

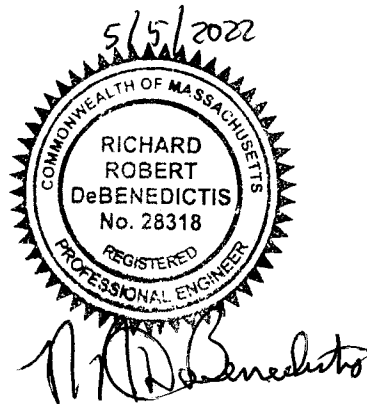
**Town of Cohasset
Stormwater Management Rules and Regulations**

Stormwater Management Summary Form

Applicant: _____ Project Name: 46 Black Rock Road
 Stormwater Plan Prepared by: Webby Engineering
 Sub-watershed # _____

Hydrologic Item	Pre-development	Post-Development
Runoff Curve Number	42	41
Time of Concentration	20.9 min.	20.9 min.
Peak Rate 2 yr	0.00 cfs	0.00 cfs
Peak Rate 10 yr	0.03 cfs	0.02 cfs
Peak Rate 100 yr	0.29 cfs	0.22 cfs
Volume 2 yr	0.001 af	0.000 af
Volume 10 yr	0.013 af	0.009 af
Volume 100 yr	0.049 af	0.040 af
Sq. ft. Impervious Area and Percent Impervious	2,168 S.F. (imp) 7.00% of imp.	6,199 S.F. (imp) 19.97% of imp.
Water Quality Volume (per MADEP Stormwater Policy)	XXXXXXXXXXXX	

Drainage Report
and
Calculations
for
46 Black Rock Road
in
Cohasset, MA



Date: April 25, 2022

Prepared by:

Webby Engineering Associates, Inc.
180 County Road
Plympton, MA

Prepared for:

29 Marion Drive LLC
147 Summer Street
Kingston, MA 02364

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SECTION ONE

DRAINAGE REPORT

BACKGROUND INFORMATION

Both the rate and volume of stormwater runoff, resulting from site construction at 46 Black Rock Road in Cohasset Ma has been calculated using the TR-20 method. The design of the Infiltration basin is based on these calculations. The overall drainage design incorporates the general recommendations and accepted Best Management Practices (BMP's) outlined in *STORMWATER MANAGEMENT Volume two: Stormwater Technical Handbook, February 2008 prepared by MA Department of Environmental Protection and MA Department of Coastal Zone Management.*

EXISTING SITE CONDITIONS

The existing site is located on the east side of Black Rock Road in Cohasset MA. The property is a 30,994 s.f., single family lot consisting of a combination of lawn and woods, crushed shell driveway and walkway, a dwelling and a garage. The land slopes down towards the front of the lot to the roadway.

DRAINAGE DESIGN

The applicant is proposing to add an addition and deck to the existing dwelling replace the existing garage with a new detached garage and replace a portion of crushed shell driveway with paved parking. The drainage system proposed is designed to handle 100 year storm event and designated to recharge back to watershed for the new pavement and garage.

Components of the existing drainage system servicing the pavement include the following:

- Subsurface drainage Basin

SCS TR-20 STORMWATER RUNOFF

Stormwater runoff for pre and post-development of the site has been computed using *HydroCAD*® *Stormwater Modeling System Version-8* for 2, 10, 25 and 100-year storm events. Rainfall distribution is based on a type III storm distribution; rainfall intensity is based on USDA, SCS Precipitation Values for Massachusetts TP-40 which is as follows for the storm events indicated:

- 2-yr 24 hour storm 3.4 inches
- 10-yr 24 hour storm 4.8 inches
- 25-yr 24 hour storm 5.6 inches
- 100-yr 24 hour storm 7.0 inches

Site soils have been classified, using *Soil Survey Plymouth County Massachusetts, USDA Soil Conservation Service*. These classifications have been field verified and assigned runoff curve numbers (RCN) for the following site conditions:

- Paved parking lot / Roof 98-RCN
- Gravel Area 76-RCN
- Grass / Woods 32-RCN

STORMWATER MANAGEMENT STANDARDS AND COMPLIANCE

The drainage design as proposed is in compliance with the Stormwater Management Standards (SMS) issued by the Massachusetts Department of Environmental Protection (DEP).

These policies are incorporated into ten standards, which are outlined below, is presented as follows:

Standard #1: Untreated Stormwater

SMS requires treatment of new stormwater discharges. This standard does not apply to this project.

Standard #2: Post-Development Peak Discharge Rates

SMS requires that the post development peak discharge rates do not exceed pre-development peak discharge rates. As shown in the hydrocad calculations, there are no increases to the peak discharge of the post development site. The Reduction in runoff has been achieved for the 2, 10 and 100-year storm events. Summaries of the runoff calculations are provided in Section Two of this report.

Standard #3: Recharge to Groundwater

SMS requires that loss of annual recharge to groundwater should be minimized through the use of infiltration measures to the maximum extent possible. As designed, the drainage system recharges all of the increases in stormwater runoff.

Standard #4: Removal of 80% Total Suspended Solids (TSS)

SMS requires that for new development stormwater management systems remove 80% of the annual average load of TSS. This standard does not apply to this project.

Standard #5: Land Uses with Higher Potential Pollutant Loads

The development as proposed, does not qualify as land use with a higher potential pollutant load.

Standard #6: Critical Areas

SMS requires that the stormwater discharge to critical areas i.e. Outstanding Resource Waters, shellfish beds, swimming beaches, cold water fisheries and recharge areas for public water supplies use approved BMPs. This project does not lie in a critical area.

Standard #7: Redevelopment

SMP requires that redevelopment of previously developed sites must meet the Stormwater Management Standards to the maximum extent practicable. This project is not a redevelopment.

Standard #8: Erosion and Sedimentation Control

SMS requires the implementation of erosion and sedimentation control during construction and/or land disturbance activities. This project will employ proper erosion and sedimentation control.

Standard #9: Operation & Maintenance Plan

SMS requires a written operation and maintenance plan be in place for the proposed drainage system. An operation and maintenance plan will be provided.

Standard #10: Illicit discharges

SMS prohibits all illicit discharges to the stormwater management system. This site is a gravel pit, and there are no known illicit discharges on site.

MITIGATION

As designed, the drainage system will reduce the peak rate of runoff and the volume of runoff to pre-development values. Runoff from the new garage and pavement will be recharged back into groundwater through the use of a subsurface basin.

SECTION TWO

DRAINAGE CALCULATIONS
USING
TR-20 METHOD

46 BLACK ROCK ROAD COHASSET

Type III 24-hr 2 YEAR Rainfall=3.20"

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Subcatchment E1: Existing

Runoff = 0.00 cfs @ 21.76 hrs, Volume= 0.001 af, Depth> 0.01"

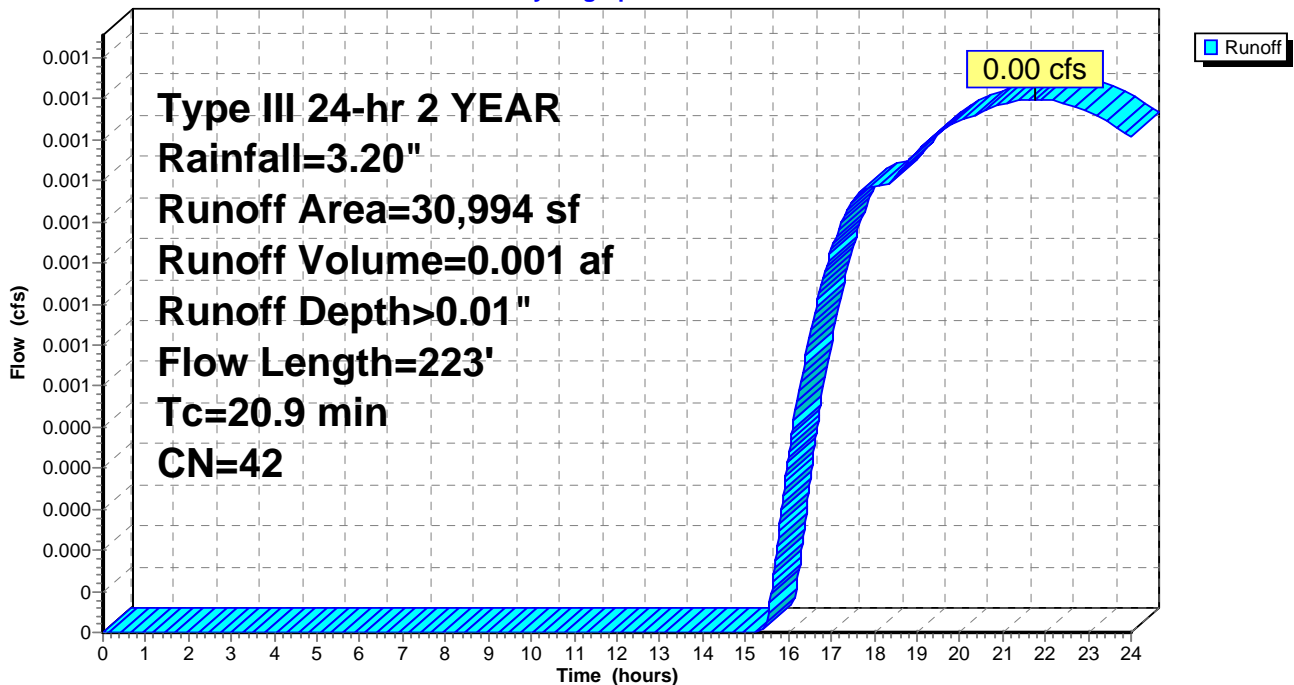
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YEAR Rainfall=3.20"

Area (sf)	CN	Description
2,168	98	Paved parking & roofs
3,657	76	Gravel roads, HSG A
25,169	32	Woods/grass comb., Good, HSG A
30,994	42	Weighted Average
28,826		Pervious Area
2,168		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.8	50	0.0300	0.04		Sheet Flow, Grass/Woods Woods: Light underbrush n= 0.400 P2= 1.00"
2.1	173	0.0370	1.35		Shallow Concentrated Flow, Lawn Short Grass Pasture Kv= 7.0 fps
20.9	223	Total			

