Hayes Engineering, Inc

603 Salem Street
Wakefield, MA 01880
Tel: (781) 246-2800
Fax: (781) 246-7596

Nantucket, MA 02554
Tel: (508) 228-7909

Refer to File No. **LYF-0934A**

January 29, 2021

Conservation Commission
55 Summer Street
Lynnfield, MA 01940

RE: Stormwater Management Filing
Bali Hai Restaurant – 160 Moulton Drive / 160 Moulton Drive, LLC

Dear Commissioners,

Accompanying this letter, please find the required form, fee and supporting plans and documentation for the Stormwater Permit for the Bali Hai Restaurant site conversion to a 23-unit apartment building.

As a result of the Planning Board meeting on January 27, 2021, it became apparent that the Town was expecting this filing. Note that under the Judge's Order, the Site Plan Approval and other necessary permits for this site are to issue by March 11, 2021, and I believe you need to have this filing in order to consider it at your February meeting.

Very truly yours,

Peter J. Ogren, P.E., P.L.S.
President

PJO/dab
Enclosures
cc: 160 Moulton Drive, LLC
Attorney Ted Regnante

STORMWATER PERMIT APPLICATION

To: Lynnfield Conservation Commission
55 Summer Street
Lynnfield, MA 01940
(781) 334-9495
ecademartori@town.lynnfield.ma.us

The undersigned hereby submits a Stormwater Management Permit Application as defined in the Town of Lynnfield Charter and Bylaws, Chapter 4A - Stormwater Management Bylaw and requests a review and determination by the Authorized Enforcement Authority of the enclosed Stormwater Management Plan, Erosion and Sediment Control Plan, and Operation and Maintenance Plan. The applicant hereby authorizes the Authorized Enforcement Authority and/or its designees to inspect the property described below from time to time for the purpose of establishing compliance with any permit or order of the Authorized Enforcement Authority, pursuant to the said bylaw.

The Stormwater Management Permit involves property where owner's title to the land is derived under deed for 160 Moulton Drive, dated 12/21/2018, and recorded in the Essex County Registry of Deeds, Book _____, Page_____, or Land Court Certificate of Title No., Registered in Essex South District, Book 37249, Page 518.

Give a brief summary of the nature of the project. Re-use of the existing Bali Hai Restaurant to an apartment building containing 23 units with an associated 72 parking spaces, including 16 spaces for seasonal Little League use.

Total Parcel Size: 78,000± s. f. Proposed Area of Disturbance 76,768 s. f.
(including fee in Suntaug Street)
The property (building) is described as being located at 160 Moulton Dr, Lynnfield, MA; it is currently used as Chinese Restaurant, and the changes proposed to be made are demolish existing building and build a new apartment house.

The project is located on the parcel shown on Lynnfield Assessors Map ____, Parcel _____.

Applicant's Signature [signature] Owner's Signature(s) [signature]
(if different than Applicant)
Applicant's Name (print) David Palumbo Owner's Names(s) 160 Moulton LLC

Applicant's Address 18 Riverview Rd Owner's Address 33 Maple St
Lynnfield MA 01940 Malden MA 02148

Date Received by Conservation Commission Office: _____
Signature _____

3/21/17

TOP TIER PROPERTIES LLC
33 MAPLE ST
MALDEN, MA 02148-3566

East Boston Savings Bank
EAST BOSTON, MA 02128
53-7012/2110

3962

PAY TO THE ORDER OF Town of Lynnfield

1/28/2021

Two Thousand Five Hundred and 00/100********** $ **2,500.00 DOLLARS

Town of Lynnfield
PO BOX 314
Lynnfield, MA 01940

MEMO

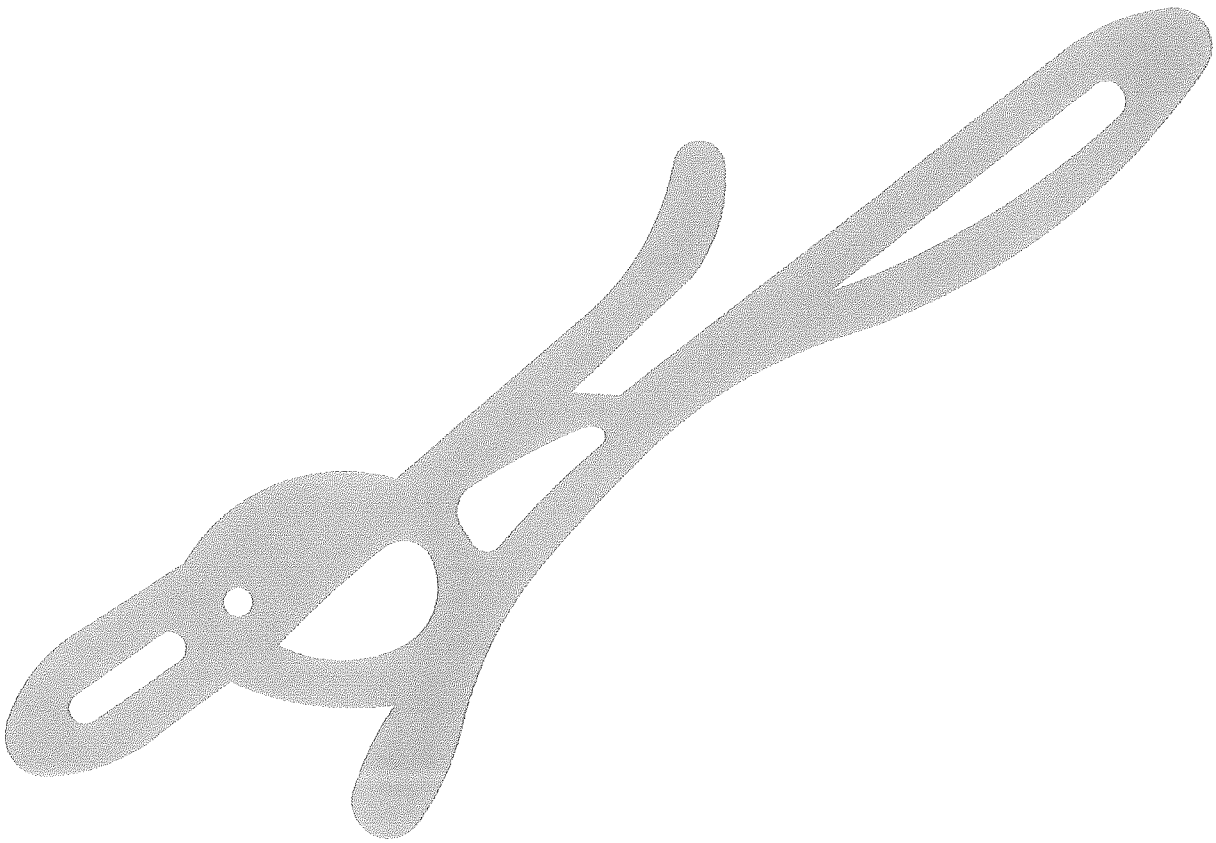
AUTHORIZED SIGNATURE

Security features. Details on back.

Owner:
160 Moulton Drive, LLC
33 Maple Street
Malden, MA 02148

Hayes Engineering, Inc

Stormwater Analysis and Maintenance Plans
Bali Hai Apartments - 160 Moulton Drive
Lynnfield, Massachusetts 01940



January 26, 2021

MITIGATIVE DRAINAGE ANALYSIS
#160 MOULTON DRIVE
(BALI-HAI)
LYNNFIELD, MASSACHUSETTS

July 6, 2018

The following Drainage Analysis has been prepared in conjunction with designing the drainage system for the proposed redevelopment of the restaurant site known as Bali Hai Lynnfield, Massachusetts to a luxury apartment building.

PROJECT DESCRIPTION

The scope of the project is to demolish the existing restaurant building and parking then develop a new apartment building and associated parking, as shown on the plan. The goal of this analysis is to determine potential hydrologic impacts by comparing runoff from the subject property under both the existing and proposed conditions in accordance with the requirements set forth in the Rules and Regulations of the Lynnfield Planning Board and the Massachusetts Department of Environmental Protection's (DEP's) Stormwater Management Standards. Drainage BMP will consist of a subsurface chamber system as shown on the plans along with a reduction of paved surfaces.

PROJECT COMPLIANCE WITH STORMWATER STANDARDS

Standard 1: No New Untreated Discharges

No new storm water conveyances (e.g. outfalls) may discharge untreated storm water directly to or cause erosion in wetlands or waters of the Commonwealth.

The project is a redevelopment utilizing the same drainage patterns as currently exists. Runoff from the existing site runs untreated from the parking lot to either Oak Street or Newhall Memorial Park. In the proposed condition the same drainage patterns will remain. The proposed development will result in a reduction of untreated surfaces by approximately 40%. Landscaping will increase by approximately 75%.

Standard 2: Peak Rate Attenuation

Storm water management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.

Refer to the attached summary tables and calculations for peak rate runoff analysis. To comply with the Lynnfield Rules and Regulations, the 2, 10, 25, and 100-year, Type III, 24-hour storms have been studied.

The existing subject site has one watershed which storm water runoff flows overland towards Newhall Memorial Park. For analysis the watershed has been split in two, one showing the volume which flows towards the parking lot and a second which flows towards the Little League fields. Under the existing conditions approximately 72% of the site is impervious. The proposed plan will reduce imperviousness to approximately 52%. Additionally, the entire roof of the proposed apartment building will be piped to a subsurface set of infiltration chambers. The watersheds are all depicted on the existing and proposed watershed maps which are included in this report.

The runoff computations for this project were all conducted utilizing the HydroCAD Stormwater Modeling System by HydroCAD Software Solutions, LLC. The methodology used is based on TR-55 and TR-20 as developed by the Soil Conservation Service of the USDA. Runoff curve numbers and concentration times were calculated for each sub-watershed in the existing and proposed condition. A computer model for both conditions was then created using the software program. Schematics of the models are included at the beginning of the respective (existing vs. proposed) sections of this report. Included in the proposed design is a subsurface detention chamber system through which the runoff from the roof will be directed.

There are two sets of calculations: the existing and proposed 2-year, 10-year, 25-year, and 100-year storms. Each calculation set includes: 1) summary sheets for each watershed and link; and 2) detailed summary sheets for the stormwater management basins for all design storms.

The results of the calculations indicate that there a reduction of both peak rate of runoff and volume from the entire site as compared to the existing condition.

Standard 3: Recharge

Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration ... At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the storm water management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Storm Water Handbook.

This standard is presumed met since this is a redevelopment project with a large reduction in impervious area. Runoff volume has been reduced by approximately 50 percent in all storms indicating no loss of annual recharge to groundwater.

The soil types and hydrologic soil groups were determined using the Web Soil Survey from the National Cooperative Soil Survey for Essex County. The soil survey indicates that the soil in the relevant watershed area as Urban Land which does not have a Hydrologic rating, however surrounding soils are Merrimac-Urban land complex which is in the Hydrologic group "A". The soils information is all contained in the soils section of this report. There are also logs for test holes that were excavated throughout the site for determination of soil types and groundwater elevations.

Percolation tests have been performed on the site for septic system designs. Although percolation testing is not recognized by the Stormwater Handbook, they did confirm the soils to be consistent with the Soil Survey Maps and therefore justification to using the Rawl's Rate of 8.27"/hour for sandy hydrologic group "A" soils.

Standard 4: Water Quality

Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS).

The site has been graded so the stormwater runoff from all paved surfaces flows towards the parking lot for Newhall Memorial Park which has a recently improved drainage system including a proprietary particle separator. Additionally, untreated impervious surfaces have been reduced by approximately 40% which will reduce the amount of Total Suspended Solids leaving the site.

Standard 5: Land Use with Higher Potential Pollutant Loads

For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.

NOT APPLICABLE

Standard 6: Critical Areas

Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or to any other critical area require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook.

NOT APPLICABLE

Standard 7: Redevelopment

A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural stormwater best management practice requirements of Standards 4, 5, and 6.

The project is a Redevelopment. Standards 2, 3, 5, and 6 have been met. Standard 4 has been met to the maximum extent practicable.

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

A plan to control construction-related impacts, including erosion, sedimentation, and other pollutant sources during construction and land disturbance activities shall be developed and implemented.

A complete Construction Period Pollution Prevention and Erosion and Sedimentation Control is included with this study.

Standard 9: Operation and Maintenance Plan

A Long-Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed.

An Operation and Maintenance is included with this study.

Standard 10: Prohibition of Illicit Discharges

All illicit discharges to the stormwater management system are prohibited.

No discharge to resource areas is proposed.

#160 Moulton
Lynnfield, MA
Runoff Sumary

To Oak

Storm	Existing Q (C.F.S.)	Proposed Q (C.F.S.)	Change Q (C.F.S.)	Existing Volume (C.F.)	Proposed Volume (C.F)	Change Volume (C.F.)
2 Year	1.00	1.30	0.30	3200	4284	1084
10 Year	1.95	2.80	0.85	6150	8884	2734
25 Year	2.47	3.67	1.20	7834	11589	3755
100 Year	3.21	4.90	1.69	10226	15489	5263

To Newhall Park Field

Storm	Existing Q (C.F.S.)	Proposed Q (C.F.S.)	Change Q (C.F.S.)	Existing Volume (C.F.)	Proposed Volume (C.F)	Change Volume (C.F.)
2 Year	2.11	0.00	-2.11	6662	26	-6636
10 Year	3.75	0.03	-3.72	11951	285	-11666
25 Year	4.64	0.07	-4.57	14895	526	-14369
100 Year	5.87	0.18	0.00	19023	950	-18073

Total

Storm	Existing Q (C.F.S.)	Proposed Q (C.F.S.)	Change Q (C.F.S.)	Existing Volume (C.F.)	Proposed Volume (C.F)	Change Volume (C.F.)
2 Year	3.11	1.30	-1.81	9862	4310	-5552
10 Year	5.70	2.8	-2.90	18100	9169	-8931
25 Year	7.12	3.72	-3.40	22729	12115	-10614
100 Year	9.08	5.08	-4.00	29249	16439	-12810

#160 Moulton
Lynnfield, MA
BMP Peak Elevations

BMP 1P Infiltration

Storm	Peak Elevation
2 Year	118.95
10 Year	119.53
25 Year	119.87
100 Year	120.39

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Drawdown Worksheet

Refer to File No. LYF-0934A

Draw Down Analysis:

Static Method:

$$Time_{drawdown} = \frac{Rv}{(K)(Bottom\ Area)}$$

Where:

Rv is the Maximum Storage Volume Provided
K is the Saturated Hydraulic Conductivity (for "Static" Method, use Rawls Rate)
Bottom Area is the Bottom Area of Recharge Structure

1982 Rawls Rates

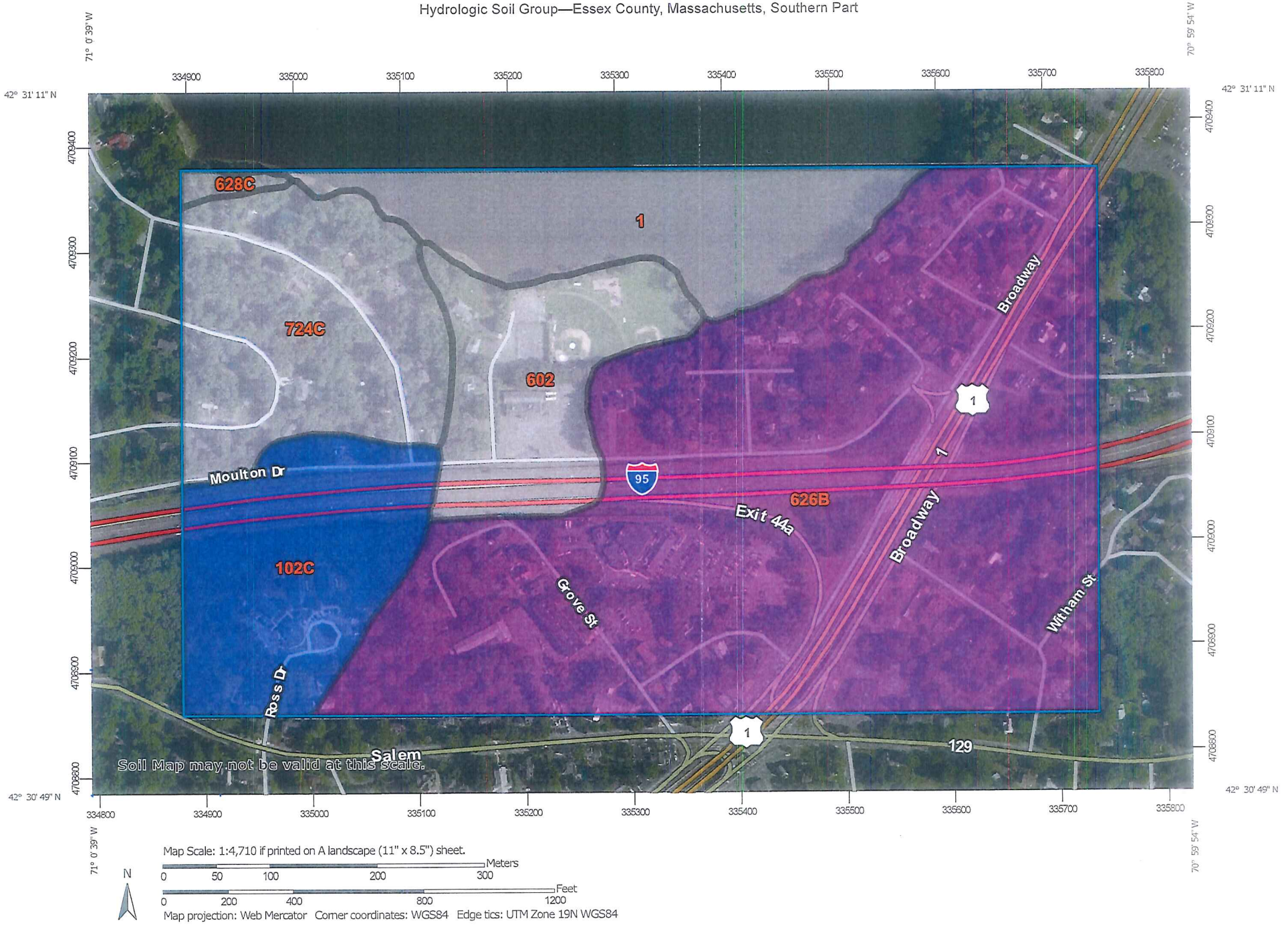
Texture Class	NRCS Hydrologic Soil Group (HSG)	Infiltration Rate Inches/Hour
Sand	A	8.27
Loamy Sand	A	2.41
Sandy Loam	B	1.02
Loam	B	0.52
Silt Loam	C	0.27
Sandy Clay Loam	C	0.17
Clay Loam	D	0.09
Silty Clay Loam	D	0.06
Sandy Clay	D	0.05
Silty Clay	D	0.04
Clay	D	0.02

Chambers 1P: $Time_{drawdown} = \frac{Rv}{(K)(Bottom\ Area)}$

$$= \frac{3{,}084\ cf}{(8.27"/hr)(1{,}390sf)} = 3.2\ hours$$

Chambers 1P will draw down within the required 72-hour time frame.

Hydrologic Soil Group—Essex County, Massachusetts, Southern Part



Map Scale: 1:4,710 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil 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 1:15,800.

