

### Aspen Hill Estates – Phase 1

The site is located approximately 440 feet north of the intersection of Boonville New Harmony Road and Petersburg Road in Scott Township, Vanderburgh, Indiana. Schlensker Ditch runs along the north property line of the subdivision.

The 53.14 acre site is located on rolling ground of 2% to 10% slopes which has been previously cultivated ground and woods. The floodway boundary and the F.I.R.M. panel line identifying the location of the 100-year flood zone "A" boundary are depicted on the enclosed 'developed' condition maps.

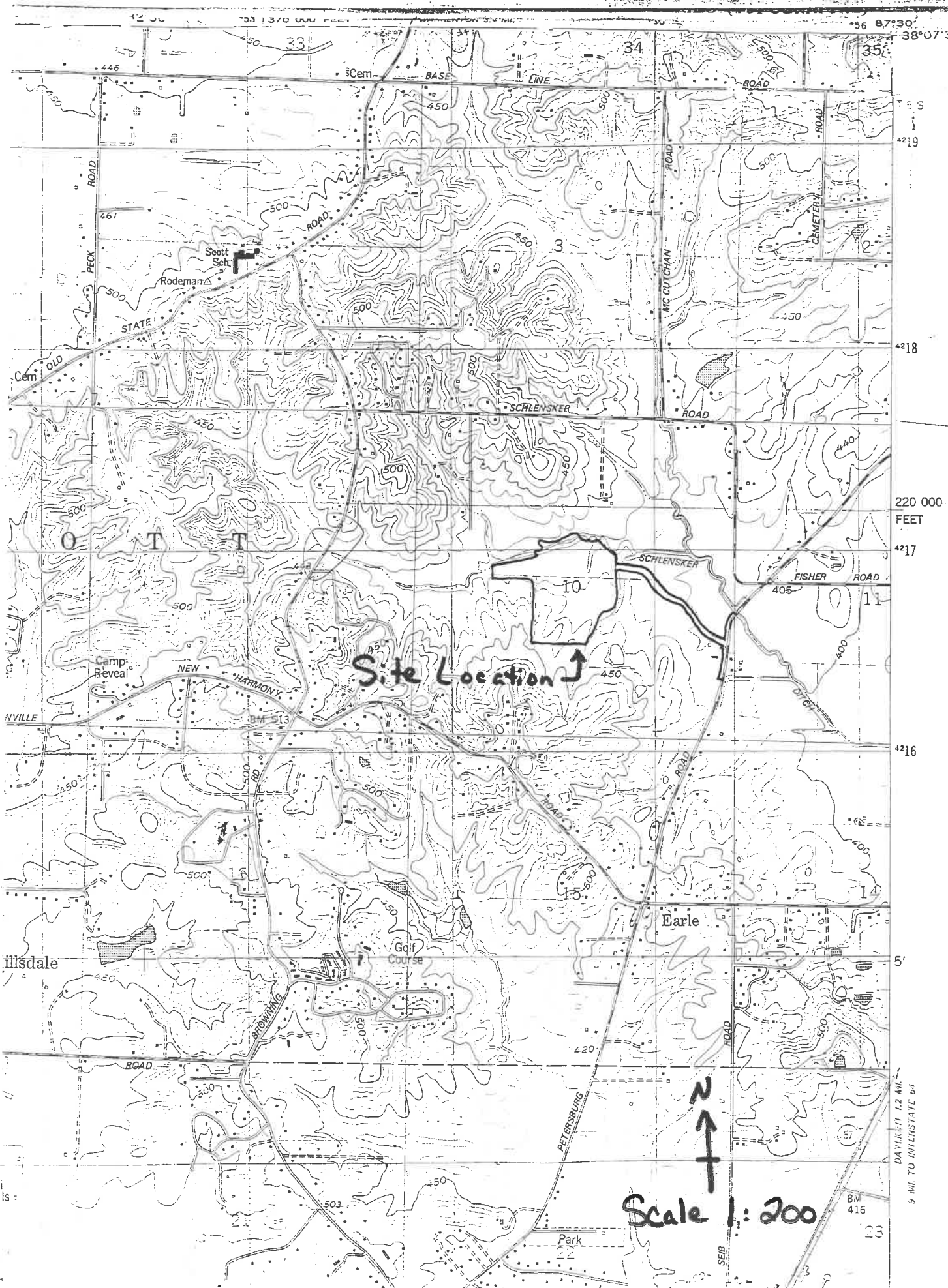
7.76 acres are located within the floodway boundary and will not be disturbed. The landowners will not be able to develop and/or build within the floodway. Therefore, the storm water runoff from this area will sheet flow to Schlensker Ditch unchanged. This storm runoff will not be included in this drainage study. The 2.64 acres that encompasses the entrance Road #1 from Petersburg Road to the Phase #1 boundary line will not be included in this drainage study. This area will be included in future phase drainage studies of the project. The 53.14 acre site drains north into Schlensker Ditch.

The retention basin will be constructed on site to provide adequate storm water retention. Storm water will be conveyed to the basin via storm sewers, swales, and overland sheet flow. Due to the topography, storm runoff from Subbasins #2 and #3 from the site will be allowed to exit the property undetained. The total allowable discharge rate was determined to be 64.59 cfs, which is the peak runoff rate for the 10-year storm event for the remaining undeveloped 42.734 acres for the Aspen Hill Estates subdivision plus the peak runoff rate for the 25-year storm event on 22.76 acres of offsite areas upstream from the site. Taking into account the undetained peak runoff for the 25-year storm event runoff from Subbasins #2 and #3 the allowable discharge rate is reduced to 42.46 cfs. The required detention volumes from the Form 800 calculations are 136,305 cubic feet and 200,702 cubic feet for the 25-year and 100-year storms, respectively.

As shown on the drainage plan, the primary and emergency spillways and drainage swales along Road #1 will be located within the defined floodway. Before any construction can occur within the floodway, a Construction in a Floodway Permit will have to be obtained from the Indiana Department of Natural Resources, Division of Water. This permit will be obtained and submitted to the Drainage Board as part of the request for final drainage approval.

A portion of the site and the ditch located along the eastside of the property is also within the 100 year flood zone "A" boundary according to the FIRM Panel Number 180256 0015 B revised August 5, 1991, for Vanderburgh County, Indiana. The zone "A" boundary is plotted on the 'developed' condition map.

Based on the most recent soil survey of Vanderburgh County, Indiana the site contains the following soils: Barlte Silt Loam (Ba); Bonnie Silt Loam (Bo); Hosmer Silt Loam, 0 to 2 percent (HoA); Hosmer Silt Loam, 2 to 6 percent slopes (HoB2); Hosmer Silt Loam, 6 to 12 percent slopes (HoC3), and Stendal Silt Loam (St).



56 87°30' 38°07'5

Site Location ↑

Scale 1:200

DAYLIGHT 1.2 MI.  
9 MI. TO INTERSTATE 64

BM 416

Contact your insurance agent, or call the National Flood Insurance Program, at (800) 638-6620.



APPROXIMATE SCALE



**NATIONAL FLOOD INSURANCE PROGRAM**

**FIRM  
FLOOD INSURANCE RATE MAP**

**VANDEBURGH  
COUNTY,  
INDIANA  
UNINCORPORATED AREAS**

**PANEL 15 OF 100**

*N.W. OF N.E.*

**COMMUNITY-PANEL NUMBER**

**180256 0015 C**

**MAP REVISED:**

**AUGUST 5, 1991**



**Federal Emergency Management Agency**

### KEY TO MAP

500-Year Flood Boundary	-----	
100-Year Flood Boundary	-----	ZONE B
Floodway	-----	ZONE A1
100-Year Flood Boundary	-----	ZONE A5
500-Year Flood Boundary	-----	ZONE B
Base Flood Elevation Line With Elevation In Feet**	~~~~~	513
Base Flood Elevation in Feet Where Uniform Within Zone**		FE 08/1
Elevation Reference Mark		RM7x
Zone D Boundary	-----	
River Mile		*M1.5

\*\*Referenced to the National Geodetic Vertical Datum of 1929

### \*EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

### NOTES TO USER

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas.

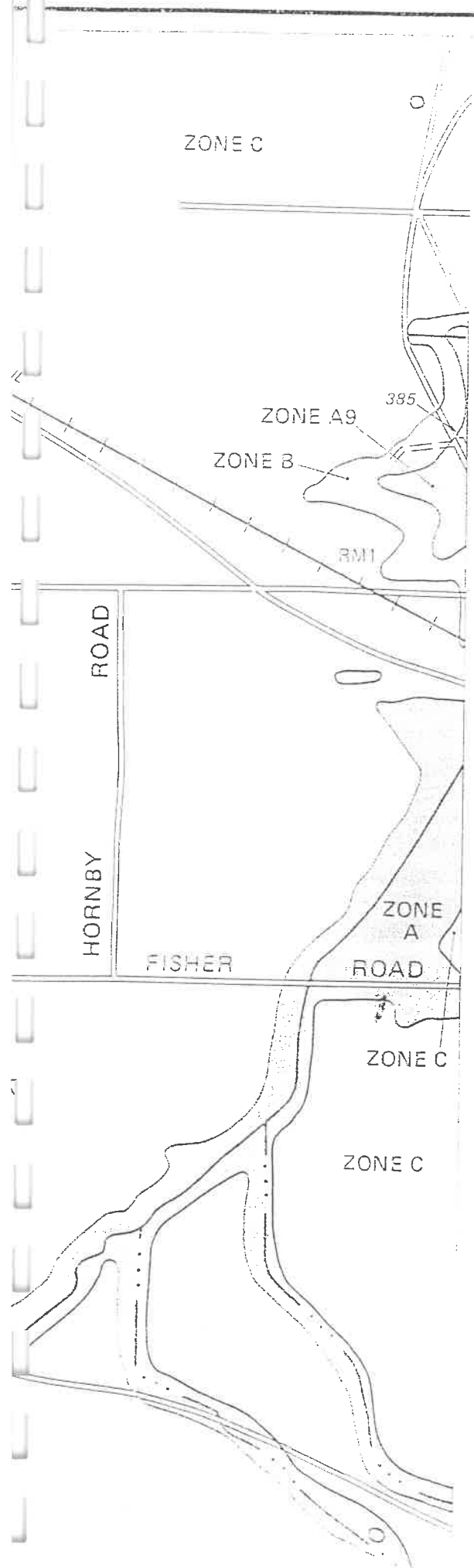
Certain areas not in the Special Flood Hazard Areas may be protected by flood control structures.

