



**CASH WAGGNER**

**& ASSOCIATES, PC**

CONSULTING ENGINEERS & LAND SURVEYORS

DATE: 08.20.18

ATTENTION: Jeff Mueller

PROJECT NO.: 15-2184

COMPANY: Vanderburgh County Surveyor

REFERENCE: Saddle Creek Estates  
- Section 1

ADDRESS: Civic Center Complex -  
Room 325

YOUR FILE NO.:

CITY, ST, ZIP: Evansville, IN 47708

PHONE:

**THE FOLLOWING ITEMS:**

COPIES:	ORIG./LAST REV. DATE:	DESCRIPTION:
1	08.15.18	Drainage & Road Plans
1	08.17.18	Final Drainage Report

LETTER OF TRANSMITTAL

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- PER YOUR REQUEST
- FOR YOUR FILES
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**COMMENTS:**

If you have any questions or comments, please give me a call. Thank you

414 CITADEL CIRCLE  
SUITE B  
EVANSVILLE, IN 47715  
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[G.MERITT@CASHWAGGNER.COM](mailto:G.MERITT@CASHWAGGNER.COM)

FROM:

  
GLEN MERITT, JR., P.E.

cc: File

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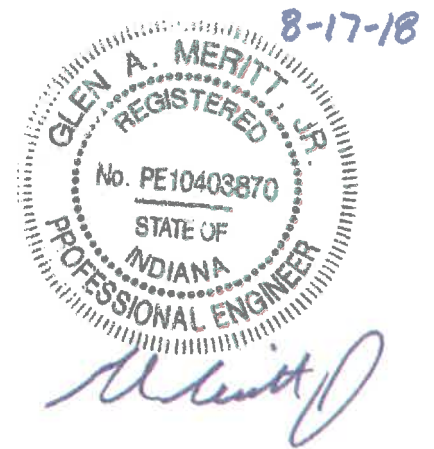


**CASH WAGGNER**  
**& ASSOCIATES, PC**  
 CONSULTING ENGINEERS • LAND SURVEYORS

August 17, 2018

Mr. Jeff Mueller  
 Vanderburgh County Surveyor  
 Room 325 Civic Center - 1 NW Martin Luther King Jr. Blvd.  
 Evansville, IN 47708

**RE: Final Drainage Report  
 Saddle Creek Estates – Section 1  
 Baumgart Road  
 Our Project #: 15-2184**



Mr. Mueller:

Below is a summary of the drainage calculations for the above-referenced project.

SITE DESCRIPTION

Section 1 of this development will consist of a single-family residential subdivision with 47 lots and its associated improvements (i.e. roads, utilities). Section 1 is located on a 36.58-acre parcel that lies on the west side of Baumgart Road approximately 1,200 feet southwest of the Browning Road and Baumgart Road intersection. All of Section 1 which includes detention basin #2 will be constructed in one phase. This portion of the subdivision is heavily wooded and 50' on either side of the centerline of the roadways will be cleared to allow the roads and utilities to be constructed. All of the trees will be cleared from Lots 21 - 26 to allow fill to be placed and detention basin #2 to be constructed. Some of the remaining trees will be removed from the individual lots to allow the homes and driveways to be constructed once the secondary plat is recorded.

No regulated drains, inlets or outfalls exist on this site. An existing 8" sanitary sewer main is located along the west property line of Lot 116. No existing combined sewers or outfalls are located on this site. No known wells, septic tanks systems or outfalls exist on this site. No seeps, springs, sinkholes, caves, shafts, faults or other such geological features are visible or of record on this site.

DRAINAGE PATTERNS

Undeveloped sub-basin UN-2 contains 52.56-acres (UN-2) of which 44.62-acres is heavily wooded and 7.94-acres is a cultivated field that drains to an existing ditch that meanders through the wooded area along the west boundary of Section 1. See attached Undeveloped Sub-basin Exhibit for the location of this sub-basin.

The 25-year flows were calculated for each developed sub-basin. Undetained runoff will account for 35.98-acres and 11.52-acres will be collected by detention basin #2. There is also 16.30-acres of off-site runoff from the south that will be collected by detention basin #2. Section 1 was divided into four (4) developed sub-basins and

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one (1) off-site sub-basin. Sub-basin #1 and OS-4 will be collected by detention basin #2 while sub-basin #2, #4 & #5 will be allowed to exit the site undetained. See attached Developed Sub-basin Exhibit for the locations of each sub-basin.

A drainage swale and storm sewer network will be installed within the development to capture the storm water runoff and convey it to detention basin #2 located at the southwest corner of Section 1. All storm sewers will be constructed with reinforced concrete pipe. Due to the existing topography, Lots 1 - 8 will be graded from the rear of the lot to the front of the lot. I have shown 10 foot drainage easements along these property lines to allow side yard swales to be constructed when the homes are built which will divert the upstream runoff away from the homes. The primary outlet and emergency spillway of Detention Basin #2 will discharge into the existing ditch that is located on the west side of the detention basin. All runoff ultimately discharges to Little Pigeon Creek.

### CALCULATIONS

A hydrologic and hydraulic analyses was performed for detention basin #2 using HydroCAD Stormwater Modeling System, version 9.1, developed by HydroCAD Software Solutions LLC. HydroCAD is capable of modeling the hydrology and hydraulics of stormwater runoff using the hydrology techniques developed by the NRCS and various other accepted H&H calculation techniques. The program calculates the peak runoff rates and total runoff volume for each sub-basin and routes the resulting hydrographs through the network of storm pipes, inlets and basins defined in the model. The program routes the various converging flows together, taking into account differences in time of concentration and travel time through the network structures to accurately calculate peak and total discharge rates for sizing of the detention basin outlet structures.

Peak discharge and total runoff volume calculations were performed using the NRCS (formerly SCS) Curve Number Method. Rainfall data was obtained from the Type II 24-hr storm for Vanderburgh County. The watershed sub-basin areas for the detention basin were then combined into one large sub-basin for each storm sewer run to simplify the modeling process. The weighted developed runoff Curve Number,  $C_N$ , for each sub-basin was determined for the proposed conditions based on land use and hydrologic soil group rating. The models of the proposed drainage system were subjected to H&H analyses for the 25-year return period storm event.

The outlet structure for detention basin #2 was sized for the 25-year design storm event while allowing a discharge rate less than the undeveloped 10-year storm event from the system minus the undetained 25-year runoff plus the 25-year off-site runoff. The emergency spillway for detention basin #2 was designed to convey the 100-year storm flow.



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Below is a summary of the detention basin design elements:

<b>Detention Basin #2</b>		<b>NOTES</b>
Detention Basin #2 Developed Q(25)	44.12 - cfs	#1
Detention Basin #2 Undeveloped Q(10)	85.34 - cfs	Undeveloped Sub-basin UN-2
Undetained Developed Q(25)	103.10 - cfs	#2, #4 & #5
Off-Site Developed Q(25)	45.39 - cfs	Off-Site Sub-basin OS-4
25-year Provided Storage Volume	188,464 - cf	
25-year Required Storage Volume	134,687 - cf	
Allowable Detention Basin Release Rate	27.63 - cfs	Undeveloped Q(10) - Undetained Developed Q(25) + Off-Site Developed Q(25)
<i>Proposed Detention Basin Release Rate</i>	13.88 - cfs	<i>Detention Basin #2 Primary Outlet</i>
<i>Primary Outlet Structure</i>	<i>45-LF of 18" R.C.P.</i>	<i>P-607</i>
Primary Outlet I.E.	402.60	
25-year Storage Vol. Elev.	406.01	
HW (25-yr. elev. - I.E.)	3.41 - ft.	
Minimum Top/Bank	407.10	

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**Summary for Subcatchment UN-2: UN-2**

Runoff = 85.34 cfs @ 12.27 hrs, Volume= 7.796 af, Depth> 1.78"

