STORMWATER MANAGEMENT NARRATIVE

for

40 Centre Street
Brookline, Massachusetts

Prepared by:
Schofield Brothers LLC
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40 CENTRE STREET, BROOKLINE

Stormwater Standards Summary

MassDEP Stormwater Management Standards:

Standard 1: (Untreated Discharges)

There are no new stormwater conveyances proposed that discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

Prior to discharge to the public drainage system, stormwater runoff from the roof is passed through a subsurface infiltration system. Parking is located under the building; there are no proposed paved parking areas outside the footprint of the building.

Standard 2: (Peak rate control and flood protection)

Under proposed conditions, there is a decrease in impervious area. Stormwater runoff peak flows and volume following redevelopment will be less than the existing conditions. There will be no increases from any storm event up to and including the 100 year storm. The computations have been made for the 2, 10, 25 and 100-year design storm events, and are included.

TABLE 1 - Existing vs. Proposed Peak Flows and Volumes

		DP#1 (Centre Street)			
Storm Event	24 hr Rainfall	Peak Flow (cfs)		Volume (Acre feet)	
		Existing	Proposed	Existing	Proposed
2 year	3.2 in	0.72	0.60	0.051	0.023
10 year	4.6 in	1.09	0.91	0.079	0.048
25 year	5.5 in	1.33	1.12	0.098	0.064
100 year	6.5 in	1.59	1.35	0.118	0.083

Standard 3: (Recharge to Groundwater)

Under existing developed conditions, there are no known infiltration BMP's. Published NRCS soil data indicates "Urban land." For sizing purposes, the soil is conservatively considered HSG "A" and the permeability rate is based on a Rawl's rate of 1.02 inches/hour (sandy loam). Soil testing will be performed at the site and at the location of the proposed infiltration system to confirm these assumptions and to determine the permeability, soil texture, and depth to ground water.

The required recharge volume based on an HSG "A" soil with a target factor of 0.6" is 390 cubic feet. This proposed infiltration Best Management Practice (BMP) consists of underground concrete leaching chambers surrounded with stone. Roof runoff will be directed to a subsurface infiltration system, where the capture volume meets the required recharge volume. A storage table of the infiltration system is included. The infiltration system consists of two (2) rows of four (4) underground concrete chambers which are four (4) feet wide by four (4) feet long by four (4) feet high. An outlet control structure, with a concrete weir, controls the retained water within the infiltration system. The recharge volume provided is 630 cubic feet. The proposed infiltration BMP will drain within 72 hours.

Note that item 6b of the Town of Brookline Site Plan Review Checklist requires onsite infiltration structures to be designed to retain 5.5" of rain. As a redevelopment project, coupled with a reduction in impervious area, the applicant is proposing that the infiltration facility be sized in accordance with the MassDEP Stormwater Management Regulations.

Standard 4: (80% TSS Removal)

Non-contaminated runoff (roof area) is routed directly to the subsurface infiltration system to provide 80% TSS removal for that treatment train. The entrance driveway is untreated.

A Long-Term Pollution Prevention Plan LTPPP) will be prepared.

Standard 5: (Land Use with Higher Potential Pollutant Load)

Not Applicable.

Standard 6: (Critical Areas)

Stormwater does not discharge near or to a Critical Area (such as a Zone II, Interim Wellhead Protection Areas, Shellfish Growing Areas, Bathing Beaches, Outstanding Resource Waters, Special Resource Waters, or Cold-Water Fisheries).

Standard 7: (Redevelopment)

The project is a redevelopment project. The project fully complies with Standard 1, 2, and 3 and meets to the maximum extent practicable Standard 4. The project reduces impervious cover by 1,504 square feet, and therefore reduces the peak flows and volume to the existing drain in Centre Street. A long term pollution plan, a stormwater operation plan, an erosion control plan, and an illicit discharge statement will be prepared when submitting for Site Plan Review.

## Standard 8: (Erosion, Sediment Control)

Erosion and sediment control BMPs will be included in the Erosion and Sediment Control Plan as part of the Site Plan set.