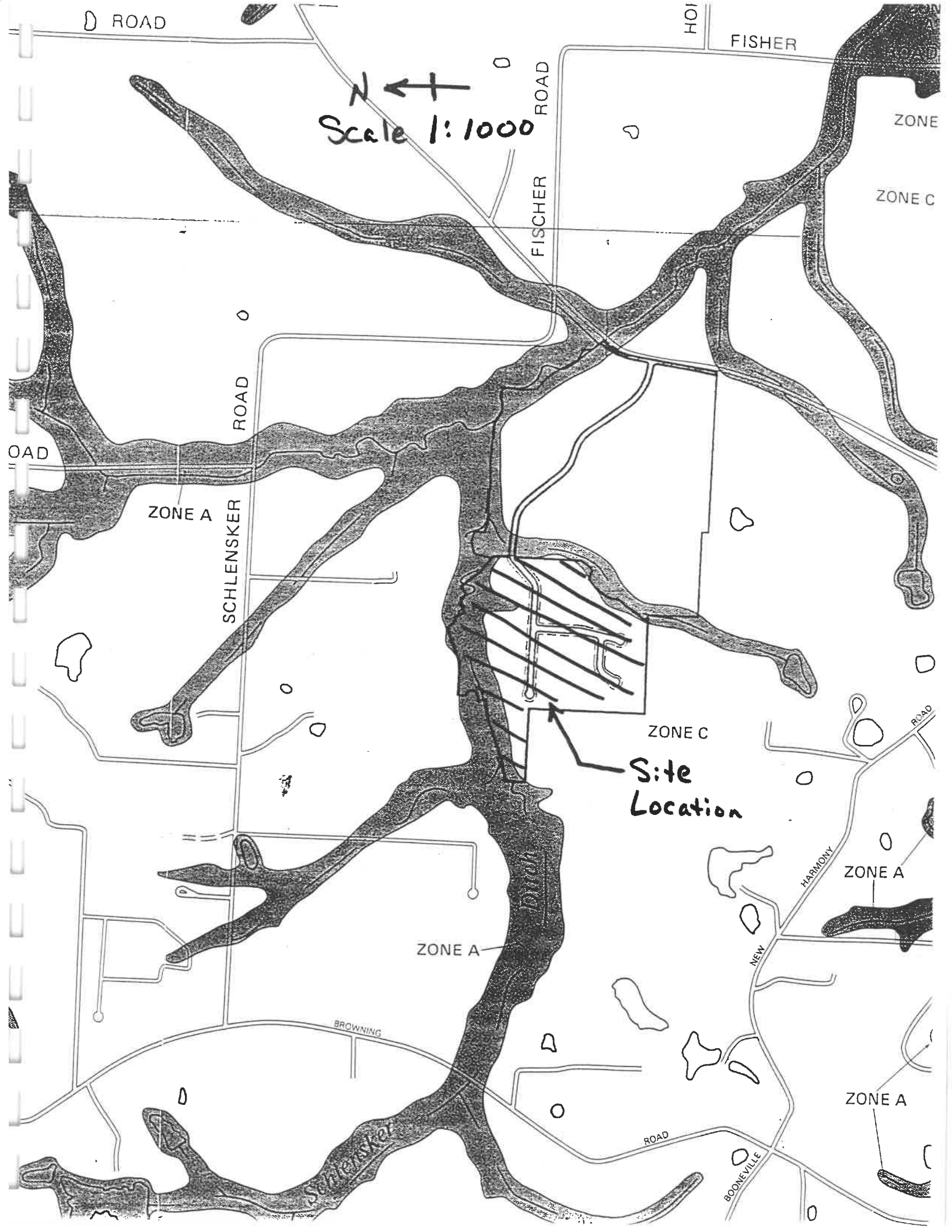
Boundary limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if boundary limits have changed subsequent to the issuance of this map.

For adjoining panels, see separately printed map index.

INITIAL IDENTIFICATION

FEBRUARY 1, 1980





ROAD

HOI

FISHER

N ←  
Scale 1:1000

ZONE

ZONE C

FISHER ROAD

ROAD

ZONE A

SCHLENSKER

ZONE C

Site Location

ZONE A

HARMONY

ZONE A

BROWNING

NEW

ZONE A

ROAD

BOONEVILLE

Schlenker

## Undeveloped Conditions

Aspen Hill Estates Only

<u>Subbasin</u>	<u>Ac</u>	<u>C</u>	<u>N</u>
1	29.44	0.338	0.245
2	8.512	0.168	0.361
3	4.778	0.191	0.245
	<u>42.73</u>	<u>Wt C = 0.288</u>	<u>Wt N = 0.268</u>

$$t_c = 0.827 \left[ \frac{NL}{S^{1/2}} \right]^{0.467} = 0.827 \left[ \frac{(0.268)(1600')}{(0.01375)^{1/2}} \right]^{0.467}$$

$$t_c = 38.15 \text{ min.}$$

$$I(10) = 2.84 \text{ In/Hr.}$$

$$Q_{(10)} = CIA = (0.288)(2.84)(42.73) = \underline{\underline{34.95 \text{ cfs}}}$$

Developed Conditions

<u>Subbasin</u>	<u>Ac</u>	<u>C</u>	<u>N</u>
1	29.44	0.506	0.325
2	8.512	0.441	0.371
3	4.778	0.519	0.320
	<u>42.73</u>	<u>Wt C = 0.495</u>	<u>Wt N = 0.334</u>

Undeveloped Drainage Sub-Basins

Sub-basin No.:	1	Total Area =	S.F. = 1,282,586	29.444 Ac.																
Surface																				
Structures	0 Total	2,000 S.F.	=	0 S.F. = 0.00 Ac. 0.92 0.02																
Drives	0 Total	400 S.F.	=	0 S.F. = 0.00 Ac. 0.92 0.02																
Pavement	0 L.F.	15 Width	=	0 S.F. = 0.00 Ac. 0.96 0.02																
Patios	0 Total	200 S.F.	=	0 S.F. = 0.00 Ac. 0.92 0.02																
Sidewalks	0 L.F.	4 Width	=	0 S.F. = 0.00 Ac. 0.96 0.02																
Pasture (2-5%)		0 S.F.	=	0.00 Ac. 0.24 0.40																
Woods (2-5%)		143,221 S.F.	=	3.29 Ac. 0.24 0.60																
Cultivated Fields (2-5%)		1,139,365 S.F.	=	26.16 Ac. 0.35 0.20																
Water		0 S.F.	=	0.00 Ac. 1.00 0.00																
Misc.		0 S.F.	=	0.00 Ac.																
				29.44																
<table border="1"> <tr> <td>Weighted c =</td> <td>0.338</td> </tr> <tr> <td>Weighted N =</td> <td>0.245</td> </tr> <tr> <td>L =</td> <td>1,900 Ft.</td> </tr> <tr> <td>H =</td> <td>32.0 Ft.</td> </tr> <tr> <td>S =</td> <td>0.0168 Ft./Ft.</td> </tr> <tr> <td>tc =</td> <td>37.78 Minutes</td> </tr> <tr> <td>I(10) =</td> <td>2.861 In./Hr.</td> </tr> <tr> <td>Q(10) =</td> <td>28.45 CFS</td> </tr> </table>					Weighted c =	0.338	Weighted N =	0.245	L =	1,900 Ft.	H =	32.0 Ft.	S =	0.0168 Ft./Ft.	tc =	37.78 Minutes	I(10) =	2.861 In./Hr.	Q(10) =	28.45 CFS
Weighted c =	0.338																			
Weighted N =	0.245																			
L =	1,900 Ft.																			
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tc =	37.78 Minutes																			
I(10) =	2.861 In./Hr.																			
Q(10) =	28.45 CFS																			
				(Min. 5 minutes)																

Undeveloped Drainage Sub-Basins

Sub-basin No.:	2	Total Area =	S.F. = 370,764	8.512 Ac.																
Surface																				
Structures	0 Total	2,000 S.F.	=	0 S.F. = 0.00 Ac. 0.92 0.02																
Drives	0 Total	400 S.F.	=	0 S.F. = 0.00 Ac. 0.92 0.02																
Pavement	0 L.F.	15 Width	=	0 S.F. = 0.00 Ac. 0.96 0.02																
Patios	0 Total	200 S.F.	=	0 S.F. = 0.00 Ac. 0.92 0.02																
Sidewalks	0 L.F.	4 Width	=	0 S.F. = 0.00 Ac. 0.96 0.02																
Pasture (0-2%)		0 S.F.	=	0.00 Ac. 0.12 0.40																
Woods (0-2%)		148,801 S.F.	=	3.42 Ac. 0.12 0.60																
Cultivated Fields (0-2%)		221,963 S.F.	=	5.10 Ac. 0.20 0.20																
Water		0 S.F.	=	0.00 Ac. 1.00 0.00																
Misc.		0 S.F.	=	0.00 Ac.																
				8.51																
<table border="1"> <tr> <td>Weighted c =</td> <td>0.168</td> </tr> <tr> <td>Weighted N =</td> <td>0.361</td> </tr> <tr> <td>L =</td> <td>1,530 Ft.</td> </tr> <tr> <td>H =</td> <td>17.0 Ft.</td> </tr> <tr> <td>S =</td> <td>0.0111 Ft./Ft.</td> </tr> <tr> <td>tc =</td> <td>45.10 Minutes</td> </tr> <tr> <td>I(10) =</td> <td>2.518 In./Hr.</td> </tr> <tr> <td>Q(10) =</td> <td>3.60 CFS</td> </tr> </table>					Weighted c =	0.168	Weighted N =	0.361	L =	1,530 Ft.	H =	17.0 Ft.	S =	0.0111 Ft./Ft.	tc =	45.10 Minutes	I(10) =	2.518 In./Hr.	Q(10) =	3.60 CFS
Weighted c =	0.168																			
Weighted N =	0.361																			
L =	1,530 Ft.																			
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tc =	45.10 Minutes																			
I(10) =	2.518 In./Hr.																			
Q(10) =	3.60 CFS																			
				(Min. 5 minutes)																



