STORMWATER MANAGEMENT REPORT

FOR

128 MAIN STREET GROTON

SITE PLAN OF LAND IN GROTON, MA
PREPARED FOR 128 MAIN STREET, LLC

APRIL, 2014

4/21/14

PREPARED BY: **DAVID E. ROSS ASSOCIATES, INC.**
111 FITCHBURG ROAD
AYER, MA. 01432

APRIL 2014
"128 MAIN STREET"
GROTON, MASS.
PROJECT NO. 29228

DRAINAGE CALCULATIONS

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Narrative Summary

Drainage calculations have been prepared using the HydroCAD Stormwater Modeling System. HydroCAD uses the Soil Conservation Service (SCS) TR-20 methodology.

Pre-Development Conditions:

The locus property contains 8.36 acres of varying terrain. Approximately half of the locus is proposed for disturbance and re-development. The property is currently developed with a commercial function hall, two multi-family dwellings, and a shed. It also had an historic inn toward the front of the property that was destroyed by fire. The area developed is covered by pavement, hard-packed gravel, lawn, landscaping and a few scattered specimen trees. The remaining portion of the site, not proposed for disturbance, is primarily vegetated wetlands or adjacent buffer areas.

The Soil Survey of Middlesex County, issued by the USDA Soil Conservation Service (SCS), now the Natural Resources Conservation Service, includes delineation of soils in the vicinity of the locus by name and by hydrologic characteristics. The soils located within the drainage area are identified as Bernardston. The Soil Survey identifies these soils within

DRAINAGE CALCULATIONS

hydrologic soil group C. On December 18th, 2013 and April 3rd, 2014, soil test holes (see Appendix A) were conducted to confirm soils shown by the USGS and the USDA and to establish groundwater elevations and soil permeability at the site. Soil testing confirmed Type C very fine sandy loams throughout the property.

The existing predevelopment drainage area has been divided into three (3) drainage systems (subcatchments 1 through 3). Subcatchment 1 includes the portion of property proposed for development that naturally flows southwesterly toward Main Street with a point of concentration at the right-of-way line along Main Street. Most of this existing runoff flows overland and ultimately deposits into catch basins along Main Street with no pre-treatment anywhere on the site. Subcatchment 2 naturally flows northeasterly to a point of concentration at the edge bordering vegetated wetlands spanning the back of the property. The edge of the wetlands was chosen as a point of analysis. Subcatchment 3 naturally flows northwesterly with a point of concentration at the property line along the abutting property. This property line was chosen as a point of analysis. All pre-development flows from the site were routed to a summation pond (SUM).

Post-Development Conditions:

The proposed project is for construction of a new Inn and six other residential structures. There will be improved parking, access, landscaping, and utilities. The proposed re-development will require clearing and regrading of most of the existing developed areas on the site in order to establish final grades. All existing pavement and the buildings will be removed and disposed of offsite. A new stormwater collection system is proposed to collect, treat, and attenuate runoff from the site. Proposed (postdevelopment) runoff patterns will generally continue as in predevelopment. The postdevelopment points of analysis are the same as predevelopment.

The soil testing results revealed high groundwater (3' on average) throughout the project site. This severely limits option available for stormwater mitigation. Given minimum groundwater separation from infiltration or treatment systems, treatment media thickness, and cover over infrastructure, the site can only be improved in a limited number of ways. Runoff from paved areas will be collected by hooded deep sump catch basins. The catch basins will pre-treat all the stormwater. The stormwater directed toward Main Street will be reduced by reducing the subcatchment area(s) contributing in that direction. We also propose to treat the stormwater a second time with a water quality inlet prior to its discharge into the Main Street drainage infrastructure. This improves the existing conditions by providing 44% TSS removal and reducing the rate and volume of stormwater for all storm events.

The portion of the project generating stormwater runoff toward the wetlands will be improved by the use of the catch basins, direct recharge of roof runoff, disconnected impervious areas, and routing through a sediment forebay and infiltration basin prior to discharge. Exfiltration over the infiltration basin surface area serves as an outlet to provide recharge for the site. An exfiltration rate of 0.27 inches/hour was used to conservatively estimate the rate of exfiltration for the basin. In order to reduce potential groundwater influence, the bottom of the infrastructure was designed more than 2' above the groundwater.

The stormwater system for the project is designed to fully comply with all the Massachusetts Stormwater Design Standards for a redevelopment project. The increase in impervious surfaces will be completely mitigated and existing conditions will be improved by providing a conveyance system, treatment, mitigation. Additionally, a formal operation and maintenance plan will be put in place and monitored.

Summary of Calculations

The following charts summarize the peak surface stormwater runoff (in cubic feet per second (CFS)) for each storm event using (SCS) TR-20 methodology. Calculations have been provided for the 2, 10, 25, and 100-year storm events to illustrate the collection systems performance under various design storm rates. All predevelopment flows are summarized by four nodes (1 through 3 and SUM). All postdevelopment flows are summarized by four nodes (Main, WetSum, 15, and SUM).

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SUMMARY OF 2-YEAR STORM:

(Pre / Post)	Pre-development	Post-development
1 / Main	2.72 CFS	2.00 CFS
2 / WetSum	5.06 CFS	4.82 CFS
3 / 15	0.20 CFS	0.09 CFS
Sum / Sum	7.96 CFS	6.36 CFS

SUMMARY OF 10-YEAR STORM:

(Pre / Post)	Pre-development	Post-development
1 / Main	4.59 CFS	3.22 CFS
2 / WetSum	9.86 CFS	8.34 CFS
3 / 15	0.44 CFS	0.20 CFS
Sum / Sum	14.81 CFS	11.00 CFS

SUMMARY OF 25-YEAR STORM:

(Pre / Post)	Pre-development	Post-development
1 / Main	5.66 CFS	3.92 CFS
2 / WetSum	12.76 CFS	10.39 CFS
3 / 15	0.59 CFS	0.27 CFS
Sum / Sum	18.91 CFS	13.68 CFS

SUMMARY OF 100-YEAR STORM:

(Pre / Post)	Pre-development	Post-development
1 / Main	7.25 CFS	4.97 CFS
2 / WetSum	17.24 CFS	15.91 CFS
3 / 15	0.83 CFS	0.37 CFS
Sum / Sum	25.18 CFS	19.56 CFS

Under post development conditions, the results indicate that the overall drainage area will experience a decrease in peak rate of runoff for the calculated storm event. Accordingly, we do not anticipate adverse effects or flooding of neighboring or down gradient properties or sensitive receptors.

Stormwater Management Standards

The proposed drainage system meets the Stormwater Management Policy (SMP) of the Massachusetts Department of Environmental Protection as follows:

Standard #1 **NO UNTREATED DISCHARGES OR EROSION TO WETLANDS**

The proposed project will not discharge untreated stormwater from any impervious surfaces or cause erosion to any wetland. Stormwater runoff from impervious surfaces will be collected and directed to the stormwater management system which includes catch basins and an infiltration structure with a sediment forebay.

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Standard #2 PEAK RATE ATTENUATION

The proposed project has been designed with stormwater controls to attenuate flows for the 2-year, 10-year, 25-year and 100-year 24-hour design storm events. The post-development peak discharge rates for these storms are at or below the pre-development conditions for the site.

Standard #3 STORMWATER RECHARGE

The existing site is developed with 60,444 sq.ft. of impervious surfaces. None of the existing impervious surface is directed to a recharge structure. The proposed project contains 83,499 sq. ft. of impervious area. That yields a net increase of 23,055 sq.ft impervious surface for the proposed development.

The site consists of HSG C soils. This yields a recharge requirement of **481 cu.ft**. (23,055 sq.ft. x 0.25/12) for the increase in impervious surface. The proposed basin provides the following volume below the orifice outlets: **1,001 cu.ft**.. In addition, there is at least **285 cu.ft**. of storage in the roof recharge trenches along the foundations of the buildings yielding a total of **1,286 cu.ft.**

In addition, sufficient runoff must be directed to exfiltration practices to ensure post project recharge equals or exceeds pre-development recharge. To accomplish this, at least 65% of the site's impervious cover shall be directed to recharge facilities. This would require that at least **54,275 sq.ft**. (83,499 x 0.65) to be directed to recharge facilities. This is conservative because it considers all the impervious surface for the project and not just the increase from the redevelopment. This requirement is accomplished as follows: 46,875 sq.ft. of impervious surface directed toward the detention basin (Subcatchments 6,7,8,9,10, and 13). In addition, there is at least 7,421 sq.ft. of roof area within Subcatchment 11 that is directed to recharge trenches along the foundations. That yields **54,296 sq.ft.**

Given the above, the Minimum Required Recharge Volume must be adjusted to compensate for only 65% going to recharge facilities. The yields a requirement of (1/0.65) x 481 = **740 cu.ft.** recharge volume. Based on the design information above, this requirement will still be met.

The SMP requires infiltration structures to drain within 72 hours using the Rawls Rate and the bottom surface area only for each structure. Using the Static Method and the Rawls Table, the minimum infiltration rate is 0.27 inches/hour for the site. Drawdown Time = Req. Volume x (1/Infil Rate)(1/Conversion for Inches to Feet)(1/Bot. Area)

	Bottom Area	Drawdown Time
Infiltration Basin 1:	1,662 sq.ft.	26.8 hours

The bottom of the infiltration basin is less than 4' from the seasonal high water table. It is also designed to attenuate the 10-year storm or greater. Therefore, a mounding analysis is required to ensure the basin will empty within 72-hours. Please find those calculations and an explanation of the methodology in Appendix C.

Standard #4 WATER QUALITY

Water quality volumes are based on 0.5 inch per square foot of new impervious area. Using the totals listed above, the required water quality volume is **961 cu.ft.** (23,055 x 0.5 / 12). Due to the oversized water quality volumes provided in Standard #3 above (1,001 cu.ft + 285 cu.ft. = **1,286 cu.ft.**), they will satisfy Standard #4 as well.

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Total suspended solids removal of 80% total is met as follows:

Deep Sump Catch Basins with Hood
TSS removal = 25% removal
TSS remaining = 1.00 - 0.25 = 0.75 = 75% remaining
Infiltration Basin w/ Pretreatment*
TSS removal = 80% removal
TSS remaining = 0.75 – (0.8 x 0.75) = 0.15 = 15% remaining
Total TSS removal = 1.00 – 0.15 = 0.85 = 85% total removal.

* In order to get the full credit of 80% for TSS removal. The basin must have a properly sized sediment forebay. The forebay shall be designed to hold 0.1-inch/impervious acre (363 cu.ft/ac) contributing to it. That requires the proposed forebay to have **391 cu.ft.** (46,875/43.560 x 363). The volume to the top of the overflow is **420 cu.ft.**

Standard #5 **LAND USES WITH HIGHER POTENTIAL POLLUTANT LOADS**

The project would not be considered a land use with Higher Potential Pollutant Loads.

Standard #6 **CRITICAL AREAS**

The site is not located within a Zone II or other critical area.

Standard #7 **REDEVLEOPMENT**

This site is currently developed with commercial and residential uses. There is extensive pavement, multiple buildings, lawn, and landscaping. There are no existing treatment BMP's on the site that meet DEP standards. The proposed project will be within existing disturbed areas. There will be a net increase in impervious surface. However, there will be significant upgrades to the stormwater management system that will enable it to fully meet the Standards for the increase. In addition, all impervious areas for the project will be directed to at least 2 structural BMP's for treatment. These design features demonstrate that the existing conditions have been improved.

Standard #8 **CONSTRUCTION PERIOD CONTROLS**

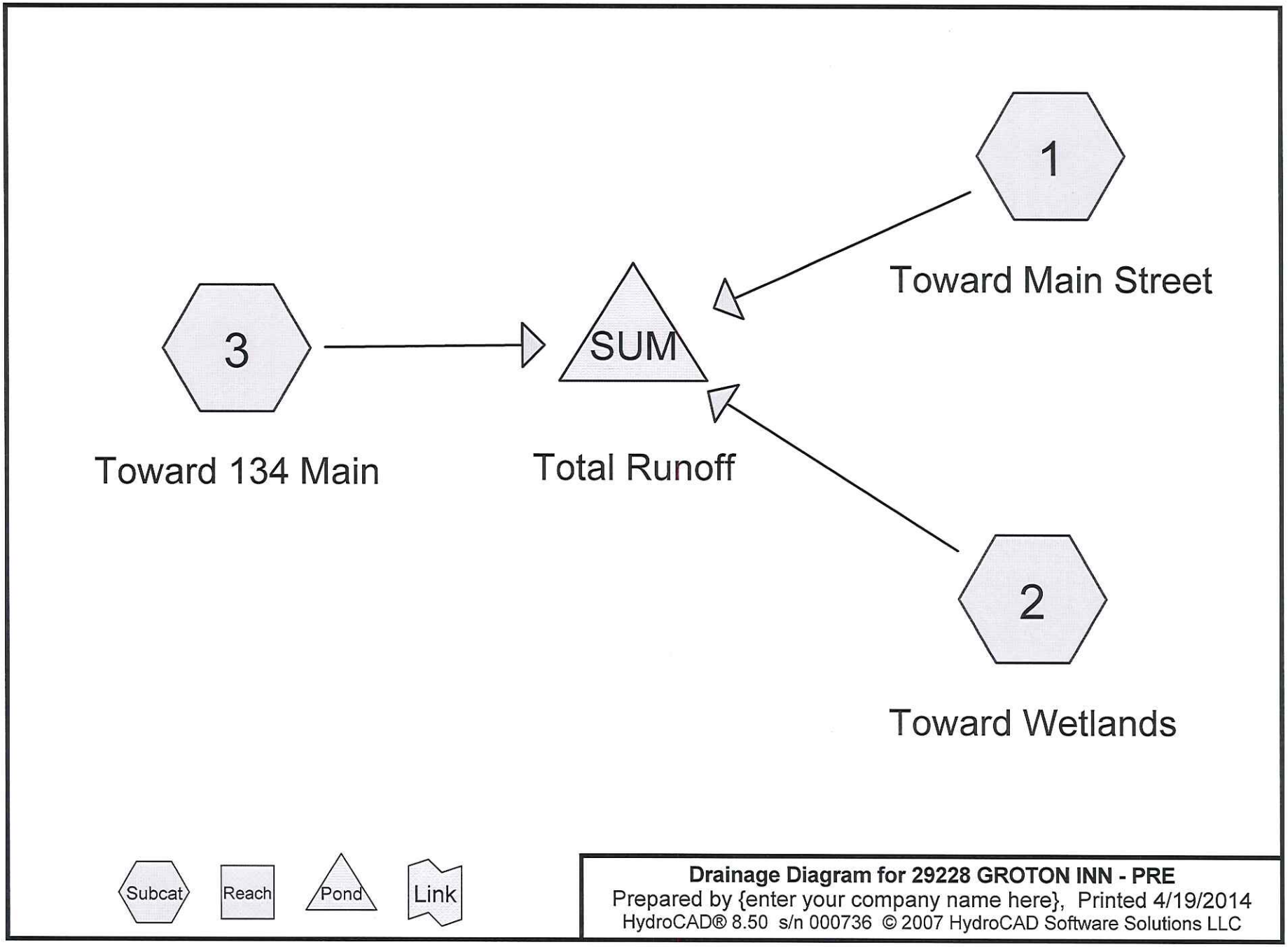
The necessary erosion and sedimentation controls have been included on the design plans. The drainage system shall be constructed and stabilized prior to any other construction activities on site. A Stormwater Pollution Prevention Plan is also included on the design plans.