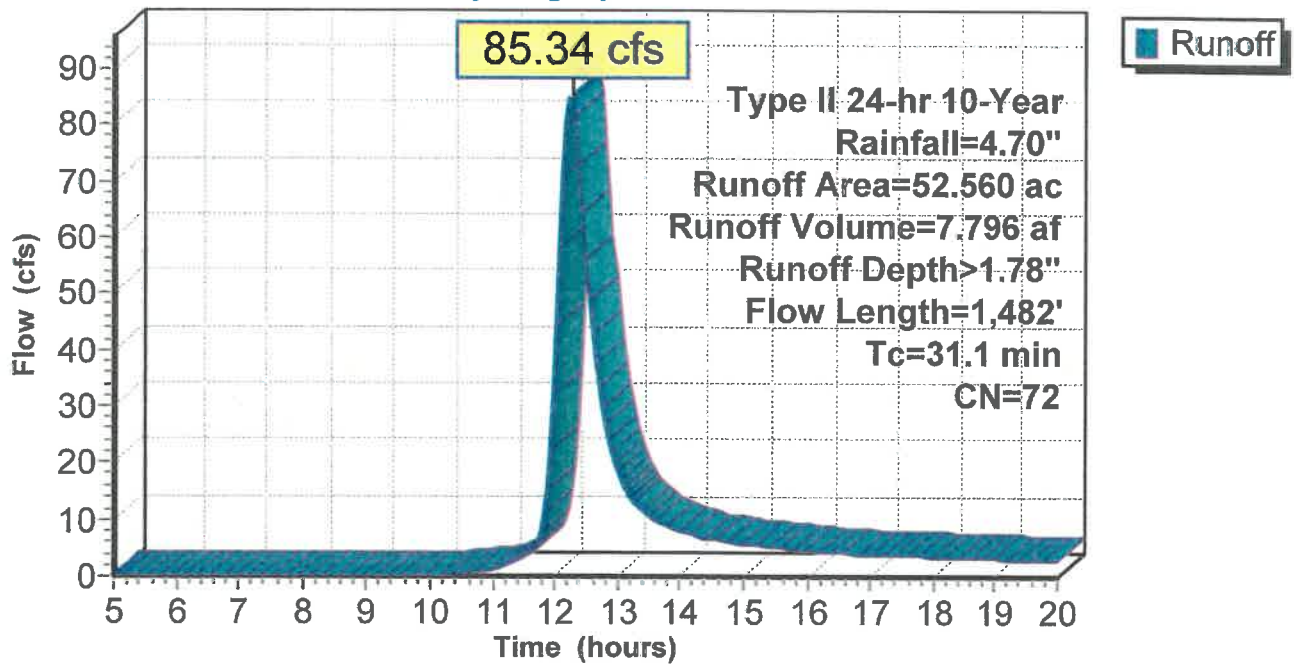
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 10-Year Rainfall=4.70"

Area (ac)	CN	Description
7.940	85	Row crops, straight row, Good, HSG C
44.620	70	Woods, Good, HSG C
52.560	72	Weighted Average
52.560		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.6	300	0.1367	0.21		<b>Sheet Flow, Sheet Flow</b>
5.5	300	0.0333	0.91		Woods: Light underbrush n= 0.400 P2= 3.30" <b>Shallow Concentrated Flow, Shallow Concentrated</b>
2.0	882	0.0215	7.26	72.63	Woodland Kv= 5.0 fps <b>Channel Flow,</b> Area= 10.0 sf Perim= 10.0' r= 1.00' n= 0.030 Earth, clean & winding
31.1	1,482	Total			

Subcatchment UN-2: UN-2

Hydrograph



**Hydrograph for Subcatchment UN-2: UN-2**

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
5.00	0.30	0.00	0.00	7.60	0.52	0.00	0.00
5.05	0.30	0.00	0.00	7.65	0.53	0.00	0.00
5.10	0.30	0.00	0.00	7.70	0.53	0.00	0.00
5.15	0.31	0.00	0.00	7.75	0.54	0.00	0.00
5.20	0.31	0.00	0.00	7.80	0.54	0.00	0.00
5.25	0.32	0.00	0.00	7.85	0.55	0.00	0.00
5.30	0.32	0.00	0.00	7.90	0.55	0.00	0.00
5.35	0.32	0.00	0.00	7.95	0.56	0.00	0.00
5.40	0.33	0.00	0.00	8.00	0.56	0.00	0.00
5.45	0.33	0.00	0.00	8.05	0.57	0.00	0.00
5.50	0.33	0.00	0.00	8.10	0.57	0.00	0.00
5.55	0.34	0.00	0.00	8.15	0.58	0.00	0.00
5.60	0.34	0.00	0.00	8.20	0.59	0.00	0.00
5.65	0.35	0.00	0.00	8.25	0.59	0.00	0.00
5.70	0.35	0.00	0.00	8.30	0.60	0.00	0.00
5.75	0.36	0.00	0.00	8.35	0.60	0.00	0.00
5.80	0.36	0.00	0.00	8.40	0.61	0.00	0.00
5.85	0.36	0.00	0.00	8.45	0.62	0.00	0.00
5.90	0.37	0.00	0.00	8.50	0.62	0.00	0.00
5.95	0.37	0.00	0.00	8.55	0.63	0.00	0.00
6.00	0.38	0.00	0.00	8.60	0.63	0.00	0.00
6.05	0.38	0.00	0.00	8.65	0.64	0.00	0.00
6.10	0.38	0.00	0.00	8.70	0.65	0.00	0.00
6.15	0.39	0.00	0.00	8.75	0.65	0.00	0.00
6.20	0.39	0.00	0.00	8.80	0.66	0.00	0.00
6.25	0.40	0.00	0.00	8.85	0.67	0.00	0.00
6.30	0.40	0.00	0.00	8.90	0.68	0.00	0.00
6.35	0.41	0.00	0.00	8.95	0.68	0.00	0.00
6.40	0.41	0.00	0.00	9.00	0.69	0.00	0.00
6.45	0.42	0.00	0.00	9.05	0.70	0.00	0.00
6.50	0.42	0.00	0.00	9.10	0.71	0.00	0.00
6.55	0.42	0.00	0.00	9.15	0.71	0.00	0.00
6.60	0.43	0.00	0.00	9.20	0.72	0.00	0.00
6.65	0.43	0.00	0.00	9.25	0.73	0.00	0.00
6.70	0.44	0.00	0.00	9.30	0.74	0.00	0.00
6.75	0.44	0.00	0.00	9.35	0.74	0.00	0.00
6.80	0.45	0.00	0.00	9.40	0.75	0.00	0.00
6.85	0.45	0.00	0.00	9.45	0.76	0.00	0.00
6.90	0.46	0.00	0.00	9.50	0.77	0.00	0.00
6.95	0.46	0.00	0.00	9.55	0.77	0.00	0.00
7.00	0.47	0.00	0.00	9.60	0.78	0.00	0.00
7.05	0.47	0.00	0.00	9.65	0.79	0.00	0.00
7.10	0.47	0.00	0.00	9.70	0.80	0.00	0.00
7.15	0.48	0.00	0.00	9.75	0.81	0.00	0.00
7.20	0.48	0.00	0.00	9.80	0.81	0.00	0.00
7.25	0.49	0.00	0.00	9.85	0.82	0.00	0.01
7.30	0.49	0.00	0.00	9.90	0.83	0.00	0.02
7.35	0.50	0.00	0.00	9.95	0.84	0.00	0.03
7.40	0.50	0.00	0.00	10.00	0.85	0.00	0.04
7.45	0.51	0.00	0.00	10.05	0.86	0.00	0.06
7.50	0.51	0.00	0.00	10.10	0.87	0.00	0.09
7.55	0.52	0.00	0.00	10.15	0.88	0.00	0.12

