard No. 3 of the Massachusetts Stormwater Management Handbook requires post-development conditions to, at a minimum, approximate the annual recharge from pre-development conditions. The Handbook provides guidance for the design of best management practices (BMP's) used in new development and redevelopment projects.

Test pits performed throughout the site indicated poor soils unsuitable for recharge. The test pits indicated silt loam and silt clay loam soils, which will prevent any underground infiltration system from being properly designed.

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 = 43,200 s.f.

43,200 s.f. x 0.5" / 12 (to convert to ft) = 1,800 c.f. of runoff to be treated for water quality.

Volume of Constructed Wetlands = 28,463 c.f.

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 constructed wetlands. The following demonstrates that the proposed storm water management system for the development satisfies the requirement for treatment of 80% of total Suspended Solids:

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.

7.0 CONCLUSIONS

The results of this report indicate the proposed stormwater management system for the proposed development is capable of storing and 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.

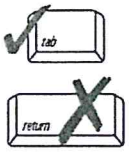
8.0 APPENDIX A – STORMWATER REPORT CHECKLIST

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

[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

Checklist for Stormwater Report

conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

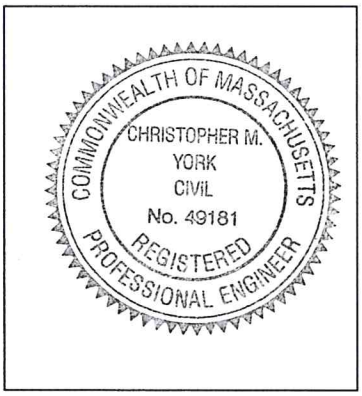
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



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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)

Checklist for Stormwater Report

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): _____

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

Checklist for Stormwater Report

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☐ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist (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)

Checklist for Stormwater Report

☒ 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

Checklist for Stormwater Report

☐ 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)

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

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.

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

LONG-TERM POLLUTION PREVENTION PLAN

AND

OPERATION & MAINTENANCE PLAN

For

DANIEL S. DESTEFANO
804 HAVERHILL STREET
ROWLEY, MA 01969

PROPOSED SUBDIVISION AT 9 GERRISH ROAD

PREPARED BY:

MILLENNIUM ENGINEERING, INC.
62 ELM STREET
SALISBURY, MA 01952
(978) 463–8980

SEPTEMBER 1, 2020

This long-term Stormwater Management System Operations and Maintenance (O&M) Plan, filed with the Town of Salisbury, shall be implemented at 9 Gerrish Road 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
Daniel S. Destefano
804 Haverhill Street
Rowley, MA 01969
(978) 833-7438

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.

POST-CONSTRUCTION BMPs

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 two 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 Homeowner's Association shall be responsible for the catch basin 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 Homeowner's Association. Sediments removed during cleaning shall be disposed of at an approved DEP landfill.

Constructed Wetland

Constructed wetlands are included in the stormwater management plan design for the proposed development. The Homeowner's Association 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

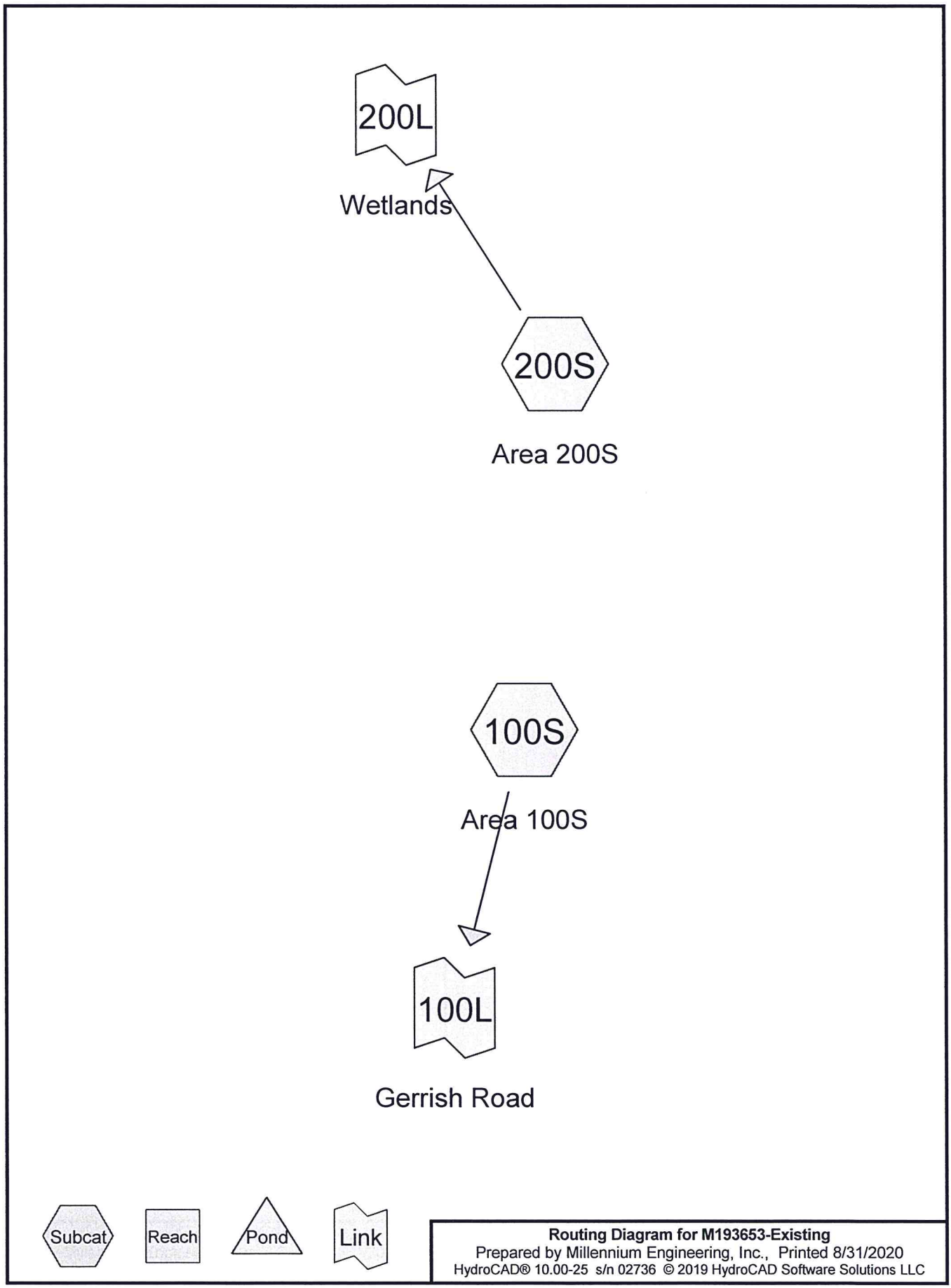
Loam and hydroseed any disturbed surfaces after the final design grades have been achieved. A minimum of 6" of loam shall be installed. Seed mix shall be MA State Slope Mixture (50% creeping red fescue, 30% Kentucky 31 tall fescue, 10% annual ryegrass, 5% red top, 5% ladino clover) and MA State Plot 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*
Street Sweeping (1x per year)			
Forebay Sediment Removal Incl. rip rap and pipe (2x per year)			
Constructed Wetland Cleaning (2x per year min.)			
Deep Sump Catch Basin (2x per year)			
Rip-rap Outlet Protection (2x per year)			
Vegetation and Landscaping (2x per year)			

10.0 APPENDIX C – PRE-DEVELOPMENT DRAINAGE CALCULATIONS



Routing Diagram for M193653-Existing
Prepared by Millennium Engineering, Inc., Printed 8/31/2020

Summary for Subcatchment 100S: Area 100S

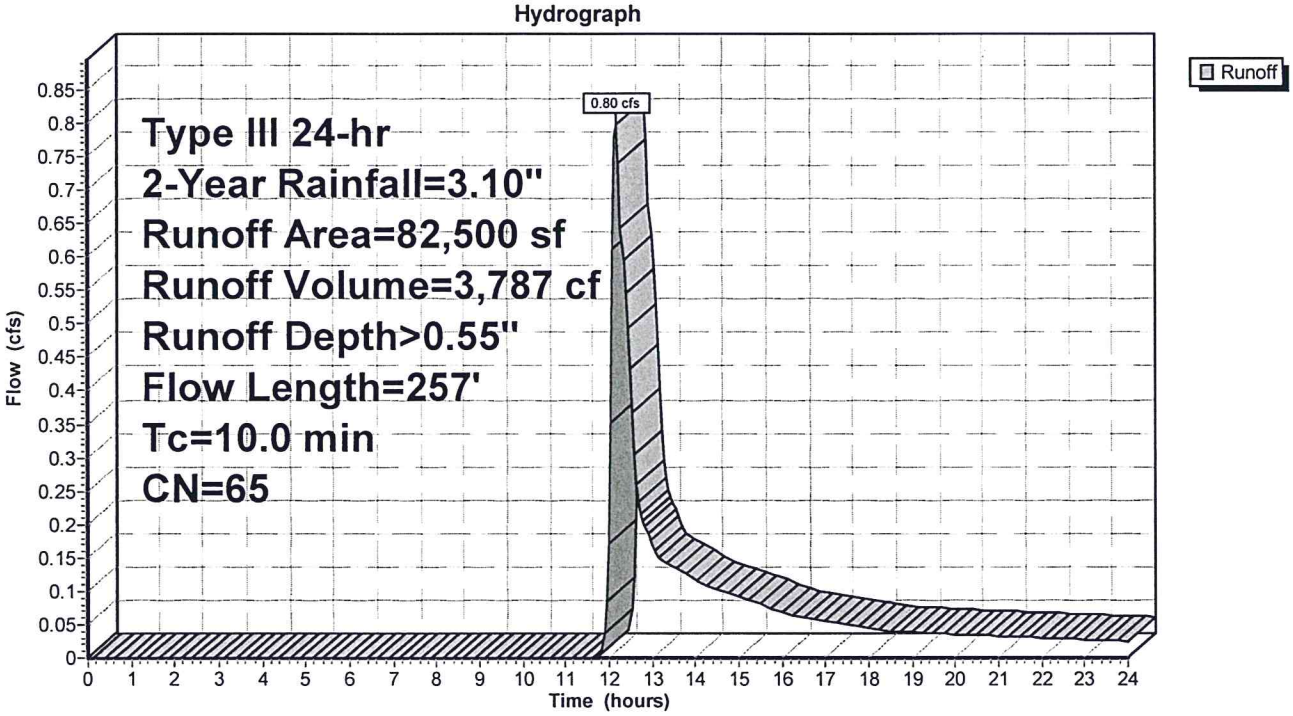
Runoff = 0.80 cfs @ 12.17 hrs, Volume= 3,787 cf, Depth> 0.55"

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
*	3,055	98	Roofs
*	7,965	98	Paved roads w/curbs & sewers
*	1,480	96	Gravel surface
	11,160	39	>75% Grass cover, Good, HSG A
	32,940	74	>75% Grass cover, Good, HSG C
	14,100	30	Woods, Good, HSG A
	11,800	70	Woods, Good, HSG C
	82,500	65	Weighted Average
	71,480		86.64% Pervious Area
	11,020		13.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	50	0.0600	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.7	170	0.0540	1.63		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	37	0.0210	2.94		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.0	257	Total			

Subcatchment 100S: Area 100S

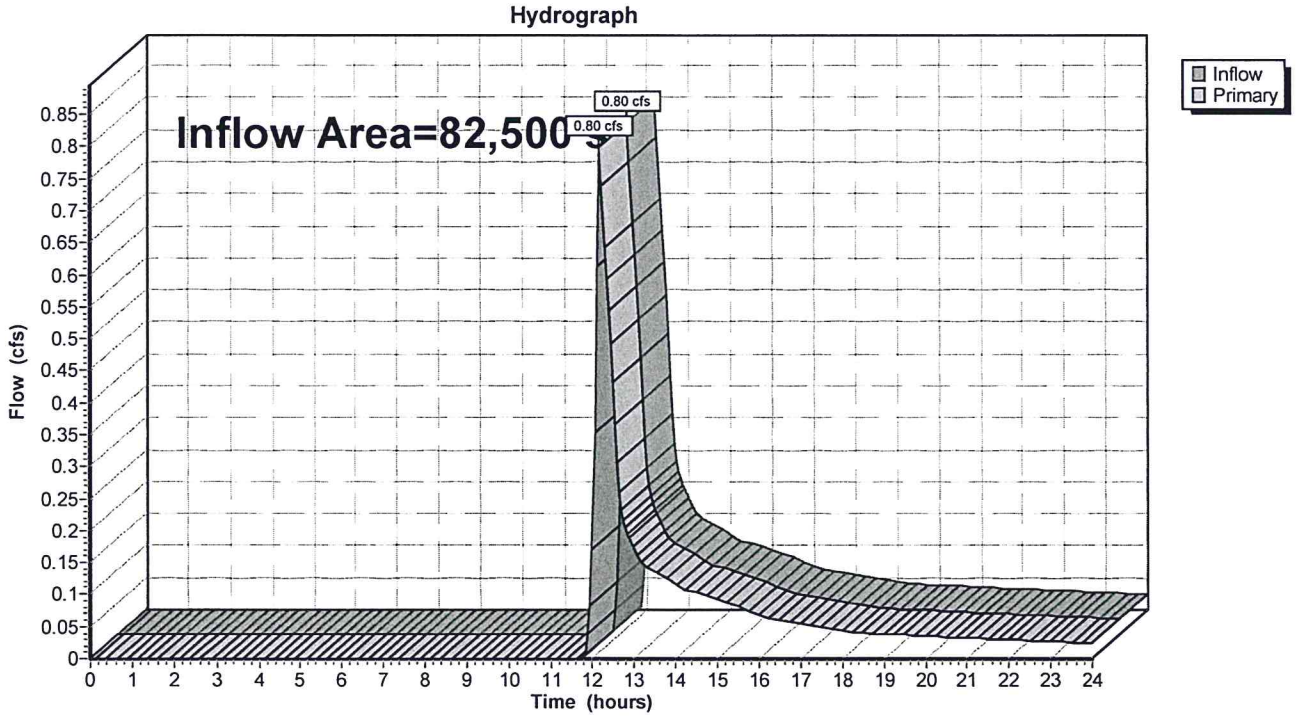


Summary for Link 100L: Gerrish Road

Inflow Area = 82,500 sf, 13.36% Impervious, Inflow Depth > 0.55" for 2-Year event
Inflow = 0.80 cfs @ 12.17 hrs, Volume= 3,787 cf
Primary = 0.80 cfs @ 12.17 hrs, Volume= 3,787 cf, Atten= 0%, Lag= 0.0 min

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

Link 100L: Gerrish Road



Summary for Subcatchment 200S: Area 200S

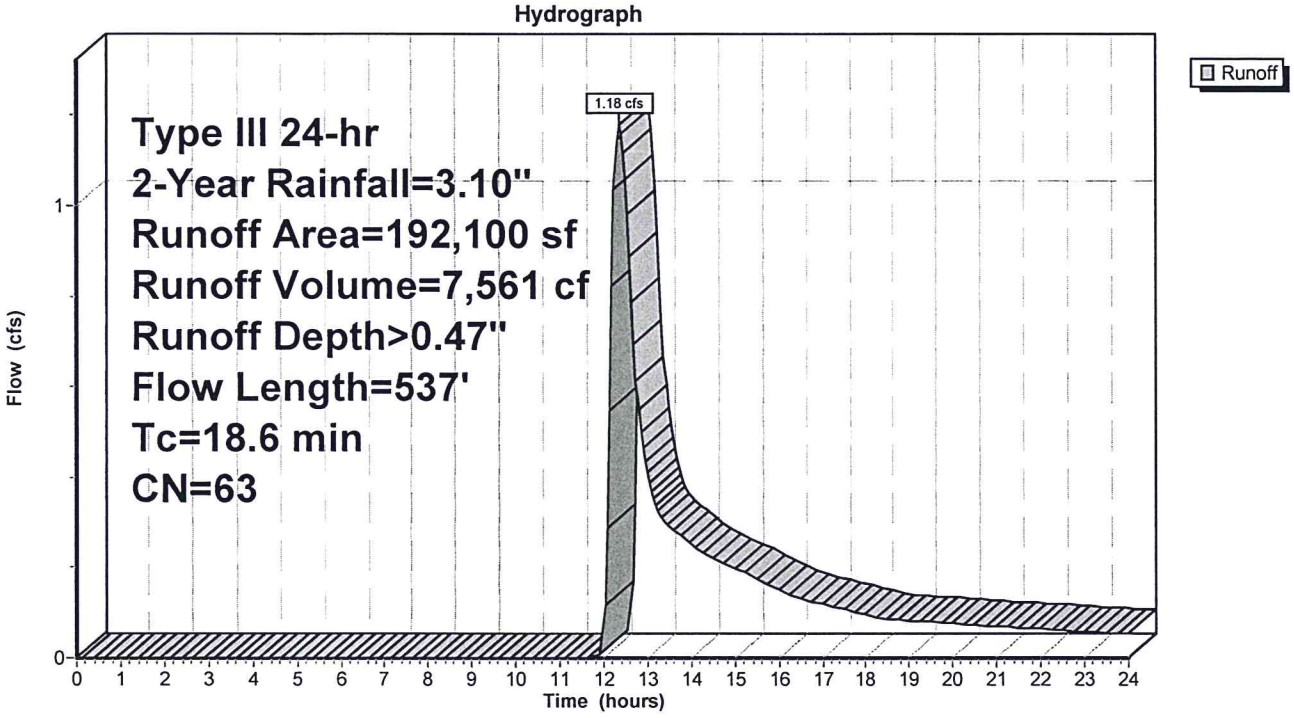
Runoff = 1.18 cfs @ 12.36 hrs, Volume= 7,561 cf, Depth> 0.47"

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
*	810	98	Roofs
	17,500	39	>75% Grass cover, Good, HSG A
	66,000	74	>75% Grass cover, Good, HSG C
	28,200	30	Woods, Good, HSG A
	79,590	70	Woods, Good, HSG C
	192,100	63	Weighted Average
	191,290		99.58% Pervious Area
	810		0.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	50	0.0340	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.6	111	0.0520	1.14		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.4	192	0.0180	0.94		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.5	184	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
18.6	537	Total			

Subcatchment 200S: Area 200S

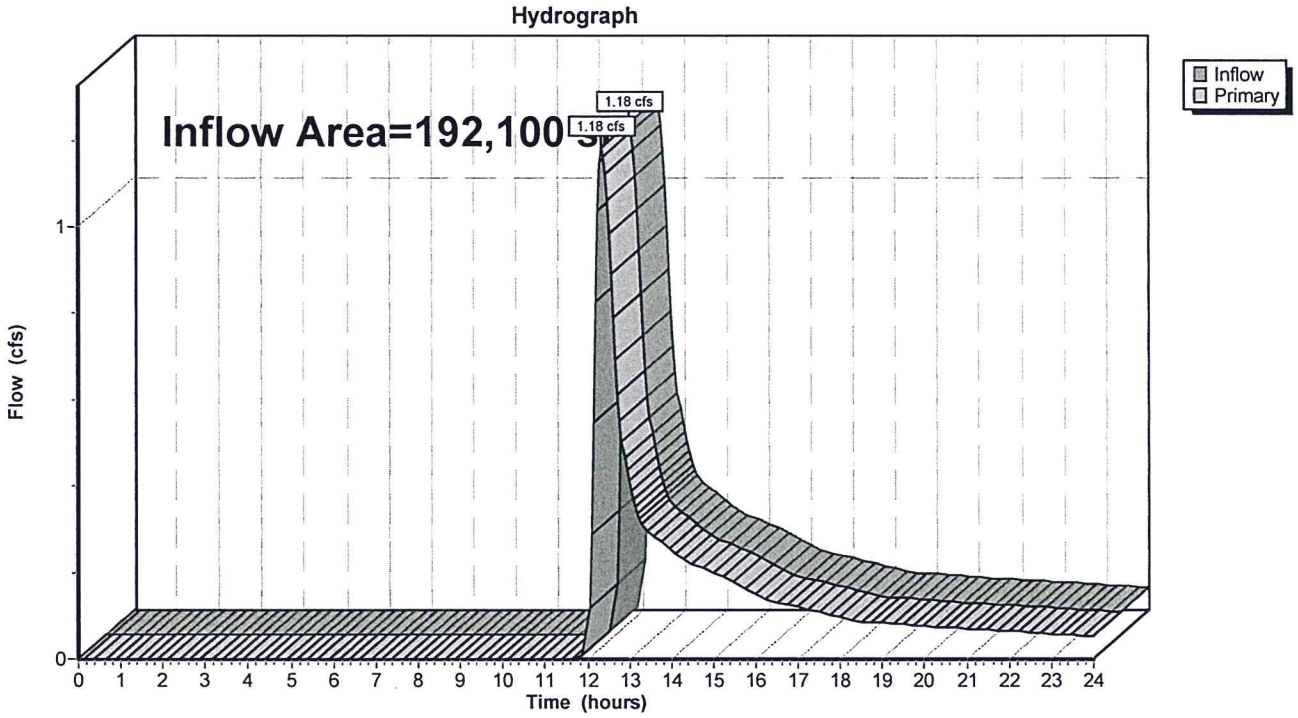


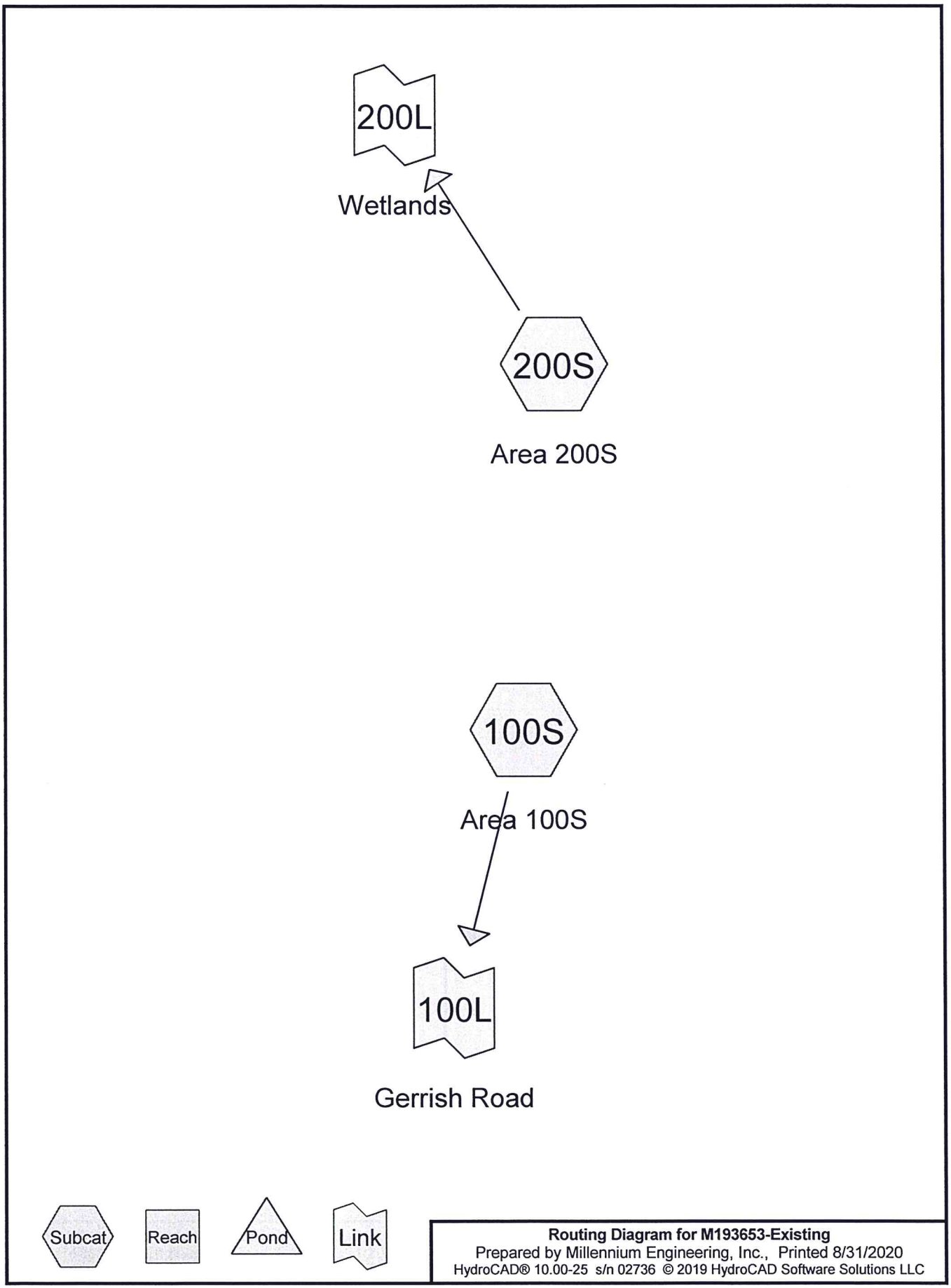
Summary for Link 200L: Wetlands

Inflow Area = 192,100 sf, 0.42% Impervious, Inflow Depth > 0.47" for 2-Year event
Inflow = 1.18 cfs @ 12.36 hrs, Volume= 7,561 cf
Primary = 1.18 cfs @ 12.36 hrs, Volume= 7,561 cf, Atten= 0%, Lag= 0.0 min