Standard #9 **OPERATION AND MAINTENANCE PLAN**

An Operation and Maintenance Plan is attached to the Stormwater Analysis as well as included on the design plans.

Standard #10 **ILLICIT DISCHARGES TO THE DRAIN SYSTEM**

There are no existing or proposed illicit discharges to the drainage system for the proposed project.



Drainage Diagram for 29228 GROTON INN - PRE
Prepared by {enter your company name here}, Printed 4/19/2014

PRE-DEVELOPMENT HYDROCAD DATA

2 Year Event -Summary Only
10 Year Event – Summary Only
25 Year Event – Summary Only
100 Year Event – Summary Only

Time span=1.00-24.00 hrs, dt=0.05 hrs, 461 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: Toward Main Street Runoff Area=55,439 sf 51.58% Impervious Runoff Depth>1.83"
Flow Length=311' Tc=5.0 min CN=87 Runoff=2.72 cfs 0.194 af

Subcatchment 2: Toward Wetlands Runoff Area=159,668 sf 13.21% Impervious Runoff Depth>1.20"
Flow Length=455' Tc=5.0 min CN=78 Runoff=5.06 cfs 0.366 af

Subcatchment 3: Toward 134 Main Runoff Area=9,665 sf 0.00% Impervious Runoff Depth>0.92"
Flow Length=70' Tc=8.3 min CN=73 Runoff=0.20 cfs 0.017 af

Pond SUM: Total Runoff Inflow=7.96 cfs 0.577 af
Primary=7.96 cfs 0.577 af

Total Runoff Area = 5.160 ac Runoff Volume = 0.577 af Average Runoff Depth = 1.34"
77.89% Pervious = 4.019 ac 22.11% Impervious = 1.141 ac

Time span=1.00-24.00 hrs, dt=0.05 hrs, 461 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: Toward Main Street Runoff Area=55,439 sf 51.58% Impervious Runoff Depth>3.10"
Flow Length=311' Tc=5.0 min CN=87 Runoff=4.59 cfs 0.328 af

Subcatchment 2: Toward Wetlands Runoff Area=159,668 sf 13.21% Impervious Runoff Depth>2.29"
Flow Length=455' Tc=5.0 min CN=78 Runoff=9.86 cfs 0.700 af

Subcatchment 3: Toward 134 Main Runoff Area=9,665 sf 0.00% Impervious Runoff Depth>1.89"
Flow Length=70' Tc=8.3 min CN=73 Runoff=0.44 cfs 0.035 af

Pond SUM: Total Runoff Inflow=14.81 cfs 1.063 af
Primary=14.81 cfs 1.063 af

Total Runoff Area = 5.160 ac Runoff Volume = 1.063 af Average Runoff Depth = 2.47"
77.89% Pervious = 4.019 ac 22.11% Impervious = 1.141 ac

Time span=1.00-24.00 hrs, dt=0.05 hrs, 461 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: Toward Main Street Runoff Area=55,439 sf 51.58% Impervious Runoff Depth>3.85"
Flow Length=311' Tc=5.0 min CN=87 Runoff=5.66 cfs 0.408 af

Subcatchment 2: Toward Wetlands Runoff Area=159,668 sf 13.21% Impervious Runoff Depth>2.97"
Flow Length=455' Tc=5.0 min CN=78 Runoff=12.76 cfs 0.906 af

Subcatchment 3: Toward 134 Main Runoff Area=9,665 sf 0.00% Impervious Runoff Depth>2.51"
Flow Length=70' Tc=8.3 min CN=73 Runoff=0.59 cfs 0.046 af

Pond SUM: Total Runoff Inflow=18.91 cfs 1.361 af
Primary=18.91 cfs 1.361 af

Total Runoff Area = 5.160 ac Runoff Volume = 1.361 af Average Runoff Depth = 3.16"
77.89% Pervious = 4.019 ac 22.11% Impervious = 1.141 ac

Time span=1.00-24.00 hrs, dt=0.05 hrs, 461 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: Toward Main Street Runoff Area=55,439 sf 51.58% Impervious Runoff Depth>4.99"
Flow Length=311' Tc=5.0 min CN=87 Runoff=7.25 cfs 0.530 af

Subcatchment 2: Toward Wetlands Runoff Area=159,668 sf 13.21% Impervious Runoff Depth>4.02"
Flow Length=455' Tc=5.0 min CN=78 Runoff=17.24 cfs 1.228 af

Subcatchment 3: Toward 134 Main Runoff Area=9,665 sf 0.00% Impervious Runoff Depth>3.50"
Flow Length=70' Tc=8.3 min CN=73 Runoff=0.83 cfs 0.065 af

Pond SUM: Total Runoff Inflow=25.18 cfs 1.823 af
Primary=25.18 cfs 1.823 af

Total Runoff Area = 5.160 ac Runoff Volume = 1.823 af Average Runoff Depth = 4.24"
77.89% Pervious = 4.019 ac 22.11% Impervious = 1.141 ac

25-YEAR STORM EVENT

Pre-development

Summary for Subcatchment 1: Toward Main Street

[49] Hint: Tc<2dt may require smaller dt

Runoff = 5.78 cfs @ 12.07 hrs, Volume= 0.419 af, Depth> 3.95"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.30"

Area (sf)	CN	Description
31,719	98	Paved parking & roofs
2,321	73	Woods, Fair, HSG C
21,399	74	>75% Grass cover, Good, HSG C
55,439	88	Weighted Average
23,720		Pervious Area
31,719		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0300	1.39		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.10"
1.2	228	0.0240	3.14		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	33	0.0450	1.48		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.2	311	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment 2: Toward Wetlands

[49] Hint: Tc<2dt may require smaller dt

Runoff = 12.76 cfs @ 12.08 hrs, Volume= 0.906 af, Depth> 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.30"

Area (sf)	CN	Description
28,725	98	Paved parking & roofs
71,740	74	>75% Grass cover, Good, HSG C
59,203	73	Woods, Fair, HSG C
159,668	78	Weighted Average
130,943		Pervious Area
28,725		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0300	1.39		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.10"
0.2	43	0.0470	3.49		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.9	236	0.0850	2.04		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.7	126	0.0630	1.25		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
4.4	455	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment 3: Toward 134 Main

Runoff = 0.59 cfs @ 12.12 hrs, Volume= 0.046 af, Depth> 2.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.30"

Area (sf)	CN	Description
9,665	73	Woods, Fair, HSG C
9,665		Pervious Area

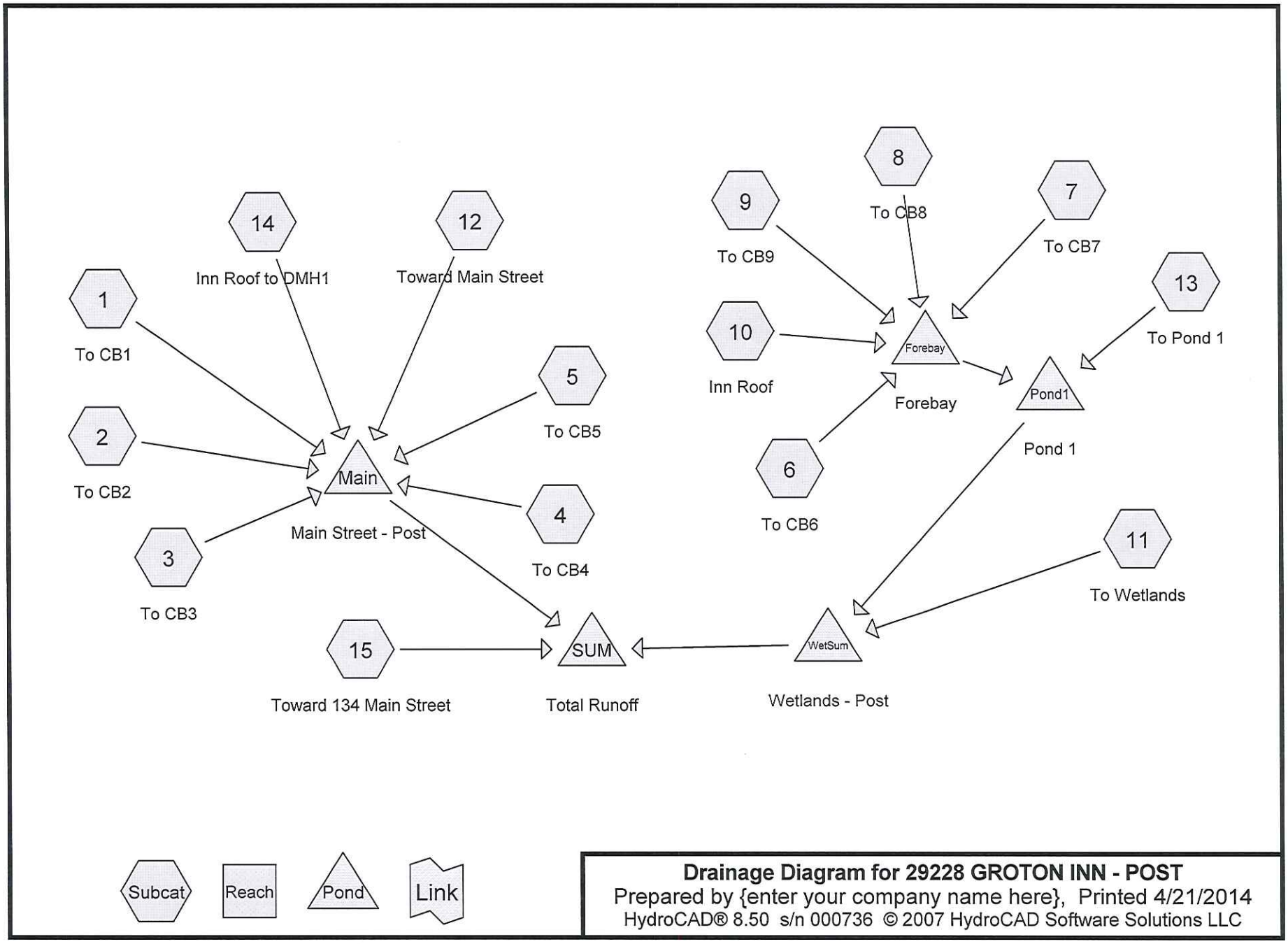
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	50	0.0600	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.2	20	0.0750	1.37		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
8.3	70	Total			

Summary for Pond SUM: Total Runoff

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 5.160 ac, 26.89% Impervious, Inflow Depth > 3.19" for 25 Year Storm event
Inflow = 19.03 cfs @ 12.08 hrs, Volume= 1.372 af
Primary = 19.03 cfs @ 12.08 hrs, Volume= 1.372 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs



Drainage Diagram for 29228 GROTON INN - POST

Prepared by {enter your company name here}, Printed 4/21/2014

POST-DEVELOPMENT HYDROCAD DATA

2 Year Event -Summary Only
10 Year Event – Summary Only
25 Year Event – Summary Only
100 Year Event – Summary Only

Time span=1.00-24.00 hrs, dt=0.05 hrs, 461 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: To CB1 Runoff Area=2,282 sf 91.24% Impervious Runoff Depth>2.65"
Tc=5.0 min CN=96 Runoff=0.15 cfs 0.012 af

Subcatchment 2: To CB2 Runoff Area=2,115 sf 74.37% Impervious Runoff Depth>2.25"
Tc=5.0 min CN=92 Runoff=0.13 cfs 0.009 af

Subcatchment 3: To CB3 Runoff Area=7,411 sf 87.92% Impervious Runoff Depth>2.55"
Tc=5.0 min CN=95 Runoff=0.48 cfs 0.036 af

Subcatchment 4: To CB4 Runoff Area=9,303 sf 51.12% Impervious Runoff Depth>1.75"
Flow Length=262' Tc=5.4 min CN=86 Runoff=0.43 cfs 0.031 af