Standard 9: (Operation & Maintenance)

An Operation and Maintenance Plan for the stormwater system (infiltration) will be prepared.
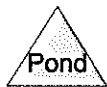
Standard 10: (Illicit Discharges)

The proposed building design will be in compliance with state and local building codes. There are no illicit discharges designed or proposed. An Illicit Discharge Statement will be prepared.
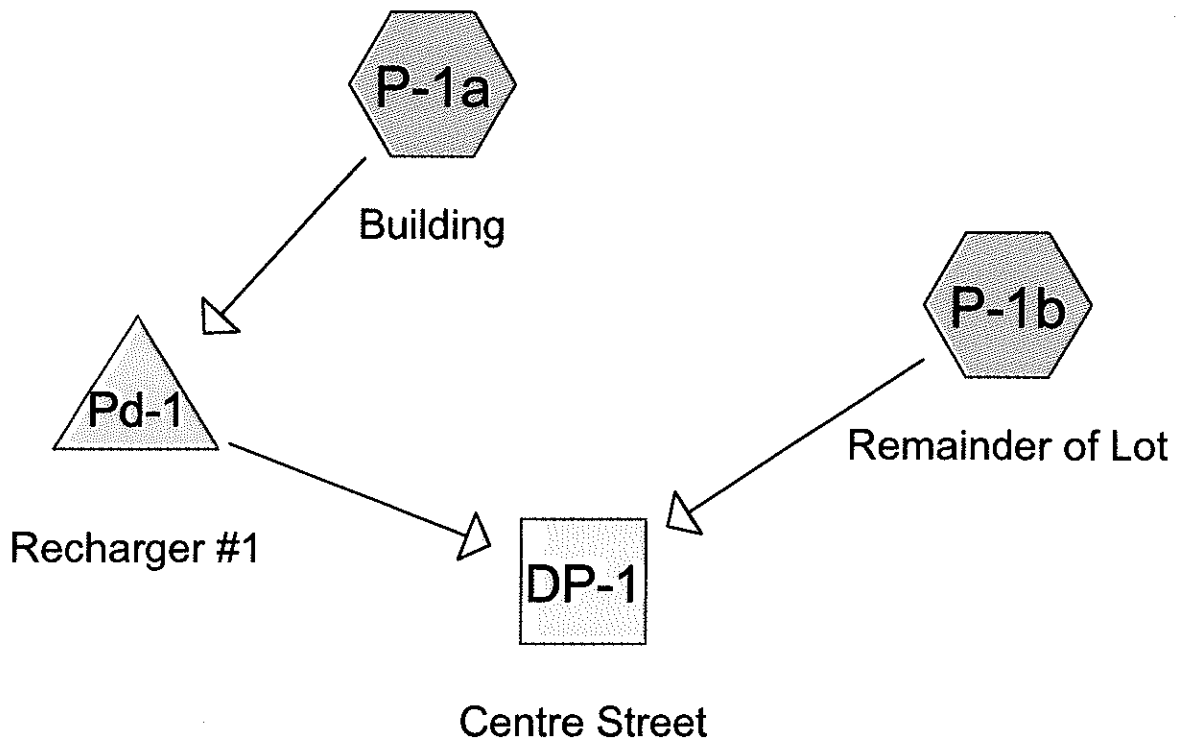
P-1a

Building

P-1b

Pd-1

Remainder of Lot

Recharger #1

DP-1

Centre Street

Subcat   Reach   Pond   Link

24766-40 Centre Street-Proposed Conditions
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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.065	61	>75% Grass cover, Good, HSG B (P-1b)
0.007	98	Paved parking, HSG B (P-1b)
0.178	98	Roofs, HSG B (P-1a)
0.250	**88**	**TOTAL AREA**

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1a: Building   Runoff Area=7,768 sf 100.00% Impervious Runoff Depth=2.97"
Tc=5.0 min CN=98 Runoff=0.57 cfs 0.044 af

Subcatchment P-1b: Remainder of Lot   Runoff Area=3,121 sf 9.61% Impervious Runoff Depth=0.60"
Tc=0.0 min CN=65 Runoff=0.05 cfs 0.004 af

