Summit Engineering & Survey, Inc.

HYDRAULIC / HYDROLOGIC CALCULATIONS

SITE PLAN
150 Charlton Road
STURBRIDGE, MASSACHUSETTS

Prepared For:

Interstate Towing

Owner:

Cobra Realty Trust

Prepared By:

SUMMIT ENGINEERING & SURVEY, INC.
710 MAIN STREET
OXFORD, MASSACHUSETTS

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DRAINAGE SUMMARY

Summit Engineering & Survey, Inc. is pleased to provide the following Hydraulic / Hydrologic analysis for 150 Charlton Road, Sturbridge, Massachusetts. The existing site consists of predominantly un-developed land, portion of it is a grass field and the rest of it wooded with mature woodland. The hydrologic conditions were analyzed using TR-55 and HydroCAD® for the 2, 10, 25 and 100 year storm events utilizing Technical Paper 40, 24 hour Rainfall events.

The proposed site consists of the construction of a new 8,000 square foot light industrial building and supporting infrastructure. The project will also consist of the installation of all utilities to service the proposed building. The proposed drainage system for the site will consist of proposed catch basins to drain manholes to hydrodynamic separators (Stormceptor or equal) to underground storage/infiltration basin. The proposed roof runoff will be collected discharges directly into the underground basin for infiltration. All portions of the paved area will be pretreated by hydrodynamic separators prior to discharging into the underground basin for infiltration. The project as designed conforms to the Massachusetts DEP Stormwater Management Policy.

EXISTING CONDITIONS:

The site is abutted by Charlton Road (Route 20) and the Massachusetts Turnpike Authority. The site is predominately wooded with a grass field in the middle of it. There is a bordering vegetated wetland system on the westerly portion of the site with a stream located within it. There is another isolated wetland located adjacent to Route 20. The wetland system conveys water from the south to the north toward the Massachusetts Turnpike.

The topography of the site is sloped from Route 20 toward the northwest where the wetland with the stream is located. A majority of the site is graded toward the northwest.

For the purpose of the analysis of the effect on site development, the site was analyzed as one independent watershed. In the Pre-Development Condition, Subcatchment 1 represents the tributary area of the property that flows to the wetland and the stream.

According to the online USGS soil survey, the analyzed area consists of soils with “C” hydrologic ratings. On site soil testing confirms the condition along with varying depths to groundwater. The cover consists of a grass field and woodland.

PROPOSED CONDITIONS:

The proposed condition of the site includes the construction of an access driveway, employee and visitor parking areas, loading area and the 8,000 square foot light industrial building. The site is serviced by municipal water and sewer systems.

The site will be re-graded to support the project and control stormwater in accordance with the Massachusetts Stormwater Management Policy. The development includes the construction of a subsurface drainage basin, roof runoff collection system, catch basins and proprietary devices to provide stormwater treatment and attenuation to reduce the impact of surface alterations.

In order to analyze the surface water flows, the site was divided into multiple Subcatchment. The interest point, which is the wetland to the north is then compared to the Pre-Development Conditions.

DRAINAGE CHECKLIST

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

Checklist for Stormwater Report

Cobra Realty trust, 150 Charlton Road, Sturbridge, Mass.

A. Introduction

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

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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

Cobra Realty trust, 150 Charlton Road, Sturbridge, Mass.

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

August 17, 2022, 2022
Mikael A. Lassila, P.E.

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Cobra Realty trust, 150 Charlton Road, Sturbridge, Mass.

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Massachusetts Department of Environmental Protection
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Checklist for Stormwater Report

Cobra Realty trust, 150 Charlton Road, Sturbridge, Mass.

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Massachusetts Department of Environmental Protection
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Checklist for Stormwater Report

Cobra Realty trust, 150 Charlton Road, Sturbridge, Mass.

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Cobra Realty trust, 150 Charlton Road, Sturbridge, Mass.

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Massachusetts Department of Environmental Protection
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Checklist for Stormwater Report

Cobra Realty trust, 150 Charlton Road, Sturbridge, Mass.

Checklist (continued)

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

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Cobra Realty trust, 150 Charlton Road, Sturbridge, Mass.

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

DEP Stormwater Management Standards:

Standard #1:
The proposed changes will not cause erosion in adjacent waters of the Commonwealth, as BMP measures are proposed in accordance with the design requirements of the Stormwater Management handbook. The Erosion & Sedimentation Control Plan provides for the installation of siltation barriers, temporary basins, and temporary construction entrances and outlines intermediary measures to control runoff during construction and after construction.

Standard #2:
The proposed development peak discharge rates for the total off-site flow are less than or equal to pre-development discharge rates for the 2 year, 10 year, and 100 year storm events for the design points analyzed. Attached calculations show how the site mitigates the increased flow rates due to surface changes from the site development.

In summary, the peak rates of runoff were compared under pre-development and post-development conditions for analysis of the 2 year, 10 year, 25 year and 100 year storm events. The following is a **Peak Discharge Summary Table**:

Design Point Analysis:

Watershed		Design Event			
		2 Year	10 Year	25 Year	100 Year
Pre-Development	IP-E	3.25	7.24	8.70	13.32
Post Development	IP-P	3.19	7.06	8.36	12.84

Standard #3:
The roof drain runoff is directed to the infiltration basin that meets the recharge requirement for Class C Soils. Basin 6P is also designed to infiltrate runoff from the driveway and parking areas after pre-treatment. Infiltration depths are designed to drain in under 72 hours as required by the Policy.

The site is predominately un-developed. The site design incorporates direct recharge of roof drains to infiltration basins. Basins A and B are designed to infiltrate retained runoff after pre-treatment. Soils were found to be Class C permeability.

The table below shows the required and provided recharge volumes for the project. As shown, the proposed condition exceeds the minimum requirement for the additional impervious areas.

Recharge Volume Summary

Soil Type	Recharge Factor (in. runoff)	Existing Impervious Area (sf)	Additional Impervious Area (sf)	Min. Req. Recharge Volume (cf)
A	0.60	0	0	0
B	0.35	0	0	0
C	0.25	0	46,996	979
D	0.10	0	0	0
Total Required				**979**

Standard #3 Only Applies to Additional Impervious

Provided Recharge Volume (cf)		
Basin 6P		984
Total Provided		**984**

Recharge Volume Calculation:

Rv = F x I
Rv = Required Recharge Volume
F = Recharge Factor
I = Total Impervious Area
Rv = (0.25")/(1'/12") x 46,996 s.f. = 979 c.f. (Required)

Provided Infiltration is 984 c.f. taken from Hydrograph

Drawdown Calculation:

Basin#6P

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

Where:

Rv = Storage Volume (984 c.f.)

K = Saturated Hydraulic Conductivity For “Static” and “Simple Dynamic” Methods, use Rawls Rate (see 0.27 in/hour)

Bottom Area = Bottom Area of Recharge Structure 1122 s.f.)

984 c.f./ (0.52 in/hour)(foot/12inch)(1122 s.f.) =20.2 hours

Standard #4:
Over 80% TSS shall occur based on the BMP measurements provided. The treatment train varies for each section. TSS worksheets are provided in the report for each treatment train in the site. The water quality volume was determined using 1.0” of runoff over the proposed impervious area.

ESTIMATED PROPOSED NEW PAVED COVER= 38,996 S.F.
REQUIRED WATER QUALITY VOLUME:

Water Quality Volume		
Required Treatment Volume	0.5	Inches Over Impervious Areas
Watershed Series	Paved Area	Water Quality Volume
DA- P-1	38,996	1,625

The design of the drainage system is such that the site is routed through a series of treatment BMP’s meeting the Standard. The attached TSS worksheets and Proprietary systems show the site meeting this requirement. No bypass is designed of the BMP's reducing the WQV.

Standard #5:
The proposed development will not generate higher potential pollutant loads and therefore will not require additional BMP's.

Standard #6:
The proposed project is not near a critical area.

Standard #7:
The proposed project is not a redevelopment project.

Standard #8:
Erosion and sediment control measures are proposed as part of the proposed project.

Standard #9:
An Operation & Maintenance plan is provided within this document

Standard #10:
This project does not propose any illicit discharges, signed statement included.

APPENDICES:

HydroCAD Pre & Post Development calculations

HydroCAD Literature & SCS CN's & Rainfall

Rip Rap Reference

Groundwater Mounding Calculations

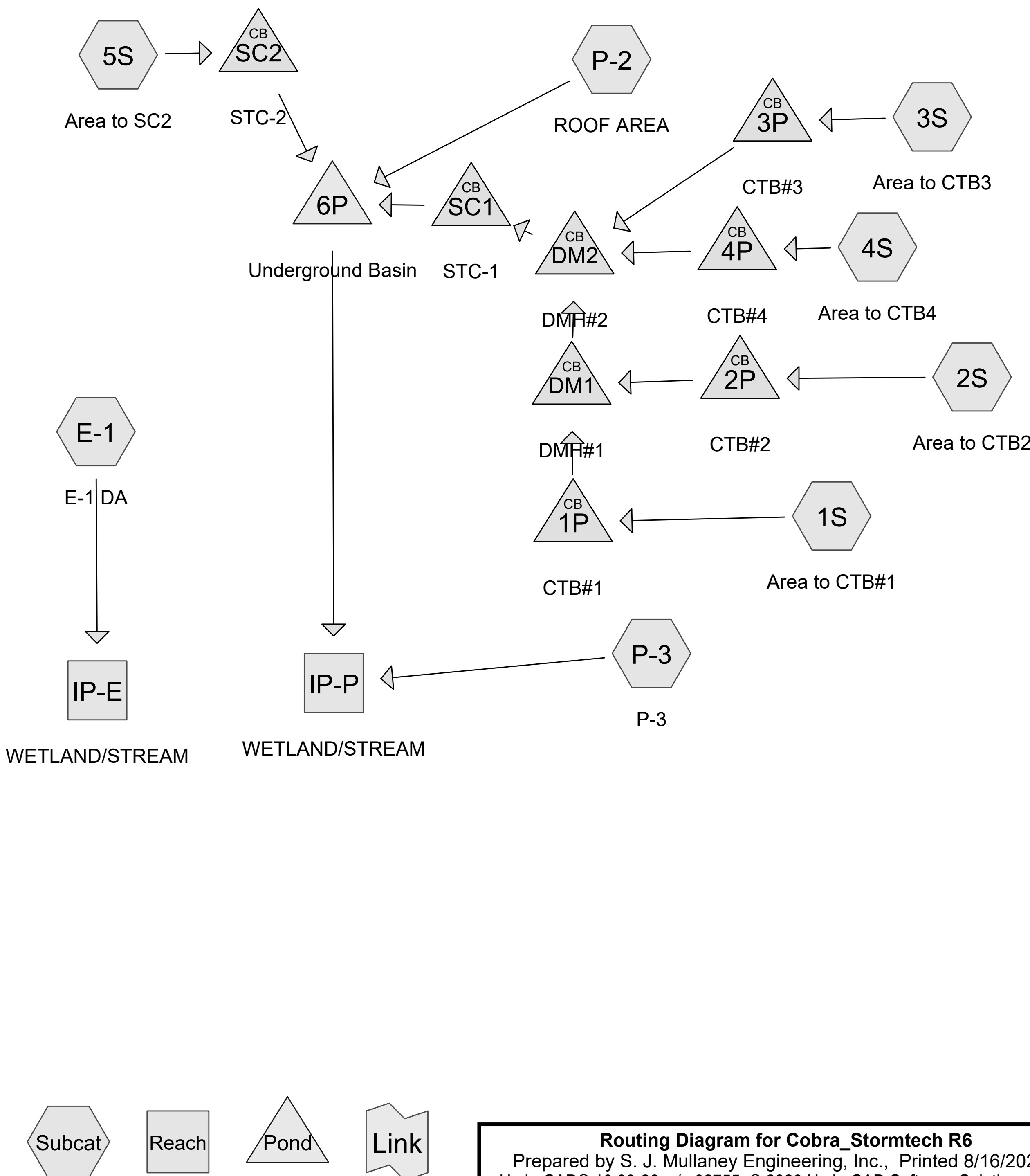
Soil Information

After & During Inspection Logs

BMP Inspection Map

Illicit Discharge Statement

HydroCAD Pre & Post Development calculations



Routing Diagram for Cobra_Stormtech R6
Prepared by S. J. Mullaney Engineering, Inc., Printed 8/16/2022
HydroCAD® 10.00-26 s/n 02755 © 2020 HydroCAD Software Solutions LLC

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

Subcatchment 1S: Area to CTB#1 Runoff Area=6,440 sf 100.00% Impervious Runoff Depth>3.17"
Tc=5.0 min CN=98 Runoff=0.49 cfs 0.039 af

Subcatchment 2S: Area to CTB2 Runoff Area=9,984 sf 59.69% Impervious Runoff Depth>2.18"
Tc=5.0 min CN=88 Runoff=0.58 cfs 0.042 af

Subcatchment 3S: Area to CTB3 Runoff Area=19,463 sf 43.97% Impervious Runoff Depth>1.93"
Tc=5.0 min CN=85 Runoff=1.01 cfs 0.072 af

Subcatchment 4S: Area to CTB4 Runoff Area=5,789 sf 67.44% Impervious Runoff Depth>2.35"
Tc=5.0 min CN=90 Runoff=0.36 cfs 0.026 af

Subcatchment 5S: Area to SC2 Runoff Area=15,135 sf 92.07% Impervious Runoff Depth>2.94"
Tc=5.0 min CN=96 Runoff=1.12 cfs 0.085 af

Subcatchment E-1: E-1 DA Runoff Area=180,059 sf 0.00% Impervious Runoff Depth>0.94"
Flow Length=355' Tc=13.6 min CN=70 Runoff=3.25 cfs 0.325 af

Subcatchment P-2: ROOF AREA Runoff Area=8,000 sf 100.00% Impervious Runoff Depth>3.17"
Tc=5.0 min CN=98 Runoff=0.61 cfs 0.048 af

Subcatchment P-3: P-3 Runoff Area=115,048 sf 0.00% Impervious Runoff Depth>1.00"
Flow Length=459' Slope=0.0400 '/' Tc=13.1 min CN=71 Runoff=2.25 cfs 0.220 af

Reach IP-E: WETLAND/STREAM Inflow=3.25 cfs 0.325 af
Outflow=3.25 cfs 0.325 af

Reach IP-P: WETLAND/STREAM Inflow=3.19 cfs 0.474 af
Outflow=3.19 cfs 0.474 af

Pond 1P: CTB#1 Peak Elev=609.63' Inflow=0.49 cfs 0.039 af
8.0" Round Culvert n=0.013 L=18.0' S=0.0200 '/' Outflow=0.49 cfs 0.039 af

Pond 2P: CTB#2 Peak Elev=610.43' Inflow=0.58 cfs 0.042 af
8.0" Round Culvert n=0.013 L=110.0' S=0.0100 '/' Outflow=0.58 cfs 0.042 af

Pond 3P: CTB#3 Peak Elev=609.01' Inflow=1.01 cfs 0.072 af
12.0" Round Culvert n=0.013 L=145.0' S=0.0052 '/' Outflow=1.01 cfs 0.072 af

Pond 4P: CTB#4 Peak Elev=607.80' Inflow=0.36 cfs 0.026 af
8.0" Round Culvert n=0.013 L=25.0' S=0.0100 '/' Outflow=0.36 cfs 0.026 af

Pond 6P: Underground Basin Peak Elev=606.84' Storage=4,638 cf Inflow=4.19 cfs 0.312 af
Discarded=0.07 cfs 0.033 af Primary=1.07 cfs 0.254 af Outflow=1.14 cfs 0.288 af

Pond DM1: DMH#1 Peak Elev=609.32' Inflow=1.08 cfs 0.081 af
12.0" Round Culvert n=0.013 L=95.0' S=0.0111 '/' Outflow=1.08 cfs 0.081 af

Pond DM2: DMH#2 Peak Elev=608.21' Inflow=2.46 cfs 0.178 af
12.0" Round Culvert n=0.013 L=10.0' S=0.0100 '/' Outflow=2.46 cfs 0.178 af

Pond SC1: STC-1 Peak Elev=607.87' Inflow=2.46 cfs 0.178 af
12.0" Round Culvert n=0.013 L=20.0' S=0.0100 '/' Outflow=2.46 cfs 0.178 af

Pond SC2: STC-2 Peak Elev=607.33' Inflow=1.12 cfs 0.085 af
12.0" Round Culvert n=0.013 L=15.0' S=0.0200 '/' Outflow=1.12 cfs 0.085 af

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

Subcatchment 1S: Area to CTB#1 Runoff Area=6,440 sf 100.00% Impervious Runoff Depth>4.66"
Tc=5.0 min CN=98 Runoff=0.71 cfs 0.057 af

Subcatchment 2S: Area to CTB2 Runoff Area=9,984 sf 59.69% Impervious Runoff Depth>3.57"
Tc=5.0 min CN=88 Runoff=0.94 cfs 0.068 af

Subcatchment 3S: Area to CTB3 Runoff Area=19,463 sf 43.97% Impervious Runoff Depth>3.27"
Tc=5.0 min CN=85 Runoff=1.71 cfs 0.122 af

Subcatchment 4S: Area to CTB4 Runoff Area=5,789 sf 67.44% Impervious Runoff Depth>3.78"
Tc=5.0 min CN=90 Runoff=0.57 cfs 0.042 af

Subcatchment 5S: Area to SC2 Runoff Area=15,135 sf 92.07% Impervious Runoff Depth>4.43"
Tc=5.0 min CN=96 Runoff=1.65 cfs 0.128 af

Subcatchment E-1: E-1 DA Runoff Area=180,059 sf 0.00% Impervious Runoff Depth>1.96"
Flow Length=355' Tc=13.6 min CN=70 Runoff=7.24 cfs 0.674 af

Subcatchment P-2: ROOF AREA Runoff Area=8,000 sf 100.00% Impervious Runoff Depth>4.66"
Tc=5.0 min CN=98 Runoff=0.89 cfs 0.071 af

Subcatchment P-3: P-3 Runoff Area=115,048 sf 0.00% Impervious Runoff Depth>2.04"
Flow Length=459' Slope=0.0400 '/' Tc=13.1 min CN=71 Runoff=4.89 cfs 0.448 af

Reach IP-E: WETLAND/STREAM Inflow=7.24 cfs 0.674 af
Outflow=7.24 cfs 0.674 af

Reach IP-P: WETLAND/STREAM Inflow=7.06 cfs 0.874 af
Outflow=7.06 cfs 0.874 af

Pond 1P: CTB#1 Peak Elev=609.78' Inflow=0.71 cfs 0.057 af
8.0" Round Culvert n=0.013 L=18.0' S=0.0200 '/' Outflow=0.71 cfs 0.057 af

Pond 2P: CTB#2 Peak Elev=610.73' Inflow=0.94 cfs 0.068 af
8.0" Round Culvert n=0.013 L=110.0' S=0.0100 '/' Outflow=0.94 cfs 0.068 af

Pond 3P: CTB#3 Peak Elev=609.24' Inflow=1.71 cfs 0.122 af
12.0" Round Culvert n=0.013 L=145.0' S=0.0052 '/' Outflow=1.71 cfs 0.122 af

Pond 4P: CTB#4 Peak Elev=607.92' Inflow=0.57 cfs 0.042 af
8.0" Round Culvert n=0.013 L=25.0' S=0.0100 '/' Outflow=0.57 cfs 0.042 af

Pond 6P: Underground Basin Peak Elev=607.37' Storage=6,399 cf Inflow=6.47 cfs 0.489 af
Discarded=0.07 cfs 0.038 af Primary=2.29 cfs 0.426 af Outflow=2.36 cfs 0.464 af

Pond DM1: DMH#1 Peak Elev=609.51' Inflow=1.66 cfs 0.126 af
12.0" Round Culvert n=0.013 L=95.0' S=0.0111 '/' Outflow=1.66 cfs 0.126 af

Pond DM2: DMH#2 Peak Elev=609.27' Inflow=3.94 cfs 0.289 af
12.0" Round Culvert n=0.013 L=10.0' S=0.0100 '/' Outflow=3.94 cfs 0.289 af

Pond SC1: STC-1 Peak Elev=608.92' Inflow=3.94 cfs 0.289 af
12.0" Round Culvert n=0.013 L=20.0' S=0.0100 '/' Outflow=3.94 cfs 0.289 af

Pond SC2: STC-2 Peak Elev=607.51' Inflow=1.65 cfs 0.128 af
12.0" Round Culvert n=0.013 L=15.0' S=0.0200 '/' Outflow=1.65 cfs 0.128 af

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

Subcatchment 1S: Area to CTB#1 Runoff Area=6,440 sf 100.00% Impervious Runoff Depth>5.16"
Tc=5.0 min CN=98 Runoff=0.79 cfs 0.064 af

Subcatchment 2S: Area to CTB2 Runoff Area=9,984 sf 59.69% Impervious Runoff Depth>4.05"
Tc=5.0 min CN=88 Runoff=1.06 cfs 0.077 af

Subcatchment 3S: Area to CTB3 Runoff Area=19,463 sf 43.97% Impervious Runoff Depth>3.74"
Tc=5.0 min CN=85 Runoff=1.94 cfs 0.139 af

Subcatchment 4S: Area to CTB4 Runoff Area=5,789 sf 67.44% Impervious Runoff Depth>4.26"
Tc=5.0 min CN=90 Runoff=0.64 cfs 0.047 af

Subcatchment 5S: Area to SC2 Runoff Area=15,135 sf 92.07% Impervious Runoff Depth>4.93"
Tc=5.0 min CN=96 Runoff=1.82 cfs 0.143 af

Subcatchment E-1: E-1 DA Runoff Area=180,059 sf 0.00% Impervious Runoff Depth>2.33"
Flow Length=355' Tc=13.6 min CN=70 Runoff=8.70 cfs 0.803 af

Subcatchment P-2: ROOF AREA Runoff Area=8,000 sf 100.00% Impervious Runoff Depth>5.16"
Tc=5.0 min CN=98 Runoff=0.98 cfs 0.079 af

Subcatchment P-3: P-3 Runoff Area=115,048 sf 0.00% Impervious Runoff Depth>2.42"
Flow Length=459' Slope=0.0400 '/' Tc=13.1 min CN=71 Runoff=5.85 cfs 0.532 af

Reach IP-E: WETLAND/STREAM Inflow=8.70 cfs 0.803 af
Outflow=8.70 cfs 0.803 af

Reach IP-P: WETLAND/STREAM Inflow=8.36 cfs 1.016 af
Outflow=8.36 cfs 1.016 af

Pond 1P: CTB#1 Peak Elev=609.84' Inflow=0.79 cfs 0.064 af
8.0" Round Culvert n=0.013 L=18.0' S=0.0200 '/' Outflow=0.79 cfs 0.064 af

Pond 2P: CTB#2 Peak Elev=610.87' Inflow=1.06 cfs 0.077 af
8.0" Round Culvert n=0.013 L=110.0' S=0.0100 '/' Outflow=1.06 cfs 0.077 af

Pond 3P: CTB#3 Peak Elev=609.32' Inflow=1.94 cfs 0.139 af
12.0" Round Culvert n=0.013 L=145.0' S=0.0052 '/' Outflow=1.94 cfs 0.139 af

Pond 4P: CTB#4 Peak Elev=607.97' Inflow=0.64 cfs 0.047 af
8.0" Round Culvert n=0.013 L=25.0' S=0.0100 '/' Outflow=0.64 cfs 0.047 af

Pond 6P: Underground Basin Peak Elev=607.59' Storage=7,017 cf Inflow=7.23 cfs 0.549 af
Discarded=0.07 cfs 0.039 af Primary=2.63 cfs 0.484 af Outflow=2.70 cfs 0.524 af

Pond DM1: DMH#1 Peak Elev=609.58' Inflow=1.85 cfs 0.141 af
12.0" Round Culvert n=0.013 L=95.0' S=0.0111 '/' Outflow=1.85 cfs 0.141 af

Pond DM2: DMH#2 Peak Elev=609.73' Inflow=4.43 cfs 0.327 af
12.0" Round Culvert n=0.013 L=10.0' S=0.0100 '/' Outflow=4.43 cfs 0.327 af

Pond SC1: STC-1 Peak Elev=609.38' Inflow=4.43 cfs 0.327 af
12.0" Round Culvert n=0.013 L=20.0' S=0.0100 '/' Outflow=4.43 cfs 0.327 af

Pond SC2: STC-2 Peak Elev=607.57' Inflow=1.82 cfs 0.143 af
12.0" Round Culvert n=0.013 L=15.0' S=0.0200 '/' Outflow=1.82 cfs 0.143 af

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

Subcatchment 1S: Area to CTB#1 Runoff Area=6,440 sf 100.00% Impervious Runoff Depth>6.66"
Tc=5.0 min CN=98 Runoff=1.01 cfs 0.082 af

Subcatchment 2S: Area to CTB2 Runoff Area=9,984 sf 59.69% Impervious Runoff Depth>5.49"
Tc=5.0 min CN=88 Runoff=1.42 cfs 0.105 af

Subcatchment 3S: Area to CTB3 Runoff Area=19,463 sf 43.97% Impervious Runoff Depth>5.15"
Tc=5.0 min CN=85 Runoff=2.64 cfs 0.192 af

Subcatchment 4S: Area to CTB4 Runoff Area=5,789 sf 67.44% Impervious Runoff Depth>5.72"
Tc=5.0 min CN=90 Runoff=0.85 cfs 0.063 af

Subcatchment 5S: Area to SC2 Runoff Area=15,135 sf 92.07% Impervious Runoff Depth>6.42"
Tc=5.0 min CN=96 Runoff=2.35 cfs 0.186 af

Subcatchment E-1: E-1 DA Runoff Area=180,059 sf 0.00% Impervious Runoff Depth>3.53"
Flow Length=355' Tc=13.6 min CN=70 Runoff=13.32 cfs 1.215 af

Subcatchment P-2: ROOF AREA Runoff Area=8,000 sf 100.00% Impervious Runoff Depth>6.66"
Tc=5.0 min CN=98 Runoff=1.25 cfs 0.102 af

Subcatchment P-3: P-3 Runoff Area=115,048 sf 0.00% Impervious Runoff Depth>3.63"
Flow Length=459' Slope=0.0400 '/' Tc=13.1 min CN=71 Runoff=8.87 cfs 0.799 af

Reach IP-E: WETLAND/STREAM Inflow=13.32 cfs 1.215 af
Outflow=13.32 cfs 1.215 af

Reach IP-P: WETLAND/STREAM Inflow=12.84 cfs 1.460 af
Outflow=12.84 cfs 1.460 af

Pond 1P: CTB#1 Peak Elev=610.06' Inflow=1.01 cfs 0.082 af
8.0" Round Culvert n=0.013 L=18.0' S=0.0200 '/' Outflow=1.01 cfs 0.082 af

Pond 2P: CTB#2 Peak Elev=611.42' Inflow=1.42 cfs 0.105 af
8.0" Round Culvert n=0.013 L=110.0' S=0.0100 '/' Outflow=1.42 cfs 0.105 af

Pond 3P: CTB#3 Peak Elev=609.67' Inflow=2.64 cfs 0.192 af
12.0" Round Culvert n=0.013 L=145.0' S=0.0052 '/' Outflow=2.64 cfs 0.192 af

Pond 4P: CTB#4 Peak Elev=608.14' Inflow=0.85 cfs 0.063 af
8.0" Round Culvert n=0.013 L=25.0' S=0.0100 '/' Outflow=0.85 cfs 0.063 af

Pond 6P: Underground Basin Peak Elev=608.75' Storage=8,717 cf Inflow=9.52 cfs 0.730 af
Discarded=0.07 cfs 0.043 af Primary=4.48 cfs 0.661 af Outflow=4.55 cfs 0.704 af

Pond DM1: DMH#1 Peak Elev=609.86' Inflow=2.43 cfs 0.187 af
12.0" Round Culvert n=0.013 L=95.0' S=0.0111 '/' Outflow=2.43 cfs 0.187 af

Pond DM2: DMH#2 Peak Elev=611.44' Inflow=5.92 cfs 0.442 af
12.0" Round Culvert n=0.013 L=10.0' S=0.0100 '/' Outflow=5.92 cfs 0.442 af

Pond SC1: STC-1 Peak Elev=611.09' Inflow=5.92 cfs 0.442 af
12.0" Round Culvert n=0.013 L=20.0' S=0.0100 '/' Outflow=5.92 cfs 0.442 af

Pond SC2: STC-2 Peak Elev=607.81' Inflow=2.35 cfs 0.186 af
12.0" Round Culvert n=0.013 L=15.0' S=0.0200 '/' Outflow=2.35 cfs 0.186 af