Undeveloped Drainage Sub-Basins									
Sub-basin No. :	3	Total Area =	S.F. =	208,115		4.778	Ac.		
Surface								C	N
Structures	0 Total	2,000	S.F. =	0	S.F. =	0.00	Ac.	0.92	0.02
Drives	0 Total	400	S.F. =	0	S.F. =	0.00	Ac.	0.92	0.02
Pavement	0 L.F.	15	Width =	0	S.F. =	0.00	Ac.	0.96	0.02
Patios	0 Total	200	S.F. =	0	S.F. =	0.00	Ac.	0.92	0.02
Sidewalks	0 L.F.	4	Width =	0	S.F. =	0.00	Ac.	0.96	0.02
Pasture (0-2%)		0	S.F. =			0.00	Ac.	0.12	0.40
Woods (0-2%)		23,560	S.F. =			0.54	Ac.	0.12	0.60
Cultivated Fields (0-2%)		184,555	S.F. =			4.24	Ac.	0.20	0.20
Water		0	S.F. =			0.00	Ac.	1.00	0.00
Misc.		0	S.F. =			0.00	Ac.		
						4.78			
		Weighted c =		0.191					
		Weighted N =		0.245					
			L =	300	Ft.				
			H =	4.0	Ft.				
			S =	0.0133	Ft./Ft.				
			tc =	16.87	Minutes	(Min. 5 minutes)			
			I(10) =	4.354	In./Hr.				
			Q(10) :	3.97	CFS				

Undeveloped Drainage Sub-Basins									
Sub-basin No. :	4	Total Area =	S.F. =	115,053		2.641	Ac.		
Surface								C	N
Structures	0 Total	2,000	S.F. =	0	S.F. =	0.00	Ac.	0.92	0.02
Drives	1 Total	-	S.F. =	6,200	S.F. =	0.14	Ac.	0.92	0.02
Pavement	0 L.F.	15	Width =	0	S.F. =	0.00	Ac.	0.96	0.02
Patios	0 Total	200	S.F. =	0	S.F. =	0.00	Ac.	0.92	0.02
Sidewalks	0 L.F.	4	Width =	0	S.F. =	0.00	Ac.	0.96	0.02
Pasture (2-5%)		0	S.F. =			0.00	Ac.	0.24	0.40
Woods (2-5%)		9,300	S.F. =			0.21	Ac.	0.24	0.60
Cultivated Fields (2-5%)		99,553	S.F. =			2.29	Ac.	0.35	0.20
Water		0	S.F. =			0.00	Ac.	1.00	0.00
Misc.		0	S.F. =			0.00	Ac.		
						2.64			
		Weighted c =		0.372					
		Weighted N =		0.223					
			L =	50	Ft.				
			H =	0.7	Ft.				
			S =	0.0130	Ft./Ft.				
			tc =	7.02	Minutes	(Min. 5 minutes)			
			I(10) =	6.122	In./Hr.				
			Q(10) :	6.01	CFS				

Developed Drainage Sub-Basins																									
Sub-basin No.:	1	Total Area = 1,282,586 S.F. = 29.444 Ac.																							
Surface																									
Structures	18	Total	3,500	S.F. =	63,000	S.F. =	1.45	Ac.	0.92 0.02																
Drives	19	Total	1,000	S.F. =	19,000	S.F. =	0.44	Ac.	0.92 0.02																
Pavement	2300	L.F.	14.5	Width =	33,350	S.F. =	0.77	Ac.	0.92 0.02																
Patios	16	Total	500	S.F. =	8,000	S.F. =	0.18	Ac.	0.92 0.02																
Sidewalks	4600	L.F.	4	Width =	18,400	S.F. =	0.42	Ac.	0.92 0.02																
Lawn (0-2%)				S.F. =			0.00	Ac.	0.15 0.40																
Lawn (2-5%)				S.F. =			0.00	Ac.	0.25 0.40																
Lawn (5-10%)			1,036,292	S.F. =			23.79	Ac.	0.40 0.40																
Lawn (>10%)				S.F. =			0.00	Ac.	0.55 0.40																
Water			104,161	S.F. =			2.39	Ac.	1.00 0.00																
Misc.				S.F. =			0.00	Ac.																	
							29.44																		
<table border="1"> <tr> <td>Weighted c =</td> <td>0.506</td> </tr> <tr> <td>Weighted N =</td> <td>0.325</td> </tr> <tr> <td>L =</td> <td>1,900 Ft.</td> </tr> <tr> <td>H =</td> <td>32.0 Ft.</td> </tr> <tr> <td>S =</td> <td>0.0168 Ft./Ft.</td> </tr> <tr> <td>tc =</td> <td>43.16 Minutes</td> </tr> <tr> <td>I(25) =</td> <td>2.959 In./Hr.</td> </tr> <tr> <td>Q(25) =</td> <td>44.09 CFS</td> </tr> </table>										Weighted c =	0.506	Weighted N =	0.325	L =	1,900 Ft.	H =	32.0 Ft.	S =	0.0168 Ft./Ft.	tc =	43.16 Minutes	I(25) =	2.959 In./Hr.	Q(25) =	44.09 CFS
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Q(25) =	44.09 CFS																								
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Developed Drainage Sub-Basins																									
Sub-basin No.:	2	Total Area = 370,764 S.F. = 8.51 Ac.																							
Surface																									
Structures	2	Total	3,500	S.F. =	7,000	S.F. =	0.16	Ac.	0.92 0.02																
Drives	2	Total	1,000	S.F. =	2,000	S.F. =	0.05	Ac.	0.92 0.02																
Pavement	300	L.F.	14.5	Width =	4,350	S.F. =	0.10	Ac.	0.92 0.02																
Patios	4	Total	500	S.F. =	2,000	S.F. =	0.05	Ac.	0.92 0.02																
Sidewalks	600	L.F.	4	Width =	2,400	S.F. =	0.06	Ac.	0.92 0.02																
Lawn (0-2%)				S.F. =			0.00	Ac.	0.15 0.40																
Lawn (2-5%)				S.F. =			0.00	Ac.	0.25 0.40																
Lawn (5-10%)			342,817	S.F. =			7.87	Ac.	0.40 0.40																
Lawn (>10%)				S.F. =			0.00	Ac.	0.55 0.40																
Water			9,920	S.F. =			0.23	Ac.	1.00 0.00																
Misc.				S.F. =			0.00	Ac.																	
							8.51																		
<table border="1"> <tr> <td>Weighted c =</td> <td>0.441</td> </tr> <tr> <td>Weighted N =</td> <td>0.371</td> </tr> <tr> <td>L =</td> <td>1,530 Ft.</td> </tr> <tr> <td>H =</td> <td>17.0 Ft.</td> </tr> <tr> <td>S =</td> <td>0.0111 Ft./Ft.</td> </tr> <tr> <td>tc =</td> <td>45.69 Minutes</td> </tr> <tr> <td>I(25) =</td> <td>2.824 In./Hr.</td> </tr> <tr> <td>Q(25) =</td> <td>10.59 CFS</td> </tr> </table>										Weighted c =	0.441	Weighted N =	0.371	L =	1,530 Ft.	H =	17.0 Ft.	S =	0.0111 Ft./Ft.	tc =	45.69 Minutes	I(25) =	2.824 In./Hr.	Q(25) =	10.59 CFS
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(Min. 5 minutes)																									