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

Link 200L: Wetlands





Routing Diagram for M193653-Existing
Prepared by Millennium Engineering, Inc., Printed 8/31/2020

Summary for Subcatchment 100S: Area 100S

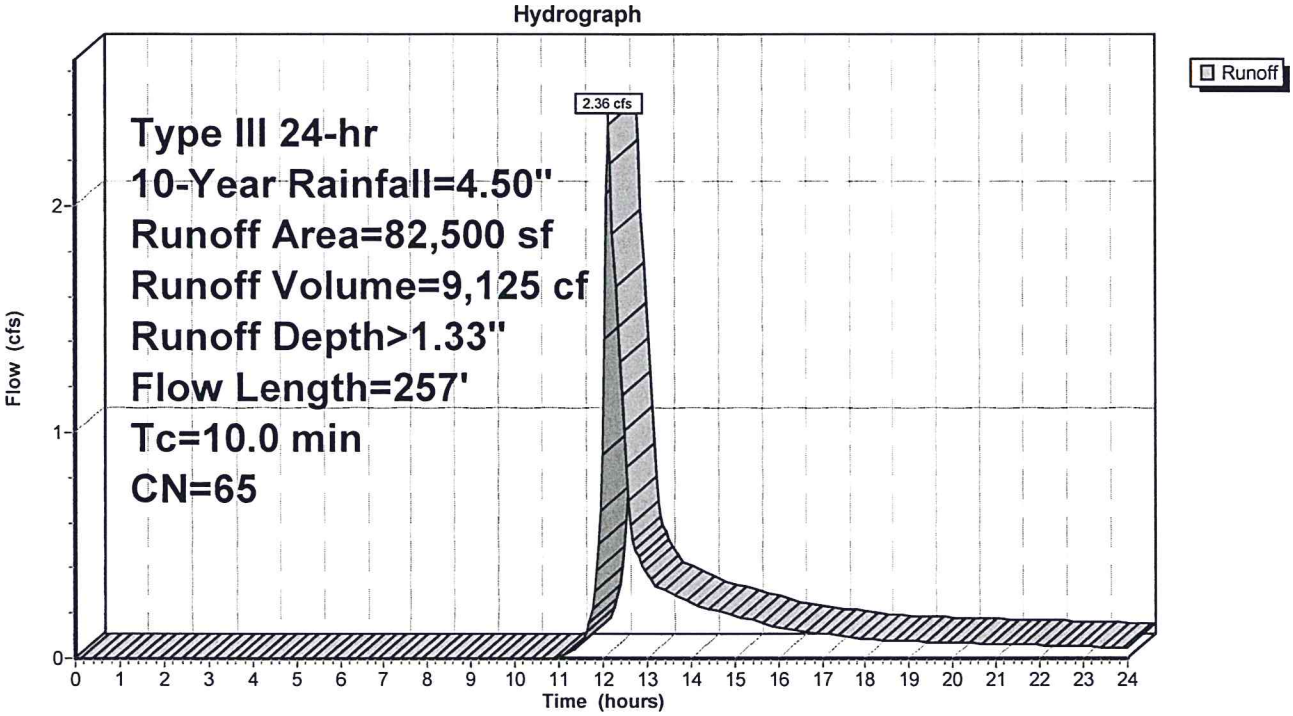
Runoff = 2.36 cfs @ 12.16 hrs, Volume= 9,125 cf, Depth> 1.33"

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
*	3,055	98	Roofs
*	7,965	98	Paved roads w/curbs & sewers
*	1,480	96	Gravel surface
	11,160	39	>75% Grass cover, Good, HSG A
	32,940	74	>75% Grass cover, Good, HSG C
	14,100	30	Woods, Good, HSG A
	11,800	70	Woods, Good, HSG C
	82,500	65	Weighted Average
	71,480		86.64% Pervious Area
	11,020		13.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	50	0.0600	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.7	170	0.0540	1.63		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	37	0.0210	2.94		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.0	257	Total			

Subcatchment 100S: Area 100S

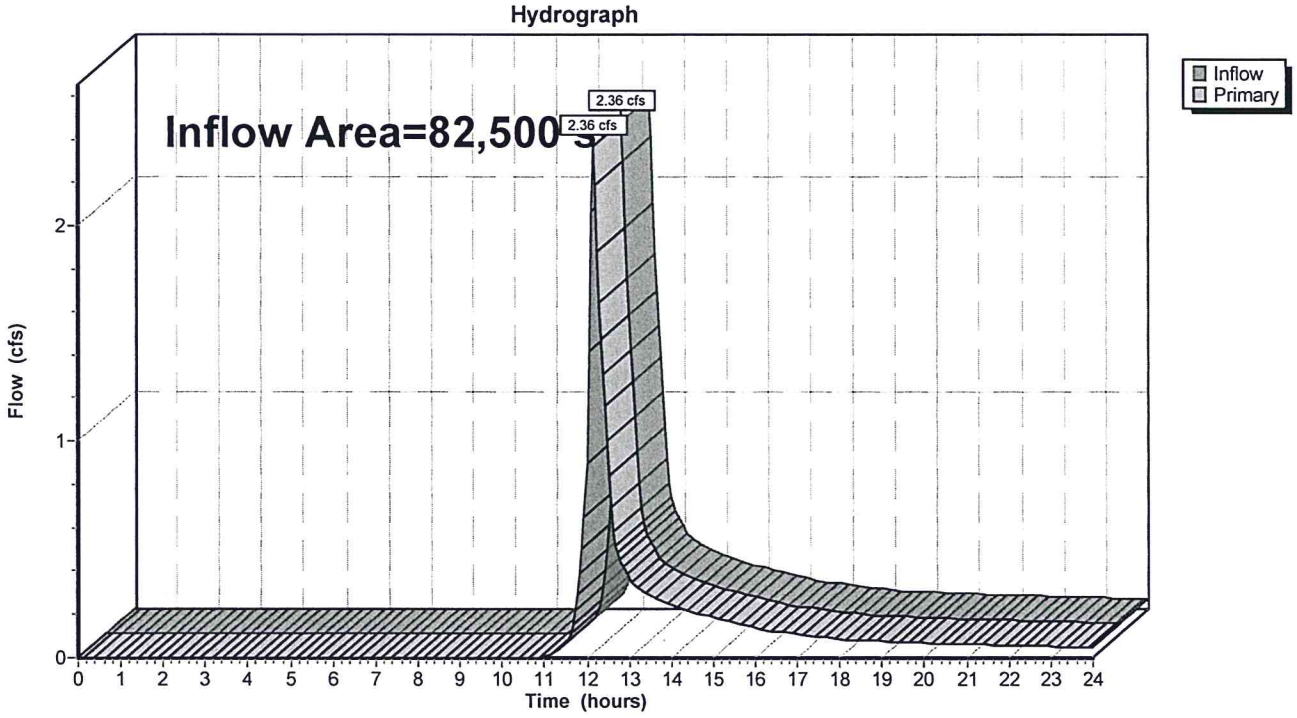


Summary for Link 100L: Gerrish Road

Inflow Area = 82,500 sf, 13.36% Impervious, Inflow Depth > 1.33" for 10-Year event
Inflow = 2.36 cfs @ 12.16 hrs, Volume= 9,125 cf
Primary = 2.36 cfs @ 12.16 hrs, Volume= 9,125 cf, Atten= 0%, Lag= 0.0 min

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

Link 100L: Gerrish Road



Summary for Subcatchment 200S: Area 200S

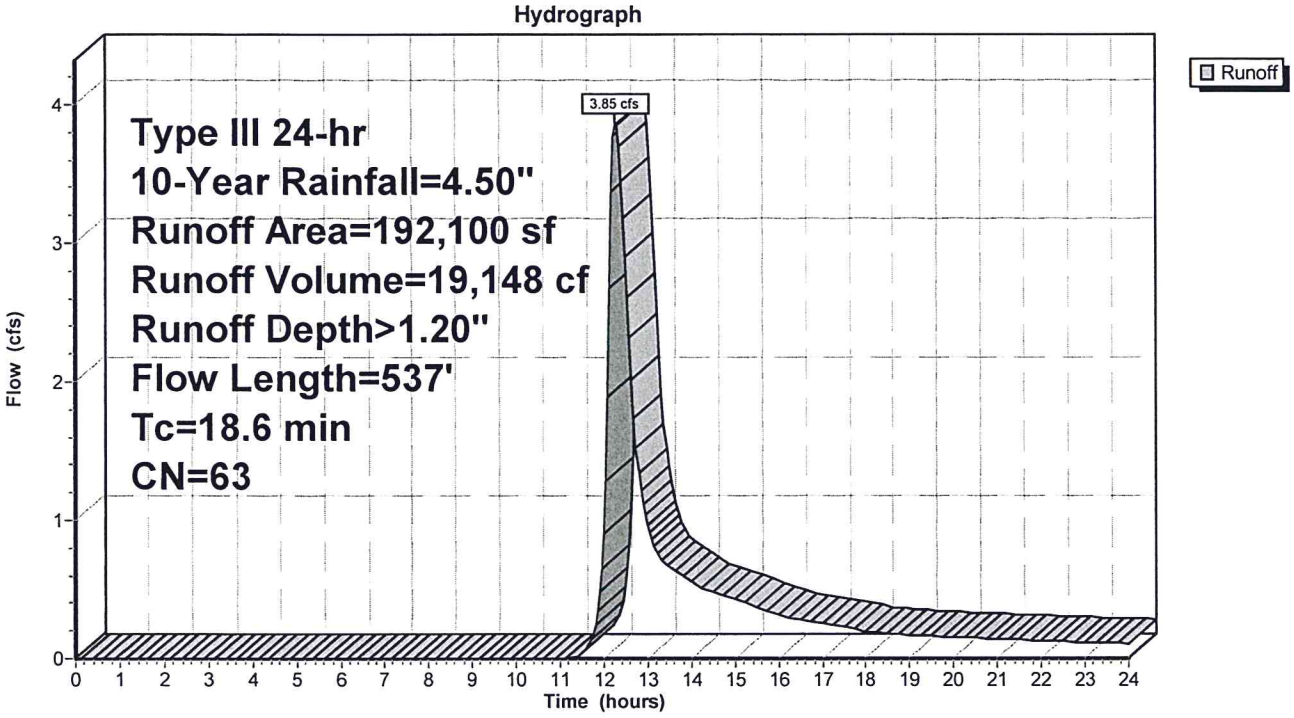
Runoff = 3.85 cfs @ 12.29 hrs, Volume= 19,148 cf, Depth> 1.20"

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
*	810	98	Roofs
	17,500	39	>75% Grass cover, Good, HSG A
	66,000	74	>75% Grass cover, Good, HSG C
	28,200	30	Woods, Good, HSG A
	79,590	70	Woods, Good, HSG C
	192,100	63	Weighted Average
	191,290		99.58% Pervious Area
	810		0.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	50	0.0340	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.6	111	0.0520	1.14		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.4	192	0.0180	0.94		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.5	184	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
18.6	537	Total			

Subcatchment 200S: Area 200S

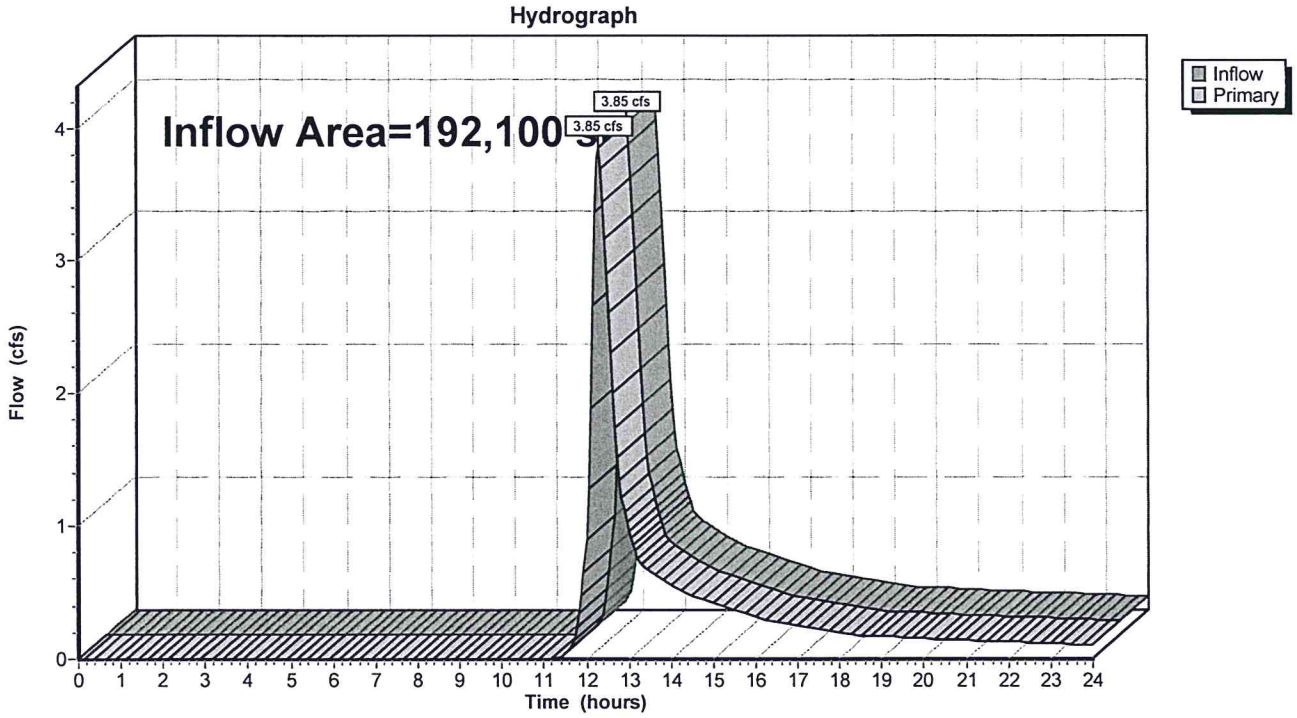


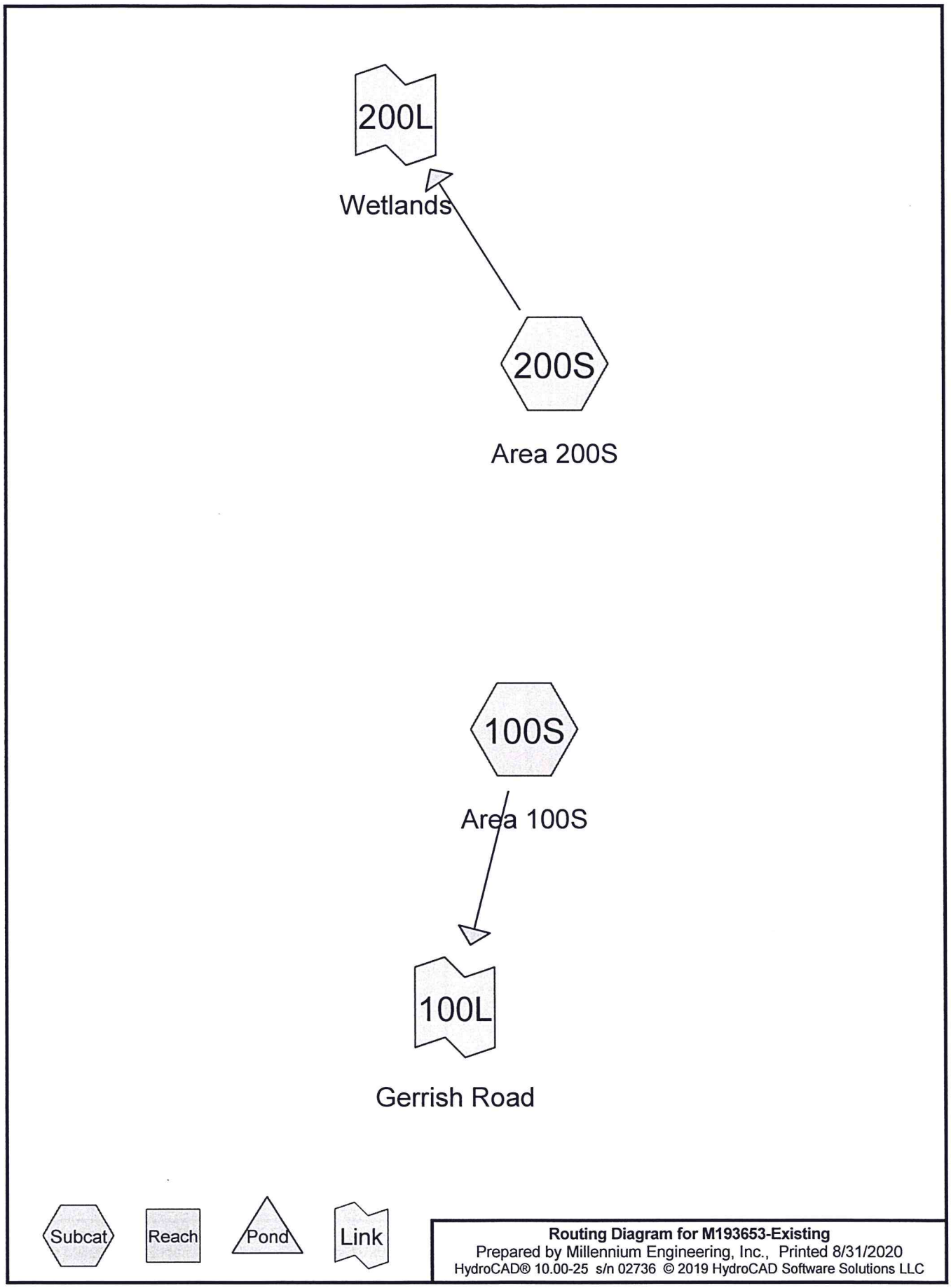
Summary for Link 200L: Wetlands

Inflow Area = 192,100 sf, 0.42% Impervious, Inflow Depth > 1.20" for 10-Year event
Inflow = 3.85 cfs @ 12.29 hrs, Volume= 19,148 cf
Primary = 3.85 cfs @ 12.29 hrs, Volume= 19,148 cf, Atten= 0%, Lag= 0.0 min

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

Link 200L: Wetlands





Routing Diagram for M193653-Existing
Prepared by Millennium Engineering, Inc., Printed 8/31/2020

Summary for Subcatchment 100S: Area 100S

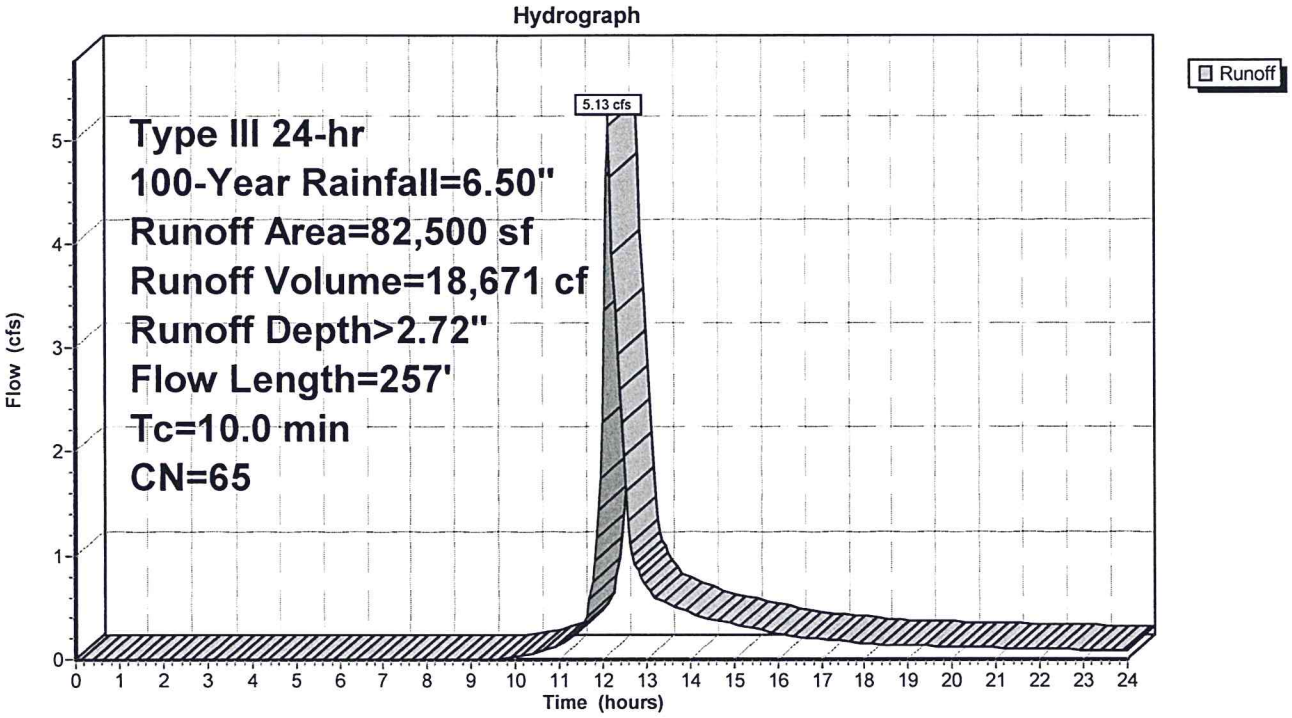
Runoff = 5.13 cfs @ 12.15 hrs, Volume= 18,671 cf, Depth> 2.72"

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 100-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	3,055	98	Roofs
*	7,965	98	Paved roads w/curbs & sewers
*	1,480	96	Gravel surface
	11,160	39	>75% Grass cover, Good, HSG A
	32,940	74	>75% Grass cover, Good, HSG C
	14,100	30	Woods, Good, HSG A
	11,800	70	Woods, Good, HSG C
	82,500	65	Weighted Average
	71,480		86.64% Pervious Area
	11,020		13.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	50	0.0600	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.7	170	0.0540	1.63		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	37	0.0210	2.94		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.0	257	Total			

Subcatchment 100S: Area 100S

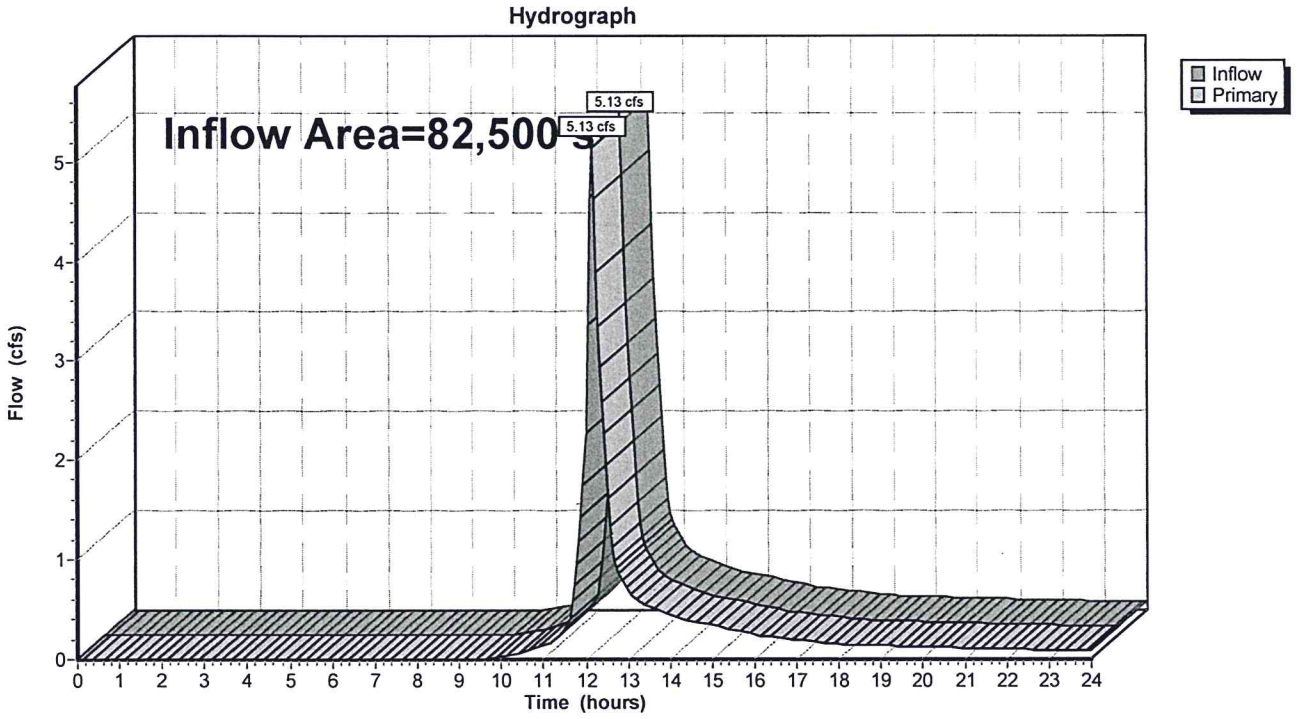


Summary for Link 100L: Gerrish Road

Inflow Area = 82,500 sf, 13.36% Impervious, Inflow Depth > 2.72" for 100-Year event
Inflow = 5.13 cfs @ 12.15 hrs, Volume= 18,671 cf
Primary = 5.13 cfs @ 12.15 hrs, Volume= 18,671 cf, Atten= 0%, Lag= 0.0 min