Subcatchment 5: To CB5 Runoff Area=6,790 sf 70.54% Impervious Runoff Depth>2.16"
Tc=5.0 min CN=91 Runoff=0.39 cfs 0.028 af

Subcatchment 6: To CB6 Runoff Area=11,247 sf 82.40% Impervious Runoff Depth>2.45"
Tc=5.0 min CN=94 Runoff=0.72 cfs 0.053 af

Subcatchment 7: To CB7 Runoff Area=6,527 sf 92.65% Impervious Runoff Depth>2.65"
Tc=5.0 min CN=96 Runoff=0.44 cfs 0.033 af

Subcatchment 8: To CB8 Runoff Area=20,393 sf 67.76% Impervious Runoff Depth>2.07"
Flow Length=175' Tc=5.5 min CN=90 Runoff=1.12 cfs 0.081 af

Subcatchment 9: To CB9 Runoff Area=10,775 sf 86.86% Impervious Runoff Depth>2.55"
Flow Length=184' Tc=5.6 min CN=95 Runoff=0.69 cfs 0.052 af

Subcatchment 10: Inn Roof Runoff Area=7,172 sf 100.00% Impervious Runoff Depth>2.87"
Tc=5.0 min CN=98 Runoff=0.50 cfs 0.039 af

Subcatchment 11: To Wetlands Runoff Area=109,029 sf 11.45% Impervious Runoff Depth>1.08"
Flow Length=364' Tc=10.4 min CN=76 Runoff=2.60 cfs 0.225 af

Subcatchment 12: Toward Main Street Runoff Area=5,950 sf 16.47% Impervious Runoff Depth>1.20"
Tc=5.0 min CN=78 Runoff=0.19 cfs 0.014 af

Subcatchment 13: To Pond 1 Runoff Area=18,523 sf 27.55% Impervious Runoff Depth>1.39"
Flow Length=173' Tc=6.5 min CN=81 Runoff=0.67 cfs 0.049 af

Subcatchment 14: Inn Roof to DMH1 Runoff Area=3,440 sf 100.00% Impervious Runoff Depth>2.87"
Tc=5.0 min CN=98 Runoff=0.24 cfs 0.019 af

Subcatchment 15: Toward 134 Main Street Runoff Area=3,815 sf 0.00% Impervious Runoff Depth>0.97"
Tc=5.0 min CN=74 Runoff=0.09 cfs 0.007 af

Pond Forebay: Forebay Peak Elev=324.53' Storage=437 cf Inflow=3.44 cfs 0.258 af
Outflow=3.45 cfs 0.250 af

Pond Main: Main Street - Post Inflow=2.00 cfs 0.148 af
Primary=2.00 cfs 0.148 af

Pond Pond1: Pond 1 Peak Elev=325.19' Storage=3,300 cf Inflow=4.10 cfs 0.299 af
Discarded=0.03 cfs 0.021 af Primary=2.25 cfs 0.252 af Outflow=2.28 cfs 0.273 af

Pond SUM: Total Runoff Inflow=6.36 cfs 0.633 af
Primary=6.36 cfs 0.633 af

Pond WetSum: Wetlands - Post Inflow=4.82 cfs 0.477 af
Primary=4.82 cfs 0.477 af

Total Runoff Area = 5.160 ac Runoff Volume = 0.689 af Average Runoff Depth = 1.60"
61.12% Pervious = 3.154 ac 38.88% Impervious = 2.006 ac

Time span=1.00-24.00 hrs, dt=0.05 hrs, 461 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: To CB1 Runoff Area=2,282 sf 91.24% Impervious Runoff Depth>4.03"
Tc=5.0 min CN=96 Runoff=0.23 cfs 0.018 af

Subcatchment 2: To CB2 Runoff Area=2,115 sf 74.37% Impervious Runoff Depth>3.60"
Tc=5.0 min CN=92 Runoff=0.20 cfs 0.015 af

Subcatchment 3: To CB3 Runoff Area=7,411 sf 87.92% Impervious Runoff Depth>3.92"
Tc=5.0 min CN=95 Runoff=0.73 cfs 0.056 af

Subcatchment 4: To CB4 Runoff Area=9,303 sf 51.12% Impervious Runoff Depth>3.00"
Flow Length=262' Tc=5.4 min CN=86 Runoff=0.74 cfs 0.053 af

Subcatchment 5: To CB5 Runoff Area=6,790 sf 70.54% Impervious Runoff Depth>3.50"
Tc=5.0 min CN=91 Runoff=0.62 cfs 0.045 af

Subcatchment 6: To CB6 Runoff Area=11,247 sf 82.40% Impervious Runoff Depth>3.81"
Tc=5.0 min CN=94 Runoff=1.09 cfs 0.082 af

Subcatchment 7: To CB7 Runoff Area=6,527 sf 92.65% Impervious Runoff Depth>4.03"
Tc=5.0 min CN=96 Runoff=0.65 cfs 0.050 af

Subcatchment 8: To CB8 Runoff Area=20,393 sf 67.76% Impervious Runoff Depth>3.39"
Flow Length=175' Tc=5.5 min CN=90 Runoff=1.79 cfs 0.132 af

Subcatchment 9: To CB9 Runoff Area=10,775 sf 86.86% Impervious Runoff Depth>3.92"
Flow Length=184' Tc=5.6 min CN=95 Runoff=1.04 cfs 0.081 af

Subcatchment 10: Inn Roof Runoff Area=7,172 sf 100.00% Impervious Runoff Depth>4.26"
Tc=5.0 min CN=98 Runoff=0.73 cfs 0.058 af

Subcatchment 11: To Wetlands Runoff Area=109,029 sf 11.45% Impervious Runoff Depth>2.13"
Flow Length=364' Tc=10.4 min CN=76 Runoff=5.31 cfs 0.443 af

Subcatchment 12: Toward Main Street Runoff Area=5,950 sf 16.47% Impervious Runoff Depth>2.29"
Tc=5.0 min CN=78 Runoff=0.37 cfs 0.026 af

Subcatchment 13: To Pond 1 Runoff Area=18,523 sf 27.55% Impervious Runoff Depth>2.55"
Flow Length=173' Tc=6.5 min CN=81 Runoff=1.23 cfs 0.090 af

Subcatchment 14: Inn Roof to DMH1 Runoff Area=3,440 sf 100.00% Impervious Runoff Depth>4.26"
Tc=5.0 min CN=98 Runoff=0.35 cfs 0.028 af

Subcatchment 15: Toward 134 Main Street Runoff Area=3,815 sf 0.00% Impervious Runoff Depth>1.97"
Tc=5.0 min CN=74 Runoff=0.20 cfs 0.014 af

Pond Forebay: Forebay Peak Elev=324.58' Storage=459 cf Inflow=5.26 cfs 0.404 af
Outflow=5.27 cfs 0.396 af

Pond Main: Main Street - Post Inflow=3.22 cfs 0.241 af
Primary=3.22 cfs 0.241 af

Pond Pond1: Pond 1 Peak Elev=325.56' Storage=4,863 cf Inflow=6.49 cfs 0.486 af
Discarded=0.03 cfs 0.024 af Primary=3.13 cfs 0.435 af Outflow=3.15 cfs 0.459 af

Pond SUM: Total Runoff Inflow=11.00 cfs 1.133 af
Primary=11.00 cfs 1.133 af

Pond WetSum: Wetlands - Post Inflow=8.34 cfs 0.878 af
Primary=8.34 cfs 0.878 af

Total Runoff Area = 5.160 ac Runoff Volume = 1.193 af Average Runoff Depth = 2.77"
61.12% Pervious = 3.154 ac 38.88% Impervious = 2.006 ac

Time span=1.00-24.00 hrs, dt=0.05 hrs, 461 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: To CB1 Runoff Area=2,282 sf 91.24% Impervious Runoff Depth>4.83"
Tc=5.0 min CN=96 Runoff=0.27 cfs 0.021 af

Subcatchment 2: To CB2 Runoff Area=2,115 sf 74.37% Impervious Runoff Depth>4.38"
Tc=5.0 min CN=92 Runoff=0.24 cfs 0.018 af

Subcatchment 3: To CB3 Runoff Area=7,411 sf 87.92% Impervious Runoff Depth>4.71"
Tc=5.0 min CN=95 Runoff=0.87 cfs 0.067 af

Subcatchment 4: To CB4 Runoff Area=9,303 sf 51.12% Impervious Runoff Depth>3.75"
Flow Length=262' Tc=5.4 min CN=86 Runoff=0.91 cfs 0.067 af

Subcatchment 5: To CB5 Runoff Area=6,790 sf 70.54% Impervious Runoff Depth>4.27"
Tc=5.0 min CN=91 Runoff=0.75 cfs 0.055 af

Subcatchment 6: To CB6 Runoff Area=11,247 sf 82.40% Impervious Runoff Depth>4.60"
Tc=5.0 min CN=94 Runoff=1.30 cfs 0.099 af

Subcatchment 7: To CB7 Runoff Area=6,527 sf 92.65% Impervious Runoff Depth>4.83"
Tc=5.0 min CN=96 Runoff=0.77 cfs 0.060 af

Subcatchment 8: To CB8 Runoff Area=20,393 sf 67.76% Impervious Runoff Depth>4.16"
Flow Length=175' Tc=5.5 min CN=90 Runoff=2.17 cfs 0.162 af

Subcatchment 9: To CB9 Runoff Area=10,775 sf 86.86% Impervious Runoff Depth>4.71"
Flow Length=184' Tc=5.6 min CN=95 Runoff=1.23 cfs 0.097 af

Subcatchment 10: Inn Roof Runoff Area=7,172 sf 100.00% Impervious Runoff Depth>5.06"
Tc=5.0 min CN=98 Runoff=0.86 cfs 0.069 af

Subcatchment 11: To Wetlands Runoff Area=109,029 sf 11.45% Impervious Runoff Depth>2.78"
Flow Length=364' Tc=10.4 min CN=76 Runoff=6.98 cfs 0.580 af

Subcatchment 12: Toward Main Street Runoff Area=5,950 sf 16.47% Impervious Runoff Depth>2.97"
Tc=5.0 min CN=78 Runoff=0.48 cfs 0.034 af

Subcatchment 13: To Pond 1 Runoff Area=18,523 sf 27.55% Impervious Runoff Depth>3.25"
Flow Length=173' Tc=6.5 min CN=81 Runoff=1.56 cfs 0.115 af

Subcatchment 14: Inn Roof to DMH1 Runoff Area=3,440 sf 100.00% Impervious Runoff Depth>5.06"
Tc=5.0 min CN=98 Runoff=0.41 cfs 0.033 af

Subcatchment 15: Toward 134 Main Street Runoff Area=3,815 sf 0.00% Impervious Runoff Depth>2.60"
Tc=5.0 min CN=74 Runoff=0.27 cfs 0.019 af

Pond Forebay: Forebay Peak Elev=324.60' Storage=471 cf Inflow=6.30 cfs 0.488 af
Outflow=6.31 cfs 0.480 af

Pond Main: Main Street - Post Inflow=3.92 cfs 0.295 af
Primary=3.92 cfs 0.295 af

Pond Pond1: Pond 1 Peak Elev=325.77' Storage=5,847 cf Inflow=7.86 cfs 0.595 af
Discarded=0.03 cfs 0.026 af Primary=3.76 cfs 0.542 af Outflow=3.79 cfs 0.567 af

Pond SUM: Total Runoff Inflow=13.68 cfs 1.435 af
Primary=13.68 cfs 1.435 af

Pond WetSum: Wetlands - Post Inflow=10.39 cfs 1.122 af
Primary=10.39 cfs 1.122 af

Total Runoff Area = 5.160 ac Runoff Volume = 1.497 af Average Runoff Depth = 3.48"
61.12% Pervious = 3.154 ac 38.88% Impervious = 2.006 ac

Time span=1.00-24.00 hrs, dt=0.05 hrs, 461 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1: To CB1 Runoff Area=2,282 sf 91.24% Impervious Runoff Depth>6.02"
Tc=5.0 min CN=96 Runoff=0.33 cfs 0.026 af

Subcatchment 2: To CB2 Runoff Area=2,115 sf 74.37% Impervious Runoff Depth>5.56"
Tc=5.0 min CN=92 Runoff=0.30 cfs 0.022 af

Subcatchment 3: To CB3 Runoff Area=7,411 sf 87.92% Impervious Runoff Depth>5.91"
Tc=5.0 min CN=95 Runoff=1.07 cfs 0.084 af

Subcatchment 4: To CB4 Runoff Area=9,303 sf 51.12% Impervious Runoff Depth>4.88"
Flow Length=262' Tc=5.4 min CN=86 Runoff=1.18 cfs 0.087 af

Subcatchment 5: To CB5 Runoff Area=6,790 sf 70.54% Impervious Runoff Depth>5.44"
Tc=5.0 min CN=91 Runoff=0.94 cfs 0.071 af

Subcatchment 6: To CB6 Runoff Area=11,247 sf 82.40% Impervious Runoff Depth>5.79"
Tc=5.0 min CN=94 Runoff=1.61 cfs 0.125 af

Subcatchment 7: To CB7 Runoff Area=6,527 sf 92.65% Impervious Runoff Depth>6.02"
Tc=5.0 min CN=96 Runoff=0.95 cfs 0.075 af

Subcatchment 8: To CB8 Runoff Area=20,393 sf 67.76% Impervious Runoff Depth>5.33"
Flow Length=175' Tc=5.5 min CN=90 Runoff=2.74 cfs 0.208 af

