STORMWATER MANAGEMENT REPORT
1497 GRAFTON ROAD
MILLBURY, MASSACHUSETTS
November 2, 2021
Revised: February 3, 2022

Prepared for:
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Project Number:
G-613
Millbury, Massachusetts

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DRAINAGE NARRATIVE

Design Methods and Objectives

The following drainage analysis has been prepared in accordance with the most current rules and regulations of the Town of Millbury, Massachusetts. Watershed areas were calculated for both the pre-development and post-development conditions. Existing and proposed ground cover conditions as well as tourain slopes were evaluated. Based upon the increased peak runoff from pre-development to the post development, storm water management systems were designed to attenuate the post development peak flows and runoff to be less than or equal to the pre-development rates of runoff. These calculations were performed using Hydrocad Stormwater Modeling Software for determining peak runoff and sizing detention/infiltration facilities for the 2, 10, 25 and 100 year storm event frequencies. Runoff hydrographs are calculated using the SCS Runoff equation and the SCS unitless hydrograph.

Existing Site Conditions

The existing site conditions were analyzed to determine tributary site runoff areas, flow patterns, open space including wooded areas, as well as existing soil types. The drainage area that was analyzed includes the portion of the site at Abbott Place to be developed. The existing study area includes wooded area. The total tributary drainage area is 0.61 acres. The existing slopes on site range from 5-60%. The potion of the site to be developed currently drains to the east

Existing soils located on site were determined to be Hinckley Loamy Sand. Hinckley is classified as Hydrologic Group A and has a drainage class rating of "excessively drained". Included in the Stormwater Management Report are soil log forms detailing our finding from on site soil testing performed at this site. This soil testing was used to verify the hydrologic group of the soils at the site and determine seasonal high groundwater levels as the drainage design includes infiltration.

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Proposed Site Conditions

In the post development condition, the property is proposed to be developed with a two family dwelling with associated pavement/parking area. The total impervious area in the post development condition is 0.24 acres. The total percentage of impervious area in the post development condition is 40.1%. The remaining portion of the site is to remain lawn or wooded.

The proposed site drainage is separated into two subcatchment drainage areas. These subcatchments are physically separate in the post development condition through the use of a Stormceptor treatment unit and infiltration chambers. These methods are used in order to reduce peak runoff rates and treat runoff from developed paved areas in order to meet TSS removal requirements.

"Subcatchment P1" includes pavement/parking area, rood area and some lawn. The runoff is directed into infiltration chambers prior to discharge. The infiltration chambers provides 80% TSS removal for paved areas.

"Subcatchment P2" includes lawn and wooded area. This clean runoff flows toward the east as it does in the existing condition.

The proposed drainage design for this development meets or exceeds all requirements by the Town of Millbury and the Department of Environmental Protection. As the calculations demonstrate the proposed drainage design provides attenuation of peak rates of runoff, improves the quality of site runoff that flows toward offsite areas and by achieving a minimum of 80% TSS for new paved areas. Note that MassDEP typically requires at least 50 feet from wetlands to subsurface infiltration structures, however almost the entire property is within 50 feet of the wetland which makes compliance with this provision impractical. The drainage design as proposed will improve the quality of runoff that currently exists on this site.

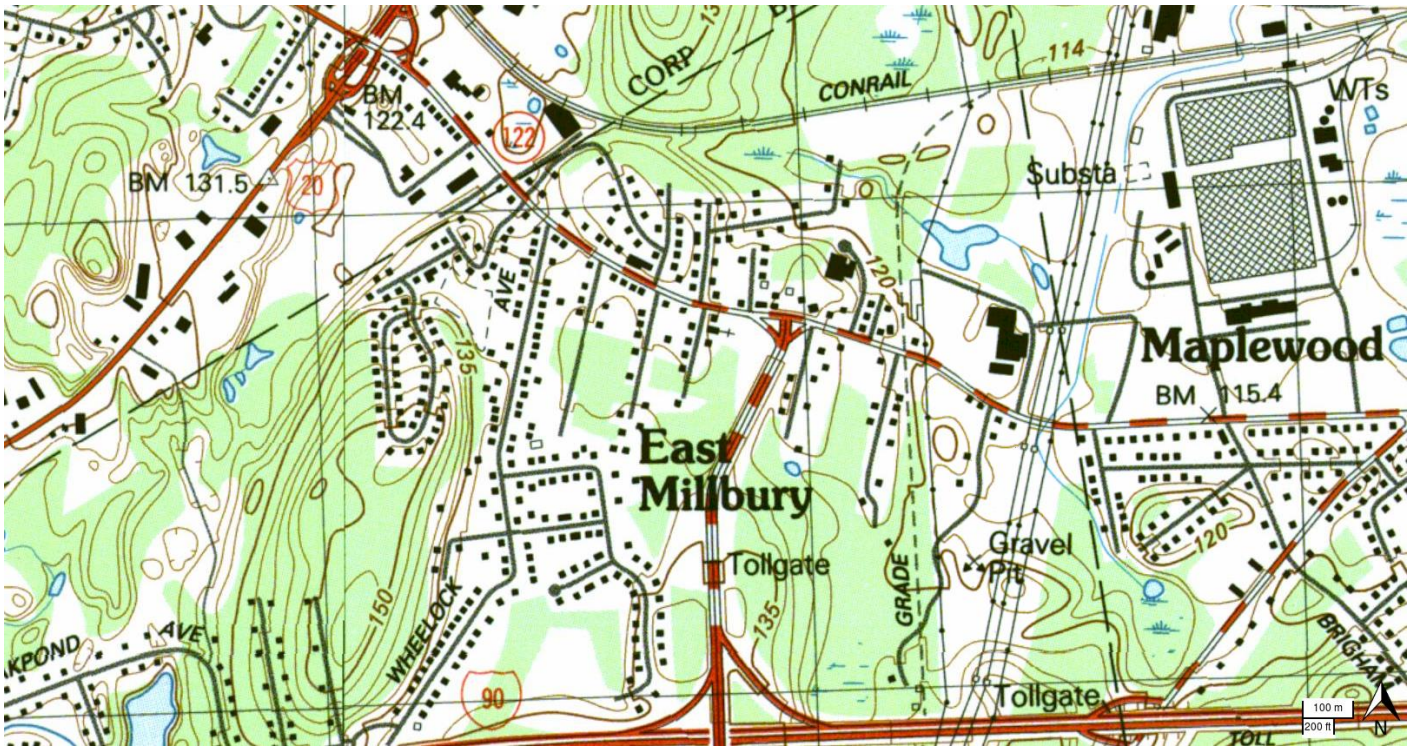
Drainage Analysis Summary

Pre-Development Drainage Reach (1R) – Existing Conditions Runoff to Wetland (E1)

Post-Development Drainage Reach (1R) – Combined Post Development Runoff to Wetland (P1, P2)

Note: (Peak Flow Rate in cfs)

	2 Year	**10 Year**	**25 Year**	**100 Year**
Storm Intensity	**3.2 inches**	**4.9 inches**	**6.1 inches**	**8.5 inches**
Pre-Development (E1)	0.00	0.00	0.01	0.11
Pre-Development (1R) To Wetland	**0.00**	**0.00**	**0.01**	**0.11**
Post-Development (P1 Routed Through Chambers)	0.00	0.00	0.00	0.07
Post-Development (P2)	0.00	0.00	0.01	0.09
Post-Development (1R) To Wetland	**0.00**	**0.00**	**0.01**	**0.10**
Reduction From Pre-Development to Post-Development	**-0.00**	**-0.00**	**-0.00**	**-0.01**