Subcatchment E1: Existing

Hydrograph



46 BLACK ROCK ROAD COHASSET

Type III 24-hr 10 YEAR Rainfall=4.60"

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Subcatchment E1: Existing

Runoff = 0.03 cfs @ 12.68 hrs, Volume= 0.013 af, Depth> 0.21"

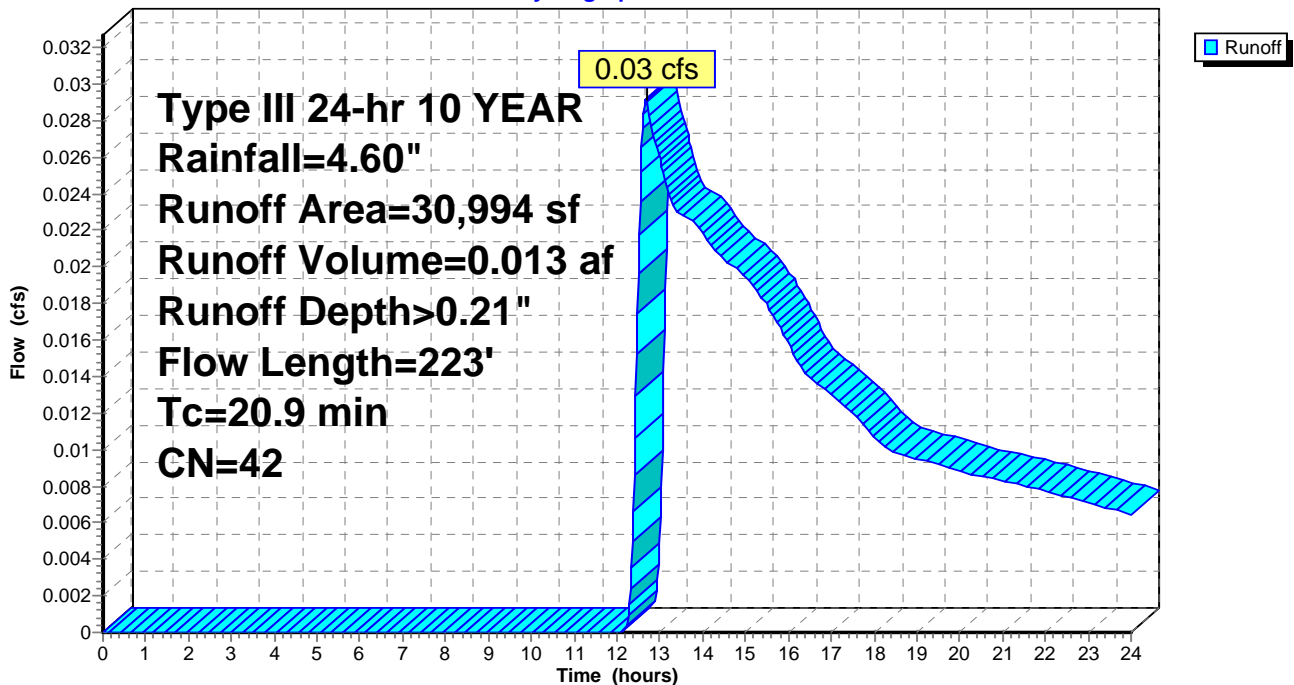
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YEAR Rainfall=4.60"

Area (sf)	CN	Description
2,168	98	Paved parking & roofs
3,657	76	Gravel roads, HSG A
25,169	32	Woods/grass comb., Good, HSG A
30,994	42	Weighted Average
28,826		Pervious Area
2,168		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.8	50	0.0300	0.04		Sheet Flow, Grass/Woods Woods: Light underbrush n= 0.400 P2= 1.00"
2.1	173	0.0370	1.35		Shallow Concentrated Flow, Lawn Short Grass Pasture Kv= 7.0 fps
20.9	223	Total			

Subcatchment E1: Existing

Hydrograph



46 BLACK ROCK ROAD COHASSET

Type III 24-hr 100 YEAR Rainfall=6.60"

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Subcatchment E1: Existing

Runoff = 0.29 cfs @ 12.44 hrs, Volume= 0.049 af, Depth> 0.83"

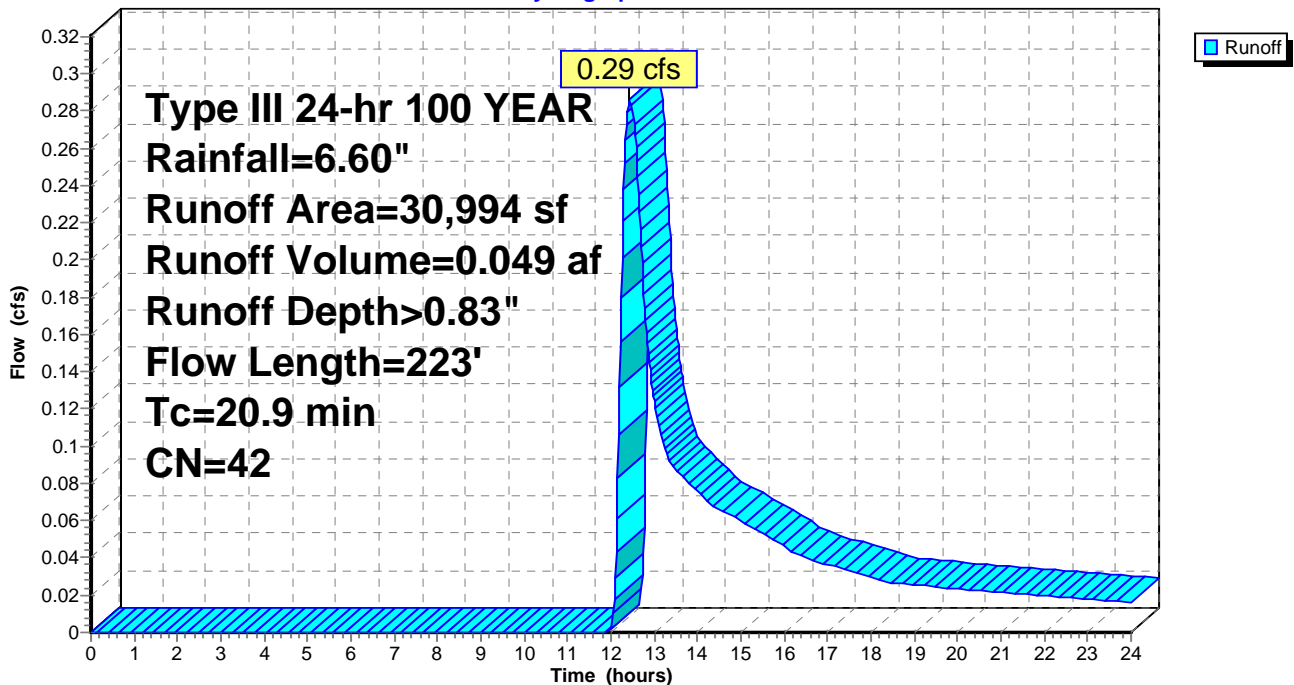
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YEAR Rainfall=6.60"

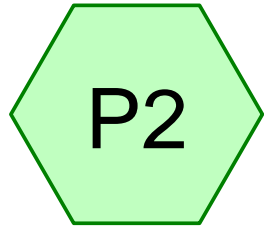
Area (sf)	CN	Description
2,168	98	Paved parking & roofs
3,657	76	Gravel roads, HSG A
25,169	32	Woods/grass comb., Good, HSG A
30,994	42	Weighted Average
28,826		Pervious Area
2,168		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.8	50	0.0300	0.04		Sheet Flow, Grass/Woods Woods: Light underbrush n= 0.400 P2= 1.00"
2.1	173	0.0370	1.35		Shallow Concentrated Flow, Lawn Short Grass Pasture Kv= 7.0 fps
20.9	223	Total			

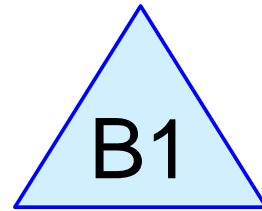
Subcatchment E1: Existing

Hydrograph

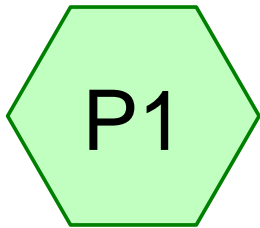




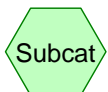
Garage / Pavement



Drain Basin



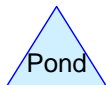
Remaining Area



Subcat



Reach



Pond



Link

46 BLACK ROCK ROAD COHASSET

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Area Listing (selected nodes)

<u>Area (acres)</u>	<u>CN</u>	<u>Description (subcats)</u>
0.525	32	Woods/grass comb., Good, HSG A (P1)
0.044	76	Gravel roads, HSG A (P1)
0.046	98	Paved parking (P2)
0.057	98	Paved parking & roofs (P1)
0.039	98	Roofs (P2)
<hr/>		
0.712		

46 BLACK ROCK ROAD COHASSET

Type III 24-hr 2 YEAR Rainfall=3.20"

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Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Remaining Area

Runoff Area=27,308 sf Runoff Depth>0.01"

Flow Length=223' Tc=20.9 min CN=41 Runoff=0.00 cfs 0.000 af

Subcatchment P2: Garage / Pavement

Runoff Area=3,686 sf Runoff Depth>2.96"

Flow Length=200' Tc=9.9 min CN=98 Runoff=0.23 cfs 0.021 af

Pond B1: Drain Basin

Peak Elev=81.58' Storage=121 cf Inflow=0.23 cfs 0.021 af

Outflow=0.09 cfs 0.021 af

Total Runoff Area = 0.712 ac Runoff Volume = 0.021 af Average Runoff Depth = 0.36"
80.03% Pervious Area = 0.569 ac 19.97% Impervious Area = 0.142 ac

