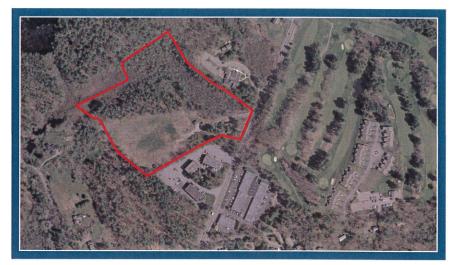


Allen & Major Associates, inc.

SITE LOCUS: N.T.S.



ELDERLY HOUSING DEVELOPMENT 470 BOSTON STREET

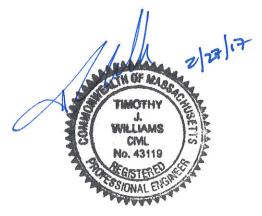
TOPSFIELD, MASSACHUSETTS DRAINAGE REPORT

DATE PREPARED: OCTOBER 13, 2016

REVISED: JANUARY 17, 2017 FEBRUARY 27, 2017

APPLICANT: SARKIS DEVELOPMENT COMPANY 2 ELM SQUARE ANDOVER, MA 01810

PREPARED BY: ALLEN & MAJOR ASSOCIATES, INC. P.O. BOX 2118 100 COMMERCE WAY WOBURN, MASSACHUSETTS 01888-0118



ELDERLY HOUSING DEVELOPMENT #470 BOSTON STREET TOPSFIELD, MA

PROPONENT:

SARKIS DEVELOPMENT COMPANY 2 ELM SQUARE ANDOVER, MA 01810

PREPARED BY:

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ISSUED: OCTOBER 13, 2016 Revised: January 17, 2017 February 27, 2017

A&M PROJECT #2165-01A

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INTRODUCTION

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The purpose of this drainage report is to provide an overview of the proposed stormwater management system (SMS) for the proposed site development at #470 Boston Street in Topsfield, MA. The report will show by means of narrative, calculations, and exhibits that the proposed stormwater management system will meet or exceed the 10 Massachusetts Department of Environment Protection (DEP) stormwater standards, as well as the Town of Topsfield's Stormwater Management Regulations.

The proposed site improvements include construction of 15 condominium-style duplexes consisting of 30 elderly housing units, as well as two common area structures, pedestrian sidewalks, paved drives, landscaped islands, grading, underground utilities, and associated site work. Proposed site improvements also include Best Management Practices (BMP) to effectively handle stormwater runoff from the site.

The proposed Stormwater Management System (SMS) incorporates structural and nonstructural BMPs to provide stormwater peak flow mitigation, quality treatment, stormwater infiltration and conveyance. The SMS includes roof drains, drain manholes, underground piping, deep-sump catch basins, proprietary hydro-dynamic separators, infiltration chambers to treat roof runoff, a surface detention/infiltration basin, and a long term Operation and Maintenance Plan.

SITE CATEGORIZATION FOR STORMWATER REGULATIONS

The proposed site improvements at #470 Boston Street are considered a new development under the MA DEP Stormwater Management Standards.

All improvements are considered a "new" development and shall comply with all ten (10) of the MA DEP Stormwater Management Standards. Furthermore, the Town of Topsfield Conservation Commission has eleven (11) Stormwater Standards of their own, which the project will comply with as well.

SITE LOCATION AND ACCESS

The project site is located at #470 Boston Street and is identified on the Town of Topsfield's Assessor's Map #7, Lot #3. The site is a single lot with frontage on Boston Street (Route 1). The site is comprised of $16.32\pm$ acres located within both the towns of Topsfield ($13.24\pm$ acres) and Ipswich ($3.08\pm$ acres), is located approximately 5.0 miles north of the Exit 50 off-ramp from Route 95 Northbound, and is owned by Sarkis Development Company. The site contains approximately 9.45 \pm acres of "upland" area, which are considered buildable areas located outside of flagged bordering vegetated wetland resource areas.

The site has one existing paved access driveway from Boston Street, a public right-of-way 66

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feet in width, also known as Route 1. This access drive will continue to serve as the primary access point for the development of the parcel. A gated emergency egress drive is proposed to be constructed just south of the existing drive, with access to Boston Street.

WATERSHED

The project site is located within the Ipswich River Watershed. The site primarily drains into surrounding wetlands to the north of the site, with a relatively small amount draining to a wetland along Boston Street.

EXISTING SITE CONDITIONS

The Site consists of approximately 16.32± acres, all of which is located within the Elderly Housing District (EHD) Overlay, known as "Rolling Green Elderly Housing District," per Article 33 of Annual and Special Town Meeting Warrant for fiscal year 2017, from the May 3, 2016 Town Meeting. The lot is currently occupied by a garage with a paved drive and gravel area nearby, as well as grassed meadow areas, a small garden area, vegetated wetlands and treed woodlands.

Southeast of the garage, is an abandoned residential dwelling, which is proposed to be razed. A concrete surface detention structure and associated catch basins and a drain manhole are also located on-site. The parcel is identified as Map #7 Lot #3 on the Town of Topsfield's Assessor's Maps. The surrounding land uses are primarily Business Park District (BP) and Outlying Residential and Agricultural District (ORA).

Areas of Bordering Vegetated Wetlands (BVW) to the southeast of the site were flagged by Seekamp Environmental Consulting on or between June 27 and June 30, 2016. With the exception of the possible gravel emergency drive and an 18" outlet pipe mandated by the Town Planning Board and Conservation Commission, respectively, it should be noted that all construction for the project is proposed outside of the 100' wetland buffer. No work is proposed to disturb the existing BVW.

The majority of the site is comprised of undeveloped meadow and woodland. There is also a large wetland area to the north and a small wetland area abutting Boston Street. An impervious drive and a gravel area outside of the existing garage area slope towards existing catch basins and a drain manhole, which outlet to an existing concrete detention structure located on-site. The site generally slopes from south to north from approximate El. 84+/- at the southwestern property corner to El. 57+/- at the Bordering Vegetated Wetlands (BVW) to the north. See the attached Existing Watershed Plan (EWP) and Aerial Photo (EX-1).

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Drainage peak flows and volumes were analyzed at three (3) Study Points:

- <u>Study point 1</u>: This point represents flows to the existing wetlands near Boston Street. Runoff from subcatchments areas E-1 and E-2 eventually collect at Study Point 1. Stormwater runoff from E-1 flows over the paved drive, to the existing catch basins within the existing drive, to a drain manhole, where it is eventually routed to an existing concrete surface detention basin. Overflow from the basin flows overland to the existing downgradient wetlands along Boston Street, designated as Study Point 1, where it is recharged to groundwater. Runoff from E-2 flows overland to the wetland area, defined as Study Point 1.
- <u>Study Point 2</u> is a large wetland resource area on the northern portion of the site. Runoff from subcatchment area E-3 flows overland and eventually reaches the wetland area, where it is recharged to groundwater.
- <u>Study Point 3</u> is a large wetland resource area on the northern portion of the site. Runoff from subcatchment area E-4 flows overland and eventually reaches the wetland area, where it is recharged to groundwater.

EXISTING SOIL CONDITIONS

The on-site soils were identified using the USDA Natural Resources Conservation Services (NRCS) Soil Survey for Essex County. The site's soil types and corresponding Hydrologic Soil Groups (HSG) include:

٠	52A	(HSG - B/D)	- Freetown Muck, 0-3% slopes
٠	420B	(HSG - A)	- Canton Fine Sandy Loam, 3-8% slopes
٠	420C	(HSG - A)	- Canton Fine Sandy Loam, 8-15% slopes
٠	421C	(HSG - C)	- Canton Fine Sandy Loam, 8-15% slopes (Very stony)
٠	421D	(HSG - C)	- Canton Fine Sandy Loam, 15-25% slopes (Very stony)

See the Section 6.1 of the Appendix of this report for a copy of the soil mapping with Hydrological Soil Groups (HSG).

FEMA FLOODPLAIN/ENVIRONMENTAL DUE DILIGENCE

An environmental due diligence was completed by consulting the latest Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) dated July 3, 2012 noted as community panel #25009CO266F (Exhibit 3 - FEMA FIRM). A portion of the project site lies within a 100-year floodplain area (Zone A – Areas subject to inundation by the 1-

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percent-annual-chance flood, with no Base Flood Elevation (BFE)). No portion of the project site lies within the 500-year floodplain.

A review of the latest Massachusetts Natural Heritage Atlas (13th Edition) reveals that there are no Estimated Habitats, Priority Habitats or Certified Vernal Pools onsite or directly adjacent to the site (Exhibit 4 - Priority & Estimated Habitats). Additionally, the site is not located within any Areas of Critical Environmental Concern (ACEC).

On or between June 27 to June 30, 2016, approximately $1,600\pm$ linear feet of Bordering Vegetated Wetland to the north of the site was delineated by Seekamp Environmental Consultants, Inc. (SEC). Approximately $300\pm$ linear feet of Bordering Vegetated Wetland to the east of the site was delineated by SEC. In total, approximately, $1,900\pm$ linear feet of Bordering Vegetated Wetland were delineated on-site. The BVW and its associated buffer zone (100 ft. State Jurisdictional and Local Buffer) are shown on the plans.

DRAINAGE ANALYSIS METHODOLOGY

Peak rates of runoff were determined using techniques and data found in the following reference materials:

- 1. <u>Urban Hydrology for Small Watersheds Technical Release 55</u> by the United States Department of Agriculture Soils Conservation Service (SCS), June 1986. Runoff curve numbers and 24-hour precipitation values were obtained from this reference.
- 2. <u>HydroCAD[©] Stormwater Modeling System</u> by HydroCAD Software Solutions LLC, version 10.00, 2013. The HydroCAD[©] program was used to generate the runoff hydrographs for the watershed areas, to determine discharge/stage/storage characteristics for the stormwater BMPs, to perform drainage routing and to combine the results of the runoff hydrographs. HydroCAD[©] uses the TR-20 methodology of the SCS Unit Hydrograph procedure (SCS-UH).
- 3. <u>Soil Survey of Essex County Massachusetts</u> by United States Department of Agriculture, NRCS. Soil types and boundaries were obtained from this reference.

PEAK RATE OF RUNOFF

The storm water runoff analysis of the existing and proposed conditions includes an estimate of the peak rate of runoff from various rainfall events. Peak runoff rates were developed using TR-55 Urban Hydrology for Small Watersheds, developed by the U.S. Department of Commerce, Engineering Division and the HydroCAD computer program. Furthermore, the analysis has been prepared in accordance with the MA DEP and the Town of Topsfield requirements, as well as standard engineering practices. The peak rates of runoff have been

Elderly Housing DevelopmentA&M Project # 2165-01ATopsfield, MAFebruary 27, 2017estimated for each watershed for the theoretical 2-, 10-, and 25-year storm events.

A surface infiltration basin and subsurface infiltration chambers will receive stormwater directly from the proposed roofs and pretreated impervious site areas (parking lots and driveways). Pretreatment for runoff from paved surfaces is provided by deep sump catch basins and proprietary hydro-dynamic separators which prevents sediment from being deposited into the infiltration systems, inhibiting stormwater treatment. The systems have been designed to mitigate the required recharge and water quality volume generated on the developed surfaces. The systems maintain at least two (2) feet of separation from groundwater and drain down within the required 72 hours.

The HydroCAD storm water runoff model shows that *the proposed site development reduces the overall peak rate of runoff at all identified points of analysis*. The following tables provide a summary of the estimated peak flow rate and peak volume at each Study Point during each of the design storm events. The HydroCAD worksheets are included in Section 4 of this report.

STUDY POINT #1 (Flow to wetland near Boston Street)

	/			
Peak Flows	2-Year	10-Year	25-Year	
Existing Runoff (CFS)	0.07	0.58	1.14	
Proposed Runoff (CFS)	0.01	0.18	0.45	
% REDUCTION	85.7%	69.0%	60.5%	

STUDY POINT #1 (Flow to wetland near Boston Street)

Peak Volumes	2-Year	10-Year	25-Year	100-Year
Existing Runoff (AF)	0.05	0.15	0.23	0.34
Proposed Runoff (AF)	0.01	0.07	0.12	0.20
% REDUCTION	80.0%	53.3%	47.8%	41.2%

STUDY POINT #2 (Flow to wetland to northeast of the project site)

Peak Flows	2-Year	10-Year	25-Year	
Existing Runoff (CFS)	0.08	0.62	1.52	
Proposed Runoff (CFS)	0.01	0.21	0.67	
% REDUCTION	87.5%	66.1%	55.9%	

STUDY POINT #2 (Flow to wetland to northeast of the project site)

Peak Volumes	2-Year	10-Year	25-Year	100-Year
Existing Runoff (AF)	0.05	0.21	0.36	0.59
Proposed Runoff (AF)	0.01	0.10	0.19	0.42
% REDUCTION	80.0%	52.4%	47.2%	28.8%

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Peak Flows	2-Year	10-Year	25-Year	
Existing Runoff (CFS)	0.08	0.82	2.29	
Proposed Runoff (CFS)	0.01	0.32	1.22	
% REDUCTION	87.5%	61.0%	46.7%	

STUDY POINT #3 (Flow to wetland to northwest of the project site)

Peak Volumes	2-Year	10-Year	25-Year	100-Year
Existing Runoff (AF)	0.06	0.29	0.53	0.89
Proposed Runoff (AF)	0.01	0.15	0.41	0.87
% REDUCTION	83.3%	48.3%	22.6%	2.2%

As described in the tables above, the total existing storm water peak flow and volume decrease in the post-construction watershed, as compared to the pre-construction watershed. Therefore, based on the HydroCAD model, the proposed watershed area will <u>not</u> increase in flow and/or volume.

MA DEP STORMWATER PERFORMANCE STANDARDS

The MA DEP Stormwater Management Policy was developed to improve water quality by implementing performance standards for storm water management. The intent is to implement the stormwater management standards through the review of Notice of Intent filings by the issuing authority (Conservation Commission or DEP). The following section outlines how the proposed Stormwater Management System (SMS) meets the standards set forth by the Policy.

Stormwater Best Management Practices (BMPs) implemented in the proposed SMS design include:

Deep Sump Catch Basins with Hoods Surface Infiltration Basin Subsurface Infiltration Chambers Proprietary Hydro-dynamic Separators

Stormwater BMPs have been incorporated into the design of the project to mitigate the anticipated pollutant loading. Temporary erosion and sedimentation controls will be incorporated during the construction phase of the project. These temporary controls include coir logs and/or silt fence barriers, inlet sediment traps, diversion channels, slope stabilization and stabilized construction entrances.

The Massachusetts Department of Environmental Protection has established ten (10)

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Stormwater Management Standards. A project that meets or exceeds the standards is presumed to satisfy the regulatory requirements regarding stormwater management. The Standards are as follows:

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

The proposed development will not introduce any new outfalls with direct discharge to a wetland areas or waters of the Commonwealth of Massachusetts. All discharges will be treated for water quality.

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

The proposed development has been designed such that the post-development peak discharge rates do not exceed the pre-development peak discharge rates. A summary of the existing and proposed discharge rates is included within this document.

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

The existing annual recharge for the site has been approximated in the developed condition. Subsurface infiltration chambers and a surface infiltration basin have been designed to meet this requirement. Soil test data can be found in the appendix of this report. The proposed Recharge Volume is based on the Static Method per the MA DEP Stormwater Management Standards, Volume 3, Chapter 1.

The primary on-site soils are classified as follows by the USDA NRSC:

- 52A (HSG B/D) Freetown Muck, 0-3% slopes
- 420B (HSG A) Canton Fine Sandy Loam, 3-8% slopes
- 420C (HSG A) Canton Fine Sandy Loam, 8-15% slopes
- 421C (HSG C) Canton Fine Sandy Loam, 8-15% slopes (Very stony)

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• 421D (HSG - C) - Canton Fine Sandy Loam, 15-25% slopes (Very stony)

See attached Standard DEP Calculations in the appendix of this report for Recharge Volume and 72-hour drawdown time calculations.

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

The proposed stormwater management system has been designed such that the 80% TSS removal standard will be met for each drainage area. Standard #4 is met when structural stormwater best management practices are sized to capture and treat the required water quality volume and pretreatment is provided in accordance with the Massachusetts Stormwater Handbook. Standard #4 also requires that suitable source control measures are identified in the Long Term Pollution Prevention Plan.

Water quality volume for the developed site will be captured and treated using deep sump catch basins and proprietary hydro-dynamic separators. All systems will be sized to meet the water quality flow rate for the $\frac{1}{2}$ " storm event.

The TSS removal efficiencies for the deep sump catch basins and infiltration basin are based on the values assigned under the MA DEP Stormwater handbook. All proprietary separators have been sized using *water quality discharge flow rate* and for a minimum TSS removal based on values assigned by the PC version of EPA's Stormwater Management Model (PCSWMM).

The PCSWMM program was used to size the proprietary separators. Water Quality Units #2 and #3 shall be Stormceptor STC-900 units, which will remove a minimum of 80% of total suspended solids (TSS). Water Quality Unit #1 is sized to be a Stormceptor 450i treatment unit, and in combination with catch basins with deep sumps and hoods as well as Underground Infiltration System #1 with an isolator row

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wrapped in filter fabric will achieve a minimum of 80% TSS removal. See the MADEP TSS removal worksheets in the Appendix for more data.

Standard #4 also requires that suitable source control measures are identified in the Long Term Pollution Prevention Plan including street sweeping and proper cleaning of the water quality swale, drainage structures (catch basins), and proprietary separators.

See attached Standard DEP Calculations in the appendix of this report for TSS removal and water quality discharge flow rate calculations.

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

The proposed development is not considered a land use with higher potential pollutant loads (LUHPPL).

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

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CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.

The project site does not discharge stormwater within a Zone II and Interim Wellhead Protection Area or near a critical area.

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

The proposed project is not considered a re-development project under the Stormwater Management Handbook guidelines because while there is an existing, abandoned structure, driveway, and garage, the total impervious area for the site will increase.

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

A plan to control construction-related impacts, including erosion, sedimentation and other pollutant sources during construction and land disturbance activities has been developed. A detailed Erosion and Sedimentation Control Plan is included in the Permit Drawings. The proponent will prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) prior to commencement of construction activities that will result in the disturbance of one acre of land or more.

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

A Long-Term Operation and Maintenance (O&M) Plan has been developed for the proposed stormwater management system and can be found within this Drainage Report.

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

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There are no expected illicit discharges to the stormwater management system. An Illicit Discharge Compliance Statement is attached in the Appendix of this report.

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WATER REPEARAANCE CTANDARDO	

TOWN OF TOPSFIELD STORMWATER PERFORMANCE STANDARDS The Town of Topsfield has also developed their own Stormwater Standards to ensure that the waters within the town are protected.

 Stormwater run-off directed or channeled into any resource area has the potential of degrading or altering that area as a result of pollution conveyed and/or the disposition of silt and sediments into that area. It is presumed that a fully viable resource area is significantly to the interests of the Act and the Bylaw. Therefore, any discharge of any stormwater directed or channeled into a resource area by any new or repaired stormwater management system shall conform to all listed standards contained in the Massachusetts Stormwater Management Regulations adopted by the Mass Department of Environmental Protection as they may amended from time to time, hereafter called the Stormwater Regulations, and the provisions of 310 CMR-10.05, paragraphs: (k), (m), (n), (p), and (q), as they may be amended over time. Detailed performance requirements of stormwater management systems constructed in compliance with the above standards are found in the Massachusetts Stormwater Handbook volumes 1-4.

The proposed Stormwater Management System has been designed to meet or exceed all ten (10) of the Massachusetts Stormwater Standards (see section entitled "MA DEP Stormwater Performance Standards", above.

2) Any lot proposed for development, redevelopment, or additional development that borders on or contains any resource area protected by the Act and the Bylaw located in the red zone of the Soils Map or on a drumlin shall demonstrate by engineered design that stormwater runoff from the proposed construction would be retained onsite in either bio-retention ponds, rain gardens, drywells, or similarly functioning low impact features. Where that is proved not to be feasible, the drainage system shall be designed to intercept suspended solids and hydrocarbon pollutants using best management practices (BMP's) in conformance with standard four of the Stormwater Regulations prior to being discharged into the resource area.

The proposed Stormwater Management System has been designed to meet Standard #4 in the Massachusetts Stormwater Handbook. Subsurface infiltration chambers and an infiltration basin are used to ensure waters are kept on site and charged to groundwater.

3) All designs and BMPs managing stormwater runoff shall be sized to accommodate a 100-year storm frequency event without causing erosion or siltation of the retention area.

The analysis shows the overall volume has been reduced for the 100-year storm and no erosion or scouring will be caused to the retention areas.

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4) During the construction of the proposed development and until such time that the disturbed soil has been stabilized appropriately, erosion and sedimentation control measures shall be installed around the perimeter of the construction site in accordance with standard eight of the Stormwater Regulations. Erosion and sedimentation controls for the proposed construction site shall be approved by the Topsfield Conservation Commission or its designated agent prior to the start of any work onsite. All soils stored at the construction site for greater than 24 hours shall be covered by a waterproof tarpaulin or equivalent rainwater protection.

A detailed Erosion and Sedimentation Control Plan is included in the Permit Drawings. The proponent will prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) prior to commencement of construction activities that will result in the disturbance of one acre of land or more.

5) No snow hauled from parking lots or public ways shall be deposited in any resource area under the jurisdiction of the Topsfield Conservation Commission unless authorized under (permit) conditions deemed necessary by the Topsfield Conservation Commission to protect interests of the Act and the Bylaw.

Snow storage regulations have been included as part of the O&M Plan. See also the Snow Storage Plan.

6) All stormwater management systems permitted hereunder shall have operations and maintenance plans approved by the Commission in conformance with standard nine of the Stormwater Regulations.

An Operation and Maintenance (O&M) Plan is included within this drainage report. As part of the O&M Plan, there is an attachment entitled "Snow Disposal Guidance" issued by the MassDEP which outlines appropriate snow disposal methods.

7) Impervious areas such as driveways, patios, and parking lots shall be graded to facilitate stormwater runoff into adjacent grassy swales or catchment areas. No driveway shall be constructed or modified with a pitch such that runoff is directed onto a public road or street. Wherever possible, vegetated drainage swales and rain gardens shall be located to retain stormwater runoff onsite. The Commission encourages the use of pervious pavement materials such as pavers and porous asphalt. For information on porous asphalt contact: National Asphalt Pavement Assoc.

The proposed Stormwater Management System has been designed such that all stormwater remains on site. Subsurface infiltration chambers and a surface infiltration system infiltration the majority of the sites runoff back to groundwater. However, during intense storm events, the emergency overflow outlets both the subsurface infiltration chambers and the surface infiltration basin outlet to the abutting wetlands to prevent onsite flooding.

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8) As part of new construction and modifications to existing structures, stormwater runoff from all roof drains shall be conveyed into infiltration trenches, drywells, rain gardens, or similar BMPs to facilitate groundwater recharge and protect water quality.

All proposed roof drains are conveyed to infiltration chambers.

9) Developments or construction in Riverfront Areas or Buffer Zones shall be designed to be in conformance with LID practices.

The proposed site development is not located within a Riverfront Area and primarily avoids work within the wetland buffer zone, with the exception of the gravel emergency access driveway requested by the Town Planning Board. The access road will primarily be gravel to promote infiltration and an LID practice.

10) As-built plans of stormwater management systems permitted hereunder shall be submitted to the Conservation Commission upon completion of the construction together with a certificate signed by an engineer or professional land surveyor that the system meets the relevant requirements of the Stormwater Regulations. This submission is required at least 14 days prior to the issuance of a Certificate of Compliance by the Commission.

An as-built plan shall be submitted to the Topsfield Conservation Commission before the issuance of the Certificate of Compliance.

MA DEP CHECKLIST FOR STORMWATER REPORTS

See following pages.

Elderly Housing Development Topsfield, MA A&M Project # 2165-01A October 13, 2016

Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

The proposed development is not considered a land use with higher potential pollutant loads (LUHPPL).

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

The project site does not discharge stormwater within a Zone II and Interim Wellhead Protection Area or near a critical area.

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

The proposed project is not considered a re-development project under the Stormwater Management Handbook guidelines because while there is an existing, abandoned structure, driveway, and garage, the total impervious area for the site will increase.

Elderly Housing Development Topsfield, MA

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

A plan to control construction-related impacts, including erosion, sedimentation and other pollutant sources during construction and land disturbance activities has been developed. A detailed Erosion and Sedimentation Control Plan is included in the Permit Drawings. The proponent will prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) prior to commencement of construction activities that will result in the disturbance of one acre of land or more.

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

A Long-Term Operation and Maintenance (O&M) Plan has been developed for the proposed stormwater management system and can be found within this Drainage Report.

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

There are no expected illicit discharges to the stormwater management system. An Illicit Discharge Compliance Statement is attached in the Appendix of this report.

Elderly Housing Development

A&M Project # 2165-01A October 13, 2016

Topsfield, MA October 13, 2016 TOWN OF TOPSFIELD STORMWATER PERFORMANCE STANDARDS The Town of Topsfield has also developed their own Stormwater Standards to ensure that the waters within the town are protected.

 Stormwater run-off directed or channeled into any resource area has the potential of degrading or altering that area as a result of pollution conveyed and/or the disposition of silt and sediments into that area. It is presumed that a fully viable resource area is significantly to the interests of the Act and the Bylaw. Therefore, any discharge of any stormwater directed or channeled into a resource area by any new or repaired stormwater management system shall conform to all listed standards contained in the Massachusetts Stormwater Management Regulations adopted by the Mass Department of Environmental Protection as they may amended from time to time, hereafter called the Stormwater Regulations, and the provisions of 310 CMR-10.05, paragraphs: (k), (m), (n), (p), and (q), as they may be amended over time. Detailed performance requirements of stormwater management systems constructed in compliance with the above standards are found in the Massachusetts Stormwater Handbook volumes 1-4.

The proposed Stormwater Management System has been designed to meet or exceed all ten (10) of the Massachusetts Stormwater Standards (see section entitled "MA DEP Stormwater Performance Standards", above.

2) Any lot proposed for development, redevelopment, or additional development that borders on or contains any resource area protected by the Act and the Bylaw located in the red zone of the Soils Map or on a drumlin shall demonstrate by engineered design that stormwater runoff from the proposed construction would be retained onsite in either bio-retention ponds, rain gardens, drywells, or similarly functioning low impact features. Where that is proved not to be feasible, the drainage system shall be designed to intercept suspended solids and hydrocarbon pollutants using best management practices (BMP's) in conformance with standard four of the Stormwater Regulations prior to being discharged into the resource area.

The proposed Stormwater Management System has been designed to meet Standard #4 in the Massachusetts Stormwater Handbook. Subsurface infiltration chambers and an infiltration basin are used to ensure waters are kept on site and charged to groundwater.

3) All designs and BMPs managing stormwater runoff shall be sized to accommodate a 100-year storm frequency event without causing erosion or siltation of the retention area.

The analysis shows the overall volume has been reduced for the 100-year storm and no erosion or scouring will be caused to the retention areas.

Elderly Housing Development Topsfield, MA A&M Project # 2165-01A October 13, 2016

4) During the construction of the proposed development and until such time that the disturbed soil has been stabilized appropriately, erosion and sedimentation control measures shall be installed around the perimeter of the construction site in accordance with standard eight of the Stormwater Regulations. Erosion and sedimentation controls for the proposed construction site shall be approved by the Topsfield Conservation Commission or its designated agent prior to the start of any work onsite. All soils stored at the construction site for greater than 24 hours shall be covered by a waterproof tarpaulin or equivalent rainwater protection.

A detailed Erosion and Sedimentation Control Plan is included in the Permit Drawings. The proponent will prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) prior to commencement of construction activities that will result in the disturbance of one acre of land or more.

5) No snow hauled from parking lots or public ways shall be deposited in any resource area under the jurisdiction of the Topsfield Conservation Commission unless authorized under (permit) conditions deemed necessary by the Topsfield Conservation Commission to protect interests of the Act and the Bylaw.

Snow storage regulations have been included as part of the O&M Plan. See also the Snow Storage Plan.

6) All stormwater management systems permitted hereunder shall have operations and maintenance plans approved by the Commission in conformance with standard nine of the Stormwater Regulations.

An Operation and Maintenance (O&M) Plan is included within this drainage report. As part of the O&M Plan, there is an attachment entitled "Snow Disposal Guidance" issued by the MassDEP which outlines appropriate snow disposal methods.

7) Impervious areas such as driveways, patios, and parking lots shall be graded to facilitate stormwater runoff into adjacent grassy swales or catchment areas. No driveway shall be constructed or modified with a pitch such that runoff is directed onto a public road or street. Wherever possible, vegetated drainage swales and rain gardens shall be located to retain stormwater runoff onsite. The Commission encourages the use of pervious pavement materials such as pavers and porous asphalt. For information on porous asphalt contact: National Asphalt Pavement Assoc.

The proposed Stormwater Management System has been designed such that all stormwater remains on site. Subsurface infiltration chambers and a surface infiltration system infiltration the majority of the sites runoff back to groundwater. However, during intense storm events, the emergency overflow outlets both the subsurface infiltration chambers and the surface infiltration basin outlet to the abutting wetlands to prevent onsite flooding.

Elderly Housing Development Topsfield, MA

8) As part of new construction and modifications to existing structures, stormwater runoff from all roof drains shall be conveyed into infiltration trenches, drywells, rain gardens, or similar BMPs to facilitate groundwater recharge and protect water quality.

All proposed roof drains are conveyed to infiltration chambers.

9) Developments or construction in Riverfront Areas or Buffer Zones shall be designed to be in conformance with LID practices.

The proposed site development is not located within a Riverfront Area and primarily avoids work within the wetland buffer zone, with the exception of the gravel emergency access driveway requested by the Town Planning Board. The access road will primarily be gravel to promote infiltration and an LID practice.

10) As-built plans of stormwater management systems permitted hereunder shall be submitted to the Conservation Commission upon completion of the construction together with a certificate signed by an engineer or professional land surveyor that the system meets the relevant requirements of the Stormwater Regulations. This submission is required at least 14 days prior to the issuance of a Certificate of Compliance by the Commission.

An as-built plan shall be submitted to the Topsfield Conservation Commission before the issuance of the Certificate of Compliance.

MA DEP CHECKLIST FOR STORMWATER REPORTS

See following pages.



Massachusetts Department of Environmental Protection Bureau of Resource Protection - Wetlands Program Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.¹ This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8²
- 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.



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.

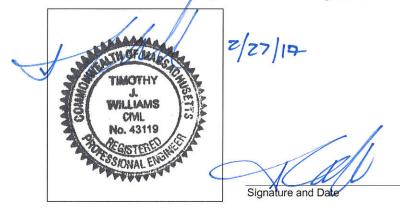
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

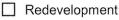
Registered Professional Engineer Block and Signature



Checklist

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

New development



Mix of New Development and Redevelopment



Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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



Checklist (continued)

Standard 2: Peak Rate Attenuation

- Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.
- Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

Calculations provided to show that post-development peak discharge rates do not exceed predevelopment 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 24hour storm.

Standard 3: Recharge

\boxtimes	Soil	Anal	ysis	provided.
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- 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
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amic Dynamic Field¹

- Runoff from all impervious areas at the site discharging to the infiltration BMP.
- Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
 - Site is comprised solely of C and D soils and/or bedrock at the land surface
 - M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
 - Solid Waste Landfill pursuant to 310 CMR 19.000
 - Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

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



Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
- Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
 - is within the Zone II or Interim Wellhead Protection Area
 - is near or to other critical areas
 - is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
 - involves runoff from land uses with higher potential pollutant loads.
- The Required Water Quality Volume is reduced through use of the LID site Design Credits.
- Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.



Massachusetts Department of Environmental Protection Bureau of Resource Protection - Wetlands Program Checklist for Stormwater Report

Checklist ((continued)
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Standard 4: Water Quality (continued)

- The BMP is sized (and calculations provided) based on:
 - The 1/2" or 1" Water Quality Volume or
 - The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

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

- The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted **prior to** the discharge of stormwater to the post-construction stormwater BMPs.
- The NPDES Multi-Sector General Permit does *not* cover the land use.
- LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- All exposure has been eliminated.
- All exposure has *not* been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- ☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

- The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- Critical areas and BMPs are identified in the Stormwater Report.



Checklist (continued)

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

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

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

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

- Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- Bike Path and/or Foot Path
- Redevelopment Project
- Redevelopment portion of mix of new and redevelopment.
- Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

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

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

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

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.
- A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.



Checklist (continued)

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

- ☐ 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.

Section 2.0 – Operation & Maintenance Plan

Elderly Housing Development Topsfield, MA A&M Project # 2165-01A October 13, 2016 January 17, 2017 February 27, 2017

OPERATION AND MAINTENANCE PLAN

In accordance with the standards set forth by the Stormwater Management Policy issued by the Department of Environmental Protection (DEP), Allen & Major Associates, Inc. (A&M) has prepared the following Operation and Maintenance plan for the proposed elderly housing development and drainage improvements at #470 Boston Street (Route 1).

This plan is broken into three major sections. The first section describes construction-related erosion and sedimentation controls (Construction Period). The second section describes the long term pollution prevention measures (Long Term Pollution Prevention Plan). The third section is devoted to a post-development operation and maintenance plan designed to address the long-term maintenance needs of the stormwater management system (Long Term Maintenance Plan). An operation and maintenance schedule has been included with this report.

Stormwater Management System Owner:

Sarkis Development Company 2 Elm Square Andover, MA 01810

Emergency Contact Information:

Sarkis Development Company	(Owner)	Phone (978) 475-4055
• Allen & Major Associates, Inc	c. (Site Civil Engineer)	Phone (781) 935-6889
Topsfield Public Works - Water		Phone (978) 887-1517
 Topsfield Public Works – Highway 		Phone (978) 887-1542
Topsfield Conservation Commission		Phone (978) 887-1510
• Topsfield Fire Department (non-emergency line)		Phone (978) 887-5148
• DEP Emergency Response (M	lass DEP)	Phone (888) 304-1133

INTRODUCTION

The stormwater management system (SMS) for this project is owned by Sarkis Development Company, and shall be legally responsible for long-term operation and maintenance for this SMS as outlined in this Operation and Maintenance (O&M) Plan. Should ownership of the SMS change the succeeding owner will be presented with this O&M Plan and supporting attachments at or before legal conveyance of ownership and will assume the obligations of the O&M Plan.

In the event that the SMS will be operated and maintained by an entity other than that listed in this document, the applicant shall provide a plan and easement deed that provides a right of access for the legal entity to be able to perform said operation and maintenance functions. In the event the SMS will serve multiple lots/owners, the applicant shall also provide a copy Elderly Housing Development Topsfield, MA

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 entire SMS.

DEMOLITION & CONSRUCTION MAINTENANCE PLAN

- 1. Contact the Topsfield Conservation Commission Agent at least three (3) days prior to start of demolition and/or construction activities.
- 2. Install Erosion Control measures as shown on the Plans prepared by A&M. The Topsfield Conservation agent shall approve the installation of coir logs and silt fencing prior to the start of any site demolition work. Install construction fencing, if determined to be necessary, at the commencement of construction.
- 3. Install construction entrances, coir logs and silt fence at the locations shown on the Demolition and Erosion Control Plan prepared by A&M.
- 4. Site access shall be achieved only from the designated construction entrances.
- 5. Stockpiles of materials subject to erosion shall be stabilized with erosion control matting or temporary seeding whenever practicable, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased.
- 6. Install silt sacks and straw bales around each drain inlet prior to any demolition and or construction activities.
- All erosion control measures shall be inspected weekly and after every rainfall event. Records of these inspections shall be kept on site for review.
- 8. All erosion control measures shall be maintained, repaired or replaced as required or at the direction of the owner's engineer or the Town Conservation Agent.
- 9. Sediment accumulation up-gradient of the straw bales, silt fence, and stone check dams greater than 6" in depth shall be removed and disposed of in accordance with all applicable regulations.
- 10. Silt sacks shall be installed in all catch basins adjacent to the site. Sediment accumulation on all adjacent catch basin inlets shall be removed and the silt sack

Elderly Housing Development Topsfield, MA A&M Project # 2165-01A October 13, 2016 January 17, 2017 February 27, 2017

replaced if torn or damaged. Install stone check dams on site during construction as needed; refer to the erosion control details. Temporary sediment basins combined with stone check dams shall be installed on site during construction to control and collect runoff from upland areas of this site during demolition and construction activities.

- 11. The contractor shall comply with the Sedimentation and Erosion Control Notes as shown on the Site Development Plans and Specifications.
- 12. The stabilized construction entrances shall be inspected weekly and records of inspections kept. The entrances shall be maintained by adding additional clean, angular, durable stone to remove the soil from the construction vehicle's tires when exiting the site. If soil is still leaving the site via the construction vehicle tires, adjacent roadways shall be kept clean by street sweeping.
- 13. Dust pollution shall be controlled using on-site water trucks and or an approved soil stabilization product.
- 14. During demolition and construction activities, Status Reports on compliance with this O&M Document shall be submitted weekly to the Conservation agent. The report shall document any deficiencies and corrective actions taken by the applicant.

LONG TERM POLLUTION PREVENTION PLAN

Standard #4 from the MA DEP Stormwater Management Handbook requires that a Long Term Pollution Prevention Plan (LTPPP) be prepared and incorporated as part of the Operation and Maintenance of the Stormwater Management System. The purpose of the LTPPP is to identify potential sources of pollution that may affect the quality of stormwater discharges, and to describe the implementation of practices to reduce the pollutants in stormwater discharges. The following items describe the source control and proper procedures for the LTPPP.

• HOUSEKEEPING

The proposed site development has been designed to maintain a high level of water quality treatment for all stormwater discharge to the wetland area. An Operation and Maintenance (O&M) plan has been prepared and is included in this section of the report. The owner (or its designee) is responsible for adherence to the O&M plan in a strict and complete manner.

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o Storing of Materials and Waste Products

There are no proposed exterior (un-covered) storage areas.. The stormwater drainage system has water quality inlets designed to capture trash and debris.

• VEHICLE WASHING

The proposed project does not include any designated vehicle washing areas.

• SPILL PREVENTION AND RESPONSE

Sources of potential spill hazards include vehicle fluids, liquid fuels, pesticides, paints, solvents and liquid cleaning products. The majority of the spill hazards would likely occur within the building and would not enter the stormwater drainage system. However, there are spill hazards from vehicle fluids or liquid fuels located outside of the buildings. These exterior spill hazards have the potential to enter the stormwater drainage system and are to be addressed as follows:

- 1. Spill Hazards of pesticides, paints, and solvents shall be remediated using the Manufacturers' recommended spill cleanup protocol.
- 2. Vehicle fluids and liquid fuel spill shall be remediated according to the local and state regulations governing fuel spills.
- 3. The owner shall have the following equipment and materials on hand to address a spill clean-up: brooms, dust pans, mops, rags, gloves, absorptive material, sand, sawdust, plastic and metal trash containers.
- 4. All spills shall be cleaned up immediately after discovery
- 5. Spills of toxic or hazardous material shall be reported, regardless of size, to the Massachusetts Department of Environmental Protection at 888-304-1133.
- 6. Should a spill occur, the pollution prevention plan will be adjusted to include measures to prevent another spill of a similar nature. A description of the spill, along with the causes and cleanup measures will be included in the updated pollution prevention plan.

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LANDSCAPE MAINTENANCE PLAN

• MAINTENANCE OF LAWNS, GARDENS AND OTHER LANDSCAPED AREAS

It should be recognized that this is a general guideline towards achieving high quality and well-groomed landscaped areas. The grounds staff / landscape contractor must recognize the shortcomings of a general maintenance plan such as this, and modify and/or augment it based on weekly, monthly, and yearly observations. In order to assure the highest quality conditions, the staff must also recognize and appreciate the need to be aware of the constantly changing conditions of the landscaping and be able to respond to them on a proactive basis.

Fertilizer

Maintenance practices should be aimed at reducing environmental, mechanical and pest stresses to promote healthy and vigorous growth. When necessary, pest outbreaks should be treated with the most sensitive control measure available. Synthetic chemical controls should be used only as a last resort to organic and biological control methods. Fertilizer, synthetic chemical controls and pest management applications (when necessary) shall be performed only by licensed applicators in accordance with the manufacturer's label instructions when environmental conditions are conducive to controlled product application.

Both slow-release organic fertilizers and synthetic fertilizers can be used onsite. Fertilization of the planting, lawns and mulch areas will be performed within manufacturers labeling instructions. Examples of some fertilizers options include but is not limited to:

> LESCO[®] 28-0-12 (Lawn Fertilizer) MERIT[®] 0.2 Plus Turf Fertilizer MOMENTUMTM Force Weed & Feed

Landscape Maintenance Program Practices:

♦ Lawn

- 1. Mow a minimum of once a week in spring, to a height of 2" to 2 1/2" high. Mowing should be frequent enough so that no more than 1/3 of grass blade is removed at each mowing. The top growth supports the roots; the shorter the grass is cut, the less the roots will grow. Short cutting also dries out the soil and encourages weeds to germinate.
- 2. Mow approximately once every two weeks from July 1st to August 15th depending on lawn growth.

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- 3. Mow on a ten-day cycle in fall, when growth is stimulated by cooler nights and increased moisture.
- 4. Do not remove grass clippings after mowing.
- 5. Keep mower blades sharp to prevent ragged cuts on grass leaves, which cause a brownish appearance and increase the chance for disease to enter a leaf.
- ♦ Shrubs
 - 1. Mulch not more than 3" depth with shredded pine or fir bark.
 - 2. Hand prune annually, immediately after blooming, to remove 1/3 of the above-ground biomass (older stems). Stem removals to occur within 6" of the ground to open up shrub and maintain two-year wood (the blooming wood).
 - 3. Hand prune evergreen shrubs only as needed to remove dead and damaged wood and to maintain the naturalistic form of the shrub. Never mechanically shear evergreen shrubs.
- ♦ Trees
 - 1. Provide aftercare for new tree plantings for the first three years.
 - 2. Do not fertilize trees, it artificially stimulates them (unless tree health warrants).
 - 3. Water once a week for the first year; twice a month the second, once a month the third year.
 - 4. Prune trees on a four-year cycle.
- ♦ Invasive Species
 - 1. Inform the Conservation Commission Agent prior to the removal of invasive species proposed either through hand work or through chemical removal.

• STORAGE AND USE OF HERBICIDES AND PESTICIDES

Integrated Pest Management is the combination of all methods (of pest control) which may prevent, reduce, suppress, eliminate, or repel an insect population. The main requirements necessary to support any pest population are food, shelter and water, and any upset of the balance of these will assist in controlling a pest population. Scientific pest management is the knowledgeable use of all pest control methods (sanitation, mechanical, chemical) to benefit mankind's health, welfare, comfort, property and food. A Pest Management Professional (PMP) will be retained who is licensed with the Commonwealth of Massachusetts Executive

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Office of Energy and Environmental Affairs, Department of Agricultural Resources.

The site manager will be provided with approved bulletin before entering into or renewing an agreement to apply pesticides for the control of indoor or structural pests. 333 CMR 13.08.

Before beginning each application, the applicator must inform the conservation commission and post a state and local approved notice on all of the entrances to the treated room or area. The applicator must leave such notices posted after the application. The notice will be posted at conspicuous point(s) of access to the area treated. The location and number of signs will be determined by the configuration of the area to be treated based on the applicator's best judgment. It is intended to give sufficient notice that no one comes into an area being treated unaware that the applicator is working and pesticides are being applied. However, if the contracting entity does not want the signs posted, he/she may sign a Department approved waiver indicating this.

The applicator or employer will provide to any person upon their request the following information on previously conducted applications:

- 1. Name and phone number of pest control company
- 2. Date and time of the application;
- 3. Name and license number of the applicator
- 4. Target pests
- 5. Name and EPA Registration Number of pesticide products applied

The notification must be made in writing. The intent is so that individuals, who wish to avoid exposure or want to avoid encountering the applicator, can make necessary arrangements. Applicators are required by law to follow all directions on the pesticide label and must take all steps necessary to avoid applications with people present in a room or area to be treated. Individuals occupying a room or area to be treated at the time of application shall be informed of the procedure. Whenever possible, the applicator should not apply pesticides with anyone present. That may mean treating other areas and returning when occupants have left, asking people to leave the area while the work is being done, or treating before or after people occupy the room. If people do not leave, the applicator must make it clear that he is there to apply pesticides. The applicator will be prepared

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to provide whatever information possible about the pesticides and techniques used.

• MANAGEMENT OF DEICING CHEMICALS AND SNOW

It will be the responsibility of the snow removal contractor to properly dispose of transported snow according to Massachusetts DEP, Bureau of Resource Protection – Snow Disposal Guideline #BRPG01-01, governing the proper disposal of snow. It will be the responsibility of the snow removal contractor to follow these guidelines and all applicable laws and regulations.

The owner's maintenance staff (or its designee) will be responsible for the clearing of the sidewalk and building entrances. The owner may be required to use a de-icing agent such as potassium chloride to maintain a safe walking surface. The de-icing agent for the walkways and building entrances will be kept within the storage rooms located within the building. De-icing agents will not be stored outside. The owner's maintenance staff will limit the application of sand and salt to the amounts needed for public safety.

POST CONSRUCTION MAINTENANCE PLAN

The SMS shall be inspected immediately after construction. A maintenance log will be kept (i.e. report) summarizing inspections, maintenance, and any corrective actions taken. The log will include the date on which each inspection or maintenance task was performed, a description of the inspection findings or maintenance completed, and the name of the inspector or maintenance personnel performing the task. If a maintenance task requires the clean-out of any sediments or debris, the location where the sediment and debris was disposed after removal will be indicated. The log will be made accessible to department staff and a copy provided to the department upon request.

Inspection and Maintenance Frequency and Corrective Measures:

In accordance with MA DEP Stormwater Handbook: Volume 2, Chapter 2; the following areas, facilities, and measures will be inspected and the identified deficiencies will be corrected. Clean-out must include the removal and legal disposal of any accumulated sediments, trash, and debris. In any and all cases, operations, inspections, and maintenance activities shall utilize best practical measures to avoid and minimize impacts to wetland resource areas outside the foot print of the SMS.

<u>Structural Pretreatment BMPs:</u> Regular maintenance of these BMPs is especially critical because they typically receive the highest concentration of suspended solids during the first flush of a storm event.

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Deep Sump Catch Basins:

Inspect or clean catch basins at least 4 times per year and at the end of the foliage and snow removal seasons. Sediments must also be removed four (4) times a year or whenever the depth of the deposits is greater than or equal to open half of the bottom of the invert of the lowest pipe in the basin. Structures will be skimmed of floatable debris at each inspection and if the basin outlet is designed with a hood to trap floatable materials (i.e. Snout), check to ensure watertight seal is working. Clamshell buckets or vacuum trucks are typically used, however, vacuum trucks are preferred.

Proprietary Separators:

Proprietary Separators will be inspected and cleaned out in accordance with the manufacturer's requirements, or at least twice per year. Sediments and debris removed should be disposed of in accordance with all applicable local, state and federal laws and regulations including M.G.L.c. 21C and 310 CMR 30.00.

Cultec Isolator Row:

At a minimum, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observations. However, the isolator row should be inspected at least once a year. A stadia rod should be used during inspection to measure the depth of sediment in the isolator row. Once there is three inches (3") of sediment throughout the bottom of the isolator row, a clean-out should be performed. The isolator row should be cleaned using a JetVac process.

Infiltration BMPs:

Stormwater Infiltration Basin:

The basin must be inspected and preventive maintenance must be performed at least twice a year and after every time drainage discharges through the high outlet orifice. Maintenance of upstream pre-treatment measures is critically important to the function of infiltration BMPs. Pre-treatment BMPs should be inspected for sediment and floatables accumulation and maintained at least twice per year (every other month recommended) and after every major storm event.

Other BMPs and Accessories:

Culverts:

Inspect culverts 2 times per year (preferably in spring and fall) to ensure that the culverts are working in their intended fashion and that they are free of debris. Remove any obstructions to flow; remove accumulated sediments and debris at the inlet, at the outlet, and within the conduit and to repair any erosion damage at the culvert's inlet and outlet.

Surface Infiltration Basin:

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The operation and maintenance plan required must include inspections and preventative maintenance at least twice a year, and after every time drainage discharges through the high outlet orifice. The basin should be inspected after every major storm event for the first few months to ensure it is stabilized and functioning properly. Note how long water remain in the basin after a major storm event; standing water within 48 to 72 hours of an event may indicate the infiltration capacity may have been overestimated.

Thereafter, inspect the infiltration basin at least twice a year. Important items to check include:

- Signs of differential settlement
- Cracking
- Erosion
- Leakage of embankments
- Tree growth on embankments
- Condition of rip-rap
- Sediment accumulation
- The health of the turf

At least twice a year the side slopes, buffer area, and basin bottom need to be mowed. Glass clippings should be removed to prevent an organic, impervious mat from forming.

Roadways and Parking Surfaces:

Clear accumulations of winter sand in parking lots and along roadways at least once a year, preferably in the spring. Accumulations on pavement may be removed by pavement sweeping. Accumulations of sand along road shoulders may be removed by grading excess sand to the pavement edge and removing it manually or by a front-end loader.

Level Spreaders, Check Dams, and Rip-rap:

These accessories will be inspected twice a year for erosion, debris accumulation, and unwanted vegetation. Erosion will be stabilized and sediment, debris, and wood vegetation shall be removed.

OPERATION & MAINTENANCE PLAN SCHEDULE

Project: #470 Boston Street Address: Topsfield, MA

Party Responsible for O & M Plan: Sarkis Development Company Address: 2 Elm Square Andover, MA 01810 Phone: (978) 475-4055

 Date:
 10/13/2016

 Revised
 2/27/2017
 10/13/2016

Structure or Task	Maintenance Activity	Schedule/Notes	Annual Maintenance Cost	Inspection Performed Date: By:
Street Sweeping	Sweep, power broom or vacuum paved areas.	Sweep paved areas as needed, but not less than four times annually.	#0.000	, , , , , , , , , , , , , , , , ,
		Submit information that confirms that all street sweepings have been disposed in accordance with state and local requirements	\$2,000	
	Inspect basin to make sure vegetation is adequate and slopes are not eroding Remove trash, debris, leaves and grass clippings Check Outlets for clogging	Perform every six months and after rain event larger than 3".		
	Remove tree seedings before they become established Mow basin bottom, side slopes, and buffer area twice a year	72 hours after major rain events. See also note #1 below.		
Deep Sump Catch Basins(s)		Inspect at least twice annually. Clean when sediment is within 2.5 feet of the outlet invert.	\$500	
	Clam shell or vacuum sumps (vacuum preferred)	Submit information that confirms that all catch basin sediments have been disposed in accordance with state and local requirements		
Storm Water Management System				
	See the Stormceptor maintenance package for the inspection and cleaning procedure	Inspect at least four times annually as well as following storms exceeding 1" of rainfall. Devices shall be cleaned at leaast once annually or when sediment reaches 6 inches of depth whichever is more frequent. See also note #1 below.	\$250	
		Submit information that confirms that all water quality inlets sediments have been disposed in accordance with state and local requirements	\$25U	
Inspect to ensure it is draining properly. Perform every other month as well as after every st Subsurface Infiltration below.	Perform every other month as well as after every storm event over 1/2". See also note #1 below.	\$500		
	Inspect isolator row using inspection ports and remove any accumulated sediment when average depth reaches 1" per the manufacturers recommendation.	On a semi-annual basis.	\$200	
Structure(s)	Vacuum.	Periodic cleaning of Outlet Control Structures as needed.	\$50	
	CB management targeted larviciding treatment to CB's and all storm drains to control mosquitoes in their aquatic stages.	Surveillance is a non chemical inspection method that involves classification of mosquito breeding sites, larval presents, and survey.	\$100	
	Debris shall be cleared from the site and properly disposed of at the end of the snow season, but shall be cleared no later than May 15.	Avoid dumping snow removal over catch basins, in detention ponds, sediment forebays, rivers, wetlands, and flood plain. It is also prohibited to dump snow in the bioretention basins or gravel swales. (See Site Plan for appropriate locations)	\$500	



Energy and Environmental Affairs

A Home > Agencies > MassDEP > Water Resources > Laws & Rules > Snow Disposal Guidance

Snow Disposal Guidance

Effective Date: March 8, 2001

Guideline No. BRPG01-01

Applicability: Applies to all federal, state, regional and local agencies, as well as to private businesses.

Supersedes: BRP Snow Disposal Guideline BRPG97-1 issued 12/19/97, and all previous snow disposal guidance

Approved by: Glenn Haas, Assistant Commissioner for Resource Protection

PURPOSE: To provide guidelines to all government agencies and private businesses regarding snow disposal site selection, site preparation and maintenance, and emergency snow disposal options that are acceptable to the Department of Environmental Protection, Bureau of Resource Protection.

APPLICABILITY: These Guidelines are issued by the Bureau of Resource Protection on behalf of all Bureau Programs (including Drinking Water Supply, Wetlands and Waterways, Wastewater Management, and Watershed Planning and Permitting). They apply to public agencies and private businesses disposing of snow in the Commonwealth of Massachusetts.

INTRODUCTION

Finding a place to dispose of collected snow poses a challenge to municipalities and businesses as they clear roads, parking lots, bridges, and sidewalks. While we are all aware of the threats to public safety caused by snow, collected snow that is contaminated with road salt, sand, litter, and automotive pollutants such as oil also threatens public health and the environment.

As snow melts, road salt, sand, litter, and other pollutants are transported into surface water or through the soil where they may eventually reach the groundwater. Road salt and other pollutants can contaminate water supplies and are toxic to aquatic life at certain levels. Sand washed into waterbodies can create sand bars or fill in wetlands and ponds, impacting aquatic life, causing flooding, and affecting our use of these resources.

There are several steps that communities can take to minimize the impacts of snow disposal on public health and the environment. These steps will help communities avoid the costs of a contaminated water supply, degraded waterbodies, and flooding. Everything we do on the land has the potential to impact our water resources. Given the authority of local government over the use of the land, municipal officials and staff have a critically important role to play in protecting our water resources.

The purpose of these guidelines is to help municipalities and businesses select, prepare, and maintain appropriate snow disposal sites before the snow begins to accumulate through the winter.

RECOMMENDED GUIDELINES

These snow disposal guidelines address: (1) site selection; (2) site preparation and maintenance; and (3) emergency snow disposal.

1. SITE SELECTION

The key to selecting effective snow disposal sites is to locate them adjacent to or on pervious surfaces in upland areas away from water resources and wells. At these locations, the snow meltwater can filter in to the soil, leaving behind sand and debris which can be removed in the springtime. The following areas should be avoided:

- Avoid dumping of snow into any waterbody, including rivers, the ocean, reservoirs, ponds, or wetlands. In addition to
 water quality impacts and flooding, snow disposed of in open water can cause navigational hazards when it freezes into
 ice blocks.
- Do not dump snow within a Zone II or Interim Wellhead Protection Area (IWPA) of a public water supply well or within 75 feet of a private well, where road salt may contaminate water supplies.
- Avoid dumping snow on MassDEP-designated high and medium-yield aquifers where it may contaminate groundwater (see the next page for information on ordering maps from MassGIS showing the locations of aquifers, Zone II's, and IWPAs in your community).
- Avoid dumping snow in sanitary landfills and gravel pits. Snow meltwater will create more contaminated leachate in landfills posing a greater risk to groundwater, and in gravel pits, there is little opportunity for pollutants to be filtered out of the meltwater because groundwater is close to the land surface.



Avoid disposing of snow on top of storm drain catch basins or in stormwater drainage swales or ditches. Snow
combined with sand and debris may block a storm drainage system, causing localized flooding. A high volume of sand,
sediment, and litter released from melting snow also may be quickly transported through the system into surface water.

Site Selection Procedures

- 1. It is important that the municipal Department of Public Works or Highway Department, Conservation Commission, and Board of Health work together to select appropriate snow disposal sites. The following steps should be taken:
- 2. Estimate how much snow disposal capacity is needed for the season so that an adequate number of disposal sites can be selected and prepared.
- 3. Identify sites that could potentially be used for snow disposal such as municipal open space (e.g., parking lots or parks).
- 4. Sites located in upland locations that are not likely to impact sensitive environmental resources should be selected first.
- 5. If more storage space is still needed, prioritize the sites with the least environmental impact (using the site selection criteria, and local or MassGIS maps as a guide).

MassGIS Maps of Open Space and Water Resources

If local maps do not show the information you need to select appropriate snow disposal sites, you may order maps from MassGIS (Massachusetts Geographic Information System) which show publicly owned open spaces and approximate locations of sensitive environmental resources (locations should be field-verified where possible). Different coverages or map themes depicting sensitive environmental resources are available from MassGIS on the map you order. At a minimum, you should order the Priority Resources Map. The Priority Resources Map includes aquifers, public water supplies, MassDEP-approved Zone II's, Interim Wellhead Protection Areas, Wetlands, Open Space, Areas of Critical Environmental Concern, NHESP Wetlands Habitats, MassDEP Permitted Solid Waste facilities, Surface Water Protection areas (Zone A's) and base map features. The cost of this map is \$25.00. Other coverages or map themes you may consider, depending on the location of your city or town, include Outstanding Resource Waters and MassDEP Eelgrass Resources. These are available at \$25.00 each, with each map theme being depicted on a separate map. Maps should be ordered from MassGIS . Maps may also be ordered by fax at 617-626-1249 (order form available from the MassGIS web site) or mail. For further information, contact MassGIS at 617-626-1189.

2. SITE PREPARATION AND MAINTENANCE

In addition to carefully selecting disposal sites before the winter begins, it is important to prepare and maintain these sites to maximize their effectiveness. The following maintenance measures should be undertaken for all snow disposal sites:

- A silt fence or equivalent barrier should be placed securely on the downgradient side of the snow disposal site.
- To filter pollutants out of the meltwater, a 50-foot vegetative buffer strip should be maintained during the growth season between the disposal site and adjacent waterbodies.
- Debris should be cleared from the site prior to using the site for snow disposal.
- Debris should be cleared from the site and properly disposed of at the end of the snow season and no later than May 15.

3. EMERGENCY SNOW DISPOSAL

As mentioned earlier, it is important to estimate the amount of snow disposal capacity you will need so that an adequate number of upland disposal sites can be selected and prepared.

If despite your planning, upland disposal sites have been exhausted, snow may be disposed of near waterbodies. A vegetated buffer of at least 50 feet should still be maintained between the site and the waterbody in these situations. Furthermore, it is essential that the other guidelines for preparing and maintaining snow disposal sites be followed to minimize the threat to adjacent waterbodies.

Under extraordinary conditions, when all land-based snow disposal options are exhausted, disposal of snow that is not obviously contaminated with road salt, sand, and other pollutants may be allowed in certain waterbodies under certain conditions. In these dire situations, notify your Conservation Commission and the appropriate MassDEP Regional Service Center before disposing of snow in a waterbody.

Use the following guidelines in these emergency situations:

- Dispose of snow in open water with adequate flow and mixing to prevent ice dams from forming.
- Do not dispose of snow in saltmarshes, vegetated wetlands, certified vernal pools, shellfish beds, mudflats, drinking water reservoirs and their tributaries, Zone IIs or IWPAs of public water supply wells, Outstanding Resource Waters, or Areas of Critical Environmental Concern.
- Do not dispose of snow where trucks may cause shoreline damage or erosion.
- Consult with the municipal Conservation Commission to ensure that snow disposal in open water complies with local

ordinances and bylaws.

FOR MORE INFORMATION

If you need more information, contact one of MassDEP's Regional Service Centers:

Northeast Regional Office, Wilmington, 978-694-3200 Southeast Regional Office, Lakeville, 508-946-2714 Central Regional Office, Worcester, 508-792-7683 Western Regional Office, Springfield, 413-755-2214

or

Call Thomas Maguire of DEP's Bureau of Resource Protection in Boston at 617-292-5602.

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Chapter 5 Miscellaneous Stormwater Topics

Mosquito Control in Stormwater Management Practices

Both aboveground and underground stormwater BMPs have the potential to serve as mosquito breeding areas. Good design, proper operation and maintenance and treatment with larvicides can minimize this potential.

EPA recommends that stormwater treatment practices dewater within 3 days (72 hours) to reduce the number of mosquitoes that mature to adults, since the aquatic stage of many mosquito species is 7 to 10 days. Massachusetts has had a 72-hour dewatering rule in its Stormwater Management Standards since 1996. The 2008 technical specifications for BMPs set forth in Volume 2, Chapter 2 of the Massachusetts Stormwater Handbook also concur with this practice by requiring that all stormwater practices designed to drain do so within 72 hours.

Some stormwater practices are designed to include permanent wet pools. These practices – if maintained properly – can limit mosquito breeding by providing habitat for mosquito predators. Additional measures that can be taken to reduce mosquito populations include increasing water circulation, attracting mosquito predators by adding suitable habitat, and applying larvicides.

The Massachusetts State Reclamation and Mosquito Control Board (SRMCB), through the Massachusetts Mosquito Control Districts, can undertake further mosquito control actions specifically for the purpose of mosquito control pursuant to Massachusetts General Law Chapter 252. The Mosquito Control Board, <u>http://www.mass.gov/agr/mosquito/</u>, describes mosquito control methods and is in the process of developing guidance documents that describe Best Management Practices for mosquito control projects.

The SRMCB and Mosquito Control Districts are not responsible for operating and maintaining stormwater BMPs to reduce mosquito populations. The owners of property that construct the stormwater BMPs or municipalities that "accept" them through local subdivision approval are responsible for their maintenance.¹ The SRMCB is composed of officials from MassDEP, Department of Agricultural Resources, and Department of Conservation and Recreation. The nine (9) Mosquito Control Districts overseen by the SRMCB are located throughout Massachusetts, covering 176 municipalities.

Construction Period Best Management Practices for Mosquito Control

To minimize mosquito breeding during construction, it is essential that the following actions be taken to minimize the creation of standing pools by taking the following actions:

- *Minimize Land Disturbance:* Minimizing land disturbance reduces the likelihood of mosquito breeding by reducing silt in runoff that will cause construction period controls to clog and retain standing pools of water for more than 72 hours.
- *Catch Basin inlets:* Inspect and refresh filter fabric, hay bales, filter socks or stone dams on a regular basis to ensure that any stormwater ponded at the inlet drains within 8 hours after precipitation stops. Shorter periods may be necessary to avoid hydroplaning in roads

¹ MassDEP and MassHighway understand that the numerous stormwater BMPs along state highways pose a unique challenge. To address this challenge, the 2004 MassHighway Stormwater Handbook will provide additional information on appropriate operation and maintenance practices for mosquito control when the Handbook is revised to reflect the 2008 changes to the Stormwater Management Standards..

caused by water ponded at the catch basin inlet. Treat catch basin sumps with larvicides such as *Bacillus sphaericus* (*Bs*) using a licensed pesticide applicator.

- *Check Dams:* If temporary check dams are used during the construction period to lag peak rate of runoff or pond runoff for exfiltration, inspect and repair the check dams on a regular basis to ensure that any stormwater ponded behind the check dam drains within 72 hours.
- **Design construction period sediment traps** to dewater within 72 hours after precipitation. Because these traps are subject to high silt loads and tend to clog, treat them with the larvicide *Bs* after it rains from June through October, until the first frost occurs.
- *Construction period open conveyances:* When temporary manmade ditches are used for channelizing construction period runoff, inspect them on a regular basis to remove any accumulated sediment to restore flow capacity to the temporary ditch.
- *Revegetating Disturbed Surfaces:* Revegetating disturbed surfaces reduces sediment in runoff that will cause construction period controls to clog and retain standing pools of water for greater than 72 hours.
- *Sediment fences/hay bale barriers:* When inspections find standing pools of water beyond the 24-hour period after a storm, take action to restore barrier to its normal function.

Post-Construction Stormwater Treatment Practices

- Mosquito control begins with the environmentally sensitive site design. Environmentally sensitive site design that minimizes impervious surfaces reduces the amount of stormwater runoff. Disconnecting runoff using the LID Site Design credits outlined in the Massachusetts Stormwater Handbook reduces the amount of stormwater that must be conveyed to a treatment practice. Utilizing green roofs minimizes runoff from smaller storms. Storage media must be designed to dewater within 72 hours after precipitation.
- Mosquito control continues with the selection of structural stormwater BMPs that are unlikely to become breeding grounds for mosquitoes, such as:
 - **Bioretention Areas/Rain Gardens/Sand Filter:** These practices tend not to result in mosquito breeding. If any level spreaders, weirs or sediment forebays are used as part of the design, inspect them and correct them as necessary to prevent standing pools of water for more than 72 hours.
 - *Infiltration Trenches:* This practice tends not to result in mosquito breeding. If any level spreaders, weirs, or sediment forebays are used as part of the design, inspect them and correct them as necessary to prevent standing pools of water for more than 72 hours.
- Another mosquito control strategy is to select BMPs that can become habitats for mosquito predators, such as:
 - *Constructed Stormwater Wetlands:* Habitat features can be incorporated in constructed stormwater wetlands to attract dragonflies, amphibians, turtles, birds, bats, and other natural predators of mosquitoes.
 - Wet Basins: Wet basins can be designed to incorporate fish habitat features, such as deep pools. Introduce fish in consultation with Massachusetts Division of Fisheries and Wildlife. Vegetation within wet basins designed as fish habitat must be properly managed to ensure that vegetation does not overtake the habitat. Proper design to ensure that no low circulation or "dead" zones are created may reduce the potential for mosquito breeding. Introducing bubblers may increase water circulation in the wet basin.

Massachusetts Stormwater Handbook

Effective mosquito controls require proponents to design structural BMPs to prevent ponding and facilitate maintenance and, if necessary, the application of larvicides. Examples of such design practices include the following:

- **Basins:** Provide perimeter access around wet basins, extended dry detention basins and dry detention basins for both larviciding and routine maintenance. Control vegetation to ensure that access pathways stay open.
- *BMPs without a permanent pool of water:* All structural BMPs that do not rely on a permanent pool of water must drain and completely dewater within 72 hours after precipitation. This includes dry detention basins, extended dry detention basins, infiltration basins, and dry water quality swales. Use underdrains at extended dry detention basins to drain the small pools that form due to accumulation of silts. Wallace indicates that extended dry extended detention basins may breed more mosquitoes than wet basins. It is, therefore, imperative to design outlets from extended dry detention basins to completely dewater within the 72-hour period.
- *Energy Dissipators and Flow Spreaders:* Currier and Moeller, 2000 indicate that shallow recesses in energy dissipators and flow spreaders trap water where mosquitoes breed. Set the riprap in grout to reduce the shallow recesses and minimize mosquito breeding.
- *Outlet control structures:* Debris trapped in small orifices or on trash racks of outlet control structures such as multiple stage outlet risers may clog the orifices or the trash rack, causing a standing pool of water. Optimize the orifice size or trash rack mesh size to provide required peak rate attenuation/water quality detention/retention time while minimizing clogging.
- *Rain Barrels and Cisterns:* Seal lids to reduce the likelihood of mosquitoes laying eggs in standing water. Install mosquito netting over inlets. The cistern system should be designed to ensure that all collected water is drained into it within 72 hours.
- Subsurface Structures, Deep Sump Catch Basins, Oil Grit Separators, and Leaching Catch Basins: Seal all manhole covers to reduce likelihood of mosquitoes laying eggs in standing water. Install mosquito netting over the outlet (CALTRANS 2004).

The Operation and Maintenance Plan should provide for mosquito prevention and control.

- *Check dams:* Inspect permanent check dams on the schedule set forth in the O&M Plan. Inspect check dams 72 hours after storms for standing water ponding behind the dam. Take corrective action if standing water is found.
- *Cisterns:* Apply *Bs* larvicide in the cistern if any evidence of mosquitoes is found. The Operation and Maintenance Plan shall specify how often larvicides should be applied to waters in the cistern.
- *Water quality swales:* Remove and properly dispose of any accumulated sediment as scheduled in the Operation and Maintenance Plan.
- *Larvicide Treatment:* The Operation and Maintenance Plan must include measures to minimize mosquito breeding, including larviciding.
- The party identified in the Operation and Maintenance Plan as responsible for maintenance shall see that larvicides are applied as necessary to the following stormwater treatment practices: catch basins, oil/grit separators, wet basins, wet water quality swales, dry extended detention basins, infiltration basins, and constructed stormwater wetlands. The Operation and Maintenance Plan must ensure that all larvicides are applied by a licensed pesticide applicator and in compliance with all pesticide label requirements.
- The Operation and Maintenance Plan should identify the appropriate larvicide and the time and method of application. For example, *Bacillus sphaericus (Bs)*, the preferred

larvicide for stormwater BMPs, should be hand-broadcast.² Alternatively, Altosid, a Methopren product, may be used. Because some practices are designed to dewater between storms, such as dry extended detention and infiltration basins, the Operation and Maintenance Plan should provide that larviciding must be conducted during or immediately after wet weather, when the detention or infiltration basin has a standing pool of water, unless a product is used that can withstand extended dry periods.

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² Bacillus thuringienis israelensis or Bti is usually applied by helicopter to wetlands and floodplains

Contactor[®] & Recharger[®] Stormwater Chambers The Chamber With The Stripe®



Operation and Maintenance Guidelines



-Operation & Maintenance

This manual contains guidelines recommended by CULTEC, Inc. and may be used in conjunction with, but not to supersede, local regulations or regulatory authorities. OSHA Guidelines must be followed when inspecting or cleaning any structure.

Introduction

The CULTEC Subsurface Stormwater Management System is a high-density polyethylene (HDPE) chamber system arranged in parallel rows surrounded by washed stone. The CULTEC chambers create arch-shaped voids within the washed stone to provide stormwater detention, retention, infiltration, and reclamation. Filter fabric is placed between the native soil and stone interface to prevent the intrusion of fines into the system. In order to minimize the amount of sediment which may enter the CULTEC system, a sediment collection device (stormwater pretreatment device) is recommended upstream from the CULTEC chamber system. Examples of pretreatment devices include, but are not limited to, an appropriately sized catch basin with sump, pretreatment catchment device, oil grit separator, or baffled distribution box. Manufactured pretreatment devices may also be used in accordance with CULTEC chambers. Installation, operation, and maintenance of these devices shall be in accordance with manufacturer's recommendations. Almost all of the sediment entering the stormwater management system will be collected within the pretreatment device.

Best Management Practices allow for the maintenance of the preliminary collection systems prior to feeding the CULTEC chambers. The pretreatment structures shall be inspected for any debris that will restrict inlet flow rates. Outfall structures, if any, such as outlet control must also be inspected for any obstructions that would restrict outlet flow rates. OSHA Guidelines must be followed when inspecting or cleaning any structure.

Operation and Maintenance Requirements

I. Operation

CULTEC stormwater management systems shall be operated to receive only stormwater run-off in accordance with applicable local regulations. CULTEC subsurface stormwater management chambers operate at peak performance when installed in series with pretreatment. Pretreatment of suspended solids is superior to treatment of solids once they have been introduced into the system. The use of pretreatment is adequate as long as the structure is maintained and the site remains stable with finished impervious surfaces such as parking lots, walkways, and pervious areas are properly maintained. If there is to be an unstable condition, such as improvements to buildings or parking areas, all proper silt control measures shall be implemented according to local regulations.

II. Inspection and Maintenance Options

- A. The CULTEC system may be equipped with an inspection port located on the inlet row. The inspection port is a circular cast box placed in a rectangular concrete collar. When the lid is removed, a 6-inch (150 mm) pipe with a screw-in plug will be exposed. Remove the plug. This will provide access to the CULTEC Chamber row below. From the surface, through this access, the sediment may be measured at this location. A stadia rod may be used to measure the depth of sediment if any in this row. If the depth of sediment is in excess of 3 inches (76 mm), then this row should be cleaned with high pressure water through a culvert cleaning nozzle. This would be carried out through an upstream manhole or through the CULTEC StormFilter Unit (or other pre-treatment device). CCTV inspection of this row can be deployed through this access port to determine if any sediment has accumulated in the inlet row.
- **B.** If the CULTEC bed is not equipped with an inspection port, then access to the inlet row will be through an upstream manhole or the CULTEC StormFilter.

1. Manhole Access

This inspection should only be carried out by persons trained in confined space entry and sewer inspection services. After the manhole cover has been removed a gas detector must be lowered into the manhole to ensure that there are not high concentrations of toxic gases present. The inspector should be lowered into the manhole with the proper safety equipment as per OSHA requirements. The inspector may be able to observe sediment from this location. If this is not possible, the inspector will need to deploy a CCTV robot to permit viewing of the sediment.

Operation & Maintenance



2. StormFilter Access

Remove the manhole cover to allow access to the unit. Typically a 30-inch (750 mm) pipe is used as a riser from the StormFilter to the surface. As in the case with manhole access, this access point requires a technician trained in confined space entry with proper gas detection equipment. This individual must be equipped with the proper safety equipment for entry into the StormFilter. The technician will be lowered onto the StormFilter unit. The hatch on the unit must be removed. Inside the unit are two filters which may be removed according to StormFilter maintenance guidelines. Once these filters are removed the inspector can enter the StormFilter unit to launch the CCTV camera robot.

C. The inlet row of the CULTEC system is placed on a polyethylene liner to prevent scouring of the washed stone beneath this row. This also facilitates the flushing of this row with high pressure water through a culvert cleaning nozzle. The nozzle is deployed through a manhole or the StormFilter and extended to the end of the row. The water is turned on and the inlet row is back-flushed into the manhole or StormFilter. This water is to be removed from the manhole or StormFilter using a vacuum truck.

III. Maintenance Guidelines

The following guidelines shall be adhered to for the operation and maintenance of the CULTEC 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.

IV. Suggested Maintenance Schedules

A. Minor Maintenance

The following suggested schedule shall be followed for routine maintenance during the regular operation of the stormwater system:

Frequency	Action
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.

B. Major Maintenance

The following suggested maintenance schedule shall be followed to maintain the performance of the CULTEC stormwater management chambers. Additional work may be necessary due to insufficient performance and other issues that might be found during the inspection of the stormwater management chambers. (See table on next page)

Major Maintenance (continued)

	Frequency	Action
Inlets and Outlets	Every 3 years	Obtain documentation that the inlets, outlets and vents have been cleaned and will function as intended.
	Spring and Fall	 Check inlet and outlets for clogging and remove any debris as re- quired.
CULTEC Stormwater Chambers	2 years after commis- sioning	Inspect the interior of the stormwater management chambers through inspection port for deficiencies using CCTV or comparable technique.
		Obtain documentation that the stormwater management chambers and feed connectors will function as anticipated.
	9 years after commis- sioning every 9 years following	Clean stormwater management chambers and feed connectors of any debris.
		 Inspect the interior of the stormwater management structures for deficiencies using CCTV or comparable technique.
		 Obtain documentation that the stormwater management chambers and feed connectors have been cleaned and will function as intend- ed.
	45 years after com- missioning	Clean stormwater management chambers and feed connectors of any debris.
		• Determine the remaining life expectancy of the stormwater man- agement chambers and recommended schedule and actions to reha- bilitate the stormwater management chambers as required.
		 Inspect the interior of the stormwater management chambers for deficiencies using CCTV or comparable technique.
	45 to 50 years after commissioning	• Replace or restore the stormwater management chambers in accor- dance with the schedule determined at the 45-year inspection.
		Attain the appropriate approvals as required.
		Establish a new operation and maintenance schedule.
Surrounding Site	Monthly in 1 st year	Check for depressions in areas over and surrounding the stormwater management system.
	Spring and Fall	Check for depressions in areas over and surrounding the stormwater management system.
	Yearly	Confirm that no unauthorized modifications have been performed to the site.

For additional information concerning the maintenance of CULTEC Subsurface Stormwater Management Chambers, please contact CULTEC, Inc. at 1-800-428-5832.



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Inspection and Maintenance. Easy. Convenient.

When it rains, oils, sediment and other contaminants are captured and contained by over 40,000 Stormceptor units operating worldwide. While Stormceptor's patented scour prevention technology ensures captured pollutants remain in the unit during all rainfall events, the accumulated pollutants must eventually be removed as part of a regular maintenance program.

If neglected, oil and sediment gradually build up and diminish any BMP's efficiency, harming the environment and leaving owners and operators vulnerable to fines, surcharges and bad publicity.

Maintenance is a must

Ease, frequency and cost of maintenance are often overlooked by specifiers when considering the merits of a stormwater treatment system. In reality, maintenance is fundamental to the long-term performance of any stormwater quality treatment device.





While regular maintenance is crucial, it shouldn't be complicated. An ongoing maintenance program with Stormceptor is convenient and

practically effortless. With virtually no disruptions, you can concentrate on your core business.

Quick inspections

Inspections are easily carried out above ground from any standard surface access cover through a visual inspection of the orifice and drop tee components. A sludge judge and oil dip-stick are all that are needed for sediment and oil depth measurements.

Easy unit access

Maintenance is typically conducted from the same surface access cover, eliminating the need for confined space entry into the unit. Your site remains undisturbed, saving you time and money.



No muss, no fuss and fast

Maintenance is performed quickly and inexpensively with a standard vacuum truck. Servicing usually takes less than two hours, with no disruption to your site.

A complete stormwater management plan for Stormceptor extends beyond installation and performance to regular maintenance. It's the smart, cost-effective way to ensure your unit continues to remove more pollutants than any other separator for decades to come.



Stormceptor maintenance recommendations

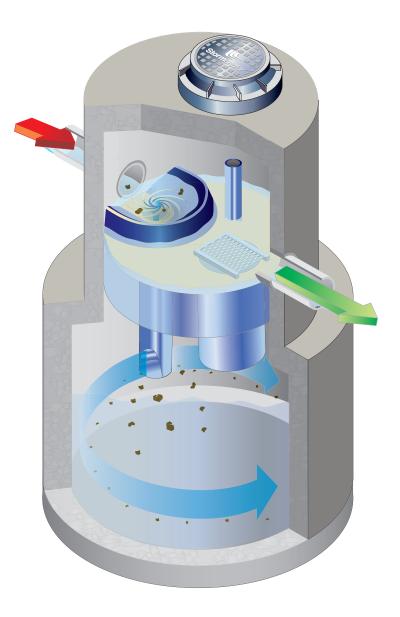
- Units should be inspected post-construction, prior to being put into service.
- . Inspect every six months for the first year of operation to determine the oil and sediment accumulation rate.
- . In subsequent years, inspections can be based on first-year observations or local requirements.
- Cleaning is recommended once the sediment depth reaches 15% of storage capacity, (generally taking one year or longer). Local regulations for maintenance frequency may vary.
- · Inspect the unit immediately after an oil, fuel or chemical spill.
- A licensed waste management company should remove captured petroleum waste products from any oil, chemical or fuel spills and dispose responsibly.

With over 40,000 units operating worldwide, Stormceptor performs and protects every day, in every storm.



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Stormceptor® Owner's Manual



Stormceptor is protected by one or more of the following patents:

Canadian Patent No. 2,137,942 Canadian Patent No. 2,175,277 Canadian Patent No. 2,180,305 Canadian Patent No. 2,180,338 Canadian Patent No. 2,206,338 Canadian Patent No. 2,327,768 U.S. Patent No. 5,753,115 U.S. Patent No. 5,849,181 U.S. Patent No. 6,068,765 U.S. Patent No. 6,371,690 U.S. Patent No. 7,582,216 U.S. Patent No. 7,666,303 Australia Patent No. 693.164 Australia Patent No. 707,133 Australia Patent No. 729,096 Australia Patent No. 779,401 Australia Patent No. 2008,279,378 Australia Patent No. 2008,288,900 Indonesia Patent No. 0007058 Japan Patent No. 3581233 Japan Patent No. 9-11476 Korean Patent No. 0519212 Malaysia Patent No. 118987 New Zealand Patent No. 314,646 New Zealand Patent No. 583,008 New Zealand Patent No. 583,583 South African Patent No. 2010/00682 South African Patent No. 2010/01796 Other Patents Pending

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- 5 Contact Information (Stormceptor Licensees)

Congratulations!

Your selection of a Stormceptor[®] means that you have chosen the most recognized and efficient stormwater oil/sediment separator available for protecting the environment. Stormceptor is a pollution control device often referred to as a "Hydrodynamic Separator (HDS)" or an "Oil Grit Separator (OGS)", engineered to remove and retain pollutants from stormwater runoff to protect our lakes, rivers and streams from the harmful effects of non-point source pollution.

1 – Stormceptor Overview

Stormceptor is a patented stormwater quality structure most often utilized as a treatment component of the underground storm drain network for stormwater pollution prevention. Stormceptor is designed to remove sediment, total suspended solids (TSS), other pollutants attached to sediment, hydrocarbons and free oil from stormwater runoff. Collectively the Stormceptor provides spill protection and prevents non-point source pollution from entering downstream waterways.

Key benefits of Stormceptor include:

- Removes sediment, suspended solids, debris, nutrients, heavy metals, and hydrocarbons (oil and grease) from runoff and snowmelt.
- Will not scour or re-suspend trapped pollutants.
- Provides sediment and oil storage.
- Provides spill control for accidents, commercial and industrial developments.
- · Easy to inspect and maintain (vacuum truck).
- "STORMCEPTOR" is clearly marked on the access cover (excluding inlet designs).
- Relatively small footprint.
- 3rd Party tested and independently verified.
- Dedicated team of experts available to provide support.

Model Types:

- STC (Standard)
- STF (Fiberglass)
- EOS (Extended Oil Storage)
- OSR (Oil and Sand Removal)
- MAX (Custom designed unit, specific to site)

Configuration Types:

- Inlet unit (accommodates inlet flow entry, and multi-pipe entry)
- In-Line (accommodates multi-pipe entry)
- Submerged Unit (accommodates the site's tailwater conditions)
- Series Unit (combines treatment in two systems)

Please Maintain Your Stormceptor

To ensure long-term environmental protection through continued performance as originally designed for your site, **Stormceptor must be maintained**, as any stormwater treatment practice does. The need for maintenance is determined through inspection of the Stormceptor. Procedures for inspection are provided within this document. Maintenance of the Stormceptor is performed from the surface via vacuum truck.

If you require information about Stormceptor, or assistance in finding resources to facilitate inspections or maintenance of your Stormceptor please call your local Stormceptor Licensee or Imbrium[®] Systems.

2 – Stormceptor Operation & Components

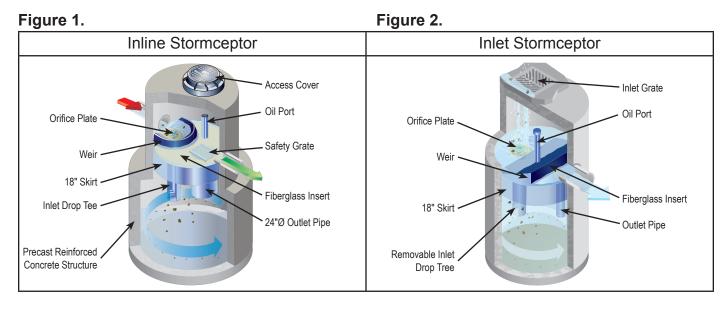
Stormceptor is a flexibly designed underground stormwater quality treatment device that is unparalleled in its effectiveness for pollutant capture and retention using patented flow separation technology.

Stormceptor creates a non-turbulent treatment environment below the insert platform within the system. The insert diverts water into the lower chamber, allowing free oils and debris to rise, and sediment to settle under relatively low velocity conditions. These pollutants are trapped and stored below the insert and protected from large runoff events for later removal during the maintenance procedure.

With thousands of units operating worldwide, Stormceptor delivers reliable protection every day, in every storm. The patented Stormceptor design prohibits the scour and release of captured pollutants, ensuring superior water quality treatment and protection during even the most extreme storm events. Stormceptor's proven performance is backed by the longest record of lab and field verification in the industry.

Stormceptor Schematic and Component Functions

Below are schematics of two common Stormceptor configurations with key components identified and their functions briefly described.



- Manhole access cover provides access to the subsurface components
- Precast reinforced concrete structure provides the vessel's watertight structural support
- Fiberglass insert separates vessel into upper and lower chambers
- Weir directs incoming stormwater and oil spills into the lower chamber
- Orifice plate prevents scour of accumulated pollutants
- Inlet drop tee conveys stormwater into the lower chamber
- Fiberglass skirt provides double-wall containment of hydrocarbons
- Outlet riser pipe conveys treated water to the upper chamber; primary vacuum line access port for sediment removal
- Oil inspection port primary access for measuring oil depth and oil removal
- Safety grate safety measure to cover riser pipe in the event of manned entry into vessel

3 – Stormceptor Identification

Stormceptor is available in both precast concrete and fiberglass vessels, with precast concrete often being the dominant material of construction.

In the Stormceptor, a patented, engineered fiberglass insert separates the structure into an upper chamber and lower chamber. The lower chamber will remain full of water, as this is where the pollutants are sequestered for later removal. Multiple Stormceptor model (STC, OSR, EOS, MAX and STF) configurations exist, each to be inspected and maintained in a similar fashion.

Each unit is easily identifiable as a Stormceptor by the trade name "Stormceptor" embossed on each access cover at the surface. To determine the location of "inlet" Stormceptor units with horizontal catch basin inlet, look down into the grate as the Stormceptor insert will be visible. The name "Stormceptor" is not embossed on inlet models due to the variability of inlet grates used/ approved across North America.

⁶ Stormceptor® Owner's Manual

Once the location of the Stormceptor is determined, the model number may be identified by comparing the measured depth from the fiberglass insert level at the outlet pipe's invert (water level) to the bottom of the tank using **Table 1**.

In addition, starting in 1996 a metal serial number tag containing the model number has been affixed to the inside of the unit, on the fiberglass insert. If the unit does not have a serial number, or if there is any uncertainty regarding the size of the unit using depth measurements, please contact your local Stormceptor Representative for assistance.

Sizes/Models

Typical general dimensions and capacities of the standard precast STC, EOS & OSR Stormceptor models in both USA and Canada/International (excluding South East Asia and Australia) are provided in **Tables 1 and 2**. Typical rim to invert measurements are provided later in this document. The total depth for cleaning will be the sum of the depth from outlet pipe invert (generally the water level) to rim (grade) and the depth from outlet pipe invert to the precast bottom of the unit. Note that depths and capacities may vary slightly between regions.

STC Model	Insert to Base (in.)	EOS Model	Insert to Base (in.)	OSR Model	Insert to Base (in.)	Typical STF m (in.)
450	60	4-175	60	65	60	1.5 (60)
900	55	9-365	55	140	55	1.5 (61)
1200	71	12-590	71			1.8 (73)
1800	105	18-1000	105			2.9 (115)
2400	94	24-1400	94	250	94	2.3 (89)
3600	134	36-1700	134			3.2 (127)
4800	128	48-2000	128	390	128	2.9 (113)
6000	150	60-2500	150			3.5 (138)
7200	134	72-3400	134	560	134	3.3 (128)
11000*	128	110-5000*	128	780*	128	
13000*	150	130-6000*	150			
16000*	134	160-7800*	134	1125*	134	

Table 1A.	. (US) Stormcepto	r Dimensions –	Insert to B	ase of Structure
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Notes:

1. Depth Below Pipe Inlet Invert to the Bottom of Base Slab can vary slightly by manufacturing facility, and can be modified to accommodate specific site designs, pollutant loads or site conditions. Contact your local representative for assistance.

*Consist of two chamber structures in series.

STC Model	Insert to Base (m)	EOS Model	Insert to Base (m)	OSR Model	Insert to Base (m)	Typical STF m (in.)
300	1.5	300	1.5	300	1.7	1.5 (60)
750	1.5	750	1.5	750	1.6	1.5 (61)
1000	1.8	1000	1.8			1.8 (73)
1500	2.8					2.9 (115)
2000	2.8	2000	2.8	2000	2.6	2.3 (89)
3000	3.7	3000	3.7			3.2 (127)
4000	3.4	4000	3.4	4000	3.6	2.9 (113)
5000	4.0	5000	4.0			3.5 (138)
6000	3.7	6000	3.7	6000	3.7	3.3 (128)
9000*	3.4	9000*	3.4	9000*	3.6	
11000*	4.0	10000*	4.0			
14000*	3.7	14000*	3.7	14000*	3.7	

Table 1B. (CA & Int'l) Stormceptor Dimensions – Insert to Base of Structure

Notes:

1. Depth Below Pipe Inlet Invert to the Bottom of Base Slab can vary slightly by manufacturing facility, and can be modified to accommodate specific site designs, pollutant loads or site conditions. Contact your local representative for assistance.

*Consist of two chamber structures in series.

Table 2A. (US) Storage Capacities

STC Model	Hydrocarbon Storage Capacity	Sediment Capacity	EOS Model	Hydrocarbon Storage Capacity	OSR Model	Hydrocarbon Storage Capacity	Sediment Capacity
	gal	ft ³		gal		gal	ft ³
450	86	46	4-175	175	065	115	46
900	251	89	9-365	365	140	233	58
1200	251	127	12-590	591			
1800	251	207	18-1000	1198			
2400	840	205	24-1400	1457	250	792	156
3600	840	373	36-1700	1773			
4800	909	543	48-2000	2005	390	1233	465
6000	909	687	60-2500	2514			
7200	1059	839	72-3400	3418	560	1384	690
11000*	2797	1089	110-5000*	5023	780*	2430	930
13000*	2797	1374	130-6000*	6041			
16000*	3055	1677	160-7800*	7850	1125*	2689	1378

Notes:

1. Hydrocarbon & Sediment capacities can be modified to accommodate specific site design requirements, contact your local representative for assistance.

*Consist of two chamber structures in series.

STC Model	Hydrocarbon Storage Capacity L	Sediment Capacity L	EOS Model	Hydrocarbon Storage Capacity L	OSR Model	Hydrocarbon Storage Capacity L	Sediment Capacity L
300	300	1450	300	662	300	300	1500
750	915	3000	750	1380	750	900	3000
1000	915	3800	1000	2235			
1500	915	6205					
2000	2890	7700	2000	5515	2000	2790	7700
3000	2890	11965	3000	6710			
4000	3360	16490	4000	7585	4000	4700	22200
5000	3360	20940	5000	9515			
6000	3930	26945	6000	12940	6000	5200	26900
9000*	10555	32980	9000*	19010	9000*	9300	33000
11000*	10555	37415	10000*	22865			
14000*	11700	53890	14000*	29715	14000*	10500	53900

Table 2B. (CA & Int'l) Storage Capacities

Notes:

1. Hydrocarbon & Sediment capacities can be modified to accommodate specific site design requirements, contact your local representative for assistance.

*Consist of two chamber structures in series.

4 – Stormceptor Inspection & Maintenance

Regular inspection and maintenance is a proven, cost-effective way to maximize water resource protection for all stormwater pollution control practices, and is required to insure proper functioning of the Stormceptor. Both inspection and maintenance of the Stormceptor is easily performed from the surface. Stormceptor's patented technology has no moving parts, simplifying the inspection and maintenance process.

Please refer to the following information and guidelines before conducting inspection and maintenance activities.

When is inspection needed?

- Post-construction inspection is required prior to putting the Stormceptor into service.
- Routine inspections are recommended during the first year of operation to accurately assess the sediment accumulation.
- Inspection frequency in subsequent years is based on the maintenance plan developed in the first year.
- Inspections should also be performed immediately after oil, fuel, or other chemical spills.

When is maintenance cleaning needed?

• For optimum performance, the unit should be cleaned out once the sediment depth reaches the recommended maintenance sediment depth, which is approximately 15% of the unit's total storage capacity (see **Table 2**). The frequency should be adjusted based on historical inspection results due to variable site pollutant loading.

- Sediment removal is easier when removed on a regular basis at or prior to the recommended maintenance sediment depths, as sediment build-up can compact making removal more difficult.
- The unit should be cleaned out immediately after an oil, fuel or chemical spill.

What conditions can compromise Stormceptor performance?

- If construction sediment and debris is not removed prior to activating the Stormceptor unit, maintenance frequency may be reduced.
- If the system is not maintained regularly and fills with sediment and debris beyond the capacity as indicated in **Table 2**, pollutant removal efficiency may be reduced.
- If an oil spill(s) exceeds the oil capacity of the system, subsequent spills may not be captured.
- If debris clogs the inlet of the system, removal efficiency of sediment and hydrocarbons may be reduced.
- If a downstream blockage occurs, a backwater condition may occur for the Stormceptor and removal efficiency of sediment and hydrocarbons may be reduced.

What training is required?

The Stormceptor is to be inspected and maintained by professional vacuum cleaning service providers with experience in the maintenance of underground tanks, sewers and catch basins. For typical inspection and maintenance activities, no specific supplemental training is required for the Stormceptor. Information provided within this Manual (provided to the site owner) contains sufficient guidance to maintain the system properly.

In unusual circumstances, such as if a damaged component needs replacement or some other condition requires manned entry into the vessel, confined space entry procedures must be followed. Only professional maintenance service providers trained in these procedures should enter the vessel. Service provider companies typically have personnel who are trained and certified in confined space entry procedures according to local, state, and federal standards.

What equipment is typically required for inspection?

- Manhole access cover lifting tool
- Oil dipstick / Sediment probe with ball valve (typically ³/₄-inch to 1-inch diameter)
- Flashlight
- Camera
- Data log / Inspection Report
- · Safety cones and caution tape
- · Hard hat, safety shoes, safety glasses, and chemical-resistant gloves

Recommended Stormceptor Inspection Procedure:

- Stormceptor is to be inspected from grade through a standard surface manhole access cover.
- Sediment and oil depth inspections are performed with a sediment probe and oil dipstick.
- Oil depth is measured through the oil inspection port, either a 4-inch (100 mm) or 6-inch (150 mm) diameter port.
- Sediment depth can be measured through the oil inspection port or the 24-inch (610 mm) diameter outlet riser pipe.
- Inspections also involve a visual inspection of the internal components of the system.



Figure 4.



What equipment is typically required for maintenance?

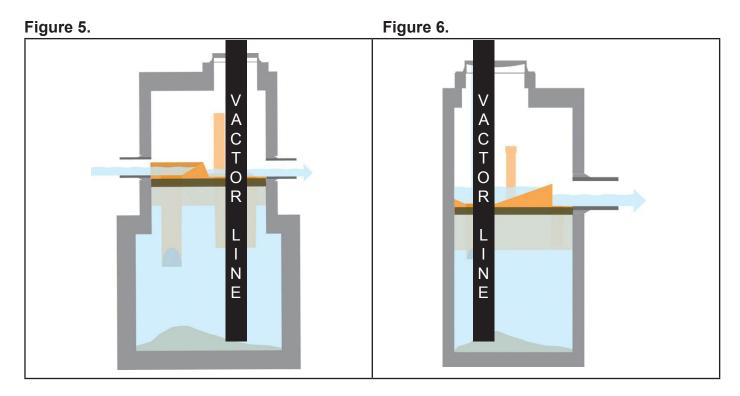
- · Vacuum truck equipped with water hose and jet nozzle
- Small pump and tubing for oil removal
- Manhole access cover lifting tool
- Oil dipstick / Sediment probe with ball valve (typically ¾-inch to 1-inch diameter)
- Flashlight
- Camera
- Data log / Inspection Report
- Safety cones
- Hard hats, safety shoes, safety glasses, chemical-resistant gloves, and hearing protection for service providers
- Gas analyzer, respiratory gear, and safety harness for specially trained personnel if confined space entry is required

Recommended Stormceptor Maintenance Procedure

Maintenance of Stormceptor is performed using a vacuum truck.

No entry into the unit is required for maintenance. **DO NOT ENTER THE STORMCEPTOR CHAMBER** unless you have the proper personal safety equipment, have been trained and are qualified to enter a confined space, as identified by local Occupational Safety and Health Regulations (e.g. 29 CFR 1910.146 or Canada Occupational Safety and Health Regulations – SOR/86-304). Without the proper equipment, training and permit, entry into confined spaces can result in serious bodily harm and potentially death. Consult local, provincial, and/or state regulations to determine the requirements for confined space entry. Be aware, and take precaution that the Stormceptor fiberglass insert may be slippery. In addition, be aware that some units do not have a safety grate to cover the outlet riser pipe that leads to the submerged, lower chamber.

- Ideally maintenance should be conducted during dry weather conditions when no flow is entering the unit.
- Stormceptor is to be maintained through a standard surface manhole access cover.
- Insert the oil dipstick into the oil inspection port. If oil is present, pump off the oil layer into separate containment using a small pump and tubing.
- Maintenance cleaning of accumulated sediment is performed with a vacuum truck.
 - For 6-ft (1800 mm) diameter models and larger, the vacuum hose is inserted into the lower chamber via the 24-inch (610 mm) outlet riser pipe.
 - For 4-ft (1200 mm) diameter model, the removable drop tee is lifted out, and the vacuum hose is inserted into the lower chamber via the 12-inch (305 mm) drop tee hole.



- Using the vacuum hose, decant the water from the lower chamber into a separate containment tank or to the sanitary sewer, if permitted by the local regulating authority.
- Remove the sediment sludge from the bottom of the unit using the vacuum hose. For large Stormceptor units, a flexible hose is often connected to the primary vacuum line for ease of movement in the lower chamber.
- Units that have not been maintained regularly, have surpassed the maximum recommended sediment capacity, or contain damaged components may require manned entry by trained personnel using safe and proper confined space entry procedures.

<image>

A maintenance worker stationed at the above ground surface uses a vacuum hose to evacuate water, sediment, and debris from the system.

What is required for proper disposal?

The requirements for the disposal of material removed from Stormceptor units are similar to that of any other stormwater treatment Best Management Practices (BMP). Local guidelines should be consulted prior to disposal of the separator contents. In most areas the sediment, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste. This could be site and pollutant dependent. In some cases, approval from the disposal facility operator/agency may be required.

What about oil spills?

Stormceptor is often implemented in areas where there is high potential for oil, fuel or other hydrocarbon or chemical spills. Stormceptor units should be cleaned immediately after a spill occurs by a licensed liquid waste hauler. You should also notify the appropriate regulatory agencies as required in the event of a spill.