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

Link 100L: Gerrish Road



Summary for Subcatchment 200S: Area 200S

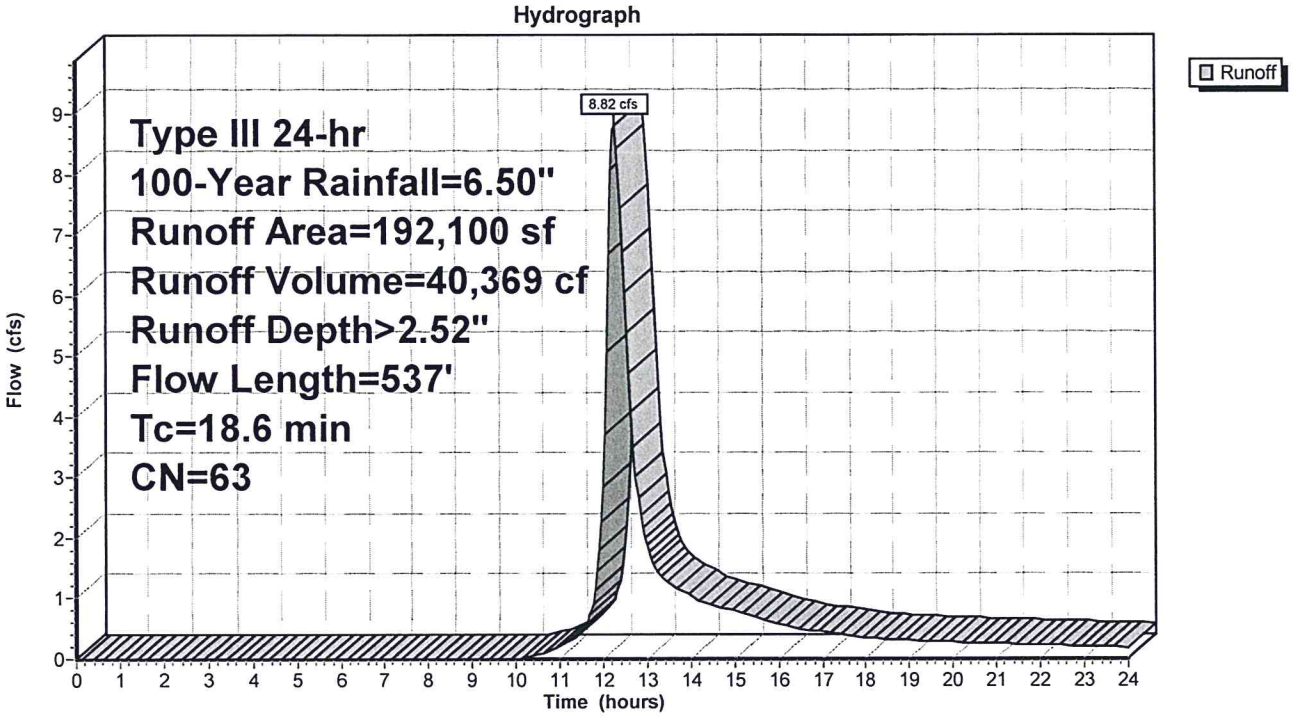
Runoff = 8.82 cfs @ 12.27 hrs, Volume= 40,369 cf, Depth> 2.52"

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 100-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	810	98	Roofs
	17,500	39	>75% Grass cover, Good, HSG A
	66,000	74	>75% Grass cover, Good, HSG C
	28,200	30	Woods, Good, HSG A
	79,590	70	Woods, Good, HSG C
	192,100	63	Weighted Average
	191,290		99.58% Pervious Area
	810		0.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	50	0.0340	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.6	111	0.0520	1.14		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.4	192	0.0180	0.94		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.5	184	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
18.6	537	Total			

Subcatchment 200S: Area 200S

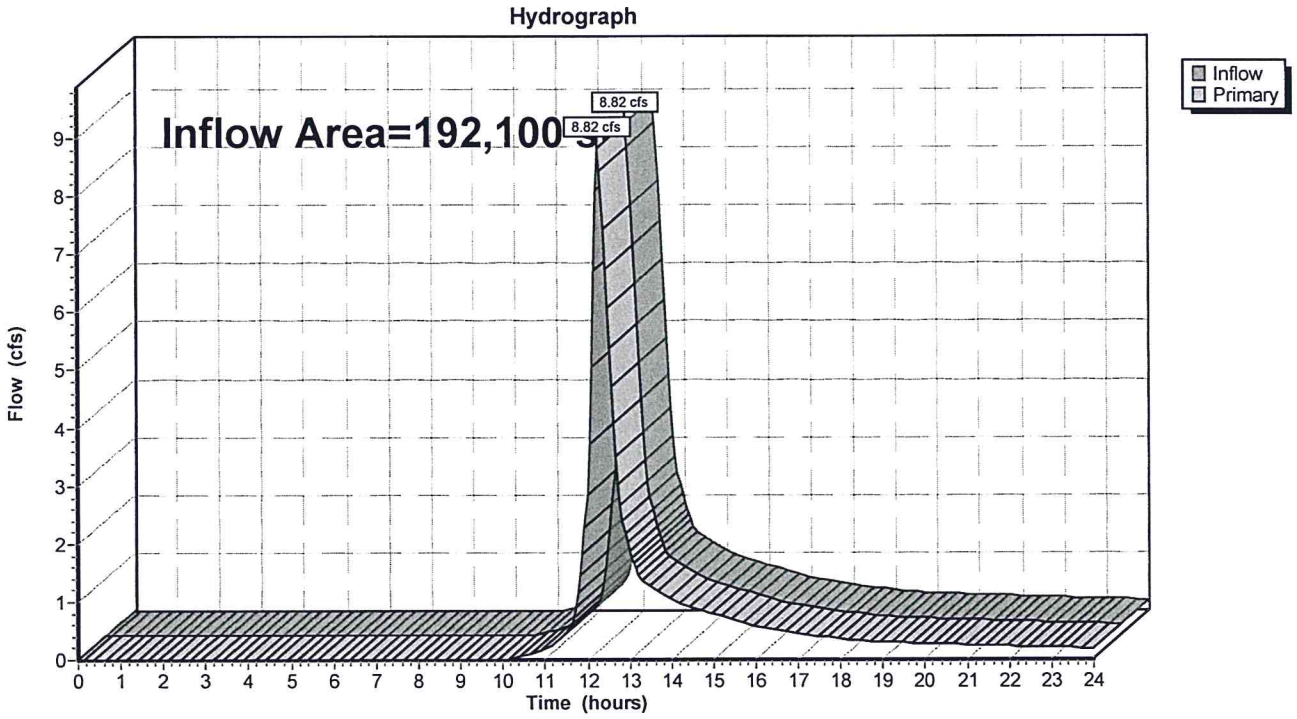


Summary for Link 200L: Wetlands

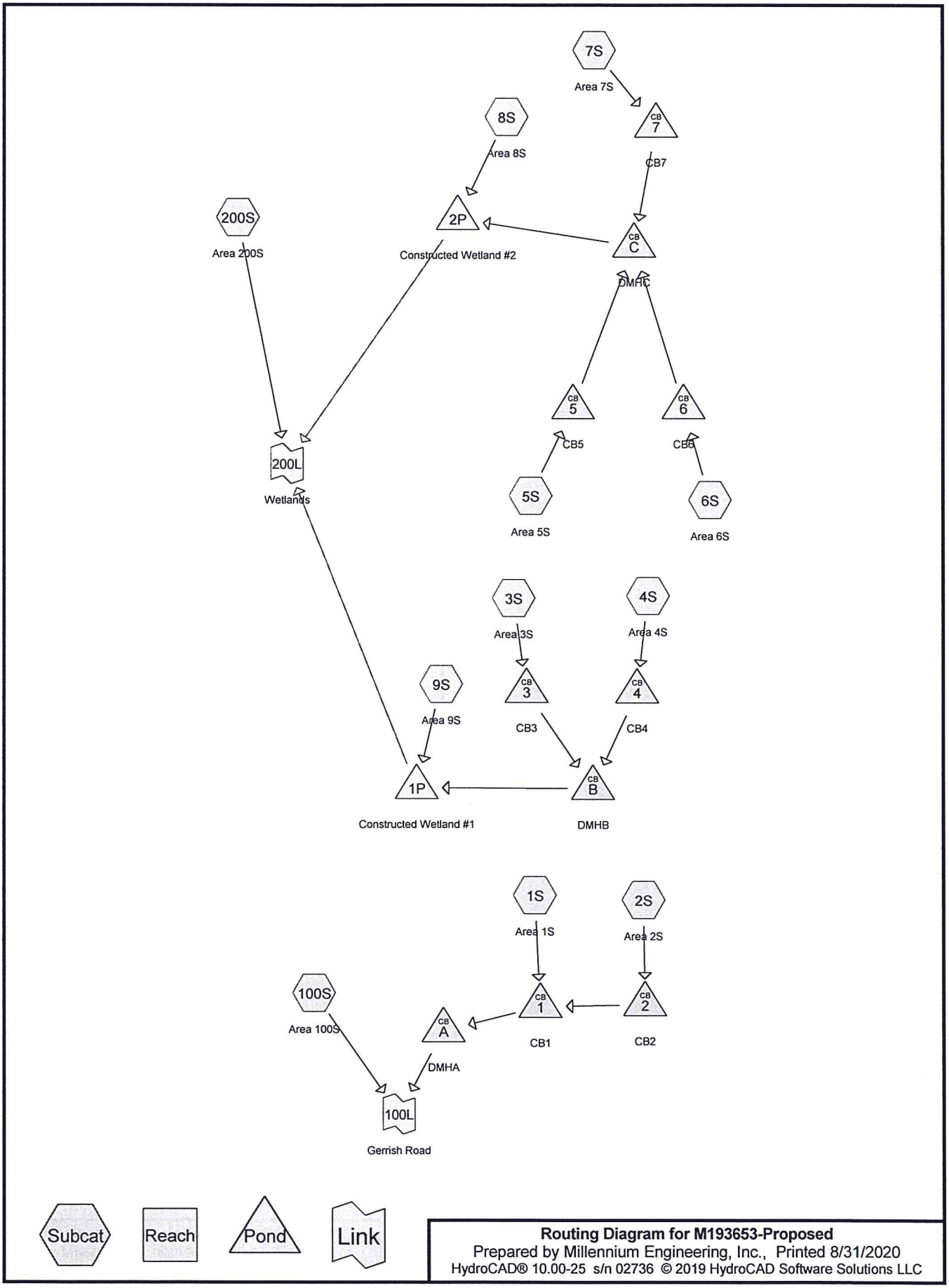
Inflow Area = 192,100 sf, 0.42% Impervious, Inflow Depth > 2.52" for 100-Year event
Inflow = 8.82 cfs @ 12.27 hrs, Volume= 40,369 cf
Primary = 8.82 cfs @ 12.27 hrs, Volume= 40,369 cf, Atten= 0%, Lag= 0.0 min

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

Link 200L: Wetlands



11.0 APPENDIX D – POST-DEVELOPMENT DRAINAGE CALCULATIONS



Routing Diagram for M193653-Proposed
Prepared by Millennium Engineering, Inc., Printed 8/31/2020
HydroCAD® 10.00-25 s/n 02736 © 2019 HydroCAD Software Solutions LLC

Summary for Subcatchment 1S: Area 1S

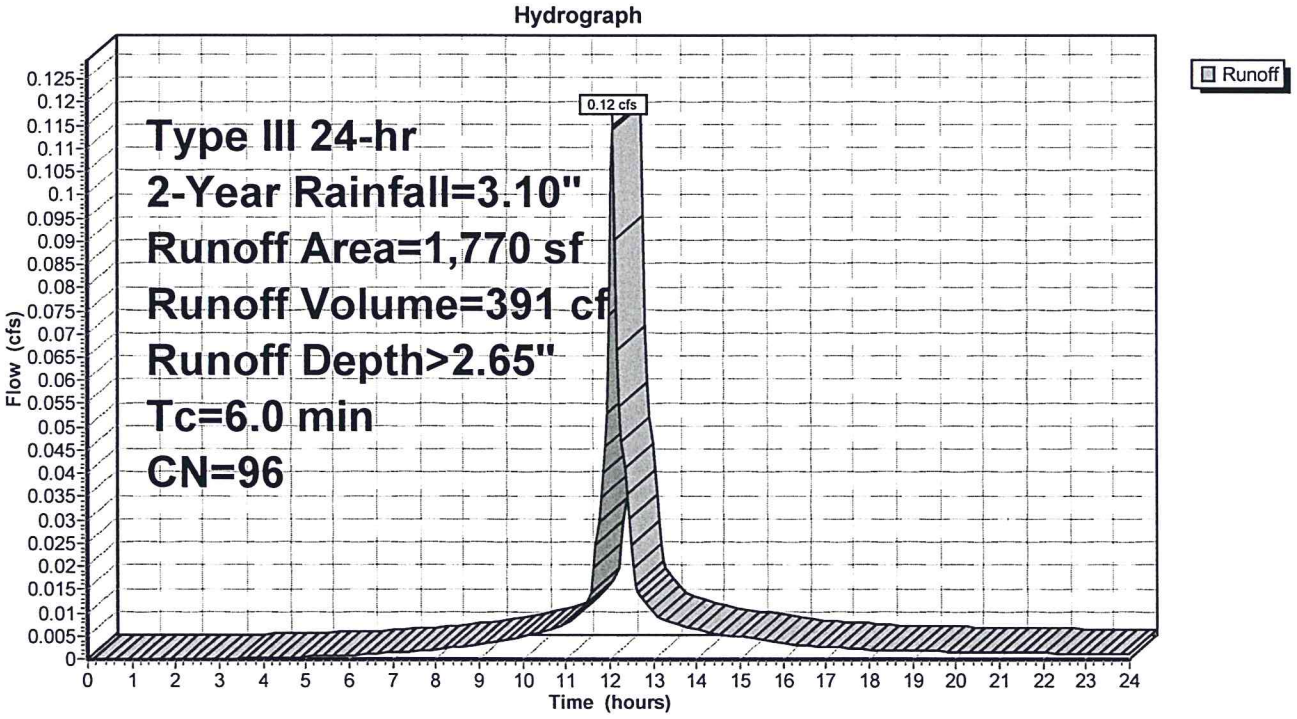
Runoff = 0.12 cfs @ 12.09 hrs, Volume= 391 cf, Depth> 2.65"

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
*	1,680	98	Paved roads w/curbs & sewers
	25	39	>75% Grass cover, Good, HSG A
	65	74	>75% Grass cover, Good, HSG C
	1,770	96	Weighted Average
	90		5.08% Pervious Area
	1,680		94.92% 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

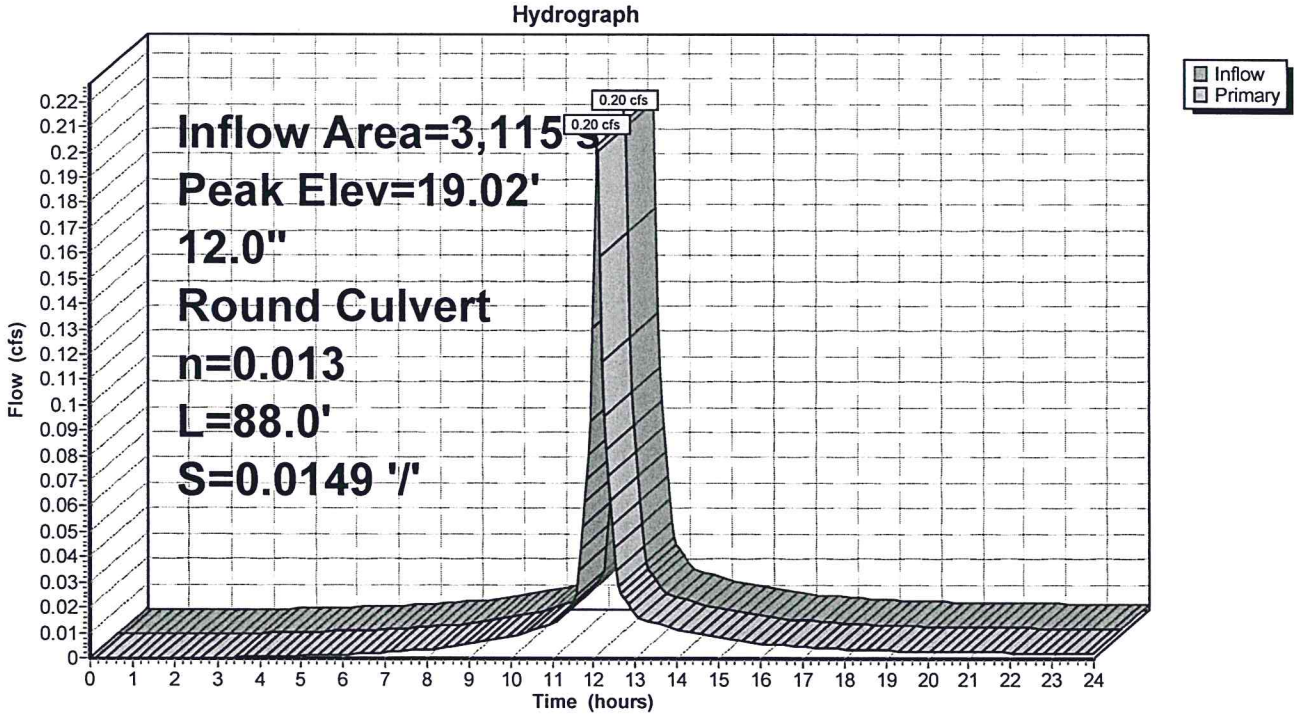
Inflow Area = 3,115 sf, 93.58% Impervious, Inflow Depth > 2.65" for 2-Year event
Inflow = 0.20 cfs @ 12.09 hrs, Volume= 688 cf
Outflow = 0.20 cfs @ 12.09 hrs, Volume= 688 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.20 cfs @ 12.09 hrs, Volume= 688 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 19.02' @ 12.09 hrs
Flood Elev= 22.70'

Device	Routing	Invert	Outlet Devices
#1	Primary	18.80'	**12.0" Round Culvert** L= 88.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 18.80' / 17.49' S= 0.0149 '/' 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=19.02' (Free Discharge)
1=Culvert (Inlet Controls 0.20 cfs @ 1.58 fps)

Pond 1: CB1



Summary for Subcatchment 2S: Area 2S

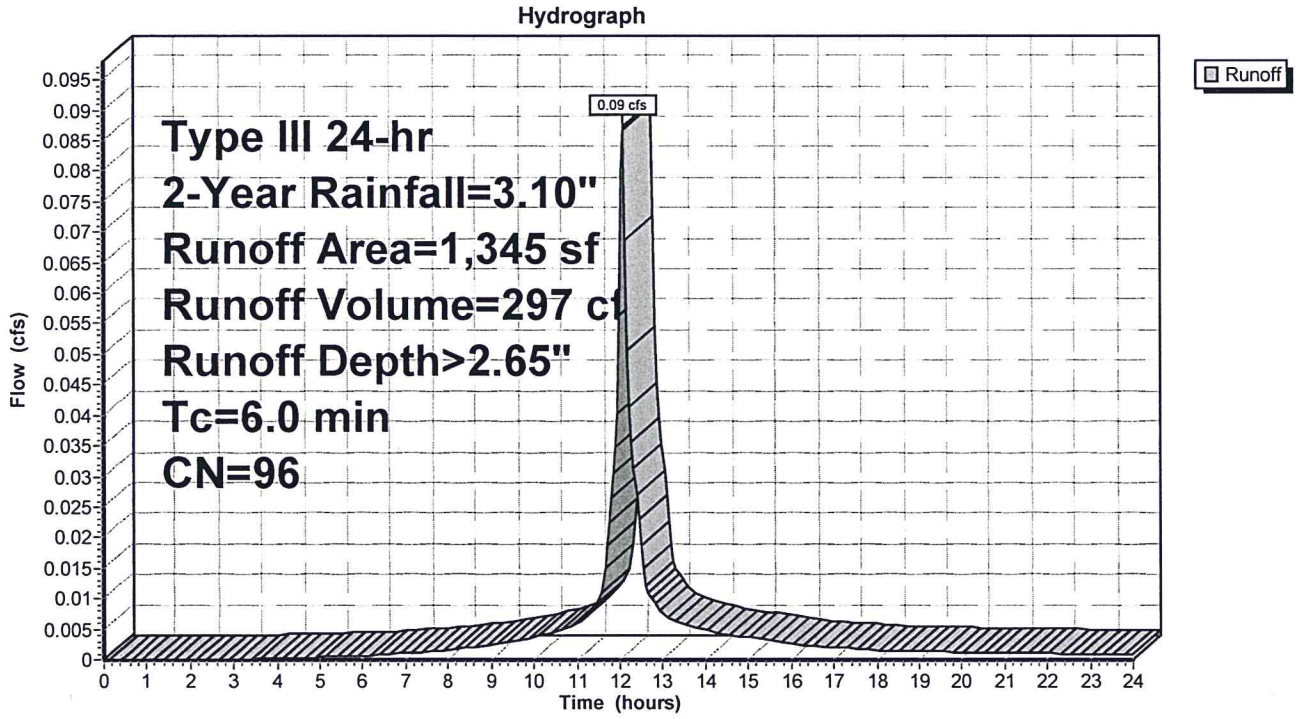
Runoff = 0.09 cfs @ 12.09 hrs, Volume= 297 cf, Depth> 2.65"

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
*	1,235	98	Paved roads w/curbs & sewers
	20	39	>75% Grass cover, Good, HSG A
	90	74	>75% Grass cover, Good, HSG C
	1,345	96	Weighted Average
	110		8.18% Pervious Area
	1,235		91.82% 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

