HANCOCK
ASSOCIATES
Surveyors | Engineers | Scientists

Stormwater Management Report

HCP Asbury

466 Highland Street
Hamilton, MA 01982

Prepared For:

Harborlight Community Partners

283 Elliot Street
Beverly, MA 01915

COMMONWEALTH OF MASSACHUSETTS
CHARLES E. WEAR, III
CIVIL
No. 37876
REGISTERED PROFESSIONAL ENGINEER

10/21/22

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Project: 24819
Date: February 18th, 2022
Revised: October 21, 2022

Table of Contents

BACKGROUND INFORMATION

- **A.)** Project Description
- **B.)** Existing Conditions
- **C.)** Proposed Conditions - Stormwater Management Narrative

DOCUMENTING COMPLIANCE

- **A.)** MassDEP Stormwater Standards
  1. No Untreated Discharges or Erosion to Wetlands
  2. Peak Rate Attenuation
     i. Runoff Summary Table
  3. Stormwater Recharge
     i. Required Recharge Volume
     ii. 72-hour Drawdown Analysis
  4. Water Quality
     i. TSS Removal Train
     ii. Water Quality Volume and Flow Calculation
  5. Land Uses With Higher Potential Pollutant Loads (LUHPPLs)
  6. Critical Areas
  7. Redevelopments and Other Projects Subject to the Standards only to the Maximum Extent Practicable
  8. Construction Period Pollution Prevention and Erosion & Sedimentation Controls
     i. Erosion and Sediment Control Plan
  9. Operation and Maintenance Plan
     i. Owner Certification Statement
     ii. BMP Inspection Logs
  10. Prohibition of Illicit Discharges
     i. Illicit Discharge Statement

ATTACHMENTS

- A- Pre-development Subcatchment Plan
- B- Post-development Subcatchment Plan
- C- HydroCAD Worksheets
- D- Mounding Analysis
- E- USGS Topographic Map
- F- USDA NRCS Web Soil Survey Information
- G- VortSentry HS Technical Abstract

Background Information

A. Project Description

This project intends to construct a 45-unit Multi-Family Residential Building and accompanying infrastructure in Hamilton, Massachusetts. The proposed building will have its own on-site parking lot in front of the building and will contain 68 parking spaces. Site access is proposed via a curb cut on Asbury Street. A 20' wide fire access lane is proposed to loop around the rear of the building to provide egress for emergency vehicles. There is a four-foot-wide stone dust walking trail that meanders around the proposed building and parking lot.

The proposed building will be serviced by existing municipal water from Asbury Street and a private onsite septic system to the northwest of the proposed building. Gas and electric service connections will be coordinated with utility providers to service the new building.

In order to mitigate any increase in stormwater runoff from the proposed development, stormwater management practices have been designed to mirror existing drainage patterns and provide full compliance with MassDEP Stormwater Management Standards. Best Management Practices (BMPs) include an underground infiltration system, deep sump hooded catch basins, a surface infiltration basin, and pre-treatment units.

B. Existing Site Conditions

The subject parcel is 85.7± acres and has an address 466 Highland Street (Map 20, Lot 11). Said parcel is located within the Single Residential (R1-B) Zoning District. This parcel Is subject to several conservation restrictions on site, this project is limited to small portion of said lot that totals 4.8± acres and is intended to be subdivided away from the larger parcel. The project location on the property is bounded by Asbury Street to the southwest, a 20' wide Right of Way and a residential development to the southeast and maintained farmland/fields around located around the remainder of the proposed project location. Project frontage is located along Asbury Street with vehicle access via said road.

Currently, the site is in use as a field used to farm hay and no structures or utilities exist on-site to our knowledge. The property is bounded by a 25'-50' wide swath of trees surround the boundary of the property from the western sideline of Asbury Street up to the eastern corner of the project location at the 20-foot wide Right of Way.

Site topography ranges from a high of 72'± at the southern corner of the project location to 54'± at the northeastern corner of the project location. Slopes on site vary from smooth and relatively flat at the southern portion of the project location to moderate and steep as you travel across the site to the north.

An on-the-ground survey was performed by Meridian Associates, Inc. in June of 2019. Onsite soils are mapped as Hydrologic Group A by USDA NRCS Web Soil Survey. Soi Testing was conducted on-site by Meridian Associates, Inc. on several occasions on June, December, and January of 2020. The results of this testing varied from showing the parent material as gravelly, sandy soils to loamy soils across the site.

C. Proposed Conditions – Stormwater Management and Methodology

The Stormwater Management design methodology implemented for this redevelopment project is intended to treat and exfiltrate runoff via a surface infiltration basin and an underground infiltration system. This hydrologic analysis methodology will approximate pre-development peak flow rates at design points: Asbury Road, Northwest, and Northeast.

Overland to Asbury Steet (10S/100R)
In the pre-development condition, runoff from grass and wooded areas flow overland off property towards into the gutter line of Asbury Street (10S).

In the post-development condition, the subcatchment is intended to mimic the existing drainage patterns. Stormwater runoff generated by grassed, wooded, and paved areas flows overland to Asbury Street (100R).

Overland to Northwest (20S/200R)
In the pre-development condition, runoff from grass and wooded areas flow overland to the Northeast (20S) into Conservation Restricted land.

Post-development, stormwater runoff generated by the paved parking areas is collected vis deep sump hooded catch basins, conveyed to Contech pretreatment units, then discharges to a Proposed Infiltration Basin (P.IB). The Proposed Surface Infiltration Basin is designed to infiltrated, attenuate, and further treat stormwater before it ultimately discharges and flows overland to the Northwest (200R) into Conservation Restricted land.

Overland to Northeast (30S/300R)
In the pre-development condition, runoff from grass and wooded areas flow overland to the Northeast (30S) into Conservation Restricted land.

Post-development, stormwater runoff generated by the paved parking areas is collected via deep sump hooded catch basins, conveyed to Contech pretreatment units, then discharges to a Proposed Underground Infiltration System (P.UIS) comprising of 130 Stormtech SC-740 chambers. Stormwater runoff generated by the roof of the proposed residential building is also directed to the Proposed Underground Infiltration System. The Proposed Underground Infiltration System is designed to infiltrate, attenuate, and further treat stormwater before it ultimately discharges and flows overland to the Northeast (300R) into Conservation Restricted land.

This project, as outlined above, complies with all Massachusetts Department of Environmental Protection Stormwater Management requirements to the maximum extent practicable for redevelopment. Documentation of the evaluation of each Stormwater Management Standard are found in the Stormwater Management – Documenting Compliance section.

Documenting Compliance

A. MassDEP Stormwater Management Standards

The following sections provide a discussion of how the requirements of the Stormwater Management Standards are addressed by the proposed new development.

Standard 1: No Untreated Discharges or Erosion to Wetlands

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

No new untreated conveyances or direct discharge to wetlands are proposed; all points of discharge mirror existing discharge patterns. See computations completed in Standards 4 & 6 that demonstrate proper treatment of suspended solids and required water quality volume.

Standard 2: Peak Rate Attenuation

Stormwater Management Systems must be designed so that post-development peak discharge rates do not exceed pre-development discharge rates.

Runoff Summary Table:

Rainfall Frequency	2-year	10-year	100-year	
24-hour Rainfall Intensity	3.15 in	4.83 in	8.94 in	
Pre-Development Overland to Asbury Street (10S)	0.00 cfs	0.00 cfs	0.18 cfs	1,200 cf
Post-Development Overland to Asbury Street (100R)	0.00 cfs	0.00 cfs	0.18 cfs	876 cf
Delta	***0.00 cfs***	***0.00 cfs***	***0.00 cfs***	***-324 cf***
Percentage Difference (%)	***0%***	***0%***	***0%***	***-27%***
Pre-Development Overland to Northwest (20S)	0.00 cfs	0.03 cfs	1.40 cfs	6,336 cf
Post-Development Overland to Northwest (200R)	0.00 cfs	0.02 cfs	0.76 cfs	6,220 cf
Delta	***0.00 cfs***	***-0.01 cfs***	***-0.64 cfs***	***-119 cf***
Percentage Difference (%)	***0%***	***-33%***	***-46%***	***-2%***
Pre-Development Overland to Northeast (30S)	0.00 cfs	0.06 cfs	3.04 cfs	14,856 cf
Post-Development Overland to Northeast (300R)	0.00 cfs	0.05 cfs	2.64 cfs	11,297 cf
Delta	***0.00 cfs***	***-0.01 cfs***	***-0.40 cfs***	***-3,559 cf***
Percentage Difference (%)	***0%***	***-17%***	***-13%***	***-24%***

As detailed in the Stormwater Methodology and Introduction and summarized in the preceding table, there will be no increase in peak runoff rate for the 2, 10, or 100-year frequency events as compared to existing conditions. HydroCAD worksheets are attached herewith.

Standard 3: Stormwater Recharge

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

Required Recharge Volume

The Required Recharge Volume equals a depth of runoff corresponding to the soil type times the impervious areas covering that soil type at the post-development site.

Rv = F x impervious area Equation (1)
Rv = Required Recharge Volume, expressed in Ft3, cubic yards, or acre-feet
F = Target Depth Factor associated with each Hydrologic Soil Group
Impervious Area = pavement and rooftop area on site

Target Depth Factor (F) = 0.60-inch (Class A Soils)
Rv = [(0.60 inches x 1 ft / 12 IN) (60,525 SF) = 3,557 CF
Total Recharge Required = 3,557 CF (**17,008 CF Provided)**

Town of Hamilton Stormwater Management Permit Rules Regulations (11-16-2021) Section (8.C.IV-2)
Retaining the volume of runoff equivalent to, or greater than, one (1.0) inch multiplied by the total post-construction impervious surface area on the new development site.

Rv = [(1.00 inches x 1 ft / 12 IN) (60,525 SF) = 5,044 CF
Total Recharge Required = 5,044 CF (**17,008 CF Provided)**

P.IB = 7,420 CF Provided
P.UIS = 9,588 CF Provided
Total Provided = 17,008 CF

Drawdown within 72 Hours

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

Rv = Storage Volume
K = Saturated Hydraulic Conductivity For "Static" and "Simple Dynamic" Methods, use Rawls Rate (see Table 2.3.3). For "Dynamic Field" Method, use 50% of the in-situ saturated hydraulic conductivity.
Bottom Area = Bottom Area of Recharge Structure

P.IB
Time = 7,420 CF / [(1.02 inches / hour) (1ft / 12inches) (2,980 SF)]
Time = 29.29 hours (< 72 hours)

P.UIS
Time = 9,588 CF / [(8.27 inches / hour) (1ft / 12 inches) (4,766 SF)]
Time = 6.06 hours (< 72 hours)

Per Massachusetts Stormwater Standards a mounding analysis is required, this is provided in Attachment D in the Appendix of this Report.

Standard 4: Water Quality

Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This standard is met when:
(a) Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;
(b) Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and
(c) Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

Town of Hamilton Stormwater Management Permit Rules Regulations (11-16-2021) Section (8.C.I)
Stormwater management systems on new development shall be designed to meet an average annual pollutant removal equivalent to 90% of the average annual load of Total Suspended Solids (TSS) related to the total post-construction impervious area on the site AND 60% of the average annual load of Total Phosphorus (TP) related to the total postconstruction impervious surface area on the site.

TSS & TP Removal for Infiltration Basin (P.IB)

TSS Removal		
Deep Sump Hooded Catch Basin	25%	(1 - [0.25 x 1.00] = 0.75 remaining)
Contech VortSentry Unit	80%	(0.75 - [0.80 x 0.75] = 0.15 remaining)
Total Pretreatment	44%	([1.00 – 0.15] x 100 = 85%) **Requirement Met**
Infiltration Basin	80%	(0.15 - [0.80 x 0.15] = 0.03 remaining)
TSS Removal	80%	([1.00 – 0.03] x 100 = 97%) **Requirement Met**
TP Removal		
Infiltration Basin	60%	(1.00 - [1.00 x 0.60] = 0.40 remaining)
TP Removal	60%	([1.00 – 0.40] x 100 = 60%) **Requirement Met**

TSS & TP Removal for Stormtech SC-740 Chambers (P.UIS)

TSS Removal		
Deep Sump Hooded Catch Basin	25%	(1 - [0.25 x 1.00] = 0.75 remaining)
Contech VortSentry Unit	80%	(0.75 - [0.80 x 0.75] = 0.15 remaining)
Total Pretreatment	44%	([1.00 – 0.15] x 100 = 85%) **Requirement Met**
Subsurface Infiltration System	80%	(0.15 - [0.80 x 0.15] = 0.03 remaining)
Total Suspended Solids Removal	97%	([1.00 – 0.03] x 100 = 97%) **Requirement Met**
TP Removal		
Subsurface Infiltration System	60%	(1.00 - [1.00 x 0.60] = 0.40 remaining)
TP Removal	60%	([1.00 – 0.40] x 100 = 60%) **Requirement Met**

Water Quality Volume and Flow Calculations

The Massachusetts Department of Environmental Protection Wetlands Program Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices, the Q rate associated with the 1-inch water quality volume is calculated using the following equations:

WQV = (A)*1in.