## Hydrograph for Subcatchment UN-2: UN-2 (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
10.20	0.89	0.00	0.15	12.80	3.57	1.16	26.96
10.25	0.90	0.00	0.19	12.85	3.58	1.18	24.29
10.30	0.91	0.00	0.23	12.90	3.60	1.19	22.04
10.35	0.92	0.01	0.27	12.95	3.61	1.20	20.13
10.40	0.93	0.01	0.32	13.00	3.63	1.21	18.51
10.45	0.95	0.01	0.37	13.05	3.64	1.22	17.17
10.50	0.96	0.01	0.43	13.10	3.66	1.22	16.03
10.55	0.97	0.01	0.49	13.15	3.67	1.23	15.05
10.60	0.98	0.01	0.55	13.20	3.68	1.24	14.18
10.65	1.00	0.01	0.62	13.25	3.70	1.25	13.43
10.70	1.01	0.01	0.69	13.30	3.71	1.26	12.77
10.75	1.03	0.01	0.77	13.35	3.72	1.27	12.17
10.80	1.04	0.02	0.85	13.40	3.73	1.28	11.65
10.85	1.06	0.02	0.94	13.45	3.74	1.28	11.19
10.90	1.07	0.02	1.04	13.50	3.76	1.29	10.76
10.95	1.09	0.02	1.15	13.55	3.77	1.30	10.35
11.00	1.10	0.03	1.26	13.60	3.78	1.31	9.99
11.05	1.12	0.03	1.38	13.65	3.79	1.31	9.66
11.10	1.14	0.03	1.51	13.70	3.80	1.32	9.36
11.15	1.16	0.03	1.65	13.75	3.81	1.33	9.10
11.20	1.18	0.04	1.80	13.80	3.82	1.33	8.86
11.25	1.20	0.04	1.96	13.85	3.83	1.34	8.64
11.30	1.23	0.05	2.15	13.90	3.84	1.35	8.42
11.35	1.25	0.05	2.35	13.95	3.85	1.35	8.21
11.40	1.28	0.06	2.58	14.00	3.85	1.36	8.02
11.45	1.30	0.06	2.83	14.05	3.86	1.36	7.83
11.50	1.33	0.07	3.12	14.10	3.87	1.37	7.65
11.55	1.37	0.08	3.43	14.15	3.88	1.38	7.47
11.60	1.44	0.10	3.79	14.20	3.89	1.38	7.30
11.65	1.54	0.12	4.27	14.25	3.90	1.39	7.14
11.70	1.67	0.16	4.98	14.30	3.90	1.39	6.99
11.75	1.82	0.22	6.13	14.35	3.91	1.40	6.85
11.80	2.02	0.30	8.01	14.40	3.92	1.40	6.72
11.85	2.31	0.43	11.02	14.45	3.93	1.41	6.61
11.90	2.67	0.62	15.61	14.50	3.94	1.42	6.50
11.95	2.98	0.80	22.55	14.55	3.94	1.42	6.41
12.00	3.12	0.88	32.29	14.60	3.95	1.43	6.33
12.05	3.16	0.91	44.69	14.65	3.96	1.43	6.25
12.10	3.21	0.93	58.40	14.70	3.97	1.44	6.18
12.15	3.25	0.96	71.28	14.75	3.98	1.44	6.11
12.20	3.28	0.98	80.69	14.80	3.98	1.45	6.04
12.25	3.32	1.00	<b>85.02</b>	14.85	3.99	1.45	5.98
12.30	3.35	1.02	84.29	14.90	4.00	1.46	5.92
12.35	3.38	1.04	80.01	14.95	4.00	1.46	5.86
12.40	3.41	1.06	73.03	15.00	4.01	1.47	5.79
12.45	3.43	1.08	64.81	15.05	4.02	1.47	5.74
12.50	3.45	1.09	56.43	15.10	4.03	1.48	5.68
12.55	3.47	1.10	48.99	15.15	4.03	1.48	5.62
12.60	3.49	1.12	42.95	15.20	4.04	1.49	5.56
12.65	3.51	1.13	37.97	15.25	4.05	1.49	5.51
12.70	3.53	1.14	33.76	15.30	4.05	1.50	5.45
12.75	3.55	1.15	30.11	15.35	4.06	1.50	5.39



## Hydrograph for Subcatchment UN-2: UN-2 (continued)

Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)	Time (hours)	Precip. (inches)	Excess (inches)	Runoff (cfs)
15.40	4.07	1.51	5.34	18.00	4.33	1.69	3.46
15.45	4.07	1.51	5.28	18.05	4.33	1.70	3.44
15.50	4.08	1.51	5.22	18.10	4.34	1.70	3.42
15.55	4.08	1.52	5.16	18.15	4.34	1.70	3.40
15.60	4.09	1.52	5.11	18.20	4.35	1.71	3.38
15.65	4.10	1.53	5.05	18.25	4.35	1.71	3.36
15.70	4.10	1.53	4.99	18.30	4.35	1.71	3.33
15.75	4.11	1.54	4.93	18.35	4.36	1.72	3.31
15.80	4.11	1.54	4.88	18.40	4.36	1.72	3.29
15.85	4.12	1.54	4.82	18.45	4.37	1.72	3.27
15.90	4.13	1.55	4.76	18.50	4.37	1.72	3.25
15.95	4.13	1.55	4.70	18.55	4.37	1.73	3.23
16.00	4.14	1.56	4.65	18.60	4.38	1.73	3.21
16.05	4.14	1.56	4.59	18.65	4.38	1.73	3.19
16.10	4.15	1.56	4.53	18.70	4.39	1.74	3.17
16.15	4.15	1.57	4.47	18.75	4.39	1.74	3.14
16.20	4.16	1.57	4.41	18.80	4.39	1.74	3.12
16.25	4.16	1.58	4.36	18.85	4.40	1.74	3.10
16.30	4.17	1.58	4.30	18.90	4.40	1.75	3.08
16.35	4.17	1.58	4.26	18.95	4.40	1.75	3.06
16.40	4.18	1.59	4.21	19.00	4.41	1.75	3.04
16.45	4.18	1.59	4.17	19.05	4.41	1.75	3.01
16.50	4.19	1.59	4.13	19.10	4.41	1.76	2.99
16.55	4.19	1.60	4.10	19.15	4.42	1.76	2.97
16.60	4.20	1.60	4.07	19.20	4.42	1.76	2.95
16.65	4.20	1.60	4.04	19.25	4.43	1.77	2.93
16.70	4.21	1.61	4.02	19.30	4.43	1.77	2.91
16.75	4.21	1.61	3.99	19.35	4.43	1.77	2.88
16.80	4.22	1.62	3.97	19.40	4.44	1.77	2.86
16.85	4.22	1.62	3.94	19.45	4.44	1.78	2.84
16.90	4.23	1.62	3.92	19.50	4.44	1.78	2.82
16.95	4.23	1.63	3.90	19.55	4.45	1.78	2.80
17.00	4.24	1.63	3.88	19.60	4.45	1.78	2.78
17.05	4.24	1.63	3.86	19.65	4.45	1.79	2.75
17.10	4.25	1.64	3.84	19.70	4.46	1.79	2.73
17.15	4.25	1.64	3.81	19.75	4.46	1.79	2.71
17.20	4.26	1.64	3.79	19.80	4.46	1.79	2.69
17.25	4.26	1.65	3.77	19.85	4.47	1.79	2.67
17.30	4.27	1.65	3.75	19.90	4.47	1.80	2.64
17.35	4.27	1.65	3.73	19.95	4.47	1.80	2.62
17.40	4.28	1.66	3.71	20.00	<b>4.47</b>	<b>1.80</b>	2.60
17.45	4.28	1.66	3.69				
17.50	4.28	1.66	3.67				
17.55	4.29	1.67	3.65				
17.60	4.29	1.67	3.63				
17.65	4.30	1.67	3.61				
17.70	4.30	1.68	3.59				
17.75	4.31	1.68	3.56				
17.80	4.31	1.68	3.55				
17.85	4.32	1.69	3.52				
17.90	4.32	1.69	3.50				
17.95	4.32	1.69	3.48				

**Summary for Subcatchment OS-4: OS-4**

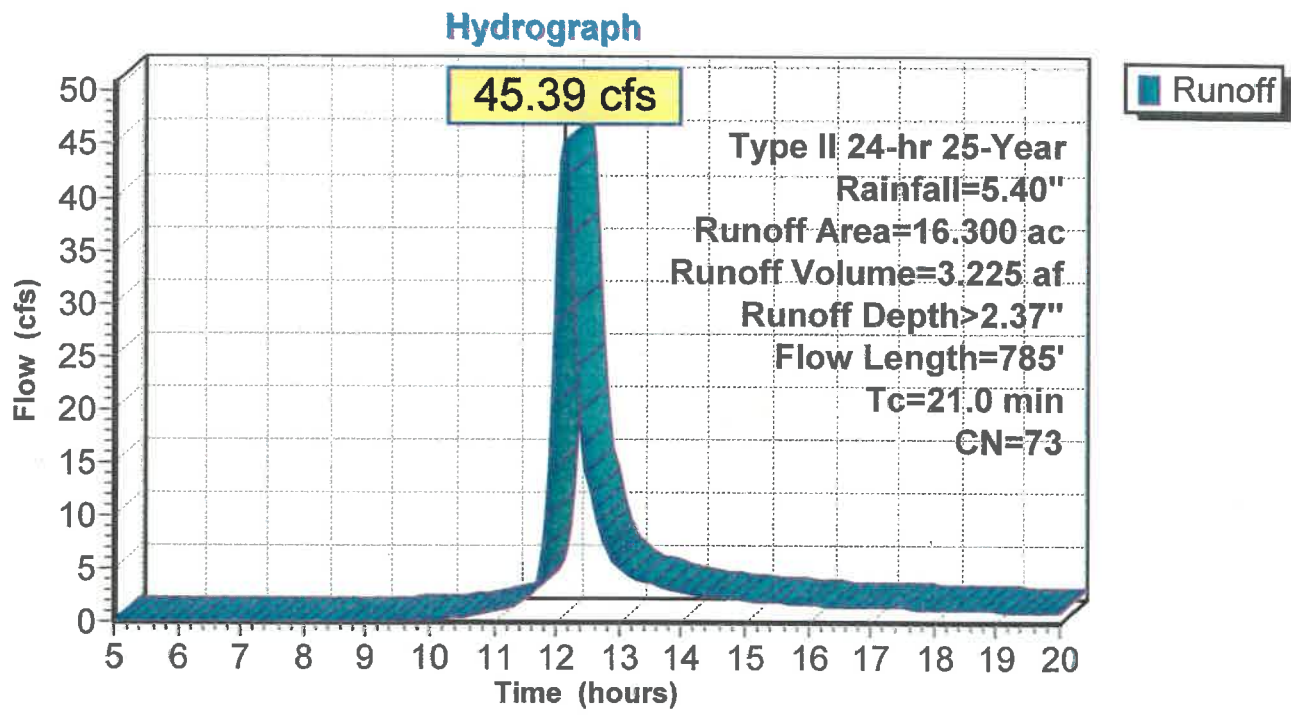
Runoff = 45.39 cfs @ 12.14 hrs, Volume= 3.225 af, Depth> 2.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 25-Year Rainfall=5.40"

