

DRAINAGE REPORT

49 UPLAND STREET WORCESTER, MA

Job #348-522 Client #522

SEPTEMBER 25, 2023



James I. Tetreault
9/25/2023

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INTRODUCTION

The purpose of this Drainage Report is to confirm that the peak rate of runoff from the proposed apartment development at 49 and 39 Upland Street will not increase in any of the 2, 10, 25 or 100 year return frequency storm events.

This property is previously undeveloped with wooded cover. According to the web soil survey, attached at the end of this report, all soils on site are Paxton series soils categorized as hydrologic soil group C soils with the exception of the most southerly corner of the property which lies over Scarborough series soils categorized as hydrologic soil group D soils.

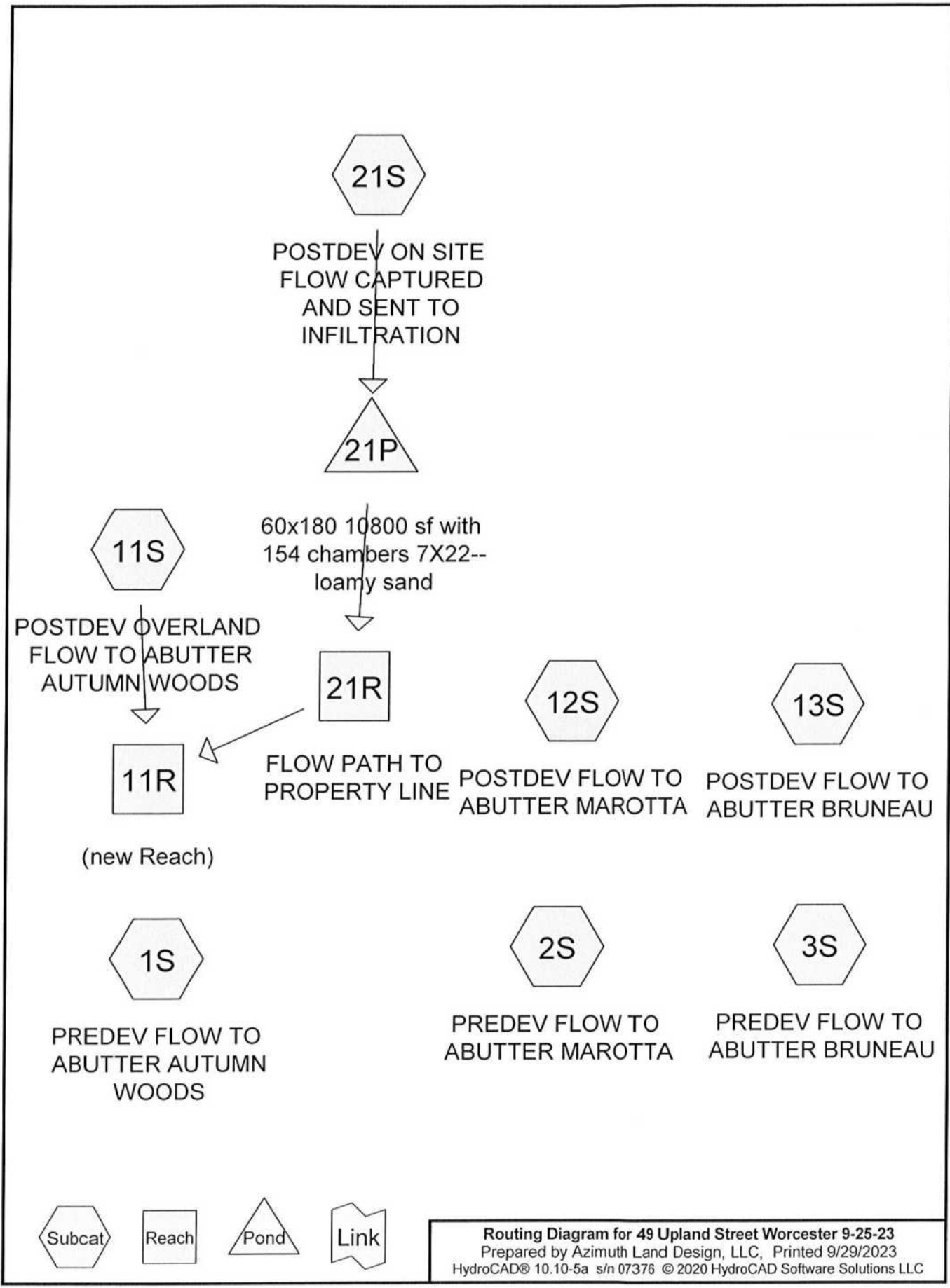
Stormwater runoff from this site drains to three abutting properties. Most drains to the adjacent apartment development to the south and southwest of this site. Some drains to the abutter Marotta and some to the abutter Bruneau. We will decrease the peak rate of flow to the latter two properties simply by decreasing that area that will drain to them. We will decrease the flow to the abutting existing apartment development by capturing stormwater runoff and then directing it through a CDS stormwater filtration unit and into an infiltration structure with a footprint measuring 60'x180' and with a depth of 8 feet. Inside that large stone envelope, there will be 154 Retain-It precast concrete chambers measuring 8'x8' and 5' high.

We excavated 3 deep observation holes on site to determine soil textures and depths to seasonal high groundwater for use in designing that infiltration structure. At deep observation holes #'s 2 and 3 in the area of that structure, we observed loamy sand texture soils with mottling indicating seasonal high groundwater (SHGW) at 60 inches and 90 inches respectively.