Q1 = (qu)(A)(WQV)

Where:

Q1 = flow rate associated with first 1-inch of runoff

qu = the unit peak discharge, in csm/in.

A = impervious surface drainage area (in square miles)

WQV = water quality volume in watershed inches (1-inch in this case)

P.IB

WQV = (18,145 SF)(1 inch.) (1ft / 12inches)

WQV = 1,512 CF (**7,420 CF Provided)**

tc = 6 minutes (0.1 hours)

qu = 774 csm/in [per Figure 4 on page 7 in MassDEP Q Rate, Sept. 10, 2013]

Q1 = (774 csm/in)(18,145 SF / 43,560 Ac x 0.0015625 mi2/Ac)(1.0 in)

Q1 = 0.50 CFS

Contech Vortsentry HS36: 0.55 CFS (>0.48 CFS Req'd)

P.UIS

WQV = (18,350 SF)(1 inch.) (1ft / 12inches)

WQV = 1,529 CF (**9,588 CF Provided)**

tc = 6 minutes (0.1 hours)

qu = 774 csm/in [per Figure 4 on page 7 in MassDEP Q Rate, Sept. 10, 2013]

Q1 = (774 csm/in)(18,350 SF / 43,560 Ac x 0.0015625 mi2/Ac)(1.0 in)

Q1 = 0.51 CFS

Contech Vortsentry HS36: 0.55 CFS (0.51 CFS Req'd)

Standard 5: Land Uses with Higher Potential Pollutant Loads

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

The proposed development does not qualify as a Land Use with Higher Potential Pollutant Loads (LUHPPL). The proposed development meets this standard.

Standard 6: Critical Areas

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

The project does discharges to a Zone II Wellhead Protection Area. Discharging to a Zone II requires 44% pretreatment prior to discharging to the infiltration BMP and requires 1-inch of runoff from impervious areas be used in calculating the Water Quality Volume, See Standard 4. Both of these requirements are met in the design. Source controls and pollution prevention measures for the construction period are highlighted and discussed in Standard 8 of this report. Long-term Pollution prevention methods are discussed in Standard 9 portion of this report.

Standard 7: Redevelopments Subject to the Standards only to the Maximum Extent Practicable

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

The proposed project is not a redevelopment and shall comply with all requirements of the Stormwater Management Standards.

Standard 8: Construction Period Pollution Prevention and Erosion & Sedimentation Controls

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

EROSION AND SEDIMENTATION CONTROL PLAN

Best management practices (BMP) for erosion and sedimentation control are staked silt fence, hydro seeding, and phased development. Many stormwater BMP technologies (e.g., infiltration technologies) are not designed to handle the high concentrations of sediments typically found in construction runoff and must be protected from construction-related sediment loadings. Construction BMP's **must** be maintained.

In developing the proposed project certain measures will be implemented to minimize impacts erosion and sedimentation could have on surrounding areas. This section addresses items that involve proper construction techniques, close surveillance of workmanship, and immediate response to emergency situations. The developer must be prepared to provide whatever reasonable measures are necessary to protect the environment during construction and to stabilize all disturbed areas as soon as construction ends.

Pre-Construction

1. Prior to clearing, excavation, construction, or any land disturbing activity requiring a permit, the applicant, the applicant's technical representative, the general contractor, pertinent subcontractors, and any person with authority to make changes to the project, shall meet with the Town's designated Agent and to review the permitted plans and proposed implementation.
2. The contractor shall have a stockpile of materials required to control erosion on-site to be used to supplement or repair erosion control devices. These materials shall include, but are not limited to straw wattles, catch basin filter bags and crushed stone.
3. The contractor is responsible for erosion control on site and shall utilize erosion control measures where needed, regardless of whether the measures are specified on the plan or in the decisions.

Preliminary Site Work

1. Materials such as gravel to be removed should be stockpiled, separating the topsoil for future use on the site. Erosion control shall be utilized along the down slope side of the piles if the piles are to remain for more than three weeks.
2. If intense rainfall is anticipated, the installation of supplemental straw bale dikes, silt fences, or armored dikes shall be considered.

Site Inspections During Construction

1. During construction, the permittee or his/her Agent shall conduct and document inspections of all control measures no less than weekly or as specified in the permit, and prior to and following anticipated storm events. The purpose of such inspections will be to determine the overall effectiveness of the Erosion and Sedimentation Control Plan, and the need for maintenance or additional control measures.

Landscaping/Seeding

1. Landscaping/Seeding shall occur as soon as possible to provide permanent stabilization of disturbed surfaces.
2. If the season or adverse weather conditions do not allow the establishment of vegetation, temporary mulching with straw, wood chips weighted with snow fence or branches, or other methods shall be provided.
3. A minimum of 4 inches of topsoil shall be placed and its surface smoothed to the specified grades.
4. The use of herbicides is strongly discouraged.
5. Hydro seeding is encouraged for steep slopes. Application rates on slopes greater than 3:1 shall have a minimum seeding rate of 5-lbs/1000 SF. A latex or fiber tackifier shall be used on these slopes at a minimum rate of 50 lbs. of tackifier per 500 gallons of water used.

Standard 9: Operation and Maintenance Plan

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

STORMWATER OPERATION AND MAINTENANCE PLAN

Corporate Certification

(Harbor Light Community Partners - Developer)

I certify under penalty of law that the Owner/Developer and its associated entities established for purposes of ownership, operations and maintenance of the property located at 466 Highland Street, Hamilton, MA is solely and legally responsible for implementing the Stormwater Operation and Maintenance Plan. The Owner/Developer has reviewed said plan and fully accepts all responsibilities inherent therein; including inspection, maintenance, repair, modification and/or replacement of the recharge systems as may be required to maintain intended recharge functions. The Owner/Developer shall file yearly maintenance reports including annual certification that the plan has been fully implemented as outline herein. Furthermore, the Owner/Developer understands various stormwater management systems have a certain life expectancy and that replacement of system components will be required. The Owner/Developer accepts all financial responsibilities associated with future replacements.

Name:

Title:
Date:

Deep Sump Hooded Catch Basins

Inspect or clean deep sump catch basins four times per year at the end of the foliage and snow removal seasons. Sediments must also be removed when the depth of deposits is greater than or equal to one half the depth from the bottom of the lowest pipe in the basin. Vacuum trucks are to be used to remove trapped sediment and supernatant. Although catch basin debris often contains concentrations of oil and hazardous materials such as petroleum hydrocarbons and metals, MassDEP classifies them as solid waste. Any contaminated materials must be evaluated in accordance with the Hazardous Waste Regulations, 310 CMR 30.00, and handled as hazardous waste. MassDEP regulations prohibit landfills from accepting materials that contain free draining liquids.

Annual Inspection & Maintenance Report

Attach additional pages as required to fully document conditions and maintenance performed.

Date	Inspector	Condition	Maintenance Performed*

*Receipts must be attached to report showing payment for maintenance performed.

Infiltration Basin

Once the basin is in use, inspect it after every major storm for the first few months to ensure it is stabilized and functioning properly and if necessary take corrective action. Note how long water remains standing in the basin after a storm; standing water within the basin 48 to 72 hours after a storm indicates that the infiltration capacity may have been overestimated. If the ponding is due to clogging, immediately address the reasons for the clogging (such as upland sediment erosion, excessive compaction of soils, or low spots). Thereafter, inspect the infiltration basin at least twice per year. Important items to check during the inspection include:

- Signs of differential settlement,
- Cracking,
- Erosion,
- Emergency Spillway,
- Leakage in the embankments
- Tree growth on the embankments
- Condition of riprap,
- Sediment accumulation and
- The health of the turf.

At least twice a year, mow the buffer area, side slopes, and basin bottom. Remove grass clippings and accumulated organic matter to prevent an impervious organic mat from forming. Remove trash and debris at the same time. Use deep tilling to break up clogged surfaces, and revegetate immediately. Remove sediment from the basin as necessary, but wait until the floor of the basin is thoroughly dry. Use light equipment to remove the top layer so as to not compact the underlying soil. Deeply till the remaining soil, and revegetate as soon as possible. Inspect and clean pretreatment devices associated with basins at least twice a year, and ideally every other month.

Annual Inspection & Maintenance Report

Attach additional pages as required to fully document conditions and maintenance performed.

Date	Inspector	Condition	Maintenance Performed*

*Receipts must be attached to report showing payment for maintenance performed.

StormTech SC-740 Chambers

At a minimum, StormTech recommends annual inspections. Initially, the SC-740 Chambers should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition. If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the chamber, clean-out should be performed.

See StormTech Isolator Row O&M Manual attached.

Annual Inspection & Maintenance Report

Attach additional pages as required to fully document conditions and maintenance performed.

Date	Inspector	Condition	Maintenance Performed*

*Receipts must be attached to report showing payment for maintenance performed.

Contech CDS Unit

At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

Annual Inspection & Maintenance Report

Attach additional pages as required to fully document conditions and maintenance performed.

Date	Inspector	Condition	Maintenance Performed*

*Receipts must be attached to report showing payment for maintenance performed

Standard 10: Illicit Discharges to Drainage System

All illicit discharges to the stormwater management system are prohibited.

Measures to prevent illicit discharges are included in Standard 4 & 8 of this report. It is the responsibility of the owner post construction to uphold this standard.

A no illicit discharges statement has not been attached but will be submitted by the owner prior to discharge of stormwater to post construction BMPs.

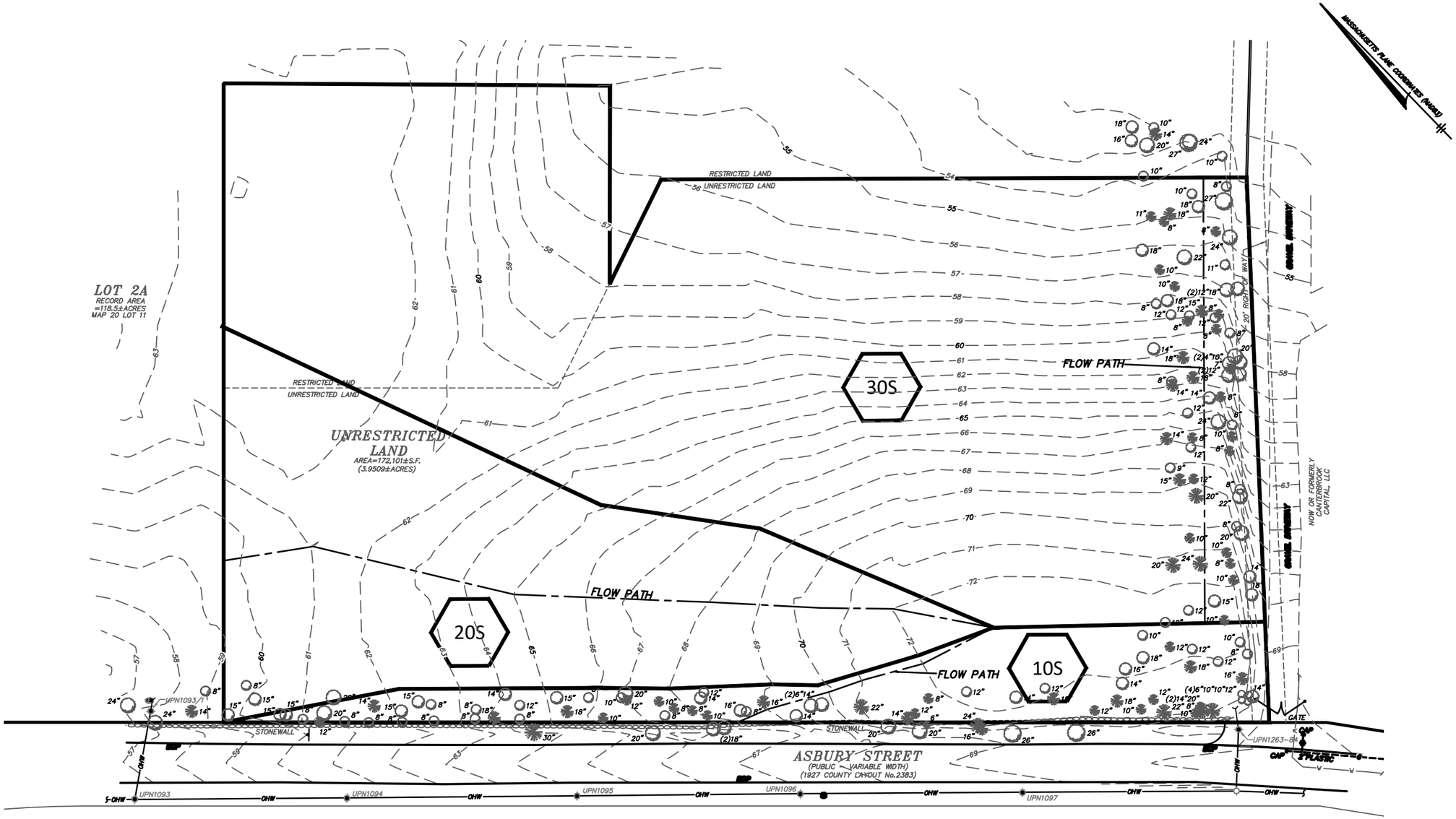
Illicit Discharge Compliance Statement

To the best of my knowledge no illicit discharges currently exist on the site and no future illicit discharge will be allowed, including wastewater discharges and discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease.