Area (ac)	CN	Description
15.140	71	Meadow, non-grazed, HSG C
0.660	98	Paved parking, HSG C
0.500	98	Water Surface, HSG C
16.300	73	Weighted Average
15.140		92.88% Pervious Area
1.160		7.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.9	300	0.1133	0.30		<b>Sheet Flow, Sheet Flow</b> Grass: Dense n= 0.240 P2= 3.30"
3.5	300	0.0417	1.43		<b>Shallow Concentrated Flow, Shallow Concentrated</b> Short Grass Pasture Kv= 7.0 fps
0.6	185	0.0297	5.21	15.62	<b>Channel Flow,</b> Area= 3.0 sf Perim= 5.0' r= 0.60' n= 0.035 Earth, dense weeds
21.0	785	Total			

Subcatchment OS-4: OS-4



**Summary for Pond DB #2: Det. Basin #2**

Inflow Area = 27.820 ac, 16.59% Impervious, Inflow Depth > 2.67" for 25-Year event  
 Inflow = 88.76 cfs @ 12.13 hrs, Volume= 6.194 af  
 Outflow = 13.88 cfs @ 12.73 hrs, Volume= 5.609 af, Atten= 84%, Lag= 36.3 min  
 Primary = 13.88 cfs @ 12.73 hrs, Volume= 5.609 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 406.01' @ 12.73 hrs Surf.Area= 46,901 sf Storage= 134,687 cf

Plug-Flow detention time= 132.8 min calculated for 5.590 af (90% of inflow)  
 Center-of-Mass det. time= 101.4 min ( 894.7 - 793.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	402.60'	188,464 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

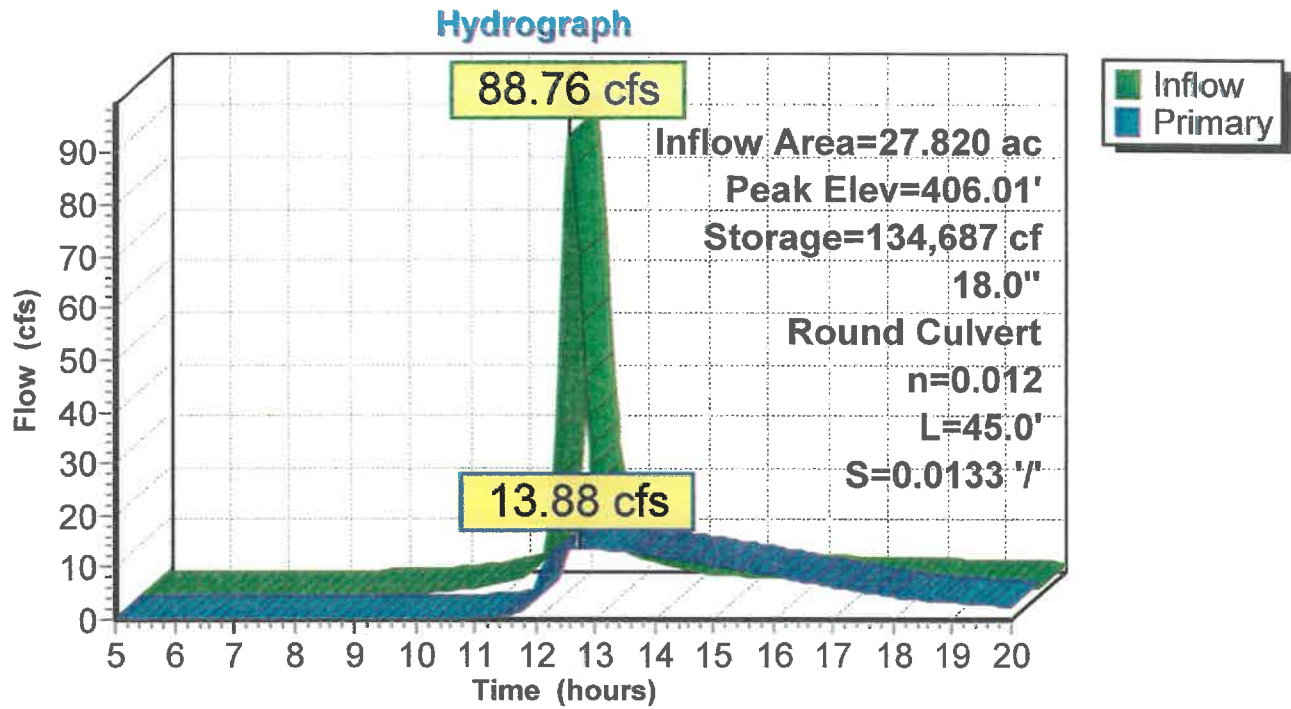
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
402.60	32,268	0	0
403.10	34,340	16,652	16,652
404.10	38,558	36,449	53,101
405.10	42,878	40,718	93,819
406.10	47,297	45,088	138,907
407.10	51,818	49,558	188,464

Device	Routing	Invert	Outlet Devices
#1	Primary	402.60'	<b>18.0" Round Culvert</b> L= 45.0' RCP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 402.60' / 402.00' S= 0.0133 '/' Cc= 0.900 n= 0.012

**Primary OutFlow** Max=13.88 cfs @ 12.73 hrs HW=406.01' (Free Discharge)  
 1=Culvert (Inlet Controls 13.88 cfs @ 7.85 fps)

*REPLACED BY  
 9/12/2018  
 SUBMITTAL*

Pond DB #2: Det. Basin #2



*REMOVED BY  
9/12/2018  
SUBMITTER*

**Hydrograph for Pond DB #2: Det. Basin #2**

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
5.00	0.00	0	402.60	0.00
5.05	0.00	0	402.60	0.00
5.10	0.00	0	402.60	0.00
5.15	0.00	0	402.60	0.00
5.20	0.00	0	402.60	0.00
5.25	0.00	0	402.60	0.00
5.30	0.00	0	402.60	0.00
5.35	0.00	0	402.60	0.00
5.40	0.00	0	402.60	0.00
5.45	0.00	0	402.60	0.00
5.50	0.00	0	402.60	0.00
5.55	0.00	0	402.60	0.00
5.60	0.00	0	402.60	0.00
5.65	0.00	0	402.60	0.00
5.70	0.00	0	402.60	0.00
5.75	0.00	0	402.60	0.00
5.80	0.00	0	402.60	0.00
5.85	0.00	0	402.60	0.00
5.90	0.00	0	402.60	0.00
5.95	0.00	0	402.60	0.00
6.00	0.00	0	402.60	0.00
6.05	0.00	0	402.60	0.00
6.10	0.00	0	402.60	0.00
6.15	0.00	0	402.60	0.00
6.20	0.00	0	402.60	0.00
6.25	0.00	0	402.60	0.00
6.30	0.00	0	402.60	0.00
6.35	0.00	0	402.60	0.00
6.40	0.00	0	402.60	0.00
6.45	0.00	0	402.60	0.00
6.50	0.00	0	402.60	0.00
6.55	0.00	0	402.60	0.00
6.60	0.00	0	402.60	0.00
6.65	0.00	1	402.60	0.00
6.70	0.01	2	402.60	0.00
6.75	0.01	4	402.60	0.00
6.80	0.02	6	402.60	0.00
6.85	0.02	10	402.60	0.00
6.90	0.03	14	402.60	0.00
6.95	0.03	19	402.60	0.00
7.00	0.04	25	402.60	0.00
7.05	0.04	32	402.60	0.00
7.10	0.05	39	402.60	0.00
7.15	0.05	48	402.60	0.00
7.20	0.06	58	402.60	0.00
7.25	0.06	69	402.60	0.00
7.30	0.07	81	402.60	0.00
7.35	0.07	93	402.60	0.00
7.40	0.08	107	402.60	0.00
7.45	0.09	122	402.60	0.00
7.50	0.09	138	402.60	0.00
7.55	0.10	154	402.60	0.00