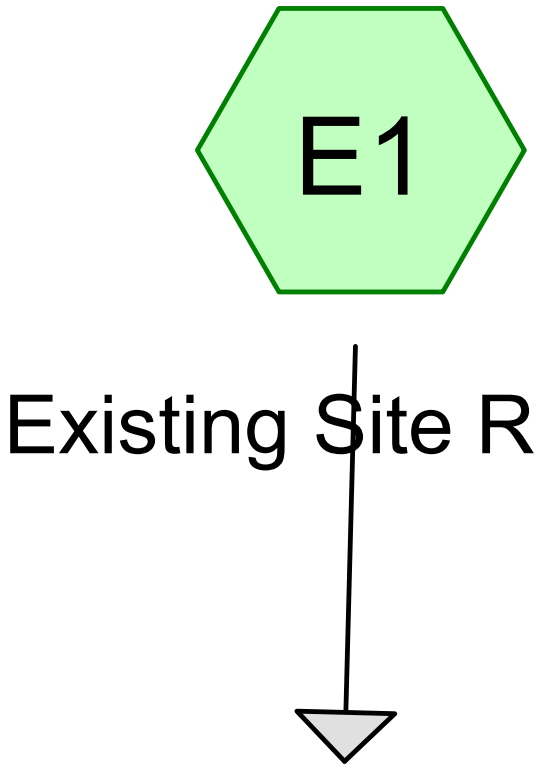


LOCUS PLAN

Source: USGS Quadrangles for
Worcester South, MA
7.5 x 15 minute series (metric)
Scale: 1:25,000 or 1" = 2083.33'

Abbott Place
Millbury, Massachusetts

Prepared by: J.M. GRENIER ASSOCIATES – Marlborough, MA



Subcat Reach Pond Link

Routing Diagram for G-613-PRE
Prepared by J.M. Grenier Associates Inc., Printed 2/3/2022

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.610	30	Woods, Good, HSG A (E1)
0.610	**30**	**TOTAL AREA**

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 E1: Existing Site Runoff Runoff Area=26,569 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=275' Tc=12.5 min CN=30 Runoff=0.00 cfs 0.000 af

Reach 1R: Wetland Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 0.610 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
100.00% Pervious = 0.610 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment E1: Existing Site Runoff

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

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 2-YR Rainfall=3.20"

Area (sf)	CN	Description
26,569	30	Woods, Good, HSG A
26,569		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, Segment 1** Woods: Light underbrush n= 0.400 P2= 3.20"
3.2	225	0.0560	1.18		**Shallow Concentrated Flow, Segment 2** Woodland Kv= 5.0 fps
12.5	275	Total			

Summary for Reach 1R: Wetland

Inflow Area = 0.610 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-YR event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

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

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 E1: Existing Site Runoff Runoff Area=26,569 sf 0.00% Impervious Runoff Depth>0.00"
Flow Length=275' Tc=12.5 min CN=30 Runoff=0.00 cfs 0.000 af

Reach 1R: Wetland Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 0.610 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
100.00% Pervious = 0.610 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment E1: Existing Site Runoff

Runoff = 0.00 cfs @ 20.00 hrs, Volume= 0.000 af, Depth> 0.00"

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-YR Rainfall=4.90"

Area (sf)	CN	Description
26,569	30	Woods, Good, HSG A
26,569		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, Segment 1** Woods: Light underbrush n= 0.400 P2= 3.20"
3.2	225	0.0560	1.18		**Shallow Concentrated Flow, Segment 2** Woodland Kv= 5.0 fps
12.5	275	Total			

Summary for Reach 1R: Wetland

Inflow Area = 0.610 ac, 0.00% Impervious, Inflow Depth > 0.00" for 10-YR event
Inflow = 0.00 cfs @ 20.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 20.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

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

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 E1: Existing Site Runoff Runoff Area=26,569 sf 0.00% Impervious Runoff Depth>0.05"
Flow Length=275' Tc=12.5 min CN=30 Runoff=0.01 cfs 0.003 af

Reach 1R: Wetland Inflow=0.01 cfs 0.003 af
Outflow=0.01 cfs 0.003 af

Total Runoff Area = 0.610 ac Runoff Volume = 0.003 af Average Runoff Depth = 0.05"
100.00% Pervious = 0.610 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment E1: Existing Site Runoff

Runoff = 0.01 cfs @ 15.47 hrs, Volume= 0.003 af, Depth> 0.05"

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 25-YR Rainfall=6.10"

Area (sf)	CN	Description
26,569	30	Woods, Good, HSG A
26,569		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, Segment 1** Woods: Light underbrush n= 0.400 P2= 3.20"
3.2	225	0.0560	1.18		**Shallow Concentrated Flow, Segment 2** Woodland Kv= 5.0 fps
12.5	275	Total			

Summary for Reach 1R: Wetland

Inflow Area = 0.610 ac, 0.00% Impervious, Inflow Depth > 0.05" for 25-YR event
Inflow = 0.01 cfs @ 15.47 hrs, Volume= 0.003 af
Outflow = 0.01 cfs @ 15.47 hrs, Volume= 0.003 af, Atten= 0%, Lag= 0.0 min

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

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 E1: Existing Site Runoff Runoff Area=26,569 sf 0.00% Impervious Runoff Depth>0.44"
Flow Length=275' Tc=12.5 min CN=30 Runoff=0.11 cfs 0.023 af

Reach 1R: Wetland Inflow=0.11 cfs 0.023 af
Outflow=0.11 cfs 0.023 af

Total Runoff Area = 0.610 ac Runoff Volume = 0.023 af Average Runoff Depth = 0.44"
100.00% Pervious = 0.610 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment E1: Existing Site Runoff

Runoff = 0.11 cfs @ 12.48 hrs, Volume= 0.023 af, Depth> 0.44"

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-YR Rainfall=8.50"

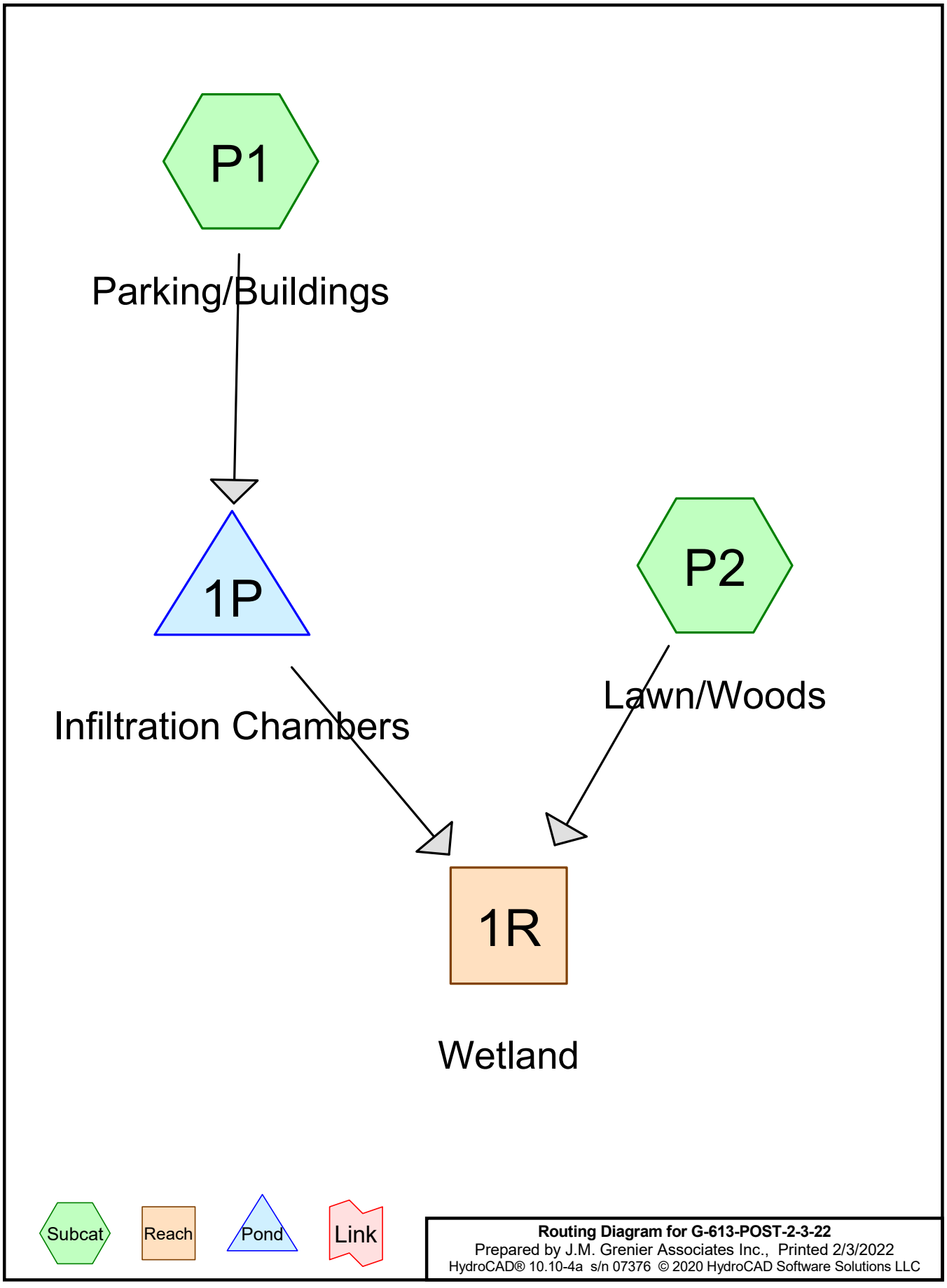
Area (sf)	CN	Description
26,569	30	Woods, Good, HSG A
26,569		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	50	0.0400	0.09		**Sheet Flow, Segment 1** Woods: Light underbrush n= 0.400 P2= 3.20"
3.2	225	0.0560	1.18		**Shallow Concentrated Flow, Segment 2** Woodland Kv= 5.0 fps
12.5	275	Total			

