Nitsch Engineering

January 29, 2016

STORMWATER REPORT

For

SMAST I/SMAST II, UMASS DARTMOUTH
706/838 Rodney French Boulevard
New Bedford, Massachusetts

Prepared for:

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Nitsch Project #9236.2

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1.0 INTRODUCTION

Nitsch Engineering has prepared this Stormwater Report to support the Notice of Intent application for the SMAST I/SMAST II facility in New Bedford, Massachusetts. The Project site is located at 706 and 838 Rodney French Boulevard in New Bedford, Massachusetts (subsequently referred to as the "Site"). The Project consists of (i) the demolition of an existing building and construction of a new facility for UMass Dartmouth's School for Marine Science and Technology (SMAST); and (ii) various site improvements, including construction of a connecting driveway to the existing SMAST I site, parking areas, and utility work. The Project includes a stormwater management system, which has been designed to comply with the requirements of the Massachusetts Department of Environmental Protection (DEP) Stormwater Management Standards.

2.0 EXISTING CONDITIONS

The Site is located at 706 and 838 Rodney French Boulevard in New Bedford, Massachusetts (Figures 1 and 2). The SMAST I site is located at 706 Rodney French Boulevard and the SMAST II site is located at 838 Rodney French Boulevard.

The existing SMAST I site is located at 706 Rodney French Boulevard. The existing building is a 2-story brick building, which houses the School for Marine Science and Technology for the University of Massachusetts Dartmouth. There are parking areas and a loading dock to support the building. Metal storage containers are present throughout the site. The majority of the existing SMAST I site is impervious.

The existing SMAST II site is located at 838 Rodney French Boulevard. The existing building to be demolished is a 2-story brick building that was previously owned by New Bedford Public Schools. There are associated driveways and parking areas associated with the building. The majority of the existing SMAST II site is impervious, except for the wooded area to the south of the existing parking lot.

The easement area between the SMAST I and SMAST II sites is predominately wooded.

2.1 Existing Drainage Infrastructure

Stormwater generated by the existing SMAST I site is collected using catch basins and is piped via a closed drainage system to the closed drainage system in Rodney French Boulevard.

Stormwater generated by the existing SMAST II site appears to sheet flow toward the southern boundary of the site. There are several catch basins located along the perimeter of the site which connect into a closed drainage system which heads south off-site. The existing stormwater management system for both SMAST I and SMAST II sites were constructed prior to the 2008 MassDEP Stormwater Management Standards, and the Site provides minimal peak flow attenuation, water quality treatment, and groundwater recharge.

2.2 NRSC Soil Designations

The Soil Classification Summary (Table 1) outlines the Natural Resources Conservation Services (NRCS) designation of the soil series at the Site. The majority of soils are classified as Udorthents – Urban Land Complex and Urban Land. The NRSC does not provide a Hydrologic Soil Group classification for these soils.

Table 1. NRCS Soil Classification Summary

Soil Unit	Soil Series	Hydrologic Soil Group
602	Urban land	---
656	Udorthents – Urban Land Complex	---

2.3 On-Site Soil Investigations

Three test pits were performed on the SMAST II site on September 29, 2016 by GZA Geoenvironmental and Marini Corporation in the areas of the stormwater BMPs. The results were generally consistent, indicating that the site contains fill generally consisting of fine to coarse sand, up to 35% gravel, and 15% silt. The fill was underlain by a natural sand deposit generally consisting of fine to coarse sand, containing about 26 to 31 percent silt and up to 19 to 27 percent gravel. Nitsch Engineering determined that based on the soil investigations, Hydrologic Soil Group A is appropriate for the site.

2.4 Wetland Resource Areas

The SMAST I site borders along Clarks Cove and Buzzards Bay. A portion of the seawater utility work will take place within the Buffer Zone associated with these water bodies. Refer to the Notice of Intent Application for more information.

2.5 Total Maximum Daily Load (TMDL)

The Site ultimately discharges into Buzzards Bay. Therefore, the Site is subject to a Pathogen Total Maximum Daily Load (TMDL). The Project has been designed to minimize stormwater discharge and associated pathogen pollutants through extensive infiltration practices to meet the intent of the TMDL.

3.0 PROPOSED CONDITIONS

3.1 Project Description

The Project site is located at 706 and 838 Rodney French Boulevard in New Bedford, Massachusetts (subsequently referred to as the “Site”). The Project consists of (i) the demolition of an existing building and construction of a new facility for UMass Dartmouth’s School for Marine Science and Technology (SMAST) on the SMAST II site; and (ii) various site improvements, including construction of a connecting driveway to the existing SMAST I site, parking areas, and utility work. The Project includes a stormwater management system, which has been designed to comply with the requirements of the Massachusetts Department of Environmental Protection (DEP) Stormwater Management Standards.

The proposed building will be a new facility for the School for Marine Science and Technology. New driveways, parking areas, and utilities are proposed to support the new building. The Project also includes a seawater utility connection near the existing SMAST I building. There is no proposed sitework on the SMAST I site other than this seawater utility connection. Ground types will remain the same; therefore, the hydrologic analyses only include the SMAST II site and the easement area with the connecting driveway between the two sites.

The Project is anticipated to decrease the overall impervious area for SMAST II and the easement area by approximately 0.07 acres. Refer to Table 2 for a comparison of the existing and proposed land use for the Site.

Table 2. Proposed land use for SMAST II Site (in acres)

Land Use	Existing Site (acres)	Proposed Site (acres)	Change
Buildings	0.42	0.73	+ 0.31
Site Pavement	1.36	0.98	-0.38
Gravel	0.00	0.97	+0.97
Other Altered Areas	0.76	0.79	+ 0.04
Undeveloped Areas	2.05	1.12	- 0.93
Total	**4.59**	**4.59**	---

3.2 Stormwater Management System

The Site will include the installation of a stormwater management system that is being designed to meet the MassDEP Stormwater Management Standards. As a redevelopment, the Project is required to provide peak flow mitigation and provide water quality treatment and groundwater recharge.

The Project has been designed using environmentally-sensitive site design and LID techniques. This design prevents the generation of stormwater and non-point source pollution by reducing impervious surfaces, disconnecting flow paths, treating and infiltrating stormwater at its source, and protecting natural processes. Stormwater systems have been designed to model natural hydrologic features, including promoting infiltration throughout the site.

The existing drainage system on the SMAST I site is being maintained; no site work or drainage changes are proposed.

The proposed stormwater management system for the SMAST II Project will include area drains, infiltrating bioretention areas with vegetated filter strips and gravel diaphragm, perforated pipes, Stormwater Buffer Zone water quality inlets, and a dry well. Overflow from the proposed BMPs (excluding the drywell) will be discharged to the existing closed drainage system located on site. The drywell will overflow through the proposed grate and sheet flow overland.

Area Drains

Area drains are proposed within the grassed area in the front of the new SMAST II building to capture any runoff that does not infiltrate.

Bioretention Areas with Vegetated Filter Strips and Gravel Diaphragm

Bioretention areas are proposed to treat stormwater runoff generated by the proposed parking areas. The bioretention areas include a minimum 24-inch media filter to provide TSS and nutrient pollutant removal and will provide infiltration.

Pretreatment for the Bioretention Areas 1 and 2 will be provided by vegetated filter strips, and pretreatment for Bioretention Area 3 will be provided by a gravel diaphragm.

Perforated Pipes

A 24-inch perforated pipe is proposed beneath Bioretention Areas 1 and 2. The 24-inch perforated pipe is 222 feet long and surrounded by crushed stone. There is 6 inches of crushed stone above and below the pipe, and 40 inches of crushed stone on either side (which spans the width of the bioretention areas). This perforated pipe will collect runoff from parking lot that has been treated by the bioretention areas and Stormwater Buffer Zone water quality inlets, as well as half of the runoff from the proposed roof. Overflow from this perforated pipe is controlled by an outlet control structure which directs water that does not infiltrate to the closed drainage system.

A 12-inch perforated pipe is proposed beneath Bioretention Area 3. The 12-inch perforated pipe is 182 feet long and surrounded by crushed stone. There is 6 inches of crushed stone above and below the pipe, and 12 inches of crushed stone on either side (which spans the width of the bioretention area). This perforated pipe will collect runoff from gravel parking lot that has been treated by the bioretention area. Overflow from this perforated pipe is controlled by an outlet control structure which directs water that does not infiltrate to the closed drainage system.

Site impervious area that is tributary to these systems will be pretreated as described above to meet the 44% TSS removal requirement set forth by the MassDEP Stormwater Standards for discharge to highly permeable soils.

Stormwater Buffer Zone Water Quality Inlets

Stormwater Buffer Zone Water Quality Inlets are proposed for water quality treatment in areas of the Site where space is limited or additional pretreatment is required prior to infiltration.

Refer to the TSS Removal spreadsheets in Appendix A for TSS removal summaries for each treatment train.

3.3 Stormwater Management During Construction

The Site Contractor will be responsible for stormwater management of the active construction site and is required to adhere to the conditions of the 2012 Construction General Permit under the Environmental Protection Agency (through the preparation and implementation of the New Bedford Conservation Commission and MassDEP.) A draft SWPPP has been prepared in accordance with the MassDEP Stormwater Management Standards and the 2012 Construction General Permit (Appendix F).

4.0 STORMWATER MANAGEMENT ANALYSIS

4.1 Methodology

Nitsch Engineering completed a hydrologic analysis of the existing project site utilizing Soil Conservation Service (SCS) Runoff Curve Number (CN) methodology. The SCS method calculates the rate at which the runoff reaches the design point considering several factors: the slope and flow lengths of the subcatchment area, the soil type of the subcatchment area, and the type of surface cover in the subcatchment area. HydroCAD Version 10.00 computer modeling software was used in conjunction with the SCS method to determine the peak runoff rates and runoff volumes for the 2-, 10-, 25-, and 100-year, 24-hour storm events. The proposed project site is being analyzed with the same methodology.

The Site was divided into multiple drainage areas, or subcatchments, which drain to the design point along the property boundary. For each subcatchment area, SCS Runoff Curve Numbers (CNs) were selected by using the cover type and hydrologic soil group of each area. The peak runoff rates and

runoff volumes for the 2-, 10-, 25- and 100-year 24-hour storm events were then determined by inputting the drainage areas, CNs, and time of concentration (T_c) paths into the HydroCAD model.

4.2 HydroCAD Version 10.00

The HydroCAD computer program uses SCS and TR-20 methods to model drainage systems. TR-20 (Technical Release 20) was developed by the Soil Conservation Service to estimate runoff and peak discharges in small watersheds. TR-20 is generally accepted by engineers and reviewing authorities as the standard method for estimating runoff and peak discharges.

HydroCAD Version 10.00 uses up to four types of components to analyze the hydrology of a given site: subcatchments, reaches, basins, and links. Subcatchments are areas of land that produce surface runoff. The area, weighted CN, and T_c characterize each individual subcatchment area. Reaches are generally uniform streams, channels, or pipes that convey water from one point to another. A basin is any impoundment that fills with water from one or more sources and empties via an outlet structure. Links are used to introduce hydrographs into a project from another source or to provide a junction for more than one hydrograph within a project. The time span for the model was set for 0-48 hours in order to prevent truncation of the hydrograph.

4.3 Precipitation Data

Nitsch Engineering, Inc. used Technical Paper 40 by the National Weather Service to estimate the rainfall for the 2-year, 10-year, 25-year and 100-year 24-hour storms. The rainfall values for Bristol County that will be used are as follows:

Storm Event	24–hour Rainfall
2-year	3.4 in.
10-year	4.8 in.
25-year	5.6 in.
100-year	7.0 in.

4.4 Existing Hydrologic Conditions

As summarized in Table 4, Nitsch Engineering delineated the project site into two (2) on-site subcatchment (watershed) areas discharging to one (1) design point utilizing an existing conditions survey and on-site observations (See DR-1). Table 4 summarizes the design point, location and area of each watershed. The design point (DP) is defined as the southern edge of the site. The HydroCAD model for existing conditions is provided in Appendix B.

Table 4. Existing Drainage Area Summary

Design Point	Watershed	Area (acres)	Description
EX	5S	3.38	Existing SMAST II Site
	6S	1.21	Existing Easement Area
Total Area		**4.59**	

4.5 Proposed Hydrologic Conditions

The proposed project has been designed to mitigate the change in stormwater runoff at the design point as required by the DEP Stormwater Management. The existing watershed areas were modified to reflect the proposed topography, storm drainage structures and BMPs, and roof areas. (See DR-2 and Table 5). The proposed BMPs included as ponds or reaches in the HydroCAD model are:

- Bioretention Areas
- Perforated Pipes
- Drywell

Table 5. Proposed Drainage Area Summary

Design Point	Watershed	Area (acres)	Description	Proposed Treatment BMP(s)
PR	2S	0.30	Gravel Parking	Bioretention Area
	11S	2.35	Portion of Proposed Roof, Driveway, Gravel, and Woods	Stormwater Buffer Zone
	17S	0.34	Portion of Proposed Roof	Perforated Pipe
	20S	1.07	Gravel, Woods, Walkway	Sheet Flow
	21S	0.34	Parking Area	Bioretention Area
	22S	0.05	Pavement	Stormwater Buffer Zone, Perforate Pipe
	24S	0.14	Pavement	Drywell
Total Area		**4.59**		

4.6 Peak Flow Rates

The proposed stormwater management system is expected to reduce the proposed peak runoff rates to below the existing rates for the design point. Table 6 below summarizes the existing and proposed hydrologic analyses for the site at the design point.

Table 6 – Peak Rates of Runoff for Design Point (in cfs)

Storm Event	2-year	10-year	25-year	100-year
Existing	4.09	8.67	11.56	16.90
Proposed	3.93	7.69	11.10	16.07

The proposed stormwater management system is also expected to reduce the post-development peak volume of runoff to below the pre-development volume. Table 10 below demonstrates a reduction in runoff volumes for the required storm events.

Table 10 –Volumes of Runoff for Total Site (in cubic feet)

Storm Event	2-year	10-year	25-year	100-year
Existing	16,752	32,846	43,064	62,107
Proposed	11,700	24,893	33,566	50,118

5.0 MassDEP Stormwater Management Standards

The Project is considered a ***redevelopment*** under the DEP Stormwater Management System. The Site will be designed to meet the MassDEP Stormwater Management Standards as summarized below:

Standard 1: No New Untreated Discharges

The Project will not discharge any untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth. Stormwater from the Site will be collected and treated in accordance with the MassDEP Stormwater Management Standards and stormwater outfalls will be stabilized to prevent erosion.

Standard 2: Peak Rate Attenuation

The proposed stormwater management system will be designed so that the post-development peak discharge rates do not exceed pre-development peak discharge rates. To prevent storm damage and downstream flooding, the proposed stormwater management practices will mitigate peak runoff rates for the 2-, 10-, 25- and 100-year, 24 hour storm events.

In addition to peak rate attenuation, the proposed stormwater management system is expected to reduce the post-development volumes of runoff to below the pre-development volumes. Therefore, the proposed system will exceed the DEP Stormwater Management Guidelines.

Standard 3: Groundwater Recharge

The Project is a redevelopment and required to provide groundwater recharge to the maximum extent practicable. The Site was designed using environmentally-sensitive site design, low impact development techniques, and stormwater BMP treatment trains to minimize the loss of annual recharge to groundwater. The Project reduces impervious area in the proposed condition, thereby increasing natural groundwater recharge throughout the site. The stormwater design includes several infiltrating BMPs. The Site also contains a substantial amount of gravel (close to an acre) which will also promote infiltration in those areas.

The exfiltrating bioretention areas with perforated pipes and drywell provide the following recharge volumes (Table 11).

Table 11 – Proposed Recharge Volumes for Stormwater BMPs

Infiltration BMP	Recharge Volume (cf)
Bioretention Area with 24" Perforated Pipe	590
Bioretention Area with 12" Perforated Pipe	438
Drywell	240
Total	**1,268**

The HydroCAD reports provided in Appendix C indicate that all proposed infiltration BMPs will drain within 27 hours for the 2-, 10-, 25-, and 100-year storm events, exceeding the 72-hour MassDEP drawdown requirement.

Standard 4: Water Quality Treatment

The proposed stormwater management system will be designed to remove greater than 80% of the average annual post-construction load of Total Suspended Solids (TSS). Structural stormwater BMPs including area drains, bioretention areas, perforated pipes, and Stormwater Buffer Zone water quality units are sized to capture the required water quality volume (1 inch over the project site) and remove a minimum of 80% of total suspended solids.

The proposed water quality treatment BMPs are subject to the 44% TSS removal pretreatment requirement and the 1-inch rule for calculating water quality volumes because the site contains soils with a rapid infiltration rate (greater than 2.4 inches per hour).

Pretreatment for all infiltration BMPs will meet or exceed the 44% TSS removal requirement. Pretreatment for the proposed bioretention areas will be provided using a vegetated filter strip for Bioretention Areas 1 and 2 and a gravel diaphragm for Bioretention Area 3. Pretreatment for the perforated pipes includes Stormwater Buffer Zone water quality inlets and the bioretention basins. TSS removal calculation spreadsheets and Stormceptor® sizing calculations are provided in Appendix A.

Source control and pollution prevention measures, such as vacuum cleaning, street sweeping, proper snow management, and stabilization of eroded surfaces, are included in the Long-Term Pollution Prevention Plan and Operation and Maintenance Plan (Appendix E).

Standard 5: Land Uses with Higher Potential Pollutant Loads

The Project is not considered a LUHPPL. Therefore, this standard is not available.

Standard 6: Critical Areas

The Project is not located within any critical areas. Therefore, this standard is not applicable.

Standard 7: Redevelopments

The Project is considered a redevelopment under the MassDEP Stormwater Management Standards. Therefore, the project is required to meet Standard 2, Standard 3, and the pretreatment and structural stormwater BMP requirements of Standards 4, 5, and 6 to the maximum extent practicable. The projects should comply with all other requirements of the Stormwater Management Standards and improve existing conditions. The Project meets this standard.

Standard 8: Construction Period Pollution Prevention and Sedimentation Control

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) will be developed and implemented during the Notice of Intent permitting process.

Since the Project will disturb more than one (1) acre of land, a Notice of Intent will be submitted to the Environmental Protection Agency (EPA) for coverage under the National Pollution Discharge Elimination System (NPDES) Construction General Permit. As part of this application the Applicant is required to prepare a Stormwater Pollution Prevention Plan (SWPPP) and implement the measures in the SWPPP. The SWPPP, which is to be kept on site, includes erosion and sediment controls (stabilization practices and structural practices), temporary and permanent stormwater management measures, Contractor inspection schedules and reporting of all SWPPP features, materials management, waste disposal, off-site vehicle tracking, spill prevention and response, sanitation, and non-stormwater discharges. A draft SWPPP is provided in Appendix F.

Standard 9: Operation and Maintenance Plan

A post-construction operation and maintenance plan has been prepared and will be implemented to ensure that stormwater management systems function as designed. Source control and stormwater BMP operation requirements for the academic campus are summarized in the Long-Term Pollution Prevention Plan and Operation and Maintenance Plan provided in Appendix E.

Standard 10: Prohibition of Illicit Discharges

There will be no illicit discharges to the stormwater management system associated with the Project. An Illicit Discharge Compliance Statement is provided in Appendix A.

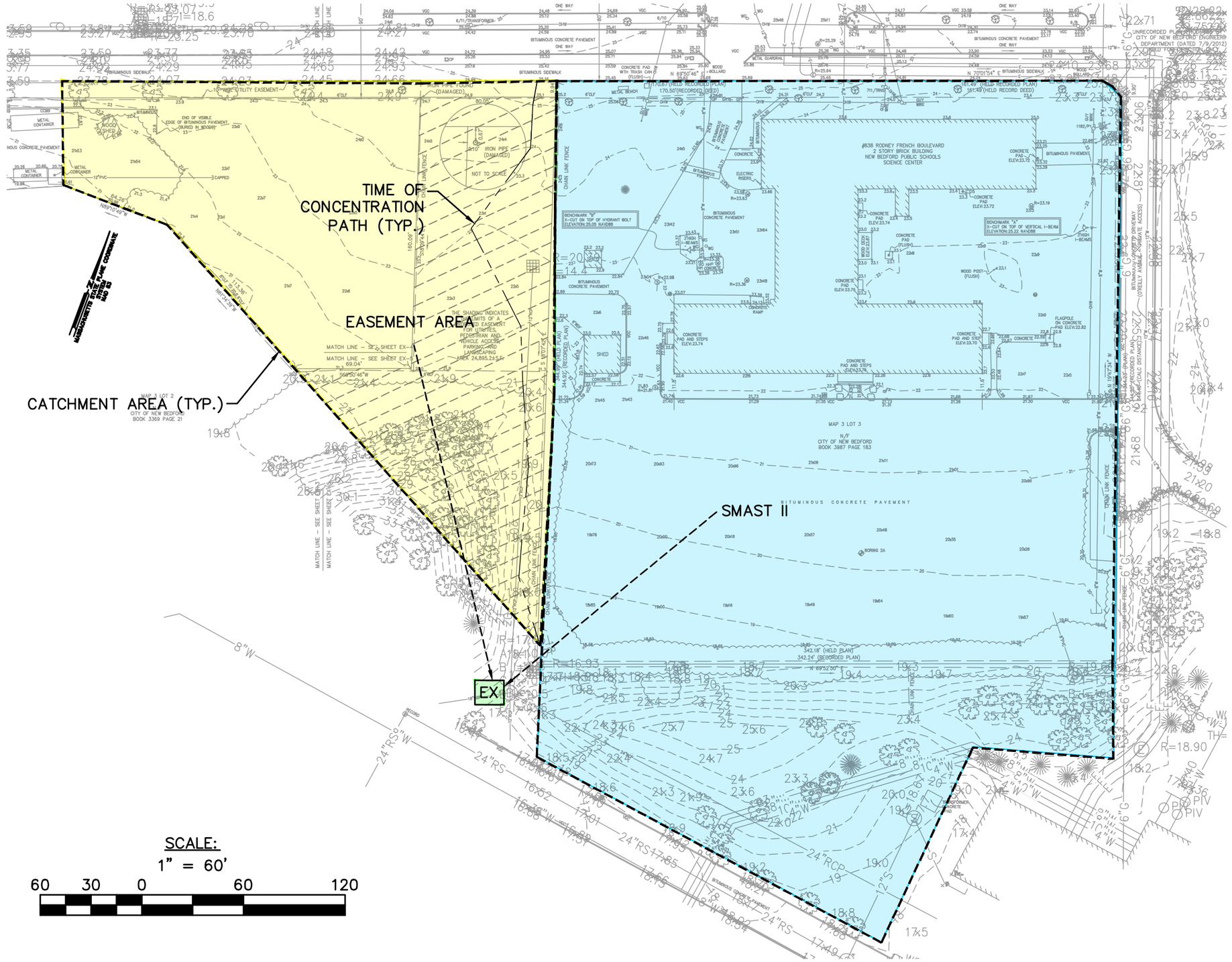
6.0 CLOSED DRAINAGE SYSTEM DESIGN

The proposed closed drainage system consists of deep sump and hooded catch basins, drainage manholes, and proprietary water quality inlets connected with corrugated polyethylene pipe. The closed drainage system was designed to convey the 25-year storm event using the Rational method, as required by the City of New Bedford. Refer to Appendix D for more information.

7.0 CONCLUSION

In conclusion, the Project's stormwater management system will reduce peak runoff rates and volumes through decreasing impervious area and the widespread use of infiltration BMPs and improve the water quality of stormwater being discharged from the Site. Environmentally sensitive site design and low impact development techniques will be implemented throughout the Site. The Project is being designed to meet the MassDEP Stormwater Management Standards.

FIGURES



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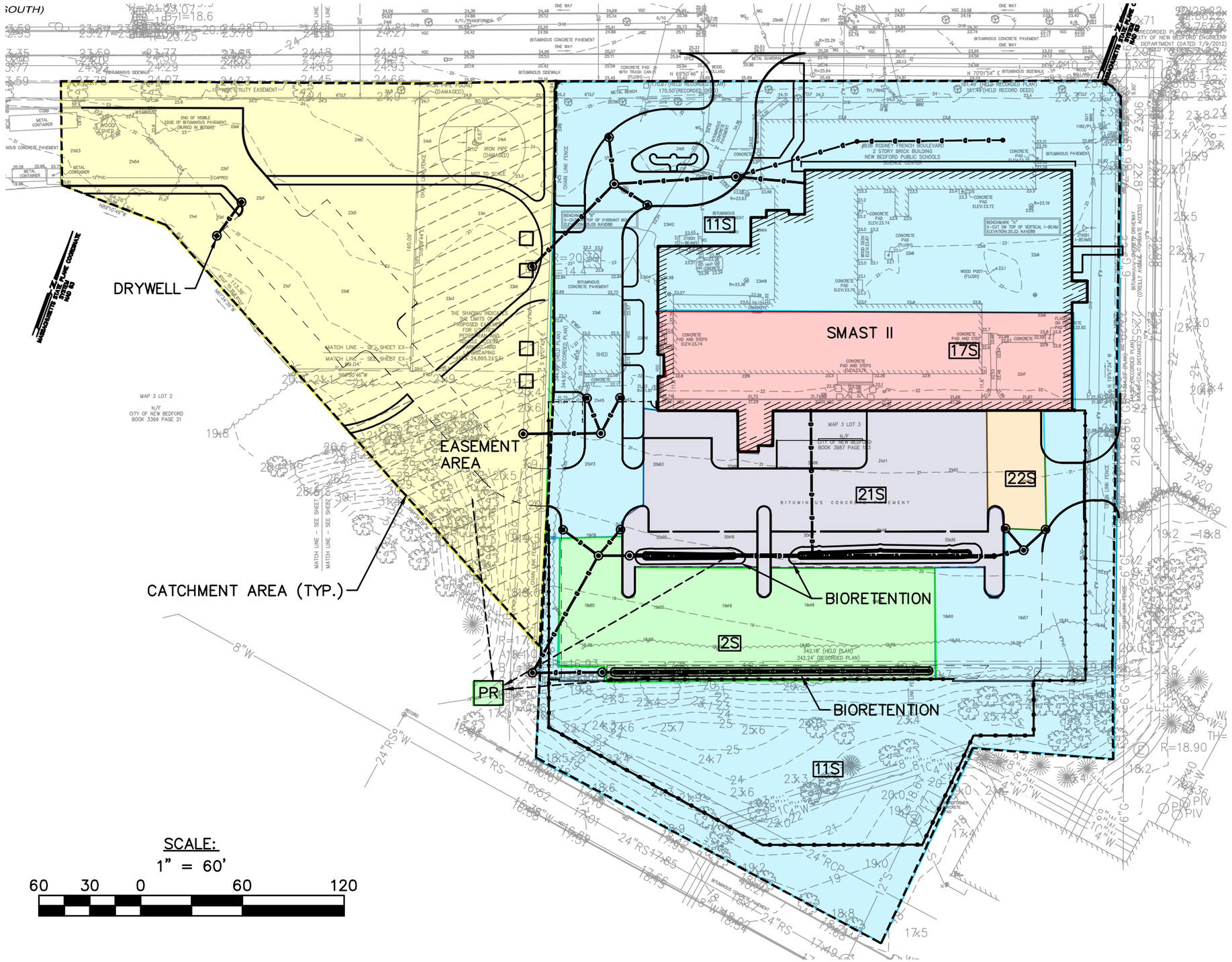
- Transportation Engineering
- Sustainable Site Consulting
- Planning
- GIS

EXISTING WATERSHED AREAS
SMAST II
UNIVERSITY OF MASSACHUSETTS, DARTMOUTH

PREPARED FOR:
ELLENZWEIG ARCHITECTS
230 CONGRESS STREET, BOSTON, MA 02110

PROJECT #	9236.2
FILE:	9236.2CDA.DWG
SCALE:	1"= 60'
DATE:	1/28/2016
PROJECT MGR:	DC
SURVEYOR:	
DRAFTED BY:	BMV
CHECKED BY:	MLC

DR-1



PROPOSED WATERSHED AREAS
SMAST II
UNIVERSITY OF MASSACHUSETTS, DARTMOUTH

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APPENDIX A

Stormwater Management Standards Documentation

MassDEP Checklist for Stormwater Report

Standard 4: TSS Removal Calculations

MASTEP Technology Review – Stormwater Buffer Zone

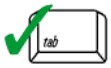
Standard 10: Illicit Discharge Compliance Statement

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

2/11/16
Signature and Date

Checklist

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

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☐ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

☐ Limited Project

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

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

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

☐ Bike Path and/or Foot Path

☒ Redevelopment Project

☐ Redevelopment portion of mix of new and redevelopment.

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

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SMAST II
WATER QUALITY TREATMENT SUMMARY (01/29/2016)

Nitsch Engineering has prepared this Water Quality Treatment Summary for the proposed SMAST II site. In compliance with MassDEP Stormwater Management Standard #4, the proposed stormwater management system is designed to remove at least 80% of the average annual post-construction load of TSS prior to discharge. The stormwater management system is designed to remove at least 44% of the average annual post-construction TSS load prior to discharge to the infiltration systems because the infiltration systems are located within areas where soils with rapid infiltration rates were observed.

A summary of treatment trains proposed to provide water quantity control and water quality improvement at the proposed project site is provided below.

Treatment Train A
Catchment Areas: 21S
Vegetated Filter Strip → Bioretention Area → Perforated Pipe→ Discharge

Treatment Train B
Catchment Areas: 22S
Stormwater Buffer Zone → Perforated Pipe → Discharge

Treatment Train C
Catchment Areas: 2S
Gravel Diaphragm → Bioretention Area → Perforated Pipe → Discharge

Treatment Train D
Catchment Areas: 24S
Stormwater Buffer Zone → Drywell → Discharge

Treatment Train E
Catchment Areas: 2S
Stormwater Buffer Zone → Discharge

SMAST II
New Bedford, MA
January 29, 2016

Nitsch Project No. 9236.2

Treatment Train A:
Vegetated Filter Strip → Bioretention Area → Perforated Pipe→ Discharge

Pretreatment Spreadsheet

B	C	D	E	F
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (C*D)	Remaining Load (D-E)
Bioretention Area with Vegetated Filter Strip	**0.90**	**1.00**	**0.90**	**0.10**

Total TSS Removal = **90%** **Meets 44% TSS removal pretreatment requirement**

Treatment Spreadsheet

B	C	D	E	F
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (C*D)	Remaining Load (D-E)
Perforated Pipe	**0.80**	**1.00**	**0.80**	**0.20**

Total TSS Removal = **90%** **Meets 80% TSS removal requirement**

SMAST II
New Bedford, MA
January 29, 2016

Nitsch Project No. 9236.2

Treatment Train B:
Stormwater Buffer Zone → Perforated Pipe → Discharge

Pretreatment Spreadsheet

B	C	D	E	F
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (C*D)	Remaining Load (D-E)
Stormwater Buffer Zone	**0.63**	**1.00**	**0.63**	**0.37**

Total TSS Removal = **63%**

Meets 44% TSS removal pretreatment requirement

Treatment Spreadsheet

B	C	D	E	F
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (C*D)	Remaining Load (D-E)
Perforated Pipe	**0.80**	**1.00**	**0.80**	**0.20**

Total TSS Removal = **80%**

Meets 80% TSS removal requirement

SMAST II
New Bedford, MA
January 29, 2016

Nitsch Project No. 9236.2

Treatment Train C:
Gravel Diaphragm → Bioretention Area → Perforated Pipe→ Discharge

Pretreatment Spreadsheet

B	C	D	E	F
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (C*D)	Remaining Load (D-E)
Bioretention Area with Gravel Diaphragm	**0.90**	**1.00**	**0.90**	**0.10**

Total TSS Removal = **90%**

Meets 44% TSS removal pretreatment requirement

Treatment Spreadsheet

B	C	D	E	F
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (C*D)	Remaining Load (D-E)
Perforated Pipe	**0.80**	**1.00**	**0.80**	**0.20**

Total TSS Removal = **90%**

Meets 80% TSS removal requirement

SMAST II
New Bedford, MA
January 29, 2016

Nitsch Project No. 9236.2

Treatment Train D:
Stormwater Buffer Zone → Drywell → Discharge

Pretreatment Spreadsheet

B	C	D	E	F
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (C*D)	Remaining Load (D-E)
Stormwater Buffer Zone	**0.63**	**1.00**	**0.63**	**0.37**

Total TSS Removal =	**63%**	**Meets 44% TSS removal pretreatment requirement**

Treatment Spreadsheet

B	C	D	E	F
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (C*D)	Remaining Load (D-E)
Drywell	**0.80**	**1.00**	**0.80**	**0.20**

Total TSS Removal =	**80%**	**Meets 80% TSS removal requirement**

SMAST II
New Bedford, MA
January 29, 2016

Nitsch Project No. 9236.2

Treatment Train E:
Stormwater Buffer Zone → Discharge

Treatment Spreadsheet

B	C	D	E	F
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (C*D)	Remaining Load (D-E)
Stormwater Buffer Zone	**0.63**	**1.00**	**0.66**	**0.37**
Deep Sump Manhole	**0.25**	**0.37**	**0.09**	**0.28**
		Total TSS Removal =	**72%**	

***Meets TSS removal requirement through de minimus calculation**

De Minimus Calculations

Treatment Train A
Catchment Areas: 21S
15,000 square feet, 90% TSS removal

Treatment Train B
Catchment Areas: 22S
2,150 square feet, 80% TSS removal

Treatment Train C
Catchment Areas: 2S
13,155 square feet, 90% TSS removal

Treatment Train D
Catchment Areas: 24S
5,881 square feet, 80% TSS removal

Treatment Train E
Catchment Areas: 2S
16,943 square feet, 72% TSS removal

$$\text{Average TSS removal} = \frac{(15{,}000 \times 0.90) + (2{,}150 \times 0.80) + (13{,}155 \times 0.90) + (5{,}881 \times 0.80) + (16{,}943 \times 0.72)}{(15{,}000 + 2{,}150 + 13{,}155 + 5{,}881 + 16{,}943)}$$

Average TSS removal = 83%, exceeding the 80% minimum

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MASTEP Technology Review

Technology Name: Stormwater Buffer Zone

Studies Reviewed: Verification Testing of a 4-ft Stormwater Buffer Zone Stormwater Catch Basin Treatment Unit, Alden Laboratory 2012

Date: 1/7/2013

Reviewer: Jerry Schoen

Rating: 2

Brief rationale for rating: This laboratory study in general followed New Jersey protocols for laboratory testing, but only test 7 runs were performed (15 or more recommended). The report lacks details on quality control procedures.

Other Comments:

- ASTM 3977, the Suspended Sediment Concentration method was used.
- Influent sediment concentration generally 200 mg/l range, within NJCAT guidelines.
- Sediment mix used had a mean particle size of 70 microns, within NJCAT guidelines.
- 5 flow rates tested, ranging from < 10% to 125% of system design flow.
- Scour test was performed according to NJCAT guidelines. No scour found.
- Sediment removal efficiency ranged from 41% - 77%, depending on flow rates tested. Overall removal efficiency of 62.6% reported.

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STANDARD 10: Illicit Discharge Compliance Statement

Project Name: SMAST II	Nitsch Project #: 9236.2
Location: New Bedford, MA	Checked by: DMC
Prepared by: MLC	Sheet No. 1 of 1
Date: January 29, 2016	

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

This is to verify:

1. Based on the information available there are no know or suspected illicit discharges to the stormwater management system at SMAST II site as defined in the MassDEP Stormwater Handbook.

2. The design of the stormwater system includes no proposed illicit discharges.

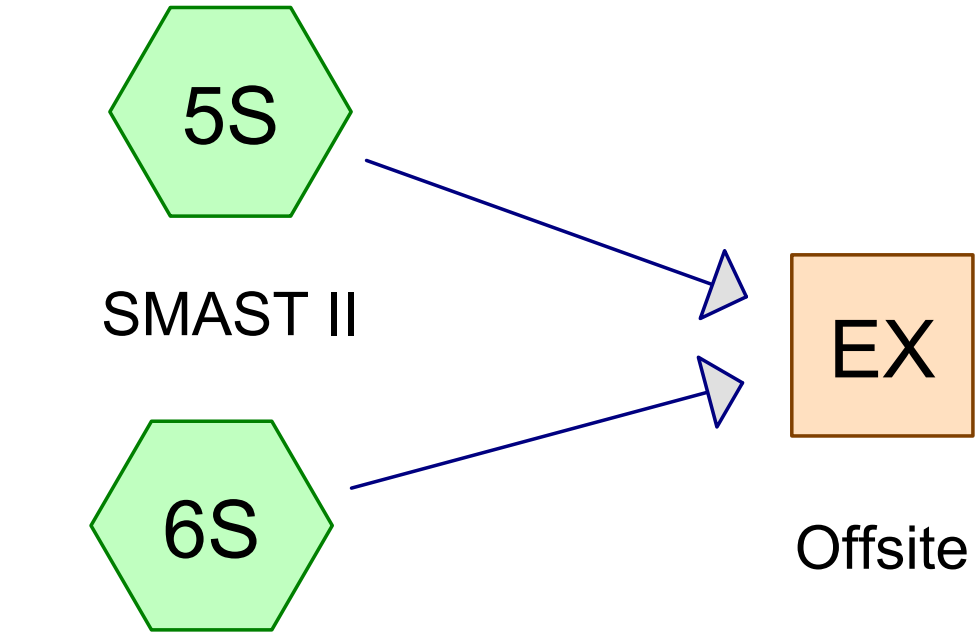
COMMONWEALTH OF MASSACHUSETTS
DAVID M. CONWAY
CIVIL
No. 40068
REGISTERED PROFESSIONAL ENGINEER

David Conway, PE

2/11/16
Date

APPENDIX B

Pre-Development Conditions – HydroCAD Calculations



Subcat Reach Pond Link

Routing Diagram for 9236.2HydroCAD -CD
Prepared by Nitsch Engineering, Inc., Printed 1/29/2016

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
33,193	49	50-75% Grass cover, Fair, HSG A (5S)
2,875	98	Pavement (6S)
39,422	36	Woods, Fair, HSG A (5S)
49,746	73	Woods, Fair, HSG C (6S)
56,410	98	impervious (5S)
18,165	98	roof (5S)
199,811	**71**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
72,615	HSG A	5S
0	HSG B	
49,746	HSG C	6S
0	HSG D	
77,450	Other	5S, 6S
199,811		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
33,193	0	0	0	0	33,193	50-75% Grass cover, Fair	
0	0	0	0	2,875	2,875	Pavement	
39,422	0	49,746	0	0	89,168	Woods, Fair	
0	0	0	0	56,410	56,410	impervious	
0	0	0	0	18,165	18,165	roof	
72,615	**0**	**49,746**	**0**	**77,450**	**199,811**	**TOTAL AREA**	

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment5S: SMAST II Runoff Area=147,190 sf 50.67% Impervious Runoff Depth=0.95"
Tc=6.0 min CN=70 Runoff=3.43 cfs 11,615 cf

Subcatchment6S: Easement Area Runoff Area=52,621 sf 5.46% Impervious Runoff Depth=1.17"
Flow Length=353' Tc=17.6 min CN=74 Runoff=1.12 cfs 5,137 cf

Reach EX: Offsite Inflow=4.09 cfs 16,752 cf
Outflow=4.09 cfs 16,752 cf

Total Runoff Area = 199,811 sf Runoff Volume = 16,752 cf Average Runoff Depth = 1.01"
61.24% Pervious = 122,361 sf 38.76% Impervious = 77,450 sf

Summary for Subcatchment 5S: SMAST II

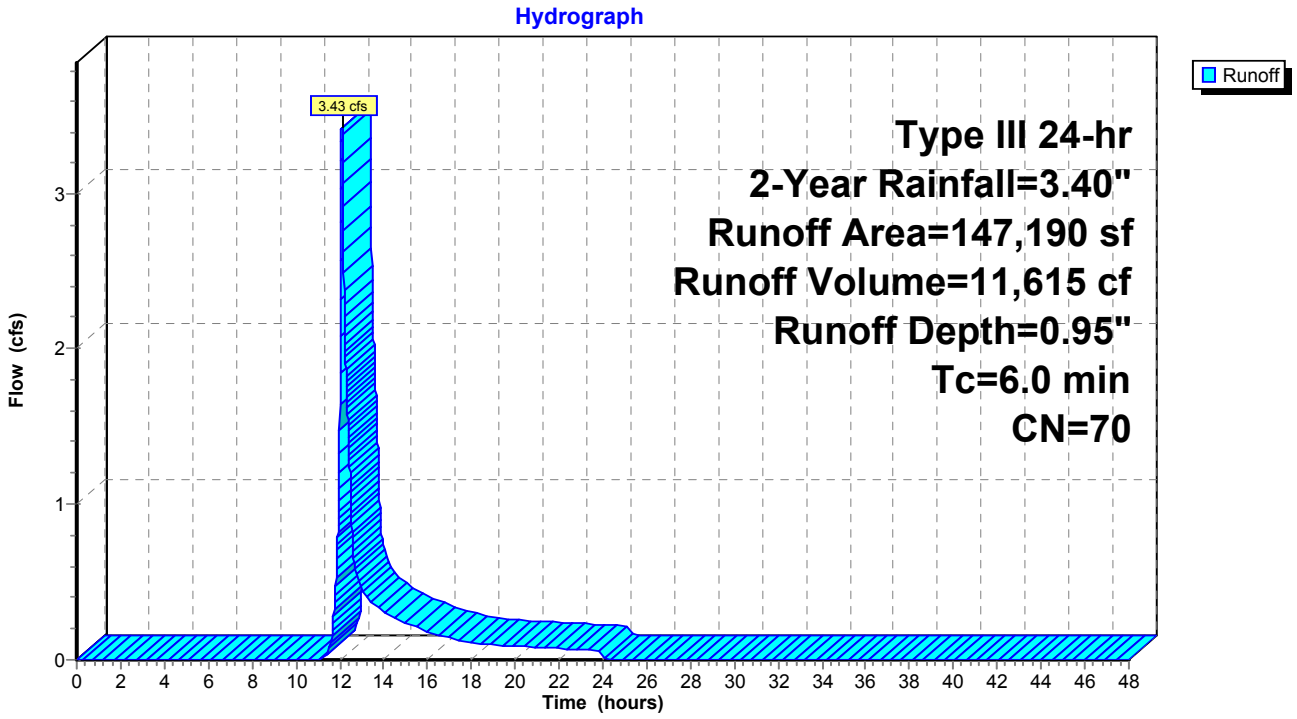
Runoff = 3.43 cfs @ 12.10 hrs, Volume= 11,615 cf, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
	33,193	49	50-75% Grass cover, Fair, HSG A
*	18,165	98	roof
*	56,410	98	impervious
	39,422	36	Woods, Fair, HSG A
	147,190	70	Weighted Average
	72,615		49.33% Pervious Area
	74,575		50.67% Impervious Area

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

Subcatchment 5S: SMAST II



Summary for Subcatchment 6S: Easement Area

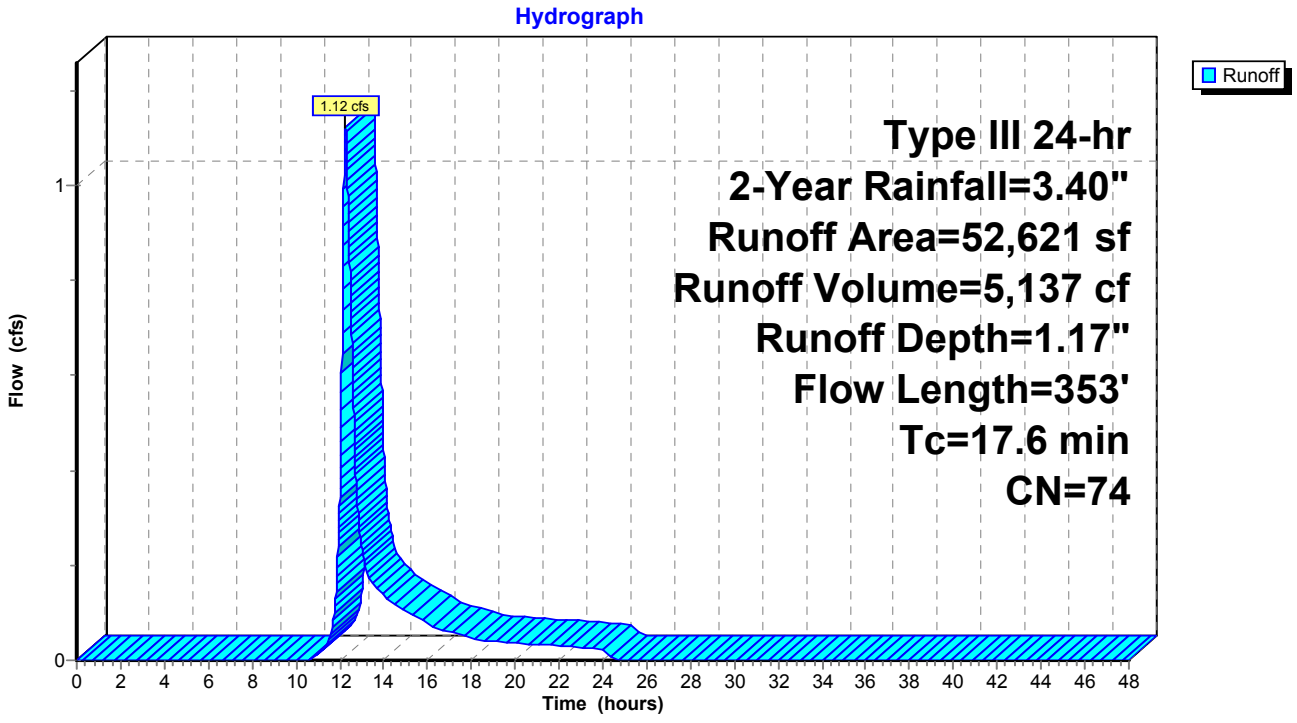
Runoff = 1.12 cfs @ 12.26 hrs, Volume= 5,137 cf, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
	49,746	73	Woods, Fair, HSG C
*	2,875	98	Pavement
	52,621	74	Weighted Average
	49,746		94.54% Pervious Area
	2,875		5.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.20"
7.1	303	0.0200	0.71		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
17.6	353	Total			

Subcatchment 6S: Easement Area



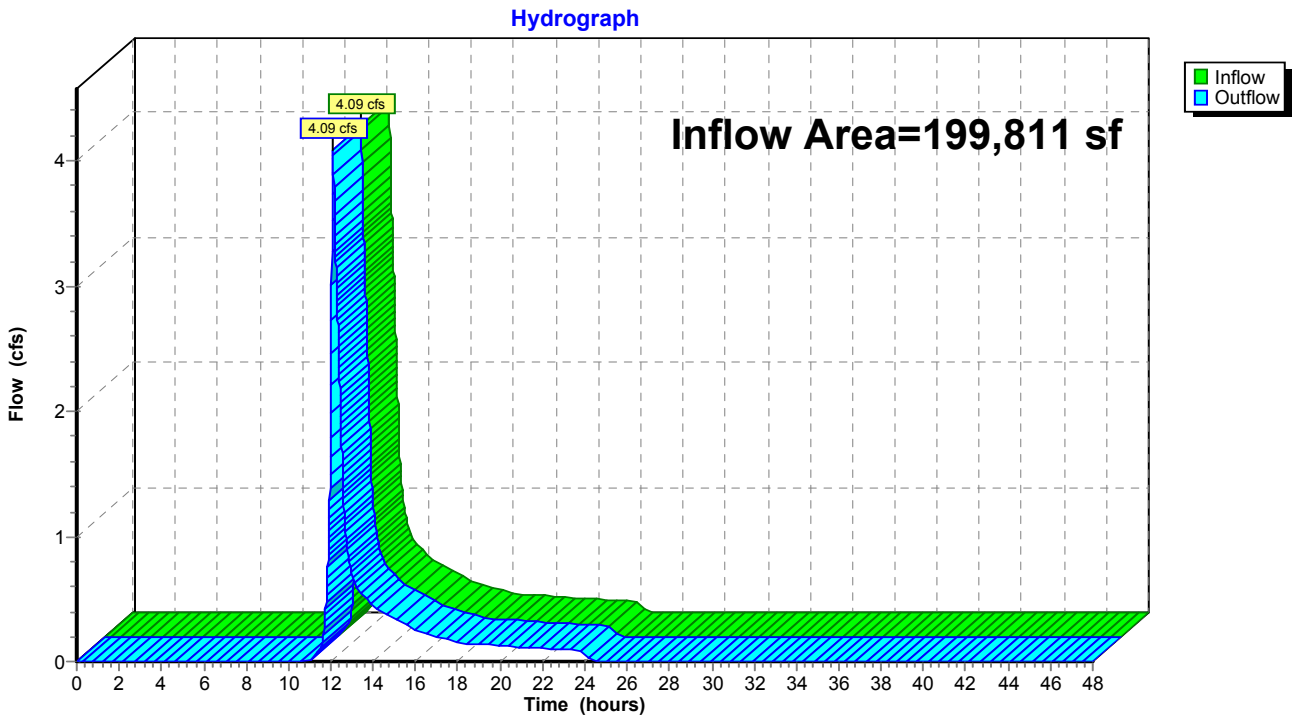
Summary for Reach EX: Offsite

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 199,811 sf, 38.76% Impervious, Inflow Depth = 1.01" for 2-Year event
Inflow = 4.09 cfs @ 12.11 hrs, Volume= 16,752 cf
Outflow = 4.09 cfs @ 12.11 hrs, Volume= 16,752 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach EX: Offsite



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment5S: SMAST II Runoff Area=147,190 sf 50.67% Impervious Runoff Depth=1.89"
Tc=6.0 min CN=70 Runoff=7.32 cfs 23,174 cf

Subcatchment6S: Easement Area Runoff Area=52,621 sf 5.46% Impervious Runoff Depth=2.21"
Flow Length=353' Tc=17.6 min CN=74 Runoff=2.20 cfs 9,673 cf

Reach EX: Offsite Inflow=8.67 cfs 32,846 cf
Outflow=8.67 cfs 32,846 cf

Total Runoff Area = 199,811 sf Runoff Volume = 32,846 cf Average Runoff Depth = 1.97"
61.24% Pervious = 122,361 sf 38.76% Impervious = 77,450 sf

Summary for Subcatchment 5S: SMAST II

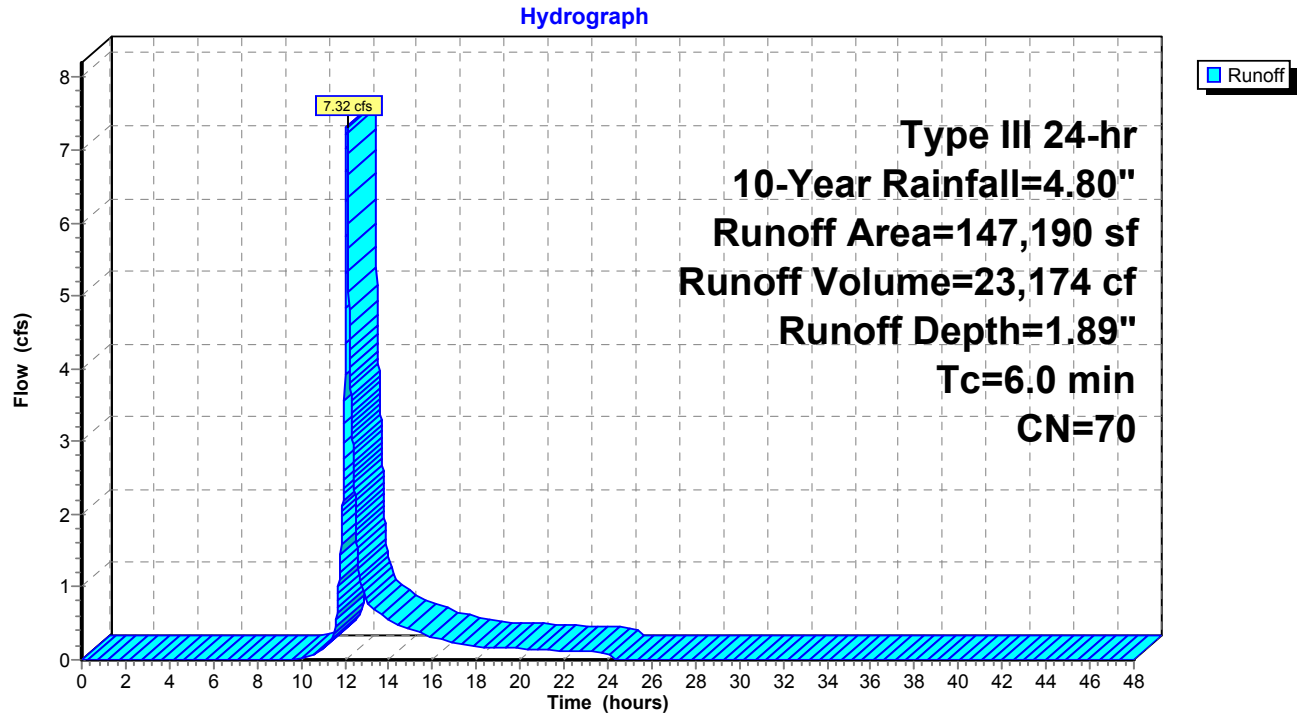
Runoff = 7.32 cfs @ 12.09 hrs, Volume= 23,174 cf, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
	33,193	49	50-75% Grass cover, Fair, HSG A
*	18,165	98	roof
*	56,410	98	impervious
	39,422	36	Woods, Fair, HSG A
	147,190	70	Weighted Average
	72,615		49.33% Pervious Area
	74,575		50.67% Impervious Area