Subcatchment 9: To CB9 Runoff Area=10,775 sf 86.86% Impervious Runoff Depth>5.91"
Flow Length=184' Tc=5.6 min CN=95 Runoff=1.53 cfs 0.122 af

Subcatchment 10: Inn Roof Runoff Area=7,172 sf 100.00% Impervious Runoff Depth>6.26"
Tc=5.0 min CN=98 Runoff=1.06 cfs 0.086 af

Subcatchment 11: To Wetlands Runoff Area=109,029 sf 11.45% Impervious Runoff Depth>3.81"
Flow Length=364' Tc=10.4 min CN=76 Runoff=9.56 cfs 0.794 af

Subcatchment 12: Toward Main Street Runoff Area=5,950 sf 16.47% Impervious Runoff Depth>4.02"
Tc=5.0 min CN=78 Runoff=0.64 cfs 0.046 af

Subcatchment 13: To Pond 1 Runoff Area=18,523 sf 27.55% Impervious Runoff Depth>4.34"
Flow Length=173' Tc=6.5 min CN=81 Runoff=2.07 cfs 0.154 af

Subcatchment 14: Inn Roof to DMH1 Runoff Area=3,440 sf 100.00% Impervious Runoff Depth>6.26"
Tc=5.0 min CN=98 Runoff=0.51 cfs 0.041 af

Subcatchment 15: Toward 134 Main Street Runoff Area=3,815 sf 0.00% Impervious Runoff Depth>3.61"
Tc=5.0 min CN=74 Runoff=0.37 cfs 0.026 af

Pond Forebay: Forebay Peak Elev=324.63' Storage=487 cf Inflow=7.84 cfs 0.615 af
Outflow=7.86 cfs 0.607 af

Pond Main: Main Street - Post Inflow=4.97 cfs 0.377 af
Primary=4.97 cfs 0.377 af

Pond Pond1: Pond 1 Peak Elev=325.93' Storage=6,625 cf Inflow=9.91 cfs 0.760 af
Discarded=0.03 cfs 0.027 af Primary=6.39 cfs 0.705 af Outflow=6.42 cfs 0.732 af

Pond SUM: Total Runoff Inflow=19.56 cfs 1.903 af
Primary=19.56 cfs 1.903 af

Pond WetSum: Wetlands - Post Inflow=15.91 cfs 1.499 af
Primary=15.91 cfs 1.499 af

Total Runoff Area = 5.160 ac Runoff Volume = 1.967 af Average Runoff Depth = 4.57"
61.12% Pervious = 3.154 ac 38.88% Impervious = 2.006 ac

25-YEAR STORM EVENT
Post-development

Summary for Subcatchment 1: To CB1

Runoff = 0.27 cfs @ 12.07 hrs, Volume= 0.021 af, Depth> 4.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.30"

Area (sf)	CN	Description
2,082	98	Paved parking & roofs
200	74	>75% Grass cover, Good, HSG C
2,282	96	Weighted Average
200		Pervious Area
2,082		Impervious Area

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

Summary for Subcatchment 2: To CB2

Runoff = 0.24 cfs @ 12.07 hrs, Volume= 0.018 af, Depth> 4.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.30"

Area (sf)	CN	Description
1,573	98	Paved parking & roofs
542	74	>75% Grass cover, Good, HSG C
2,115	92	Weighted Average
542		Pervious Area
1,573		Impervious Area

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

Summary for Subcatchment 3: To CB3

Runoff = 0.87 cfs @ 12.07 hrs, Volume= 0.067 af, Depth> 4.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.30"

Area (sf)	CN	Description
6,516	98	Paved parking & roofs
895	74	>75% Grass cover, Good, HSG C
7,411	95	Weighted Average
895		Pervious Area
6,516		Impervious Area

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

Summary for Subcatchment 4: To CB4

Runoff = 0.91 cfs @ 12.08 hrs, Volume= 0.067 af, Depth> 3.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.30"

Area (sf)	CN	Description
4,756	98	Paved parking & roofs
4,547	74	>75% Grass cover, Good, HSG C
9,303	86	Weighted Average
4,547		Pervious Area
4,756		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.2	42	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
1.2	220	0.0230	3.08		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
5.4	262	Total			

Summary for Subcatchment 5: To CB5

Runoff = 0.75 cfs @ 12.07 hrs, Volume= 0.055 af, Depth> 4.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.30"

Area (sf)	CN	Description
4,790	98	Paved parking & roofs
2,000	74	>75% Grass cover, Good, HSG C
6,790	91	Weighted Average
2,000		Pervious Area
4,790		Impervious Area

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

Summary for Subcatchment 6: To CB6

Runoff = 1.30 cfs @ 12.07 hrs, Volume= 0.099 af, Depth> 4.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.30"

Area (sf)	CN	Description
9,268	98	Paved parking & roofs
1,979	74	>75% Grass cover, Good, HSG C
11,247	94	Weighted Average
1,979		Pervious Area
9,268		Impervious Area

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

Summary for Subcatchment 7: To CB7

Runoff = 0.77 cfs @ 12.07 hrs, Volume= 0.060 af, Depth> 4.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.30"

Area (sf)	CN	Description
6,047	98	Paved parking & roofs
480	74	>75% Grass cover, Good, HSG C
6,527	96	Weighted Average
480		Pervious Area
6,047		Impervious Area

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

Summary for Subcatchment 8: To CB8

Runoff = 2.17 cfs @ 12.08 hrs, Volume= 0.162 af, Depth> 4.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.30"

Area (sf)	CN	Description
13,818	98	Paved parking & roofs
6,575	74	>75% Grass cover, Good, HSG C
20,393	90	Weighted Average
6,575		Pervious Area
13,818		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.6	47	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.9	128	0.0130	2.31		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
5.5	175	Total			

Summary for Subcatchment 9: To CB9

Runoff = 1.23 cfs @ 12.08 hrs, Volume= 0.097 af, Depth> 4.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.30"

Area (sf)	CN	Description
9,359	98	Paved parking & roofs
1,416	74	>75% Grass cover, Good, HSG C
10,775	95	Weighted Average
1,416		Pervious Area
9,359		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.7	134	0.0250	3.21		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
5.6	184	Total			

Summary for Subcatchment 10: Inn Roof

Runoff = 0.86 cfs @ 12.07 hrs, Volume= 0.069 af, Depth> 5.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.30"

Area (sf)	CN	Description
7,172	98	Paved parking & roofs
7,172		Impervious Area

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

Summary for Subcatchment 11: To Wetlands

Runoff = 6.98 cfs @ 12.15 hrs, Volume= 0.580 af, Depth> 2.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.30"

Area (sf)	CN	Description
12,487	98	Paved parking & roofs
48,108	74	>75% Grass cover, Good, HSG C
41,701	73	Woods, Fair, HSG C
6,733	71	Meadow, non-grazed, HSG C
109,029	76	Weighted Average
96,542		Pervious Area
12,487		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	50	0.0150	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
2.2	93	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	40	0.1000	2.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3	51	0.1900	3.05		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.2	130	0.1300	1.80		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.4	364	Total			

Summary for Subcatchment 12: Toward Main Street

Runoff = 0.48 cfs @ 12.08 hrs, Volume= 0.034 af, Depth> 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.30"

Area (sf)	CN	Description
980	98	Paved parking & roofs
4,970	74	>75% Grass cover, Good, HSG C
5,950	78	Weighted Average
4,970		Pervious Area
980		Impervious Area

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

Summary for Subcatchment 13: To Pond 1

Runoff = 1.56 cfs @ 12.10 hrs, Volume= 0.115 af, Depth> 3.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.30"

Area (sf)	CN	Description
1,211	98	Paved parking & roofs
13,419	74	>75% Grass cover, Good, HSG C
3,893	98	Water Surface
18,523	81	Weighted Average
13,419		Pervious Area
5,104		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.8	123	0.1300	2.52		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
6.5	173	Total			

Summary for Subcatchment 14: Inn Roof to DMH1

Runoff = 0.41 cfs @ 12.07 hrs, Volume= 0.033 af, Depth> 5.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.30"

Area (sf)	CN	Description
3,440	98	Paved parking & roofs
3,440		Impervious Area

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

Summary for Subcatchment 15: Toward 134 Main Street

Runoff = 0.27 cfs @ 12.08 hrs, Volume= 0.019 af, Depth> 2.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.30"

Area (sf)	CN	Description
3,815	74	>75% Grass cover, Good, HSG C
3,815		Pervious Area

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

Summary for Pond Forebay: Forebay

Inflow Area = 1.288 ac, 81.38% Impervious, Inflow Depth > 4.55" for 25 Year Storm event
Inflow = 6.30 cfs @ 12.08 hrs, Volume= 0.488 af
Outflow = 6.31 cfs @ 12.08 hrs, Volume= 0.480 af, Atten= 0%, Lag= 0.3 min
Primary = 6.31 cfs @ 12.08 hrs, Volume= 0.480 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 324.60' @ 12.08 hrs Surf.Area= 523 sf Storage= 471 cf

Plug-Flow detention time= 20.5 min calculated for 0.480 af (98% of inflow)
Center-of-Mass det. time= 9.3 min (779.8 - 770.6)

Volume	Invert	Avail.Storage	Storage Description
#1	323.00'	710 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
323.00	125	0	0
324.00	315	220	220
324.50	485	200	420
325.00	675	290	710

Device	Routing	Invert	Outlet Devices
#1	Primary	324.40'	**30.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=6.11 cfs @ 12.08 hrs HW=324.60' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 6.11 cfs @ 1.04 fps)

Summary for Pond Main: Main Street - Post

Inflow Area = 0.856 ac, 64.73% Impervious, Inflow Depth > 4.13" for 25 Year Storm event
Inflow = 3.92 cfs @ 12.07 hrs, Volume= 0.295 af
Primary = 3.92 cfs @ 12.07 hrs, Volume= 0.295 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond Pond1: Pond 1

Inflow Area = 1.713 ac, 68.02% Impervious, Inflow Depth > 4.17" for 25 Year Storm event
Inflow = 7.86 cfs @ 12.08 hrs, Volume= 0.595 af
Outflow = 3.79 cfs @ 12.25 hrs, Volume= 0.567 af, Atten= 52%, Lag= 10.0 min
Discarded = 0.03 cfs @ 12.25 hrs, Volume= 0.026 af
Primary = 3.76 cfs @ 12.25 hrs, Volume= 0.542 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 325.77' @ 12.25 hrs Surf.Area= 4,734 sf Storage= 5,847 cf
Flood Elev= 326.50' Surf.Area= 6,410 sf Storage= 9,831 cf

Plug-Flow detention time= 56.1 min calculated for 0.567 af (95% of inflow)
Center-of-Mass det. time= 29.9 min (816.9 - 786.9)

Volume	Invert	Avail.Storage	Storage Description
#1	324.00'	9,831 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
324.00	1,662	0	0
324.50	2,342	1,001	1,001
325.00	3,867	1,552	2,553
325.50	4,388	2,064	4,617
326.00	5,029	2,354	6,971
326.50	6,410	2,860	9,831

Device	Routing	Invert	Outlet Devices
#1	Primary	325.75'	**10.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74
#2	Discarded	324.00'	**0.270 in/hr Exfiltration over Surface area**
#3	Device 6	324.50'	**6.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Device 6	324.50'	**8.0" Vert. Orifice/Grate** C= 0.600
#5	Device 6	325.75'	**1.5" Horiz. Orifice/Grate X 36.00** Limited to weir flow C= 0.600
#6	Primary	324.00'	**12.0" x 20.0' long Culvert** CPP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 323.00' S= 0.0500 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior

Discarded OutFlow Max=0.03 cfs @ 12.25 hrs HW=325.77' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=3.72 cfs @ 12.25 hrs HW=325.77' (Free Discharge)
├**1=Broad-Crested Rectangular Weir** (Weir Controls 0.07 cfs @ 0.34 fps)
└**6=Culvert** (Passes 3.66 cfs of 4.26 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 1.91 cfs @ 4.86 fps)
  ├**4=Orifice/Grate** (Orifice Controls 1.63 cfs @ 4.66 fps)
  └**5=Orifice/Grate** (Weir Controls 0.12 cfs @ 0.45 fps)

Summary for Pond SUM: Total Runoff

Inflow Area = 5.160 ac, 38.88% Impervious, Inflow Depth > 3.34" for 25 Year Storm event
Inflow = 13.68 cfs @ 12.12 hrs, Volume= 1.435 af
Primary = 13.68 cfs @ 12.12 hrs, Volume= 1.435 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond WetSum: Wetlands - Post

Inflow Area = 4.216 ac, 34.44% Impervious, Inflow Depth > 3.19" for 25 Year Storm event
Inflow = 10.39 cfs @ 12.16 hrs, Volume= 1.122 af
Primary = 10.39 cfs @ 12.16 hrs, Volume= 1.122 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

100-YEAR STORM EVENT

Post-Development

Ponds Only

Summary for Pond Forebay: Forebay

Inflow Area = 1.288 ac, 81.38% Impervious, Inflow Depth > 5.73" for 100 Year Storm event
Inflow = 7.84 cfs @ 12.08 hrs, Volume= 0.615 af
Outflow = 7.86 cfs @ 12.08 hrs, Volume= 0.607 af, Atten= 0%, Lag= 0.3 min
Primary = 7.86 cfs @ 12.08 hrs, Volume= 0.607 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 324.63' @ 12.08 hrs Surf.Area= 535 sf Storage= 487 cf

Plug-Flow detention time= 17.0 min calculated for 0.607 af (99% of inflow)
Center-of-Mass det. time= 7.9 min (773.4 - 765.5)

