

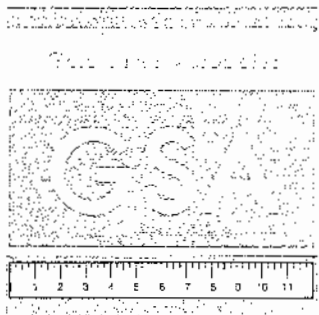
***Engineering Drainage Calculations
for
22 Highland Avenue
Winchester, Massachusetts***

***Prepared for
Winchester Housing Authority
Winchester, Massachusetts***

Prepared by

***Gala Simon Associates, Inc.
394 Lowell Street, Suite 18
Lexington, MA 02420
781-676-2962***

January 20, 2010



A handwritten signature in black ink, appearing to be 'A. John', written over a circular embossed seal.

Project: 22 Highland Avenue, MA

Date: January 20, 2010

Summary of Results:

The following tables summarize the peak flows for the watersheds under Existing and Proposed Conditions.

Summary of Stormwater Runoff – (Area onto Wetlands and Highland Avenue)

<i>Storm Event</i>	<i>Existing Conditions Peak</i>		<i>Proposed Conditions Peak</i>	
	<i>Runoff (cfs)</i>	<i>Volume (af)</i>	<i>Runoff (cfs)</i>	<i>Volume (af)</i>
<i>2-Year (3.2 in/hr)</i>	<i>0.09</i>	<i>0.010</i>	<i>0.05</i>	<i>0.005</i>
<i>25-Year (5.5 in/hr)</i>	<i>0.55</i>	<i>0.039</i>	<i>0.26</i>	<i>0.018</i>
<i>100-Year (8.5 in/hr)</i>	<i>1.36</i>	<i>0.092</i>	<i>0.62</i>	<i>0.042</i>

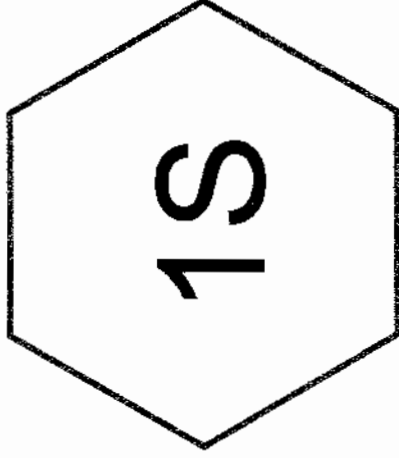
Design Assumptions

1. The subsurface drainage systems were designed for the 100 year storm event using a precipitation of 8.5" in 24 hours.
2. By field observation the percolation rate of the underlying soils was assumed to be 10 min/in. Both subsurface drainage systems will be installed in fill with a percolation rate of 2 min/in.
3. Under existing conditions the entire property (14,000 s.f.) drains to the adjacent wetlands. Under proposed conditions this will continue to be the case.

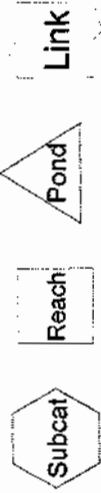
Conclusions:

1. As analyzed, the peak rates of runoff and volumes will be reduced below existing levels for the 2, 25 and 100 year storm events.

***Existing Conditions Drainage Calculations
2 Year Storm Event***



Existing Watershed



Area Listing (selected nodes)

<u>Area</u> (acres)	<u>CN</u>	<u>Description</u> (subcats)
0.252	49	50-75% Grass cover, Fair, HSG A (1S)
0.069	98	Paved parking & roofs (1S)
<hr/>		
0.321		

EXISTING CONDITIONS

Type III 24-hr Rainfall=3.20"

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Page 3

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SCS TR-20 method, UH=SCS

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

Subcatchment 1S: EXISTING

Runoff Area=14,000 sf Runoff Depth>0.36"

Tc=6.0 min CN=60 Runoff=0.09 cfs 0.010 af

Runoff Area = 0.321 ac Runoff Volume = 0.010 af Average Runoff Depth = 0.36"
78.49% Pervious Area = 0.252 ac 21.51% Impervious Area = 0.069 ac

Subcatchment 1S: EXISTING

Runoff = 0.09 cfs @ 12.14 hrs, Volume= 0.010 af, Depth> 0.36"

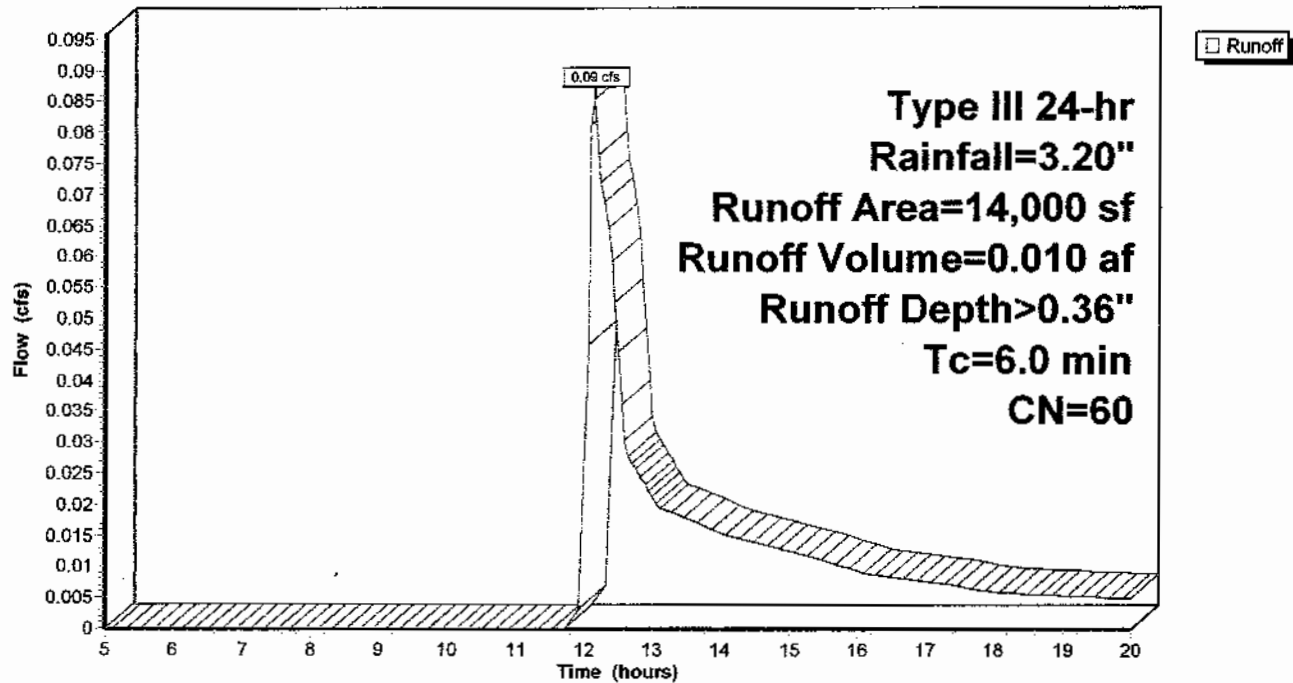
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr Rainfall=3.20"

Area (sf)	CN	Description
3,011	98	Paved parking & roofs
10,989	49	50-75% Grass cover, Fair, HSG A
14,000	60	Weighted Average
10,989		Pervious Area
3,011		Impervious Area

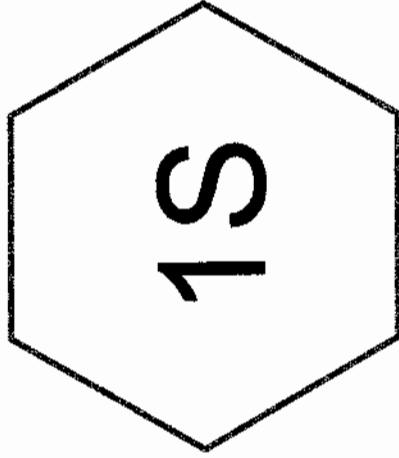
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry,

Subcatchment 1S: EXISTING

Hydrograph



***Existing Conditions Drainage Calculations
25 Year Storm Event***



Existing Watershed



Drainage Diagram for EXISTING CONDITIONS

Prepared by Gala Simon Associates, Inc. 1/20/2010

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EXISTING CONDITIONS

Area Listing (selected nodes)

<u>Area</u> (acres)	<u>CN</u>	<u>Description</u> (subcats)
0.252	49	50-75% Grass cover, Fair, HSG A (1S)
0.069	98	Paved parking & roofs (1S)
<hr/>		
0.321		

EXISTING CONDITIONS

Type III 24-hr Rainfall=5.50"

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Page 3

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1/20/2010

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SCS TR-20 method, UH=SCS

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

Subcatchment 1S: EXISTING

Runoff Area=14,000 sf Runoff Depth>1.45"

Tc=6.0 min CN=60 Runoff=0.55 cfs 0.039 af

Runoff Area = 0.321 ac Runoff Volume = 0.039 af Average Runoff Depth = 1.45"
78.49% Pervious Area = 0.252 ac 21.51% Impervious Area = 0.069 ac

Subcatchment 1S: EXISTING

Runoff - 0.55 cfs @ 12.10 hrs, Volume= 0.039 af, Depth> 1.45"