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

Subcatchment 5S: SMAST II



Summary for Subcatchment 6S: Easement Area

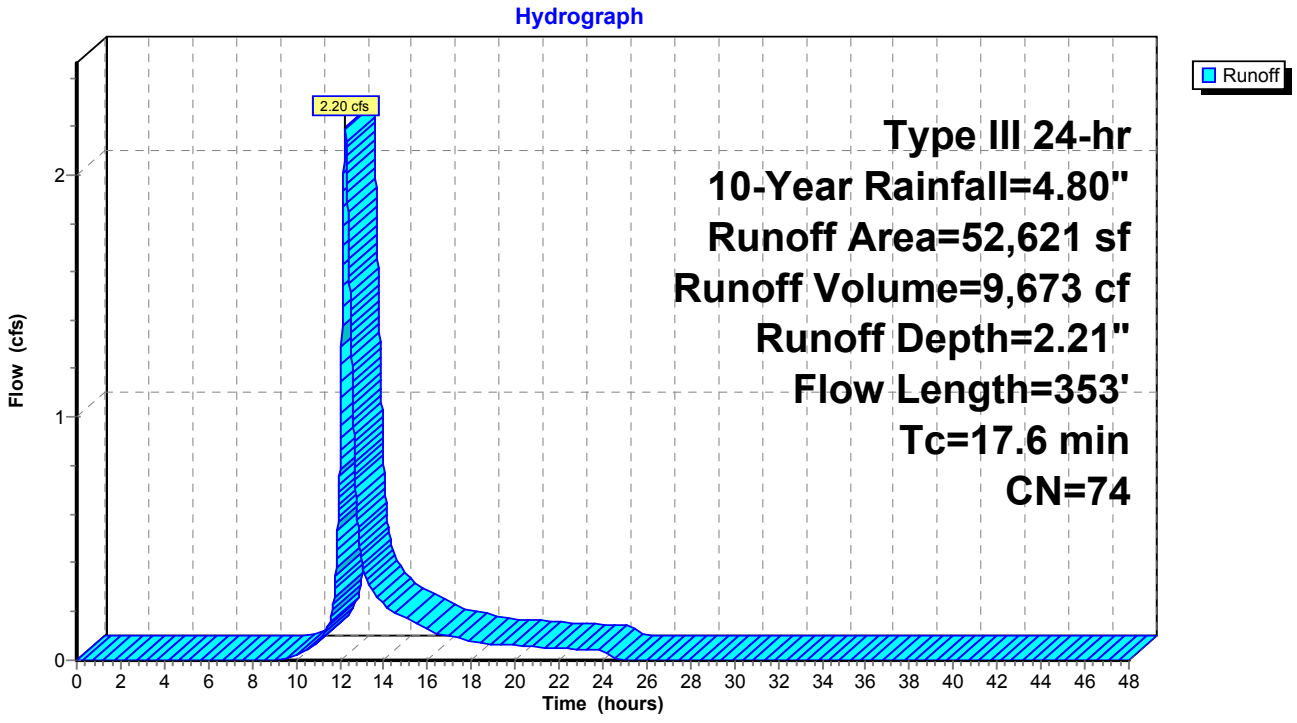
Runoff = 2.20 cfs @ 12.25 hrs, Volume= 9,673 cf, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
	49,746	73	Woods, Fair, HSG C
*	2,875	98	Pavement
	52,621	74	Weighted Average
	49,746		94.54% Pervious Area
	2,875		5.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.20"
7.1	303	0.0200	0.71		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
17.6	353	Total			

Subcatchment 6S: Easement Area



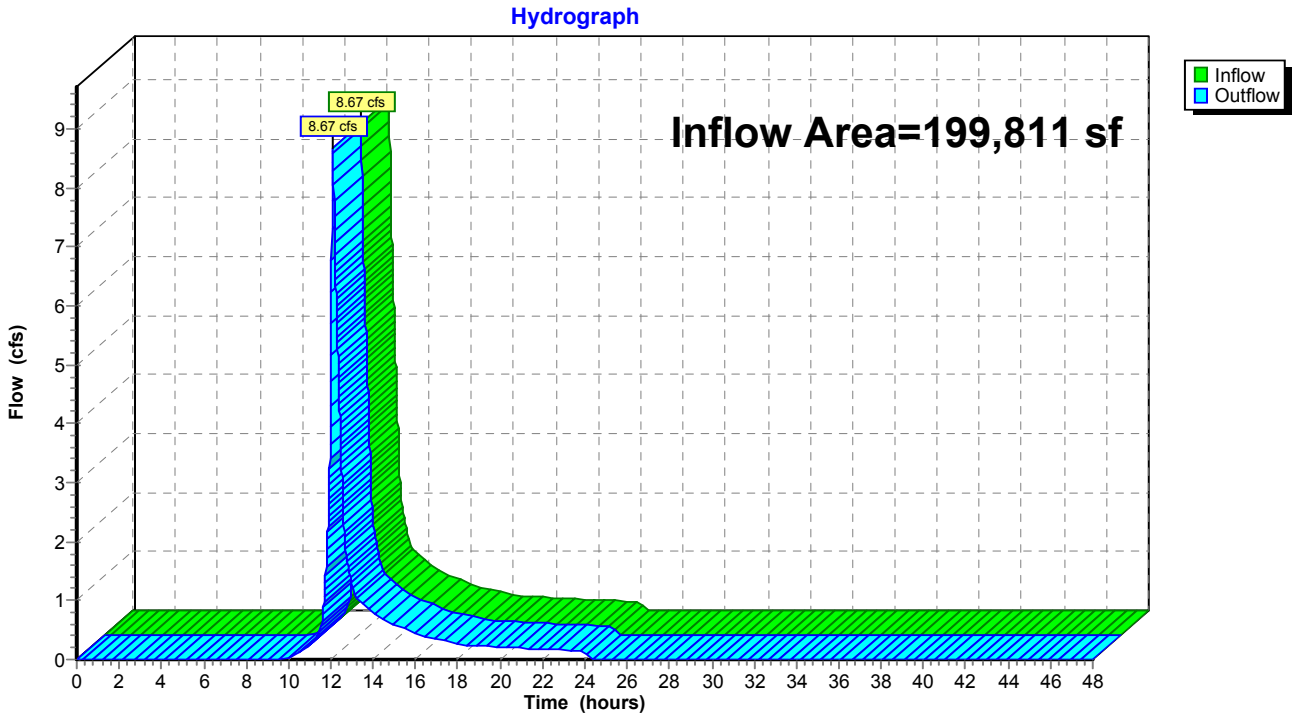
Summary for Reach EX: Offsite

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 199,811 sf, 38.76% Impervious, Inflow Depth = 1.97" for 10-Year event
Inflow = 8.67 cfs @ 12.10 hrs, Volume= 32,846 cf
Outflow = 8.67 cfs @ 12.10 hrs, Volume= 32,846 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach EX: Offsite



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment5S: SMAST II Runoff Area=147,190 sf 50.67% Impervious Runoff Depth=2.49"
Tc=6.0 min CN=70 Runoff=9.79 cfs 30,560 cf

Subcatchment6S: Easement Area Runoff Area=52,621 sf 5.46% Impervious Runoff Depth=2.85"
Flow Length=353' Tc=17.6 min CN=74 Runoff=2.86 cfs 12,504 cf

Reach EX: Offsite Inflow=11.56 cfs 43,064 cf
Outflow=11.56 cfs 43,064 cf

Total Runoff Area = 199,811 sf Runoff Volume = 43,064 cf Average Runoff Depth = 2.59"
61.24% Pervious = 122,361 sf 38.76% Impervious = 77,450 sf

Summary for Subcatchment 5S: SMAST II

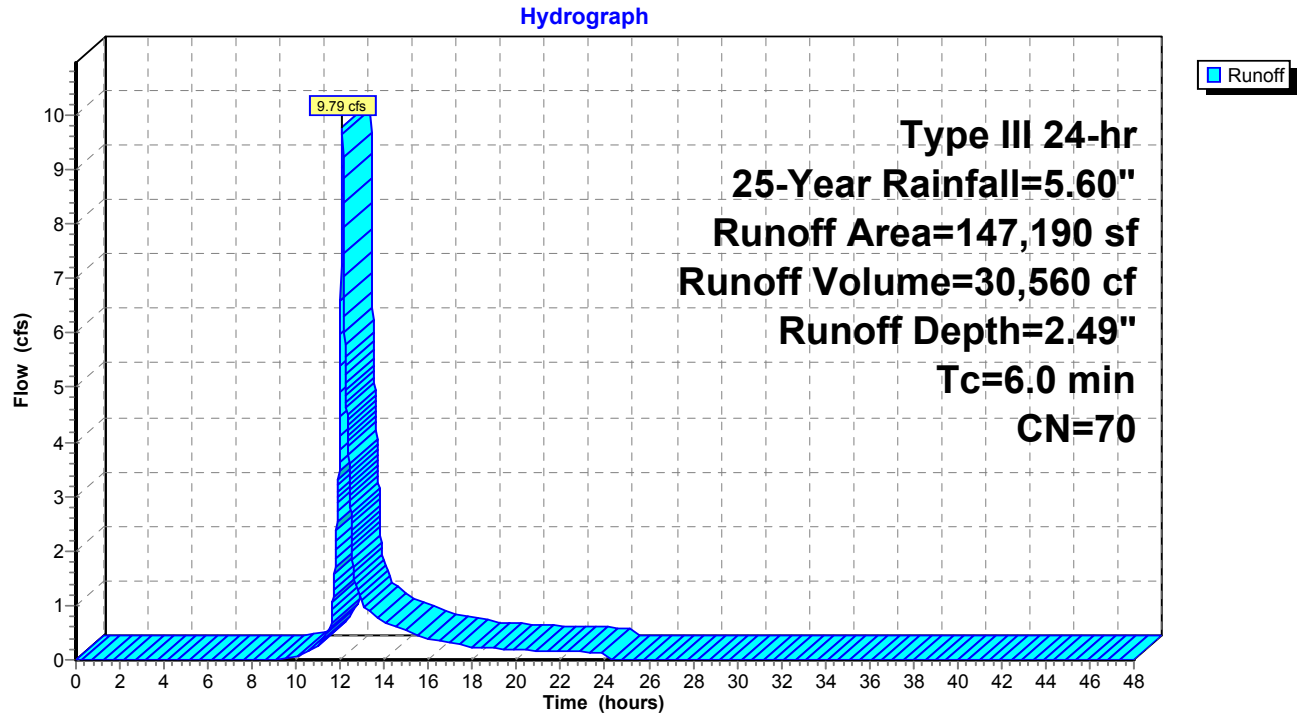
Runoff = 9.79 cfs @ 12.09 hrs, Volume= 30,560 cf, Depth= 2.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.60"

	Area (sf)	CN	Description
	33,193	49	50-75% Grass cover, Fair, HSG A
*	18,165	98	roof
*	56,410	98	impervious
	39,422	36	Woods, Fair, HSG A
	147,190	70	Weighted Average
	72,615		49.33% Pervious Area
	74,575		50.67% Impervious Area

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

Subcatchment 5S: SMAST II



Summary for Subcatchment 6S: Easement Area

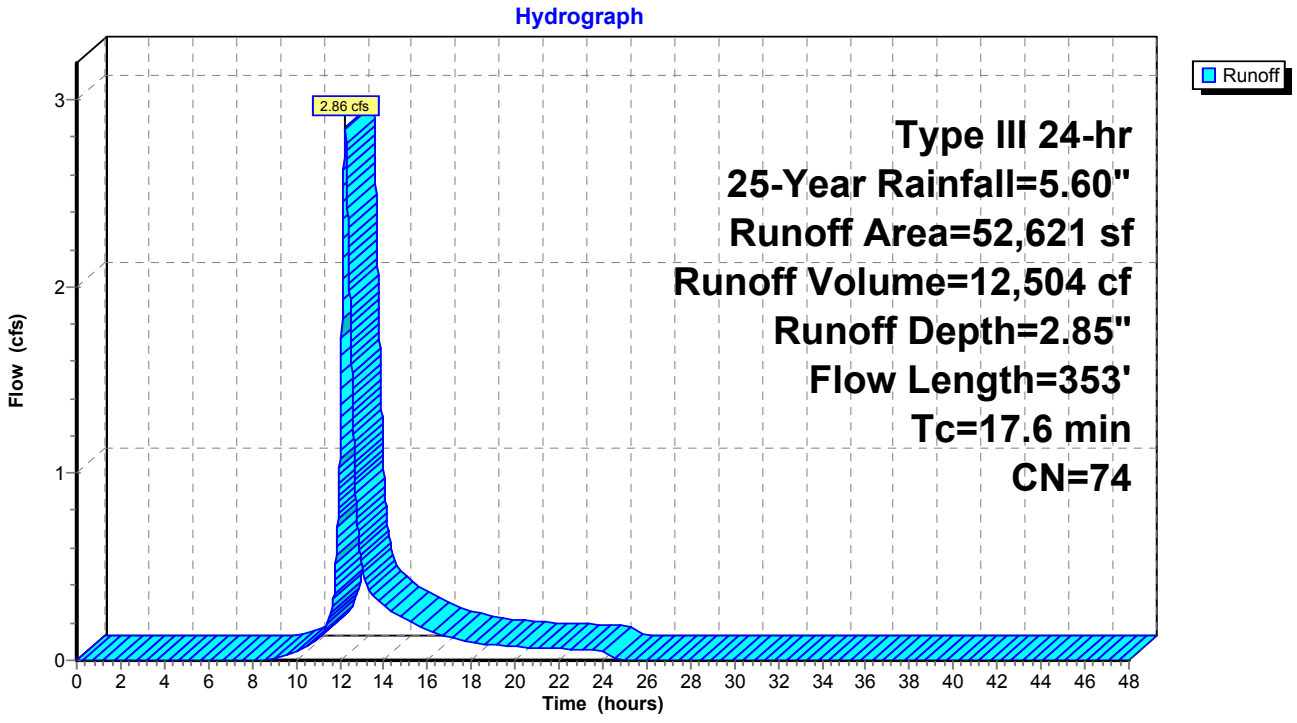
Runoff = 2.86 cfs @ 12.24 hrs, Volume= 12,504 cf, Depth= 2.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.60"

	Area (sf)	CN	Description
	49,746	73	Woods, Fair, HSG C
*	2,875	98	Pavement
	52,621	74	Weighted Average
	49,746		94.54% Pervious Area
	2,875		5.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.20"
7.1	303	0.0200	0.71		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
17.6	353	Total			

Subcatchment 6S: Easement Area



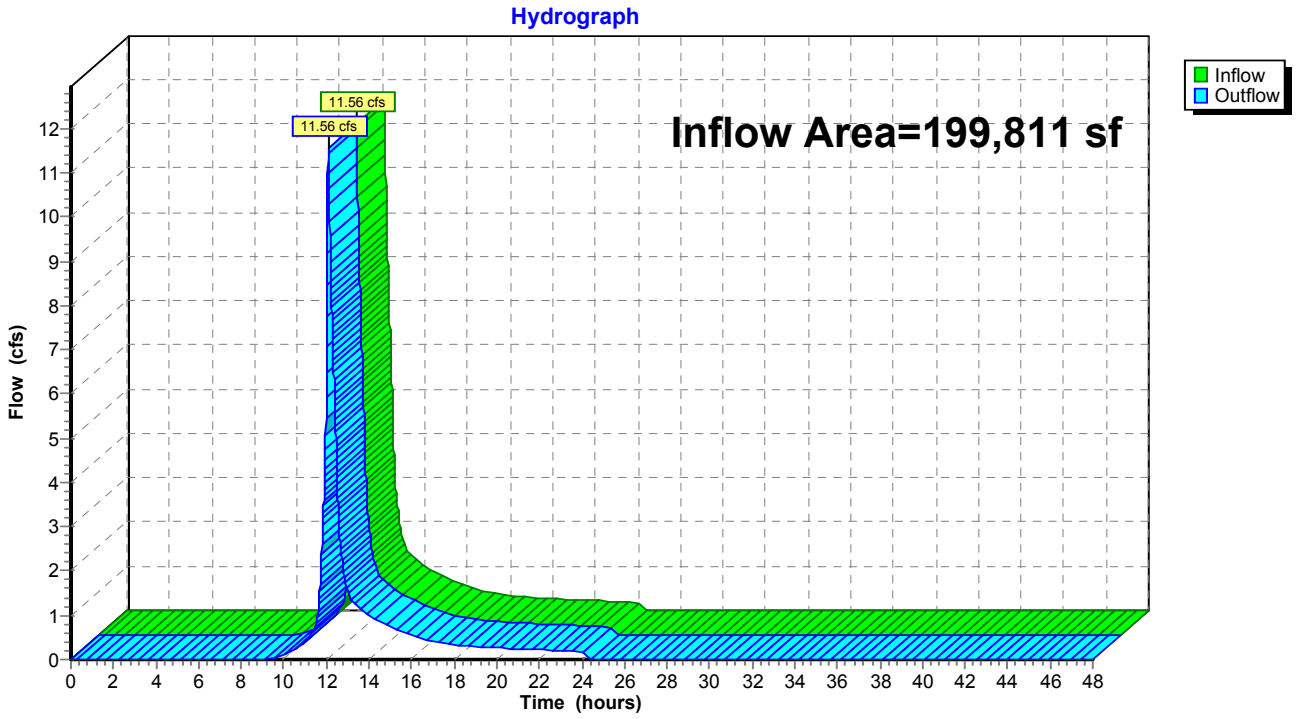
Summary for Reach EX: Offsite

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 199,811 sf, 38.76% Impervious, Inflow Depth = 2.59" for 25-Year event
Inflow = 11.56 cfs @ 12.10 hrs, Volume= 43,064 cf
Outflow = 11.56 cfs @ 12.10 hrs, Volume= 43,064 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach EX: Offsite



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment5S: SMAST II Runoff Area=147,190 sf 50.67% Impervious Runoff Depth=3.62"
Tc=6.0 min CN=70 Runoff=14.33 cfs 44,383 cf

Subcatchment6S: Easement Area Runoff Area=52,621 sf 5.46% Impervious Runoff Depth=4.04"
Flow Length=353' Tc=17.6 min CN=74 Runoff=4.07 cfs 17,725 cf

Reach EX: Offsite Inflow=16.90 cfs 62,107 cf
Outflow=16.90 cfs 62,107 cf

Total Runoff Area = 199,811 sf Runoff Volume = 62,107 cf Average Runoff Depth = 3.73"
61.24% Pervious = 122,361 sf 38.76% Impervious = 77,450 sf

Summary for Subcatchment 5S: SMAST II

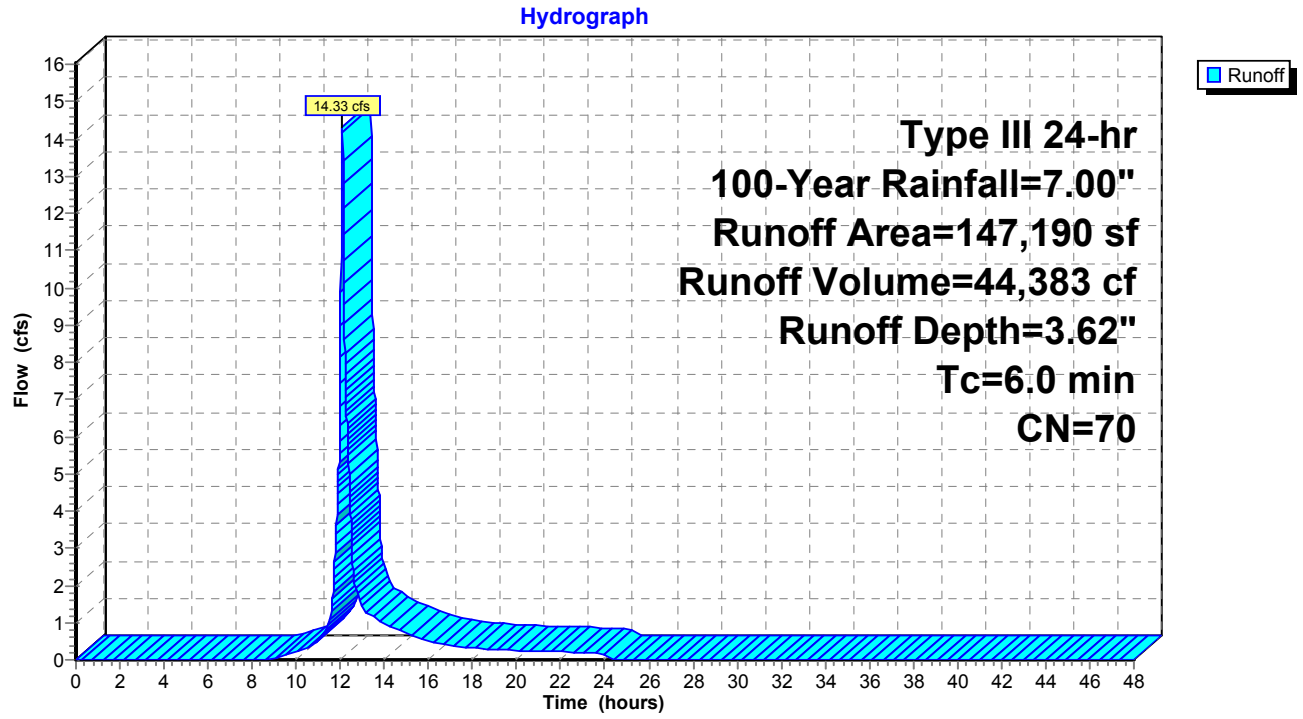
Runoff = 14.33 cfs @ 12.09 hrs, Volume= 44,383 cf, Depth= 3.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.00"

	Area (sf)	CN	Description
	33,193	49	50-75% Grass cover, Fair, HSG A
*	18,165	98	roof
*	56,410	98	impervious
	39,422	36	Woods, Fair, HSG A
	147,190	70	Weighted Average
	72,615		49.33% Pervious Area
	74,575		50.67% Impervious Area

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

Subcatchment 5S: SMAST II



Summary for Subcatchment 6S: Easement Area

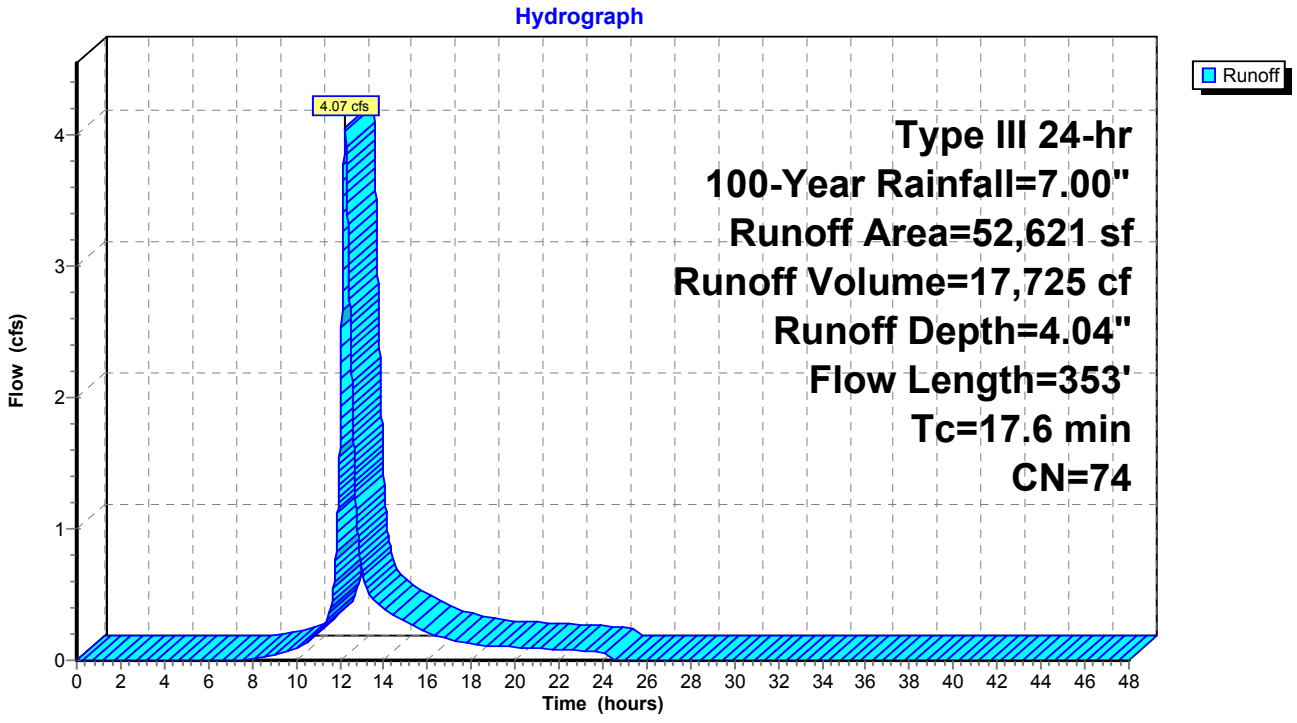
Runoff = 4.07 cfs @ 12.24 hrs, Volume= 17,725 cf, Depth= 4.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.00"

	Area (sf)	CN	Description
	49,746	73	Woods, Fair, HSG C
*	2,875	98	Pavement
	52,621	74	Weighted Average
	49,746		94.54% Pervious Area
	2,875		5.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.5	50	0.0300	0.08		**Sheet Flow, Sheet Flow** Woods: Light underbrush n= 0.400 P2= 3.20"
7.1	303	0.0200	0.71		**Shallow Concentrated Flow, Shallow Concentrated Flow** Woodland Kv= 5.0 fps
17.6	353	Total			

Subcatchment 6S: Easement Area



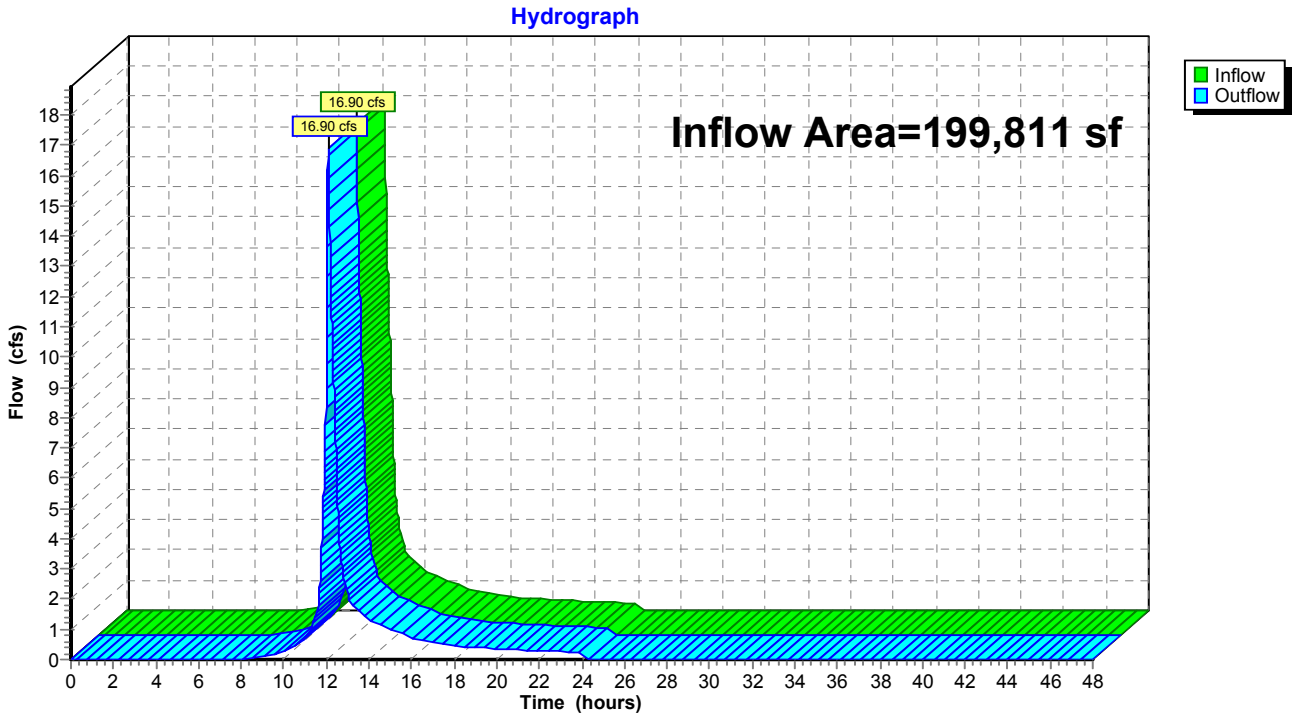
Summary for Reach EX: Offsite

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 199,811 sf, 38.76% Impervious, Inflow Depth = 3.73" for 100-Year event
Inflow = 16.90 cfs @ 12.10 hrs, Volume= 62,107 cf
Outflow = 16.90 cfs @ 12.10 hrs, Volume= 62,107 cf, Atten= 0%, Lag= 0.0 min

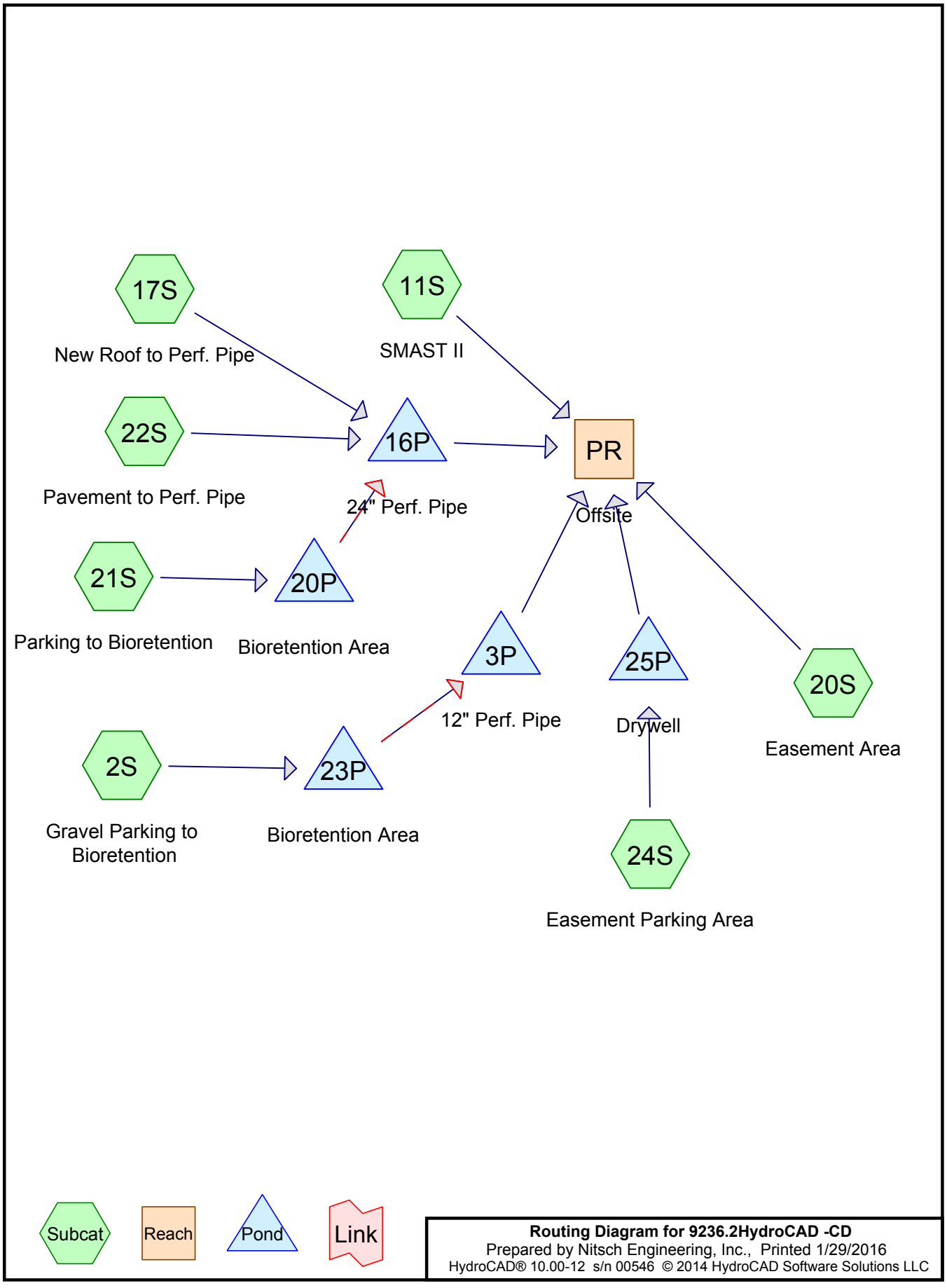
Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach EX: Offsite



APPENDIX C

Post-Development Conditions – HydroCAD Calculations



Routing Diagram for 9236.2HydroCAD -CD
Prepared by Nitsch Engineering, Inc., Printed 1/29/2016

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
34,630	49	50-75% Grass cover, Fair, HSG A (11S)
42,341	76	Gravel roads, HSG A (2S, 11S, 20S)
35,545	36	Woods, Fair, HSG A (20S)
13,024	30	Woods, Good, HSG A (11S)
19,339	98	impervious (11S, 20S)
15,000	98	parking (21S)
8,031	98	pavement (22S, 24S)
31,901	98	roof (11S, 17S)
199,811	**69**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
125,540	HSG A	2S, 11S, 20S
0	HSG B	
0	HSG C	
0	HSG D	
74,271	Other	11S, 17S, 20S, 21S, 22S, 24S
199,811		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Su Nu
34,630	0	0	0	0	34,630	50-75% Grass cover, Fair	
42,341	0	0	0	0	42,341	Gravel roads	
35,545	0	0	0	0	35,545	Woods, Fair	
13,024	0	0	0	0	13,024	Woods, Good	
0	0	0	0	19,339	19,339	impervious	
0	0	0	0	15,000	15,000	parking	
0	0	0	0	8,031	8,031	pavement	
0	0	0	0	31,901	31,901	roof	
125,540	**0**	**0**	**0**	**74,271**	**199,811**	**TOTAL AREA**	

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	3P	11.10	11.00	50.0	0.0020	0.013	12.0	0.0	0.0
2	16P	14.00	13.80	18.0	0.0111	0.013	12.0	0.0	0.0

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2S: Gravel Parking to Runoff Area=13,155 sf 0.00% Impervious Runoff Depth=1.29"
Tc=6.0 min CN=76 Runoff=0.45 cfs 1,418 cf

Subcatchment11S: SMAST II Runoff Area=101,928 sf 33.20% Impervious Runoff Depth=0.84"
Tc=6.0 min CN=68 Runoff=2.04 cfs 7,168 cf

Subcatchment17S: New Roof to Perf. Runoff Area=15,000 sf 100.00% Impervious Runoff Depth=3.17"
Tc=6.0 min CN=98 Runoff=1.14 cfs 3,958 cf

Subcatchment20S: Easement Area Runoff Area=46,697 sf 5.13% Impervious Runoff Depth=0.11"
Tc=6.0 min CN=47 Runoff=0.02 cfs 410 cf

Subcatchment21S: Parking to Runoff Area=15,000 sf 100.00% Impervious Runoff Depth=3.17"
Tc=6.0 min CN=98 Runoff=1.14 cfs 3,958 cf

Subcatchment22S: Pavement to Perf. Pipe Runoff Area=2,150 sf 100.00% Impervious Runoff Depth=3.17"
Tc=6.0 min CN=98 Runoff=0.16 cfs 567 cf

Subcatchment24S: Easement Parking Runoff Area=5,881 sf 100.00% Impervious Runoff Depth=3.17"
Tc=6.0 min CN=98 Runoff=0.45 cfs 1,552 cf

Reach PR: Offsite Inflow=3.93 cfs 11,700 cf
Outflow=3.93 cfs 11,700 cf

Pond 3P: 12" Perf. Pipe Peak Elev=13.02' Storage=442 cf Inflow=0.44 cfs 1,418 cf
Discarded=0.03 cfs 1,352 cf Primary=0.02 cfs 66 cf Outflow=0.05 cfs 1,418 cf

Pond 16P: 24" Perf. Pipe Peak Elev=14.91' Storage=1,228 cf Inflow=2.32 cfs 8,484 cf
Discarded=0.11 cfs 5,521 cf Primary=1.71 cfs 2,964 cf Outflow=1.82 cfs 8,484 cf

Pond 20P: Bioretention Area Peak Elev=20.63' Storage=759 cf Inflow=1.14 cfs 3,958 cf
Primary=0.07 cfs 2,676 cf Secondary=0.99 cfs 1,283 cf Outflow=1.06 cfs 3,958 cf

Pond 23P: Bioretention Area Peak Elev=17.78' Storage=157 cf Inflow=0.45 cfs 1,418 cf
Primary=0.04 cfs 980 cf Secondary=0.40 cfs 438 cf Outflow=0.44 cfs 1,418 cf

Pond 25P: Drywell Peak Elev=22.04' Storage=243 cf Inflow=0.45 cfs 1,552 cf
Discarded=0.00 cfs 459 cf Primary=0.44 cfs 1,092 cf Outflow=0.45 cfs 1,551 cf

Total Runoff Area = 199,811 sf Runoff Volume = 19,032 cf Average Runoff Depth = 1.14"
62.83% Pervious = 125,540 sf 37.17% Impervious = 74,271 sf

Summary for Subcatchment 2S: Gravel Parking to Bioretention

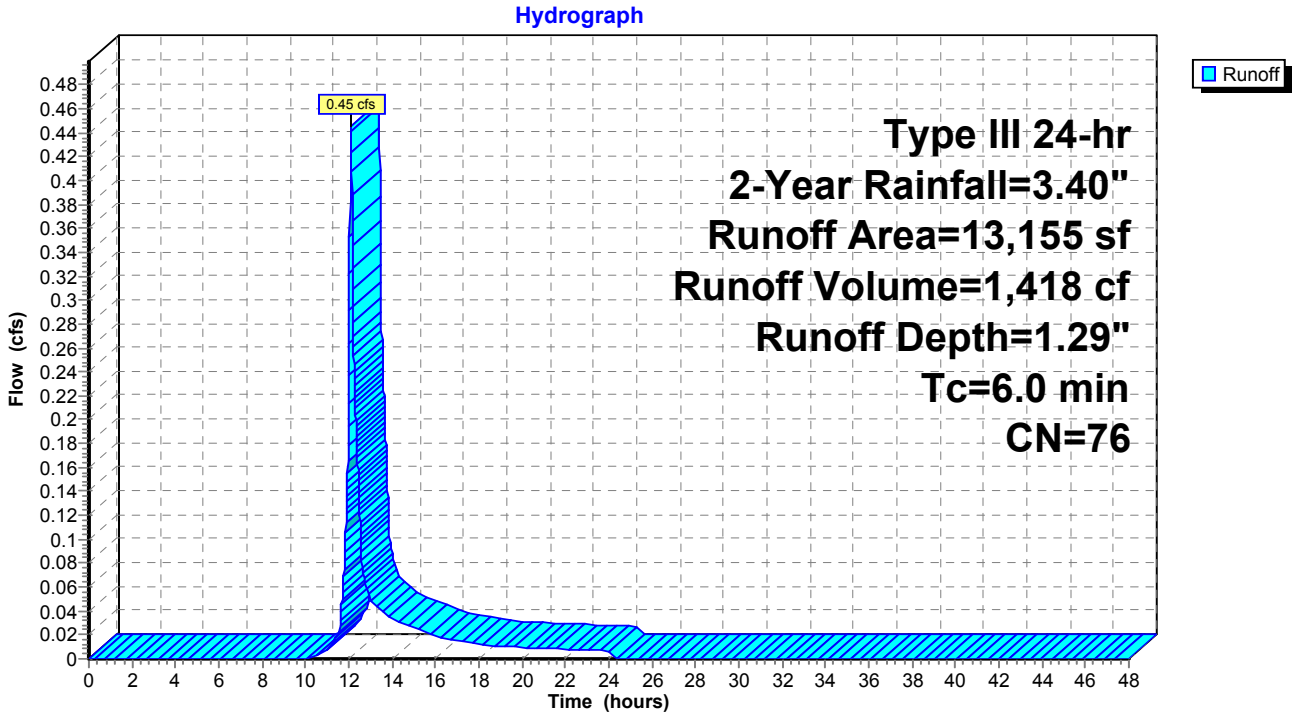
Runoff = 0.45 cfs @ 12.09 hrs, Volume= 1,418 cf, Depth= 1.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

Area (sf)	CN	Description
13,155	76	Gravel roads, HSG A
13,155		100.00% Pervious Area

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

Subcatchment 2S: Gravel Parking to Bioretention



Summary for Subcatchment 11S: SMAST II

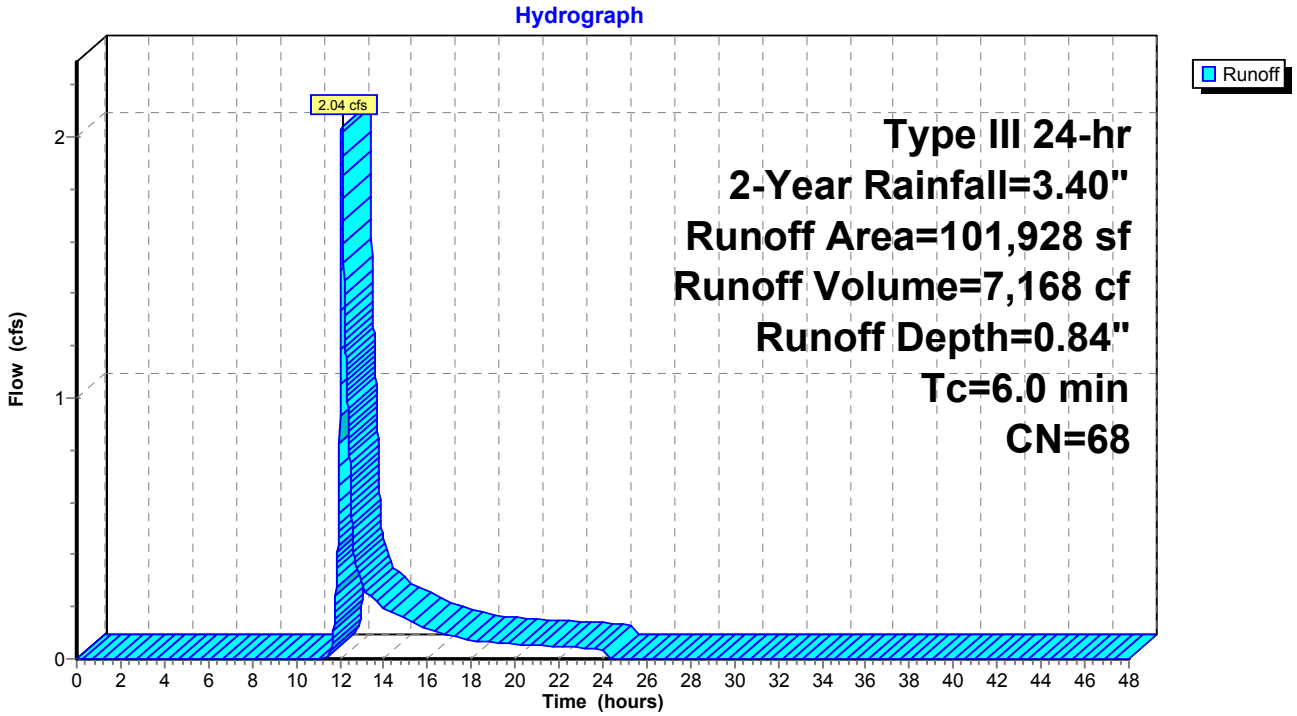
Runoff = 2.04 cfs @ 12.10 hrs, Volume= 7,168 cf, Depth= 0.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
	34,630	49	50-75% Grass cover, Fair, HSG A
	16,771	76	Gravel roads, HSG A
*	16,943	98	impervious
*	16,901	98	roof
	13,024	30	Woods, Good, HSG A
	3,659	76	Gravel roads, HSG A
	101,928	68	Weighted Average
	68,084		66.80% Pervious Area
	33,844		33.20% Impervious Area

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

Subcatchment 11S: SMAST II



Summary for Subcatchment 17S: New Roof to Perf. Pipe

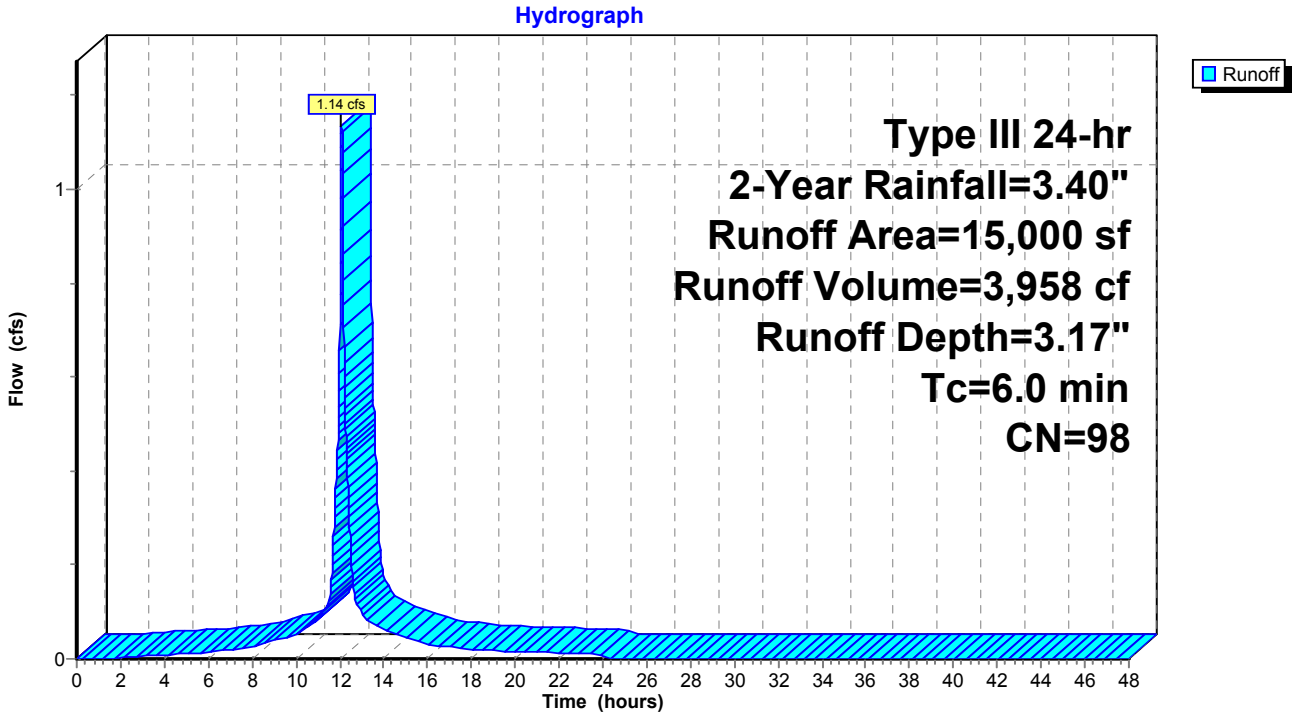
Runoff = 1.14 cfs @ 12.08 hrs, Volume= 3,958 cf, Depth= 3.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	15,000	98	roof
	15,000		100.00% Impervious Area

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

Subcatchment 17S: New Roof to Perf. Pipe



Summary for Subcatchment 20S: Easement Area

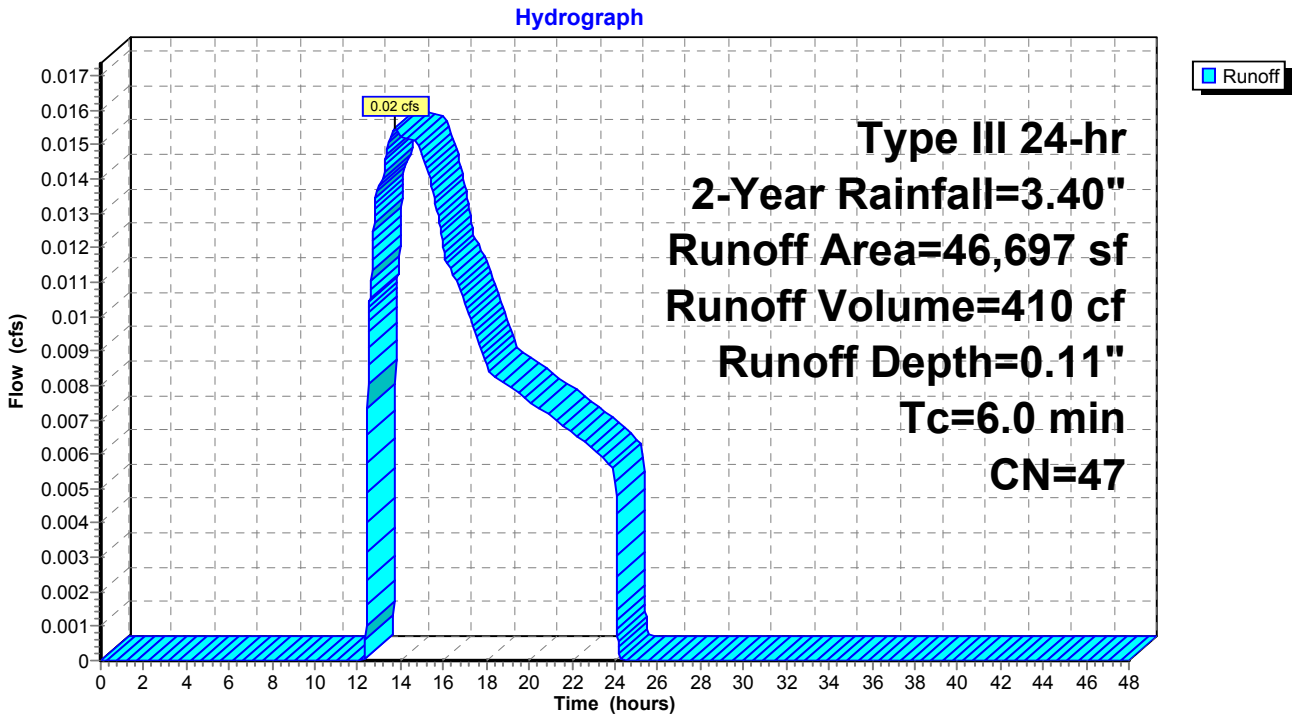
Runoff = 0.02 cfs @ 13.74 hrs, Volume= 410 cf, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	2,396	98	impervious
	35,545	36	Woods, Fair, HSG A
	8,756	76	Gravel roads, HSG A
	46,697	47	Weighted Average
	44,301		94.87% Pervious Area
	2,396		5.13% Impervious Area

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

Subcatchment 20S: Easement Area



Summary for Subcatchment 21S: Parking to Bioretention

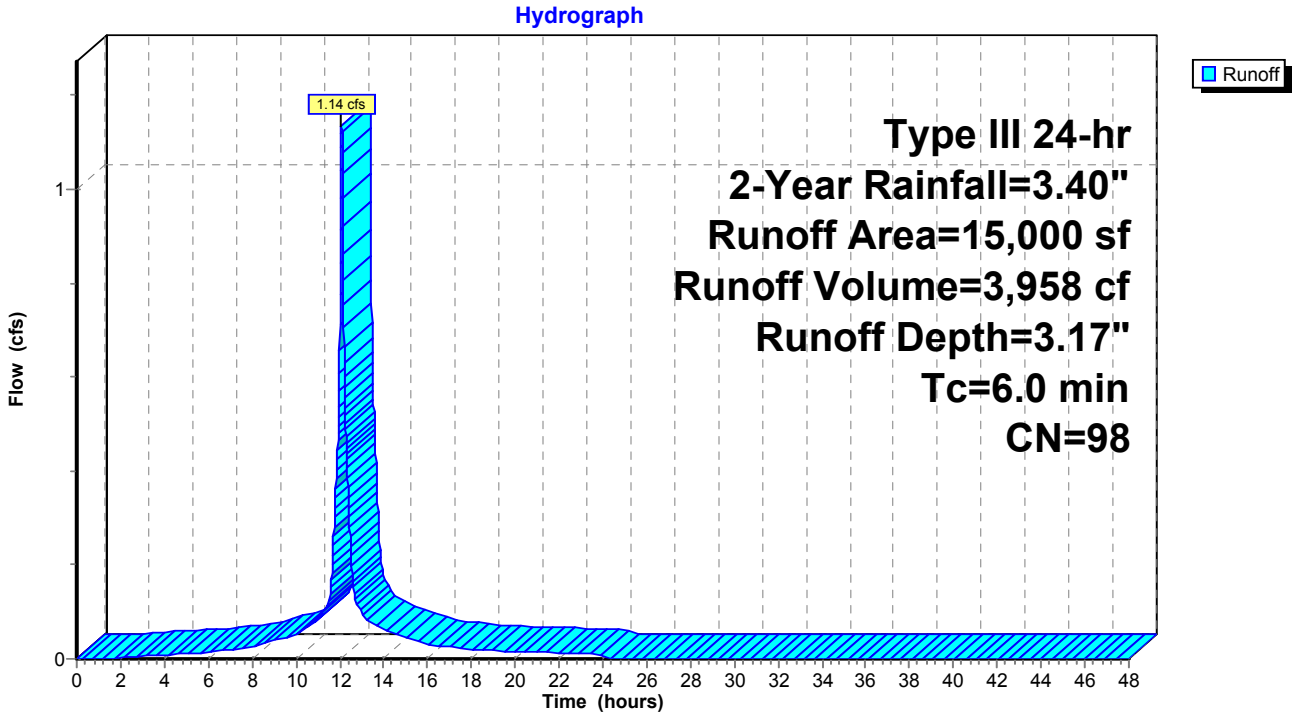
Runoff = 1.14 cfs @ 12.08 hrs, Volume= 3,958 cf, Depth= 3.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	15,000	98	parking
	15,000		100.00% Impervious Area

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

Subcatchment 21S: Parking to Bioretention



Summary for Subcatchment 22S: Pavement to Perf. Pipe

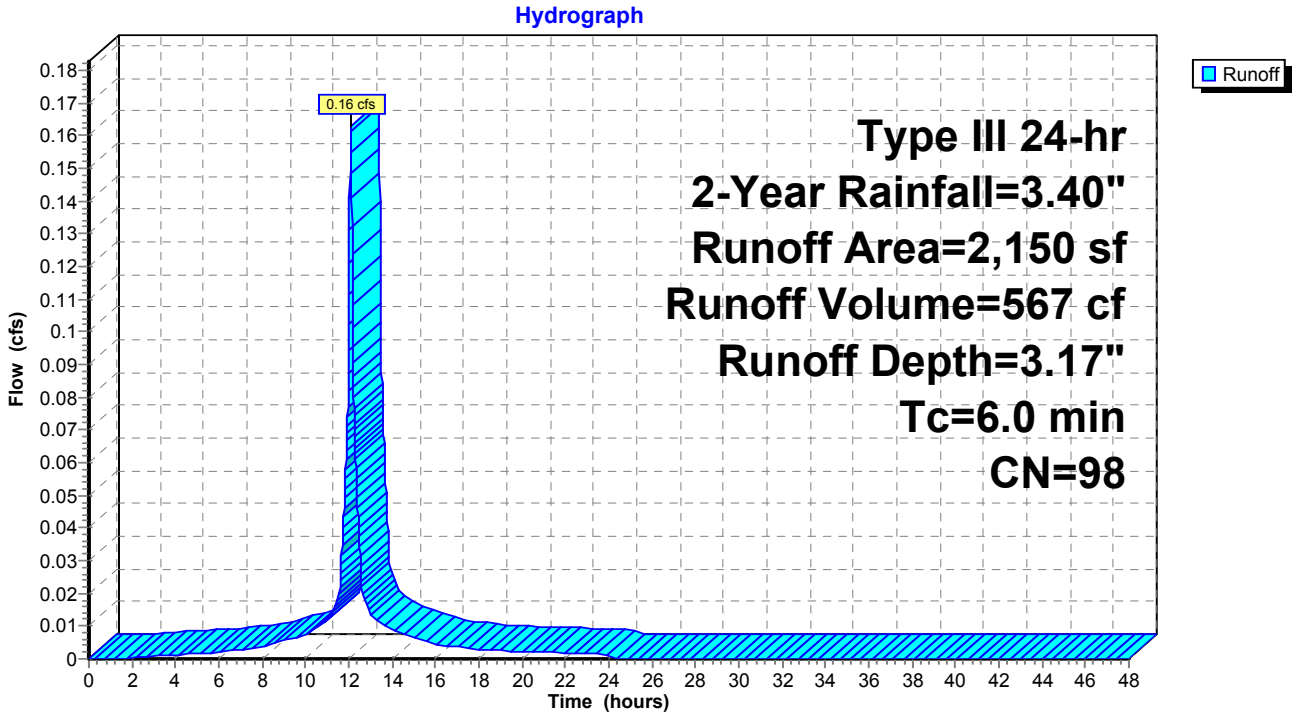
Runoff = 0.16 cfs @ 12.08 hrs, Volume= 567 cf, Depth= 3.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	2,150	98	pavement
	2,150		100.00% Impervious Area