Reach DP-1: Centre Street   Inflow=0.60 cfs 0.023 af
Outflow=0.60 cfs 0.023 af

Pond Pd-1: Recharger #1   Peak Elev=65.39' Storage=644 cf Inflow=0.57 cfs 0.044 af
Discarded=0.01 cfs 0.013 af Primary=0.57 cfs 0.019 af Outflow=0.57 cfs 0.033 af

Total Runoff Area = 0.250 ac   Runoff Volume = 0.048 af   Average Runoff Depth = 2.29"
25.91% Pervious = 0.065 ac   74.09% Impervious = 0.185 ac

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1a: Building   Runoff Area=7,768 sf 100.00% Impervious Runoff Depth=4.36"
Tc=5.0 min CN=98 Runoff=0.83 cfs 0.065 af

Subcatchment P-1b: Remainder of Lot   Runoff Area=3,121 sf 9.61% Impervious Runoff Depth=1.39"
Tc=0.0 min CN=65 Runoff=0.13 cfs 0.008 af

Reach DP-1: Centre Street   Inflow=0.91 cfs 0.048 af
Outflow=0.91 cfs 0.048 af

Pond Pd-1: Recharger #1   Peak Elev=65.42' Storage=646 cf Inflow=0.83 cfs 0.065 af
Discarded=0.01 cfs 0.014 af Primary=0.82 cfs 0.039 af Outflow=0.83 cfs 0.053 af

Total Runoff Area = 0.250 ac Runoff Volume = 0.073 af Average Runoff Depth = 3.51"
25.91% Pervious = 0.065 ac   74.09% Impervious = 0.185 ac

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1a: Building   Runoff Area=7,768 sf 100.00% Impervious Runoff Depth=5.26"
Tc=5.0 min   CN=98   Runoff=0.99 cfs 0.078 af

Subcatchment P-1b: Remainder of Lot   Runoff Area=3,121 sf 9.61% Impervious Runoff Depth=1.99"
Tc=0.0 min   CN=65   Runoff=0.20 cfs 0.012 af

Reach DP-1: Centre Street   Inflow=1.12 cfs 0.064 af
Outflow=1.12 cfs 0.064 af

Pond Pd-1: Recharger #1   Peak Elev=65.45' Storage=648 cf   Inflow=0.99 cfs 0.078 af
Discarded=0.01 cfs 0.014 af   Primary=0.99 cfs 0.052 af   Outflow=0.99 cfs 0.067 af

Total Runoff Area = 0.250 ac   Runoff Volume = 0.090 af   Average Runoff Depth = 4.33"
25.91% Pervious = 0.065 ac   74.09% Impervious = 0.185 ac

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1a: Building   Runoff Area=7,768 sf 100.00% Impervious Runoff Depth=6.26"
Tc=5.0 min CN=98 Runoff=1.18 cfs 0.093 af

Subcatchment P-1b: Remainder of Lot   Runoff Area=3,121 sf 9.61% Impervious Runoff Depth=2.72"
Tc=0.0 min CN=65 Runoff=0.28 cfs 0.016 af

Reach DP-1: Centre Street   Inflow=1.35 cfs 0.083 af
Outflow=1.35 cfs 0.083 af

Pond Pd-1: Recharger #1   Peak Elev=65.47' Storage=649 cf Inflow=1.18 cfs 0.093 af
Discarded=0.01 cfs 0.014 af Primary=1.17 cfs 0.067 af Outflow=1.18 cfs 0.081 af

Total Runoff Area = 0.250 ac   Runoff Volume = 0.109 af   Average Runoff Depth = 5.25"
25.91% Pervious = 0.065 ac   74.09% Impervious = 0.185 ac

Summary for Pond Pd-1: Recharger #1

Inflow Area =   0.178 ac,100.00% Impervious, Inflow Depth = 2.97" for 2 yr event
Inflow   =   0.57 cfs @ 12.07 hrs, Volume=   0.044 af
Outflow   =   0.57 cfs @ 12.07 hrs, Volume=   0.033 af, Atten= 0%, Lag= 0.2 min
Discarded   =   0.01 cfs @   5.87 hrs, Volume=   0.013 af
Primary   =   0.57 cfs @ 12.07 hrs, Volume=   0.019 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 65.39' @ 12.07 hrs   Surf.Area= 260 sf   Storage= 644 cf

