



*MAP 16F, PARCEL 3430
35 FOREST RIDGE RD
CONCORD, MA*

STORMWATER MANAGEMENT REPORT

THIS REPORT HAS BEEN PREPARED UNDER THE SUPERVISION OF A REGISTERED
PROFESSIONAL ENGINEER LICENSED IN THE STATE OF MASSACHUSETTS



Date: May 8, 2020

PREPARED FOR:

MINUTEMAN ARC FOR HUMAN SERVICES INC
*35 FOREST RIDGE RD
CONCORD, MA 01742*

PREPARED BY:

MEISNER BREM CORPORATION
*142 LITTLETON RD, STE 16
WESTFORD, MA 01886*

PROJECT NUMBER: 2860.00

STORMWATER MANAGEMENT REPORT
MINUTE MAN ARC
Concord, Massachusetts

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STORMWATER MANAGEMENT REPORT
MINUTE MAN ARC
Concord, Massachusetts

SECTION 1.0 INTRODUCTION

The following Drainage Report is intended to demonstrate that the existing stormwater system contains sufficient capacity for the proposed work. The design engineer recognizes this report is not a full stormwater analysis; it is instead a supplement to the original stormwater report prepared for the initial development of this site.

This report accompanies a Site Plan filing to the Concord Planning Board for a proposed sport court, sidewalk, and new parking for the property located at 35 Forest Ridge Road. This is a re-development of a previously developed site. The original site plan for this property was prepared by Hayner/Swanson, Inc and approved by the Concord Planning Board in 1998. The original approval included the full buildout of the site as it presently exists.

Currently, runoff on the site is directed to a series of catch basins and pipes that drain northwest and eventually outlet to a detention facility. This facility primarily controls runoff through infiltration into the groundwater. This is accomplished by a leaching catch basin surrounded by gravel, located in the center of the facility.

As part of the original site plan submittal in 1998, a drainage report was prepared by Hayner/Swanson, Inc which analyzed the pre-development and post-development conditions of the site at the time. Excerpts of Hayner/Swanson Inc's report are included in Appendix A; the entire report is on file with Town of Concord.

In summary, this report analyzes the proposed re-development and demonstrates that the existing detention facility, modified with a higher berm, is sufficient to control runoff. There are no proposed changes to the existing stormwater system other than raising the berm and the addition of two new landscape catch basins and pipes. The runoff generated by the re-development will not cause the existing system to overtop. The Massachusetts Stormwater Standards do not apply to this project as no portion of the project is within a wetland resource area or buffer zone.

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SECTION 2.0 COMPARISON OF IMPERVIOUS AREAS

See Table 2.1, below, for a comparison of impervious areas:

Table 2.1 Minute Man Arc Impervious Area Analysis				
Total - As Constructed (SF)¹		Total – After Re-Development (SF)		Net Increase (SF)
44,922		51,963		+ 7,041

The project proposal will add roughly 7,041 SF of new impervious are to the site.

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¹ SF = square feet (typical)

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SECTION 3.0 CONCLUSION

Storm Event	Hayner/Swanson Inc's Design (cfs)	Proposed Re-Development (cfs)
2-year (3.1 in)	0	0
10-year (4.5 in)	0	0
25-year (5.3 in)	0	0
100-year (6.6 in)	0	0

As can be seen above, the flow leaving the site will not increase as a result of the proposed re-development. This is accomplished via the existing detention facility.

It is important to note that Hayner/Swanson Inc's model indicates that the detention basin would overtop in the 25-year and 100-year storms. This is based on a surveyed berm elevation of 155.6, which is lower than the peak elevations displayed in their model. The designer is unaware of any instance of this basin overtopping. However, the berm elevation of the detention facility will be raised as part of this re-development, in order to ensure no overtopping occurs.

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STORMWATER MANAGEMENT REPORT
MINUTE MAN ARC
Concord, Massachusetts

SECTION 4.0

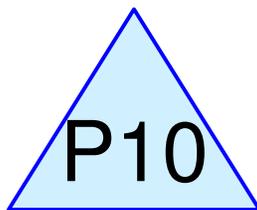
HYDROCAD WORKSHEETS



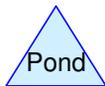
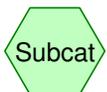
Hydrocad



Direct to Basin



Detention Pond



2860 Drainage RE-DEV

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Area Listing (all nodes)

<u>Area (sq-ft)</u>	<u>CN</u>	<u>Description (subcats)</u>
429,937	36	Woods, Fair, HSG A (4347POST)
17,424	39	>75% Grass cover, Good, HSG A (4347POST)
45,302	49	50-75% Grass cover, Fair, HSG A (4347POST)
51,836	98	Paved parking & roofs (4347POST)
<hr/>		
544,500		

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Type III 24-hr 2-Year Rainfall=3.10", Ia/S=0.21

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Time span=1.00-24.00 hrs, dt=0.01 hrs, 2301 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 4347POST: Direct to Basin

Runoff Area=12.500 ac Runoff Depth>0.01"

Tc=12.0 min CN=43 Runoff=0.02 cfs 324 cf

Pond P10: Detention Pond

Peak Elev=154.29' Storage=0 cf Inflow=0.02 cfs 324 cf

Outflow=0.02 cfs 324 cf

Total Runoff Area = 544,500 sf Runoff Volume = 324 cf Average Runoff Depth = 0.01"

90.48% Pervious Area = 492,664 sf 9.52% Impervious Area = 51,836 sf

2860 Drainage RE-DEV

Type III 24-hr 2-Year Rainfall=3.10", la/S=0.21

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Subcatchment 4347POST: Direct to Basin

Runoff = 0.02 cfs @ 22.76 hrs, Volume= 324 cf, Depth> 0.01"

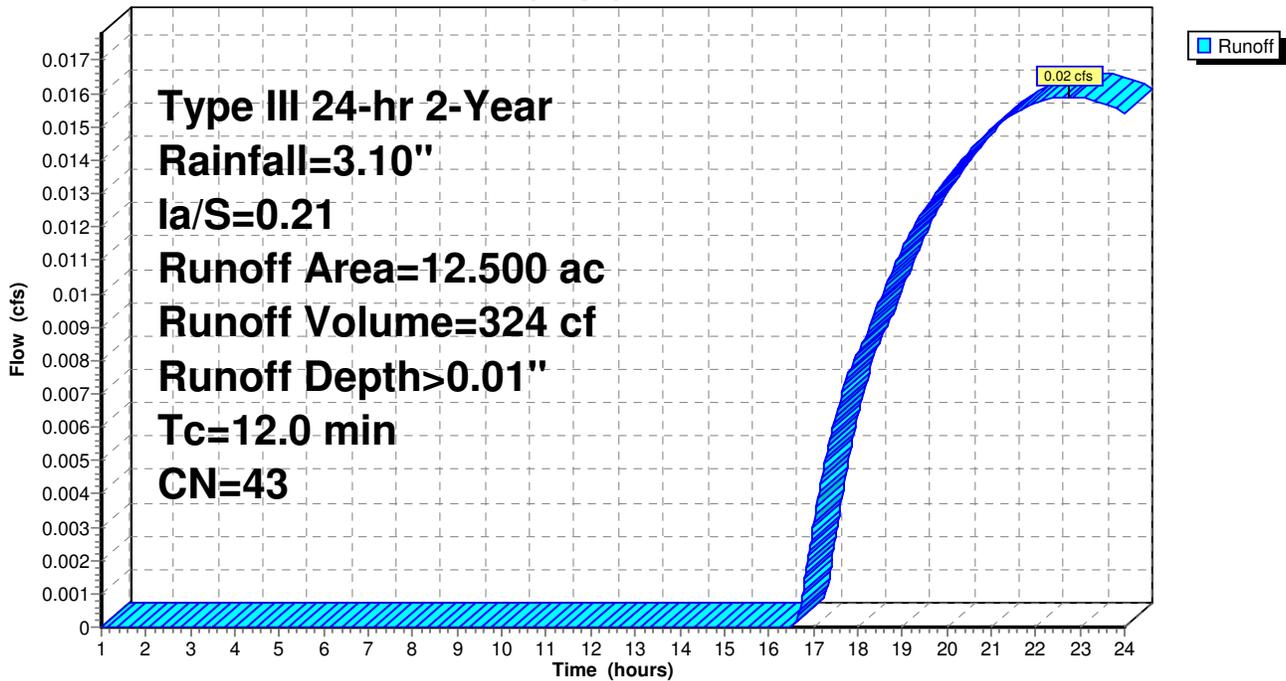
Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 2-Year Rainfall=3.10", la/S=0.21

Area (ac)	CN	Description
9.870	36	Woods, Fair, HSG A
1.040	49	50-75% Grass cover, Fair, HSG A
0.400	39	>75% Grass cover, Good, HSG A
1.190	98	Paved parking & roofs
12.500	43	Weighted Average
11.310		Pervious Area
1.190		Impervious Area

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

Subcatchment 4347POST: Direct to Basin

Hydrograph



2860 Drainage RE-DEV

Type III 24-hr 2-Year Rainfall=3.10", Ia/S=0.21

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Pond P10: Detention Pond

Inflow Area = 544,500 sf, Inflow Depth > 0.01" for 2-Year event
 Inflow = 0.02 cfs @ 22.76 hrs, Volume= 324 cf
 Outflow = 0.02 cfs @ 22.74 hrs, Volume= 324 cf, Atten= 0%, Lag= 0.0 min
 Discarded = 0.02 cfs @ 22.74 hrs, Volume= 324 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 154.29' @ 22.74 hrs Surf.Area= 23 sf Storage= 0 cf
 Flood Elev= 158.00' Surf.Area= 4,300 sf Storage= 7,449 cf

Plug-Flow detention time= 0.5 min calculated for 324 cf (100% of inflow)
 Center-of-Mass det. time= 0.2 min (1,259.0 - 1,258.8)

Volume	Invert	Avail.Storage	Storage Description
#1	154.25'	7,449 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

