

Hydrologic Report

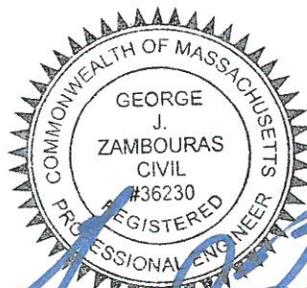
*Definitive Subdivision
Under Special Permit
Cluster Residential/Common Access Driveway
located at
47 1/2 – 57 Kimball Road
Amesbury, Massachusetts 01913*

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AMESBURY CITY CLERK

Prepared For

*BC Realty Trust
65 School Street
Merrimac, MA 01860*

25 & 100 Year Storm
24 Hour Duration



Date: January 17, 2015

Atlantic Engineering & Survey Consultants Inc.
97 Tenney Street, Georgetown, Massachusetts 01833
(978) 352-7870

TABLE OF CONTENTS

- I. INTRODUCTION
- II. EXISTING CONDITIONS
- III. PROPOSED CONDITIONS
- IV. SITE SOILS
- V. STORMWATER MANAGEMENT
- VI. TSS REMOVAL CALCULATIONS & STORMWATER CALCULATIONS
- VII. SUMMARY
- VIII. ASSUMPTIONS AND DESIGN CRITERIA
- IX. NRCS SOILS RESOURCE REPORT
- X. PRE-DEVELOPMENT CALCULATIONS
- XI. POST-DEVELOPMENT CALCULATIONS

INTRODUCTION:

This report describes the pre and post hydraulic analysis and stormwater management measures to be implemented to mitigate the impacts to the environment and surrounding properties in the development of the Special Permit, Cluster Residential/Common Access Driveway Definitive Subdivision located at 47 1/2 – 57 Kimball Road Amesbury, Massachusetts 01913

The design of the storm water system's components are based on the hydraulic analysis performed utilizing "HydroCAD Storm water Modeling Software" for storm events of 25 and 100-year storm frequencies in accordance with the Town of Amesbury's subdivision regulations and guidelines.

EXISTING CONDITIONS:

The site is located on the westerly side of Kimball Road east of Arcadia Kimball Road. The site encompasses 19.34 acres and is presently undeveloped except for the New England Power transmission lines which traverse the property in a southwest to northeast direction. The parcel is primarily wooded and contains a 5.65 acre wetland along the southerly border of the parcel.

PROPOSED CONDITIONS:

The proposed site development consists of the construction of an 8 lot Cluster Residential Common Access Driveway subdivision. The subdivisions residential lots and associated access driveway will utilize approximately 3 acres of the site leaving the remaining undeveloped 16.08 acres open space. In addition to the portion of the parcel utilized to develop the subdivision approximately 17,000 s.f. of the open space will be used for the construction of portions of the sites stormwater management facilities the remaining area will remain in its natural state.

The methods and components incorporated to manage stormwater are explained later in this report.

SITE SOILS:

Existing soils are comprised of Hinckley loamy sands, Sudbury fine sandy loams, and Scarboro mucky fine sandy loams as identified in the NRCS Soils Resource Report and Map appended to this analysis.

Soils within the portion of the property to be developed are of the Hinckley soil group. The Sudbury and Scarboro soil groups are located on the remaining open space and wetland portions of the property.

Soil testing was performed of the site in August 2014. A total of 5 test pits were analyzed and soils were found to be loamy sands with cobbles, consistent with the NRCS reported soils. With the exception of Test Pit #5 located adjacent to the wetland area no ground water was observed in any of the test pits.

Throughout this analysis infiltration rates are based using the Rawls infiltration rate of 2.41 inches per hour for Loamy Sands HSG A soils with the exception on the rain gardens calculations where 1.02 inches per hour is utilize to account for the amended planting soils.

STORMWATER MANAGEMENT:

In order to effectively manage the impacts of the development to the environment, to surrounding properties, to provide required re-charge of run-off and to minimize post construction maintenance conventional and LID stormwater management components were used.

To meet these goals the development's design incorporates roof infiltrations systems, driveway infiltrating trenches, water quality swales, sedimentation basins, sub-surface infiltration and rain gardens.

In order to capture and treat the access driveway and portions of the residential driveways runoff is directed to a settling basin and then passes into a water quality swale. Due the super-elevated design of the access driveway portions of the access driveway's run-off also flows directly into a roadside water quality swale. All run-off is then directed into the subsurface infiltration system. The remainder of the residential driveways are equipped with infiltrating trenches to mitigate the effects of the added impervious surface.

The roof infiltration systems are designed to capture 100% of the 100-year run-off. The roof infiltration calculation provided depicts the largest proposed dwelling and the infiltration unit size indicated in the calculations will be used for each lot.

TSS REMOVAL CALCULATION:

The BMP's proposed for the management of storm water enable the development to achieve TSS removal rate of 96% for the major sub-catchment area 3S and approximately 98% for the smaller sub-catchments 4S and 5S as identified below.

Sub-Catchment 3S

Location:

TSS Removal Calculation Worksheet	B	C	D	E	F
	BMP ¹	TSS Removal Rate	Starting TSS Load	Amount Removed (C*D)	Remaining Load (D-E)
	Street Sweeping - 5%	0.05	1.00	0.05	0.95
	Sediment Fore bay	0.25	0.95	0.24	0.71
	Water Quality Swale - Dry	0.70	0.71	0.50	0.21
	Infiltration Basin	0.80	0.21	0.17	0.04
Total TSS Removal =				96%	

Sub-Catchments 4S and 5S

Location:

TSS Removal Calculation Worksheet	B	C	D	E	F
	BMP ¹	TSS Removal Rate	Starting TSS Load	Amount Removed (C*D)	Remaining Load (D-E)
	Driveway Infiltration Trenches	0.80	1.00	0.80	0.20
	Rain Garden	0.09	0.20	0.18	0.02
Total TSS Removal =				98%	

STORM WATER RECHARGE CALCULATION:

Required Recharge Volume

The Required Recharge Volume (Rv) is calculated using the following formula:

$$Rv = F \times \text{Impervious Area}$$

Where Target Depth Factor F: F= 0.60 inch (for HSG A Soils)

Site Impervious Area = 30,679 square feet (4.860 acres)

Access Driveway and lot Driveways	= 18,035 square feet
Dwellings (Lot 1-8)	= <u>12,644 square feet</u>
Total Site Impervious	= 30,679 square feet

$$Rv = \{(0.60/12) \times 30,679\} = 1,534 \text{ cubic feet}$$

Site Recharge Volumes Provided: Static Method

Access Driveway Infiltration = 2,954 cubic feet

Roof Infiltration 8 units at 415 cubic feet/each = 3,320 cubic feet

Driveway Infiltration Units (5P=191, 6P=331, 7P=331, 8P=280) = 1,133 cubic feet =

Total Site Recharge Volumes Provided 7,407 cubic feet

The stormwater management system provides > 100% of the required recharge volume

SUMMARY:

The proposed stormwater management systems employed in the site's development provide for the removal of suspended solids and for the recharge of stormwater runoff thereby meeting DEP Stormwater Standards.

As indicated in the summary below the stormwater management system effectively mitigates the effects of the site's development by reducing peak runoff rates and volumes for the 25 and 100-year events.

<i>Summary of Site Discharge Flows and Volumes</i>				
<i>Design Storm</i>	<i>Max. Discharge (CFS.)</i>	<i>Max. Discharge (CFS.)</i>	<i>Max. Volume (Cubic-FT.)</i>	<i>Max. Volume (Cubic-FT.)</i>
	<i>Pre- Development.</i>	<i>Post- Development</i>	<i>Pre- Development.</i>	<i>Post- Development</i>
<i>25 Yr.</i>	<i>0.01</i>	<i>0.00</i>	<i>295</i>	<i>0.0</i>
<i>100 Yr.</i>	<i>0.06</i>	<i>0.04</i>	<i>1,795</i>	<i>235</i>

Assumptions:

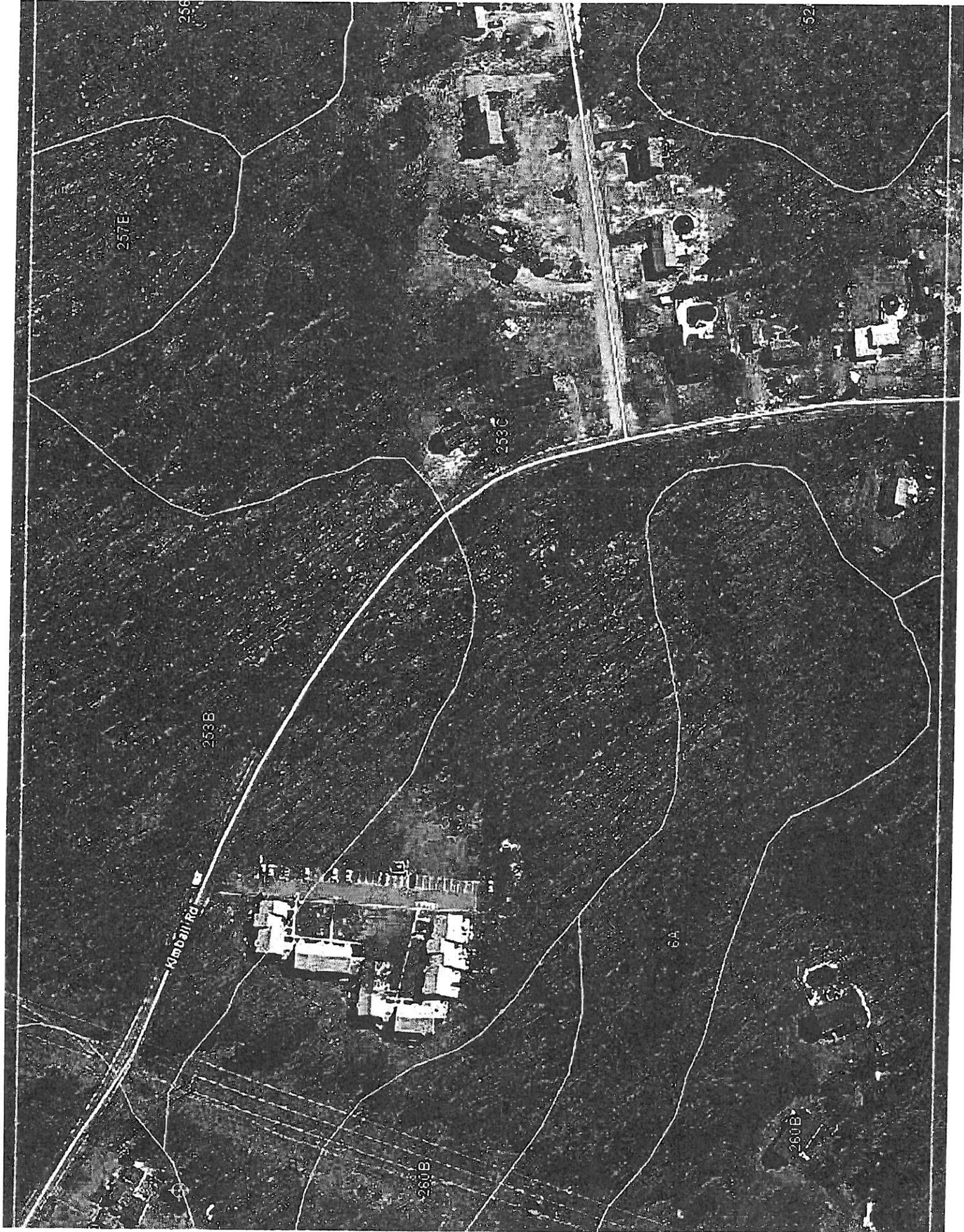
The following assumptions are being used for design purposes:

- 1) *25 & 100 year storm frequency.*
- 2) *24 hour storm duration (min.)*
- 3) *Hydro logic soils groups for the run-off areas are classified class as "A" – loamy sands.*
- 4) *Existing and proposed Cn values are as noted in the report.*
- 5) *Within small drainage areas a minimum Tc value of 6 min. is used.*
- 6) *Exfiltration rate based on applicable Rawls rates of 2.41 and 1.02 in/hr.*

Design Criteria:

- 1) *Run-off quantities are calculated using TR-20 intensity numbers*
- 2) *$I = 3.1$ for 2 yr / 24 hr. duration , 5.3 in./25 yr. & 6.5 in./100 yr.*
- 3) *Proposed Cn values are as noted in the report.*
- 4) *Hyetograph shape = S.C.S.III (eastern U.S.)*
- 5) *The maximum flow rate of run-off for the 2, 25 & 100 yr. design storms which are routed thru drainage system will be equal or less than pre-development run-off.*

NRCS SOILS RESOURCE REPORT



MAP LEGEND

- Area of Interest (AOI)
- Soils**
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points
- 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
- Water Features**
- Streams and Canals
- Transportation**
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads
- Background**
- Aerial Photography
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features**

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 9, Dec 17, 2013

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

Date(s) aerial images were photographed: Jun 20, 2010—May 1, 2011

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

Map Unit Legend

Essex County, Massachusetts, Northern Part (MA605)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
6A	Scarboro mucky fine sandy loam, 0 to 1 percent slopes	6.1	11.3%
52A	Freetown muck, 0 to 1 percent slopes	3.4	6.3%
253B	Hinckley loamy sand, 3 to 8 percent slopes	7.7	14.4%
253C	Hinckley loamy sand, 8 to 15 percent slopes	21.2	39.6%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	2.8	5.2%
257E	Hinckley and Windsor loamy sands, steep	1.5	2.8%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	8.7	16.3%
306D	Paxton fine sandy loam, 15 to 25 percent slopes, very stony	2.2	4.1%
Totals for Area of Interest		53.6	100.0%

Essex County, Massachusetts, Northern Part

253C—Hinckley loamy sand, 8 to 15 percent slopes

Map Unit Setting

Elevation: 0 to 1,000 feet

Mean annual precipitation: 45 to 54 inches

Mean annual air temperature: 43 to 54 degrees F

Frost-free period: 145 to 240 days

Map Unit Composition

Hinckley and similar soils: 80 percent

Minor components: 20 percent

Description of Hinckley

Setting

Landform: Terraces, drainageways, kames

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope, riser

Down-slope shape: Linear

Across-slope shape: Convex

Parent material: Loose sandy and gravelly glaciofluvial deposits

Typical profile

O - 0 to 1 inches: , muck

H2 - 1 to 8 inches: very strongly acid, loamy sand

H3 - 8 to 20 inches: very strongly acid, very gravelly loamy sand

H4 - 20 to 60 inches: very strongly acid, stratified cobbly coarse sand
to very gravelly loamy fine sand

Properties and qualities

Slope: 8 to 15 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Excessively drained

Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Farmland classification: Not prime farmland

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 4s

Hydrologic Soil Group: A

Minor Components

Windsor

Percent of map unit: 15 percent

Carver

Percent of map unit: 2 percent

Sudbury

Percent of map unit: 1 percent

Swansea

Percent of map unit: 1 percent

Landform: Bogs

Wareham

Percent of map unit: 1 percent

Landform: Terraces

Data Source Information

Soil Survey Area: Essex County, Massachusetts, Northern Part

Survey Area Data: Version 9, Dec 17, 2013

Essex County, Massachusetts, Northern Part

253B—Hinckley loamy sand, 3 to 8 percent slopes

Map Unit Setting

Elevation: 0 to 1,000 feet

Mean annual precipitation: 45 to 54 inches

Mean annual air temperature: 43 to 54 degrees F

Frost-free period: 145 to 240 days

Map Unit Composition

Hinckley and similar soils: 80 percent

Minor components: 20 percent

Description of Hinckley

Setting

Landform: Deltas on terraces, outwash plains on terraces

Landform position (two-dimensional): Shoulder, footslope

Landform position (three-dimensional): Tread

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Loose sandy and gravelly glaciofluvial deposits