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

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

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

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

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

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

Soil Survey Area: Essex County, Massachusetts, Southern Part
Survey Area Data: Version 14, Oct 6, 2017

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—Aug 25, 2014

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

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		12.2	11.0%
102C	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	B	12.1	11.0%
602	Urban land		10.0	9.0%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	A	61.1	55.4%
628C	Canton-Urban land complex, sloping		0.5	0.5%
724C	Hollis-Urban land-Rock outcrop complex, sloping		14.4	13.1%
Totals for Area of Interest			110.3	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.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

LOCATION: LOT Bale Hai 93 Moulton Drive Lynnfield

DEEP HOLE # T-1-16 DATE: 9/20/06 TIME: 930AM WEATHER: Cloudy 70°F

LAND USE: EDGE WOODS LAWN MEADOW GARDEN OTHER: Parking lot

SLOPE: (0-3) 3-8 8-15 15-25 25-35 SURFACE STONES: None BOULDERS STONES COBBLES

VEGETATION: (OAK) (MAPLE) R. MAPLE W. PINE P. PINE CEDAR FIR HEMLOCK YEW W. BIRCH Y. BIRCH ASPEN HICKORY BEECH PRNCSS. PINE GRND. PINE LEATHERLEAF HUCKLEBERRY H.B. BLUEBERRY L.B. BLUEBERRY GRASS

LANDFORM: DRUMLIN KAME TERRACE TILL RIDGE (OUTWASH PLAIN) ESKER

Williams & Sparages

POSITION ON LANDSCAPE: TOP BOTTOM (MIDDLE) SLOPE SADDLE RIDGE

DISTANCES FROM: OPEN WATER BODY: 520'± POSSIBLE WET AREA: 500'± DRINKING WATER WELL: NA

DRAINAGE WAY: PROPERTY LINE: 12' ? OTHER:

DEEP OBSERVATION HOLE LOG

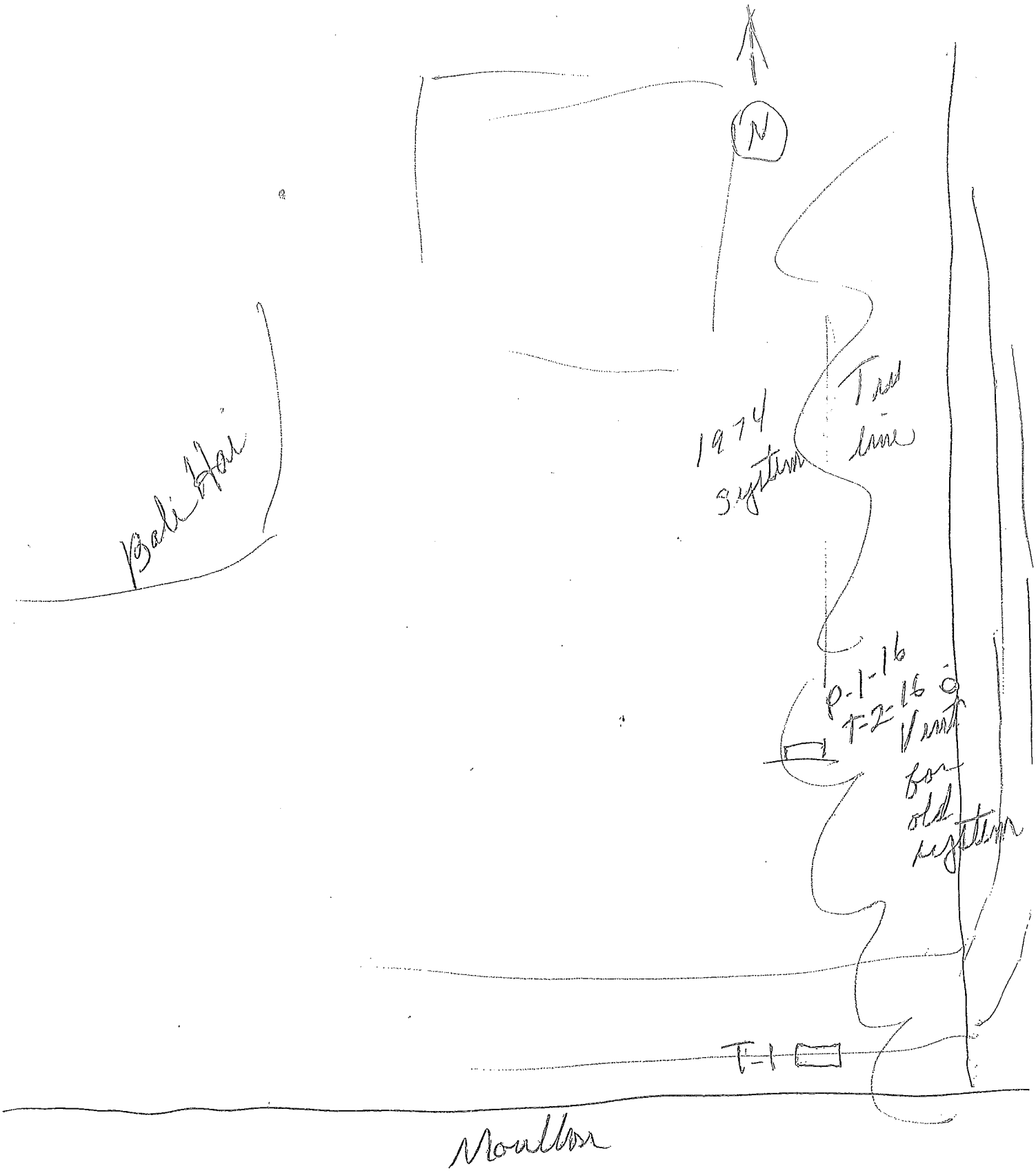
DEPTH	SOIL HORIZON	SOIL TEXTURE			SOIL COLOR			SOIL MOTTLING	OTHER		
T-1-16											
0 108+	A BW1 BW2 BW3 BC (C1) C2 C3 C4	V. EXT. (GRAVELLY) STONY COBBLY BOULDERY	FINE ~~MEDIUM~~ ~~COARSE~~ (STRATIFIED)	(SAND) LOAMY SAND SANDY LOAM LOAM SILTY LOAM SL. CL. LOAM Coarse [illegible] fast	5YR 7.5YR (10YR) 2.5Y 5Y 2.5Y	1 2 3 (4) 5 6 7 8	1 2 3 (4) 5 6 7 8	None 2.5Y 7/4	(S. GRAIN) GRANULAR MASSIVE BLOCKY PLATY	(LOOSE) V. FRIABLE FRIABLE SL. FIRM IN PLACE FIRM IN PLACE V. FIRM CEMENTED	FEW ROOTS TO: COMM. MANY 30 % GRAVEL % COBBLES % STONES % BOULDERS
No R 108+	A BW1 BW2 BW3 BC C1 C2 C3 C4	V. EXT. GRAVELLY STONY COBBLY BOULDERY	FINE MEDIUM COARSE STRATIFIED	SAND LOAMY SAND SANDY LOAM LOAM SILTY LOAM SL. CL. LOAM	5YR 7.5YR 10YR 2.5Y 5Y	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	Fine sand	S. GRAIN GRANULAR MASSIVE BLOCKY PLATY	LOOSE V. FRIABLE FRIABLE SL. FIRM IN PLACE FIRM IN PLACE V. FIRM CEMENTED	FEW ROOTS TO: COMM. MANY % GRAVEL % COBBLES % STONES % BOULDERS
	A BW1 BW2 BW3 BC C1 C2 C3 C4	V. EXT. GRAVELLY STONY COBBLY BOULDERY	FINE MEDIUM COARSE STRATIFIED	SAND LOAMY SAND SANDY LOAM LOAM SILTY LOAM SL. CL. LOAM	5YR 7.5YR 10YR 2.5Y 5Y	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	HIGH CHROMA 5YR 7.5YR 10YR 1 2 3 4 5 6 7 8 1 2 3 4 5 6 7 8	S. GRAIN GRANULAR MASSIVE BLOCKY PLATY	LOOSE V. FRIABLE FRIABLE SL. FIRM IN PLACE FIRM IN PLACE V. FIRM CEMENTED	FEW ROOTS TO: COMM. MANY % GRAVEL % COBBLES % STONES % BOULDERS
	A BW1 BW2 BW3 BC C1 C2 C3 C4	V. EXT. GRAVELLY STONY COBBLY BOULDERY	FINE MEDIUM COARSE STRATIFIED	SAND LOAMY SAND SANDY LOAM LOAM SILTY LOAM SL. CL. LOAM	5YR 7.5YR 10YR 2.5Y 5Y	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	LOW CHROMA 10YR 2.5Y 5Y 1 2 3 4 5 6 7 8 1 2 3 4 5 6 7 8	S. GRAIN GRANULAR MASSIVE BLOCKY PLATY	LOOSE V. FRIABLE FRIABLE SL. FIRM IN PLACE FIRM IN PLACE V. FIRM CEMENTED	FEW ROOTS TO: COMM. MANY % GRAVEL % COBBLES % STONES % BOULDERS
	A BW1 BW2 BW3 BC C1 C2 C3 C4	V. EXT. GRAVELLY STONY COBBLY BOULDERY	FINE MEDIUM COARSE STRATIFIED	SAND LOAMY SAND SANDY LOAM LOAM SILTY LOAM SL. CL. LOAM	5YR 7.5YR 10YR 2.5Y 5Y	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	FEW COMMON MANY FINE MEDIUM COARSE	S. GRAIN GRANULAR MASSIVE BLOCKY PLATY	LOOSE V. FRIABLE FRIABLE SL. FIRM IN PLACE FIRM IN PLACE V. FIRM CEMENTED	FEW ROOTS TO: COMM. MANY % GRAVEL % COBBLES % STONES % BOULDERS
	A BW1 BW2 BW3 BC C1 C2 C3 C4	V. EXT. GRAVELLY STONY COBBLY BOULDERY	FINE MEDIUM COARSE STRATIFIED	SAND LOAMY SAND SANDY LOAM LOAM SILTY LOAM SL. CL. LOAM	5YR 7.5YR 10YR 2.5Y 5Y	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	FAINT DISTINCT PROMINENT DEPTH:	S. GRAIN GRANULAR MASSIVE BLOCKY PLATY	LOOSE V. FRIABLE FRIABLE SL. FIRM IN PLACE FIRM IN PLACE V. FIRM CEMENTED	FEW ROOTS TO: COMM. MANY % GRAVEL % COBBLES % STONES % BOULDERS

Rounded stone sand

PARENT MATERIAL: Gravel No Topsoil stripped out 60-70 yrs ago.

DEPTH TO BEDROCK:

DEPTH TO GROUNDWATER: >106 STANDING IN THE HOLE: NO WEEPING FROM PIT FACE: NO E.S.H.W.T.: >108"


N
Bali Hai
1974 system
Trail line
P-1-16
T-2-16 &
Vent for old system
T-1
Moultrie

LOCATION: LOT Bale Har 93 Moulton Lynnfield

DEEP HOLE # T-2-16 DATE: 9-20-16 TIME: 1023 WEATHER: Cloudy breezy 70°F

LAND USE: EDGE WOODS LAWN MEADOW GARDEN OTHER: Pavement Parking lot

SLOPE: **0-3** 3-8 8-15 15-25 25-35 SURFACE STONES: BOULDERS NA STONES COBBLES

VEGETATION: **OAK** **MAPLE** R. MAPLE W. PINE P.PINE CEDAR FIR HEMLOCK YEW W. BIRCH Y. BIRCH ASPEN HICKORY BEECH PRNCSS. PINE GRND. PINE LEATHERLEAF HUCKLEBERRY H.B. BLUEBERRY L.B. BLUEBERRY GRASS

LANDFORM: DRUMLIN KAME TERRACE TILL RIDGE **OUTWASH PLAIN** ESKER

POSITION ON LANDSCAPE: TOP BOTTOM **MIDDLE** SLOPE SADDLE RIDGE

DISTANCES FROM: OPEN WATER BODY: 400'? DRAINAGE WAY: POSSIBLE WET AREA: 400'? PROPERTY LINE: 15' DRINKING WATER WELL: NA OTHER:

T-2-16

DEEP OBSERVATION HOLE LOG

DEPTH	SOIL HORIZON	SOIL TEXTURE			SOIL COLOR			SOIL MOTTLING	OTHER		
1	O										
0 38" 120+	A BW1 BW2 ~~BW3~~ BC **C3** C2 C3 C4	V. EXT. **GRAVELLY** STONY COBBLY BOULDERY Cave in	**FINE** **MEDIUM** COARSE **STRATIFIED**	**SAND** ~~LOAMY SAND~~ SANDY LOAM LOAM SILTY LOAM SL. CL. LOAM	5YR 7.5YR 10YR **2.5Y** 5Y 2.5Y	1 2 3 4 5 6 **7** 8	1 2 3 **4** 5 6 7 8	Root area	**S. GRAIN** GRANULAR MASSIVE BLOCKY PLATY	**LOOSE** V. FRIABLE FRIABLE SL. FIRM IN PLACE FIRM IN PLACE V. FIRM CEMENTED	FEW ROOTS TO: COMM. MANY 35 % GRAVEL % COBBLES 15 % STONES % BOULDERS
38" 10' 120 ND	A BW1 BW2 BW3 BC C1 **C2** C3 C4 R	V. EXT. GRAVELLY STONY COBBLY BOULDERY	**FINE** MEDIUM COARSE **STRATIFIED**	**SAND** ~~LOAMY SAND~~ SANDY LOAM LOAM SILTY LOAM SL. CL. LOAM	5YR 7.5YR **10YR** 2.5Y 5Y	1 2 3 **4** 5 6 7 8	1 2 3 **4** 5 6 7 8	NONE	**S. GRAIN** ~~GRANULAR~~ MASSIVE BLOCKY PLATY	**LOOSE** V. FRIABLE FRIABLE SL. FIRM IN PLACE FIRM IN PLACE V. FIRM CEMENTED	FEW ROOTS TO: COMM. MANY 35 % GRAVEL % COBBLES 15 % STONES % BOULDERS
	A BW1 BW2 BW3 BC C1 C2 C3 C4	V. EXT. GRAVELLY STONY COBBLY BOULDERY	FINE MEDIUM COARSE STRATIFIED	SAND LOAMY SAND SANDY LOAM LOAM SILTY LOAM SL. CL. LOAM	5YR 7.5YR 10YR 2.5Y 5Y	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	HIGH CHROMA 1 1 2 2 5YR 3 3 7.5YR 4 4 10YR 5 5 6 6 7 7 8 8	S. GRAIN GRANULAR MASSIVE BLOCKY PLATY	LOOSE V. FRIABLE FRIABLE SL. FIRM IN PLACE FIRM IN PLACE V. FIRM CEMENTED	FEW ROOTS TO: COMM. MANY % GRAVEL % COBBLES % STONES % BOULDERS
	A BW1 BW2 BW3 BC C1 C2 C3 C4	V. EXT. GRAVELLY STONY COBBLY BOULDERY	FINE MEDIUM COARSE STRATIFIED	SAND LOAMY SAND SANDY LOAM LOAM SILTY LOAM SL. CL. LOAM	5YR 7.5YR 10YR 2.5Y 5Y	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	LOW CHROMA 1 1 2 2 10YR 3 3 2.5Y 4 4 5Y 5 5 6 6 7 7 8 8	S. GRAIN GRANULAR MASSIVE BLOCKY PLATY	LOOSE V. FRIABLE FRIABLE SL. FIRM IN PLACE FIRM IN PLACE V. FIRM CEMENTED	FEW ROOTS TO: COMM. MANY % GRAVEL % COBBLES % STONES % BOULDERS
	A BW1 BW2 BW3 BC C1 C2 C3 C4	V. EXT. GRAVELLY STONY COBBLY BOULDERY	FINE MEDIUM COARSE STRATIFIED	SAND LOAMY SAND SANDY LOAM LOAM SILTY LOAM SL. CL. LOAM	5YR 7.5YR 10YR 2.5Y 5Y	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	FEW COMMON MANY FINE MEDIUM COARSE	S. GRAIN GRANULAR MASSIVE BLOCKY PLATY	LOOSE V. FRIABLE FRIABLE SL. FIRM IN PLACE FIRM IN PLACE V. FIRM CEMENTED	FEW ROOTS TO: COMM. MANY % GRAVEL % COBBLES % STONES % BOULDERS
	A BW1 BW2 BW3 BC C1 C2 C3 C4	V. EXT. GRAVELLY STONY COBBLY BOULDERY	FINE MEDIUM COARSE STRATIFIED	SAND LOAMY SAND SANDY LOAM LOAM SILTY LOAM SL. CL. LOAM	5YR 7.5YR 10YR 2.5Y 5Y	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	FAINT DISTINCT PROMINENT DEPTH:	S. GRAIN GRANULAR MASSIVE BLOCKY PLATY	LOOSE V. FRIABLE FRIABLE SL. FIRM IN PLACE FIRM IN PLACE V. FIRM CEMENTED	FEW ROOTS TO: COMM. MANY % GRAVEL % COBBLES % STONES % BOULDERS

PARENT MATERIAL: Sand Gravel Rounded stones

DEPTH TO BEDROCK: >10'

DEPTH TO GROUNDWATER: STANDING IN THE HOLE: No WEEPING FROM PIT FACE: ND E.S.H.W.T.: >10'

LOCATION: LOT Ball Haw Moulton Drive Lyons field

DEEP HOLE # T-3-16 DATE: 9-20-16 TIME: 1100 WEATHER: Cloudy 91°F

LAND USE: EDGE WOODS LAWN MEADOW GARDEN OTHER: Parking Lot - Walkway

SLOPE: (0-3) 3-8 8-15 15-25 25-35 SURFACE STONES: BOULDERS STONES COBBLES

VEGETATION: NA OAK MAPLE R. MAPLE W. PINE P. PINE CEDAR FIR HEMLOCK YEW W. BIRCH Y. BIRCH ASPEN HICKORY BEECH PRNCSS. PINE GRND. PINE LEATHERLEAF HUCKLEBERRY H.B. BLUEBERRY L.B. BLUEBERRY GRASS

LANDFORM: DRUMLIN KAME TERRACE TILL RIDGE OUTWASH PLAIN ESKER

POSITION ON LANDSCAPE: TOP BOTTOM MIDDLE SLOPE SADDLE RIDGE

DISTANCES FROM: OPEN WATER BODY: 500+ POSSIBLE WET AREA: 500+ DRINKING WATER WELL: NA

DRAINAGE WAY: South fork of hole. ? PROPERTY LINE: 20' ? OTHER:

T-3-16

DEEP OBSERVATION HOLE LOG

DEPTH	SOIL HORIZON	SOIL TEXTURE			SOIL COLOR			SOIL MOTTLING	OTHER		
Pavement +		Fill									
0	A BW1 BW2 BW3 BC C1 C2 C3 C4	V. EXT. GRAVELLY STONY COBBLY BOULDERY	FINE MEDIUM COARSE STRATIFIED	SAND LOAMY SAND SANDY LOAM LOAM SILTY LOAM SI. CL. LOAM	5YR 7.5YR 10YR 2.5Y 5Y 2.5Y	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8		S. GRAIN GRANULAR MASSIVE BLOCKY PLATY	LOOSE V. FRIABLE FRIABLE SL. FIRM IN PLACE FIRM IN PLACE V. FIRM CEMENTED	FEW ROOTS TO: COMM. MANY % GRAVEL % COBBLES % STONES % BOULDERS
10"	Fill										
14"	A BW1 BW2 BW3 BC C1 C2 C3 C4	V. EXT. GRAVELLY STONY COBBLY BOULDERY	FINE MEDIUM COARSE STRATIFIED	SAND LOAMY SAND SANDY LOAM LOAM SILTY LOAM SI. CL. LOAM	5YR 7.5YR 10YR 2.5Y 5Y	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8		S. GRAIN GRANULAR MASSIVE BLOCKY PLATY	LOOSE V. FRIABLE FRIABLE SL. FIRM IN PLACE FIRM IN PLACE V. FIRM CEMENTED	FEW ROOTS TO: COMM. MANY No Roots % GRAVEL % COBBLES % STONES % BOULDERS
20	BW1 BW2 BW3 BC C1 C2 C3 C4	V. EXT. GRAVELLY STONY COBBLY BOULDERY	FINE MEDIUM COARSE STRATIFIED	SAND LOAMY SAND SANDY LOAM LOAM SILTY LOAM SI. CL. LOAM	5YR 7.5YR 10YR 2.5Y 5Y	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	HIGH CHROMA 1 1 2 2 5YR 3 3 7.5YR 4 4 10YR 5 5 6 6 7 7 8 8 LOW CHROMA 1 1 2 2 10YR 3 3 2.5Y 4 4 5Y 5 5 6 6 7 7 8 8	S. GRAIN GRANULAR MASSIVE BLOCKY PLATY	LOOSE V. FRIABLE FRIABLE SL. FIRM IN PLACE FIRM IN PLACE V. FIRM CEMENTED	FEW ROOTS TO: COMM. MANY % GRAVEL % COBBLES % STONES % BOULDERS
14"											
22"											
22"	A BW1 BW2 BW3 BC C1 C2 C3 C4	V. EXT. GRAVELLY STONY COBBLY BOULDERY	FINE MEDIUM COARSE STRATIFIED	SAND LOAMY SAND SANDY LOAM LOAM SILTY LOAM SI. CL. LOAM	5YR 7.5YR 10YR 2.5Y 5Y	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8		S. GRAIN GRANULAR MASSIVE BLOCKY PLATY	LOOSE V. FRIABLE FRIABLE SL. FIRM IN PLACE FIRM IN PLACE V. FIRM CEMENTED	FEW ROOTS TO: COMM. MANY % GRAVEL % COBBLES % STONES % BOULDERS
30											
30	A BW1 BW2 BW3 BC C1 C2 C3 C4	V. EXT. GRAVELLY STONY COBBLY BOULDERY	FINE MEDIUM COARSE STRATIFIED	SAND LOAMY SAND SANDY LOAM LOAM SILTY LOAM SI. CL. LOAM	5YR 7.5YR 10YR 2.5Y 5Y	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8	FEW COMMON MANY FINE MEDIUM COARSE FAINT DISTINCT PROMINENT DEPTH:	S. GRAIN GRANULAR MASSIVE BLOCKY PLATY	LOOSE V. FRIABLE FRIABLE SL. FIRM IN PLACE FIRM IN PLACE V. FIRM CEMENTED	FEW ROOTS TO: COMM. MANY % GRAVEL % COBBLES % STONES % BOULDERS
120											
NO R 10'	A BW1 BW2 BW3 BC C1 C2 C3 C4	V. EXT. GRAVELLY STONY COBBLY BOULDERY	FINE MEDIUM COARSE STRATIFIED	SAND LOAMY SAND SANDY LOAM LOAM SILTY LOAM SI. CL. LOAM	5YR 7.5YR 10YR 2.5Y 5Y	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8		S. GRAIN GRANULAR MASSIVE BLOCKY PLATY	LOOSE V. FRIABLE FRIABLE SL. FIRM IN PLACE FIRM IN PLACE V. FIRM CEMENTED	FEW ROOTS TO: COMM. MANY % GRAVEL % COBBLES % STONES % BOULDERS