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

Subcatchment 22S: Pavement to Perf. Pipe



Summary for Subcatchment 24S: Easement Parking Area

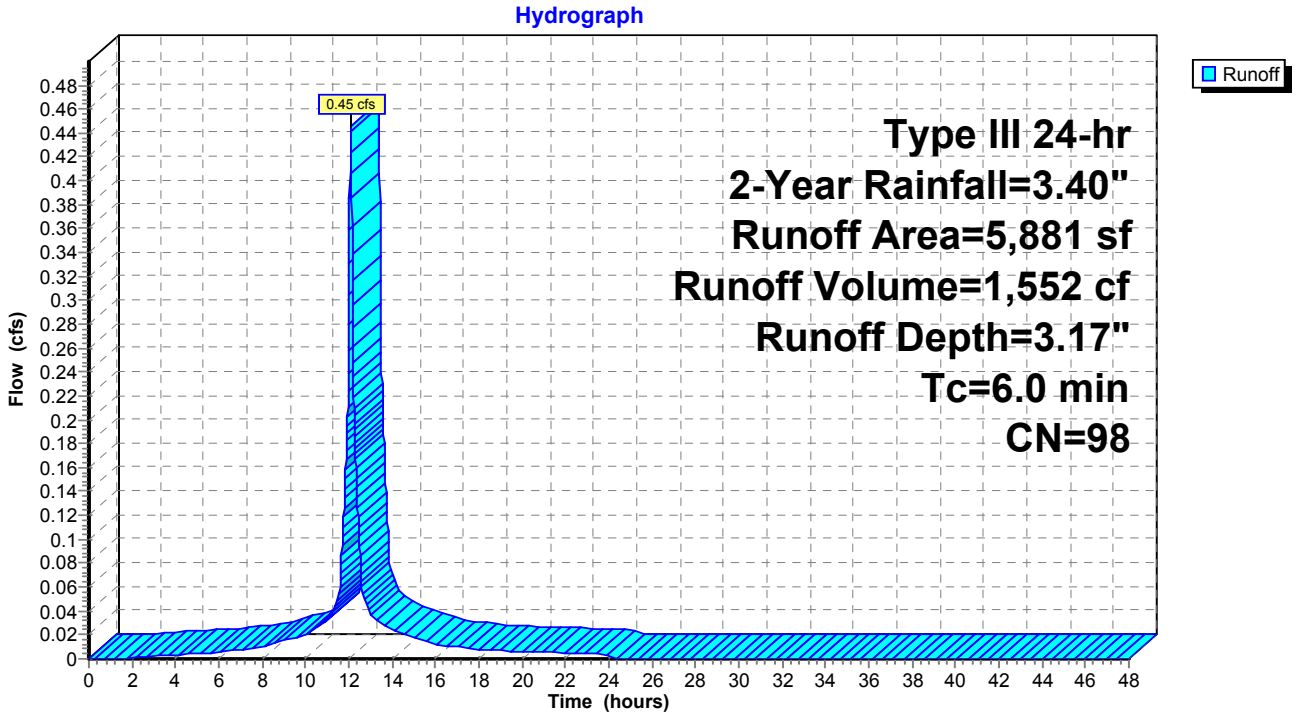
Runoff = 0.45 cfs @ 12.08 hrs, Volume= 1,552 cf, Depth= 3.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.40"

	Area (sf)	CN	Description
*	5,881	98	pavement
	5,881		100.00% Impervious Area

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

Subcatchment 24S: Easement Parking Area



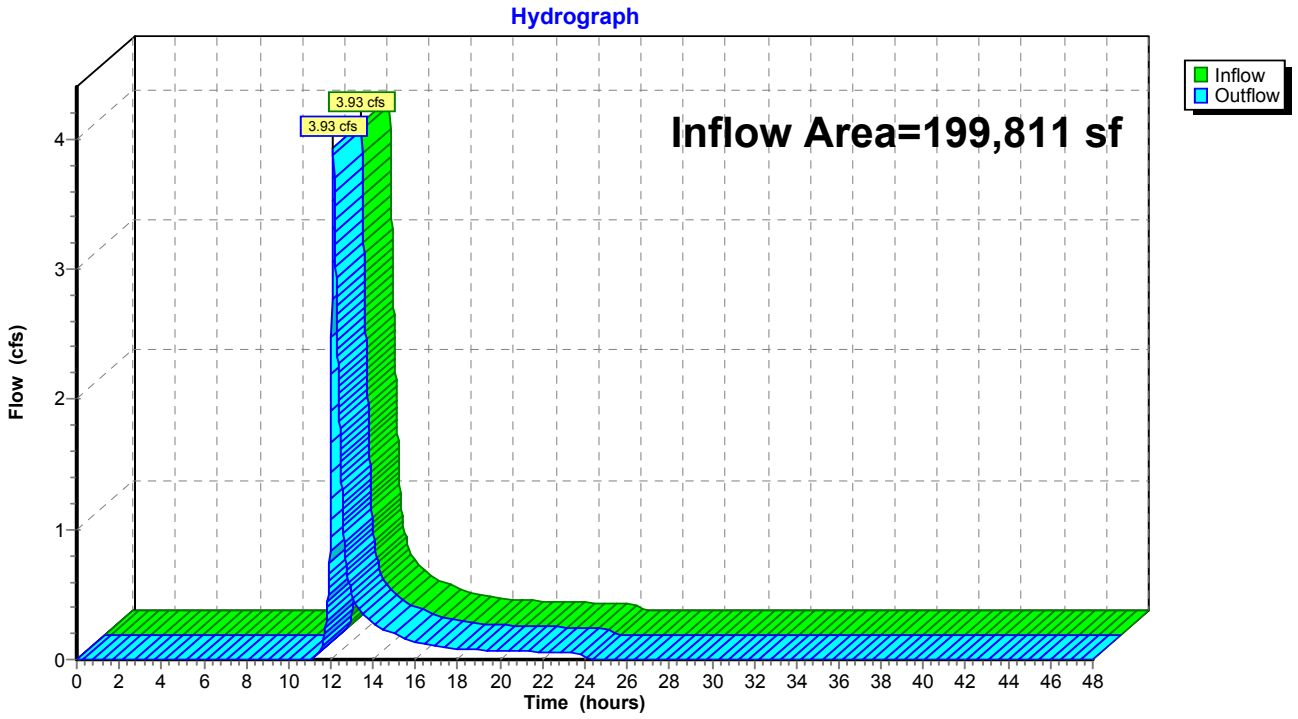
Summary for Reach PR: Offsite

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 199,811 sf, 37.17% Impervious, Inflow Depth = 0.70" for 2-Year event
Inflow = 3.93 cfs @ 12.12 hrs, Volume= 11,700 cf
Outflow = 3.93 cfs @ 12.12 hrs, Volume= 11,700 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PR: Offsite



Summary for Pond 3P: 12" Perf. Pipe

Inflow Area = 13,155 sf, 0.00% Impervious, Inflow Depth = 1.29" for 2-Year event
Inflow = 0.44 cfs @ 12.11 hrs, Volume= 1,418 cf
Outflow = 0.05 cfs @ 12.98 hrs, Volume= 1,418 cf, Atten= 88%, Lag= 52.5 min
Discarded = 0.03 cfs @ 12.01 hrs, Volume= 1,352 cf
Primary = 0.02 cfs @ 12.98 hrs, Volume= 66 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 13.02' @ 12.98 hrs Surf.Area= 584 sf Storage= 442 cf

Plug-Flow detention time= 141.9 min calculated for 1,418 cf (100% of inflow)
Center-of-Mass det. time= 141.9 min (1,017.6 - 875.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	11.25'	386 cf	**3.21'W x 182.00'L x 2.21'H Field A** 1,290 cf Overall - 188 cf Embedded = 1,102 cf x 35.0% Voids
#2A	11.75'	146 cf	**ADS N-12 12** x 9 Inside #1 Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf
		531 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	11.25'	**2.410 in/hr Exfiltration over Surface area**
#2	Device 3	13.00'	**2.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Primary	11.10'	**12.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 11.10' / 11.00' S= 0.0020 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.03 cfs @ 12.01 hrs HW=11.27' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.02 cfs @ 12.98 hrs HW=13.02' (Free Discharge)
└**3=Culvert** (Passes 0.02 cfs of 3.42 cfs potential flow)
└**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.02 cfs @ 0.48 fps)

Pond 3P: 12" Perf. Pipe - Chamber Wizard Field A

Chamber Model = ADS N-12 12 (ADS N-12® Pipe)
Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf
Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf

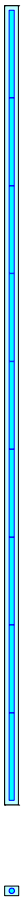
9 Chambers/Row x 20.00' Long = 180.00' Row Length +12.0" End Stone x 2 = 182.00' Base Length
1 Rows x 14.5" Wide + 12.0" Side Stone x 2 = 3.21' Base Width
6.0" Base + 14.5" Chamber Height + 6.0" Cover = 2.21' Field Height

9 Chambers x 16.2 cf = 145.8 cf Chamber Storage
9 Chambers x 20.9 cf = 188.4 cf Displacement

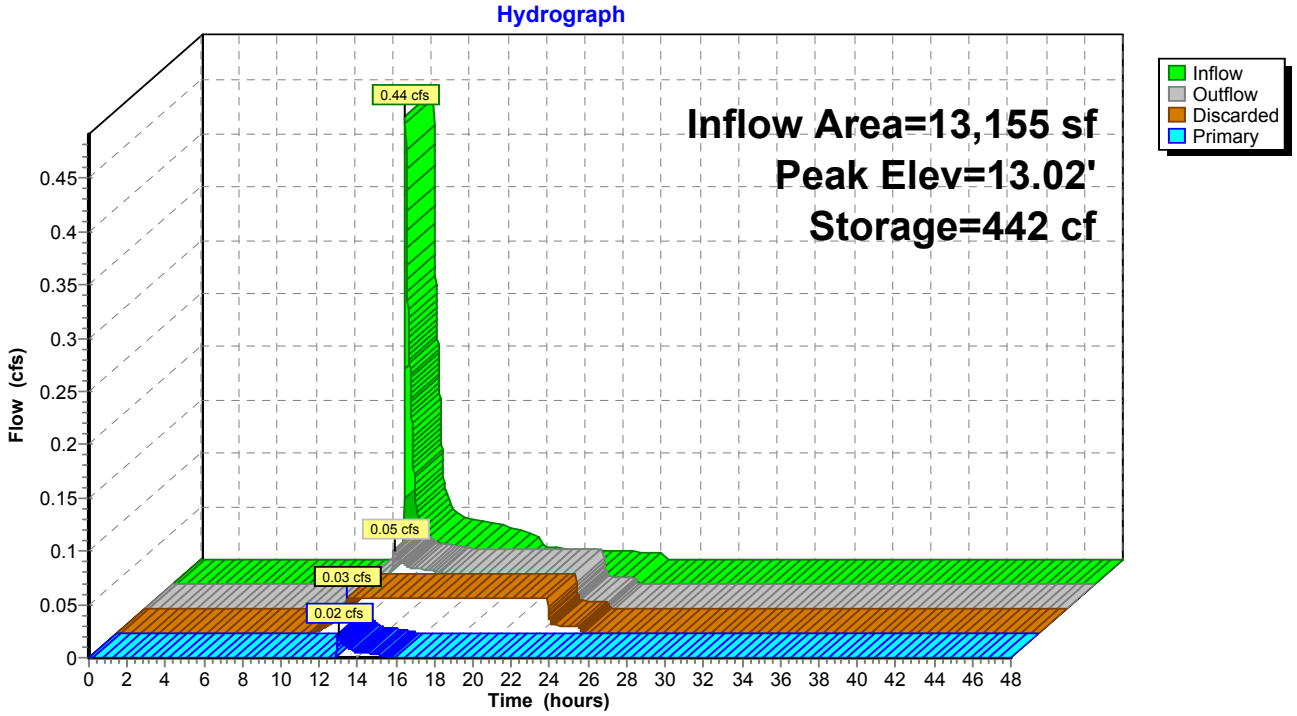
1,290.0 cf Field - 188.4 cf Chambers = 1,101.6 cf Stone x 35.0% Voids = 385.6 cf Stone Storage

Chamber Storage + Stone Storage = 531.4 cf = 0.012 af
Overall Storage Efficiency = 41.2%

9 Chambers
47.8 cy Field
40.8 cy Stone



Pond 3P: 12" Perf. Pipe



Summary for Pond 16P: 24" Perf. Pipe

Inflow Area = 32,150 sf,100.00% Impervious, Inflow Depth = 3.17" for 2-Year event
Inflow = 2.32 cfs @ 12.10 hrs, Volume= 8,484 cf
Outflow = 1.82 cfs @ 12.17 hrs, Volume= 8,484 cf, Atten= 22%, Lag= 4.1 min
Discarded = 0.11 cfs @ 10.53 hrs, Volume= 5,521 cf
Primary = 1.71 cfs @ 12.17 hrs, Volume= 2,964 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 14.91' @ 12.17 hrs Surf.Area= 1,998 sf Storage= 1,228 cf

Plug-Flow detention time= 31.7 min calculated for 8,484 cf (100% of inflow)
Center-of-Mass det. time= 31.7 min (815.4 - 783.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	13.50'	2,319 cf	**9.00'W x 222.00'L x 3.33'H Field A** 6,660 cf Overall - 863 cf Embedded = 5,797 cf x 40.0% Voids
#2A	14.00'	682 cf	**ADS N-12 24** x 11 Inside #1 Inside= 23.8"W x 23.8"H => 3.10 sf x 20.00'L = 62.0 cf Outside= 28.0"W x 28.0"H => 3.92 sf x 20.00'L = 78.4 cf
		3,001 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	13.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Device 3	14.25'	**12.0" W x 8.0" H Vert. Orifice/Grate** C= 0.600
#3	Primary	14.00'	**12.0" Round Culvert** L= 18.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 14.00' / 13.80' S= 0.0111 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#4	Device 3	16.50'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.11 cfs @ 10.53 hrs HW=13.53' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=1.70 cfs @ 12.17 hrs HW=14.91' (Free Discharge)
└**3=Culvert** (Passes 1.70 cfs of 1.91 cfs potential flow)
  └**2=Orifice/Grate** (Orifice Controls 1.70 cfs @ 2.60 fps)
  └**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 16P: 24" Perf. Pipe - Chamber Wizard Field A

Chamber Model = ADS N-12 24 (ADS N-12® Pipe)
Inside= 23.8"W x 23.8"H => 3.10 sf x 20.00'L = 62.0 cf
Outside= 28.0"W x 28.0"H => 3.92 sf x 20.00'L = 78.4 cf

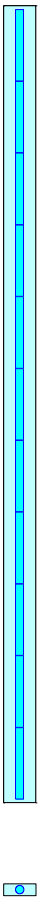
11 Chambers/Row x 20.00' Long = 220.00' Row Length +12.0" End Stone x 2 = 222.00' Base Length
1 Rows x 28.0" Wide + 40.0" Side Stone x 2 = 9.00' Base Width
6.0" Base + 28.0" Chamber Height + 6.0" Cover = 3.33' Field Height

11 Chambers x 62.0 cf = 682.0 cf Chamber Storage
11 Chambers x 78.4 cf = 862.7 cf Displacement

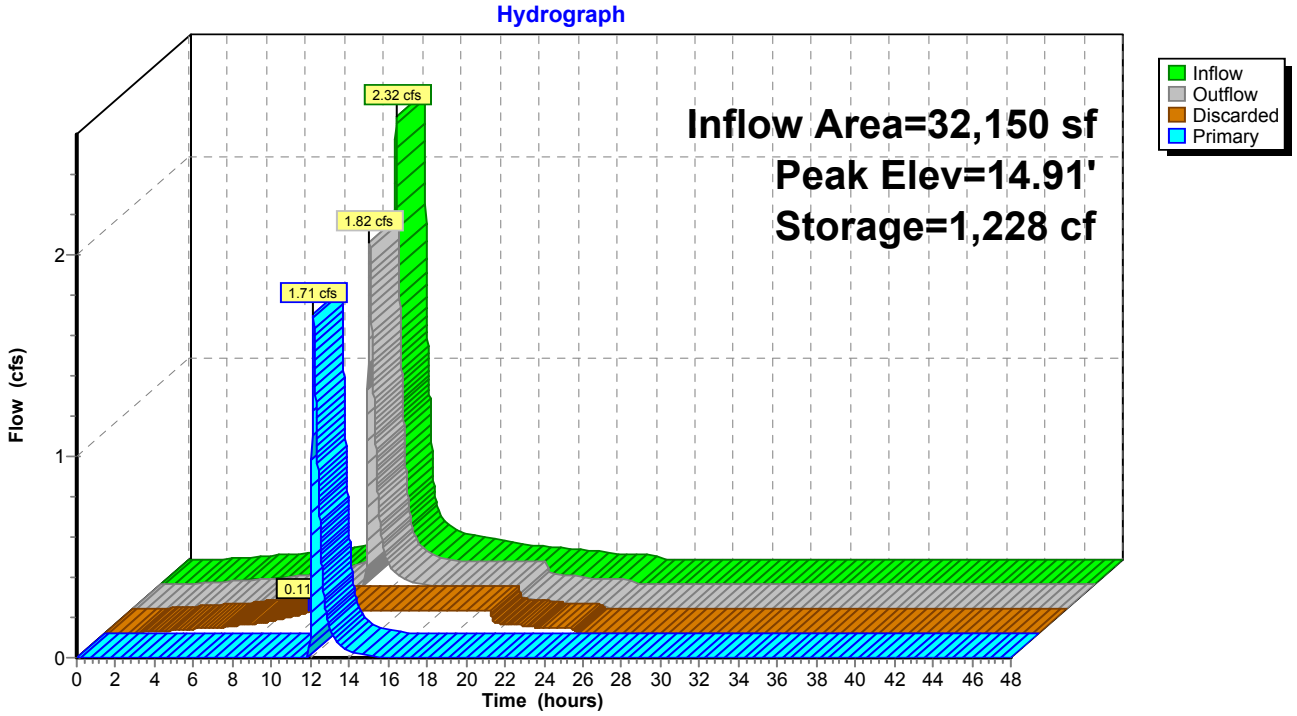
6,660.1 cf Field - 862.7 cf Chambers = 5,797.4 cf Stone x 40.0% Voids = 2,319.0 cf Stone Storage

Chamber Storage + Stone Storage = 3,001.0 cf = 0.069 af
Overall Storage Efficiency = 45.1%

11 Chambers
246.7 cy Field
214.7 cy Stone



Pond 16P: 24" Perf. Pipe



Summary for Pond 20P: Bioretention Area

Inflow Area = 15,000 sf,100.00% Impervious, Inflow Depth = 3.17" for 2-Year event
Inflow = 1.14 cfs @ 12.08 hrs, Volume= 3,958 cf
Outflow = 1.06 cfs @ 12.11 hrs, Volume= 3,958 cf, Atten= 7%, Lag= 1.9 min
Primary = 0.07 cfs @ 12.11 hrs, Volume= 2,676 cf
Secondary = 0.99 cfs @ 12.11 hrs, Volume= 1,283 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 20.63' @ 12.11 hrs Surf.Area= 1,343 sf Storage= 759 cf

Plug-Flow detention time= 61.2 min calculated for 3,958 cf (100% of inflow)
Center-of-Mass det. time= 61.2 min (816.4 - 755.1)

Volume	Invert	Avail.Storage	Storage Description
#1	19.75'	1,326 cf	**Bioretention (Prismatic)**Listed below (Recalc)

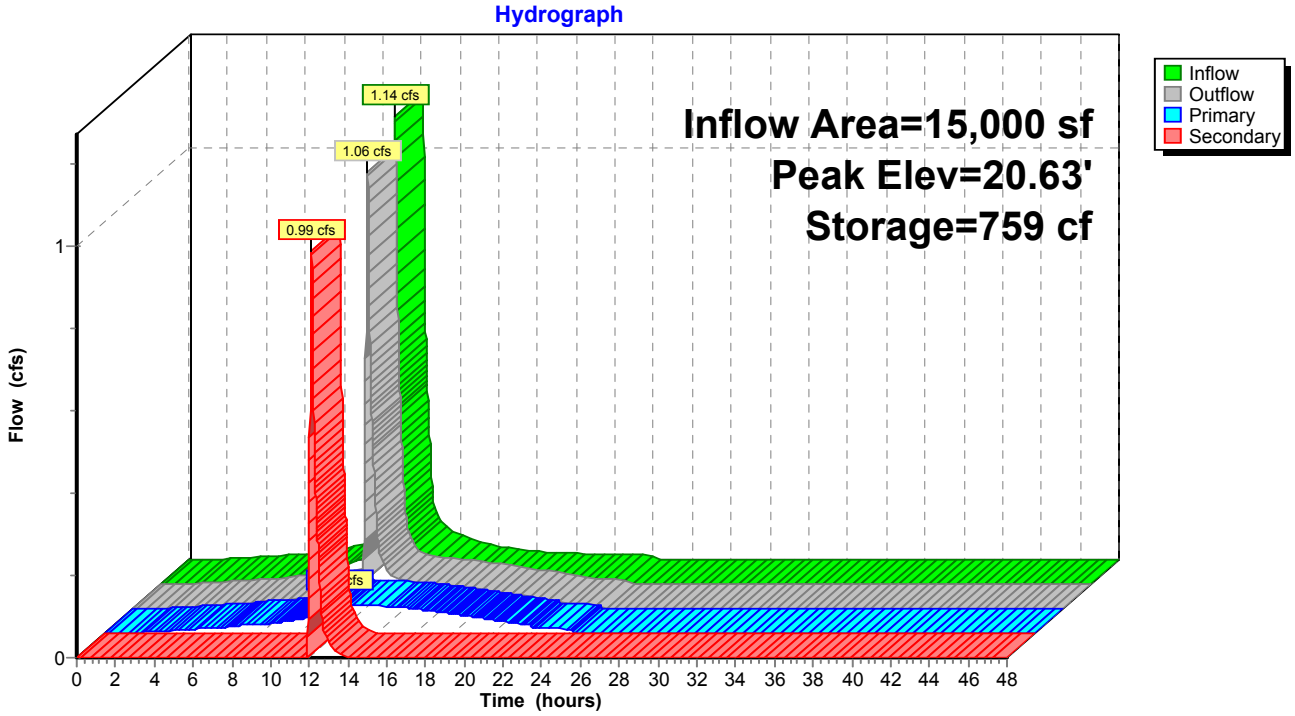
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
19.75	345	0	0
20.00	660	126	126
21.00	1,740	1,200	1,326

Device	Routing	Invert	Outlet Devices
#1	Primary	19.75'	**2.410 in/hr Flow through Bioretention over Horizontal area**
#2	Secondary	20.50'	**12.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.07 cfs @ 12.11 hrs HW=20.63' (Free Discharge)
└**1=Flow through Bioretention** (Exfiltration Controls 0.07 cfs)

Secondary OutFlow Max=0.98 cfs @ 12.11 hrs HW=20.63' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 0.98 cfs @ 1.19 fps)

Pond 20P: Bioretention Area



Summary for Pond 23P: Bioretention Area

Inflow Area = 13,155 sf, 0.00% Impervious, Inflow Depth = 1.29" for 2-Year event
Inflow = 0.45 cfs @ 12.09 hrs, Volume= 1,418 cf
Outflow = 0.44 cfs @ 12.11 hrs, Volume= 1,418 cf, Atten= 2%, Lag= 0.9 min
Primary = 0.04 cfs @ 12.11 hrs, Volume= 980 cf
Secondary = 0.40 cfs @ 12.11 hrs, Volume= 438 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 17.78' @ 12.11 hrs Surf.Area= 725 sf Storage= 157 cf

Plug-Flow detention time= 23.5 min calculated for 1,418 cf (100% of inflow)
Center-of-Mass det. time= 23.6 min (875.7 - 852.1)

Volume	Invert	Avail.Storage	Storage Description
#1	17.50'	341 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

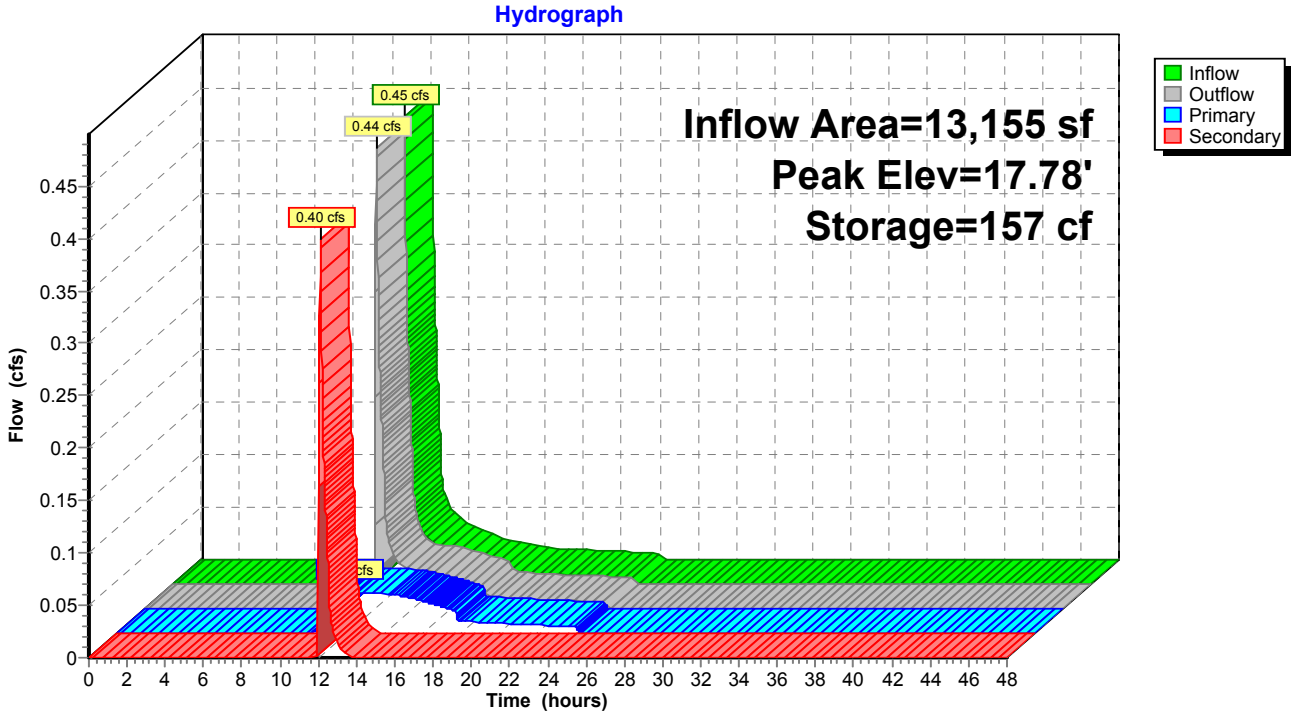
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
17.50	376	0	0
18.00	989	341	341

Device	Routing	Invert	Outlet Devices
#1	Primary	17.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Secondary	17.75'	**24.0" Horiz. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.04 cfs @ 12.11 hrs HW=17.78' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=0.40 cfs @ 12.11 hrs HW=17.78' (Free Discharge)
↑—**2=Orifice/Grate** (Weir Controls 0.40 cfs @ 0.61 fps)

Pond 23P: Bioretention Area



Summary for Pond 25P: Drywell

Inflow Area = 5,881 sf,100.00% Impervious, Inflow Depth = 3.17" for 2-Year event
Inflow = 0.45 cfs @ 12.08 hrs, Volume= 1,552 cf
Outflow = 0.45 cfs @ 12.08 hrs, Volume= 1,551 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 12.08 hrs, Volume= 459 cf
Primary = 0.44 cfs @ 12.08 hrs, Volume= 1,092 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 22.04' @ 12.08 hrs Surf.Area= 62 sf Storage= 243 cf

Plug-Flow detention time= 249.9 min calculated for 1,551 cf (100% of inflow)
Center-of-Mass det. time= 249.6 min (1,004.7 - 755.1)

Volume	Invert	Avail.Storage	Storage Description
#1	15.50'	170 cf	**6.00'D x 6.00'H Dry Well** Inside #2
#2	15.00'	73 cf	**8.00'D x 7.00'H Stone** 352 cf Overall - 170 cf Embedded = 182 cf x 40.0% Voids
#3	22.00'	26 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		269 cf	Total Available Storage

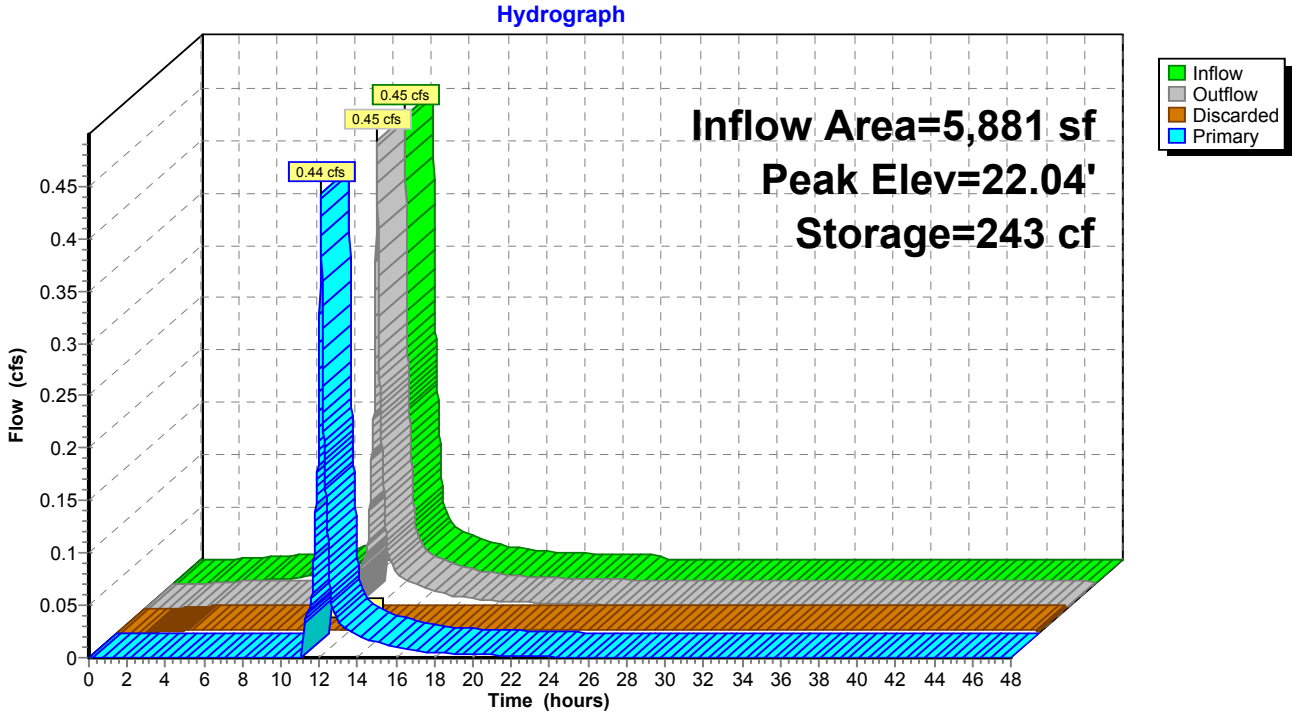
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
22.00	4	0	0
22.50	100	26	26

Device	Routing	Invert	Outlet Devices
#1	Primary	21.95'	**24.0" x 24.0" Horiz. Orifice/Grate X 0.60** C= 0.600 Limited to weir flow at low heads
#2	Discarded	15.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 12.08 hrs HW=22.04' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.43 cfs @ 12.08 hrs HW=22.04' (Free Discharge)
↑—**1=Orifice/Grate** (Weir Controls 0.43 cfs @ 0.59 fps)

Pond 25P: Drywell



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2S: Gravel Parking to Runoff Area=13,155 sf 0.00% Impervious Runoff Depth=2.37"
Tc=6.0 min CN=76 Runoff=0.84 cfs 2,600 cf

Subcatchment11S: SMAST II Runoff Area=101,928 sf 33.20% Impervious Runoff Depth=1.74"
Tc=6.0 min CN=68 Runoff=4.61 cfs 14,768 cf

Subcatchment17S: New Roof to Perf. Runoff Area=15,000 sf 100.00% Impervious Runoff Depth=4.56"
Tc=6.0 min CN=98 Runoff=1.62 cfs 5,704 cf

Subcatchment20S: Easement Area Runoff Area=46,697 sf 5.13% Impervious Runoff Depth=0.47"
Tc=6.0 min CN=47 Runoff=0.24 cfs 1,823 cf

Subcatchment21S: Parking to Runoff Area=15,000 sf 100.00% Impervious Runoff Depth=4.56"
Tc=6.0 min CN=98 Runoff=1.62 cfs 5,704 cf

Subcatchment22S: Pavement to Perf. Pipe Runoff Area=2,150 sf 100.00% Impervious Runoff Depth=4.56"
Tc=6.0 min CN=98 Runoff=0.23 cfs 818 cf

Subcatchment24S: Easement Parking Runoff Area=5,881 sf 100.00% Impervious Runoff Depth=4.56"
Tc=6.0 min CN=98 Runoff=0.63 cfs 2,236 cf

Reach PR: Offsite Inflow=7.69 cfs 24,893 cf
Outflow=7.69 cfs 24,893 cf

Pond 3P: 12" Perf. Pipe Peak Elev=13.21' Storage=480 cf Inflow=0.83 cfs 2,600 cf
Discarded=0.03 cfs 1,683 cf Primary=0.62 cfs 917 cf Outflow=0.65 cfs 2,600 cf

Pond 16P: 24" Perf. Pipe Peak Elev=15.21' Storage=1,549 cf Inflow=3.33 cfs 12,226 cf
Discarded=0.11 cfs 6,608 cf Primary=2.52 cfs 5,619 cf Outflow=2.63 cfs 12,226 cf

Pond 20P: Bioretention Area Peak Elev=20.67' Storage=811 cf Inflow=1.62 cfs 5,704 cf
Primary=0.08 cfs 3,276 cf Secondary=1.45 cfs 2,428 cf Outflow=1.53 cfs 5,704 cf

Pond 23P: Bioretention Area Peak Elev=17.80' Storage=172 cf Inflow=0.84 cfs 2,600 cf
Primary=0.04 cfs 1,355 cf Secondary=0.79 cfs 1,245 cf Outflow=0.83 cfs 2,600 cf

Pond 25P: Drywell Peak Elev=22.07' Storage=243 cf Inflow=0.63 cfs 2,236 cf
Discarded=0.00 cfs 469 cf Primary=0.63 cfs 1,767 cf Outflow=0.63 cfs 2,236 cf

Total Runoff Area = 199,811 sf Runoff Volume = 33,654 cf Average Runoff Depth = 2.02"
62.83% Pervious = 125,540 sf 37.17% Impervious = 74,271 sf

Summary for Subcatchment 2S: Gravel Parking to Bioretention

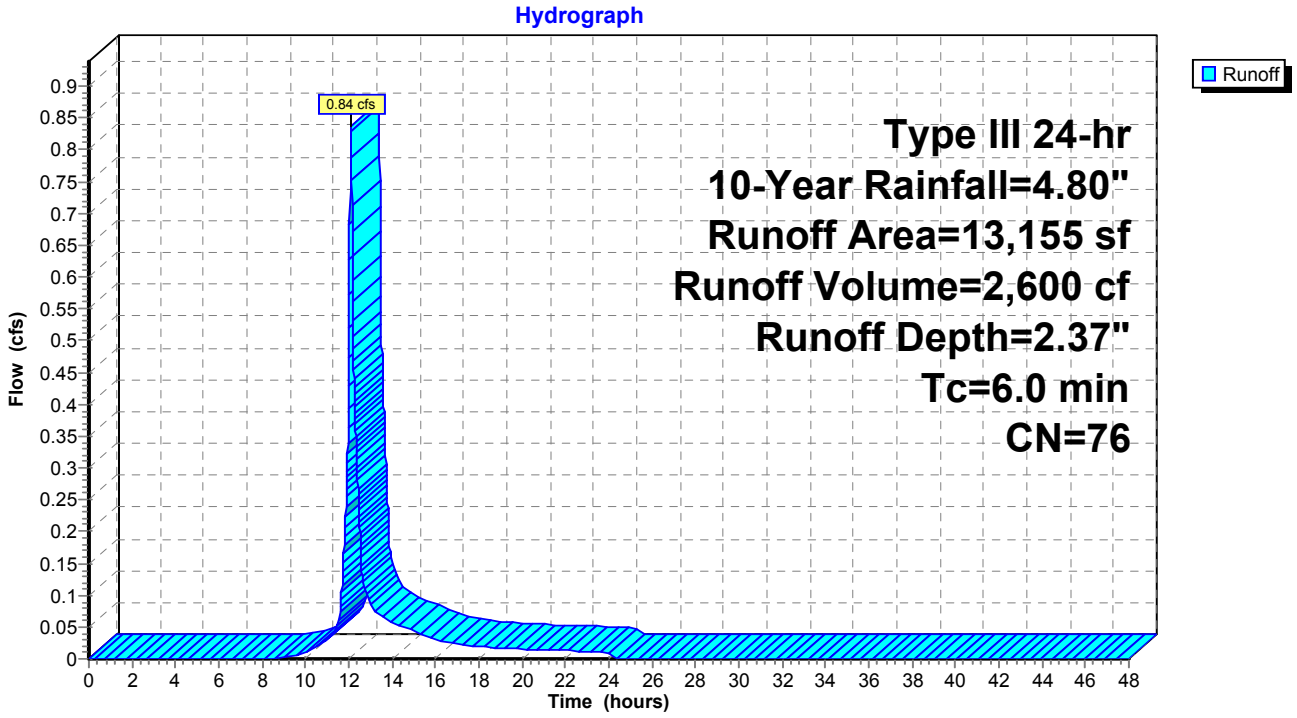
Runoff = 0.84 cfs @ 12.09 hrs, Volume= 2,600 cf, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
13,155	76	Gravel roads, HSG A
13,155		100.00% Pervious Area

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

Subcatchment 2S: Gravel Parking to Bioretention



Summary for Subcatchment 11S: SMAST II

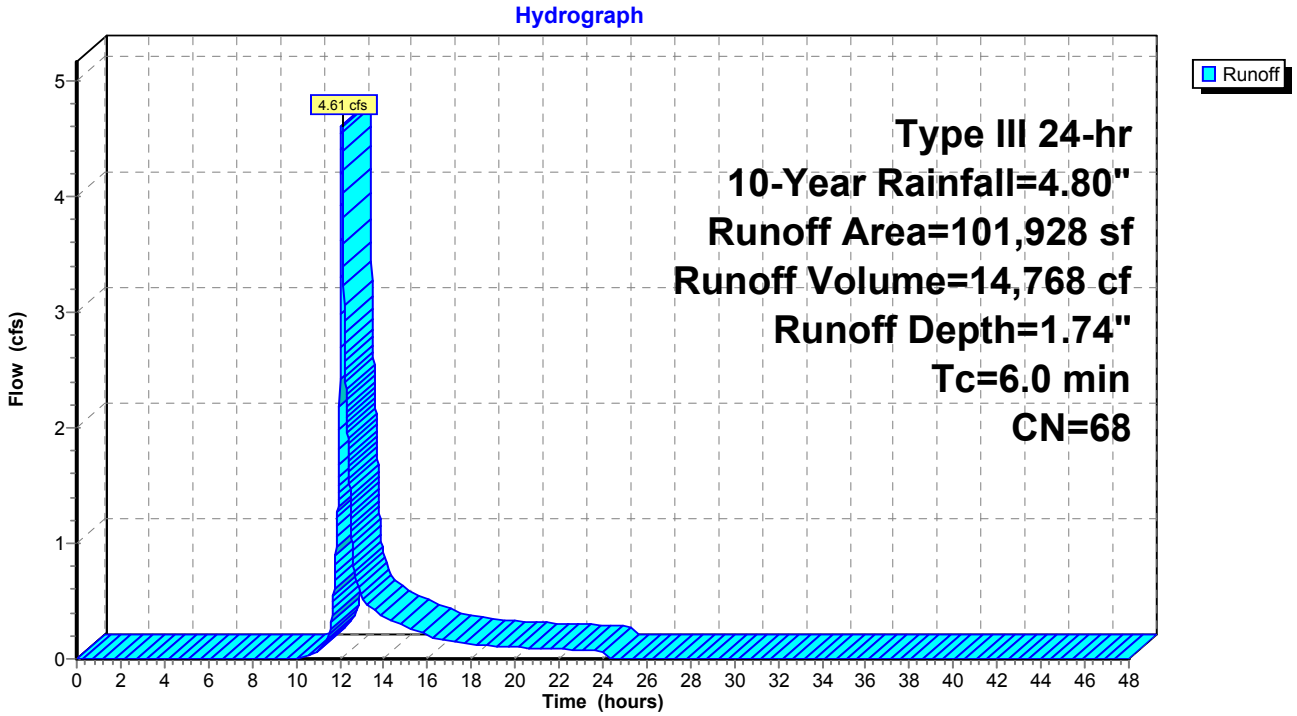
Runoff = 4.61 cfs @ 12.09 hrs, Volume= 14,768 cf, Depth= 1.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
	34,630	49	50-75% Grass cover, Fair, HSG A
	16,771	76	Gravel roads, HSG A
*	16,943	98	impervious
*	16,901	98	roof
	13,024	30	Woods, Good, HSG A
	3,659	76	Gravel roads, HSG A
	101,928	68	Weighted Average
	68,084		66.80% Pervious Area
	33,844		33.20% Impervious Area

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

Subcatchment 11S: SMAST II



Summary for Subcatchment 17S: New Roof to Perf. Pipe

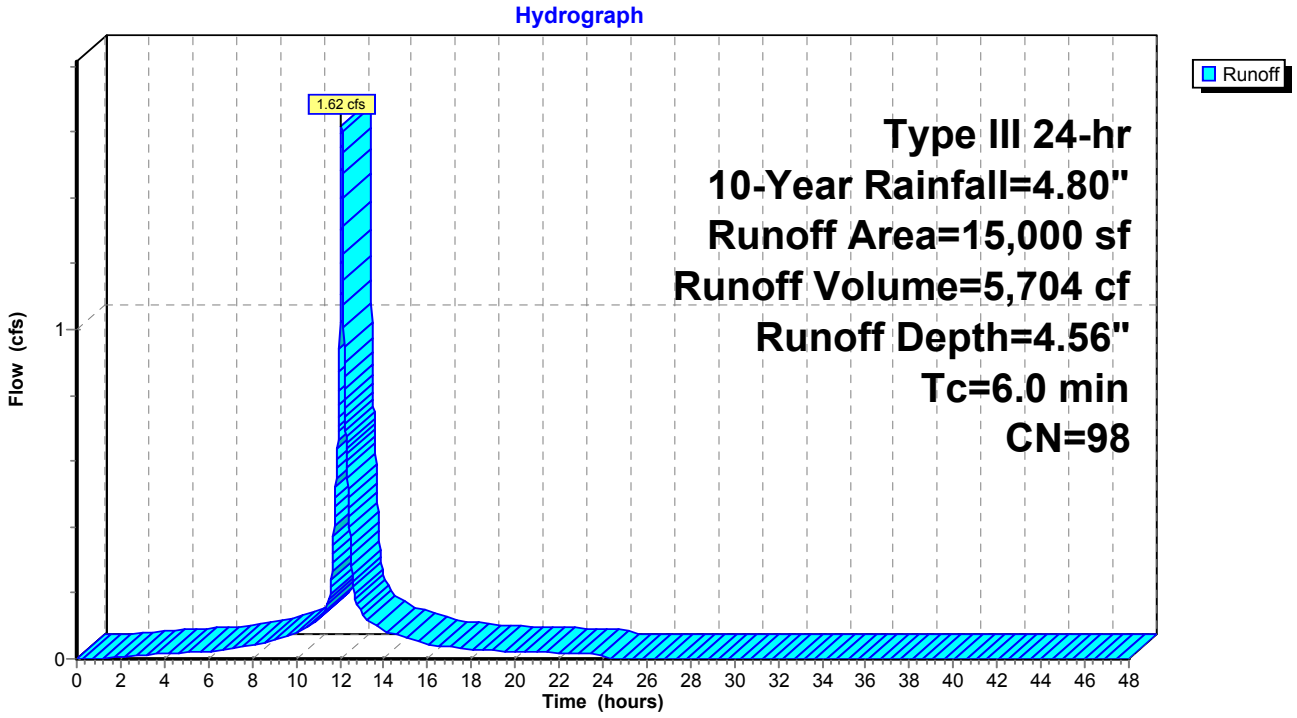
Runoff = 1.62 cfs @ 12.08 hrs, Volume= 5,704 cf, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	15,000	98	roof
	15,000		100.00% Impervious Area

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

Subcatchment 17S: New Roof to Perf. Pipe



Summary for Subcatchment 20S: Easement Area

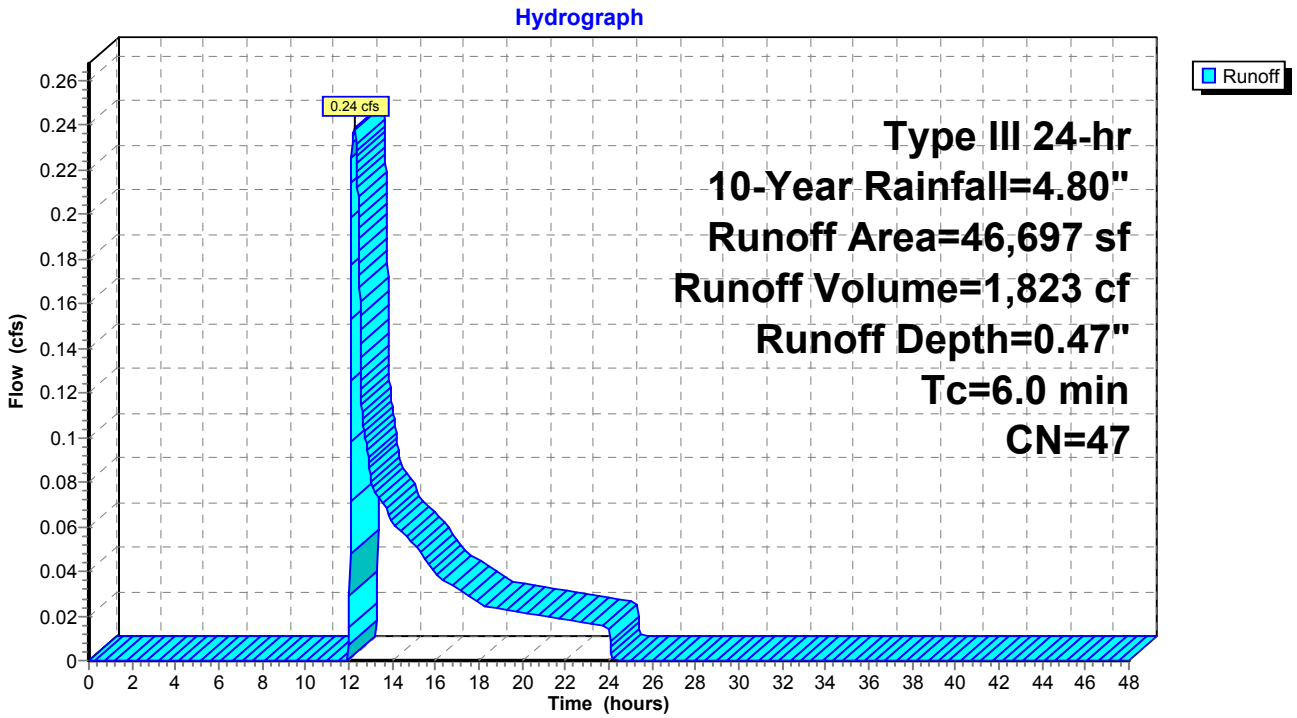
Runoff = 0.24 cfs @ 12.27 hrs, Volume= 1,823 cf, Depth= 0.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	2,396	98	impervious
	35,545	36	Woods, Fair, HSG A
	8,756	76	Gravel roads, HSG A
	46,697	47	Weighted Average
	44,301		94.87% Pervious Area
	2,396		5.13% Impervious Area

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

Subcatchment 20S: Easement Area



Summary for Subcatchment 21S: Parking to Bioretention

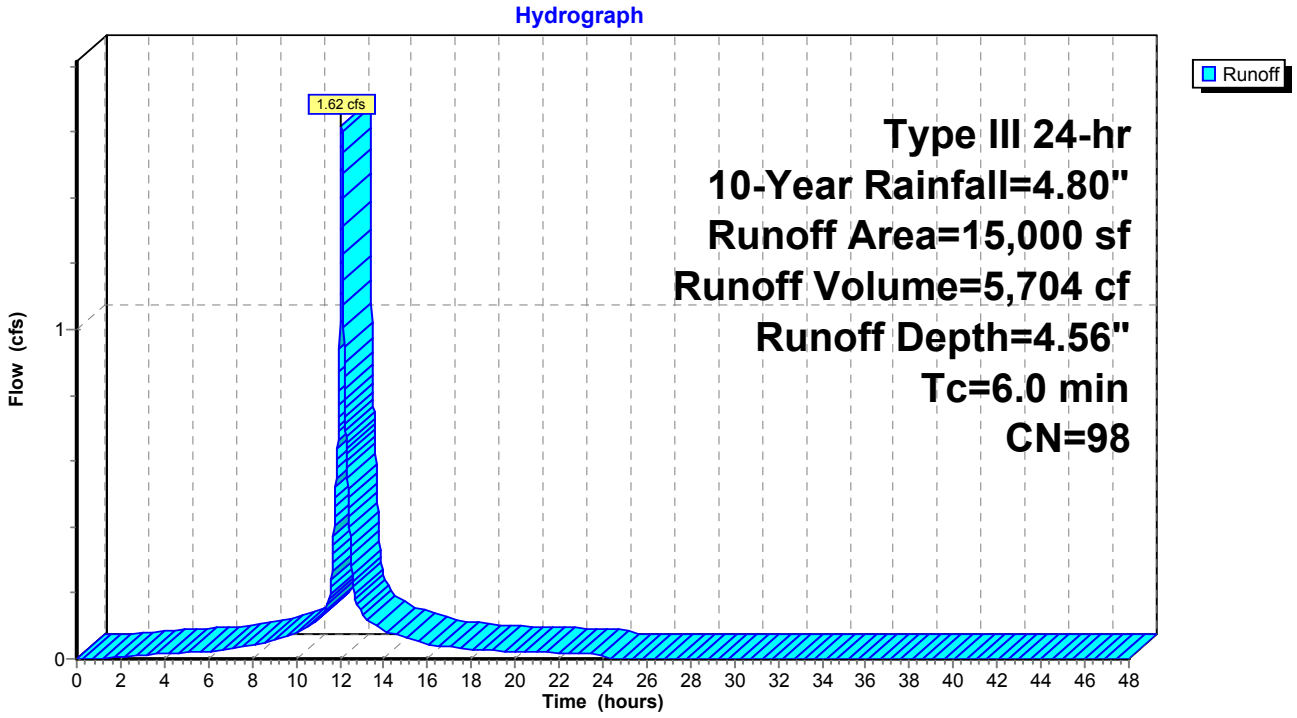
Runoff = 1.62 cfs @ 12.08 hrs, Volume= 5,704 cf, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	15,000	98	parking
	15,000		100.00% Impervious Area

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

Subcatchment 21S: Parking to Bioretention



Summary for Subcatchment 22S: Pavement to Perf. Pipe

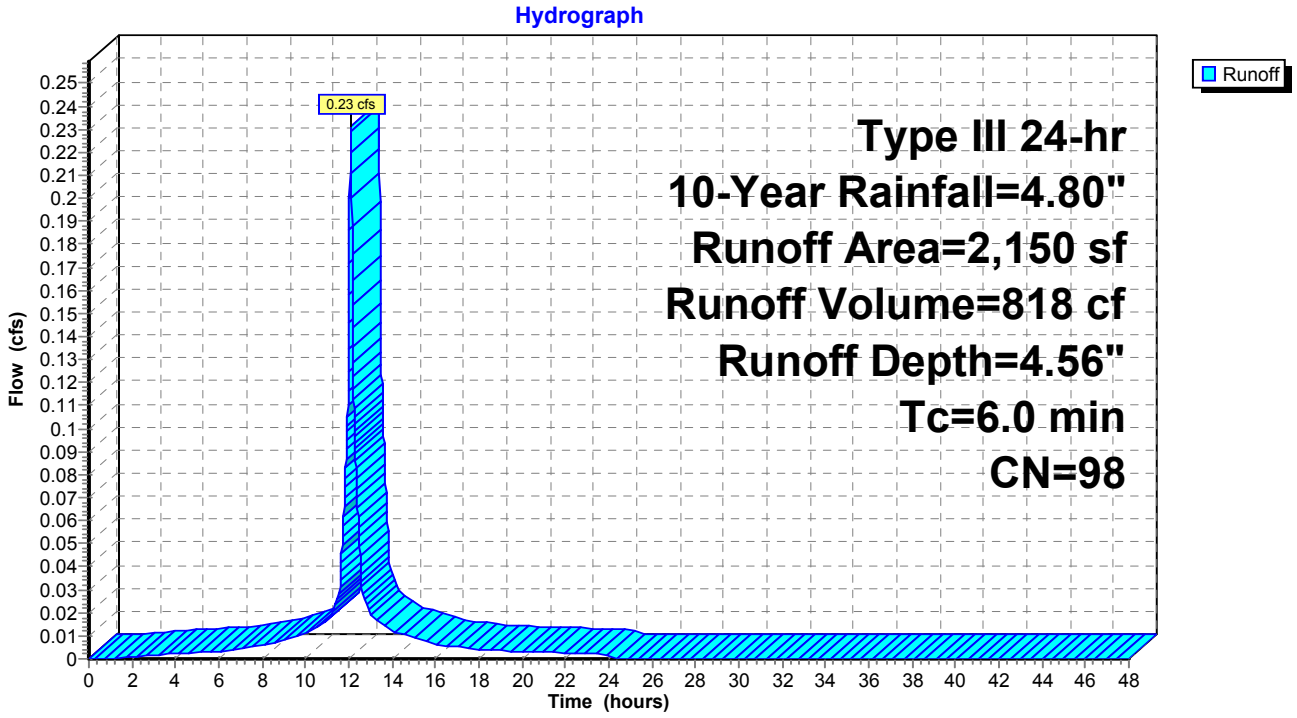
Runoff = 0.23 cfs @ 12.08 hrs, Volume= 818 cf, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	2,150	98	pavement
	2,150		100.00% Impervious Area