Volume	Invert	Avail.Storage	Storage Description
#1	323.00'	710 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
323.00	125	0	0
324.00	315	220	220
324.50	485	200	420
325.00	675	290	710

Device	Routing	Invert	Outlet Devices
#1	Primary	324.40'	**30.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=7.60 cfs @ 12.08 hrs HW=324.63' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 7.60 cfs @ 1.12 fps)

Summary for Pond Main: Main Street - Post

Inflow Area = 0.856 ac, 64.73% Impervious, Inflow Depth > 5.29" for 100 Year Storm event
Inflow = 4.97 cfs @ 12.07 hrs, Volume= 0.377 af
Primary = 4.97 cfs @ 12.07 hrs, Volume= 0.377 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond Pond1: Pond 1

Inflow Area = 1.713 ac, 68.02% Impervious, Inflow Depth > 5.33" for 100 Year Storm event
Inflow = 9.91 cfs @ 12.08 hrs, Volume= 0.760 af
Outflow = 6.42 cfs @ 12.18 hrs, Volume= 0.732 af, Atten= 35%, Lag= 6.1 min
Discarded = 0.03 cfs @ 12.18 hrs, Volume= 0.027 af
Primary = 6.39 cfs @ 12.18 hrs, Volume= 0.705 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Peak Elev= 325.93' @ 12.18 hrs Surf.Area= 4,940 sf Storage= 6,625 cf
Flood Elev= 326.50' Surf.Area= 6,410 sf Storage= 9,831 cf

Plug-Flow detention time= 49.3 min calculated for 0.732 af (96% of inflow)
Center-of-Mass det. time= 27.5 min (807.9 - 780.4)

Volume	Invert	Avail.Storage	Storage Description
#1	324.00'	9,831 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
324.00	1,662	0	0
324.50	2,342	1,001	1,001
325.00	3,867	1,552	2,553
325.50	4,388	2,064	4,617
326.00	5,029	2,354	6,971
326.50	6,410	2,860	9,831

Device	Routing	Invert	Outlet Devices
#1	Primary	325.75'	**10.0' long x 8.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74
#2	Discarded	324.00'	**0.270 in/hr Exfiltration over Surface area**
#3	Device 6	324.50'	**6.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Device 6	324.50'	**8.0" Vert. Orifice/Grate** C= 0.600
#5	Device 6	325.75'	**1.5" Horiz. Orifice/Grate X 36.00** Limited to weir flow C= 0.600
#6	Primary	324.00'	**12.0" x 20.0' long Culvert** CPP, end-section conforming to fill, Ke= 0.500 Outlet Invert= 323.00' S= 0.0500 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior

Discarded OutFlow Max=0.03 cfs @ 12.18 hrs HW=325.93' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=6.31 cfs @ 12.18 hrs HW=325.93' (Free Discharge)
├**1=Broad-Crested Rectangular Weir** (Weir Controls 1.79 cfs @ 1.02 fps)
└**6=Culvert** (Inlet Controls 4.52 cfs @ 5.75 fps)
  ├**3=Orifice/Grate** (Passes < 2.05 cfs potential flow)
  ├**4=Orifice/Grate** (Passes < 1.76 cfs potential flow)
  └**5=Orifice/Grate** (Passes < 0.89 cfs potential flow)

Summary for Pond SUM: Total Runoff

Inflow Area = 5.160 ac, 38.88% Impervious, Inflow Depth > 4.42" for 100 Year Storm event
Inflow = 19.56 cfs @ 12.15 hrs, Volume= 1.903 af
Primary = 19.56 cfs @ 12.15 hrs, Volume= 1.903 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

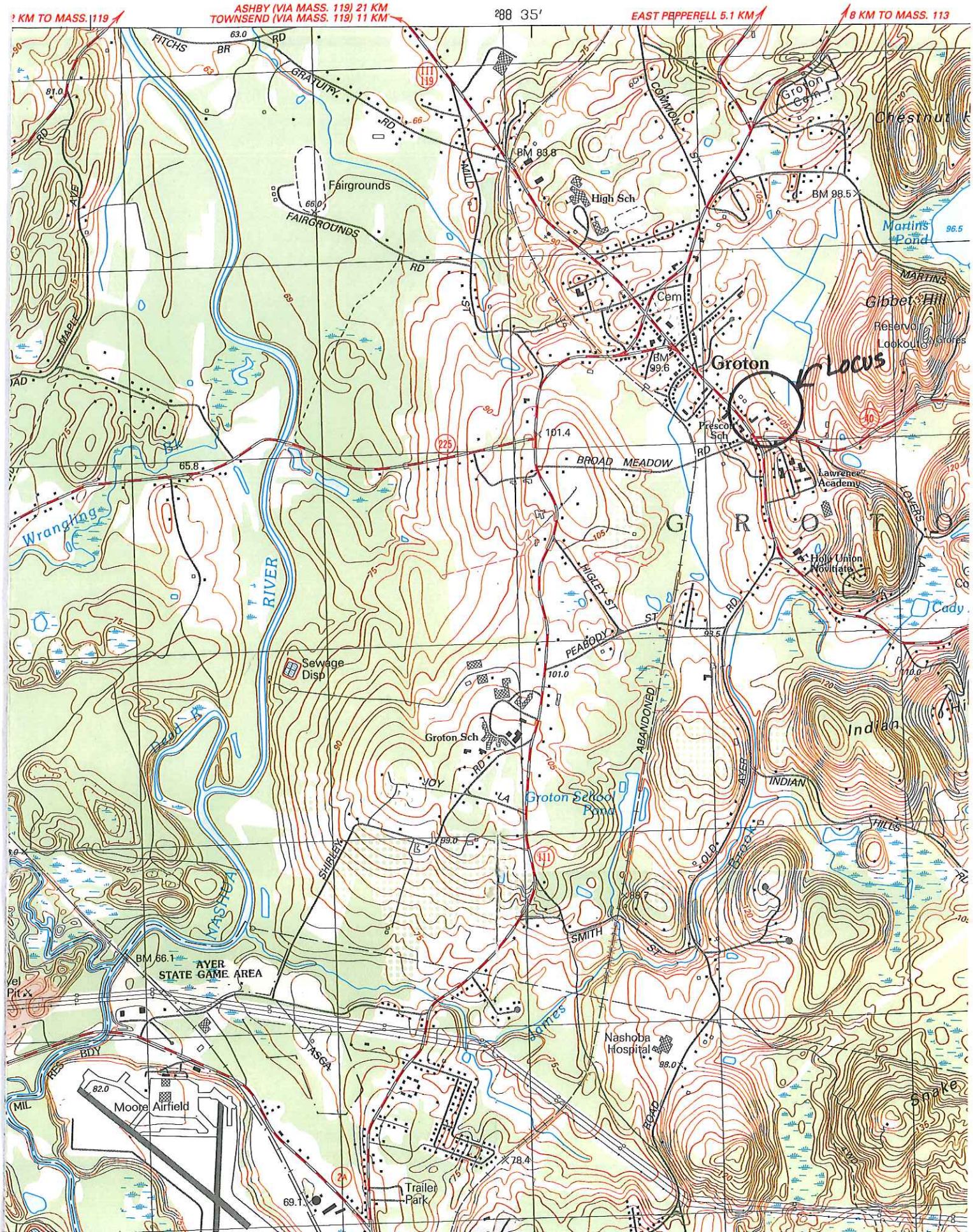
Summary for Pond WetSum: Wetlands - Post

Inflow Area = 4.216 ac, 34.44% Impervious, Inflow Depth > 4.27" for 100 Year Storm event
Inflow = 15.91 cfs @ 12.16 hrs, Volume= 1.499 af
Primary = 15.91 cfs @ 12.16 hrs, Volume= 1.499 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

APPENDIX A

USGS Locus Map
SCS Soils Map
Soil Testing Logs


KM TO MASS. 119
ASHBY (VIA MASS. 119) 21 KM
TOWNSEND (VIA MASS. 119) 11 KM
88 35'
EAST PEPPERELL 5.1 KM
8 KM TO MASS. 113
FITCHS BR RD
GRATUITY RD
Fairgrounds
FAIRGROUNDS RD
MAPLE AVE
MILL ST
COMMON ST
Groton Cem
BM 83.8
High Sch
BM 98.5
Martins Pond
MARTINS
Gibbet Hill
Reservoir
Lookout Tower
Cem
BM 99.6
Groton
Locus
Prescott Sch
101.4
BROAD MEADOW RD
Lawrence Academy
LOVERS
Holy Union Novitiate
Wrangling
NASHUA RIVER
HIGLEY ST
PEABODY ST
Sewage Disp
Groton Sch
JOY LA
Groton School Pond
ABANDONED
Indian
INDIAN HILLS
AYER
SHIRLEY
OLD
SMITH ST
BM 66.1
AYER STATE GAME AREA
Nashoba Hospital
HOSPITAL ROAD
Moore Airfield
RES BDY
MIL
Trailer Park
69.1
78.4
Snake

Hydrologic Soil Group—Middlesex County, Massachusetts
(128 MAIN STREET - GROTON)

MAP LEGEND

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

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
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: Middlesex County, Massachusetts
Survey Area Data: Version 13, Dec 17, 2013

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

Date(s) aerial images were photographed: Mar 30, 2011—May 1, 2011

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Middlesex County, Massachusetts (MA017)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
52A	Freetown muck, 0 to 1 percent slopes	A/D	1.8	12.4%
330B	Bernardston very fine sandy loam, 3 to 8 percent slopes	C	12.4	87.6%
Totals for Area of Interest			**14.2**	**100.0%**

Description

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

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

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

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

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

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

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

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

JOB #29228

128 Main St., LLC
Owner Name

128 Main Street
Street Address

113/10
Map/Lot #

Groton
City

MA
State

01450
Zip Code

B. Site Information

1. (Check one) ☒ TESTING FOR STORMWATER DESIGN ☐ New Construction ☐ Upgrade ☐ Repair

2. Published Soil Survey Available? ☒ Yes ☐ No If yes: Web Soil Survey (Year Published) ____ (Publication Scale) 330B (Soil Map Unit)

Bernardston Very Fine Sandy Loam
Soil Name

slow permeability
Soil Limitations

3. Surficial Geological Report Available? ☐ Yes ☐ No If yes: ____ (Year Published) ____ (Publication Scale) ____ (Map Unit)

Geologic Material

Landform

4. Flood Rate Insurance Map # 25017C0202E

Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☐ Yes ☒ No

Within the 500-year flood boundary? ☐ Yes ☒ No Within a velocity zone? ☐ Yes ☒ No

5. Wetland Area: National Wetland Inventory Map ____ (Map Unit) ____ (Name)

Wetlands Conservancy Program Map ____ (Map Unit) ____ (Name)

6. Current Water Resource Conditions (USGS): Dec/2013 (Month/Year) Range: ☐ Above Normal ☐ Normal ☒ Below Normal

7. Other references reviewed:

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserved disposal area)*

Deep Observation Hole Number: 1213-1 | 12/18/13 (Date) | 9 AM (Time) | Cloudy 20's (Weather)

1. Location

   Ground Elevation at Surface of Hole: _____ Location (identify on plan): Northwest of Building III

2. Land Use: field (e.g., woodland, agricultural field, vacant lot, etc.) | none (Surface Stones) | 3-8 (Slope (%))

   field grass (Vegetation) | ground moraine (Landform) | shoulder (Position on Landscape (attach sheet))

3. Distances from: Open Water Body _____ feet | Drainage Way _____ feet | Possible Wet Area 120' feet

   Property Line 135' feet | Drinking Water Well _____ feet | Other _____ feet

4. Parent Material: glacial till Unsuitable Materials Present: ☒ Yes ☐ No

   If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

   Estimated Depth to High Groundwater: 103 inches _____ elevation

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: 1213-1

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-88	HTM	-	-	-	-	-	-	-	-	-	fill & trash
88-118	C1	10YR 5/4	103	10YR5/6	>5	Gr. S	35	-	loose	granular	
118-150	C2	2.5Y 4/4				FSL	5	2	massive	friable	No Obs. G.W.
No	Refusal										

Additional Notes:

Commonwealth of Massachusetts
City/Town of Groton
Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: 1213-2 | 12/18/13 (Date) | 9 AM (Time) | Cloudy 20's (Weather)

1. Location

Ground Elevation at Surface of Hole: _____ Location (identify on plan): North of Building III

2. Land Use: woods (e.g., woodland, agricultural field, vacant lot, etc.) | few (Surface Stones) | 10-15 (Slope (%))

Vegetation | ground moraine (Landform) | Position on Landscape (attach sheet)

3. Distances from: Open Water Body _____ feet | Drainage Way _____ feet | Possible Wet Area 100 feet

Property Line 150 feet | Drinking Water Well _____ feet | Other _____ feet

4. Parent Material: glacial till | Unsuitable Materials Present: ☒ Yes ☐ No

If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No | If yes: 90 Depth Weeping from Pit | _____ Depth Standing Water in Hole

Estimated Depth to High Groundwater: 62 inches _____ elevation

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: 1213-2

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-30	HTM	-	-	-	-	-	-	-	-	-	disturbed
30-46	Ab	10YR 3/1	-	-	-	Sandy Loam	-	-	massive	friable	
46-54	Bw	10YR 5/4	-	-	-	Sandy Loam	-	-	massive	friable	
54-120	C	2.5Y 5/4	62	10YR 5/8	>5	FSL	2	2	massive	friable	Damp @ 90"
No	Refusal										

Additional Notes:

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:

	A.	B.
☐ Depth observed standing water in observation hole	A. _____ inches	B. _____ inches
☐ Depth weeping from side of observation hole	A. _____ inches	B. _____ inches
☒ Depth to soil redoximorphic features (mottles)	A. 103 inches	B. 62 inches
☐ Groundwater adjustment (USGS methodology)	A. _____ inches	B. _____ inches