Summary for Reach 1R: Wetland

Inflow Area = 0.610 ac, 0.00% Impervious, Inflow Depth > 0.44" for 100-YR event
Inflow = 0.11 cfs @ 12.48 hrs, Volume= 0.023 af
Outflow = 0.11 cfs @ 12.48 hrs, Volume= 0.023 af, Atten= 0%, Lag= 0.0 min

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



Routing Diagram for G-613-POST-2-3-22
Prepared by J.M. Grenier Associates Inc., Printed 2/3/2022

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.244	98	Impervious (P1)
0.119	39	Lawn, Good, HSG A (P1, P2)
0.247	30	Woods, Good, HSG A (P2)
0.610	**59**	**TOTAL AREA**

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 P1: Parking/Buildings Runoff Area=12,396 sf 85.83% Impervious Runoff Depth>2.04"
Flow Length=255' Tc=6.0 min CN=90 Runoff=0.70 cfs 0.048 af

Subcatchment P2: Lawn/Woods Runoff Area=14,173 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=325' Tc=11.1 min CN=32 Runoff=0.00 cfs 0.000 af

Reach 1R: Wetland Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Pond 1P: Infiltration Chambers Peak Elev=412.12' Storage=1,052 cf Inflow=0.70 cfs 0.048 af
Discarded=0.04 cfs 0.035 af Primary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.035 af

Total Runoff Area = 0.610 ac Runoff Volume = 0.048 af Average Runoff Depth = 0.95"
59.95% Pervious = 0.366 ac 40.05% Impervious = 0.244 ac

Summary for Subcatchment P1: Parking/Buildings

Runoff = 0.70 cfs @ 12.09 hrs, Volume= 0.048 af, Depth> 2.04"

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 2-YR Rainfall=3.20"

	Area (sf)	CN	Description
*	10,640	98	Impervious
*	1,756	39	Lawn, Good, HSG A
	12,396	90	Weighted Average
	1,756		14.17% Pervious Area
	10,640		85.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	255		0.71		**Direct Entry, Segment 1**

Summary for Subcatchment P2: Lawn/Woods

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

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 2-YR Rainfall=3.20"

	Area (sf)	CN	Description
	10,750	30	Woods, Good, HSG A
*	3,423	39	Lawn, Good, HSG A
	14,173	32	Weighted Average
	14,173		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	13	0.0760	0.19		**Sheet Flow, Segment 1** Grass: Short n= 0.150 P2= 3.20"
4.2	37	0.1620	0.15		**Sheet Flow, Segment 2** Woods: Light underbrush n= 0.400 P2= 3.20"
5.8	275	0.0250	0.79		**Shallow Concentrated Flow, Segment 2** Woodland Kv= 5.0 fps
11.1	325	Total			

Summary for Reach 1R: Wetland

Inflow Area = 0.610 ac, 40.05% Impervious, Inflow Depth = 0.00" for 2-YR event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 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 Pond 1P: Infiltration Chambers

Inflow Area = 0.285 ac, 85.83% Impervious, Inflow Depth > 2.04" for 2-YR event
Inflow = 0.70 cfs @ 12.09 hrs, Volume= 0.048 af
Outflow = 0.04 cfs @ 11.35 hrs, Volume= 0.035 af, Atten= 94%, Lag= 0.0 min
Discarded = 0.04 cfs @ 11.35 hrs, Volume= 0.035 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 412.12' @ 14.04 hrs Surf.Area= 1,759 sf Storage= 1,052 cf

Plug-Flow detention time= 185.1 min calculated for 0.035 af (71% of inflow)
Center-of-Mass det. time= 120.3 min (894.9 - 774.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	411.00'	2,590 cf	**30.92'W x 56.89'L x 5.50'H Field A** 9,674 cf Overall - 3,198 cf Embedded = 6,476 cf x 40.0% Voids
#2A	411.75'	3,198 cf	**ADS_StormTech MC-3500 d +Cap** x 28 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 28 Chambers in 4 Rows Cap Storage= +14.9 cf x 2 x 4 rows = 119.2 cf
		5,788 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	411.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	414.75'	**6.0" Round Culvert** L= 31.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 414.75' / 408.50' S= 0.2016 '/' Cc= 0.900 n= 0.011, Flow Area= 0.20 sf

Discarded OutFlow Max=0.04 cfs @ 11.35 hrs HW=411.06' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=411.00' (Free Discharge)
↑**2=Culvert** (Controls 0.00 cfs)

Stage-Area-Storage for Pond 1P: Infiltration Chambers

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
411.00	**1,759**	0
411.10	1,759	70
411.20	1,759	141
411.30	1,759	211
411.40	1,759	281
411.50	1,759	352
411.60	1,759	422
411.70	1,759	492
411.80	1,759	599
411.90	1,759	743
412.00	1,759	886
412.10	1,759	1,028
412.20	1,759	1,170
412.30	1,759	1,311
412.40	1,759	1,451
412.50	1,759	1,591
412.60	1,759	1,731
412.70	1,759	1,869
412.80	1,759	2,007
412.90	1,759	2,144
413.00	1,759	2,280
413.10	1,759	2,415
413.20	1,759	2,549
413.30	1,759	2,682
413.40	1,759	2,814
413.50	1,759	2,944
413.60	1,759	3,074
413.70	1,759	3,202
413.80	1,759	3,328
413.90	1,759	3,454
414.00	1,759	3,577
414.10	1,759	3,699
414.20	1,759	3,818
414.30	1,759	3,936
414.40	1,759	4,052
414.50	1,759	4,165
414.60	1,759	4,276
414.70	1,759	4,384
414.80	1,759	4,488
414.90	1,759	4,589
415.00	1,759	4,686
415.10	1,759	4,777
415.20	1,759	4,860
415.30	1,759	4,938
415.40	1,759	5,013
415.50	1,759	5,085
415.60	1,759	5,155
415.70	1,759	5,225
415.80	1,759	5,296
415.90	1,759	5,366
416.00	1,759	5,436
416.10	1,759	5,507
416.20	1,759	5,577
416.30	1,759	5,647
416.40	1,759	5,718
416.50	1,759	**5,788**

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 P1: Parking/Buildings Runoff Area=12,396 sf 85.83% Impervious Runoff Depth>3.57"
Flow Length=255' Tc=6.0 min CN=90 Runoff=1.19 cfs 0.085 af

Subcatchment P2: Lawn/Woods Runoff Area=14,173 sf 0.00% Impervious Runoff Depth>0.01"
Flow Length=325' Tc=11.1 min CN=32 Runoff=0.00 cfs 0.000 af

Reach 1R: Wetland Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Pond 1P: Infiltration Chambers Peak Elev=412.95' Storage=2,214 cf Inflow=1.19 cfs 0.085 af
Discarded=0.04 cfs 0.040 af Primary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.040 af

Total Runoff Area = 0.610 ac Runoff Volume = 0.085 af Average Runoff Depth = 1.67"
59.95% Pervious = 0.366 ac 40.05% Impervious = 0.244 ac

Summary for Subcatchment P1: Parking/Buildings

Runoff = 1.19 cfs @ 12.09 hrs, Volume= 0.085 af, Depth> 3.57"

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-YR Rainfall=4.90"