Summary for Subcatchment 1S: Area to CTB#1

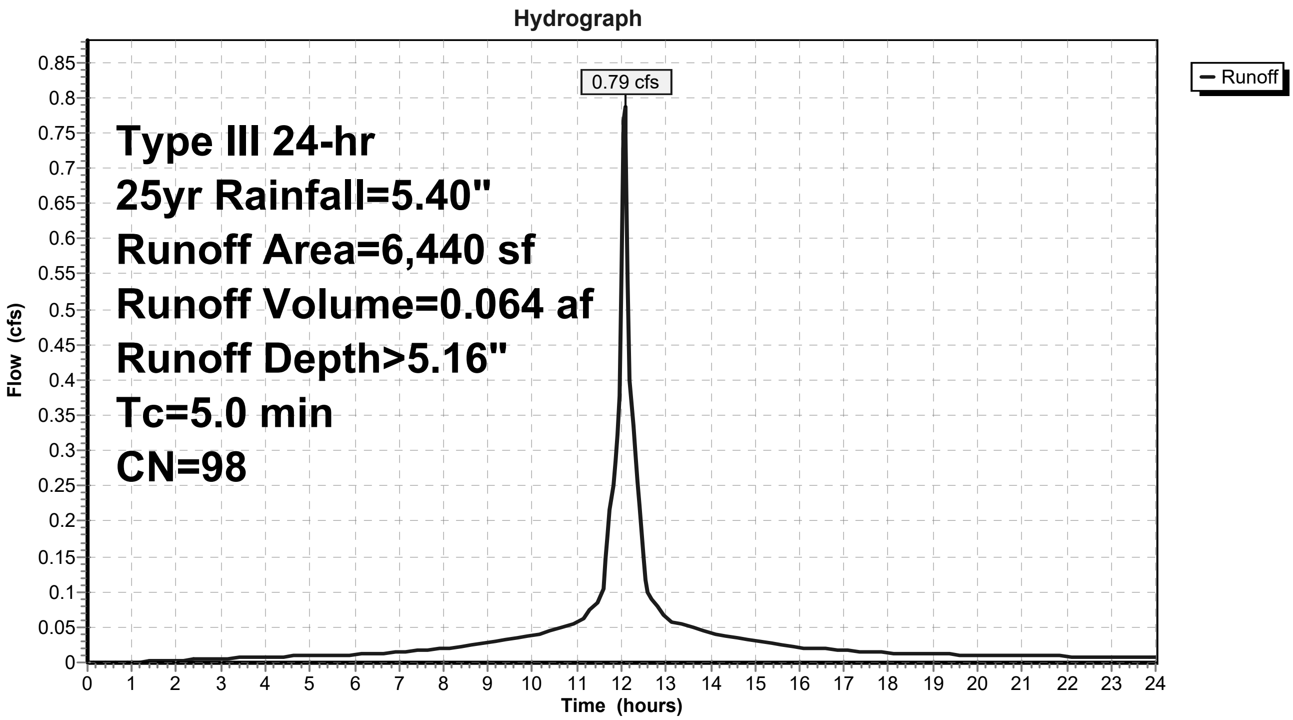
Runoff = 0.79 cfs @ 12.07 hrs, Volume= 0.064 af, Depth> 5.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25yr Rainfall=5.40"

Area (sf)	CN	Description
6,440	98	Paved parking, HSG C
6,440		100.00% Impervious Area

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

Subcatchment 1S: Area to CTB#1



Summary for Subcatchment 2S: Area to CTB2

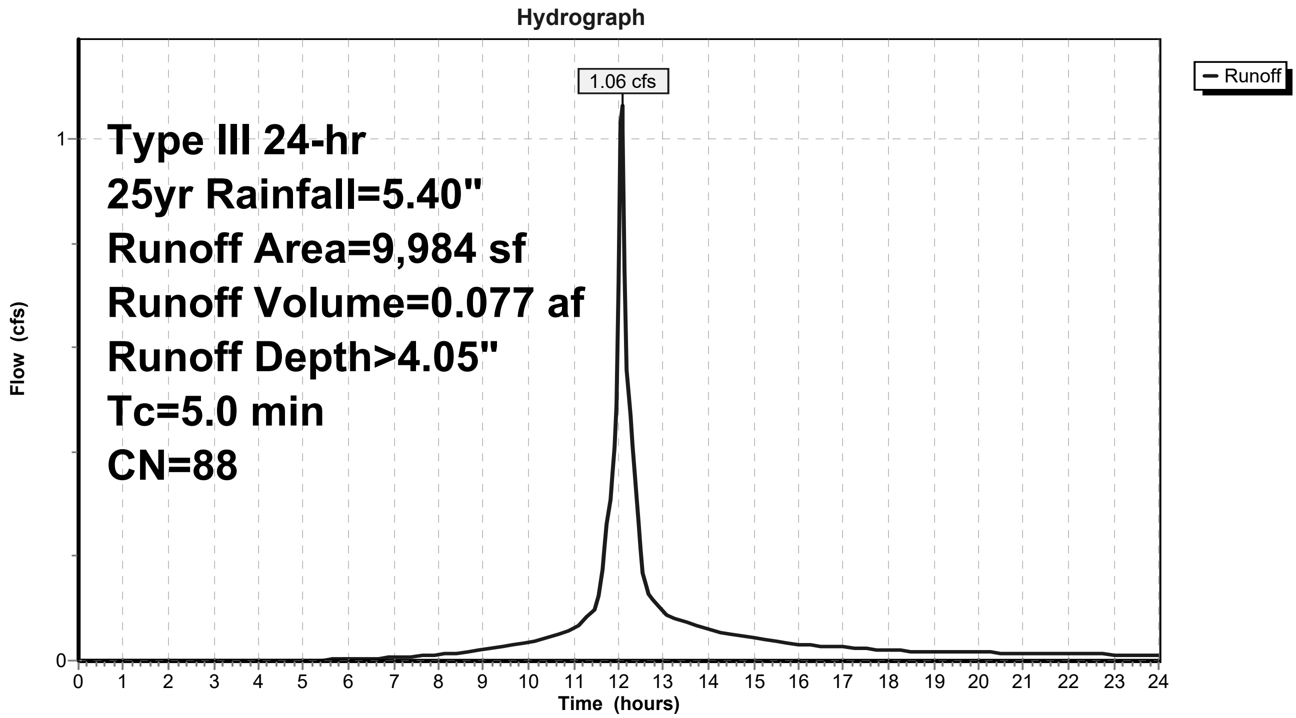
Runoff = 1.06 cfs @ 12.07 hrs, Volume= 0.077 af, Depth> 4.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25yr Rainfall=5.40"

Area (sf)	CN	Description
5,959	98	Paved parking, HSG C
4,025	74	>75% Grass cover, Good, HSG C
9,984	88	Weighted Average
4,025		40.31% Pervious Area
5,959		59.69% Impervious Area

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

Subcatchment 2S: Area to CTB2



Summary for Subcatchment 3S: Area to CTB3

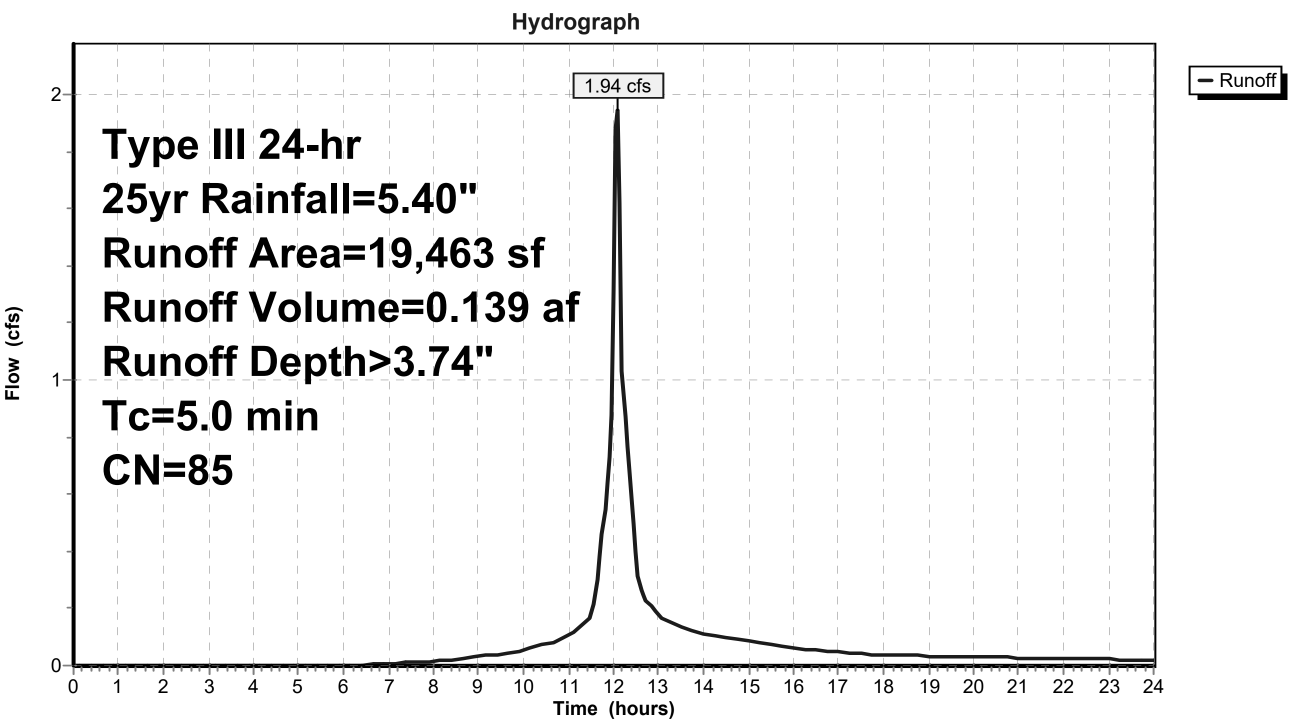
Runoff = 1.94 cfs @ 12.07 hrs, Volume= 0.139 af, Depth> 3.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25yr Rainfall=5.40"

Area (sf)	CN	Description
8,558	98	Paved parking, HSG C
10,905	74	>75% Grass cover, Good, HSG C
19,463	85	Weighted Average
10,905		56.03% Pervious Area
8,558		43.97% Impervious Area

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

Subcatchment 3S: Area to CTB3



Summary for Subcatchment 4S: Area to CTB4

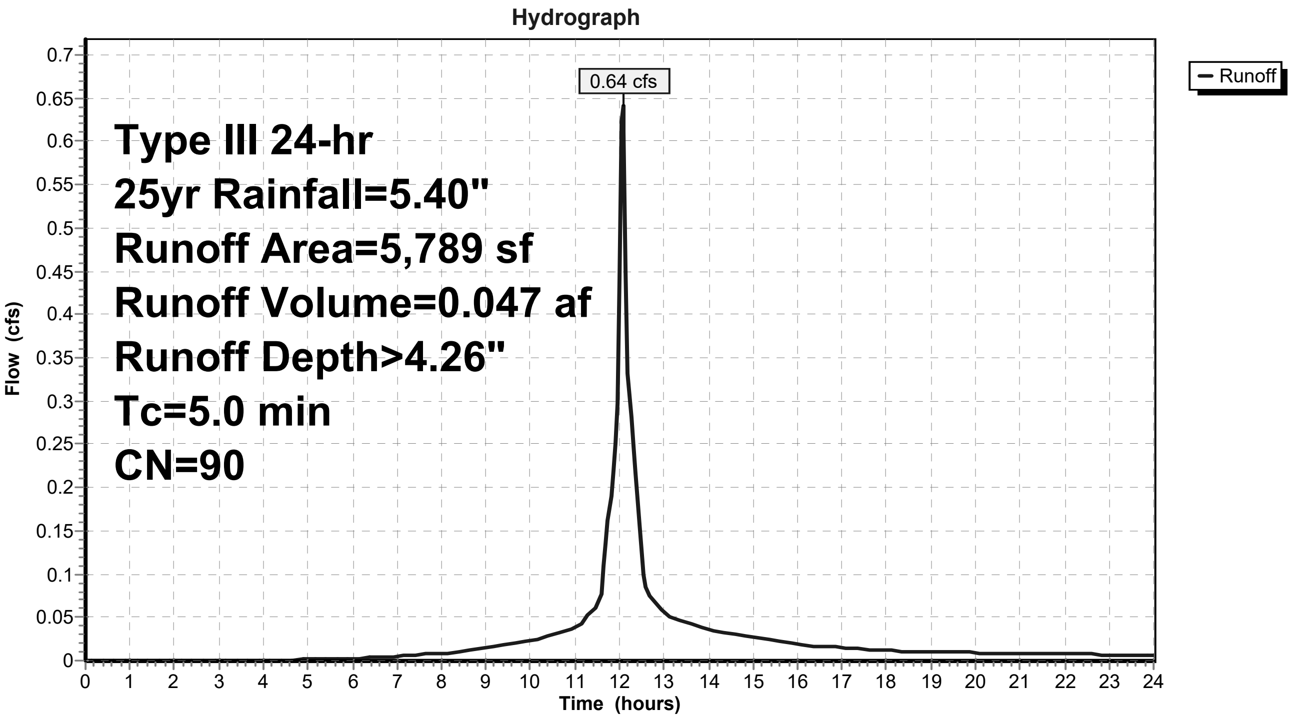
Runoff = 0.64 cfs @ 12.07 hrs, Volume= 0.047 af, Depth> 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25yr Rainfall=5.40"

Area (sf)	CN	Description
3,904	98	Paved parking, HSG C
1,885	74	>75% Grass cover, Good, HSG C
5,789	90	Weighted Average
1,885		32.56% Pervious Area
3,904		67.44% Impervious Area

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

Subcatchment 4S: Area to CTB4



Summary for Subcatchment 5S: Area to SC2

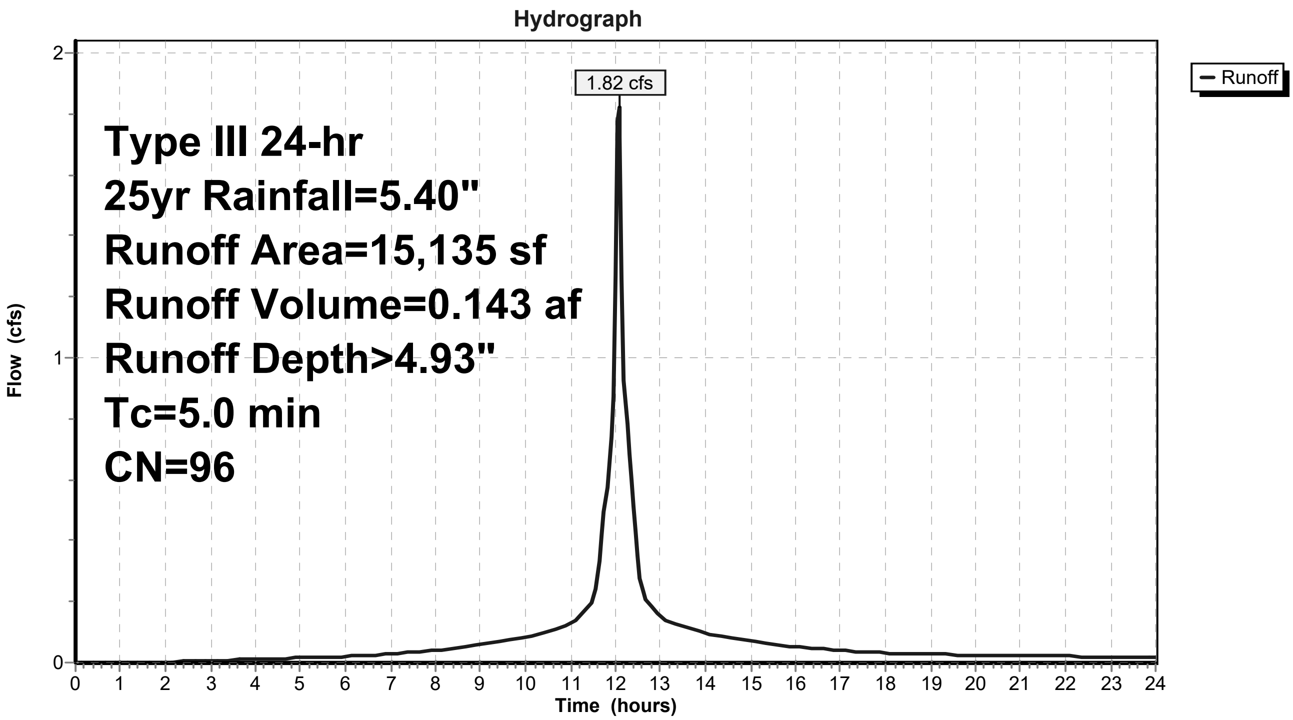
Runoff = 1.82 cfs @ 12.07 hrs, Volume= 0.143 af, Depth> 4.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25yr Rainfall=5.40"

Area (sf)	CN	Description
13,935	98	Paved parking, HSG C
1,200	74	>75% Grass cover, Good, HSG C
15,135	96	Weighted Average
1,200		7.93% Pervious Area
13,935		92.07% Impervious Area

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

Subcatchment 5S: Area to SC2



Summary for Subcatchment E-1: E-1 DA

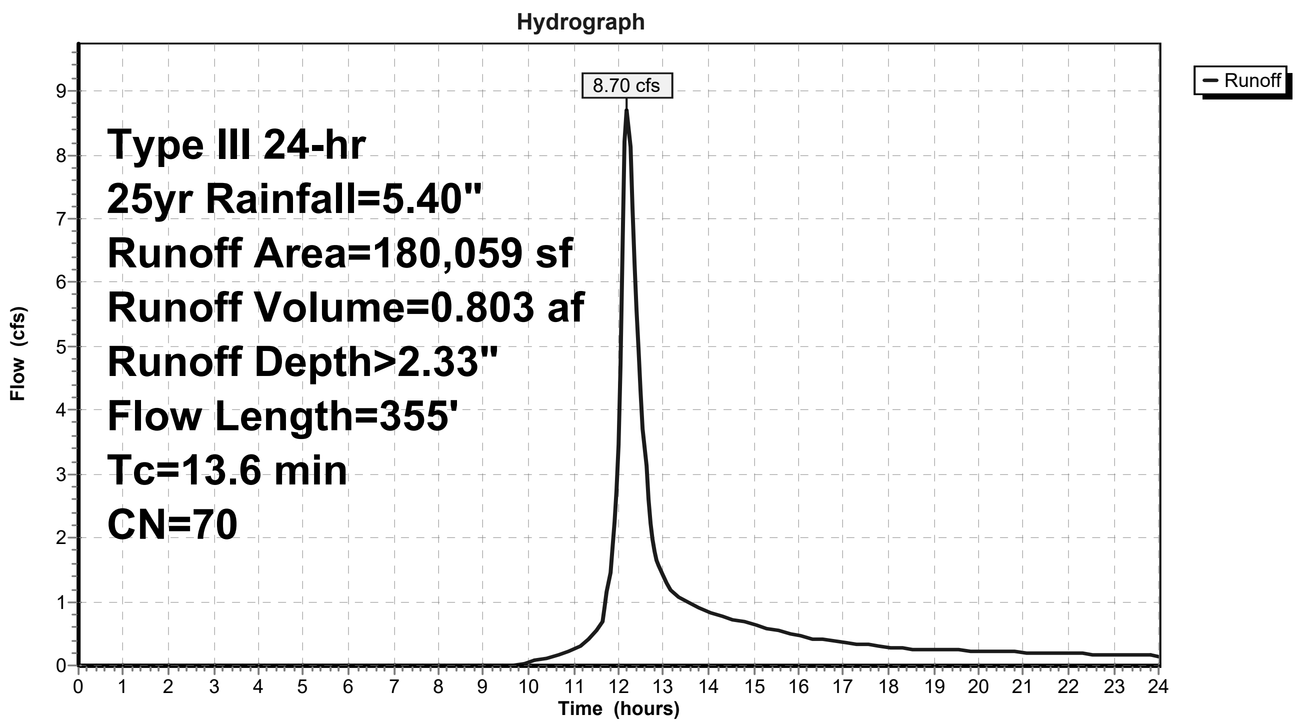
Runoff = 8.70 cfs @ 12.20 hrs, Volume= 0.803 af, Depth> 2.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25yr Rainfall=5.40"

Area (sf)	CN	Description
65,390	71	Meadow, non-grazed, HSG C
114,669	70	Woods, Good, HSG C
180,059	70	Weighted Average
180,059		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	35	0.0700	0.06		**Sheet Flow, TRAVEL PATH A TO B** Woods: Dense underbrush n= 0.800 P2= 3.20"
1.4	96	0.0500	1.12		**Shallow Concentrated Flow, TRAVEL PATH B TO C** Woodland Kv= 5.0 fps
2.4	224	0.0500	1.57		**Shallow Concentrated Flow, TRAVEL PATH C TO D** Short Grass Pasture Kv= 7.0 fps
13.6	355	Total			

Subcatchment E-1: E-1 DA



Summary for Subcatchment P-2: ROOF AREA

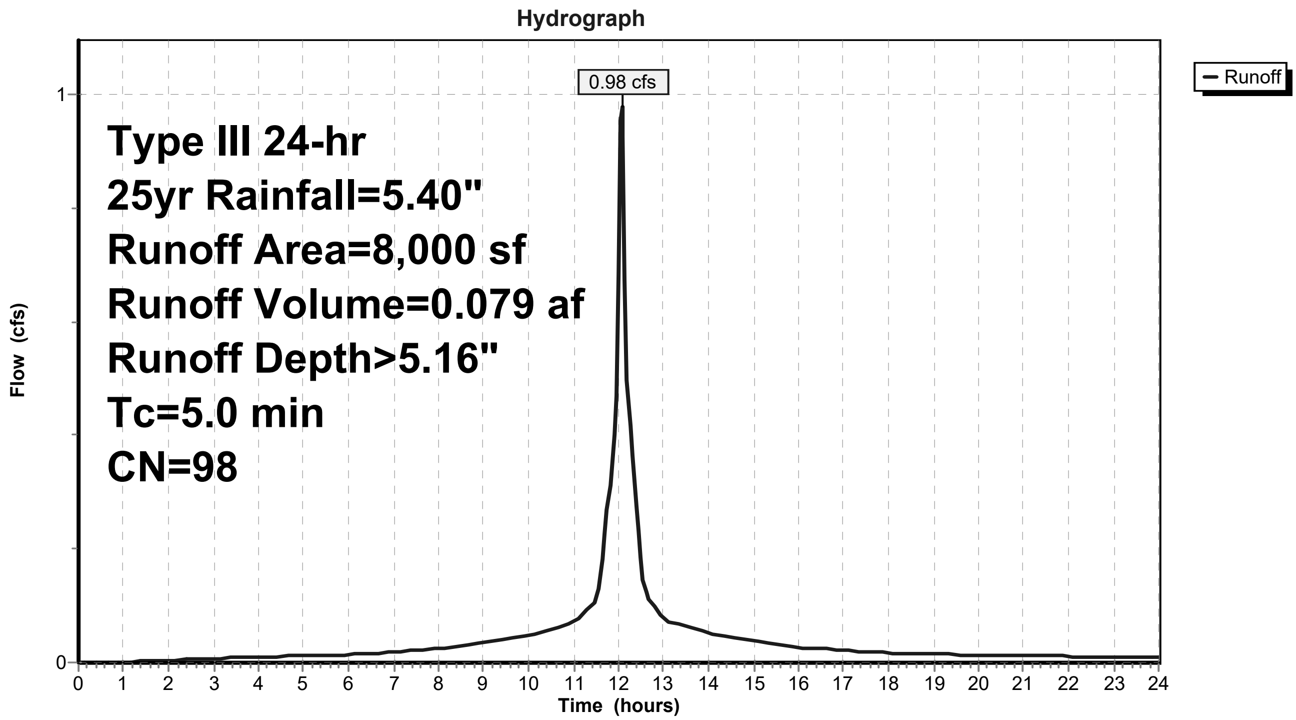
Runoff = 0.98 cfs @ 12.07 hrs, Volume= 0.079 af, Depth> 5.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25yr Rainfall=5.40"

Area (sf)	CN	Description
8,000	98	Roofs, HSG C
8,000		100.00% Impervious Area

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

Subcatchment P-2: ROOF AREA



Summary for Subcatchment P-3: P-3

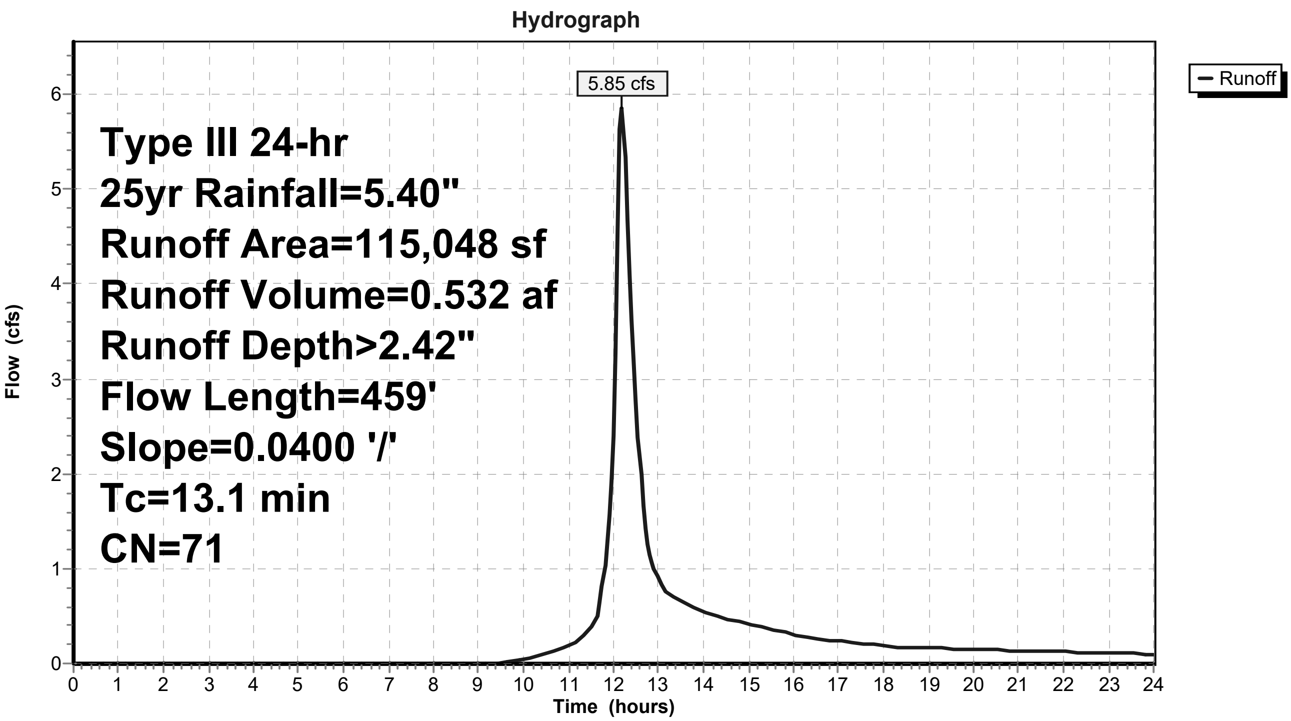
Runoff = 5.85 cfs @ 12.19 hrs, Volume= 0.532 af, Depth> 2.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25yr Rainfall=5.40"

Area (sf)	CN	Description
74,543	70	Woods, Good, HSG C
11,328	74	>75% Grass cover, Good, HSG C
29,177	71	Meadow, non-grazed, HSG C
115,048	71	Weighted Average
115,048		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.0400	0.20		**Sheet Flow, TRAVEL PATH A TO B** Grass: Short n= 0.150 P2= 3.20"
6.1	184	0.0400	0.50		**Shallow Concentrated Flow, TRAVEL PATH B TO C** Forest w/Heavy Litter Kv= 2.5 fps
2.7	225	0.0400	1.40		**Shallow Concentrated Flow, TRAVEL PATH C TO D** Short Grass Pasture Kv= 7.0 fps
13.1	459	Total			

Subcatchment P-3: P-3

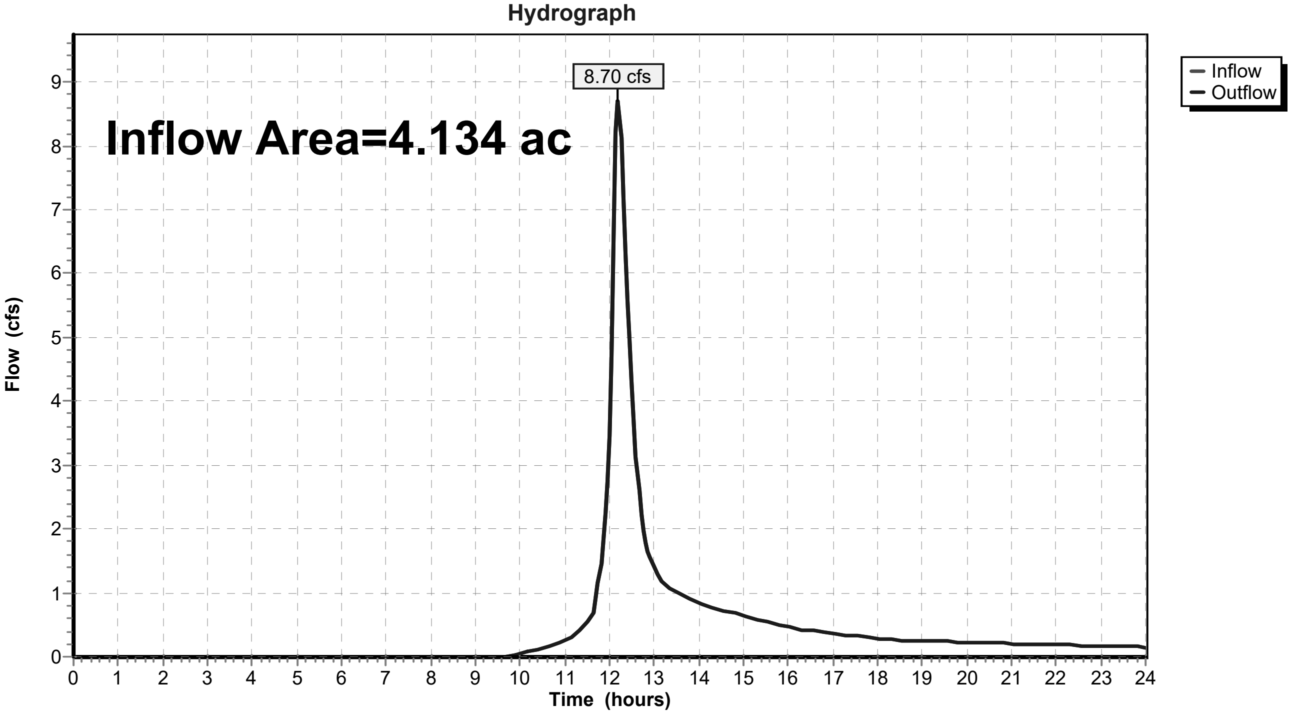


Summary for Reach IP-E: WETLAND/STREAM

Inflow Area = 4.134 ac, 0.00% Impervious, Inflow Depth > 2.33" for 25yr event
Inflow = 8.70 cfs @ 12.20 hrs, Volume= 0.803 af
Outflow = 8.70 cfs @ 12.20 hrs, Volume= 0.803 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach IP-E: WETLAND/STREAM