2. _____ Index Well Number _____ Reading Date _____ Index Well Level

_____ Adjustment Factor _____ Adjusted Groundwater Level

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

   ☐ Yes N/A ☐ No NO PERCOLATION TESTS PERFORMED

   b. If yes, at what depth was it observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserved disposal area)*

Deep Observation Hole Number: 1213-3 | 12/18/13 (Date) | 9 AM (Time) | Cloudy 20's (Weather)

1. Location

   Ground Elevation at Surface of Hole: _____ Location (identify on plan): West of Building III near property line

2. Land Use: woods (e.g., woodland, agricultural field, vacant lot, etc.) | none (Surface Stones) | 10-15 (Slope (%))

   _____ (Vegetation) | ground moraine (Landform) | _____ (Position on Landscape (attach sheet))

3. Distances from: Open Water Body _____ feet | Drainage Way _____ feet | Possible Wet Area 120' feet

   Property Line 20 feet | Drinking Water Well _____ feet | Other _____ feet

4. Parent Material: glacial till Unsuitable Materials Present: ☒ Yes ☐ No

   If Yes: ☒ Disturbed Soil ☒ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ (Depth Weeping from Pit) _____ (Depth Standing Water in Hole)

   Estimated Depth to High Groundwater: 60 inches _____ elevation

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: 1213-3

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-40	HTM	-	-	-	-	-	-	-	-	-	disturbed
40-50	Bb	10YR 5/4	-	-	-	SL	-	-	massive	friable	
50-120	C	2.5Y 4/4	60"	10YR5/6	>5	SL	10	5	massive	friable	No Obs. G.W.
No	Refusal										

Additional Notes:

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: 1213-4 | 12/18/13 (Date) | 9 AM (Time) | Cloudy 20's (Weather)

1. Location

Ground Elevation at Surface of Hole: _____ Location (identify on plan): East of former inn

2. Land Use: lawn (e.g., woodland, agricultural field, vacant lot, etc.) | none (Surface Stones) | 0-3 (Slope (%))

grass (Vegetation) | ground moraine (Landform) | _____ (Position on Landscape (attach sheet))

3. Distances from: Open Water Body _____ feet | Drainage Way _____ feet | Possible Wet Area >200' feet

Property Line 75 feet | Drinking Water Well _____ feet | Other _____ feet

4. Parent Material: glacial till Unsuitable Materials Present: ☒ Yes ☐ No

If Yes: ☒ Disturbed Soil ☒ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Estimated Depth to High Groundwater: 40" inches _____ elevation

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: 1213-4

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-16	HTM	-	-	-	-	-	-	-	-	-	disturbed
16-19	Ab	10YR 3/1	-	-	-	SL	-	-	massive	friable	
19-30	Bw	10YR 5/6	-	-	-	SL	-	-	massive	friable	
30-120	C	2.5Y 5/4	40	10YR 5/6	>5	FSL	2	2	massive	friable	No Obs. G.W.
No	Refusal										

Additional Notes:

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:

	A.	B.
☐ Depth observed standing water in observation hole	A. ____ inches	B. ____ inches
☐ Depth weeping from side of observation hole	A. ____ inches	B. ____ inches
☒ Depth to soil redoximorphic features (mottles)	A. 60 inches	B. 40 inches
☐ Groundwater adjustment (USGS methodology)	A. ____ inches	B. ____ inches

2. ____ Index Well Number ____ Reading Date ____ Index Well Level

____ Adjustment Factor ____ Adjusted Groundwater Level

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material
   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?
      ☐ Yes N/A ☐ No NO PERCOLATION TESTS PERFORMED
   b. If yes, at what depth was it observed? Upper boundary: ____ inches Lower boundary: ____ inches

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserved disposal area)*

Deep Observation Hole Number: 1213-5 | 12/18/13 (Date) | 9 AM (Time) | Cloudy 20's (Weather)

1. Location

   Ground Elevation at Surface of Hole: _____ Location (identify on plan): Center front of property

2. Land Use: lawn (e.g., woodland, agricultural field, vacant lot, etc.) | none (Surface Stones) | 0-3 (Slope (%))

   grass (Vegetation) | ground moraine (Landform) | _____ (Position on Landscape (attach sheet))

3. Distances from: Open Water Body _____ feet | Drainage Way _____ feet | Possible Wet Area >250' feet

   Property Line 20 feet | Drinking Water Well _____ feet | Other _____ feet

4. Parent Material: glacial till Unsuitable Materials Present: ☒ Yes ☐ No

   If Yes: ☒ Disturbed Soil ☒ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

   Estimated Depth to High Groundwater: 52 inches _____ elevation

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: 1213-5

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-28	HTM	-	-	-	-	-	-	-	-	-	disturbed
28-32	Ab	10YR 3/1	-	-	-	SL	-	-	massive	friable	
32-52	Bw	10YR 5/6	-	-	-	SL	5	5	massive	friable	
52-106	C	2.5Y 5/4	52	10YR 5/6 10YR 3/2	>5	SL	10	5	massive	friable	No Obs. G.W.
No	Refusal										

Additional Notes:

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: 1213-6 | 12/18/13 (Date) | 9 AM (Time) | Cloudy 20's (Weather)

1. Location

   Ground Elevation at Surface of Hole: _____ Location (identify on plan): NW of Building III

2. Land Use: lawn (e.g., woodland, agricultural field, vacant lot, etc.) | none (Surface Stones) | 0-3 (Slope (%))

   field grass (Vegetation) | ground moraine (Landform) | _____ (Position on Landscape (attach sheet))

3. Distances from: Open Water Body _____ feet | Drainage Way _____ feet | Possible Wet Area 175' feet

   Property Line 150' feet | Drinking Water Well _____ feet | Other _____ feet

4. Parent Material: glacial till Unsuitable Materials Present: ☒ Yes ☐ No

   If Yes: ☒ Disturbed Soil ☒ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

   Estimated Depth to High Groundwater: N/A inches _____ elevation

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: 1213-6

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-72	HTM	-	-	-	-	-	-	-	-	-	Trash/fill
Ask for by	Ira G.	suspected	trash	dump		found: fill,	metal,	plastic,	carpet,	etc.	

Additional Notes:

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:

☐ Depth observed standing water in observation hole	A. _____ inches	B. _____ inches
☐ Depth weeping from side of observation hole	A. _____ inches	B. _____ inches
☒ Depth to soil redoximorphic features (mottles)	A. 52 inches	B. _____ inches
☐ Groundwater adjustment (USGS methodology)	A. _____ inches	B. _____ inches

2. _____ Index Well Number | _____ Reading Date | _____ Index Well Level

_____ Adjustment Factor | _____ Adjusted Groundwater Level

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

   ☐ Yes N/A ☐ No NO PERCOLATION TESTS PERFORMED

   b. If yes, at what depth was it observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Neil Gorman
Signature of Soil Evaluator

1/27/14
Date

Neil Gorman (#SE2954)
Typed or Printed Name of Soil Evaluator / License #

6/28/05
Date of Soil Evaluator Exam

Ira Grossman
Name of Board of Health Witness

Nashoba Associated Boards of Health
Board of Health

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

128 Main St., LLC
Owner Name

128 Main Street | 113/10
Street Address | Map/Lot #

Groton | MA | 01450
City | State | Zip Code

B. Site Information

1. (Check one) ☐ New Construction ☐ Upgrade ☐ Repair

2. Published Soil Survey Available? ☒ Yes ☐ No If yes: Web Soil Survey (Year Published) | (Publication Scale) | 330B (Soil Map Unit)
   Bernardston Very Fine Sandy Loam (Soil Name) | slow permeability (Soil Limitations)

3. Surficial Geological Report Available? ☐ Yes ☐ No If yes: (Year Published) | (Publication Scale) | (Map Unit)
   (Geologic Material) | (Landform)

4. Flood Rate Insurance Map
   Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☐ Yes ☒ No
   Within the 500-year flood boundary? ☐ Yes ☒ No Within a velocity zone? ☐ Yes ☒ No

5. Wetland Area: National Wetland Inventory Map (Map Unit) (Name)
   Wetlands Conservancy Program Map (Map Unit) (Name)

6. Current Water Resource Conditions (USGS): (Month/Year) Range: ☐ Above Normal ☐ Normal ☐ Below Normal

7. Other references reviewed:

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review *(minimum of two holes required at every proposed primary and reserved disposal area)*

Deep Observation Hole Number: 414-2 | 4/3/14 (Date) | 11 AM (Time) | Sunny 50's (Weather)

1. Location

   Ground Elevation at Surface of Hole: 323.0+/- Location (identify on plan): Toe of slope from "fill area"

2. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | none (Surface Stones) | 0-3 (Slope (%))

   woodland and brush (Vegetation) | ground moraine (Landform) | (Position on Landscape (attach sheet))

3. Distances from: Open Water Body ____ feet | Drainage Way ____ feet | Possible Wet Area >75' feet

   Property Line >80 feet | Drinking Water Well ____ feet | Other ____ feet

4. Parent Material: glacial till | Unsuitable Materials Present: ☐ Yes ☒ No

   If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No | If yes: 16" Depth Weeping from Pit | 72" Depth Standing Water in Hole

   Estimated Depth to High Groundwater: 16" inches | 321.67' elevation

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: 414-2

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-8	Ab	10YR 3/1	-	-	-	SL	-	-	massive	friable	
8-15	Bw	10YR 5/6	-	-	-	SL	5	5	massive	friable	
15-72	C	2.5Y 5/4	16"	10YR 5/6 10YR 3/2	>5	SL	5	10	massive	friable	GW at Bot.
No	Refusal										

Additional Notes:

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

D. Determination of High Groundwater Elevation

1. Method Used:

	A.	B.
☐ Depth observed standing water in observation hole	A. _____ inches	B. _____ inches
☒ Depth weeping from side of observation hole	A. 16 inches	B. _____ inches
☒ Depth to soil redoximorphic features (mottles)	A. 16 inches	B. _____ inches
☐ Groundwater adjustment (USGS methodology)	A. _____ inches	B. _____ inches

2. _____ Index Well Number _____ Reading Date _____ Index Well Level

_____ Adjustment Factor _____ Adjusted Groundwater Level

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material
   a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?
      ☐ Yes ☐ No
   b. If yes, at what depth was it observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Groton

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Signature of Soil Evaluator	4/21/14 Date
Jesse Johnson, P.E. (#SE2826) Typed or Printed Name of Soil Evaluator / License #	11/13/03 Date of Soil Evaluator Exam
Ira Grossman Name of Board of Health Witness	Nashoba Associated Boards of Health Board of Health

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

APPENDIX B

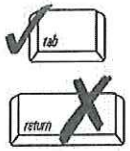
Stormwater Checklist
TSS Removal Calculations Worksheets
Operation and Maintenance Plan

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 4/21/14

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): Roof Recharge Trenches under eaves

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.

INSTRUCTIONS:
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.

Version 1, Automated: Mar. 4, 2008

Location: Outfall Discharging toward Wetlands

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**
Infiltration Basin	**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: **128 Main Street, LLC**
Prepared By: **JESSE JOHNSON, P.E.**
Date: **4/21/2014**

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

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

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:
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.

Version 1, Automated: Mar. 4, 2008

Location: Pipe Discharging into Town System

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
Oil Grit Separator	0.25	0.75	0.19	0.56
	0.00	0.56	0.00	0.56
	0.00	0.56	0.00	0.56
	0.00	0.56	0.00	0.56

Total TSS Removal = 44%

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

Project: 128 Main Street, LLC
Prepared By: JESSE JOHNSON, P.E.
Date: 4/21/2014

*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

128 MAIN STREET, LLC
128 MAIN STREET
GROTON, MASSACHUSETTS

STORMWATER COLLECTION AND TREATMENT SYSTEM

OPERATION AND MAINTENANCE PLAN
APRIL, 2014

This Operation and Maintenance Plan outlines the efforts necessary to ensure that the stormwater collection and treatment system of this site operates in accordance with Massachusetts Department of Environmental Protection Stormwater Management policy. In the event that the system performance becomes inadequate, adjustments in the Plan may become necessary to improve the performance.

It is noted that the following restrictions on the use of this property are recommended, for the protection of groundwater and sensitive environmental receptors:

Use of salt on paved areas is to be minimized. Under any conditions where sand or other non-toxic materials are suitable, they are to be used.

Use of pesticides, herbicides and fertilizers are to be restricted and/or eliminated.

1. Long Term Pollution Prevention Plan.

In accordance with DEP Stormwater Standards, the development and implementation of suitable practices for source control and pollution prevention shall be incorporated in a Long Term Pollution Prevention Plan (LTPPP). The primary focus of the LTPPP is to establish procedures and controls for limiting the potential sources of pollutants, including nutrients that may contribute to excessive contaminant levels in the site's stormwater runoff. To this end the following sources controls and procedures will be in place at the site:

- **Good House Keeping** – It shall be the responsibility of the property owner to keep the site clean at all times. Refuse disposal and pickup shall occur on a regular basis and all material shall be disposed of in designated locations.
- **Storing Material and waste products inside or under cover** – No material storage is to take place outside at the facility on either paved or lawn areas. All materials stored on-site will conform with all storage requirements of local, state, and federal agencies.
- **Vehicle washing** – Vehicle washing in not allowed to take place on the premises. Rinsing with a hose is allowed on impervious surfaces.
- **Routine inspections and maintenance of stormwater BMP's** – Refer to the Operation & Maintenance procedures for each BMP as described herein and on the O&M plan.
- **Spill Prevention and Response** – A spill recovery kit shall be readily accessible at the facility at all times. Contact information for an emergency cleanup vendor

shall be visible and apparent at the facility. All employees shall be briefed on clean-up response and procedures.