Developed Drainage Sub-Basins

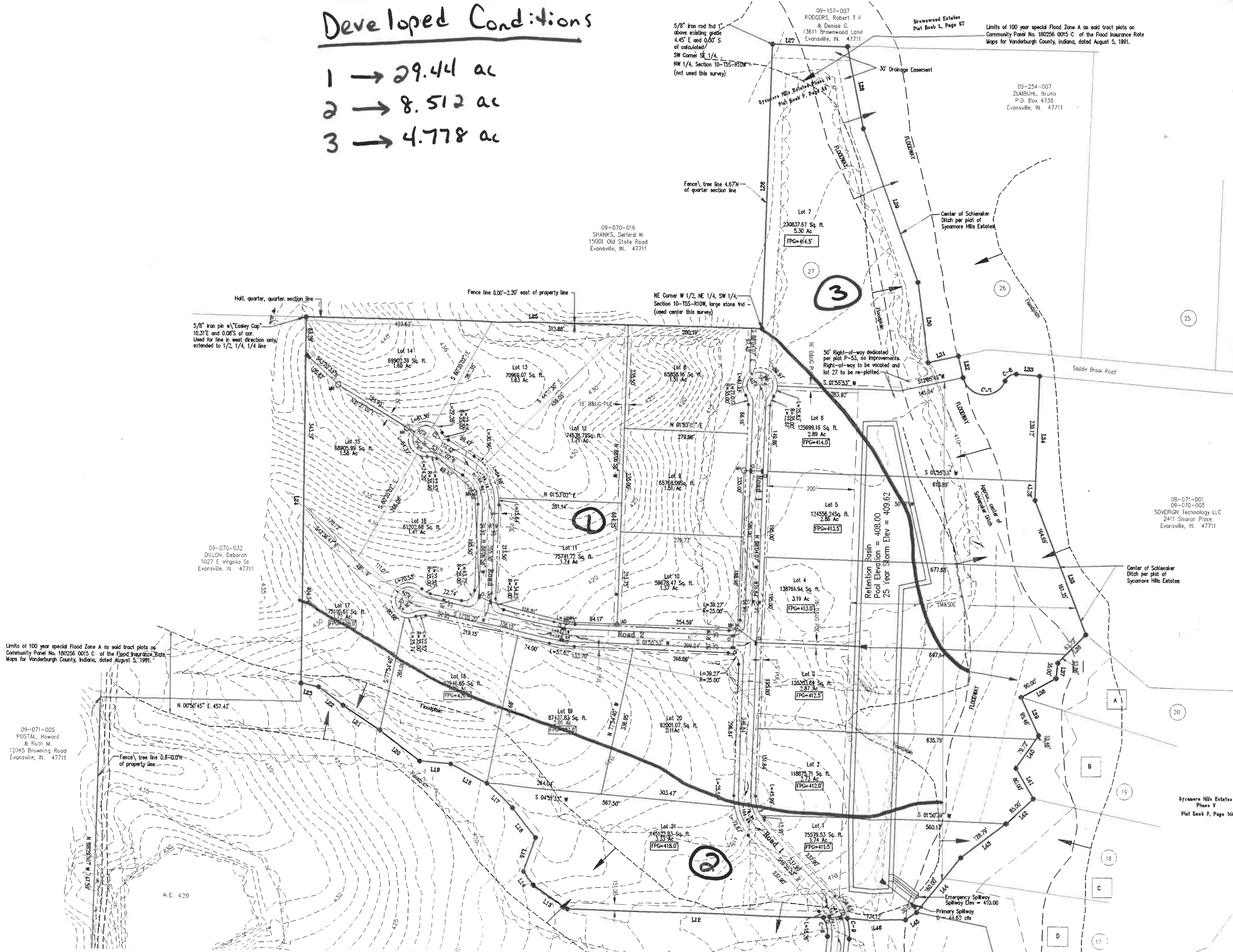
Sub-basin No. :	3	Total Area =	208,115 S.F. =	4.78 Ac.																		
Surface																						
Structures	1 Total	3,500 S.F. =	3,500 S.F. =	0.08 Ac.	C	N																
Drives	0 Total	1,000 S.F. =	0 S.F. =	0.00 Ac.	0.92	0.02																
Pavement	0 L.F.	14.5 Width =	0 S.F. =	0.00 Ac.	0.92	0.02																
Patios	1 Total	500 S.F. =	500 S.F. =	0.01 Ac.	0.92	0.02																
Sidewalks	0 L.F.	4 Width =	0 S.F. =	0.00 Ac.	0.92	0.02																
Lawn (0-2%)		S.F. =		0.00 Ac.	0.15	0.40																
Lawn (2-5%)		S.F. =		0.00 Ac.	0.25	0.40																
Lawn (5-10%)		166,400 S.F. =		3.82 Ac.	0.40	0.40																
Lawn (>10%)		S.F. =		0.00 Ac.	0.55	0.40																
Water		37,820 S.F. =		0.87 Ac.	1.00	0.00																
Misc.		S.F. =		0.00 Ac.																		
				4.78																		
<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>Weighted c =</td> <td>0.519</td> </tr> <tr> <td>Weighted N =</td> <td>0.320</td> </tr> <tr> <td>L =</td> <td>300 Ft.</td> </tr> <tr> <td>H =</td> <td>4.0 Ft.</td> </tr> <tr> <td>S =</td> <td>0.0133 Ft./Ft.</td> </tr> <tr> <td>tc =</td> <td>19.11 Minutes (Min. 5 minutes)</td> </tr> <tr> <td>I(25) =</td> <td>4.653 In./Hr.</td> </tr> <tr> <td>Q(25) =</td> <td>11.54 CFS</td> </tr> </table>							Weighted c =	0.519	Weighted N =	0.320	L =	300 Ft.	H =	4.0 Ft.	S =	0.0133 Ft./Ft.	tc =	19.11 Minutes (Min. 5 minutes)	I(25) =	4.653 In./Hr.	Q(25) =	11.54 CFS
Weighted c =	0.519																					
Weighted N =	0.320																					
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I(25) =	4.653 In./Hr.																					
Q(25) =	11.54 CFS																					

Developed Drainage Sub-Basins

Sub-basin No. :	4	Total Area =	115,053 S.F. =	2.64 Ac.																		
Surface																						
Structures	0 Total	1,600 S.F. =	0 S.F. =	0.00 Ac.	C	N																
Drives	0 Total	400 S.F. =	0 S.F. =	0.00 Ac.	0.92	0.02																
Pavement	2258 L.F.	29.0 Width =	66,778 S.F. =	1.53 Ac.	0.92	0.02																
Patios	0 Total	120 S.F. =	0 S.F. =	0.00 Ac.	0.92	0.02																
Sidewalks	0 L.F.	4 Width =	0 S.F. =	0.00 Ac.	0.92	0.02																
Lawn (0-2%)		S.F. =		0.00 Ac.	0.15	0.40																
Lawn (2-5%)		48,220 S.F. =		1.11 Ac.	0.25	0.40																
Lawn (5-10%)		S.F. =		0.00 Ac.	0.40	0.40																
Lawn (>10%)		S.F. =		0.00 Ac.	0.55	0.40																
Water		S.F. =		0.00 Ac.	1.00	0.00																
Misc.		S.F. =		0.00 Ac.																		
				2.64																		
<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>Weighted c =</td> <td>0.639</td> </tr> <tr> <td>Weighted N =</td> <td>0.179</td> </tr> <tr> <td>L =</td> <td>50 Ft.</td> </tr> <tr> <td>H =</td> <td>0.7 Ft.</td> </tr> <tr> <td>S =</td> <td>0.0140 Ft./Ft.</td> </tr> <tr> <td>tc =</td> <td>6.24 Minutes (Min. 5 minutes)</td> </tr> <tr> <td>I(25) =</td> <td>6.890 In./Hr.</td> </tr> <tr> <td>Q(25) =</td> <td>11.62 CFS</td> </tr> </table>							Weighted c =	0.639	Weighted N =	0.179	L =	50 Ft.	H =	0.7 Ft.	S =	0.0140 Ft./Ft.	tc =	6.24 Minutes (Min. 5 minutes)	I(25) =	6.890 In./Hr.	Q(25) =	11.62 CFS
Weighted c =	0.639																					
Weighted N =	0.179																					
L =	50 Ft.																					
H =	0.7 Ft.																					
S =	0.0140 Ft./Ft.																					
tc =	6.24 Minutes (Min. 5 minutes)																					
I(25) =	6.890 In./Hr.																					
Q(25) =	11.62 CFS																					

# Developed Conditions

- 1 → 29.44 ac
- 2 → 8.512 ac
- 3 → 4.778 ac



# Developed Conditions

4 → 2.64 acres

09-071-008  
KRACHT, B. Harold  
& Ruth F. (Co-trust)  
& DELBERT, Etal  
12715 Petersburg Road  
Evansville, IN. 47711

09-071-041  
KRACHT, Delbert A  
& KRACHT Dorothy  
12715 Petersburg Road  
Evansville, IN. 47711

Limits of 100 year special Flood Zone A as sold tract plots on  
Community Panel No. 180256 0015 C of the Flood Insurance F  
Maps for Vanderburgh County, Indiana, dated August 5, 1991.

06-071-009  
SCHUCKER, Timothy S.  
& Laurie Ann  
604 N. 12th Avenue  
Evansville, IN. 47712

Approx. center of  
Schenker Ditch

FLOODWAY

upbank

Sycamore Hill Estates  
Plot East D, Page 198

Emergency Spillway  
Spillway Elev = 410.00  
Primary Spillway

Lot 1  
75679.53 Sq. Ft.  
1.74 Ac  
FPC=411.6

Lot 21  
145127.43 Sq. Ft.  
3.33 Ac  
FPC=418.0

W.E. 429

N 00°27'52" E  
59.20'

S 61°14'10" E  
255.91'

N 00°27'52" E  
59.20'

S 01°50'30" W  
560.1'

Road 1  
S 21°30' E  
231.80'

Road 1

Road 1

C-1

C-2

C-3

C-4

416

415

410

410

410

415

425

420

415

410

405

405

410

18

17

16

E

D

C

4

FLOODWAY

Floodplain

FLOODWAY

## Undeveloped Conditions

Aspen Hill Estates

Area = 53.14 acres

- 7.765 acres w/ Floodway Boundary - Area

Not included in drainage calculations

- 2.641 acres Road #1 area from Peterburg Road  
to Phase #1 - area not included  
in drainage calculations.

---

42.734 acres

## Offsite Subbasins

Subbasin A is Wellington Acres Phase #1

Q = 5.58 cfs using conditions of Drainage Report  
dated June 4, 1999 by Crane Environmental  
Services, LLC.

25 year peak discharge rate offsite basins

$$Q_{25} = \text{Subbasin A} + C + D$$

$$Q_{25} = 5.58 + 1.56 + 22.50 = \underline{\underline{29.64 \text{ cfs}}}$$

## Undeveloped Conditions - Cont

<u>Subbasin</u>	<u>Ac</u>	<u>C</u>	<u>N</u>
1	29.44	0.338	0.245
2	8.512	0.168	0.361
3	4.778	0.191	0.245
A (A1+A2+A3)	8.83	0.451*	0.465*
C	0.773	0.350	0.200
D	<u>13.152</u>	<u>0.471</u>	<u>0.314</u>
	65.485 Ac	WtC = 0.347	WtN = 0.303

$$t_c = 0.827 \left[ \frac{NL}{S^{1/2}} \right]^{0.467} = 0.827 \left[ \frac{(0.303)(2900')}{(0.02037)^{1/2}} \right]^{0.467}$$

$$t_c = 48.66 \text{ min.}$$

$$I_{(10)} = 2.35 I_n^{0.7} / \text{hr}$$

Subbasin B is a part of a future phase of Wellington Acres. The area is not included as a part of this drainage study and the water will not pass through the retention basin.