Plug-Flow detention time= 213.7 min calculated for 0.033 af (74% of inflow)
Center-of-Mass det. time= 126.1 min (881.6 - 755.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	61.00'	347 cf	**13.00'W x 20.00'L x 5.25'H Field A** 1,365 cf Overall - 499 cf Embedded = 866 cf x 40.0% Voids
#2A	61.50'	371 cf	**Galley 4x4x4.25** x 8 Inside #1 Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf 2 Rows of 4 Chambers
		718 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	61.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	65.25'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.01 cfs @ 5.87 hrs HW=61.05' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.56 cfs @ 12.07 hrs HW=65.39' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 0.56 cfs @ 1.03 fps)

24766-40 Centre Street-Proposed Conditions
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10-NOV-2016
Type III 24-hr 2 yr Rainfall=3.20"

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Pond Pd-1: Recharger #1 - Chamber Wizard Field A

Chamber Model = Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

4 Chambers/Row x 4.00' Long = 16.00' Row Length +24.0" End Stone x 2 = 20.00' Base Length
2 Rows x 54.0" Wide + 24.0" Side Stone x 2 = 13.00' Base Width
6.0" Base + 51.0" Chamber Height + 6.0" Cover = 5.25' Field Height

8 Chambers x 46.4 cf = 371.0 cf Chamber Storage
8 Chambers x 62.3 cf = 498.7 cf Displacement

1,365.0 cf Field - 498.7 cf Chambers = 866.3 cf Stone x 40.0% Voids = 346.5 cf Stone Storage
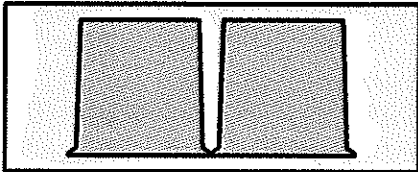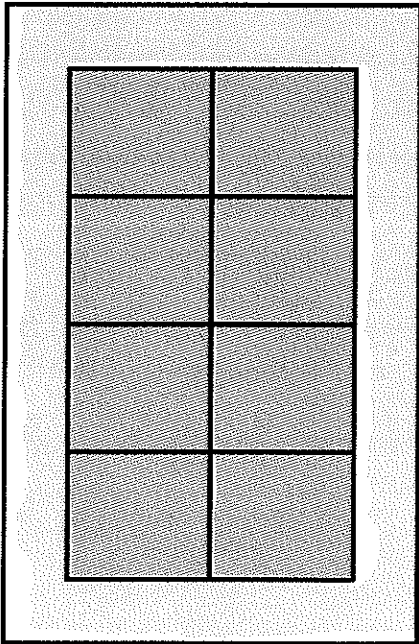
Chamber Storage + Stone Storage = 717.6 cf = 0.016 af
Overall Storage Efficiency = 52.6%

8 Chambers
50.6 cy Field
32.1 cy Stone

Summary for Pond Pd-1: Recharger #1

Inflow Area =	0.178 ac,100.00% Impervious, Inflow Depth = 4.36" for 10 yr event	
Inflow =	0.83 cfs @ 12.07 hrs, Volume=	0.065 af
Outflow =	0.83 cfs @ 12.07 hrs, Volume=	0.053 af, Atten= 0%, Lag= 0.1 min
Discarded =	0.01 cfs @ 3.75 hrs, Volume=	0.014 af
Primary =	0.82 cfs @ 12.07 hrs, Volume=	0.039 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 65.42' @ 12.07 hrs Surf.Area= 260 sf Storage= 646 cf

Plug-Flow detention time= 163.3 min calculated for 0.053 af (82% of inflow)
Center-of-Mass det. time= 91.3 min (839.8 - 748.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	61.00'	347 cf	**13.00'W x 20.00'L x 5.25'H Field A**
			1,365 cf Overall - 499 cf Embedded = 866 cf x 40.0% Voids
#2A	61.50'	371 cf	**Galley 4x4x4.25 x 8 Inside #1**
			Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
			Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf
			2 Rows of 4 Chambers
		718 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	61.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	65.25'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.01 cfs @ 3.75 hrs HW=61.05' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.82 cfs @ 12.07 hrs HW=65.42' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 0.82 cfs @ 1.17 fps)

