2014

DRAINAGE REPORT

FOR
807 EAST TERRA LANE

MAY 22, 2013

INDEX

INTRODUCTION

The project scope of work include the construction of parking lot for approximately 30 cars. The property is approximately 2.5 Acres.

The Water Quality will be addressed for the relevant improvements and the Dry Swale per Georgia Stormwater Management Manual has been selected.

The Channel Protection will be addressed for entire lot and for future improvements. The required volume will be stored in the detention basin and released with appropriate flow rate.

The Flood Protection will be addressed for the entire lot and for future improvements. The required volumes will be detained and released with appropriate rates to meet City of O'Fallon design criteria.

Summary Table

	2 - year peak discharge	15 - year peak discharge	25 - year peak discharge	100 - year peak discharge
Pre - Developed	1.62 cfs	7.84 cfs	8.84 cfs	12.71 cfs
Post - Developed no detention	7.62 cfs	13.84 cfs	14.96 cfs	19.14 cfs
Post - Developed with detention	1.11 cfs	6.92 cfs	7.98 cfs	11.98 cfs
High Water Elevation	536.08	536.90	537.03	537.44
High Water Elevation Low flow Blocked				537.49

WATER QUALITY

The Water Quality Volume (denoted as WQv) is the storage needed to capture and treat the runoff from 90% of the recorded daily rainfall events. In numerical terms, it is equivalent to 1.14 inches of rainfall multiplied by the volumetric runoff coefficient (Rv) and site area. The WQv is directly related to the amount of impervious cover created at a site.

The following equations are used to determine the storage volume, WQv (in acre-feet

of storage):

WQv = [(P) (Rv) (A)]/12 P = 1.14 inches of rainfall

Where: WQv =water quality volume (in acre-feet)

Rv =0.05 + 0.009 (I) where I is percent impervious cover

A =area in acres

(2) Measuring Impervious Cover: The measured area of a site plan that does not have vegetative or permeable cover shall be considered total impervious cover.

(3) Multiple Drainage Areas: When a project contains or is divided by multiple drainage areas, the WQv volume shall be addressed for each drainage area.

(4) Offsite Drainage Areas: Offsite existing impervious areas may be excluded from the calculation of the water quality volume requirements.

WQv = [(P) (Rv) (A)] / 12 (Ac-ft)

P = Rainfall depth in inches and equal to 1.14.

Rv = 0.05 + 0.009(I);

Where (I) is present impervious cover

A1= Parking Lot = 10,300 sq.ft. = 0.236 Acres

A2= Roof and Driveway = 3,700 sq.ft. = 0.085 Acres

I= (A1 + A2) / Atotal = (0.236 + 0.085) / 2.52 = 0.127 = 12.7%

Rv = 0.05 + 0.009 (12.7) = 0.164

Atotal = 2.52 Acres

WQv = [(1.14) (0.164) (2.52)] / 12 = 0.0393 Ac-ft = 1,710 cu. ft.

Check minimum: [(0.2") (2.52 Ac)]/12 = 0.042 Ac-ft = 1,830 cu. ft.

Water Quality Volume Required = 0.1634 Ac-ft = 1,830 cu. ft.

The Dry Swale per Georgia Stormwater Management Manual has been selected. The required volume will be stored at and above the contour 539 with the ponding not to exceed 18". Area of the contour 539 is 920 sq. ft. and contour 540 is 1,658 sq. ft. That would provide (920 + 1,658)/2 x 1.5= 1,918 cu. ft. That is more then required 1,830 cu. ft.

CHANNEL PROTECTION

To protect channels from erosion, a 24-hour extended detention of the one-year, 24-hour storm event shall be provided. The rationale for this criterion is that runoff will be stored and released in such a gradual manner those critical erosive velocities during bankfull and near-bankfull events will seldom be exceeded in downstream channels.

A detention pond or underground vault is normally needed to meet the CPv requirement.

As a Basis for determining Channel Protection Storage Volume the following assumptions have been made:

(1) The rainfall depth for the one-year, 24-hour storm event is 2.50 inches. Use Type II rainfall distribution.

(2) The length of overland flow used in time of concentration (Tc) calculations is limited to no more than 100 feet for post-project conditions.

(3) The 24-hour extended detention is defined as providing a 24-hour detention lag time (T) for the one-year storm. The lag time is defined as the interval between the center of mass of the inflow hydrograph and the center of mass of the outflow hydrograph.

(4) Cpv is not required at sites where the one-year post development peak discharge is less than or equal to 2.0 cfs. A Cpv orifice diameter of less than 3.0" is not recommended.

(5) Cpv shall be addressed for the entire site. If a site consists of multiple drainage areas, Cpv may be distributed proportionately to each drainage area.

(6) Extended detention storage provided for the Cpv does not fully meet the WQv requirement (that is Cpv and WQv should be treated separately).

(7) Infiltration is not recommended for Cpv control because of large storage requirements associated with the clayey soils in the area.

TR-55 method has been used to estimate the time of concentration Tc. The CN=94 for Urban Commercial 85% imp. Soils Class C would be used.

Post-Developed Conditions *Type II 24-hr 1 year Rainfall=2.50"*
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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: Post-developed Runoff Area=2.600 ac 85.00% Impervious Runoff Depth>1.75"
Flow Length=400' Tc=15.8 min CN=94 Runoff=5.90 cfs 0.379 af

Pond 2P: Detention Basin Inflow=5.90 cfs 0.379 af
Primary=5.90 cfs 0.379 af

Total Runoff Area = 2.600 ac Runoff Volume = 0.379 af Average Runoff Depth = 1.75"
15.00% Pervious = 0.390 ac 85.00% Impervious = 2.210 ac

T= 15.8 min = 0.263 hours

Compute the "initial abstraction"

Ia = 200/CN-2; CN = 94; Ia=200/94 - 2 = 0.128

P is the 1yr rainfall depth P = 2.50 inches

Compute the ratio Ia/P = 0.128/2.50 = 0.0512

TR-55 has been used to estimate one year post-developed runoff depth Qa = 1.75 inches as follows:

Summary for Subcatchment 1S: Post-developed

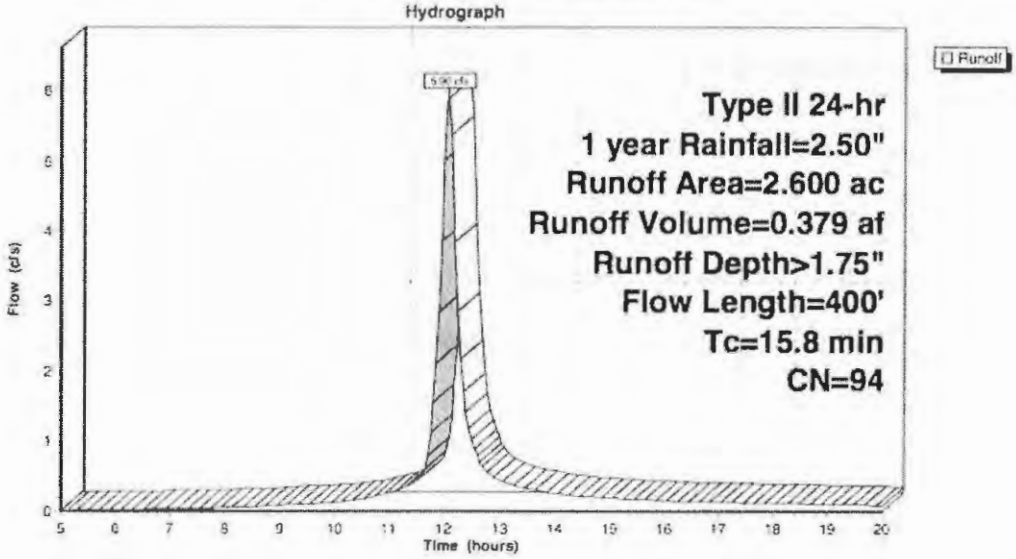
Runoff = 5.90 cfs @ 12.07 hrs, Volume= 0.379 af, Depth> 1.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 year Rainfall=2.50"

Area (ac)	CN	Description
2.600	94	Urban commercial, 85% imp, HSG C
0.390		15.00% Pervious Area
2.210		85.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	100	0.0200	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.10"
1.3	300	0.0338	3.73		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
15.8	400	Total			

Subcatchment 1S: Post-developed



With = 0.263 hours and Ia/P = 0.0512 known we can find out the peak factor qu = 760 csm/in

From the chart on Figure D.11.1 (see next page):

Appendix D-11....Method for Computing the Channel Protection Storage Volume (Cp.)

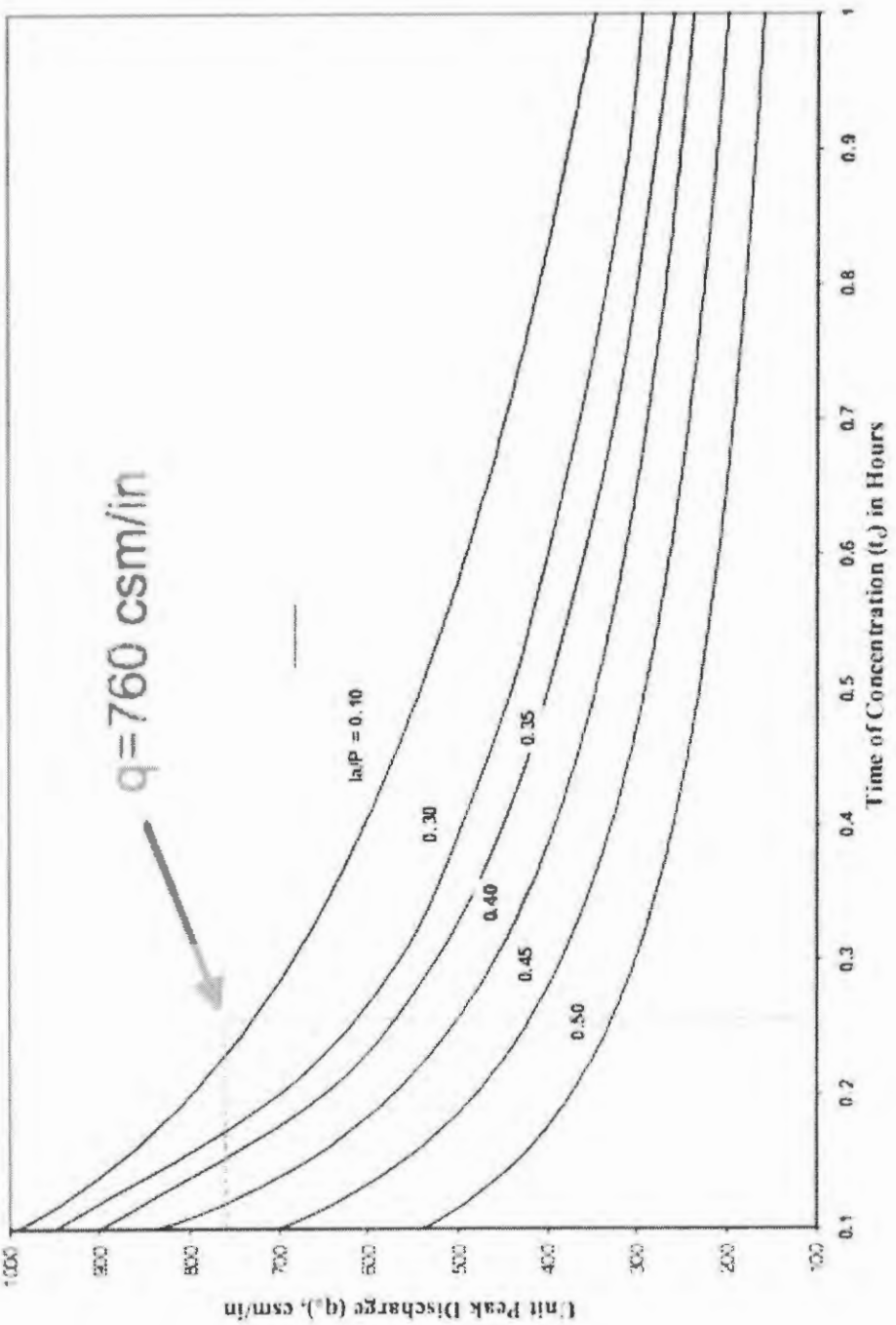


Figure D.11.1 SCS Graphical Method of Determining Peak Discharge (q_u) in csm/in for 24-Hour Type II Storm Distribution

Compute the one year post-development peak discharge

$qi = quAQa$ = 760 x 0.0040625 x 1.75 = 5.40 cfs

A is the drainage in square miles. A= 2.60 Ac. = 2.60 / 640 = 0.0040625 sq. mi.

q i =5.40 cfs > 2.0 cfs, Therefore the channel protection storage Cpv is required.