	Area (sf)	CN	Description
*	10,640	98	Impervious
*	1,756	39	Lawn, Good, HSG A
	12,396	90	Weighted Average
	1,756		14.17% Pervious Area
	10,640		85.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	255		0.71		**Direct Entry, Segment 1**

Summary for Subcatchment P2: Lawn/Woods

Runoff = 0.00 cfs @ 20.00 hrs, Volume= 0.000 af, Depth> 0.01"

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 10-YR Rainfall=4.90"

	Area (sf)	CN	Description
	10,750	30	Woods, Good, HSG A
*	3,423	39	Lawn, Good, HSG A
	14,173	32	Weighted Average
	14,173		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	13	0.0760	0.19		**Sheet Flow, Segment 1** Grass: Short n= 0.150 P2= 3.20"
4.2	37	0.1620	0.15		**Sheet Flow, Segment 2** Woods: Light underbrush n= 0.400 P2= 3.20"
5.8	275	0.0250	0.79		**Shallow Concentrated Flow, Segment 2** Woodland Kv= 5.0 fps
11.1	325	Total			

Summary for Reach 1R: Wetland

Inflow Area = 0.610 ac, 40.05% Impervious, Inflow Depth > 0.00" for 10-YR event
Inflow = 0.00 cfs @ 20.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 20.00 hrs, Volume= 0.000 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 Pond 1P: Infiltration Chambers

Inflow Area = 0.285 ac, 85.83% Impervious, Inflow Depth > 3.57" for 10-YR event
Inflow = 1.19 cfs @ 12.09 hrs, Volume= 0.085 af
Outflow = 0.04 cfs @ 10.25 hrs, Volume= 0.040 af, Atten= 97%, Lag= 0.0 min
Discarded = 0.04 cfs @ 10.25 hrs, Volume= 0.040 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 412.95' @ 15.66 hrs Surf.Area= 1,759 sf Storage= 2,214 cf

Plug-Flow detention time= 176.9 min calculated for 0.040 af (47% of inflow)
Center-of-Mass det. time= 88.2 min (849.6 - 761.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	411.00'	2,590 cf	**30.92'W x 56.89'L x 5.50'H Field A** 9,674 cf Overall - 3,198 cf Embedded = 6,476 cf x 40.0% Voids
#2A	411.75'	3,198 cf	**ADS_StormTech MC-3500 d +Cap** x 28 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 28 Chambers in 4 Rows Cap Storage= +14.9 cf x 2 x 4 rows = 119.2 cf
		5,788 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	411.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	414.75'	**6.0" Round Culvert** L= 31.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 414.75' / 408.50' S= 0.2016 '/' Cc= 0.900 n= 0.011, Flow Area= 0.20 sf

Discarded OutFlow Max=0.04 cfs @ 10.25 hrs HW=411.06' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=411.00' (Free Discharge)
↑**2=Culvert** (Controls 0.00 cfs)

Stage-Area-Storage for Pond 1P: Infiltration Chambers

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
411.00	**1,759**	0
411.10	1,759	70
411.20	1,759	141
411.30	1,759	211
411.40	1,759	281
411.50	1,759	352
411.60	1,759	422
411.70	1,759	492
411.80	1,759	599
411.90	1,759	743
412.00	1,759	886
412.10	1,759	1,028
412.20	1,759	1,170
412.30	1,759	1,311
412.40	1,759	1,451
412.50	1,759	1,591
412.60	1,759	1,731
412.70	1,759	1,869
412.80	1,759	2,007
412.90	1,759	2,144
413.00	1,759	2,280
413.10	1,759	2,415
413.20	1,759	2,549
413.30	1,759	2,682
413.40	1,759	2,814
413.50	1,759	2,944
413.60	1,759	3,074
413.70	1,759	3,202
413.80	1,759	3,328
413.90	1,759	3,454
414.00	1,759	3,577
414.10	1,759	3,699
414.20	1,759	3,818
414.30	1,759	3,936
414.40	1,759	4,052
414.50	1,759	4,165
414.60	1,759	4,276
414.70	1,759	4,384
414.80	1,759	4,488
414.90	1,759	4,589
415.00	1,759	4,686
415.10	1,759	4,777
415.20	1,759	4,860
415.30	1,759	4,938
415.40	1,759	5,013
415.50	1,759	5,085
415.60	1,759	5,155
415.70	1,759	5,225
415.80	1,759	5,296
415.90	1,759	5,366
416.00	1,759	5,436
416.10	1,759	5,507
416.20	1,759	5,577
416.30	1,759	5,647
416.40	1,759	5,718
416.50	1,759	**5,788**

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 P1: Parking/Buildings Runoff Area=12,396 sf 85.83% Impervious Runoff Depth>4.67"
Flow Length=255' Tc=6.0 min CN=90 Runoff=1.53 cfs 0.111 af

Subcatchment P2: Lawn/Woods Runoff Area=14,173 sf 0.00% Impervious Runoff Depth>0.11"
Flow Length=325' Tc=11.1 min CN=32 Runoff=0.01 cfs 0.003 af

Reach 1R: Wetland Inflow=0.01 cfs 0.003 af
Outflow=0.01 cfs 0.003 af

Pond 1P: Infiltration Chambers Peak Elev=413.65' Storage=3,141 cf Inflow=1.53 cfs 0.111 af
Discarded=0.04 cfs 0.042 af Primary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.042 af

Total Runoff Area = 0.610 ac Runoff Volume = 0.114 af Average Runoff Depth = 2.24"
59.95% Pervious = 0.366 ac 40.05% Impervious = 0.244 ac

Summary for Subcatchment P1: Parking/Buildings

Runoff = 1.53 cfs @ 12.09 hrs, Volume= 0.111 af, Depth> 4.67"

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-YR Rainfall=6.10"

	Area (sf)	CN	Description
*	10,640	98	Impervious
*	1,756	39	Lawn, Good, HSG A
	12,396	90	Weighted Average
	1,756		14.17% Pervious Area
	10,640		85.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	255		0.71		**Direct Entry, Segment 1**

Summary for Subcatchment P2: Lawn/Woods

Runoff = 0.01 cfs @ 14.80 hrs, Volume= 0.003 af, Depth> 0.11"

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-YR Rainfall=6.10"

	Area (sf)	CN	Description
	10,750	30	Woods, Good, HSG A
*	3,423	39	Lawn, Good, HSG A
	14,173	32	Weighted Average
	14,173		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	13	0.0760	0.19		**Sheet Flow, Segment 1** Grass: Short n= 0.150 P2= 3.20"
4.2	37	0.1620	0.15		**Sheet Flow, Segment 2** Woods: Light underbrush n= 0.400 P2= 3.20"
5.8	275	0.0250	0.79		**Shallow Concentrated Flow, Segment 2** Woodland Kv= 5.0 fps
11.1	325	Total			

Summary for Reach 1R: Wetland

Inflow Area = 0.610 ac, 40.05% Impervious, Inflow Depth > 0.06" for 25-YR event
Inflow = 0.01 cfs @ 14.80 hrs, Volume= 0.003 af
Outflow = 0.01 cfs @ 14.80 hrs, Volume= 0.003 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 Pond 1P: Infiltration Chambers

Inflow Area = 0.285 ac, 85.83% Impervious, Inflow Depth > 4.67" for 25-YR event
Inflow = 1.53 cfs @ 12.09 hrs, Volume= 0.111 af
Outflow = 0.04 cfs @ 9.45 hrs, Volume= 0.042 af, Atten= 97%, Lag= 0.0 min
Discarded = 0.04 cfs @ 9.45 hrs, Volume= 0.042 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 413.65' @ 16.40 hrs Surf.Area= 1,759 sf Storage= 3,141 cf

Plug-Flow detention time= 176.5 min calculated for 0.042 af (38% of inflow)
Center-of-Mass det. time= 71.0 min (826.7 - 755.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	411.00'	2,590 cf	**30.92'W x 56.89'L x 5.50'H Field A** 9,674 cf Overall - 3,198 cf Embedded = 6,476 cf x 40.0% Voids
#2A	411.75'	3,198 cf	**ADS_StormTech MC-3500 d +Cap** x 28 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 28 Chambers in 4 Rows Cap Storage= +14.9 cf x 2 x 4 rows = 119.2 cf
		5,788 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	411.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	414.75'	**6.0" Round Culvert** L= 31.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 414.75' / 408.50' S= 0.2016 '/' Cc= 0.900 n= 0.011, Flow Area= 0.20 sf