## Hydrograph for Pond DB #2: Det. Basin #2 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
7.60	0.10	172	402.61	0.00
7.65	0.11	191	402.61	0.00
7.70	0.12	211	402.61	0.00
7.75	0.12	232	402.61	0.00
7.80	0.13	254	402.61	0.00
7.85	0.13	277	402.61	0.00
7.90	0.14	301	402.61	0.00
7.95	0.15	327	402.61	0.00
8.00	0.15	353	402.61	0.00
8.05	0.16	380	402.61	0.00
8.10	0.16	409	402.61	0.00
8.15	0.17	439	402.61	0.00
8.20	0.18	469	402.61	0.00
8.25	0.19	502	402.62	0.00
8.30	0.19	535	402.62	0.00
8.35	0.20	570	402.62	0.00
8.40	0.21	607	402.62	0.00
8.45	0.22	646	402.62	0.00
8.50	0.24	686	402.62	0.01
8.55	0.25	728	402.62	0.01
8.60	0.26	773	402.62	0.01
8.65	0.27	819	402.63	0.01
8.70	0.28	868	402.63	0.01
8.75	0.30	919	402.63	0.01
8.80	0.31	972	402.63	0.01
8.85	0.32	1,028	402.63	0.01
8.90	0.34	1,087	402.63	0.01
8.95	0.36	1,148	402.64	0.01
9.00	0.38	1,213	402.64	0.01
9.05	0.40	1,282	402.64	0.01
9.10	0.43	1,355	402.64	0.01
9.15	0.45	1,433	402.64	0.01
9.20	0.48	1,515	402.65	0.01
9.25	0.51	1,601	402.65	0.01
9.30	0.53	1,692	402.65	0.02
9.35	0.55	1,786	402.66	0.02
9.40	0.58	1,885	402.66	0.02
9.45	0.60	1,987	402.66	0.02
9.50	0.62	2,093	402.66	0.03
9.55	0.65	2,202	402.67	0.03
9.60	0.67	2,315	402.67	0.03
9.65	0.69	2,432	402.67	0.03
9.70	0.72	2,552	402.68	0.04
9.75	0.74	2,677	402.68	0.04
9.80	0.78	2,806	402.69	0.04
9.85	0.81	2,942	402.69	0.04
9.90	0.85	3,083	402.69	0.05
9.95	0.89	3,230	402.70	0.06
10.00	0.93	3,384	402.70	0.06
10.05	0.98	3,544	402.71	0.07
10.10	1.03	3,712	402.71	0.07
10.15	1.08	3,888	402.72	0.08

## Hydrograph for Pond DB #2: Det. Basin #2 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
10.20	1.13	4,071	402.73	0.09
10.25	1.19	4,263	402.73	0.09
10.30	1.25	4,464	402.74	0.10
10.35	1.31	4,675	402.74	0.11
10.40	1.38	4,896	402.75	0.12
10.45	1.45	5,127	402.76	0.14
10.50	1.52	5,368	402.76	0.15
10.55	1.60	5,622	402.77	0.16
10.60	1.68	5,887	402.78	0.17
10.65	1.76	6,164	402.79	0.19
10.70	1.85	6,453	402.80	0.21
10.75	1.95	6,756	402.81	0.23
10.80	2.06	7,075	402.82	0.25
10.85	2.18	7,409	402.83	0.27
10.90	2.30	7,761	402.84	0.30
10.95	2.43	8,130	402.85	0.33
11.00	2.57	8,519	402.86	0.36
11.05	2.71	8,927	402.87	0.39
11.10	2.86	9,355	402.88	0.43
11.15	3.02	9,804	402.90	0.47
11.20	3.21	10,277	402.91	0.51
11.25	3.42	10,778	402.93	0.56
11.30	3.66	11,310	402.94	0.61
11.35	3.94	11,880	402.96	0.67
11.40	4.24	12,490	402.98	0.73
11.45	4.56	13,144	403.00	0.80
11.50	4.91	13,844	403.02	0.89
11.55	5.28	14,594	403.04	0.98
11.60	5.77	15,404	403.06	1.08
11.65	6.64	16,316	403.09	1.20
11.70	8.36	17,436	403.12	1.35
11.75	11.37	18,949	403.17	1.57
11.80	15.96	21,098	403.23	1.90
11.85	22.47	24,170	403.32	2.40
11.90	31.58	28,533	403.44	3.17
11.95	44.41	34,697	403.61	4.33
12.00	60.83	43,247	403.84	5.93
12.05	77.31	54,467	404.14	7.54
12.10	87.62	67,820	404.47	9.02
12.15	<b>87.69</b>	81,859	404.82	10.31
12.20	78.95	94,908	405.13	11.34
12.25	65.92	105,836	405.38	12.11
12.30	52.85	114,296	405.57	12.67
12.35	42.31	120,545	405.70	13.06
12.40	34.65	125,096	405.80	13.33
12.45	29.06	128,414	405.88	13.52
12.50	24.80	130,816	405.93	13.66
12.55	21.45	132,511	405.96	13.76
12.60	18.75	133,647	405.99	13.82
12.65	16.53	134,330	406.00	13.86
12.70	14.72	134,647	406.01	13.88
12.75	13.27	<b>134,668</b>	<b>406.01</b>	<b>13.88</b>



## Hydrograph for Pond DB #2: Det. Basin #2 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
12.80	12.12	134,457	406.01	13.87
12.85	11.21	134,063	406.00	13.84
12.90	10.49	133,527	405.99	13.81
12.95	9.89	132,877	405.97	13.78
13.00	9.38	132,135	405.96	13.74
13.05	8.95	131,317	405.94	13.69
13.10	8.56	130,434	405.92	13.64
13.15	8.23	129,495	405.90	13.58
13.20	7.93	128,508	405.88	13.53
13.25	7.66	127,482	405.86	13.47
13.30	7.42	126,420	405.83	13.41
13.35	7.20	125,328	405.81	13.34
13.40	7.00	124,211	405.78	13.28
13.45	6.82	123,072	405.76	13.21
13.50	6.64	121,912	405.73	13.14
13.55	6.47	120,733	405.71	13.07
13.60	6.30	119,537	405.68	12.99
13.65	6.14	118,324	405.66	12.92
13.70	5.98	117,097	405.63	12.84
13.75	5.84	115,856	405.60	12.77
13.80	5.70	114,603	405.57	12.69
13.85	5.56	113,339	405.55	12.61
13.90	5.43	112,067	405.52	12.52
13.95	5.31	110,788	405.49	12.44
14.00	5.19	109,501	405.46	12.36
14.05	5.07	108,208	405.43	12.27
14.10	4.95	106,909	405.40	12.18
14.15	4.84	105,605	405.37	12.10
14.20	4.73	104,297	405.34	12.01
14.25	4.64	102,987	405.31	11.92
14.30	4.56	101,679	405.28	11.83
14.35	4.49	100,373	405.25	11.73
14.40	4.43	99,073	405.22	11.64
14.45	4.38	97,779	405.19	11.55
14.50	4.33	96,493	405.16	11.45
14.55	4.28	95,215	405.13	11.36
14.60	4.24	93,946	405.10	11.27
14.65	4.20	92,686	405.07	11.17
14.70	4.16	91,436	405.04	11.08
14.75	4.11	90,195	405.02	10.98
14.80	4.07	88,964	404.99	10.88
14.85	4.03	87,744	404.96	10.79
14.90	3.99	86,533	404.93	10.69
14.95	3.95	85,333	404.90	10.59
15.00	3.91	84,142	404.87	10.50
15.05	3.87	82,962	404.84	10.40
15.10	3.83	81,793	404.82	10.30
15.15	3.79	80,633	404.79	10.20
15.20	3.75	79,485	404.76	10.10
15.25	3.71	78,346	404.73	10.00
15.30	3.67	77,219	404.70	9.90
15.35	3.63	76,102	404.68	9.80