With *qu*, find the ratio of outflow to inflow (*qo/qi*) for T = 24 hours from Figure D.11.2

(See next page)

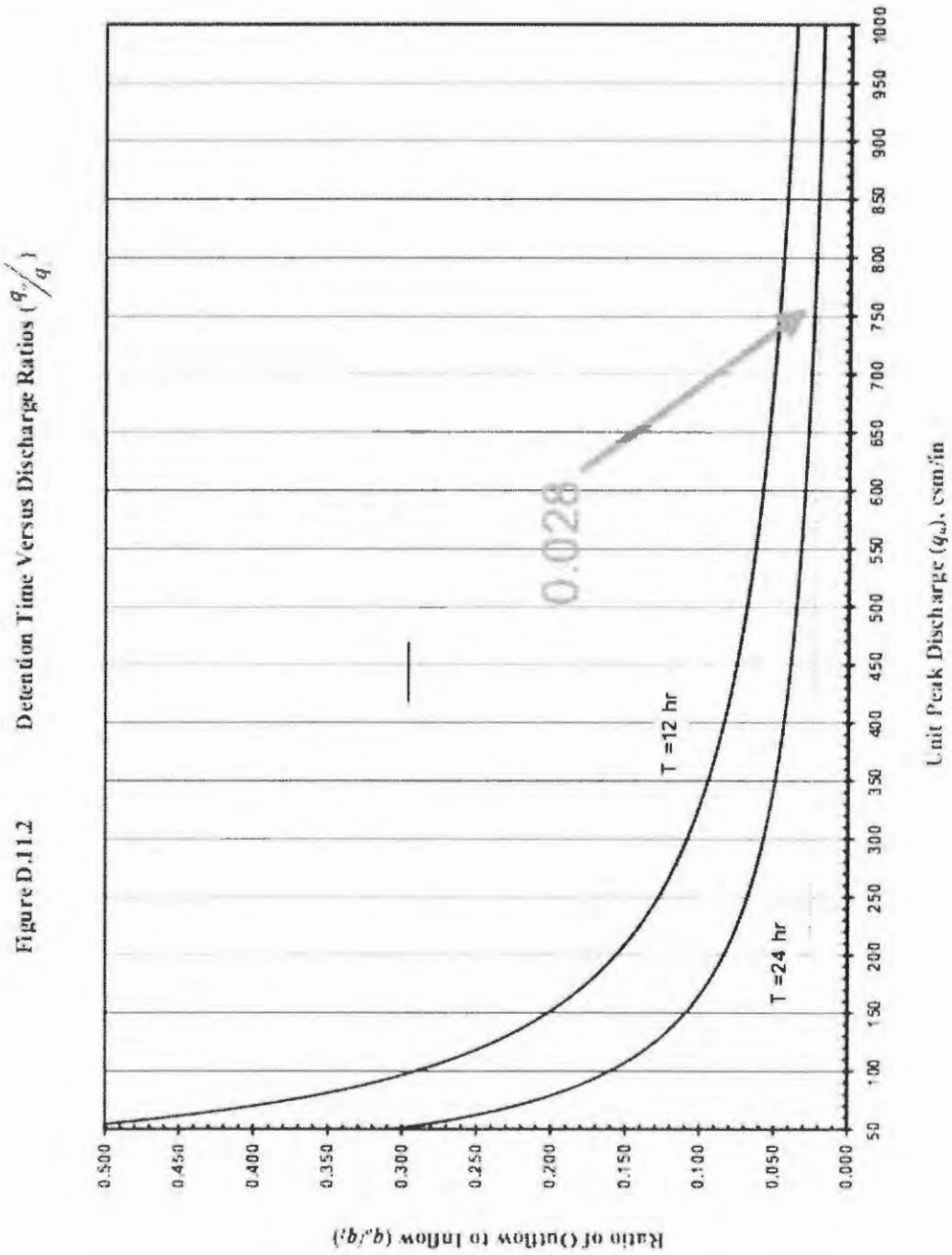


Figure D.11.2

From the graph D.11.2. q0/qi = 0.028

Compute the peak outflow discharge q0 = (q0/qi) x qi = 0.028 x 5.40 = 0.1512 cfs

With q0/qi compute the ratio of storage to runoff volume (Vs/Vr)

$Vs/Vr = 0.683 - 1.43(q0/qi) + 1.64(q0/qi)^2 - 0.804(q0/qi)^3 =$

$= 0.683 - 1.43(0.028) + 1.64(0.028)^2 - 0.804(0.028)^3 = 0.683 - 0.040 + 0.001286 - 0.00001765 = 0.644$

Compute the extended detention storage volume Vs = (Vs/Vr) x Vr = 0.644 (1.75) (1/12) (2.60) = 0.2442 Ac-ft = 10,637 cu. ft.

Storage Volume *Vs = 10,637 cu. ft. = 0.244 Acre-ft.*

qi is known *qi = 5.40 cfs,* therefore,

qo =(qo/qi)qi = 0.028(5.40) = 0.151 cfs

Release rate *qo = 0.151 cfs*

The low flow orifice in the detention outflow structure will be sized to address the required storage volume and rate of release.

Ab it shown on the following pages the required storage would be reached at elevation 535.75 and with the rate of release at that elevation 0.14 cfs

Post-Developed Conditions *Type II 24-hr 1 year Rainfall=2.50"*
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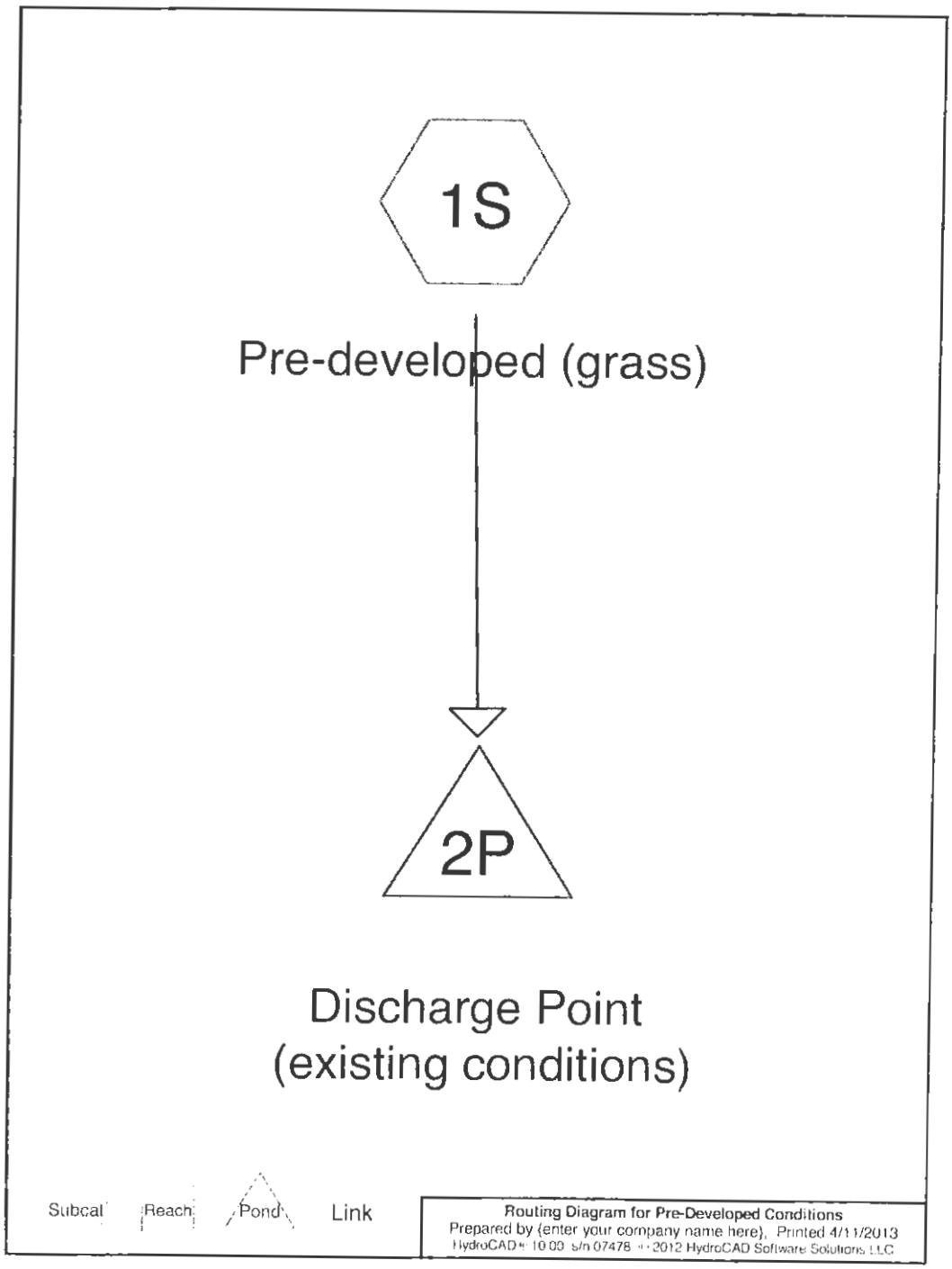
Stage-Area-Storage for Pond 2P: Detention Basin

Elevation (feet)	Surface (acres)	Storage (acre-feet)	Elevation (feet)	Surface (acres)	Storage (acre-feet)
533.90	0.001	0.000	536.50	0.172	0.370
533.95	0.065	0.002	536.55	0.173	0.379
534.00	0.129	0.007	536.60	0.174	0.387
534.05	0.129	0.013	536.65	0.176	0.396
534.10	0.130	0.019	536.70	0.177	0.405
534.15	0.130	0.026	536.75	0.178	0.414
534.20	0.130	0.032	536.80	0.179	0.423
534.25	0.131	0.039	536.85	0.180	0.432
534.30	0.131	0.046	536.90	0.182	0.441
534.35	0.131	0.052	536.95	0.183	0.450
534.40	0.132	0.059	537.00	0.184	0.459
534.45	0.132	0.065	537.05	0.185	0.468
534.50	0.132	0.072	537.10	0.185	0.477
534.55	0.133	0.079	537.15	0.186	0.487
534.60	0.133	0.085	537.20	0.187	0.496
534.65	0.134	0.092	537.25	0.187	0.505
534.70	0.134	0.099	537.30	0.188	0.515
534.75	0.134	0.105	537.35	0.189	0.524
534.80	0.135	0.112	537.40	0.189	0.534
534.85	0.135	0.119	537.45	0.190	0.543
534.90	0.135	0.125	537.50	0.190	0.553
534.95	0.136	0.132	537.55	0.191	0.562
535.00	0.136	0.139	537.60	0.192	0.572
535.05	0.137	0.146	537.65	0.192	0.581
535.10	0.138	0.153	537.70	0.193	0.591
535.15	0.140	0.160	537.75	0.194	0.601
535.20	0.141	0.167	537.80	0.194	0.610
535.25	0.142	0.174	537.85	0.195	0.620
535.30	0.143	0.181	537.90	0.196	0.630
535.35	0.144	0.188	537.95	0.196	0.640
535.40	0.146	0.195	538.00	0.197	0.650
535.45	0.147	0.203			
535.50	0.148	0.210			
535.55	0.149	0.217			
535.60	0.150	0.225			
535.65	0.152	0.232			
535.70	0.153	0.240			
535.75	0.154	0.248			
535.80	0.155	0.255			
535.85	0.156	0.263			
535.90	0.158	0.271			
535.95	0.159	0.279			
536.00	0.160	0.287			
536.05	0.161	0.295			
536.10	0.162	0.303			
536.15	0.164	0.311			
536.20	0.165	0.319			
536.25	0.166	0.328			
536.30	0.167	0.336			
536.35	0.168	0.344			
536.40	0.170	0.353			
536.45	0.171	0.361			


1S
Pre-developed (grass)
2P
Discharge Point
(existing conditions)
Subcat
Reach
Pond
Link
Routing Diagram for Pre-Developed Conditions
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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.600	74	>75% Grass cover, Good, HSG C (1S)
2.600	**74**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
2.600	HSG C	1S
0.000	HSG D	
0.000	Other	
2.600		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	2.600	0.000	0.000	2.600	>75% Grass cover, Good	1S
0.000	**0.000**	**2.600**	**0.000**	**0.000**	**2.600**	**TOTAL AREA**	

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: Pre-developed (grass) Runoff Area=2.600 ac 0.00% Impervious Runoff Depth>0.54"
Flow Length=400' Tc=18.4 min CN=74 Runoff=1.62 cfs 0.116 af

Pond 2P: Discharge Point (existing conditions) Inflow=1.62 cfs 0.116 af
Primary=1.62 cfs 0.116 af

Total Runoff Area = 2.600 ac Runoff Volume = 0.116 af Average Runoff Depth = 0.54"
100.00% Pervious = 2.600 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Pre-developed (grass)

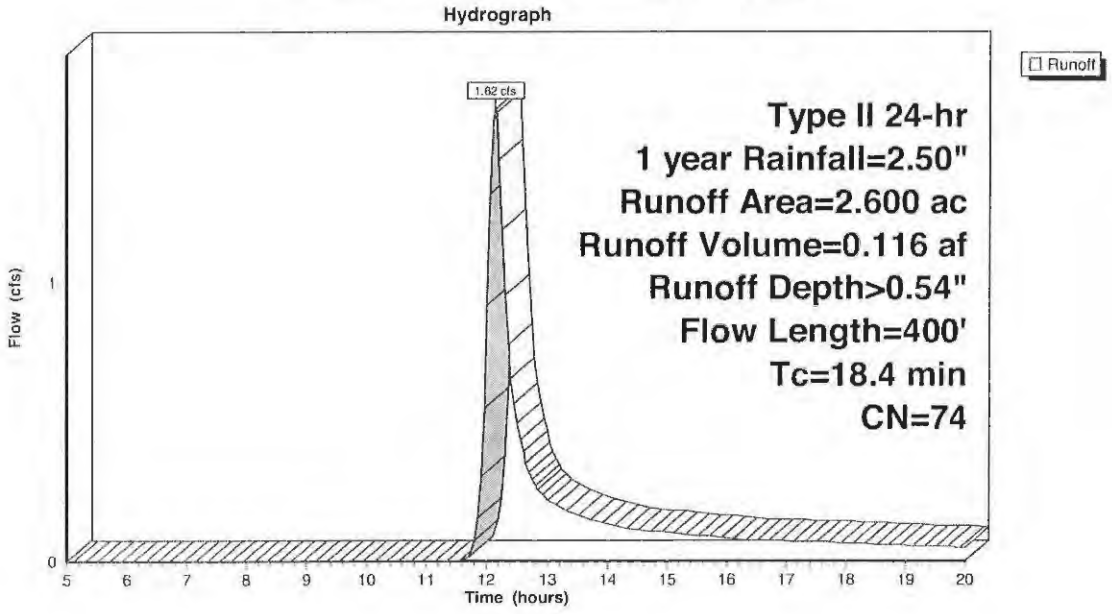
Runoff = 1.62 cfs @ 12.13 hrs, Volume= 0.116 af, Depth> 0.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1 year Rainfall=2.50"

Area (ac)	CN	Description
2.600	74	>75% Grass cover, Good, HSG C
2.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	100	0.0200	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.10"
3.9	300	0.0338	1.29		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
18.4	400	Total			