What if I see an oil rainbow or sheen at the Stormceptor outlet?

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 hydrocarbon rainbow or sheen can be seen at

Figure 7.

Figure 8.

very small oil concentrations (< 10 ppm). Stormceptor is effective at removing 95% of free oil, and the appearance of a sheen at the outlet with high influent oil concentrations does not mean that 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 or dissolved oil conditions.

What factors affect the costs involved with inspection/maintenance?

The Vacuum Service Industry for stormwater drainage and sewer systems is a well-established sector of the service industry that cleans underground tanks, sewers and catch basins. Costs to clean Stormceptor units will vary. Inspection and maintenance costs are most often based on unit size, the number of units on a site, sediment/oil/hazardous material loads, transportation distances, tipping fees, disposal requirements and other local regulations.

What factors predict maintenance frequency?

Maintenance frequency will vary with the amount of pollution on your site (number of hydrocarbon spills, amount of sediment, site activity and use, etc.). It is recommended that the frequency of maintenance be increased or reduced based on local conditions. If the sediment load is high from an unstable site or sediment loads transported from upstream catchments, maintenance may be required semi-annually. Conversely once a site has stabilized, maintenance may be required less frequently (for example: two to seven year, site and situation dependent). Maintenance should be performed immediately after an oil spill or once the sediment depth in Stormceptor reaches the value specified in **Table 3** based on the unit size.

STC Model	Maintenance Sediment depth (in)	EOS Model	Maintenance Sediment depth (in)	Oil Storage Depth (in)	OSR Model	Maintenance Sediment depth (in)
450	8	4-175	9	24	065	8
900	8	9-365	9	24	140	8
1200	10	12-590	11	39		
1800	15					
2400	12	24-1400	14	68	250	12
3600	17	36-1700	19	79		
4800	15	48-2000	16	68	390	17
6000	18	60-2500	20	79		
7200	15	72-3400	17	79	560	17
11000*	17	110-5000*	16	68	780*	17
13000*	20	130-6000*	20	79		
16000*	17	160-7800*	17	79	1125*	17

Table 3A. (US) Recommended Sediment Depths Indicating Maintenance

Note:

1. The values above are for typical standard units.

*Per structure.

STC Model	Maintenance Sediment depth (mm)	EOS Model	Maintenance Sediment depth (mm)	Oil Storage Depth (mm)	OSR Model	Maintenance Sediment depth (mm)
300	225	300	225	610	300	200
750	230	750	230	610	750	200
1000	275	1000	275	990		
1500	400					
2000	350	2000	350	1727	2000	300
3000	475	3000	475	2006		
4000	400	4000	400	1727	4000	375
5000	500	5000	500	2006		
6000	425	6000	425	2006	6000	375
9000*	400	9000*	400	1727	9000*	425
11000*	500	10000*	500	2006		
14000*	425	14000*	425	2006	14000*	425

Table 3B. (CA & Int'l) Recommended Sediment Depths Indicating Maintenance

Note:

1. The values above are for typical standard units.

*Per structure.

Replacement parts

Since there are no moving parts during operation in a Stormceptor, broken, damaged, or worn parts are not typically encountered. Therefore, inspection and maintenance activities are generally focused on pollutant removal. However, if replacements parts are necessary, they may be purchased by contacting your local Stormceptor Representative, or Imbrium Systems.

The benefits of regular inspection and maintenance are many – from ensuring maximum operation efficiency, to keeping maintenance costs low, to the continued protection of natural waterways – and provide the key to Stormceptor's long and effective service life.

Stormceptor Inspection and Maintenance Log

Stormceptor Model No:
Allowable Sediment Depth:
Serial Number:
Installation Date:
Location Description of Unit:
Other Comments:

Contact Information

Questions regarding the Stormceptor can be addressed by contacting your area Stormceptor Licensee, Imbrium Systems, or visit our website at www.stormceptor.com.

Stormceptor Licensees:

CANADA

Lafarge Canada Inc. www.lafargepipe.com 403-292-9502 / 1-888-422-4022 780-468-5910 204-958-6348	Calgary, AB Edmonton, AB Winnipeg, MB, NW. ON, SK
Langley Concrete Group www.langleyconcretegroup.com 604-502-5236	BC
Hanson Pipe & Precast Inc. www.hansonpipeandprecast.com 519-622-7574 / 1-888-888-3222	ON
Lécuyer et Fils Ltée. www.lecuyerbeton.com 450-454-3928 / 1-800-561-0970	QC
Strescon Limited www.strescon.com 902-494-7400 506-633-8877	NS, NF NB, PE

UNITED STATES

Rinker Materials www.rinkerstormceptor.com 1-800-909-7763

AUSTRALIA & SOUTHEAST ASIA, including New Zealand & Japan

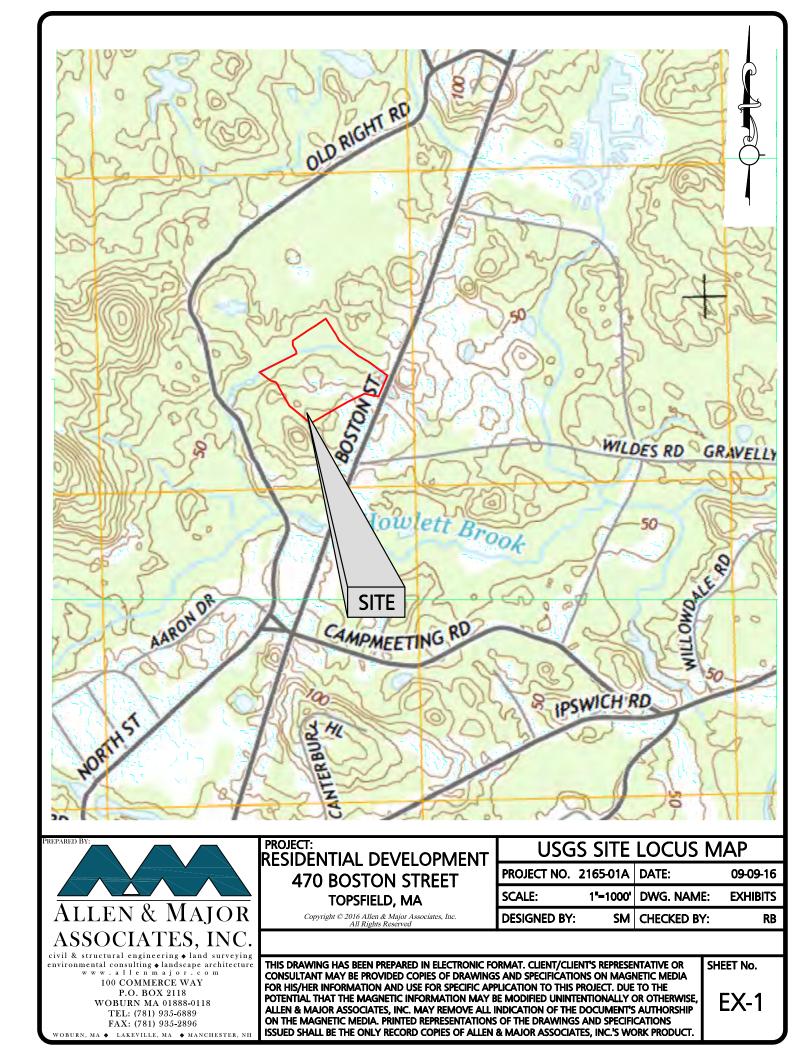
Humes Water Solutions www.humes.com.au +61 7 3364 2894

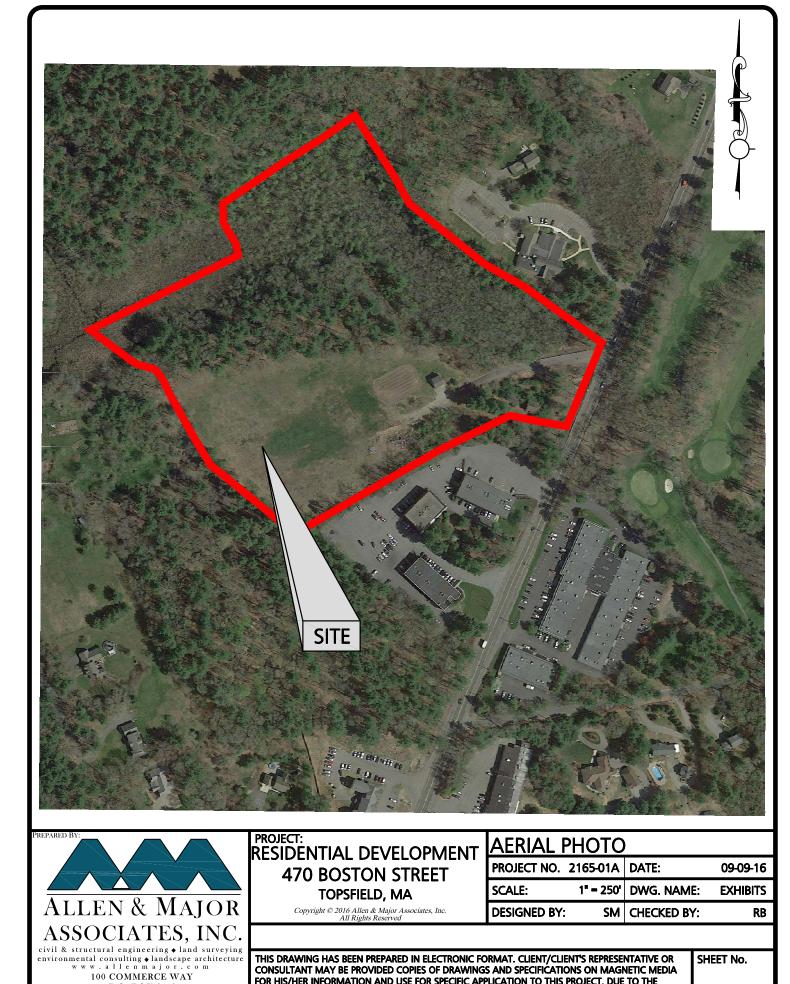
Imbrium Systems Inc. & Imbrium Systems LLC

Canada			
United States			
International			
Email			

1-416-960-9900 / 1-800-565-4801 1-301-279-8827 / 1-888-279-8826 +1-416-960-9900 / +1-301-279-8827 info@imbriumsystems.com

www.imbriumsystems.com www.stormceptor.com Section 3.0 – Exhibits





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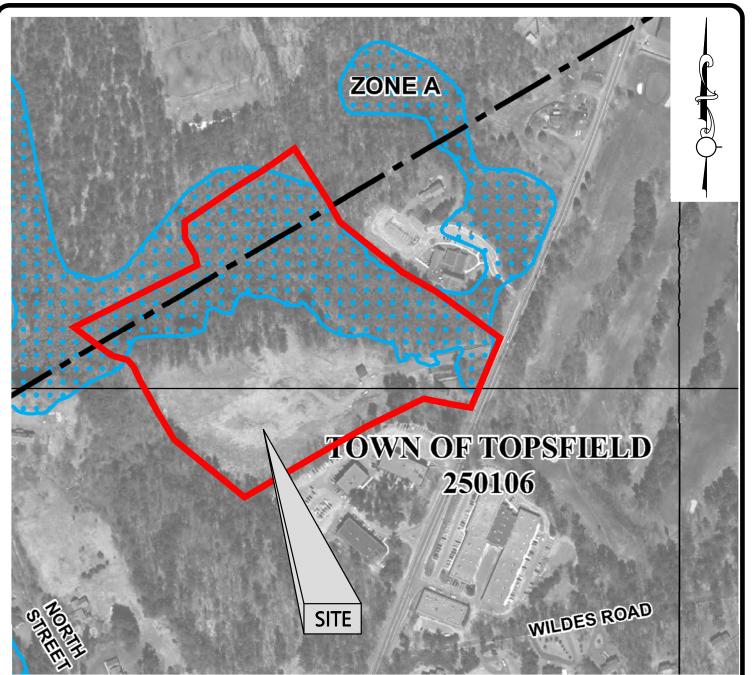
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WOBURN, MA 🔶 LAKEVILLE, MA 🔶 MANCHESTER, NE

EX-2

SHEET No.



LEGEND

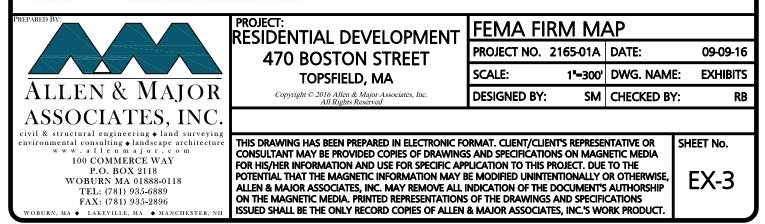
SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

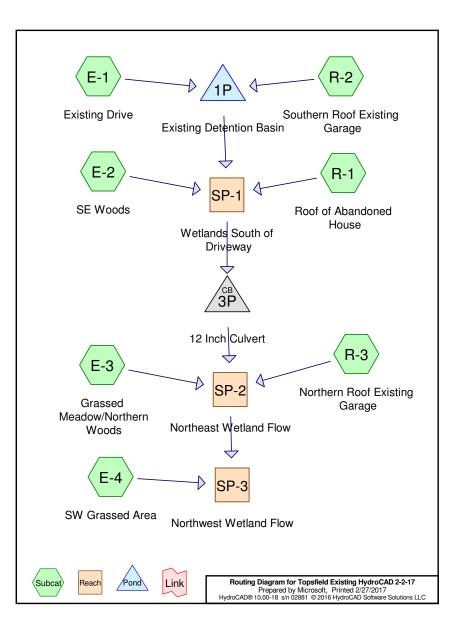
FEMA FLOOD INSURANCE RATE MAP ESSEX COUNTY, MASSACHUSETTS MAP NUMBER, 25009C0266F REVISED: JULY 3, 2012

ZONE A

No Base Flood Elevations determined.



Section 4.0 – HydroCAD Reports



Topsfield Existing HydroCAD 2-2-17				
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Area Listing (all nodes)				

Area	CN	Description
(acres)		(subcatchment-numbers)
0.186	49	50-75% Grass cover, Fair, HSG A (E-1, E-2)
0.059	79	50-75% Grass cover, Fair, HSG C (E-1, E-2)
3.887	39	>75% Grass cover, Good, HSG A (E-3, E-4)
0.872	74	>75% Grass cover, Good, HSG C (E-3, E-4)
0.094	96	Gravel surface, HSG A (E-1)
0.320	98	Paved parking, HSG A (E-1)
0.026	98	Roofs, HSG A (R-1, R-3)
0.081	98	Unconnected pavement, HSG A (E-2)
0.008	98	Unconnected roofs, HSG A (R-2)
3.217	30	Woods, Good, HSG A (E-1, E-2, E-3, E-4)
0.315	55	Woods, Good, HSG B (E-3)
0.803	70	Woods, Good, HSG C (E-1, E-2, E-3, E-4)
0.140	77	Woods, Good, HSG D (E-2)
10.008	46	TOTAL AREA

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Soil Listing (all nodes)

Area	Soil	Subcatchment
(acres)	Group	Numbers
7.819	HSG A	E-1, E-2, E-3, E-4, R-1, R-2, R-3
0.315	HSG B	E-3
1.734	HSG C	E-1, E-2, E-3, E-4
0.140	HSG D	E-2
0.000	Other	
10.008		TOTAL AREA

Topsfield Ex Prepared by HydroCAD® 10	Microsoft	•		Softwara			ted 2/27/2017
	.00-18 5/110	2001 @ 201		Covers (a		,	Page 4
HSG-A	HSG-B	HSG-C	HSG-D	Other	Total	Ground Cover	Subcatchment Numbers
(acres) 0.186	(acres)	(acres)	(acres)	(acres)	(acres)		
3.887	0.000	0.059	0.000 0.000	0.000	0.244 4.759	50-75% Grass cover, Fair >75% Grass cover, Good	,
0.094	0.000	0.072	0.000	0.000	0.094	Gravel surface	E-1
0.320	0.000	0.000	0.000	0.000	0.320	Paved parking	E-1
0.026	0.000	0.000	0.000	0.000	0.026	Roofs	R-1, R-3
0.081	0.000	0.000	0.000	0.000	0.081	Unconnected pavement	E-2
0.008	0.000	0.000	0.000	0.000	0.008	Unconnected roofs	R-2
3.217	0.315	0.803	0.140	0.000	4.474	Woods, Good	E-1, E-2, E-3, E-4
7.819	0.315	1.734	0.140	0.000	10.008	TOTAL AREA	

parec	by Micros	soft	CAD 2-2-17	CAD Softw	vare Soluti	ons LLC		Prir	ted 2/27/2017 Page 5	Topsfield Existing HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD	Type III 24-hr 2-Year Rainfali Printed 2/2 Software Solutions LLC
ine#	Node	In-Invert	Pi Out-Invert	pe Listin Length	g (all no Slope		Diam/Width	Height	Inside-Fill	Runoff by SCS TR-20	.00 hrs, dt=0.01 hrs, 2401 points 0 method, UH=SCS, Weighted-CN s method - Pond routing by Stor-Ind method
1	Number E-1	(feet) 0.00	(feet) 0.00	(feet) 25.0	(ft/ft) 0.0100	0.015	(inches) 12.0	(inches) 0.0	(inches) 0.0	Subcatchment E-1: Existing Drive	Runoff Area=22,922 sf 60.86% Impervious Runoff Dept Flow Length=444' Tc=10.2 min CN=91 Runoff=1.15 cfs (
2	3P	56.51	56.38	51.0	0.0025	0.011	12.0	0.0	0.0	Subcatchment E-2: SE Woods	Runoff Area=49,278 sf 7.20% Impervious Runoff Dept 420' Tc=12.0 min UI Adjusted CN=53 Runoff=0.05 cfs (
											Runoff Area=180,525 sf 0.00% Impervious Runoff Dept low Length=465' Tc=12.3 min CN=41 Runoff=0.00 cfs (
										Subcatchment E-4: SW Grassed Area	Runoff Area=181,751 sf 0.00% Impervious Runoff Dept low Length=622' Tc=15.7 min CN=43 Runoff=0.01 cfs (
										Subcatchment R-1: Roof of Abandoned House	Runoff Area=787 sf 100.00% Impervious Runoff Dept Tc=6.0 min CN=98 Runoff=0.05 cfs (
										Subcatchment R-2: Southern Roof Existing	Runoff Area=346 sf 100.00% Impervious Runoff Dept Tc=6.0 min CN=98 Runoff=0.02 cfs (
										Subcatchment R-3: Northern Roof Existing	Runoff Area=346 sf 100.00% Impervious Runoff Dept Tc=6.0 min CN=98 Runoff=0.02 cfs
										Reach SP-1: Wetlands South of Driveway	Inflow=0.07 cfs Outflow=0.07 cfs
										Reach SP-2: Northeast Wetland Flow	Inflow=0.08 cfs Outflow=0.08 cfs
										Reach SP-3: Northwest Wetland Flow	Inflow=0.08 cfs (Outflow=0.08 cfs (
										Pond 1P: Existing Detention Basin	Peak Elev=58.23' Storage=3,183 cf Inflow=1.16 cfs (Outflow=0.05 cfs (
										Pond 3P: 12 Inch Culvert 12.0" Round	Peak Elev=56.68' Inflow=0.07 cfs (Culvert n=0.011 L=51.0' S=0.0025 '/ Outflow=0.07 cfs (
										Total Runoff Area = 10.008 ac	c Runoff Volume = 0.125 af Average Runoff Depth 95.65% Pervious = 9.572 ac 4.35% Impervious = 0

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 Type III 24-hr
 2-Year Rainfall=3.10"

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 C
 Page 7

Summary for Subcatchment E-1: Existing Drive

Runoff = 1.15 cfs @ 12.14 hrs, Volume= 0.095 af, Depth> 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

A	rea (sf)	CN D	escription		
	13,950	98 P	aved park	ing, HSG A	ι
	4,096	96 G	aravel surfa	ace, HSG A	A Contraction of the second seco
	411	30 V	Voods, Go	od, HSG A	
	3,284	70 V	Voods, Go	od, HSG C	
	509	49 5	0-75% Gra	ass cover, F	Fair, HSG A
	672	79 5	0-75% Gra	ass cover, F	Fair, HSG C
	22,922	91 V	Veighted A	verage	
	8,972	3	9.14% Per	vious Area	
	13,950	6	0.86% lmp	pervious Ar	ea
	,				
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
8.1	50	0.0600	0.10		Sheet Flow, A-B
					Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	33	0.1060	1.63		Shallow Concentrated Flow, B-C
					Woodland Kv= 5.0 fps
0.1	19	0.2200	3.28		Shallow Concentrated Flow, C-D
					Short Grass Pasture Kv= 7.0 fps
0.5	112	0.0450	3.42		Shallow Concentrated Flow, D-E
					Unpaved Kv= 16.1 fps
1.1	205	0.0240	3.14		Shallow Concentrated Flow, E-F
					Paved Kv= 20.3 fps
0.1	25	0.0100	3.93	3.09	
					12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25'
					n= 0.015 Corrugated PE, smooth interior

10.2 444 Total

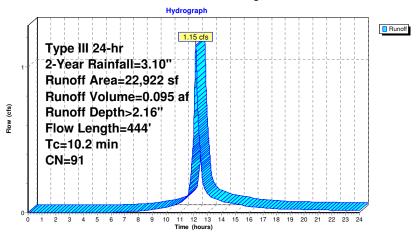
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 Type III 24-hr
 2-Year Rainfall=3.10"

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 Page 8

Subcatchment E-1: Existing Drive



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Summary for Subcatchment E-2: SE Woods

Page 9

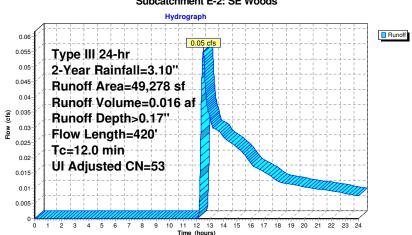
Runoff = 0.05 cfs @ 12.49 hrs, Volume= 0.016 af, Depth> 0.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

A	rea (sf)	CN /	Adj Desc	cription	
	3,550	98	Unco	onnected pa	avement, HSG A
	7,582	49	50-7	5% Grass c	cover, Fair, HSG A
	1,887	79	50-7	5% Grass o	cover, Fair, HSG C
	18,787	30	Woo	ds, Good, H	HSG A
	11,389	70	Woo	ds, Good, H	HSG C
	6,083	77	Woo	ds, Good, H	HSG D
	49,278	55	53 Weig	hted Avera	age, UI Adjusted
	45,728		92.80	0% Perviou	s Area
	3,550		7.209	% Impervio	us Area
	3,550		100.0	00% Üncon	nected
Tc	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
6.3	50	0.1100	0.13		Sheet Flow, A-B
					Woods: Light underbrush n= 0.400 P2= 3.10"
0.8	75	0.0930	1.52		Shallow Concentrated Flow, B-C
					Woodland Kv= 5.0 fps
0.4	35	0.0430	1.45		Shallow Concentrated Flow, C-D
					Short Grass Pasture Kv= 7.0 fps
4.5	260	0.0370	0.96		Shallow Concentrated Flow, D-E
					Woodland Kv= 5.0 fps
120	100	Total			

420 Total 12.0

Topsfield Existing HydroCAD 2-2-17 Type III 24-hr 2-Year Rainfall=3.10" Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Printed 2/27/2017



Subcatchment E-2: SE Woods

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ype III 24-hr 2-Year Rainfall=3.10" Printed 2/27/2017 Page 11

Summary for Subcatchment E-3: Grassed Meadow/Northern Woods

[73] Warning: Peak may fall outside time span

Runoff = 0.00 cfs @ 23.82 hrs, Volume= 0.001 af, Depth> 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

A	rea (sf)	CN E	escription		
	76,402	30 V	Voods, Go	od, HSG A	
	13,713	55 V	Voods, Go	od, HSG B	
	15,503			od, HSG C	
	67,450				bod, HSG A
	7,457	74 >	75% Gras	s cover, Go	ood, HSG C
	80,525		Veighted A		
1	80,525	1	00.00% Pe	ervious Are	a
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0800	0.12		Sheet Flow, A-B
3.6	293	0.0375	1.36		Woods: Light underbrush n= 0.400 P2= 3.10" Shallow Concentrated Flow, B-C
1.5	122	0.0740	1.36		Short Grass Pasture Kv= 7.0 fps Shallow Concentrated Flow, C-D Woodland Kv= 5.0 fps

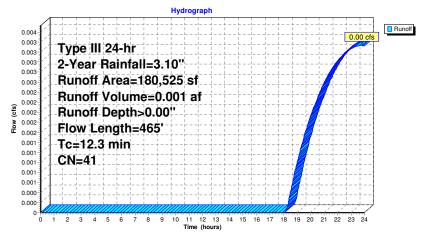
12.3 465 Total

Type III 24-hr 2-Year Rainfall=3.10" Topsfield Existing HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC

Subcatchment E-3: Grassed Meadow/Northern Woods

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Summary for Subcatchment E-4: SW Grassed Area

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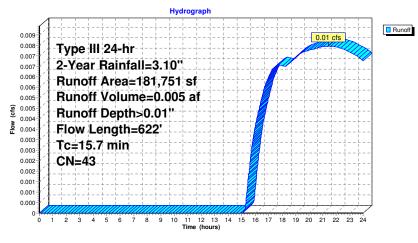
Runoff = 0.01 cfs @ 21.44 hrs, Volume= 0.005 af, Depth> 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

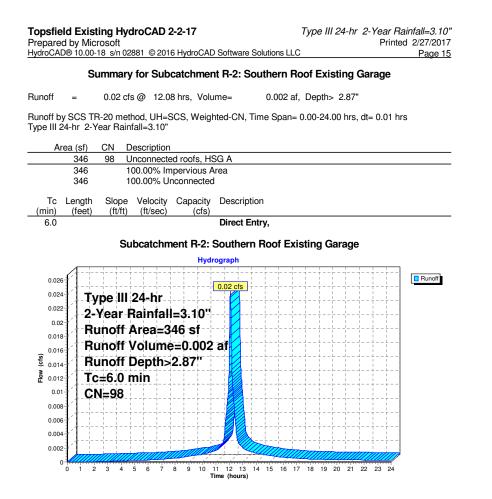
A	rea (sf)	CN [Description		
	44.530	30 V	Voods, Go	od, HSG A	
	4.806			od. HSG C	
1	01.870	39 >	75% Gras	s cover. Go	bod, HSG A
	30,545				ood, HSG C
1	81.751	43 V	Veighted A	verage	
	81.751			ervious Area	a
	01,701		00.00701		u
Тс	Length	Slope	Velocitv	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
8.7	50	0.0500	0.10	()	Sheet Flow, A-B
0		0.0000	00		Woods: Light underbrush n= 0.400 P2= 3.10"
5.6	462	0.0390	1.38		Shallow Concentrated Flow, B-C
0.0	.02	0.0000			Short Grass Pasture Kv= 7.0 fps
1.4	110	0.0682	1.31		Shallow Concentrated Flow, C-D
	110	0.000L	1.01		Woodland Ky= 5.0 fps

15.7 622 Total

Subcatchment E-4: SW Grassed Area



	2-Year Rainfall=3.10" Printed 2/27/2017
Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC	Printed 2/27/2017 Page 14
Summary for Subcatchment R-1: Roof of Abandoned Hou	
Runoff = 0.05 cfs @ 12.08 hrs, Volume= 0.004 af, Depth> 2.87"	
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, d Type III 24-hr 2-Year Rainfall=3.10"	t= 0.01 hrs
Area (sf) CN Description	
787 98 Roofs, HSG A	
787 100.00% Impervious Area	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	
6.0 Direct Entry,	
Subcatchment R-1: Roof of Abandoned House	
Hydrograph	
0.06 0.055 0.045 0.045 0.045 Runoff Area=787 sf Runoff Volume=0.004 af Runoff Depth>2.87" Tc=6.0 min CN=98 0.025 0.02	Runoff



	Summary for Subcatchment R-3: Northern Roof Existing Garage
Runoff	= 0.02 cfs @ 12.08 hrs, Volume= 0.002 af, Depth> 2.87"
	CCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
ype III 24-	hr 2-Year Rainfall=3.10"
Area	
	346 98 Roofs, HSG A 346 100.00% Impervious Area
	ength Slope Velocity Capacity Description (feet) (ft/ft) (ft/sec) (cfs)
6.0	Direct Entry,
	Subcatchment R-3: Northern Roof Existing Garage
0.026	0.02 cfs
0.024	
0.022	2-Year Rainfall=3.10"
0.02	Runoff Area=346 sf
0.018	
0.016 <u> <u> </u> 0.016</u>	Runoff Volume=0.002 af
(cls) 0.014	Runoff Depth>2.87"
- 1	Tc=6.0 min
0.01	CN=98
0.008	┟╶╬╴╬╴╬╴╫╴╫╴╫╴╫╴╫╴╫╶╫╴╢
0.006	<u></u> ╉╌╬╌╬╌╬╌╬╌╬╌╬╌╬╌╬╌╬╌╬╶ ╴ <mark>┙</mark> ┇╬╌╠╌┾╌╬╌╬╌╫╌╠╴╬╶╬╌╫╌╫
0.004	
0.002	
0	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Time (hours)
	This (fours)

Topsfield Existing HydroCAD 2-2-17 Type III 24-hr 2-Year Rainfall=3.10" Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Printed 2/27/2017

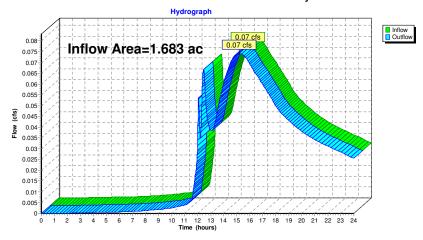
Summary for Reach SP-1: Wetlands South of Driveway

Page 17

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

Inflow Area =	1.683 ac, 25.41% Impervious, Inflow Depth > 0.35" for 2-Year event
Inflow =	0.07 cfs @ 15.19 hrs, Volume= 0.049 af
Outflow =	0.07 cfs @ 15.19 hrs, Volume= 0.049 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



Reach SP-1: Wetlands South of Driveway

Topsfield Existing HydroCAD 2-2-17	Type III 24-hr 2-Year Rainfall=3.10"
Prepared by Microsoft	Printed 2/27/2017
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Summary for Reach SP-2: Northeast Wetland Flow

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

Inflow Area =	5.836 ac,	7.47% Impervious, Inflow	Depth > 0.11"	for 2-Year event
Inflow =	0.08 cfs @	12.08 hrs, Volume=	0.052 af	
Outflow =	0.08 cfs @	12.08 hrs, Volume=	0.052 af, Atte	en= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Hydrograph Inflow Outflow 0.085 Inflow Area=5.836 0.08 0.075 0.07 0.065 0.06 0.055 0.05 (cfs) 0.045 Flow 0.04 0.035 0.03 0.025 0.02 0.015 0.01 0.005 0 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Time (hours)

Reach SP-2: Northeast Wetland Flow

Topsfield Existing HydroCAD 2-2-17 Type III 24-hr 2-Year Rainfall=3.10" Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Printed 2/27/2017

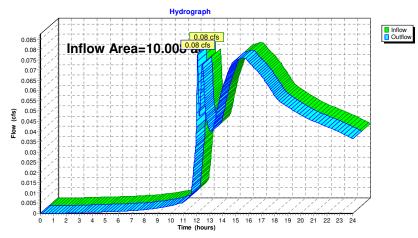
Summary for Reach SP-3: Northwest Wetland Flow

Page 19

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

Inflow Area =	10.008 ac,	4.35% Impervious, Inflow I	Depth > 0.07"	for 2-Year event
Inflow =	0.08 cfs @	12.08 hrs, Volume=	0.057 af	
Outflow =	0.08 cfs @	12.08 hrs, Volume=	0.057 af, Atte	en= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



Reach SP-3:	Northwest	Wetlan	d Flow
-------------	-----------	--------	--------

Topsfield Existing HydroCAD 2-2-17	Type III 24-hr 2-Year Rainfall=3.10"
Prepared by Microsoft	Printed 2/27/2017
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Summary for Pond 1P: Existing Detention Basin

Inflow Area =	0.534 ac, 61.44% Impervious, Inflow I	Depth > 2.17" for 2-Year event
Inflow =	1.16 cfs @ 12.14 hrs, Volume=	0.097 af
Outflow =	0.05 cfs @ 15.56 hrs, Volume=	0.028 af, Atten= 96%, Lag= 205.6 min
Primary =	0.05 cfs @ 15.56 hrs, Volume=	0.028 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 58.23' @ 15.56 hrs Surf.Area= 3,090 sf Storage= 3,183 cf

Plug-Flow detention time= 409.2 min calculated for 0.028 af (29% of inflow) Center-of-Mass det. time= 270.3 min (1,075.8 - 805.5)

Volume	Inve	ert Avail.S	Storage	Storage D	escription				
#1	57.2	20' 9	9,020 cf	Custom S	tage Data	(Prismatic) Listed bel	ow (Recalc)	
Elevatio		Surf.Area		.Store	Cum.Sto				
(fee	t)	(sq-ft)	(cubic	c-feet)	(cubic-fe	et)			
57.2	20	3,090		0		0			
58.0	0	3,090		2,472	2,4	72			
59.0	0	3,090		3,090	5,5	62			
59.4	0	3,550		1,328	6,8	90			
60.0	00	3,550		2,130	9,0	20			
Device	Routing	Inve	ert Outle	et Devices					
#1	Primary	58.0	8' 4.0''	Vert. Orific	e/Grate	C= 0.600			
#2	Primary	58.8	0' 8.0''	Vert. Orific	e/Grate	C= 0.600			

Primary OutFlow Max=0.05 cfs @ 15.56 hrs HW=58.23' (Free Discharge) 1=Orifice/Grate (Orifice Controls 0.05 cfs @ 1.32 fps) 2=Orifice/Grate (Controls 0.00 cfs)

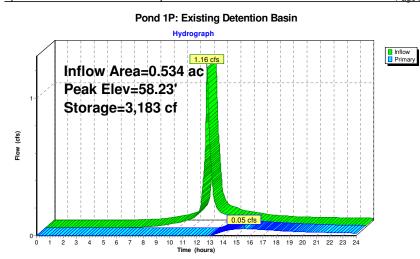
 Topsfield Existing HydroCAD 2-2-17
 Type

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 Type III 24-hr
 2-Year Rainfall=3.10"

 Printed
 2/27/2017

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 Page 21



Topsfield Existing HydroCAD 2-2-17	Type III 24-hr 2-Year Rainfall=3.10"
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Summary for Pond 3P: 12 Inch Culvert

[57] Hint: Peaked at 56.68' (Flood elevation advised)

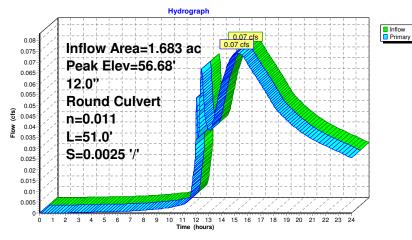
Inflow Area =	1.683 ac, 25.41% Impervious, Inflow	Depth > 0.35" for 2-Year event
Inflow =	0.07 cfs @ 15.19 hrs, Volume=	0.049 af
Outflow =	0.07 cfs @ 15.19 hrs, Volume=	0.049 af, Atten= 0%, Lag= 0.0 min
Primary =	0.07 cfs @ 15.19 hrs, Volume=	0.049 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 56.68' @ 15.19 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	56.51'	12.0" Round Culvert L= 51.0' Ke= 0.200 Inlet / Outlet Invert= 56.51' / 56.38' S= 0.0025 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.07 cfs @ 15.19 hrs HW=56.68' (Free Discharge) └─1=Culvert (Barrel Controls 0.07 cfs @ 1.30 fps)

Pond 3P: 12 Inch Culvert

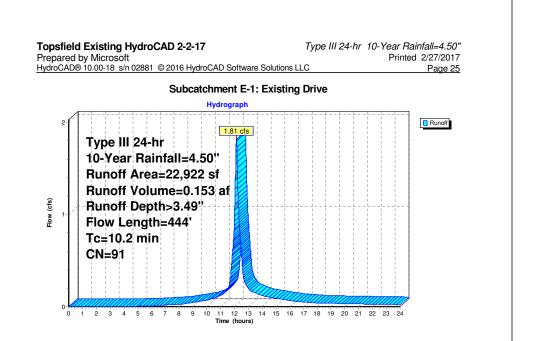


Topsfield Existing HydroCAD 2-2-1 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 Hyc	Printed 2/27/2017
Runoff by SCS	.00-24.00 hrs, dt=0.01 hrs, 2401 points TR-20 method, UH=SCS, Weighted-CN +Trans method - Pond routing by Stor-Ind method
Subcatchment E-1: Existing Drive	Runoff Area=22,922 sf 60.86% Impervious Runoff Depth>3.49" Flow Length=444' Tc=10.2 min CN=91 Runoff=1.81 cfs 0.153 af
Subcatchment E-2: SE Woods Flow L	Runoff Area=49,278 sf 7.20% Impervious Runoff Depth>0.64" ength=420' Tc=12.0 min UI Adjusted CN=53 Runoff=0.44 cfs 0.060 af
Subcatchment E-3: Grassed Meadow/No	rthern Runoff Area=180,525 sf 0.00% Impervious Runoff Depth>0.16" Flow Length=465' Tc=12.3 min CN=41 Runoff=0.10 cfs 0.056 af
Subcatchment E-4: SW Grassed Area	Runoff Area=181,751 sf 0.00% Impervious Runoff Depth>0.22" Flow Length=622' Tc=15.7 min CN=43 Runoff=0.22 cfs 0.078 af
Subcatchment R-1: Roof of Abandoned I	House Runoff Area=787 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.08 cfs 0.006 af
Subcatchment R-2: Southern Roof Existi	ng Runoff Area=346 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.03 cfs 0.003 af
Subcatchment R-3: Northern Roof Existi	ng Runoff Area=346 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.03 cfs 0.003 af
Reach SP-1: Wetlands South of Driveway	Inflow=0.58 cfs 0.153 af Outflow=0.58 cfs 0.153 af
Reach SP-2: Northeast Wetland Flow	Inflow=0.62 cfs 0.212 af Outflow=0.62 cfs 0.212 af
Reach SP-3: Northwest Wetland Flow	Inflow=0.82 cfs 0.290 af Outflow=0.82 cfs 0.290 af
Pond 1P: Existing Detention Basin	Peak Elev=58.52' Storage=4,084 cf Inflow=1.84 cfs 0.156 af Outflow=0.22 cfs 0.086 af
Pond 3P: 12 Inch Culvert 12.0"	Peak Elev=56.97' Inflow=0.58 cfs 0.153 af Round Culvert n=0.011 L=51.0' S=0.0025 '/' Outflow=0.58 cfs 0.153 af

 Total Runoff Area = 10.008 ac
 Runoff Volume = 0.360 af
 Average Runoff Depth = 0.43"

 95.65% Pervious = 9.572 ac
 4.35% Impervious = 0.436 ac

Prepare	d by Mic	rosoft 18 s/n 02		6 HydroCAD	Type III 24-hr 10-Year Rainfall=4.50" Printed 2/27/2017 Software Solutions LLC Page 24 Catchment E-1: Existing Drive
Runoff	=	1.81 cf	s@ 12.1	4 hrs, Volu	ume= 0.153 af, Depth> 3.49"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 10-Year Rainfall=4.50"					
A	rea (sf)	CN E	escription		
	13,950			ing, HSG A	
	4,096			ace, HSG A	
	411			od, HSG A	
	3,284 509			od, HSG C	Fair, HSG A
	672				Fair, HSG C
	22.922		Veighted A		
	8,972			vious Area	
13,950 60.86% Impervious Area					ea
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	50	0.0600	0.10		Sheet Flow, A-B
0.3	33	0.1060	1.63		Woods: Light underbrush n= 0.400 P2= 3.10" Shallow Concentrated Flow, B-C
0.1	19	0.2200	3.28		Woodland Kv= 5.0 fps Shallow Concentrated Flow, C-D
0.5	112	0.0450	3.42		Short Grass Pasture Kv= 7.0 fps Shallow Concentrated Flow, D-E
0.0			0		Unpaved Kv= 16.1 fps
1.1	205	0.0240	3.14		Shallow Concentrated Flow, E-F
	05	0.0100	0.00	0.00	Paved Kv= 20.3 fps
0.1	25	0.0100	3.93	3.09	Pipe Channel, F-G 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25'
					n= 0.015 Corrugated PE, smooth interior
10.2	444	Total			



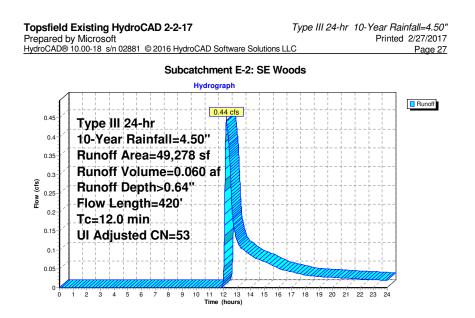
Topsfield Existing HydroCAD 2-2-17	Type III 24-hr 10-Year Rainfall=4.50"
Prepared by Microsoft	Printed 2/27/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions	LLC Page 26

Summary for Subcatchment E-2: SE Woods

Runoff = 0.44 cfs @ 12.23 hrs, Volume= 0.060 af, Depth> 0.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 10-Year Rainfall=4.50"

_	A	rea (sf)	CN /	Adj Desc	ription		
		3,550	98	Unco	onnected pa	avement, HSG A	
		7,582	49	50-7	5% Grass o	cover, Fair, HSG A	
		1,887	79	50-7	5% Grass o	cover, Fair, HSG C	
		18,787	30	Woo	Woods, Good, HSG A		
		11,389	70	Woo	ds, Good, I	HSG C	
		6,083	77	Woo	ds, Good, I	HSG D	
	49,278 55 53 Weighted Average, UI Adjusted						
	45,728 92.80% Pervious Area					is Area	
		3,550			7.20% Impervious Area		
		3,550		100.	100.00% Unconnected		
	Та	المعمول	Clana	Velesity	Conneitre	Description	
	Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description	
-					(CIS)	Chast Flow A D	
	6.3	50	0.1100	0.13		Sheet Flow, A-B	
	0.0	75	0 0000	1 50		Woods: Light underbrush n= 0.400 P2= 3.10" Shallow Concentrated Flow, B-C	
	0.8	75	0.0930	1.52			
	0.4	35	0.0430	1.45		Woodland Kv= 5.0 fps Shallow Concentrated Flow, C-D	
	0.4	35	0.0430	1.45		Short Grass Pasture Kv= 7.0 fps	
	4.5	260	0.0370	0.96		Shallow Concentrated Flow, D-E	
	4.5	200	0.0070	0.00		Woodland $Ky = 5.0 \text{ fps}$	
-	12.0	420	Total				
	12.0	420	ioidi				



Topsfield Existing HydroCAD 2-2-17	Type III 24-hr	10-Year Rainfall=4.50"
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Summary for Subcatchment E-3: Grassed Meadow/Northern Woods

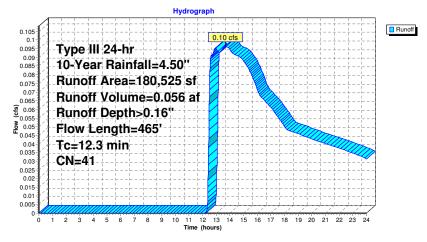
Runoff = 0.10 cfs @ 13.68 hrs, Volume= 0.056 af, Depth> 0.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 10-Year Rainfall=4.50"

A	rea (sf)	CN [Description			
76,402 30			Woods, Good, HSG A			
13,713 55			Woods, Good, HSG B			
15,503 70			Woods, Good, HSG C			
67,450 39			>75% Grass cover, Good, HSG A			
7,457 74			>75% Grass cover, Good, HSG C			
180,525 41			Veighted A			
180,525		-	100.00% Pervious Area			
_				. .		
Tc	Length	Slope		Capacity	Description	
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)		
7.2	50	0.0800	0.12		Sheet Flow, A-B	
					Woods: Light underbrush n= 0.400 P2= 3.10"	
3.6	293	0.0375	1.36		Shallow Concentrated Flow, B-C	
					Short Grass Pasture Kv= 7.0 fps	
1.5	122	0.0740	1.36		Shallow Concentrated Flow, C-D	
					Woodland Kv= 5.0 fps	
100	105	Tetel				

12.3 465 Total

Subcatchment E-3: Grassed Meadow/Northern Woods



Topsfield Existing HydroCAD 2-2-17	Type III 24-hr 10-Y
Prepared by Microsoft	
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I 24-hr 10-Year Rainfall=4.50" Printed 2/27/2017 Page 29

Summary for Subcatchment E-4: SW Grassed Area

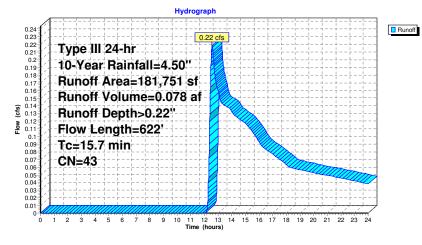
Runoff = 0.22 cfs @ 12.57 hrs, Volume= 0.078 af, Depth> 0.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 10-Year Rainfall=4.50"

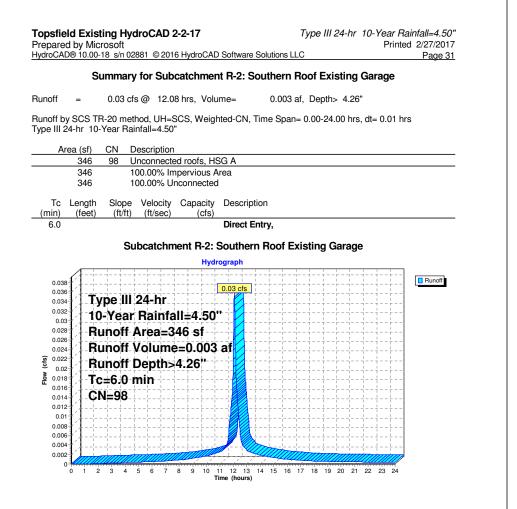
_	A	rea (sf)	CN I	Description		
		44,530	30 \	Woods, Go	od, HSG A	
		4,806	70 N	Woods, Go	od, HSG C	
	1	01,870	39 >	>75% Gras	s cover, Go	bod, HSG A
		30,545	74 >	>75% Gras	s cover, Go	bod, HSG C
	1	81,751	43 N	Weighted A	verage	
	1	81,751		100.00% Pe	ervious Area	a
	Tc	Length	Slope	Velocity	Capacity	Description
_	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	8.7	50	0.0500	0.10		Sheet Flow, A-B
						Woods: Light underbrush n= 0.400 P2= 3.10"
	5.6	462	0.0390	1.38		Shallow Concentrated Flow, B-C
						Short Grass Pasture Kv= 7.0 fps
	1.4	110	0.0682	1.31		Shallow Concentrated Flow, C-D
						Woodland Kv= 5.0 fps
_	45.7	000	T 1 1			

15.7 622 Total

Subcatchment E-4: SW Grassed Area



repared by Mic ydroCAD® 10.00	crosoft -18 s/n 02881 © 2016 H Summary for Subo			andoned I		d 2/27/2017 Page 30
unoff =	0.08 cfs @ 12.08 hi	rs, Volume=	0.006 af,	Depth> 4.26	6"	
	R-20 method, UH=SCS -Year Rainfall=4.50"	S, Weighted-CN, T	īme Span= 0	.00-24.00 hr:	s, dt= 0.01 hr	S
Area (sf)	CN Description					
<u>787</u> 787	98 Roofs, HSG A 100.00% Impe	rvious Area				
Tc Length		apacity Descript	ion			
(min) (feet) 6.0	(ft/ft) (ft/sec)	(cfs) Direct E	atra /			
0.0						
	Subcatchm	ent R-1: Roof c Hydrograph	of Abandon	ed House		
0.075 0.065 0.065 0.065 0.055 0.045 0.045 0.035 0.035 0.035 0.035 0.035 0.035 0.035 0.035 0.035 0.035 0.035 0.055 0.04 0.055 0.055 0.055 0.055 0.055 0.055 0.055 0.055 0.045 0.055 0.045 0.045 0.055 0.045 0.055 0.045 0	/pe III 24-hr)-Year Rainfall: unoff Area=787 unoff Volume=(unoff Depth>4. :=6.0 min N=98	' sf D.006 af 26''				Runoff
0 1 2	2 3 4 5 6 7 8	9 10 11 12 13 Time (hours)	14 15 16 17	18 19 20 21	22 23 24	



repared by Mi	sting HydroCAD 2 crosoft)-18 s/n 02881 © 2016			r 10-Year Rainfall=4.50 Printed 2/27/2017 Page 32
			orthern Roof Existing	-
unoff =	0.03 cfs @ 12.08	hrs, Volume=	0.003 af, Depth> 4.2	6"
	FR-20 method, UH=S)-Year Rainfall=4.50"	CS, Weighted-CN,	Time Span= 0.00-24.00 hr	rs, dt= 0.01 hrs
Area (sf)	CN Description			
346	98 Roofs, HSG			
346	100.00% Imj	pervious Area		
Tc Length (min) (feet)		Capacity Descript (cfs)	ion	
6.0		Direct E	ntry,	
	Subostohm	ont D.2. Northorn	Poof Existing Cores	10
	Subcatchm		n Roof Existing Garag	je
		Hydrograph		
0.038	+ +			Runoff
0.036	ype III 24-hr	0.03 cfs		
- / .		-++		
0.03	0-Year Rainfa	l=4.50"		
0.028	unoff Area=34	l6 sf		
0.026	unoff Volume			
e _{0.02}	unoff Depth>4	1.26	·	
₽ 0.018 0.018	c=6.0 min	-++		
0.016	N=98		· · · · - · · - · · - · · - · · - · · - ·	
0.012				
0.01				
0.008				
0.004				
0.002				
0	2 3 4 5 6 7 4	<u>, 10 11 12 13</u>	14 15 16 17 18 19 20 2	1 22 23 24
		Time (hours)		

Topsfield Existing HydroCAD 2-2-17 Type III 24-hr 10-Year Rainfall=4.50" Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Printed 2/27/2017

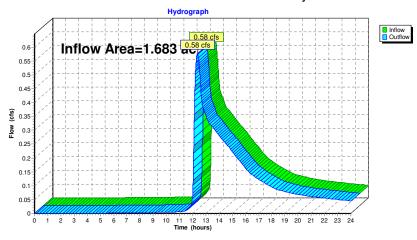
Summary for Reach SP-1: Wetlands South of Driveway

Page 33

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

Inflow Area =	1.683 ac, 25.41% Impervious, Inflow D	epth > 1.09" for 10-Year event
Inflow =	0.58 cfs @ 12.36 hrs, Volume=	0.153 af
Outflow =	0.58 cfs @ 12.36 hrs, Volume=	0.153 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



Reach SP-1: Wetlands South of Driveway

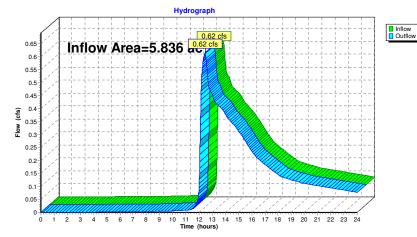
Topsfield Existing HydroCAD 2-2-17	Type III 24-hr	10-Year Rainfall=4.50"
Prepared by Microsoft		Printed 2/27/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LI	LC	Page 34

Summary for Reach SP-2: Northeast Wetland Flow

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

Inflow Area =	5.836 ac,	7.47% Impervious, Inflow	Depth > 0.44"	for 10-Year event
Inflow =	0.62 cfs @	12.47 hrs, Volume=	0.212 af	
Outflow =	0.62 cfs @	12.47 hrs, Volume=	0.212 af, Atte	en= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



Reach SP-2: Northeast Wetland Flow

Topsfield Existing HydroCAD 2-2-17 Type III 24-hr 10-Year Rainfall=4.50" Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Printed 2/27/2017

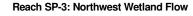
Summary for Reach SP-3: Northwest Wetland Flow

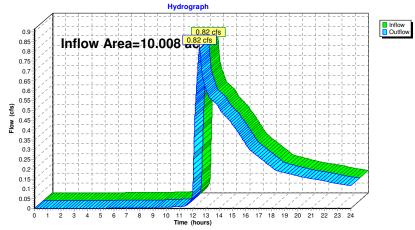
Page 35

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

Inflow Area =	10.008 ac,	4.35% Impervious, Inflow [Depth > 0.35"	for 10-Year event
Inflow =	0.82 cfs @	12.51 hrs, Volume=	0.290 af	
Outflow =	0.82 cfs @	12.51 hrs, Volume=	0.290 af, Atte	en= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs





Topsfield Existing HydroCAD 2-2-17	Type III 24-hr 10-Year Rainfall=4.50"
Prepared by Microsoft	Printed 2/27/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solution	s LLC Page 36

Summary for Pond 1P: Existing Detention Basin

Inflow Area =	0.534 ac, 61.44% Impervious, Inflow	Depth > 3.50" for 10-Year event
Inflow =	1.84 cfs @ 12.14 hrs, Volume=	0.156 af
Outflow =	0.22 cfs @ 12.91 hrs, Volume=	0.086 af, Atten= 88%, Lag= 46.1 min
Primary =	0.22 cfs @ 12.91 hrs, Volume=	0.086 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 58.52' @ 12.91 hrs Surf.Area= 3,090 sf Storage= 4,084 cf

Plug-Flow detention time= 265.0 min calculated for 0.086 af (55% of inflow) Center-of-Mass det. time= 157.9 min (950.3 - 792.4)

Volume	Inv	ert Avail.S	Storage	Storage	Description				
#1	57.	20' 9	9,020 cf	Custom	Stage Data	(Prismatio	c) Listed be	low (Recalc)	
Elevatio (fee		Surf.Area (sq-ft)		Store -feet)	Cum.Sto (cubic-fe				
57.2	20	3,090		0		0			
58.0	00	3,090		2,472	2,4	72			
59.0	00	3,090		3,090	5,5	62			
59.4	40	3,550		1,328	6,8	90			
60.0	00	3,550		2,130	9,0	20			
Device	Routing	Inve	ert Outle	et Device	s				
#1	Primary	58.0	8' 4.0''	Vert. Ori	fice/Grate	C= 0.600			
#2	Primary	58.8	0' 8.0''	Vert. Ori	fice/Grate	C= 0.600			
	-								

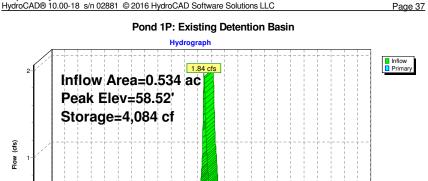
Primary OutFlow Max=0.22 cfs @ 12.91 hrs HW=58.52' (Free Discharge) 1=Orifice/Grate (Orifice Controls 0.22 cfs @ 2.53 fps) 2=Orifice/Grate (Controls 0.00 cfs)



Ó

1 2 3 4 5 6 7 8 9

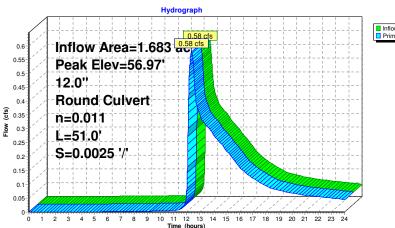
Type III 24-hr 10-Year Rainfall=4.50" Printed 2/27/2017



Time (hours)

10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Topsfield Existing HydroCAD 2-2-17 Type III 24-hr 10-Year Rainfall=4.50" Prepared by Microsoft Printed 2/27/2017 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 38 Summary for Pond 3P: 12 Inch Culvert [57] Hint: Peaked at 56.97' (Flood elevation advised) 1.683 ac, 25.41% Impervious, Inflow Depth > 1.09" for 10-Year event Inflow Area = 0.58 cfs @ 12.36 hrs, Volume= 0.153 af Inflow = Outflow = 0.58 cfs @ 12.36 hrs, Volume= 0.153 af, Atten= 0%, Lag= 0.0 min Primary = 0.58 cfs @ 12.36 hrs, Volume= 0.153 af Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 56.97' @ 12.36 hrs Device Routing Invert Outlet Devices Primary 56.51' 12.0" Round Culvert L= 51.0' Ke= 0.200 #1 Inlet / Outlet Invert= 56.51' / 56.38' S= 0.0025 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf Primary OutFlow Max=0.58 cfs @ 12.36 hrs HW=56.97' (Free Discharge) 1=Culvert (Barrel Controls 0.58 cfs @ 2.37 fps) Pond 3P: 12 Inch Culvert Hydrograph Inflow
Primary 0.58 cfs Inflow Area=1.683 0.6 0.55 Peak Elev=56.97' 0.5 12.0" 0.45 **Round Culvert** 0.4

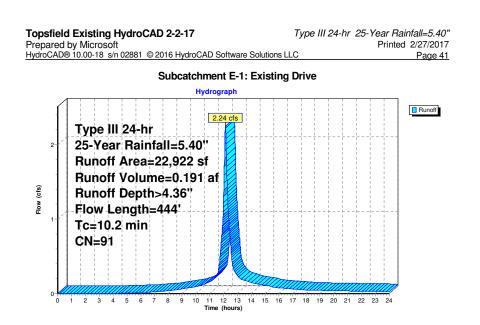


Topsfield Existing HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 Hydro	Printed 2/27/2017
Runoff by SCS T	- 0-24.00 hrs, dt=0.01 hrs, 2401 points R-20 method, UH=SCS, Weighted-CN Trans method - Pond routing by Stor-Ind method
Subcatchment E-1: Existing Drive	Runoff Area=22,922 sf 60.86% Impervious Runoff Depth>4.36" Flow Length=444' Tc=10.2 min CN=91 Runoff=2.24 cfs 0.191 af
Subcatchment E-2: SE Woods Flow Ler	Runoff Area=49,278 sf 7.20% Impervious Runoff Depth>1.05" ngth=420' Tc=12.0 min UI Adjusted CN=53 Runoff=0.90 cfs 0.099 af
Subcatchment E-3: Grassed Meadow/Nort	hern Runoff Area=180,525 sf 0.00% Impervious Runoff Depth>0.37" Flow Length=465' Tc=12.3 min CN=41 Runoff=0.55 cfs 0.129 af
Subcatchment E-4: SW Grassed Area	Runoff Area=181,751 sf 0.00% Impervious Runoff Depth>0.47" Flow Length=622' Tc=15.7 min CN=43 Runoff=0.79 cfs 0.163 af
Subcatchment R-1: Roof of Abandoned Ho	Runoff Area=787 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.10 cfs 0.008 af
Subcatchment R-2: Southern Roof Existing	g Runoff Area=346 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.04 cfs 0.003 af
Subcatchment R-3: Northern Roof Existing	g Runoff Area=346 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.04 cfs 0.003 af
Reach SP-1: Wetlands South of Driveway	Inflow=1.14 cfs 0.231 af Outflow=1.14 cfs 0.231 af
Reach SP-2: Northeast Wetland Flow	Inflow=1.52 cfs 0.363 af Outflow=1.52 cfs 0.363 af
Reach SP-3: Northwest Wetland Flow	Inflow=2.29 cfs 0.526 af Outflow=2.29 cfs 0.526 af
Pond 1P: Existing Detention Basin	Peak Elev=58.81' Storage=4,979 cf Inflow=2.27 cfs 0.195 af Outflow=0.32 cfs 0.124 af
Pond 3P: 12 Inch Culvert 12.0" R	Peak Elev=57.18' Inflow=1.14 cfs 0.231 af ound Culvert n=0.011 L=51.0' S=0.0025 '/' Outflow=1.14 cfs 0.231 af

 Total Runoff Area = 10.008 ac
 Runoff Volume = 0.597 af
 Average Runoff Depth = 0.72"

 95.65% Pervious = 9.572 ac
 4.35% Impervious = 0.436 ac

Prepar	ed by Mic	rosoft	droCAD 2		Type III 24-hr 25-Year Rainfall=5.40" Printed 2/27/2017 O Software Solutions LLC Page 40					
	Summary for Subcatchment E-1: Existing Drive									
Runoff	=	2.24 c	fs@ 12.1	4 hrs, Volu	me= 0.191 af, Depth> 4.36"					
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 25-Year Rainfall=5.40"										
	Area (sf)	CN [Description							
	13,950	98 F	Paved park	ing, HSG A	\					
	4,096		Gravel surfa							
	411		Noods, Go							
	3,284		Noods, Go							
	509				Fair, HSG A					
	672				Fair, HSG C					
	22,922 8,972		Neighted A 39.14% Per							
	13,950		59.14% Fei 50.86% Imp							
	10,000		0.00 % mi		ea					
Тс	Length	Slope	Velocity	Capacity	Description					
(min)		(ft/ft)		(cfs)	··· [···					
8.1	50	0.0600	0.10		Sheet Flow, A-B					
					Woods: Light underbrush n= 0.400 P2= 3.10"					
0.3	33	0.1060	1.63		Shallow Concentrated Flow, B-C					
					Woodland Kv= 5.0 fps					
0.1	19	0.2200	3.28		Shallow Concentrated Flow, C-D					
0.5	110	0.0450	3.42		Short Grass Pasture Kv= 7.0 fps Shallow Concentrated Flow, D-E					
0.5	112	0.0450	3.42		Unpaved Kv= 16.1 fps					
1.1	205	0.0240	3.14		Shallow Concentrated Flow, E-F					
	200	5.02 10	0.14		Paved Kv= 20.3 fps					
0.1	25	0.0100	3.93	3.09	Pipe Channel, F-G					
					12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25'					
					n= 0.015 Corrugated PE, smooth interior					
10.2	444	Total								



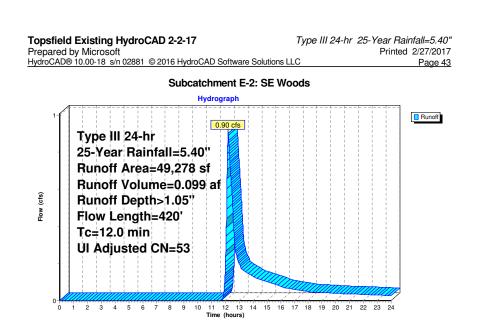
Topsfield Existing HydroCAD 2-2-17	Type III 24-hr 25-Year Rainfall=5.40"
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HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions L	LC Page 42

Summary for Subcatchment E-2: SE Woods

Runoff = 0.90 cfs @ 12.20 hrs, Volume= 0.099 af, Depth> 1.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 25-Year Rainfall=5.40"

A	rea (sf)	CN /	Adj Desc	ription					
	3,550	98	Unco	onnected pa	avement, HSG A				
	7,582	49	50-7	50-75% Grass cover, Fair, HSG A					
	1,887	79	50-7	5% Grass o	cover, Fair, HSG C				
	18,787	30	Woo	ds, Good, I	HSG A				
	11,389	70	Woo	ds, Good, I	HSG C				
	6,083	77	Woo	ds, Good, I	HSG D				
	49,278	55			age, UI Adjusted				
	45,728		92.80	0% Perviou	is Area				
	3,550			% Impervio					
	3,550		100.0	00% Uncor	nected				
Та	المعمول	Clana	Valasity	Canaaitu	Description				
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description				
			/	(CIS)	Chast Flow A D				
6.3	50	0.1100	0.13		Sheet Flow, A-B				
0.0	75	0 0000	1 50		Woods: Light underbrush n= 0.400 P2= 3.10" Shallow Concentrated Flow, B-C				
0.8	75	0.0930	1.52		Woodland Kv= 5.0 fps				
0.4	35	0.0430	1.45		Shallow Concentrated Flow, C-D				
0.4	35	0.0430	1.45		Short Grass Pasture Kv= 7.0 fps				
4.5	260	0.0370	0.96		Shallow Concentrated Flow, D-E				
4.5	200	0.0070	0.00		Woodland $Ky = 5.0 \text{ fps}$				
		-							
12.0	420	Total							



Topsfield Existing HydroCAD 2-2-17	Type III 24-hr 25-Year Rainfall=5.40"
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Summary for Subcatchment E-3: Grassed Meadow/Northern Woods

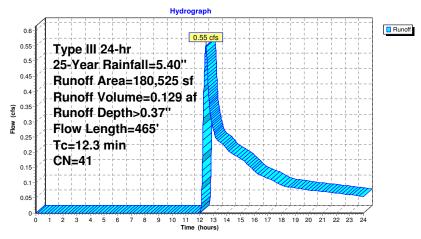
Runoff = 0.55 cfs @ 12.45 hrs, Volume= 0.129 af, Depth> 0.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 25-Year Rainfall=5.40"

_	Ai	rea (sf)	CN E	Description		
		76,402	30 V	Voods, Go	od, HSG A	
		13,713	55 V	Voods, Go	od, HSG B	
		15,503	70 V	Voods, Go	od, HSG C	
		67,450	39 >	75% Gras	s cover, Go	bod, HSG A
-		7,457	74 >	75% Gras	s cover, Go	bod, HSG C
	1	80,525	41 V	Veighted A	verage	
	1	80,525	1	00.00% Pe	ervious Are	a
	Тс	Length	Slope	Velocity	Capacity	Description
-	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	7.2	50	0.0800	0.12		Sheet Flow, A-B
						Woods: Light underbrush n= 0.400 P2= 3.10"
	3.6	293	0.0375	1.36		Shallow Concentrated Flow, B-C
						Short Grass Pasture Kv= 7.0 fps
	1.5	122	0.0740	1.36		Shallow Concentrated Flow, C-D
-						Woodland Kv= 5.0 fps
	100	405	Tatal			

12.3 465 Total

Subcatchment E-3: Grassed Meadow/Northern Woods



Topsfield Existing HydroCAD 2-2-17	Type III 24-hr 25-Year Rainfall=5.40"
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Summary for Subcatchment E-4: SW Grassed Area

Printed 2/27/2017 Page 45

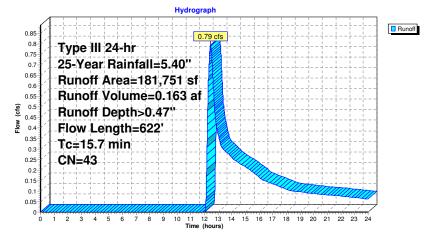
0.79 cfs @ 12.47 hrs, Volume= Runoff = 0.163 af, Depth> 0.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 25-Year Rainfall=5.40"

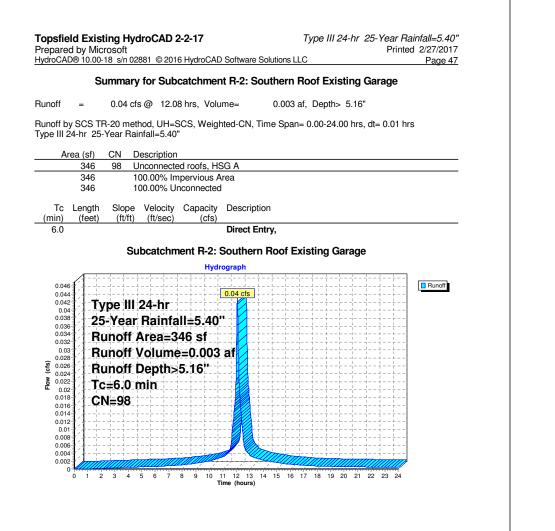
_	A	rea (sf)	CN E	Description		
		44,530	30 V	Voods, Go	od, HSG A	
		4,806	70 V	Voods, Go	od, HSG C	
	1	01,870	39 >	75% Gras	s cover, Go	bod, HSG A
_		30,545	74 >	75% Gras	s cover, Go	bod, HSG C
	1	81,751	43 V	Veighted A	verage	
	1	81,751	1	00.00% Pe	ervious Area	a
	Tc	Length	Slope	Velocity	Capacity	Description
-	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	8.7	50	0.0500	0.10		Sheet Flow, A-B
						Woods: Light underbrush n= 0.400 P2= 3.10"
	5.6	462	0.0390	1.38		Shallow Concentrated Flow, B-C
						Short Grass Pasture Kv= 7.0 fps
	1.4	110	0.0682	1.31		Shallow Concentrated Flow, C-D
_						Woodland Kv= 5.0 fps

15.7 622 Total

Subcatchment E-4: SW Grassed Area



	0 10.00-18 s/n Sum	mary for S	ubcatchn				ando	ned H	lous	е	Page 4
Runoff	= 0.10	cfs@ 12.0	8 hrs, Volu	ıme=	0.00)8 af,	Depth	> 5.16	5"		
Runoff by S	SCS TB-20 m	nethod, UH=8	SCS Weid	hted-CN	Time Sn	an= 0	00-24	00 hrs	dt=	0 01 hr	s
		Rainfall=5.40			o op				, at	0.0	0
Area	a (sf) CN	Description									
	787 98	Roofs, HSC									
	787	100.00% In	npervious A	Area							
Tc L	ength Slop	be Velocity	Capacity	Descrip	tion						
(min)	(feet) (ft/		(cfs)	Beeeinp							
6.0				Direct E	Entry,						
		Subcato	hment R-	1. Boof	of Abo	ndon	od Ho				
		Subcalc		rograph		luon		use			
0.105	<u>}</u>			0.10 cfs		<u>-</u>			- <u>+</u> <u>+</u>		Runoff
0.095	Type II	l 24-hr	+						+ +		
0.09		r Rainfa	II_5 40'						- + +		
0.08	1	Area=78				<u>1</u>			- <u>1</u> <u>1</u>		
0.075					+- 	+		+	+ +	 	
0.065	1	Volume		af 💋 💷		<u>+</u>				·	
0.06 (cts)	Runoff	Depth>:	5.16"		{	- 			- 		
0.03	Tc=6.0	min					 				
0.045 0.04	CN=98	-+	+		+- +-			+ +	- + + - + +		
0.035		-+			+-	<u>i</u>			$-\frac{1}{1}\frac{1}{1}$		
0.03		- 4 4 4 4					 		- <u>+</u> <u>+</u>		
0.02		-+	+	00	+-				- + +		
0.015	1				Think						
0.015	1 1 1 1										
			MAN MARKAN AND AND AND AND AND AND AND AND AND A			ųЩ	//////	11/11/			



	vy Microsoft Printed 2/2 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC P	7/2017 age 48
	Summary for Subcatchment R-3: Northern Roof Existing Garage	
unoff =	= 0.04 cfs @ 12.08 hrs, Volume= 0.003 af, Depth> 5.16"	
	CS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs nr 25-Year Rainfall=5.40"	
Area	(sf) CN Description	
	346 98 Roofs, HSG A	
	346 100.00% Impervious Area	
	ength Slope Velocity Capacity Description (feet) (ft/ft) (ft/sec) (cfs)	
6.0	Direct Entry,	
	Subcatchment R-3: Northern Roof Existing Garage	
	Hydrograph	
0.046		unoff
0.044	Type III 24-hr	
0.04		
0.036	25-Year Rainfall≑5.40"	
0.034	Runoff Area=346 sf	
0.03	Runoff Volume=0.003 af	
0.028 (f) 0.026	Runoff Depth>5.16"	
	1	
₫ 0.02	Tc ≢6.0 min	
0.018	CN=98	
0.014		
0.012		
0.008		
0.004		
0.002		
0	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Time (hours)	

Topsfield Existing HydroCAD 2-2-17 Type III 24-hr 25-Year Rainfall=5.40" Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Printed 2/27/2017

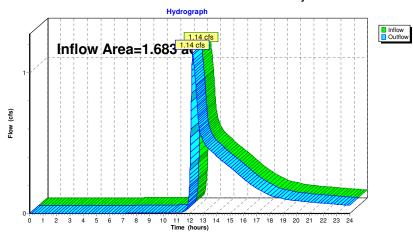
Summary for Reach SP-1: Wetlands South of Driveway

Page 49

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

Inflow Area =	1.683 ac, 25.41% Impervious, Inflow Depth > 1.65" for 25-Year event
Inflow =	1.14 cfs @ 12.21 hrs, Volume= 0.231 af
Outflow =	1.14 cfs @ 12.21 hrs, Volume= 0.231 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs





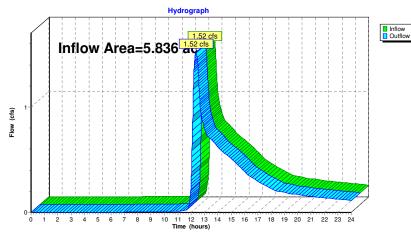
Topsfield Existing HydroCAD 2-2-17	Type III 24-hr	25-Year Rainfall=5.40"
Prepared by Microsoft		Printed 2/27/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions L	LC	Page 50

Summary for Reach SP-2: Northeast Wetland Flow

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

Inflow Area =	5.836 ac,	7.47% Impervious, Inflow	Depth > 0.75"	for 25-Year event
Inflow =	1.52 cfs @	12.38 hrs, Volume=	0.363 af	
Outflow =	1.52 cfs @	12.38 hrs, Volume=	0.363 af, Atte	en= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



Reach SP-2: Northeast Wetland Flow

Topsfield Existing HydroCAD 2-2-17 Type III 24-hr 25-Year Rainfall=5.40" Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Printed 2/27/2017

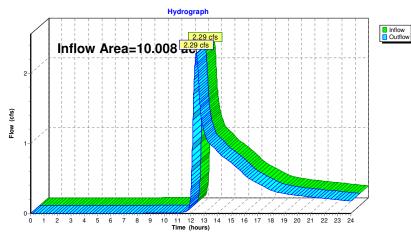
Summary for Reach SP-3: Northwest Wetland Flow

Page 51

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

Inflow Area =	10.008 ac,	4.35% Impervious, Inflow I	Depth > 0.63"	for 25-Year event
Inflow =	2.29 cfs @	12.42 hrs, Volume=	0.526 af	
Outflow =	2.29 cfs @	12.42 hrs, Volume=	0.526 af, Atte	en= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



Reach \$	SP-3:	Northwest	Wetland	Flow
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Topsfield Existing HydroCAD 2-2-17	Type III 24-hr 25-Year Rainfall=5.40"
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Summary for Pond 1P: Existing Detention Basin

Inflow Are	a =	0.534 ac, 61.44% Impervious, Inflow Depth > 4.38" for 25-Year event	
Inflow	=	2.27 cfs @ 12.14 hrs, Volume= 0.195 af	
Outflow	=	0.32 cfs @ 12.76 hrs, Volume= 0.124 af, Atten= 86%, Lag= 37.5	min
Primary	=	0.32 cfs @ 12.76 hrs, Volume= 0.124 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 58.81' @ 12.76 hrs Surf.Area= 3,090 sf Storage= 4,979 cf

Plug-Flow detention time= 248.3 min calculated for 0.124 af (64% of inflow) Center-of-Mass det. time= 149.9 min (936.4 - 786.5)

Volume	Inve	rt Avail.Ste	orage Stor	rage Description	on	
#1	57.2	0' 9,0)20 cf Cus	tom Stage Data	ta (Prismatic) Listed below (Recalc)	
Elevatio		Surf.Area	Inc.Stor			
(fee	t)	(sq-ft)	(cubic-fee	t) (cubic-fe	teet)	
57.2	0	3,090		0	0	
58.0	0	3,090	2,47	2 2,4	,472	
59.0	0	3,090	3,09	0 5,5	,562	
59.4	0	3,550	1,32	8 6,8	,890	
60.0	0	3,550	2,13	0 9,0	,020	
Device	Routing	Invert	Outlet De	evices		
#1	Primary	58.08	4.0" Vert	Orifice/Grate	C= 0.600	
#2	Primary	58.80	8.0" Vert	Orifice/Grate	C= 0.600	

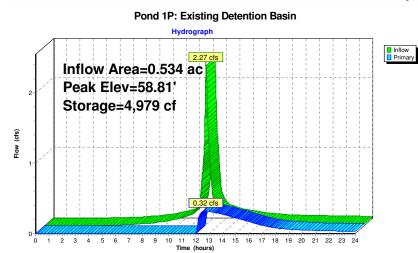
Primary OutFlow Max=0.32 cfs @ 12.76 hrs HW=58.81' (Free Discharge) 1=Orifice/Grate (Orifice Controls 0.32 cfs @ 3.62 fps) 2=Orifice/Grate (Orifice Controls 0.00 cfs @ 0.36 fps)



 Type III 24-hr
 25-Year Rainfall=5.40"

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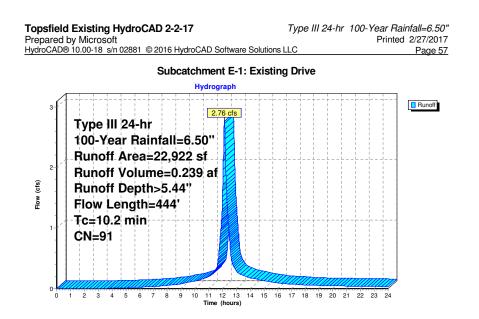
LudroCA		10 0/0 02001	2016 HydroCAD S	Coffworo Sc	Jutiona I I	<u>^</u>			rinted 2/27/2
		10 S/1102001 @		Soliware Sc	DIULIONS LL	5			Page
		S	ummary for P	ond 3P:	12 Inch	Culver	t		
[57] Hint	t: Peaked	at 57.18' (Flood	d elevation advis	ed)					
Inflow A	rea =	1.683 ac, 25	5.41% Impervious	s, Inflow D	Depth >	1.65" f	or 25-Y	'ear eve	ent
Inflow	=		12.21 hrs, Volum		0.231 a	f			
Outflow			12.21 hrs, Volum		0.231 a		= 0%, L	.ag= 0.0) min
Primary	=	1.14 cfs @ 1	12.21 hrs, Volum	1e=	0.231 a	f			
		nd method, Tim ' @ 12.21 hrs	e Span= 0.00-24	.00 hrs, dt	= 0.01 hrs	5			
Device	0		Outlet Devices	-					
#1	Primary	56.51'						-	
			Inlet / Outlet Ir						
			n= 0.011 Con	crete pipe	, straight	& clean,	Flow A	Area= 0.	.79 st
			Pond 3P	• 12 Inch					
			Pond 3P Hydrog	: 12 Inch	Culver	t			⊐
-	l li	nflow Are	Hydrog	raph	Culver	t			Inflow Primary
	L Jin-i-		Hydrog a=1.683 a	raph		t 			
1-	/ P	eak Elev:	Hydrog a=1.683 a	raph		L 			
1-	/ P		Hydrog a=1.683 a	raph					
1-	P	eak Elev: 2.0''	Hydrog a=1.683 ^{1.1} =57.18'	raph		t 			
	P	eak Elev:	Hydrog a=1.683 ^{1.1} =57.18'	raph					
	P 1 R	eak Elev: 2.0'' ound Cu	Hydrog a=1.683 ^{1.1} =57.18'	raph					
	P 1 R	eak Elev: 2.0'' ound Cu =0.011	Hydrog a=1.683 ^{1.1} =57.18'	raph	Culver				
Flow (cfs) 1	P 1 R	eak Elev: 2.0'' ound Cu	Hydrog a=1.683 ^{1.1} =57.18'	raph					
	P 1 R N	eak Elev: 2.0'' ound Cu =0.011 =51.0'	Hydrog a=1.683 <mark>11</mark> =57.18' Ivert	raph		t			
	P 1 R N	eak Elev: 2.0'' ound Cu =0.011	Hydrog a=1.683 <mark>11</mark> =57.18' Ivert	raph					
	P 1 R N	eak Elev: 2.0'' ound Cu =0.011 =51.0'	Hydrog a=1.683 <mark>11</mark> =57.18' Ivert	raph	Culveri				
	P 1 R N	eak Elev: 2.0'' ound Cu =0.011 =51.0'	Hydrog a=1.683 <mark>11</mark> =57.18' Ivert	raph					
	P 1 R N	eak Elev: 2.0'' ound Cu =0.011 =51.0'	Hydrog a=1.683 <mark>11</mark> =57.18' Ivert	raph	Culver				
	P 1 R N	eak Elev: 2.0'' ound Cu =0.011 =51.0'	Hydrog a=1.683 <mark>11</mark> =57.18' Ivert	raph					

Topsfield Existing HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 Hydro	Type III 24-hr 100-Year Rainfall=6.50' Printed 2/27/2017 CAD Software Solutions LLC Page 55
Runoff by SCS TI	0-24.00 hrs, dt=0.01 hrs, 2401 points R-20 method, UH=SCS, Weighted-CN Trans method - Pond routing by Stor-Ind method
Subcatchment E-1: Existing Drive	Runoff Area=22,922 sf 60.86% Impervious Runoff Depth>5.44" Flow Length=444' Tc=10.2 min CN=91 Runoff=2.76 cfs 0.239 af
Subcatchment E-2: SE Woods Flow Len	Runoff Area=49,278 sf 7.20% Impervious Runoff Depth>1.64" gth=420' Tc=12.0 min UI Adjusted CN=53 Runoff=1.57 cfs 0.154 af
Subcatchment E-3: Grassed Meadow/North	hern Runoff Area=180,525 sf 0.00% Impervious Runoff Depth>0.72" Flow Length=465' Tc=12.3 min CN=41 Runoff=1.50 cfs 0.250 af
Subcatchment E-4: SW Grassed Area	Runoff Area=181,751 sf 0.00% Impervious Runoff Depth>0.86" Flow Length=622' Tc=15.7 min CN=43 Runoff=1.94 cfs 0.299 af
Subcatchment R-1: Roof of Abandoned Ho	Runoff Area=787 sf 100.00% Impervious Runoff Depth>6.26" Tc=6.0 min CN=98 Runoff=0.12 cfs 0.009 af
Subcatchment R-2: Southern Roof Existing	g Runoff Area=346 sf 100.00% Impervious Runoff Depth>6.26" Tc=6.0 min CN=98 Runoff=0.05 cfs 0.004 af
Subcatchment R-3: Northern Roof Existing	Runoff Area=346 sf 100.00% Impervious Runoff Depth>6.26" Tc=6.0 min CN=98 Runoff=0.05 cfs 0.004 af
Reach SP-1: Wetlands South of Driveway	Inflow=1.93 cfs 0.335 af Outflow=1.93 cfs 0.335 af
Reach SP-2: Northeast Wetland Flow	Inflow=3.31 cfs 0.589 af Outflow=3.31 cfs 0.589 af
Reach SP-3: Northwest Wetland Flow	Inflow=5.19 cfs 0.889 af Outflow=5.19 cfs 0.889 af
Pond 1P: Existing Detention Basin	Peak Elev=59.10' Storage=5,880 cf Inflow=2.80 cfs 0.243 af Outflow=0.67 cfs 0.171 af
Pond 3P: 12 Inch Culvert 12.0" Ro	Peak Elev=57.44' Inflow=1.93 cfs 0.335 af pund Culvert n=0.011 L=51.0' S=0.0025 '/' Outflow=1.93 cfs 0.335 af

 Total Runoff Area = 10.008 ac
 Runoff Volume = 0.960 af
 Average Runoff Depth = 1.15"

 95.65% Pervious = 9.572 ac
 4.35% Impervious = 0.436 ac

Inguioor	D® 10.00-	-18 s/n ()2881 © 201	6 HydroCAE	D Software Solutions LLC Page 5
			Summar	y for Sub	catchment E-1: Existing Drive
Runoff	=	2.76 0	cfs@ 12.1	4 hrs, Volu	ume= 0.239 af, Depth> 5.44"
			ethod, UH=9 Rainfall=6.5		hted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
A	rea (sf)	CN	Description	l	
	13,950		Paved park		
	4,096		Gravel surf		
	411		Woods, Go		
	3,284		Woods, Go		
	509				Fair, HSG A
	672			/	Fair, HSG C
	22,922		Weighted A 39,14% Pe		
	8,972 13.950		39.14% Pe 60.86% Im		•
	13,950		00.00% 111	Jervious Ar	ea
Тс	Length	Slope	e Velocitv	Capacity	Description
(min)	(feet)	(ft/ft		(cfs)	
8.1	50	0.0600	0.10		Sheet Flow, A-B
					Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	33	0.1060	0 1.63		Shallow Concentrated Flow, B-C
					Woodland Kv= 5.0 fps
0.1	19	0.2200) 3.28		Shallow Concentrated Flow, C-D
		0.045			Short Grass Pasture Kv= 7.0 fps
0.5	112	0.0450	3.42		Shallow Concentrated Flow, D-E Unpaved Kv= 16.1 fps
1.1	205	0.0240) 3.14		Shallow Concentrated Flow, E-F
1.1	205	0.0240	5 3.14		Paved Kv= 20.3 fps
0.1	25	0.0100	3.93	3 09	Pipe Channel, F-G
0.1	20	5.0100	. 0.00	0.00	12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25'
					n= 0.015 Corrugated PE, smooth interior



Topsfield Existing HydroCAD 2-2-17	Type III 24-hr	100-Year Rainfall=6.50"
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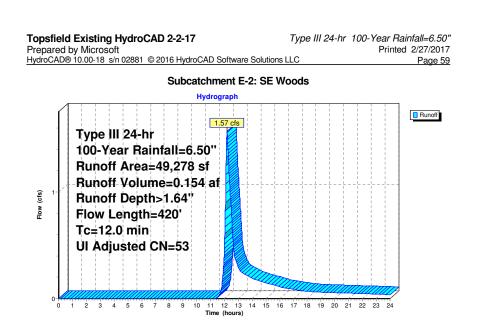
Summary for Subcatchment E-2: SE Woods

Runoff = 1.57 cfs @ 12.18 hrs, Volume= 0.154 af, Depth> 1.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50"

_	A	rea (sf)	CN /	Adj Desc	ription	
		3,550	98	Unco	onnected pa	avement, HSG A
		7,582	49	50-7	5% Grass o	cover, Fair, HSG A
		1,887	79	50-7	5% Grass o	cover, Fair, HSG C
		18,787	30		ds, Good, I	
		11,389	70		ds, Good, I	
-		6,083	77	Woo	ds, Good, I	HSG D
		49,278	55			age, UI Adjusted
		45,728			0% Perviou	
		3,550			% Impervio	
		3,550		100.0	00% Uncor	inected
	Tc	Length	Slope	Velocity	Capacity	Description
	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	Description
-	6.3	50	0.1100	0.13	(0.0)	Sheet Flow, A-B
	0.0	00	0.1100	0.10		Woods: Light underbrush n= 0.400 P2= 3.10"
	0.8	75	0.0930	1.52		Shallow Concentrated Flow, B-C
		-		-		Woodland Kv= 5.0 fps
	0.4	35	0.0430	1.45		Shallow Concentrated Flow, C-D
						Short Grass Pasture Kv= 7.0 fps
	4.5	260	0.0370	0.96		Shallow Concentrated Flow, D-E
_						Woodland Kv= 5.0 fps
	12.0	420	Total			

12.0 420 Total



Topsfield Existing HydroCAD 2-2-17	Type III 24-hr	100-Year Rainfall=6.50"
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Summary for Subcatchment E-3: Grassed Meadow/Northern Woods

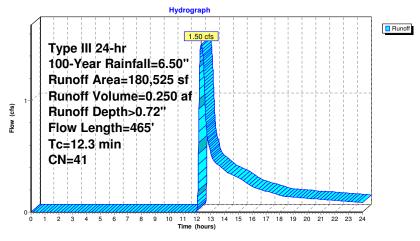
Runoff = 1.50 cfs @ 12.34 hrs, Volume= 0.250 af, Depth> 0.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50"

_	Ai	rea (sf)	CN E	Description		
		76,402	30 V	Voods, Go	od, HSG A	
		13,713	55 V	Voods, Go	od, HSG B	
		15,503	70 V	Voods, Go	od, HSG C	
		67,450	39 >	75% Gras	s cover, Go	ood, HSG A
		7,457	74 >	75% Gras	s cover, Go	ood, HSG C
	180,525 41 Weighted Average			Veighted A	verage	
	1	80,525	1	00.00% Pe	ervious Are	a
	Tc	Length	Slope	Velocity	Capacity	Description
	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
	7.2	50	0.0800	0.12		Sheet Flow, A-B
						Woods: Light underbrush n= 0.400 P2= 3.10"
	3.6	293	0.0375	1.36		Shallow Concentrated Flow, B-C
						Short Grass Pasture Kv= 7.0 fps
	1.5	122	0.0740	1.36		Shallow Concentrated Flow, C-D
						Woodland Kv= 5.0 fps

12.3 465 Total

Subcatchment E-3: Grassed Meadow/Northern Woods



Topsfield Existing HydroCAD 2-2-17	Type III 24-hr
Prepared by Microsoft	
HydroCAD® 10.00-18 s/n 02881 @ 2016 HydroCAD Software Solutions	SLLC

I 24-hr 100-Year Rainfall=6.50" Printed 2/27/2017 Page 61

Summary for Subcatchment E-4: SW Grassed Area

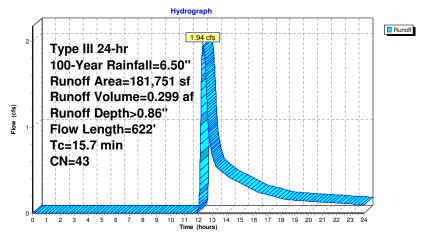
Runoff = 1.94 cfs @ 12.33 hrs, Volume= 0.299 af, Depth> 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50"

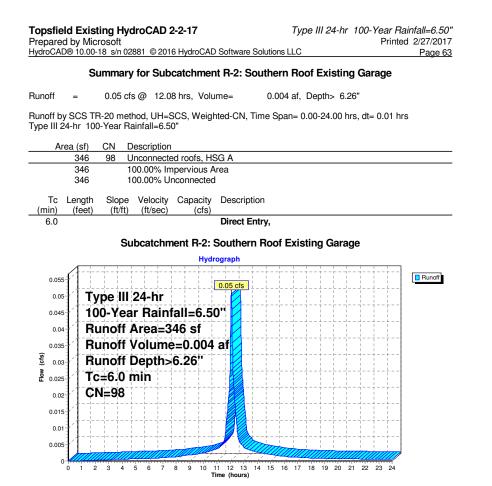
_	A	rea (sf)	CN [Description			
		44,530	30 \	Noods, Go	od, HSG A		
		4,806	70 N	Noods, Go	od, HSG C		
	1	01,870	39 >	>75% Gras	s cover, Go	bod, HSG A	
_		30,545	74 >	>75% Gras	s cover, Go	bod, HSG C	
	1	81,751	43 N	Neighted A	verage		
	1	81,751	1	100.00% Pe	ervious Area	a	
	Tc	Length	Slope	Velocity	Capacity	Description	
	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)		
	8.7	50	0.0500	0.10		Sheet Flow, A-B	
						Woods: Light underbrush n= 0.400 P2= 3.10"	
	5.6	462	0.0390	1.38		Shallow Concentrated Flow, B-C	
						Short Grass Pasture Kv= 7.0 fps	
	1.4	110	0.0682	1.31		Shallow Concentrated Flow, C-D	
						Woodland Kv= 5.0 fps	
	45 7	000	Tatal				

15.7 622 Total

Subcatchment E-4: SW Grassed Area



Topsfield Existing HydroCAD 2-2-17 Type III 24-hr 100-Year Rainfall=6.50" Prepared by Microsoft Printed 2/27/2017 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 62
Summary for Subcatchment R-1: Roof of Abandoned House
Runoff = 0.12 cfs @ 12.08 hrs, Volume= 0.009 af, Depth> 6.26"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50"
Area (sf) CN Description
787 98 Roofs, HSG A
787 100.00% Impervious Area
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)
6.0 Direct Entry,
Subcatchment R-1: Roof of Abandoned House
Hydrograph
0.12 cfs Type III 24-hr 0.1 100-Year Rainfall=6.50" 0.08 Runoff Area=787 sf 0.08 Runoff Depth>6.26" 0.04 0.05 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.05 0.04 0.06 0.04 0.07 0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Time (hours)



Type III 24-hr 100-Year Rainfall=6.50" Topsfield Existing HydroCAD 2-2-17 Prepared by Microsoft Printed 2/27/2017 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 64 Summary for Subcatchment R-3: Northern Roof Existing Garage 0.05 cfs @ 12.08 hrs, Volume= Runoff = 0.004 af, Depth> 6.26" Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50" Area (sf) CN Description 346 98 Roofs, HSG A 346 100.00% Impervious Area Tc Lenath Slope Velocity Capacity Description (ft/ft) (ft/sec) (cfs) (min) (feet) Direct Entry, 6.0 Subcatchment R-3: Northern Roof Existing Garage Hydrograph Runoff 0.055 0.05 cfs Type III 24-hr 0.05 100-Year Rainfall=6.50" 0.045 Runoff Area=346 sf 0.04 Runoff Volume=0.004 af 0.035 (cfs) Runoff Depth>6.26" 0.03-Tc=6.0 min <u>s</u> 0.025 CN=98 0.02 0.015 0.01 0.005 2 3 4 5 6 7 8 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Time (hours) Ó - i -9

 Topsfield Existing HydroCAD 2-2-17
 Type

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 Type III 24-hr 100-Year Rainfall=6.50"

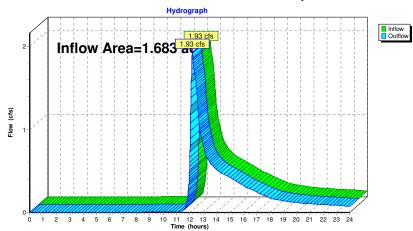
Summary for Reach SP-1: Wetlands South of Driveway

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

Inflow Area =	1.683 ac, 25.41% Impervious, Inflow Depth > 2.39" for 100-Year event
Inflow =	1.93 cfs @ 12.19 hrs, Volume= 0.335 af
Outflow =	1.93 cfs @ 12.19 hrs, Volume= 0.335 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs





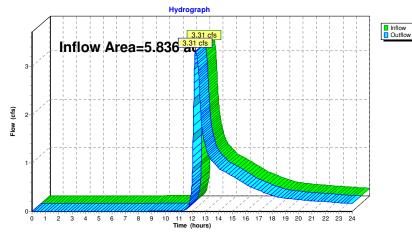
Topsfield Existing HydroCAD 2-2-17	Type III 24-hr	100-Year Rainfall=6.50"
Prepared by Microsoft		Printed 2/27/2017
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Summary for Reach SP-2: Northeast Wetland Flow

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

Inflow Area =	5.836 ac,	7.47% Impervious, Inflow	Depth > 1.21"	for 100-Year event
Inflow =	3.31 cfs @	12.23 hrs, Volume=	0.589 af	
Outflow =	3.31 cfs @	12.23 hrs, Volume=	0.589 af, Atte	en= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



Reach SP-2: Northeast Wetland Flow

 Topsfield Existing HydroCAD 2-2-17
 Type III 24-hr
 1

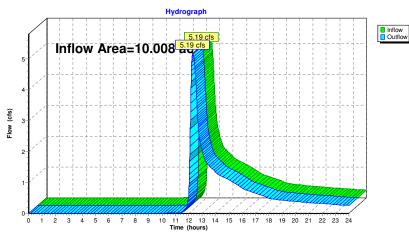
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 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC
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Summary for Reach SP-3: Northwest Wetland Flow

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

Inflow Area =	10.008 ac,	4.35% Impervious, Inflow D	epth > 1.07" for 100-Year event
Inflow =	5.19 cfs @	12.30 hrs, Volume=	0.889 af
Outflow =	5.19 cfs @	12.30 hrs, Volume=	0.889 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



Reach	SP-3:	Northwest	Wetland F	Flow
-------	-------	-----------	-----------	------

Topsfield Existing HydroCAD 2-2-17	Type III 24-hr	100-Year Rainfall=6.50"
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Summary for Pond 1P: Existing Detention Basin

Inflow Area =	0.534 ac, 61.44% Impervious, Inflow E	Depth > 5.45" for 100-Year event
Inflow =	2.80 cfs @ 12.14 hrs, Volume=	0.243 af
Outflow =	0.67 cfs @ 12.57 hrs, Volume=	0.171 af, Atten= 76%, Lag= 25.8 min
Primary =	0.67 cfs @ 12.57 hrs, Volume=	0.171 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 59.10' @ 12.57 hrs Surf.Area= 3,206 sf Storage= 5,880 cf

Plug-Flow detention time= 228.3 min calculated for 0.171 af (71% of inflow) Center-of-Mass det. time= 138.2 min (919.0 - 780.8)

Volume	Inve	ert Avail.S	Storage	Storage	Description				
#1	57.2	20' 9	,020 cf	Custom	Stage Data	(Prismatic)	Listed below	w (Recalc)	
Elevatio (fee 57.2 58.0 59.0 59.4 60.0	t) 20 00 00 40	Surf.Area (sq-ft) 3,090 3,090 3,090 3,550 3,550 3,550	(cubic	Store -feet) 0 2,472 3,090 1,328 2,130	Cum.Sto (cubic-fee 2,4 5,5 6,8 9,0	et) 0 72 62 90			
Device	Routing	Inve	rt Outle	t Device	s				
#1 #2	Primary Primary	58.0 58.8				C= 0.600 C= 0.600			

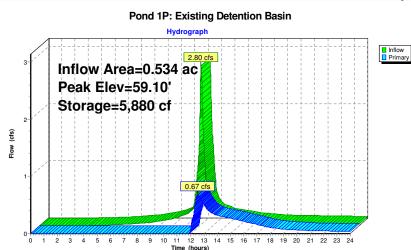
Primary OutFlow Max=0.67 cfs @ 12.57 hrs HW=59.10' (Free Discharge) 1=Orifice/Grate (Orifice Controls 0.39 cfs @ 4.45 fps) 2=Orifice/Grate (Orifice Controls 0.29 cfs @ 1.87 fps)



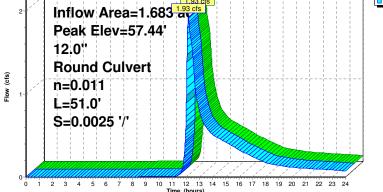
 Type III 24-hr
 100-Year Rainfall=6.50"