10/25/22

Signed by Owner (FOR OWNER) *Date*

ATTACHMENT A
PRE-DEVELOPMENT SUBCATCHMENT PLAN



GRAPHIC SCALE: 1 INCH = 30 FEET

0 15 30 60 120

PERMIT SITE PLAN

466 Highland Street
Hamilton, Massachusetts 01982

ASSESSORS:

MAP	LOT
19	11

PREPARED FOR:

HARBORLIGHT COMMUNITY PARTNERS

283 Elliot Street
Beverly, Massachusetts 01915

HANCOCK ASSOCIATES

Civil Engineers

Land Surveyors

Wetland Scientists

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NO.	BY	APP	DATE	ISSUE/REVISION DESCRIPTION

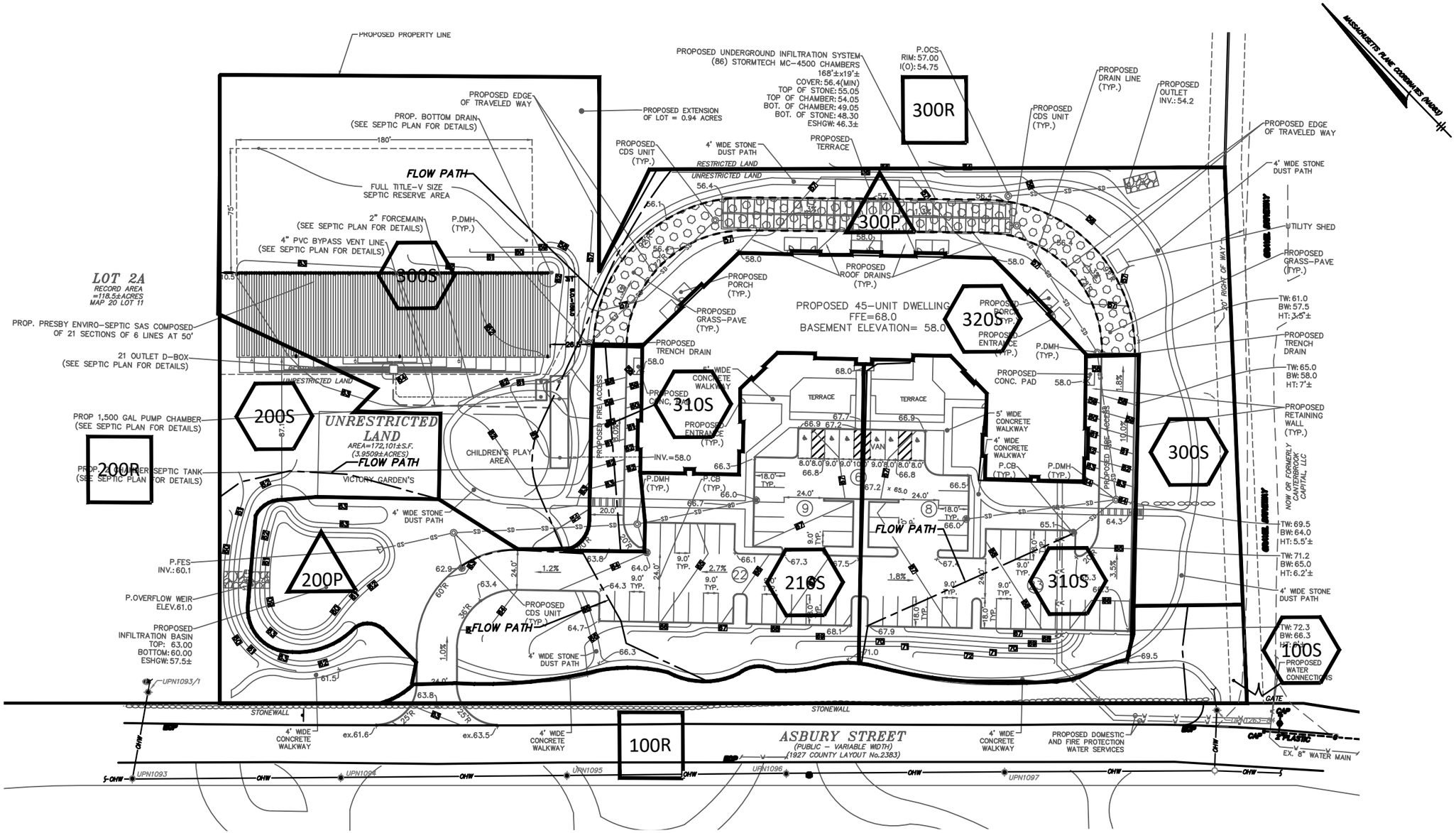
PROGRESS:	1/26/22	DESIGN BY:	CEW
SCALE:	1" = 30'	DRAWN BY:	RCT
APPRVD. BY:	CEW	CHECK BY:	CEW

PRE DEVELOPMENT WATERSHED PLAN

PLOT DATE: Oct 21, 2022 2:52 pm
File: G:\all_set\Old 30 Projects\24819-Harborlight Community Partners-Hamilton\dwg\24819\

DWG: 24819 SW.dwg	PRE
LAYOUT: PRE	
SHEET: 1 OF 1	
PROJECT NO.:	24819

ATTACHMENT B
POST-DEVELOPMENT SUBCATCHMENT PLAN



GRAPHIC SCALE: 1 INCH = 30 FEET
0 15 30 60 120

PERMIT SITE PLAN

466 Highland Street
Hamilton, Massachusetts 01982

ASSESSORS:

MAP	LOT
19	11

PREPARED FOR:

HARBORLIGHT COMMUNITY PARTNERS

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NO.	BY	APP	DATE	ISSUE/REVISION DESCRIPTION

PROGRESS:	1/26/22	DESIGN BY:	CEW
SCALE:	1" = 30'	DRAWN BY:	RCT
APPRVD. BY:	CEW	CHECK BY:	CEW

POST DEVELOPMENT WATERSHED PLAN

PLOT DATE: Oct 21, 2022 2:51 pm
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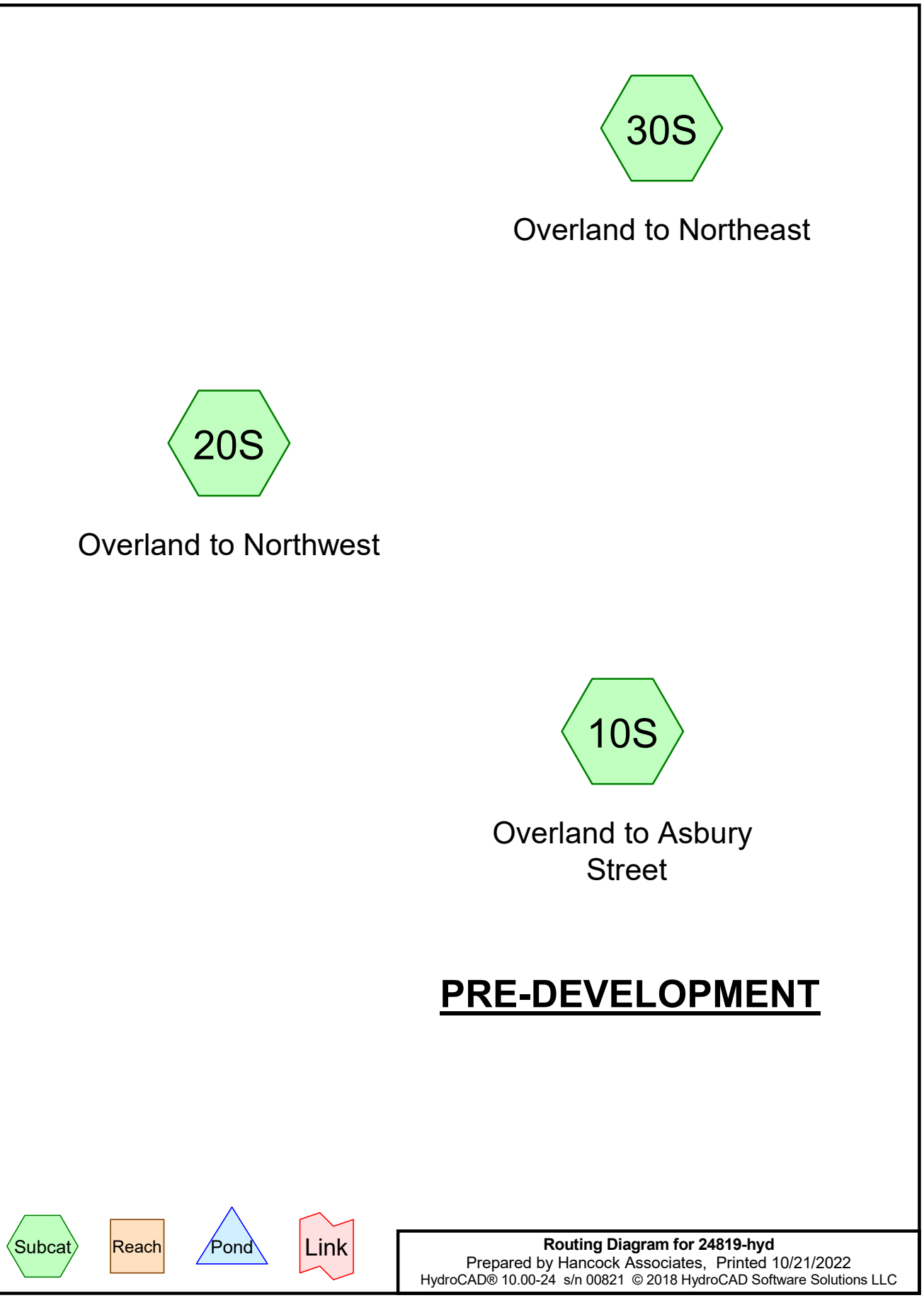
DWG: 24819 SW.dwg	POST
LAYOUT: POST	
SHEET: 1 OF 1	
PROJECT NO.: 24819	

ATTACHMENT C
HYDROCAD WORKSHEETS



Routing Diagram for 24819-hyd
Prepared by Hancock Associates, Printed 10/21/2022
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Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
178,590	39	Pasture/grassland/range, Good, HSG A (10S, 20S, 30S)
34,540	30	Woods, Good, HSG A (10S, 20S, 30S)
213,130	**38**	**TOTAL AREA**

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10S: Overland to Asbury Street Runoff Area=19,920 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=180' Tc=6.0 min CN=32 Runoff=0.00 cfs 0 cf

Subcatchment 20S: Overland to Northwest Runoff Area=54,715 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=465' Tc=12.1 min CN=39 Runoff=0.00 cfs 0 cf

Subcatchment 30S: Overland to Northeast Runoff Area=138,495 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=270' Tc=13.2 min CN=38 Runoff=0.00 cfs 0 cf

Total Runoff Area = 213,130 sf Runoff Volume = 0 cf Average Runoff Depth = 0.00"
100.00% Pervious = 213,130 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 10S: Overland to Asbury Street

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
15,840	30	Woods, Good, HSG A
4,080	39	Pasture/grassland/range, Good, HSG A
19,920	32	Weighted Average
19,920		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	50	0.0500	0.21		**Sheet Flow, Sheet Flow**
					Grass: Short n= 0.150 P2= 3.15"
0.8	50	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concentrated**
					Short Grass Pasture Kv= 7.0 fps
1.3	80	0.0400	1.00		**Shallow Concentrated Flow, Shalliow Concentrated- Ground Cover Change**
					Woodland Kv= 5.0 fps
6.0	180	Total			

Summary for Subcatchment 20S: Overland to Northwest

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
1,500	30	Woods, Good, HSG A
53,215	39	Pasture/grassland/range, Good, HSG A
54,715	39	Weighted Average
54,715		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0150	0.13		**Sheet Flow, Sheet Flow**
					Grass: Short n= 0.150 P2= 3.15"
5.7	415	0.0300	1.21		**Shallow Concentrated Flow, Shallow Concentrated**
					Short Grass Pasture Kv= 7.0 fps
12.1	465	Total			

Summary for Subcatchment 30S: Overland to Northeast

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
17,200	30	Woods, Good, HSG A
121,295	39	Pasture/grassland/range, Good, HSG A
138,495	38	Weighted Average
138,495		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	50	0.0300	0.08		**Sheet Flow, Sheet Flow**
					Woods: Light underbrush n= 0.400 P2= 3.15"
0.3	20	0.0500	1.12		**Shallow Concentrated Flow, Shallow Concentrated**
					Woodland Kv= 5.0 fps
1.6	155	0.1000	1.58		**Shallow Concentrated Flow, Shallow Concentrated-Slope Change**
					Woodland Kv= 5.0 fps
0.7	45	0.0500	1.12		**Shallow Concentrated Flow, Shallow Concentrated- Slope Change**
					Woodland Kv= 5.0 fps
13.2	270	Total			