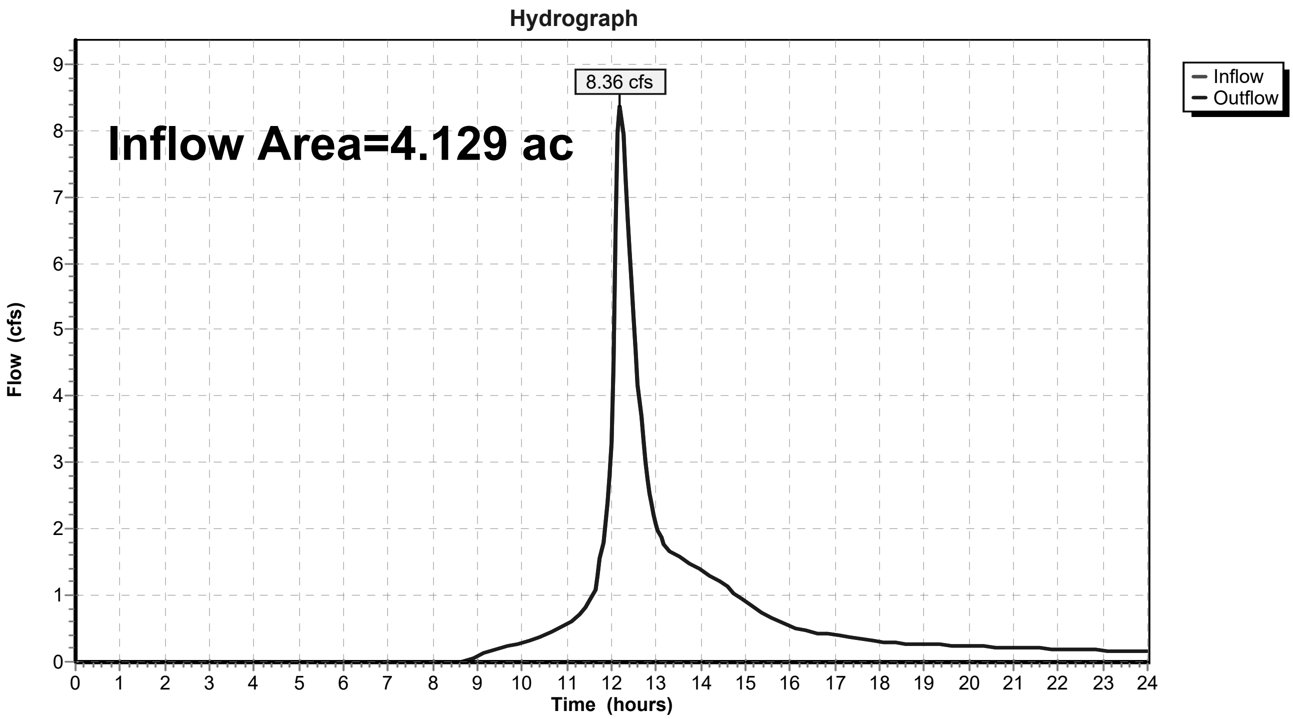


Summary for Reach IP-P: WETLAND/STREAM

Inflow Area = 4.129 ac, 26.02% Impervious, Inflow Depth > 2.95" for 25yr event
Inflow = 8.36 cfs @ 12.20 hrs, Volume= 1.016 af
Outflow = 8.36 cfs @ 12.20 hrs, Volume= 1.016 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach IP-P: WETLAND/STREAM



Summary for Pond 1P: CTB#1

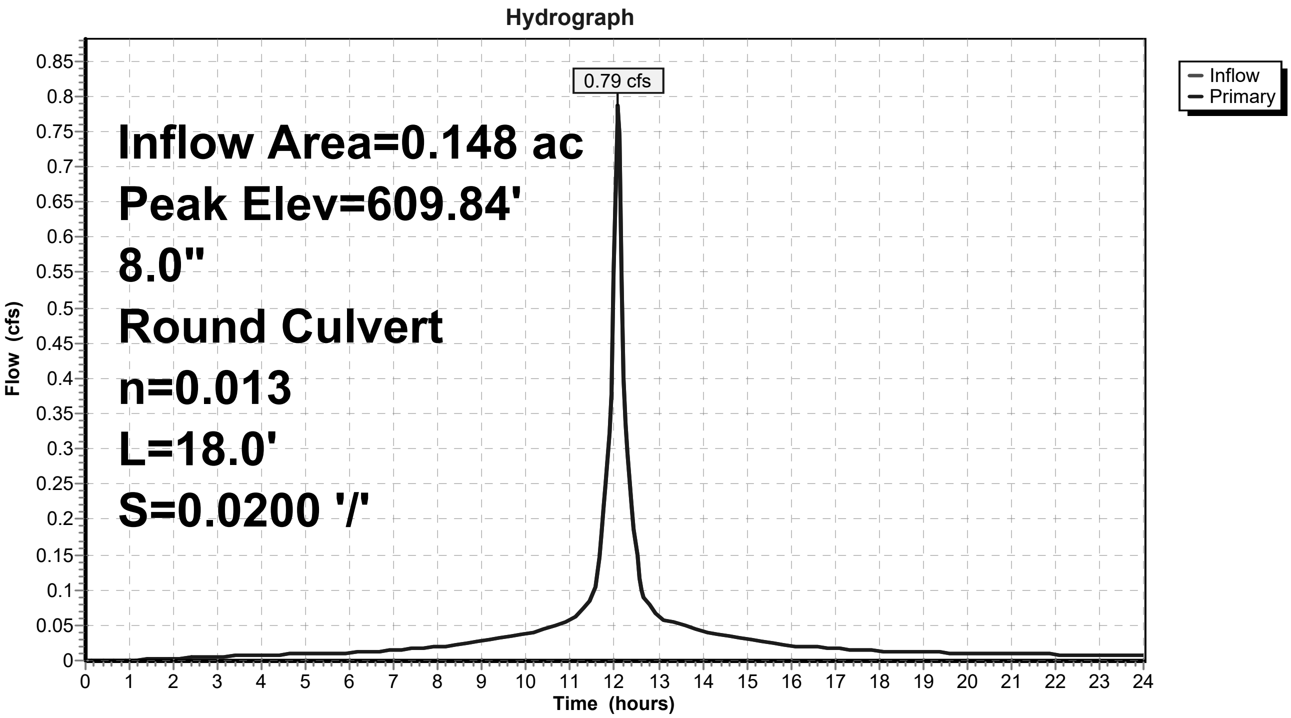
Inflow Area =	0.148 ac,100.00% Impervious,	Inflow Depth > 5.16"	for 25yr event	
Inflow =	0.79 cfs @	12.07 hrs, Volume=	0.064 af	
Outflow =	0.79 cfs @	12.07 hrs, Volume=	0.064 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.79 cfs @	12.07 hrs, Volume=	0.064 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 609.84' @ 12.07 hrs
Flood Elev= 613.10'

Device	Routing	Invert	Outlet Devices
#1	Primary	609.16'	**8.0" Round Culvert** L= 18.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 609.16' / 608.80' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.76 cfs @ 12.07 hrs HW=609.82' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 0.76 cfs @ 2.18 fps)

Pond 1P: CTB#1



Cobra_Stormtech R6 *Type III 24-hr 25yr Rainfall=5.40"*
Prepared by S. J. Mullaney Engineering, Inc. Printed 8/16/2022
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Summary for Pond 2P: CTB#2

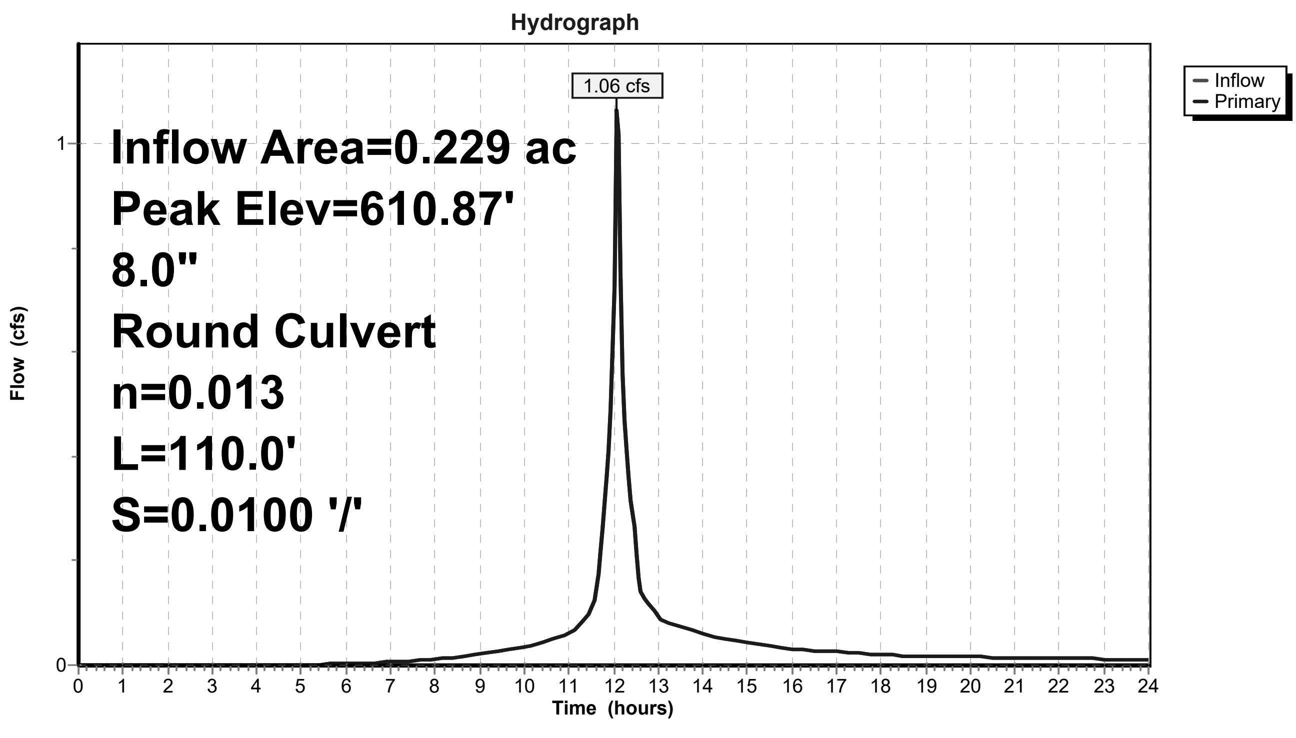
Inflow Area = 0.229 ac, 59.69% Impervious, Inflow Depth > 4.05" for 25yr event
Inflow = 1.06 cfs @ 12.07 hrs, Volume= 0.077 af
Outflow = 1.06 cfs @ 12.07 hrs, Volume= 0.077 af, Atten= 0%, Lag= 0.0 min
Primary = 1.06 cfs @ 12.07 hrs, Volume= 0.077 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 610.87' @ 12.07 hrs
Flood Elev= 612.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	609.90'	**8.0" Round Culvert** L= 110.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 609.90' / 608.80' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=1.02 cfs @ 12.07 hrs HW=610.83' (Free Discharge)
↑—**1=Culvert** (Inlet Controls 1.02 cfs @ 2.94 fps)

Pond 2P: CTB#2



Cobra_Stormtech R6 *Type III 24-hr 25yr Rainfall=5.40"*
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Summary for Pond 3P: CTB#3

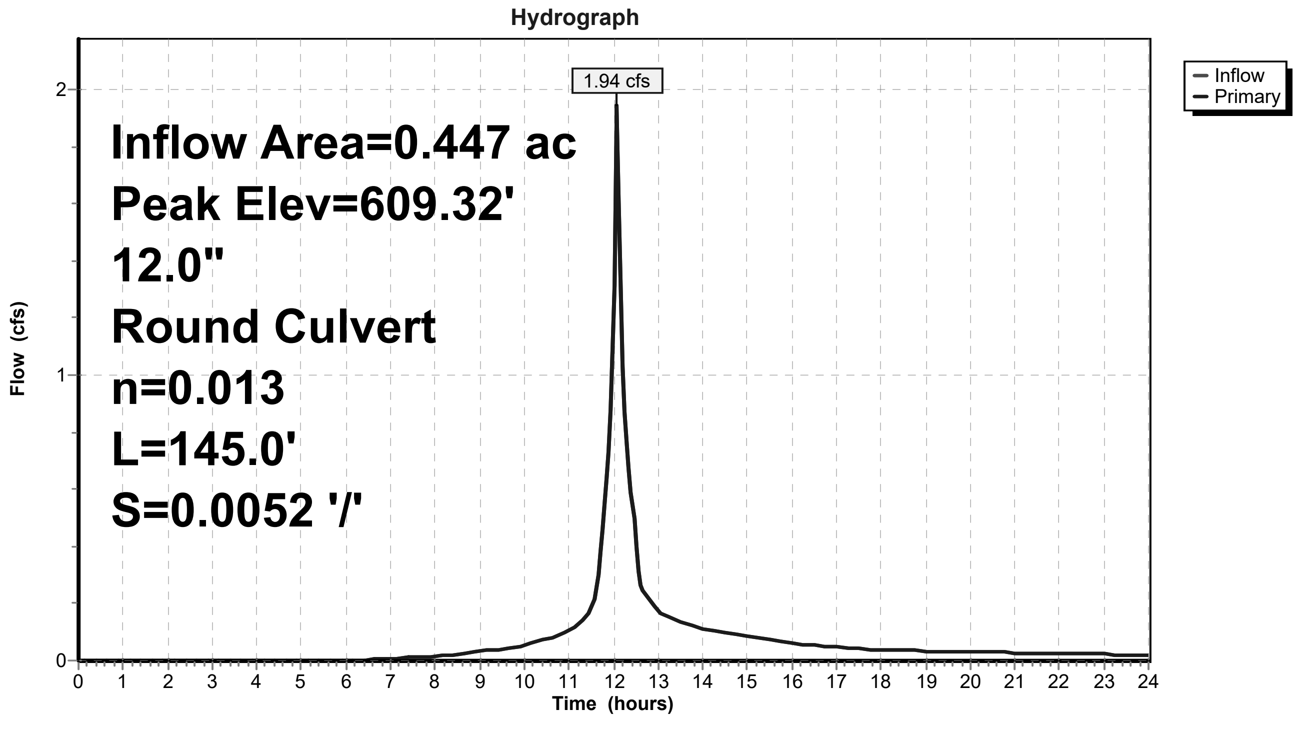
Inflow Area = 0.447 ac, 43.97% Impervious, Inflow Depth > 3.74" for 25yr event
Inflow = 1.94 cfs @ 12.07 hrs, Volume= 0.139 af
Outflow = 1.94 cfs @ 12.07 hrs, Volume= 0.139 af, Atten= 0%, Lag= 0.0 min
Primary = 1.94 cfs @ 12.07 hrs, Volume= 0.139 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 609.32' @ 12.07 hrs
Flood Elev= 611.40'

Device	Routing	Invert	Outlet Devices
#1	Primary	608.40'	**12.0" Round Culvert** L= 145.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 608.40' / 607.65' S= 0.0052 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.87 cfs @ 12.07 hrs HW=609.29' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.87 cfs @ 3.34 fps)

Pond 3P: CTB#3



Cobra_Stormtech R6 *Type III 24-hr 25yr Rainfall=5.40"*
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Summary for Pond 4P: CTB#4

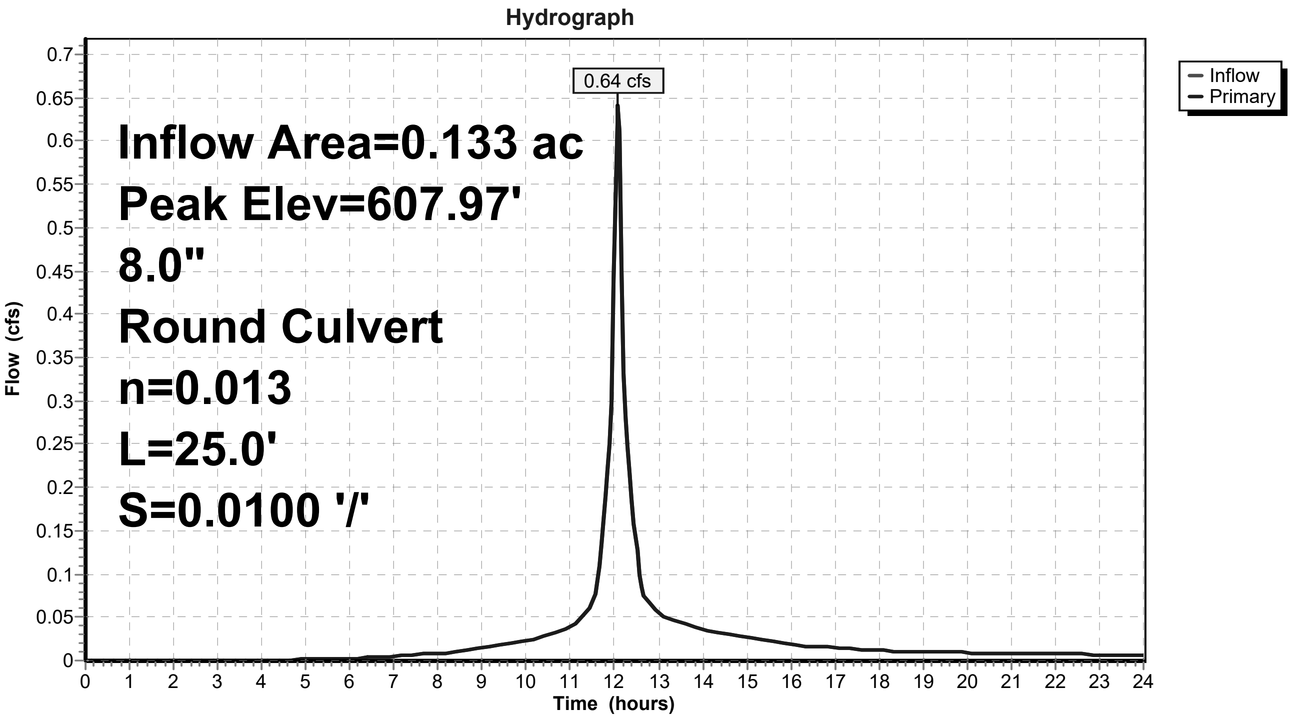
Inflow Area = 0.133 ac, 67.44% Impervious, Inflow Depth > 4.26" for 25yr event
Inflow = 0.64 cfs @ 12.07 hrs, Volume= 0.047 af
Outflow = 0.64 cfs @ 12.07 hrs, Volume= 0.047 af, Atten= 0%, Lag= 0.0 min
Primary = 0.64 cfs @ 12.07 hrs, Volume= 0.047 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 607.97' @ 12.07 hrs
Flood Elev= 610.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	607.40'	**8.0" Round Culvert** L= 25.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 607.40' / 607.15' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=0.62 cfs @ 12.07 hrs HW=607.95' (Free Discharge)
└─**1=Culvert** (Inlet Controls 0.62 cfs @ 2.00 fps)

Pond 4P: CTB#4



Summary for Pond 6P: Underground Basin

Inflow Area = 1.488 ac, 72.20% Impervious, Inflow Depth > 4.43" for 25yr event
Inflow = 7.23 cfs @ 12.07 hrs, Volume= 0.549 af
Outflow = 2.70 cfs @ 12.31 hrs, Volume= 0.524 af, Atten= 63%, Lag= 14.4 min
Discarded = 0.07 cfs @ 12.31 hrs, Volume= 0.039 af
Primary = 2.63 cfs @ 12.31 hrs, Volume= 0.484 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 607.59' @ 12.31 hrs Surf.Area= 4,983 sf Storage= 7,017 cf

Plug-Flow detention time= 71.4 min calculated for 0.522 af (95% of inflow)
Center-of-Mass det. time= 45.1 min (819.2 - 774.1)

Volume	Invert	Avail.Storage	Storage Description
#1	603.00'	1,726 cf	**Custom Stage Data (Conic)** Listed below (Recalc) 6,452 cf Overall - 2,136 cf Embedded = 4,315 cf x 40.0% Voids
#2	603.75'	2,136 cf	**Cultec R-902HD** x 33 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap
#3	606.00'	2,761 cf	**Custom Stage Data (Conic)** Listed below (Recalc) 8,996 cf Overall - 2,093 cf Embedded = 6,903 cf x 40.0% Voids
#4	606.50'	2,093 cf	**ADS_StormTech SC-310 +Cap** x 142 Inside #3 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap
		8,717 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
603.00	1,122	0	0	1,122
608.75	1,122	6,452	6,452	1,805

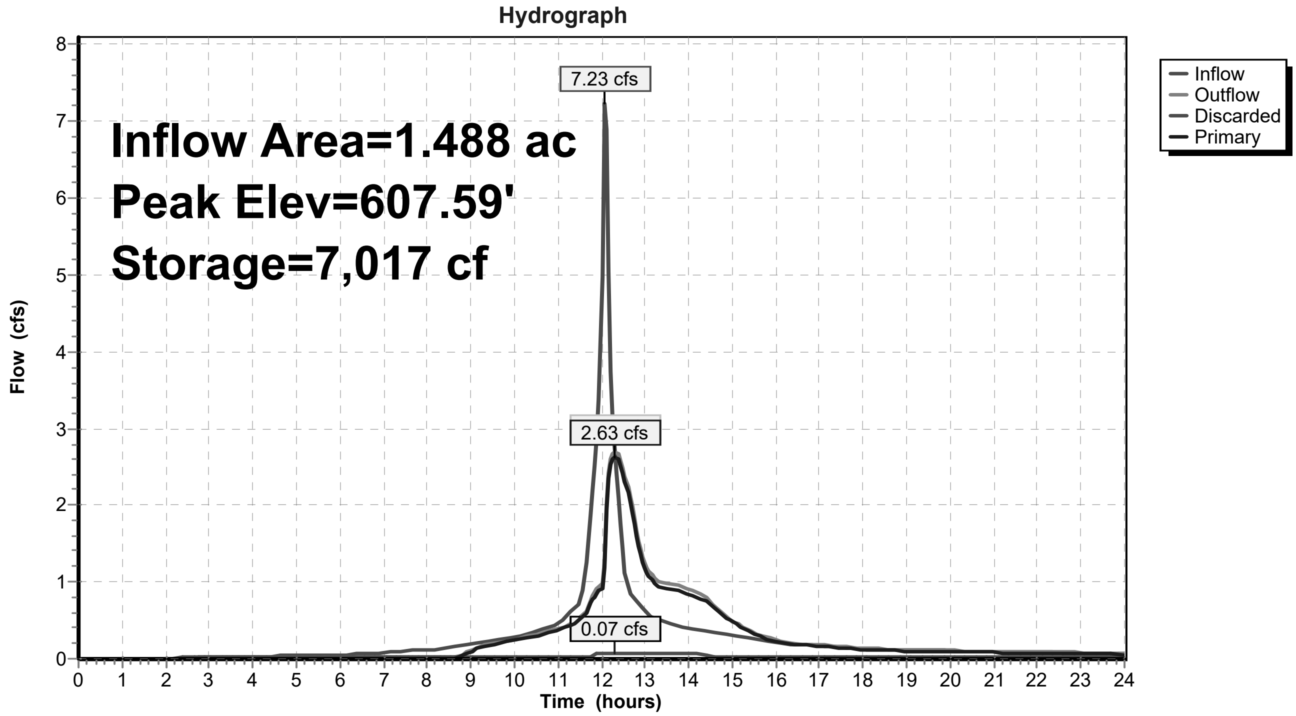
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
606.00	3,861	0	0	3,861
608.33	3,861	8,996	8,996	4,374

Device	Routing	Invert	Outlet Devices
#1	Discarded	603.00'	**0.520 in/hr Exfiltration over Wetted area**
#2	Primary	600.00'	**12.0" Round Culvert** L= 25.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 600.00' / 598.00' S= 0.0800 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#3	Device 2	604.50'	**5.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	606.70'	**6.0" Vert. Orifice/Grate X 2.00** C= 0.600
#5	Device 2	608.60'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.07 cfs @ 12.31 hrs HW=607.59' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=2.63 cfs @ 12.31 hrs HW=607.59' (Free Discharge)
└─**2=Culvert** (Passes 2.63 cfs of 7.95 cfs potential flow)
  ├─**3=Orifice/Grate** (Orifice Controls 1.11 cfs @ 8.18 fps)
  ├─**4=Orifice/Grate** (Orifice Controls 1.51 cfs @ 3.86 fps)
  └─**5=Orifice/Grate** (Controls 0.00 cfs)

Pond 6P: Underground Basin



Cobra_Stormtech R6 *Type III 24-hr 25yr Rainfall=5.40"*
Prepared by S. J. Mullaney Engineering, Inc. Printed 8/16/2022
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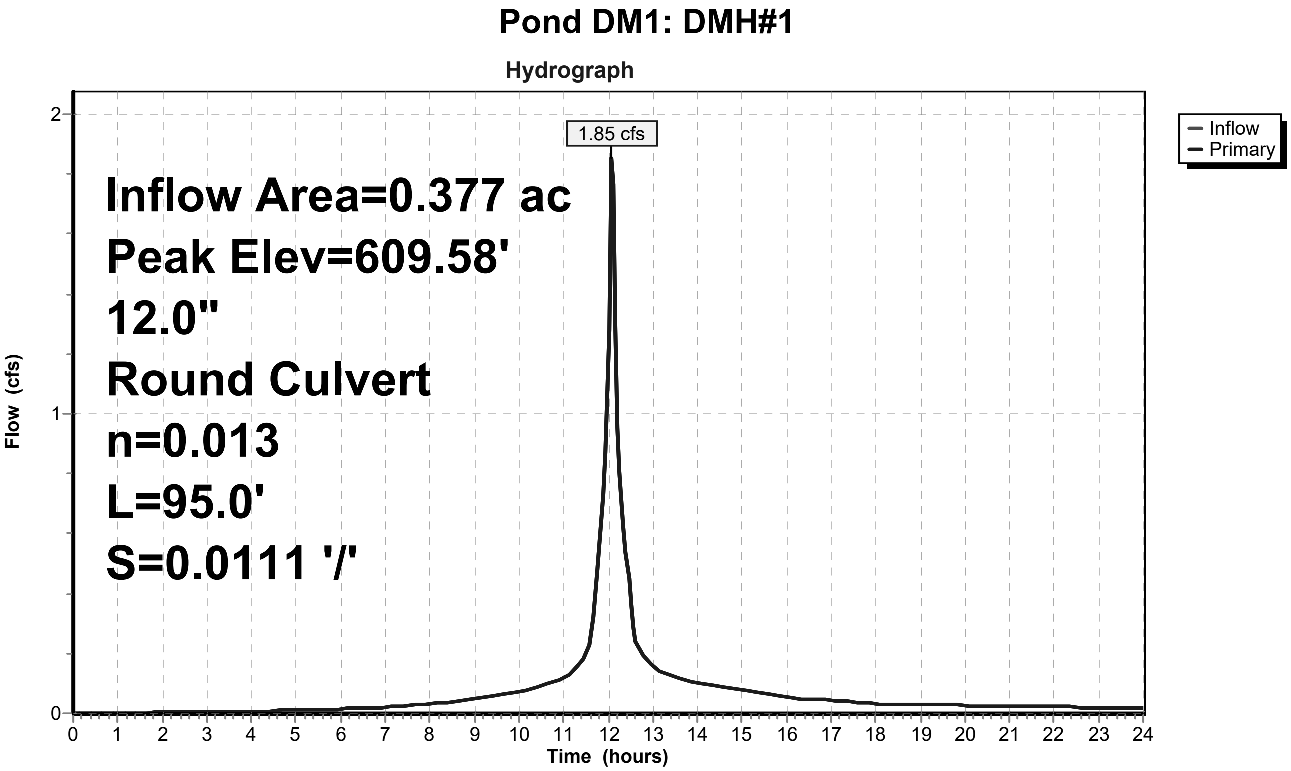
Summary for Pond DM1: DMH#1

Inflow Area = 0.377 ac, 75.49% Impervious, Inflow Depth > 4.48" for 25yr event
Inflow = 1.85 cfs @ 12.07 hrs, Volume= 0.141 af
Outflow = 1.85 cfs @ 12.07 hrs, Volume= 0.141 af, Atten= 0%, Lag= 0.0 min
Primary = 1.85 cfs @ 12.07 hrs, Volume= 0.141 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 609.58' @ 12.07 hrs
Flood Elev= 613.45'

Device	Routing	Invert	Outlet Devices
#1	Primary	608.70'	**12.0" Round Culvert** L= 95.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 608.70' / 607.65' S= 0.0111 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.78 cfs @ 12.07 hrs HW=609.56' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.78 cfs @ 2.49 fps)



Cobra_Stormtech R6 *Type III 24-hr 25yr Rainfall=5.40"*
Prepared by S. J. Mullaney Engineering, Inc. Printed 8/16/2022
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Summary for Pond DM2: DMH#2