Typical profile

O - 0 to 1 inches: , muck

H2 - 1 to 8 inches: very strongly acid, loamy sand

H3 - 8 to 20 inches: very strongly acid, very gravelly loamy sand

H4 - 20 to 60 inches: very strongly acid, stratified cobbly coarse sand
to very gravelly loamy fine sand

Properties and qualities

Slope: 3 to 8 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Excessively drained

Capacity of the most limiting layer to transmit water (Ksat): High to
very high (6.00 to 20.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Farmland classification: Farmland of statewide importance

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3s

Hydrologic Soil Group: A

Minor Components

Windsor

Percent of map unit: 12 percent

Sudbury

Percent of map unit: 3 percent

Carver

Percent of map unit: 2 percent

Wareham

Percent of map unit: 2 percent

Landform: Terraces

Swansea

Percent of map unit: 1 percent

Landform: Bogs

Data Source Information

Soil Survey Area: Essex County, Massachusetts, Northern Part

Survey Area Data: Version 9, Dec 17, 2013

Essex County, Massachusetts, Northern Part

6A—Scarboro mucky fine sandy loam, 0 to 1 percent slopes

Map Unit Setting

Elevation: 0 to 2,100 feet

Mean annual precipitation: 45 to 54 inches

Mean annual air temperature: 43 to 54 degrees F

Frost-free period: 145 to 240 days

Map Unit Composition

Scarboro and similar soils: 85 percent

Minor components: 15 percent

Description of Scarboro

Setting

Landform: Depressions, terraces

Landform position (two-dimensional): Toeslope

Landform position (three-dimensional): Dip

Down-slope shape: Concave

Across-slope shape: Concave

Parent material: Loose sandy glaciofluvial deposits derived from granite and gneiss

Typical profile

O - 0 to 6 inches: , muck

H2 - 6 to 11 inches: strongly acid, mucky fine sandy loam

H3 - 11 to 22 inches: strongly acid, loamy sand

H4 - 22 to 60 inches: strongly acid, stratified sand to fine sand to loamy sand

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches

Natural drainage class: Very poorly drained

Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)

Depth to water table: About 0 to 12 inches

Frequency of flooding: None

Frequency of ponding: Frequent

Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Farmland classification: Not prime farmland

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 5w

Hydrologic Soil Group: D

Minor Components

Wareham

Percent of map unit: 5 percent

Landform: Terraces

Freetown

Percent of map unit: 5 percent

Landform: Bogs

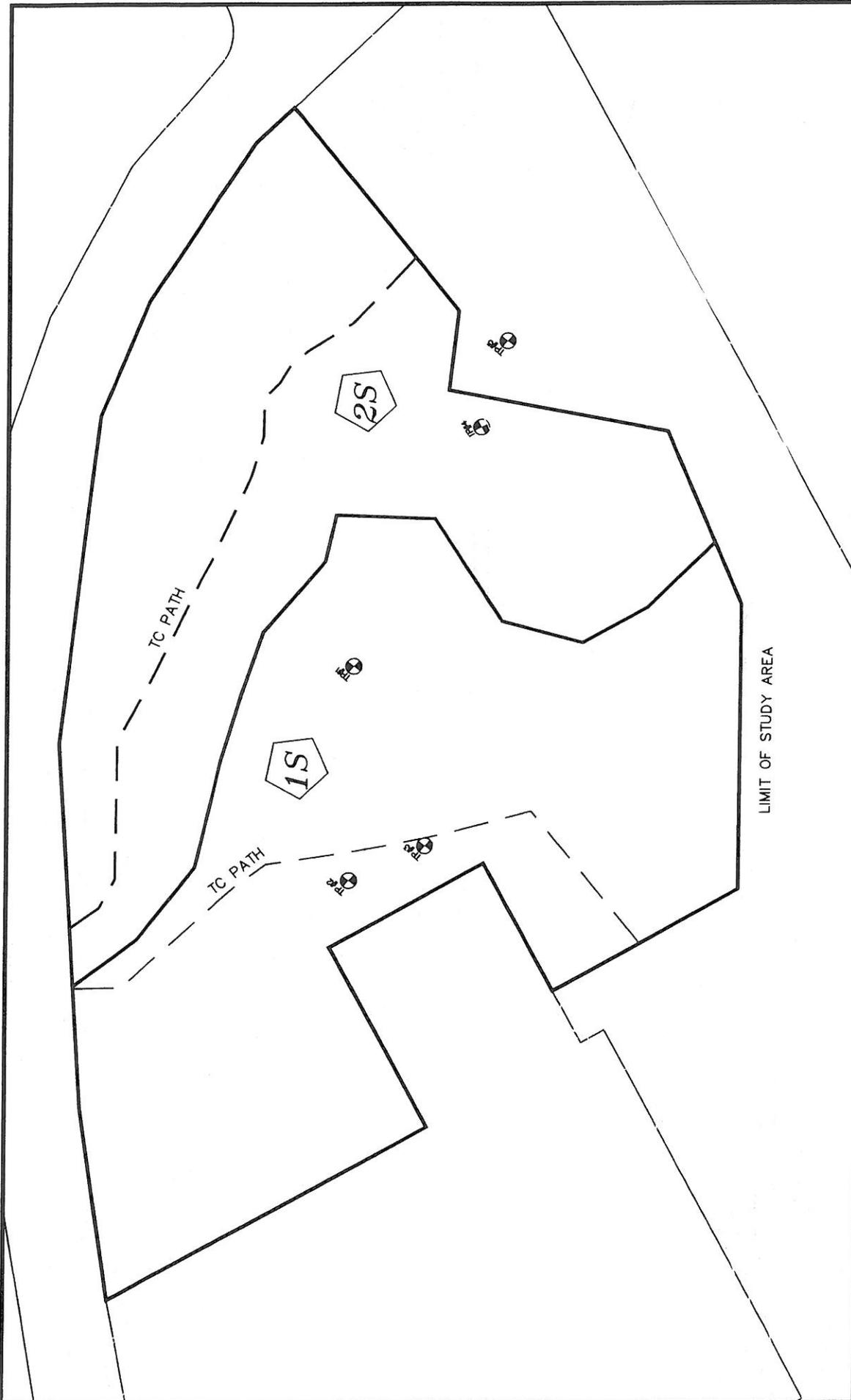
Deerfield

Percent of map unit: 5 percent

Data Source Information

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 9, Dec 17, 2013

PRE- DEVELOPMENT



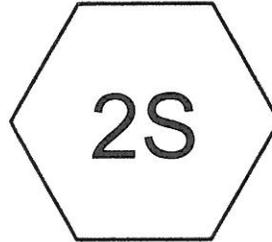
**PRE-DEVELOPMENT WATERSHED
DEFINITIVE SUBDIVISION
47.5-57 KIMBALL ROAD
AMESBURY, MASSACHUSETTS**

DATE: JANUARY 17, 2015 SCALE 1"=80'

ENGINEER:
ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.
 97 TENNEY STREET - GEORGETOWN, MA 01833
 PHONE: 978-352-7870 FAX: 978-352-9940



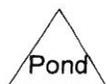
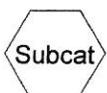
Area 1E



Area 2E



TOTAL EXIST



Routing Diagram for KIMBAL

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KIMBAL

Prepared by Atlantic Engineering & Survey Consultants Inc.

HydroCAD® 10.00 s/n 05086 © 2012 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
158,596	30	Woods, Good, HSG A (1S, 2S)
158,596	30	TOTAL AREA

KIMBAL

47.5 - 57 Kimball - Pre Development
Type III 24-hr 25-Year Rainfall=5.40"

Prepared by Atlantic Engineering & Survey Consultants Inc.

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Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points

Runoff by SCS TR-20 method, UH=SCS

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

Subcatchment 1S: Area 1E

Runoff Area=85,895 sf 0.00% Impervious Runoff Depth=0.02"
Flow Length=381' Tc=23.0 min CN=30 Runoff=0.01 cfs 160 cf

Subcatchment 2S: Area 2E

Runoff Area=72,701 sf 0.00% Impervious Runoff Depth=0.02"
Flow Length=444' Tc=18.0 min CN=30 Runoff=0.01 cfs 135 cf

Link 5L: TOTAL EXIST

Inflow=0.01 cfs 295 cf
Primary=0.01 cfs 295 cf

Total Runoff Area = 158,596 sf Runoff Volume = 295 cf Average Runoff Depth = 0.02"
100.00% Pervious = 158,596 sf 0.00% Impervious = 0 sf

KIMBAL

Summary for Subcatchment 2S: Area 2E

Runoff = 0.01 cfs @ 21.78 hrs, Volume= 135 cf, Depth= 0.02"

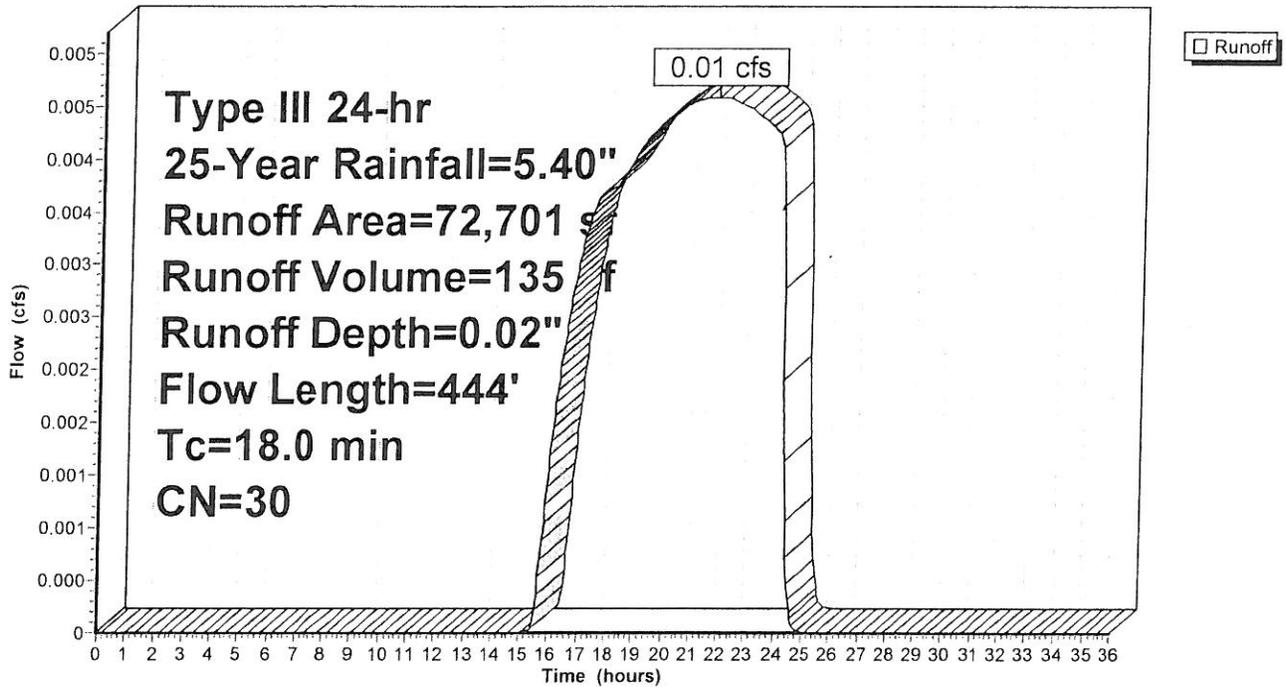
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
72,701	30	Woods, Good, HSG A
72,701		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0300	0.08		Sheet Flow, Sheet 1 Woods: Light underbrush n= 0.400 P2= 3.10"
5.0	164	0.0120	0.55		Shallow Concentrated Flow, SEC 1 Woodland Kv= 5.0 fps
0.7	90	0.1800	2.12		Shallow Concentrated Flow, SEC 2 Woodland Kv= 5.0 fps
1.6	140	0.0800	1.41		Shallow Concentrated Flow, SEC 3 Woodland Kv= 5.0 fps
18.0	444	Total			

Subcatchment 2S: Area 2E

Hydrograph



KIMBAL

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Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points

Runoff by SCS TR-20 method, UH=SCS

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

Subcatchment 1S: Area 1E

Runoff Area=85,895 sf 0.00% Impervious Runoff Depth=0.13"
Flow Length=381' Tc=23.0 min CN=30 Runoff=0.03 cfs 956 cf

Subcatchment 2S: Area 2E

Runoff Area=72,701 sf 0.00% Impervious Runoff Depth=0.13"
Flow Length=444' Tc=18.0 min CN=30 Runoff=0.03 cfs 809 cf

Link 5L: TOTAL EXIST

Inflow=0.06 cfs 1,765 cf
Primary=0.06 cfs 1,765 cf

Total Runoff Area = 158,596 sf Runoff Volume = 1,765 cf Average Runoff Depth = 0.13"
100.00% Pervious = 158,596 sf 0.00% Impervious = 0 sf

KIMBAL

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Summary for Subcatchment 2S: Area 2E

Runoff = 0.03 cfs @ 15.10 hrs, Volume= 809 cf, Depth= 0.13"

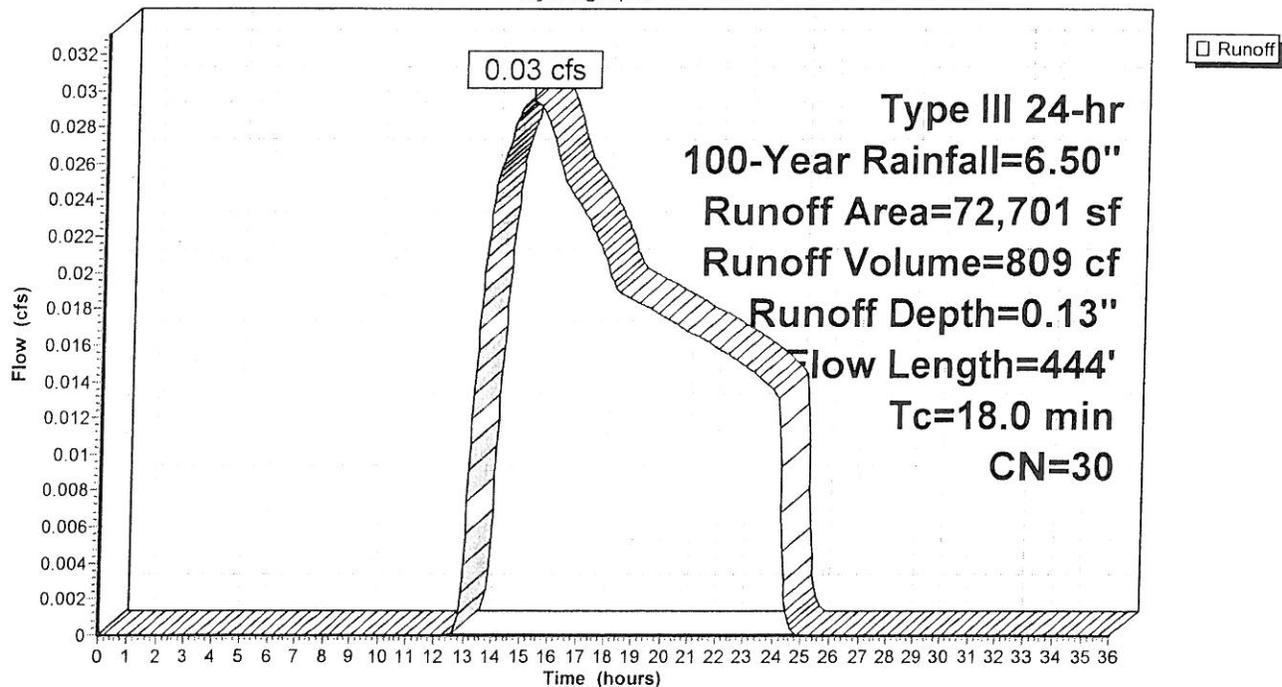
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
72,701	30	Woods, Good, HSG A
72,701		100.00% Pervious Area