Subcatchment 1S: Pre-developed (grass)

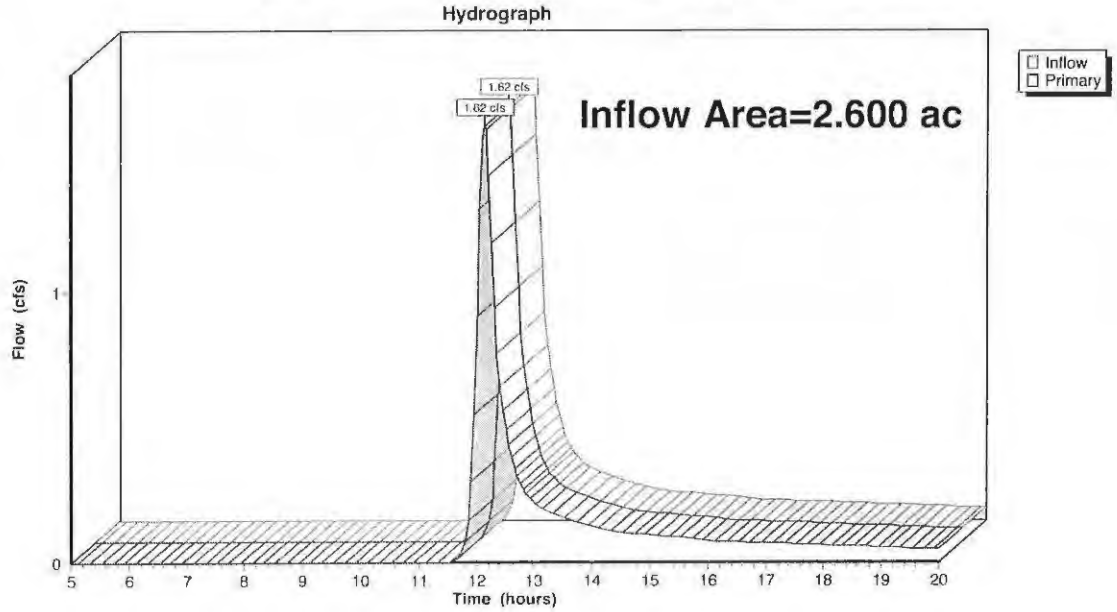


Summary for Pond 2P: Discharge Point (existing conditions)

Inflow Area = 2.600 ac, 0.00% Impervious, Inflow Depth > 0.54" for 1 year event
Inflow = 1.62 cfs @ 12.13 hrs, Volume= 0.116 af
Primary = 1.62 cfs @ 12.13 hrs, Volume= 0.116 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Pond 2P: Discharge Point (existing conditions)



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: Pre-developed (grass) Runoff Area=2.600 ac 0.00% Impervious Runoff Depth>0.87"
Flow Length=400' Tc=18.4 min CN=74 Runoff=2.77 cfs 0.189 af

Pond 2P: Discharge Point (existing conditions) Inflow=2.77 cfs 0.189 af
Primary=2.77 cfs 0.189 af

Total Runoff Area = 2.600 ac Runoff Volume = 0.189 af Average Runoff Depth = 0.87"
100.00% Pervious = 2.600 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Pre-developed (grass)

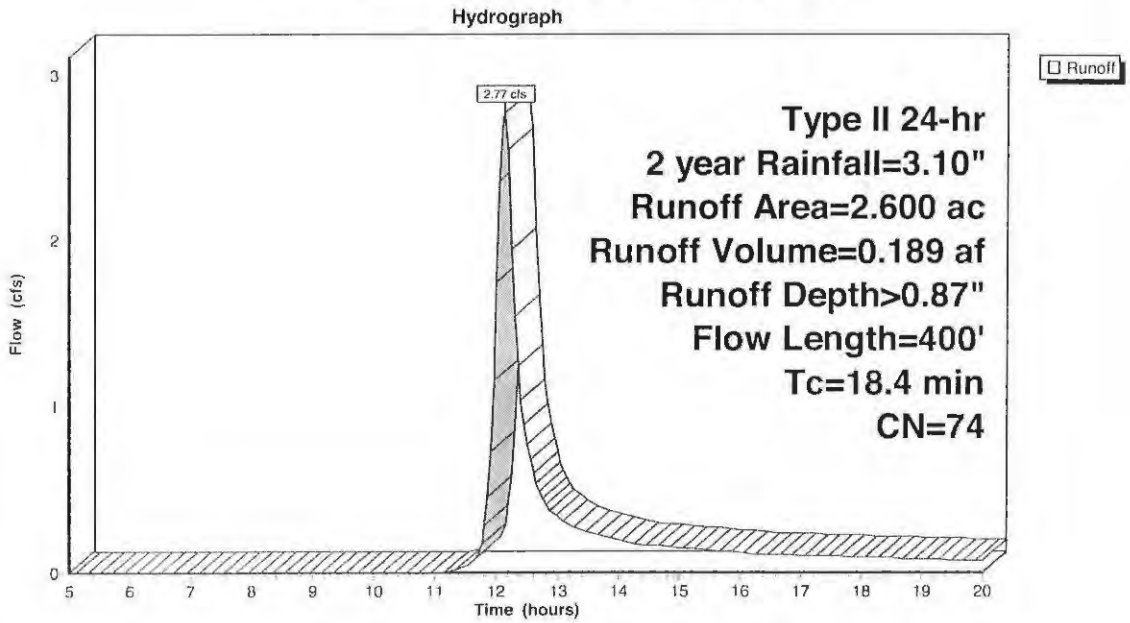
Runoff = 2.77 cfs @ 12.12 hrs, Volume= 0.189 af, Depth> 0.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2 year Rainfall=3.10"

Area (ac)	CN	Description
2.600	74	>75% Grass cover, Good, HSG C
2.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	100	0.0200	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.10"
3.9	300	0.0338	1.29		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
18.4	400	Total			

Subcatchment 1S: Pre-developed (grass)

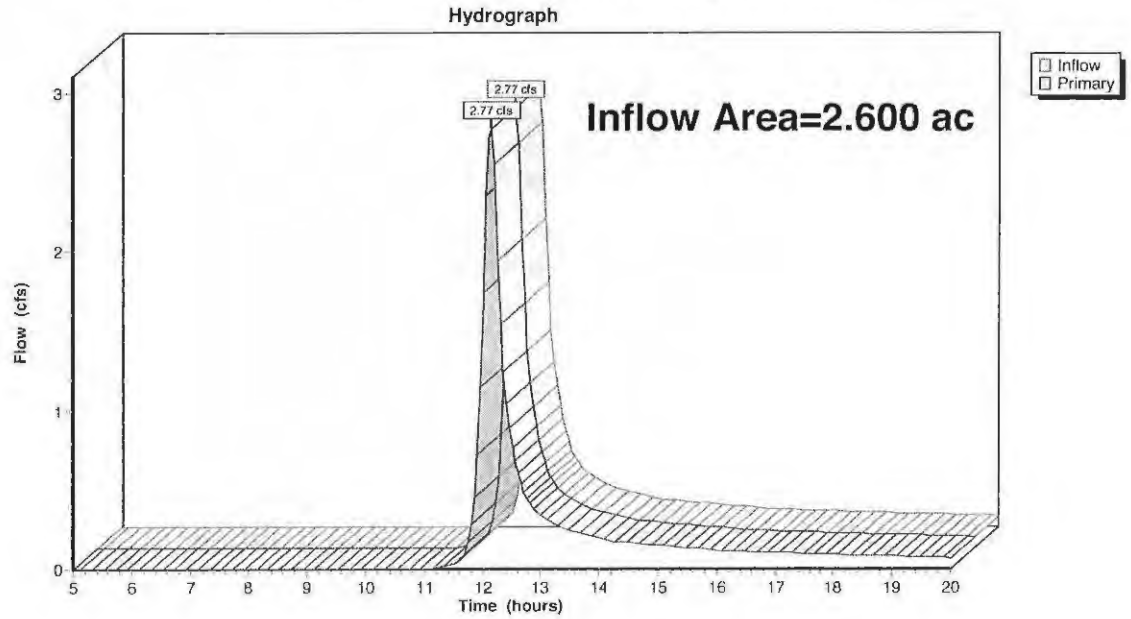


Summary for Pond 2P: Discharge Point (existing conditions)

Inflow Area = 2.600 ac, 0.00% Impervious, Inflow Depth > 0.87" for 2 year event
Inflow = 2.77 cfs @ 12.12 hrs, Volume= 0.189 af
Primary = 2.77 cfs @ 12.12 hrs, Volume= 0.189 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Pond 2P: Discharge Point (existing conditions)



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: Pre-developed (grass) Runoff Area=2.600 ac 0.00% Impervious Runoff Depth>2.39"
Flow Length=400' Tc=18.4 min CN=74 Runoff=7.84 cfs 0.517 af

Pond 2P: Discharge Point (existing conditions) Inflow=7.84 cfs 0.517 af
Primary=7.84 cfs 0.517 af

Total Runoff Area = 2.600 ac Runoff Volume = 0.517 af Average Runoff Depth = 2.39"
100.00% Pervious = 2.600 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: Pre-developed (grass)

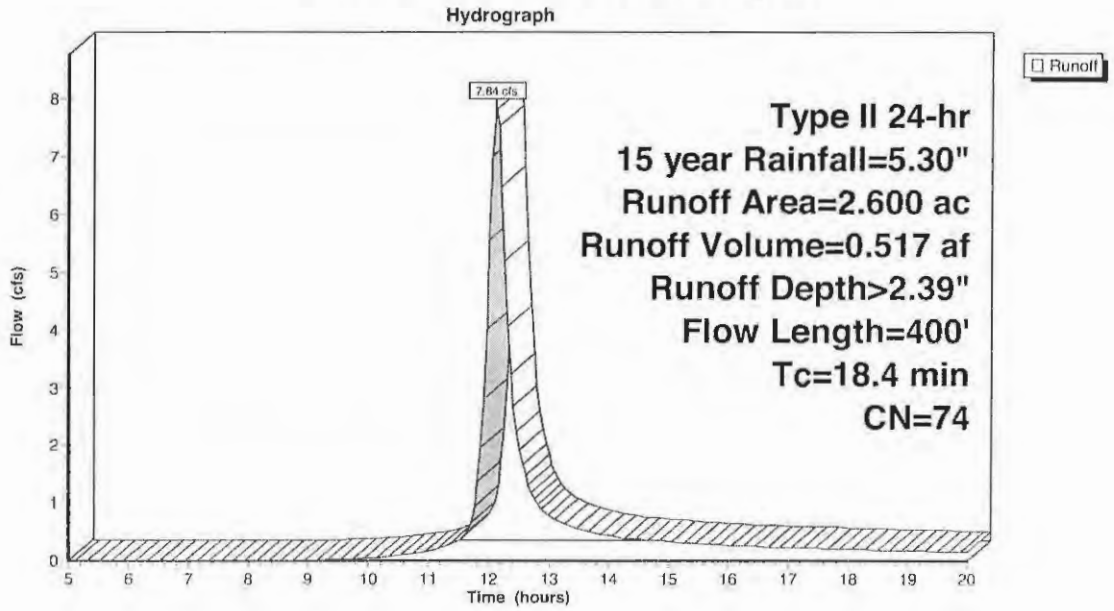
Runoff = 7.84 cfs @ 12.11 hrs, Volume= 0.517 af, Depth> 2.39"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 15 year Rainfall=5.30"

Area (ac)	CN	Description
2.600	74	>75% Grass cover, Good, HSG C
2.600		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	100	0.0200	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.10"
3.9	300	0.0338	1.29		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
18.4	400	Total			

Subcatchment 1S: Pre-developed (grass)

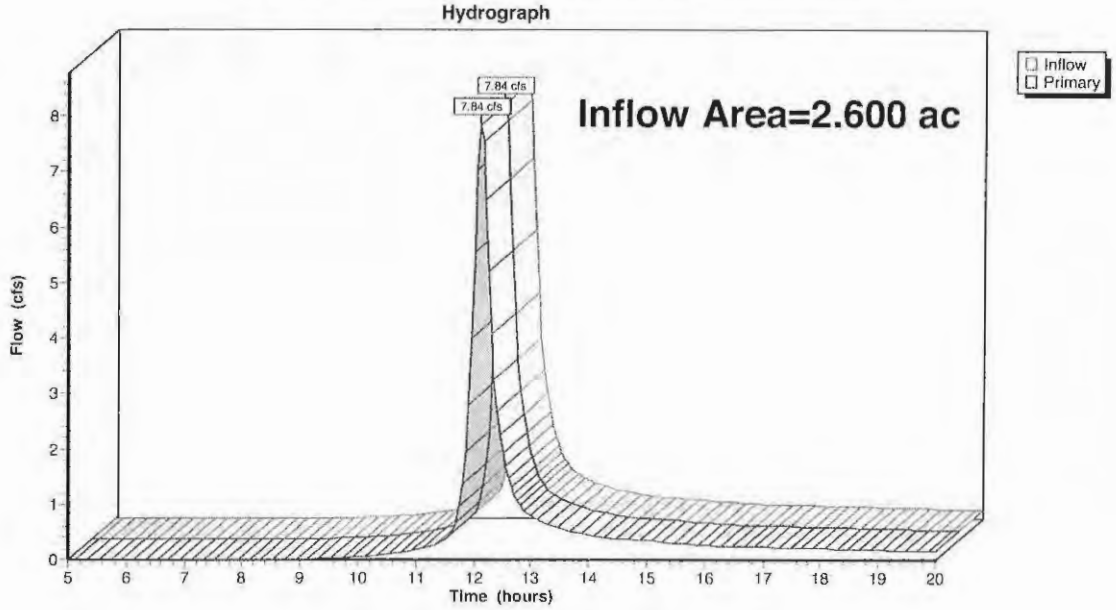


Summary for Pond 2P: Discharge Point (existing conditions)