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

Subcatchment 22S: Pavement to Perf. Pipe



Summary for Subcatchment 24S: Easement Parking Area

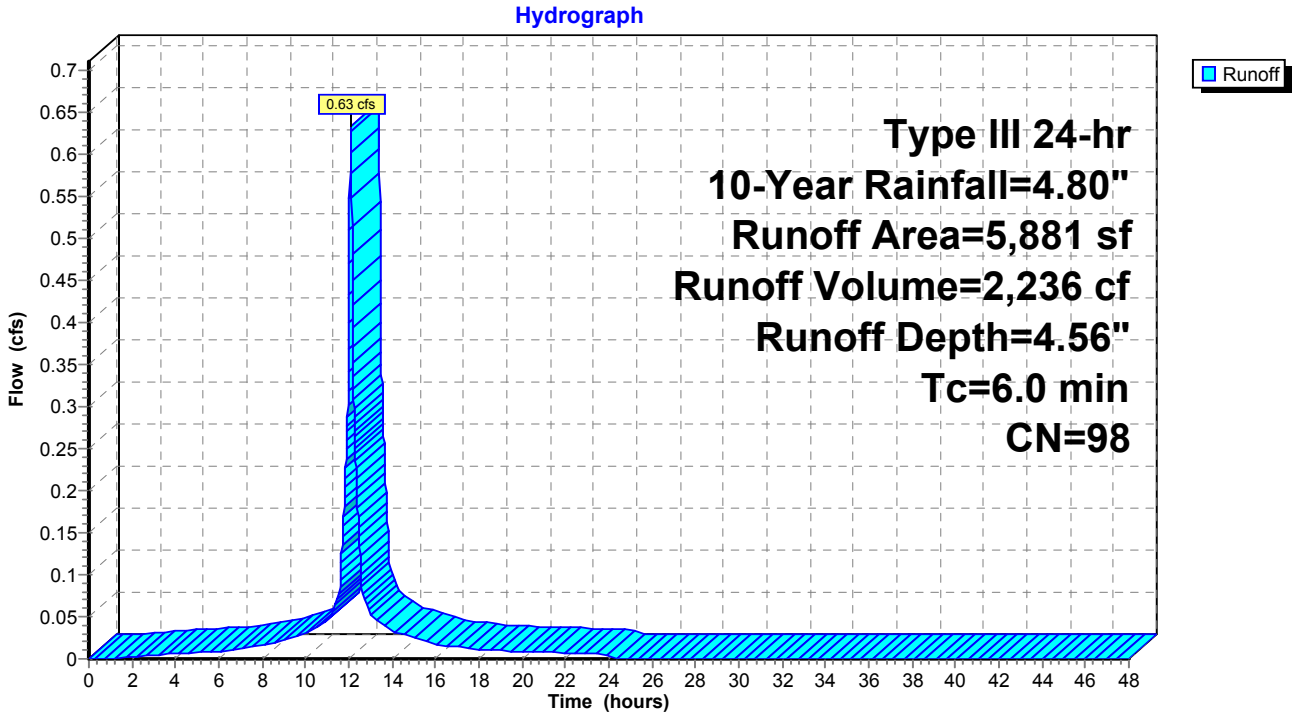
Runoff = 0.63 cfs @ 12.08 hrs, Volume= 2,236 cf, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (sf)	CN	Description
*	5,881	98	pavement
	5,881		100.00% Impervious Area

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

Subcatchment 24S: Easement Parking Area



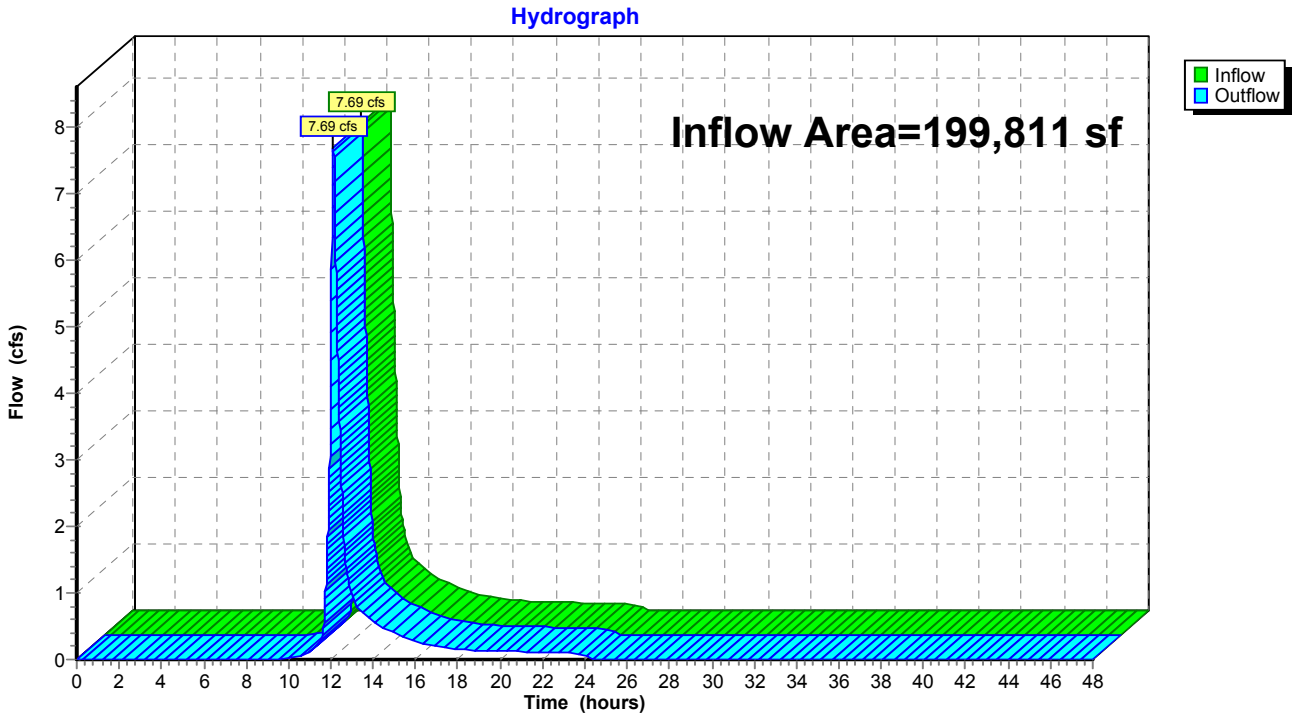
Summary for Reach PR: Offsite

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 199,811 sf, 37.17% Impervious, Inflow Depth = 1.49" for 10-Year event
Inflow = 7.69 cfs @ 12.10 hrs, Volume= 24,893 cf
Outflow = 7.69 cfs @ 12.10 hrs, Volume= 24,893 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PR: Offsite



Summary for Pond 3P: 12" Perf. Pipe

Inflow Area = 13,155 sf, 0.00% Impervious, Inflow Depth = 2.37" for 10-Year event
Inflow = 0.83 cfs @ 12.10 hrs, Volume= 2,600 cf
Outflow = 0.65 cfs @ 12.17 hrs, Volume= 2,600 cf, Atten= 22%, Lag= 4.0 min
Discarded = 0.03 cfs @ 11.77 hrs, Volume= 1,683 cf
Primary = 0.62 cfs @ 12.17 hrs, Volume= 917 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 13.21' @ 12.17 hrs Surf.Area= 584 sf Storage= 480 cf

Plug-Flow detention time= 103.9 min calculated for 2,600 cf (100% of inflow)
Center-of-Mass det. time= 103.9 min (957.9 - 854.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	11.25'	386 cf	**3.21'W x 182.00'L x 2.21'H Field A** 1,290 cf Overall - 188 cf Embedded = 1,102 cf x 35.0% Voids
#2A	11.75'	146 cf	**ADS N-12 12** x 9 Inside #1 Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf
		531 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	11.25'	**2.410 in/hr Exfiltration over Surface area**
#2	Device 3	13.00'	**2.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Primary	11.10'	**12.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 11.10' / 11.00' S= 0.0020 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.03 cfs @ 11.77 hrs HW=11.27' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.61 cfs @ 12.17 hrs HW=13.21' (Free Discharge)
└**3=Culvert** (Passes 0.61 cfs of 3.72 cfs potential flow)
└**2=Sharp-Crested Rectangular Weir** (Weir Controls 0.61 cfs @ 1.50 fps)

Pond 3P: 12" Perf. Pipe - Chamber Wizard Field A

Chamber Model = ADS N-12 12 (ADS N-12® Pipe)
Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf
Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf

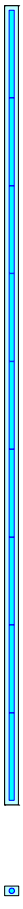
9 Chambers/Row x 20.00' Long = 180.00' Row Length +12.0" End Stone x 2 = 182.00' Base Length
1 Rows x 14.5" Wide + 12.0" Side Stone x 2 = 3.21' Base Width
6.0" Base + 14.5" Chamber Height + 6.0" Cover = 2.21' Field Height

9 Chambers x 16.2 cf = 145.8 cf Chamber Storage
9 Chambers x 20.9 cf = 188.4 cf Displacement

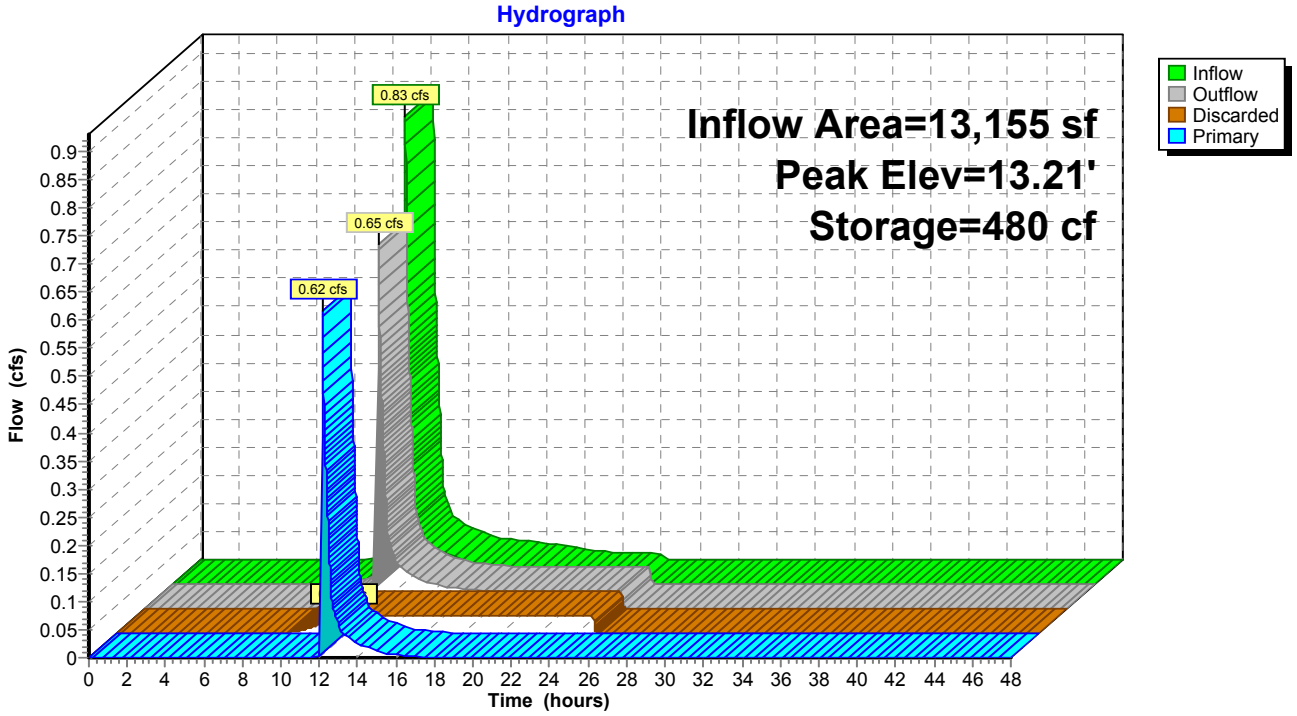
1,290.0 cf Field - 188.4 cf Chambers = 1,101.6 cf Stone x 35.0% Voids = 385.6 cf Stone Storage

Chamber Storage + Stone Storage = 531.4 cf = 0.012 af
Overall Storage Efficiency = 41.2%

9 Chambers
47.8 cy Field
40.8 cy Stone



Pond 3P: 12" Perf. Pipe



Summary for Pond 16P: 24" Perf. Pipe

Inflow Area = 32,150 sf,100.00% Impervious, Inflow Depth = 4.56" for 10-Year event
Inflow = 3.33 cfs @ 12.10 hrs, Volume= 12,226 cf
Outflow = 2.63 cfs @ 12.16 hrs, Volume= 12,226 cf, Atten= 21%, Lag= 4.0 min
Discarded = 0.11 cfs @ 9.42 hrs, Volume= 6,608 cf
Primary = 2.52 cfs @ 12.16 hrs, Volume= 5,619 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 15.21' @ 12.16 hrs Surf.Area= 1,998 sf Storage= 1,549 cf

Plug-Flow detention time= 29.3 min calculated for 12,224 cf (100% of inflow)
Center-of-Mass det. time= 29.3 min (804.6 - 775.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	13.50'	2,319 cf	**9.00'W x 222.00'L x 3.33'H Field A** 6,660 cf Overall - 863 cf Embedded = 5,797 cf x 40.0% Voids
#2A	14.00'	682 cf	**ADS N-12 24** x 11 Inside #1 Inside= 23.8"W x 23.8"H => 3.10 sf x 20.00'L = 62.0 cf Outside= 28.0"W x 28.0"H => 3.92 sf x 20.00'L = 78.4 cf
		3,001 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	13.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Device 3	14.25'	**12.0" W x 8.0" H Vert. Orifice/Grate** C= 0.600
#3	Primary	14.00'	**12.0" Round Culvert** L= 18.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 14.00' / 13.80' S= 0.0111 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#4	Device 3	16.50'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.11 cfs @ 9.42 hrs HW=13.53' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=2.51 cfs @ 12.16 hrs HW=15.21' (Free Discharge)
└**3=Culvert** (Passes 2.51 cfs of 2.52 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 2.51 cfs @ 3.77 fps)
  └**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 16P: 24" Perf. Pipe - Chamber Wizard Field A

Chamber Model = ADS N-12 24 (ADS N-12® Pipe)
Inside= 23.8"W x 23.8"H => 3.10 sf x 20.00'L = 62.0 cf
Outside= 28.0"W x 28.0"H => 3.92 sf x 20.00'L = 78.4 cf

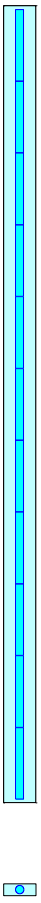
11 Chambers/Row x 20.00' Long = 220.00' Row Length +12.0" End Stone x 2 = 222.00' Base Length
1 Rows x 28.0" Wide + 40.0" Side Stone x 2 = 9.00' Base Width
6.0" Base + 28.0" Chamber Height + 6.0" Cover = 3.33' Field Height

11 Chambers x 62.0 cf = 682.0 cf Chamber Storage
11 Chambers x 78.4 cf = 862.7 cf Displacement

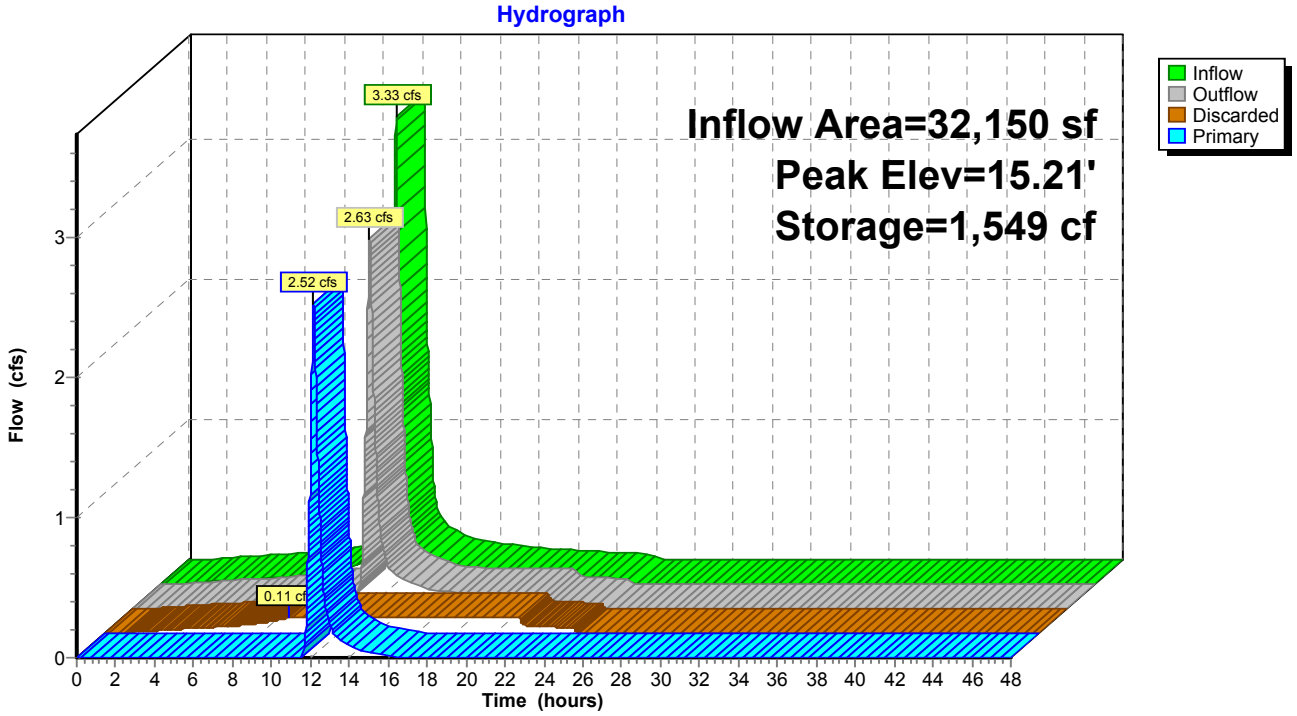
6,660.1 cf Field - 862.7 cf Chambers = 5,797.4 cf Stone x 40.0% Voids = 2,319.0 cf Stone Storage

Chamber Storage + Stone Storage = 3,001.0 cf = 0.069 af
Overall Storage Efficiency = 45.1%

11 Chambers
246.7 cy Field
214.7 cy Stone



Pond 16P: 24" Perf. Pipe



Summary for Pond 20P: Bioretention Area

Inflow Area = 15,000 sf,100.00% Impervious, Inflow Depth = 4.56" for 10-Year event
Inflow = 1.62 cfs @ 12.08 hrs, Volume= 5,704 cf
Outflow = 1.53 cfs @ 12.11 hrs, Volume= 5,704 cf, Atten= 5%, Lag= 1.7 min
Primary = 0.08 cfs @ 12.11 hrs, Volume= 3,276 cf
Secondary = 1.45 cfs @ 12.11 hrs, Volume= 2,428 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 20.67' @ 12.11 hrs Surf.Area= 1,384 sf Storage= 811 cf

Plug-Flow detention time= 57.0 min calculated for 5,703 cf (100% of inflow)
Center-of-Mass det. time= 57.0 min (805.7 - 748.7)

Volume	Invert	Avail.Storage	Storage Description
#1	19.75'	1,326 cf	**Bioretention (Prismatic)**Listed below (Recalc)

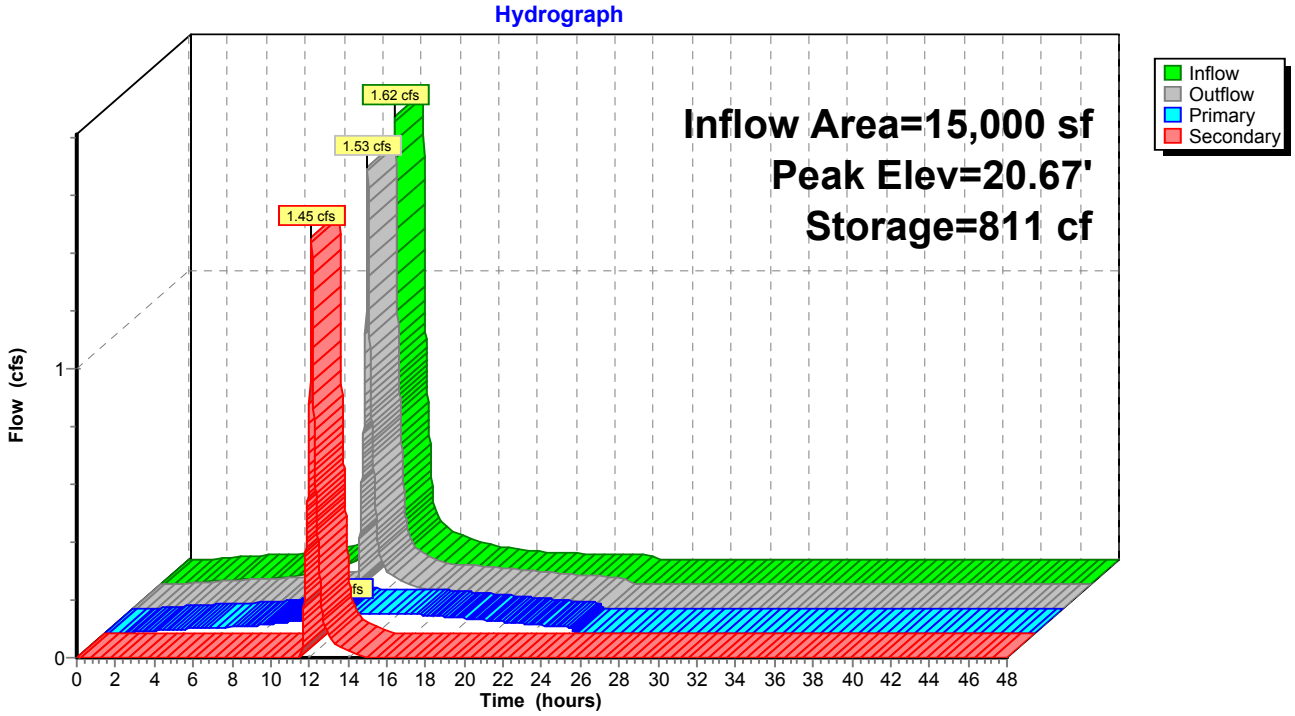
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
19.75	345	0	0
20.00	660	126	126
21.00	1,740	1,200	1,326

Device	Routing	Invert	Outlet Devices
#1	Primary	19.75'	**2.410 in/hr Flow through Bioretention over Horizontal area**
#2	Secondary	20.50'	**12.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.08 cfs @ 12.11 hrs HW=20.67' (Free Discharge)
└**1=Flow through Bioretention** (Exfiltration Controls 0.08 cfs)

Secondary OutFlow Max=1.45 cfs @ 12.11 hrs HW=20.67' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 1.45 cfs @ 1.35 fps)

Pond 20P: Bioretention Area



Summary for Pond 23P: Bioretention Area

Inflow Area = 13,155 sf, 0.00% Impervious, Inflow Depth = 2.37" for 10-Year event
Inflow = 0.84 cfs @ 12.09 hrs, Volume= 2,600 cf
Outflow = 0.83 cfs @ 12.10 hrs, Volume= 2,600 cf, Atten= 1%, Lag= 0.6 min
Primary = 0.04 cfs @ 12.10 hrs, Volume= 1,355 cf
Secondary = 0.79 cfs @ 12.10 hrs, Volume= 1,245 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 17.80' @ 12.10 hrs Surf.Area= 750 sf Storage= 172 cf

Plug-Flow detention time= 19.8 min calculated for 2,600 cf (100% of inflow)
Center-of-Mass det. time= 19.8 min (854.0 - 834.2)

Volume	Invert	Avail.Storage	Storage Description
#1	17.50'	341 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

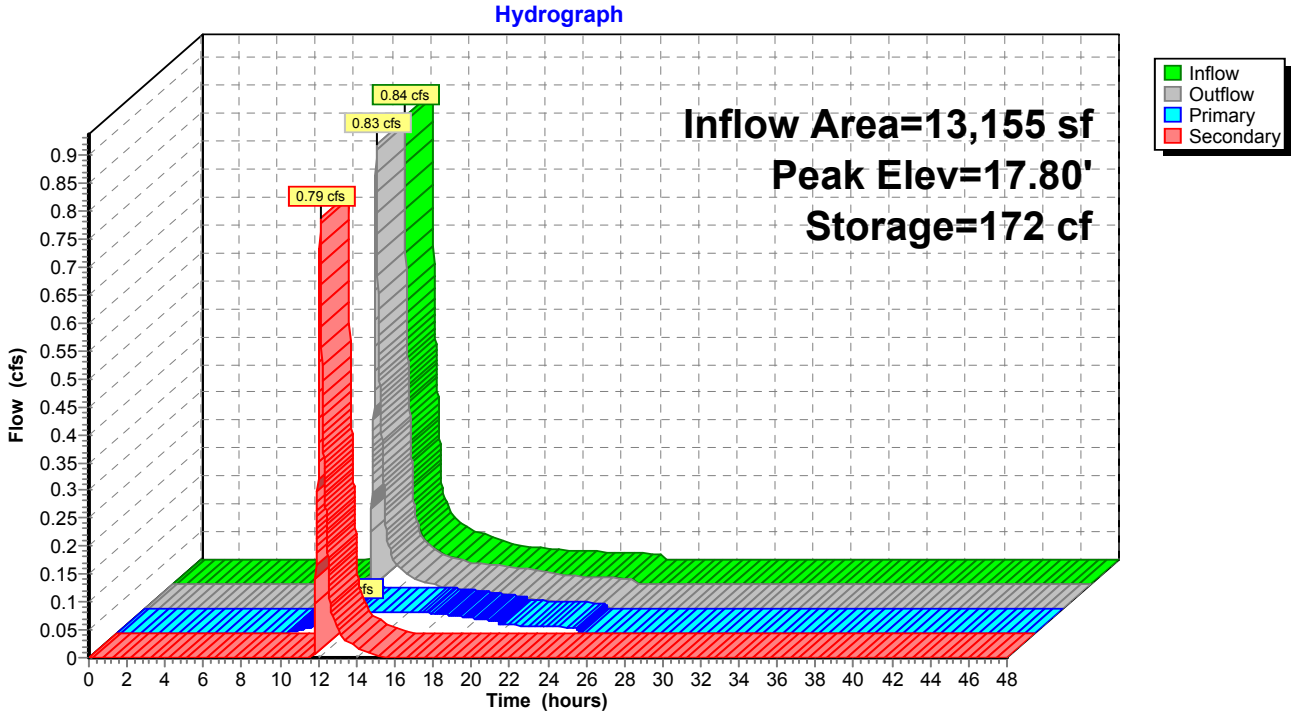
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
17.50	376	0	0
18.00	989	341	341

Device	Routing	Invert	Outlet Devices
#1	Primary	17.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Secondary	17.75'	**24.0" Horiz. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.04 cfs @ 12.10 hrs HW=17.80' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=0.79 cfs @ 12.10 hrs HW=17.80' (Free Discharge)
↑—**2=Orifice/Grate** (Weir Controls 0.79 cfs @ 0.77 fps)

Pond 23P: Bioretention Area



Summary for Pond 25P: Drywell

Inflow Area = 5,881 sf,100.00% Impervious, Inflow Depth = 4.56" for 10-Year event
Inflow = 0.63 cfs @ 12.08 hrs, Volume= 2,236 cf
Outflow = 0.63 cfs @ 12.08 hrs, Volume= 2,236 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 12.08 hrs, Volume= 469 cf
Primary = 0.63 cfs @ 12.08 hrs, Volume= 1,767 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 22.07' @ 12.08 hrs Surf.Area= 67 sf Storage= 243 cf

Plug-Flow detention time= 183.0 min calculated for 2,235 cf (100% of inflow)
Center-of-Mass det. time= 183.0 min (931.7 - 748.7)

Volume	Invert	Avail.Storage	Storage Description
#1	15.50'	170 cf	**6.00'D x 6.00'H Dry Well** Inside #2
#2	15.00'	73 cf	**8.00'D x 7.00'H Stone** 352 cf Overall - 170 cf Embedded = 182 cf x 40.0% Voids
#3	22.00'	26 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		269 cf	Total Available Storage

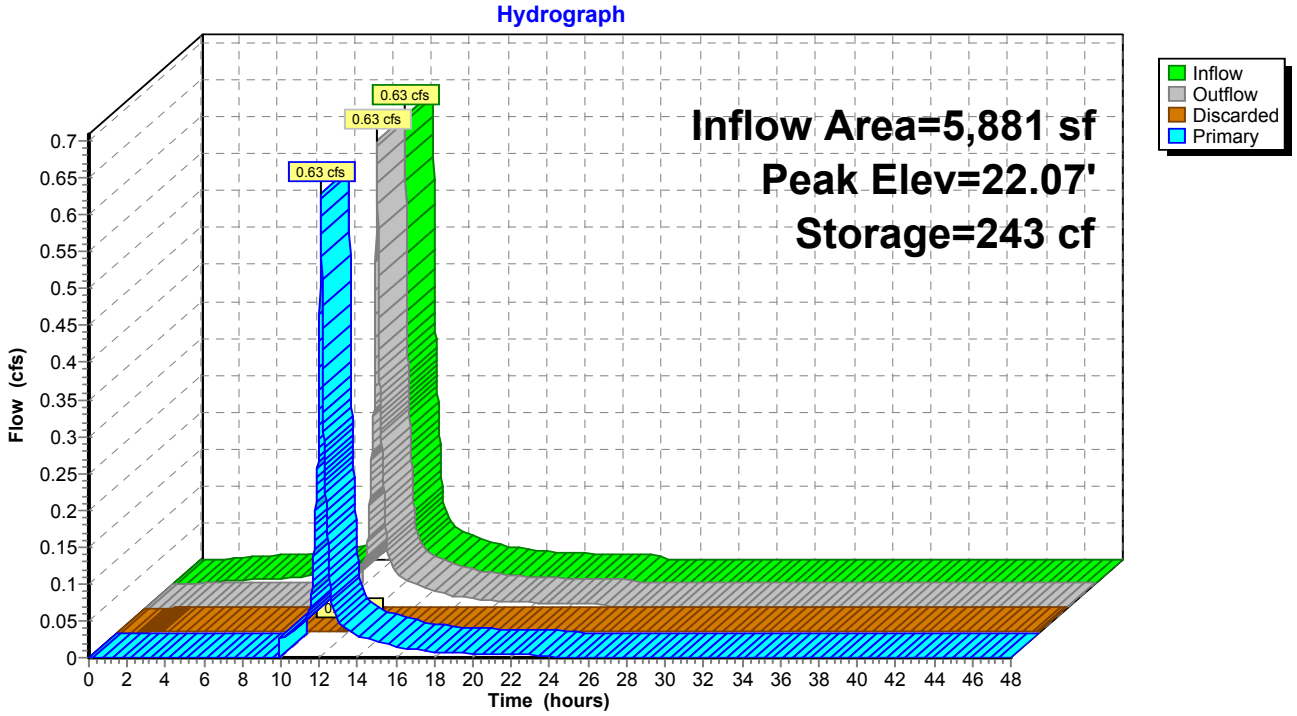
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
22.00	4	0	0
22.50	100	26	26

Device	Routing	Invert	Outlet Devices
#1	Primary	21.95'	**24.0" x 24.0" Horiz. Orifice/Grate X 0.60** C= 0.600 Limited to weir flow at low heads
#2	Discarded	15.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 12.08 hrs HW=22.07' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.61 cfs @ 12.08 hrs HW=22.07' (Free Discharge)
↑—**1=Orifice/Grate** (Weir Controls 0.61 cfs @ 0.67 fps)

Pond 25P: Drywell



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2S: Gravel Parking to Runoff Area=13,155 sf 0.00% Impervious Runoff Depth=3.04"
Tc=6.0 min CN=76 Runoff=1.08 cfs 3,330 cf

Subcatchment11S: SMAST II Runoff Area=101,928 sf 33.20% Impervious Runoff Depth=2.32"
Tc=6.0 min CN=68 Runoff=6.26 cfs 19,687 cf

Subcatchment17S: New Roof to Perf. Runoff Area=15,000 sf 100.00% Impervious Runoff Depth=5.36"
Tc=6.0 min CN=98 Runoff=1.89 cfs 6,703 cf

Subcatchment20S: Easement Area Runoff Area=46,697 sf 5.13% Impervious Runoff Depth=0.77"
Tc=6.0 min CN=47 Runoff=0.59 cfs 2,977 cf

Subcatchment21S: Parking to Runoff Area=15,000 sf 100.00% Impervious Runoff Depth=5.36"
Tc=6.0 min CN=98 Runoff=1.89 cfs 6,703 cf

Subcatchment22S: Pavement to Perf. Pipe Runoff Area=2,150 sf 100.00% Impervious Runoff Depth=5.36"
Tc=6.0 min CN=98 Runoff=0.27 cfs 961 cf

Subcatchment24S: Easement Parking Runoff Area=5,881 sf 100.00% Impervious Runoff Depth=5.36"
Tc=6.0 min CN=98 Runoff=0.74 cfs 2,628 cf

Reach PR: Offsite Inflow=11.10 cfs 33,566 cf
Outflow=11.10 cfs 33,566 cf

Pond 3P: 12" Perf. Pipe Peak Elev=13.29' Storage=498 cf Inflow=1.07 cfs 3,330 cf
Discarded=0.03 cfs 1,840 cf Primary=1.01 cfs 1,490 cf Outflow=1.05 cfs 3,330 cf

Pond 16P: 24" Perf. Pipe Peak Elev=15.40' Storage=1,747 cf Inflow=3.90 cfs 14,367 cf
Discarded=0.11 cfs 7,109 cf Primary=2.84 cfs 7,257 cf Outflow=2.95 cfs 14,367 cf

Pond 20P: Bioretention Area Peak Elev=20.69' Storage=839 cf Inflow=1.89 cfs 6,703 cf
Primary=0.08 cfs 3,567 cf Secondary=1.71 cfs 3,136 cf Outflow=1.79 cfs 6,703 cf

Pond 23P: Bioretention Area Peak Elev=17.82' Storage=179 cf Inflow=1.08 cfs 3,330 cf
Primary=0.04 cfs 1,534 cf Secondary=1.03 cfs 1,796 cf Outflow=1.07 cfs 3,330 cf

Pond 25P: Drywell Peak Elev=22.08' Storage=243 cf Inflow=0.74 cfs 2,628 cf
Discarded=0.00 cfs 472 cf Primary=0.74 cfs 2,155 cf Outflow=0.74 cfs 2,627 cf

Total Runoff Area = 199,811 sf Runoff Volume = 42,989 cf Average Runoff Depth = 2.58"
62.83% Pervious = 125,540 sf 37.17% Impervious = 74,271 sf

Summary for Subcatchment 2S: Gravel Parking to Bioretention

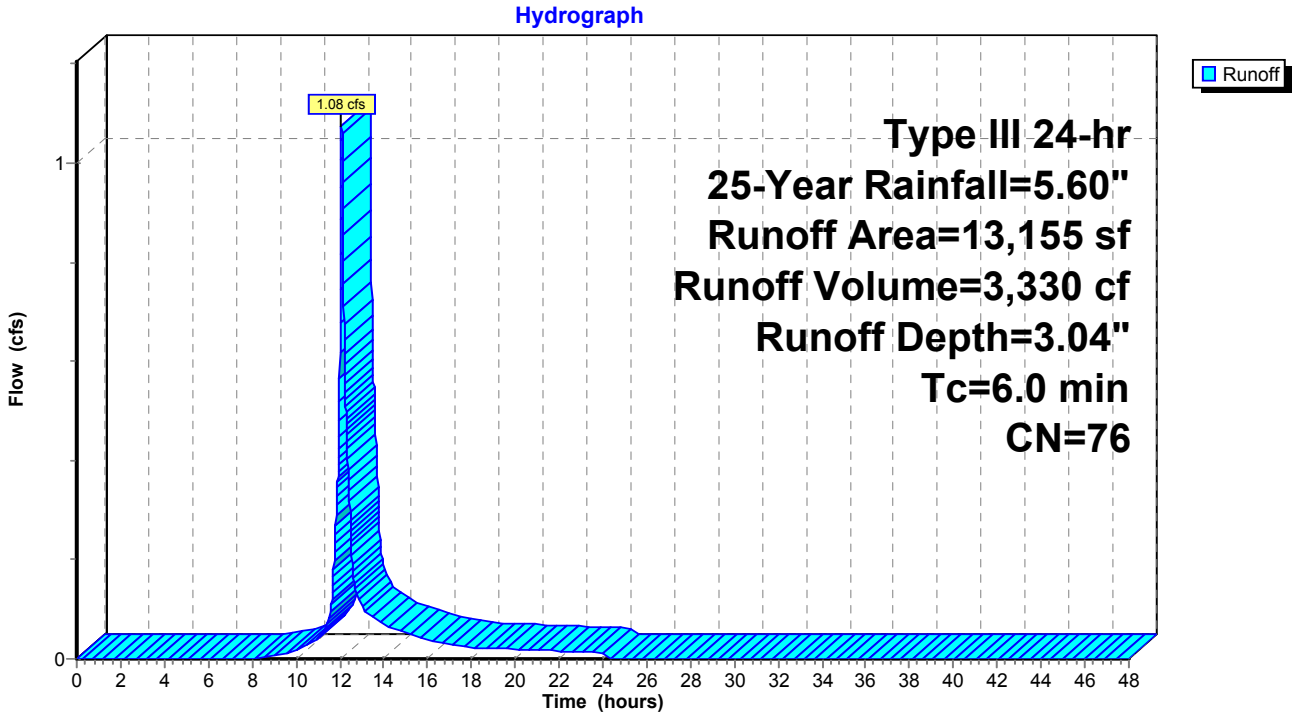
Runoff = 1.08 cfs @ 12.09 hrs, Volume= 3,330 cf, Depth= 3.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.60"

Area (sf)	CN	Description
13,155	76	Gravel roads, HSG A
13,155		100.00% Pervious Area

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

Subcatchment 2S: Gravel Parking to Bioretention



Summary for Subcatchment 11S: SMAST II

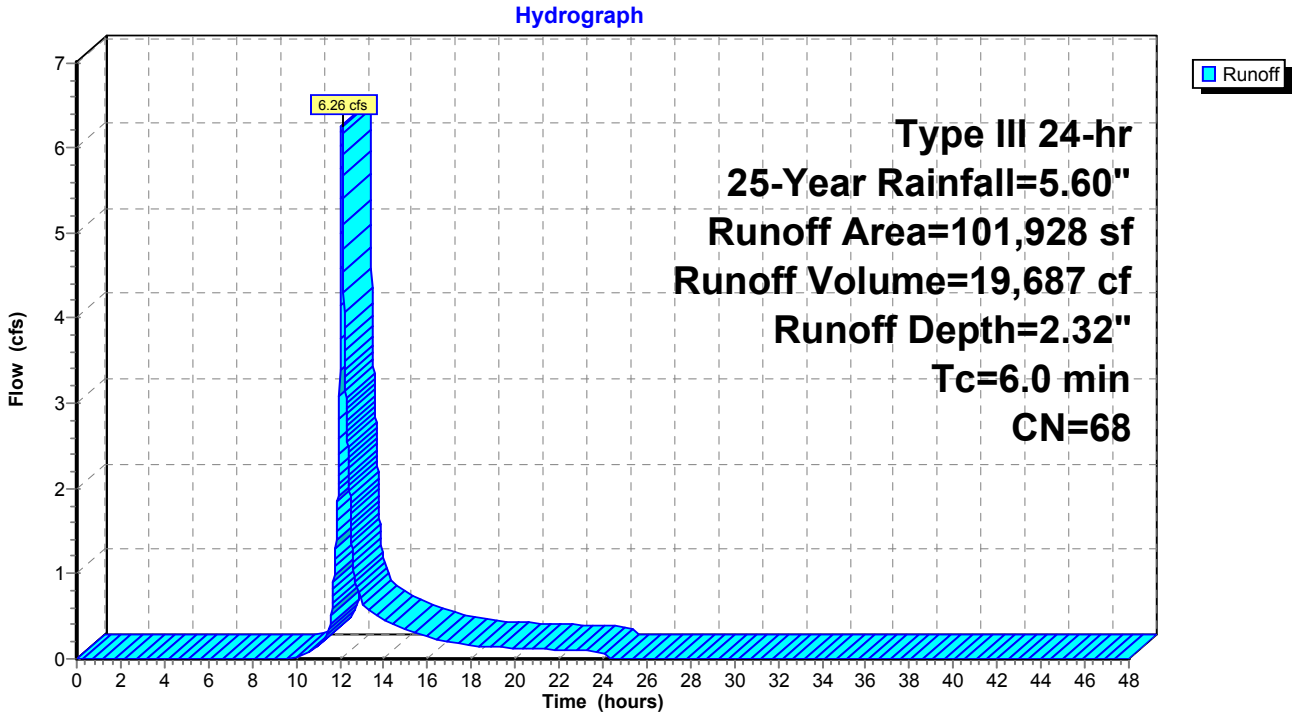
Runoff = 6.26 cfs @ 12.09 hrs, Volume= 19,687 cf, Depth= 2.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.60"

	Area (sf)	CN	Description
	34,630	49	50-75% Grass cover, Fair, HSG A
	16,771	76	Gravel roads, HSG A
*	16,943	98	impervious
*	16,901	98	roof
	13,024	30	Woods, Good, HSG A
	3,659	76	Gravel roads, HSG A
	101,928	68	Weighted Average
	68,084		66.80% Pervious Area
	33,844		33.20% Impervious Area

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

Subcatchment 11S: SMAST II



Summary for Subcatchment 17S: New Roof to Perf. Pipe

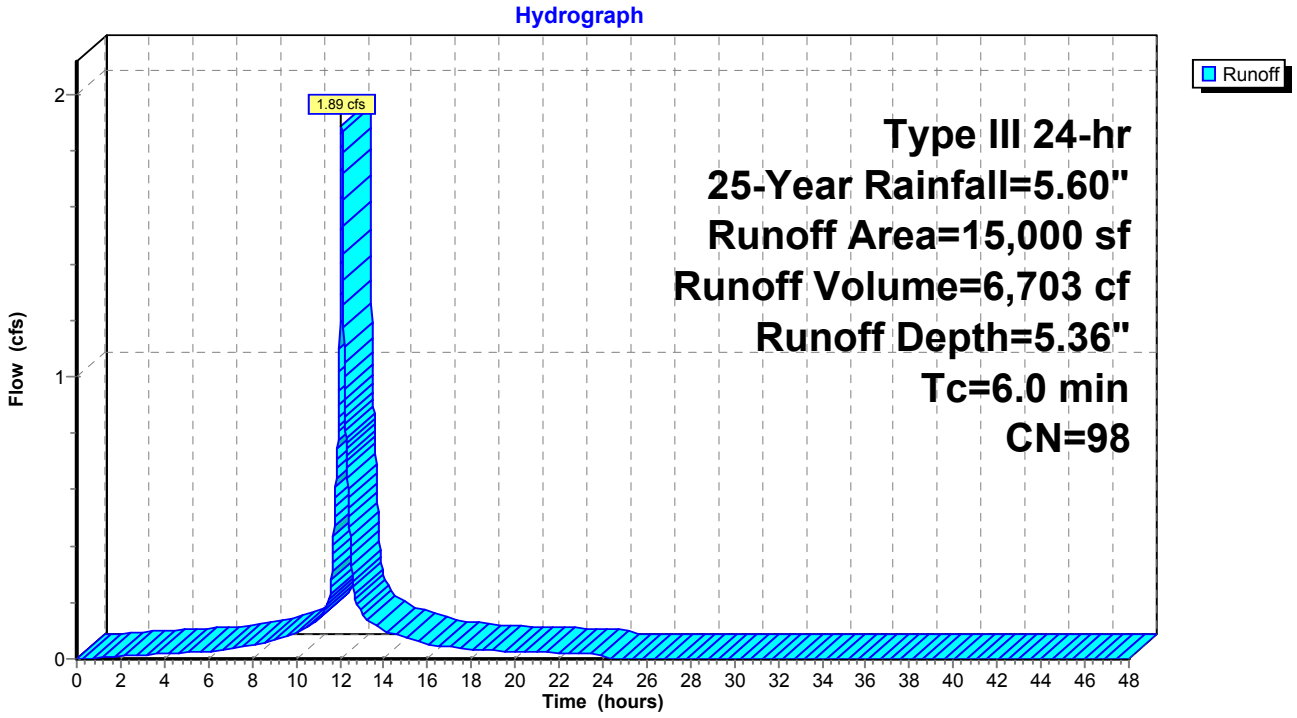
Runoff = 1.89 cfs @ 12.08 hrs, Volume= 6,703 cf, Depth= 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.60"

	Area (sf)	CN	Description
*	15,000	98	roof
	15,000		100.00% Impervious Area

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

Subcatchment 17S: New Roof to Perf. Pipe



Summary for Subcatchment 20S: Easement Area

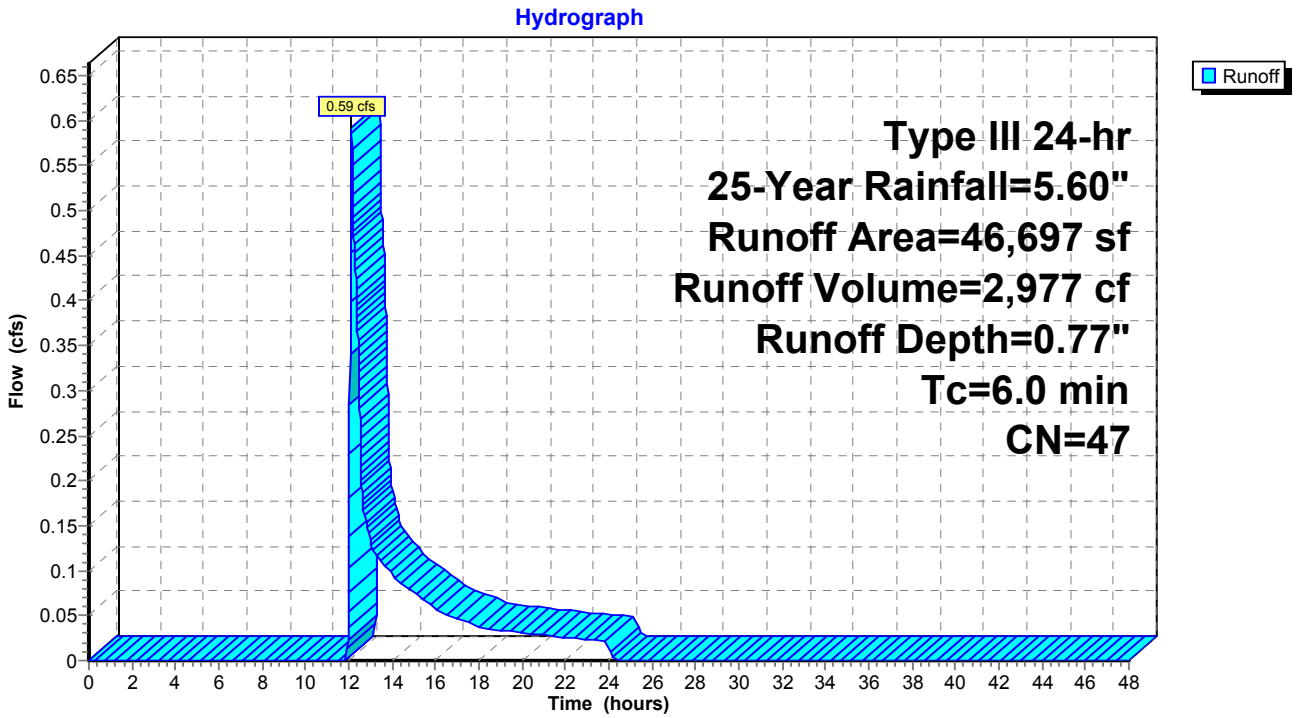
Runoff = 0.59 cfs @ 12.12 hrs, Volume= 2,977 cf, Depth= 0.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.60"

	Area (sf)	CN	Description
*	2,396	98	impervious
	35,545	36	Woods, Fair, HSG A
	8,756	76	Gravel roads, HSG A
	46,697	47	Weighted Average
	44,301		94.87% Pervious Area
	2,396		5.13% Impervious Area

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

Subcatchment 20S: Easement Area



Summary for Subcatchment 21S: Parking to Bioretention

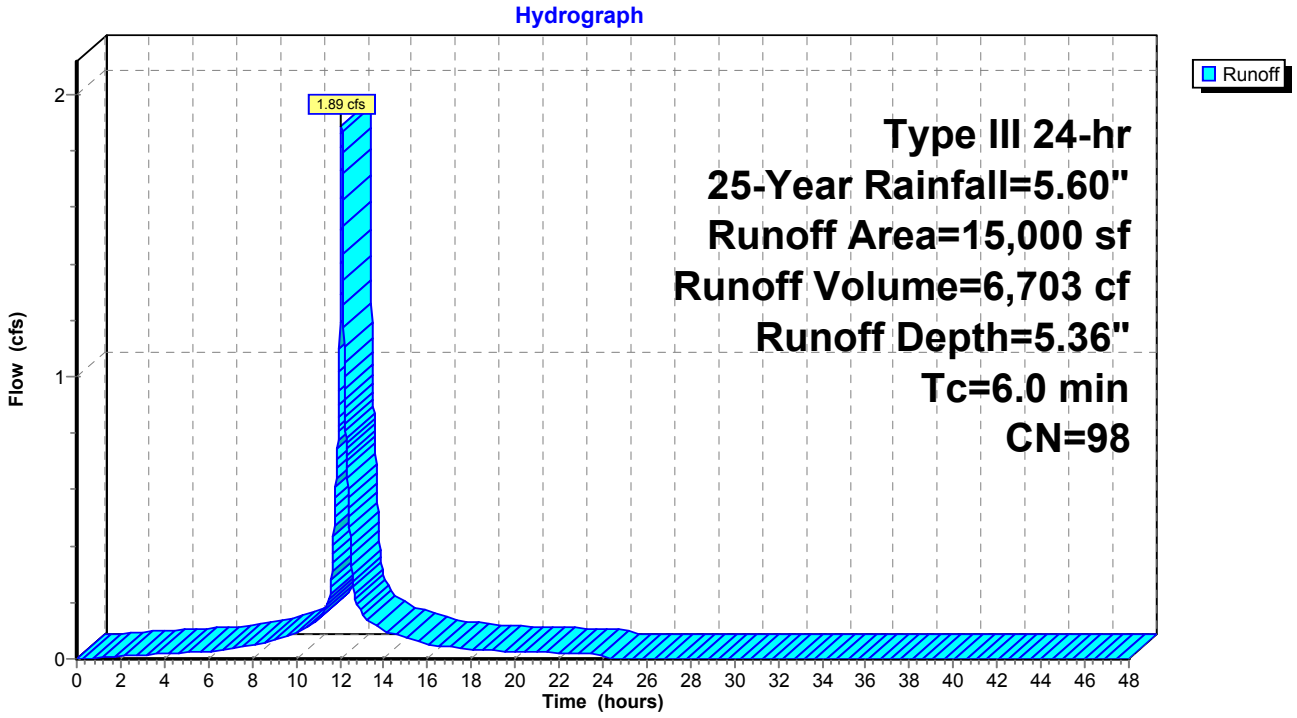
Runoff = 1.89 cfs @ 12.08 hrs, Volume= 6,703 cf, Depth= 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.60"

	Area (sf)	CN	Description
*	15,000	98	parking
	15,000		100.00% Impervious Area

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

Subcatchment 21S: Parking to Bioretention



Summary for Subcatchment 22S: Pavement to Perf. Pipe

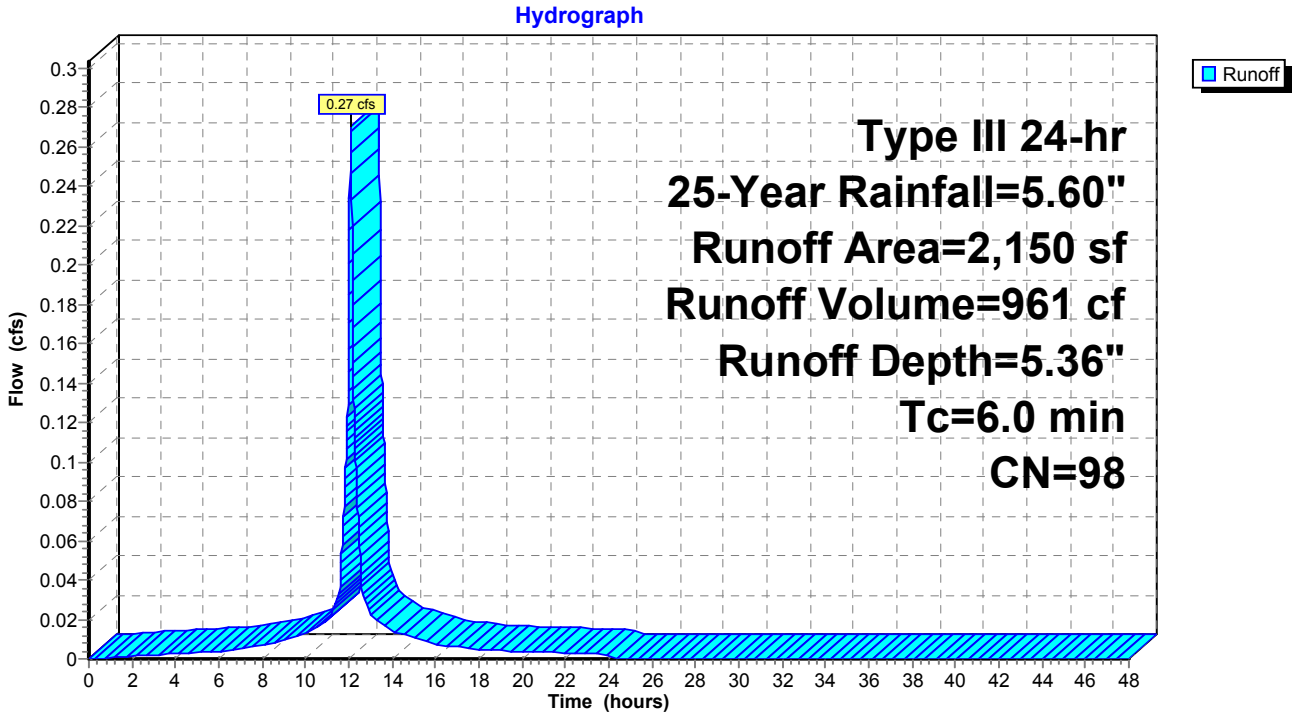
Runoff = 0.27 cfs @ 12.08 hrs, Volume= 961 cf, Depth= 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.60"