- **Maintenance of lawns and other landscaped areas** – All landscaping and maintenance shall be performed by an authorized company chosen by the property owner.
- **Storage and use of fertilizers, herbicides and pesticides** – All landscape maintenance will be conducted by an authorized company chosen by the property owner. Any application of herbicides or pesticides will be applied by a licensed applicator.
- **Proper management of deicing chemicals and snow** – Deicing chemicals and snow removal shall primarily be the responsibility of the property owner. Snow storage shall primarily be on paved surfaces. Any excess snow is to be trucked offiste. Snow is to be stored such that snowmelt is controlled. The minimum amount of deicing chemicals needed is to be used. Avoid disposing of snow on top of storm drain catch basins or in stormwater detention basins.
- **Nutrient management plan** – The goal of the nutrient management plan is to minimize the potential sources of excess nutrients on the site and the release of nutrients in the stormwater from the site. This minimization relates both to infiltrated water and runoff. In general, the nature of the site sue will tend to reduce nutrients in the stormwater. Further, procedures indicated above or in the O&M Plan will act to reduce the levels of nutrients in the stormwater and the nutrients entering the adjacent wetland and the groundwater.

2. Inspection.

It is necessary that the components which contribute to drainage, collection. treatment, storage and discharge of stormwater be regularly, routinely inspected to verify that conditions are suitable for its operation. Inspection of the system should be performed monthly, particularly during the first year of operation, but must take place quarterly at a minimum. As experience determines the frequency of necessary maintenance, inspections may be adjusted to match conditions which increase the necessity of maintenance.

The components requiring inspection, and the criteria required for verification are as follows.

Onsite Drainage Areas: Areas that drain into the collection area from onsite must be inspected to verify that soil surfaces are stable and that erosion of soils into the collection system is not occurring.

Paved Surfaces: Inspect paved surfaces for accumulation of sand, litter, eroded soils or other deleterious materials. Verify that no hazardous materials, such as fuel oil, motor oils or other material has occurred.

Catch Basins/Oil Grit Separator: Inspect catch basins and the water quality inlet to ensure that they are watertight, have adequate sump capacity, oil/gas traps are in place, all frames and grates are free from structural damage and draining freely. Verify that there is no accumulation of oil or gasoline in the structure.

Sediment Forebay and Infiltration Basin. Verify that the floor of the forebay and basin have not accumulated sediment, and that neither erosion of the floor nor walls of the area has occurred. Any time that the infiltration basin retains stormwater greater than 6" in depth and for a period greater than 72 hours (when precipitation is not occurring), the pond should be inspected.

3. Maintenance Activities

When inspection reveals that maintenance is appropriate, the following maintenance activities are necessary:

Onsite Drainage areas. In the event that erosion of onsite soils is occurring, the soils must be stabilized against further erosion. Permanently finish the surface against erosion. By placing stable vegetation such as loam and grass seed, or by armoring the surface against erosion with riprap placed on filter fabric blanket.

Paved Surfaces. Pick up all litter, junk or other material left on the surface. Upon detecting accumulation of sand, sediment or other materials, the paved surface must be swept to remove all such materials. All paved surfaces shall be swept biannually at a minimum. All street sweepings collected must be disposed of in accordance with current Massachusetts Department of Environmental Protection standards for such waste disposal. Any material deposits deemed to be hazardous must be removed and disposed of by a licensed contractor.

Catch Basins/Oil Grit Separators. Upon detecting accumulation of sand, sediment or other materials to a depth greater than 2 feet at any time during the year within the catch basins or Oil Grit Separator, it shall be removed and disposed of offsite in accordance with all local and state regulations. Regardless of the depth of sediment accumulation, catch basins and water quality inlets shall be cleansed at least once per year. Upon detecting accumulation of any oil or gasoline, it shall be removed and disposed of offsite in accordance with all local and state regulations.

Sediment Forebay and Infiltration Basin. Once constructed, the structures should be inspected after several storm events to confirm drainage system functions, bank stability, and vegetation growth. Any problem should be addressed immediately. The structures should be inspected once per year to ensure that they are operating as designed. At least twice during the growing season, side slopes and embankment should be mowed. And accumulated trash and debris should be removed. Sediment should be removed as necessary, and at least once every five years.

4. Record keeping.

It is necessary that a record of each inspection and maintenance activity be kept.
Such information should include the following:

Person performing the activity
The date of the activity, and the weather conditions
The preceding weather conditions
The site conditions (dry, heavy snow cover, saturated conditions, etc.)

The specific activity (inspection, cleaning, etc)
The facility inspected
The conditions of the facility
The results of the activity

The records should be utilized to determine what frequency of inspection and maintenance is appropriate for the system, and what times of year such activities may be needed more frequently. Any activity performed subsequent to a major storm event or prolonged weather episode should be noted so that system performance may be evaluated in association with prevailing conditions.

5. Ownership and operation responsibilities

Responsibility for the proper operation and maintenance of this system including financial responsibilities accordance with this Operation and Maintenance Plan and with the requirements of the Town of Groton and the Massachusetts Department of Environmental Protection are that of 128 Main Street, LLC., who shall own the system in its entirety.

OPERATION AND MAINTENANCE LOG FORM
39 Great Road – Shirley, MA.

Date of Inspection: **Circle Yes or No**

Weather Conditions

Inspection 1.	Paved Surfaces:	
	Evidence of litter	Yes / No
	Evidence of sand	Yes / No
	Evidence of eroded soil	Yes / No
	Evidence of hazardous materials	Yes / No
	Curbing intact and aligned	Yes / No
Inspection 2.	Catch Basins:	
	Evidence of litter	Yes / No
	Evidence of accumulation of solids in sump	Yes / No
	Evidence of oil or gasoline	Yes / No
	Oil/Gas trap intact	Yes / No
	Structural damage	Yes / No
Inspection 3.	Water Quality Inlet:	
	Evidence of accumulation of solids in chambers	Yes / No
	Evidence of oil or gasoline	Yes / No
	Structural damage	Yes / No
Inspection 4.	Pipe Outfalls (FES):	
	Evidence of erosion	Yes / No
	Excessive silt accumulating	Yes / No
	Evidence of vegetation accumulation	Yes / No
Inspection 5.	Sediment Forebay/Infiltration Basin:	
	Evidence of erosion of side slopes	Yes / No
	Excessive silt accumulating in bottom	Yes / No
	Evidence of water retention at surface	Yes / No
	Trash or debris in basin	Yes / No
	Trash or debris in wick	Yes / No
	Evidence of vegetation dying	Yes / No
	Evidence of erosion of overflow berm/weir	Yes / No
Inspection 6.	Outlet Structures/Manholes:	
	Evidence of litter	Yes / No
	Evidence of accumulation of solids in sump	Yes / No
	Evidence of oil or gasoline	Yes / No
	Structural damage	Yes / No

If any above the above inspections yield a YES, a complete description of the problem and the corrective action taken must be documented below.

Signature of Inspector: _____

APPENDIX C

Pipe Velocity Calculations

Mounding Analysis

CB 8 TO DMH 4
Worksheet for Circular Channel

Project Description	
Worksheet	128 MAIN STREET
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	8	in
Discharge	0.39	cfs

Results		
Depth	0.26	ft
Flow Area	0.1	ft²
Wetted Perime	0.90	ft
Top Width	0.65	ft
Critical Depth	0.29	ft
Percent Full	39.1	%
Critical Slope	0.006716	ft/ft
Velocity	3.09	ft/s
Velocity Head	0.15	ft
Specific Energ	0.41	ft
Froude Numbe	1.23	
Maximum Disc	1.30	cfs
Discharge Full	1.21	cfs
Slope Full	0.001042	ft/ft
Flow Type	Supercritical	

David E. Ross Associates Inc
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CB 4 TO DMH 3
Worksheet for Circular Channel

Project Description	
Worksheet	128 MAIN STREET
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	12	in
Discharge	0.43	cfs

Results		
Depth	0.23	ft
Flow Area	0.1	ft²
Wetted Perime	1.01	ft
Top Width	0.85	ft
Critical Depth	0.27	ft
Percent Full	23.5	%
Critical Slope	0.005644	ft/ft
Velocity	3.06	ft/s
Velocity Head	0.15	ft
Specific Energ	0.38	ft
Froude Numbe	1.33	
Maximum Disc	3.83	cfs
Discharge Full	3.56	cfs
Slope Full	0.000146	ft/ft
Flow Type	Supercritical	

CB 3 TO DMH 3
Worksheet for Circular Channel

Project Description	
Worksheet	128 MAIN STREET
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	12	in
Discharge	0.48	cfs

Results		
Depth	0.25	ft
Flow Area	0.2	ft²
Wetted Perime	1.04	ft
Top Width	0.86	ft
Critical Depth	0.29	ft
Percent Full	24.8	%
Critical Slope	0.005598	ft/ft
Velocity	3.16	ft/s
Velocity Head	0.16	ft
Specific Energ	0.40	ft
Froude Numbe	1.33	
Maximum Disc	3.83	cfs
Discharge Full	3.56	cfs
Slope Full	0.000182	ft/ft
Flow Type	Supercritical	

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DMH 3 TO DMH 2
Worksheet for Circular Channel

Project Description	
Worksheet	128 MAIN STREET
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	12	in
Discharge	1.30	cfs

Results		
Depth	0.42	ft
Flow Area	0.3	ft²
Wetted Perime	1.41	ft
Top Width	0.99	ft
Critical Depth	0.48	ft
Percent Full	41.8	%
Critical Slope	0.006052	ft/ft
Velocity	4.18	ft/s
Velocity Head	0.27	ft
Specific Energ	0.69	ft
Froude Numbe	1.31	
Maximum Disc	3.83	cfs
Discharge Full	3.56	cfs
Slope Full	0.001332	ft/ft
Flow Type	Supercritical	

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CB 1 TO DMH 2
Worksheet for Circular Channel

Project Description	
Worksheet	128 MAIN STREET
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	12	in
Discharge	0.15	cfs

Results		
Depth	0.14	ft
Flow Area	0.1	ft²
Wetted Perime	0.77	ft
Top Width	0.69	ft
Critical Depth	0.16	ft
Percent Full	14.0	%
Critical Slope	0.005981	ft/ft
Velocity	2.25	ft/s
Velocity Head	0.08	ft
Specific Energ	0.22	ft
Froude Numbe	1.28	
Maximum Disc	3.83	cfs
Discharge Full	3.56	cfs
Slope Full	0.000018	ft/ft
Flow Type	Supercritical	

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DMH 2 TO DMH 1
Worksheet for Circular Channel

Project Description	
Worksheet	128 MAIN STREET
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.013	
Slope	083000	ft/ft
Diameter	12	in
Discharge	1.45	cfs

Results		
Depth	0.25	ft
Flow Area	0.2	ft²
Wetted Perime	1.06	ft
Top Width	0.87	ft
Critical Depth	0.51	ft
Percent Full	25.4	%
Critical Slope	0.006194	ft/ft
Velocity	9.24	ft/s
Velocity Head	1.33	ft
Specific Energ	1.58	ft
Froude Numbe	3.84	
Maximum Disc	11.04	cfs
Discharge Full	10.26	cfs
Slope Full	0.001657	ft/ft
Flow Type	Supercritical	

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DMH 1 TO EXISTING
Worksheet for Circular Channel

Project Description	
Worksheet	128 MAIN STREET
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	12	in
Discharge	1.82	cfs

Results		
Depth	0.51	ft
Flow Area	0.4	ft²
Wetted Perime	1.58	ft
Top Width	1.00	ft
Critical Depth	0.57	ft
Percent Full	50.6	%
Critical Slope	0.006616	ft/ft
Velocity	4.56	ft/s
Velocity Head	0.32	ft
Specific Energ	0.83	ft
Froude Numbe	1.27	
Maximum Disc	3.83	cfs
Discharge Full	3.56	cfs
Slope Full	0.002610	ft/ft
Flow Type	Supercritical	

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CB 2 TO DMH 1
Worksheet for Circular Channel

Project Description	
Worksheet	128 MAIN STREET
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	12	in
Discharge	0.13	cfs

Results		
Depth	0.13	ft
Flow Area	0.1	ft²
Wetted Perime	0.74	ft
Top Width	0.67	ft
Critical Depth	0.15	ft
Percent Full	13.1	%
Critical Slope	0.006070	ft/ft
Velocity	2.15	ft/s
Velocity Head	0.07	ft
Specific Energ	0.20	ft
Froude Numbe	1.27	
Maximum Disc	3.83	cfs
Discharge Full	3.56	cfs
Slope Full	0.000013	ft/ft
Flow Type	Supercritical	

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CB 8 TO DMH 5
Worksheet for Circular Channel

Project Description	
Worksheet	128 MAIN STREET
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	12	in
Discharge	1.12	cfs

Results		
Depth	0.39	ft
Flow Area	0.3	ft²
Wetted Perime	1.34	ft
Top Width	0.97	ft
Critical Depth	0.45	ft
Percent Full	38.5	%
Critical Slope	0.005896	ft/ft
Velocity	4.02	ft/s
Velocity Head	0.25	ft
Specific Energ	0.64	ft
Froude Numbe	1.32	
Maximum Disc	3.83	cfs
Discharge Full	3.56	cfs
Slope Full	0.000988	ft/ft
Flow Type	Supercritical	

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DMH 5 TO DMH 6
Worksheet for Circular Channel

Project Description	
Worksheet	128 MAIN STREET
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	12	in
Discharge	1.62	cfs