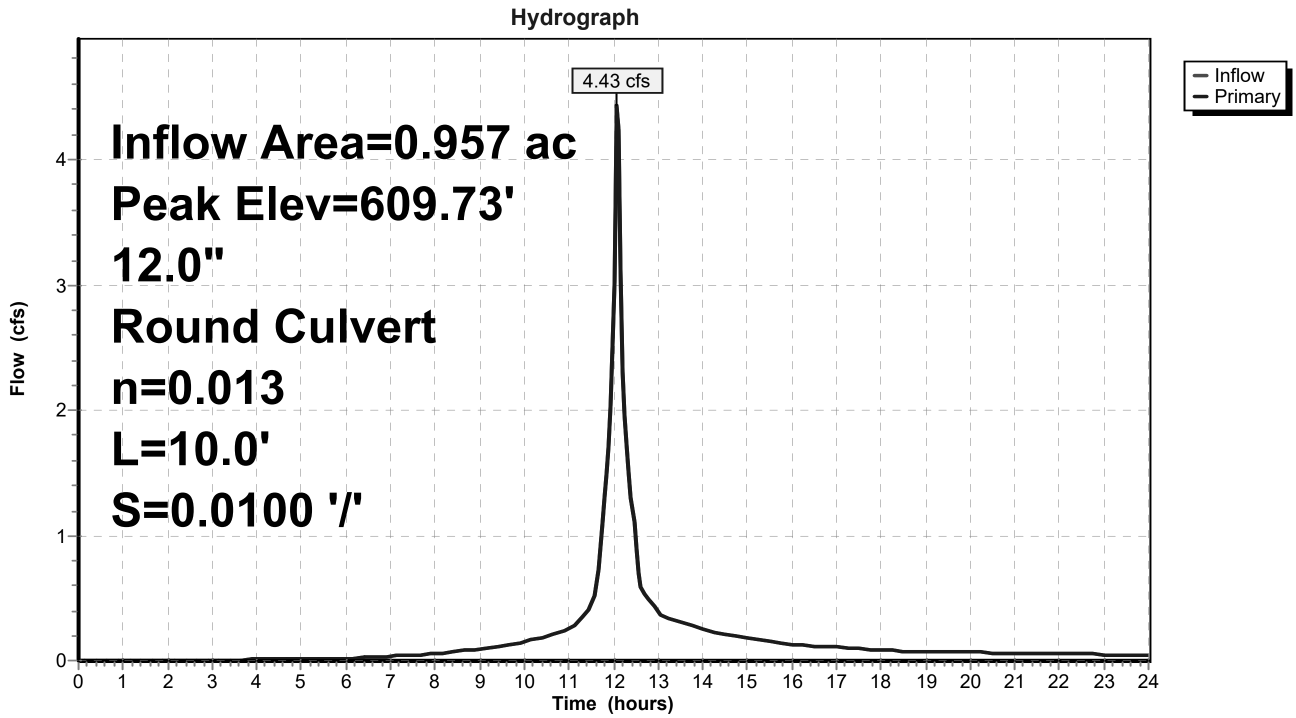
Inflow Area = 0.957 ac, 59.65% Impervious, Inflow Depth > 4.10" for 25yr event
Inflow = 4.43 cfs @ 12.07 hrs, Volume= 0.327 af
Outflow = 4.43 cfs @ 12.07 hrs, Volume= 0.327 af, Atten= 0%, Lag= 0.0 min
Primary = 4.43 cfs @ 12.07 hrs, Volume= 0.327 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 609.73' @ 12.07 hrs
Flood Elev= 611.75'

Device	Routing	Invert	Outlet Devices
#1	Primary	607.05'	**12.0" Round Culvert** L= 10.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 607.05' / 606.95' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=4.27 cfs @ 12.07 hrs HW=609.60' (Free Discharge)
└─**1=Culvert** (Inlet Controls 4.27 cfs @ 5.44 fps)

Pond DM2: DMH#2



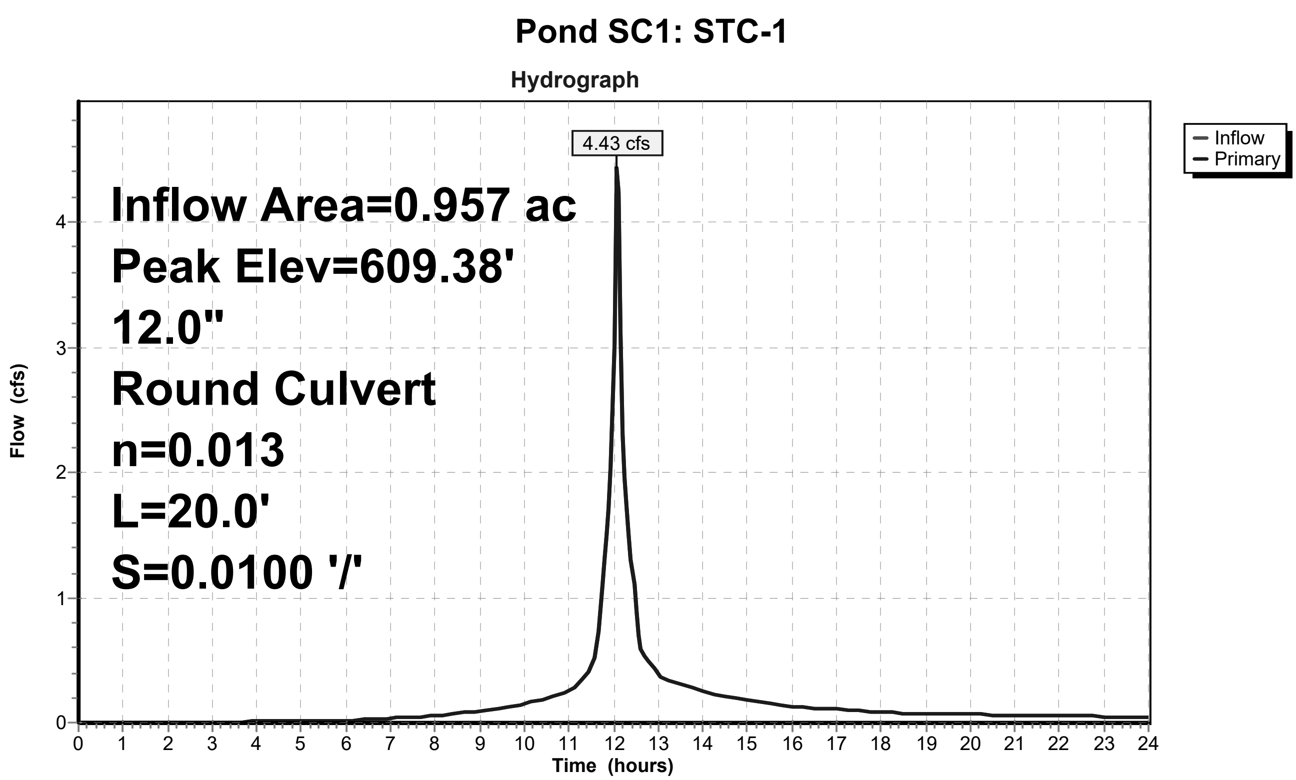
Summary for Pond SC1: STC-1

Inflow Area = 0.957 ac, 59.65% Impervious, Inflow Depth > 4.10" for 25yr event
Inflow = 4.43 cfs @ 12.07 hrs, Volume= 0.327 af
Outflow = 4.43 cfs @ 12.07 hrs, Volume= 0.327 af, Atten= 0%, Lag= 0.0 min
Primary = 4.43 cfs @ 12.07 hrs, Volume= 0.327 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 609.38' @ 12.07 hrs
Flood Elev= 611.70'

Device	Routing	Invert	Outlet Devices
#1	Primary	606.70'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 606.70' / 606.50' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=4.27 cfs @ 12.07 hrs HW=609.25' (Free Discharge)
└─**1=Culvert** (Inlet Controls 4.27 cfs @ 5.44 fps)



Summary for Pond SC2: STC-2

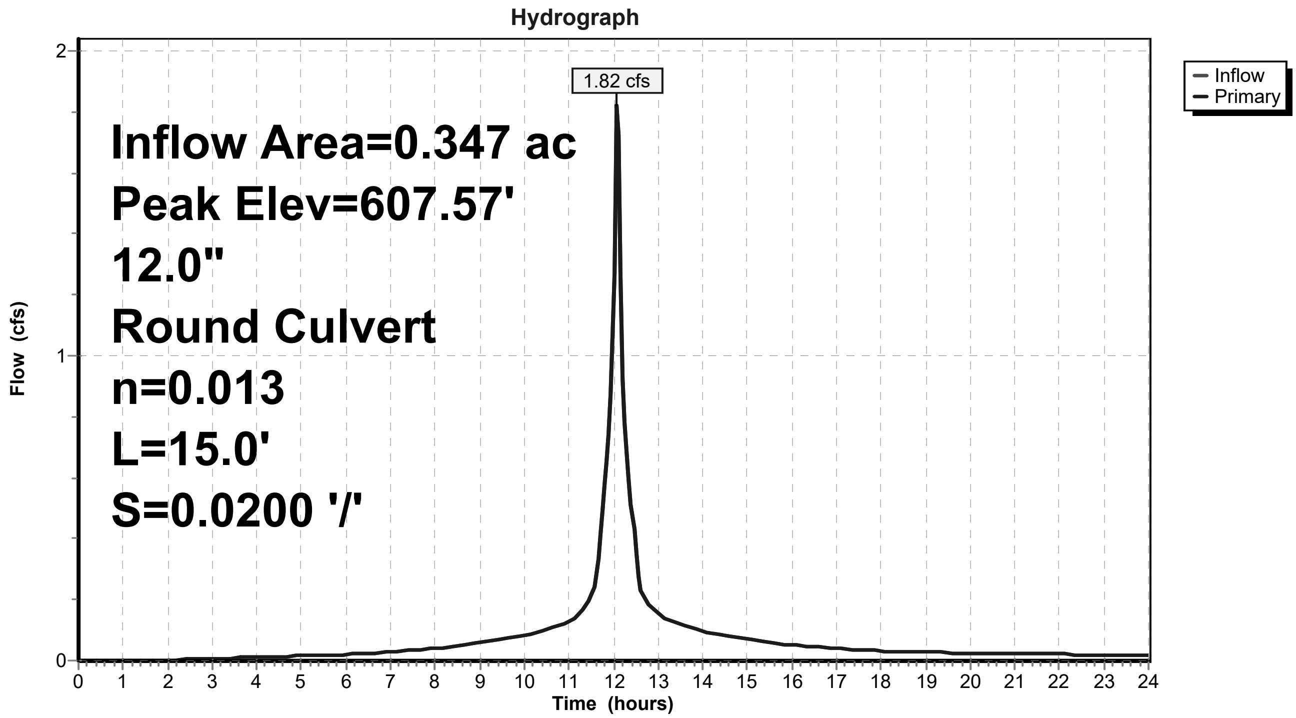
Inflow Area = 0.347 ac, 92.07% Impervious, Inflow Depth > 4.93" for 25yr event
Inflow = 1.82 cfs @ 12.07 hrs, Volume= 0.143 af
Outflow = 1.82 cfs @ 12.07 hrs, Volume= 0.143 af, Atten= 0%, Lag= 0.0 min
Primary = 1.82 cfs @ 12.07 hrs, Volume= 0.143 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 607.57' @ 12.07 hrs
Flood Elev= 609.75'

Device	Routing	Invert	Outlet Devices
#1	Primary	606.70'	**12.0" Round Culvert** L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 606.70' / 606.40' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.76 cfs @ 12.07 hrs HW=607.55' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.76 cfs @ 2.47 fps)

Pond SC2: STC-2



Stage-Area-Storage for Pond 6P: Underground Basin

Elevation (feet)	Wetted (sq-ft)	Storage (cubic-feet)
603.00	1,122	0
603.10	1,134	45
603.20	1,146	90
603.30	1,158	135
603.40	1,169	180
603.50	1,181	224
603.60	1,193	269
603.70	1,205	314
603.80	1,217	380
603.90	1,229	467
604.00	1,241	554
604.10	1,253	640
604.20	1,264	726
604.30	1,276	812
604.40	1,288	898
604.50	1,300	984
604.60	1,312	1,069
604.70	1,324	1,154
604.80	1,336	1,238
604.90	1,348	1,322
605.00	1,359	1,406
605.10	1,371	1,490
605.20	1,383	1,573
605.30	1,395	1,656
605.40	1,407	1,738
605.50	1,419	1,820
605.60	1,431	1,902
605.70	1,443	1,983
605.80	1,454	2,064
605.90	1,466	2,145
606.00	5,339	2,224
606.10	5,373	2,458
606.20	5,407	2,691
606.30	5,441	2,923
606.40	5,475	3,155
606.50	5,509	3,385
606.60	5,543	3,760
606.70	5,577	4,131
606.80	5,610	4,495
606.90	5,644	4,853
607.00	5,678	5,202
607.10	5,712	5,542
607.20	5,746	5,871
607.30	5,780	6,189
607.40	5,814	6,491
607.50	5,848	6,775
607.60	5,882	7,031
607.70	5,916	7,260
607.80	5,949	7,471
607.90	5,983	7,671
608.00	6,017	7,871
608.10	6,051	8,070
608.20	6,085	8,269
608.30	6,119	8,469
608.40	6,137	8,560
608.50	6,149	8,605
608.60	6,161	8,649
608.70	**6,173**	**8,694**
608.80	**6,179**	**8,717**

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: 150 Charlton Road Sturbridge SC-1

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Stormceptor 450i Proprietary Device	**83%**	**1.00**	**0.83**	**0.17**
Infiltration Trench	**80%**	**0.17**	**0.14**	**0.03**
		0.03	**0.00**	**0.03**
		0.03	**0.00**	**0.03**
		0.03	**0.00**	**0.03**

Total TSS Removal = 97%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **20-409**
Prepared By: **MAL**
Date: **8/17/2022**

*Equals remaining load from previous BMP (E) which enters the BMP

Brief Stormceptor Sizing Report - 150 Charlton SC#1

Project Information & Location			
Project Name	Cobra Realty	**Project Number**	49649
City	Sturbridge	**State/ Province**	Massachusetts
Country	United States of America	**Date**	8/16/2022
Designer Information		**EOR Information (optional)**	
Name	Mikael Lassila	**Name**	
Company	S. J. Mullaney Engineering, Inc	**Company**	
Phone #	978-534-3131	**Phone #**	
Email	mlassila@sjmullaney.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	150 Charlton SC#1
Target TSS Removal (%)	80
TSS Removal (%) Provided	83
Recommended Stormceptor Model	STC 450i

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	83
STC 900	89
STC 1200	89
STC 1800	89
STC 2400	92
STC 3600	92
STC 4800	94
STC 6000	94
STC 7200	95
STC 11000	97
STC 13000	97
STC 16000	97

Sizing Details

Drainage Area

Drainage Area	
Total Area (acres)	0.96
Imperviousness %	59.8

Rainfall

Rainfall	
Station Name	WORCESTER WSO AP
State/Province	Massachusetts
Station ID #	9923
Years of Records	58
Latitude	42°16'2"N
Longitude	71°52'34"W

Water Quality Objective

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	

Up Stream Storage

Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: 150 Charlton Road Sturbridge SC-2

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Stormceptor 450i Proprietary Device	**87%**	**1.00**	**0.87**	**0.13**
Infiltration Trench	**80%**	**0.13**	**0.10**	**0.03**
		0.03	**0.00**	**0.03**
		0.03	**0.00**	**0.03**
		0.03	**0.00**	**0.03**

Total TSS Removal = **97%**

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: **20-409**
Prepared By: **MAL**
Date: **8/17/2022**

*Equals remaining load from previous BMP (E) which enters the BMP

Brief Stormceptor Sizing Report - 150 Charlton SC#2

Project Information & Location			
Project Name	Cobra Realty	**Project Number**	49649
City	Sturbridge	**State/ Province**	Massachusetts
Country	United States of America	**Date**	8/16/2022
Designer Information		**EOR Information (optional)**	
Name	Mikael Lassila	**Name**	
Company	S. J. Mullaney Engineering, Inc	**Company**	
Phone #	978-534-3131	**Phone #**	
Email	mlassila@sjmullaney.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	150 Charlton SC#2
Target TSS Removal (%)	80
TSS Removal (%) Provided	87
Recommended Stormceptor Model	STC 450i

The recommended Stormceptor Model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary

Stormceptor Model	% TSS Removal Provided
STC 450i	87
STC 900	92
STC 1200	92
STC 1800	92
STC 2400	94
STC 3600	95
STC 4800	96
STC 6000	96
STC 7200	97
STC 11000	98
STC 13000	98
STC 16000	98

Sizing Details

Drainage Area

Drainage Area	
Total Area (acres)	0.35
Imperviousness %	92.0

Rainfall

Rainfall	
Station Name	WORCESTER WSO AP
State/Province	Massachusetts
Station ID #	9923
Years of Records	58
Latitude	42°16'2"N
Longitude	71°52'34"W

Water Quality Objective

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	

Up Stream Storage

Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cfs)	

Particle Size Distribution (PSD)
The selected PSD defines TSS removal

Fine Distribution

Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

HydroCAD Literature & SCS CN's & Rainfall

HydroCAD, TR-20, TR-55 Comparison

The following table summarizes the technical similarities and differences between these three programs. Note that HydroCAD combines the most-used capabilities of TR-20 and TR-55, plus many other techniques and features not provided by either program.

	HydroCAD	TR-20	TR-55
Runoff methodology	SCS unit hydrograph procedure (unlimited points)	SCS unit hydrograph procedure (301 points)	Tabular method derived from TR-20
Rainfall types	Extensive rainfall library plus user-defined storms	SCS type I, IA, II & III	SCS type I, IA, II & III
Unit hydrograph	SCS or Delmarva U.H., plus user defined curves	SCS Unit Hydrograph or user defined curve	SCS Unit Hydrograph only
Curve number entry	Automatic curve number lookup and weighting	Requires direct entry of composite curve number	Automatic curve number lookup and weighting
Curve number limitations	No restrictions	No restrictions	Reduced accuracy as CN differs from 75
Time of concentration calculations	All TR-55 methods plus common channel shapes, upland method, and CN method	Contains no Tc calculations: Requires direct entry of Tc	Calculates Tc for sheet, shallow concentrated, & channel flow
Tc limitations	No restrictions	Must be greater than zero	Limited to .1 to 2 hrs
Tc precision	1/10 minute or 1/600 hour	1/100 hour	Rounded to nearest step
Subarea limitations	None	None	Must not differ by more than factor of 5
Runoff accuracy	Within 1% of TR-20	"The standard"	Within ±25% of TR-20
Reach routing	Storage-indication method with optional routing delay (translation)	Modified Att-Kin procedure	No routing, separate tables for travel times of 0 to 3 hours
Pond routing	Storage-indication method, *dynamic* storage-indication method, or simultaneous routing	Storage-indication	None, only estimates ponding effects
Pond Sizing Estimate	Using actual inflow hydrograph	none	Using standard hydrograph shape
Detention Time	By plug-flow and center-of-mass methods	not calculated	not calculated
Stage-discharge hydraulics	Automatic calculation for simple *and* compound outlets	Must be entered directly, no calculations provided	n/a, no pond routing
Stage-storage curve	Automatic calculation from pond dimensions or surface areas, plus direct entry	Direct entry only	n/a, no pond routing
Flow diversions (split flows)	Automatic diversion of outflow from specified pond outlet(s)	Separate "Divert" procedure based on user-defined curve	n/a
Routing diagram	Interactive, on-screen, with labels and background image	none	none
Calculation procedure	Automatically calculated as required	"Batch mode" calculation of entire watershed	Manual initiation of each calculation
Graphics capabilities	Full graphics to screen or printer	none	none
Reports	Automatic reports with headings, graphics, etc.	Manual	Manual
Data Storage	Automatic by job name	Manual	Manual

Section 12 - HydroCAD Fundamentals

Understanding HydroCAD

HydroCAD provides a number of techniques for the generation and routing of hydrographs. It also provides many other related calculations, such as time of concentration, weighted curve numbers, pond volumes, stage-discharge curves, etc. This broad range of capabilities allows a large number of studies to be performed entirely within HydroCAD.

HydroCAD is a *hydrograph routing model.* It is designed specifically to handle *time varying flows*, as required for pond design and other volume-sensitive calculations.

Certain calculations, such as channel backwater or pressurized pipe networks, are often analyzed under *constant flow* conditions. This may require steady-state numerical techniques, rather than a hydrograph routing system such as HydroCAD. Some projects may require the use of HydroCAD to model the overall drainage system, combined with a steady-state analysis of specific components. This is an unavoidable consequence of the different methodologies.

Although HydroCAD's sequence of operations is *very* flexible, its power is most easily understood by viewing it in four phases.

Phase I - Construction of Routing Diagram

A diagram is constructed showing the functional components, or nodes, that make up the watershed. The diagram shows the location of each node and how water is routed from one node to another.

Phase II - Description of each Node

Each node is described in detail so that HydroCAD can calculate the outflow from each node once the inflow is known.

Phase III- Calculation of flow through each Node

Calculations occur automatically whenever a report is selected. Starting at the upstream end of the diagram and working downstream, HydroCAD calculates the outflow and other results for each node. Multiple inflows are summed automatically. A *minimal recalculation* feature automatically reuses the results of previous calculations where no changes have occurred.

Phase IV - Display and Examination of Results

Opening one or more report windows lets the user verify the behavior of the watershed. If any changes are required, the user may modify the watershed, causing the calculations and reports to be automatically updated.

☞ In practice, it is generally recommended that these phases be completed for *each node* as it is added to the routing diagram. This allows the model to be fine-tuned at an early stage, while the calculations are relatively easy to understand. As the model becomes more complex, a single modeling error can have widespread consequences, making it more difficult to locate.

The Routing Diagram

The routing diagram shows the individual *nodes* that make up each project. The nodes are usually connected by arrows that indicate how their outflows are routed. Multiple inflows are summed automatically as required.[1]

Based on the routing diagram, HydroCAD is able to determine the correct sequence of calculations, and then calculate the flows throughout the project. Routing calculations are automatically updated as required. You can manipulate the diagram display with the main scroll bars, the tool bar, the main menu, the palette, and the mouse.

Watershed components

Each drainage system is represented by a network of the following types of *nodes*:

- **Subcatchment**: A relatively homogenous area of land that typically drains into a reach or pond. Each subcatchment generates a *runoff hydrograph*. A subcatchment may also be used to account for the rain falling directly on the surface of a pond. A subcatchment *cannot* be used to route an inflow hydrograph. Instead, use a subcatchment to calculate the runoff and a separate reach to perform the routing.

- **Pond**: A pond, swamp, dam, catch basin, manhole, drywell, or other impoundment that fills with water from one or more sources and empties in a manner determined by a weir, culvert, or other outlet device(s). The outflow of each pond is determined by a *hydrograph routing* calculation which attenuates and delays the peak flow. A pond may empty into a reach or into another pond. An optional *secondary* outflow may be used to *divert* the discharge from specific outlet devices and route them separately. A *discarded* outflow is also available for outflows that are not subject to further routing, such as exfiltration.

- **Catch Basin**: A special type of pond that provides an insignificant amount of storage, but otherwise has all the properties and capabilities of a pond. Since a catch basin has no storage capability, it cannot detain or attenuation its inflow. However, the routing calculations will determine the water surface level (headwater) at each point in time.

- **Reach**: A uniform stream, channel, or pipe that conveys water from one point to another and operates under *open channel flow*.[2] A reach may also be used to route an upstream hydrograph through a subcatchment.[3] The outflow of each reach is determined by a *hydrograph routing* calculation. This generally delays and attenuates the peak flow. A reach may be routed into a pond or into another reach.

- **Link**: A link may be used to 1) enter a hydrograph generated outside HydroCAD, 2) interconnect several routing diagrams, 3) scale a hydrograph, 4) split a hydrograph into two components for independent routing, or 5) define a tidal tailwater elevation.

---

[1] To sum multiple flows without performing a hydrograph routing, use an undescribed reach, pond, or link.

[2] To model a pipe under other flow conditions, including headwater and tailwater effects, use a *catch basin or pond with a culvert outlet*. This applies to most culverted road crossings, manholes, and other impoundments that feed a pipe.

[3] When a reach drains a subcatchment *along its length*, it may be best modeled as a component of the subcatchment's Tc calculation, rather than as an independent reach.

Appendix A2: Runoff Curve Numbers

Table 2-2a Runoff curve numbers for urban areas [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

1 Average runoff condition, and $I_a = 0.2S$.

2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

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Appendix A2: Runoff Curve Numbers (continued)

Table 2-2b Runoff curve numbers for cultivated agricultural lands [1]

Cover description			Curve numbers for hydrologic soil group			
Cover type	Treatment [2]	Hydrologic condition [3]	A	B	C	D
Fallow	Bare soil	—	77	86	91	94
	Crop residue cover (CR)	Poor	76	85	90	93
		Good	74	83	88	90
Row crops	Straight row (SR)	Poor	72	81	88	91
		Good	67	78	85	89
	SR + CR	Poor	71	80	87	90
		Good	64	75	82	85
	Contoured (C)	Poor	70	79	84	88
		Good	65	75	82	86
	C + CR	Poor	69	78	83	87
		Good	64	74	81	85
	Contoured & terraced (C&T)	Poor	66	74	80	82
		Good	62	71	78	81
	C&T+ CR	Poor	65	73	79	81
		Good	61	70	77	80
Small grain	SR	Poor	65	76	84	88
		Good	63	75	83	87
	SR + CR	Poor	64	75	83	86
		Good	60	72	80	84
	C	Poor	63	74	82	85
		Good	61	73	81	84
	C + CR	Poor	62	73	81	84
		Good	60	72	80	83
	C&T	Poor	61	72	79	82
		Good	59	70	78	81
	C&T+ CR	Poor	60	71	78	81
		Good	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	66	77	85	89
		Good	58	72	81	85
	C	Poor	64	75	83	85
		Good	55	69	78	83
	C&T	Poor	63	73	80	83
		Good	51	67	76	80

1 Average runoff condition, and I_a=0.2S

2 Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.

3 Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness.

Poor: Factors impair infiltration and tend to increase runoff.

Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

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Table 2-2c Runoff curve numbers for other agricultural lands [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4]	48	65	73
Woods—grass combination (orchard or tree farm). [5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

1 Average runoff condition, and $I_a = 0.2S$.
2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.
3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.
4 Actual curve number is less than 30; use CN = 30 for runoff computations.
5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.
6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

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Appendix A2: Runoff Curve Numbers (continued)

Table 2-2d Runoff curve numbers for arid and semiarid rangelands [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition [2]	A [3]	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

1 Average runoff condition, and I_a, = 0.2S. For range in humid regions, use table 2-2c.
2 Poor: <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: > 70% ground cover.
3 Curve numbers for group A have been developed only for desert shrub.

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SCS Synthetic Rainfall Distributions

The highest peak discharges from small watersheds in the United States are usually caused by intense, brief rainfalls that may occur as distinct events or as part of a longer storm. These intense rainstorms do not usually extended over a large area and intensities vary greatly. One common practice in rainfall-runoff analysis is to develop a synthetic rainfall distribution to use in lieu of actual storm events. This distribution includes maximum rainfall intensities for the selected design frequency arranged in a sequence that is critical for producing peak runoff.

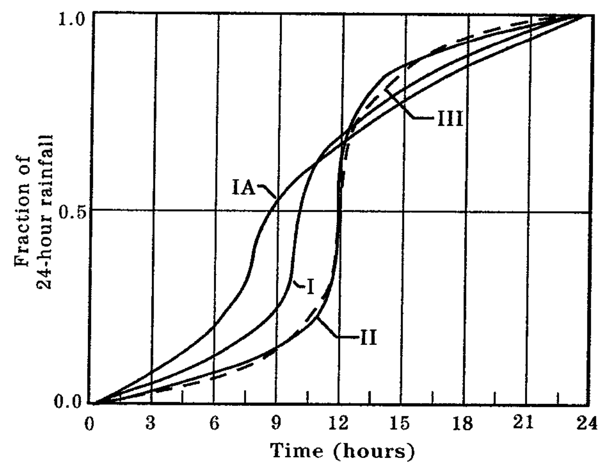
Synthetic rainfall distributions

The length of the most intense rainfall period contributing to the peak runoff rate is related to the time of concentration (T_c) for the watershed. In a hydrograph created with NRCS procedures, the duration of rainfall that directly contributes to the peak is about 170 percent of the T_c. For example, the most intense 8.5-minute rainfall period would contribute to the peak discharge for a watershed with a T_c of 5 minutes. The most intense 8.5-hour period would contribute to the peak for a watershed with a 5-hour T_c.

Different rainfall distributions can be developed for each of these watersheds to emphasize the critical rainfall duration for the peak discharges. However, to avoid the use of a different set of rainfall intensities for each drainage area size, a set of synthetic rainfall distributions having "nested" rainfall intensities was developed. The set "maximizes" the rainfall intensities by incorporating selected short duration intensities within those needed for longer durations at the same probability level.

For the size of the drainage areas for which NRCS usually provides assistance, a storm period of 24 hours was chosen the synthetic rainfall distributions. The 24-hour storm, while longer than that needed to determine peaks for these drainage areas, is appropriate for determining runoff volumes. Therefore, a single storm duration and associated synthetic rainfall distribution can be used to represent not only the peak discharges but also the runoff volumes for a range of drainage area sizes.

SCS 24-hour rainfall distributions



The intensity of rainfall varies considerably during a storm as well as geographic regions. To represent various regions of the United States, NRCS developed four synthetic 24-hour rainfall distributions (I, IA, II, and III) from available National Weather Service (NWS) duration-frequency data (Hershfield 1061; Frederick et al., 1977) or local storm data. Type IA is the least intense and type II the most intense short duration rainfall. The four distributions are shown in figure B-1, and figure B-2 shows their approximate geographic boundaries.

Types I and IA represent the Pacific maritime climate with wet winters and dry summers. Type III represents Gulf of Mexico and Atlantic coastal areas where tropical storms bring large 24-hour rainfall amounts. Type II represents the rest of the country. For more precise distribution boundaries in a state having more than one type, contact the NRCS State Conservation Engineer.