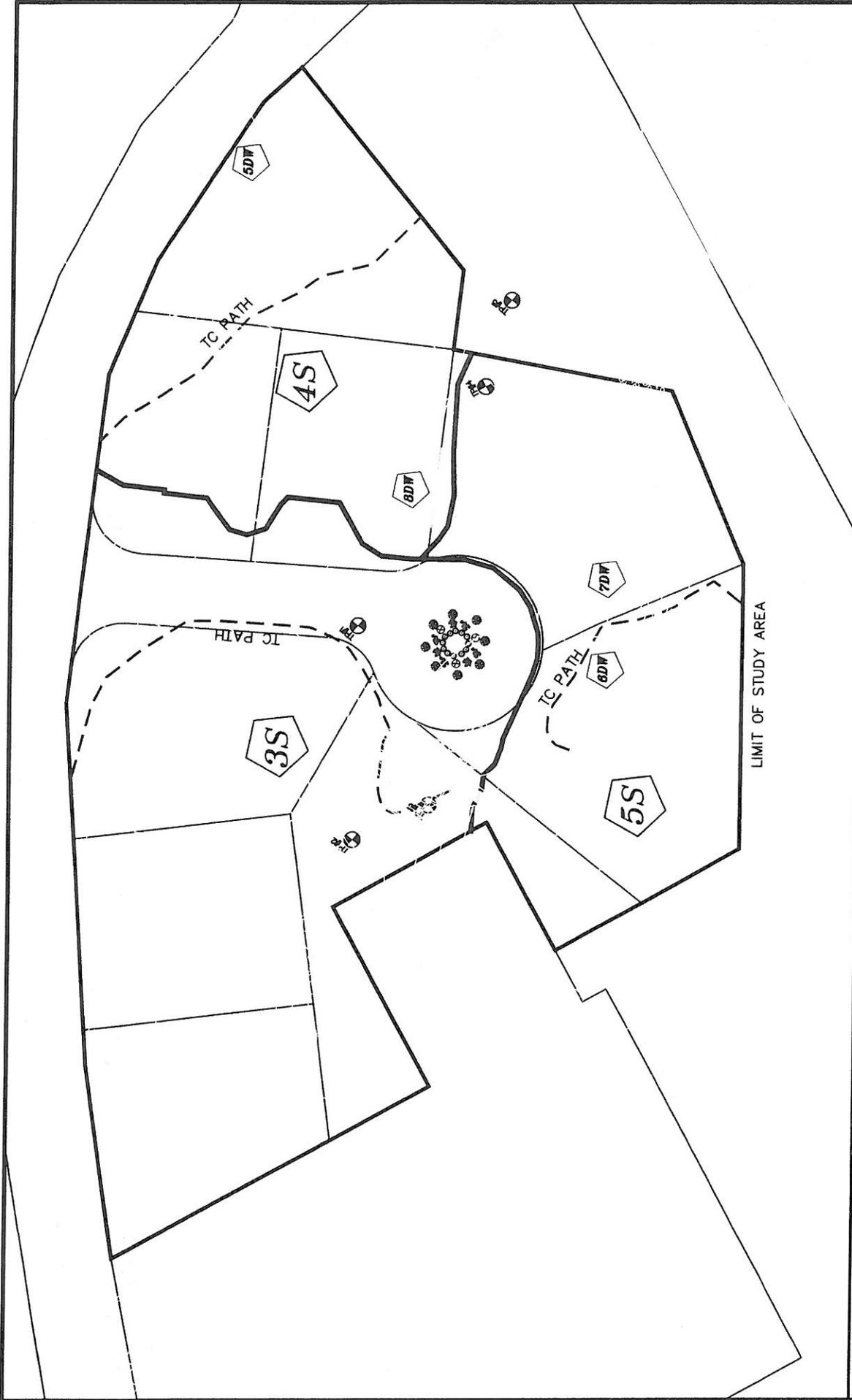
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.7	50	0.0300	0.08		Sheet Flow, Sheet 1 Woods: Light underbrush n= 0.400 P2= 3.10"
5.0	164	0.0120	0.55		Shallow Concentrated Flow, SEC 1 Woodland Kv= 5.0 fps
0.7	90	0.1800	2.12		Shallow Concentrated Flow, SEC 2 Woodland Kv= 5.0 fps
1.6	140	0.0800	1.41		Shallow Concentrated Flow, SEC 3 Woodland Kv= 5.0 fps
18.0	444	Total			

Subcatchment 2S: Area 2E

Hydrograph



POST DEVELOPMENT

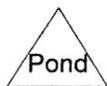
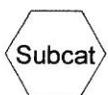
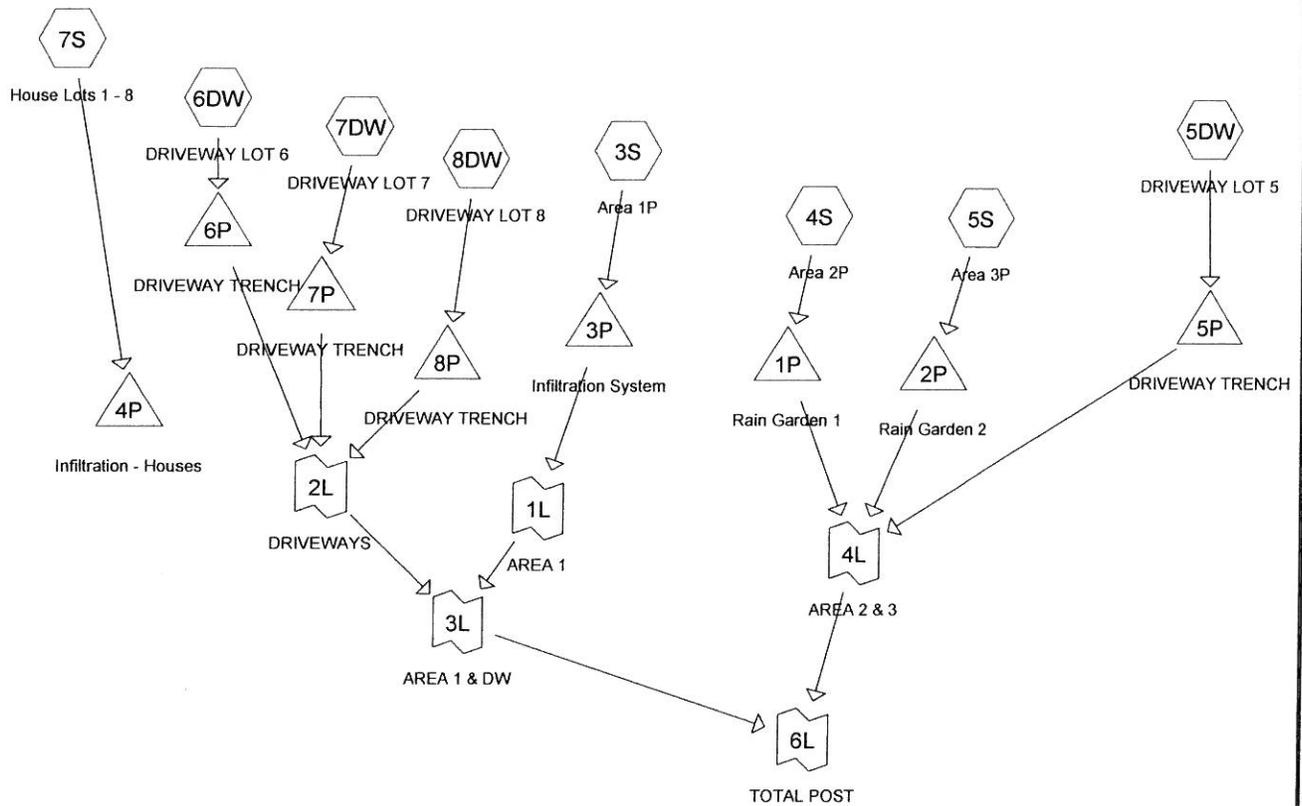


POST-DEVELOPMENT WATERSHED
DEFINITIVE SUBDIVISION
47.5-57 KIMBALL ROAD
AMESBURY, MASSACHUSETTS

DATE: JANUARY 17, 2015 SCALE 1"=80'

ENGINEER:

ATLANTIC ENGINEERING & SURVEY CONSULTANTS INC.
 97 TENNEY STREET - GEORGETOWN, MA 01833
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Routing Diagram for KIMBAL

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KIMBAL

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HydroCAD® 10.00 s/n 05086 © 2012 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
98,632	39	>75% Grass cover, Good, HSG A (3S, 4S, 5S)
1,521	32	Landscape, Good, HSG A (3S)
18,035	98	Paved parking, HSG A (3S, 4S, 5DW, 6DW, 7DW, 8DW)
1,653	98	Roofs, HSG A (7S)
4,560	98	Water Surface, HSG A (3S)
23,574	30	Woods, Good, HSG A (3S, 4S, 5S)
147,975	47	TOTAL AREA

KIMBAL

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 3S: Area 1P Runoff Area=74,422 sf 24.10% Impervious Runoff Depth=0.99"
Flow Length=373' Tc=19.1 min CN=52 Runoff=1.04 cfs 6,127 cf

Subcatchment 4S: Area 2P Runoff Area=31,603 sf 0.41% Impervious Runoff Depth=0.21"
Flow Length=229' Tc=11.2 min CN=37 Runoff=0.02 cfs 551 cf

Subcatchment 5DW: DRIVEWAY LOT 5 Runoff Area=887 sf 100.00% Impervious Runoff Depth=5.16"
Tc=6.0 min CN=98 Runoff=0.11 cfs 382 cf

Subcatchment 5S: Area 3P Runoff Area=35,764 sf 0.00% Impervious Runoff Depth=0.17"
Flow Length=177' Tc=11.8 min CN=36 Runoff=0.02 cfs 517 cf

Subcatchment 6DW: DRIVEWAY LOT 6 Runoff Area=1,183 sf 100.00% Impervious Runoff Depth=5.16"
Tc=6.0 min CN=98 Runoff=0.14 cfs 509 cf

Subcatchment 7DW: DRIVEWAY LOT 7 Runoff Area=1,376 sf 100.00% Impervious Runoff Depth=5.16"
Tc=6.0 min CN=98 Runoff=0.16 cfs 592 cf

Subcatchment 7S: House Lots 1 - 8 Runoff Area=1,653 sf 100.00% Impervious Runoff Depth=5.16"
Tc=6.0 min CN=98 Runoff=0.20 cfs 711 cf

Subcatchment 8DW: DRIVEWAY LOT 8 Runoff Area=1,087 sf 100.00% Impervious Runoff Depth=5.16"
Tc=6.0 min CN=98 Runoff=0.13 cfs 468 cf

Pond 1P: Rain Garden 1 Peak Elev=124.11' Storage=147 cf Inflow=0.02 cfs 551 cf
Discarded=0.01 cfs 551 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 551 cf

Pond 2P: Rain Garden 2 Peak Elev=118.52' Storage=124 cf Inflow=0.02 cfs 517 cf
Discarded=0.01 cfs 517 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 517 cf

Pond 3P: Infiltration System Peak Elev=122.67' Storage=2,678 cf Inflow=1.04 cfs 6,127 cf
Discarded=0.11 cfs 6,127 cf Primary=0.00 cfs 0 cf Outflow=0.11 cfs 6,127 cf

Pond 4P: Infiltration - Houses Peak Elev=122.36' Storage=305 cf Inflow=0.20 cfs 711 cf
Outflow=0.01 cfs 711 cf

Pond 5P: DRIVEWAY TRENCH Peak Elev=129.07' Storage=175 cf Inflow=0.11 cfs 382 cf
Discarded=0.01 cfs 382 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 382 cf

Pond 6P: DRIVEWAY TRENCH Peak Elev=102.12' Storage=195 cf Inflow=0.14 cfs 509 cf
Discarded=0.01 cfs 509 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 509 cf

Pond 7P: DRIVEWAY TRENCH Peak Elev=102.78' Storage=243 cf Inflow=0.16 cfs 592 cf
Discarded=0.01 cfs 592 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 592 cf

Pond 8P: DRIVEWAY TRENCH Peak Elev=124.59' Storage=167 cf Inflow=0.13 cfs 468 cf
Discarded=0.01 cfs 468 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 468 cf

Link 1L: AREA 1 Inflow=0.00 cfs 0 cf
Primary=0.00 cfs 0 cf

Summary for Subcatchment 3S: Area 1P

Areas of proposed houses for all Lots are calculated separately for Roof Infiltration sizing. Refer to Sub-Catchment 7S and Pond 4P.

Runoff = 1.04 cfs @ 12.33 hrs, Volume= 6,127 cf, Depth= 0.99"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
49,980	39	>75% Grass cover, Good, HSG A
4,988	30	Woods, Good, HSG A
4,560	98	Water Surface, HSG A
* 4,744	98	Paved parking, HSG A
8,629	98	Paved parking, HSG A
* 1,521	32	Landscape, Good, HSG A
74,422	52	Weighted Average
56,489		75.90% Pervious Area
17,933		24.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	50	0.0150	0.06		Sheet Flow, LAWN Grass: Bermuda n= 0.410 P2= 3.10"
0.7	83	0.0700	1.85		Shallow Concentrated Flow, LAWN Short Grass Pasture Kv= 7.0 fps
1.2	124	0.0560	1.66		Shallow Concentrated Flow, SWALE 1 Short Grass Pasture Kv= 7.0 fps
2.9	116	0.0020	0.67		Shallow Concentrated Flow, SWALE 2 Grassed Waterway Kv= 15.0 fps
19.1	373	Total			

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Summary for Subcatchment 4S: Area 2P

Areas of proposed houses for all Lots are calculated separately for Roof Infiltration sizing. Refer to Sub-Catchment 7S and Pond 4P.

Areas of driveway for Lots 5 & 8 are calculated separately for Infiltration Trench sizing. Refer to sub-catchments 5DW and 8DW and Ponds 5P & 1P.