PARENT MATERIAL: Sand & Gravel Rounded stones

DEPTH TO GROUNDWATER: >10' STANDING IN THE HOLE: NO DEPTH TO BEDROCK: >10'

WEEPING FROM PIT FACE: NO E.S.H.W.T.: >10'

LOCATION: LOT Bak Hal R3 Moulton Drive

DEEP HOLE # T-4-16 DATE: 9-20-16 TIME: 1:20pm WEATHER: P.Cloudy 78° F

LAND USE: EDGE WOODS LAWN MEADOW GARDEN OTHER: Parking Lot / No vegetation

SLOPE: (0-3) 3-8 8-15 15-25 25-35 SURFACE STONES: BOULDERS NO STONES NO COBBLES NO

VEGETATION: OAK MAPLE R. MAPLE W. PINE P.PINE CEDAR FIR HEMLOCK YEW W. BIRCH Y. BIRCH ASPEN HICKORY
BEECH PRNCSS. PINE GRND. PINE LEATHERLEAF HUCKLEBERRY H.B. BLUEBERRY L.B. BLUEBERRY GRASS

LANDFORM: DRUMLIN KAME TERRACE TILL RIDGE (OUTWASH PLAIN) ESKER

POSITION ON LANDSCAPE: TOP BOTTOM (MIDDLE) SLOPE SADDLE RIDGE

DISTANCES FROM: OPEN WATER BODY: 500? POSSIBLE WET AREA: 500? DRINKING WATER WELL: NA
DRAINAGE WAY: PROPERTY LINE: 70' OTHER:

T-4-16

DEEP OBSERVATION HOLE LOG

DEPTH	SOIL HORIZON	SOIL TEXTURE			SOIL COLOR			SOIL MOTTLING	OTHER		
	O										
0	A	V. EXT.		SAND	5YR	1	1			LOOSE	FEW ROOTS TO:
	BW1 BW2		FINE	LOAMY SAND	7.5YR	2	2		S. GRAIN	V. FRIABLE	COMM.
	BW3 BC	GRAVELLY	MEDIUM	SANDY LOAM	10YR	3	3		GRANULAR	FRIABLE	MANY
	C1 C2	STONY	COARSE	LOAM	2.5Y	4	4		MASSIVE	SL. FIRM IN PLACE	
	C3 C4	COBBLY	STRATIFIED	SILTY LOAM	5Y	5	5		BLOCKY	FIRM IN PLACE	% GRAVEL
36		BOULDERY		SL. CL. LOAM	2.5Y	6	6		PLATY		% COBBLES
	Fill					7	7			V. FIRM	% STONES
						8	8			CEMENTED	% BOULDERS
36	(A)	V. EXT.		SAND	5YR	1	1			LOOSE	FEW ROOTS TO:
	BW1 BW2		FINE	LOAMY SAND	7.5YR	2	2		S. GRAIN	V. FRIABLE	COMM.
	BW3 BC	GRAVELLY	MEDIUM	SANDY LOAM	10YR	3	3		GRANULAR	FRIABLE	MANY
	C1 C2	STONY	COARSE	LOAM	2.5Y	4	4	NONE	MASSIVE	SL. FIRM IN PLACE	
	C3 C4	COBBLY	STRATIFIED	SILTY LOAM	5Y	5	5		BLOCKY	FIRM IN PLACE	% GRAVEL
39		BOULDERY		SL. CL. LOAM		6	6		PLATY	V. FIRM	% COBBLES
	Ah	Mn A Horizon				7	7			CEMENTED	% STONES
						8	8	HIGH CHROMA			% BOULDERS
	A	V. EXT.		SAND	5YR	1	1	1 1		LOOSE	FEW ROOTS TO:
39	BW1 BW2		FINE	LOAMY SAND	7.5YR	2	2	2 2	S. GRAIN	V. FRIABLE	COMM.
	BW3 BC	GRAVELLY	MEDIUM	SANDY LOAM	10YR	3	3	5YR 3 3	GRANULAR	FRIABLE	MANY
	C1 C2	STONY	COARSE	LOAM	2.5Y	4	4	7.5YR 4 4	MASSIVE	SL. FIRM IN PLACE	
	C3 C4	COBBLY	STRATIFIED	SILTY LOAM	5Y	5	5	10YR 5 5	BLOCKY	FIRM IN PLACE	15 % GRAVEL
127		BOULDERY		SL. CL. LOAM		6	6	6 6	PLATY	V. FIRM	% COBBLES
						7	7	7 7		CEMENTED	% STONES
						8	8	8 8			% BOULDERS
	A	V. EXT.		SAND	5YR	1	1	LOW CHROMA		LOOSE	FEW ROOTS TO:
	BW1 BW2		FINE	LOAMY SAND	7.5YR	2	2	1 1	S. GRAIN	V. FRIABLE	COMM.
	BW3 BC	GRAVELLY	MEDIUM	SANDY LOAM	10YR	3	3	2 2	GRANULAR	FRIABLE	MANY
NO	C1 C2	STONY	COARSE	LOAM	2.5Y	4	4	10YR 3 3	MASSIVE	SL. FIRM IN PLACE	
	C3 C4	COBBLY	STRATIFIED	SILTY LOAM	5Y	5	5	2.5Y 4 4	BLOCKY	FIRM IN PLACE	% GRAVEL
R	10'	7"	Fine	Sand		6	7	5Y 5 5	PLATY	V. FIRM	% COBBLES
						7		6 6		CEMENTED	% STONES
						8		7 7			% BOULDERS
								8 8			
	A	V. EXT.	bottom	SAND	5YR	1	1			LOOSE	FEW ROOTS TO:
	BW1 BW2		FINE	LOAMY SAND	7.5YR	2	2	FEW	S. GRAIN	V. FRIABLE	COMM.
	BW3 BC	GRAVELLY	MEDIUM	SANDY LOAM	10YR	3	3	COMMON	GRANULAR	FRIABLE	MANY
	C1 C2	STONY	COARSE	LOAM	2.5Y	4	4	MANY	MASSIVE	SL. FIRM IN PLACE	
	C3 C4	COBBLY	STRATIFIED	SILTY LOAM	5Y	5	5		BLOCKY	FIRM IN PLACE	% GRAVEL
		BOULDERY		SL. CL. LOAM		6	6	FINE	PLATY	V. FIRM	% COBBLES
						7	7	MEDIUM		CEMENTED	% STONES
						8	8	COARSE			% BOULDERS
	A	V. EXT.		SAND	5YR	1	1			LOOSE	FEW ROOTS TO:
	BW1 BW2		FINE	LOAMY SAND	7.5YR	2	2	FAINT	S. GRAIN	V. FRIABLE	COMM.
	BW3 BC	GRAVELLY	MEDIUM	SANDY LOAM	10YR	3	3	DISTINCT	GRANULAR	FRIABLE	MANY
	C1 C2	STONY	COARSE	LOAM	2.5Y	4	4	PROMINENT	MASSIVE	SL. FIRM IN PLACE	
	C3 C4	COBBLY	STRATIFIED	SILTY LOAM	5Y	5	5		BLOCKY	FIRM IN PLACE	% GRAVEL
		BOULDERY		SL. CL. LOAM		6	6	DEPTH:	PLATY	V. FIRM	% COBBLES
						7	7			CEMENTED	% STONES
						8	8				% BOULDERS

PARENT MATERIAL: Sand gravel fine sand DEPTH TO BEDROCK: > 10' 7"

DEPTH TO GROUNDWATER: > 10' 7" STANDING IN THE HOLE: NO WEEPING FROM PIT FACE: NO E.S.H.W.T.: N/A

Commonwealth of Massachusetts
City/Town of
Percolation Test
Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

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

A. Site Information

Owner Name: Bah Hai

Street Address or Lot #: 43 Moulton St. (#160?)

City/Town: Springfield | State | Zip Code

Contact Person (if different from Owner) | Telephone Number

B. Test Results

	P-2-16	P-1-16	P-2-16
	11"		
Date		9-20-16	9/20/16
Time	12:21,38	9:45	11:48 AM
Observation Hole #		P-1-16	P-2-16
Depth of Perc	10"	26+24=50"	23"+20"=44
Start Pre-Soak	12:29,47	9:47,18	12:00,30
End Pre-Soak	used 25gal Water	12" 9:48,31	12:15,30
Time at 12"	8"	11" 40	12:15,30
Time at 9"		10" 50	9" 12:35,18
Time at 6"		9" 9:50,02	6" abandoned
Time (9"-6")		8" 16	TIME Buried & ask? lawyer
Rate (Min./Inch)	1 3" 42 seconds	<2 MPI 7" 26	RATE
	6"	6" 9:58,44	
Test Passed:		☑	☑ see 2nd test
Test Failed:		☐	☐

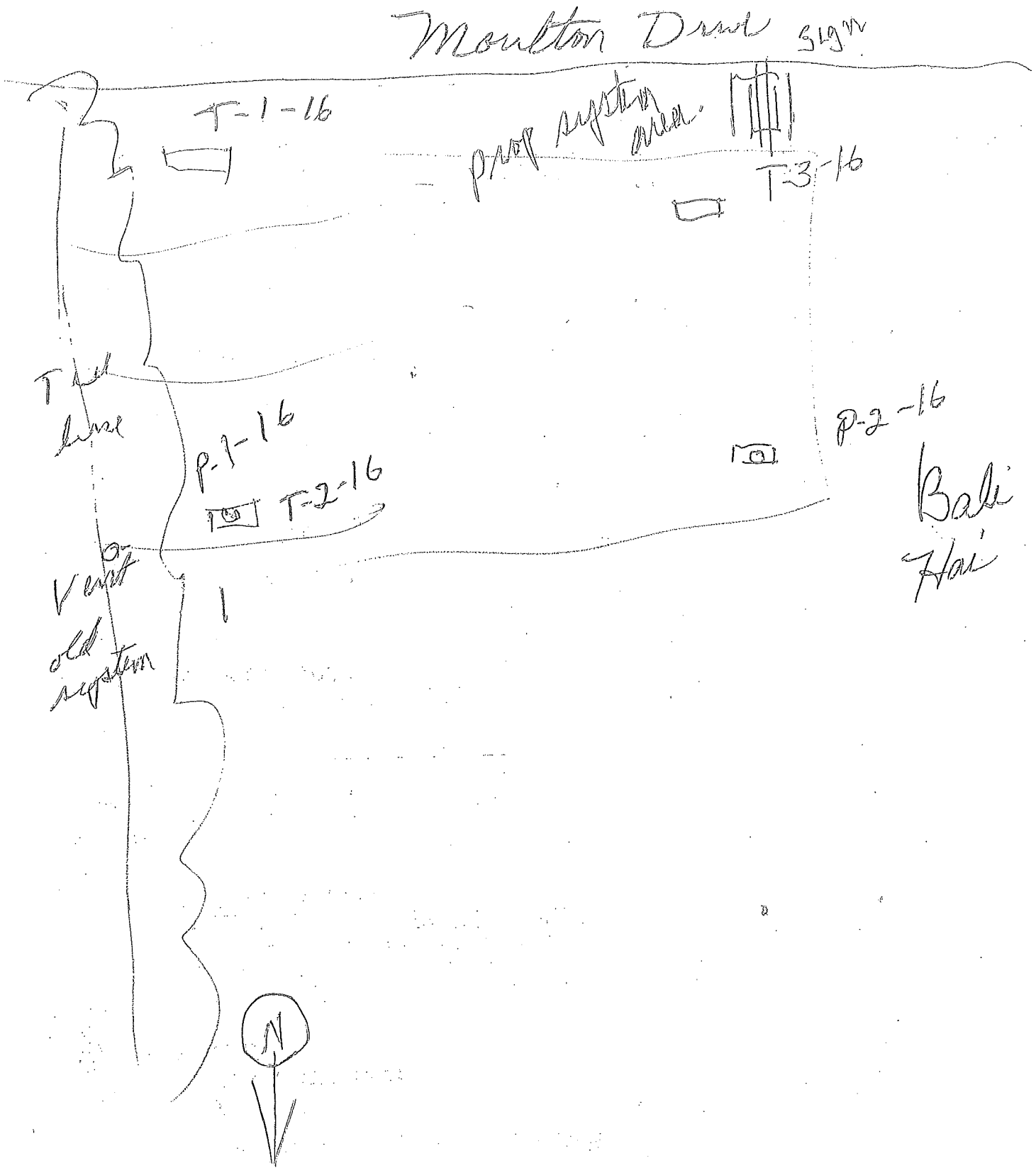
Test Performed By: Matt Provencher SE. 13869

Witnessed By: Gary Tousignant, Kilkett Co

Comments: Leo Flannin / Kristin M. Ra, Tim Kellett

OVER

P-2-16 Silty soil.


Moulton Drive
T-1-16
prop system area
T-3-16
T-2-16
P-1-16
P-2-16
Bali Hai
Vent old system
N

Commonwealth of Massachusetts
City/Town of
Percolation Test
Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

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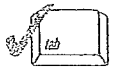


A. Site Information

Owner Name: Bali Hai

Street Address or Lot #: 93 Moulton Drive

City/Town: Lynnfield | State: | Zip Code:

Contact Person (if different from Owner): Greg Monastero | Telephone Number:

B. Test Results

	Date: 9-20-16	Time: 12:50	Date:	Time:
Observation Hole #	1	P-2-A-16		
Depth of Perc	11"	53 + 18" = 71"		
Start Pre-Soak	1:09,17	1:07,45		
End Pre-Soak		1:09,12		
Time at 12"	10"	11"		
Time at 9"	1:09,25	1:09,33		
Time at 6"		1:09 52		
Time (9"-6")	8"	19 seconds		
Rate (Min./Inch)	1:09,40	< 1 MPI		
	7"			
	1:09,46			
Test Passed: ☑ / Test Failed: ☐			Test Passed: ☐ / Test Failed: ☐	

25 gal. Water

Test Performed By: Matt Provencher, Jim Kellett

Witnessed By: Leo F. Cormier, Kristin McRay

Comments:

Dug P2-16 out deeper

No. 80/74

FEE 40 CK Ed 10/8

THE COMMONWEALTH OF MASSACHUSETTS

BOARD OF HEALTH

OCT 7 1974

Town OF Lynnfield

Application for Disposal Works Construction Permit

Application is hereby made for a Permit to Construct ( ) or Repair (X) an Individual Sewage Disposal System at:

Moulton Dr. & Oak St — or Lot No. —

Location - Address

Bali-Hai Restaurant — Same — Address

Owner

Sears Construction Corp. — P.O. Box 111 Falmouth, Mass — Address

Installer

Size Lot 81,000 Sq. feet

Type of Building

Dwelling — No. of Bedrooms ..... Expansion Attic ( ) Garbage Grinder ( )

Other — Type of Building Restaurant No. of persons ..... Showers ( ) — Cafeteria ( )

Other fixtures .....

Design Flow 35 gallons per person per day. Total daily flow 10,000 gallons.

Septic Tank — Liquid capacity 15120 gallons Length 28'7½" Width 11'0" Diameter ..... Depth 9'2½"

Disposal Trench — No. 32 Width 5'4" Total Length 192' Total leaching area 10368 sq. ft.

Seepage Pit No. ..... Diameter ..... Depth below inlet ..... Total leaching area ..... sq. ft.

Other Distribution box (2) Dosing tank ( )

Percolation Test Results Performed by Cleverdon Varney & Pike Date 5/21/74

Test Pit No. 1 4 minutes per inch Depth of Test Pit 9-10' Depth to ground water no ground wa

Test Pit No. 2 4 minutes per inch Depth of Test Pit 9-10' Depth to ground water " 0 "

Description of Soil Sandy fill

Nature of Repairs or Alterations — Answer when applicable Install new Septic Tank and Grease Trap - Remove existing leaching beds and replace w/ 2 fields

Agreement:

The undersigned agrees to install the aforedescribed Individual Sewage Disposal System in accordance with the provisions of Article XI of the State Sanitary Code — The undersigned further agrees not to place the system in operation until a Certificate of Compliance has been issued by the board of health.

Signed CG Peterson 10/2/74 Date

Application Approved By ..... Date .....

Application Disapproved *for the following reasons:* ..... Date .....

Permit No. 80/74 Issued ..... Date

CHECK OR FILL IN WHERE APPLICABLE

THE COMMONWEALTH OF MASSACHUSETTS

BOARD OF HEALTH

OF .....

Certificate of Compliance

THIS IS TO CERTIFY, That the Individual Sewage Disposal System constructed ( ) or Repaired (✓)

by ..... Installer (Bali Hai Restaurant

at Moulton Drive has been installed in accordance with the provisions of Article XI of The State Sanitary Code as described in the application for Disposal Works Construction Permit No. 80/74 dated .....

THE ISSUANCE OF THIS CERTIFICATE SHALL NOT BE CONSTRUED AS A GUARANTEE THAT THE SYSTEM WILL FUNCTION SATISFACTORY.

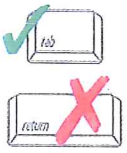
DATE ..... Inspector .....

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.

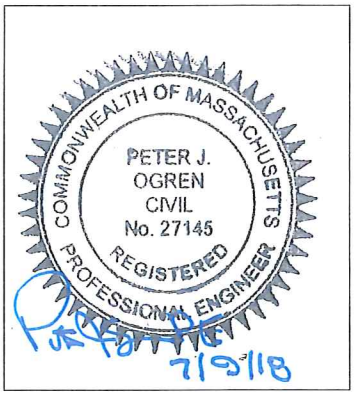
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



7-9-18

Signature and Date

Checklist

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

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

- ☒ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☒ Reduced Impervious Area (Redevelopment Only)
- ☒ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☐ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☐ Required Recharge Volume calculation provided.

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

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

☐ Static ☒ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist (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:

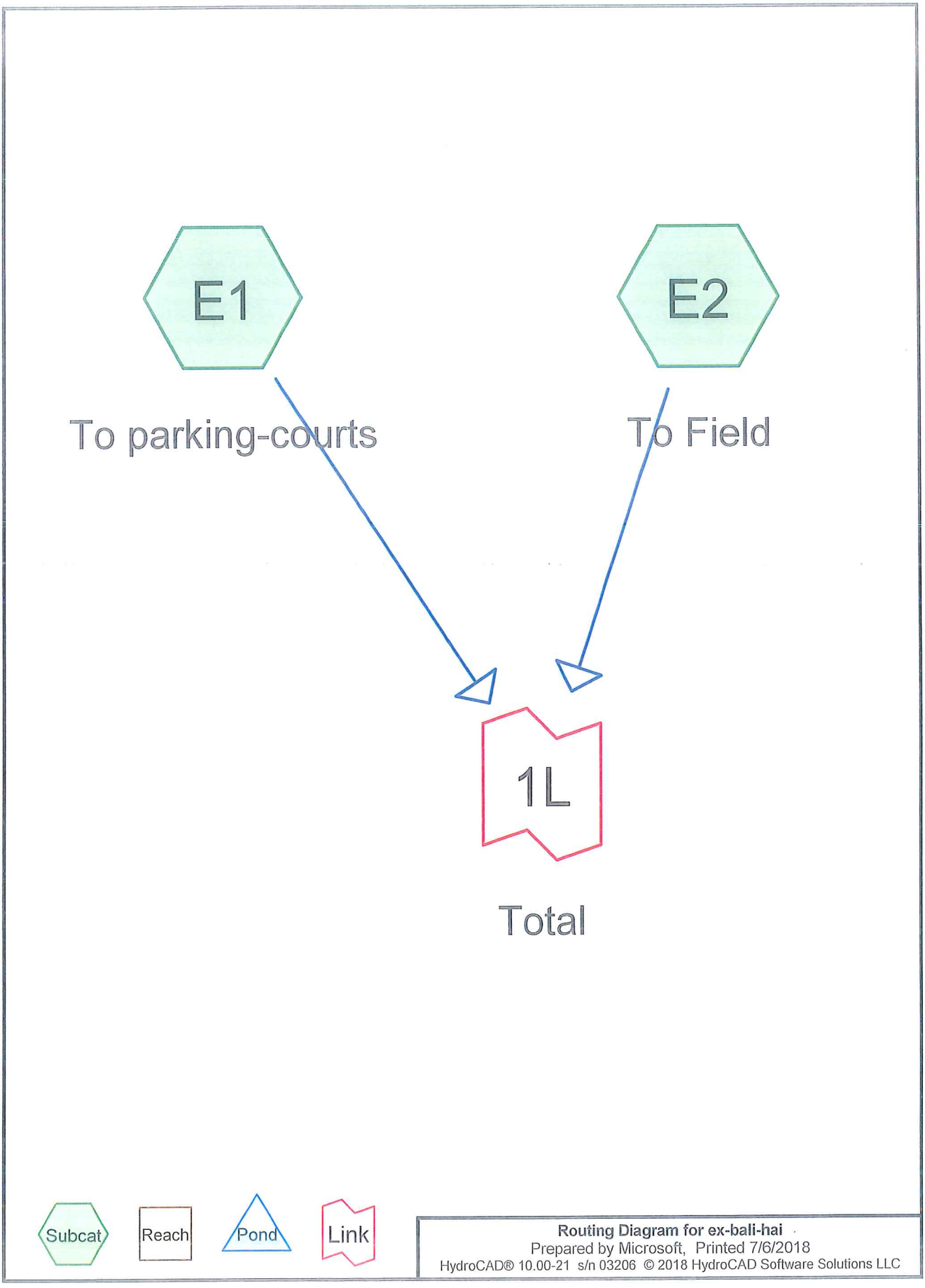
- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity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