Calculations were made using the HydroCAD stormwater modeling program. This program calculates hydrographs using a method very similar to that outlined in the Soil Conservation Service Technical Release Number 20 (TR-20). HydroCAD uses the TR-20 "curve number" evaluations of ground cover and the same times of concentration. The 2, 10, 25 and 100 year storm rainfall amounts were taken from the Cornell web site and were 3.26, 4.92, 6.22 and 8.88 inches, respectively.

The following table compares the peak pre and post rates of flows of stormwater at the design points:
DESIGN POINT

	PEAK FLOW RATE (in cfs)			
	2 yr storm	10 yr storm	25 yr storm	100 yr storm
Abutter Autumn Woods property line to the south				
Subcat #1 pre	7.66 pre	18.02 pre	27.06 pre	46.62 pre
Reach #11 post	2.81	8.38	17.43	38.77
Abutter Marotta property Line to the southeast				
Subcat #2 pre	0.26 pre	0.62 pre	0.94 pre	1.63 pre
Subcat #12 post	0.16	0.36	0.54	0.91
Abutter Bruneau property Line to the east				
Subcat #3 pre	0.25 pre	0.44 pre	0.59 pre	0.89 pre
Subcat #13 post	0.06	0.10	0.14	0.22



21S

POSTDEV ON SITE
FLOW CAPTURED
AND SENT TO
INFILTRATION

21P

60x180 10800 sf with
154 chambers 7X22--
loamy sand

11S

POSTDEV OVERLAND
FLOW TO ABUTTER
AUTUMN WOODS

21R

12S

13S

11R

FLOW PATH TO
PROPERTY LINE

POSTDEV FLOW TO
ABUTTER MAROTTA

POSTDEV FLOW TO
ABUTTER BRUNEAU

(new Reach)

1S

PREDEV FLOW TO
ABUTTER AUTUMN
WOODS

2S

PREDEV FLOW TO
ABUTTER MAROTTA

3S

PREDEV FLOW TO
ABUTTER BRUNEAU

Subcat

Reach

Pond

Link

Routing Diagram for 49 Upland Street Worcester 9-25-23
Prepared by Azimuth Land Design, LLC, Printed 9/29/2023
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2 YEAR STORM

Summary for Subcatchment 1S: PREDEV FLOW TO ABUTTER AUTUMN WOODS

Runoff = 7.66 cfs @ 12.15 hrs, Volume= 0.613 af, Depth> 0.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 YEAR Rainfall=3.26"

Area (sf)	CN	Description
10,000	98	Paved parking, HSG C
18,570	74	>75% Grass cover, Good, HSG C
59,395	74	>75% Grass cover, Good, HSG C
273,165	70	Woods, Good, HSG C
4,456	77	Woods, Good, HSG D
365,586	72	Weighted Average
355,586		97.26% Pervious Area
10,000		2.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.1600	0.23		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
0.3	94	0.1200	5.20		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.9	585	0.1100	1.66		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
9.8	729	Total			

Summary for Subcatchment 2S: PREDEV FLOW TO ABUTTER MAROTTA

Runoff = 0.26 cfs @ 12.11 hrs, Volume= 0.018 af, Depth> 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 YEAR Rainfall=3.26"

Area (sf)	CN	Description
1,653	74	>75% Grass cover, Good, HSG C
9,988	70	Woods, Good, HSG C
11,641	71	Weighted Average
11,641		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.1000	0.19		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
2.0	180	0.0900	1.50		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
6.3	230	Total			

Summary for Subcatchment 3S: PREDEV FLOW TO ABUTTER BRUNEAU

Runoff = 0.25 cfs @ 12.05 hrs, Volume= 0.015 af, Depth> 1.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 YEAR Rainfall=3.26"

Area (sf)	CN	Description
1,918	74	>75% Grass cover, Good, HSG C
2,457	98	Paved parking, HSG C
4,375	87	Weighted Average
1,918		43.84% Pervious Area
2,457		56.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	31	0.1300	0.20		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
0.1	56	0.1400	7.60		Shallow Concentrated Flow, Paved Kv= 20.3 fps
2.7	87	Total			

Summary for Subcatchment 11S: POSTDEV OVERLAND FLOW TO ABUTTER AUTUMN WOODS

Runoff = 1.63 cfs @ 12.11 hrs, Volume= 0.115 af, Depth> 0.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 YEAR Rainfall=3.26"

Area (sf)	CN	Description
4,456	77	Woods, Good, HSG D
45,936	74	>75% Grass cover, Good, HSG C
14,454	70	Woods, Good, HSG C
64,846	73	Weighted Average
64,846		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.1600	0.23		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
1.5	302	0.0530	3.45		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
1.4	96	0.0500	1.12		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
6.5	448	Total			

Summary for Subcatchment 12S: POSTDEV FLOW TO ABUTTER MAROTTA

Runoff = 0.16 cfs @ 12.10 hrs, Volume= 0.011 af, Depth> 0.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 YEAR Rainfall=3.26"

Area (sf)	CN	Description
2,187	70	Woods, Good, HSG C
3,988	74	>75% Grass cover, Good, HSG C
6,175	73	Weighted Average
6,175		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	50	0.0850	0.18		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
1.2	110	0.0900	1.50		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
5.8	160	Total			