Results		
Depth	0.47	ft
Flow Area	0.4	ft²
Wetted Perime	1.52	ft
Top Width	1.00	ft
Critical Depth	0.54	ft
Percent Full	47.3	%
Critical Slope	0.006375	ft/ft
Velocity	4.43	ft/s
Velocity Head	0.30	ft
Specific Energ	0.78	ft
Froude Numbe	1.29	
Maximum Disc	3.83	cfs
Discharge Full	3.56	cfs
Slope Full	0.002068	ft/ft
Flow Type	Supercritical	

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CB 7 TO DMH 6
Worksheet for Circular Channel

Project Description	
Worksheet	128 MAIN STREET
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	12	in
Discharge	0.44	cfs

Results		
Depth	0.24	ft
Flow Area	0.1	ft²
Wetted Perime	1.02	ft
Top Width	0.85	ft
Critical Depth	0.27	ft
Percent Full	23.7	%
Critical Slope	0.005612	ft/ft
Velocity	3.08	ft/s
Velocity Head	0.15	ft
Specific Energ	0.39	ft
Froude Numbe	1.33	
Maximum Disc	3.83	cfs
Discharge Full	3.56	cfs
Slope Full	0.000153	ft/ft
Flow Type	Supercritical	

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CB 9 TO DMH 6
Worksheet for Circular Channel

Project Description	
Worksheet	128 MAIN STREET
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	12	in
Discharge	0.69	cfs

Results		
Depth	0.30	ft
Flow Area	0.2	ft²
Wetted Perime	1.16	ft
Top Width	0.92	ft
Critical Depth	0.35	ft
Percent Full	29.8	%
Critical Slope	0.005645	ft/ft
Velocity	3.51	ft/s
Velocity Head	0.19	ft
Specific Energ	0.49	ft
Froude Numbe	1.33	
Maximum Disc	3.83	cfs
Discharge Full	3.56	cfs
Slope Full	0.000375	ft/ft
Flow Type	Supercritical	

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DMH 6 TO DMH 7
Worksheet for Circular Channel

Project Description	
Worksheet	128 MAIN STREET
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	12	in
Discharge	2.75	cfs

Results		
Depth	0.66	ft
Flow Area	0.5	ft²
Wetted Perime	1.90	ft
Top Width	0.95	ft
Critical Depth	0.71	ft
Percent Full	65.9	%
Critical Slope	0.008166	ft/ft
Velocity	5.01	ft/s
Velocity Head	0.39	ft
Specific Energ	1.05	ft
Froude Numbe	1.16	
Maximum Disc	3.83	cfs
Discharge Full	3.56	cfs
Slope Full	0.005958	ft/ft
Flow Type	Supercritical	

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CB 6 TO DMH 7
Worksheet for Circular Channel

Project Description	
Worksheet	128 MAIN STREET
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	12	in
Discharge	0.72	cfs

Results		
Depth	0.30	ft
Flow Area	0.2	ft²
Wetted Perime	1.17	ft
Top Width	0.92	ft
Critical Depth	0.35	ft
Percent Full	30.5	%
Critical Slope	0.005656	ft/ft
Velocity	3.55	ft/s
Velocity Head	0.20	ft
Specific Energ	0.50	ft
Froude Numbe	1.33	
Maximum Disc	3.83	cfs
Discharge Full	3.56	cfs
Slope Full	0.000408	ft/ft
Flow Type	Supercritical	

DMH 7 TO FES 1
Worksheet for Circular Channel

Project Description	
Worksheet	128 MAIN STREET
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.013	
Slope	010000	ft/ft
Diameter	15	in
Discharge	3.47	cfs

Results		
Depth	0.65	ft
Flow Area	0.6	ft²
Wetted Perime	2.02	ft
Top Width	1.25	ft
Critical Depth	0.75	ft
Percent Full	52.2	%
Critical Slope	0.006350	ft/ft
Velocity	5.36	ft/s
Velocity Head	0.45	ft
Specific Energ	1.10	ft
Froude Numbe	1.31	
Maximum Disc	6.95	cfs
Discharge Full	6.46	cfs
Slope Full	0.002886	ft/ft
Flow Type	Supercritical	

APRIL 2014
"128 MAIN STREET"
GROTON, MASS.
PROJECT NO. 29228

GROUNDWATER MOUNDING CALCULATIONS

Methodology

The Infiltration Basin (Pond 1) for this project is designed with less then 4' of groundwater separation. It is also designed to attenuate the 10-year storm event or larger. Therefore, groundwater mounding calculations were required according to MA DEP Stormwater Management Guidelines. The purpose of the calculations is to ensure that the mound will not prevent the full draining of the basin. The mounding analysis must show that the recharge volume will exfiltrate within 72 hours and that the groundwater will not break out above the land surface or raise the water elevation in a nearby resource area.

The groundwater mounding analysis was performed by a proprietary program using the Hantush Method with Glover's Solution. Input parameters are site specific and determined based on existing and proposed conditions. The required input parameters are the following: application rate; duration of application; fillable porosity; hydraulic conductivity; initial saturated thickness; length of application area; width of application area; and distance to closest resource area.

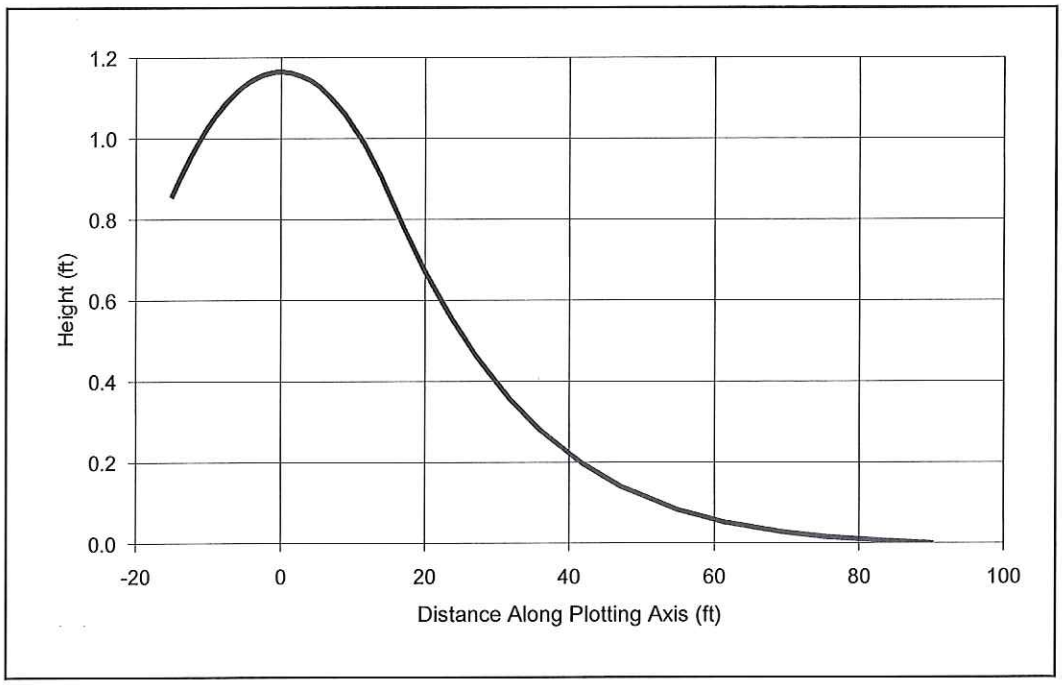
Calculations using the Hantush Method are considered conservative due to the fact that the unsaturated soil zone is not incorporated. In practice, this zone will have a significant positive effect on reducing the groundwater mounding under an infiltration basin by allowing horizontal migration. Our unsaturated zone is at least 2.0 feet for the Infiltration Basin. This means that the mounding must be less then 2.0 feet at the end of 72 hours in order to ensure that stormwater will not bypass the basin floor and exit out an overflow device or breakout the sides of the basin.

The application rate is based on the Rawls Table for the soil type (very fine sandy loam) and converted to a daily rate. The fillable porosity and hydraulic conductivity used for the analysis are based on the existing soil type as well. The initial saturated thickness is based on estimates used for the approved drainage infrastructure at 134 Main Street. The length and width of the application area and the distance to the closest resource are based on the proposed basin size and location. The duration of the application is based on the drawdown time it takes for the storage volume to exfiltrate through the bottom of the basin. The mounding was evaluated for 72 hours as required.

Results

Based on the criteria mentioned above, the analysis (see attached) indicates that a mound of approximately 1.2 feet is possible during the first 30 hours of infiltration. At the end of 72-hours, the mound is under 0.3 feet and will not inhibit the basin from draining fully. Additionally, the mounding effect at 90 feet from the center of the basin is less than 0.1 feet. Given these results, we feel as though the basin will infiltratE the recharge volume within 72 hours as required. It will also have no effect on the water elevation in the nearby wetland.

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: 128 Main Street, LLC

PROJECT: 128 Main Street - Groton

ANALYST: Jesse Johnson

DATE: 4/19/2014 TIME: 2:05:47 PM

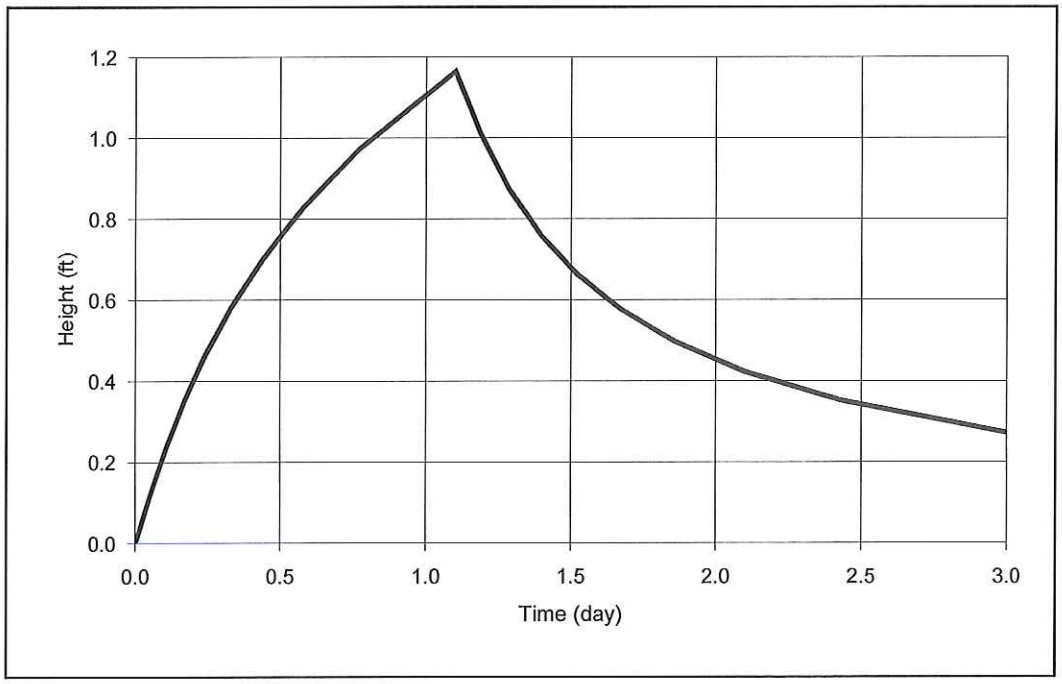
INPUT PARAMETERS

Application rate: 0.54 c.ft/day/sq. ft
Duration of application: 1.1 days
Fillable porosity: 0.23
Hydraulic conductivity: 8 ft/day
Initial saturated thickness: 15 ft
Length of application area: 60 ft
Width of application area: 30 ft
Constant head boundary used at: 90 ft
Plotting axis from Y-Axis: 89 degrees
Edge of recharge area:
positive X: 15 ft
positive Y: 0.3 ft
Total volume applied: 1069.2 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-15	-0.3	-15	0.86
-12.6	-0.2	-13	0.95
-10.2	-0.2	-10	1.02
-7.8	-0.1	-8	1.08
-6	-0.1	-6	1.12
-4.5	-0.1	-5	1.14
-3.3	-0.1	-3	1.15
-2.3	0	-2	1.16
-1.5	0	-1	1.16
-0.9	0	-1	1.16
-0.5	0	0	1.16
0	0	0	1.16
2.8	0	3	1.15
5.2	0.1	5	1.13
8.7	0.2	9	1.06
13.9	0.2	14	0.9
20	0.3	20	0.67
27.1	0.5	27	0.46
35.8	0.6	36	0.28
47.1	0.8	47	0.14
61.4	1.1	61	0.05
75.7	1.3	76	0.02
90	1.6	90	0

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: 128 Main Street, LLC

PROJECT: 128 Main Street - Groton

ANALYST: Jesse Johnson

DATE: 4/19/2014 TIME: 2:06:12 PM

INPUT PARAMETERS

Application rate: 0.54 c.ft/day/sq. ft
Duration of application: 1.1 day
Total simulation time: 3 day
Fillable porosity: 0.23
Hydraulic conductivity: 8 ft/day
Initial saturated thickness: 15 ft
Length of application area: 60 ft
Width of application area: 30 ft
Constant head boundary used at: 90 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 1069.2 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.03
0.1	0.12
0.1	0.24
0.2	0.35
0.2	0.47
0.3	0.58
0.4	0.7
0.6	0.83
0.8	0.97
1.1	1.16
1.1	1.12
1.2	1.01
1.3	0.88
1.4	0.76
1.5	0.66
1.7	0.58
1.9	0.5
2.1	0.42
2.4	0.35
3	0.27

DRAINAGE DELINEATION SKETCHES

Pre-development

Post-development