## Hydrograph for Pond DB #2: Det. Basin #2 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
15.40	3.59	74,995	404.65	9.70
15.45	3.55	73,900	404.62	9.60
15.50	3.51	72,815	404.60	9.50
15.55	3.46	71,741	404.57	9.40
15.60	3.42	70,677	404.54	9.30
15.65	3.38	69,625	404.52	9.20
15.70	3.34	68,583	404.49	9.10
15.75	3.30	67,553	404.47	8.99
15.80	3.26	66,533	404.44	8.89
15.85	3.22	65,525	404.42	8.79
15.90	3.17	64,528	404.39	8.68
15.95	3.13	63,542	404.37	8.58
16.00	3.09	62,567	404.34	8.48
16.05	3.05	61,604	404.32	8.37
16.10	3.01	60,652	404.29	8.27
16.15	2.97	59,712	404.27	8.16
16.20	2.93	58,784	404.25	8.05
16.25	2.90	57,868	404.22	7.95
16.30	2.87	56,966	404.20	7.84
16.35	2.84	56,078	404.18	7.74
16.40	2.82	55,205	404.15	7.63
16.45	2.80	54,347	404.13	7.53
16.50	2.79	53,505	404.11	7.42
16.55	2.77	52,678	404.09	7.33
16.60	2.75	51,863	404.07	7.24
16.65	2.74	51,061	404.05	7.15
16.70	2.72	50,274	404.03	7.05
16.75	2.71	49,503	404.01	6.95
16.80	2.69	48,748	403.99	6.84
16.85	2.68	48,011	403.97	6.73
16.90	2.66	47,291	403.95	6.61
16.95	2.65	46,589	403.93	6.50
17.00	2.63	45,904	403.91	6.39
17.05	2.62	45,238	403.89	6.27
17.10	2.60	44,588	403.88	6.16
17.15	2.59	43,956	403.86	6.05
17.20	2.58	43,341	403.84	5.94
17.25	2.56	42,743	403.83	5.84
17.30	2.55	42,162	403.81	5.73
17.35	2.53	41,596	403.80	5.63
17.40	2.52	41,047	403.78	5.53
17.45	2.50	40,512	403.77	5.43
17.50	2.49	39,993	403.75	5.33
17.55	2.47	39,488	403.74	5.24
17.60	2.46	38,998	403.73	5.15
17.65	2.44	38,521	403.71	5.05
17.70	2.43	38,057	403.70	4.97
17.75	2.41	37,606	403.69	4.88
17.80	2.40	37,168	403.68	4.80
17.85	2.38	36,742	403.67	4.72
17.90	2.37	36,328	403.65	4.64
17.95	2.35	35,925	403.64	4.56

## Hydrograph for Pond DB #2: Det. Basin #2 (continued)

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Primary (cfs)
18.00	2.34	35,533	403.63	4.49
18.05	2.32	35,152	403.62	4.41
18.10	2.31	34,781	403.61	4.34
18.15	2.29	34,419	403.60	4.27
18.20	2.28	34,068	403.59	4.21
18.25	2.26	33,725	403.58	4.14
18.30	2.25	33,391	403.57	4.08
18.35	2.23	33,066	403.56	4.02
18.40	2.22	32,749	403.56	3.96
18.45	2.20	32,441	403.55	3.90
18.50	2.19	32,139	403.54	3.84
18.55	2.17	31,846	403.53	3.79
18.60	2.16	31,559	403.52	3.73
18.65	2.14	31,279	403.52	3.68
18.70	2.13	31,006	403.51	3.63
18.75	2.11	30,739	403.50	3.58
18.80	2.10	30,479	403.49	3.53
18.85	2.08	30,224	403.49	3.48
18.90	2.07	29,975	403.48	3.44
18.95	2.05	29,731	403.47	3.39
19.00	2.04	29,493	403.47	3.35
19.05	2.02	29,260	403.46	3.30
19.10	2.01	29,032	403.45	3.26
19.15	1.99	28,808	403.45	3.22
19.20	1.98	28,590	403.44	3.18
19.25	1.96	28,375	403.43	3.14
19.30	1.95	28,165	403.43	3.10
19.35	1.93	27,958	403.42	3.07
19.40	1.92	27,756	403.42	3.03
19.45	1.90	27,558	403.41	2.99
19.50	1.89	27,363	403.41	2.96
19.55	1.87	27,172	403.40	2.92
19.60	1.86	26,983	403.40	2.89
19.65	1.84	26,799	403.39	2.86
19.70	1.82	26,617	403.39	2.83
19.75	1.81	26,438	403.38	2.79
19.80	1.79	26,263	403.38	2.76
19.85	1.78	26,090	403.37	2.73
19.90	1.76	25,919	403.37	2.70
19.95	1.75	25,752	403.36	2.67
20.00	1.73	25,587	403.36	2.64

**Stage-Discharge for Pond DB #2: Det. Basin #2**

Elevation (feet)	Primary (cfs)
402.60	0.00
402.70	0.05
402.80	0.21
402.90	0.47
403.00	0.81
403.10	1.24
403.20	1.74
403.30	2.30
403.40	2.92
403.50	3.58
403.60	4.26
403.70	4.96
403.80	5.65
403.90	6.32
404.00	6.92
404.10	7.37
404.20	7.84
404.30	8.29
404.40	8.72
404.50	9.12
404.60	9.51
404.70	9.89
404.80	10.25
404.90	10.59
405.00	10.93
405.10	11.26
405.20	11.57
405.30	11.88
405.40	12.18
405.50	12.48
405.60	12.76
405.70	13.04
405.80	13.32
405.90	13.59
406.00	13.85
406.10	14.11
406.20	14.36
406.30	14.61
406.40	14.86
406.50	15.10
406.60	15.34
406.70	15.57
406.80	15.80
406.90	16.03
407.00	16.26
407.10	<b>16.48</b>

**Stage-Area-Storage for Pond DB #2: Det. Basin #2**

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
402.60	32,268	0
402.70	32,682	3,248
402.80	33,097	6,536
402.90	33,511	9,867
403.00	33,926	13,239
403.10	34,340	16,652
403.20	34,762	20,107
403.30	35,184	23,604
403.40	35,605	27,144
403.50	36,027	30,725
403.60	36,449	34,349
403.70	36,871	38,015
403.80	37,293	41,723
403.90	37,714	45,474
404.00	38,136	49,266
404.10	38,558	53,101
404.20	38,990	56,978
404.30	39,422	60,899
404.40	39,854	64,863
404.50	40,286	68,870
404.60	40,718	72,920
404.70	41,150	77,013
404.80	41,582	81,150
404.90	42,014	85,330
405.00	42,446	89,553
405.10	42,878	93,819
405.20	43,320	98,129
405.30	43,762	102,483
405.40	44,204	106,881
405.50	44,646	111,324
405.60	45,088	115,810
405.70	45,529	120,341
405.80	45,971	124,916
405.90	46,413	129,535
406.00	46,855	134,199
406.10	47,297	138,907
406.20	47,749	143,659
406.30	48,201	148,456
406.40	48,653	153,299
406.50	49,105	158,187
406.60	49,558	163,120
406.70	50,010	168,098
406.80	50,462	173,122
406.90	50,914	178,191
407.00	51,366	183,305
407.10	<b>51,818</b>	<b>188,464</b>

**Summary for Subcatchment 1: #1 Dev**

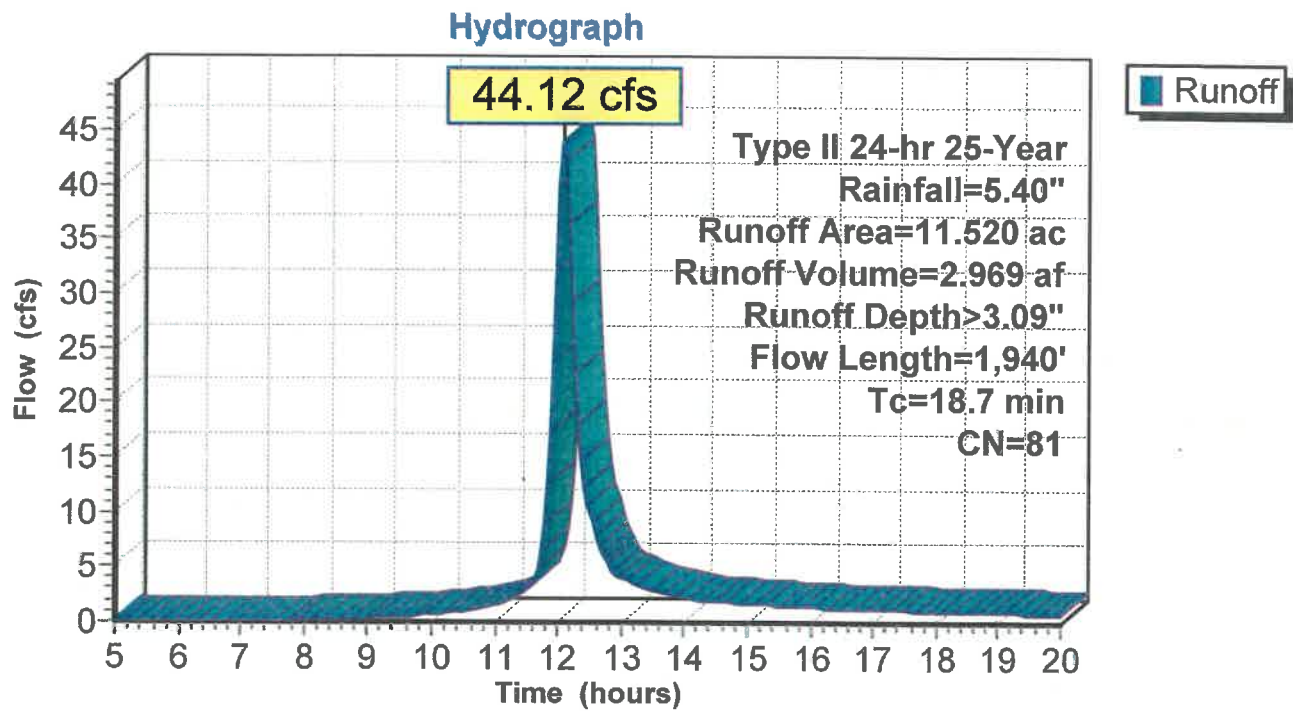
Runoff = 44.12 cfs @ 12.11 hrs, Volume= 2.969 af, Depth> 3.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 25-Year Rainfall=5.40"