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10S: Overland to Asbury Street Runoff Area=19,920 sf 0.00% Impervious Runoff Depth>0.01"
Flow Length=180' Tc=6.0 min CN=32 Runoff=0.00 cfs 10 cf

Subcatchment 20S: Overland to Northwest Runoff Area=54,715 sf 0.00% Impervious Runoff Depth>0.13"
Flow Length=465' Tc=12.1 min CN=39 Runoff=0.03 cfs 586 cf

Subcatchment 30S: Overland to Northeast Runoff Area=138,495 sf 0.00% Impervious Runoff Depth>0.10"
Flow Length=270' Tc=13.2 min CN=38 Runoff=0.06 cfs 1,187 cf

Total Runoff Area = 213,130 sf Runoff Volume = 1,784 cf Average Runoff Depth = 0.10"
100.00% Pervious = 213,130 sf 0.00% Impervious = 0 sf

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 10S: Overland to Asbury Street
Runoff Area=19,920 sf 0.00% Impervious Runoff Depth>0.72"
Flow Length=180' Tc=6.0 min CN=32 Runoff=0.18 cfs 1,200 cf

Subcatchment 20S: Overland to Northwest
Runoff Area=54,715 sf 0.00% Impervious Runoff Depth>1.39"
Flow Length=465' Tc=12.1 min CN=39 Runoff=1.40 cfs 6,336 cf

Subcatchment 30S: Overland to Northeast
Runoff Area=138,495 sf 0.00% Impervious Runoff Depth>1.29"
Flow Length=270' Tc=13.2 min CN=38 Runoff=3.04 cfs 14,856 cf

Total Runoff Area = 213,130 sf Runoff Volume = 22,392 cf Average Runoff Depth = 1.26"
100.00% Pervious = 213,130 sf 0.00% Impervious = 0 sf

Summary for Subcatchment 10S: Overland to Asbury Street

Runoff = 0.18 cfs @ 12.28 hrs, Volume= 1,200 cf, Depth> 0.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.94"

Area (sf)	CN	Description
15,840	30	Woods, Good, HSG A
4,080	39	Pasture/grassland/range, Good, HSG A
19,920	32	Weighted Average
19,920		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	50	0.0500	0.21		**Sheet Flow, Sheet Flow**
					Grass: Short n= 0.150 P2= 3.15"
0.8	50	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concentrated**
					Short Grass Pasture Kv= 7.0 fps
1.3	80	0.0400	1.00		**Shallow Concentrated Flow, Shalliow Concentrated- Ground Cover Change**
					Woodland Kv= 5.0 fps
6.0	180	Total			

Summary for Subcatchment 20S: Overland to Northwest

Runoff = 1.40 cfs @ 12.21 hrs, Volume= 6,336 cf, Depth> 1.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.94"

Area (sf)	CN	Description
1,500	30	Woods, Good, HSG A
53,215	39	Pasture/grassland/range, Good, HSG A
54,715	39	Weighted Average
54,715		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0150	0.13		**Sheet Flow, Sheet Flow**
					Grass: Short n= 0.150 P2= 3.15"
5.7	415	0.0300	1.21		**Shallow Concentrated Flow, Shallow Concentrated**
					Short Grass Pasture Kv= 7.0 fps
12.1	465	Total			

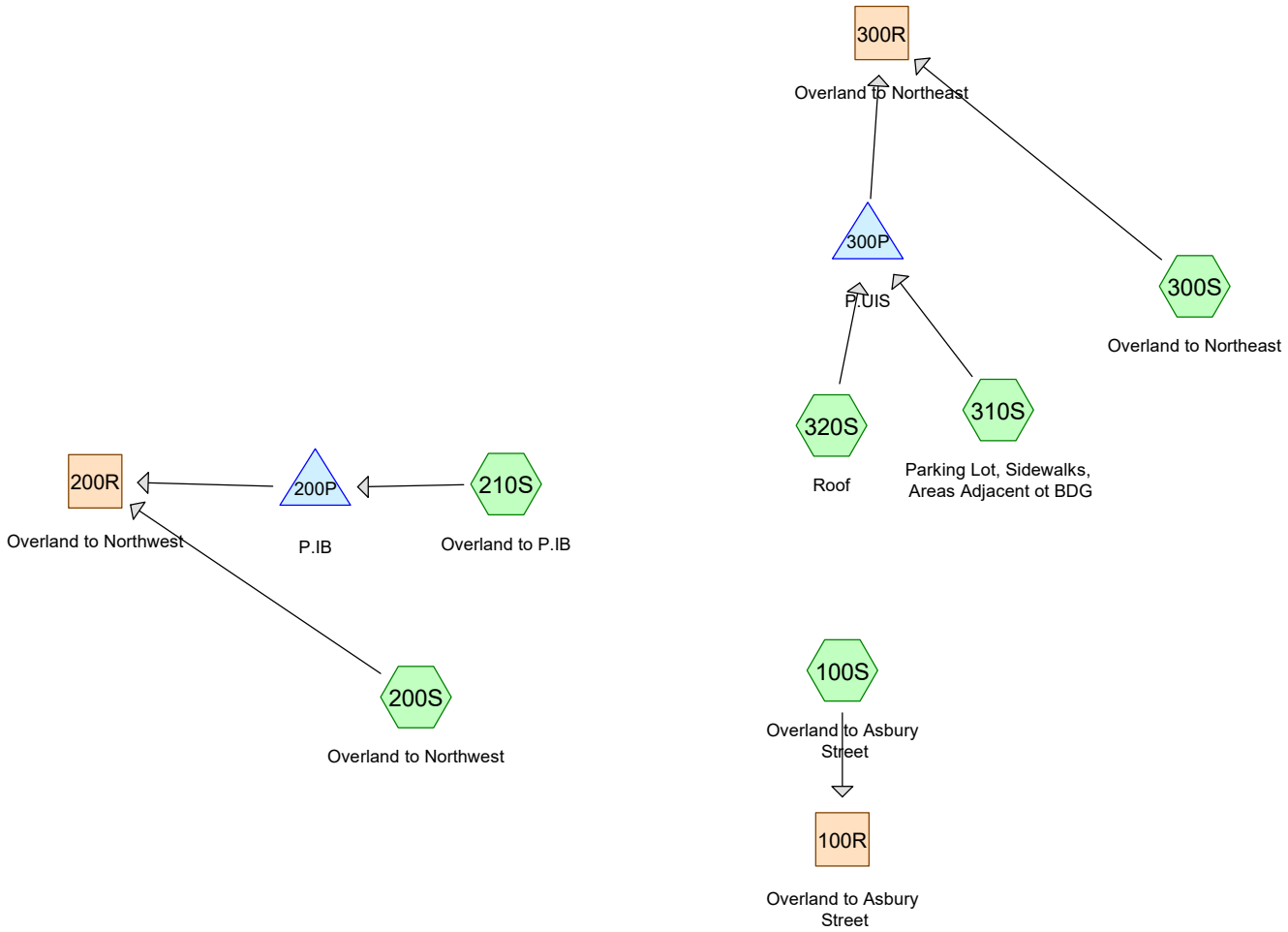
Summary for Subcatchment 30S: Overland to Northeast

Runoff = 3.04 cfs @ 12.24 hrs, Volume= 14,856 cf, Depth> 1.29"

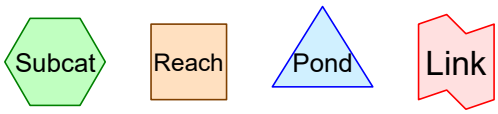
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.94"

Area (sf)	CN	Description
17,200	30	Woods, Good, HSG A
121,295	39	Pasture/grassland/range, Good, HSG A
138,495	38	Weighted Average
138,495		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	50	0.0300	0.08		**Sheet Flow, Sheet Flow**
					Woods: Light underbrush n= 0.400 P2= 3.15"
0.3	20	0.0500	1.12		**Shallow Concentrated Flow, Shallow Concentrated**
					Woodland Kv= 5.0 fps
1.6	155	0.1000	1.58		**Shallow Concentrated Flow, Shallow Concentrated-Slope Change**
					Woodland Kv= 5.0 fps
0.7	45	0.0500	1.12		**Shallow Concentrated Flow, Shallow Concentrated- Slope Change**
					Woodland Kv= 5.0 fps
13.2	270	Total			



POST-DEVELOPMENT



Routing Diagram for 24819-hyd
Prepared by Hancock Associates, Printed 10/21/2022
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Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
122,890	39	>75% Grass cover, Good, HSG A (200S, 210S, 300S, 310S)
33,830	98	Paved parking, HSG A (100S, 210S, 310S)
23,050	98	Roofs, HSG A (320S)
3,645	98	Sidewalks, HSG A (210S, 310S)
500	72	Ston Dust Walkway, HSG A (100S)
5,145	72	Stone Dust Walkway, HSG A (200S, 210S, 300S)
24,070	30	Woods, Good, HSG A (100S, 300S)
213,130	**56**	**TOTAL AREA**

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 100S: Overland to Asbury Street Runoff Area=10,530 sf 5.03% Impervious Runoff Depth=0.00"
Flow Length=180' Tc=6.6 min CN=35 Runoff=0.00 cfs 0 cf

Subcatchment 200S: Overland to Northwest Runoff Area=17,721 sf 0.00% Impervious Runoff Depth>0.00"
Flow Length=290' Tc=8.7 min CN=40 Runoff=0.00 cfs 0 cf

Subcatchment 210S: Overland to P.IB Runoff Area=43,031 sf 42.17% Impervious Runoff Depth>0.47"
Tc=6.0 min CN=64 Runoff=0.45 cfs 1,699 cf

Subcatchment 300S: Overland to Northeast Runoff Area=90,326 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=270' Tc=13.2 min CN=39 Runoff=0.00 cfs 0 cf

Subcatchment 310S: Parking Lot, Sidewalks, Areas Adjacent ot BDG Runoff Area=28,472 sf 66.03% Impervious Runoff Depth>1.14"
Tc=6.0 min CN=78 Runoff=0.91 cfs 2,698 cf

Subcatchment 320S: Roof Runoff Area=23,050 sf 100.00% Impervious Runoff Depth>2.73"
Tc=6.0 min CN=98 Runoff=1.58 cfs 5,240 cf

Reach 100R: Overland to Asbury Street Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Reach 200R: Overland to Northwest Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Reach 300R: Overland to Northeast Inflow=0.00 cfs 0 cf
Outflow=0.00 cfs 0 cf

Pond 200P: P.IB Peak Elev=60.16' Storage=490 cf Inflow=0.45 cfs 1,699 cf
Discarded=0.07 cfs 1,698 cf Primary=0.00 cfs 0 cf Outflow=0.07 cfs 1,698 cf

Pond 300P: P.UIS Peak Elev=52.13' Storage=1,058 cf Inflow=2.49 cfs 7,938 cf
Discarded=0.91 cfs 7,936 cf Primary=0.00 cfs 0 cf Outflow=0.91 cfs 7,936 cf

Total Runoff Area = 213,130 sf Runoff Volume = 9,637 cf Average Runoff Depth = 0.54"
71.60% Pervious = 152,605 sf 28.40% Impervious = 60,525 sf

Summary for Subcatchment 100S: Overland to Asbury Street

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.15"

	Area (sf)	CN	Description
	9,500	30	Woods, Good, HSG A
	530	98	Paved parking, HSG A
*	500	72	Ston Dust Walkway, HSG A
	10,530	35	Weighted Average
	10,000		94.97% Pervious Area
	530		5.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	50	0.0500	0.21		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.15"
0.8	50	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
1.9	80	0.0200	0.71		**Shallow Concentrated Flow, Shallow Concentrated-Ground Cover** Woodland Kv= 5.0 fps
6.6	180	Total			

Summary for Subcatchment 200S: Overland to Northwest

Runoff = 0.00 cfs @ 20.00 hrs, Volume= 0 cf, Depth> 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.15"

	Area (sf)	CN	Description
*	475	72	Stone Dust Walkway, HSG A
	17,246	39	>75% Grass cover, Good, HSG A
	17,721	40	Weighted Average
	17,721		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.15"
0.7	50	0.0300	1.21		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
3.2	190	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concnetrated-Slope Change** Short Grass Pasture Kv= 7.0 fps
8.7	290	Total			

Summary for Subcatchment 210S: Overland to P.IB

Runoff = 0.45 cfs @ 12.12 hrs, Volume= 1,699 cf, Depth> 0.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.15"

	Area (sf)	CN	Description
	15,800	98	Paved parking, HSG A
*	2,345	98	Sidewalks, HSG A
	24,676	39	>75% Grass cover, Good, HSG A
*	210	72	Stone Dust Walkway, HSG A
	43,031	64	Weighted Average
	24,886		57.83% Pervious Area
	18,145		42.17% Impervious Area

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

Summary for Subcatchment 300S: Overland to Northeast

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.15"