\* Subbasin A Coefficients are calculated using developed Wellington Acres Subdivision Conditions.

## Developed Conditions - Cont

<u>Subbasin</u>	<u>Ac</u>	<u>C</u>	<u>N</u>
1	29.44	0.506	0.325
2	8.512	0.441	0.371
3	4.778	0.519	0.320
A	8.83	0.451	0.465
C	0.773	0.350	0.200
D	13.152	0.471	0.314
	<u>65.485 Ac</u>	<u>Wt C = 0.482</u>	<u>Wt N = 0.346</u>



Developed Conditions

The retention basin will receive stormwater runoff from Subbasin #1 only within the subdivision. Subbasins #2 and #3 will exit the site undetained.

<u>Subbasin</u>	<u>Q<sub>25</sub></u>
#2	10.59
#3	11.54
	<u>22.13 cfs</u>

Allowable Discharge Rate

Q<sub>25</sub> Allow. = Peak Undeveloped 10 year rate for Aspen Hill Estates subbasins #1- #3, plus the Peak 25-year rate for the offsite Subbasins A, C, D, minus the undetained developed 25-year rate for Subbasins #2- #3.

$$Q_{25} \text{ Allow} = 34.95 + 29.64 - 22.13 = 42.46 \text{ cfs}$$

Offsite Drainage Sub-Basins

Sub-basin No. : B		Total Area =	S.F. =	586,939	13.474 Ac																		
Surface																							
Structures	0 Total	2,000 S.F.	=	0 S.F.	=	0.00 Ac.	C N 0.92 0.02																
Drives	0 Total	400 S.F.	=	0 S.F.	=	0.00 Ac.	0.92 0.02																
Pavement	0 L.F.	15 Width	=	0 S.F.	=	0.00 Ac.	0.96 0.02																
Patios	0 Total	200 S.F.	=	0 S.F.	=	0.00 Ac.	0.92 0.02																
Sidewalks	0 L.F.	4 Width	=	0 S.F.	=	0.00 Ac.	0.96 0.02																
Pasture (2-5%)		0 S.F.	=		=	0.00 Ac.	0.24 0.40																
Woods (2-5%)		222,582 S.F.	=		=	5.11 Ac.	0.24 0.60																
Cultivated Fields (2-5%)		364,357 S.F.	=		=	8.36 Ac.	0.35 0.20																
Water		0 S.F.	=		=	0.00 Ac.	1.00 0.00																
Misc.		0 S.F.	=		=	0.00 Ac.																	
						13.47																	
<table border="1"> <tr> <td>Weighted c =</td> <td>0.308</td> </tr> <tr> <td>Weighted N =</td> <td>0.352</td> </tr> <tr> <td>L =</td> <td>1.160 Ft</td> </tr> <tr> <td>H =</td> <td>33.0 Ft.</td> </tr> <tr> <td>S =</td> <td>0.0284 Ft./Ft.</td> </tr> <tr> <td>tc =</td> <td>31.45 Minutes</td> </tr> <tr> <td>I(25) =</td> <td>3.570 In./Hr.</td> </tr> <tr> <td>Q(25) =</td> <td>14.83 CFS</td> </tr> </table>								Weighted c =	0.308	Weighted N =	0.352	L =	1.160 Ft	H =	33.0 Ft.	S =	0.0284 Ft./Ft.	tc =	31.45 Minutes	I(25) =	3.570 In./Hr.	Q(25) =	14.83 CFS
Weighted c =	0.308																						
Weighted N =	0.352																						
L =	1.160 Ft																						
H =	33.0 Ft.																						
S =	0.0284 Ft./Ft.																						
tc =	31.45 Minutes																						
I(25) =	3.570 In./Hr.																						
Q(25) =	14.83 CFS																						
						(Min. 5 minutes)																	

Offsite Drainage Sub-Basins

Sub-basin No. : C		Total Area =	S.F. =	33,687	0.773 Ac.																		
Surface																							
Structures	0 Total	2,000 S.F.	=	0 S.F.	=	0.00 Ac.	C N 0.92 0.02																
Drives	0 Total	400 S.F.	=	0 S.F.	=	0.00 Ac.	0.92 0.02																
Pavement	0 L.F.	15 Width	=	0 S.F.	=	0.00 Ac.	0.96 0.02																
Patios	0 Total	200 S.F.	=	0 S.F.	=	0.00 Ac.	0.92 0.02																
Sidewalks	0 L.F.	4 Width	=	0 S.F.	=	0.00 Ac.	0.96 0.02																
Pasture (2-5%)		0 S.F.	=		=	0.00 Ac.	0.24 0.40																
Woods (2-5%)		0 S.F.	=		=	0.00 Ac.	0.24 0.60																
Cultivated Fields (2-5%)		33,687 S.F.	=		=	0.77 Ac.	0.35 0.20																
Water		0 S.F.	=		=	0.00 Ac.	1.00 0.00																
Misc.		0 S.F.	=		=	0.00 Ac.																	
						0.77																	
<table border="1"> <tr> <td>Weighted c =</td> <td>0.350</td> </tr> <tr> <td>Weighted N =</td> <td>0.200</td> </tr> <tr> <td>L =</td> <td>250 Ft.</td> </tr> <tr> <td>H =</td> <td>10.0 Ft.</td> </tr> <tr> <td>S =</td> <td>0.0400 Ft./Ft.</td> </tr> <tr> <td>tc =</td> <td>10.90 Minutes</td> </tr> <tr> <td>I(25) =</td> <td>5.764 In./Hr.</td> </tr> <tr> <td>Q(25) =</td> <td>1.56 CFS</td> </tr> </table>								Weighted c =	0.350	Weighted N =	0.200	L =	250 Ft.	H =	10.0 Ft.	S =	0.0400 Ft./Ft.	tc =	10.90 Minutes	I(25) =	5.764 In./Hr.	Q(25) =	1.56 CFS
Weighted c =	0.350																						
Weighted N =	0.200																						
L =	250 Ft.																						
H =	10.0 Ft.																						
S =	0.0400 Ft./Ft.																						
tc =	10.90 Minutes																						
I(25) =	5.764 In./Hr.																						
Q(25) =	1.56 CFS																						
						(Min. 5 minutes)																	

Offsite Drainage Sub-Basins

Sub-basin No. : D	Total Area =	S.F. =	572,886	13.152 Ac.
Surface				
Structures	4 Total	- S.F. =	6,820	S.F. = 0.16 Ac. 0.92 0.02
Drives	2 Total	- S.F. =	9,920	S.F. = 0.23 Ac. 0.92 0.02
Pavement	0 L.F.	15 Width =	0	S.F. = 0.00 Ac. 0.96 0.02
Patios	0 Total	200 S.F. =	0	S.F. = 0.00 Ac. 0.92 0.02
Sidewalks	0 L.F.	4 Width =	0	S.F. = 0.00 Ac. 0.96 0.02
Pasture (5-10%)		0 S.F. =		0.00 Ac. 0.36 0.40
Woods (5-10%)	170,503	S.F. =		3.91 Ac. 0.36 0.60
Cultivated Fields (5-10%)	385,643	S.F. =		8.85 Ac. 0.50 0.20
Water	0	S.F. =		0.00 Ac. 1.00 0.00
Misc.	0	S.F. =		0.00 Ac.
				13.15
		Weighted c =	0.471	
		Weighted N =	0.314	
		L =	1,600 Ft.	
		H =	82.0 Ft.	
		S =	0.0513 Ft./Ft.	
		tc =	30.20 Minutes	(Min. 5 minutes)
		I(25) =	3.636 In./Hr.	
		Q(25) =	22.50 CFS	

Offsite Drainage Sub-Basins

Sub-basin No. : E	Total Area =	S.F. =	1,650,870	37.899 Ac.
Surface				
Structures	7 Total	- S.F. =	9,300	S.F. = 0.21 Ac. 0.92 0.02
Drives	1 Total	- S.F. =	10,540	S.F. = 0.24 Ac. 0.92 0.02
Pavement	0 L.F.	15 Width =	0	S.F. = 0.00 Ac. 0.96 0.02
Patios	0 Total	200 S.F. =	0	S.F. = 0.00 Ac. 0.92 0.02
Sidewalks	0 L.F.	4 Width =	0	S.F. = 0.00 Ac. 0.96 0.02
lawns (2-5%)	4,350	S.F. =		0.10 Ac. 0.25 0.40
Woods (2-5%)	419,124	S.F. =		9.62 Ac. 0.24 0.60
Woods (5-10%)	667,731	S.F. =		15.33 Ac. 0.36 0.60
Cultivated Fields (2-5%)	510,059	S.F. =		11.71 Ac. 0.35 0.20
Water	29,140	S.F. =		0.67 Ac. 1.00 0.00
Misc.	0	S.F. =		0.00 Ac.
				37.88
		Weighted c =	0.344	
		Weighted N =	0.458	
		L =	2,450 Ft.	
		H =	89.0 Ft.	
		S =	0.0363 Ft./Ft.	
		tc =	47.65 Minutes	(Min. 5 minutes)
		I(25) =	2.722 In./Hr.	
		Q(25) =	35.49 CFS	

Offsite Drainage Sub-Basins

Sub-basin No.: F                      Total Area =      S.F. = 1,747,178                      40.110 Ac.