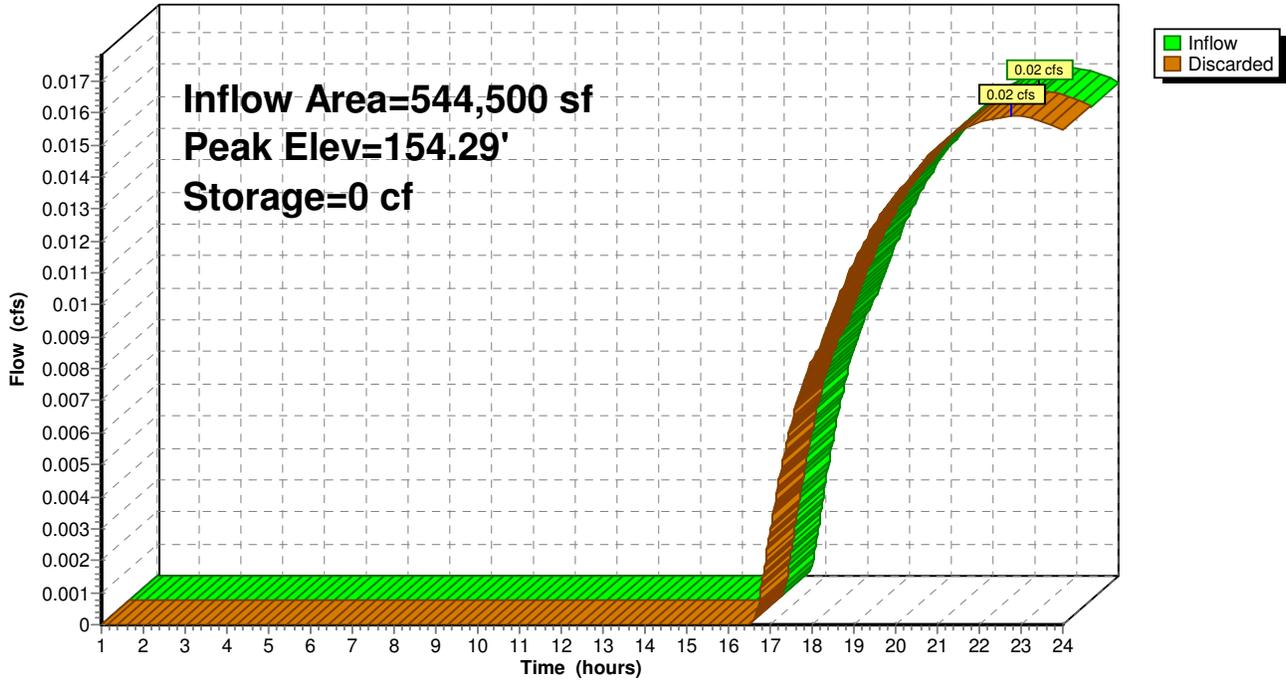
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.25	0	0	0
155.25	536	268	268
156.25	2,024	1,280	1,548
157.25	3,703	2,864	4,412
157.50	4,000	963	5,374
158.00	4,300	2,075	7,449

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	30.000 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.02 cfs @ 22.74 hrs HW=154.29' (Free Discharge)
 ↑ **1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Pond P10: Detention Pond

Hydrograph



2860 Drainage RE-DEV

Type III 24-hr 10-Year Rainfall=4.50", Ia/S=0.21

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Time span=1.00-24.00 hrs, dt=0.01 hrs, 2301 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 4347POST: Direct to Basin

Runoff Area=12.500 ac Runoff Depth>0.20"

Tc=12.0 min CN=43 Runoff=0.45 cfs 8,859 cf

Pond P10: Detention Pond

Peak Elev=155.22' Storage=251 cf Inflow=0.45 cfs 8,859 cf

Outflow=0.36 cfs 8,836 cf

Total Runoff Area = 544,500 sf Runoff Volume = 8,859 cf Average Runoff Depth = 0.20"

90.48% Pervious Area = 492,664 sf 9.52% Impervious Area = 51,836 sf

Subcatchment 4347POST: Direct to Basin

Runoff = 0.45 cfs @ 12.56 hrs, Volume= 8,859 cf, Depth> 0.20"

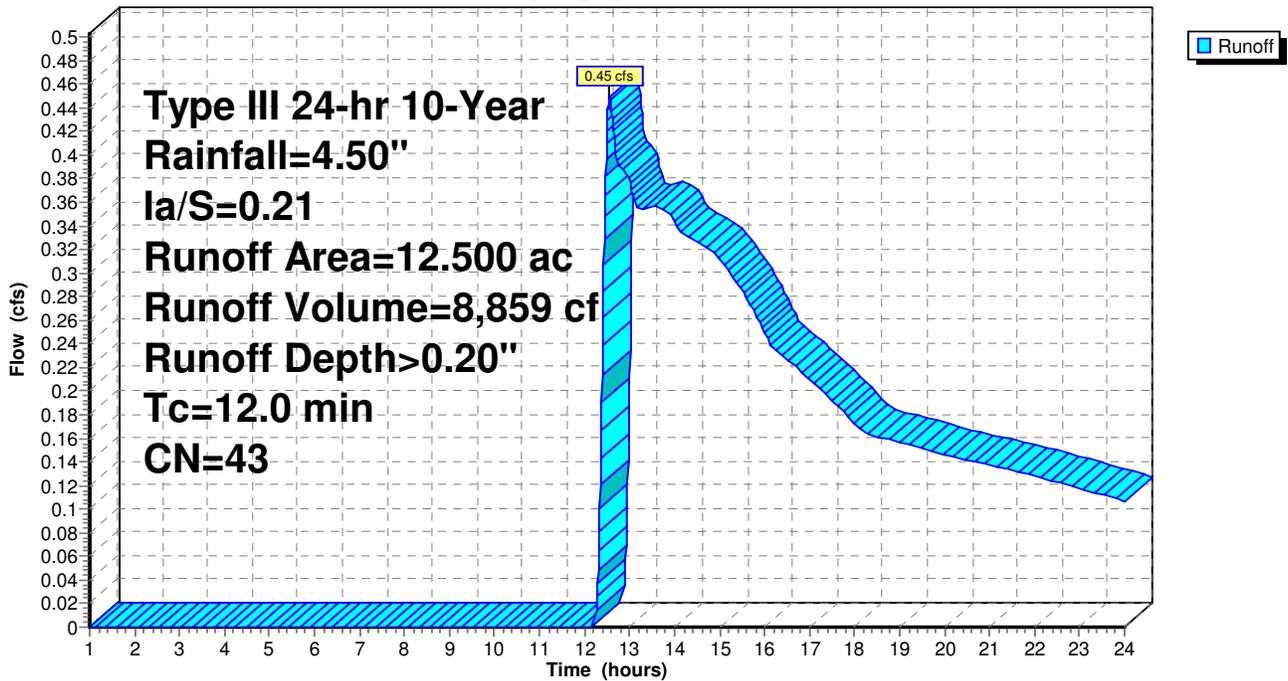
Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 10-Year Rainfall=4.50", la/S=0.21

Area (ac)	CN	Description
9.870	36	Woods, Fair, HSG A
1.040	49	50-75% Grass cover, Fair, HSG A
0.400	39	>75% Grass cover, Good, HSG A
1.190	98	Paved parking & roofs
12.500	43	Weighted Average
11.310		Pervious Area
1.190		Impervious Area

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

Subcatchment 4347POST: Direct to Basin

Hydrograph



2860 Drainage RE-DEV

Type III 24-hr 10-Year Rainfall=4.50", Ia/S=0.21

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Pond P10: Detention Pond

Inflow Area = 544,500 sf, Inflow Depth > 0.20" for 10-Year event
 Inflow = 0.45 cfs @ 12.56 hrs, Volume= 8,859 cf
 Outflow = 0.36 cfs @ 13.12 hrs, Volume= 8,836 cf, Atten= 20%, Lag= 33.9 min
 Discarded = 0.36 cfs @ 13.12 hrs, Volume= 8,836 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 155.22' @ 13.12 hrs Surf.Area= 519 sf Storage= 251 cf
 Flood Elev= 158.00' Surf.Area= 4,300 sf Storage= 7,449 cf

Plug-Flow detention time= 7.9 min calculated for 8,836 cf (100% of inflow)
 Center-of-Mass det. time= 6.8 min (1,015.1 - 1,008.3)

Volume	Invert	Avail.Storage	Storage Description
#1	154.25'	7,449 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

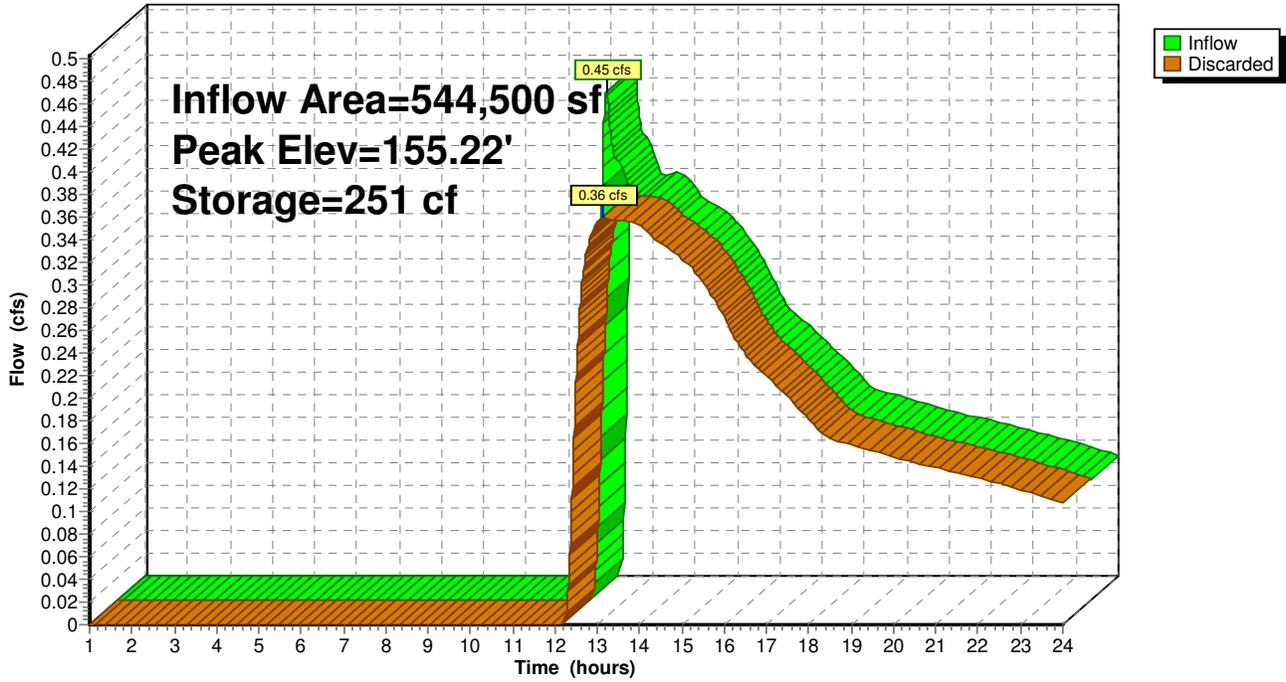
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.25	0	0	0
155.25	536	268	268
156.25	2,024	1,280	1,548
157.25	3,703	2,864	4,412
157.50	4,000	963	5,374
158.00	4,300	2,075	7,449