Routing Diagram for ex-bali-hai
Prepared by Microsoft, Printed 7/6/2018

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
3,265	39	>75% Grass cover, Good, HSG A (E1)
2,177	35	Brush, Fair, HSG A along oak (E1)
695	48	Brush, Poor, HSG A front landscape (E1, E2)
51,271	98	Paved parking, HSG A (E1, E2)
7,950	98	Roofs, HSG A (E1)
11,413	30	Woods, Good, HSG A (E1, E2)
76,771	83	TOTAL AREA

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
76,771	HSG A	E1, E2
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
76,771		TOTAL AREA

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
3,265	0	0	0	0	3,265	>75% Grass cover, Good
2,177	0	0	0	0	2,177	Brush, Fair
695	0	0	0	0	695	Brush, Poor
51,271	0	0	0	0	51,271	Paved parking
7,950	0	0	0	0	7,950	Roofs
11,413	0	0	0	0	11,413	Woods, Good
76,771	0	0	0	0	76,771	TOTAL AREA

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: To parking-courts Runoff Area=28,974 sf 70.83% Impervious Runoff Depth=1.33"
Tc=6.0 min CN=80 Runoff=1.00 cfs 3,200 cf

Subcatchment E2: To Field Runoff Area=47,797 sf 80.97% Impervious Runoff Depth=1.67"
Tc=6.0 min CN=85 Runoff=2.11 cfs 6,662 cf

Link 1L: Total Inflow=3.11 cfs 9,862 cf
Primary=3.11 cfs 9,862 cf

Total Runoff Area = 76,771 sf Runoff Volume = 9,862 cf Average Runoff Depth = 1.54"
22.86% Pervious = 17,550 sf 77.14% Impervious = 59,221 sf

Summary for Subcatchment E1: To parking-courts

Runoff = 1.00 cfs @ 12.10 hrs, Volume= 3,200 cf, Depth= 1.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

	Area (sf)	CN	Description
	7,950	98	Roofs, HSG A
*	226	48	Brush, Poor, HSG A front landscape
*	2,177	35	Brush, Fair, HSG A along oak
	3,265	39	>75% Grass cover, Good, HSG A
	2,784	30	Woods, Good, HSG A
	12,572	98	Paved parking, HSG A
	28,974	80	Weighted Average
	8,452		29.17% Pervious Area
	20,522		70.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Direct, calc <2

Summary for Subcatchment E2: To Field

Runoff = 2.11 cfs @ 12.09 hrs, Volume= 6,662 cf, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

	Area (sf)	CN	Description
*	469	48	Brush, Poor, HSG A front landscape
	8,629	30	Woods, Good, HSG A
	38,699	98	Paved parking, HSG A
	47,797	85	Weighted Average
	9,098		19.03% Pervious Area
	38,699		80.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Direct, calc <2

Summary for Link 1L: Total

Inflow Area = 76,771 sf, 77.14% Impervious, Inflow Depth = 1.54" for 2 Year event
Inflow = 3.11 cfs @ 12.09 hrs, Volume= 9,862 cf
Primary = 3.11 cfs @ 12.09 hrs, Volume= 9,862 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: To parking-courts Runoff Area=28,974 sf 70.83% Impervious Runoff Depth=2.55"
Tc=6.0 min CN=80 Runoff=1.95 cfs 6,150 cf

Subcatchment E2: To Field Runoff Area=47,797 sf 80.97% Impervious Runoff Depth=3.00"
Tc=6.0 min CN=85 Runoff=3.75 cfs 11,951 cf

Link 1L: Total Inflow=5.70 cfs 18,100 cf
Primary=5.70 cfs 18,100 cf

Total Runoff Area = 76,771 sf Runoff Volume = 18,100 cf Average Runoff Depth = 2.83"
22.86% Pervious = 17,550 sf 77.14% Impervious = 59,221 sf

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: To parking-courts Runoff Area=28,974 sf 70.83% Impervious Runoff Depth=3.24"
Tc=6.0 min CN=80 Runoff=2.47 cfs 7,834 cf

Subcatchment E2: To Field Runoff Area=47,797 sf 80.97% Impervious Runoff Depth=3.74"
Tc=6.0 min CN=85 Runoff=4.64 cfs 14,895 cf

Link 1L: Total Inflow=7.12 cfs 22,729 cf
Primary=7.12 cfs 22,729 cf

Total Runoff Area = 76,771 sf Runoff Volume = 22,729 cf Average Runoff Depth = 3.55"
22.86% Pervious = 17,550 sf 77.14% Impervious = 59,221 sf

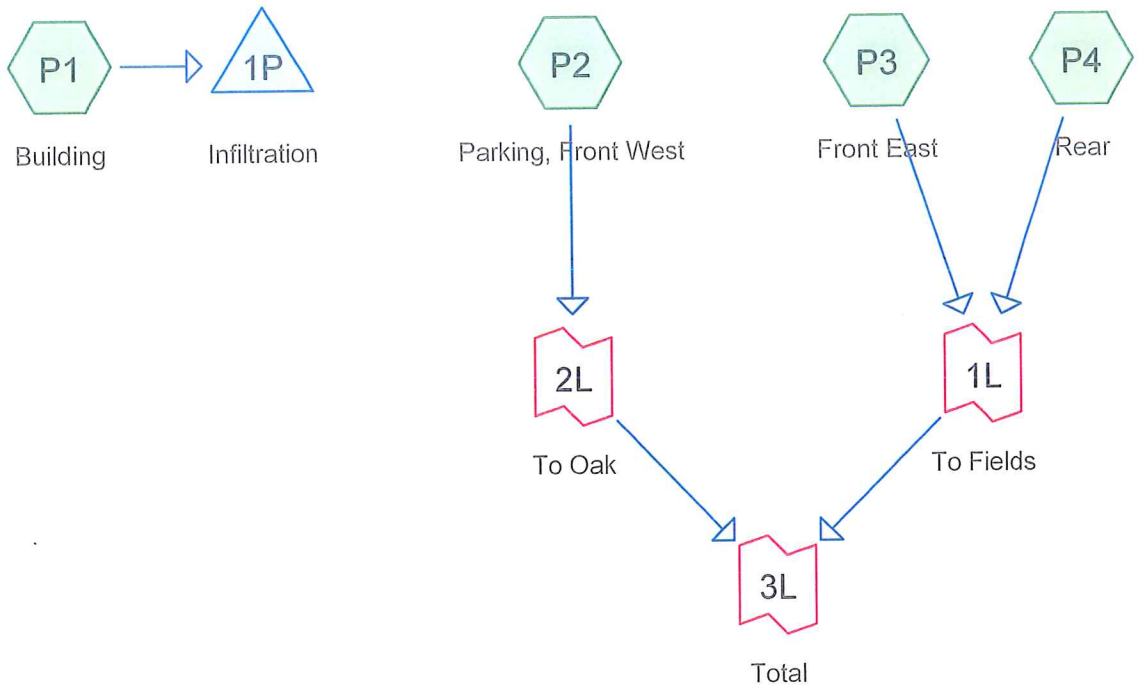
Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E1: To parking-courts Runoff Area=28,974 sf 70.83% Impervious Runoff Depth=4.24"
Tc=6.0 min CN=80 Runoff=3.21 cfs 10,226 cf

Subcatchment E2: To Field Runoff Area=47,797 sf 80.97% Impervious Runoff Depth=4.78"
Tc=6.0 min CN=85 Runoff=5.87 cfs 19,023 cf

Link 1L: Total Inflow=9.08 cfs 29,249 cf
Primary=9.08 cfs 29,249 cf

Total Runoff Area = 76,771 sf Runoff Volume = 29,249 cf Average Runoff Depth = 4.57"
22.86% Pervious = 17,550 sf 77.14% Impervious = 59,221 sf



Subcat Reach Pond Link

Routing Diagram for pr-bali-hai
Prepared by Microsoft, Printed 7/6/2018

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
31,147	39	>75% Grass cover, Good, HSG A (P2, P3, P4)
30,899	98	Paved parking, HSG A (P2, P3)
14,723	98	Roofs, HSG A (P1, P2, P3)
76,769	74	TOTAL AREA

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
76,769	HSG A	P1, P2, P3, P4
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
76,769		TOTAL AREA

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
31,147	0	0	0	0	31,147	>75% Grass cover, Good
30,899	0	0	0	0	30,899	Paved parking
14,723	0	0	0	0	14,723	Roofs
76,769	**0**	**0**	**0**	**0**	**76,769**	**TOTAL AREA**

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Building Runoff Area=14,000 sf 100.00% Impervious Runoff Depth=2.87"
Tc=6.0 min CN=98 Runoff=0.94 cfs 3,346 cf

Subcatchment P2: Parking, Front West Runoff Area=50,071 sf 61.38% Impervious Runoff Depth=1.03"
Tc=6.0 min CN=75 Runoff=1.30 cfs 4,284 cf

Subcatchment P3: Front East Runoff Area=9,223 sf 9.63% Impervious Runoff Depth=0.03"
Tc=6.0 min CN=45 Runoff=0.00 cfs 26 cf

Subcatchment P4: Rear Runoff Area=3,475 sf 0.00% Impervious Runoff Depth=0.00"
Tc=6.0 min CN=39 Runoff=0.00 cfs 0 cf

Pond 1P: Infiltration Peak Elev=118.95' Storage=0.013 af Inflow=0.94 cfs 3,346 cf
Outflow=0.27 cfs 3,346 cf

Link 1L: To Fields Inflow=0.00 cfs 26 cf
Primary=0.00 cfs 26 cf

Link 2L: To Oak Inflow=1.30 cfs 4,284 cf
Primary=1.30 cfs 4,284 cf

Link 3L: Total Inflow=1.30 cfs 4,310 cf
Primary=1.30 cfs 4,310 cf

Total Runoff Area = 76,769 sf Runoff Volume = 7,656 cf Average Runoff Depth = 1.20"
40.57% Pervious = 31,147 sf 59.43% Impervious = 45,622 sf

Summary for Subcatchment P1: Building

Runoff = 0.94 cfs @ 12.09 hrs, Volume= 3,346 cf, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
14,000	98	Roofs, HSG A
14,000		100.00% Impervious Area

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

Summary for Subcatchment P2: Parking, Front West

Runoff = 1.30 cfs @ 12.10 hrs, Volume= 4,284 cf, Depth= 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
19,337	39	>75% Grass cover, Good, HSG A
362	98	Roofs, HSG A
30,372	98	Paved parking, HSG A
50,071	75	Weighted Average
19,337		38.62% Pervious Area
30,734		61.38% Impervious Area

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

Summary for Subcatchment P3: Front East

Runoff = 0.00 cfs @ 15.61 hrs, Volume= 26 cf, Depth= 0.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
8,335	39	>75% Grass cover, Good, HSG A
361	98	Roofs, HSG A
527	98	Paved parking, HSG A
9,223	45	Weighted Average
8,335		90.37% Pervious Area
888		9.63% Impervious Area

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

Summary for Subcatchment P4: Rear

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
3,475	39	>75% Grass cover, Good, HSG A
3,475		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Direct, calc <2

Summary for Pond 1P: Infiltration

Inflow Area = 14,000 sf,100.00% Impervious, Inflow Depth = 2.87" for 2 Year event
Inflow = 0.94 cfs @ 12.09 hrs, Volume= 3,346 cf
Outflow = 0.27 cfs @ 11.80 hrs, Volume= 3,346 cf, Atten= 72%, Lag= 0.0 min
Discarded = 0.27 cfs @ 11.80 hrs, Volume= 3,346 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 118.95' @ 12.42 hrs Surf.Area= 0.032 ac Storage= 0.013 af

Plug-Flow detention time= 10.3 min calculated for 3,340 cf (100% of inflow)
Center-of-Mass det. time= 10.3 min (767.3 - 757.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	118.05'	0.033 af	**30.00'W x 46.34'L x 3.75'H Field A** 0.120 af Overall - 0.038 af Embedded = 0.081 af x 40.0% Voids
#2A	118.80'	0.038 af	**ADS_StormTech DC-780 +Cap** x 36 Inside #1 Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 6 Rows of 6 Chambers
		0.071 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	118.05'	**8.270 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.27 cfs @ 11.80 hrs HW=118.09' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.27 cfs)

Summary for Link 1L: To Fields

Inflow Area = 12,698 sf, 6.99% impervious, Inflow Depth = 0.02" for 2 Year event
Inflow = 0.00 cfs @ 15.61 hrs, Volume= 26 cf
Primary = 0.00 cfs @ 15.61 hrs, Volume= 26 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Link 2L: To Oak

Inflow Area = 50,071 sf, 61.38% Impervious, Inflow Depth = 1.03" for 2 Year event
Inflow = 1.30 cfs @ 12.10 hrs, Volume= 4,284 cf
Primary = 1.30 cfs @ 12.10 hrs, Volume= 4,284 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Link 3L: Total

Inflow Area = 62,769 sf, 50.38% Impervious, Inflow Depth = 0.82" for 2 Year event
Inflow = 1.30 cfs @ 12.10 hrs, Volume= 4,310 cf
Primary = 1.30 cfs @ 12.10 hrs, Volume= 4,310 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Building Runoff Area=14,000 sf 100.00% Impervious Runoff Depth=4.36"
Tc=6.0 min CN=98 Runoff=1.41 cfs 5,091 cf

Subcatchment P2: Parking, Front West Runoff Area=50,071 sf 61.38% Impervious Runoff Depth=2.13"
Tc=6.0 min CN=75 Runoff=2.80 cfs 8,884 cf

Subcatchment P3: Front East Runoff Area=9,223 sf 9.63% Impervious Runoff Depth=0.32"
Tc=6.0 min CN=45 Runoff=0.03 cfs 248 cf

Subcatchment P4: Rear Runoff Area=3,475 sf 0.00% Impervious Runoff Depth=0.13"
Tc=6.0 min CN=39 Runoff=0.00 cfs 37 cf

Pond 1P: Infiltration Peak Elev=119.53' Storage=0.028 af Inflow=1.41 cfs 5,091 cf
Outflow=0.27 cfs 5,091 cf

Link 1L: To Fields Inflow=0.03 cfs 285 cf
Primary=0.03 cfs 285 cf

Link 2L: To Oak Inflow=2.80 cfs 8,884 cf
Primary=2.80 cfs 8,884 cf

Link 3L: Total Inflow=2.80 cfs 9,169 cf
Primary=2.80 cfs 9,169 cf

Total Runoff Area = 76,769 sf Runoff Volume = 14,260 cf Average Runoff Depth = 2.23"
40.57% Pervious = 31,147 sf 59.43% Impervious = 45,622 sf

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Building	Runoff Area=14,000 sf 100.00% Impervious Runoff Depth=5.16" Tc=6.0 min CN=98 Runoff=1.66 cfs 6,023 cf
Subcatchment P2: Parking, Front West	Runoff Area=50,071 sf 61.38% Impervious Runoff Depth=2.78" Tc=6.0 min CN=75 Runoff=3.67 cfs 11,589 cf
Subcatchment P3: Front East	Runoff Area=9,223 sf 9.63% Impervious Runoff Depth=0.58" Tc=6.0 min CN=45 Runoff=0.07 cfs 442 cf
Subcatchment P4: Rear	Runoff Area=3,475 sf 0.00% Impervious Runoff Depth=0.29" Tc=6.0 min CN=39 Runoff=0.01 cfs 83 cf
Pond 1P: Infiltration	Peak Elev=119.87' Storage=0.036 af Inflow=1.66 cfs 6,023 cf Outflow=0.27 cfs 6,023 cf
Link 1L: To Fields	Inflow=0.07 cfs 526 cf Primary=0.07 cfs 526 cf
Link 2L: To Oak	Inflow=3.67 cfs 11,589 cf Primary=3.67 cfs 11,589 cf
Link 3L: Total	Inflow=3.72 cfs 12,115 cf Primary=3.72 cfs 12,115 cf

Total Runoff Area = 76,769 sf Runoff Volume = 18,138 cf Average Runoff Depth = 2.84"
40.57% Pervious = 31,147 sf 59.43% Impervious = 45,622 sf

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Building Runoff Area=14,000 sf 100.00% Impervious Runoff Depth=6.26"
Tc=6.0 min CN=98 Runoff=2.00 cfs 7,305 cf

Subcatchment P2: Parking, Front West Runoff Area=50,071 sf 61.38% Impervious Runoff Depth=3.71"
Tc=6.0 min CN=75 Runoff=4.90 cfs 15,489 cf

Subcatchment P3: Front East Runoff Area=9,223 sf 9.63% Impervious Runoff Depth=1.01"
Tc=6.0 min CN=45 Runoff=0.17 cfs 777 cf

Subcatchment P4: Rear Runoff Area=3,475 sf 0.00% Impervious Runoff Depth=0.60"
Tc=6.0 min CN=39 Runoff=0.02 cfs 173 cf

Pond 1P: Infiltration Peak Elev=120.39' Storage=0.048 af Inflow=2.00 cfs 7,305 cf
Outflow=0.27 cfs 7,305 cf

Link 1L: To Fields Inflow=0.18 cfs 950 cf
Primary=0.18 cfs 950 cf

Link 2L: To Oak Inflow=4.90 cfs 15,489 cf
Primary=4.90 cfs 15,489 cf

Link 3L: Total Inflow=5.08 cfs 16,439 cf
Primary=5.08 cfs 16,439 cf

Total Runoff Area = 76,769 sf Runoff Volume = 23,744 cf Average Runoff Depth = 3.71"
40.57% Pervious = 31,147 sf 59.43% Impervious = 45,622 sf

Pond 1P: Infiltration - Chamber Wizard Field A

Chamber Model = ADS_StormTech DC-780 +Cap (ADS StormTech® DC-780 with cap length)
Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

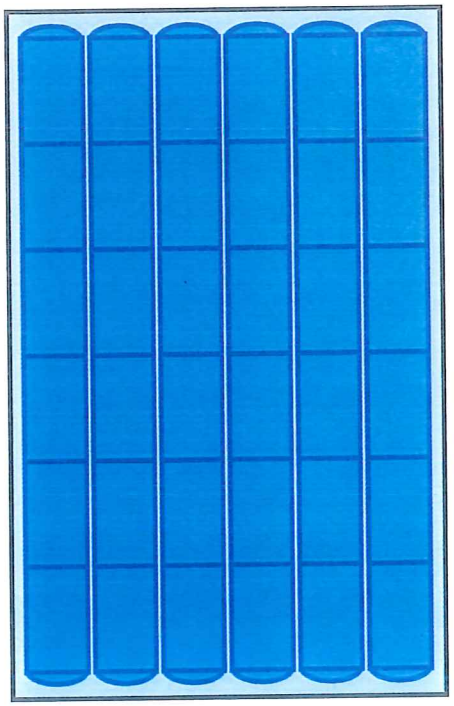
6 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 44.34' Row Length +12.0" End Stone x 2 = 46.34' Base Length
6 Rows x 51.0" Wide + 6.0" Spacing x 5 + 12.0" Side Stone x 2 = 30.00' Base Width
9.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.75' Field Height

36 Chambers x 46.2 cf = 1,664.6 cf Chamber Storage

5,212.9 cf Field - 1,664.6 cf Chambers = 3,548.3 cf Stone x 40.0% Voids = 1,419.3 cf Stone Storage

Chamber Storage + Stone Storage = 3,083.9 cf = 0.071 af
Overall Storage Efficiency = 59.2%
Overall System Size = 46.34' x 30.00' x 3.75'

36 Chambers
193.1 cy Field
131.4 cy Stone



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

SITE DESCRIPTION

Project Name and Location: (Latitude, Longitude, or Address)

160 Moulton Drive
Lynnfield, MA 01940

Owner Name and Address

Top Tier Properties
93 Maple Street
Malden, MA 02148

Applicant Name and Address

Top Tier Properties
93 Maple Street
Malden, MA 02148

Description: (Purpose and Types of Soil Disturbing Activities)

The proposed project is the redevelopment of an existing restaurant site to accommodate a new luxury apartment building, parking and stormwater BMPs, and all appurtenant site work. Soil disturbing activities include installation of erosion and sediment control devices; excavation; drainage system and utility installation; stormwater BMP installation and construction; building construction; parking lot paving; and landscaping.

Sequence of Major Activities

The order of activities shall be as follows:

1. Install erosion and sediment control devices
2. Demolish existing restaurant building, remove existing pavement.
3. Stabilize stockpiles within 14 days of last construction activity in that area
4. Stabilize exposed surfaces where the period of exposure shall be more than two months, but less than twelve months within 14 days of last construction activity in that area
5. Commence grading and excavation activities.
6. Commence building and stormwater management area, and parking lot construction (grade to subgrade elevations, install drainage structures; install utilities, install gravel to appropriate elevations, install binder coat of pavement followed by curbing).
7. Install binder coat of pavement followed by curbing
8. Loam and seed all disturbed areas.
9. Install final pavement course and final inspection of all stormwater BMPs.

CONTROLS

Erosion and Sediment Control Stabilization Practices

The Site Contractor / Project Manager ("Manager") is responsible for ensuring that erosion and sedimentation control practices and controls are followed upon commencement of, and during project construction.