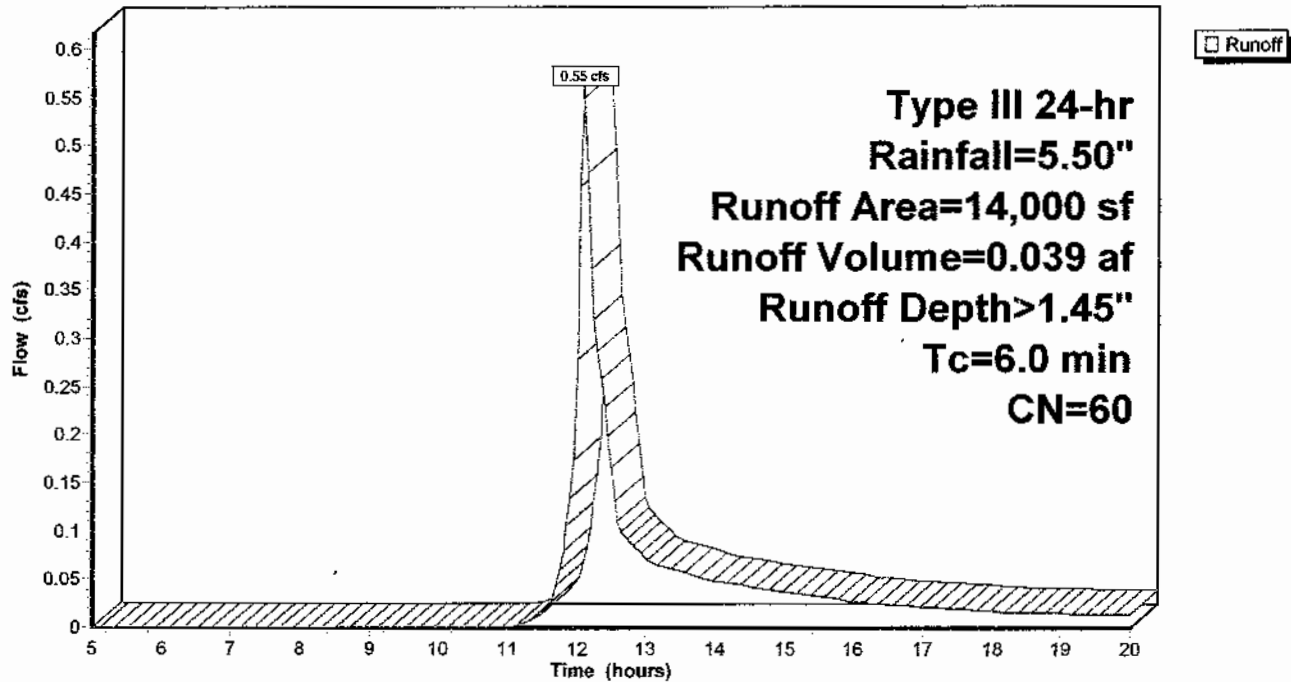
Runoff by SCS IR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=5.50"

Area (sf)	CN	Description
3,011	98	Paved parking & roofs
10,989	49	50-75% Grass cover, Fair, HSG A
14,000	60	Weighted Average
10,989		Pervious Area
3,011		Impervious Area

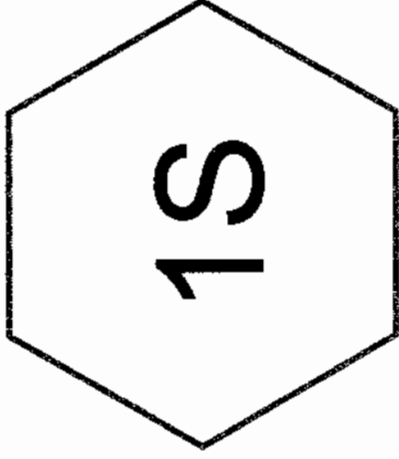
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry,

Subcatchment 1S: EXISTING

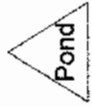
Hydrograph



***Existing Conditions Drainage Calculations
100 Year Storm Event***



Existing Watershed



Area Listing (selected nodes)

<u>Area (acres)</u>	<u>CN</u>	<u>Description (subcats)</u>
0.252	49	50-75% Grass cover, Fair, HSG A (1S)
0.069	98	Paved parking & roofs (1S)
<hr/>		
0.321		

EXISTING CONDITIONS

Type III 24-hr Rainfall=8.50"

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Page 3

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SCS TR-20 method, UH-SCS

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

Subcatchment 1S: EXISTING

Runoff Area=14,000 sf Runoff Depth>3.43"

Tc=6.0 min CN=60 Runoff=1.36 cfs 0.092 af

Runoff Area = 0.321 ac Runoff Volume = 0.092 af Average Runoff Depth = 3.43"
78.49% Pervious Area = 0.252 ac 21.51% Impervious Area = 0.069 ac

Subcatchment 1S: EXISTING

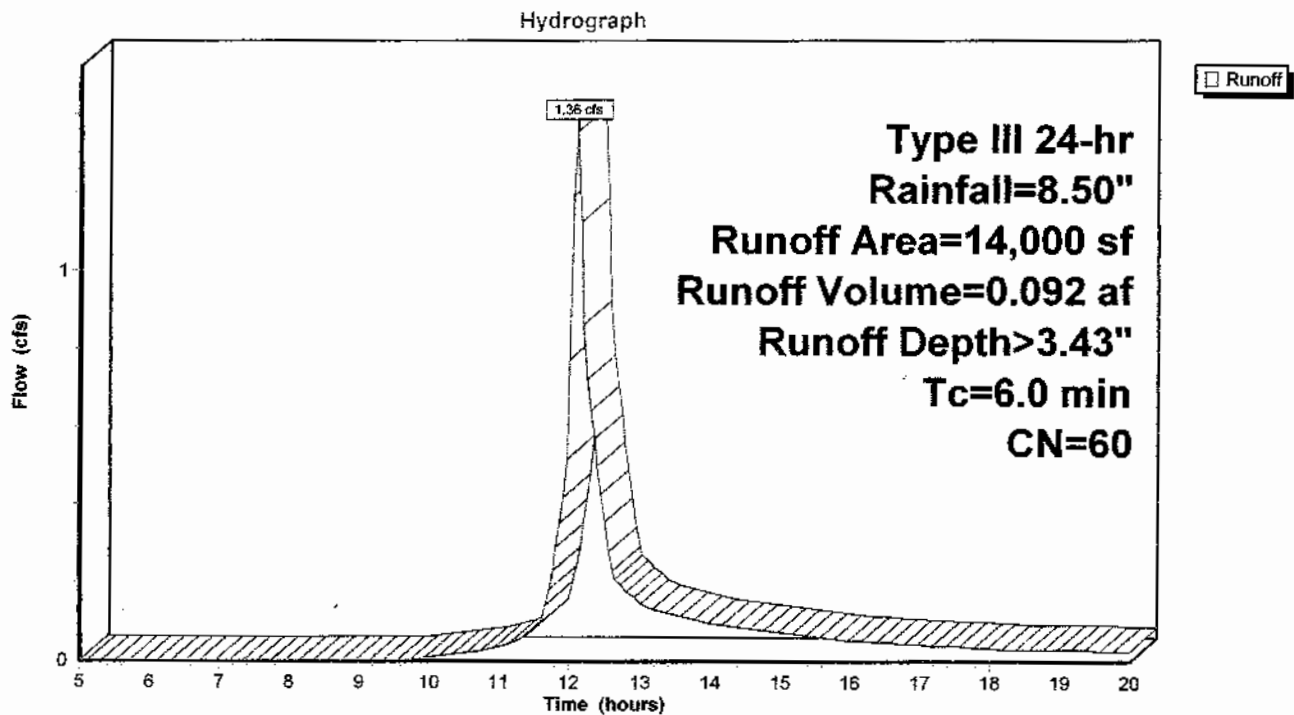
Runoff = 1.36 cfs @ 12.10 hrs, Volume= 0.092 af, Depth> 3.43"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=8.50"

Area (sf)	CN	Description
3,011	98	Paved parking & roofs
10,989	49	50-75% Grass cover, Fair, HSG A
14,000	60	Weighted Average
10,989		Pervious Area
3,011		Impervious Area

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

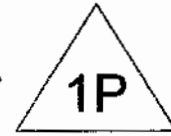
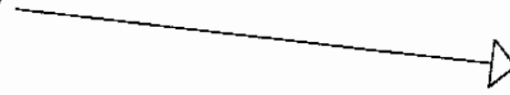
Subcatchment 1S: EXISTING



***Proposed Conditions Drainage Calculations
2 Year Storm Event***



Roof & Rear parking/drive



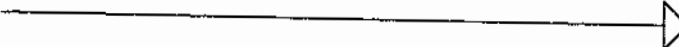
Parking Subsurface Drainage System



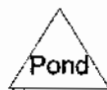
Remainder of site



Driveway



Entrance Subsurface Drainage System



Drainage Diagram for PROPOSED CONDITIONS
Prepared by Gala Simon Associates, Inc. 1/20/2010
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Area Listing (all nodes)

<u>Area (acres)</u>	<u>CN</u>	<u>Description (subcats)</u>
0.144	61	>75% Grass cover, Good, HSG B (1S,2S,3S)
0.178	98	Paved parking & roofs (1S,2S,3S)
<hr/>		
0.321		

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SCS TR-20 method, UH-SCS

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

Subcatchment 1S: Roof & Rear parking/d Runoff Area=7,015 sf Runoff Depth>2.69"
Tc=6.0 min CN=97 Runoff=0.48 cfs 0.036 af

Subcatchment 2S: Remainder of site Runoff Area=5,954 sf Runoff Depth>0.42"
Tc=6.0 min CN=62 Runoff=0.05 cfs 0.005 af

Subcatchment 3S: Driveway Runoff Area=1,031 sf Runoff Depth>1.87"
Tc=6.0 min CN=88 Runoff=0.05 cfs 0.004 af

Pond 1P: Parking Subsu Peak Elev=93.34' Storage=245 cf Inflow=0.48 cfs 0.036 af
Outflow=0.16 cfs 0.036 af

Pond 2P: Entrance Subsu Peak Elev=88.75' Storage=15 cf Inflow=0.05 cfs 0.004 af
Outflow=0.03 cfs 0.004 af

Total Runoff Area = 0.321 ac Runoff Volume = 0.045 af Average Runoff Depth = 1.66"
44.72% Pervious Area = 0.144 ac 55.28% Impervious Area = 0.178 ac

Subcatchment 1S: Roof & Rear parking/drive

Runoff = 0.48 cfs @ 12.09 hrs, Volume= 0.036 af, Depth> 2.69"