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	30.000 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.36 cfs @ 13.12 hrs HW=155.22' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.36 cfs)

Pond P10: Detention Pond

Hydrograph



2860 Drainage RE-DEV

Type III 24-hr 25-Year Rainfall=5.30", Ia/S=0.21

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Time span=1.00-24.00 hrs, dt=0.01 hrs, 2301 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 4347POST: Direct to Basin

Runoff Area=12.500 ac Runoff Depth>0.40"
Tc=12.0 min CN=43 Runoff=1.85 cfs 18,106 cf

Pond P10: Detention Pond

Peak Elev=156.07' Storage=1,204 cf Inflow=1.85 cfs 18,106 cf
Outflow=1.22 cfs 18,047 cf

Total Runoff Area = 544,500 sf Runoff Volume = 18,106 cf Average Runoff Depth = 0.40"
90.48% Pervious Area = 492,664 sf 9.52% Impervious Area = 51,836 sf

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Type III 24-hr 25-Year Rainfall=5.30", la/S=0.21

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Subcatchment 4347POST: Direct to Basin

Runoff = 1.85 cfs @ 12.44 hrs, Volume= 18,106 cf, Depth> 0.40"

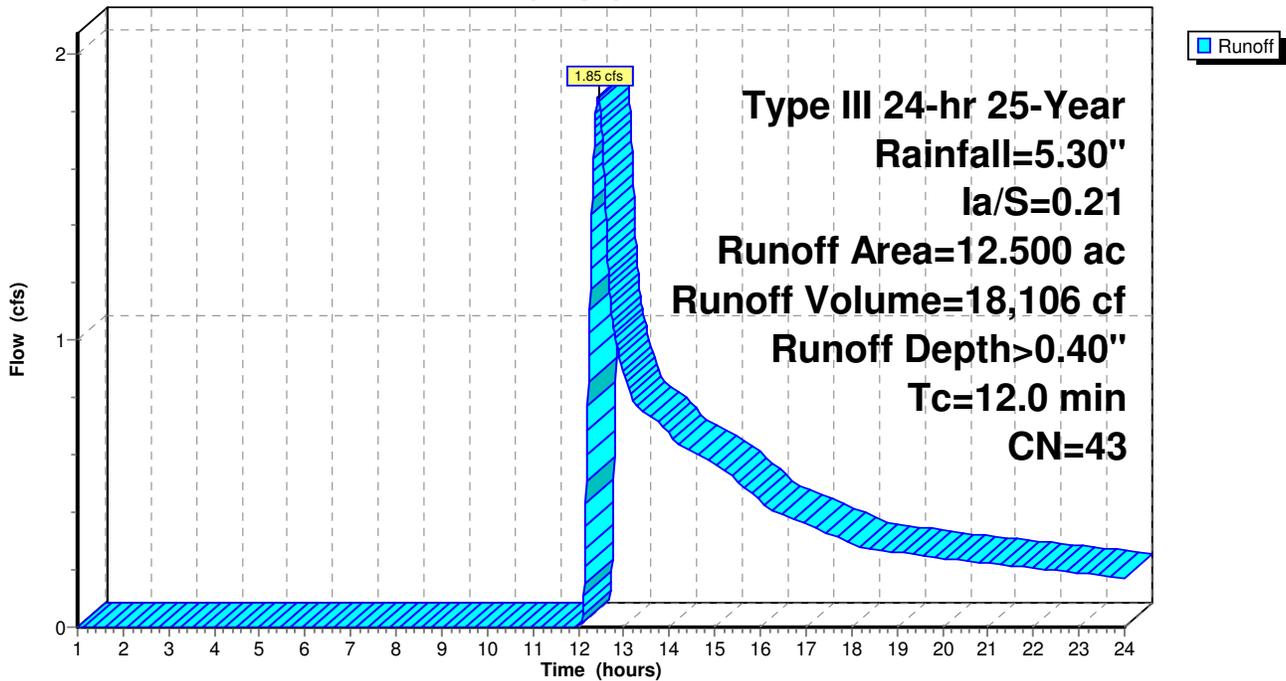
Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 25-Year Rainfall=5.30", la/S=0.21

Area (ac)	CN	Description
9.870	36	Woods, Fair, HSG A
1.040	49	50-75% Grass cover, Fair, HSG A
0.400	39	>75% Grass cover, Good, HSG A
1.190	98	Paved parking & roofs
12.500	43	Weighted Average
11.310		Pervious Area
1.190		Impervious Area

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

Subcatchment 4347POST: Direct to Basin

Hydrograph



2860 Drainage RE-DEV

Type III 24-hr 25-Year Rainfall=5.30", Ia/S=0.21

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Pond P10: Detention Pond

Inflow Area = 544,500 sf, Inflow Depth > 0.40" for 25-Year event
 Inflow = 1.85 cfs @ 12.44 hrs, Volume= 18,106 cf
 Outflow = 1.22 cfs @ 12.67 hrs, Volume= 18,047 cf, Atten= 34%, Lag= 13.8 min
 Discarded = 1.22 cfs @ 12.67 hrs, Volume= 18,047 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 156.07' @ 12.67 hrs Surf.Area= 1,753 sf Storage= 1,204 cf
 Flood Elev= 158.00' Surf.Area= 4,300 sf Storage= 7,449 cf

Plug-Flow detention time= 11.5 min calculated for 18,039 cf (100% of inflow)
 Center-of-Mass det. time= 9.9 min (973.3 - 963.4)

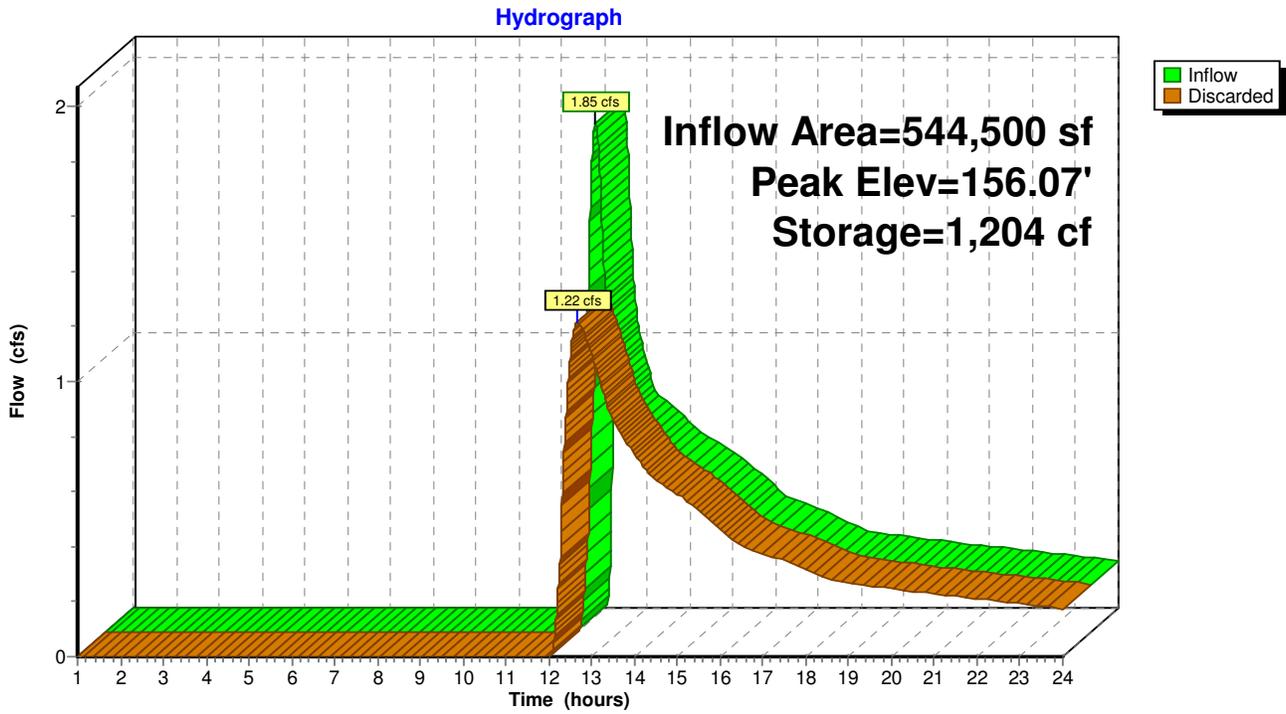
Volume	Invert	Avail.Storage	Storage Description
#1	154.25'	7,449 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.25	0	0	0
155.25	536	268	268
156.25	2,024	1,280	1,548
157.25	3,703	2,864	4,412
157.50	4,000	963	5,374
158.00	4,300	2,075	7,449

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	30.000 in/hr Exfiltration over Surface area

Discarded OutFlow Max=1.22 cfs @ 12.67 hrs HW=156.07' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 1.22 cfs)

