

STORMWATER REPORT AND CALCULATIONS

FOR

“SPRUCE CORNER”

A Proposed Mixed Use Development at

232 Arlington Street
Acton, Massachusetts

July 12, 2010
Revised October 8, 2010

Prepared for:

West Acton Trio, LLC
P.O. Box 401012
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I. Introduction

The site of the proposed “Spruce Corner” development is a 0.84 acre tract of land located at the southeast corner of Arlington Street and Spruce Street in the West Acton village identified on Acton Assessors Maps as Map F2A Parcels 70, 71 & 83. The project site is located within the West Acton Village (WAV) zoning district and abuts the Village Residential (VR) zone to the east and across Arlington Street to the north. The project site is currently used for residential purposes and contains two single family dwellings and an accessory garage. There are currently no other structures on the site and all uses of the site are residential or accessory to residential uses (single family dwellings with accessory yard and garden areas).

According to the United States Department of Agriculture (USDA) Soil Survey of Middlesex County the soils on site are Merrimac series. These soils are deep outwash deposits that exhibit rapid permeability at the surface layer and very rapid permeability in the substratum (Hydrologic Soil Group A) and typically have a relatively deep water table. Hinckley and Merrimac soils have no major limitations for building site development or for local roads and streets making the site well suited to development, sewage disposal, and storm water recharge systems. The soils were evaluated in the field to verify these conditions. Deep observation test holes and percolation tests were conducted throughout the site and the results of those tests are documented in Appendix E.

The development proposal for the site involves demolition of the two existing dwellings and garage, clearing of vegetation, grading, and construction of 3 structures – 2 duplex residences and a building at the corner of Arlington Street and Spruce Street with approximately 4,396 square feet of commercial space in the basement and on the first floor and (3) 2-bedroom apartments on the second and third floors. Appurtenant to the principal use of the buildings is construction of access drives, parking areas, walkways, drainage and sewerage infrastructure and extension of utilities from Arlington Street and Spruce Street to serve the buildings on site. The change in surface cover (from pervious vegetated cover to impervious cover and less pervious lawn) and the alteration of grade, increase the rate and volume of runoff from the site. Runoff is collected in the drainage system and treated to meet DEP Stormwater Management Policy standards where necessary. Increases in the rate and volume of runoff are managed with infiltrative measures such as a retention/detention basin and pervious pavers where feasible. All infiltrative measures have been sized to effectively manage storm water from the proposed development for the 2-year, 10-year, 25-year and 100-year design storms.

II. Methodology & References

Methodology:

SCS TR-55 & SCS TR-20 utilizing HydroCAD (v 8.0) software.

References:

A Guide to Hydrologic Analysis Using SCS Methods, Richard McCuen, copyright 1982, Prentice Hall, Inc.

Interim Soil Survey of Middlesex County, Massachusetts, 1995

USGS Quadrangle Map, Maynard, Massachusetts, 1987

III. Results

The drainage study area was divided into 2 sections (or subcatchments as they are defined in the HydroCAD software) each of which drains to a different off-site location. Under pre-development conditions these areas are defined as Subcatchment 1S (draining off site north towards Arlington Street), and Subcatchment 2S (draining off site south to wetlands). Table 1 below shows the key of each off-site area as it is referenced in the HydroCAD calculations in Appendix H.

TABLE 1

Pre-development & Post-development Comparison Areas

Description	Pre-development	Post-development
Off-site north to Arlington Street	1S	20R
Off-site south to wetlands	2S	21R

The off-site areas were analyzed for rate and volume of runoff under existing conditions for the 2-yr, 10-yr, 25-yr, and 100-yr design storms and the results are shown in Table 2. Under post-development conditions increases in runoff from development activities are controlled with the implementation of stormwater detention and recharge Best Management Practices (BMP's). Comparison of the off site rates and volumes of runoff under pre-development conditions to the off site runoff to the same areas under post-development conditions illustrates the effectiveness of the proposed stormwater controls. The results in Table 2 clearly show that off site runoff rates and volumes are effectively maintained or reduced by the proposed drainage system for the design storms analyzed.

TABLE 2

Pre-development & Post-development Off-site Rates and Volumes of Runoff

2-YR STORM	PRE-DEVELOPMENT		POST-DEVELOPMENT	
Area	Rate, Q (cfs)	Volume, V (cu.ft)	Rate, Q (cfs)	Volume, V (cu.ft.)
North (1S vs 20R)	0.00	37	0.00	11
South (2S vs 21R)	0.03	432	0.00	6

10-YR STORM	PRE-DEVELOPMENT		POST-DEVELOPMENT	
Area	Rate, Q (cfs)	Volume, V (cu.ft)	Rate, Q (cfs)	Volume, V (cu.ft.)
North (1S vs 20R)	0.03	121	0.01	85
South (2S vs 21R)	0.27	1,570	0.00	81

25-YR STORM	PRE-DEVELOPMENT		POST-DEVELOPMENT	
Area	Rate, Q (cfs)	Volume, V (cu.ft)	Rate, Q (cfs)	Volume, V (cu.ft.)
North (1S vs 20R)	0.05	189	0.02	149
South (2S vs 21R)	0.59	2,530	0.14	228

Table 2 (Cont'd)

Pre-development & Post-development Off-site Rates and Volumes of Runoff

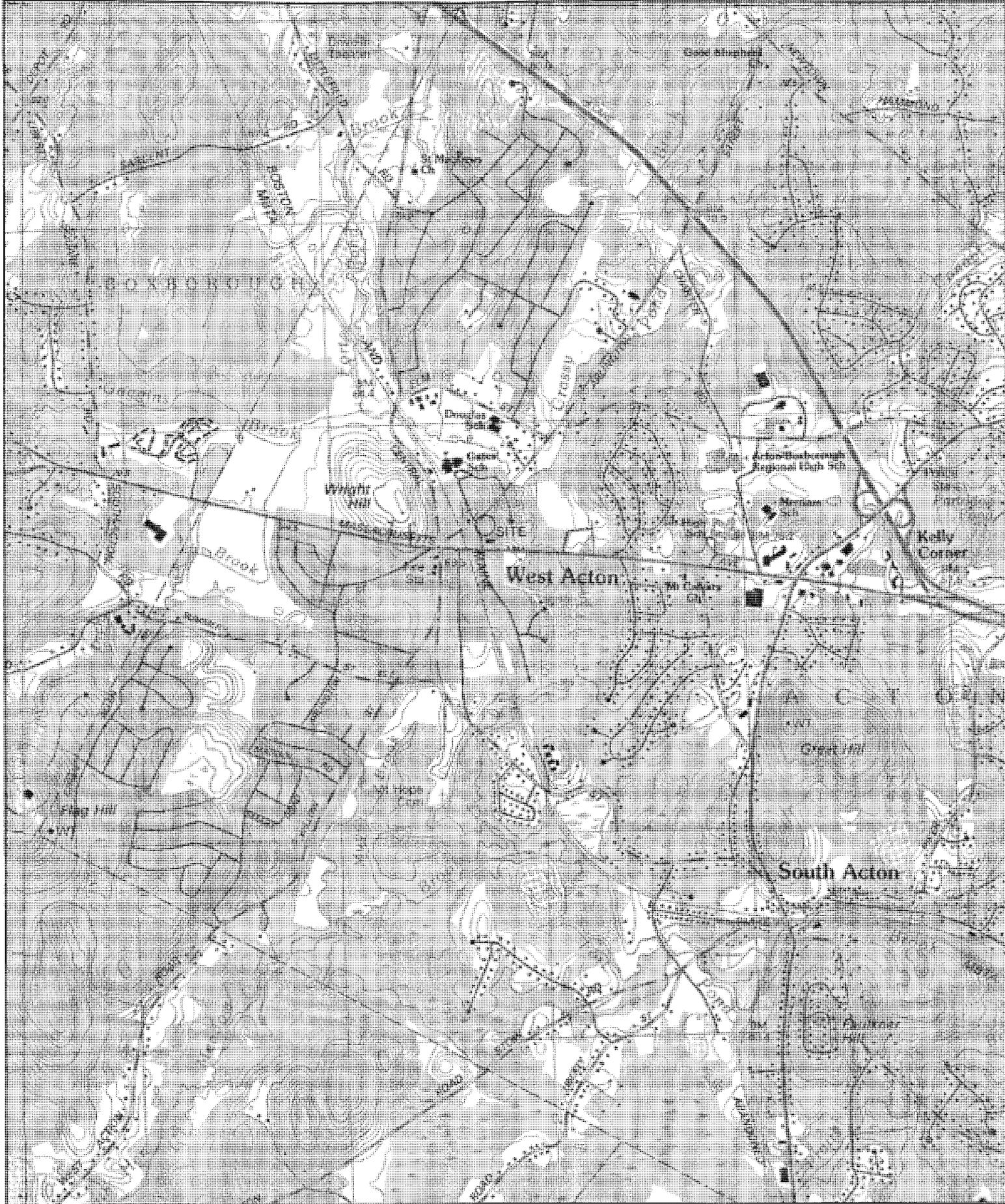
100-YR STORM	PRE-DEVELOPMENT		POST-DEVELOPMENT	
Area	Rate, Q (cfs)	Volume, V (cu.ft)	Rate, Q (cfs)	Volume, V (cu.ft.)
North (1S vs 20R)	0.10	320	0.08	320
South (2S vs 21R)	1.22	4,409	0.95	1076

IV. Conclusions

The proposed drainage system adequately controls both the rate and volume of runoff from proposed site improvements at Spruce Corner. There is no increase in runoff rate or volume from the site above predevelopment rates and volumes to the same off-site areas. The proposed stormwater management controls proposed sufficiently detain and recharge the increase in runoff generated by development to similar or lesser rates and volumes as under predevelopment conditions. Runoff from impervious surfaces subject to vehicular traffic is properly pretreated with a Stormceptor water quality catch basin prior to being directed to the proposed detention basin for detention and infiltration. All storm water controls have been sized to properly manage storm events up to and including the 100-year, 24 hour design storm. Runoff rates and volumes are reduced or maintained following development and runoff quality is greatly improved through implementation of the proposed stormwater BMP's. Additionally, the proposed retention basin will fully drain from a maximum depth of 18 inches to 0" in approximately 9 hours. The proposed site development plan meets or exceeds the standards set forth in the Massachusetts Department of Environmental Protection's Stormwater Management Policy.

Appendix A

Portion of USGS Quadrangle Map, Maynard, Massachusetts, 1987
(Scale: 1:25,000)



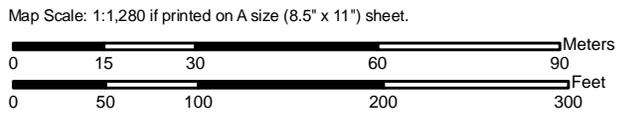
Name: MAYNARD
Date: 7/12/2010
Scale: 1 inch equals 2000 feet

Location: 042° 28' 25.5" N 071° 28' 17.1" W
Caption: USGS MAYNARD QUADRANGLE, 1987

Appendix B

Soil descriptions from “Interim Soil Survey of Middlesex County,
Massachusetts”, published by USDA, 1995

Soil Map—Middlesex County, Massachusetts
(232 ARLINGTON STREET, ACTON)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Units

Special Point Features

-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot
-  Spoil Area
-  Stony Spot

-  Very Stony Spot
-  Wet Spot
-  Other

Special Line Features

-  Gully
-  Short Steep Slope
-  Other

Political Features

-  Cities

Water Features

-  Oceans
-  Streams and Canals

Transportation

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

MAP INFORMATION

Map Scale: 1:1,280 if printed on A size (8.5" × 11") sheet.

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: UTM Zone 19N NAD83

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 8, Mar 13, 2009

Date(s) aerial images were photographed: 7/28/2003

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

Map Unit Legend

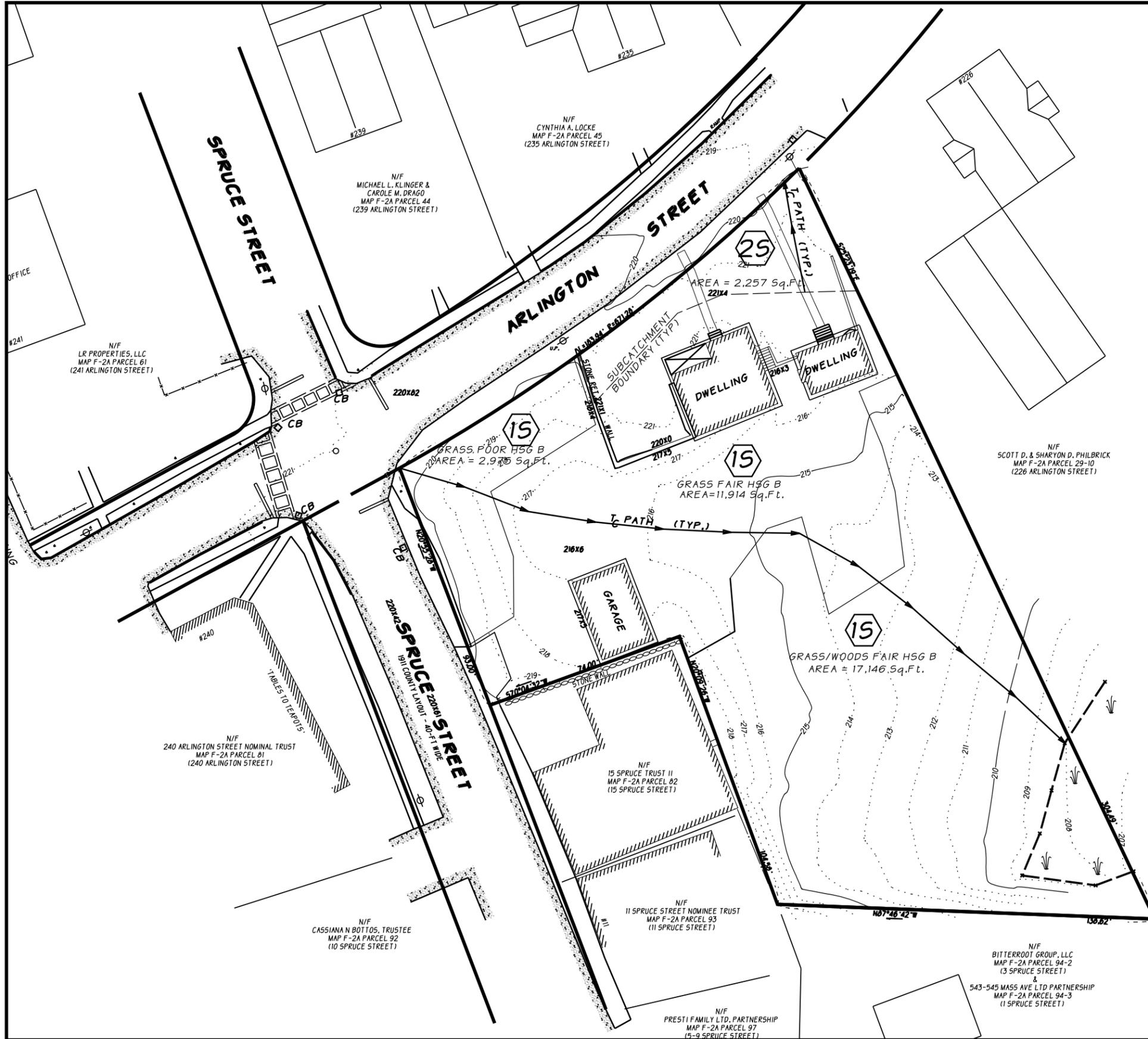
Middlesex County, Massachusetts (MA017)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
602	Urban land	1.9	26.3%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	3.5	49.5%
655	Udorthents, wet substratum	1.7	24.2%
Totals for Area of Interest		7.2	100.0%

MERRIMAC series consists of nearly level to steep, deep (5+ ft.), somewhat excessively drained soils on glacial outwash plains, terraces and kames. They formed in water-sorted, sandy glacial material. Merrimac soils have friable fine sandy loam and sandy loam surface soil and subsoil with moderately rapid permeability over a loose stratified sand and gravel substrata at 18 to 30 inches with rapid permeability. They have few limitations for most uses.