Pond Pd-1: Recharger #1 - Chamber Wizard Field A

Chamber Model = Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

4 Chambers/Row x 4.00' Long = 16.00' Row Length +24.0" End Stone x 2 = 20.00' Base Length
2 Rows x 54.0" Wide + 24.0" Side Stone x 2 = 13.00' Base Width
6.0" Base + 51.0" Chamber Height + 6.0" Cover = 5.25' Field Height

8 Chambers x 46.4 cf = 371.0 cf Chamber Storage
8 Chambers x 62.3 cf = 498.7 cf Displacement

1,365.0 cf Field - 498.7 cf Chambers = 866.3 cf Stone x 40.0% Voids = 346.5 cf Stone Storage
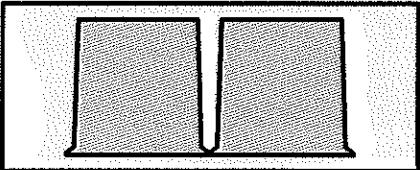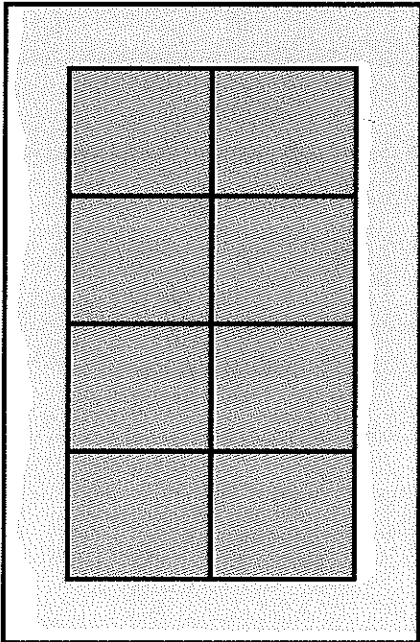
Chamber Storage + Stone Storage = 717.6 cf = 0.016 af
Overall Storage Efficiency = 52.6%

8 Chambers
50.6 cy Field
32.1 cy Stone

Summary for Pond Pd-1: Recharger #1

Inflow Area =   0.178 ac,100.00% Impervious, Inflow Depth = 5.26"   for 25 yr event
Inflow   =   0.99 cfs @ 12.07 hrs, Volume=   0.078 af
Outflow   =   0.99 cfs @ 12.07 hrs, Volume=   0.067 af, Atten= 0%, Lag= 0.1 min
Discarded =   0.01 cfs @   2.97 hrs, Volume=   0.014 af
Primary   =   0.99 cfs @ 12.07 hrs, Volume=   0.052 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 65.45' @ 12.07 hrs   Surf.Area= 260 sf   Storage= 648 cf

Plug-Flow detention time= 146.2 min calculated for 0.067 af (85% of inflow)
Center-of-Mass det. time= 81.6 min (827.1 - 745.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	61.00'	347 cf	**13.00'W x 20.00'L x 5.25'H Field A**
			1,365 cf Overall - 499 cf Embedded = 866 cf x 40.0% Voids
#2A	61.50'	371 cf	**Galley 4x4x4.25** x 8 Inside #1
			Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
			Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf
			2 Rows of 4 Chambers
		718 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	61.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	65.25'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.01 cfs @ 2.97 hrs HW=61.05' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.98 cfs @ 12.07 hrs HW=65.45' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 0.98 cfs @ 1.24 fps)

Pond Pd-1: Recharger #1 - Chamber Wizard Field A

Chamber Model = Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

4 Chambers/Row x 4.00' Long = 16.00' Row Length +24.0" End Stone x 2 = 20.00' Base Length
2 Rows x 54.0" Wide + 24.0" Side Stone x 2 = 13.00' Base Width
6.0" Base + 51.0" Chamber Height + 6.0" Cover = 5.25' Field Height