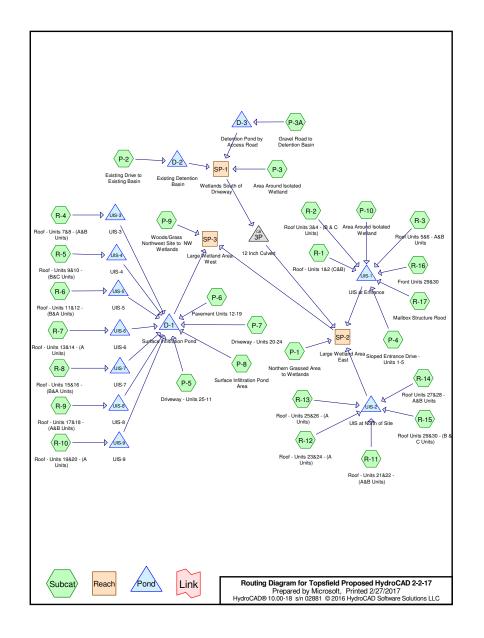
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Topsfield Existing HydroCAD 2-2-17 Type III 24-hr 100-Year Rainfall=6.50" Prepared by Microsoft Printed 2/27/2017 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 70 Summary for Pond 3P: 12 Inch Culvert [57] Hint: Peaked at 57.44' (Flood elevation advised) Inflow Area = 1.683 ac, 25.41% Impervious, Inflow Depth > 2.39" for 100-Year event 1.93 cfs @ 12.19 hrs, Volume= 0.335 af Inflow = Outflow = 1.93 cfs @ 12.19 hrs, Volume= 0.335 af, Atten= 0%, Lag= 0.0 min Primary = 1.93 cfs @ 12.19 hrs, Volume= 0.335 af Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 57.44' @ 12.19 hrs Device Routing Invert Outlet Devices Primary 56.51' 12.0" Round Culvert L= 51.0' Ke= 0.200 #1 Inlet / Outlet Invert= 56.51' / 56.38' S= 0.0025 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf Primary OutFlow Max=1.93 cfs @ 12.19 hrs HW=57.44' (Free Discharge) Pond 3P: 12 Inch Culvert Hydrograph Inflow
Primary 1.93 cfs Inflow Area=1.683





Topsfield Proposed HydroCAD 2-2-17	
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Area Listi	ng (all	nodes)
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	Area	CN	Description
(a	cres)		(subcatchment-numbers)
().376	49	50-75% Grass cover, Fair, HSG A (P-6, P-7)
2	2.356	39	>75% Grass cover, Good, HSG A (P-1, P-2, P-3, P-3A, P-4, P-5, P-8, P-9)
().926	74	>75% Grass cover, Good, HSG C (P-10, P-2, P-3, P-4, P-5, P-9)
(0.090	72	Dirt roads, HSG A (P-1, P-9)
(0.101	76	Gravel roads, HSG A (P-2, P-3, P-3A)
	1.245	98	Paved parking, HSG A (P-3A, P-4, P-5, P-6, P-7, P-8)
(0.166	98	Roofs, HSG A (R-14, R-3)
().322	98	Unconnected pavement, HSG A (P-1, P-2, P-3, P-9)
(0.083	98	Unconnected pavement, HSG B (P-2)
(0.088	98	Unconnected pavement, HSG C (P-2, P-5)
	1.123	98	Unconnected roofs, HSG A (P-10, R-1, R-10, R-11, R-12, R-13, R-15, R-16, R-17, R-2,
			R-4, R-5, R-6, R-7, R-8, R-9)
2	2.393	30	Woods, Good, HSG A (P-1, P-3, P-9)
().323	55	Woods, Good, HSG B (P-1, P-9)
().297	70	Woods, Good, HSG C (P-1, P-3)
(0.118	77	Woods, Good, HSG D (P-3)
1(0.007	61	TOTAL AREA

d by Mici D® 10.00-		Printed 2/27/2017 1 © 2016 HydroCAD Software Solutions LLC Page 3	Prepared by HydroCAD® 1	Microsoft 0.00-18 s/n (02881 ©201	6 HydroCAE) Software S	olutions LLC		nted 2/27/201 Page
		Soil Listing (all nodes)				Ground	l Covers (a	all nodes)		
Area	Soil	Subcatchment	HSG-A	HSG-B	HSG-C	HSG-D	Other	Total	Ground	Subcatchme
(acres)	Group	Numbers	(acres)	(acres)	(acres)	(acres)	(acres)	(acres)	Cover	Numbers
8.172	HSG A	P-1, P-10, P-2, P-3, P-3A, P-4, P-5, P-6, P-7, P-8, P-9, R-1, R-10, R-11, R-12, R-13,	0.376	0.000	0.000	0.000	0.000	0.376	50-75% Grass cover, Fai	r P-6, P-7
		R-14, R-15, R-16, R-17, R-2, R-3, R-4, R-5, R-6, R-7, R-8, R-9	2.356	0.000	0.926	0.000	0.000	3.281	>75% Grass cover, Good	I P-1, P-10,
0.407	HSG B	P-1, P-2, P-9								P-2, P-3,
1.310	HSG C	P-1, P-10, P-2, P-3, P-4, P-5, P-9								P-3A, P-4,
0.118	HSG D	P-3								P-5, P-8, P-9
0.000	Other		0.090	0.000	0.000	0.000	0.000	0.090	Dirt roads	P-1, P-9
10.007		TOTAL AREA	0.101	0.000	0.000	0.000	0.000	0.101	Gravel roads	P-2, P-3,
										P-3A
			1.245	0.000	0.000	0.000	0.000	1.245	Paved parking	P-3A, P-4,
										P-5, P-6,
			0.400	0.000	0.000	0.000	0.000	0.400	D (P-7, P-8
			0.166	0.000	0.000	0.000	0.000	0.166	Roofs	R-14, R-3
			0.322	0.083	0.088	0.000	0.000	0.492	Unconnected pavement	P-1, P-2, P-3, P-5, P-9
			1.123	0.000	0.000	0.000	0.000	1.123	Unconnected roofs	P-3, P-5, P-3 P-10, R-1,
			1.125	0.000	0.000	0.000	0.000	1.123	Unconnected roots	R-10, R-11,
										R-12, R-13,
										R-15, R-16,
										R-17, R-2,
										R-4, R-5,
										R-6, R-7,
										R-8, R-9
			2.393	0.323	0.297	0.118	0.000	3.131	Woods, Good	P-1, P-3, P-
			8.172	0.407	1.310	0.118	0.000	10.007	TOTAL AREA	. ,

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			Pi	pe Listing	g (all no	des)			
Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	3P	56.51	56.38	51.0	0.0025	0.011	12.0	0.0	0.0
2	D-1	70.10	67.00	234.0	0.0132	0.015	18.0	0.0	0.0
3	UIS-3	73.40	70.70	30.0	0.0900	0.011	6.0	0.0	0.0
4	UIS-4	74.20	74.06	30.0	0.0047	0.011	6.0	0.0	0.0
5	UIS-5	74.80	74.60	22.0	0.0091	0.011	6.0	0.0	0.0
6	UIS-6	74.00	72.18	106.0	0.0172	0.011	6.0	0.0	0.0
7	UIS-7	73.50	73.00	17.5	0.0286	0.011	6.0	0.0	0.0
8	UIS-8	72.80	72.18	37.0	0.0168	0.011	6.0	0.0	0.0
9	UIS-9	72.18	71.38	79.0	0.0101	0.011	6.0	0.0	0.0

Topsfield Proposed HydroCAD 2-2-17 Prepared by Microsoft	Type III 24-hr 2-Year Rainfall=3.10" Printed 2/27/2017
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Runoff by SCS TR-20	.00 hrs, dt=0.01 hrs, 2401 points) method, UH=SCS, Weighted-CN s method - Pond routing by Stor-Ind method
Subcatchment P-1: Northern Grassed Area to	Runoff Area=81,776 sf 1.57% Impervious Runoff Depth>0.01" Tc=6.0 min UI Adjusted CN=42 Runoff=0.00 cfs 0.001 af
Subcatchment P-10: Area Around Isolated	Runoff Area=31,595 sf 7.29% Impervious Runoff Depth>1.03" Tc=6.0 min UI Adjusted CN=75 Runoff=0.83 cfs 0.062 af
Subcatchment P-2: Existing Drive to Existing	Runoff Area=22,978 sf 59.84% Impervious Runoff Depth>1.39" Tc=6.0 min CN=81 Runoff=0.85 cfs 0.061 af
Subcatchment P-3: Area Around Isolated	Runoff Area=27,549 sf 12.75% Impervious Runoff Depth>0.11" Tc=6.0 min UI Adjusted CN=50 Runoff=0.01 cfs 0.006 af
Subcatchment P-3A: Gravel Road to Detention	Runoff Area=4,950 sf 31.35% Impervious Runoff Depth>0.82" Tc=6.0 min CN=71 Runoff=0.10 cfs 0.008 af
Subcatchment P-4: Sloped Entrance Drive -	Runoff Area=21,239 sf 62.65% Impervious Runoff Depth>1.32" Tc=6.0 min CN=80 Runoff=0.75 cfs 0.054 af
Subcatchment P-5: Driveway - Units 25-11	Runoff Area=39,272 sf 52.13% Impervious Runoff Depth>0.97" Tc=6.0 min CN=74 Runoff=0.97 cfs 0.073 af
Subcatchment P-6: Pavement Units 12-19	Runoff Area=19,137 sf 59.86% Impervious Runoff Depth>1.20" Tc=6.0 min CN=78 Runoff=0.60 cfs 0.044 af
Subcatchment P-7: Driveway - Units 20-24	Runoff Area=15,670 sf 44.56% Impervious Runoff Depth>0.82" Tc=6.0 min CN=71 Runoff=0.31 cfs 0.024 af
Subcatchment P-8: Surface Infiltration Pond	Runoff Area=15,307 sf 7.00% Impervious Runoff Depth>0.01" Tc=6.0 min CN=43 Runoff=0.00 cfs 0.000 af
Subcatchment P-9: Woods/Grass Northwest Flow Length=	Runoff Area=102,567 sf 2.25% Impervious Runoff Depth=0.00" 502' Tc=10.8 min UI Adjusted CN=36 Runoff=0.00 cfs 0.000 af
Subcatchment R-1: Roof - Units 1&2 (C&B)	Runoff Area=3,185 sf 100.00% Impervious Runoff Depth>2.87" Tc=6.0 min CN=98 Runoff=0.22 cfs 0.017 af
Subcatchment R-10: Roof - Units 19&20 - (A	Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>2.87" Tc=6.0 min CN=98 Runoff=0.27 cfs 0.021 af
Subcatchment R-11: Roof - Units 21&22 - (A&B	Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>2.87" Tc=6.0 min CN=98 Runoff=0.25 cfs 0.020 af
Subcatchment R-12: Roof - Units 23&24 - (A	Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>2.87" Tc=6.0 min CN=98 Runoff=0.27 cfs 0.021 af
Subcatchment R-13: Roof - Units 25&26 - (A	Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>2.87" Tc=6.0 min CN=98 Runoff=0.27 cfs 0.021 af

Typesfield Proposed HydroCAD 2-2-17 Type III 24-hr 2-Year Rainfall=3.10" Irepared by Microsoft Printed 2/27/2017 ydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 7	Topsfield Proposed HydroCAD 2-2-17 Type III 24-hr 2-Year Rainfall=3.10' Prepared by Microsoft Printed 2/27/2017 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 8
ubcatchment R-14: Roof Units 27&28 - A&B Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>2.87" Tc=6.0 min CN=98 Runoff=0.25 cfs 0.020 af	Pond D-2: Existing Detention Basin Peak Elev=58.06' Storage=2,660 cf Inflow=0.85 cfs 0.061 at Outflow=0.00 cfs 0.000 at Outflow=0.000 at Outflow=0.0000 at Outflow=0.000 at Outflow=0.000 at Outflow=0.0000 at
ubcatchment R-15: Roof Units 29&30 - (B & C Runoff Area=1,705 sf 100.00% Impervious Runoff Depth>2.87" Tc=6.0 min CN=98 Runoff=0.12 cfs 0.009 af	Pond D-3: Detention Pond by Access Road Peak Elev=63.24' Storage=81 cf Inflow=0.10 cfs 0.008 af Discarded=0.02 cfs 0.008 af Primary=0.00 cfs 0.000 af Outflow=0.02 cfs 0.008 af
ubcatchment R-16: Front Units 29&30 Runoff Area=1,490 sf 100.00% Impervious Runoff Depth>2.87" Tc=6.0 min CN=98 Runoff=0.10 cfs 0.008 af	Pond UIS-1: UIS at Entrance Peak Elev=62.02' Storage=4,431 cf Inflow=2.38 cfs 0.179 at Discarded=0.08 cfs 0.100 af Primary=0.00 cfs 0.000 af Outflow=0.08 cfs 0.100 at
ubcatchment R-17: Mailbox Structure Rood Runoff Area=120 sf 100.00% Impervious Runoff Depth>2.87" Tc=6.0 min CN=98 Runoff=0.01 cfs 0.001 af	Pond UIS-2: UIS at North of Site Peak Elev=63.00' Storage=956 Inflow=1.16 cfs 0.092 at Discarded=0.23 cfs 0.092 af Primary=0.00 cfs 0.000 af Outflow=0.23 cfs 0.092 at
ubcatchment R-2: Roof Units 3&4 - (B & C Runoff Area=3,195 sf 100.00% Impervious Runoff Depth>2.87" Tc=6.0 min CN=98 Runoff=0.22 cfs 0.018 af	Pond UIS-3: UIS-3 Peak Elev=73.67' Storage=130 cf Inflow=0.25 cfs 0.020 at Discarded=0.00 cfs 0.004 af Primary=0.25 cfs 0.013 af Outflow=0.25 cfs 0.017 at
ubcatchment R-3: Roof Units 5&6 - A&B Units Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>2.87" Tc=6.0 min CN=98 Runoff=0.25 cfs 0.020 af	Pond UIS-4: UIS-4 Peak Elev=74.55' Storage=134 cf Inflow=0.22 cfs 0.018 al Discarded=0.00 cfs 0.004 af Primary=0.21 cfs 0.011 af Outflow=0.22 cfs 0.015 al
ubcatchment R-4: Roof - Units 7&8 - (A&B Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>2.87" Tc=6.0 min CN=98 Runoff=0.25 cfs 0.020 af	Pond UIS-5: UIS-5 Peak Elev=75.17' Storage=136 cf Inflow=0.25 cfs 0.020 al Discarded=0.00 cfs 0.004 af Primary=0.24 cfs 0.013 af Outflow=0.24 cfs 0.017 al
ubcatchment R-5: Roof - Units 9&10 - (B&C Runoff Area=3,195 sf 100.00% Impervious Runoff Depth>2.87" Tc=6.0 min CN=98 Runoff=0.22 cfs 0.018 af	Pond UIS-6: UIS-6 Peak Elev=74.39' Storage=137 cf Inflow=0.27 cfs 0.021 al Discarded=0.00 cfs 0.004 af Primary=0.26 cfs 0.015 af Outflow=0.26 cfs 0.019 al
ubcatchment R-6: Roof - Units 11&12 - (B&A Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>2.87" Tc=6.0 min CN=98 Runoff=0.25 cfs 0.020 af	Pond UIS-7: UIS-7 Peak Elev=73.87' Storage=136 cf Inflow=0.25 cfs 0.020 al Discarded=0.00 cfs 0.004 af Primary=0.24 cfs 0.013 af Outflow=0.24 cfs 0.017 al
ubcatchment R-7: Roof - Units 13&14 - (A Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>2.87" Tc=6.0 min CN=98 Runoff=0.27 cfs 0.021 af	Pond UIS-8: UIS-8 Peak Elev=73.17' Storage=136 cf Inflow=0.25 cfs 0.020 al Discarded=0.00 cfs 0.004 af Primary=0.24 cfs 0.013 af Outflow=0.24 cfs 0.017 al
ubcatchment R-8: Roof - Units 15&16 - (B&A Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>2.87" Tc=6.0 min CN=98 Runoff=0.25 cfs 0.020 af	Pond UIS-9: UIS-9 Peak Elev=72.57' Storage=81 cf Inflow=0.27 cfs 0.021 al Discarded=0.00 cfs 0.004 af Primary=0.26 cfs 0.016 af Outflow=0.26 cfs 0.020 al
ubcatchment R-9: Roof - Units 17&18 - (A&B Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>2.87" Tc=6.0 min CN=98 Runoff=0.25 cfs 0.020 af	Total Runoff Area = 10.007 ac Runoff Volume = 0.628 af Average Runoff Depth = 0.75" 69.75% Pervious = 6.980 ac 30.25% Impervious = 3.027 ac
lnflow=0.01 cfs 0.006 af Outflow=0.01 cfs 0.006 af	
each SP-2: Large Wetland Area East Inflow=0.01 cfs 0.007 af Outflow=0.01 cfs 0.007 af	
leach SP-3: Large Wetland Area West Inflow=0.01 cfs 0.007 af Outflow=0.01 cfs 0.007 af	
Peak Elev=56.57' Inflow=0.01 cfs 0.006 af 12.0" Round Culvert n=0.011 L=51.0' S=0.0025 '/' Outflow=0.01 cfs 0.006 af	
ond D-1: Surface Infiltration Pond Peak Elev=68.76' Storage=7,349 cf Inflow=3.58 cfs 0.236 af Discarded=0.09 cfs 0.086 af Primary=0.00 cfs 0.000 af Outflow=0.09 cfs 0.086 af	

Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr 2-Year Rainfall=3.10"
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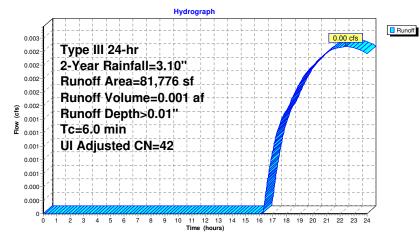
Summary for Subcatchment P-1: Northern Grassed Area to Wetlands

Runoff = 0.00 cfs @ 22.42 hrs, Volume= 0.001 af, Depth> 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

Ar	ea (sf)	CN	Adj	Desc	ription	
	36,287	30		Woo	ds, Good, H	HSG A
	10,782	70		Woo	ds, Good, ⊦	HSG C
	9,419	55		Woo	ds, Good, F	HSG B
:	22,149	39		>75%	6 Grass cov	ver, Good, HSG A
	1,287	98		Unco	nnected pa	avement, HSG A
	1,852	72		Dirt r	oads, HSG	i A
8	81,776	43	42	Weig	hted Avera	age, UI Adjusted
8	80,489			98.43	3% Perviou	s Area
	1,287			1.579	% Impervio	us Area
	1,287			100.0	00% Uncon	nected
	Length	Slope		locity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft	/sec)	(cfs)	
6.0						Direct Entry,

Subcatchment P-1: Northern Grassed Area to Wetlands



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	Summary for Subcatchment P-10: Area Around Isolated Wetland
Inoff	= 0.83 cfs @ 12.10 hrs, Volume= 0.062 af, Depth> 1.03"
	SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs -hr 2-Year Rainfall=3.10"
	a (sf) CN Adj Description
	2,304 98 Unconnected roofs, HSG A
	0,291 74 >75% Grass cover, Good, HSG C
	,595 76 75 Weighted Average, UI Adjusted 291 92.71% Pervious Area
2	2,304 7.29% Impervious Area
2	2,304 100.00% Unconnected
	ength Slope Velocity Capacity Description
(<u>min)</u> 6.0	(feet) (ft/ft) (ft/sec) (cfs) Direct Entry,
0.0	Direct Entry,
	Subcatchment P-10: Area Around Isolated Wetland
	Hydrograph
0.9	
0.85	
0.8	Type III 24-hr
0.75	2-Year Rainfall=3.10"
0.65	Runoff Area=31,595 sf
0.6	Runoff Volume=0.062 af
Llow (cls) 0.5	Runoff Depth>1.03"
0.45 0.4	Tc=6.0 min
0.35	UI Adjusted CN=75
0.3	
0.2	
0.15	
0.1	
0.1	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
1 /	
0.05	Time (hours)
0.05	Time (hours)
0.05	Time (hours)

Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr 2-Year Rainfall=3.10"
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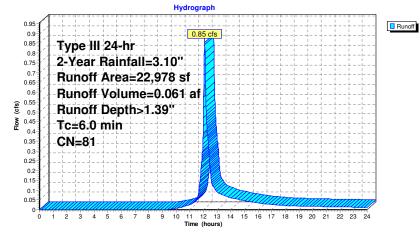
Summary for Subcatchment P-2: Existing Drive to Existing Basin

Runoff = 0.85 cfs @ 12.09 hrs, Volume= 0.061 af, Depth> 1.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

A	rea (sf)	CN	Description
	6,902	98	Unconnected pavement, HSG A
	1,353	76	Gravel roads, HSG A
	4,824	39	>75% Grass cover, Good, HSG A
	3,050	74	>75% Grass cover, Good, HSG C
	3,632	98	Unconnected pavement, HSG B
	3,217	98	Unconnected pavement, HSG C
	22,978	81	Weighted Average
	9,227		40.16% Pervious Area
	13,751		59.84% Impervious Area
	13,751		100.00% Unconnected
Tc	Length	Slop	
(min)	(feet)	(ft/ft	ft) (ft/sec) (cfs)
6.0			Direct Entry, Min. 6.0 TC
		5	Subcatchment P-2: Existing Drive to Existing Basin

Subcatchment P-2: Existing Drive to Existing Basin



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lydroCAI	D® 10.00-	18 s/n 0288	31 © 2016 HydroCAD Soft	ware Solutions LLC)	Page 12
	S	Summary	for Subcatchment P	3: Area Arour	nd Isolated We	tland
lunoff	=	0.01 cfs (@ 13.62 hrs, Volume=	0.006 at	, Depth> 0.11"	
			d, UH=SCS, Weighted-	CN, Time Span=	0.00-24.00 hrs, c	tt= 0.01 hrs
		'ear Rainfa				
Ar	rea (sf)	CN Ad				
	3,512 1,224	98 76	Unconnected pavem Gravel roads, HSG A			
	212	74	>75% Grass cover, C			
	2,166	70	Woods, Good, HSG			
	5,125	77	Woods, Good, HSG			
	14,867	30	Woods, Good, HSG			
	443 27,549	<u>39</u> 53 50	 >75% Grass cover, Q Weighted Average, L 			
	24.037	55 50	87.25% Pervious Are			
	3,512		12.75% Impervious A			
	3,512		100.00% Unconnecte	ed		
т.	L	01				
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity Capacity Des (ft/sec) (cfs)	scription		
6.0	(ieet)	(1011)		ect Entry,		
0.0			2	, <u>,</u> ,		
		C	ocatchment P-3: Area			
		Sui	Scatchinent F-S. Area	a Around Isola	ated Wetland	
		Sui	Hydrograp		ted Wetland	
					eted Wetland	
0.011			Hydrograp		ated Wetland	- + +
0.011 0.01 0.009		ype III 2	Hydrograp	h	ated Wetland	
0.01 0.009 0.009	, T	/pe III 2	Hydrograp 4-hr	h		
0.01 0.009	T)	vpe III 2 Year Ra	Hydrograf 4-hr ainfall=3.10°	h	ated Wetland	Bunoff
0.01 0.009 0.009 0.008 0.008 0.008	-T) 	vpe III 2 Year Ra unoff A	Hydrograf 4-hr ainfall=3.10" rea=27,549 sf	h		Bunoff
0.01 0.009 0.009 0.008 0.008	-T) T) 	vpe III 2 Year Ra unoff A	Hydrograf 4-hr ainfall=3.10°	h		
0.01 0.009 0.008 0.008 0.007 0.007 0.007		/pe III 2 Year Ra Jnoff A	Hydrograp 4-hr ainfall=3.10" rea=27,549 sf olume=0.006 af	h	tted Wetland	Bunoff Bunoff Comparison
0.01 0.009 0.008 0.007 0.007 0.007 0.006 9 0.006		vpe III 2 Year Ra unoff A unoff V unoff D	Hydrograp 4-hr ainfall=3.10" rea=27,549 sf olume=0.006 af epth>0.11"	h	tted Wetland	Bunoff
10.0 20.		/pe III 2 Year Ra unoff A unoff V unoff D :=6.0 m	Hydrograp 4-hr ainfall=3.10" rea=27,549 sf olume=0.006 af epth>0.11" in	h	ted Wetland	
0.01 0.009 0.009 0.008 0.007 0.007 0.007 0.007 0.006 0.006 0.009 0.009 0.004		/pe III 2 Year Ra unoff A unoff V unoff D :=6.0 m	Hydrograp 4-hr ainfall=3.10" rea=27,549 sf olume=0.006 af epth>0.11"	h		Runoff
10.0 20.		/pe III 2 Year Ra unoff A unoff V unoff D :=6.0 m	Hydrograp 4-hr ainfall=3.10" rea=27,549 sf olume=0.006 af epth>0.11" in	h	ted Wetland	Runoff
 10.0 200.0 2		/pe III 2 Year Ra unoff A unoff V unoff D :=6.0 m	Hydrograp 4-hr ainfall=3.10" rea=27,549 sf olume=0.006 af epth>0.11" in	h	ted Wetland	Runoff
10.0 200.0 300.0 300.0 300.0 300.0 300.0 300.0 300.0 300.0 300.0 400.0 400.0 5	-T) 2- Rı Rı R	/pe III 2 Year Ra unoff A unoff V unoff D :=6.0 m	Hydrograp 4-hr ainfall=3.10" rea=27,549 sf olume=0.006 af epth>0.11" in	h	ted Wetland	Runoff
10.0 20.	-T.) 2- RI RI RI - TC	/pe III 2 Year Ra unoff A unoff V unoff D :=6.0 m	Hydrograp 4-hr ainfall=3.10" rea=27,549 sf olume=0.006 af epth>0.11" in	h	ted Wetland	Bunoff

Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr 2-Year Rainfall=3.10"
Prepared by Microsoft	Printed 2/27/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC	Page 13

Summary for Subcatchment P-3A: Gravel Road to Detention Basin

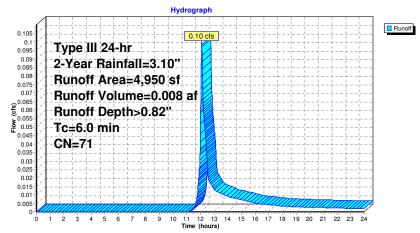
Page 13

Runoff = 0.10 cfs @ 12.10 hrs, Volume= 0.008 af, Depth> 0.82"

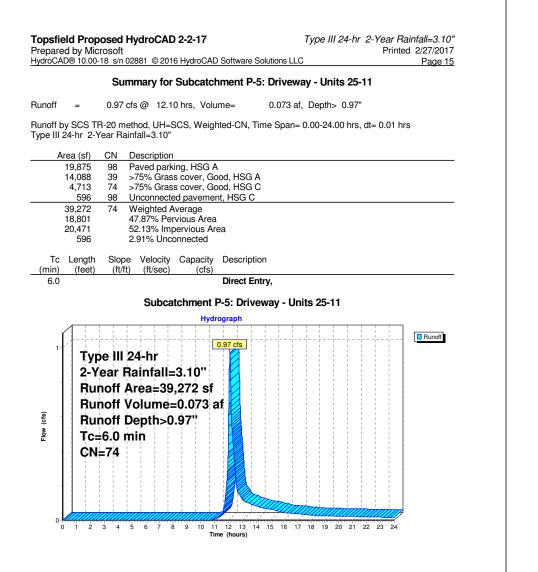
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

A	rea (sf)	CN	Description										
	1,552	98	Paved park	aved parking, HSG A									
	1,841	76	Gravel road	avel roads, HSG A									
	1,557	39	>75% Gras	5% Grass cover, Good, HSG A									
	4,950	71 Weighted Average											
	3,398		68.65% Pervious Area										
	1,552		31.35% Imp	pervious Are	ea								
Tc (min)	Length (feet)	Slop (ft/f	,	Capacity (cfs)	Description								
6.0					Direct Entry,								

Subcatchment P-3A: Gravel Road to Detention Basin



Prepared	by Microsoft	I HydroCAD t 1 02881 © 2010		Software So		51	4-hr 2-`		infall=3.10" 2/27/2017 Page 14
	Summa	ry for Subc	atchment	P-4: Slope	ed Entra	nce Drive	e - Unit	s 1-5	
Runoff	= 0.75	5 cfs @ 12.0	9 hrs, Volur	ne=	0.054 af,	Depth> 1	.32"		
Runoff by Type III 24	SCS TR-20 r -hr 2-Year R	method, UH=S Rainfall=3.10"	CS, Weigh	ted-CN, Tim	ie Span= (0.00-24.00	hrs, dt=	0.01 hr	5
Area	a (sf) CN	Description							
5	3,306985,234392,69974	Paved park >75% Grass >75% Grass	s cover, Goo						
21	1,239 80 7,933 3,306	Weighted A 37.35% Per 62.65% Imp	verage vious Area						
Tc L (min)	ength Slo (feet) (ft/	pe Velocity /ft) (ft/sec)	Capacity (cfs)	Descriptior	1				
6.0				Direct Entr	у,				
0.8 0.75 0.65 0.65 0.55 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.3 0.3 0.25 0.15 0.15	Type I 2-Year Runof Runof		Hydro =3.10" ,239 sf =0.054 a	Digraph 			s 1-5		Runoff
0-14	1 2 3 4	4 5 6 7 8		12 13 14 ne (hours)	15 16 17	18 19 20	21 22	23 24	



Topsfield Proposed HydroCAD 2-2-17 Type Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC	be III 24-hr 2-Year Rainfall=3.10" Printed 2/27/2017 Page 16
Summary for Subcatchment P-6: Pavement	Units 12-19
Runoff = 0.60 cfs @ 12.09 hrs, Volume= 0.044 af, De	pth> 1.20"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00 Type III 24-hr 2-Year Rainfall=3.10"	-24.00 hrs, dt= 0.01 hrs
Area (sf) CN Description	
11,455 98 Paved parking, HSG A	
7,682 49 50-75% Grass cover, Fair, HSG A 19,137 78 Weighted Average	
7,682 40.14% Pervious Area 11,455 59.86% Impervious Area	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	
6.0 Direct Entry,	
Subcatchment P-6: Pavement Units 1	2-19
Hydrograph	
0.65 0.6 0.5 0.5 0.5 0.4 0.4 0.4 0.35 0.4 0.4 0.35 0.4 0.4 0.35 0.4 0.4 0.4 0.5 0.4 0.4 0.35 0.4 0.35 0.4 0.35 0.4 0.4 0.4 0.4 0.4 0.4 0.5 0.5 0.4 0.4 0.4 0.4 0.4 0.4 0.4 0.4	Runoff

Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr 2-Year Rainfall=3.10"
Prepared by Microsoft	Printed 2/27/2017
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Summary for Subcatchment P-7: Driveway - Units 20-24

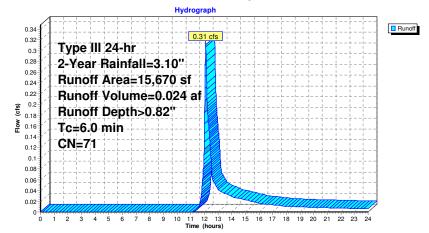
Page 17

Runoff = 0.31 cfs @ 12.10 hrs, Volume= 0.024 af, Depth> 0.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

vrea (sf)	CN	Description							
6,983	98	Paved park	ing, HSG A	N					
8,687	49	50-75% Gra	ass cover, F	Fair, HSG A					
15,670	71	Weighted A	verage						
8,687 55.44% Pervious Area									
6,983		44.56% Imp	pervious Are	ea					
Length (feet)			Capacity (cfs)	Description					
				Direct Entry,					
	6,983 8,687 15,670 8,687 6,983 Length	6,983 98 8,687 49 15,670 71 8,687 6,983 Length Slope	6,983 98 Paved park 8,687 49 50-75% Gra 15,670 71 Weighted A 8,687 55.44% Per 6,983 44.56% Imp Length Slope Velocity	6,98398Paved parking, HSG A8,6874950-75% Grass cover, F15,67071Weighted Average8,68755.44% Pervious Area6,98344.56% Impervious ArLengthSlopeVelocityCapacity					

Subcatchment P-7: Driveway - Units 20-24



droCAD®	y Microsoft 10.00-18 s/n		2016 H	ydroCA	D Softw	are Sol	utions I	LLC					d 2/27/201 Page 1
	Summ	ary for	Subca	tchm	ent P-8	3: Sur	face	Infilt	ratio	n Pon	d Are	ea	
noff =	= 0.00	cfs@2	1.26 hi	s, Vol	ume=		0.000	af, D	epth:	> 0.01			
	CS TR-20 m nr 2-Year Ra			s, Weig	hted-C	N, Tim	e Spa	n= 0.0	00-24	.00 hrs	, dt= ().01 hr:	S
Area	(sf) CN	Descrip	tion										
	072 98 235 39	Paved p >75% G				SG A							
15, 14,	307 43 235 072	Weighte 93.00% 7.00% I	ed Aver Pervio	age us Are	a								
Tc Le	ength Slop feet) (ft/f	e Veloo	city Ca	apacity (cfs)	Desc	ription							
6.0					Direc	ct Entr	у,						
		Subcat	chme	nt P-8	: Surfa	ace In	filtrat	tion F	ond	Area			
				Нус	Irograph	1							
0.001							L			L]		Runoff
0.001	Type I	II 24-h	r							0.00	cfs		
0.001	2-Year			10"		+							
0.001	Runof	1 1 1			i i	+					+- +-	- +	
0.000	Runof					<u>+</u>				i i 			
0.000	Runof					+		+	+		+-	- +	
0.000	Tc=6.0												
0.000	CN=43			·	 					 			
0.000						+			+		- +-	- +	
0.000		· - +		+		+			+				
											+-		
0								<u>, j</u>		ļ	<u> </u>	Ļ	
0	<u>,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</u>	1 5 6	7 8	9 10	11 12		15 16	17 1	8 19	20 21	22 2	3 24	
1	1 2 3 4				Time (hor	urs)							
0	1 2 3 4												
0	1234												

Topsfield Proposed HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 2-Year Rainfall=3.10" Printed 2/27/2017 Page 19

Summary for Subcatchment P-9: Woods/Grass Northwest Site to NW Wetlands

Walking path in woods described as "Dirt road," closest CN value in HydroCAD, actual material to be mulch, wood chips or packed earth

[45] Hint: Runoff=Zero

Runoff 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00" =

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

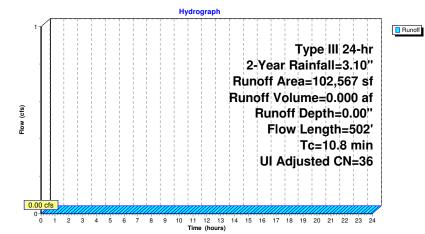
	A	rea (sf)	CN /	Adj Desc	cription								
		2,068	72	Dirt r	oads, HSG	A							
		40,086	39	>75%	6 Grass co	ver, Good, HSG A							
		357	74	>75%	6 Grass co	ver, Good, HSG C							
		53,082	30	Woo	oods, Good, HSG A								
	4,670 55 Woods, Good, HSG B												
	2,304 98 Unconnected pavement, HSG A												
		02,567	37			age, UI Adjusted							
	1	00,263			5% Perviou								
		2,304			% Impervio								
		2,304		100.0	00% Uncon	inected							
	Тс	Length	Slope	Velocity	Capacity	Description							
	(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	Description							
•	4.9	50	0.0300	0.17	(013)	Sheet Flow, A-B							
	4.5	50	0.0000	0.17		Grass: Short $n = 0.150$ P2= 3.10"							
	4.9	342	0.0280	1.17		Shallow Concentrated Flow, B-C							
		0.2				Short Grass Pasture Kv= 7.0 fps							
	1.0	110	0.1270	1.78		Shallow Concentrated Flow, C-D							
						Woodland Kv= 5.0 fps							
•													

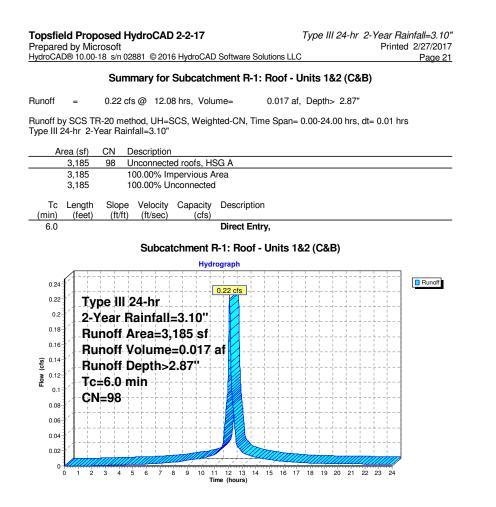
10.8 502 Total Topsfield Proposed HydroCAD 2-2-17 Type III 24-hr 2-Year Rainfall=3.10" Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC

Subcatchment P-9: Woods/Grass Northwest Site to NW Wetlands

Printed 2/27/2017

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												(、	Page 22
				Subcate			IU: R					•	nits)	
noff	=	0.27 cf	s@ 1	2.08 hrs	, Volu	me=		0.02	1 af,	Dept	h> 2	2.87"			
	y SCS TR-				Weigh	ted-C	N, Tir	ne Sp	an= ().00-2	4.00	hrs, d	= 0.0	01 hrs	s
pe III 2	24-hr 2-Ye	ar Rair	nfall=3.1	0"											
A			Descript												
	3,895			ected ro											
	3,895 3,895			Imperv Uncon		rea									
т.	,	0				D									
Tc min)	Length (feet)	Slope (ft/ft)	Veloc (ft/se		oacity (cfs)	Desc	criptio	n							
6.0				_/		Dire	ct Ent	ry,							
		c	ubcato	hment	P-10-	Boo	f _ 1 h	nite 1	08.2	n _ //	lln	ite)			
		5	ubcall	ment				111.5	302	0 - (r	, on	113)			
						ograph			-+			++-	-+		
0.3	 					0.27 cf	is i					11-			Runoff
	Тур	e III :	24-hr		-++-			+-	-+		!	++-	- + 	 	
0.26			lainf	all=3.	10"						!	++-		 	
0.26	2-Ye	ear F	unnu					1 1	1	1 1		1 1			
0.24 0.22	1 1 1			3,895	5-sf		1	11	- <u>-</u>		j	T T -			
0.24 0.22 0.2	Run	noff /	Area=	:3,895 ne=0.		āf			- + - +		i	7 - 7 - 7 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -			
0.24 0.22 0.2 0.2	Run	noff / noff \	Area= /olun	ne=0.	021 ส	āf			- +						
0.24 0.22 0.2 0.18 0.16	-Run Run Run	noff / noff \ noff [Area= /olun Depth	r 1	021 ส	āf									
0.24 0.22 0.2 0.18 0.16	Run Run Run Tc=	noff / noff \ noff [6.0 n	Area= /olun Depth	ne=0.	021 ส	==== āf ===============================									
0.24 0.22 0.2 0.18 0.16 0.16 0.14 0.12 0.1	-Run Run Run	noff / noff \ noff [6.0 n	Area= /olun Depth	ne=0.	021 ส										
0.24 0.22 0.2 0.18 0.16 0.14 0.12 0.1 0.08	Run Run Run Tc=	noff / noff \ noff [6.0 n	Area= /olun Depth	ne=0.	021 ส										
0.24 0.22 0.2 0.18 0.16 0.16 0.14 0.12 0.1	Run Run Run Tc=	noff / noff \ noff [6.0 n	Area= /olun Depth	ne=0.	021 ส	af									
0.24 0.22 0.2 0.18 0.16 0.14 0.12 0.1 0.08 0.06	Run Run Run Tc=	noff / noff \ noff [6.0 n	Area= /olun Depth	ne=0.	021 ส										
0.24 0.22 0.2 0.18 0.16 0.14 0.12 0.1 0.08 0.06 0.04 0.02 0	Run Run Tc= CN=	noff / noff \ noff [6.0 r =98	Area= /olun Depth	ne=0.	021 :									24	
0.24 0.22 0.2 0.18 0.16 0.14 0.12 0.1 0.08 0.06 0.04 0.02 0	Run Run Tc= CN=	noff / noff \ noff [6.0 n =98	Area= /olun Depth nin	ne=0.			13 14 13 14							24	

Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr 2-Year Rainfall=3.10"
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HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC	C Page 23

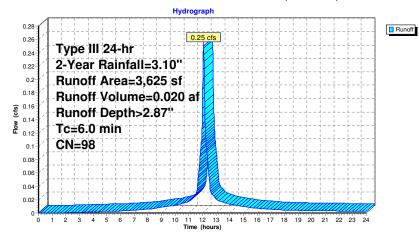
Summary for Subcatchment R-11: Roof - Units 21&22 - (A&B Units)

Runoff = 0.25 cfs @ 12.08 hrs, Volume= 0.020 af, Depth> 2.87"

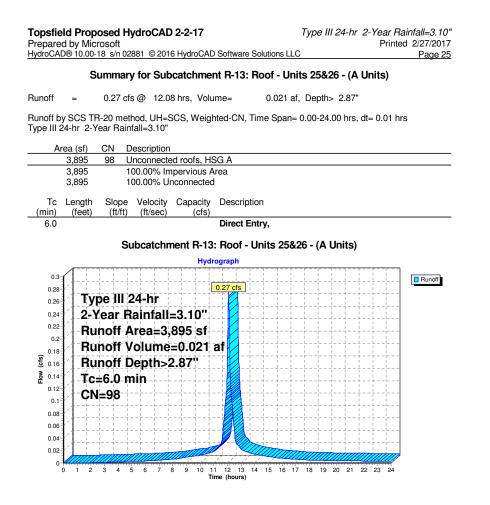
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

	A	ea (sf)	CN	Description									
		3,625	98	Unconnecte	ed roofs, HS	SG A							
		3,625		100.00% Impervious Area									
		3,625	100.00% Unconnected										
(m	Tc nin)	Length (feet)	Slope (ft/ft)		Capacity (cfs)	Description							
	6.0		(()	(/	Direct Entry,							

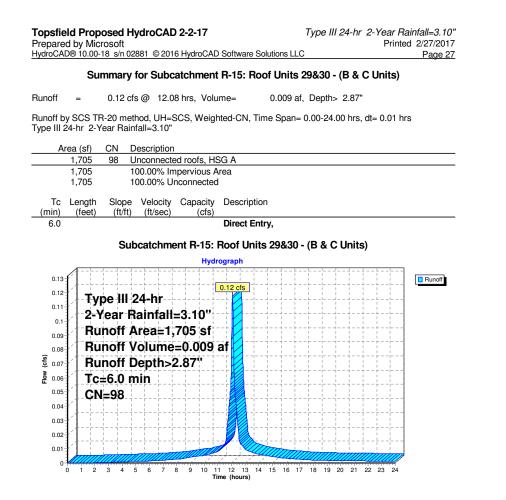
Subcatchment R-11: Roof - Units 21&22 - (A&B Units)



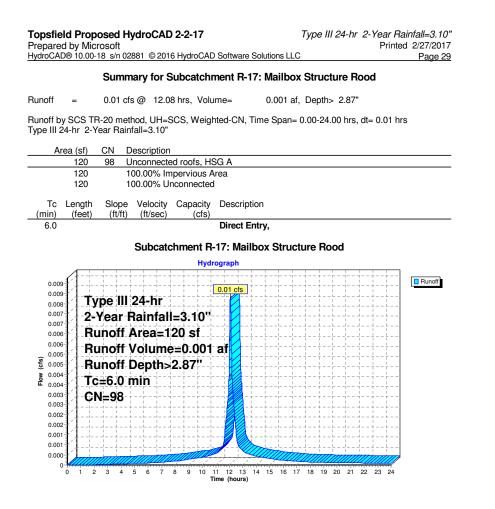
	Microsoft 0.00-18 s/n 028	81 ©2016	HydroCAD) Software	Solutio	ns LLC				Printe	d 2/27/2017 Page 24
	Summary	for Subc	atchme	nt R-12:	Roof	- Unite	23&	24 - (A	\ Uni	ts)	
Runoff =	0.27 cfs	@ 12.08	hrs, Volu	me=	0.0)21 af,	Depth	> 2.87			
Runoff by SC Type III 24-hr	S TR-20 meth 2-Year Rainfa	od, UH=SC all=3.10"	S, Weigł	nted-CN,	Time S	pan= 0	00-24	.00 hrs	, dt=	0.01 hı	S
Area (s		escription									
3,8		connected									
3,8		0.00% Imp									
3,89	95 10	0.00% Und	connected								
Tc Len			Capacity	Descrip	tion						
<u>(min)</u> (fe 6.0	eet) (ft/ft)	(ft/sec)	(cfs)	Direct E	ntry						
0.0				Billoot	y,						
	Sul	bcatchme	ent R-12	: Roof -	Units	23&24	- (A	Units))		
			Hydr	ograph							
0.22 0.2 0.18 (st) 0.16	Type III 2 2-Year Ra Runoff Ar Runoff D Runoff D Tc=6.0 m CN=98	ainfall= rea=3,8 olume= epth>2	3.10" 95 sf 0.021	0.27 cfs							Runoff
0	2 3 4 5	6 7 8	9 10 1		14 15	16 17	18 19	20 21	22 2	3 24	
			ті	me (hours)							



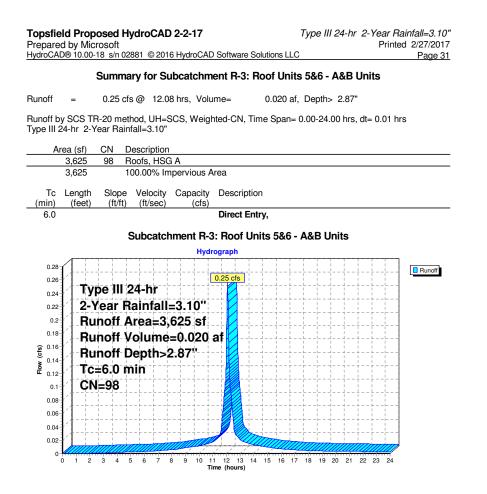
unoff = 0.25 cfs @ 12.08 hrs, Volume= 0.020 af, Depth> 2.87" unoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs ype III 24-hr 2-Year Rainfall=3.10" <u>Area (sf) CN Description</u> <u>3.625 98 Roofs, HSG A</u> <u>3.625 100.00% Impervious Area</u> <u>Tc Length Slope Velocity Capacity Description (min) (teet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-14: Roof Units 27&28 - A&B Units Hydrograph <u>U25 cfs</u> <u>CN Pear Rainfall=3.10"</u> <u>Runoff Area=3,625 sf</u> <u>Runoff Area=3,625 sf</u> <u>Runoff Area=3,625 sf</u> <u>Runoff Depth>2.87"</u> <u>Tc=6.0 min</u> <u>CN=98</u></u>		Summary fo	r Subcatchmer	nt R-14: Re	oof Units	3 27&28	3 - A&I	3 Unit	s	
Area (sf) CN Description 3,625 98 Roofs, HSG A 3,625 100.00% Impervious Area Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-14: Roof Units 27&28 - A&B Units Hydrograph 0.28 0.24 0.25 0.25 0.25 0.26 0.27 0.27 0.28 0.28 0.28 0.28 0.28 0.28 0.28 0.28 0.28 0.28 0.28 0.28 0.28 0.28 0.25 0.25 0.25 0.25 0.28 <t< td=""><td>lunoff</td><td>= 0.25 cfs @</td><td>12.08 hrs, Volu</td><td>me=</td><td>0.020 af</td><td>, Depth:</td><td>> 2.87"</td><td></td><td></td><td></td></t<>	lunoff	= 0.25 cfs @	12.08 hrs, Volu	me=	0.020 af	, Depth:	> 2.87"			
Area (sf) CN Description 3,625 98 Roofs, HSG A 3,625 100.00% Impervious Area Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sc) (cfs) 6.0 Direct Entry, Subcatchment R-14: Roof Units 27&28 - A&B Units Hydrograph 0.25 cfs 0.25 cfs 0.26 cfs 0.25 cfs 0.27 (ear Rainfall=3.10" Runoff Area=3,625 sf Runoff Depth>2.87" Tc=6.0 min 0.16 ch 0.16 ch 0.17 ch 0.16 ch 0.18 ch 0.04 ch 0.19 ch 0.02 ch 0.10 ch 0.02 ch 0.11 ch 0.02 ch 0.12 ch 0.				nted-CN, Tin	ne Span=	0.00-24	.00 hrs,	dt= 0.	01 hrs	3
3,625 98 Roofs, HSG A 3,625 100.00% Impervious Area Tc Length Slope Velocity Capacity Description (min) (fet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-14: Roof Units 27&28 - A&B Units Hydrograph 0.28 0.24 0.25 cfs 0.24 0.25 cfs 0.25 cfs Output for the second sec										
3,625 100.00% Impervious Area Tc Length Slope Velocity Capacity Description (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-14: Roof Units 27&28 - A&B Units Hydrograph 0.28 cfs 0.24 0.24 0.24 0.24 0.25 cfs 7ype III 24-hr 2-Year Rainfall=3.10" Runoff Area=3,625 sf Runoff Volume=0.020 af Runoff Depth>2.87" Tc=6.0 min CN=98	Ar									
Tc Length (feet) Slope (t/ft) (ft/sec) Capacity (cfs) Description (cfs) 6.0 Direct Entry, Subcatchment R-14: Roof Units 27&28 - A&B Units Image: Subcatchment R-14: Roof Units 27&28 - A&B Units Units 27&28 - A&B Units Image: Subcatchment R-14: Roof Units 27&28 - A&B Units Units 27&28 - A&B Units Image: Subcatchment R-14: Roof Units 27&28 - A&B Units Image: Subcatchment R-14: Roof Units 27&28 - A&B Units Image: Subcatchment R-14: Roof Units 27&28 - A&B Units Image: Subcatchment R-14: Roof Units 27&28 - A&B Units Image: Subcatchment R-14: Roof Units 27&28 - A&B Units Image: Subcatchment R-14: Roof Units 27&28 - A&B Units Image: Subcatchment R-14: Roof Units 27&28 - A&B Units Image: Subcatchment R-14: Roof Units 27&28 - A&B Units Image: Subcatchment R-14: Roof Units 27&28 - A&B Units Image: Subcatchment R-14: Roof Units 27&28 - A&B Units Image: Subcatchment R-14: Roof Units 27&28 - A&B Units Image: Subcatchment R-14: Roof Units 27&28 - A&B Units Image: Subcatchment R-14: Roof Units 27&28 - A&B Units Image: Subcatchment R		1		roa						
(min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-14: Roof Units 27&28 - A&B Units Hydrograph 0.28 0.26 0.28 0.25 cfs 0.24 0.25 cfs 0.29 0.29 0.16 0.14 0.16 0.14 0.16 0.14 0.16 0.14 0.16 0.14 0.16 0.14 0.16 0.14 0.16 0.14 0.16 0.14 0.17 Tc=6.0 min 0.08 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.04 0.05 0.04 0.06 0.04 0.07 0.04		5,025 100.0		lica						
6.0 Direct Entry, Subcatchment R-14: Roof Units 27&28 - A&B Units Hydrograph 0.28 0.24 0.24 0.29 0.10 0.29 0.10 0.10 0.29 0.10 0.020 0.10 0.020 0.10 0.020 0.00 0				Descriptio	n					
Subcatchment R-14: Roof Units 27&28 - A&B Units Hydrograph		(feet) (ft/ft) (f	t/sec) (cfs)	Direct Ent						
Hydrograph 0.28 0.26 0.25 cts 0.26 cts 0.27 0.28 cts	0.0			Direct Ent	y,					
0.28 0.26 0.25 cfs 0.24 Type III 24-hr 0.25 cfs 0.24 2-Year Rainfall=3.10" 0.25 cfs 0.29 Runoff Area=3,625 sf 0.20 af 0.16 Runoff Volume=0.020 af 0.287" 0.16 0.17 c=6.0 min CN=98 0.06 0.04 0.02		Subc	atchment R-14	: Roof Uni	ts 27&28	- A&B	Units			
0.26 0.25 cfs 0.24 Type III 24-hr 0.22 0.24 0.24 2-Year Rainfall=3.10" 0.25 Runoff Area=3,625 sf 0.16 Runoff Volume=0.020 af 0.16 Runoff Depth>2.87" 0.16 CN=98 0.06 0.04 0.08 0.06 0.04 0.02			Hydr	ograph						
	0.26 0.24 0.22 0.18 0.16 0.14 0.12 0.12 0.11 0.08 0.06 0.04 0.02	2-Year Rain Runoff Are Runoff Volu Runoff Dep Tc=6.0 min	hr nfall=3.10" a=3,625 sf ume=0.020 uth>2.87"							Runoff
				me (hours)						



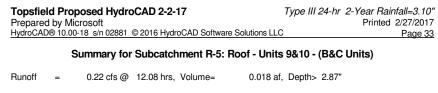
Topsfield Proposed HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LL	Type III 24-hr 2-Year Rainfall=3.10" Printed 2/27/2017 C Page 28
Summary for Subcatchment R-16: From	nt Units 29&30
Runoff = 0.10 cfs @ 12.08 hrs, Volume= 0.008 a	uf, Depth> 2.87"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= Type III 24-hr 2-Year Rainfall=3.10"	= 0.00-24.00 hrs, dt= 0.01 hrs
Area (sf) CN Description	
1,490 98 Unconnected roofs, HSG A	
1,490 100.00% Impervious Area 1,490 100.00% Unconnected	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	
6.0 Direct Entry,	
Subcatchment R-16: Front Units	s 29&30
Hydrograph	
0.115 0.10 0.09 0.05 0.09 0.05 0.09	T 16 19 20 21 22 23 24



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Summary for Subcatchment R-2: Roof Units 3	&4 - (B & C Units)
Runoff = 0.22 cfs @ 12.08 hrs, Volume= 0.018 af,	Depth> 2.87"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0 Type III 24-hr 2-Year Rainfall=3.10"	.00-24.00 hrs, dt= 0.01 hrs
Area (sf) CN Description	
3,195 98 Unconnected roofs, HSG A	
3,195 100.00% Impervious Area 3,195 100.00% Unconnected	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	
6.0 Direct Entry,	
Subcatchment R-2: Roof Units 3&4 - (E	& C Units)
Hydrograph	
0.24 0.22 0.22 0.22 0.18 0.16 0.16 0.16 0.16 0.16 Runoff Area=3,195 sf Runoff Volume=0.018 af Runoff Depth>2.87" Tc=6.0 min 0.08 0.08 0.08 0.09 0.19 0.19 0.19 0.10 0.19 0.10 0.19 0.10 0.12	
0 1 2 3 4 5 6 7 8 9 10 11 2 13 14 15 16 17 Time (hours)	18 19 20 21 22 23 24



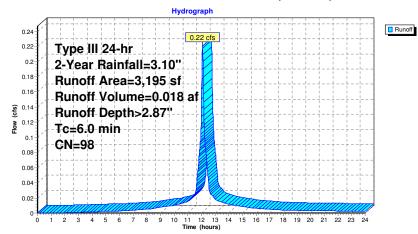
Summary	for Cubastabase							Page 32
	for Subcatchmer	nt R-4: Ro	of - Uni	ts 7&8 -	(A&B	Unit	s)	
noff = 0.25 cfs	@ 12.08 hrs, Volur	ne=	0.020 a	f, Depth	> 2.87	•		
noff by SCS TR-20 meth pe III 24-hr 2-Year Rainfa		ted-CN, Tir	ne Span=	= 0.00-24	.00 hrs	, dt= 0	.01 hr	S
Area (sf) CN De	escription							
	nconnected roofs, HS							
	0.00% Impervious Ar 0.00% Unconnected	ea						
Tc Length Slope (min) (feet) (ft/ft)	Velocity Capacity (ft/sec) (cfs)	Descriptio	n					
6.0		Direct Ent	ry,					
Su	bcatchment R-4:	Roof - Un	ite 78.8	- (A&R	(Inite)			
00		ograph	113 / 00		5111(3)			
0.2 0.18 0.16 0.14 0.12 0.14 0.12 0.14 0.12 0.14 CN=98 0.08 0.06 0.04 0.02 0.04 0.02 0.04 0.02 0.04 0.05 0.04 0.05 0.05 0.14 0.12 0.15 0.14 0.12 0.15 0.14 0.12 0.15 0.14 0.15 0.14 0.14 0.15 0.15	4-hr ainfall=3.10" rea=3,625 sf olume=0.020 a epth>2.87" in							Runoff
0 1 2 3 4 5	6 7 8 9 10 11 Tin	12 13 14 ne (hours)	15 16 1	7 18 19	20 21	22 23	24	



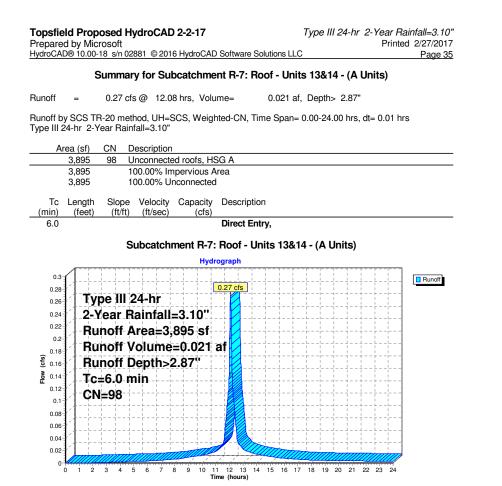
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

_	A	rea (sf)	CN E	Description		
		3,195	98 l	Inconnecte	ed roofs, HS	SG A
		3,195	1	00.00% Im	pervious A	vrea
		3,195	1	00.00% UI	nconnected	1
	Тс	Longth	Slope	Velocity	Capacity	Description
	(min)	Length (feet)	(ft/ft)	(ft/sec)	(cfs)	Description
-	6.0	(1001)	(1010)	(10000)	(0.0)	Direct Entry,

Subcatchment R-5: Roof - Units 9&10 - (B&C Units)



	c	nmary for Su	hoatohmor	+ D. 6. D.	oof - Uni	to 1191	2 /P		ite)	
	Sui						•		115)	
unoff	=	0.25 cfs @ 12	2.08 hrs, Vol	ume=	0.020	af, Dep	th> 2.8	7"		
		-20 method, UH		hted-CN,	Time Spa	n= 0.00-2	24.00 hr	s, dt=	0.01 h	rs
pe III	24-nr 2-Ye	ear Rainfall=3.1	U							
A		CN Descripti								
	3,625 3,625		cted roofs, H Impervious							
	3,625		Unconnecte							
Тс	Lenath	Slope Veloci	ty Capacity	Descrip	tion					
(min)	(feet)	(ft/ft) (ft/see		Descrip	lion					
6.0				Direct E	intry,					
		Subcatch	ment R-6:	Roof - Lli	nite 11&	12 - (B8	Δ I Init	c)		
		Cubcuton		rograph	110 110	12 (00		3)		
0.28									1	
0.20	1.4			0.25 cfs		+		$-\frac{1}{1}\frac{1}{1}$		Runoff
0.26						+				
0.26	1 Typ	e III 24-hr				1 I I		1 1		
	Тур	e III 24-hr ear Rainfa	ll=3.10"			+		-++	! - -	
0.24	Тур 2-Ү	ear Rainfa						- + + - + + - + +		
0.24 0.22	2-Y	ear Rainfa noff Area=	3,625 sf							
0.24 0.22 0.2 0.18	2-Y	ear Rainfa noff Area= noff Volum	3,625 sf ie=0.020	af						
0.24 0.22 0.2 0.18 0.16 0.14 0.14	2-Y Rur Rur Rur	ear Rainfa noff Area= noff Volum noff Depth	3,625 sf ie=0.020	af						
0.24 0.22 0.2 0.18 0.18 0.14 0.14 0.12	Rur Rur Rur Rur Tc=	ear Rainfa noff Area= noff Volum noff Depth 6.0 min	3,625 sf ie=0.020	af						
0.24 0.22 0.2 0.18 0.16 0.14 0.14 0.12 0.12	Typ 2-Y Rur Rur Rur Tc= CN:	ear Rainfa noff Area= noff Volum noff Depth 6.0 min	3,625 sf ie=0.020	af						
0.24 0.22 0.2 0.18 (cs) 0.14 0.12 0.12 0.12	Typ 2-Y Rur Rur Tc= CN	ear Rainfa noff Area= noff Volum noff Depth 6.0 min	3,625 sf ie=0.020	af						
22.0 2.2 2.0 31.0 (cts) 0.12 Lion 10.12 10.12 10.12 10.0 10.0 10.0 10.0 1	Typ 2-Y Rur Rur Rur Tc= CN	ear Rainfa noff Area= noff Volum noff Depth 6.0 min	3,625 sf ie=0.020	af						
0.24 0.22 0.2 0.18 (cs) 0.14 0.12 0.12 0.12	Typ 2-Y Rur Rur Rur Tc= CN	ear Rainfa noff Area= noff Volum noff Depth 6.0 min	3,625 sf ie=0.020	af						



Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr 2-Year Rainfall=3.10"
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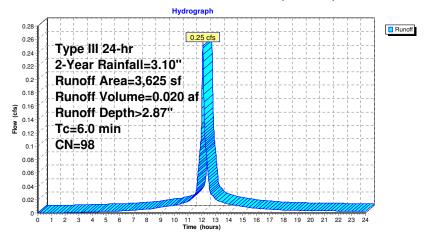
Summary for Subcatchment R-8: Roof - Units 15&16 - (B&A Units)

Runoff = 0.25 cfs @ 12.08 hrs, Volume= 0.020 af, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

A	rea (sf)	CN	Description				
	3,625	98	8 Unconnected roofs, HSG A				
	3,625		100.00% In	npervious A	Area		
	3,625		100.00% Ui	nconnected	b		
Тс	Length	Slope	Velocity	Capacity	Description		
(min)	(feet)	(ft/ft)		(cfs)			
6.0					Direct Entry,		

Subcatchment R-8: Roof - Units 15&16 - (B&A Units)





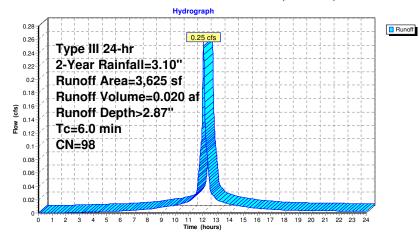
Summary for Subcatchment R-9: Roof - Units 17&18 - (A&B Units)

Runoff = 0.25 cfs @ 12.08 hrs, Volume= 0.020 af, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 2-Year Rainfall=3.10"

_	A	rea (sf)	CN	Description		
		3,625	98	Unconnecte	ed roofs, HS	SG A
		3,625		100.00% In	pervious A	rea
		3,625		100.00% U	nconnected	
	Tc (min)	Length	Slope		Capacity	Description
-	· /	(feet)	(ft/ft)	(ft/sec)	(cfs)	Direct Entry
-	6.0					Direct Entry,

Subcatchment R-9: Roof - Units 17&18 - (A&B Units)



Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr 2-Year Rainfall=3.10"
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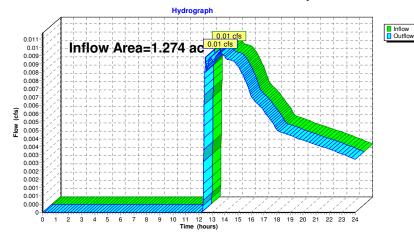
Summary for Reach SP-1: Wetlands South of Driveway

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

Inflow Area =	1.274 ac, 33.91% Impervious, Inflow	Depth > 0.05"	for 2-Year event
Inflow =	0.01 cfs @ 13.62 hrs, Volume=	0.006 af	
Outflow =	0.01 cfs @ 13.62 hrs, Volume=	0.006 af, Atte	en= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach SP-1: Wetlands South of Driveway



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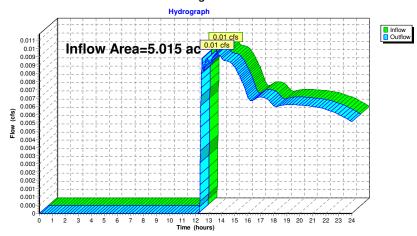
Summary for Reach SP-2: Large Wetland Area East

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

Inflow Area =	5.015 ac, 29.33% Impervious, Inflow Depth > 0.02" for 2-Year event
Inflow =	0.01 cfs @ 13.62 hrs, Volume= 0.007 af
Outflow =	0.01 cfs @ 13.62 hrs, Volume= 0.007 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



Reach SP-2: Large Wetland Area East

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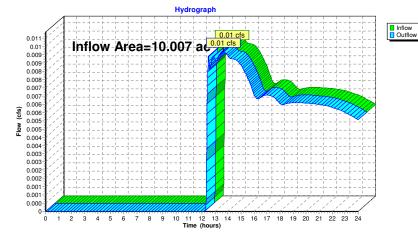
Summary for Reach SP-3: Large Wetland Area West

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

Inflow Area =	10.007 ac, 30.25% Impervious, Inflow	Depth > 0.01"	for 2-Year event
Inflow =	0.01 cfs @ 13.62 hrs, Volume=	0.007 af	
Outflow =	0.01 cfs @ 13.62 hrs, Volume=	0.007 af, Atte	en= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach SP-3: Large Wetland Area West



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Summary for Pond 3P: 12 Inch Culvert

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[57] Hint: Peaked at 56.57' (Flood elevation advised)

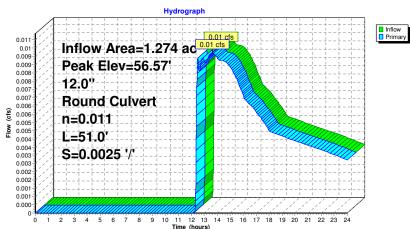
Inflow Area =	1.274 ac, 33.91% Impervious, Inflow Depth > 0.05" for 2-Year event	
Inflow =	0.01 cfs @ 13.62 hrs, Volume= 0.006 af	
Outflow =	0.01 cfs @ 13.62 hrs, Volume= 0.006 af, Atten= 0%, Lag= 0.0 min	
Primary =	0.01 cfs @ 13.62 hrs, Volume= 0.006 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 56.57' @ 13.62 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	56.51'	12.0" Round RCP_Round 12" L= 51.0' Ke= 0.200 Inlet / Outlet Invert= 56.51' / 56.38' S= 0.0025 '/ Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf
			· · · · · · · · · · · · · · · · · · ·

Primary OutFlow Max=0.01 cfs @ 13.62 hrs HW=56.57' (Free Discharge) 1=RCP_Round 12'' (Barrel Controls 0.01 cfs @ 0.70 fps)

Pond 3P: 12 Inch Culvert



Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr 2-Year Rainfall=3.10"
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Summary for Pond D-1: Surface Infiltration Pond

Inflow Area =	2.637 ac, 56.99% Impervious, Inflow D	epth > 1.07" for 2-Year event
Inflow =	3.58 cfs @ 12.10 hrs, Volume=	0.236 af
Outflow =	0.09 cfs @ 17.35 hrs, Volume=	0.086 af, Atten= 98%, Lag= 315.0 min
Discarded =	0.09 cfs @ 17.35 hrs, Volume=	0.086 af
Primary =	0.00 cfs @ 0.00 hrs, Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 68.76' @ 17.35 hrs Surf.Area= 3,625 sf Storage= 7,349 cf Flood Elev= 70.00' Surf.Area= 4,583 sf Storage= 12,420 cf

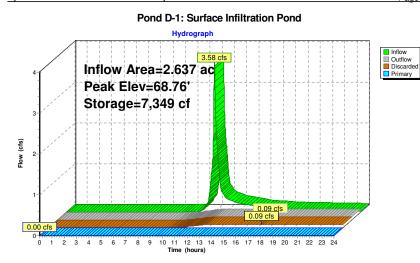
Plug-Flow detention time= 352.4 min calculated for 0.086 af (36% of inflow) Center-of-Mass det. time= 241.3 min (1,068.4 - 827.1)

Volume	Invert	Avail.Sto	rage	Storage	Description	
#1	66.00	56,2	33 cf	Custom	Stage Data (Pris	smatic) Listed below (Recalc)
Elevatio	-	urf.Area		.Store c-feet)	Cum.Store (cubic-feet)	
(fee 66.0		(sq-ft)	(Cubi	0	<i>L</i>	
67.0		1,817 2,361		2,089	0	
					2,089	
68.0		3,059		2,710	4,799	
69.0		3,800		3,430	8,229	
70.0		4,583		4,192	12,420	
71.0	00	5,403		4,993	17,413	
72.0	00	6,280		5,842	23,255	
73.0	00	7,213		6,747	30,001	
74.0	00	8,202		7,708	37,709	
75.0	00	9.248		8.725	46,434	
76.0	00	10,350		9,799	56,233	
Device	Routing	Invert	Outl	et Device	s	
#1	Discarded	66.00'	1.02	0 in/hr Ex	filtration over S	urface area
#2	Primary	70.10'	18.0	" Round	Culvert L= 234	.0' Ke= 0.200
						7.00' S= 0.0132 '/' Cc= 0.900
						both interior, Flow Area= 1.77 sf
			= 0		agaioa r E, sint	

Discarded OutFlow Max=0.09 cfs @ 17.35 hrs HW=68.76' (Free Discharge) 1=Exfiltration (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=66.00' (Free Discharge) 2=Culvert (Controls 0.00 cfs)

Type III 24-hr 2-Year Rainfall=3.10" Printed 2/27/2017 Page 43



Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr 2-Year Rainfall=3.10"
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Summary for Pond D-2: Existing Detention Basin

Inflow Area =	0.528 ac, 59.84% Impervious, Inflow Depth > 1.39" for 2-Year event
Inflow =	0.85 cfs @ 12.09 hrs, Volume= 0.061 af
Outflow =	0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary =	0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 58.06' @ 24.00 hrs Surf.Area= 3,090 sf Storage= 2,660 cf Flood Elev= 58.08' Surf.Area= 3,090 sf Storage= 2,719 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow) Center-of-Mass det. time= (not calculated: no outflow)

Volume	Inv	ert Avail.Sto	orage Storage	Description	
#1	57.2	20' 9,0	20 cf Custom	Stage Data (Prismatic) Listed below (Recalc)	
Elevatio	on	Surf.Area	Inc.Store	Cum.Store	
(fee	et)	(sq-ft)	(cubic-feet)	(cubic-feet)	
57.2	20	3,090	0	0	
58.0	00	3,090	2,472	2,472	
59.0	00	3,090	3,090	5,562	
59.4	10	3,550	1,328	6,890	
60.0	00	3,550	2,130	9,020	
Device	Routing	Invert	Outlet Device	25	
#1	Primary	58.08'	4.0" Vert. Orifice/Grate C= 0.600		
#2	Primary	58.80'	8.0" Vert. Orif	fice/Grate C= 0.600	

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=57.20' (Free Discharge) 1=Orifice/Grate (Controls 0.00 cfs) 2=Orifice/Grate (Controls 0.00 cfs)

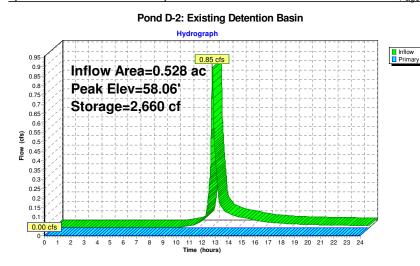
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 Type III 24-hr
 2-Year Rainfall=3.10"

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Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr 2-Year Rainfall=3.10"
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Summary for Pond D-3: Detention Pond by Access Road

Inflow Area =	0.114 ac, 31.35% Impervious, Inflow D	epth > 0.82" for 2-Year event
Inflow =	0.10 cfs @ 12.10 hrs, Volume=	0.008 af
Outflow =	0.02 cfs @ 12.58 hrs, Volume=	0.008 af, Atten= 78%, Lag= 28.7 min
Discarded =	0.02 cfs @ 12.58 hrs, Volume=	0.008 af
Primary =	0.00 cfs @ 0.00 hrs, Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 63.24' @ 12.58 hrs Surf.Area= 386 sf Storage= 81 cf

Plug-Flow detention time= 26.9 min calculated for 0.008 af (100% of inflow) Center-of-Mass det. time= 26.3 min (899.9 - 873.6)

Volume	Inver	t Avail.Stor	age Storag	ge Description
#1	63.00	l' 47	8 cf Custo	m Stage Data (Prismatic) Listed below (Recalc)
Elevatio	n S	urf.Area	Inc.Store	Cum.Store
(fee	t)	(sq-ft)	(cubic-feet)	(cubic-feet)
63.0	0	305	0	0
64.0	0	650	478	478
Device	Routing	Invert	Outlet Devic	ces
#1	Primary	64.00'	5.0' long x	5.0' breadth Broad-Crested Rectangular Weir
			Head (feet)	0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00
			2.50 3.00 3	3.50 4.00 4.50 5.00 5.50
			Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2	ish) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65
			2.67 2.66 2	2.68 2.70 2.74 2.79 2.88
#2	Discarded	63.00'	2.410 in/hr l	Exfiltration over Horizontal area

Discarded OutFlow Max=0.02 cfs @ 12.58 hrs HW=63.24' (Free Discharge) **12=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=63.00' (Free Discharge)

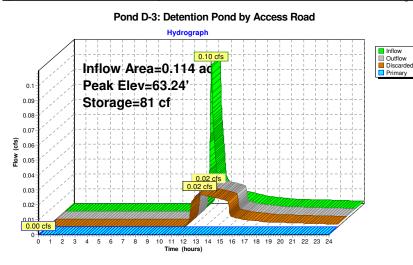
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 2-Year Rainfall=3.10"

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Summary for Pond UIS-1: UIS at Entrance

Inflow Area =	1.480 ac, 42.24% Impervious, Inflow	<pre>/ Depth > 1.46" for 2-Year event</pre>
Inflow =	2.38 cfs @ 12.09 hrs, Volume=	0.179 af
Outflow =	0.08 cfs @ 11.28 hrs, Volume=	0.100 af, Atten= 97%, Lag= 0.0 min
Discarded =	0.08 cfs @ 11.28 hrs, Volume=	0.100 af
Primary =	0.00 cfs @ 0.00 hrs, Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 62.02' @ 16.38 hrs Surf.Area= 3,486 sf Storage= 4,431 cf Flood Elev= 68.40' Surf.Area= 3,486 sf Storage= 13,981 cf

Plug-Flow detention time= 293.3 min calculated for 0.100 af (55% of inflow) Center-of-Mass det. time= 172.2 min (990.5 - 818.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	60.00'	5,786 cf	50.50'W x 69.03'L x 6.50'H Field A
			22,660 cf Overall - 8,195 cf Embedded = 14,465 cf x 40.0% Voids
#2A	61.00'	8,195 cf	Cultec R-902HD x 126 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
			7 Rows of 18 Chambers
			Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf
		12 091 of	Total Available Storage

13,981 cf Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices	
#1	Discarded	60.00'	1.020 in/hr Exfiltration over Surface	ce area
#2	Primary	68.40'	24.0" x 24.0" Horiz. Orifice/Grate	C= 0.600
	-		Limited to weir flow at low heads	

Discarded OutFlow Max=0.08 cfs @ 11.28 hrs HW=60.08' (Free Discharge)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=60.00' (Free Discharge)

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Pond UIS-1: UIS at Entrance - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)

Effective Size= $69.8"W \times 48.0"H \Rightarrow 17.65 \text{ sf } \times 3.67L = 64.7 \text{ cf}$ Overall Size= $78.0"W \times 48.0"H \times 4.10'L \text{ with } 0.44' \text{ Overlap}$ Cap Storage= $+2.8 \text{ cf } \times 2 \times 7 \text{ rows} = 38.6 \text{ cf}$

78.0" Wide + 6.0" Spacing = 84.0" C-C Row Spacing

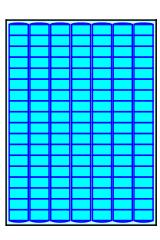
18 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 67.03' Row Length +12.0" End Stone x 2 = 69.03' Base Length 7 Rows x 78.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 50.50' Base Width 12.0" Base + 48.0" Chamber Height + 18.0" Cover = 6.50' Field Height

126 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 7 Rows = 8,195.3 cf Chamber Storage

22,660.2 cf Field - 8,195.3 cf Chambers = 14,464.9 cf Stone x 40.0% Voids = 5,786.0 cf Stone Storage

Chamber Storage + Stone Storage = 13,981.2 cf = 0.321 af Overall Storage Efficiency = 61.7%Overall System Size = $69.03' \times 50.50' \times 6.50'$

126 Chambers 839.3 cy Field 535.7 cy Stone



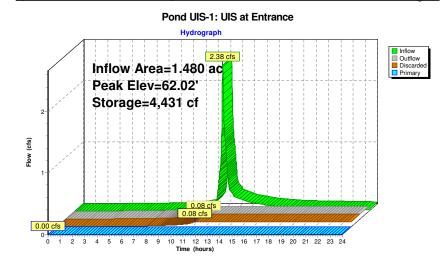


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Summary for Pond UIS-2: UIS at North of Site

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Inflow Area =	0.384 ac,100.00% Impervious, Inflow D	Depth > 2.87" for 2-Year event
Inflow =	1.16 cfs @ 12.08 hrs, Volume=	0.092 af
Outflow =	0.23 cfs @ 11.72 hrs, Volume=	0.092 af, Atten= 81%, Lag= 0.0 min
Discarded =	0.23 cfs @ 11.72 hrs, Volume=	0.092 af
Primary =	0.00 cfs @ 0.00 hrs, Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 63.00' @ 12.51 hrs Surf.Area= 1,176 sf Storage= 956 cf Flood Elev= 68.25' Surf.Area= 1,176 sf Storage= 2,860 cf

Plug-Flow detention time= 22.6 min calculated for 0.092 af (100% of inflow) Center-of-Mass det. time= 22.3 min (778.8 - 756.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	61.50'	1,262 cf	16.00'W x 73.50'L x 4.04'H Field A
			4,753 cf Overall - 1,598 cf Embedded = 3,155 cf x 40.0% Voids
#2A	62.50'	1,598 cf	Cultec R-330XLHD x 30 Inside #1
			Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
			Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
			Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
		2,860 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	61.50'	8.270 in/hr Exfiltration over Surface area
#2	Primary	68.25'	6.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.23 cfs @ 11.72 hrs HW=61.57' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.23 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=61.50' (Free Discharge) 2=Orifice/Grate (Controls 0.00 cfs)

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Pond UIS-2: UIS at North of Site - Chamber Wizard Field A

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Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

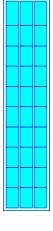
10 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 71.50' Row Length +12.0" End Stone x 2 = 73.50' Base Length 3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width 12.0" Base + 30.5" Chamber Height + 6.0" Cover = 4.04' Field Height

30 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 3 Rows = 1,598.2 cf Chamber Storage

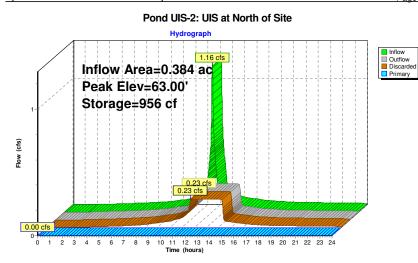
4,753.0 cf Field - 1,598.2 cf Chambers = 3,154.8 cf Stone x 40.0% Voids = 1,261.9 cf Stone Storage

Chamber Storage + Stone Storage = 2,860.1 cf = 0.066 af Overall Storage Efficiency = 60.2% Overall System Size = 73.50' x 16.00' x 4.04'

30 Chambers 176.0 cy Field 116.8 cy Stone



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Summary for Pond UIS-3: UIS-3

[58] Hint: Peaked 1.46' above defined flood level

Inflow Area =	0.083 ac,100.00% Impervious, Inflow D	epth > 2.87" for 2-Year event
Inflow =	0.25 cfs @ 12.08 hrs, Volume=	0.020 af
Outflow =	0.25 cfs @ 12.10 hrs, Volume=	0.017 af, Atten= 1%, Lag= 0.7 min
Discarded =	0.00 cfs @ 5.30 hrs, Volume=	0.004 af
Primary =	0.25 cfs @ 12.10 hrs, Volume=	0.013 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 73.67' @ 12.10 hrs Surf.Area= 103 sf Storage= 130 cf Flood Elev= 72.21' Surf.Area= 103 sf Storage= 22 cf

Plug-Flow detention time= 87.7 min calculated for 0.017 af (87% of inflow) Center-of-Mass det. time= 29.7 min (786.3 - 756.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	71.69'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
			332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	72.19'	97 cf	Cultec R-280HD x 2 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	71.69'	1.020 in/hr Exfiltration over Surface area
#2	Primary	73.40'	6.0" Round Culvert L= 30.0' Ke= 0.200 Inlet / Outlet Invert= 73.40' / 70.70' S= 0.0900 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.00 cfs @ 5.30 hrs HW=71.72' (Free Discharge) 1=Exfiltration (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.24 cfs @ 12.10 hrs HW=73.67' (Free Discharge) -2=Culvert (Inlet Controls 0.24 cfs @ 2.23 fps)

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Pond UIS-3: UIS-3 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

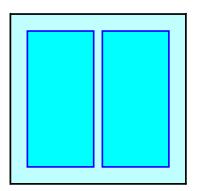
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

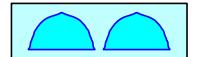
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

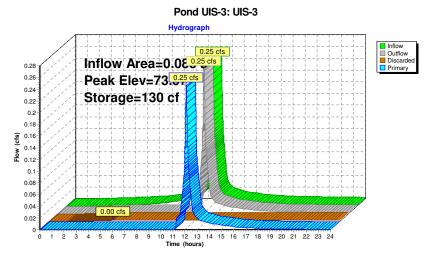
Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

2 Chambers 12.3 cy Field 8.7 cy Stone









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Summary for Pond UIS-4: UIS-4

[58] Hint: Peaked 0.35' above defined flood level

Inflow Area =	0.073 ac,100.00% Impervious, Inflow Depth > 2.87" for 2-Year event
Inflow =	0.22 cfs @ 12.08 hrs, Volume= 0.018 af
Outflow =	0.22 cfs @ 12.10 hrs, Volume= 0.015 af, Atten= 2%, Lag= 1.1 min
Discarded =	0.00 cfs @ 5.85 hrs, Volume= 0.004 af
Primary =	0.21 cfs @ 12.10 hrs, Volume= 0.011 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 74.55' @ 12.10 hrs Surf.Area= 103 sf Storage= 134 cf Flood Elev= 74.20' Surf.Area= 103 sf Storage= 111 cf

Plug-Flow detention time= 94.4 min calculated for 0.015 af (86% of inflow) Center-of-Mass det. time= 32.3 min (788.8 - 756.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	72.50'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
			332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	73.00'	97 cf	Cultec R-280HD x 2 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	72.50'	1.020 in/hr Exfiltration over Surface area
#2	Primary	74.20'	

Discarded OutFlow Max=0.00 cfs @ 5.85 hrs HW=72.53' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.21 cfs @ 12.10 hrs HW=74.55' (Free Discharge) -2=Culvert (Barrel Controls 0.21 cfs @ 2.01 fps)

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Pond UIS-4: UIS-4 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

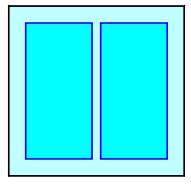
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

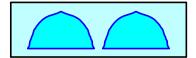
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

2 Chambers 12.3 cy Field 8.7 cy Stone

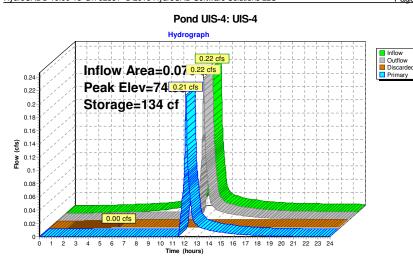




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Topsfield Proposed HydroCAD 2-2-17 Type III 24-hr 2-Year Rainfall=3.10" Prepared by Microsoft Printed 2/27/2017 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 60 Summary for Pond UIS-5: UIS-5 Inflow Area = 0.083 ac,100.00% Impervious, Inflow Depth > 2.87" for 2-Year event Inflow = 0.25 cfs @ 12.08 hrs, Volume= 0.020 af 0.017 af, Atten= 2%, Lag= 1.0 min 0.24 cfs @ 12.10 hrs, Volume= Outflow = Discarded = 0.00 cfs @ 5.30 hrs, Volume= 0.004 af Primary = 0.24 cfs @ 12.10 hrs, Volume= 0.013 af Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 75.17' @ 12.10 hrs Surf.Area= 103 sf Storage= 136 cf Plug-Flow detention time= 88.8 min calculated for 0.017 af (87% of inflow) Center-of-Mass det. time= 30.6 min (787.1 - 756.5) Volume Invert Avail.Storage Storage Description #1A 94 cf 10.33'W x 10.00'L x 3.21'H Field A 73.09' 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids #2A 97 cf Cultec R-280HD x 2 Inside #1 73.59' Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows 191 cf Total Available Storage Storage Group A created with Chamber Wizard Device Routing Invert Outlet Devices #1 Discarded 73.09' 1.020 in/hr Exfiltration over Surface area 74.80' 6.0" Round Culvert L= 22.0' Ke= 1.000 #2 Primary Inlet / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 n= 0.011 PVC, smooth interior. Flow Area= 0.20 sf Discarded OutFlow Max=0.00 cfs @ 5.30 hrs HW=73.12' (Free Discharge) 1=Exfiltration (Exfiltration Controls 0.00 cfs) Primary OutFlow Max=0.24 cfs @ 12.10 hrs HW=75.17' (Free Discharge) -2=Culvert (Inlet Controls 0.24 cfs @ 1.55 fps)

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Pond UIS-5: UIS-5 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

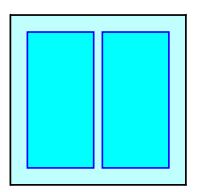
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

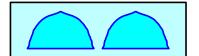
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

2 Chambers 12.3 cy Field 8.7 cy Stone

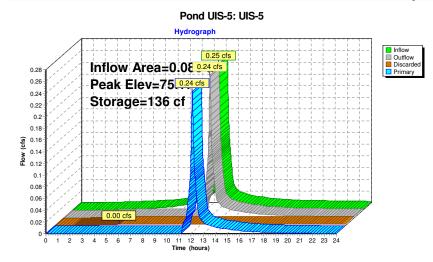




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		Sur	nmary for Pond UIS-6): UIS-6
Inflow Are				> 2.87" for 2-Year event
Inflow		7 cfs @ 12.08 h		21 af
Outflow		8 cfs @ 12.10 h		19 af, Atten= 2%, Lag= 1.0 min
Discardec Primary		10 cfs @ 5.03 h 26 cfs @ 12.10 h		04 af 15 af
	0.2			
			= 0.00-24.00 hrs, dt= 0.0 rea= 103 sf Storage= 13	
	- / 1.00 @			
Plug-Flow	I detention tir	ne= 85.5 min cal	culated for 0.019 af (88%	of inflow)
		ne= 85.5 min cal ne= 30.0 min (78		of inflow)
Center-of	-Mass det. tir	me= 30.0 min (78	36.5 - 756.5)	of inflow)
Center-of	-Mass det. tir Invert	me= 30.0 min (78	36.5 - 756.5) Storage Description	,
Center-of	-Mass det. tir	me= 30.0 min (78	36.5 - 756.5) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'	'H Field A
Center-of <u>Volume</u> #1A	-Mass det. tir Invert 72.29'	ne= 30.0 min (78 <u>Avail.Storage</u> 94 cf	36.5 - 756.5) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21' 332 cf Overall - 97 cf Em	' H Field A nbedded = 234 cf x 40.0% Voids
Center-of	-Mass det. tir Invert	ne= 30.0 min (78 <u>Avail.Storage</u> 94 cf	86.5 - 756.5) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21' 332 cf Overall - 97 cf Err Cultec R-280HD x 2 Ins	'H Field A nbedded = 234 cf x 40.0% Voids side #1
Center-of <u>Volume</u> #1A	-Mass det. tir Invert 72.29'	ne= 30.0 min (78 <u>Avail.Storage</u> 94 cf	86.5 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21' 332 cf Overall - 97 cf Em Cultec R-280HD x 2 Ins Effective Size= 46.9''W >	'H Field A nbedded = 234 cf x 40.0% Voids side #1 x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
Center-of <u>Volume</u> #1A	-Mass det. tir Invert 72.29'	ne= 30.0 min (78 <u>Avail.Storage</u> 94 cf	86.5 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21' 332 cf Overall - 97 cf Em Cultec R-280HD x 2 Ins Effective Size= 46.9'W x Overall Size= 47.0''W x 3	'H Field A hbedded = 234 cf x 40.0% Voids side #1 x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 26.5"H x 8.00'L with 1.00' Overlap
Center-of <u>Volume</u> #1A	-Mass det. tir Invert 72.29'	ne= 30.0 min (78 <u>Avail.Storage</u> 94 cf 97 cf	36.5 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21' 332 cf Overall - 97 cf Em Cultec R-280HD x 2 Ins Effective Size= 46.9'W > Overall Size= 47.0'W x 2 Row Length Adjustments	'H Field A nbedded = 234 cf x 40.0% Voids side #1 x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
Center-of <u>Volume</u> #1A	-Mass det. tir Invert 72.29'	ne= 30.0 min (78 <u>Avail.Storage</u> 94 cf 97 cf	86.5 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21' 332 cf Overall - 97 cf Em Cultec R-280HD x 2 Ins Effective Size= 46.9'W x Overall Size= 47.0''W x 3	'H Field A hbedded = 234 cf x 40.0% Voids side #1 x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 26.5"H x 8.00'L with 1.00' Overlap
Center-of Volume #1A #2A	-Mass det. tir 172.29' 72.79'	ne= 30.0 min (78 <u>Avail.Storage</u> 94 cf 97 cf	Storage Description 10.33'W x 10.00'L x 3.21' 332 cf Overall - 97 cf En Cultec R-280HD x 2 Ins Effective Size= 46.9'W x Overall Size= 47.0'W x x Row Length Adjustments Total Available Storage	'H Field A hbedded = 234 cf x 40.0% Voids side #1 x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 26.5"H x 8.00'L with 1.00' Overlap
Center-of- Volume #1A #2A Storag	-Mass det. tir Invert 72.29' 72.79' e Group A cr	ne= 30.0 min (78 Avail.Storage 94 cf 97 cf 191 cf reated with Cham	36.5 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21' 332 cf Overall - 97 cf Em Cultec R-280HD x 2 Ins Effective Size= 46.9'W x Overall Size= 47.0'W x 2 Row Length Adjustments Total Available Storage ber Wizard	'H Field A hbedded = 234 cf x 40.0% Voids side #1 x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 26.5"H x 8.00'L with 1.00' Overlap
Center-of Volume #1A #2A Storag Device	-Mass det. tir Invert 72.29' 72.79' e Group A cr Routing	ne= 30.0 min (78 Avail.Storage 94 cf 97 cf 191 cf reated with Cham Invert Outl	36.5 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21' 332 cf Overall - 97 cf Err Cultec R-280HD x 2 Ins Effective Size= 46.9''W x Overall Size= 47.0''W x 2 Row Length Adjustment Total Available Storage ber Wizard et Devices	'H Field A hbedded = 234 cf x 40.0% Voids side #1 x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 26.5"H x 8.00'L with 1.00' Overlap = +1.00' x 6.07 sf x 2 rows
Center-of- #1A #2A Storag Device #1	-Mass det. tir Invert 72.29' 72.79' e Group A cr Routing Discarded	ne= 30.0 min (78 <u>Avail.Storage</u> 94 cf 97 cf 191 cf reated with Cham <u>Invert</u> Outl 72.29' 1.02	36.5 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21' 332 cf Overall - 97 cf Em Cultec R-280HD x 2 Ins Effective Size= 46.9''W x Overall Size= 47.0''W x 2 Row Length Adjustments Total Available Storage ber Wizard et Devices 0 in/hr Exfiltration over S	'H Field A hbedded = 234 cf x 40.0% Voids side #1 x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 26.5"H x 8.00'L with 1.00' Overlap = +1.00' x 6.07 sf x 2 rows Surface area
Center-of- #1A #2A Storag Device #1	-Mass det. tir Invert 72.29' 72.79' e Group A cr Routing	ne= 30.0 min (78 <u>Avail.Storage</u> 94 cf 97 cf 191 cf reated with Cham <u>Invert Outl</u> 72.29' 1.02 74.00' 6.0"	Storage Description 10.33'W x 10.00'L x 3.21' 332 cf Overall - 97 cf En Cultec R-280HD x 2 Ins Effective Size= 46.9'W y Overall Size= 47.0'W x 2 Row Length Adjustments Total Available Storage ber Wizard et Devices 0 in/hr Exfiltration over S Round Culvert L= 106.	'H Field A hbedded = 234 cf x 40.0% Voids side #1 x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 26.5"H x 8.00'L with 1.00' Overlap = +1.00' x 6.07 sf x 2 rows Surface area .0' Ke= 1.000
Center-of- #1A #2A Storag Device #1	-Mass det. tir Invert 72.29' 72.79' e Group A cr Routing Discarded	ne= 30.0 min (78 Avail.Storage 94 cf 97 cf 191 cf reated with Cham Invert Outl 72.29' 1.02 74.00' 6.0"	Storage Description 10.33'W x 10.00'L x 3.21' 332 cf Overall - 97 cf En Cultec R-280HD x 2 Ins Effective Size= 46.9'W y Overall Size= 47.0'W x 2 Row Length Adjustments Total Available Storage ber Wizard et Devices 0 in/hr Exfiltration over S Round Culvert L= 106.	'H Field A hbedded = 234 cf x 40.0% Voids side #1 x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 26.5"H x 8.00'L with 1.00' Overlap = +1.00' x 6.07 sf x 2 rows Surface area .0' Ke= 1.000 2.18' S= 0.0172 '/ Cc= 0.900

Discarded OutFlow Max=0.00 cfs @ 5.03 hrs HW=72.32' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.26 cfs @ 12.10 hrs HW=74.39' (Free Discharge) -2=Culvert (Inlet Controls 0.26 cfs @ 1.59 fps)
 Topsfield Proposed HydroCAD 2-2-17
 Type I

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Pond UIS-6: UIS-6 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

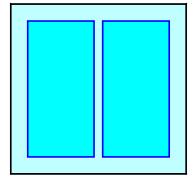
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

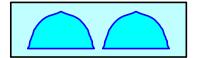
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 afOverall Storage Efficiency = 57.6%Overall System Size = $10.00' \times 10.33' \times 3.21'$

2 Chambers 12.3 cy Field 8.7 cy Stone

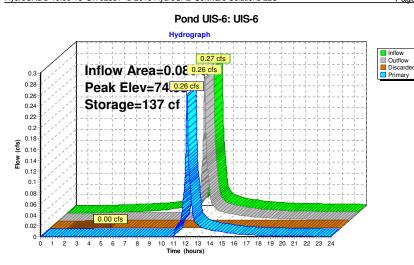




 Type III 24-hr
 2-Year Rainfall=3.10"

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Topsfield Proposed HydroCAD 2-2-17 Type III 24-hr 2-Year Rainfall=3.10" Prepared by Microsoft Printed 2/27/2017 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 66 Summary for Pond UIS-7: UIS-7 0.083 ac,100.00% Impervious, Inflow Depth > 2.87" for 2-Year event Inflow Area = Inflow 0.25 cfs @ 12.08 hrs, Volume= 0.020 af = 0.24 cfs @ 12.10 hrs, Volume= 0.017 af, Atten= 2%, Lag= 1.0 min Outflow = Discarded = 0.00 cfs @ 5.30 hrs, Volume= 0.004 af Primary = 0.24 cfs @ 12.10 hrs, Volume= 0.013 af Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 73.87' @ 12.10 hrs Surf.Area= 103 sf Storage= 136 cf Plug-Flow detention time= 88.8 min calculated for 0.017 af (87% of inflow) Center-of-Mass det. time= 30.6 min (787.1 - 756.5) Volume Invert Avail.Storage Storage Description #1A 94 cf 10.33'W x 10.00'L x 3.21'H Field A 71.79 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids #2A 97 cf Cultec R-280HD x 2 Inside #1 72.29' Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows 191 cf Total Available Storage Storage Group A created with Chamber Wizard Device Routing Invert Outlet Devices #1 Discarded 71.79' 1.020 in/hr Exfiltration over Surface area 73.50' 6.0" Round Culvert L= 17.5' Ke= 1.000 #2 Primary Inlet / Outlet Invert= 73.50' / 73.00' S= 0.0286 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf Discarded OutFlow Max=0.00 cfs @ 5.30 hrs HW=71.82' (Free Discharge) 1=Exfiltration (Exfiltration Controls 0.00 cfs) Primary OutFlow Max=0.24 cfs @ 12.10 hrs HW=73.87' (Free Discharge) -2=Culvert (Inlet Controls 0.24 cfs @ 1.55 fps)

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 Type III 24-hr
 2-Year Rainfall=3.10"

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Pond UIS-7: UIS-7 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

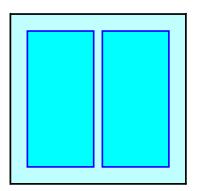
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

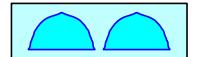
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

2 Chambers 12.3 cy Field 8.7 cy Stone



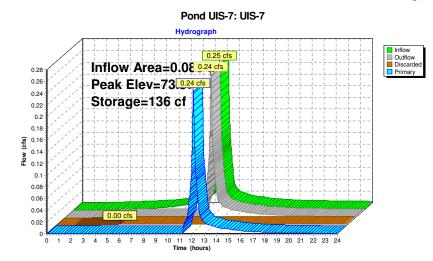




 Type III 24-hr
 2-Year Rainfall=3.10"