MERRIMAC-URBAN LAND COMPLEX consists of nearly level to undulating, deep, somewhat excessively drained Merrimac soils and areas of urban land. Although urban development has altered the soils and landscapes on these areas, the soil can be identified at widely separated points, and the general nature of the area can be determined. Broad delineations are made on the map. This map unit consists of about 75 percent Merrimac and similar soils and at least 25 percent urban land and other disturbed areas. Urban land consists of streets, parking lots, buildings, and other structures. For information on Merrimac soils, see "Merrimac" series description.

Appendix C

Pre-development Drainage Plan
(Scale: 1" = 40')



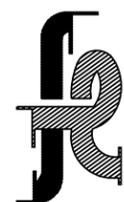
NOTE: ALL SOILS ON SITE ARE MERRIMAC URBAN LAND COMPLEX
NRCS HYDROLOGIC SOIL GROUP A

**PRE-DEVELOPMENT DRAINAGE PLAN
SPRUCE CORNER
ARLINGTON ST. & SPRUCE STREET
ACTON, MASSACHUSETTS**

PREPARED FOR:
WEST ACTON TRIO, LLC
P.O. BOX 401012
CAMBRIDGE, MASSACHUSETTS 02140

DATE: JULY 6, 2010
SCALE: 1 INCH = 40 FEET

www.foresitel.com



**FORESITE
ENGINEERING**
ENGINEERING SURVEYING PLANNING

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1495PRE.2D

Appendix D

Post-development Drainage Plan
(Scale: 1" = 40')



NOTE: ALL SOILS ON SITE ARE MERRIMAC URBAN LAND COMPLEX
NRCS HYDROLOGIC SOIL GROUP A

POST-DEVELOPMENT DRAINAGE PLAN
SPRUCE CORNER
ARLINGTON ST. & SPRUCE STREET
ACTON, MASSACHUSETTS

PREPARED FOR:
WEST ACTON TRIO, LLC
P.O. BOX 401012
CAMBRIDGE, MASSACHUSETTS 02140

DATE: JULY 6, 2010
SCALE: 1 INCH = 40 FEET

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Phone: (978) 461-2350
1495POST.2D

Appendix E

Deep Observation Test and Percolation Test Results



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

COPY

MassDEP has provided this form for use by on-site professionals and local Boards of Health. Other forms may be used, but the information must be substantially the same as provided here. Before using this form, check with your local Board of Health to determine the form they use.

A. Facility Information

West Acton Trio, LLC

Owner Name

232 Arlington Street

Street Address

Acton

City

MA

State

Map F-2A Parcel 70, 71 & 83

Map/Lot #

01720

Zip Code

B. Site Information

- (Check one) New Construction Upgrade Repair
- Published Soil Survey Available? Yes No
 If yes: 1995 1:25,000 626B
 Year Published Publication Scale Soil Map Unit
Merrimac Urban Land Complex Few
 Soil Name Soil Limitations
- Surficial Geological Report Available? Yes No
 If yes: _____
 Year Published Publication Scale Map Unit

 Geologic Material Landform
- Flood Rate Insurance Map
 Above the 500-year flood boundary? Yes No Within the 100-year flood boundary? Yes No
 Within the 500-year flood boundary? Yes No Within a velocity zone? Yes No
- Wetland Area: National Wetland Inventory Map U Upland
 Map Unit Name
 Wetlands Conservancy Program Map _____
 Map Unit Name



Commonwealth of Massachusetts

City/Town of Acton

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

B. Site Information (Continued)

6. Current Water Resource Conditions (USGS): 03/09 Range: [] Above Normal [X] Normal [] Below Normal

7. Other references reviewed: USGS Topo Quadrangle

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

Deep Observation Hole Number: 409-1 Date: 4/27/09 Time: 9:00AM Weather: Sunny, 70's

1. Location

Ground Elevation at Surface of Hole: 213.0 Location (identify on plan): See Sketch

2. Land Use: None (e.g., woodland, agricultural field, vacant lot, etc.) None Surface Stones 3-5% Slope (%) Brushland Vegetation Outwash Plain Landform See Sketch Position on Landscape (attach sheet)

3. Distances from: Open Water Body >200' feet Drainage Way 60' feet Possible Wet Area 60' feet Property Line 50' feet Drinking Water Well ND feet Other feet

4. Parent Material: Glacial Outwash Unsuitable Materials Present: [] Yes [X] No

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

5. Groundwater Observed: [X] Yes [] No If yes: 76" Depth Weeping from Pit Depth Standing Water in Hole

Estimated Depth to High Groundwater: 56" inches 208.33 elevation



Commonwealth of Massachusetts

City/Town of Acton

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

C. On-Site Review (Continued)

Deep Observation Hole Number: 409-1

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12"	A	10YR3/2				SL			Weak	Dry	
12-22"	Bw	10YR5/8				SL			Weak	Dry	
22-120"	C	2.5YR5/4	56"	10YR5/8 2.5Y6/1	>5%	S	>90%	<10%	Weak	Moist	

Additional Notes:



Commonwealth of Massachusetts

City/Town of Acton

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

C. On-Site Review (Continued)

Deep Observation Hole Number: 409-2 Date: 4/27/09 Time: 9:15 AM Weather: Sunny, 70's

1. Location

Ground Elevation at Surface of Hole: 213.9 Location (identify on plan): See Sketch

2. Land Use: Yard (e.g., woodland, agricultural field, vacant lot, etc.), None Surface Stones, 3-5% Slope (%), Lawn Vegetation, Outwash Plain Landform, See Sketch Position on Landscape (attach sheet)

3. Distances from: Open Water Body >200' feet, Drainage Way >100' feet, Possible Wet Area >100' feet, Property Line 40' feet, Drinking Water Well ND feet, Other

4. Parent Material: Glacial Outwash Unsuitable Materials Present: Yes No

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

5. Groundwater Observed: Yes No If yes: 68" Depth Weeping from Pit, Depth Standing Water in Hole

Estimated Depth to High Groundwater: 60" inches, 208.90 elevation



Commonwealth of Massachusetts

City/Town of Acton

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

C. On-Site Review (Continued)

Deep Observation Hole Number: 409-2

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-30"	A	10YR3/2				SL			Weak	Dry	
30-60"	Bw	10YR5/8				SL			Weak	Dry	
60-110"	C	2.5Y5/4	60"	10YR5/8 2.5Y6/1	>5%	LS	>50%	>10%	Weak to mod. Firm	Moist	Boulders @ 110"

Additional Notes:



Commonwealth of Massachusetts

City/Town of Acton

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

C. On-Site Review (Continued)

Deep Observation Hole Number: 409-3 Date: 4/27/09 Time: 9:30 AM Weather: Sunny, 70's

1. Location

Ground Elevation at Surface of Hole: 215.5 Location (identify on plan): See Sketch

2. Land Use: Yard (e.g., woodland, agricultural field, vacant lot, etc.), None Surface Stones, 3-5% Slope (%), Lawn Vegetation, Outwash Plain Landform, See Sketch Position on Landscape (attach sheet)

3. Distances from: Open Water Body >200' feet, Drainage Way >100' feet, Possible Wet Area >100' feet, Property Line 40' feet, Drinking Water Well ND feet, Other

4. Parent Material: Glacial Outwash Unsuitable Materials Present: [] Yes [X] No

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

5. Groundwater Observed: [X] Yes [] No If yes: 60" Depth Weeping from Pit, Depth Standing Water in Hole

Estimated Depth to High Groundwater: 54" inches, 211.00 elevation



Commonwealth of Massachusetts

City/Town of Acton

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

C. On-Site Review (Continued)

Deep Observation Hole Number: 409-3

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12"	A	10YR3/2				SL			Weak	Dry	
12-34"	Bw	10YR5/8				SL			Weak	Dry	
34-112"	C	2.5Y5/4	54"	10YR5/8 2.5Y6/1	>5%	LS	>50%	>10%	Weak to mod. Firm	Moist	Boulders @ 112"

Additional Notes:



Commonwealth of Massachusetts

City/Town of Acton

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

C. On-Site Review (Continued)

Deep Observation Hole Number: 409-4 Date: 4/27/09 Time: 9:50 AM Weather: Sunny, 70's

1. Location

Ground Elevation at Surface of Hole: 215.6 Location (identify on plan): See Sketch

2. Land Use: Yard (e.g., woodland, agricultural field, vacant lot, etc.), None Surface Stones, 3-5% Slope (%), Lawn Vegetation, Outwash Plain Landform, See Sketch Position on Landscape (attach sheet)

3. Distances from: Open Water Body >200' feet, Drainage Way >100' feet, Possible Wet Area >100' feet, Property Line 70' feet, Drinking Water Well ND feet, Other

4. Parent Material: Glacial Outwash Unsuitable Materials Present: [] Yes [X] No

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

5. Groundwater Observed: [X] Yes [] No If yes: 64" Depth Weeping from Pit Depth Standing Water in Hole

Estimated Depth to High Groundwater: 58" inches 210.77 elevation



Commonwealth of Massachusetts

City/Town of Acton

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

C. On-Site Review (Continued)

Deep Observation Hole Number: 409-4

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-14"	A	10YR3/2				SL			Weak	Dry	
14-30"	Bw	10YR5/8				SL			Weak	Dry	
30-112"	C	2.5Y5/4	58"	10YR5/8 2.5Y6/1	>5%	LS	>50%	>10%	Weak to mod. Firm	Moist	Boulders @ 112"

Additional Notes:



Commonwealth of Massachusetts

City/Town of Acton

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

C. On-Site Review (Continued)

Deep Observation Hole Number: 409-5 Date: 4/27/09 Time: 10:00 AM Weather: Sunny, 70's

1. Location

Ground Elevation at Surface of Hole: 215.0 Location (identify on plan): See Sketch

2. Land Use: Yard (e.g., woodland, agricultural field, vacant lot, etc.) None Surface Stones 3-5% Slope (%) Lawn Vegetation Outwash Plain Landform See Sketch Position on Landscape (attach sheet)

3. Distances from: Open Water Body >200' feet Drainage Way >100' feet Possible Wet Area >100' feet Property Line 70' feet Drinking Water Well ND feet Other feet

4. Parent Material: Glacial Outwash Unsuitable Materials Present: [] Yes [X] No

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

5. Groundwater Observed: [X] Yes [] No If yes: 63" Depth Weeping from Pit Depth Standing Water in Hole

Estimated Depth to High Groundwater: 46" inches 211.17 elevation



Commonwealth of Massachusetts

City/Town of Acton

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

C. On-Site Review (Continued)

Deep Observation Hole Number: 409-5

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-18"	A	10YR3/2				SL			Weak	Dry	
18-30"	Bw	10YR5/8				SL			Weak	Dry	
30-104"	C	2.5Y5/4	46"	10YR5/8 2.5Y6/1	>5%	LS	>50%	>10%	Weak to mod. Firm	Moist	Boulders @ 104"

Additional Notes:



Commonwealth of Massachusetts

City/Town of Acton

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

C. On-Site Review (Continued)

Deep Observation Hole Number: 409-6 Date: 4/27/09 Time: 10:20 AM Weather: Sunny, 70's

1. Location

Ground Elevation at Surface of Hole: 215.6 Location (identify on plan): See Sketch

2. Land Use: Yard (e.g., woodland, agricultural field, vacant lot, etc.), None Surface Stones, 3-5% Slope (%), Lawn Vegetation, Outwash Plain Landform, See Sketch Position on Landscape (attach sheet)

3. Distances from: Open Water Body >200' feet, Drainage Way >100' feet, Possible Wet Area >100' feet, Property Line 70' feet, Drinking Water Well ND feet, Other

4. Parent Material: Glacial Outwash Unsuitable Materials Present: [] Yes [x] No

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

5. Groundwater Observed: [x] Yes [] No If yes: 60" Depth Weeping from Pit Depth Standing Water in Hole

Estimated Depth to High Groundwater: 52" inches 211.27 elevation



Commonwealth of Massachusetts

City/Town of Acton

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

C. On-Site Review (Continued)

Deep Observation Hole Number: 409-6

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-22"	A	10YR3/2				SL			Weak	Dry	
22-36"	Bw	10YR5/8				SL			Weak	Dry	
36-102"	C	2.5Y5/4	52"	10YR5/8 2.5Y6/1	>5%	LS	>50%	>10%	Weak to mod. Firm	Moist	Boulders @ 102"

Additional Notes:



Commonwealth of Massachusetts

City/Town of Acton

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

C. On-Site Review (Continued)

Deep Observation Hole Number: 409-7 Date: 4/27/09 Time: 10:45 AM Weather: Sunny, 70's

1. Location

Ground Elevation at Surface of Hole: 216.3 Location (identify on plan): See Sketch

2. Land Use: Yard (e.g., woodland, agricultural field, vacant lot, etc.), None Surface Stones, 3-5% Slope (%), Lawn Vegetation, Outwash Plain Landform, See Sketch Position on Landscape (attach sheet)

3. Distances from: Open Water Body >200' feet, Drainage Way >100' feet, Possible Wet Area >100' feet, Property Line 30' feet, Drinking Water Well ND feet, Other feet

4. Parent Material: Glacial Outwash Unsuitable Materials Present: [] Yes [x] No

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

5. Groundwater Observed: [x] Yes [] No If yes: 70" Depth Weeping from Pit, 210.97 elevation, Depth Standing Water in Hole, Estimated Depth to High Groundwater: 64" inches



Commonwealth of Massachusetts

City/Town of Acton

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

C. On-Site Review (Continued)

Deep Observation Hole Number: 409-7

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-15"	A	10YR3/2				SL			Weak	Dry	
15-28"	Bw	10YR5/8				LS			Weak	Dry	
28-108"	C	2.5Y5/4	64"	10YR5/8 2.5Y6/1	>5%	S	>50%	>10%	Weak	Moist	Boulders @ 108"

Additional Notes:



Commonwealth of Massachusetts

City/Town of Acton

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

C. On-Site Review (Continued)

Deep Observation Hole Number: 409-8 Date: 4/27/09 Time: 11:30 AM Weather: Sunny, 70's

1. Location

Ground Elevation at Surface of Hole: 216.8 Location (identify on plan): See Sketch

2. Land Use: Yard (e.g., woodland, agricultural field, vacant lot, etc.), Lawn Vegetation, Outwash Plain Landform, None Surface Stones, 3-5% Slope (%), See Sketch Position on Landscape (attach sheet)

3. Distances from: Open Water Body >200' feet, Property Line 30' feet, Drainage Way >100' feet, Drinking Water Well ND feet, Possible Wet Area >100' feet, Other

4. Parent Material: Glacial Outwash Unsuitable Materials Present: [] Yes [x] No

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

5. Groundwater Observed: [x] Yes [] No If yes: 74" Depth Weeping from Pit Depth Standing Water in Hole

Estimated Depth to High Groundwater: 66" inches 211.30 elevation



Commonwealth of Massachusetts

City/Town of Acton

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

C. On-Site Review (Continued)

Deep Observation Hole Number: 409-8

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-20"	A	10YR3/2				SL			Weak	Dry	
20-35"	Bw	10YR5/8				LS			Weak	Dry	
35-100"	C	2.5Y5/4	66"	10YR5/8 2.5Y6/1	>5%	S	>50%	>10%	Weak	Moist	Boulders @ 100"

Additional Notes:



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

C. On-Site Review (Continued)

Deep Observation Hole Number: 409-9 4/27/09 12:30 PM Sunny, 70's
Date Time Weather

1. Location

Ground Elevation at Surface of Hole: 221.1 Location (identify on plan): See Sketch

2. Land Use Yard None 3-5%
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones Slope (%)
Lawn Outwash Plain See Sketch
Vegetation Landform Position on Landscape (attach sheet)

3. Distances from: Open Water Body >200' Drainage Way >100' Possible Wet Area >100'
feet feet feet feet
Property Line 30' Drinking Water Well ND Other _____
feet feet feet feet

4. Parent Material: Glacial Outwash Unsuitable Materials Present: Yes No

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

5. Groundwater Observed: Yes No If yes: _____ _____
Depth Weeping from Pit Depth Standing Water in Hole
Estimated Depth to High Groundwater: 60" 216.10
inches elevation



Commonwealth of Massachusetts

City/Town of Acton

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

C. On-Site Review (Continued)

Deep Observation Hole Number: 409-9

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features (mottles)			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-14"	A	10YR3/2				SL			Weak	Dry	
14-32"	Bw	10YR5/8				LS			Weak	Dry	
32-120"	C	2.5Y5/4	60"	10YR5/8 2.5Y6/1	>5%	S	>50%	>10%	Weak	Dry	

Additional Notes:



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

D. Determination of High Groundwater Elevation

1. Method Used:

- | | | |
|--|--------------------|--------------------|
| <input type="checkbox"/> Depth observed standing water in observation hole | A. _____
inches | B. _____
inches |
| <input type="checkbox"/> Depth weeping from side of observation hole | A. _____
inches | B. _____
inches |
| <input checked="" type="checkbox"/> Depth to soil redoximorphic features (mottles) | A. 46"
inches | B. 52"
inches |
| <input type="checkbox"/> Groundwater adjustment (USGS methodology) | A. _____
inches | B. _____
inches |

2.

