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Job: Lot B[14] (#19) Staniford St, Newton, MA
Sheet No. 1 of
Calculated By T.T.C Date 1/20/22
Checked By Date
Scale

Storm Water Analysis & Control Facility Design

I. Project Description

The proposed project is to construct a residential house including driveway, and utilities on lot with total area of 15,297 ft² or 0.351Ac. On site soil test, performed by Bibbo Brothers, indicates the soil is sandy-gravel with percolation rate of less than 2 MPI. No sign of ground water can be found in the 8 ft deep test pits. It is recommended that runoff from all impervious area shall be controlled.

II. Storm Water Analysis

Based on city of Newton requirement, any runoff increased, at 24 hours duration, 100-year storm with total rainfall of 8.78 inches, due to development shall be controlled on site. The increase of runoff due to addition of impervious area is the difference of runoff from an impervious area and landscaped area. It is difficult to seperated the runoff from addition, therefore, it is better to completely control the total runoff from the addition impervious area.

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Job: Lot B (#19) Stanford St, Newton, MA
Sheet No: 2 of
Calculated By: T.T.C Date: 1/20/22
Checked By: Date:
Scale:

A. Land Use Analysis: Total Land Area = 15297 Ft², 0.351 Ac.

1. Pre-Development Land Use

Building Area - Ft²

Pavement Area - Ft²

Other Impervious Area - Ft²

Total Impervious Area - Ft²

$$\text{Runoff Coefficient} = \frac{0.3 \times 15297 + 0.9 \times 0}{15297} = 0.30$$

2. Post-Development Land Use

Building Area: 1,832 Ft²

Pavement Area: 2500 Ft²

Other Impervious Area: Patio 160, Walk 300 Ft²

Total Impervious Area: 4792 Ft²

$$\text{Runoff Coefficient} = \frac{0.3 \times 10505 + 0.9 \times 4792}{15297} = 0.488$$

B. Method Used To Analyze Storm Runoff

Due to small site area (much less than sq. mile)

Rational Formula shall be used for runoff analysis.

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Job: Lot B (#19) Staniford St, Newton, MA
Sheet No: 3 of
Calculated By: T.T.C Date: 1/20/22
Checked By: Date:
Scale:

Rational Formula: $Q = CiA$, where

Q = Runoff peak rate, cfs

i = Rainfall Intensity, in/hr

A = Site Area, Acre

For Compute runoff volume, $V_R = CiAt$, where t is rainfall duration time, Hr. Also, A is changed to sq. ft (FT^2), i, rainfall intensity, in ft/hr, and V_R is total runoff volume of the storm from area A, in cu. Ft (FT^3).

C is runoff coefficient, $C = 0.9$ for impervious Area, $C = 0.3$ for wooded/grass, pervious area.

In general, peak runoff rate occurs at short duration high intensity storm, but runoff volume is larger at long duration storm. For small project site, it is difficult to control runoff rate. The easy way is to control the runoff from impervious area, so to reduce runoff volume.

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Job: Lot B (#14) Staniford St, Newton, MA
Sheet No: 4 of
Calculated By: T.T.C Date: 1/20/22
Checked By: Date:
Scale:

C. Storm Peak Runoff Rate & Total Runoff Volume @ 8.78"/24 Hr

Storm Duration Hr	Rainfall Intensity In/Hr	Peak Runoff Rate, cfs			Total Runoff Volume, Cu. Ft.		
		Pre-Devel. Condition C=0.30	Post-Devel. Condition C=0.488	Increase (Decrease)	Pre-Develop. Condition C=0.30	Post-Develop Condition C=0.488	Increase (Decrease)
24	0.37	0.039	0.063	0.024	3395.9	5524.1	2128.2
0.5	4.6	0.484	0.788	0.304	879.6	1430.8	551.2

Project site = 0.351 Ac = 15,297 Ft²

Minimum Total Runoff Volume Need To Be Controlled

24 Hr, 100-y storm : V_R = 2128.2 Ft³

0.5 Hr, 100-y storm: V_R = 551.2 Ft³

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Total Runoff Volume From New Paved Area, It is recommended that runoff from impervious, should it be new, shall be controlled. Total Impervious Area = 4792 Ft²

24 Hr, 100-y storm, $V_R = \frac{8.78}{12} \times 0.9 \times 4792 = 3155.5$ Ft³

0.5 Hr, 100-y storm, $V_R = \frac{4.6}{12} \times 0.5 \times 0.9 \times 4792 = 826.6$ Ft³

There shall be no increased runoff at post-condition than at pre-development condition from the site. Should the total runoff volume from new paved area is less than the minimum required control volume, addition impervious area need to be added to control area.

