STORMWATER MANAGEMENT REPORT

Site Development Plan
"Moose Hill Condominiums"
Walpole, Massachusetts

March 10, 2020
Revised: May 6, 2021
Prepared for:

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5-10-2021

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CONTENTS

Introduction:

The applicant, RADKE Associates, LLC, is proposing to develop an eight (8) Unit Condominium project, located off Moose Hill Road, in Walpole Massachusetts. The proposed project was filed with Massachusetts Housing pursuant to Massachusetts General Laws Chapter 40B. The Moose Hill Condominiums project consists of eight residential units in four (4) duplex style buildings. The units will be individually owned in a condominium setting.

The project will be accessed via Moosehill Road with a twenty (20) foot wide paved access drive. The proposed drive will extend approximately 350 feet from Moosehill Road providing access and egress to all units. The individual units will have two outdoor parking spaces and one garage space for a total of three parking spaces per unit with exception of unit one, having only two total. There are four (4) visitor parking spaces provided within the cul-de-sac turnaround.

The proposal is to raze the existing house at 270 Moose Hill Road and accessory buildings. The Project will be serviced by Town water, onsite sewage disposal systems and other available public utilities. The stormwater generated from the Project will be captured, conveyed, treated an*d* mitigated on-site utilizing Best Management Practices.

The purpose of these calculations is to demonstrate design compliance of the Project's stormwater management system for water quality and quantity, specifically post-development peak discharge rates per the DEP's Stormwater Management Policy, the Town of Walpole Land Subdivision Regulations. As designed, the system will mitigate peak rates of runoff for storms up to and including the 100-year event under post-construction conditions.

Methodology/Sources of Data:

The overall storm water management plan for the project is designed to maintain the peak rate of storm water runoff from the site after development. The Soil Conservation Service Modified Soil Cover Complex Method, the computer program "HydroCAD" by Applied Microcomputer Systems, and the procedures specified in Urban Hydrology for storm Small Watersheds were used to determine pre-and post-developed peak flow rates of runoff from the site. The 2, 10, 25 and 100-year, 24-hour storm frequencies were used in the comparison of pre and post- development conditions. The rainfall data for the Type III, 24-hour storm events follow:

Frequency (Years)	Rainfall (inches)
2	3.25
10	4.90
50	6.10
100	7.00

The storm water runoff will be controlled through the use of "Best Management Practices" and in conformance with the MADEP Stormwater Management Policy.

Soils:

The Natural Resources Conservation Service, Hydrologic Soils Group Map indicates that the on-site soils consist of Hinckley loamy sand (245C) in the project area. NRCS has assigned the soils a hydrologic soil rating of "A". On-site soil testing was performed on May 3, 2016 to determine groundwater and soil type. The field testing confirmed the hydrologic soil rating and no groundwater was encountered in the test holes. The recharge systems were designed using a Rawles Rate of 8.27 in/hr.

Existing Site Conditions:

The site is located at 270 Moose Hill Road in the Town of Walpole, Massachusetts. The property is comprised of two parcels as shown on Assessor Map 36, Parcels 64 and 65, (See Attached Map) totaling 50,487 square feet of land area. The property is consists of a single family dwelling with related driveway, lawn area and accessory structures.

The existing runoff flows via overland from Moose Hill Road to the rear of the property. The site is primarily lawn area with landscaped gardens. The existing runoff has been modeled as Subcatchment E1.

Proposed Site Conditions:

The Moose Hill Condominiums project consists of eight residential units in four (4) duplex style buildings. The units will be individually owned in a condominium setting.

The project will be accessed via Moosehill Road with a twenty (20) foot wide paved access drive. The proposed drive will extend approximately 350 feet from Moosehill Road providing access and egress to all units. The individual units will have two outdoor parking spaces and one garage space for a total of three parking spaces per unit.

The runoff from the roof areas will be captured and discharge to underground infiltration systems. Two systems are proposed, each will accommodate two buildings. All roof runoff will be captured via gutters, downspouts and a piping network that will direct the runoff to the recharge system.

The runoff generated from the paved surfaces will be collected via catch basins, manholes and culverts then directed to an underground stormwater recharge system. All impervious areas will be directed to an underground recharge systems. The remaining lawn area has been modeled as Subcatchment P3 for comparison of pre- and pos-developed offsite runoff.

The following is a summary comparison of peak flows:

Summary of *Peak* Stormwater Runoff Rates								
Design Point	**2Yr Peak Flow (cfs)**		**10-Yr Peak Flow (cfs)**		**25-Yr Peak Flow (cfs)**		**100-Yr Peak Flow (cfs)**	
	Exist.	***Prop.***	***Exist.***	***Prop.***	***Exist.***	***Prop.***	***Exist.***	***Prop.***
(1E) P3	0.00	0.00	0.12	0.01	0.17	0.02	0.88	0.19

The following is a summary comparison of peak volumes:

Summary of Stormwater Runoff Volumes								
Design Point	**2-Yr Volume (ac-ft)**		**10-Yr Volume (ac-ft)**		**25-Yr Volume (ac-ft)**		**100-Yr Volume (ac-ft)**	
	Exist.	***Prop.***	***Exist.***	***Prop.***	***Exist.***	***Prop.***	***Exist.***	***Prop.***
(1E) P3	91.0	1.0	1,255	264	1,599	361	4,504	1,258

The following is a summary of the Recharge Systems:

Summary of Recharge System for 100 year Storm Event			
System	**Inflow (c.f.s)**	**Peak Elevation (feet)**	**Flood Elevation (feet)**
1P	**0.72**	**206.69**	**207.50**
2P	**3.46**	**202.50**	**203.00**

The proposed pipe network has been designed to convey stormwater flows for the 25-year storm event.

Summary:

The calculations performed for all design storm events indicate that there is no net increase in the peak rate of runoff or volume for the Project as proposed. Therefore, with the implementation of the stormwater management system as designed, there will be adequate protection against pollutants, flooding, siltation, or other drainage problems. The stormwater management system along with the Operation and Maintenance plan contained herein will satisfy all of the objectives of the DEP's Stormwater Management Regulations and the Town of Walpole Subdivision Rules.

Massachusetts Stormwater Management Standards:

Standard 1: No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the commonwealth:
All new stormwater discharges will be treated and remove a minimum of eighty (80) percent total suspended solids. The surface runoff from the proposed impervious surfaces will be treated and mitigated prior to discharge to abutting properties.

Standard 2: Stormwater management systems shall be designed so that the Post-developed peak discharge rates do not exceed Pre-developed peak discharge rates:
The proposed project as designed will result in no increase in post-development runoff over pre-developed rates. ***See Appendix A.***

Standard 3: Loss of annual recharge to groundwater shall be eliminated or minimized through the use of environmentally sensitive site design, low impact development techniques, stormwater best management practices and good operation and maintenance:
No proposed change from existing.

Standard 4: Stormwater management systems shall be designed to remove 80% of average annual post-construction load of total suspended solids (TSS):
The proposed design will provide treatment and groundwater recharge through the use of an infiltration systems to control runoff from the impervious surfaces.

Standard 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 discharge of stormwater runoff from such land uses to the maximum extent practicable:
The project is not a land use with higher potential pollutant load (LUHPPL).

Standard 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 specific source control and pollution prevention measures and 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.
The project site is not located in a Critical area.

Standard 7: A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extend practible:
The proposed project is not a redevelopment.

Standard 8: A plan to control construction-related impacts, including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented:
The proposed project plan set includes an erosion control plan to be implemented during construction period. A Stormwater Pollution Prevention Plan (SWPPP) will be prepared prior to the commencement of construction.

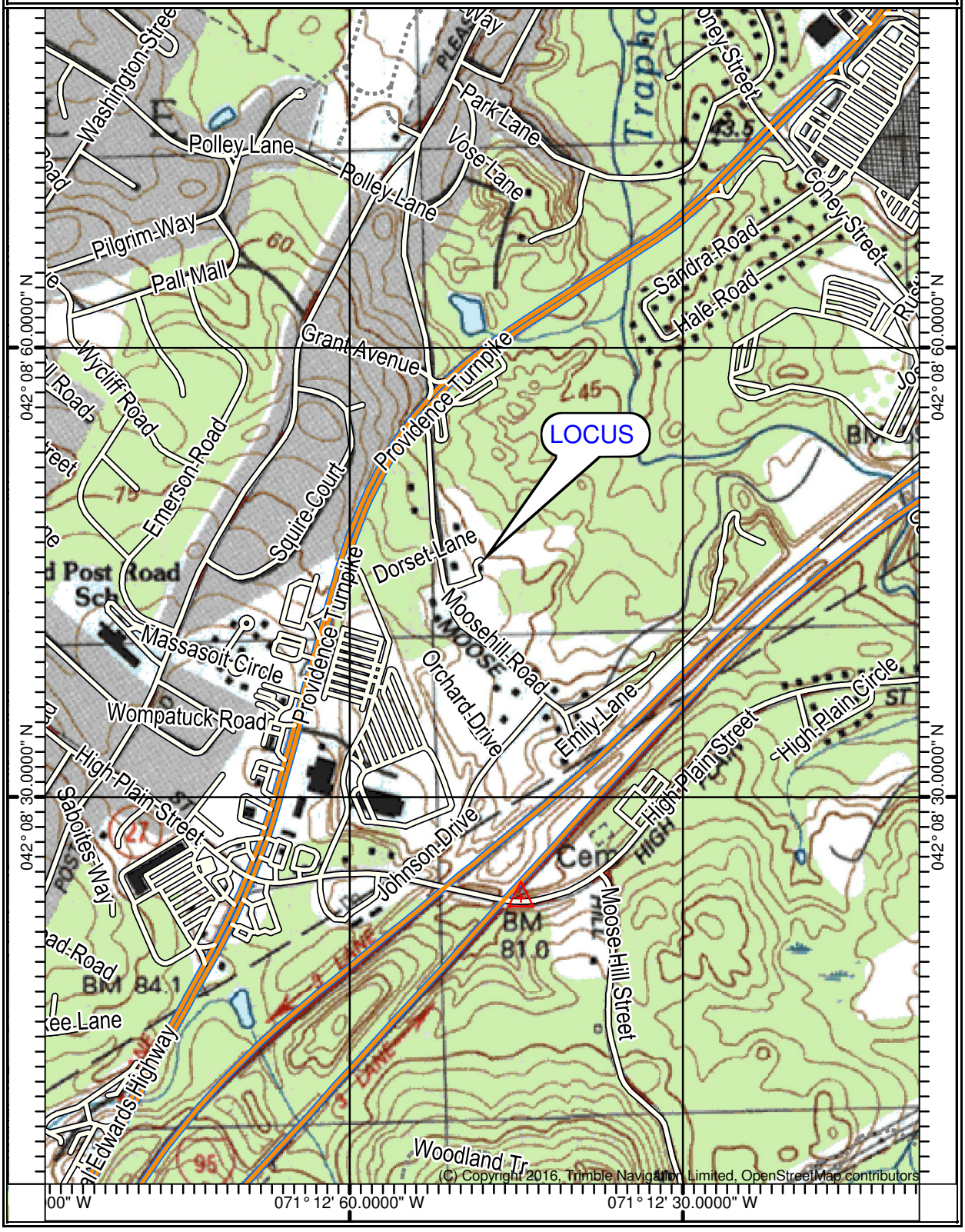
Standard 9: A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed:
A Stormwater Operation and Maintenance Plan are included. ***See Appendix D.***

Standard 10: All illicit discharges to the stormwater management system are prohibited:
An Illicit Discharge Compliance Statement was prepared for the project***. See Appendix E.***

Map Name: NORWOOD
Print Date: 03/10/20

Scale: 1 inch = 1,000 ft.
Map Center: 042° 08' 44.4440" N,

Horizontal Datum: NAD27



SCALE 1:12000

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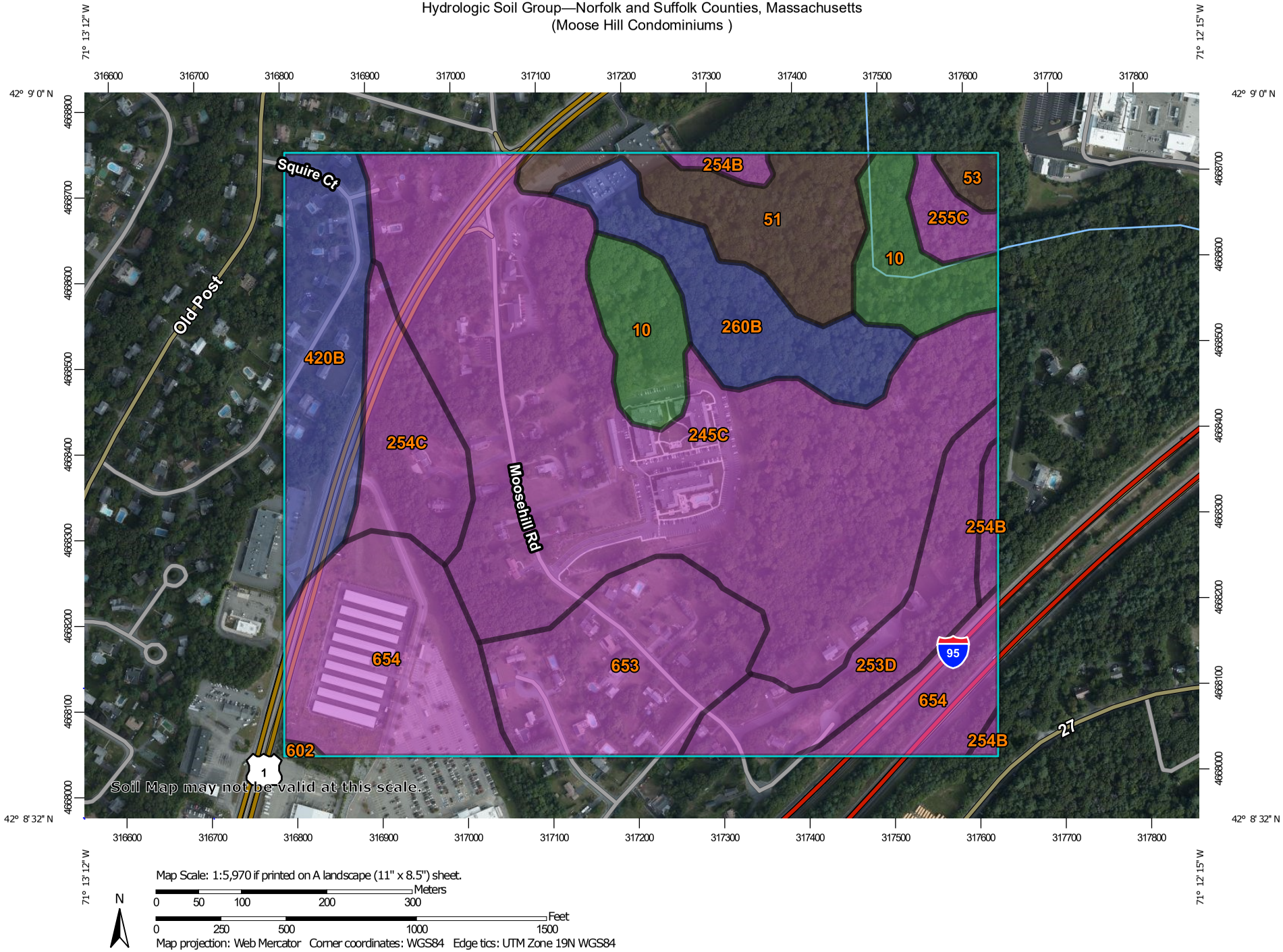
Feet