46 BLACK ROCK ROAD COHASSET

Type III 24-hr 2 YEAR Rainfall=3.20"

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Subcatchment P1: Remaining Area

Runoff = 0.00 cfs @ 22.92 hrs, Volume= 0.000 af, Depth> 0.01"

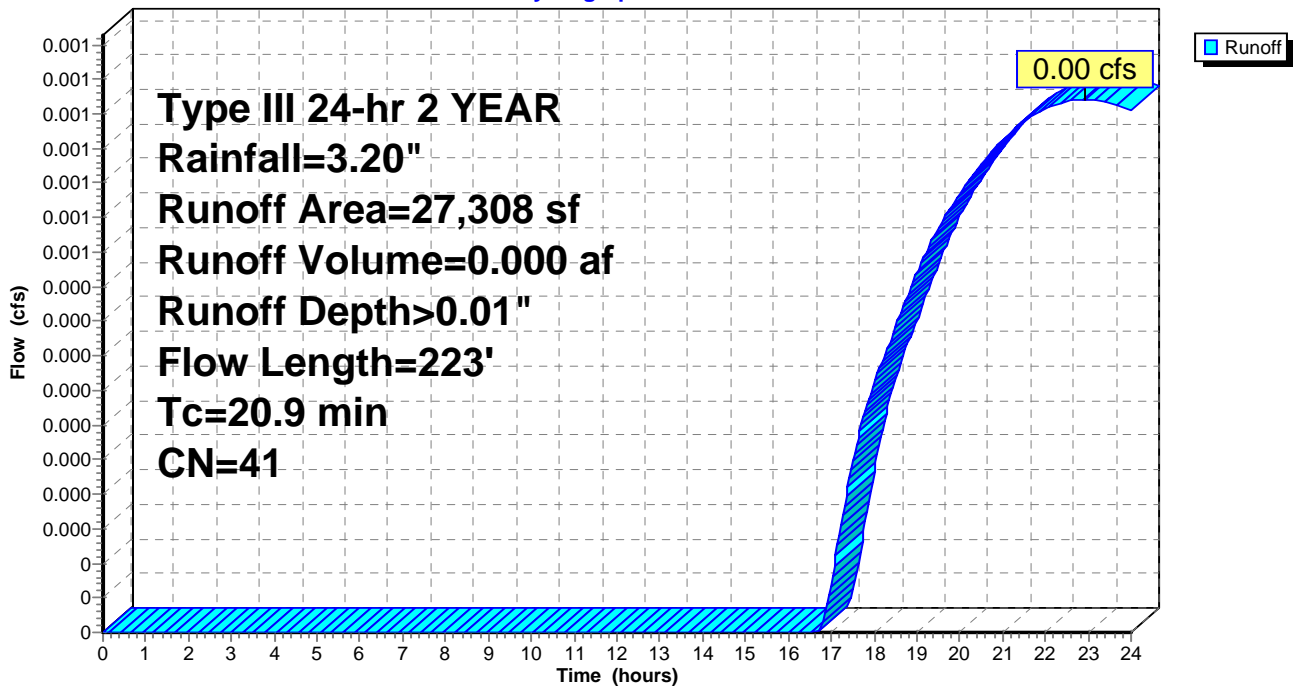
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YEAR Rainfall=3.20"

Area (sf)	CN	Description
2,504	98	Paved parking & roofs
1,931	76	Gravel roads, HSG A
22,873	32	Woods/grass comb., Good, HSG A
27,308	41	Weighted Average
24,804		Pervious Area
2,504		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.8	50	0.0300	0.04		Sheet Flow, Grass/Woods Woods: Light underbrush n= 0.400 P2= 1.00"
2.1	173	0.0370	1.35		Shallow Concentrated Flow, Lawn Short Grass Pasture Kv= 7.0 fps
20.9	223	Total			

Subcatchment P1: Remaining Area

Hydrograph



46 BLACK ROCK ROAD COHASSET

Type III 24-hr 2 YEAR Rainfall=3.20"

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Subcatchment P2: Garage / Pavement

Runoff = 0.23 cfs @ 12.13 hrs, Volume= 0.021 af, Depth> 2.96"

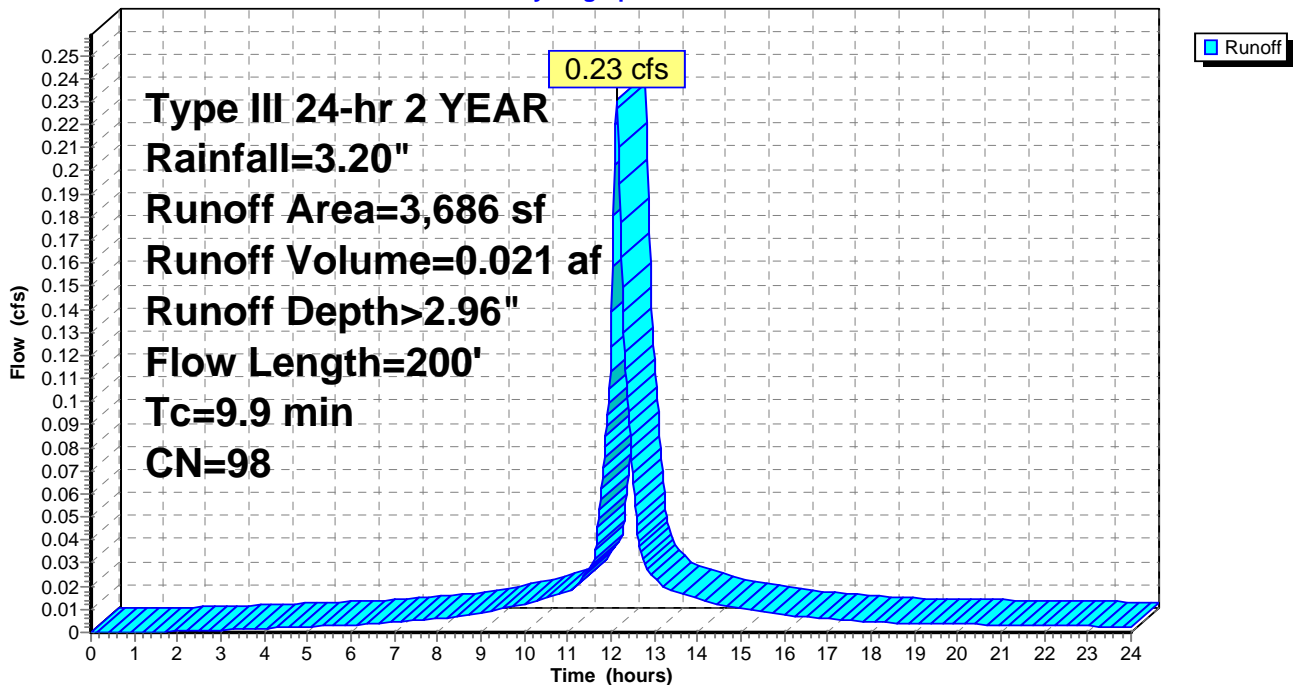
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 2 YEAR Rainfall=3.20"

Area (sf)	CN	Description
1,685	98	Roofs
2,001	98	Paved parking
3,686	98	Weighted Average
3,686		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	50	0.1000	0.11		Sheet Flow, GRASS Grass: Dense n= 0.240 P2= 1.00"
0.4	35	0.1100	1.66		Shallow Concentrated Flow, WOODS Woodland Kv= 5.0 fps
1.8	115	0.0440	1.05		Shallow Concentrated Flow, WOODS Woodland Kv= 5.0 fps
9.9	200	Total			

Subcatchment P2: Garage / Pavement

Hydrograph



46 BLACK ROCK ROAD COHASSET

Type III 24-hr 2 YEAR Rainfall=3.20"

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Pond B1: Drain Basin

Inflow Area = 0.085 ac, Inflow Depth > 2.96" for 2 YEAR event
 Inflow = 0.23 cfs @ 12.13 hrs, Volume= 0.021 af
 Outflow = 0.09 cfs @ 11.92 hrs, Volume= 0.021 af, Atten= 62%, Lag= 0.0 min
 Discarded = 0.09 cfs @ 11.92 hrs, Volume= 0.021 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs / 2
 Peak Elev= 81.58' @ 12.43 hrs Surf.Area= 460 sf Storage= 121 cf

Plug-Flow detention time= 6.1 min calculated for 0.021 af (100% of inflow)
 Center-of-Mass det. time= 5.8 min (764.9 - 759.1)

Volume	Invert	Avail.Storage	Storage Description
#1	81.00'	293 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 943 cf Overall - 209 cf Embedded = 734 cf x 40.0% Voids
#2	81.50'	209 cf	32.1"W x 12.0"H x 7.50"L Cultec C-100 x 15 Inside #1
		503 cf	Total Available Storage