Surface							C	N
Structures	0 Total	2,000	S.F.	=	0	S.F. =	0.00 Ac.	0.92 0.02
Drives	0 Total	400	S.F.	=	0	S.F. =	0.00 Ac.	0.92 0.02
Pavement	0 L.F.	15	Width	=	0	S.F. =	0.00 Ac.	0.96 0.02
Patios	0 Total	200	S.F.	=	0	S.F. =	0.00 Ac.	0.92 0.02
Sidewalks	0 L.F.	4	Width	=	0	S.F. =	0.00 Ac.	0.96 0.02
Pasture (0-2%)		0	S.F.	=			0.00 Ac.	0.12 0.40
Woods (5-10%)		327,364	S.F.	=			7.52 Ac.	0.36 0.60
Cultivated Fields (2-5%)		1,336,940	S.F.	=			30.69 Ac.	0.35 0.20
Water		82,874	S.F.	=			1.90 Ac.	1.00 0.00
Misc.		0	S.F.	=			0.00 Ac.	

Weighted c =	0.383
Weighted N =	0.265
L =	1,900 Ft.
H =	33.0 Ft.
S =	0.0174 Ft./Ft.
tc =	38.97 Minutes
I(25) =	3.177 In./Hr.
Q(25) :	48.77 CFS

40.11  
(Min. 5 minutes)

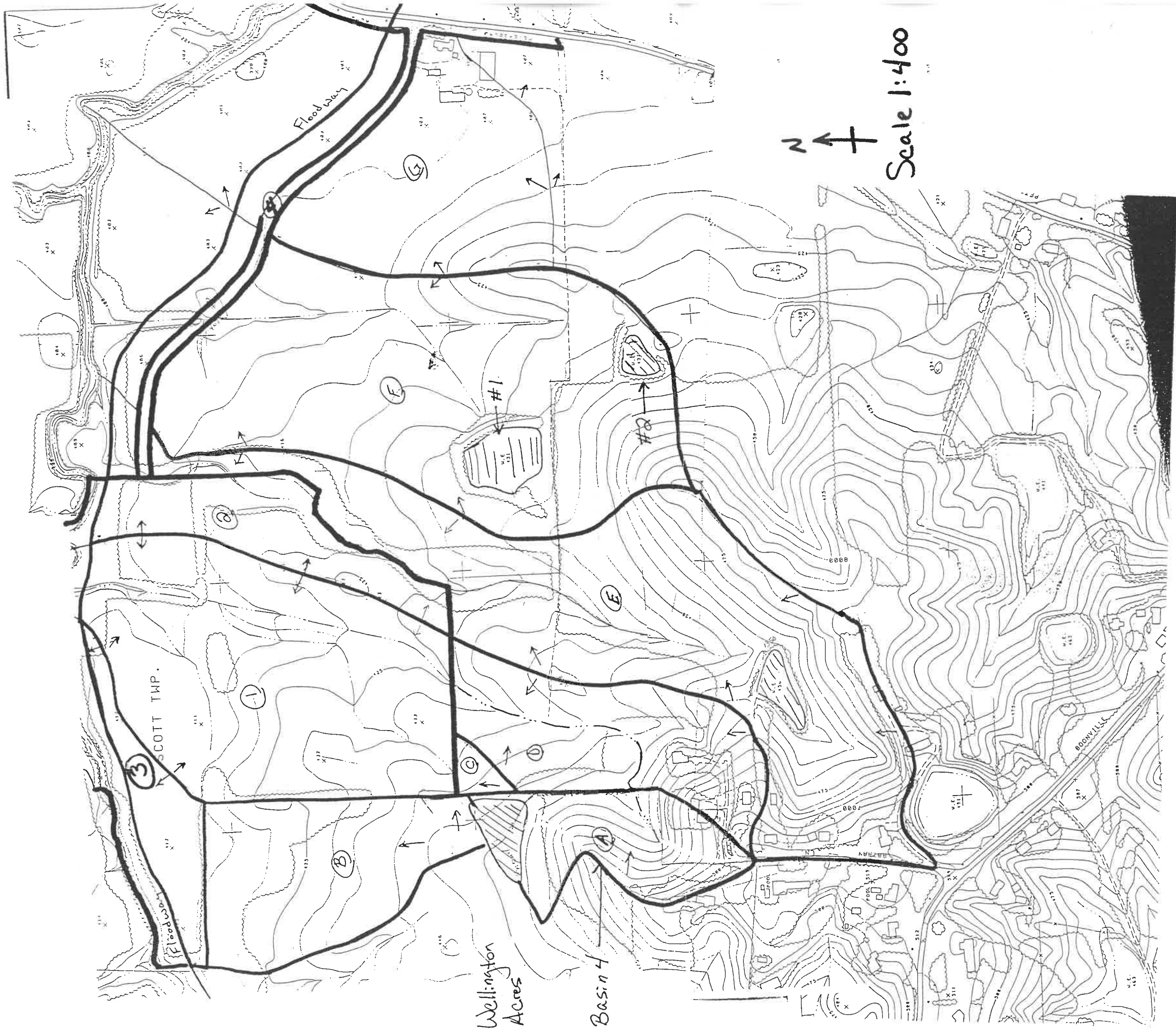
Offsite Drainage Sub-Basins

Sub-basin No.: G                      Total Area =      S.F. = 711,354                      16.330 Ac.

Surface							C	N
Structures	6 Total	-	S.F.	=	9,684	S.F. =	0.22 Ac.	0.92 0.02
Drives	1 Total	-	S.F.	=	19,220	S.F. =	0.44 Ac.	0.92 0.02
Pavement	0 L.F.	15	Width	=	0	S.F. =	0.00 Ac.	0.96 0.02
Patios	0 Total	200	S.F.	=	0	S.F. =	0.00 Ac.	0.92 0.02
Sidewalks	0 L.F.	4	Width	=	0	S.F. =	0.00 Ac.	0.96 0.02
Pasture (2-5%)		0	S.F.	=			0.00 Ac.	0.24 0.40
Woods (2-5%)		4,340	S.F.	=			0.10 Ac.	0.24 0.60
Cultivated Fields (2-5%)		648,970	S.F.	=			14.90 Ac.	0.35 0.20
Water		29,140	S.F.	=			0.67 Ac.	1.00 0.00
Misc.		0	S.F.	=			0.00 Ac.	

Weighted c =	0.399
Weighted N =	0.187
L =	1,170 Ft.
H =	28.0 Ft.
S =	0.0239 Ft./Ft.
tc =	24.48 Minutes
I(25) =	4.157 In./Hr.
Q(25) :	27.09 CFS

16.33  
(Min. 5 minutes)



Off site # Undeveloped Water Shed

- Area A (By Others) → 8.83 acres
- Area B → 13.47 acres
- Area C → 0.77 acres
- Area D → 13.15 acres
- Area E → 37.90 acres
- Area F → 40.11 acres
- Area G → 16.33 acres

Retention Basin Area / Volume

Req'd Storage Volume (Form 800)

25 year Storm = 136,305 cu ft

100 year Storm = 200,702 cu ft

Spillway Elevation = 410.00

Permanent Pool Elevation = 408.00

Elev                      Square Foot Area

410.00	93,262
409.50	88,707
409.00	84,185
408.00	75,235

$$\text{Volume} = \frac{93,262 + 75,235}{2} = 84,248 \text{ S.F. } (2.0 \text{ ft}) = 168,496 \text{ cu. ft} > 136,305 \text{ cu. ft}$$

25 year Elevation = 409.62



VANDERBURGH COUNTY DRAINAGE BOARD  
FORM 800

PROJECT: Aspen Hill Estates      DETENTION FACILITY DESIGN RETURN PERIOD: 100 YRS  
 DESIGNER: MORLEY & ASSOC.      4037-4B      RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA: 65.485 ACRES  
 TIME OF CONCENTRATION (UNDEVELOPED WATERSHED): 48.66 MINUTES  
 RAINFALL INTENSITY (Iu): 2.35 INCHES/HR  
 UNDEVELOPED RUNOFF COEFFICIENT (Cu): 0.347  
 UNDEVELOPED RUNOFF RATE - As Calculated 42.46 CFS  
 DEVELOPED RUNOFF COEFFICIENT (Cd): 0.482

STORM DURATION Td (HRS)	RAINFALL INTENSITY Id (INCH/HR)	INFLOW RATE I(Td) (Cd*Id*A) (CFS)	OUTFLOW RATE O As Calculated (CFS)	STORAGE RATE I(Td)-O (CFS)	REQUIRED STORAGE (Td)-O)*Td/12 (ACRE-FT)
0.08	8.469	267.31	42.46	224.85	1.499
0.17	7.126	224.92	42.46	182.46	2.585
0.25	6.194	195.51	42.46	153.05	3.188
0.33	5.665	178.82	42.46	136.36	3.750
0.42	5.137	162.13	42.46	119.67	4.189
0.50	4.608	145.45	42.46	102.99	4.291
0.58	4.284	135.21	42.46	92.75	4.483
0.67	3.960	124.98	42.46	82.52	4.607
0.75	3.636	114.75	42.46	72.29	4.518
0.83	3.311	104.52	42.46	62.06	4.292
0.92	2.987	94.29	42.46	51.83	3.973
1.00	2.663	84.05	42.46	41.59	3.466
1.25	2.444	77.13	42.46	34.67	3.611
1.50	2.224	70.20	42.46	27.74	3.467
1.75	2.005	63.27	42.46	20.81	3.035
2.00	1.785	56.34	42.46	13.88	2.314
2.50	1.538	48.55	42.46	6.09	1.268
3.00	1.291	40.75	42.46	-1.71	-0.428
4.00	1.062	33.52	42.46	-8.94	-2.980