Hydrologic Soil Group—Norfolk and Suffolk Counties, Massachusetts
(Moose Hill Condominiums)



Map Scale: 1:5,970 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 15, Sep 12, 2019

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

Date(s) aerial images were photographed: Aug 31, 2019—Sep 24, 2019

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10	Scarboro and Birdsall soils, 0 to 3 percent slopes	A/D	9.8	6.7%
51	Swansea muck, 0 to 1 percent slopes	B/D	8.9	6.1%
53	Freetown muck, ponded, 0 to 1 percent slopes	B/D	0.9	0.6%
245C	Hinckley loamy sand, 8 to 15 percent slopes	A	54.4	37.3%
253D	Hinckley loamy sand, 15 to 35 percent slopes	A	9.1	6.2%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	1.9	1.3%
254C	Merrimac fine sandy loam, 8 to 15 percent slopes	A	7.0	4.8%
255C	Windsor loamy sand, 8 to 15 percent slopes	A	2.0	1.4%
260B	Sudbury fine sandy loam, 2 to 8 percent slopes	B	9.2	6.3%
420B	Canton fine sandy loam, 3 to 8 percent slopes	B	11.2	7.7%
602	Urban land, 0 to 15 percent slopes		0.1	0.1%
653	Udorthents, sandy	A	13.3	9.1%
654	Udorthents, loamy	A	18.2	12.5%
Totals for Area of Interest			**146.1**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

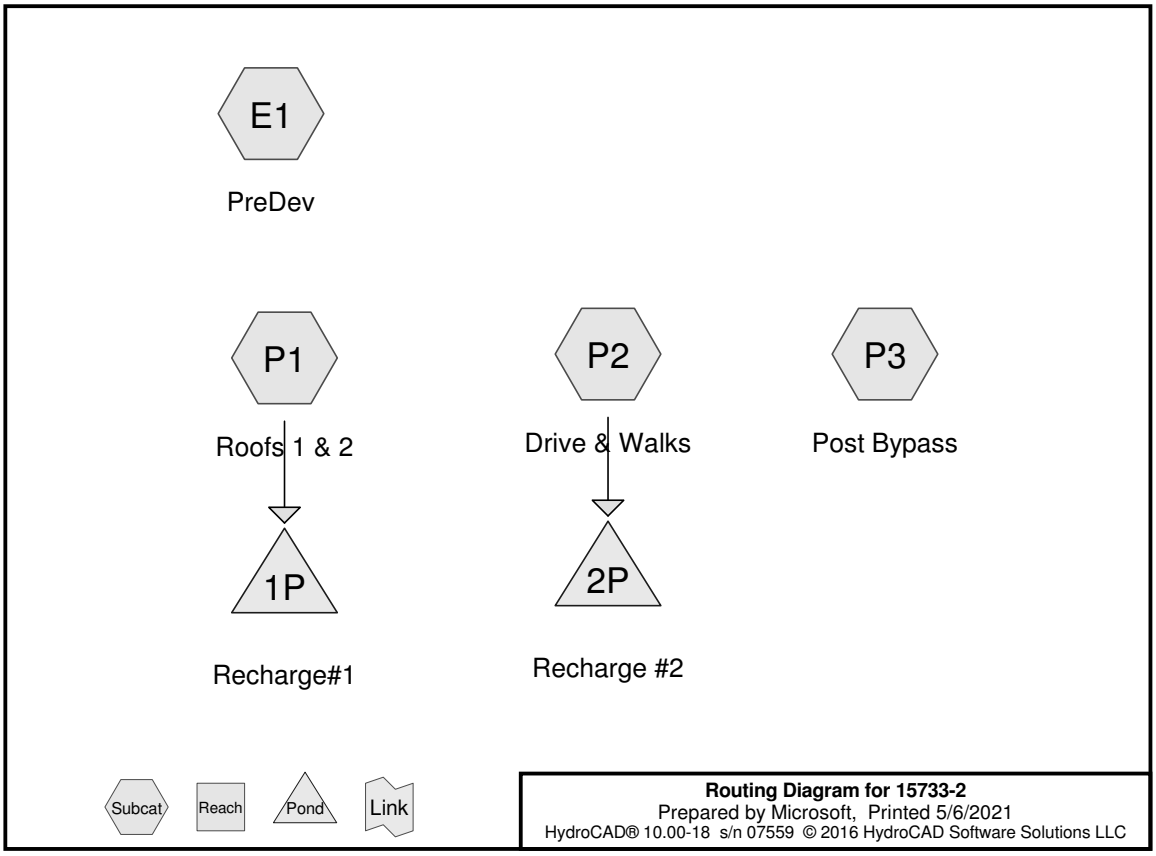
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX – A

Calculations for Pre & Post Development

Standard 2:



Summary for Subcatchment E1: PreDev

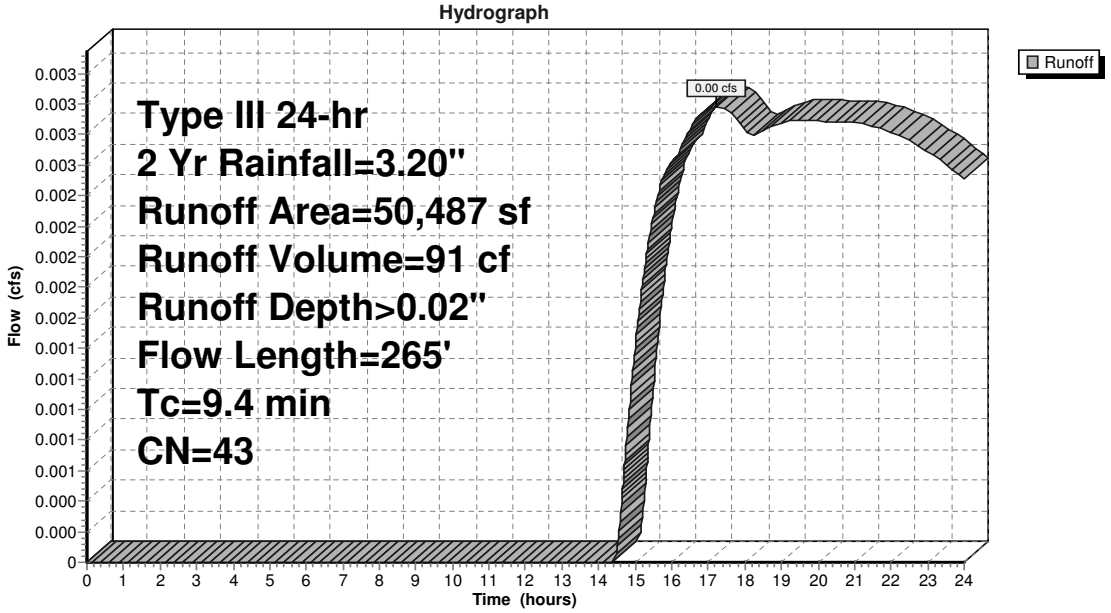
Runoff = 0.00 cfs @ 17.20 hrs, Volume= 91 cf, Depth> 0.02"

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 Yr Rainfall=3.20"

	Area (sf)	CN	Description
*	3,491	98	Imp. Surfaces, HSG A
	46,996	39	>75% Grass cover, Good, HSG A
	50,487	43	Weighted Average
	46,996		93.09% Pervious Area
	3,491		6.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0240	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
1.2	100	0.0200	1.41		**Shallow Concentrated Flow, B-C** Nearly Bare & Untilled Kv= 10.0 fps
0.6	115	0.0450	3.18		**Shallow Concentrated Flow, C-D** Grassed Waterway Kv= 15.0 fps
9.4	265	Total			

Subcatchment E1: PreDev



Summary for Subcatchment P1: Roofs 1 & 2

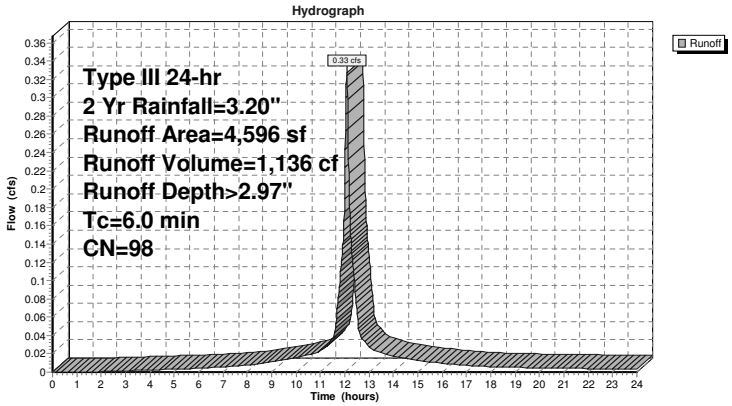
Runoff = 0.33 cfs @ 12.08 hrs, Volume= 1,136 cf, Depth> 2.97"

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 Yr Rainfall=3.20"

	Area (sf)	CN	Description
*	4,596	98	Roof, HSG A
	4,596		100.00% Impervious Area

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

Subcatchment P1: Roofs 1 & 2



Summary for Subcatchment P2: Drive & Walks

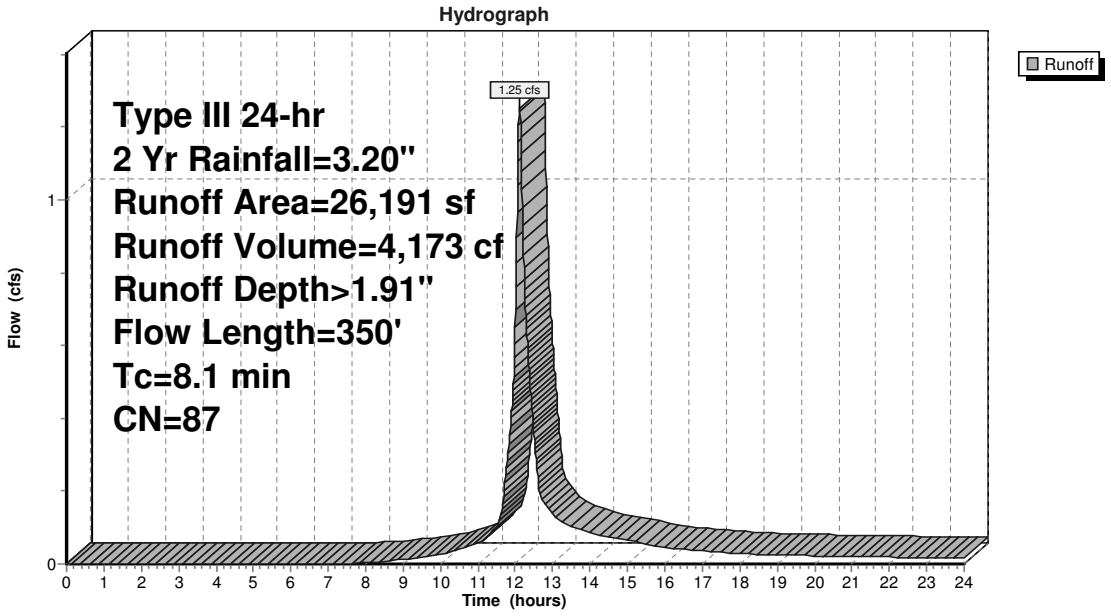
Runoff = 1.25 cfs @ 12.12 hrs, Volume= 4,173 cf, Depth> 1.91"

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 Yr Rainfall=3.20"

	Area (sf)	CN	Description
	4,761	39	>75% Grass cover, Good, HSG A
	16,834	98	Paved parking, HSG A
*	4,596	98	Roof HSG A
	26,191	87	Weighted Average
	4,761		18.18% Pervious Area
	21,430		81.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	25	0.0100	0.07		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
1.9	325	0.0200	2.87		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
8.1	350	Total			

Subcatchment P2: Drive & Walks



Summary for Subcatchment P3: Post Bypass

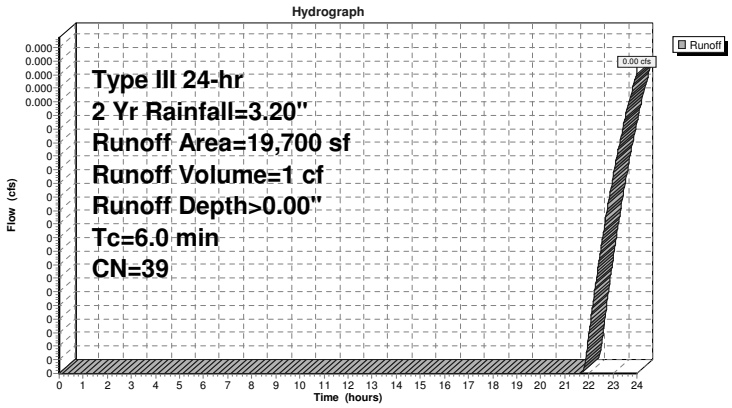
Runoff = 0.00 cfs @ 24.00 hrs, Volume= 1 cf, Depth> 0.00"