Index Well Number _____	Reading Date _____	Index Well Level _____
Adjustment Factor _____	Adjusted Groundwater Level _____	

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

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

- Yes No

b. If yes, at what depth was it observed? Upper boundary: 36"
inches Lower boundary: 102"
inches



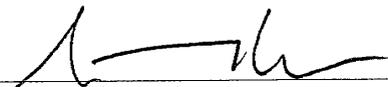
Commonwealth of Massachusetts

City/Town of Acton

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

F. Certification

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



 Signature of Soil Evaluator
 Scott Hayes, PE SE#1030

 Typed or Printed Name of Soil Evaluator / License #
 Justin Snair

 Name of Board of Health Witness

5/1/09

 Date
 July 1995

 Date of Soil Evaluator Exam
 Acton Health Department

 Board of Health

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



Commonwealth of Massachusetts
 City/Town of Acton
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

West Acton Trio, LLC
 Owner Name
 232 Arlington Street
 Street Address or Lot #
 Acton MA 01720
 City/Town State Zip Code
 Mark Roderick (617) 230-3674
 Contact Person (if different from Owner) Telephone Number

B. Test Results

	4/27/09 Date	9:30 AM Time	4/27/09 Date	12:05 AM Time
Observation Hole #	PT-A		PT-B	
Depth of Perc	44"		52"	
Start Pre-Soak	9:32		12:05	
End Pre-Soak	24 Gal. Applied < 15 Min.		24 Gal. Applied < 15 Min.	
Time at 12"	Could not saturate		Could not saturate	
Time at 9"				
Time at 6"				
Time (9"-6")				
Rate (Min./Inch)	<2 MPI		<2 MPI	
	Test Passed: <input checked="" type="checkbox"/>		Test Passed: <input checked="" type="checkbox"/>	
	Test Failed: <input type="checkbox"/>		Test Failed: <input type="checkbox"/>	

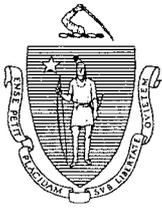
Scott Hayes, PE, FORESITE Engineering

Test Performed By:

Justin Snair, Acton Health Dept.

Witnessed By:

Comments:



Commonwealth of Massachusetts
 City/Town of Acton
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

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 Owner Name
232 Arlington Street
 Street Address or Lot #
Acton MA 01720
 City/Town State Zip Code
Mark Roderick (617) 230-3674
 Contact Person (if different from Owner) Telephone Number

B. Test Results

	<u>4/27/09</u> Date	<u>12:29 PM</u> Time	<u>4/27/09</u> Date	<u>1:07 PM</u> Time
Observation Hole #	<u>PT-C</u>		<u>PT-D</u>	
Depth of Perc	<u>44"</u>		<u>60"</u>	
Start Pre-Soak	<u>12:29 PM</u>		<u>1:07 PM</u>	
End Pre-Soak	<u>24 Gal. Applied < 15 Min.</u>		<u>24 Gal. Applied < 15 Min.</u>	
Time at 12"	<u>Could not saturate</u>		<u>Could not saturate</u>	
Time at 9"	_____		_____	
Time at 6"	_____		_____	
Time (9"-6")	_____		_____	
Rate (Min./Inch)	<u><2 MPI</u>		<u><2 MPI</u>	
	Test Passed:	<input checked="" type="checkbox"/>	Test Passed:	<input checked="" type="checkbox"/>
	Test Failed:	<input type="checkbox"/>	Test Failed:	<input type="checkbox"/>

Scott Hayes, PE, FORESITE Engineering

Test Performed By:

Justin Snair, Acton Health Dept.

Witnessed By:

Comments:

Appendix F

Stormceptor Sizing Report & Manufacturers Inspection and Maintenance
Procedures



Stormceptor Design Summary

PCSWMM for Stormceptor

Project Information

Date	7/7/2010
Project Name	SPRUCE CORNER
Project Number	1495
Location	ACTON MA

Designer Information

Company	FORESITE ENGINEERING
Contact	SCOTT HAYES

Notes

N/A

Drainage Area

Total Area (ac)	0.244
Imperviousness (%)	75

The Stormceptor System model STC 450i achieves the water quality objective removing 90% TSS for a Fine (organics, silts and sand) particle size distribution.

Rainfall

Name	BOSTON WSFO AP
State	MA
ID	770
Years of Records	1948 to 2005
Latitude	42°21'38"N
Longitude	71°0'38"W

Water Quality Objective

TSS Removal (%)	80
-----------------	----

Upstream Storage

Storage (ac-ft)	Discharge (cfs)
0	0

Stormceptor Sizing Summary

Stormceptor Model	TSS Removal %
STC 450i	90
STC 900	94
STC 1200	95
STC 1800	95
STC 2400	96
STC 3600	96
STC 4800	97
STC 6000	97
STC 7200	98
STC 11000	99
STC 13000	99
STC 16000	99



Particle Size Distribution

Removing silt particles from runoff ensures that the majority of the pollutants, such as hydrocarbons and heavy metals that adhere to fine particles, are not discharged into our natural water courses. The table below lists the particle size distribution used to define the annual TSS removal.

Fine (organics, silts and sand)							
Particle Size µm	Distribution %	Specific Gravity	Settling Velocity ft/s	Particle Size µm	Distribution %	Specific Gravity	Settling Velocity ft/s
20	20	1.3	0.0013				
60	20	1.8	0.0051				
150	20	2.2	0.0354				
400	20	2.65	0.2123				
2000	20	2.65	0.9417				

Stormceptor Design Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal.
- Only the STC 450i is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 450i to STC 7200 may accommodate multiple inlet pipes.
- Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences

Inlet Pipe Configuration	STC 450i	STC 900 to STC 7200	STC 11000 to STC 16000
Single inlet pipe	3 in.	1 in.	3 in.
Multiple inlet pipes	3 in.	3 in.	Only one inlet pipe.

- Design estimates are based on stable site conditions only, after construction is completed.
- Design estimates assume that the storm drain is not submerged during zero flows. For submerged applications, please contact your local Stormceptor representative.
- Design estimates may be modified for specific spills controls. Please contact your local Stormceptor representative for further assistance.
- For pricing inquiries or assistance, please contact Rinker Materials 1 (800) 909-7763 www.rinkerstormceptor.com

Stormceptor® STC Inspection and Maintenance Information

Stormceptor® Inspection and Maintenance

Regular inspection and maintenance is a proven, cost-effective way to maximize water resource protection for all stormwater pollution control practices, and are required to insure proper functioning of the Stormceptor System. Both inspection and maintenance of the Stormceptor system is easily performed from the surface. Stormceptor's patented technology has no moving parts, simplifying the inspection and maintenance process.

Please refer to the following information and guidelines before conducting inspection and maintenance activities.

When is inspection needed?

- Post-construction inspection is required prior to putting the Stormceptor System into service.
- Routine inspections are recommended during the first year of operation to accurately assess the sediment accumulation.
- Specifically for New Jersey installations, regulations require all BMPs to be inspected a minimum four times per year and after every storm with greater than one inch of rainfall.
- Inspection frequency in subsequent years is based on the maintenance plan developed in the first year.
- Inspections should also be performed immediately after an oil, fuel or other chemical spill.

When is maintenance cleaning needed?

- For optimum performance, the unit should be cleaned out once the sediment depth reaches 15% of the unit's total storage capacity (see Table 1). Generally, the minimum cleaning frequency is once annually, although the frequency can be based on historical inspection results.
- The unit should be cleaned out immediately after an oil, fuel or chemical spill.

Table 1

Sediment Maintenance Depth* and Oil Capacity		
STC Model	Sediment Depth* (inches)	Oil Capacity (gallons)
450i	8	86
900	8	251
1200	10	251
1800	15	251
2400	12	840

3600	17	840
4800	15	909
6000	18	909
7200	15	1059
11000	17	2797
13000	20	2797
16000	17	3055
* based on 15% of the lower chamber volume		

What conditions can compromise the Stormceptor System performance?

- If the system is not maintained regularly and fills with sediment and debris beyond the capacity indicated in Table 1, sediment removal efficiency may be reduced.
- If an oil spill(s) exceeds the oil capacity of the system, subsequent spills may not be captured.
- If debris clogs the inlet of the system, removal efficiency of sediment and hydrocarbons may be reduced.
- If a downstream blockage occurs, a backwater condition may occur in the system and removal efficiency of sediment and hydrocarbons may be reduced.

What training is required?

The Stormceptor System is inspected and maintained by professional vacuum cleaning service providers with experience in the maintenance of underground tanks, sewers and catch basins. For typical inspection and maintenance activities, no specific supplemental training is required for the Stormceptor System. Information provided in this document or the Stormceptor Operation and Maintenance Manual (provided to the system owner) contains sufficient guidance to maintain the system properly.

In unusual circumstances, such as if a damaged component needs replacement or some other condition requires manned entry into the vessel, confined space entry procedures must be followed. Only professional maintenance service providers trained in these procedures should enter the vessel. Service provider companies typically have personnel who are trained and certified in confined space entry procedures according to local, state, and federal standards.

What equipment is typically required for inspection?

- Manhole access cover lifting tool
- Oil dipstick
- Sediment probe
- Flashlight
- Camera
- Data log
- Safety cones and caution tape
- Hard hat, safety shoes, safety glasses, and chemical-resistant gloves

How is the Stormceptor System inspected?

- The Stormceptor System can be inspected through a standard surface manhole

access cover.

- Sediment and oil depth inspections are performed with a sediment probe and oil dipstick. Oil depth is measured through the oil inspection port. Sediment depth can be measured through the oil inspection port or exit riser pipe.
- Inspections also involve a visual inspection of the internal components of the system.

What equipment is typically required for maintenance?

- Vacuum truck equipped with water hose and jet nozzle
- Small pump and tubing for oil removal
- Manhole access cover lifting tool
- Oil dipstick
- Sediment probe
- Flashlight
- Camera
- Data log
- Safety cones and caution tape
- Hard hats, safety shoes, safety glasses, chemical-resistant gloves, and hearing protection for service providers
- Gas analyzer, respiratory gear, and safety harness for specially trained personnel if confined space entry is required

How is the Stormceptor System maintained?

- The Stormceptor System can be maintained through a standard surface manhole access cover.
- Insert the oil dipstick into the oil inspection port. If oil is present, pump off the oil layer into separate containment using a small pump and tubing.
- Maintenance cleaning of accumulated sediment is performed with a vacuum truck.
- For 6-ft diameter models and larger, the vacuum hose is inserted into the lower chamber via the 24-inch outlet riser pipe.
- For 4-ft diameter model, the removable drop tee is lifted out, and the vacuum hose is inserted into the lower chamber via the 12-inch drop tee hole.
- Using the vacuum hose, decant the water from the lower chamber to the sanitary sewer, if permitted by the local regulating authority, or into a separate containment tank.
- Remove the sludge from the bottom of the unit using the vacuum hose.
- Re-fill the lower chamber with water where required by the local jurisdiction.
- Units that have not been maintained regularly, have surpassed the maximum recommended sediment capacity, or contain damaged components may require manned entry by trained personnel using proper confined space entry procedures.

What is required for proper disposal?

- Disposal requirements for recovered pollutants may vary depending on local guidelines. In most areas the sediment, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste.

What about oil spills?

- Petroleum-based pollutants captured by the Stormceptor system (oil/chemical/fuel spills) should be removed and disposed of by a licensed waste management company.
- Although Stormceptor captures virtually all free oil, a sheen at the outlet **does not** mean the unit isn't working. A rainbow or sheen can be visible at oil concentrations of less than 10 mg/L (ppm).

What factors affect the costs involved with inspection/maintenance?

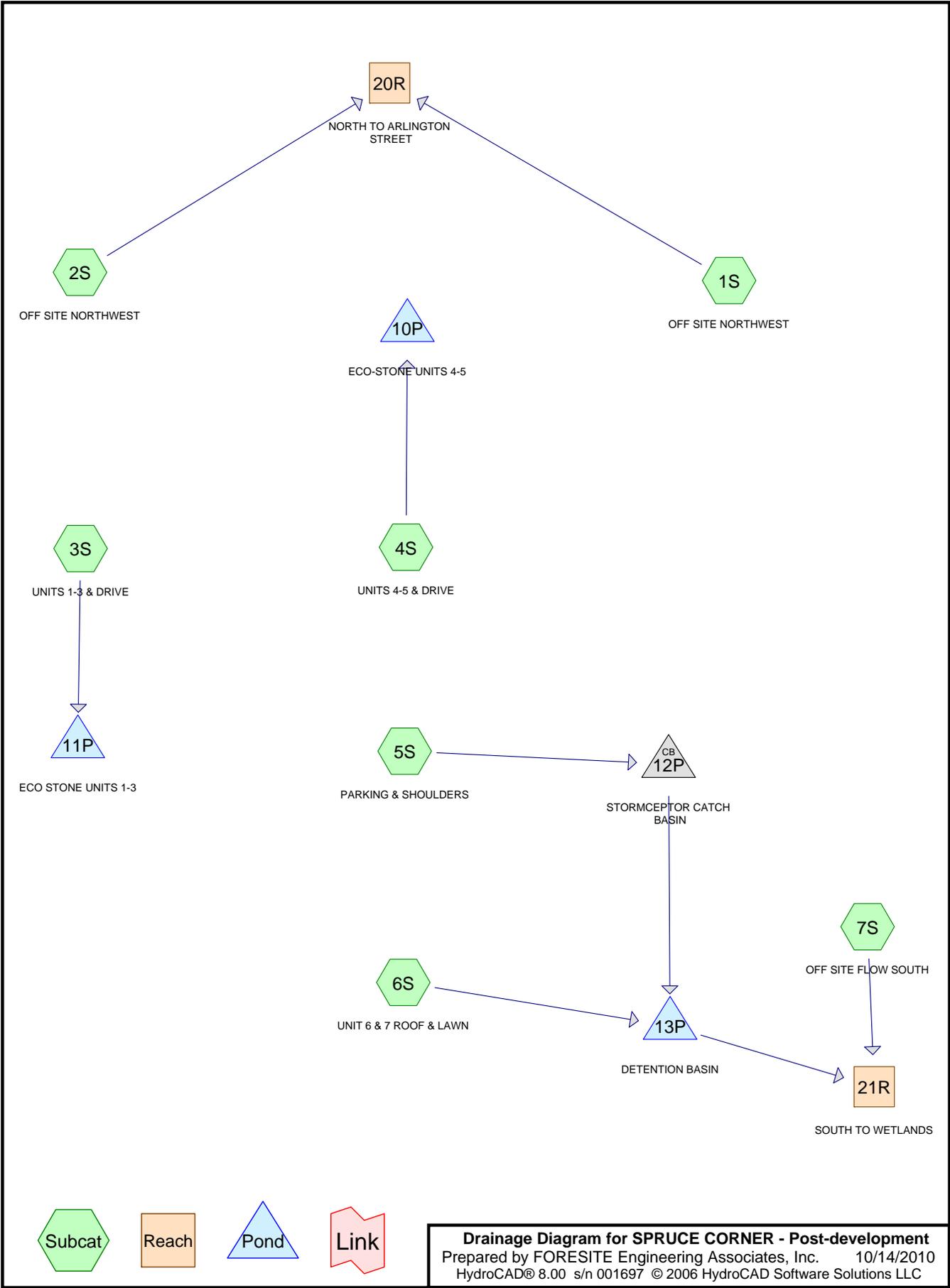
- Inspection and maintenance costs are based on unit size, sediment/oil/hazardous material loads, transportation distances, tipping fees, disposal requirements and other local regulations.

System schematic and component functions

Below is a schematic of the Stormceptor System with key components identified and their functions briefly described.