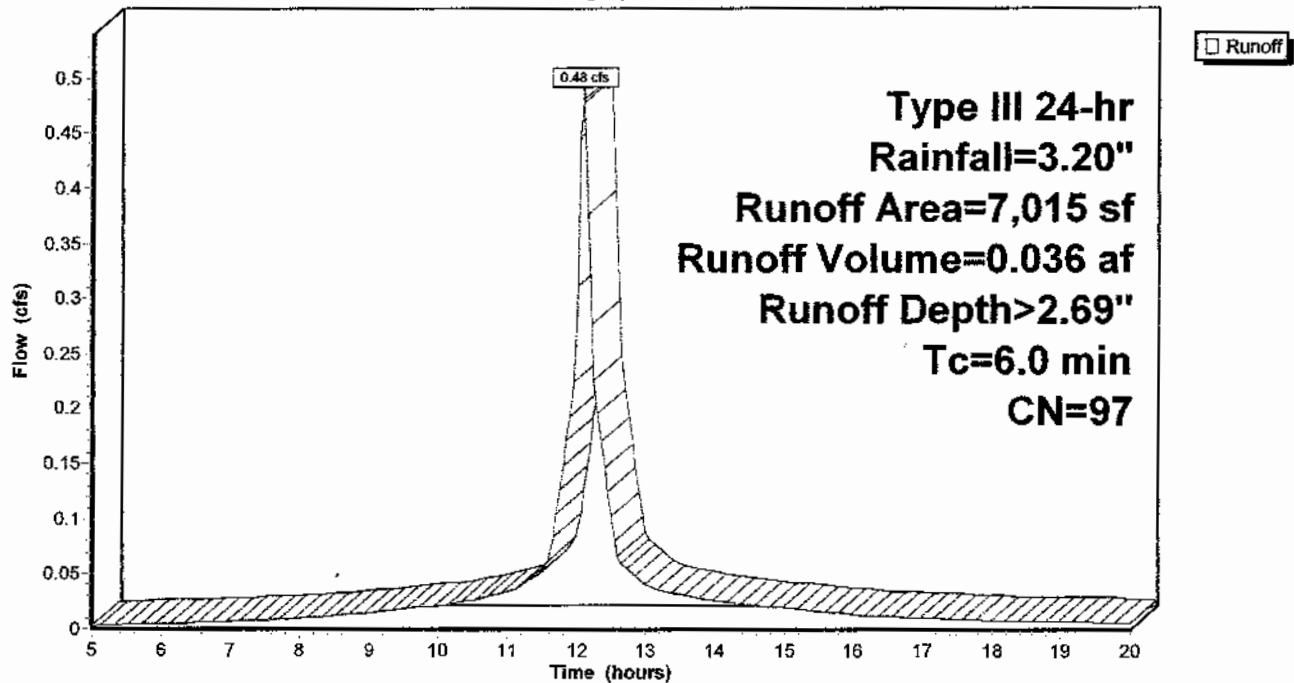
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=3.20"

Area (sf)	CN	Description
6,783	98	Paved parking & roofs
232	61	>75% Grass cover, Good, HSG B
7,015	97	Weighted Average
232		Pervious Area
6,783		Impervious Area

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

Subcatchment 1S: Roof & Rear parking/drive

Hydrograph



Subcatchment 2S: Remainder of site

Runoff = 0.05 cfs @ 12.12 hrs, Volume= 0.005 af, Depth> 0.42"

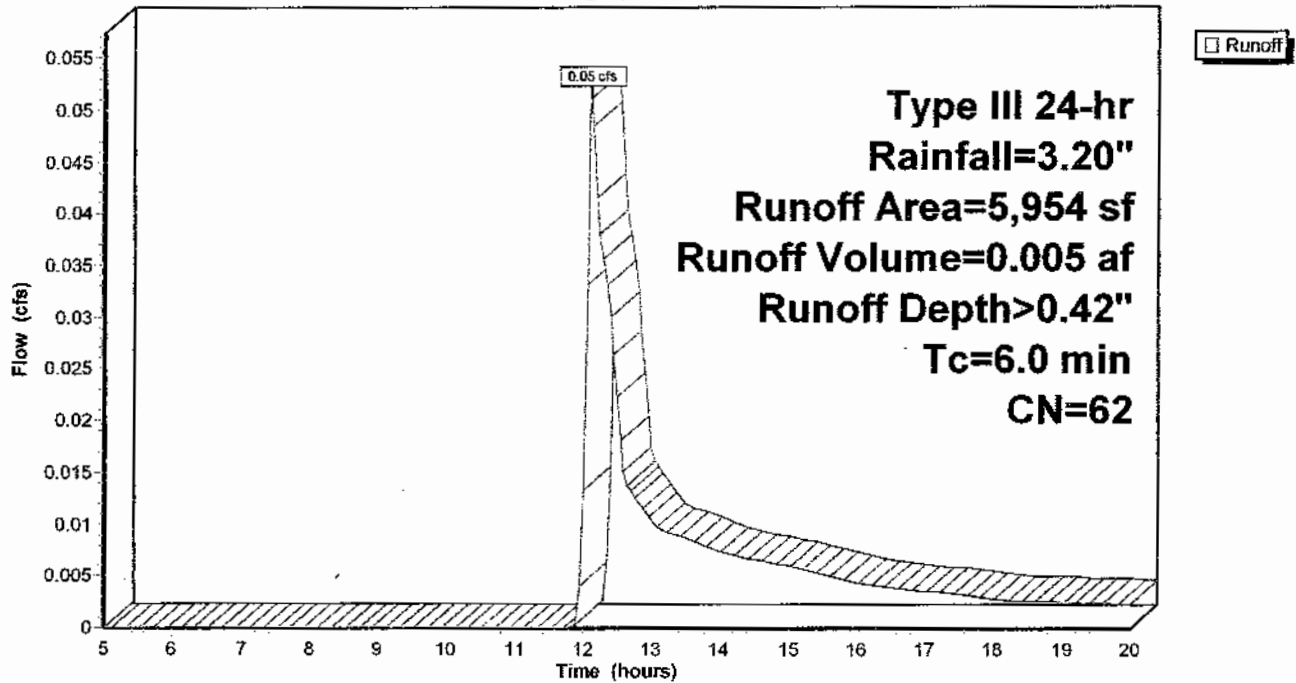
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr Rainfall=3.20"

Area (sf)	CN	Description
5,764	61	>75% Grass cover, Good, HSG B
190	98	Paved parking & roofs
5,954	62	Weighted Average
5,764		Pervious Area
190		Impervious Area

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

Subcatchment 2S: Remainder of site

Hydrograph



Subcatchment 3S: Driveway

Runoff = 0.05 cfs @ 12.09 hrs, Volume= 0.004 af, Depth> 1.87"

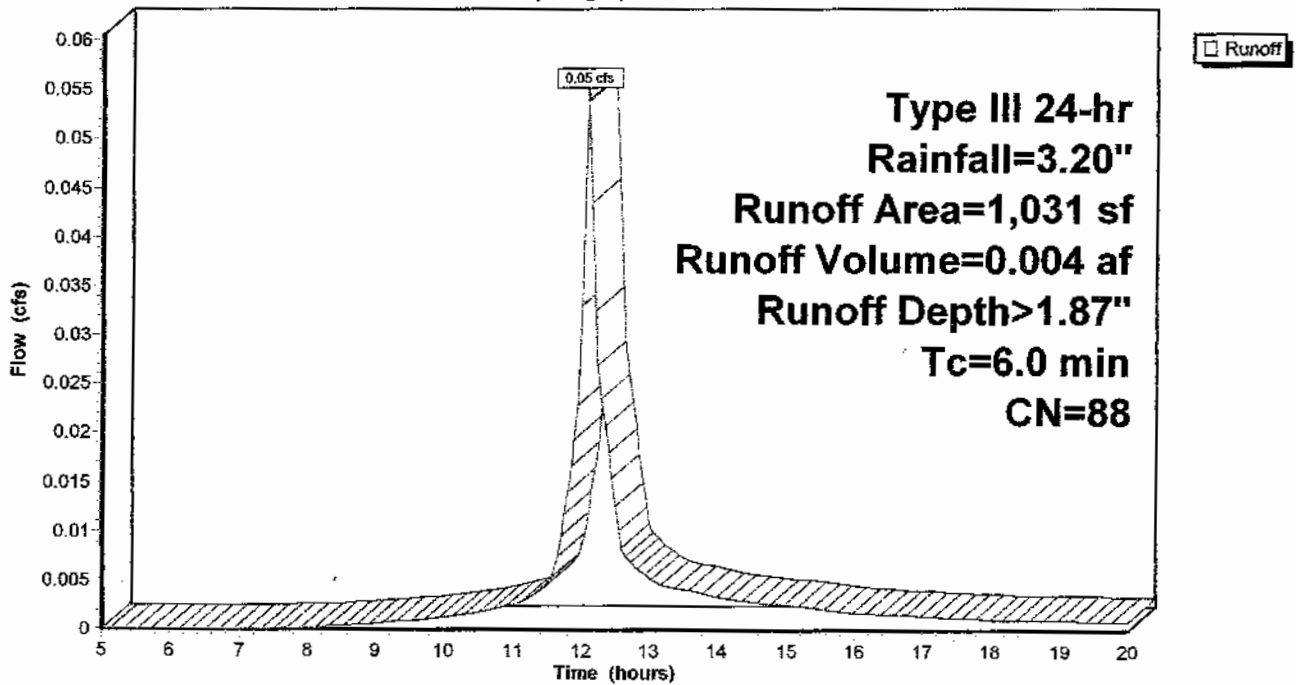
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=3.20"

Area (sf)	CN	Description
265	61	>75% Grass cover, Good, HSG B
766	98	Paved parking & roofs
1,031	88	Weighted Average
265		Pervious Area
766		Impervious Area

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

Subcatchment 3S: Driveway

Hydrograph



Pond 1P: Parking Subsurface Drainage System

Inflow Area = 0.161 ac, Inflow Depth > 2.69"
 Inflow = 0.48 cfs @ 12.09 hrs, Volume= 0.036 af
 Outflow = 0.16 cfs @ 12.37 hrs, Volume= 0.036 af, Atten= 66%, Lag=
 Primary = 0.16 cfs @ 12.37 hrs, Volume= 0.036 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 93.34' @ 12.37 hrs Surf.Arec= 0 sf Storage= 245 cf

Plug-Flow detention time= 7.0 min calculated for 0.036 af (100% of inflow)
 Center-of-Mass det. time= 6.9 min (750.6 - 743.6)

Volume	Invert	Avail.Storage	Storage Description
#1	92.75'	1,459 cf	Custom Stage Data Listed below