Runoff = 0.02 cfs @ 12.57 hrs, Volume= 551 cf, Depth= 0.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
24,998	39	>75% Grass cover, Good, HSG A
129	98	Paved parking, HSG A
6,476	30	Woods, Good, HSG A
31,603	37	Weighted Average
31,474		99.59% Pervious Area
129		0.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.7	50	0.0400	0.09		Sheet Flow, LAWN Grass: Bermuda n= 0.410 P2= 3.10"
0.7	90	0.0880	2.08		Shallow Concentrated Flow, LAWN Short Grass Pasture Kv= 7.0 fps
0.3	42	0.1200	2.42		Shallow Concentrated Flow, LAWN Short Grass Pasture Kv= 7.0 fps
0.5	47	0.1200	1.73		Shallow Concentrated Flow, WOODS Woodland Kv= 5.0 fps
11.2	229	Total			

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Summary for Subcatchment 5DW: DRIVEWAY LOT 5

Runoff = 0.11 cfs @ 12.09 hrs, Volume= 382 cf, Depth= 5.16"

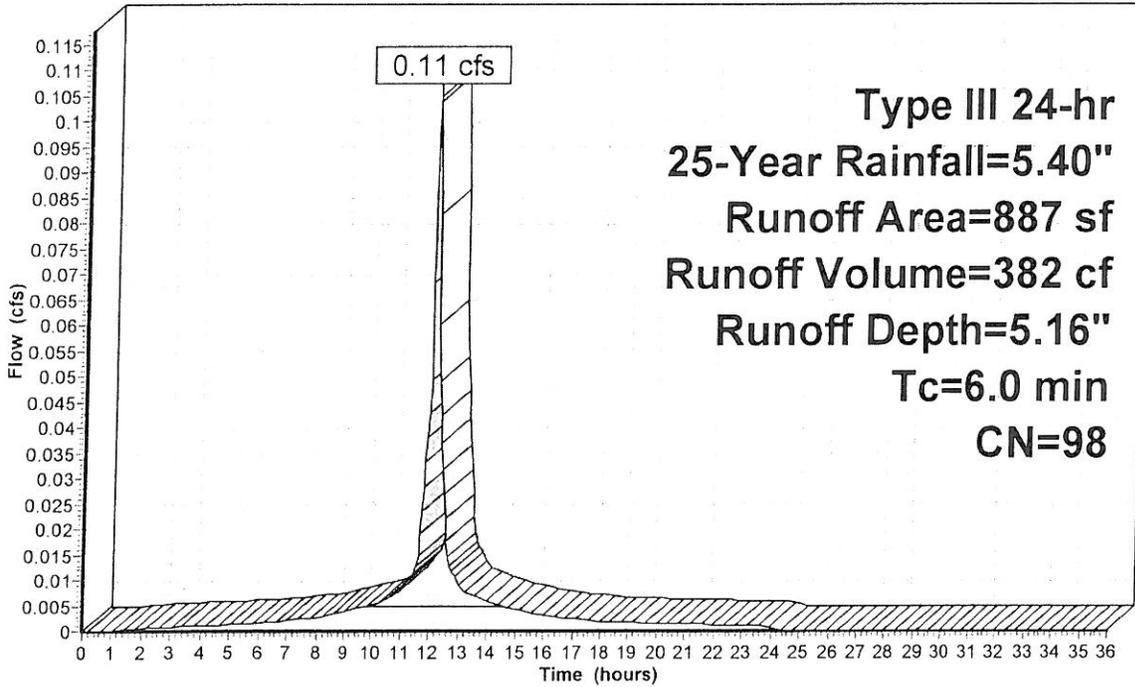
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
887	98	Paved parking, HSG A
887		100.00% Impervious Area

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

Subcatchment 5DW: DRIVEWAY LOT 5

Hydrograph



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Summary for Subcatchment 6DW: DRIVEWAY LOT 6

Runoff = 0.14 cfs @ 12.09 hrs, Volume= 509 cf, Depth= 5.16"

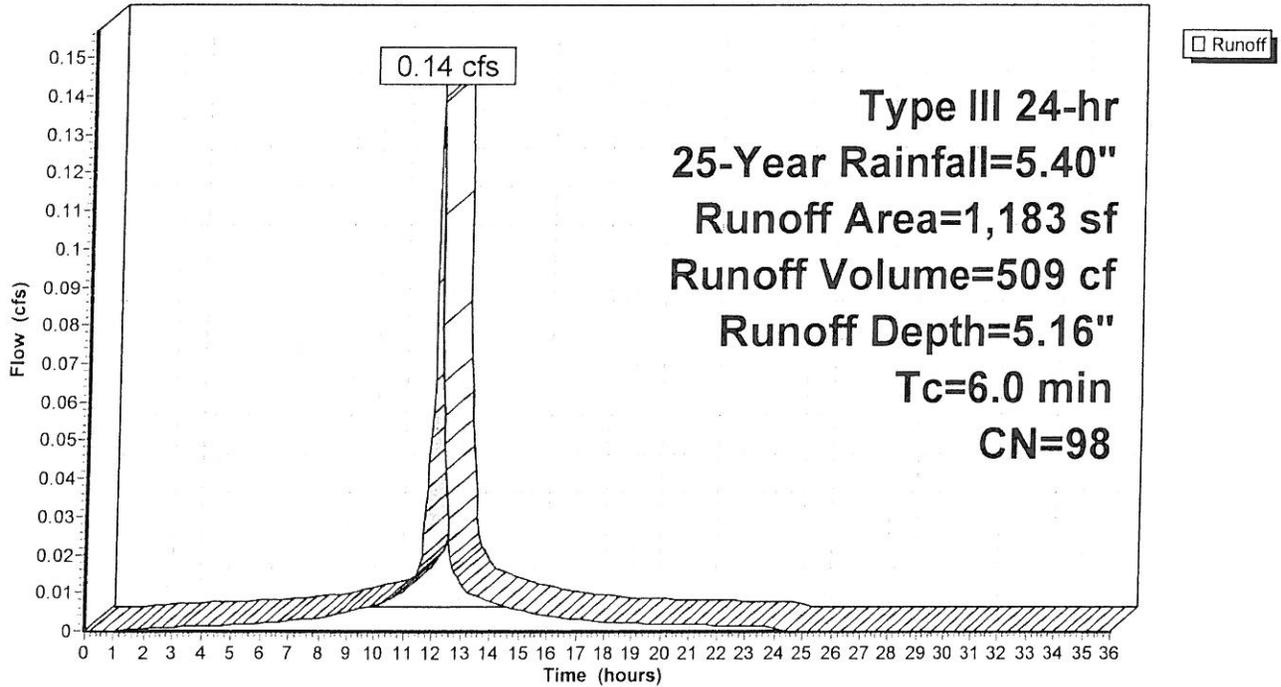
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
1,183	98	Paved parking, HSG A
1,183		100.00% Impervious Area

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

Subcatchment 6DW: DRIVEWAY LOT 6

Hydrograph



Summary for Subcatchment 7S: House Lots 1 - 8

Area of maximum proposed house size for all Lots is used to determine Roof Infiltration sizing for 100-Year Storm Event.

Maximum House footprint = 1,653 s.f.

Total House Impervious fro entire site = 12,644 s.f.

Runoff = 0.20 cfs @ 12.09 hrs, Volume= 711 cf, Depth= 5.16"

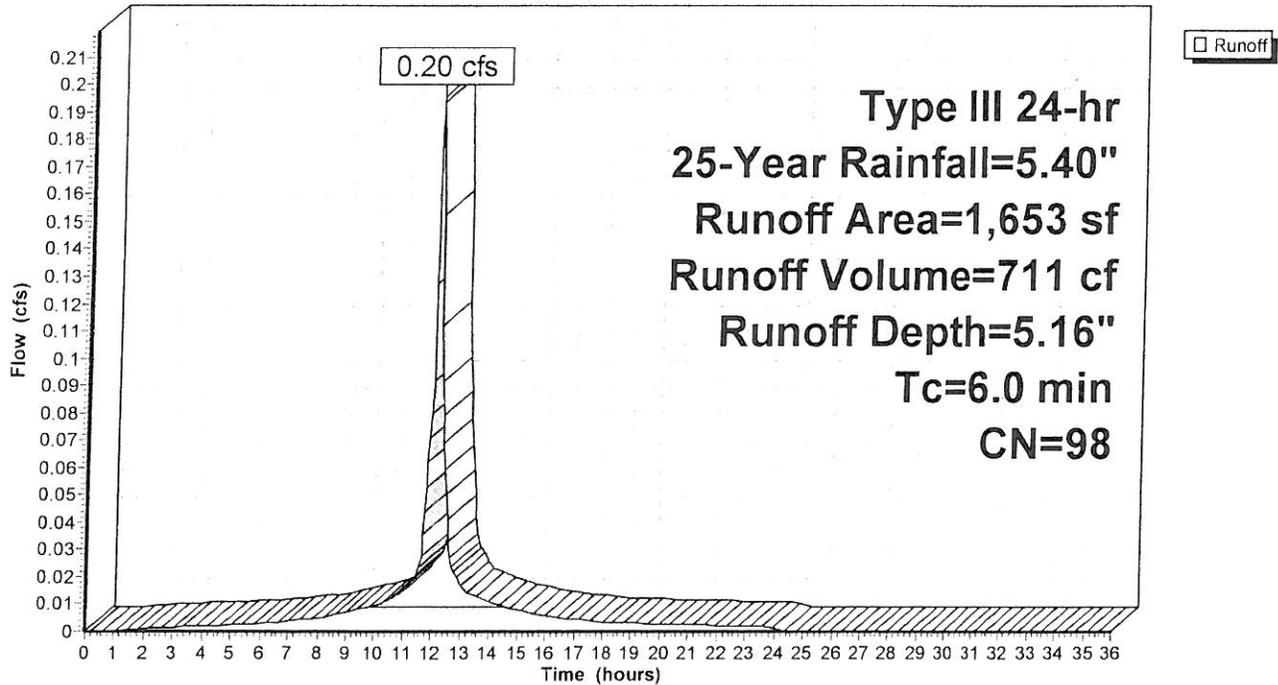
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
1,653	98	Roofs, HSG A
1,653		100.00% Impervious Area

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

Subcatchment 7S: House Lots 1 - 8

Hydrograph



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Summary for Pond 1P: Rain Garden 1

Inflow Area = 31,603 sf, 0.41% Impervious, Inflow Depth = 0.21" for 25-Year event
 Inflow = 0.02 cfs @ 12.57 hrs, Volume= 551 cf
 Outflow = 0.01 cfs @ 17.81 hrs, Volume= 551 cf, Atten= 52%, Lag= 314.2 min
 Discarded = 0.01 cfs @ 17.81 hrs, Volume= 551 cf
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 124.11' @ 17.81 hrs Surf.Area= 281 sf Storage= 147 cf

Plug-Flow detention time= 160.8 min calculated for 550 cf (100% of inflow)
 Center-of-Mass det. time= 160.9 min (1,178.8 - 1,018.0)

Volume	Invert	Avail.Storage	Storage Description			
#1	123.50'	564 cf	Custom Stage Data (Irregular) Listed below (Recalc)			
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
123.50	206	60.0	0	0	206	
125.25	455	82.0	564	564	484	

Device	Routing	Invert	Outlet Devices										
#1	Primary	125.10'	5.0' long x 1.0' breadth Broad-Crested Rectangular Weir										
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00										
			Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32										
#2	Discarded	123.50'	1.750 in/hr Exfiltration over Surface area										

Discarded OutFlow Max=0.01 cfs @ 17.81 hrs HW=124.11' (Free Discharge)
 ↳2=Exfiltration (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=123.50' (Free Discharge)
 ↳1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

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Summary for Pond 2P: Rain Garden 2

Inflow Area = 35,764 sf, 0.00% Impervious, Inflow Depth = 0.17" for 25-Year event
 Inflow = 0.02 cfs @ 13.81 hrs, Volume= 517 cf
 Outflow = 0.01 cfs @ 17.98 hrs, Volume= 517 cf, Atten= 44%, Lag= 250.6 min
 Discarded = 0.01 cfs @ 17.98 hrs, Volume= 517 cf
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 118.52' @ 17.98 hrs Surf.Area= 270 sf Storage= 124 cf

Plug-Flow detention time= 139.8 min calculated for 516 cf (100% of inflow)
 Center-of-Mass det. time= 139.8 min (1,174.9 - 1,035.1)

Volume	Invert	Avail.Storage	Storage Description			
#1	118.00'	564 cf	Custom Stage Data (Irregular) Listed below (Recalc)			
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
118.00	206	60.0	0	0	206	
119.75	455	82.0	564	564	484	

Device	Routing	Invert	Outlet Devices										
#1	Primary	119.60'	5.0' long x 1.0' breadth Broad-Crested Rectangular Weir										
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00										
			2.50 3.00										
			Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31										
			3.30 3.31 3.32										
#2	Discarded	118.00'	1.750 in/hr Exfiltration over Surface area										

Discarded OutFlow Max=0.01 cfs @ 17.98 hrs HW=118.52' (Free Discharge)
 ↖2=Exfiltration (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=118.00' (Free Discharge)
 ↖1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

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Summary for Pond 3P: Infiltration System

Inflow Area = 74,422 sf, 24.10% Impervious, Inflow Depth = 0.99" for 25-Year event
 Inflow = 1.04 cfs @ 12.33 hrs, Volume= 6,127 cf
 Outflow = 0.11 cfs @ 12.10 hrs, Volume= 6,127 cf, Atten= 89%, Lag= 0.0 min
 Discarded = 0.11 cfs @ 12.10 hrs, Volume= 6,127 cf
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 122.67' @ 16.07 hrs Surf.Area= 2,012 sf Storage= 2,678 cf

Plug-Flow detention time= 267.7 min calculated for 6,118 cf (100% of inflow)
 Center-of-Mass det. time= 267.6 min (1,176.7 - 909.1)

Volume	Invert	Avail.Storage	Storage Description
#1	124.50'	5,243 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#2	123.00'	8 cf	4.00'D x 1.50'H Vertical Cone/Cylinder 19 cf Overall x 40.0% Voids
#3A	120.47'	1,439 cf	37.25'W x 54.00'L x 2.54'H Field A 5,113 cf Overall - 1,515 cf Embedded = 3,597 cf x 40.0% Voids
#4A	120.97'	1,515 cf	Cultec R-150XLHD x 55 Inside #3 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 11 rows
		8,205 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
124.50	160	56.0	0	0	160
125.00	1,094	277.0	279	279	6,017
126.00	2,093	309.0	1,567	1,845	7,538
127.00	4,898	303.0	3,398	5,243	7,961

Device	Routing	Invert	Outlet Devices
#1	Primary	126.50'	5.0' long x 2.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#2	Discarded	120.47'	2.410 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.11 cfs @ 12.10 hrs HW=120.54' (Free Discharge)
 ↳2=Exfiltration (Exfiltration Controls 0.11 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=120.47' (Free Discharge)
 ↳1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

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Summary for Pond 4P: Infiltration - Houses

Inflow Area = 1,653 sf, 100.00% Impervious, Inflow Depth = 5.16" for 25-Year event
 Inflow = 0.20 cfs @ 12.09 hrs, Volume= 711 cf
 Outflow = 0.01 cfs @ 10.40 hrs, Volume= 711 cf, Atten= 94%, Lag= 0.0 min
 Discarded = 0.01 cfs @ 10.40 hrs, Volume= 711 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 122.36' @ 13.93 hrs Surf.Area= 195 sf Storage= 305 cf

Plug-Flow detention time= 223.9 min calculated for 711 cf (100% of inflow)
 Center-of-Mass det. time= 223.8 min (970.6 - 746.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	120.00'	184 cf	11.17'W x 17.50'L x 3.54'H Field A 692 cf Overall - 231 cf Embedded = 461 cf x 40.0% Voids
#2A	120.50'	231 cf	Cultec R-330XL x 4 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 2 rows
		415 cf	Total Available Storage