- **Manhole access cover** – provides access to the subsurface components
- **Precast reinforced concrete structure** – provides the vessel's watertight structural support
- **Fiberglass insert** – separates vessel into upper and lower chambers
- **Weir** – directs incoming stormwater and oil spills into the lower treatment chamber
- **Orifice plate** – controls water flow rate into the lower treatment chamber and prevents scour of accumulated pollutants
- **Inlet drop tee** – conveys stormwater into the lower treatment chamber and splits flow into two opposite tangential streams
- **Fiberglass skirt** – provides double-wall containment of hydrocarbons
- **Outlet riser pipe** – conveys treated water to the upper chamber; primary vector access port for sediment removal



20R

NORTH TO ARLINGTON STREET

2S

OFF SITE NORTHWEST

1S

OFF SITE NORTHWEST

10P

ECO-STONE UNITS 4-5

3S

UNITS 1-3 & DRIVE

4S

UNITS 4-5 & DRIVE

11P

ECO STONE UNITS 1-3

5S

PARKING & SHOULDERS

CB
12P

STORMCEPTOR CATCH BASIN

6S

UNIT 6 & 7 ROOF & LAWN

13P

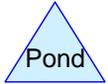
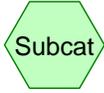
DETENTION BASIN

7S

OFF SITE FLOW SOUTH

21R

SOUTH TO WETLANDS



Drainage Diagram for SPRUCE CORNER - Post-development
 Prepared by FORESITE Engineering Associates, Inc. 10/14/2010
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SPRUCE CORNER - Post-development

Prepared by FORESITE Engineering Associates, Inc.

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10/14/2010

Area Listing (all nodes)

<u>Area (sq-ft)</u>	<u>CN</u>	<u>Description (subcats)</u>
16,501	39	>75% Grass cover, Good, HSG A (1S,2S,3S,5S,6S,7S)
4,003	43	Woods/grass comb., Fair, HSG A (7S)
12,323	98	Paved parking & roofs (2S,4S,5S,6S)
3,967	98	Paved roads w/curbs & sewers (3S)
<hr/>		
36,794		

SPRUCE CORNER - Post-development

Type III 24-hr 2-YR Rainfall=3.20"

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points

Runoff by SCS TR-20 method, UH=SCS

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

Subcatchment 1S: OFF SITE NORTHWEST Runoff Area=924 sf Runoff Depth>0.00"
Flow Length=50' Slope=0.0300 '/' Tc=1.8 min CN=39 Runoff=0.00 cfs 0 cf

Subcatchment 2S: OFF SITE NORTHWEST Runoff Area=3,092 sf Runoff Depth>0.04"
Flow Length=35' Slope=0.0300 '/' Tc=1.6 min CN=45 Runoff=0.00 cfs 11 cf

Subcatchment 3S: UNITS 1-3 & DRIVE Runoff Area=4,557 sf Runoff Depth>2.17"
Flow Length=25' Slope=0.0300 '/' Tc=0.3 min CN=90 Runoff=0.32 cfs 824 cf

Subcatchment 4S: UNITS 4-5 & DRIVE Runoff Area=2,541 sf Runoff Depth>2.97"
Flow Length=20' Slope=0.0500 '/' Tc=0.2 min CN=98 Runoff=0.22 cfs 628 cf

Subcatchment 5S: PARKING & SHOULDERS Runoff Area=10,640 sf Runoff Depth>1.76"
Flow Length=110' Slope=0.0100 '/' Tc=0.7 min CN=85 Runoff=0.61 cfs 1,558 cf

Subcatchment 6S: UNIT 6 & 7 ROOF & LAWN Runoff Area=10,050 sf Runoff Depth>0.04"
Flow Length=225' Slope=0.0400 '/' Tc=2.7 min CN=45 Runoff=0.00 cfs 37 cf

Subcatchment 7S: OFF SITE FLOW SOUTH Runoff Area=4,990 sf Runoff Depth>0.01"
Flow Length=125' Slope=0.0400 '/' Tc=4.1 min CN=42 Runoff=0.00 cfs 6 cf

Reach 20R: NORTH TO ARLINGTON STREET Inflow=0.00 cfs 11 cf
Outflow=0.00 cfs 11 cf

Reach 21R: SOUTH TO WETLANDS Inflow=0.00 cfs 6 cf
Outflow=0.00 cfs 6 cf

Pond 10P: ECO-STONE UNITS 4-5 Peak Elev=217.75' Storage=59 cf Inflow=0.22 cfs 628 cf
Outflow=0.08 cfs 628 cf

Pond 11P: ECO STONE UNITS 1-3 Peak Elev=217.56' Storage=37 cf Inflow=0.32 cfs 824 cf
Outflow=0.21 cfs 823 cf

Pond 12P: STORMCEPTOR CATCH BASIN Peak Elev=213.80' Inflow=0.61 cfs 1,558 cf
12.0" x 45.0' Culvert Outflow=0.61 cfs 1,558 cf

Pond 13P: DETENTION BASIN Peak Elev=211.04' Storage=364 cf Inflow=0.61 cfs 1,595 cf
Discarded=0.16 cfs 1,595 cf Primary=0.00 cfs 0 cf Outflow=0.16 cfs 1,595 cf

Total Runoff Area = 36,794 sf Runoff Volume = 3,064 cf Average Runoff Depth = 1.00"
55.73% Pervious Area = 20,504 sf 44.27% Impervious Area = 16,290 sf

SPRUCE CORNER - Post-development

Type III 24-hr 2-YR Rainfall=3.20"

Prepared by FORESITE Engineering Associates, Inc.

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10/14/2010

Subcatchment 1S: OFF SITE NORTHWEST

Runoff = 0.00 cfs @ 24.00 hrs, Volume= 0 cf, Depth> 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 2-YR Rainfall=3.20"

Area (sf)	CN	Description
924	39	>75% Grass cover, Good, HSG A
924		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	10	0.0300	0.13		Sheet Flow, SHEET FLOW Grass: Short n= 0.150 P2= 3.20"
0.5	40	0.0300	1.21		Shallow Concentrated Flow, OVERLAND FLOW Short Grass Pasture Kv= 7.0 fps
1.8	50	Total			

Subcatchment 2S: OFF SITE NORTHWEST

Runoff = 0.00 cfs @ 15.28 hrs, Volume= 11 cf, Depth> 0.04"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 2-YR Rainfall=3.20"

Area (sf)	CN	Description
2,792	39	>75% Grass cover, Good, HSG A
300	98	Paved parking & roofs
3,092	45	Weighted Average
2,792		Pervious Area
300		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	10	0.0300	0.13		Sheet Flow, SHEET FLOW Grass: Short n= 0.150 P2= 3.20"
0.3	25	0.0300	1.21		Shallow Concentrated Flow, OVERLAND FLOW Short Grass Pasture Kv= 7.0 fps
1.6	35	Total			

Subcatchment 3S: UNITS 1-3 & DRIVE

Runoff = 0.32 cfs @ 12.01 hrs, Volume= 824 cf, Depth> 2.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 2-YR Rainfall=3.20"

SPRUCE CORNER - Post-development

Type III 24-hr 2-YR Rainfall=3.20"

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Area (sf)	CN	Description
3,967	98	Paved roads w/curbs & sewers
590	39	>75% Grass cover, Good, HSG A
4,557	90	Weighted Average
590		Pervious Area
3,967		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	25	0.0300	1.23		Sheet Flow, TR-55 SHEET FLOW Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 4S: UNITS 4-5 & DRIVE

Runoff = 0.22 cfs @ 12.00 hrs, Volume= 628 cf, Depth> 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 2-YR Rainfall=3.20"

Area (sf)	CN	Description
2,541	98	Paved parking & roofs
2,541		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	20	0.0500	1.44		Sheet Flow, TR-55 SHEET FLOW Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 5S: PARKING & SHOULDERS

Runoff = 0.61 cfs @ 12.01 hrs, Volume= 1,558 cf, Depth> 1.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 2-YR Rainfall=3.20"

Area (sf)	CN	Description
8,380	98	Paved parking & roofs
2,260	39	>75% Grass cover, Good, HSG A
10,640	85	Weighted Average
2,260		Pervious Area
8,380		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	20	0.0100	0.76		Sheet Flow, TR-55 SHEET FLOW Smooth surfaces n= 0.011 P2= 3.20"
0.3	90	0.0100	4.96	59.50	Channel Flow, GUTTER FLOW Area= 12.0 sf Perim= 42.0' r= 0.29' n= 0.013
0.7	110	Total			

SPRUCE CORNER - Post-development

Type III 24-hr 2-YR Rainfall=3.20"

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Subcatchment 6S: UNIT 6 & 7 ROOF & LAWN

Runoff = 0.00 cfs @ 15.30 hrs, Volume= 37 cf, Depth> 0.04"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 2-YR Rainfall=3.20"

Area (sf)	CN	Description
1,102	98	Paved parking & roofs
8,948	39	>75% Grass cover, Good, HSG A
10,050	45	Weighted Average
8,948		Pervious Area
1,102		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	25	0.0400	1.40		Shallow Concentrated Flow, SHEET FLOW Short Grass Pasture Kv= 7.0 fps
2.4	200	0.0400	1.40		Shallow Concentrated Flow, OVERLAND FLOW Short Grass Pasture Kv= 7.0 fps
2.7	225	Total			

Subcatchment 7S: OFF SITE FLOW SOUTH

Runoff = 0.00 cfs @ 21.52 hrs, Volume= 6 cf, Depth> 0.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 2-YR Rainfall=3.20"

Area (sf)	CN	Description
4,003	43	Woods/grass comb., Fair, HSG A
987	39	>75% Grass cover, Good, HSG A
4,990	42	Weighted Average
4,990		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	25	0.0400	0.17		Sheet Flow, SHEET FLOW Grass: Short n= 0.150 P2= 3.20"
1.7	100	0.0400	1.00		Shallow Concentrated Flow, OVERLAND FLOW Woodland Kv= 5.0 fps
4.1	125	Total			

Reach 20R: NORTH TO ARLINGTON STREET

Inflow Area = 4,016 sf, Inflow Depth > 0.03" for 2-YR event

Inflow = 0.00 cfs @ 15.28 hrs, Volume= 11 cf

Outflow = 0.00 cfs @ 15.28 hrs, Volume= 11 cf, Atten= 0%, Lag= 0.0 min

SPRUCE CORNER - Post-development

Type III 24-hr 2-YR Rainfall=3.20"

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Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach 21R: SOUTH TO WETLANDS

Inflow Area = 25,680 sf, Inflow Depth > 0.00" for 2-YR event
Inflow = 0.00 cfs @ 21.52 hrs, Volume= 6 cf
Outflow = 0.00 cfs @ 21.52 hrs, Volume= 6 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond 10P: ECO-STONE UNITS 4-5

Inflow Area = 2,541 sf, Inflow Depth > 2.97" for 2-YR event
Inflow = 0.22 cfs @ 12.00 hrs, Volume= 628 cf
Outflow = 0.08 cfs @ 11.90 hrs, Volume= 628 cf, Atten= 62%, Lag= 0.0 min
Discarded = 0.08 cfs @ 11.90 hrs, Volume= 628 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 217.75' @ 12.13 hrs Surf.Area= 595 sf Storage= 59 cf

Plug-Flow detention time= 3.3 min calculated for 628 cf (100% of inflow)
Center-of-Mass det. time= 3.2 min (754.2 - 751.0)

Volume	Invert	Avail.Storage	Storage Description
#1	217.50'	595 cf	ECO STONE PAVERS (Prismatic) Listed below (Recalc) 1,488 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
217.50	595	0	0
218.00	595	298	298
218.50	595	298	595
219.00	595	298	893
220.00	595	595	1,488

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	6.000 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.08 cfs @ 11.90 hrs HW=217.53' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Pond 11P: ECO STONE UNITS 1-3

Inflow Area = 4,557 sf, Inflow Depth > 2.17" for 2-YR event
Inflow = 0.32 cfs @ 12.01 hrs, Volume= 824 cf
Outflow = 0.21 cfs @ 11.97 hrs, Volume= 823 cf, Atten= 35%, Lag= 0.0 min
Discarded = 0.21 cfs @ 11.97 hrs, Volume= 823 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

SPRUCE CORNER - Post-development

Type III 24-hr 2-YR Rainfall=3.20"

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Peak Elev= 217.56' @ 12.07 hrs Surf.Area= 1,490 sf Storage= 37 cf

Plug-Flow detention time= 1.2 min calculated for 823 cf (100% of inflow)

Center-of-Mass det. time= 1.1 min (802.7 - 801.6)

Volume	Invert	Avail.Storage	Storage Description
#1	217.50'	1,192 cf	ECO STONE PAVERS (Prismatic) Listed below (Recalc) 2,980 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
217.50	1,490	0	0
218.00	1,490	745	745
218.50	1,490	745	1,490
219.00	1,490	745	2,235
219.50	1,490	745	2,980

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	6.000 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.21 cfs @ 11.97 hrs HW=217.52' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.21 cfs)

Pond 12P: STORMCEPTOR CATCH BASIN

Inflow Area = 10,640 sf, Inflow Depth > 1.76" for 2-YR event
 Inflow = 0.61 cfs @ 12.01 hrs, Volume= 1,558 cf
 Outflow = 0.61 cfs @ 12.01 hrs, Volume= 1,558 cf, Atten= 0%, Lag= 0.0 min
 Primary = 0.61 cfs @ 12.01 hrs, Volume= 1,558 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Peak Elev= 213.80' @ 12.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	213.40'	12.0" x 45.0' long Culvert CPP, square edge headwall, Ke= 0.500 Outlet Invert= 212.50' S= 0.0200 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior

Primary OutFlow Max=0.60 cfs @ 12.01 hrs HW=213.80' (Free Discharge)

↑**1=Culvert** (Barrel Controls 0.60 cfs @ 3.03 fps)

Pond 13P: DETENTION BASIN

Inflow Area = 20,690 sf, Inflow Depth > 0.93" for 2-YR event
 Inflow = 0.61 cfs @ 12.01 hrs, Volume= 1,595 cf
 Outflow = 0.16 cfs @ 12.34 hrs, Volume= 1,595 cf, Atten= 74%, Lag= 19.9 min
 Discarded = 0.16 cfs @ 12.34 hrs, Volume= 1,595 cf
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

SPRUCE CORNER - Post-development

Type III 24-hr 2-YR Rainfall=3.20"

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Peak Elev= 211.04' @ 12.34 hrs Surf.Area= 855 sf Storage= 364 cf

Plug-Flow detention time= 16.6 min calculated for 1,594 cf (100% of inflow)

Center-of-Mass det. time= 16.5 min (844.1 - 827.6)

Volume	Invert	Avail.Storage	Storage Description
#1	210.33'	1,771 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
210.33	0	0	0
210.50	380	32	32
211.00	812	298	330
211.50	1,339	538	868
212.00	2,271	903	1,771

Device	Routing	Invert	Outlet Devices
#1	Primary	211.51'	10.0' long (Profile 1) Broad-Crested Rectangular Weir Head (feet) 0.49 0.98 1.48 Coef. (English) 2.92 3.37 3.59
#2	Discarded	0.00'	8.000 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.16 cfs @ 12.34 hrs HW=211.04' (Free Discharge)

↳2=Exfiltration (Exfiltration Controls 0.16 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=210.33' (Free Discharge)

↳1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

SPRUCE CORNER - Post-development

Type III 24-hr 10-YR Rainfall=4.50"

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points

Runoff by SCS TR-20 method, UH=SCS

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

Subcatchment 1S: OFF SITE NORTHWEST Runoff Area=924 sf Runoff Depth>0.11"
Flow Length=50' Slope=0.0300 '/' Tc=1.8 min CN=39 Runoff=0.00 cfs 9 cf

Subcatchment 2S: OFF SITE NORTHWEST Runoff Area=3,092 sf Runoff Depth>0.30"
Flow Length=35' Slope=0.0300 '/' Tc=1.6 min CN=45 Runoff=0.01 cfs 76 cf

Subcatchment 3S: UNITS 1-3 & DRIVE Runoff Area=4,557 sf Runoff Depth>3.40"
Flow Length=25' Slope=0.0300 '/' Tc=0.3 min CN=90 Runoff=0.49 cfs 1,290 cf

Subcatchment 4S: UNITS 4-5 & DRIVE Runoff Area=2,541 sf Runoff Depth>4.26"
Flow Length=20' Slope=0.0500 '/' Tc=0.2 min CN=98 Runoff=0.31 cfs 903 cf