Inflow Area = 2.600 ac, 0.00% Impervious, Inflow Depth > 2.39" for 15 year event
Inflow = 7.84 cfs @ 12.11 hrs, Volume= 0.517 af
Primary = 7.84 cfs @ 12.11 hrs, Volume= 0.517 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Pond 2P: Discharge Point (existing conditions)



Pre-Developed Conditions add 25 year event *Type II 24-hr 25-Year Rainfall=5.70"*
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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: Pre-developed (grass) Runoff Area=2.600 ac 0.00% Impervious Runoff Depth>2.69"
Flow Length=400' Tc=18.4 min CN=74 Runoff=8.84 cfs 0.583 af

Pond 2P: Discharge Point (existing conditions) Inflow=8.84 cfs 0.583 af
Primary=8.84 cfs 0.583 af

Total Runoff Area = 2.600 ac Runoff Volume = 0.583 af Average Runoff Depth = 2.69"
100.00% Pervious = 2.600 ac 0.00% Impervious = 0.000 ac

Post-Developed Conditions add 25 year event *Type II 24-hr 25-Year Rainfall=5.70"*
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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Post-developed Runoff Area=2.600 ac 85.00% Impervious Runoff Depth>4.99"
Flow Length=400' Tc=15.8 min CN=94 Runoff=14.96 cfs 1.080 af

Pond 2P: Detention Basin Peak Elev=537.03' Storage=0.464 af Inflow=14.96 cfs 1.080 af
Outflow=7.98 cfs 0.821 af

Total Runoff Area = 2.600 ac Runoff Volume = 1.080 af Average Runoff Depth = 4.99"
15.00% Pervious = 0.390 ac 85.00% Impervious = 2.210 ac

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: Pre-developed (grass) Runoff Area=2.600 ac 0.00% Impervious Runoff Depth>3.89"
Flow Length=400' Tc=18.4 min CN=74 Runoff=12.71 cfs 0.844 af

Pond 2P: Discharge Point (existing conditions) Inflow=12.71 cfs 0.844 af
Primary=12.71 cfs 0.844 af

Total Runoff Area = 2.600 ac Runoff Volume = 0.844 af Average Runoff Depth = 3.89"
100.00% Pervious = 2.600 ac 0.00% Impervious = 0.000 ac

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
2.600	HSG C	1S
0.000	HSG D	
0.000	Other	
2.600		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	2.600	0.000	0.000	2.600	Urban commercial, 85% imp	1S
0.000	**0.000**	**2.600**	**0.000**	**0.000**	**2.600**	**TOTAL AREA**	

Hydrograph for Subcatchment 1S: Post-developed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	13.00	2.39	1.77	0.57
0.25	0.01	0.00	0.00	13.25	2.44	1.81	0.48
0.50	0.02	0.00	0.00	13.50	2.48	1.85	0.42
0.75	0.02	0.00	0.00	13.75	2.51	1.88	0.37
1.00	0.03	0.00	0.00	14.00	2.54	1.91	0.33
1.25	0.04	0.00	0.00	14.25	2.57	1.94	0.29
1.50	0.05	0.00	0.00	14.50	2.60	1.96	0.27
1.75	0.06	0.00	0.00	14.75	2.62	1.99	0.26
2.00	0.07	0.00	0.00	15.00	2.65	2.01	0.25
2.25	0.08	0.00	0.00	15.25	2.67	2.03	0.23
2.50	0.09	0.00	0.00	15.50	2.69	2.05	0.22
2.75	0.10	0.00	0.00	15.75	2.71	2.07	0.21
3.00	0.11	0.00	0.00	16.00	2.73	2.09	0.19
3.25	0.12	0.00	0.00	16.25	2.75	2.10	0.18
3.50	0.13	0.00	0.00	16.50	2.76	2.12	0.17
3.75	0.14	0.00	0.00	16.75	2.78	2.14	0.17
4.00	0.15	0.00	0.00	17.00	2.80	2.15	0.17
4.25	0.16	0.00	0.01	17.25	2.81	2.17	0.16
4.50	0.17	0.00	0.01	17.50	2.83	2.18	0.16
4.75	0.18	0.00	0.02	17.75	2.84	2.20	0.15
5.00	0.20	0.01	0.02	18.00	2.86	2.21	0.15
5.25	0.21	0.01	0.02	18.25	2.87	2.22	0.14
5.50	0.22	0.01	0.03	18.50	2.88	2.24	0.14
5.75	0.23	0.02	0.03	18.75	2.89	2.25	0.13
6.00	0.25	0.02	0.04	19.00	2.91	2.26	0.13
6.25	0.26	0.02	0.04	19.25	2.92	2.27	0.12
6.50	0.28	0.03	0.05	19.50	2.93	2.28	0.12
6.75	0.29	0.03	0.05	19.75	2.94	2.29	0.11
7.00	0.31	0.04	0.06	20.00	2.95	2.30	0.11
7.25	0.32	0.05	0.06	20.25	2.96	2.31	0.10
7.50	0.34	0.05	0.07	20.50	2.97	2.32	0.10
7.75	0.36	0.06	0.07	20.75	2.98	2.33	0.10
8.00	0.37	0.07	0.08	21.00	2.99	2.34	0.10
8.25	0.39	0.08	0.09	21.25	3.00	2.35	0.10
8.50	0.41	0.09	0.10	21.50	3.01	2.36	0.10
8.75	0.43	0.10	0.11	21.75	3.02	2.37	0.10
9.00	0.46	0.11	0.13	22.00	3.03	2.38	0.10
9.25	0.48	0.13	0.14	22.25	3.04	2.39	0.09
9.50	0.51	0.14	0.15	22.50	3.05	2.40	0.09
9.75	0.53	0.16	0.16	22.75	3.06	2.40	0.09
10.00	0.56	0.18	0.18	23.00	3.07	2.41	0.09
10.25	0.59	0.20	0.21	23.25	3.07	2.42	0.09
10.50	0.63	0.22	0.25	23.50	3.08	2.43	0.09
10.75	0.68	0.25	0.30	23.75	3.09	2.44	0.09
11.00	0.73	0.29	0.36	24.00	3.10	2.45	0.09
11.25	0.79	0.34	0.45				
11.50	0.88	0.40	0.60				
11.75	1.20	0.67	1.50				
12.00	2.06	1.45	6.49				
12.25	2.19	1.57	3.65				
12.50	2.28	1.66	1.30				
12.75	2.34	1.72	0.74				

Summary for Pond 2P: Detention Basin

Inflow Area = 2.600 ac, 85.00% Impervious, Inflow Depth > 2.44" for 2 year event
Inflow = 7.62 cfs @ 12.07 hrs, Volume= 0.529 af
Outflow = 1.11 cfs @ 12.56 hrs, Volume= 0.289 af, Atten= 85%, Lag= 29.5 min
Primary = 1.11 cfs @ 12.56 hrs, Volume= 0.289 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 536.08' @ 12.56 hrs Surf.Area= 0.162 ac Storage= 0.300 af

Plug-Flow detention time= 250.2 min calculated for 0.289 af (55% of inflow)
Center-of-Mass det. time= 141.9 min (933.9 - 792.0)

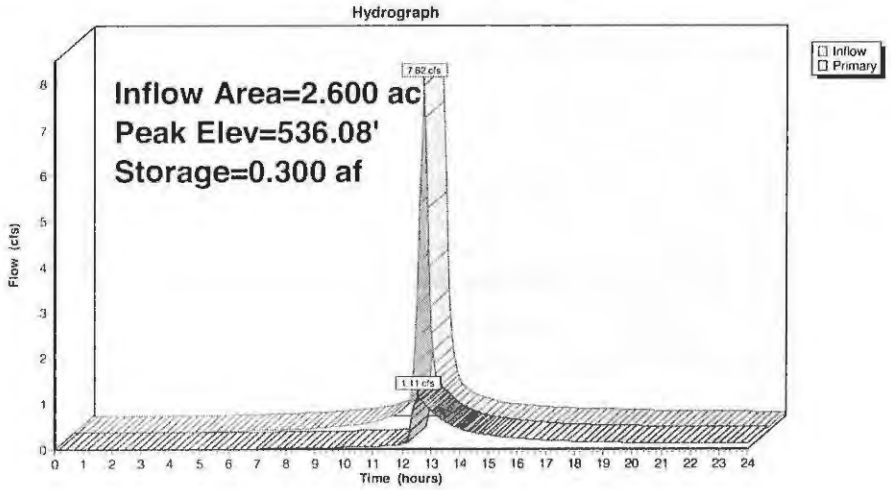
Volume	Invert	Avail.Storage	Storage Description
#1	533.90'	0.650 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
533.90	0.001	0.000	0.000
534.00	0.129	0.007	0.007
535.00	0.136	0.132	0.139
536.00	0.160	0.148	0.287
537.00	0.184	0.172	0.459
538.00	0.197	0.190	0.650

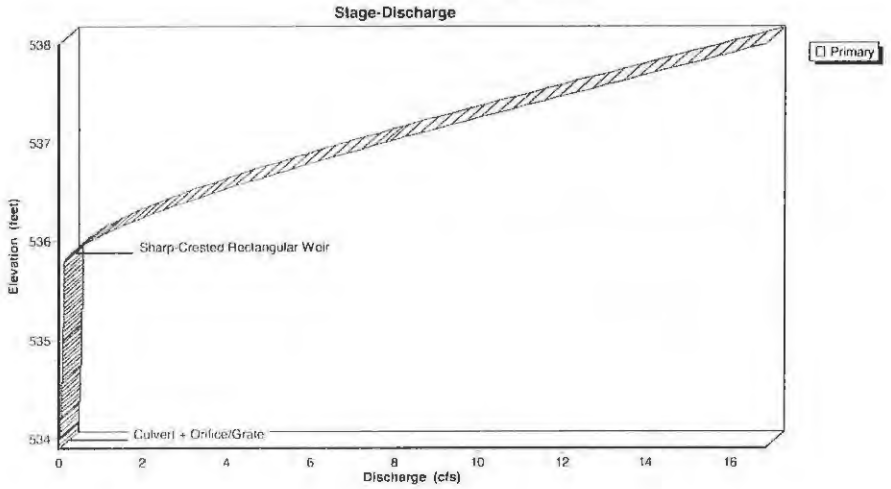
Device	Routing	Invert	Outlet Devices
#1	Primary	533.90'	**18.0" Round Culvert** L= 58.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 533.90' / 533.00' S= 0.0155 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Device 1	533.90'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	535.80'	**2.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=1.11 cfs @ 12.56 hrs HW=536.08' (Free Discharge)
└─**1=Culvert** (Passes 1.11 cfs of 11.87 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.15 cfs @ 6.98 fps)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.96 cfs @ 1.74 fps)

Pond 2P: Detention Basin



Pond 2P: Detention Basin



Hydrograph for Pond 2P: Detention Basin

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.000	533.90	0.00
0.50	0.00	0.000	533.90	0.00
1.00	0.00	0.000	533.90	0.00
1.50	0.00	0.000	533.90	0.00
2.00	0.00	0.000	533.90	0.00
2.50	0.00	0.000	533.90	0.00
3.00	0.00	0.000	533.90	0.00
3.50	0.00	0.000	533.90	0.00
4.00	0.00	0.000	533.90	0.00
4.50	0.01	0.000	533.91	0.00
5.00	0.02	0.001	533.93	0.00
5.50	0.03	0.002	533.95	0.00
6.00	0.04	0.003	533.96	0.01
6.50	0.05	0.004	533.98	0.01
7.00	0.06	0.006	534.00	0.01
7.50	0.07	0.008	534.01	0.02
8.00	0.08	0.010	534.03	0.02
8.50	0.10	0.013	534.05	0.03
9.00	0.13	0.016	534.08	0.03
9.50	0.15	0.021	534.11	0.04
10.00	0.18	0.026	534.15	0.04
10.50	0.25	0.033	534.20	0.05
11.00	0.36	0.043	534.28	0.06
11.50	0.60	0.060	534.41	0.07
12.00	**6.49**	0.147	535.06	0.11
12.50	**1.30**	**0.300**	**536.08**	**1.09**
13.00	0.57	**0.292**	**536.03**	**0.85**
13.50	0.42	0.282	535.97	0.60
14.00	0.33	0.276	535.93	0.45
14.50	0.27	0.271	535.90	0.36
15.00	0.25	0.269	535.88	0.31
15.50	0.22	0.266	535.87	0.27
16.00	0.19	0.265	535.86	0.24
16.50	0.17	0.263	535.85	0.21
17.00	0.17	0.261	535.84	0.19
17.50	0.16	0.260	535.83	0.18
18.00	0.15	0.259	535.82	0.17
18.50	0.14	0.258	535.82	0.16
19.00	0.13	0.257	535.81	0.15
19.50	0.12	0.256	535.80	0.15
20.00	0.11	0.255	535.80	0.14
20.50	0.10	0.253	535.79	0.14
21.00	0.10	0.252	535.77	0.14
21.50	0.10	0.250	535.76	0.14
22.00	0.10	0.248	535.75	0.14
22.50	0.09	0.246	535.74	0.14
23.00	0.09	0.244	535.73	0.14
23.50	0.09	0.242	535.71	0.14
24.00	0.09	0.240	535.70	0.14

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Post-developed Runoff Area=2.600 ac 85.00% Impervious Runoff Depth>4.59"
Flow Length=400' Tc=15.8 min CN=94 Runoff=13.84 cfs 0.995 af

Pond 2P: Detention Basin Peak Elev=536.90' Storage=0.441 af Inflow=13.84 cfs 0.995 af
Outflow=6.92 cfs 0.736 af

Total Runoff Area = 2.600 ac Runoff Volume = 0.995 af Average Runoff Depth = 4.59"
15.00% Pervious = 0.390 ac 85.00% Impervious = 2.210 ac