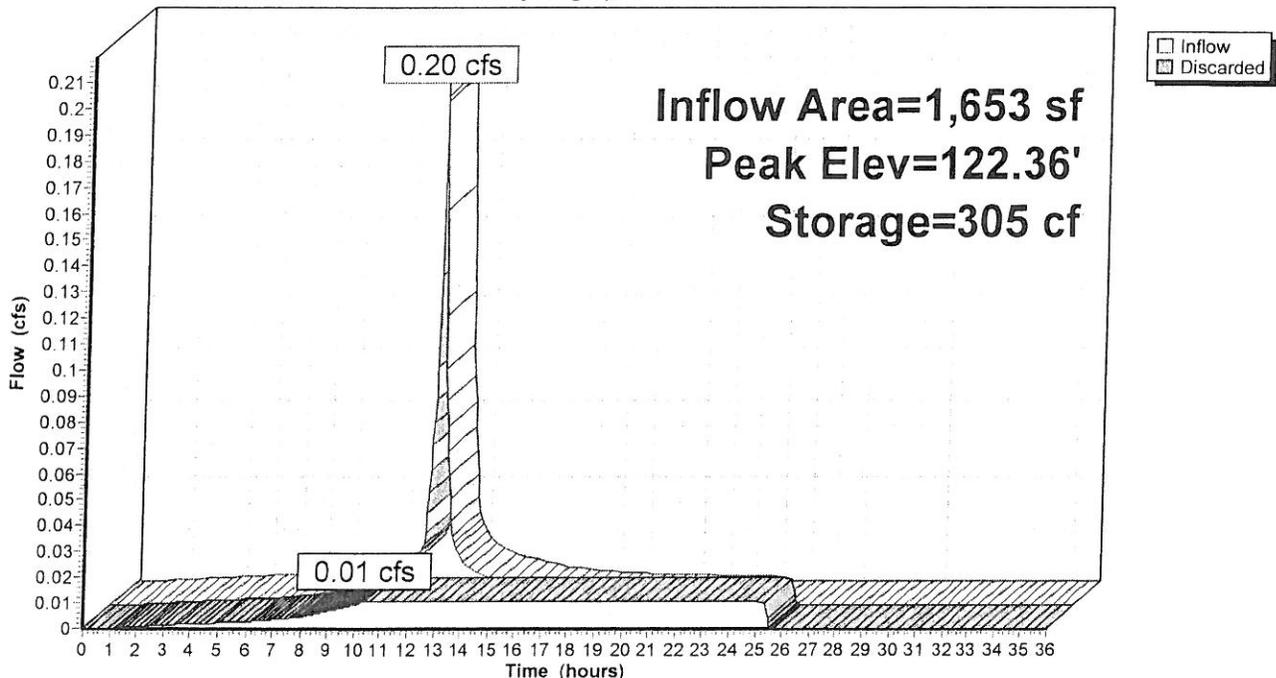
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	120.00'	2.410 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.01 cfs @ 10.40 hrs HW=120.04' (Free Discharge)
 1=Exfiltration (Exfiltration Controls 0.01 cfs)

Pond 4P: Infiltration - Houses

Hydrograph

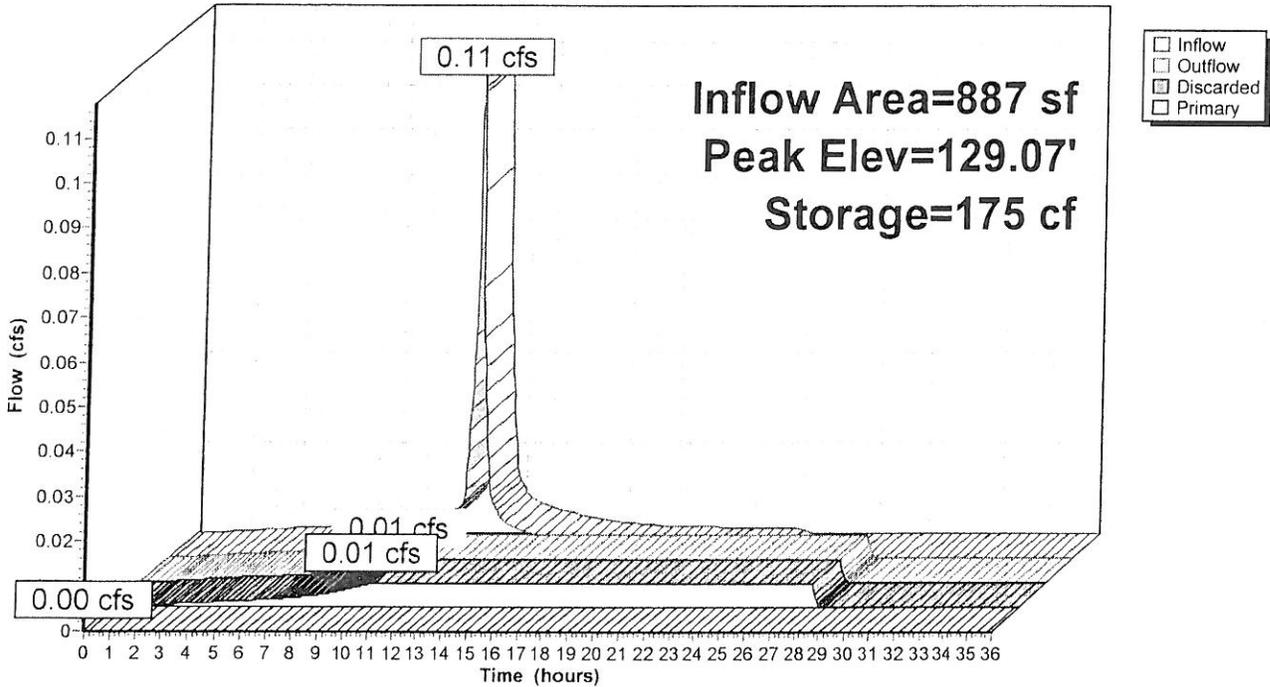


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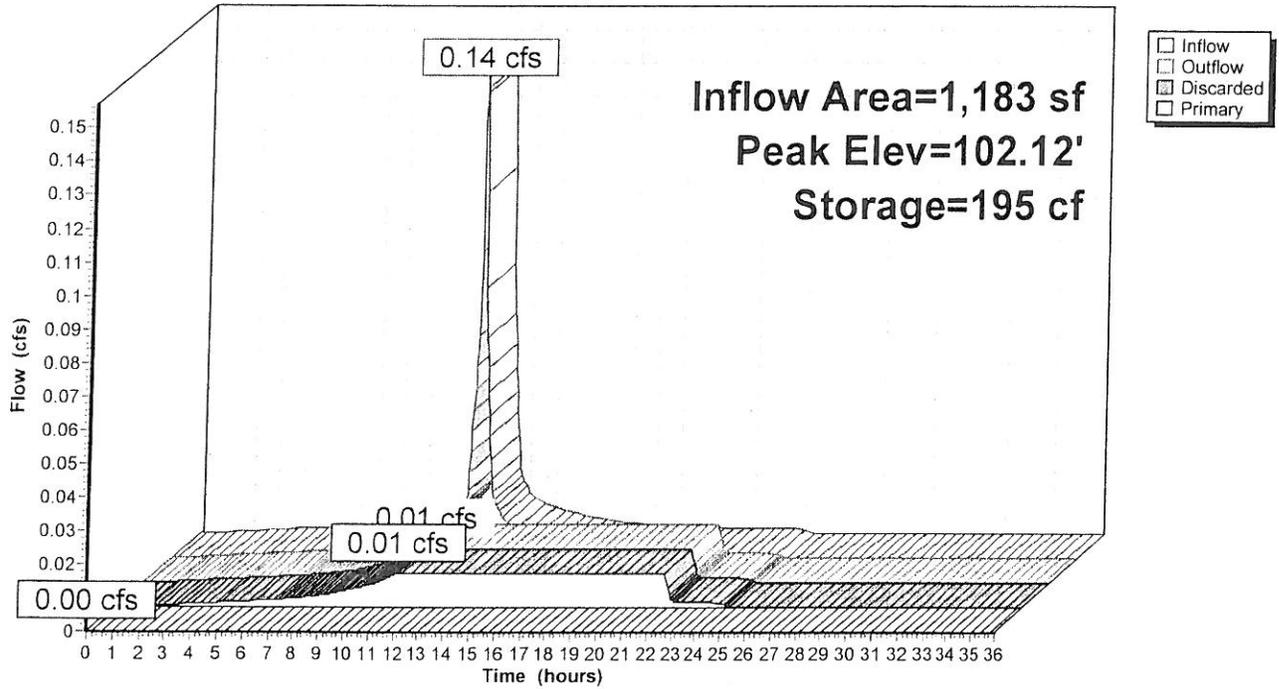
Pond 5P: DRIVEWAY TRENCH

Hydrograph



Pond 6P: DRIVEWAY TRENCH

Hydrograph

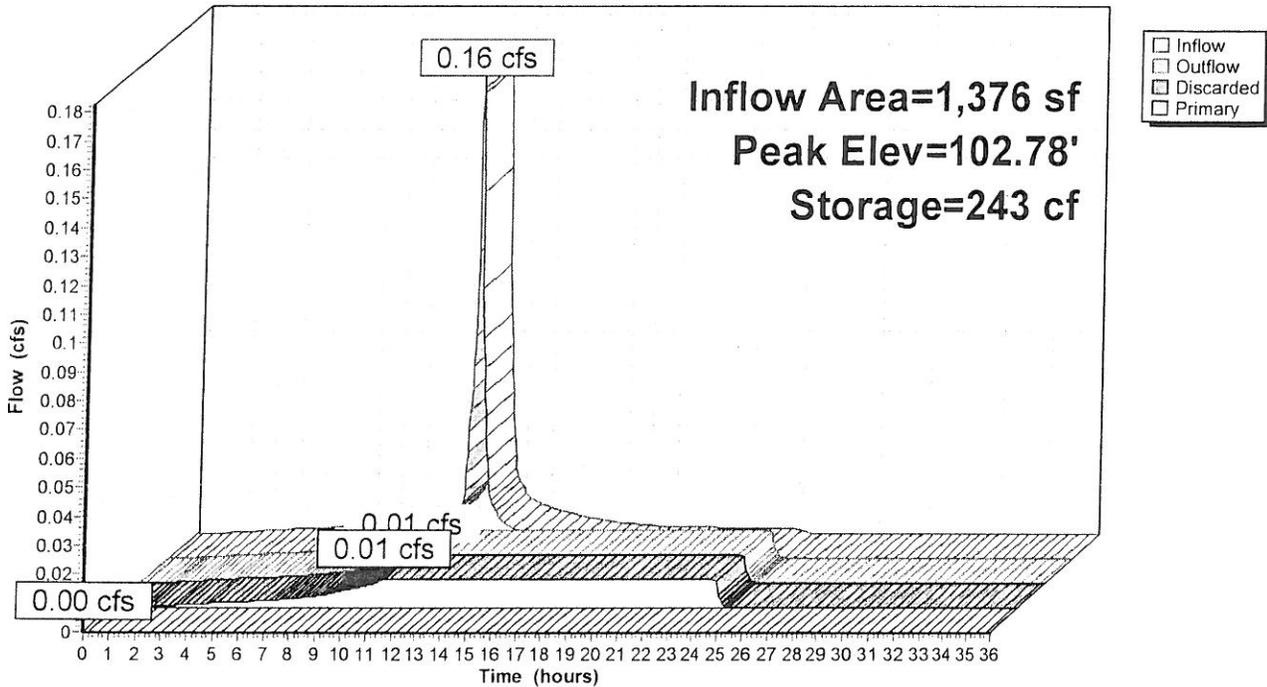


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Pond 7P: DRIVEWAY TRENCH

Hydrograph

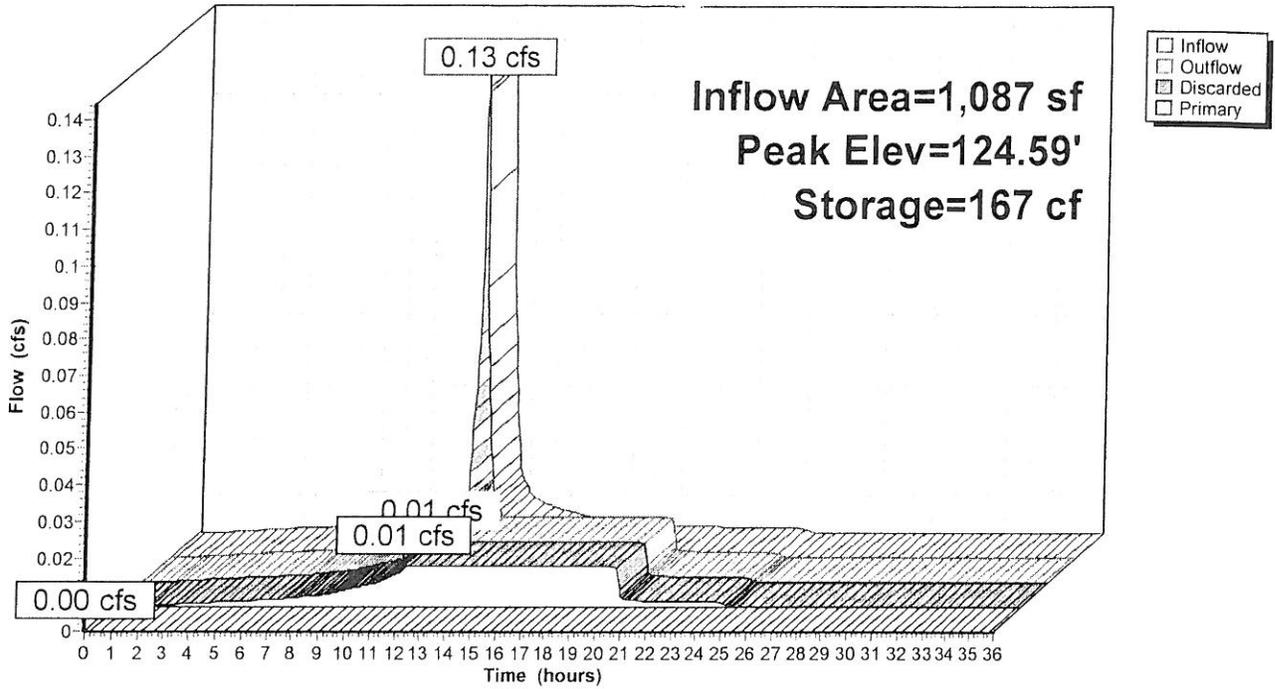


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Pond 8P: DRIVEWAY TRENCH

Hydrograph



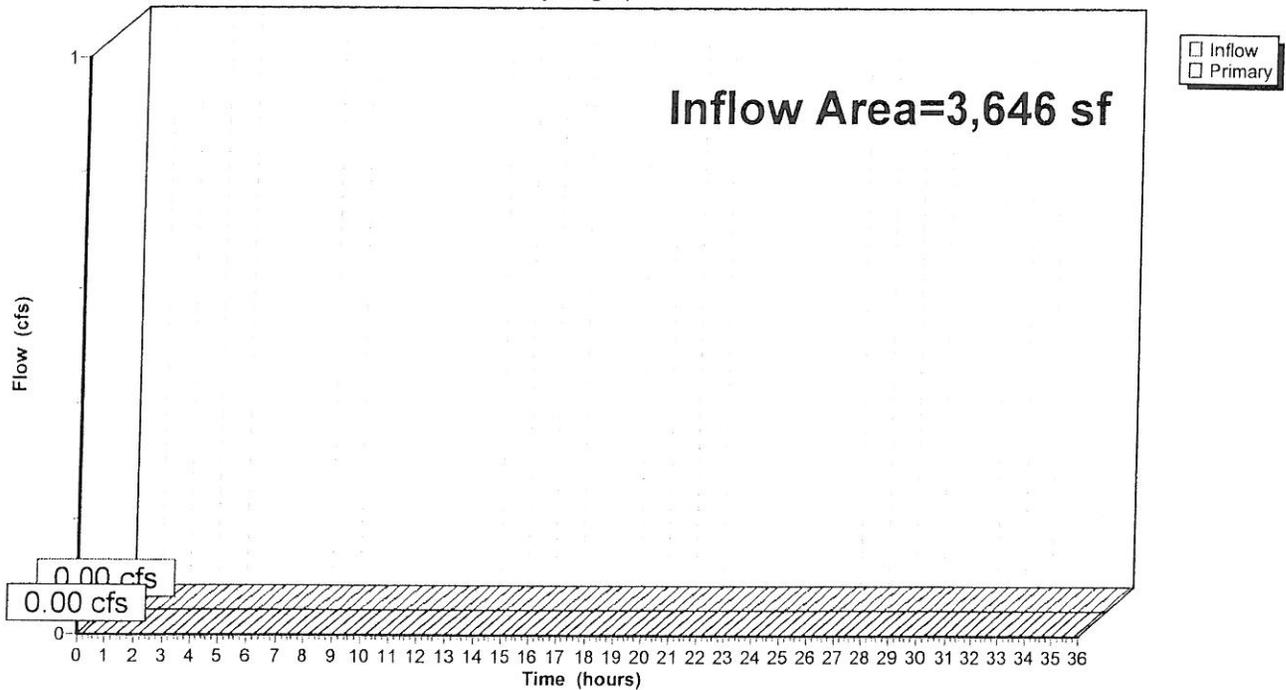
Summary for Link 2L: DRIVEWAYS

Inflow Area = 3,646 sf, 100.00% Impervious, Inflow Depth = 0.00" for 25-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Link 2L: DRIVEWAYS