Subcatchment 5S: PARKING & SHOULDERS Runoff Area=10,640 sf Runoff Depth>2.91"
Flow Length=110' Slope=0.0100 '/' Tc=0.7 min CN=85 Runoff=1.00 cfs 2,579 cf

Subcatchment 6S: UNIT 6 & 7 ROOF & LAWN Runoff Area=10,050 sf Runoff Depth>0.30"
Flow Length=225' Slope=0.0400 '/' Tc=2.7 min CN=45 Runoff=0.03 cfs 248 cf

Subcatchment 7S: OFF SITE FLOW SOUTH Runoff Area=4,990 sf Runoff Depth>0.19"
Flow Length=125' Slope=0.0400 '/' Tc=4.1 min CN=42 Runoff=0.00 cfs 81 cf

Reach 20R: NORTH TO ARLINGTON STREET Inflow=0.01 cfs 85 cf
Outflow=0.01 cfs 85 cf

Reach 21R: SOUTH TO WETLANDS Inflow=0.00 cfs 81 cf
Outflow=0.00 cfs 81 cf

Pond 10P: ECO-STONE UNITS 4-5 Peak Elev=218.05' Storage=131 cf Inflow=0.31 cfs 903 cf
Outflow=0.08 cfs 903 cf

Pond 11P: ECO STONE UNITS 1-3 Peak Elev=217.69' Storage=113 cf Inflow=0.49 cfs 1,290 cf
Outflow=0.21 cfs 1,289 cf

Pond 12P: STORMCEPTOR CATCH BASIN Peak Elev=213.93' Inflow=1.00 cfs 2,579 cf
12.0" x 45.0' Culvert Outflow=1.00 cfs 2,579 cf

Pond 13P: DETENTION BASIN Peak Elev=211.39' Storage=724 cf Inflow=1.00 cfs 2,827 cf
Discarded=0.23 cfs 2,826 cf Primary=0.00 cfs 0 cf Outflow=0.23 cfs 2,826 cf

Total Runoff Area = 36,794 sf Runoff Volume = 5,185 cf Average Runoff Depth = 1.69"
55.73% Pervious Area = 20,504 sf 44.27% Impervious Area = 16,290 sf

SPRUCE CORNER - Post-development

Type III 24-hr 10-YR Rainfall=4.50"

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Subcatchment 1S: OFF SITE NORTHWEST

Runoff = 0.00 cfs @ 14.65 hrs, Volume= 9 cf, Depth> 0.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
924	39	>75% Grass cover, Good, HSG A
924		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	10	0.0300	0.13		Sheet Flow, SHEET FLOW Grass: Short n= 0.150 P2= 3.20"
0.5	40	0.0300	1.21		Shallow Concentrated Flow, OVERLAND FLOW Short Grass Pasture Kv= 7.0 fps
1.8	50	Total			

Subcatchment 2S: OFF SITE NORTHWEST

Runoff = 0.01 cfs @ 12.30 hrs, Volume= 76 cf, Depth> 0.30"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
2,792	39	>75% Grass cover, Good, HSG A
300	98	Paved parking & roofs
3,092	45	Weighted Average
2,792		Pervious Area
300		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	10	0.0300	0.13		Sheet Flow, SHEET FLOW Grass: Short n= 0.150 P2= 3.20"
0.3	25	0.0300	1.21		Shallow Concentrated Flow, OVERLAND FLOW Short Grass Pasture Kv= 7.0 fps
1.6	35	Total			

Subcatchment 3S: UNITS 1-3 & DRIVE

Runoff = 0.49 cfs @ 12.00 hrs, Volume= 1,290 cf, Depth> 3.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 10-YR Rainfall=4.50"

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Type III 24-hr 10-YR Rainfall=4.50"

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Area (sf)	CN	Description
3,967	98	Paved roads w/curbs & sewers
590	39	>75% Grass cover, Good, HSG A
4,557	90	Weighted Average
590		Pervious Area
3,967		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	25	0.0300	1.23		Sheet Flow, TR-55 SHEET FLOW Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 4S: UNITS 4-5 & DRIVE

Runoff = 0.31 cfs @ 12.00 hrs, Volume= 903 cf, Depth> 4.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
2,541	98	Paved parking & roofs
2,541		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	20	0.0500	1.44		Sheet Flow, TR-55 SHEET FLOW Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 5S: PARKING & SHOULDERS

Runoff = 1.00 cfs @ 12.01 hrs, Volume= 2,579 cf, Depth> 2.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
8,380	98	Paved parking & roofs
2,260	39	>75% Grass cover, Good, HSG A
10,640	85	Weighted Average
2,260		Pervious Area
8,380		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	20	0.0100	0.76		Sheet Flow, TR-55 SHEET FLOW Smooth surfaces n= 0.011 P2= 3.20"
0.3	90	0.0100	4.96	59.50	Channel Flow, GUTTER FLOW Area= 12.0 sf Perim= 42.0' r= 0.29' n= 0.013
0.7	110	Total			

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Type III 24-hr 10-YR Rainfall=4.50"

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Subcatchment 6S: UNIT 6 & 7 ROOF & LAWN

Runoff = 0.03 cfs @ 12.32 hrs, Volume= 248 cf, Depth> 0.30"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
1,102	98	Paved parking & roofs
8,948	39	>75% Grass cover, Good, HSG A
10,050	45	Weighted Average
8,948		Pervious Area
1,102		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	25	0.0400	1.40		Shallow Concentrated Flow, SHEET FLOW Short Grass Pasture Kv= 7.0 fps
2.4	200	0.0400	1.40		Shallow Concentrated Flow, OVERLAND FLOW Short Grass Pasture Kv= 7.0 fps
2.7	225	Total			

Subcatchment 7S: OFF SITE FLOW SOUTH

Runoff = 0.00 cfs @ 12.43 hrs, Volume= 81 cf, Depth> 0.19"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-YR Rainfall=4.50"

Area (sf)	CN	Description
4,003	43	Woods/grass comb., Fair, HSG A
987	39	>75% Grass cover, Good, HSG A
4,990	42	Weighted Average
4,990		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	25	0.0400	0.17		Sheet Flow, SHEET FLOW Grass: Short n= 0.150 P2= 3.20"
1.7	100	0.0400	1.00		Shallow Concentrated Flow, OVERLAND FLOW Woodland Kv= 5.0 fps
4.1	125	Total			

Reach 20R: NORTH TO ARLINGTON STREET

Inflow Area = 4,016 sf, Inflow Depth > 0.25" for 10-YR event
 Inflow = 0.01 cfs @ 12.30 hrs, Volume= 85 cf
 Outflow = 0.01 cfs @ 12.30 hrs, Volume= 85 cf, Atten= 0%, Lag= 0.0 min

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Type III 24-hr 10-YR Rainfall=4.50"

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Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach 21R: SOUTH TO WETLANDS

Inflow Area = 25,680 sf, Inflow Depth > 0.04" for 10-YR event
Inflow = 0.00 cfs @ 12.43 hrs, Volume= 81 cf
Outflow = 0.00 cfs @ 12.43 hrs, Volume= 81 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond 10P: ECO-STONE UNITS 4-5

Inflow Area = 2,541 sf, Inflow Depth > 4.26" for 10-YR event
Inflow = 0.31 cfs @ 12.00 hrs, Volume= 903 cf
Outflow = 0.08 cfs @ 11.75 hrs, Volume= 903 cf, Atten= 73%, Lag= 0.0 min
Discarded = 0.08 cfs @ 11.75 hrs, Volume= 903 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 218.05' @ 12.28 hrs Surf.Area= 595 sf Storage= 131 cf

Plug-Flow detention time= 7.1 min calculated for 903 cf (100% of inflow)
Center-of-Mass det. time= 7.0 min (751.4 - 744.4)

Volume	Invert	Avail.Storage	Storage Description
#1	217.50'	595 cf	ECO STONE PAVERS (Prismatic) Listed below (Recalc) 1,488 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
217.50	595	0	0
218.00	595	298	298
218.50	595	298	595
219.00	595	298	893
220.00	595	595	1,488

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	6.000 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.08 cfs @ 11.75 hrs HW=217.53' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Pond 11P: ECO STONE UNITS 1-3

Inflow Area = 4,557 sf, Inflow Depth > 3.40" for 10-YR event
Inflow = 0.49 cfs @ 12.00 hrs, Volume= 1,290 cf
Outflow = 0.21 cfs @ 11.93 hrs, Volume= 1,289 cf, Atten= 58%, Lag= 0.0 min
Discarded = 0.21 cfs @ 11.93 hrs, Volume= 1,289 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

SPRUCE CORNER - Post-development

Type III 24-hr 10-YR Rainfall=4.50"

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Peak Elev= 217.69' @ 12.11 hrs Surf.Area= 1,490 sf Storage= 113 cf

Plug-Flow detention time= 2.6 min calculated for 1,289 cf (100% of inflow)

Center-of-Mass det. time= 2.5 min (791.5 - 789.1)

Volume	Invert	Avail.Storage	Storage Description
#1	217.50'	1,192 cf	ECO STONE PAVERS (Prismatic) Listed below (Recalc) 2,980 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
217.50	1,490	0	0
218.00	1,490	745	745
218.50	1,490	745	1,490
219.00	1,490	745	2,235
219.50	1,490	745	2,980

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	6.000 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.21 cfs @ 11.93 hrs HW=217.52' (Free Discharge)↑**1=Exfiltration** (Exfiltration Controls 0.21 cfs)**Pond 12P: STORMCEPTOR CATCH BASIN**

Inflow Area = 10,640 sf, Inflow Depth > 2.91" for 10-YR event
 Inflow = 1.00 cfs @ 12.01 hrs, Volume= 2,579 cf
 Outflow = 1.00 cfs @ 12.01 hrs, Volume= 2,579 cf, Atten= 0%, Lag= 0.0 min
 Primary = 1.00 cfs @ 12.01 hrs, Volume= 2,579 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Peak Elev= 213.93' @ 12.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	213.40'	12.0" x 45.0' long Culvert CPP, square edge headwall, Ke= 0.500 Outlet Invert= 212.50' S= 0.0200 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior

Primary OutFlow Max=1.00 cfs @ 12.01 hrs HW=213.93' (Free Discharge)↑**1=Culvert** (Barrel Controls 1.00 cfs @ 3.43 fps)**Pond 13P: DETENTION BASIN**

Inflow Area = 20,690 sf, Inflow Depth > 1.64" for 10-YR event
 Inflow = 1.00 cfs @ 12.01 hrs, Volume= 2,827 cf
 Outflow = 0.23 cfs @ 12.40 hrs, Volume= 2,826 cf, Atten= 77%, Lag= 23.3 min
 Discarded = 0.23 cfs @ 12.40 hrs, Volume= 2,826 cf
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

SPRUCE CORNER - Post-development

Type III 24-hr 10-YR Rainfall=4.50"

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Peak Elev= 211.39' @ 12.40 hrs Surf.Area= 1,220 sf Storage= 724 cf

Plug-Flow detention time= 25.8 min calculated for 2,825 cf (100% of inflow)

Center-of-Mass det. time= 25.6 min (846.2 - 820.6)

Volume	Invert	Avail.Storage	Storage Description
#1	210.33'	1,771 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
210.33	0	0	0
210.50	380	32	32
211.00	812	298	330
211.50	1,339	538	868
212.00	2,271	903	1,771

Device	Routing	Invert	Outlet Devices
#1	Primary	211.51'	10.0' long (Profile 1) Broad-Crested Rectangular Weir Head (feet) 0.49 0.98 1.48 Coef. (English) 2.92 3.37 3.59
#2	Discarded	0.00'	8.000 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.23 cfs @ 12.40 hrs HW=211.39' (Free Discharge)
↳2=Exfiltration (Exfiltration Controls 0.23 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=210.33' (Free Discharge)
↳1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

SPRUCE CORNER - Post-development

Type III 24-hr 25-YR Rainfall=5.20"

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points

Runoff by SCS TR-20 method, UH=SCS

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

Subcatchment 1S: OFF SITE NORTHWEST

Runoff Area=924 sf Runoff Depth>0.24"

Flow Length=50' Slope=0.0300 '/' Tc=1.8 min CN=39 Runoff=0.00 cfs 19 cf

Subcatchment 2S: OFF SITE NORTHWEST

Runoff Area=3,092 sf Runoff Depth>0.51"

Flow Length=35' Slope=0.0300 '/' Tc=1.6 min CN=45 Runoff=0.02 cfs 131 cf

Subcatchment 3S: UNITS 1-3 & DRIVE

Runoff Area=4,557 sf Runoff Depth>4.07"

Flow Length=25' Slope=0.0300 '/' Tc=0.3 min CN=90 Runoff=0.58 cfs 1,545 cf

Subcatchment 4S: UNITS 4-5 & DRIVE

Runoff Area=2,541 sf Runoff Depth>4.96"

Flow Length=20' Slope=0.0500 '/' Tc=0.2 min CN=98 Runoff=0.36 cfs 1,051 cf

Subcatchment 5S: PARKING & SHOULDERS

Runoff Area=10,640 sf Runoff Depth>3.55"

Flow Length=110' Slope=0.0100 '/' Tc=0.7 min CN=85 Runoff=1.21 cfs 3,150 cf

Subcatchment 6S: UNIT 6 & 7 ROOF & LAWN

Runoff Area=10,050 sf Runoff Depth>0.51"

Flow Length=225' Slope=0.0400 '/' Tc=2.7 min CN=45 Runoff=0.06 cfs 424 cf

Subcatchment 7S: OFF SITE FLOW SOUTH

Runoff Area=4,990 sf Runoff Depth>0.37"

Flow Length=125' Slope=0.0400 '/' Tc=4.1 min CN=42 Runoff=0.02 cfs 152 cf

Reach 20R: NORTH TO ARLINGTON STREET

Inflow=0.02 cfs 149 cf

Outflow=0.02 cfs 149 cf

Reach 21R: SOUTH TO WETLANDS

Inflow=0.14 cfs 228 cf

Outflow=0.14 cfs 228 cf

Pond 10P: ECO-STONE UNITS 4-5

Peak Elev=218.25' Storage=179 cf Inflow=0.36 cfs 1,051 cf

Outflow=0.08 cfs 1,051 cf

Pond 11P: ECO STONE UNITS 1-3

Peak Elev=217.78' Storage=165 cf Inflow=0.58 cfs 1,545 cf

Outflow=0.21 cfs 1,545 cf

Pond 12P: STORMCEPTOR CATCH BASIN

Peak Elev=213.99' Inflow=1.21 cfs 3,150 cf

12.0" x 45.0' Culvert Outflow=1.21 cfs 3,150 cf

Pond 13P: DETENTION BASIN

Peak Elev=211.54' Storage=916 cf Inflow=1.22 cfs 3,575 cf

Discarded=0.26 cfs 3,497 cf Primary=0.12 cfs 76 cf Outflow=0.38 cfs 3,573 cf

Total Runoff Area = 36,794 sf Runoff Volume = 6,472 cf Average Runoff Depth = 2.11"

55.73% Pervious Area = 20,504 sf 44.27% Impervious Area = 16,290 sf

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Type III 24-hr 25-YR Rainfall=5.20"

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Subcatchment 1S: OFF SITE NORTHWEST

Runoff = 0.00 cfs @ 12.37 hrs, Volume= 19 cf, Depth> 0.24"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=5.20"

Area (sf)	CN	Description
924	39	>75% Grass cover, Good, HSG A
924		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	10	0.0300	0.13		Sheet Flow, SHEET FLOW Grass: Short n= 0.150 P2= 3.20"
0.5	40	0.0300	1.21		Shallow Concentrated Flow, OVERLAND FLOW Short Grass Pasture Kv= 7.0 fps
1.8	50	Total			

Subcatchment 2S: OFF SITE NORTHWEST

Runoff = 0.02 cfs @ 12.08 hrs, Volume= 131 cf, Depth> 0.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=5.20"

Area (sf)	CN	Description
2,792	39	>75% Grass cover, Good, HSG A
300	98	Paved parking & roofs
3,092	45	Weighted Average
2,792		Pervious Area
300		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	10	0.0300	0.13		Sheet Flow, SHEET FLOW Grass: Short n= 0.150 P2= 3.20"
0.3	25	0.0300	1.21		Shallow Concentrated Flow, OVERLAND FLOW Short Grass Pasture Kv= 7.0 fps
1.6	35	Total			