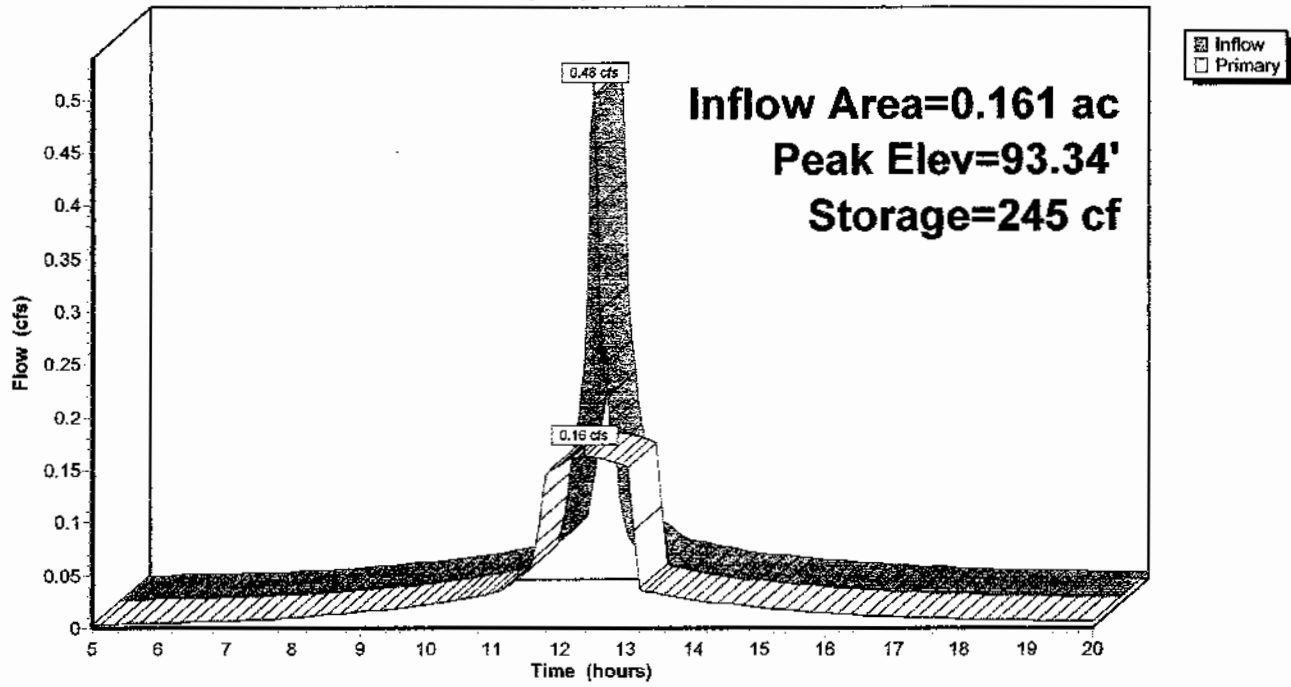
Elevation (feet)	Cum.Store (cubic-feet)
92.75	0
93.25	174
94.25	936
95.45	1,459

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	Custom Exfiltration
			Elev. (feet) 92.75 92.76 93.25 94.25 95.45
			Disch. (cfs) 0.000 0.150 0.160 0.180 0.200

Primary OutFlow Max=0.16 cfs @ 12.37 hrs HW=93.34' (Free Discharge)
 ←1=Custom Exfiltration (Custom Controls 0.16 cfs)

Pond 1P: Parking Subsurface Drainage System

Hydrograph



Pond 2P: Entrance Subsurface Drainage System

Inflow Area = 0.024 ac, Inflow Depth > 1.87"
 Inflow = 0.05 cfs @ 12.09 hrs, Volume= 0.004 af
 Outflow = 0.03 cfs @ 12.25 hrs, Volume= 0.001 af, Atten= 49%, Lag=
 Primary = 0.03 cfs @ 12.25 hrs, Volume= 0.001 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 88.75' @ 12.25 hrs Surf.Area= 0 sf Storage= 15 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. time= 2.5 min (783.9 - 781.4)

Volume	Invert	Avail.Storage	Storage Description
#1	88.50'	217 cf	Custom Stage Data Listed below

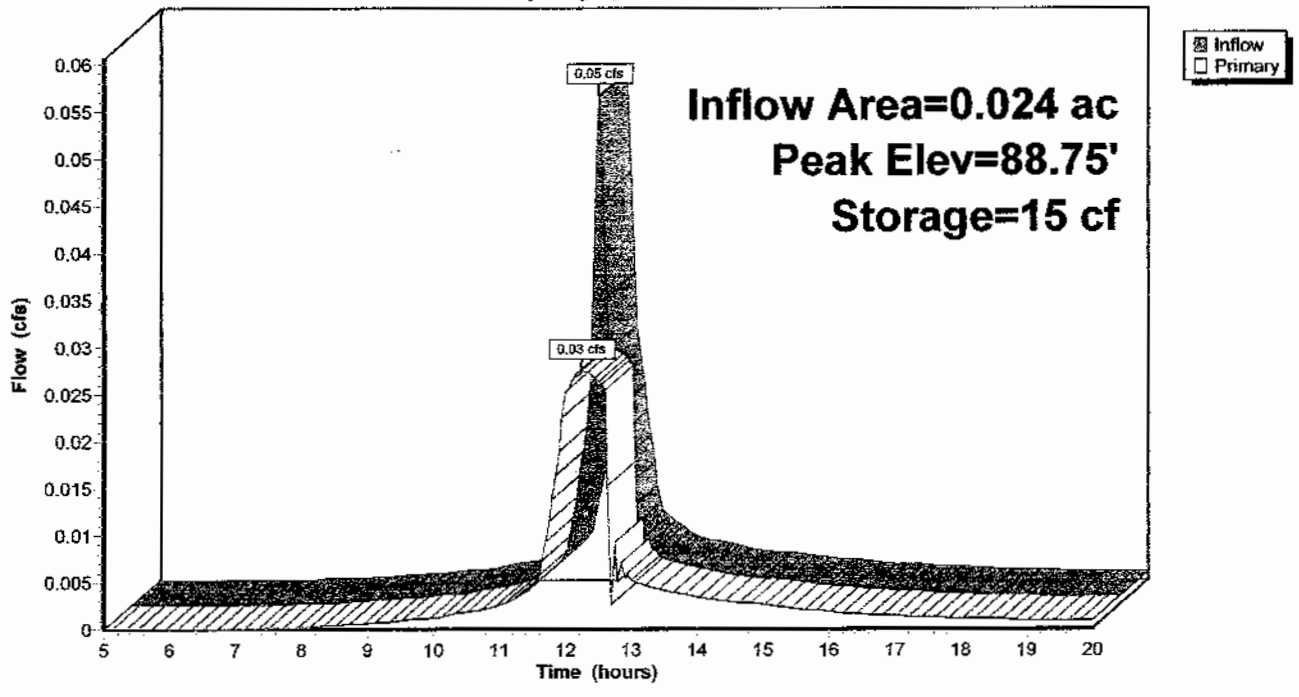
Elevation (feet)	Cum.Store (cubic-feet)
88.50	0
89.00	30
90.00	141
91.20	217

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	Exfiltration
			Elev. (feet) 88.50 88.51 89.00 90.00 91.20
			Disch. (cfs) 0.000 0.025 0.030 0.037 0.046

Primary OutFlow Max=0.03 cfs @ 12.25 hrs HW=88.75' (Free Discharge)
 1=Exfiltration (Custom Controls 0.03 cfs)

Pond 2P: Entrance Subsurface Drainage System

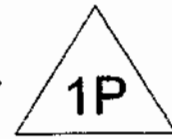
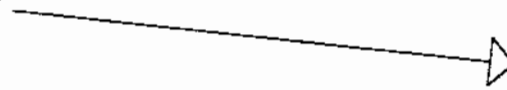
Hydrograph



***Proposed Conditions Drainage Calculations
25 Year Storm Event***



Roof & Rear parking/drive



Parking Subsurface Drainage System



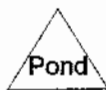
Remainder of site



Driveway



Entrance Subsurface Drainage System



Drainage Diagram for PROPOSED CONDITIONS
Prepared by Gala Simon Associates, Inc. 1/20/2010
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Area Listing (all nodes)

<u>Area (acres)</u>	<u>CN</u>	<u>Description (subcats)</u>
0.144	61	>75% Grass cover, Good, HSG B (1S,2S,3S)
0.178	98	Paved parking & roofs (1S,2S,3S)
<hr/>		
0.321		

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SCS TR-20 method, UH=SCS

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

Subcatchment 1S: Roof & Rear parking/d Runoff Area=7,015 sf Runoff Depth>4.80"
Tc=6.0 min CN=97 Runoff=0.84 cfs 0.064 af

Subcatchment 2S: Remainder of site Runoff Area=5,954 sf Runoff Depth>1.60"
Tc=6.0 min CN=67 Runoff=0.26 cfs 0.018 af

Subcatchment 3S: Driveway Runoff Area=1,031 sf Runoff Depth>3.91"
Tc=6.0 min CN=88 Runoff=0.11 cfs 0.008 af

Pond 1P: Parking Subsu Peak Elev=93.95' Storage=708 cf Inflow=0.84 cfs 0.064 af
Outflow=0.17 cfs 0.064 af

Pond 2P: Entrance Subsu Peak Elev=89.35' Storage=69 cf Inflow=0.11 cfs 0.008 af
Outflow=0.03 cfs 0.008 af

Total Runoff Area = 0.321 ac Runoff Volume = 0.090 af Average Runoff Depth = 3.37"
44.72% Pervious Area = 0.144 ac 55.28% Impervious Area = 0.178 ac

Subcatchment 1S: Roof & Rear parking/drive

Runoff = 0.84 cfs @ 12.09 hrs, Volume= 0.064 af, Depth> 4.80"