Hydrograph



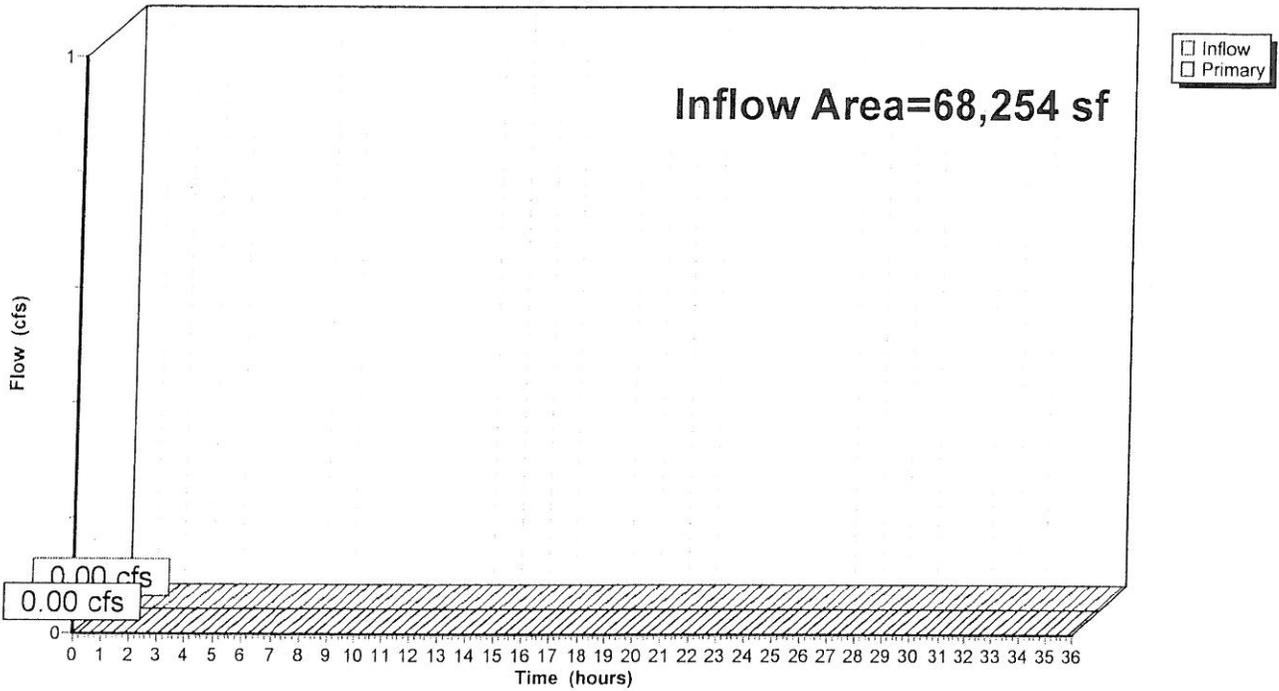
Summary for Link 4L: AREA 2 & 3

Inflow Area = 68,254 sf, 1.49% Impervious, Inflow Depth = 0.00" for 25-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Link 4L: AREA 2 & 3

Hydrograph



KIMBAL47.5 - 57 Kimball - Post Development
Type III 24-hr 100-Year Rainfall=6.50"Prepared by Atlantic Engineering & Survey Consultants Inc.
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Page 36

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment3S: Area 1P	Runoff Area=74,422 sf 24.10% Impervious Runoff Depth=1.56" Flow Length=373' Tc=19.1 min CN=52 Runoff=1.85 cfs 9,674 cf
Subcatchment4S: Area 2P	Runoff Area=31,603 sf 0.41% Impervious Runoff Depth=0.48" Flow Length=229' Tc=11.2 min CN=37 Runoff=0.13 cfs 1,253 cf
Subcatchment5DW: DRIVEWAY LOT 5	Runoff Area=887 sf 100.00% Impervious Runoff Depth=6.26" Tc=6.0 min CN=98 Runoff=0.13 cfs 463 cf
Subcatchment5S: Area 3P	Runoff Area=35,764 sf 0.00% Impervious Runoff Depth=0.42" Flow Length=177' Tc=11.8 min CN=36 Runoff=0.11 cfs 1,247 cf
Subcatchment6DW: DRIVEWAY LOT 6	Runoff Area=1,183 sf 100.00% Impervious Runoff Depth=6.26" Tc=6.0 min CN=98 Runoff=0.17 cfs 617 cf
Subcatchment7DW: DRIVEWAY LOT 7	Runoff Area=1,376 sf 100.00% Impervious Runoff Depth=6.26" Tc=6.0 min CN=98 Runoff=0.20 cfs 718 cf
Subcatchment7S: House Lots 1 - 8	Runoff Area=1,653 sf 100.00% Impervious Runoff Depth=6.26" Tc=6.0 min CN=98 Runoff=0.24 cfs 863 cf
Subcatchment8DW: DRIVEWAY LOT 8	Runoff Area=1,087 sf 100.00% Impervious Runoff Depth=6.26" Tc=6.0 min CN=98 Runoff=0.16 cfs 567 cf
Pond 1P: Rain Garden 1	Peak Elev=125.11' Storage=502 cf Inflow=0.13 cfs 1,253 cf Discarded=0.02 cfs 1,166 cf Primary=0.02 cfs 87 cf Outflow=0.03 cfs 1,253 cf
Pond 2P: Rain Garden 2	Peak Elev=119.61' Storage=502 cf Inflow=0.11 cfs 1,247 cf Discarded=0.02 cfs 1,170 cf Primary=0.01 cfs 77 cf Outflow=0.03 cfs 1,247 cf
Pond 3P: Infiltration System	Peak Elev=125.75' Storage=4,322 cf Inflow=1.85 cfs 9,674 cf Discarded=0.21 cfs 9,674 cf Primary=0.00 cfs 0 cf Outflow=0.21 cfs 9,674 cf
Pond 4P: Infiltration - Houses	Peak Elev=123.36' Storage=401 cf Inflow=0.24 cfs 863 cf Outflow=0.01 cfs 863 cf
Pond 5P: DRIVEWAY TRENCH	Peak Elev=129.51' Storage=191 cf Inflow=0.13 cfs 463 cf Discarded=0.01 cfs 423 cf Primary=0.04 cfs 71 cf Outflow=0.04 cfs 495 cf
Pond 6P: DRIVEWAY TRENCH	Peak Elev=102.97' Storage=256 cf Inflow=0.17 cfs 617 cf Discarded=0.01 cfs 617 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 617 cf
Pond 7P: DRIVEWAY TRENCH	Peak Elev=103.84' Storage=319 cf Inflow=0.20 cfs 718 cf Discarded=0.01 cfs 718 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 718 cf
Pond 8P: DRIVEWAY TRENCH	Peak Elev=125.20' Storage=218 cf Inflow=0.16 cfs 567 cf Discarded=0.01 cfs 567 cf Primary=0.00 cfs 0 cf Outflow=0.01 cfs 567 cf
Link 1L: AREA 1	Inflow=0.00 cfs 0 cf Primary=0.00 cfs 0 cf

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Summary for Subcatchment 3S: Area 1P

Areas of proposed houses for all Lots are calculated separately for Roof Infiltration sizing. Refer to Sub-Catchment 7S and Pond 4P.

Runoff = 1.85 cfs @ 12.31 hrs, Volume= 9,674 cf, Depth= 1.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
49,980	39	>75% Grass cover, Good, HSG A
4,988	30	Woods, Good, HSG A
4,560	98	Water Surface, HSG A
* 4,744	98	Paved parking, HSG A
8,629	98	Paved parking, HSG A
* 1,521	32	Landscape, Good, HSG A
74,422	52	Weighted Average
56,489		75.90% Pervious Area
17,933		24.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	50	0.0150	0.06		Sheet Flow, LAWN Grass: Bermuda n= 0.410 P2= 3.10"
0.7	83	0.0700	1.85		Shallow Concentrated Flow, LAWN Short Grass Pasture Kv= 7.0 fps
1.2	124	0.0560	1.66		Shallow Concentrated Flow, SWALE 1 Short Grass Pasture Kv= 7.0 fps
2.9	116	0.0020	0.67		Shallow Concentrated Flow, SWALE 2 Grassed Waterway Kv= 15.0 fps
19.1	373	Total			

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Summary for Subcatchment 4S: Area 2P

Areas of proposed houses for all Lots are calculated separately for Roof Infiltration sizing. Refer to Sub-Catchment 7S and Pond 4P.

Areas of driveway for Lots 5 & 8 are calculated separately for Infiltration Trench sizing. Refer to sub-catchments 5DW and 8DW and Ponds 5P & 1P.

Runoff = 0.13 cfs @ 12.43 hrs, Volume= 1,253 cf, Depth= 0.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
24,998	39	>75% Grass cover, Good, HSG A
129	98	Paved parking, HSG A
6,476	30	Woods, Good, HSG A
31,603	37	Weighted Average
31,474		99.59% Pervious Area
129		0.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.7	50	0.0400	0.09		Sheet Flow, LAWN Grass: Bermuda n= 0.410 P2= 3.10"
0.7	90	0.0880	2.08		Shallow Concentrated Flow, LAWN Short Grass Pasture Kv= 7.0 fps
0.3	42	0.1200	2.42		Shallow Concentrated Flow, LAWN Short Grass Pasture Kv= 7.0 fps
0.5	47	0.1200	1.73		Shallow Concentrated Flow, WOODS Woodland Kv= 5.0 fps
11.2	229	Total			

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Type III 24-hr 100-Year Rainfall=6.50"

Summary for Subcatchment 5DW: DRIVEWAY LOT 5

Runoff = 0.13 cfs @ 12.09 hrs, Volume= 463 cf, Depth= 6.26"

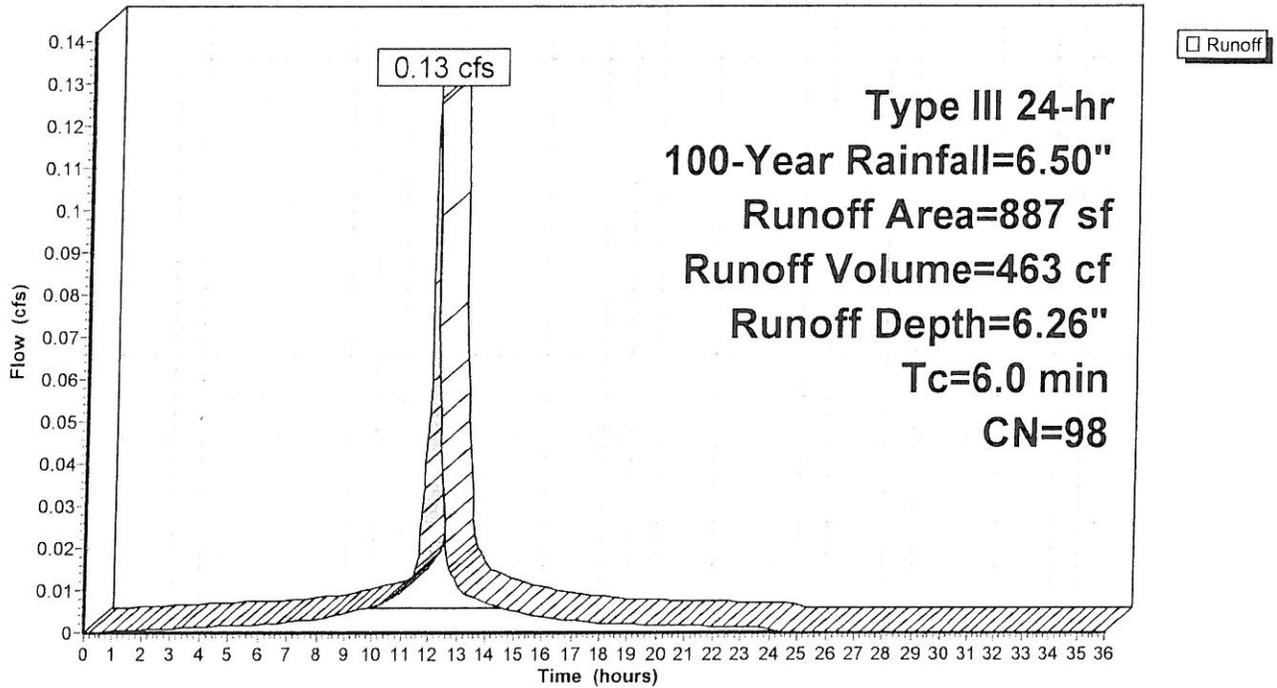
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
887	98	Paved parking, HSG A
887		100.00% Impervious Area

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

Subcatchment 5DW: DRIVEWAY LOT 5

Hydrograph



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 Type III 24-hr 100-Year Rainfall=6.50"

Summary for Subcatchment 6DW: DRIVEWAY LOT 6

Runoff = 0.17 cfs @ 12.09 hrs, Volume= 617 cf, Depth= 6.26"