Subcatchment 3S: UNITS 1-3 & DRIVE

Runoff = 0.58 cfs @ 12.00 hrs, Volume= 1,545 cf, Depth> 4.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=5.20"

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Type III 24-hr 25-YR Rainfall=5.20"

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Area (sf)	CN	Description
3,967	98	Paved roads w/curbs & sewers
590	39	>75% Grass cover, Good, HSG A
4,557	90	Weighted Average
590		Pervious Area
3,967		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	25	0.0300	1.23		Sheet Flow, TR-55 SHEET FLOW Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 4S: UNITS 4-5 & DRIVE

Runoff = 0.36 cfs @ 12.00 hrs, Volume= 1,051 cf, Depth> 4.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=5.20"

Area (sf)	CN	Description
2,541	98	Paved parking & roofs
2,541		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	20	0.0500	1.44		Sheet Flow, TR-55 SHEET FLOW Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 5S: PARKING & SHOULDERS

Runoff = 1.21 cfs @ 12.01 hrs, Volume= 3,150 cf, Depth> 3.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-YR Rainfall=5.20"

Area (sf)	CN	Description
8,380	98	Paved parking & roofs
2,260	39	>75% Grass cover, Good, HSG A
10,640	85	Weighted Average
2,260		Pervious Area
8,380		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	20	0.0100	0.76		Sheet Flow, TR-55 SHEET FLOW Smooth surfaces n= 0.011 P2= 3.20"
0.3	90	0.0100	4.96	59.50	Channel Flow, GUTTER FLOW Area= 12.0 sf Perim= 42.0' r= 0.29' n= 0.013
0.7	110	Total			

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Type III 24-hr 25-YR Rainfall=5.20"

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Subcatchment 6S: UNIT 6 & 7 ROOF & LAWN

Runoff = 0.06 cfs @ 12.10 hrs, Volume= 424 cf, Depth> 0.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 25-YR Rainfall=5.20"

Area (sf)	CN	Description
1,102	98	Paved parking & roofs
8,948	39	>75% Grass cover, Good, HSG A
10,050	45	Weighted Average
8,948		Pervious Area
1,102		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	25	0.0400	1.40		Shallow Concentrated Flow, SHEET FLOW
					Short Grass Pasture Kv= 7.0 fps
2.4	200	0.0400	1.40		Shallow Concentrated Flow, OVERLAND FLOW
					Short Grass Pasture Kv= 7.0 fps
2.7	225	Total			

Subcatchment 7S: OFF SITE FLOW SOUTH

Runoff = 0.02 cfs @ 12.32 hrs, Volume= 152 cf, Depth> 0.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 25-YR Rainfall=5.20"

Area (sf)	CN	Description
4,003	43	Woods/grass comb., Fair, HSG A
987	39	>75% Grass cover, Good, HSG A
4,990	42	Weighted Average
4,990		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	25	0.0400	0.17		Sheet Flow, SHEET FLOW
					Grass: Short n= 0.150 P2= 3.20"
1.7	100	0.0400	1.00		Shallow Concentrated Flow, OVERLAND FLOW
					Woodland Kv= 5.0 fps
4.1	125	Total			

Reach 20R: NORTH TO ARLINGTON STREET

Inflow Area = 4,016 sf, Inflow Depth > 0.45" for 25-YR event

Inflow = 0.02 cfs @ 12.08 hrs, Volume= 149 cf

Outflow = 0.02 cfs @ 12.08 hrs, Volume= 149 cf, Atten= 0%, Lag= 0.0 min

SPRUCE CORNER - Post-development

Type III 24-hr 25-YR Rainfall=5.20"

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Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach 21R: SOUTH TO WETLANDS

Inflow Area = 25,680 sf, Inflow Depth > 0.11" for 25-YR event
 Inflow = 0.14 cfs @ 12.31 hrs, Volume= 228 cf
 Outflow = 0.14 cfs @ 12.31 hrs, Volume= 228 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond 10P: ECO-STONE UNITS 4-5

Inflow Area = 2,541 sf, Inflow Depth > 4.96" for 25-YR event
 Inflow = 0.36 cfs @ 12.00 hrs, Volume= 1,051 cf
 Outflow = 0.08 cfs @ 11.70 hrs, Volume= 1,051 cf, Atten= 77%, Lag= 0.0 min
 Discarded = 0.08 cfs @ 11.70 hrs, Volume= 1,051 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Peak Elev= 218.25' @ 12.33 hrs Surf.Area= 595 sf Storage= 179 cf

Plug-Flow detention time= 9.8 min calculated for 1,050 cf (100% of inflow)

Center-of-Mass det. time= 9.7 min (751.7 - 742.0)

Volume	Invert	Avail.Storage	Storage Description
#1	217.50'	595 cf	ECO STONE PAVERS (Prismatic) Listed below (Recalc) 1,488 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
217.50	595	0	0
218.00	595	298	298
218.50	595	298	595
219.00	595	298	893
220.00	595	595	1,488

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	6.000 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.08 cfs @ 11.70 hrs HW=217.53' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Pond 11P: ECO STONE UNITS 1-3

Inflow Area = 4,557 sf, Inflow Depth > 4.07" for 25-YR event
 Inflow = 0.58 cfs @ 12.00 hrs, Volume= 1,545 cf
 Outflow = 0.21 cfs @ 11.89 hrs, Volume= 1,545 cf, Atten= 64%, Lag= 0.0 min
 Discarded = 0.21 cfs @ 11.89 hrs, Volume= 1,545 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

SPRUCE CORNER - Post-development

Type III 24-hr 25-YR Rainfall=5.20"

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Peak Elev= 217.78' @ 12.18 hrs Surf.Area= 1,490 sf Storage= 165 cf

Plug-Flow detention time= 3.7 min calculated for 1,544 cf (100% of inflow)

Center-of-Mass det. time= 3.6 min (787.7 - 784.1)

Volume	Invert	Avail.Storage	Storage Description
#1	217.50'	1,192 cf	ECO STONE PAVERS (Prismatic) Listed below (Recalc) 2,980 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
217.50	1,490	0	0
218.00	1,490	745	745
218.50	1,490	745	1,490
219.00	1,490	745	2,235
219.50	1,490	745	2,980

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	6.000 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.21 cfs @ 11.89 hrs HW=217.52' (Free Discharge)↑**1=Exfiltration** (Exfiltration Controls 0.21 cfs)**Pond 12P: STORMCEPTOR CATCH BASIN**

Inflow Area = 10,640 sf, Inflow Depth > 3.55" for 25-YR event
 Inflow = 1.21 cfs @ 12.01 hrs, Volume= 3,150 cf
 Outflow = 1.21 cfs @ 12.01 hrs, Volume= 3,150 cf, Atten= 0%, Lag= 0.0 min
 Primary = 1.21 cfs @ 12.01 hrs, Volume= 3,150 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Peak Elev= 213.99' @ 12.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	213.40'	12.0" x 45.0' long Culvert CPP, square edge headwall, Ke= 0.500 Outlet Invert= 212.50' S= 0.0200 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior

Primary OutFlow Max=1.21 cfs @ 12.01 hrs HW=213.99' (Free Discharge)↑**1=Culvert** (Barrel Controls 1.21 cfs @ 3.59 fps)**Pond 13P: DETENTION BASIN**

Inflow Area = 20,690 sf, Inflow Depth > 2.07" for 25-YR event
 Inflow = 1.22 cfs @ 12.01 hrs, Volume= 3,575 cf
 Outflow = 0.38 cfs @ 12.31 hrs, Volume= 3,573 cf, Atten= 69%, Lag= 18.0 min
 Discarded = 0.26 cfs @ 12.31 hrs, Volume= 3,497 cf
 Primary = 0.12 cfs @ 12.31 hrs, Volume= 76 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

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Type III 24-hr 25-YR Rainfall=5.20"

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Peak Elev= 211.54' @ 12.31 hrs Surf.Area= 1,405 sf Storage= 916 cf

Plug-Flow detention time= 29.0 min calculated for 3,573 cf (100% of inflow)

Center-of-Mass det. time= 28.8 min (845.9 - 817.0)

Volume	Invert	Avail.Storage	Storage Description
#1	210.33'	1,771 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
210.33	0	0	0
210.50	380	32	32
211.00	812	298	330
211.50	1,339	538	868
212.00	2,271	903	1,771

Device	Routing	Invert	Outlet Devices
#1	Primary	211.51'	10.0' long (Profile 1) Broad-Crested Rectangular Weir Head (feet) 0.49 0.98 1.48 Coef. (English) 2.92 3.37 3.59
#2	Discarded	0.00'	8.000 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.26 cfs @ 12.31 hrs HW=211.54' (Free Discharge)
↳2=Exfiltration (Exfiltration Controls 0.26 cfs)

Primary OutFlow Max=0.12 cfs @ 12.31 hrs HW=211.54' (Free Discharge)
↳1=Broad-Crested Rectangular Weir (Weir Controls 0.12 cfs @ 0.46 fps)

SPRUCE CORNER - Post-development

Type III 24-hr 100-YR Rainfall=6.60"

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Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points

Runoff by SCS TR-20 method, UH=SCS

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

Subcatchment 1S: OFF SITE NORTHWEST

Runoff Area=924 sf Runoff Depth>0.63"

Flow Length=50' Slope=0.0300 '/' Tc=1.8 min CN=39 Runoff=0.01 cfs 49 cf

Subcatchment 2S: OFF SITE NORTHWEST

Runoff Area=3,092 sf Runoff Depth>1.05"

Flow Length=35' Slope=0.0300 '/' Tc=1.6 min CN=45 Runoff=0.07 cfs 272 cf

Subcatchment 3S: UNITS 1-3 & DRIVE

Runoff Area=4,557 sf Runoff Depth>5.43"

Flow Length=25' Slope=0.0300 '/' Tc=0.3 min CN=90 Runoff=0.76 cfs 2,063 cf

Subcatchment 4S: UNITS 4-5 & DRIVE

Runoff Area=2,541 sf Runoff Depth>6.36"

Flow Length=20' Slope=0.0500 '/' Tc=0.2 min CN=98 Runoff=0.46 cfs 1,347 cf

Subcatchment 5S: PARKING & SHOULDERS

Runoff Area=10,640 sf Runoff Depth>4.87"

Flow Length=110' Slope=0.0100 '/' Tc=0.7 min CN=85 Runoff=1.64 cfs 4,319 cf

Subcatchment 6S: UNIT 6 & 7 ROOF & LAWN

Runoff Area=10,050 sf Runoff Depth>1.05"

Flow Length=225' Slope=0.0400 '/' Tc=2.7 min CN=45 Runoff=0.23 cfs 882 cf

Subcatchment 7S: OFF SITE FLOW SOUTH

Runoff Area=4,990 sf Runoff Depth>0.83"

Flow Length=125' Slope=0.0400 '/' Tc=4.1 min CN=42 Runoff=0.07 cfs 347 cf

Reach 20R: NORTH TO ARLINGTON STREET

Inflow=0.08 cfs 320 cf

Outflow=0.08 cfs 320 cf

Reach 21R: SOUTH TO WETLANDS

Inflow=0.95 cfs 1,076 cf

Outflow=0.95 cfs 1,076 cf

Pond 10P: ECO-STONE UNITS 4-5

Peak Elev=218.70' Storage=285 cf Inflow=0.46 cfs 1,347 cf

Outflow=0.08 cfs 1,347 cf

Pond 11P: ECO STONE UNITS 1-3

Peak Elev=218.02' Storage=312 cf Inflow=0.76 cfs 2,063 cf

Outflow=0.21 cfs 2,062 cf

Pond 12P: STORMCEPTOR CATCH BASIN

Peak Elev=214.11' Inflow=1.64 cfs 4,319 cf

12.0" x 45.0' Culvert Outflow=1.64 cfs 4,319 cf

Pond 13P: DETENTION BASIN

Peak Elev=211.61' Storage=1,022 cf Inflow=1.80 cfs 5,201 cf

Discarded=0.28 cfs 4,469 cf Primary=0.89 cfs 729 cf Outflow=1.17 cfs 5,199 cf

Total Runoff Area = 36,794 sf Runoff Volume = 9,277 cf Average Runoff Depth = 3.03"

55.73% Pervious Area = 20,504 sf 44.27% Impervious Area = 16,290 sf

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Type III 24-hr 100-YR Rainfall=6.60"

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Subcatchment 1S: OFF SITE NORTHWEST

Runoff = 0.01 cfs @ 12.08 hrs, Volume= 49 cf, Depth> 0.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=6.60"

Area (sf)	CN	Description
924	39	>75% Grass cover, Good, HSG A
924		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	10	0.0300	0.13		Sheet Flow, SHEET FLOW Grass: Short n= 0.150 P2= 3.20"
0.5	40	0.0300	1.21		Shallow Concentrated Flow, OVERLAND FLOW Short Grass Pasture Kv= 7.0 fps
1.8	50	Total			

Subcatchment 2S: OFF SITE NORTHWEST

Runoff = 0.07 cfs @ 12.04 hrs, Volume= 272 cf, Depth> 1.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=6.60"

Area (sf)	CN	Description
2,792	39	>75% Grass cover, Good, HSG A
300	98	Paved parking & roofs
3,092	45	Weighted Average
2,792		Pervious Area
300		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.3	10	0.0300	0.13		Sheet Flow, SHEET FLOW Grass: Short n= 0.150 P2= 3.20"
0.3	25	0.0300	1.21		Shallow Concentrated Flow, OVERLAND FLOW Short Grass Pasture Kv= 7.0 fps
1.6	35	Total			

Subcatchment 3S: UNITS 1-3 & DRIVE

Runoff = 0.76 cfs @ 12.00 hrs, Volume= 2,063 cf, Depth> 5.43"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-YR Rainfall=6.60"

SPRUCE CORNER - Post-development

Type III 24-hr 100-YR Rainfall=6.60"

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Area (sf)	CN	Description
3,967	98	Paved roads w/curbs & sewers
590	39	>75% Grass cover, Good, HSG A
4,557	90	Weighted Average
590		Pervious Area
3,967		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	25	0.0300	1.23		Sheet Flow, TR-55 SHEET FLOW Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 4S: UNITS 4-5 & DRIVE

Runoff = 0.46 cfs @ 12.00 hrs, Volume= 1,347 cf, Depth> 6.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 100-YR Rainfall=6.60"

Area (sf)	CN	Description
2,541	98	Paved parking & roofs
2,541		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	20	0.0500	1.44		Sheet Flow, TR-55 SHEET FLOW Smooth surfaces n= 0.011 P2= 3.20"

Subcatchment 5S: PARKING & SHOULDERS

Runoff = 1.64 cfs @ 12.01 hrs, Volume= 4,319 cf, Depth> 4.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 100-YR Rainfall=6.60"

Area (sf)	CN	Description
8,380	98	Paved parking & roofs
2,260	39	>75% Grass cover, Good, HSG A
10,640	85	Weighted Average
2,260		Pervious Area
8,380		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	20	0.0100	0.76		Sheet Flow, TR-55 SHEET FLOW Smooth surfaces n= 0.011 P2= 3.20"
0.3	90	0.0100	4.96	59.50	Channel Flow, GUTTER FLOW Area= 12.0 sf Perim= 42.0' r= 0.29' n= 0.013
0.7	110	Total			

SPRUCE CORNER - Post-development

Type III 24-hr 100-YR Rainfall=6.60"

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Subcatchment 6S: UNIT 6 & 7 ROOF & LAWN

Runoff = 0.23 cfs @ 12.06 hrs, Volume= 882 cf, Depth> 1.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 100-YR Rainfall=6.60"

Area (sf)	CN	Description
1,102	98	Paved parking & roofs
8,948	39	>75% Grass cover, Good, HSG A
10,050	45	Weighted Average
8,948		Pervious Area
1,102		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	25	0.0400	1.40		Shallow Concentrated Flow, SHEET FLOW
					Short Grass Pasture Kv= 7.0 fps
2.4	200	0.0400	1.40		Shallow Concentrated Flow, OVERLAND FLOW
					Short Grass Pasture Kv= 7.0 fps
2.7	225	Total			

Subcatchment 7S: OFF SITE FLOW SOUTH

Runoff = 0.07 cfs @ 12.10 hrs, Volume= 347 cf, Depth> 0.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Type III 24-hr 100-YR Rainfall=6.60"