A. Protecting and Minimizing Exposed Areas

The project will temporarily leave bare earth open to erosion. Steps shall be taken to minimize this area of exposure by preserving existing vegetation and providing soil stabilization. Equipment and trucks shall be routed only over the existing pavement or areas of proposed work and workers shall minimize foot traffic in vegetated areas adjacent to the work area as much as possible. During site work, utilization of stabilization techniques is necessary for controlling erosion on exposed areas, including grading, seeding and otherwise stabilizing the areas.

B. Sediment And Erosion Control / Soil Stabilization

i) Prior to any construction occurring adjacent to identified resource areas (shown on the plan and/or marked in the field), proper erosion and siltation barriers shall be installed so that throughout and until completion of construction, those areas will be afforded maximum protection. Temporary stockpiles of soil shall be surrounded with an erosion control barrier to prevent sediments from exiting the subject property. All erosion control barriers must be maintained in functioning condition and periodically inspected until areas of bare soil are stabilized to ensure that they are in functioning condition. Any accumulations of sediments present along erosion control barriers shall be removed as soon as possible after deposition in order to ensure the effectiveness of all sedimentation controls.

On sites where grading or other work will occur on moderately steep slopes (3:1 and greater) located immediately upgradient of wetlands, the contractor shall work on one portion of the slope at a time, ensuring the stability of the disturbed soil by immediately loaming and seeding the slope, or otherwise vegetating the slope as desired, and installing erosion control mats (straw or cocoanut fiber designed for the slope steepness). If work is interrupted and the slope is to be left bare or otherwise unstabilized for duration of a day or more, a series of erosion control fences oriented parallel to the slope.

Vegetational Covers

Temporary Vegetational Cover

Any area proposed for removal of vegetation where soil will be exposed for more than 10 days shall be mulched or otherwise treated to prevent erosion. On sediment-producing areas in the buffer zone, where the period of exposure will be more than 30 days, the following procedures should be followed for a cover of annual rye. When bare soils are not completely graded and vegetated by September 30 of any year, winter rye shall be planted as specified in table and mulched with three (3) inches of hay or straw.

a. Install needed surface water control measures.

b. Perform all cultural operations at right angles to the slope.

c. Establish grass or other ground cover species as recommended in the attached excerpt (pgs 144 -146) from Massachusetts Erosion and Sedimentation Guidelines for Urban and Suburban Areas, 2003.

1. Permanent Vegetational Cover

To reduce damages from the potential incidence of sedimentation and runoff to other properties, and to avoid erosion on the site itself, a permanent type cover shall be established in disturbed areas located adjacent to resource areas immediately upon completion of grading. Seeding herbaceous cover is usually the most economical and practical way to stabilize any large area. For this site, all disturbed areas where lawns are desired will be seeded in fall during the period of August 1 to October 1; or in spring by May 15 with a commercial lawn mixture utilizing standard landscape methods and as recommended by the seed manufacturer. Grass sod or landscape plantings may be used instead of seed, if preferred.

In upland/ buffer zone areas, outside of lawn locations, where an erosion control - wildlife seed mixture is desired, prepare soil and use one of grass seed mixes #1 through #6 as recommended in the attached excerpts (pgs 136 -139) from Massachusetts Erosion and Sedimentation Guidelines for Urban and Suburban Areas 2003, to establish a stable, permanent cover.

REFERENCES

Department of Environmental Protection, Bureau of Resource Protection and U.S. Environmental Protection Agency, Massachusetts Erosion and Sedimentation Guidelines for Urban and Suburban Areas: A Guide for Planners, Designers and Municipal Officials. Massachusetts Executive Office of Environmental Affairs, Boston, Massachusetts, Reprint: May 2003.

Seeding Dates
Seeding operations should be performed as an early spring seeding (April 1-May 15) with the use of cold treated seed. A late fall early winter dormant seeding (November 1 - December 15) can also be made, however the seeding rate will need to be increased by 50%.

Seeding Methods
Seeding should be performed by one of the following methods:
- Drill seedings (de-awned or de-bearded seed should be used unless the drill is equipped with special features to accept awned seed).
- Broadcast seeding with subsequent rolling, cultipacking or tracking the seeding with small track construction equipment. Tracking should be oriented up and down the slope.
- Hydroseeding with subsequent tracking. If wood fiber mulch is used, it should be applied as a separate operation after seeding and tracking to assure good seed to soil contact.

Mulch
Mulch the seedings with straw applied at the rate of ½ tons per acre. Anchor the mulch with erosion control netting or fabric on sloping areas.

Seed Mixtures for Permanent Cover
Recommended mixtures for permanent seeding are provided on the following pages. Select plant species which are suited to the site conditions and planned use. Soil moisture conditions, often the major limiting site factor, are usually classified as follows:

Dry - Sands and gravels to sandy loams. No effective moisture supply from seepage or a high water table.

Moist - Well drained to moderately well drained sandy loams, loams, and finer, or coarser textured material with moderate influence on root zone from seepage or a high water table

Wet - All textures with a water table at or very near the soil surface, or with enduring seepage.

When other factors strongly influence site conditions, the plants selected must also be tolerant of these conditions.

Permanent Seeding Mixtures

Mix	Site	Seed Mixture	Seed, Pounds per: Acre	1,000 sf	Remarks
1	Dry	Little Bluestem or Broomsedge	10	0.25	* Use Warm Season planting procedure. * Roadsides
		Tumble Lovegrass*	1	0.10	* Sand and Gravel Stabilization
		Switchgrass	10	0.25	* Clover requires inoculation with nitrogen-fixing bacteria
		Bush Clover*	2	0.10	
		Red Top	1	0.10	* Rates for this mix are for PLS.
2	Dry	Deertongue	15	0.35	* Use Warm Season planting procedures.
		Broomsedge	10	0.25	* Acid sites/Mine spoil
		Bush Clover*	2	0.10	* Clover requires inoculation with nitrogen-fixing bacteria.
		Red Top	1	0.10	*Rates for this mix are for PLS.
3	Dry	Big Bluestem	10	0.25	* Use Warm Season planting procedures.
		Indian Grass	10	0.25	* Eastern Prairie appearance
		Switchgrass	10	0.25	* Sand and Gravel pits.
		Little Bluestem	10	0.25	* Golf Course Wild Areas
		Red Top or	1	0.10	* Sanitary Landfill Cover seeding
		Perennial Ryegrass	10	0.25	* Wildlife Areas *OK to substitute Poverty Dropseed in place of Red Top/Ryegrass. *Rates for this mix are for PLS.
4	Dry	Flat Pea	25	0.60	* Use Cool Season planting procedures
		Red Top or	2	0.10	* Utility Rights-of-Ways (tends to suppress
		Perennial Ryegrass	15	0.35	woody growth)
5	Dry	Little Bluestem	5	0.10	* Use Warm Season planting procedures.
		Switchgrass	10	0.25	* Coastal sites
		Beach Pea*	20	0.45	* Rates for Bluestein and Switchgrass are for
		Perennial Ryegrass	10	0.25	PLS.
6	Dry - Moist	Red Fescue	10	0.25	* Use Cool Season planting procedure.
		Canada Bluegrass	10	0.25	* Provides quick cover but is non-aggressive;
		Perennial Ryegrass	10	0.25	will tend to allow indigenous plant colonization.
		Red Top	1	0.10	* General erosion control on variety of sites, including forest roads, skid trails and landings.
7	Moist-Wet	Switchgrass	10	0.25	* Use Warm Season planting procedure.
		Virginia Wild Rye	5	0.10	* Coastal plain/flood plain
		Big Bluestem	15	0.35	* Rates for Bluestem and Switchgrass are for
		Red Top	1	0.10	PLS.

Permanent Seeding Mixtures

Mix	Site	Seed Mixture	Seed, Pounds per: Acre	1,000 sf	Remarks
8	Moist Wet	Creeping Bentgrass	5	0.10	* Use Cool Season planting procedures.
		Fringed Bromegrass	5	0.10	* Pond Banks
		Fowl Meadowgrass	5	0.10	* Waterways/ditch banks
		Bluejoint Reedgrass or Rice Cutgrass	2	0.10	
		Perennial Ryegrass	10	0.25	
9	Moist Wet	Red Fescue	5	0.10	*Salt Tolerant
		Creeping Bentgrass	2	0.10	* Fescue and Bentgrass provide low growing appearance, while Switchgrass provides tall cover for wildlife.
		Switchgrass	8	0.20	
		Perennial Ryegrass	10	0.25	
10	Moist Wet	Red Fescue	5	0.10	* Use Cool Season planting procedure.
		Creeping Bentgrass	5	0.10	* Trefoil requires inoculation with nitrogen fixing bacteria.
		Virginia Wild Rye	8	0.20	
		Wood Reed Grass*	1	0.10	* Suitable for forest access roads, skid trails and other partial shade situations.
		Showy Tick Trefoil*	1	0.10	
11	Moist Wet	Creeping Bentgrass	5	0.10	* Use Cool Season planting procedure.
		Bluejoint Reed Grass	1	0.10	* Suitable for waterways, pond or ditch banks.
		Virginia Wild Rye	3	0.10	* Trefoil requires inoculation with nitrogen fixing bacteria.
		Fowl Meadow Grass	10	0.25	
		Showy Tick Trefoil*	1	0.10	
		Red Top	1	0.10	
12	Wet	Blue Joint Reed Grass	1	0.10	* Use Cool Season planting procedure.
		Canada Manna Grass	1	0.10	* OK to seed in saturated soil conditions, but not in standing water.
		Rice Cut Grass	1	0.10	
		Creeping Bent Grass	5	0.10	* Suitable as stabilization seeding for created wetland.
		Fowl Meadow Grass	5	0.10	* All species in this mix are native to Massachusetts.
13	Dry-Moist	American Beachgrass	18" centers	18' centers	*Vegetative planting with dormant culms, 3-5 culms per planting
14	Inter-Tidal	Smooth Cordgrass Saltmeadow Cordgrass	12-18" centers	12-18" centers	* Vegetative planting with transplants.

Notes:

* Species such as Tumble Lovegrass, Fringed Bromegrass, Wood Reedgrass, Bush Clover and Beach Pea, while known to be commercially available from specific seed suppliers, may not always be available from your particular seed suppliers. The local Natural Resources Conservation Service office may be able to help with a source of supply. In the event a particular species listed in a mix can not be obtained, however, it may be possible to substitute another species.

Seed mixtures by courtesy of Natural Resources Conservation Service, Amherst, MA.

(PLS) Pure Live Seed

Warm Season grass seed is sold and planted on the basis of pure live seed. An adjustment is made to the bulk rate of the seed to compensate for inert material and non-viable seed. Percent of pure live seed is calculated by multiplying the percent purity by the percent germination: (% purity) x (% germination) = percent PLS.

For example, if the seeding rate calls for 10 lbs /acre PLS and the seed lot has a purity of 70% and germination of 75%, the PLS factor is:

(.70 x .75) =.53

10 lbs. divided by .53 = approx. 19 lbs.

Therefore, 19 lbs of seed from the particular lot will need to be applied to obtain 10 lbs. of pure live seed.

Special Note

Tall Fescue, Reed Canary Grass, Crownvetch and Birdsfoot Trefoil are no longer recommended for general erosion control use in Massachusetts due to the invasive characteristics of each. If these species are used, it is recommended that the ecosystem of the site be analyzed for the effects species invasiveness may impose. The mixes listed in the above mixtures include either species native to Massachusetts or non-native species that are not perceived to be invasive, as per the Massachusetts Native Plant Advisory Committee.

Wetlands Seed Mixtures

For newly created wetlands, a wetlands specialist should design plantings to provide the best chance of success. Do not use introduced, invasive plants like reed canarygrass (Phalaris arundinacea) or purple loosestrife (Lythrum salicaria). Using plants such as these will cause many more problems than they will solve

The following grasses all thrive in wetland situations

- Fresh Water Cordgrass (*Spartina pectinata*)
- Marsh/Creeping Bentgrass (*Agrostis stolonifera, var. Palustric*)
- Broomsedge (*Andropogon virginicus*)
- Fringed Bromegrass (*Bromus ciliatus*)
- Blue Joint Reed Grass (*Calamagrostis cavedensis*)
- Fowl Meadow Grass (*Glyceria striata*)
- Riverbank Wild Rye (*Elymus riparius*)
- Rice Cutgrass (*Leersia oryzoides*)
- Stout Wood Reed (*Cinna arundinacea*)
- Canada Manna Grass (*Glyceria canadensis*)

A sample wetlands seed mix developed by The New England Environmental Wetland Plant Nursery is shown on the following page.

Wetland Seed Mixture

The New England Environmental Wetland Plant Nursery has developed a seed mixture which is specifically designed to be used in wetland replication projects and stormwater detention basins. It is composed of seeds from a variety of indigenous wetland species. Establishing a native wetland plant understory in these areas provides quick erosion control, wildlife food and cover, and helps to reduce the establishment of undesirable invasive species such as Phragmites and purple loosestrife (Lythrum salicaria). The species have been selected to represent varying degrees of drought tolerance, and will establish themselves based upon microtopography and the resulting variation in soil moisture.

Common Name (*Scientific Name*)	% in Mix	Comments
Lurid Sedge (*Carex lurida*)	30	A low ground cover that tolerates mesic sites in addition to saturated areas; prolific seeder in second growing season.
Fowl Meadow Grass (*Glyceria Canadensis*)	25	Prolific seed producer that is a valuable wildlife food source.
Fringed Sedge (*Carex crinita*)	10	A medium to large sedge that tolerates saturated areas; good seed producer.
Joe-Pye Weed (*Eupatoriadelphus maculatus*)	10	Flowering plant that is valuable for wildlife cover. Grows to 4 feet.
Brook Sedge (*Carex spp., Ovales group*)	10	Tolerates a wide range of hydrologic conditions.
Woolgrass (*Scirpus cyperinus*)	5	Tolerates fluctuating hydrology.
Boneset (*Eupatorium perfoliatum*)	5	Flowering Plant that is valuable for wildlife cover. Grows to 3 feet.
Tussock Sedge (*Carex stricta*)	<5	Grows in elevated hummocks on wet sites, may grow rhizomonously on drier sites.
Blue Vervain (*Verbena hastata*)	<5	A native plant that bears attractive, blue flowers.

The recommended application rate is one pound per 5,000 square feet when used as an understory cover. This rate should be increased to one pound per 2,500 square feet for detention basins and other sites which require a very dense cover. For best results, a late fall application is recommended. This mix is not recommended for standing water.

Maintenance

Inspect seeded areas for failure and make necessary repairs and reseed immediately. Conduct or follow-up survey after one year and replace failed plants where necessary.

If vegetative cover is inadequate to prevent rill erosion, overseed and fertilize in accordance with soil test results.

If a stand has less than 40% cover, reevaluate choice of plant materials and quantities of lime and fertilizer. Re-establish the stand following seedbed preparation and seeding recommendations, omitting lime and fertilizer in the absence of soil test results. If the season prevents reseeding, mulch or jute netting is an effective temporary cover.

Seeded areas should be fertilized during the second growing season. Lime and fertilize thereafter at periodic intervals, as needed.

References

North Carolina Department of Environment, Health, and Natural Resources, *Erosion and Sediment Control Field Manual*, Raleigh, NC, February 1991.

Personal communication, Richard J. DeVergilio, USDA, Natural Resources Conservation Service, Amherst, MA.

U.S. Environmental Protection Agency, *Storm Water Management For Construction Activities*, EPA-832-R- 92-005, Washington, DC, September, 1992.

Washington State Department of Ecology, *Stormwater Management Manual for the Puget Sound Basin*, Olympia, WA, February, 1992.

Seeding, Temporary

Planting rapid-growing annual grasses, small grains, or legumes to provide initial, temporary cover for erosion control on disturbed areas.

Purpose

To temporarily stabilize areas that will not be brought to final grade for a period of more than 30 working days.

To stabilize disturbed areas before final grading or in a season not suitable for permanent seeding.

Temporary seeding controls runoff and erosion until permanent vegetation or other erosion control measures can be established.

Root systems hold down the soils so that they are less apt to be carried offsite by storm water runoff or wind.

Temporary seeding also reduces the problems associated with mud and dust from bare soil surfaces during construction.

Where Practice Applies

On any cleared, unvegetated, or sparsely vegetated soil surface where vegetative cover is needed for less than one year. Applications of this practice include diversions, dams, temporary sediment basins, temporary road banks, and topsoil stockpiles.

Where permanent structures are to be installed or extensive re-grading of the area will occur prior to the establishment of permanent vegetation.

Areas which will not be subjected to heavy wear by construction traffic.

Areas sloping up to 10% for 100 feet or less, where temporary seeding is the only practice used.

Advantages

This is a relatively inexpensive form of erosion control but should only be used on sites awaiting permanent planting or grading. Those sites should have permanent measures used.

Vegetation will not only prevent erosion from occurring, but will also trap sediment in runoff from other parts of the site.

Temporary seeding offers fairly rapid protection to exposed areas.

Disadvantages/Problems

Temporary seeding is only viable when there is a sufficient window in time for plants to grow and establish cover. It depends heavily on the season and rainfall rate for success.

If sown on subsoil, growth will be poor unless heavily fertilized and limed. Because overfertilization can cause pollution of stormwater runoff, other practices such as mulching alone may be more appropriate. The potential for over-fertilization is an even worse problem in or near aquatic systems.

Once seeded, areas should not be travelled over.

Irrigation may be needed for successful growth. Regular irrigation is not encouraged because of the expense and the potential for erosion in areas that are not regularly inspected.

Planning Considerations

Temporary seedings provide protective cover for less than one year. Areas must be reseeded annual or planted with perennial vegetation.

Temporary seeding is used to protect earthen sediment control practices and to stabilize denuded areas that will not be brought into final grade for several weeks or months. Temporary seeding can provide a nurse crop for permanent vegetation, provide residue for soil protection and seedbed preparation, and help prevent dust production during construction.

Use low-maintenance native species wherever possible.

Planting should be timed to minimize the need for irrigation.

Sheet erosion, caused by the impact of rain on bare soil, is the source of most fine particles in sediment. To reduce this sediment load in runoff, the soil surface itself should be protected. The most efficient and economical means of controlling sheet and rill erosion is to establish vegetative cover. Annual plants which sprout rapidly and survive for only one growing season are suitable for establishing temporary vegetative cover. Temporary seeding is effective when combined with construction phasing so bare areas of the site are minimized at all times.

Temporary seeding may prevent costly maintenance operations on other erosion control systems. For example, sediment basin clean-outs will be reduced if the drainage area of the basin is seeded where grading and construction are not taking place. Perimeter dikes will be more effective if not choked with sediment.

Proper seedbed preparation and the use of quality seed are important in this practice just as in permanent seeding. Failure to carefully follow sound agronomic recommendations will often result in an inadequate stand of vegetation that provides little or no erosion control.

Soil that has been compacted by heavy traffic or machinery may need to be loosened. Successful growth usually requires that the soil be tilled before the seed is applied. Topsoiling is not necessary for temporary seeding; however, it may improve the chances of establishing temporary vegetation in an area.

Planting Procedures

Time of Planting

Planting should preferably be done between April 1 and June 30, and September 1 through September 30. If planting is done in the months of July and August, irrigation may be required. If planting is done between October 1 and March 31, mulching should be applied immediately after planting. If seeding is done during the summer months, irrigation of some sort will probably be necessary.

Site Preparation

Before seeding, install needed surface runoff control measures such as gradient terraces, interceptor dike/swales, level spreaders, and sediment basins.

Seedbed Preparation

The seedbed should be firm with a fairly fine surface.

Perform all cultural operations across or at right angles to the slope. See **Topsoiling** and **Surface Roughening** for more information on seedbed preparation. A minimum of 2 to 4 inches of tilled topsoil is required.

Liming and Fertilization

Apply uniformly 2 tons of ground limestone per acre (100 lbs. per 1,000 Sq. Ft.) or according to soil test.

Apply uniformly 10-10-10 analysis fertilizer at the rate of 400 lbs. per acre (14 lbs. per 1,000 Sq. Ft.) or as indicated by soil test. Forty percent of the nitrogen should be in organic form.

Work in lime and fertilizer to a depth of 4 inches using any suitable equipment.

Seedings for Temporary Cover

Species	*Seeding Rates lbs/sq.ft.* 1,000 Sq.Ft.	Acre	*Recommended* Seeding Dates
Annual Ryegrass	1	40	April 1 to June 1 Aug. 15 to Sept. 15
Foxtail Millet	0.7	30	May 1 to June 30
Oats	2	80	April 1 to July 1 August 15 to Sept. 15
Winter Rye	3	120	Aug. 15 to Oct. 15

"Hydro-seeding" applications with appropriate seed-mulch-fertilizer mixtures may also be used.

Seeding

Select adapted species from the accompanying table.

Apply seed uniformly according to the rate indicated in the table by broadcasting, drilling or hydraulic application.

Cover seeds with suitable equipment as follows:

- Rye grass ¼ inch
- Millet ½ to ¾ inch
- Oats 1 to 1-1/2 inches
- Winter rye 1 to 1-1/2 inches.

Mulch

Use an effective mulch, such as clean grain straw; tacked and/or tied down with netting to protect seedbed and encourage plant growth.

Common Trouble Points

Lime and fertilizer not incorporated to at least 4 inches

May be lost to runoff or remain concentrated near the surface where they may inhibit germination.