PEAK STORAGE (ACRE/FT):	4.61
PEAK STORAGE (CUBIC FT):	200.702



TABLE 807

## RAINFALL INTENSITY-DURATION-FREQUENCY TABLE FOR EVANSVILLE

INTENSITY IN INCHES PER HOUR

STORM DURATION	STORM RETURN PERIOD IN YEARS				
	5	10	25	50	100
5 MIN	6.063	6.625	7.208	7.936	8.469
10 MIN	4.863	5.380	5.925	6.616	7.126
15 MIN	4.029	4.515	5.033	5.697	6.194
30 MIN	2.837	3.226	3.646	4.194	4.608
60 MIN	1.549	1.819	2.078	2.412	2.663
2.0 HRS	1.053	1.230	1.400	1.620	1.785
3.0 HRS	0.774	0.899	1.019	1.175	1.291
4.0 HRS	0.632	0.736	0.836	0.965	1.062
5.0 HRS	0.524	0.606	0.684	0.785	0.861
6.0 HRS	0.453	0.522	0.589	0.676	0.741
7.0 HRS	0.399	0.459	0.516	0.591	0.647
8.0 HRS	0.358	0.412	0.463	0.530	0.581
9.0 HRS	0.323	0.370	0.415	0.472	0.516
10 HRS	0.297	0.339	0.379	0.431	0.470
11 HRS	0.276	0.314	0.351	0.399	0.435
12 HRS	0.259	0.296	0.331	0.376	0.410
13 HRS	0.245	0.280	0.314	0.357	0.390
14 HRS	0.233	0.267	0.299	0.341	0.372
15 HRS	0.220	0.252	0.281	0.320	0.349
16 HRS	0.209	0.238	0.266	0.302	0.329
17 HRS	0.198	0.225	0.251	0.284	0.310

TABLE 803

UNDEVELOPED RUNOFF COEFFICIENTS ( $C_u$ )

SURFACE TYPE:

WOODLAND, TURFED MEADOWS  
ROUGH PASTURE, FALLOW BRUSE:

SLOPE:

Less than 2%	C = 0.12
2% to 5%	C = 0.24
5+% to 10%	C = 0.36
Over 10%	C = 0.48

CULTIVATED FIELDS:

Less than 2%	C = 0.20
2% to 5%	C = 0.35
5+% to 10%	C = 0.50
Over 10%	C = 0.65

TABLE 804

DEVELOPED RUNOFF COEFFICIENTS ( $C_d$ )

SURFACE TYPE:

PAVEMENT, ROOFTOP  
OTHER IMPERVIOUS SURFACES:

Less than 2%	C = 0.92
2% to 5%	C = 0.94
5+% to 10%	C = 0.96
Over 10%	C = 0.98

LAWNS WITH TURF:

Less than 2%	C = 0.15
2% to 5%	C = 0.25
5+% to 10%	C = 0.40
Over 10%	C = 0.55

ALL WATER SURFACES  
BASINS, PONDS & LAKES:

$C = 1.00$

TABLE 1002

TYPICAL VALUES OF MANNING'S "n"

TYPE OF MATERIAL	MANNING'S "n"	MAX. VELOCITY
CLOSED CONDUITS/CULVERTS:		
PVC; STORM SEWER GRADES	0.010	15 fps
CONCRETE (circular or elliptical)	0.011	15 fps
SMOOTH FLOW HDPE	0.010	15 fps
PRECAST CONCRETE BOXES	0.013	15 fps
C.1 or D.1 S.J. Type/Cement Lined	0.013	15 fps
CORRUGATED METAL PIPE:		
	CIRC. WELD	SPIRAL WELD
Unpaved	0.024	0.021
25% Paved	0.021	0.018
50% Paved	0.018	0.015
100% Paved	0.013	0.013
		7 fps
		7 fps
		7 fps
		7 fps
OTHER CONCRETE CULVERTS	0.013	
OPEN CHANNELS:		
CONCRETE, Trowel Finish	0.013	
CONCRETE, Broom or Float Finish	0.015	
GUNITE	0.018	
RIPRAP, Placed	0.030	
RIPRAP, Dumped	0.035	
GABIONS	0.028	
NEW EARTH	0.025	
MATURE EARTH, Some Weeds	0.030	
MATURE, Dense Weeds	0.040	
MATURE, Weeds & Brush	0.040	
SWALE, Grass Cover	0.035	

OTHER "n" VALUES SHALL BE TAKEN FROM MANUFACTURERS' DATA.

Table 3.2.2  
Urban Runoff Coefficients for the Rational Method (ASCE, 1992)

<u>Description of Area</u>	<u>Runoff Coefficients</u>
Business	
Downtown	0.70 to 0.95
Neighborhood	0.50 to 0.70
Residential	
Single-family	0.30 to 0.50
Multi-units, detached	0.40 to 0.60
Multi-units, attached	0.60 to 0.75
Residential (suburban)	0.25 to 0.40
Apartment	0.50 to 0.70
Industrial	
Light	0.50 to 0.80
Heavy	0.60 to 0.90
Parks, cemeteries	0.10 to 0.25
Playgrounds	0.20 to 0.35
Railroad yard	0.20 to 0.35
Unimproved	0.10 to 0.30

Table 3.2.3  
Values Used to Determine a Composite Runoff Coefficient for an Urban Area  
(ASCE, 1992)

<u>Character of Surface</u>	<u>Runoff Coefficients</u>
Pavement	
Asphalt and Concrete	0.70 to 0.95
Brick	0.70 to 0.85
Roofs	0.75 to 0.95
Lawns, sandy soil	
Flat, 2 percent	0.05 to 0.10
Average, 2 to 7 percent	0.10 to 0.15
Steep, 7 percent	0.15 to 0.20
Lawns, heavy soil	
Flat, 2 percent	0.13 to 0.17
Average, 2 to 7 percent	0.18 to 0.22
Steep, 7 percent	0.25 to 0.35
Water Impoundment	1.00

### 3.2.1 - Determination of Runoff Coefficient, C

Values of the runoff coefficient are given in Table 3.2.1 for rural areas and Table 3.2.2 for urban areas. Table 3.2.2 presents runoff coefficients for particular types of urban areas and Table 3.2.3 gives coefficients which are used to compute a weighted C based on the actual percentage of lawns, streets, roofs, etc. The determination of the runoff coefficient is illustrated in Example 3.2.1.

Table 3.2.1  
Rural Runoff Coefficients (Schwab et al., 1966)

Vegetation and <u>Topography</u>	Open Sandy <u>Loam</u>	<u>Soil Texture</u>	
		Clay and Silt <u>Loam</u>	Tight <u>Clay</u>
Woodland			
Flat 0-5% slope	0.10	0.30	0.40
Rolling 5-10% slope	0.25	0.35	0.50
Hilly 10-30% slope	0.30	0.50	0.60
Pasture			
Flat	0.10	0.30	0.40
Rolling	0.16	0.36	0.55
Hilly	0.22	0.42	0.60
Cultivated			
Flat	0.30	0.50	0.60
Rolling	0.40	0.60	0.70
Hilly	0.52	0.72	0.82

As mentioned before, this coefficient represents the runoff-rainfall ratio and includes many factors such as type of cover, soil types, infiltration, evaporation, evapo-transpiration, and any antecedent moisture condition. For many years it has been known that C actually does not remain constant during a storm (Homer, 1910). The strong dependence on "engineering judgment" in selecting a runoff coefficient is one of the main weaknesses of the rational method.

Table 3.2.4 (cont'd)

Kerby (1959)

$$t_c = K (L N s^{-0.5})^{0.467}$$

where K is equal to 0.83 (US Customary units) or 1.44 (Metric units), L is the length of flow in ft (m), s is the average slope of overland flow, ft/ft (m/m), and N is the retardance roughness coefficient given in Table 3.2.5.

The length used in the equation is the straight-line distance from the most distant point of the watershed to the outlet, measured parallel to the slope of the land until a well-defined channel is reached. Watersheds of less than 10 acres were used to calibrate the model; slopes were less than 1%; N values were 0.8 and less and surface flow dominated (McCuen, 1989).

Izzard (1946)

$$t_c = \frac{K(Bi + c') L^{\frac{1}{3}}}{s^{\frac{1}{3}} i^{\frac{2}{3}}}$$

where K is equal to 41.025 for U.S. customary units (113.391 for metric), B is equal to 0.0007 for U.S. customary units (0.00027 for metric), c' is the retardance coefficient given in Table 3.2.7, i is the rainfall intensity, in/hr (cm/hr), L is the length of flow path in ft (m), and s is the slope of overland flow path, ft/ft (m/m).

The product of i and L must be less than 500 in-ft/hr (390 cm-m/hr) to consider using this formula. In addition, well defined channels should not be present. This method was developed in laboratory experiments for the overland flow on roadway and turf surfaces.

Table 3.2.5  
Values of N for Kerby's Formula (Kerby, 1959)

<u>Type of Surface</u>	<u>N</u>
Smooth impervious surface	0.02
Smooth bare packed soil	0.10
Poor grass, cultivated row crops or moderately rough bare surface	0.20
Deciduous timberland	0.60
Pasture or Overage grass	0.40
Conifer timberland, deciduous timberland with deep forest litter or dense grass	0.80

Table 3.2.6  
Manning's  $n$  Roughness Coefficients for Sheet Flow (Engman, 1983)

<u>Type of Surface</u>	<u><math>n</math></u>
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (with no residue)	0.05
Cultivated soils	
Cover $\leq$ 20%	0.06
Cover $\geq$ 20%	0.17
Grass	
Short grass, prairie	0.15
Dense grass	0.24
Bermudagrass	0.41
Range	0.13
Woods	
Light underbrush	0.40
Dense underbrush	0.80

Table 3.2.7  
Values of  $c$  for Izzard's Formula

<u>Surface</u>	<u><math>c</math></u>
Smooth asphalt surface	0.007
Concrete pavement	0.012
Tar and gravel pavement	0.017
Closely clipped sod	0.046
Dense bluegrass turf	0.060

### 3.2.3 - Application of the Rational Method

The following procedure is used to apply the Rational Method.