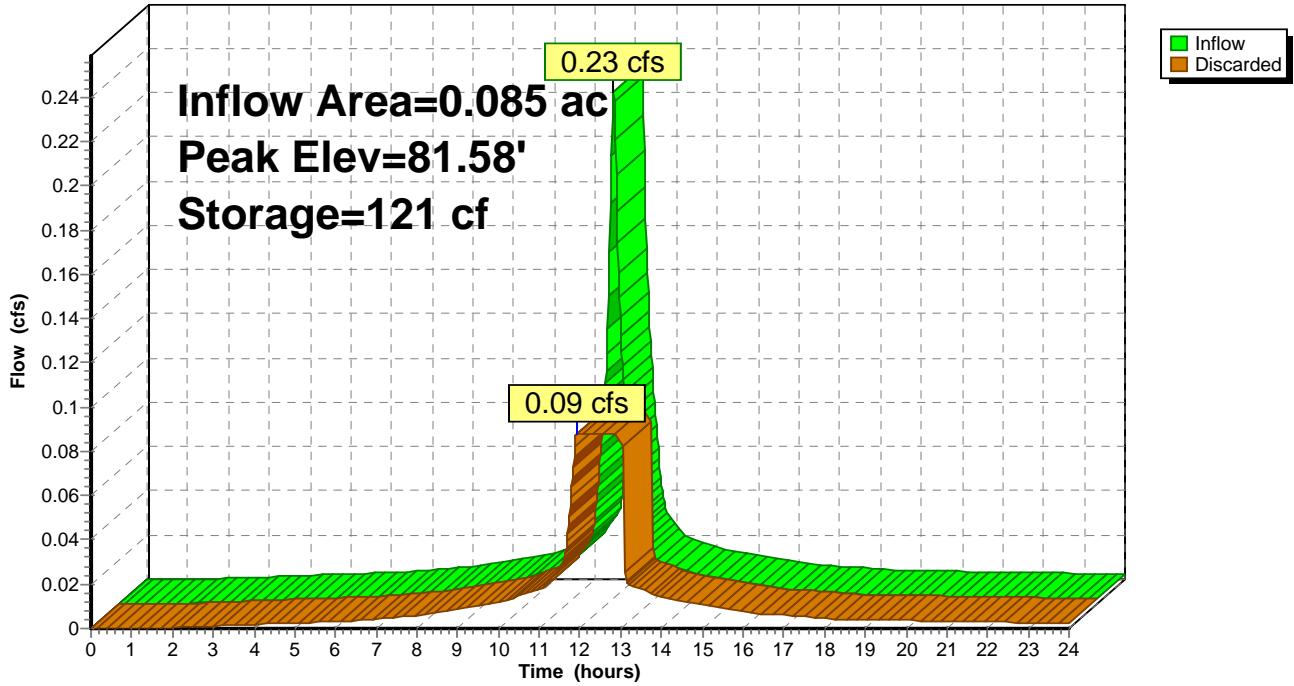
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
81.00	460	0	0
83.05	460	943	943

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	8.270 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.09 cfs @ 11.92 hrs HW=81.02' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Pond B1: Drain Basin

Hydrograph



46 BLACK ROCK ROAD COHASSET

Type III 24-hr 10 YEAR Rainfall=4.60"

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Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Remaining Area

Runoff Area=27,308 sf Runoff Depth>0.18"

Flow Length=223' Tc=20.9 min CN=41 Runoff=0.02 cfs 0.009 af

Subcatchment P2: Garage / Pavement

Runoff Area=3,686 sf Runoff Depth>4.36"

Flow Length=200' Tc=9.9 min CN=98 Runoff=0.33 cfs 0.031 af

Pond B1: Drain Basin

Peak Elev=82.00' Storage=265 cf Inflow=0.33 cfs 0.031 af

Outflow=0.09 cfs 0.031 af

Total Runoff Area = 0.712 ac Runoff Volume = 0.040 af Average Runoff Depth = 0.68"
80.03% Pervious Area = 0.569 ac 19.97% Impervious Area = 0.142 ac

46 BLACK ROCK ROAD COHASSET

Type III 24-hr 10 YEAR Rainfall=4.60"

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Subcatchment P1: Remaining Area

Runoff = 0.02 cfs @ 12.98 hrs, Volume= 0.009 af, Depth> 0.18"

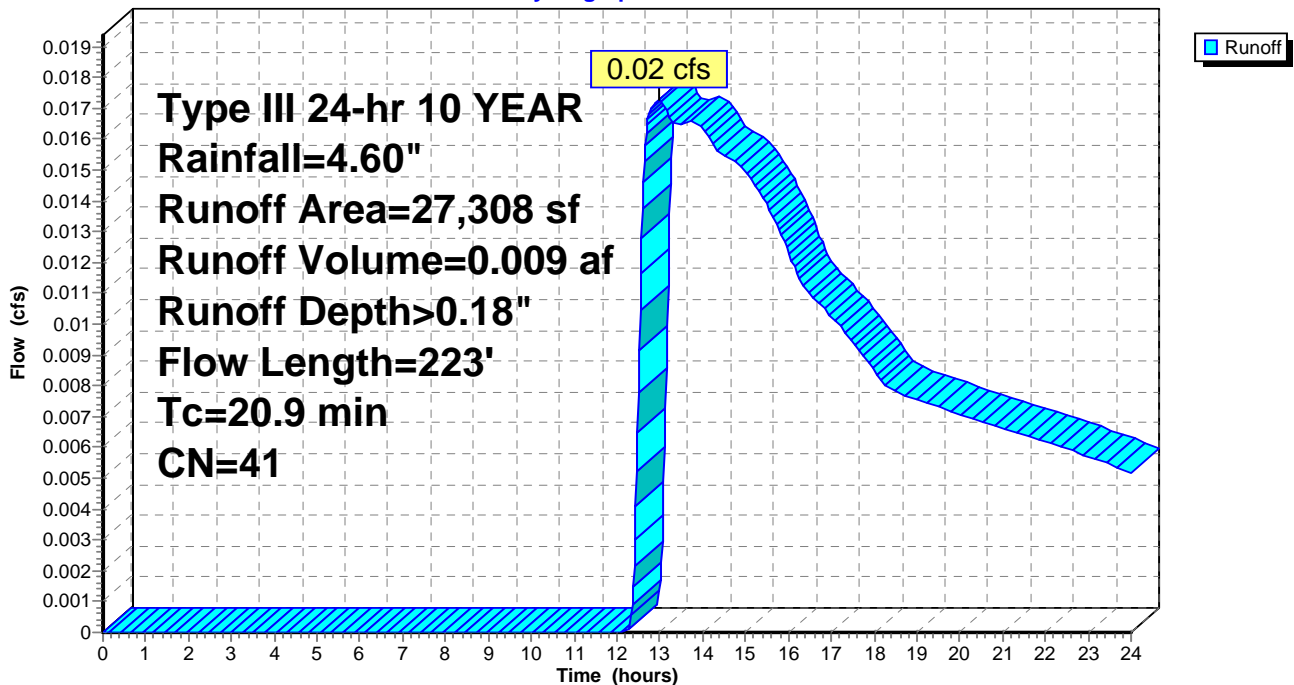
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
 Type III 24-hr 10 YEAR Rainfall=4.60"

Area (sf)	CN	Description
2,504	98	Paved parking & roofs
1,931	76	Gravel roads, HSG A
22,873	32	Woods/grass comb., Good, HSG A
27,308	41	Weighted Average
24,804		Pervious Area
2,504		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.8	50	0.0300	0.04		Sheet Flow, Grass/Woods Woods: Light underbrush n= 0.400 P2= 1.00"
2.1	173	0.0370	1.35		Shallow Concentrated Flow, Lawn Short Grass Pasture Kv= 7.0 fps
20.9	223	Total			

Subcatchment P1: Remaining Area

Hydrograph



46 BLACK ROCK ROAD COHASSET

Type III 24-hr 10 YEAR Rainfall=4.60"

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Subcatchment P2: Garage / Pavement

Runoff = 0.33 cfs @ 12.13 hrs, Volume= 0.031 af, Depth> 4.36"

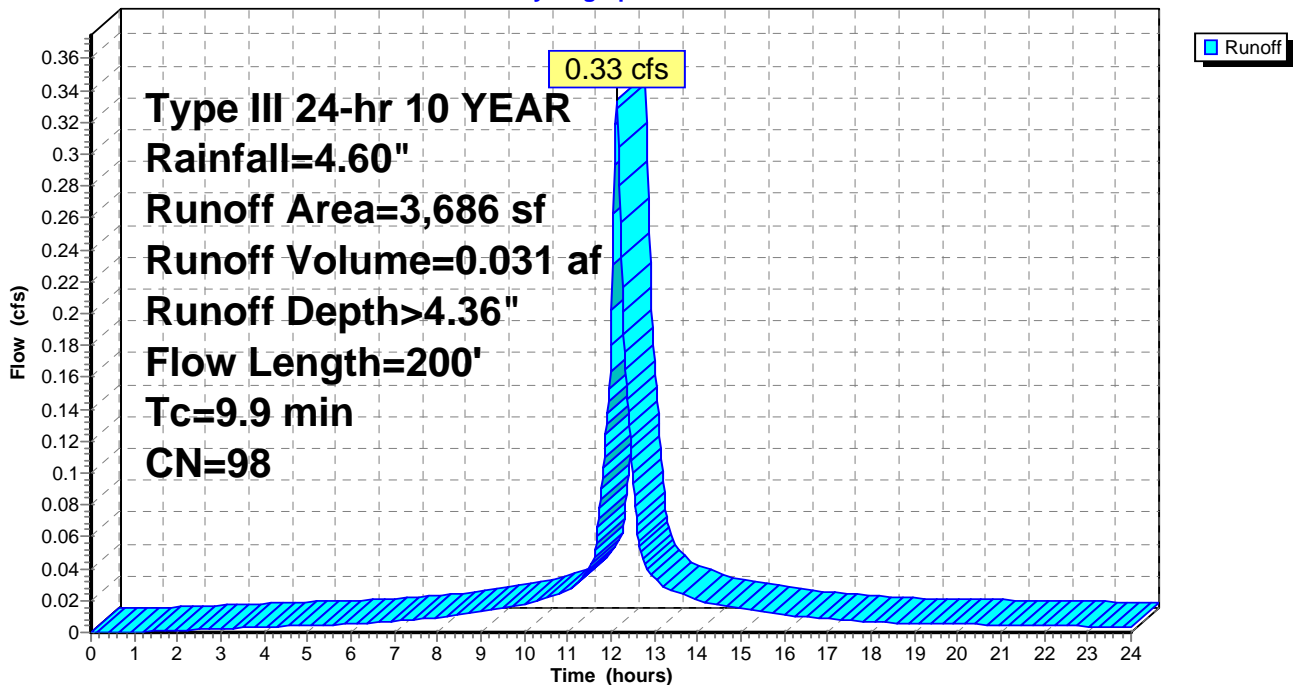
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 10 YEAR Rainfall=4.60"