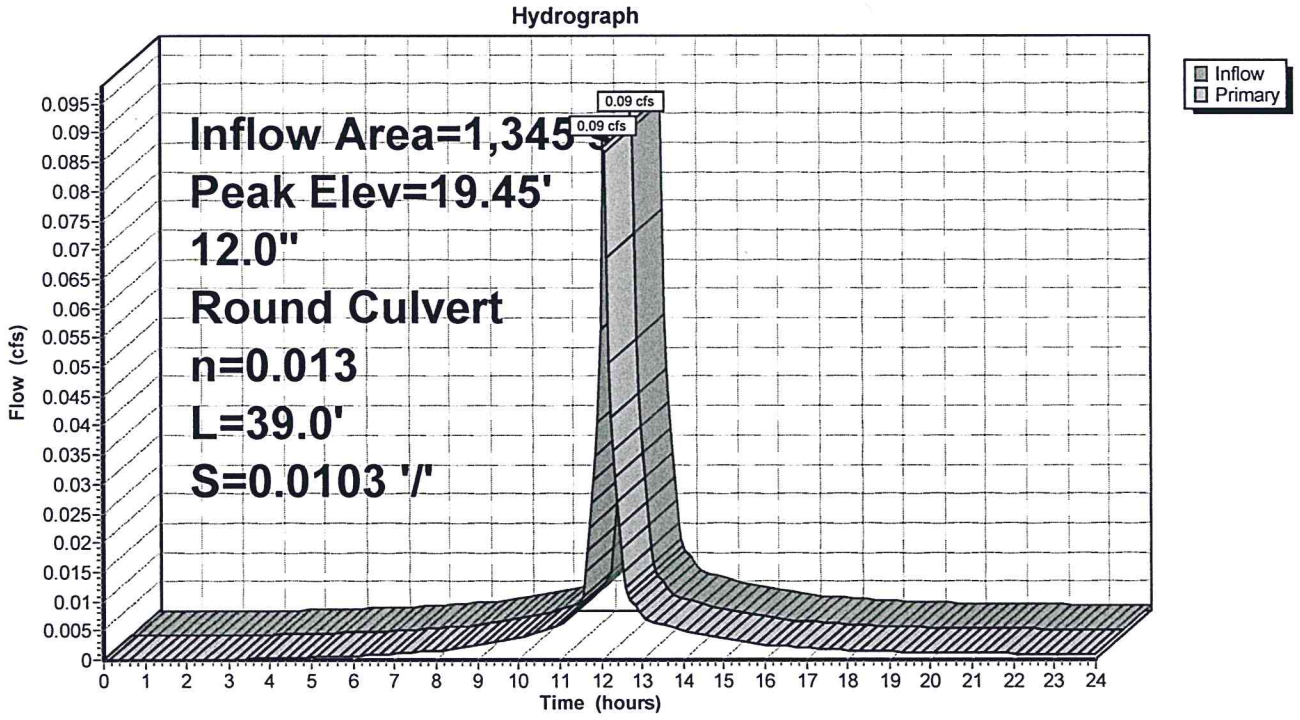
Inflow Area = 1,345 sf, 91.82% Impervious, Inflow Depth > 2.65" for 2-Year event
Inflow = 0.09 cfs @ 12.09 hrs, Volume= 297 cf
Outflow = 0.09 cfs @ 12.09 hrs, Volume= 297 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.09 cfs @ 12.09 hrs, Volume= 297 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 19.45' @ 12.09 hrs
Flood Elev= 22.70'

Device	Routing	Invert	Outlet Devices
#1	Primary	19.30'	**12.0" Round Culvert** L= 39.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 19.30' / 18.90' S= 0.0103 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.08 cfs @ 12.09 hrs HW=19.44' (Free Discharge)
1=Culvert (Barrel Controls 0.08 cfs @ 1.83 fps)

Pond 2: CB2



Summary for Pond A: DMHA

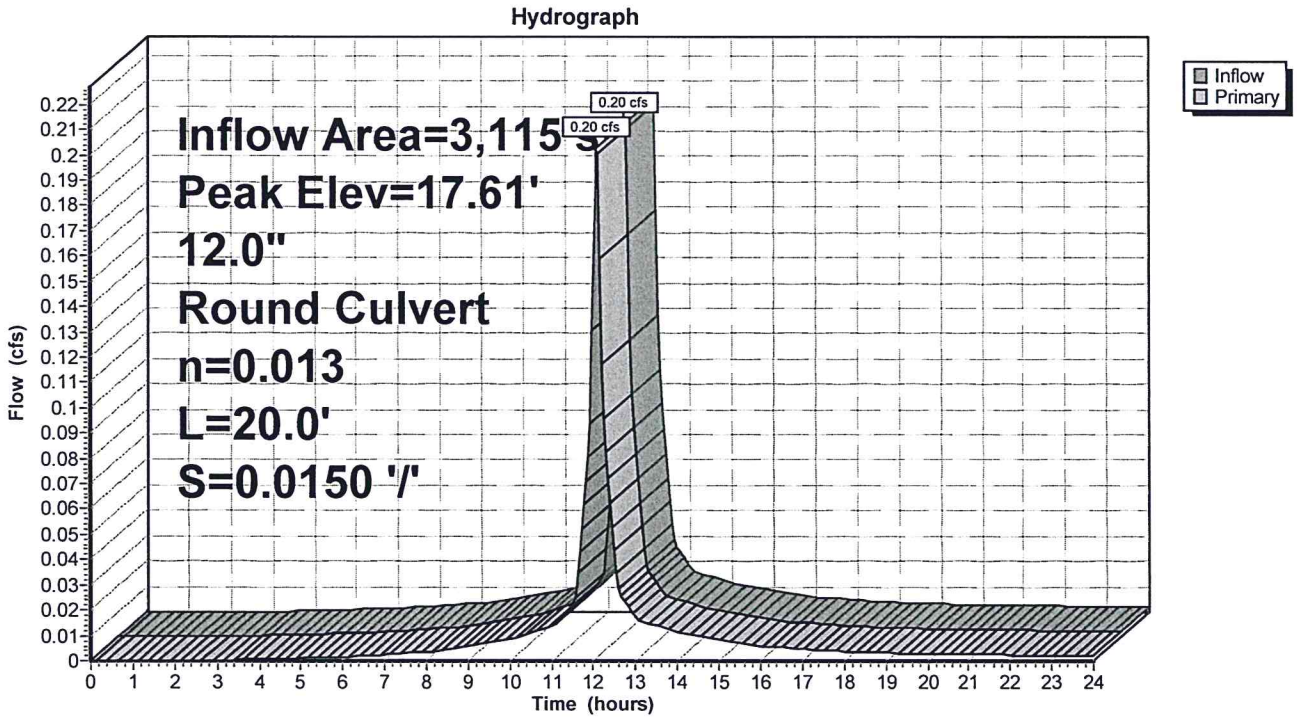
Inflow Area = 3,115 sf, 93.58% Impervious, Inflow Depth > 2.65" for 2-Year event
Inflow = 0.20 cfs @ 12.09 hrs, Volume= 688 cf
Outflow = 0.20 cfs @ 12.09 hrs, Volume= 688 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.20 cfs @ 12.09 hrs, Volume= 688 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 17.61' @ 12.09 hrs
Flood Elev= 21.70'

Device	Routing	Invert	Outlet Devices
#1	Primary	17.39'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 17.39' / 17.09' S= 0.0150 '/' 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=17.61' (Free Discharge)
1=Culvert (Inlet Controls 0.20 cfs @ 1.58 fps)

Pond A: DMHA



Summary for Subcatchment 100S: Area 100S

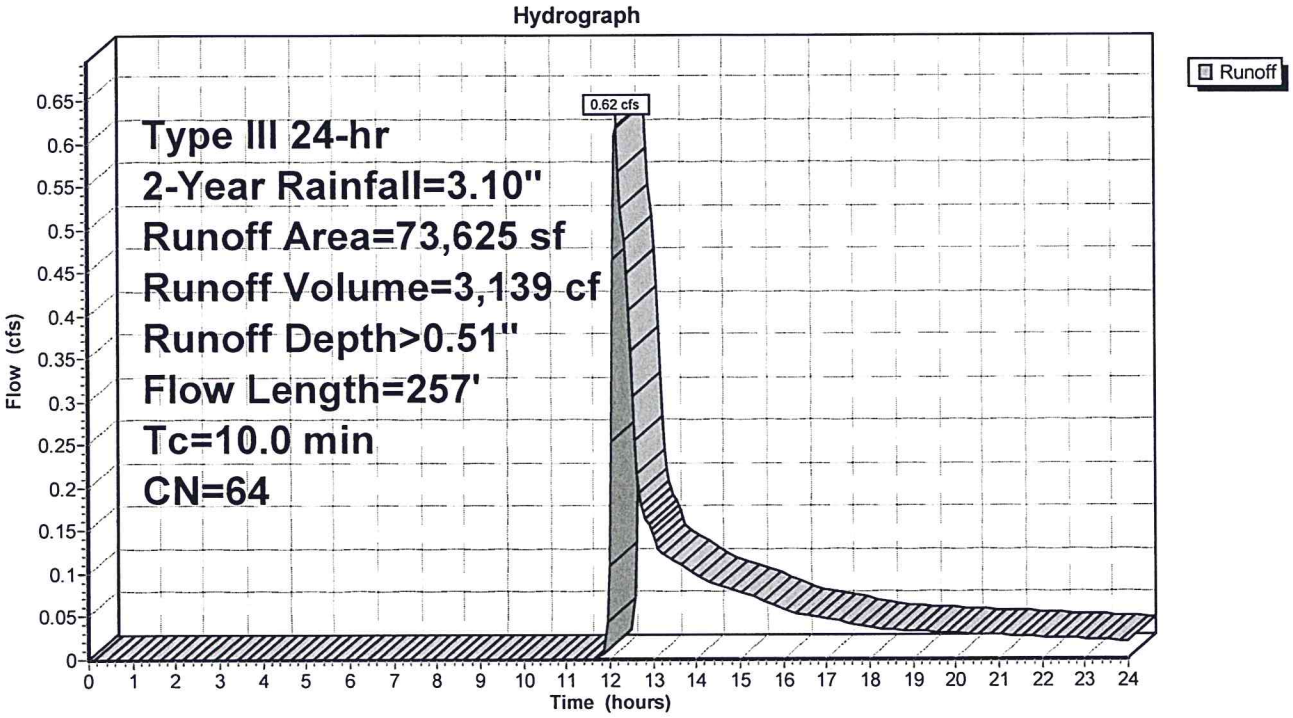
Runoff = 0.62 cfs @ 12.18 hrs, Volume= 3,139 cf, Depth> 0.51"

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
*	2,390	98	Roofs
*	7,620	98	Paved roads w/curbs & sewers
	10,080	39	>75% Grass cover, Good, HSG A
	28,510	74	>75% Grass cover, Good, HSG C
	13,225	30	Woods, Good, HSG A
	11,800	70	Woods, Good, HSG C
	73,625	64	Weighted Average
	63,615		86.40% Pervious Area
	10,010		13.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	50	0.0600	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.7	170	0.0540	1.63		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	37	0.0210	2.94		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.0	257	Total			

Subcatchment 100S: Area 100S

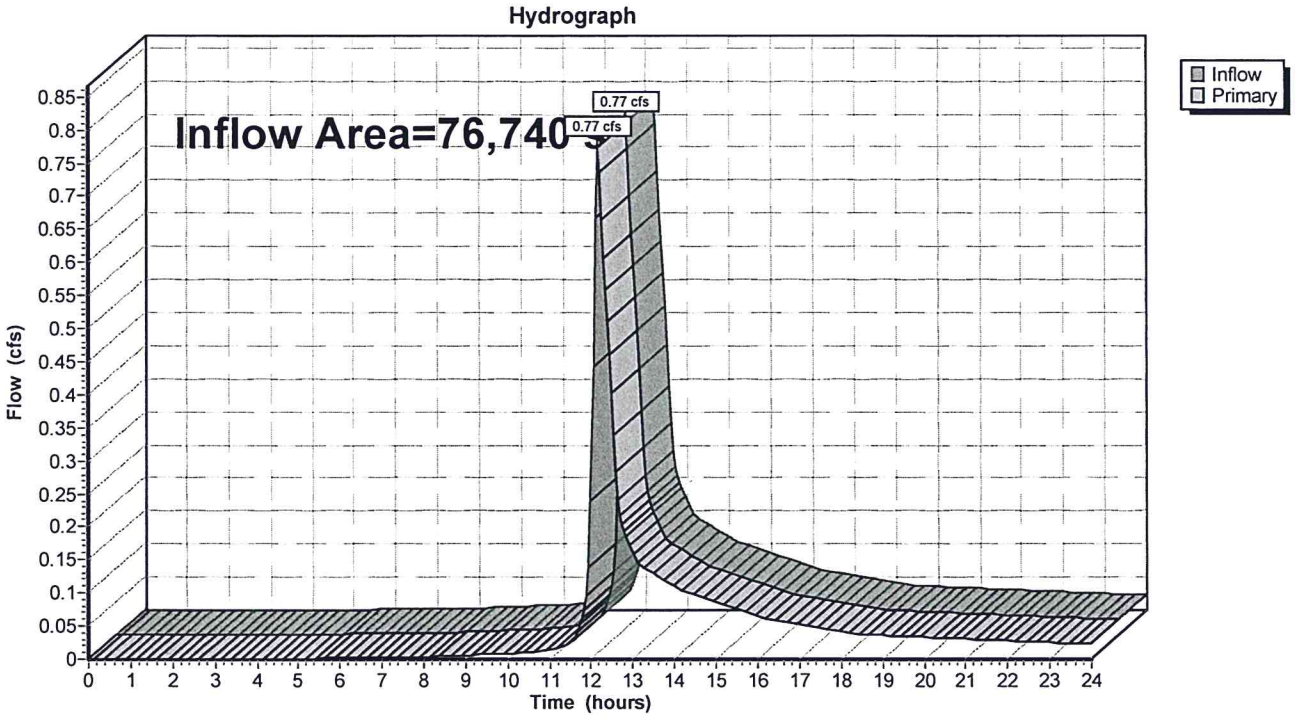


Summary for Link 100L: Gerrish Road

Inflow Area = 76,740 sf, 16.84% Impervious, Inflow Depth > 0.60" for 2-Year event
Inflow = 0.77 cfs @ 12.16 hrs, Volume= 3,827 cf
Primary = 0.77 cfs @ 12.16 hrs, Volume= 3,827 cf, Atten= 0%, Lag= 0.0 min

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

Link 100L: Gerrish Road



Summary for Subcatchment 3S: Area 3S

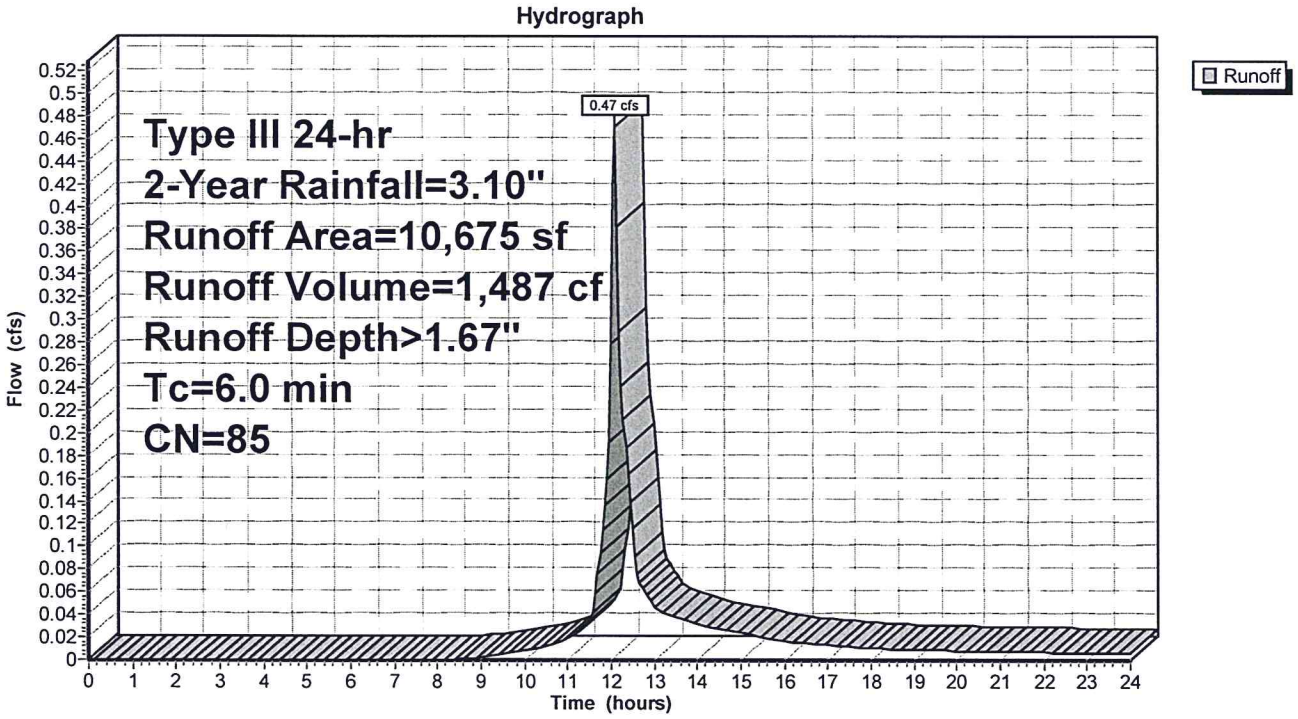
Runoff = 0.47 cfs @ 12.09 hrs, Volume= 1,487 cf, Depth> 1.67"

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
*	3,150	98	Roofs
*	5,085	98	Paved roads w/curbs & sewers
	2,440	39	>75% Grass cover, Good, HSG A
	10,675	85	Weighted Average
	2,440		22.86% Pervious Area
	8,235		77.14% 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: CB3

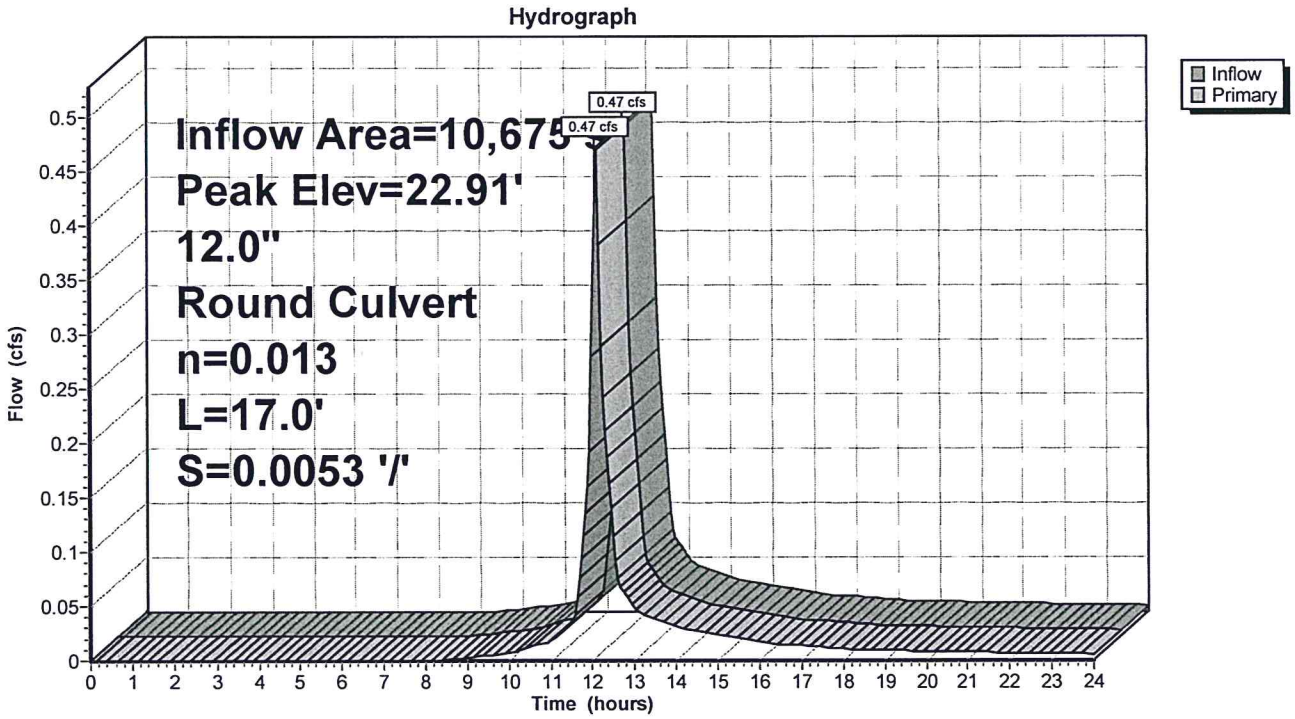
Inflow Area = 10,675 sf, 77.14% Impervious, Inflow Depth > 1.67" for 2-Year event
Inflow = 0.47 cfs @ 12.09 hrs, Volume= 1,487 cf
Outflow = 0.47 cfs @ 12.09 hrs, Volume= 1,487 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.47 cfs @ 12.09 hrs, Volume= 1,487 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 22.91' @ 12.09 hrs
Flood Elev= 25.60'

Device	Routing	Invert	Outlet Devices
#1	Primary	22.50'	**12.0" Round Culvert** L= 17.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 22.50' / 22.41' S= 0.0053 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.46 cfs @ 12.09 hrs HW=22.91' (Free Discharge)
1=Culvert (Barrel Controls 0.46 cfs @ 2.28 fps)

Pond 3: CB3



Summary for Subcatchment 4S: Area 4S

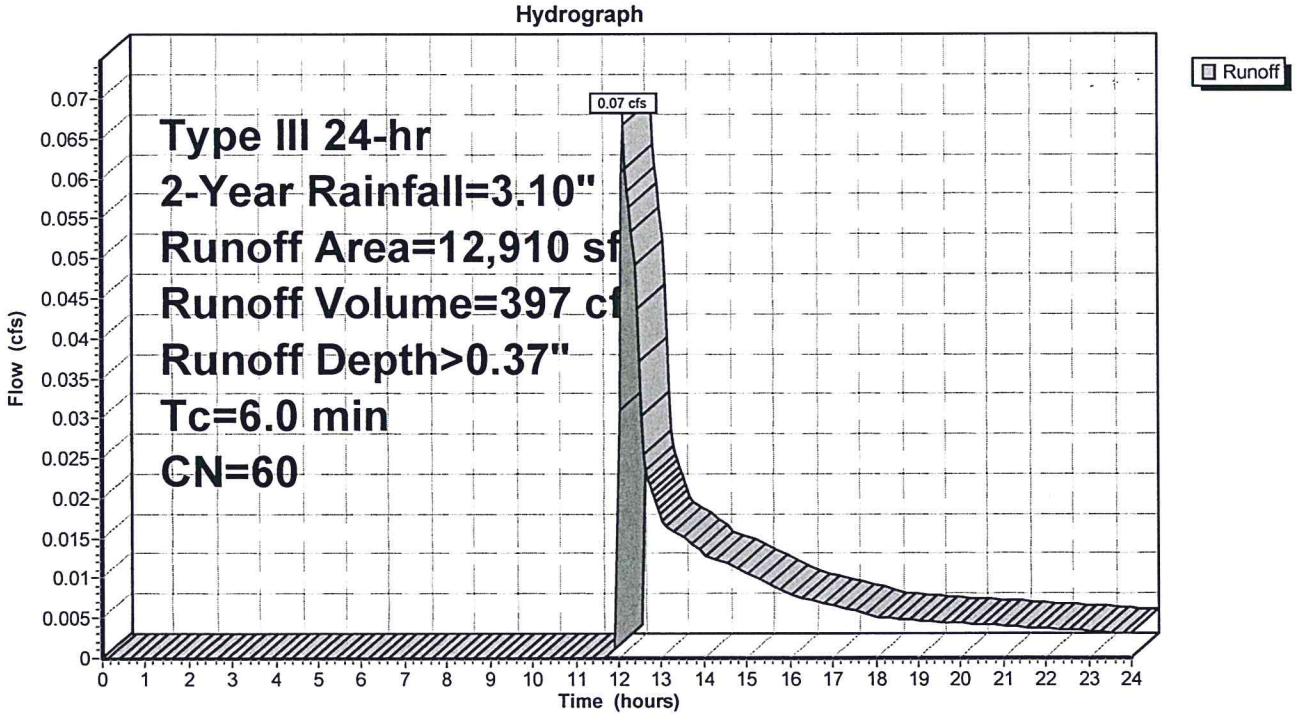
Runoff = 0.07 cfs @ 12.15 hrs, Volume= 397 cf, Depth> 0.37"

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
*	1,615	98	Roofs
*	3,180	98	Paved roads w/curbs & sewers
	6,525	39	>75% Grass cover, Good, HSG A
	1,590	30	Woods, Good, HSG A
	12,910	60	Weighted Average
	8,115		62.86% Pervious Area
	4,795		37.14% 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: CB4