Discarded OutFlow Max=0.04 cfs @ 9.45 hrs HW=411.06' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=411.00' (Free Discharge)
↑**2=Culvert** (Controls 0.00 cfs)

Stage-Area-Storage for Pond 1P: Infiltration Chambers

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
411.00	**1,759**	0
411.10	1,759	70
411.20	1,759	141
411.30	1,759	211
411.40	1,759	281
411.50	1,759	352
411.60	1,759	422
411.70	1,759	492
411.80	1,759	599
411.90	1,759	743
412.00	1,759	886
412.10	1,759	1,028
412.20	1,759	1,170
412.30	1,759	1,311
412.40	1,759	1,451
412.50	1,759	1,591
412.60	1,759	1,731
412.70	1,759	1,869
412.80	1,759	2,007
412.90	1,759	2,144
413.00	1,759	2,280
413.10	1,759	2,415
413.20	1,759	2,549
413.30	1,759	2,682
413.40	1,759	2,814
413.50	1,759	2,944
413.60	1,759	3,074
413.70	1,759	3,202
413.80	1,759	3,328
413.90	1,759	3,454
414.00	1,759	3,577
414.10	1,759	3,699
414.20	1,759	3,818
414.30	1,759	3,936
414.40	1,759	4,052
414.50	1,759	4,165
414.60	1,759	4,276
414.70	1,759	4,384
414.80	1,759	4,488
414.90	1,759	4,589
415.00	1,759	4,686
415.10	1,759	4,777
415.20	1,759	4,860
415.30	1,759	4,938
415.40	1,759	5,013
415.50	1,759	5,085
415.60	1,759	5,155
415.70	1,759	5,225
415.80	1,759	5,296
415.90	1,759	5,366
416.00	1,759	5,436
416.10	1,759	5,507
416.20	1,759	5,577
416.30	1,759	5,647
416.40	1,759	5,718
416.50	1,759	**5,788**

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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 P1: Parking/Buildings Runoff Area=12,396 sf 85.83% Impervious Runoff Depth>6.89"
Flow Length=255' Tc=6.0 min CN=90 Runoff=2.21 cfs 0.163 af

Subcatchment P2: Lawn/Woods Runoff Area=14,173 sf 0.00% Impervious Runoff Depth>0.60"
Flow Length=325' Tc=11.1 min CN=32 Runoff=0.09 cfs 0.016 af

Reach 1R: Wetland Inflow=0.10 cfs 0.032 af
Outflow=0.10 cfs 0.032 af

Pond 1P: Infiltration Chambers Peak Elev=414.93' Storage=4,617 cf Inflow=2.21 cfs 0.163 af
Discarded=0.04 cfs 0.046 af Primary=0.07 cfs 0.016 af Outflow=0.11 cfs 0.062 af

Total Runoff Area = 0.610 ac Runoff Volume = 0.179 af Average Runoff Depth = 3.53"
59.95% Pervious = 0.366 ac 40.05% Impervious = 0.244 ac

Summary for Subcatchment P1: Parking/Buildings

Runoff = 2.21 cfs @ 12.09 hrs, Volume= 0.163 af, Depth> 6.89"

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-YR Rainfall=8.50"

	Area (sf)	CN	Description
*	10,640	98	Impervious
*	1,756	39	Lawn, Good, HSG A
	12,396	90	Weighted Average
	1,756		14.17% Pervious Area
	10,640		85.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	255		0.71		**Direct Entry, Segment 1**

Summary for Subcatchment P2: Lawn/Woods

Runoff = 0.09 cfs @ 12.40 hrs, Volume= 0.016 af, Depth> 0.60"

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-YR Rainfall=8.50"

	Area (sf)	CN	Description
	10,750	30	Woods, Good, HSG A
*	3,423	39	Lawn, Good, HSG A
	14,173	32	Weighted Average
	14,173		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.1	13	0.0760	0.19		**Sheet Flow, Segment 1** Grass: Short n= 0.150 P2= 3.20"
4.2	37	0.1620	0.15		**Sheet Flow, Segment 2** Woods: Light underbrush n= 0.400 P2= 3.20"
5.8	275	0.0250	0.79		**Shallow Concentrated Flow, Segment 2** Woodland Kv= 5.0 fps
11.1	325	Total			

Summary for Reach 1R: Wetland

Inflow Area = 0.610 ac, 40.05% Impervious, Inflow Depth > 0.62" for 100-YR event
Inflow = 0.10 cfs @ 14.16 hrs, Volume= 0.032 af
Outflow = 0.10 cfs @ 14.16 hrs, Volume= 0.032 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 Pond 1P: Infiltration Chambers

Inflow Area = 0.285 ac, 85.83% Impervious, Inflow Depth > 6.89" for 100-YR event
Inflow = 2.21 cfs @ 12.09 hrs, Volume= 0.163 af
Outflow = 0.11 cfs @ 14.22 hrs, Volume= 0.062 af, Atten= 95%, Lag= 128.3 min
Discarded = 0.04 cfs @ 8.35 hrs, Volume= 0.046 af
Primary = 0.07 cfs @ 14.22 hrs, Volume= 0.016 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 414.93' @ 14.22 hrs Surf.Area= 1,759 sf Storage= 4,617 cf

Plug-Flow detention time= 187.9 min calculated for 0.062 af (38% of inflow)
Center-of-Mass det. time= 76.2 min (824.9 - 748.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	411.00'	2,590 cf	**30.92'W x 56.89'L x 5.50'H Field A** 9,674 cf Overall - 3,198 cf Embedded = 6,476 cf x 40.0% Voids
#2A	411.75'	3,198 cf	**ADS_StormTech MC-3500 d +Cap** x 28 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 28 Chambers in 4 Rows Cap Storage= +14.9 cf x 2 x 4 rows = 119.2 cf
		5,788 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	411.00'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	414.75'	**6.0" Round Culvert** L= 31.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 414.75' / 408.50' S= 0.2016 '/' Cc= 0.900 n= 0.011, Flow Area= 0.20 sf

Discarded OutFlow Max=0.04 cfs @ 8.35 hrs HW=411.06' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.07 cfs @ 14.22 hrs HW=414.93' (Free Discharge)
↑**2=Culvert** (Inlet Controls 0.07 cfs @ 1.14 fps)

Stage-Area-Storage for Pond 1P: Infiltration Chambers

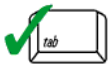
Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
411.00	**1,759**	0
411.10	1,759	70
411.20	1,759	141
411.30	1,759	211
411.40	1,759	281
411.50	1,759	352
411.60	1,759	422
411.70	1,759	492
411.80	1,759	599
411.90	1,759	743
412.00	1,759	886
412.10	1,759	1,028
412.20	1,759	1,170
412.30	1,759	1,311
412.40	1,759	1,451
412.50	1,759	1,591
412.60	1,759	1,731
412.70	1,759	1,869
412.80	1,759	2,007
412.90	1,759	2,144
413.00	1,759	2,280
413.10	1,759	2,415
413.20	1,759	2,549
413.30	1,759	2,682
413.40	1,759	2,814
413.50	1,759	2,944
413.60	1,759	3,074
413.70	1,759	3,202
413.80	1,759	3,328
413.90	1,759	3,454
414.00	1,759	3,577
414.10	1,759	3,699
414.20	1,759	3,818
414.30	1,759	3,936
414.40	1,759	4,052
414.50	1,759	4,165
414.60	1,759	4,276
414.70	1,759	4,384
414.80	1,759	4,488
414.90	1,759	4,589
415.00	1,759	4,686
415.10	1,759	4,777
415.20	1,759	4,860
415.30	1,759	4,938
415.40	1,759	5,013
415.50	1,759	5,085
415.60	1,759	5,155
415.70	1,759	5,225
415.80	1,759	5,296
415.90	1,759	5,366
416.00	1,759	5,436
416.10	1,759	5,507
416.20	1,759	5,577
416.30	1,759	5,647
416.40	1,759	5,718
416.50	1,759	**5,788**

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

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

☐ Reduced Impervious Area (Redevelopment Only)

☐ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

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

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

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☐ Other (describe): _____

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

STORMWATER MANAGEMENT CALCULATIONS

Total Impervious Area

Pavement:	7,440 sq.ft. /0.171 ac.
Buildings:	3,200 sq.ft. /0.073 ac.
Total	10,640 sq.ft. /0.244 ac.