Pond P10: Detention Pond



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Type III 24-hr 100-Year Rainfall=6.60", Ia/S=0.21

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Time span=1.00-24.00 hrs, dt=0.01 hrs, 2301 points

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 4347POST: Direct to Basin

Runoff Area=12.500 ac Runoff Depth>0.85"
Tc=12.0 min CN=43 Runoff=5.82 cfs 38,524 cf

Pond P10: Detention Pond

Peak Elev=157.54' Storage=5,535 cf Inflow=5.82 cfs 38,524 cf
Outflow=2.79 cfs 38,352 cf

Total Runoff Area = 544,500 sf Runoff Volume = 38,524 cf Average Runoff Depth = 0.85"
90.48% Pervious Area = 492,664 sf 9.52% Impervious Area = 51,836 sf

2860 Drainage RE-DEV

Type III 24-hr 100-Year Rainfall=6.60", la/S=0.21

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Subcatchment 4347POST: Direct to Basin

Runoff = 5.82 cfs @ 12.25 hrs, Volume= 38,524 cf, Depth> 0.85"

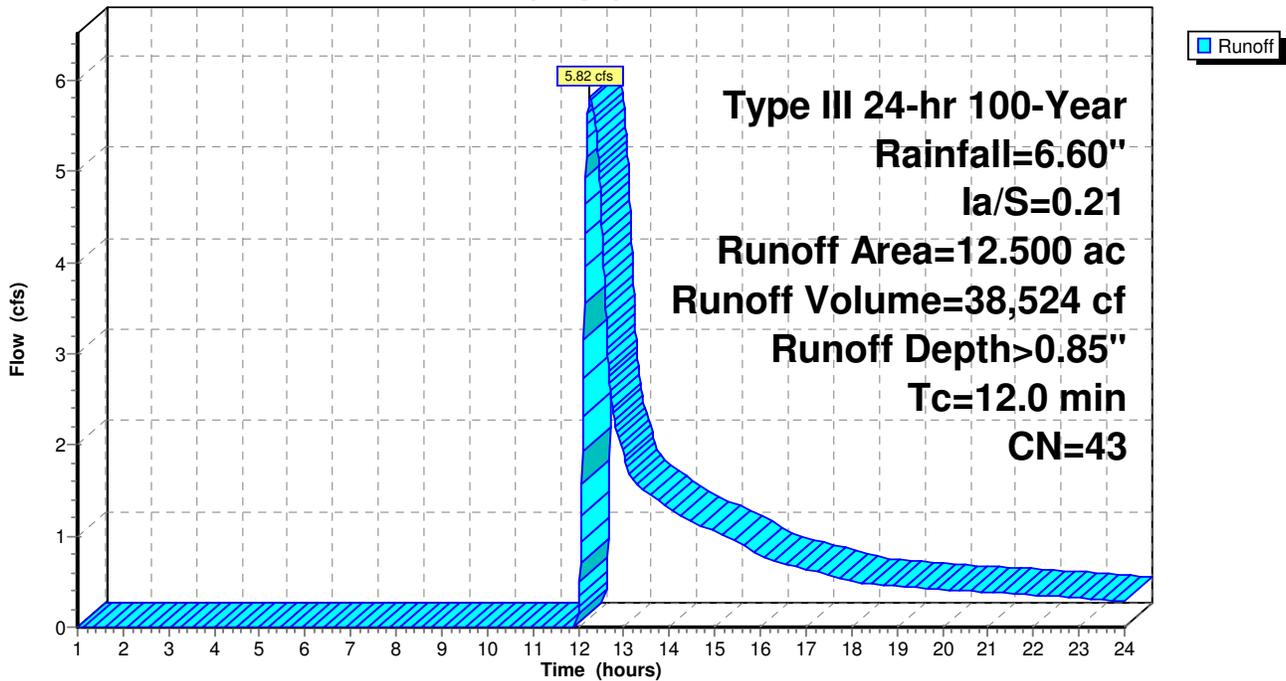
Runoff by SCS TR-20 method, UH=SCS, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
 Type III 24-hr 100-Year Rainfall=6.60", la/S=0.21

Area (ac)	CN	Description
9.870	36	Woods, Fair, HSG A
1.040	49	50-75% Grass cover, Fair, HSG A
0.400	39	>75% Grass cover, Good, HSG A
1.190	98	Paved parking & roofs
12.500	43	Weighted Average
11.310		Pervious Area
1.190		Impervious Area

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

Subcatchment 4347POST: Direct to Basin

Hydrograph



2860 Drainage RE-DEV

Type III 24-hr 100-Year Rainfall=6.60", Ia/S=0.21

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Pond P10: Detention Pond

Inflow Area = 544,500 sf, Inflow Depth > 0.85" for 100-Year event
 Inflow = 5.82 cfs @ 12.25 hrs, Volume= 38,524 cf
 Outflow = 2.79 cfs @ 12.67 hrs, Volume= 38,352 cf, Atten= 52%, Lag= 25.1 min
 Discarded = 2.79 cfs @ 12.67 hrs, Volume= 38,352 cf

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 157.54' @ 12.67 hrs Surf.Area= 4,024 sf Storage= 5,535 cf
 Flood Elev= 158.00' Surf.Area= 4,300 sf Storage= 7,449 cf

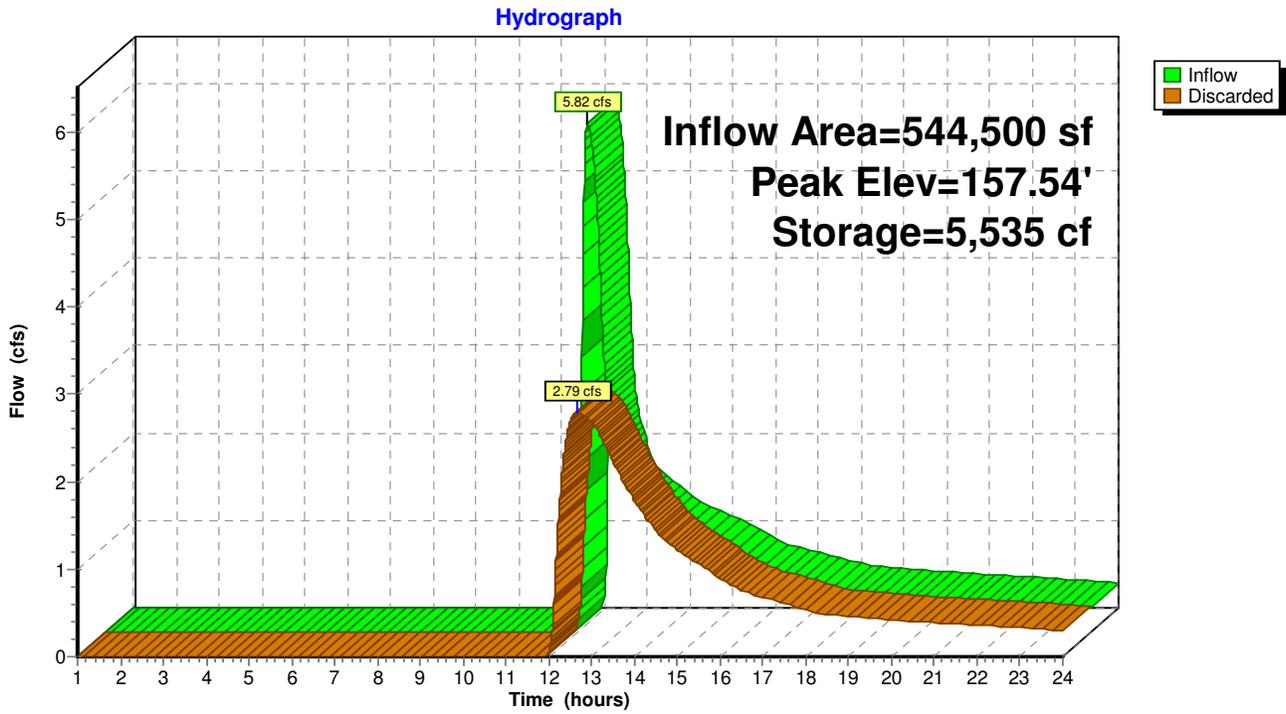
Plug-Flow detention time= 19.5 min calculated for 38,335 cf (100% of inflow)
 Center-of-Mass det. time= 17.2 min (941.8 - 924.6)

Volume	Invert	Avail.Storage	Storage Description
#1	154.25'	7,449 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
154.25	0	0	0
155.25	536	268	268
156.25	2,024	1,280	1,548
157.25	3,703	2,864	4,412
157.50	4,000	963	5,374
158.00	4,300	2,075	7,449

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	30.000 in/hr Exfiltration over Surface area

Discarded OutFlow Max=2.79 cfs @ 12.67 hrs HW=157.54' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 2.79 cfs)

Pond P10: Detention Pond



MEISNER BREM CORPORATION
142 LITTLETON ROAD, SUITE 16, WESTFORD, MA 01886

STORMWATER MANAGEMENT REPORT
MINUTE MAN ARC
Concord, Massachusetts

APPENDIX A

SELECTED EXCERPTS –
HAYNER/SWANSON INC'S REPORT

STORMWATER MANAGEMENT STUDY

***WILLIAM K. BRADFORD
PUBLISHING, INC.
FOREST RIDGE ROAD
CONCORD, MASSACHUSETTS***

PREPARED FOR

**R. L. JEANNOTTE, INC.
1000 Mt. LAUREL CIRCLE
P.O. BOX 415
SHIRLEY, MASSACHUSETTS 01742**



HAYNER/SWANSON, INC.

3 Congress Street

Nashua, New Hampshire 03062

Tel: (603) 883-2057 Fax: (603) 883-5057

STORMWATER MANAGEMENT STUDY

***WILLIAM K. BRADFORD
PUBLISHING, INC.
FOREST RIDGE ROAD
CONCORD, MASSACHUSETTS***

8 OCTOBER 1998



PREPARED FOR

R. L. JEANNOTTE, INC.
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P.O. BOX 415
SHIRLEY, MASSACHUSETTS 01742



HAYNER/SWANSON, INC.