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Job: Lot B (#19) Stanford St., Newton, MA
Sheet No. 5 of
Calculated By T.T.C Date 1/20/22
Checked By Date
Scale

III. Runoff Control Facility Design

For small watershed area, control of the increased runoff rate is very difficult, therefore control runoff from selected impervious area is a better way to control the runoff increased due to development.

A. Minimum Required Control Volume – At 100-y Storm

0.5 Hour Duration, $V_R = 551.2$

24 Hour Duration, $V_R = 2128.2$

COMMONWEALTH OF MASSACHUSETTS
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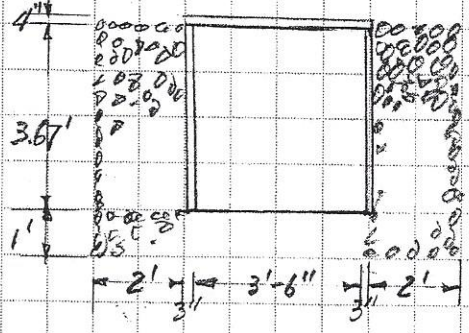
B. Control Facility

1. Leaching Galley: 4'x4'x4' with 2 ft thickness crushed stone around it and 1.0 ft thickness crushed stone under it



Storage Volume = $3.5 \times 3.5 \times 3.67 = 45$ ft^3

Stone Void = $0.35[4\times4\times2\times2$ (2-sides) $+ 4\times8\times2\times2$ (2-Ends) $+ 8\times8\times1$ (bottom)$]$
$= 0.35 \times 256 = 89.6$ ft^3/Ea

Total Storage Capacity = $89.6 + 45 = 134.6$ ft^3/Ea

Exfiltration Volume (Use Bottom Area Only) = $64 \times \frac{1}{12} \times \frac{60}{2} \times \frac{1}{2}$ (Safety Factor)
$= 80$ ft^3/Hr/Ea.

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Job: Lot B (#19) Stanford St., Newton, MA
Sheet No: 6 of
Calculated By: T.T.C Date: 1/20/22
Checked By: Date:
Scale:

Total Capacity of Galley

At 0.5 Hr Storm = 134.6 + 0.5×80 = 174.6 Ft^3/Ea

At 24 Hr Storm = 134.6×6 = 807.6 Ft^3/Ea Use the small one

or

= 134.6 + 24×80 = 2054.6 Ft^3/Ea

C. Control Area Analysis & Control System Design

1. Front System - Control Area

Part of Driveway, 1000 Ft^2

100-y storm runoff volume

at 0.5 Hr Duration Storm = $0.9 \times 1000 \times \frac{4.6}{12} \times 0.5 = 172.5\ Ft^3$

at 24 Hr Duration Storm = $0.9 \times 1000 \times \frac{0.37}{12} \times 24 = 666\ Ft^3$

One galley is adequate to control the 100-y storm runoff from the 1000 ± Ft^2 Impervious area.

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2. REAR System - Control Area

Part of driveway, walk (Pavement)	1800 Ft^2
House	1832 Ft^2
Patio	160 Ft^2
Total Impervious Area	3792 Ft^2

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JOB: Lot B (#19) Stanford St., Newton, MA
Sheet No: 7 of
Calculated By: T.T.C Date: 1/20/22
Checked By: Date:
Scale:

Runoff Volume :

At 100-year, 24 Hr Storm $= 0.9 \times 3792 \times \frac{0.37}{12} \times 24$

$= 2525.5 \text{ Ft}^3$

At 100-year, 0.5 Hr Storm $= 0.9 \times 3792 \times \frac{4.6}{12} \times 0.5$

$= 654.1 \text{ Ft}^3$

No. of Galley Need At 100-year 0.5 Hr Storm $= \frac{654.1}{174.6} = 3.7$ Say 4 galleys.

No. of Galley Need at 100-year, 24 Hr Storm $= \frac{2525.5}{807.6} = 3.1$ Say 4 galleys

D. Control Facilities Arrangement

Refer to Plan

1. Use two catchbasins, one for Front System, one for Rear System, to collect runoff from paved area then discharge to leaching facilities. The C.B shall have 4' deep sump and oil/gas seperator.
2. All PVC pipe under paved area shall be Sch. 40.

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Job: Lot B (#14) Stanford St., Newton, MA
Sheet No: 8 of
Calculated By: T.T.C Date: 1/20/22
Checked By: Date:
Scale:

3. All downspouts shall have an overflow Y-sec in case of strange storm, or suddenly wealth changes.

E. Runoff Reduction Due to Development

The controlled impervious area was wooded or landscaping area. After control the 100-year storm, its runoff is reduced.

Runoff Volume Reduced at 24 hour, 100-year storm $= 0.3 \times 4792 \times \frac{0.37}{12} \times 24$

$= 1063.8\ ft^3$

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