Standard #3: Recharge to Groundwater

Recharge Required: (0.6"/12)*10,640 sq. ft. "A" impervious = 532 cu.ft.

Recharge Provided: 4,436 cu. ft. @ elev. 414.75 in infiltration chamber

Drawdown within 72 hours

Time: (4,436 cu.ft./(1.02"/hr*(1'/12")*1,759 sq.ft.)) = 29.7 hours in infiltration chamber

Standard #4: Water Quality

Treatment Volume Required: (1.0"/12)*7,440 sq. ft. pavement area = 620 cu. ft.
Treatment Volume Provided: 4,436 cu. ft. @ elev. 414.75 in infiltration chamber (all runoff recharged)

Riprap Apron Sizing

FE 1

$L = (k_2*q)/(D^{1/2}) = (3*0.1\ cfs)/(0.5\ ft^{1/2}) = 1.2$ ft (use 3.0 ft)
W1 = 3*D = 3*0.5 ft = 1.5 ft
W2 = (3*D)+L = (3*0.5 ft)+3.0 ft = 4.5 ft

STORMWATER NARRATIVE

Design Methods and Objectives

The design of this two family residential development project has been prepared in accordance with Stormwater Management Standards as outlined in the Stormwater Management Handbook. In particular, the site has been designed to ensure:

1. No new stormwater conveyances will discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth. All new pavement runoff use is routed through infiltration chambers.

2. Stormwater management systems are designed so that the post-development peak discharge rated does not exceed pre-development peak discharge rates. Drainage calculations demonstrate that the peak rate of runoff is reduced in the post development condition through the use of infiltration chambers.

3. Loss of annual recharge to ground water is minimized through the use of infiltration chambers. The chambers as designed will provide 4,436 cu.ft. of storage volume which is greater than the recharge volume for "A" soils, 532 cu.ft.

4. Stormwater management systems are designed to remove a minimum of 80% TSS. The use of infiltration chambers provides a minimum of 80% TSS removal new parking areas.

5. The use of the site for a two family dwelling is not a risk for producing higher pollutant loads. Notwithstanding, the treatment of runoff from this portion of the site will ensure treatment of any potential pollutants.

6. This site is not within a Zone II or interim wellhead protection area.

7. This project is a new development and stormwater management guidelines are met.

8. For construction related activities, an operation and maintenance plan has been incorporated into the Stormwater Management Report to ensure that a protocol for runoff control is in place prior to any construction activities.

9. The operation and maintenance plan as provided provides a protocol to ensure that the stormwater management system will function as designed.

10. A certification regarding illicit discharges has been submitted.

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: 1497 Grafton Road, Millbury

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Subsurface Infiltration Structure	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**

Total TSS Removal = **85%**

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

Project: G-613

Prepared By:

Date: 2/3/2022

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

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

1. From MassDEP Stormwater Handbook Vol. 1

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values

2.0400	***R***	**Recharge (infiltration) rate (feet/day)**
0.300	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
20.40	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
15.000	**x**	**1/2 length of basin (x direction, in feet)**
28.000	**y**	**1/2 width of basin (y direction, in feet)**
1.080	**t**	**duration of infiltration period (days)**
20.000	**hi(0)**	**initial thickness of saturated zone (feet)**

21.645	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
1.645	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Conversion Table

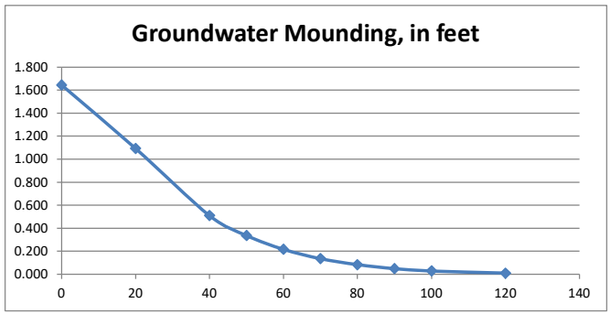
inch/hour	**feet/day**
0.67	1.33
2.00	4.00

hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
1.645	**0**
1.094	**20**
0.510	**40**
0.337	**50**
0.217	**60**
0.136	**70**
0.083	**80**
0.050	**90**
0.029	**100**
0.010	**120**

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Table 1. Project Summary Credit for MILLBURY

	Removed Phosphorus Load (lb/yr)	Removed Nitrogen Load (lb/yr)	Removed Sediment Load (lb/yr)
Structural	0.26	2.4	74.62
Non-Structural	0.01	0	0
Land Use Conversion	-0.07	-0.44	33.69
Total	0.2	1.95	108.31

Table 2. Structural Project Summary for MILLBURY

Project ID	BMP Type	BMP Storage Capacity (ft^3)/ Filter Depth (in.)	Phosphorus BMP Efficiency (%)	Nitrogen BMP Efficiency (%)	Sediment BMP Efficiency (%)	Removed Phosphorus Load (lb/yr)	Removed Nitrogen Load (lb/yr)	Removed Sediment Load (lb/yr)	Impervious Area Treated (ac)	Runoff Depth (in.)
CHAMBER 1	INFILTRATION TRENCH	7000	100	100	100	0.26	2.4	74.62	0.17	11.34

Table 3. Non-Structural Project Summary for MILLBURY

Project ID	BMP Type	BMP Storage Capacity	Phosphorus BMP Efficiency (%)	Nitrogen BMP Efficiency (%)	Sediment BMP Efficiency (%)	Removed Phosphorus Load (lb/yr)	Removed Nitrogen Load (lb/yr)	Removed Sediment Load (lb/yr)	Impervious Area Treated (ac)	Runoff Depth (in.)
CHAMBER 1	CATCH BASIN CLEANING	N/A	2	0	0	0.01	0	0	0.16	N/A

Table 4. Land Use Conversion Project Summary for MILLBURY

Project ID	Removed Phosphorus Load (lb/yr)	Removed Nitrogen Load (lb/yr)	Removed Sediment Load (lb/yr)	Impervious Area Treated (ac)
CHAMBER 1	-0.07	-0.44	33.69	0.16

Project: **G-613** By: **DCT** Date: **2/3/2022**
Location: **Millbury, Massachusetts** Chkd: **JMG** Date: **2/3/2022**

Catchment Watershed Areas

Design Storm: **25** year

WA: **cb-1**

	Area (Ac)		C		AxC			
Paved:	**0.07**	x	**0.9**	=	0.063	Overland Flow Time:	**5**	min.
Dense grass:	**0.03**	x	**0.3**	=	0.009	Intensity:	**8.5**	in/hr
TOTAL:	**0.10**	x	**0.72**	=	**0.07**	Flow (Q=AxCxi):	**0.6**	cfs

WA: **cb-2**

	Area (Ac)		C		AxC			
Paved:	**0.10**	x	**0.9**		0.09	Overland Flow Time:	**5**	min.
Dense grass:	**0.01**	x	**0.3**		0.003	Intensity:	**8.5**	in/hr
TOTAL:	**0.11**	x	**0.85**	=	**0.09**	Flow (Q=AxCxi):	**0.8**	cfs

WA: **bldg**

	Area (Ac)		C		AxC			
Paved:	**0.07**	x	**0.9**		0.063	Overland Flow Time:	**5**	min.
Dense grass:		x				Intensity:	**8.5**	in/hr
TOTAL:	**0.07**	x	**0.90**	=	**0.06**	Flow (Q=AxCxi):	**0.5**	cfs

WA:

	Area (Ac)		C		AxC			
Paved:		x				Overland Flow Time:		min.
Dense grass:		x				Intensity:		in/hr
TOTAL:		x		=		Flow (Q=AxCxi):		cfs

WA:

	Area (Ac)		C		AxC			
Paved:		x				Overland Flow Time:		min.
Dense grass:		x				Intensity:		in/hr
TOTAL:		x		=		Flow (Q=AxCxi):		cfs

J.M. GRENIER ASSOCIATES

PIPE HYDRAULICS

DESIGN STORM: 25 yr.