Summary for Subcatchment 13S: POSTDEV FLOW TO ABUTTER BRUNEAU

Runoff = 0.06 cfs @ 12.08 hrs, Volume= 0.004 af, Depth> 1.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 YEAR Rainfall=3.26"

Area (sf)	CN	Description
717	74	>75% Grass cover, Good, HSG C
480	98	Paved parking, HSG C
1,197	84	Weighted Average
717		59.90% Pervious Area
480		40.10% Impervious Area

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

Summary for Subcatchment 21S: POSTDEV ON SITE FLOW CAPTURED AND SENT TO INFILTRATION

Runoff = 15.59 cfs @ 12.08 hrs, Volume= 1.044 af, Depth> 1.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 YEAR Rainfall=3.26"

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Type III 24-hr 2 YEAR Rainfall=3.26"

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Area (sf)	CN	Description
28,031	70	Woods, Good, HSG C
10,000	98	Roofs, HSG C
42,472	98	Unconnected roofs, HSG C
105,178	98	Paved parking, HSG C
7,134	74	>75% Grass cover, Good, HSG C
116,569	74	>75% Grass cover, Good, HSG C
309,384	86	Weighted Average
151,734		49.04% Pervious Area
157,650		50.96% Impervious Area
42,472		26.94% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.1600	0.23		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
0.3	94	0.1200	5.20		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
1.5	187	0.0200	2.12		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.4	331	Total			

Summary for Reach 11R: (new Reach)

Inflow Area = 8.591 ac, 42.13% Impervious, Inflow Depth > 0.56" for 2 YEAR event
 Inflow = 2.81 cfs @ 12.50 hrs, Volume= 0.400 af
 Outflow = 2.81 cfs @ 12.50 hrs, Volume= 0.400 af, Atten= 0%, Lag= 0.0 min

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

Summary for Reach 21R: FLOW PATH TO PROPERTY LINE

Inflow Area = 7.102 ac, 50.96% Impervious, Inflow Depth = 0.48" for 2 YEAR event
 Inflow = 2.37 cfs @ 12.54 hrs, Volume= 0.285 af
 Outflow = 2.37 cfs @ 12.56 hrs, Volume= 0.285 af, Atten= 0%, Lag= 0.9 min

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

Max. Velocity= 2.05 fps, Min. Travel Time= 0.5 min

Avg. Velocity = 1.11 fps, Avg. Travel Time= 0.9 min

Peak Storage= 73 cf @ 12.55 hrs

Average Depth at Peak Storage= 0.10', Surface Width= 13.88'

Bank-Full Depth= 1.00' Flow Area= 30.0 sf, Capacity= 228.16 cfs

10.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds

Side Slope Z-value= 20.0 ' Top Width= 50.00'

Length= 63.0' Slope= 0.0635 ' /'

Inlet Invert= 448.00', Outlet Invert= 444.00'



Summary for Pond 21P: 60x180 10800 sf with 154 chambers 7X22-- loamy sand

Inflow Area = 7.102 ac, 50.96% Impervious, Inflow Depth > 1.76" for 2 YEAR event
 Inflow = 15.59 cfs @ 12.08 hrs, Volume= 1.044 af
 Outflow = 2.97 cfs @ 12.54 hrs, Volume= 0.789 af, Atten= 81%, Lag= 27.5 min
 Discarded = 0.60 cfs @ 11.05 hrs, Volume= 0.504 af
 Primary = 2.37 cfs @ 12.54 hrs, Volume= 0.285 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 458.38' @ 12.54 hrs Surf.Area= 10,800 sf Storage= 19,479 cf

Plug-Flow detention time= 136.5 min calculated for 0.786 af (75% of inflow)
 Center-of-Mass det. time= 77.2 min (863.7 - 786.5)

Volume	Invert	Avail.Storage	Storage Description
#1	456.00'	12,220 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 86,400 cf Overall - 55,851 cf Embedded = 30,549 cf x 40.0% Voids
#2	456.50'	44,255 cf	retain_it retain_it 5.0' x 154 Inside #1 Inside= 84.0"W x 60.0"H => 36.41 sf x 8.00'L = 291.3 cf Outside= 96.0"W x 68.0"H => 45.33 sf x 8.00'L = 362.7 cf 7 Rows adjusted for 602.6 cf perimeter wall
		56,474 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
456.00	10,800	0	0
464.00	10,800	86,400	86,400

Device	Routing	Invert	Outlet Devices
#1	Discarded	456.00'	2.410 in/hr Exfiltration over Surface area
#2	Primary	457.75'	10.0" Round Culvert X 2.00 L= 70.0' Ke= 0.500 Inlet / Outlet Invert= 457.75' / 450.00' S= 0.1107 ' /' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.55 sf
#3	Primary	459.75'	15.0" Round Culvert X 2.00 L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 459.75' / 450.00' S= 0.1950 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Discarded OutFlow Max=0.60 cfs @ 11.05 hrs HW=456.08' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.60 cfs)

Primary OutFlow Max=2.37 cfs @ 12.54 hrs HW=458.38' (Free Discharge)
 ↑2=Culvert (Inlet Controls 2.37 cfs @ 2.69 fps)
 ↑3=Culvert (Controls 0.00 cfs)

10 YEAR STORM

Summary for Subcatchment 1S: PREDEV FLOW TO ABUTTER AUTUMN WOODS

Runoff = 18.02 cfs @ 12.15 hrs, Volume= 1.378 af, Depth> 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 YEAR Rainfall=4.92"