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	10.00-10 5	1102001 @ 2010 F	ydroCAD Software Solutions LLC	Page 69
		Sur	nmary for Pond UIS-8: UI	S-8
nflow Area			mpervious, Inflow Depth > 2	.87" for 2-Year event
nflow		25 cfs @ 12.08 h		
Dutflow Discarded		24 cfs @ 12.10 h 00 cfs @ 5.30 h		, Atten= 2%, Lag= 1.0 min
Primary		24 cfs @ 12.10 h		
	0.1			
			= 0.00-24.00 hrs, dt= 0.01 hrs	
Peak Elev=	= 73.17' @	12.10 hrs Surf.A	ea= 103 sf Storage= 136 cf	
	detention ti			
			ulated for 0.017 af (87% of inf	
			ulated for 0.017 af (87% of inf 7.1 - 756.5)	ilow)
		me= 88.8 min cai me= 30.6 min (78		low)
		me= 30.6 min (78		low)
Center-of-I	Mass det. ti	me= 30.6 min (78	7.1 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Fig	eld A
Center-of- I <u>Volume</u> #1A	Mass det. ti Invert 71.09'	me= 30.6 min (78 <u>Avail.Storage</u> 94 cf	7.1 - 756.5) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'H Fit 332 cf Overall - 97 cf Embedd	eld A ded = 234 cf x 40.0% Voids
Center-of-I	Mass det. ti Invert	me= 30.6 min (78 Avail.Storage	7.1 - 756.5) <u>torage Description</u> 10.33'W x 10.00'L x 3.21'H Fit 332 cf Overall - 97 cf Embed Cultec R-280HD x 2 Inside #	eld A ded = 234 cf x 40.0% Voids f1
Center-of- I <u>Volume</u> #1A	Mass det. ti Invert 71.09'	me= 30.6 min (78 <u>Avail.Storage</u> 94 cf	7.1 - 756.5) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'H Fi 332 cf Overall - 97 cf Embedd Cultec R-280HD x 2 Inside # Effective Size= 46.9''W x 26.0	eld A ded = 234 cf x 40.0% Voids f1 0"H => 6.07 sf x 7.00'L = 42.5 cf
Center-of- I <u>Volume</u> #1A	Mass det. ti Invert 71.09'	me= 30.6 min (78 <u>Avail.Storage</u> 94 cf	7.1 - 756.5) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'H Fir 332 cf Overall - 97 cf Embed Cultec R-280HD x 2 Inside # Effective Size= 46.9''W x 26.0' Overall Size= 47.0''W x 26.5''	eld A ded = 234 cf x 40.0% Voids f1 0"H => 6.07 sf x 7.00'L = 42.5 cf H x 8.00'L with 1.00' Overlap
Center-of- I <u>Volume</u> #1A	Mass det. ti Invert 71.09'	me= 30.6 min (78 <u>Avail.Storage</u> 94 cf 97 cf	7.1 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Fi 332 cf Overall - 97 cf Embede Cultec R-280HD x 2 Inside # Effective Size= 46.9'W x 26.0' Overall Size= 47.0'W x 26.5'' Row Length Adjustment= +1.	eld A ded = 234 cf x 40.0% Voids f1 0"H => 6.07 sf x 7.00'L = 42.5 cf H x 8.00'L with 1.00' Overlap
Center-of- I <u>Volume</u> #1A	Mass det. ti Invert 71.09'	me= 30.6 min (78 <u>Avail.Storage</u> 94 cf 97 cf	7.1 - 756.5) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'H Fir 332 cf Overall - 97 cf Embed Cultec R-280HD x 2 Inside # Effective Size= 46.9''W x 26.0' Overall Size= 47.0''W x 26.5''	eld A ded = 234 cf x 40.0% Voids f1 0"H => 6.07 sf x 7.00'L = 42.5 cf H x 8.00'L with 1.00' Overlap
Center-of-I <u>Volume</u> #1A #2A	Mass det. ti <u>Invert</u> 71.09' 71.59'	me= 30.6 min (78 <u>Avail.Storage</u> 94 cf 97 cf	7.1 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Fit 332 cf Overall - 97 cf Embede Cultec R-280HD x 2 Inside # Effective Size= 46.9''W x 26.5'' Row Length Adjustment= +1. Total Available Storage	eld A ded = 234 cf x 40.0% Voids f1 0"H => 6.07 sf x 7.00'L = 42.5 cf H x 8.00'L with 1.00' Overlap
Center-of-I Volume #1A #2A Storage	Mass det. ti <u>Invert</u> 71.09' 71.59' e Group A c	me= 30.6 min (78 Avail.Storage 94 cf 97 cf 191 cf reated with Cham	7.1 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Fi 332 cf Overall - 97 cf Embedd Cultec R-280HD x 2 Inside # Effective Size= 46.9'W x 26.0 Overall Size= 47.0'W x 26.5'' Row Length Adjustment= +1. Total Available Storage per Wizard	eld A ded = 234 cf x 40.0% Voids f1 0"H => 6.07 sf x 7.00'L = 42.5 cf H x 8.00'L with 1.00' Overlap
Center-of-I <u>Volume</u> #1A #2A Storage <u>Device</u> F	Mass det. ti <u>Invert</u> 71.09' 71.59' e Group A c Routing	me= 30.6 min (78 Avail.Storage 94 cf 97 cf 191 cf reated with Cham Invert Outl	7.1 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Fi 332 cf Overall - 97 cf Embedd Cultec R-280HD x 2 Inside # Effective Size= 46.9''W x 26.0 Overall Size= 47.0''W x 26.5'' Row Length Adjustment= +1. Total Available Storage ber Wizard et Devices	eld A ded = 234 cf x 40.0% Voids f1 0"H => 6.07 sf x 7.00'L = 42.5 cf H x 8.00'L with 1.00' Overlap 00' x 6.07 sf x 2 rows
Center-of-I <u>Volume</u> #1A #2A Storage <u>Device F</u> #1 D	Mass det. ti <u>Invert</u> 71.09' 71.59' e Group A c <u>Routing</u> Discarded	me= 30.6 min (78 Avail.Storage 94 cf 97 cf 191 cf reated with Cham Invert Outl 71.09' 1.02	7.1 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Fid 332 cf Overall - 97 cf Embedd Cultec R-280HD x 2 Inside # Effective Size= 46.9'W x 26.0' Overall Size= 47.0''W x 26.5'' Row Length Adjustment= +1. Total Available Storage ber Wizard at Devices D in/hr Exfiltration over Surface	eld A ded = 234 cf x 40.0% Voids f1 "H => 6.07 sf x 7.00'L = 42.5 cf H x 8.00'L with 1.00' Overlap 00' x 6.07 sf x 2 rows ce area
Center-of-I <u>Volume</u> #1A #2A Storage <u>Device F</u> #1 D	Mass det. ti <u>Invert</u> 71.09' 71.59' e Group A c Routing	me= 30.6 min (78 <u>Avail.Storage</u> 94 cf 97 cf 191 cf reated with Cham <u>Invert Outl</u> 71.09' 1.02 72.80' 6.0 ''	7.1 - 756.5) Storage Description 10.33'W x 10.00'L x 3.21'H Fi 332 cf Overall - 97 cf Embedd Cultec R-280HD x 2 Inside # Effective Size= 46.9''W x 26.0 Overall Size= 47.0''W x 26.5'' Row Length Adjustment= +1. Total Available Storage ber Wizard et Devices	eld A ded = 234 cf x 40.0% Voids f1 0"H => 6.07 sf x 7.00'L = 42.5 cf H x 8.00'L with 1.00' Overlap 00' x 6.07 sf x 2 rows ce area = 1.000

Discarded OutFlow Max=0.00 cfs @ 5.30 hrs HW=71.12' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.24 cfs @ 12.10 hrs HW=73.17' (Free Discharge) -2=Culvert (Inlet Controls 0.24 cfs @ 1.55 fps)

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Pond UIS-8: UIS-8 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

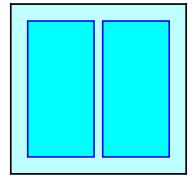
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

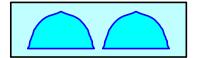
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

 $\begin{array}{l} \mbox{Chamber Storage + Stone Storage = 190.9 cf = 0.004 af} \\ \mbox{Overall Storage Efficiency = 57.6\%} \\ \mbox{Overall System Size = 10.00' x 10.33' x 3.21'} \end{array}$

2 Chambers 12.3 cy Field 8.7 cy Stone





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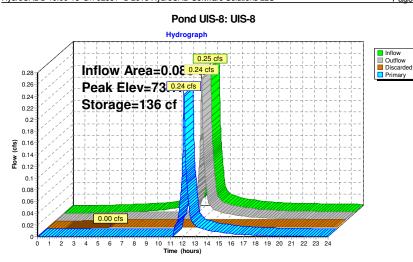
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Summary for Pond UIS-9: UIS-9

Inflow Area =	0.089 ac,100.00% Impervious, Inflow Dep	pth > 2.87" for 2-Year event
Inflow =	0.27 cfs @ 12.08 hrs, Volume= 0	0.021 af
Outflow =	0.26 cfs @ 12.10 hrs, Volume= (0.020 af, Atten= 3%, Lag= 1.2 min
Discarded =	0.00 cfs @ 5.03 hrs, Volume= 0	0.004 af
Primary =	0.26 cfs @ 12.10 hrs, Volume= 0	0.016 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 72.57' @ 12.10 hrs Surf.Area= 103 sf Storage= 81 cf

Plug-Flow detention time= 51.1 min calculated for 0.020 af (94% of inflow) Center-of-Mass det. time= 19.6 min (776.1 - 756.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	71.28'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
			332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	71.78'	97 cf	Cultec R-280HD x 2 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	71.28'	1.020 in/hr Exfiltration over Surface area
#2	Primary	72.18'	6.0" Round Culvert L= 79.0' Ke= 1.000
			Inlet / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900
			n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.00 cfs @ 5.03 hrs HW=71.31' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.26 cfs @ 12.10 hrs HW=72.57' (Free Discharge) -2=Culvert (Inlet Controls 0.26 cfs @ 1.59 fps)

Type III 24-hr 2-Year Rainfall=3.10" Printed 2/27/2017 Page 73

Pond UIS-9: UIS-9 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

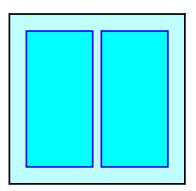
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

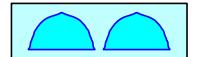
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

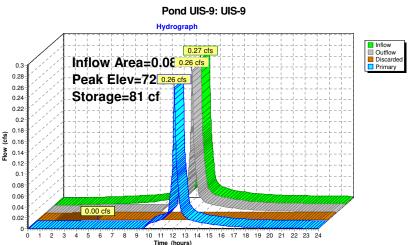
Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

2 Chambers 12.3 cy Field 8.7 cy Stone









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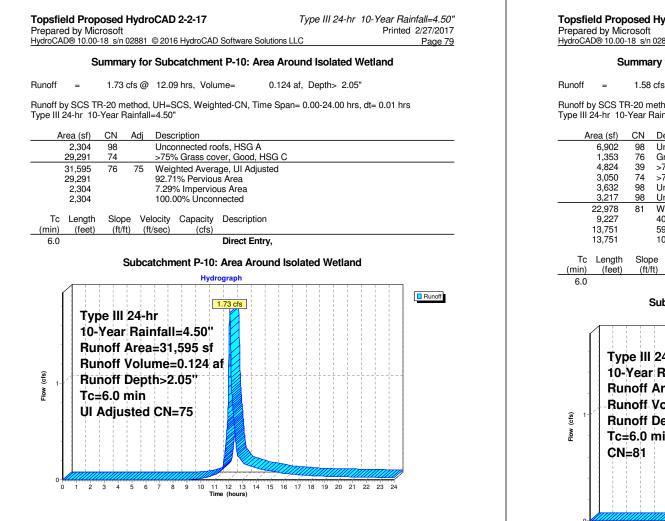
Type III 24-hr 10-Year Rainfall=4.5 Printed 2/27/20 D Software Solutions LLC Page	Topsfield Proposed HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD	Type III 24-hr 10-Year Rainfall=4.50" Printed 2/27/2017 Software Solutions LLC Page 75	opsfield Proposed HydroCAD 2-2-17 repared by Microsoft ydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD
Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>4.2 Tc=6.0 min CN=98 Runoff=0.37 cfs 0.030	Subcatchment R-14: Roof Units 27&28 - A&B	00 hrs, dt=0.01 hrs, 2401 points method, UH=SCS, Weighted-CN ; method - Pond routing by Stor-Ind method	Runoff by SCS TR-2
C Runoff Area=1,705 sf 100.00% Impervious Runoff Depth>4.2 Tc=6.0 min CN=98 Runoff=0.17 cfs 0.014	Subcatchment R-15: Roof Units 29&30 - (B & C	Runoff Area=81,776 sf 1.57% Impervious Runoff Depth>0.19" Tc=6.0 min UI Adjusted CN=42 Runoff=0.08 cfs 0.030 af	ubcatchment P-1: Northern Grassed Area to
Runoff Area=1,490 sf 100.00% Impervious Runoff Depth>4.2 Tc=6.0 min CN=98 Runoff=0.15 cfs 0.012	Subcatchment R-16: Front Units 29&30	Runoff Area=31,595 sf 7.29% Impervious Runoff Depth>2.05" Tc=6.0 min UI Adjusted CN=75 Runoff=1.73 cfs 0.124 af	ubcatchment P-10: Area Around Isolated
Runoff Area=120 sf 100.00% Impervious Runoff Depth>4.2 Tc=6.0 min CN=98 Runoff=0.01 cfs 0.001	Subcatchment R-17: Mailbox Structure Rood	Runoff Area=22,978 sf 59.84% Impervious Runoff Depth>2.55" Tc=6.0 min CN=81 Runoff=1.58 cfs 0.112 af	ubcatchment P-2: Existing Drive to Existing
Runoff Area=3,195 sf 100.00% Impervious Runoff Depth>4.2 Tc=6.0 min CN=98 Runoff=0.32 cfs 0.026	Subcatchment R-2: Roof Units 3&4 - (B & C	Runoff Area=27,549 sf 12.75% Impervious Runoff Depth>0.50" Tc=6.0 min UI Adjusted CN=50 Runoff=0.18 cfs 0.026 af	ubcatchment P-3: Area Around Isolated
its Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>4.2 Tc=6.0 min CN=98 Runoff=0.37 cfs 0.030	Subcatchment R-3: Roof Units 5&6 - A&B Units	Runoff Area=4,950 sf 31.35% Impervious Runoff Depth>1.74" Tc=6.0 min CN=71 Runoff=0.23 cfs 0.017 af	ubcatchment P-3A: Gravel Road to Detentior
Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>4.2 Tc=6.0 min CN=98 Runoff=0.37 cfs 0.030	Subcatchment R-4: Roof - Units 7&8 - (A&B	Runoff Area=21,239 sf 62.65% Impervious Runoff Depth>2.46" Tc=6.0 min CN=80 Runoff=1.41 cfs 0.100 af	ubcatchment P-4: Sloped Entrance Drive -
Runoff Area=3,195 sf 100.00% Impervious Runoff Depth>4.2 Tc=6.0 min CN=98 Runoff=0.32 cfs 0.026	Subcatchment R-5: Roof - Units 9&10 - (B&C	Runoff Area=39,272 sf 52.13% Impervious Runoff Depth>1.97" Tc=6.0 min CN=74 Runoff=2.06 cfs 0.148 af	ubcatchment P-5: Driveway - Units 25-11
A Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>4.2 Tc=6.0 min CN=98 Runoff=0.37 cfs 0.030	Subcatchment R-6: Roof - Units 11&12 - (B&A	Runoff Area=19,137 sf 59.86% Impervious Runoff Depth>2.29" Tc=6.0 min CN=78 Runoff=1.18 cfs 0.084 af	ubcatchment P-6: Pavement Units 12-19
Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>4.2 Tc=6.0 min CN=98 Runoff=0.39 cfs 0.032	Subcatchment R-7: Roof - Units 13&14 - (A	Runoff Area=15,670 sf 44.56% Impervious Runoff Depth>1.74" Tc=6.0 min CN=71 Runoff=0.72 cfs 0.052 af	ubcatchment P-7: Driveway - Units 20-24
A Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>4.2 Tc=6.0 min CN=98 Runoff=0.37 cfs 0.030	Subcatchment R-8: Roof - Units 15&16 - (B&A	Runoff Area=15,307 sf 7.00% Impervious Runoff Depth>0.23"	ubcatchment P-8: Surface Infiltration Pond
B Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>4.2 Tc=6.0 min CN=98 Runoff=0.37 cfs 0.030	Subcatchment R-9: Roof - Units 17&18 - (A&B	Tc=6.0 min CN=43 Runoff=0.02 cfs 0.007 af Runoff Area=102,567 sf 2.25% Impervious Runoff Depth>0.05"	ubcatchment P-9: Woods/Grass Northwest
Inflow=0.18 cfs 0.069 Outflow=0.18 cfs 0.069	Reach SP-1: Wetlands South of Driveway	502' Tc=10.8 min UI Adjusted CN=36 Runoff=0.01 cfs 0.009 af Runoff Area=3,185 sf 100.00% Impervious Runoff Depth>4.26"	Flow Length= ubcatchment R-1: Roof - Units 1&2 (C&B)
Inflow=0.21 cfs 0.099 Outflow=0.21 cfs 0.099	Reach SP-2: Large Wetland Area East	Tc=6.0 min CN=98 Runoff=0.32 cfs 0.026 af Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>4.26"	ubcatchment R-10: Roof - Units 19&20 - (A
Inflow=0.32 cfs 0.152 Outflow=0.32 cfs 0.152	Reach SP-3: Large Wetland Area West	Tc=6.0 min CN=98 Runoff=0.39 cfs 0.032 af Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>4.26"	ubcatchment R-11: Roof - Units 21&22 - (A&E
Peak Elev=56.77' Inflow=0.18 cfs 0.069 nd Culvert n=0.011 L=51.0' S=0.0025 '/' Outflow=0.18 cfs 0.069	Pond 3P: 12 Inch Culvert 12.0" Round	Tc=6.0 min CN=98 Runoff=0.37 cfs 0.030 af Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>4.26"	ubcatchment R-12: Roof - Units 23&24 - (A
Peak Elev=70.27' Storage=13,673 cf Inflow=6.42 cfs 0.451 cfs 0.118 af Primary=0.16 cfs 0.044 af Outflow=0.27 cfs 0.162	Pond D-1: Surface Infiltration Pond Discarded=0.11 cf	Tc=6.0 min CN=98 Runoff=0.39 cfs 0.032 af Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>4.26" Tc=6.0 min CN=98 Runoff=0.39 cfs 0.032 af	ubcatchment R-13: Roof - Units 25&26 - (A

Topsfield Proposed Hydr Prepared by Microsoft					10-Year Rainfa Printed 2	
HydroCAD® 10.00-18 s/n 02881	© 2016 HydroCAD	Software S	Solutions LL	.C		Page 77
Pond D-2: Existing Detention	Basin	Peak E	Elev=58.27'	Storage=3,319 c	f Inflow=1.58 cfs Outflow=0.08 cfs	
Pond D-3: Detention Pond by	Access Road Discarded=0.03 cfs				f Inflow=0.23 cfs Outflow=0.03 cfs	
Pond UIS-1: UIS at Entrance	Discarded=0.08 cfs				f Inflow=4.31 cfs Outflow=0.08 cfs	
Pond UIS-2: UIS at North of S	ite Discarded=0.23 cfs				f Inflow=1.69 cfs Outflow=0.23 cfs	
Pond UIS-3: UIS-3	Discarded=0.00 cfs				f Inflow=0.37 cfs Outflow=0.36 cfs	
Pond UIS-4: UIS-4	Discarded=0.00 cfs				f Inflow=0.32 cfs Outflow=0.32 cfs	
Pond UIS-5: UIS-5	Discarded=0.00 cfs				f Inflow=0.37 cfs Outflow=0.35 cfs	
Pond UIS-6: UIS-6	Discarded=0.00 cfs				f Inflow=0.39 cfs Outflow=0.38 cfs	
Pond UIS-7: UIS-7	Discarded=0.00 cfs				f Inflow=0.37 cfs Outflow=0.35 cfs	
Pond UIS-8: UIS-8	Discarded=0.00 cfs				f Inflow=0.37 cfs Outflow=0.35 cfs	
Pond UIS-9: UIS-9	Discarded=0.00 cfs				f Inflow=0.39 cfs Outflow=0.38 cfs	

 Total Runoff Area = 10.007 ac
 Runoff Volume = 1.147 af
 Average Runoff Depth = 1.38"

 69.75% Pervious = 6.980 ac
 30.25% Impervious = 3.027 ac

	® 10.00	-18 s/n 0	2001		roCAD S	Software	Solut	ions L	LC						Page 7
	Sur	nmary	for Si	ubcatchn	nent P-	1: No	ther	n Gra	assec	l Are	ea to	We	tlan	ds	
Runoff	=	0.08 c	fs @	12.46 hrs,	Volum	e=	C	0.030	af, De	pth>	0.19	9"			
Runoff by Type III 2				UH=SCS, 4.50"	Weighte	ed-CN,	Time	Spar	= 0.00)-24.0	00 hr	s, dt=	= 0.01	1 hrs	
Are	ea (sf)	CN	Adj	Descriptio	n										
	86,287	30		Woods, G											
1	0,782 9,419	70 55		Woods, G Woods, G											
2	2,149	39		>75% Gra			d, HS	GΑ							
	1,287	98		Unconnec			HSG	А							
	<u>1,852</u> 31,776	72 43	42	Dirt roads Weighted			diucto	d							
	30,489	43	42	98.43% P			ajuste	a							
	1,287			1.57% Im											
	1,287			100.00% l	Jnconne	ected									
Тс	Length	Slope	e Vel	ocity Cap	acity	Descrip	tion								
(min)	(feet)	(ft/ft) (ft/	sec)	(cfs)										
6.0					I	Direct E	Entry,								
			catel	ment P-		hern (Gras	sed	Area t	οW	etla	nds			
		Sub													
		Sub				-									
		Sut	+	+-	Hydrog	-	1 I +		1 +	+			+ +		
0.085		Suk				Jraph	++			+					Runoff
0.08						-	++								Bunoff
		ype II	24-	hr	Hydrog	Jraph	++								Runoff
0.08	1.10	ype II)-Yea	24- r Ra	hr infall≠4	Hydrog	Jraph	++							 	Runoff
0.08 0.075 0.07 0.065 0.06	-1(R	ype II)-Yea unoff	24- r Ra Are	hr infall=4 a=81,77	Hydroc .50'' 76 sf	Jraph	++							 	Runoff
0.08 0.075 0.07 0.065 0.065 0.055	-1(R	ype II)-Yea unoff unoff	24- r Ra Are Volu	hr infall=4 a=81,7 ume=0.	Hydroc 	Jraph	++							 	Runoff
0.08 0.075 0.07 0.065 0.065 0.055	-1(R	ype II)-Yea unoff unoff	24- r Ra Are Volu	hr infall=4 a=81,77	Hydroc 	Jraph	++							 -	Runoff
0.08 0.075 0.065 0.066 0.055 (2005)	R R R	ype II)-Yea unoff unoff	24- r Ra Are Volu Dep	hr infall=4 a=81,7 ume=0. th>0.19	Hydroc 	Jraph	++								Runoff
0.08 0.075 0.065 0.06 0.055 (c) 0.05 0.045 0.045 0.045 0.045	-1(-R -R	ype III)-Yea unoff unoff unoff c=6.0	24- r Ra Are Volu Dep min	hr infall=4 a=81,77 ume=0. th>0.11	Hydroc 50'' 76 sf 030 a 9''	Jraph	++								Runoff
0.08 0.075 0.07 0.065 0.06 0.055 0.05 0.05 0.05 0.05 0.	-1(-R -R	ype III)-Yea unoff unoff unoff c=6.0	24- r Ra Are Volu Dep min	hr infall=4 a=81,7 ume=0. th>0.19	Hydroc 50'' 76 sf 030 a 9''	Jraph	++								Runoff
0.08 0.075 0.07 0.065 0.06 0.055 0.05 0.05 0.05 0.05 0.	-1(-R -R	ype III)-Yea unoff unoff unoff c=6.0	24- r Ra Are Volu Dep min	hr infall=4 a=81,77 ume=0. th>0.11	Hydroc 50'' 76 sf 030 a 9''	Jraph	++								Runoff
0.08 0.075 0.07 0.065 0.06 0.055 0.05 0.05 0.05 0.05 0.	-1(-R -R	ype III)-Yea unoff unoff unoff c=6.0	24- r Ra Are Volu Dep min	hr infall=4 a=81,77 ume=0. th>0.11	Hydroc 50'' 76 sf 030 a 9''	Jraph	++								Runoff
0.08 0.075 0.065 0.065 0.055 (st) 0.055 (st) 0.045 0.045 0.035 0.035 0.035 0.03 0.035	-1(-R -R	ype III)-Yea unoff unoff unoff c=6.0	24- r Ra Are Volu Dep min	hr infall=4 a=81,77 ume=0. th>0.11	Hydroc 50'' 76 sf 030 a 9''	Jraph	++								Runoff



Prepared by Micros	ed HydroCAD 2-2-17 soft s/n 02881 © 2016 HydroCAD Software S		ainfall=4.50" ed 2/27/2017 Page 80
Sum	mary for Subcatchment P-2: Exi	sting Drive to Existing Basin	
Runoff = 1	.58 cfs @ 12.09 hrs, Volume=	0.112 af, Depth> 2.55"	
Runoff by SCS TR-2 Type III 24-hr 10-Ye	0 method, UH=SCS, Weighted-CN, Ti ar Rainfall=4.50"	me Span= 0.00-24.00 hrs, dt= 0.01 h	rs
6,902 9 1,353 7 4,824 3 3,050 7 3,632 9 3,217 9 22,978 8 9,227 13,751 13,751	N Description W Unconnected pavement, HSG A 76 Gravel roads, HSG A 9 >75% Grass cover, Good, HSG A 74 >75% Grass cover, Good, HSG C 88 Unconnected pavement, HSG B 98 Unconnected pavement, HSG C 81 Weighted Average 40.16% Pervious Area 59.84% Impervious Area 100.00% Unconnected Slope Velocity Capacity Descriptic (ft/ft) (ft/sec) (cfs)		
6.0		try, Min. 6.0 TC	
	Subcatchment P-2: Existing D	Prive to Existing Basin	
	Hydrograph		
End to the second secon	11.58 cfs ear Rainfall=4.50" ff Area=22,978 sf ff Volume=0.112 af ff Depth>2.55" .0 min		Runoff

Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr	10-Year Rainfall=4.50"
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Summary for Subcatchment P-3: Area Around Isolated Wetland

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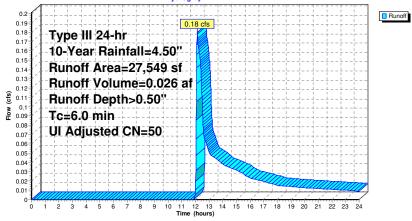
Runoff = 0.18 cfs @ 12.14 hrs, Volume= 0.026 af, Depth> 0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 10-Year Rainfall=4.50"

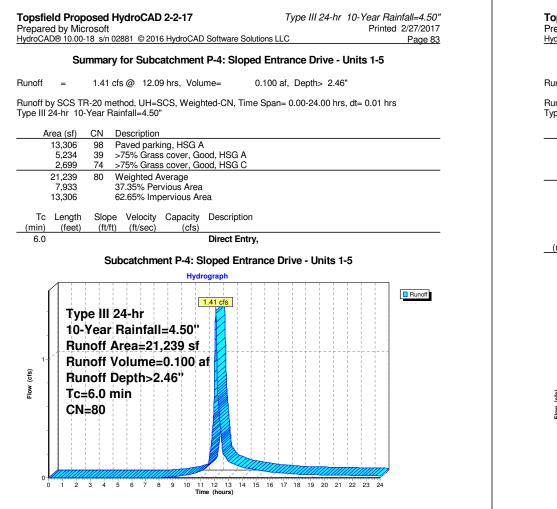
A	vrea (sf)	CN /	Adj Des	cription					
	3,512	98	Unc	onnected pa	pavement, HSG A				
	1,224	76	Grav	el roads, H	HSG A				
	212	74	>75	% Grass cov	over, Good, HSG C				
	2,166	70	Woo	Woods, Good, HSG C					
	5,125	77	Woo	ds, Good, H	HSG D				
	14,867	30	Woo	ds, Good, H	HSG A				
	443	39	>75	% Grass cov	over, Good, HSG A				
	27,549	53	50 Wei	ghted Avera	age, UI Adjusted				
	24,037		87.25% Pervious Area						
	3,512		12.75% Impervious Area						
	3,512		100.	00% Uncon	nnected				
_		-							
Tc	- 3-	Slope							
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)					
6.0					Direct Entry,				

Subcatchment P-3: Area Around Isolated Wetland

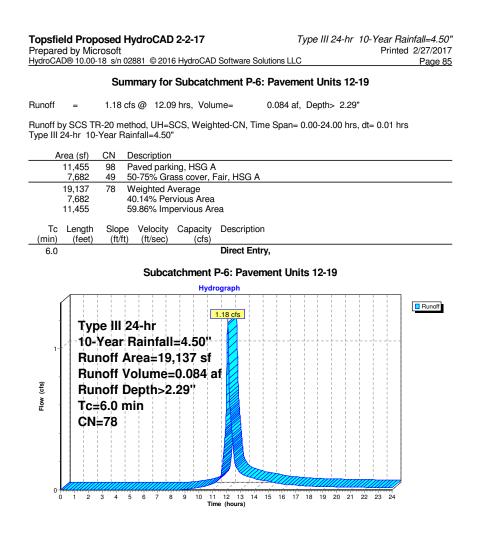




Summary for Subcatchment P-3A: Gravel Road to Detention Basin Runoff = 0.23 cfs @ 12.09 hrs, Volume= 0.017 af, Depth> 1.74" Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs 1.74" Provide the structure	
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 10-Year Rainfall=4.50" Area (sf) CN Description 1,552 98 Paved parking, HSG A 1,841 76 Gravel roads, HSG A 1,557 39 >75% Grass cover, Good, HSG A 4,950 71 Weighted Average	
Type III 24-hr 10-Year Rainfall=4.50" Area (sf) CN Description 1,552 98 Paved parking, HSG A 1,841 76 Gravel roads, HSG A 1,557 39 >75% Grass cover, Good, HSG A 4,950 71 Weighted Average	
1,552 98 Paved parking, HSG A 1,841 76 Gravel roads, HSG A 1,557 39 >75% Grass cover, Good, HSG A 4,950 71 Weighted Average	
1,841 76 Gravel roads, HSG A 1,557 39 >75% Grass cover, Good, HSG A 4,950 71 Weighted Average	
4,950 71 Weighted Average	
1,552 31.35% Impervious Area	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	
6.0 Direct Entry,	
Subcatchment P-3A: Gravel Road to Detention Basin Hydrograph	off
0.22 10-Year Rainfall=4.50"	
0.18 Runoff Area=4,950 sf	
^{0.16} Runoff Volume=0.017 af	
້ອີ ^{0.14} Runoff Depth>1.74" ⁸ ^{0.12} Tc=6.0 min	
0.1 CN=71	
0.06	
0.04	
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	
Time (hours)	



Topsfield Proposed HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Sol	Type III 24-hr 10-Year Rainfall=4.50" Printed 2/27/2017 utions LLC Page 84
Summary for Subcatchment P-5:	Driveway - Units 25-11
Runoff = 2.06 cfs @ 12.09 hrs, Volume=	0.148 af, Depth> 1.97"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Tim Type III 24-hr 10-Year Rainfall=4.50"	e Span= 0.00-24.00 hrs, dt= 0.01 hrs
Area (sf) CN Description 19,875 98 Paved parking, HSG A 14,088 39 >75% Grass cover, Good, HSG A 4,713 74 >75% Grass cover, Good, HSG C 596 98 Unconnected pavement, HSG C 39,272 74 Weighted Average 18,801 47,87% Pervious Area 20,471 52.13% Impervious Area 596 2.91% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) Direct Entr	
Subcatchment P-5: Drivew Hydrograph	vay - Units 25-11
Type III 24-hr 10-Year Rainfall=4.50" Runoff Area=39,272 sf Runoff Volume=0.148 af Runoff Depth>1.97" Tc=6.0 min CN=74	Runoff
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 Time (hours)	15 16 17 18 19 20 21 22 23 24



Topsfield Proposed HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions I	<i>Type III 24-hr 10-Year Rainfall=4.50"</i> Printed 2/27/2017 LC Page 86
Summary for Subcatchment P-7: Drive	
	•
Runoff = 0.72 cfs @ 12.09 hrs, Volume= 0.052	af, Depth> 1.74"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Spat Type III 24-hr 10-Year Rainfall=4.50"	n= 0.00-24.00 hrs, dt= 0.01 hrs
Area (sf) CN Description	
6,983 98 Paved parking, HSG A 8,687 49 50-75% Grass cover, Fair, HSG A	
15,670 71 Weighted Average	
8,687 55.44% Pervious Area	
6,983 44.56% Impervious Area	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	
6.0 Direct Entry,	
Subcatchment P-7: Driveway - U	Jnits 20-24
- Hydrograph	
0.8 0.75 0.75 0.75 0.75 0.75 0.66 0.55 0.66 0.55 0.65 0.55 0	Rundf

Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr	10-Year Rainfall=4.50"
Prepared by Microsoft		Printed 2/27/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LL	C	Page 87

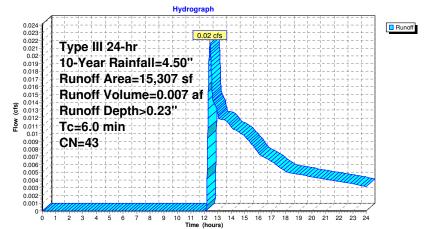
Summary for Subcatchment P-8: Surface Infiltration Pond Area

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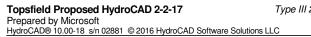
Runoff = 0.02 cfs @ 12.42 hrs, Volume= 0.007 af, Depth> 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 10-Year Rainfall=4.50"

Area (sf) CN	Description		
1,0	72 98	Paved park	ing, HSG A	1
14,2	35 39	>75% Gras	s cover, Go	bod, HSG A
15,3	07 43	Weighted A	verage	
14,2	35	93.00% Per	rvious Area	L
1,0	72	7.00% Impe	ervious Area	a
- .			a	
Tc Len		ope Velocity	Capacity	Description
(min) (fe	eet) (f	t/ft) (ft/sec)	(cfs)	
6.0				Direct Entry,
		Subcatch	ment P-8:	Surface Infiltration Pond Area



Prepare	d by Mic	rosoft	ydroCAE) Software Solu	,,	10-Year Rainfall=4.50 Printed 2/27/2017 Page 88	
						s Northwest Site to	-	
			scribed as ked earth	"Dirt road,"	closest CN v	alue in HydroCAD, acti	ual material to be	
Runoff	=	0.01 cf	s@ 15.7	1 hrs, Volu	me=	0.009 af, Depth> 0.05	"	
			hod, UH=9 infall=4.50		nted-CN, Time	e Span= 0.00-24.00 hrs	s, dt= 0.01 hrs	
A	rea (sf)	CN A	Adj Desc	cription				
	2,068	72	Dirt I	roads, HSG	A			
	40,086	39	>759	>75% Grass cover, Good, HSG A				
	357	74	>759	% Grass co	ver, Good, HS	G C		
	53,082	30	Woo	ds, Good, H	ISG A			
	4,670	55	Woo	ds, Good, H	ISG B			
	2,304	98	Unco	onnected pa	avement, HSC	λA		
1	02,567	37			age, UI Adjust	ed		
1	00,263		• • • • •	5% Perviou				
	2,304			% Impervio				
	2,304		100.	00% Uncon	nected			
Тс	Length	Slope	Velocity	Capacity	Description			
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	2 000101011			
4.9	50	0.0300	0.17	()	Sheet Flow,	A-B		
						t n= 0.150 P2= 3.10'		
4.9	342	0.0280	1.17		Shallow Co	ncentrated Flow, B-C		
						Pasture Kv= 7.0 fps		
1.0	110	0.1270	1.78		Shallow Co	ncentrated Flow, C-D		
					Woodland	Kv= 5.0 fps		
10.8	502	Total						

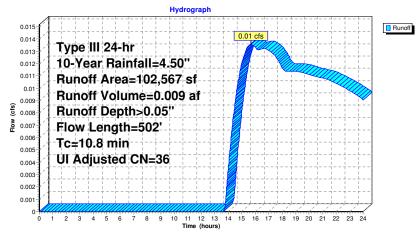


 Type III 24-hr
 10-Year Rainfall=4.50"

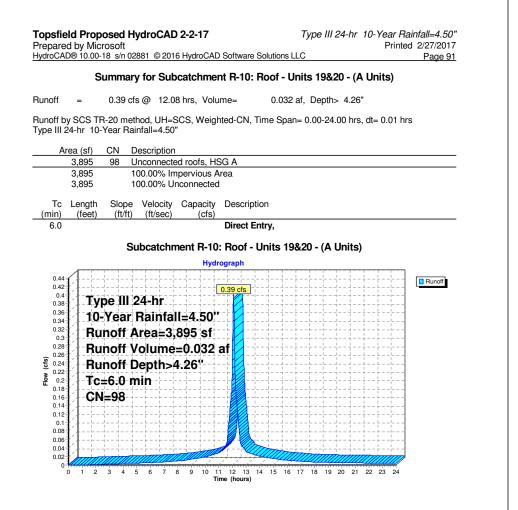
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 Page 89

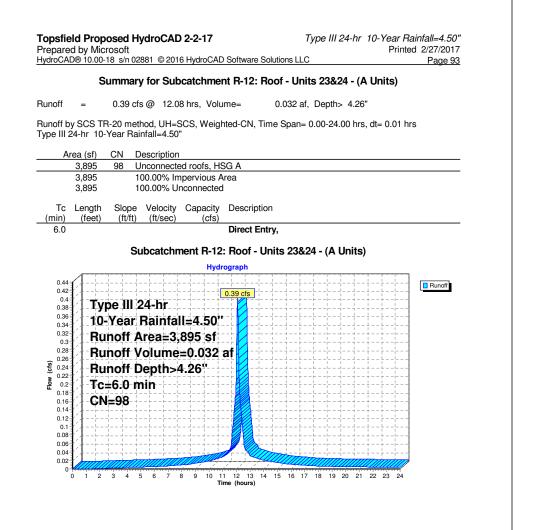
Subcatchment P-9: Woods/Grass Northwest Site to NW Wetlands



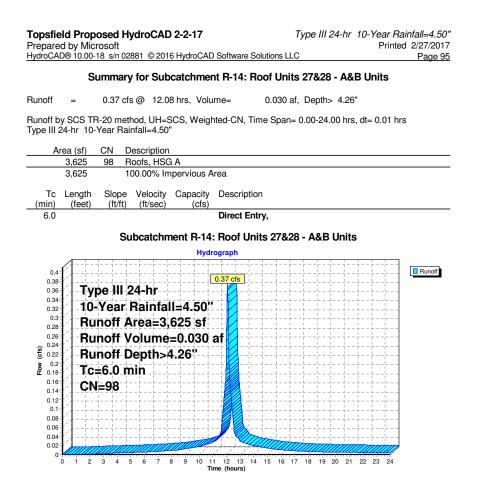
	10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page :
	Summary for Subcatchment R-1: Roof - Units 1&2 (C&B)
Runoff	= 0.32 cfs @ 12.08 hrs, Volume= 0.026 af, Depth> 4.26"
Runoff by	SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24	-hr 10-Year Rainfall=4.50"
Are	a (sf) CN Description
	3,185 98 Unconnected roofs, HSG A
	3,185 100.00% Impervious Area 3,185 100.00% Unconnected
	,
Tc L (min)	ength Slope Velocity Capacity Description (feet) (ft/ft) (ft/sec) (cfs)
6.0	Direct Entry,
	Subcatchment R-1: Roof - Units 1&2 (C&B)
	Hydrograph
0.36	
0.34	
0.32	}- Type III 24-hr
0.3 0.28	10-Year Rainfall=4.50'
0.26 0.24	Runoff Area=3,185 sf
0.24	Runoff Volume=0.026 af
2.0 (cts)	Runoff Depth>4.26"
0.18 0.16	Tc=6.0 min
0.14	CN=98
0.12	
0.08	
0.06	
0.02	



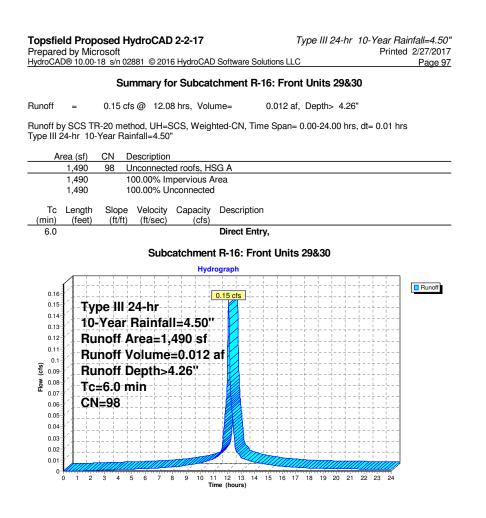
	10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page S Summary for Subcatchment R-11: Roof - Units 21&22 - (A&B Units)
Runoff	= 0.37 cfs @ 12.08 hrs, Volume= 0.030 af, Depth> 4.26"
Runoff by	SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
ype III 24	1-hr 10-Year Rainfall=4.50"
	a (sf) CN Description
	3,625 98 Unconnected roofs, HSG A
	3,625 100.00% Impervious Area 3.625 100.00% Unconnected
	3,025 100.00 % Onconnected
Tc (min)	Length Slope Velocity Capacity Description (feet) (ft/ft) (ft/sec) (cfs)
6.0	Direct Entry,
	Subcatchment R-11: Roof - Units 21&22 - (A&B Units)
	Hydrograph
1	
0.4 0.38	1
0.36	/ Type III 24-hr
0.34 0.32	10-Year Rainfall=4.50"
0.3	Runoff Area=3,625 sf
0.28	A
0.26	Runoff Volume=0.030 af
sj 0.22	A Runoff Depth>4.26"
0.2 0.18	1 Tc=6.0 min
0.16	
0.14	1 CN=98
0.12	
0.08	
0.06	╱┟╌┾╌┾╌┾╌┾╌┾╌┾╌┼╴┽╴┽╴╴┙╸┛╱╵╴┼╴┼╴┾╴┾╶┾╶┾╴┼╴┼╴┼╴┼
0.04 0.02	
0	
0	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Time (hours)



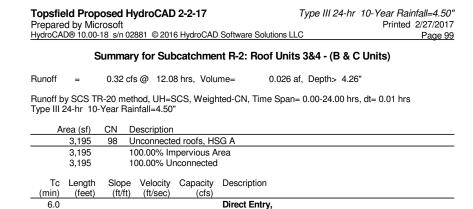
iyaroo, i	d by Mic D® 10.00-		02881 ©	2016	Hydro	CAD	Softwa	are So	lutior	ns L	LC						ted 2/27/2017 Page 94
	S	umma	ary for	Subc	atchr	nen	t R-1	3: R	oof	- U	nits	25&	26 -	(A	Uni	ts)	
Runoff	=	0.39	cfs @	12.08	hrs, N	/olun	16=		0.0	32	af, I	Depth	ı> 4	.26"			
	y SCS TF 24-hr 10-				CS, W	eight	ed-Cl	N, Tir	ne S	pan	= 0.	00-24	1.00	hrs,	dt=	0.01	hrs
A	rea (sf)	CN	Descrip														
	3,895	98	Uncon														
	3,895 3,895		100.00 100.00				ea										
Tc (min)	Length (feet)	Slop (ft/f			Capac (c	fs)		riptio									
6.0							Direc	t Ent	ry,								
		:	Subcat	chme	ent R-	-13:	Roo	f - Ui	nits	258	&26	- (A	Uni	ts)			
					E F	lydro	graph										
0.44 0.42 0.4 0.38 0.36 0.34	Ty 10-	Yea	l 24-h r Rair	nfall:		0''	.39 cfs										- Runoff
0.32 0.3	} ⊓u		Area	i r				l l			- -	l l	-	+ +	+ +	 	-
0.28	골 슈프트트프	12242	Volu	US 7	1.2.212	82 a	f							+ +	· +		-
(\$j) 0.24 0.22	Ru	noff	Dept	h>4.	26"	- +		!									-
0.22 0.2 0.18	Tc:	=6.0	min -												· +		-
0.16	CN	=98	· + +			-+		!				!		+ +	+		-
0.14 0.12	[/ <u> </u> ⊢		++	 	+-	-+							-1	+ + + +	+	 	-
0.1 0.08]/{		. <u> </u> <u> </u>	 	44-									i i			-
0.06	1 2 1		· + +			-+								+ +	+		-
0.04					m	Ø	,	Ų			m					;	
0.02		<u> </u>		7 8	9 1		12	1	15	16	17 1	8 19	20	21	22 2	3 24	<i>,</i>
0.02 0	0 1 2	3 4	56	/ 8													



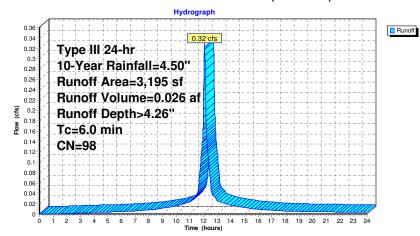
Topsfield Proposed HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LL		10-Year Rainfall=4.50" Printed 2/27/2017 Page 96
Summary for Subcatchment R-15: Roof Units		C Units)
Runoff = 0.17 cfs @ 12.08 hrs, Volume= 0.014 a	af, Depth> 4.26	"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span- Type III 24-hr 10-Year Rainfall=4.50"	= 0.00-24.00 hrs	, dt= 0.01 hrs
Area (sf) CN Description		
1,705 98 Unconnected roofs, HSG A		
1,705 100.00% Impervious Area 1,705 100.00% Unconnected		
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)		
6.0 Direct Entry,		
Subcatchment R-15: Roof Units 29&30	- (B & C Unit	s)
Hydrograph		
0.19 0.17 cfs 10-Year Rainfall=4.50'' Runoff Area=1,705 sf Runoff Depth>4.26'' Tc=6.0 min CN=98 0.00 0.1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 1 Time (hours)		Runoff



unoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01	hrs
Area (sf) CN Description Area (sf) CN Description 120 98 Unconnected roofs, HSG A 120 100.00% Impervious Area 120 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-17: Mailbox Structure Rood Hydrograph 0.013 0.012	hrs
120 98 Unconnected roofs, HSG A 120 100.00% Impervious Area 120 100.00% Unconnected Tc Length Slope (feet) (ft/ft) (ft/sec) 6.0 Direct Entry, Subcatchment R-17: Mailbox Structure Rood Hydrograph 0.013 0.01 cfs 0.011	hrs
120 98 Unconnected roofs, HSG A 120 100.00% Impervious Area 120 100.00% Unconnected Tc Length Slope (feet) (ft/ft) (ft/sec) 6.0 Direct Entry, Subcatchment R-17: Mailbox Structure Rood Hydrograph 0.013 0.011 0.011	
120 100.00% Impervious Area 120 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-17: Mailbox Structure Rood Hydrograph 0.013 0.011 0.011 cfs 0.0113	
120 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-17: Mailbox Structure Rood Hydrograph 0.013 0.011 cfs 0.012 Type III 24-hr	
(min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-17: Mailbox Structure Rood Hydrograph 0.013 0.012 Type III 24-hr	
(min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-17: Mailbox Structure Rood Hydrograph 0.013 0.012 Type III 24-hr	
Subcatchment R-17: Mailbox Structure Rood Hydrograph	
Hydrograph 0.013 0.012 Type III 24-hr	
0.01 Runoff Area=120 sf 0.008 Runoff Volume=0.001 af 0.008 Runoff Depth>4.26" 0.006 Tc=6.0 min 0.003 CN=98 0.003 0.002 0.001 Image: Constant of the second	
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24	7
Time (hours)	



Subcatchment R-2: Roof Units 3&4 - (B & C Units)



	by Microsoft 10.00-18 s/n 028	81 © 2016	i HydroCAI) Software	e Solutio	ns LLC	-			Pri	inted 2/27/2017 Page 100
	Summar	y for Su	bcatchm	ent R-3	: Roof	Units	5&6 ·	A&E	8 Un	its	
Runoff	= 0.37 cfs	@ 12.08	shrs, Volu	ume=	0.0)30 af,	Depth	> 4.2	6"		
	SCS TR-20 meth -hr 10-Year Rain			hted-CN,	Time S	pan= ().00-24	.00 hr	s, dt=	= 0.0	1 hrs
		escription									
-		ofs, HSG	A pervious A	\roo							
	3,625 10	0.00% 111	pervious P	Area							
Tc L (min)	ength Slope (feet) (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Descrip							
6.0				Direct	Entry,						
	s	ubcatch	ment R-3	3: Roof	Units !	5&6 -	A&B l	Jnits			
			Hyd	rograph							
0.4	1					++			-+	+	
0.38	T			0.37 cfs		T T 			- <u>+</u>		
0.36 0.34	Type III 2	- i i			_	↓ ↓ ↓ ↓	. L I II . L		- + - +		·
0.32	10-Year F					+			-+	+ -	·
0.28	Runoff A								-+	+	
0.26	Runoff V			af	-ii -ii	i i i i		-ii- -ii-	- † - +	ii- -	
(cts)	Runoff D		.26"						- +		·
0.2 0.18	Tc=6.0 m	in							- <u>-</u>		
0.16	CN=98					i i					
0.12	}		+			+			-+	+ -	·
0.1 0.08	*		+ + + +	00		+ + + +		-1+-	- + - +		
0.06	*		++]]-		++			-+	+	·
0.04			111111		4MM				/////		
0	1 2 3 4 5	6 7 8				16 17	18 19	20 2	1 22	23 2	24
			т	ime (hours)							



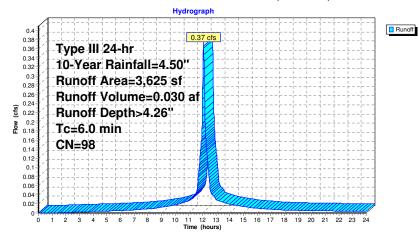
Summary for Subcatchment R-4: Roof - Units 7&8 - (A&B Units)

Runoff = 0.37 cfs @ 12.08 hrs, Volume= 0.030 af, Depth> 4.26"

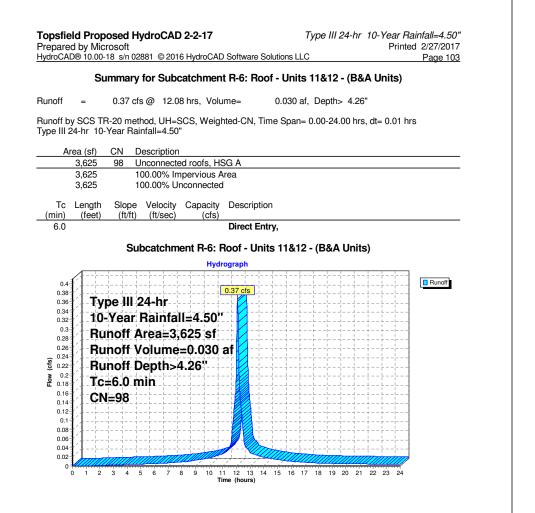
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN [Description					
	3,625	98 l	8 Unconnected roofs, HSG A					
	3,625	1	100.00% Impervious Area					
	3,625	1	100.00% Unconnected					
Тс	Lenath	Slope	Velocity	Capacity	Description			
(min)	(feet)	(ft/ft)						
6.0					Direct Entry,			

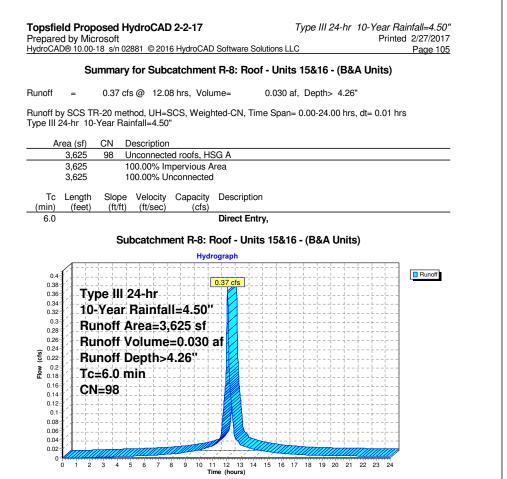
Subcatchment R-4: Roof - Units 7&8 - (A&B Units)



Topsfield Proposed HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solu	Type III 24-hr 10-Year Rainfall=4.50 Printed 2/27/201 titons LLC Page 10
Summary for Subcatchment R-5: Roof	
Runoff = 0.32 cfs @ 12.08 hrs, Volume=	0.026 af, Depth> 4.26"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Type III 24-hr 10-Year Rainfall=4.50"	e Span= 0.00-24.00 hrs, dt= 0.01 hrs
Area (sf) CN Description	
3,195 98 Unconnected roofs, HSG A	
3,195 100.00% Impervious Area	
3,195 100.00% Unconnected	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	
6.0 Direct Entry	<u>,</u>
	·
Subcatchment R-5: Roof - Units	s 9&10 - (B&C Units)
Hydrograph	
0.36	+
0.34	
0.32 0.3	
0.28 10-Year Rainfall=4.50"	
^{0.26} Runoff Area=3,195 sf	+
Runoff Volume=0.026 af	
· · · · · · · · · · · · · · · · · · ·	
▶ 0.18 ¥ L L L	
0.14 0.12	
0.1	
0.08	
0.06	+++++++++++++
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14	



repared	Proposed HydroCAD 2-2-17 Type III 24-hr 10- 0 June 10.00-18 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC	Year Rainfall=4.50" Printed 2/27/2017 Page 104
	Summary for Subcatchment R-7: Roof - Units 13&14 - (A Un	its)
Runoff	= 0.39 cfs @ 12.08 hrs, Volume= 0.032 af, Depth> 4.26"	
	SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt- hr 10-Year Rainfall=4.50"	₌ 0.01 hrs
	(sf) CN Description	
	895 98 Unconnected roofs, HSG A .895 100.00% Impervious Area	
	895 100.00% Imperious Area	
Tc L (min)	ength Slope Velocity Capacity Description (feet) (ft/ft) (ft/sec) (cfs)	
6.0	Direct Entry,	
	Subcatchment R-7: Roof - Units 13&14 - (A Units)	
	Hydrograph	
0.44 0.42 0.4 0.38 0.36 0.34 0.32 0.33 0.28 0.24 0.22 0.22 0.22 0.22 0.24 0.24 0.22 0.24 0.24	U.39 cfs Type III 24-hr 10-Year Rainfall=4.50" Runoff Area=3,895 sf Runoff Volume=0.032 af Runoff Depth>4.26" Tc=6.0 min CN=98	End of the second
0.02	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22	23 24
U	Tize (hours)	20 24



Type III 24-hr 10-Year Rainfall=4.50" Topsfield Proposed HydroCAD 2-2-17 Prepared by Microsoft Printed 2/27/2017 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 106 Summary for Subcatchment R-9: Roof - Units 17&18 - (A&B Units) 0.37 cfs @ 12.08 hrs, Volume= 0.030 af, Depth> 4.26" Runoff _ Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Area (sf) CN Description 3,625 98 Unconnected roofs, HSG A 3,625 100.00% Impervious Area 3,625 100.00% Unconnected Tc Length Slope Velocity Capacity Description (feet) (ft/ft) (ft/sec) (cfs) Direct Entry, 6.0 Subcatchment R-9: Roof - Units 17&18 - (A&B Units) Hydrograph Runoff 0.4 0.38 0.37 cfs Type III 24-hr 0.36 0.34 10-Year Rainfall=4.50" 0.32 0.3 Runoff Area=3.625 sf 0.28 0.26 Runoff Volume=0.030 af 0.24 (s) 0.24 Runoff Depth>4.26" 0.2 0.2 0.18 Tc=6.0 min 0.16 **CN=98** 0.14 0.12 0.1 0.08 0.06 0.04 0.02

10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Time (hours)

Type III 24-hr 10-Year Rainfall=4.50"

(min)

0 1 2 3 4 5 6 7 8 9

Topsfield Proposed HydroCAD 2-2-17 Type III 24-hr 10-Year Rainfall=4.50" Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Printed 2/27/2017

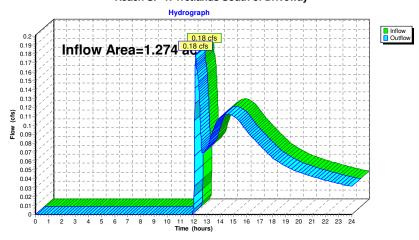
Summary for Reach SP-1: Wetlands South of Driveway

Page 107

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

Inflow Area =	1.274 ac, 33.91% Impervious, Inflow Depth > 0.65" for 10-Year event
Inflow =	0.18 cfs @ 12.14 hrs, Volume= 0.069 af
Outflow =	0.18 cfs @ 12.14 hrs, Volume= 0.069 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs





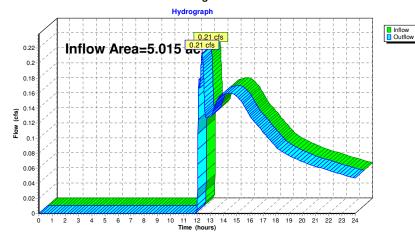
Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr 10-Year Rainfall=4.50"
Prepared by Microsoft	Printed 2/27/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solution	is LLC Page 108

Summary for Reach SP-2: Large Wetland Area East

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

Inflow Area =	5.015 ac, 29.33% Impervious, Inflow	Depth > 0.24" for 10-Year event
Inflow =	0.21 cfs @ 12.39 hrs, Volume=	0.099 af
Outflow =	0.21 cfs @ 12.39 hrs, Volume=	0.099 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



Reach SP-2: Large Wetland Area East

Topsfield Proposed HydroCAD 2-2-17 Type III 24-hr 10-Year Rainfall=4.50" Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Printed 2/27/2017

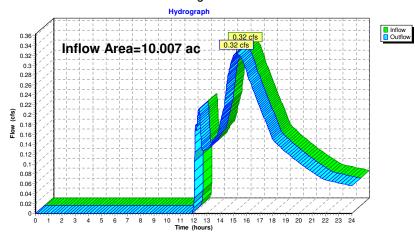
Summary for Reach SP-3: Large Wetland Area West

Page 109

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

Inflow Area =	10.007 ac, 30.25% Impervious, Inflow D	epth > 0.18" for 10-Year event
Inflow =	0.32 cfs @ 15.26 hrs, Volume=	0.152 af
Outflow =	0.32 cfs @ 15.26 hrs, Volume=	0.152 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



Reach SP-3: Large Wetland Area West

Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr	10-Year Rainfall=4.50"
Prepared by Microsoft		Printed 2/27/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LL	C	Page 110

Summary for Pond 3P: 12 Inch Culvert

[57] Hint: Peaked at 56.77' (Flood elevation advised)

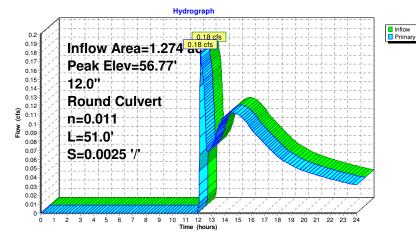
Inflow Area =	1.274 ac, 33.91% Impervious, Inflow	Depth > 0.65" for 10-Year event
Inflow =	0.18 cfs @ 12.14 hrs, Volume=	0.069 af
Outflow =	0.18 cfs @ 12.14 hrs, Volume=	0.069 af, Atten= 0%, Lag= 0.0 min
Primary =	0.18 cfs @ 12.14 hrs, Volume=	0.069 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 56.77' @ 12.14 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	56.51'	12.0" Round RCP_Round 12" L= 51.0' Ke= 0.200
	-		Inlet / Outlet Invert= 56.51' / 56.38' S= 0.0025 '/' Cc= 0.900
			n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.18 cfs @ 12.14 hrs HW=56.77' (Free Discharge) 1=RCP_Round 12'' (Barrel Controls 0.18 cfs @ 1.69 fps)

Pond 3P: 12 Inch Culvert



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Summary for Pond D-1: Surface Infiltration Pond

[58] Hint: Peaked 0.27' above defined flood level

Inflow Area =	2.637 ac, 56.99% Impervious, Inflow Depth > 2.05" for 10-Year event
Inflow =	6.42 cfs @ 12.10 hrs, Volume= 0.451 af
Outflow =	0.27 cfs @ 15.40 hrs, Volume= 0.162 af, Atten= 96%, Lag= 198.5 min
Discarded =	0.11 cfs @ 15.40 hrs, Volume= 0.118 af
Primary =	0.16 cfs @ 15.40 hrs, Volume= 0.044 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 70.27' @ 15.40 hrs Surf.Area= 4,802 sf Storage= 13,673 cf Flood Elev= 70.00' Surf.Area= 4,583 sf Storage= 12,420 cf

Plug-Flow detention time= 331.7 min calculated for 0.162 af (36% of inflow) Center-of-Mass det. time= 215.1 min (1,034.1 - 819.1)

Volume	Invert	Avail.St	orage St	orage	Description		
#1	66.00'	56,	233 cf C	ustom	Stage Data (Pri	smatic) Listed below (Re	calc)
Elevatio (fee		urf.Area (sq-ft)	Inc.Sto (cubic-fe		Cum.Store (cubic-feet)		
66.0	00	1,817		0	0		
67.0	00	2,361	2,0	89	2,089		
68.0	00	3,059	2,7	'10	4,799		
69.0	00	3,800	3,4	30	8,229		
70.0	00	4,583	4,1	92	12,420		
71.0	00	5,403	4,9	93	17,413		
72.0	00	6,280	5,8	342	23,255		
73.0	00	7,213	6,7	'47	30,001		
74.0	00	8,202	7,7	'08	37,709		
75.0	00	9,248	8,7	25	46,434		
76.0	00	10,350	9,7	'99	56,233		
Device	Routing	Inver			-		
#1	Discarded	66.00	' 1.020 ir	hr Ex	filtration over S	urface area	

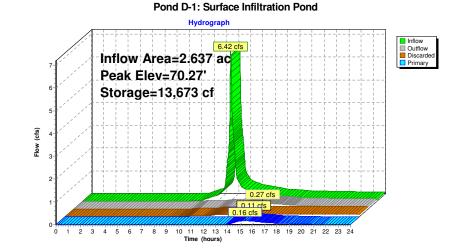
#1	Discarded	66.00'	1.020 in/hr Exfiltration over Surface area
#2	Primary	70.10'	18.0" Round Culvert L= 234.0' Ke= 0.200
			Inlet / Outlet Invert= $70.10'$ / $67.00'$ S= $0.0132'$ /' Cc= 0.900 n= 0.015 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Discarded OutFlow Max=0.11 cfs @ 15.40 hrs HW=70.27' (Free Discharge)

Primary OutFlow Max=0.15 cfs @ 15.40 hrs HW=70.27' (Free Discharge) -2=Culvert (Barrel Controls 0.15 cfs @ 2.10 fps)



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Summary for Pond D-2: Existing Detention Basin

[58] Hint: Peaked 0.19' above defined flood level

Inflow Area =	0.528 ac, 59.84% Impervious, Inflow D	epth > 2.55" for 10-Year event
Inflow =	1.58 cfs @ 12.09 hrs, Volume=	0.112 af
Outflow = 0	0.08 cfs @ 14.89 hrs, Volume=	0.043 af, Atten= 95%, Lag= 168.0 min
Primary = (0.08 cfs @ 14.89 hrs. Volume=	0.043 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 58.27 @ 14.89 hrs Surf.Area= 3,090 sf Storage= 3,319 cf Flood Elev= 58.08' Surf.Area= 3,090 sf Storage= 2,719 cf

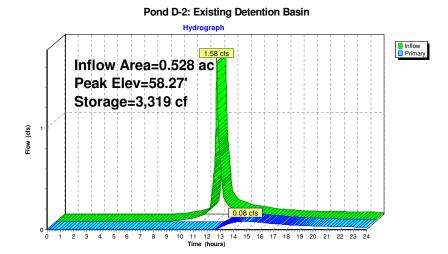
Plug-Flow detention time= 343.1 min calculated for 0.043 af (38% of inflow) Center-of-Mass det. time= 220.0 min (1,042.9 - 822.9)

Volume	Inve	ert Avail.Sto	rage Storage	Description	
#1	57.2	20' 9,02	20 cf Custom	n Stage Data (Pr	ismatic) Listed below (Recalc)
Elevatio	t)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	
57.2		3,090	0	0	
58.0	00	3,090	2,472	2,472	
59.0	0	3,090	3,090	5,562	
59.4	0	3,550	1,328	6,890	
60.0	00	3,550	2,130	9,020	
Device	Routing	Invert	Outlet Device	es	
#1	Primary	58.08'	4.0" Vert. Or	ifice/Grate C=	0.600
#2	Primary	58.80'	8.0" Vert. Ori	ifice/Grate C=	0.600
Primary	OutFlow	Max=0.08 cfs (@ 14.89 hrs H	W=58.27' (Free	e Discharge)

1=Orifice/Grate (Orifice Controls 0.08 cfs @ 1.50 fps) 2=Orifice/Grate (Controls 0.00 cfs)

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	Summary for P	ond D-3: Deten	tion Pond by Acces	ss Road
Inflow Area =			w Depth > 1.74 " for	10-Year event
Inflow = Outflow =	0.23 cfs @ 12.09 0.03 cfs @ 12.89		0.017 af 0.017 af Atten= 8	37%, Lag= 48.1 min
Discarded =	0.03 cfs @ 12.89		0.017 af	,, ,o, Lag- 10.1 mill
Primary =	0.00 cfs @ 0.00	nrs, Volume=	0.000 af	
Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 63.62' @ 12.89 hrs Surf.Area= 517 sf Storage= 253 cf Plug-Flow detention time= 83.5 min calculated for 0.016 af (100% of inflow) Center-of-Mass det. time= 83.0 min (933.0 - 850.0)				
Volume Inve #1 63.0		Storage Descrip	Data (Prismatic) Listed	bolow (Booolo)
#1 03.0	4/001	Cusion Stage I	ata (FIISIIIatic) Listeu	below (necalc)
Elevation			.Store	
(feet)	1 1 1		<u>c-feet)</u>	
63.00 64.00	305 650	0 478	0 478	
04.00	050	470	470	
Device Routing	Invert Out			
#1 Primary	Hea 2.5 Co	ad (feet) 0.20 0.4 0 3.00 3.50 4.00	4.50 5.00 5.50 2.50 2.70 2.68 2.68	tangular Weir D 1.40 1.60 1.80 2.00 2.66 2.65 2.65 2.65 2.65
#2 Discarde	d 63.00' 2.4	10 in/hr Exfiltratio	n over Horizontal area	l

Discarded OutFlow Max=0.03 cfs @ 12.89 hrs HW=63.62' (Free Discharge) **-2=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=63.00' (Free Discharge)

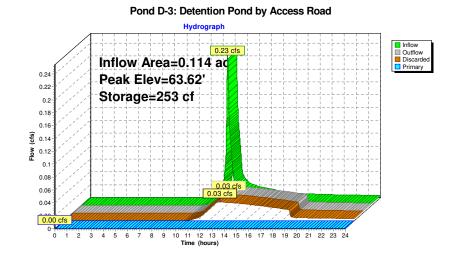
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Summary for Pond UIS-1: UIS at Entrance

Inflow Area =	1.480 ac, 42.24% Impervious, Inflow Depth > 2.58"	for 10-Year event
Inflow =	4.31 cfs @ 12.09 hrs, Volume= 0.318 af	
Outflow =	0.08 cfs @ 10.15 hrs, Volume= 0.109 af, Atte	en= 98%, Lag= 0.0 min
Discarded =	0.08 cfs @ 10.15 hrs, Volume= 0.109 af	
Primary =	0.00 cfs @ 0.00 hrs, Volume= 0.000 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 63.84' @ 18.94 hrs Surf.Area= 3,486 sf Storage= 9,451 cf Flood Elev= 68.40' Surf.Area= 3,486 sf Storage= 13,981 cf

Plug-Flow detention time= 284.6 min calculated for 0.109 af (34% of inflow) Center-of-Mass det. time= 141.9 min (950.2 - 808.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	60.00'	5,786 cf	50.50'W x 69.03'L x 6.50'H Field A
			22,660 cf Overall - 8,195 cf Embedded = 14,465 cf x 40.0% Voids
#2A	61.00'	8,195 cf	Cultec R-902HD x 126 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
			7 Rows of 18 Chambers
			Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf
		13,981 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1 #2	Discarded Primary	60.00' 68.40'	1.020 in/hr Exfiltration over Surface area 24.0" x 24.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.08 cfs @ 10.15 hrs HW=60.08' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=60.00' (Free Discharge)

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Pond UIS-1: UIS at Entrance - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD) 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 Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf

78.0" Wide + 6.0" Spacing = 84.0" C-C Row Spacing

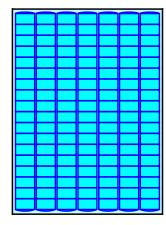
18 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 67.03' Row Length +12.0" End Stone x 2 = 69.03' Base Length 7 Rows x 78.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 50.50' Base Width 12.0" Base + 48.0" Chamber Height + 18.0" Cover = 6.50' Field Height

126 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 7 Rows = 8,195.3 cf Chamber Storage

22,660.2 cf Field - 8,195.3 cf Chambers = 14,464.9 cf Stone x 40.0% Voids = 5,786.0 cf Stone Storage

Chamber Storage + Stone Storage = 13,981.2 cf = 0.321 af Overall Storage Efficiency = 61.7%Overall System Size = $69.03' \times 50.50' \times 6.50'$

126 Chambers 839.3 cy Field 535.7 cy Stone





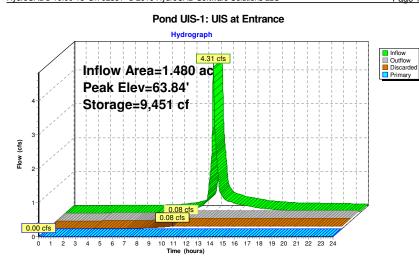
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Summary for Pond UIS-2: UIS at North of Site

0.384 ac,100.00% Impervious, Inflow D	epth > 4.26" for 10-Year event
1.69 cfs @ 12.08 hrs, Volume=	0.136 af
0.23 cfs @ 11.63 hrs, Volume=	0.136 af, Atten= 87%, Lag= 0.0 min
0.23 cfs @ 11.63 hrs, Volume=	0.136 af
0.00 cfs @ 0.00 hrs, Volume=	0.000 af
	1.69 cfs @ 12.08 hrs, Volume= 0.23 cfs @ 11.63 hrs, Volume= 0.23 cfs @ 11.63 hrs, Volume=

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 63.82' @ 12.60 hrs Surf.Area= 1,176 sf Storage= 1,729 cf Flood Elev= 68.25' Surf.Area= 1,176 sf Storage= 2,860 cf

Plug-Flow detention time= 45.8 min calculated for 0.136 af (100% of inflow) Center-of-Mass det. time= 45.6 min (794.8 - 749.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	61.50'	1,262 cf	16.00'W x 73.50'L x 4.04'H Field A
			4,753 cf Overall - 1,598 cf Embedded = 3,155 cf x 40.0% Voids
#2A	62.50'	1,598 cf	Cultec R-330XLHD x 30 Inside #1
			Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
			Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
			Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
		2.860 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices		
#1	Discarded	61.50'	8.270 in/hr Exfiltration ov	er Surface	area
#2	Primary	68.25'	6.0" Horiz. Orifice/Grate	C= 0.600	Limited to weir flow at low heads

Discarded OutFlow Max=0.23 cfs @ 11.63 hrs HW=61.57' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.23 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=61.50' (Free Discharge)

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Pond UIS-2: UIS at North of Site - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

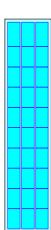
10 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 71.50' Row Length +12.0" End Stone x 2 = 73.50' Base Length 3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width 12.0" Base + 30.5" Chamber Height + 6.0" Cover = 4.04' Field Height

30 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 3 Rows = 1,598.2 cf Chamber Storage

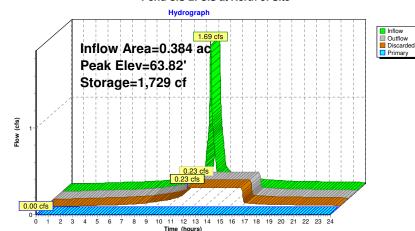
4,753.0 cf Field - 1,598.2 cf Chambers = 3,154.8 cf Stone x 40.0% Voids = 1,261.9 cf Stone Storage

Chamber Storage + Stone Storage = 2,860.1 cf = 0.066 af Overall Storage Efficiency = 60.2% Overall System Size = 73.50' x 16.00' x 4.04'

30 Chambers 176.0 cy Field 116.8 cy Stone



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Summary for Pond UIS-3: UIS-3

[58] Hint: Peaked 1.53' above defined flood level

Inflow Area =	0.083 ac,100.00% Impervious, Inflow Depth > 4.26" for 10-Year event
Inflow =	0.37 cfs @ 12.08 hrs, Volume= 0.030 af
Outflow =	0.36 cfs @ 12.09 hrs, Volume= 0.027 af, Atten= 1%, Lag= 0.7 min
Discarded =	0.00 cfs @ 3.34 hrs, Volume= 0.004 af
Primary =	0.36 cfs @ 12.09 hrs, Volume= 0.023 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 73.74' @ 12.09 hrs Surf.Area= 103 sf Storage= 135 cf Flood Elev= 72.21' Surf.Area= 103 sf Storage= 22 cf

Plug-Flow detention time= 72.9 min calculated for 0.027 af (91% of inflow) Center-of-Mass det. time= 28.0 min (777.3 - 749.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	71.69'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
			332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	72.19'	97 cf	Cultec R-280HD x 2 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	71.69'	1.020 in/hr Exfiltration over Surface area
#2	Primary	73.40'	6.0" Round Culvert L= 30.0' Ke= 0.200
			Inlet / Outlet Invert= 73.40' / 70.70' S= 0.0900 '/' Cc= 0.900
			n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.00 cfs @ 3.34 hrs HW=71.72' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.36 cfs @ 12.09 hrs HW=73.74' (Free Discharge) -2=Culvert (Inlet Controls 0.36 cfs @ 2.50 fps)

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Pond UIS-3: UIS-3 - Chamber Wizard Field A

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Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

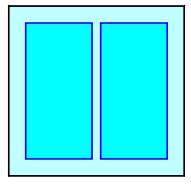
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

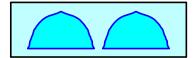
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

2 Chambers 12.3 cy Field 8.7 cy Stone





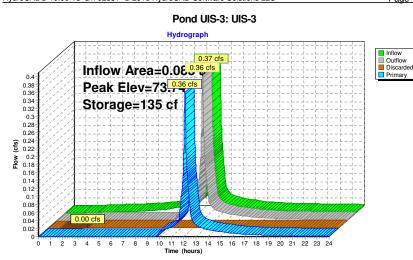
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Summary for Pond UIS-4: UIS-4

[58] Hint: Peaked 0.45' above defined flood level

Inflow Area	ι=	0.073 ac,10	0.00% Imperv	vious, Inflow I	Depth > 4.26"	for 10-Year event
Inflow	=	0.32 cfs @	12.08 hrs, Vo	olume=	0.026 af	
Outflow	=	0.32 cfs @	12.10 hrs, Vo	olume=	0.023 af, Att	en= 2%, Lag= 1.0 min
Discarded	=	0.00 cfs @	3.68 hrs, Vo	olume=	0.004 af	
Primary	=	0.31 cfs @	12.10 hrs, Vo	olume=	0.019 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 74.65' @ 12.10 hrs Surf.Area= 103 sf Storage= 141 cf Flood Elev= 74.20' Surf.Area= 103 sf Storage= 111 cf

Plug-Flow detention time= 78.6 min calculated for 0.023 af (90% of inflow) Center-of-Mass det. time= 29.9 min (779.1 - 749.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	72.50'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
			332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	73.00'	97 cf	Cultec R-280HD x 2 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	72.50'	1.020 in/hr Exfiltration over Surface area
#2	Primary	74.20'	6.0" Round Culvert L= 30.0' Ke= 1.000 Inlet / Outlet Invert= 74.20' / 74.06' S= 0.0047 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.00 cfs @ 3.68 hrs HW=72.53' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.31 cfs @ 12.10 hrs HW=74.65' (Free Discharge) -2=Culvert (Barrel Controls 0.31 cfs @ 2.20 fps)

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Pond UIS-4: UIS-4 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

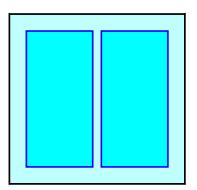
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

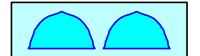
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

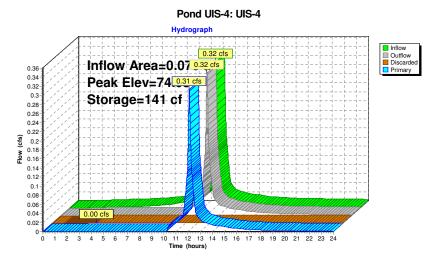
Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

2 Chambers 12.3 cy Field 8.7 cy Stone





Topsfield Proposed HydroCAD 2-2-17 Type III 24-hr 10-Year Rainfall=4.50" Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Printed 2/27/2017



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		Sui	mmary for Pond UIS-5: UIS-5
flow Area flow utflow iscarded rimary	= 0. = 0. = 0.	.083 ac,100.00% 37 cfs @ 12.08 h 35 cfs @ 12.10 h 00 cfs @ 3.34 h 35 cfs @ 12.10 h	nrs, Volume= 0.027 af, Atten= 3%, Lag= 1.3 min nrs, Volume= 0.004 af
innary	- 0.	00 013 @ 12.101	13, Volume= 0.020 al
outing by	Stor-Ind m	nethod, Time Spar	n= 0.00-24.00 hrs, dt= 0.01 hrs
eak Elev	= 75.29' @	12.10 hrs Surf.A	rea= 103 sf Storage= 144 cf
			evilated for 0.007 of (010) of inflow)
			culated for 0.027 af (91% of inflow)
		ime= 73.6 min cal ime= 28.5 min (7	
		ime= 28.5 min (7	
enter-of-l	Mass det. t	ime= 28.5 min (7	77.8 - 749.3) Storage Description
enter-of-l <u>olume</u> #1A	Mass det. t Invert 73.09'	ime= 28.5 min (7 Avail.Storage 94 cf	77.8 - 749.3) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
enter-of-l olume	Mass det. t Invert	ime= 28.5 min (7 Avail.Storage	77.8 - 749.3) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1
enter-of-l <u>olume</u> #1A	Mass det. t Invert 73.09'	ime= 28.5 min (7 Avail.Storage 94 cf	77.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
enter-of-l <u>olume</u> #1A	Mass det. t Invert 73.09'	ime= 28.5 min (7 Avail.Storage 94 cf	77.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
enter-of-l <u>olume</u> #1A	Mass det. t Invert 73.09'	ime= 28.5 min (7 <u>Avail.Storage</u> 94 cf 97 cf	77.8 - 749.3) 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
enter-of-l <u>olume</u> #1A	Mass det. t Invert 73.09'	ime= 28.5 min (7 <u>Avail.Storage</u> 94 cf 97 cf	77.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
enter-of-l olume #1A #2A	Mass det. t <u>Invert</u> 73.09' 73.59'	ime= 28.5 min (7 <u>Avail.Storage</u> 94 cf 97 cf	77.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage
enter-of-l olume #1A #2A Storage	Mass det. t <u>Invert</u> 73.09' 73.59' e Group A c	ime= 28.5 min (7' Avail.Storage 94 cf 97 cf 191 cf created with Cham	$\begin{array}{l} \hline \textbf{T7.8 - 749.3} \end{array} \\ \hline \textbf{Storage Description} \\ \hline \textbf{10.33'W x 10.00'L x 3.21'H Field A} \\ \hline \textbf{332 cf Overall - 97 cf Embedded} = 234 cf x 40.0\% Voids \\ \hline \textbf{Cultec R-280HD x 2} \ lnside \#1 \\ \hline \textbf{Effective Size} = 47.0''W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf \\ \hline \textbf{Overall Size} = 47.0''W x 26.5''H x 8.00'' with 1.00' Overlap \\ \hline \textbf{Row Length Adjustment} + +1.00' x 6.07 sf x 2 rows \\ \hline \textbf{Total Available Storage} \\ \hline \textbf{Ner Wizard} \end{array}$
enter-of-l olume #1A #2A	Mass det. t <u>Invert</u> 73.09' 73.59' e Group A c	ime= 28.5 min (7' <u>Avail.Storage</u> 94 cf 97 cf 191 cf	$\begin{array}{l} \hline \textbf{T7.8 - 749.3} \end{array} \\ \hline \textbf{Storage Description} \\ \hline \textbf{10.33'W x 10.00'L x 3.21'H Field A} \\ \hline \textbf{332 cf Overall - 97 cf Embedded} = 234 cf x 40.0\% Voids \\ \hline \textbf{Cultec R-280HD x 2} \ lnside \#1 \\ \hline \textbf{Effective Size} = 47.0''W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf \\ \hline \textbf{Overall Size} = 47.0''W x 26.5''H x 8.00'' with 1.00' Overlap \\ \hline \textbf{Row Length Adjustment} + +1.00' x 6.07 sf x 2 rows \\ \hline \textbf{Total Available Storage} \\ \hline \textbf{Ner Wizard} \end{array}$
enter-of-I olume #1A #2A Storage evice F #1 C	Mass det. t <u>Invert</u> 73.09' 73.59' e Group A d <u>Routing</u> Discarded	ime= 28.5 min (7' <u>Avail.Storage</u> 94 cf 97 cf 191 cf created with Cham <u>Invert</u> <u>Out</u> 73.09' 1.02	$\begin{array}{l} \hline \hline \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $
enter-of-I olume #1A #2A Storage evice F #1 C	Mass det. t Invert 73.09' 73.59' e Group A d Routing	ime= 28.5 min (7' <u>Avail.Storage</u> 94 cf 97 cf 191 cf created with Cham <u>Invert</u> Outt 73.09' 1.02 74.80' 6.0 ''	$\begin{array}{l} \hline \textbf{Storage Description} \\ \hline \textbf{10.33'W x 10.00'L x 3.21'H Field A} \\ \hline \textbf{32} cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids \\ \hline \textbf{Cultec R-280HD } x 2 \text{ Inside #1} \\ \hline \textbf{Effective Size} 46.9''W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf \\ \hline \textbf{Overall Size} 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap \\ \hline \textbf{Row Length Adjustment} + 1.00' x 6.07 sf x 2 rows \\ \hline \textbf{Total Available Storage} \\ \hline \textbf{Nber Wizard} \\ \hline \textbf{let Devices} \\ \hline \textbf{20 in/hr Exfiltration over Surface area} \\ \hline \textbf{Round Culvert } L = 22.0' \\ \hline \textbf{Ke} = 1.000 \\ \hline \end{array}$
enter-of-I olume #1A #2A Storage evice F #1 C	Mass det. t <u>Invert</u> 73.09' 73.59' e Group A d <u>Routing</u> Discarded	ime= 28.5 min (7' <u>Avail.Storage</u> 94 cf 97 cf 191 cf created with Cham <u>Invert</u> Outi 73.09' 1.02 74.80' 6.0" Inlei	$\begin{array}{l} \hline \hline \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ $

Discarded OutFlow Max=0.00 cfs @ 3.34 hrs HW=73.12' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.35 cfs @ 12.10 hrs HW=75.29' (Free Discharge) -2=Culvert (Inlet Controls 0.35 cfs @ 1.80 fps)

Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr	10-Year Rainfall=4.50"
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Pond UIS-5: UIS-5 - Chamber Wizard Field A

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Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

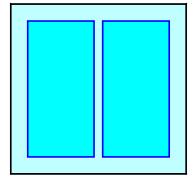
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

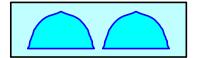
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

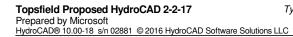
331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

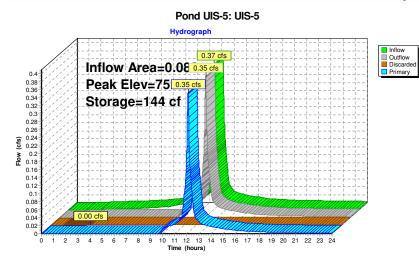
2 Chambers 12.3 cy Field 8.7 cy Stone







Type III 24-hr 10-Year Rainfall=4.50" Printed 2/27/2017 Page 131



HydroCAD	₿10.00-18 s/	n 02881 © 2016 F	HydroCAD Software Solutions LLC Page 13
		Sur	mmary for Pond UIS-6: UIS-6
Inflow Are Inflow Outflow Discardec Primary	= 0.3 = 0.3 = 0.0	9 cfs @ 12.08 h 8 cfs @ 12.11 h	nrs, Volume= 0.029 af, Atten= 4%, Lag= 1.3 min nrs, Volume= 0.004 af
			n= 0.00-24.00 hrs, dt= 0.01 hrs rea= 103 sf Storage= 146 cf
		me= 70.5 min cal me= 27.8 min (77	lculated for 0.029 af (92% of inflow) 77.1 - 749.3)
Volume	Invert	Avail.Storage	Storage Description
#1A	72.29'	94 cf	
#2A	72.79'	97 cf	332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
			Row Length Adjustment= $+1.00' \times 6.07$ sf x 2 rows
#1 I	Routing Discarded Primary	72.29' 1.02 74.00' 6.0'' Inlet	let Devices 20 in/hr Exfiltration over Surface area ' Round Culvert L= 106.0' Ke= 1.000 t / Outlet Invert= 74.00' / 72.18' S= 0.0172 '/ Cc= 0.900 .011 PVC, smooth interior, Flow Area= 0.20 sf
Ê—1=Exfil	tration (Exfi	ax=0.00 cfs @ 3	3.17 hrs HW=72.32' (Free Discharge) 0.00 cfs)
		<=0.38 cfs @ 12. ontrols 0.38 cfs @	11 hrs HW=74.53' (Free Discharge) 9 1.92 fps)

Type III 24-hr 10-Year Rainfall=4.50" Printed 2/27/2017 Page 133

Pond UIS-6: UIS-6 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

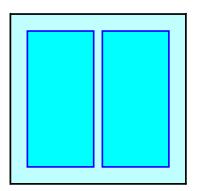
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

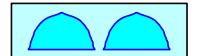
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

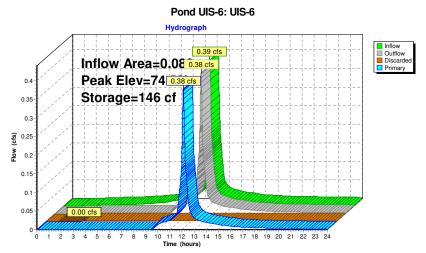
Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

2 Chambers 12.3 cy Field 8.7 cy Stone









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	D® 10.00-1				
			Sur	nmary for Pond UIS-7: UIS-7	
Inflow A	rea =	0.083 ac.100).00% I	npervious, Inflow Depth > 4.26" for 10	-Year event
Inflow	=			rs, Volume= 0.030 af	
Outflow	=	0.35 cfs @	12.10 h	rs, Volume= 0.027 af, Atten= 3%,	Lag= 1.3 min
Discard				rs, Volume= 0.004 af	
Primary	=	0.35 cfs @	12.10 h	rs, Volume= 0.023 af	
	ev= 73.99° (@ 12.10 hrs	Surf.A	ea= 103 sf Storage= 144 cf	
				ulated for 0.027 af (91% of inflow)	
		n time= 73.6 r :. time= 28.5 r			
		. time= 28.5 r	min (77		
Center-o	of-Mass det	time= 28.5 r t Avail.St	min (77 orage	7.8 - 749.3)	
Center-o <u>Volume</u> #1A	of-Mass dei Inver 71.79	:. time= 28.5 r t <u>Avail.St</u> 9'	min (77 <u>orage</u> 94 cf	7.8 - 749.3) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf	x 40.0% Voids
Center-o Volume	of-Mass det Inver	:. time= 28.5 r t <u>Avail.St</u> 9'	min (77 <u>orage</u> 94 cf	7.8 - 749.3) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf Cultec R-280HD x 2 Inside #1	
Center-o <u>Volume</u> #1A	of-Mass dei Inver 71.79	:. time= 28.5 r t <u>Avail.St</u> 9'	min (77 <u>orage</u> 94 cf	7.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 s	sf x 7.00'L = 42.5 cf
Center-o <u>Volume</u> #1A	of-Mass dei Inver 71.79	:. time= 28.5 r t <u>Avail.St</u> 9'	min (77 <u>orage</u> 94 cf	7.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 s Overall Size= 47.0''W x 26.5''H x 8.00'L w	sf x 7.00'L = 42.5 cf ith 1.00' Overlap
Center-o <u>Volume</u> #1A	of-Mass dei Inver 71.79	:. time= 28.5 r <u>t Avail.St</u> ?'	min (77 <u>orage</u> 94 cf 97 cf	7.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 so Overall Size= 47.0"W x 26.5"H x 8.00'L w Row Length Adjustment= +1.00' x 6.07 sf	sf x 7.00'L = 42.5 cf ith 1.00' Overlap
Center-o <u>Volume</u> #1A	of-Mass dei Inver 71.79	:. time= 28.5 r <u>t Avail.St</u> ?'	min (77 <u>orage</u> 94 cf 97 cf	7.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 s Overall Size= 47.0''W x 26.5''H x 8.00'L w	sf x 7.00'L = 42.5 cf ith 1.00' Overlap
Center-o <u>Volume</u> #1A #2A	of-Mass dei Inver 71.79 72.29	:. time= 28.5 r <u>t Avail.St</u> ?'	min (77 <u>orage</u> 94 cf 97 cf 191 cf	7.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 sf Overall Size= 47.0''W x 26.5''H x 8.00'L w Row Length Adjustment= +1.00' x 6.07 sf Total Available Storage	sf x 7.00'L = 42.5 cf ith 1.00' Overlap
Center-o Volume #1A #2A Stora	of-Mass del Inver 71.79 72.29 ge Group /	. time= 28.5 r t Avail.St y y A created with	min (77 orage 94 cf 97 cf 191 cf n Cham	7.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 so Overall Size= 47.0'W x 26.5''H x 8.00'L w Row Length Adjustment= +1.00' x 6.07 sf Total Available Storage per Wizard	sf x 7.00'L = 42.5 cf ith 1.00' Overlap
Center-o Volume #1A #2A Stora Device	of-Mass del Inver 71.75 72.25 ge Group / Routing	. time= 28.5 r t <u>Avail.St</u> y A created with Inver	min (77 orage 94 cf 97 cf 191 cf n Cham t_Outl	7.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 s Overall Size= 47.0''W x 26.5''H x 8.00'L w Row Length Adjustment= +1.00' x 6.07 sf Total Available Storage per Wizard et Devices	sf x 7.00'L = 42.5 cf ith 1.00' Overlap
Center-o Volume #1A #2A Stora Device #1	of-Mass del Inver 71.75 72.25 ge Group / Routing Discarded	. time= 28.5 r <u>t</u> Avail.St y A created with <u>Inver</u> t 71.79	min (77 orage 94 cf 97 cf 191 cf n Cham t Outl ' 1.02	7.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 s Overall Size= 47.0''W x 26.5''H x 8.00'L w Row Length Adjustment= +1.00' x 6.07 sf Total Available Storage ber Wizard at Devices Din/hr Exfiltration over Surface area	sf x 7.00'L = 42.5 cf ith 1.00' Overlap
Center-o Volume #1A #2A Stora Device	of-Mass del Inver 71.75 72.25 ge Group / Routing	. time= 28.5 r <u>t</u> Avail.St y A created with <u>Inver</u> t 71.79	min (77 94 cf 97 cf 191 cf 191 cf 1 Cham t Outl ' 1.02 ' 6.0"	7.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9'W x 26.0''H => 6.07 s Overall Size= 47.0''W x 26.5''H x 8.00'L w Row Length Adjustment= +1.00' x 6.07 sf Total Available Storage per Wizard et Devices	sf x 7.00'L = 42.5 cf ith 1.00' Overlap x 2 rows

Discarded OutFlow Max=0.00 cfs @ 3.34 hrs HW=71.82' (Free Discharge) 1=Exfiltration (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.35 cfs @ 12.10 hrs HW=73.99' (Free Discharge) -2=Culvert (Inlet Controls 0.35 cfs @ 1.80 fps)

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Pond UIS-7: UIS-7 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

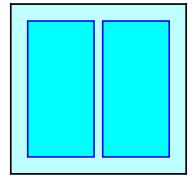
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

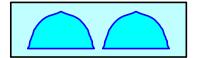
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

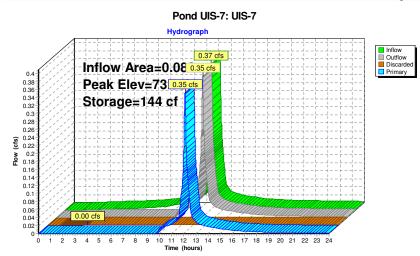
2 Chambers 12.3 cy Field 8.7 cy Stone







Type III 24-hr 10-Year Rainfall=4.50" Printed 2/27/2017 Page 137



	d by Micros				Printed 2/27/20
HydroCA	D® 10.00-18	<u>s/n 02881 © 2016 F</u>	lydroCAD Software S	olutions LLC	Page 1
		Su	mmary for Pond	UIS-8: UIS-8	
Inflow A Inflow Outflow Discarde	= 0 = 0	.37 cfs @ 12.08 h .35 cfs @ 12.10 h	rs, Volume=	Depth > 4.26" for 0.030 af 0.027 af, Atten= 3° 0.004 af	
Primary		.35 cfs @ 12.10 h		0.004 af	
			n= 0.00-24.00 hrs, di rea= 103 sf Storag		
		time= 73.6 min cal time= 28.5 min (7	culated for 0.027 af 77.8 - 749.3)	(91% of inflow)	
Volume	Invert	Avail.Storage	Storage Description		
#1A	71.09'	94 cf		x 3.21'H Field A of Embedded = 234	cf_x 40.0% Voids
#2A	71.59'	97 cf	Cultec R-280HD x Effective Size= 46	2 Inside #1	7 sf x 7.00'L = 42.5 cf
			Row Length Adjus	tment= +1.00' x 6.07	sf x 2 rows
	• .	191 cf created with Cham		brage	
	• .	created with Cham Invert Outl 71.09' 1.02 72.80' 6.0 ''	ber Wizard et Devices 0 in/hr Exfiltration (Round Culvert L:	over Surface area = 37.0' Ke= 1.000	18.14 Co. 0.000
Device #1	Routing Discarded	Invert Out 71.09' 1.02 72.80' 6.0''	ber Wizard <u>et Devices</u> 10 in/hr Exfiltration Round Culvert : / Outlet Invert= 72.3	over Surface area	
Device #1 #2 Discarde	Routing Discarded Primary ed OutFlow	created with Cham Invert Out 71.09' 1.02 72.80' 6.0" Inlei n= 0	ber Wizard <u>et Devices</u> 10 in/hr Exfiltration (Round Culvert L: / Outlet Invert= 72. 0.011 PVC, smooth .34 hrs HW=71.12'	over Surface area = 37.0' Ke= 1.000 80' / 72.18' S= 0.016 interior, Flow Area=	
Device #1 #2 Discarde 1=Ex Primary	Routing Discarded Primary ed OutFlow filtration (E) OutFlow Ma	Invert Out 71.09' 1.02 72.80' 6.0" Inlei n= (Max=0.00 cfs @ 3 cfiltration Controls	ber Wizard <u>et Devices</u> 0 in/hr Exfiltration (Round Culvert L: / Outlet Invert= 72: 0.011 PVC, smooth .34 hrs HW=71.12' 0.00 cfs) 10 hrs HW=73.29'	over Surface area = 37.0' Ke= 1.000 80' / 72.18' S= 0.016 interior, Flow Area= (Free Discharge)	
Device #1 #2 Discarde 1=Ex Primary	Routing Discarded Primary ed OutFlow filtration (E) OutFlow Ma	Invert Out 71.09' 1.02 72.80' 6.0" Inlei n= 0 Max=0.00 cfs @ 3 Giltration Controls ax=0.35 cfs @ 12.	ber Wizard <u>et Devices</u> 0 in/hr Exfiltration (Round Culvert L: / Outlet Invert= 72: 0.011 PVC, smooth .34 hrs HW=71.12' 0.00 cfs) 10 hrs HW=73.29'	over Surface area = 37.0' Ke= 1.000 80' / 72.18' S= 0.016 interior, Flow Area= (Free Discharge)	
Device #1 #2 Discarde 1=Ex Primary	Routing Discarded Primary ed OutFlow filtration (E) OutFlow Ma	Invert Out 71.09' 1.02 72.80' 6.0" Inlei n= 0 Max=0.00 cfs @ 3 Giltration Controls ax=0.35 cfs @ 12.	ber Wizard <u>et Devices</u> 0 in/hr Exfiltration (Round Culvert L: / Outlet Invert= 72: 0.011 PVC, smooth .34 hrs HW=71.12' 0.00 cfs) 10 hrs HW=73.29'	over Surface area = 37.0' Ke= 1.000 80' / 72.18' S= 0.016 interior, Flow Area= (Free Discharge)	
Device #1 #2 Discarde 1=Ex Primary	Routing Discarded Primary ed OutFlow filtration (E) OutFlow Ma	Invert Out 71.09' 1.02 72.80' 6.0" Inlei n= 0 Max=0.00 cfs @ 3 Giltration Controls ax=0.35 cfs @ 12.	ber Wizard <u>et Devices</u> 0 in/hr Exfiltration (Round Culvert L: / Outlet Invert= 72: 0.011 PVC, smooth .34 hrs HW=71.12' 0.00 cfs) 10 hrs HW=73.29'	over Surface area = 37.0' Ke= 1.000 80' / 72.18' S= 0.016 interior, Flow Area= (Free Discharge)	
Device #1 #2 Discarde 1=Ex Primary	Routing Discarded Primary ed OutFlow filtration (E) OutFlow Ma	Invert Out 71.09' 1.02 72.80' 6.0" Inlei n= 0 Max=0.00 cfs @ 3 Giltration Controls ax=0.35 cfs @ 12.	ber Wizard <u>et Devices</u> 0 in/hr Exfiltration (Round Culvert L: / Outlet Invert= 72: 0.011 PVC, smooth .34 hrs HW=71.12' 0.00 cfs) 10 hrs HW=73.29'	over Surface area = 37.0' Ke= 1.000 80' / 72.18' S= 0.016 interior, Flow Area= (Free Discharge)	
Device #1 #2 Discarde 1=Ex Primary	Routing Discarded Primary ed OutFlow filtration (E) OutFlow Ma	Invert Out 71.09' 1.02 72.80' 6.0" Inlei n= 0 Max=0.00 cfs @ 3 Giltration Controls ax=0.35 cfs @ 12.	ber Wizard <u>et Devices</u> 0 in/hr Exfiltration (Round Culvert L: / Outlet Invert= 72: 0.011 PVC, smooth .34 hrs HW=71.12' 0.00 cfs) 10 hrs HW=73.29'	over Surface area = 37.0' Ke= 1.000 80' / 72.18' S= 0.016 interior, Flow Area= (Free Discharge)	
Device #1 #2 Discarde 1=Ex Primary	Routing Discarded Primary ed OutFlow filtration (E) OutFlow Ma	Invert Out 71.09' 1.02 72.80' 6.0" Inlei n= 0 Max=0.00 cfs @ 3 Giltration Controls ax=0.35 cfs @ 12.	ber Wizard <u>et Devices</u> 0 in/hr Exfiltration (Round Culvert L: / Outlet Invert= 72: 0.011 PVC, smooth .34 hrs HW=71.12' 0.00 cfs) 10 hrs HW=73.29'	over Surface area = 37.0' Ke= 1.000 80' / 72.18' S= 0.016 interior, Flow Area= (Free Discharge)	
Device #1 #2 Discarde 1=Ex Primary	Routing Discarded Primary ed OutFlow filtration (E) OutFlow Ma	Invert Out 71.09' 1.02 72.80' 6.0" Inlei n= 0 Max=0.00 cfs @ 3 Giltration Controls ax=0.35 cfs @ 12.	ber Wizard <u>et Devices</u> 0 in/hr Exfiltration (Round Culvert L: / Outlet Invert= 72: 0.011 PVC, smooth .34 hrs HW=71.12' 0.00 cfs) 10 hrs HW=73.29'	over Surface area = 37.0' Ke= 1.000 80' / 72.18' S= 0.016 interior, Flow Area= (Free Discharge)	