Area (sf)	CN	Description
1,685	98	Roofs
2,001	98	Paved parking
3,686	98	Weighted Average
3,686		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	50	0.1000	0.11		Sheet Flow, GRASS Grass: Dense n= 0.240 P2= 1.00"
0.4	35	0.1100	1.66		Shallow Concentrated Flow, WOODS Woodland Kv= 5.0 fps
1.8	115	0.0440	1.05		Shallow Concentrated Flow, WOODS Woodland Kv= 5.0 fps
9.9	200	Total			

Subcatchment P2: Garage / Pavement

Hydrograph



46 BLACK ROCK ROAD COHASSET

Type III 24-hr 10 YEAR Rainfall=4.60"

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Pond B1: Drain Basin

Inflow Area = 0.085 ac, Inflow Depth > 4.36" for 10 YEAR event
 Inflow = 0.33 cfs @ 12.13 hrs, Volume= 0.031 af
 Outflow = 0.09 cfs @ 11.80 hrs, Volume= 0.031 af, Atten= 74%, Lag= 0.0 min
 Discarded = 0.09 cfs @ 11.80 hrs, Volume= 0.031 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs / 2
 Peak Elev= 82.00' @ 12.53 hrs Surf.Area= 460 sf Storage= 265 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 14.0 min (766.1 - 752.2)

Volume	Invert	Avail.Storage	Storage Description
#1	81.00'	293 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 943 cf Overall - 209 cf Embedded = 734 cf x 40.0% Voids
#2	81.50'	209 cf	32.1"W x 12.0"H x 7.50"L Cultec C-100 x 15 Inside #1
		503 cf	Total Available Storage

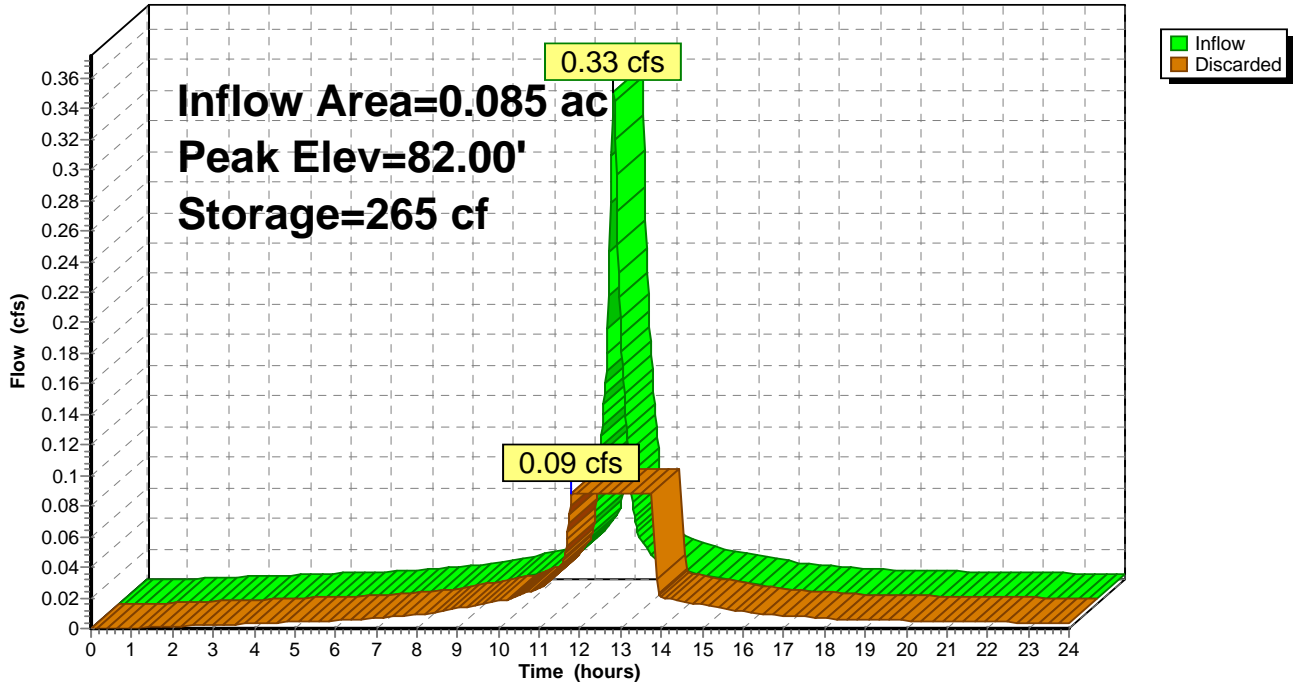
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
81.00	460	0	0
83.05	460	943	943

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	8.270 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.09 cfs @ 11.80 hrs HW=81.02' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Pond B1: Drain Basin

Hydrograph



46 BLACK ROCK ROAD COHASSET

Type III 24-hr 100 YEAR Rainfall=6.60"

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Time span=0.00-24.00 hrs, dt=0.02 hrs, 1201 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Remaining Area

Runoff Area=27,308 sf Runoff Depth>0.76"

Flow Length=223' Tc=20.9 min CN=41 Runoff=0.22 cfs 0.040 af

Subcatchment P2: Garage / Pavement

Runoff Area=3,686 sf Runoff Depth>6.35"

Flow Length=200' Tc=9.9 min CN=98 Runoff=0.48 cfs 0.045 af

Pond B1: Drain Basin

Peak Elev=83.02' Storage=498 cf Inflow=0.48 cfs 0.045 af

Outflow=0.09 cfs 0.045 af

Total Runoff Area = 0.712 ac Runoff Volume = 0.084 af Average Runoff Depth = 1.42"
80.03% Pervious Area = 0.569 ac 19.97% Impervious Area = 0.142 ac

46 BLACK ROCK ROAD COHASSET

Type III 24-hr 100 YEAR Rainfall=6.60"

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Subcatchment P1: Remaining Area

Runoff = 0.22 cfs @ 12.47 hrs, Volume= 0.040 af, Depth> 0.76"

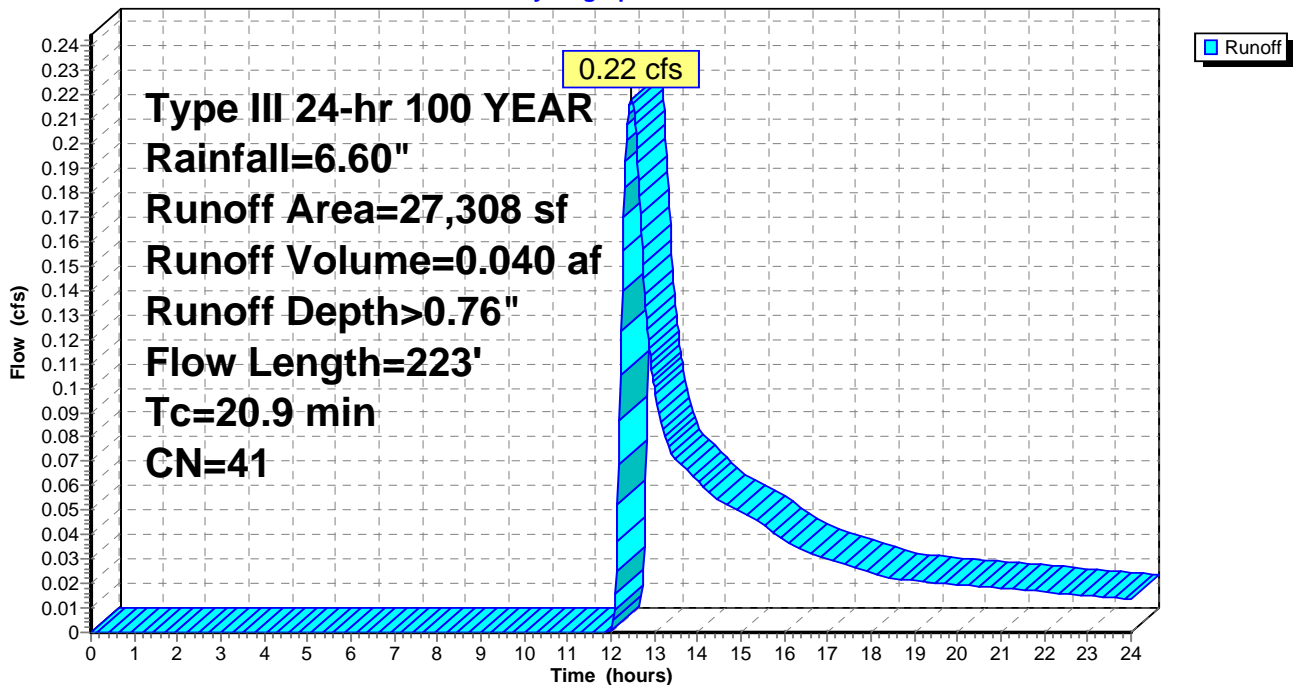
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YEAR Rainfall=6.60"

Area (sf)	CN	Description
2,504	98	Paved parking & roofs
1,931	76	Gravel roads, HSG A
22,873	32	Woods/grass comb., Good, HSG A
27,308	41	Weighted Average
24,804		Pervious Area
2,504		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.8	50	0.0300	0.04		Sheet Flow, Grass/Woods Woods: Light underbrush n= 0.400 P2= 1.00"
2.1	173	0.0370	1.35		Shallow Concentrated Flow, Lawn Short Grass Pasture Kv= 7.0 fps
20.9	223	Total			

Subcatchment P1: Remaining Area

Hydrograph



46 BLACK ROCK ROAD COHASSET

Type III 24-hr 100 YEAR Rainfall=6.60"

Prepared by Webby Engineering Associates, Inc.