	Area (sf)	CN	Description
	14,570	30	Woods, Good, HSG A
*	4,460	72	Stone Dust Walkway, HSG A
	71,296	39	>75% Grass cover, Good, HSG A
	90,326	39	Weighted Average
	90,326		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	50	0.0300	0.08		**Sheet Flow, Sheet Flow**
					Woods: Light underbrush n= 0.400 P2= 3.15"
0.3	20	0.0500	1.12		**Shallow Concentrated Flow, Shallow Concentrated**
					Woodland Kv= 5.0 fps
1.6	155	0.1000	1.58		**Shallow Concentrated Flow, Shallow Concentrated-Slope Change**
					Woodland Kv= 5.0 fps
0.7	45	0.0500	1.12		**Shallow Concentrated Flow, Shallow Concentrated-Slope Change**
					Woodland Kv= 5.0 fps
13.2	270	Total			

Summary for Subcatchment 310S: Parking Lot, Sidewalks, Areas Adjacent ot BDG

Runoff = 0.91 cfs @ 12.10 hrs, Volume= 2,698 cf, Depth> 1.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.15"

	Area (sf)	CN	Description
	17,500	98	Paved parking, HSG A
*	1,300	98	Sidewalks, HSG A
	9,672	39	>75% Grass cover, Good, HSG A
	28,472	78	Weighted Average
	9,672		33.97% Pervious Area
	18,800		66.03% Impervious Area

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

Summary for Subcatchment 320S: Roof

Runoff = 1.58 cfs @ 12.09 hrs, Volume= 5,240 cf, Depth> 2.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.15"

Area (sf)	CN	Description
23,050	98	Roofs, HSG A
23,050		100.00% Impervious Area

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

Summary for Reach 100R: Overland to Asbury Street

Inflow Area = 10,530 sf, 5.03% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 200R: Overland to Northwest

Inflow Area = 60,752 sf, 29.87% Impervious, Inflow Depth > 0.00" for 2-Year event
Inflow = 0.00 cfs @ 20.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 20.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 300R: Overland to Northeast

Inflow Area = 141,848 sf, 29.50% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond 200P: P.IB

Inflow Area = 43,031 sf, 42.17% Impervious, Inflow Depth > 0.47" for 2-Year event
Inflow = 0.45 cfs @ 12.12 hrs, Volume= 1,699 cf
Outflow = 0.07 cfs @ 13.23 hrs, Volume= 1,698 cf, Atten= 84%, Lag= 66.8 min
Discarded = 0.07 cfs @ 13.23 hrs, Volume= 1,698 cf
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 60.16' @ 13.23 hrs Surf.Area= 3,096 sf Storage= 490 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 66.3 min (913.5 - 847.2)

Volume	Invert	Avail.Storage	Storage Description
#1	60.00'	12,100 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
60.00	2,980	0	0
61.00	3,700	3,340	3,340
62.00	4,460	4,080	7,420
63.00	4,900	4,680	12,100

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	62.00'	**10.0' long x 4.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50
			Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.07 cfs @ 13.23 hrs HW=60.16' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=60.00' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 300P: P.UIS

Inflow Area = 51,522 sf, 81.23% Impervious, Inflow Depth > 1.85" for 2-Year event
Inflow = 2.49 cfs @ 12.09 hrs, Volume= 7,938 cf
Outflow = 0.91 cfs @ 12.00 hrs, Volume= 7,936 cf, Atten= 63%, Lag= 0.0 min
Discarded = 0.91 cfs @ 12.00 hrs, Volume= 7,936 cf
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 52.13' @ 12.37 hrs Surf.Area= 4,766 sf Storage= 1,058 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 4.9 min (767.6 - 762.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	51.60'	4,283 cf	**25.25'W x 188.74'L x 3.50'H Field A**
			16,680 cf Overall - 5,972 cf Embedded = 10,707 cf x 40.0% Voids
#2A	52.10'	5,972 cf	**ADS_StormTech SC-740 +Cap** x 130 Inside #1
			Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
			Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap
			130 Chambers in 5 Rows
		10,255 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	51.60'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	54.75'	**12.0" Round Culvert** L= 74.0' CPP, projecting, no headwall, Ke= 0.900
			Inlet / Outlet Invert= 54.75' / 54.20' S= 0.0074 '/' Cc= 0.900
			n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.91 cfs @ 12.00 hrs HW=51.65' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.91 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=51.60' TW=0.00' (Dynamic Tailwater)
└**2=Culvert** (Controls 0.00 cfs)

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 100S: Overland to Asbury Street Runoff Area=10,530 sf 5.03% Impervious Runoff Depth>0.04"
Flow Length=180' Tc=6.6 min CN=35 Runoff=0.00 cfs 37 cf

Subcatchment 200S: Overland to Northwest Runoff Area=17,721 sf 0.00% Impervious Runoff Depth>0.16"
Flow Length=290' Tc=8.7 min CN=40 Runoff=0.02 cfs 232 cf

Subcatchment 210S: Overland to P.IB Runoff Area=43,031 sf 42.17% Impervious Runoff Depth>1.34"
Tc=6.0 min CN=64 Runoff=1.57 cfs 4,798 cf

Subcatchment 300S: Overland to Northeast Runoff Area=90,326 sf 0.00% Impervious Runoff Depth>0.13"
Flow Length=270' Tc=13.2 min CN=39 Runoff=0.05 cfs 966 cf

Subcatchment 310S: Parking Lot, Sidewalks, Areas Adjacent ot BDG Runoff Area=28,472 sf 66.03% Impervious Runoff Depth>2.39"
Tc=6.0 min CN=78 Runoff=1.93 cfs 5,672 cf

Subcatchment 320S: Roof Runoff Area=23,050 sf 100.00% Impervious Runoff Depth>4.26"
Tc=6.0 min CN=98 Runoff=2.44 cfs 8,190 cf

Reach 100R: Overland to Asbury Street Inflow=0.00 cfs 37 cf
Outflow=0.00 cfs 37 cf

Reach 200R: Overland to Northwest Inflow=0.02 cfs 232 cf
Outflow=0.02 cfs 232 cf

Reach 300R: Overland to Northeast Inflow=0.05 cfs 966 cf
Outflow=0.05 cfs 966 cf

Pond 200P: P.IB Peak Elev=60.82' Storage=2,688 cf Inflow=1.57 cfs 4,798 cf
Discarded=0.08 cfs 2,563 cf Primary=0.00 cfs 0 cf Outflow=0.08 cfs 2,563 cf

Pond 300P: P.UIS Peak Elev=52.73' Storage=3,417 cf Inflow=4.37 cfs 13,862 cf
Discarded=0.91 cfs 13,863 cf Primary=0.00 cfs 0 cf Outflow=0.91 cfs 13,863 cf

Total Runoff Area = 213,130 sf Runoff Volume = 19,896 cf Average Runoff Depth = 1.12"
71.60% Pervious = 152,605 sf 28.40% Impervious = 60,525 sf

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 100S: Overland to Asbury Street Runoff Area=10,530 sf 5.03% Impervious Runoff Depth>1.00"
Flow Length=180' Tc=6.6 min CN=35 Runoff=0.18 cfs 876 cf

Subcatchment 200S: Overland to Northwest Runoff Area=17,721 sf 0.00% Impervious Runoff Depth>1.50"
Flow Length=290' Tc=8.7 min CN=40 Runoff=0.56 cfs 2,209 cf

Subcatchment 210S: Overland to P.IB Runoff Area=43,031 sf 42.17% Impervious Runoff Depth>4.22"
Tc=6.0 min CN=64 Runoff=5.16 cfs 15,142 cf

Subcatchment 300S: Overland to Northeast Runoff Area=90,326 sf 0.00% Impervious Runoff Depth>1.39"
Flow Length=270' Tc=13.2 min CN=39 Runoff=2.23 cfs 10,453 cf

Subcatchment 310S: Parking Lot, Sidewalks, Areas Adjacent ot BDG Runoff Area=28,472 sf 66.03% Impervious Runoff Depth>5.90"
Tc=6.0 min CN=78 Runoff=4.63 cfs 13,997 cf

Subcatchment 320S: Roof Runoff Area=23,050 sf 100.00% Impervious Runoff Depth>8.00"
Tc=6.0 min CN=98 Runoff=4.54 cfs 15,360 cf

Reach 100R: Overland to Asbury Street Inflow=0.18 cfs 876 cf
Outflow=0.18 cfs 876 cf

Reach 200R: Overland to Northwest Inflow=0.76 cfs 6,220 cf
Outflow=0.76 cfs 6,220 cf

Reach 300R: Overland to Northeast Inflow=2.64 cfs 11,297 cf
Outflow=2.64 cfs 11,297 cf

Pond 200P: P.IB Peak Elev=62.09' Storage=7,810 cf Inflow=5.16 cfs 15,142 cf
Discarded=0.11 cfs 3,718 cf Primary=0.61 cfs 4,011 cf Outflow=0.72 cfs 7,730 cf

Pond 300P: P.UIS Peak Elev=55.44' Storage=10,255 cf Inflow=9.16 cfs 29,358 cf
Discarded=0.91 cfs 28,516 cf Primary=1.29 cfs 844 cf Outflow=2.20 cfs 29,361 cf

Total Runoff Area = 213,130 sf Runoff Volume = 58,037 cf Average Runoff Depth = 3.27"
71.60% Pervious = 152,605 sf 28.40% Impervious = 60,525 sf

Summary for Subcatchment 100S: Overland to Asbury Street

Runoff = 0.18 cfs @ 12.15 hrs, Volume= 876 cf, Depth> 1.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.94"

	Area (sf)	CN	Description
	9,500	30	Woods, Good, HSG A
	530	98	Paved parking, HSG A
*	500	72	Ston Dust Walkway, HSG A
	10,530	35	Weighted Average
	10,000		94.97% Pervious Area
	530		5.03% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	50	0.0500	0.21		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.15"
0.8	50	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concentrated** Short Grass Pasture Kv= 7.0 fps
1.9	80	0.0200	0.71		**Shallow Concentrated Flow, Shallow Concentrated-Ground Cover** Woodland Kv= 5.0 fps
6.6	180	Total			

Summary for Subcatchment 200S: Overland to Northwest

Runoff = 0.56 cfs @ 12.16 hrs, Volume= 2,209 cf, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.94"

	Area (sf)	CN	Description
*	475	72	Stone Dust Walkway, HSG A
	17,246	39	>75% Grass cover, Good, HSG A
	17,721	40	Weighted Average
	17,721		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow, Sheet Flow**
					Grass: Short n= 0.150 P2= 3.15"
0.7	50	0.0300	1.21		**Shallow Concentrated Flow, Shallow Concentrated**
					Short Grass Pasture Kv= 7.0 fps
3.2	190	0.0200	0.99		**Shallow Concentrated Flow, Shallow Concnetrated-Slope Change**
					Short Grass Pasture Kv= 7.0 fps
8.7	290	Total			

Summary for Subcatchment 210S: Overland to P.IB

Runoff = 5.16 cfs @ 12.09 hrs, Volume= 15,142 cf, Depth> 4.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.94"

	Area (sf)	CN	Description
	15,800	98	Paved parking, HSG A
*	2,345	98	Sidewalks, HSG A
	24,676	39	>75% Grass cover, Good, HSG A
*	210	72	Stone Dust Walkway, HSG A
	43,031	64	Weighted Average
	24,886		57.83% Pervious Area
	18,145		42.17% Impervious Area

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

Summary for Subcatchment 300S: Overland to Northeast

Runoff = 2.23 cfs @ 12.23 hrs, Volume= 10,453 cf, Depth> 1.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.94"

	Area (sf)	CN	Description
	14,570	30	Woods, Good, HSG A
*	4,460	72	Stone Dust Walkway, HSG A
	71,296	39	>75% Grass cover, Good, HSG A
	90,326	39	Weighted Average
	90,326		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	50	0.0300	0.08		**Sheet Flow, Sheet Flow**
					Woods: Light underbrush n= 0.400 P2= 3.15"
0.3	20	0.0500	1.12		**Shallow Concentrated Flow, Shallow Concentrated**
					Woodland Kv= 5.0 fps
1.6	155	0.1000	1.58		**Shallow Concentrated Flow, Shallow Concentrated-Slope Change**
					Woodland Kv= 5.0 fps
0.7	45	0.0500	1.12		**Shallow Concentrated Flow, Shallow Concentrated-Slope Change**
					Woodland Kv= 5.0 fps
13.2	270	Total			

Summary for Subcatchment 310S: Parking Lot, Sidewalks, Areas Adjacent ot BDG

Runoff = 4.63 cfs @ 12.09 hrs, Volume= 13,997 cf, Depth> 5.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.94"

	Area (sf)	CN	Description
	17,500	98	Paved parking, HSG A
*	1,300	98	Sidewalks, HSG A
	9,672	39	>75% Grass cover, Good, HSG A
	28,472	78	Weighted Average
	9,672		33.97% Pervious Area
	18,800		66.03% Impervious Area

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

Summary for Subcatchment 320S: Roof

Runoff = 4.54 cfs @ 12.09 hrs, Volume= 15,360 cf, Depth> 8.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.94"