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Tel: (603) 883-2057 Fax: (603) 883-5057*

Stormwater Management Study

William K. Bradford Publishing, Inc.

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1.0. ABSTRACT

The following study is a detailed drainage report of the proposed William K. Bradford Publishing building located on Lot 1 Forest Ridge Road in Concord, Massachusetts. The purpose of the study is to evaluate the qualitative and quantitative impacts of the proposed development. Drainage computations for this analysis and the individual drain line design are contained herewith.

Reference is hereby made to the drainage area maps that are included in this study.

2.0 SITE DESCRIPTION

The 6.5+/- acre site is located on Forest Ridge Road in Concord, Massachusetts. The parcel is zoned as limited industrial park. Main Street abuts the site to the north, Forest Ridge Road to the west, a vacant industrial parcel to the south and an industrial facility (STARMET) abuts the parcel to the East.

The site building area is currently cleared and some excavation and filling occurred during the construction of Forest Ridge Road. The topography of the site is mostly flat with a low detention area located in the northwest portion of the site. The detention area handles all stormwater runoff from the entire drainage area.

The site contains group 'A' soils (Windsor) as classified by the Soil Conservation Service.

The site is currently serviced by underground telephone & electric, as well as gas and water utilities. The site will utilize an onsite subsurface sewage disposal system

3.0 PROJECT DESCRIPTION

It is being proposed to construct a 2-story 19,500 square foot facility with accompanying parking, access drives and utilities. The facility is to be occupied by William K. Bradford Publishing, Inc as well as some leasable general office space. The sitework construction will consist of earthwork, septic system, storm drainage, utilities and landscaping. The stormwater intent is to address both qualitative and quantitative aspects of the runoff. The proposed drainage system will consist of a closed conduit

network (curbs, leaching catch basins and drainpipe). Stormwater presently flows to a depressed area of the site located near the northwest corner of the site. This area will remain and will be analyzed for both existing and proposed site conditions.

4.0 METHODOLOGY

In order to evaluate the quantitative impact of the proposed development, pre-and post-development flows will be analyzed and compared.

The SCS. Type III distribution routing system is based on the theory that during significant 24 hour storm events, the peak rates of runoff are produced between the 11th and 15th hours of the storm. This method is being used for this analysis to check the adequacy of the detention pond during a 24-hour storm.

Rainfall time distributions, runoff curve numbers (CN), and hydrologic soil groups were obtained by using the various charts and tables shown on the following pages.

The Heated Methods, Inc. Quick TR.-55 Hydrology for Small Watersheds as copyrighted by Michael K. Glazier is hereby incorporated by reference.

The Technical Release 55 (TR.), Urban Hydrology for Small Watersheds, Soil Conversions Service (SC.) first issued in January 1975 and revised in June 1986 is also incorporated by reference.

The Rational Method ($Q=CiA$) will be used to design the individual on-site drainage system.

5.0 DETERMINATION OF PRE-DEVELOPMENT FLOWS

As can be seen on the attached Pre-Development Drainage Area Map (Exhibit A) the site drains to the northwest portion of the site. Included in the drainage area is a good portion of the adjacent wooded site to the southeast. In order to determine the peak rate of runoff for the drainage area was broken down into different categories and assigned a runoff curve number (See Support Data – Appendix 'A'). The storm events were then routed through the detention area to determine the runoff from the site. The results of the 2-year, 10-year, 25-year and 100-year 24-hour storms are as follows:

Pre-development Peak Rates of Runoff		
Storm Event (24-hr Type III)	Peak Inflow to Detention Area (cfs)	Peak Runoff from site* (cfs)
2-yr	0	0
10-yr	0	0
25-yr	1	0
100-yr	4	0

* Storm events were routed through detention area.

(See Appendix 'B' for pre-development computations)

6.0 DETERMINATION OF POST-DEVELOPMENT FLOWS

As can be seen on the attached Post-Development Drainage Area Map (See Exhibit 'B') the existing detention area has been maintained in its existing condition. The design utilized leaching catch basins and drainpipe to convey runoff from the parking and roof areas to the detention area. The runoff from the remainder of the drainage area will be conveyed around the parking and building by a drainage swale. The results of the 2-year, 10-year, 25-year and 100-year 24-hour storms are as follows:

Post-development: Peak Runoff & Peak Outflow		
Storm Frequency (24 hr. Type III)	Peak Inflow to Detention Area (cfs)	Peak Runoff from site* (cfs)
2 yr.	0	0
10 yr.	1	0
25 yr.	2	0
50 yr.	5	0

* Storm events were routed through detention area.

(See Appendix 'C' for post-development computations)

7.0 INDIVIDUAL DRAIN LINE DESIGN

The on-site runoff will be collected in a closed conduit system that discharges into the large detention pond. The drainage system was designed for the 10-year storm frequency.

The rational method will be used to determine peak rates of runoff in order to compute the on-site drainage pipe sizing.

$$Q = C i A$$

where:

Q = rate of runoff (cfs)

C = runoff coefficient

i = rainfall intensity factor (inches/hour)

A = drainage area (acres)

C = 0.90 for pavement/roofs

C = 0.30 for grassed areas

C = 0.20 for wooded areas



DRAINAGE AREA LCB5 0.65 ACRES

$$0.35 \times 0.90 = 0.315$$

$$0.30 \times 0.30 = 0.09$$

$$\text{---} \times 0.20 = \text{---}$$

$$\Sigma = 0.405$$

$$C_w = 0.62$$

DRAINAGE AREA LCB4 0.17 ACRES

$$0.14 \times 0.90 = 0.126$$

$$0.03 \times 0.30 = 0.009$$

$$\text{---} \times 0.20 = \text{---}$$

$$\Sigma = 0.135$$

$$C_w = 0.79$$

DRAINAGE AREA LCB3 0.32 ACRES

$$0.25 \times 0.90 = 0.225$$

$$0.07 \times 0.30 = 0.021$$

$$\text{---} \times 0.20 = \text{---}$$

$$\Sigma = 0.246$$

$$C_w = 0.77$$

DRAINAGE AREA RD3 0.22 ACRES

$$0.22 \times 0.90 =$$

$$\text{---} \times 0.30 =$$

$$\text{---} \times 0.20 =$$

$$\Sigma =$$

$$C_w = 0.90$$

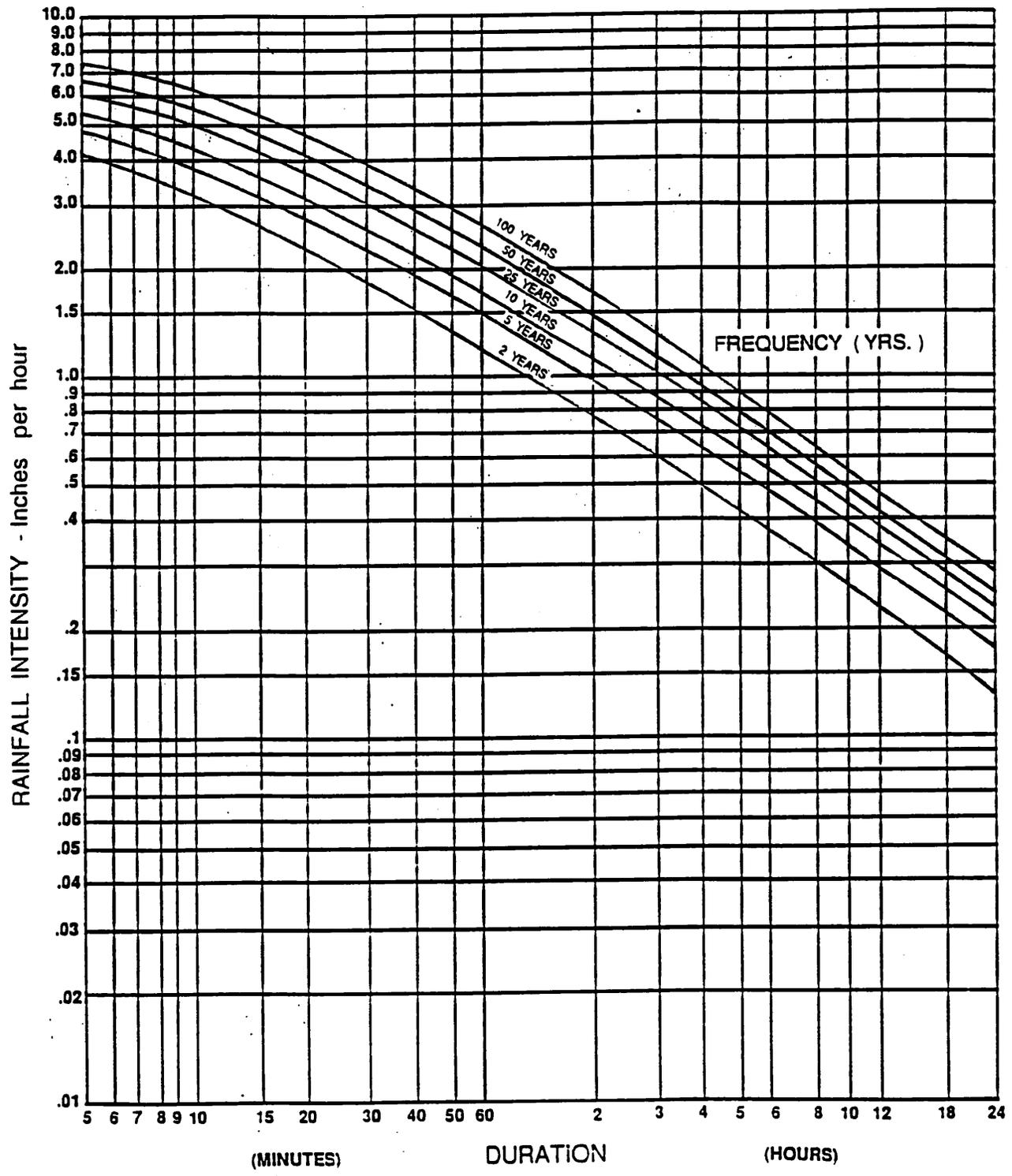


Figure 10-4. Intensity — Duration — Frequency Curve for Boston, MA

8.0 SUMMARY

The Stormwater Management Design for the proposed development utilizes the existing drainage patterns and detention area. We have shown that the detention area can handle the 100-year storm event for both present and proposed conditions. The resulting runoff from the site will be zero as the detention area will allow all storm events up to the 100-year 24-hour storm to infiltrate directly into the ground. The analysis has shown that there will not be any adverse impacts to the quality or quantity of stormwater runoff from this site as a result of this development.