8 Chambers x 46.4 cf = 371.0 cf Chamber Storage
8 Chambers x 62.3 cf = 498.7 cf Displacement

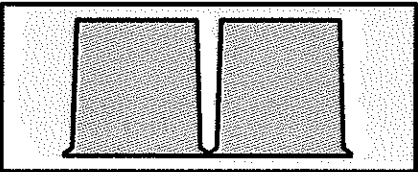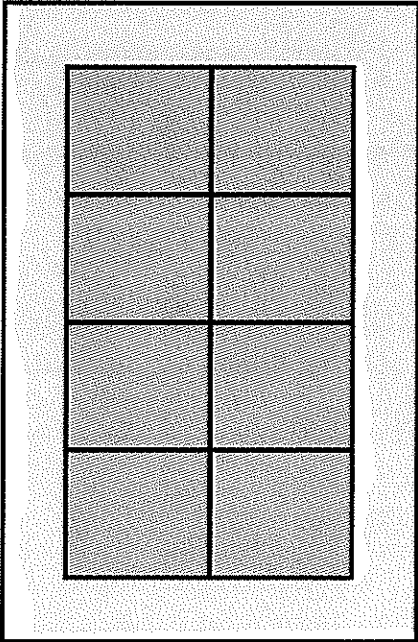1,365.0 cf Field - 498.7 cf Chambers = 866.3 cf Stone x 40.0% Voids = 346.5 cf Stone Storage

Chamber Storage + Stone Storage = 717.6 cf = 0.016 af
Overall Storage Efficiency = 52.6%

8 Chambers
50.6 cy Field
32.1 cy Stone

24766-40 Centre Street-Proposed Conditions   *Type III 24-hr 100 yr Rainfall=6.50"*

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Summary for Pond Pd-1: Recharger #1

Inflow Area =	0.178 ac,100.00% Impervious, Inflow Depth = 6.26" for 100 yr event			
Inflow·	=	1.18 cfs @ 12.07 hrs, Volume=	0.093 af	
Outflow	=	1.18 cfs @ 12.07 hrs, Volume=	0.081 af, Atten= 0%, Lag= 0.1 min	
Discarded =		0.01 cfs @ 2.35 hrs, Volume=	0.014 af	
Primary	=	1.17 cfs @ 12.07 hrs, Volume=	0.067 af	

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 65.47' @ 12.07 hrs   Surf.Area= 260 sf   Storage= 649 cf

Plug-Flow detention time= 132.4 min calculated for 0.081 af (88% of inflow)
Center-of-Mass det. time= 74.1 min (817.2 - 743.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	61.00'	347 cf	**13.00'W x 20.00'L x 5.25'H Field A**
			1,365 cf Overall - 499 cf Embedded = 866 cf x 40.0% Voids
#2A	61.50'	371 cf	**Galley 4x4x4.25** x 8 Inside #1
			Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
			Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf
			2 Rows of 4 Chambers
		718 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	61.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	65.25'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.01 cfs @ 2.35 hrs HW=61.05' (Free Discharge)
└—**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=1.16 cfs @ 12.07 hrs HW=65.47' (Free Discharge)
└—**2=Broad-Crested Rectangular Weir** (Weir Controls 1.16 cfs @ 1.32 fps)

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Type III 24-hr 100 yr Rainfall=6.50"

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Pond Pd-1: Recharger #1 - Chamber Wizard Field A

Chamber Model = Galley 4x4x4.25 (Concrete Galley, Shea LE-EGH, LE-CGH or equivalent)
Inside= 42.2"W x 45.0"H => 13.25 sf x 3.50'L = 46.4 cf
Outside= 54.0"W x 51.0"H => 15.58 sf x 4.00'L = 62.3 cf

4 Chambers/Row x 4.00' Long = 16.00' Row Length +24.0" End Stone x 2 = 20.00' Base Length
2 Rows x 54.0" Wide + 24.0" Side Stone x 2 = 13.00' Base Width
6.0" Base + 51.0" Chamber Height + 6.0" Cover = 5.25' Field Height

8 Chambers x 46.4 cf = 371.0 cf Chamber Storage
8 Chambers x 62.3 cf = 498.7 cf Displacement

1,365.0 cf Field - 498.7 cf Chambers = 866.3 cf Stone x 40.0% Voids = 346.5 cf Stone Storage

Chamber Storage + Stone Storage = 717.6 cf = 0.016 af
Overall Storage Efficiency = 52.6%

8 Chambers
50.6 cy Field
32.1 cy Stone