Additional rainfall information is available on the internet at www.hydrocad.net/rainfall.htm

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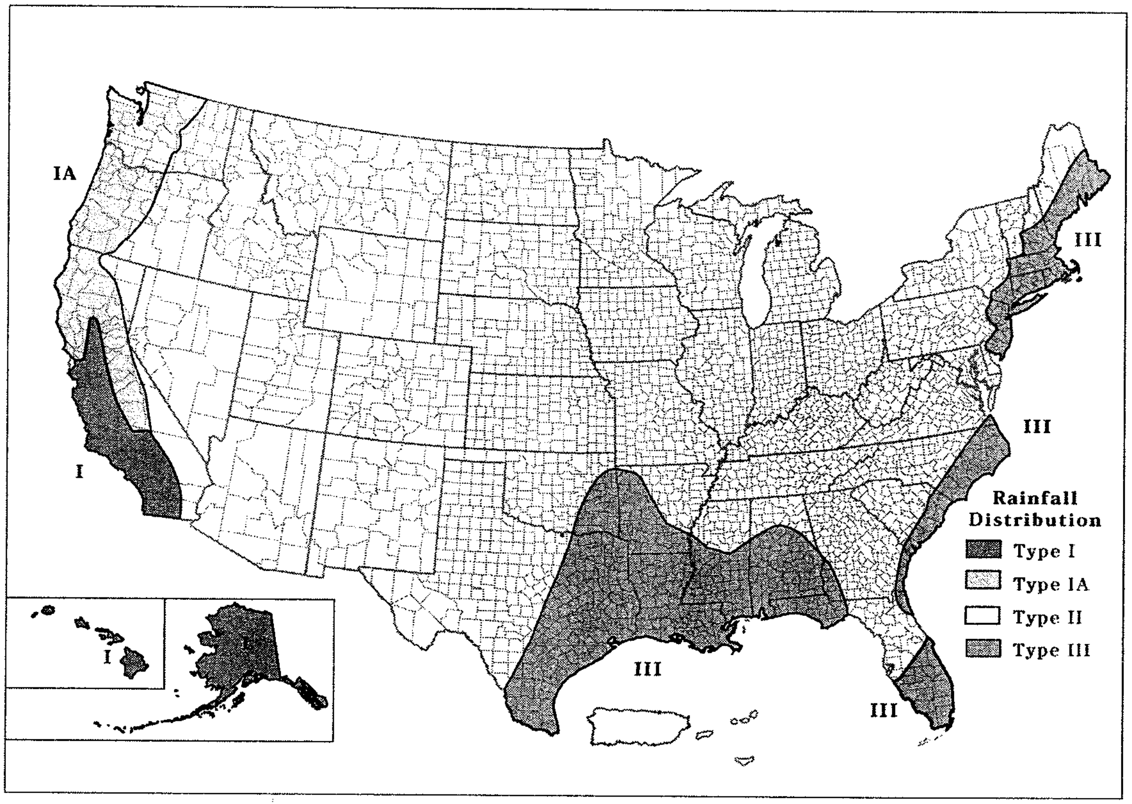

Rainfall data sources

This section lists the most current 24-hour rainfall data published by the National Weather Service (NWS) for various parts of the country. Because NWS Technical Paper 40 (TP-40) is out of print, the 24-hour rainfall maps for areas east of the 105th meridian are included here as figures B-3 through B-8. For the area generally west of the 105th meridian, TP-40 has been superseded by NOAA Atlas 2, the Precipitation-Frequency Atlas of the Western United States, published by the National Ocean and Atmospheric Administration.

East of 105th meridian

Hershfield, D.M. 1961. Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 40. Washington, DC. 155 p.

West of 105th meridian

Miller, J.F., R.H. Frederick, and R.J. Tracey. 1973. Precipitation-frequency atlas of the Western United States. Vol. I Montana; Vol. II, Wyoming; Vol III, Colorado; Vol. IV, New Mexico; Vol V, Idaho; Vol. VI, Utah; Vol. VII, Nevada; Vol. VIII, Arizona; Vol. IX, Washington; Vol. X, Oregon; Vol. XI, California. U.S. Dept. of Commerce, National Weather Service, NOAA Atlas 2. Silver Spring, MD.

Alaska

Miller, John F. 1963. Probable maximum precipitation and rainfall-frequency data for Alaska for areas to 400 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. of Commerce, Weather Bur. Tech. Pap. No. 47. Washington, DC. 69 p.

Hawaii

Weather Bureau. 1962. Rainfall-frequency atlas of the Hawaiian Islands for areas to 200 square miles, durations to 24 hours and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 43. Washington, DC. 60 p.

Puerto Rico and Virgin Islands

Weather Bureau. 1961. Generalized estimates of probable maximum precipitation and rainfall-frequency data for Puerto Rico and Virgin Islands for areas to 400 square miles, durations to 24 hours, and return periods from 1 to 100 years. U.S. Dept. Commerce, Weather Bur. Tech. Pap. No. 42. Washington, DC. 94 P.

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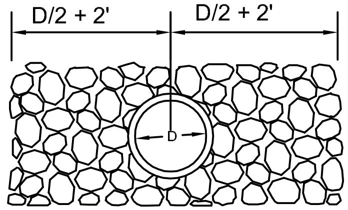
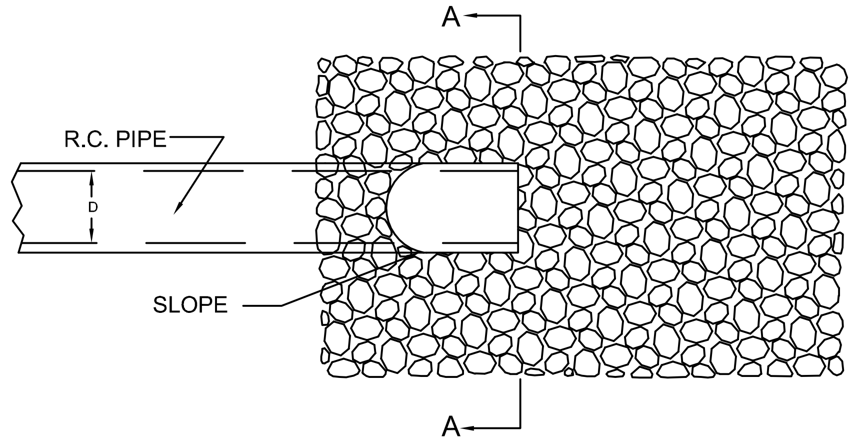
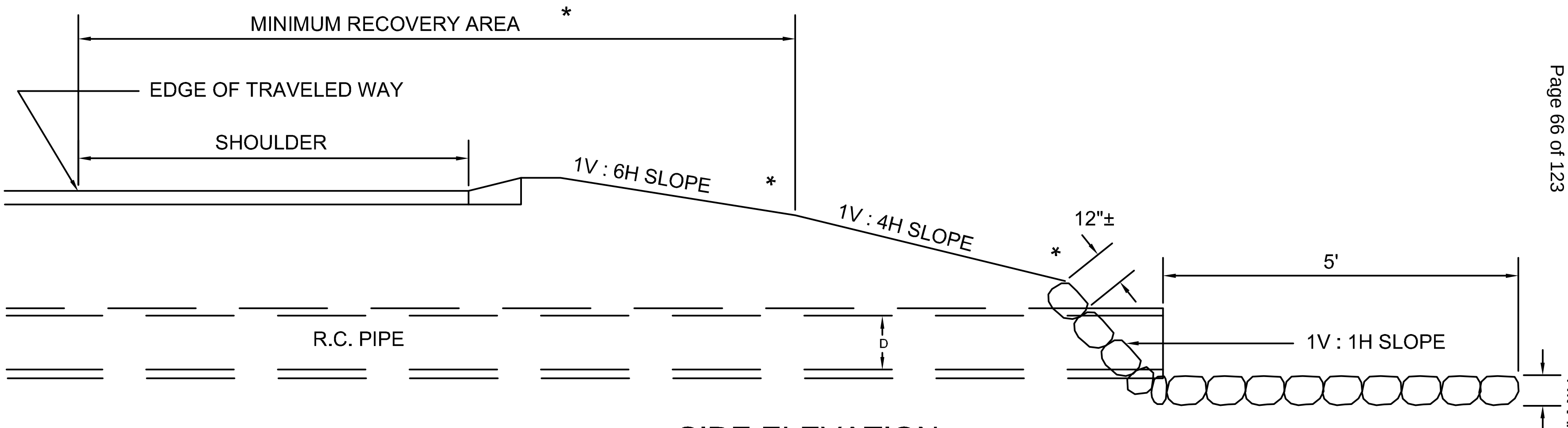
Rip Rap Reference:



SECTION A-A



PLAN



SIDE ELEVATION

* SEE TYPICAL SECTIONS.

NOTES:

1. STONE TREATMENT OF PIPE ENDS SHALL NOT BE USED IN THE VEHICLE RECOVERY AREA.
2. MINIMUM MASS PER STONE = 50 LBS; MAXIMUM MASS PER STONE = 125 LBS.
3. FOR DESCRIPTION, MATERIALS AND CONSTRUCTION METHODS, SEE STANDARD SPECIFICATIONS.

massDOT Massachusetts Department of Transportation Highway Division

CONSTRUCTION STANDARDS

STONE PIPE ENDS FOR PIPES 24" AND LESS IN DIA.

DATE OF ISSUE
OCTOBER 2017

DRAWING NUMBER
E 206.7.0

Groundwater Mounding Calculations

20-409 -UG Pond 6P
150 Charlton Road Sturbridge Ma
HANTUSH GROUNDWATER MOUND CALCULATOR

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin.

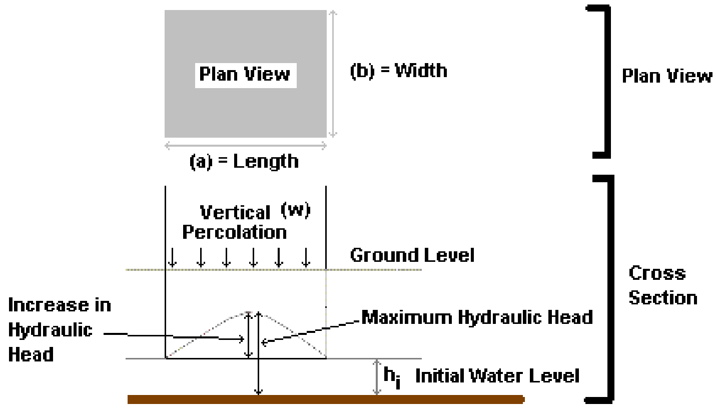
Basin	Length	Width	Volume	Time		Total		w (perc)
	ft	ft	cf	start	end	Hrs	Days	ft/d
6P	82	63	663	5	55	50	2.08	0.062

di

K (hyd. Conductivity)*

Texture	m/yr	m/d	ft/d
sand	5.55E+03	15.21	49.89
loamy sand	4.93E+03	13.51	44.31
sandy loam	1.09E+03	2.99	9.80
silty loam	2.27E+02	0.62	2.04
loam	2.19E+02	0.60	1.97
sandy clay loam	1.99E+02	0.55	1.79
silty clay loam	5.36E+01	0.15	0.48
clay loam	7.73E+01	0.21	0.69
sandy clay	6.84E+01	0.19	0.61
silty clay	3.21E+01	0.09	0.29
clay	4.05E+01	0.11	0.36

Source: Clapp and Hornberger (1978)

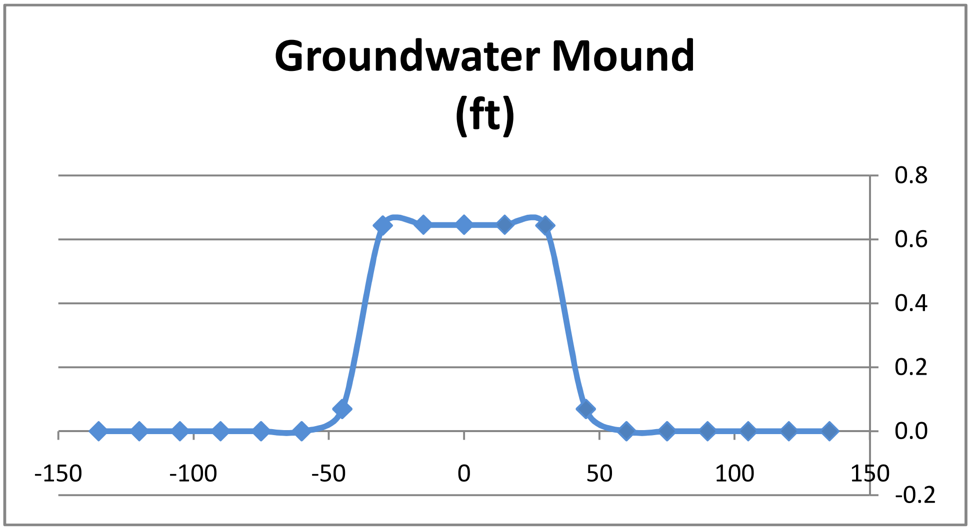


Input Values

0.54	K	Horizontal hydraulic conductivity (feet/day)
0.200	Sy	Specific yield (dimensionless)
2.000	hi	Initial Water Level (feet)
82.000	a	Basin Length (feet)
63.000	b	Basin Width (feet)
0.0620	*w*	Recharge (infiltration) rate (feet/day)
2.083	t	duration of infiltration period (days)

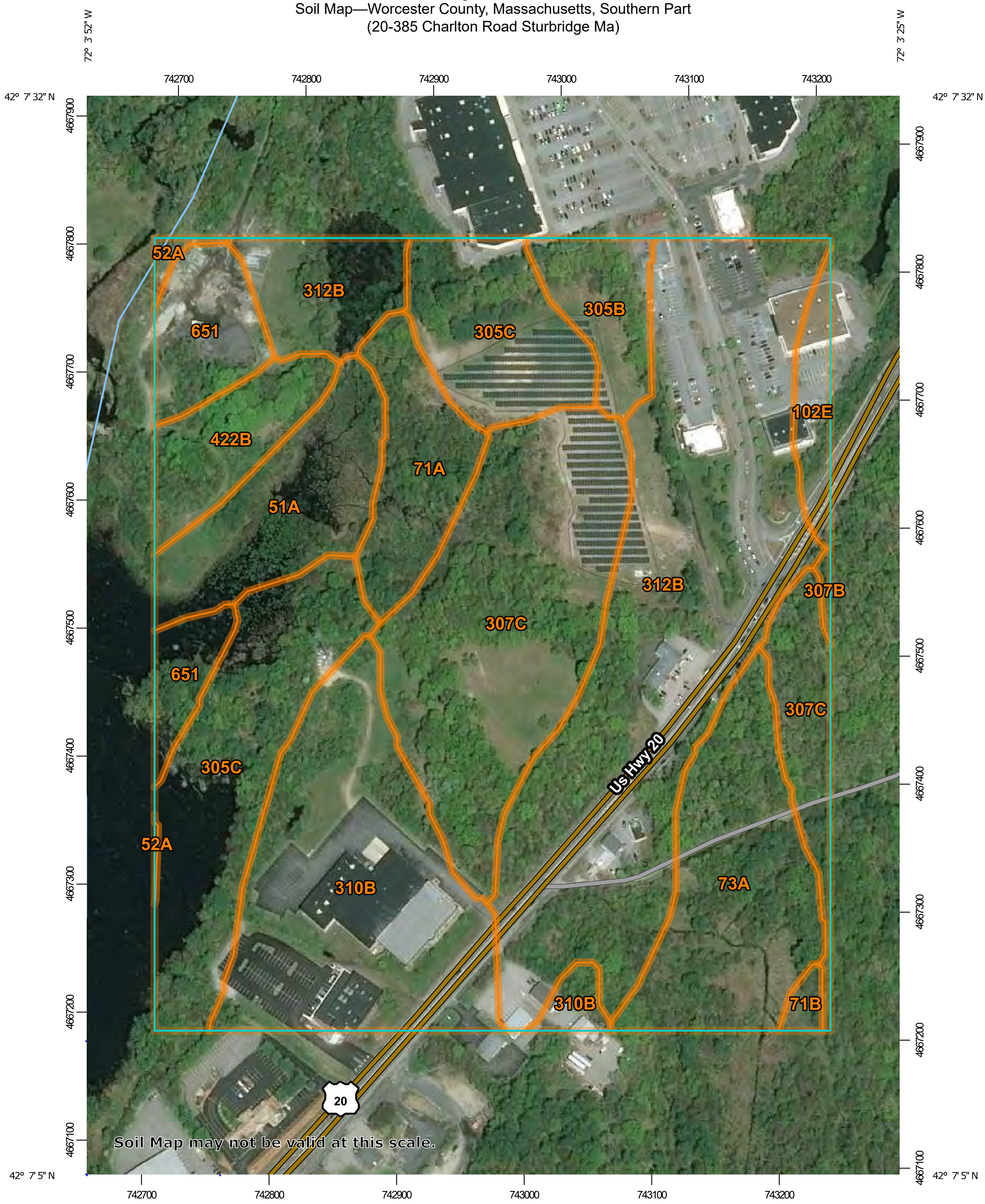
2.646	h(max)	Maximum Hydraulic Head (feet)
0.646	Δh(max)	Maximum Groundwater Mound (feet)

Ground-water Mound (ft)	Distance from Center (ft)
0.646	0
0.646	15
0.644	30
0.070	45
0.000	60
0.000	75
0.000	90
0.000	105
0.000	120
0.000	135
Increment	15

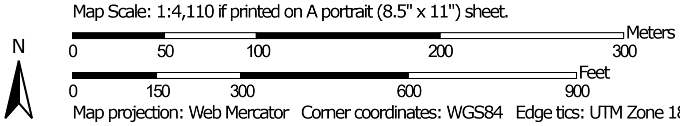


Soil Information

Soil Map—Worcester County, Massachusetts, Southern Part
(20-385 Charlton Road Sturbridge Ma)



Map Scale: 1:4,110 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N 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 1:25,000.

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

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

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

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

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

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

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

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

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

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
51A	Swansea muck, 0 to 1 percent slopes	4.5	5.5%
52A	Freetown muck, 0 to 1 percent slopes	0.2	0.3%
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	3.3	4.1%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	0.3	0.4%
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	6.7	8.3%
102E	Chatfield-Hollis-Rock outcrop complex, 15 to 35 percent slopes	1.2	1.5%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	2.2	2.7%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	11.1	13.6%
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	0.1	0.2%
307C	Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony	13.1	16.1%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	11.0	13.5%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	21.6	26.6%
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	2.6	3.2%
651	Udorthents, smoothed	3.4	4.2%
Totals for Area of Interest		**81.4**	**100.0%**

Commonwealth of Massachusetts
City/Town of Sturbridge

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

A. Facility Information

Interstate Towing
Owner Name

Charlton Road — Street Address
208-2612-150 — Map/Lot #

Sturbridge — City
MA — State
01566 — Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair
2. Soil Survey Available? ☒ Yes ☐ No If yes: Mass. GIS (Source) 307C (Soil Map Unit)

   Paxton — Soil Name
   stony — Soil Limitations

   Glacial Till — Soil Parent material
   Ground Moraine — Landform
3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: ______ Year Published/Source ______ Map Unit

   ______ Description of Geologic Map Unit:
4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No
5. Within a velocity zone? ☐ Yes ☒ No
6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: ______ Wetland Type
7. Current Water Resource Conditions (USGS): December 2020 (Month/Day/ Year) Range: ☐ Above Normal ☐ Normal ☒ Below Normal
8. Other references reviewed: ______

Commonwealth of Massachusetts
City/Town of Sturbridge

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

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

Deep Observation Hole Number: 1 (Hole #) 12-3-20 (Date) 8:00 (Time) clear 45 (Weather) ______ (Latitude) ______ (Longitude:)

1. Land Use Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) Grass Field (Vegetation) none (Surface Stones (e.g., cobbles, stones, boulders, etc.)) 2% (Slope (%))

Description of Location: ______

2. Soil Parent Material: Glacial Till Ground Moraine (Landform) ______ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body n/a feet Drainage Way n/a feet Wetlands 80 feet
Property Line 150 feet Drinking Water Well n/a feet Other ______ feet

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

5. Groundwater Observed: ☒ Yes ☐ No If yes: 30" Depth Weeping from Pit n/a Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-18	AP	S.L.	10YR4/4	N/A			N/A				
18-30	Bw	S.L.	10YR6/6	30"	10YR5/8	50	N/A				
30-76	Cd	S.L.	10YR5/8	N/A			N/A	10			

Additional Notes:

Commonwealth of Massachusetts
City/Town of Sturbridge

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

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

Deep Observation Hole Number: 2 (Hole #) 12/3/20 (Date) 8:30 (Time) Clear (Weather) ______ (Latitude) ______ (Longitude:)

1. Land Use: Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) Grass Field (Vegetation) none (Surface Stones (e.g., cobbles, stones, boulders, etc.)) 2% (Slope (%))

Description of Location: ______

2. Soil Parent Material: Glacial Till Ground Moraine (Landform) ______ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body n/a feet Drainage Way n/a feet Wetlands 80 feet
Property Line 150 feet Drinking Water Well n/a feet Other ______ feet

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

5. Groundwater Observed: ☒ Yes ☐ No If yes: 30" Depth Weeping from Pit n/a Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-10	Ap	S.L.	10YR4/4	N/A							
10-24	Bw	S.L.	10YR6/6	24"							
24-76	Cd	Silty Loam	10YR5/8	N/A							

Additional Notes: ______

Commonwealth of Massachusetts
City/Town of Sturbridge

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

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

Deep Observation Hole Number: 3 (Hole #) 12-3-20 (Date) 8:45 (Time) clear 45 (Weather) ______ (Latitude) ______ (Longitude:)

1. Land Use: Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) Grass Field (Vegetation) none (Surface Stones (e.g., cobbles, stones, boulders, etc.)) 2% (Slope (%))

   Description of Location: ______

2. Soil Parent Material: Glacial Till   Ground Moraine (Landform)   ______ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body n/a feet   Drainage Way n/a feet   Wetlands 125 feet
   Property Line 300 feet   Drinking Water Well n/a feet   Other ______ feet

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

5. Groundwater Observed: ☒ Yes ☐ No   If yes: 24" Depth Weeping from Pit   n/a Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-10	AP	S.L.	10YR4/4	N/A			N/A				
10-18	Bw	S.L.	10YR6/6	N/A			N/A				
18-76	Cd	Silty Loam.	10YR5/6	24"	10YR5/8	45	N/A	10			

Additional Notes:

Commonwealth of Massachusetts
City/Town of Sturbridge

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

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

Deep Observation Hole Number: 4 (Hole #) 12/3/20 (Date) 9:00 (Time) Clear (Weather) ______ (Latitude) ______ (Longitude:)

1. Land Use: Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) Wooded Area (Vegetation) none (Surface Stones (e.g., cobbles, stones, boulders, etc.)) 2% (Slope (%))

Description of Location: ______

2. Soil Parent Material: Glacial Till   Ground Moraine (Landform)   ______ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body n/a feet   Drainage Way n/a feet   Wetlands 65 feet
Property Line 75 feet   Drinking Water Well n/a feet   Other ______ feet

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

5. Groundwater Observed: ☒ Yes ☐ No   If yes: 30" Depth Weeping from Pit   n/a Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-10	Ap	S.L.	10YR4/4	N/A							
10-30	Bw	S.L.	10YR6/6	30"	10YR5/8	50					
30-76	Cd	Silty Loam	10YR5/6	N/A							

Additional Notes: ______

Commonwealth of Massachusetts
City/Town of Sturbridge

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

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

Deep Observation Hole Number: 5 (Hole #) 12-3-20 (Date) 9:15 (Time) clear 45 (Weather) ______ (Latitude) ______ (Longitude:)

1. Land Use Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) Grass Field (Vegetation) none (Surface Stones (e.g., cobbles, stones, boulders, etc.)) 2% (Slope (%))

   Description of Location: ______

2. Soil Parent Material: Glacial Till Ground Moraine (Landform) ______ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body n/a feet Drainage Way n/a feet Wetlands 200 feet
   Property Line 100 feet Drinking Water Well n/a feet Other ______ feet

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

5. Groundwater Observed: ☒ Yes ☐ No If yes: 20" Depth Weeping from Pit n/a Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-10	AP	S.L.	10YR4/4	N/A			N/A				
10-24	Bw	S.L.	10YR6/6	N/A			N/A				
24-76	C	S.L..	10YR5/6	24"	10YR5/8	45	N/A	10			

Additional Notes:

Commonwealth of Massachusetts
City/Town of Sturbridge

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

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

Deep Observation Hole Number: 6 (Hole #) 12/3/20 (Date) 9:30 (Time) Clear (Weather) ______ (Latitude) ______ (Longitude:)

1. Land Use: Vacant Lot (e.g., woodland, agricultural field, vacant lot, etc.) Grass Field (Vegetation) none (Surface Stones (e.g., cobbles, stones, boulders, etc.)) 2% (Slope (%))

   Description of Location: ______

2. Soil Parent Material: Glacial Till Ground Moraine (Landform) ______ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body n/a feet Drainage Way n/a feet Wetlands 65 feet
   Property Line 30 feet Drinking Water Well n/a feet Other ______ feet

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

5. Groundwater Observed: ☒ Yes ☐ No If yes: 24" Depth Weeping from Pit n/a Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-12	Ap	S.L.	10YR4/4	N/A							
12-24	Bw	S.L.	10YR6/6	24"	10YR5/8	50					
24-76	C	S.L.	10YR5/6	N/A							

Additional Notes:

Commonwealth of Massachusetts
City/Town of Sturbridge

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

A. Facility Information

Interstate Towing
Owner Name

Charlton Road
Street Address

208-2612-150
Map/Lot #

Sturbridge
City

MA
State

01566
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: Mass. GIS (Source) 307C (Soil Map Unit)

   Paxton
   Soil Name

   stony
   Soil Limitations

   Glacial Till
   Soil Parent material

   Ground Moraine
   Landform

3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: ____ Year Published/Source ____ Map Unit

   ____
   Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: ____ Wetland Type

7. Current Water Resource Conditions (USGS): December 2020 (Month/Day/ Year) Range: ☐ Above Normal ☐ Normal ☒ Below Normal

8. Other references reviewed:

Commonwealth of Massachusetts
City/Town of Sturbridge

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

D. Determination of High Groundwater Elevation

1. Method Used: Obs. Hole #1 Obs. Hole #2

	Obs. Hole #1	Obs. Hole #2
☐ Depth observed standing water in observation hole	_____ inches	_____ inches
☒ Depth weeping from side of observation hole	30 inches	24 inches
☒ Depth to soil redoximorphic features (mottles)	36 inches	30 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

________________ Index Well Number ________________ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: 24 inches Lower boundary: 76+ inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Sturbridge

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

D. Determination of High Groundwater Elevation

1. Method Used:

	Obs. Hole #3	Obs. Hole #4
☐ Depth observed standing water in observation hole	_____ inches	_____ inches
☒ Depth weeping from side of observation hole	24 inches	30 inches
☒ Depth to soil redoximorphic features (mottles)	24 inches	30 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

Index Well Number ____________ Reading Date ____________

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: 30 inches Lower boundary: 76+ inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Sturbridge

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

D. Determination of High Groundwater Elevation

1. Method Used: Obs. Hole #5 Obs. Hole #6

	Obs. Hole #5	Obs. Hole #6
☐ Depth observed standing water in observation hole	_____ inches	_____ inches
☒ Depth weeping from side of observation hole	20 inches	24 inches
☒ Depth to soil redoximorphic features (mottles)	24 inches	24 inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

Index Well Number ____________ Reading Date ____________

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: 24 inches Lower boundary: 76+ inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Sturbridge

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

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

	12-3-20
Signature of Soil Evaluator	Date
Peter Lavoie #1332	2023
Typed or Printed Name of Soil Evaluator / License #	Expiration Date of License
Name of Approving Authority Witness	Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

Flood Map

National Flood Hazard Layer FIRMette

FEMA

72°3'56"W 42°7'30"N

72°3'19"W 42°7'3"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/7/2022 at 11:04 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

After & During Inspection Logs

Inspection and Maintenance Log FOR: 150 Charlton Road
AFTER CONSTRUCTION & After 3.0” Rain

Components	**Date**
UG Basin#6P **– twice a year**	
Comments during insp.	
Note corrective measures performed & Date	
Catch Basin 1 **– 8 inches of sediment or twice a year**	
Comments during insp.	
Note corrective measures performed & date	
Catch Basin 2 **– 8 inches of sediment or twice a year**	
Comments during insp.	
Note corrective measures performed & date	
Catch Basin 3 **– 8 inches of sediment or twice a year**	
Comments during insp.	
Note corrective measures performed & date	
Catch Basin 4 **– 8 inches of sediment or twice a year**	
Comments during insp.	
Note corrective measures performed & date ______________________________. Inspector Title Date	
______________________________.	