**A
P
P
E
N
D
I
X

A**

Job File: H:\HAESTAD\PPK6\DATA\4347\4347.PPK
Rain Dir: .\util\

=====
JOB TITLE
=====

WILLIAM K. BRADFORD PUBLISHING
FOREST RIDGE ROAD (LOT 1)
CONCORD, MA

PRE-DEV.
WATERSHED RUNOFF
TO DETENTION AREAS

DETERMINATION OF WEIGHTED C_N VALUE

(PRE-DEVELOPMENT)

DESCRIPTION	AREA ACRE	C _N (GROUP A SOIL)	C _N * A
WOODED	10.0	36	360
Open (meadow)	2.5	49	122.5
	<u>Σ 12.5</u>		<u>Σ 482.5</u>

$$\text{WEIGHTED } C_N = \frac{\sum C_N * A}{\sum A} = 38.2$$

TIME OF CONCENTRATION:

$$S = \frac{54'}{1200'} = 0.0533$$

$$t_c = 12 \text{ min} \quad (\text{SEE CHART})$$

Type.... TR-55 Tabular Hyd.Peaks
Name.... 4347PRE Tag: 2

File.... H:\HAESTAD\PPK6\DATA\4347\4347.PPK
HYG Dir = H:\HAESTAD\PPK6\DATA\4347\
HYG file = 4347PRE.HYG HYG 10 2

TR-55 TABULAR HYDROGRAPH METHOD
TYPE III Distribution
2yr, 24hr Rainfall Depth = 3.10 in

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
----- PREDEVELOPMENT -----	0	.0
Composite Watershed	0	.0

Type.... TR-55 Tabular Hyd.Peaks
Name.... 4347PRE Tag: 10

File.... H:\HAESTAD\PPK6\DATA\4347\4347.PPK
HYG Dir = H:\HAESTAD\PPK6\DATA\4347\
HYG file = 4347PRE.HYG HYG 10 10

TR-55 TABULAR HYDROGRAPH METHOD
TYPE III Distribution
10yr, 24hr Rainfall Depth = 4.50 in

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
----- PREDEVELOPMENT -----	0	.0
Composite Watershed	0	.0

Type.... TR-55 Tabular Hyd.Peaks
Name.... 4347PRE Tag: 25

File.... H:\HAESTAD\PPK6\DATA\4347\4347.PPK
HYG Dir = H:\HAESTAD\PPK6\DATA\4347\
HYG file = 4347PRE.HYG HYG 10 25

TR-55 TABULAR HYDROGRAPH METHOD
TYPE III Distribution
25yr, 24hr Rainfall Depth = 5.30 in

>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
----- PREDEVELOPMENT -----	1	12.4
----- Composite Watershed	1	12.4

Type.... TR-55 Tabular Hyd.Peaks
Name.... 4347PRE Tag: 100

File.... H:\HAESTAD\PPK6\DATA\4347\4347.PPK
HYG Dir = H:\HAESTAD\PPK6\DATA\4347\
HYG file = 4347PRE.HYG HYG 10 100

TR-55 TABULAR HYDROGRAPH METHOD
TYPE III Distribution
100yr, 24hr Rainfall Depth = 6.60 in

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
----- PREDEVELOPMENT -----	----- 3 -----	----- 12.6 -----
Composite Watershed	3	12.6

Job File: H:\HAESTAD\PPK6\DATA\4347\4347.PPK
Rain Dir: .\util\

=====
JOB TITLE
=====

WILLIAM K. BRADFORD PUBLISHING
FOREST RIDGE ROAD (LOT 1)
CONCORD, MA

ROUTING ANALYSIS
25 yr + 100 yr
24-HR
STORM EVENTS

PEAK RUNOFF (OUTFLOW)

25yr Ø CFS

100yr Ø CFS

Type.... Pond Routing Summary
Name.... POND ROUTING Tag: 25

File.... H:\HAESTAD\PPK6\DATA\4347\4347.PPK

LEVEL POOL ROUTING SUMMARY

25yr

HYG Dir = H:\HAESTAD\PPK6\DATA\4347\
Inflow HYG file = 4347PRE.HYG - HYG 10 25
Outflow HYG file = RT-PRE.HYG - HYG 10 25

Pond Node Data = P 10
Pond Volume Data = P 10
Pond Outlet Data = POND RT 10

Infiltration = 30.0000 in/hr

INITIAL CONDITIONS

Starting WS Elev = 154.25 ft
Starting Volume = .000 ac-ft
Starting Outflow = .00 cfs
Starting Infiltr. = .00 cfs
Starting Total Qout = .00 cfs
Time Increment = .1000 hrs

INFLOW/OUTFLOW HYDROGRAPH SUMMARY

=====
Peak Inflow = 1.00 cfs at 12.4000 hrs
Peak Outflow = .00 cfs at 11.1000 hrs
Peak Infiltration = .98 cfs at 13.5000 hrs



Peak Elevation = 155.84 ft
Peak Storage = .016 ac-ft
=====

MASS BALANCE (ac-ft)

+ Initial Vol = .000
+ HYG Vol IN = .099
- Infiltration = .099
- HYG Vol OUT = .000
- Retained Vol = .000

Unrouted Vol = -.000 ac-ft (.000% of Inflow Volume)

Type.... Pond Routing Summary
Name.... POND ROUTING Tag: 100

File.... H:\HAESTAD\PPK6\DATA\4347\4347.PPK

LEVEL POOL ROUTING SUMMARY

6042

HYG Dir = H:\HAESTAD\PPK6\DATA\4347\
Inflow HYG file = 4347PRE.HYG - HYG 10 100
Outflow HYG file = RT-PRE.HYG - HYG 10 100

Pond Node Data = P 10
Pond Volume Data = P 10
Pond Outlet Data = POND RT 10

Infiltration = 30.0000 in/hr

INITIAL CONDITIONS

Starting WS Elev = 154.25 ft
Starting Volume = .000 ac-ft
Starting Outflow = .00 cfs
Starting Infiltr. = .00 cfs
Starting Total Qout = .00 cfs
Time Increment = .1000 hrs

INFLOW/OUTFLOW HYDROGRAPH SUMMARY

=====
Peak Inflow = 3.00 cfs at 12.6000 hrs
Peak Outflow = .00 cfs at 11.1000 hrs
Peak Infiltration = 1.83 cfs at 13.1000 hrs

Peak Elevation = 156.61 ft
Peak Storage = .052 ac-ft
=====



MASS BALANCE (ac-ft)

+ Initial Vol = .000
+ HYG Vol IN = .496
- Infiltration = .496
- HYG Vol OUT = .000
- Retained Vol = .000

Unrouted Vol = -.000 ac-ft (.000% of Inflow Volume)

Job File: H:\HAESTAD\PPK6\DATA\4347\4347.PPK
Rain Dir: .\util\

=====
JOB TITLE
=====

WILLIAM K. BRADFORD PUBLISHING
FOREST RIDGE ROAD (LOT 1)
CONCORD, MA

Post-Dev
WATERSHED RUNOFF
TO DETENTION AREA

S/N: HOMOL0120068 HAYNER/SWANSON INC.
Pond Pack Ver: 5-05-97 :050 Compute Time: 09:44:12 Date: 10-08-1998

DETERMINATION OF WEIGHTED CN VALUE
(POST DEVELOPMENT)

DESCRIPTION	AREA	CN	CN * A
WOODED	10.0	36	360
OPEN	1.14	49	55.86
Open (lawv)	0.4	39	15.6
IMPERVIOUS	<u>0.96</u>	98	<u>94.08</u>

$\Sigma A = 12.5$

$\Sigma Cn * A = 525.54$

WEIGHTED $C_n = 42.0$

$t_c = 12 \text{ min}$

Type.... TR-55 Tabular Hyd.Peaks
Name.... 4347POST Tag: 2

File.... H:\HAESTAD\PPK6\DATA\4347\4347.PPK
HYG Dir = H:\HAESTAD\PPK6\DATA\4347\
HYG file = 4347POST.HYG HYG 10 2

TR-55 TABULAR HYDROGRAPH METHOD
TYPE III Distribution
2yr, 24hr Rainfall Depth = 3.10 in

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
----- 4347POST -----	----- 0 -----	----- .0 -----
Composite Watershed	0	.0

Type.... TR-55 Tabular Hyd.Peaks
Name.... 4347POST Tag: 10

Page 1.07

File.... H:\HAESTAD\PPK6\DATA\4347\4347.PPK
HYG Dir = H:\HAESTAD\PPK6\DATA\4347\
HYG file = 4347POST.HYG HYG 10 10

TR-55 TABULAR HYDROGRAPH METHOD
TYPE III Distribution
10yr, 24hr Rainfall Depth = 4.50 in

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
----- 4347POST -----	----- 1 -----	----- 12.5 -----
Composite Watershed	1	12.5

Type.... TR-55 Tabular Hyd.Peaks
Name.... 4347POST Tag: 25

File.... H:\HAESTAD\PPK6\DATA\4347\4347.PPK
HYG Dir = H:\HAESTAD\PPK6\DATA\4347\
HYG file = 4347POST.HYG HYG 10 25

TR-55 TABULAR HYDROGRAPH METHOD
TYPE III Distribution
25yr, 24hr Rainfall Depth = 5.30 in

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
----- 4347POST -----	----- 2 -----	----- 12.6 -----
Composite Watershed	2	12.6

Type.... TR-55 Tabular Hyd.Peaks
Name.... 4347POST Tag: 100

File.... H:\HAESTAD\PPK6\DATA\4347\4347.PPK
HYG Dir = H:\HAESTAD\PPK6\DATA\4347\
HYG file = 4347POST.HYG HYG 10 100

TR-55 TABULAR HYDROGRAPH METHOD
TYPE III Distribution
100yr, 24hr Rainfall Depth = 6.60 in