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Subcatchment P2: Garage / Pavement

Runoff = 0.48 cfs @ 12.13 hrs, Volume= 0.045 af, Depth> 6.35"

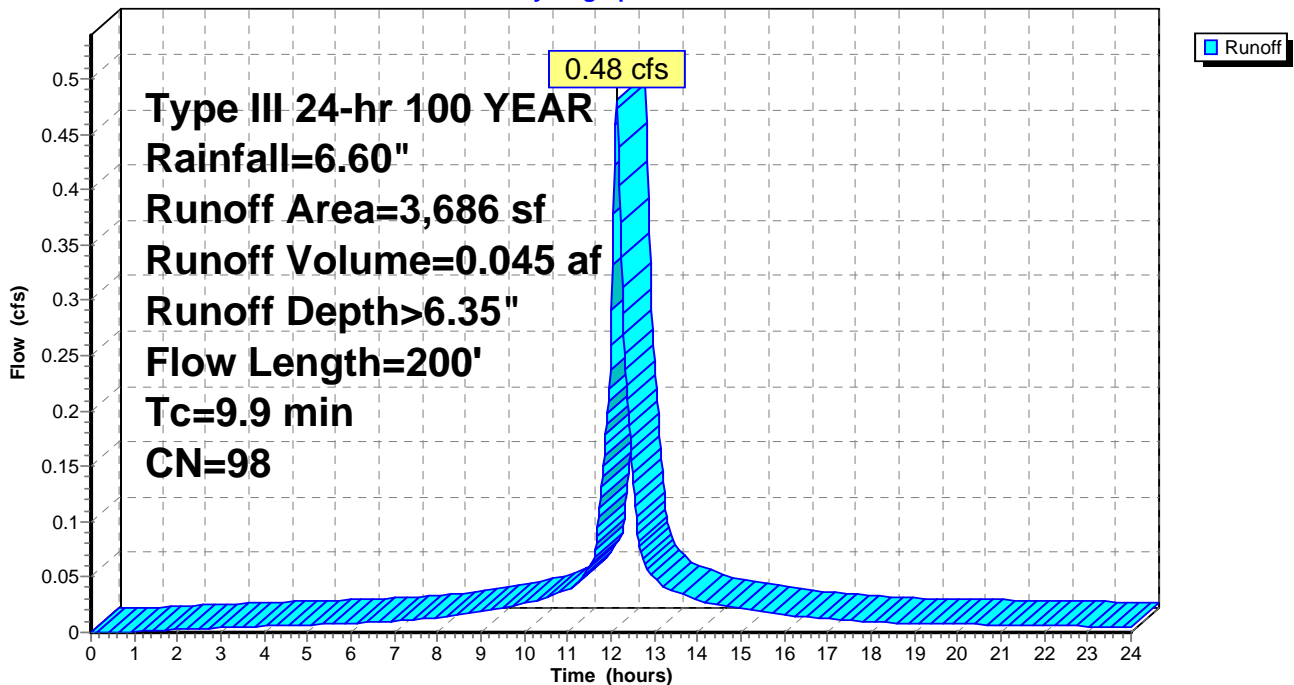
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs
Type III 24-hr 100 YEAR Rainfall=6.60"

Area (sf)	CN	Description
1,685	98	Roofs
2,001	98	Paved parking
3,686	98	Weighted Average
3,686		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	50	0.1000	0.11		Sheet Flow, GRASS Grass: Dense n= 0.240 P2= 1.00"
0.4	35	0.1100	1.66		Shallow Concentrated Flow, WOODS Woodland Kv= 5.0 fps
1.8	115	0.0440	1.05		Shallow Concentrated Flow, WOODS Woodland Kv= 5.0 fps
9.9	200	Total			

Subcatchment P2: Garage / Pavement

Hydrograph



46 BLACK ROCK ROAD COHASSET

Type III 24-hr 100 YEAR Rainfall=6.60"

Prepared by Webby Engineering Associates, Inc.

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Pond B1: Drain Basin

Inflow Area = 0.085 ac, Inflow Depth > 6.35" for 100 YEAR event
 Inflow = 0.48 cfs @ 12.13 hrs, Volume= 0.045 af
 Outflow = 0.09 cfs @ 11.70 hrs, Volume= 0.045 af, Atten= 82%, Lag= 0.0 min
 Discarded = 0.09 cfs @ 11.70 hrs, Volume= 0.045 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.02 hrs / 2
 Peak Elev= 83.02' @ 12.62 hrs Surf.Area= 460 sf Storage= 498 cf

Plug-Flow detention time= 30.1 min calculated for 0.045 af (100% of inflow)
 Center-of-Mass det. time= 30.0 min (776.5 - 746.5)

Volume	Invert	Avail.Storage	Storage Description
#1	81.00'	293 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 943 cf Overall - 209 cf Embedded = 734 cf x 40.0% Voids
#2	81.50'	209 cf	32.1"W x 12.0"H x 7.50"L Cultec C-100 x 15 Inside #1
		503 cf	Total Available Storage

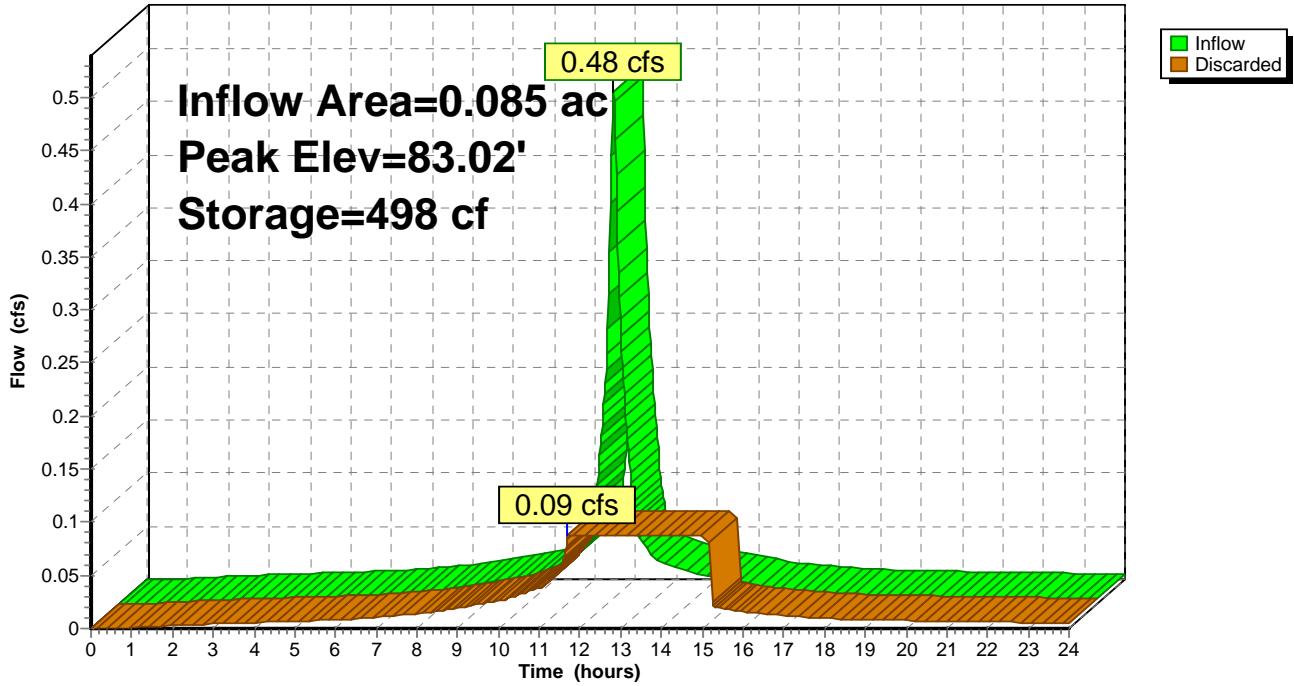
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
81.00	460	0	0
83.05	460	943	943

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	8.270 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.09 cfs @ 11.70 hrs HW=81.02' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.09 cfs)

Pond B1: Drain Basin

Hydrograph



SECTION THREE

RECHARGE VOLUME CALCULATIONS – BASIN #1

Required Recharge Volume

Use Hydrologic Soil Type A (.60-inch target depth)

Use: $R_v = F \times \text{Impervious Area}$

$$R_v = .05 \times 3,960 \text{ s.f.}$$

$$R_v = 198 \text{ c.f.}$$

Recharge Volume needed for Basin is 198 cubic feet.

Recharge Volume provided for Basin is 296 cubic feet @ 6" depth.

Drawdown within 72 hours

Use: $\text{Time} = R_v / (K) (\text{Bottom Area})$

$$\text{Time} = 198 / (8.27 \text{ in.} / 12) \times 592 \text{ s.f.}$$

$$\text{Time} = 0.33 \text{ hours} < 72 \text{ Hours}$$

WATER QUALITY

Water Quality Treatment Volume

$$V_{wq} = (D_{wq} / 12 \text{ inches/foot}) * (A_{imp} * 43,560 \text{ s.f./acre})$$