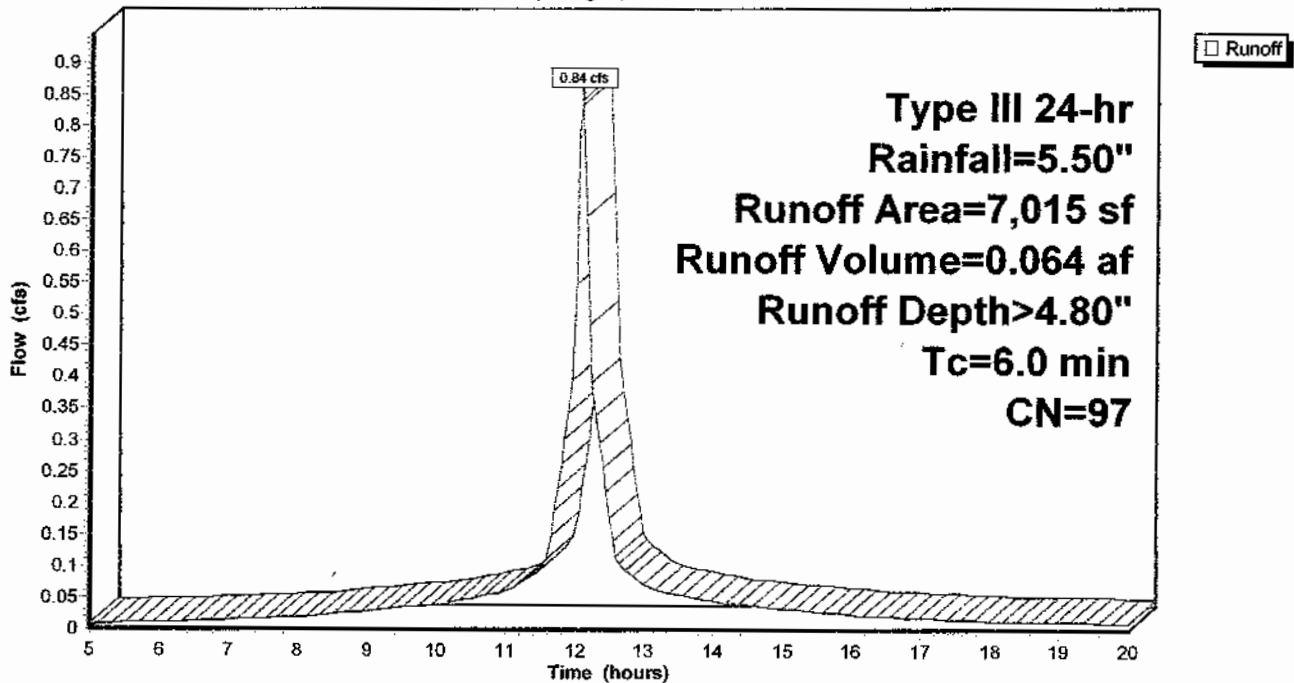
Runoff by SCS IR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=5.50"

Area (sf)	CN	Description
6,783	98	Paved parking & roofs
232	61	>5% Grass cover, Good, HSG B
7,015	97	Weighted Average
232		Pervious Area
6,783		Impervious Area

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

Subcatchment 1S: Roof & Rear parking/drive

Hydrograph



Subcatchment 2S: Remainder of site

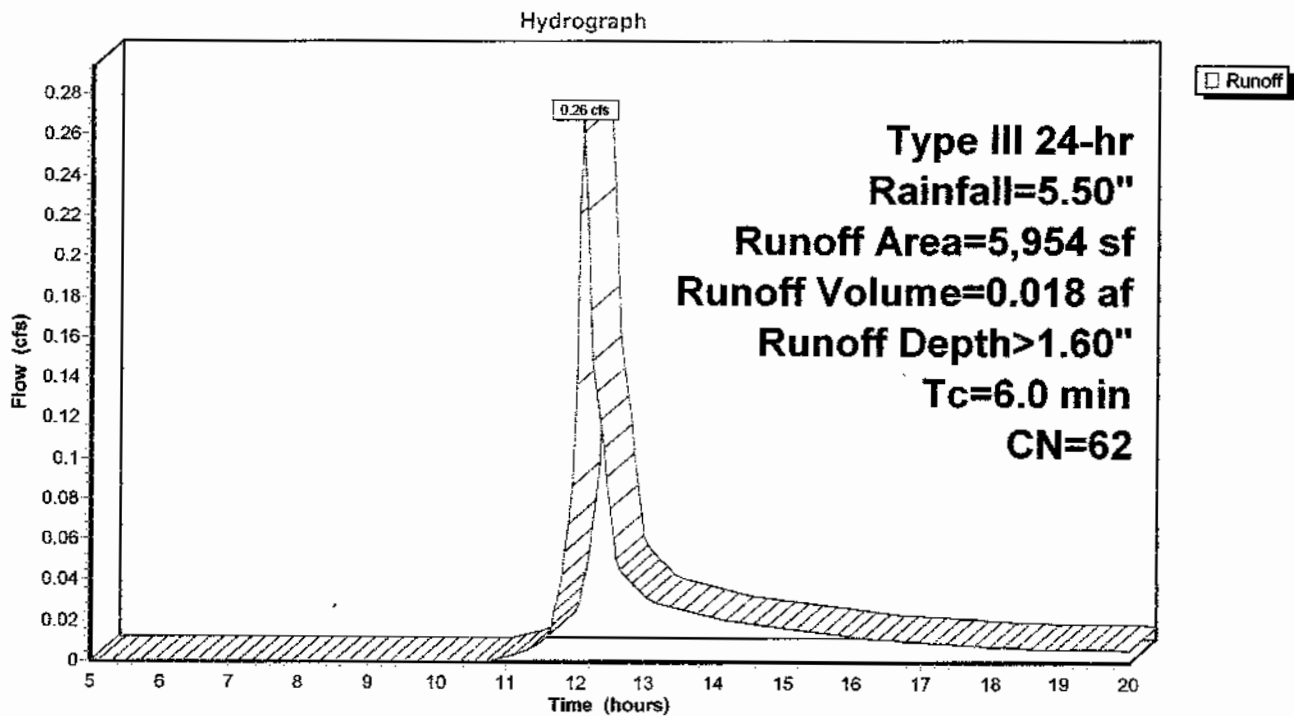
Runoff = 0.26 cfs @ 12.10 hrs, Volume= 0.018 af, Depth> 1.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=5.50"

Area (sf)	CN	Description
5,764	61	>75% Grass cover, Good, HSG B
190	98	Paved parking & roofs
5,954	62	Weighted Average
5,764		Pervious Area
190		Impervious Area

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

Subcatchment 2S: Remainder of site



Subcatchment 3S: Driveway

Runoff = 0.11 cfs @ 12.09 hrs, Volume= 0.008 af, Depth> 3.91"

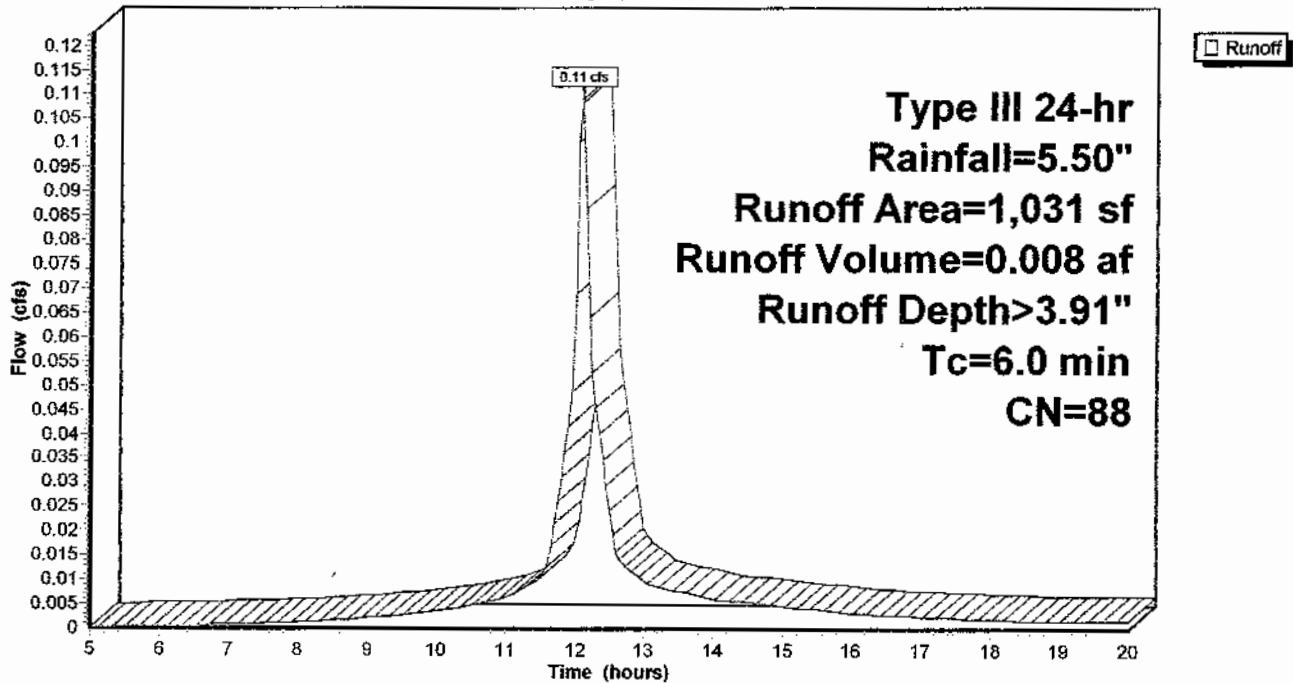
Runoff by SCS TR-20 method, UH-SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=5.50"

Area (sf)	CN	Description
265	61	>/5% Grass cover, Good, HSG B
766	98	Paved parking & roofs
1,031	88	Weighted Average
265		Pervious Area
766		Impervious Area

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

Subcatchment 3S: Driveway

Hydrograph



Pond 1P: Parking Subsurface Drainage System

Inflow Area = 0.161 ac, Inflow Depth > 4.80"
 Inflow = 0.84 cfs @ 12.09 hrs, Volume= 0.064 af
 Outflow = 0.17 cfs @ 12.51 hrs, Volume= 0.064 af, Atten= 79%, Lag=
 Primary = 0.17 cfs @ 12.51 hrs, Volume= 0.064 af