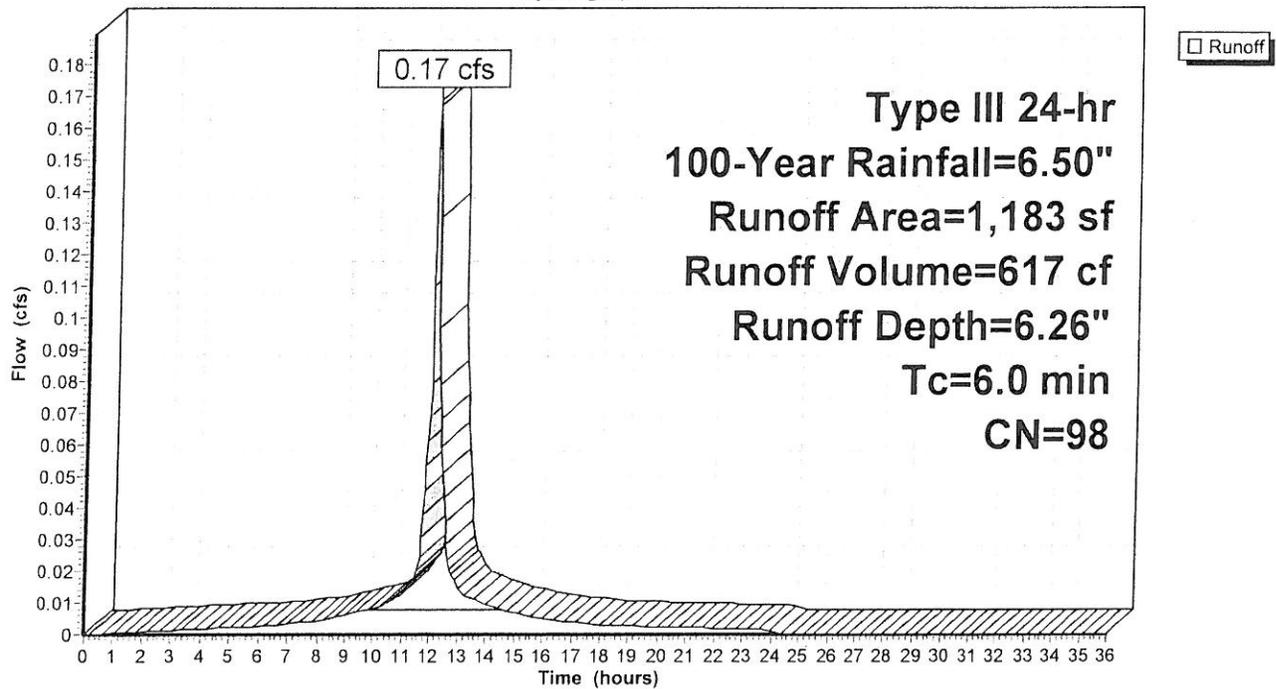
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
1,183	98	Paved parking, HSG A
1,183		100.00% Impervious Area

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

Subcatchment 6DW: DRIVEWAY LOT 6

Hydrograph



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Type III 24-hr 100-Year Rainfall=6.50"

Summary for Subcatchment 7S: House Lots 1 - 8

Area of maximum proposed house size for all Lots is used to determine Roof Infiltration sizing for 100-Year Storm Event.

Maximum House footprint = 1,653 s.f.

Total House Impervious fro entire site = 12,644 s.f.

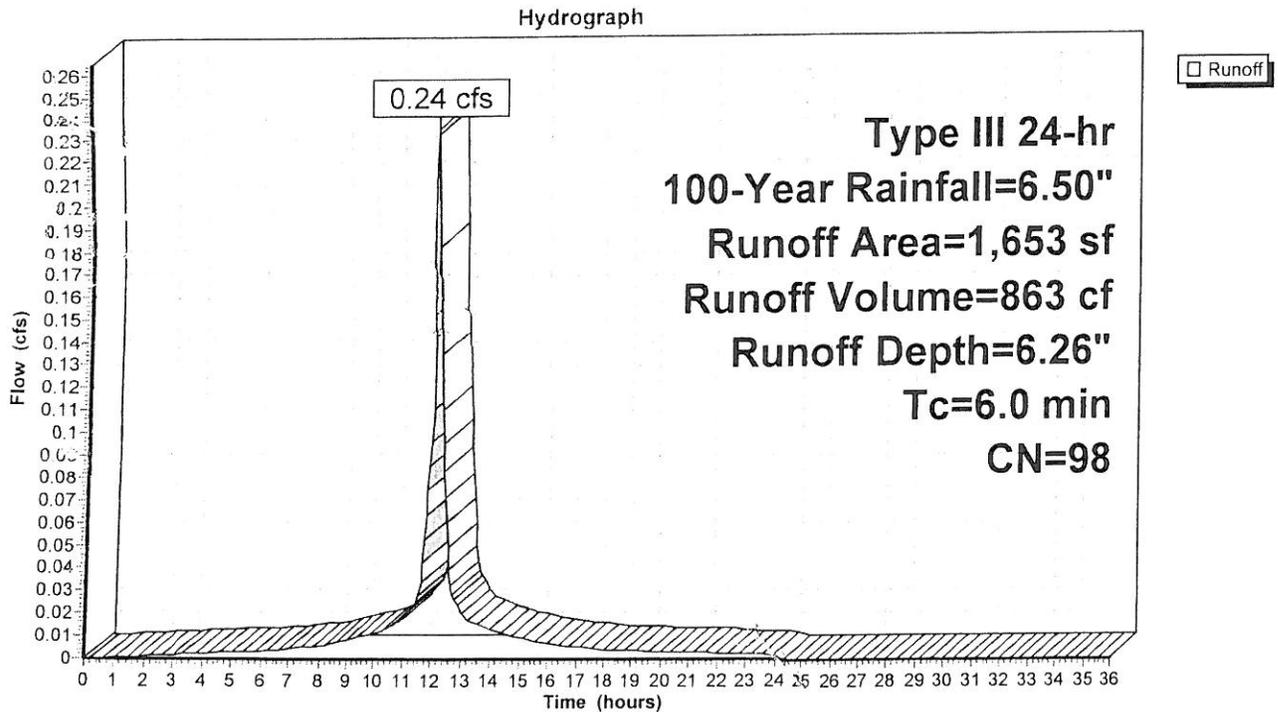
Runoff = 0.24 cfs @ 12.09 hrs, Volume= 863 cf, Depth= 6.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
1,653	98	Roofs, HSG A
1,653		100.00% Impervious Area

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

Subcatchment 7S: House Lots 1 - 8



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Summary for Pond 1P: Rain Garden 1

Inflow Area = 31,603 sf, 0.41% Impervious, Inflow Depth = 0.48" for 100-Year event
 Inflow = 0.13 cfs @ 12.43 hrs, Volume= 1,253 cf
 Outflow = 0.03 cfs @ 15.68 hrs, Volume= 1,253 cf, Atten= 74%, Lag= 194.8 min
 Discarded = 0.02 cfs @ 15.68 hrs, Volume= 1,166 cf
 Primary = 0.02 cfs @ 15.68 hrs, Volume= 87 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 125.11' @ 15.68 hrs Surf.Area= 432 sf Storage= 502 cf

Plug-Flow detention time= 352.7 min calculated for 1,252 cf (100% of inflow)
 Center-of-Mass det. time= 353.0 min (1,318.5 - 965.4)

Volume	Invert	Avail.Storage	Storage Description			
#1	123.50'	564 cf	Custom Stage Data (Irregular) Listed below (Recalc)			
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
123.50	206	60.0	0	0	206	
125.25	455	82.0	564	564	484	

Device	Routing	Invert	Outlet Devices												
#1	Primary	125.10'	5.0' long x 1.0' breadth Broad-Crested Rectangular Weir												
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00												
			Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32												
#2	Discarded	123.50'	1.750 in/hr Exfiltration over Surface area												

Discarded OutFlow Max=0.02 cfs @ 15.68 hrs HW=125.11' (Free Discharge)
 ↗**2=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.02 cfs @ 15.68 hrs HW=125.11' (Free Discharge)
 ↗**1=Broad-Crested Rectangular Weir** (Weir Controls 0.02 cfs @ 0.28 fps)

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Summary for Pond 2P: Rain Garden 2

Inflow Area = 35,764 sf, 0.00% Impervious, Inflow Depth = 0.42" for 100-Year event
 Inflow = 0.11 cfs @ 12.47 hrs, Volume= 1,247 cf
 Outflow = 0.03 cfs @ 16.11 hrs, Volume= 1,247 cf, Atten= 73%, Lag= 218.4 min
 Discarded = 0.02 cfs @ 16.11 hrs, Volume= 1,170 cf
 Primary = 0.01 cfs @ 16.11 hrs, Volume= 77 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 119.61' @ 16.11 hrs Surf.Area= 431 sf Storage= 502 cf

Plug-Flow detention time= 354.5 min calculated for 1,245 cf (100% of inflow)
 Center-of-Mass det. time= 354.9 min (1,331.0 - 976.1)

Volume	Invert	Avail.Storage	Storage Description			
#1	118.00'	564 cf	Custom Stage Data (Irregular) Listed below (Recalc)			
Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)	
118.00	206	60.0	0	0	206	
119.75	455	82.0	564	564	484	

Device	Routing	Invert	Outlet Devices										
#1	Primary	119.60'	5.0' long x 1.0' breadth Broad-Crested Rectangular Weir										
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00										
			Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32										
#2	Discarded	118.00'	1.750 in/hr Exfiltration over Surface area										

Discarded OutFlow Max=0.02 cfs @ 16.11 hrs HW=119.61' (Free Discharge)
 ↑2=Exfiltration (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.01 cfs @ 16.11 hrs HW=119.61' (Free Discharge)
 ↑1=Broad-Crested Rectangular Weir (Weir Controls 0.01 cfs @ 0.26 fps)

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Summary for Pond 3P: Infiltration System

Inflow Area = 74,422 sf, 24.10% Impervious, Inflow Depth = 1.56" for 100-Year event
 Inflow = 1.85 cfs @ 12.31 hrs, Volume= 9,674 cf
 Outflow = 0.21 cfs @ 15.15 hrs, Volume= 9,674 cf, Atten= 88%, Lag= 170.4 min
 Discarded = 0.21 cfs @ 15.15 hrs, Volume= 9,674 cf
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 125.75' @ 15.15 hrs Surf.Area= 3,839 sf Storage= 4,322 cf

Plug-Flow detention time= 297.1 min calculated for 9,674 cf (100% of inflow)
 Center-of-Mass det. time= 297.0 min (1,189.4 - 892.4)

Volume	Invert	Avail.Storage	Storage Description
#1	124.50'	5,243 cf	Custom Stage Data (Irregular) Listed below (Recalc)
#2	123.00'	8 cf	4.00'D x 1.50'H Vertical Cone/Cylinder 19 cf Overall x 40.0% Voids
#3A	120.47'	1,439 cf	37.25'W x 54.00'L x 2.54'H Field A 5,113 cf Overall - 1,515 cf Embedded = 3,597 cf x 40.0% Voids
#4A	120.97'	1,515 cf	Cultec R-150XLHD x 55 Inside #3 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 11 rows
		8,205 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
124.50	160	56.0	0	0	160
125.00	1,094	277.0	279	279	6,017
126.00	2,093	309.0	1,567	1,845	7,538
127.00	4,898	303.0	3,398	5,243	7,961

Device	Routing	Invert	Outlet Devices
#1	Primary	126.50'	5.0' long x 2.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#2	Discarded	120.47'	2.410 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.21 cfs @ 15.15 hrs HW=125.75' (Free Discharge)
 ↖2=Exfiltration (Exfiltration Controls 0.21 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=120.47' (Free Discharge)
 ↖1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

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Summary for Pond 4P: Infiltration - Houses

Inflow Area = 1,653 sf, 100.00% Impervious, Inflow Depth = 6.26" for 100-Year event
 Inflow = 0.24 cfs @ 12.09 hrs, Volume= 863 cf
 Outflow = 0.01 cfs @ 9.85 hrs, Volume= 863 cf, Atten= 95%, Lag= 0.0 min
 Discarded = 0.01 cfs @ 9.85 hrs, Volume= 863 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
 Peak Elev= 123.36' @ 14.54 hrs Surf.Area= 195 sf Storage= 401 cf

Plug-Flow detention time= 302.2 min calculated for 861 cf (100% of inflow)
 Center-of-Mass det. time= 302.1 min (1,046.1 - 744.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	120.00'	184 cf	11.17'W x 17.50'L x 3.54'H Field A 692 cf Overall - 231 cf Embedded = 461 cf x 40.0% Voids
#2A	120.50'	231 cf	Cultec R-330XL x 4 Inside #1 Effective Size= 47.8"W x 30.0"H => 7.45 sf x 7.00'L = 52.2 cf Overall Size= 52.0"W x 30.5"H x 8.50'L with 1.50' Overlap Row Length Adjustment= +1.50' x 7.45 sf x 2 rows
		415 cf	Total Available Storage

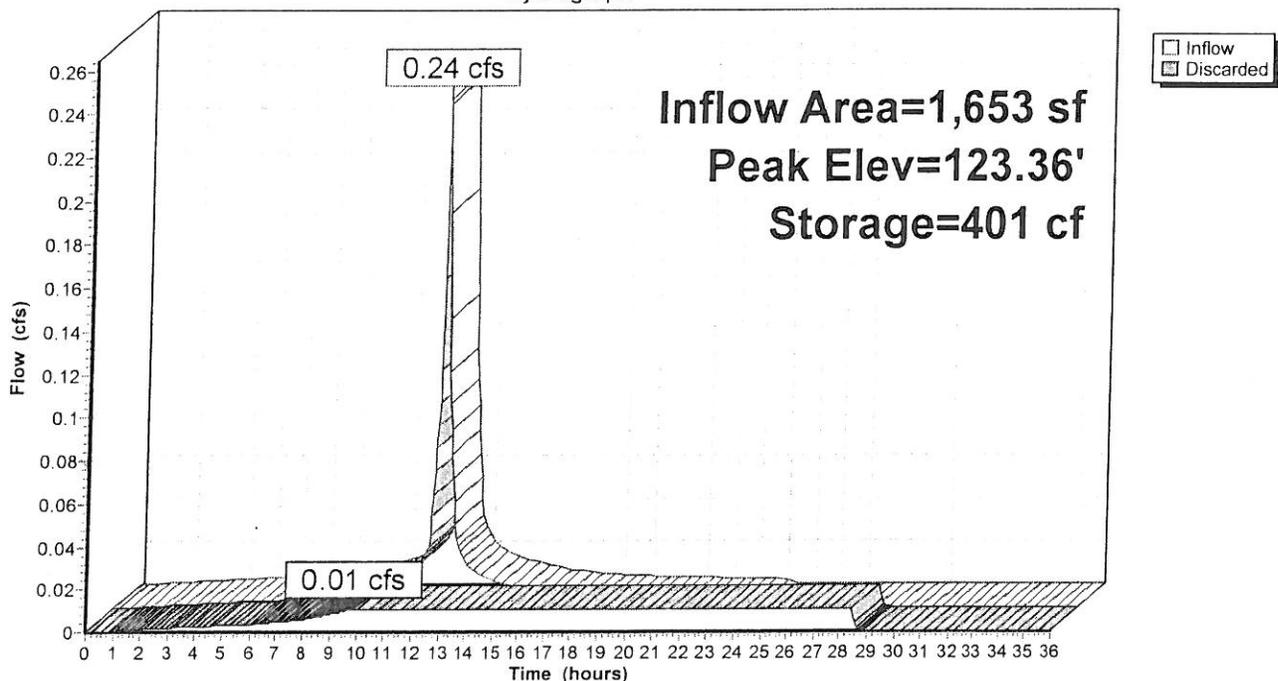
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	120.00'	2.410 in/hr Exfiltration over Surface area