Type III 24-hr 10-Year Rainfall=4.50" Printed 2/27/2017 Page 139

Pond UIS-8: UIS-8 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

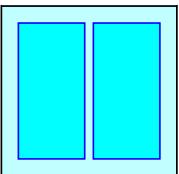
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

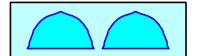
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

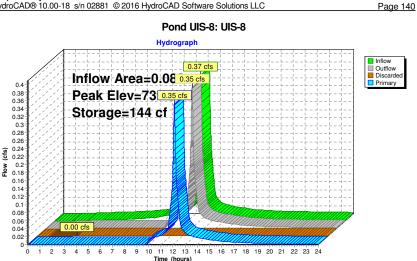
2 Chambers 12.3 cy Field 8.7 cy Stone





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Flow



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	by Microso 10.00-18 s		- 2-17 HydroCAD Software Solu	Type III 24-hr tions LLC	Printed 2	2/27/2017 Page 141	Topsfi Prepare HydroCA
		Su	mmary for Pond U	S-9: UIS-9			
Inflow Are	a = 0.	089 ac,100.00%	Impervious, Inflow De	pth > 4.26" for 10-Y	'ear event		Chambe
Inflow		39 cfs @ 12.08 h		0.032 af			Effective
Outflow		38 cfs @ 12.11 h		0.031 af, Atten= 4%, L	.ag= 1.5 min		Overall
Discarded Primary		0 cfs @ 3.17 h 37 cfs @ 12.11 h		0.004 af 0.026 af			Row Ler
		•	, ,	0.01 hrs			47.0" W
			n= 0.00-24.00 hrs, dt= 0 rea= 103 sf Storage=				
Feak Elev	= 72.71 @	12.111115 Juli.A	iea= 105 Si Siorage=	910			1 Cham
							Deeele
Plug-Flow	detention til	me= 40 7 min cal	culated for 0.031 af (96	5% of inflow)			Base Le
			culated for 0.031 af (96 66.8 - 749.3)	6% of inflow)			
		me= 40.7 min cal me= 17.5 min (7		6% of inflow)			2 Rows
		me= 17.5 min (7		6% of inflow)			2 Rows 6.0" Bas
Center-of-	Mass det. ti	me= 17.5 min (7 Avail.Storage	66.8 - 749.3)	,			2 Rows
Center-of- Volume	Mass det. tii Invert 71.28'	me= 17.5 min (7 Avail.Storage	66.8 - 749.3) <u>Storage Description</u> 10.33'W x 10.00'L x 3	,	40.0% Voids		2 Rows 6.0" Bas
Center-of- Volume	Mass det. til Invert	me= 17.5 min (7 Avail.Storage 94 cf	66.8 - 749.3) <u>Storage Description</u> 10.33'W x 10.00'L x 3 332 cf Overall - 97 cf Cultec R-280HD x 2	3.21'H Field A Embedded = 234 cf x Inside #1			2 Rows 6.0" Bas
Center-of- <u>Volume</u> #1A	Mass det. tii Invert 71.28'	me= 17.5 min (7 Avail.Storage 94 cf	66.8 - 749.3) <u>Storage Description</u> 10.33'W x 10.00'L x 3 332 cf Overall - 97 cf Cultec R-280HD x 2 Effective Size= 46.9"	3.21'H Field A Embedded = 234 cf x Inside #1 W x 26.0"H => 6.07 sf	x 7.00'L = 42.5		2 Rows 6.0" Bas 2 Cham
Center-of- <u>Volume</u> #1A	Mass det. tii Invert 71.28'	me= 17.5 min (7 Avail.Storage 94 cf	66.8 - 749.3) <u>Storage Description</u> 10.33'W x 10.00'L x 3 332 cf Overall - 97 cf Cultec R-280HD x 2 Effective Size= 46.9" Overall Size= 47.0"W	3.21'H Field A Embedded = 234 cf x Inside #1 W x 26.0"H => 6.07 sf / x 26.5"H x 8.00'L with	x 7.00'L = 42.5 1.00' Overlap		2 Rows 6.0" Bas 2 Cham 331.5 cf Chambe
Center-of- <u>Volume</u> #1A	Mass det. tii Invert 71.28'	me= 17.5 min (7 <u>Avail.Storage</u> 94 cf 97 cf	66.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3 332 cf Overall - 97 cf Cultec R-280HD x 2 Effective Size= 46.9" Overall Size= 47.0"W Row Length Adjustm	2.21'H Field A Embedded = 234 cf x Inside #1 W x 26.0"H => 6.07 sf x 26.5"H × 8.00'L with ent= +1.00' x 6.07 sf x 3	x 7.00'L = 42.5 1.00' Overlap		2 Rows 6.0" Bas 2 Cham 331.5 cf
Center-of- <u>Volume</u> #1A	Mass det. tii Invert 71.28'	me= 17.5 min (7 <u>Avail.Storage</u> 94 cf 97 cf	66.8 - 749.3) <u>Storage Description</u> 10.33'W x 10.00'L x 3 332 cf Overall - 97 cf Cultec R-280HD x 2 Effective Size= 46.9" Overall Size= 47.0"W	2.21'H Field A Embedded = 234 cf x Inside #1 W x 26.0"H => 6.07 sf x 26.5"H × 8.00'L with ent= +1.00' x 6.07 sf x 3	x 7.00'L = 42.5 1.00' Overlap		2 Rows 6.0" Bas 2 Cham 331.5 cf Chambe
Center-of- Volume #1A #2A	Mass det. tin <u>Invert</u> 71.28' 71.78'	me= 17.5 min (7 <u>Avail.Storage</u> 94 cf 97 cf	66.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3 332 cf Overall - 97 cf Cultec R-280HD x 2 Effective Size= 46.9" Overall Size= 47.0"W Row Length Adjustm Total Available Stora	2.21'H Field A Embedded = 234 cf x Inside #1 W x 26.0"H => 6.07 sf x 26.5"H × 8.00'L with ent= +1.00' x 6.07 sf x 3	x 7.00'L = 42.5 1.00' Overlap		2 Rows 6.0" Bas 2 Cham 331.5 cf Chambe Overall
Center-of- Volume #1A #2A Storage	Mass det. til Invert 71.28' 71.78' e Group A cr	me= 17.5 min (7/ Avail.Storage 94 cf 97 cf 191 cf reated with Cham	66.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3 332 cf Overall - 97 cf Cultec R-280HD x 2 Effective Size= 46.9" Overall Size= 47.0"W Row Length Adjustm Total Available Stora wher Wizard	2.21'H Field A Embedded = 234 cf x Inside #1 W x 26.0"H => 6.07 sf x 26.5"H × 8.00'L with ent= +1.00' x 6.07 sf x 3	x 7.00'L = 42.5 1.00' Overlap		2 Rows 6.0" Bas 2 Cham 331.5 cf Chambe Overall Overall
Center-of- Volume #1A #2A Storag	Mass det. tin Invert 71.28' 71.78' e Group A cr Routing	me= 17.5 min (7/ Avail.Storage 94 cf 97 cf 191 cf reated with Cham Invert Out	66.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3 332 cf Overall - 97 cf Cultec R-260HD x 2 Effective Size= 46.9" Overall Size= 47.0"W Row Length Adjustm Total Available Stora wher Wizard let Devices	5.21'H Field A Embedded = 234 cf x Inside #1 W x 26.0"H => 6.07 sf x / x 26.5"H x 8.00'L with ent= +1.00' x 6.07 sf x ge	x 7.00'L = 42.5 1.00' Overlap		2 Rows 6.0" Bas 2 Cham 331.5 cf Chambe Overall Overall 2 Cham
Center-of- <u>Volume</u> #1A #2A Storage <u>Device F</u> #1 [Mass det. tii Invert 71.28' 71.78' e Group A cr Routing Discarded	me= 17.5 min (7/ <u>Avail.Storage</u> 94 cf 97 cf 191 cf reated with Charr <u>Invert</u> <u>Out</u> 71.28' 1.02	66.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3 332 cf Overall - 97 cf Cultec R-280HD x 2 Effective Size= 46.9" Overall Size= 47.0"W Row Length Adjustm Total Available Stora aber Wizard let Devices 20 in/hr Exfiltration over	2.21'H Field A Embedded = 234 cf x Inside #1 W x 26.0"H => 6.07 sf / x 26.5"H x 8.00'L with ent= +1.00' x 6.07 sf x : ge er Surface area	x 7.00'L = 42.5 1.00' Overlap		2 Rows 6.0" Bas 2 Cham 331.5 cf Chambe Overall Overall 2 Cham 12.3 cy
Center-of- <u>Volume</u> #1A #2A Storage <u>Device F</u> #1 [Mass det. tin Invert 71.28' 71.78' e Group A cr Routing	me= 17.5 min (7/ Avail.Storage 94 cf 97 cf 191 cf reated with Charr Invert Out 71.28' 1.02 72.18' 6.0''	66.8 - 749.3) Storage Description 10.33'W x 10.00'L x 3 332 cf Overall - 97 cf Cultec R-280HD x 2 Effective Size= 46.9" Overall Size= 47.0"W Row Length Adjustm Total Available Stora aber Wizard let Devices 20 in/hr Exfiltration ovi Round Culvert L= 7	2.21'H Field A Embedded = 234 cf x Inside #1 W x 26.0"H => 6.07 sf / x 26.5"H x 8.00'L with ent= +1.00' x 6.07 sf x : ge er Surface area	x 7.00'L = 42.5 1.00' Overlap 2 rows		2 Rows 6.0" Bas 2 Cham 331.5 cf Chambe Overall Overall 2 Cham 12.3 cy

Discarded OutFlow Max=0.00 cfs @ 3.17 hrs HW=71.31' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.37 cfs @ 12.11 hrs HW=72.71' (Free Discharge) -2=Culvert (Inlet Controls 0.37 cfs @ 1.90 fps)

posed HydroCAD 2-2-17 Type III 24-hr 10-Year Rainfall=4.50" Printed 2/27/2017 icrosoft 0-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC

Pond UIS-9: UIS-9 - Chamber Wizard Field A

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= Cultec R-280HD (Cultec Recharger® 280HD)

46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 7.0"W x 26.5"H x 8.00'L with 1.00' Overlap ustment= +1.00' x 6.07 sf x 2 rows

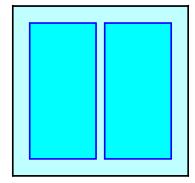
" Spacing = 53.0" C-C Row Spacing

w x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width " Chamber Height + 6.0" Cover = 3.21' Field Height

2.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

ge + Stone Storage = 190.9 cf = 0.004 af Efficiency = 57.6% Size = 10.00' x 10.33' x 3.21'





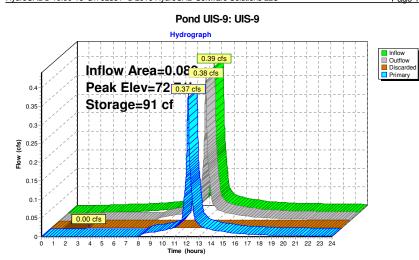
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 Type III 24-hr
 10-Year Rainfall=4.50"

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Topsfield Proposed HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD	Type III 24-hr 25-Year Rainfall=5.40" Printed 2/27/2017 Software Solutions LLC Page 144
Runoff by SCS TR-20	00 hrs, dt=0.01 hrs, 2401 points method, UH=SCS, Weighted-CN s method - Pond routing by Stor-Ind method
Subcatchment P-1: Northern Grassed Area to	Runoff Area=81,776 sf 1.57% Impervious Runoff Depth>0.42" Tc=6.0 min UI Adjusted CN=42 Runoff=0.33 cfs 0.066 af
Subcatchment P-10: Area Around Isolated	Runoff Area=31,595 sf 7.29% Impervious Runoff Depth>2.77" Tc=6.0 min UI Adjusted CN=75 Runoff=2.36 cfs 0.168 af
Subcatchment P-2: Existing Drive to Existing	Runoff Area=22,978 sf 59.84% Impervious Runoff Depth>3.34" Tc=6.0 min CN=81 Runoff=2.06 cfs 0.147 af
Subcatchment P-3: Area Around Isolated	Runoff Area=27,549 sf 12.75% Impervious Runoff Depth>0.86" Tc=6.0 min UI Adjusted CN=50 Runoff=0.45 cfs 0.045 af
Subcatchment P-3A: Gravel Road to Detention	Runoff Area=4,950 sf 31.35% Impervious Runoff Depth>2.42" Tc=6.0 min CN=71 Runoff=0.32 cfs 0.023 af
Subcatchment P-4: Sloped Entrance Drive -	Runoff Area=21,239 sf 62.65% Impervious Runoff Depth>3.24" Tc=6.0 min CN=80 Runoff=1.85 cfs 0.132 af
Subcatchment P-5: Driveway - Units 25-11	Runoff Area=39,272 st 52.13% Impervious Runoff Depth>2.68" Tc=6.0 min CN=74 Runoff=2.84 cfs 0.202 af
Subcatchment P-6: Pavement Units 12-19	Runoff Area=19,137 sf 59.86% Impervious Runoff Depth>3.05" Tc=6.0 min CN=78 Runoff=1.57 cfs 0.112 af
Subcatchment P-7: Driveway - Units 20-24	Runoff Area=15,670 sf 44.56% Impervious Runoff Depth>2.42" Tc=6.0 min CN=71 Runoff=1.01 cfs 0.073 af
Subcatchment P-8: Surface Infiltration Pond	Runoff Area=15,307 sf 7.00% Impervious Runoff Depth>0.47" Tc=6.0 min CN=43 Runoff=0.07 cfs 0.014 af
Subcatchment P-9: Woods/Grass Northwest Flow Length=5	Runoff Area=102,567 sf 2.25% Impervious Runoff Depth>0.17" 502' Tc=10.8 min UI Adjusted CN=36 Runoff=0.06 cfs 0.034 af
Subcatchment R-1: Roof - Units 1&2 (C&B)	Runoff Area=3,185 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.39 cfs 0.031 af
Subcatchment R-10: Roof - Units 19&20 - (A	Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.47 cfs 0.038 af
Subcatchment R-11: Roof - Units 21&22 - (A&B	Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.44 cfs 0.036 af
Subcatchment R-12: Roof - Units 23&24 - (A	Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.47 cfs 0.038 af
Subcatchment R-13: Roof - Units 25&26 - (A	Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.47 cfs 0.038 af

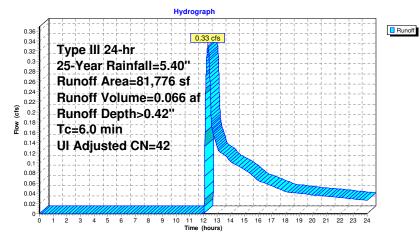
ppsfield Proposed HydroCAD 2-2-17 Type III 24-hr 25-Year Rainfall=5.40" repared by Microsoft Printed 2/27/2017 vdroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 145	Topsfield Proposed HydroCAD 2-2-17 Type III 24-hr 25-Year Rainfall=5.4 Prepared by Microsoft Printed 2/27/20 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 14
ubcatchment R-14: Roof Units 27&28 - A&B Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.44 cfs 0.036 af	Pond D-2: Existing Detention Basin Peak Elev=58.41' Storage=3,738 cf Inflow=2.06 cfs 0.147 Outflow=0.17 cfs 0.077
ubcatchment R-15: Roof Units 29&30 - (B & C Runoff Area=1,705 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.21 cfs 0.017 af	Pond D-3: Detention Pond by Access Road Peak Elev=63.86' Storage=390 cf Inflow=0.32 cfs 0.023 Discarded=0.03 cfs 0.023 af Primary=0.00 cfs 0.000 af Outflow=0.03 cfs 0.023
Ibcatchment R-16: Front Units 29&30 Runoff Area=1,490 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.18 cfs 0.015 af	Pond UIS-1: UIS at Entrance Peak Elev=65.94' Storage=13,194 cf Inflow=5.62 cfs 0.414 Discarded=0.08 cfs 0.114 af Primary=0.00 cfs 0.000 af Outflow=0.08 cfs 0.114
Jbcatchment R-17: Mailbox Structure Rood Runoff Area=120 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.01 cfs 0.001 af	Pond UIS-2: UIS at North of Site Peak Elev=64.45' Storage=2,255 cf Inflow=2.03 cfs 0.165 Discarded=0.23 cfs 0.165 af Primary=0.00 cfs 0.000 af Outflow=0.23 cfs 0.165
Jbcatchment R-2: Roof Units 3&4 - (B & C Runoff Area=3,195 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.39 cfs 0.032 af	Pond UIS-3: UIS-3 Peak Elev=73.79' Storage=137 cf Inflow=0.44 cfs 0.036 Discarded=0.00 cfs 0.004 af Primary=0.43 cfs 0.029 af Outflow=0.44 cfs 0.033
Jbcatchment R-3: Roof Units 5&6 - A&B Units Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.44 cfs 0.036 af	Pond UIS-4: UIS-4 Peak Elev=74.73' Storage=146 cf Inflow=0.39 cfs 0.032 Discarded=0.00 cfs 0.004 af Primary=0.37 cfs 0.024 af Outflow=0.38 cfs 0.029
Ibcatchment R-4: Roof - Units 7&8 - (A&B Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.44 cfs 0.036 af	Pond UIS-5: UIS-5 Peak Elev=75.40' Storage=151 cf Inflow=0.44 cfs 0.036 Discarded=0.00 cfs 0.004 af Primary=0.42 cfs 0.029 af Outflow=0.42 cfs 0.033
Ibcatchment R-5: Roof - Units 9&10 - (B&C Runoff Area=3,195 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.39 cfs 0.032 af	Pond UIS-6: UIS-6 Peak Elev=74.65' Storage=154 cf Inflow=0.47 cfs 0.038 Discarded=0.00 cfs 0.005 af Primary=0.45 cfs 0.031 af Outflow=0.45 cfs 0.036
ubcatchment R-6: Roof - Units 11&12 - (B&A Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.44 cfs 0.036 af	Pond UIS-7: UIS-7 Peak Elev=74.10' Storage=151 cf Inflow=0.44 cfs 0.036 Discarded=0.00 cfs 0.004 af Primary=0.42 cfs 0.029 af Outflow=0.42 cfs 0.033
Jbcatchment R-7: Roof - Units 13&14 - (ARunoff Area=3,895 sf100.00% ImperviousRunoff Depth>5.16"Tc=6.0 min CN=98 Runoff=0.47 cfs0.038 af	Pond UIS-8: UIS-8 Peak Elev=73.40' Storage=151 cf Inflow=0.44 cfs 0.036 Discarded=0.00 cfs 0.004 af Primary=0.42 cfs 0.029 af Outflow=0.42 cfs 0.033
ubcatchment R-8: Roof - Units 15&16 - (B&A Runoff Area=3,625 sf 100.00% Impervious Runoff Depth⊳5.16" Tc=6.0 min CN=98 Runoff=0.44 cfs 0.036 af	Pond UIS-9: UIS-9 Peak Elev=72.82' Storage=99 cf Inflow=0.47 cfs 0.038 Discarded=0.00 cfs 0.005 af Primary=0.44 cfs 0.033 af Outflow=0.45 cfs 0.037
ubcatchment R-9: Roof - Units 17&18 - (A&B Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>5.16" Tc=6.0 min CN=98 Runoff=0.44 cfs 0.036 af	Total Runoff Area = 10.007 ac Runoff Volume = 1.545 af Average Runoff Depth = 1.8 69.75% Pervious = 6.980 ac 30.25% Impervious = 3.027
each SP-1: Wetlands South of Driveway Inflow=0.45 cfs 0.122 af Outflow=0.45 cfs 0.122 af	
each SP-2: Large Wetland Area East Inflow=0.67 cfs 0.188 af Outflow=0.67 cfs 0.188 af	
each SP-3: Large Wetland Area West Inflow=1.22 cfs 0.405 af Outflow=1.22 cfs 0.405 af	
Peak Elev=56.92' Inflow=0.45 cfs 0.122 af 12.0" Round Culvert n=0.011 L=51.0' S=0.0025 '/' Outflow=0.45 cfs 0.122 af	
Discarded=0.12 cfs 0.124 af Primary=0.77 cfs 0.183 af Outflow=0.89 cfs 0.603 af Outflow=0.89 cfs 0.307 af	

Prepared	d by Mi 0® 10.00	0-18 s/n 02881	© 2016 HydroCAD Softv		-hr 25-Year Rainfall=5.40" Printed 2/27/2017 Page 147 to Wetlands		
Runoff	=	0.33 cfs @	12.33 hrs, Volume=	0.066 af, Depth>	0.42"		
Pupoff by	Pupperf by SCS TP 20 method LIU-SCS, Weighted CN, Time Span-0.00.24.00 hrs. dt= 0.01 hrs.						

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 25-Year Rainfall=5.40"

/	Area (sf)	CN	Adj	Desc	ription				
	36,287	30			ds, Good, H				
	10,782	70		Wood	ds, Good, ⊦	ISG C			
	9,419	55		Wood	ds, Good, ⊦	ISG B			
	22,149	39			>75% Grass cover, Good, HSG A				
	1,287	98		Unco	nnected pa	avement, HSG A			
	1,852	72		Dirt ro	oads, HSG	Α			
	81,776	43	42	Weig	hted Avera	ige, UI Adjusted			
	80,489			98.43	8% Perviou	s Area			
	1,287			1.57%	6 Impervior	us Area			
	1,287			100.0	0% Uncon	nected			
Tc	- 3-	Slope		ocity	Capacity	Description			
(min)	(feet)	(ft/ft)	(ft/s	sec)	(cfs)				
6.0						Direct Entry,			

Subcatchment P-1: Northern Grassed Area to Wetlands



	J® 10.00-	18 s/n 02	581 © 201	6 HydroCA	D Software	Solution	S LLC					Page 148
	S	ummary	for Sub	catchme	nt P-10:	Area A	round	Isola	ted V	Vetla	and	
Runoff	=	2.36 cfs	s@ 12.0	9 hrs, Vol	ume=	0.16	68 af, D	epth>	2.77			
				SCS, Weig	hted-CN,	Time Sp	an= 0.0	0-24.	00 hrs	, dt=	0.01 hr	s
Type III 2	.4-hr 25∙	Year Rai	nfall=5.40	'								
Ar	<u>ea (sf)</u> 2,304	<u>CN</u> A 98		ription	oofo USC	<u>` ^</u>						
	29,291	74	>75%	6 Grass co	over, Goo	d, HSG (2					
	31,595 29,291	76		hted Aver 1% Pervio		djusted						
-	2,304 2,304		7.29	% Impervi 00% Unco	ous Area							
_	,											
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)		otion						
6.0					Direct I	Entry,						
		Su	bcatchm	ent P-10): Area A	round	Isolate	d We	etland	ł		
				Нус	Irograph							
- 	25- Rui Rui Rui Tc=	noff Ai noff Vo noff Do =6.0 m	Rainfall rea=31 olume= epth>2									Runoff
		3 4 5	6 7 8	9 10		14 15 1						
0,1	1 2	3 4 5	0 / 8		ime (hours)	14 15 1	u i/ 18	19	20 21	22 ²	-5 24	
0												

Topsfield Proposed HydroCAD 2-2-17 Type III 24-hr 25-Year Rainfall=5.40" Prepared by Microsoft Printed 2/27/2017 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 149	Topsfield Proposed HydroCAD 2-2-17 Type III 24-hr 25-Year Rainfall=5.40 Prepared by Microsoft Printed 2/27/201 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 150
Summary for Subcatchment P-2: Existing Drive to Existing Basin	Summary for Subcatchment P-3: Area Around Isolated Wetland
unoff = 2.06 cfs @ 12.09 hrs, Volume= 0.147 af, Depth> 3.34" unoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs ype III 24-hr 25-Year Rainfall=5.40" Area (sf) CN Description 6,902 98 Unconnected pavement, HSG A 1,353 76 Gravel roads, HSG A 4,824 39 >75% Grass cover, Good, HSG A 3,050 74 >75% Grass cover, Good, HSG C 3,632 98 Unconnected pavement, HSG B 3,217 98 Unconnected pavement, HSG B 3,217 98 Unconnected pavement, HSG C 22,978 81 Weighted Average 9,227 40.16% Pervious Area 13,751 59.84% Impervious Area 13,751 100.00% Unconnected Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Min. 6.0 TC	$\begin{array}{rcl} \mbox{Runoff} &=& 0.45 \mbox{ cfs } @ \ 12.11 \mbox{ hrs, Volume} &=& 0.045 \mbox{ af, Depth} > 0.86" \\ \mbox{Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 \mbox{ hrs, dt= 0.01 \mbox{ hrs} Type III 24-hr 25-Year Rainfall=5.40"} \\ \hline \mbox{Area (sf) } & \mbox{CN } & \mbox{Adj } & \mbox{Description} \\ \hline \mbox{3,512 } & 98 & \mbox{Unconnected pavement, HSG A} \\ & \mbox{1,224 } & 76 & \mbox{Gravel roads, HSG A} \\ & \mbox{212 } & 74 & >75\% \mbox{ Grass cover, Good, HSG C} \\ & \mbox{2,166 } & 70 & \mbox{Woods, Good, HSG D} \\ \hline \mbox{14,867 } & 30 & \mbox{Woods, Good, HSG A} \\ \hline \mbox{27,549 } & 53 & 50 & \mbox{Weighted Average, UI Adjusted} \\ \hline \mbox{24,037 } & \mbox{87.25\% \ Pervious Area} \\ \hline \mbox{3,512 } & \mbox{10,00\% \ Unconnected} \\ \hline \mbox{Tc Length } & \mbox{Slope Velocity Capacity Description} \\ \hline \mbox{min (feet) } & \mbox{(ft/ft) (ft/sec) } & \mbox{Direct Entry,} \\ \hline \end{tabular}$
Subcatchment P-2: Existing Drive to Existing Basin Hydrograph 2.06 cfs Type III 24-hr 25-Year Rainfall=5.40'' Runoff Area=22,978 sf Runoff Volume=0.147 af Runoff Depth>3.34'' Tc=6.0 min CN=81 CN=	Subcatchment P-3: Area Around Isolated Wetland Hydrograph Type III 24-hr 25-Year Rainfall=5.40'' Runoff Area=27,549 sf Runoff Depth>0.86'' Tc=6.0 min UI Adjusted CN=50 045 cfs Runoff Depth>0.86'' Tc=6.0 min Tc=6.0 min UI Adjusted CN=50 045 cfs Runoff Depth>0.86'' Tc=6.0 min Tc=6.0 min UI Adjusted CN=50 045 cfs Tc=6.0 min Tc=6.0 min Tc=7.0 min Tc=6.0 min Tc=7.0 min Tc=6.0 min Tc=7.0 min Tc=6.0 min Tc=7.0 min Tc=6.0 min Tc=7.0 min

Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr 25-Year Rainfall=5.40"
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Summary for Subcatchment P-3A: Gravel Road to Detention Basin

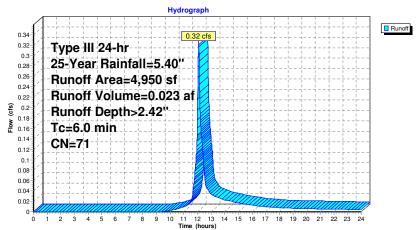
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Runoff = 0.32 cfs @ 12.09 hrs, Volume= 0.023 af, Depth> 2.42"

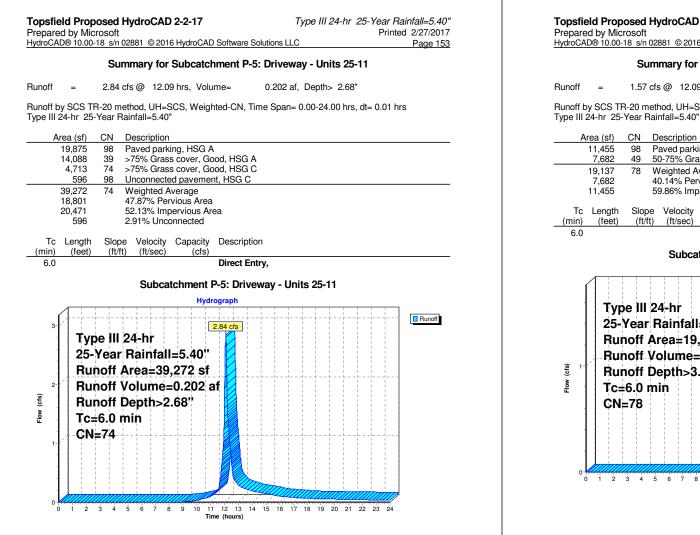
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 25-Year Rainfall=5.40"

A	rea (sf)	CN	Description					
	1,552	98	Paved park	ing, HSG A	Α			
	1,841	76	Gravel road	ls, HSG A				
	1,557	39	>75% Gras	s cover, Go	bod, HSG A			
	4,950	71	Weighted A	verage				
	3,398		68.65% Pervious Area					
	1,552		31.35% Imp	pervious Ar	ea			
Tc	Length	Slop	e Velocity	Capacity	Description			
(min)	(feet)	(ft/f	t) (ft/sec)	(cfs)				
6.0					Direct Entry,			

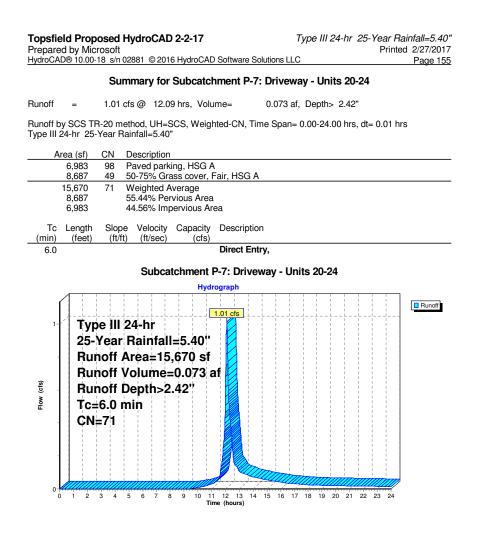
Subcatchment P-3A: Gravel Road to Detention Basin



Topsfield Proposed HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Softwa	Type III 24-hr 25-Year Rainfall=5.40" Printed 2/27/2017 re Solutions LLC Page 152
Summary for Subcatchment P-4: S	Sloped Entrance Drive - Units 1-5
Runoff = 1.85 cfs @ 12.09 hrs, Volume=	0.132 af, Depth> 3.24"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN Type III 24-hr 25-Year Rainfall=5.40"	l, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Area (sf) CN Description	
13,306 98 Paved parking, HSG A 5,234 39 >75% Grass cover, Good, HS 2,699 74 >75% Grass cover, Good, HS	
21,239 80 Weighted Average 7,933 37.35% Pervious Area 13,306 62.65% Impervious Area	
Tc Length Slope Velocity Capacity Descr (min) (feet) (ft/ft) (ft/sec) (cfs)	iption
6.0 Direct	Entry,
Subcatchment P-4: Sloped	Entrance Drive - Units 1-5
Hydrograph	
Type III 24-hr 25-Year Rainfall=5.40" Runoff Area=21,239 sf Runoff Volume=0.132 af Runoff Depth>3.24" Tc=6.0 min CN=80	■ Runoff
0 1 2 3 4 5 6 7 8 9 10 11 12 13 Time (hours	



Topsfield Proposed HydroCAD 2-2-17 Type III 24-hr 25-Year Rainfall=5.40" Printed 2/27/2017 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 154 Summary for Subcatchment P-6: Pavement Units 12-19 1.57 cfs @ 12.09 hrs, Volume= 0.112 af, Depth> 3.05" Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Area (sf) CN Description Paved parking, HSG A 50-75% Grass cover, Fair, HSG A 78 Weighted Average 40.14% Pervious Area 59.86% Impervious Area Slope Velocity Capacity Description (cfs) Direct Entry, Subcatchment P-6: Pavement Units 12-19 Hydrograph Runoff 1.57 cfs 25-Year Rainfall=5.40" Runoff Area=19.137 sf Runoff Volume=0.112 af Runoff Depth>3.05" 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Time (hours)



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:	Summary for Subcatchment P-8: Surface Infiltration Pond Area
Runoff =	0.07 cfs @ 12.31 hrs, Volume= 0.014 af, Depth> 0.47"
	IR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
	5-Year Rainfall=5.40"
Area (sf)	CN Description
1,072 14,235	98 Paved parking, HSG A 39 >75% Grass cover, Good, HSG A
15,307	43 Weighted Average
14,235 1,072	93.00% Pervious Area 7.00% Impervious Area
Tc Length	·
(min) (feet)) (ft/ft) (ft/sec) (cfs)
6.0	Direct Entry,
	Subcatchment P-8: Surface Infiltration Pond Area
	Hydrograph
0.08	
0.075	vpe III 24-hr
	5-Year Rainfall=5.40"
0.06 0.055	Runoff Area=15,307 sf
0.05	lunoff Volume=0.014 af
ê 0.045	Runoff Depth>0.47"
₿ 0.04 0.035	'c=6.0 min
0.03 C	N=43
a 21	
0.025	
0.025	
0.025	
0.025	
0.025	2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Time (hours)

Summary for Subcatchment P-9: Woods/Grass Northwest Site to NW Wetlands

Walking path in woods described as "Dirt road," closest CN value in HydroCAD, actual material to be mulch, wood chips or packed earth

Runoff = 0.06 cfs @ 13.79 hrs, Volume= 0.034 af, Depth> 0.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 25-Year Rainfall=5.40"

A	rea (sf)	CN /	Adj Desc	cription	
	2,068	72	Dirt r	roads, HSG	iA
	40,086	39	>75%	6 Grass co	ver, Good, HSG A
	357	74	>75%	% Grass co	ver, Good, HSG C
	53,082	30	Woo	ds, Good, H	HSG A
	4,670	55	Woo	ds, Good, H	HSG B
	2,304	98	Unco	onnected pa	avement, HSG A
1	02,567	37			age, UI Adjusted
1	00,263		97.7	5% Perviou	is Area
	2,304			% Impervio	
	2,304		100.0	00% Uncon	nected
-		~		a	
Tc	Length	Slope		Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	
4.9	50	0.0300	0.17		Sheet Flow, A-B
					Grass: Short n= 0.150 P2= 3.10"
4.9	342	0.0280	1.17		Shallow Concentrated Flow, B-C
			. =-		Short Grass Pasture Kv= 7.0 fps
1.0	110	0.1270	1.78		Shallow Concentrated Flow, C-D
		T · ·			Woodland Kv= 5.0 fps

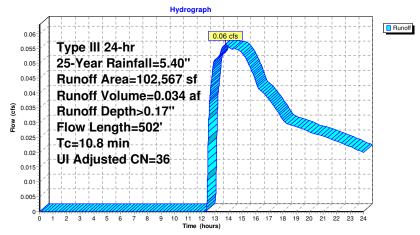
10.8 502 Total

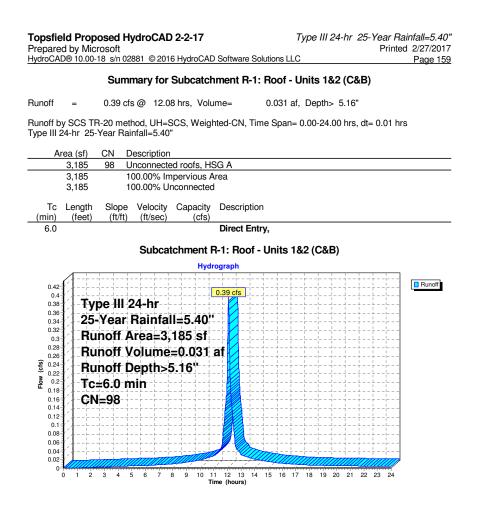
Topsfield Proposed HydroCAD 2-2-17 Type III 24-hr 25-Year Rainfall=5.40" Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC

Subcatchment P-9: Woods/Grass Northwest Site to NW Wetlands

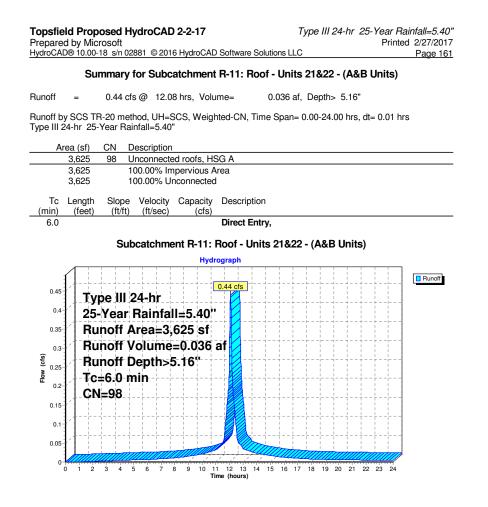
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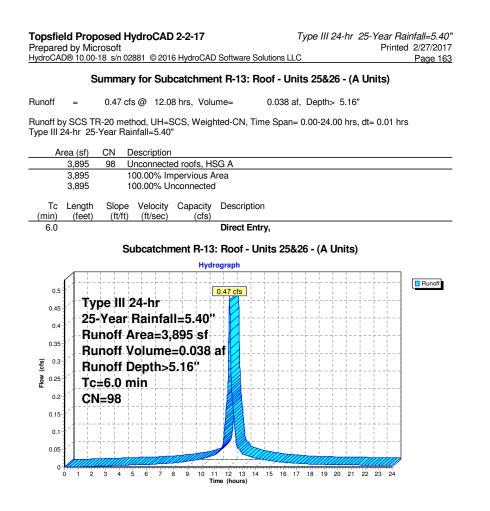




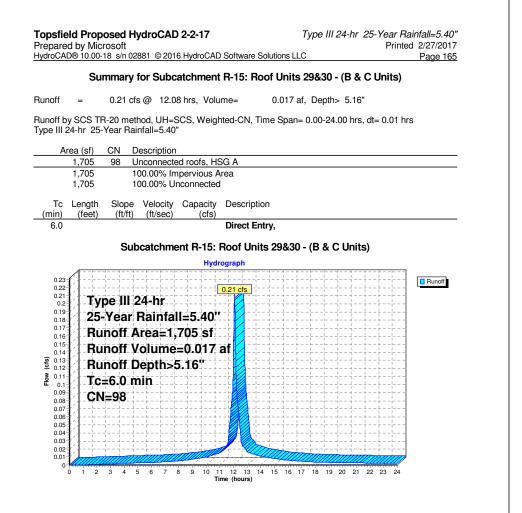
Topsfield Proposed HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC		Rainfall=5.40" ed 2/27/2017 Page 160
Summary for Subcatchment R-10: Roof - Un	its 19&20 - (A Units)	
Runoff = 0.47 cfs @ 12.08 hrs, Volume= 0.038 at	f, Depth> 5.16"	
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= Type III 24-hr 25-Year Rainfall=5.40"	= 0.00-24.00 hrs, dt= 0.01 h	nrs
Area (sf) CN Description		
3,895 98 Unconnected roofs, HSG A		
3,895 100.00% Impervious Area 3,895 100.00% Unconnected		
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)		
6.0 Direct Entry,		
Subcatchment R-10: Roof - Units 19&	20 - (A Units)	
Hydrograph		
0.47 cfs 0.47 cfs Runoff Area=3,895 sf Runoff Depth>5.16" Tc=6.0 min CN=98 0.15 0.1 cos 0.1 c	7 18 19 20 21 22 23 24	



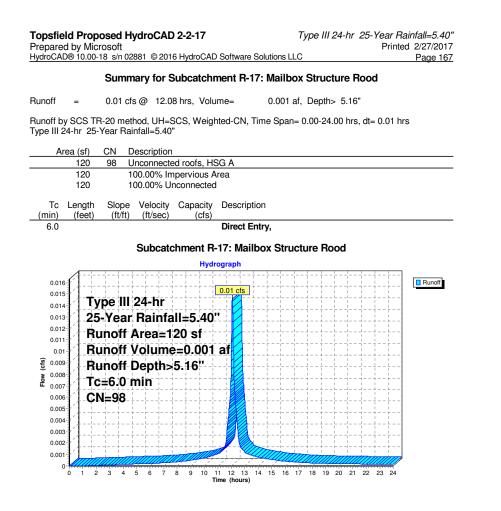
Topsfield Proposed HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LL	Type III 24-hr 25-Year Rainfall=5.40" Printed 2/27/2017 C Page 162
Summary for Subcatchment R-12: Roof - Ur	nits 23&24 - (A Units)
Runoff = 0.47 cfs @ 12.08 hrs, Volume= 0.038 a	af, Depth> 5.16"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span- Type III 24-hr 25-Year Rainfall=5.40"	= 0.00-24.00 hrs, dt= 0.01 hrs
Area (sf) CN Description	
3,895 98 Unconnected roofs, HSG A	
3,895 100.00% Impervious Area 3,895 100.00% Unconnected	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	
6.0 Direct Entry,	
Subcatchment R-12: Roof - Units 238	24 - (A Units)
Hydrograph	
0.5 0.47 cfs 0.45 -25-Year Rainfall=5.40" 0.47 cfs -25-Year Rainfall=5.40"	Rundfi
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 1 Time (hours)	17 18 19 20 21 22 23 24



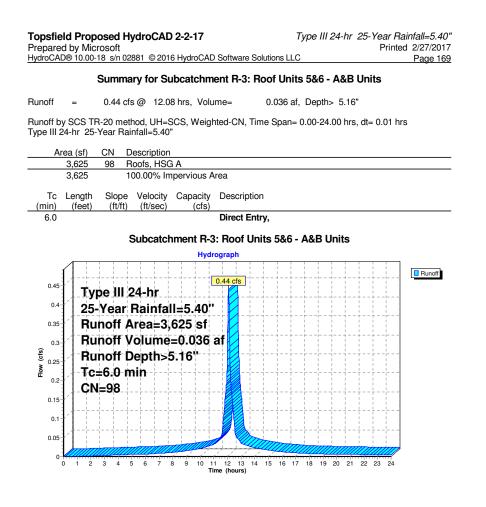
Summary for Subcatchment R-14: Roof Units 27&28 - A&B Units Runoff = 0.44 cfs @ 12.08 hrs, Volume 0.036 af, Depth> 5.16" Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 25-Year Rainfal=5.40" Area (sf) CN Description $3,625$ 98 Roofs, HSG A $3,625$ 100.00% Impervious Area Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/scc) (cfs) 0.01 hrs Type III 24-hr	Topsfield Proposed HydroCAD 2-2-17 Type III 24-hr 25-Year Rainfall=5.40" Prepared by Microsoft Printed 2/27/2017 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 164
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 25-Year Rainfall=5.40" Area (sf) CN Description 3,625 98 Roofs, HSG A 3,625 100.00% Impervious Area Tc Length Slope Velocity Capacity Description 6.0 Direct Entry, Subcatchment R-14: Roof Units 27&28 - A&B Units Hydrograph Image: Runoff	Summary for Subcatchment R-14: Roof Units 27&28 - A&B Units
Type III 24-hr 25-Year Rainfall=5.40" Area (sf) CN Description 3,625 98 Roofs, HSG A 3,625 100.00% Impervious Area Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) 6.0 Direct Entry, Subcatchment R-14: Roof Units 27&28 - A&B Units Hydrograph Image: Punoff	Runoff = 0.44 cfs @ 12.08 hrs, Volume= 0.036 af, Depth> 5.16"
3,625 98 Roofs, HSG A 3,625 100.00% Impervious Area Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-14: Roof Units 27&28 - A&B Units Hydrograph 0.44 cfs Type III 24-hr	
3,625 100.00% Impervious Area Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-14: Roof Units 27&28 - A&B Units Hydrograph 0.45 Type III 24-hr	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-14: Roof Units 27&28 - A&B Units Hydrograph 0.45 Type III 24-hr	
(min) (feet) (ft/ft) (ft/sec) (cfs) 6.0 Direct Entry, Subcatchment R-14: Roof Units 27&28 - A&B Units Hydrograph 0.45 Type III 24-hr	3,625 100.00% Impervious Area
Subcatchment R-14: Roof Units 27&28 - A&B Units Hydrograph U.44 cfs Type III 24-hr	
Hydrograph 0.45 Type III 24-hr	6.0 Direct Entry,
Hydrograph 0.45 Type III 24-hr	Subcatchment B-14: Boof Units 27&28 - A&B Units
0.45 Type III 24-hr	
25-Year Rainfall=5.40" Runoff Area=3,625 sf Runoff Volume=0.036 af Runoff Depth>5.16" Tc=6.0 min CN=98 0.15	0.45 0.4 0.4 0.4 0.5 0.25-Year Rainfall=5.40'' Runoff Area=3,625 sf Runoff Volume=0.036 af Runoff Depth>5.16'' Tc=6.0 min CN=98 0.25 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.



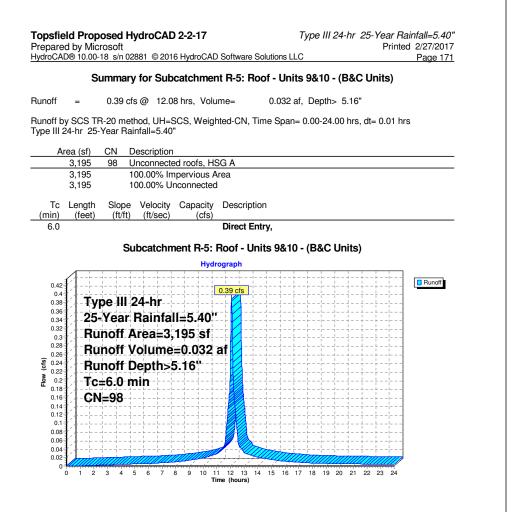
Topsfield Proposed HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions L	<i>Type III 24-hr 25-Year Rainfall=5.40"</i> Printed 2/27/2017 LC Page 166
Summary for Subcatchment R-16: Free	ont Units 29&30
Runoff = 0.18 cfs @ 12.08 hrs, Volume= 0.015	af, Depth> 5.16"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Spar Type III 24-hr 25-Year Rainfall=5.40"	n= 0.00-24.00 hrs, dt= 0.01 hrs
Area (sf) CN Description	
1,490 98 Unconnected roofs, HSG A	
1,490 100.00% Impervious Area 1,490 100.00% Unconnected	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	
6.0 Direct Entry,	
Subcatchment R-16: Front Uni	its 29&30
Hydrograph	
0.2	+ + +
0.19	
0.18 0.17 0.17	+ + + +
0.16 25-Year Rainfall=5.40"	+ + + +
0.15 0.14 Runoff Area=1,490 sf	+
^{0.14} Runoff Volume=0.015 af	+
	+
³ 0.11 Runoff Depth>5.16 "	+ + + +
0.08 0.07 CN=98	+ + - + +
0.06	+
	+
0.03	+
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 Time (hours)	17 18 19 20 21 22 23 24



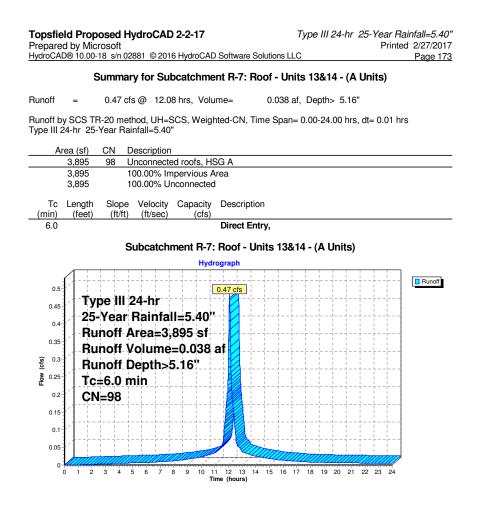
/droCAI	d by Mici 0® 10.00-	18 s/n 028	81 © 2016	B HydroCA	D Softwa	are Solu	utions Ll	_C				Page 168
	S	ummary	for Sub	catchm	ent R-2	: Roc	f Unit	s 3&4	- (B 8	CU	nits)	
unoff	=	0.39 cfs	@ 12.08	8 hrs, Vol	ume=		0.032 a	af, Dep	th> 5	.16"		
		R-20 meth Year Rain			phted-Cl	N, Tim	e Span	= 0.00-2	24.00	hrs, dt	≔ 0.01 ŀ	Irs
Ar	ea (sf)		escription									
	3,195		connecte									
	3,195 3,195		0.00% Im 0.00% Ur									
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)		ription						
6.0					Direc	t Entry	Ι,					
0.42 0.4 0.38 0.36 0.34 0.32 0.28 0.24 0.24 0.2 0.2 0.2 0.2 0.18 0.16 0.12	25- Ru Ru Ru Tc:	be III 2 Year F noff Ai noff V noff D =6.0 m =98	Rainfal rea=3, olume epth>5	l=5.40 195 sf =0.032								Runoff)
0.1 0.08 0.06 0.04 0.02 0												
	0 1 2	3 4 5	678		11 12 1 Time (hou		15 16	17 18	19 20	21 22	23 24	



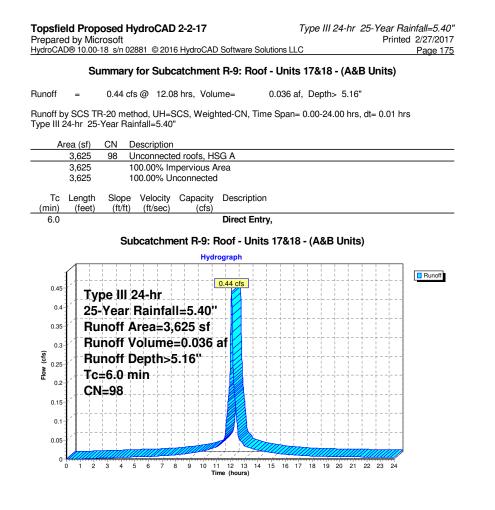
Topsfield Proposed Hydro Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881			Year Rainfall=5.40" Printed 2/27/2017 Page 170
Summary for	Subcatchment R-4: Roof	· Units 7&8 - (A&B Un	its)
Runoff = 0.44 cfs @	12.08 hrs, Volume= 0.	036 af, Depth> 5.16"	
Runoff by SCS TR-20 method, I Type III 24-hr 25-Year Rainfall=		Span= 0.00-24.00 hrs, dt=	0.01 hrs
Area (sf) CN Descri			
	inected roofs, HSG A		
	0% Impervious Area 0% Unconnected		
	ocity Capacity Description (sec) (cfs)		
6.0	Direct Entry,		
Subca	atchment R-4: Roof - Units	7&8 - (A&R Inits)	
Cubb	Hydrograph	ruo (Aub onito)	
0.45 0.4 0.4 0.4 0.5 0.25-Year Rail Runoff Area Runoff Dept Tc=6.0 min CN=98 0.15 0.1 2 3 4 5 6	nfall=5.40" =3,625 sf me=0.036 af	16 17 18 19 20 21 22	



unoff = unoff by SCS pe III 24-hr <u>Area (sf</u> 3,624 3,624 <u>3,624</u> <u>3,624</u> <u>1</u> <u>6,0</u>	3 TR-20 m 25-Year R 5 98 5 5 th Slop et) (tt/f S	cfs @ 12 ethod, UH ainfall=5. <u>Descript</u> <u>Unconne</u> 100.00% 100.00% e Veloc	2.08 hrs, 1 H=SCS, 1 40" ion <u>ected roo</u> Impervi Unconn ity Cap c)	Volum Weighte ous Are ected acity [(cfs)	ie= ed-CN, ea Descrip Direct	0 Time otion Entry,	.036 a Span=	af, De = 0.00	epth>)-24.(• 5.16	5" s, dt=		Page 172
unoff by SCS pe III 24-hr Area (sf 3,62! 3,62! 3,62! 3,62! 3,62! 0.45	3 TR-20 m 25-Year R 5 98 5 5 th Slop et) (tt/f S	ethod, UF ainfall=5. <u>Descript</u> <u>Unconne</u> 100.00% 100.00% e Veloc	H=SCS, N 40" <u>ected roo</u> Impervi- Unconn ity Cap. c)	Weighte	ed-CN, <u>à A</u> Descrip Direct Doof - U	Time otion Entry,	Span:	= 0.00)-24.(00 hrs	s, dt=	0.01 F	hrs
pe III 24-hr <u>Area (sf</u> 3,62: 3,62: 3,62: 3,62: TC Leng (min) (fee 6.0	25-Year R <u>5 98</u> 5 5 th Slop et) (ft/f S	ainfall=5. <u>Descript</u> <u>Unconne</u> 100.00% 100.00% e Veloc <u>(ft/se</u>)	40" ion Impervi Unconn ity Cap c)	fs, HSG ous Are ected acity [(cfs) I R-6: Ro	A Descrip Direct	otion Entry,						0.01 ł	hrs
Area (sf 3,624 3,624 3,624 Tc Leng (min) (fee 6.0	t) <u>CN</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u> <u>5</u>	Descript Unconne 100.00% 100.00% e Veloc c) (ft/se	ion ected roo Impervi Unconn ity Cap c)	ous Are ected acity [(cfs) [R-6: Ro	ea Descrip Direct I Dof - U	Entry,	11&1:	2 - (B	8&A	Unit	s)		
3,62 3,62 Tc Leng (min) (fee 6.0	5 5 2th Slop 2t) (ft/ft S	100.00% 100.00% e Veloc i) (ft/se	impervi Unconn ity Cap	ous Are ected acity [(cfs) [R-6: Ro	ea Descrip Direct I Dof - U	Entry,	11&12	2 - (B	8&A	Unit	s)		
3,62 Tc Leng (min) (fee 6.0	5 th Slop et) (ft/f	100.00% e Veloc) (ft/se	Unconn ity Cap c)	ected acity [(cfs) I R-6: Ro	Descrip Direct Dof - U	Entry,	11&12	2 - (B	8&A	Unit	s)		
(<u>min)</u> (fee 6.0	et) (ft/ff S	:) (ft/se	C)	(cfs) I R-6: Ro	Direct	Entry,	11&12	2 - (B	8&A	Unit	s)		
0.45		ubcatch	nment F	R-6: Ro	oof - U		11&12	2 - (B	8&A	Unit	s)		
			nment F			Inits 1	11&12	2 - (B	8&A	Unit	s)		
	vpe III	24-hr		0.	44 cfs								Runoff
	25-Yea	Rain	fall=5.	+ +			- + +				-++		_
	Runoff Runoff		P 1		f		-++				-++		_
	Runoff	1 1 1		1 I I I I I I I I I I I I I I I I I I I		- 	- + +				- + +		-
	C=6.0			++	-		- + +				- + +		_
_	CN=98						- + +			+	- -		_
0.15-	 						- 1 1				- 1 1		_
0.1-				 									_
0.05				m				11111					
0 1	2 3 4	5 6 7	7 8 9	10 11 Time	12 13 (hours)	14 15	i 16 1	17 18	19	20 21	22	23 24	, ,
					()								



unoff	51	ummary				D 0.	Deed	c 11.		4 - 0 4	c /		I Inclu	h-1	
							ROO				•		Unit	.s)	
un off by	=	0.44 cf	s@ 12	2.08 hrs,	Volu	me=		0.03	6 af,	Dep	th> 5	5.16"			
		R-20 met -Year Rai			Weigh	ited-CN	√, Tim	ie Sp	an= ().00-2	24.00	hrs, c	lt= 0.	01 hr	S
Are	ea (sf)		escripti												
	3,625			cted roo											-
	3,625 3,625			Impervi											
	0,020		00.0070	Oncom	lected										
	Length (feet)	Slope	Veloci		acity (cfs)	Desci	riptior	1							
(min) 6.0	(ieel)	(ft/ft)	(ft/see	-)	(015)	Direc	t Entr	v.							
		_			_							_			
		Su	bcatch	ment F	₹-8: R	loof -	Units	s 158	×16 -	· (B8	AU	nits)			
					Hydro	ograph		, , , , , , , , , , , , , , , , , , ,							
:						11						i i i i			Runoff
0.45	Τ.,	pe III 2)/_hr			0.44 cfs									<u> </u>
0.4-		-Year			40"							++-	+		
1	4	+-			++-				- +			++-	 		
0.35		inoff A		- I				i i i i				i i ++-	<u> </u>		
0.3		inoff V			1.1.1	af									
Llow (cfs)	∕†⁻Ru	inoff D	epth	>5.16	1 41			i i -				++-	· - +		
Flow	. ∤-Tc	=6.0 n	in										·		
0.2	CN	l=98			i										
0.15	1												-		
0.1-	十十			·	++-							++-	· = = = =		
	/					- 0-6	<u></u>		· - <u> </u>						
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0	1 2	3 4	5 6 7	8 9	10 11	1 12 1	11111111111111111111111111111111111111	15 1		18 1	9 20	21 2	2 23	24	
U U	1 2	54.	, , ,	0 9		me (hour		15 1	5 17	10 1	5 20	21 2	2 23	24	



Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr 25-Year Rainfall=5.40"
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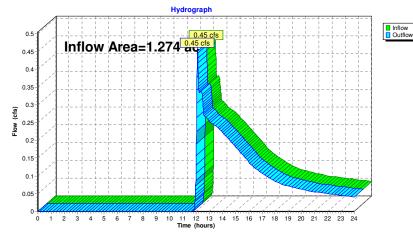
Summary for Reach SP-1: Wetlands South of Driveway

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

Inflow Area =	1.274 ac, 33.91% Impervious, Inflow	v Depth > 1.15"	for 25-Year event
Inflow =	0.45 cfs @ 12.11 hrs, Volume=	0.122 af	
Outflow =	0.45 cfs @ 12.11 hrs, Volume=	0.122 af, Atte	en= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach SP-1: Wetlands South of Driveway



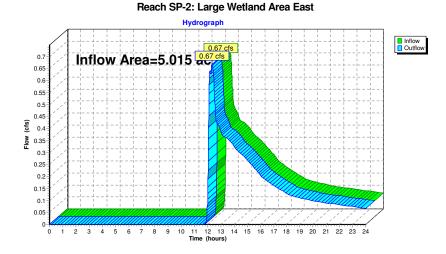
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Summary for Reach SP-2: Large Wetland Area East

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

Inflow Area =	5.015 ac, 29.33% Impervious, Inflow D	Depth > 0.45" for 25-Year event
Inflow =	0.67 cfs @ 12.34 hrs, Volume=	0.188 af
Outflow =	0.67 cfs @ 12.34 hrs, Volume=	0.188 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



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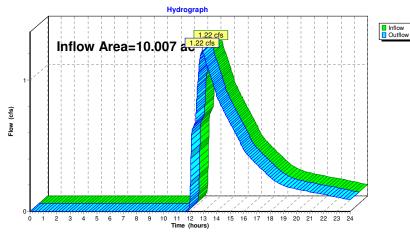
Inflow Area =	10.007 ac, 30.25% Impervious, Inflow	v Depth > 0.49"	for 25-Year event
Inflow =	1.22 cfs @ 12.90 hrs, Volume=	0.405 af	
Outflow =	1.22 cfs @ 12.90 hrs, Volume=	0.405 af, Atte	en= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

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Topsfield Proposed HydroCAD 2-2-17

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



Reach SP-3: Large Wetland Area West

Summary for Reach SP-3: Large Wetland Area West

Type III 24-hr 25-Year Rainfall=5.40"

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l 24-hr 25-Year Rainfall=5.40" Printed 2/27/2017 Page 179

Summary for Pond 3P: 12 Inch Culvert

[57] Hint: Peaked at 56.92' (Flood elevation advised)

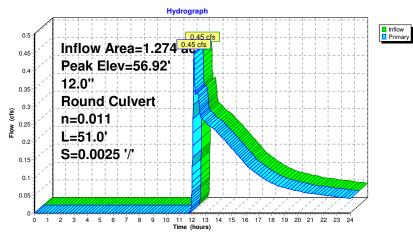
Inflow Area =	1.274 ac, 33.91% Impervious, Inflow Depth > 1.15" for 25-Year event	
Inflow =	0.45 cfs @ 12.11 hrs, Volume= 0.122 af	
Outflow =	0.45 cfs @ 12.11 hrs, Volume= 0.122 af, Atten= 0%, Lag= 0.0 min	
Primary =	0.45 cfs @ 12.11 hrs, Volume= 0.122 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 56.92' @ 12.11 hrs

Devic	ce	Routing	Invert	Outlet Devices
#		Primary	56.51'	12.0" Round RCP_Round 12" L= 51.0' Ke= 0.200 Inlet / Outlet Invert= 56.51' / 56.38' S= 0.0025 '/ Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.45 cfs @ 12.11 hrs HW=56.92' (Free Discharge) 1=RCP_Round 12'' (Barrel Controls 0.45 cfs @ 2.21 fps)

Pond 3P: 12 Inch Culvert



Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr	25-Year Rainfall=5.40"
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Summary for Pond D-1: Surface Infiltration Pond

[58] Hint: Peaked 0.47' above defined flood level

Inflow Area	ι =	2.637 ac, 5	6.99% Imp	ervious,	Inflow Depth >	2.74"	for 25-1	'ear event
Inflow	=	8.39 cfs @	12.10 hrs,	Volume	= 0.603	af		
Outflow	=	0.89 cfs @	12.95 hrs,	Volume	= 0.307	af, Atte	en= 89%,	Lag= 51.1 min
Discarded	=	0.12 cfs @	12.95 hrs,	Volume	= 0.124	af		-
Primary	=	0.77 cfs @	12.95 hrs,	Volume	= 0.183	af		

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 70.47' @ 12.95 hrs Surf.Area= 4,967 sf Storage= 14,656 cf Flood Elev= 70.00' Surf.Area= 4,583 sf Storage= 12,420 cf

Plug-Flow detention time= 245.6 min calculated for 0.307 af (51% of inflow) Center-of-Mass det. time= 137.6 min (951.6 - 814.0)

Volume	Inver	Avail.S	storage St	orage	Description			
#1	66.00	56	,233 cf Cu	stom	Stage Data (Pri	smatic) Listed below (Recalc)		
Elevatio	on S	urf.Area	Inc.Sto	ore	Cum.Store			
(fee	-	(sq-ft)	(cubic-fe		(cubic-feet)			
66.0	00	1,817		Ó	0			
67.0	00	2,361	2,0	89	2,089			
68.0	00	3,059	2,7	10	4,799			
69.0		3,800	3,4		8,229			
70.0		4,583	4,1		12,420			
71.0		5,403	4,9		17,413			
72.0		6,280	5,8		23,255			
73.0		7,213	6,7		30,001			
74.0 75.0		8,202 9,248	7,7 8,7		37,709 46,434			
76.0		10.350	9,7		56,233			
D .	:	, ,						
Device	Routing	Inve			-	-		
#1 #2	Discarded Primary	66.0 70.1						
			= 0.01	001	agaiou i E, Sin			

Discarded OutFlow Max=0.12 cfs @ 12.95 hrs HW=70.47' (Free Discharge)

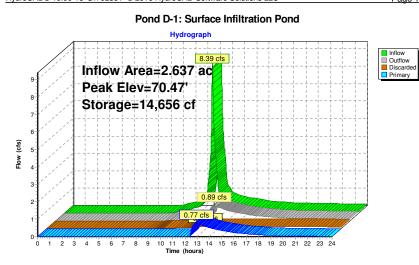
Primary OutFlow Max=0.76 cfs @ 12.95 hrs HW=70.47' (Free Discharge) -2=Culvert (Barrel Controls 0.76 cfs @ 3.40 fps)
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 Type III 24-hr
 25-Year Rainfall=5.40"

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Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr 25-Year Rainfall=5.40"
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Summary for Pond D-2: Existing Detention Basin

[58] Hint: Peaked 0.33' above defined flood level

Inflow Area =	0.528 ac, 59.84% Impervious, Inflow	Depth > 3.34" for 25-Year event
Inflow =	2.06 cfs @ 12.09 hrs, Volume=	0.147 af
Outflow =	0.17 cfs @ 13.21 hrs, Volume=	0.077 af, Atten= 92%, Lag= 67.5 min
Primary =	0.17 cfs @ 13.21 hrs, Volume=	0.077 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 58.41' @ 13.21 hrs Surf.Area= 3,090 sf Storage= 3,738 cf Flood Elev= 58.08' Surf.Area= 3,090 sf Storage= 2,719 cf

Plug-Flow detention time= 270.1 min calculated for 0.077 af (52% of inflow) Center-of-Mass det. time= 158.9 min (974.1 - 815.2)

Volume	Inv	ert Avail.S	torage S	Storage De	escription	
#1	57.	20' 9	,020 cf	Custom St	age Data ((Prismatic) Listed below (Recalc)
Elevatio (fee		Surf.Area (sq-ft)	Inc.S (cubic-		Cum.Stor (cubic-fee	
57.2	20	3,090		0		0
58.0	00	3,090	2	,472	2,47	72
59.0	00	3,090	3	,090	5,56	62
59.4	40	3,550	1	,328	6,89	90
60.0	00	3,550	2	,130	9,02	20
Device	Routing	Inve	rt Outlet	Devices		
#1	Primary	58.0	3' 4.0'' V	ert. Orifice	e/Grate (C= 0.600
#2	Primary	58.8)' 8.0'' V	ert. Orifice	e/Grate (C= 0.600

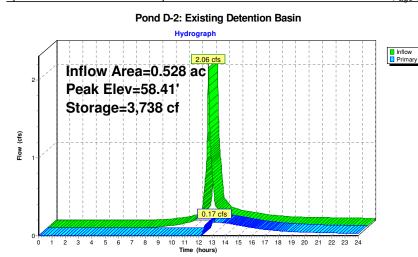
Primary OutFlow Max=0.17 cfs @ 13.21 hrs HW=58.41' (Free Discharge) 1=Orifice/Grate (Orifice Controls 0.17 cfs @ 1.95 fps) 2=Orifice/Grate (Controls 0.00 cfs)
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 Type III

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 Type III 24-hr
 25-Year Rainfall=5.40"

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Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr 25-Year Rainfall=5.40"
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Summary for Pond D-3: Detention Pond by Access Road

Inflow Area =	0.114 ac, 31.35% Impervious, Inflow D	epth > 2.42" for 25-Year event
Inflow =	0.32 cfs @ 12.09 hrs, Volume=	0.023 af
Outflow =	0.03 cfs @ 13.03 hrs, Volume=	0.023 af, Atten= 90%, Lag= 56.1 min
Discarded =	0.03 cfs @ 13.03 hrs, Volume=	0.023 af
Primary =	0.00 cfs @ 0.00 hrs, Volume=	0.000 af

Plug-Flow detention time= 118.7 min calculated for 0.023 af (100% of inflow) Center-of-Mass det. time= 118.2 min (958.6 - 840.3)

Volume	Inve	rt Avail.Sto	age Storage	e Description
#1	63.0	0' 47	'8 cf Custom	n Stage Data (Prismatic) Listed below (Recalc)
Elevatio	on s	Surf.Area	Inc.Store	Cum.Store
(fee	et)	(sq-ft)	(cubic-feet)	(cubic-feet)
63.0	00	305	0	0
64.0	00	650	478	478
Device	Routing	Invert	Outlet Device	es
#1	Primary	64.00'	5.0' long x 5.	5.0' breadth Broad-Crested Rectangular Weir
			Head (feet) 0	0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00
			2.50 3.00 3.	.50 4.00 4.50 5.00 5.50
			Coef. (Englisl	sh) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.6
			2.67 2.66 2.0	.68 2.70 2.74 2.79 2.88
#2	Discarde	d 63.00'	2.410 in/hr Ex	xfiltration over Horizontal area

Discarded OutFlow Max=0.03 cfs @ 13.03 hrs HW=63.86' (Free Discharge)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=63.00' (Free Discharge)

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 Type III 24-hr
 25-Year Rainfall=5.40"

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Pond D-3: Detention Pond by Access Road Hydrograph Inflow Outflow 0.32 cfs Discarded Inflow Area=0.114 ad 0.34 Peak Elev=63.86' 0.32 0.3 Storage=390 cf 0.28 0.26 0.24 0.22 0.2 0.2 0.18 0.18 0.16 0.14 0.12 0.1 0.08 0.03 cfs 0.06 0.04 0.00 0 1 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 2 3 4 5 6 7 8 9 Time (hours)

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Summary for Pond UIS-1: UIS at Entrance

Inflow Area =	1.480 ac, 42.24% Impervious, Inflow D	Depth > 3.36" for 25-Year event
Inflow =	5.62 cfs @ 12.09 hrs, Volume=	0.414 af
Outflow =	0.08 cfs @ 9.47 hrs, Volume=	0.114 af, Atten= 99%, Lag= 0.0 min
Discarded =	0.08 cfs @ 9.47 hrs, Volume=	0.114 af
Primary =	0.00 cfs @ 0.00 hrs, Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 65.94' @ 21.25 hrs Surf.Area= 3,486 sf Storage= 13,194 cf Flood Elev= 68.40' Surf.Area= 3,486 sf Storage= 13,981 cf

Plug-Flow detention time= 283.5 min calculated for 0.114 af (27% of inflow) Center-of-Mass det. time= 126.3 min (929.4 - 803.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	60.00'	5,786 cf	50.50'W x 69.03'L x 6.50'H Field A
			22,660 cf Overall - 8,195 cf Embedded = 14,465 cf x 40.0% Voids
#2A	61.00'	8,195 cf	Cultec R-902HD x 126 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
			7 Rows of 18 Chambers
			Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf
		12 001 of	Total Available Storage

13,981 cf Total Available Storage

Storage Group A created with Chamber Wizard

Devic	e Routing	Invert	Outlet Devices	
#1 #2	Discarded Primary	60.00' 68.40'	1.020 in/hr Exfiltration over Surfac 24.0" x 24.0" Horiz. Orifice/Grate Limited to weir flow at low heads	

Discarded OutFlow Max=0.08 cfs @ 9.47 hrs HW=60.08' (Free Discharge)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=60.00' (Free Discharge)

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 Type III 24-hr
 25-Year Rainfall=5.40"

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Pond UIS-1: UIS at Entrance - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD)

Effective Size= $69.8''W \times 48.0''H \Rightarrow 17.65 \text{ sf } x 3.67'L = 64.7 \text{ cf}$ Overall Size= $78.0''W \times 48.0''H \times 4.10'L \text{ with } 0.44' \text{ Overlap}$ Cap Storage= $+2.8 \text{ cf } x 2 \times 7 \text{ rows} = 38.6 \text{ cf}$

78.0" Wide + 6.0" Spacing = 84.0" C-C Row Spacing

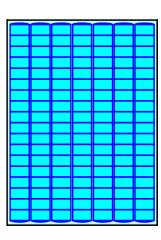
18 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 67.03' Row Length +12.0" End Stone x 2 = 69.03' Base Length 7 Rows x 78.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 50.50' Base Width 12.0" Base + 48.0" Chamber Height + 18.0" Cover = 6.50' Field Height

126 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 7 Rows = 8,195.3 cf Chamber Storage

22,660.2 cf Field - 8,195.3 cf Chambers = 14,464.9 cf Stone x 40.0% Voids = 5,786.0 cf Stone Storage

Chamber Storage + Stone Storage = 13,981.2 cf = 0.321 af Overall Storage Efficiency = 61.7%Overall System Size = $69.03' \times 50.50' \times 6.50'$

126 Chambers 839.3 cy Field 535.7 cy Stone





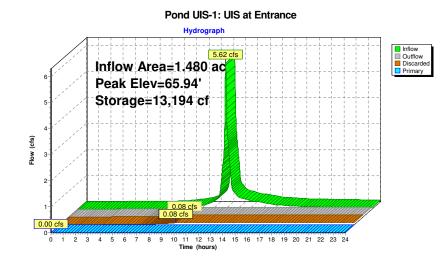
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 25-Year Rainfall=5.40"

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Summary for Pond UIS-2: UIS at North of Site

Inflow Area =	0.384 ac,100.00% Impervious, Inflow D	Depth > 5.16" for 25-Year event
Inflow =	2.03 cfs @ 12.08 hrs, Volume=	0.165 af
Outflow =	0.23 cfs @ 11.53 hrs, Volume=	0.165 af, Atten= 89%, Lag= 0.0 min
Discarded =	0.23 cfs @ 11.53 hrs, Volume=	0.165 af
Primary =	0.00 cfs @ 0.00 hrs, Volume=	0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 64.45' @ 12.72 hrs Surf.Area= 1,176 sf Storage= 2,255 cf Flood Elev= 68.25' Surf.Area= 1,176 sf Storage= 2,860 cf

Plug-Flow detention time= 63.5 min calculated for 0.165 af (100% of inflow) Center-of-Mass det. time= 63.3 min (809.5 - 746.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	61.50'	1,262 cf	16.00'W x 73.50'L x 4.04'H Field A
			4,753 cf Overall - 1,598 cf Embedded = 3,155 cf x 40.0% Voids
#2A	62.50'	1,598 cf	Cultec R-330XLHD x 30 Inside #1
			Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
			Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
			Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
		2,860 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices	
#1	Discarded	61.50'	8.270 in/hr Exfiltration over Surface area	
#2	Primary	68.25'	6.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads	

Discarded OutFlow Max=0.23 cfs @ 11.53 hrs HW=61.57' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.23 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=61.50' (Free Discharge)

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Pond UIS-2: UIS at North of Site - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

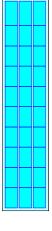
10 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 71.50' Row Length +12.0" End Stone x 2 = 73.50' Base Length 3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width 12.0" Base + 30.5" Chamber Height + 6.0" Cover = 4.04' Field Height

30 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 3 Rows = 1,598.2 cf Chamber Storage

4,753.0 cf Field - 1,598.2 cf Chambers = 3,154.8 cf Stone x 40.0% Voids = 1,261.9 cf Stone Storage

Chamber Storage + Stone Storage = 2,860.1 cf = 0.066 af Overall Storage Efficiency = 60.2% Overall System Size = 73.50' x 16.00' x 4.04'

30 Chambers 176.0 cy Field 116.8 cy Stone



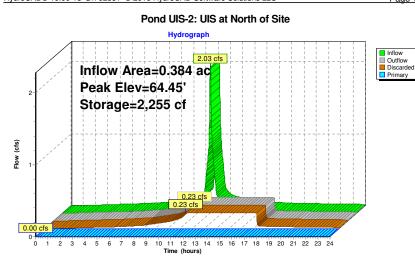
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Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr	25-Year Rainfall=5.40"
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Summary for Pond UIS-3: UIS-3

[58] Hint: Peaked 1.58' above defined flood level

Inflow Area =	0.083 ac,100.00% Impervious, Inflow D	epth > 5.16" for 25-Year event
Inflow =	0.44 cfs @ 12.08 hrs, Volume=	0.036 af
Outflow =	0.44 cfs @ 12.09 hrs, Volume=	0.033 af, Atten= 1%, Lag= 0.6 min
Discarded =	0.00 cfs @ 2.62 hrs, Volume=	0.004 af
Primary =	0.43 cfs @ 12.09 hrs, Volume=	0.029 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 73.79' @ 12.09 hrs Surf.Area= 103 sf Storage= 137 cf Flood Elev= 72.21' Surf.Area= 103 sf Storage= 22 cf

Plug-Flow detention time= 65.9 min calculated for 0.033 af (93% of inflow) Center-of-Mass det. time= 26.7 min (772.9 - 746.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	71.69'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
			332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	72.19'	97 cf	Cultec R-280HD x 2 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	71.69'	1.020 in/hr Exfiltration over Surface area
#2	Primary	73.40'	6.0" Round Culvert L= 30.0' Ke= 0.200 Inlet / Outlet Invert= 73.40' / 70.70' S= 0.0900 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.00 cfs @ 2.62 hrs HW=71.72' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.43 cfs @ 12.09 hrs HW=73.79' (Free Discharge) -2=Culvert (Inlet Controls 0.43 cfs @ 2.65 fps) Topsfield Proposed HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC

Type III 24-hr 25-Year Rainfall=5.40" Printed 2/27/2017 Page 193

Pond UIS-3: UIS-3 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

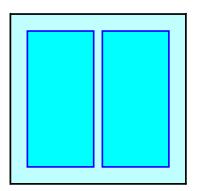
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

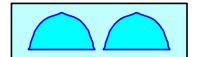
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

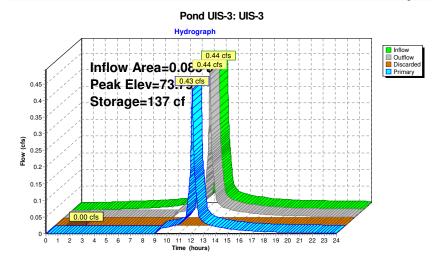
2 Chambers 12.3 cy Field 8.7 cy Stone







Type III 24-hr 25-Year Rainfall=5.40" Printed 2/27/2017 Page 194



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Type III 24-hr 25-Year Rainfall=5.40" Printed 2/27/2017 Page 195

Summary for Pond UIS-4: UIS-4

[58] Hint: Peaked 0.53' above defined flood level

Inflow Area =	0.073 ac,100.00% Impervious, Inflow Depth > 5.16" for 25-Year event
Inflow =	0.39 cfs @ 12.08 hrs, Volume= 0.032 af
Outflow =	0.38 cfs @ 12.10 hrs, Volume= 0.029 af, Atten= 3%, Lag= 1.2 min
Discarded =	0.00 cfs @ 2.88 hrs, Volume= 0.004 af
Primary =	0.37 cfs @ 12.10 hrs, Volume= 0.024 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 74.73' @ 12.10 hrs Surf.Area= 103 sf Storage= 146 cf Flood Elev= 74.20' Surf.Area= 103 sf Storage= 111 cf

Plug-Flow detention time= 71.7 min calculated for 0.029 af (92% of inflow) Center-of-Mass det. time= 28.8 min (775.0 - 746.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	72.50'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
			332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	73.00'	97 cf	Cultec R-280HD x 2 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	72.50'	1.020 in/hr Exfiltration over Surface area
#2	Primary	74.20'	6.0" Round Culvert L= 30.0' Ke= 1.000 Inlet / Outlet Invert= 74.20' / 74.06' S= 0.0047 '/' Cc= 0.900
			n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.00 cfs @ 2.88 hrs HW=72.53' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.37 cfs @ 12.10 hrs HW=74.73' (Free Discharge) -2=Culvert (Inlet Controls 0.37 cfs @ 1.90 fps)

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Pond UIS-4: UIS-4 - Chamber Wizard Field A

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Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

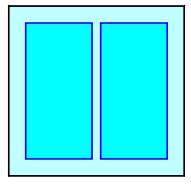
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

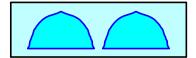
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

2 Chambers 12.3 cy Field 8.7 cy Stone

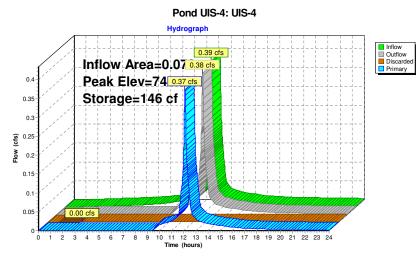






Type III 24-hr 25-Year Rainfall=5.40" Printed 2/27/2017 Page 197





Inflow Area = 0.083 ac, 100.00% Impervious, Inflow Depth > 5.16° for 25-Year event Inflow = 0.44 cts @ 12.08 hrs, Volume 0.033 at, Atten 4%, Lag = 1.4 min Discarded 0.00 cts @ 2.62 hrs, Volume 0.004 at Primary = 0.42 cts @ 12.11 hrs, Volume 0.029 at Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 75.40° @ 12.11 hrs, Volume 0.029 at Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 75.40° @ 12.11 hrs, Volume 0.029 at Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 75.40° @ 12.11 hrs, Surf.Area= 103 st Storage = 151 ct Plug-Flow detention time= 66.5 min calculated for 0.033 at (39% of inflow) Center-of-Mass det. time= 27.3 min (773.5 - 748.2) Volume Invert Avail.Storage Storage Description #1A 73.09° 94 ct 10.33 Wx 10.00° Lx 3.21'H Field A 332 cf Overall - 37 cf Embedded = 234 cf x 40.0% Voids #2A 73.59° 97 cf Utiltec R-2000 Lx 2 inside #1 Effective Size-46.9°W x 28.0°H =>.6.07 sf x 7.00°L + 24.5 cf Worrall Size Ar-00°W x 28.5°H × 8.00C lwith 1.00° Overlap Coveral Size Ar-00° × 6.07 sf x 2.000 Lr Proveral Size Ar-00°W x 28.5°H × 8.00C lwith 1.00°C overlap Coveral Size Ar-00°W x 28.5°H × 8.00C lwith 1.00°C overlap Coveral Size Ar-00°W x 28.5°H × 8.00C lwith 1.00°C overlap Coveral Size Ar-00°W x 28.5°H × 8.00C lwith 1.00°C overlap Coveral Size Ar-00°W x 28.5°H × 8.00C lwith 1.00°C overlap Coveral Size Ar-00°W x 28.5°H × 8.00C lwith 1.00°C overlap Coveral Size Ar-00°W x 28.5°H × 8.00C lwith 1.00°C	HydroCA	ed by Microso D® 10.00-18 s		Printed 2/27/201 HydroCAD Software Solutions LLC Page 15
Inflow = 0.44 cfs @ 12.08 hrs, Volume= 0.036 af Outflow = 0.42 cfs @ 12.11 hrs, Volume= 0.033 af, Atten= 4%, Lag= 1.4 min Discarded = 0.00 cfs @ 2.62 hrs, Volume= 0.004 af Primary = 0.42 cfs @ 12.11 hrs, Volume= 0.029 af Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 75.40' @ 12.11 hrs Surf.Area= 103 sf Storage= 151 cf Plug-Flow detention time= 66.5 min calculated for 0.033 af (93% of inflow) Center-of-Mass det. time= 27.3 min (773.5 - 746.2) Volume Invert Avail.Storage Storage Description #1A 73.09' 94 cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids #2A 73.59' 97 cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9''W x 26.0''H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows 191 cf Total Available Storage Storage Group A created with Chamber Wizard Evice 6.0'' Round Culvert L = 22.0'' Ke= 1.000 #2			Sur	mmary for Pond UIS-5: UIS-5
Peak Élev= 75.40' @ 12.11 hrs Surf.Area= 103 sf Storage= 151 cf Plug-Flow detention time= 66.5 min calculated for 0.033 af (93% of inflow) Center-of-Mass det. time= 27.3 min (773.5 - 746.2) Volume Invert Avail.Storage Storage Description #1A 73.09' 94 cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids #2A 73.59' 97 cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows 191 cf Total Available Storage Storage Group A created with Chamber Wizard Device Routing Invert Outlet Devices #1 Discarded 73.09' 1.020 in/hr Exfiltration over Surface area #2 Primary 74.80' 6.0" Round Culvert L = 22.0' Ke = 1.000 Inlet / Outlet Invert - 74.80' / 74.60' S = 0.0091 '/' Cc = 0.900 n = 0.011 PVC, smooth interior, Flow Area = 0.20 sf Discarded OutFlow Max=0.00 cfs @ 2.62 hrs HW=73.12' (Free Discharge) Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=75.40' (Free Discharge)	Inflow Outflow Discard	= 0.4 = 0.4 = 0.4 = 0.0	14 cfs @ 12.08 h 12 cfs @ 12.11 h 00 cfs @ 2.62 h	nrs, Volume= 0.036 af nrs, Volume= 0.033 af, Atten= 4%, Lag= 1.4 min nrs, Volume= 0.004 af
Center-of-Mass det. time= 27.3 min (773.5 - 746.2) Volume Invert Avail.Storage Storage Description #1A 73.09' 94 cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids #2A 73.59' 97 cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows 191 cf Total Available Storage Storage Group A created with Chamber Wizard Device Routing #1 Discarded #2 73.09' 1020 in/hr Exfiltration over Surface area #2 #1 Discarded 74.80' 6.0" Round Culvert Le 22.0' Ke= 1.000 Inlet / Outlet Invert= 74.80' / 74.60' S = 0.0091 '/' Cc= 0.900 n = 0.011 PVC, smooth interior, Flow Area= 0.20 sf Discarded OutFlow Max=0.00 cfs @ 2.62 hrs HW=73.12' (Free Discharge) —1=Exfiltration (Exfiltration Controls 0.00 cfs) Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=75.40' (Free Discharge)				
#1A 73.09' 94 cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids #2A 73.59' 97 cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.5"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows 191 cf Total Available Storage Storage Group A created with Chamber Wizard Device Routing #1 Discarded #2 Primary 74.80' 6.0" Round Culvert Le 22.0' Ke= 1.000 Inlet / Outlet Invert 24.80' / 74.60' S = 0.0091 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf Discarded OutFlow Max=0.00 cfs @ 2.62 hrs HW=73.12' (Free Discharge) —1=Exfiltration (Exfiltration Controls 0.00 cfs) Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=75.40' (Free Discharge)				
#1A 73.09' 94 cf 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids #2A 73.59' 97 cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.5"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows 191 cf Total Available Storage Storage Group A created with Chamber Wizard Device Routing #1 Discarded #2 Primary 74.80' 6.0" Round Culvert Le 22.0' Ke= 1.000 Inlet / Outlet Invert 24.80' / 74.60' S = 0.0091 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf Discarded OutFlow Max=0.00 cfs @ 2.62 hrs HW=73.12' (Free Discharge) —1=Exfiltration (Exfiltration Controls 0.00 cfs) Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=75.40' (Free Discharge)	Volumo	Invert	Avail Storage	Storage Description
#2A 73.59' 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids #2A 73.59' 97 cf Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00'x 6.07 sf x 2 rows 191 cf Total Available Storage Storage Group A created with Chamber Wizard Device Routing Invert #1 Discarded 73.09' #2 Primary 74.80' 6.0" Round Culvert L= 22.0' Ke= 1.000 Inlet / Outlet Invert= 74.80' / 74.60' S = 0.0091 '/' Cc= 0.900 n = 0.011 PVC, smooth interior, Flow Area= 0.20 sf Discarded OutFlow Max=0.00 cfs @ 2.62 hrs HW=73.12' (Free Discharge) 1=Extiltration (Exfiltration Controls 0.00 cfs) Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=75.40' (Free Discharge)			u	
Row Length Adjustment= +1.00' x 6.07 sf x 2 rows 191 cf Total Available Storage Storage Group A created with Chamber Wizard Device Routing 11 Discarded 73.09' 1.020 in/hr Exfiltration over Surface area #1 Discarded 74.80' 6.0'' Round Culvert Le 22.0' Ke= 1.000 Inlet / Outlet Invert= 74.80' / 74.60' Storage OutFlow Max=0.00 cfs @ 2.62 hrs HW=73.12' (Free Discharge) Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=75.40' (Free Discharge)				332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1
Storage Group A created with Chamber Wizard Device Routing Invert Outlet Devices #1 Discarded 73.09' 1.020 in/hr Exfiltration over Surface area #2 Primary 74.80' 6.0" Round Culvert L= 22.0' Ke= 1.000 Inlet / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf Discarded OutFlow Max=0.00 cfs @ 2.62 hrs HW=73.12' (Free Discharge) —1=Exfiltration (Exfiltration Controls 0.00 cfs) Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=75.40' (Free Discharge)				
Device Routing Invert Outlet Devices #1 Discarded 73.09' 1.020 in/hr Exfiltration over Surface area #2 Primary 74.80' 6.0" Round Culvert L= 22.0' Ke= 1.000 Inlet / Outlet Invert= 74.80' 74.60' S= 0.0091 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf Discarded OutFlow Max=0.00 cfs @ 2.62 hrs HW=73.12' (Free Discharge) -1=Exfiltration (Exfiltration Controls 0.00 cfs) Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=75.40' (Free Discharge)			191 cf	Total Available Storage
Device Routing Invert Outlet Devices #1 Discarded 73.09' 1.020 in/hr Exfiltration over Surface area #2 Primary 74.80' 6.0" Round Culvert L= 22.0' Ke= 1.000 Inlet / Outlet Invert= 74.80' 74.60' S= 0.0091 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf Discarded OutFlow Max=0.00 cfs @ 2.62 hrs HW=73.12' (Free Discharge) -1=Exfiltration (Exfiltration Controls 0.00 cfs) Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=75.40' (Free Discharge)	0.	· ·		1 Mar 1
#1 Discarded 73.09' 1.020 in/hr Exfiltration over Surface area #2 Primary 74.80' 6.0'' Round Culvert L= 22.0' Ke= 1.000 Inlet / Outlet Invert= 74.80' 74.60' S= 0.0091 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf Discarded OutFlow Max=0.00 cfs @ 2.62 hrs HW=73.12' (Free Discharge) —1=Exfiltration (Exfiltration Controls 0.00 cfs) Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=75.40' (Free Discharge)	Stora	age Group A ci	reated with Cham	iber Wizard
 #2 Primary 74.80' 6.0" Round Culvert L = 22.0' Ke = 1.000 Inlet / Outlet Invert= 74.80' 74.60' S = 0.0091 '/' Cc = 0.900 n = 0.011 PVC, smooth interior, Flow Area = 0.20 sf Discarded OutFlow Max=0.00 cfs @ 2.62 hrs HW=73.12' (Free Discharge) T=Exfiltration (Exfiltration Controls 0.00 cfs) Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=75.40' (Free Discharge) 			Invort Out	
Inlet / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf Discarded OutFlow Max=0.00 cfs @ 2.62 hrs HW=73.12' (Free Discharge) —1=Exfiltration (Exfiltration Controls 0.00 cfs) Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=75.40' (Free Discharge)	Device	Routing	Invent Out	let Devices
n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf	#1	Discarded	73.09' 1.02	20 in/hr Exfiltration over Surface area
Discarded OutFlow Max=0.00 cfs @ 2.62 hrs HW=73.12' (Free Discharge) 1=Exfiltration (Exfiltration Controls 0.00 cfs) Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=75.40' (Free Discharge)	#1	Discarded	73.09' 1.02 74.80' 6.0''	20 in/hr Exfiltration over Surface area ' Round Culvert L= 22.0' Ke= 1.000
←1=Exfiltration (Exfiltration Controls 0.00 cfs) Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=75.40' (Free Discharge)	#1	Discarded	73.09' 1.02 74.80' 6.0'' Inlet	20 in/hr Exfiltration over Surface area ' Round Culvert L= 22.0' Ke= 1.000 t / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900
Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=75.40' (Free Discharge)	#1 #2	Discarded Primary	73.09' 1.02 74.80' 6.0'' Inlet n= 0	20 in/hr Exfiltration over Surface area / Round Culvert L= 22.0' Ke= 1.000 t/ Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf
	#1 #2 Discard	Discarded Primary ed OutFlow M	73.09' 1.02 74.80' 6.0'' Inlet n= 0 Max=0.00 cfs @ 2	20 in/hr Exfiltration over Surface area ' Round Culvert L= 22.0' Ke= 1.000 / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.62 hrs HW=73.12' (Free Discharge)
T—2=Culvert (Inlet Controls 0.42 cfs @ 2.14 fps)	#1 #2 Discard	Discarded Primary ed OutFlow M	73.09' 1.02 74.80' 6.0'' Inlet n= 0 Max=0.00 cfs @ 2	20 in/hr Exfiltration over Surface area ' Round Culvert L= 22.0' Ke= 1.000 / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.62 hrs HW=73.12' (Free Discharge)
	#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow M filtration (Exf OutFlow Ma:	73.09' 1.02 74.80' 6.0'' Inlet n= 0 Max=0.00 cfs @ 2 iltration Controls x=0.42 cfs @ 12.'	20 in/hr Extiltration over Surface area ' Round Culvert L= 22.0' Ke= 1.000 t / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.62 hrs HW=73.12' (Free Discharge) 0.00 cfs) 11 hrs HW=75.40' (Free Discharge)
	#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow M filtration (Exf OutFlow Ma:	73.09' 1.02 74.80' 6.0'' Inlet n= 0 Max=0.00 cfs @ 2 iltration Controls x=0.42 cfs @ 12.'	20 in/hr Extiltration over Surface area ' Round Culvert L= 22.0' Ke= 1.000 t / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.62 hrs HW=73.12' (Free Discharge) 0.00 cfs) 11 hrs HW=75.40' (Free Discharge)
	#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow M filtration (Exf OutFlow Ma:	73.09' 1.02 74.80' 6.0'' Inlet n= 0 Max=0.00 cfs @ 2 iltration Controls x=0.42 cfs @ 12.'	20 in/hr Extiltration over Surface area ' Round Culvert L= 22.0' Ke= 1.000 t / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.62 hrs HW=73.12' (Free Discharge) 0.00 cfs) 11 hrs HW=75.40' (Free Discharge)
	#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow M filtration (Exf OutFlow Ma:	73.09' 1.02 74.80' 6.0'' Inlet n= 0 Max=0.00 cfs @ 2 iltration Controls x=0.42 cfs @ 12.'	20 in/hr Extiltration over Surface area ' Round Culvert L= 22.0' Ke= 1.000 t / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.62 hrs HW=73.12' (Free Discharge) 0.00 cfs) 11 hrs HW=75.40' (Free Discharge)
	#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow M filtration (Exf OutFlow Ma:	73.09' 1.02 74.80' 6.0'' Inlet n= 0 Max=0.00 cfs @ 2 iltration Controls x=0.42 cfs @ 12.'	20 in/hr Extiltration over Surface area ' Round Culvert L= 22.0' Ke= 1.000 t / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.62 hrs HW=73.12' (Free Discharge) 0.00 cfs) 11 hrs HW=75.40' (Free Discharge)
	#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow M filtration (Exf OutFlow Ma:	73.09' 1.02 74.80' 6.0'' Inlet n= 0 Max=0.00 cfs @ 2 iltration Controls x=0.42 cfs @ 12.'	20 in/hr Extiltration over Surface area ' Round Culvert L= 22.0' Ke= 1.000 t / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.62 hrs HW=73.12' (Free Discharge) 0.00 cfs) 11 hrs HW=75.40' (Free Discharge)
	#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow M filtration (Exf OutFlow Ma:	73.09' 1.02 74.80' 6.0'' Inlet n= 0 Max=0.00 cfs @ 2 iltration Controls x=0.42 cfs @ 12.'	20 in/hr Extiltration over Surface area ' Round Culvert L= 22.0' Ke= 1.000 t / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.62 hrs HW=73.12' (Free Discharge) 0.00 cfs) 11 hrs HW=75.40' (Free Discharge)
	#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow M filtration (Exf OutFlow Ma:	73.09' 1.02 74.80' 6.0'' Inlet n= 0 Max=0.00 cfs @ 2 iltration Controls x=0.42 cfs @ 12.'	20 in/hr Extiltration over Surface area ' Round Culvert L= 22.0' Ke= 1.000 t / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.62 hrs HW=73.12' (Free Discharge) 0.00 cfs) 11 hrs HW=75.40' (Free Discharge)
	#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow M filtration (Exf OutFlow Ma:	73.09' 1.02 74.80' 6.0'' Inlet n= 0 Max=0.00 cfs @ 2 iltration Controls x=0.42 cfs @ 12.'	20 in/hr Extiltration over Surface area ' Round Culvert L= 22.0' Ke= 1.000 t / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.62 hrs HW=73.12' (Free Discharge) 0.00 cfs) 11 hrs HW=75.40' (Free Discharge)
	#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow M filtration (Exf OutFlow Ma:	73.09' 1.02 74.80' 6.0'' Inlet n= 0 Max=0.00 cfs @ 2 iltration Controls x=0.42 cfs @ 12.'	20 in/hr Extiltration over Surface area ' Round Culvert L= 22.0' Ke= 1.000 t / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.62 hrs HW=73.12' (Free Discharge) 0.00 cfs) 11 hrs HW=75.40' (Free Discharge)
	#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow M filtration (Exf OutFlow Ma:	73.09' 1.02 74.80' 6.0'' Inlet n= 0 Max=0.00 cfs @ 2 iltration Controls x=0.42 cfs @ 12.'	20 in/hr Extiltration over Surface area ' Round Culvert L= 22.0' Ke= 1.000 t / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.62 hrs HW=73.12' (Free Discharge) 0.00 cfs) 11 hrs HW=75.40' (Free Discharge)
	#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow M filtration (Exf OutFlow Ma:	73.09' 1.02 74.80' 6.0'' Inlet n= 0 Max=0.00 cfs @ 2 iltration Controls x=0.42 cfs @ 12.'	20 in/hr Extiltration over Surface area ' Round Culvert L= 22.0' Ke= 1.000 t / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.62 hrs HW=73.12' (Free Discharge) 0.00 cfs) 11 hrs HW=75.40' (Free Discharge)
	#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow M filtration (Exf OutFlow Ma:	73.09' 1.02 74.80' 6.0'' Inlet n= 0 Max=0.00 cfs @ 2 iltration Controls x=0.42 cfs @ 12.'	20 in/hr Extiltration over Surface area ' Round Culvert L= 22.0' Ke= 1.000 t / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.62 hrs HW=73.12' (Free Discharge) 0.00 cfs) 11 hrs HW=75.40' (Free Discharge)
	#1 #2 Discard 1=Ex Primary	Discarded Primary ed OutFlow M filtration (Exf OutFlow Ma:	73.09' 1.02 74.80' 6.0'' Inlet n= 0 Max=0.00 cfs @ 2 iltration Controls x=0.42 cfs @ 12.'	20 in/hr Extiltration over Surface area ' Round Culvert L= 22.0' Ke= 1.000 t / Outlet Invert= 74.80' / 74.60' S= 0.0091 '/ Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.62 hrs HW=73.12' (Free Discharge) 0.00 cfs) 11 hrs HW=75.40' (Free Discharge)

 Topsfield Proposed HydroCAD 2-2-17
 Ty,

 Prepared by Microsoft
 HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC

 Type III 24-hr
 25-Year Rainfall=5.40"

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Pond UIS-5: UIS-5 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

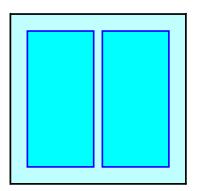
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

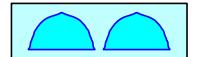
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

2 Chambers 12.3 cy Field 8.7 cy Stone





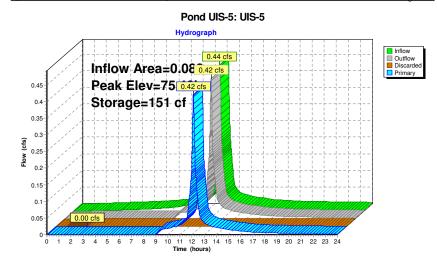
 Topsfield Proposed HydroCAD 2-2-17
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 Prepared by Microsoft
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 Type III 24-hr
 25-Year Rainfall=5.40"

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Summary for Pond UIS-6: UIS-6							
nflow Ar			Impervious, Inflow Depth > 5.16" for 25-Year even	nt			
nflow).47 cfs @ 12.08					
Outflow).45 cfs @ 12.11		min			
Discarde		0.00 cfs @ 2.48					
Primary	= ().45 cfs @ 12.11	hrs, Volume= 0.031 af				
Plua-Flo							
Center-o	of-Mass det.	time= 26.6 min (
Center-o Volume	of-Mass det. Invert	time= 26.6 min (Avail.Storage	72.8 - 746.2)				
Center-o	of-Mass det.	time= 26.6 min (Avail.Storage	72.8 - 746.2) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'H Field A				
Center-o <u>Volume</u> #1A	of-Mass det. Invert 72.29	time= 26.6 min (Avail.Storage 94 cf	72.8 - 746.2) <u>Storage Description</u> 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% \	Voids			
Center-o /olume	of-Mass det. Invert	time= 26.6 min (Avail.Storage 94 cf	72.8 - 746.2) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% \ Cultec R-280HD x 2 Inside #1				
Center-o <u>/olume</u> #1A	of-Mass det. Invert 72.29	time= 26.6 min (Avail.Storage 94 cf	72.8 - 746.2) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% V Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L	= 42.5 cf			
Center-o <u>/olume</u> #1A	of-Mass det. Invert 72.29	time= 26.6 min (Avail.Storage 94 cf	72.8 - 746.2) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% V Cultec R-280HD x 2 Inside #1 Effective Size= 46.9''W x 26.0''H => 6.07 sf x 7.00'L Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' O	= 42.5 cf			
Center-o <u>Volume</u> #1A	of-Mass det. Invert 72.29	time= 26.6 min (<u>Avail.Storage</u> 94 cf 97 cf	72.8 - 746.2) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% V Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L	= 42.5 cf			
Center-o <u>Volume</u> #1A	of-Mass det. Invert 72.29	time= 26.6 min (<u>Avail.Storage</u> 94 cf 97 cf	72.8 - 746.2) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% \ Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' O Row Length Adjustment= +1.00' x 6.07 sf x 2 rows	= 42.5 cf			
Center-o <u>Volume</u> #1A #2A	of-Mass det. Invert 72.29 72.79	time= 26.6 min (<u>Avail.Storage</u> 94 cf 97 cf	72.8 - 746.2) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% \ Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' O Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage	= 42.5 cf			
Volume #1A #2A Stora	of-Mass det. Invert 72.29 72.79	time= 26.6 min (Avail.Storage 94 cf 97 cf 191 cf created with Char	72.8 - 746.2) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% \ Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' O Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage	= 42.5 cf			
Volume #1A #2A Stora	of-Mass det. Invert 72.29 72.79 ge Group A	time= 26.6 min (Avail.Storage 94 cf 97 cf 191 cf created with Char Invert Ou	72.8 - 746.2) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% \ Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' O Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage hber Wizard	= 42.5 cf			
Volume #1A #2A Stora	of-Mass det. Invert 72.29' 72.79' ge Group A Routing	time= 26.6 min (<u>Avail.Storage</u> 94 cf 97 cf 191 cf created with Char <u>Invert</u> <u>OL</u> 72.29' 1. 0	72.8 - 746.2) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% V Cultec R-280HD x 2 Inside #1 Effective Size= 46.9''W x 26.0''H => 6.07 sf x 7.00'L Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' O Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage hber Wizard let Devices	= 42.5 cf			
Volume #1A #2A Stora Device #1	of-Mass det. Invert 72.29' 72.79' ge Group A <u>Routing</u> Discarded	time= 26.6 min (<u>Avail.Storage</u> 94 cf 97 cf 191 cf created with Char <u>Invert</u> OL 72.29' 1.0 74.00' 6.0 Inh	72.8 - 746.2) Storage Description 10.33'W x 10.00'L x 3.21'H Field A 332 cf Overall - 97 cf Embedded = 234 cf x 40.0% \ Cultec R-280HD x 2 Inside #1 Effective Size= 46.9''W x 26.0''H => 6.07 sf x 7.00'L Overall Size= 47.0''W x 26.5''H x 8.00'L with 1.00' O Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage nber Wizard let Devices 20 in/hr Exfiltration over Surface area	= 42.5 cf verlap			

Discarded OutFlow Max=0.00 cfs @ 2.48 hrs HW=72.32' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.45 cfs @ 12.11 hrs HW=74.65' (Free Discharge) -2=Culvert (Inlet Controls 0.45 cfs @ 2.29 fps)
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 Type III 24-hr
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 Type III 24-hr
 25-Year Rainfall=5.40"

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Pond UIS-6: UIS-6 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

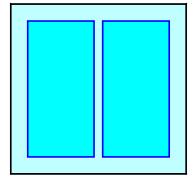
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

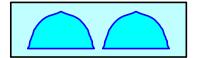
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 afOverall Storage Efficiency = 57.6%Overall System Size = $10.00' \times 10.33' \times 3.21'$

2 Chambers 12.3 cy Field 8.7 cy Stone





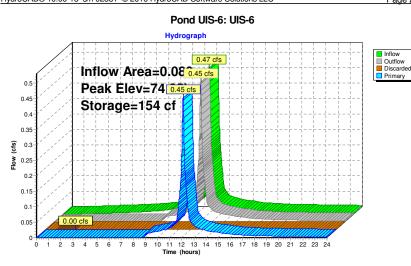
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 25-Year Rainfall=5.40"

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Summary for Pond UIS-7: UIS-7

Inflow Area =	0.083 ac,100.00% Impervious, Inflow Depth > 5.16" for 25-Year event
Inflow =	0.44 cfs @ 12.08 hrs, Volume= 0.036 af
Outflow =	0.42 cfs @ 12.11 hrs, Volume= 0.033 af, Atten= 4%, Lag= 1.4 min
Discarded =	0.00 cfs @ 2.62 hrs, Volume= 0.004 af
Primary =	0.42 cfs @ 12.11 hrs, Volume= 0.029 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 74.10' @ 12.11 hrs Surf.Area= 103 sf Storage= 151 cf

Plug-Flow detention time= 66.5 min calculated for 0.033 af (93% of inflow) Center-of-Mass det. time= 27.3 min (773.5 - 746.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	71.79'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
			332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	72.29'	97 cf	Cultec R-280HD x 2 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	Total Available Storage

.