	Area (sf)	CN	Description
*	2,150	98	pavement
	2,150		100.00% Impervious Area

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

Subcatchment 22S: Pavement to Perf. Pipe



Summary for Subcatchment 24S: Easement Parking Area

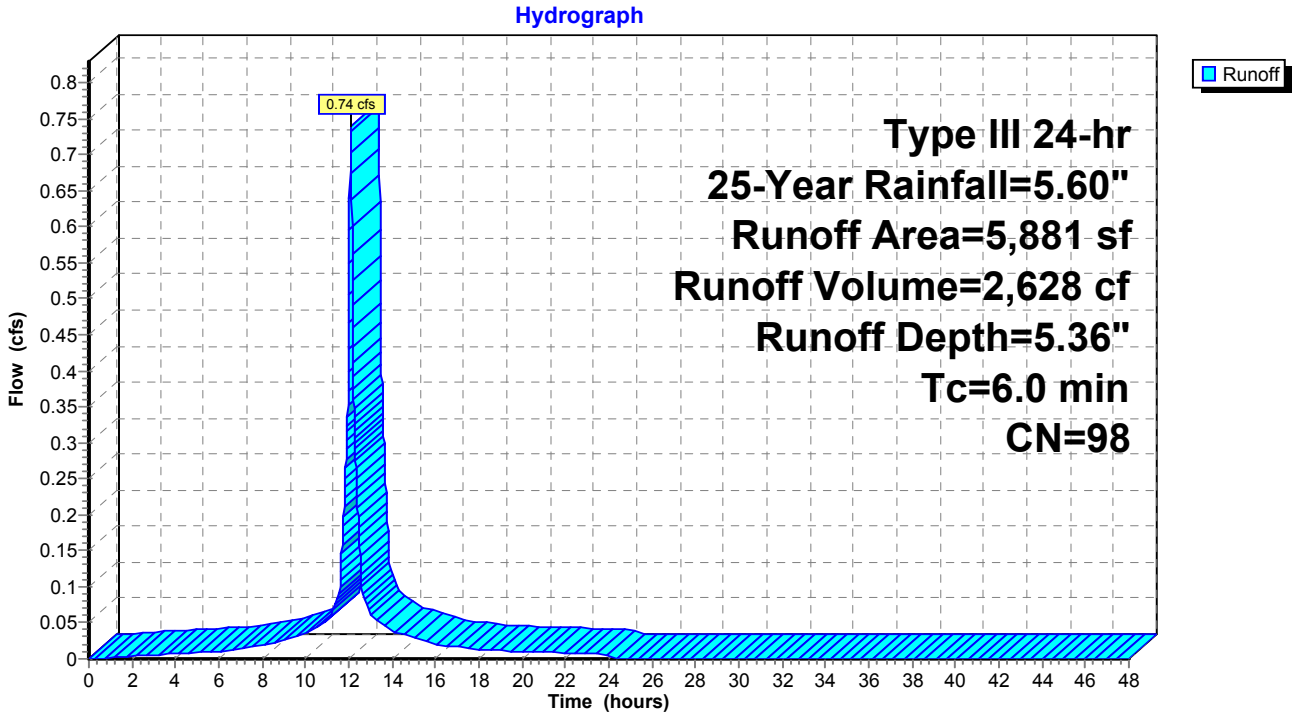
Runoff = 0.74 cfs @ 12.08 hrs, Volume= 2,628 cf, Depth= 5.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.60"

	Area (sf)	CN	Description
*	5,881	98	pavement
	5,881		100.00% Impervious Area

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

Subcatchment 24S: Easement Parking Area



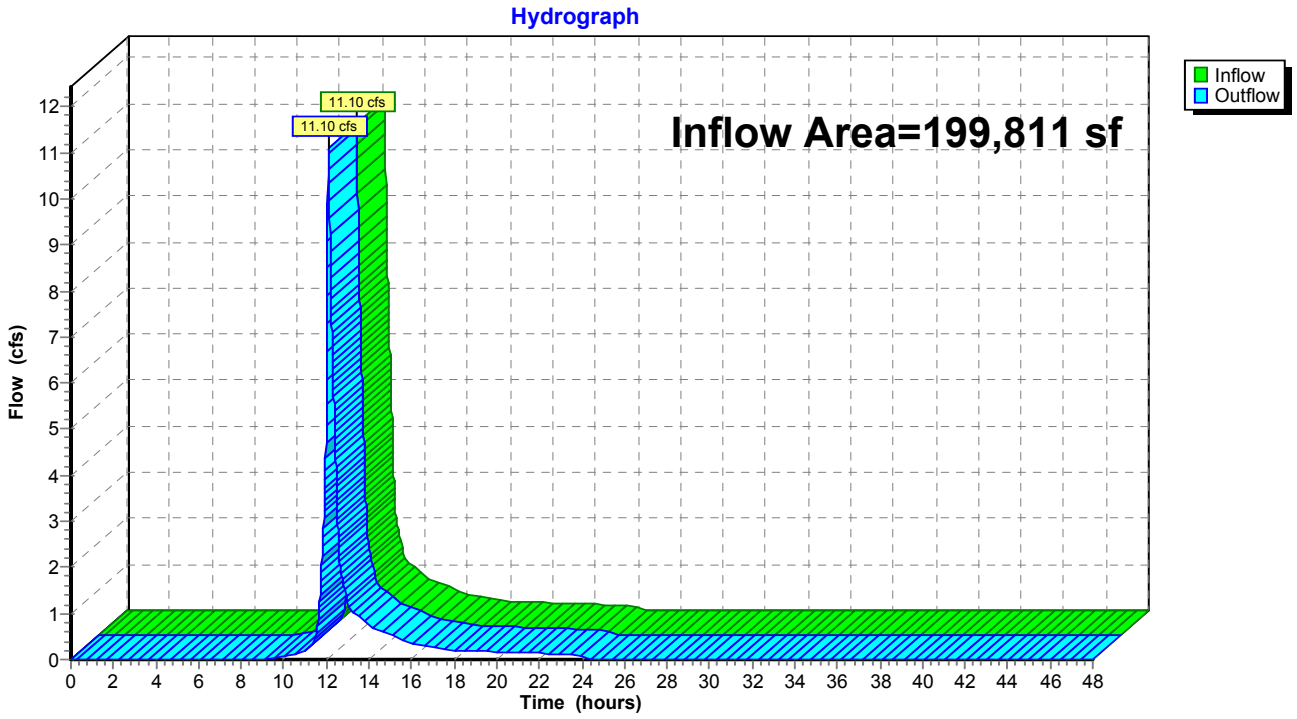
Summary for Reach PR: Offsite

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 199,811 sf, 37.17% Impervious, Inflow Depth = 2.02" for 25-Year event
Inflow = 11.10 cfs @ 12.10 hrs, Volume= 33,566 cf
Outflow = 11.10 cfs @ 12.10 hrs, Volume= 33,566 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PR: Offsite



Summary for Pond 3P: 12" Perf. Pipe

Inflow Area = 13,155 sf, 0.00% Impervious, Inflow Depth = 3.04" for 25-Year event
Inflow = 1.07 cfs @ 12.10 hrs, Volume= 3,330 cf
Outflow = 1.05 cfs @ 12.12 hrs, Volume= 3,330 cf, Atten= 2%, Lag= 1.1 min
Discarded = 0.03 cfs @ 11.57 hrs, Volume= 1,840 cf
Primary = 1.01 cfs @ 12.12 hrs, Volume= 1,490 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 13.29' @ 12.12 hrs Surf.Area= 584 sf Storage= 498 cf

Plug-Flow detention time= 90.6 min calculated for 3,329 cf (100% of inflow)
Center-of-Mass det. time= 90.6 min (936.1 - 845.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	11.25'	386 cf	**3.21'W x 182.00'L x 2.21'H Field A** 1,290 cf Overall - 188 cf Embedded = 1,102 cf x 35.0% Voids
#2A	11.75'	146 cf	**ADS N-12 12** x 9 Inside #1 Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf
		531 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	11.25'	**2.410 in/hr Exfiltration over Surface area**
#2	Device 3	13.00'	**2.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Primary	11.10'	**12.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 11.10' / 11.00' S= 0.0020 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.03 cfs @ 11.57 hrs HW=11.27' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=1.01 cfs @ 12.12 hrs HW=13.29' (Free Discharge)
└**3=Culvert** (Passes 1.01 cfs of 3.85 cfs potential flow)
└**2=Sharp-Crested Rectangular Weir** (Weir Controls 1.01 cfs @ 1.77 fps)

Pond 3P: 12" Perf. Pipe - Chamber Wizard Field A

Chamber Model = ADS N-12 12 (ADS N-12® Pipe)
Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf
Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf

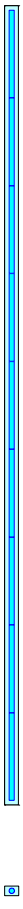
9 Chambers/Row x 20.00' Long = 180.00' Row Length +12.0" End Stone x 2 = 182.00' Base Length
1 Rows x 14.5" Wide + 12.0" Side Stone x 2 = 3.21' Base Width
6.0" Base + 14.5" Chamber Height + 6.0" Cover = 2.21' Field Height

9 Chambers x 16.2 cf = 145.8 cf Chamber Storage
9 Chambers x 20.9 cf = 188.4 cf Displacement

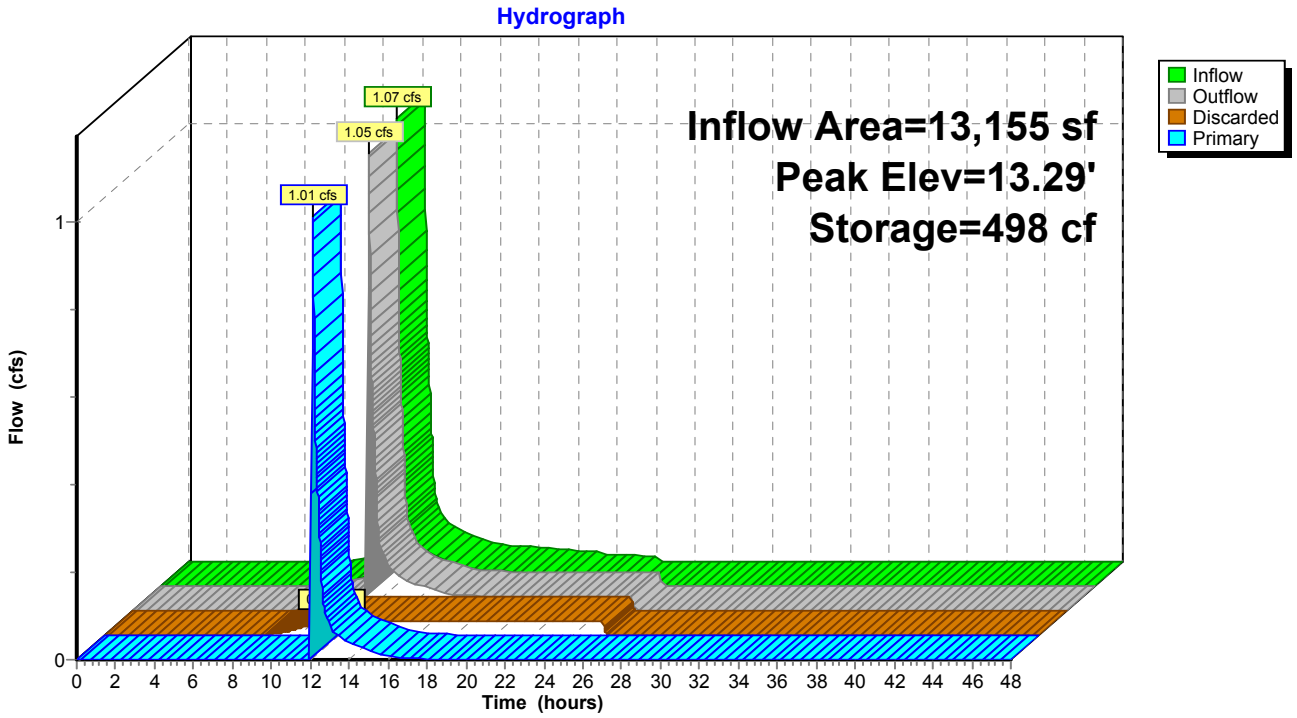
1,290.0 cf Field - 188.4 cf Chambers = 1,101.6 cf Stone x 35.0% Voids = 385.6 cf Stone Storage

Chamber Storage + Stone Storage = 531.4 cf = 0.012 af
Overall Storage Efficiency = 41.2%

9 Chambers
47.8 cy Field
40.8 cy Stone



Pond 3P: 12" Perf. Pipe



Summary for Pond 16P: 24" Perf. Pipe

Inflow Area = 32,150 sf,100.00% Impervious, Inflow Depth = 5.36" for 25-Year event
Inflow = 3.90 cfs @ 12.09 hrs, Volume= 14,367 cf
Outflow = 2.95 cfs @ 12.17 hrs, Volume= 14,367 cf, Atten= 24%, Lag= 4.4 min
Discarded = 0.11 cfs @ 8.91 hrs, Volume= 7,109 cf
Primary = 2.84 cfs @ 12.17 hrs, Volume= 7,257 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 15.40' @ 12.17 hrs Surf.Area= 1,998 sf Storage= 1,747 cf

Plug-Flow detention time= 28.7 min calculated for 14,364 cf (100% of inflow)
Center-of-Mass det. time= 28.7 min (800.7 - 771.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	13.50'	2,319 cf	**9.00'W x 222.00'L x 3.33'H Field A** 6,660 cf Overall - 863 cf Embedded = 5,797 cf x 40.0% Voids
#2A	14.00'	682 cf	**ADS N-12 24** x 11 Inside #1 Inside= 23.8"W x 23.8"H => 3.10 sf x 20.00'L = 62.0 cf Outside= 28.0"W x 28.0"H => 3.92 sf x 20.00'L = 78.4 cf
		3,001 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	13.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Device 3	14.25'	**12.0" W x 8.0" H Vert. Orifice/Grate** C= 0.600
#3	Primary	14.00'	**12.0" Round Culvert** L= 18.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 14.00' / 13.80' S= 0.0111 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#4	Device 3	16.50'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.11 cfs @ 8.91 hrs HW=13.53' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=2.84 cfs @ 12.17 hrs HW=15.40' (Free Discharge)
└**3=Culvert** (Inlet Controls 2.84 cfs @ 3.61 fps)
  └**2=Orifice/Grate** (Passes 2.84 cfs of 2.88 cfs potential flow)
  └**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 16P: 24" Perf. Pipe - Chamber Wizard Field A

Chamber Model = ADS N-12 24 (ADS N-12® Pipe)
Inside= 23.8"W x 23.8"H => 3.10 sf x 20.00'L = 62.0 cf
Outside= 28.0"W x 28.0"H => 3.92 sf x 20.00'L = 78.4 cf

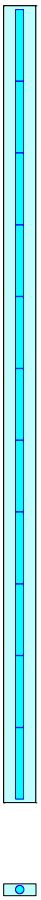
11 Chambers/Row x 20.00' Long = 220.00' Row Length +12.0" End Stone x 2 = 222.00' Base Length
1 Rows x 28.0" Wide + 40.0" Side Stone x 2 = 9.00' Base Width
6.0" Base + 28.0" Chamber Height + 6.0" Cover = 3.33' Field Height

11 Chambers x 62.0 cf = 682.0 cf Chamber Storage
11 Chambers x 78.4 cf = 862.7 cf Displacement

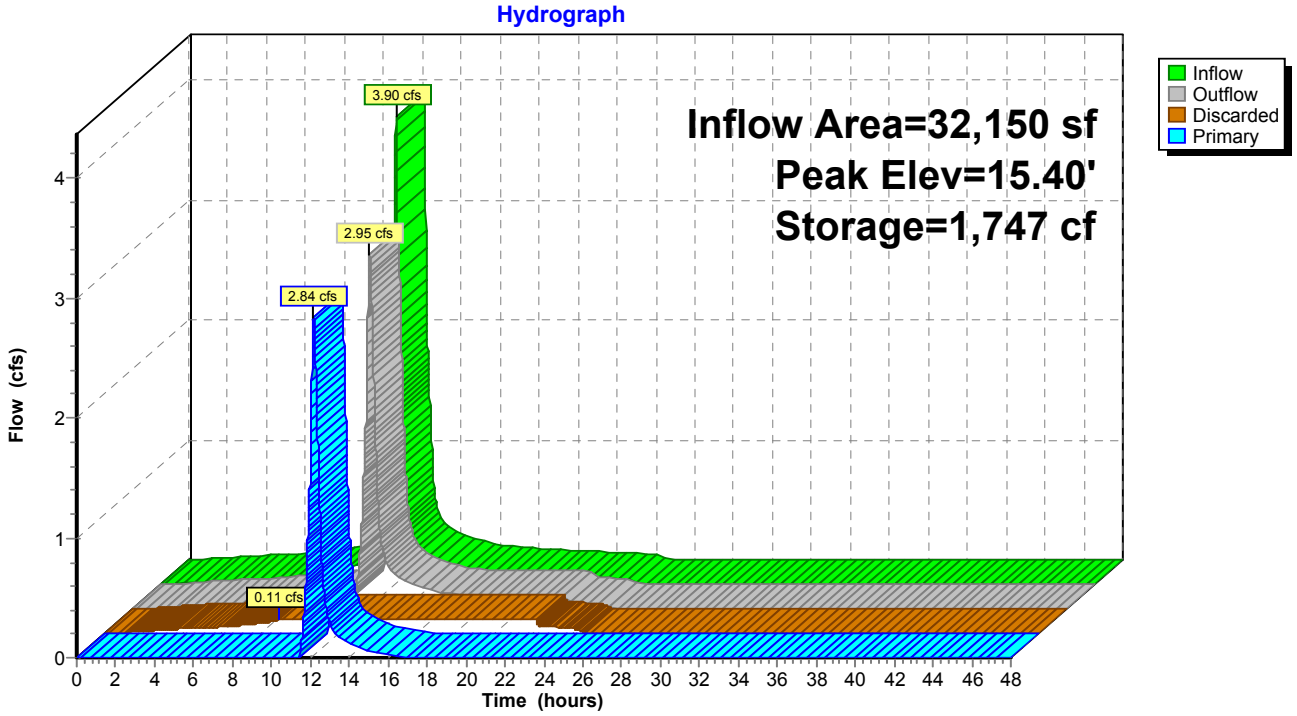
6,660.1 cf Field - 862.7 cf Chambers = 5,797.4 cf Stone x 40.0% Voids = 2,319.0 cf Stone Storage

Chamber Storage + Stone Storage = 3,001.0 cf = 0.069 af
Overall Storage Efficiency = 45.1%

11 Chambers
246.7 cy Field
214.7 cy Stone



Pond 16P: 24" Perf. Pipe



Summary for Pond 20P: Bioretention Area

Inflow Area = 15,000 sf,100.00% Impervious, Inflow Depth = 5.36" for 25-Year event
Inflow = 1.89 cfs @ 12.08 hrs, Volume= 6,703 cf
Outflow = 1.79 cfs @ 12.11 hrs, Volume= 6,703 cf, Atten= 5%, Lag= 1.6 min
Primary = 0.08 cfs @ 12.11 hrs, Volume= 3,567 cf
Secondary = 1.71 cfs @ 12.11 hrs, Volume= 3,136 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 20.69' @ 12.11 hrs Surf.Area= 1,406 sf Storage= 839 cf

Plug-Flow detention time= 55.1 min calculated for 6,703 cf (100% of inflow)
Center-of-Mass det. time= 55.1 min (801.3 - 746.2)

Volume	Invert	Avail.Storage	Storage Description
#1	19.75'	1,326 cf	**Bioretention (Prismatic)**Listed below (Recalc)

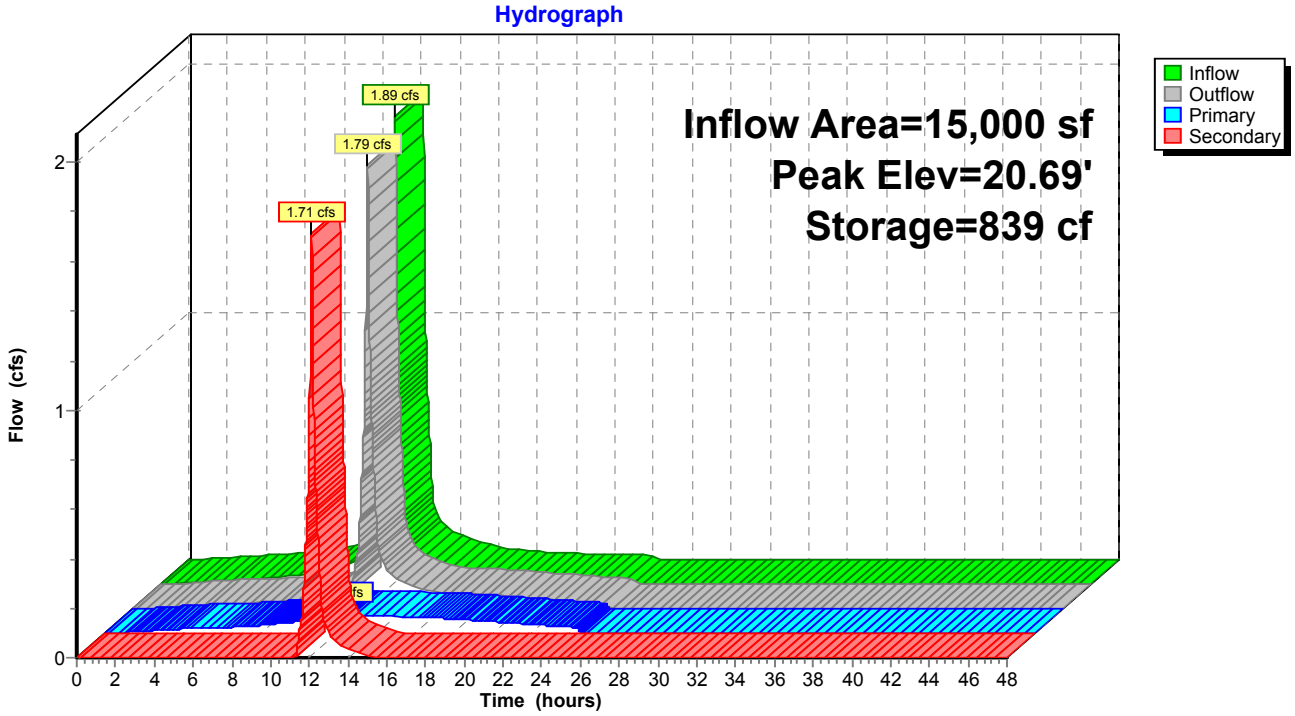
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
19.75	345	0	0
20.00	660	126	126
21.00	1,740	1,200	1,326

Device	Routing	Invert	Outlet Devices
#1	Primary	19.75'	**2.410 in/hr Flow through Bioretention over Horizontal area**
#2	Secondary	20.50'	**12.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.08 cfs @ 12.11 hrs HW=20.69' (Free Discharge)
└**1=Flow through Bioretention** (Exfiltration Controls 0.08 cfs)

Secondary OutFlow Max=1.71 cfs @ 12.11 hrs HW=20.69' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 1.71 cfs @ 1.43 fps)

Pond 20P: Bioretention Area



Summary for Pond 23P: Bioretention Area

Inflow Area = 13,155 sf, 0.00% Impervious, Inflow Depth = 3.04" for 25-Year event
Inflow = 1.08 cfs @ 12.09 hrs, Volume= 3,330 cf
Outflow = 1.07 cfs @ 12.10 hrs, Volume= 3,330 cf, Atten= 1%, Lag= 0.6 min
Primary = 0.04 cfs @ 12.10 hrs, Volume= 1,534 cf
Secondary = 1.03 cfs @ 12.10 hrs, Volume= 1,796 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 17.82' @ 12.10 hrs Surf.Area= 762 sf Storage= 179 cf

Plug-Flow detention time= 18.4 min calculated for 3,329 cf (100% of inflow)
Center-of-Mass det. time= 18.4 min (845.5 - 827.1)

Volume	Invert	Avail.Storage	Storage Description
#1	17.50'	341 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

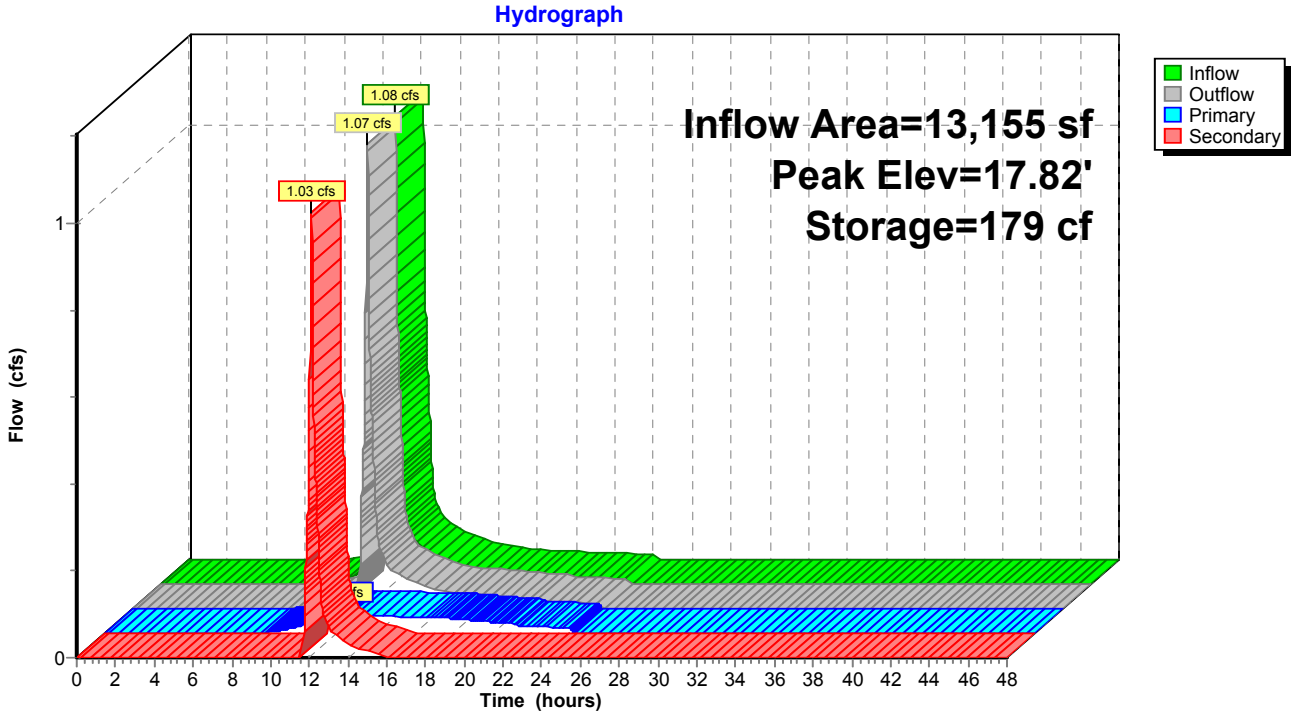
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
17.50	376	0	0
18.00	989	341	341

Device	Routing	Invert	Outlet Devices
#1	Primary	17.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Secondary	17.75'	**24.0" Horiz. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.04 cfs @ 12.10 hrs HW=17.82' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=1.02 cfs @ 12.10 hrs HW=17.82' (Free Discharge)
↑—**2=Orifice/Grate** (Weir Controls 1.02 cfs @ 0.83 fps)

Pond 23P: Bioretention Area



Summary for Pond 25P: Drywell

Inflow Area = 5,881 sf,100.00% Impervious, Inflow Depth = 5.36" for 25-Year event
Inflow = 0.74 cfs @ 12.08 hrs, Volume= 2,628 cf
Outflow = 0.74 cfs @ 12.08 hrs, Volume= 2,627 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 12.08 hrs, Volume= 472 cf
Primary = 0.74 cfs @ 12.08 hrs, Volume= 2,155 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 22.08' @ 12.08 hrs Surf.Area= 69 sf Storage= 243 cf

Plug-Flow detention time= 159.5 min calculated for 2,627 cf (100% of inflow)
Center-of-Mass det. time= 159.6 min (905.8 - 746.2)

Volume	Invert	Avail.Storage	Storage Description
#1	15.50'	170 cf	**6.00'D x 6.00'H Dry Well** Inside #2
#2	15.00'	73 cf	**8.00'D x 7.00'H Stone** 352 cf Overall - 170 cf Embedded = 182 cf x 40.0% Voids
#3	22.00'	26 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		269 cf	Total Available Storage

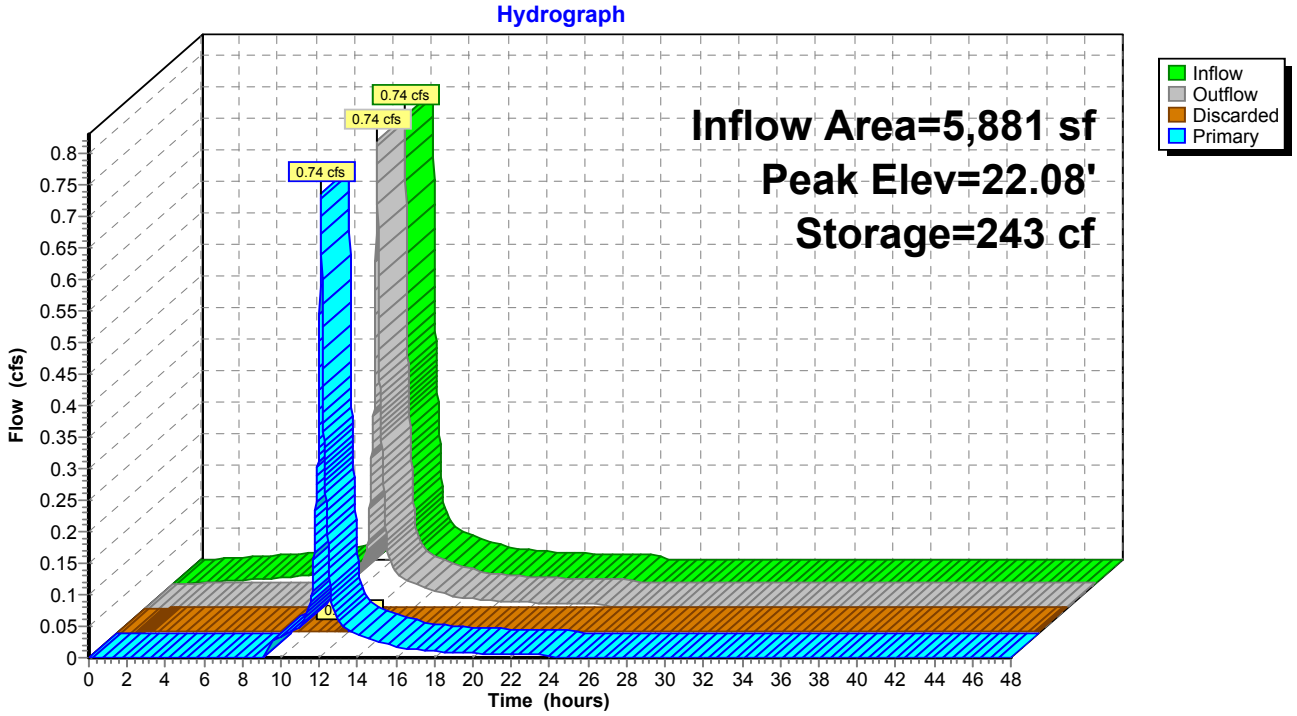
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
22.00	4	0	0
22.50	100	26	26

Device	Routing	Invert	Outlet Devices
#1	Primary	21.95'	**24.0" x 24.0" Horiz. Orifice/Grate X 0.60** C= 0.600 Limited to weir flow at low heads
#2	Discarded	15.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 12.08 hrs HW=22.08' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.71 cfs @ 12.08 hrs HW=22.08' (Free Discharge)
↑—**1=Orifice/Grate** (Weir Controls 0.71 cfs @ 0.70 fps)

Pond 25P: Drywell



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2S: Gravel Parking to Runoff Area=13,155 sf 0.00% Impervious Runoff Depth=4.26"
Tc=6.0 min CN=76 Runoff=1.50 cfs 4,667 cf

Subcatchment11S: SMAST II Runoff Area=101,928 sf 33.20% Impervious Runoff Depth=3.41"
Tc=6.0 min CN=68 Runoff=9.33 cfs 28,966 cf

Subcatchment17S: New Roof to Perf. Runoff Area=15,000 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=2.36 cfs 8,451 cf

Subcatchment20S: Easement Area Runoff Area=46,697 sf 5.13% Impervious Runoff Depth=1.41"
Tc=6.0 min CN=47 Runoff=1.43 cfs 5,468 cf

Subcatchment21S: Parking to Runoff Area=15,000 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=2.36 cfs 8,451 cf

Subcatchment22S: Pavement to Perf. Pipe Runoff Area=2,150 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=0.34 cfs 1,211 cf

Subcatchment24S: Easement Parking Runoff Area=5,881 sf 100.00% Impervious Runoff Depth=6.76"
Tc=6.0 min CN=98 Runoff=0.93 cfs 3,313 cf

Reach PR: Offsite Inflow=16.07 cfs 50,118 cf
Outflow=16.07 cfs 50,118 cf

Pond 3P: 12" Perf. Pipe Peak Elev=13.38' Storage=514 cf Inflow=1.50 cfs 4,667 cf
Discarded=0.03 cfs 2,073 cf Primary=1.45 cfs 2,594 cf Outflow=1.48 cfs 4,667 cf

Pond 16P: 24" Perf. Pipe Peak Elev=15.78' Storage=2,131 cf Inflow=4.90 cfs 18,114 cf
Discarded=0.11 cfs 7,860 cf Primary=3.38 cfs 10,254 cf Outflow=3.49 cfs 18,114 cf

Pond 20P: Bioretention Area Peak Elev=20.72' Storage=886 cf Inflow=2.36 cfs 8,451 cf
Primary=0.08 cfs 4,010 cf Secondary=2.17 cfs 4,441 cf Outflow=2.25 cfs 8,451 cf

Pond 23P: Bioretention Area Peak Elev=17.83' Storage=193 cf Inflow=1.50 cfs 4,667 cf
Primary=0.04 cfs 1,808 cf Secondary=1.45 cfs 2,859 cf Outflow=1.50 cfs 4,667 cf

Pond 25P: Drywell Peak Elev=22.10' Storage=244 cf Inflow=0.93 cfs 3,313 cf
Discarded=0.00 cfs 476 cf Primary=0.92 cfs 2,837 cf Outflow=0.93 cfs 3,313 cf

Total Runoff Area = 199,811 sf Runoff Volume = 60,528 cf Average Runoff Depth = 3.64"
62.83% Pervious = 125,540 sf 37.17% Impervious = 74,271 sf

Summary for Subcatchment 2S: Gravel Parking to Bioretention

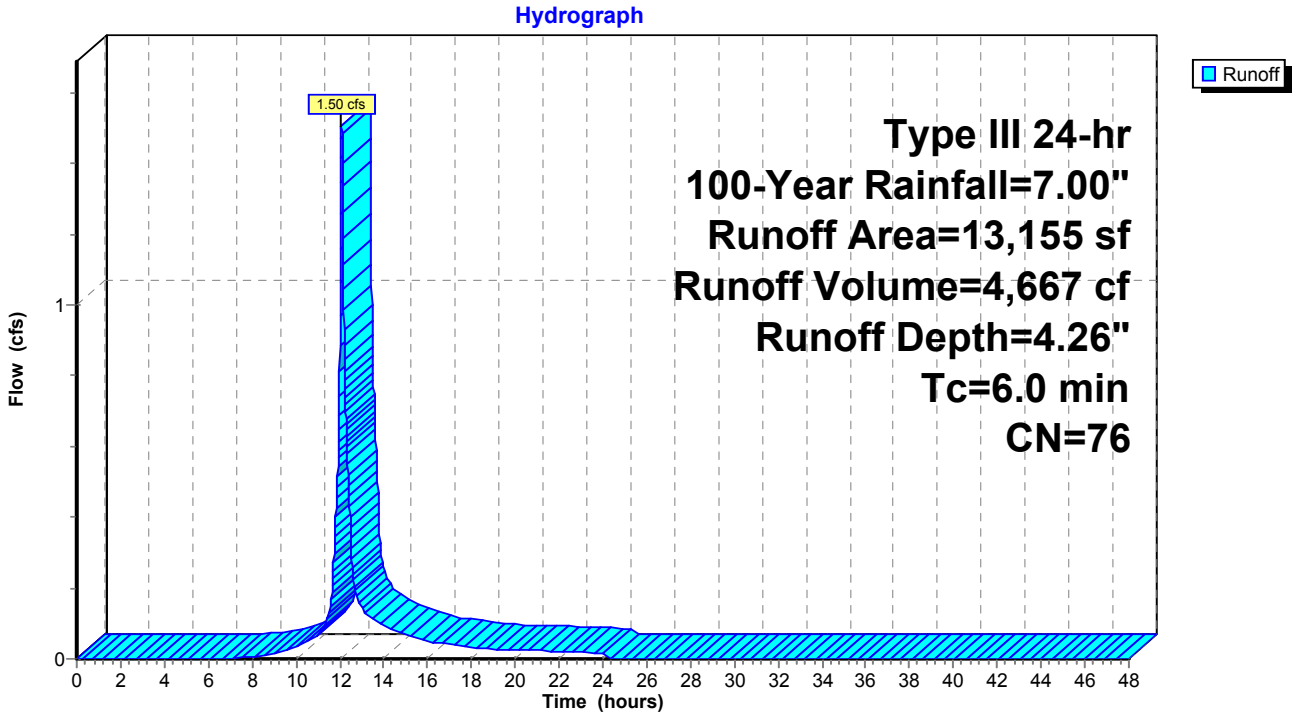
Runoff = 1.50 cfs @ 12.09 hrs, Volume= 4,667 cf, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.00"

Area (sf)	CN	Description
13,155	76	Gravel roads, HSG A
13,155		100.00% Pervious Area

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

Subcatchment 2S: Gravel Parking to Bioretention



Summary for Subcatchment 11S: SMAST II

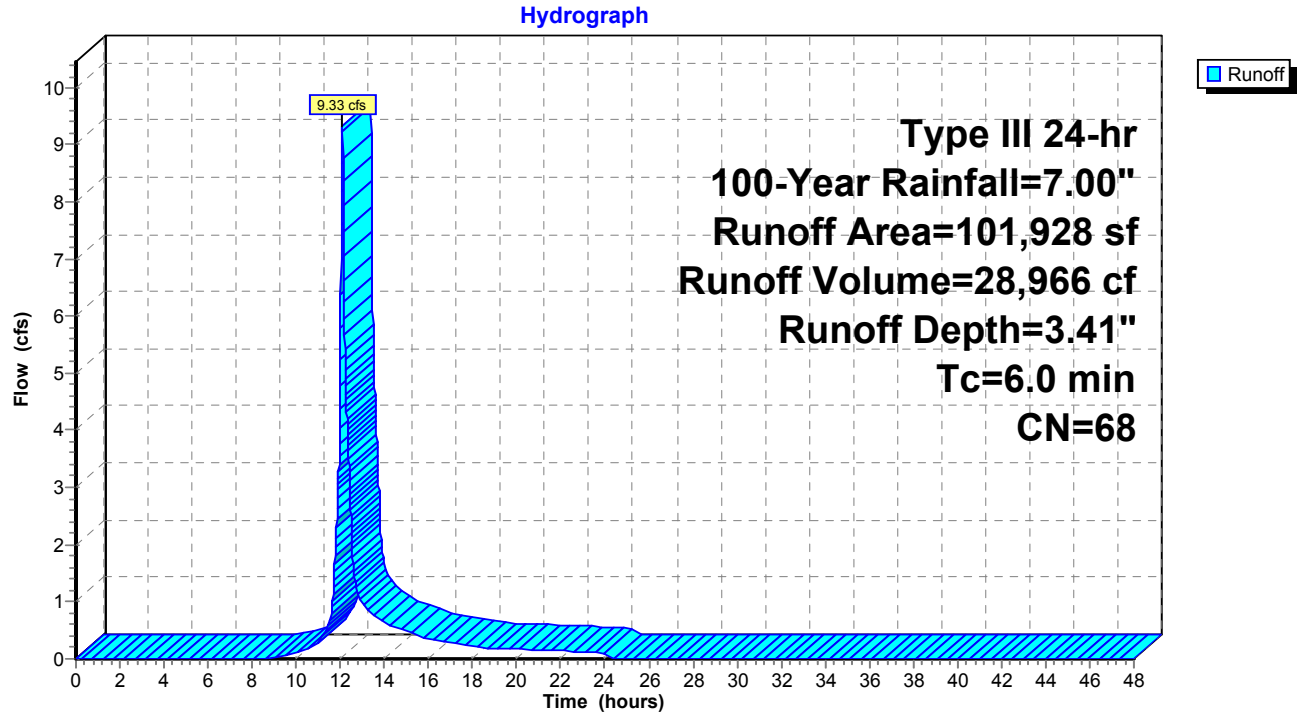
Runoff = 9.33 cfs @ 12.09 hrs, Volume= 28,966 cf, Depth= 3.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.00"

	Area (sf)	CN	Description
	34,630	49	50-75% Grass cover, Fair, HSG A
	16,771	76	Gravel roads, HSG A
*	16,943	98	impervious
*	16,901	98	roof
	13,024	30	Woods, Good, HSG A
	3,659	76	Gravel roads, HSG A
	101,928	68	Weighted Average
	68,084		66.80% Pervious Area
	33,844		33.20% Impervious Area

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

Subcatchment 11S: SMAST II



Summary for Subcatchment 17S: New Roof to Perf. Pipe

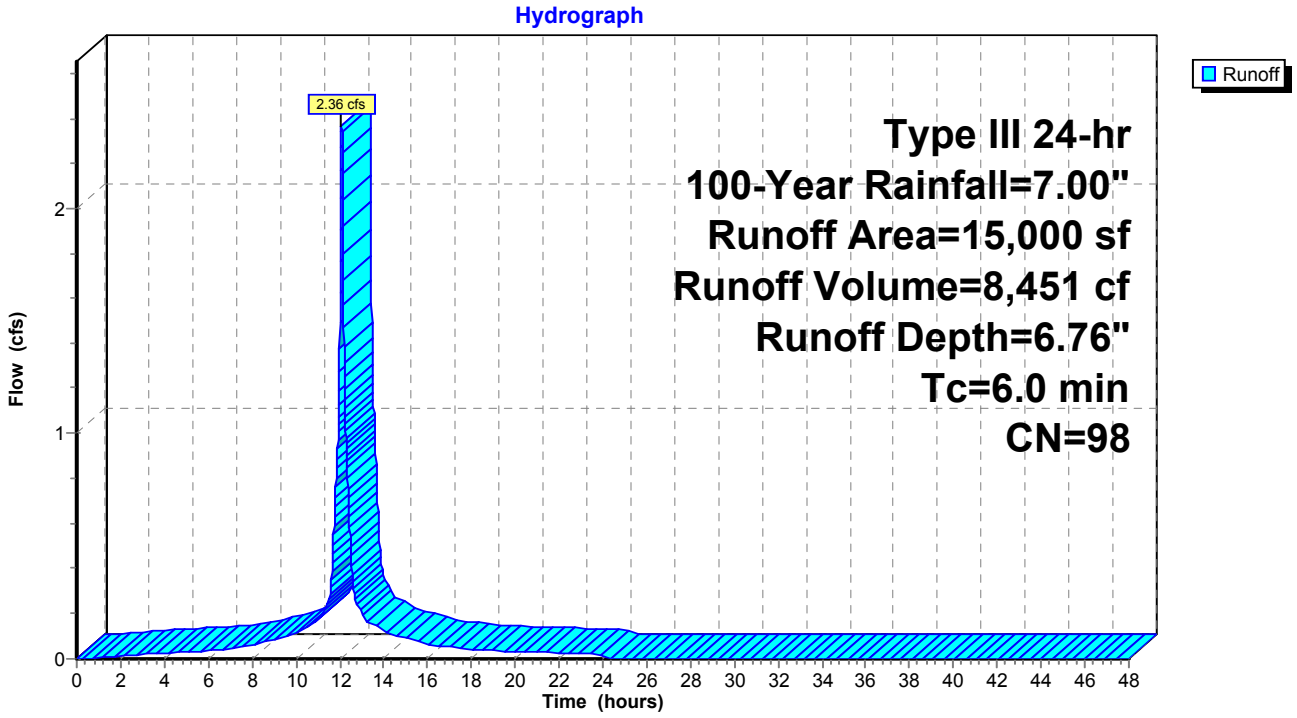
Runoff = 2.36 cfs @ 12.08 hrs, Volume= 8,451 cf, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.00"

	Area (sf)	CN	Description
*	15,000	98	roof
	15,000		100.00% Impervious Area

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

Subcatchment 17S: New Roof to Perf. Pipe



Summary for Subcatchment 20S: Easement Area

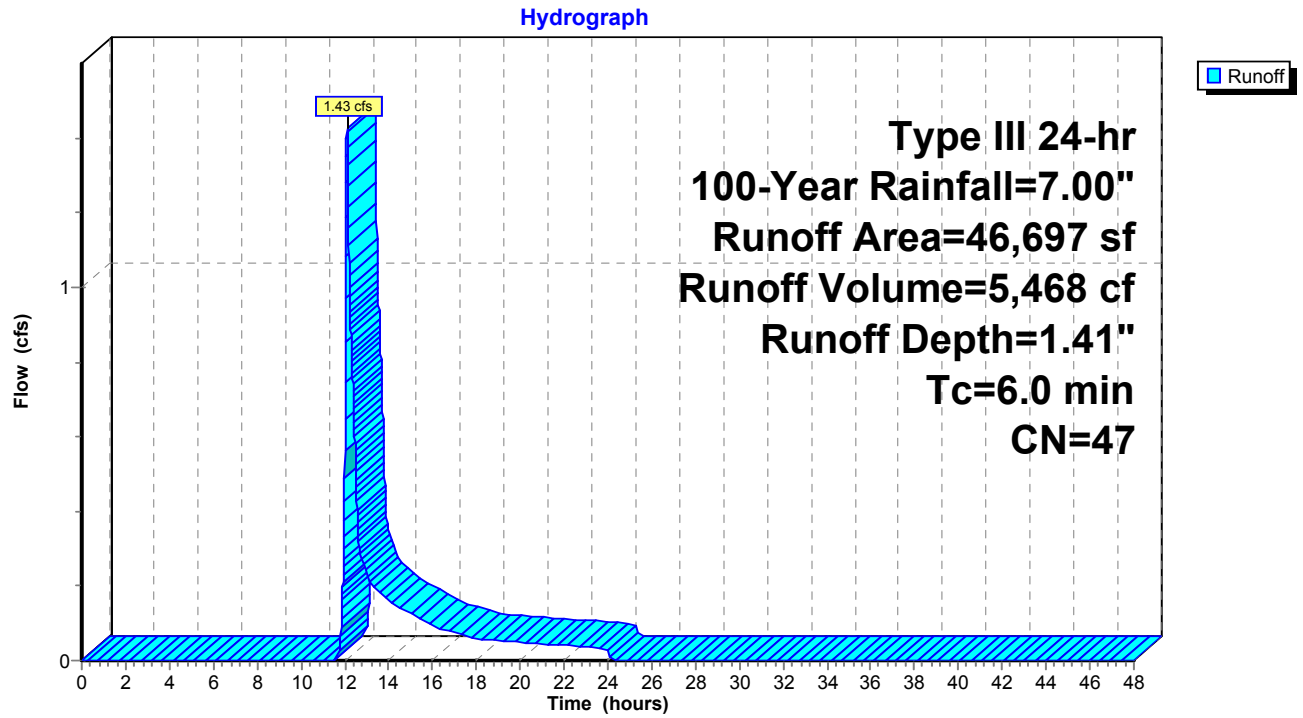
Runoff = 1.43 cfs @ 12.11 hrs, Volume= 5,468 cf, Depth= 1.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.00"

	Area (sf)	CN	Description
*	2,396	98	impervious
	35,545	36	Woods, Fair, HSG A
	8,756	76	Gravel roads, HSG A
	46,697	47	Weighted Average
	44,301		94.87% Pervious Area
	2,396		5.13% Impervious Area

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

Subcatchment 20S: Easement Area



Summary for Subcatchment 21S: Parking to Bioretention

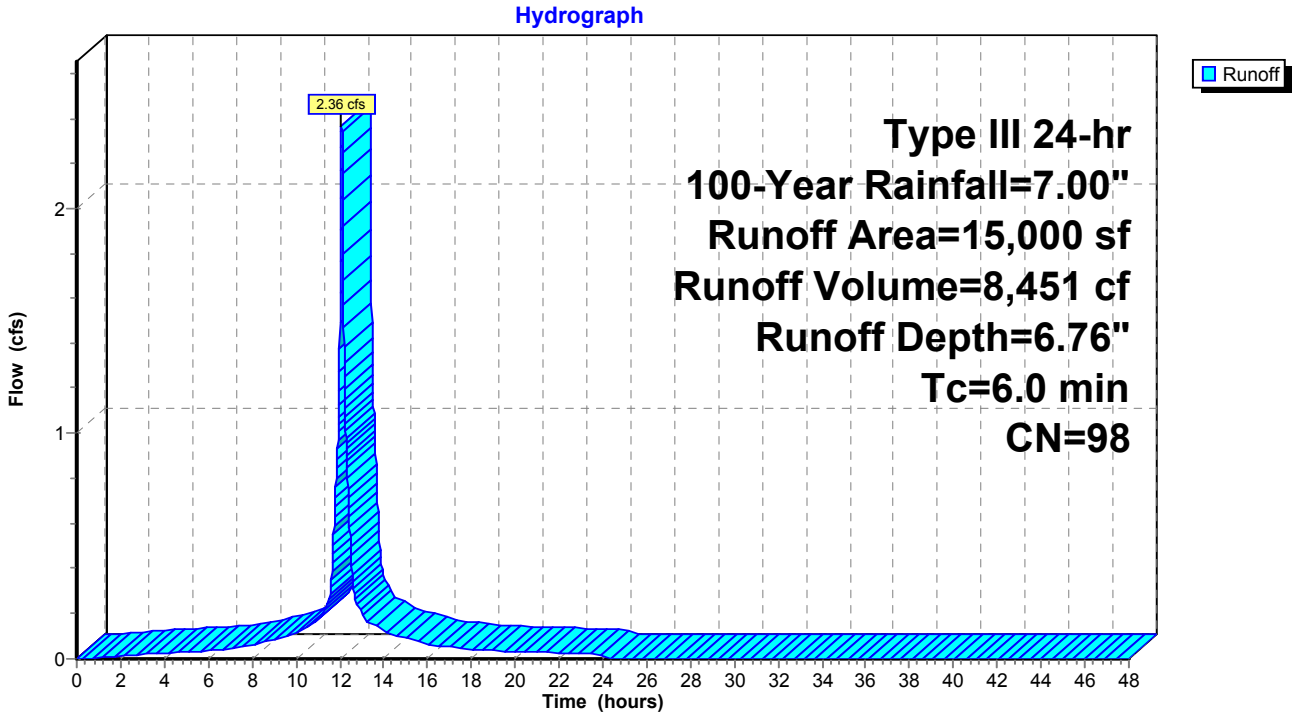
Runoff = 2.36 cfs @ 12.08 hrs, Volume= 8,451 cf, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.00"

	Area (sf)	CN	Description
*	15,000	98	parking
	15,000		100.00% Impervious Area

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

Subcatchment 21S: Parking to Bioretention



Summary for Subcatchment 22S: Pavement to Perf. Pipe

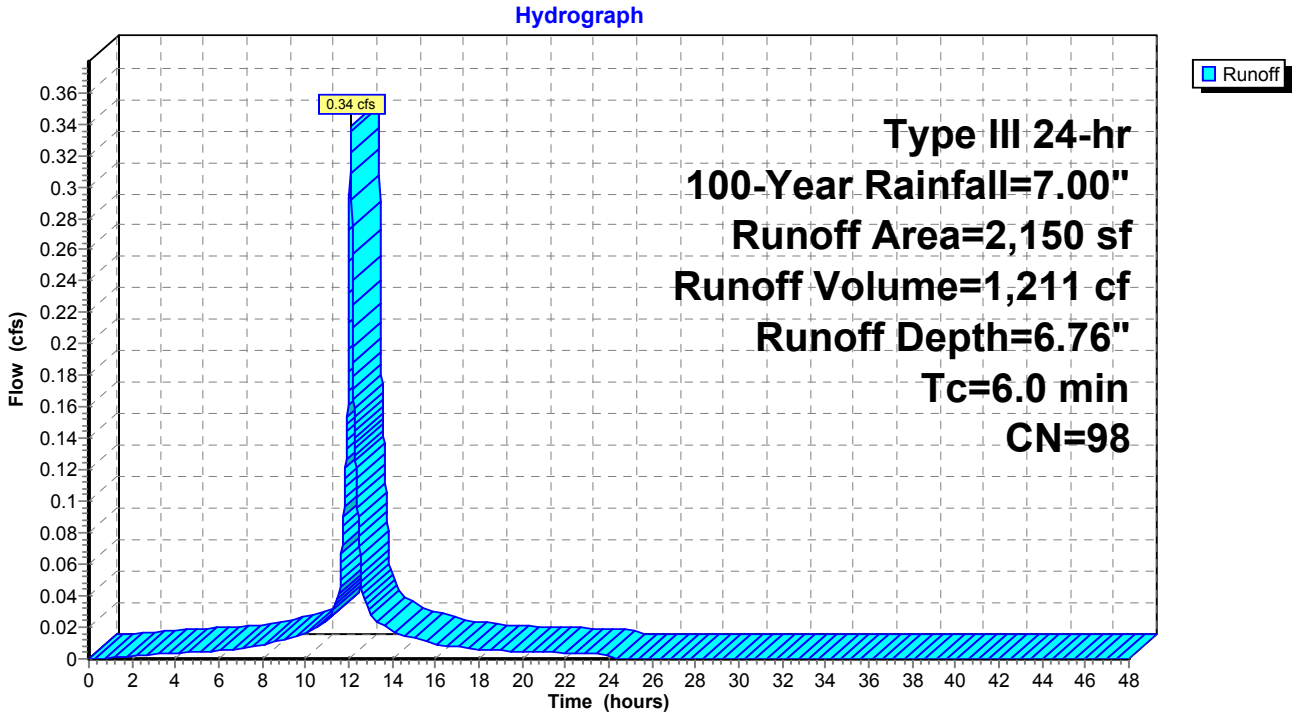
Runoff = 0.34 cfs @ 12.08 hrs, Volume= 1,211 cf, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.00"