>>>> Summary of Subarea Times to Peak <<<<

Subarea	Peak Discharge at Composite Outfall (cfs)	Time to Peak at Composite Outfall (hrs)
4347POST	5	12.6
Composite Watershed	5	12.6

Job File: H:\HAESTAD\PPK6\DATA\4347\4347.PPK
Rain Dir: .\util\

=====
JOB TITLE
=====

WILLIAM K. BRADFORD PUBLISHING
FOREST RIDGE ROAD (LOT 1)
CONCORD, MA

ROUTING ANALYSIS

10-yr, 25yr, + 100 yr

24-HR

STORM EVENTS

PEAK RUNOFF (OUTFLOW)

10yr 0 CFS

25yr 0 CFS

100yr 0 CFS

Type.... Pond Routing Summary
Name.... POND ROUTING Tag: 25

File.... H:\HAESTAD\PPK6\DATA\4347\4347.PPK

LEVEL POOL ROUTING SUMMARY

HYG Dir = H:\HAESTAD\PPK6\DATA\4347\
Inflow HYG file = 4347POST.HYG - HYG 10
Outflow HYG file = RT-POST.HYG - RTPST

25
25 *ya*

Pond Node Data = P 10
Pond Volume Data = P 10
Pond Outlet Data = POND RT 10

Infiltration = 30.0000 in/hr

INITIAL CONDITIONS

Starting WS Elev = 154.25 ft
Starting Volume = .000 ac-ft
Starting Outflow = .00 cfs
Starting Infiltr. = .00 cfs
Starting Total Qout = .00 cfs
Time Increment = .1000 hrs

INFLOW/OUTFLOW HYDROGRAPH SUMMARY

=====
Peak Inflow = 2.00 cfs at 12.6000 hrs
Peak Outflow = .00 cfs at 11.1000 hrs
Peak Infiltration = 1.20 cfs at 12.8000 hrs

Peak Elevation = 156.05 ft
Peak Storage = .024 ac-ft
=====

MASS BALANCE (ac-ft)

+ Initial Vol = .000
+ HYG Vol IN = .298
- Infiltration = .298
- HYG Vol OUT = .000
- Retained Vol = .000

Unrouted Vol = -.000 ac-ft (.000% of Inflow Volume)

Type.... Pond Routing Summary
Name.... POND ROUTING Tag: 100

File.... H:\HAESTAD\PPK6\DATA\4347\4347.PPK

LEVEL POOL ROUTING SUMMARY

HYG Dir = H:\HAESTAD\PPK6\DATA\4347\
Inflow HYG file = 4347POST.HYG - HYG 10
Outflow HYG file = RT-POST.HYG - RTPST

100 yr
100

Pond Node Data = P 10
Pond Volume Data = P 10
Pond Outlet Data = POND RT 10

Infiltration = 30.0000 in/hr

INITIAL CONDITIONS

Starting WS Elev = 154.25 ft
Starting Volume = .000 ac-ft
Starting Outflow = .00 cfs
Starting Infiltr. = .00 cfs
Starting Total Qout = .00 cfs
Time Increment = .1000 hrs

INFLOW/OUTFLOW HYDROGRAPH SUMMARY

=====
Peak Inflow = 5.00 cfs at 12.6000 hrs
Peak Outflow = .00 cfs at 11.1000 hrs
Peak Infiltration = 2.71 cfs at 13.0000 hrs

Peak Elevation = 157.42 ft
Peak Storage = .114 ac-ft
=====

MASS BALANCE (ac-ft)

+ Initial Vol = .000
+ HYG Vol IN = .744
- Infiltration = .744
- HYG Vol OUT = .000
- Retained Vol = .000

Unrouted Vol = -.000 ac-ft (.000% of Inflow Volume)

MEISNER BREM CORPORATION
142 LITTLETON ROAD, SUITE 16, WESTFORD, MA 01886

STORMWATER MANAGEMENT REPORT
MINUTE MAN ARC
Concord, Massachusetts

APPENDIX B

SUBCATCHMENT AREA MAPS

LOT 2008 MAP 82
BENJAMIN REALTY TRUST
100 MAIN STREET
CONCORD, MA 01742
TEL 978/365-1234

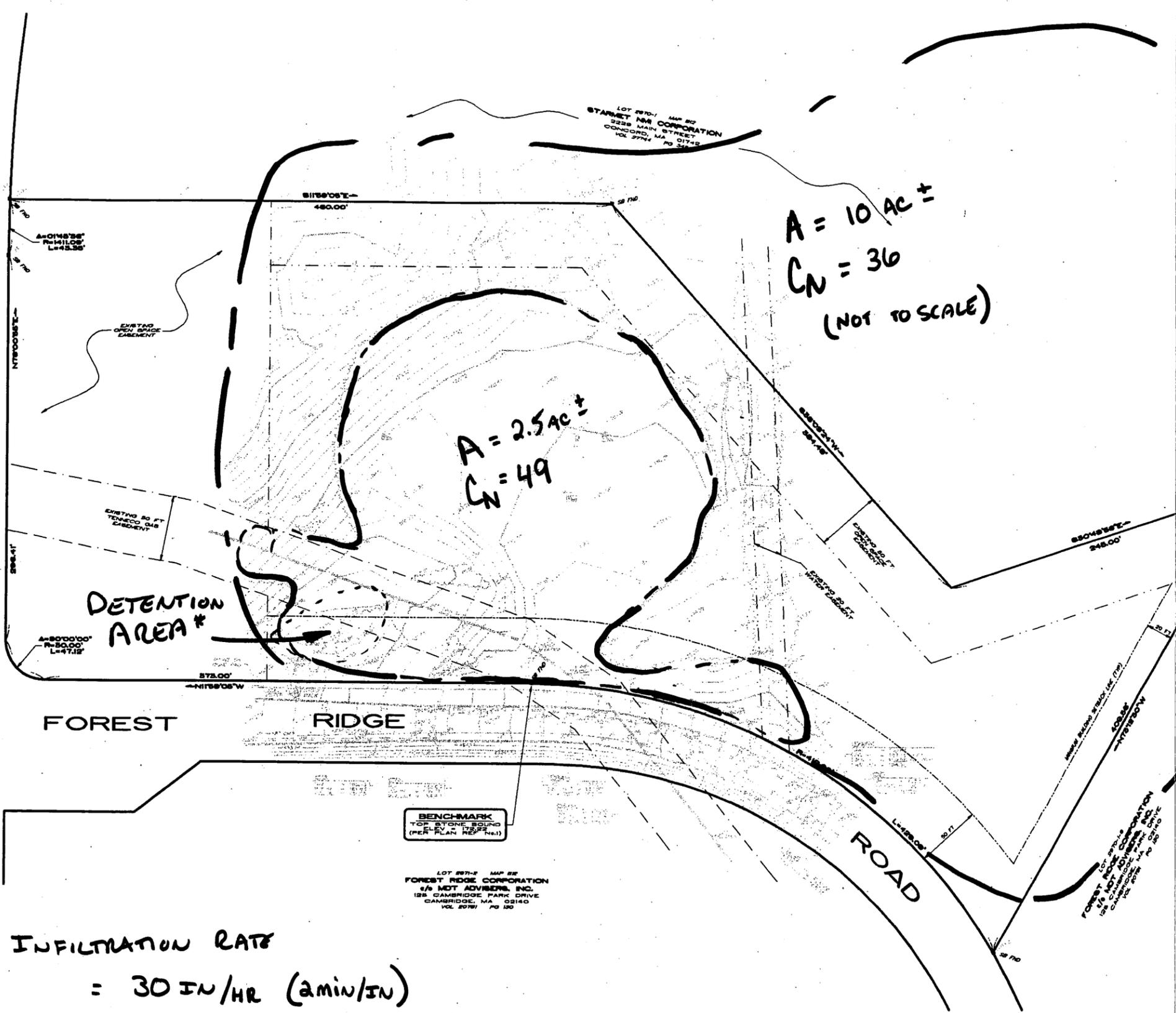
LOT 2004 MAP 82
NATIONAL REALTY TRUST
780 BARRETT'S HILL ROAD
CONCORD, MA 01742
TEL 978/365-1234

LOT 2004-0 MAP 82
VALLEY SPORTS, INC.
100 MAIN STREET
CONCORD, MA 01742
TEL 978/365-1234

STREET

(ROUTE 92)

MAIN



* INFILTRATION RATE
= 30 IN/HR (2 MIN/IN)

BENCHMARK
TOP STONE BOUND
ELEV. = 122.87'
(PER PLAN REF. #1)

LOT 2074-2 MAP 82
FOREST RIDGE CORPORATION
c/o MDT ADVISERS, INC.
125 CAMBRIDGE PARK DRIVE
CAMBRIDGE, MA 02140
TEL 207/741-1234

A = 10 AC +/-
CN = 36
(NOT TO SCALE)

A = 2.5 AC +/-
CN = 49

DETENTION
AREA #

FOREST RIDGE

ROAD

LEGEND

- EXISTING GROUND CONTOUR
- PROPOSED GRADE
- EXISTING SPOT ELEVATION
- PROPOSED SPOT ELEVATION
- STORM DRAIN & CATCH BASIN
- STORM DRAIN & MANHOLE
- SANITARY SEWER & MANHOLE
- WATER MAIN & HYDRANT
- WATER LINE & GATE VALVE
- OVERHEAD ELECTRIC AND TELEPHONE
- UNDERGROUND ELECTRIC & MANHOLE
- UNDERGROUND TELEPHONE & MANHOLE
- GAS LINE & GATE VALVE
- EXISTING TREE LINE
- PROPOSED TREE CUTTING LIMIT
- IRON PIPE
- STONE BOUND
- CONCRETE BOUND
- HANDICAP PARKING SPACE
- HANDICAP SIDEWALK RAMP
- PARKING SPACE COUNT
- STORMWATER RUNOFF DIRECTION
- PAVEMENT SAWCUT LINE
- MINIMUM BUILDING SETBACK LINE
- TEST PIT LOCATION & NUMBER
- PERCOLATION TEST LOCATION & NUMBER
- RIPRAP