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	71.79'	1.020 in/hr Exfiltration over Surface area
#2	Primary	73.50'	6.0" Round Culvert L= 17.5' Ke= 1.000
			Inlet / Outlet Invert= 73.50' / 73.00' S= 0.0286 '/' Cc= 0.900
			n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.00 cfs @ 2.62 hrs HW=71.82' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=74.10' (Free Discharge) -2=Culvert (Inlet Controls 0.42 cfs @ 2.14 fps)
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Pond UIS-7: UIS-7 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

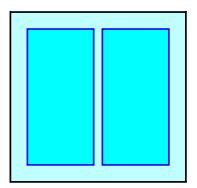
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

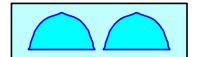
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

2 Chambers 12.3 cy Field 8.7 cy Stone





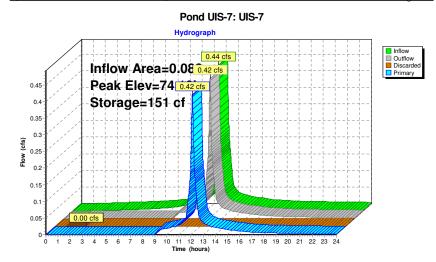
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HydroCA	.D® 10.00-18 s	n 02881 © 2010	6 HydroCAD Software	e Solutions LLC Page 207				
		s	ummary for Pon	d UIS-8: UIS-8				
Inflow A			6 Impervious, Inflo 3 hrs, Volume=	w Depth > 5.16" for 25-Year event 0.036 af				
Outflow			I hrs, Volume=	0.033 af, Atten= 4%, Lag= 1.4 min				
Discarde			2 hrs, Volume=	0.004 af				
Primary			I hrs. Volume=	0.029 af				
_								
			an= 0.00-24.00 hrs					
Peak Ele	ev= /3.40'@ 1	2.11 hrs Surf	Area= 103 sf Stor	rage= 151 cf				
	wy detention tim	no CCEmina						
	Plug-Flow detention time= 66.5 min calculated for 0.033 af (93% of inflow)							
Contor o	of Maga dat tir			af (93% of inflow)				
Center-c	of-Mass det. tir		alculated for 0.033 773.5 - 746.2)	af (93% of inflow)				
Center-c Volume		ne= 27.3 min (
		ne= 27.3 min (773.5 - 746.2) e Storage Descrip					
<u>Volume</u> #1A	Invert 71.09'	me= 27.3 min (<u>Avail.Storag</u> 94 c	773.5 - 746.2) e Storage Descrip f 10.33'W x 10.00 332 cf Overall -	bion / L x 3.21'H Field A 97 cf Embedded = 234 cf x 40.0% Voids				
Volume	Invert	me= 27.3 min (<u>Avail.Storag</u> 94 c	773.5 - 746.2) e Storage Descrip f 10.33'W x 10.00 332 cf Overall - f Cultec R-280HD	btion 'L x 3.21'H Field A 97 cf Embedded = 234 cf x 40.0% Voids 0 x 2 Inside #1				
<u>Volume</u> #1A	Invert 71.09'	me= 27.3 min (<u>Avail.Storag</u> 94 c	773.5 - 746.2) e Storage Descrip f 10.33'W x 10.00 332 cf Overall - f Cultec R-280HE Effective Size=	bition 'L x 3.21'H Field A 97 cf Embedded = 234 cf x 40.0% Voids 0 x 2 Inside #1 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf				
<u>Volume</u> #1A	Invert 71.09'	me= 27.3 min (<u>Avail.Storag</u> 94 c	773.5 - 746.2) e Storage Descrip f 10.33'W x 10.00 332 cf Overall - f Cultec R-280HD Effective Size= Overall Size= 4	tion 'L x 3.21'H Field A 97 cf Embedded = 234 cf x 40.0% Voids 0 x 2 Inside #1 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 7.0"W x 26.5"H x 8.00'L with 1.00' Overlap				
<u>Volume</u> #1A	Invert 71.09'	ne= 27.3 min (<u>Avail.Storag</u> 94 c 97 c	773.5 - 746.2) e Storage Descrip f 10.33'W x 10.00 332 cf Overall - f Cultec R-280HE Effective Size= Overall Size= 4 Row Length Adj	Dition 'L x 3.21'H Field A 97 cf Embedded = 234 cf x 40.0% Voids) x 2 Inside #1 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 7.0"W x 26.5"H x 8.00'L with 1.00' Overlap justment= +1.00' x 6.07 sf x 2 rows				
<u>Volume</u> #1A	Invert 71.09'	me= 27.3 min (<u>Avail.Storag</u> 94 c	773.5 - 746.2) e Storage Descrip f 10.33'W x 10.00 332 cf Overall - f Cultec R-280HE Effective Size= Overall Size= 4 Row Length Adj	Dition 'L x 3.21'H Field A 97 cf Embedded = 234 cf x 40.0% Voids) x 2 Inside #1 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 7.0"W x 26.5"H x 8.00'L with 1.00' Overlap justment= +1.00' x 6.07 sf x 2 rows				
<u>Volume</u> #1A #2A	Invert 71.09' 71.59'	ne= 27.3 min (<u>Avail.Storag</u> 94 c 97 c 191 c	773.5 - 746.2) e Storage Descrip f 10.33'W x 10.00 332 cf Overall - f Cultec R-280HD Effective Size= Overall Size= 4' Row Length Adj f Total Available 3'	Dition 'L x 3.21'H Field A 97 cf Embedded = 234 cf x 40.0% Voids) x 2 Inside #1 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 7.0"W x 26.5"H x 8.00'L with 1.00' Overlap justment= +1.00' x 6.07 sf x 2 rows				
<u>Volume</u> #1A #2A	Invert 71.09' 71.59'	ne= 27.3 min (<u>Avail.Storag</u> 94 c 97 c	773.5 - 746.2) e Storage Descrip f 10.33'W x 10.00 332 cf Overall - f Cultec R-280HD Effective Size= Overall Size= 4' Row Length Adj f Total Available 3'	Dition 'L x 3.21'H Field A 97 cf Embedded = 234 cf x 40.0% Voids) x 2 Inside #1 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 7.0"W x 26.5"H x 8.00'L with 1.00' Overlap justment= +1.00' x 6.07 sf x 2 rows				
Volume #1A #2A Stora	Invert 71.09' 71.59'	ne= 27.3 min (<u>Avail.Storag</u> 94 c 97 c 191 c reated with Cha	773.5 - 746.2) e Storage Descrip f 10.33'W x 10.00 332 cf Overall - f Cultec R-280HD Effective Size= Overall Size= 4' Row Length Adj f Total Available 3'	Dition 'L x 3.21'H Field A 97 cf Embedded = 234 cf x 40.0% Voids) x 2 Inside #1 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 7.0"W x 26.5"H x 8.00'L with 1.00' Overlap justment= +1.00' x 6.07 sf x 2 rows				
Volume #1A #2A Stora	Invert 71.09' 71.59' age Group A cr	ne= 27.3 min (<u>Avail.Storag</u> 94 c 97 c 191 c reated with Cha Invert O	773.5 - 746.2) e Storage Descrip f 10.33'W x 10.00 332 cf Overall - f Cultec R-280HE Effective Size= Overall Size= 4: Row Length Adj f Total Available : amber Wizard utlet Devices	Dition 'L x 3.21'H Field A 97 cf Embedded = 234 cf x 40.0% Voids) x 2 Inside #1 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 7.0"W x 26.5"H x 8.00'L with 1.00' Overlap justment= +1.00' x 6.07 sf x 2 rows				
Volume #1A #2A Stora Device	Invert 71.09' 71.59' nge Group A cr Routing	ne= 27.3 min (<u>Avail.Storag</u> 94 c 97 c 191 c reated with Cha <u>Invert O</u> 71.09' 1 .	773.5 - 746.2) e Storage Descrip f 10.33'W x 10.00 332 cf Overall - f Cultec R-280HD Effective Size= Overall Size= 4' Row Length Adj f Total Available 3' amber Wizard utlet Devices 020 in/hr Exfiltratio	bition 'L x 3.21'H Field A 97 cf Embedded = 234 cf x 40.0% Voids 0 x 2 Inside #1 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 7.0"W x 26.5"H x 8.00'L with 1.00' Overlap justment= +1.00' x 6.07 sf x 2 rows Storage				
Volume #1A #2A Stora Device #1	Invert 71.09' 71.59' age Group A cr Routing Discarded	ne= 27.3 min (<u>Avail.Storag</u> 94 c 97 c 191 c reated with Cha <u>Invert</u> O 71.09' 1. 72.80' 6. In	773.5 - 746.2) e Storage Descrip f 10.33'W x 10.00 332 cf Overall - Cultec R-280HE Effective Size= Overall Size= 4 Row Length Adj f Total Available s amber Wizard utlet Devices 020 in/hr Exfiltratio 0'' Round Culvert let / Outlet Invert= 7	bition 'L x 3.21'H Field A 97 cf Embedded = 234 cf x 40.0% Voids 0 x 2 Inside #1 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf 7.0"W x 26.5"H x 8.00'L with 1.00' Overlap justment= +1.00' x 6.07 sf x 2 rows Storage on over Surface area				

Discarded OutFlow Max=0.00 cfs @ 2.62 hrs HW=71.12' (Free Discharge) 1=Exfiltration (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.42 cfs @ 12.11 hrs HW=73.40' (Free Discharge) -2=Culvert (Inlet Controls 0.42 cfs @ 2.14 fps)

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Pond UIS-8: UIS-8 - Chamber Wizard Field A

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Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

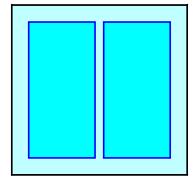
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

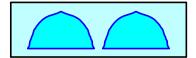
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

2 Chambers 12.3 cy Field 8.7 cy Stone





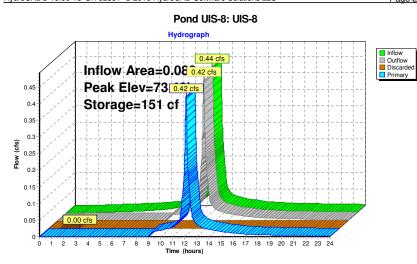
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Summary for Pond UIS-9: UIS-9						
Inflow A			Impervious, Inflow Depth > 5.16" for 25-Year event			
Outflow	= 0	.47 cfs @ 12.08	hrs, Volume= 0.037 af, Atten= 5%, Lag= 1.7 min			
Discard Primary		.00 cfs @ 2.48 .44 cfs @ 12.11				
			an= 0.00-24.00 hrs, dt= 0.01 hrs Area= 103 sf Storage= 99 cf			
		time= 36.2 min ca time= 16.4 min (7	alculated for 0.037 af (97% of inflow) 762.7 - 746.2)			
Volume	Invert	Avail.Storage	Storage Description			
#1A	71.28'	94 cf				
#2A	71.78'	97 cf	332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1			
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf			
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap			
Store	age Group A	191 cf	Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage			
Device	Routing	created with Chan	Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage mber Wizard tlet Devices			
	•	Invert Out 71.28' 1.02 72.18' 6.0'	Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage nber Wizard			
Device #1 #2 Discard	Routing Discarded Primary	created with Chan <u>Invert</u> Out 71.28' 1.0 72.18' 6.0' Inle n= 0	Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage mber Wizard ttet Devices 20 in/hr Exfiltration over Surface area "Round Culvert 27.000 Kerter 20 in/hr Exfiltration over Surface area "Round Culvert 27.000 Kerter 20 in/hr Exfiltration over Surface area "Round Culvert 2.79.0° Ke= 1.000 et / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge)			
Device #1 #2 Discard 1=Ex Primary	Routing Discarded Primary ded OutFlow filtration (E:	Invert Out 71.28' 1.0; 72.18' 6.0' Nate Max=0.00 cfs @ 2 filtration Controls	Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage mber Wizard ttlet Devices 20 in/hr Exfiltration over Surface area '' Round Culvert L= 79.0' Ke= 1.000 et / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s0.00 cfs) 1.11 hrs HW=72.82' (Free Discharge)			
Device #1 #2 Discard 1=Ex Primary	Routing Discarded Primary ded OutFlow filtration (E:	Invert Out 71.28' 1.0 72.18' 6.0' 72.18' 6.0' Inle n= 0 Max=0.00 cfs @ 2 (filtration Controls ax=0.44 cfs @ 12.	Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage mber Wizard ttlet Devices 20 in/hr Exfiltration over Surface area '' Round Culvert L= 79.0' Ke= 1.000 et / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s0.00 cfs) 1.11 hrs HW=72.82' (Free Discharge)			
Device #1 #2 Discard 1=Ex Primary	Routing Discarded Primary ded OutFlow filtration (E:	Invert Out 71.28' 1.0 72.18' 6.0' 72.18' 6.0' Inle n= 0 Max=0.00 cfs @ 2 (filtration Controls ax=0.44 cfs @ 12.	Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage mber Wizard ttlet Devices 20 in/hr Exfiltration over Surface area '' Round Culvert L= 79.0' Ke= 1.000 et / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s0.00 cfs) 1.11 hrs HW=72.82' (Free Discharge)			
Device #1 #2 Discard 1=Ex Primary	Routing Discarded Primary ded OutFlow filtration (E:	Invert Out 71.28' 1.0 72.18' 6.0' 72.18' 6.0' Inle n= 0 Max=0.00 cfs @ 2 (filtration Controls ax=0.44 cfs @ 12.	Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage mber Wizard ttlet Devices 20 in/hr Exfiltration over Surface area '' Round Culvert L= 79.0' Ke= 1.000 et / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s0.00 cfs) 1.11 hrs HW=72.82' (Free Discharge)			
Device #1 #2 Discard 1=Ex Primary	Routing Discarded Primary ded OutFlow filtration (E:	Invert Out 71.28' 1.0 72.18' 6.0' 72.18' 6.0' Inle n= 0 Max=0.00 cfs @ 2 (filtration Controls ax=0.44 cfs @ 12.	Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage mber Wizard ttlet Devices 20 in/hr Exfiltration over Surface area '' Round Culvert L= 79.0' Ke= 1.000 et / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s0.00 cfs) 1.11 hrs HW=72.82' (Free Discharge)			
Device #1 #2 Discard 1=Ex Primary	Routing Discarded Primary ded OutFlow filtration (E:	Invert Out 71.28' 1.0 72.18' 6.0' 72.18' 6.0' Inle n= 0 Max=0.00 cfs @ 2 (filtration Controls ax=0.44 cfs @ 12.	Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage mber Wizard ttlet Devices 20 in/hr Exfiltration over Surface area '' Round Culvert L= 79.0' Ke= 1.000 et / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s0.00 cfs) 1.11 hrs HW=72.82' (Free Discharge)			
Device #1 #2 Discard 1=Ex Primary	Routing Discarded Primary ded OutFlow filtration (E:	Invert Out 71.28' 1.0 72.18' 6.0' 72.18' 6.0' Inle n= 0 Max=0.00 cfs @ 2 (filtration Controls ax=0.44 cfs @ 12.	Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage mber Wizard ttlet Devices 20 in/hr Exfiltration over Surface area '' Round Culvert L= 79.0' Ke= 1.000 et / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s0.00 cfs) 1.11 hrs HW=72.82' (Free Discharge)			
Device #1 #2 Discard 1=Ex Primary	Routing Discarded Primary ded OutFlow filtration (E:	Invert Out 71.28' 1.0 72.18' 6.0' 72.18' 6.0' Inle n= 0 Max=0.00 cfs @ 2 (filtration Controls ax=0.44 cfs @ 12.	Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage mber Wizard ttlet Devices 20 in/hr Exfiltration over Surface area '' Round Culvert L= 79.0' Ke= 1.000 et / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s0.00 cfs) 1.11 hrs HW=72.82' (Free Discharge)			
Device #1 #2 Discard 1=Ex Primary	Routing Discarded Primary ded OutFlow filtration (E:	Invert Out 71.28' 1.0 72.18' 6.0' 72.18' 6.0' Inle n= 0 Max=0.00 cfs @ 2 (filtration Controls ax=0.44 cfs @ 12.	Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage mber Wizard ttlet Devices 20 in/hr Exfiltration over Surface area '' Round Culvert L= 79.0' Ke= 1.000 et / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s0.00 cfs) 1.11 hrs HW=72.82' (Free Discharge)			
Device #1 #2 Discard 1=Ex Primary	Routing Discarded Primary ded OutFlow filtration (E:	Invert Out 71.28' 1.0 72.18' 6.0' 72.18' 6.0' Inle n= 0 Max=0.00 cfs @ 2 (filtration Controls ax=0.44 cfs @ 12.	Row Length Adjustment= +1.00' x 6.07 sf x 2 rows Total Available Storage mber Wizard ttlet Devices 20 in/hr Exfiltration over Surface area '' Round Culvert L= 79.0' Ke= 1.000 et / Outlet Invert= 72.18' / 71.38' S= 0.0101 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf 2.48 hrs HW=71.31' (Free Discharge) s0.00 cfs) 1.11 hrs HW=72.82' (Free Discharge)			

 Topsfield Proposed HydroCAD 2-2-17
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 Type III 24-hr
 25-Year Rainfall=5.40"

 Printed
 2/27/2017

 C
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Pond UIS-9: UIS-9 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

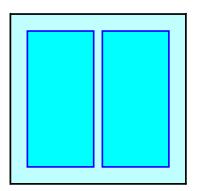
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

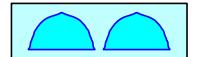
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

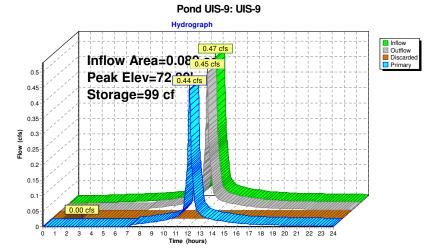
Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

2 Chambers 12.3 cy Field 8.7 cy Stone









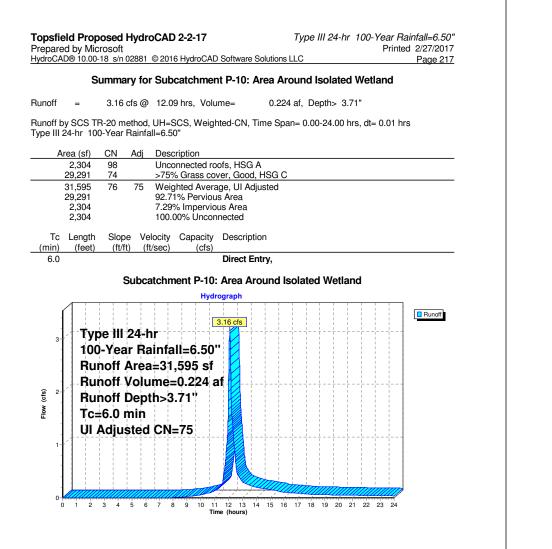
Type III 24-hr 100-Year Rainfall=6 Printed 2/27/2 Software Solutions LLC Page	Topsfield Proposed HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAE	Type III 24-hr 100-Year Rainfall=6.50" Printed 2/27/2017 Software Solutions LLC Page 213	opsfield Proposed HydroCAD 2-2-17 repared by Microsoft /droCAD® 10.00-18 s/n 02881 © 2016 HydroCAI
Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>6 Tc=6.0 min CN=98 Runoff=0.53 cfs 0.04		00 hrs, dt=0.01 hrs, 2401 points method, UH=SCS, Weighted-CN	Time span=0.00-2 Runoff by SCS TR-2
Runoff Area=1,705 sf 100.00% Impervious Runoff Depth>6 Tc=6.0 min CN=98 Runoff=0.25 cfs 0.02	Subcatchment R-15: Roof Units 29&30 - (B & C	method - Pond routing by Stor-Ind method Runoff Area=81,776 sf 1.57% Impervious Runoff Depth>0.79" Tc=6.0 min UI Adjusted CN=42 Runoff=0.96 cfs 0.124 af	ubcatchment P-1: Northern Grassed Area to
Runoff Area=1,490 sf 100.00% Impervious Runoff Depth>6 Tc=6.0 min CN=98 Runoff=0.22 cfs 0.01	Subcatchment R-16: Front Units 29&30	Runoff Area=31,595 sf 7.29% Impervious Runoff Depth>3.71" Tc=6.0 min UI Adjusted CN=75 Runoff=3.16 cfs 0.224 af	ubcatchment P-10: Area Around Isolated
Runoff Area=120 sf 100.00% Impervious Runoff Depth>6 Tc=6.0 min CN=98 Runoff=0.02 cfs 0.00	Subcatchment R-17: Mailbox Structure Rood	Runoff Area=22,978 sf 59.84% Impervious Runoff Depth>4.34" Tc=6.0 min CN=81 Runoff=2.66 cfs 0.191 af	ubcatchment P-2: Existing Drive to Existing
Runoff Area=3,195 sf 100.00% Impervious Runoff Depth>6 Tc=6.0 min CN=98 Runoff=0.47 cfs 0.02	Subcatchment R-2: Roof Units 3&4 - (B & C	Runoff Area=27,549 sf 12.75% Impervious Runoff Depth>1.39" Tc=6.0 min UI Adjusted CN=50 Runoff=0.86 cfs 0.073 af	ubcatchment P-3: Area Around Isolated
Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>6 Tc=6.0 min CN=98 Runoff=0.53 cfs 0.04	Subcatchment R-3: Roof Units 5&6 - A&B Unit	Runoff Area=4,950 sf 31.35% Impervious Runoff Depth>3.30" Tc=6.0 min CN=71 Runoff=0.44 cfs 0.031 af	ubcatchment P-3A: Gravel Road to Detention
Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>6 Tc=6.0 min CN=98 Runoff=0.53 cfs 0.04	Subcatchment R-4: Roof - Units 7&8 - (A&B	Runoff Area=21,239 sf 62.65% Impervious Runoff Depth>4.23" Tc=6.0 min CN=80 Runoff=2.41 cfs 0.172 af	ubcatchment P-4: Sloped Entrance Drive -
Runoff Area=3,195 sf 100.00% Impervious Runoff Depth-6 Tc=6.0 min CN=98 Runoff=0.47 cfs 0.00	Subcatchment R-5: Roof - Units 9&10 - (B&C	Runoff Area=39,272 sf 52.13% Impervious Runoff Depth>3.61" Tc=6.0 min CN=74 Runoff=3.82 cfs 0.271 af	ibcatchment P-5: Driveway - Units 25-11
Runoff Area=3,625 sf 100.00% Impervious Runoff Depth-6 Tc=6.0 min CN=98 Runoff=0.53 cfs 0.04	Subcatchment R-6: Roof - Units 11&12 - (B&A	Runoff Area=19,137 sf 59.86% Impervious Runoff Depth>4.02" Tc=6.0 min CN=78 Runoff=2.07 cfs 0.147 af	bcatchment P-6: Pavement Units 12-19
Runoff Area=3,895 sf 100.00% Impervious Runoff Depth-6 Tc=6.0 min CN=98 Runoff=0.57 cfs 0.04	Subcatchment R-7: Roof - Units 13&14 - (A	Runoff Area=15,670 sf 44.56% Impervious Runoff Depth>3.30" Tc=6.0 min CN=71 Runoff=1.39 cfs 0.099 af	bcatchment P-7: Driveway - Units 20-24
Runoff Area=3,625 sf 100.00% Impervious Runoff Depth-6 Tc=6.0 min CN=98 Runoff=0.53 cfs 0.04	Subcatchment R-8: Roof - Units 15&16 - (B&A	Runoff Area=15,307 sf 7.00% Impervious Runoff Depth>0.86" Tc=6.0 min CN=43 Runoff=0.21 cfs 0.025 af	bcatchment P-8: Surface Infiltration Pond
Runoff Area=3,625 sf 100.00% Impervious Runoff Depth-6 Tc=6.0 min CN=98 Runoff=0.53 cfs 0.04	Subcatchment R-9: Roof - Units 17&18 - (A&B	Runoff Area=102,567 sf 2.25% Impervious Runoff Depth>0.42" i02' Tc=10.8 min UI Adjusted CN=36 Runoff=0.33 cfs 0.082 af	ubcatchment P-9: Woods/Grass Northwest
Inflow=0.90 cfs 0.19 Outflow=0.90 cfs 0.19	Reach SP-1: Wetlands South of Driveway	Runoff Area=3,185 sf 100.00% Impervious Runoff Depth>6.26" Tc=6.0 min CN=98 Runoff=0.47 cfs 0.038 af	ubcatchment R-1: Roof - Units 1&2 (C&B)
Inflow=1.85 cfs 0.41 Outflow=1.85 cfs 0.41	Reach SP-2: Large Wetland Area East	Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>6.26" Tc=6.0 min CN=98 Runoff=0.57 cfs 0.047 af	ıbcatchment R-10: Roof - Units 19&20 - (A
Inflow=4.64 cfs 0.86 Outflow=4.64 cfs 0.86	Reach SP-3: Large Wetland Area West	Runoff Area=3,625 sf 100.00% Impervious Runoff Depth>6.26" Tc=6.0 min CN=98 Runoff=0.53 cfs 0.043 af	ubcatchment R-11: Roof - Units 21&22 - (A&
Peak Elev=57.10' Inflow=0.90 cfs 0.15 Culvert n=0.011 L=51.0' S=0.0025 '/' Outflow=0.90 cfs 0.15	Pond 3P: 12 Inch Culvert 12.0" Round	Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>6.26" Tc=6.0 min CN=98 Runoff=0.57 cfs 0.047 af	ıbcatchment R-12: Roof - Units 23&24 - (A
Peak Elev=70.84' Storage=16,567 cf Inflow=10.97 cfs 0.75 s 0.130 af Primary=2.94 cfs 0.367 af Outflow=3.06 cfs 0.45	Pond D-1: Surface Infiltration Pond Discarded=0.12 cf	Runoff Area=3,895 sf 100.00% Impervious Runoff Depth>6.26" Tc=6.0 min CN=98 Runoff=0.57 cfs 0.047 af	ubcatchment R-13: Roof - Units 25&26 - (A

Topsfield Proposed Hydr Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881		Software S				<i>fall=6.50"</i> 2/27/2017 Page 215
Pond D-2: Existing Detention	Basin	Peak E	ilev=58.70' S	torage=4,642	cf Inflow=2.66 cf Outflow=0.28 cf	s 0.191 af
Pond D-3: Detention Pond by	Access Road Discarded=0.04 cfs				cf Inflow=0.44 cf Outflow=0.21 cf	
Pond UIS-1: UIS at Entrance	Discarded=0.08 cfs				cf Inflow=7.26 cf Outflow=0.80 cf	
Pond UIS-2: UIS at North of S	i te Discarded=0.23 cfs				cf Inflow=2.45 cf Outflow=0.65 cf	
Pond UIS-3: UIS-3	Discarded=0.00 cfs				cf Inflow=0.53 cf Outflow=0.53 cf	
Pond UIS-4: UIS-4	Discarded=0.00 cfs				cf Inflow=0.47 cf Outflow=0.45 cf	
Pond UIS-5: UIS-5	Discarded=0.00 cfs				cf Inflow=0.53 cf Outflow=0.51 cf	
Pond UIS-6: UIS-6	Discarded=0.00 cfs				cf Inflow=0.57 cf Outflow=0.54 cf	
Pond UIS-7: UIS-7	Discarded=0.00 cfs				cf Inflow=0.53 cf Outflow=0.51 cf	
Pond UIS-8: UIS-8	Discarded=0.00 cfs	0.005 af	Primary=0.50	0 cfs 0.036 af		s 0.041 af
Pond UIS-9: UIS-9	Discarded=0.00 cfs				cf Inflow=0.57 cl Outflow=0.53 cl	

 Total Runoff Area = 10.007 ac
 Runoff Volume = 2.084 af
 Average Runoff Depth = 2.50"

 69.75% Pervious = 6.980 ac
 30.25% Impervious = 3.027 ac

	/ Microsoft						
HydroCAD® 1	10.00-18 s/n 028	81 © 2016 HydroC/	AD Software	Solutions LLC)		Page 216
	Summary for	r Subcatchmen	t P-1: Nor	thern Gras	sed Area t	o Wetlands	6
Runoff =	0.96 cfs	@ 12.13 hrs, Vo	olume=	0.124 af	, Depth> 0.7	79"	
	CS TR-20 meth r 100-Year Rai	od, UH=SCS, Wei nfall=6.50"	ghted-CN,	Time Span=	0.00-24.00 h	urs, dt= 0.01 h	nrs
Area		dj Description					
36,2 10,7		Woods, Good Woods, Good					
	419 55	Woods, Good					
22,1		>75% Grass of					
,	287 98	Unconnected		HSG A			
1,8 81.7	3 <u>52 72</u> 776 43 4	Dirt roads, HS 2 Weighted Ave		hiusted			
80,4		98.43% Pervi		Justeu			
	287	1.57% Imperv					
1,2	287	100.00% Ünce	onnected				
To Lo							
	nath Slope	Volocity Conocit		tion			
		Velocity Capacit (ft/sec) (cfs		tion			
	ngth Slope feet) (ft/ft)	Velocity Capacit (ft/sec) (cfs					
(min) (f	eet) (ft/ft)	(ft/sec) (cfs	Direct E	Entry,			
(min) (f	eet) (ft/ft)		Direct E	Entry,	ea to Wetla	ands	
(min) (f	eet) (ft/ft)	(ft/sec) (cfs	Direct E	Entry,	ea to Wetla	ands	1
(min) (f 6.0 1- (s; 5) MOH	eet) (ft/ft) Subca Type III 24 100-Year I Runoff Ar	(ft/sec) (cfs atchment P-1: N Hy -hr Rainfall=6.50 ea=81,776 s lume=0.124 pth>0.79" n	Direct E Northern C Idrograph	Entry,	ea to Wetla	ands	Runoff
(min) (f 6.0 1- (s; 5) MOH	eet) (ft/ft) Subca Type III 24 100-Year I Runoff Ard Runoff Vo Runoff De Tc=6.0 mi	(ft/sec) (cfs atchment P-1: N Hy -hr Rainfall=6.50 ea=81,776 s lume=0.124 pth>0.79" n	Direct E Northern C Idrograph	Entry,	ea to Wetla	ands	Runoff



repare	d by Mic	osed Hyd rosoft				24-111 1		Rainfall=6.50" nted 2/27/2017	
ydroCA			1 © 2016 HydroC/						Page 218
	Sı	ummary fo	or Subcatchme	ent P-2: Ex	sting D	rive to E	Existin	g Basin	
unoff	=	2.66 cfs @	12.09 hrs, Vo	lume=	0.191 a	af, Depth	n> 4.34	•	
		R-20 metho)-Year Rain	d, UH=SCS, Wei fall=6.50"	ghted-CN, Ti	me Span	= 0.00-24	1.00 hrs	, dt= 0.01	hrs
A	rea (sf)		cription						
	6,902 1,353		onnected pavem vel roads, HSG A						
	4,824	39 >75	% Grass cover, (Good, HSG A					
	3,050 3,632		% Grass cover, (connected pavem		;				
	3,217		connected pavem						
	22,978		ighted Average 6% Pervious Are						
	9,227 13,751		34% Impervious Ar						
	13,751	100	.00% Unconnect	ed					
Tc (min)	Length (feet)		/elocity Capacit (ft/sec) (cfs		วท				
6.0				Direct En	try, Min.	6.0 TC			
		Subo	atchment P-2	Existing	Drive to	Existing	g Basir	า	
			Ну	drograph					
- - -	100 Rui	noff Are	ainfall=6.5 a=22,978 s	f					Runoff
	Ru	noff Vol	ume=0.191	af 🖌					
[−] low (cfs)	Ru	noff Dep	oth>4.34"						
Flow	Tc=	:6.0 min	1						
1_	CN	=81					·		
-							1.1.1	1 1 1	1
-					4MM				

Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr	100-Year Rainfall=6.50"
Prepared by Microsoft		Printed 2/27/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions L	LC	Page 219

Summary for Subcatchment P-3: Area Around Isolated Wetland

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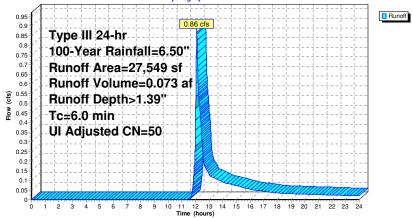
Runoff = 0.86 cfs @ 12.10 hrs, Volume= 0.073 af, Depth> 1.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50"

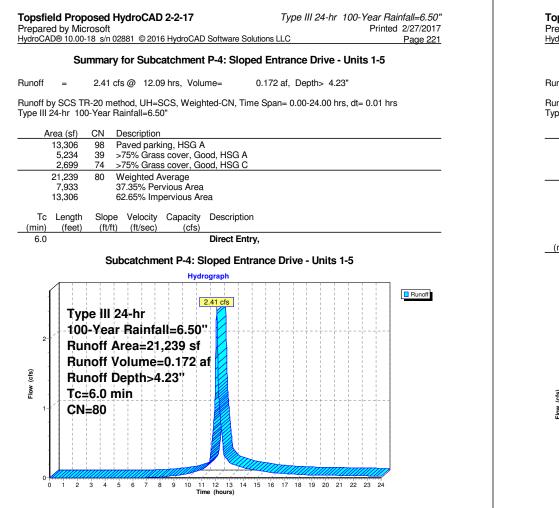
A	rea (sf)	CN	Adj De	scription		
	3,512	98	Un	connected pa	avement, HSG A	
	1,224	76	Gr	avel roads, H	ISG A	
	212	74	>7	5% Grass cov	ver, Good, HSG C	
	2,166	70	W	Voods, Good, HSG C		
	5,125	77	W	oods, Good, H	HSG D	
	14,867	30	W	oods, Good, H	HSG A	
	443	39	>7	5% Grass cov	ver, Good, HSG A	
	27,549	53	50 We	eighted Avera	age, UI Adjusted	
	24,037		87	.25% Perviou	is Area	
	3,512		12	.75% Impervi	ious Area	
	3,512		10	0.00% Uncon	nnected	
_		.		- ·		
Tc	Length	Slope			Description	
(min)	(feet)	(ft/ft)	(ft/sec	c) (cfs)		
6.0					Direct Entry,	

Subcatchment P-3: Area Around Isolated Wetland

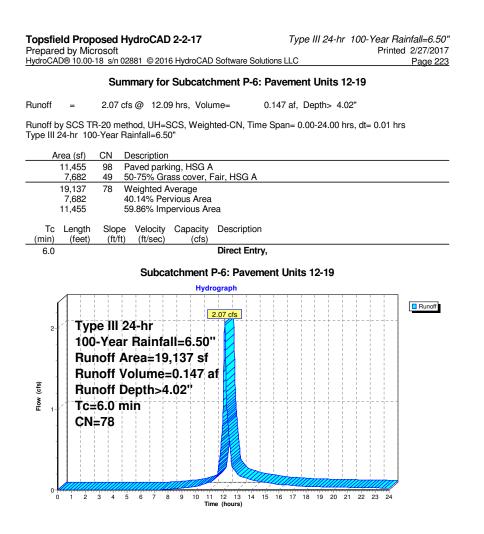
Hydrograph



	<i>fall=6.50"</i> 2/27/2017 <u>Page 220</u>
Summary for Subcatchment P-3A: Gravel Road to Detention Basin	
Runoff = 0.44 cfs @ 12.09 hrs, Volume= 0.031 af, Depth> 3.30"	
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50" $$	
Area (sf) CN Description	
1,552 98 Paved parking, HSG A 1,841 76 Gravel roads, HSG A 1,557 39 >75% Grass cover, Good, HSG A	
4,950 71 Weighted Average 3,398 68.65% Pervious Area 1,552 31.35% Impervious Area	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	
6.0 Direct Entry,	
Subcatchment P-3A: Gravel Road to Detention Basin	
Hydrograph	
0.44 cfs	Runoff
⁰⁴ 100-Year Rainfall=6.50"	
•35 Runoff Area=4,950 sf	
0.3 Runoff Volume=0.031 af	
ا المراجع (Runoff Depth>3.30)	
end for the second sec	
⁰² CN=71	
0.05	
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Time (hours)	



Topsfield Proposed HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solution	Type III 24-hr 100-Year Rainfall=6.50" Printed 2/27/2017 ons LLC Page 222
Summary for Subcatchment P-5: D	riveway - Units 25-11
Runoff = 3.82 cfs @ 12.09 hrs, Volume= 0.	271 af, Depth> 3.61"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time S Type III 24-hr 100-Year Rainfall=6.50"	Span= 0.00-24.00 hrs, dt= 0.01 hrs
Area (sf) CN Description	
19,875 98 Paved parking, HSG A 14.088 39 >75% Grass cover, Good, HSG A	
4,713 74 >75% Grass cover, Good, HSG C	
<u>596 98 Unconnected pavement, HSG C</u> 39.272 74 Weighted Average	
18,801 47.87% Pervious Area	
20,471 52.13% Impervious Area 596 2.91% Unconnected	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	
6.0 Direct Entry,	
Subcatchment P-5: Driveway	v - Unito 25.11
Hydrograph	y - Onits 23-11
4 3.82 cfs	L
Type III 24-hr	
100-Year Rainfall=6.50"	
₃ Runoff Area=39,272 sf	
Runoff Volume=0.271 af	
🗄 Runoff Depth>3.61"	
[®] Runoff Depth>3.61" [™] ² Tc=6.0 min	
CN=74	
1	
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	16 17 18 19 20 21 22 23 24
Time (hours)	



Topsfield Proposed HydroCAD 2-2-17 Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solution	Type III 24-hr 100-Year Rainfall=6.50" Printed 2/27/2017 s LLC Page 224
Summary for Subcatchment P-7: Driv	/eway - Units 20-24
Runoff = 1.39 cfs @ 12.09 hrs, Volume= 0.05	99 af, Depth> 3.30"
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Sp Type III 24-hr 100-Year Rainfall=6.50"	an= 0.00-24.00 hrs, dt= 0.01 hrs
Area (sf) CN Description	
6,983 98 Paved parking, HSG A 8,687 49 50-75% Grass cover, Fair, HSG A	
15,670 71 Weighted Average 8,687 55.44% Pervious Area 6,983 44.56% Impervious Area	
Tc Length Slope Velocity Capacity Description (min) (feet) (ft/ft) (ft/sec) (cfs)	
6.0 Direct Entry,	
Subcatchment P-7: Driveway	· Units 20-24
Hydrograph	
Type III 24-hr 100-Year Rainfall=6.50" Runoff Area=15,670 sf Runoff Volume=0.099 af Runoff Depth>3.30" Tc=6.0 min CN=71	
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 1 Time (hours)	6 17 18 19 20 21 22 23 24

Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr
Prepared by Microsoft	
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24-hr 100-Year Rainfall=6.50" Printed 2/27/2017 Page 225

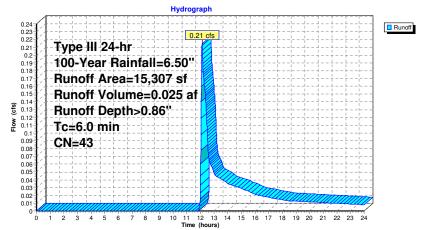
Summary for Subcatchment P-8: Surface Infiltration Pond Area

Runoff = 0.21 cfs @ 12.12 hrs, Volume= 0.025 af, Depth> 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50"

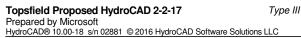
Ar	rea (sf)	CN	Description		
	1,072	98	Paved park	ing, HSG A	
	14,235	39	>75% Gras	s cover, Go	ood, HSG A
	15,307	43	Weighted A	verage	
	14,235		93.00% Per	vious Area	
	1,072		7.00% Impe	ervious Area	a
т.	1	01	- \/-l!+-	0	Description
Tc	Length	Slop	,	Capacity	Description
(min)	(feet)	(ft/f	t) (ft/sec)	(cfs)	
6.0					Direct Entry,
			Subcatchr	nent P-8·	Surface Infiltration Pond Area

Subcatchment P-8: Surface Infiltration Pond Area



Prepare	d by Mic	rosoft	ydroCAD		21	hr 100-Year Rainfall=6.50' Printed 2/27/2017
HydroCA	D® 10.00-	18 s/n 02	881 © 201	6 HydroCAD	Software Solutions LLC	Page 226
S	ummary	for Su	bcatchm	ent P-9: V	loods/Grass Northwest Si	ite to NW Wetlands
			scribed as ked earth	"Dirt road,"	closest CN value in HydroCAD), actual material to be
Runoff	=	0.33 cf	s@ 12.4	5 hrs, Volu	me= 0.082 af, Depth>	0.42"
			hod, UH=9 ainfall=6.5		ted-CN, Time Span= 0.00-24.0	00 hrs, dt= 0.01 hrs
A	rea (sf)	CN A	Adj Desc	ription		
	2,068	72	Dirt r	oads, HSG	A	
	40,086	39	>75%	6 Grass co	ver, Good, HSG A	
	357	74	>75%	6 Grass cov	ver, Good, HSG C	
	53,082	30		ds, Good, H		
	4,670	55		ds, Good, H		
	2,304	98	Unco	nnected pa	vement, HSG A	
1	02,567	37	36 Weig	hted Avera	ge, UI Adjusted	
1	00,263			5% Perviou		
	2,304			% Impervio		
	2,304		100.0	0% Uncon	nected	
Tc	Length	Slope	Velocity	Capacity	Description	
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)		
4.9	50	0.0300	0.17		Sheet Flow, A-B	
					Grass: Short n= 0.150 P2=	
4.9	342	0.0280	1.17		Shallow Concentrated Flow,	
					Short Grass Pasture Kv= 7.0	
1.0	110	0.1270	1.78		Shallow Concentrated Flow,	C-D
					Woodland Kv= 5.0 fps	

10.8 502 Total

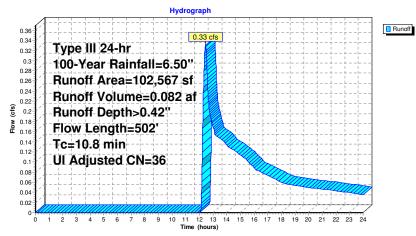


 Type III 24-hr
 100-Year Rainfall=6.50"

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 2/27/2017

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Subcatchment P-9: Woods/Grass Northwest Site to NW Wetlands



	D® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Page 22 Summary for Subcatchment R-1: Roof - Units 1&2 (C&B)
Runoff	= 0.47 cfs @ 12.08 hrs. Volume= 0.038 af. Depth> 6.26"
nunon	
	y SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs 24-hr 100-Year Rainfall=6.50"
A	rea (sf) CN Description
	3,185 98 Unconnected roofs, HSG A
	3,185 100.00% Impervious Area 3,185 100.00% Unconnected
Tc (min)	Length Slope Velocity Capacity Description (feet) (ft/ft) (ft/sec) (cfs)
6.0	Direct Entry,
0.5 0.45 0.4 0.35 0.3 0.2 0.2 0.15	Hydrograph U.47 cfs Type III 24-hr 100-Year Rainfall=6.50" Runoff Area=3,185 sf Runoff Volume=0.038 af Runoff Depth>6.26" Tc=6,0 min CN=98
0.05	

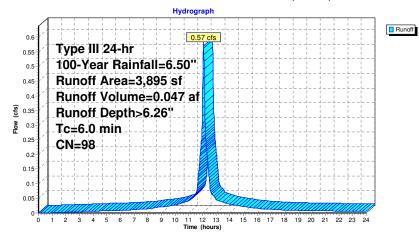


Runoff = 0.57 cfs @ 12.08 hrs, Volume= 0.047 af, Depth> 6.26"

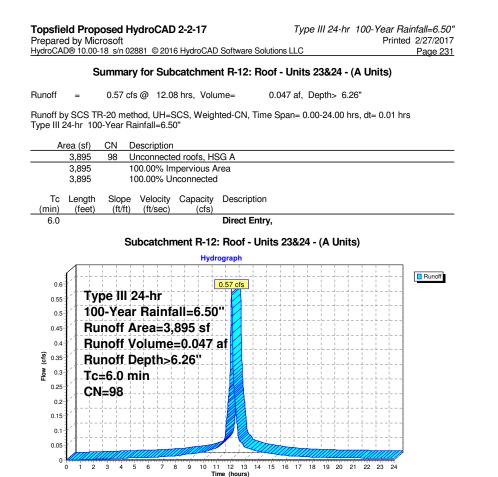
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50"

	A	rea (sf)	CN	Description		
		3,895	98	Unconnecte	ed roofs, HS	SG A
		3,895		100.00% In	pervious A	vrea
		3,895		100.00% U	nconnected	1
	Tc (min)	Length (feet)	Slope (ft/ft)		Capacity (cfs)	Description
-	6.0					Direct Entry,

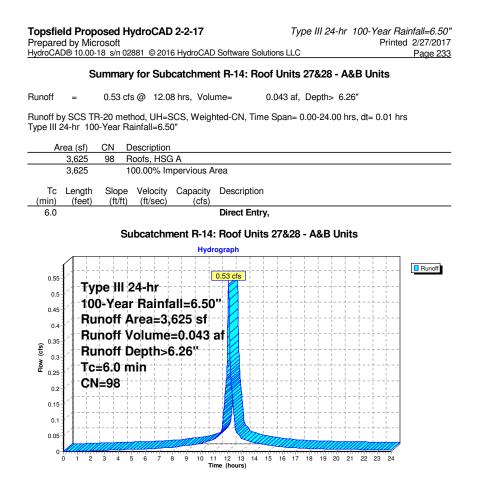
Subcatchment R-10: Roof - Units 19&20 - (A Units)



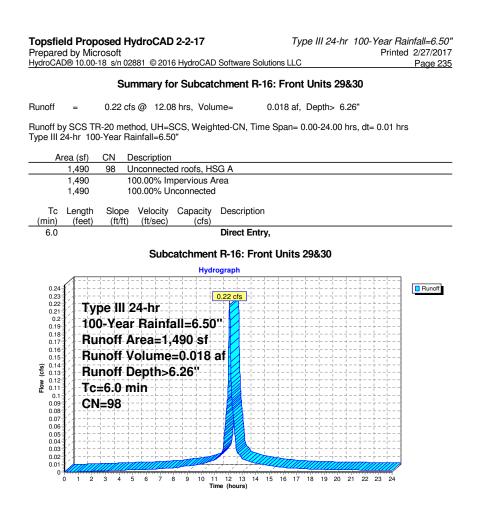
	<u>-D® 10.00</u>	nmary for								8.99	. (A	8.R	Ilni	te)	Page 230
- "	oui	-											0	13)	
Runoff	=	0.53 cfs @	12.0	8 nrs, Vo	olume=		0.	043 a	r, De	ptn>	> 6.2	6			
		R-20 method Year Rainf			ighted-C	N, T	ïme S	Span=	0.00	-24.	.00 h	rs, dt	= 0.	01 hr	S
Ar	rea (sf)		ription												
	3,625			ed roofs,											
	3,625 3,625			npervious nconnect											
	0,020	100.	0 /0 01		cu										
Tc (min)	Length (feet)		elocity t/sec)	Capaci (cf:		cripti	on								
6.0	(ct Er	ntry,								
		Outras	l						- <i></i>						
		Subca	tcnme	ent R-11			lits 2	2182	2 - (#	١œΕ	sun	its)			
				H	/drograp	h						-	-		
	[]	 						+ + -				· - + - ·			Runoff
0.55	Tv	be III 24	hr		0.53 c	IS 		 + + -							
0.5)-Year F					_	1							
0.45			- i i				Ì			1					
0.4	1 1 1	noff Are	- F					11-		1					
0.35	Į∕†⁻Ru	noff Vol	ume	=0.04	3 af 🚺			†+·				· - † - ·	- -		
Elow (cfs)	Ru	noff Dep	oth>6	5.26"	·+			++-							
NOL-	Tc	=6.0 min			·+			++-				- +	+		
L 0.25	1 I I I	=98			. <u>+</u> <u>+</u>			1 1 -				 			
0.2		_30						i		į	į., į.		. <u> </u>		
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	trantin dur	3 4 5	3 7	8 9 10	11 12	13 1	4 15	16 1	7 18	19	20 2	1 22	23	24	
0-	0 1 2	0.0	, ,		Time (ho	ure)									



	Summary for Subcatchment R-13: Roof - Units 25&26 - (A Units)	
Runoff	= 0.57 cfs @ 12.08 hrs, Volume= 0.047 af, Depth> 6.26"	
	VSCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs 4-hr 100-Year Rainfall=6.50"	
A	ea (sf) CN Description	
	3,895 98 Unconnected roofs, HSG A	
	3,895 100.00% Impervious Area 3,895 100.00% Unconnected	
	3,035 100.00 % Onconnected	
	Length Slope Velocity Capacity Description	
<u>(min)</u> 6.0	(feet) (ft/ft) (ft/sec) (cfs) Direct Entry,	
	Subcatchment R-13: Roof - Units 25&26 - (A Units)	
	Hydrograph	
		Runoff
0.6		
0.55	Type III 24-hr	
0.5	100-Year Rainfall=6.50"	
0.45	Runoff Area=3,895 sf	
0.4	Runoff Volume=0.047 af	
(cts) 0.35	Runoff Depth>6.26"	
0.3	Tc=6.0 min	
0.25	CN=98	
0.2		
0.15		
0.1		



	Summary for Subcatchment R-15: Roof Units 29&30 - (B & C Units)
unoff	= 0.25 cfs @ 12.08 hrs, Volume= 0.020 af, Depth> 6.26"
	SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
/pe III 24	I-hr 100-Year Rainfall=6.50"
	a (sf) CN Description
	1,705 98 Unconnected roofs, HSG A 1,705 100.00% Impervious Area
	1,705 100.00% Impervious Area 1,705 100.00% Unconnected
То	angth Sland Velocity Concerts Description
Tc I (min)	Length Slope Velocity Capacity Description (feet) (ft/ft) (ft/sec) (cfs)
6.0	Direct Entry,
	Subcatchment R-15: Roof Units 29&30 - (B & C Units)
	Hydrograph
6	
0.26	0.25 cfs
0.24	Type III 24-hr
0.22	100-Year Rainfall=6.50"
0.2	Runoff Area=1,705 sf
0.18	Runoff Volume=0.020 af
<u>چ</u> 0.16	Runoff Depth>6.26"
0.14	Tc=6.0 min
8 0.14	
0.12] CN=98
0.12	
0.12	, A
0.1 0.08 0.06	
0.1 0.08 0.06 0.04	
0.1 0.08 0.06 0.04 0.02	
0.12 0.12 0.08 0.06	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 Time (bours)



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	Summary for Subcatchment R-17: M	lailbox Structure	Rood	
Runoff	= 0.02 cfs @ 12.08 hrs, Volume= 0	.001 af, Depth> 6.2	:6"	
	/ SCS TR-20 method, UH=SCS, Weighted-CN, Time 4-hr 100-Year Rainfall=6.50"	Span= 0.00-24.00 h	rs, dt= 0.01 hr	ſS
A	ea (sf) CN Description			
	120 98 Unconnected roofs, HSG A			
	120 100.00% Impervious Area 120 100.00% Unconnected			
Tc (min)	Length Slope Velocity Capacity Description (feet) (ft/ft) (ft/sec) (cfs)			
6.0	Direct Entry,			
	Subcatchment R-17: Mailbox	Structure Rood		
	Hydrograph			
				Runoff
0.019] ∕] i i i i i i i i i <mark>0.02 cfs</mark> i i	+ +	+ +	
0.01				
0.01			++	
0.014				
0.012 <u> </u> 0.01				
<u> </u>	Runoff Depth>6.26"			
0.00				
0.00	CN=98			
0.00				
0.004				
0.003				
0.00				
		5 16 17 18 19 20 2	1 22 23 24	



Summary for Subcatchment R-2: Roof Units 3&4 - (B & C Units)

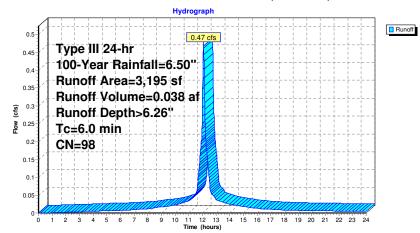
Page 237

Runoff = 0.47 cfs @ 12.08 hrs, Volume= 0.038 af, Depth> 6.26"

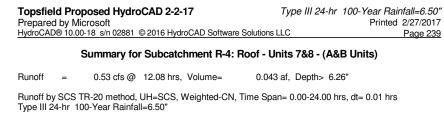
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50"

A	rea (sf)	CN I	Description						
	3,195	98 I	Unconnecte	ed roofs, HS	SG A				
	3,195		100.00% In	npervious A	rea				
	3,195 100.00% Unconnected								
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description				
6.0					Direct Entry,				

Subcatchment R-2: Roof Units 3&4 - (B & C Units)

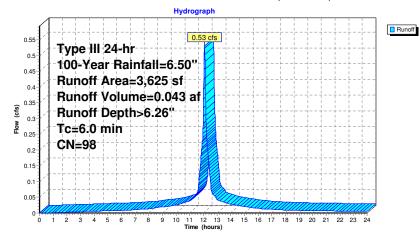


		Su	mm	ary f	or S	Sub	cat	chr	nen	t R	-3:	Ro	of	Un	its	5&	6 -	A٤	kΒ	Uni	its		
Runoff	=	0.	53 c	fs @	12.	08 ł	nrs,	Vo	lume)=			0.0	43	af,	De	oth	> 6	.26'				
Runoff b Type III 2							S, \	Nei	ghteo	d-Cl	N, 1	Tim	e Sp	bar	n= 0	.00	-24.	.00	hrs,	dt=	= 0.0	01 hr	S
	ea (s			Desci																			
	3.62			Roofs																			
	3,62			100.0				ous	Area	3													
	0,01				0,0.	p.		000	/ 00	•													
Tc	Len		lope		locity			acity		esc	ript	tion											
(min)	(fe	et)	(ft/ft)	(fl	/sec)		(cfs	·														
6.0									U	irec	πE	ntr	/,										
				Sub	cato	chm	nen	t R	-3: F	Roc	of L	Jnit	s 5	&6	5 - /	٨&	3 U	Init	s				
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	[.ł-			i						3 cfs	-		+		- 								Runoff
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0.45	fi	100-\	1 1	L L	1	1	1	1	I I.	R					+ 					+	+ 		
0.4-	.∤-	Runc	off i	Are	a=3	3,6	25	sf		И					<u> </u>					+	<u> </u>		
	1-	Runc	off 1	Voli	Jm	e=(0.0	43	af				÷					i	÷	÷			
^{0.35}	f 1	Runc					1								 					¦ +			
Flow (cfs)	т і		1		u1>	×0.	20	1										i -	1	1	1		
운 _{0.25} -	11-	Tc=6	.0 1	nın							!								+ 	+			
0.2	1-1-	CN=9)8												<u> </u>					+	+		
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									Time	(nou	is)												



	Ar	ea (sf)	CN	Description		
		3,625	98	Unconnecte	ed roofs, HS	SG A
		3,625		100.00% In	npervious A	Area
		3,625		100.00% U	nconnected	1
(m	Tc in)	Length (feet)	Slop (ft/ft		Capacity (cfs)	Description
	6.0					Direct Entry,

Subcatchment R-4: Roof - Units 7&8 - (A&B Units)



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	mmary for Subcatchment			
Runoff =	0.47 cfs @ 12.08 hrs, Volum	ne= 0.0	038 af, Depth> 6.2	6"
	-20 method, UH=SCS, Weighte Year Rainfall=6.50"	ed-CN, Time S	Span= 0.00-24.00 hr	rs, dt= 0.01 hrs
Area (sf)	CN Description			
3,195	98 Unconnected roofs, HSC			
3,195 3,195	100.00% Impervious Are 100.00% Unconnected	ea		
<u>(min) (feet)</u> 6.0	(ft/ft) (ft/sec) (cfs) Subcatchment R-5: R	Direct Entry, coof - Units 9)&10 - (B&C Unit	s)
	Hydrog	graph		
0.4- 0.35-	e III 24-hr -Year Rainfall=6.50" noff Area=3,195 sf			Runoff
_}-Ru	noff Volume=0.038 a noff Depth>6.26"	I f		
⁸ ^{0.25} TC :	:6.0 min			
^{0.2} CN	=98			

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

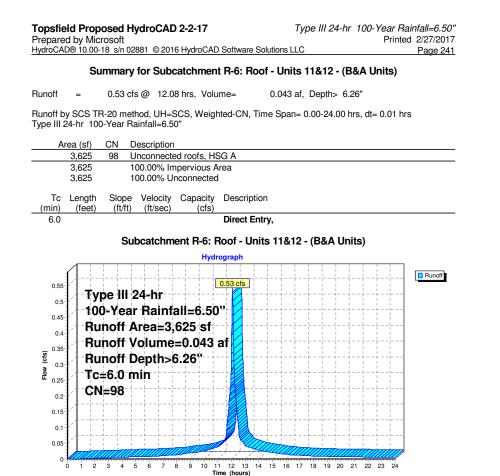
Time (hours)

0.15

0.1-

0.05

6.50" /2017 <u>ə 240</u>



Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr	100-Year Rainfall=6.50"
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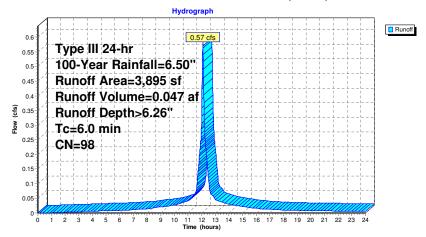
Summary for Subcatchment R-7: Roof - Units 13&14 - (A Units)

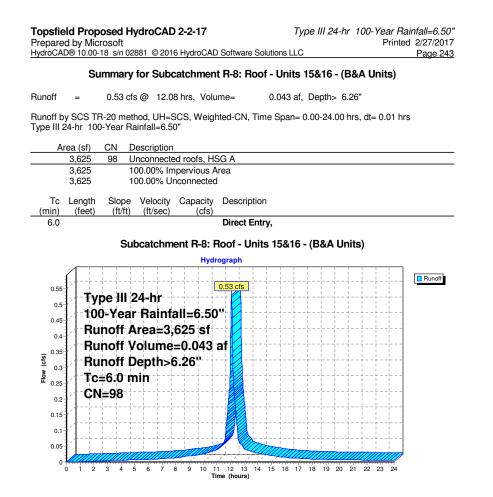
Runoff = 0.57 cfs @ 12.08 hrs, Volume= 0.047 af, Depth> 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Type III 24-hr 100-Year Rainfall=6.50"

A	rea (sf)	CN I	Description		
	3,895	98 I	Jnconnecte	d roofs, HS	SG A
	3,895		100.00% In	pervious A	Area
	3,895		100.00% Ui	nconnected	ł
Тс	Length	Slope	Velocity	Capacity	Description
(min)	(feet)	(ft/ft)	(ft/sec)	(cfs)	•
6.0					Direct Entry,

Subcatchment R-7: Roof - Units 13&14 - (A Units)





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	Su	umma	ry for	Subc	atchi	nen	t R-9	: Ro	of -	Uni	ts 17	'&18	- (4	A&B	Uni	ts)	
unoff	=	0.53	cfs @	12.08	hrs,	Volu	me=		0.	.043	af, D	epth	> 6	26"			
	SCS TI 4-hr 10					Veigh	nted-C	CN, T	ime	Spar	n= 0.0	0-24	.00	nrs, c	dt= 0.	.01 hi	rs
Ar	ea (sf)	CN	Descr	iption													
	3,625	98	Uncor														
	3,625 3,625		100.00 100.00														
Tc (min)	Length (feet)	Slop (ft/f		ocity (sec)	Capa (acity cfs)		cript									
6.0							Dire	ect Ei	ntry,								
		S	Subcat	chme	ent R	-9: F	Roof	- Un	its 1	7&1	8 - (A&E	3 Un	its)			
						Hydr	ograp	h									
0.55 0.45 0.45 0.45 0.35 0.35 0.25 0.25 0.2 0.15 0.15 0.11	-10 Ru Ru Ru	0-Ye inoff inoff inoff	l 24-ł ar Ra Area Volu Dep min	ainfa a=3,6 ıme=	625 =0.0	50 sf 43											Runoff
0-	1 2	3 4	5 6	7 8	9	10 1			4 15	16	17 1	6 19	20	21 2	2 23	24	
						Ti	me (ho	urs)									

Topsfield Proposed HydroCAD 2-2-17 Type III 24-hr 100-Year Rainfall=6.50" Prepared by Microsoft HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC Printed 2/27/2017

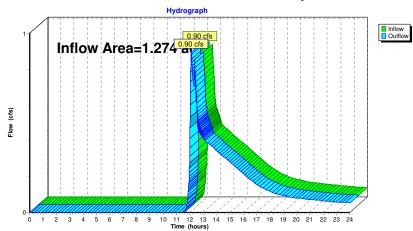
Summary for Reach SP-1: Wetlands South of Driveway

Page 245

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

Inflow Area =	1.274 ac, 33.91% Impervious, Inflow Depth >	1.84" for 100-Year event
Inflow =	0.90 cfs @ 12.12 hrs, Volume= 0.196	af
Outflow =	0.90 cfs @ 12.12 hrs, Volume= 0.196	af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



Reach SP-1: Wetlands South of Driveway

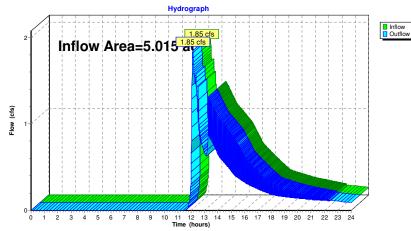
Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr	100-Year Rainfall=6.50"
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Summary for Reach SP-2: Large Wetland Area East

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

Inflow Area =	5.015 ac, 29.33% Impervious, Inflow	Depth > 1.00" for 100-Year event
Inflow =	1.85 cfs @ 12.13 hrs, Volume=	0.418 af
Outflow =	1.85 cfs @ 12.13 hrs, Volume=	0.418 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs



Reach SP-2: Large Wetland Area East

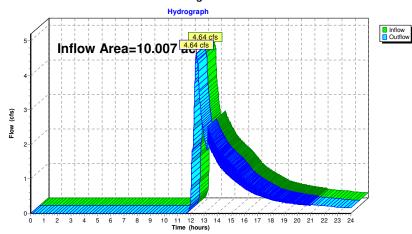
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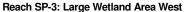
Summary for Reach SP-3: Large Wetland Area West

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

Inflow Area =	10.007 ac, 30.25% Impervious, Inflow De	epth > 1.04" for 100-Year event
Inflow =	4.64 cfs @ 12.42 hrs, Volume=	0.867 af
Outflow =	4.64 cfs @ 12.42 hrs, Volume=	0.867 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs





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Summary for Pond 3P: 12 Inch Culvert

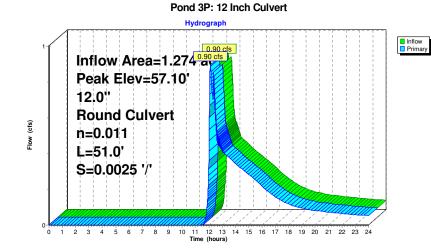
[57] Hint: Peaked at 57.10' (Flood elevation advised)

Inflow Area =	1.274 ac, 33.91% Impervious, Inflow	Depth > 1.84" for 100-Year event
Inflow =	0.90 cfs @ 12.12 hrs, Volume=	0.196 af
Outflow =	0.90 cfs @ 12.12 hrs, Volume=	0.196 af, Atten= 0%, Lag= 0.0 min
Primary =	0.90 cfs @ 12.12 hrs, Volume=	0.196 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 57.10' @ 12.12 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	56.51'	12.0" Round RCP_Round 12" L= 51.0' Ke= 0.200
			Inlet / Outlet Invert= 56.51' / 56.38' S= 0.0025 '/' Cc= 0.900
			n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.90 cfs @ 12.12 hrs HW=57.10' (Free Discharge) 1=RCP_Round 12'' (Barrel Controls 0.90 cfs @ 2.68 fps)



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Summary for Pond D-1: Surface Infiltration Pond

[58] Hint: Peaked 0.84' above defined flood level [79] Warning: Submerged Pond UIS-3 Primary device # 2 OUTLET by 0.14'

Inflow Area =	2.637 ac, 56.99% Impervious, Inflow De	epth > 3.63" for 100-Year event
Inflow =	10.97 cfs @ 12.09 hrs, Volume=	0.799 af
Outflow =	3.06 cfs @ 12.46 hrs, Volume=	0.497 af, Atten= 72%, Lag= 22.1 min
Discarded =	0.12 cfs @ 12.46 hrs, Volume=	0.130 af
Primary =	2.94 cfs @ 12.46 hrs, Volume=	0.367 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 70.84' @ 12.46 hrs Surf.Area= 5,273 sf Storage= 16,567 cf Flood Elev= 70.00' Surf.Area= 4,583 sf Storage= 12,420 cf

Plug-Flow detention time= 194.0 min calculated for 0.497 af (62% of inflow) Center-of-Mass det. time= 94.5 min (903.0 - 808.6)

Volume	Invert	Avail.Sto	rage	Storage	Description	
#1	66.00'	56,2	33 cf	Custom	Stage Data (Pr	ismatic) Listed below (Recalc)
Elevation (feet)	Surf. <i>F</i> (s	Area q-ft)	Inc. (cubic	Store -feet)	Cum.Store (cubic-feet)	
66.00	1,	817		0	0	
67.00	2,	361	:	2,089	2,089	
68.00	3,	059	:	2,710	4,799	
69.00	3,	800	:	3,430	8,229	
70.00	4,	583		4,192	12,420	
71.00	5,	403	4	4,993	17,413	
72.00	6,	280	!	5,842	23,255	
73.00	7,	213	(6,747	30,001	
74.00	8,	202		7,708	37,709	
75.00	9,	248	1	8,725	46,434	
76.00	10,	350	9	9,799	56,233	
Device F	Routing	Invert	Outle	t Devices	-	

Device	nouting	Invent	Outlet Devices
#1	Discarded	66.00'	1.020 in/hr Exfiltration over Surface area
#2	Primary	70.10'	18.0" Round Culvert L= 234.0' Ke= 0.200
			Inlet / Outlet Invert= 70.10' / 67.00' S= 0.0132 '/' Cc= 0.900
			n= 0.015 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Discarded OutFlow Max=0.12 cfs @ 12.46 hrs HW=70.84' (Free Discharge)

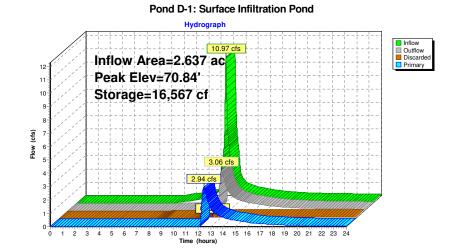
Primary OutFlow Max=2.93 cfs @ 12.46 hrs HW=70.84' (Free Discharge) -2=Culvert (Barrel Controls 2.93 cfs @ 4.92 fps)
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Summary for Pond D-2: Existing Detention Basin

[58] Hint: Peaked 0.62' above defined flood level

Inflow Area =	0.528 ac, 59.84% Impervious, Inflow Depth > 4.34" for 100-Year event
Inflow =	2.66 cfs @ 12.09 hrs, Volume= 0.191 af
Outflow =	0.28 cfs @ 12.87 hrs, Volume= 0.120 af, Atten= 89%, Lag= 46.8 min
Primary =	0.28 cfs @ 12.87 hrs, Volume= 0.120 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 58.70' @ 12.87 hrs Surf.Area= 3,090 sf Storage= 4,642 cf Flood Elev= 58.08' Surf.Area= 3,090 sf Storage= 2,719 cf

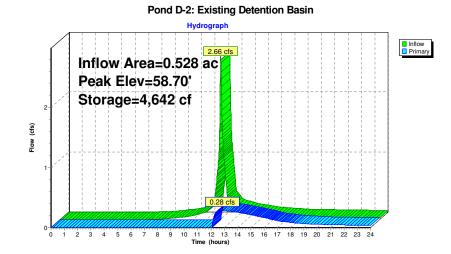
Plug-Flow detention time= 241.1 min calculated for 0.120 af (63% of inflow) Center-of-Mass det. time= 139.9 min (947.6 - 807.7)

Volume	Inve	ert Avail.Sto	rage Storag	e Description	
#1	57.2	9,02	20 cf Custor	n Stage Data (Pr	ismatic) Listed below (Recalc)
Elevatio		Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	
57.2	20	3,090	0	0	
58.0	00	3,090	2,472	2,472	
59.0	0	3,090	3,090	5,562	
59.4	-0	3,550	1,328	6,890	
60.0	00	3,550	2,130	9,020	
Device	Routing	Invert	Outlet Devic	es	
#1	Primary	58.08'	4.0" Vert. O	rifice/Grate C=	0.600
#2	Primary	58.80'	8.0" Vert. O	rifice/Grate C=	0.600
Primary	OutFlow	Max=0.28 cfs (@ 12.87 hrs +	IW=58.70' (Free	e Discharge)

1=Orifice/Grate (Orifice Controls 0.28 cfs @ 3.25 fps) 2=Orifice/Grate (Controls 0.00 cfs)

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Summary for Pond D-3: Detention Pond by Access Road

[93] Warning: Storage range exceeded by 0.06'[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=50)

Inflow Area =	0.114 ac, 31.35% Impervious, Inflow De	epth > 3.30" for 100-Year event
Inflow =	0.44 cfs @ 12.09 hrs, Volume=	0.031 af
Outflow =	0.21 cfs @ 12.36 hrs, Volume=	0.031 af, Atten= 53%, Lag= 16.2 min
Discarded =	0.04 cfs @ 12.35 hrs, Volume=	0.029 af
Primary =	0.17 cfs @ 12.36 hrs, Volume=	0.003 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 64.06' @ 12.36 hrs Surf.Area= 650 sf Storage= 478 cf

Plug-Flow detention time= 130.5 min calculated for 0.031 af (100% of inflow) Center-of-Mass det. time= 130.1 min (961.4 - 831.3)

Volume	Inve	ert Avail.Sto	rage Storage	Description	
#1	63.0	0' 47	78 cf Custom	I Stage Data (Pri	smatic) Listed below (Recalc)
Elevatio (fee		Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	
63.0	00	305	0	0	
64.0	00	650	478	478	
Device	Routing	Invert	Outlet Device	es	
#1	Primary	64.00'	Head (feet) (2.50 3.00 3. Coef. (Englis	0.20 0.40 0.60 50 4.00 4.50 5.	70 2.68 2.68 2.66 2.65 2.65 2.65 2.65
#2	Discarde	d 63.00'	2.410 in/hr E	xfiltration over H	lorizontal area

Discarded OutFlow Max=0.04 cfs @ 12.35 hrs HW=64.04' (Free Discharge) **2=Exfiltration** (Exfiltration Controls 0.04 cfs)

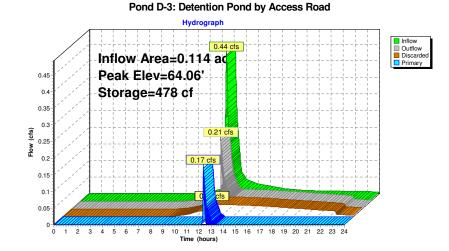
Primary OutFlow Max=0.17 cfs @ 12.36 hrs HW=64.06' (Free Discharge) 1=Broad-Crested Rectangular Weir (Weir Controls 0.17 cfs @ 0.57 fps)

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Summary for Pond UIS-1: UIS at Entrance

[93] Warning: Storage range exceeded by 1.99'
[58] Hint: Peaked 0.09' above defined flood level
[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=490)

Inflow Area =	1.480 ac, 42.24% Impervious, Inflow E	Depth > 4.34" for 100-Year event
Inflow =	7.26 cfs @ 12.09 hrs, Volume=	0.535 af
Outflow =	0.80 cfs @ 13.27 hrs, Volume=	0.214 af, Atten= 89%, Lag= 71.0 min
Discarded =	0.08 cfs @ 8.82 hrs, Volume=	0.119 af
Primary =	0.71 cfs @ 13.27 hrs, Volume=	0.096 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 68.49' @ 13.27 hrs Surf.Area= 3,486 sf Storage= 13,981 cf Flood Elev= 68.40' Surf.Area= 3,486 sf Storage= 13,981 cf

Plug-Flow detention time= 251.3 min calculated for 0.214 af (40% of inflow) Center-of-Mass det. time= 119.6 min (917.4 - 797.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	60.00'	5,786 cf	50.50'W x 69.03'L x 6.50'H Field A
			22,660 cf Overall - 8,195 cf Embedded = 14,465 cf x 40.0% Voids
#2A	61.00'	8,195 cf	Cultec R-902HD x 126 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
			7 Rows of 18 Chambers
			Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf
		12.091 of	Total Available Storage

13,981 cf Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	1.020 in/hr Exfiltration over Surface area
#2	Primary	68.40'	24.0" x 24.0" Horiz. Orifice/Grate C= 0.600
			Limited to weir flow at low heads

Discarded OutFlow Max=0.08 cfs @ 8.82 hrs HW=60.08' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Primary OutFlow Max=0.70 cfs @ 13.27 hrs HW=68.49' (Free Discharge)

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Pond UIS-1: UIS at Entrance - Chamber Wizard Field A

Chamber Model = Cultec R-902HD (Cultec Recharger® 902HD) 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 Cap Storage= +2.8 cf x 2 x 7 rows = 38.6 cf

78.0" Wide + 6.0" Spacing = 84.0" C-C Row Spacing

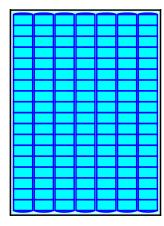
18 Chambers/Row x 3.67' Long +0.52' Cap Length x 2 = 67.03' Row Length +12.0" End Stone x 2 = 69.03' Base Length 7 Rows x 78.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 50.50' Base Width 12.0" Base + 48.0" Chamber Height + 18.0" Cover = 6.50' Field Height

126 Chambers x 64.7 cf + 2.8 cf Cap Volume x 2 x 7 Rows = 8,195.3 cf Chamber Storage

22,660.2 cf Field - 8,195.3 cf Chambers = 14,464.9 cf Stone x 40.0% Voids = 5,786.0 cf Stone Storage

Chamber Storage + Stone Storage = 13,981.2 cf = 0.321 af Overall Storage Efficiency = 61.7%Overall System Size = $69.03' \times 50.50' \times 6.50'$

126 Chambers 839.3 cy Field 535.7 cy Stone

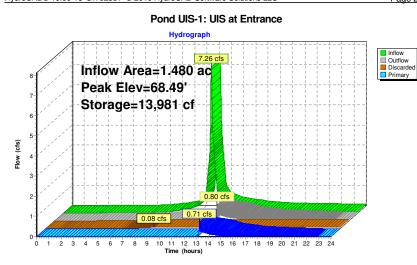




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Summary for Pond UIS-2: UIS at North of Site

[93] Warning: Storage range exceeded by 2.91'
[58] Hint: Peaked 0.20' above defined flood level
[85] Warning: Oscillations may require smaller dt or Finer Routing (severity=17)

Inflow Area =	0.384 ac,100.00% Impervious, Inflow Depth > 6.26" for 100-Year event	
Inflow =	2.45 cfs @ 12.08 hrs, Volume= 0.200 af	
Outflow =	0.65 cfs @ 12.53 hrs, Volume= 0.200 af, Atten= 73%, Lag= 26.8 min	
Discarded =	0.23 cfs @ 11.33 hrs, Volume= 0.198 af	
Primary =	0.43 cfs @ 12.53 hrs, Volume= 0.002 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 68.45' @ 12.53 hrs Surf.Area= 1,176 sf Storage= 2,860 cf Flood Elev= 68.25' Surf.Area= 1,176 sf Storage= 2,860 cf

Plug-Flow detention time= 84.5 min calculated for 0.200 af (100% of inflow) Center-of-Mass det. time= 84.2 min (827.7 - 743.4)

1	/olume	Invert	Avail.Storage	Storage Description
	#1A	61.50'	1,262 cf	16.00'W x 73.50'L x 4.04'H Field A
				4,753 cf Overall - 1,598 cf Embedded = 3,155 cf x 40.0% Voids
	#2A	62.50'	1,598 cf	Cultec R-330XLHD x 30 Inside #1
				Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf
				Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap
_				Row Length Adjustment= +1.50' x 7.45 sf x 3 rows
_			2,860 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices	
#1 #2	Discarded Primary		8.270 in/hr Exfiltration ov 6.0" Horiz. Orifice/Grate	area Limited to weir flow at low heads

Discarded OutFlow Max=0.23 cfs @ 11.33 hrs HW=61.57' (Free Discharge)

Primary OutFlow Max=0.42 cfs @ 12.53 hrs HW=68.45' (Free Discharge) -2=Orifice/Grate (Orifice Controls 0.42 cfs @ 2.15 fps)

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Pond UIS-2: UIS at North of Site - Chamber Wizard Field A

Chamber Model = Cultec R-330XLHD (Cultec Recharger® 330XLHD)

Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 3 rows

52.0" Wide + 6.0" Spacing = 58.0" C-C Row Spacing

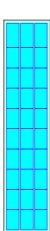
10 Chambers/Row x 7.00' Long +1.50' Row Adjustment = 71.50' Row Length +12.0" End Stone x 2 = 73.50' Base Length 3 Rows x 52.0" Wide + 6.0" Spacing x 2 + 12.0" Side Stone x 2 = 16.00' Base Width 12.0" Base + 30.5" Chamber Height + 6.0" Cover = 4.04' Field Height

30 Chambers x 52.2 cf +1.50' Row Adjustment x 7.45 sf x 3 Rows = 1,598.2 cf Chamber Storage

4,753.0 cf Field - 1,598.2 cf Chambers = 3,154.8 cf Stone x 40.0% Voids = 1,261.9 cf Stone Storage

Chamber Storage + Stone Storage = 2,860.1 cf = 0.066 af Overall Storage Efficiency = 60.2% Overall System Size = 73.50' x 16.00' x 4.04'

30 Chambers 176.0 cy Field 116.8 cy Stone



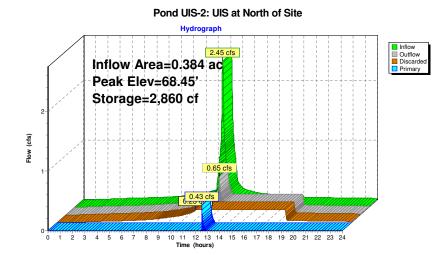
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Summary for Pond UIS-3: UIS-3

[58] Hint: Peaked 1.63' above defined flood level

Inflow Area =	0.083 ac,100.00% Impervious, Inflow Depth > 6.26" for 100-Year event
Inflow =	0.53 cfs @ 12.08 hrs, Volume= 0.043 af
Outflow =	0.53 cfs @ 12.09 hrs, Volume= 0.041 af, Atten= 1%, Lag= 0.7 min
Discarded =	0.00 cfs @ 1.97 hrs, Volume= 0.005 af
Primary =	0.52 cfs @ 12.09 hrs, Volume= 0.036 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 73.84' @ 12.09 hrs Surf.Area= 103 sf Storage= 141 cf Flood Elev= 72.21' Surf.Area= 103 sf Storage= 22 cf

Plug-Flow detention time= 59.0 min calculated for 0.041 af (94% of inflow) Center-of-Mass det. time= 25.2 min (768.7 - 743.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	71.69'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
			332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	72.19'	97 cf	Cultec R-280HD x 2 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	71.69'	1.020 in/hr Exfiltration over Surface area
#2	Primary	73.40'	

Discarded OutFlow Max=0.00 cfs @ 1.97 hrs HW=71.72' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.52 cfs @ 12.09 hrs HW=73.84' (Free Discharge) -2=Culvert (Inlet Controls 0.52 cfs @ 2.83 fps)

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Pond UIS-3: UIS-3 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

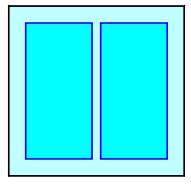
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

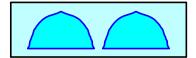
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

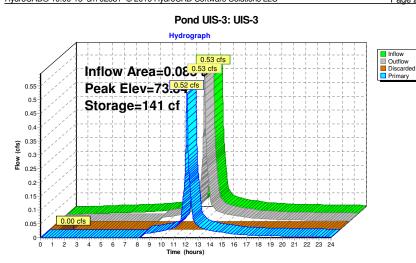




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Summary for Pond UIS-4: UIS-4

[58] Hint: Peaked 0.65' above defined flood level

Inflow Area =	0.073 ac,100.00% Impervious, Inflow De	epth > 6.26" for 100-Year event
Inflow =	0.47 cfs @ 12.08 hrs, Volume=	0.038 af
Outflow =	0.45 cfs @ 12.11 hrs, Volume=	0.036 af, Atten= 4%, Lag= 1.4 min
Discarded =	0.00 cfs @ 2.21 hrs, Volume=	0.005 af
Primary =	0.45 cfs @ 12.11 hrs, Volume=	0.031 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs Peak Elev= 74.85' @ 12.11 hrs Surf.Area= 103 sf Storage= 153 cf Flood Elev= 74.20' Surf.Area= 103 sf Storage= 111 cf

Plug-Flow detention time= 64.5 min calculated for 0.036 af (93% of inflow)Center-of-Mass det. time= 27.3 min (770.7 - 743.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	72.50'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
			332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids
#2A	73.00'	97 cf	Cultec R-280HD x 2 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	72.50'	1.020 in/hr Exfiltration over Surface area
#2	Primary	74.20'	6.0" Round Culvert L= 30.0' Ke= 1.000 Inlet / Outlet Invert= 74.20' / 74.06' S= 0.0047 '/ Cc= 0.900 n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.00 cfs @ 2.21 hrs HW=72.53' (Free Discharge)

Primary OutFlow Max=0.45 cfs @ 12.11 hrs HW=74.84' (Free Discharge) -2=Culvert (Inlet Controls 0.45 cfs @ 2.27 fps)

 Type III 24-hr
 100-Year Rainfall=6.50"

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Pond UIS-4: UIS-4 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

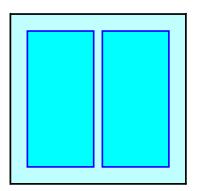
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

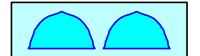
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 afOverall Storage Efficiency = 57.6%Overall System Size = $10.00' \times 10.33' \times 3.21'$

2 Chambers 12.3 cy Field 8.7 cy Stone

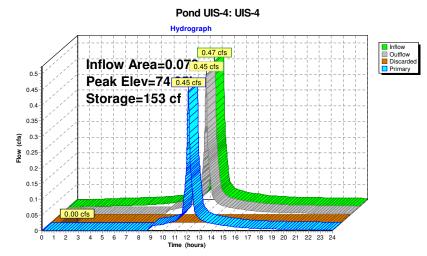




 Topsfield Proposed HydroCAD 2-2-17
 Type III 24-hr
 100-Year Rainfall=6.50"

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 Printed 2/27/2017

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HydroCA	DB 10.00-18 s	/n 02881 © 2016	HydroCAD Software S	Solutions LLC	Page 267
		S	ummary for Pond	UIS-5: UIS-5	
Inflow A Inflow			6 Impervious, Inflow 8 hrs, Volume=	Depth > 6.26" for 0.043 af	100-Year event
Outflow Discarde Primary	ed = 0.0	00 cfs @ 1.97	hrs, Volume= 'hrs, Volume= hrs, Volume=	0.041 af, Atten= 5 0.005 af 0.036 af	%, Lag= 1.5 min
Deutin -	hu Char In-I	athed Time Or	an 0.00.04.00 have a	4 0.01 hrs	
			an= 0.00-24.00 hrs, c .Area= 103 sf Storad		
	ev= 75.50 @		Area= 103 SI Siora(ye= 159 Ci	
Plua-Fla	w detention ti				
		me= 59.8 min c	alculated for 0.041 af	f (94% of inflow)	
		me= 59.8 min c me= 25.9 min (alculated for 0.041 af 769.3 - 743.4)	f (94% of inflow)	
Center-o	of-Mass det. ti	me= 25.9 min (769.3 - 743.4)	· · · ·	
Center-o Volume	of-Mass det. ti Invert	me= 25.9 min (Avail.Storage	769.3 - 743.4) e Storage Description	on	
Center-o	of-Mass det. ti	me= 25.9 min (769.3 - 743.4) <u>Storage Description</u> f 10.33'W x 10.00'L	on x 3.21'H Field A	of x 40.0% Voide
Center-o <u>Volume</u> #1A	of-Mass det. ti Invert 73.09'	me= 25.9 min (<u>Avail.Storage</u> 94 c	769.3 - 743.4) <u>Storage Description</u> f 10.33'W x 10.00'L 332 cf Overall - 93	on • x 3.21'H Field A 7 cf Embedded = 234	cf x 40.0% Voids
Center-o Volume	of-Mass det. ti Invert	me= 25.9 min (Avail.Storage	769.3 - 743.4) <u>Storage Description</u> f 10.33'W x 10.00'L 332 cf Overall - 93 f Cultec R-280HD	on x 3.21'H Field A 7 cf Embedded = 234 x 2 Inside #1	
Center-o <u>Volume</u> #1A	of-Mass det. ti Invert 73.09'	me= 25.9 min (<u>Avail.Storage</u> 94 c	769.3 - 743.4) <u>Storage Descriptii</u> f 10.33'W x 10.00'L 332 cf Overall - 93 f Cultec R-280HD Effective Size= 46	on x 3.21'H Field A 7 cf Embedded = 234 x 2 Inside #1	7 sf x 7.00'L = 42.5 cf
Center-o <u>Volume</u> #1A	of-Mass det. ti Invert 73.09'	me= 25.9 min (<u>Avail.Storage</u> 94 c	769.3 - 743.4) <u>storage Descriptiv</u> f 10.33'W x 10.00'L 332 cf Overall - 97 f Cultec R-280HD 4 Effective Size= 47.0 Overall Size= 47.0	on x 3.21'H Field A 7 cf Embedded = 234 x 2 Inside #1 5.9''W x 26.0''H => 6.0	7 sf x 7.00'L = 42.5 cf with 1.00' Overlap
Center-o <u>Volume</u> #1A	of-Mass det. ti Invert 73.09'	me= 25.9 min (<u>Avail.Storage</u> 94 c	769.3 - 743.4) <u>e</u> Storage Description f 10.33'W x 10.00'L 332 cf Overall - 91 f Cultec R-280HD Effective Size= 440 Overall Size= 47.1 Row Length Adjus	on x 3.21'H Field A 7 cf Embedded = 234 x 2 Inside #1 5.9"W x 26.0"H => 6.0 "W x 26.5"H x 8.00'L stment= +1.00' x 6.07	7 sf x 7.00'L = 42.5 cf with 1.00' Overlap
Center-o <u>Volume</u> #1A #2A	of-Mass det. ti <u>Invert</u> 73.09' 73.59'	me= 25.9 min (<u>Avail.Storage</u> 94 c 97 c 191 c	769.3 - 743.4) Storage Descriptii f 10.33'W x 10.00'L 332 cf Overall - 9 f Cultec R-280HD Effective Size= 47. Row Length Adjus f Total Available St	on x 3.21'H Field A 7 cf Embedded = 234 x 2 Inside #1 5.9"W x 26.0"H => 6.0 "W x 26.5"H x 8.00'L stment= +1.00' x 6.07	7 sf x 7.00'L = 42.5 cf with 1.00' Overlap
Center-o <u>Volume</u> #1A #2A	of-Mass det. ti <u>Invert</u> 73.09' 73.59'	me= 25.9 min (<u>Avail.Storage</u> 94 c 97 c	769.3 - 743.4) Storage Descriptii f 10.33'W x 10.00'L 332 cf Overall - 9 f Cultec R-280HD Effective Size= 47. Row Length Adjus f Total Available St	on x 3.21'H Field A 7 cf Embedded = 234 x 2 Inside #1 5.9"W x 26.0"H => 6.0 "W x 26.5"H x 8.00'L stment= +1.00' x 6.07	7 sf x 7.00'L = 42.5 cf with 1.00' Overlap
Center-o Volume #1A #2A Stora	of-Mass det. ti Invert 73.09' 73.59' age Group A c	me= 25.9 min (<u>Avail.Storage</u> 94 c 97 c 191 c 191 c	769.3 - 743.4) <u>e</u> Storage Descriptii f 10.33'W x 10.00'L 332 cf Overall - 91 f Cultec R-280HD Effective Size= 47. Overall Size= 47. Overall Size= 47. Row Length Adjus f Total Available St mber Wizard	on x 3.21'H Field A 7 cf Embedded = 234 x 2 Inside #1 5.9"W x 26.0"H => 6.0 "W x 26.5"H x 8.00'L stment= +1.00' x 6.07	7 sf x 7.00'L = 42.5 cf with 1.00' Overlap
Center-o Volume #1A #2A Stora	of-Mass det. ti Invert 73.09' 73.59' age Group A c	me= 25.9 min (<u>Avail.Storage</u> 94 c 97 c 191 c 191 c reated with Cha Invert O	769.3 - 743.4) Storage Descriptii f 10.33'W x 10.00'L 332 cf Overall - 9 f Cultec R-280HD Effective Size= 47. Row Length Adjus f Total Available St	on x 3.21'H Field A 7 cf Embedded = 234 x 2 Inside #1 5.9"W x 26.0"H => 6.0 0"W x 26.5"H x 8.00'L stment= +1.00' x 6.07 orage	7 sf x 7.00'L = 42.5 cf with 1.00' Overlap
Center-o Volume #1A #2A Stora Device	of-Mass det. ti Invert 73.09' 73.59' age Group A c Routing	me= 25.9 min (<u>Avail.Storage</u> 94 c 97 c 191 c reated with Cha <u>Invert Ot</u> 73.09' 1.	769.3 - 743.4) <u>e</u> Storage Descriptii f 10.33'W x 10.00'L 332 cf Overall - 91 f Cultec R-280HD : Effective Size= 47. Row Length Adjus f Total Available St mber Wizard utlet Devices	on x 3.21'H Field A 7 cf Embedded = 234 x 2 Inside #1 5.9"W x 26.0"H => 6.0 0"W x 26.5"H x 8.00'L stment= +1.00' x 6.07 orage over Surface area	7 sf x 7.00'L = 42.5 cf with 1.00' Overlap
Center-o Volume #1A #2A Stora Device #1	of-Mass det. ti Invert 73.09' 73.59' age Group A c <u>Routing</u> Discarded	me= 25.9 min (<u>Avail.Storage</u> 94 c 97 c 191 c reated with Cha <u>Invert</u> Or 73.09' 1.0 74.80' 6.1 Inl	769.3 - 743.4) Storage Description f 10.33'W x 10.00'L 332 cf Overall - 91 f Cultec R-280HD Effective Size= 47. Overall Size= 47. Overall Size= 47. Coverall Siz	on x 3.21'H Field A 7 cf Embedded = 234 x 2 Inside #1 5.9"W x 26.0"H => 6.0 0"W x 26.5"H x 8.00'L stment= +1.00' x 6.07 orage over Surface area	7 sf x 7.00'L = 42.5 cf with 1.00' Overlap sf x 2 rows