Area (sf)	CN	Description
10,000	98	Paved parking, HSG C
18,570	74	>75% Grass cover, Good, HSG C
59,395	74	>75% Grass cover, Good, HSG C
273,165	70	Woods, Good, HSG C
4,456	77	Woods, Good, HSG D
365,586	72	Weighted Average
355,586		97.26% Pervious Area
10,000		2.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.1600	0.23		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
0.3	94	0.1200	5.20		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.9	585	0.1100	1.66		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
9.8	729	Total			

Summary for Subcatchment 2S: PREDEV FLOW TO ABUTTER MAROTTA

Runoff = 0.62 cfs @ 12.10 hrs, Volume= 0.042 af, Depth> 1.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 YEAR Rainfall=4.92"

Area (sf)	CN	Description
1,653	74	>75% Grass cover, Good, HSG C
9,988	70	Woods, Good, HSG C
11,641	71	Weighted Average
11,641		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.1000	0.19		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
2.0	180	0.0900	1.50		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
6.3	230	Total			

Summary for Subcatchment 3S: PREDEV FLOW TO ABUTTER BRUNEAU

Runoff = 0.44 cfs @ 12.05 hrs, Volume= 0.028 af, Depth> 3.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 YEAR Rainfall=4.92"

Area (sf)	CN	Description
1,918	74	>75% Grass cover, Good, HSG C
2,457	98	Paved parking, HSG C
4,375	87	Weighted Average
1,918		43.84% Pervious Area
2,457		56.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	31	0.1300	0.20		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
0.1	56	0.1400	7.60		Shallow Concentrated Flow, Paved Kv= 20.3 fps
2.7	87	Total			

Summary for Subcatchment 11S: POSTDEV OVERLAND FLOW TO ABUTTER AUTUMN WOODS

Runoff = 3.72 cfs @ 12.10 hrs, Volume= 0.254 af, Depth> 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 YEAR Rainfall=4.92"

Area (sf)	CN	Description
4,456	77	Woods, Good, HSG D
45,936	74	>75% Grass cover, Good, HSG C
14,454	70	Woods, Good, HSG C
64,846	73	Weighted Average
64,846		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.1600	0.23		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
1.5	302	0.0530	3.45		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
1.4	96	0.0500	1.12		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
6.5	448	Total			

Summary for Subcatchment 12S: POSTDEV FLOW TO ABUTTER MAROTTA

Runoff = 0.36 cfs @ 12.09 hrs, Volume= 0.024 af, Depth> 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 YEAR Rainfall=4.92"

Area (sf)	CN	Description
2,187	70	Woods, Good, HSG C
3,988	74	>75% Grass cover, Good, HSG C
6,175	73	Weighted Average
6,175		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	50	0.0850	0.18		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
1.2	110	0.0900	1.50		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
5.8	160	Total			

Summary for Subcatchment 13S: POSTDEV FLOW TO ABUTTER BRUNEAU

Runoff = 0.10 cfs @ 12.07 hrs, Volume= 0.007 af, Depth> 3.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 YEAR Rainfall=4.92"

Area (sf)	CN	Description
717	74	>75% Grass cover, Good, HSG C
480	98	Paved parking, HSG C
1,197	84	Weighted Average
717		59.90% Pervious Area
480		40.10% Impervious Area

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

Summary for Subcatchment 21S: POSTDEV ON SITE FLOW CAPTURED AND SENT TO INFILTRATION

Runoff = 27.62 cfs @ 12.08 hrs, Volume= 1.889 af, Depth> 3.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 YEAR Rainfall=4.92"

49 Upland Street Worcester 9-25-23

Type III 24-hr 10 YEAR Rainfall=4.92"

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Area (sf)	CN	Description
28,031	70	Woods, Good, HSG C
10,000	98	Roofs, HSG C
42,472	98	Unconnected roofs, HSG C
105,178	98	Paved parking, HSG C
7,134	74	>75% Grass cover, Good, HSG C
116,569	74	>75% Grass cover, Good, HSG C
309,384	86	Weighted Average
151,734		49.04% Pervious Area
157,650		50.96% Impervious Area
42,472		26.94% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.1600	0.23		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
0.3	94	0.1200	5.20		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
1.5	187	0.0200	2.12		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.4	331	Total			

Summary for Reach 11R: (new Reach)

Inflow Area = 8.591 ac, 42.13% Impervious, Inflow Depth > 1.75" for 10 YEAR event
 Inflow = 8.38 cfs @ 12.15 hrs, Volume= 1.253 af
 Outflow = 8.38 cfs @ 12.15 hrs, Volume= 1.253 af, Atten= 0%, Lag= 0.0 min

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

Summary for Reach 21R: FLOW PATH TO PROPERTY LINE

Inflow Area = 7.102 ac, 50.96% Impervious, Inflow Depth = 1.69" for 10 YEAR event
 Inflow = 6.79 cfs @ 12.45 hrs, Volume= 0.998 af
 Outflow = 6.79 cfs @ 12.46 hrs, Volume= 0.998 af, Atten= 0%, Lag= 0.6 min

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

Max. Velocity= 2.87 fps, Min. Travel Time= 0.4 min
 Avg. Velocity = 1.38 fps, Avg. Travel Time= 0.8 min

Peak Storage= 149 cf @ 12.45 hrs

Average Depth at Peak Storage= 0.18', Surface Width= 17.00'
 Bank-Full Depth= 1.00' Flow Area= 30.0 sf, Capacity= 228.16 cfs