Rouling by Stor-Ind method, lime Span= 5.00-20.00 hrs, dl= 0.05 hrs
 Peak Elev= 93.95' @ 12.51 hrs Surf.Area= 0 sf Storage= 708 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
 Center-of-Mass det. lime= 22.7 min (760.1 - 737.4)

Volume	Invert	Avail.Storage	Storage Description
#1	92.75'	1,459 cf	Custom Stage Data Listed below

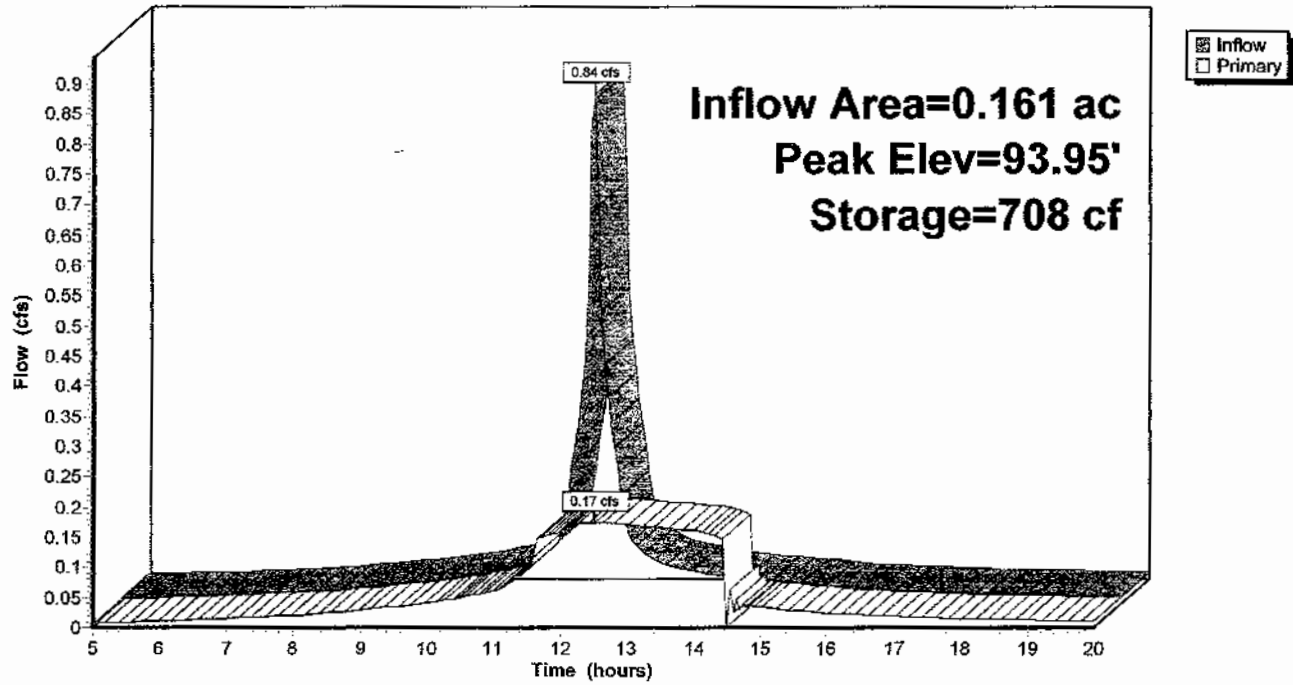
Elevation (feet)	Cum.Store (cubic-feet)
92.75	0
93.25	174
94.25	936
95.45	1,459

Device	Rouling	Invert	Outlet Devices
#1	Primary	0.00'	Custom Exfiltration
			Flev. (feet) 92.75 92.76 93.25 94.25 95.45
			Disch. (cfs) 0.000 0.150 0.160 0.180 0.200

Primary OutFlow Max=0.17 cfs @ 12.51 hrs HW=93.95' (Free Discharge)
 1=Custom Exfiltration (Custom Controls 0.17 cfs)

Pond 1P: Parking Subsurface Drainage System

Hydrograph



Pond 2P: Entrance Subsurface Drainage System

Inflow Area = 0.024 ac, Inflow Depth > 3.91"
 Inflow = 0.11 cfs @ 12.09 hrs, Volume= 0.008 af
 Outflow = 0.03 cfs @ 12.42 hrs, Volume= 0.008 af, Atten= 70%, Lag=
 Primary = 0.03 cfs @ 12.42 hrs, Volume= 0.008 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Flev= 89.35' @ 12.42 hrs Surf.Area= 0 sf Storage= 69 cf

Plug-Flow detention time= 11.6 min calculated for 0.008 af (100% of inflow)
 Center-of-Mass del. time= 11.5 min (775.4 - 763.9)

Volume	Invert	Avail.Storage	Storage Description
#1	88.50'	217 cf	Custom Stage Data listed below

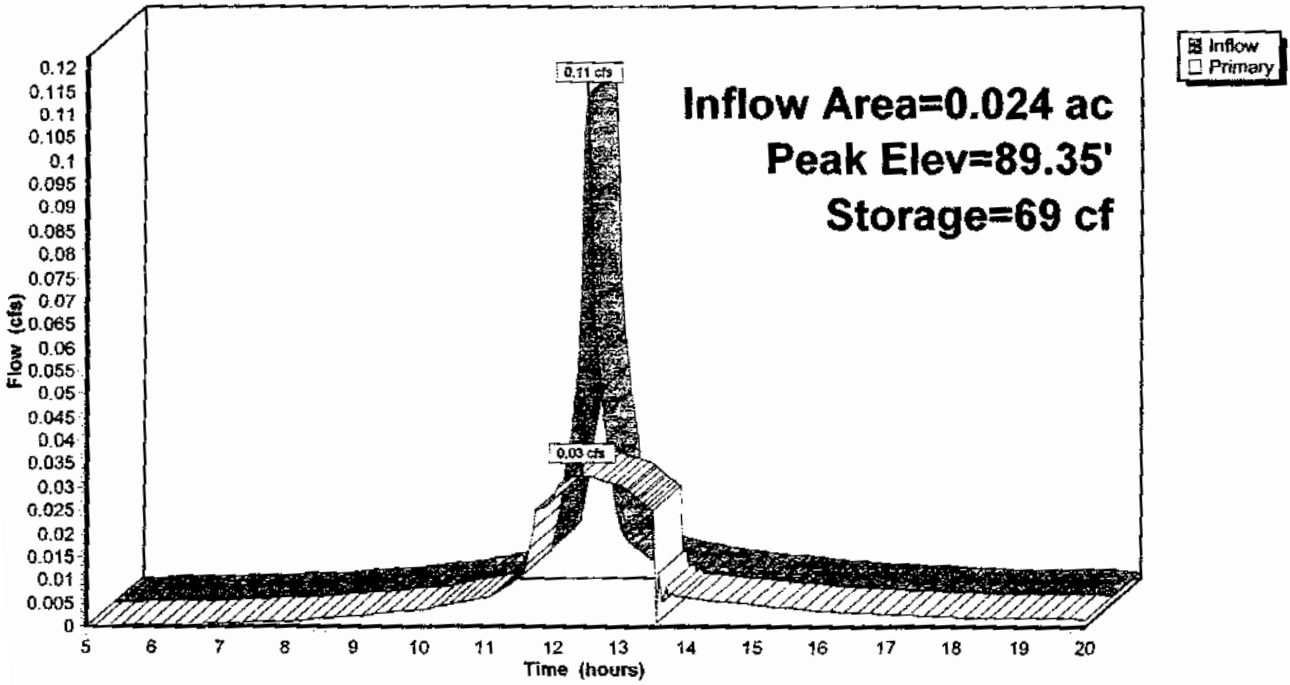
Elevation (feet)	Cum.Store (cubic-feet)
88.50	0
89.00	30
90.00	141
91.20	217

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	Exfiltration
			Elev. (feet) 88.50 88.51 89.00 90.00 91.20
			Disch. (cfs) 0.000 0.025 0.030 0.037 0.046

Primary OutFlow Max=0.03 cfs @ 12.42 hrs HW=89.35' (Free Discharge)
 ←1=Exfiltration (Custom Controls 0.03 cfs)

Pond 2P: Entrance Subsurface Drainage System

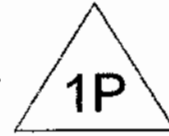
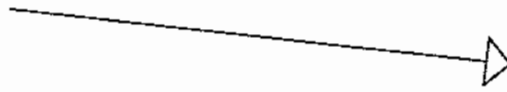
Hydrograph



***Proposed Conditions Drainage Calculations
100 Year Storm Event***



Roof & Rear parking/drive



Parking Subsurface Drainage System



Remainder of site



Driveway



Entrance Subsurface Drainage System



Drainage Diagram for PROPOSED CONDITIONS
Prepared by Gala Simon Associates, Inc. 1/20/2010
HydroCAD® 8.00 s/n 004688 © 2006 HydroCAD Software Solutions LLC

Area Listing (all nodes)

<u>Area (acres)</u>	<u>CN</u>	<u>Description (subcats)</u>
0.144	61	>75% Grass cover, Good, HSG B (1S,2S,3S)
0.178	98	Paved parking & roofs (1S,2S,3S)
<hr/>		
0.321		

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SCS TR-20 method, UH=SCS

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

Subcatchment 1S: Roof & Rear parking/d Runoff Area=7,015 sf Runoff Depth>7.54"
Tc=6.0 min CN=97 Runoff=1.31 cfs 0.101 af

Subcatchment 2S: Remainder of site Runoff Area=5,954 sf Runoff Depth>3.66"
Tc=6.0 min CN=62 Runoff=0.62 cfs 0.042 af

Subcatchment 3S: Driveway Runoff Area=1,031 sf Runoff Depth>6.67"
Tc=6.0 min CN=88 Runoff=0.18 cfs 0.013 af

Pond 1P: Parking Sub Peak Elev=95.24' Storage=1,369 cf Inflow=1.31 cfs 0.101 af
Outflow=0.20 cfs 0.101 af

Pond 2P: Entrance Subs Peak Elev=90.27' Storage=158 cf Inflow=0.18 cfs 0.013 af
Outflow=0.04 cfs 0.013 af