	Area (sf)	CN	Description
*	2,150	98	pavement
	2,150		100.00% Impervious Area

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

Subcatchment 22S: Pavement to Perf. Pipe



Summary for Subcatchment 24S: Easement Parking Area

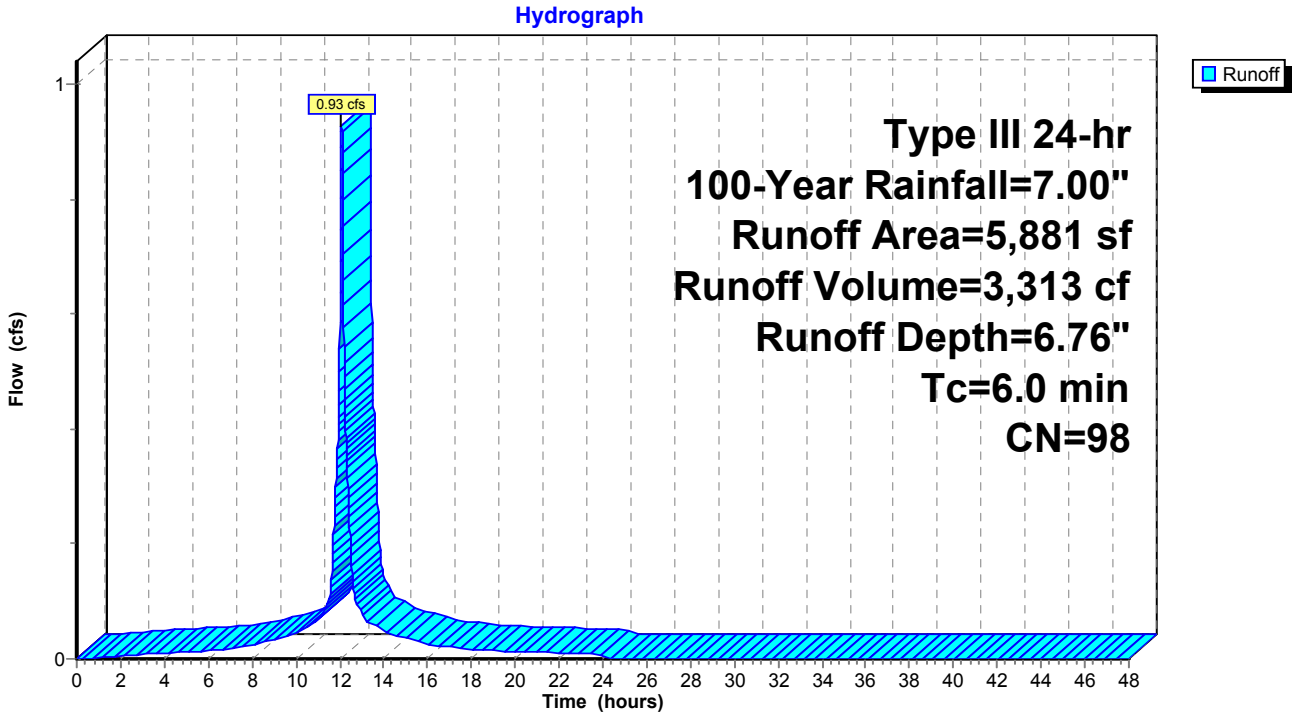
Runoff = 0.93 cfs @ 12.08 hrs, Volume= 3,313 cf, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=7.00"

	Area (sf)	CN	Description
*	5,881	98	pavement
	5,881		100.00% Impervious Area

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

Subcatchment 24S: Easement Parking Area



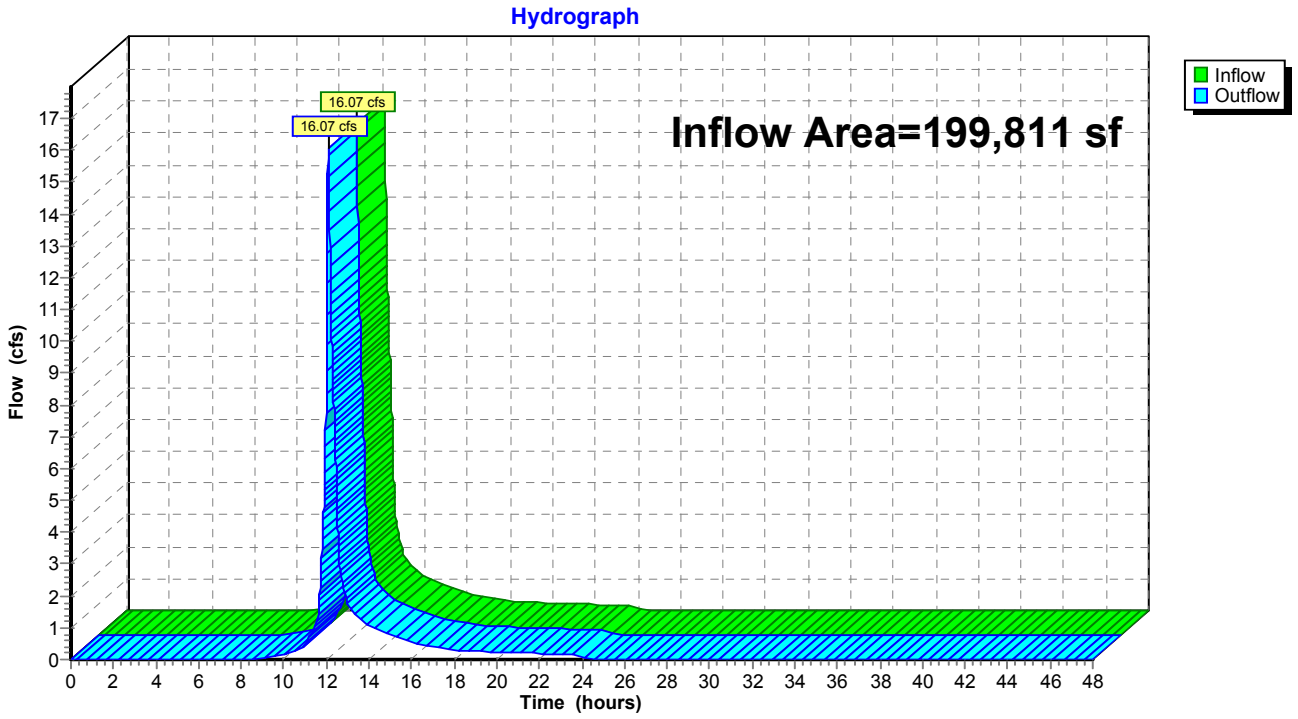
Summary for Reach PR: Offsite

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 199,811 sf, 37.17% Impervious, Inflow Depth = 3.01" for 100-Year event
Inflow = 16.07 cfs @ 12.10 hrs, Volume= 50,118 cf
Outflow = 16.07 cfs @ 12.10 hrs, Volume= 50,118 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Reach PR: Offsite



Summary for Pond 3P: 12" Perf. Pipe

Inflow Area = 13,155 sf, 0.00% Impervious, Inflow Depth = 4.26" for 100-Year event
Inflow = 1.50 cfs @ 12.10 hrs, Volume= 4,667 cf
Outflow = 1.48 cfs @ 12.11 hrs, Volume= 4,667 cf, Atten= 1%, Lag= 0.6 min
Discarded = 0.03 cfs @ 11.00 hrs, Volume= 2,073 cf
Primary = 1.45 cfs @ 12.11 hrs, Volume= 2,594 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 13.38' @ 12.11 hrs Surf.Area= 584 sf Storage= 514 cf

Plug-Flow detention time= 74.5 min calculated for 4,667 cf (100% of inflow)
Center-of-Mass det. time= 74.5 min (909.1 - 834.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	11.25'	386 cf	**3.21'W x 182.00'L x 2.21'H Field A** 1,290 cf Overall - 188 cf Embedded = 1,102 cf x 35.0% Voids
#2A	11.75'	146 cf	**ADS N-12 12** x 9 Inside #1 Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf
		531 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	11.25'	**2.410 in/hr Exfiltration over Surface area**
#2	Device 3	13.00'	**2.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Primary	11.10'	**12.0" Round Culvert** L= 50.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 11.10' / 11.00' S= 0.0020 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.03 cfs @ 11.00 hrs HW=11.27' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=1.45 cfs @ 12.11 hrs HW=13.38' (Free Discharge)
└**3=Culvert** (Passes 1.45 cfs of 3.97 cfs potential flow)
└**2=Sharp-Crested Rectangular Weir** (Weir Controls 1.45 cfs @ 2.00 fps)

Pond 3P: 12" Perf. Pipe - Chamber Wizard Field A

Chamber Model = ADS N-12 12 (ADS N-12® Pipe)
Inside= 12.2"W x 12.2"H => 0.81 sf x 20.00'L = 16.2 cf
Outside= 14.5"W x 14.5"H => 1.05 sf x 20.00'L = 20.9 cf

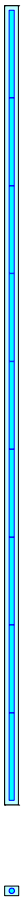
9 Chambers/Row x 20.00' Long = 180.00' Row Length +12.0" End Stone x 2 = 182.00' Base Length
1 Rows x 14.5" Wide + 12.0" Side Stone x 2 = 3.21' Base Width
6.0" Base + 14.5" Chamber Height + 6.0" Cover = 2.21' Field Height

9 Chambers x 16.2 cf = 145.8 cf Chamber Storage
9 Chambers x 20.9 cf = 188.4 cf Displacement

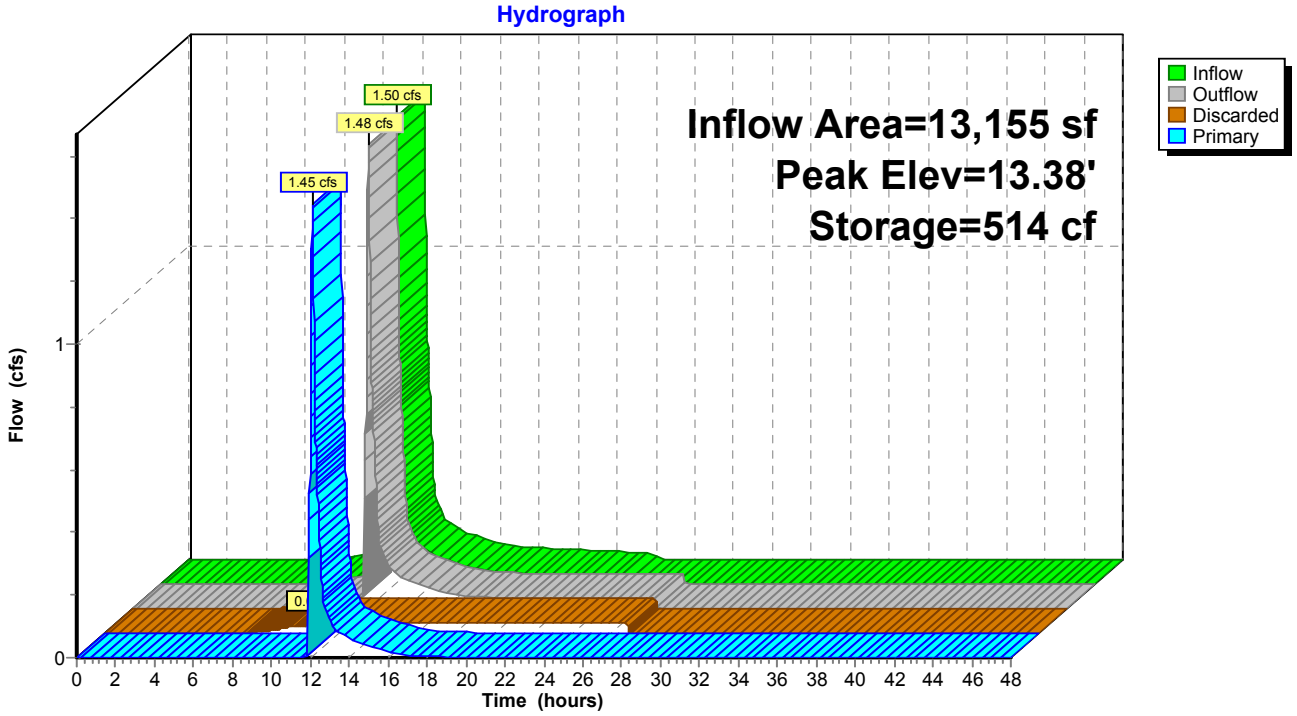
1,290.0 cf Field - 188.4 cf Chambers = 1,101.6 cf Stone x 35.0% Voids = 385.6 cf Stone Storage

Chamber Storage + Stone Storage = 531.4 cf = 0.012 af
Overall Storage Efficiency = 41.2%

9 Chambers
47.8 cy Field
40.8 cy Stone



Pond 3P: 12" Perf. Pipe



Summary for Pond 16P: 24" Perf. Pipe

Inflow Area = 32,150 sf,100.00% Impervious, Inflow Depth = 6.76" for 100-Year event
Inflow = 4.90 cfs @ 12.09 hrs, Volume= 18,114 cf
Outflow = 3.49 cfs @ 12.18 hrs, Volume= 18,114 cf, Atten= 29%, Lag= 5.0 min
Discarded = 0.11 cfs @ 8.23 hrs, Volume= 7,860 cf
Primary = 3.38 cfs @ 12.18 hrs, Volume= 10,254 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 15.78' @ 12.18 hrs Surf.Area= 1,998 sf Storage= 2,131 cf

Plug-Flow detention time= 28.1 min calculated for 18,110 cf (100% of inflow)
Center-of-Mass det. time= 28.1 min (795.5 - 767.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	13.50'	2,319 cf	**9.00'W x 222.00'L x 3.33'H Field A** 6,660 cf Overall - 863 cf Embedded = 5,797 cf x 40.0% Voids
#2A	14.00'	682 cf	**ADS N-12 24** x 11 Inside #1 Inside= 23.8"W x 23.8"H => 3.10 sf x 20.00'L = 62.0 cf Outside= 28.0"W x 28.0"H => 3.92 sf x 20.00'L = 78.4 cf
		3,001 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	13.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Device 3	14.25'	**12.0" W x 8.0" H Vert. Orifice/Grate** C= 0.600
#3	Primary	14.00'	**12.0" Round Culvert** L= 18.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 14.00' / 13.80' S= 0.0111 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#4	Device 3	16.50'	**6.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.11 cfs @ 8.23 hrs HW=13.53' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=3.38 cfs @ 12.18 hrs HW=15.78' (Free Discharge)
└**3=Culvert** (Inlet Controls 3.38 cfs @ 4.30 fps)
  └**2=Orifice/Grate** (Passes 3.38 cfs of 3.50 cfs potential flow)
  └**4=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 16P: 24" Perf. Pipe - Chamber Wizard Field A

Chamber Model = ADS N-12 24 (ADS N-12® Pipe)
Inside= 23.8"W x 23.8"H => 3.10 sf x 20.00'L = 62.0 cf
Outside= 28.0"W x 28.0"H => 3.92 sf x 20.00'L = 78.4 cf

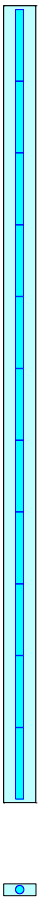
11 Chambers/Row x 20.00' Long = 220.00' Row Length +12.0" End Stone x 2 = 222.00' Base Length
1 Rows x 28.0" Wide + 40.0" Side Stone x 2 = 9.00' Base Width
6.0" Base + 28.0" Chamber Height + 6.0" Cover = 3.33' Field Height

11 Chambers x 62.0 cf = 682.0 cf Chamber Storage
11 Chambers x 78.4 cf = 862.7 cf Displacement

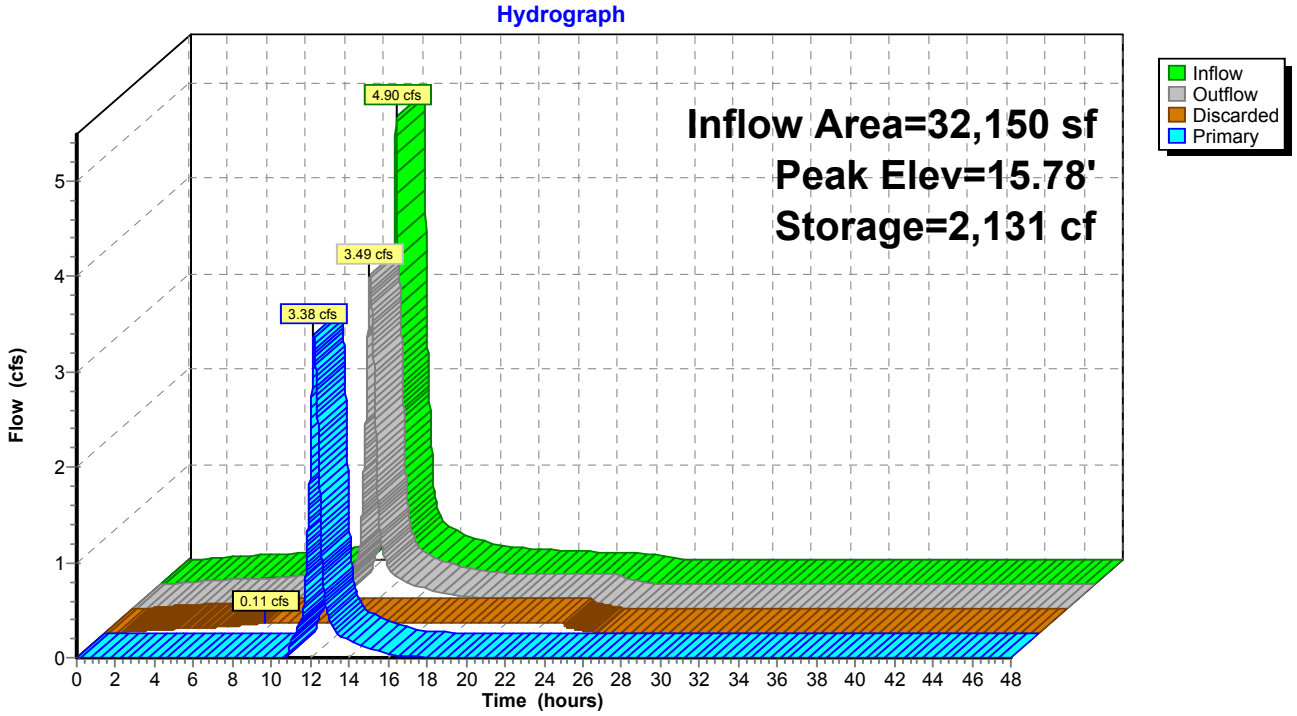
6,660.1 cf Field - 862.7 cf Chambers = 5,797.4 cf Stone x 40.0% Voids = 2,319.0 cf Stone Storage

Chamber Storage + Stone Storage = 3,001.0 cf = 0.069 af
Overall Storage Efficiency = 45.1%

11 Chambers
246.7 cy Field
214.7 cy Stone



Pond 16P: 24" Perf. Pipe



Summary for Pond 20P: Bioretention Area

Inflow Area = 15,000 sf,100.00% Impervious, Inflow Depth = 6.76" for 100-Year event
Inflow = 2.36 cfs @ 12.08 hrs, Volume= 8,451 cf
Outflow = 2.25 cfs @ 12.11 hrs, Volume= 8,451 cf, Atten= 5%, Lag= 1.5 min
Primary = 0.08 cfs @ 12.11 hrs, Volume= 4,010 cf
Secondary = 2.17 cfs @ 12.11 hrs, Volume= 4,441 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 20.72' @ 12.11 hrs Surf.Area= 1,442 sf Storage= 886 cf

Plug-Flow detention time= 52.3 min calculated for 8,449 cf (100% of inflow)
Center-of-Mass det. time= 52.3 min (795.3 - 743.0)

Volume	Invert	Avail.Storage	Storage Description
#1	19.75'	1,326 cf	**Bioretention (Prismatic)**Listed below (Recalc)

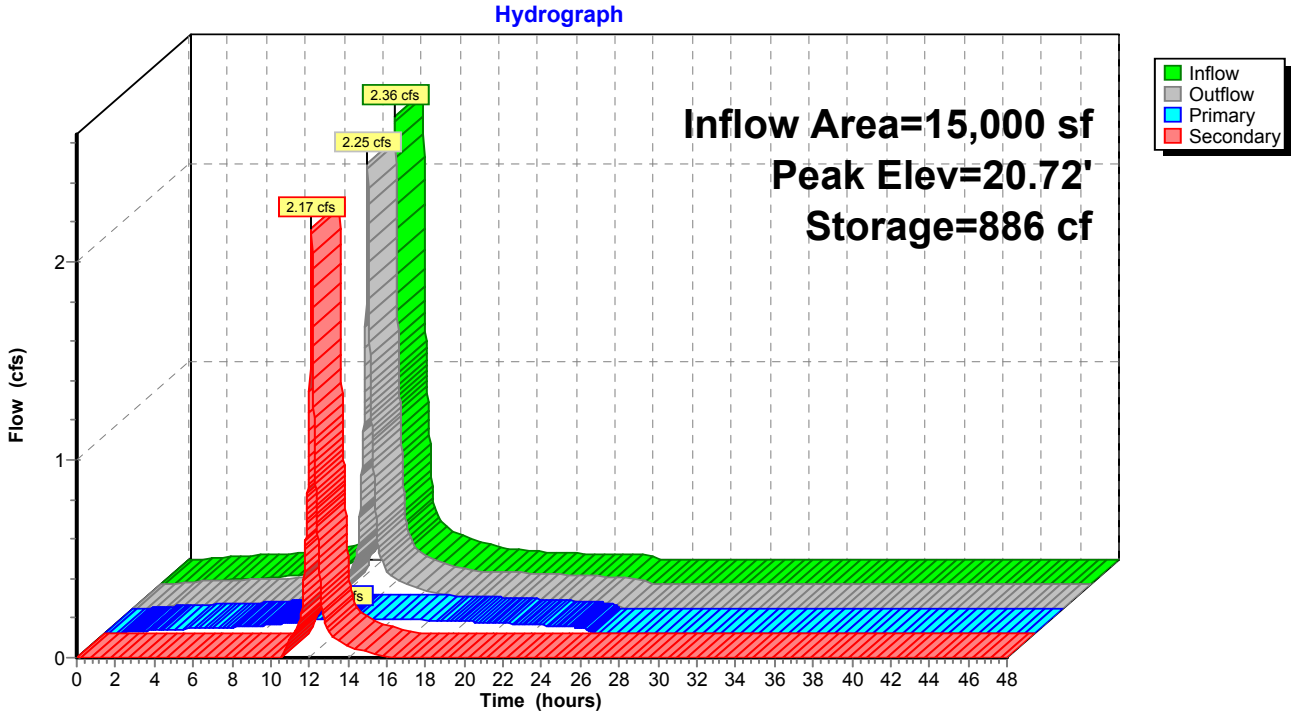
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
19.75	345	0	0
20.00	660	126	126
21.00	1,740	1,200	1,326

Device	Routing	Invert	Outlet Devices
#1	Primary	19.75'	**2.410 in/hr Flow through Bioretention over Horizontal area**
#2	Secondary	20.50'	**12.0" Horiz. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.08 cfs @ 12.11 hrs HW=20.72' (Free Discharge)
└**1=Flow through Bioretention** (Exfiltration Controls 0.08 cfs)

Secondary OutFlow Max=2.17 cfs @ 12.11 hrs HW=20.72' (Free Discharge)
└**2=Orifice/Grate** (Weir Controls 2.17 cfs @ 1.55 fps)

Pond 20P: Bioretention Area



Summary for Pond 23P: Bioretention Area

Inflow Area = 13,155 sf, 0.00% Impervious, Inflow Depth = 4.26" for 100-Year event
Inflow = 1.50 cfs @ 12.09 hrs, Volume= 4,667 cf
Outflow = 1.50 cfs @ 12.10 hrs, Volume= 4,667 cf, Atten= 1%, Lag= 0.5 min
Primary = 0.04 cfs @ 12.10 hrs, Volume= 1,808 cf
Secondary = 1.45 cfs @ 12.10 hrs, Volume= 2,859 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 17.83' @ 12.10 hrs Surf.Area= 783 sf Storage= 193 cf

Plug-Flow detention time= 17.2 min calculated for 4,666 cf (100% of inflow)
Center-of-Mass det. time= 17.2 min (834.6 - 817.4)

Volume	Invert	Avail.Storage	Storage Description
#1	17.50'	341 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

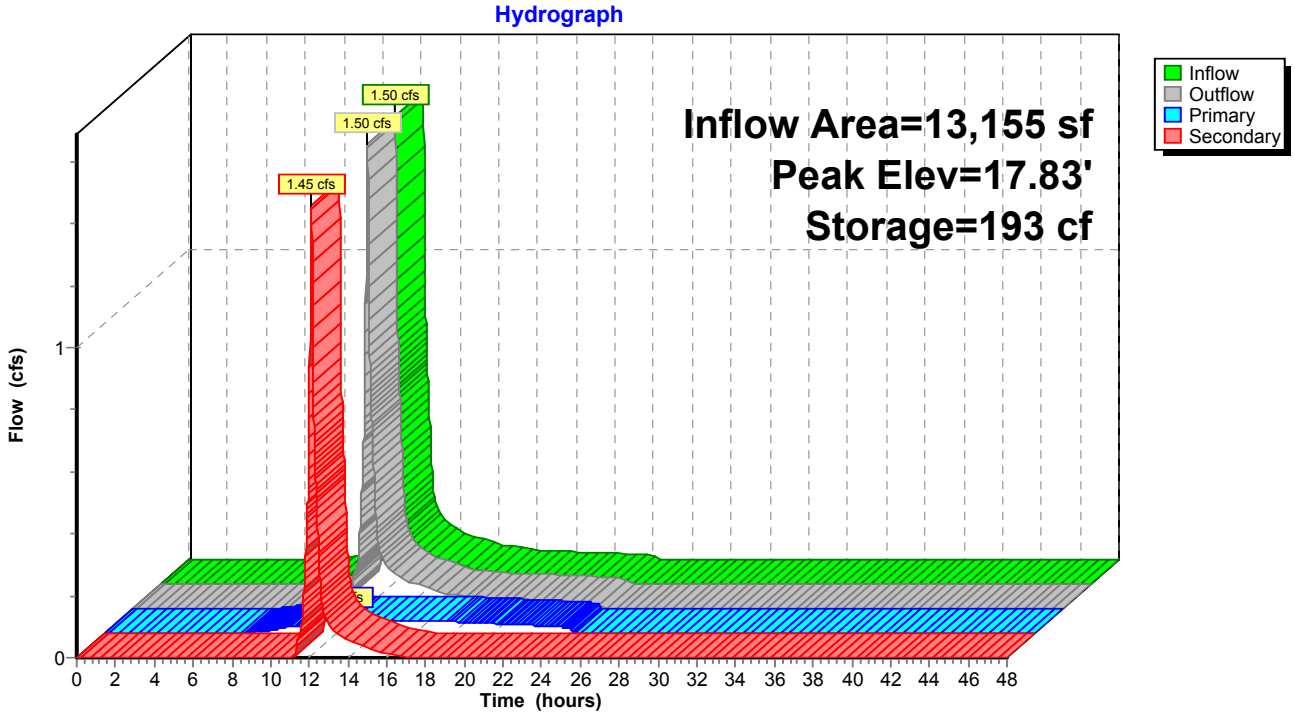
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
17.50	376	0	0
18.00	989	341	341

Device	Routing	Invert	Outlet Devices
#1	Primary	17.50'	**2.410 in/hr Exfiltration over Surface area**
#2	Secondary	17.75'	**24.0" Horiz. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.04 cfs @ 12.10 hrs HW=17.83' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Secondary OutFlow Max=1.45 cfs @ 12.10 hrs HW=17.83' (Free Discharge)
↑—**2=Orifice/Grate** (Weir Controls 1.45 cfs @ 0.94 fps)

Pond 23P: Bioretention Area



Summary for Pond 25P: Drywell

Inflow Area = 5,881 sf,100.00% Impervious, Inflow Depth = 6.76" for 100-Year event
Inflow = 0.93 cfs @ 12.08 hrs, Volume= 3,313 cf
Outflow = 0.93 cfs @ 12.08 hrs, Volume= 3,313 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 12.08 hrs, Volume= 476 cf
Primary = 0.92 cfs @ 12.08 hrs, Volume= 2,837 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 22.10' @ 12.08 hrs Surf.Area= 73 sf Storage= 244 cf

Plug-Flow detention time= 131.2 min calculated for 3,313 cf (100% of inflow)
Center-of-Mass det. time= 131.1 min (874.1 - 743.0)

Volume	Invert	Avail.Storage	Storage Description
#1	15.50'	170 cf	**6.00'D x 6.00'H Dry Well** Inside #2
#2	15.00'	73 cf	**8.00'D x 7.00'H Stone** 352 cf Overall - 170 cf Embedded = 182 cf x 40.0% Voids
#3	22.00'	26 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)
		269 cf	Total Available Storage

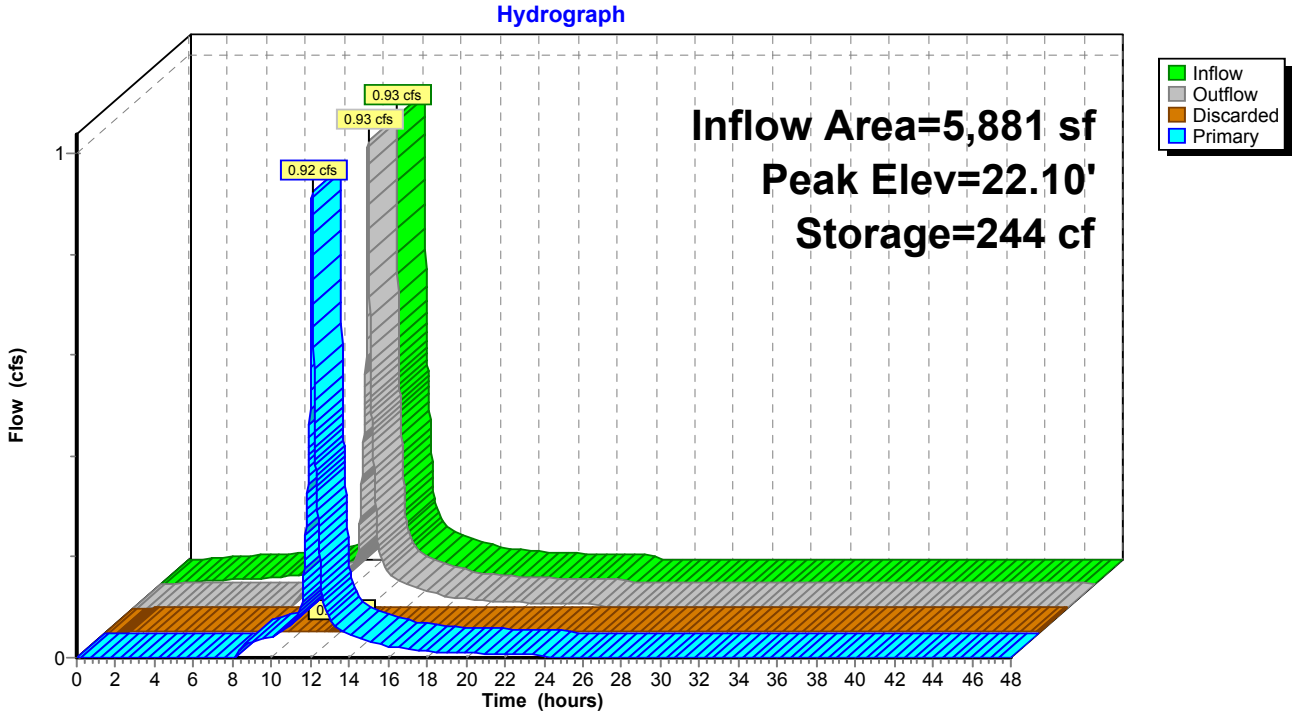
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
22.00	4	0	0
22.50	100	26	26

Device	Routing	Invert	Outlet Devices
#1	Primary	21.95'	**24.0" x 24.0" Horiz. Orifice/Grate X 0.60** C= 0.600 Limited to weir flow at low heads
#2	Discarded	15.00'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 12.08 hrs HW=22.10' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.90 cfs @ 12.08 hrs HW=22.10' (Free Discharge)
↑—**1=Orifice/Grate** (Weir Controls 0.90 cfs @ 0.76 fps)

Pond 25P: Drywell



APPENDIX D

Closed Drainage System Design

Rainfall Details

Return Period..... 25 year(s)

Subbasin Summary

Subbasin Name	Area (ac)	Weighted Runoff Coefficient	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
Sub-01	0.11	0.30	0.22	0 00:05:00
Sub-02	0.15	0.41	0.40	0 00:05:00
Sub-03	0.37	0.90	2.21	0 00:05:00
Sub-04	0.03	0.90	0.15	0 00:05:00
Sub-05	0.13	0.83	0.69	0 00:05:00
Sub-06	0.06	0.90	0.35	0 00:05:00
Sub-07	0.11	0.76	0.56	0 00:05:00
Sub-08	0.10	0.90	0.62	0 00:05:00
Sub-09	0.03	0.90	0.20	0 00:05:00
Sub-10	0.04	0.90	0.21	0 00:05:00
Sub-11	0.01	0.90	0.07	0 00:05:00
Sub-12	0.36	0.90	2.13	0 00:05:00
Sub-13	0.11	0.90	0.66	0 00:05:00

Link Summary

From (Inlet) Node	Inlet Invert Elevation	To (Outlet) Node	Outlet Invert Elevation	Pipe Length	Pipe Slope	Pipe Diameter	Manning's Roughness	Peak Flow Q	Peak Flow Velocity	Pipe Design Capacity Qf	Q/Qf Ratio
	(ft)		(ft)	(ft)	(%)	(in)		(cfs)	(ft/sec)	(cfs)	
ROOF DRAIN 1	21.50	OCS-1	14.00	137	5.47	18	0.0150	2.09	5.10	21.30	0.10
AD-104	14.00	OCS-1	14.00	34	0.00	24	0.0120	1.02	1.63	17.33	0.06
AD-104	14.00	AD-105	14.00	137	0.00	24	0.0120	0.90	1.48	17.33	0.05
AD-105	14.00	Out-1Pipe - (102) (1) (1)	14.00	44	0.00	24	0.0120	0.83	1.98	17.33	0.05
OCS-1	14.00	DMH-206	14.00	18	0.00	12	0.0120	0.97	2.40	2.73	0.36
ROOF DRAIN 2	21.58	DMH-200	19.77	41	4.43	12	0.0120	2.18	3.63	8.12	0.27
WQI-104	19.50	DMH-201	19.30	23	0.86	12	0.0120	0.68	2.99	3.58	0.19
WQI-103	20.50	DMH-201	19.66	28	3.04	12	0.0120	0.15	3.25	6.73	0.02
DMH-201	18.85	Out-1Pipe - (120)	18.00	69	1.24	12	0.0120	3.46	5.43	4.29	0.81
DMH-206	13.90	Out-1Pipe - (122)	13.20	79	0.88	12	0.0120	1.75	4.23	3.63	0.48
DMH-200	19.67	DMH-201	18.95	72	1.00	12	0.0120	2.71	4.36	3.86	0.70
WQI-105	19.12	DMH-211	18.45	24	2.81	12	0.0120	0.55	4.52	6.47	0.09
AD-100	21.00	AD-101	20.50	86	0.58	8	0.0120	0.22	2.11	1.00	0.22
AD-101	20.40	DMH-200	19.77	74	0.85	8	0.0120	0.59	2.17	1.20	0.49
WQI-110	19.00	DMH-112	18.80	16	1.26	12	0.0120	0.07	1.82	4.33	0.02
DMH-112	18.70	Out-1Pipe - (130)	18.50	16	1.27	12	0.0120	0.27	2.76	4.35	0.06
WQI-109	19.00	DMH-112	18.80	14	1.39	12	0.0120	0.21	2.65	4.55	0.05
WQI-107	18.20	DMH-206	18.00	26	0.77	12	0.0120	0.60	2.93	3.39	0.18
WQI-108	18.20	DMH-206	18.00	20	0.99	12	0.0120	0.19	2.35	3.84	0.05
DMH-211	18.35	Out-1Pipe - (134)	17.27	46	2.36	12	0.0120	0.89	5.02	5.93	0.15
AD-107	11.75	AD-106	11.75	184	0.00	12	0.0120	0.00	0.00	2.73	0.00
AD-106	11.75	OCS-2	11.75	8	0.00	12	0.0120	0.00	0.00	2.73	0.00
OCS-2	11.10	Out-1Pipe - (142) (1) (1)	13.59	41	-6.05	12	0.0120	0.00	0.00	9.49	0.00
WQI-102	18.00	Out-1Pipe - (93)	16.70	25	5.30	12	0.0120	0.66	5.99	8.89	0.07
WQI-106	18.89	DMH-211	18.45	22	1.97	12	0.0120	0.35	3.27	5.42	0.06

Junction Input

Juntion Name	Invert Elevation	Rim Elevation
	(ft)	(ft)
AD-100	21.00	23.03
AD-101	20.40	23.03
AD-104	14.00	20.50
AD-105	14.00	20.50
AD-106	11.75	17.75
AD-107	11.75	17.75
DMH-112	18.70	22.50
DMH-200	19.67	24.27
DMH-201	18.85	23.98
DMH-206	13.90	21.05
DMH-211	18.35	22.85
OCS-1	14.00	21.75
OCS-2	11.10	18.60
ROOF DRAIN 1	21.50	22.66
ROOF DRAIN 2	21.58	22.74
WQI-102	18.00	22.27
WQI-103	20.50	24.86
WQI-104	19.50	23.50
WQI-105	19.12	23.12
WQI-106	18.89	22.89
WQI-107	18.20	21.50
WQI-108	18.20	21.95
WQI-109	19.00	23.05
WQI-110	19.00	23.00

APPENDIX E

Long-Term Pollution Prevention and Stormwater Operation and Maintenance Plan

LONG-TERM POLLUTION PREVENTION PLAN AND STORMWATER OPERATION AND MAINTENANCE PLAN

SMAST I/II, New Bedford, MA

TABLE OF CONTENTS

INTRODUCTION

The purpose of this document is to specify the pollution prevention measures and stormwater management system operation and maintenance for the SMAST I/II site. The Responsible Party indicated below shall implement the management practices outlined in this document and proactively conduct operations at the project site in an environmentally responsible manner. Compliance with this Manual does not in any way dismiss the responsible party, owner, property manager, or occupants from compliance with other applicable federal, state or local laws.

Responsible Party: University of Massachusetts Dartmouth
285 Old Westport Road
North Dartmouth, MA

This Document has been prepared in compliance with Standards 4 and 9 of the 2008 Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards, which state:

Standard 4:
The Long Term Pollution Prevention Plan shall include the proper procedures for the following:

- Good housekeeping
- Storing materials and waste products inside or under cover
- Vehicle washing
- Routine inspections of stormwater best management practices
- Spill prevention and response
- Maintenance of lawns, gardens, and other landscaped areas
- Pet waste management
- Operation and management of septic systems
- Proper management of deicing chemicals and snow

Standard 9:
The Long-Term Operation and Maintenance Plan shall at a minimum include:

- Stormwater management system(s) owner(s)
- The party or parties responsible for operation and maintenance, including how future property owners shall be notified of the presence of the stormwater management system and the requirement for operation and maintenance
- The routine and non-routine maintenance tasks to be undertaken after construction is complete and a schedule for implementing those tasks
- A plan that is drawn to scale and shows the location of all stormwater BMPs in each treatment train along with the discharge point
- A description of public safety features
- An estimated operations and maintenance budget

1.0 LONG-TERM POLLUTION PREVENTION PLAN

The Responsible Party shall implement the following good housekeeping procedures at the project site to reduce the possibility of accidental releases and to reduce safety hazards.

1.1 Storage of Hazardous Materials

To prevent leaks and spills, keep hazardous materials and waste products under cover or inside. Use drip pans or spill containment systems to prevent chemicals from entering the drainage system. Inspect storage areas for materials and waste products at least once per year to determine amount and type of the material on site, and if the material requires disposal.

Securely store liquid petroleum products and other liquid chemicals in federally- and state-approved containers. Restrict access to maintenance personnel and administrators.

1.2 Storage of Waste Products

Collect and store all waste materials in securely lidded dumpster(s) or other secure containers as applicable to the material. Keep dumpster lids closed and the areas around them clean. Do not fill the dumpsters with liquid waste or hose them out. Sweep areas around the dumpster regularly and put the debris in the garbage, instead of sweeping or hosing it into the parking lot. Legally dispose of collected waste on a regular basis.

Segregate liquid wastes, including motor oil, antifreeze, solvents, and lubricants, from solid waste and recycle through hazardous waste disposal companies, whenever possible. Separate oil filters, batteries, tires, and metal filings from grinding and polishing metal parts from common trash items and recycle. These items are not trash and are illegal to dump. Contact a hazardous waste hauler for proper disposal to a hazardous waste collection center.

1.3 Spill Prevention and Response

Implement spill response procedures for releases of significant materials such as fuels, oils, or chemical materials onto the ground or other area that could reasonably be expected to discharge to surface or groundwater.

- For minor spills, keep fifty (50) gallon spill control kits and Speedy Dry at all shop and work areas.
- Immediately contact applicable Federal, State, and local agencies for reportable quantities as required by law.
- Immediately perform applicable containment and cleanup procedures following a spill release.
- Promptly remove and dispose of all material collected during the response in accordance with Federal, State and local requirements. A licensed emergency response contractor may be required to assist in cleanup of releases depending on the amount of the release, and the ability of the Contractor to perform the required response.
- Reportable quantities of chemicals, fuels, or oils are established under the Clean Water Act and enforced through Massachusetts Department of Environmental Protection (DEP).

1.4 Minimize Soil Erosion

Soil erosion facilitates mechanical transport of nutrients, pathogens, and organic matter to surface water bodies. Repair all areas where erosion is occurring throughout the project site. Stabilize bare soil with riprap, seed, mulch, or vegetation.

1.5 Maintenance of Lawns, Gardens, and other Landscaped Areas

Pesticides and fertilizers shall not be used in the landscaped areas associated with the project site and shall not be stored on-site. Dumping of lawn wastes, brush or leaves or other materials or debris is not permitted in any Resource Area. Grass clippings, pruned branches and any other landscaped waste should be disposed of or composted in an appropriate location. No irrigation shall

be used in the landscaped areas for this project.

1.6 Management of Deicing Chemicals and Snow

The qualified contractor selected for snow plowing and deicing shall be made fully aware of the requirements of this section.

No road salt (sodium chloride) shall be stored on-site. The use of magnesium chloride de-icing product with a 0.5 to 1.0 percent sodium chloride mix for snow and ice treatment is permitted. The product shall be stored in a locked room inside the building and shall be used at exterior stairs and walkways. The snow plow contractor shall adhere to these magnesium chloride use and storage requirements.

During typical snow plowing operations, snow shall be pushed to the designated snow removal areas. Snow shall not be stockpiled in wetland resource areas or the 100-foot Buffer Zone, catch basins, or bioretention areas. In severe conditions where snow cannot be stockpiled on site, the snow shall be removed from the site and properly disposed of in accordance with DEP Guideline BRP601-01.

Use of sand is permitted only for impervious roadways and parking areas.

Before winter begins, the property owner and the contractor shall review snow plowing, deicing, and stockpiling procedures. Areas designated for stockpiling should be cleaned of any debris. Street and parking lot sweeping should be followed in accordance with the Operation and Maintenance Plan.

1.7 Coordination with other Permits and Requirements

Certain conditions of other approvals affecting the long term management of the property shall be considered part of this Long Term Pollution Prevention Plan. The Owner shall become familiar with those documents and comply with the guidelines set forth in those documents.

2.0 STORMWATER MANAGEMENT SYSTEM OPERATION AND MAINTENANCE PLAN

2.1 Introduction

This Operation and Maintenance Plan (O&M Plan) for SMAST I/II site is required under Standard 9 of the 2008 MassDEP Stormwater Handbook to provide best management practices for implementing maintenance activities for the stormwater management system in a manner that minimizes impacts to wetland resource areas.

The Owner shall implement this O&M Plan and proactively conduct operations at the site in an environmentally responsible manner. Compliance with this O&M Plan does not in any way dismiss the Owner from compliance with other applicable Federal, State or local laws.

Routine maintenance during construction and post-development phases of the project, as defined in the Operation and Maintenance Plan, shall be permitted without amendment to the Order of Conditions. A continuing condition in the Certificate of Compliance shall ensure that maintenance can be performed without triggering further filings under the Wetlands Protection Act.

All stormwater best management practices (BMPs) shall be operated and maintained in accordance with the design plans and the Operation and Maintenance Plan approved by the issuing authority. The Owner shall:

a. Maintain an operation and maintenance log for the last three years, including inspections, repairs, replacement and disposal (for disposal the log shall indicate the type of material and the disposal location). This is a rolling log in which the responsible party records all operation and maintenance activities for the past three years.

b. Make this log available to MassDEP and the Conservation Commissions upon request; and

c. Allow members and agents of the MassDEP and the Conservation Commissions to enter and inspect the premises to evaluate and ensure that the Owner complies with the Operation and Maintenance requirements for each BMP.

2.2 Stormwater Operation and Maintenance Requirements

Inspect and maintain the stormwater management system as directed below. Repairs to any component of the system shall be made as soon as possible to prevent any potential pollutants (including silt) from entering the resource areas.

<u>Area Drains</u>

Inspect area drains at least once per month and remove debris from the grate. Clean out accumulated sediments at least once per year and more frequently as necessary.

<u>Stormwater Buffer Zone Water Quality Inlets</u>

Maintain water quality units according the recommendations set forth by the manufacturer. General inspection and maintenance procedures for proprietary devices are provided below:

- Inspect units following completion of construction, prior to being put into service.
- Inspect units at least twice per year following installation and no less than once per year thereafter.
- Inspect units immediately after any oil, fuel or chemical spill.
- All inspections shall include checking the oil level and sediment depth in the unit. Removal of sediments/oils shall occur per manufacturer recommendations.
- A licensed waste management company shall remove captured petroleum waste products from any oil, chemical or fuel spills and dispose.
- OSHA confined space entry protocols shall be followed if entry into the unit is required.

Dry Wells

The dry wells shall be inspected twice per year and after rain events greater than 3 inches in 24 hours. The inlets and outlets shall be inspected, and all debris that may clog the structure shall be removed.

Subsurface Infiltration Structures (Perforated Pipes)

Inspect subsurface infiltration structures twice per year. Inspect the inlets and observation ports to determine if there is accumulated sediment within the system. Remove all debris and accumulated sediment that may clog the system.

Bioretention Areas

Perform annual maintenance of all components of the bioretention area, including plants, soil, and mulch. Table 1, below, outlines recommended maintenance activities.

Table 1. Bioretention area maintenance recommendations

Location	Description	Frequency	Time of Year
Surface	Inspect and remove trash	Monthly	Year round
Soil	Inspect and repair erosion	Monthly	Year round
Organic Layer	Remulch void areas	Annually	Spring
	Remove previous mulch layer before applying new layer (optional)	Annually	Spring
Plants	Water vegetation at end of day for 14 consecutive days after planting	Immediately after planting	As needed
	Remove and replace all dead and diseased vegetation that cannot be treated	Annually	Spring
	Treat all diseased trees and shrubs	As needed	Variable

During and after storm events, record the length of time standing water remains in the bioretention areas. If the time is greater than 72 hours, thoroughly inspect the basins for signs of clogging and develop a corrective action plan. The corrective action plan, prepared by a qualified professional, will outline procedures to restore infiltrative function. The owner of the site shall take immediate action to implement these corrective measures.

2.3 Street Sweeping

Perform street sweeping at least twice per year, whenever there is significant debris present on roads and parking lots. Street sweeping shall occur in the spring and fall. Sweepings must be handled and disposed of properly according to the New Bedford Conservation Commission.

2.4 Repair of the Stormwater Management System

The stormwater management system shall be maintained. The repair of any component of the system shall be made as soon as possible to prevent any potential pollutants including silt from entering the resource areas or the existing closed drainage system.

2.5 Reporting

The Owner shall maintain a record of drainage system inspections and maintenance (per this Plan) and submit a yearly report to the New Bedford Conservation Commission.

STORMWATER MANAGEMENT SYSTEM INSPECTION FORM

SMAST I/II
New Bedford, MA

Inspected by:_____
Date:_____

Component	Status/Inspection	Action Taken
Deep Sump Catch Basins, Area Drains and Drain Manholes		
Bioretention Areas		
Subsurface Infiltration Systems (Perforated Pipes)		
Stormwater Buffer Zone Water Quality Inlets		
Dry Well		
General site conditions – evidence of erosion, etc.		

SUBMIT COPIES OF STORMWATER MANAGEMENT SYSTEM INSPECTION FORM TO THE NEW BEDFORD CONSERVATION COMMISSION WITH THE YEARLY REPORT.

APPENDIX F

DRAFT Stormwater Pollution Prevention Plan (SWPPP)

Stormwater Pollution Prevention Plan (SWPPP)

For Construction Activities At:

SMAST II
University of Massachusetts, Dartmouth
Dartmouth, MA 02714
Insert Project/Site Telephone Number

SWPPP Prepared For:

Bond Brothers, Inc.
145 Spring Street
Insert Address
Everett, MA 02149
617-387-3400
617-389-1412

SWPPP Prepared By:

Nitsch Engineering
2 Center Plaza
Suite 430
Boston, MA 02108
T: 617-338-0063
F: 617-338-6472

SWPPP Preparation Date:

07/31/2015

Estimated Project Dates:

Project Start Date: February 2016
Project Completion Date: October 2017

Contents

SECTION 1: CONTACT INFORMATION/RESPONSIBLE PARTIES

1.1 Operator(s) / Subcontractor(s)

Instructions (see definition of "operator" at CGP Part 1.1.a):

- Identify the operator(s) who will be engaged in construction activities at the site. Indicate respective responsibilities, where appropriate. Also include the 24-hour emergency contact.
- List subcontractors expected to work on-site. Notify subcontractors of stormwater requirements applicable to their work.
- Consider using Subcontractor Agreements such as the type included as a sample in Appendix G of the Template.

Operator(s):

Bond Brothers, Inc.
Dale Burr
Sr. Project Manager
145 Spring Street
Everett, MA 02146
508-498-0276
dburr@bondbrothers.com

Subcontractor(s):

Insert Company or Organization Name:
Insert Name:
Insert Address:
Insert City, State, Zip Code:
Insert Telephone Number:
Insert Fax/Email:
Insert area of control (if more than one operator at site):

[Repeat as necessary.]

Emergency 24-Hour Contact:

Bond Brothers, Inc.
Dale Burr
508-498-0276

1.2 Stormwater Team

Instructions (see CGP Part 7.2.1):

- Identify the staff members (by name or position) that comprise the project's stormwater team as well as their individual responsibilities. At a minimum the stormwater team is comprised of individuals who are responsible for overseeing the development of the SWPPP, any later modifications to it, and for compliance with the requirements in this permit (i.e., installing and maintaining stormwater controls, conducting site inspections, and taking corrective actions where required).
- Each member of the stormwater team must have ready access to either an electronic or paper copy of applicable portions of the 2012 CGP and your SWPPP.

Dale Burr
Sr. Project Manager
508-498-0276
dburr@bondbrothers.com

Insert Role or Responsibility:
Insert Position:
Insert Name:
Insert Telephone Number:
Insert Email:

Insert Role or Responsibility:
Insert Position:
Insert Name:
Insert Telephone Number:
Insert Email:

[Repeat as necessary.]

SECTION 2: SITE EVALUATION, ASSESSMENT, AND PLANNING

2.1 Project/Site Information

Instructions (see "Project/Site Information" section of Appendix J – NOI form):

- In this section, you are asked to compile basic site information that will be helpful to you when you file your NOI.
- Detailed information on determining your site's latitude and longitude can be found at www.epa.gov/npdes/stormwater/latlong

Project Name and Address

Project/Site Name: SMAST II
Project Street/Location: Brock Avenue and Rodney French Boulevard South, UMASS Dartmouth
City: New Bedford
State: MA
ZIP Code: 02744
County or Similar Subdivision: Bristol

Project Latitude/Longitude

(Use **one** of three possible formats, and specify method)

Latitude:
3. 41.5961° N (decimal)

Longitude:
3. 71.9073 ° W (decimal)

Method for determining latitude/longitude:
☐ USGS topographic map (specify scale: _____) ☐ EPA Web site ☐ GPS
☒ Other (please specify): Google Earth

Horizontal Reference Datum:
☐ NAD 27 ☒ NAD 83 or WGS 84 ☐ Unknown

If you used a U.S.G.S topographic map, what was the scale?
_____

Additional Project Information

Is the project/site located on Indian country lands, or located on a property of religious or cultural significance to an Indian tribe? ☐ Yes ☒ No

If yes, provide the name of the Indian tribe associated with the area of Indian country (including the name of Indian reservation if applicable), or if not in Indian country, provide the name of the Indian tribe associated with the property: INSERT TEXT HERE

If you are conducting earth-disturbing activities in response to a public emergency, document the cause of the public emergency *(e.g., natural disaster, extreme flooding conditions)*, information substantiating its occurrence *(e.g., state disaster declaration)*, and a description of the construction necessary to reestablish effective public services: INSERT TEXT HERE

Are you applying for permit coverage as a "federal operator" as defined in Appendix A of the 2012 CGP? ☐ Yes ☒ No

2.2 Discharge Information

Instructions (see "Discharge Information" section of Appendix J – NOI form):

- In this section, include information relating to your site's discharge. This information corresponds to the "Discharge Information" section of the NOI form. Because you may be using EPA's mapping tool to answer some of these questions, and the tool is accessed in the eNOI system, you may find it necessary to leave some questions unanswered until you have completed that portion of the NOI.
- For Table 1, list the name of the first surface water that receives discharges from your site. If your site has discharges to multiple surface waters, indicate the names of all such waters.
- For Table 2, if any of the surface waters you listed out in Table 1 are listed as impaired by the applicable State or Tribe, provide specified information about pollutants causing the impairment and whether or not a Total Maximum Daily Load (TMDL) has been completed for the surface water. For more information on TMDLs and impaired waters, including a list of TMDL contacts and links by state, visit www.epa.gov/npdes/stormwater/tmdl.
- For Table 3, indicate whether any of the surface waters you listed out in Table 1 are designated as Tier 2, 2.5, or 3 waters by your State or Tribe. See Appendix F for more information.