Area (sf)	CN	Description
23,050	98	Roofs, HSG A
23,050		100.00% Impervious Area

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

Summary for Reach 100R: Overland to Asbury Street

Inflow Area = 10,530 sf, 5.03% Impervious, Inflow Depth > 1.00" for 100-Year event
Inflow = 0.18 cfs @ 12.15 hrs, Volume= 876 cf
Outflow = 0.18 cfs @ 12.15 hrs, Volume= 876 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 200R: Overland to Northwest

Inflow Area = 60,752 sf, 29.87% Impervious, Inflow Depth > 1.23" for 100-Year event
Inflow = 0.76 cfs @ 12.67 hrs, Volume= 6,220 cf
Outflow = 0.76 cfs @ 12.67 hrs, Volume= 6,220 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Reach 300R: Overland to Northeast

Inflow Area = 141,848 sf, 29.50% Impervious, Inflow Depth > 0.96" for 100-Year event
Inflow = 2.64 cfs @ 12.54 hrs, Volume= 11,297 cf
Outflow = 2.64 cfs @ 12.54 hrs, Volume= 11,297 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond 200P: P.IB

Inflow Area = 43,031 sf, 42.17% Impervious, Inflow Depth > 4.22" for 100-Year event
Inflow = 5.16 cfs @ 12.09 hrs, Volume= 15,142 cf
Outflow = 0.72 cfs @ 12.71 hrs, Volume= 7,730 cf, Atten= 86%, Lag= 36.9 min
Discarded = 0.11 cfs @ 12.71 hrs, Volume= 3,718 cf
Primary = 0.61 cfs @ 12.71 hrs, Volume= 4,011 cf

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 62.09' @ 12.71 hrs Surf.Area= 4,498 sf Storage= 7,810 cf

Plug-Flow detention time= 161.0 min calculated for 7,704 cf (51% of inflow)
Center-of-Mass det. time= 79.3 min (874.6 - 795.3)

Volume	Invert	Avail.Storage	Storage Description
#1	60.00'	12,100 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
60.00	2,980	0	0
61.00	3,700	3,340	3,340
62.00	4,460	4,080	7,420
63.00	4,900	4,680	12,100

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	62.00'	**10.0' long x 4.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50
			Coef. (English) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.11 cfs @ 12.71 hrs HW=62.09' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.61 cfs @ 12.71 hrs HW=62.09' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.61 cfs @ 0.70 fps)

Stage-Area-Storage for Pond 200P: P.IB

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
60.00	2,980	0	61.34	3,958	4,642	62.68	4,759	10,555
60.02	2,994	60	61.36	3,974	4,721	62.70	4,768	10,650
60.04	3,009	120	61.38	3,989	4,801	62.72	4,777	10,745
60.06	3,023	180	61.40	4,004	4,881	62.74	4,786	10,841
60.08	3,038	241	61.42	4,019	4,961	62.76	4,794	10,937
60.10	3,052	302	61.44	4,034	5,042	62.78	4,803	11,033
60.12	3,066	363	61.46	4,050	5,122	62.80	4,812	11,129
60.14	3,081	424	61.48	4,065	5,204	62.82	4,821	11,225
60.16	3,095	486	61.50	4,080	5,285	62.84	4,830	11,322
60.18	3,110	548	61.52	4,095	5,367	62.86	4,838	11,418
60.20	3,124	610	61.54	4,110	5,449	62.88	4,847	11,515
60.22	3,138	673	61.56	4,126	5,531	62.90	4,856	11,612
60.24	3,153	736	61.58	4,141	5,614	62.92	4,865	11,709
60.26	3,167	799	61.60	4,156	5,697	62.94	4,874	11,807
60.28	3,182	863	61.62	4,171	5,780	62.96	4,882	11,904
60.30	3,196	926	61.64	4,186	5,864	62.98	4,891	12,002
60.32	3,210	990	61.66	4,202	5,948	63.00	**4,900**	**12,100**
60.34	3,225	1,055	61.68	4,217	6,032			
60.36	3,239	1,119	61.70	4,232	6,116			
60.38	3,254	1,184	61.72	4,247	6,201			
60.40	3,268	1,250	61.74	4,262	6,286			
60.42	3,282	1,315	61.76	4,278	6,371			
60.44	3,297	1,381	61.78	4,293	6,457			
60.46	3,311	1,447	61.80	4,308	6,543			
60.48	3,326	1,513	61.82	4,323	6,630			
60.50	3,340	1,580	61.84	4,338	6,716			
60.52	3,354	1,647	61.86	4,354	6,803			
60.54	3,369	1,714	61.88	4,369	6,890			
60.56	3,383	1,782	61.90	4,384	6,978			
60.58	3,398	1,850	61.92	4,399	7,066			
60.60	3,412	1,918	61.94	4,414	7,154			
60.62	3,426	1,986	61.96	4,430	7,242			
60.64	3,441	2,055	61.98	4,445	7,331			
60.66	3,455	2,124	62.00	4,460	7,420			
60.68	3,470	2,193	62.02	4,469	7,509			
60.70	3,484	2,262	62.04	4,478	7,599			
60.72	3,498	2,332	62.06	4,486	7,688			
60.74	3,513	2,402	62.08	4,495	7,778			
60.76	3,527	2,473	62.10	4,504	7,868			
60.78	3,542	2,543	62.12	4,513	7,958			
60.80	3,556	2,614	62.14	4,522	8,049			
60.82	3,570	2,686	62.16	4,530	8,139			
60.84	3,585	2,757	62.18	4,539	8,230			
60.86	3,599	2,829	62.20	4,548	8,321			
60.88	3,614	2,901	62.22	4,557	8,412			
60.90	3,628	2,974	62.24	4,566	8,503			
60.92	3,642	3,046	62.26	4,574	8,594			
60.94	3,657	3,119	62.28	4,583	8,686			
60.96	3,671	3,193	62.30	4,592	8,778			
60.98	3,686	3,266	62.32	4,601	8,870			
61.00	3,700	3,340	62.34	4,610	8,962			
61.02	3,715	3,414	62.36	4,618	9,054			
61.04	3,730	3,489	62.38	4,627	9,147			
61.06	3,746	3,563	62.40	4,636	9,239			
61.08	3,761	3,638	62.42	4,645	9,332			
61.10	3,776	3,714	62.44	4,654	9,425			
61.12	3,791	3,789	62.46	4,662	9,518			
61.14	3,806	3,865	62.48	4,671	9,611			
61.16	3,822	3,942	62.50	4,680	9,705			
61.18	3,837	4,018	62.52	4,689	9,799			
61.20	3,852	4,095	62.54	4,698	9,893			
61.22	3,867	4,172	62.56	4,706	9,987			
61.24	3,882	4,250	62.58	4,715	10,081			
61.26	3,898	4,328	62.60	4,724	10,175			
61.28	3,913	4,406	62.62	4,733	10,270			
61.30	3,928	4,484	62.64	4,742	10,365			
61.32	3,943	4,563	62.66	4,750	10,459			

Summary for Pond 300P: P.UIS

Inflow Area = 51,522 sf, 81.23% Impervious, Inflow Depth > 6.84" for 100-Year event
Inflow = 9.16 cfs @ 12.09 hrs, Volume= 29,358 cf
Outflow = 2.20 cfs @ 12.55 hrs, Volume= 29,361 cf, Atten= 76%, Lag= 27.6 min
Discarded = 0.91 cfs @ 11.65 hrs, Volume= 28,516 cf
Primary = 1.29 cfs @ 12.55 hrs, Volume= 844 cf

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 55.44' @ 12.55 hrs Surf.Area= 4,766 sf Storage= 10,255 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 79.2 min (830.4 - 751.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	51.60'	4,283 cf	**25.25'W x 188.74'L x 3.50'H Field A** 16,680 cf Overall - 5,972 cf Embedded = 10,707 cf x 40.0% Voids
#2A	52.10'	5,972 cf	**ADS_StormTech SC-740 +Cap** x 130 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 130 Chambers in 5 Rows
		10,255 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	51.60'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	54.75'	**12.0" Round Culvert** L= 74.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 54.75' / 54.20' S= 0.0074 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Discarded OutFlow Max=0.91 cfs @ 11.65 hrs HW=51.67' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.91 cfs)

Primary OutFlow Max=1.25 cfs @ 12.55 hrs HW=55.43' TW=0.00' (Dynamic Tailwater)
└**2=Culvert** (Inlet Controls 1.25 cfs @ 2.21 fps)

Stage-Area-Storage for Pond 300P: P.UIS

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)	Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
51.60	**4,766**	0	54.95	4,766	9,969
51.65	4,766	95	55.00	4,766	10,065
51.70	4,766	191	55.05	4,766	10,160
51.75	4,766	286	55.10	4,766	**10,255**
51.80	4,766	381	55.15	4,766	10,255
51.85	4,766	477	55.20	4,766	10,255
51.90	4,766	572	55.25	4,766	10,255
51.95	4,766	667	55.30	4,766	10,255
52.00	4,766	762	55.35	4,766	10,255
52.05	4,766	858	55.40	4,766	10,255
52.10	4,766	953	55.45	4,766	10,255
52.15	4,766	1,152	55.50	4,766	10,255
52.20	4,766	1,350	55.55	4,766	10,255
52.25	4,766	1,548	55.60	4,766	10,255
52.30	4,766	1,746	55.65	4,766	10,255
52.35	4,766	1,943	55.70	4,766	10,255
52.40	4,766	2,139	55.75	4,766	10,255
52.45	4,766	2,335			
52.50	4,766	2,530			
52.55	4,766	2,724			
52.60	4,766	2,918			
52.65	4,766	3,111			
52.70	4,766	3,302			
52.75	4,766	3,493			
52.80	4,766	3,683			
52.85	4,766	3,872			
52.90	4,766	4,060			
52.95	4,766	4,247			
53.00	4,766	4,433			
53.05	4,766	4,618			
53.10	4,766	4,801			
53.15	4,766	4,984			
53.20	4,766	5,165			
53.25	4,766	5,345			
53.30	4,766	5,523			
53.35	4,766	5,700			
53.40	4,766	5,875			
53.45	4,766	6,049			
53.50	4,766	6,221			
53.55	4,766	6,392			
53.60	4,766	6,560			
53.65	4,766	6,727			
53.70	4,766	6,893			
53.75	4,766	7,056			
53.80	4,766	7,216			
53.85	4,766	7,374			
53.90	4,766	7,529			
53.95	4,766	7,682			
54.00	4,766	7,833			
54.05	4,766	7,980			
54.10	4,766	8,125			
54.15	4,766	8,266			
54.20	4,766	8,403			
54.25	4,766	8,535			
54.30	4,766	8,662			
54.35	4,766	8,782			
54.40	4,766	8,895			
54.45	4,766	9,002			
54.50	4,766	9,105			
54.55	4,766	9,205			
54.60	4,766	9,302			
54.65	4,766	9,397			
54.70	4,766	9,493			
54.75	4,766	9,588			
54.80	4,766	9,683			
54.85	4,766	9,779			
54.90	4,766	9,874			

ATTACHMENT D
MOUDING ANALYSIS

Length of field:

188.74 feet

Width of Field:

25.25 feet

Rate of application: 9,588 c.f. over 4,766 s.f. area

9,588 c.f. / 4,766 s.f. = **2.01 ft/day**

Aquifer hydraulic conductivity:

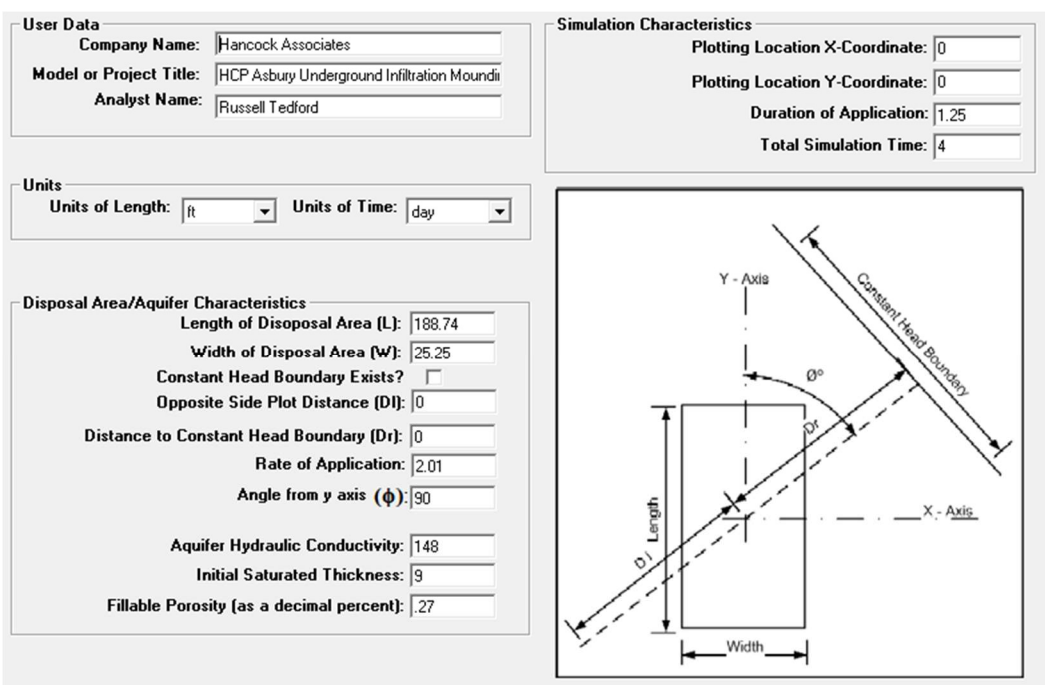
148 ft/day is used, which is the average hydraulic conductivity of coarse sand per DEP guidelines, and is corroborated by in-situ perc. Testing at <2 min/inch.