10.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds

Side Slope Z-value= 20.0 ' / ' Top Width= 50.00'

Length= 63.0' Slope= 0.0635 ' / '

Inlet Invert= 448.00', Outlet Invert= 444.00'



Summary for Pond 21P: 60x180 10800 sf with 154 chambers 7X22-- loamy sand

Inflow Area = 7.102 ac, 50.96% Impervious, Inflow Depth > 3.19" for 10 YEAR event
 Inflow = 27.62 cfs @ 12.08 hrs, Volume= 1.889 af
 Outflow = 7.40 cfs @ 12.45 hrs, Volume= 1.578 af, Atten= 73%, Lag= 21.9 min
 Discarded = 0.60 cfs @ 9.70 hrs, Volume= 0.580 af
 Primary = 6.79 cfs @ 12.45 hrs, Volume= 0.998 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 459.81' @ 12.45 hrs Surf.Area= 10,800 sf Storage= 32,737 cf

Plug-Flow detention time= 94.9 min calculated for 1.573 af (83% of inflow)
 Center-of-Mass det. time= 48.7 min (821.2 - 772.5)

Volume	Invert	Avail.Storage	Storage Description
#1	456.00'	12,220 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 86,400 cf Overall - 55,851 cf Embedded = 30,549 cf x 40.0% Voids
#2	456.50'	44,255 cf	retain_it retain_it 5.0' x 154 Inside #1 Inside= 84.0"W x 60.0"H => 36.41 sf x 8.00'L = 291.3 cf Outside= 96.0"W x 68.0"H => 45.33 sf x 8.00'L = 362.7 cf 7 Rows adjusted for 602.6 cf perimeter wall
		56,474 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
456.00	10,800	0	0
464.00	10,800	86,400	86,400

Device	Routing	Invert	Outlet Devices
#1	Discarded	456.00'	2.410 in/hr Exfiltration over Surface area
#2	Primary	457.75'	10.0" Round Culvert X 2.00 L= 70.0' Ke= 0.500 Inlet / Outlet Invert= 457.75' / 450.00' S= 0.1107 ' /' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.55 sf
#3	Primary	459.75'	15.0" Round Culvert X 2.00 L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 459.75' / 450.00' S= 0.1950 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Discarded OutFlow Max=0.60 cfs @ 9.70 hrs HW=456.08' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.60 cfs)

Primary OutFlow Max=6.78 cfs @ 12.45 hrs HW=459.81' (Free Discharge)
 ↑2=Culvert (Inlet Controls 6.74 cfs @ 6.18 fps)
 ↑3=Culvert (Inlet Controls 0.04 cfs @ 0.85 fps)

25 YEAR STORM

Summary for Subcatchment 1S: PREDEV FLOW TO ABUTTER AUTUMN WOODS

Runoff = 27.06 cfs @ 12.14 hrs, Volume= 2.060 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 YEAR Rainfall=6.22"

Area (sf)	CN	Description
10,000	98	Paved parking, HSG C
18,570	74	>75% Grass cover, Good, HSG C
59,395	74	>75% Grass cover, Good, HSG C
273,165	70	Woods, Good, HSG C
4,456	77	Woods, Good, HSG D
365,586	72	Weighted Average
355,586		97.26% Pervious Area
10,000		2.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.1600	0.23		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
0.3	94	0.1200	5.20		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.9	585	0.1100	1.66		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
9.8	729	Total			

Summary for Subcatchment 2S: PREDEV FLOW TO ABUTTER MAROTTA

Runoff = 0.94 cfs @ 12.10 hrs, Volume= 0.064 af, Depth> 2.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 YEAR Rainfall=6.22"

Area (sf)	CN	Description
1,653	74	>75% Grass cover, Good, HSG C
9,988	70	Woods, Good, HSG C
11,641	71	Weighted Average
11,641		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.1000	0.19		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
2.0	180	0.0900	1.50		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
6.3	230	Total			

Summary for Subcatchment 3S: PREDEV FLOW TO ABUTTER BRUNEAU

Runoff = 0.59 cfs @ 12.04 hrs, Volume= 0.037 af, Depth> 4.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 YEAR Rainfall=6.22"

Area (sf)	CN	Description
1,918	74	>75% Grass cover, Good, HSG C
2,457	98	Paved parking, HSG C
4,375	87	Weighted Average
1,918		43.84% Pervious Area
2,457		56.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	31	0.1300	0.20		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
0.1	56	0.1400	7.60		Shallow Concentrated Flow, Paved Kv= 20.3 fps
2.7	87	Total			

Summary for Subcatchment 11S: POSTDEV OVERLAND FLOW TO ABUTTER AUTUMN WOODS

Runoff = 5.53 cfs @ 12.10 hrs, Volume= 0.378 af, Depth> 3.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 YEAR Rainfall=6.22"

Area (sf)	CN	Description
4,456	77	Woods, Good, HSG D
45,936	74	>75% Grass cover, Good, HSG C
14,454	70	Woods, Good, HSG C
64,846	73	Weighted Average
64,846		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.1600	0.23		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
1.5	302	0.0530	3.45		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
1.4	96	0.0500	1.12		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
6.5	448	Total			

Summary for Subcatchment 12S: POSTDEV FLOW TO ABUTTER MAROTTA

Runoff = 0.54 cfs @ 12.09 hrs, Volume= 0.036 af, Depth> 3.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 YEAR Rainfall=6.22"