LOCATION			AREA (Acres)		C	CxA	FLOW	TIME	RAINFALL	FLOW	DESIGN												STATEMENT
STREET OR PROPERTY	FROM	TO	INCRE-MENTAL (A)	TOTAL (A)			TO INLET (Min)	IN PIPE T= (L/V_A)/60 (Min)	INTENSITY (i)	ACTUAL Q_A=CxAxi	RIM ELEV UPPER END (Ft)	INV ELEV UPPER END (Ft)	RIM ELEV LOWER END (Ft)	INV ELEV LOWER END (Ft)	PIPE SIZE (Inches)	PIPE TYPE	PIPE LENGTH (Ft)	PIPE SLOPE (Ft/Ft)	n	VEL_{FULL} V_F= $(1.49/n)(R^{2/3})(S^{1/2})$	$FLOW_{FULL}$ $Q_F=V_F xA$	VEL_{ACTUAL} $V_A=(Q_A/Q_F)xVAR$	FREEFLOW OR SUBMERGED
Parking	CB-1	DMH-1	0.10		0.72	0.07	5.0	0.5	8.5	0.6	418.30	415.10	417.90	413.82	12	HDPE	114	0.011	0.011	5.6	4.4	3.8	FREEFLOW
Parking	CB-2	DMH-1	0.11		0.85	0.09	5.0	0.2	8.5	0.8	417.50	414.30	417.90	413.82	12	HDPE	43	0.011	0.011	5.6	4.4	4.0	FREEFLOW
Parking	DMH-1	DMH-2		0.20		0.17	5.0	0.1	8.5	1.4	417.90	413.72	418.10	413.60	12	HPDE	16	0.007	0.011	4.5	3.5	4.2	FREEFLOW
Parking	BLDG	DMH-2	0.07		0.90	0.06	5.0	0.1	8.5	0.5		415.50	418.10	414.10	6	PVC	46	0.030	0.011	5.9	1.2	5.6	FREEFLOW

PROJECT_____
LOCATION_____
JOB NO._____
FILE NO._____

CALC BY_____
DATE_____
CHKD BY_____
DATE_____

OPERATION AND MAINTENANCE PLAN

1497 Grafton Road, Millbury
February 3, 2022

The following are operation and maintenance instructions for both construction and post-development stormwater controls. The goal of these plans is to ensure that the stormwater system, as designed, will function properly during construction and for the future of the site. The developer of the parcel is Parklund Place, LLC. Donna Manes is the contact person for work related to this project, and can be contacted at the following number: (508) 335-7191.

Construction Operation and Maintenance Plan:

1. All erosion and sediment control devices installed prior to construction shall be inspected on a daily basis. Any deficiencies in the siltation fence shall be corrected immediately. Any accumulated silt shall be removed manually from the silt fence. Silt barrier should be inspected daily to ensure that there is no accumulation of sediments.

2. The most important aspects of controlling erosion and sedimentation are limiting the extent of disturbance and stabilizing surfaces as soon as possible. Of secondary importance in erosion control is limiting the size and length of the tributary drainage area within the work site and drainage structures. These fundamental principles shall be the key factor in the control of erosion on the site.

3. All disturbed surfaces shall be stabilized a minimum of 14 days after construction in any portion of the site has ceased or is temporarily halted unless additional construction is intended to be initiated within 21 days.

4. Hydroseeding and hay mulching shall be performed immediately after construction to minimize erosion damage. Newly seeded slopes shall be inspected every two weeks for the first few months to ensure that revegatation has occurred. Repairs and reseeding shall be performed immediately as the need arises.

5. The catch basin is to be covered with plywood prior to the installation of pavement. This will prevent excess silt from accumulating in sumps and pipes. After pavement has been installed, a block and gravel inlet protection device shall be constructed surrounding the catch basin rim. This will keep silt out of the drainage system until the remainder of the site has been stabilized. The stone from the inlet protection shall be maintained frequently to ensure the highest degree of filtration.

6. At no time shall silt laden water be allowed to enter sensitive areas (wetlands, and off-site areas). Any runoff from disturbed surfaces shall be directed through settling basins and erosion control barriers prior to entering any sensitive areas.

7. At the completion of construction all areas are to be loamed and seeded to ensure that the site is stabilized.

Post Development Operation and Maintenance Plan:

1. Seeding and repairs shall be performed as required. Sediment and debris shall be removed at least once a year, typically in early spring prior to the commencement of the growing season.

2. The catch basins on the site shall be inspected annually. Units shall be cleaned when accumulated sediments reach a depth of 6 inches. Accumulated sediment must be disposed of in accordance with applicable local state, and federal guidelines and regulations. The contractor will be responsible for the maintenance of the unit until such time as the site work is complete. The maintenance will then be the responsibility of the owner(s).

3. A contract with a licensed hauler shall be in place for maintenance of drainage structures to ensure the long term performance of the drainage system.

4. The subsurface infiltration systems shall be inspected after every major storm for the first 3 months to ensure proper function. It shall be inspected once per year after that. Water levels should be inspected and recorded for several days after a major storm event to check infiltration capacity.

5. The existing buried culvert shall be inspected twice annually to ensure proper function. Any sediment and debris shall be removed as required.

6. Snow disposal shall not be directed toward wetland resource areas.

7. Washing of vehicles shall not include the use of chemicals/detergents.

8. No sodium based de-icing agents shall be used on site. Agents such as potassium chloride or calcium chloride are acceptable.

9. The contractor will be responsible for the maintenance of all drainage structures and until such time as the site work is complete. The maintenance will then be the responsibility of the property owners.

Owner Signature _____

LONG TERM POLLUTION PREVENTION PLAN

1497 Grafton Road, Millbury
February 3, 2022

This plan was developed in compliance with the Massachusetts Department of Environmental Protection Stormwater Requirements

Good Housekeeping

The proposed site is designed to maintain high quality water treatment for all runoff. A general maintenance plan has been prepared and will be followed in a strict and complete manner as required.

Spill Prevention Plan

No hazardous materials will be stored on site. However the flowing spill prevention plan will be incorporated into the Long Term Pollution Prevention Plan

1. Manufacturers recommended methods for spill cleanup will be clearly posted. Site personnel will be made aware of the procedures and location of the information and cleanup supplies.

2. Materials and equipment necessary for spill cleanup will be kept in the materials storage area. Equipment and materials will include, but is not limited to, brooms dust pans, mops, rags, gloves, sand and trash containers specifically for this purpose.

3. All spills will be cleaned up immediately after discovery.

4. The spill area will be kept will ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance.

5. Spills of toxic or hazardous material will be reported, regardless of size, to the Massachusetts Department of Environmental Protection (888) 304-1133

6. Should a spill occur, the spill prevention plan will be adjusted to include measures to prevent another spill and to cleanup the spill should another occur. A description of the spill along with the causes and cleanup measures will be included in the updated pollution prevention plan.

7. The construction superintendant responsible for daily operation on the site will be the spill prevention and cleanup coordinator. The superintendant will designate at least three site personnel to receive spill prevention cleanup training. The names of the responsible spill personnel will be posted in the material storage area.

Construction Sequencing

1. Selectively cut trees and clear brush to be chipped and hauled off site.

2. Stake location of and install erosion control barrier as delineated on site plan.

3. Strip top and subsoil as necessary in work area. Stockpile material on western portion of lot for backfilling purposes at completion of construction.

4. Perform site grading, cuts and fills as well as construct retaining walls. Temporary basin(s) shall be constructed during this process to ensure stormwater is controlled during construction.

5. Construct building and install utilities. Subsurface drainage system shall NOT be connected to parking lot drainage system until all tributary drainage areas are stabilized and there is no potential for silt laden water to enter the subsurface recharge chambers.

6. Install finish pavement, curbing and landscaping.

Construction Inspection & Maintenance Schedule

1. Wattles and silt fence shall be inspected weekly and after storm events for damage and excessive silting. Damaged fence shall be replaced immediately.

2. Temporary construction entrance shall be inspected weekly and after heavy storm events or heavy use. The entrance shall be maintained in a condition that will prevent sediment tracking offsite. All sediment tracked onto Grafton Road shall be swept up immediately

3. Stockpiled sediment shall be mulched if they are to remain for more than three weeks. The stockpiles shall be inspected weekly and after storm events for erosion damage. Additional mulch shall be added if needed.