Fillable Porosity:

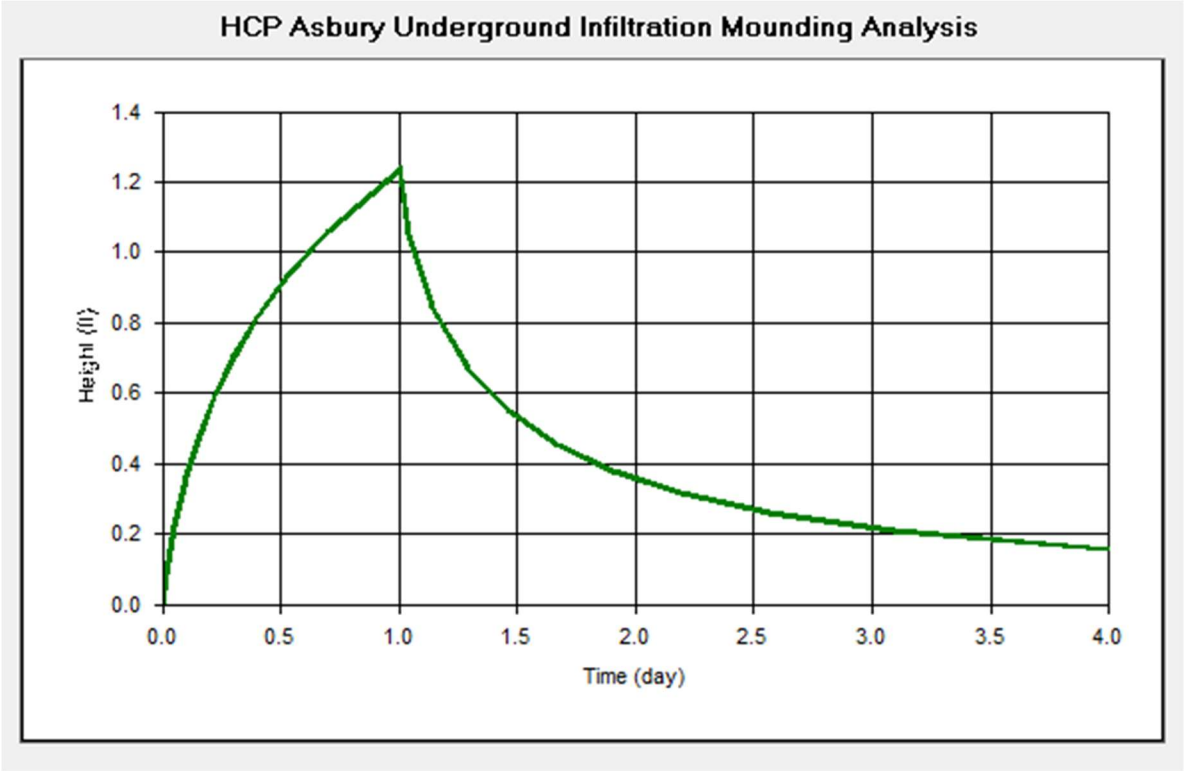
0.27 was used for coarse sand per DEP guidance

Initial Saturated Thickness:

Soil testing on site has discovered no ledge down to an elevation of 47.3, an assumed saturated thickness of 9' has been used.



Output:



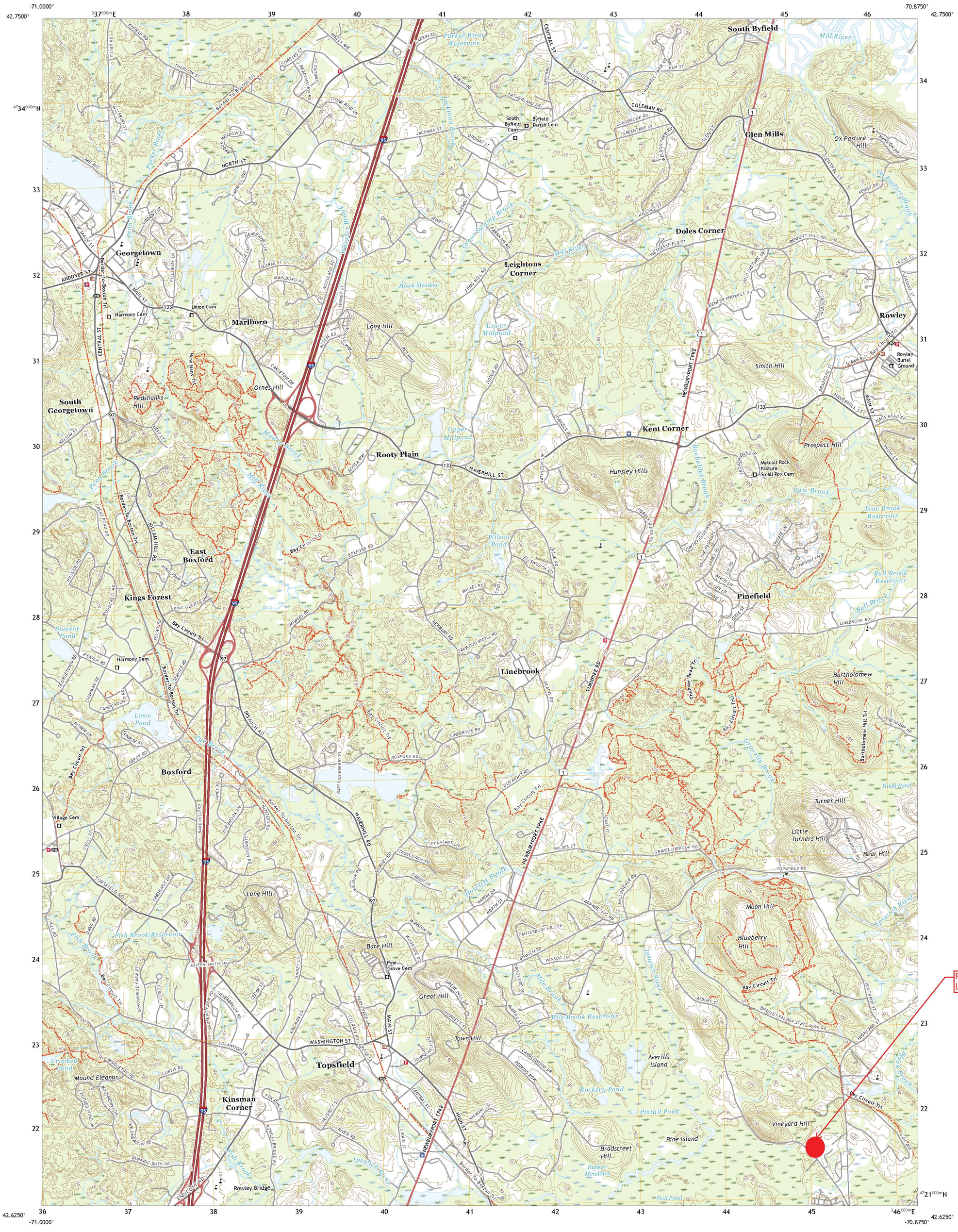
Conclusion: Peak mounding beneath the system after a 24 hour storm event and 72-hour drawdown period is approximately 1.25 feet and is incorporated in the design of the underground system.

ATTACHEMENT E
USGS TOPOGRAPHIC MAP

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

GEORGETOWN QUADRANGLE
MASSACHUSETTS - ESSEX COUNTY
7.5-MINUTE SERIES



Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid:Universal Transverse Mercator, Zone 19T

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery	NAIP,	October 2018
Roads	U.S. Census Bureau,	2018
Names	GNIS,	1974 - 2020
Hydrography	National Hydrography Dataset,	2005
Contours	National Elevation Dataset,	2012 - 2019
Boundaries	Multiple sources; see metadata file	2018 - 2019
Wetlands	FWS National Wetlands Inventory	1985 - 2011

MN GN
14°35'
259 MILS
1°19'
23 MILS
UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

U.S. National Grid
100,000 - m Square ID
CH
Grid Zone Designation 19T

SCALE 1:24 000

KILOMETERS 1 0.5 0 1 2
METERS 1000 500 0 1000 2000
MILES 1 0.5 0 1
FEET 1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard.

MASSACHUSETTS
QUADRANGLE LOCATION

1	2	3
4		5
6	7	8

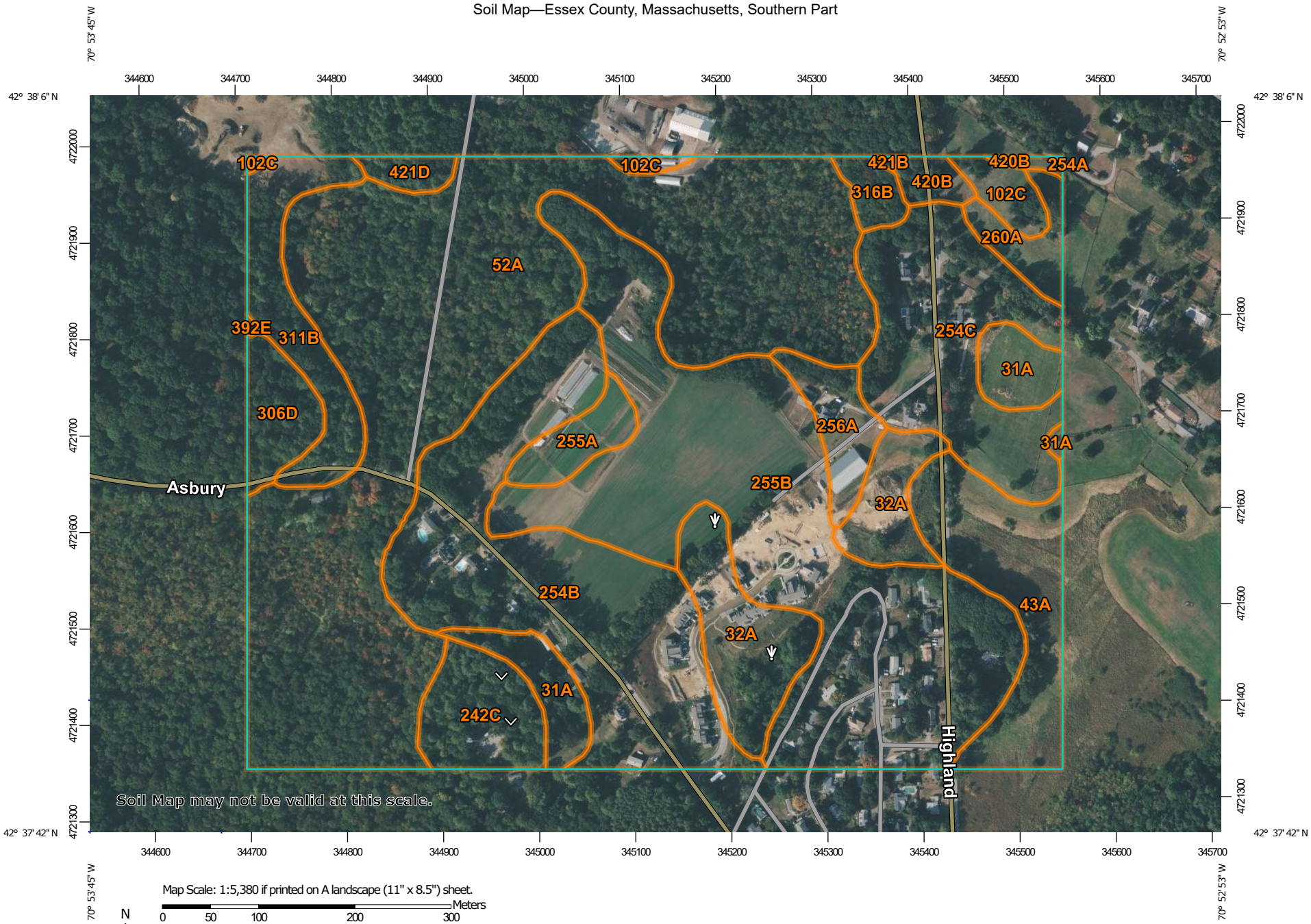
ADJOINING QUADRANGLES
1 Haverhill
2 Newburyport West
3 Newburyport East
4 South Groveland
5 Ipswich
6 Reading
7 Salem
8 Marblehead North

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

GEORGETOWN, MA
2021

NSN. 7643016369531
NGA REF NO. USGSX24K17090

ATTACHMENT F
USDA NRCS WEB SOIL SURVEY INFORMATION



Map Scale: 1:5,380 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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