Summary for Subcatchment 1S: Post-developed

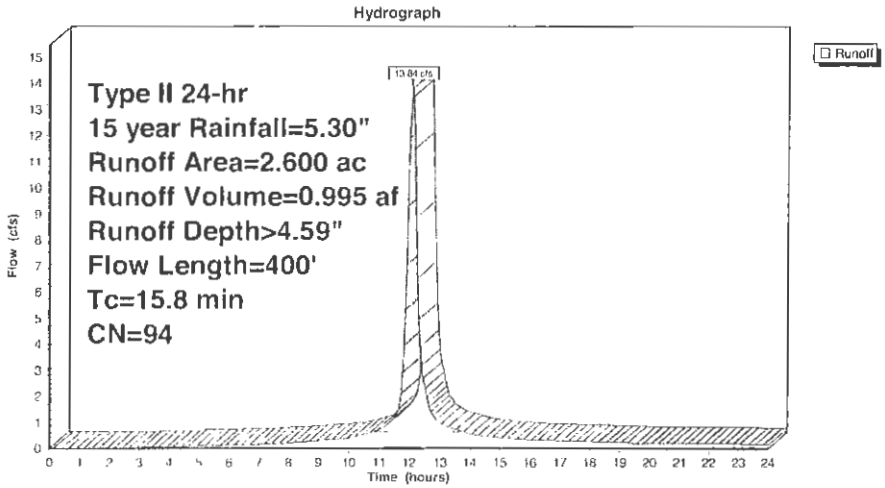
Runoff = 13.84 cfs @ 12.07 hrs, Volume= 0.995 af, Depth> 4.59"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 15 year Rainfall=5.30"

Area (ac)	CN	Description
2.600	94	Urban commercial, 85% imp, HSG C
0.390		15.00% Pervious Area
2.210		85.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	100	0.0200	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.10"
1.3	300	0.0338	3.73		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
15.8	400	Total			

Subcatchment 1S: Post-developed



Hydrograph for Subcatchment 1S: Post-developed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	13.00	4.09	3.41	1.01
0.25	0.01	0.00	0.00	13.25	4.17	3.49	0.84
0.50	0.03	0.00	0.00	13.50	4.23	3.55	0.74
0.75	0.04	0.00	0.00	13.75	4.29	3.61	0.64
1.00	0.06	0.00	0.00	14.00	4.35	3.66	0.57
1.25	0.07	0.00	0.00	14.25	4.39	3.71	0.51
1.50	0.09	0.00	0.00	14.50	4.44	3.76	0.48
1.75	0.10	0.00	0.00	14.75	4.48	3.80	0.46
2.00	0.12	0.00	0.00	15.00	4.52	3.84	0.43
2.25	0.13	0.00	0.00	15.25	4.56	3.88	0.41
2.50	0.15	0.00	0.00	15.50	4.60	3.91	0.39
2.75	0.17	0.00	0.01	15.75	4.63	3.95	0.36
3.00	0.18	0.00	0.02	16.00	4.66	3.98	0.34
3.25	0.20	0.01	0.03	16.25	4.69	4.01	0.32
3.50	0.22	0.01	0.04	16.50	4.72	4.04	0.31
3.75	0.24	0.02	0.04	16.75	4.75	4.06	0.30
4.00	0.25	0.02	0.05	17.00	4.78	4.09	0.29
4.25	0.27	0.03	0.06	17.25	4.81	4.12	0.28
4.50	0.29	0.03	0.07	17.50	4.83	4.14	0.27
4.75	0.31	0.04	0.08	17.75	4.86	4.17	0.26
5.00	0.33	0.05	0.09	18.00	4.88	4.19	0.25
5.25	0.36	0.06	0.10	18.25	4.90	4.21	0.25
5.50	0.38	0.07	0.10	18.50	4.93	4.24	0.24
5.75	0.40	0.08	0.11	18.75	4.95	4.26	0.23
6.00	0.42	0.09	0.12	19.00	4.97	4.28	0.22
6.25	0.45	0.11	0.13	19.25	4.99	4.30	0.21
6.50	0.47	0.12	0.14	19.50	5.01	4.32	0.20
6.75	0.50	0.14	0.15	19.75	5.03	4.34	0.20
7.00	0.52	0.15	0.16	20.00	5.05	4.35	0.19
7.25	0.55	0.17	0.17	20.25	5.06	4.37	0.18
7.50	0.58	0.19	0.18	20.50	5.08	4.39	0.18
7.75	0.61	0.21	0.19	20.75	5.10	4.40	0.17
8.00	0.64	0.23	0.20	21.00	5.11	4.42	0.17
8.25	0.67	0.25	0.21	21.25	5.13	4.44	0.17
8.50	0.70	0.27	0.24	21.50	5.15	4.45	0.17
8.75	0.74	0.30	0.27	21.75	5.16	4.47	0.17
9.00	0.78	0.33	0.30	22.00	5.18	4.48	0.17
9.25	0.82	0.36	0.33	22.25	5.19	4.50	0.16
9.50	0.86	0.39	0.34	22.50	5.21	4.51	0.16
9.75	0.91	0.43	0.36	22.75	5.23	4.53	0.16
10.00	0.96	0.47	0.40	23.00	5.24	4.55	0.16
10.25	1.02	0.52	0.46	23.25	5.26	4.56	0.16
10.50	1.08	0.57	0.53	23.50	5.27	4.58	0.16
10.75	1.16	0.64	0.62	23.75	5.29	4.59	0.15
11.00	1.25	0.71	0.74	24.00	5.30	4.60	0.15
11.25	1.36	0.81	0.90				
11.50	1.50	0.94	1.19				
11.75	2.05	1.44	2.89				
12.00	3.51	2.85	11.92				
12.25	3.74	3.07	6.55				
12.50	3.90	3.22	2.32				
12.75	4.00	3.33	1.30				

Summary for Pond 2P: Detention Basin

Inflow Area = 2.600 ac, 85.00% Impervious, Inflow Depth > 4.59" for 15 year event
Inflow = 13.84 cfs @ 12.07 hrs, Volume= 0.995 af
Outflow = 6.92 cfs @ 12.25 hrs, Volume= 0.736 af, Atten= 50%, Lag= 10.6 min
Primary = 6.92 cfs @ 12.25 hrs, Volume= 0.736 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 536.90' @ 12.25 hrs Surf.Area= 0.182 ac Storage= 0.441 af

Plug-Flow detention time= 162.7 min calculated for 0.736 af (74% of inflow)
Center-of-Mass det. time= 74.2 min (849.7 - 775.5)

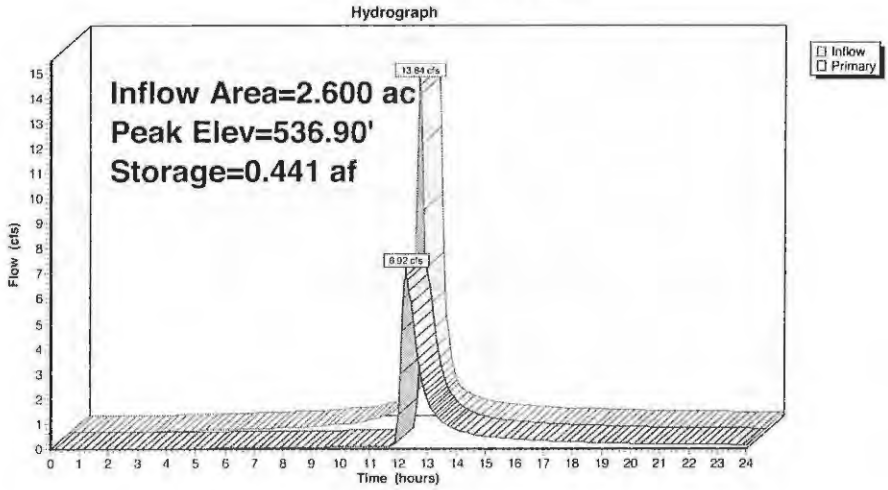
Volume	Invert	Avail.Storage	Storage Description
#1	533.90'	0.650 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
533.90	0.001	0.000	0.000
534.00	0.129	0.007	0.007
535.00	0.136	0.132	0.139
536.00	0.160	0.148	0.287
537.00	0.184	0.172	0.459
538.00	0.197	0.190	0.650

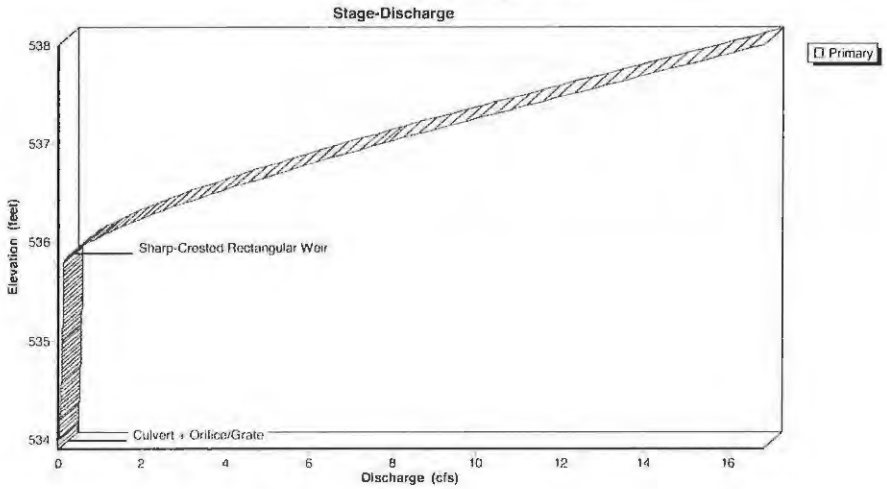
Device	Routing	Invert	Outlet Devices
#1	Primary	533.90'	**18.0" Round Culvert** L= 58.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 533.90' / 533.00' S= 0.0155 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Device 1	533.90'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	535.80'	**2.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=6.91 cfs @ 12.25 hrs HW=536.90' (Free Discharge)
↑—**1=Culvert** (Passes 6.91 cfs of 14.62 cfs potential flow)
↑—**2=Orifice/Grate** (Orifice Controls 0.18 cfs @ 8.23 fps)
—**3=Sharp-Crested Rectangular Weir** (Weir Controls 6.73 cfs @ 3.43 fps)

Pond 2P: Detention Basin



Pond 2P: Detention Basin



Hydrograph for Pond 2P: Detention Basin

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.000	533.90	0.00
0.50	0.00	0.000	533.90	0.00
1.00	0.00	0.000	533.90	0.00
1.50	0.00	0.000	533.90	0.00
2.00	0.00	0.000	533.90	0.00
2.50	0.00	0.000	533.90	0.00
3.00	0.02	0.000	533.92	0.00
3.50	0.04	0.002	533.95	0.00
4.00	0.05	0.003	533.97	0.01
4.50	0.07	0.005	533.99	0.01
5.00	0.09	0.008	534.01	0.02
5.50	0.10	0.011	534.03	0.02
6.00	0.12	0.015	534.06	0.03
6.50	0.14	0.019	534.09	0.03
7.00	0.16	0.023	534.13	0.04
7.50	0.18	0.029	534.17	0.05
8.00	0.20	0.035	534.22	0.05
8.50	0.24	0.042	534.27	0.06
9.00	0.30	0.050	534.34	0.06
9.50	0.34	0.061	534.42	0.07
10.00	0.40	0.073	534.51	0.08
10.50	0.53	0.089	534.63	0.08
11.00	0.74	0.111	534.79	0.09
11.50	1.19	0.145	535.04	0.11
12.00	**11.92**	**0.308**	**536.13**	**1.35**
12.50	**2.32**	**0.396**	**536.65**	**4.86**
13.00	1.01	0.326	536.24	1.96
13.50	0.74	0.300	536.08	1.11
14.00	0.57	0.289	536.01	0.78
14.50	0.48	0.282	535.97	0.60
15.00	0.43	0.278	535.95	0.51
15.50	0.39	0.276	535.93	0.45
16.00	0.34	0.273	535.91	0.39
16.50	0.31	0.271	535.90	0.35
17.00	0.29	0.269	535.89	0.32
17.50	0.27	0.268	535.88	0.30
18.00	0.25	0.267	535.87	0.28
18.50	0.24	0.266	535.87	0.26
19.00	0.22	0.265	535.86	0.25
19.50	0.20	0.264	535.85	0.23
20.00	0.19	0.263	535.85	0.22
20.50	0.18	0.262	535.84	0.20
21.00	0.17	0.261	535.84	0.19
21.50	0.17	0.260	535.83	0.18
22.00	0.17	0.260	535.83	0.18
22.50	0.16	0.260	535.83	0.17
23.00	0.16	0.259	535.82	0.17
23.50	0.16	0.259	535.82	0.17
24.00	0.15	0.258	535.82	0.16

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Post-developed Runoff Area=2.600 ac 85.00% Impervious Runoff Depth>6.47"
Flow Length=400' Tc=15.8 min CN=94 Runoff=19.14 cfs 1.402 af

Pond 2P: Detention Basin Peak Elev=537.44' Storage=0.541 af Inflow=19.14 cfs 1.402 af
Outflow=11.69 cfs 1.139 af

Total Runoff Area = 2.600 ac Runoff Volume = 1.402 af Average Runoff Depth = 6.47"
15.00% Pervious = 0.390 ac 85.00% Impervious = 2.210 ac

Summary for Subcatchment 1S: Post-developed

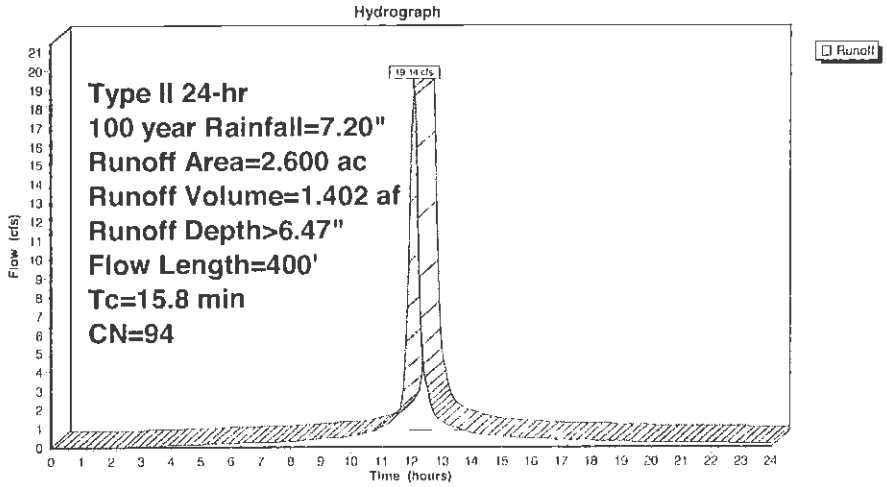
Runoff = 19.14 cfs @ 12.07 hrs, Volume= 1.402 af, Depth> 6.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 year Rainfall=7.20"