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 Yr Rainfall=3.20"

Area (sf)	CN	Description
19,700	39	>75% Grass cover, Good, HSG A
19,700		100.00% Pervious Area

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

Subcatchment P3: Post Bypass



Summary for Pond 1P: Recharge#1

Inflow Area = 4,596 sf,100.00% Impervious, Inflow Depth > 2.97" for 2 Yr event
Inflow = 0.33 cfs @ 12.08 hrs, Volume= 1,136 cf
Outflow = 0.07 cfs @ 12.49 hrs, Volume= 1,135 cf, Atten= 79%, Lag= 24.6 min
Discarded = 0.07 cfs @ 12.49 hrs, Volume= 1,135 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 204.11' @ 12.49 hrs Surf.Area= 322 sf Storage= 263 cf
Flood Elev= 207.50' Surf.Area= 322 sf Storage= 920 cf

Plug-Flow detention time= 20.1 min calculated for 1,135 cf (100% of inflow)
Center-of-Mass det. time= 19.9 min (775.8 - 755.8)

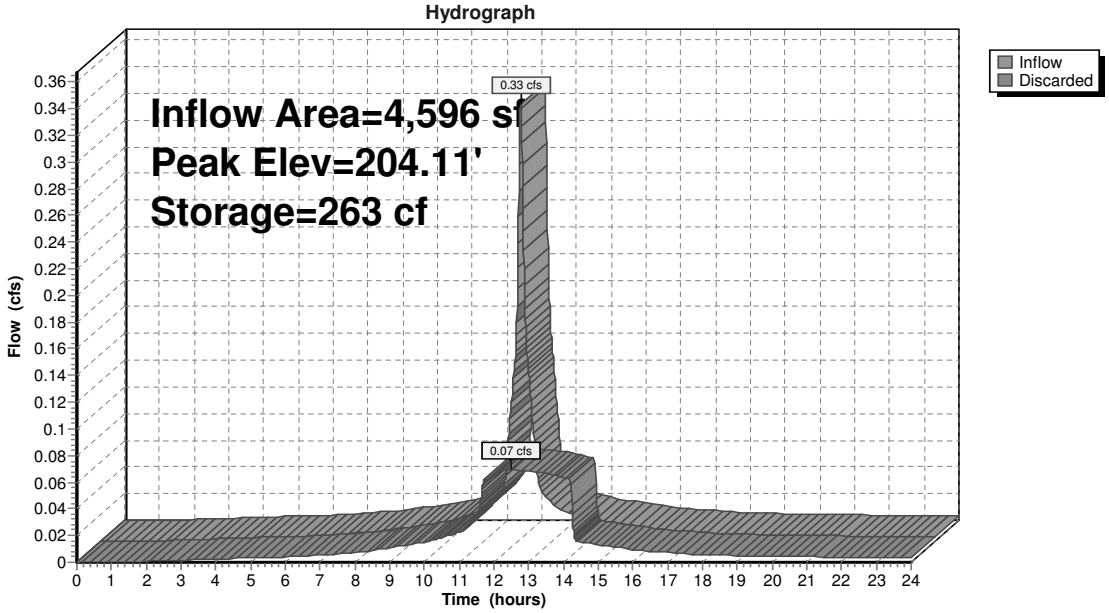
Volume	Invert	Avail.Storage	Storage Description
#1A	202.50'	526 cf	**10.50'W x 30.70'L x 5.50'H Field A** 1,773 cf Overall - 459 cf Embedded = 1,314 cf x 40.0% Voids
#2A	203.50'	459 cf	**Cultec R-902HD** x 7 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap Cap Storage= +2.8 cf x 2 x 1 rows = 5.5 cf
		984 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	202.50'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 190.00'

Discarded OutFlow Max=0.07 cfs @ 12.49 hrs HW=204.11' (Free Discharge)
1=Exfiltration (Controls 0.07 cfs)

Pond 1P: Recharge#1



Summary for Pond 2P: Recharge #2

Inflow Area = 26,191 sf, 81.82% Impervious, Inflow Depth > 1.91" for 2 Yr event
Inflow = 1.25 cfs @ 12.12 hrs, Volume= 4,173 cf
Outflow = 0.36 cfs @ 12.50 hrs, Volume= 4,171 cf, Atten= 71%, Lag= 22.9 min
Discarded = 0.36 cfs @ 12.50 hrs, Volume= 4,171 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 198.95' @ 12.50 hrs Surf.Area= 1,303 sf Storage= 941 cf
Flood Elev= 203.00' Surf.Area= 1,303 sf Storage= 4,157 cf

Plug-Flow detention time= 16.2 min calculated for 4,171 cf (100% of inflow)
Center-of-Mass det. time= 15.9 min (835.8 - 819.9)

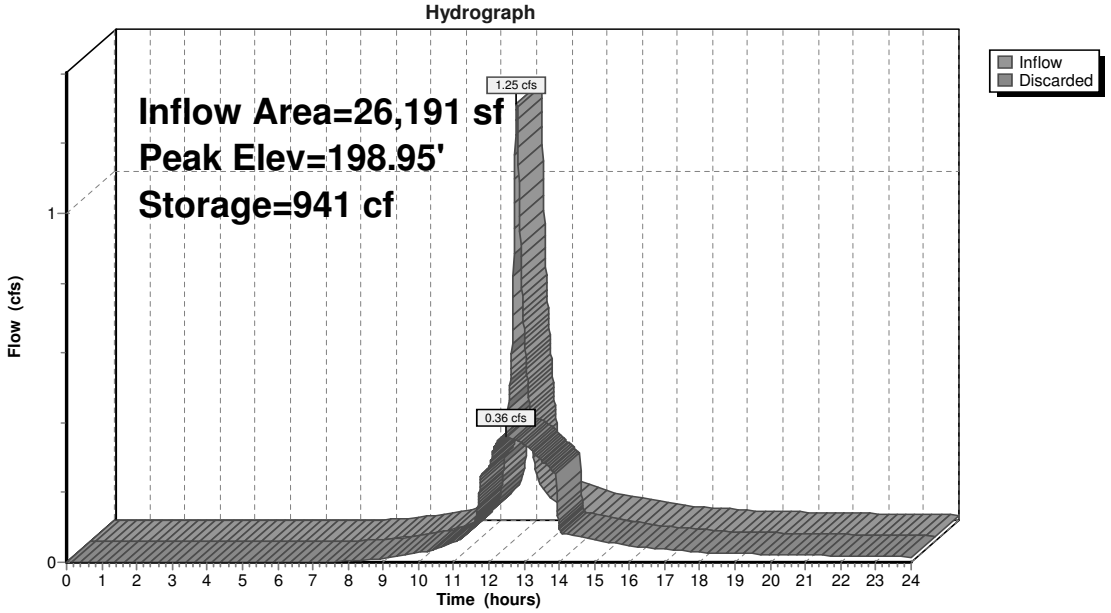
Volume	Invert	Avail.Storage	Storage Description
#1A	197.50'	2,005 cf	**27.50'W x 47.37'L x 5.50'H Field A** 7,164 cf Overall - 2,153 cf Embedded = 5,011 cf x 40.0% Voids
#2A	198.50'	2,153 cf	**Cultec R-902HD** x 33 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 3 Rows of 11 Chambers Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
		4,157 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	197.50'	**8.270 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 192.00'

Discarded OutFlow Max=0.36 cfs @ 12.50 hrs HW=198.95' (Free Discharge)
1=Exfiltration (Controls 0.36 cfs)

Pond 2P: Recharge #2



Summary for Subcatchment E1: PreDev

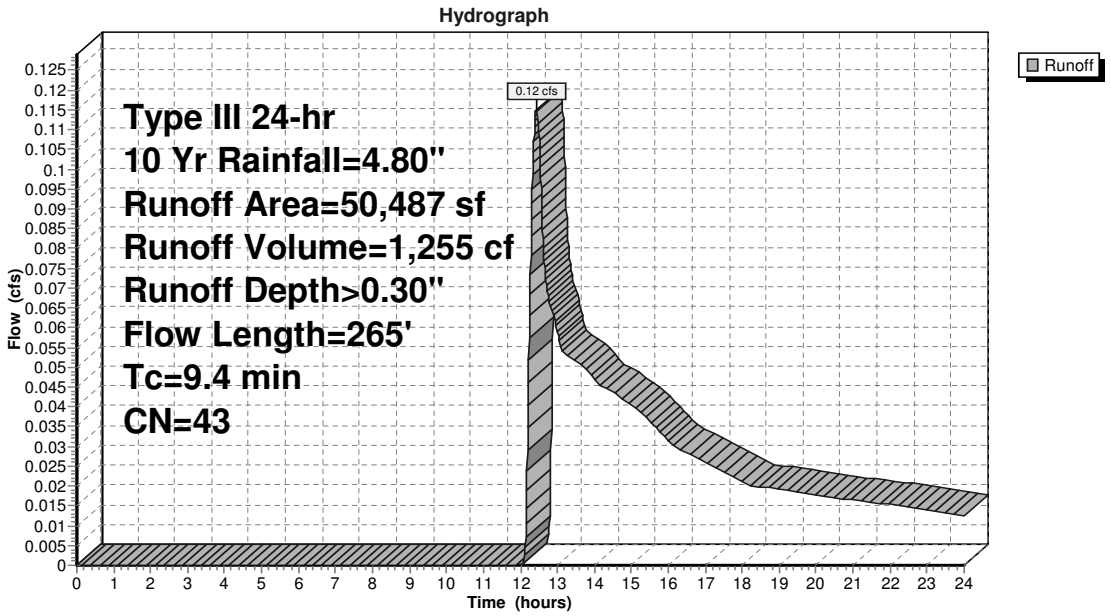
Runoff = 0.12 cfs @ 12.44 hrs, Volume= 1,255 cf, Depth> 0.30"

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 10 Yr Rainfall=4.80"

	Area (sf)	CN	Description
*	3,491	98	Imp. Surfaces, HSG A
	46,996	39	>75% Grass cover, Good, HSG A
	50,487	43	Weighted Average
	46,996		93.09% Pervious Area
	3,491		6.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0240	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
1.2	100	0.0200	1.41		**Shallow Concentrated Flow, B-C** Nearly Bare & Untilled Kv= 10.0 fps
0.6	115	0.0450	3.18		**Shallow Concentrated Flow, C-D** Grassed Waterway Kv= 15.0 fps
9.4	265	Total			

Subcatchment E1: PreDev



Summary for Subcatchment P1: Roofs 1 & 2

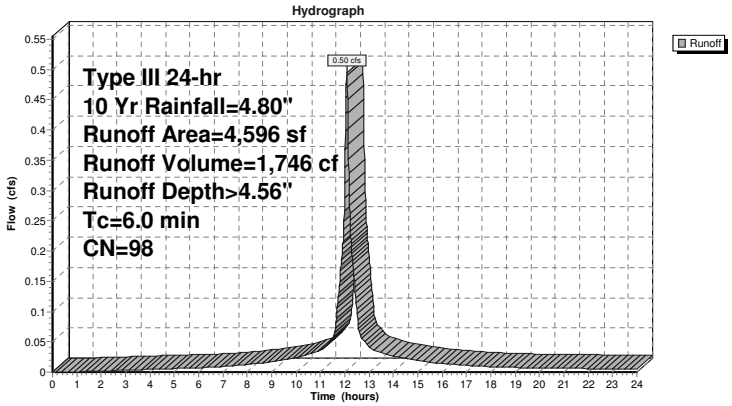
Runoff = 0.50 cfs @ 12.08 hrs, Volume= 1,746 cf, Depth> 4.56"

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 Yr Rainfall=4.80"

	Area (sf)	CN	Description
*	4,596	98	Roof, HSG A
	4,596		100.00% Impervious Area

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

Subcatchment P1: Roofs 1 & 2



Summary for Subcatchment P2: Drive & Walks

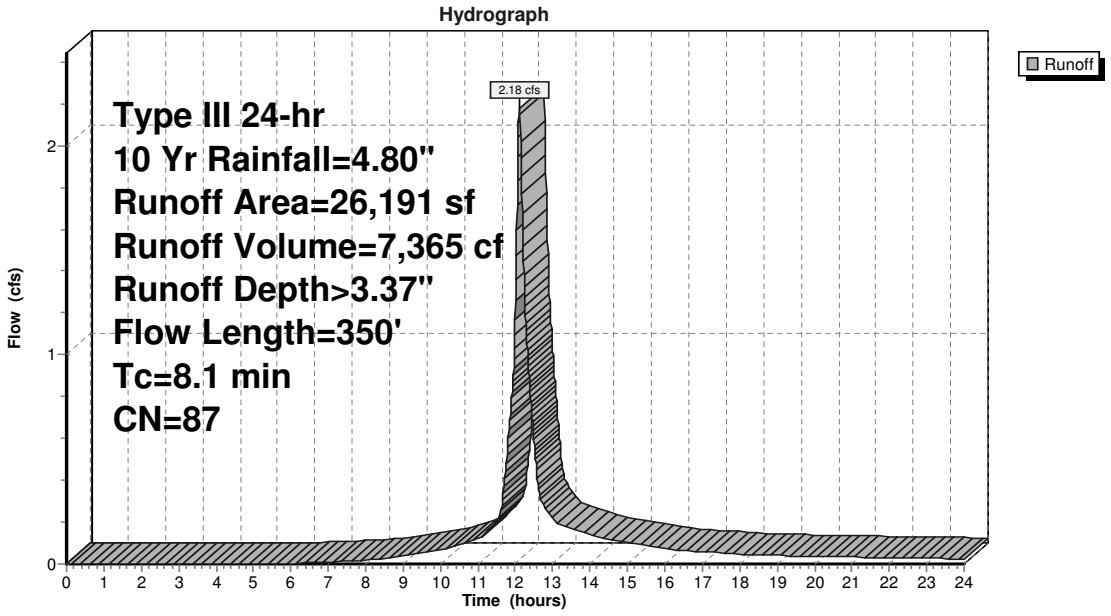
Runoff = 2.18 cfs @ 12.11 hrs, Volume= 7,365 cf, Depth> 3.37"