Inspection and Maintenance Log FOR: 150 Charlton Road
AFTER CONSTRUCTION & After 3.0" Rain

Address Tel#	

Components	Date
Outlet Control Structure 1 **-as-needed**	
Comments during insp.	
Note corrective measures performed & date	
All Flared end sections and rip rap aprons **– twice a year**	
Comments during insp.	
Note corrective measures performed & date	
Rip Rap & Flared End After Outlet Basin 6P **-twice a year**	
Comments during insp.	
Note corrective measures performed & date	
Gutters on Building **-As needed**	
Comments during insp.	
Note corrective measures performed & date	
Street Sweeping **– twice a year**	
Comments during insp.	
Note corrective measures performed & date	
Comments during insp.	
Note corrective measures performed & date ______________________________. Inspector Title Date	

Inspection and Maintenance Log FOR: 150 Charlton Road
AFTER CONSTRUCTION & After 3.0" Rain

Components	Date
Comments during insp.	
Note corrective measures performed & date	
Comments during insp.	
Note corrective measures performed & date	
Comments during insp.	
Note corrective measures performed & date	
Comments during insp.	
Note corrective measures performed & date	
Comments during insp.	
Note corrective measures performed & date	
Comments during insp.	
Note corrective measures performed & date ______________________________ . Inspector Title Date	

20-409

WEEKLY
Inspection and Maintenance Log FOR: 150 Charlton RD
DURING CONSTRUCTION & After 0.5" Rain

Components	**Date**
Erosion Control – Weekly	
Comments during insp.	
Note corrective measures performed & Date	
On Site Pavement Sweeping – as Needed	
Comments during insp.	
Note corrective measures performed & date	
Silt Fence & Composite Sock– Monthly	
Comments during insp.	
Note corrective measures performed & date	
Temporary Basin Area as Needed	
Comments during insp.	
Note corrective measures performed & date	
Construction Entrance as Needed	
Comments during insp.	
Note corrective measures performed & date ______________________________. Inspector Title Date	
______________________________. Address Tel#	

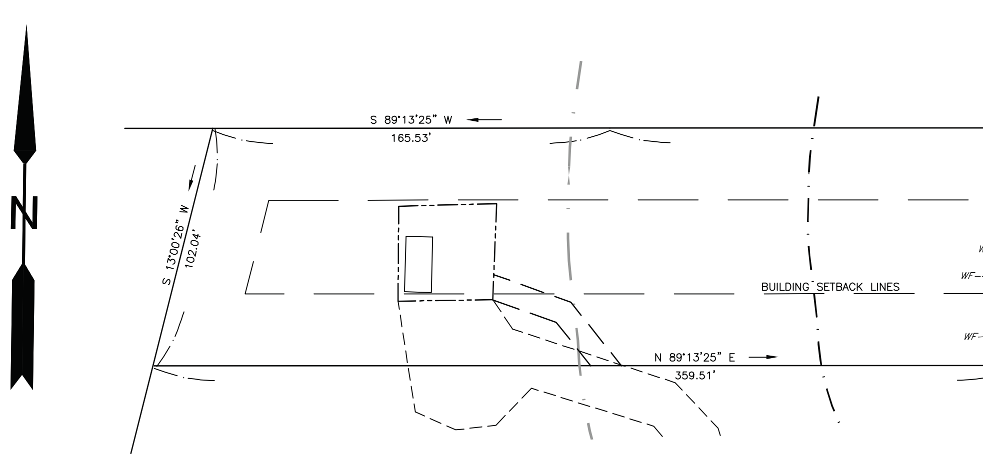
20-409

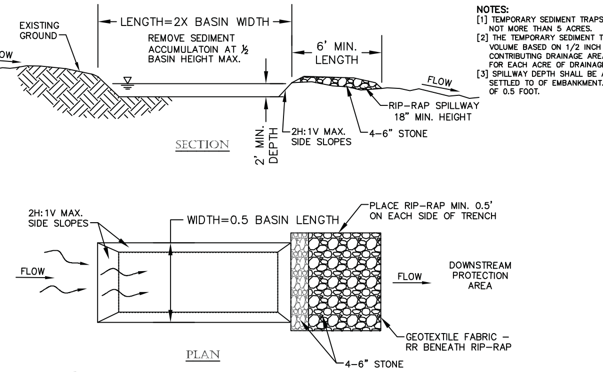
WEEKLY
Inspection and Maintenance Log FOR: 150 Charlton RD
DURING CONSTRUCTION & After 0.5" Rain

Components	Date
Lawn Area / Mulch Area Erosion, Washouts	
Comments during insp.	
Note corrective measures performed & date	
Stone Aprons at Outfalls Exit as Needed	
Comments during insp.	
Note corrective measures performed & date	
Forebay as Needed	
Comments during insp.	
Note corrective measures performed & date	
Basins 6P as Needed	
Comments during insp.	
Note corrective measures performed & date	
Illicit Drainage Discharge	
Comments during insp.	
Note corrective measures performed & date ______________________________. Inspector Title Date	
______________________________. Address Tel#	

WEEKLY
Inspection and Maintenance Log FOR: 150 Charlton RD
DURING CONSTRUCTION & After 0.5” Rain

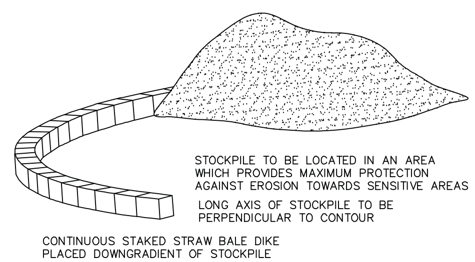
BMP Inspection Map



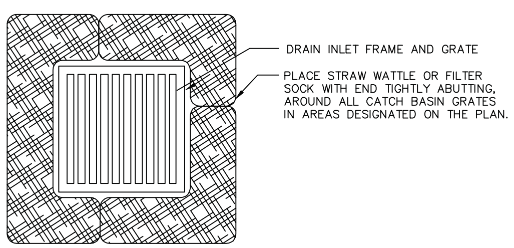


NOTES:
[1] TEMPORARY SEDIMENT TRAPS SHALL HAVE A DRAINAGE AREA OF NOT MORE THAN 5 ACRES.
[2] THE TEMPORARY SEDIMENT TRAP SHALL HAVE A MINIMUM VOLUME BASED ON 1/2 INCH OF STORAGE FOR EACH ACRE OF CONTRIBUTING DRAINAGE AREA OR 67 CUBIC YARDS OF VOLUME FOR EACH ACRE OF DRAINAGE AREA.
[3] SPILLWAY DEPTH SHALL BE A MINIMUM OF 1.5 BELOW DESIGNED, SETTLED TO OF EMBANKMENT. FREEBOARD SHALL BE A MINIMUM OF 0.5 FOOT.

1/6 TEMPORARY SEDIMENT BASIN
N.T.S.

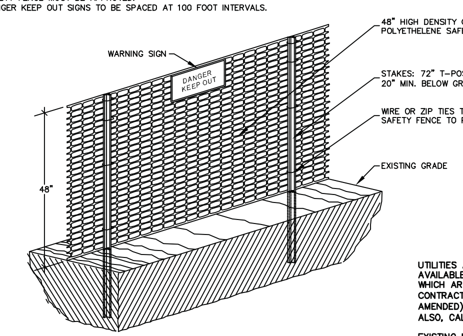


2/6 TEMPORARY STOCKPILE
N.T.S.



3/6 CATCH BASIN STRAW WATTLE/FILTER SOCK
N.T.S.

NOTES:
[1] ALL ACTIVE CONSTRUCTION AREAS SHALL BE PROTECTED PER PLAN.
[2] SAFETY FENCE SHALL BE FASTENED SECURELY TO T-POSTS.
[3] FENCING MUST REMAIN IN PLACE DURING ALL PHASES OF CONSTRUCTION; ANY CHANGE OF THE SAFETY FENCE MUST BE APPROVED.
[4] "DANGER KEEP OUT SIGNS TO BE SPACED AT 100 FOOT INTERVALS.



4/6 CONSTRUCTION SAFETY FENCE
N.T.S.

DIG SAFE NOTE:

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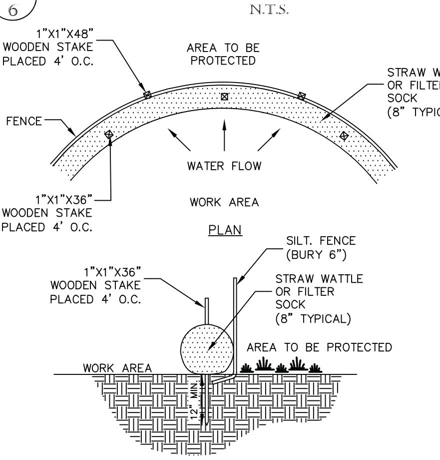
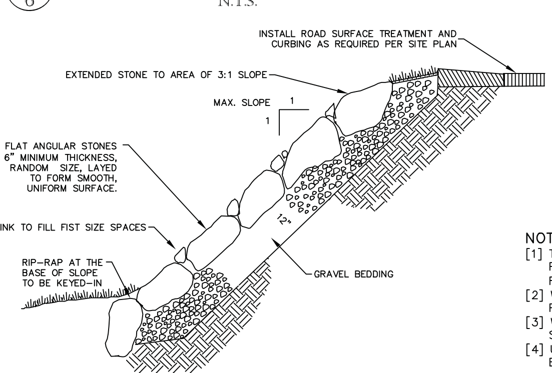
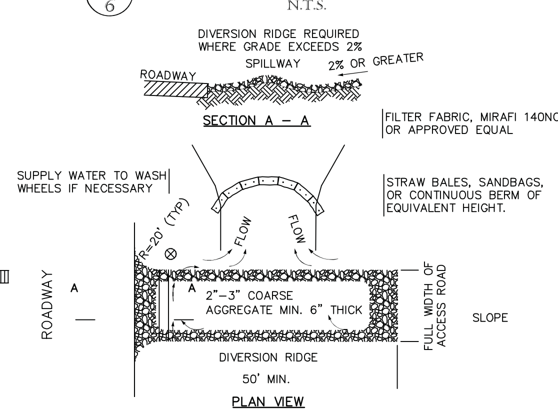
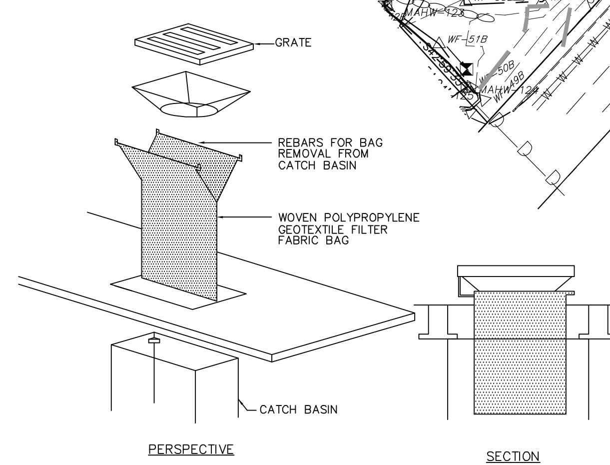


5/6 EROSION CONTROL BARRIER (ECB)
N.T.S.





NOTES:
[1] THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHT-OF-WAYS. THIS MAY REQUIRE TOP DRESSING, REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT.
[2] WHEN NECESSARY, WHEELS SHALL BE CLEANED PRIOR TO ENTRANCE ONTO PUBLIC RIGHT-OF-WAY.
[3] WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON AREA STABILIZED WITH CRUSHED STONE THAT DRAINS INTO AN APPROVED SEDIMENT TRAP OR SEDIMENT BASIN.
[4] USE SANDBAGS, STRAW BALES OR OTHER APPROVED METHODS TO CHANNELIZE RUNOFF TO BASIN AS REQUIRED.



NOTES:
[1] TO BE SILTSACK BY ATLANTIC CONSTRUCTION FABRICS, INC., OR APPROVED EQUAL.
[2] TO BE INSTALLED IMMEDIATELY FOLLOWING THE INSTALLATION OF CATCH BASIN STRUCTURE AND REMAIN UNTIL FINISH COURSE IS PLACED.
[3] FILTER BAG SHALL BE MAINTAINED AND CLEANED AS NEEDED.

EROSION AND SEDIMENT CONTROL REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. FURNISH, INSTALL, AND MAINTAIN TEMPORARY AND PERMANENT EROSION AND SEDIMENT CONTROL MEASURES, SUCH AS, BUT NOT NECESSARILY LIMITED TO, STRAW BALE AND SILT FENCE BARRIERS, RIPRAP, VEHICLE TRACKING PADS, DIVERSION CHANNELS AND BERMS, CHECK DAMS, STRATEGICALLY LOCATED STOCKPILES, SEDIMENT BASINS, MULCH, AND SEED MIX (HEREINAFTER "CONTROL MEASURES") ADEQUATE TO PREVENT THE CONVEYANCE OF EROSION PRODUCTS (E.G. SOIL, MULCH, SOD) OFF SITE, OR INTO ENVIRONMENTALLY SENSITIVE AREAS, OR INTO AREAS WHERE WORK WILL BE ADVERSELY IMPACTED. ENVIRONMENTALLY SENSITIVE AREAS INCLUDE, BUT ARE NOT NECESSARILY LIMITED TO, WETLANDS, TRIBUTARIES TO WETLANDS, WETLAND BUFFER ZONES, INTERMITTENT AND PERENNIAL STREAMS / RIVERS, AND THEIR ATTENDANT BUFFER ZONES.

ALL METHODS AND MATERIALS USED FOR EROSION CONTROL SHALL CONFORM TO THE REQUIREMENTS SET FORTH IN "EROSION AND SEDIMENT CONTROL GUIDELINES FOR URBAN AND SUBURBAN AREAS A GUIDE FOR PLANNERS, DESIGNERS, AND MUNICIPAL OFFICIALS" AS PUBLISHED BY THE MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION, BUREAU OF RESOURCE PROTECTION, UNLESS OTHERWISE APPROVED IN WRITING.

1. REFER TO DRAWINGS FOR LOCATION AND DETAILS OF LIMITS OF DISTURBANCE AND CONTROL MEASURES REQUIRED TO COMMENCE WORK. LIMITS OF DISTURBANCE SHALL BE MARKED WITH TAPE, SIGNS, OR ORANGE CONSTRUCTION FENCE PRIOR TO COMMENCING ANY LAND DISTURBANCE ACTIVITIES. CONTROL MEASURES WILL BE ADEQUATE ONLY FOR VEGETATION CLEARING. THE DRAWINGS ARE NOT INTENDED TO GRAPHICALLY DEPICT ALL CONTROL MEASURES THAT WILL BE REQUIRED TO MEET THE REQUIREMENTS DESCRIBED IN 1.01.A.

2. DEVISE AND EMPLOY CONTROL MEASURES THROUGHOUT THE DURATION OF PROJECT, OVER ALL AREAS DISTURBED OR UNDISTURBED BY CONSTRUCTION, AS NECESSARY TO MEET THE REQUIREMENTS DESCRIBED IN 1.01.A.

3. DEVISE AND EMPLOY TEMPORARY CONTROL MEASURES AS NECESSARY TO MEET THE REQUIREMENTS DESCRIBED IN 1.01.A, WHILE ALLOWING WORK TO PROCEED IN AN EFFICIENT, COST EFFECTIVE MANNER.

4. DEVISE, EMPLOY AND MAINTAIN CONTROL MEASURES UNTIL SUCH TIME AS THE ENTIRE SITE IS PERMANENTLY STABILIZED BY ESTABLISHED VEGETATION, FINISH LANDSCAPE MATERIALS, PAVED SURFACES, AND/OR ROOF AREA.

5. ONCE THE SITE IS PERMANENTLY STABILIZED AND CERTIFIED AS SUCH BY ENGINEER, REMOVE TEMPORARY CONTROL MEASURES WHILE PROTECTING STABILIZED SURFACES.

1.02 SUBMITTALS

A. SUBMIT PRODUCT DATA, WARRANTY, AND TEST REPORTS AS INDICATED ON THE DRAWINGS.

B. SUBMIT SKETCH SHOWING LOCATIONS OF PROPOSED STOCKPILE AREAS, CONSTRUCTION ENTRANCES AND EROSION CONTROLS IF NOT SHOWN ON THE SITE PLAN OR DIFFERENT FROM THOSE LOCATIONS SHOWN ON THE SITE PLAN.

C. A SITE SPECIFIC SEQUENCE OF CONSTRUCTION FOR EACH PORTION OF THE SITE. NO PORTION OF THE SITE SHALL EXCEED FIVE (5) ACRES.

1.03 QUALITY ASSURANCE

A. COMPLY WITH GOVERNING CODES AND REGULATIONS. PROVIDE PRODUCTS FROM ACCEPTABLE MANUFACTURERS. USE EXPERIENCED INSTALLERS. DELIVER, HANDLE, AND STORE MATERIALS IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS.

B. CONFORM TO CONDITIONS OF APPROVAL ISSUED BY REGULATORY AGENCIES INCLUDING, BUT NOT NECESSARILY LIMITED TO, LOCAL PLANNING BOARD, CONSERVATION COMMISSION, CITY COUNCIL, BOARD OF HEALTH, PUBLIC WORKS / HIGHWAY DEPARTMENT, STATE ENVIRONMENTAL PROTECTION DEPARTMENT, AND U.S. GOVERNMENT, ENVIRONMENTAL PROTECTION AGENCY. WHERE CONDITIONS OF REGULATORY APPROVAL DIFFER FROM REQUIREMENTS CONTAINED HEREIN OR ON THE DRAWINGS, COMPLY WITH THE MORE STRINGENT REQUIREMENT.

PART 2 – PRODUCTS

2.01 MATERIALS

A. STRAW BALES: WEED FREE DRY GRASS OR STRAW, MACHINE BOUND WITH JUTE OR WIRE, APPROXIMATE SIZE EACH BALE 42" X 16" X 16". EACH BALE SHALL BE STAKED WITH A MINIMUM OF TWO 24" LONG HARDWOOD STAKES. NOTE: HAY SHALL NOT BE USED.

B. STRAW WATTLES: NORTH AMERICAN GREEN MODEL WS1210 OR APPROVED EQUAL.

C. SILT FENCE: NON-WOVEN, UV-RESISTANT, POLYPROPYLENE FABRIC, FLOW RATED AT 10 GPM/SF MINIMUM, GRAB TENSILE RATED AT 124 POUNDS MINIMUM, WITH INTEGRAL STAKE LOOPS, AND HARDWOOD STAKES. USE NO. 2130 BY AMOCO FABRICS & FIBERS, OR APPROVED EQUAL.

D. MULCH: ORGANICS INCLUDING STRAW, PROCESSED PINE / HEMLOCK TWIGS AND NEEDLES.

E. SEED MIXES: SHALL MEET THE REQUIREMENTS OF MASSACHUSETTS HIGHWAY DEPARTMENT STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES, LATEST EDITION SECTION 6.03.0 OR 6.03.1 AS APPROPRIATE.

F. EXCELSIOR BLANKET: CURLED WOOD FIBER ON PHOTODEGRADABLE EXTRUDED PLASTIC MATRIX, 80% OF FIBERS 6-INCHES LONG OR LONGER, WEIGHT 0.975 POUNDS / SY, CONTAINING NO CHEMICAL ADDITIVES. USE CURLEX I BLANKET BY AMERICAN EXCELSIOR COMPANY, OR APPROVED EQUAL.

G. ROCK RIPRAP: SOUND, ANGULAR, 6-INCH MINUS PROCESSED ROCK, BLAST ROCK, OR TAILINGS.

H. CRUSHED STONE: SOUND, ANGULAR, 2-INCH MINUS PROCESSED CRUSHED STONE.

PART 3 – EXECUTION

3.01 THROUGHOUT CONSTRUCTION

A. DEVISE WORK SEQUENCE SO AS TO LIMIT DRAINAGE AREA THAT IS TRIBUTARY TO DISTURBED AREAS. DEVISE, EMPLOY, AND MAINTAIN CONTROL MEASURES SUCH AS DIVERSION CHANNELS AND BERMS, STRATEGICALLY LOCATED STOCKPILES, AND SEDIMENT BASINS TO SUBDIVIDE DRAINAGE AREAS INTO SMALL, MANAGEABLE SUBAREAS, THEREBY MINIMIZING RUNOFF AND THE POTENTIAL FOR EROSION.

B. MAINTAIN BARRIER AT LIMIT OF WORK AND PROTECT EXISTING VEGETATION / FACILITIES OUTSIDE OF LIMIT OF WORK.

C. MAINTAIN SPARE MATERIAL STOCKPILES FOR IMMEDIATE EMPLOYMENT / REPAIR / EXPANSION OF CONTROL MEASURES. AT A MINIMUM, SUCH MATERIALS SHALL INCLUDE HAY BALES, SILT FENCE AND STAKES, AND CRUSHED STONE.

D. INSPECT AND MAINTAIN EFFECTIVENESS OF CONTROL MEASURES BY REPAIRING AS NECESSARY TO ENSURE INTENDED FUNCTION; BY SUPPLEMENTING AS NECESSARY FOR ADEQUATE EXTENT; BY REMOVING TRAPPED PRODUCTS OF EROSION AS NECESSARY TO MAINTAIN EFFECTIVE TRAP VOLUME.

E. LIMIT EXTENT OF WORK AREA SO THAT ALL DISTURBED AREAS CAN BE STABILIZED WITH CONTROL MEASURES WITHIN A 24-HOUR PERIOD.

F. INSTALL CONTROL MEASURES AS SOON AS PRACTICABLE AFTER EACH MANAGEABLE PORTION OF EARTHWORK IS COMPLETE. EMPLOY TEMPORARY MEASURES AS NECESSARY TO STABILIZE DISTURBED AREAS, EVEN WHERE SUBSEQUENT CONSTRUCTION OPERATIONS MAY REQUIRE RE-DISTURBANCE.

G. WHEN INTENSE RAINFALL IS EXPECTED, CONSIDER, DEVISE, AND EMPLOY REINFORCING CONTROL MEASURES PRIOR TO THE RAINFALL EVENT TO MEET THE REQUIREMENTS DESCRIBED IN 1.01.A. IF NECESSARY, EMPLOY TEMPORARY CONTROL MEASURES ON MATERIAL STOCKPILES TO COUNTERACT POTENTIAL SEDIMENT TRANSPORT DURING INTENSE RAINFALL.

H. WHEN VEHICLE REFUELING IS REQUIRED ON SITE, CONDUCT REFUELING OPERATIONS OUTSIDE OF ENVIRONMENTALLY SENSITIVE AREAS.

PART 3 – CONTINUED

I. PROPERLY DISPOSE OF DEBRIS, SOLID WASTE, TRASH, AND CONSTRUCTION WASTE / BYPRODUCTS OFF SITE.

J. SWEEP ON-SITE PAVED AREAS AND OFF-SITE STREETS AS NECESSARY TO PREVENT SILT AND DEBRIS ORIGINATING ON SITE FROM ENTERING CLOSED DRAINAGE SYSTEMS AND / OR ENVIRONMENTALLY SENSITIVE AREAS. WHEN NECESSARY UTILIZE WATER SPRAYING, SURFACE ROUGHENING AND/OR APPLY POLYMERS, SPRAY-ON TACKIFIERS, CHLORIDES AND BARRIERS FOR DUST CONTROL.

K. INSPECT EROSION CONTROLS DAILY THROUGHOUT CONSTRUCTION REPAIR DAMAGED CONTROLS IMMEDIATELY.

3.02 SITE PREPARATION AND ACCESS

A. WALK SITE AND IDENTIFY LOCATIONS OF LIMIT OF WORK AND ENVIRONMENTALLY SENSITIVE AREAS. ESTABLISH CONSTRUCTION STAGING AREA, LOCATED BEYOND ENVIRONMENTALLY SENSITIVE AREAS.

B. INSTALL CONTROL MEASURES AS SHOWN ON THE DRAWINGS, INCLUDING THOSE DEFINING THE LIMIT OF WORK.

C. LIMIT VEHICULAR TRAFFIC TO AND FROM SITE TO MINIMIZE TRANSPORT OF SEDIMENT.

3.03 CLEARING, GRUBBING, AND STRIPPING

A. SCHEDULE GRUBBING AND STRIPPING TO OCCUR IMMEDIATELY PRIOR TO EARTH DISTURBANCE. DEPENDING ON SITE AREA, CONSIDER MULTIPLE GRUBBING PHASES, SEQUENCED TO TAKE ADVANTAGE OF THE EROSION PREVENTION POTENTIAL OF EXISTING VEGETATIVE COVER.

B. MINIMIZE THE AREA OF EXISTING VEGETATION REMOVED WHEREVER POSSIBLE. NO GREATER THAN FIVE (5) ACRES SHALL BE UNSTABLE AT ANY TIME.

C. LOCATE AND SIZE STOCKPILES TO MINIMIZE EROSION POTENTIAL, TAKING ADVANTAGE OF TERRAIN SLOPE AND ASPECT, WHERE APPROPRIATE.

D. PROTECT VEGETATION, INCLUDING ROOT SYSTEMS, BEYOND LIMIT OF CLEARING.

E. PROCESS TIMBER, STUMPS, SLASH, AND BRUSH SO AS TO PROTECT ENVIRONMENTALLY SENSITIVE AREAS AND INSTALLED CONTROL MEASURES. PROPERLY DISPOSE OF EXCESS OFF SITE. BURIAL OF STUMPS ON SITE IS PROHIBITED.

3.04 EXCAVATION FOR BUILDING FOUNDATIONS AND UTILITIES

A. DEVISE AND INSTALL CONTROL MEASURES ADEQUATE TO HANDLE DISCHARGES AND TRAP SEDIMENT FROM FOOTING SUMP AND WELL POINT PUMPS PRIOR TO EXCAVATION.

B. ARMOR SUMP PUMP DISCHARGE LOCATIONS TO PREVENT EROSION AT POINT OF DISCHARGE AND AREAS DOWNSTREAM.

C. IF FOUNDATION EXCAVATIONS GRADE TO DAYLIGHT ON THE LOW SIDE, DEVISE AND INSTALL CONTROL MEASURES TO HANDLE SURFACE AND GROUNDWATER FLOW FROM EXCAVATION LOW POINT.

D. STOCKPILE EXCAVATED MATERIALS TO BAFFLE OVERLAND RUNOFF, AVOIDING THE CREATION OF LENGTHY PATHS OF CONCENTRATED RUNOFF. STOCKPILE SLOPES SHALL NOT EXCEED 2:1.

E. BACKFILL UTILITY TRENCHES AS SOON AS PRACTICABLE TO PREVENT FLOODING, SLOUGHING, POTENTIAL OVERFLOW, AND REPETITIVE EARTH DISTURBANCE.

3.05 SITE GRADING

A. WHERE APPLICABLE, FOLLOW EXCAVATION AND FILL PRACTICES SHOWN ON DRAWINGS TO LOCALIZE AND MINIMIZE EROSION.

B. MONITOR SEDIMENT VOLUME IN TEMPORARY SEDIMENT BASINS AND AT DIVERSION BERMS AND CHECK DAMS. IN ALL AREAS EXCEPT THOSE THAT DO NOT PRESENT POTENTIAL PROBLEMS WITH REGARD TO FUTURE SOIL STABILITY, DRAINAGE, OR BEARING CAPACITY, REMOVE AND PROPERLY DISPOSE OF TRAPPED SEDIMENT BEFORE BRINGING SITE TO FINAL SUBGRADE.

C. EXPOSED SOILS SHALL BE PERMANENTLY STABILIZED WITHIN FIVE (5) BUSINESS DAYS OF COMPLETION OF CONSTRUCTION OF A GIVEN AREA. EXPOSED AREAS WHERE NO WORK HAS OCCURRED FOR FOURTEEN (14) DAYS SHALL BE TEMPORARILY STABILIZED WITH HYDROSEED OR OTHER APPROVED METHOD.

D. SLOPES STEEPER THAN 3:1 SHALL BE STABILIZED IMMEDIATELY AFTER COMPLETION.

3.06 LANDSCAPING

A. COMPLETE LANDSCAPING AS SOON AS POSSIBLE AFTER COMPLETION OF FINAL SUBGRADE.

B. IMMEDIATELY AFTER PLACEMENT OF TOPSOIL, STABILIZE WITH CONTROL MEASURES INCLUDING, BUT NOT NECESSARILY LIMITED TO, SEED MIX, MULCH, AND / OR BLANKET.

C. PERMANENT SEEDING MAY BE PERFORMED IN THE SPRING PRIOR TO JULY 1 AND IN BETWEEN AUGUST 1 AND OCTOBER 15. PERMANENT SEEDING AT OTHER TIMES SHALL BE APPROVED AND SHALL ONLY BE ALLOWED WITH AN APPROVED MULCHING AND IRRIGATION PROGRAM.

CONSTRUCTION SEQUENCE PLAN

1. LIMIT OF CLEARING AND EROSION CONTROL WILL BE STAKED OUT BY A PROFESSIONAL LAND SURVEYOR PER THE APPROVED SITE PLANS.
2. EROSION CONTROLS WILL BE INSTALLED ALONG THE WETLANDS AREAS.
3. LOT WILL BE CLEARED UP TO THE LIMIT OF CLEARING FLAGS.
4. ALL TEMPORARY SETTLING BASIN WILL BE CONSTRUCTED TO CONTROL RUNOFF GENERATED DURING CONSTRUCTION.
5. PERMANENT BASIN TO BE CONSTRUCTED AND EROSION CONTROL TO BE PLACED UP GRADIENT TO PREVENT SEDIMENT FROM ENTERING THE PERMANENT BASIN.
6. SITE TO BE BROUGHT DOWN TO THE DESIRED ELEVATIONS PER GRADING PLAN.
7. DRAINAGE STRUCTURES TO BE INSTALLED STARTING AT THE LOWEST AREAS AND WORKING INTO THE SITE.
8. TEMPORARY BASIN TO BE CONSTRUCTED AS NEEDED TO CONTROL THE RUNOFF GENERATED FROM THE SITE AND DIRECTED TOWARD THE PERMANENT BASIN PRIOR TO ENTERING THE ADJACENT WETLANDS.
9. ONCE SITE HAS MEET DESIRED GRADES AREAS TO BE STABILIZED.
10. EXISTING TREES TO BE CLEAR ALONG THE WETLANDS ONCE THE SITE HAS BEEN STABLIZED AND DRAINAGE STRUCTURES ARE CONSTRUCTED.
11. PROPOSED BUILDING TO BE CONSTRUCTED.
12. PAVE AREAS TO BE PAVED.
13. ONCE SITE IS COMPLETED PROFESSIONAL LAND SURVEYOR TO PERFORM AS-BUILT OF SITE AND SUBMIT TO THE STURBRIDGE CONSERVATION COMMISSION.

P.E.	P.L.S.
COMMONWEALTH OF MASSACHUSETTS, MIKAEL A. LASSILA, CIVIL, No. 45680, REGISTERED PROFESSIONAL ENGINEER	COMMONWEALTH OF MASSACHUSETTS, JAMES PATRICK SMITH, No. 46170, REGISTERED PROFESSIONAL LAND SURVEYOR

APPROVAL UNDER SITE PLAN REVIEW.
STURBRIDGE PLANNING BOARD

BEING A MAJORITY

APPROVAL DATE: ____________________

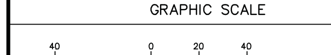
ENDORSEMENT DATE: ____________________

REVISIONS

REV.	DATE	DESCRIPTION
5	6/22/22	REMOVED TEMP. CONST. ACCESS
4	6/13/22	ISSUED FOR COBRA REALTY TRUST
3	4/13/22	REVISED PER COMMENTS.
2	2/24/22	REVISED PER COMMENTS.
1	1/20/22	REVISED PER COMMENTS.

PROJECT NO.	20-409
DESIGNED BY	PML
CHECKED BY	AB
DATE	9/13/21
CAD FILE	19-288_150...Alt2.dwg

GRAPHIC SCALE



PREPARED BY:

SUMMIT
Engineering & Survey, Inc.
710 MAIN STREET
OXFORD, MA 01537
P:(508) 987-8713 F:(508) 987-8714

SHEET TITLE

EROSION CONTROL PLAN

DEFINITIVE SITE PLAN
at
150 CHARLTON ROAD (ROUTE 20)
STURBRIDGE, MA
PREPARED FOR
COBRA REALTY TRUST
SHEET 6 OF 11

SHEET NO.