Area (ac)	CN	Description
2.600	94	Urban commercial, 85% imp, HSG C
0.390		15.00% Pervious Area
2.210		85.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	100	0.0200	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.10"
1.3	300	0.0338	3.73		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
15.8	400	Total			

Subcatchment 1S: Post-developed



Hydrograph for Subcatchment 1S: Post-developed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	13.00	5.56	4.86	1.39
0.25	0.02	0.00	0.00	13.25	5.66	4.96	1.15
0.50	0.04	0.00	0.00	13.50	5.75	5.05	1.01
0.75	0.06	0.00	0.00	13.75	5.83	5.13	0.88
1.00	0.08	0.00	0.00	14.00	5.90	5.20	0.78
1.25	0.10	0.00	0.00	14.25	5.97	5.27	0.70
1.50	0.12	0.00	0.00	14.50	6.03	5.33	0.66
1.75	0.14	0.00	0.00	14.75	6.09	5.39	0.63
2.00	0.16	0.00	0.01	15.00	6.15	5.44	0.59
2.25	0.18	0.00	0.02	15.25	6.20	5.49	0.56
2.50	0.20	0.01	0.03	15.50	6.25	5.54	0.53
2.75	0.23	0.01	0.05	15.75	6.29	5.59	0.49
3.00	0.25	0.02	0.06	16.00	6.34	5.63	0.46
3.25	0.27	0.03	0.07	16.25	6.38	5.67	0.43
3.50	0.30	0.04	0.08	16.50	6.42	5.71	0.42
3.75	0.32	0.04	0.10	16.75	6.46	5.75	0.41
4.00	0.35	0.06	0.11	17.00	6.49	5.78	0.40
4.25	0.37	0.07	0.12	17.25	6.53	5.82	0.38
4.50	0.40	0.08	0.13	17.50	6.56	5.86	0.37
4.75	0.43	0.09	0.14	17.75	6.60	5.89	0.36
5.00	0.45	0.11	0.16	18.00	6.63	5.92	0.35
5.25	0.48	0.13	0.17	18.25	6.66	5.95	0.34
5.50	0.51	0.15	0.18	18.50	6.69	5.98	0.33
5.75	0.54	0.16	0.20	18.75	6.72	6.01	0.31
6.00	0.58	0.18	0.21	19.00	6.75	6.04	0.30
6.25	0.61	0.21	0.22	19.25	6.78	6.07	0.29
6.50	0.64	0.23	0.24	19.50	6.81	6.10	0.28
6.75	0.68	0.25	0.25	19.75	6.83	6.12	0.27
7.00	0.71	0.28	0.26	20.00	6.85	6.14	0.25
7.25	0.75	0.31	0.28	20.25	6.88	6.17	0.25
7.50	0.79	0.33	0.29	20.50	6.90	6.19	0.24
7.75	0.82	0.36	0.30	20.75	6.92	6.21	0.24
8.00	0.86	0.39	0.31	21.00	6.95	6.23	0.24
8.25	0.91	0.43	0.33	21.25	6.97	6.26	0.23
8.50	0.95	0.46	0.37	21.50	6.99	6.28	0.23
8.75	1.00	0.51	0.41	21.75	7.01	6.30	0.23
9.00	1.06	0.55	0.46	22.00	7.03	6.32	0.23
9.25	1.12	0.60	0.50	22.25	7.06	6.34	0.22
9.50	1.17	0.65	0.51	22.50	7.08	6.36	0.22
9.75	1.23	0.70	0.53	22.75	7.10	6.39	0.22
10.00	1.30	0.76	0.59	23.00	7.12	6.41	0.22
10.25	1.38	0.83	0.67	23.25	7.14	6.43	0.22
10.50	1.47	0.91	0.77	23.50	7.16	6.45	0.21
10.75	1.57	1.00	0.90	23.75	7.18	6.47	0.21
11.00	1.69	1.11	1.07	24.00	**7.20**	**6.49**	0.21
11.25	1.84	1.25	1.30				
11.50	2.04	1.43	1.69				
11.75	2.79	2.14	4.08				
12.00	4.77	4.08	**16.53**				
12.25	5.08	4.39	**9.03**				
12.50	5.29	4.60	3.18				
12.75	5.44	4.74	1.79				

Summary for Pond 2P: Detention Basin

Inflow Area = 2.600 ac, 85.00% Impervious, Inflow Depth > 6.47" for 100 year event
Inflow = 19.14 cfs @ 12.07 hrs, Volume= 1.402 af
Outflow = 11.69 cfs @ 12.21 hrs, Volume= 1.139 af, Atten= 39%, Lag= 8.5 min
Primary = 11.69 cfs @ 12.21 hrs, Volume= 1.139 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 537.44' @ 12.21 hrs Surf.Area= 0.190 ac Storage= 0.541 af

Plug-Flow detention time= 141.2 min calculated for 1.139 af (81% of inflow)
Center-of-Mass det. time= 65.1 min (832.5 - 767.4)

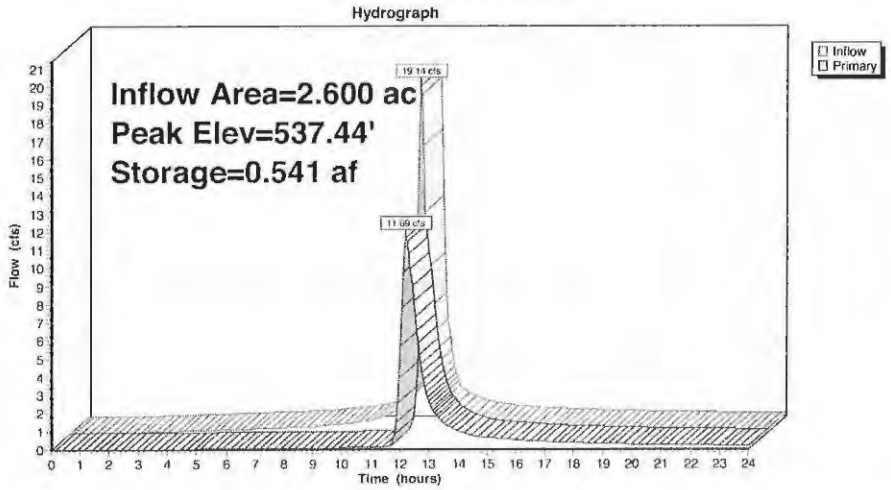
Volume	Invert	Avail.Storage	Storage Description
#1	533.90'	0.650 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
533.90	0.001	0.000	0.000
534.00	0.129	0.007	0.007
535.00	0.136	0.132	0.139
536.00	0.160	0.148	0.287
537.00	0.184	0.172	0.459
538.00	0.197	0.190	0.650

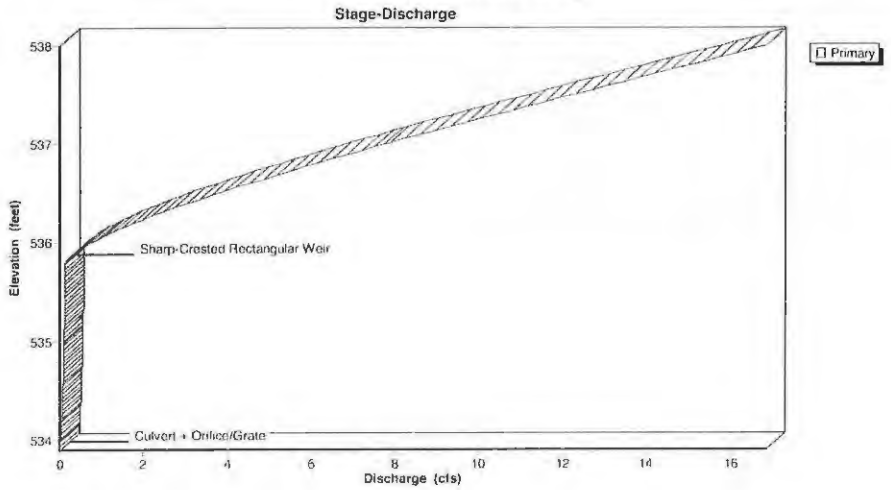
Device	Routing	Invert	Outlet Devices
#1	Primary	533.90'	**18.0" Round Culvert** L= 58.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 533.90' / 533.00' S= 0.0155 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Device 1	533.90'	**2.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	535.80'	**2.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=11.63 cfs @ 12.21 hrs HW=537.43' (Free Discharge)
└─1=**Culvert** (Passes 11.63 cfs of 16.16 cfs potential flow)
  ├─2=**Orifice/Grate** (Orifice Controls 0.20 cfs @ 8.94 fps)
  └─3=**Sharp-Crested Rectangular Weir** (Weir Controls 11.43 cfs @ 4.18 fps)

Pond 2P: Detention Basin



Pond 2P: Detention Basin

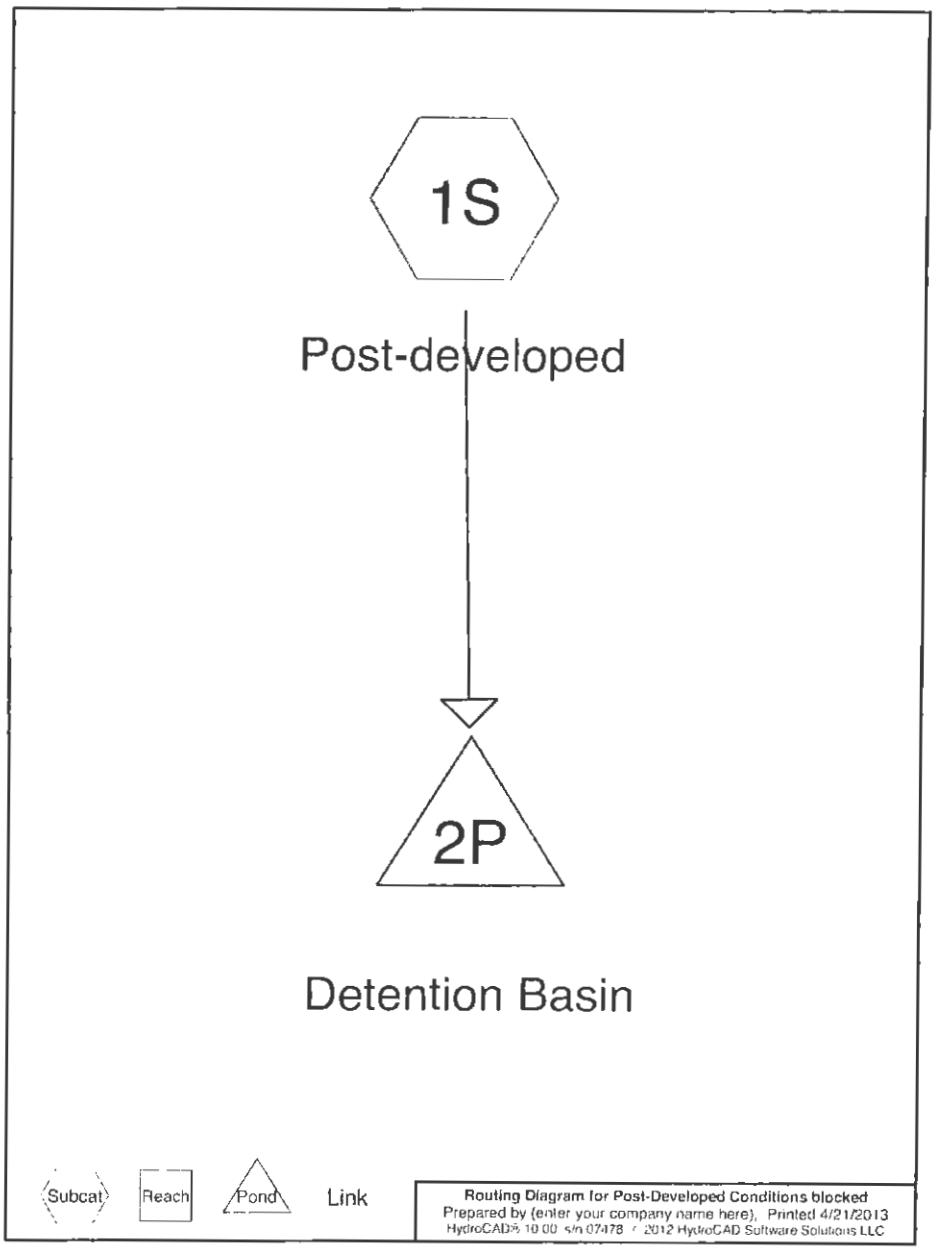


Hydrograph for Pond 2P: Detention Basin

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.000	533.90	0.00
0.50	0.00	0.000	533.90	0.00
1.00	0.00	0.000	533.90	0.00
1.50	0.00	0.000	533.90	0.00
2.00	0.01	0.000	533.90	0.00
2.50	0.03	0.001	533.93	0.00
3.00	0.06	0.003	533.96	0.01
3.50	0.08	0.005	533.99	0.01
4.00	0.11	0.009	534.02	0.02
4.50	0.13	0.013	534.05	0.03
5.00	0.16	0.017	534.08	0.03
5.50	0.18	0.023	534.13	0.04
6.00	0.21	0.029	534.17	0.05
6.50	0.24	0.036	534.23	0.05
7.00	0.26	0.044	534.29	0.06
7.50	0.29	0.053	534.36	0.06
8.00	0.31	0.063	534.43	0.07
8.50	0.37	0.074	534.51	0.08
9.00	0.46	0.087	534.62	0.08
9.50	0.51	0.104	534.74	0.09
10.00	0.59	0.122	534.88	0.10
10.50	0.77	0.146	535.05	0.11
11.00	1.07	0.179	535.28	0.12
11.50	1.69	0.228	535.62	0.13
12.00	**16.53**	**0.415**	**536.76**	**5.73**
12.50	**3.18**	**0.450**	**536.95**	**7.33**
13.00	1.39	0.345	536.35	2.69
13.50	1.01	0.312	536.15	1.48
14.00	0.78	0.298	536.07	1.03
14.50	0.66	0.290	536.02	0.80
15.00	0.59	0.285	535.99	0.68
15.50	0.53	0.282	535.97	0.60
16.00	0.46	0.279	535.95	0.53
16.50	0.42	0.277	535.94	0.47
17.00	0.40	0.275	535.92	0.43
17.50	0.37	0.274	535.92	0.40
18.00	0.35	0.272	535.91	0.38
18.50	0.33	0.271	535.90	0.35
19.00	0.30	0.270	535.89	0.33
19.50	0.28	0.269	535.88	0.31
20.00	0.25	0.268	535.88	0.29
20.50	0.24	0.266	535.87	0.26
21.00	0.24	0.266	535.86	0.25
21.50	0.23	0.265	535.86	0.24
22.00	0.23	0.265	535.86	0.24
22.50	0.22	0.264	535.86	0.23
23.00	0.22	0.264	535.85	0.23
23.50	0.21	0.263	535.85	0.22
24.00	0.21	0.263	535.85	0.22