Area (sf)	CN	Description
2,187	70	Woods, Good, HSG C
3,988	74	>75% Grass cover, Good, HSG C
6,175	73	Weighted Average
6,175		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	50	0.0850	0.18		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
1.2	110	0.0900	1.50		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
5.8	160	Total			

Summary for Subcatchment 13S: POSTDEV FLOW TO ABUTTER BRUNEAU

Runoff = 0.14 cfs @ 12.07 hrs, Volume= 0.009 af, Depth> 4.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 YEAR Rainfall=6.22"

Area (sf)	CN	Description
717	74	>75% Grass cover, Good, HSG C
480	98	Paved parking, HSG C
1,197	84	Weighted Average
717		59.90% Pervious Area
480		40.10% Impervious Area

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

Summary for Subcatchment 21S: POSTDEV ON SITE FLOW CAPTURED AND SENT TO INFILTRATION

Runoff = 37.10 cfs @ 12.08 hrs, Volume= 2.580 af, Depth> 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 YEAR Rainfall=6.22"

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Type III 24-hr 25 YEAR Rainfall=6.22"

Prepared by Azimuth Land Design, LLC

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Area (sf)	CN	Description
28,031	70	Woods, Good, HSG C
10,000	98	Roofs, HSG C
42,472	98	Unconnected roofs, HSG C
105,178	98	Paved parking, HSG C
7,134	74	>75% Grass cover, Good, HSG C
116,569	74	>75% Grass cover, Good, HSG C
309,384	86	Weighted Average
151,734		49.04% Pervious Area
157,650		50.96% Impervious Area
42,472		26.94% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.1600	0.23		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
0.3	94	0.1200	5.20		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
1.5	187	0.0200	2.12		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.4	331	Total			

Summary for Reach 11R: (new Reach)

Inflow Area = 8.591 ac, 42.13% Impervious, Inflow Depth > 2.79" for 25 YEAR event
 Inflow = 17.43 cfs @ 12.28 hrs, Volume= 2.001 af
 Outflow = 17.43 cfs @ 12.28 hrs, Volume= 2.001 af, Atten= 0%, Lag= 0.0 min

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

Summary for Reach 21R: FLOW PATH TO PROPERTY LINE

Inflow Area = 7.102 ac, 50.96% Impervious, Inflow Depth > 2.74" for 25 YEAR event
 Inflow = 14.75 cfs @ 12.29 hrs, Volume= 1.623 af
 Outflow = 14.77 cfs @ 12.30 hrs, Volume= 1.623 af, Atten= 0%, Lag= 0.6 min

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

Max. Velocity= 3.63 fps, Min. Travel Time= 0.3 min
 Avg. Velocity = 1.63 fps, Avg. Travel Time= 0.6 min

Peak Storage= 257 cf @ 12.30 hrs
 Average Depth at Peak Storage= 0.27', Surface Width= 20.65'
 Bank-Full Depth= 1.00' Flow Area= 30.0 sf, Capacity= 228.16 cfs

10.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
 Side Slope Z-value= 20.0 ' ' Top Width= 50.00'
 Length= 63.0' Slope= 0.0635 ' '
 Inlet Invert= 448.00', Outlet Invert= 444.00'



Summary for Pond 21P: 60x180 10800 sf with 154 chambers 7X22-- loamy sand

Inflow Area = 7.102 ac, 50.96% Impervious, Inflow Depth > 4.36" for 25 YEAR event
 Inflow = 37.10 cfs @ 12.08 hrs, Volume= 2.580 af
 Outflow = 15.35 cfs @ 12.29 hrs, Volume= 2.248 af, Atten= 59%, Lag= 12.9 min
 Discarded = 0.60 cfs @ 8.85 hrs, Volume= 0.625 af
 Primary = 14.75 cfs @ 12.29 hrs, Volume= 1.623 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 460.68' @ 12.29 hrs Surf.Area= 10,800 sf Storage= 40,731 cf

Plug-Flow detention time= 82.9 min calculated for 2.248 af (87% of inflow)
 Center-of-Mass det. time= 43.1 min (808.1 - 765.1)

Volume	Invert	Avail.Storage	Storage Description
#1	456.00'	12,220 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 86,400 cf Overall - 55,851 cf Embedded = 30,549 cf x 40.0% Voids
#2	456.50'	44,255 cf	retain_it retain_it 5.0' x 154 Inside #1 Inside= 84.0"W x 60.0"H => 36.41 sf x 8.00'L = 291.3 cf Outside= 96.0"W x 68.0"H => 45.33 sf x 8.00'L = 362.7 cf 7 Rows adjusted for 602.6 cf perimeter wall
		56,474 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
456.00	10,800	0	0
464.00	10,800	86,400	86,400

Device	Routing	Invert	Outlet Devices
#1	Discarded	456.00'	2.410 in/hr Exfiltration over Surface area
#2	Primary	457.75'	10.0" Round Culvert X 2.00 L= 70.0' Ke= 0.500 Inlet / Outlet Invert= 457.75' / 450.00' S= 0.1107 ' /' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.55 sf
#3	Primary	459.75'	15.0" Round Culvert X 2.00 L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 459.75' / 450.00' S= 0.1950 ' /' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Discarded OutFlow Max=0.60 cfs @ 8.85 hrs HW=456.08' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.60 cfs)