Discarded OutFlow Max=0.00 cfs @ 1.97 hrs HW=73.12' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.50 cfs @ 12.11 hrs HW=75.55' (Free Discharge) -2=Culvert (Inlet Controls 0.50 cfs @ 2.56 fps)
 Topsfield Proposed HydroCAD 2-2-17
 Type III 24-hr
 100-Year Rainfall=6.50"

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 s/n 02881
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Pond UIS-5: UIS-5 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

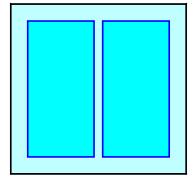
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

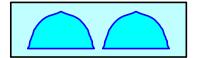
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

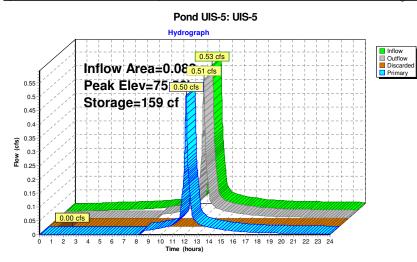
Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'







Type III 24-hr 100-Year Rainfall=6.50" Printed 2/27/2017 Page 269



HydroCA	ed by Microso D® 10.00-18 s/		Printed 2/27/20 HydroCAD Software Solutions LLC Page 2
		Su	mmary for Pond UIS-6: UIS-6
Inflow A Inflow Outflow Discarde Primary	= 0.5 = 0.5 ed = 0.0	57 cfs @ 12.08 54 cfs @ 12.11	hrs, Volume= 0.044 af, Atten= 5%, Lag= 1.5 min hrs, Volume= 0.005 af
			n= 0.00-24.00 hrs, dt= 0.01 hrs Area= 103 sf Storage= 163 cf
		me= 57.1 min ca me= 25.0 min (7	lculated for 0.044 af (94% of inflow) 768.4 - 743.4)
Volume	Invert	Avail.Storage	Storage Description
#1A	72.29'	94 cf	10.33'W x 10.00'L x 3.21'H Field A
#2A	72.79'	97 cf	332 cf Overall - 97 cf Embedded = 234 cf x 40.0% Voids Cultec R-280HD x 2 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		191 cf	
	0	reated with Chan	
Device #1	Routing Discarded		tlet Devices 20 in/hr Exfiltration over Surface area
#2	Primary	74.00' 6.0' Inle	Round Culvert L = 106.0' Ke= 1.000 et / Outlet Invert= 74.00' / 72.18' S= 0.0172 '/' Cc= 0.900 0.011 PVC, smooth interior, Flow Area= 0.20 sf
Discard 1=Ex	ed OutFlow M filtration (Exf	Ax=0.00 cfs @ ⁻ iltration Controls	1.86 hrs HW=72.32' (Free Discharge) 0.00 cfs)
Primarv	OutFlow Max	x=0.54 cfs @ 12. ontrols 0.54 cfs @	.11 hrs HW=74.83' (Free Discharge) ⊉ 2.75 fps)
€2=Cu			
1—2=Cu			
1-2=Cu			
1 —2=Cu			
1 —2=Cu			
t—2=Cu			
←_2=Cu			
1 —2=Cu			
↑ _2=Cu			
↑ _2=Cu			

 Type III 24-hr
 100-Year Rainfall=6.50"

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Pond UIS-6: UIS-6 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

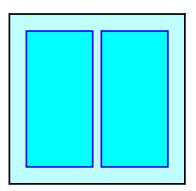
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

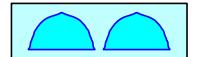
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

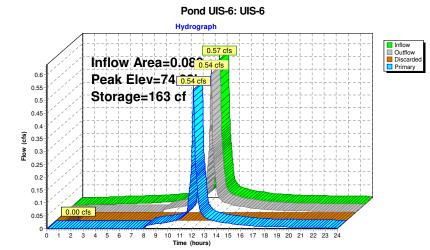
331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 afOverall Storage Efficiency = 57.6%Overall System Size = $10.00' \times 10.33' \times 3.21'$









				CAD Software Solutions LLC		Page 27
			Sumr	ary for Pond UIS-7: UIS-7		
Inflow A				ervious, Inflow Depth > 6.26"	for 100)-Year event
Inflow		.53 cfs @ 12				
Outflow Discarde		0.51 cfs @ 12			en= 5%,	Lag= 1.5 min
Primary		0.00 cfs @ 12				
i iiiiai y	- (2.111115	volume_ 0.000 dl		
Routina	by Stor-Ind	nethod Time	Span=	.00-24.00 hrs, dt= 0.01 hrs		
				= 103 sf Storage= 159 cf		
				0		
Plua-Flo	w detention	time= 59.8 m	nin calcul	ted for 0.041 af (94% of inflow)		
				ted for 0.041 af (94% of inflow) - 743.4)		
		time= 59.8 m time= 25.9 m				
Center-c		time= 25.9 m	nin (769.			
Center-c	of-Mass det.	time= 25.9 m Avail.Sto	nin (769. orage S	- 743.4)		
Center-c <u>Volume</u> #1A	of-Mass det. Invert 71.79	time= 25.9 m Avail.Stor	nin (769. p <u>rage S</u> 94 cf 1 3	- 743.4) <u>orage Description</u> 33'W x 10.00'L x 3.21'H Field A 2 cf Overall - 97 cf Embedded =	4	x 40.0% Voids
Center-c Volume	of-Mass det. Invert	time= 25.9 m Avail.Stor	nin (769. o <u>rage S</u> 94 cf 1 3 97 cf C	- 743.4) prage Description 33'W x 10.00'L x 3.21'H Field A 2 cf Overall - 97 cf Embedded = Itec R-280HD x 2 Inside #1	A = 234 cf	
Center-c <u>Volume</u> #1A	of-Mass det. Invert 71.79	time= 25.9 m Avail.Stor	nin (769. o <u>rage S</u> 94 cf 1 3 97 cf C E	- 743.4) <u>orage Description</u> 33'W x 10.00'L x 3.21'H Field A 2 cf Overall - 97 cf Embedded = Itec R-280HD x 2 Inside #1 ective Size= 46.9''W x 26.0''H =	A = 234 cf => 6.07 s	f x 7.00'L = 42.5 cf
Center-c <u>Volume</u> #1A	of-Mass det. Invert 71.79	time= 25.9 m Avail.Stor	nin (769. <u>prage S</u> 94 cf 1 3 97 cf C E C	- 743.4) 33'W x 10.00'L x 3.21'H Field A 2 cf Overall - 97 cf Embedded = Itec R-280HD x 2 Inside #1 ective Size= 46.9"W x 26.0"H = erall Size= 47.0"W x 26.5"H x 3	A = 234 cf => 6.07 s 8.00'L wit	f x 7.00'L = 42.5 cf th 1.00' Overlap
Center-c <u>Volume</u> #1A	of-Mass det. Invert 71.79	time= 25.9 m Avail.Stor	nin (769. o <u>rage S</u> 94 cf 1 3 97 cf C C F	- 743.4) prage Description 33'W x 10.00'L x 3.21'H Field A 2 cf Overall - 97 cf Embedded = 1tec R-280HD x 2 Inside #1 ective Size= 46.9'W x 26.0''H = erall Size= 47.0''W x 26.5'''H x 4 w Length Adjustment= +1.00' x	A = 234 cf => 6.07 s 8.00'L wit	f x 7.00'L = 42.5 cf th 1.00' Overlap
Center-c <u>Volume</u> #1A	of-Mass det. Invert 71.79	time= 25.9 m Avail.Stor	nin (769. o <u>rage S</u> 94 cf 1 3 97 cf C C F	- 743.4) 33'W x 10.00'L x 3.21'H Field A 2 cf Overall - 97 cf Embedded = Itec R-280HD x 2 Inside #1 ective Size= 46.9"W x 26.0"H = erall Size= 47.0"W x 26.5"H x 3	A = 234 cf => 6.07 s 8.00'L wit	f x 7.00'L = 42.5 cf th 1.00' Overlap
Center-c <u>Volume</u> #1A #2A	of-Mass det. Invert 71.79 72.29	time= 25.9 m <u>Avail.Sto</u> s	hin (769. <u>orage S</u> 94 cf 1 3 97 cf C F 91 cf T	- 743.4) brage Description 33'W x 10.00'L x 3.21'H Field A 2 cf Overall - 97 cf Embedded - ltec R-280HD x 2 Inside #1 ective Size= 46.9''W x 26.0''H = erall Size= 47.0''W x 26.5''H x t w Length Adjustment= +1.00' x tal Available Storage	A = 234 cf => 6.07 s 8.00'L wit	f x 7.00'L = 42.5 cf th 1.00' Overlap
Center-c <u>Volume</u> #1A #2A	of-Mass det. Invert 71.79 72.29	time= 25.9 m Avail.Stor	hin (769. <u>orage S</u> 94 cf 1 3 97 cf C F 91 cf T	- 743.4) brage Description 33'W x 10.00'L x 3.21'H Field A 2 cf Overall - 97 cf Embedded - ltec R-280HD x 2 Inside #1 ective Size= 46.9''W x 26.0''H = erall Size= 47.0''W x 26.5''H x t w Length Adjustment= +1.00' x tal Available Storage	A = 234 cf => 6.07 s 8.00'L wit	f x 7.00'L = 42.5 cf th 1.00' Overlap
Center-c Volume #1A #2A Stora	f-Mass det. Invert 71.79 72.29 ge Group A	time= 25.9 m Avail.Sto c	nin (769. orage S 94 cf 1 3 97 cf C F 91 cf T Chambe	- 743.4) prage Description 33'W x 10.00'L x 3.21'H Field A 2 cf Overall - 97 cf Embedded = 1tec F-280HD x 2 Inside #1 ective Size= 46.9'W x 26.0''H = erall Size= 47.0''W x 26.5'''H x 4 w Length Adjustment= +1.00' x tal Available Storage Wizard	A = 234 cf => 6.07 s 8.00'L wit	f x 7.00'L = 42.5 cf th 1.00' Overlap
Center-c Volume #1A #2A Stora Device	of-Mass det. Invert 71.79 72.29 ge Group A Routing	time= 25.9 m Avail.Sto S S S S S S S S S S S S S S S S S S	nin (769. <u>vrage S</u> 94 cf 1 3 97 cf C F 91 cf T Chambe <u>Outlet</u>	- 743.4) prage Description 33'W x 10.00'L x 3.21'H Field A 2 cf Overall - 97 cf Embedded = Itec R-280HD x 2 Inside #1 ective Size= 46.9"W x 26.0"H = erall Size= 47.0"W x 26.5"H x t w Length Adjustment= +1.00' x tal Available Storage Wizard evices	A = 234 cf => 6.07 s 8.00'L wit < 6.07 sf >	f x 7.00'L = 42.5 cf th 1.00' Overlap
Center-c Volume #1A #2A Stora Device #1	f-Mass det. Invert 71.79' 72.29' ge Group A <u>Routing</u> Discarded	time= 25.9 m Avail.Stor \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	nin (769. <u>arage S</u> 94 cf 1 3 97 cf C F 91 cf T Chambe Outlet 1.020 i	- 743.4) prage Description 33'W x 10.00'L x 3.21'H Field A 2 cf Overall - 97 cf Embedded = Itec R-280HD x 2 Inside #1 ective Size= 46.9''W x 26.0''H = erall Size= 47.0''W x 26.5''H x 12 w Length Adjustment= +1.00' x tal Available Storage Wizard evices /hr Exfiltration over Surface ar	A = 234 cf => 6.07 s 8.00'L wit < 6.07 sf >	f x 7.00'L = 42.5 cf th 1.00' Overlap
Center-c Volume #1A #2A Stora Device	of-Mass det. Invert 71.79 72.29 ge Group A Routing	time= 25.9 m Avail.Sto S S S S S S S S S S S S S S S S S S	nin (769. <u>vrage S</u> 94 cf 1 3 97 cf C F 91 cf T Chambe <u>Outlet</u> 1.020 i 6.0" F	- 743.4) prage Description 33'W x 10.00'L x 3.21'H Field A 2 cf Overall - 97 cf Embedded = Itec R-280HD x 2 Inside #1 ective Size= 46.9"W x 26.0"H = erall Size= 47.0"W x 26.5"H x t w Length Adjustment= +1.00' x tal Available Storage Wizard evices	A = 234 cf => 6.07 s 8.00'L wit < 6.07 sf > rea 000	f x 7.00'L = 42.5 cf th 1.00' Overlap < 2 rows

Discarded OutFlow Max=0.00 cfs @ 1.97 hrs HW=71.82' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.50 cfs @ 12.11 hrs HW=74.25' (Free Discharge)

Topsfield Proposed HydroCAD 2-2-17	Type III 24-hr	100-Year Rainfall=6.50"
Prepared by Microsoft		Printed 2/27/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions	LLC	Page 274

Pond UIS-7: UIS-7 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

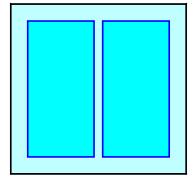
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

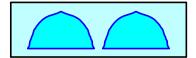
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

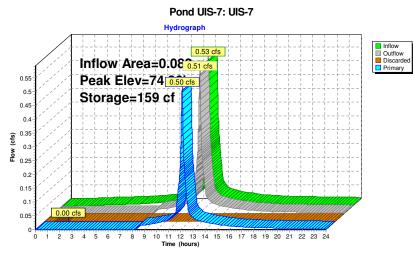
Chamber Storage + Stone Storage = 190.9 cf = 0.004 afOverall Storage Efficiency = 57.6%Overall System Size = $10.00' \times 10.33' \times 3.21'$







Type III 24-hr 100-Year Rainfall=6.50" Printed 2/27/2017 Page 275



	d by Micros D® 10.00-18		HydroCAD Software S	olutions LLC		Printed 2/27/201 Page 27
		Su	mmary for Pond	UIS-8: UIS-8		
Inflow Ar Inflow Outflow Discarde Primary	= 0. = 0. ed = 0.	.53 cfs @ 12.08 .51 cfs @ 12.11	hrs, Volume= hrs, Volume=	Depth > 6.26" 0.043 af 0.041 af, Atte 0.005 af 0.036 af	for 100-Y en= 5%, La	
			n= 0.00-24.00 hrs, d Area= 103 sf Storag			
		time= 59.8 min ca time= 25.9 min (7	lculated for 0.041 af 769.3 - 743.4)	(94% of inflow)		
Volume	Invert	Avail Storage	Storage Description	n		
#1A	71.09	94 cf				
#2A	71.59'	97 cf	332 cf Overall - 97 Cultec R-280HD > Effective Size= 46	2 Inside #1	> 6.07 sf x	
			Overall Size= 47.0			
	ge Group A o	191 cf created with Char Invert Ou	Row Length Adjus Total Available Sto	tment= +1.00' x		
	0 1	created with Char Invert Ou 71.09' 1.0 72.80' 6.0 Inle	Row Length Adjus Total Available Stender nber Wizard tlet Devices 20 in/hr Exfiltration "Round Culvert Let / Outlet Invert= 72.	tment= +1.00' x prage over Surface are = 37.0' Ke= 1.0 80' / 72.18' S=	6.07 sf x 2 ea 000 0.0168 1/ 0	rows
Device #1 #2 Discarde	Routing Discarded Primary	created with Char <u>Invert</u> Ou 71.09' 1.0 72.80' 6.0 Inle n=	Row Length Adjus Total Available Stanber Wizard tet Devices 20 in/hr Exfiltration "Round Culvert Let / Outlet Invert= 72. 0.011 PVC, smooth 1.97 hrs HW=71.12	tment= +1.00' x prage over Surface and = 37.0' Ke= 1.0 80' / 72.18' S= interior, Flow A	<u>6.07 sf x 2</u> ea 100 0.0168 '/' (0 rrea= 0.20 s	rows
Device #1 #2 Discarde _1=Exf Primary	Routing Discarded Primary ad OutFlow illtration (Ex	Invert Ou 71.09' 1.0 72.80' 6.0 Inle n= Max=0.00 cfs @ (filtration Controls	Row Length Adjus Total Available Str nber Wizard 20 in/hr Exfiltration " Round Culvert L et / Outlet Invert= 72. 0.011 PVC, smooth 1.97 hrs HW=71.12 0.00 cfs) .11 hrs HW=73.55'	tment= +1.00' x prage over Surface arc = 37.0' Ke= 1.0 80' / 72.18' S= interior, Flow A (Free Discharg	<u>6.07 sf x 2</u> ea 000 0.0168 '/' (urea= 0.20 s ge)	rows
Device #1 #2 Discarde _1=Exf Primary	Routing Discarded Primary ad OutFlow illtration (Ex	reated with Char Invert Ou 71.09' 1.0 72.80' 6.0 Inle n= Max=0.00 cfs @ filtration Controls ax=0.50 cfs @ 12	Row Length Adjus Total Available Str nber Wizard 20 in/hr Exfiltration " Round Culvert L et / Outlet Invert= 72. 0.011 PVC, smooth 1.97 hrs HW=71.12 0.00 cfs) .11 hrs HW=73.55'	tment= +1.00' x prage over Surface arc = 37.0' Ke= 1.0 80' / 72.18' S= interior, Flow A (Free Discharg	<u>6.07 sf x 2</u> ea 000 0.0168 '/' (urea= 0.20 s ge)	rows
Device #1 #2 Discarde _1=Exf Primary	Routing Discarded Primary ad OutFlow illtration (Ex	reated with Char Invert Ou 71.09' 1.0 72.80' 6.0 Inle n= Max=0.00 cfs @ filtration Controls ax=0.50 cfs @ 12	Row Length Adjus Total Available Str nber Wizard 20 in/hr Exfiltration " Round Culvert L et / Outlet Invert= 72. 0.011 PVC, smooth 1.97 hrs HW=71.12 0.00 cfs) .11 hrs HW=73.55'	tment= +1.00' x prage over Surface arc = 37.0' Ke= 1.0 80' / 72.18' S= interior, Flow A (Free Discharg	<u>6.07 sf x 2</u> ea 000 0.0168 '/' (urea= 0.20 s ge)	rows
Device #1 #2 Discarde _1=Exf Primary	Routing Discarded Primary ad OutFlow illtration (Ex	reated with Char Invert Ou 71.09' 1.0 72.80' 6.0 Inle n= Max=0.00 cfs @ filtration Controls ax=0.50 cfs @ 12	Row Length Adjus Total Available Str nber Wizard 20 in/hr Exfiltration " Round Culvert L et / Outlet Invert= 72. 0.011 PVC, smooth 1.97 hrs HW=71.12 0.00 cfs) .11 hrs HW=73.55'	tment= +1.00' x prage over Surface arc = 37.0' Ke= 1.0 80' / 72.18' S= interior, Flow A (Free Discharg	<u>6.07 sf x 2</u> ea 000 0.0168 '/' (urea= 0.20 s ge)	rows
Device #1 #2 Discarde _1=Exf Primary	Routing Discarded Primary ad OutFlow illtration (Ex	reated with Char Invert Ou 71.09' 1.0 72.80' 6.0 Inle n= Max=0.00 cfs @ filtration Controls ax=0.50 cfs @ 12	Row Length Adjus Total Available Str nber Wizard 20 in/hr Exfiltration " Round Culvert L et / Outlet Invert= 72. 0.011 PVC, smooth 1.97 hrs HW=71.12 0.00 cfs) .11 hrs HW=73.55'	tment= +1.00' x prage over Surface arc = 37.0' Ke= 1.0 80' / 72.18' S= interior, Flow A (Free Discharg	<u>6.07 sf x 2</u> ea 000 0.0168 '/' (urea= 0.20 s ge)	rows
Device #1 #2 Discarde _1=Exf Primary	Routing Discarded Primary ad OutFlow illtration (Ex	reated with Char Invert Ou 71.09' 1.0 72.80' 6.0 Inle n= Max=0.00 cfs @ filtration Controls ax=0.50 cfs @ 12	Row Length Adjus Total Available Str nber Wizard 20 in/hr Exfiltration " Round Culvert L et / Outlet Invert= 72. 0.011 PVC, smooth 1.97 hrs HW=71.12 0.00 cfs) .11 hrs HW=73.55'	tment= +1.00' x prage over Surface arc = 37.0' Ke= 1.0 80' / 72.18' S= interior, Flow A (Free Discharg	<u>6.07 sf x 2</u> ea 000 0.0168 '/' (urea= 0.20 s ge)	rows
Device #1 #2 Discarde _1=Exf Primary	Routing Discarded Primary ad OutFlow illtration (Ex	reated with Char Invert Ou 71.09' 1.0 72.80' 6.0 Inle n= Max=0.00 cfs @ filtration Controls ax=0.50 cfs @ 12	Row Length Adjus Total Available Str nber Wizard 20 in/hr Exfiltration " Round Culvert L et / Outlet Invert= 72. 0.011 PVC, smooth 1.97 hrs HW=71.12 0.00 cfs) .11 hrs HW=73.55'	tment= +1.00' x prage over Surface arc = 37.0' Ke= 1.0 80' / 72.18' S= interior, Flow A (Free Discharg	<u>6.07 sf x 2</u> ea 000 0.0168 '/' (urea= 0.20 s ge)	rows

 Type III 24-hr
 100-Year Rainfall=6.50"

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 2/27/2017

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Pond UIS-8: UIS-8 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

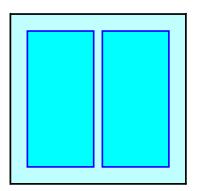
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

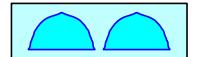
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

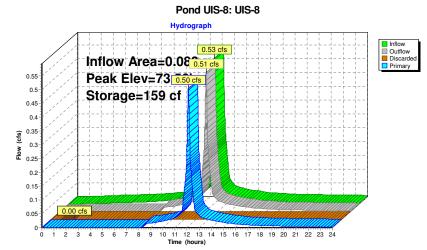
331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

Chamber Storage + Stone Storage = 190.9 cf = 0.004 afOverall Storage Efficiency = 57.6%Overall System Size = $10.00' \times 10.33' \times 3.21'$









HydroCA	D® 10.00-18	s/n 02881 © 20	16 HydroCAD Softwar	e Solutions LLC	Page 27			
Summary for Pond UIS-9: UIS-9								
Inflow Area = 0.089 ac,100.00% Impervious, Inflow Depth > 6.26" for 100-Year event Inflow = 0.57 cfs @ 12.08 hrs, Volume= 0.047 af Outflow = 0.53 cfs @ 12.11 hrs, Volume= 0.045 af, Atten= 7%, Lag= 1.9 min Discarded = 0.00 cfs @ 1.86 hrs, Volume= 0.005 af Primary = 0.53 cfs @ 12.11 hrs, Volume= 0.001 af Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs 0.041 af Plag-Flow detention time= 32.1 min calculated for 0.045 af (97% of inflow) Center-of-Mass det. time= 15.2 min (758.7 - 743.4)								
				af (97% of inflow)				
Center-o		time= 15.2 mir		. ,				
Center-o	of-Mass det.	time= 15.2 mir Avail.Stora	n (758.7 - 743.4) age Storage Descrip 4 cf 10.33'W x 10.00	otion I'L x 3.21'H Field A				
Center-o <u>Volume</u> #1A	of-Mass det. Invert 71.28'	time= 15.2 mir Avail.Stora 94	n (758.7 - 743.4) age <u>Storage Descrip</u> 4 cf 10.33'W x 10.00 332 cf Overall -	btion I' L x 3.21'H Field A 97 cf Embedded = 2	34 cf x 40.0% Voids			
Center-o Volume	of-Mass det.	time= 15.2 mir Avail.Stora 94	n (758.7 - 743.4) age Storage Descrip 4 cf 10.33'W x 10.00 332 cf Overall - 7 cf Cultec R-280HL Effective Size= Overall Size= 4	bition YL x 3.21'H Field A 97 cf Embedded = 2 0 x 2 Inside #1 46.9"W x 26.0"H =>	6.07 sf x 7.00'L = 42.5 cf 0'L with 1.00' Overlap			
Center-o <u>Volume</u> #1A	of-Mass det. Invert 71.28'	time= 15.2 mir <u>Avail.Stora</u> 94 97	n (758.7 - 743.4) age Storage Descrip 4 cf 10.33'W x 10.00 332 cf Overall - 7 cf Cultec R-280HL Effective Size= Overall Size= 4	btion 1'L x 3.21'H Field A 97 cf Embedded = 2 y x 2 Inside #1 46.9"W x 26.0"H => 7.0"W x 26.5"H x 8.0 justment= +1.00' x 6.	6.07 sf x 7.00'L = 42.5 cf 0'L with 1.00' Overlap			
Center-o <u>Volume</u> #1A #2A	of-Mass det. <u>Invert</u> 71.28' 71.78'	time= 15.2 mir <u>Avail.Stora</u> 94 97 97 191	n (758.7 - 743.4) age Storage Descrip 4 cf 10.33'W x 10.00 332 cf Overall - 7 cf Cultec R-280HL Effective Size= Overall Size= Overall Size= Age Now Length Ad	btion 1'L x 3.21'H Field A 97 cf Embedded = 2 y x 2 Inside #1 46.9"W x 26.0"H => 7.0"W x 26.5"H x 8.0 justment= +1.00' x 6.	6.07 sf x 7.00'L = 42.5 cf 0'L with 1.00' Overlap			
Center-o <u>Volume</u> #1A #2A	of-Mass det. Invert 71.28' 71.78' age Group A	time= 15.2 mir Avail.Stora 94 97 191 created with C	n (758.7 - 743.4) age Storage Descrip 4 cf 10.33'W x 10.00 332 cf Overall - 7 cf Cultec R-280HI Effective Size= Overall Size= 4 Row Length Ad I cf Total Available	btion 1'L x 3.21'H Field A 97 cf Embedded = 2 y x 2 Inside #1 46.9"W x 26.0"H => 7.0"W x 26.5"H x 8.0 justment= +1.00' x 6.	6.07 sf x 7.00'L = 42.5 cf 0'L with 1.00' Overlap			
Center-o Volume #1A #2A Stora	of-Mass det. Invert 71.28' 71.78' 71.78'	time= 15.2 mir Avail.Stora 94 97 191 created with C Invert 71.28'	n (758.7 - 743.4) age Storage Descrip 4 cf 10.33'W x 10.00 332 cf Overall - 7 cf Cultec R-280HL Effective Size= Overall Size= Overall Size= An An A	bion YL x 3.21'H Field A 97 cf Embedded = 2 X 2 Inside #1 46.9'W x 26.0"H => 7.0"W x 26.5"H x 8.0 justment= +1.00' x 6. Storage on over Surface area	6.07 sf x 7.00'L = 42.5 cf 10'L with 1.00' Overlap 07 sf x 2 rows			

n= 0.011 PVC, smooth interior, Flow Area= 0.20 sf

Discarded OutFlow Max=0.00 cfs @ 1.86 hrs HW=71.31' (Free Discharge) **1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.53 cfs @ 12.11 hrs HW=72.99' (Free Discharge) -2=Culvert (Inlet Controls 0.53 cfs @ 2.69 fps)
 Topsfield Proposed HydroCAD 2-2-17
 Type III 24-hr
 100-Year Rainfall=6.50"

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 s/n 02881
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Pond UIS-9: UIS-9 - Chamber Wizard Field A

Chamber Model = Cultec R-280HD (Cultec Recharger® 280HD)

Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows

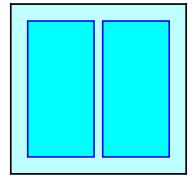
47.0" Wide + 6.0" Spacing = 53.0" C-C Row Spacing

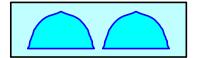
1 Chambers/Row x 7.00' Long +1.00' Row Adjustment = 8.00' Row Length +12.0" End Stone x 2 = 10.00' Base Length 2 Rows x 47.0" Wide + 6.0" Spacing x 1 + 12.0" Side Stone x 2 = 10.33' Base Width 6.0" Base + 26.5" Chamber Height + 6.0" Cover = 3.21' Field Height

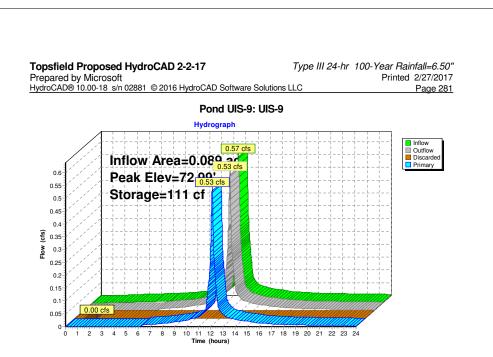
2 Chambers x 42.5 cf +1.00' Row Adjustment x 6.07 sf x 2 Rows = 97.1 cf Chamber Storage

331.5 cf Field - 97.1 cf Chambers = 234.4 cf Stone x 40.0% Voids = 93.8 cf Stone Storage

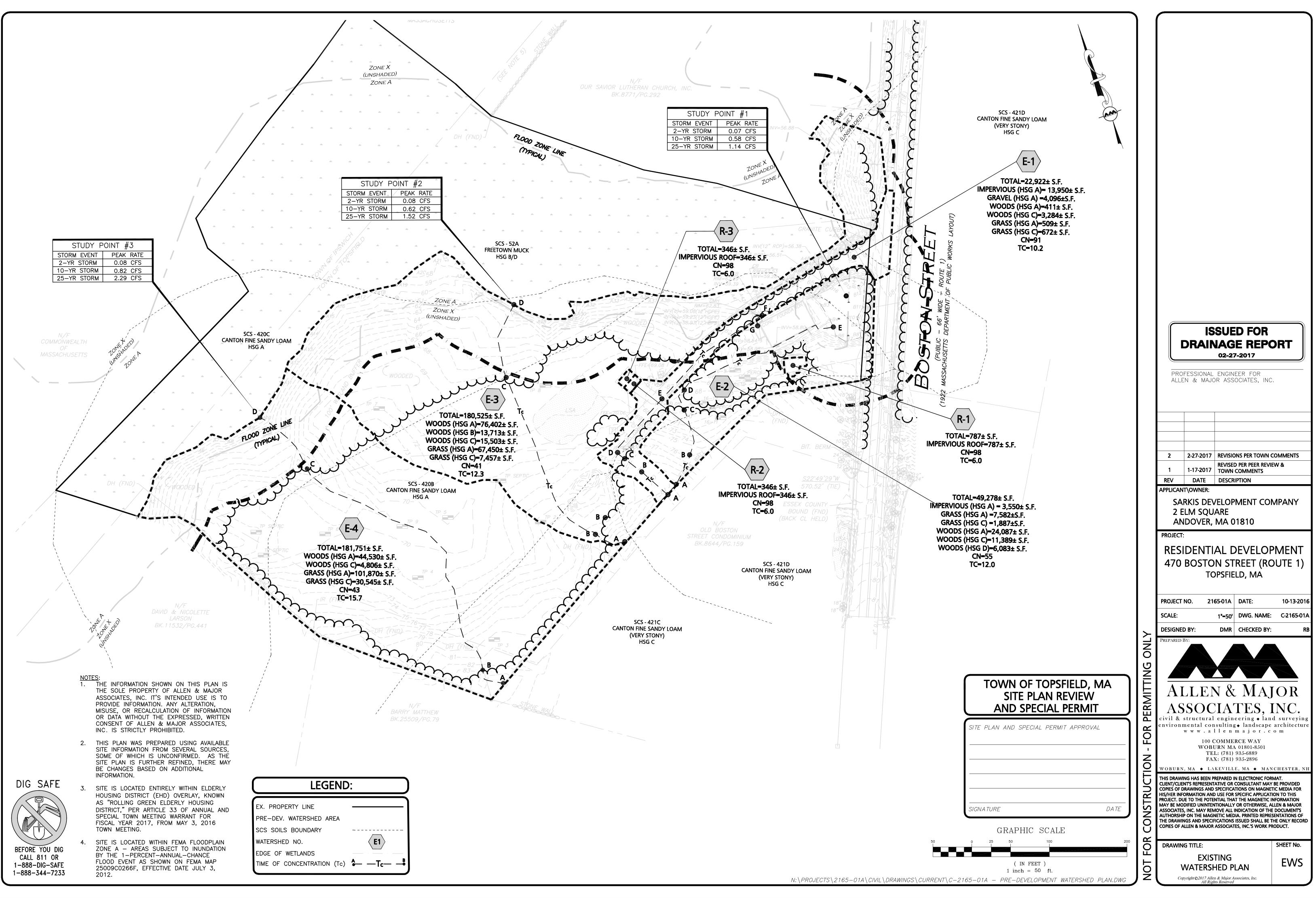
Chamber Storage + Stone Storage = 190.9 cf = 0.004 af Overall Storage Efficiency = 57.6% Overall System Size = 10.00' x 10.33' x 3.21'

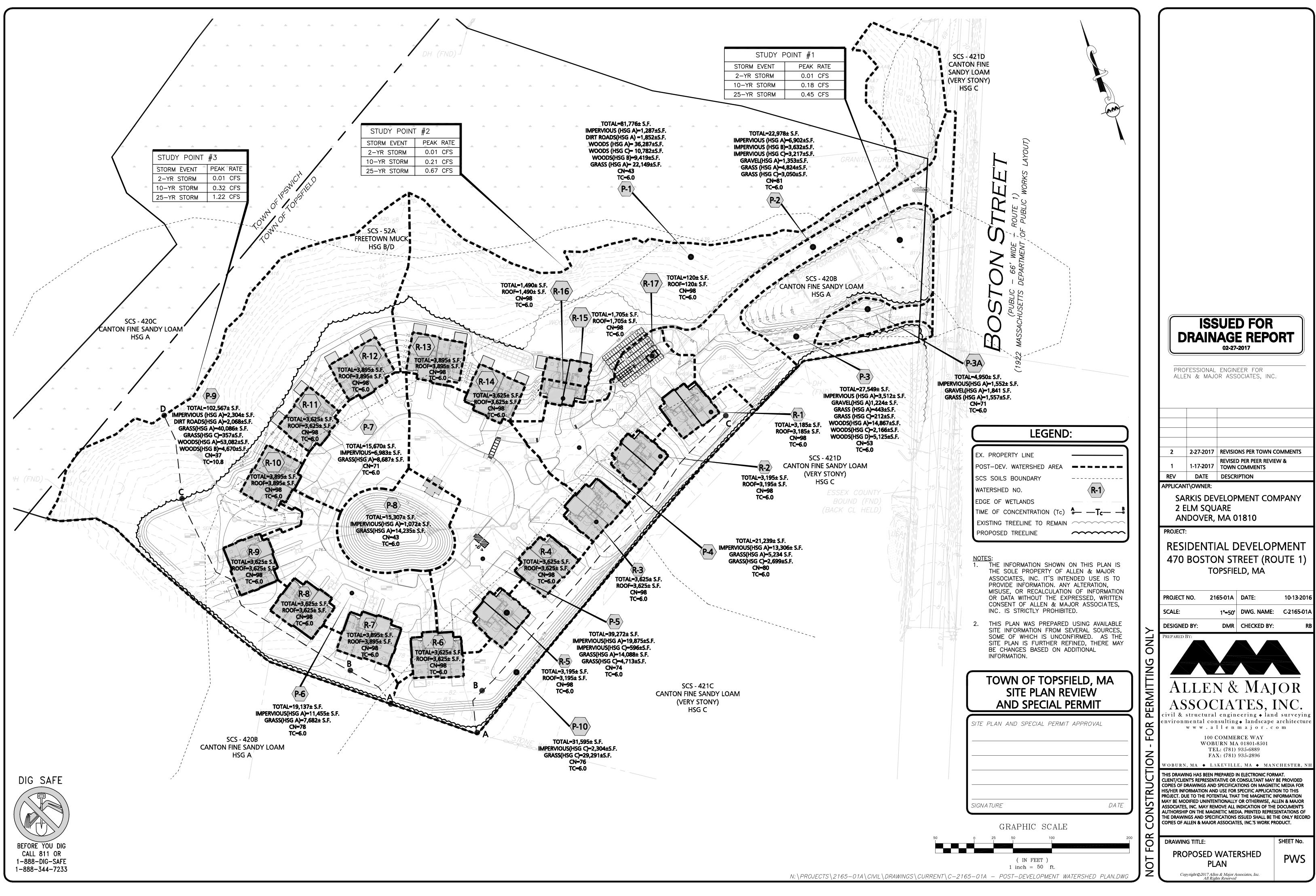


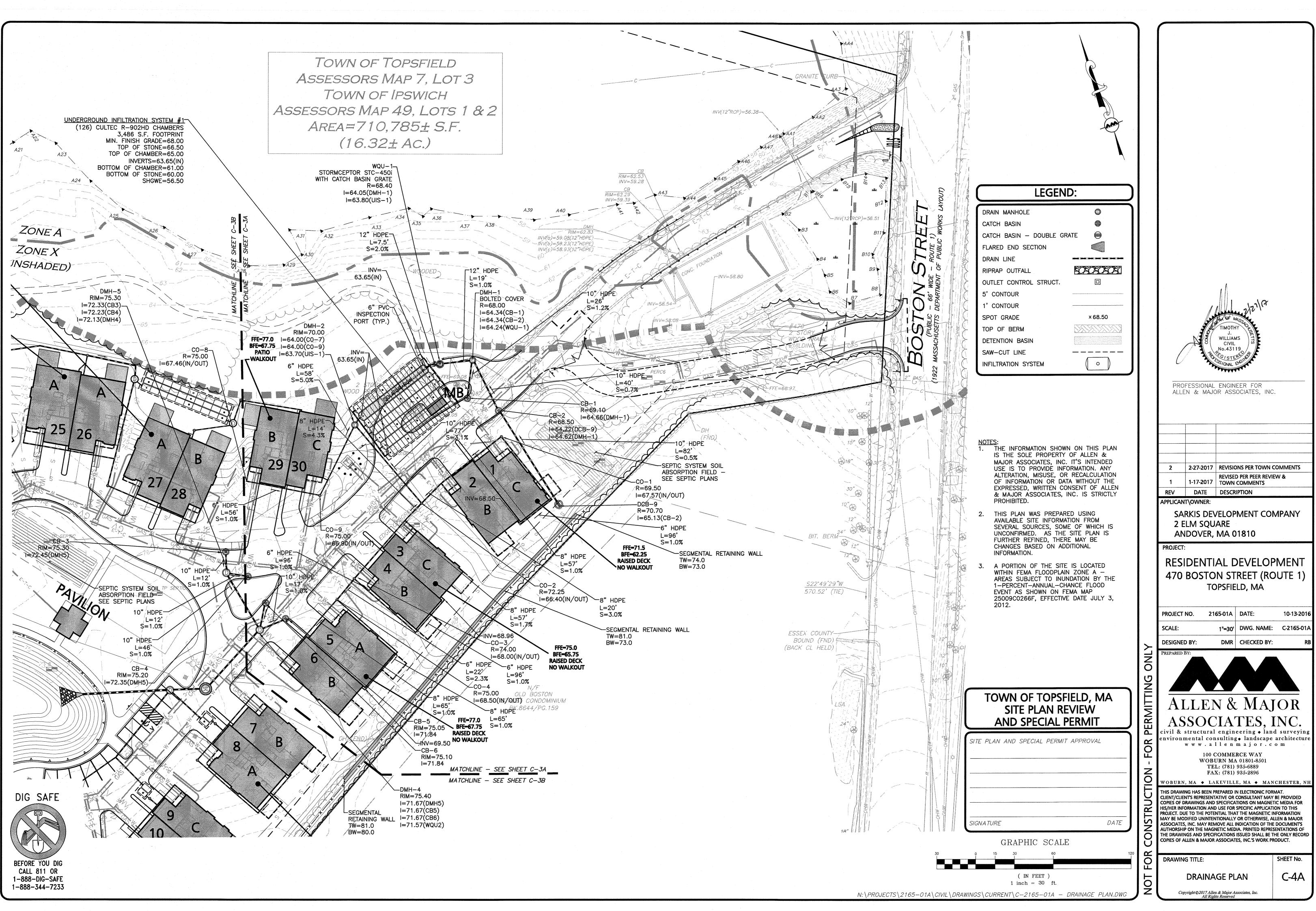


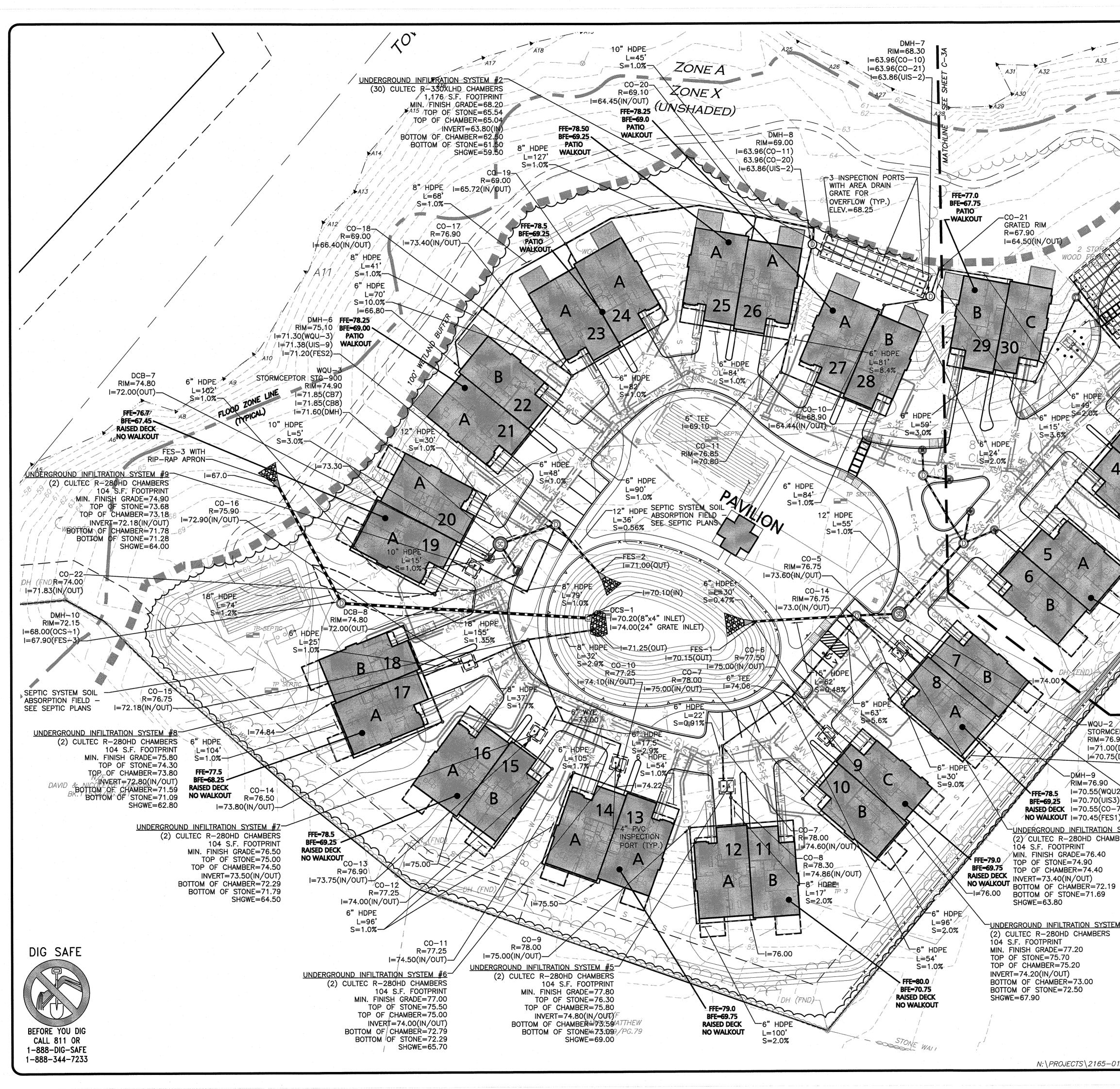


Section 5.0 – Drainage Site Plans

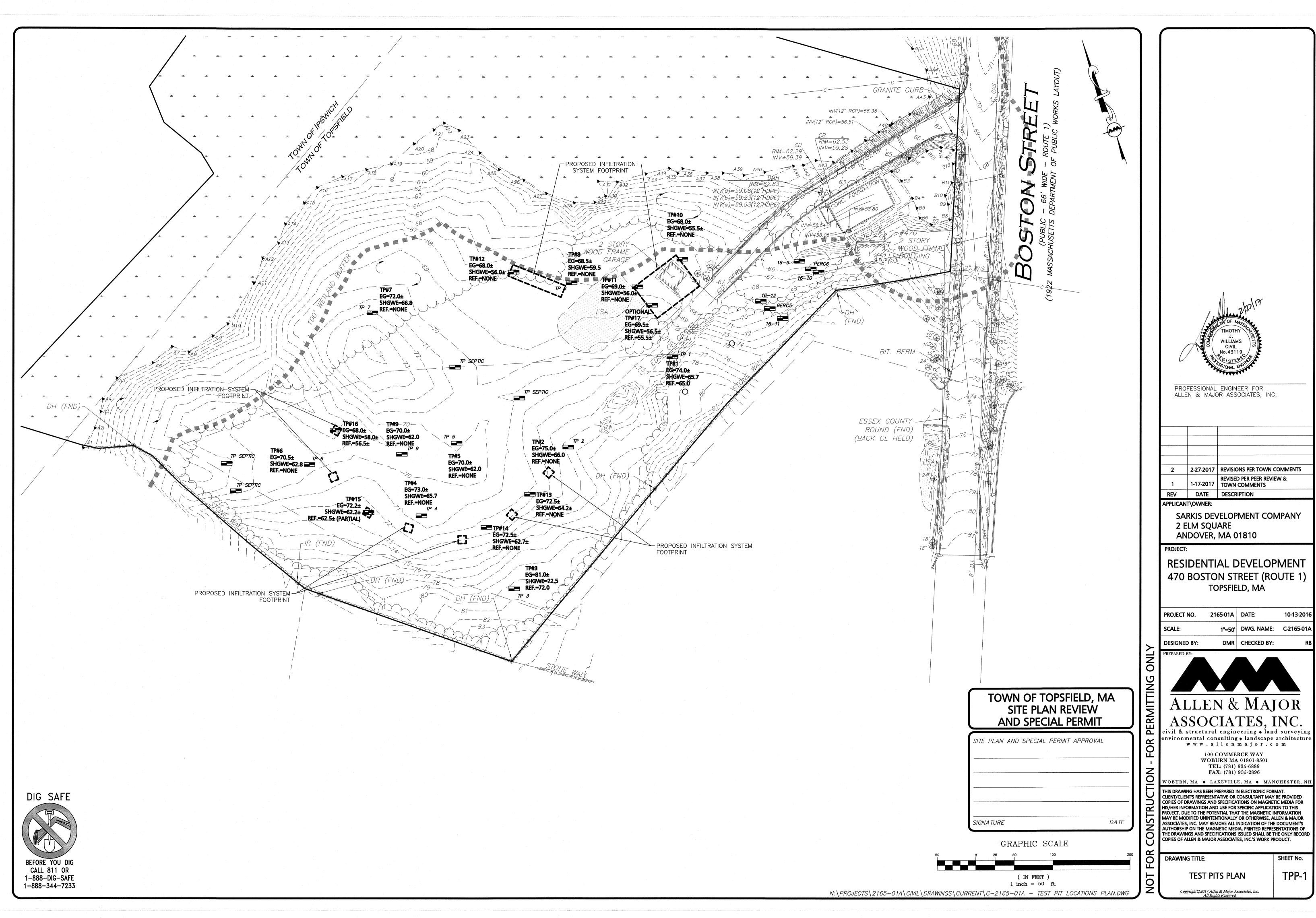








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a contra			
- Lwoo			
and and and and and			
-15			
	LEGEND:		
	DRAIN MANHOLE		
	CATCH BASIN		
	CATCH BASIN – DOUBLE GRATE 🔲 FLARED END SECTION		
	RIPRAP OUTFALL ECREASE OUTLET CONTROL STRUCT.		
0.00	5' CONTOUR		
	1' CONTOUR		1/1/1/12
	TOP OF BERM		JUNIOF MUSSIC
	DETENTION BASIN		J. WILLIAMS
	INFILTRATION SYSTEM		No.43119 Bacc/stere
\mathbb{N}	NOTES:		TODIOVAL ENGINE
3	1. THE INFORMATION SHOWN ON THIS PLAN IS THE SOLE PROPERTY OF ALLEN & MAJOR ASSOCIATES, INC. IT'S INTENDED		PROFESSIONAL ENGINEER FOR ALLEN & MAJOR ASSOCIATES, INC.
	USE IS TO PROVIDE INFORMATION. ANY ALTERATION, MISUSE, OR RECALCULATION		
BX	OF INFORMATION OR DATA WITHOUT THE EXPRESSED, WRITTEN CONSENT OF ALLEN & MAJOR ASSOCIATES, INC. IS STRICTLY		
	PROHIBITED. 2. THIS PLAN WAS PREPARED USING		
	AVAILABLE SITE INFORMATION FROM SEVERAL SOURCES, SOME OF WHICH IS UNCONFIRMED. AS THE SITE PLAN IS		
	FURTHER REFINED, THERE MAY BE CHANGES BASED ON ADDITIONAL		2 2-27-2017 REVISIONS PER TOWN COMMENTS REVISED PER REVIEW & 1 1-17-2017 TOWN COMMENTS
	3. A PORTION OF THE SITE IS LOCATED		REV DATE DESCRIPTION APPLICANT\OWNER:
	WITHIN FEMA FLOODPLAIN ZONE A - AREAS SUBJECT TO INUNDATION BY THE 1-PERCENT-ANNUAL-CHANCE FLOOD		SARKIS DEVELOPMENT COMPANY
HJ .	EVENT AS SHOWN ON FEMA MAP 25009C0266F, EFFECTIVE DATE JULY 3, 2012.		2 ELM SQUARE ANDOVER, MA 01810
	 ALL ROOF LEADERS ARE TO BE 6" HDPE UNLESS OTHERWISE SPECIFIED. 		PROJECT:
	UNLESS UTHERWISE SPECIFIED.		RESIDENTIAL DEVELOPMENT
			470 BOSTON STREET (ROUTE 1) TOPSFIELD, MA
	MATCHLINE - SEE SHEET C-3A		
ZEPTOR STC 900			PROJECT NO. 2165-01A DATE: 10-13-2016 SCALE: 1"=30" DWG. NAME: C-2165-01A
(DMH4) (DMH9)			DESIGNED BY: DMR CHECKED BY: RB
L=1	HDPE 100' 1.0%	ONLY	PREPARED BY:
2) 12" HDPE			
7) S=1.0%) SYSTEM #3	TOWN OF TOPSFIELD, MA	ERMITTING	
BERS	SITE PLAN REVIEW	LΙΜ	ALLEN & MAJOR
Ļ	AND SPECIAL PERMIT	PER	ASSOCIATES, INC. civil & structural engineering • land surveying
SI	ITE PLAN AND SPECIAL PERMIT APPROVAL	FOR	environmental consulting • landscape architecture www.allenmajor.com 100 COMMERCE WAY
-		1	WOBURN MA 01801-8501 TEL: (781) 935-6889 FAX: (781) 935-2896
<u>M #4</u>		TION	WOBURN, MA ♦ LAKEVILLE, MA ♦ MANCHESTER, NH THIS DRAWING HAS BEEN PREPARED IN ELECTRONIC FORMAT.
_		NC NC	THIS DRAWING HAS BEEN PREPARED IN ELECTRONIC FORMAT. CLIENT/CLIENT'S REPRESENTATIVE OR CONSULTANT MAY BE PROVIDED COPIES OF DRAWINGS AND SPECIFICATIONS ON MAGNETIC MEDIA FOR HIS/HER INFORMATION AND USE FOR SPECIFIC APPLICATION TO THIS
	IGNATURE DATE	ONSTRUC	PRÓJECT. DUE TO THE POTENTIAL THAT THE MAGNETIC INFORMATION MAY BE MODIFIED UNINTENTIONALLY OR OTHERWISE, ALLEN & MAJOR ASSOCIATES, INC. MAY REMOVE ALL INDICATION OF THE DOCUMENT'S
Ć	GRAPHIC SCALE	CON	AUTHORSHIP ON THE MAGNETIC MEDIA. PRINTED REPRESENTATIONS OF THE DRAWINGS AND SPECIFICATIONS ISSUED SHALL BE THE ONLY RECORD COPIES OF ALLEN & MAJOR ASSOCIATES, INC.'S WORK PRODUCT.
30	0 15 30 60 120		DRAWING TITLE: SHEET No.
	(IN FEET)		DRAINAGE PLAN C-4B
1A\CIVIL\DRAWIN	1 inch = 30 ft. $GS \setminus CURRENT \setminus C - 2165 - 01A - DRAINAGE PLAN.DWG$	N	Copyright©2017 Allen & Major Associates, Inc. All Rights Reserved



Section 6.0 - Appendix



United States Department of Agriculture

NRCS

Natural Resources Conservation Service A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants Custom Soil Resource Report for Essex County, Massachusetts, Northern Part; and Essex County, Massachusetts, Southern Part





Map Unit Legend

	Essex County, Massachusetts,	Northern Part (MA605)	
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	1.2	0.6%
31A	Walpole sandy loam, 0 to 3 percent slopes	1.9	0.9%
32A	Wareham loamy sand, 0 to 3 percent slopes	0.5	0.2%
52A	Freetown muck, 0 to 1 percent slopes	31.2	14.3%
253B	Hinckley loamy sand, 3 to 8 percent slopes	16.9	7.7%
253C	Hinckley loamy sand, 8 to 15 percent slopes	4.8	2.2%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	5.7	2.6%
254C	Merrimac fine sandy loam, 8 to 15 percent slopes	14.5	6.7%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	17.5	8.0%
420B	Canton fine sandy loam, 3 to 8 percent slopes	6.1	2.8%
420C	Canton fine sandy loam, 8 to 15 percent slopes	9.8	4.5%
420D	Canton fine sandy loam, 15 to 25 percent slopes	0.1	0.0%
421B	Canton fine sandy loam, 3 to 8 percent slopes, very stony	10.2	4.7%
421C	Canton fine sandy loam, 8 to 15 percent slopes, very stony	21.1	9.7%
421D	Canton fine sandy loam, 15 to 25 percent slopes, very stony	17.6	8.1%
600	Pits, gravel	8.9	4.1%
651	Udorthents, smoothed	4.0	1.8%
717E	Rock outcrop-Charlton-Hollis complex, 15 to 35 percent slopes	1.2	0.6%
Subtotals for Soil Survey A	rea	173.2	79.3%
Totals for Area of Interest		218.4	100.0%

Essex County, Massachusetts, Southern Part (MA606)									
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI						
31B	Walpole fine sandy loam, 3 to 8 percent slopes	2.6	1.2%						
52A	Freetown muck, 0 to 1 percent slopes	13.5	6.2%						

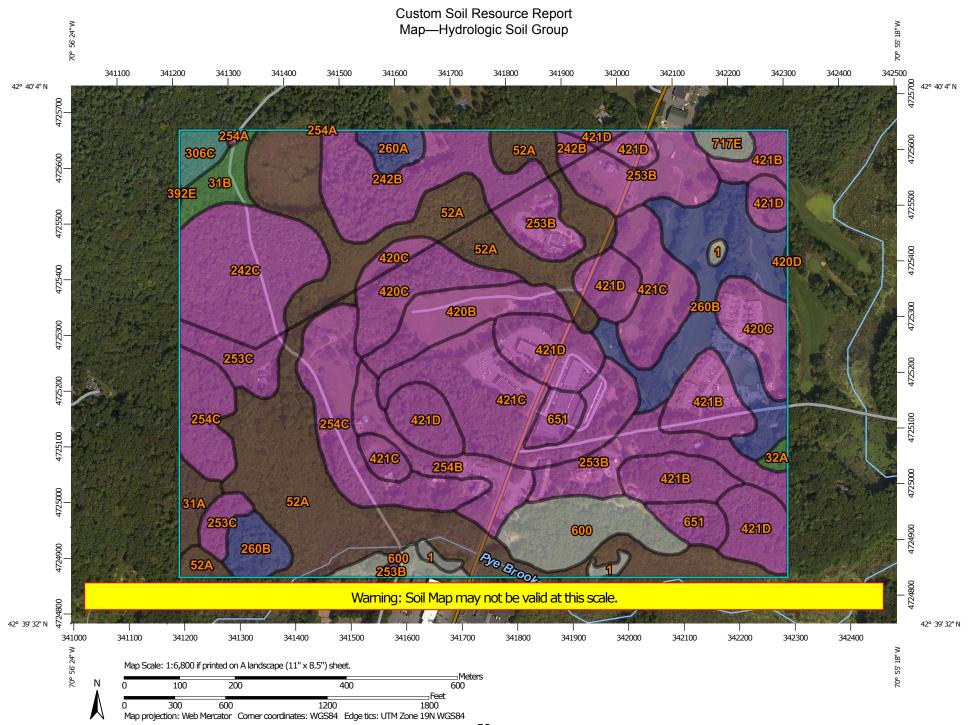
	Essex County, Massachusett	s, Southern Part (MA606)	
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
242B	Hinckley gravelly fine sandy loam, 3 to 8 percent slopes	11.1	5.1%
242C	Hinckley loamy sand, 8 to 15 percent slopes	12.7	5.8%
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	0.2	0.1%
260A	Sudbury fine sandy loam, 0 to 3 percent slopes	1.8	0.8%
306C	Paxton fine sandy loam, 8 to 15 percent slopes, very stony	1.7	0.8%
392E	Paxton and Montauk fine sandy loams, 15 to 35 percent slopes, extremely stony	0.0	0.0%
420C	Canton fine sandy loam, 8 to 20 percent slopes	1.2	0.6%
421D	Canton fine sandy loam, 15 to 25 percent slopes, very stony	0.5	0.2%
Subtotals for Soil Survey A	Area	45.2	20.7%
Totals for Area of Interest		218.4	100.0%

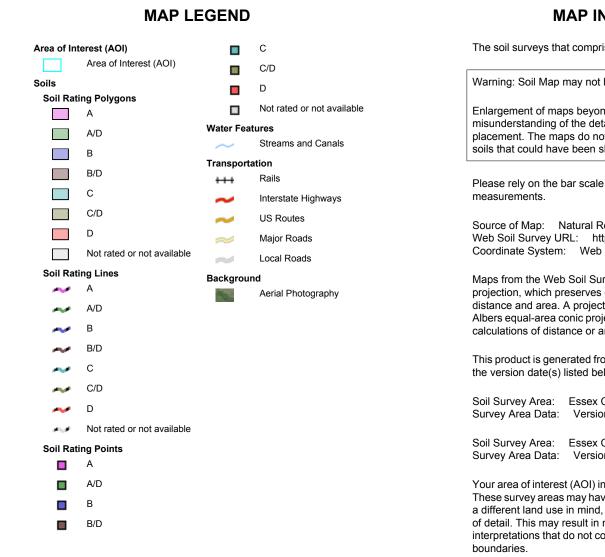
Map Unit Descriptions

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

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

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





MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Essex County, Massachusetts, Northern Part Survey Area Data: Version 11, Sep 28, 2015

Soil Survey Area: Essex County, Massachusetts, Southern Part Survey Area Data: Version 12, Sep 28, 2015

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area

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

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		1.2	0.6%
31A	Walpole sandy loam, 0 to 3 percent slopes	B/D	1.9	0.9%
32A	Wareham loamy sand, 0 to 3 percent slopes	A/D	0.5	0.2%
52A	Freetown muck, 0 to 1 percent slopes	B/D	31.2	14.3%
253B	Hinckley loamy sand, 3 to 8 percent slopes	A	16.9	7.7%
253C	Hinckley loamy sand, 8 to 15 percent slopes	A	4.8	2.2%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	5.7	2.6%
254C	Merrimac fine sandy loam, 8 to 15 percent slopes	A	14.5	6.7%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	В	17.5	8.0%
420B	Canton fine sandy loam, 3 to 8 percent slopes	A	6.1	2.8%
420C	Canton fine sandy loam, 8 to 15 percent slopes	A	9.8	4.5%
420D	Canton fine sandy loam, 15 to 25 percent slopes	A	0.1	0.0%
421B	Canton fine sandy loam, 3 to 8 percent slopes, very stony	A	10.2	4.7%
421C	Canton fine sandy loam, 8 to 15 percent slopes, very stony	A	21.1	9.7%
421D	Canton fine sandy loam, 15 to 25 percent slopes, very stony	A	17.6	8.1%
600	Pits, gravel		8.9	4.1%
651	Udorthents, smoothed	A	4.0	1.8%
717E	Rock outcrop-Charlton- Hollis complex, 15 to 35 percent slopes		1.2	0.6%
Subtotals for Soil Surv	rey Area		173.2	79.3%
Totals for Area of Inter	rest		218.4	100.0%

Hydrologic \$	Soil Group— Summary by M	lap Unit — Essex Coun	ty, Massachusetts, Southern I	Part (MA606)
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
31B	Walpole fine sandy loam, 3 to 8 percent slopes	A/D	2.6	1.2%
52A	Freetown muck, 0 to 1 percent slopes	B/D	13.5	6.2%
242B	Hinckley gravelly fine sandy loam, 3 to 8 percent slopes	A	11.1	5.1%
242C	Hinckley loamy sand, 8 to 15 percent slopes	A	12.7	5.8%
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	A	0.2	0.1%
260A	Sudbury fine sandy loam, 0 to 3 percent slopes	В	1.8	0.8%
306C	Paxton fine sandy loam, 8 to 15 percent slopes, very stony	С	1.7	0.8%
392E	Paxton and Montauk fine sandy loams, 15 to 35 percent slopes, extremely stony	С	0.0	0.0%
420C	Canton fine sandy loam, 8 to 20 percent slopes	A	1.2	0.6%
421D	Canton fine sandy loam, 15 to 25 percent slopes, very stony	A	0.5	0.2%
Subtotals for Soil Surv	ey Area	•	45.2	20.7%
Totals for Area of Inter	est		218.4	100.0%

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition Component Percent Cutoff: None Specified Tie-break Rule: Higher



	Sarkis Development Company						
	Owner Name 470 Boston Street					Map 2, Lot 5	5
	Street Address					Map/Lot #	
	Topsfield			MA		01983	
	City			State		Zip Code	
B	Site Information						
1.	(Check one) X New Constr	ruction	Upgrade		Repair		
2.	Soil Survey Available?	x Yes	🗌 No	If yes:	UC Davis Web Soil S	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedroc	Source k		Soil Map Unit
	Soil Name			Soil Limita			
	Sandy till			Morra	ine		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	🗌 Yes	X No	If yes:			
							Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary? If Yes, continue to #5.	X Yes	🗌 No		e 100-year flood boundary A Zone A	/? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	X Yes	🗌 No	MassGI	S Wetland Data Layer: $^{ m W}$	Vooded Swamp Wetland Type	Deciduous/Mixe
7.	Current Water Resource Conditions	(USGS):	June, 2016 Month/Year	Range:	Above Normal	Normal X Bel	ow Normal
8.	Other references reviewed: N	J/A					



Commonwealth of Massachusetts City/Town of

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

C.	On-Site Revi	ew (minimum of tw	vo holes req	uired at every pro	oposed prim	ary and reserve dispos	al area)	
	Deep Observation	Hole Number:	TP-1	7/7/2016 8:00AM		Overcast, 65 deg	grees	
		-		Date	Time	Weather		
1.	Location							
	Ground Elevation a	t Surface of Hole:	74.0	Latitude/Longitude: 42.664163 / -70.930328				
	Description of Loca	tion: Crushed	stone drive n	ear end of paved d	riveway			
2.	Land Use C	pen field			N/A		0-3%	
	(e.g., woodland, agricultural field, vacant lo Grass			Morraine N/A				
	Veg	etation		Landform		Position on Landscape (SU, SH, I	BS, FS, TS)	
3.	Distances from:	Open Water Body	N/A feet	_ Drainage Way	<u>N/A</u> feet	Wetlands	$\frac{200 + feet}{feet}$	
		Property Line	110' feet	_ Drinking Water	Well <u>N/A</u>	Other	N/A feet	
4.	Parent Material:	Sandy till		Unsuita	able Materials	Present: X Yes	□ No	
	If Yes: Dist	urbed Soil 🛛 🗌 F	ill Material	x Impervious Layer(s) 🛛 🖾 (/eathered/Fractured Rock	X Bedrock	
5.	Groundwater Obse	rved: 🗌 Yes	x No	If yes:	N/A	N/A		
0.				ii yooi	-	Depth Weeping from Pit Depth Standin		
	Estimated Depth to	High Groundwater:	100"	65.7				
		i	nches	elevation	1			



City/Town of

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

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-1

Depth (in.)	Soil Horizon/	oil Horizon/ Soil Matrix: Color-	Redoximorphic Features		Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil	Other	
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other
2-0	Crushed stone										
0-66	2C1	5R3/6				SL	5%	10%			
66-108	2C2	5R3/6	100	7.5YR6/8	2%	SL	5%	15%			

Additional Notes:

Fractured/weathered rock throughout. No water noted, no weeping.

ESHWT @ 100" (2% mottles - concentrations)

Refusal @ 108" (Ledge)



City/Town of

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

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	eld, vacant lot, etc.)		Surface Stones (e.g., cob	bles, stones, boulders,	etc.) Slope (%)
		Vegetation		Landform		Position on Landscap	e (SU, SH, BS, FS,
3.	Distances from:	Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material:	:		Unsuita	ble Materials Presen	t: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	ed/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
				,	Depth Weeping from	n Pit Depth S	Standing Water in Hole
	Estimated Dept	h to High Groundwater:					
	-		inches	elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	oil Horizon/ Soil Matrix: Color- Layer Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence	Other	
Depth (m.)	Layer		Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	

Additional Notes:



City/Town of

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

D. Determination of High Groundwater Elevation

1.	Me	thod Used:			Obs. Hole #	TP- <u>1</u>	Obs. Hole #		
		Depth observed standing	water in observ	ation hole					
		Depth weeping from side		hala	inches		inches		
		Depth weeping from side of	of observation i	noie	inches		inches		
	X	 Depth to soil redoximorphic features (mottles) Depth to adjusted seasonal high groundwater (S_h) (USGS methodology) 			100"				
	_				inches		inches		
					inches		inches		
		Index Well Number		Reading Date					
		$S_{h} = S_{c} - [S_{r} \times (OW_{c} - OW_{c})]$							
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	

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?	Upper boundary:	0	Lower boundary:	108
			inches		inches
C.	If no, at what depth was impervious material observ	ved? Upper boundary:		Lower boundary:	
			inches		inches
			¥C:		

*Significant amounts fractured rock throughout



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator 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.

ature of Soil Evaluator 3799 Typed or Printed Name of Soil Evaluator / License #

Date

Expiration Date of License

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 <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Sarkis Development Company						
	Owner Name 470 Boston Street					Map 2, Lot 5	5
	Street Address			Map/Lot #			
	Topsfield			MA		01983	
	City			State		Zip Code	
B	Site Information						
1.	(Check one) X New Constr	ruction	Upgrade		Repair		
2.	Soil Survey Available?	x Yes	🗌 No	If yes:	UC Davis Web Soil S	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedroc	Source k		Soil Map Unit
	Soil Name			Soil Limita			
	Sandy till			Morra	ine		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	🗌 Yes	X No	If yes:			
							Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary? If Yes, continue to #5.	X Yes	🗌 No		e 100-year flood boundary A Zone A	/? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	X Yes	🗌 No	MassGI	S Wetland Data Layer: $^{ m W}$	Vooded Swamp Wetland Type	Deciduous/Mixe
7.	Current Water Resource Conditions	(USGS):	June, 2016 Month/Year	Range:	Above Normal	Normal X Bel	ow Normal
8.	Other references reviewed: N	J/A					



Commonwealth of Massachusetts City/Town of

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

C.	On-Site Re	eview (minimum of t	wo holes req	uired at every pro	oposed prim	ary and reserve dispo	sal area)
	Deep Observat	tion Hole Number:	TP-2	7/7/2016	8:00AM	Overcast, 65 de	grees
		-		Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	75.0	Latit	ude/Longitude	:42.664163 / -70.930328	3
	Description of L	ocation: Slope al		property line, 110'	from PL		
2.	Land Use	Open field			N/A		3-8%
		(e.g., woodland, agricultural fie Grass	ld, vacant lot, etc.)	Morraine	Surface Stones	(e.g., cobbles, stones, boulders, N/A	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape (SU, SH,	BS, FS, TS)
3.	Distances from:	Open Water Body	N/A feet	_ Drainage Way	<u>N/A</u> feet	Wetlands	<u>300+ feet</u>
		Property Line	110' feet	Drinking Water	Well $\frac{N/A}{feet}$	Other	N/A feet
4.	Parent Material	Sandy till		Unsuit	able Materials	Present: X Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material	x Impervious Layer(s) X V	/eathered/Fractured Rock	X Bedrock
5.	Groundwater O	bserved: 🗌 Yes	x No	If yes:	N/A	N/A	
0.					Depth Wee	ping from Pit Depth St	anding Water in Hole
	Estimated Dept	h to High Groundwater:	108"	66.0 elevation	1		



City/Town of

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

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-2

Depth (in.)	Soil Horizon/ Layer	orizon/ Soil Matrix: Color- ver Moist (Munsell)	Redoximorphic Features		Soil Texture	Coarse Fragments % by Volume		Soil Consistence	Other	
Depth (m.)			Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones	(Moist)	Other
0-8	А	10YR5/6				FSL				
8-24	В	10YR4/6				SL	5%	15%		
24-150	С	10YR3/6	108	7.5YR6/8	2%	S&G	5%	15%		

Additional Notes:

Fractured/weathered rock 60"-150". No water noted, no weeping.

ESHWT @ 108" (2% mottles - concentrations)

No Refusal



City/Town of

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

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	eld, vacant lot, etc.)		Surface Stones (e.g., cob	bles, stones, boulders,	etc.) Slope (%)
		Vegetation		Landform		Position on Landscap	e (SU, SH, BS, FS,
3.	Distances from:	Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material:	:		Unsuita	ble Materials Presen	t: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	ed/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
				,	Depth Weeping from	n Pit Depth S	Standing Water in Hole
	Estimated Dept	h to High Groundwater:					
	-		inches	elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/ Layer	/ Soil Matrix: Color- Moist (Munsell)	Rec	loximorphic Featu	ures	(USDA)	Coarse Fragments % by Volume		Soil Structuro	Soil Consistence	Other
Depth (m.)			Depth	Color	Percent		Gravel	Cobbles & Stones		(Moist)	other

Additional Notes:



City/Town of

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

D. Determination of High Groundwater Elevation

1.	Method Used:				Obs. Hole #		Obs. Hole #	
		Depth observed standing	water in observ	ation hole				
		Depth weeping from side of	of observation l	hole	inches		inches	
	x				inches 108		inches	
	Δ		,	inches		inches		
		Depth to adjusted seasona	vater (S _h)					
		(USGS methodology)			inches ate		inches	
		Index Well Number	,	Reading Date				
		$S_h = S_c - [S_r x (OW_c - OW_{max})/OW_r]$ Obs. Hole # S_c S_r						
				S _r	OW _c	OW _{max}	OW _r	S _h
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h

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?	Upper boundary:	0	Lower boundary:	150
			inches		inches
C.	If no, at what depth was impervious material observe	d? Upper boundary:		Lower boundary:	
			inches		inches

*Significant amounts fractured rock throughout



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator 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.

ature of Soil Evaluator 3799 Typed or Printed Name of Soil Evaluator / License #

Date

Expiration Date of License

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 <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Sarkis Development Company						
	Owner Name 470 Boston Street					Map 2, Lot 5	5
	Street Address			Map/Lot #			
	Topsfield			MA		01983	
	City			State		Zip Code	
B	Site Information						
1.	(Check one) X New Constr	ruction	Upgrade		Repair		
2.	Soil Survey Available?	x Yes	🗌 No	If yes:	UC Davis Web Soil S	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedroc	Source k		Soil Map Unit
	Soil Name			Soil Limita			
	Sandy till			Morra	ine		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	🗌 Yes	X No	If yes:			
							Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary? If Yes, continue to #5.	X Yes	🗌 No		e 100-year flood boundary A Zone A	/? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	X Yes	🗌 No	MassGI	S Wetland Data Layer: $^{ m W}$	Vooded Swamp Wetland Type	Deciduous/Mixe
7.	Current Water Resource Conditions	(USGS):	June, 2016 Month/Year	Range:	Above Normal	Normal X Bel	ow Normal
8.	Other references reviewed: N	J/A					



Commonwealth of Massachusetts City/Town of

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 Observat	ion Hole Number:	TP-3	7/7/2016 Date	8:00AM Time	Overcast, 65 degre Weather	ees
1.	Location		01.0			10 ((11/2) 50 020220	
	Ground Elevation	on at Surface of Hole:	81.0	Latitu	de/Longitude: ·	42.664163 / -70.930328	
	Description of L	ocation: Southwe	stern corner				
2.	Land Use	Open field			N/A		0-3%
		(e.g., woodland, agricultural fie Grass	ld, vacant lot, etc.)	Morraine	Surface Stones (e	e.g., cobbles, stones, boulders, etc.) $\mathrm{N/A}$	Slope (%)
		Vegetation		Landform	F	Position on Landscape (SU, SH, BS	, FS, TS)
3.	Distances from:	Open Water Body	N/A feet	Drainage Way	N/A feet	Wetlands	<u>500+ feet</u>
		Property Line	45'	_ Drinking Water V	Vell <u>N/A</u>	Other	N/A feet
4.	Parent Material:	Sandy till		Unsuital	ble Materials P	Present: X Yes	🗌 No
	If Yes:	Disturbed Soil	ill Material	x Impervious Layer(s)	X We	eathered/Fractured Rock	Bedrock
5.	Groundwater Ol	bserved: 🗌 Yes	x No	If yes:	N/A	N/A	
	Estimated Dept	h to High Groundwater:	102" nches	72.5 elevation	Depth Weep	ing from Pit Depth Stand	ling Water in Hole



City/Town of

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

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-3

Depth (in.)	Soil Horizon/	il Horizon/ Soil Matrix: Color- Layer Moist (Munsell)	Redoximorphic Features		Soil Texture		ragments /olume	Soil Structure	Soil	Other	
Depth (m.)	Layer		Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	
0-8	А	10YR4/4				FSL					
8-32	В	10YR3/6				LS		10%			
32-108	С	10YR3/6	102	7.5YR6/8	2%	LS		10%			Ref.@108"

Additional Notes:

No water noted, no weeping. ESHWT @ 102"

Angular cobbles and fractured rock throughout B & C layers

Refusal @ 108" (Ledge)



City/Town of

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

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	eld, vacant lot, etc.)		Surface Stones (e.g., cob	bles, stones, boulders,	etc.) Slope (%)
		Vegetation		Landform		Position on Landscap	e (SU, SH, BS, FS,
3.	Distances from:	Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material:	:		Unsuita	ble Materials Presen	t: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	ed/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
				,	Depth Weeping from	n Pit Depth S	Standing Water in Hole
	Estimated Dept	h to High Groundwater:					
	-		inches	elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	il Horizon/ Soil Matrix: Color-	Rec	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

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

D. Determination of High Groundwater Elevation

1.	Me	thod Used:			Obs. Hole #	TP-3	Obs. Hole #		
		Depth observed standing	water in observ	ation hole					
		Depth weeping from side of	of observation l	hole	inches		inches		
					inches		inches		
	х	Depth to soil redoximorphi	c features (mo	ottles)	102"				
				inches		inches			
		Depth to adjusted seasonal high groundwater (S_h)							
		(USGS methodology)		inches		inches			
		Index Well Number		Reading Date					
		$S_h = S_c - [S_r \times (OW_c - OW_c)]$							
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	

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?	Upper boundary:		ower boundary:	108
C.	If no, at what depth was impervious material observed?	Upper boundary:	inches Lo	ower boundary:	inches
0.		oppor boundary:	inches	iner seandary:	inches
			*Significant am	ounts fractured i	ock throughout



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator 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.

ature of Soil Evaluator 3799 Typed or Printed Name of Soil Evaluator / License #

Date

Expiration Date of License

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 <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street			Map 2, Lot 5	
	Street Address			Map/Lot #	
	Topsfield		MA	01983	
	City		State	Zip Code	
В.	Site Information				
1.	(Check one) X New Construction	Upgrade	Repair		
2.	Soil Survey Available?	es 🗌 No	If yes: UC Davis Web Soil S	burvey	420B, 421C
			Source		Soil Map Unit
	Canton Fine Sandy Loam		Bedrock		
	Soil Name		Soil Limitations		
	Sandy till		Morraine		
	Geologic/Parent Material		Landform		
3.	Surficial Geological Report Available?	es X No	If yes:		
					Map Unit
4.	Flood Rate Insurance Map				
	Above the 500-year flood boundary? $\boxed{\mathbf{X}}$ Year flood boundary? $\boxed{\mathbf{X}}$ Year flood boundary?	es 🗌 No	Within the 100-year flood boundary FEMA Zone A	/? X Yes	🗌 No
5.	Within a velocity zone?	es 🛛 🗴 No			
6.	Within a Mapped Wetland Area? X	es 🗌 No	MassGIS Wetland Data Layer: $^{ m W}$	Vooded Swamp Wetland Type	Deciduous/Mix
7.	Current Water Resource Conditions (USG	S): June, 2016 Month/Year	Range: 🗌 Above Normal 🗌 I	Normal X Belo	ow Normal
8.	Other references reviewed: N/A				



Commonwealth of Massachusetts City/Town of

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 Observat	ion Hole Number:	TP-4	7/7/2016 Date	8:00AM Time	Overcast, 65 degree Weather	es
1.	Location						
	Ground Elevation	on at Surface of Hole:	73.0 feet	Latit	ude/Longitude	e: 42.664163 / -70.930328	_
	Description of L	ocation: Southw	est corner of p	property			
2.	Land Use	Open field			N/A		3-8%
		(e.g., woodland, agricultural fie Grass	eld, vacant lot, etc.)	Morraine	Surface Stones	(e.g., cobbles, stones, boulders, etc.) $N/A \label{eq:N}$	Slope (%)
		Vegetation		Landform		Position on Landscape (SU, SH, BS,	FS, TS)
3.	Distances from:	Open Water Body	N/A feet	_ Drainage Way	N/A feet	Wetlands	<u>500+ feet</u>
		Property Line	110' feet	_ Drinking Water	Well $\frac{N/A}{feet}$	Other	N/A feet
4.	Parent Material:	Sandy till		Unsuita	able Materials	Present: Yes	X No
	If Yes:	Disturbed Soil	Fill Material	Impervious Layer(s) 🗆 V	Neathered/Fractured Rock	Bedrock
5.	Groundwater O	oserved: <u>x</u> Yes	🗌 No	If yes:	N/A	<u>144"</u>	
	Estimated Dept	h to High Groundwater:	88" inches	65.7 elevation		eping from Pit Depth Standir	ng Water in Hole



City/Town of

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

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-4

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Redoximorphic Features		Soil Texture	Coarse F % by \	ragments /olume	Soil e Consistence	Other	
Deptin (int.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones	(Moist)	Other
0-10	А	10YR3/1				SL				
10-22	В	10YR3/2				SL				
22-80	B/C	10YR5/6				Sand				
80-144	С	10YR5/4	88	7.5YR5/8	5%	F. Sand				Moist

Additional Notes:

Standing water @ 144". ESHWT @ 88" (Some mottling in B/C transition layer - concentrations & depletions)

Concentrations - 5YR5/8, depletions - 10YR6/1

No Refusal.



City/Town of

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

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	eld, vacant lot, etc.)		Surface Stones (e.g., cob	bles, stones, boulders,	etc.) Slope (%)
		Vegetation		Landform		Position on Landscap	e (SU, SH, BS, FS,
3.	Distances from:	Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material:	:		Unsuita	ble Materials Presen	t: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	ed/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
				,	Depth Weeping from	n Pit Depth S	Standing Water in Hole
	Estimated Dept	h to High Groundwater:					
	-		inches	elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	il Horizon/ Soil Matrix: Color-	Rec	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

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

D. Determination of High Groundwater Elevation

1.	Me	thod Used:			Obs. Hole #	TP-4	Obs. Hole #	
		Depth observed standing	water in observ	ation hole				
		Depth weeping from side of	of observation I	hole	inches		inches	
	x	Depth to soil redoximorphi			inches 88"		inches	
	11	- op o oo o			inches		inches	
		Depth to adjusted seasona (USGS methodology)	vater (S _h)	inches		inches		
		Index Well Number		Reading Date				
		$S_h = S_c - [S_r \times (OW_c - OW_c)]$	/ _{max})/OW _r]					
		Obs. Hole # S _c		S _r	OW _c	OW _{max}	OW _r	S _h
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h

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?

b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	144
			inches		inches
c.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator 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.

ature of Soil Evaluator 3799 Typed or Printed Name of Soil Evaluator / License #

Date

Expiration Date of License

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 <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Sarkis Development Company						
	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address					Map/Lot #	
	Topsfield			MA		01983	
	City			State		Zip Code	
B	Site Information						<u> </u>
1.	(Check one) X New Construct	tion	Upgrade		Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil S Source	urvey	420B, 421C Soil Map Unit
	Canton Fine Sandy Loam			Bedroc			Soil Map Unit
	Soil Name			Soil Limita	tions		
	Sandy till			Morra	ine		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?] Yes	x No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary?	Yes	🗌 No		e 100-year flood boundary A Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	Yes	🗌 No	MassGI	S Wetland Data Layer: $^{ m W}$	Vooded Swamp Wetland Type	Deciduous/Mixe
7.	Current Water Resource Conditions (L	JSGS):	June, 2016 Month/Year	Range:	Above Normal	Normal 🛛 Belo	w Normal
8.	Other references reviewed: N/2	A					



Commonwealth of Massachusetts City/Town of

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

C	. On-Site Re	eview (minimum	of two holes red	quired at every pro	posed prin	nary and reserve dispose	al area)
	Deep Observa	tion Hole Number:	TP-5	7/7/2016	8:00AM	Overcast, 65 degr	rees
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole	$\frac{70.0}{\text{feet}}$	Latitu	ude/Longitude	e: 42.664163 / -70.930328	
	Description of L	ocation: Cru		near end of paved di	riveway		
2.	Land Use	Open field			N/A		0-3%
		(e.g., woodland, agricult Grass	ural field, vacant lot, etc.) Morraine	Surface Stones	(e.g., cobbles, stones, boulders, etc N/A	:.) Slope (%)
		Vegetation		Landform		Position on Landscape (SU, SH, B	S, FS, TS)
3.	Distances from	: Open Water E	Body N/A	Drainage Way	N/A	Wetlands	375+ feet
			feet		feet		feet
		Property Line	220' feet	Drinking Water \	Well <u>N/A</u>	Other	N/A feet
4.	Parent Material	: Sandy till		Unsuita	ble Materials	Present: 🗌 Yes	X No
	If Yes:	Disturbed Soil	Fill Material	Impervious Layer(s)		Weathered/Fractured Rock	Bedrock
5.	Groundwater O	bserved: X Yes	s 🗌 No	If yes:	N/A	132"	
5.						eping from Pit Depth Star	nding Water in Hole
	Estimated Dept	h to High Groundwa	ter: 96"	62.0			-
		-	inches	elevation			



City/Town of

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

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-5

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Rec	loximorphic Feat	ures	Soil Texture		ragments /olume		Soil Consistence (Moist)	Other
Depth (in.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones			Other
0-8	А	10YR3/2				SL					
8-34	В	10YR3/1				SL					
34-72	2C1	10YR5/8				M. sand					Moist
72-132	2C2	10YR5/4	96	7.5YR6/8	5%	Sand			Loose, SG		

Additional Notes:

ESHWT @ 96" (5% mottles - concentrations & depletions)

Standing water @ 132" (bottom)

No Refusal, coarse sand layer at 60-70".



City/Town of

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

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	eld, vacant lot, etc.)		Surface Stones (e.g., cob	bles, stones, boulders,	etc.) Slope (%)
		Vegetation		Landform		Position on Landscap	e (SU, SH, BS, FS,
3.	Distances from:	Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material:	:		Unsuita	ble Materials Presen	t: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	ed/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
				,	Depth Weeping from	n Pit Depth S	Standing Water in Hole
	Estimated Dept	h to High Groundwater:					
	-		inches	elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structuro	Soil Consistence	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

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

D. Determination of High Groundwater Elevation

1.	Met	thod Used:			Obs. Hole #	TP-5	Obs. Hole #	
		Depth observed standing	water in observ	ation hole				
		Depth weeping from side of	of observation I	hole	inches		inches	
					inches		inches	
	х	Depth to soil redoximorphi	ic features (mo	ottles)	96"			
					inches		inches	
		Depth to adjusted seasona	al high groundv	vater (S _h)				
		(USGS methodology)			inches		inches	
		Index Well Number		Reading Date				
		$S_{h} = S_{c} - [S_{r} \times (OW_{c} - OW_{c})]$	/ _{max})/OW _r]					
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h

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?

	X Yes No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	132
			inches		inches
C.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator 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.

ature of Soil Evaluator 3799 Typed or Printed Name of Soil Evaluator / License #

Date

Expiration Date of License

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 <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Sarkis Development Company						
	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address					Map/Lot #	
	Topsfield			MA		01983	
	City			State		Zip Code	
B	Site Information						
1.	(Check one) X New Construct	ion	Upgrade	[Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil S Source	urvey	420B, 421C Soil Map Unit
	Canton Fine Sandy Loam			Bedroc			Soli Map Onit
	Soil Name			Soil Limitat	tions		
	Sandy till			Morra	ine		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	Yes	X No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary? X If Yes, continue to #5.	Yes	🗌 No		e 100-year flood boundary A Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	Yes	🗌 No	MassGIS	S Wetland Data Layer: $^{ m W}$	Vooded Swamp I Wetland Type	Deciduous/Mixe
7.	Current Water Resource Conditions (U		June, 2016 Month/Year	Range:	Above Normal	Normal X Belov	w Normal
8.	Other references reviewed: N/A						



Commonwealth of Massachusetts City/Town of

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

C.	. On-Site Revie	W (minimum of t	wo holes req	uired at every pr	oposed pr	imary and reserve o	disposal a	area)
	Deep Observation	Hole Number:	TP-6	7/7/2016	8:00AM	Overcast,	65 degree	S
	•			Date	Time	Weather	C	
1.	Location							
	Ground Elevation at	t Surface of Hole:	70.5	Lati	tude/Longitu	de: 42. <u>664163 / -70.9</u>	930328	_
	Description of Locat	tion: Crushe		ear end of paved of	driveway			
2.		pen field			N/A			0-3%
	_	., woodland, agricultural fie rass	eld, vacant lot, etc.)	Morraine	Surface Stor	les (e.g., cobbles, stones, bol $\mathrm{N/A}$	ulders, etc.)	Slope (%)
	Veg	etation		Landform		Position on Landscape (SU, SH, BS, F	FS, TS)
3.	Distances from:	Open Water Body	N/A feet	_ Drainage Way	<u>N</u> feet			$\underbrace{175+feet}_{feet}$
		Property Line	<u>115'</u> feet	Drinking Water	Well <u>N</u>			N/A feet
4.	Parent Material:	Sandy till		Unsuit	able Materia	als Present:	Yes	X No
	If Yes: Distu	urbed Soil	Fill Material	Impervious Layer(s) 🗌	Weathered/Fractured Ro	ock 🗌	Bedrock
5.	Groundwater Obser	ved: 🗌 Yes	x No	If yes:	N/A		N/A	
				,		Veeping from Pit	Depth Standin	g Water in Hole
	Estimated Depth to	High Groundwater:	92"	62.8				-
	-		inches	elevatio	n			



City/Town of

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

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-6

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Red	loximorphic Feat	ures	Soil Texture	Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Deptin (int.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other
0-8	А	10YR4/3				FSL					
8-28	В	10YR6/6				FSL					
28-72	B/C	10YR3/3				FSL	5%	2%			
72-136	С	10YR3/3	92"	7.5YR6/8	2%	FSL	5%	2%			

Additional Notes:

ESHWT @ 92". No refusal, no weeping, no standing water.

Heavy manganese deposits throughout B/C and C layers, color 10R3/3



City/Town of

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

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	eld, vacant lot, etc.)		Surface Stones (e.g., cob	bles, stones, boulders,	etc.) Slope (%)
		Vegetation		Landform		Position on Landscap	e (SU, SH, BS, FS,
3.	Distances from:	Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material:	:		Unsuita	ble Materials Presen	t: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	ed/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
				,	Depth Weeping from	n Pit Depth S	Standing Water in Hole
	Estimated Dept	h to High Groundwater:					
	-		inches	elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	izon/ Soil Matrix: Color-	Redoximorphic Features		ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

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

D. Determination of High Groundwater Elevation

1.	Met	thod Used:			Obs. Hole #	TP-6	Obs. Hole #		
		Depth observed standing v	water in observ	ation hole					
		Depth weeping from side of	of observation I	hole	inches		inches		
					inches		inches		
	х	Depth to soil redoximorphic features (mottles)			92"				
		Depth to adjusted seasonal high groundwater (S _r (USGS methodology)			inches		inches		
				vater (S _h)					
					inches		inches		
		Index Well Number		Reading Date					
		$S_h = S_c - [S_r \times (OW_c - OW_c)]$	/ _{max})/OW _r]						
		Obs. Hole # S _c S _r		S _r	OW _c	OW _{max}	OW _r	S _h	
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	

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?

	X Yes No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	136
			inches		inches
c.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator 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.

ature of Soil Evaluator 3799 Typed or Printed Name of Soil Evaluator / License #

Date

Expiration Date of License

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 <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



Owner Name 470 Boston Street			Map 2, Lot 5	
Street Address			Map/Lot #	
Topsfield		MA	01983	
City		State	Zip Code	
B. Site Information				
. (Check one) X New Construction	Upgrade	Repair		
2. Soil Survey Available?	es 🗌 No	If yes: UC Davis Web Soil Su	rvey	420B, 421C
		Source	<u> </u>	Soil Map Unit
Canton Fine Sandy Loam		Bedrock		
Soil Name		Soil Limitations		
Sandy till		Morraine		
Geologic/Parent Material		Landform		
8. Surficial Geological Report Available? 🗌 Ye	es <u>x</u> No	If yes:		
				Map Unit
 Flood Rate Insurance Map 				
Above the 500-year flood boundary? $\boxed{\mathbf{x}}$ Ye If Yes, continue to #5.	es 🗌 No	Within the 100-year flood boundary? FEMA Zone A	X Yes	🗌 No
5. Within a velocity zone?	es X No			
6. Within a Mapped Wetland Area? X	es 🗌 No	MassGIS Wetland Data Layer: $^{ m Wo}$	ooded Swamp Wetland Type	Deciduous/Mix
7. Current Water Resource Conditions (USG	S): June, 2016 Month/Year	Range: 🗌 Above Normal 🗌 No	ormal X Belo	ow Normal
3. Other references reviewed: N/A				



City/Town of

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 Observatio	n Hole Number:	TP-7	7/7/2016 Date	8:00AM Time	Overcast, 65 degree	es
1.	Location						
	Ground Elevation	at Surface of Hole:	72.0	Latitu	ide/Longitude	e: 42.664163 / -70.930328	_
	Description of Loc	cation: Woodla	nd area by we	etlands			
2.	Land Use	Woodland			N/A		0-3%
		.g., woodland, agricultural fie Grass	ld, vacant lot, etc.)) Morraine	Surface Stones	σ (e.g., cobbles, stones, boulders, etc.) $$N/A$$	Slope (%)
	V	egetation		Landform		Position on Landscape (SU, SH, BS,	FS, TS)
3.	Distances from:	Open Water Body	N/A feet	Drainage Way	<u>N/A</u> feet	Wetlands	<u>130+ feet</u>
		Property Line	250' feet	Drinking Water \	Vell <u>N/A</u>	Other	N/A feet
4.	Parent Material:	Sandy till		Unsuita	ble Materials	Present: 🗌 Yes	x No
	If Yes: 🗌 Di	sturbed Soil 🛛 🗌 F	Fill Material	Impervious Layer(s)		Weathered/Fractured Rock	Bedrock
5.	Groundwater Obs	erved: 🗌 Yes	x No	If yes:	N/A	N/A	
	Estimated Depth	o High Groundwater:	62" inches	66.8 elevation	Depth we	eping from Pit Depth Standi	ng Water in Hole



City/Town of

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

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-7

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Rec	loximorphic Feat	ures	Soil Texture		ragments /olume		Soil Consistence	Other
Depth (In.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other
0-8	А	10YR3/3				FSL					
8-28	В	10YR5/6				FSL	5%	10%			
28-76	B/C	10YR4/4	62	7.5YR6/8	2%	FSL	5%	15%	Massive, fri.		
76-144	С	10YR4/4				FSL			Massive, fri.		5% cobbles

Additional Notes:

No water noted, no weeping. No refusal.

ESHWT @ 62" (Significant mottling - concentrations, color 7.5YR6/8)



City/Town of

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

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	eld, vacant lot, etc.)		Surface Stones (e.g., cob	bles, stones, boulders,	etc.) Slope (%)
		Vegetation		Landform		Position on Landscap	e (SU, SH, BS, FS,
3.	Distances from:	Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material:	:		Unsuita	ble Materials Presen	t: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	ed/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
				,	Depth Weeping from	n Pit Depth S	Standing Water in Hole
	Estimated Dept	h to High Groundwater:					
	-		inches	elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	izon/ Soil Matrix: Color-	Redoximorphic Features		ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

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

D. Determination of High Groundwater Elevation

1.	Met	thod Used:			Obs. Hole #	TP-7	Obs. Hole #	
		Depth observed standing	water in observ	ation hole				
		Depth weeping from side of	of observation l	hole	inches		inches	
	x	Depth to soil redoximorphic features (mottles)			inches 62"		inches	
	_				inches		inches	
		Depth to adjusted seasona (USGS methodology)	vater (S _h)	inches		inches		
		Index Well Number		Reading Date				
		$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$						
		Obs. Hole # S _c S _r		S _r	OW _c	OW _{max}	OW _r	S _h
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h

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?

b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	144
			inches		inches
c.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator 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.

ature of Soil Evaluator 3799 Typed or Printed Name of Soil Evaluator / License #

Date

Expiration Date of License

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 <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street			Map 2, Lot 5			
	Street Address		Map/Lot #				
	Topsfield			01983			
	City		State Z	lip Code			
В.	Site Information						
1.	(Check one) X New Construction	Upgrade	Repair				
2.	Soil Survey Available? X Yes	🗌 No	If yes: UC Davis Web Soil Sur	vey	420B, 421C		
			Source		Soil Map Unit		
	Canton Fine Sandy Loam		Bedrock				
	Soil Name		Soil Limitations				
	Sandy till		Morraine				
	Geologic/Parent Material		Landform				
3.	Surficial Geological Report Available? Yes	X No	If yes:				
					Map Unit		
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary? \boxed{x} Yes If Yes, continue to #5.	🗌 No	Within the 100-year flood boundary? FEMA Zone A	X Yes	🗌 No		
5.	Within a velocity zone?	X No					
6.	Within a Mapped Wetland Area? X Yes	🗌 No	MassGIS Wetland Data Layer: $^{ m Wot}$	oded Swamp Wetland Type	Deciduous/Mix		
7.	Current Water Resource Conditions (USGS):	June, 2016 Month/Year	Range: 🗌 Above Normal 🗌 No	rmal X Belo	w Normal		
8.	Other references reviewed: N/A						



Commonwealth of Massachusetts City/Town of

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

C.	On-Site Review	w (minimum of tw	vo holes requ	uired at eve	ry propose	ed primary ar	nd reserve o	disposal	area)
	Deep Observation H	lole Number:	TP-8	7/7/2016	8:0	0AM	Overcast,	65 degree	es
	•			Date	Time		Weather	U	
1.	Location								
	Ground Elevation at	Surface of Hole:	68.5	Latitude/Longitude: 42.664163 / -70.930328					_
	Description of Location	on: Norther	n treeline, 50	' back corner	existing ga	arage			
2.	Land Use Op	en field			N/2	A			0-3%
		woodland, agricultural field ass	l, vacant lot, etc.)	Morraine	Surfa	ce Stones (e.g., cob N/A	bles, stones, bo	ulders, etc.)	Slope (%)
	Vegetation			Landform Position on Landscape (SU, SH, BS,				SU, SH, BS,	FS, TS)
3.	Distances from:	Open Water Body	N/A feet	Drainage	Way	N/A feet	Wetlands		$\underset{\text{feet}}{\underline{115+\text{ feet}}}$
		Property Line	<u>275'</u> feet	Drinking \	Water Well	N/A feet	Other		N/A feet
4.	Parent Material:	Sandy till		ι	Insuitable M	laterials Presen	t: 🗌 ר	/es	x No
	If Yes: Distur	bed Soil 🛛 🗌 Fi	Il Material] Impervious L	ayer(s)	U Weathere	d/Fractured R	ock 🗌	Bedrock
5.	Groundwater Observ	ed: X Yes	🗌 No	ľ	yes:	N/A		150"	
0.						Depth Weeping fron	n Pit [Depth Standir	ng Water in Hole
	Estimated Depth to High Groundwater: 108"				59.5				-
	•	in	ches	e	levation				



City/Town of

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

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-8

Depth (in.)	Soil Horizon/ Layer	/ Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence	Other
Depth (m.)			Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	
0-8	А	10YR4/3				LS					
8-18	В	10YR56				LS	5%				
18-45	B/C	10YR5/8				LS	20%				
45-150	С	10YR5/6	108	7.5YR6/8	2%	Fine sand			Loose, SG		

Additional Notes:

ESHWT @ 108", some mottling, concentrations, color 7.5YR6/8

Standing water @ 150"

No Refusal. Well defined transition from LS to fine sand.