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 10 Yr Rainfall=4.80"

	Area (sf)	CN	Description
	4,761	39	>75% Grass cover, Good, HSG A
	16,834	98	Paved parking, HSG A
*	4,596	98	Roof HSG A
	26,191	87	Weighted Average
	4,761		18.18% Pervious Area
	21,430		81.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	25	0.0100	0.07		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
1.9	325	0.0200	2.87		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
8.1	350	Total			

Subcatchment P2: Drive & Walks



Summary for Subcatchment P3: Post Bypass

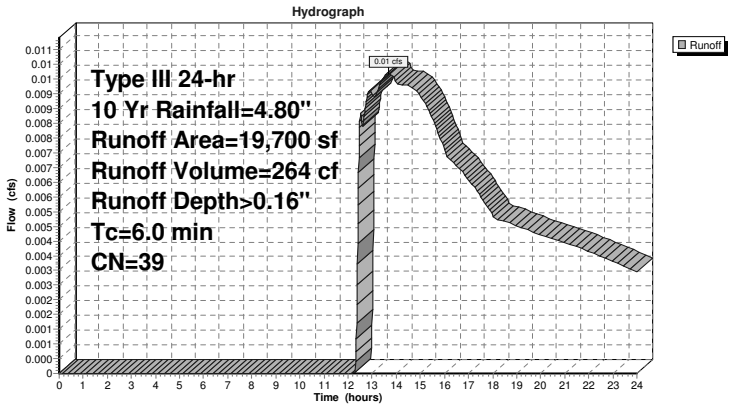
Runoff = 0.01 cfs @ 13.66 hrs, Volume= 264 cf, Depth> 0.16"

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 Yr Rainfall=4.80"

Area (sf)	CN	Description
19,700	39	>75% Grass cover, Good, HSG A
19,700		100.00% Pervious Area

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

Subcatchment P3: Post Bypass



Summary for Pond 1P: Recharge#1

Inflow Area = 4,596 sf,100.00% Impervious, Inflow Depth > 4.56" for 10 Yr event
Inflow = 0.50 cfs @ 12.08 hrs, Volume= 1,746 cf
Outflow = 0.08 cfs @ 12.56 hrs, Volume= 1,746 cf, Atten= 85%, Lag= 28.9 min
Discarded = 0.08 cfs @ 12.56 hrs, Volume= 1,746 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 205.20' @ 12.56 hrs Surf.Area= 322 sf Storage= 494 cf
Flood Elev= 207.50' Surf.Area= 322 sf Storage= 920 cf

Plug-Flow detention time= 39.9 min calculated for 1,746 cf (100% of inflow)
Center-of-Mass det. time= 39.7 min (787.8 - 748.2)

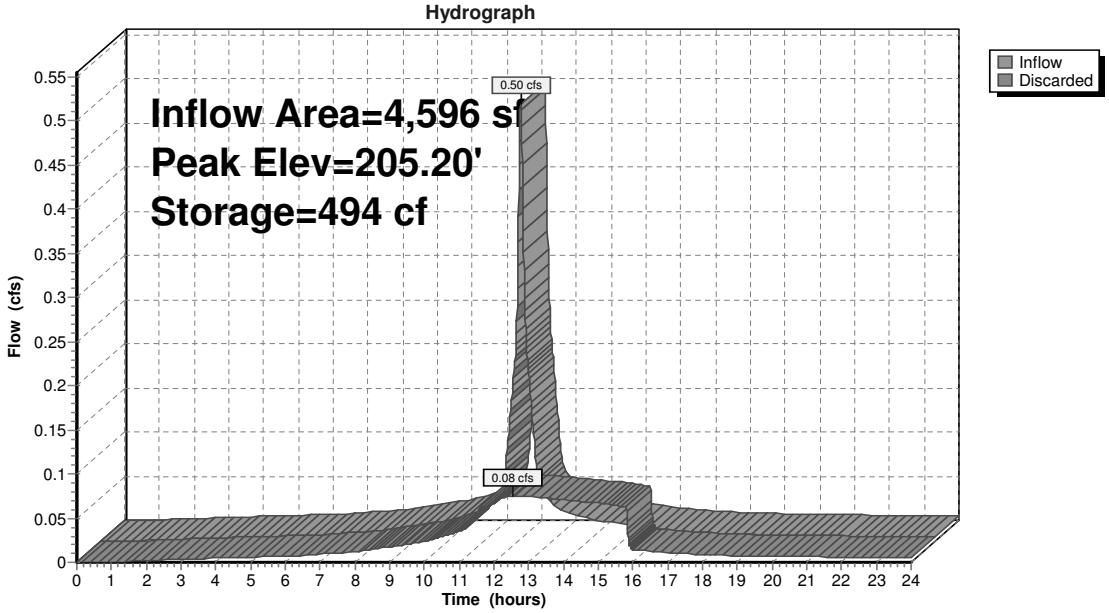
Volume	Invert	Avail.Storage	Storage Description
#1A	202.50'	526 cf	**10.50'W x 30.70'L x 5.50'H Field A** 1,773 cf Overall - 459 cf Embedded = 1,314 cf x 40.0% Voids
#2A	203.50'	459 cf	**Cultec R-902HD** x 7 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap Cap Storage= +2.8 cf x 2 x 1 rows = 5.5 cf
		984 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	202.50'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 190.00'

Discarded OutFlow Max=0.08 cfs @ 12.56 hrs HW=205.20' (Free Discharge)
1=Exfiltration (Controls 0.08 cfs)

Pond 1P: Recharge#1



Summary for Pond 2P: Recharge #2

Inflow Area = 26,191 sf, 81.82% Impervious, Inflow Depth > 3.37" for 10 Yr event
Inflow = 2.18 cfs @ 12.11 hrs, Volume= 7,365 cf
Outflow = 0.47 cfs @ 12.55 hrs, Volume= 7,363 cf, Atten= 78%, Lag= 26.5 min
Discarded = 0.47 cfs @ 12.55 hrs, Volume= 7,363 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 200.25' @ 12.55 hrs Surf.Area= 1,303 sf Storage= 2,141 cf
Flood Elev= 203.00' Surf.Area= 1,303 sf Storage= 4,157 cf

Plug-Flow detention time= 33.2 min calculated for 7,360 cf (100% of inflow)
Center-of-Mass det. time= 33.0 min (836.8 - 803.8)

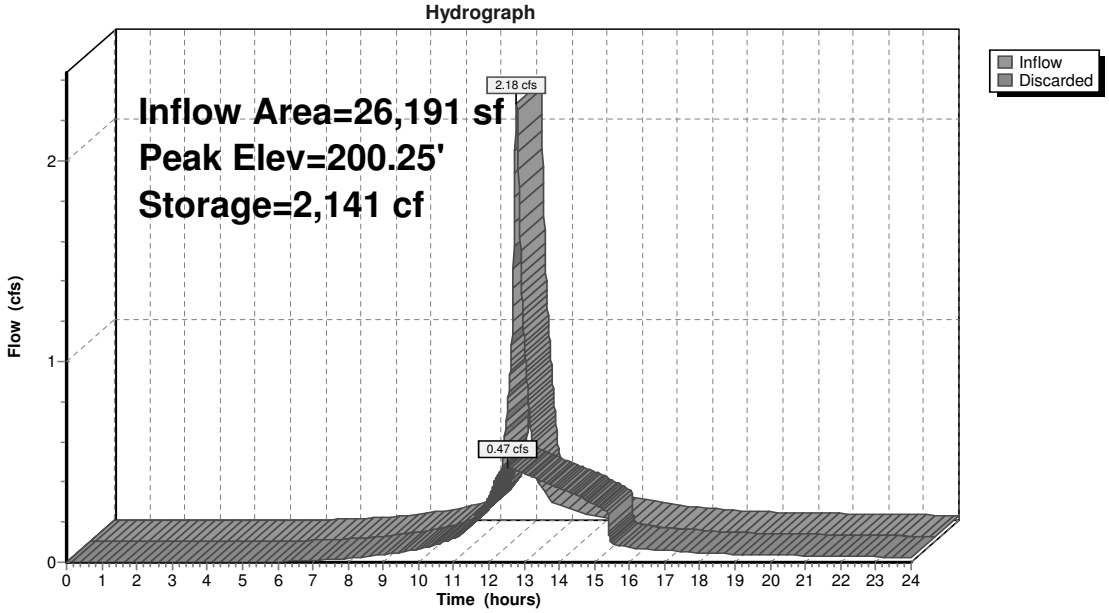
Volume	Invert	Avail.Storage	Storage Description
#1A	197.50'	2,005 cf	**27.50'W x 47.37'L x 5.50'H Field A** 7,164 cf Overall - 2,153 cf Embedded = 5,011 cf x 40.0% Voids
#2A	198.50'	2,153 cf	**Cultec R-902HD** x 33 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 3 Rows of 11 Chambers Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
		4,157 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	197.50'	**8.270 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 192.00'

Discarded OutFlow Max=0.47 cfs @ 12.55 hrs HW=200.25' (Free Discharge)
1=Exfiltration (Controls 0.47 cfs)

Pond 2P: Recharge #2



Summary for Subcatchment E1: PreDev

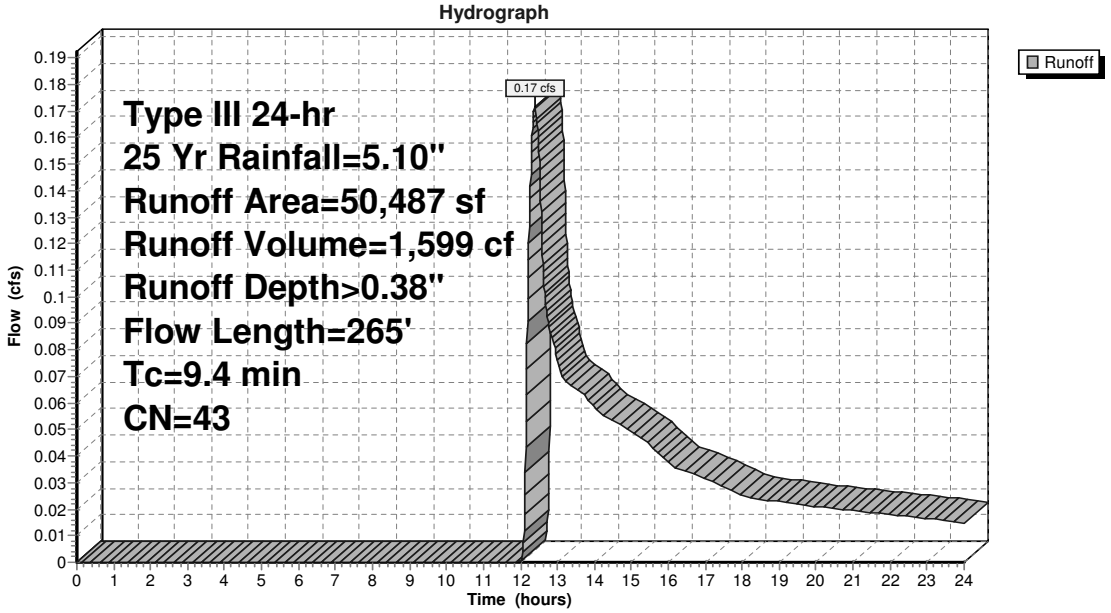
Runoff = 0.17 cfs @ 12.40 hrs, Volume= 1,599 cf, Depth> 0.38"

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 Yr Rainfall=5.10"

	Area (sf)	CN	Description
*	3,491	98	Imp. Surfaces, HSG A
	46,996	39	>75% Grass cover, Good, HSG A
	50,487	43	Weighted Average
	46,996		93.09% Pervious Area
	3,491		6.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0240	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
1.2	100	0.0200	1.41		**Shallow Concentrated Flow, B-C** Nearly Bare & Untilled Kv= 10.0 fps
0.6	115	0.0450	3.18		**Shallow Concentrated Flow, C-D** Grassed Waterway Kv= 15.0 fps
9.4	265	Total			

Subcatchment E1: PreDev



Summary for Subcatchment P1: Roofs 1 & 2

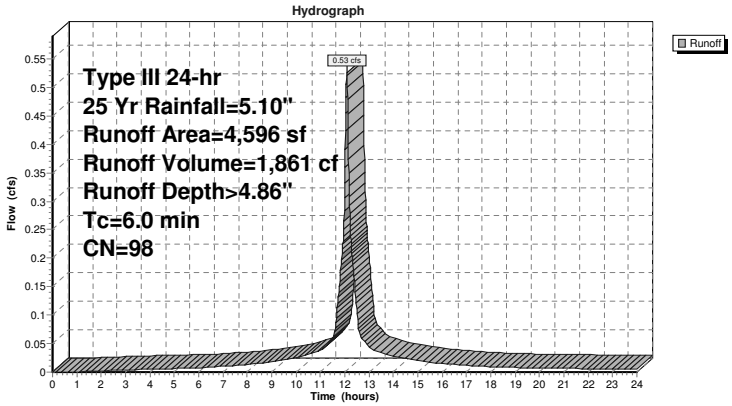
Runoff = 0.53 cfs @ 12.08 hrs, Volume= 1,861 cf, Depth> 4.86"

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 25 Yr Rainfall=5.10"