Primary OutFlow Max=14.73 cfs @ 12.29 hrs HW=460.68' (Free Discharge)
 ↑2=Culvert (Inlet Controls 8.32 cfs @ 7.63 fps)
 ↑3=Culvert (Inlet Controls 6.41 cfs @ 3.28 fps)

100 YEAR STORM

Summary for Subcatchment 1S: PREDEV FLOW TO ABUTTER AUTUMN WOODS

Runoff = 46.62 cfs @ 12.14 hrs, Volume= 3.582 af, Depth> 5.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 YEAR Rainfall=8.88"

Area (sf)	CN	Description
10,000	98	Paved parking, HSG C
18,570	74	>75% Grass cover, Good, HSG C
59,395	74	>75% Grass cover, Good, HSG C
273,165	70	Woods, Good, HSG C
4,456	77	Woods, Good, HSG D
365,586	72	Weighted Average
355,586		97.26% Pervious Area
10,000		2.74% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.1600	0.23		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
0.3	94	0.1200	5.20		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.9	585	0.1100	1.66		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
9.8	729	Total			

Summary for Subcatchment 2S: PREDEV FLOW TO ABUTTER MAROTTA

Runoff = 1.63 cfs @ 12.10 hrs, Volume= 0.112 af, Depth> 5.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 YEAR Rainfall=8.88"

Area (sf)	CN	Description
1,653	74	>75% Grass cover, Good, HSG C
9,988	70	Woods, Good, HSG C
11,641	71	Weighted Average
11,641		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	50	0.1000	0.19		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
2.0	180	0.0900	1.50		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
6.3	230	Total			

Summary for Subcatchment 3S: PREDEV FLOW TO ABUTTER BRUNEAU

Runoff = 0.89 cfs @ 12.04 hrs, Volume= 0.058 af, Depth> 6.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 YEAR Rainfall=8.88"

Area (sf)	CN	Description
1,918	74	>75% Grass cover, Good, HSG C
2,457	98	Paved parking, HSG C
4,375	87	Weighted Average
1,918		43.84% Pervious Area
2,457		56.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	31	0.1300	0.20		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
0.1	56	0.1400	7.60		Shallow Concentrated Flow, Paved Kv= 20.3 fps
2.7	87	Total			

Summary for Subcatchment 11S: POSTDEV OVERLAND FLOW TO ABUTTER AUTUMN WOODS

Runoff = 9.41 cfs @ 12.10 hrs, Volume= 0.651 af, Depth> 5.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 YEAR Rainfall=8.88"

Area (sf)	CN	Description
4,456	77	Woods, Good, HSG D
45,936	74	>75% Grass cover, Good, HSG C
14,454	70	Woods, Good, HSG C
64,846	73	Weighted Average
64,846		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.1600	0.23		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
1.5	302	0.0530	3.45		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
1.4	96	0.0500	1.12		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
6.5	448	Total			

Summary for Subcatchment 12S: POSTDEV FLOW TO ABUTTER MAROTTA

Runoff = 0.91 cfs @ 12.09 hrs, Volume= 0.062 af, Depth> 5.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 YEAR Rainfall=8.88"

Area (sf)	CN	Description
2,187	70	Woods, Good, HSG C
3,988	74	>75% Grass cover, Good, HSG C
6,175	73	Weighted Average
6,175		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	50	0.0850	0.18		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
1.2	110	0.0900	1.50		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
5.8	160	Total			

Summary for Subcatchment 13S: POSTDEV FLOW TO ABUTTER BRUNEAU

Runoff = 0.22 cfs @ 12.07 hrs, Volume= 0.015 af, Depth> 6.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 YEAR Rainfall=8.88"

Area (sf)	CN	Description
717	74	>75% Grass cover, Good, HSG C
480	98	Paved parking, HSG C
1,197	84	Weighted Average
717		59.90% Pervious Area
480		40.10% Impervious Area

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

Summary for Subcatchment 21S: POSTDEV ON SITE FLOW CAPTURED AND SENT TO INFILTRATION

Runoff = 56.39 cfs @ 12.08 hrs, Volume= 4.021 af, Depth> 6.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 YEAR Rainfall=8.88"

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Type III 24-hr 100 YEAR Rainfall=8.88"

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Area (sf)	CN	Description
28,031	70	Woods, Good, HSG C
10,000	98	Roofs, HSG C
42,472	98	Unconnected roofs, HSG C
105,178	98	Paved parking, HSG C
7,134	74	>75% Grass cover, Good, HSG C
116,569	74	>75% Grass cover, Good, HSG C
309,384	86	Weighted Average
151,734		49.04% Pervious Area
157,650		50.96% Impervious Area
42,472		26.94% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	50	0.1600	0.23		Sheet Flow, Grass: Dense n= 0.240 P2= 3.22"
0.3	94	0.1200	5.20		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
1.5	187	0.0200	2.12		Shallow Concentrated Flow, Grassed Waterway Kv= 15.0 fps
5.4	331	Total			

Summary for Reach 11R: (new Reach)

Inflow Area = 8.591 ac, 42.13% Impervious, Inflow Depth > 5.06" for 100 YEAR event
 Inflow = 38.77 cfs @ 12.16 hrs, Volume= 3.624 af
 Outflow = 38.77 cfs @ 12.16 hrs, Volume= 3.624 af, Atten= 0%, Lag= 0.0 min