Total Runoff Area = 0.321 ac Runoff Volume = 0.156 af Average Runoff Depth = 5.82"
44.72% Pervious Area = 0.144 ac 55.28% Impervious Area = 0.178 ac

Subcatchment 1S: Roof & Rear parking/drive

Runoff = 1.31 cfs @ 12.09 hrs, Volume= 0.101 af, Depth> 7.54"

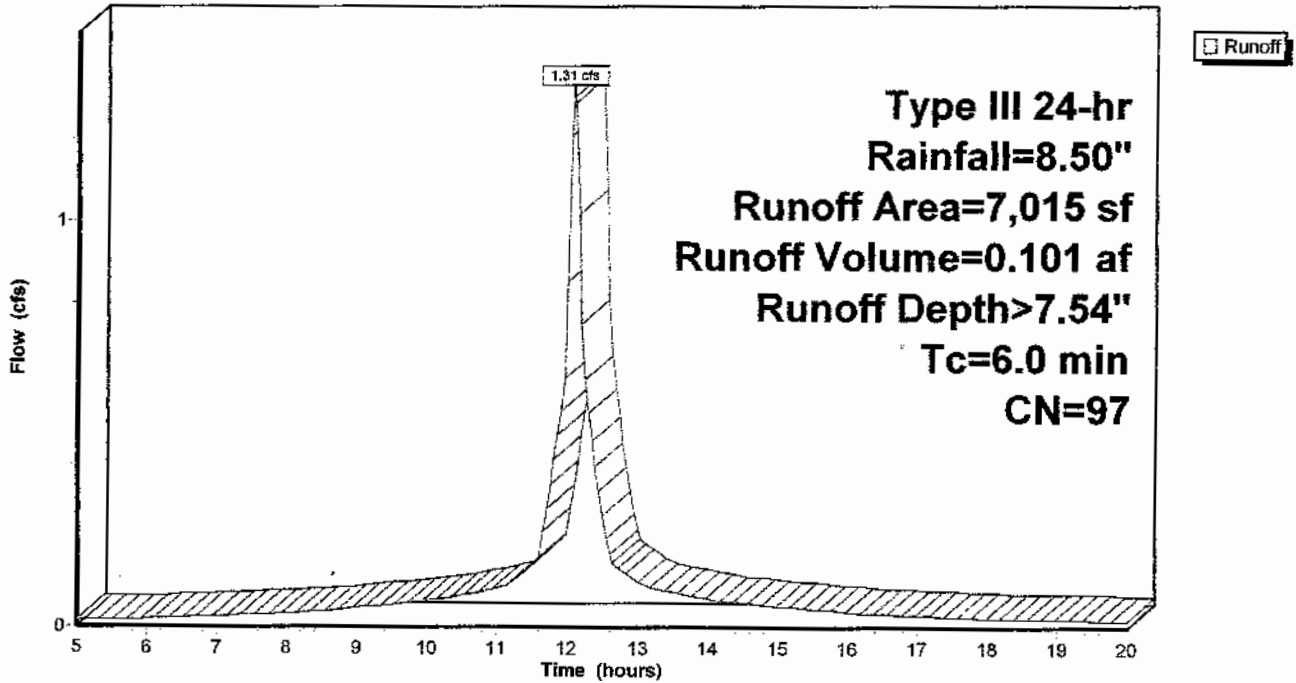
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr Rainfall=8.50"

Area (sf)	CN	Description
6,783	98	Paved parking & roofs
232	61	>75% Grass cover, Good, HSG B
7,015	97	Weighted Average
232		Pervious Area
6,783		Impervious Area

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

Subcatchment 1S: Roof & Rear parking/drive

Hydrograph



Subcatchment 2S: Remainder of site

Runoff = 0.62 cfs @ 12.10 hrs, Volume= 0.042 af, Depth> 3.66"

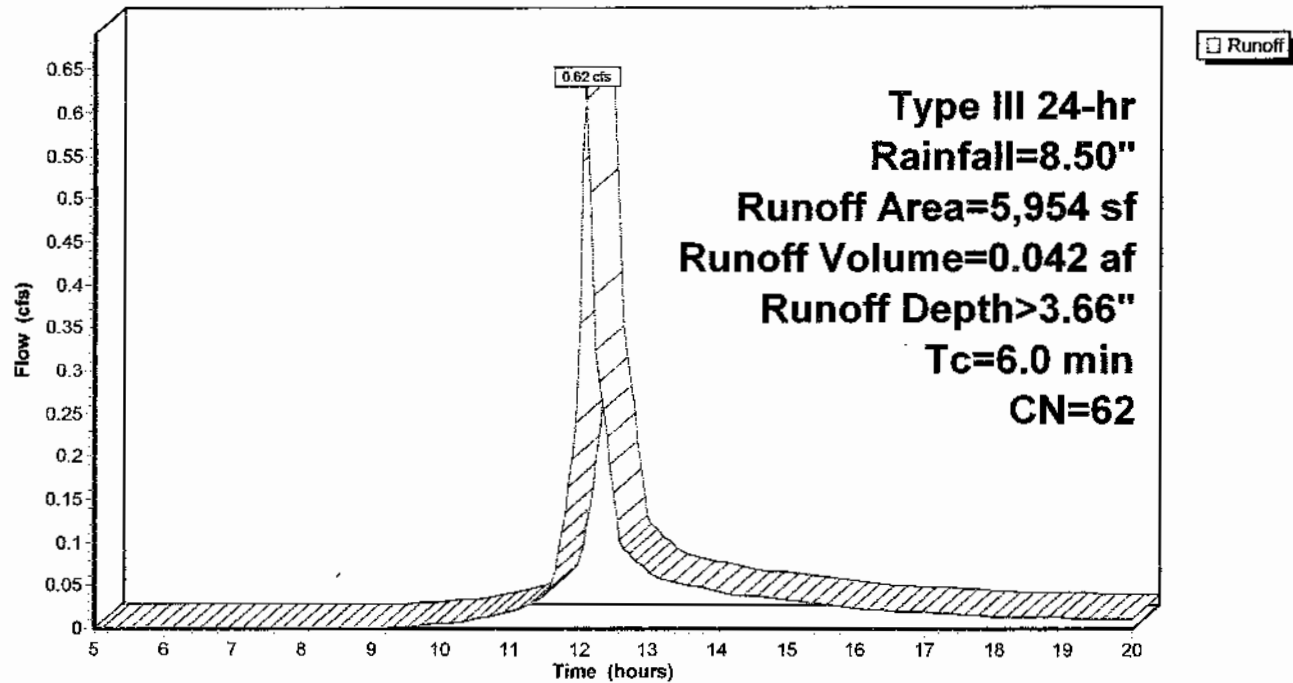
Runoff by SCS IR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Type III 24-hr Rainfall=8.50"

Area (sf)	CN	Description
5,764	61	>75% Grass cover, Good, HSG B
190	98	Paved parking & roofs
5,954	62	Weighted Average
5,764		Pervious Area
190		Impervious Area

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

Subcatchment 2S: Remainder of site

Hydrograph



Subcatchment 3S: Driveway

Runoff = 0.18 cfs @ 12.09 hrs, Volume= 0.013 af, Depth> 6.67"

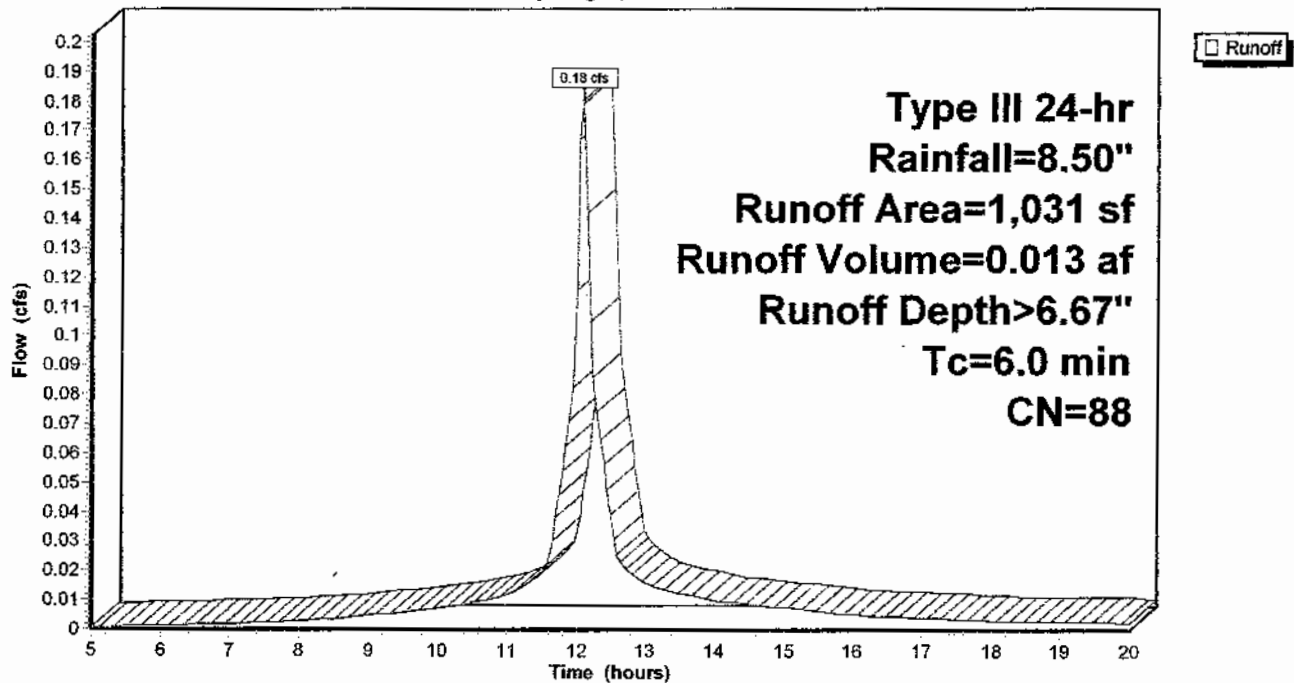
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dl= 0.05 hrs
Type III 24-hr Rainfall=8.50"