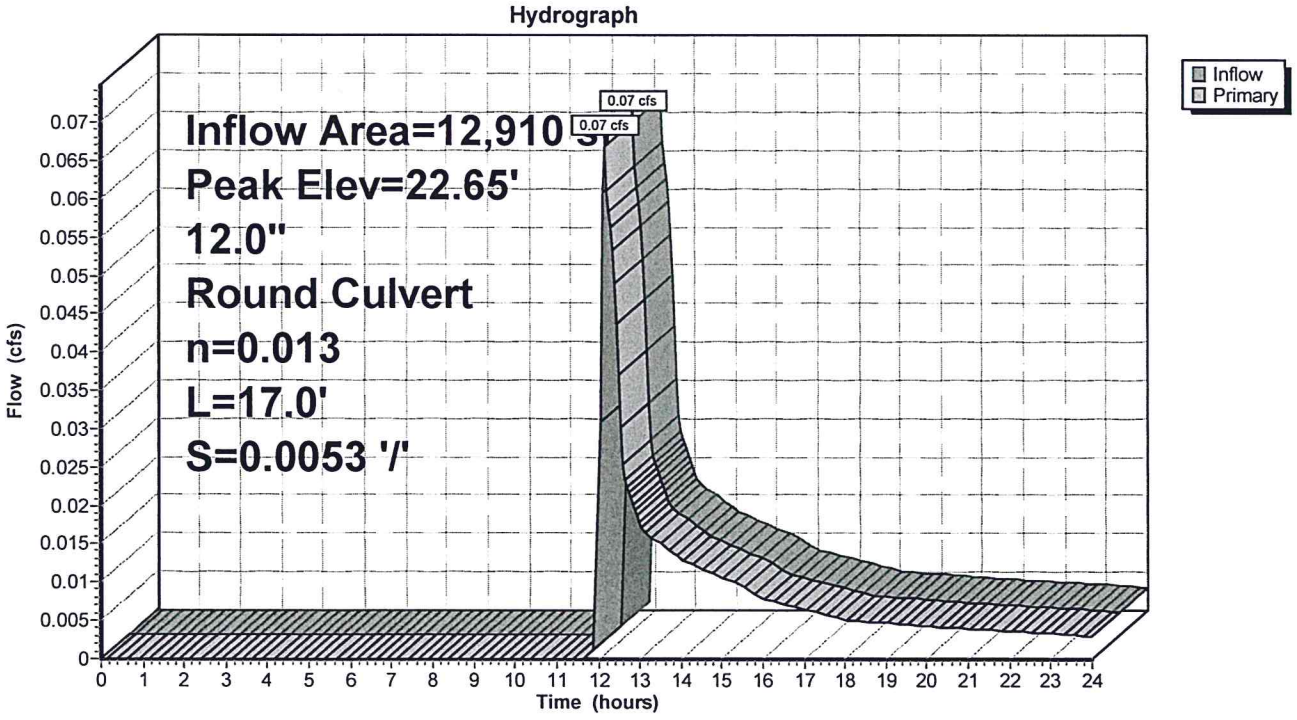
Inflow Area = 12,910 sf, 37.14% Impervious, Inflow Depth > 0.37" for 2-Year event
Inflow = 0.07 cfs @ 12.15 hrs, Volume= 397 cf
Outflow = 0.07 cfs @ 12.15 hrs, Volume= 397 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.07 cfs @ 12.15 hrs, Volume= 397 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 22.65' @ 12.15 hrs
Flood Elev= 25.60'

Device	Routing	Invert	Outlet Devices
#1	Primary	22.50'	**12.0" Round Culvert** L= 17.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 22.50' / 22.41' S= 0.0053 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.07 cfs @ 12.15 hrs HW=22.65' (Free Discharge)
1=Culvert (Barrel Controls 0.07 cfs @ 1.37 fps)

Pond 4: CB4



Summary for Pond B: DMHB

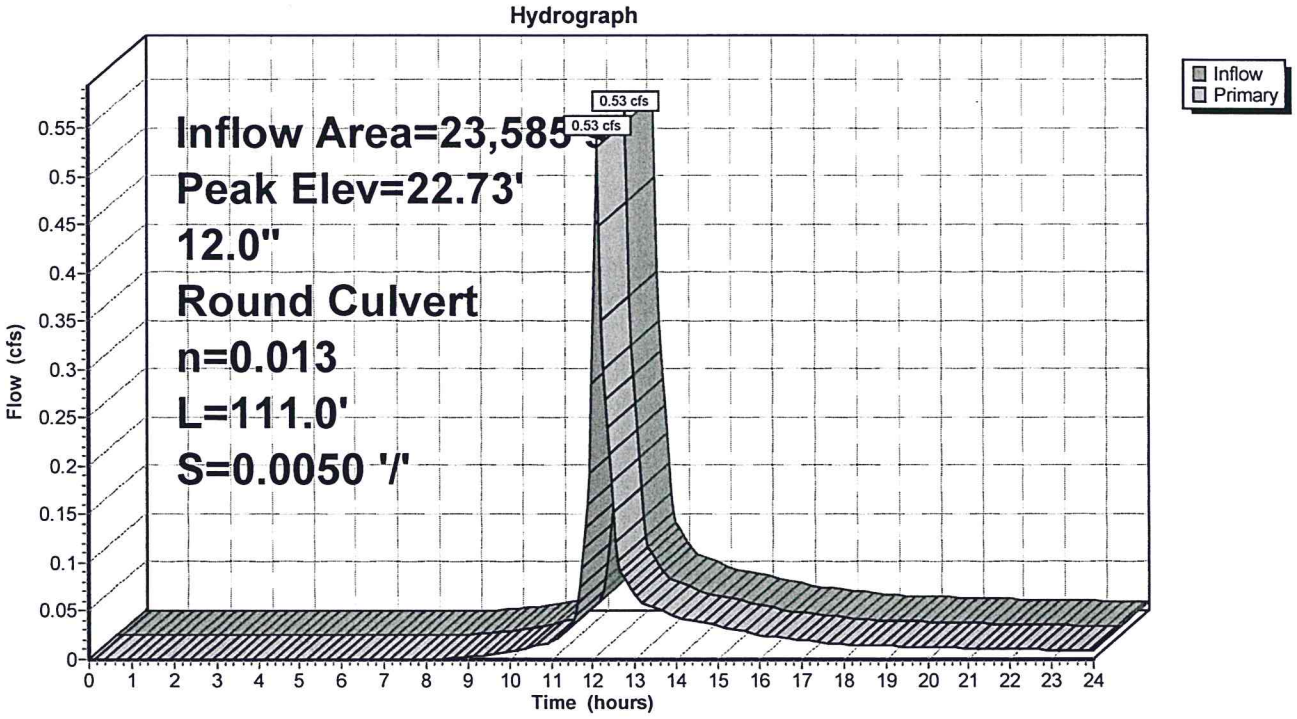
Inflow Area = 23,585 sf, 55.25% Impervious, Inflow Depth > 0.96" for 2-Year event
Inflow = 0.53 cfs @ 12.10 hrs, Volume= 1,884 cf
Outflow = 0.53 cfs @ 12.10 hrs, Volume= 1,884 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.53 cfs @ 12.10 hrs, Volume= 1,884 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 22.73' @ 12.10 hrs
Flood Elev= 25.14'

Device	Routing	Invert	Outlet Devices
#1	Primary	22.31'	**12.0" Round Culvert** L= 111.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 22.31' / 21.75' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.53 cfs @ 12.10 hrs HW=22.73' (Free Discharge)
1=Culvert (Barrel Controls 0.53 cfs @ 2.48 fps)

Pond B: DMHB



Summary for Subcatchment 9S: Area 9S

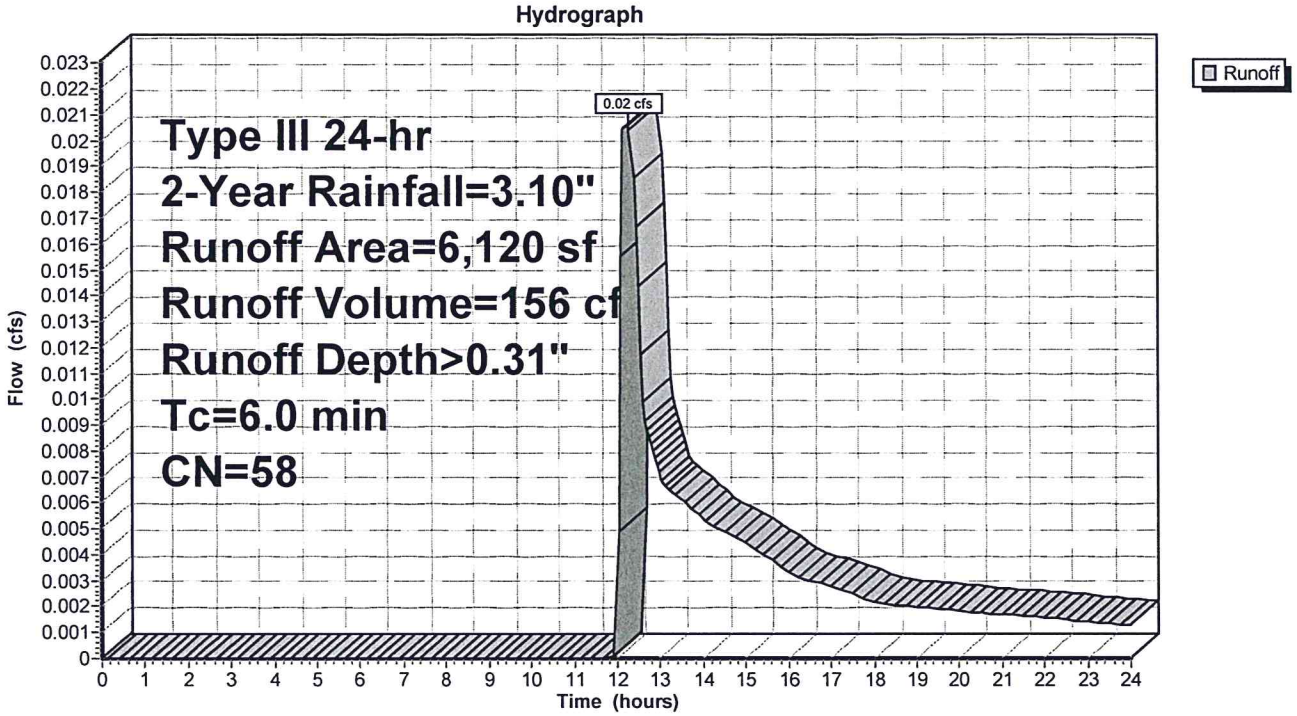
Runoff = 0.02 cfs @ 12.26 hrs, Volume= 156 cf, Depth> 0.31"

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
2,850	39	>75% Grass cover, Good, HSG A
3,270	74	>75% Grass cover, Good, HSG C
6,120	58	Weighted Average
6,120		100.00% Pervious 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 1P: Constructed Wetland #1

Inflow Area = 29,705 sf, 43.86% Impervious, Inflow Depth > 0.82" for 2-Year event
Inflow = 0.55 cfs @ 12.10 hrs, Volume= 2,040 cf
Outflow = 0.16 cfs @ 12.51 hrs, Volume= 1,902 cf, Atten= 71%, Lag= 24.8 min
Primary = 0.16 cfs @ 12.51 hrs, Volume= 1,902 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 21.35' @ 12.51 hrs Surf.Area= 1,984 sf Storage= 655 cf
Flood Elev= 23.00' Surf.Area= 3,240 sf Storage= 4,865 cf

Plug-Flow detention time= 97.1 min calculated for 1,902 cf (93% of inflow)
Center-of-Mass det. time= 61.9 min (916.2 - 854.3)

Volume	Invert	Avail.Storage	Storage Description
#1	21.00'	4,865 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

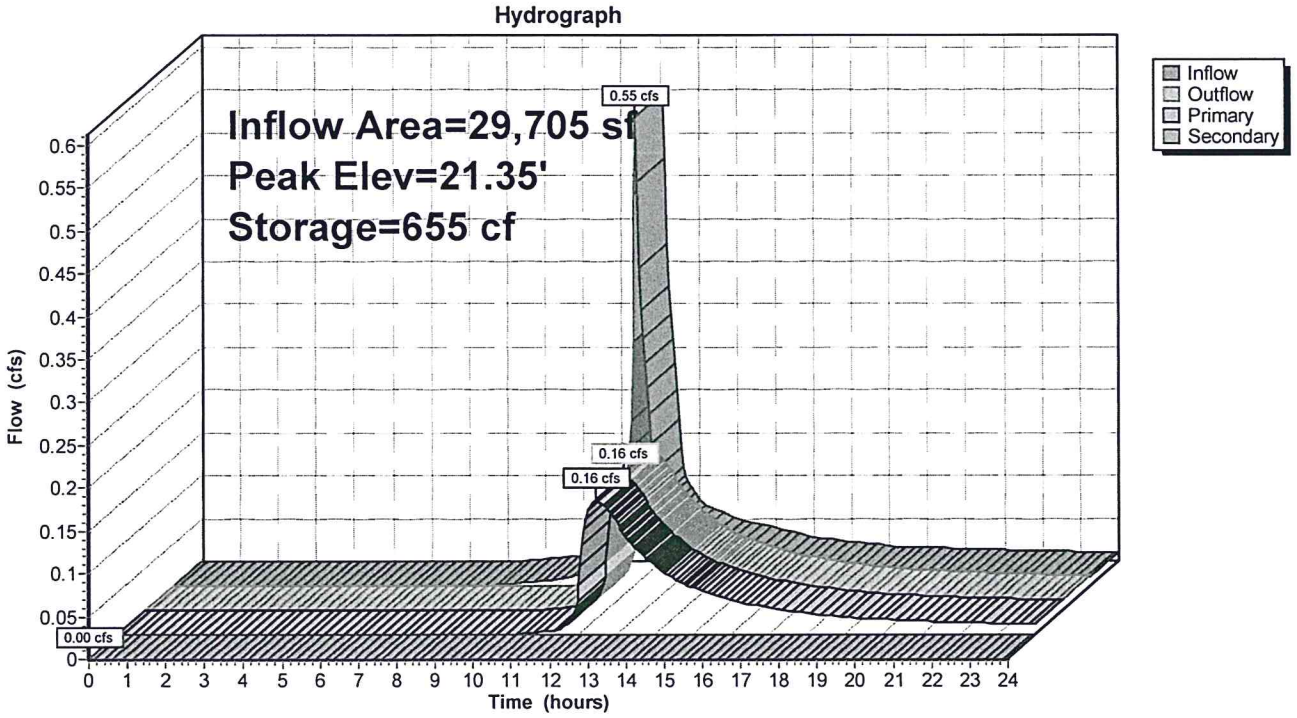
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
21.00	1,790	0	0
22.00	2,350	2,070	2,070
23.00	3,240	2,795	4,865

Device	Routing	Invert	Outlet Devices
#1	Primary	21.00'	**4.0" Round Culvert** L= 20.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 21.00' / 20.80' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.09 sf
#2	Secondary	22.50'	**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=0.16 cfs @ 12.51 hrs HW=21.35' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.16 cfs @ 1.80 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=21.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Constructed Wetland #1



Summary for Subcatchment 5S: Area 5S

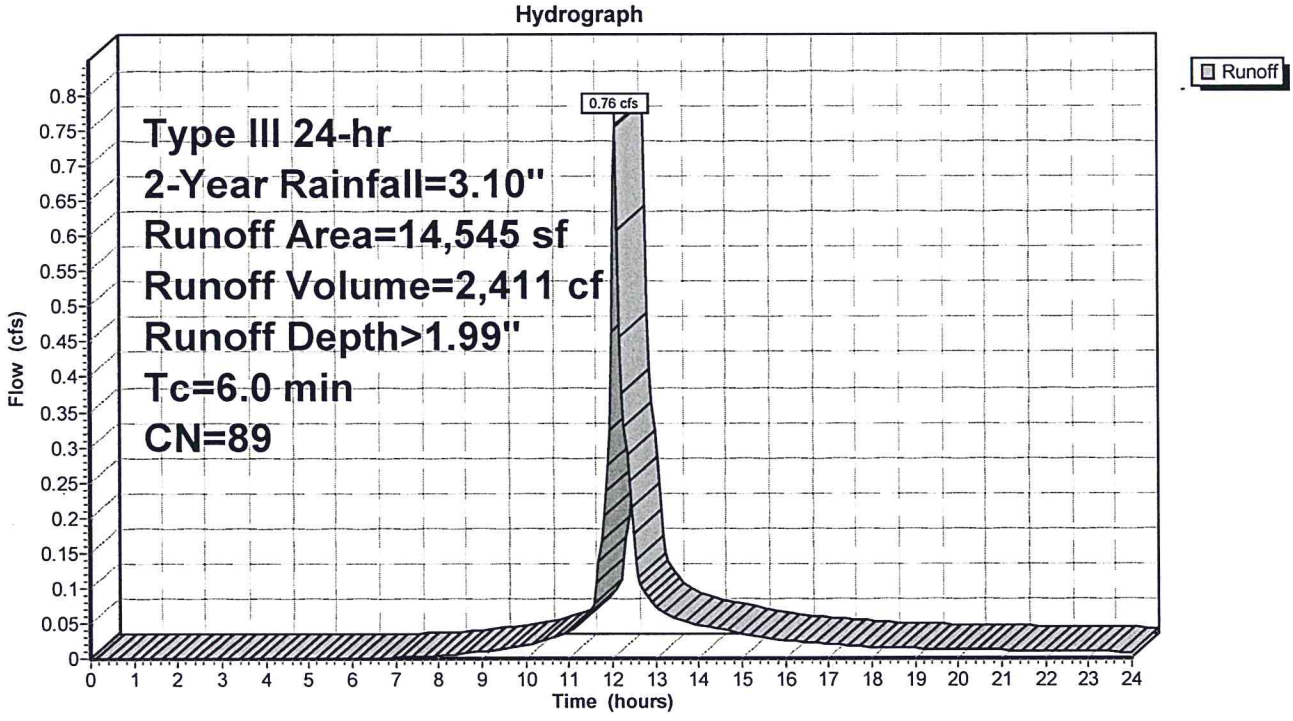
Runoff = 0.76 cfs @ 12.09 hrs, Volume= 2,411 cf, Depth> 1.99"

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
*	1,910	98	Roofs
*	7,615	98	Paved roads w/curbs & sewers
	235	39	>75% Grass cover, Good, HSG A
	4,785	74	>75% Grass cover, Good, HSG C
	14,545	89	Weighted Average
	5,020		34.51% Pervious Area
	9,525		65.49% 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: CB5

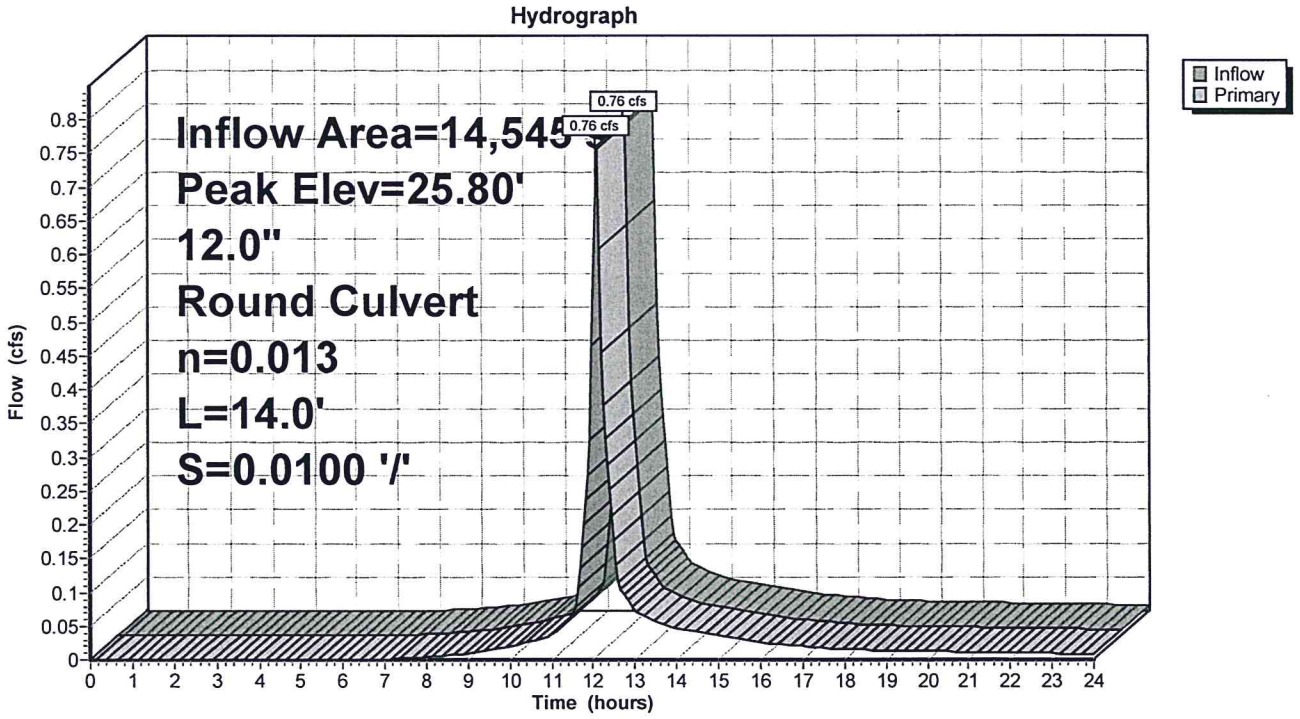
Inflow Area = 14,545 sf, 65.49% Impervious, Inflow Depth > 1.99" for 2-Year event
Inflow = 0.76 cfs @ 12.09 hrs, Volume= 2,411 cf
Outflow = 0.76 cfs @ 12.09 hrs, Volume= 2,411 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.76 cfs @ 12.09 hrs, Volume= 2,411 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 25.80' @ 12.09 hrs
Flood Elev= 28.70'

Device	Routing	Invert	Outlet Devices
#1	Primary	25.30'	**12.0" Round Culvert** L= 14.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 25.30' / 25.16' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.74 cfs @ 12.09 hrs HW=25.79' (Free Discharge)
1=Culvert (Barrel Controls 0.74 cfs @ 2.84 fps)

Pond 5: CB5



Summary for Subcatchment 6S: Area 6S

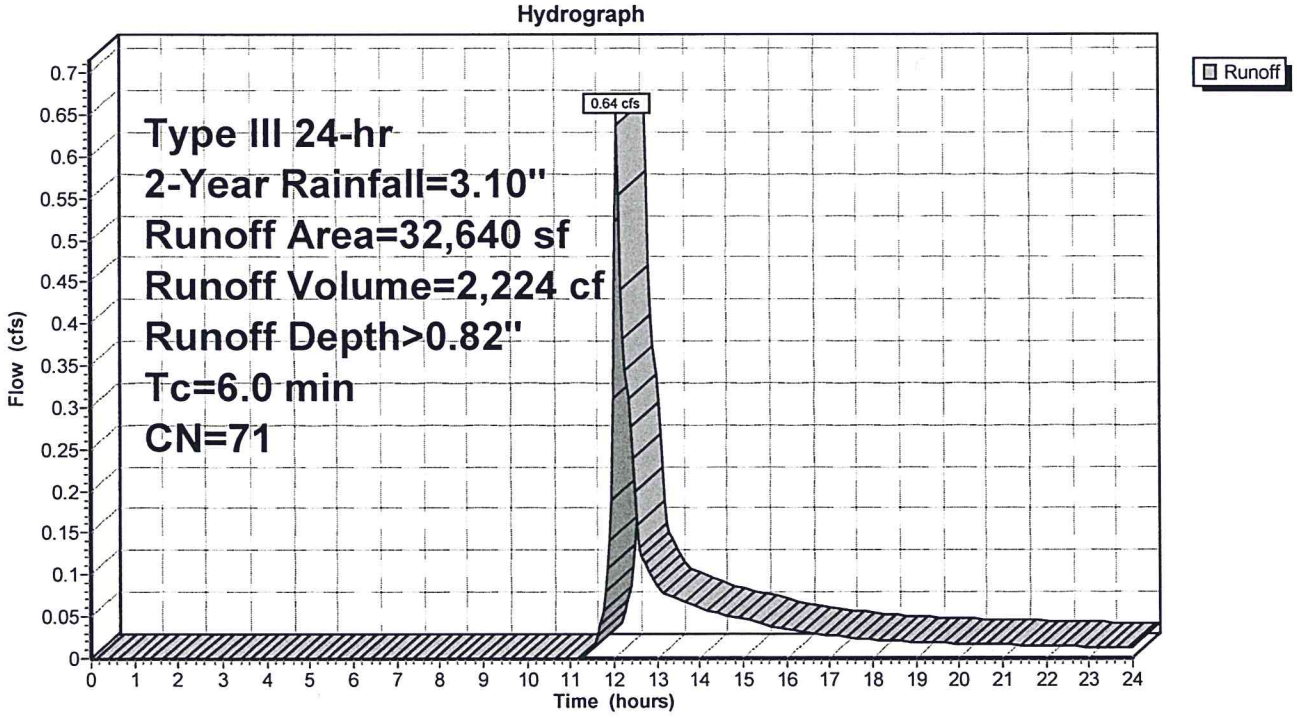
Runoff = 0.64 cfs @ 12.10 hrs, Volume= 2,224 cf, Depth> 0.82"

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
*	5,815	98	Roofs
*	7,240	98	Paved roads w/curbs & sewers
	10,395	39	>75% Grass cover, Good, HSG A
	5,645	74	>75% Grass cover, Good, HSG C
	900	30	Woods, Good, HSG A
	2,645	70	Woods, Good, HSG C
	32,640	71	Weighted Average
	19,585		60.00% Pervious Area
	13,055		40.00% 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: CB6