POST-DEVELOPED

LOW FLOW BLOCKED


1S
Post-developed
2P
Detention Basin
Subcat
Reach
Pond
Link
Routing Diagram for Post-Developed Conditions blocked
Prepared by {enter your company name here}, Printed 4/21/2013
HydroCAD® 10.00 s/n 07478 © 2012 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.600	94	Urban commercial, 85% imp, HSG C (1S)
2.600	**94**	**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	2.600	0.000	0.000	2.600	Urban commercial, 85% imp	1S
0.000	**0.000**	**2.600**	**0.000**	**0.000**	**2.600**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	2P	533.90	533.00	58.0	0.0155	0.013	18.0	0.0	0.0

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Post-developed Runoff Area=2.600 ac 85.00% Impervious Runoff Depth>6.47"
Flow Length=400' Tc=15.8 min CN=94 Runoff=19.14 cfs 1.402 af

Pond 2P: Detention Basin Peak Elev=537.49' Storage=0.552 af Inflow=19.14 cfs 1.402 af
Outflow=11.98 cfs 1.130 af

Total Runoff Area = 2.600 ac Runoff Volume = 1.402 af Average Runoff Depth = 6.47"
15.00% Pervious = 0.390 ac 85.00% Impervious = 2.210 ac

Summary for Subcatchment 1S: Post-developed

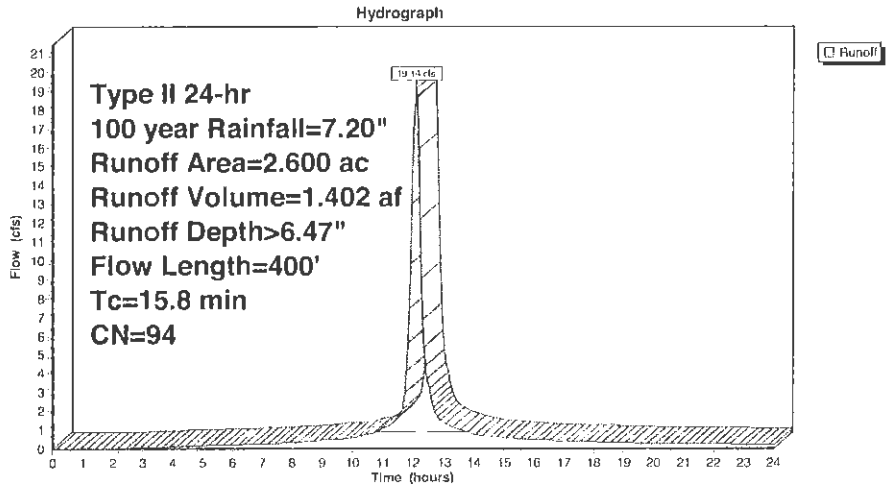
Runoff = 19.14 cfs @ 12.07 hrs, Volume= 1.402 af, Depth> 6.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 year Rainfall=7.20"

Area (ac)	CN	Description
2.600	94	Urban commercial, 85% imp, HSG C
0.390		15.00% Pervious Area
2.210		85.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.5	100	0.0200	0.11		**Sheet Flow, A-B** Grass: Dense n= 0.240 P2= 3.10"
1.3	300	0.0338	3.73		**Shallow Concentrated Flow, B-C** Paved Kv= 20.3 fps
15.8	400	Total			

Subcatchment 1S: Post-developed



Hydrograph for Subcatchment 1S: Post-developed

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
0.00	0.00	0.00	0.00	13.00	5.56	4.86	1.39
0.25	0.02	0.00	0.00	13.25	5.66	4.96	1.15
0.50	0.04	0.00	0.00	13.50	5.75	5.05	1.01
0.75	0.06	0.00	0.00	13.75	5.83	5.13	0.88
1.00	0.08	0.00	0.00	14.00	5.90	5.20	0.78
1.25	0.10	0.00	0.00	14.25	5.97	5.27	0.70
1.50	0.12	0.00	0.00	14.50	6.03	5.33	0.66
1.75	0.14	0.00	0.00	14.75	6.09	5.39	0.63
2.00	0.16	0.00	0.01	15.00	6.15	5.44	0.59
2.25	0.18	0.00	0.02	15.25	6.20	5.49	0.56
2.50	0.20	0.01	0.03	15.50	6.25	5.54	0.53
2.75	0.23	0.01	0.05	15.75	6.29	5.59	0.49
3.00	0.25	0.02	0.06	16.00	6.34	5.63	0.46
3.25	0.27	0.03	0.07	16.25	6.38	5.67	0.43
3.50	0.30	0.04	0.08	16.50	6.42	5.71	0.42
3.75	0.32	0.04	0.10	16.75	6.46	5.75	0.41
4.00	0.35	0.06	0.11	17.00	6.49	5.78	0.40
4.25	0.37	0.07	0.12	17.25	6.53	5.82	0.38
4.50	0.40	0.08	0.13	17.50	6.56	5.86	0.37
4.75	0.43	0.09	0.14	17.75	6.60	5.89	0.36
5.00	0.45	0.11	0.16	18.00	6.63	5.92	0.35
5.25	0.48	0.13	0.17	18.25	6.66	5.95	0.34
5.50	0.51	0.15	0.18	18.50	6.69	5.98	0.33
5.75	0.54	0.16	0.20	18.75	6.72	6.01	0.31
6.00	0.58	0.18	0.21	19.00	6.75	6.04	0.30
6.25	0.61	0.21	0.22	19.25	6.78	6.07	0.29
6.50	0.64	0.23	0.24	19.50	6.81	6.10	0.28
6.75	0.68	0.25	0.25	19.75	6.83	6.12	0.27
7.00	0.71	0.28	0.26	20.00	6.85	6.14	0.25
7.25	0.75	0.31	0.28	20.25	6.88	6.17	0.25
7.50	0.79	0.33	0.29	20.50	6.90	6.19	0.24
7.75	0.82	0.36	0.30	20.75	6.92	6.21	0.24
8.00	0.86	0.39	0.31	21.00	6.95	6.23	0.24
8.25	0.91	0.43	0.33	21.25	6.97	6.26	0.23
8.50	0.95	0.46	0.37	21.50	6.99	6.28	0.23
8.75	1.00	0.51	0.41	21.75	7.01	6.30	0.23
9.00	1.06	0.55	0.46	22.00	7.03	6.32	0.23
9.25	1.12	0.60	0.50	22.25	7.06	6.34	0.22
9.50	1.17	0.65	0.51	22.50	7.08	6.36	0.22
9.75	1.23	0.70	0.53	22.75	7.10	6.39	0.22
10.00	1.30	0.76	0.59	23.00	7.12	6.41	0.22
10.25	1.38	0.83	0.67	23.25	7.14	6.43	0.22
10.50	1.47	0.91	0.77	23.50	7.16	6.45	0.21
10.75	1.57	1.00	0.90	23.75	7.18	6.47	0.21
11.00	1.69	1.11	1.07	24.00	**7.20**	**6.49**	0.21
11.25	1.84	1.25	1.30				
11.50	2.04	1.43	1.69				
11.75	2.79	2.14	4.08				
12.00	4.77	4.08	**16.53**				
12.25	5.08	4.39	**9.03**				
12.50	5.29	4.60	3.18				
12.75	5.44	4.74	1.79				

Summary for Pond 2P: Detention Basin

Inflow Area = 2.600 ac, 85.00% Impervious, Inflow Depth > 6.47" for 100 year event
Inflow = 19.14 cfs @ 12.07 hrs, Volume= 1.402 af
Outflow = 11.98 cfs @ 12.21 hrs, Volume= 1.130 af, Atten= 37%, Lag= 8.3 min
Primary = 11.98 cfs @ 12.21 hrs, Volume= 1.130 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 537.49' @ 12.21 hrs Surf.Area= 0.190 ac Storage= 0.552 af

Plug-Flow detention time= 148.6 min calculated for 1.128 af (80% of inflow)
Center-of-Mass det. time= 72.6 min (840.0 - 767.4)

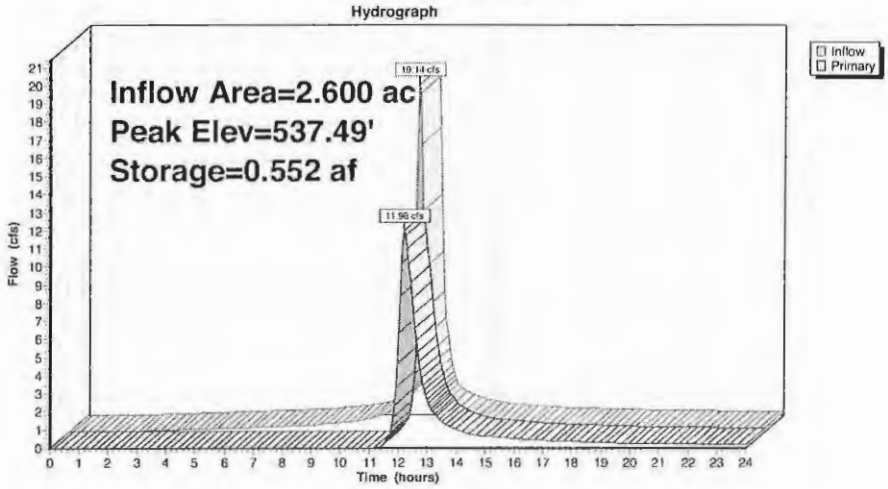
Volume	Invert	Avail.Storage	Storage Description
#1	533.90'	0.650 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
533.90	0.001	0.000	0.000
534.00	0.129	0.007	0.007
535.00	0.136	0.132	0.139
536.00	0.160	0.148	0.287
537.00	0.184	0.172	0.459
538.00	0.197	0.190	0.650

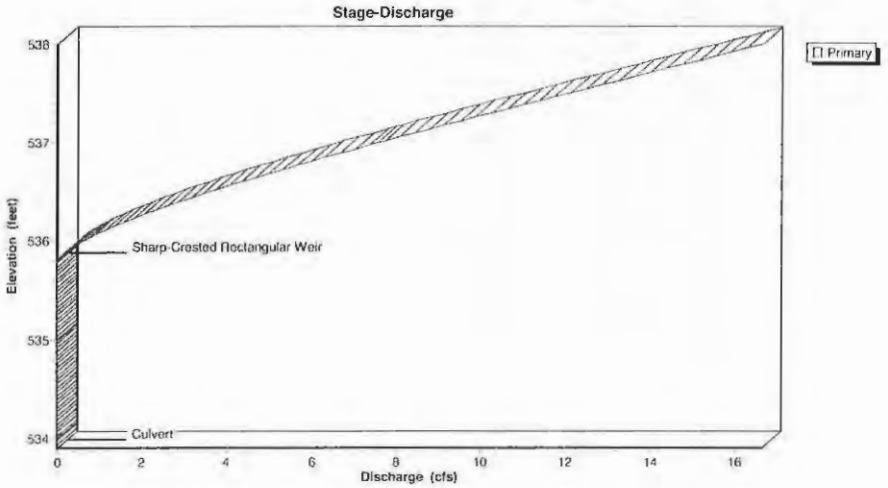
Device	Routing	Invert	Outlet Devices
#1	Primary	533.90'	**18.0" Round Culvert** L= 58.0' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 533.90' / 533.00' S= 0.0155 '/' Cc= 0.900 n= 0.013 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Device 1	535.80'	**2.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=11.94 cfs @ 12.21 hrs HW=537.49' (Free Discharge)
└**1=Culvert** (Passes 11.94 cfs of 16.31 cfs potential flow)
└**2=Sharp-Crested Rectangular Weir** (Weir Controls 11.94 cfs @ 4.25 fps)