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

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

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

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

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

Soil Survey Area: Essex County, Massachusetts, Southern Part
Survey Area Data: Version 18, Sep 2, 2021

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

Date(s) aerial images were photographed: May 22, 2020—Sep 25, 2020

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
31A	Walpole sandy loam, 0 to 3 percent slopes	3.6	2.7%
32A	Wareham loamy sand, 0 to 3 percent slopes	6.9	5.2%
43A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	6.9	5.2%
52A	Freetown muck, 0 to 1 percent slopes	41.4	30.9%
102C	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	1.5	1.1%
242C	Hinckley loamy sand, 8 to 15 percent slopes	3.5	2.6%
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	0.2	0.1%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	17.7	13.3%
254C	Merrimac fine sandy loam, 8 to 15 percent slopes	10.0	7.5%
255A	Windsor loamy sand, 0 to 3 percent slopes	1.7	1.3%
255B	Windsor loamy sand, 3 to 8 percent slopes	27.0	20.2%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	2.2	1.6%
260A	Sudbury fine sandy loam, 0 to 3 percent slopes	1.6	1.2%
306D	Paxton fine sandy loam, 15 to 25 percent slopes, very stony	2.2	1.7%
311B	Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony	4.6	3.4%
316B	Scituate fine sandy loam, 3 to 8 percent slopes, very stony	1.0	0.7%
392E	Paxton and Montauk fine sandy loams, 15 to 35 percent slopes, extremely stony	0.0	0.0%
420B	Canton fine sandy loam, 3 to 8 percent slopes	0.9	0.7%
421B	Canton fine sandy loam, 0 to 8 percent slopes, very stony	0.1	0.0%
421D	Canton fine sandy loam, 15 to 25 percent slopes, very stony	0.8	0.6%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Totals for Area of Interest		**133.8**	**100.0%**

Essex County, Massachusetts, Southern Part

254B—Merrimac fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyqs
Elevation: 0 to 1,290 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Merrimac

Setting

Landform: Outwash plains, outwash terraces, moraines, eskers, kames
Landform position (two-dimensional): Backslope, footslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Maximum salinity: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0

Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Ecological site: F145XY008MA - Dry Outwash
Hydric soil rating: No

Minor Components

Hinckley

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

Sudbury

Percent of map unit: 5 percent
Landform: Deltas, terraces, outwash plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Windsor

Percent of map unit: 3 percent
Landform: Outwash terraces, dunes, deltas, outwash plains
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Agawam

Percent of map unit: 2 percent
Landform: Outwash plains, outwash terraces, moraines, stream terraces, eskers, kames
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Data Source Information

Soil Survey Area: Essex County, Massachusetts, Southern Part
Survey Area Data: Version 18, Sep 2, 2021

Essex County, Massachusetts, Southern Part

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

Map Unit Setting

National map unit symbol: 2svkf
Elevation: 0 to 1,210 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Windsor, Loamy Sand

Setting

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

Typical profile

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

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s

Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Hinckley, loamy sand
Percent of map unit: 10 percent
Landform: Deltas, kames, eskers, outwash plains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, nose slope, head slope, crest, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

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

Data Source Information

Soil Survey Area: Essex County, Massachusetts, Southern Part
Survey Area Data: Version 18, Sep 2, 2021

ATTACHMENT G
VORTSENTRY HS TECHNICAL ABSTRACT

CONTECH®
ENGINEERED SOLUTIONS

VortSentry® HS Guide
Operation, Design, Performance and Maintenance

VortSentry® HS

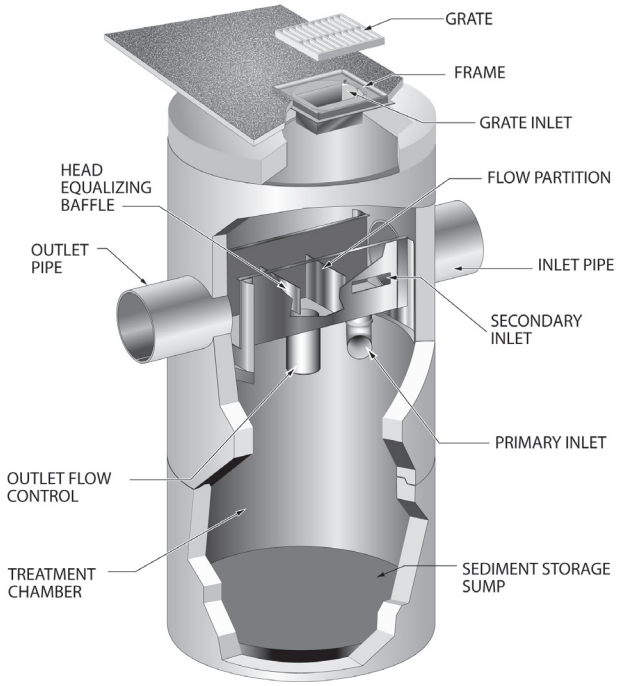
The VortSentry HS is a compact, below grade stormwater treatment system that employs helical flow technology to enhance gravitational separation of floating and settling pollutants from stormwater flows. With the ability to accept a wide range of pipe sizes, the VortSentry HS can treat and convey flows from small to large sites. A unique internal bypass design means higher flows can be diverted without the use of external bypass structures. The VortSentry HS is also available in a grate inlet configuration, which is ideal for retrofit installations.

Operation Overview

Low, frequently occurring storm flows are directed into the treatment chamber through the primary inlet. The tangentially oriented downward pipe induces a swirling motion in the treatment chamber that increases capture and containment abilities. Moderate storm flows are directed into the treatment chamber through the secondary inlet, which allows for capture of floating trash and debris. The secondary inlet also provides for treatment of higher flows without significantly increasing the velocity or turbulence in the treatment chamber. This allows for a more quiescent separation environment. Settleable solids and floating pollutants are captured and contained in the treatment chamber.

Flow exits the treatment chamber through the outlet flow control, which manages the amount of flow that is treated and helps maintain the helical flow patterns developed within the treatment chamber.

Flows exceeding the system's rated treatment flow are diverted away from the treatment chamber by the flow partition. Internal diversion of high flows eliminates the need for external bypass structures. During bypass, the head equalizing baffle applies head on the outlet flow control to limit the flow through the treatment chamber. This helps prevent re-suspension of previously captured pollutants.



Design Basics

There are two primary methods of sizing a VortSentry HS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow for a defined particle size. The summation process of the Rational Rainfall Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically, VortSentry HS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a particle gradation with an average particle size (d_{50}) of 240-microns (μm).

Water Quality Flow Rate Method

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

The VortSentry HS is designed to treat all flows up to the WQQ. Due to its internal bypass weir configuration, flow rates in the treatment chamber only increase minimally once the WQQ is surpassed. At influent rates higher than the WQQ, the flow partition will allow most flow exceeding the treatment flow rate to bypass the treatment chamber. This allows removal efficiency to remain relatively constant in the treatment chamber and reduces the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the VortSentry HS will remove a specific gradation of sediment at a specific removal efficiency. Therefore they are variable based on the gradation and removal efficiency specified by the design engineer and the unit size is scaled according to the project goal.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. The Rational Rainfall Method is a sizing program Contech uses to estimate a net annual sediment load reduction for a particular VortSentry HS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics. For more information on the Rational Rainfall Method, see *Vortechs Technical Bulletin 4: Modeling Long Term Load Reduction: The Rational Rainfall Method*, available at **www.ContechES.com/stormwater**

Treatment Flow Rate

The outlet flow control is sized to allow the WQQ to pass entirely through the treatment chamber at a water surface elevation equal to the crest of the flow partition. The head equalizing baffle applies head on the outlet flow control to limit the flow through the treatment chamber when bypass occurs, thus helping to prevent re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The VortSentry HS is available in three standard configurations: inline (with inlet and outlet pipes at 180° to each other), grated inlet, and a combination of grate and pipe inlets. All three configurations are available in 36-inch (900-mm) through 96-inch (2400-mm) diameter manholes.

The configuration of the system is determined by the suffix of the model name:

- A model name without a suffix denotes a standard pipe inlet (Example HS48).
- A "G" at the end of the model designation denotes a grate inlet (Example HS48G).
- A "GP" at the end of the model designation denotes a combination of grate and pipe inlets (Example HS48GP).

Performance

Full-Scale Laboratory Test Results

Laboratory testing of the VortSentry HS was conducted using F-55 Silica, a commercially available sand product with an average particle size of 240-μm (Table 1). This material was metered into a model HS48 VortSentry HS at an average concentration of between 250-mg/L and 300-mg/L at flow rates ranging from 0.50-cfs to 1.5-cfs (14-L/s to 56-L/s).

US Standard Sieve Size	Particle Size Micron (μm)	Cumulative Passing %
30	600	99.7%
40	425	95.7%
50	300	74.7%
70	212	33.7%
100	150	6.7%
140	106	0.7%

Table 1 : US Silica F-55 Particle Size Distribution

Removal efficiencies at each flow rate were calculated based on net sediment loads passing the influent and effluent sampling points. Results are illustrated in Figure 1.

Assuming that sediment in the inlet chamber is ideally mixed, removal rates through the system will decay according to the percentage of flow bypassed. This effect has been observed in the laboratory where the test system is designed to produce a

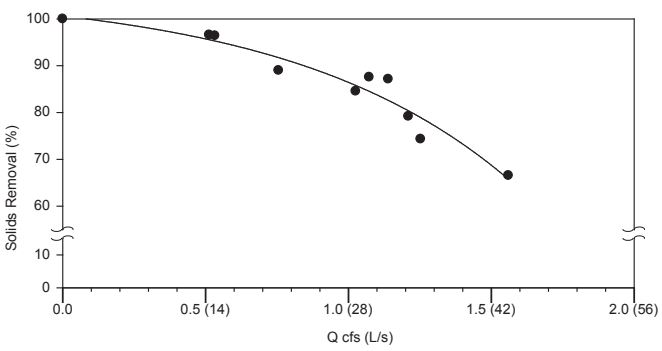


Figure 1: VortSentry HS Removal Efficiencies for 240-μm Particle Gradation

thoroughly mixed inlet stream. All VortSentry HS models have the same aspect ratio regardless of system diameter (i.e. an increase in diameter results in a corresponding increase in depth). Operating rates are expressed volumetrically.

Removal efficiency at each operating rate is calculated according to the average of volumetric and Froude scaling methods and is described by Equation 1.

Equation 1: $$\left(\frac{\text{Diameter Prototype}}{\text{Diameter Model}}\right)^{2.75} = \left(\frac{\text{Flow Rate Prototype}}{\text{Flow Rate Model}}\right)$$

Equation 1 and actual laboratory test results were used to determine the flow rate which would be required for the various VortSentry HS models to remove 80% of solids.

View report at **www.ContechES.com/stormwater**

Maintenance

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

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant deposition and transport may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (i.e. spring and fall) however more frequent inspections may be necessary in equipment washdown areas and in climates where winter sanding operations may lead to rapid accumulations of a large volume of sediment. It is useful and often required as part of a permit to keep a record of each inspection. A simple inspection and maintenance log form for doing so is available for download at **www.ContechES.com/stormwater**

The VortSentry HS should be cleaned when the sediment has accumulated to a depth of two feet in the treatment chamber. This determination can be made by taking two measurements with a stadia rod or similar measuring device; one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the distance given in Table 2, the VortSentry HS should be maintained to ensure effective treatment.

Cleaning

Cleaning of the VortSentry HS should be done during dry weather conditions when no flow is entering the system. Cleanout of the VortSentry HS with a vacuum truck is generally the most effective and convenient method of excavating pollutants from the system. Simply remove the manhole cover and insert the vacuum hose into the sump. All pollutants can be removed from this one access point from the surface with no requirements for Confined Space Entry.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use adsorbent pads, which solidify the oils. These are usually much easier to remove from the unit individually, and less expensive to dispose than the oil/water emulsion that may be

created by vacuuming the oily layer. Floating trash can be netted out if you wish to separate it from the other pollutants.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure proper safety precautions. If anyone physically enters the unit, Confined Space Entry procedures need to be followed.

Disposal of all material removed from the VortSentry HS should be done is accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

VortSentry HS Model	Diameter		Distance Between Water Surface and Top of Storage Sump		Sediment Storage		Oil Spill Storage	
	in.	m	ft.	m	yd^3	m^3	gal.	liter
HS36	36	0.9	3.6	1.1	0.5	0.4	83	314
HS48	48	1.2	4.7	1.4	0.9	0.7	158	598
HS60	60	1.5	6.0	1.8	1.5	1.1	258	978
HS72	72	1.8	7.1	2.2	2.1	1.6	372	1409
HS84	84	2.1	8.4	2.6	2.9	2.2	649	2458
HS96	96	2.4	9.5	2.9	3.7	2.8	845	3199

Table 2: VortSentry HS Maintenance Indicators and Sediment Storage Capacities.

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

Logon to **www.ContechES.com/stormwater** to download the VortSentry HS Inspection and Maintenance Log.

For assistance with maintaining your VortSentry HS, contact us regarding the Contech Maintenance compliance certification program.

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Support

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

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