City/Town of

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

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation at Surface of Hole:			Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cob	bles, stones, boulders,	etc.) Slope (%)
		Vegetation		Landform		Position on Landscap	e (SU, SH, BS, FS,
3.	Distances from:	Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Presen	t: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material	Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:					
			inches	elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	/ Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		 Soil Structure 	Soil Consistence	Other	
Depth (m.)	Layer		Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Childr

Additional Notes:



City/Town of

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

D. Determination of High Groundwater Elevation

1.	Method Used:				Obs. Hole #	TP-8	Obs. Hole #			
		Depth observed standing	water in observ	ation hole						
		Depth weeping from side of	of observation h	nole	inches		inches			
					inches		inches			
	х] Depth to soil redoximorphic features (mottles)			108"					
					inches		inches			
	Depth to adjusted seasonal high groundwater (S _h)									
		(USGS methodology)		inches		inches				
		Index Well Number		Reading Date	ding Date					
	$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$									
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h		
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h		

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?

	X Yes No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	108
			inches		inches
c.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator 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.

ature of Soil Evaluator 3799 Typed or Printed Name of Soil Evaluator / License #

Date

Expiration Date of License

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 <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



Owner Name 470 Bostor	n Street					Map 2, Lot 5	i i i i i i i i i i i i i i i i i i i	
Street Address				Map/Lot #				
Topsfield				MA		01983		
City				State		Zip Code		
B. Site Info	mation							
1. (Check one)	x New Co	onstruction	Upgrade] Repair			
2. Soil Survey A	vailable?	x Yes	🗌 No	If yes:	UC Davis Web Soil S	urvey	420B, 421C	
, een een een een een een een een een ee				•	Source	<u> </u>	Soil Map Unit	
Canton Fi	ne Sandy Loam			Bedrock				
Soil Name				Soil Limitatio				
Sandy till				Morraii	ne			
Geologic/Parent				Landform				
3. Surficial Geol	ogical Report Availa	ble? 🔄 Yes	x No	If yes:				
							Map Unit	
4. Flood Rate Ir	surance Map							
Above the 500 If Yes, continue)-year flood boundai o #5.	ry? 🗴 Yes	🗌 No		100-year flood boundary Zone A	? X Yes	🗌 No	
5. Within a veloc	ity zone?	Yes	X No					
	ped Wetland Area?	Yes	□ No	MassGIS	Wetland Data Layer: $^{ m W}$	Vooded Swamp Wetland Type	Deciduous/Mix	
7. Current Wate	r Resource Conditi	ons (USGS):	June, 2016 Month/Year	Range:] Above Normal 🗌 N	lormal X Belo	ow Normal	
B. Other referer	ces reviewed:	N/A						



Commonwealth of Massachusetts City/Town of

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

C.	On-Site Review	N (minimum of two	vo holes req	uired at every pro	posed prim	ary and reserve dispos	sal area)		
	Deep Observation H	lole Number:	TP-9	7/7/2016	8:00AM	Overcast, 65 deg	grees		
	·	_		Date	Time	Weather			
1.	Location								
	Ground Elevation at S	Surface of Hole:	70.0	Latitude/Longitude: 42.664163 / -70.930328					
	Description of Location	on: Open fi	eld, proposed	detention basin					
2.	Land Use Op	en field			N/A		0-3%		
	(e.g., v Gra	woodland, agricultural field	d, vacant lot, etc.)	Morraine	Surface Stones (e.g., cobbles, stones, boulders, et N/A	tc.) Slope (%)		
	Vegetation			Landform	BS, FS, TS)				
3.	Distances from:	Open Water Body	N/A feet	Drainage Way	<u>N/A</u> feet	Wetlands	<u>225+ feet</u>		
		Property Line	<u>175'</u> feet	Drinking Water	Well <u>N/A</u>	Other	N/A feet		
4.	Parent Material:	Sandy till		Unsuita	able Materials	Present: 🗌 Yes	x No		
	If Yes: Disturb	bed Soil 🛛 🗌 Fi	II Material	Impervious Layer(s)) 🗆 W	/eathered/Fractured Rock	Bedrock		
5.	Groundwater Observe	ed: 🗌 Yes	x No	If yes:	120"	138"			
0.				n yes.			anding Water in Hole		
	Estimated Depth to H	Estimated Depth to High Groundwater: 96"		62.0	·	'	2		
	incl		nches	elevation					



City/Town of

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

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-9

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Red	loximorphic Feat	ures	Soil Texture		ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other
0-8	А	10YR3/3				LS					
8-32	В	10YR5/4				LS					
32-72	2C1	10YR6/6				Sand					
72-138	2C2	10YR3/6	96	7.5YR6/8	2%	LS	10%				

Additional Notes:

Fractured/weathered rock throughout C layer. Standing water at 138", weeping at 120". ESHWT @ 96" (mottling)

No Refusal.



City/Town of

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

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	eld, vacant lot, etc.)		Surface Stones (e.g., cob	bles, stones, boulders,	etc.) Slope (%)
		Vegetation		Landform		Position on Landscap	e (SU, SH, BS, FS,
3.	Distances from:	Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material:	:		Unsuita	ble Materials Presen	t: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	ed/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
				,	Depth Weeping from	n Pit Depth S	Standing Water in Hole
	Estimated Dept	h to High Groundwater:					
	-		inches	elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

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

D. Determination of High Groundwater Elevation

1.	Me	thod Used:			Obs. Hole #	TP-9	Obs. Hole #		
		Depth observed standing	water in observ	ation hole					
		Dopth waaping from side	of obconvotion l		inches		inches		
		Depth weeping from side of	of observation i	lole	inches		inches		
	х	Depth to soil redoximorphi	ic features (mo	ottles)	96"				
		Depth to adjusted seasonal high groundwater (S_{h})			inches		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 # S _c S _r		S _r	OW _c	OW _{max}	OW _r	S _h	
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	

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?	Upper boundary:	0	Lower boundary:	138
C.	If no, at what depth was impervious material observed?	Upper boundary:	inches	Lower boundary:	inches
			inches		inches
			*Significant a	mounts fractured	rock throughout



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator 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.

ature of Soil Evaluator 3799 Typed or Printed Name of Soil Evaluator / License #

Date

Expiration Date of License

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 <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address					Map/Lot #	
	_ Topsfield			MA		01983	
	City			State		Zip Code	
B	. Site Information						
1.	(Check one) X New Construct	ction	Upgrade] Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil Su	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedrock	Source		Soil Map Unit
	Soil Name			Soil Limitatio			
	Sandy till			Morrai	ne		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	Yes	X No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary?	x Yes	🗌 No		100-year flood boundary Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	x Yes	🗌 No	MassGIS	Wetland Data Layer: $^{ m W}$	ooded Swamp	Deciduous/Mixed
7.	Current Water Resource Conditions (L	JSGS):	Dec, 2016 Month/Year	Range:	Above Normal	lormal X Belo	w Normal
8.	Other references reviewed: N/2	А					



Commonwealth of Massachusetts City/Town of

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

С.	. On-Site Review (minimum of the	vo holes requ	uired at every pro	oposed prim	ary and reserve disposa	l area)
	Deep Observation Hole Number:	TP-10	12/9/2016	7:30AM	Overcast, 35 degr	ees
	•		Date	Time	Weather	
1.	Location					
	Ground Elevation at Surface of Hole:	68.0	Latit	ude/Longitude	42.664163 / -70.930328	
	Description of Location: Northea	st corner exist	ing garage			
2.	Land Use Open field			N/A		0-3%
	(e.g., woodland, agricultural fie Grass	d, vacant lot, etc.)	Morraine	Surface Stones	(e.g., cobbles, stones, boulders, etc. N/A) Slope (%)
	Vegetation		Landform		Position on Landscape (SU, SH, BS	S, FS, TS)
3.	Distances from: Open Water Body	N/A feet	Drainage Way	<u>N/A</u> feet	Wetlands	<u>120+/- feet</u>
	Property Line	150'+/- feet	Drinking Water	Well $\frac{N/A}{feet}$	Other	N/A feet
4.	Parent Material: Sandy till		Unsuit	able Materials	Present: 🗌 Yes	X No
	If Yes: Disturbed Soil F	ill Material] Impervious Layer(s) 🗆 V	/eathered/Fractured Rock	Bedrock
5.	Groundwater Observed: X Yes	🗌 No	If yes:	150"	154"	
0.					ping from Pit Depth Stan	ding Water in Hole
	Estimated Depth to High Groundwater:	150"	55.5		· - ·	-
		nches	elevation	า		



City/Town of

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

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-10

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Red	loximorphic Feat	ures	Soil Texture	Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	other
0-18	А	10YR2/3				SL					
18-28	В	10YR5/6				LS	10%				
28-60	1C	10YR5/6				SL		2%			
60-156	2C	10YR5/6				SL		2%			

Additional Notes:

Water noted at 154", weeping at 150. ESHWT @ 150"

Cobbles and stones throughout B & C layers, no refusal,

layer fine sand at 60-70", no mottling noted.



City/Town of

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

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

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

D. Determination of High Groundwater Elevation

1.	Met	thod Used:			Obs. Hole #	TP-10	Obs. Hole #	
		Depth observed standing v	water in observ	ation hole	154			
		Depth weeping from side of	of observation h	nole	inches 150		inches	
		Depth to soil redoximorphi	c features (mc	ottles)	inches		inches	
		Depth to adjusted seasonal high groundwater ($S_{\rm c}$)			inches		inches	
		Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)			inches		inches	
		Index Well Number		Reading Date				
		$S_h = S_c - [S_r \times (OW_c - OW_c)]$	/ _{max})/OW _r]					
		Obs. Hole # S _c S _r			OW _c	OW _{max}	OW _r	S _h
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h

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?

b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	156
			inches		inches
c.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator 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.

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Date

Expiration Date of License

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 <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address					Map/Lot #	
	_ Topsfield			MA		01983	
	City			State		Zip Code	
B	. Site Information						
1.	(Check one) X New Construct	ction	Upgrade] Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil Su	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedrock	Source		Soil Map Unit
	Soil Name			Soil Limitatio			
	Sandy till			Morrai	ne		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	Yes	X No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary?	x Yes	🗌 No		100-year flood boundary Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	x Yes	🗌 No	MassGIS	Wetland Data Layer: $^{ m W}$	ooded Swamp	Deciduous/Mixed
7.	Current Water Resource Conditions (L	JSGS):	Dec, 2016 Month/Year	Range:	Above Normal	lormal X Belo	w Normal
8.	Other references reviewed: N/2	А					



Commonwealth of Massachusetts City/Town of

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

C.	. On-Site Re	eview (minimum of t	wo holes requ	uired at every pro	oposed prim	ary and reserve dispos	sal area)
	Deep Observa	tion Hole Number:	TP-11	12/9/2016	8:00AM	Overcast, 35 deg	grees
	•			Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	69.0	Latit	ude/Longitude	42.664163 / -70.930328	
	Description of L	_ocation:SouthW	est corner exis	sting garage			
2.	Land Use	Open field			N/A		0-3%
		(e.g., woodland, agricultural fie Grass	eld, vacant lot, etc.)	Morraine	Surface Stones	(e.g., cobbles, stones, boulders, e N/A	stc.) Slope (%)
		Vegetation		Landform		Position on Landscape (SU, SH,	BS, FS, TS)
3.	Distances from	: Open Water Body	N/A feet	_ Drainage Way	<u>N/A</u> feet	Wetlands	$\frac{120 + - feet}{feet}$
		Property Line	150'+/- feet	Drinking Water	Well <u>N/A</u>	Other	N/A feet
4.	Parent Material	: Sandy till		Unsuita	able Materials	Present: 🗌 Yes	X No
	If Yes:	Disturbed Soil	-ill Material] Impervious Layer(s)) 🗆 🛛	/eathered/Fractured Rock	Bedrock
5.	Groundwater O	bserved: x Yes	🗌 No	If yes:	156"	174"	
••						ping from Pit Depth Sta	anding Water in Hole
	Estimated Dept	th to High Groundwater:	156"	56.0			
			inches	elevation	1		



City/Town of

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

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-11

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Redoximorphic Features		ures	Soil Texture		ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other
0-12	А	10YR2/3				SL					
12-36	B1	10YR5/4				LS					
36-66	B2	10YR5/6				Coarse sand	10-15%		Loose, SG		
66-120	1C	10YR5/8				Sand			Loose, SG		
120-180	2C	10YR5/8				LS					

Additional Notes:

Standing Water noted at 174", weeping at 156. ESHWT

@ 156", no refusal, no mottling noted.



City/Town of

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

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	zon/ Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

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

D. Determination of High Groundwater Elevation

1.	Me	thod Used:			Obs. Hole #	TP-11	Obs. Hole #	
		Depth observed standing	vater in observ	ation hole	174			
		Depth weeping from side of	of observation h	hole	inches 156		inches	
		Depth to soil redoximorphi	c features (mo	ottles)	inches		inches	
		Depth to adjusted seasona	al high groundw	vater (S _b)	inches		inches	
		(USGS methodology)	0 0		inches		inches	
		Index Well Number		Reading Date				
		$S_{h} = S_{c} - [S_{r} \times (OW_{c} - OW)]$	_{max})/OW _r]					
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h

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?

	X Yes No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	180
			inches		inches
c.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator 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.

ature of Soil Evaluator Typed or Printed Name of Soil Evaluator /

Date

Expiration Date of License

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 <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address					Map/Lot #	
	_ Topsfield			MA		01983	
	City			State		Zip Code	
B	. Site Information						
1.	(Check one) X New Construct	ction	Upgrade] Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil Su	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedrock	Source		Soil Map Unit
	Soil Name			Soil Limitatio			
	Sandy till			Morrai	ne		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	Yes	X No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary?	x Yes	🗌 No		100-year flood boundary Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	x Yes	🗌 No	MassGIS	Wetland Data Layer: $^{ m W}$	ooded Swamp	Deciduous/Mixed
7.	Current Water Resource Conditions (L	JSGS):	Dec, 2016 Month/Year	Range:	Above Normal	lormal X Belo	w Normal
8.	Other references reviewed: N/2	А					



Commonwealth of Massachusetts City/Town of

Estimated Depth to High Groundwater:

144''

inches

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

С	. On-Site Review (minimum of	two holes re	equired at every	proposed primary	/ and reserve disposal area)
	Deep Observation Hole Number:	TP-12	12/9/2016	8:30AM	Overcast, 35 degrees
			Date	Time	Weather
1.	Location				
		(0.0	_		C(41(2), 70, 020220)

	Ground Elevation	on at Surface of	Hole:	68.0	Latitu	ide/Longitude	+42.664163 / -/0.9	30328	
	Description of L	ocation:	North w	vest corner pr	oposed UIS-2, alor	ng treeline			
2.	Land Use	Open field				N/A			0-3%
		(e.g., woodland, as Grass	gricultural field	, vacant lot, etc.)	Morraine	Surface Stones	(e.g., cobbles, stones, bou N/A	Ilders, etc.)	Slope (%)
		Vegetation			Landform		Position on Landscape (S	U, SH, BS, F	S, TS)
3.	Distances from	Open Wa	ater Body	N/A feet	Drainage Way	<u>N/A</u> feet	Wetlands		$\frac{100 + - feet}{feet}$
		Property	Line	300'+/-	Drinking Water \	Well <u>N/A</u>	Other		N/A feet
4.	Parent Material	: Sandy t	ill		Unsuita	ble Materials	Present: Y	′es	X No
	If Yes:	Disturbed Soil	🗌 Fil	I Material] Impervious Layer(s)	□ v	Veathered/Fractured Rc	ock	Bedrock
5.	Groundwater O	bserved: X	Yes	🗌 No	If yes:	144"		158"	
					•	Depth Wee	eping from Pit D	epth Standing	g Water in Hole

56.0

elevation



City/Town of

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

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-12

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Red	loximorphic Feat	ures	Soil Texture	Coarse F % by \	Fragments Volume	Soil Structure	Soil	Other	
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other	
0-6	A	10YR2/3				SL						
6-26	Bw	10YR5/4				LS	5-7%					
26786	1C	10YR5/6				Med. sand			Loose, SG		Boulder boundar	-
78-162	2C	10YR5/8				Sand					Angular	cobbles

Additional Notes:

Standing Water noted at 158", weeping at 144.

ESHWT @ 144", no refusal, very little/no mottling

noted. Some fractured ledge at 160", easily broken up.



City/Town of

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

C. On-Site Review (continued)

	Deep Observation	n Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
	(e.	g., woodland, agricultural fi	eld, vacant lot, etc.)		Surface Stones (e.g., cobl	bles, stones, boulders,	etc.) Slope (%)
	Ve	getation		Landform		Position on Landscap	e (SU, SH, BS, FS,
3.	Distances from:	Open Water Body		Drainage Way		Wetlands	
			feet	_ • •	feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material:			Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes: 🗌 Dis	sturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater Obse	erved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Depth to	b High Groundwater:					
			inches	elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	il Horizon/ Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

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

D. Determination of High Groundwater Elevation

1.	Metho	od Used:			Obs. Hole #	TP-12	Obs. Hole #		
	De	epth observed standing v	vater in observ	ation hole	158				
	De	epth weeping from side o	of observation h	nole	inches 144		inches		
	De	epth to soil redoximorphic	c features (mo	ttles)	inches		inches		
		Depth to adjusted seasonal high groundwater (S _h)			inches		inches		
	(U	JSGS methodology)		inches		inches			
		Index Well Number		Reading Date					
	Sh	$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$							
	O	Obs. Hole # S _c S _r			OW _c	OW _{max}	OW _r	S _h	
	O	Obs. Hole # S _c S _r			OW _c	OW _{max}	OW _r	S _h	

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?

	X Yes No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	162
			inches		inches
c.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator Certification

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Date

Expiration Date of License

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Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address					Map/Lot #	
	_ Topsfield			MA		01983	
	City			State		Zip Code	
B	. Site Information						
1.	(Check one) X New Constru-	ction	Upgrade	Γ	Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil S	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedrock	Source		Soil Map Unit
	Soil Name			Soil Limitati			
	Sandy till			Morrai	ne		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	Yes	X No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary? [If Yes, continue to #5.	x Yes	🗌 No		e 100-year flood boundary A Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	x Yes	🗌 No	MassGIS	Wetland Data Layer: $^{\mathrm{W}}$	ooded Swamp	Deciduous/Mixed
7.	Current Water Resource Conditions (USGS):	Dec, 2016 Month/Year	Range:	Above Normal	lormal 🛛 Belo	w Normal
8.	Other references reviewed: N/	А					



City/Town of

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 Observat	ion Hole Number:	TP-13	12/9/2016 Date	9:30AM Time	Overcast, 35 degree Weather	25
1.	Location						
	Ground Elevation	on at Surface of Hole:	72.5	Latit	ude/Longitude	e: 42.664163 / -70.930328	_
	Description of L	ocation: South	east corner (Se	e Test Pits Plan, T	PP-1)		
2.	Land Use	Open field			N/A		3-8%
		(e.g., woodland, agricultural field Grass	eld, vacant lot, etc.)	Morraine	Surface Stones	s (e.g., cobbles, stones, boulders, etc.) N/A	Slope (%)
		Vegetation		Landform		Position on Landscape (SU, SH, BS, I	FS, TS)
3.	Distances from:	Open Water Body	N/A feet	_ Drainage Way	<u>N/A</u> feet	Wetlands	$\frac{450 + - feet}{feet}$
		Property Line	100'+/	_ Drinking Water	Well <u>N/A</u>	Other	N/A feet
4.	Parent Material:	Sandy till		Unsuit	able Materials	s Present: 🗌 Yes	X No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s) 🗆 '	Weathered/Fractured Rock	Bedrock
5.	Groundwater Ol	bserved: x Yes	🗌 No	If yes:	100"	122"	
			_	,	Depth We	eeping from Pit Depth Standir	ng Water in Hole
	Estimated Dept	h to High Groundwater:	122"	62.3		-	
			inches	elevation	ו		



City/Town of

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

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-13

Depth (in.)	Soil Horizon/	Soil Matrix: Color- Moist (Munsell)			Soil Texture	Coarse F % by \	ragments /olume		Soil	Other	I	
Depth (m.)	Layer		Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones	Soil Structure	(Moist)		I
0-10	А	10YR2/3				FSL						I
10-40	Bw	10YR5/4				FSL						I
40-132	С	10YR5/6				FSL		2%	Massive, fri	able	Some frac	tured
											ledge	I
												I
												I
												I

Additional Notes:

Standing Water noted at 122", weeping at 100. ESHWT @ 100", no

refusal, very little/no mottling noted. Some fractured ledge in C

horizon, easily broken up.



City/Town of

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

C. On-Site Review (continued)

	Deep Observation	n Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
	(e.	g., woodland, agricultural fi	eld, vacant lot, etc.)		Surface Stones (e.g., cobl	bles, stones, boulders,	etc.) Slope (%)
	Ve	getation		Landform		Position on Landscap	e (SU, SH, BS, FS,
3.	Distances from:	Open Water Body		Drainage Way		Wetlands	
			feet	_ • •	feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material:			Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes: 🗌 Dis	sturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater Obse	erved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Depth to	b High Groundwater:					
			inches	elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	il Horizon/ Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

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

D. Determination of High Groundwater Elevation

1.	Met	thod Used:			Obs. Hole #	TP-13	Obs. Hole #		
		Depth observed standing	water in observ	ation hole	122				
		Depth weeping from side of	of observation I	nole	inches 100		inches		
		Depth to soil redoximorphi	c features (mo	ottles)	inches		inches		
	_				inches		inches		
		Depth to adjusted seasona (USGS methodology)	vater (S _h)	inches		inches			
		Index Well Number		Reading Date					
		$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$							
		Obs. Hole #	S _r	OW _c	OW _{max}	OW _r	S _h		
		Obs. Hole # Sc Sr Sr			OW _c	OW _{max}	OW _r	S _h	

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?

	X Yes No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	132
			inches		inches
c.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator 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.

ature of Soil Evaluator Typed or Printed Name of Soil Evaluator /

Date

Expiration Date of License

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 <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address					Map/Lot #	
	_ Topsfield			MA		01983	
	City			State		Zip Code	
B	. Site Information						
1.	(Check one) X New Construct	ction	Upgrade] Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil Su	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedrock	Source		Soil Map Unit
	Soil Name			Soil Limitatio			
	Sandy till			Morrai	ne		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	Yes	X No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary?	x Yes	🗌 No		100-year flood boundary Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	x Yes	🗌 No	MassGIS	Wetland Data Layer: $^{ m W}$	ooded Swamp	Deciduous/Mixed
7.	Current Water Resource Conditions (L	JSGS):	Dec, 2016 Month/Year	Range:	Above Normal	lormal X Belo	w Normal
8.	Other references reviewed: N/2	А					



City/Town of

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 Observa	tion Hole Number:	TP-14	12/9/2016 Date	10:30AM Time	Overcast, 35 degree Weather	28
1.	Location						
	Ground Elevation	on at Surface of Hole:	72.5	Latit	ude/Longitude	e: 42.664163 / -70.930328	_
	Description of L	ocation: South	ern corner (Se	e Test Pits Plan, TI	PP-1)		
2.	Land Use	Open field			N/A		3-8%
		(e.g., woodland, agricultural fi $$Grass$$	eld, vacant lot, etc.)	Morraine	Surface Stones	(e.g., cobbles, stones, boulders, etc.)	Slope (%)
~		Vegetation	N/A	Landform		Position on Landscape (SU, SH, BS, F	
3.	Distances from:	Open Water Body	feet	_ Drainage Way	<u>N/A</u> feet	Wetlands	$\frac{430+-\text{feet}}{\text{feet}}$
		Property Line	125'+/	- Drinking Water	Well <u>N/A</u>	Other	N/A feet
4.	Parent Material	Sandy till		Unsuit	able Materials	Present: Yes	X No
	If Yes:	Disturbed Soil	Fill Material	Impervious Layer(s) 🗆 '	Neathered/Fractured Rock	Bedrock
5.	Groundwater O	bserved: <u>x</u> Yes	🗌 No	If yes:	118"	122"	
	Estimated Dept	h to High Groundwater:	122" inches	62.7 elevation		eping from Pit Depth Standin	g Water in Hole



City/Town of

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

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-14

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume			Soil Consistence	Other
Depth (m.)			Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other
0-12	А	10YR2/3				LS					
12-36	Bw	10YR5/4				LS					
36-132	С	10YR5/6				FSL		2%	Massive, fri	able	

Additional Notes:

Standing Water noted at 122", weeping at 118. ESHWT @ 118",

no refusal, very little/no mottling noted.



City/Town of

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

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	Soil Matrix: Color- Moist (Munsell)	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structuro	Soil Consistence	Other
Depth (m.)	Layer		Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

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

D. Determination of High Groundwater Elevation

1.	Me	thod Used:			Obs. Hole #	TP-14	Obs. Hole #	
		Depth observed standing	water in observ	ation hole	122			
		Depth weeping from side of	of observation h	nole	inches 118		inches	
		Depth to soil redoximorphi	c features (mo	ottles)	inches		inches	
		Depth to adjusted seasona	al high groundw	$vator(S_{i})$	inches		inches	
		(USGS methodology)	a nign grounuw	valer (O _h)	inches		inches	
		Index Well Number		Reading Date				
		$S_h = S_c - [S_r \times (OW_c - OW_c)]$	/ _{max})/OW _r]					
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h

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?

	X Yes No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	132
			inches		inches
C.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator 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.

ature of Soil Evaluator Typed or Printed Name of Soil Evaluator /

Date

Expiration Date of License

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 <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address					Map/Lot #	
	_ Topsfield			MA		01983	
	City			State		Zip Code	
B	. Site Information						
1.	(Check one) X New Construct	ction	Upgrade] Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil Su	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedrock	Source		Soil Map Unit
	Soil Name			Soil Limitatio			
	Sandy till			Morrai	ne		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	Yes	X No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary?	x Yes	🗌 No		100-year flood boundary Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	x Yes	🗌 No	MassGIS	Wetland Data Layer: $^{ m W}$	ooded Swamp	Deciduous/Mixed
7.	Current Water Resource Conditions (L	JSGS):	Dec, 2016 Month/Year	Range:	Above Normal	lormal X Belo	w Normal
8.	Other references reviewed: N/2	А					



City/Town of

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 at	rea)
--	------

	Deep Observa	tion Hole Number:	TP-15	12/9/2016 Date	11:00AM Time	Overcast, 35 degr Weather	ees
1.	Location						
	Ground Elevation	on at Surface of Hole:	72.2	Lat	itude/Longitud	e: 42.664163 / -70.930328	
	Description of L	ocation: South	ern corner (See	e Test Pits Plan, T	'PP-1)		
2.	Land Use	Open field			N/A		3-8%
		(e.g., woodland, agricultural fie Grass	eld, vacant lot, etc.)	Morraine	Surface Stones	s (e.g., cobbles, stones, boulders, etc. N/A) Slope (%)
		Vegetation		Landform		Position on Landscape (SU, SH, BS	S, FS, TS)
3.	Distances from	Open Water Body	N/A feet	_ Drainage Way	<u>N/A</u> feet	A Wetlands	<u>300+/- feet</u>
		Property Line	125'+/	- Drinking Wate	r Well <u>N/A</u>	A Other	N/A feet
4.	Parent Material	: Sandy till		Unsui	itable Materials	s Present: 🗌 Yes	X No
	If Yes:	Disturbed Soil	Fill Material	Impervious Layer((s)	Weathered/Fractured Rock	Bedrock
5.	Groundwater O	bserved: x Yes	🗌 No	If yes:	: 120"	136"	
-				j		eeping from Pit Depth Stan	ding Water in Hole
	Estimated Dept	h to High Groundwater:	120	62.2			-
		-	inches	elevatio	on	_	



City/Town of

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

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-15

Depth (in.)	Soil Horizon/	/ Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture	Coarse Fragments % by Volume		Soil Structure	Soil Consistence	Other	
Depth (m.)	Layer		Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other	
0-12	А	10YR2/3				FSL						
12-40	Bw	10YR5/4				FSL						
40-140	С	10YR5/6				SL		5%	Massive, fri	able	Angular	cobbles

Additional Notes:

Standing Water noted at 136", weeping at 120. ESHWT @ 120", partial refusal west

side of pit @116", mottling noted below weep line. Some fine materials in C layer.

Some angular cobbles in C layer (~5%)



City/Town of

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

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

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

D. Determination of High Groundwater Elevation

1.	Me	thod Used:			Obs. Hole #	TP-15	Obs. Hole #		
		Depth observed standing	water in observ	ation hole	136				
		Depth weeping from side of	of observation I	nole	inches 120		inches		
		Depth to soil redoximorphi	ottles)	inches		inches			
		Depth to adjusted seasona	vater (S _h)	inches		inches			
		(USGS methodology)		inches			inches		
		Index Well Number		Reading Date					
		$S_{h} = S_{c} - [S_{r} \times (OW_{c} - OW_{c})]$	/ _{max})/OW _r]						
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	

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?

	X Yes No				
b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	140
			inches		inches
C.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator 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.

ature of Soil Evaluator Typed or Printed Name of Soil Evaluator /

Date

Expiration Date of License

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 <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address					Map/Lot #	
	_ Topsfield			MA		01983	
	City			State		Zip Code	
B	. Site Information						
1.	(Check one) X New Construct	ction	Upgrade] Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil Su	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedrock	Source		Soil Map Unit
	Soil Name			Soil Limitatio			
	Sandy till			Morrai	ne		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	Yes	X No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary?	x Yes	🗌 No		100-year flood boundary Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	x Yes	🗌 No	MassGIS	Wetland Data Layer: $^{ m W}$	ooded Swamp	Deciduous/Mixed
7.	Current Water Resource Conditions (L	JSGS):	Dec, 2016 Month/Year	Range:	Above Normal	lormal X Belo	w Normal
8.	Other references reviewed: N/2	А					



City/Town of

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 Observat	tion Hole Number:	TP-16	12/9/2016 Date	11:30AM Time	Overcast, 35 degree	S
1.	Location						
	Ground Elevation	on at Surface of Hole:	68.0	Latit	ude/Longitude	e: 42.664163 / -70.930328	_
	Description of L	ocation: Cente	r of site (See T	est Pits Plan, TPP-	1)		
2.	Land Use	Open field			N/A		0-3%
		(e.g., woodland, agricultural finder Grass	eld, vacant lot, etc.)	Morraine	Surface Stones	s (e.g., cobbles, stones, boulders, etc.) N/A	Slope (%)
3.	Distances from:	Vegetation Open Water Body	N/A feet	Landform _ Drainage Way	<u>N/A</u> feet	Position on Landscape (SU, SH, BS, F Wetlands	⁻ S, TS) <u>200+/- feet</u> feet
		Property Line	$\frac{180'+/}{\text{feet}}$	Drinking Water	Well <u>N/A</u> feet	Conter	N/A feet
4.	Parent Material	Sandy till		Unsuit	able Materials	s Present: Yes	X No
	If Yes:	Disturbed Soil	Fill Material	Impervious Layer(s	s) 🗌 V	Weathered/Fractured Rock	Bedrock
5.	Groundwater O	bserved: <u>x</u> Yes	🗌 No	If yes:	120"	128"	
	Estimated Dept	h to High Groundwater:	120 inches	58.0 elevatio		eeping from Pit Depth Standin	g Water in Hole



City/Town of

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

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-16	
-------	--

Depth (in.)		n/ Soil Matrix: Color-	Rec	loximorphic Feat	ures	Soil Texture % by Volume		ragments /olume	Soil Structure	Soil Consistence	e Other	
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)		
0-18	A	10YR2/3				FSL						
18-24	Bw	10YR5/4				FSL						_
24-60	1C	10YR5/6				Sand						_
60-138	2C	10YR5/6				SL		5%			Angular	cobbles

Additional Notes:

Standing Water noted at 128", weeping at 120. ESHWT @ 120", refusal @

138" (bedrock), Some angular cobbles in C layer (~5%)



City/Town of

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

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cobl	oles, stones, boulders, o	etc.) Slope (%)
		Vegetation		Landform		Position on Landscape	e (SU, SH, BS, FS,
3.	Distances from:	: Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Present	:: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material [Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:	inches	elevation			
				elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	Soil Matrix: Color-	Rec	loximorphic Featu	ures		Coarse F % by \	ragments /olume	Soil Structure	Soil	Other
Depth (m.)	Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

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

D. Determination of High Groundwater Elevation

1.	Me	thod Used:			Obs. Hole #	TP-16	Obs. Hole #		
		Depth observed standing	water in observ	ation hole	128				
		Depth weeping from side of	of observation h	hole	inches 120		inches		
		Depth to soil redoximorphic features (mottles)			inches		inches		
		Depth to adjusted seasona	vater (S⊾)	inches		inches			
		(USGS methodology)		inches					
		Index Well Number		Reading Date					
		$S_{h} = S_{c} - [S_{r} \times (OW_{c} - OW)]$	/oW _r]						
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	

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?

b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	138
			inches		inches
c.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator 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.

ature of Soil Evaluator Typed or Printed Name of Soil Evaluator /

Date

Expiration Date of License

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 <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"



	Owner Name 470 Boston Street					Map 2, Lot 5	
	Street Address					Map/Lot #	
	_ Topsfield			MA		01983	
	City			State		Zip Code	
B	. Site Information						
1.	(Check one) X New Constru-	ction	Upgrade	Γ	Repair		
2.	Soil Survey Available?	Yes	🗌 No	If yes:	UC Davis Web Soil S	urvey	420B, 421C
	Canton Fine Sandy Loam			Bedrock	Source		Soil Map Unit
	Soil Name			Soil Limitati			
	Sandy till			Morrai	ne		
	Geologic/Parent Material			Landform			
3.	Surficial Geological Report Available?	Yes	X No	If yes:			Map Unit
4.	Flood Rate Insurance Map						
	Above the 500-year flood boundary? [If Yes, continue to #5.	x Yes	🗌 No		e 100-year flood boundary A Zone A	? X Yes	🗌 No
5.	Within a velocity zone?	Yes	X No				
6.	Within a Mapped Wetland Area?	x Yes	🗌 No	MassGIS	Wetland Data Layer: $^{\mathrm{W}}$	ooded Swamp	Deciduous/Mixed
7.	Current Water Resource Conditions (USGS):	Dec, 2016 Month/Year	Range:	Above Normal	lormal 🛛 Belo	w Normal
8.	Other references reviewed: N/	А					



Commonwealth of Massachusetts City/Town of

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: <u>TP-17</u> <u>12/9/2016</u> <u>12:30AM</u> <u>Overcast, 35 degrees</u> <u>Time</u> <u>Weather</u>

	-	D		ime	weather	
1.	Location					
	Ground Elevation at Surface of Hole:	69.5	Latitude	e/Longitude: 42	.664163 / -70.930328	3
	Description of Location: Souther	n corner of exi	sting garage (See T	est Pits Plan, T	TPP-1)	
2.	Land Use Open field		1	N/A		0-3%
	(e.g., woodland, agricultural field Grass		Morraine	urface Stones (e.g., N	etc.) Slope (%)	
	Vegetation	La	andform	Pos	ition on Landscape (SU, SH	BS, FS, TS)
3.	Distances from: Open Water Body	N/A feet	Drainage Way	<u>N/A</u> feet	Wetlands	<u>150+/- feet</u>
	Property Line	$\frac{160'+/-}{\text{feet}}$	Drinking Water We		Other	<u>N/A</u> feet
4.	Parent Material: Sandy till		Unsuitabl	e Materials Pre	sent: 🗌 Yes	X No
	If Yes: Disturbed Soil Fil	l Material	Impervious Layer(s)	🗌 Weatl	nered/Fractured Rock	Bedrock
5.	Groundwater Observed: X Yes	🗌 No	If yes:	156" Depth Weeping	from Pit Dopth S	tanding Water in Hole
	· · · · ·	156 ches	56.5 elevation			



City/Town of

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

C. On-Site Review (continued)

Deep Observation Hole Number:

TP-17

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-	Redoximorphic Features		Soil Texture	Coarse Fragments % by Volume		Soil Consistence	Other		
Depth (m.)		Layer	Moist (Munsell)	Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones	(Moist)	Other
0-20	A	10YR2/1				LS				Heavily p	lowed
20-36	Bw	10YR5/8				SL					
36-60	1C	10YR5/6				Med. Sand		5%		Some coa	rse sand
60-168	2C	10YR5/6				SL				Angular	cobbles
										manganes	e deposits

Additional Notes:

Standing Water noted at 166", weeping at 156. ESHWT @ 156", refusal

@ 168" (bedrock), Some angular cobbles in 1C layer (~5%)



City/Town of

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

C. On-Site Review (continued)

	Deep Observat	tion Hole Number:					
				Date	Time	Weather	
1.	Location						
	Ground Elevation	on at Surface of Hole:	eet	Latitude/	Longitude:	/	
2.	Land Use						
		(e.g., woodland, agricultural f	ield, vacant lot, etc.)		Surface Stones (e.g., cob	bles, stones, boulders,	etc.) Slope (%)
		Vegetation		Landform		Position on Landscap	e (SU, SH, BS, FS,
3.	Distances from:	Open Water Body		Drainage Way		Wetlands	
			feet		feet		feet
		Property Line		Drinking Water	Well	Other	
			feet		feet		feet
4.	Parent Material	:		Unsuita	ble Materials Presen	t: 🗌 Yes	🗌 No
	If Yes:	Disturbed Soil	Fill Material	Impervious Layer(s)	U Weathere	d/Fractured Rock	Bedrock
5.	Groundwater O	bserved: 🗌 Yes	🗌 No	If yes:			
					Depth Weeping from	Pit Depth S	tanding Water in Hole
	Estimated Dept	h to High Groundwater:					
			inches	elevation			



C. On-Site Review (continued)

Deep Observation Hole Number:

Depth (in.)	Soil Horizon/	orizon/ Soil Matrix: Color- ver Moist (Munsell)	Redoximorphic Features				Coarse Fragments % by Volume		Soil Structuro	Soil Consistence	Other
Depth (m.)	Layer		Depth	Color	Percent	(USDA)	Gravel	Cobbles & Stones		(Moist)	Other

Additional Notes:



City/Town of

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

D. Determination of High Groundwater Elevation

1.	Me	thod Used:			Obs. Hole #	TP-17	Obs. Hole #		
		Depth observed standing	water in observ	ation hole	166				
		Depth weeping from side of	of observation h	nole	inches 156		inches		
		Depth to soil redoximorphi	c features (mo	ottles)	inches		inches		
	_			(-)	inches		inches		
		Depth to adjusted seasona (USGS methodology)	dwater (S _h) inches			inches			
		Index Well Number		Reading Date					
		$S_h = S_c - [S_r \times (OW_c - OW_c)]$	/ _{max})/OW _r]						
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	
		Obs. Hole #	S _c	S _r	OW _c	OW _{max}	OW _r	S _h	

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?

b.	If yes, at what depth was it observed?	Upper boundary:	0	Lower boundary:	166
			inches		inches
C.	If no, at what depth was impervious material observed?	Upper boundary:		Lower boundary:	
			inches		inches



F. Board of Health Witness

Name of Board of Health Witness

Board of Health

G. Soil Evaluator 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.

ature of Soil Evaluator Typed or Printed Name of Soil Evaluator /

Date

Expiration Date of License

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 <u>Percolation Test Form 12</u>.



Field Diagrams

Use this sheet for field diagrams:

See attached Sketch, "Test Pit Locations Plan, TPP-1"

F-1. Rainfall Data for Massachusetts from *Rainfall Frequency Atlas of the United States* (TP-40)

Users of this Handbook should note that current MA DEP written guidance (see DEP Waterlines newsletter -- Fall 2000) requires the use of TP-40 Rainfall Data for calculations under the Wetlands Protection Regulations and the Stormwater Management Policy. More stringent design storms may be used under a local bylaw or ordinance. However, DEP will continue to require the use of TP-40 in any case it reviews under the Wetlands Protection Act and Stormwater Management Policy.

County Name	1-yr 24-hr	2-yr 24-hr	5-yr 24-hr	10-yr 24-hr	25-yr 24-hr	50-yr 24-hr	100-yr 24-hr
Barnstable	2.5	3.6	4.5	4.8	5.7	6.4	7.1
Berkshire	2.5	2.9	3.8	4.4	5.1	5.9	6.4
Bristol	2.5	3.4	4.3	4.8	5.6	6.3	7.0
Dukes	2.5	3.6	4.6	4.9	5.8	6.5	7.2
Essex	2.5	3.1	3.9	4.5	5.4	5.9	6.5
Franklin	2.5	2.9	3.8	4.3	5.1	5.8	6.2
Hampden	2.5	3.0	4.0	4.6	5.3	6.0	6.5
Hampshire	2.5	3.0	3.9	4.5	5.2	5.9	6.4
Middlesex	2.5	3.1	4.0	4.5	5.3	5.9	6.5
Nantucket	2.5	3.6	4.6	4.9	5.8	6.5	7.2
Norfolk	2.5	3.2	4.1	4.7	5.5	6.1	6.7
Plymouth	2.5	3.4	4.3	4.7	5.6	6.2	7.0
Suffolk	2.5	3.2	4.0	4.6	5.5	6.0	6.6
Worcester	2.5	3.0	4.0	4.5	5.3	5.9	6.5

Adjusted Technical Paper 40 Design Storms for 24-hour Event by County

Conduit	Manning's Coefficients
Closed Conduits	
Asbestos-Cement Pipe	0.011 to 0.015
Brick	0.013 to 0.017
Cast Iron Pipe	
Cement-lined and seal-coated	0.011 to 0.015
Concrete (Monolithic)	
Smooth forms	0.012 to 0.014
Rough forms	0.015 to 0.017
Concrete Pipe	0.011 to 0.015
Corrugated-Metal Pipe (1/2 - STUL 34470 2 1/2-inch corrgtn.)	
Plain	0.022 to 0.026
Paved invert	0.018 to 0.022
Spun asphalt-lined	0.011 to 0.015
Plastic Pipe (Smooth)	0.011 to 0.015
Vitrified Clay	
Pipes	0.011 to 0.015
Liner channels	0.013 to 0.017
Open Channels	
Lined Channels	
Asphalt	0.013 to 0.017
Brick	0.012 to 0.018
Concrete	0.011 to 0.020
Rubble or riprap	0.020 to 0.035
Vegetal	0.030 to 0.040
Excavated or Dredged	
Earth, straight and uniform	0.020 to 0.030
Earth, winding, fairly uniform	0.025 to 0.040
Rock	0.030 to 0.045
Unmaintained	0.050 to 0.140
Natural Channels (minor streams, top width at flood state < 100 feet)	
Fairly regular section	0.030 to 0.070
Irregular section with pools	0.040 to 0.100

Manning's Roughness Coefficients ("n")

- .

1





Detailed Stormceptor Sizing Report – Rolling Green EHD - 470 Boston Street

	Project Information & Location			
Project Name	470 Boston Street EHD	Project Number 2165-01A		
City	Topsfield	State/ Province Massachusetts		
Country	United States of America	Date 9/26/2016		
Designer Information	1	EOR Information (optional)		
Name	Dave Robinson	Name		
Company	Allen & Major Associates	Company		
Phone #	603-553-8151	Phone #		
Email	drobinson@allenmajor.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	Rolling Green EHD - 470 Boston Street
Recommended Stormceptor Model	STC 900
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	86
PSD	Fine Distribution
Rainfall Station	ROCKPORT 1 ESE

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	79		
STC 900	86		
STC 1200	87		
STC 1800	87		
STC 2400	90		
STC 3600	91		
STC 4800	93		
STC 6000	93		
STC 7200	94		
STC 11000	96		
STC 13000	96		
STC 16000	97		
StormceptorMAX	Custom		





Stormceptor

The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur. Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology

Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:

- Site parameters
- Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
- Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
- TSS load
- Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour). Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station			
State/Province	Massachusetts	Total Number of Rainfall Events	5100
Rainfall Station Name	ROCKPORT 1 ESE	Total Rainfall (in)	1244.3
Station ID #	6977	Average Annual Rainfall (in)	34.6
Coordinates	42°39'0"N, 70°36'0"W	Total Evaporation (in)	81.7
Elevation (ft)	79	Total Infiltration (in)	307.2
Years of Rainfall Data	36	Total Rainfall that is Runoff (in)	855.4

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.



Drainage Area		Up Stre	eam Storage	
Total Area (acres)	1.0	Storage (ac-ft) Discharge (cfs)		arge (cfs)
Imperviousness %	75.0	0.000 0.000		.000
Water Quality Objective)	Up Stream	Flow Diversi	on
TSS Removal (%)	80.0	Max. Flow to Stormce	ptor (cfs)	
Runoff Volume Capture (%)		Design Details		
Oil Spill Capture Volume (Gal)		Stormceptor Inlet Invert Elev (ft) 63.80		63.80
Peak Conveyed Flow Rate (CFS)		Stormceptor Outlet Invert Elev (ft) 63.55		63.55
Water Quality Flow Rate (CFS)		Stormceptor Rim Elev (ft) 68.00		68.00
		Normal Water Level Ele	evation (ft)	
		Pipe Diameter (in)	12
		Pipe Material		HDPE - plastic
		Multiple Inlets ()	(/N)	No
		Grate Inlet (Y/I	N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

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	

Stormceptor*

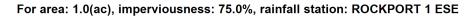


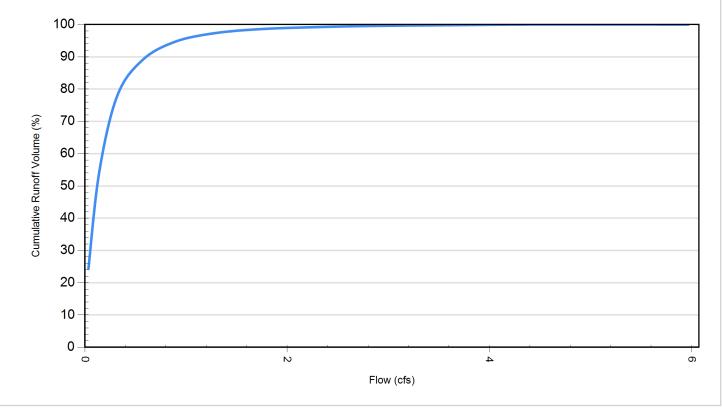
Site Name		Rolling Green EHD - 470 Boston Street		
Site Details				
Drainage Area		Infiltration Parameters		
Total Area (acres)	1.0	Horton's equation is used to estimate infiltration		
Imperviousness %	75.0	Max. Infiltration Rate (in/hr)2.44		
Surface Characteristics	5	Min. Infiltration Rate (in/hr)0.4		
Width (ft)	417.00	Decay Rate (1/sec) 0.00055		
Slope %	2	Regeneration Rate (1/sec)0.01		
Impervious Depression Storage (in)	0.02	Evaporation		
Pervious Depression Storage (in)	0.2	Daily Evaporation Rate (in/day)0.1		
Impervious Manning's n	0.015	Dry Weather Flow		
Pervious Manning's n	0.25	Dry Weather Flow (cfs) 0		
Maintenance Frequency	y	Winter Months		
Maintenance Frequency (months) >	12	Winter Infiltration 0		
	TSS Loadin	g Parameters		
TSS Loading Function				
Buildup/Wash-off Parame	eters	TSS Availability Parameters		
Target Event Mean Conc. (EMC) mg/L		Availability Constant A		
Exponential Buildup Power		Availability Factor B		
Exponential Washoff Exponent		Availability Exponent C		
		Min. Particle Size Affected by Availability (micron)		



	Cumulative Runoff Volume by Runoff Rate				
Runoff Rate (cfs)	Runoff Volume (ft ³)	Volume Over (ft ³)	Cumulative Runoff Volume (%)		
0.035	781308	2438162	24.3		
0.141	1743789	1476073	54.2		
0.318	2503688	716008	77.8		
0.565	2862925	356485	88.9		
0.883	3045655	173672	94.6		
1.271	3132611	86643	97.3		
1.730	3173051	46186	98.6		
2.260	3194425	24795	99.2		
2.860	3207086	12132	99.6		
3.531	3214240	4973	99.8		
4.273	3217757	1454	100.0		
5.085	3218958	251	100.0		
5.968	3219209	0	100.0		

Cumulative Runoff Volume by Runoff Rate

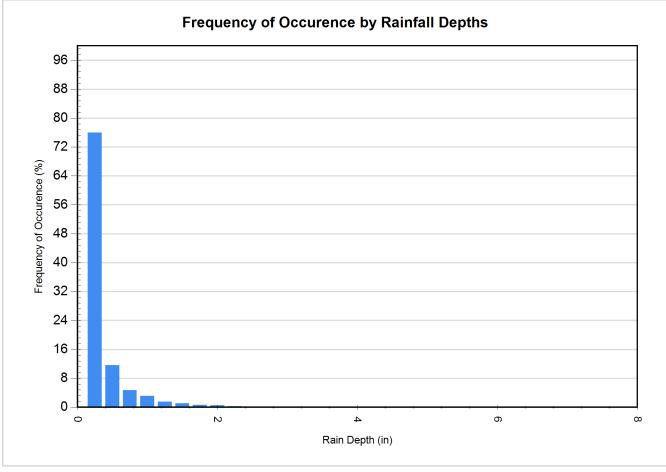






Rainfall Event Analysis				
Rainfall Depth (in)	No. of Events	Percentage of Total Events (%)	Total Volume (in)	Percentage of Annual Volume (%)
0.25	3874	76.0	354	28.4
0.50	591	11.6	215	17.3
0.75	242	4.7	152	12.2
1.00	159	3.1	137	11.0
1.25	79	1.5	89	7.1
1.50	57	1.1	78	6.2
1.75	30	0.6	48	3.9
2.00	24	0.5	44	3.6
2.25	14	0.3	30	2.4
2.50	9	0.2	21	1.7
2.75	5	0.1	13	1.0
3.00	5	0.1	14	1.1
3.25	0	0.0	0	0.0
3.50	3	0.1	10	0.8
3.75	2	0.0	7	0.6
4.00	1	0.0	4	0.3
4.25	1	0.0	4	0.3
4.50	0	0.0	0	0.0
4.75	0	0.0	0	0.0
5.00	0	0.0	0	0.0
5.25	0	0.0	0	0.0
5.50	2	0.0	11	0.9
5.75	1	0.0	6	0.5
6.00	0	0.0	0	0.0
6.25	0	0.0	0	0.0
6.50	0	0.0	0	0.0
6.75	0	0.0	0	0.0
7.00	0	0.0	0	0.0
7.25	1	0.0	7	0.6
7.50	0	0.0	0	0.0
7.75	0	0.0	0	0.0





For Stormceptor Specifications and Drawings Please Visit: http://www.imbriumsystems.com/technical-specifications





Detailed Stormceptor Sizing Report – Topsfield Rolling Green EHD

	Project Information & Location			
Project Name	470 Boston Street EHD	Project Number 2165-01A		
City	Topsfield	State/ Province Massachusetts		
Country	United States of America	Date 9/26/2016		
Designer Information		EOR Information (optional)		
Name	Dave Robinson	Name		
Company	Allen & Major Associates	Company		
Phone #	603-553-8151	Phone #		
Email	drobinson@allenmajor.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	Topsfield Rolling Green EHD
Recommended Stormceptor Model	STC 900
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	83
PSD	Fine Distribution
Rainfall Station	ROCKPORT 1 ESE

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	77		
STC 900	83		
STC 1200	83		
STC 1800	84		
STC 2400	87		
STC 3600	88		
STC 4800	90		
STC 6000	90		
STC 7200	92		
STC 11000	94		
STC 13000	94		
STC 16000	95		
StormceptorMAX	Custom		





Stormceptor

The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur. Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology

Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:

- Site parameters
- Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
- Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
- TSS load
- Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour). Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station					
State/Province Massachusetts Total Number of Rainfall Events 5100					
Rainfall Station Name	ROCKPORT 1 ESE	Total Rainfall (in)	1244.3		
Station ID #	6977	Average Annual Rainfall (in)	34.6		
Coordinates	42°39'0"N, 70°36'0"W	Total Evaporation (in)	80.0		
Elevation (ft)	79	Total Infiltration (in)	319.5		
Years of Rainfall Data	36	Total Rainfall that is Runoff (in)	844.8		

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.



Drainage Area		Up Stream Storage		
Total Area (acres)	0.90	Storage (ac-ft) Discharge (cfs)		arge (cfs)
Imperviousness %	74.0	0.000 0.000		.000
Water Quality Objective)	Up Stream	Flow Diversi	on
TSS Removal (%)	80.0	Max. Flow to Stormce	ptor (cfs)	
Runoff Volume Capture (%)		Design Details		
Oil Spill Capture Volume (Gal)		Stormceptor Inlet Invert Elev (ft) 71.00		71.00
Peak Conveyed Flow Rate (CFS)		Stormceptor Outlet Invert Elev (ft)		70.75
Water Quality Flow Rate (CFS)		Stormceptor Rim Elev (ft)		76.90
		Normal Water Level Elevation (ft)		
		Pipe Diameter (in)	12
		Pipe Material		HDPE - plastic
		Multiple Inlets ()	(/N)	No
		Grate Inlet (Y/N) No		

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

	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			

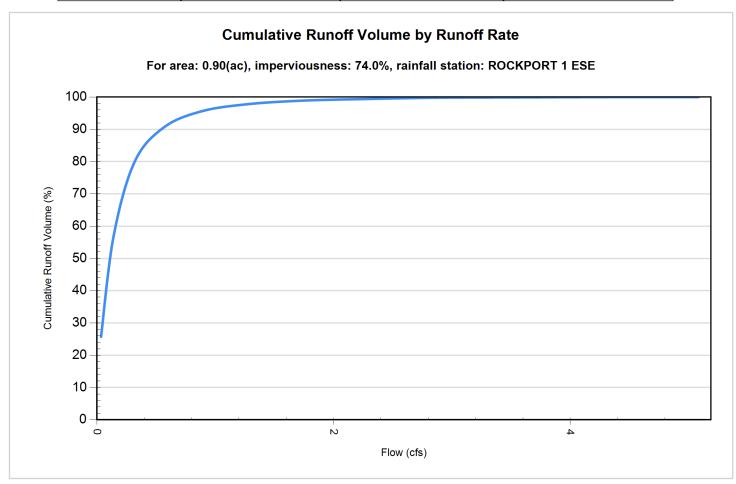
Stormceptor*



		MALERIALS ***	
Site Name Topsfield Rolling Green EHD			
	Site	Details	
Drainage Area		Infiltration Parameters	
Total Area (acres)	0.90	Horton's equation is used to estimate infiltration	
Imperviousness %	74.0	Max. Infiltration Rate (in/hr)2.44	
Surface Characteristics	5	Min. Infiltration Rate (in/hr)0.4	
Width (ft)	396.00	Decay Rate (1/sec) 0.00055	
Slope %	2	Regeneration Rate (1/sec)0.01	
Impervious Depression Storage (in)	0.02	Evaporation	
Pervious Depression Storage (in)	0.2	Daily Evaporation Rate (in/day)0.1	
Impervious Manning's n	0.015	Dry Weather Flow	
Pervious Manning's n	0.25	Dry Weather Flow (cfs) 0	
Maintenance Frequency	у	Winter Months	
Maintenance Frequency (months) >	12	Winter Infiltration0	
	TSS Loadin	g Parameters	
TSS Loading Function			
Buildup/Wash-off Parame	eters	TSS Availability Parameters	
Target Event Mean Conc. (EMC) mg/L		Availability Constant A	
Exponential Buildup Power		Availability Factor B	
Exponential Washoff Exponent		Availability Exponent C	
		Min. Particle Size Affected by Availability (micron)	



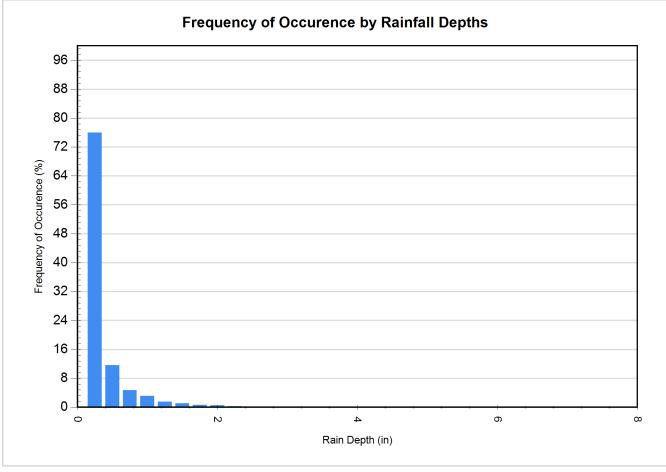
Cumulative Runoff Volume by Runoff Rate				
Runoff Rate (cfs)	Runoff Volume (ft ³)	Volume Over (ft ³)	Cumulative Runoff Volume (%)	
0.035	734475	2128825	25.7	
0.141	1629599	1233729	56.9	
0.318	2287293	576176	79.9	
0.565	2595545	267910	90.6	
0.883	2736282	127129	95.6	
1.271	2801437	61948	97.8	
1.730	2831045	32333	98.9	
2.260	2846869	16501	99.4	
2.860	2856266	7098	99.8	
3.531	2860910	2453	99.9	
4.273	2862855	508	100.0	
5.085	2863364	0	100.0	





Rainfall Event Analysis				
Rainfall Depth (in)	No. of Events	Percentage of Total Events (%)	Total Volume (in)	Percentage of Annual Volume (%)
0.25	3874	76.0	354	28.4
0.50	591	11.6	215	17.3
0.75	242	4.7	152	12.2
1.00	159	3.1	137	11.0
1.25	79	1.5	89	7.1
1.50	57	1.1	78	6.2
1.75	30	0.6	48	3.9
2.00	24	0.5	44	3.6
2.25	14	0.3	30	2.4
2.50	9	0.2	21	1.7
2.75	5	0.1	13	1.0
3.00	5	0.1	14	1.1
3.25	0	0.0	0	0.0
3.50	3	0.1	10	0.8
3.75	2	0.0	7	0.6
4.00	1	0.0	4	0.3
4.25	1	0.0	4	0.3
4.50	0	0.0	0	0.0
4.75	0	0.0	0	0.0
5.00	0	0.0	0	0.0
5.25	0	0.0	0	0.0
5.50	2	0.0	11	0.9
5.75	1	0.0	6	0.5
6.00	0	0.0	0	0.0
6.25	0	0.0	0	0.0
6.50	0	0.0	0	0.0
6.75	0	0.0	0	0.0
7.00	0	0.0	0	0.0
7.25	1	0.0	7	0.6
7.50	0	0.0	0	0.0
7.75	0	0.0	0	0.0





For Stormceptor Specifications and Drawings Please Visit: http://www.imbriumsystems.com/technical-specifications





Detailed Stormceptor Sizing Report – Topsfield EHD STC #3

Project Information & Location				
Project Name	470 Boston Street EHD	Project Number 2165-01A		
City	Topsfield	State/ Province	Massachusetts	
Country	United States of America	Date 9/26/2016		
Designer Information	on EOR Information (optional)		ptional)	
Name	Dave Robinson	Name		
Company	Allen & Major Associates	Company		
Phone #	603-553-8151	Phone #		
Email	drobinson@allenmajor.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	Topsfield EHD STC #3	
Recommended Stormceptor Model	STC 900	
Target TSS Removal (%)	80.0	
TSS Removal (%) Provided	84	
PSD	Fine Distribution	
Rainfall Station	ROCKPORT 1 ESE	

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	78		
STC 900	84		
STC 1200	84		
STC 1800	85		
STC 2400	87		
STC 3600	88		
STC 4800	90		
STC 6000	91		
STC 7200	92		
STC 11000	94		
STC 13000	94		
STC 16000	95		
StormceptorMAX	Custom		





Stormceptor

The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur. Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology

Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:

- Site parameters
- Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
- Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
- TSS load
- Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour). Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station					
State/Province Massachusetts Total Number of Rainfall Events 5100					
Rainfall Station Name	ROCKPORT 1 ESE	Total Rainfall (in)	1244.3		
Station ID #	6977	6977 Average Annual Rainfall (in)			
Coordinates	42°39'0"N, 70°36'0"W	Total Evaporation (in)	80.9		
Elevation (ft)	79	Total Infiltration (in)	307.0		
Years of Rainfall Data	36	Total Rainfall that is Runoff (in)	856.4		

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.



Drainage Area		Up Stream Storage		
Total Area (acres)	0.8	Storage (ac-ft) Discharge (cfs)		arge (cfs)
Imperviousness %	75.0	0.000 0.000		.000
Water Quality Objective	;	Up Stream	Flow Diversi	on
TSS Removal (%)	80.0	Max. Flow to Stormce	ptor (cfs)	
Runoff Volume Capture (%)		Design Details		
Oil Spill Capture Volume (Gal)		Stormceptor Inlet Invert Elev (ft) 71.85		71.85
Peak Conveyed Flow Rate (CFS)		Stormceptor Outlet Invert Elev (ft) 71		71.60
Water Quality Flow Rate (CFS)		Stormceptor Rim Elev (ft)		74.90
		Normal Water Level Ele	evation (ft)	
		Pipe Diameter (in)	12
		Pipe Material		
		Multiple Inlets ()	(/N)	No
		Grate Inlet (Y/I	N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

	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					

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Total Area (a Imperviousn

> Surface Width (ff Slope %

Impervious Depression Pervious Depression

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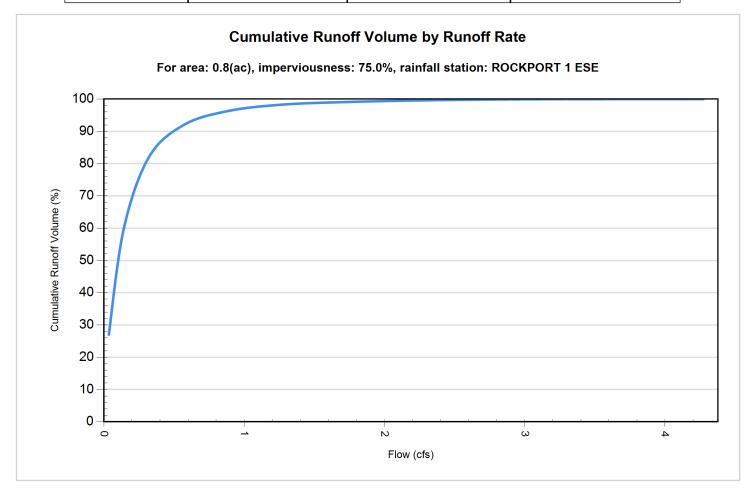
Mainten

or°			Rind	KET
Site Name			Topsfield EHD STC #3	
	Site I	Deta	ils	
ainage Area			Infiltration Parameters	
acres)	0.8		Horton's equation is used to estimate	infiltration
ness %	75.0		Max. Infiltration Rate (in/hr)	2.44
e Characteristics	3		Min. Infiltration Rate (in/hr)	0.4
ft)	373.00		Decay Rate (1/sec)	0.00055
%	2		Regeneration Rate (1/sec)	0.01
ion Storage (in)	0.02		Evaporation	
on Storage (in)	0.2		Daily Evaporation Rate (in/day)	0.1
nning's n	0.015		Dry Weather Flow	
ning's n	0.25		Dry Weather Flow (cfs)	0
nance Frequency	y		Winter Months	
ncy (months) >	12		Winter Infiltration	0
	TSS Loading	g Pa	rameters	

TSS Loading Function	
Buildup/Wash-off Parameters	TSS Availability Parameters
Target Event Mean Conc. (EMC) mg/L	Availability Constant A
Exponential Buildup Power	Availability Factor B
Exponential Washoff Exponent	Availability Exponent C
	Min. Particle Size Affected by Availability (micron)



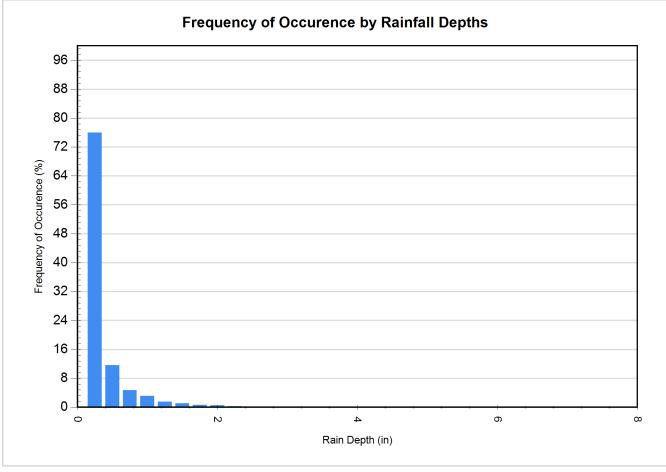
	Cumulative Runof	f Volume by Runoff Ra	te
Runoff Rate (cfs)	Rate (cfs) Runoff Volume (ft ³) Volume Over (ft ³)		Cumulative Runoff Volume (%)
0.035	698053	1883179	27.0
0.141	1540137	1040872	59.7
0.318	2112665	468531	81.8
0.565	2372353	208893	91.9
0.883	2486945	94262	96.3
1.271	2536127	45060	98.3
1.730	2558575	22607	99.1
2.260	2570751	10430	99.6
2.860	2577312	3865	99.9
3.531	2580237	939	100.0
4.273	2581100	77	100.0





		Rainfall Event Analy	ysis	
Rainfall Depth (in)	No. of Events	Percentage of Total Events (%)	Total Volume (in)	Percentage of Annual Volume (%)
0.25	3874	76.0	354	28.4
0.50	591	11.6	215	17.3
0.75	242	4.7	152	12.2
1.00	159	3.1	137	11.0
1.25	79	1.5	89	7.1
1.50	57	1.1	78	6.2
1.75	30	0.6	48	3.9
2.00	24	0.5	44	3.6
2.25	14	0.3	30	2.4
2.50	9	0.2	21	1.7
2.75	5	0.1	13	1.0
3.00	5	0.1	14	1.1
3.25	0	0.0	0	0.0
3.50	3	0.1	10	0.8
3.75	2	0.0	7	0.6
4.00	1	0.0	4	0.3
4.25	1	0.0	4	0.3
4.50	0	0.0	0	0.0
4.75			0	0.0
5.00			0	0.0
5.25	0	0.0	0	0.0
5.50	2	0.0	11	0.9
5.75	1	0.0	6	0.5
6.00	0	0.0	0	0.0
6.25	0	0.0	0	0.0
6.50	0	0.0	0	0.0
6.75			0	0.0
7.00	0	0.0	0	0.0
7.25	1	0.0	7	0.6
7.50	0	0.0	0	0.0
7.75	0	0.0	0	0.0





For Stormceptor Specifications and Drawings Please Visit: http://www.imbriumsystems.com/technical-specifications



Stormceptor has TARP covered

TARP Tier I Approval Verifies Stormceptor's Superior Performance

What is TARP?

TARP (Technology Acceptance and Reciprocity Partnership) was established in 2000 as a standardized method of evaluating the performance of stormwater treatment technologies.

The TARP program is a three-tiered process that includes rigorous laboratory testing, field tests and regulatory permits. TARP standards are currently recognized by eight participating states - New Jersey, California, Illinois, Maryland, Massachusetts, New York, Pennsylvania and Virginia.

What does TARP do?

TARP's certification program provides scientific data on stormwater technologies and related performance claims, which helps:

- Regulators and engineers make sound decisions when addressing stormwater treatment needs.
- Spread technology performance data quickly, giving jurisdictions an opportunity to better meet their water quality objectives.

How was Stormceptor recognized by TARP?

In February 2005, Stormceptor received TARP Tier I interim certification from the New Jersey Department of Environmental Protection (NJDEP), verifying Stormceptor's ability to perform beyond normal operational capacity during extreme rainfall.

What does TARP test for?

TARP Tier I focused on the removal of total suspended solids (TSS) and scour testing under various operating rates and sediment loadings. Seven stormwater treatment technologies were tested, including the Stormceptor System.

Particle Size Distribution (PSD) testing

Stormceptor was one of only two units tested to utilize the NJDEP PSD testing – treating a sample of particles between one and 1,000 microns. Instead of following TARP standards, the other technologies opted to test a preferred particle size range that best suited their unit's performance (see TARP Tier I – Hydrodynamic Comparison Results) – testing coarser, larger particles that are easier to remove.

Of the devices tested, Stormceptor removed the broadest range of pollutants.



Total Suspended Solids (TSS) removal efficiency

TARP protocol required testing at varying TSS concentrations – 100 mg/L, 200 mg/L, 300 mg/L, with the unit filled to 50% of the recommended capacity before maintenance.

How did Stormceptor perform?

Of all the technologies tested, Stormceptor recorded the highest TSS removal while removing a significant portion of clay and fine silts (NJDEP PSD).

Stormceptor:	75% TSS removal, tested with NJDEP fine PSD		
High Efficiency CDS:	73.7%, tested with a much coarser PSD than NJDEP PSD		
Downstream Defender:	wnstream Defender: 70%, tested with sand particles		
VortSentry:	69%, tested with sand particles		
Vortechs:	64%, tested with a much coarser PSD than NJDEP PSD		
Aquaswirl:	60%, tested with sand particles		
BaySaver:	51%, tested with NJDEP fine PSD		

Not only did Stormceptor record the highest TSS removal, it did so removing NJDEP's specified PSD, meaning it removed both a higher percentage as well as a broader range of particles than the other technologies.

Scour test results

Stormceptor was one of only two technologies that completed the scour test as mandated by NJDEP. Tests demonstrated Stormceptor did not scour with the unit loaded to design capacity.

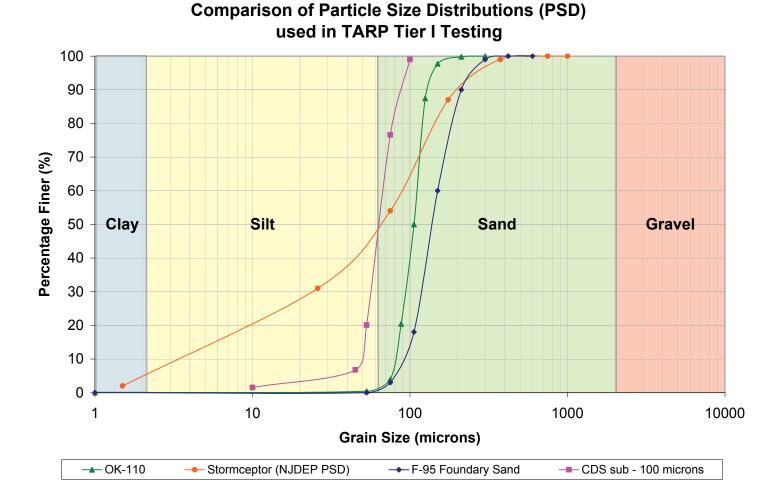
The calm during the storm

Stormceptor removes more pollutants from stormwater than any other separator. Stormceptor does not scour as the flow rate increases, maintaining a continuous positive treatment of suspended solids. Stormceptor is designed to remove a wide range of particles, as well as free oils, heavy metals and nutrients that attach to fine sediment. Units can also be designed to remove a specific particle size distribution.

With over 18,000 units operating worldwide, Stormceptor protects waterways every day in every storm.

					dynamic Hydro	DDYNAMIC DE			
DESCRIPTION		Stormceptor	High Efficiency CDS	Downstream Defender	VortSentry	Vortechs	Aquaswirl	Baysaver System	
		Model ID	STC 900	New Design: PMSU20_20_6 (tank diameter incr. by 1 foot, diff. baffle arrangement)	4-FT	VS40	Model 2000	AS-3	1К
		Treatment Chamber Diameter (ID)	6 ft	6 ft	4 ft	4 ft	4 ft	2.5 ft	2 ft
U U U U U U U	2 	Marketed Water Quality Peak Flow Treatment Capacity	n/a ²	1.1 cfs (31.1 L/s)	3.0 cfs (85 L/s)	1.1 cfs (31.1 L/s)	2.8 cfs (79.3 L/s)	1.8 cfs (51 L/s)	2.4 cfs (68 L/s
III 100% Operation		100% Operating Rate Tested	0.64 cfs (18 L/s)	1.1 cfs (31.1 L/s)	1.1 cfs (31.1 L/s)	1.1 cfs (31.1 L/s)	1.12 cfs (32 L/s) (40 % of Original)	0.9 cfs (30.6 L/s) (60 % of Original)	1.1 cfs (31 L/s (46 % of Origin
2	2	Original Physical Design Tested	YES	NO (New Design: Increased Tank Volume & Changed Baffle Arrangement)	YES	YES	YES	YES	YES
	шО	Used NJCAT Specified PSD	YES	NO	NO	NO	NO	NO	YES
PARTICLE SIZE USED		PSD Range	NJCAT PSD Tested	10-100 μm (i.e. fines washed out of sediment samples used via plankton nets)	53 - 300 µm	53 - 300 μm	38 - 75 μm	50 - 150 μm	NJCAT PSD Te
	PZ SI2	PSD Name	_	sub-100 PSD	F-95 Sand	F-95 Sand		OK-110	
			Refe	r to Particle Size D	istribution (PSD) C	hart for details & d			
TION		100% Operating Rate Tested	YES	YES	YES	YES	NO (Up to 40% of operating rate tested)	NO (Up to 60% of operating rate tested)	NO (Up to 46% of operatin tested)
Ϋ́.	TS V	125% Operating Rate Teste	YES	NO	YES	YES	NO	NO	NO
NJCAT VERIFICATION	REMOVAL ESULTS	Pre-loaded unit at 50% Sediment Capacity prior to evaluating performance	YES	NO	NO	YES	NO	NO	YES
~ +	TSS RI	NJCAT Verification	75 % TSS	73.7 % TSS	70 % TSS	69 % TSS	64 % TSS	60 % TSS	51 % TSS
JCA	–	For TSS Remova	(up to 125% of operating rate)	(up to 100% of operating rate)	(up to 125% of operating rate)	(up to 125% of operating rate)	(up to 40% of operating rate)	(up to 60% of operating rate)	(up to 46% of opera rate)
Z	L.	Scour Test Performed	YES	NO	NO	YES	NO	NO	Yes - in second cha only
	COUR TEST RESULTS	50% Sediment Loading Capacity at 125% Operating Rate		Not Tested	Not Tested	NO SCOUR 0 ppm	Not Tested	Not Tested	SCOUR 11 ppm
	UF		0 ppm NO SCOUR ³			SCOUR			SCOUR
	Rate 0 ppm 100% Sediment Loading Capacity at 125% Operating Rate (Level were maintenance is recommended) NO SCOUR ³ 3 ppm Not T	Not Tested	Not Tested	8 ppm	Not Tested	Not Tested	16 ppm		
- -		NJDEP Accepted NJCAT Verified Value for TSS Removal	Interim Approval set at 50% TSS	Interim Approval set at 50% TSS	Interim Approval set at 50% TSS	Interim Approval set at 50% TSS	Interim Approval set at 50% TSS	Interim Approval set at 50% TSS	Interim Approva set at 50% TSS
<u>ሠ</u> ብ	ĨŽ			NO			NO	NO	NO
TARP TIER NJDEP	INTERIM APPROVAL	Original Design Approved by NJDEP	YES	Only the "new" high efficiency design can be used. Original CDS design not approved.	YES	YES	Must reduce original flow capacity marketed in literature by 60%.	Must reduce original flow capacity marketed in literature by 50%.	Must reduce origina capacity marketer literature by 54%; I increase tank surface by 44% to 79% for d

 Stormceptor is marketed and designed to achieve water quality objectives, rather than sizing primarily for flow-based criteria.
 Indicated in the NUDEP interim-certification letter (Feb. 15, 2005) which can be obtained from the below web link. Stormceptor did not scour at a 125% operating rate and 100% unit sediment loading. 3 ppm is considered to be within the tolerance of the testing error. For NJDEP Interim Certified Stormwater Technologies go to: http://www.state.nj.us/dep/dsr/bscit/CertifiedMain.htm



TIER I - Lab Testing Protocol

1. Measure TSS Removal Efficiency

- Influent concentrations: 100, 200, 300 mg/L
- Five operating rates (25, 50, 75, 100, 125%)
- 50% pre-loaded with sediment

2. Measure Scouring / Re-suspension

• 50% and 100% pre-loaded at 125% operating rate

3. Utilize Pre-defined NJDEP Particle Size Distribution

5% clay / 40% silt / 55% sand

Source of all NJDEP and TARP documented information, go to: http://www.state.nj.us/dep/dsr/bscit/CertifiedMain.htm



Allen & Ma	jor Associates	Inc
Allell a Ma	IOI ASSOCIATES	,

Title	MA DEP Standard Calculations	Ву	DMR
Project	Rolling Green Elderly Housing Development, Topsfield, MA	Chk'd	SRC
Date	October 13, 2016	Apprv'd	SRC
Revised	February 27, 2017		

Computation Sheet

Stormwater Recharge/Water Quality Volume Table

Required Recharge Equation: Rv = F * Impervious Area

Rv = Required Recharge Volume, expressed in ft³, cubic yards or acre-feet <math>F = Target Depth Factor associated with each Hydraulic Soil Group Impervious Area = pavement & rooftop area on site

Required Water Quality Treatment Volume Equation: V wq = (D wq/12 inches/foot) * (A IMP * 43,560 square feet/acre)

 V_{WQ} = Required Water Quality Treatment Volume, expressed in ft³

 $D_{WQ} = Water Quality Depth$

 $A_{IMP} = Impervious Area (excluding non-metal roofs)$

							1	Recharge Required		Water Quality Vo	lume Required
				Impervio	us Area (Feet)			Impervious Area		D (Inch)	V
W'SHED	Area (Feet)	Pervious	HSG A (F=0.6)*	HSG B (F=0.35)*	HSG C (F=0.25)*	HSG D (F=0.1)*	F Avg. (Inches)	(Feet)	$\mathbf{R}\mathbf{v}$ (ft ³)	D_{WQ} (Inch)	V _{WQ}
P-1	81,776	78,637	3,139	0	0	0	0.000	3,139	0	0.5	131
P-2	22,978	9,227	6,902	3,632	3,217	0	0.452	13,751	518	0.5	573
P-3	27,549	24,037	3,512	0	0	0	0.600	3,512	176	0.5	146
P-3A	4,950	1,557	3,393	0	0	0	0.600	3,393	170	0.5	141
P-4	21,239	7,933	13,306	0	0	0	0.600	13,306	665	0.5	554
P-5	39,272	18,801	19,875	0	596	0	0.590	20,471	1,006	0.5	853
P-6	19,137	7,682	11,455	0	0	0	0.600	11,455	573	0.5	477
P-7	15,670	8,687	6,983	0	0	0	0.600	6,983	349	0.5	291
P-8	15,307	14,235	1,072	0	0	0	0.600	1,072	54	0.5	45
P-9	102,567	98,195	4,372	0	0	0	0.600	4,372	219	0.5	182
P-10	31,595	29,291	0	0	2,304	0	0.250	2,304	48	0.5	96
R-1	3,185	0	850	0	2,335	0	0.343	3,185	91	0.5	133
R-2	3,195	0	0	0	3,195	0	0.250	3,195	67	0.5	133
R-3	3,625	0	0	0	3,625	0	0.250	3,625	76	0.5	151
R-4	3,625	0	0	0	3,625	0	0.250	3,625	76	0.5	151
R-5	3,195	0	0	0	3,195	0	0.250	3,195	67	0.5	133
R-6	3,625	0	630	0	2,995	0	0.311	3,625	94	0.5	151
R-7	3,895	0	3,895	0	0	0	0.600	3,895	195	0.5	162
R-8	3,625	0	3,625	0	0	0	0.600	3,625	181	0.5	151
R-9	3,625	0	3,625	0	0	0	0.600	3,625	181	0.5	151
R-10	3,895	0	3,895	0	0	0	0.600	3,895	195	0.5	162
R-11	3,625	0	3,625	0	0	0	0.600	3,625	181	0.5	151
R-12	3,895	0	3,895	0	0	0	0.600	3,895	195	0.5	162
R-13	3,895	0	3,895	0	0	0	0.600	3,895	195	0.5	162
R-14	3,625	0	3,625	0	0	0	0.600	3,625	181	0.5	151
R-15	1,705	0	1,705	0	0	0	0.600	1,705	85	0.5	71
R-16	1,490	0	1,490	0	0	0	0.600	1,490	75	0.5	62
R-17	120	0	120	0	0	0	0.600	120	6	0.5	5
Total	435,885	0			0	0			5,910		5,728

Allen & Major	Associates, Inc.	Computation Sheet	i		
Title	MA DEP Standard Calculations	Ву	DMR		
Project	Rolling Green Elderly Housing Development, Topsfield, MA	Chk'd	SRC		
Date	October 13, 2016	Apprv'd	SRC		
Revised February 27, 2017					
Equations prov	Equations provided above				
Rv = F * Imper	Ry = F * Impervious Area				

Underground Infiltration System #1 - #9 and Surface Detention Basins #1-3

Water Quality Volume

 $D_{WQ} = Water Quality Depth$

 $A_{WQ} =$

 $A_{WQ} =$

 $A_{WQ} = Required Water Quality Treatment Volume, expressed in ft³$ $<math>D_{WQ} = Water Quality Depth$ $A_{IMP} = Impervious Area (excluding non-metal roofs)$

Rv = Required Recharge Volume, expressed in fi³, cubic yards or acre-feet F = Target Depth Factor associated with each Hydraulic Soil Group

Provided (cf)

34,716

34,716

 A_{WQ} = Required Water Quality Treatment Volume, expressed in ft³

Impervious Area = pavement & rooftop area on site

A IMP = Impervious Area (excluding non-metal roofs)

Required (cf)

5,910 5,910

[Required (cf)	Provided (cf)]	
	$A_{WQ} =$	5,728	34,716		Underground Infiltration System #1 - #9 and Surface Detention Basins #1-3
[$A_{WQ} =$	5,728	34,716		Total

Total

Draindown Within 72 Hours

Timedrawdown=(Rv) (1/Design Infiltration Rate in inches per hour) (Conversion for inches to feet) (1/bottom area in feet)

Underground Infiltration System #1 (Assumed Sand)	
Infiltration Rate (in/Hr)=	1.02
Bottom Area $(ft^2) =$	3,396
Infiltration Volume $(ft^3) =$	1,027
Time _{drawdown} (Hours)=	3.56

Underground Infiltration System #2 (Sand)								
Infiltration Rate (in/Hr)=	8.27							
Bottom Area $(ft^2) =$	1,176							
Infiltration Volume $(ft^3) =$	837							
Time _{drawdown} (Hours)=	1.03							

Underground Infiltration Systems #3-9 (Sandy Loam)							
Infiltration Rate (in/Hr)=	1.02						
Bottom Area $(ft^2) =$	104						
Infiltration Volume $(ft^3) =$	195						
Time _{drawdown} (Hours)=	22.03						

Surface Infiltration System (Sandy Loam & Sa	nd)	
Infiltration Rate (in/Hr)=	1.02	
Bottom Area $(ft^2) =$	1,817	
Infiltration Volume $(ft^3) =$	2,970	
Time _{drawdown} (Hours)=	19.23 Pa	ge 2

Allen & Major Associates, Inc.

Title	MA DEP Standard Calculations
Project	Rolling Green Elderly Housing Development, Topsfield, MA
Date	October 13, 2016
Revised	February 27, 2017

TSS Removal Worksheet

Α	B BMP'	C TSS Removal Rate'		D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)	
llation #1	Deep Sump and Hooded Catch Basin	0.25		1.00	0.25	0.75	(25% has been removed prior to infiltration)
TSS Removal Calculation Worksheet - UIS#1	Proprietary Treatment Practice WQU- 1	0.77		0.75	0.58	0.17	
TSS Ren Work	Subsurface Infiltration Basin #1 with Filter Fabric	0.80		0.17	0.14	0.03	
			Total ⁻	TSS Removal =	97%		-
Α	В	С		D	E	F	
	BMP'	TSS Removal Rate		Starting TSS Load*	Amount Removed (C*D)	Remaining Load (D-E)	
S oval ation #2	Deep Sump Catch Basins	0.25		1.00	0.25	0.75	(25% has been removed prior to infiltration)
TSS Removal Calculation Worksheet · UIS #2	Subsurface Infiltration Basin #1	0.80		0.75	0.60	0.15	
			Total	TSS Removal =	85%		

Computation Sheet

By DMR Chk'd SRC Apprv'd SRC

Allen & Major Associates, Inc.

Allen & Major Ass	ociates, Inc.	Computation She	et
Title	MA DEP Standard Calculations	Ву	DMR
Project	Rolling Green Elderly Housing Development, Topsfield, MA	Chk'd	SRC
Date Revised	October 13, 2016 February 27, 2017	Apprv'd	SRC

Α	B BMP ¹	C TSS Removal Rate ¹		D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)	
ioval tion 3	Deep Sump Catch Basins	0.25		1.00	0.25	0.75	(25% has been removed prior to infiltration)
TSS Rem Calculat orksheet #2 & 3	Proprietary Treatment Practice	0.80		0.75	0.60	0.15]
To Non	Infiltration Basin	0.80		0.15	0.12	0.03	

Total TSS Removal =

Mounding Analysis

Infiltration System	Water Table		System Bottom	Vertical Separation	Attenuated System	Mounding Analysis Required
1	56.50		60.00	3.5	YES	YES
2	59.50		61.50	2.0	YES	YES

97%

Allen & Major Associates, Inc.

TitlePipe Sizing TableProjectTopsfield Elderly Housing DevelopmentDateOctober 13, 2016RevisedFebruary 27, 2017A&M Project Number: 2165-01A

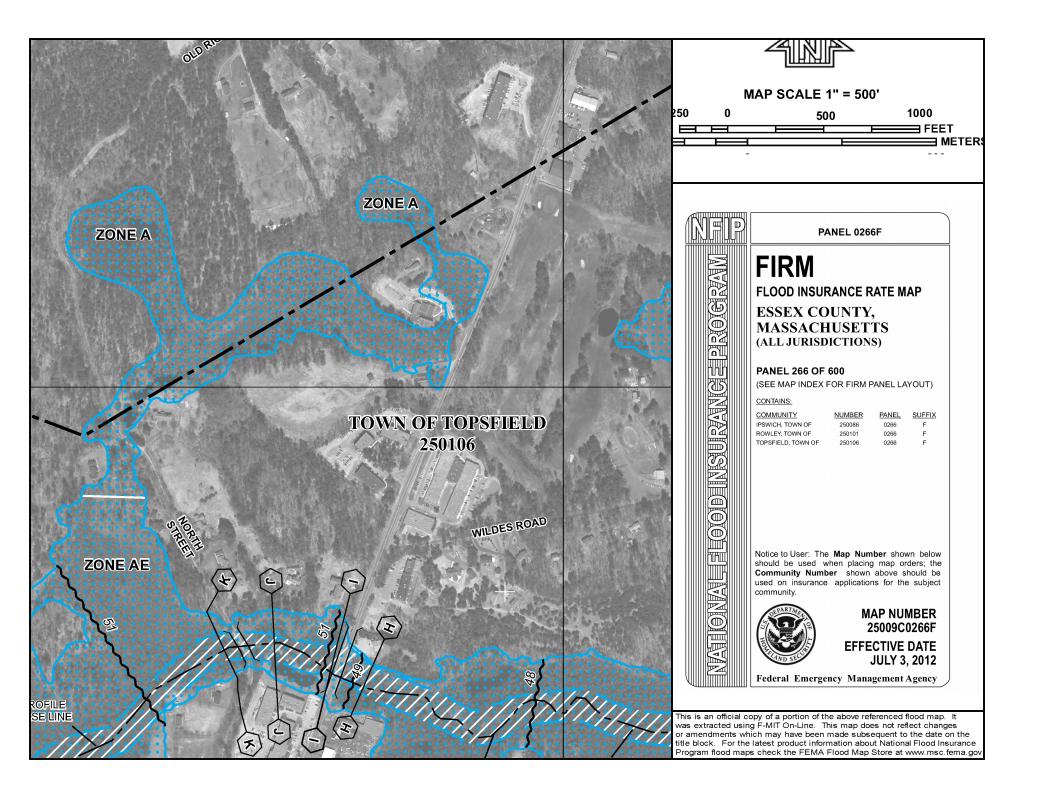
Minimum Slope:	0.0047	_	By	DMR	
Minimum Pipe Size:	6		Chk'd	SRC	
Rainfall Intensity (in/hr):	5.40	(25 year storm)	Apprv'd	TJW	
Manning's n:	0.011	HDPE/PVC			
Manning's n:	0.013	RCP			
Minimum Pipe Cover:	1.84'	_			

Computation Sheet

Elderly Housing Development - Topsfield, MA

Line						Req'd. Capac.	Pipe Size	Slope	Design	Capacity	Drop	Invert Elev	ation	Rim Elev.	
From	То	Length	Area	wgt. C	CA	Qd	D	S	Q _{full}	V _{full}		Upper	Lower	Upper	Cover
Upper	Lower	(feet)	(acres)			(cfs)	(in)	(%)	(cfs)	(fps)	(feet)	(ft)	(ft)	(ft)	(ft)
CB1	DMH-1	32	0.402	0.57	0.228	1.23	10	1.00%	2.6	4.75	0.32	64.66	64.34	69.10	3.48
CB2	DMH-1	40	0.060	0.91	0.054	0.29	10	0.70%	2.2	3.97	0.28	64.62	64.34	68.50	2.92
DMH-1	WQU-1	19				1.52	12	1.53%	5.2	6.62	0.29	64.34	64.05	68.00	2.54
REAR OF UNITS	CLEANOUT	100	0.046	0.95	0.044	0.24	6	1.00%	0.7	3.38	1.00	100.00	99.00	102.00	VARIES
LARGEST UNIT (AA)	CLEANOUT	100	0.087	0.95	0.083	0.45	6	1.00%	0.7	3.38	1.00	100.00	99.00	102.00	VARIES
WQU1	UIS1	7.5	1.047	0.69	0.719	2.21	12	2.00%	6.0	7.58	0.15	63.80	63.65	68.40	3.48
CB3	DMH5	12	0.130	0.79	0.103	0.55	10	1.00%	2.6	4.75	0.12	72.45	72.33	75.30	1.89
CB4	DMH5	12	0.130	0.79	0.103	0.55	10	1.00%	2.6	4.75	0.12	72.35	72.23	75.20	1.89
CB5	DMH4	17	0.207	0.75	0.155	0.84	10	1.00%	2.6	4.75	0.17	71.84	71.67	75.05	2.25
CB6	DMH4	17	0.207	0.75	0.155	0.84	10	1.00%	2.6	4.75	0.17	71.84	71.67	75.10	2.30
WQU2	DMH9	21	0.673	3.08	0.515	2.78	12	0.95%	4.1	5.23	0.20	70.75	70.55	76.90	5.03
UIS 3	DMH9	30	0.083	0.95	0.079	0.43	6	9.00%	2.0	10.13	2.70	73.40	70.70	76.75	2.72
UIS 4	6" TEE	30	0.073	0.95	0.070	0.38	6	0.47%	0.5	2.31	0.14	74.20	74.06	77.50	2.68
UIS 5	CO-7	22	0.083	0.95	0.079	0.43	6	0.91%	0.6	3.22	0.20	74.80	74.60	78.30	2.88
CO-7	6" TEE	54	0.083	0.95	0.079	0.43	6	1.00%	0.7	3.38	0.54	74.60	74.06	78.00	2.78
6" TEE	DMH 9	63	0.083	0.95	0.079	0.43	8	5.57%	3.4	9.66	3.51	74.06	70.55	78.00	3.15
DMH9	FES1	62				3.58	15	0.48%	5.3	4.33	0.30	70.45	70.15	76.90	5.08
DMH5	DMH4	46	0.402	0.57	0.228	1.23	10	1.00%	2.6	4.75	0.46	72.13	71.67	75.30	2.21
CB7	WQU3	5	0.281	0.80	0.226	1.22	10	3.00%	4.5	8.22	0.15	72.00	71.85	74.80	1.84
CB8	WQU3	15	0.281	0.80	0.226	1.22	10	1.00%	2.6	4.75	0.15	72.00	71.85	74.80	1.84
WQU3	DMH6	31	0.562	1.61	0.452	2.44	12	0.97%	4.2	5.27	0.30	71.60	71.30	74.90	2.18
DMH-6	FES-2	36	0.888	0.70	0.619	6.11	12	0.56%	3.1	4.00	0.20	71.20	71.00	75.10	2.77
OCS-1	DMH-10	155				9.69	18	1.35%	14.5	8.18	2.10	70.10	68.00	74.00	2.28
DMH-10	FES-3	74				9.69	18	1.22%	13.7	7.75	0.90	67.90	67.00	72.15	2.63
DCB-9	CB-2	82	0.725	0.39	0.286	1.54	10	0.50%	1.8	3.36	0.41	65.13	64.72	70.70	4.61

Allen & Major Associates, In	Computation Sh By	DMR							
Title: Project:	RipRap Sizing	Spreadsheet HD, 470 Boston Stree	at Tapafiald MA			Chk'd Apprv'd	SRC TJW		
Date:	Feb. 27, 2017	TD, 470 BOSION SILE				Αρρινα	1300		
A&M Project Number:	2165-01A								
OUTLET	Do (ft.)	Q10 (cfs)	Tw (ft.)	La (ft.)	Wup (ft.)	Wdn (ft.)	d50 (ft.)*		
FES-1	1.25	2.06	0.5	11.4	3.8	15.2	0.08		
FES-2	1.00	0.72	0.5	8.3	3.0	11.3	0.03		
FES-3	1.25	0.14	0.5	8.9	3.8	12.7	0.00		
Notes: Assume 6" Tw at Outfall Use MHD M2.02.2 Stone Depth of Stone to be 6" or 1.5 * 6" Stone Minimum **Apron width shall meet defin		-							
When Tw < 0.5Do at pipe ou	tlet:	Where:							
La = 1.8Q/Do^1.5 + 7Do		Tw = the tailwate	•						
Wup = 3Do		Do = the diameter of the pipe or the width of channel							
Wdn = 3Do + La		Q = the discharge from the pipe of channel (10 year Storm)							
d50 = (0.02Q^1.3)/(TwDo)		La = the length of apron Wup = the upstream width of apron							
When Tw > or = 0.5Do at pip	e outlet:	W dp = the dpstream W dn = the downs	-						
La = 3Q/Do^1.5 + 7Do		d50 = the median	stone diameter						
Wup = 3Do									
Wdn = 3Do + 0.4La									



Illicit Discharge Compliance Statement

Responsibility:

The Owner is responsible for ultimate compliance with all provisions of the Massachusetts Stormwater Management Policy, the USEPA NPDES Construction General Permit and responsible for identifying and eliminating illicit discharges (as defined by the USEPA).

OWNER NAME:	Sarkis Development Company
ADDRESS:	2 Elm Square
	Andover, MA 01810
TEL. NUMBER:	(978) 475-4055

Engineer's Compliance Statement:

To the best of my knowledge, the attached plans, computations and specifications meet the requirements of Standard 10 of the Massachusetts Stormwater Handbook regarding illicit discharges to the stormwater management system and that no detectable illicit discharges exist on the site. All documents and attachments were prepared under my direction and qualified personnel properly gathered and evaluated the information submitted, to the best of my knowledge.

Included with this statement are site plans, drawn to scale, that identify the location of systems for conveying stormwater on the site and show that these systems do not allow the entry of any illicit discharges into the stormwater management system. The plans also show any systems for conveying wastewater and/or groundwater on the site and show that there are no connections between the stormwater and wastewater systems.

For a redevelopment project (if applicable), all actions taken to identify and remove illicit discharges, including without limitation, visual screening, dye or smoke testing, and the removal of any sources of illicit discharges to the stormwater management system are documented and included with this statement.