Area (sf)	CN	Description
4,003	43	Woods/grass comb., Fair, HSG A
987	39	>75% Grass cover, Good, HSG A
4,990	42	Weighted Average
4,990		Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	25	0.0400	0.17		Sheet Flow, SHEET FLOW
					Grass: Short n= 0.150 P2= 3.20"
1.7	100	0.0400	1.00		Shallow Concentrated Flow, OVERLAND FLOW
					Woodland Kv= 5.0 fps
4.1	125	Total			

Reach 20R: NORTH TO ARLINGTON STREET

Inflow Area = 4,016 sf, Inflow Depth > 0.96" for 100-YR event

Inflow = 0.08 cfs @ 12.05 hrs, Volume= 320 cf

Outflow = 0.08 cfs @ 12.05 hrs, Volume= 320 cf, Atten= 0%, Lag= 0.0 min

SPRUCE CORNER - Post-development

Type III 24-hr 100-YR Rainfall=6.60"

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Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach 21R: SOUTH TO WETLANDS

Inflow Area = 25,680 sf, Inflow Depth > 0.50" for 100-YR event
 Inflow = 0.95 cfs @ 12.09 hrs, Volume= 1,076 cf
 Outflow = 0.95 cfs @ 12.09 hrs, Volume= 1,076 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Pond 10P: ECO-STONE UNITS 4-5

Inflow Area = 2,541 sf, Inflow Depth > 6.36" for 100-YR event
 Inflow = 0.46 cfs @ 12.00 hrs, Volume= 1,347 cf
 Outflow = 0.08 cfs @ 11.64 hrs, Volume= 1,347 cf, Atten= 82%, Lag= 0.0 min
 Discarded = 0.08 cfs @ 11.64 hrs, Volume= 1,347 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
 Peak Elev= 218.70' @ 12.40 hrs Surf.Area= 595 sf Storage= 285 cf

Plug-Flow detention time= 16.5 min calculated for 1,346 cf (100% of inflow)
 Center-of-Mass det. time= 16.4 min (754.8 - 738.4)

Volume	Invert	Avail.Storage	Storage Description
#1	217.50'	595 cf	ECO STONE PAVERS (Prismatic) Listed below (Recalc) 1,488 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
217.50	595	0	0
218.00	595	298	298
218.50	595	298	595
219.00	595	298	893
220.00	595	595	1,488

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	6.000 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.08 cfs @ 11.64 hrs HW=217.53' (Free Discharge)
 ↑**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

Pond 11P: ECO STONE UNITS 1-3

Inflow Area = 4,557 sf, Inflow Depth > 5.43" for 100-YR event
 Inflow = 0.76 cfs @ 12.00 hrs, Volume= 2,063 cf
 Outflow = 0.21 cfs @ 11.77 hrs, Volume= 2,062 cf, Atten= 73%, Lag= 0.0 min
 Discarded = 0.21 cfs @ 11.77 hrs, Volume= 2,062 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

SPRUCE CORNER - Post-development

Type III 24-hr 100-YR Rainfall=6.60"

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Peak Elev= 218.02' @ 12.29 hrs Surf.Area= 1,490 sf Storage= 312 cf

Plug-Flow detention time= 7.0 min calculated for 2,061 cf (100% of inflow)

Center-of-Mass det. time= 6.9 min (783.3 - 776.4)

Volume	Invert	Avail.Storage	Storage Description
#1	217.50'	1,192 cf	ECO STONE PAVERS (Prismatic) Listed below (Recalc) 2,980 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
217.50	1,490	0	0
218.00	1,490	745	745
218.50	1,490	745	1,490
219.00	1,490	745	2,235
219.50	1,490	745	2,980

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	6.000 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.21 cfs @ 11.77 hrs HW=217.52' (Free Discharge)

↑**1=Exfiltration** (Exfiltration Controls 0.21 cfs)

Pond 12P: STORMCEPTOR CATCH BASIN

Inflow Area = 10,640 sf, Inflow Depth > 4.87" for 100-YR event
 Inflow = 1.64 cfs @ 12.01 hrs, Volume= 4,319 cf
 Outflow = 1.64 cfs @ 12.01 hrs, Volume= 4,319 cf, Atten= 0%, Lag= 0.0 min
 Primary = 1.64 cfs @ 12.01 hrs, Volume= 4,319 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Peak Elev= 214.11' @ 12.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	213.40'	12.0" x 45.0' long Culvert CPP, square edge headwall, Ke= 0.500 Outlet Invert= 212.50' S= 0.0200 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior

Primary OutFlow Max=1.64 cfs @ 12.01 hrs HW=214.11' (Free Discharge)

↑**1=Culvert** (Barrel Controls 1.64 cfs @ 3.85 fps)

Pond 13P: DETENTION BASIN

Inflow Area = 20,690 sf, Inflow Depth > 3.02" for 100-YR event
 Inflow = 1.80 cfs @ 12.01 hrs, Volume= 5,201 cf
 Outflow = 1.17 cfs @ 12.09 hrs, Volume= 5,199 cf, Atten= 35%, Lag= 4.3 min
 Discarded = 0.28 cfs @ 12.09 hrs, Volume= 4,469 cf
 Primary = 0.89 cfs @ 12.09 hrs, Volume= 729 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

SPRUCE CORNER - Post-development

Type III 24-hr 100-YR Rainfall=6.60"

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Peak Elev= 211.61' @ 12.09 hrs Surf.Area= 1,539 sf Storage= 1,022 cf

Plug-Flow detention time= 26.9 min calculated for 5,199 cf (100% of inflow)

Center-of-Mass det. time= 26.6 min (837.5 - 810.8)

Volume	Invert	Avail.Storage	Storage Description
#1	210.33'	1,771 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
210.33	0	0	0
210.50	380	32	32
211.00	812	298	330
211.50	1,339	538	868
212.00	2,271	903	1,771

Device	Routing	Invert	Outlet Devices
#1	Primary	211.51'	10.0' long (Profile 1) Broad-Crested Rectangular Weir Head (feet) 0.49 0.98 1.48 Coef. (English) 2.92 3.37 3.59
#2	Discarded	0.00'	8.000 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.28 cfs @ 12.09 hrs HW=211.61' (Free Discharge)

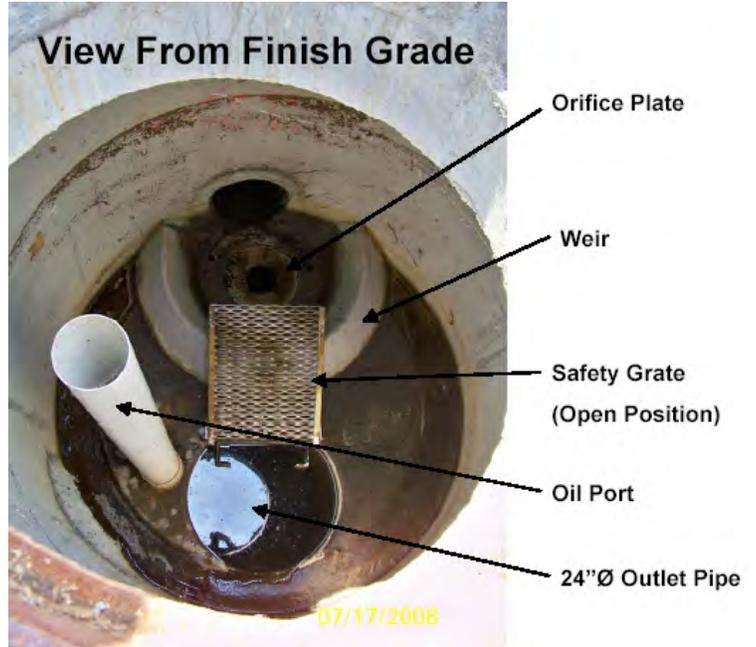
↳ **2=Exfiltration** (Exfiltration Controls 0.28 cfs)

Primary OutFlow Max=0.88 cfs @ 12.09 hrs HW=211.61' (Free Discharge)

↳ **1=Broad-Crested Rectangular Weir** (Weir Controls 0.88 cfs @ 0.91 fps)

- **Oil inspection port** – primary access for measuring oil depth and oil removal
- **Safety grate** – safety measure to cover riser pipe in the event of manned entry into vessel

The Stormceptor System has no moving parts to wear out and therefore maintenance activities are generally focused on pollutant removal.



The depth of sediment can be measured from the surface by using a sediment probe or dipstick tube equipped with a ball check valve and inserted through the 24-inch outlet riser pipe. Oil level can similarly be checked through the oil inspection port.



A maintenance worker stationed on the surface uses a vacuum hose to evacuate water, sediment, and debris from the system.

Purchasing replacement parts

Since there are no moving parts in the Stormceptor System, broken, damaged, or worn parts are not typically encountered. However, if replacements parts are necessary, they may be obtained by contacting the following supplier of authentic Stormceptor components.

In New Jersey, contact:

Camtek Construction Products Corp.
3481 Treeline Drive
Murrysville, PA 15668
Phone: (724) 327-3400

The benefits of regular inspection and maintenance are many – from ensuring maximum operation efficiency, to keeping maintenance costs low, to the continued protection of natural waterways – and provide the key to Stormceptor’s long and effective service life.

Appendix G

Stormwater Operation & Maintenance Plan

**STORMWATER OPERATION & MAINTENANCE
PLAN FOR**

“SPRUCE CORNER”

**232 Arlington Street
Acton, Massachusetts**

July 12, 2010

Prepared for:
West Acton Trio, LLC
P.O. Box 401012
Cambridge, Massachusetts 02140

Prepared By:
FORESITE Engineering Associates, Inc.
16 Gleasondale Road, Suite 1-1
Stow, Massachusetts 01775
Phone (978) 461-2350

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- 1 Project Description
- 2 Planned Erosion & Sedimentation Controls
During Construction
- 3 Long Term Inspection & Maintenance Measures
After Construction
- 4 Illicit Discharge Compliance Statement

1. Project Description

The site of the proposed “Spruce Corner” development is a 0.84 acre tract of land located at the southeast corner of Arlington Street and Spruce Street in the West Acton village identified on Acton Assessors Maps as Map F2A Parcels 70, 71 & 83. The project site is located within the West Acton Village (WAV) zoning district and abuts the Village Residential (VR) zone to the east and across Arlington Street to the north. The project site is currently used for residential purposes and contains two single family dwellings and an accessory garage. There are currently no other structures on the site and all uses of the site are residential or accessory to residential uses (single family dwellings with accessory yard and garden areas).

According to the United States Department of Agriculture (USDA) Soil Survey of Middlesex County the soils on site are Merrimac series. These soils are deep outwash deposits that exhibit rapid permeability at the surface layer and very rapid permeability in the substratum (Hydrologic Soil Group A) and typically have a relatively deep water table. Hinckley and Merrimac soils have no major limitations for building site development or for local roads and streets making the site well suited to development, sewage disposal, and storm water recharge systems. The soils were evaluated in the field to verify these conditions. Deep observation test holes and percolation tests were conducted throughout the site and the results of those tests are documented in Appendix E.

The development proposal for the site involves demolition of the two existing dwellings and garage, clearing of vegetation, grading, and construction of 3 structures – 2 duplex residences and a building at the corner of Arlington Street and Spruce Street with approximately 4,396 square feet of commercial space in the basement and on the first floor and (3) 2-bedroom apartments on the second and third floors. Appurtenant to the principal use of the buildings is construction of access drives, parking areas, walkways, drainage and sewerage infrastructure and extension of utilities from Arlington Street and Spruce Street to serve the buildings on site. The change in surface cover (from pervious vegetated cover to impervious cover and less pervious lawn) and the alteration of grade, increase the rate and volume of runoff from the site. Runoff is collected in the drainage system and treated to meet DEP Stormwater Management Policy standards where necessary. Increases in the rate and volume of runoff are managed with infiltrative measures such as a retention/detention basin and pervious pavers where feasible.

2. Planned Erosion and Sedimentation Control Measures During Construction

Haybales/Siltation Fence

Staked hay bales with silt fence are proposed to be installed, as shown on the site plan, around the perimeter and up gradient of the bordering vegetated wetlands. The siltation barrier will be installed prior to the commencement of any work on-site and in accordance with the design plans. An additional supply of hay bales shall be on-site to replace and/or repair hay bale fencing that is

disturbed. The lines of hay bales shall be inspected and maintained on a weekly basis during construction.

Storm Drain Inlet Protection

A temporary storm inlet protection filter or hay bales will be placed around all catch basin units during construction. The purpose of the filter is to prevent the inflow of sediments into the closed drainage system. The filter or hay bales shall remain in place until a permanent vegetative cover is established and the transport of sediment is no longer a potential hazard. The filter shall be inspected and maintained on a weekly basis and after every storm event during construction. Storm drain inlet protection shall be removed upon completion of site improvements and stabilization of site.

Surface Stabilization

The surface of all disturbed areas shall be stabilized during and after construction. Temporary measures shall be taken during construction to prevent erosion and siltation. All disturbed slopes will be stabilized with a permanent vegetative cover. Some or all of the following measures will be utilized on this project as conditions may warrant.

- a. Temporary Seeding
- b. Temporary Mulching
- c. Permanent Seeding
- d. Placement of Sod
- e. Hydroseeding
- f. Placement of Hay
- g. Placement of Jute Netting

Inspection and Maintenance of Stormceptor 450i Catch Basin

The performance of the Stormceptor 450i catch basin will be limited during construction by filter fabric and haybale inlet protection proposed to keep sediments out of the system. The Stormceptor shall be inspected after every rainfall event during construction and cleaned of sediments and debris as necessary (typically when sediment depth in the sump reaches 8" or greater).

3. Long-Term Inspection and Maintenance Measures After Construction

Stormwater Mangement System Owners & Party Responsible for Maintenance:

West Acton Trio, LLC
P.O. Box 041012
Cambridge, MA 02140

Erosion Control

Eroded sediments can adversely affect the performance of the stormwater management system. Eroding or barren areas should be re-vegetated immediately.

Debris and Litter Removal

Trash may collect in the BMP's, potentially causing clogging of the facilities. All debris and litter shall be removed from the site as soon as possible upon discovery, and after each storm event.

Inspection and Maintenance of Catch Basin

The Stormceptor 450i catch basin shall be inspected four (4) times per year in the first year following construction, and if necessary, maintenance shall be performed so that it functions as designed. The Stormceptor shall be cleaned twice per year, and when sediment depth reaches 8 inches or greater. Inlet and outlet pipes should be checked for clogging. At a minimum, inspection of the catch basin shall be performed during the last week of April and the first week of October each calendar year.

Detention Basin

Detention basin should be inspected at least semi-annually, and maintenance and repairs made as necessary. Additional inspections should be scheduled regularly during the first few months to make sure the covering vegetation is adequately established. Repairs and reseedling should be done as required. Basins slopes should be mowed at least once per year. Grass clippings should be removed. The grass must not be cut too often or shorter than four inches, in order to maintain the effectiveness of the basin. Sediment and debris should be removed from the basin manually (by hand), at least once per year, before vegetation is adversely impacted. Care should be taken to protect the water quality basins from snow removal and disposal practices and off-street parking.

Parking Lot Sweeping

Parking lot sweeping shall be conducted once per year during late spring. The period immediately following winter snowmelt when roads and other accumulated sediment are washed off shall be swept. Conventional mechanical sweepers or vacuum type sweepers demonstrate higher removal efficiencies and shall be utilized.

4. Illicit Discharge Compliance Statement

(1) Prohibition of Illicit Discharges.

(a) Prohibition. No person shall throw, drain, discharge, cause to be discharged, or allow others under their control to discharge into the storm sewer system or watercourse any materials other than stormwater, including but not limited to pollutants or waters containing pollutants.

(b) Exemptions. The following non-stormwater discharges are excluded from (a) above:

(1) waterline flushing or other potable water sources;

(2) landscape irrigation or lawn watering;

(3) diverted, natural riparian habitat and/or wetland flows;

(4) rising ground water, ground water infiltration to storm drains, and/or uncontaminated pumped groundwater;

(5) foundation or footing drains (not including active ground water dewatering systems) and crawl space pumps;

(6) air conditioning condensation;

(7) springs;

(8) other water sources determined by the Massachusetts Department of Environmental Protection, in writing, as not containing pollutants that cause or contribute to waterway degradation, including but not limited to a violation of applicable water quality standards and/or degradation of the biotic integrity of surface water bodies and their floodplains.