	Area (sf)	CN	Description
*	4,596	98	Roof, HSG A
	4,596		100.00% Impervious Area

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

Subcatchment P1: Roofs 1 & 2



Summary for Subcatchment P2: Drive & Walks

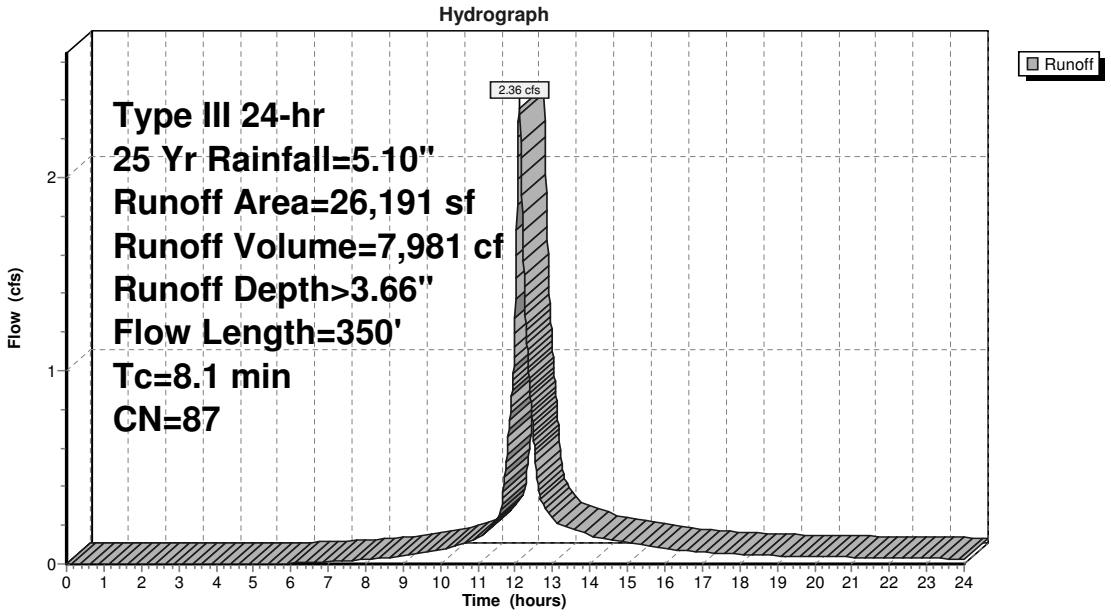
Runoff = 2.36 cfs @ 12.11 hrs, Volume= 7,981 cf, Depth> 3.66"

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 Yr Rainfall=5.10"

	Area (sf)	CN	Description
	4,761	39	>75% Grass cover, Good, HSG A
	16,834	98	Paved parking, HSG A
*	4,596	98	Roof HSG A
	26,191	87	Weighted Average
	4,761		18.18% Pervious Area
	21,430		81.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	25	0.0100	0.07		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
1.9	325	0.0200	2.87		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
8.1	350	Total			

Subcatchment P2: Drive & Walks



Summary for Subcatchment P3: Post Bypass

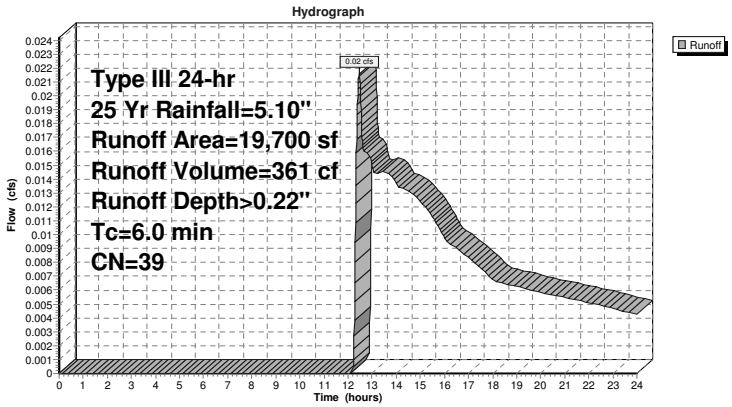
Runoff = 0.02 cfs @ 12.46 hrs, Volume= 361 cf, Depth> 0.22"

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 25 Yr Rainfall=5.10"

Area (sf)	CN	Description
19,700	39	>75% Grass cover, Good, HSG A
19,700		100.00% Pervious Area

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

Subcatchment P3: Post Bypass



Summary for Pond 1P: Recharge#1

Inflow Area = 4,596 sf,100.00% Impervious, Inflow Depth > 4.86" for 25 Yr event
Inflow = 0.53 cfs @ 12.08 hrs, Volume= 1,861 cf
Outflow = 0.08 cfs @ 12.58 hrs, Volume= 1,861 cf, Atten= 86%, Lag= 29.6 min
Discarded = 0.08 cfs @ 12.58 hrs, Volume= 1,861 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 205.42' @ 12.58 hrs Surf.Area= 322 sf Storage= 539 cf
Flood Elev= 207.50' Surf.Area= 322 sf Storage= 920 cf

Plug-Flow detention time= 43.8 min calculated for 1,860 cf (100% of inflow)
Center-of-Mass det. time= 43.6 min (790.7 - 747.1)

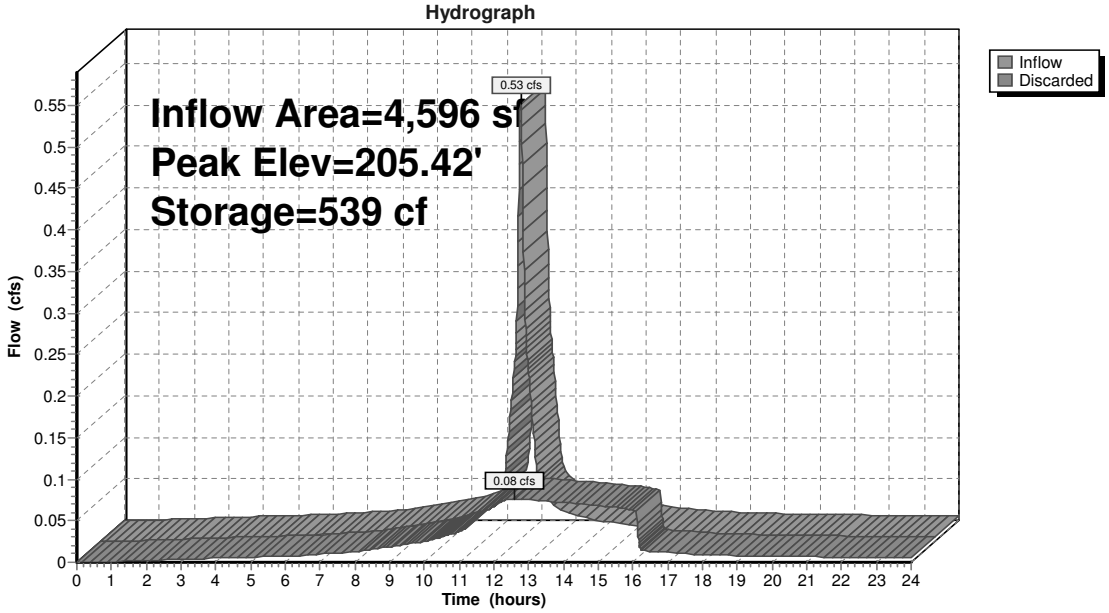
Volume	Invert	Avail.Storage	Storage Description
#1A	202.50'	526 cf	**10.50'W x 30.70'L x 5.50'H Field A** 1,773 cf Overall - 459 cf Embedded = 1,314 cf x 40.0% Voids
#2A	203.50'	459 cf	**Cultec R-902HD** x 7 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap Cap Storage= +2.8 cf x 2 x 1 rows = 5.5 cf
		984 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	202.50'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 190.00'

Discarded OutFlow Max=0.08 cfs @ 12.58 hrs HW=205.42' (Free Discharge)
1=Exfiltration (Controls 0.08 cfs)

Pond 1P: Recharge#1



Summary for Pond 2P: Recharge #2

Inflow Area = 26,191 sf, 81.82% Impervious, Inflow Depth > 3.66" for 25 Yr event
Inflow = 2.36 cfs @ 12.11 hrs, Volume= 7,981 cf
Outflow = 0.49 cfs @ 12.56 hrs, Volume= 7,978 cf, Atten= 79%, Lag= 26.9 min
Discarded = 0.49 cfs @ 12.56 hrs, Volume= 7,978 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 200.52' @ 12.56 hrs Surf.Area= 1,303 sf Storage= 2,374 cf
Flood Elev= 203.00' Surf.Area= 1,303 sf Storage= 4,157 cf

Plug-Flow detention time= 36.0 min calculated for 7,975 cf (100% of inflow)
Center-of-Mass det. time= 35.8 min (837.3 - 801.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	197.50'	2,005 cf	**27.50'W x 47.37'L x 5.50'H Field A** 7,164 cf Overall - 2,153 cf Embedded = 5,011 cf x 40.0% Voids
#2A	198.50'	2,153 cf	**Cultec R-902HD** x 33 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 3 Rows of 11 Chambers Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
		4,157 cf	Total Available Storage

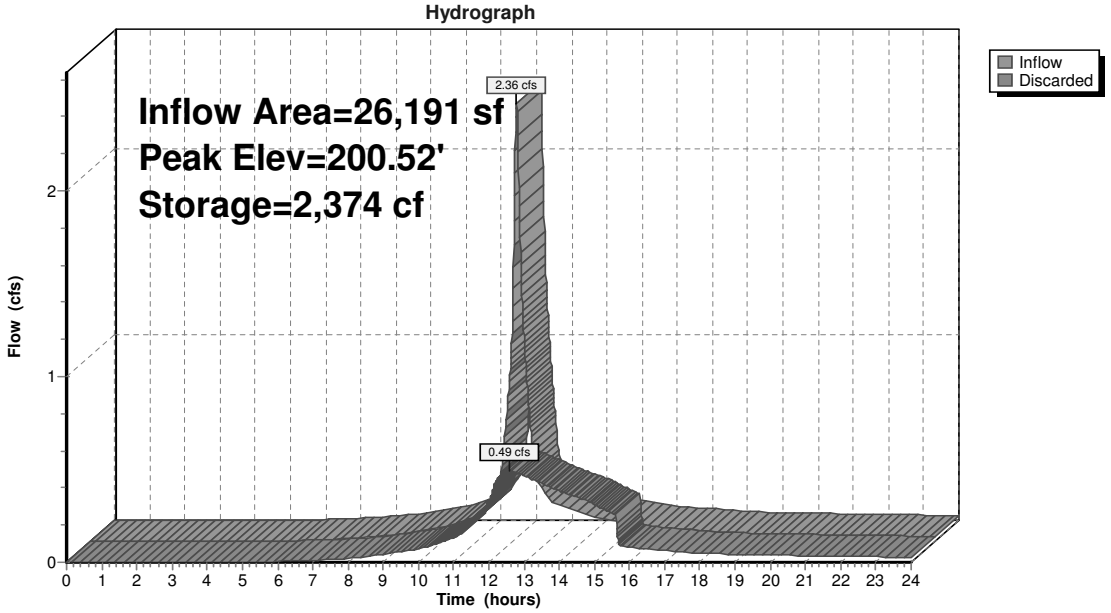
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	197.50'	**8.270 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 192.00'

Discarded OutFlow Max=0.49 cfs @ 12.56 hrs HW=200.52' (Free Discharge)
1=Exfiltration (Controls 0.49 cfs)

Pond 2P: Recharge #2

Hydrograph



Summary for Subcatchment E1: PreDev

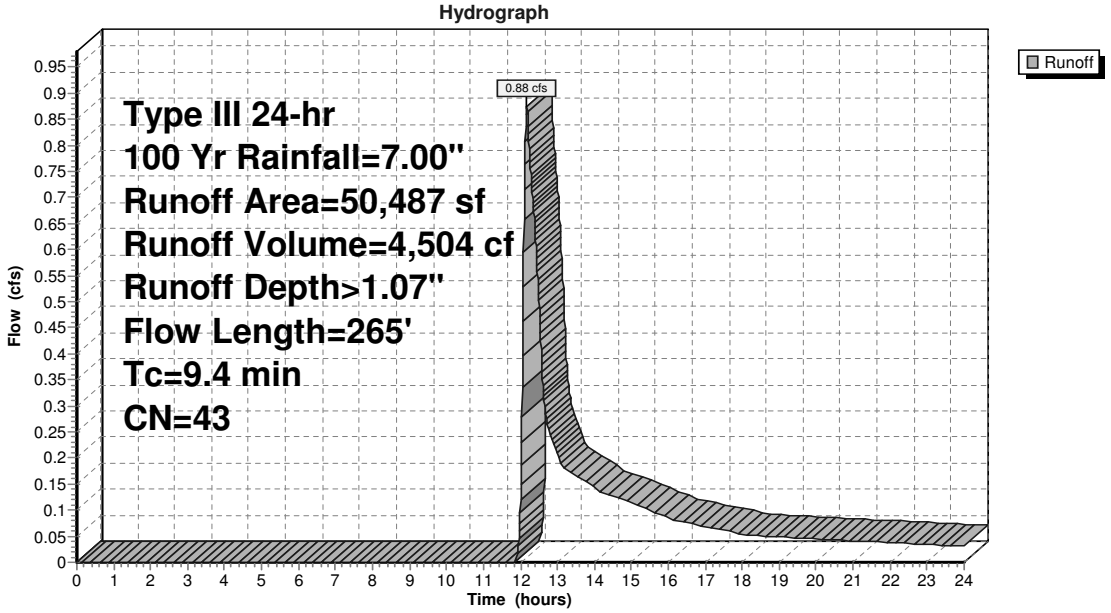
Runoff = 0.88 cfs @ 12.17 hrs, Volume= 4,504 cf, Depth> 1.07"

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 Yr Rainfall=7.00"

	Area (sf)	CN	Description
*	3,491	98	Imp. Surfaces, HSG A
	46,996	39	>75% Grass cover, Good, HSG A
	50,487	43	Weighted Average
	46,996		93.09% Pervious Area
	3,491		6.91% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0240	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
1.2	100	0.0200	1.41		**Shallow Concentrated Flow, B-C** Nearly Bare & Untilled Kv= 10.0 fps
0.6	115	0.0450	3.18		**Shallow Concentrated Flow, C-D** Grassed Waterway Kv= 15.0 fps
9.4	265	Total			