DIG SAFE NOTE:

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APPROVAL UNDER SITE PLAN REVIEW.
STURBRIDGE PLANNING BOARD

BEING A MAJORITY

APPROVAL DATE: ____________

ENDORSEMENT DATE: ____________

LEGEND

- IRON PIPE FOUND
- DRILL HOLE FOUND
- STONE OR CONCRETE MONUMENT
- SEWER MANHOLE
- DRAIN MANHOLE
- ELECTRIC MANHOLE
- TELEPHONE MANHOLE
- WATER MANHOLE
- UNDETERMINED MANHOLE
- CATCH BASIN
- CLEANOUT
- MONITORING WELL
- ANCHOR
- UTILITY POLE
- WATER GATE VALVE
- WATER SHUT OFF
- HYDRANT
- BENCHMARK
- GAS VALVE
- SIGN
- LIGHT POLE / LAMP POST
- SPOT LIGHT
- MAILBOX (MBX)
- BOLLARD
- OBSERVATION TEST PIT
- HYDRIC SOIL TEST PIT
- BORING TEST PIT
- SHRUBS, BUSHES, ETC.
- DECIDUOUS TREE
- CONIFEROUS TREE
- WETLAND FLAG
- BOULDER
- VGC VERTICAL GRANITE CURBING
- CNCRB CONCRETE CURBING
- CCB CAPE COD BERM (BITUMINOUS)
- BTCRB BITUMINOUS CURBING (GENERIC)
- E ELECTRIC LINE
- S SEWER LINE
- D DRAIN LINE
- W WATER LINE
- G GAS LINE
- T TELEPHONE LINE
- F FIRE PROTECTION LINE
- OHW OVERHEAD WIRES
- C CABLE TELEVISION
- RD ROOF DRAIN
- STONEWALL
- EDGE OF PAVEMENT
- X FENCING (AS NOTED)
- GUARD RAILING (AS NOTED)
- TREE LINE
- EDGE OF LANDSCAPING
- BORDERING VEGETATED WETLAND
- PROPERTY LINE
- SSD SUBSURFACE DRAIN

REVISIONS		
REV.	DATE	DESCRIPTION

PROJECT NO.	19-288
DESIGNED BY	PML
CHECKED BY	AB
DATE	5/26/22
CAD FILE	19-288_150 CHARLTON ST. SITE

GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

1 inch = 40 feet

PREPARED BY:

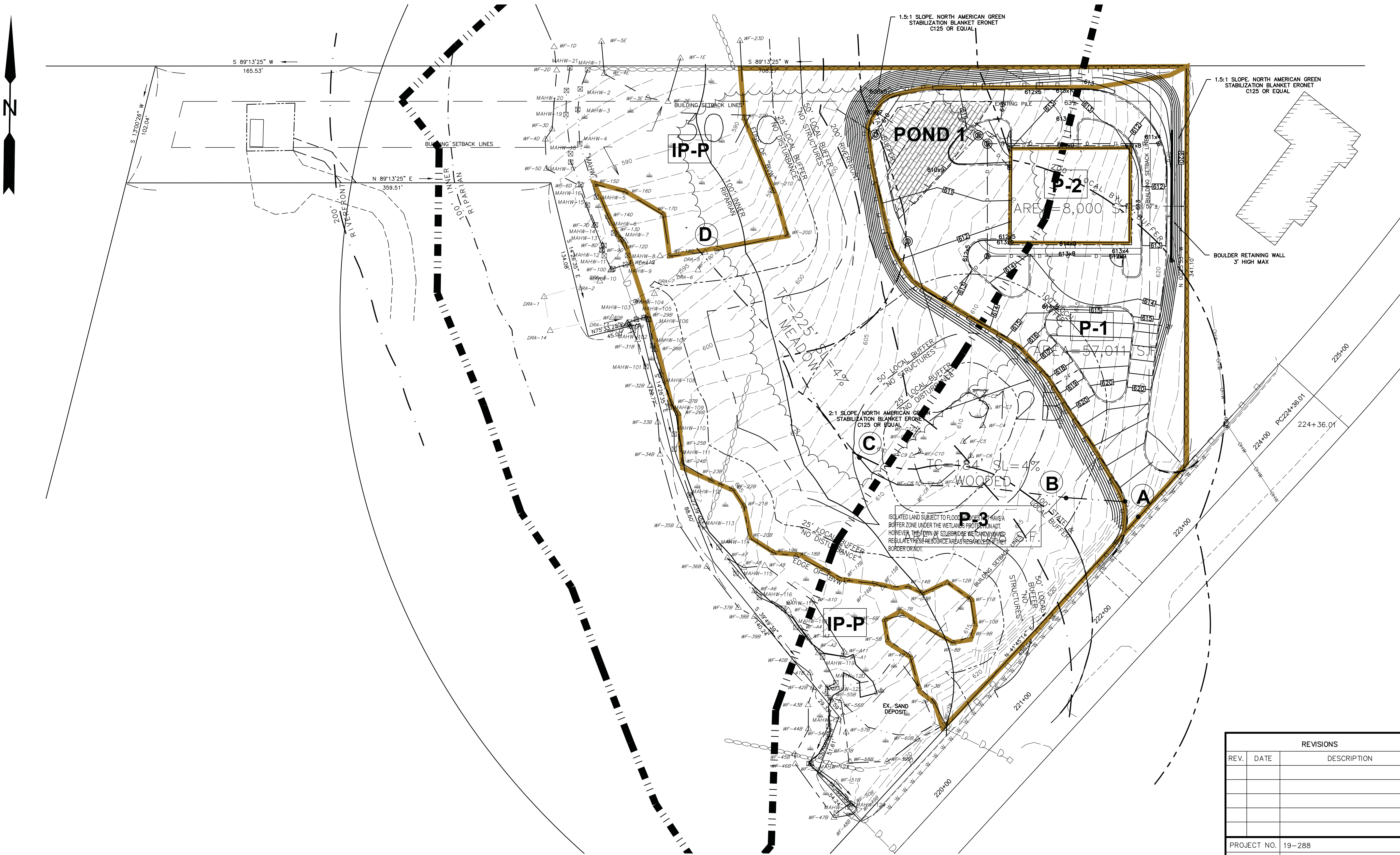
SUMMIT
Engineering & Survey, Inc.
710 MAIN STREET
OXFORD, MA 01537
P:(508) 987-8713 F:(508) 987-8714

SHEET TITLE

PRE-DEVELOPMENT

DEFINITIVE SITE PLAN
at
150 CHARLTON ROAD (ROUTE 20) STURBRIDGE, MA
PREPARED FOR
COBRA REALTY TRUST

SHEET NO.



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APPROVAL UNDER SITE PLAN REVIEW.
STURBRIDGE PLANNING BOARD

BEING A MAJORITY

APPROVAL DATE: ____________

ENDORSEMENT DATE: ____________

LEGEND

- IRON PIPE FOUND
- DRILL HOLE FOUND
- STONE OR CONCRETE MONUMENT
- SEWER MANHOLE
- DRAIN MANHOLE
- ELECTRIC MANHOLE
- TELEPHONE MANHOLE
- WATER MANHOLE
- UNDETERMINED MANHOLE
- CATCH BASIN
- C/O CLEANOUT
- MW MONITORING WELL
- ANCHOR
- UTILITY POLE
- WG WATER GATE VALVE
- WSO WATER SHUT OFF
- HYDRANT
- BENCHMARK
- GV GAS VALVE
- SIGN
- LIGHT POLE / LAMP POST
- SPOT LIGHT
- MBX MAILBOX (MBX)
- BOLLARD
- OBSERVATION TEST PIT
- HYDRIC SOIL TEST PIT
- BORING TEST PIT
- SHRUBS, BUSHES, ETC.
- DECIDUOUS TREE
- CONIFEROUS TREE
- WF-26 WETLAND FLAG
- BOULDER
- VGC VERTICAL GRANITE CURBING
- CNCRB CONCRETE CURBING
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- T TELEPHONE LINE
- F FIRE PROTECTION LINE
- OHW OVERHEAD WIRES
- C CABLE TELEVISION
- RD ROOF DRAIN
- STONEWALL
- EDGE OF PAVEMENT
- X FENCING (AS NOTED)
- GUARD RAILING (AS NOTED)
- TREE LINE
- EDGE OF LANDSCAPING
- BORDERING VEGETATED WETLAND
- PROPERTY LINE
- SSD SUBSURFACE DRAIN

PREPARED BY:

SUMMIT
Engineering & Survey, Inc.
710 MAIN STREET
OXFORD, MA 01537
P:(508) 987-8713 F:(508) 987-8714

REVISIONS		
REV.	DATE	DESCRIPTION

PROJECT NO.	19-288
DESIGNED BY	PML
CHECKED BY	SB
DATE	5/26/22
CAD FILE	19-288_150 CHARLTON ST. SITE

SHEET TITLE

POST-DEVELOPMENT

DEFINITIVE SITE PLAN
at
150 CHARLTON ROAD
(ROUTE 20)
STURBRIDGE, MA
PREPARED FOR
COBRA REALTY TRUST

GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

1 inch = 40 feet

SHEET NO.

STANDARD #9- OPERATION & MAINTENANCE

OPERATION & MAINTENANCE PLAN:

Property Tax Id:
ASSESSORS PARCEL ID: 208-02612-150

CURRENT OWNER & RESPONSIBLE PARTY:
COBRA REALTY TRUST MICHAEL CIESLA & MELVIN GLICKMAN
14 HARVARD STREET
WORCESTER, MA
(Contractor/Future Owner shall be responsible during construction)
COBRA REALTY TRUST MICHAEL CIESLA & MELVIN GLICKMAN
14 HARVARD STREET
WORCESTER, MA
413-593-1900

FUTURE OWNER & RESPONSIBLE PARTY:
TBD

DURING CONSTRUCTION:

***SILT FENCE BARRIER*:**

The silt fence barrier shall be installed prior to construction.

During construction the contractor shall inspect the silt fence barrier on a weekly basis and after any significant rainstorm resulting in greater than 0.5” of rainfall. The barrier shall be inspected for any breaches or disturbed silt fence and repaired immediately.

After construction the barrier shall be maintained as stated above until all new areas are vegetated.

After construction these duties shall transfer to the property owner.

***CONSTRUCTION ENTRANCE APRONS*:**

Construction aprons shall be installed to protect Route 20. The construction entrance apron shall be installed prior to commencement of construction and shall be inspected weekly. The construction entrance apron shall be replaced when debris becomes noticeable on the existing pavement surfaces leading to and from the construction site.

***SLOPE STABILIZATION*:**

The slope stabilization controls shall be installed immediately upon obtaining final grades as shown on the project plans. Slopes in the swale area shall be stabilized according to the details provided. All 3:1 slopes established on-site shall be loamed and seeded as soon as weather permits. Any 2:1 slopes established shall be covered with slope stabilization fabric, then loamed and seeded as soon as weather permits. Areas in failure shall be re-graded to final grade and stabilized as necessary.

***TEMPORARY BASINS*:**

The temporary basins shall be inspected immediately after storm events and cleaned to remove sediment build-up. Outfalls shall be inspected for erosion or scouring. Additional rip rap shall be added as required to minimize erosion.

***CATCH BASINS*:**

Catch basin entrances shall have temporary stone or other filtration device installed around inlet to prevent sediment deposits. Sediment shall be removed when accumulation exceeds 1" depth on paved surfaces.

***PROPRIETARY SEPARATOR*:**

The proprietary separator shall be inspected immediately after storm events and cleaned to remove sediment build-up. Cleaning methods shall adhere to the manufacturer's directions.

During construction the proprietary separator shall be inspected on a weekly basis for evidence of clogging or other situation that may adversely affect its function.

***CONSTRUCTION COMPLETION*:**

The entire stormwater management system shall be inspected upon completion of construction. Portions of the system containing sediment shall be cleaned and all sediment properly removed.

AFTER CONSTRUCTION:

Stormceptor Units 1 & 2 (Manhole & Catch Basin)

At a minimum, the catch basins shall be inspected and cleaned on a quarterly basis. It is preferred that collection of accumulated sediment shall be accomplished by means of vacuum pumping and not by means of a clamshell bucket. Disposal of accumulated sediment shall be performed in accordance with applicable local, state, and federal guidelines and regulations

***CATCH BASINS*:**

At a minimum, the catch basins shall be inspected and cleaned on a quarterly basis. It is preferred that collection of accumulated sediment shall be accomplished by means of vacuum pumping and not by means of a clamshell bucket. Disposal of accumulated sediment shall be performed in accordance with applicable local, state, and federal guidelines and regulations.

Rip Rap Aprons

Rip Rap Aprons shall be visually inspected monthly for accumulation of debris, slope failure, or stone displacement. Slopes shall be mowed quarterly. Bottom shall be swept, vacuumed of accumulated debris semi-annually.

Underground Dry Wells

The following guidelines shall be adhered to for the operation and maintenance of the Cultec/Stormtech stormwater management system:
A. The owner shall keep a maintenance log which shall include details of any events which would have an effect on the system's operational capacity.
B. The operation and maintenance procedure shall be reviewed periodically and changed to meet site conditions.
C. Maintenance of the stormwater management system shall be performed by qualified workers and shall follow applicable occupational health and safety requirements.
D. Debris removed from the stormwater management system shall be disposed of in accordance with applicable laws and regulations.

- Monthly in first year - Check inlets and outlets for clogging and remove any debris, as required. Spring and Fall Check inlets and outlets for clogging and remove any debris, as required.

- One year after commissioning and every third year following Check inlets and outlets for clogging and remove any debris, as required.

LONG TERM POLLUTION PREVENTION PLAN

The following are the material management practices that shall be used to reduce the risk of spills or other accidental exposure of materials and substances to stormwater runoff.

Good Housekeeping: The following good housekeeping practices will be followed on site during the construction project and continued upon completion of the construction activities.

1. A concerted effort shall be made to store only enough product required to complete a particular task.
2. All materials stored on site shall be stored in a neat and orderly fashion in their appropriate containers and, if possible, under a roof or other secure enclosure.

3. Products shall be kept in their original containers with the original manufacture's label.
4. Substances shall not be mixed with one another unless recommended by the manufacturer.
5. Whenever possible, all of a product shall be used up before disposing of the container.
6. Manufacture's recommendations for proper use and disposal shall be followed.
7. The site superintendent shall inspect daily to ensure proper use and disposal of materials on site.

Hazardous Products: The following practices are intended to reduce the risks associated with hazardous materials.

1. Products shall be kept in original containers unless they are not re-sealable.
2. Where feasible, the original label and material safety data shall be retained, whereas they contain important product information.
3. If surplus product must be disposed of, follow manufacturers or local and State recommended methods for proper disposal.

Product Specific Practices: The following product-specific practices shall be followed on site:
Petroleum Products:

1. All on site vehicles shall be monitored for leaks and receive regular preventative maintenance to reduce the risk of leakage.
2. Petroleum products shall be stored in tightly sealed containers which are clearly labeled.
3. Petroleum Products shall be stored in compliance with Fire Marshall regulations.

Bituminous Concrete:
Any bituminous concrete or asphalt substances used on site shall be applied according to the manufacturer's recommendations.

Fertilizers:
No pesticides or fertilizers may be used within 100' buffer zone of any wetlands, water body or resource area. No quick release fertilizers may be used within 200' buffer of any wetlands, water body or resource area. No alteration or disturbance of any vegetation or soil may be conducted within 25 feet of any wetland, water body or resource area.

Paints:

1. All containers shall be tightly sealed and stored when not required for use.
2. Excess paint shall not be discharged into any catch basin, drain manhole or any portion of the stormwater management system.
3. Excess paint shall be properly disposed of according to manufacturer's recommendations or State and local regulations.

Concrete Trucks:
Concrete trucks shall not be allowed to wash out or discharge surplus concrete or drum wash water on site.

SPILL CONTROL PRACTICES

In addition to the good housekeeping and material management practices discussed in the previous sections of this plan, the following practices shall be followed for spill prevention and cleanup:

1. Manufacturer's recommended methods for cleanup shall be readily available at the onsite trailer, and site personnel shall be made aware of the procedures and the location of the information.
2. Materials and equipment necessary for spill cleanup shall be kept in the material storage area on site. Equipment and materials shall include, but not be limited to, brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand, sawdust and plastic and metal trash containers specifically for this purpose.
3. All spills shall be cleaned up immediately after discovery.
4. The spill area shall be kept well ventilated, and personnel shall wear appropriate protective clothing to prevent injury from contact with hazardous substance.
5. Spills of toxic or hazardous material shall be reported to the appropriate State and/or local authority in accordance with local and/or State regulations.
6. The spill prevention plan shall be adjusted to include measures to prevent a particular type of spill from reoccurring and instructions on how to clean up the spill if there is another occurrence. A description of the spill, what caused it, and the cleanup measures shall also be included.
7. The "Manager" shall be the spill prevention and cleanup coordinator. The "Manager" shall designate at least three other site personnel who will be trained in the spill control practices identified above.

PUBLIC SAFETY

All cast iron stormwater structures grates and covers shall be kept in good condition and kept closed at all times. Any damaged or broken structures, guard rails shall be replaced immediately upon discovery.

STANDARD #10: Illicit Discharge Statement.

Attachment
Illicit Discharge Compliance Statement

It is the intent of the Owner/Applicant, Michael Ciesla, Cobra Realty to control illicit disposal into the storm drainage system. There will be no connection to the storm water system to inadvertently direct other types of liquids, chemicals or solids into the storm drainage system. The Applicant will also promote a clean Green Environment by mitigating spills onto pavements; oils, soda, chemicals, pet waste, debris and litter.

Respectfully Acknowledged,

Michael L Ciesla Trustee

Michael Ciesla
Cobra Realty

STORMCEPTOR OWNERS MANUAL:.

Stormceptor® STC

OPERATION AND MAINTENANCE GUIDE
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1. About Stormceptor

The Stormceptor® STC (Standard Treatment Cell) was developed by Imbrium™ Systems to address the growing need to remove and isolate pollution from the storm drain system before it enters the environment. The Stormceptor STC targets hydrocarbons and total suspended solids (TSS) in stormwater runoff. It improves water quality by removing contaminants through the gravitational settling of fine sediments and floatation of hydrocarbons while preventing the re-suspension or scour of previously captured pollutants.

The development of the Stormceptor STC revolutionized stormwater treatment, and created an entirely new category of environmental technology. Protecting thousands of waterways around the world, the Stormceptor System has set the standard for effective stormwater treatment.

1.1. Patent Information

The Stormceptor technology is protected by the following patents:

- Australia Patent No. 693,164 • 693,164 • 707,133 • 729,096 • 779401
- Austrian Patent No. 289647
- Canadian Patent No 2,009,208 •2,137,942 • 2,175,277 • 2,180,305 • 2,180,383 • 2,206,338 • 2,327,768 (Pending)
- China Patent No 1168439
- Denmark DK 711879
- German DE 69534021
- Indonesian Patent No 16688
- Japan Patent No 9-11476 (Pending)
- Korea 10-2000-0026101 (Pending)
- Malaysia Patent No PI9701737 (Pending)
- New Zealand Patent No 314646
- United States Patent No 4,985,148 • 5,498,331 • 5,725,760 • 5,753,115 • 5,849,181 • 6,068,765 • 6,371,690
- Stormceptor OSR Patent Pending • Stormceptor LCS Patent Pending

2. Stormceptor Design Overview

2.1. Design Philosophy

The patented Stormceptor System has been designed to focus on the environmental objective of providing long-term pollution control. The unique and innovative Stormceptor design allows for continuous positive treatment of runoff during all rainfall events, while ensuring that all captured pollutants are retained within the system, even during intense storm events.

An integral part of the Stormceptor design is PCSWMM for Stormceptor - sizing software developed in conjunction with Computational Hydraulics Inc. (CHI) and internationally acclaimed expert, Dr. Bill James. Using local historical rainfall data and continuous simulation modeling, this software allows a Stormceptor unit to be designed for each individual site and the corresponding water quality objectives.

By using PCSWMM for Stormceptor, the Stormceptor System can be designed to remove a wide range of particles (typically from 20 to 2,000 microns), and can also be customized to remove a specific particle size distribution (PSD). The specified PSD should accurately reflect what is in the stormwater runoff to ensure the device is achieving the desired water quality objective. Since stormwater runoff contains small particles (less than 75 microns), it is important to design a treatment system to remove smaller particles in addition to coarse particles.

2.2. Benefits

The Stormceptor System removes free oil and suspended solids from stormwater, preventing spills and non-point source pollution from entering downstream lakes and rivers. The key benefits, capabilities and applications of the Stormceptor System are as follows:

- Provides continuous positive treatment during all rainfall events
- Can be designed to remove over 80% of the annual sediment load
- Removes a wide range of particles
- Can be designed to remove a specific particle size distribution (PSD)
- Captures free oil from stormwater
- Prevents scouring or re-suspension of trapped pollutants
- Pre-treatment to reduce maintenance costs for downstream treatment measures (ponds, swales, detention basins, filters)
- Groundwater recharge protection
- Spills capture and mitigation
- Simple to design and specify
- Designed to your local watershed conditions
- Small footprint to allow for easy retrofit installations
- Easy to maintain (vacuum truck)
- Multiple inlets can connect to a single unit
- Suitable as a bend structure
- Pre-engineered for traffic loading (minimum AASHTO HS-20)
- Minimal elevation drop between inlet and outlet pipes
- Small head loss
- Additional protection provided by an 18” (457 mm) fiberglass skirt below the top of the insert, for the containment of hydrocarbons in the event of a spill.

2.3. Environmental Benefit

Freshwater resources are vital to the health and welfare of their surrounding communities. There is increasing public awareness, government regulations and corporate commitment to reducing the pollution entering our waterways. A major source of this pollution originates from stormwater runoff from urban areas. Rainfall runoff carries oils, sediment and other contaminants from roads and parking lots discharging directly into our streams, lakes and coastal waterways.

The Stormceptor System is designed to isolate contaminants from getting into the natural environment. The Stormceptor technology provides protection for the environment from spills that occur at service stations and vehicle accident sites, while also removing contaminated sediment in runoff that washes from roads and parking lots.

3. Key Operation Features

3.1. Scour Prevention

A key feature of the Stormceptor System is its patented scour prevention technology. This innovation ensures pollutants are captured and retained during all rainfall events, even extreme storms. The Stormceptor System provides continuous positive treatment for all rainfall events, including intense storms. Stormceptor slows incoming runoff, controlling and reducing velocities in the lower chamber to create a non-turbulent environment that promotes free oils and floatable debris to rise and sediment to settle.

The patented scour prevention technology, the fiberglass insert, regulates flows into the lower chamber through a combination of a weir and orifice while diverting high energy flows away through the upper chamber to prevent scouring. Laboratory testing demonstrated no scouring when tested up to 125% of the unit's operating rate, with the unit loaded to 100% sediment capacity (NJDEP, 2005). Second, the depth of the lower chamber ensures the sediment storage zone is adequately separated from the path of flow in the lower chamber to prevent scouring.

3.2. Operational Hydraulic Loading Rate

Designers and regulators need to evaluate the treatment capacity and performance of manufactured stormwater treatment systems. A commonly used parameter is the "operational hydraulic loading rate" which originated as a design methodology for wastewater treatment devices.

Operational hydraulic loading rate may be calculated by dividing the flow rate into a device by its settling area. This represents the critical settling velocity that is the prime determinant to quantify the influent particle size and density captured by the device. PCSWMM for Stormceptor uses a similar parameter that is calculated by dividing the hydraulic detention time in the device by the fall distance of the sediment.

$$v_{SC} = \frac{H}{6_H} = \frac{Q}{A_S}$$

Where:

v_{SC} = critical settling velocity, ft/s (m/s)

H = tank depth, ft (m)

$Ø_H$ = hydraulic detention time, ft/s (m/s)

Q = volumetric flow rate, ft3/s (m3/s)

A_S = surface area, ft^2 (m^2)

(Tchobanoglous, G. and Schroeder, E.D. 1987. Water Quality. Addison Wesley.)

Unlike designing typical wastewater devices, stormwater systems are designed for highly variable flow rates including intense peak flows. PCSWMM for Stormceptor incorporates all of the flows into its calculations, ensuring that the operational hydraulic loading rate is considered not only for one flow rate, but for all flows including extreme events.

3.3. Double Wall Containment

The Stormceptor System was conceived as a pollution identifier to assist with identifying illicit discharges. The fiberglass insert has a continuous skirt that lines the concrete barrel wall for a depth of 18 inches (457 mm) that provides double wall containment for hydrocarbons storage. This protective barrier ensures that toxic floatables do not migrate through the concrete wall into the surrounding soils.

4. Stormceptor Product Line

4.1. Stormceptor Models

A summary of Stormceptor models and capacities are listed in Table 1.

Table 1. Stormceptor Models

Stormceptor Model	Total Storage Volume U.S. Gal (L)	Hydrocarbon Storage Capacity U.S. Gal (L)	Maximum Sediment Capacity ft³ (L)
STC 450i	470 (1,780)	86 (330)	46 (1,302)
STC 900	952 (3,600)	251 (950)	89 (2,520)
STC 1200	1,234 (4,670)	251 (950)	127 (3,596)
STC 1800	1,833 (6,940)	251 (950)	207 (5,861)
STC 2400	2,462 (9,320)	840 (3,180)	205 (5,805)
STC 3600	3,715 (1,406)	840 (3,180)	373 (10,562)
STC 4800	5,059 (1,950)	909 (3,440)	543 (15,376)
STC 6000	6,136 (23,230)	909 (3,440)	687 (19,453)
STC 7200	7,420 (28,090)	1,059 (4,010)	839 (23,757)
STC 11000	11,194 (42,370)	2,797 (10, 590)	1,086 (30,752)
STC 13000	13,348 (50,530)	2,797 (10, 590)	1,374 (38,907)
STC 16000	15,918 (60,260)	3,055 (11, 560)	1,677 (47,487)

NOTE: Storage volumes may vary slightly from region to region. For detailed information, contact your local Stormceptor representative.

4.2. Inline Stormceptor

The Inline Stormceptor, Figure 1, is the standard design for most stormwater treatment applications. The patented Stormceptor design allows the Inline unit to maintain continuous positive treatment of total suspended solids (TSS) year-round, regardless of flow rate. The Inline Stormceptor is composed of a precast concrete tank with a fiberglass insert situated at the invert of the storm sewer pipe, creating an upper chamber above the insert and a lower chamber below the insert.

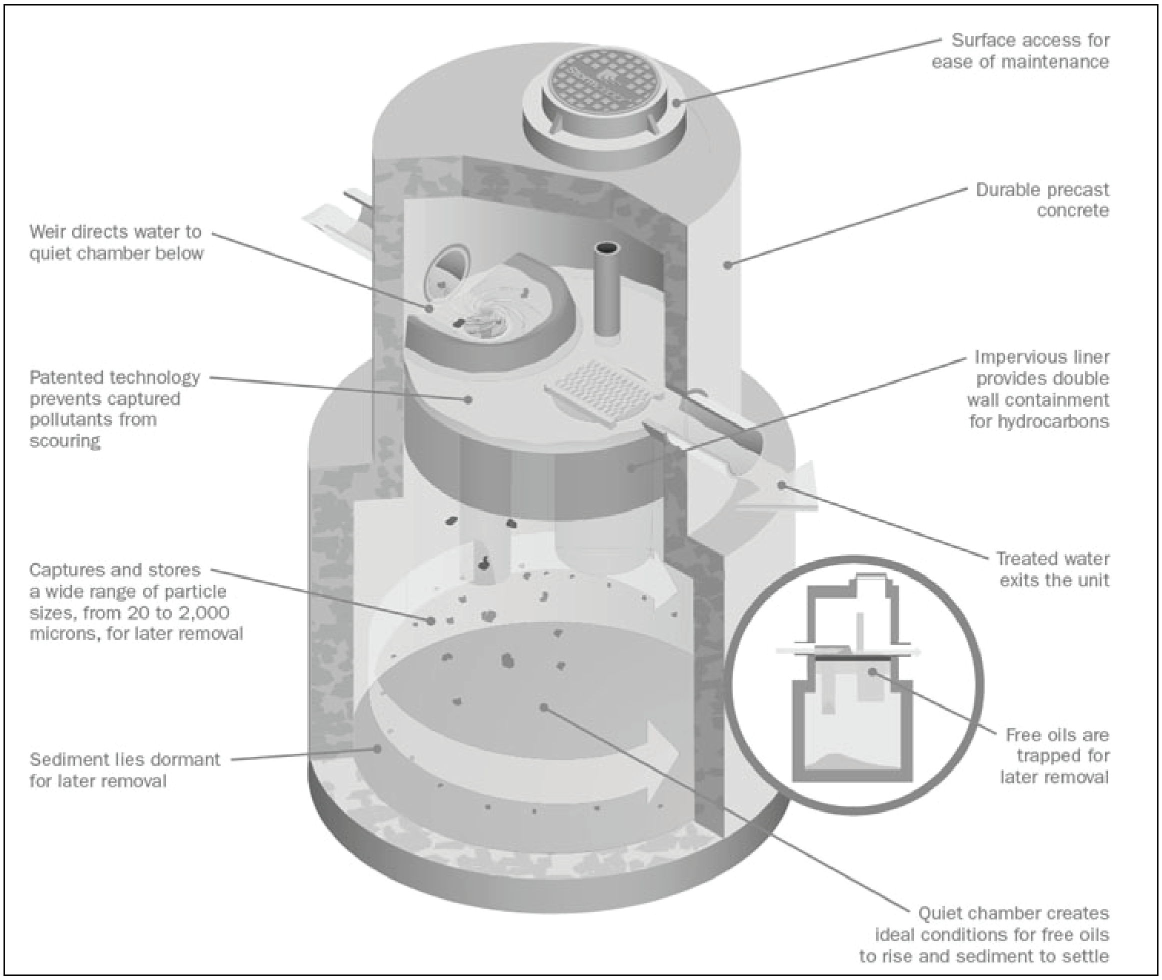

Figure 1. Inline Stormceptor

Operation

As water flows into the Stormceptor unit, it is slowed and directed to the lower chamber by a weir and drop tee. The stormwater enters the lower chamber, a non-turbulent environment, allowing free oils to rise and sediment to settle. The oil is captured underneath the fiberglass insert and shielded from exposure to the concrete walls by a fiberglass skirt. After the pollutants separate, treated water continues up a riser pipe, and exits the lower chamber on the downstream side of the weir before leaving the unit. During high flow events, the Stormceptor System's patented scour prevention technology ensures continuous pollutant removal and prevents re-suspension of previously captured pollutants.