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

Summary for Reach 21R: FLOW PATH TO PROPERTY LINE

Inflow Area = 7.102 ac, 50.96% Impervious, Inflow Depth > 5.03" for 100 YEAR event
 Inflow = 31.82 cfs @ 12.20 hrs, Volume= 2.974 af
 Outflow = 31.68 cfs @ 12.21 hrs, Volume= 2.974 af, Atten= 0%, Lag= 0.6 min

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

Max. Velocity= 4.50 fps, Min. Travel Time= 0.2 min
 Avg. Velocity= 1.97 fps, Avg. Travel Time= 0.5 min

Peak Storage= 443 cf @ 12.20 hrs
 Average Depth at Peak Storage= 0.39', Surface Width= 25.75'
 Bank-Full Depth= 1.00' Flow Area= 30.0 sf, Capacity= 228.16 cfs

10.00' x 1.00' deep channel, n= 0.035 Earth, dense weeds
 Side Slope Z-value= 20.0 ' / ' Top Width= 50.00'
 Length= 63.0' Slope= 0.0635 ' / '
 Inlet Invert= 448.00', Outlet Invert= 444.00'



Summary for Pond 21P: 60x180 10800 sf with 154 chambers 7X22-- loamy sand

Inflow Area = 7.102 ac, 50.96% Impervious, Inflow Depth > 6.79" for 100 YEAR event
 Inflow = 56.39 cfs @ 12.08 hrs, Volume= 4.021 af
 Outflow = 32.42 cfs @ 12.20 hrs, Volume= 3.666 af, Atten= 43%, Lag= 7.3 min
 Discarded = 0.60 cfs @ 7.50 hrs, Volume= 0.691 af
 Primary = 31.82 cfs @ 12.20 hrs, Volume= 2.974 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 463.24' @ 12.20 hrs Surf.Area= 10,800 sf Storage= 53,177 cf

Plug-Flow detention time= 68.9 min calculated for 3.665 af (91% of inflow)
 Center-of-Mass det. time= 38.4 min (793.8 - 755.4)

Volume	Invert	Avail.Storage	Storage Description
#1	456.00'	12,220 cf	Custom Stage Data (Prismatic) Listed below (Recalc) 86,400 cf Overall - 55,851 cf Embedded = 30,549 cf x 40.0% Voids
#2	456.50'	44,255 cf	retain_it retain_it 5.0' x 154 Inside #1 Inside= 84.0"W x 60.0"H => 36.41 sf x 8.00'L = 291.3 cf Outside= 96.0"W x 68.0"H => 45.33 sf x 8.00'L = 362.7 cf 7 Rows adjusted for 602.6 cf perimeter wall
		56,474 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
456.00	10,800	0	0
464.00	10,800	86,400	86,400

Device	Routing	Invert	Outlet Devices
#1	Discarded	456.00'	2.410 in/hr Exfiltration over Surface area
#2	Primary	457.75'	10.0" Round Culvert X 2.00 L= 70.0' Ke= 0.500 Inlet / Outlet Invert= 457.75' / 450.00' S= 0.1107 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.55 sf
#3	Primary	459.75'	15.0" Round Culvert X 2.00 L= 50.0' Ke= 0.500 Inlet / Outlet Invert= 459.75' / 450.00' S= 0.1950 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Discarded OutFlow Max=0.60 cfs @ 7.50 hrs HW=456.08' (Free Discharge)
 ↑1=Exfiltration (Exfiltration Controls 0.60 cfs)

Primary OutFlow Max=31.81 cfs @ 12.20 hrs HW=463.23' (Free Discharge)
 ↑2=Culvert (Inlet Controls 11.82 cfs @ 10.84 fps)
 ↑3=Culvert (Inlet Controls 19.98 cfs @ 8.14 fps)

Soil Map—Worcester County, Massachusetts, Northeastern Part; and Worcester County, Massachusetts, Southern Part



MAP LEGEND

- 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
- 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 scales ranging from 1:20,000 to 1:25,000.

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

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

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

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

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

Soil Survey Area: Worcester County, Massachusetts, Northeastern Part
 Survey Area Data: Version 16, Sep 3, 2021
 Soil Survey Area: Worcester County, Massachusetts, Southern Part
 Survey Area Data: Version 14, Sep 3, 2021

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Jul 26, 2019—Oct 5, 2019

MAP LEGEND

MAP INFORMATION

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
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	3.5	3.3%
31A	Walpole sandy loam, 0 to 3 percent slopes	2.9	2.7%
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	6.2	5.8%
102C	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	1.7	1.6%
102D	Chatfield-Hollis-Rock outcrop complex, 15 to 35 percent slopes	0.9	0.8%
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	0.2	0.2%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	4.2	3.9%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	0.7	0.7%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	23.0	21.5%
305D	Paxton fine sandy loam, 15 to 25 percent slopes	9.5	8.8%
306C	Paxton fine sandy loam, 8 to 15 percent slopes, very stony	7.7	7.2%
306D	Paxton fine sandy loam, 15 to 25 percent slopes, very stony	2.9	2.7%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	16.7	15.5%
Subtotals for Soil Survey Area		80.1	74.7%
Totals for Area of Interest		107.2	100.0%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	10.5	9.8%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	7.0	6.6%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	6.0	5.6%
305D	Paxton fine sandy loam, 15 to 25 percent slopes	1.2	1.1%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	2.3	2.2%
Subtotals for Soil Survey Area		27.1	25.3%
Totals for Area of Interest		107.2	100.0%