Pond 2P: Detention Basin



Pond 2P: Detention Basin



Hydrograph for Pond 2P: Detention Basin

Time (hours)	Inflow (cfs)	Storage (acre-feet)	Elevation (feet)	Primary (cfs)
0.00	0.00	0.000	533.90	0.00
0.50	0.00	0.000	533.90	0.00
1.00	0.00	0.000	533.90	0.00
1.50	0.00	0.000	533.90	0.00
2.00	0.01	0.000	533.90	0.00
2.50	0.03	0.001	533.93	0.00
3.00	0.06	0.003	533.96	0.00
3.50	0.08	0.006	533.99	0.00
4.00	0.11	0.010	534.03	0.00
4.50	0.13	0.015	534.06	0.00
5.00	0.16	0.021	534.11	0.00
5.50	0.18	0.028	534.16	0.00
6.00	0.21	0.036	534.23	0.00
6.50	0.24	0.045	534.30	0.00
7.00	0.26	0.055	534.37	0.00
7.50	0.29	0.067	534.46	0.00
8.00	0.31	0.079	534.55	0.00
8.50	0.37	0.093	534.66	0.00
9.00	0.46	0.110	534.79	0.00
9.50	0.51	0.130	534.94	0.00
10.00	0.59	0.153	535.10	0.00
10.50	0.77	0.180	535.30	0.00
11.00	1.07	0.218	535.55	0.00
11.50	1.69	0.272	535.90	0.22
12.00	**16.53**	**0.433**	**536.86**	**6.38**
12.50	**3.18**	**0.456**	**536.98**	**7.43**
13.00	1.39	0.349	536.38	2.70
13.50	1.01	0.316	536.18	1.47
14.00	0.78	0.302	536.10	1.02
14.50	0.66	0.295	536.05	0.79
15.00	0.59	0.291	536.02	0.67
15.50	0.53	0.288	536.00	0.59
16.00	0.46	0.285	535.99	0.52
16.50	0.42	0.283	535.97	0.47
17.00	0.40	0.281	535.96	0.43
17.50	0.37	0.280	535.96	0.40
18.00	0.35	0.279	535.95	0.37
18.50	0.33	0.278	535.94	0.35
19.00	0.30	0.277	535.94	0.33
19.50	0.28	0.276	535.93	0.30
20.00	0.25	0.275	535.92	0.28
20.50	0.24	0.274	535.92	0.26
21.00	0.24	0.273	535.91	0.25
21.50	0.23	0.273	535.91	0.24
22.00	0.23	0.273	535.91	0.23
22.50	0.22	0.272	535.91	0.23
23.00	0.22	0.272	535.91	0.22
23.50	0.21	0.272	535.90	0.22
24.00	0.21	0.272	535.90	0.21

CONCLUSION

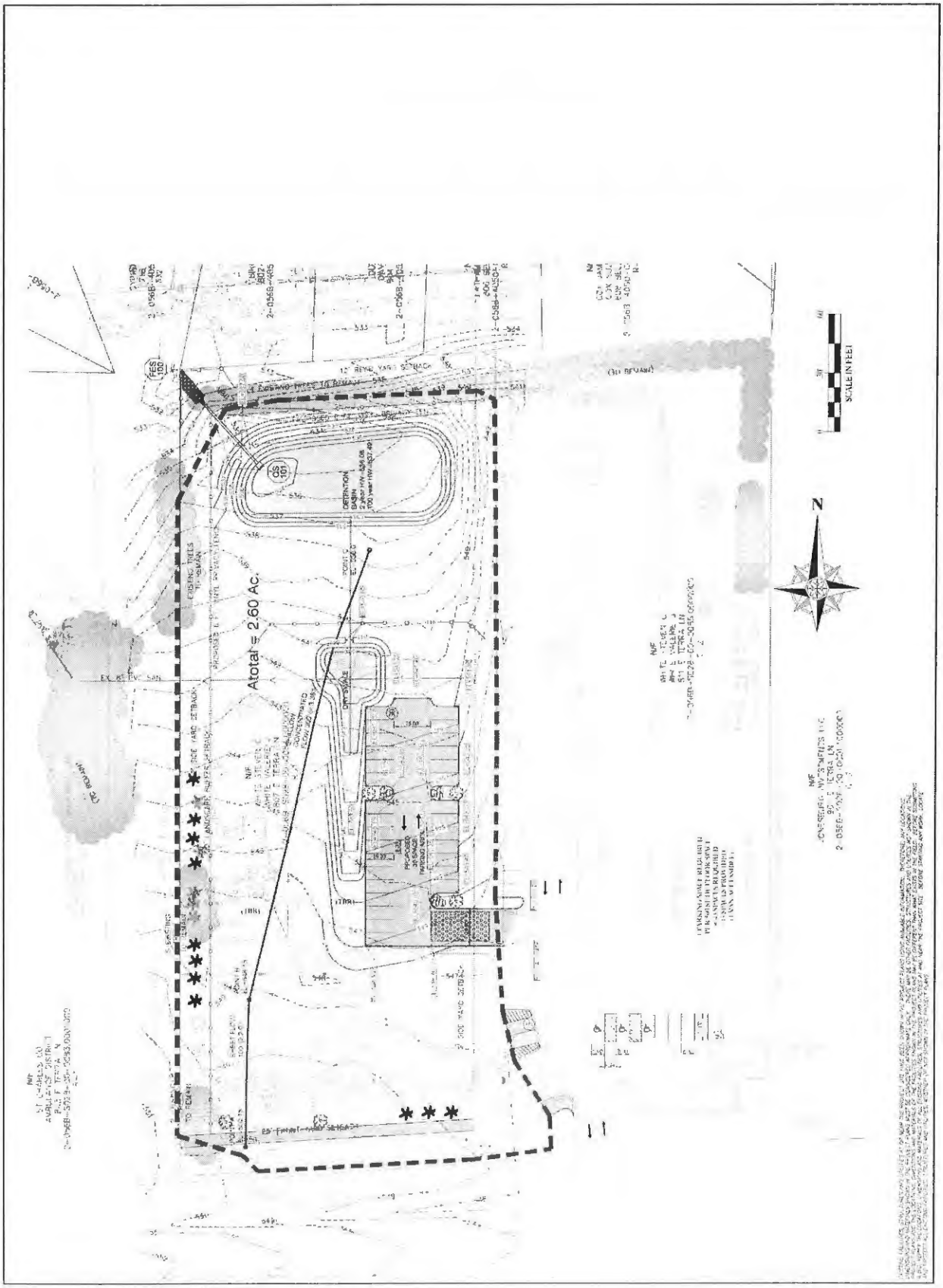
As it demonstrated above the project objectives described in the introduction has been met.

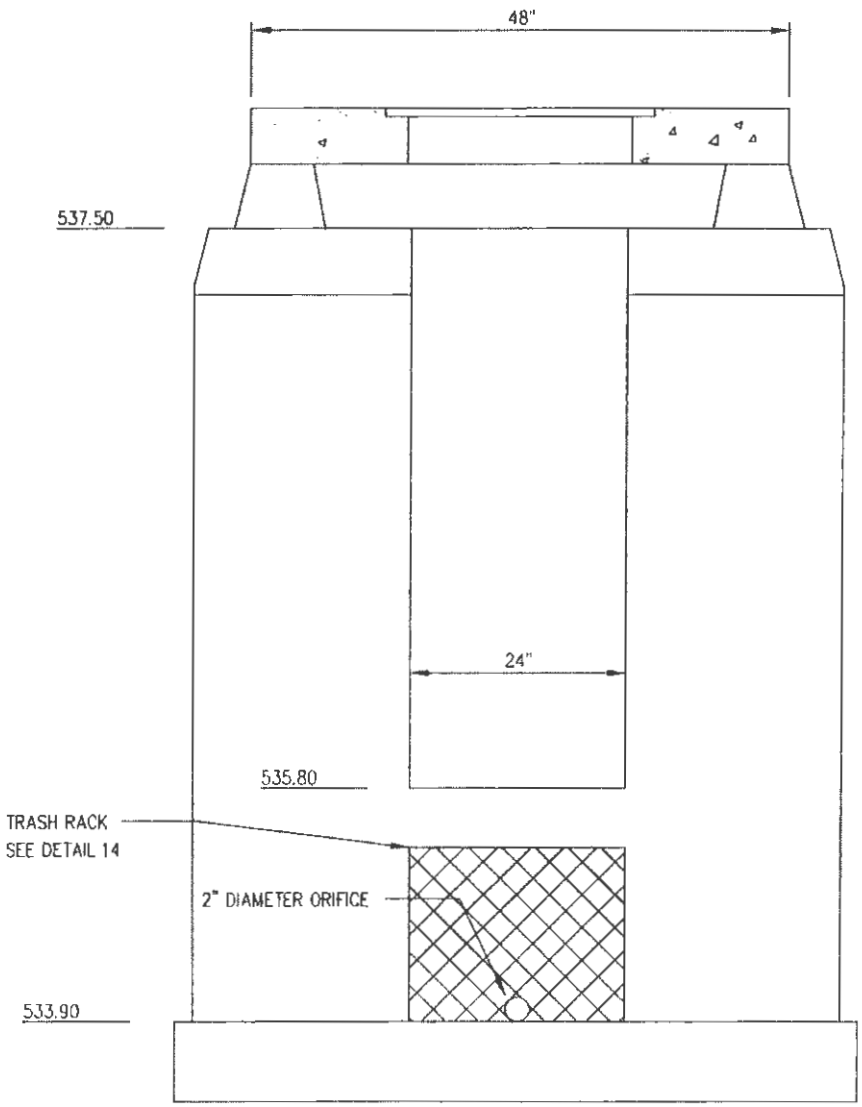
KEC

807 East Terra Lane
Automobile Parking Area
Adjacent Parking - White Auto Body
Steven C. and Valerie J. White

DRAINAGE AREA MAP

DATE 5/14/14
SCALE AS SHOWN
PROJECT NUMBER 49772
SHEET C-5



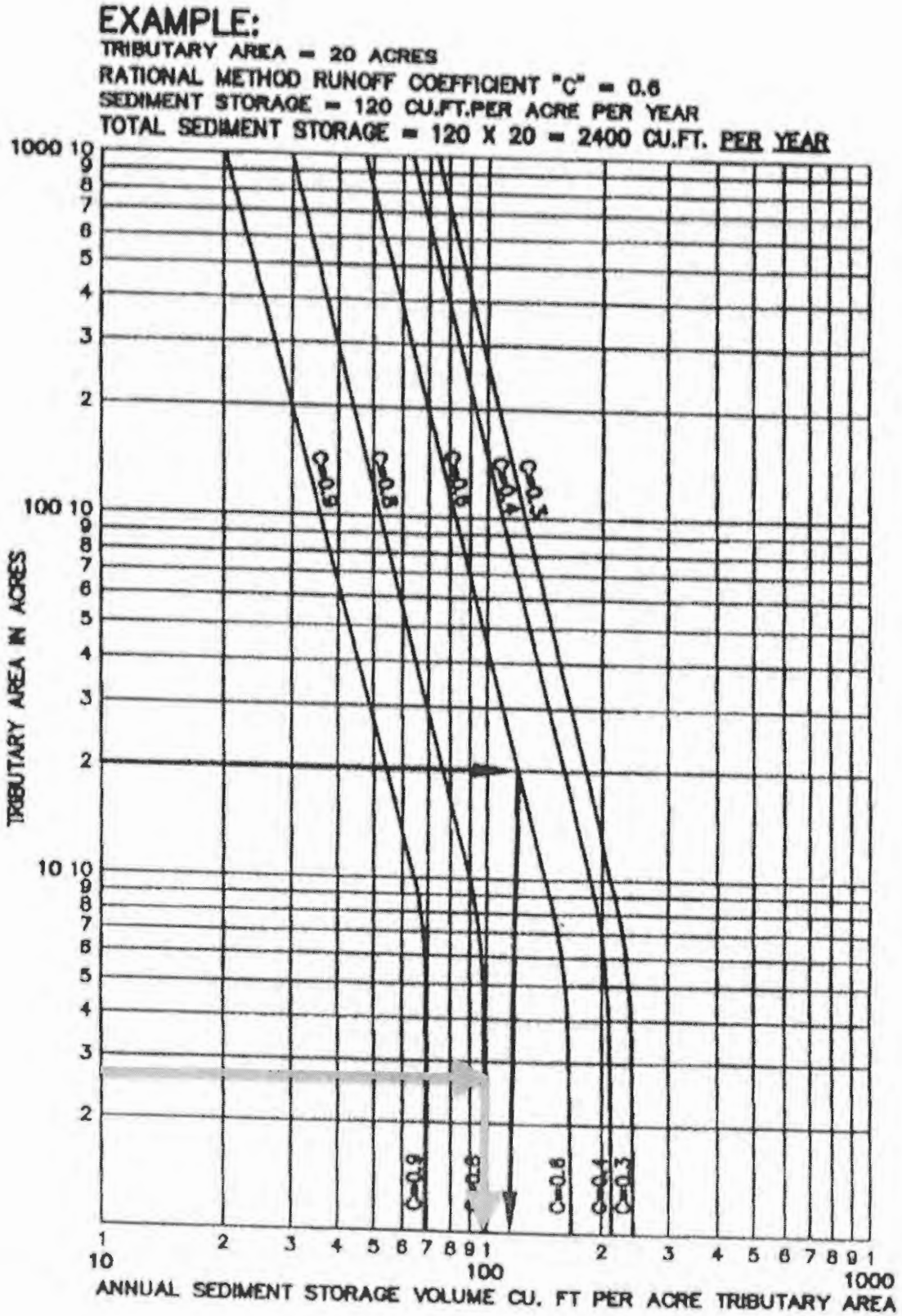


13 Overflow Structure Detail

Scale: Not To Scale

Tributary Area – 2.6 Acre.

FIGURE #1


EXAMPLE:
TRIBUTARY AREA = 20 ACRES
RATIONAL METHOD RUNOFF COEFFICIENT "C" = 0.6
SEDIMENT STORAGE = 120 CU.FT.PER ACRE PER YEAR
TOTAL SEDIMENT STORAGE = 120 X 20 = 2400 CU.FT. PER YEAR
TRIBUTARY AREA IN ACRES
1000
100
10
C=0.9
C=0.6
C=0.6
C=0.4
C=0.9
C=0.6
C=0.6
C=0.4
C=0.3
1
10
100
1000
ANNUAL SEDIMENT STORAGE VOLUME CU. FT PER ACRE TRIBUTARY AREA

Tributary Area = 2.6 Acre.

C=0.8

Sediment Storage =100 cu.ft per Acre per year.

TOTAL Sediment Storage = 100 x 2.6 = 260 cu.ft. per year.