4. Loamed and seeded area shall be inspected after final grading for areas that need to be reseeded of restabilized.

5. Temporary diversion swales shall be inspected weekly and after storm events for erosion damage and excessive silting. Silt shall be removed if necessary. Any erosion damage shall be repaired immediately.

6. The temporary construction basin shall be inspected weekly and after storm events for erosion damage and excessive silting.

Stormwater BMP Maintenance

A full BMP maintenance plan has been prepared (see Operation & Maintenance Plan) in order to ensure that the stormwater management system will function properly and as designed.

Landscape and Lawn Maintenance

Routine mowing and associated maintenance of all landscape features will occur weekly or as needed to prevent excessive growth of vegetation on site. Grass clippings and leaf litter shall not be blown into or disposed of in storm drainage systems or wetland resource areas.

Fertilizers, Herbicides & Pesticides

Fertilizer, herbicide & pesticide use will be limited to that typically associated with residential lawns. Use of slow release phosphorus fertilizers or no use or fertilizers is encouraged. All fertilizer, herbicide & pesticide use will comply with local, state and federal requirements.

Solid Waste Maintenance

Solid waste is handled on site and will comply with all local, state and federal requirements.

Pet Waste

Pet waste shall be property disposed of in a timely manner to prevent pollution of onsite stormwater management facilities and down-gradient areas.

Snow Disposal

Snow disposal shall not be directed toward wetland resource areas.

Winter Salt & Sand Use

All winter salt and/or sand will comply with all local, state and federal requirements.

Training of Staff

All personnel on site will be briefed on all requirements for implementing the Long Term Pollution Prevention Plan

Emergency Contact for Long Term Pollution Prevention Plan

J.M. Grenier Associates, Inc.
325 Donald Lynch Boulevard Suite 100
Marlborough, MA 01752

Operation & Maintenance Log Form

Property Location: Abbott Place

BMP	Required Maintenance	Frequency	Maintenance Date	Performed By
Infiltration Chambers	Clean when sediment reaches 25% of chamber volume	Annual		
Catch Basins	Clean when sediment depth reaches 6”	Annual		

ILLICIT DISCHARGE COMPLIANCE STATEMENT

Abbott Place, Millbury
November 2, 2021

Responsibility:

The owner is responsible for the ultimate compliance with all provisions of the Massachusetts Stormwater Management Policy, the U.S. EPA NPDES Construction General Permit and responsible for identifying and eliminating illicit discharges (as defined by U.S. EPA).

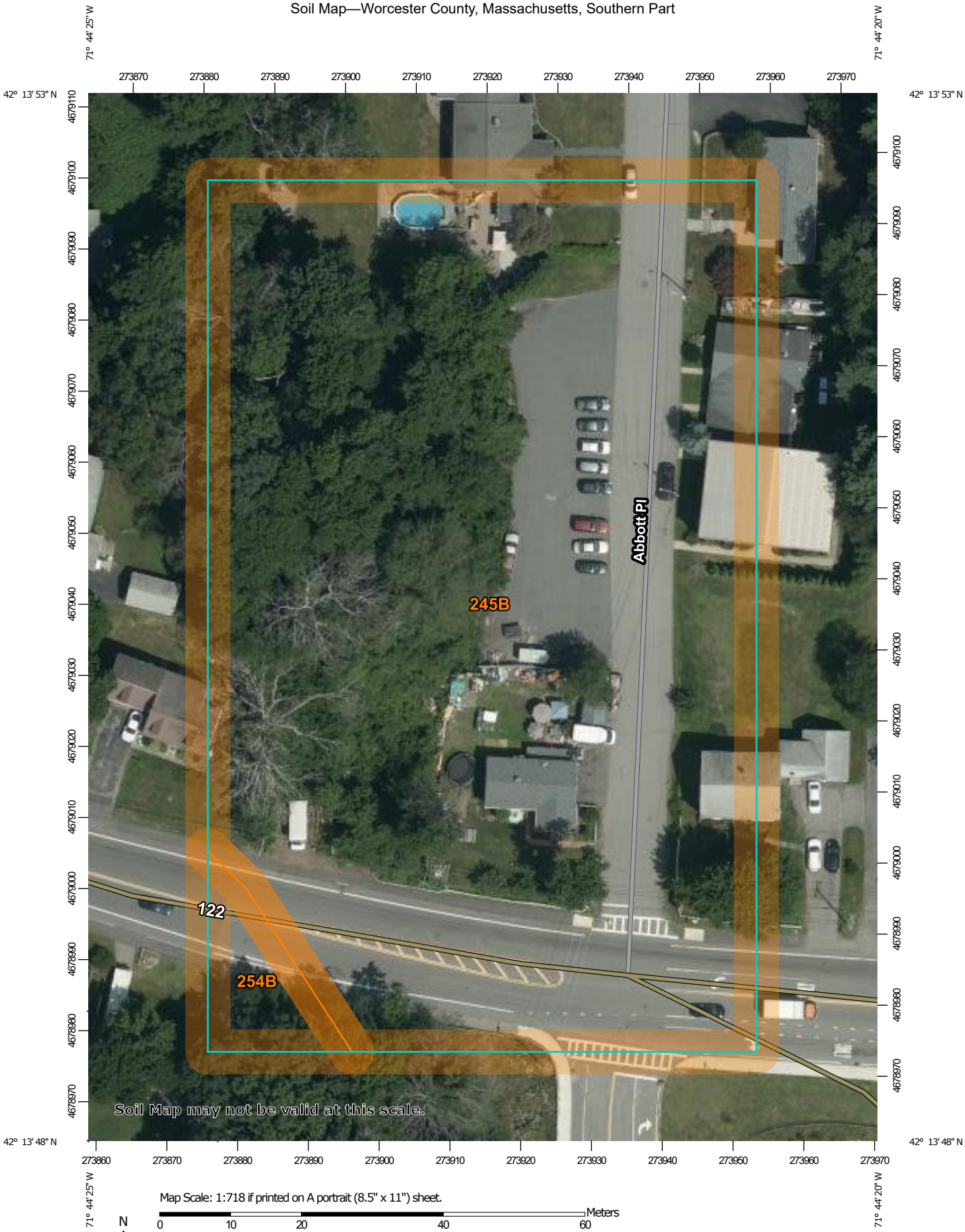
Owner: Parklund Place, LLC
4 Abbott Place
Millbury, MA 01527
(508) 335-7191

Owner's Compliance Statement

To the best of my knowledge, the attached plans, computations and specifications meet the requirements of Standard 10 of the Massachusetts Stormwater Handbook regarding illicit discharges to the stormwater management system and that no detectable illicit discharges exist on the site. All documents and attachments were prepared under my direction ad qualified personnel gathered and evaluation the information submitted, to the best of my knowledge.

Included with this statement are site plans, drawn to scale, that identify the location of systems for conveying stormwater on the site and show that these systems do not allow the entry of any illicit discharges into the stormwater management system. The plans also show any systems for conveying wastewater and/or groundwater on the site and show there are no connections between stormwater and wastewater systems.

Signature _____



Map Scale: 1:718 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 30 60 120 180

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil 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: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 13, Jun 11, 2020

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

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
245B	Hinckley loamy sand, 3 to 8 percent slopes	2.3	96.7%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	0.1	3.3%
Totals for Area of Interest		**2.4**	**100.0%**

FORM 11 – SOIL EVALUATOR FORM

Location Address or Lot No. ABBOTT PLACE, MILLBURY

On-Site Review

Deep Hole Number 1 Date: 11/19/20 Time: 9:00 A.M. Weather: 40, PARTLY CLOUDY
Location (identify on site plan):
Land Use- VACANT Slope (%) 5-50 Surface Stones NONE
Vegetation- WOODED
Landform
Position on Landscape (sketch on back)
Distances from:
Open Water Body >**300** feet Drainage way- **100** feet
Possible Wet Area **50** feet Property Line- >**30** feet
Drinking Water Well **>100** feet Other -

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
0-6	**A**	**SL**			
6-24	**B**	**SL**			
24-96	**C**	**SL**		**@60"**	

*MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) TILL Depth to Bedrock: >96"

Depth to Ground Water: Standing Water in the Hole N/A Weeping from Pit Face: N/A

Estimated Seasonal High Ground Water: 60"