Discarded OutFlow Max=0.01 cfs @ 9.85 hrs HW=120.04' (Free Discharge)
 ←1=Exfiltration (Exfiltration Controls 0.01 cfs)

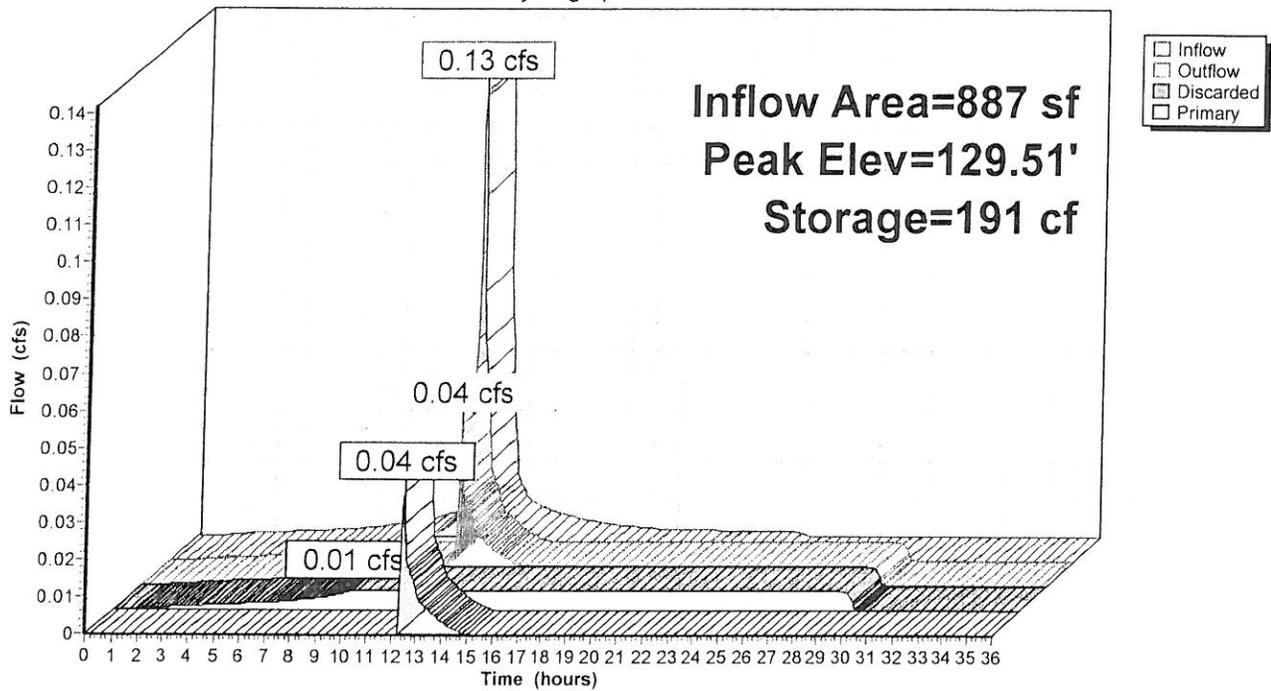
Pond 4P: Infiltration - Houses

Hydrograph



Pond 5P: DRIVEWAY TRENCH

Hydrograph



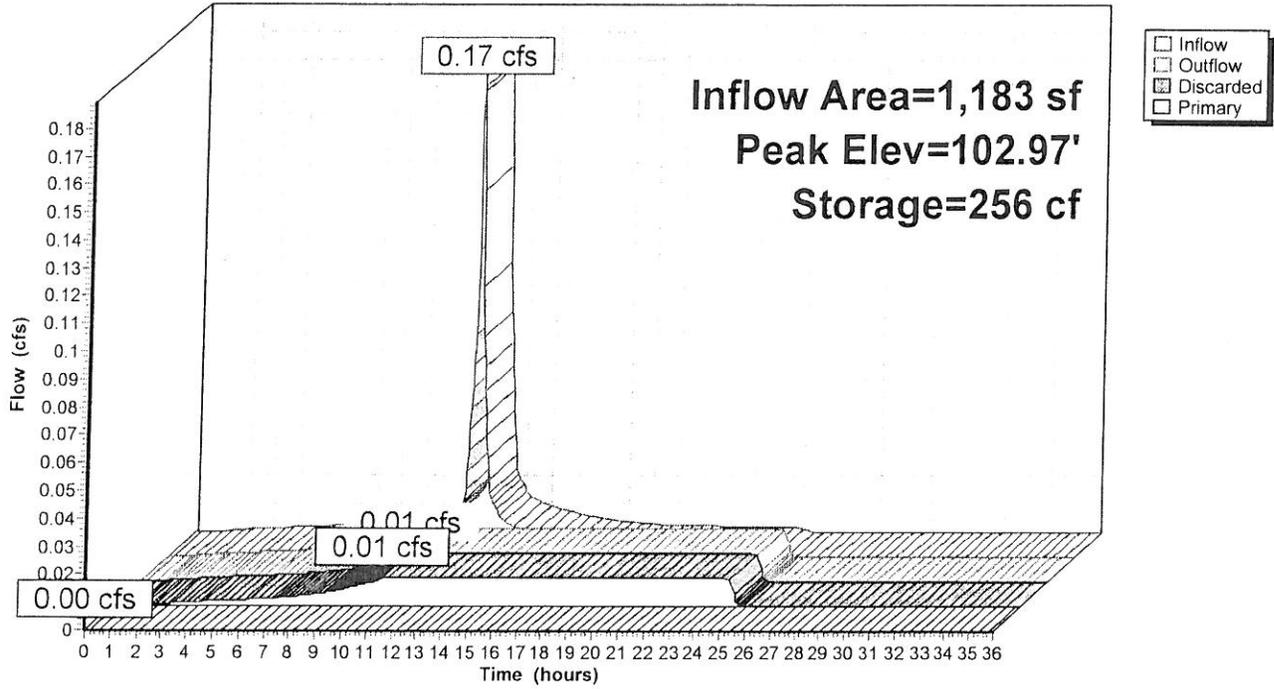
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Type III 24-hr 100-Year Rainfall=6.50"

Pond 6P: DRIVEWAY TRENCH

Hydrograph



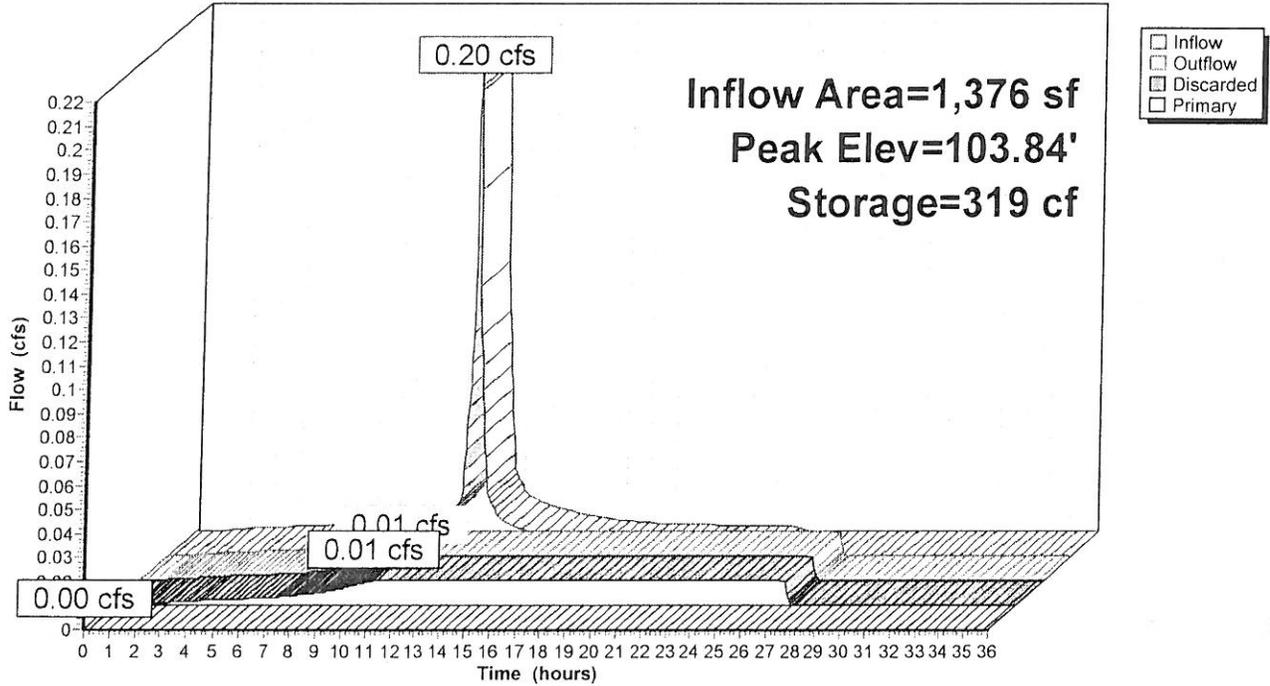
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Type III 24-hr 100-Year Rainfall=6.50"

Pond 7P: DRIVEWAY TRENCH

Hydrograph



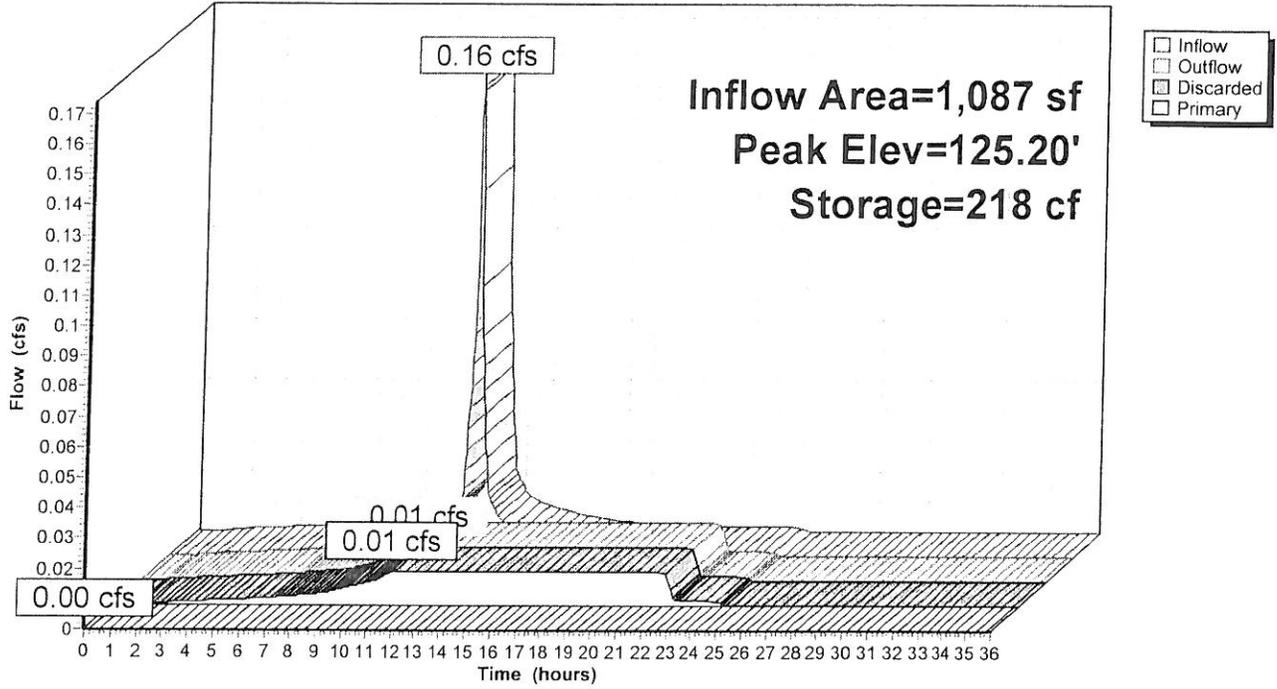
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Type III 24-hr 100-Year Rainfall=6.50"

Pond 8P: DRIVEWAY TRENCH

Hydrograph



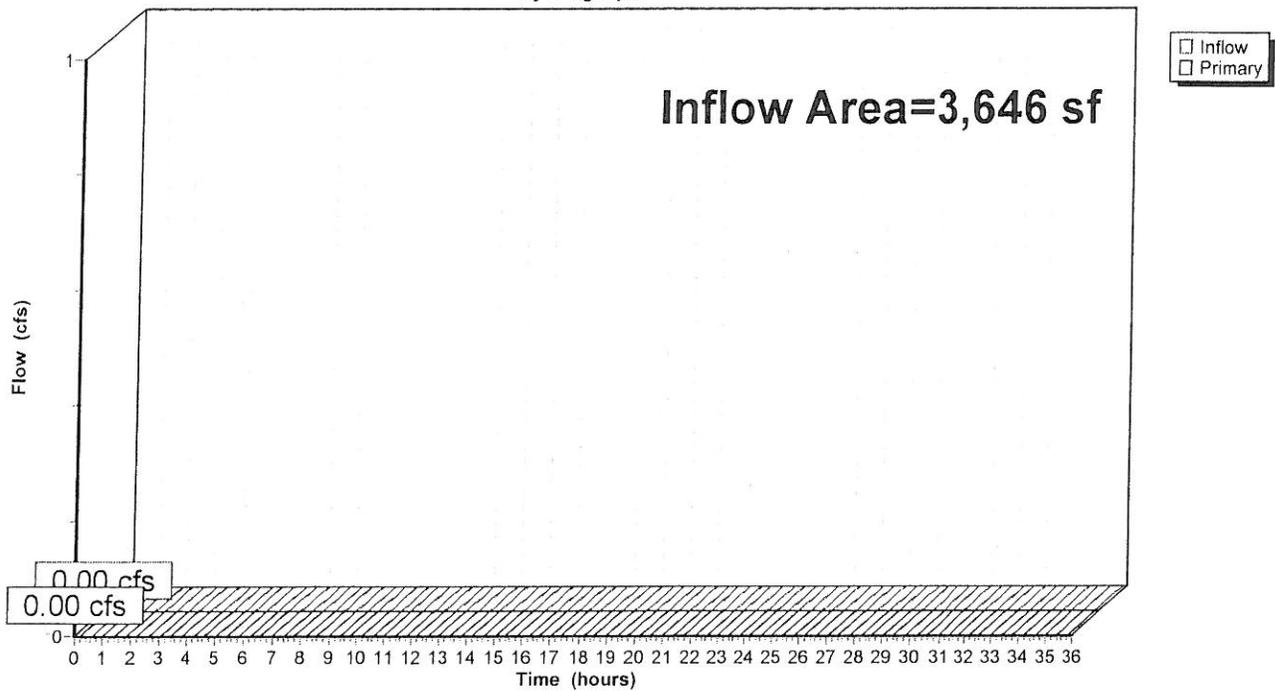
Summary for Link 2L: DRIVEWAYS

Inflow Area = 3,646 sf, 100.00% Impervious, Inflow Depth = 0.00" for 100-Year event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Link 2L: DRIVEWAYS

Hydrograph



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Summary for Link 4L: AREA 2 & 3

Inflow Area = 68,254 sf, 1.49% Impervious, Inflow Depth = 0.04" for 100-Year event
Inflow = 0.04 cfs @ 12.47 hrs, Volume= 235 cf
Primary = 0.04 cfs @ 12.47 hrs, Volume= 235 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Link 4L: AREA 2 & 3

Hydrograph