Subcatchment E1: PreDev



Summary for Subcatchment P1: Roofs 1 & 2

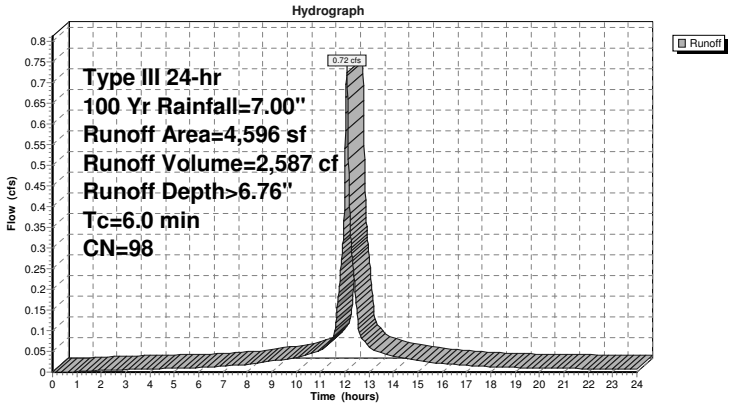
Runoff = 0.72 cfs @ 12.08 hrs, Volume= 2,587 cf, Depth> 6.76"

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 Yr Rainfall=7.00"

	Area (sf)	CN	Description
*	4,596	98	Roof, HSG A
	4,596		100.00% Impervious Area

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

Subcatchment P1: Roofs 1 & 2



Summary for Subcatchment P2: Drive & Walks

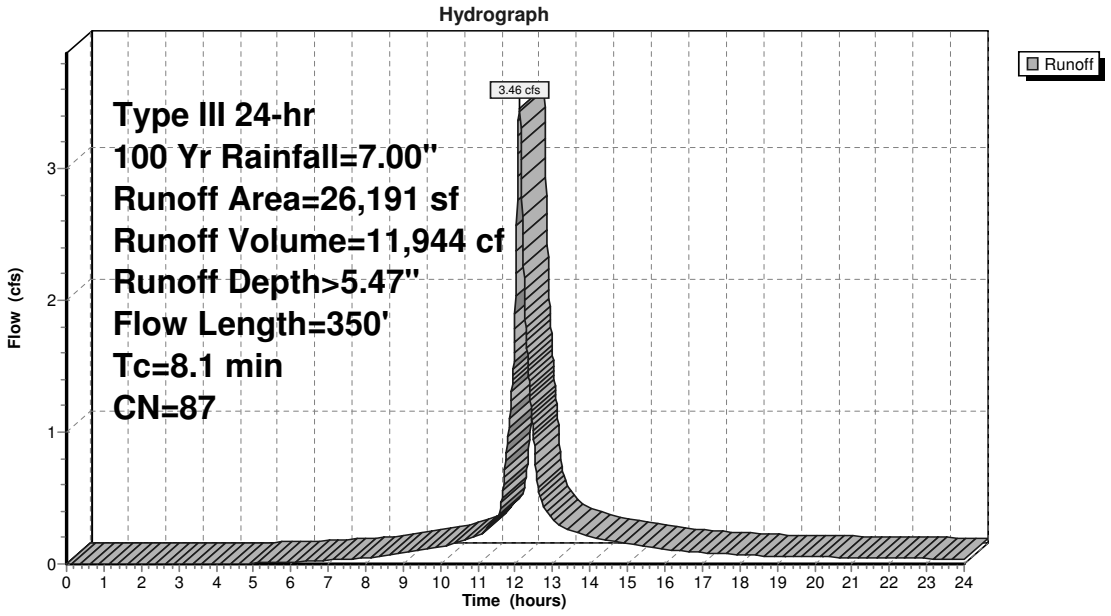
Runoff = 3.46 cfs @ 12.11 hrs, Volume= 11,944 cf, Depth> 5.47"

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 100 Yr Rainfall=7.00"

	Area (sf)	CN	Description
	4,761	39	>75% Grass cover, Good, HSG A
	16,834	98	Paved parking, HSG A
*	4,596	98	Roof HSG A
	26,191	87	Weighted Average
	4,761		18.18% Pervious Area
	21,430		81.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	25	0.0100	0.07		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.20"
1.9	325	0.0200	2.87		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
8.1	350	Total			

Subcatchment P2: Drive & Walks



Summary for Subcatchment P3: Post Bypass

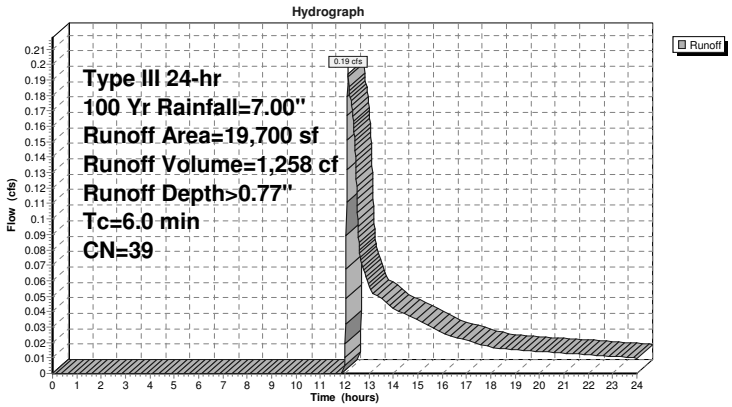
Runoff = 0.19 cfs @ 12.14 hrs, Volume= 1,258 cf, Depth> 0.77"

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 Yr Rainfall=7.00"

Area (sf)	CN	Description
19,700	39	>75% Grass cover, Good, HSG A
19,700		100.00% Pervious Area

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

Subcatchment P3: Post Bypass



Summary for Pond 1P: Recharge#1

Inflow Area = 4,596 sf,100.00% Impervious, Inflow Depth > 6.76" for 100 Yr event
Inflow = 0.72 cfs @ 12.08 hrs, Volume= 2,587 cf
Outflow = 0.08 cfs @ 12.68 hrs, Volume= 2,587 cf, Atten= 88%, Lag= 35.7 min
Discarded = 0.08 cfs @ 12.68 hrs, Volume= 2,587 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 206.96' @ 12.68 hrs Surf.Area= 322 sf Storage= 838 cf
Flood Elev= 207.50' Surf.Area= 322 sf Storage= 920 cf

Plug-Flow detention time= 69.4 min calculated for 2,587 cf (100% of inflow)
Center-of-Mass det. time= 69.2 min (811.6 - 742.4)

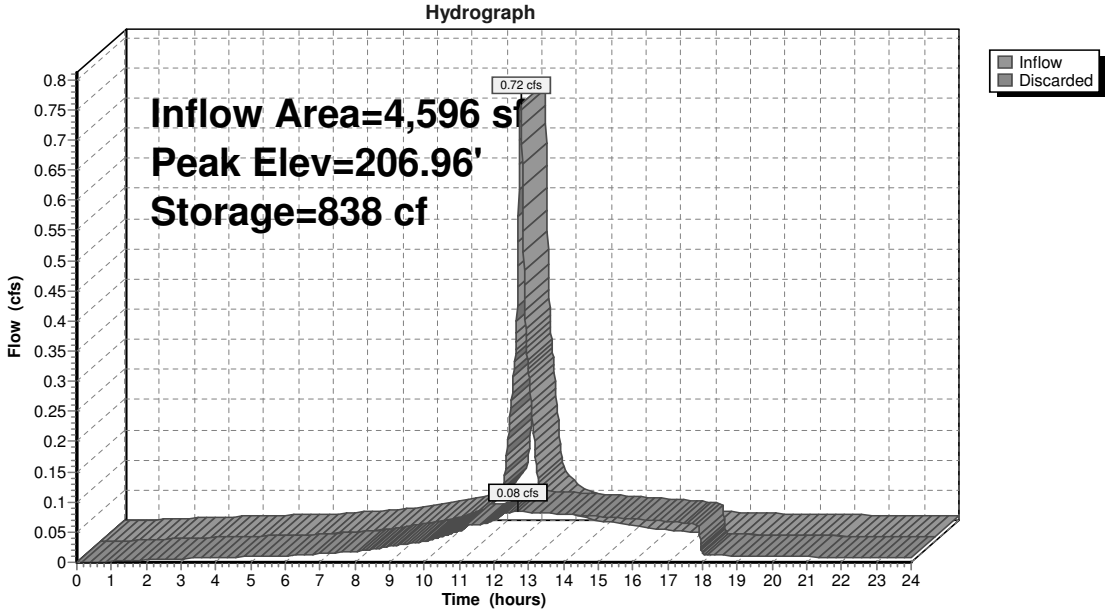
Volume	Invert	Avail.Storage	Storage Description
#1A	202.50'	526 cf	**10.50'W x 30.70'L x 5.50'H Field A** 1,773 cf Overall - 459 cf Embedded = 1,314 cf x 40.0% Voids
#2A	203.50'	459 cf	**Cultec R-902HD** x 7 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap Cap Storage= +2.8 cf x 2 x 1 rows = 5.5 cf
		984 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	202.50'	**8.270 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 190.00'

Discarded OutFlow Max=0.08 cfs @ 12.68 hrs HW=206.96' (Free Discharge)
1=Exfiltration (Controls 0.08 cfs)

Pond 1P: Recharge#1



Summary for Pond 2P: Recharge #2

Inflow Area = 26,191 sf, 81.82% Impervious, Inflow Depth > 5.47" for 100 Yr event
Inflow = 3.46 cfs @ 12.11 hrs, Volume= 11,944 cf
Outflow = 0.67 cfs @ 12.57 hrs, Volume= 11,940 cf, Atten= 81%, Lag= 27.6 min
Discarded = 0.67 cfs @ 12.57 hrs, Volume= 11,940 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 202.50' @ 12.57 hrs Surf.Area= 1,303 sf Storage= 3,894 cf
Flood Elev= 203.00' Surf.Area= 1,303 sf Storage= 4,157 cf

Plug-Flow detention time= 50.3 min calculated for 11,935 cf (100% of inflow)
Center-of-Mass det. time= 50.1 min (840.5 - 790.5)

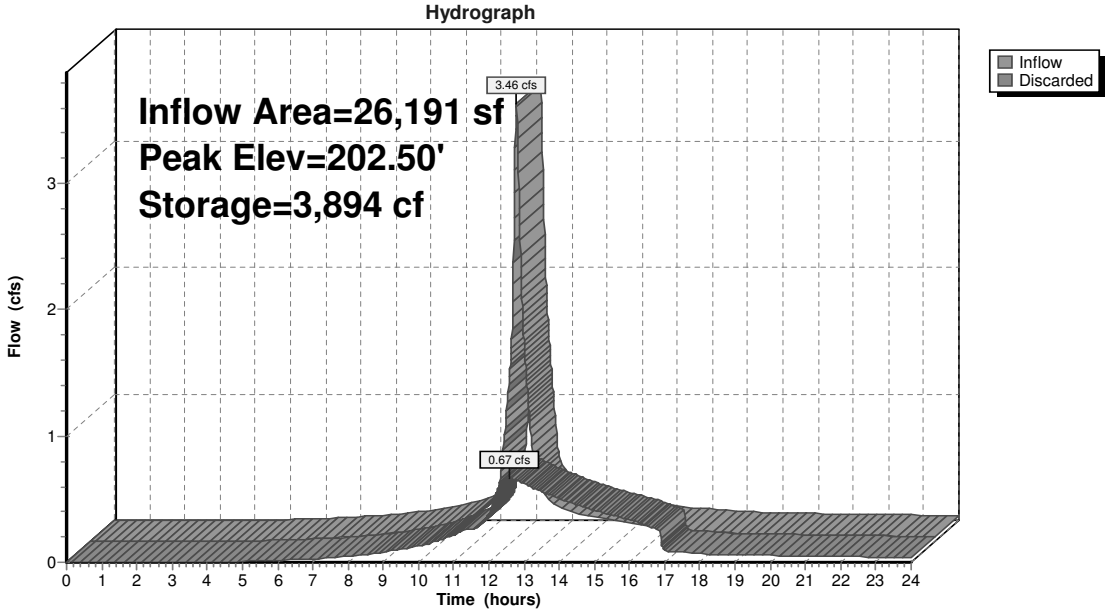
Volume	Invert	Avail.Storage	Storage Description
#1A	197.50'	2,005 cf	**27.50'W x 47.37'L x 5.50'H Field A** 7,164 cf Overall - 2,153 cf Embedded = 5,011 cf x 40.0% Voids
#2A	198.50'	2,153 cf	**Cultec R-902HD** x 33 Inside #1 Effective Size= 69.8"W x 48.0"H => 17.65 sf x 3.67'L = 64.7 cf Overall Size= 78.0"W x 48.0"H x 4.10'L with 0.44' Overlap 3 Rows of 11 Chambers Cap Storage= +2.8 cf x 2 x 3 rows = 16.6 cf
		4,157 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	197.50'	**8.270 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 192.00'

Discarded OutFlow Max=0.67 cfs @ 12.57 hrs HW=202.50' (Free Discharge)
1=Exfiltration (Controls 0.67 cfs)

Pond 2P: Recharge #2



APPENDIX – B

Stormwater Recharge Calculations & Water Quality Volumes
TSS Removal Calculations
Standards 3 & 4

APPENDIX – B
Stormwater Recharge & Water Quality Volume Calculations
Standard 3:

Project:
Moose Hill Condominiums
Walpole MA
Date: March 10, 2020
Revised: May 6, 2021

Impervious Areas*:
Project Site:

Roof:	9,192 sf
Paved:	16,834 sf
Total:	26,026 sf

Impervious Area to Recharge System #1:	4,596 s.f.
Impervious Area to Recharge System #2:	21,430 s.f.
Total Impervious Area to infiltration:	26,026 s.f.