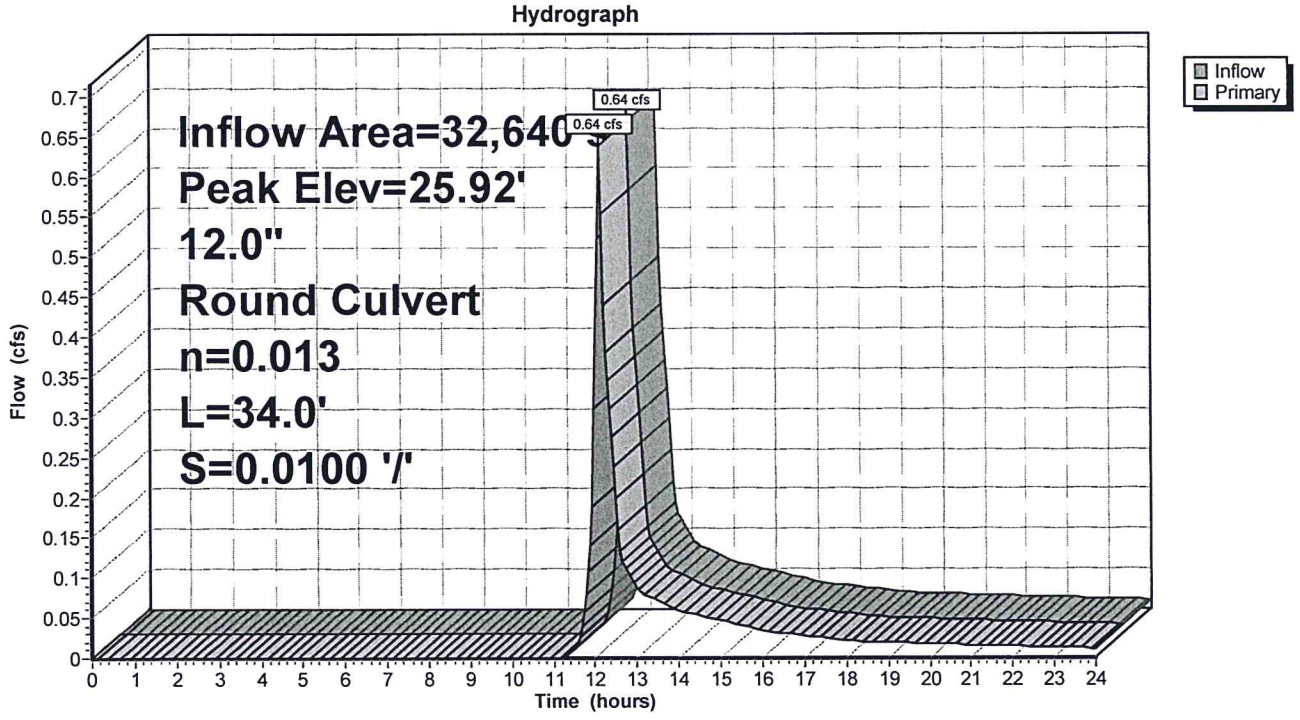
Inflow Area = 32,640 sf, 40.00% Impervious, Inflow Depth > 0.82" for 2-Year event
Inflow = 0.64 cfs @ 12.10 hrs, Volume= 2,224 cf
Outflow = 0.64 cfs @ 12.10 hrs, Volume= 2,224 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.64 cfs @ 12.10 hrs, Volume= 2,224 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 25.92' @ 12.10 hrs
Flood Elev= 28.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	25.50'	**12.0" Round Culvert** L= 34.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 25.50' / 25.16' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.63 cfs @ 12.10 hrs HW=25.92' (Free Discharge)
1=Culvert (Barrel Controls 0.63 cfs @ 3.00 fps)

Pond 6: CB6



Summary for Subcatchment 7S: Area 7S

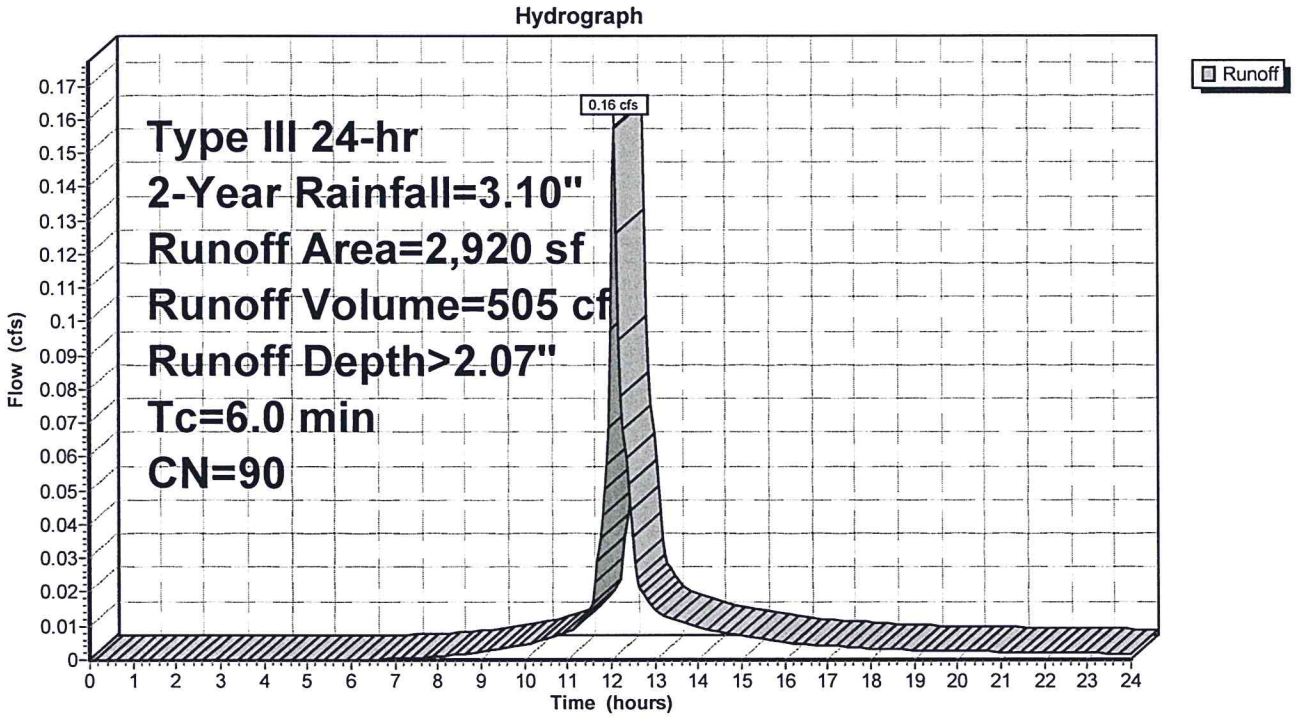
Runoff = 0.16 cfs @ 12.09 hrs, Volume= 505 cf, Depth> 2.07"

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
*	1,960	98	Paved roads w/curbs & sewers
	960	74	>75% Grass cover, Good, HSG C
	2,920	90	Weighted Average
	960		32.88% Pervious Area
	1,960		67.12% 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: CB7

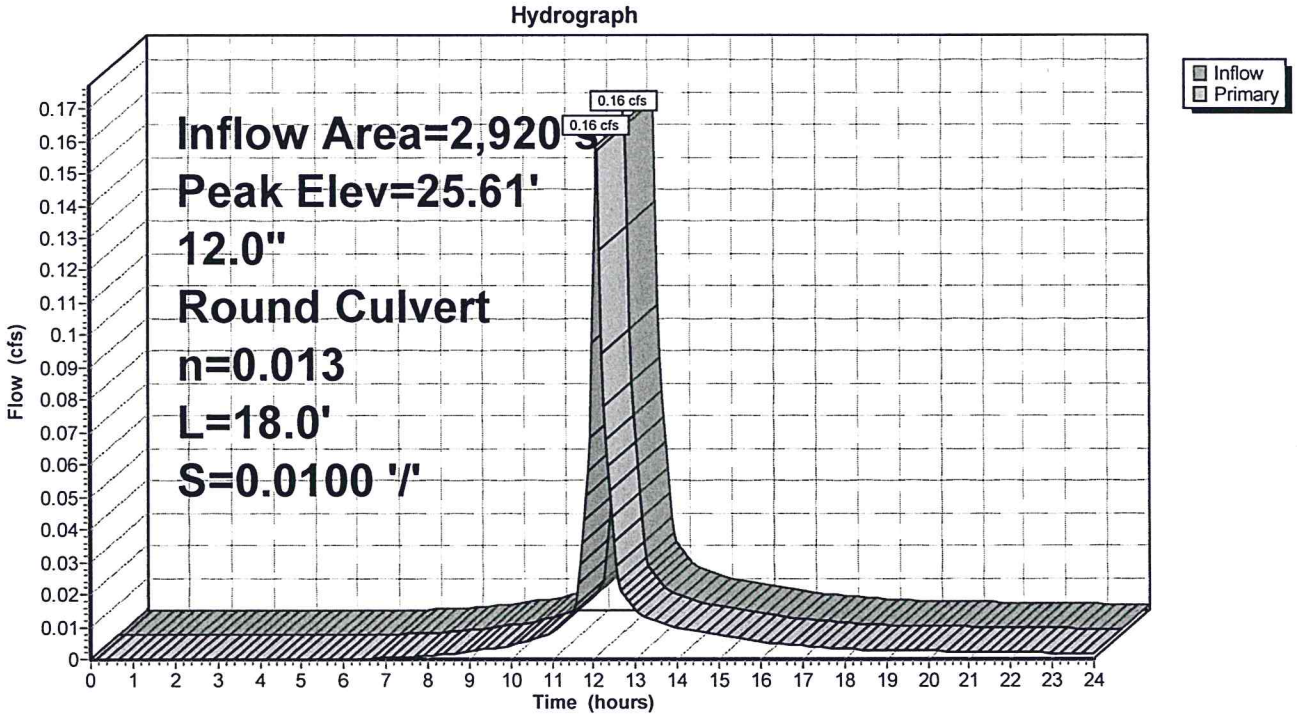
Inflow Area = 2,920 sf, 67.12% Impervious, Inflow Depth > 2.07" for 2-Year event
Inflow = 0.16 cfs @ 12.09 hrs, Volume= 505 cf
Outflow = 0.16 cfs @ 12.09 hrs, Volume= 505 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.16 cfs @ 12.09 hrs, Volume= 505 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 25.61' @ 12.09 hrs
Flood Elev= 28.80'

Device	Routing	Invert	Outlet Devices
#1	Primary	25.40'	**12.0" Round Culvert** L= 18.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 25.40' / 25.22' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.15 cfs @ 12.09 hrs HW=25.60' (Free Discharge)
1=Culvert (Barrel Controls 0.15 cfs @ 2.04 fps)

Pond 7: CB7



Summary for Pond C: DMHC

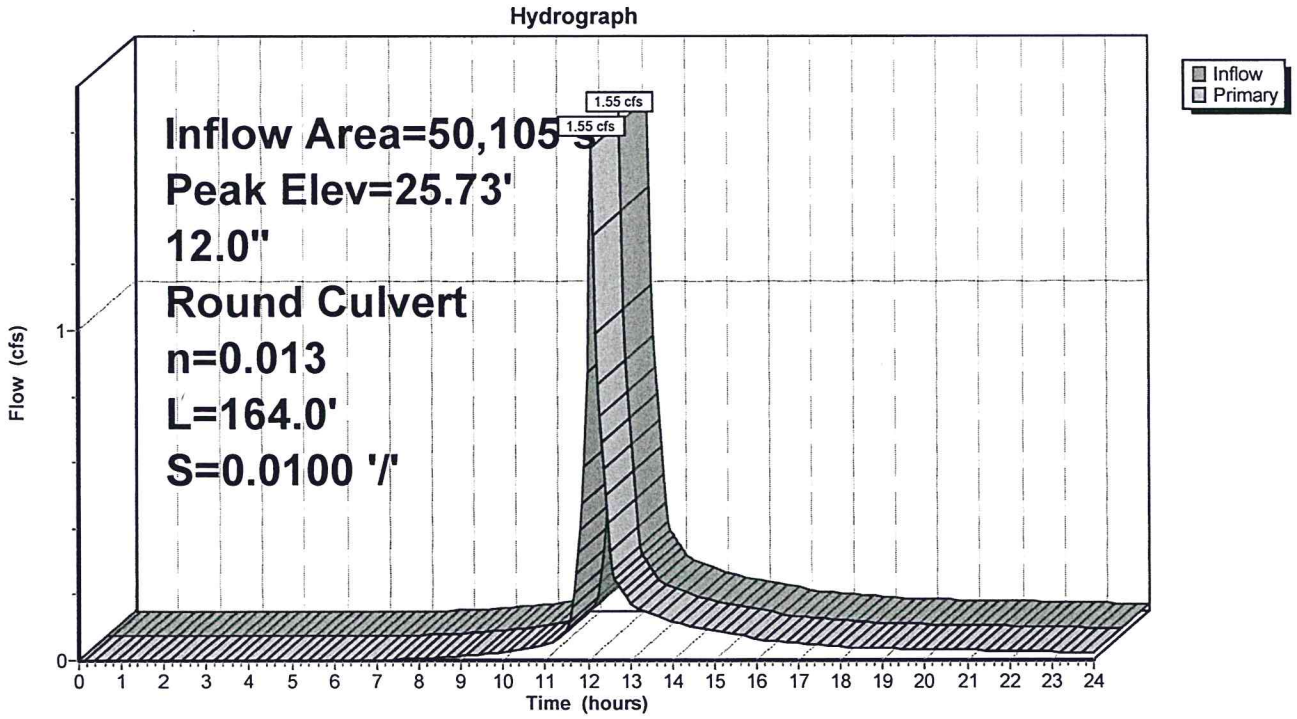
Inflow Area = 50,105 sf, 48.98% Impervious, Inflow Depth > 1.23" for 2-Year event
Inflow = 1.55 cfs @ 12.10 hrs, Volume= 5,139 cf
Outflow = 1.55 cfs @ 12.10 hrs, Volume= 5,139 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.55 cfs @ 12.10 hrs, Volume= 5,139 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 25.73' @ 12.10 hrs
Flood Elev= 29.08'

Device	Routing	Invert	Outlet Devices
#1	Primary	25.06'	**12.0" Round Culvert** L= 164.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 25.06' / 23.42' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.54 cfs @ 12.10 hrs HW=25.72' (Free Discharge)
↑**1=Culvert** (Inlet Controls 1.54 cfs @ 2.77 fps)

Pond C: DMHC



Summary for Subcatchment 8S: Area 8S

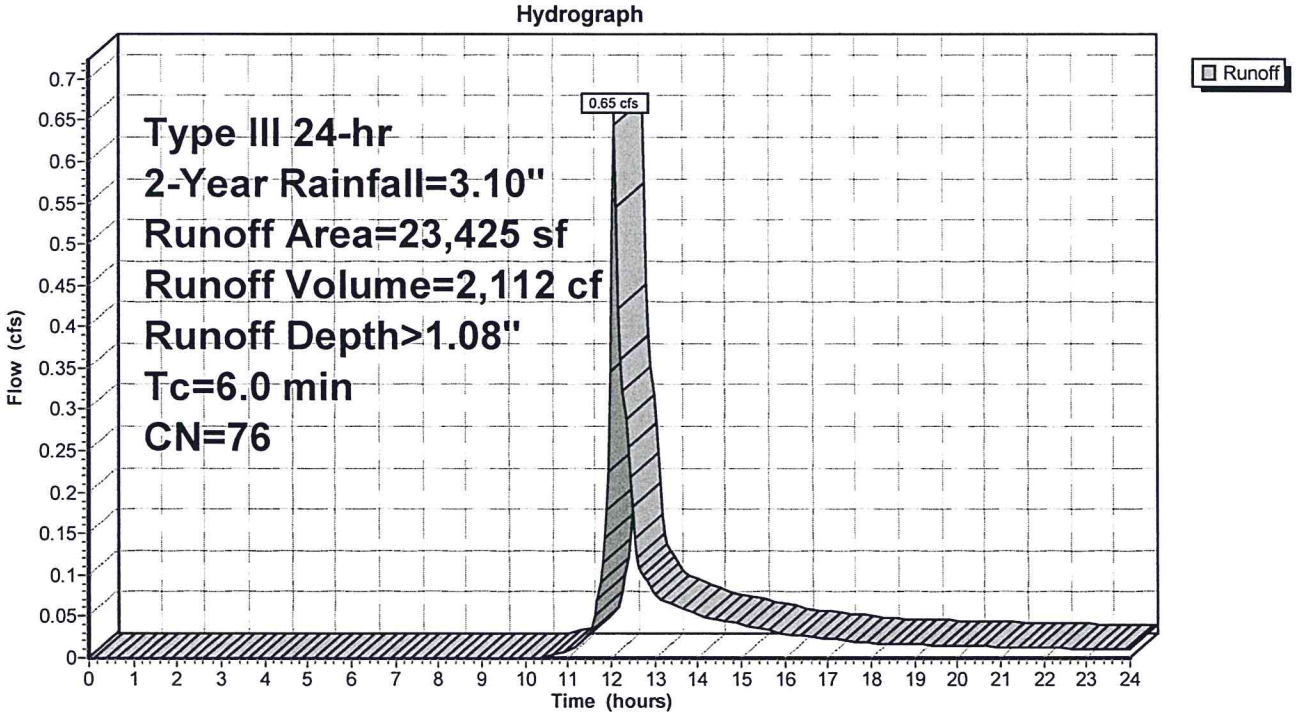
Runoff = 0.65 cfs @ 12.10 hrs, Volume= 2,112 cf, Depth> 1.08"

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 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	2,120	98	Roofs
	21,305	74	>75% Grass cover, Good, HSG C
	23,425	76	Weighted Average
	21,305		90.95% Pervious Area
	2,120		9.05% 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 2P: Constructed Wetland #2

Inflow Area = 73,530 sf, 36.26% Impervious, Inflow Depth > 1.18" for 2-Year event
Inflow = 2.20 cfs @ 12.10 hrs, Volume= 7,251 cf
Outflow = 0.18 cfs @ 13.87 hrs, Volume= 5,705 cf, Atten= 92%, Lag= 106.2 min
Primary = 0.18 cfs @ 13.87 hrs, Volume= 5,705 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Starting Elev= 22.00' Surf.Area= 7,650 sf Storage= 5,203 cf
Peak Elev= 22.45' @ 13.87 hrs Surf.Area= 8,363 sf Storage= 8,837 cf (3,635 cf above start)
Flood Elev= 24.00' Surf.Area= 10,700 sf Storage= 23,598 cf (18,395 cf above start)

Plug-Flow detention time= 738.4 min calculated for 503 cf (7% of inflow)
Center-of-Mass det. time= 181.7 min (1,025.4 - 843.6)

Volume	Invert	Avail.Storage	Storage Description
#1	19.00'	23,598 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

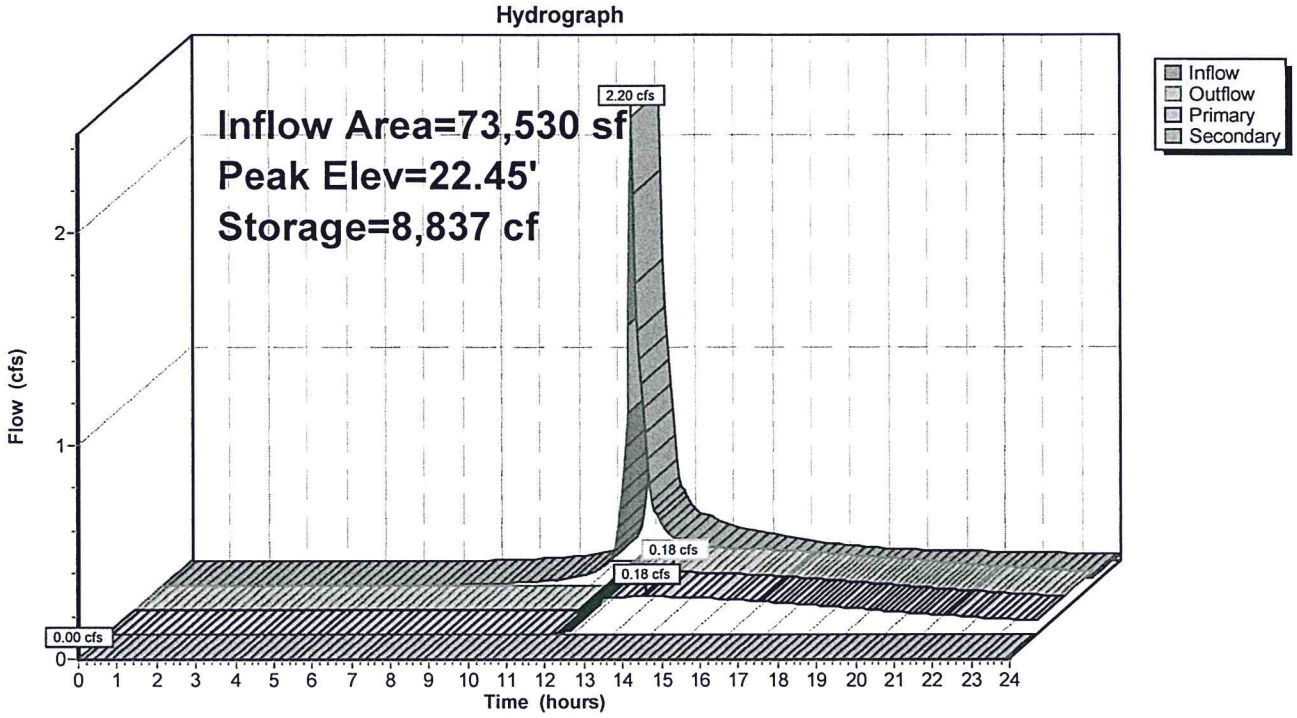
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
19.00	75	0	0
20.00	110	93	93
21.00	1,230	670	763
22.00	7,650	4,440	5,203
23.00	9,220	8,435	13,638
24.00	10,700	9,960	23,598

Device	Routing	Invert	Outlet Devices
#1	Primary	22.00'	**4.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 22.00' / 21.80' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.09 sf
#2	Secondary	23.50'	**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

Primary OutFlow Max=0.18 cfs @ 13.87 hrs HW=22.45' (Free Discharge)
1=Culvert (Inlet Controls 0.18 cfs @ 2.04 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=22.00' (Free Discharge)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 2P: Constructed Wetland #2



Summary for Subcatchment 200S: Area 200S

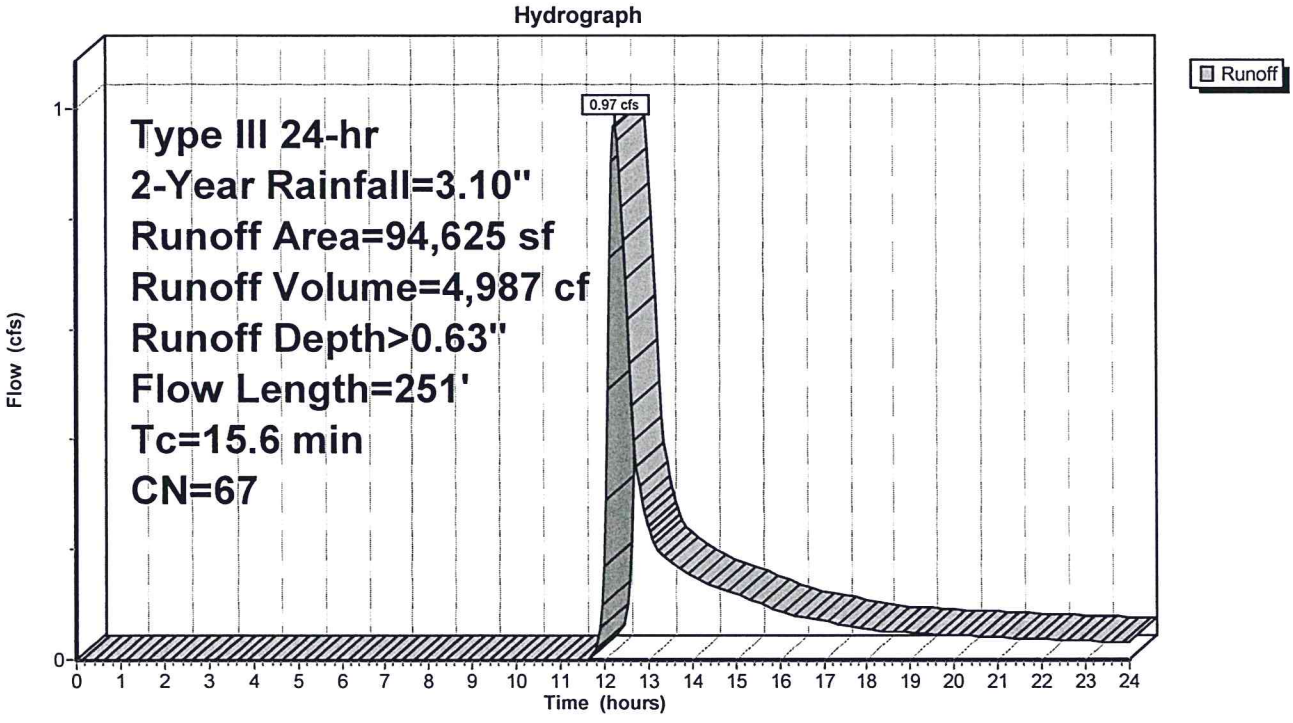
Runoff = 0.97 cfs @ 12.26 hrs, Volume= 4,987 cf, Depth> 0.63"