Does your project/site discharge stormwater into a Municipal Separate Storm Sewer System (MS4)? ☒ Yes ☐ No

Are there any surface waters that are located within 50 feet of your construction disturbances?
☒ Yes ☒ No

Table 1 – Names of Receiving Waters

Name(s) of the first surface water that receives stormwater directly from your site and/or from the MS4 (note: multiple rows provided where your site has more than one point of discharge that flows to different surface waters)
1.Clarks Cover
2.
3.
4.
5.

Table 2 – Impaired Waters / TMDLs (Answer the following for each surface water listed in Table 1 above)

	Is this surface water listed as "impaired"?	If you answered yes, then answer the following:			
		What pollutant(s) are causing the impairment?	Has a TMDL been completed?	Title of the TMDL document	Pollutant(s) for which there is a TMDL
1.	☒ YES ☐ NO	**Fecal Coliform, PCBs**	☒ YES ☐ NO	**Buzzards Bay Pathogens TMDL**	**Fecal Coliform**
2.	☐ YES ☐ NO		☐ YES ☐ NO		
3.	☐ YES ☐ NO		☐ YES ☐ NO		
4.	☐ YES ☐ NO		☐ YES ☐ NO		
5.	☐ YES ☐ NO		☐ YES ☐ NO		

[Include additional rows as necessary.]

Describe the method(s) you used to determine whether or not your project/site discharges to an impaired water: U.S. EPA Watershed Assessment, Tracking, and Environmental Results, 2012 Waterbody Report for the Charles River

Table 3 – Tier 2, 2.5, or 3 Waters (Answer the following for each surface water listed in Table 1 above)

	Is this surface water designated as a Tier 2, Tier 2.5, or Tier 3 water? (see Appendix F)	If you answered yes, specify which Tier (2, 2.5, or 3) the surface water is designated as?
1.	☐ YES ☒ NO	
2.	☐ YES ☐ NO	
3.	☐ YES ☐ NO	
4.	☐ YES ☐ NO	
5.	☐ YES ☐ NO	

2.3 Nature of the Construction Activity

Instructions (see CGP Parts 1.3.c and 7.2.2):

- Provide a general description of the nature of the construction activities at your project.
- Describe the size of the property (in acres) and the total area expected to be disturbed by the construction activities (in acres), construction support activities covered by this permit (see Part 1.3.c of the permit), and the maximum area expected to be disturbed at any one time.

General Description of Project

Provide a general description of the construction project:

The project consists of the demolition of an existing academic building and the construction of a new School for Marine Science and Technology Building. The construction of the new building will include site and utility improvements.

Size of Construction Project

What is the size of the property (in acres), the total area expected to be disturbed by the construction activities (in acres), and the maximum area expected to be disturbed at any one time?

SIZE OF PROPERTY: 7.40 acres

TOTAL AREA OF CONSTRUCTION DISTURBANCES: 7.40 acres

MAXIMUM AREA TO BE DISTURBED AT ANY ONE TIME: 7.40 acres

Construction Support Activities (only provide if applicable)

Describe any construction support activities for the project (e.g., concrete or asphalt batch plants, equipment staging yards, material storage areas, excavated material disposal areas, borrow areas)

2.4 Sequence and Estimated Dates of Construction Activities

Instructions (see CGP Part 7.2.5):

- Describe the intended construction sequence and timing of major activities.
- For each phase of construction, include the following information:
  - ✓ Installation of stormwater controls, and when they will be made operational;
  - ✓ Commencement and duration of earth-disturbing activities, including clearing and grubbing, mass grading, site preparation (i.e., excavating, cutting and filling), final grading, and creation of soil and vegetation stockpiles requiring stabilization;
  - ✓ Cessation, temporarily or permanently, of construction activities on the site, or in designated portions of the site;
  - ✓ Final or temporary stabilization of areas of exposed soil. The dates for stabilization must reflect the applicable deadlines to which you are subject to in Part 2.2.1; and
  - ✓ Removal of temporary stormwater conveyances/channels and other stormwater control measures, removal of construction equipment and vehicles, and cessation of any pollutant-generating activities.
- The construction sequence must reflect the following requirements:
  - ✓ Part 2.1.1.1 (area of disturbance);
  - ✓ Part 2.1.1.3.a (installation of stormwater controls); and
  - ✓ Parts 2.2.1.1, 2.2.1.2, 2.2.1.3 (stabilization deadlines).
- Also, see EPA's *Construction Sequencing BMP Fact Sheet* at http://www.epa.gov/npdes/stormwater/menuofbmps/construction/cons_seq)

Phase I

INSERT GENERAL DESCRIPTION OF PHASE

- INSERT ESTIMATED START AND END DATES OF CONSTRUCTION DISTURBANCES ASSOCIATED WITH THIS PHASE
- FOR EACH STORMWATER CONTROL, INSERT ESTIMATED DATE(s) OF INSTALLATION OF EACH STORMWATER CONTROL
- FOR AREAS OF THE SITE REQUIRED TO BE STABILIZED, INSERT ESTIMATED DATE(s) OF APPLICATION OF STABILIZATION MEASURES
- INSERT ESTIMATED DATE(s) WHEN STORMWATER CONTROLS WILL BE REMOVED

Phase II

INSERT GENERAL DESCRIPTION OF PHASE

- INSERT ESTIMATED START AND END DATES OF CONSTRUCTION DISTURBANCES ASSOCIATED WITH THIS PHASE
- FOR EACH STORMWATER CONTROL, INSERT ESTIMATED DATE(s) OF INSTALLATION OF EACH STORMWATER CONTROL
- FOR AREAS OF THE SITE REQUIRED TO BE STABILIZED, INSERT ESTIMATED DATE(s) OF APPLICATION OF STABILIZATION MEASURES
- INSERT ESTIMATED DATE(s) WHEN STORMWATER CONTROLS WILL BE REMOVED

[Repeat as needed.]

2.5 Allowable Non-Stormwater Discharges

Instructions (see CGP Parts 1.3.d and 7.2.8):

- Identify all allowable sources of non-stormwater discharges. The allowable non-stormwater discharges identified in Part 1.3.d of the 2012 CGP include:
  - ✓ Discharges from emergency fire-fighting activities;
  - ✓ Fire hydrant flushings;
  - ✓ Landscape irrigation;
  - ✓ Waters used to wash vehicles and equipment, provided that there is no discharge of soaps, solvents, or detergents used for such purposes;
  - ✓ Water used to control dust;
  - ✓ Potable water including uncontaminated water line flushings;
  - ✓ Routine external building wash down that does not use detergents;
  - ✓ Pavement wash waters provided spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and detergents are not used. You are prohibited from directing pavement was waters directly into any surface water, storm drain inlet, or stormwater conveyance, unless the conveyance is connected to a sediment basin, sediment trap, or similarly effective control;
  - ✓ Uncontaminated air conditioning or compressor condensate;
  - ✓ Uncontaminated, non-turbid discharges of ground water or spring water;
  - ✓ Foundation or footing drains where flows are not contaminated with process materials such as solvents or contaminated ground water; and
  - ✓ Construction dewatering water that has been treated by an appropriate control.

List of Allowable Non-Stormwater Discharges Present at the Site

Type of Allowable Non-Stormwater Discharge	Likely to be Present at Your Site?
Discharges from emergency fire-fighting activities	☐ YES ☒ NO
Fire hydrant flushings	☐ YES ☒ NO
Landscape irrigation	☒ YES ☐ NO
Waters used to wash vehicles and equipment	☒ YES ☐ NO
Water used to control dust	☒ YES ☐ NO
Potable water including uncontaminated water line flushings	☒ YES ☐ NO
Routine external building wash down	☒ YES ☐ NO
Pavement wash waters	☒ YES ☐ NO
Uncontaminated air conditioning or compressor condensate	☒ YES ☐ NO
Uncontaminated, non-turbid discharges of ground water or spring water	☐ YES ☒ NO
Foundation or footing drains	☒ YES ☐ NO
Construction dewatering water	☒ YES ☐ NO

(Note: You are reminded of the requirement to identify the likely locations of these allowable non-stormwater discharges on your site map. See Section 2.6, below, of the SWPPP Template.)

2.6 Site Maps

Instructions (see CGP Part 7.2.6):

- Attach site maps in Appendix A of the Template. For most projects, a series of site maps is necessary and recommended. The first should show the undeveloped site and its current features. An additional map or maps should be created to show the developed site or, for more complicated sites, show the major phases of development.

These maps must include the following features:

- Boundaries of the property and of the locations where construction will occur, including:
  - ✓ Locations where earth-disturbing activities will occur, noting any phasing of construction activities;
  - ✓ Approximate slopes before and after major grading activities. Note areas of steep slopes, as defined in Appendix A;
  - ✓ Locations where sediment, soil, or other construction materials will be stockpiled;
  - ✓ Locations of any crossings of surface waters;
  - ✓ Designated points on the site where vehicles will exit onto paved roads;
  - ✓ Locations of structures and other impervious surfaces upon completion of construction; and
  - ✓ Locations of construction support activity areas covered by this permit.
- Locations of all surface waters, including wetlands, that exists on or near your site. Indicate which waterbodies are listed as impaired, and which are identified by your state, tribe, or EPA as Tier 2, Tier 2.5, or Tier 3 waters.
- The boundary lines of any natural buffer areas. See CGP Part 2.1.2.1.a.
- Areas of federally-listed critical habitat for endangered or threatened species.
- Topography of the site, existing vegetative cover (e.g., forest, pasture, pavement, structures), and drainage pattern(s) of stormwater and allowable non-stormwater flow onto, over, and from the site property before and after major grading activities.
- Stormwater and allowable non-stormwater discharge locations, including:
  - ✓ Locations of any storm drain inlets on the site and in the immediate vicinity of the site; and
  - ✓ Locations where stormwater or allowable non-stormwater will be discharged to surface waters (including wetlands).
- Locations of all potential pollutant-generating activities.
- Locations of stormwater control measures.
- Locations where polymers, flocculants, or other treatment chemicals will be used and stored.

SECTION 3: DOCUMENTATION OF COMPLIANCE WITH OTHER FEDERAL REQUIREMENTS

3.1 Endangered Species Protection

Instructions (see CGP Parts 1.1.e, 7.2.14.1, Appendix D, and the "Endangered Species Protection" section of the Appendix J – NOI form):

Follow the process in Appendix D of the permit for determining which eligibility criterion (A-E) you have met with respect to the protection of endangered species. You will

- Include documentation supporting your determination of eligibility.
- Additional information on Endangered Species Act (ESA) provisions for EPA's Construction General Permit is at www.epa.gov/npdes/stormwater/esa

Eligibility Criterion

Under which criterion listed in Appendix D are you eligible for coverage under this permit?

☒ **A** ☐ **B** ☐ **C** ☐ **D** ☐ **E**

For reference purposes, the eligibility criteria listed in Appendix D are as follows:

Criterion A. No federally-listed threatened or endangered species or their designated critical habitat(s) are likely to occur in your site's "action area" as defined in Appendix A of this permit.

Supporting Documentation

Provide documentation for the applicable eligibility criterion you select in Appendix D, as follows:

For criterion A, indicate the basis for your determination that no federally-listed threatened or endangered species or their designated critical habitat(s) are likely to occur in your site's action area (as defined in Appendix A of the permit). Check the applicable source of information you relied upon:

- ☐ Specific communication with staff of the U.S. Fish & Wildlife Service or National Marine Fisheries Service.
- ☐ Publicly available species list.
- ☒ Other source: NHESP Online Viewer and GIS data (2008)

3.2 Historic Preservation

Instructions (see CGP Part 1.1.f, 7.2.14.2, Appendix E, and the "Historic Preservation" section of the Appendix J – NOI form):

Follow the screening process in Appendix E of the permit for determining whether your installation of subsurface earth-disturbing stormwater controls will have an effect on historic properties.

- Include documentation supporting your determination of eligibility.
- To contact your applicable state or tribal historic preservation office, information is available at www.achp.gov/programs/html.

Appendix E, Step 1

Do you plan on installing any of the following stormwater controls at your site? Check all that apply below, and proceed to Appendix E, Step 2.

- ☐ Dike
- ☐ Berm
- ☒ Catch Basin
- ☐ Pond
- ☐ Stormwater Conveyance Channel (e.g., ditch, trench, perimeter drain, swale, etc.)
- ☐ Culvert
- ☐ Other type of ground-disturbing stormwater control: Drain Manhole, Perforated Pipe in Crushed Stone, Tree Box Filter

(Note: If you will not be installing any ground-disturbing stormwater controls, no further documentation is required for Section 3.2 of the Template.)

Appendix E, Step 2

If you answered yes in Step 1, have prior surveys or evaluations conducted on the site already determined that historic properties do not exist, or that prior disturbances at the site have precluded the existence of historic properties? ☒ YES ☐ NO

- If yes, no further documentation is required for Section 3.2 of the Template.
- If no, proceed to Appendix E, Step 3.

3.3 Safe Drinking Water Act Underground Injection Control Requirements

Instructions (see CGP Part 7.2.14.3):

- If you will use any of the identified controls in this section, include documentation of contact between you and the applicable state agency or EPA Regional Office responsible for implementing the requirements for underground injection wells in the Safe Drinking Water Act and EPA's implementing regulations at 40 CFR Parts 144-147.
- For state UIC program contacts, refer to the following EPA website: *http://water.epa.gov/type/groundwater/uic/whereyoulive.cfm*.

Do you plan to install any of the following controls? Check all that apply below.

☐ Infiltration trenches (if stormwater is directed to any bored, drilled, driven shaft or dug hole that is deeper than its widest surface dimension, or has a subsurface fluid distribution system)

☐ Commercially manufactured pre-cast or pre-built proprietary subsurface detention vaults, chambers, or other devices designed to capture and infiltrate stormwater flow

☐ Drywells, seepage pits, or improved sinkholes (if stormwater is directed to any bored, drilled, driven shaft or dug hole that is deeper than its widest surface dimension, or has a subsurface fluid distribution system)

If yes, INSERT COPIES OF LETTERS, EMAILS, OR OTHER COMMUNICATION BETWEEN YOU AND THE STATE AGENCY OR EPA REGIONAL OFFICE

SECTION 4: EROSION AND SEDIMENT CONTROLS

General Instructions (See CGP Parts 2.1 and 7.2.10):

- Describe the erosion and sediment controls that will be installed and maintained at your site.
- For more information or ideas on BMPs, see EPA's National Menu of BMPs http://www.epa.gov/npdes/stormwater/menuofbmps

4.1 Natural Buffers or Equivalent Sediment Controls

Instructions (see CGP Parts 2.1.2.1 and 7.2.9, and Appendix G):

This section only applies to you if a surface water is located within 50 feet your construction activities. If this is the case, consult CGP Part 2.1.2.1 and Appendix G for information on how to comply with the buffer requirements.

- Describe the compliance alternative (CGP Part 2.1.2.1.a.i, ii, or iii) that was chosen to meet the buffer requirements, and include any required documentation supporting the alternative selected. The compliance alternative selected must be maintained throughout the duration of permit coverage. However, if you select a different compliance alternative during your period of permit coverage, you must modify your SWPPP to reflect this change.
- If you qualify for one of the exceptions in CGP Part 2.1.2.1.e, include documentation related to your qualification for such exceptions.

Buffer Compliance Alternatives

Are there any surface waters within 50 feet of your project's earth disturbances? ☒ YES ☐ NO

(Note: If no, no further documentation is required for Part 4.1 in the SWPPP Template. Continue on to Part 4.2.)

Check the compliance alternative that you have chosen:

☒ I will provide and maintain an undisturbed natural buffer that is less than 50 feet and is supplemented by additional erosion and sediment controls, which in combination achieves the sediment load reduction equivalent to a 50-foot undisturbed natural buffer.

(Note (1): You must show the boundary line of the natural buffer on your site map.)

(Note (2): You must show on your site map how all discharges from your construction disturbances through the natural buffer area will first be treated by the site's erosion and sediment controls. Also, show on the site map any velocity dissipation devices used to prevent erosion within the natural buffer area.)

- WIDTH OF NATURAL BUFFER TO BE RETAINED: XX Feet
- The project site within the 50' buffer of any surface water will have double erosion control barriers. Silt fence and wattle will be installed during construction along the edge of the construction site. Stabilization within the 50' buffer will occur when earth-disturbing

activities will not resume for a period of 7 days. Stabilization will occur within 7 days of the inititian of soil stabilization measures.

- Tables G-1-G-7 of the construction general permit were used to help determine an appropriate level of erosion control protection.

4.2 Perimeter Controls

Instructions (see CGP Parts 2.1.2.2 and 7.2.10):

- Describe sediment controls that will be used (e.g., silt fences, filter berms, temporary diversion dikes, or fiber rolls) to meet the Part 2.1.2.2 requirement to "install sediment controls along those perimeter areas of your site that will receive stormwater from earth-disturbing activities."
- For linear projects, where you have determined that the use of perimeter controls in portions of the site is impracticable, document why you believe this is to be the case.
- Also see, EPA's *Silt Fence BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/silt_fences or *Fiber Rolls BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/fiber_rolls

General

The area of construction activity will be enclosed by a chain link fence and silt fence, silt fence with wattles, or super silt fence as specified on the Site Erosion and Sedimentation Control plan. Construction gates will be located at the entrance to the site as shown on the Site Erosion and Sedimentation Control Plan or as determined by the contractor. Sediment tracked offsite must be removed by the end of the same workday. All construction entrances should have be stabilized construction entrances.

Specific Perimeter Controls

Perimeter Control # 1

- BMP Description: Silt Fence
- Installation Schedule: Start of construction
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

Perimeter Control # 2

- BMP Description: Silt Fence with Wattles
- Installation Schedule: Start of construction
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

Perimeter Control # 3

- BMP Description: Super Silt Fence
- Installation Schedule: Start of construction
- Maintenance and Inspection: Weekly & after storm events greater than ¼"
- Responsible Staff: Construction Manager and Site Contractor

Perimeter Control # 4

- BMP Description: Construction Fence
- Installation Schedule: Start of Construction

- Maintenance and Inspection: Weekly
- Responsible Staff: Construction Manager and Site Contractor

4.3 Sediment Track-Out

Instructions (see CGP Parts 2.1.2.3 and 7.2.10):

- Describe stormwater controls that will be used to "minimize the track-out of sediment onto off-site streets, other paved areas, and sidewalks from vehicles exiting your construction site."
- Describe location(s) of vehicle exit(s), procedures to remove accumulated sediment off-site (e.g., vehicle tracking), and stabilization practices (e.g., stone pads or wash racks or both) to minimize off-site vehicle tracking of sediment. Also include the design, installation, and maintenance specifications for each control.
- Also, see EPA's *Construction Entrances BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/cons_entrance

General

Gates will be constructed as shown on the plans to allow for construction vehicle access. Construction access points will either have a stabilized construction entrance at the access location or a wheel wash station to minimize the track-out of sediment onto off-site streets, other paved areas, and sidewalks from vehicles exiting the construction site. Sediment tracked offsite must be removed by the end of the same workday.

Specific Track-Out Controls

Track-Out Control # 1

- BMP Description: Designated truck washing area
- Installation Schedule: Start of construction
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

Track-Out Control # 2

- BMP Description: Wheel Wash station and Gravel
- Installation Schedule: Start of construction
- Maintenance and Inspection: Daily
- Responsible Staff: Construction Manager and Site Contractor

Track-Out Control # 3

- BMP Description: Street Sweeping
- Installation Schedule: Start of construction
- Maintenance and Inspection: Weekly or as needed
- Responsible Staff Construction Manager and Site Contractor

Track-Out Control # 4

- BMP Description: Stabilized Construction Entrance
- Installation Schedule: Start of construction
- Maintenance and Inspection: Weekly or as needed
- Responsible Staff Construction Manager and Site Contractor

4.4 Stockpiled Sediment or Soil

Instructions (see CGP Parts 2.1.2.4 and 7.2.10):

- Describe stormwater controls and other measures you will take to minimize the discharge of sediment or soil particles from stockpiled sediment or soil. Include a description of structural practices (e.g., diversions, berms, ditches, storage basins), including design, installation, and maintenance specifications, used to divert flows from stockpiled sediment or soil, retain or detain flows, or otherwise limit exposure and the discharge of pollutants from stockpiled sediment or soil.
- Also, describe any controls or procedures used to minimize exposure resulting from adding to or removing materials from the pile.

General

All soil stockpiles should be kept away from existing and proposed catch basins and area drains and outside of proposed detention/infiltration system footprints. Stock piles shall be kept out of the 50 foot buffer of all surface water.

Stockpiles shall be protected from contact with onsite stormwater runoff using temporary perimeter sediment barriers. Soil stockpiles shall also be provided with cover (a tarp) or appropriate temporary stabilization to avoid direct contact with precipitation and to minimize sediment discharge

Soil stabilization measures shall be initiated immediately when earth-disturbing activities have permanently or temporarily ceased on any portion of the site. Earth-disturbing activities are considered temporarily ceased when work will not resume for a period of 7 or more calendar days. Stabilization activities shall be completed within 7 calendar days after the initiation of soil stabilization measures. Wattles or a silt fence may be placed around the perimeter of stockpiles to contain sediments. Stabilized portions of a site shall be inspected at least one per month.

Specific Stockpile Controls

Stockpile Control # 1

- BMP Description: Soil Stabilization Mats
- Installation Schedule: As/if required
- Maintenance and Inspection: Weekly & after storm events greater than 0.25"
- Responsible Staff: Construction Manager and Site Contractor

Stockpile Control # 2

- BMP Description: Silt Fence
- Installation Schedule: Immediately after stockpile is established
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

Stockpile Control # 3

- BMP Description: Wattles
- Installation Schedule: Start of construction

- Maintenance and Inspection: Weekly & after storm events greater than 0.25"

Responsible Staff: Construction Manager and Site Contractor

4.5 Minimize Dust

Instructions (see CGP Parts 2.1.2.5 and 7.2.10):

Describe controls and procedures you will use at your project/site to minimize the generation of dust.

General

Disturbed land will be temporarily stabilized using measures including sprinkling/irrigation, vegetative cover, mulch, and/or stone. Wattles or a silt fence may be placed around the perimeter of stockpiles to contain sediments.

Specific Dust Controls

Dust Control # 1

- BMP Description: Sprinkling/Irrigation
- Installation Schedule: As needed throughout earthwork activities
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

Dust Control # 2

- BMP Description: Contractor's seed mix
- Installation Schedule: Start of earthwork activities
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

Dust Control # 3

- BMP Description: Hydro Seeding
- Installation Schedule: Start of earthwork activities
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

Dust Control # 4

- BMP Description: Straw or Mulch
- Installation Schedule: Start of earthwork activities
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

4.6 Minimize the Disturbance of Steep Slopes

Instructions (see CGP Parts 2.1.2.6 and 7.2.10):

- Describe how you will minimize the disturbance to steep slopes (as defined by CGP Appendix A).
- Describe controls (e.g., erosion control blankets, tackifiers), including design, installation and maintenance specifications, that will be implemented to minimize sediment discharges from slope disturbances.
- Also, see EPA's *Geotextiles BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/geotextiles

General

Steep slopes are defined as slopes of 15% or greater in grade. No steep slopes are proposed as part of this project. Should any temporary steep slopes be created during construction, the following BMP's should be used.

Specific Steep Slope Controls

Steep Slope Control # 1

- BMP Description: Straw or Mulch
- Installation Schedule: Start of earthwork activities
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

Steep Slope Control # 2

- BMP Description: Contractor's seed mix
- Installation Schedule: Start of earthwork activities
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

Steep Slope Control # 3

- BMP Description: Hydro Seeding
- Installation Schedule: Start of earthwork activities
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

Steep Slope Control # 4

- BMP Description: Soil Stabilization Mats
- Installation Schedule: Start of earthwork activities
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

Steep Slope Control # 5

- BMP Description: Rip-Rap
- Installation Schedule: Start of earthwork activities
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"

- Responsible Staff: Construction Manager and Site Contractor

4.7 Topsoil

Instructions (see CGP Parts 2.1.2.7 and 7.2.10):

- Describe how topsoil will be preserved and identify these areas and associated control measures on your site map(s).
- If it is infeasible for you to preserve topsoil on your site, provide an explanation for why this is the case.

General

Onsite native topsoil shall be preserved, unless infeasible. Soil stabilization measure shall be initiated immediately when earth-disturbing activities have permanently or temporarily ceased on any portion of the sire. Earth-disturbing activities are considered temporarily ceased when work will not resume for a period of 7 or more calendar days. Stabilization activities shall be complete within 7 calendar days after the initiation of soil stabilization measures.

Specific Topsoil Controls

Topsoil Control # 1

- BMP Description: Straw or Mulch
- Installation Schedule: Start of earthwork activities
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

Topsoil Control # 2

- BMP Description: Hydro Seeding
- Installation Schedule: Start of earthwork activities
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

Topsoil Control # 3

- BMP Description: Contractor's seed mix
- Installation Schedule: Start of earthwork activities
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

Topsoil Control # 4

- BMP Description: Annual Rye Seed Mix
- Installation Schedule: Start of earthwork activities
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

4.8 Soil Compaction

Instructions (see CGP Parts 2.1.2.8 and 7.2.10):

- In areas where final vegetative stabilization will occur or where infiltration practices will be installed, describe the controls, including design, installation, and maintenance specifications that will be used to restrict vehicle or equipment access or condition the soil for seeding or planting.

General
In landscaped areas or areas where detention/infiltration practices will be installed, soil compaction shall be minimized. This includes restricting vehicle access and equipment use.

Specific Soil Compaction Controls

Soil Compaction Control # 1
Protect areas proposed for post-construction detention.

- Areas of post-construction detention/infiltration shall be constructed after all ground surfaces are fully stabilized.
- All soil stockpiles and material storage areas shall be located outside of the areas proposed for post-construction detention.
- If proposed infiltration areas are constructed prior to the site being fully stabilized, additional erosion controls shall be installed.

Installation

- Measures will be implemented throughout construction

Maintenance Requirements

- The construction manager and site contractor are responsible for enforcing soil compactions controls.

4.9 Storm Drain Inlets

Instructions (see CGP Parts 2.1.2.9 and 7.2.10):

- Describe controls (e.g., inserts, rock-filled bags, or block and gravel) including design, installation, and maintenance specifications that will be implemented to protect all inlets that will receive stormwater from your construction activities, and that you have authority to access.
- Also, see EPA's *Storm Drain Inlet Protection BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/storm_drain

General
All existing and proposed storm drain inlets will be protected throughout the duration of construction. Inlet protection with siltation sacks and inlet protection with gravel will be the primary BMPs used during construction.

Storm Drain Inlet Control # 1

- BMP Description: Inlet Protection Catch Basin with Siltation Sacks
- Installation Schedule: Start of earthwork activities
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

Storm Drain Inlet Control # 2

- BMP Description: Inlet Protection Catch Basin with Gravel
- Installation Schedule: Start of earthwork activities
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

Storm Drain Inlet Control #32

- BMP Description: Inlet Protection Catch Basin with Block and Gravel
- Installation Schedule: Start of earthwork activities
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

4.10 Constructed Stormwater Conveyance Channels

Instructions (see CGP Parts 2.1.3.1 and 7.2.10):

If you will be installing a stormwater conveyance channel, describe control practices (e.g., velocity dissipation devices), including design specifications and details (volume, dimensions, outlet structure), that will be implemented at the construction site.

General

Storm drain conveyance channels are not expected as part of this project. Should temporary channels be used during construction, the BMPs listed below should be used.

Specific Conveyance Channel Controls

Stormwater Conveyance Channel Control # 1

- BMP Description: Check Dams
- Installation Schedule: Start of construction
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

Stormwater Conveyance Channel Control # 2

- BMP Description: Rip-Rap
- Installation Schedule: Start of earthwork activities
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

4.11 Sediment Basins

Instructions (see CGP Parts 2.1.3.2 and 7.2.10):

If you will install a sediment basin, include design specifications and other details (volume, dimensions, outlet structure) that will be implemented at in conformance with CGP Part 2.1.3.2.

- At a minimum, sediment ponds must provide storage for either (1) the calculated volume of runoff from the 2-year, 24-hour storm (see CGP App. H), or (2) 3,600 cubic feet per acre drained
- Sediment ponds must also utilize outlet structures that withdraw water from the surface, , unless infeasible
- Also, see EPA's *Sediment Basin BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/sediment_basins

General

No temporary sediment basins are currently planned during the construction of this project. Should the contractor decide to use a temporary sediment basin, it should be sized using the criteria outlined in the Construction General Permit.

4.12 Chemical Treatment

Instructions (see CGP Parts 2.1.3.3 and 7.2.10.2):

If you are using treatment chemicals at your site, provide details for each of the items below. This information is required as part of the SWPPP requirements in CGP Part 7.2.10.2.

There are no proposed chemical treatments associated with this project, and therefore no proposed BMP's.

4.13 Dewatering Practices

Instructions (see CGP Parts 2.1.3.4 and 7.2.10):

If you will be discharging stormwater that is removed from excavations, trenches, foundations, vaults, or other similar points of accumulation, include design specifications and details of all dewatering practices that are installed and maintained to comply with CGP Part 2.1.3.4.

General

If groundwater is encountered during construction, dewatering will occur using the following BMPs.

Specific Dewatering Practices

Dewatering Practice # 1

- BMP Description: Sediment Trap
- Installation Schedule: Start of de-watering activities
- Maintenance and Inspection: Weekly & after 1/4" storm events
- Responsible Staff: Construction Manager and Site Contractor

Dewatering Practice # 2

- BMP Description: Stone filter berm
- Installation Schedule: Start of construction
- Maintenance and Inspection: Weekly & after storm events greater than 1/4"
- Responsible Staff: Construction Manager and Site Contractor

Dewatering Practice # 3

- BMP Description: Dumpster Lined with Plastic Sheeting
- Installation Schedule: Start of de-watering activities
- Maintenance and Inspection: Weekly & after 1/4" storm events
- Responsible Staff: Construction Manager and Site Contractor

4.14 Other Stormwater Controls

Instructions:

– Describe any other stormwater controls that do not fit into the above categories.

Any changes in construction activity that produce other allowable non-stormwater discharges will be identified, the SWPPP will be amended, and the appropriate erosion and sedimentation controls will be implemented.

4.15 Site Stabilization

Instructions (see CGP Parts 2.2 and 7.2.10):

The CGP requires you to immediately initiate stabilization when work in an area of your site has permanently or temporarily stopped, and to complete certain stabilization activities within prescribed deadlines. See CGP Part 2.2.1. The CGP also requires that stabilization measures meet certain minimum criteria. See CGP Part 2.2.2. For your SWPPP, you must include the following:

- Describe the specific vegetative and/or non-vegetative practices that will be used to stabilize exposed soils where construction activities have temporarily or permanently ceased. Avoid using impervious surfaces for stabilization whenever possible.
- Also, see EPA's *Seeding BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/seeding
- Once you begin construction, consider using the Grading/Stabilization Activities log in Appendix H of the Template to document your compliance with the stabilization requirements in CGP Part 2.2

All excavated soil will be stockpiled in the designated areas onsite. Soil stabilization measures shall be initiated immediately when earth-disturbing activities have permanently or temporarily ceased on any portion of the site. Earth-disturbing activities are considered temporarily ceased when work will not resume for a period of 14 or more calendar days. Stabilization activities shall be completed within 14 calendar days after the initiation of soil stabilization measures. It shall be stabilized with temporary soil stabilization mats or a tarp to prevent blowing dust and siltation into the storm drain system.

☐ *Vegetative* ☒ *Non-Vegetative*
☒ *Temporary* ☐ *Permanent*

- BMP Description: Soil Stabilization Mat
- Installation Schedule: As/if required
- Maintenance and Inspection: Weekly & after storm events greater than 0.25"
- Responsible Staff: Construction Manager and Site Contractor

SECTION 5: POLLUTION PREVENTION STANDARDS

5.1 Potential Sources of Pollution

Instructions (see CGP Part 7.2.7):

- Identify and describe all pollutant-generating activities at your site (e.g., paving operations; concrete, paint, and stucco washout and waste disposal; solid waste storage and disposal).
- For each pollutant-generating activity, include an inventory of pollutants or pollutant constituents associated with that activity (e.g., sediment, fertilizers, and/or pesticides, paints, solvents, fuels), which could be exposed to rainfall or snowmelt, and could be discharged from your construction site. You must take into account where potential spills and leaks could occur that contribute pollutants to stormwater discharges.

Potential sources of sediment to stormwater runoff:

- Stockpiles and construction staging
- Clearing and grubbing operations
- Grading and site excavation
- Topsoil stripping
- Landscape operations
- Soil tracking offsite from construction vehicles
- Runoff from unstabilized areas
- Construction debris

Potential pollutants and sources, other than sediment, to stormwater runoff:

- Combined Staging Area – fueling activities, equipment maintenance, sanitary facilities, and hazardous waste storage
- Materials Storage Area – building materials, solvents, adhesives, paving materials, paints, aggregates, trash, etc.
- Construction Activity-paving, curb installation, concrete pouring, and building construction

The Contractor shall coordinate staging areas with the Owner. The location of all staging areas will be determined for each phase of construction and shown on plans produced by The Contractor.

Construction Site Pollutants

Pollutant-Generating Activity	**Pollutants or Pollutant Constituents** (that could be discharged if exposed to stormwater)	**Location on Site** (or reference SWPPP site map where this is shown)
Pesticides (insecticides, fungicides, herbicides, rodenticides)	Chlorinated hydrocarbons, organophosphates, carbonates, arsenic	Herbicides used for noxious weed control
Fertilizers	Nitrogen, phosphorous	Newly seeded areas
Plaster		Building construction

	Calcium sulphate, calcium carbonate, sulfuric acid	
Cleaning Solvents	Perchloroethylene, methylene chloride, trichloroethylene, petroleum distillates	No equipment cleaning allowed in project limits
Asphalt	Oil, petroleum distillates	Streets and parking lots
Concrete	Limestone, sand pH, chromium	Curb and gutter, sidewalk, building construction
Glue, Adhesives	Polymers, epoxies	Building construction
Paints	Metal oxides, Stoddard solvent, talc, calcium carbonate, arsenic	Building construction
Curing compounds	Naphtha	Curb and gutter, building construction
Wood preservatives	Stoddard solvent, petroleum distillates, arsenic, copper, chromium	Timber pads, bracing, building construction
Hydraulic Oils/fluids	Mineral oil	Leaks/broken hoses from equipment
Gasoline	Benzene, ethyl benzene, toluene, xylene, MTBE	Secondary containment/staging area
Diesel Fuel	Petroleum distillate, oil & grease, naphthalene, xylenes	Secondary containment/staging area
Kerosene	Coal oil, petroleum distillates	Secondary containment/staging area
Antifreeze/coolant	Ethylene glycol, propylene glycol, heavy metals (copper, lead, zinc)	Leaks or broken hoses from equipment
Sanitary toilets	Bacteria, parasites, and viruses	Staging area

5.2 Spill Prevention and Response

Instructions (see CGP Parts 2.3 and 7.2.11):

- Describe procedures you will use to prevent and respond to leaks, spills, and other releases. You must implement the following at a minimum:
  - ✓ Procedures for expeditiously stopping, containing, and cleaning up spills, leaks, and other releases. Identify the name or title of the employee(s) responsible for detection and response of spills or leaks; and
  - ✓ Procedures for notification of appropriate facility personnel, emergency response agencies, and regulatory agencies where a leak, spill, or other release containing a hazardous substance or oil in an amount equal to or in excess of a reportable quantity consistent with Part 2.3.3.4c and established under either 40 CFR Part 110, 40 CFR Part 117, or 40 CFR Part 302, occurs during a 24-hour period. Contact information must be in locations that are readily accessible and available.
- Some projects/site may be required to develop a Spill Prevention Control and Countermeasure (SPCC) plan under a separate regulatory program (40 CFR 112). If you are required to develop an SPCC plan, or you already have one, you should include references to the relevant requirements from your plan.

- BMP Description: Spill kit, vehicle washing, straw bale catch basin protection, silt fence
- Installation Schedule: Start of construction activity
- Maintenance and Inspection: Minimum weekly & as necessary
- Responsible Staff: Construction Manager and Site Contractor

- Hazardous material handling shall be provided to sub Construction Manager.
- Major vehicle maintenance on-site shall be prohibited
- Re-fueling of vehicles within 25 feet of a drainage structure shall be prohibited
- Spill kit shall be kept on-site consisting of:
  - Gloves
  - Absorbent mats
  - Drip pan

Spill Prevention and Control Plan

- Manufacturers' recommended spill control methods will be posted onsite and site personnel will be made aware of the requirements.
- Cleanup supplies will be kept onsite in a materials storage area. This equipment will include: goggles, brooms, dustpans, mops, rags, gloves, oil absorbent, sawdust, plastic and metal trash cans, and other materials and supplies specifically designated for cleanup.
- All spills will be immediately cleaned up after discovery.
- The spill area will be well ventilated.
- Cleanup personnel will wear suitable protective clothing.
- Spills of toxic and/or hazardous material will be reported to state, local, and Federal authorities, as required by law. Spills shall also be reported immediately to the owner.
- A spill incident report will be filed detailing the amount and extent of the spill, material(s) involved, and effectiveness of the cleanup. This report will be on file at the Construction

Manager/ Site Contractor office, as well as kept onsite in the field office. A copy shall also be filed with the Hazard Communication Coordinator (HCC).

The Construction Manager/ Site Contractor will designate someone onsite that will serve as the Spill Cleanup Coordinator. At least Two other personnel will be designated as alternate spill coordinators. All spill control personnel will be trained in spill prevention, control, and cleanup. The names of the responsible personnel will be posted at the jobsite office of the Construction Manager/ Site Contractor.

5.3 Fueling and Maintenance of Equipment or Vehicles

Instructions (see CGP Parts 2.3.3.1 and 7.2.11):

- Describe equipment/vehicle fueling and maintenance practices that will be implemented to eliminate the discharge of spilled or leaked chemicals (e.g., providing secondary containment *(examples: spill berms, decks, spill containment pallets)* and cover where appropriate, and/or having spill kits readily available.
- Also, see EPA's *Vehicle Maintenance and Washing Areas BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/vehicile_maintain

General

Minor vehicle and equipment emergency maintenance can be performed onsite. Major vehicle and equipment maintenance must be performed offsite. Equipment/vehicle storage areas and any onsite fuel tanks will be inspected weekly and after storm events. Equipment and vehicles will be inspected on each day of use. Any leaks will be repaired immediately or the equipment/vehicle will be removed from the site.

Minor vehicle and equipment emergency maintenance shall occur when a vehicle cannot be safely removed from the site. The vehicle should be repaired so it can be taken off-site so that the rest of the maintenance can occur.

Major vehicle maintenance on-site is prohibited. Re-fueling of vehicles within 25 feet of a drainage structure shall be prohibited.

Specific Pollution Prevention Practices

- BMP Description: Spill Kit
- Installation Schedule: Start of Construction/Onsite throughout construction

Responsible Staff: Construction Manager and Site Contractor

5.4 Washing of Equipment and Vehicles

Instructions (see CGP Parts 2.3.3.2 and 7.2.11):

- Describe equipment/vehicle washing practices that will be used to minimize the discharge of pollutants from equipment and vehicle washing, wheel wash water, and other types of washing (e.g., locating activities away from surface waters and stormwater inlets or conveyances and directing wash waters to a sediment basin or sediment trap, using filtration devices, such as filter bags or sand filters, or using other similarly effective controls).
- Describe how you will prevent the discharge of soaps, detergents, or solvents by providing either (1) cover (*examples: plastic sheeting or temporary roofs*) to prevent these detergents from coming into contact with rainwater, or (2) a similarly effective means designed to prevent the discharge of pollutants from these areas.
- Also, see EPA's *Vehicle Maintenance and Washing Areas BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/vehicile_maintain

General

Vehicle and equipment washout areas shall be constructed by the contractor so that no untreated water enters the storm drain system. Soaps, detergents, or solvents must be stored in a way to prevent these detergents from coming into contact with rainwater, or a similarly effective means designed to prevent the discharge of pollutants from these areas.

Specific Pollution Prevention Practices

Pollution Prevention Practice # 1

- BMP Description: Designated vehicle/equipment washing areas
- Installation Schedule: Start of construction
- Maintenance and Inspection: Daily
- Responsible Staff: Construction Manager and Site Contractor

Pollution Prevention Practice # 2

- BMP Description: Spill kit, vehicle washing, straw bale catch basin protection, silt fence
- Installation Schedule: Start of construction activity
- Maintenance and Inspection: Minimum weekly & as necessary
- Responsible Staff: Construction Manager and Site Contractor

5.5 Storage, Handling, and Disposal of Construction Products, Materials, and Wastes

Instructions (see CGP Parts 2.3.3.3 and 7.2.11):

- For any of the types of construction products, materials, and wastes below in Sections 5.5.1-5.5.6 below that are expected to be used or stored at your site, provide the information on how you will comply with the corresponding CGP provision and the specific practices that will be employed.
- Also, see EPA's *General Construction Site Waste Management BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/cons_wasteman

5.5.1 Building Products

(Note: Examples include asphalt sealants, copper flashing, roofing materials, adhesives, concrete admixtures.)

General

Any building materials required to be stored onsite will be stored at a combined staging and materials storage area. Larger items, such as framing materials, will be elevated by appropriate methods to minimize contact with runoff. The storage area will be inspected weekly and after storm events. It will be kept clean, organized, and equipped with appropriate cleaning supplies. Perimeter controls (silt fence, straw bales, gravel bag berms, etc.), containment structures, covers, and liners will be repaired or replaced as needed to maintain proper function.

Building product usage shall follow the following good housekeeping BMPs:

- The Responsible Staff: Construction Manager or Site Contractor representative will inspect daily for proper use, storage, and cleanup of material used on the job site.
- Store only enough material onsite required for that job as to satisfy current construction needs.
- Store required materials in tightly lidded containers under cover.
- Store materials in original containers with clearly legible labels.
- Separate and store materials apart from each other.
- Do not mix materials unless specifically in accordance with manufacturers' recommendations.
- Use all products from a container before disposing of the container.
- Follow manufacturers' instructions for handling, storage, and disposing of all materials.
- All materials shall be stored in an area to prevent the discharge of pollutants from building products.

Specific Pollution Prevention Practices

Pollution Prevention Practice # 1

- BMP Description: Stacked straw bales around soil stockpiles
- Installation Schedule: Start of construction
- Maintenance and Inspection: Weekly & after storm events greater than 0.25"
- Responsible Staff: Construction Manager and Site Contractor

Pollution Prevention Practice # 2

- BMP Description: Silt Fence
- Installation Schedule: Start of construction
- Maintenance and Inspection: Weekly & after storm events greater than 0.25"
- Responsible Staff: Construction Manager and Site Contractor

Pollution Prevention Practice # 3

- BMP Description: Plastic Cover
- Installation Schedule: Start of construction
- Maintenance and Inspection: Weekly & after storm events greater than 0.25"
- Responsible Staff: Construction Manager and Site Contractor

5.5.2 Pesticides, Herbicides, Insecticides, Fertilizers, and Landscape Materials

- Fertilizers will be used at the application rates called for in the specifications for the project.
- Once applied, fertilizer will be worked into the soil to minimize wash off from irrigation and stormwater.
- Fertilizer will be stored under cover.
- The contents of partially used fertilizer bags will be transferred to re-sealable, watertight containers clearly labeled with their contents.

5.5.3 Diesel Fuel, Oil, Hydraulic Fluids, Other Petroleum Products, and Other Chemicals

General

- Only skilled personnel in a designated area will perform fueling of vehicles onsite.
- Vehicles used onsite will be monitored for fuel and oil leaks.
- Vehicles used onsite will be maintained in good working order.
- Asphalt substances will be applied in accordance with manufacturers' recommendations.
- The use of petroleum products as a release agent for asphalt transport trucks is prohibited.
- Vehicle fueling will only be done in vehicle fueling areas located by the contractor.
- All vehicles parked overnight onsite shall have fuel absorbent pads placed beneath them to absorb any fuel leaks.
- The contractor shall be responsible for locating the fuel storage and re-fueling area onsite to minimize disturbance to construction activates and site area.

5.5.4 Hazardous or Toxic Waste

(Note: Examples include paints, solvents, petroleum-based products, wood preservatives, additives, curing compounds, acids.)

General

- Keep products in their original containers.
- Original container labels should be clearly visible.
- Material safety data sheets will be kept onsite and be available.
- Follow all state, local, and Federal regulations regarding the handling, use, storage, and disposal of hazardous material.

Paints:

- All paint containers will be tightly sealed when not in use.
- Remove excess paint in original labeled containers from the jobsite.
- Paint will not be disposed of onsite. Remove excess paint material from the site and legally dispose of.
- Paint shall not be disposed of in the storm drain system.

5.5.5 Construction and Domestic Waste

(Note: Examples include packaging materials, scrap construction materials, masonry products, timber, pipe and electrical cuttings, plastics, styrofoam, concrete, and other trash or building materials.)

General

Pollution Prevention Practice # 1

- BMP Description: Dumpster
- Installation Schedule: Start of construction
- Maintenance and Inspection: Weekly
- Responsible Staff: Construction Manager and Site Contractor

Pollution Prevention Practice # 2

- BMP Description: Litter/debris pick-up
- Installation Schedule: Start of construction
- Maintenance and Inspection: Daily
- Responsible Staff: Construction Manager and Site Contractor

5.5.6 Sanitary Waste

Pollution Prevention Practice # 1

- BMP Description: Porta John
- Installation Schedule: Start of construction
- Maintenance and Inspection: As manufacturer requires
- Responsible Staff: Construction Manager and Site Contractor

5.6 Washing of Applicators and Containers used for Paint, Concrete or Other Materials

Instructions (see CGP Parts 2.3.3.4 and 7.2.11):

- Describe how you will comply with the CGP Part 2.3.3.4 requirement to "provide an effective means of eliminating the discharge of water from the washout and cleanout of stucco, paint, concrete, form release oils, curing compounds, and other construction materials."
- Also, see EPA's *Concrete Washout BMP Fact Sheet* at www.epa.gov/npdes/stormwater/menuofbmps/construction/concrete_wash

General

Washing of applicators and containers used for paint, concrete or other materials shall follow the following good housekeeping BMPs:

- An effective means of eliminating the discharge of water from the washout and cleanout of stucco, pain, concrete, form release oils, curing compounds, and other construction materials.
- All washwater must be directed into a leak-proof container or leak-proof pit. The container or pit must be designed so that no overflows can occur due to inadequate sizing or precipitation.
- Washout and cleanout wastes should be handled as follows:
  - Do not dump liquid wastes into storm sewers.
  - Dispose of liquid wastes in accordance with applicable requirements.
  - Remove and dispose of hardened concrete waste consistent with the handling of other construction wastes.

- Locate any washout or cleanout activities as far away as possible from surface waters and stormwater inlets or conveyances, and to the extent practicable, designate areas to be used for these activities and conduct such activities only in these areas.

Specific Pollution Prevention Practices

- BMP Description: Designated applicator and container washing areas
- Installation Schedule: Start of construction
- Maintenance and Inspection: Daily
- Responsible Staff: Construction Manager and Site Contractor

5.7 Fertilizers

Instructions (CGP Parts 2.3.5 and 7.2.11):

Describe how you will comply with the CGP Part 2.3.5 requirement to "minimize discharges of fertilizers containing nitrogen or phosphorus"

General

Fertilizer usage shall follow the following good housekeeping BMPs to minimize discharges of nitrogen and phosphorous:

- Fertilizers will be used at the application rates called for in the specifications for the project and the manufacturer's specifications.
- Apply at the appropriate time of year for your location, and preferably timed to coincide as closely as possible to the period of maximum vegetation uptake and growth.
- Avoid applying before heavy rains that could cause excess nutrients to be discharged.
- Never apply to frozen ground.
- Never apply to stormwater conveyance channels with flowing water.
- Follow all other federal, state, tribal, and local requirements regarding fertilizer
- application.
- Once applied, Fertilizers will be worked into the soil to minimize wash off from irrigation and stormwater.
- Fertilizers will be stored under cover.
- The contents of partially used fertilizer bags will be transferred to re-sealable, watertight containers clearly labeled with their contents.

5.8 Other Pollution Prevention Practices

Instructions:

Describe any additional pollution prevention practices that do not fit into the above categories.

General

- INSERT GENERAL DESCRIPTION OF THE PROBLEM THIS CONTROL IS DESIGNED TO ADDRESS

Specific Pollution Prevention Practices

Pollution Prevention Practice # 1

Description

- INSERT DESCRIPTION OF PRACTICE TO BE INSTALLED
- IF APPLICABLE INCLUDE COPIES OF DESIGN SPECIFICATIONS HERE

Installation

- INSERT APPROXIMATE DATE OF INSTALLATION

Maintenance Requirements

- INSERT MAINTENANCE REQUIREMENTS FOR THE POLLUTION PREVENTION PRACTICE

[Repeat as needed.]

SECTION 6: INSPECTION AND CORRECTIVE ACTION

6.1 Inspection Personnel and Procedures

Instructions (see CGP Parts 2.1.1.4, 2.3.2, 3.3.2, 4, 5, and 7.2.12):

Describe the procedures you will follow for conducting inspections in accordance with CGP Parts 2.1.1.4, 2.3.2, 3.3.2, 4, 5, and 7.2.12.

Personnel Responsible for Inspections

INSERT NAMES OF PERSONNEL OR TYPES OF PERSONNEL WHO WILL BE CONDUCTING SITE INSPECTIONS HERE

Note: All personnel conducting inspections must be considered a "qualified person." CGP Part 4.1.1 clarifies that a "qualified person" is a person knowledgeable in the principles and practices of erosion and sediment controls and pollution prevention, who possesses the skills to assess conditions at the construction site that could impact stormwater quality, and the skills to assess the effectiveness of any stormwater controls selected and installed to meet the requirements of this permit.

Inspection Schedule

Specific Inspection Frequency

INSERT INSPECTION SCHEDULE BASED ON CGP PARTS 4.1.2, 4.1.3, OR 4.1.4, WHICHEVER APPLIES

Rain Gauge Location (if applicable)

SPECIFY LOCATION(S) OF RAIN GAUGE TO BE USED FOR DETERMINING WHETHER A RAIN EVENT OF 0.25 INCHES OR GREATER HAS OCCURRED (only applies to inspections conducted for Part 4.1.2.2, 4.1.3, or 4.1.4.2)

Reductions in Inspection Frequency (if applicable)

- For the reduction in inspections resulting from stabilization: SPECIFY (1) LOCATIONS WHERE STABILIZATION STEPS HAVE BEEN COMPLETED AND (2) DATE THAT THEY WERE COMPLETED
  (Note: It is likely that you will not be able to include this in your initial SWPPP. If you qualify for this reduction (see CGP Part 4.1.4.1), you will need to modify your SWPPP to include this information.)

- For the reduction in inspections in arid, semi-arid, or drought-stricken areas: INSERT BEGINNING AND ENDING DATES OF THE SEASONALLY-DEFINED ARID PERIOD FOR YOUR AREA OR THE VALID PERIOD OF DROUGHT

- For reduction in inspections due to frozen conditions: INSERT BEGINNING AND ENDING DATES OF FROZEN CONDITIONS ON YOUR SITE

Inspection Report Forms

INSERT COPY OF ANY INSPECTION REPORT FORMS YOU WILL USE HERE OR IN APPENDIX D

6.2 *Corrective Action*

Instructions (CGP Parts 5 and 7.2.12):

- Describe the procedures for taking corrective action in compliance with CGP Part 5.

Personnel Responsible for Corrective Actions

INSERT NAMES OF PERSONNEL OR TYPES OF PERSONNEL RESPONSIBLE FOR CORRECTIVE ACTIONS

Corrective Action Forms

INSERT A COPY OF ANY CORRECTIVE ACTION FORMS YOU WILL USE HERE OR IN APPENDIX E

6.3 *Delegation of Authority*

Instructions:

- Identify the individual(s) or positions within the company who have been delegated authority to sign inspection reports.
- Attach a copy of the signed delegation of authority (see example in Appendix J of the Template.
- For more on this topic, see Appendix I, Subsection 11 of EPA's CGP.

Duly Authorized Representative(s) or Position(s):

Insert Company or Organization Name:
Insert Name:
Insert Position:
Insert Address:
Insert City, State, Zip Code:
Insert Telephone Number:
Insert Fax/Email:

SECTION 7: TRAINING

Instructions (see CGP Part 6 and 7.2.13):

- Complete the table below to provide documentation that the personnel required to be trained in CGP Part 6 completed the appropriate training
- If personnel will be taking course training (which is not required as part of the CGP), consider using Appendix I to track completion of this training
- The following personnel, at a minimum, must be receive training, and therefore should be listed out individually in the table below:
  - ✓ Personnel who are responsible for the design, installation, maintenance, and/or repair of stormwater controls (including pollution prevention measures);
  - ✓ Personnel responsible for the application and storage of treatment chemicals (if applicable);
  - ✓ Personnel who are responsible for conducting inspections as required in Part 4.1.1; and
  - ✓ Personnel who are responsible for taking corrective actions as required in Part 5.
- CGP Part 6 requires that the required personnel must be trained to understand the following if related to the scope of their job duties:
  - ✓ The location of all stormwater controls on the site required by this permit, and how they are to be maintained;
  - ✓ The proper procedures to follow with respect to the permit's pollution prevention requirements; and
  - ✓ When and how to conduct inspections, record applicable findings, and take corrective actions.

Table 7-1: Documentation for Completion of Training

Name	Date Training Completed
INSERT NAME OF PERSONNEL HERE	INSERT COMPLETION DATE HERE

SECTION 8: CERTIFICATION AND NOTIFICATION

Instructions (CGP Appendix I, Part I.11.b):

- The following certification statement must be signed and dated by a person who meets the requirements of Appendix I, Part I.11.b.
- This certification must be re-signed in the event of a SWPPP Modification.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: _____ Title: _____

Signature: _____ Date: _____

[Repeat as needed for multiple construction operators at the site.]

SWPPP APPENDICES

Attach the following documentation to the SWPPP:

Appendix A – Site Maps

Appendix B – Copy of 2012 CGP

Appendix C – NOI and EPA Authorization Email

Appendix D – Inspection Form

(Note: EPA is in the process of developing a sample inspection form for use by CGP permittees. The form will be made available at http://cfpub.epa.gov/npdes/stormwater/cgp.cfm.)