PLAN REFERENCES:

1. PLAN OF LOT 1, FOREST RIDGE ROAD, CONCORD MASSACHUSETTS, SCALE 1"=40', DATED AUGUST 28, 1992 AND PREPARED BY DAVID W PERLEY, CIVIL ENGINEERS

NO.	DATE	REVISION	BY

EXHIBIT 'A'
DRAINAGE AREA MAP (PREDEVELOPMENT)

WILLIAM K. BRADFORD PUBLISHING, INC.
CONCORD, MASSACHUSETTS
PREPARED FOR:
R.L. JEANNOTTE, INC.
1000 MT. LAUREL CIRCLE PO BOX 415 SHIRLEY, MASSACHUSETTS 01464 (978) 425-2333

RECORD OWNER:
FOREST RIDGE CORPORATION
c/o MDT ADVISERS, INC. 125 CAMBRIDGE PARK DR. CAMBRIDGE, MASSACHUSETTS 02140

SCALE: 1"=40 Feet 20
1"=12.192 Meters

25 SEPTEMBER 1998

HESI Hayner/Swanson, Inc.
Civil Engineers/Land Surveyors
Three Congress Street Nashua, New Hampshire 03062-3301
Tel (603) 883-2037 Fax (603) 883-5037
www.haynerswanson.com

BOUNDARY INFORMATION DEPICTED HEREON WAS TAKEN FROM PLAN REF. NO. 1 AND THE TOPOGRAPHY SHOWN IS FROM AN ACTUAL SURVEY MADE ON THE GROUND IN AUGUST 1998

DATE _____

SHEET 1 OF 5 988 4347pb FQ41

David W. Perley

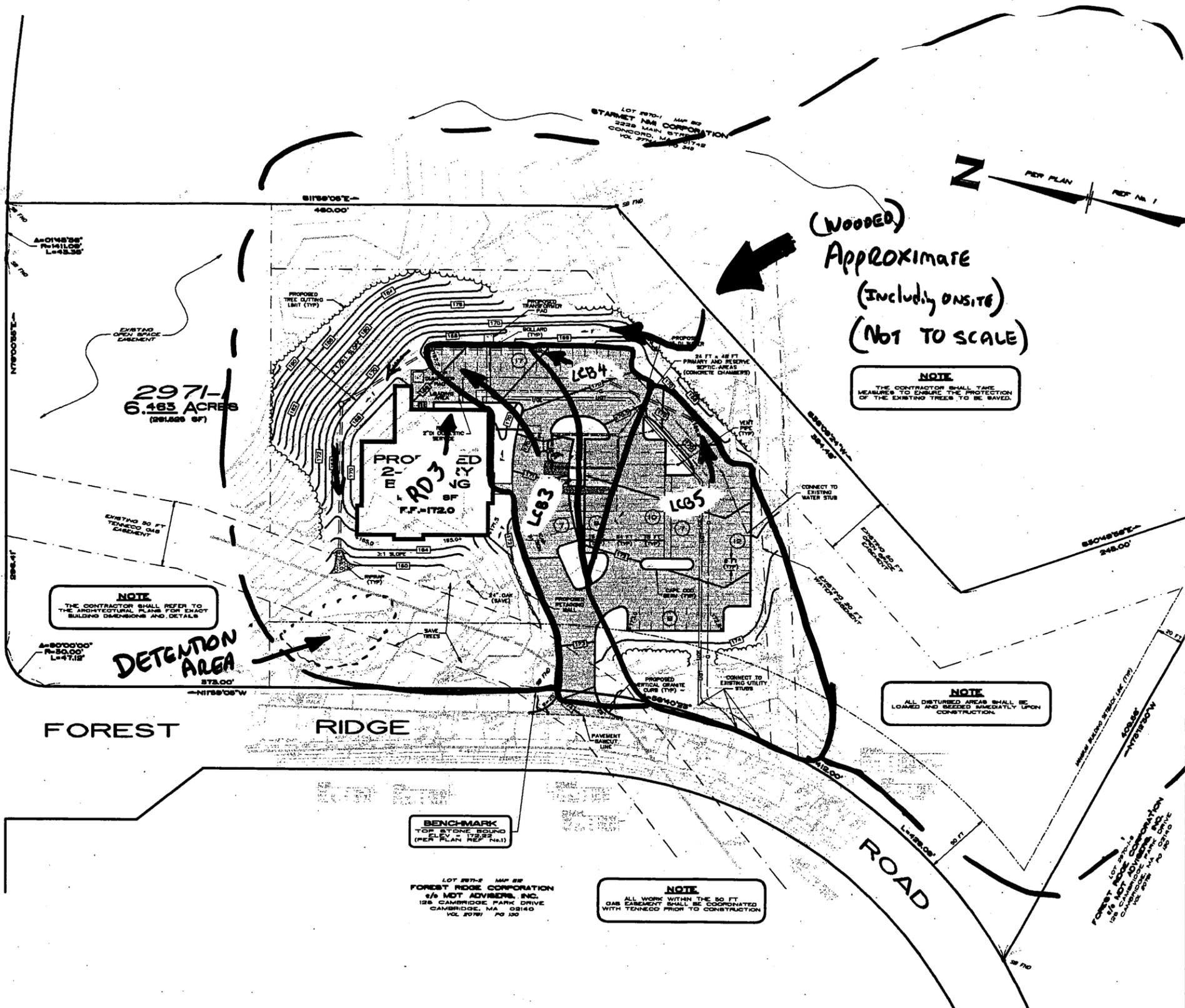
MDC'S SYSTEM PREPARED

LOT 2971-2 MAP 82
BENCHMARK REALTY TRUST
KEVIN P. HURLEY, TRUSTEE
18 WASHINGTON STREET
CONCORD, MASSACHUSETTS
03301
VOL. 278-100 PG. 248

LOT 2971-1 MAP 82
MCDONALD'S RESTAURANT
PAUL D. DAMBROSKI, TRUSTEE
780 BARRETT'S HILL ROAD
CONCORD, MASSACHUSETTS
03301
VOL. 278-100 PG. 247

LOT 2971-3 MAP 82
VALLEY SPORTS, INC.
2880 MAIN STREET
CONCORD, MASSACHUSETTS
03301
VOL. 278-100 PG. 249

STREET (ROUTE 62)
FOREST RIDGE ROAD



NOTE
THE CONTRACTOR SHALL REFER TO THE ARCHITECTURAL PLANS FOR EXACT BUILDING DIMENSIONS AND DETAILS

NOTE
THE CONTRACTOR SHALL TAKE MEASURES TO ENSURE THE PROTECTION OF THE EXISTING TREES TO BE SAVED.

NOTE
ALL DISTURBED AREAS SHALL BE LOANED AND RESEED IMMEDIATELY UPON CONSTRUCTION.

NOTE
ALL WORK WITHIN THE 50 FT OAR EASEMENT SHALL BE COORDINATED WITH TENECO PRIOR TO CONSTRUCTION

BENCHMARK
TOP STONE BOUND
ELEV. = 172.58'
(PER PLAN REF. No. 1)

LOT 2971-2 MAP 82
FOREST RIDGE CORPORATION
c/o MDT ADVISERS, INC.
125 CAMBRIDGE PARK DRIVE
CAMBRIDGE, MA 02140
VOL. 278-100 PG. 249

LEGEND

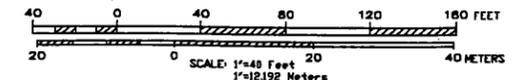
- EXISTING GROUND CONTOUR
- PROPOSED GRADE
- EXISTING SPOT ELEVATION
- 100.3+ --- PROPOSED SPOT GRADE
- STORM DRAIN & CATCH BASIN
- STORM DRAIN & MANHOLE
- SANITARY SEWER & MANHOLE
- WATER MAIN & HYDRANT
- WATER LINE & GATE VALVE
- OVERHEAD ELECTRIC AND TELEPHONE
- UNDERGROUND ELECTRIC & MANHOLE
- UNDERGROUND TELEPHONE & MANHOLE
- GAS LINE & GATE VALVE
- EXISTING TREE LINE
- PROPOSED TREE CUTTING LIMIT
- IRON PIPE
- STONE BOUND
- CONCRETE BOUND
- HANDICAP PARKING SPACE
- HANDICAP SIDEWALK RAMP
- PARKING SPACE COUNT
- STORMWATER RUNOFF DIRECTION
- PAVEMENT SAWCUT LINE
- MINIMUM BUILDING SETBACK LINE
- TEST PIT LOCATION & NUMBER
- PERCOLATION TEST LOCATION & NUMBER
- RIPRAP

PLAN REFERENCES:

1. PLAN OF LOT 1, FOREST RIDGE ROAD, CONCORD, MASSACHUSETTS, SCALE 1"=40', DATED AUGUST 28, 1992 AND PREPARED BY DAVID W. PERLEY, CIVIL ENGINEERS

NO.	DATE	REVISION	BY

EXHIBIT "B"
DRAINAGE AREA MAP (POST DEVELOPMENT)
WILLIAM K. BRADFORD PUBLISHING, INC.
CONCORD, MASSACHUSETTS
PREPARED FOR:
R.L. JEANNOTTE, INC.
1000 MT. LAUREL CIRCLE PO BOX 415 SHIRLEY, MASSACHUSETTS 01464 (978) 425-2533
RECORD OWNER:
FOREST RIDGE CORPORATION
c/o MDT ADVISERS, INC. 125 CAMBRIDGE PARK DR. CAMBRIDGE, MASSACHUSETTS 02140



25 SEPTEMBER 1998

HESI Hayner/Swanson, Inc.
Civil Engineers/Land Surveyors

Three Congress Street Nashua, New Hampshire 03062-3301
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BOUNDARY INFORMATION DEPICTED HEREON WAS TAKEN FROM PLAN REF. No. 1 AND THE TOPOGRAPHY SHOWN IS FROM AN ACTUAL SURVEY MADE ON THE GROUND IN AUGUST 1998

DATE _____

David W. Perley