Mulch rate inadequate or straw mulch not tacked down

Results in poor germination or failure, and erosion damage. Repair damaged areas, reseed and mulch.

Annual ryegrass used for temporary seeding
Ryegrass reseeds itself and makes it difficult to establish a good cover of permanent vegetation.
Seed not broadcast evenly or rate too low
Results in patchy growth and erosion.

Maintenance

Inspect within 6 weeks of planting to see if stands are adequate. Check for damage after heavy rains. Stands should be uniform and dense. Fertilize, reseed, and mulch damaged and sparse areas immediately. Tack or tie down mulch as necessary.

Seeds should be supplied with adequate moisture. Furnish water as needed, especially in abnormally hot or dry weather or on adverse sites. Water application rates should be controlled to prevent runoff.

References

Massachusetts Department of Environmental Protection, Office of Watershed Management, Nonpoint Source Program, Massachusetts *Nonpoint Source Management Manual.* Boston, Massachusetts, June, 1993.

North Carolina Department of Environment, Health, and Natural Resources, *Erosion and Sediment Control Field Manual*, Raleigh, NC, February 1991.

U.S. Environmental Protection Agency, *Storm Water Management For Construction Activities*, EPA-832-R- 92-005, Washington, DC, September, 1992.

Washington State Department of Ecology, *Stormwater Management Manual for the Puget Sound Basin*, Olympia, WA, February, 1992.

Silt Curtain

A temporary sediment barrier installed parallel to the bank of a stream or lake. Used to contain the sediment produced by construction operations on the bank of a stream or lake and allow for its removal.

Where Practice Applies

The silt curtain is used along the banks of streams or lakes where sediment could pollute or degrade the stream or lake.

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

Structural Practices

Silt Fencing/HayBales – shall be installed as shown on the approved plans to help prevent erosion and sedimentation to the downstream wetland resources on the project.
Catch Basin – shall be fitted with "silt sack"-type devices during construction to prevent the accumulation of sediments in the catch basin sumps. Catch basins are to be cleaned as needed during construction using a truck-mounted vacuum device.
Tracking Pad - shall be installed in the initial stage of construction as shown on the approved plans to reduce deposition of sediments on the existing paved road.

Stormwater Management

The proposed stormwater management plan in the drainage analysis outlines the impacts of stormwater runoff for the project as it related to the downstream areas of comparison. Elements incorporated in the design of the stormwater management plan include the following best management practices (BMPs):

1. HDPE Subsurface Detention Chambers

Utilization of these BMPs as part of the overall watershed management plan will be instrumental in reducing the peak rate of runoff from the site into the wetland.

OTHER CONTROLS

Waste Disposal:

Waste Materials: all waste material shall be collected and stored in secure metal dumpsters rented from a licensed solid waste management company in Massachusetts. The dumpsters shall meet all local and State solid waste management regulations as outlined in 310 CMR 19.00. All trash and construction debris generated on site shall be disposed of in the dumpsters. The dumpsters shall be emptied as often as necessary during construction and transferred to an approved solid waste facility licensed to accept municipal solid waste and/or construction and demolition debris. No construction waste shall be buried on site. All personnel shall be instructed regarding the correct procedure for waste disposal.
Hazardous Waste: All hazardous waste materials shall be disposed of in a manner specified by local or State regulation or by the manufacturer. Site personnel shall be instructed in these practices.
Sanitary Waste: All sanitary waste shall be collected from portable units, as needed, by a septage hauler licensed in Massachusetts, in accordance with the requirements of the local Board of Health.

Offsite Vehicle Tracking:

Construction entrance and exit shall be via Moulton Drive. Accumulated sediments must be removed on a regular basis from the site entrance and adjacent roadway via street sweeping or hand sweeping operations as necessary.

TIMING OF CONTROLS/MEASURES

As indicated in the Sequence of Major Activities, the installation of erosion and sediment control devices and installation of stabilized construction entrances shall be in place prior to major earth excavation activities. Areas where construction activities are exposed more than two months, but less than 12 months shall be stabilized with the temporary stabilization practices referred to above. Once construction activity has been completed in a particular area, that area shall then be stabilized with permanent seed and mulch.

MAINTENANCE/INSPECTION PROCEDURES

Erosion and Sediment Control Inspection and Maintenance Practices

The following items represent the inspection and maintenance practices that shall be used to maintain sediment and erosion control for the project.

1. All control measures shall be inspected at least once every fourteen (14) days and following any storm event of 0.5 inches or greater.
2. All measures shall be maintained in good working order; if a repair is necessary, it shall be initiated within 24 hours of the report.
3. Built up sediment shall be removed from erosion control when it has reached one-third the height of the fence.
4. Siltation Control shall be inspected for depth of sediment and tears.
5. The catch basin grate shall be inspected for grate elevation relative to current surface condition; condition of silt sacks, and degree to which sediment has accumulated on the grate and in the sump of the catch basin.
6. Temporary and permanent seeding and any plantings shall be inspected for bare spots, washouts, and healthy growth.
7. A maintenance inspection report shall be prepared following each inspection. A copy of the report form to be completed by the inspector is attached with this document.
8. The Site Contractor/ Project Manager ("Manager") shall select three individuals who will be responsible for inspections, maintenance and repair activities. The "Manager" shall be responsible for filling out the inspection and maintenance report.
9. Personnel selected for inspections and maintenance responsibilities shall receive training from the "Manager". They will be trained in all the inspection and maintenance practices necessary for keeping the erosion and sediment control devices used on site in good working order.

Non-Stormwater Discharges

It is expected that the following non-stormwater discharges will occur from the site during the construction period:

1. Pavement wash waters
2. No non-stormwater discharges shall be directed to unstabilized earth surfaces.

INVENTORY FOR POLLUTION PREVENTION PLAN

The materials or substances listed below are expected to be present on site during construction:

- Bituminous Concrete
- Concrete
- Petroleum Based Products
- Cleaning Solvents
- Adhesives
- Grout
- Masonry Block
- Fertilizers

SPILL PREVENTION

The following are the material management practices that shall be used to reduce the risk of spills or other accidental exposure of materials and substances to stormwater runoff.

Equipment fueling and Storage:

Equipment and associated fuels and lubricants shall be stored in designated locations.

Good Housekeeping:

The following good housekeeping practices must be followed on site during the construction project.

1. A concerted effort shall be made to store only enough product required to complete a particular task
2. All materials stored on site shall be stored in a neat and orderly fashion in their appropriate containers and, if possible, under a roof or other secure enclosure
3. Products shall be kept in their original containers with the original manufacture's label
4. Substances shall not be mixed with one another unless recommended by the manufacturer
5. Whenever possible, all of a product shall be used up before disposing of the container
6. Manufacture's recommendations for proper use and disposal shall be followed
7. The site superintendent shall inspect daily to ensure proper use and disposal of materials on site.

Hazardous Products:

Then following practices are intended to reduce the risks associated with hazardous materials.

1. Products shall be kept in original containers unless they are not re-sealable
2. Where feasible, the original labels and material safety data shall be retained, whereas they contain important product information
3. If surplus product must be disposed, follow manufacturer's or local and State recommended methods for proper disposal.

PRODUCT SPECIFIC PRACTICES

The following product specific practices shall be followed on site:

Petroleum Products:

All on site vehicles shall be monitored for leaks and receive regular preventative maintenance to reduce the risk of leakage. Petroleum products shall be stored in tightly sealed containers which are clearly labeled. Any bituminous concrete or asphalt substances used on site shall be applied according to the manufacturer's recommendations.

Fertilizers:

Fertilizers shall be applied in the minimum amounts recommended by the manufacturer. Once applied, fertilizers shall be worked into the soil to limit exposure to stormwater. Storage shall be in a covered shed or trailer. The contents of any partially used bags of fertilizers shall be transferred to a sealable plastic bag or bin to avoid spills.

Paints:

All containers shall be tightly sealed and stored when not required for use. Excess paint shall not be discharged into any catch basin, drain manhole, or any portion of the stormwater management system. Excess paint shall be properly disposed of according to manufacturer's recommendations or State and local regulations.

Concrete Trucks:

Concrete trucks shall not be allowed to wash out or discharge surplus concrete or drum wash water on site.

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

SPILL CONTROL PRACTICES

The Site Contractor / Project Manager ("Manager") is responsible for ensuring that materials spill control practices are followed upon commencement of, and during project construction.

In addition to the good housekeeping and material management practices discussed in the previous sections of this plan, the following practices must be followed for spill prevention and cleanup:

1. Manufacturer's recommended methods for cleanup for on-site materials must be readily available at the construction office, and site personnel shall be made aware of the procedures and the location of the information.
2. Materials and equipment necessary for spill cleanup shall be kept in the material storage area on site. Equipment and materials shall include, but not be limited to brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand sawdust, and plastic and metal trash containers specifically for this purpose.
3. All spills shall be cleaned up immediately after discovery.
4. The spill area shall be kept well ventilated and personnel shall wear appropriate protective clothing to prevent injury from contact with hazardous substance.
5. Spills of toxic or hazardous material shall be reported to the appropriate State and/or local authority in accordance with local and/or State regulations.
6. The spill prevention plan shall be adjusted to include measures to prevent a particular type of spill from reoccurring and how to clean up the spill if there is another occurrence. A description of the spill, what caused it, and the clean up measures shall also be included.
7. The "Manager" shall be the spill preventions and cleanup coordinator. The "Manager" shall designate at least three other site personnel who will be trained in the spill control practices identified above.

160 Moulton Drive
LYNNFIELD, MASSACHUSETTS

INSPECTION AND MAINTENANCE REPORT FORM

TO BE COMPLETED EVERY 14 DAYS AND WITHIN 24 HOURS OF
A RAINFALL EVENT OF 0.5 INCHES OR GREATER

Date: _____

Inspector: _____ Inspector's Title: _____

Days Since Last Rainfall: _____ Amount of Last Rainfall _____

	BMP	BMP Installed? (circle one)		BMP Maintenance Required or Performed? (circle one)		Corrective Action Needed And Notes
1	Erosion Control Barrier	Yes	No	Yes	No	
2	Subsurface Chambers	Yes	No	Yes	No	
3	Siltsack	Yes	No	Yes	No	
4		Yes	No	Yes	No	
5		Yes	No	Yes	No	
6						
7						

Additional Comments: _____

Project File: LYF-0934A
160 Moulton Drive
Lynnfield, Massachusetts 01940

OPERATION AND MAINTENANCE PLAN AND LONG-TERM POLLUTION PREVENTION PLAN

160 Moulton Drive

Lynnfield, Massachusetts

Date: July 6, 2018

Hayes Engineering, Inc.

Hayes Engineering, Inc.
603 Salem Street
Wakefield, MA 01880
Tel: (781) 246-2800
Fax :(781) 246-7596

OPERATION AND MAINTENANCE PLAN
160 Moulton Drive
LYNNFIELD, MASSACHUSETTS

July 6, 2018

GENERAL

The management plan incorporates the following sructural Best Management Practices to infiltrate stormwater runoff from the proposed roadway.

1. Subsurface Infiltration Chambers

These stormwater management facilities have unique characteristics, uses, planning considerations and maintenance requirements. The maintenance requirements, as suggested by the DEP in "Volume 2 Chapter 2: Structural BMP Specifications for the Massachusetts Stormwater Handbook", and the suggested schedules, are summarized in the following sections. It is suggested that the following guidelines be adhered to for a one-year cycle following completion of the project, then adjusted, as necessary, based on the results of the required inspections, unless otherwise stated.

Stormwater Management Areas (Subsurface Detention Chambers)

Chamber maintenance is not generally required. However, Subsurface systems are prone to failure due to clogging. Regulating the sediment and petroleum product input to the proposed system is the priority maintenance activity. Sediments and any oil spillage should be trapped and removed before they reach the chambers. Catch basin and proprietary particle separator pre-treatment devices which flow into the infiltration system shall be regularly cleaned according to the maintenance schedules provided herein to prevent fine sediments and debris from entering and clogging the subsurface system. Hayes Engineering, Inc. recommends the following inspection schedule to ensure that the chambers function well into the future.

- The Contractor shall verify that the required crushed stone and geotechnical fabric materials are clean and free of sediments and petroleum residue prior to, during and after the chamber system installation.

- Inspections of the chamber system shall be made by a registered profession engineer after every major storm for the first few months after construction to verify that proper function has been achieved. During these initial inspections, water levels in the chambers should be measured and recorded in a permanent log over several days to check the drainage duration and verify that sediments are not accumulating. If ponded water is present after 24 hours or an accumulation of sediment or debris is noted within the chambers, the Homeowners Association (or designated property manager) and engineer shall determine the cause for this condition and devise an action plan to improve system functionality. Any required maintenance or major repair will be documented in the permanent log book and be completed within seven business days, with a report of such to the Towns Engineer.

- Once the chamber system has been verified to perform as designed, interior chamber conditions shall be inspected at least annually. Post construction inspections (to be conducted through inspection ports) shall consist of documenting interior chamber and

bed conditions, measured water depth, and presence of sediment. If inspection indicates that the system is clogged (ponding water present after 24 hours or sediment accumulations present), replacement or major repair actions may be required as determined by a professional engineer. In this case, the Homeowners Association (or designated property manager) and engineer shall determine the cause for this condition and devise an action plan. Any required maintenance or major repair will be documented in the permanent log book and be completed within seven business days, with a report of such to the Town Engineer.

- The inspection and maintenance responsibility for the subsurface system shall belong to the Property Owner (or designated property manager).

Removal of Siltation Controls

All siltation controls, including, but not limited to, hay bales and silt fence, shall be removed, with the approval of the Town Engineer, as soon as practical after paving, re-vegetation and total stabilization of the site. Unvegetated areas remaining in the area of the siltation controls shall be loamed and seeded with the appropriate groundcover to ensure re-vegetation as rapidly as possible after the removal of the siltation controls. In the case of all proposed stormwater management facilities, during construction of the proposed stormwater management system the developer shall be the owner and party responsible for maintenance.

Owner and Maintenance Responsibilities

Once the development is complete, the Property Owner will assume the responsibility of on-going maintenance, as well as the long-term pollution prevention plan, unless other legally-binding agreements are established with another entity.

O&M / LPPP
160 Moulton Drive
Lynnfield, MA 01940
July 6, 2018

INSPECTION AND MAINTENANCE REPORT FORM
160 Moulton Drive
LYNNFIELD, MASSACHUSETTS

TO BE COMPLETED FOR REQUIRED INSPECTIONS AND MAINTENANCE
AT THE FREQUENCY SPECIFIED IN THE OPERATION AND MAINTENANCE PLAN

Inspector: _____ Date: _____

Inspector's Title: _____

Days Since Last Rainfall: _____ Amount of Last Rainfall: _____

	BMP	BMP Installed at Grade? (circle one)		BMP Maintenance Required or performed? (circle one)		Corrective Action Needed And Notes
1	Subsurface Infiltration Chambers	Yes	No	Yes	No	
2		Yes	No	Yes	No	
3		Yes	No	Yes	No	
4		Yes	No	Yes	No	
5		Yes	No	Yes	No	
6		Yes	No	Yes	No	
7		Yes	No	Yes	No	

Additional Comments:

_____

_____

_____

LONG TERM POLLUTION PREVENTION PLAN
160 Moulton Drive
LYNNFIELD, MASSACHUSETTS

- Good housekeeping practices: Prevent or reduce pollutant runoff from the project development through the use of street sweeping, erosion control and catch basin cleaning.

- Provisions for storing materials and waste products inside or under cover: All materials stored on site should be stored in a neat and orderly fashion in their appropriate containers and, if possible, under a roof or other secure enclosure. Waste products should be placed in secure receptacles until they are emptied by a licensed solid waste management company in Massachusetts.

- Vehicle washing controls: The project is comprised of an apartment building; therefore, it is not anticipated that vehicles will be washed on site.

- Requirements for routine inspections and maintenance of stormwater BMPs: Follow the guidelines outlined above.

- Spill prevention and response plans:

  Prevention: All materials stored on site should be stored in a neat and orderly fashion in their appropriate containers and, if possible, under a roof or other secure enclosure. Products should be kept in their original containers with the original manufacturer's label. Products should not be mixed with one another unless recommended by the manufacturer. If possible, all of the product should be used up before disposing of the container. The Manufacturer's recommendations for proper use and disposal should be followed.

  Response: Manufacturer's recommended methods for cleanup should be followed. Spills should be cleaned up immediately after discovery. The spill area shall be kept well ventilated and personnel shall wear appropriate protective clothing to prevent injury from contact with a hazardous substance. Spills of toxic or hazardous material shall be reported to the appropriate State and/or local authority in accordance with local and/or State regulations.

- Provisions for maintenance of lawns, gardens, and other landscaped areas: The project is comprised of single family house lots, therefore, these activities should be left up the individual homeowners to schedule and perform.

- Requirements for storage and use of fertilizers, herbicides, and pesticides (Should any questions arise about these materials the Order of Conditions for this project should be consulted if applicable):

Fertilizers: Fertilizers shall be applied in the minimum amounts recommended by the manufacturer. Once applied, fertilizers shall be worked into the soil to limit exposure to stormwater. Storage shall be stored under a roof or other secure enclosure. The contents of any partially used bags of fertilizers shall be transferred to a sealable plastic bag or bin to avoid spills.

Herbicides and Pesticides: Store herbicides and pesticides in original containers that are closed and labeled, in a secure area out of reach of children and pets. Avoid storing in damp areas where containers may become moist or rusty. Herbicides and Pesticides should not be stored near food. Follow the label instructions strictly about where and how much to apply. Do not put herbicides and pesticides in the trash or down the drain. Use rubber gloves when handling and use an appropriate cartridge mask if using products extensively.

- Pet waste management provisions: The project is comprised of an apartment building, the property manager will require individual tenants who own pets to perform the clean up and disposal of their pet waste.

- Provisions for operation and management of septic systems: The project is comprised of an apartment building; therefore, the septic system is privately owned and the responsibility for these activities lies with property manager to schedule and perform.

- Provisions for solid waste management: Waste products should be placed in secure receptacles until they are emptied by a licensed solid waste management company in Massachusetts.

- Snow disposal and plowing plans relative to Wetland Resource Areas: Snow disposal should be in accordance with the Bureau of Resource Protection Snow Disposal Guidelines, Guideline No. BRPG01-01 effective December 21, 2015, a copy of which is attached.

- Winter Road Salt and/or Sand Use and Storage restrictions:

  Road Salt: Use and storage should be in accordance with the Bureau of Resource Protection Drinking Water Program Guidelines on Deicing Chemical (Road Salt) Storage, Guideline No. DWSG97-1 effective December 19, 1997, a copy of which is attached.

  Sand: Whenever possible, use of environmentally friendly alternatives, i.e. calcium chloride and sand instead of salt for melting ice should be considered.

- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan: The responsibility lies with the property manager.

Effective Date: March 8, 2001

Guideline No. BRPG01-01

Applicability: Applies to all federal, state, regional and local agencies, as well as to private businesses.

Supersedes: BRP Snow Disposal Guideline BRPG97-1 issued 12/19/97, and all previous snow disposal guidance

Approved by: Glenn Haas, Assistant Commissioner for Resource Protection

PURPOSE: To provide guidelines to all government agencies and private businesses regarding snow disposal site selection, site preparation and maintenance, and emergency snow disposal options that are acceptable to the Department of Environmental Protection, Bureau of Resource Protection.

APPLICABILITY: These Guidelines are issued by the Bureau of Resource Protection on behalf of all Bureau Programs (including Drinking Water Supply, Wetlands and Waterways, Wastewater Management, and Watershed Planning and Permitting). They apply to public agencies and private businesses disposing of snow in the Commonwealth of Massachusetts.

INTRODUCTION

Finding a place to dispose of collected snow poses a challenge to municipalities and businesses as they clear roads, parking lots, bridges, and sidewalks. While we are all aware of the threats to public safety caused by snow, collected snow that is contaminated with road salt, sand, litter, and automotive pollutants such as oil also threatens public health and the environment.

As snow melts, road salt, sand, litter, and other pollutants are transported into surface water or through the soil where they may eventually reach the groundwater. Road salt and other pollutants can contaminate water supplies and are toxic to aquatic life at certain levels. Sand washed into waterbodies can create sand bars or fill in wetlands and ponds, impacting aquatic life, causing flooding, and affecting our use of these resources.

There are several steps that communities can take to minimize the impacts of snow disposal on public health and the environment. These steps will help communities avoid the costs of a contaminated water supply, degraded waterbodies, and flooding. Everything we do on the land has the potential to impact our water resources. Given the authority of local government over the use of the land, municipal officials and staff have a critically important role to play in protecting our water resources.

The purpose of these guidelines is to help municipalities and businesses select, prepare, and maintain appropriate snow disposal sites before the snow begins to accumulate through the winter.

RECOMMENDED GUIDELINES

These snow disposal guidelines address: (1) site selection; (2) site preparation and maintenance; and (3) emergency snow disposal.

1. SITE SELECTION

The key to selecting effective snow disposal sites is to locate them adjacent to or on pervious surfaces in upland areas away from water resources and wells. At these locations, the snow meltwater can filter in to the soil, leaving behind sand and debris which can be removed in the springtime. The following areas should be avoided:

- Avoid dumping of snow into any waterbody, including rivers, the ocean, reservoirs, ponds, or wetlands. In addition to water quality impacts and flooding, snow disposed of in open water can cause navigational hazards when it freezes into ice blocks.