Area (ac)	CN	Description
11.520	81	1/3 acre lots, 30% imp, HSG C
8.064		70.00% Pervious Area
3.456		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.6	100	0.1118	0.16		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.30"
5.3	112	0.1118	0.35		<b>Sheet Flow, Sheet Flow</b> Grass: Short n= 0.150 P2= 3.30"
0.4	97	0.0433	4.22		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Paved Kv= 20.3 fps
2.4	1,631	0.0303	11.21	19.81	<b>Pipe Channel, Storm Sewer</b> 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012
18.7	1,940	Total			

Subcatchment 1: #1 Dev



**Summary for Subcatchment 2: #2 Dev**

Runoff = 62.22 cfs @ 12.26 hrs, Volume= 5.642 af, Depth> 2.99"

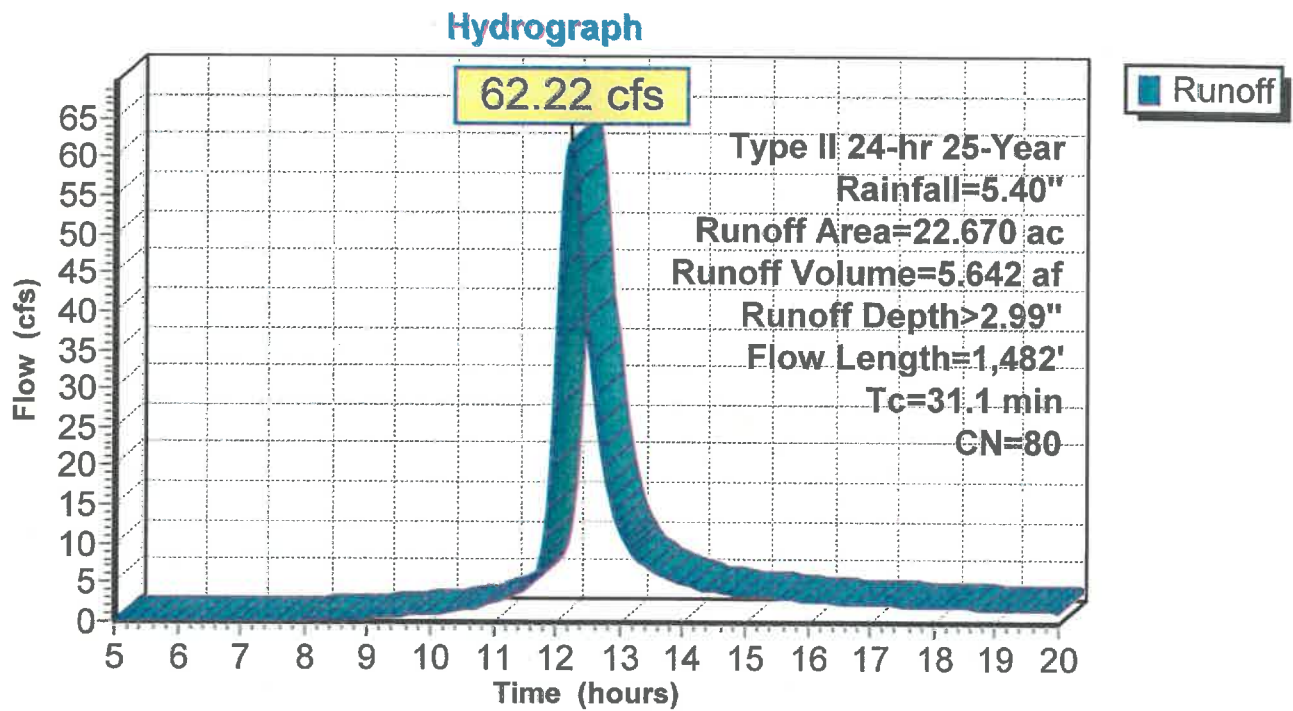
Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 25-Year Rainfall=5.40"

Area (ac)	CN	Description
22.670	80	1/2 acre lots, 25% imp, HSG C
17.002		75.00% Pervious Area
5.668		25.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.6	300	0.1367	0.21		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.30"
5.5	300	0.0333	0.91		<b>Shallow Concentrated Flow, Shallow Concentrated Flow</b> Woodland Kv= 5.0 fps
2.0	882	0.0215	7.26	72.63	<b>Channel Flow, Ditch Flow</b> Area= 10.0 sf Perim= 10.0' r= 1.00' n= 0.030
31.1	1,482	Total			



Subcatchment 2: #2 Dev



### Summary for Reach Creek: Discharge Off-Site

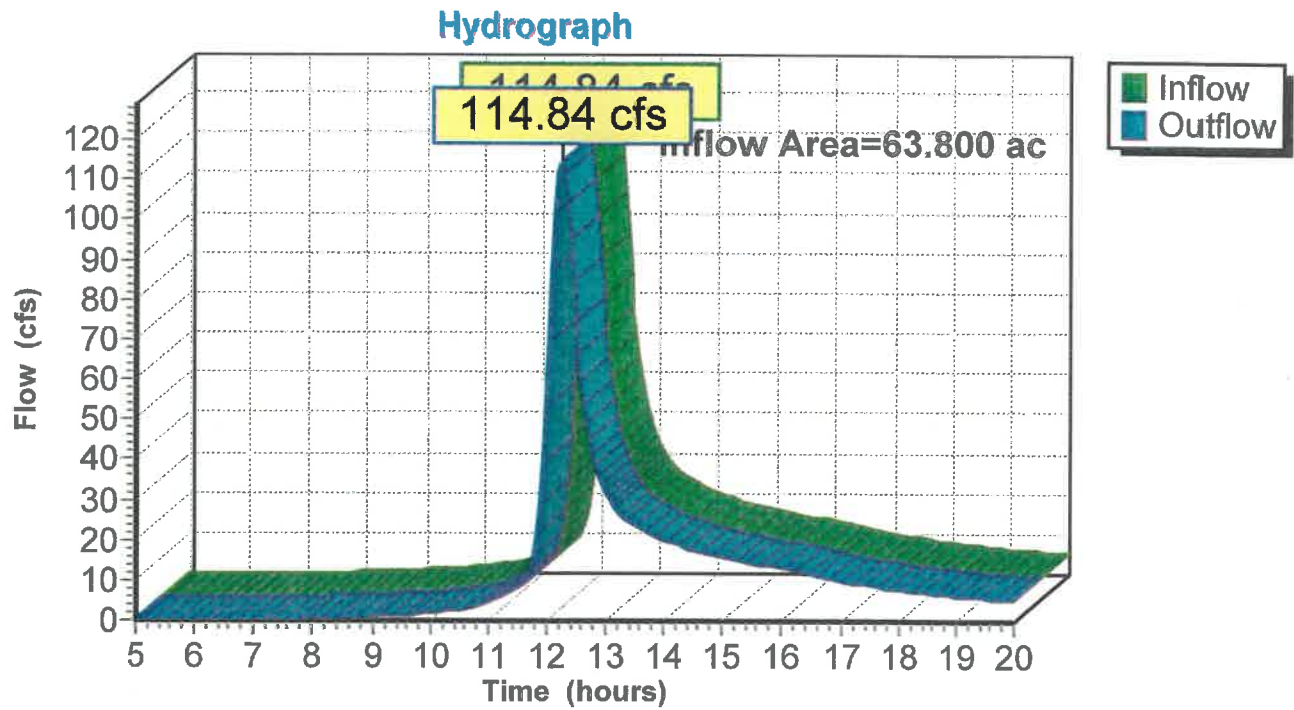
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 63.800 ac, 23.57% Impervious, Inflow Depth > 2.79" for 25-Year event  
Inflow = 114.84 cfs @ 12.25 hrs, Volume= 14.821 af  
Outflow = 114.84 cfs @ 12.25 hrs, Volume= 14.821 af, Atten= 0%, Lag= 0.0 min

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

Outlet rate at southwest corner of Lot 21 which includes detention basin #2 primary spillway plus sub-basins #2, #4 + #5.