Appendix H

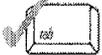
DEP Checklist for Stormwater Report



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 8²
- 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.



Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

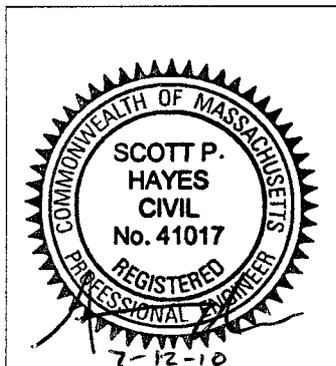
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature




Signature and Date 7-12-10

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

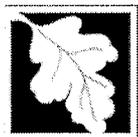
Checklist (continued)

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 Field¹
- Runoff from all impervious areas at the site discharging to the infiltration BMP.
- Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume.
- Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:
 - Site is comprised solely of C and D soils and/or bedrock at the land surface
 - M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
 - Solid Waste Landfill pursuant to 310 CMR 19.000
 - Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.
- Calculations showing that the infiltration BMPs will drain in 72 hours are provided.
- Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

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



Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

- The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.
- Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

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

- Good housekeeping practices;
 - Provisions for storing materials and waste products inside or under cover;
 - Vehicle washing controls;
 - Requirements for routine inspections and maintenance of stormwater BMPs;
 - Spill prevention and response plans;
 - Provisions for maintenance of lawns, gardens, and other landscaped areas;
 - Requirements for storage and use of fertilizers, herbicides, and pesticides;
 - Pet waste management provisions;
 - Provisions for operation and management of septic systems;
 - Provisions for solid waste management;
 - Snow disposal and plowing plans relative to Wetland Resource Areas;
 - Winter Road Salt and/or Sand Use and Storage restrictions;
 - Street sweeping schedules;
 - Provisions for prevention of illicit discharges to the stormwater management system;
 - Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
 - Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
 - List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.
- A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.
 - Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:
 - is within the Zone II or Interim Wellhead Protection Area
 - is near or to other critical areas
 - is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
 - involves runoff from land uses with higher potential pollutant loads.
 - The Required Water Quality Volume is reduced through use of the LID site Design Credits.
 - Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.



Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

- The BMP is sized (and calculations provided) based on:
 - The ½" or 1" Water Quality Volume or
 - The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.
- The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.
- A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

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

- The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.
- The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted **prior to** the discharge of stormwater to the post-construction stormwater BMPs.
- The NPDES Multi-Sector General Permit does **not** cover the land use.
- LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.
- All exposure has been eliminated.
- All exposure has **not** been eliminated and all BMPs selected are on MassDEP LUHPPL list.
- The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

- The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.
- Critical areas and BMPs are identified in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

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

- The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:
- Limited Project
 - Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
 - Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
 - Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
 - Bike Path and/or Foot Path
 - Redevelopment Project
 - Redevelopment portion of mix of new and redevelopment.
- Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.
- The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

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

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

- Narrative;
 - Construction Period Operation and Maintenance Plan;
 - Names of Persons or Entity Responsible for Plan Compliance;
 - Construction Period Pollution Prevention Measures;
 - Erosion and Sedimentation Control Plan Drawings;
 - Detail drawings and specifications for erosion control BMPs, including sizing calculations;
 - Vegetation Planning;
 - Site Development Plan;
 - Construction Sequencing Plan;
 - Sequencing of Erosion and Sedimentation Controls;
 - Operation and Maintenance of Erosion and Sedimentation Controls;
 - Inspection Schedule;
 - Maintenance Schedule;
 - Inspection and Maintenance Log Form.
- A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.



Checklist for Stormwater Report

Checklist (continued)

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

- The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- The project is **not** covered by a NPDES Construction General Permit.
- The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted **BEFORE** land disturbance begins.

Standard 9: Operation and Maintenance Plan

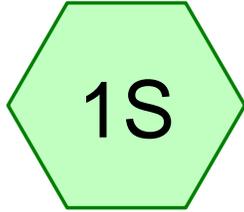
- The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
 - Name of the stormwater management system owners;
 - Party responsible for operation and maintenance;
 - Schedule for implementation of routine and non-routine maintenance tasks;
 - Plan showing the location of all stormwater BMPs maintenance access areas;
 - Description and delineation of public safety features;
 - Estimated operation and maintenance budget; and
 - Operation and Maintenance Log Form.
- The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
 - A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
 - A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

- The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- An Illicit Discharge Compliance Statement is attached;
- NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.

Appendix I

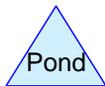
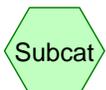
HydroCAD Output



NORTH TO ARLINGTON STREET



SOUTH TO WETLANDS



Drainage Diagram for SPRUCE CORNER - Pre-development
Prepared by FORESITE Engineering Associates, Inc. 7/7/2010
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SPRUCE CORNER - Pre-development

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Area Listing (all nodes)

<u>Area (sq-ft)</u>	<u>CN</u>	<u>Description (subcats)</u>
17,146	43	Woods/grass comb., Fair, HSG A (2S)
13,970	49	50-75% Grass cover, Fair, HSG A (1S,2S)
2,975	68	<50% Grass cover, Poor, HSG A (2S)
2,703	98	Paved parking & roofs (1S,2S)
<hr/>		
36,794		

SPRUCE CORNER - Pre-development

Type III 24-hr 2-yr Rainfall=3.20"

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Time span=6.00-28.00 hrs, dt=0.01 hrs, 2201 points

Runoff by SCS TR-20 method, UH=SCS

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

Subcatchment 1S: NORTH TO ARLINGTON STREET

Runoff Area=2,257 sf Runoff Depth=0.20"

Flow Length=50' Tc=2.6 min CN=53 Runoff=0.00 cfs 37 cf

Subcatchment 2S: SOUTH TO WETLANDS

Runoff Area=34,537 sf Runoff Depth=0.15"

Flow Length=275' Tc=6.2 min CN=51 Runoff=0.03 cfs 432 cf

Total Runoff Area = 36,794 sf Runoff Volume = 469 cf Average Runoff Depth = 0.15"

92.65% Pervious Area = 34,091 sf 7.35% Impervious Area = 2,703 sf

SPRUCE CORNER - Pre-development

Type III 24-hr 2-yr Rainfall=3.20"

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Subcatchment 1S: NORTH TO ARLINGTON STREET

Runoff = 0.00 cfs @ 12.33 hrs, Volume= 37 cf, Depth= 0.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 6.00-28.00 hrs, dt= 0.01 hrs

Type III 24-hr 2-yr Rainfall=3.20"

Area (sf)	CN	Description
2,056	49	50-75% Grass cover, Fair, HSG A
201	98	Paved parking & roofs
2,257	53	Weighted Average
2,056		Pervious Area
201		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	25	0.0400	0.17		Sheet Flow, TR-55 SHEET FLOW Grass: Short n= 0.150 P2= 3.20"
0.2	25	0.0700	1.85		Shallow Concentrated Flow, SH. CONC. UPLAND FLOW Short Grass Pasture Kv= 7.0 fps
2.6	50	Total			

Subcatchment 2S: SOUTH TO WETLANDS

Runoff = 0.03 cfs @ 12.44 hrs, Volume= 432 cf, Depth= 0.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 6.00-28.00 hrs, dt= 0.01 hrs

Type III 24-hr 2-yr Rainfall=3.20"

Area (sf)	CN	Description
17,146	43	Woods/grass comb., Fair, HSG A
11,914	49	50-75% Grass cover, Fair, HSG A
2,975	68	<50% Grass cover, Poor, HSG A
2,502	98	Paved parking & roofs
34,537	51	Weighted Average
32,035		Pervious Area
2,502		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	25	0.0300	0.15		Sheet Flow, TR-55 SHEET FLOW Grass: Short n= 0.150 P2= 3.20"
2.1	150	0.0300	1.21		Shallow Concentrated Flow, OVERLAND FLOW (GRASS) Short Grass Pasture Kv= 7.0 fps
1.4	100	0.0550	1.17		Shallow Concentrated Flow, OVERLAND FLOW (WOODS) Woodland Kv= 5.0 fps
6.2	275	Total			

SPRUCE CORNER - Pre-development

Type III 24-hr 10-yr Rainfall=4.50"

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Time span=6.00-28.00 hrs, dt=0.01 hrs, 2201 points

Runoff by SCS TR-20 method, UH=SCS

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

Subcatchment 1S: NORTH TO ARLINGTON STREET

Runoff Area=2,257 sf Runoff Depth=0.64"

Flow Length=50' Tc=2.6 min CN=53 Runoff=0.03 cfs 121 cf

Subcatchment 2S: SOUTH TO WETLANDS

Runoff Area=34,537 sf Runoff Depth=0.55"

Flow Length=275' Tc=6.2 min CN=51 Runoff=0.27 cfs 1,570 cf

Total Runoff Area = 36,794 sf Runoff Volume = 1,691 cf Average Runoff Depth = 0.55"

92.65% Pervious Area = 34,091 sf 7.35% Impervious Area = 2,703 sf

SPRUCE CORNER - Pre-development

Type III 24-hr 10-yr Rainfall=4.50"

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Subcatchment 1S: NORTH TO ARLINGTON STREET

Runoff = 0.03 cfs @ 12.07 hrs, Volume= 121 cf, Depth= 0.64"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 6.00-28.00 hrs, dt= 0.01 hrs

Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
2,056	49	50-75% Grass cover, Fair, HSG A
201	98	Paved parking & roofs
2,257	53	Weighted Average
2,056		Pervious Area
201		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	25	0.0400	0.17		Sheet Flow, TR-55 SHEET FLOW Grass: Short n= 0.150 P2= 3.20"
0.2	25	0.0700	1.85		Shallow Concentrated Flow, SH. CONC. UPLAND FLOW Short Grass Pasture Kv= 7.0 fps
2.6	50	Total			

Subcatchment 2S: SOUTH TO WETLANDS

Runoff = 0.27 cfs @ 12.13 hrs, Volume= 1,570 cf, Depth= 0.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 6.00-28.00 hrs, dt= 0.01 hrs

Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
17,146	43	Woods/grass comb., Fair, HSG A
11,914	49	50-75% Grass cover, Fair, HSG A
2,975	68	<50% Grass cover, Poor, HSG A
2,502	98	Paved parking & roofs
34,537	51	Weighted Average
32,035		Pervious Area
2,502		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	25	0.0300	0.15		Sheet Flow, TR-55 SHEET FLOW Grass: Short n= 0.150 P2= 3.20"
2.1	150	0.0300	1.21		Shallow Concentrated Flow, OVERLAND FLOW (GRASS) Short Grass Pasture Kv= 7.0 fps
1.4	100	0.0550	1.17		Shallow Concentrated Flow, OVERLAND FLOW (WOODS) Woodland Kv= 5.0 fps
6.2	275	Total			

SPRUCE CORNER - Pre-development

Type III 24-hr 25-yr Rainfall=5.30"

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Time span=6.00-28.00 hrs, dt=0.01 hrs, 2201 points

Runoff by SCS TR-20 method, UH=SCS

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

Subcatchment 1S: NORTH TO ARLINGTON STREET

Runoff Area=2,257 sf Runoff Depth=1.00"

Flow Length=50' Tc=2.6 min CN=53 Runoff=0.05 cfs 189 cf

Subcatchment 2S: SOUTH TO WETLANDS

Runoff Area=34,537 sf Runoff Depth=0.88"

Flow Length=275' Tc=6.2 min CN=51 Runoff=0.59 cfs 2,530 cf

Total Runoff Area = 36,794 sf Runoff Volume = 2,718 cf Average Runoff Depth = 0.89"

92.65% Pervious Area = 34,091 sf 7.35% Impervious Area = 2,703 sf

SPRUCE CORNER - Pre-development

Type III 24-hr 25-yr Rainfall=5.30"

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Subcatchment 1S: NORTH TO ARLINGTON STREET

Runoff = 0.05 cfs @ 12.06 hrs, Volume= 189 cf, Depth= 1.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 6.00-28.00 hrs, dt= 0.01 hrs

Type III 24-hr 25-yr Rainfall=5.30"

Area (sf)	CN	Description
2,056	49	50-75% Grass cover, Fair, HSG A
201	98	Paved parking & roofs
2,257	53	Weighted Average
2,056		Pervious Area
201		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	25	0.0400	0.17		Sheet Flow, TR-55 SHEET FLOW Grass: Short n= 0.150 P2= 3.20"
0.2	25	0.0700	1.85		Shallow Concentrated Flow, SH. CONC. UPLAND FLOW Short Grass Pasture Kv= 7.0 fps
2.6	50	Total			

Subcatchment 2S: SOUTH TO WETLANDS

Runoff = 0.59 cfs @ 12.12 hrs, Volume= 2,530 cf, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 6.00-28.00 hrs, dt= 0.01 hrs

Type III 24-hr 25-yr Rainfall=5.30"

Area (sf)	CN	Description
17,146	43	Woods/grass comb., Fair, HSG A
11,914	49	50-75% Grass cover, Fair, HSG A
2,975	68	<50% Grass cover, Poor, HSG A
2,502	98	Paved parking & roofs
34,537	51	Weighted Average
32,035		Pervious Area
2,502		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	25	0.0300	0.15		Sheet Flow, TR-55 SHEET FLOW Grass: Short n= 0.150 P2= 3.20"
2.1	150	0.0300	1.21		Shallow Concentrated Flow, OVERLAND FLOW (GRASS) Short Grass Pasture Kv= 7.0 fps
1.4	100	0.0550	1.17		Shallow Concentrated Flow, OVERLAND FLOW (WOODS) Woodland Kv= 5.0 fps
6.2	275	Total			

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Type III 24-hr 100-yr Rainfall=6.60"

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Time span=6.00-28.00 hrs, dt=0.01 hrs, 2201 points

Runoff by SCS TR-20 method, UH=SCS

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

Subcatchment 1S: NORTH TO ARLINGTON STREET

Runoff Area=2,257 sf Runoff Depth=1.70"

Flow Length=50' Tc=2.6 min CN=53 Runoff=0.10 cfs 320 cf

Subcatchment 2S: SOUTH TO WETLANDS

Runoff Area=34,537 sf Runoff Depth=1.53"

Flow Length=275' Tc=6.2 min CN=51 Runoff=1.22 cfs 4,409 cf

Total Runoff Area = 36,794 sf Runoff Volume = 4,729 cf Average Runoff Depth = 1.54"

92.65% Pervious Area = 34,091 sf 7.35% Impervious Area = 2,703 sf

SPRUCE CORNER - Pre-development

Type III 24-hr 100-yr Rainfall=6.60"

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Subcatchment 1S: NORTH TO ARLINGTON STREET

Runoff = 0.10 cfs @ 12.05 hrs, Volume= 320 cf, Depth= 1.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 6.00-28.00 hrs, dt= 0.01 hrs

Type III 24-hr 100-yr Rainfall=6.60"

Area (sf)	CN	Description
2,056	49	50-75% Grass cover, Fair, HSG A
201	98	Paved parking & roofs
2,257	53	Weighted Average
2,056		Pervious Area
201		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.4	25	0.0400	0.17		Sheet Flow, TR-55 SHEET FLOW Grass: Short n= 0.150 P2= 3.20"
0.2	25	0.0700	1.85		Shallow Concentrated Flow, SH. CONC. UPLAND FLOW Short Grass Pasture Kv= 7.0 fps
2.6	50	Total			

Subcatchment 2S: SOUTH TO WETLANDS

Runoff = 1.22 cfs @ 12.10 hrs, Volume= 4,409 cf, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 6.00-28.00 hrs, dt= 0.01 hrs

Type III 24-hr 100-yr Rainfall=6.60"

Area (sf)	CN	Description
17,146	43	Woods/grass comb., Fair, HSG A
11,914	49	50-75% Grass cover, Fair, HSG A
2,975	68	<50% Grass cover, Poor, HSG A
2,502	98	Paved parking & roofs
34,537	51	Weighted Average
32,035		Pervious Area
2,502		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	25	0.0300	0.15		Sheet Flow, TR-55 SHEET FLOW Grass: Short n= 0.150 P2= 3.20"
2.1	150	0.0300	1.21		Shallow Concentrated Flow, OVERLAND FLOW (GRASS) Short Grass Pasture Kv= 7.0 fps
1.4	100	0.0550	1.17		Shallow Concentrated Flow, OVERLAND FLOW (WOODS) Woodland Kv= 5.0 fps
6.2	275	Total			