Appendix E – Corrective Action Form

(Note: EPA is in the process of developing a sample corrective action form for use by CGP permittees. The form will be made available at http://cfpub.epa.gov/npdes/stormwater/cgp.cfm.)

Appendix F – SWPPP Amendment Log

Appendix G – Subcontractor Certifications/Agreements

Appendix H – Grading and Stabilization Activities Log

Appendix I – Training Log

Appendix J – Delegation of Authority

Appendix K – Endangered Species Documentation

Appendix L – Historic Preservation Documentation

Appendix A – Site Maps

INSERT SITE MAPS CONSISTENT WITH TEMPLATE SECTION 2.6

LOCUS

SMAST II
UNIVERSITY OF MASSACHUSETTS, DARTMOUTH

Data Source: MassGIS
Nitsch Project #9236.2

Nitsch Engineering

Appendix B – Copy of 2012 CGP

INSERT COPY OF 2012 CGP

Appendix C – Copy of NOI and EPA Authorization email

INSERT COPY OF NOI AND EPA'S AUTHORIZATION EMAIL PROVIDING COVERAGE UNDER THE CGP

Appendix D – Copy of Inspection Form

INSERT COPY OF ANY INSPECTION FORMS YOU WILL USE TO PREPARE INSPECTION REPORTS

Appendix E – Copy of Corrective Action Form

INSERT COPY OF CORRECTIVE ACTION FORMS YOU WILL USE

Appendix F – *Sample* SWPPP Amendment Log

Instructions (see CGP Part 7.4):

- Create a log here of changes and updates to the SWPPP. You may use the table below to track these modifications.
- SWPPP modifications are required pursuant to CGP Part 7.4.1 in the following circumstances:
  - ✓ Whenever new operators become active in construction activities on your site, or you make changes to your construction plans, stormwater control measures, pollution prevention measures, or other activities at your site that are no longer accurately reflected in your SWPPP;
  - ✓ To reflect areas on your site map where operational control has been transferred (and the date of transfer) since initiating permit coverage;
  - ✓ If inspections or investigations determine that SWPPP modifications are necessary for compliance with this permit;
  - ✓ Where EPA determines it is necessary to impose additional requirements on your discharge; and
  - ✓ To reflect any revisions to applicable federal, state, tribal, or local requirements that affect the stormwater control measures implemented at the site.
- If applicable, if a change in chemical treatment systems or chemically-enhanced stormwater control is made, including use of a different treatment chemical, different dosage rate, or different area of application.

No.	Description of the Amendment	Date of Amendment	Amendment Prepared by [Name(s) and Title]

Appendix G – *Sample* Subcontractor Certifications/Agreements

SUBCONTRACTOR CERTIFICATION
STORMWATER POLLUTION PREVENTION PLAN

Project Number: _____

Project Title: _____

Operator(s): _____

As a subcontractor, you are required to comply with the Stormwater Pollution Prevention Plan (SWPPP) for any work that you perform on-site. Any person or group who violates any condition of the SWPPP may be subject to substantial penalties or loss of contract. You are encouraged to advise each of your employees working on this project of the requirements of the SWPPP. A copy of the SWPPP is available for your review at the office trailer.

Each subcontractor engaged in activities at the construction site that could impact stormwater must be identified and sign the following certification statement:

I certify under the penalty of law that I have read and understand the terms and conditions of the SWPPP for the above designated project and agree to follow the practices described in the SWPPP.

This certification is hereby signed in reference to the above named project:

Company: _____

Address: _____

Telephone Number: _____

Type of construction service to be provided: _____

_____

_____

Signature: _____

Title: _____

Date: _____

Appendix H – *Sample* Grading and Stabilization Activities Log

Date Grading Activity Initiated	**Description of Grading Activity**	**Description of Stabilization Measure and Location**	**Date Grading Activity Ceased** (Indicate Temporary or Permanent)	**Date When Stabilization Measures Initiated**

Appendix I – *Sample* SWPPP Training Log

Stormwater Pollution Prevention Training Log

Project Name:

Project Location:

Instructor's Name(s):

Instructor's Title(s):

Course Location: _____ Date: _____

Course Length (hours): _____

Stormwater Training Topic: *(check as appropriate)*

- ❑ **Sediment and Erosion Controls**
- ❑ **Emergency Procedures**
- ❑ **Stabilization Controls**
- ❑ **Inspections/Corrective Actions**
- ❑ **Pollution Prevention Measures**

Specific Training Objective:_____

_____

Attendee Roster: *(attach additional pages as necessary)*

No.	Name of Attendee	Company
1		
2		
3		
4		
5		
6		
7		
8		

Appendix J – *Sample* Delegation of Authority Form

Delegation of Authority

I, _____ (name), hereby designate the person or specifically described position below to be a duly authorized representative for the purpose of overseeing compliance with environmental requirements, including the Construction General Permit, at the _____ construction site. The designee is authorized to sign any reports, stormwater pollution prevention plans and all other documents required by the permit.

_____ (name of person or position)
_____ (company)
_____ (address)
_____ (city, state, zip)
_____ (phone)

By signing this authorization, I confirm that I meet the requirements to make such a designation as set forth in Appendix I of EPA's Construction General Permit (CGP), and that the designee above meets the definition of a "duly authorized representative" as set forth in Appendix I.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: _____

Company: _____

Title: _____

Signature: _____

Date: _____

Appendix K – Endangered Species Documentation

INSERT DOCUMENTATION CONSISTENT WITH SWPPP TEMPLATE SECTION 3.1

APPENDIX K: NHESP

SMAST II

UNIVERSITY OF MASSACHUSETTS, DARTMOUTH

Data Source: MassGIS

Nitsch Project #9236.2

Nitsch Engineering

Appendix L – Historic Properties Documentation

INSERT DOCUMENTATION CONSISTENT WITH SWPPP TEMPLATE SECTION 3.2

APPENDIX G

Soil Investigations

NRCS Soil Maps and Descriptions
Geotechnical Report


70° 54' 41" W
70° 54' 20" W
41° 35' 48" N
41° 35' 38" N
340720
340770
340820
340870
340920
340970
341020
341070
341120
341170
4606780
4606730
4606680
4606630
4606580
4606530
4606480
Seymour St
Point St
Brock
Rodney French
Bayview St
602
656
Ferry Rd
Map Scale: 1:2,240 if printed on A landscape (11" x 8.5") 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 1:20,000.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Bristol County, Massachusetts, Southern Part
Survey Area Data: Version 9, Sep 28, 2015

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

Date(s) aerial images were photographed: Mar 30, 2011—Oct 8, 2011

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

Bristol County, Massachusetts, Southern Part (MA603)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
602	Urban land	3.9	53.9%
656	Udorthents - Urban land complex	3.3	46.1%
Totals for Area of Interest		**7.2**	**100.0%**

GZA
GeoEnvironmental, Inc.

Engineers and
Scientists

TO: Mr. Steve Mahler
Ellenzweig Architects
1280 Massachusetts Avenue
Cambridge, Massachusetts 02138

FROM: Matthew M. Smith, P.E., Mary B. Hall, P.E.
GZA GeoEnvironmental, Inc.

DATE: January 7, 2016

FILE NO: 01.0172205.20

SUBJECT: Supplemental Geotechnical Evaluation
838 South Rodney French Boulevard
School for Marine Science and Technology (SMAST)
University of Massachusetts – Dartmouth
New Bedford, Massachusetts

133 Federal Street
3rd Floor
Boston
Massachusetts
02110
P: 617-963-1000
F: 617-482-6868
http://www.gza.com

In accordance with our contract dated June 14, 2015 GZA GeoEnvironmental, Inc. (GZA) is pleased to submit this memorandum summarizing the results of recent test pit explorations and field testing performed for the above-referenced property (Site) to Ellenzweig Architects (Client). The objectives of this work was to perform in-situ permeability testing on shallow soils (3 to 4 feet below the existing ground surface) and provide the permeability testing data to the Design team for use in evaluating potential locations for subsurface stormwater infiltration. Elevations cited herein are referenced to the 1988 North American Vertical Datum (NAVD 88).

The information and recommendations contained within this memorandum are subject to the limitations contained in Appendix A.

BACKGROUND

Our understanding of the project is based on our previous geotechnical, environmental and permitting work on the project and recent discussions with you. GZA previously performed 16 borings (GZ-1 through GZ-3 and GZ-101 through GZ-113) and two test pits (TP-1 and TP-2) at the Site. Results and recommendations from the previous subsurface exploration program are summarized in our Preliminary Geotechnical Report for the project (dated May 13, 2013) prepared for the Division of Capital Asset Management and Maintenance (DCAMM) and Technical Memorandum (dated September 1, 2015) that was prepared for Ellenzweig Architects.

The Site is located at 838 South Rodney French Boulevard in New Bedford, Massachusetts. The property is currently improved by a vacant approximately 22,500 square foot, one- and two-story building, reportedly built about 1959, and two smaller outbuildings (a shed and garage located west of the vacant building).
The new 3-story SMAST 2 building will be constructed after demolition of the existing buildings. The new building will be constructed at grade (without a basement) in approximately the same location as the existing building. In order to accommodate the new seawater wet lab in the proposed SMAST building, the existing seawater pumping system that services the SMAST 1 building will be modified and the piping infrastructure extended to service the wet lab at the

proposed SMAST 2 building. As part of the redevelopment of the site for the proposed SMAST 2 building, stormwater infiltration systems will be constructed on-site.

SUBSURFACE EXPLORATIONS

Marini Corporation of Auburndale, Massachusetts performed three (3) test pits (TP-101 through TP-103) on September 29, 2015. A fourth test pit location was proposed in the area south of the existing parking lot at the SMAST 2 building, however this location was not performed as part of this program because the proposed location was within the portion of the Site currently owned by the National Park Service. The test pits were performed in the existing paved parking and grassy/wooded areas at locations coordinated with you and the Site Civil Engineer, Nitsch Engineering. Single ring falling head permeameter tests were performed at each of the three test pit locations. The explorations were located by tape measurements from existing features and the approximate locations are shown on Figure 1.

A GZA representative observed the test pits, classified the excavated soil, prepared the test pit logs, and performed the falling head permeability tests. The test pit logs and permeability test results are attached as Appendices B and C, respectively. Photographs of the test pits are included in the attached Appendix D.

SUBSURFACE CONDITIONS

The subsurface soil conditions encountered in the test pits appear to be generally consistent with the soil conditions indicated on the boring logs included in our September 1, 2015 Technical Memorandum. The conditions observed in the test pits are described below in further detail. Refer to the exploration logs attached as Appendix B for more detailed subsurface conditions at specific exploration locations.

Test pits TP-101 through TP-103 were performed to approximately 8 feet below grade, corresponding to approximate elevations 12 to 15. Fill was encountered below the existing asphalt/topsoil at test pits TP-101 and TP-103 and extended to 2 to 2.8 feet below ground surface. The fill generally consisted of fine to coarse sand, up to 35 percent gravel, and 15 percent silt. Buried topsoil was observed under the pavement and above the natural soils at test pit TP-102. At test pit TP-103, cobble/boulder sized chunks of broken asphalt were observed within the fill layer. The fill (and buried topsoil, where encountered) was underlain by a natural sand deposit generally consisting of fine to coarse sand containing with about 26 to 31 percent silt and up to 19 to 27 percent gravel.

Groundwater

Groundwater was not encountered in the test pits during this subsurface exploration program. As noted in our Preliminary Geotechnical Report and Technical Memorandum, groundwater has previously been measured at depths of approximately xxxx to xxxx feet below ground surface. It should be recognized that groundwater observations have been made at the times and under the conditions stated in the logs. Fluctuations in groundwater levels will occur due to variations in precipitation, temperature, and other factors different from those at the time the measurement were taken.

GEOTECHNICAL LABORATORY TESTING

Three soil samples obtained from the test pits were submitted to Thielsch Laboratories in Cranston, Rhode Island for gradation analysis to confirm field classifications and assist in evaluating on-site

reuse of soils excavated during construction. Geotechnical laboratory test results are attached as Appendix E.

FIELD INFILTRATION TESTING

GZA performed infiltration tests within test pits TP-101 through TP-103 at depths between approximately 3 and 4 feet. The infiltration tests were performed in general accordance with ASTM D5126 using a single ring infiltrometer. The test hole was pre-soaked for approximately 15 minutes prior to starting the test. The water level in the infiltrometer was measured over a period of approximately 20 minutes.

Single ring falling head permeability test results indicate approximate hydraulic conductivities as follows:

Boring	Test Depth (ft)	Soil Description Within Test Zone (excludes amount of boulders/cobbles)	Est. Hydraulic Conductivity, k (cm/sec)
TP-101	3	Light Brown fine to coarse SAND some Silt, little fine to coarse Gravel, little Cobbles	1.1×10^{-2}
TP-102	3	Light Brown fine to coarse SAND, some Silt, some fine to coarse Gravel	1.7×10^{-2}
TP-103	4	Light Brown fine to coarse SAND, some Silt, some fine to coarse Gravel	7.4×10^{-3}

The tests results for the materials described above demonstrate higher permeability values than published values for the type of soil encountered at each test pit. Typically soils of this classification and density would be an order of magnitude less permeable. Therefore, GZA suggests that a hydraulic conductivity no higher than 1×10^{-3} cm/second be used for design. Field permeability testing results are presented in the attached Appendix C.

We thank you for the opportunity to work on this project and would look forward to our continued involvement. This report was prepared by Jason Clegg under the oversight of the undersigned. Please do not hesitate to contact the undersigned if you have any questions.

Very truly yours,

GZA GEOENVIRONMENTAL, INC.

Matthew Smith, P.E.
Senior Project Manager

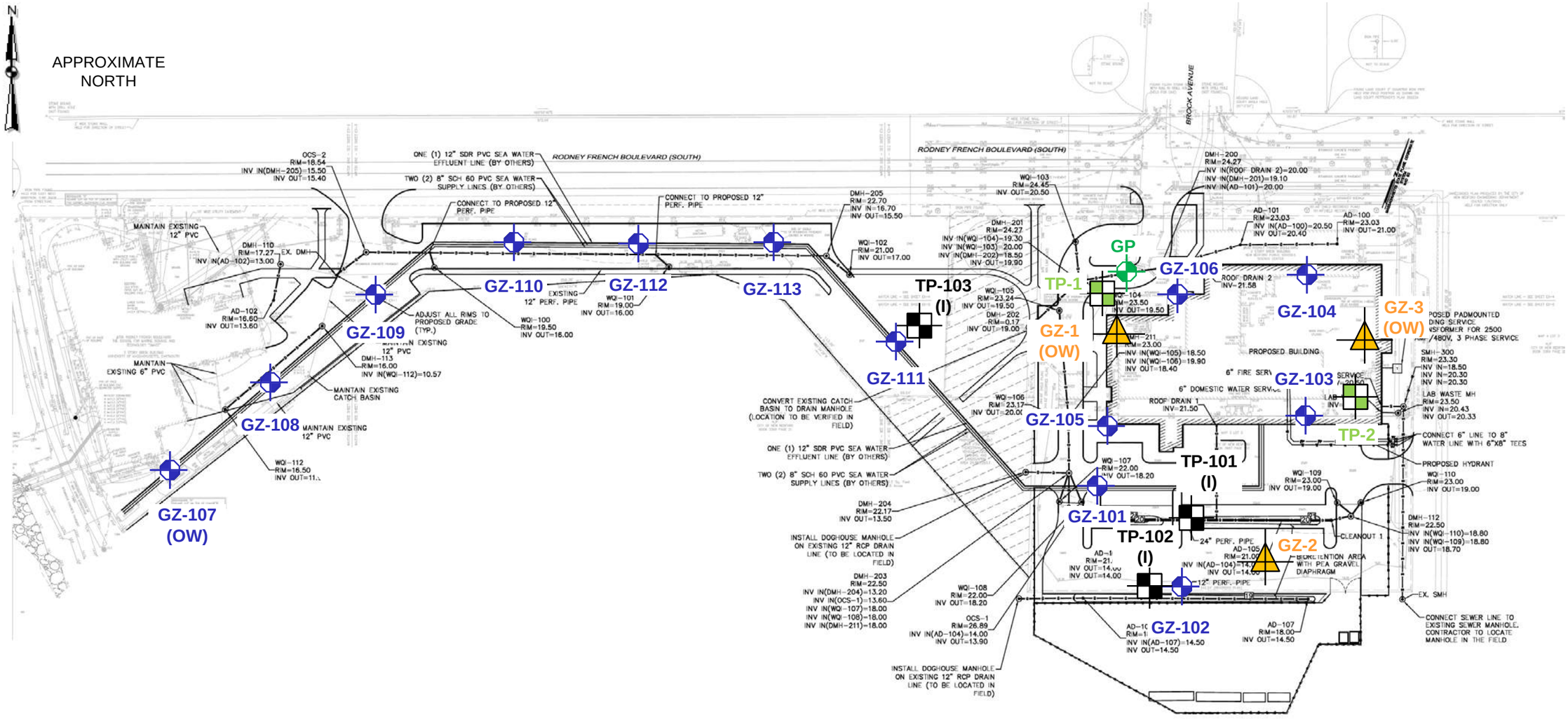
Bruce W. Fairless, P.E.
Consultant/Reviewer

Mary B. Hall, P.E.
Senior Principal

Attachments: Figure
Appendix A – Limitations
Appendix B – Test Pit Logs
Appendix C – Field Permeability Test Results
Appendix D – Test Pit Photographs
Appendix E – Geotechnical Laboratory Testing Results

J:\170,000-179,999\172205\172205-20.MMS\9-29-15 Test Pits\172205-20-2015 Test Pits Memo final 1-7-16.docx

FIGURE



LEGEND:

TP-101 (I) — TEST PITS PERFORMED BY MARINI CORPORATION OF NEWTON, MASSACHUSETTS ON AUGUST 28, 2015. OBSERVED AND LOGGED BY GZA PERSONNEL. "I" INDICATES AN INFILTRATION TEST WAS PERFORMED AT THE LOCATION.

GZ-101 (OW) — BORINGS PERFORMED BY NEW ENGLAND BORING, INC, OF BROCKTON, MASSACHUSETTS BETWEEN JULY 22 AND 27, 2015. OBSERVED AND LOGGED BY GZA PERSONNEL. "OW" INDICATES THAT A GROUNDWATER OBSERVATION WELL WAS INSTALLED.

GZ-1 (OW) — BORINGS PERFORMED BY NEW HAMPSHIRE BORING, INC. OF BROCKTON, MASSACHUSETTS ON MARCH 20, 2013. OBSERVED AND LOGGED BY GZA PERSONNEL.

TP-1 — TEST PITS PERFORMED BY MARINI CORPORATION OF NEWTON, MASSACHUSETTS ON MARCH 20 AND 21, 2013. OBSERVED AND LOGGED BY GZA PERSONNEL.

GP — APPROXIMATE LOCATION OF GEOPROBE PERFORMED BY ATLANTIC ENVIRONMENTAL TECHNOLOGIES, INC. (AET) OF NEW BEDFORD, MA ON NOVEMBER 15, 2011. OBSERVED AND LOGGED BY AET EMPLOYEES.

NOTES:

1. THE BASE MAP WAS DEVELOPED FROM A PLAN PREPARED BY ELLENZWEIG ARCHITECTURE & PLANNING. ENTITLED "OVERALL UTILITY PLAN", DATED AUGUST 25, 2015. ELEVATION DATUM REFERENCED TO NAVD 88.

PROJ MGR: MMS
DESIGNED BY: JAC
REVIEWED BY: MMS

OPERATOR: JAC
DATE: OCT. 1, 2015

GZA GeoEnvironmental, Inc.

APPROXIMATE SCALE
1" = 100'

0 50' 100'

SCHOOL FOR MARINE SCIENCE AND TECHNOLOGY
UMASS DARTMOUTH, NEW BEDFORD, MA

EXPLORATION LOCATION PLAN

JOB NO. 01.0172205.20

FIGURE NO. 1

APPENDIX A
LIMITATIONS

APPENDIX A- LIMITATIONS

Use of Report

1. GZA GeoEnvironmental, Inc. (GZA) prepared this report on behalf of, and for the exclusive use of Ellenzweig, Architecture, for the stated purpose(s) and location(s) identified in the Proposal for Services and/or Report. Use of this report, in whole or in part, at other locations, or for other purposes, may lead to inappropriate conclusions; and we do not accept any responsibility for the consequences of such use(s). Further, reliance by any party not expressly identified in the agreement, for any use, without our prior written permission, shall be at that party's sole risk, and without any liability to GZA.

Standard of Care

2. GZA's findings and conclusions are based on the work conducted as part of the Scope of Services set forth in Proposal for Services and/or Report, and reflect our professional judgment. These findings and conclusions must be considered not as scientific or engineering certainties, but rather as our professional opinions concerning the limited data gathered during the course of our work. If conditions other than those described in this report are found at the subject location(s), or the design has been altered in any way, GZA shall be so notified and afforded the opportunity to revise the report,as appropriate, to reflect the unanticipated changed conditions .

3. GZA's services were performed using the degree of skill and care ordinarily exercised by qualified professionals performing the same type of services, at the same time, under similar conditions, at the same or a similar property. No warranty, expressed or implied, is made.

4. This report describes the compliance status with respect to the environmental regulatory programs outlined in the report. Compliance with regulatory programs or specific regulatory requirements other than those outlined in this report have not been evaluated.

5. This study was not intended to be an environmental site assessment. No attempt was made to evaluate whether soil and/or groundwater at the facility is contaminated by chemicals or petroleum products. In addition, GZA renders no opinion as to the presence of hazardous material (including asbestos and polychlorinated biphenyls) on or in any of the exterior or interior processes, equipment, walls, floors, or ceilings of the onsite structures.

6. Unless otherwise specified in the report, GZA did not perform testing or analyses to determine the presence or concentration of any chemicals, oils, asbestos, or polychlorinated biphenyls at the site buildings or in the environment at the site. Where such analyses have been conducted by an outside laboratory, GZA has relied upon the data provided, and has not conducted an independent evaluation of the reliability of these data.

Subsurface Conditions

7. The generalized soil profile(s) provided in our Report are based on widely-spaced subsurface explorations and are intended only to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and were based on our assessment of subsurface conditions. The composition of strata, and the transitions between strata, may be more variable and more complex than indicated. For more specific information on soil conditions at a specific location refer to the exploration logs.

8. In preparing this report, GZA relied on certain information provided by Ellenzweig, state and local officials, and other parties referenced therein which were made available to GZA at the time of our evaluation. GZA did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this evaluation.

9. Water level readings have been made in borings, test pits and monitoring wells at the specified times and under the stated conditions. These data have been reviewed and interpretations have been made in this Report. Fluctuations in the level of the groundwater however occur due to temporal or spatial variations in areal recharge rates, soil heterogeneities, the presence of subsurface utilities, and/or natural or artificially induced perturbations. The water table encountered in the course of the work may differ from that indicated in the Report.

10. GZA's services did not include an assessment of the presence of oil or hazardous materials at the property. Consequently, we did not consider the potential impacts (if any) that contaminants in soil or groundwater may have on construction activities, or the use of structures on the property.

11. Recommendations for foundation drainage, waterproofing, and moisture control address the conventional geotechnical engineering aspects of seepage control. These recommendations may not preclude an environment that allows the infestation of mold or other biological pollutants.

Compliance with Codes and Regulations

12. We used reasonable care in identifying and interpreting applicable codes and regulations. These codes and regulations are subject to various, and possibly contradictory, interpretations. Compliance with codes and regulations by other parties is beyond our control.

13. The regulatory compliance status described in this report has been evaluated based on our interpretation of regulations, and where appropriate, the interpretations provided by the applicable regulatory authority personnel at the time of our study. In some cases, these interpretations require subjective judgment and we cannot guarantee that all applicable regulatory authority personnel will interpret the regulations in the same manner as we have, or in the manner that the agency personnel we may have spoken to have. Applicable regulatory authorities' interpretations, requirements, and enforcement policies vary from district office to district office, from state to state, and between federal and state agencies. In addition, statues, rules, standards, and regulations may be legislatively changed and inter-agency and intra-agency policies may be changed from present practices from time to time.

14. In preparing this report, GZA has relied on certain information provided by federal, State, or local applicable regulatory authorities and other parties referenced herein, and on information contained in the files of federal, State, and/or local applicable regulatory authorities available to GZA at the time of our compliance study. Although there may have been some degree of overlap in the information provided by these various sources, GZA did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of the study. Where information provided by Client was not complete, representations regarding the regulatory compliance of such operations and activities has not been made.

Screening and Analytical Testing

15. GZA collected environmental samples at the locations identified in the Report. These samples were analyzed for the specific parameters identified in the report. Additional constituents, for

which analyses were not conducted, may be present in soil, groundwater, surface water, sediment and/or air. Future Site activities and uses may result in a requirement for additional testing.

16. Our interpretation of field screening and laboratory data is presented in the Report. Unless otherwise noted, we relied upon the laboratory's QA/QC program to validate these data.

17. Variations in the types and concentrations of contaminants observed at a given location or time may occur due to release mechanisms, disposal practices, changes in flow paths, and/or the influence of various physical, chemical, biological or radiological processes. Subsequently observed concentrations may be other than indicated in the Report.

Interpretation of Data

18. GZA's work was performed in accordance with generally accepted practices of other consultants undertaking similar studies at the same time and in the same geographical area, and GZA observed that degree of care and skill generally exercised by other consultants under similar circumstances and conditions. GZA's findings and conclusions must be considered not as scientific certainties, but rather as our professional opinion concerning the significance of the limited data gathered during the course of the study. No warranty, express or implied, is made. Specifically, GZA does not and cannot represent that the Site contains no hazardous material, oil, or other latent condition beyond that observed by GZA during its study. Additionally, GZA makes no warranty that any response action or recommended action will achieve all of its objectives or that the findings of this study will be upheld by an applicable regulatory authority.

New Information

19. In the event that the Client or others authorized to use this report obtain information on environmental regulatory compliance issues at the facility not contained in this report, such information shall be brought to GZA's attention forthwith. GZA will evaluate such information and, on the basis of this study, may modify the conclusions stated in this report.

Additional Services

20. GZA recommends that we be retained to provide services during any future: site observations, design, implementation activities, construction and/or property development/redevelopment. This will allow us the opportunity to: i) observe conditions and compliance with our design concepts and opinions; ii) allow for changes in the event that conditions are other than anticipated; iii) provide modifications to our design; and iv) assess the consequences of changes in technologies and/or regulations.

APPENDIX B
BUILDING TEST PIT LOGS

GZA
GeoEnvironmental, Inc.
Engineers/Scientists

School for Marine Science and Technology
UMASS Dartmouth
New Bedford, MA

Test Pit No. TP-101
Page No. 1 of 1
File No. 01.0172205.20
Checked By: MJO/MMS

			Excavation Equipment				
GZA Rep.	Jason Clegg	Contractor	Marini Corporation			Date	9/29/2015
		Operator	Jeff Helms			Ground Elev.	20
Weather	P. Cloudy 70s	Make	CASE	Model	580	Time Started	0725
		Capacity	0.25 CY	Reach	12 ft.	Time Completed	0900

Depth	Soil Description	Sample No.		Excav. Effort	Boulders: Count/ Class	Note No.
0	0.25' Asphalt			M	1A	1
1'				M	-	
2'	2' Brown fine to coarse SAND, some fine to coarse Gravel, trace Silt (FILL)			M	-	
3'				M	2A	2
4'	Light Brown fine to coarse SAND, some Silt, little fine to coarse Gravel, little Cobbles	S-1 (3' - 5')		M	1B	
5'				M	-	
6'	(SAND & GRAVEL)			M	-	
7'				M	-	3
8'	8' Bottom of Excavation @ 8 Feet					
9'						
10'						
11'						
12'						
13'						
14'						
15'						
16'						

Notes:

1. Elevation estimated from a plan titled "Existing Conditions Survey", prepared by Ellenzweig and dated July 22, 2013. Elevation datum is the North American Vertical Datum 1988 (NAVD 88).
2. Performed single ring falling head permeameter testing at approximately 3' below ground surface. Refer to technical memo for further information.
3. Upon completion, the test pit was backfilled with excavated soil, placed in approximately 8 to 12-inch thick lifts, each tamped with the excavator bucket up to existing grade. The removed asphalt was placed at the existing grade.

Test Pit Plan
12' × 5'
NORTH
Volume = 18 cu. yd.

Boulder Class

Letter Designation	Size Range Classification
A	6" - 17"
B	18" - 36"
C	36" and Larger

Excavation Effort
E-----Easy
M-----Moderate
D-----Difficult

Proportions Used

TRACE (TR.)	0 - 10%
LITTLE (LI.)	10 - 20%
SOME (SO.)	20 - 35%
AND	35 - 50%

Abbreviations
F = Fine
M = Medium
C = Coarse
V = Very
F/M = Fine to medium
F/C = Fine to coarse
GR = Gray
BN = Brown
YEL = Yellow

GROUNDWATER
( ) Encountered
(X) Not Encountered

Elapsed Time to Reading (Hours)	Depth to Ground-water

Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurements were made.

GZA
GeoEnvironmental, Inc.
Engineers/Scientists

School for Marine Science and Technology
UMASS Dartmouth
New Bedford, MA

Test Pit No. TP-102
Page No. 1 of 1
File No. 01.0172205.20
Checked By: MJO/MMS

GZA Rep. Jason Clegg
Weather P. Cloudy 70s

Excavation Equipment
Contractor Marini Corportation
Operator Jeff Helms
Make CASE Model 580
Capacity 0.25 CY Reach 12 ft.

Date 9/29/2015
Ground Elev. 19
Time Started 0800
Time Completed 0940

Depth	Soil Description	Sample No.		Excav. Effort	Boulders: Count/ Class	Note No.
0	0.25' Asphalt					
1'	Dark Brown fine to coarse Sand, some Silt, little Gravel, trace Roots			M	-	1
	1.8' (BURIED TOPSOIL)			M	-	
2'				M	-	2
3'	Light Brown fine to coarse SAND, some Silt, some fine to coarse Gravel, little Cobbles	S-1 (3' - 5')		M	2A	
4'				M	1A, 1B	
5'				D	2A	
6'	(SAND & GRAVEL)			D	1B	
7'				D	3A	3
8'	8' Bottom of Excavation @ 8 Feet					
9'						
10'						
11'						
12'						
13'						
14'						
15'						
16'						

Notes:

1. Elevation estimated from a plan titled "Existing Conditions Survey", prepared by Ellenzweig and dated July 22, 2013. Elevation datum is the North American Vertical Datum 1988 (NAVD 88).
2. Performed single ring falling head permeameter testing at approximately 3' below ground surface. Refer to technical memo for further information.
3. Upon completion, the test pit was backfilled with excavated soil, placed in approximately 8 to 12-inch thick lifts, each tamped with the excavator bucket up to existing grade. The removed asphalt was placed at the existing grade.

Test Pit Plan
12' × 5'
NORTH
Volume = 18 cu. yd.

Boulder Class

Letter Designation	Size Range Classification
A	6" - 17"
B	18" - 36"
C	36" and Larger

Excavation Effort
E-----Easy
M-----Moderate
D-----Difficult

Proportions Used

TRACE (TR.)	0 - 10%
LITTLE (LI.)	10 - 20%
SOME (SO.)	20 - 35%
AND	35 - 50%

Abbreviations
F = Fine
M = Medium
C = Coarse
V = Very
F/M = Fine to medium
F/C = Fine to coarse
GR = Gray
BN = Brown
YEL = Yellow

GROUNDWATER
( ) Encountered
(X) Not Encountered

Elapsed Time to Reading (Hours)	Depth to Ground-water

Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurements were made.

GZA
GeoEnvironmental, Inc.
Engineers/Scientists

School for Marine Science and Technology
UMASS Dartmouth
New Bedford, MA

Test Pit No. TP-103
Page No. 1 of 1
File No. 01.0172205.20
Checked By: MJO/MMS

		Excavation Equipment					
GZA Rep.	Jason Clegg	Contractor	Marini Corporation			Date	9/29/2015
		Operator	Jeff Helms			Ground Elev.	23
Weather	P. Cloudy 70s	Make	CASE	Model	580	Time Started	1010
		Capacity	0.25 CY	Reach	12 ft.	Time Completed	1115

Depth	Soil Description	Sample No.		Excav. Effort	Boulders: Count/ Class	Note No.
0	0.5' Brown fine to coarse SAND, some Silt, little fine to coarse Gravel, trace Roots (Topsoil)			E	-	1
1'	Brown fine to coarse SAND and boulder-sized chunks of ASPHALT, little fine to coarse Gravel, little Silt, trace Brick			M	-	
2'	2.8' (FILL)			M	-	
3'				M	1A, 1B	2
4'		S-1		M	2A, 1B	
5'	Light Brown fine to coarse SAND, some Silt, some fine to coarse Gravel, little Cobbles	(4' - 6')		D	2B	
6'				D	2B	
7'	(SAND & GRAVEL)			D	2A	3
8'	8'					
9'						
10'						
11'						
12'						
13'						
14'						
15'						
16'						

Notes:

1. Elevation estimated from a plan titled "Existing Conditions Survey", prepared by Ellenzweig and dated July 22, 2013. Elevation datum is the North American Vertical Datum 1988 (NAVD 88).
2. Performed single ring falling head permeameter testing at approximately 4' below ground surface. Refer to technical memo for further information.
3. Upon completion, the test pit was backfilled with excavated soil, placed in approximately 8 to 12-inch thick lifts, each tamped with the excavator bucket up to existing grade. The removed asphalt was placed at the existing grade.

Test Pit Plan
11.5' × 5.5'
NORTH
Volume = 22 cu. yd.

Boulder Class

Letter Designation	Size Range Classification
A	6" - 17"
B	18" - 36"
C	36" and Larger

Excavation Effort
E-----Easy
M-----Moderate
D-----Difficult

Proportions Used

TRACE (TR.)	0 - 10%
LITTLE (LI.)	10 - 20%
SOME (SO.)	20 - 35%
AND	35 - 50%

Abbreviations
F = Fine
M = Medium
C = Coarse
V = Very
F/M = Fine to medium
F/C = Fine to coarse
GR = Gray
BN = Brown
YEL = Yellow

GROUNDWATER
( ) Encountered
(X) Not Encountered

Elapsed Time to Reading (Hours)	Depth to Ground-water

Stratification lines represent approximate boundaries between soil types, transitions may be gradual. Water level readings have been made at times and under conditions stated. Fluctuations of groundwater may occur due to factors other than those present at the time measurements were made.

APPENDIX C
FIELD PERMEABILITY TEST RESULTS

PERMEABILITY TEST NO. 1
Location: TP-101

Test Data

Date of Test	9/29/2015	
Casing Inside Diameter (in)	11.8	
Depth to Bottom of Casing (feet)	3.0	(measured from ground surface)
Casing Stickup (feet)	1.0	(measured from bottom of test pit)
Ground Surface Elevation (feet)	17	
Approx. Groundwater Level Depth (feet beg)	None Encountered	

Test Data

Time Elasped		Depth of Water from Top of Casing	
(minute)	(second)	(ft)	(in)
0.00	0	1.80	21.6
0.50	30	1.79	21.5
1.00	60	1.78	21.4
1.50	90	1.76	21.1
2.00	120	1.75	21.0
3.00	180	1.73	20.8
5.00	300	1.68	20.2
7.00	420	1.64	19.7
10.00	600	1.57	18.8
15.00	900	1.47	17.6
20.00	1200	1.38	16.6

Calculations

	20 Minutes
Exposed Surface Area, A (in^2)	109.59
Drop in Water Level (in)	5.0
Time Interval (sec)	1200
Volume of Water (in^3)	552.3
Flow Rate, Q (in^3/sec)	0.46
Estimated Hydraulic conductivity, k (in/sec)	4.2E-03
k (cm/sec)	**1.1E-02**

Notes

1. Data presented represents falling head permeameter testing conducted by GZA. Test hole pre-soaked for approx. 15 min. prior to recording water level drop
2. Permeability results were approximated using the formula Q=kiA where, Q is the flow rate, k is the permeability, i=1.0 (gravity drainage above the water table), and A is the area at the exposed surface area at the bottom of the casing.
3. Elevation estimated from a plan titled "Existing Conditions Survey", prepared by Ellenqweig Associates, Inc. and dated July 22, 2013. Elevation datum is the North American Vertical Datum 1988 (NAVD 88).

PERMEABILITY TEST NO. 2
Location: TP-102

Test Data

Date of Test	9/29/2015	
Casing Inside Diameter (in)	11.8	
Depth to Bottom of Casing (feet)	3.0	(measured from ground surface)
Casing Stickup (feet)	1.0	(measured from bottom of test pit)
Ground Surface Elevation (feet)	16	
Approx. Groundwater Level Depth (feet beg)	None Encountered	

Test Data

Time Elasped		Depth of Water from Top of Casing	
(minute)	(second)	(ft)	(in)
0.00	0	1.77	21.2
0.50	30	1.75	21.0
1.00	60	1.74	20.9
1.50	90	1.71	20.5
2.00	120	1.70	20.4
3.00	180	1.66	19.9
5.00	300	1.59	19.1
7.00	420	1.52	18.2
10.00	600	1.43	17.2
15.00	900	1.28	15.4
20.00	1200	1.12	13.4

Calculations

	20 Minutes
Exposed Surface Area, A (in^2)	109.59
Drop in Water Level (in)	7.8
Time Interval (sec)	1200
Volume of Water (in^3)	854.8
Flow Rate, Q (in^3/sec)	0.71
Estimated Hydraulic conductivity, k (in/sec)	6.5E-03
k (cm/sec)	**1.7E-02**

Notes

1. Data presented represents falling head permeameter testing conducted by GZA. Test hole pre-soaked for approx. 15 min. prior to recording water level drop
2. Permeability results were approximated using the formula Q=kiA where, Q is the flow rate, k is the permeability, i=1.0 (gravity drainage above the water table), and A is the area at the exposed surface area at the bottom of the casing.
3. Elevation estimated from a plan titled "Existing Conditions Survey", prepared by Ellenqweig Associates, Inc. and dated July 22, 2013. Elevation datum is the North American Vertical Datum 1988 (NAVD 88).

PERMEABILITY TEST NO. 3
Location: TP-103

Test Data

Date of Test	9/29/2015	
Casing Inside Diameter (in)	11.8	
Depth to Bottom of Casing (feet)	4.0	(measured from ground surface)
Casing Stickup (feet)	1.0	(measured from bottom of test pit)
Ground Surface Elevation (feet)	19	
Approx. Groundwater Level Depth (feet beg)	None Encountered	

Test Data

Time Elasped		Depth of Water from Top of Casing	
(minute)	(second)	(ft)	(in)
0.00	0	1.30	15.6
0.50	30	1.29	15.5
1.00	60	1.28	15.4
1.50	90	1.27	15.2
2.00	120	1.26	15.1
3.00	180	1.25	15.0
5.00	300	1.22	14.6
7.00	420	1.19	14.3
10.00	600	1.15	13.8
15.00	900	1.08	13.0
20.00	1200	1.01	12.1

Calculations

	20 Minutes
Exposed Surface Area, A (in^2)	109.59
Drop in Water Level (in)	3.5
Time Interval (sec)	1200
Volume of Water (in^3)	381.4
Flow Rate, Q (in^3/sec)	0.32
Estimated Hydraulic conductivity, k (in/sec)	2.9E-03
k (cm/sec)	**7.4E-03**

Notes

1. Data presented represents falling head permeameter testing conducted by GZA. Test hole pre-soaked for approx. 15 min. prior to recording water level drop
2. Permeability results were approximated using the formula Q=kiA where, Q is the flow rate, k is the permeability, i=1.0 (gravity drainage above the water table), and A is the area at the exposed surface area at the bottom of the casing.
3. Elevation estimated from a plan titled "Existing Conditions Survey", prepared by Ellenqweig Associates, Inc. and dated July 22, 2013. Elevation datum is the North American Vertical Datum 1988 (NAVD 88).

APPENDIX D
TEST PIT PHOTOGRAPHS

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: Ellenzweig Architects	Site Location: School for Marine Science and Technology (SMAST) New Bedford, Massachusetts	Project No. 01.0172205.20

Photo No.	Date:
1	9/29/2015

Direction Photo Taken:

SOUTH

Description:

TP-101: Southern excavation face

Photo No.	Date:
2	9/29/2015

Direction Photo Taken:

NORTH

Description:

TP-101: Pile of spoils from excavation.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: Ellenzweig Architects	Site Location: School for Marine Science and Technology (SMAST) New Bedford, Massachusetts	Project No. 01.0172205.20

Photo No.	Date:
3	9/29/2015

Direction Photo Taken:

SOUTH

Description:

TP-102: Southern and eastern sidewalls of the excavation.

Photo No.	Date:
4	9/29/2015

Direction Photo Taken:

EAST

Description:

TP-102: Typical falling head permeability test set up.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: Ellenzweig Architects	Site Location: School for Marine Science and Technology (SMAST) New Bedford, Massachusetts	Project No. 01.0172205.20

Photo No.	Date:
5	9/29/2015

Direction Photo Taken:

NORTH

Description:

TP-103: Northern sidewall of the excavation.

Photo No.	Date:
6	9/29/2015

Direction Photo Taken:

NORTH

APPENDIX E
GEOTECHNICAL LABORATORY
TEST RESULTS

LABORATORY TESTING DATA SHEET

Project Name School for Marine Science and Technology | Location New Bedford, MA | Reviewed By Matthew Smith

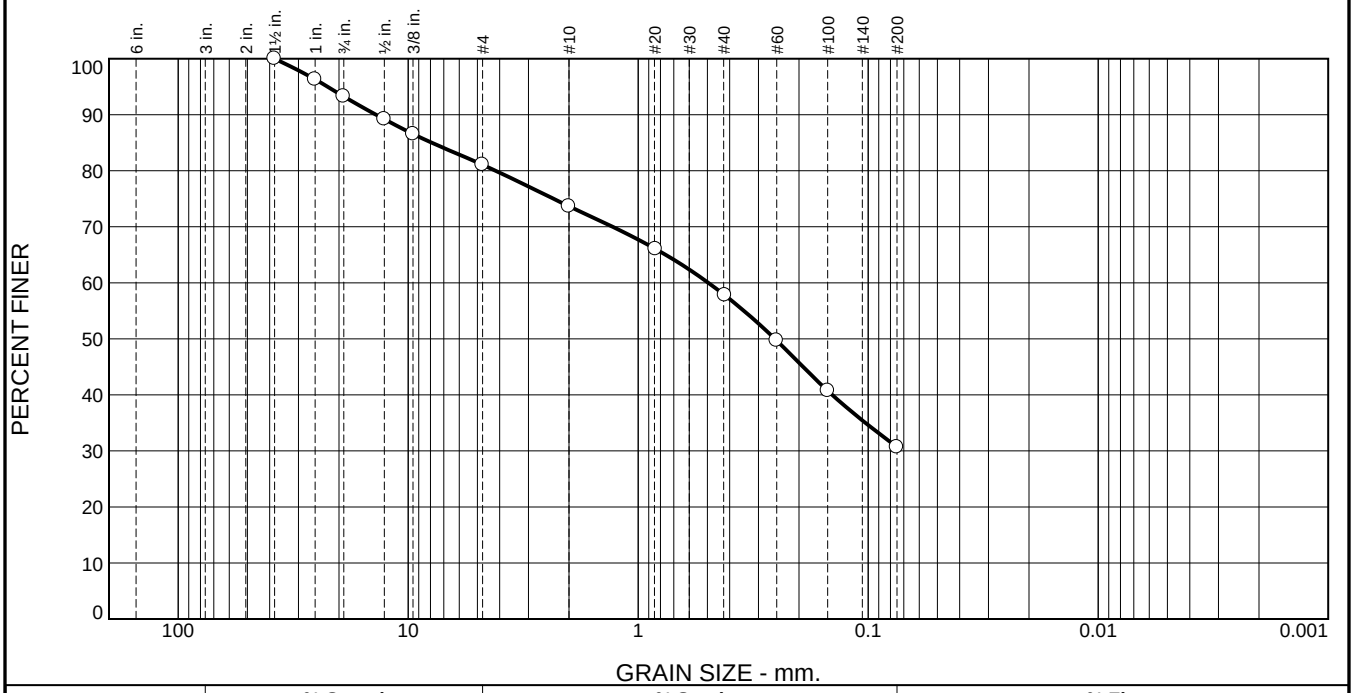
Project No. 01.0172205.20 | Assigned By J. Clegg

Project Manager Matthew Smith | Date 10/7/15 | Date Reviewed 10/7/2015

Boring/ Test Pit No.	Sample No.	Depth ft.	Lab No.	Identification Tests						Density	Strength Tests						Laboratory Log and Soil Description
				Natural Water Content %	LL %	PL %	Gravel %	Sand %	Fines (<#200) %	γ_d MAX (pcf) W_{opt} (%)	CBR Setup as % of Proctor	CBR Dry unit wt. pcf	CBR Water Content %	CBR @ 0.1" @ 0.2"	$\sigma_1 - \sigma_3$ or τ psf	Strain %	
TP-101	S-1	3 - 5	1				18.9	50.4	30.7								Brown f-c SAND, some Silt, little f-c Gravel
TP-102	S-1	3 - 5	2				26.8	44.6	28.6								Brown f-c SAND, some Silt, some f-c Gravel
TP-103	S-1	4 - 6	3				23.0	50.8	26.2								Brown f-c SAND, some Silt, some f-c Gravel

THIELSCH ENGINEERING
195 Frances Avenue
Cranston, RI 02910
401-467-6454

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.7	12.2	7.4	15.8	27.2	30.7	

TEST RESULTS (D422)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0		
1"	96.3		
0.75"	93.3		
.5"	89.2		
.375"	86.6		
#4	81.1		
#10	73.7		
#20	66.0		
#40	57.8		
#60	49.7		
#100	40.7		
#200	30.7		

* (no specification provided)

Material Description

Brown f-c SAND, some Silt, little f-c Gravel

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 13.7882 D_{85}= 7.8924 D_{60}= 0.4953
D_{50}= 0.2545 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 10/5/15 **Date Tested:** 10/7/15

Tested By: GG/JE

Checked By: Matthew Polsky

Title: Laboratory Manager

Source of Sample: Test Pits **Depth:** 3-5' **Date Sampled:**

Sample Number: TP-101: S-1

Thielsch Engineering Inc.

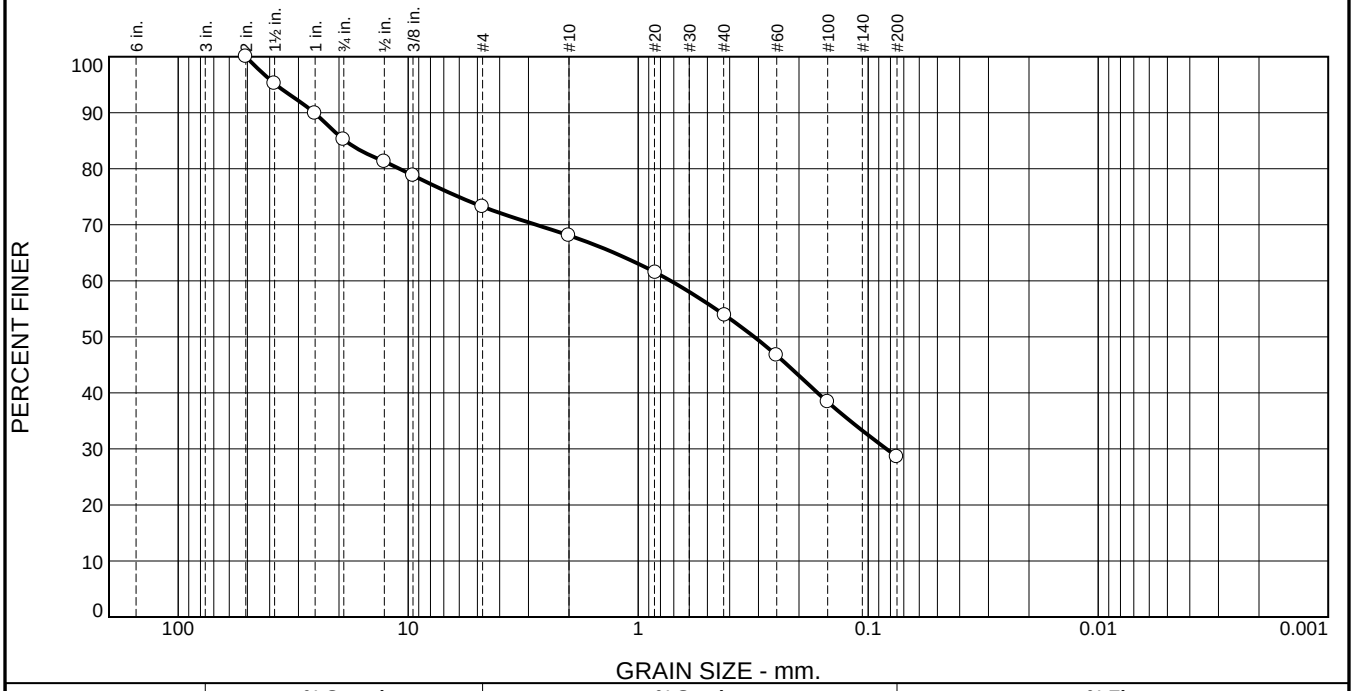
Cranston, RI

Client: GZA GeoEnvironmental, Inc.

Project: School for Marine Science and Technology
New Bedford, MA

Project No: 01.0172205.20 **Figure** 1

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	14.8	12.0	5.1	14.1	25.4	28.6	

TEST RESULTS (D422)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
2"	100.0		
1.5"	95.2		
1"	89.9		
0.75"	85.2		
.5"	81.3		
.375"	78.8		
#4	73.2		
#10	68.1		
#20	61.5		
#40	53.9		
#60	46.7		
#100	38.4		
#200	28.6		

* (no specification provided)

Material Description

Brown f-c SAND, some Silt, some f-c Gravel

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 25.6064 D_{85}= 18.7818 D_{60}= 0.7223
D_{50}= 0.3131 D_{30}= 0.0833 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 10/5/15 **Date Tested:** 10/7/15

Tested By: GG/JE

Checked By: Matthew Polsky

Title: Laboratory Manager

Source of Sample: Test Pits **Depth:** 3-5' **Date Sampled:**

Sample Number: TP-102: S-1

Thielsch Engineering Inc.

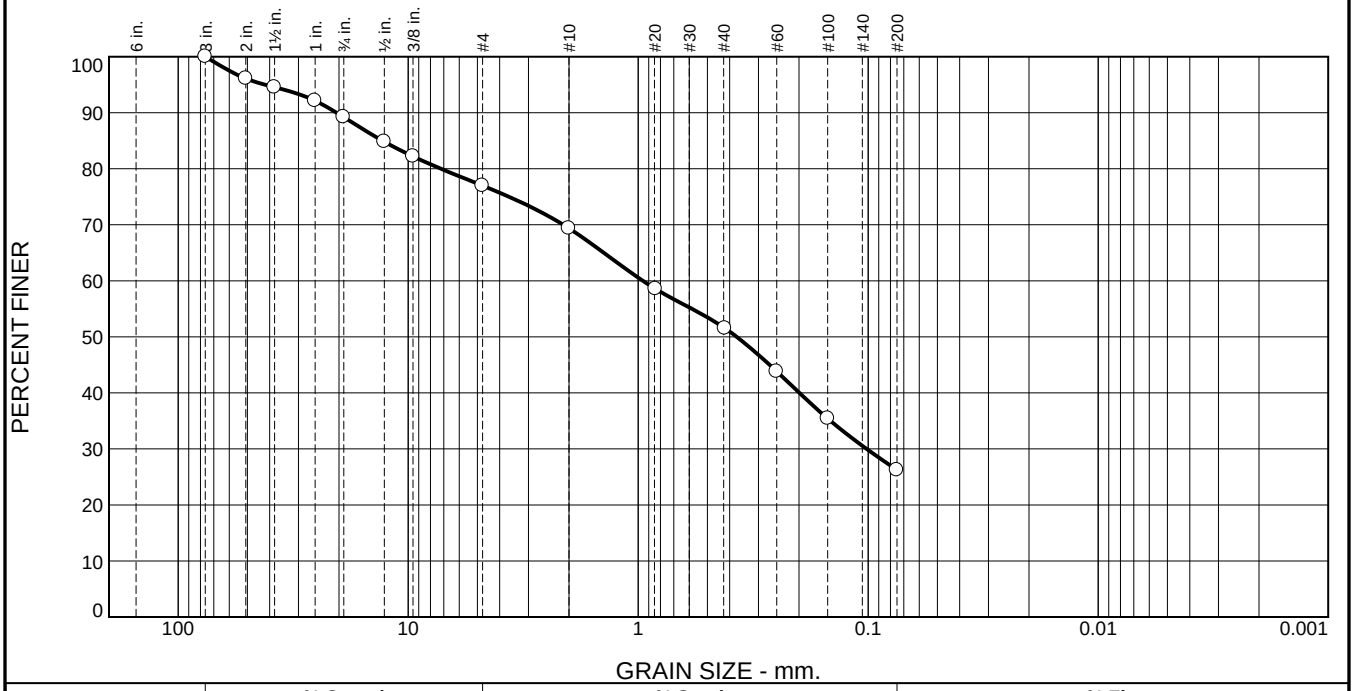
Cranston, RI

Client: GZA GeoEnvironmental, Inc.

Project: School for Marine Science and Technology
New Bedford, MA

Project No: 01.0172205.20 **Figure** 2

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	10.8	12.2	7.6	17.7	25.5	26.2	

TEST RESULTS (D422)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3"	100.0		
2"	96.1		
1.5"	94.6		
1"	92.1		
0.75"	89.2		
.5"	84.8		
.375"	82.2		
#4	77.0		
#10	69.4		
#20	58.5		
#40	51.5		
#60	43.8		
#100	35.4		
#200	26.2		

* (no specification provided)

Material Description

Brown f-c SAND, some Silt, some f-c Gravel

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= SM **AASHTO (M 145)=** A-2-4(0)

Coefficients

D_{90}= 20.4634 D_{85}= 12.9321 D_{60}= 0.9542
D_{50}= 0.3729 D_{30}= 0.1015 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 10/5/15 **Date Tested:** 10/7/15

Tested By: GG/JE

Checked By: Matthew Polsky

Title: Laboratory Manager

Source of Sample: Test Pits **Depth:** 4-6' **Date Sampled:**

Sample Number: TP-103: S-1

Thielsch Engineering Inc.

Cranston, RI

Client: GZA GeoEnvironmental, Inc.

Project: School for Marine Science and Technology
New Bedford, MA

Project No: 01.0172205.20 **Figure** 3