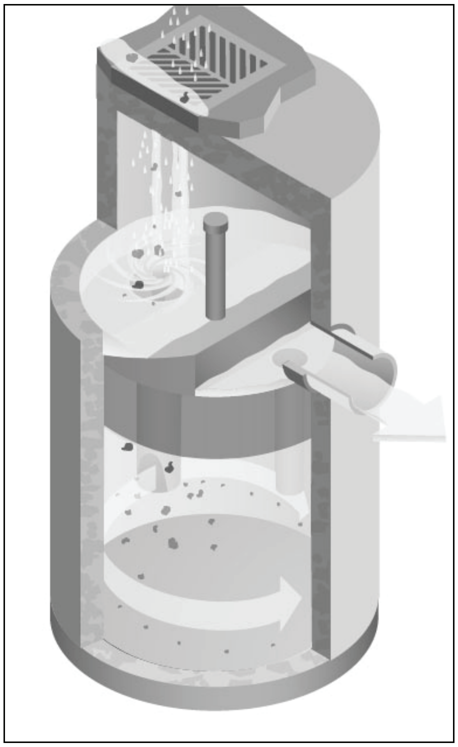

Figure 2. Inlet Stormceptor

4.3. Inlet Stormceptor

The Inlet Stormceptor System, Figure 2, was designed to provide protection for parking lots, loading bays, gas stations and other spill-prone areas. The Inlet Stormceptor is designed to remove sediment from stormwater introduced through a grated inlet, a storm sewer pipe, or both.

The Inlet Stormceptor design operates in the same manner as the Inline unit, providing continuous positive treatment, and ensuring that captured material is not re-suspended.

4.4. Series Stormceptor

Designed to treat larger drainage areas, the Series Stormceptor System, Figure 3, consists of two adjacent Stormceptor models that function in parallel. This design eliminates the need for additional structures and piping to reduce installation costs.

Figure 3. Series System

The Series Stormceptor design operates in the same manner as the Inline unit, providing continuous positive treatment, and ensuring that captured material is not re-suspended.

5. Sizing the Stormceptor System

The Stormceptor System is a versatile product that can be used for many different aspects of water quality improvement. While addressing these needs, there are conditions that the designer needs to be aware of in order to size the Stormceptor model to meet the demands of each individual site in an efficient and cost-effective manner.

PCSWMM for Stormceptor is the support tool used for identifying the appropriate Stormceptor model. In order to size a unit, it is recommended the user follow the seven design steps in the program. The steps are as follows:

STEP 1 – Project Details

The first step prior to sizing the Stormceptor System is to clearly identify the water quality objective for the development. It is recommended that a level of annual sediment (TSS) removal be identified and defined by a particle size distribution.

STEP 2 – Site Details

Identify the site development by the drainage area and the level of imperviousness. It is recommended that imperviousness be calculated based on the actual area of imperviousness based on paved surfaces, sidewalks and rooftops.

STEP 3 – Upstream Attenuation

The Stormceptor System is designed as a water quality device and is sometimes used in conjunction with onsite water quantity control devices such as ponds or underground detention systems. When possible, a greater benefit is typically achieved when installing a Stormceptor unit upstream of a detention facility. By placing the Stormceptor unit upstream of a detention structure, a benefit of less maintenance of the detention facility is realized.

STEP 4 – Particle Size Distribution

It is critical that the PSD be defined as part of the water quality objective. PSD is critical for the design of treatment system for a unit process of gravity settling and governs the size of a treatment system. A range of particle sizes has been provided and it is recommended that clays and silt-sized particles be considered in addition to sand and gravel-sized particles. Options and sample PSDs are provided in PCSWMM for Stormceptor. The default particle size distribution is the Fine Distribution, Table 2, option.

Table 2. Fine Distribution

Particle Size	Distribution	Specific Gravity
20	20%	1.3
60	20%	1.8
150	20%	2.2
400	20%	2.65
2000	20%	2.65

If the objective is the long-term removal of 80% of the total suspended solids on a given site, the PSD should be representative of the expected sediment on the site. For example, a system designed to remove 80% of coarse particles (greater than 75 microns) would provide relatively poor removal efficiency of finer particles that may be naturally prevalent in runoff from the site.

Since the small particle fraction contributes a disproportionately large amount of the total available particle surface area for pollutant adsorption, a system designed primarily for coarse particle capture will compromise water quality objectives.

STEP 5 – Rainfall Records

Local historical rainfall has been acquired from the U.S. National Oceanic and Atmospheric Administration, Environment Canada and regulatory agencies across North America. The rainfall data provided with PCSMM for Stormceptor provides an accurate estimation of small storm hydrology by modeling actual historical storm events including duration, intensities and peaks.

STEP 6 – Summary

At this point, the program may be executed to predict the level of TSS removal from the site. Once the simulation has completed, a table shall be generated identifying the TSS removal of each Stormceptor unit.

STEP 7 – Sizing Summary

Performance estimates of all Stormceptor units for the given site parameters will be displayed in a tabular format. The unit that meets the water quality objective, identified in Step 1, will be highlighted.

5.1. PCSWMM for Stormceptor

The Stormceptor System has been developed in conjunction with PCSWMM for Stormceptor as a technological solution to achieve water quality goals. Together, these two innovations model, simulate, predict and calculate the water quality objectives desired by a design engineer for TSS removal.

PCSWMM for Stormceptor is a proprietary sizing program which uses site specific inputs to a computer model to simulate sediment accumulation, hydrology and long-term total suspended solids removal. The model has been calibrated to field monitoring results from Stormceptor units that have been monitored in North America. The sizing methodology can be described by three processes:

1. Determination of real time hydrology
2. Buildup and wash off of TSS from impervious land areas
3. TSS transport through the Stormceptor (settling and discharge). The use of a calibrated model is the preferred method for sizing stormwater quality structures for the following reasons:
   - The hydrology of the local area is properly and accurately incorporated in the sizing (distribution of flows, flow rate ranges and peaks, back-to-back storms, inter-event times)
   - The distribution of TSS with the hydrology is properly and accurately considered in the sizing
   - Particle size distribution is properly considered in the sizing
   - The sizing can be optimized for TSS removal
   - The cost benefit of alternate TSS removal criteria can be easily assessed
   - The program assesses the performance of all Stormceptor models. Sizing may be selected based on a specific water quality outcome or based on the Maximum Extent Practicable

For more information regarding PCSWMM for Stormceptor, contact your local Stormceptor representative, or visit www.imbriumsystems.com to download a free copy of the program.

5.2. Sediment Loading Characteristics

The way in which sediment is transferred to stormwater can have a considerable effect on which type of system is implemented. On typical impervious surfaces (e.g. parking lots) sediment will build over time and wash off with the next rainfall. When rainfall patterns are examined, a short intense storm will have a higher concentration of sediment than a long slow drizzle. Together with rainfall data representing the site's typical rainfall patterns, sediment loading characteristics play a part in the correct sizing of a stormwater quality device.

Typical Sites

For standard site design of the Stormceptor System, PCSWMM for Stormceptor is utilized to accurately assess the unit's performance. As an integral part of the product's design, the program can be used to meet local requirements for total suspended solid removal. Typical installations of manufactured stormwater treatment devices would occur on areas such as paved parking lots or paved roads. These are considered "stable" surfaces which have non – erodible surfaces.

Unstable Sites

While standard sites consist of stable concrete or asphalt surfaces, sites such as gravel parking lots, or maintenance yards with stockpiles of sediment would be classified as "unstable". These types of sites do not exhibit first flush characteristics, are highly erodible and exhibit atypical sediment loading characteristics and must therefore be sized more carefully. Contact your local Stormceptor representative for assistance in selecting a proper unit sized for such unstable sites.

6. Spill Controls

When considering the removal of total petroleum hydrocarbons (TPH) from a storm sewer system there are two functions of the system: oil removal, and spill capture.

'Oil Removal' describes the capture of the minute volumes of free oil mobilized from impervious surfaces. In this instance relatively low concentrations, volumes and flow rates are considered. While the Stormceptor unit will still provide an appreciable oil removal function during higher flow events and/or with higher TPH concentrations, desired effluent limits may be exceeded under these conditions.

'Spill Capture' describes a manner of TPH removal more appropriate to recovery of a relatively high volume of a single phase deleterious liquid that is introduced to the storm sewer system over a relatively short duration. The two design criteria involved when considering this manner of introduction are overall volume and the specific gravity of the material. A standard Stormceptor unit will be able to capture and retain a maximum spill volume and a minimum specific gravity.

For spill characteristics that fall outside these limits, unit modifications are required. Contact your local Stormceptor Representative for more information.

One of the key features of the Stormceptor technology is its ability to capture and retain spills. While the standard Stormceptor System provides excellent protection for spill control, there are additional options to enhance spill protection if desired.

6.1. Oil Level Alarm

The oil level alarm is an electronic monitoring system designed to trigger a visual and audible alarm when a pre-set level of oil is reached within the lower chamber. As a standard, the oil

level alarm is designed to trigger at approximately 85% of the unit's available depth level for oil capture. The feature acts as a safeguard against spills caused by exceeding the oil storage capacity of the separator and eliminates the need for manual oil level inspection.

The oil level alarm installed on the Stormceptor insert is illustrated in Figure 4.

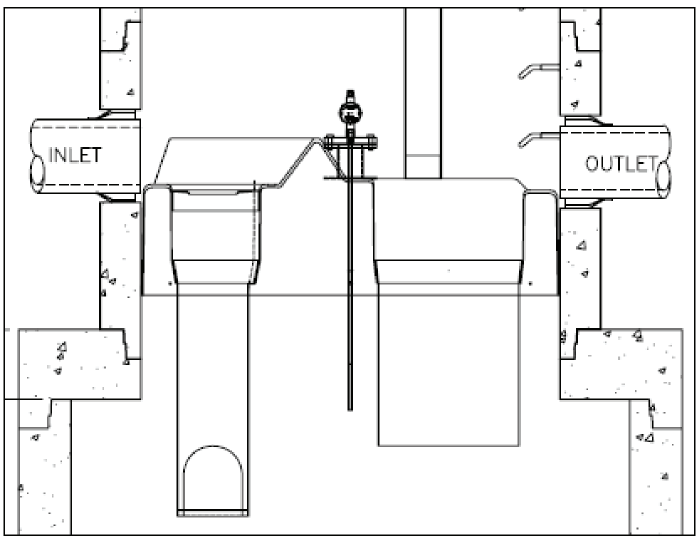

Figure 4. Oil level alarm

6.2. Increased Volume Storage Capacity

The Stormceptor unit may be modified to store a greater spill volume than is typically available. Under such a scenario, instead of installing a larger than required unit, modifications can be made to the recommended Stormceptor model to accommodate larger volumes. Contact your local Stormceptor representative for additional information and assistance for modifications.

7. Stormceptor Options

The Stormceptor System allows flexibility to incorporate to existing and new storm drainage infrastructure. The following section identifies considerations that should be reviewed when installing the system into a drainage network. For conditions that fall outside of the recommendations in this section, please contact your local Stormceptor representative for further guidance.

7.1. Installation Depth Minimum Cover

The minimum distance from the top of grade to the crown of the inlet pipe is 24 inches (600 mm). For situations that have a lower minimum distance, contact your local Stormceptor representative.

7.2. Maximum Inlet and Outlet Pipe Diameters

Maximum inlet and outlet pipe diameters are illustrated in Figure 5. Contact your local Stormceptor representative for larger pipe diameters

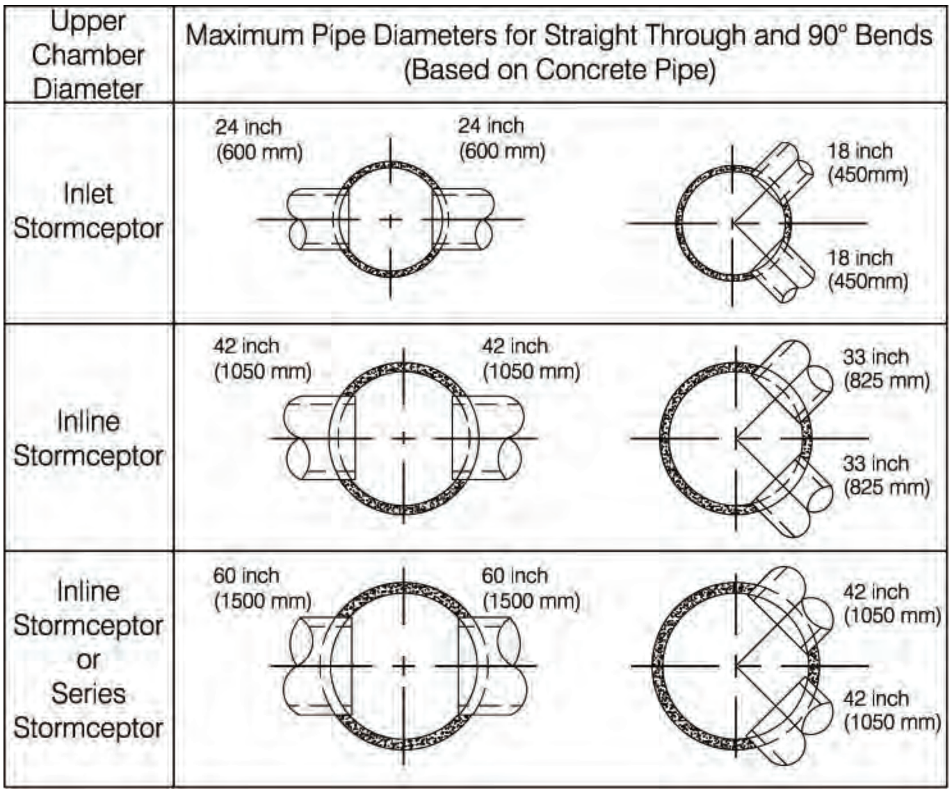

Figure 5. Maximum pipe diameters for straight through and bend applications

*****The bend should only be incorporated into the second structure (downstream structure) of the Series Stormceptor System

7.3. Bends

The Stormceptor System can be used to change horizontal alignment in the storm drain network up to a maximum of 90 degrees. Figure 6 illustrates the typical bend situations of the Stormceptor System. Bends should only be applied to the second structure (downstream structure) of the Series Stormceptor System.

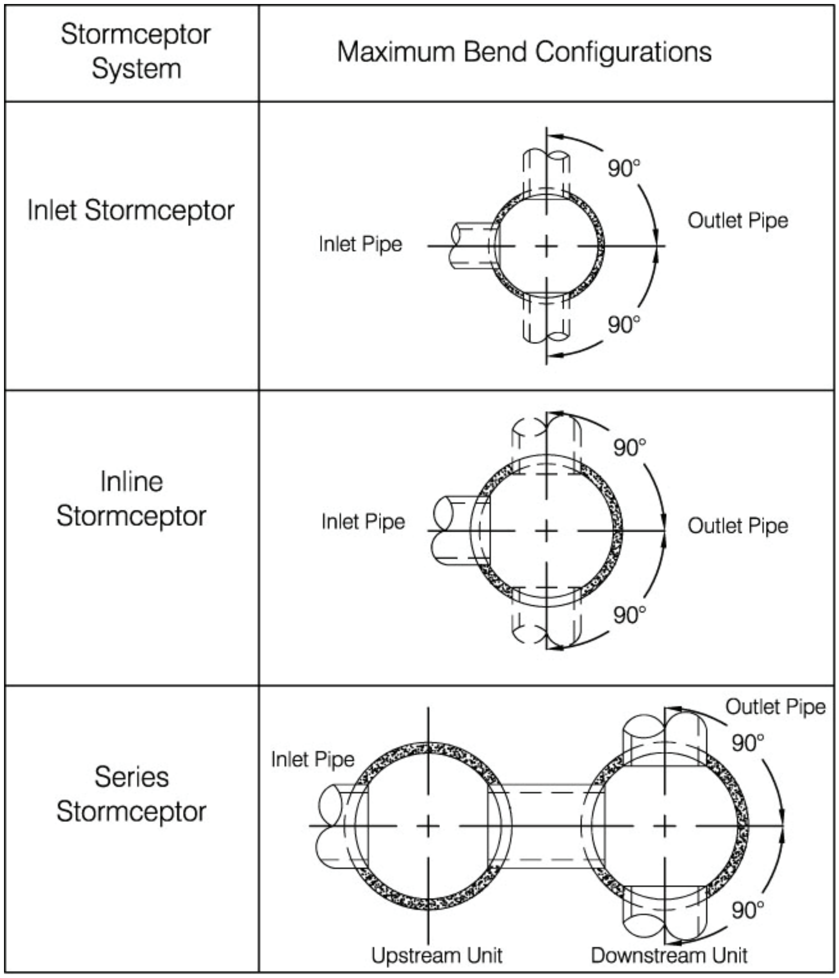

Figure 6. Maximum bend angles

7.4. Multiple Inlet Pipes

The Inlet and Inline Stormceptor System can accommodate two or more inlet pipes. The maximum number of inlet pipes that can be accommodated into a Stormceptor unit is a function of the number, alignment and diameter of the pipes and its effects on the structural integrity of the precast concrete. When multiple inlet pipes are used for new developments, each inlet pipe shall have an invert elevation 3 inches (75 mm) higher than the outlet pipe invert elevation.

7.5. Inlet/Outlet Pipe Invert Elevations

Recommended inlet and outlet pipe invert differences are listed in Table 3.

Table 3. Recommended Drops Between Inlet and Outlet Pipe Inverts

Number of Inlet Pipes	Inlet System	In-Line System	Series System
1	3 inches (75 mm)	1 inch (25 mm)	3 inches (75 mm)
>1	3 inches (75 mm)	3 inches (75 mm)	Not Applicable

7.6. Shallow Stormceptor

In cases where there may be restrictions to the depth of burial of storm sewer systems. In this situation, for selected Stormceptor models, the lower chamber components may be increased in diameter to reduce the overall depth of excavation required.

7.7. Customized Live Load

The Stormceptor system is typically designed for local highway truck loading (AASHTO HS- 20). When the project requires live loads greater than HS-20, the Stormceptor System may be customized structurally for a pre-specified live load. Contact your local Stormceptor representative for customized loading conditions.

7.8. Pre-treatment

The Stormceptor System may be sized to remove sediment and for spills control in conjunction with other stormwater BMPs to meet the water quality objective. For pretreatment applications, the Stormceptor System should be the first unit in a treatment train. The benefits of pre-treatment include the extension of the operational life (extension of maintenance frequency) of large stormwater management facilities, prevention of spills and lower total life- cycle maintenance cost.

7.9. Head loss

The head loss through the Stormceptor System is similar to a 60 degree bend at a manhole. The K value for calculating minor losses is approximately 1.3 (minor loss = k*1.3v2/2g).

However, when a Submerged modification is applied to a Stormceptor unit, the corresponding K value is 4.

7.10. Submerged

The Submerged modification, Figure 7, allows the Stormceptor System to operate in submerged or partially submerged storm sewers. This configuration can be installed on all models of the Stormceptor System by modifying the fiberglass insert. A customized weir height and a secondary drop tee are added.

Submerged instances are defined as standing water in the storm drain system during zero flow conditions. In these instances, the following information is necessary for the proper design and application of submerged modifications:

- Stormceptor top of grade elevation
- Stormceptor outlet pipe invert elevation
- Standing water elevation

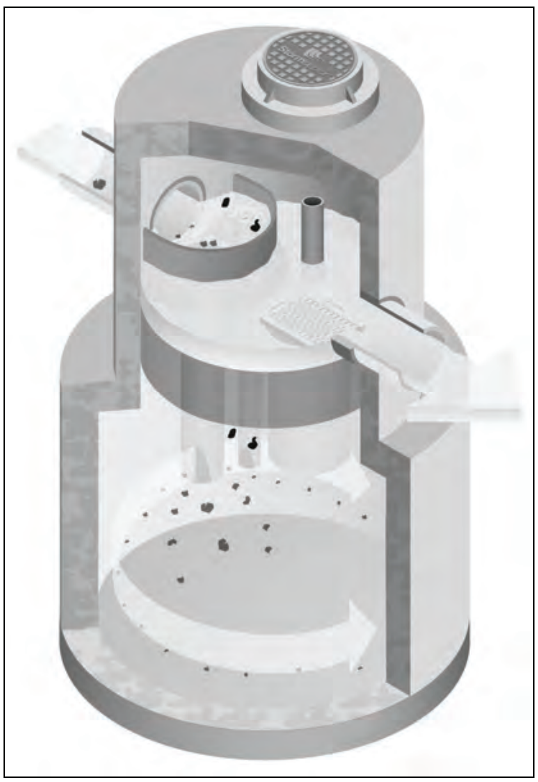

Figure 7. Submerged Stormceptor

8. Comparing Technologies

Designers have many choices available to achieve water quality goals in the treatment of stormwater runoff. Since many alternatives are available for use in stormwater quality treatment it is important to consider how to make an appropriate comparison between "approved alternatives". The following is a guide to assist with the accurate comparison of differing technologies and performance claims.

8.1. Particle Size Distribution (PSD)

The most sensitive parameter to the design of a stormwater quality device is the selection of the design particle size. While it is recommended that the actual particle size distribution (PSD) for sites be measured prior to sizing, alternative values for particle size should be selected to represent what is likely to occur naturally on the site. A reasonable estimate of a particle size distribution likely to be found on parking lots or other impervious surfaces should consist of a wide range of particles such as 20 microns to 2,000 microns (Ontario MOE, 1994).

There is no absolute right particle size distribution or specific gravity and the user is cautioned to review the site location, characteristics, material handling practices and regulatory requirements when selecting a particle size distribution. When comparing technologies, designs using different PSDs will result in incomparable TSS removal efficiencies. The PSD of the TSS removed needs to be standard between two products to allow for an accurate comparison.

8.2. Scour Prevention

In order to accurately predict the performance of a manufactured treatment device, there must be confidence that it will perform under all conditions. Since rainfall patterns cannot be predicted, stormwater quality devices placed in storm sewer systems must be able to withstand extreme events, and ensure that all pollutants previously captured are retained in the system.

In order to have confidence in a system's performance under extreme conditions, independent validation of scour prevention is essential when examining different technologies. Lack of independent verification of scour prevention should make a designer wary of accepting any product's performance claims.

8.3. Hydraulics

Full scale laboratory testing has been used to confirm the hydraulics of the Stormceptor System. Results of lab testing have been used to physically design the Stormceptor System and the sewer pipes entering and leaving the unit. Key benefits of Stormceptor are:

- Low head loss (typical k value of 1.3)
- Minimal inlet/outlet invert elevation drop across the structure
- Use as a bend structure
- Accommodates multiple inlets

The adaptability of the treatment device to the storm sewer design infrastructure can affect the overall performance and cost of the site.

8.4. Hydrology

Stormwater quality treatment technologies need to perform under varying climatic conditions. These can vary from long low intensity rainfall to short duration, high intensity storms. Since a treatment device is expected to perform under all these conditions, it makes sense that any system's design should accommodate those conditions as well.

Long-term continuous simulation evaluates the performance of a technology under the varying conditions expected in the climate of the subject site. Single, peak event design does not provide this information and is not equivalent to long-term simulation. Designers should request long-term simulation performance to ensure the technology can meet the long-term water quality objective.

9. Testing

The Stormceptor System has been the most widely monitored stormwater treatment technology in the world. Performance verification and monitoring programs are completed to the strictest standards and integrity. Since its introduction in 1990, numerous independent field tests and studies detailing the effectiveness of the Stormceptor System have been completed.

- Coventry University, UK – 97% removal of oil, 83% removal of sand and 73% removal of peat
- National Water Research Institute, Canada, - scaled testing for the development of the Stormceptor System identifying both TSS removal and scour prevention.
- New Jersey TARP Program – full scale testing of an STC 900 demonstrating 75% TSS removal of particles from 1 to 1000 microns. Scour testing completed demonstrated that the system does not scour. The New Jersey Department of Environmental Protection was followed.
- City of Indianapolis – full scale testing of an STC 900 demonstrating over 80% TSS removal of particles from 50 microns to 300 microns at 130% of the unit's operating rate. Scour testing completed demonstrated that the system does not scour.
- Westwood Massachusetts (1997), demonstrated >80% TSS removal
- Como Park (1997), demonstrated 76% TSS removal
- Ontario MOE SWAMP Program – 57% removal of 1 to 25 micron particles
- Laval Quebec – 50% removal of 1 to 25 micron particles

10. Installation

The installation of the concrete Stormceptor should conform in general to state highway, or local specifications for the installation of manholes. Selected sections of a general specification that are applicable are summarized in the following sections.

10.1. Excavation

Excavation for the installation of the Stormceptor should conform to state highway, or local specifications. Topsoil removed during the excavation for the Stormceptor should be stockpiled in designated areas and should not be mixed with subsoil or other materials.

Topsoil stockpiles and the general site preparation for the installation of the Stormceptor should conform to state highway or local specifications.

The Stormceptor should not be installed on frozen ground. Excavation should extend a minimum of 12 inches (300 mm) from the precast concrete surfaces plus an allowance for shoring and bracing where required. If the bottom of the excavation provides an unsuitable foundation additional excavation may be required.

In areas with a high water table, continuous dewatering may be required to ensure that the excavation is stable and free of water.

10.2. Backfilling

Backfill material should conform to state highway or local specifications. Backfill material should be placed in uniform layers not exceeding 12 inches (300mm) in depth and compacted to state highway or local specifications.

11. Stormceptor Construction Sequence

The concrete Stormceptor is installed in sections in the following sequence:

1. Aggregate base
2. Base slab
3. Lower chamber sections
4. Upper chamber section with fiberglass insert
5. Connect inlet and outlet pipes
6. Assembly of fiberglass insert components (drop tee, riser pipe, oil cleanout port and orifice plate
7. Remainder of upper chamber
8. Frame and access cover

The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

Adjustment of the Stormceptor can be performed by lifting the upper sections free of the excavated area, re-leveling the base and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary. Once the Stormceptor has been constructed, any lift holes must be plugged with mortar.

12. Maintenance

12.1. Health and Safety

The Stormceptor System has been designed considering safety first. It is recommended that confined space entry protocols be followed if entry to the unit is required. In addition, the fiberglass insert has the following health and safety features:

- Designed to withstand the weight of personnel
- A safety grate is located over the 24 inch (600 mm) riser pipe opening
- Ladder rungs can be provided for entry into the unit, if required

12.2. Maintenance Procedures

Maintenance of the Stormceptor system is performed using vacuum trucks. No entry into the unit is required for maintenance (in most cases). The vacuum service industry is a well- established sector of the service industry that cleans underground tanks, sewers and catch basins. Costs to clean a Stormceptor will vary based on the size of unit and transportation distances.

The need for maintenance can be determined easily by inspecting the unit from the surface. The depth of oil in the unit can be determined by inserting a dipstick in the oil inspection/cleanout port.

Similarly, the depth of sediment can be measured from the surface without entry into the Stormceptor via a dipstick tube equipped with a ball valve. This tube would be inserted through the riser pipe. Maintenance should be performed once the sediment depth exceeds the guideline values provided in the Table 4.

Table 4. Sediment Depths Indicating Required Servicing*

Particle Size	Specific Gravity
Model	Sediment Depth inches (mm)
450i	8 (200)
900	8 (200)
1200	10 (250)
1800	15 (381)
2400	12 (300)
3600	17 (430)
4800	15 (380)
6000	18 (460)
7200	15 (381)
11000	17 (380)
13000	20 (500)
16000	17 (380)
* based on 15% of the Stormceptor unit's total storage	

Although annual servicing is recommended, the frequency of maintenance may need to be increased or reduced based on local conditions (i.e. if the unit is filling up with sediment more quickly than projected, maintenance may be required semi-annually; conversely once the site has stabilized maintenance may only be required every two or three years).

Oil is removed through the oil inspection/cleanout port and sediment is removed through the riser pipe. Alternatively oil could be removed from the 24 inches (600 mm) opening if water is removed from the lower chamber to lower the oil level below the drop pipes.

The following procedures should be taken when cleaning out Stormceptor:

1. Check for oil through the oil cleanout port
2. Remove any oil separately using a small portable pump
3. Decant the water from the unit to the sanitary sewer, if permitted by the local regulating authority, or into a separate containment tank
4. Remove the sludge from the bottom of the unit using the vacuum truck
5. Re-fill Stormceptor with water where required by the local jurisdiction

12.3. Submerged Stormceptor

Careful attention should be paid to maintenance of the Submerged Stormceptor System. In cases where the storm drain system is submerged, there is a requirement to plug both the inlet and outlet pipes to economically clean out the unit.

12.4. Hydrocarbon Spills

The Stormceptor is often installed in areas where the potential for spills is great. The Stormceptor System should be cleaned immediately after a spill occurs by a licensed liquid waste hauler.

12.5. Disposal

Requirements for the disposal of material from the Stormceptor System are similar to that of any other stormwater Best Management Practice (BMP) where permitted. Disposal options for the sediment may range from disposal in a sanitary trunk sewer upstream of a sewage treatment plant, to disposal in a sanitary landfill site. Petroleum waste products collected in the Stormceptor (free oil/chemical/fuel spills) should be removed by a licensed waste management company.

12.6. Oil Sheens

With a steady influx of water with high concentrations of oil, a sheen may be noticeable at the Stormceptor outlet. This may occur because a rainbow or sheen can be seen at very small oil concentrations (<10 mg/L). Stormceptor will remove over 98% of all free oil spills from storm sewer systems for dry weather or frequently occurring runoff events.

The appearance of a sheen at the outlet with high influent oil concentrations does not mean the unit is not working to this level of removal. In addition, if the influent oil is emulsified the Stormceptor will not be able to remove it. The Stormceptor is designed for free oil removal and not emulsified conditions.

SUPPORT

Drawings and specifications are available at www.ContechES.com.

Site-specific design support is available from our engineers.

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