Area (sf)	CN	Description
265	61	>75% Grass cover, Good, HSG B
766	98	Paved parking & roofs
1,031	88	Weighted Average
265		Pervious Area
766		Impervious Area

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

Subcatchment 3S: Driveway

Hydrograph



Pond 1P: Parking Subsurface Drainage System

Inflow Area = 0.161 ac, Inflow Depth > 7.54"
 Inflow = 1.31 cfs @ 12.09 hrs, Volume= 0.101 af
 Outflow = 0.20 cfs @ 12.58 hrs, Volume= 0.101 af, Atten= 85%, Lag=
 Primary = 0.20 cfs @ 12.58 hrs, Volume= 0.101 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 95.24' @ 12.58 hrs Surf.Area= 0 sf Storage= 1,369 cf

Plug-Flow detention time= 46.9 min calculated for 0.101 af (100% of inflow)
 Center-of-Mass det. time= 46.6 min (781.1 - 734.5)

Volume	Invert	Avail.Storage	Storage Description
#1	92.75'	1,459 cf	Custom Stage Data Listed below

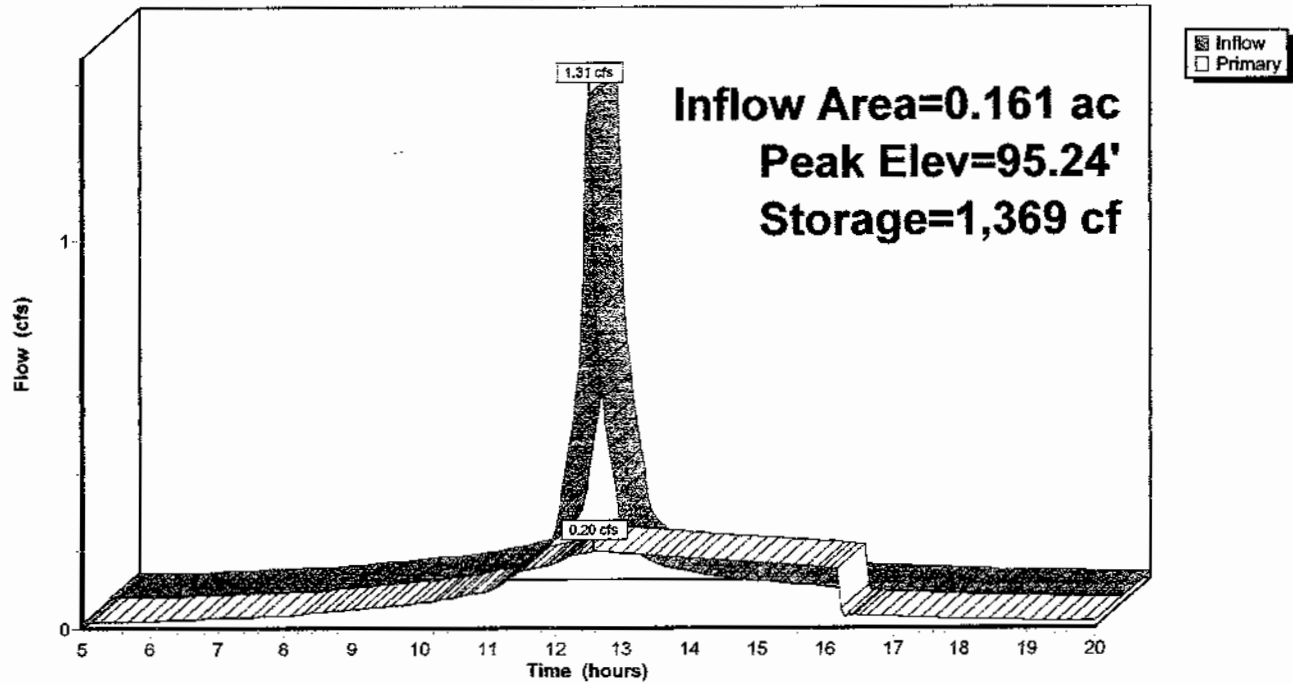
Elevation (feet)	Cum.Store (cubic-feet)
92.75	0
93.25	174
94.25	936
95.45	1,459

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	Custom Exfiltration
			Elev. (feet) 92.75 92.76 93.25 94.25 95.45
			Disch. (cfs) 0.000 0.150 0.160 0.180 0.200

Primary OutFlow Max=0.20 cfs @ 12.58 hrs HW=95.24' (Free Discharge)
 1=Custom Exfiltration (Custom Controls 0.20 cfs)

Pond 1P: Parking Subsurface Drainage System

Hydrograph



Pond 2P: Entrance Subsurface Drainage System

Inflow Area = 0.024 ac, Inflow Depth > 6.67"
 Inflow = 0.18 cfs @ 12.09 hrs, Volume= 0.013 af
 Outflow = 0.04 cfs @ 12.50 hrs, Volume= 0.013 af, Allen= 78%, Lag=
 Primary = 0.04 cfs @ 12.50 hrs, Volume= 0.013 af

Routing by Stor-Ind method, Time Spcn= 5.00-20.00 hrs, dt= 0.05 hrs
 Peak Elev= 90.27' @ 12.50 hrs Surf.Area= 0 sf Storage= 158 cf

Plug-Flow detention time= 26.5 min calculated for 0.013 af (100% of inflow)
 Center-of-Mass det. time= 26.4 min (779.2 - 752.8)

Volume	Invert	Avail.Storage	Storage Description
#1	88.50'	217 cf	Custom Stage Data Listed below

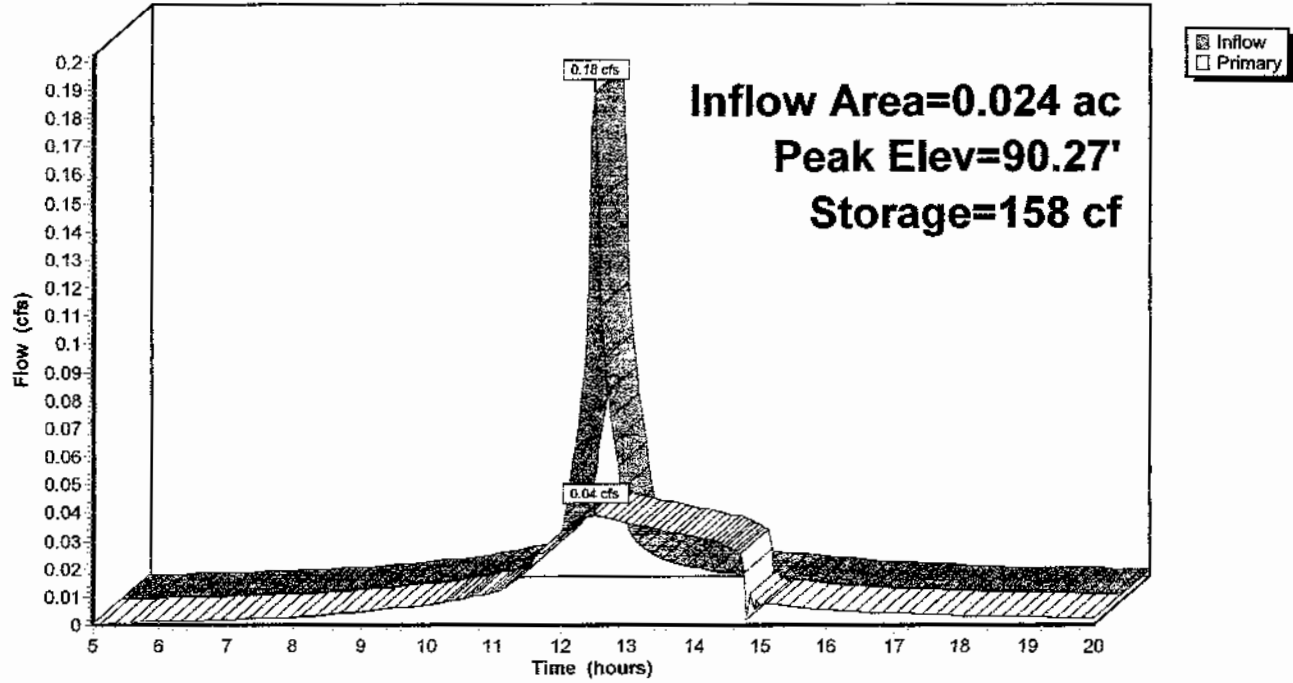
Elevation (feet)	Cum.Store (cubic-feet)
88.50	0
89.00	30
90.00	141
91.20	217

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	Exfiltration
			Flev. (feet) 88.50 88.51 89.00 90.00
			91.20
			Disch. (cfs) 0.000 0.025 0.030 0.037
			0.046

Primary OutFlow Max=0.04 cfs @ 12.50 hrs HW=90.27' (Free Discharge)
 1=Exfiltration (Custom Controls 0.04 cfs)

Pond 2P: Entrance Subsurface Drainage System

Hydrograph



***Operation and Maintenance
Plan***

Operation and Maintenance Plan for Drainage System

Project Name: 22 Highland Street, Winchester

Date: January 20, 2010

Site Location: 22 Highland Street
Winchester, Massachusetts

Site Operator:

Owner: Winchester Housing Authority
Address: 13 Westley Street
Winchester, MA 01890

The following Operation and Maintenance Plan (O & M Plan) has been developed to comply with DEP's Stormwater Management Policy. The responsibilities outlined in the O&M Plan run with ownership of the property.

Subsurface Infiltration Systems

Ensure proper operation in initial months of operation:

- Observe at several intervals during and after small and large rain storms to ensure that the systems are functioning as intended. Note how long water remains standing in structures after storm events and how well the water infiltrates over a period of 48 to 72 hours.
- Repair items such as upland sediment erosion.

Semi annually inspection of systems for proper functioning and look for:

- Subsidence
- Cracking of structures

Stormceptor STC 450i

Ensure proper operation in initial months of operation:

- Ensure that at the end of large storms the roadway grate is clear from debris.
- Follow strict manufacturer guidance for maintenance.

As necessary:

- Remove sediment from systems at least once every 2 years;
 - Dispose and transport accumulated sediment off-site in accordance with local, state and federal guidelines and regulations;
 - Any modifications to the drainage systems or the contributing watersheds shall be reported to the Winchester Town Engineer (or Consulting Engineer).
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