$$V_{wq} = (0.042) * (3,960 \text{ s.f.})$$

$$V_{wq} = 166 \text{ c.f.}$$

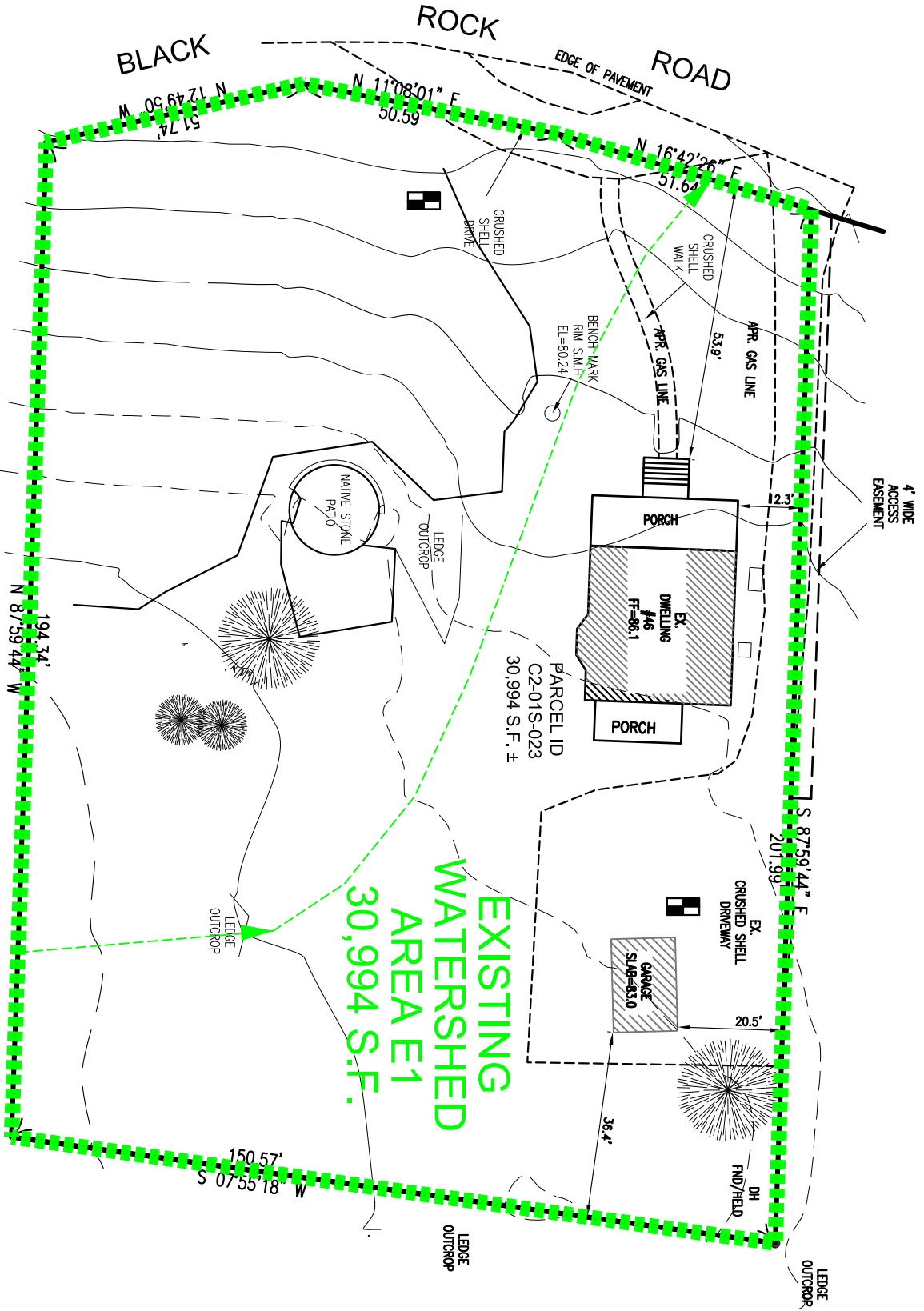
Required Water Quality volume is 166 cubic feet.

Bio-retention Basin volume provided is 296 cubic feet @ 6" depth.

PEAK FLOW AND VOLUME SUMMARIES

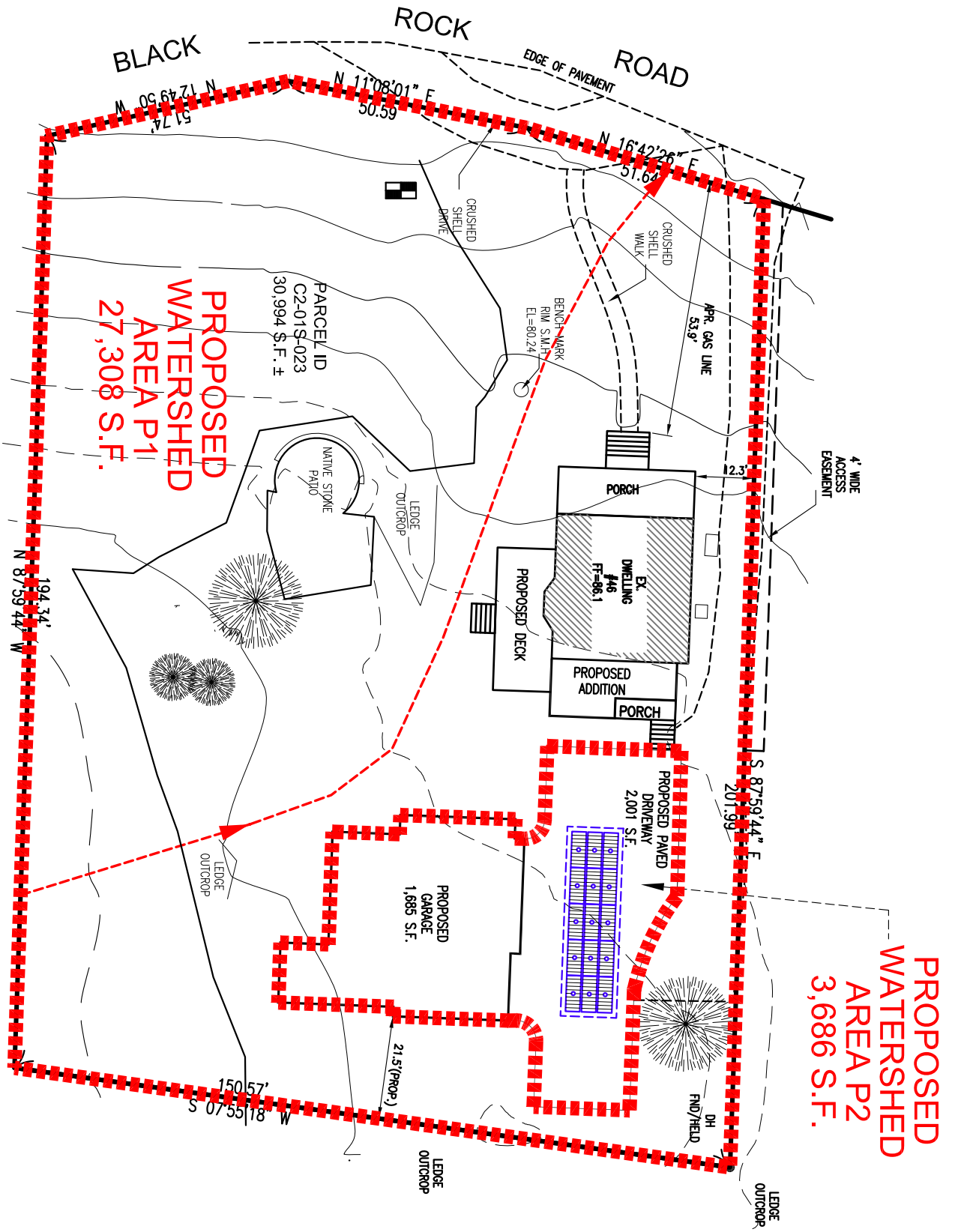
RUNOFF RATE SUMMARY					
		2 YEAR STORM (cfs)	10 YEAR STORM (cfs)	25 YEAR STORM (cfs)	100 YEAR STORM (cfs)
SITE	EXISTING (E1)	0.00	0.03	-	0.29
	PROPOSED REMAINING (P1)	0.00	0.02	-	0.22

RUNOFF VOLUME SUMMARY					
		2 YEAR STORM (ac-ft)	10 YEAR STORM (ac-ft)	25 YEAR STORM (ac-ft)	100 YEAR STORM (ac-ft)
SITE	EXISTING (E1)	0.001	0.013	-	0.049
	PROPOSED REMAINING (P1)	0.000	0.009	-	0.040



PRE-CONSTRUCTION WATERSHED PLAN

SCALE: 1" = 30'



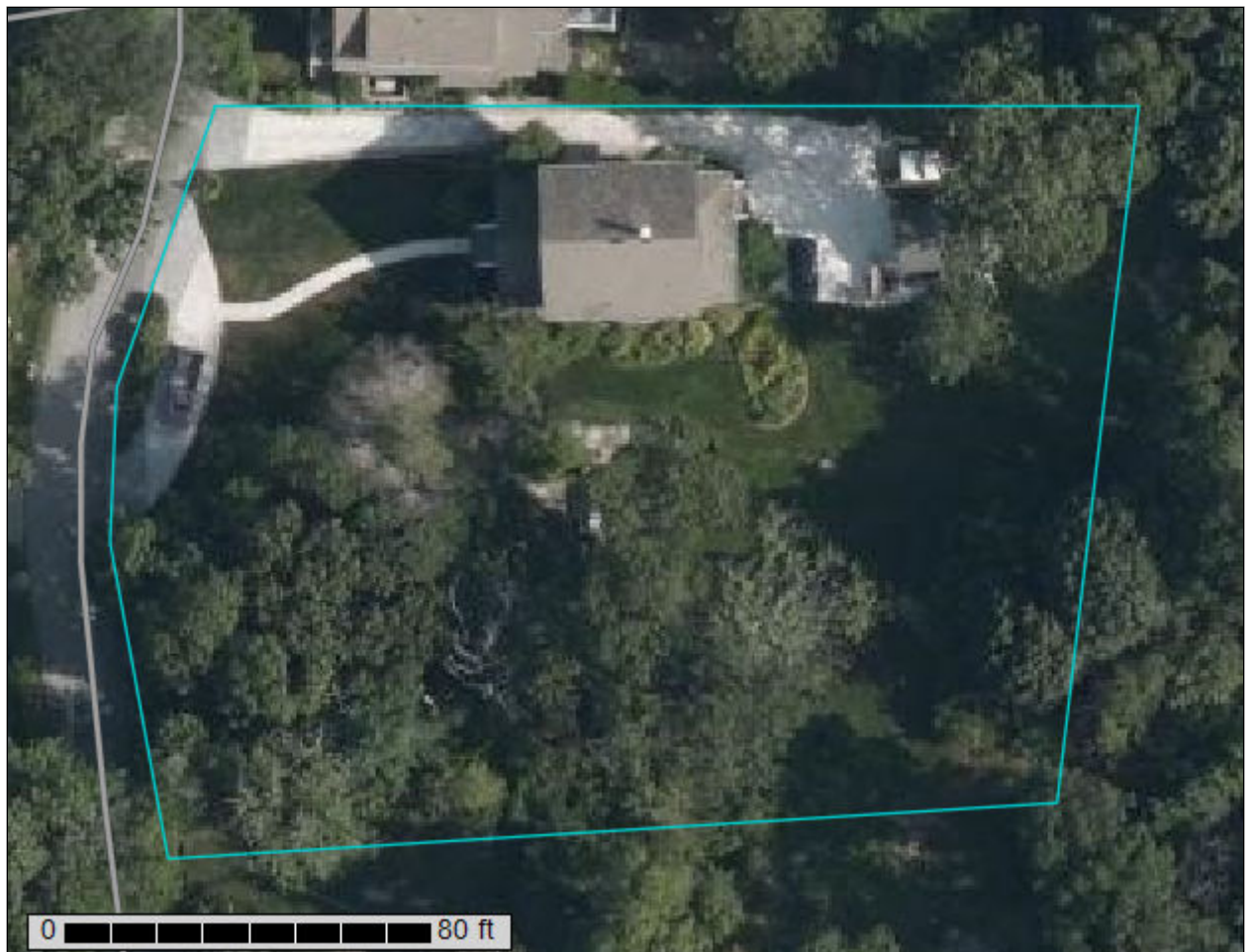
POST CONSTRUCTION WATERSHED PLAN

SCALE: 1" = 30'