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
*	640	98	Roofs
	8,450	39	>75% Grass cover, Good, HSG A
	49,895	74	>75% Grass cover, Good, HSG C
	29,530	70	Woods, Good, HSG C
	6,110	30	Woods, Good, HSG A
	94,625	67	Weighted Average
	93,985		99.32% Pervious Area
	640		0.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	50	0.0340	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
5.5	201	0.0150	0.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.6	251	Total			

Subcatchment 200S: Area 200S

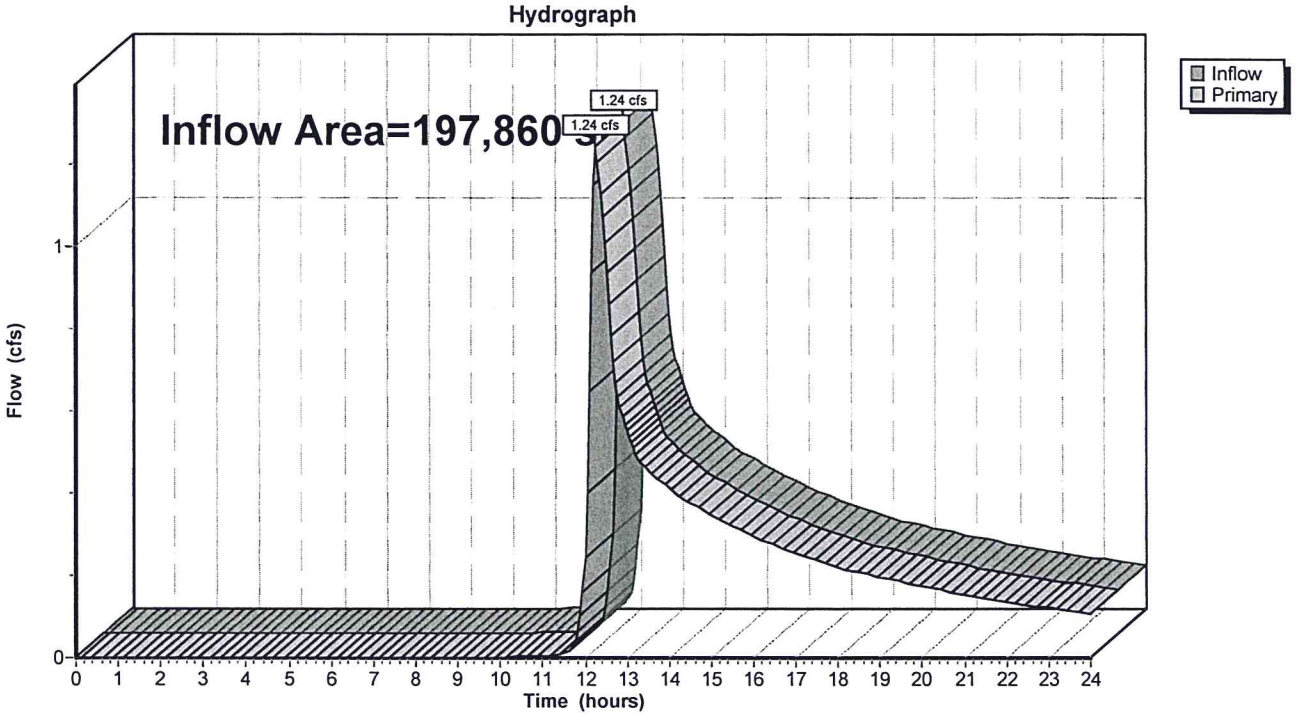


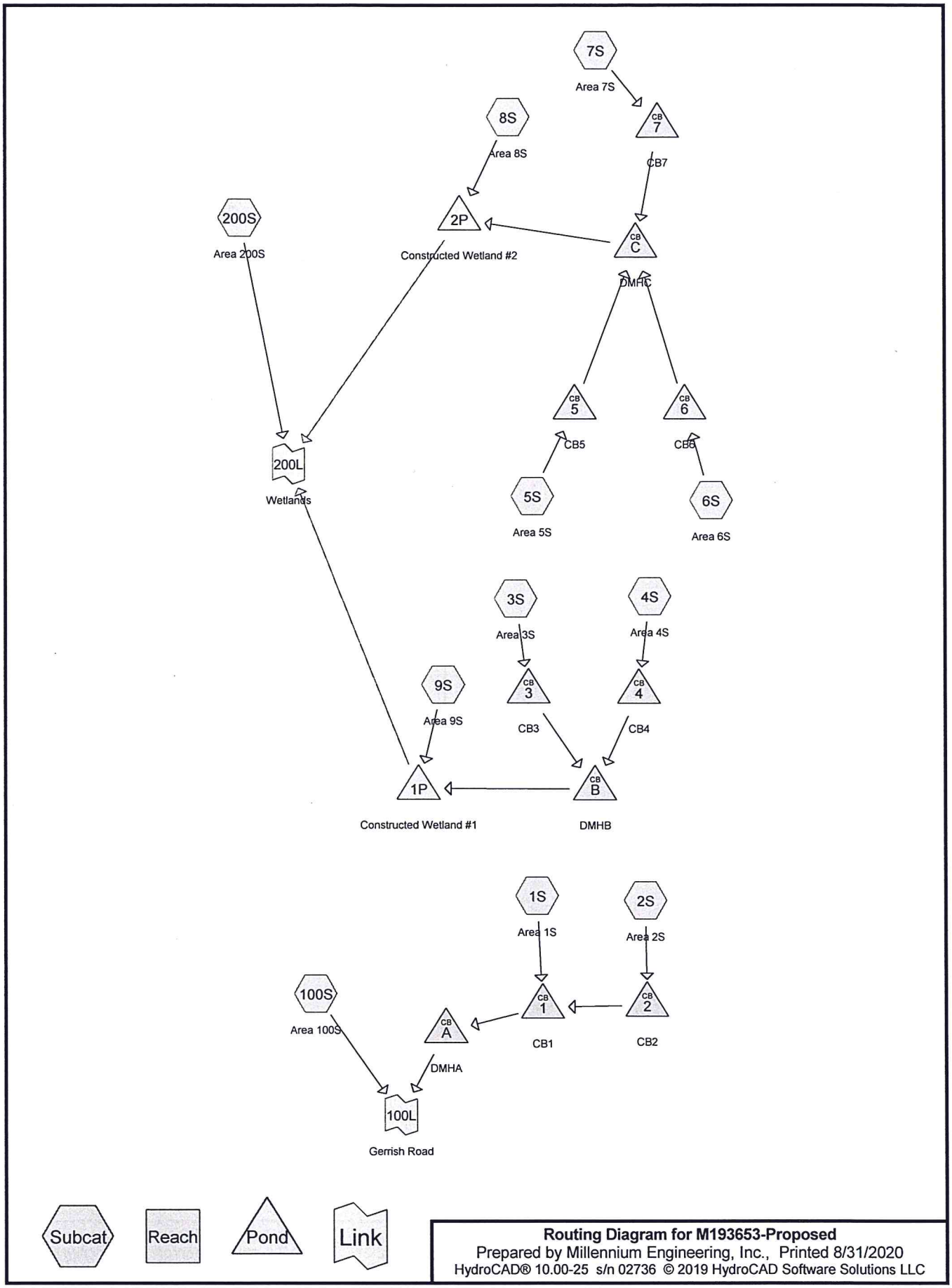
Summary for Link 200L: Wetlands

Inflow Area = 197,860 sf, 20.38% Impervious, Inflow Depth > 0.76" for 2-Year event
Inflow = 1.24 cfs @ 12.27 hrs, Volume= 12,593 cf
Primary = 1.24 cfs @ 12.27 hrs, Volume= 12,593 cf, Atten= 0%, Lag= 0.0 min

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

Link 200L: Wetlands





Routing Diagram for M193653-Proposed
Prepared by Millennium Engineering, Inc., Printed 8/31/2020

Summary for Subcatchment 1S: Area 1S

Runoff = 0.17 cfs @ 12.09 hrs, Volume= 595 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
*	1,680	98	Paved roads w/curbs & sewers
	25	39	>75% Grass cover, Good, HSG A
	65	74	>75% Grass cover, Good, HSG C
	1,770	96	Weighted Average
	90		5.08% Pervious Area
	1,680		94.92% 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 = 0.13 cfs @ 12.09 hrs, Volume= 452 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
*	1,235	98	Paved roads w/curbs & sewers
	20	39	>75% Grass cover, Good, HSG A
	90	74	>75% Grass cover, Good, HSG C
	1,345	96	Weighted Average
	110		8.18% Pervious Area
	1,235		91.82% 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 = 0.81 cfs @ 12.09 hrs, Volume= 2,586 cf, Depth> 2.91"

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 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	3,150	98	Roofs
*	5,085	98	Paved roads w/curbs & sewers
	2,440	39	>75% Grass cover, Good, HSG A
	10,675	85	Weighted Average
	2,440		22.86% Pervious Area
	8,235		77.14% 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 = 0.30 cfs @ 12.11 hrs, Volume= 1,096 cf, Depth> 1.02"

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
*	1,615	98	Roofs
*	3,180	98	Paved roads w/curbs & sewers
	6,525	39	>75% Grass cover, Good, HSG A
	1,590	30	Woods, Good, HSG A
	12,910	60	Weighted Average
	8,115		62.86% Pervious Area
	4,795		37.14% 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 = 1.23 cfs @ 12.09 hrs, Volume= 3,991 cf, Depth> 3.29"

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
*	1,910	98	Roofs
*	7,615	98	Paved roads w/curbs & sewers
	235	39	>75% Grass cover, Good, HSG A
	4,785	74	>75% Grass cover, Good, HSG C
	14,545	89	Weighted Average
	5,020		34.51% Pervious Area
	9,525		65.49% 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 = 1.47 cfs @ 12.10 hrs, Volume= 4,745 cf, Depth> 1.74"

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
*	5,815	98	Roofs
*	7,240	98	Paved roads w/curbs & sewers
	10,395	39	>75% Grass cover, Good, HSG A
	5,645	74	>75% Grass cover, Good, HSG C
	900	30	Woods, Good, HSG A
	2,645	70	Woods, Good, HSG C
	32,640	71	Weighted Average
	19,585		60.00% Pervious Area
	13,055		40.00% 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 = 0.25 cfs @ 12.09 hrs, Volume= 826 cf, Depth> 3.39"

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
*	1,960	98	Paved roads w/curbs & sewers
	960	74	>75% Grass cover, Good, HSG C
	2,920	90	Weighted Average
	960		32.88% Pervious Area
	1,960		67.12% 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 = 1.31 cfs @ 12.09 hrs, Volume= 4,153 cf, Depth> 2.13"

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
*	2,120	98	Roofs
	21,305	74	>75% Grass cover, Good, HSG C
	23,425	76	Weighted Average
	21,305		90.95% Pervious Area
	2,120		9.05% 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 = 0.12 cfs @ 12.11 hrs, Volume= 461 cf, Depth> 0.90"

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
2,850	39	>75% Grass cover, Good, HSG A
3,270	74	>75% Grass cover, Good, HSG C
6,120	58	Weighted Average
6,120		100.00% Pervious Area

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

Summary for Subcatchment 100S: Area 100S

Runoff = 1.98 cfs @ 12.16 hrs, Volume= 7,746 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
*	2,390	98	Roofs
*	7,620	98	Paved roads w/curbs & sewers
	10,080	39	>75% Grass cover, Good, HSG A
	28,510	74	>75% Grass cover, Good, HSG C
	13,225	30	Woods, Good, HSG A
	11,800	70	Woods, Good, HSG C
	73,625	64	Weighted Average
	63,615		86.40% Pervious Area
	10,010		13.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	50	0.0600	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.7	170	0.0540	1.63		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.2	37	0.0210	2.94		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.0	257	Total			

Summary for Subcatchment 200S: Area 200S

Runoff = 2.59 cfs @ 12.23 hrs, Volume= 11,499 cf, Depth> 1.46"

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
*	640	98	Roofs
	8,450	39	>75% Grass cover, Good, HSG A
	49,895	74	>75% Grass cover, Good, HSG C
	29,530	70	Woods, Good, HSG C
	6,110	30	Woods, Good, HSG A
	94,625	67	Weighted Average
	93,985		99.32% Pervious Area
	640		0.68% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	50	0.0340	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
5.5	201	0.0150	0.61		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
15.6	251	Total			

Summary for Pond 1: CB1

Inflow Area = 3,115 sf, 93.58% Impervious, Inflow Depth > 4.03" for 10-Year event
Inflow = 0.30 cfs @ 12.09 hrs, Volume= 1,047 cf
Outflow = 0.30 cfs @ 12.09 hrs, Volume= 1,047 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.30 cfs @ 12.09 hrs, Volume= 1,047 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 19.07' @ 12.09 hrs
Flood Elev= 22.70'

Device	Routing	Invert	Outlet Devices
#1	Primary	18.80'	**12.0" Round Culvert** L= 88.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 18.80' / 17.49' S= 0.0149 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.29 cfs @ 12.09 hrs HW=19.07' (Free Discharge)
↑**1=Culvert** (Inlet Controls 0.29 cfs @ 1.75 fps)

Summary for Pond 1P: Constructed Wetland #1

Inflow Area = 29,705 sf, 43.86% Impervious, Inflow Depth > 1.67" for 10-Year event
Inflow = 1.23 cfs @ 12.10 hrs, Volume= 4,142 cf
Outflow = 0.26 cfs @ 12.56 hrs, Volume= 3,958 cf, Atten= 79%, Lag= 27.8 min
Primary = 0.26 cfs @ 12.56 hrs, Volume= 3,958 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 21.73' @ 12.56 hrs Surf.Area= 2,200 sf Storage= 1,459 cf
Flood Elev= 23.00' Surf.Area= 3,240 sf Storage= 4,865 cf

Plug-Flow detention time= 89.5 min calculated for 3,958 cf (96% of inflow)
Center-of-Mass det. time= 65.2 min (904.1 - 839.0)

Volume	Invert	Avail.Storage	Storage Description
#1	21.00'	4,865 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
21.00	1,790	0	0
22.00	2,350	2,070	2,070
23.00	3,240	2,795	4,865

Device	Routing	Invert	Outlet Devices
#1	Primary	21.00'	**4.0" Round Culvert** L= 20.0' CPP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 21.00' / 20.80' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.09 sf
#2	Secondary	22.50'	**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=0.26 cfs @ 12.56 hrs HW=21.73' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 0.26 cfs @ 2.95 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=21.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 2: CB2

Inflow Area = 1,345 sf, 91.82% Impervious, Inflow Depth > 4.03" for 10-Year event
Inflow = 0.13 cfs @ 12.09 hrs, Volume= 452 cf
Outflow = 0.13 cfs @ 12.09 hrs, Volume= 452 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.13 cfs @ 12.09 hrs, Volume= 452 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 19.48' @ 12.09 hrs
Flood Elev= 22.70'

Device	Routing	Invert	Outlet Devices
#1	Primary	19.30'	**12.0" Round Culvert** L= 39.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 19.30' / 18.90' S= 0.0103 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.13 cfs @ 12.09 hrs HW=19.48' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 0.13 cfs @ 2.04 fps)

Summary for Pond 2P: Constructed Wetland #2

Inflow Area = 73,530 sf, 36.26% Impervious, Inflow Depth > 2.24" for 10-Year event
Inflow = 4.27 cfs @ 12.09 hrs, Volume= 13,715 cf
Outflow = 0.28 cfs @ 14.07 hrs, Volume= 10,511 cf, Atten= 93%, Lag= 118.5 min
Primary = 0.28 cfs @ 14.07 hrs, Volume= 10,511 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Starting Elev= 22.00' Surf.Area= 7,650 sf Storage= 5,203 cf
Peak Elev= 22.90' @ 14.07 hrs Surf.Area= 9,059 sf Storage= 12,701 cf (7,499 cf above start)
Flood Elev= 24.00' Surf.Area= 10,700 sf Storage= 23,598 cf (18,395 cf above start)

Plug-Flow detention time= 518.9 min calculated for 5,309 cf (39% of inflow)
Center-of-Mass det. time= 217.5 min (1,044.9 - 827.4)

Volume	Invert	Avail.Storage	Storage Description
#1	19.00'	23,598 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
19.00	75	0	0
20.00	110	93	93
21.00	1,230	670	763
22.00	7,650	4,440	5,203
23.00	9,220	8,435	13,638
24.00	10,700	9,960	23,598

Device	Routing	Invert	Outlet Devices
#1	Primary	22.00'	**4.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 22.00' / 21.80' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.09 sf
#2	Secondary	23.50'	**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

Primary OutFlow Max=0.28 cfs @ 14.07 hrs HW=22.90' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.28 cfs @ 3.25 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=22.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 3: CB3

Inflow Area = 10,675 sf, 77.14% Impervious, Inflow Depth > 2.91" for 10-Year event
Inflow = 0.81 cfs @ 12.09 hrs, Volume= 2,586 cf
Outflow = 0.81 cfs @ 12.09 hrs, Volume= 2,586 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.81 cfs @ 12.09 hrs, Volume= 2,586 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 23.06' @ 12.09 hrs
Flood Elev= 25.60'

Device	Routing	Invert	Outlet Devices
#1	Primary	22.50'	**12.0" Round Culvert** L= 17.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 22.50' / 22.41' S= 0.0053 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.80 cfs @ 12.09 hrs HW=23.05' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 0.80 cfs @ 2.61 fps)

Summary for Pond 4: CB4

Inflow Area = 12,910 sf, 37.14% Impervious, Inflow Depth > 1.02" for 10-Year event
Inflow = 0.30 cfs @ 12.11 hrs, Volume= 1,096 cf
Outflow = 0.30 cfs @ 12.11 hrs, Volume= 1,096 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.30 cfs @ 12.11 hrs, Volume= 1,096 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 22.82' @ 12.11 hrs
Flood Elev= 25.60'

Device	Routing	Invert	Outlet Devices
#1	Primary	22.50'	**12.0" Round Culvert** L= 17.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 22.50' / 22.41' S= 0.0053 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.29 cfs @ 12.11 hrs HW=22.82' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 0.29 cfs @ 2.03 fps)

Summary for Pond 5: CB5

Inflow Area = 14,545 sf, 65.49% Impervious, Inflow Depth > 3.29" for 10-Year event
Inflow = 1.23 cfs @ 12.09 hrs, Volume= 3,991 cf
Outflow = 1.23 cfs @ 12.09 hrs, Volume= 3,991 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.23 cfs @ 12.09 hrs, Volume= 3,991 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 25.96' @ 12.09 hrs
Flood Elev= 28.70'

Device	Routing	Invert	Outlet Devices
#1	Primary	25.30'	**12.0" Round Culvert** L= 14.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 25.30' / 25.16' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.20 cfs @ 12.09 hrs HW=25.95' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 1.20 cfs @ 3.16 fps)

Summary for Pond 6: CB6

Inflow Area = 32,640 sf, 40.00% Impervious, Inflow Depth > 1.74" for 10-Year event
Inflow = 1.47 cfs @ 12.10 hrs, Volume= 4,745 cf
Outflow = 1.47 cfs @ 12.10 hrs, Volume= 4,745 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.47 cfs @ 12.10 hrs, Volume= 4,745 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 26.19' @ 12.10 hrs
Flood Elev= 28.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	25.50'	**12.0" Round Culvert** L= 34.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 25.50' / 25.16' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.46 cfs @ 12.10 hrs HW=26.18' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 1.46 cfs @ 3.60 fps)

Summary for Pond 7: CB7

Inflow Area = 2,920 sf, 67.12% Impervious, Inflow Depth > 3.39" for 10-Year event
Inflow = 0.25 cfs @ 12.09 hrs, Volume= 826 cf
Outflow = 0.25 cfs @ 12.09 hrs, Volume= 826 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.25 cfs @ 12.09 hrs, Volume= 826 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 25.66' @ 12.09 hrs
Flood Elev= 28.80'

Device	Routing	Invert	Outlet Devices
#1	Primary	25.40'	**12.0" Round Culvert** L= 18.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 25.40' / 25.22' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.25 cfs @ 12.09 hrs HW=25.66' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 0.25 cfs @ 2.28 fps)

Summary for Pond A: DMHA

Inflow Area = 3,115 sf, 93.58% Impervious, Inflow Depth > 4.03" for 10-Year event
Inflow = 0.30 cfs @ 12.09 hrs, Volume= 1,047 cf
Outflow = 0.30 cfs @ 12.09 hrs, Volume= 1,047 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.30 cfs @ 12.09 hrs, Volume= 1,047 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 17.66' @ 12.09 hrs
Flood Elev= 21.70'

Device	Routing	Invert	Outlet Devices
#1	Primary	17.39'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 17.39' / 17.09' S= 0.0150 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.29 cfs @ 12.09 hrs HW=17.66' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.29 cfs @ 1.75 fps)

Summary for Pond B: DMHB

Inflow Area = 23,585 sf, 55.25% Impervious, Inflow Depth > 1.87" for 10-Year event
Inflow = 1.11 cfs @ 12.10 hrs, Volume= 3,681 cf
Outflow = 1.11 cfs @ 12.10 hrs, Volume= 3,681 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.11 cfs @ 12.10 hrs, Volume= 3,681 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 22.95' @ 12.10 hrs
Flood Elev= 25.14'

Device	Routing	Invert	Outlet Devices
#1	Primary	22.31'	**12.0" Round Culvert** L= 111.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 22.31' / 21.75' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.09 cfs @ 12.10 hrs HW=22.94' (Free Discharge)
1=Culvert (Barrel Controls 1.09 cfs @ 2.99 fps)

Summary for Pond C: DMHC

Inflow Area = 50,105 sf, 48.98% Impervious, Inflow Depth > 2.29" for 10-Year event
Inflow = 2.96 cfs @ 12.09 hrs, Volume= 9,562 cf
Outflow = 2.96 cfs @ 12.09 hrs, Volume= 9,562 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.96 cfs @ 12.09 hrs, Volume= 9,562 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 26.17' @ 12.09 hrs
Flood Elev= 29.08'

Device	Routing	Invert	Outlet Devices
#1	Primary	25.06'	**12.0" Round Culvert** L= 164.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 25.06' / 23.42' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.91 cfs @ 12.09 hrs HW=26.15' (Free Discharge)
1=Culvert (Inlet Controls 2.91 cfs @ 3.70 fps)