- Do not dump snow within a Zone II or Interim Wellhead Protection Area (IWPA) of a public water supply well or within 75 feet of a private well, where road salt may contaminate water supplies.

- Avoid dumping snow on MassDEP-designated high and medium-yield aquifers where it may contaminate groundwater (see the next page for information on ordering maps from MassGIS showing the locations of aquifers, Zone II's, and IWPAs in your community).

- Avoid dumping snow in sanitary landfills and gravel pits. Snow meltwater will create more contaminated leachate in landfills posing a greater risk to groundwater, and in gravel pits, there is little opportunity for pollutants to be filtered out of the meltwater because groundwater is close to the land surface.

- Avoid disposing of snow on top of storm drain catch basins or in stormwater drainage swales or ditches. Snow combined with sand and debris may block a storm drainage system, causing localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water.

Site Selection Procedures

1. It is important that the municipal Department of Public Works or Highway Department, Conservation Commission, and Board of Health work together to select appropriate snow disposal sites. The following steps should be taken:

2. Estimate how much snow disposal capacity is needed for the season so that an adequate number of disposal sites can be selected and prepared.

3. Identify sites that could potentially be used for snow disposal such as municipal open space (e.g., parking lots or parks).

4. Sites located in upland locations that are not likely to impact sensitive environmental resources should be selected first.

5. If more storage space is still needed, prioritize the sites with the least environmental impact (using the site selection criteria, and local or MassGIS maps as a guide).

MassGIS Maps of Open Space and Water Resources

If local maps do not show the information you need to select appropriate snow disposal sites, you may order maps from MassGIS (Massachusetts Geographic Information System) which show publicly owned open spaces and approximate locations of sensitive environmental resources (locations should be field-verified where possible). Different coverages or map themes depicting sensitive environmental resources are available from MassGIS on the map you order. At a minimum, you should order the Priority Resources Map. The Priority Resources Map includes aquifers, public water supplies, MassDEP-approved Zone II's, Interim Wellhead Protection Areas, Wetlands, Open Space, Areas of Critical Environmental Concern, NHESP Wetlands Habitats, MassDEP Permitted Solid Waste facilities, Surface Water Protection areas (Zone A's) and base map features. The cost of this map is $25.00. Other coverages or map themes you may consider, depending on the location of your city or town, include Outstanding Resource Waters and MassDEP Eelgrass Resources. These are available at $25.00 each, with each map theme being depicted on a separate map. Maps should be ordered from MassGIS. Maps may also be ordered by fax at 617-626-1249 (order form available from the MassGIS web site) or mail. For further information, contact MassGIS at 617-626-1189.

2. SITE PREPARATION AND MAINTENANCE

In addition to carefully selecting disposal sites before the winter begins, it is important to prepare and maintain these sites to maximize their effectiveness. The following maintenance measures should be undertaken for all snow disposal sites:

- A silt fence or equivalent barrier should be placed securely on the downgradient side of the snow disposal site.

- To filter pollutants out of the meltwater, a 50-foot vegetative buffer strip should be maintained during the growth season between the disposal site and adjacent waterbodies.

- Debris should be cleared from the site prior to using the site for snow disposal.

- Debris should be cleared from the site and properly disposed of at the end of the snow season and no later than May 15.

3. EMERGENCY SNOW DISPOSAL

As mentioned earlier, it is important to estimate the amount of snow disposal capacity you will need so that an adequate number of upland disposal sites can be selected and prepared.

If despite your planning, upland disposal sites have been exhausted, snow may be disposed of near waterbodies. A vegetated buffer of at least 50 feet should still be maintained between the site and the waterbody in these situations. Furthermore, it is essential that the other guidelines for preparing and maintaining snow disposal sites be followed to minimize the threat to adjacent waterbodies.

Under extraordinary conditions, when all land-based snow disposal options are exhausted, disposal of snow that is not obviously contaminated with road salt, sand, and other pollutants may be allowed in certain waterbodies under certain conditions. In these dire situations, notify your Conservation Commission and the appropriate MassDEP Regional Service Center before disposing of snow in a waterbody.

Use the following guidelines in these emergency situations:

- Dispose of snow in open water with adequate flow and mixing to prevent ice dams from forming.
- Do not dispose of snow in saltmarshes, vegetated wetlands, certified vernal pools, shellfish beds, mudflats, drinking water reservoirs and their tributaries, Zone IIs or IWPAs of public water supply wells, Outstanding Resource Waters, or Areas of Critical Environmental Concern.
- Do not dispose of snow where trucks may cause shoreline damage or erosion.
- Consult with the municipal Conservation Commission to ensure that snow disposal in open water complies with local ordinances and bylaws.

FOR MORE INFORMATION

If you need more information, contact one of MassDEP's Regional Service Centers:

Northeast Regional Office, Wilmington, 978-694-3200
Southeast Regional Office, Lakeville, 508-946-2714
Central Regional Office, Worcester, 508-792-7683
Western Regional Office, Springfield, 413-755-2214

or

Call Thomas Maguire of DEP's Bureau of Resource Protection in Boston at 617-292-5602.

O&M / LPPP
160 Moulton Drive
Lynnfield, MA 01940
July 6, 2018

Effective Date: December 19, 1997

Guideline No. DWSG97-1

Applicability: Applies to all parties storing road salt or other chemical deicing agents.

Supersedes: Fact Sheet: DEICING CHEMICAL (ROAD SALT) STORAGE (January 1996)

Approved by: Arleen O'Donnell, Asst. Commissioner for Resource Protection

PURPOSE: To summarize salt storage prohibition standards around drinking water supplies and current salt storage practices.

APPLICABILITY: These guidelines are issued on behalf of the Bureau of Resource Protection's Drinking Water Program. They apply to all parties storing road salt or other chemical deicing agents.

I. The Road Salt Problem:

Historically, there have been incidents in Massachusetts where improperly stored road salt has polluted public and private drinking water supplies. Recognizing the problem, state and local governments have taken steps in recent years to remediate impacted water supplies and to protect water supplies from future contamination. As a result of properly designing storage sheds, new incidents are uncommon. These guidelines summarize salt storage prohibition standards around drinking water supplies and current salt storage practices.

II. Salt Pile Restrictions in Water Supply Protection Areas:

Uncovered storage of salt is forbidden by Massachusetts General Law Chapter 85, section 7A in areas that would threaten water supplies. The Drinking Water Regulations, 310 CMR 22.21(2)(b), also restrict deicing chemical storage within wellhead protection areas (Zone I and Zone II) for public water supply wells, as follows: "storage of sodium chloride, chemically treated abrasives or other chemicals used for the removal of ice and snow on roads [are prohibited], unless such storage is within a structure designed to prevent the generation and escape of contaminated runoff or leachate." For drinking water reservoirs, 310 CMR 22.20C prohibits, through local bylaw, uncovered or uncontained storage of road or parking lot de-icing and sanding materials within Zone A at new reservoirs and at those reservoirs increasing their withdrawals under MGL Chapter 21G, the Water Management Act.

For people on a low-sodium diet, 20 mg/L of sodium in drinking water is consistent with the bottled water regulations' meaning of "sodium free." At 20 mg/L, sodium contributes 10% or less to the sodium level in people on a sodium-restricted diet. For more information contact: Catherine Sarafinas at 617-556-1070 or catherine.sarafinas@state.ma.us, or Suzanne Robert at 617-292-5620 or suzanne.robert@state.ma.us.

III. Salt Storage Best Management Practices (BMP):

Components of an "environment-friendly" roadway deicing salt storage facility include:

- the right site = a flat site;
- adequate space for salt piles;
- storage on a pad (impervious/paved area);
- storage under a roof; and
- runoff collection/containment.

For more information, see The Salt Storage Handbook, 6th ed. Virginia: Salt Institute, 2006 (phone 703-549-4648 orhttp://www.saltinstitute.org/publication/safe-and-sustainable-snowfighting/).

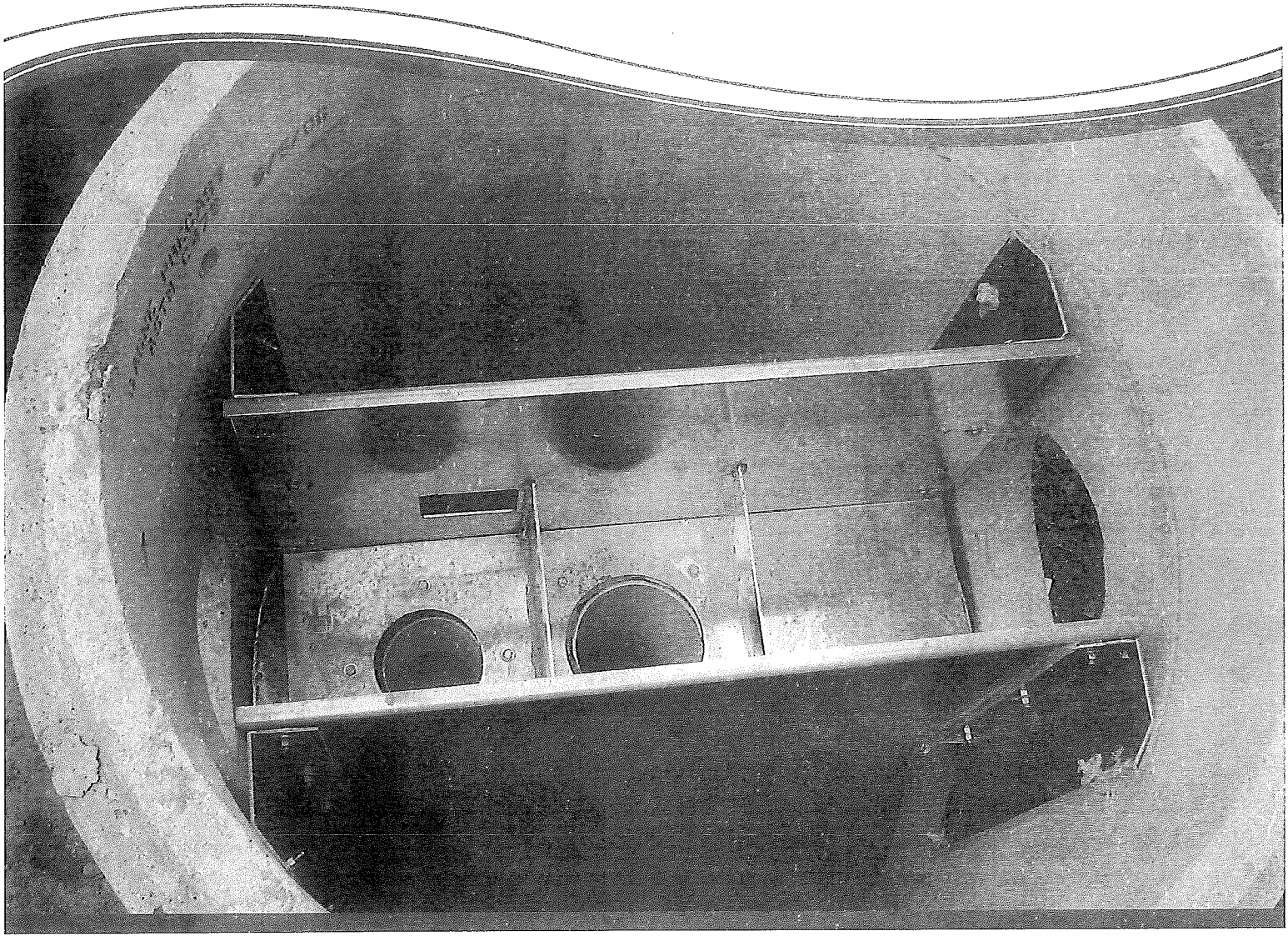
IV. Salt Storage Practices of the Massachusetts Highway Department:

The Massachusetts Highway Department (MHD) has 216 permanent salt storage sheds at 109 locations in the state. On leased land and state land under arteries and ramps, where the MHD cannot build sheds, salt piles are stored under impermeable material. This accounts for an additional 15 sites. The MHD also administers a program to assist municipalities with the construction of salt storage sheds. Of 351 communities, 201 municipalities have used state funds for salt storage facilities.

For more information about MHD's salt storage facilities, contact Paul Brown at the Massachusetts Highway Department, 10 Park Plaza, Boston, MA 02116 (phone 617-973-7792).

URBANGREEN®

VortSentry® HS Guide
Operation, Design, Performance and Maintenance



CONTECH®
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VortSentry® HS

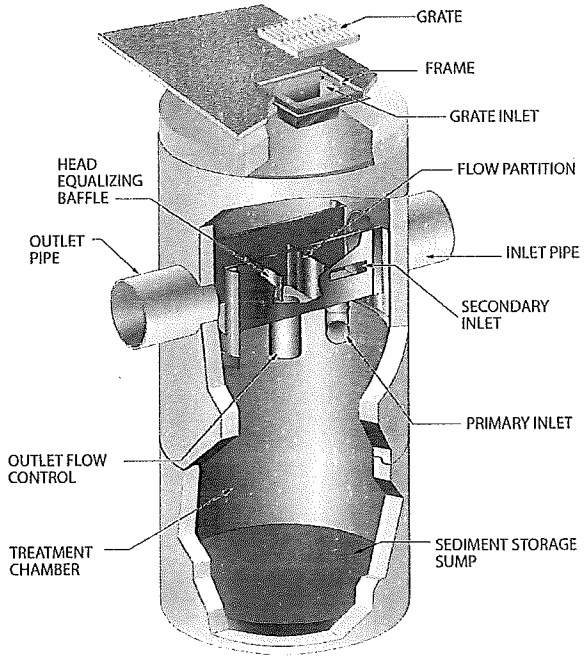
The VortSentry HS is a compact, below grade stormwater treatment system that employs helical flow technology to enhance gravitational separation of floating and settling pollutants from stormwater flows. With the ability to accept a wide range of pipe sizes, the VortSentry HS can treat and convey flows from small to large sites. A unique internal bypass design means higher flows can be diverted without the use of external bypass structures. The VortSentry HS is also available in a grate inlet configuration, which is ideal for retrofit installations.

Operation Overview

Low, frequently occurring storm flows are directed into the treatment chamber through the primary inlet. The tangentially oriented downward pipe induces a swirling motion in the treatment chamber that increases capture and containment abilities. Moderate storm flows are directed into the treatment chamber through the secondary inlet, which allows for capture of floating trash and debris. The secondary inlet also provides for treatment of higher flows without significantly increasing the velocity or turbulence in the treatment chamber. This allows for a more quiescent separation environment. Settleable solids and floating pollutants are captured and contained in the treatment chamber.

Flow exits the treatment chamber through the outlet flow control, which manages the amount of flow that is treated and helps maintain the helical flow patterns developed within the treatment chamber.

Flows exceeding the system's rated treatment flow are diverted away from the treatment chamber by the flow partition. Internal diversion of high flows eliminates the need for external bypass structures. During bypass, the head equalizing baffle applies head on the outlet flow control to limit the flow through the treatment chamber. This helps prevent re-suspension of previously captured pollutants.



Design Basics

There are two primary methods of sizing a VortSentry HS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow for a defined particle size. The summation process of the Rational Rainfall Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically, VortSentry HS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a particle gradation with an average particle size (d_{50}) of 240-microns (μm).

Water Quality Flow Rate Method

In many cases, regulations require that a specific flow rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval (i.e. the six-month storm) or a water quality depth (i.e. 1/2-inch of rainfall).

The VortSentry HS is designed to treat all flows up to the WQQ. Due to its internal bypass weir configuration, flow rates in the treatment chamber only increase minimally once the WQQ is surpassed. At influent rates higher than the WQQ, the flow partition will allow most flow exceeding the treatment flow rate to bypass the treatment chamber. This allows removal efficiency to remain relatively constant in the treatment chamber and reduces the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the VortSentry HS will remove a specific gradation of sediment at a specific removal efficiency. Therefore they are variable based on the gradation and removal efficiency specified by the design engineer and the unit size is scaled according to the project goal.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. The Rational Rainfall Method is a sizing program Contech uses to estimate a net annual sediment load reduction for a particular VortSentry HS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics. For more information on the Rational Rainfall Method, see *Vortechs Technical Bulletin 4: Modeling Long Term Load Reduction: The Rational Rainfall Method*, available at **www.ContechES.com/stormwater**

Treatment Flow Rate

The outlet flow control is sized to allow the WQQ to pass entirely through the treatment chamber at a water surface elevation equal to the crest of the flow partition. The head equalizing baffle applies head on the outlet flow control to limit the flow through the treatment chamber when bypass occurs, thus helping to prevent re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The VortSentry HS is available in three standard configurations: inline (with inlet and outlet pipes at 180° to each other), grated inlet, and a combination of grate and pipe inlets. All three configurations are available in 36-inch (900-mm) through 96-inch (2400-mm) diameter manholes.

created by vacuuming the oily layer. Floating trash can be netted out if you wish to separate it from the other pollutants.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure proper safety precautions. If anyone physically enters the unit, Confined Space Entry procedures need to be followed.

Disposal of all material removed from the VortSentry HS should be done is accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

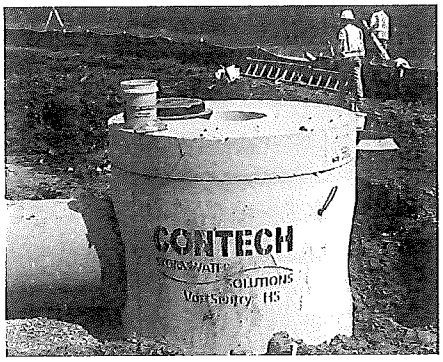
VortSentry HS Model	Diameter		Distance Between Water Surface and Top of Storage Sump		Sediment Storage		Oil Spill Storage	
	in.	m	ft.	m	yd^3	m^3	gal.	liter
HS36	36	0.9	3.6	1.1	0.5	0.4	83	314
HS48	48	1.2	4.7	1.4	0.9	0.7	158	598
HS60	60	1.5	6.0	1.8	1.5	1.1	258	978
HS72	72	1.8	7.1	2.2	2.1	1.6	372	1409
HS84	84	2.1	8.4	2.6	2.9	2.2	649	2458
HS96	96	2.4	9.5	2.9	3.7	2.8	845	3199

Table 2: VortSentry HS Maintenance Indicators and Sediment Storage Capacities.

Note: To avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile. Finer, silty particles at the top of the pile may be more difficult to feel with the measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.

Logon to **www.ContechES.com/stormwater** to download the VortSentry HS Inspection and Maintenance Log.

For assistance with maintaining your VortSentry HS, contact us regarding the Contech Maintenance compliance certification program.



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The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; related foreign patents or other patents pending.

Support

- Drawings and specifications are available at contechstormwater.com.
- Site-specific design support is available from our engineers.

The configuration of the system is determined by the suffix of the model name:

- A model name without a suffix denotes a standard pipe inlet (Example HS48).
- A "G" at the end of the model designation denotes a grate inlet (Example HS48G).
- A "GP" at the end of the model designation denotes a combination of grate and pipe inlets (Example HS48GP).

Performance

Full-Scale Laboratory Test Results

Laboratory testing of the VortSentry HS was conducted using F-55 Silica, a commercially available sand product with an average particle size of 240-μm (Table 1). This material was metered into a model HS48 VortSentry HS at an average concentration of between 250-mg/L and 300-mg/L at flow rates ranging from 0.50-cfs to 1.5-cfs (14-L/s to 56-L/s).

US Standard Sieve Size	Particle Size Micron (μm)	Cumulative Passing %
30	600	99.7%
40	425	95.7%
50	300	74.7%
70	212	33.7%
100	150	6.7%
140	106	0.7%

Table 1 : US Silica F-55 Particle Size Distribution

Removal efficiencies at each flow rate were calculated based on net sediment loads passing the influent and effluent sampling points. Results are illustrated in Figure 1.

Assuming that sediment in the inlet chamber is ideally mixed, removal rates through the system will decay according to the percentage of flow bypassed. This effect has been observed in the laboratory where the test system is designed to produce a

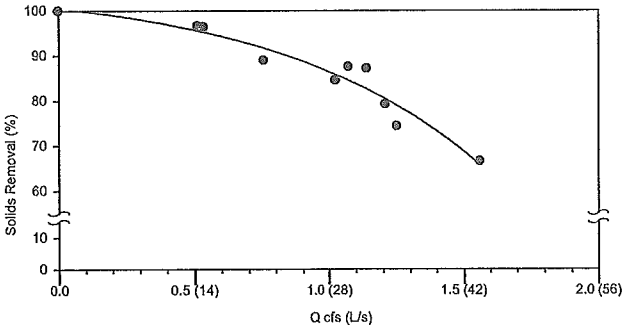

Figure 1: VortSentry HS Removal Efficiencies for 240-μm Particle Gradation

thoroughly mixed inlet stream. All VortSentry HS models have the same aspect ratio regardless of system diameter (i.e. an increase in diameter results in a corresponding increase in depth). Operating rates are expressed volumetrically.

Removal efficiency at each operating rate is calculated according to the average of volumetric and Froude scaling methods and is described by Equation 1.

Equation 1: $$\left(\frac{\text{Diameter Prototype}}{\text{Diameter Model}}\right)^{2.75} = \left(\frac{\text{Flow Rate Prototype}}{\text{Flow Rate Model}}\right)$$

Equation 1 and actual laboratory test results were used to determine the flow rate which would be required for the various VortSentry HS models to remove 80% of solids.