Rv = F * Impervious Area
Rv = Required Recharge Volume
F = Depth Factor

Hydrologic Soils Group Map indicates that the soils in the recharge areas are Hinckley loamy sand . Witnessed on-site soil testing revealed the substratum soils in the areas of the infiltration facilities consisting of sand, and gravel. The required recharge volume was calculated utilizing Hydrologic Soil Group "A".
Soil Type A – Depth Factor = 0.60 inch: Rawls Rate 8.27 inches/hour
Water Quality Volume: 1" Runoff (Rapid infiltration)

Recharge System #1:
Roof: 4,596 s.f
Recharge Volume required:
Rv = (0.60 inch * 4,596 s.f.)/ 12 = **230 c.f.**

Infiltration System #1 (Cultec R-902HD)
"Static" Storage Volume Provided**:**
Total storage volume = 984 cf
984 cf > 230 c.f. ***ok***

Time to drain:
Drawdown time = Volume/(K*Bottom Area)
Volume = 230 cf
K = 8.27 in/hr = 0.69 ft/hr
Bottom Area = 322 sf
Drawdown time = 252 cf / (0.69 ft/hr x 322 sf)
Drawdown time = 1.0 hr < 72 hr ***ok***

Recharge System #2:

Roof:	4,596 s.f.
Pavement:	16,834 s.f.
Impervious Area:	21,430 s.f

Recharge Volume required:
Rv = (0.60inch * 21,430 s.f.)/ 12 = 1,071 c.f.

Infiltration System #2(Cultec R-902HD)
"Static" Storage Volume Provided**:**
Total storage volume provided = 4,157 cf
4,157 cf > 1,071 cf ***ok***

Water Quality Volume(Pavement):
WQV=(1.0 inch * 16,834)/12
WQV= 1,402 cf
4,157 cf > 1,402 cf ***ok***

Time to drain:
Drawdown time = Volume/(K*Bottom Area)
Volume = 80 cf
K = 8.27 in/hr = 0.69 ft/hr
Bottom Area = 1,302 sf
Drawdown time = 1,402 / (0.69 ft/hr x 1,302 sf)
Drawdown time = 1.6 hr < 72 hr ***ok***

INSTRUCTIONS:

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

Non-automated: Mar. 4, 2008

Location: TOTAL REMOVAL

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
DEEP SUMP HOODED C.B	0.25	1.00	.25	0.75
PROPRIETARY CDS UNIT	0.80	0.75	.60	0.15
INFILTRATION SYSTEM	0.80	0.15	.12	0.03

Total TSS Removal = 97%

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

Project: MOOSE HILL
Prepared By: GLM
Date: 5/6/2021

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: REMOVAL PRICE to RECHARGE

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
DEEP SUMP CATCH BASIN	0.25	1.00	.25	0.75
PROPRIETARY UNIT COS	0.80	0.75	0.60	0.15

Total TSS Removal = 85%

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

Project: MOOSE HILL

Prepared By: GLM

Date: 5/6/2021

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

APPENDIX – C

Stormwater Operations & Maintenance Plan

Standard 9

Stormwater Management Operation and Maintenance Plan And Long Term Pollution Prevention Plan

Maintenance Agreement
Moose Hill Condominiums
Walpole, Massachusetts
March 10, 2020
Revised: May 6, 2021

In accordance with Standard 9 of the Massachusetts Department of Environmental Protection Stormwater Handbook (February 2008), the attached on-site maintenance program for the proposed stormwater management system has been developed to ensure the Best Management Practices (BMP's) in place will remain functioning as designed. The landowner/operator, or its successors, of the Project Site, Moose Hill Condominiums, shall be responsible for financing maintenance and emergency repairs of the entire storm water management system on the property. The Plan contains both construction period operations and maintenance as well as post construction responsibilities that shall "run" with the property if ownership is transferred.

Responsible Operator:

RADKE Associates, LLC
Donald Wright
P.O. Box 546
Dover, Massachusetts 02030

Office: 508-785-0066

_____ _____
Donald Wright Date

Estimated Maintenance Yearly Budget:

Annual Catch Basin and Infiltration Chamber Cleaning:	$ 700.00
Repairs:	$ 350.00
Total	$ 1050.00

Construction Period Operation and Maintenance:

Good Housekeeping Practices:

- Remove all debris from site and dispose of in trash dumpsters
- Plan for adequate disposal of scrap, waste and surplus materials
- Keep work area clean
- Secure loose or light material that is stored on the site
- Store flammable materials apart from other materials
- Secure all materials at the end of each work day
- Maintain a clean neat and orderly site

Safety:

Keep safety considerations at the forefront of inspection procedures at all times. Likely hazards should be anticipated and avoided. Never enter a confined space (outlet structure, manhole, etc) without proper training or equipment. A confined space should never be entered without at least one additional person present. If a toxic or flammable substance is discovered, leave the immediate area and contact the local authorities at 911.

All cast iron storm water structure grates and covers shall be kept in good condition and kept closed at all times. Any damaged or broken structures will be replaced immediately upon discovery.

Construction Entrances:

The purpose of stabilizing entrances to a construction site is to minimize the amount of sediment leaving the area as mud and sediment attached to vehicles. The entrances shall be sized according to the Massachusetts DEP and US EPA guidelines and will be maintained on a weekly basis during construction. A Detail is included in the Site Plans prepared for the Project.

Catch Basin Protection:

Temporary inlet protection barriers consisting of Silt Sacks® will be placed within all constructed inlets to prevent inflow of sediments into the constructed drainage system. The barriers shall remain in place until a permanent cover is established or diversions away from the inlets are constructed. The barriers shall be observed and maintained as necessary on a weekly basis and after every rainfall of 0.5 inches or more.

Dust Control:

Soils information for the site indicates that it is comprised of sandy soils. Therefore, Dust control BMPs to reduce surface activities and air movement that causes dust to be generated from disturbed soil surfaces will be required. The preferred measure for dust control is sprinkling/irrigation. This is an on-going/as-needed requirement until surfaces have been stabilized. There shall be a water truck on-site available as needed.

Subsurface Infiltration Chambers:

Rope or fence off the area selected for the infiltration chambers. Stabilize the site prior to installing the subsurface chambers. Do not allow runoff from any disturbed areas on site to flow to the chambers. Never allow construction equipment not performing the excavation to drive across the area where the chambers will be installed. Provide an access port, man-way, and an observation well to enable inspection of water levels within the system. Make the observation well pipe visible at grade. *See the attached Cultec Operations and Maintenance Guidelines for additional information.*

Spill Control:

A contingency plan to address the spillage/release of petroleum products and any hazardous materials will be implemented for the site during construction. The plan will include the following measures:

- Equipment necessary to quickly attend to inadvertent spills or leaks shall be on-site in a secure but accessible location. Such equipment will include, but not be limited to, the following: urethane drain cover seals (mats), a spill containment kit which includes sand and shovels, suitable absorbent materials, storage containers, safety goggles, chemically resistant gloves and overshoe boots, water and chemical fire extinguishers, and first aid equipment.
- Spills or leaks will be treated properly according to material type, volume of spillage and location of spill. Mitigation will include preventing further spillage, containing the spilled material to the smallest practical area, removing spilled material in a safe and environmentally friendly manner, and remediating any damage to the environment.
- The contractor shall be familiar with the reporting requirements of the Massachusetts Contingency Plan (310 CMR 40.00) as issued by the Massachusetts Department of Environmental Protection (DEP); specifically Subpart C Notification of Releases and Threats of Release of Oil and Hazardous Materials and Subpart D Preliminary Response Activities and Risk Reduction Measures.
- For any large spills. The Massachusetts DEP Hazardous Waste Incident Response Group shall be notified immediately at 1-617-792-7653 and an emergency response contractor will be called in.

Post-Construction Period Operation and Maintenance:

Pavement Sweeping:
Sweeping has been shown to be an effective initial treatment for reducing contaminants in stormwater runoff. Sweeping is not required to meet TSS removal goals in this case but should be performed at least once per year, in the spring to remove winter accumulations or at other when warranted.

Gutter Cleaning:
Gutter cleaning shall be done at least once per year, in the fall after the trees have dropped their leaves. Inspect downspouts and overflows periodically to prevent debris buildup.

Deep Sump Catch Basins:
Deep sump catch basins remain effective at removing pollutants only if they are cleaned out frequently. Inspect basins four (4) times per year. Clean sumps whenever the depth of sediment deposits are greater than or equal to one half the depth from the bottom of the invert to the lowest pipe in the basin, at least once (1) time per year, at the end of the foliage and snow removal seasons. Clamshell buckets or vacuum trucks shall be utilized.

Recharge Systems (Infiltration Chambers) :
The inlet pipe and observation access port shall be inspected 4 times per year. Inspect recharge facilities following a rainfall event greater than 2.5 inches in a 24 hour period. Any accumulated debris shall be removed.

If standing water is observed for more than 72 hours following a storm event, immediately retain a qualified professional to assess whether infiltration function has been lost and develop recommended correction actions.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the chambers, clean-out should be performed. Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles.

See the attached Cultec Operations and Maintenance Guidelines for additional information.

Snow Removal and De-icing:
Snow shall be stored in the designated areas shown on the site plans. If snow accumulation exceeds the limits of the storage areas, excess snow shall be removed from the site and disposed of in a proper manner.

The use of Sodium Chloride ("rock salt") for de-icing of paved surfaces will be limited; except when found to be necessary for safety of the residents. Sand will be the primary icing control agent. Alternative de-icing products such as calcium chloride may be used as temperatures or other conditions warrant.

Fertilizer:

Slow release organic fertilizers will be used in landscape areas to limit nutrient transport to groundwater and wetland areas. Application will be limited to 3 lbs. per 1000 sf of lawn area.

Catch Basin and Manhole Maintenance:

Activity	Inspection Frequency
Inspect Units	4 Times per year
Clean Units	Whenever the depth of deposits is greater than ½ the sump depth (1 time per yr minimum)

Street Sweeping:

Activity	Inspection Frequency
Sweeping Paved surfaces	2 time per yr (spring & fall). Sweeping along South Street shall be done when necessary (no tracking of materials onto the street shall be allowed)

CDS Treatment Unit:

Activity	Inspection Frequency
Inspect Inlet and Outlet	2 time per yr. After a heavy rain event 1" storm or larger
Inspect Access Ports for Sediment buildup & Cleanup	2 times per yr. Accumulated sediment buildup shall be Vacuumed cleaned as necessary

Recharge Systems:

Activity	Inspection Frequency
Sediment Removal	Inspect Monthly Remove accumulated sediment buildup Grass Mowing during growing season (Keep grasses no greater than 6 inches & no lower than 3 to 4 inches) *See the attached Cultec Operations and Maintenance Guidelines for additional information.*

Stormwater Operation & Maintenance
Site Inspection Report
Moose Hill Condominiums, Walpole, Massachusetts

General Information			
Project Name	Moose Hill Condominiums, Walpole, MA		
Date of Inspection			
Inspector's Name(s)			
Inspector's Contact Information			
Describe present phase of construction			
Type of Inspection: ❑ Regular ❑ Pre-storm event ❑ During storm event ❑ Post-storm event			
Weather Information			

	Stormwater BMP	Date of Inspection	Operation & Maintenance Activities Performed	Additional Comments
1	Catch Basin #1			
2	CDS Unit #2			
3	Cultec Infiltration System #1			
4	Cultec Infiltration System #2			
5	Access Drive Sweeping			
6	Roof Gutter System			

Non-Compliance

Describe any incidents of non-compliance not described above:

CERTIFICATION STATEMENT

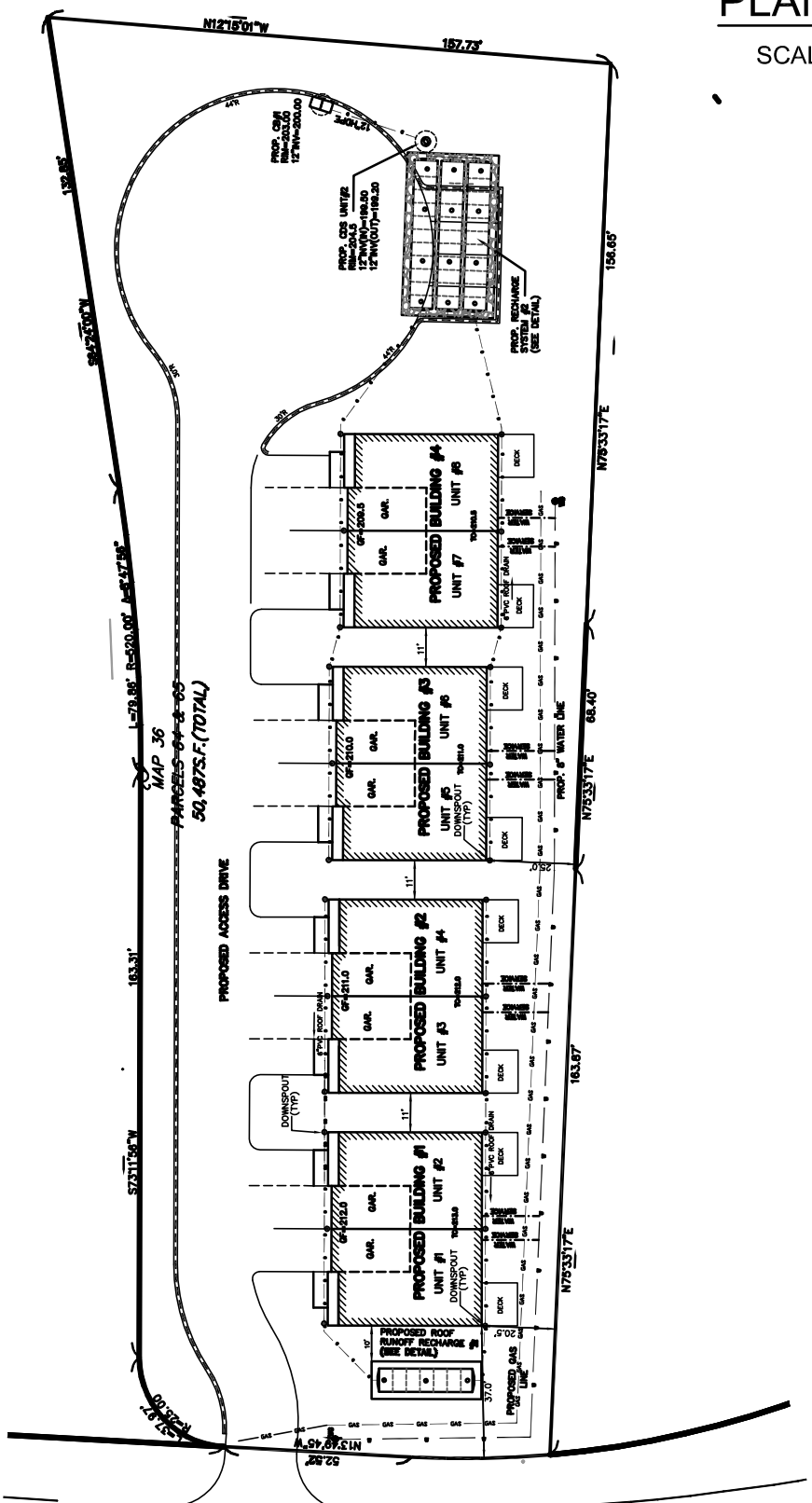
"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name and title: _____

Signature:_____ **Date:**_____

PLAN VIEW

SCALE: 1"=50'



MOOSEHILL ROAD

STORMWATER LOCATION PLAN

"Moose Hill Condominiums"

Walpole, Massachusetts

Date: May 6, 2021

Contactor® & Recharger®
Stormwater Chambers

Operation and Maintenance Guidelines
for CULTEC Stormwater Management Systems

The Founder of Plastic Chamber Technology

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Contact Information:
For general information on our other products and services, please contact our offices within the United States at (800)428-5832, (203)775-4416 ext. 202, or e-mail us at custservice@cultec.com.