Summary for Link 100L: Gerrish Road

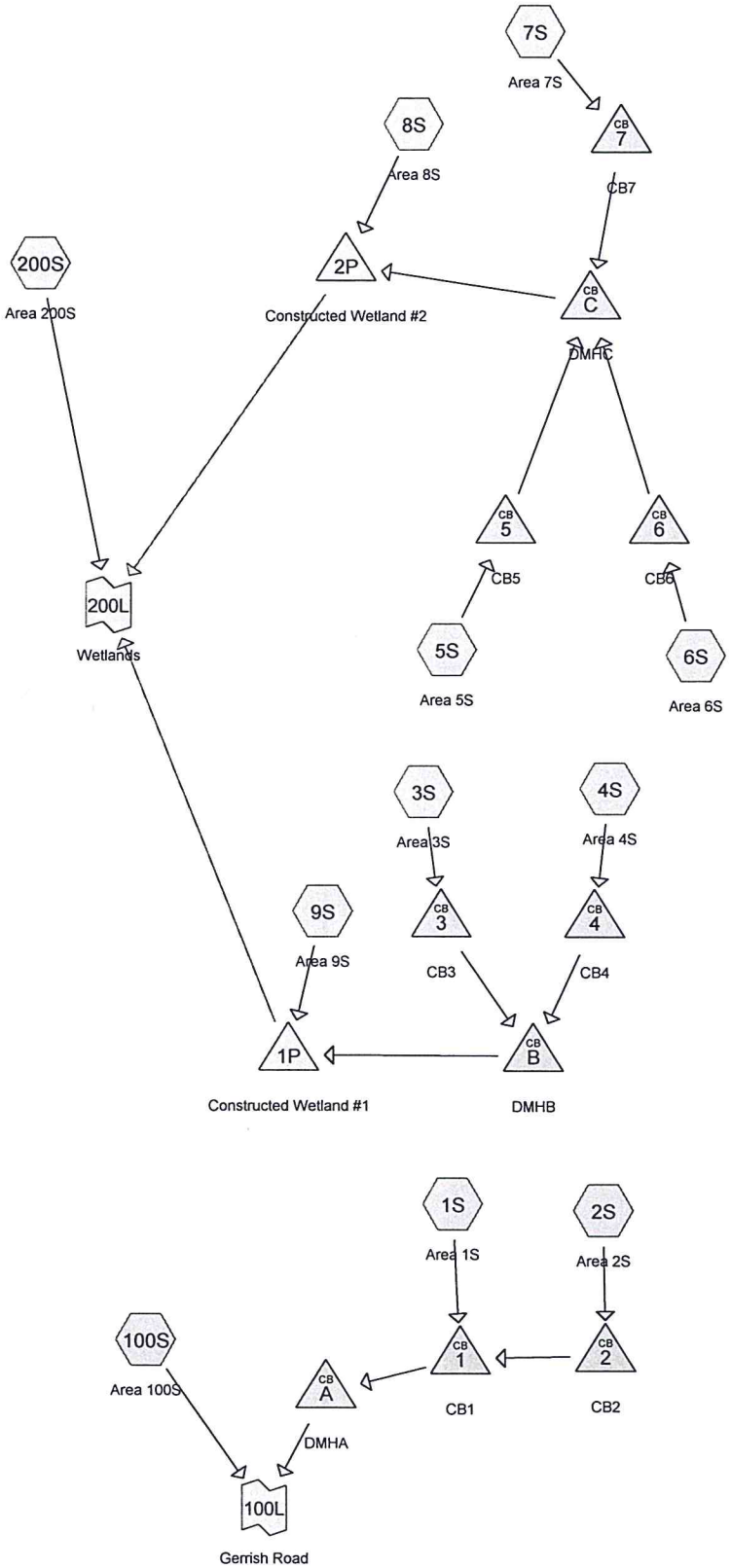
Inflow Area = 76,740 sf, 16.84% Impervious, Inflow Depth > 1.38" for 10-Year event
Inflow = 2.21 cfs @ 12.15 hrs, Volume= 8,793 cf
Primary = 2.21 cfs @ 12.15 hrs, Volume= 8,793 cf, Atten= 0%, Lag= 0.0 min

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

Summary for Link 200L: Wetlands

Inflow Area = 197,860 sf, 20.38% Impervious, Inflow Depth > 1.57" for 10-Year event
Inflow = 3.05 cfs @ 12.24 hrs, Volume= 25,968 cf
Primary = 3.05 cfs @ 12.24 hrs, Volume= 25,968 cf, Atten= 0%, Lag= 0.0 min

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



Subcat Reach Pond Link

Routing Diagram for M193653-Proposed
Prepared by Millennium Engineering, Inc., Printed 8/31/2020
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 Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area 1S Runoff Area=1,770 sf 94.92% Impervious Runoff Depth>6.02"
Tc=6.0 min CN=96 Runoff=0.25 cfs 888 cf

Subcatchment 2S: Area 2S Runoff Area=1,345 sf 91.82% Impervious Runoff Depth>6.02"
Tc=6.0 min CN=96 Runoff=0.19 cfs 675 cf

Subcatchment 3S: Area 3S Runoff Area=10,675 sf 77.14% Impervious Runoff Depth>4.77"
Tc=6.0 min CN=85 Runoff=1.31 cfs 4,245 cf

Subcatchment 4S: Area 4S Runoff Area=12,910 sf 37.14% Impervious Runoff Depth>2.25"
Tc=6.0 min CN=60 Runoff=0.74 cfs 2,424 cf

Subcatchment 5S: Area 5S Runoff Area=14,545 sf 65.49% Impervious Runoff Depth>5.22"
Tc=6.0 min CN=89 Runoff=1.91 cfs 6,324 cf

Subcatchment 6S: Area 6S Runoff Area=32,640 sf 40.00% Impervious Runoff Depth>3.30"
Tc=6.0 min CN=71 Runoff=2.85 cfs 8,986 cf

Subcatchment 7S: Area 7S Runoff Area=2,920 sf 67.12% Impervious Runoff Depth>5.33"
Tc=6.0 min CN=90 Runoff=0.39 cfs 1,297 cf

Subcatchment 8S: Area 8S Runoff Area=23,425 sf 9.05% Impervious Runoff Depth>3.81"
Tc=6.0 min CN=76 Runoff=2.36 cfs 7,441 cf

Subcatchment 9S: Area 9S Runoff Area=6,120 sf 0.00% Impervious Runoff Depth>2.07"
Tc=6.0 min CN=58 Runoff=0.32 cfs 1,057 cf

Subcatchment 100S: Area 100S Runoff Area=73,625 sf 13.60% Impervious Runoff Depth>2.62"
Flow Length=257' Tc=10.0 min CN=64 Runoff=4.40 cfs 16,081 cf

Subcatchment 200S: Area 200S Runoff Area=94,625 sf 0.68% Impervious Runoff Depth>2.90"
Flow Length=251' Tc=15.6 min CN=67 Runoff=5.45 cfs 22,897 cf

Pond 1: CB1 Peak Elev=19.13' Inflow=0.44 cfs 1,563 cf
12.0" Round Culvert n=0.013 L=88.0' S=0.0149 '/' Outflow=0.44 cfs 1,563 cf

Pond 1P: Constructed Wetland #1 Peak Elev=22.37' Storage=3,013 cf Inflow=2.36 cfs 7,727 cf
Primary=0.37 cfs 7,486 cf Secondary=0.00 cfs 0 cf Outflow=0.37 cfs 7,486 cf

Pond 2: CB2 Peak Elev=19.52' Inflow=0.19 cfs 675 cf
12.0" Round Culvert n=0.013 L=39.0' S=0.0103 '/' Outflow=0.19 cfs 675 cf

Pond 2P: Constructed Wetland #2 Peak Elev=23.53' Storage=18,698 cf Inflow=7.49 cfs 24,048 cf
Primary=0.38 cfs 15,693 cf Secondary=0.22 cfs 1,019 cf Outflow=0.60 cfs 16,712 cf

Pond 3: CB3 Peak Elev=23.23' Inflow=1.31 cfs 4,245 cf
12.0" Round Culvert n=0.013 L=17.0' S=0.0053 '/' Outflow=1.31 cfs 4,245 cf

Pond 4: CB4 Peak Elev=23.03' Inflow=0.74 cfs 2,424 cf
12.0" Round Culvert n=0.013 L=17.0' S=0.0053 '/' Outflow=0.74 cfs 2,424 cf

Pond 5: CB5 Peak Elev=26.17' Inflow=1.91 cfs 6,324 cf
12.0" Round Culvert n=0.013 L=14.0' S=0.0100 '/' Outflow=1.91 cfs 6,324 cf

Pond 6: CB6 Peak Elev=26.59' Inflow=2.85 cfs 8,986 cf
12.0" Round Culvert n=0.013 L=34.0' S=0.0100 '/' Outflow=2.85 cfs 8,986 cf

Pond 7: CB7 Peak Elev=25.73' Inflow=0.39 cfs 1,297 cf
12.0" Round Culvert n=0.013 L=18.0' S=0.0100 '/' Outflow=0.39 cfs 1,297 cf

Pond A: DMHA Peak Elev=17.72' Inflow=0.44 cfs 1,563 cf
12.0" Round Culvert n=0.013 L=20.0' S=0.0150 '/' Outflow=0.44 cfs 1,563 cf

Pond B: DMHB Peak Elev=23.25' Inflow=2.05 cfs 6,670 cf
12.0" Round Culvert n=0.013 L=111.0' S=0.0050 '/' Outflow=2.05 cfs 6,670 cf

Pond C: DMHC Peak Elev=28.83' Inflow=5.14 cfs 16,606 cf
12.0" Round Culvert n=0.013 L=164.0' S=0.0100 '/' Outflow=5.14 cfs 16,606 cf

Link 100L: Gerrish Road Inflow=4.75 cfs 17,645 cf
Primary=4.75 cfs 17,645 cf

Link 200L: Wetlands Inflow=6.11 cfs 47,095 cf
Primary=6.11 cfs 47,095 cf

Total Runoff Area = 274,600 sf Runoff Volume = 72,316 cf Average Runoff Depth = 3.16"
80.61% Pervious = 221,345 sf 19.39% Impervious = 53,255 sf

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
41,020	39	>75% Grass cover, Good, HSG A (1S, 2S, 3S, 4S, 5S, 6S, 9S, 100S, 200S)
114,525	74	>75% Grass cover, Good, HSG C (1S, 2S, 5S, 6S, 7S, 8S, 9S, 100S, 200S)
35,615	98	Paved roads w/curbs & sewers (1S, 2S, 3S, 4S, 5S, 6S, 7S, 100S)
17,640	98	Roofs (3S, 4S, 5S, 6S, 8S, 100S, 200S)
21,825	30	Woods, Good, HSG A (4S, 6S, 100S, 200S)
43,975	70	Woods, Good, HSG C (6S, 100S, 200S)
274,600	**69**	**TOTAL AREA**

12.0 APPENDIX E – NRCS SOIL DATA

United States Department of Agriculture

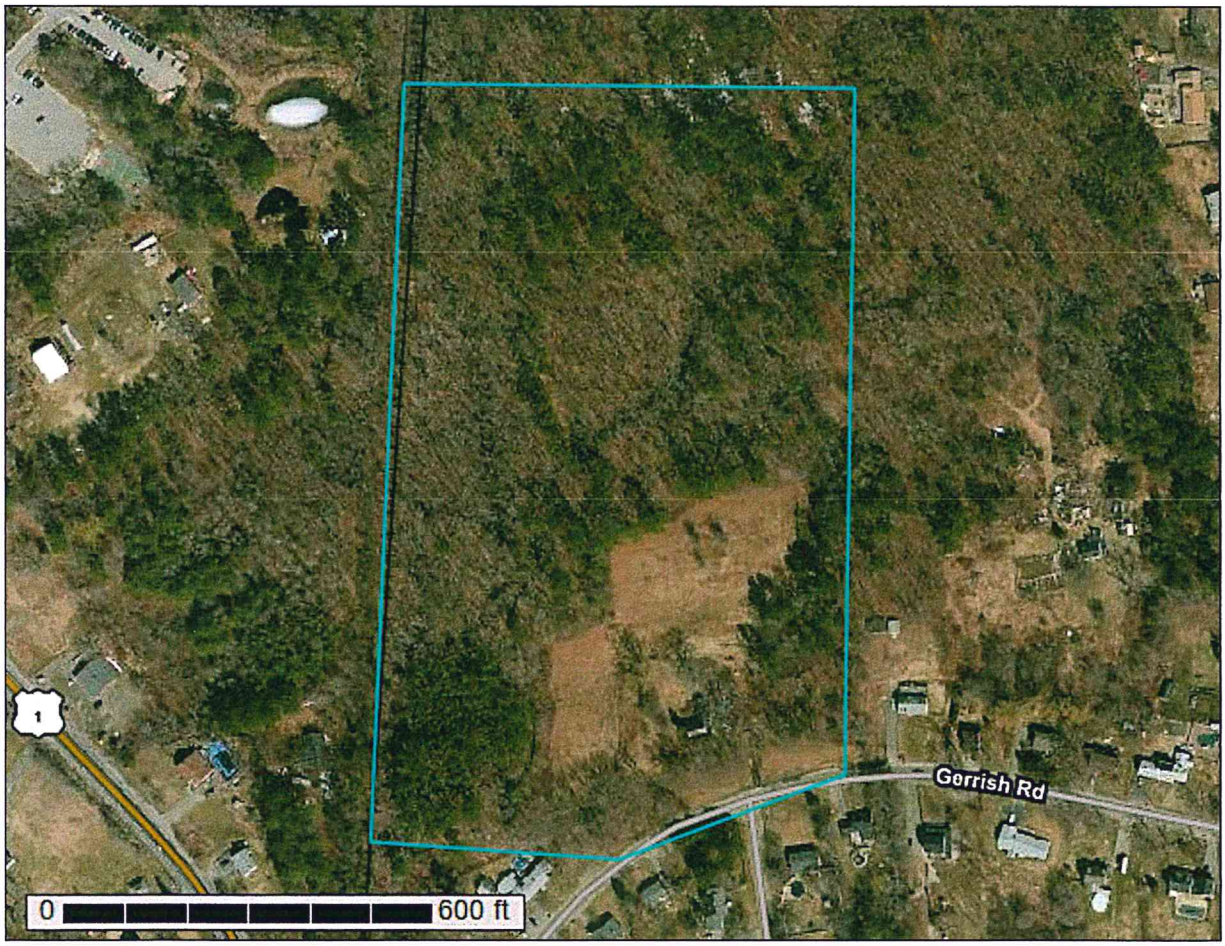
NRCS

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

9 Gerrish Road



March 9, 2020

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.

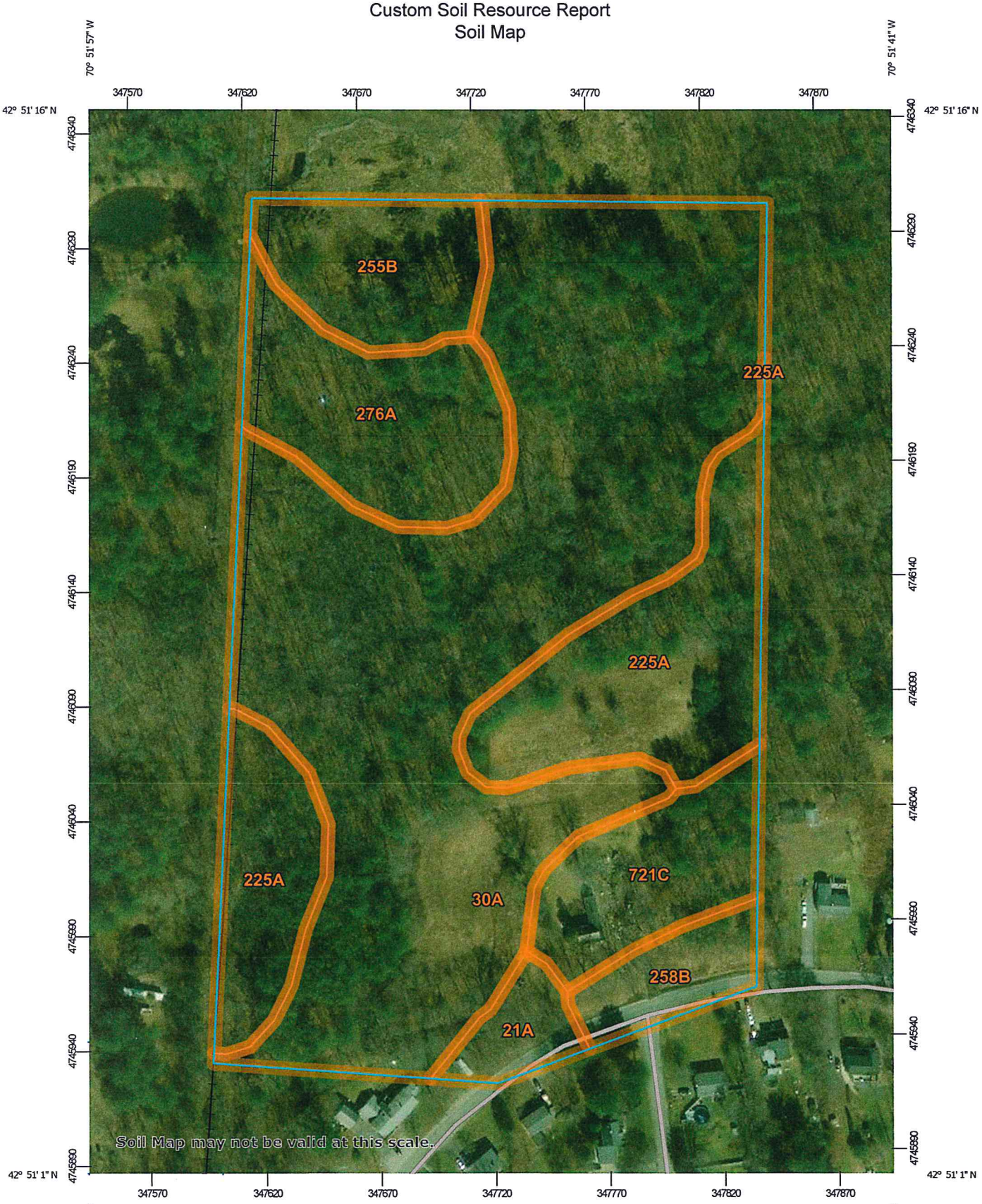
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

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.

Custom Soil Resource Report
Soil Map



Map Scale: 1:2,260 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

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 15, Sep 12, 2019

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
21A	Walpole variant fine sandy loam, 0 to 3 percent slopes	0.5	2.3%
30A	Raynham silt loam, 0 to 3 percent slopes	11.5	53.7%
225A	Belgrade very fine sandy loam, 0 to 3 percent slopes	3.8	17.7%
255B	Windsor loamy sand, 3 to 8 percent slopes	1.4	6.6%
258B	Amostown fine sandy loam, 3 to 8 percent slopes	0.7	3.3%
276A	Ninigret fine sandy loam, 0 to 3 percent slopes	2.1	9.6%
721C	Windsor-Rock outcrop complex, 3 to 15 percent slopes	1.5	6.8%
Totals for Area of Interest		**21.3**	**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

21A—Walpole variant fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: vjxl
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Walpole Variant

Setting

Landform: Terraces, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loose coarse-loamy glaciofluvial deposits over hard coarse-silty glaciolacustrine deposits

Typical profile

H1 - 0 to 8 inches: fine sandy loam
H2 - 8 to 25 inches: fine sandy loam
H3 - 25 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Hydric soil rating: Yes

Minor Components

Scarboro

Percent of map unit: 10 percent
Landform: Terraces
Hydric soil rating: Yes

Amostown

Percent of map unit: 5 percent
Hydric soil rating: No

30A—Raynham silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: vjq9
Elevation: 50 to 500 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Raynham and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Raynham

Setting

Landform: Depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Soft coarse-silty lacustrine deposits

Typical profile

H1 - 0 to 10 inches: silt loam
H2 - 10 to 27 inches: very fine sandy loam
H3 - 27 to 60 inches: very fine sandy loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: High (about 11.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D

Hydric soil rating: Yes

Minor Components

Belgrade
Percent of map unit: 10 percent
Hydric soil rating: No

Walpole variant
Percent of map unit: 5 percent
Landform: Terraces
Hydric soil rating: Yes

Amostown
Percent of map unit: 5 percent
Hydric soil rating: No

Birdsall
Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

225A—Belgrade very fine sandy loam, 0 to 3 percent slopes

Map Unit Setting
National map unit symbol: vj2n
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Belgrade and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Belgrade

Setting
Landform: Valleys
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Friable coarse-silty eolian deposits over soft coarse-silty glaciolacustrine deposits derived from metamorphic rock

Typical profile
H1 - 0 to 9 inches: very fine sandy loam
H2 - 9 to 30 inches: very fine sandy loam
H3 - 30 to 60 inches: loamy very fine sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 2.00 in/hr)
Depth to water table: About 18 to 41 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Raynham

Percent of map unit: 10 percent
Landform: Depressions
Hydric soil rating: Yes

Unadilla

Percent of map unit: 10 percent
Hydric soil rating: No

255B—Windsor loamy sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2svkf
Elevation: 0 to 1,210 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: Deltas, outwash plains, dunes, outwash terraces
Landform position (three-dimensional): Riser, tread
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: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural 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
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Hinckley, loamy sand

Percent of map unit: 10 percent
Landform: Outwash plains, kames, eskers, deltas
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: Linear, convex
Hydric soil rating: No

Deerfield, loamy sand

Percent of map unit: 5 percent
Landform: Terraces, deltas, 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

258B—Amostown fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: vj2g
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Amostown and similar soils: 70 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Amostown

Setting

Landform: Lakebeds, deltas
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Friable coarse-loamy glaciofluvial deposits derived from mica schist over hard coarse-loamy glaciolacustrine deposits

Typical profile

H1 - 0 to 11 inches: fine sandy loam
H2 - 11 to 38 inches: fine sandy loam
H3 - 38 to 60 inches: stratified very fine sand to silt loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 12 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Pollux

Percent of map unit: 20 percent
Hydric soil rating: No

Walpole variant

Percent of map unit: 10 percent
Landform: Terraces
Hydric soil rating: Yes

276A—Ninigret fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2tyr6
Elevation: 0 to 1,250 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: All areas are prime farmland

Map Unit Composition

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

Description of Ninigret

Setting

Landform: Kame terraces, drainageways, moraines, depressions, outwash terraces, kames, outwash plains
Landform position (two-dimensional): Backslope, shoulder, footslope, summit
Landform position (three-dimensional): Side slope, crest, tread, dip, rise
Down-slope shape: Convex, concave, linear
Across-slope shape: Convex, concave
Parent material: Coarse-loamy eolian deposits over sandy and gravelly glaciofluvial deposits derived from gneiss, granite, schist, and/or phyllite

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 16 inches: fine sandy loam
Bw2 - 16 to 26 inches: fine sandy loam
2C - 26 to 65 inches: stratified loamy sand to loamy fine sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 18 to 38 inches to strongly contrasting textural stratification
Natural drainage class: Moderately well drained
Runoff class: Very low

Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 17 to 39 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Agawam
Percent of map unit: 5 percent
Landform: Kame terraces, moraines, outwash terraces, kames, outwash plains
Landform position (two-dimensional): Backslope, shoulder, footslope, summit
Landform position (three-dimensional): Side slope, crest, tread, riser, rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Deerfield
Percent of map unit: 5 percent
Landform: Outwash plains, terraces, deltas
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Windsor
Percent of map unit: 5 percent
Landform: Dunes, deltas, outwash terraces, outwash plains
Landform position (three-dimensional): Tread, riser
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Hydric soil rating: No

721C—Windsor-Rock outcrop complex, 3 to 15 percent slopes

Map Unit Setting
National map unit symbol: 2w2x8
Elevation: 0 to 130 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: 60 percent
Rock outcrop: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Windsor

Setting

Landform: Outwash deltas, kames, kame terraces, eskers, outwash terraces, outwash plains
Landform position (two-dimensional): Footslope, toeslope, summit, shoulder, backslope
Landform position (three-dimensional): Head slope, side slope, nose slope, crest, riser, tread
Down-slope shape: Convex, linear, concave
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

A - 0 to 3 inches: loamy sand
Bw - 3 to 25 inches: loamy sand
C - 25 to 65 inches: sand

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural 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
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Igneous and metamorphic rock

Typical profile

R - 0 to 10 inches: bedrock

Properties and qualities

Slope: 3 to 15 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)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: Unranked

Minor Components

Mashpee

Percent of map unit: 5 percent
Landform: Depressions, terraces, drainageways
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Outwash deltas, drainageways, depressions, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave, linear
Hydric soil rating: Yes

Wareham

Percent of map unit: 5 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

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.

Custom Soil Resource Report
Map—Hydrologic Soil Group

Map Scale: 1:2,260 if printed on A portrait (8.5" x 11") sheet.

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Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

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 15, Sep 12, 2019

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
21A	Walpole variant fine sandy loam, 0 to 3 percent slopes	C/D	0.5	2.3%
30A	Raynham silt loam, 0 to 3 percent slopes	C/D	11.5	53.7%
225A	Belgrade very fine sandy loam, 0 to 3 percent slopes	C	3.8	17.7%
255B	Windsor loamy sand, 3 to 8 percent slopes	A	1.4	6.6%
258B	Amostown fine sandy loam, 3 to 8 percent slopes	C/D	0.7	3.3%
276A	Ninigret fine sandy loam, 0 to 3 percent slopes	C	2.1	9.6%
721C	Windsor-Rock outcrop complex, 3 to 15 percent slopes	A	1.5	6.8%
Totals for Area of Interest			**21.3**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

13.0 APPENDIX F – WATERSHED PLANS