View report at **www.ContechES.com/stormwater**

Maintenance

The VortSentry HS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit, i.e., unstable soils or heavy winter sanding will cause the treatment chamber to fill more quickly, but regular sweeping will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant deposition and transport may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (i.e. spring and fall) however more frequent inspections may be necessary in equipment washdown areas and in climates where winter sanding operations may lead to rapid accumulations of a large volume of sediment. It is useful and often required as part of a permit to keep a record of each inspection. A simple inspection and maintenance log form for doing so is available for download at **www.ContechES.com/stormwater**

The VortSentry HS should be cleaned when the sediment has accumulated to a depth of two feet in the treatment chamber. This determination can be made by taking two measurements with a stadia rod or similar measuring device; one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the distance given in Table 2, the VortSentry HS should be maintained to ensure effective treatment.

Cleaning

Cleaning of the VortSentry HS should be done during dry weather conditions when no flow is entering the system. Cleanout of the VortSentry HS with a vacuum truck is generally the most effective and convenient method of excavating pollutants from the system. Simply remove the manhole cover and insert the vacuum hose into the sump. All pollutants can be removed from this one access point from the surface with no requirements for Confined Space Entry.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use adsorbent pads, which solidify the oils. These are usually much easier to remove from the unit individually, and less expensive to dispose than the oil/water emulsion that may be

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603 Salem Street
Wakefield, MA 01880
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Nantucket, MA 02554
Tel: (508) 228-7909

Refer to File # LYF-0934A

September 7, 2018

Zoning Board of Appeals
55 Summer Street
Lynnfield, MA 01940

RE: Site Plan Changes
160 Moulton Drive / Palumbo

Dear Members,

As a result of Planning Board meetings, neighborhood input and discussions with other public officials, the applicants for 160 Moulton Drive made a number of changes to the site plan, which I summarize as follows.

1. The reduction of the number of units from 32 to 23.
2. The reduction of the total number of parking spaces on site from 83 to 72.
3. The reduction of total imperviousness by an additional 2,901 square feet.
4. The reduction of the building height from 3 stories to 2.
5. The access to Oak Street has been removed.
6. Drainage modifications have been made to allow for water quality improvements, as well as the significant reduction of total runoff. In addition, runoff has been directed away from Oak Street to the drainage system constructed in Newhall Park, after discussions with the Town Engineer.

The applicant believes that these changes are responsive to the concerns shown both by public agencies and participants in the hearing process.

Very truly yours,

Peter J. Ogren, P.E., P.L.S.
President

PJO/dab

#160 Moulton
Lynnfield, MA
Runoff Sumary

To Sak

Storm	Existing Q (C.F.S.)	Proposed Q (C.F.S.)	Change Q (C.F.S.)	Existing Volume (C.F.)	Proposed Volume (C.F)	Change Volume (C.F.)
2 Year	1.00	0.00	-1.00	3200	0	-3200
10 Year	1.95	0.00	-1.95	6150	25	-6125
25 Year	2.47	0.00	-2.47	7834	57	-7777
100 Year	3.21	0.02	-3.19	10226	119	-10107

To Newhall Park Field

Storm	Existing Q (C.F.S.)	Proposed Q (C.F.S.)	Change Q (C.F.S.)	Existing Volume (C.F.)	Proposed Volume (C.F)	Change Volume (C.F.)
2 Year	2.11	1.12	-0.99	6662	3827	-2835
10 Year	3.75	2.57	-1.18	11951	8410	-3541
25 Year	4.64	3.45	-1.19	14895	11214	-3681
100 Year	5.87	4.76	-1.11	19023	15345	-3678

Total

Storm	Existing Q (C.F.S.)	Proposed Q (C.F.S.)	Change Q (C.F.S.)	Existing Volume (C.F.)	Proposed Volume (C.F)	Change Volume (C.F.)
2 Year	3.11	1.12	-1.99	9862	3827	-6035
10 Year	5.70	2.57	-3.13	18100	8436	-9664
25 Year	7.12	3.45	-3.67	22729	11271	-11458
100 Year	9.08	4.77	-4.31	29249	15464	-13785

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Water Quality Flow Calculation Worksheet

Refer to File No. LYF-0934A

For First 1-inch of Runoff WQV:

Impervious Surfaces to Outlet Through Wall:

Catchment	Time of Conc. (hours)	Impervious Area (acres)	Impervious Area (sq. mi.)
P2	0.100	0.654	
Σ		0.654	
		0.654	0.001021875

Time of Concentration:

Longest Catchment Tc: 0.100h – Catchment P2

q_u from Figure 4, attached: 774 csm/in

Water Quality Flow (WQF):

$$Q_{1.0} = (q_u)(A)(WQV)$$

Where:

$Q_{1.0}$ = peak flow rate associated with the first 1-inch of runoff;

q_u = the unit peak discharge, in cubic feet per second per square mile per inch;

A = impervious surface in drainage area, in square miles;

WQV = water quality volume, in inches (1.0 inches for critical areas)

Water Quality Flow (WQF) continued:

$$Q_{1.0} = \left(774\frac{csm}{in}\right)(0.001021875\ sq.\ mi.)(1.0")$$

$$Q_{1.0} = 0.791\ cfs$$

Proprietary Separator Selection:

The VortSentry HS48 will provide a presumptive removal rate of 80% for water quality flows through 1.2 cfs. See Massachusetts sizing table below:

VortSentry HS Model	Swirl Chamber Diameter (ft)	Typical Depth Below Invert (ft)	Treatment Capacity (cfs)[1]	Max. Inlet/Outlet Pipe Diameter (in)	Maximum Sediment Storage Capacity (CF)
VortSentry HS36*	3	5.6	0.55	18	39
w/ 1' added sump	3	6.6	0.55	18	47
w/ 2' added sump	3	7.6	0.55	18	54
w/ 3' added sump	3	8.6	0.55	18	61
w/ 4' added sump	3	9.6	0.55	18	68
w/ 5' added sump	3	10.6	0.55	18	75
VortSentry HS48**[2]	4	6.8	1.2	24	85
w/ 1' added sump	4	7.8	1.2	24	97
w/ 2' added sump	4	8.8	1.2	24	110
w/ 3' added sump	4	9.8	1.2	24	123
w/ 4' added sump	4	10.8	1.2	24	135
VortSentry HS60***	5	8.0	2.2	30	150
w/ 1' added sump	5	9.0	2.2	30	176
w/ 2' added sump	5	10.0	2.2	30	195
w/ 3' added sump	5	11.0	2.2	30	215

*maintenance recommended when sediment reaches a height of 3'-7" below water surface elevation in sump.
**maintenance recommended when sediment reaches a height of 4'-9" below water surface elevation in sump.
***maintenance recommended when sediment reaches a height of 6.0' below water surface elevation in sump.
1. Design Flow Rate is based on 80% removal of particle size distribution with an average particle size of 240 micron. This flow also represents the maximum flow prior to which bypass occurs.

Notes: Systems can be sized based on a water quality flow (e.g. 1 inch storm) or on a net annual basis depending on the local regulatory requirement.
When sizing based on a water quality storm, the required flow to be treated should be equal or less than the listed water quality flow for the selected system. Systems sized based on a water quality storm are generally more conservatively sized.
Additional particle size distributions are available for sizing purposes upon request.
Depth below invert is measured to the inside bottom of the system. This depth can be adjusted to meet specific storage or maintenance requirements.
Contact our support staff for the most cost effective sizing for your area.

Water Quality Flow Calculation
Bali Hai – Lynnfield
September 6, 2018

The StormCeptor STC 900 will provide a presumptive removal rate of 77% for water quality flows through 0.89 cfs. See Massachusetts sizing table below:

Massachusetts – Water Quality (Q) Flow Rate

Stormceptor STC Model	Inside Diameter	Typical Depth Below Inlet Pipe Invert[1]	Water Quality Flow Rate Q[2]	Peak Conveyance Flow Rate[3]	Hydrocarbon Capacity[4]	Maximum Sediment Capacity[4]
	(ft)	(in)	(cfs)	(cfs)	(Gallons)	(ft³)
STC 450i	4	68	0.40	5.5	86	46
STC 900	6	89	0.89	22	251	89
STC 2400	8	104	1.58	22	840	205
STC 4800	10	140	2.47	22	909	543
STC 7200	12	149	3.56	22	1,059	839
STC 11000	2 x 10	142	4.94	48	2,792	1,025
STC 16000	2 x 12	148	7.12	48	3,055	1,677

[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

Figure 4: for First 1-inch Runoff, Table of qu values for Ia/P Curve = 0.030, listed by tc, for Type III Storm Distribution

Tc (Hours)	qu (csm/in)
0.01	835
0.03	835
0.05	831
0.067	814
0.083	795
0.1	774
0.116	755
0.133	736
0.15	717
0.167	700
0.183	685
0.2	669
0.217	654
0.233	641
0.25	628
0.3	593
0.333	572
0.35	563
0.4	536
0.416	528
0.5	491
0.583	460
0.6	454
0.667	433
0.7	424
0.8	398
0.9	376
1	356
1.1	339
1.2	323
1.3	309
1.4	296
1.5	285
1.6	274
1.7	264
1.8	255
1.9	247
2	239
2.1	232
2.2	225
2.3	219
2.4	213
2.5	207
2.6	202
2.7	197
2.8	192
2.9	187
3	183
3.1	179
3.2	175
3.3	171
3.4	168
3.5	164
3.6	161
3.7	158
3.8	155
3.9	152
4	149
4.1	146
4.2	144
4.3	141
4.4	139
4.5	137
4.6	134
4.7	132
4.8	130
4.9	128
5	126
5.1	124
5.2	122
5.3	120
5.4	119
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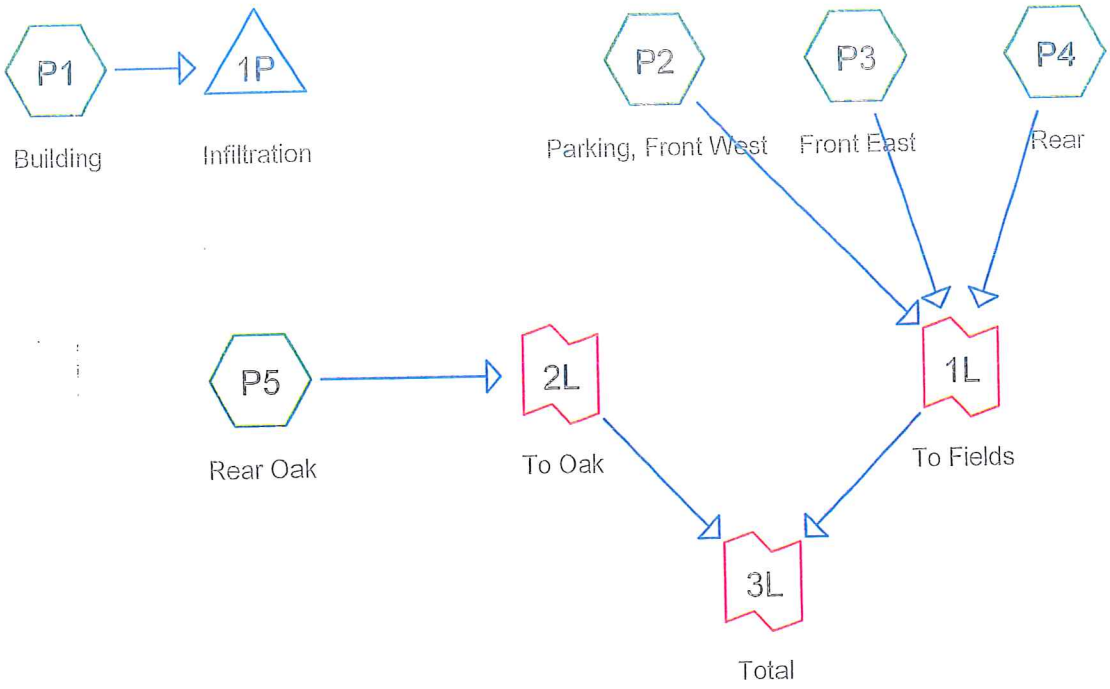
9.9	72
10	71



Subcat Reach Pond Link

Routing Diagram for pr-bali-haiR
Prepared by Microsoft, Printed 9/6/2018
HydroCAD® 10.00-21 s/n 03206 © 2018 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
33,294	39	>75% Grass cover, Good, HSG A (P2, P3, P4, P5)
28,751	98	Paved parking, HSG A (P2, P3)
14,723	98	Roofs, HSG A (P1, P2, P3)
76,768	72	TOTAL AREA

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
76,768	HSG A	P1, P2, P3, P4, P5
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
76,768		TOTAL AREA

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
33,294	0	0	0	0	33,294	>75% Grass cover, Good
28,751	0	0	0	0	28,751	Paved parking
14,723	0	0	0	0	14,723	Roofs
76,768	0	0	0	0	76,768	TOTAL AREA

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Building	Runoff Area=14,000 sf 100.00% Impervious Runoff Depth=2.87" Tc=6.0 min CN=98 Runoff=0.94 cfs 3,346 cf
Subcatchment P2: Parking, Front West	Runoff Area=49,409 sf 57.67% Impervious Runoff Depth=0.92" Tc=6.0 min CN=73 Runoff=1.12 cfs 3,786 cf
Subcatchment P3: Front East	Runoff Area=6,661 sf 14.71% Impervious Runoff Depth=0.07" Tc=6.0 min CN=48 Runoff=0.00 cfs 41 cf
Subcatchment P4: Rear	Runoff Area=4,307 sf 0.00% Impervious Runoff Depth=0.00" Tc=6.0 min CN=39 Runoff=0.00 cfs 0 cf
Subcatchment P5: Rear Oak	Runoff Area=2,391 sf 0.00% Impervious Runoff Depth=0.00" Tc=6.0 min CN=39 Runoff=0.00 cfs 0 cf
Pond 1P: Infiltration	Peak Elev=118.95' Storage=0.013 af Inflow=0.94 cfs 3,346 cf Outflow=0.27 cfs 3,346 cf
Link 1L: To Fields	Inflow=1.12 cfs 3,827 cf Primary=1.12 cfs 3,827 cf
Link 2L: To Oak	Inflow=0.00 cfs 0 cf Primary=0.00 cfs 0 cf
Link 3L: Total	Inflow=1.12 cfs 3,827 cf Primary=1.12 cfs 3,827 cf

Total Runoff Area = 76,768 sf Runoff Volume = 7,173 cf Average Runoff Depth = 1.12"
43.37% Pervious = 33,294 sf 56.63% Impervious = 43,474 sf

Summary for Subcatchment P1: Building

Runoff = 0.94 cfs @ 12.09 hrs, Volume= 3,346 cf, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
14,000	98	Roofs, HSG A
14,000		100.00% Impervious Area

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

Summary for Subcatchment P2: Parking, Front West

Runoff = 1.12 cfs @ 12.10 hrs, Volume= 3,786 cf, Depth= 0.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
20,915	39	>75% Grass cover, Good, HSG A
362	98	Roofs, HSG A
28,132	98	Paved parking, HSG A
49,409	73	Weighted Average
20,915		42.33% Pervious Area
28,494		57.67% Impervious Area

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

Summary for Subcatchment P3: Front East

Runoff = 0.00 cfs @ 14.74 hrs, Volume= 41 cf, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
5,681	39	>75% Grass cover, Good, HSG A
361	98	Roofs, HSG A
619	98	Paved parking, HSG A
6,661	48	Weighted Average
5,681		85.29% Pervious Area
980		14.71% Impervious Area

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

Summary for Subcatchment P4: Rear

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
4,307	39	>75% Grass cover, Good, HSG A
4,307		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Direct, calc <2

Summary for Subcatchment P5: Rear Oak

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
2,391	39	>75% Grass cover, Good, HSG A
2,391		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry, Direct, calc <2

Summary for Pond 1P: Infiltration

Inflow Area = 14,000 sf,100.00% Impervious, Inflow Depth = 2.87" for 2 Year event
Inflow = 0.94 cfs @ 12.09 hrs, Volume= 3,346 cf
Outflow = 0.27 cfs @ 11.80 hrs, Volume= 3,346 cf, Atten= 72%, Lag= 0.0 min
Discarded = 0.27 cfs @ 11.80 hrs, Volume= 3,346 cf

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 118.95' @ 12.42 hrs Surf.Area= 0.032 ac Storage= 0.013 af

Plug-Flow detention time= 10.3 min calculated for 3,340 cf (100% of inflow)
Center-of-Mass det. time= 10.3 min (767.3 - 757.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	118.05'	0.033 af	30.00'W x 46.34'L x 3.75'H Field A 0.120 af Overall - 0.038 af Embedded = 0.081 af x 40.0% Voids
#2A	118.80'	0.038 af	ADS_StormTech DC-780 +Cap x 36 Inside #1 Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 6 Rows of 6 Chambers
		0.071 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	118.05'	8.270 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.27 cfs @ 11.80 hrs HW=118.09' (Free Discharge)
└1=Exfiltration (Exfiltration Controls 0.27 cfs)

Summary for Link 1L: To Fields

Inflow Area = 60,377 sf, 48.82% Impervious, Inflow Depth = 0.76" for 2 Year event
Inflow = 1.12 cfs @ 12.10 hrs, Volume= 3,827 cf
Primary = 1.12 cfs @ 12.10 hrs, Volume= 3,827 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Link 2L: To Oak

Inflow Area = 2,391 sf, 0.00% Impervious, Inflow Depth = 0.00" for 2 Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Summary for Link 3L: Total

Inflow Area = 62,768 sf, 46.96% Impervious, Inflow Depth = 0.73" for 2 Year event
Inflow = 1.12 cfs @ 12.10 hrs, Volume= 3,827 cf
Primary = 1.12 cfs @ 12.10 hrs, Volume= 3,827 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Building Runoff Area=14,000 sf 100.00% Impervious Runoff Depth=5.16"
Tc=6.0 min CN=98 Runoff=1.66 cfs 6,023 cf

Subcatchment P2: Parking, Front West Runoff Area=49,409 sf 57.67% Impervious Runoff Depth=2.60"
Tc=6.0 min CN=73 Runoff=3.38 cfs 10,698 cf

Subcatchment P3: Front East Runoff Area=6,661 sf 14.71% Impervious Runoff Depth=0.74"
Tc=6.0 min CN=48 Runoff=0.08 cfs 413 cf

Subcatchment P4: Rear Runoff Area=4,307 sf 0.00% Impervious Runoff Depth=0.29"
Tc=6.0 min CN=39 Runoff=0.01 cfs 103 cf

Subcatchment P5: Rear Oak Runoff Area=2,391 sf 0.00% Impervious Runoff Depth=0.29"
Tc=6.0 min CN=39 Runoff=0.00 cfs 57 cf

Pond 1P: Infiltration Peak Elev=119.87' Storage=0.036 af Inflow=1.66 cfs 6,023 cf
Outflow=0.27 cfs 6,023 cf

Link 1L: To Fields Inflow=3.45 cfs 11,214 cf
Primary=3.45 cfs 11,214 cf

Link 2L: To Oak Inflow=0.00 cfs 57 cf
Primary=0.00 cfs 57 cf

Link 3L: Total Inflow=3.45 cfs 11,271 cf
Primary=3.45 cfs 11,271 cf

Total Runoff Area = 76,768 sf Runoff Volume = 17,294 cf Average Runoff Depth = 2.70"
43.37% Pervious = 33,294 sf 56.63% Impervious = 43,474 sf

Time span=0.00-30.00 hrs, dt=0.05 hrs, 601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Building Runoff Area=14,000 sf 100.00% Impervious Runoff Depth=6.26"
Tc=6.0 min CN=98 Runoff=2.00 cfs 7,305 cf

Subcatchment P2: Parking, Front West Runoff Area=49,409 sf 57.67% Impervious Runoff Depth=3.51"
Tc=6.0 min CN=73 Runoff=4.57 cfs 14,443 cf

Subcatchment P3: Front East Runoff Area=6,661 sf 14.71% Impervious Runoff Depth=1.24"
Tc=6.0 min CN=48 Runoff=0.17 cfs 687 cf

Subcatchment P4: Rear Runoff Area=4,307 sf 0.00% Impervious Runoff Depth=0.60"
Tc=6.0 min CN=39 Runoff=0.03 cfs 215 cf

Subcatchment P5: Rear Oak Runoff Area=2,391 sf 0.00% Impervious Runoff Depth=0.60"
Tc=6.0 min CN=39 Runoff=0.02 cfs 119 cf

Pond 1P: Infiltration Peak Elev=120.39' Storage=0.048 af Inflow=2.00 cfs 7,305 cf
Outflow=0.27 cfs 7,305 cf

Link 1L: To Fields Inflow=4.76 cfs 15,345 cf
Primary=4.76 cfs 15,345 cf

Link 2L: To Oak Inflow=0.02 cfs 119 cf
Primary=0.02 cfs 119 cf

Link 3L: Total Inflow=4.77 cfs 15,464 cf
Primary=4.77 cfs 15,464 cf

Total Runoff Area = 76,768 sf Runoff Volume = 22,769 cf Average Runoff Depth = 3.56"
43.37% Pervious = 33,294 sf 56.63% Impervious = 43,474 sf