For technical support, please call (203)775-4416 ext. 203 or e-mail tech@cultec.com.

Visit www.cultec.com/downloads.html for Product Downloads and CAD details.

Doc ID: CULG008 05-17
May 2017

These instructions are for single-layer traffic applications only. For multi-layer applications, contact CULTEC.
All illustrations and photos shown herein are examples of typical situations. Be sure to follow the engineer's drawings.
Actual designs may vary.

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 pretreatment device). CCTV inspection of this row can be deployed through this access port to deter mine 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.

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)

	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 required.
CULTEC Stormwater Chambers	2 years after commissioning	• 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 commissioning 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 intended.
	45 years after commissioning	• Clean stormwater management chambers and feed connectors of any debris. • Determine the remaining life expectancy of the stormwater management chambers and recommended schedule and actions to rehabilitate the stormwater management chambers as required. • Inspect the interior of the stormwater management chambers for deficiencies using CCTV or comparable technique. • Replace or restore the stormwater management chambers in accordance 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 1st 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.

CONTECH®
ENGINEERED SOLUTIONS

CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

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

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.3	3.0	0.9	1.3	1.0
CDS2020	5	1.3	3.5	1.1	1.3	1.0
CDS2025	5	1.3	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

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

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, earth stabilization and wastewater treament products. For information, visit www.ContechES.com or call 800.338.1122

CONTECH®
ENGINEERED SOLUTIONS
800.925.5240
www.ContechES.com

CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

APPENDIX – D

Illicit Discharge Statement

Standard 10

Illicit Discharge Compliance Statement

Moose Hill Condominiums
Walpole, Massachusetts

March 10, 2020

This statement is provided in accordance with the provisions of the Massachusetts Stormwater Management Standard #10.

To the best of the applicant's/owners knowledge there are no illicit discharges to the site's stormwater manangement system.

All proposed uses on the site will not generate, store or discharge any pollutants to the groundwater and/or wetland resource areas.

Any illicit discharges identified during or after construction will be terminated immediately.

Applicant/Owner:

RADKE Associates, LLC
Attn: Donald Wright
P.O Box 5462
Dover, MA 02030
Phone: 508-785-0066

_____ _____

Donald Wright Date

APPENDIX - E

Stormwater Pollution Prevention Plan

(to be submitted prior to construction)

APPENDIX – F

Checklist for Stormwater Report

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

Checklist for Stormwater Report

A. Introduction

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

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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

☒ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☐ Reduced Impervious Area (Redevelopment Only)

☒ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☐ Use of "country drainage" versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☐ Other (describe): _____

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☐ Static ☒ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

APPENDIX – G

Pre-Development Subcatchment Areas
Post-Development Subcatchment Areas

ASSESSOR'S REFERENCE:
MAP 36, PARCEL 64
MAP 36, PARCEL 65

DEED REFERENCE:
NORFOLK COUNTY REGISTRY OF DEEDS
Bk. 33383, Pg. 249

PLAN REFERENCE:
NORFOLK REGISTRY OF DEEDS
FILE AS No. 773 OF 1992, PLAN BK 410

OWNER OF RECORD:
DONALD WRIGHT &
PATRICIA LOPES
12 HALES HOLLOW
DOVER, MA

ZONING CLASSIFICATION:
RESIDENCE A – RA
LOT AREA: 30,000 S.F.
FRONTAGE: 150 FT.
SETBACKS:
FRONT: 30'
SIDE: 20'
REAR: 30'

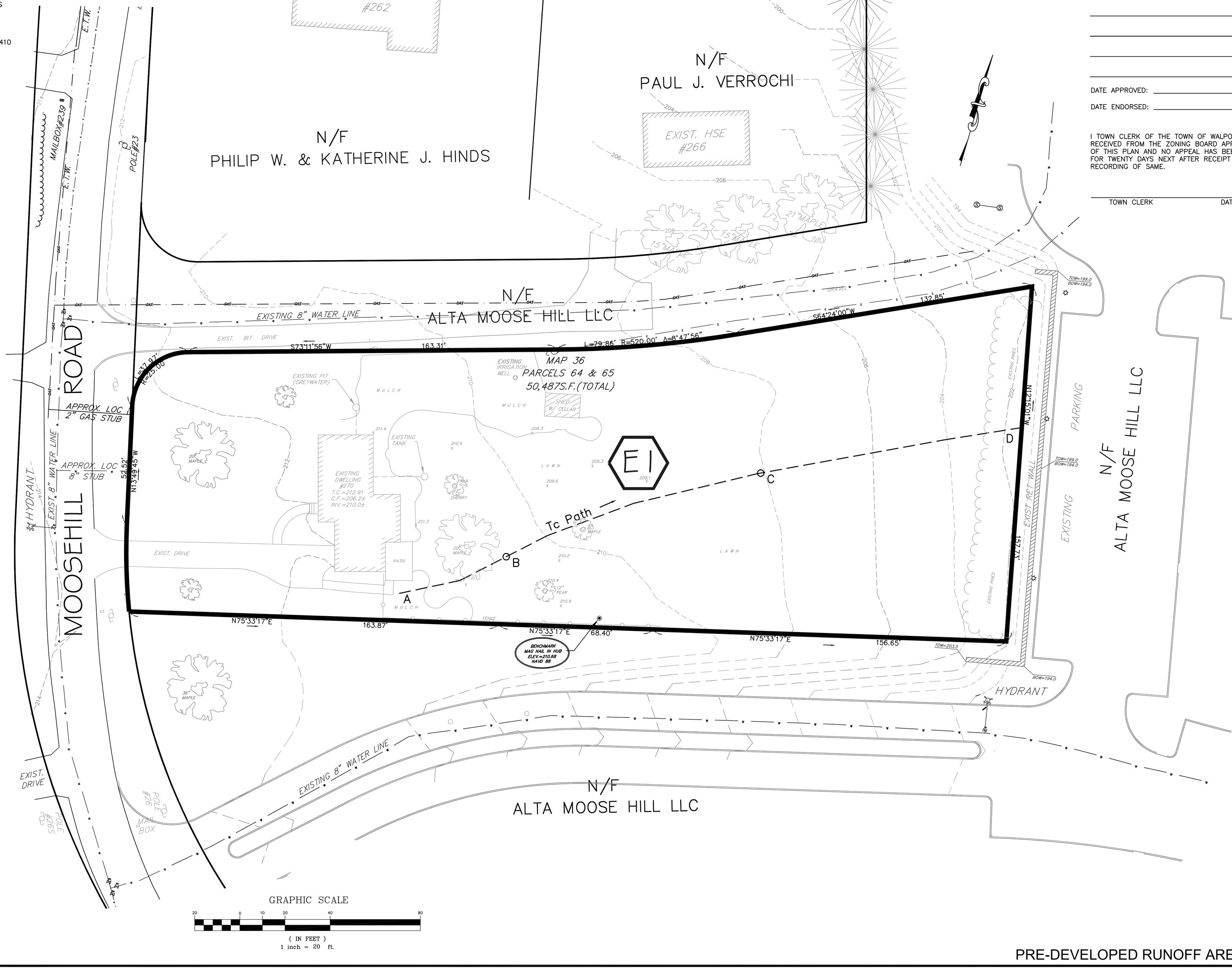
APPROVED BY THE
WALPOLE ZONING BOARD OF APPEALS:

DATE APPROVED: _____

DATE ENDORSED: _____

I TOWN CLERK OF THE TOWN OF WALPOLE, RECEIVED FROM THE ZONING BOARD APPROVAL OF THIS PLAN AND NO APPEAL HAS BEEN TAKEN FOR TWENTY DAYS NEXT AFTER RECEIPT AND RECORDING OF SAME.

TOWN CLERK DATE



GRAPHIC SCALE
20 0 10 20 40 80
(IN FEET)
1 inch = 20 ft.

PRE-DEVELOPED RUNOFF AREA

REVISIONS		
No.	DATE	DESCRIPTION
1	5/06/2021	ZBA Review Comments

JOYCE E. HASTINGS P.L.S.

SITE DEVELOPMENT PLAN
A COMPREHENSIVE PERMIT M.G.L.c. 40B
"MOOSE HILL CONDOMINIUMS"
WALPOLE, MASSACHUSETTS

PREPARED FOR:
RADKE ASSOCIATES, LLC
P.O. BOX 546
DOVER, MA 02030

GLM Engineering Consultants, Inc.
19 EXCHANGE STREET
HOLLISTON, MA 01746
P: 508-429-1100
F: 508-429-7160
www.GLMengineering.com

DRW.:	RST
JOB No.	15,733-A
DATE:	MARCH 10, 2020
SCALE:	1"=20'
SHEET:	1 of 2
PLAN #:	27,178

LEGEND:

- EXISTING CONTOUR
- EXISTING SPOT ELEVATION
- EXISTING WATER GATE
- EXISTING TREE LINE
- EXISTING TEST PIT LOCATION
- EXISTING UTILITY POLE
- EXISTING HYDRANT
- EXISTING GAS LINE
- EXISTING WATER LINE
- PROPOSED CONTOUR
- PROPOSED SPOT ELEVATION
- PROPOSED DRAIN MANHOLE
- PROPOSED CATCH BASIN
- PROPOSED WATER LINE
- PROPOSED STREET TREE
- PROPOSED CAPE COD BERM
- PROPOSED GAS LINE

APPROVED BY THE
WALPOLE ZONING BOARD OF APPEALS:

DATE APPROVED: _____

DATE ENDORSED: _____

I TOWN CLERK OF THE TOWN OF WALPOLE, RECEIVED FROM THE ZONING BOARD APPROVAL OF THIS PLAN AND NO APPEAL HAS BEEN TAKEN FOR TWENTY DAYS NEXT AFTER RECEIPT AND RECORDING OF SAME.

TOWN CLERK DATE

EXIST. HSE #262

N/F
PAUL J. VERROCHI

EXIST. HSE #266

N/F
PHILIP W. & KATHERINE J. HINDS

EXIST. HSE #241

EXIST. HSE #261

MOOSEHILL ROAD

MAILBOX#239

POLE#23

E.T.W.

HYDRANT

EXIST. 8" WATER LINE

APPROX. LOC 2" GAS STUB

APPROX. LOC 8" STUB

N/F
ALTA MOOSE HILL LLC

PROPOSED TEMPORARY CHAINLINK CONSTRUCTION FENCE

EXISTING 8" WATER LINE

EXIST. BIT. DRIVE

PROPOSED EROSION CONTROL

C.C. BERM

PROPOSED ONSITE SEWAGE DISPOSAL AREA

PROPOSED ACCESS DRIVE

DOWNSPOUT (TYP)

ROOF DRAIN

Tc Flow Path

PROPOSED BUILDING #1
UNIT #1 UNIT #2
GF=212.0
TC=212.0

PROPOSED BUILDING #2
UNIT #3 UNIT #4
GF=211.0
TC=212.0

PROPOSED BUILDING #3
UNIT #5 UNIT #6
GF=210.0
TC=211.0

PROPOSED BUILDING #4
UNIT #7 UNIT #8
GF=209.5
TC=210.5

P1 P2 P3

PROPOSED ROOF RECHARGE #1 (SEE DETAIL)

PROPOSED GAS LINE

6" PVC ROOF DRAIN

DECK

WATER SERVICE

PROP. 8" WATER LINE

PROPOSED EROSION CONTROL

PROP. CB#1
RIM=203.00
12"INV=200.00

PROP. CDS UNIT#2
RIM=204.5
12"INV(IN)=199.50
12"INV(OUT)=199.20

VISITOR PARKING (TYP)

PROP. RECHARGE SYSTEM #2 (SEE DETAIL)

EXIST. RET. WALL

EXISTING PINES

PARKING

EXISTING

TOW=199.0
BOW=194.0

TOW=203.5
BOW=194.0

BENCHMARK
MAG NAIL IN HUB
ELEV.=210.68
NAVD 88

EXIST. DRIVE

POLE #26

MAIL BOX

POLE #98

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 20 ft.

POST DEVELOPED RUNOFF AREAS

REVISIONS		
No.	DATE	DESCRIPTION
1	5/06/2021	ZBA Review Comments

SITE DEVELOPMENT PLAN
A COMPREHENSIVE PERMIT M.G.L.c. 40B
"MOOSE HILL CONDOMINIUMS"
WALPOLE, MASSACHUSETTS

PREPARED FOR:
RADKE ASSOCIATES, LLC
P.O. BOX 546
DOVER, MA 02030

GLM Engineering Consultants, Inc.
19 EXCHANGE STREET
HOLLISTON, MA 01746
P: 508-429-1100
F: 508-429-7160
www.GLMengineering.com

DRW.:	RST
JOB No.	15,733-A
DATE:	MARCH 10, 2020
SCALE:	1"=20'
SHEET:	2 of 2
PLAN #:	27,178