Reach Creek: Discharge Off-Site



**Summary for Subcatchment 4: #4 Dev**

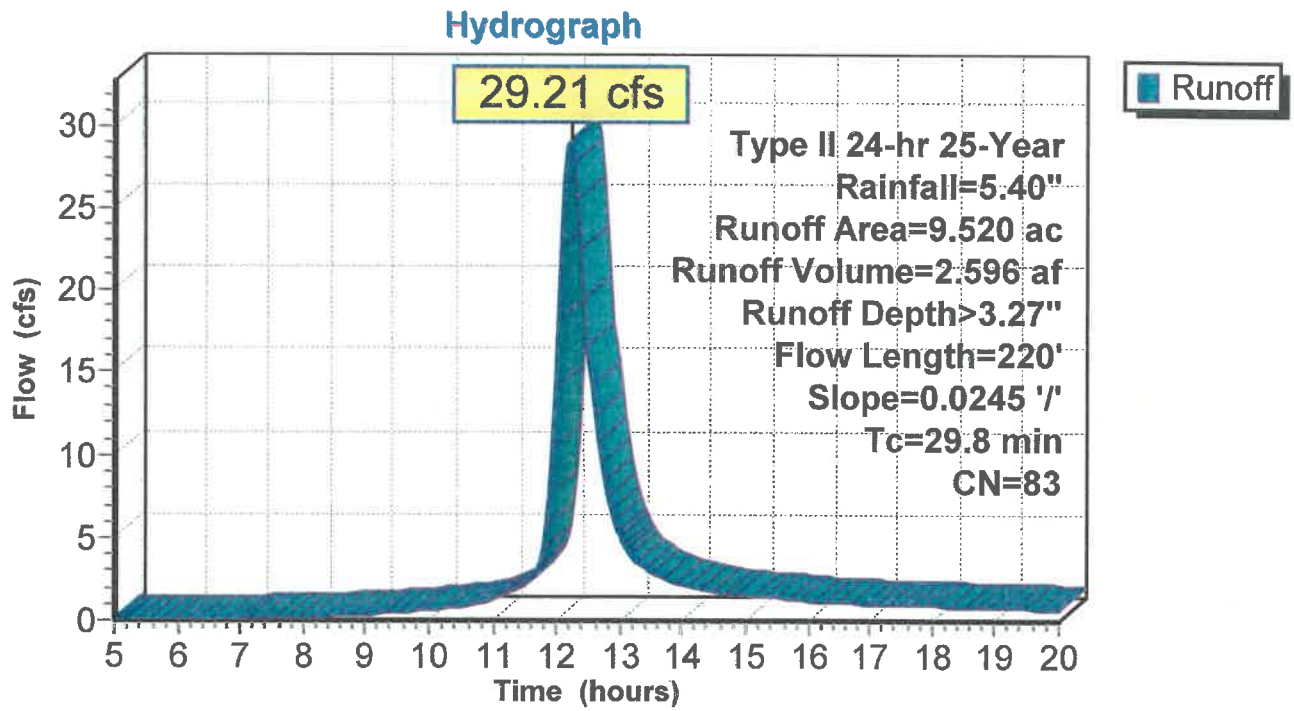
Runoff = 29.21 cfs @ 12.24 hrs, Volume= 2.596 af, Depth> 3.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 25-Year Rainfall=5.40"

Area (ac)	CN	Description
9.520	83	1/4 acre lots, 38% imp, HSG C
5.902		62.00% Pervious Area
3.618		38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.5	100	0.0245	0.09		<b>Sheet Flow, Sheet Flow</b>
					Woods: Light underbrush n= 0.400 P2= 3.30"
10.3	120	0.0245	0.19		<b>Sheet Flow,</b>
					Grass: Short n= 0.150 P2= 3.30"
29.8	220	Total			

Subcatchment 4: #4 Dev



**Summary for Subcatchment 5: #5 Dev**

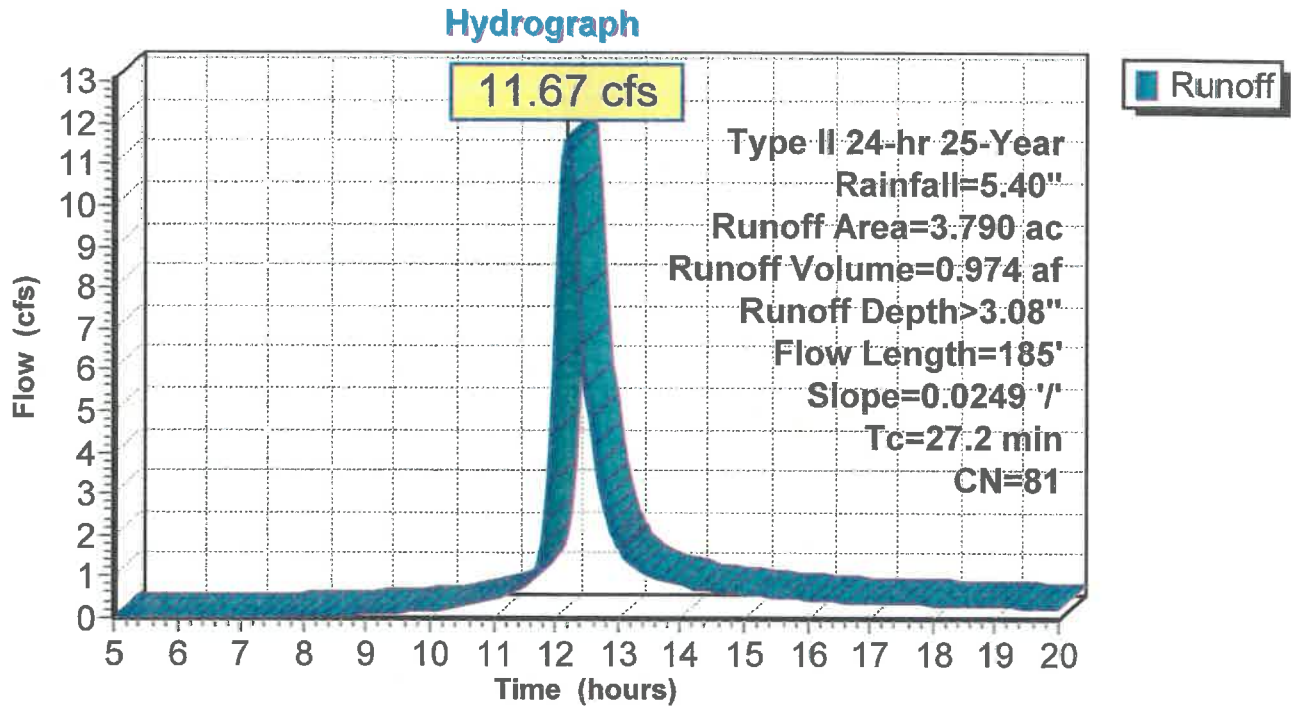
Runoff = 11.67 cfs @ 12.21 hrs, Volume= 0.974 af, Depth> 3.08"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type II 24-hr 25-Year Rainfall=5.40"

Area (ac)	CN	Description
3.790	81	1/3 acre lots, 30% imp, HSG C
2.653		70.00% Pervious Area
1.137		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.8	85	0.0249	0.18		<b>Sheet Flow, Sheet Flow</b> Grass: Short n= 0.150 P2= 3.30"
19.4	100	0.0249	0.09		<b>Sheet Flow, Sheet Flow</b> Woods: Light underbrush n= 0.400 P2= 3.30"
27.2	185	Total			

Subcatchment 5: #5 Dev



### Summary for Reach P-609: P-609

[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 89.380 ac, 20.00% Impervious, Inflow Depth > 2.99" for 25-Year event  
Inflow = 288.13 cfs @ 12.17 hrs, Volume= 22.299 af  
Outflow = 287.83 cfs @ 12.17 hrs, Volume= 22.296 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Max. Velocity= 18.41 fps, Min. Travel Time= 0.1 min  
Avg. Velocity = 7.32 fps, Avg. Travel Time= 0.2 min

Peak Storage= 1,157 cf @ 12.17 hrs  
Average Depth at Peak Storage= 3.71'  
Bank-Full Depth= 5.00', Capacity at Bank-Full= 319.68 cfs

60.0" Round Pipe  
n= 0.012  
Length= 74.0' Slope= 0.0128 '/  
Inlet Invert= 409.70', Outlet Invert= 408.75'





Reach P-609: P-609