APPENDIX A

Reference Material

Custom Soil Resource Report for Norfolk and Suffolk Counties, Massachusetts



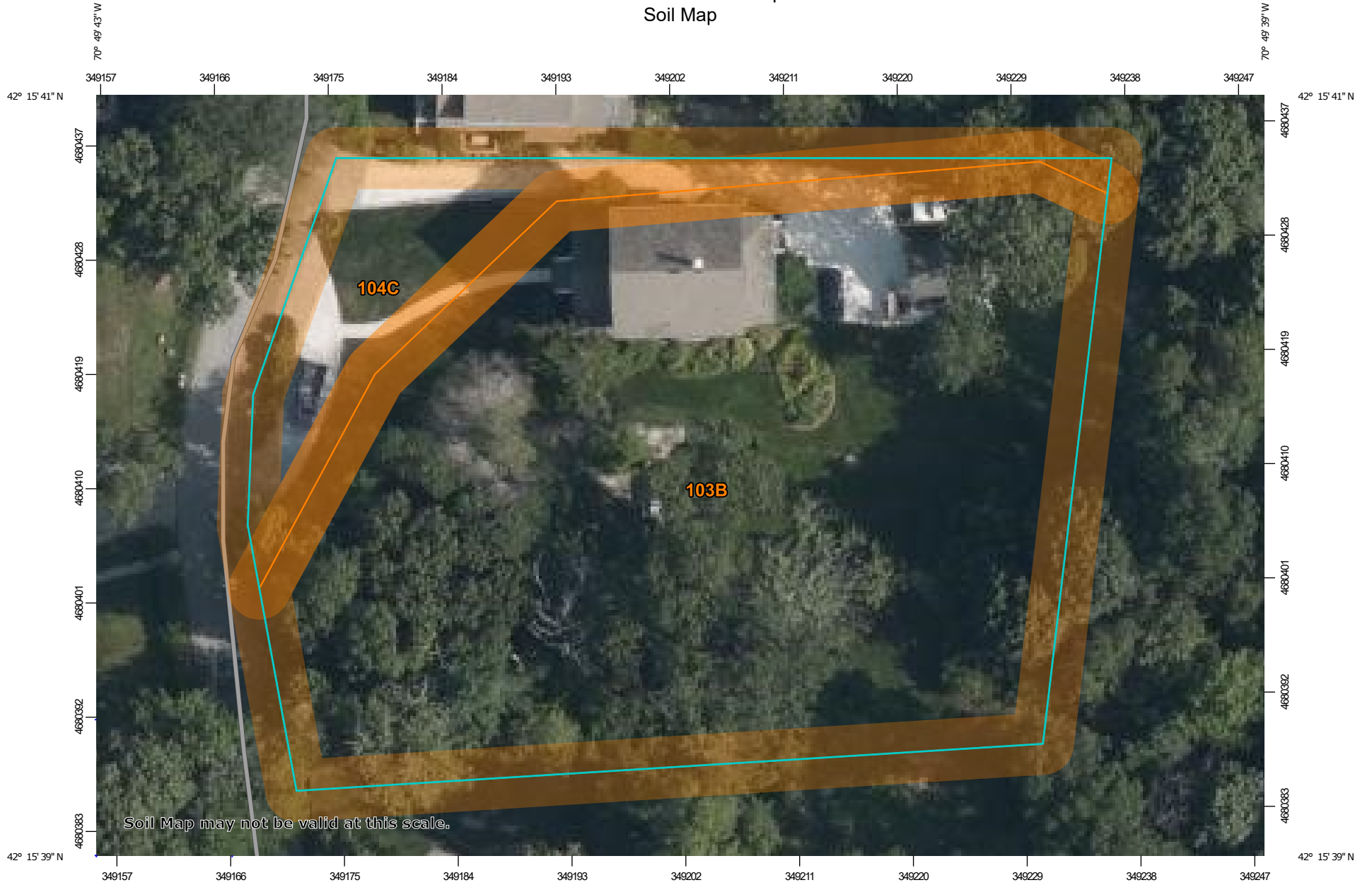
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Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report Soil Map



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines


 Soil Map Unit Points

Special Point Features






-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot

-  Spoil Area
-  Stony Spot
-  Very Stony Spot
-  Wet Spot
-  Other
-  Special Line Features


Water Features

 Streams and Canals

Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

Background

 Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
 Survey Area Data: Version 17, Sep 3, 2021

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

Date(s) aerial images were photographed: Jul 31, 2019—Sep 1, 2019

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	0.7	86.3%
104C	Hollis-Rock outcrop-Charlton complex, 0 to 15 percent slopes	0.1	13.7%
Totals for Area of Interest		0.8	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The

Custom Soil Resource Report

delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Norfolk and Suffolk Counties, Massachusetts

103B—Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: vktd
Elevation: 0 to 480 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Charlton and similar soils: 40 percent
Hollis and similar soils: 25 percent
Rock outcrop: 20 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Charlton

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable coarse-loamy ablation till derived from granite

Typical profile

H1 - 0 to 6 inches: fine sandy loam
H2 - 6 to 36 inches: fine sandy loam
H3 - 36 to 60 inches: fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Description of Hollis

Setting

Landform: Hills

Landform position (two-dimensional): Shoulder

Landform position (three-dimensional): Side slope

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Shallow, friable loamy ablation till derived from igneous rock

Typical profile

H1 - 0 to 3 inches: fine sandy loam

H2 - 3 to 14 inches: gravelly fine sandy loam

H3 - 14 to 18 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 8 percent

Surface area covered with cobbles, stones or boulders: 1.6 percent

Depth to restrictive feature: 10 to 20 inches to lithic bedrock

Drainage class: Well drained

Runoff class: High

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: Very low (about 1.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6s

Hydrologic Soil Group: D

Ecological site: F144AY033MA - Shallow Dry Till Uplands

Hydric soil rating: No

Description of Rock Outcrop

Setting

Parent material: Igneous and metamorphic rock

Properties and qualities

Slope: 3 to 8 percent

Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8s

Hydric soil rating: Unranked

Minor Components

Canton

Percent of map unit: 7 percent

Hydric soil rating: No

Chatfield

Percent of map unit: 5 percent

Hydric soil rating: No

Scituate

Percent of map unit: 2 percent
Hydric soil rating: No

Whitman

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

104C—Hollis-Rock outcrop-Charlton complex, 0 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2w69p
Elevation: 0 to 1,270 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Hollis, extremely stony, and similar soils: 35 percent
Charlton, extremely stony, and similar soils: 25 percent
Rock outcrop: 25 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hollis, Extremely Stony

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

O_i - 0 to 2 inches: slightly decomposed plant material
A - 2 to 7 inches: gravelly fine sandy loam
B_w - 7 to 16 inches: gravelly fine sandy loam
2R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 0 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 8 to 23 inches to lithic bedrock
Drainage class: Somewhat excessively drained

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Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Description of Charlton, Extremely Stony

Setting

Landform: Hills, ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 4 inches: fine sandy loam
Bw - 4 to 27 inches: gravelly fine sandy loam
C - 27 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Ridges, hills

Parent material: Igneous and metamorphic rock

Typical profile

R - 0 to 79 inches: bedrock

Properties and qualities

Slope: 0 to 15 percent

Depth to restrictive feature: 0 inches to lithic bedrock

Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)

Available water supply, 0 to 60 inches: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 8

Hydrologic Soil Group: D

Hydric soil rating: No

Minor Components

Canton, extremely stony

Percent of map unit: 7 percent

Landform: Moraines, hills, ridges

Landform position (two-dimensional): Summit, shoulder, backslope

Landform position (three-dimensional): Side slope, crest

Down-slope shape: Convex, linear

Across-slope shape: Convex

Hydric soil rating: No

Chatfield, extremely stony

Percent of map unit: 6 percent

Landform: Ridges, hills

Landform position (two-dimensional): Summit, shoulder, backslope

Landform position (three-dimensional): Nose slope, side slope, crest

Down-slope shape: Convex

Across-slope shape: Linear, convex

Hydric soil rating: No

Montauk, extremely stony

Percent of map unit: 1 percent

Landform: Hills, recessional moraines, ground moraines, drumlins

Landform position (two-dimensional): Summit, shoulder, backslope

Landform position (three-dimensional): Side slope, crest

Down-slope shape: Convex, linear

Across-slope shape: Convex

Hydric soil rating: No

Scituate, extremely stony

Percent of map unit: 1 percent

Landform: Ground moraines, hills, drumlins

Landform position (two-dimensional): Summit, backslope, footslope

Landform position (three-dimensional): Side slope, crest

Custom Soil Resource Report

Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No