Step 1: Determine the contributing basin area  $A$  (acres or hectares) by using USGS topographical maps, Indiana county drainage maps, maps developed from a survey of the area, or plans made specifically for the basin. This area is found by using a planimeter or digitizer.

Step 2: By the use of Table 3.2.1 for rural areas or Table 3.2.2 for urban areas, estimate the appropriate value of  $C$ . If the land use is mixed, a composite  $C$  value is estimated from Table 3.2.3 or is determined by:

SOIL SURVEY OF  
**Vanderburgh County, Indiana**



**United States Department of Agriculture  
Soil Conservation Service**

In cooperation with

**Purdue University Agricultural  
Experiment Station**



KEY DATA



SOIL LEGEND

The first capital letter is the initial one of the soil name. The lowercase letter that follows separates mapping units having names that begin with the same letter except that it does not separate sloping or eroded phases. The second capital letter indicates the class of slope. Symbols without a slope letter are for soils with a slope range of 0 to 2 percent or they are for land types with a considerable range of slope. A final number, 2 or 3, in the symbol indicates that the soil is eroded or severely eroded.

SYMBOL	NAME
AIB2	Alford silt loam, 2 to 6 percent slopes, eroded
AIC2	Alford silt loam, 6 to 12 percent slopes, eroded
AIC3	Alford silt loam, 6 to 12 percent slopes, severely eroded
AID3	Alford silt loam, 12 to 18 percent slopes, severely eroded
Ba	Bartle silt loam
Bd	Birds silt loam
Bo	Bonnie silt loam
Br	Borrow pits
Ev	Evansville silt loam
Gn	Ginat silt loam
Gu	Gullied land
He	Henshaw silt loam
HoA	Hosmer silt loam, 0 to 2 percent slopes
HoB2	Hosmer silt loam, 2 to 6 percent slopes, eroded
HoB3	Hosmer silt loam, 2 to 6 percent slopes, severely eroded
HoC2	Hosmer silt loam, 6 to 12 percent slopes, eroded
HoC3	Hosmer silt loam, 6 to 12 percent slopes, severely eroded
HoD3	Hosmer silt loam, 12 to 18 percent slopes, severely eroded
Ht	Huntington silty clay loam
Hu	Huntington fine sandy loam, sandy variant
IoA	Iona silt loam, 0 to 2 percent slopes
IoB2	Iona silt loam, 2 to 6 percent slopes, eroded
Iv	Iva silt loam
Ln	Lindside silty clay loam
Ma	Made land
MkB2	Markland silt loam, 2 to 6 percent slopes, eroded
MkC2	Markland silt loam, 6 to 18 percent slopes, eroded
MIC3	Markland silty clay loam, 6 to 18 percent slopes, severely eroded
Mr	McGary silt loam
MuA	Muren silt loam, 0 to 2 percent slopes
MuB2	Muren silt loam, 2 to 6 percent slopes, eroded
Nw	Newark silty clay loam
Pa	Patton silty clay loam
PrB	Princeton fine sandy loam, 2 to 6 percent slopes
Ra	Ragsdale silt loam
Rh	Rahm silty clay loam
Rs	Reesville silt loam
ScA	Sciotoville silt loam, 0 to 2 percent slopes
ScB2	Sciotoville silt loam, 2 to 6 percent slopes, eroded
St	Stendal silt loam
UnB2	Uniontown silt loam, 2 to 6 percent slopes, eroded
Wa	Wakeland silt loam
Wb	Weinbach silt loam
WeD2	Wellston silt loam, 12 to 18 percent slopes, eroded
WeD3	Wellston silt loam, 12 to 18 percent slopes, severely eroded
WeE2	Wellston silt loam, 18 to 25 percent slopes, eroded
WeF	Wellston silt loam, 25 to 50 percent slopes
WhA	Wheeling loam, 0 to 2 percent slopes
WhB2	Wheeling loam, 2 to 6 percent slopes, eroded
Wm	Wilbur silt loam
Wo	Woodmere silty clay loam
ZaC2	Zanesville silt loam, 6 to 12 percent slopes, eroded
ZaC3	Zanesville silt loam, 6 to 12 percent slopes, severely eroded
ZaD2	Zanesville silt loam, 12 to 18 percent slopes, eroded
ZaD3	Zanesville silt loam, 12 to 18 percent slopes, severely eroded
Zp	Zipp silty clay

## CONVENTIONAL SIGNS

### WORKS AND STRUCTURES

Highways and roads	
Divided .....	
Good motor .....	
Poor motor .....	
Trail .....	
Highway markers	
National Interstate .....	
U. S. .....	
State or county .....	
Railroads	
Single track .....	
Multiple track .....	
Abandoned .....	
Bridges and crossings	
Road .....	
Trail .....	
Railroad .....	
Ferry .....	
Ford .....	
Grade .....	
R. R. over .....	
R. R. under .....	
Buildings	
School .....	
Church .....	
Mine and quarry .....	
Gravel pit .....	
Power line .....	
Pipeline .....	
Cemetery .....	
Dams .....	
Levee .....	
Tanks .....	
Well, oil or gas .....	
Forest fire or lookout station .....	
Indian mound .....	
Located object .....	

### BOUNDARIES

National or state .....	
County .....	
Minor civil division .....	
Reservation .....	
Limit of soil survey .....	
Small park, cemetery, airport ...	
Land survey division corners ...	

### DRAINAGE

Streams, double-line	
Perennial .....	
Intermittent .....	
Streams, single-line	
Perennial .....	
Intermittent	
Crossable with tillage implements	
Not crossable with tillage implements	
Unclassified .....	
Canals and ditches	
Lakes and ponds	
Perennial .....	
Intermittent .....	
Spring .....	
Marsh or swamp .....	
Wet spot .....	
Drainage end or alluvial fan ...	

### SOIL SUR

Soil boundary	
and symbol .....	
Gravel .....	
Stoniness	
Stony .....	
Very stony .....	
Rock outcrops .....	
Chert fragments .....	
Clay spot .....	
Sand spot .....	
Gumbo or scabby spot .....	
Made land .....	
Severely eroded spot .....	
Blowout, wind erosion .....	
Gully .....	
Saline spot .....	

### RELIEF

Escarpments	
Bedrock .....	
Other .....	
Short steep slope .....	
Prominent peak .....	
Depressions	
Crossable with tillage implements	
Not crossable with tillage implements	
Contains water most of the time	

Large Small



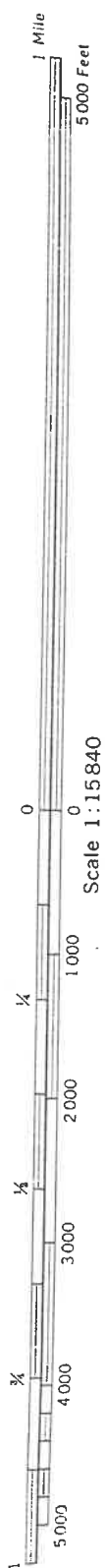
R. 10 W. HoB2

(Joins sheet 7)



(Joins sheet 12) 215 00 FEET

(Joins sheet 15) 375 00 FEET



Scale 1:15840

**Supplementary Calculations**  
**For**  
**Aspen Hill Estates Subdivision**

By:

Morley and Associates, Inc.

600 S. E. Sixth Street

Evansville, IN 47713

(812) 464-9585

December 1999

## Subbasin A - Wellington Acres - Basin #4

<u>Undeveloped</u>	<u>Ac</u>	<u>C</u>	<u>N</u>
A1	6.194	0.360	0.600
A2	1.530	0.360	0.414
A3	1.110	0.360	0.500
	<u>8.834</u>	WTC = 0.360	WEN = 0.555

$$t_c = 0.827 \left[ \frac{NL}{S^{1/2}} \right]^{0.467} = 0.827 \left[ \frac{(0.555)(600')}{(0.1133)^{1/2}} \right]^{0.467}$$

$$t_c = 20.72 \text{ min.}$$

$$I_{10} = 4.023 \text{ In/hr.}$$

$$Q_{10} = CIA = (0.360)(4.023)(8.834) = 12.79 \text{ cfs}$$

## Developed

$$WTC = 0.451$$

$$WEN = 0.465$$

$$t_c = 0.827 \left[ \frac{(0.465)(600')}{(0.1133)^{1/2}} \right]^{0.467} = 19.07 \text{ min.}$$

$$I_{25} = 4.657$$

$$Q_{25} = (0.451)(4.657)(8.834) = 18.55 \text{ cfs}$$

Offsite Drainage Sub-Basins									
Sub-basin No. : A1 (D1)		Total Area =		S.F. =		269,804		6.194 Ac.	
Surface									
Structures	0 Total	2,000	S.F.	=	0	S.F. =	0.00	Ac.	0.92 0.02
Drives	0 Total	400	S.F.	=	0	S.F. =	0.00	Ac.	0.92 0.02
Pavement	0 L.F.	15	Width	=	0	S.F. =	0.00	Ac.	0.96 0.02
Patios	0 Total	200	S.F.	=	0	S.F. =	0.00	Ac.	0.92 0.02
Sidewalks	0 L.F.	4	Width	=	0	S.F. =	0.00	Ac.	0.96 0.02
Pasture (5-10%)		0	S.F.	=			0.00	Ac.	0.36 0.40
Woods (5-10%)		269,804	S.F.	=			6.19	Ac.	0.36 0.60
Cultivated Fields (5-10%)			S.F.	=			0.00	Ac.	0.50 0.20
Water		0	S.F.	=			0.00	Ac.	1.00 0.00
Misc.		0	S.F.	=			0.00	Ac.	
							6.19		
Weighted c =					0.360				
Weighted N =					0.600				
					L = 1.287 Ft.				
					H = 66.9 Ft.				
					S = 0.0520 Ft./Ft.				
					tc = 36.81 Minutes (Min. 5 minutes)				
					I(10) = 2.901 In./Hr.				
					Q(10) = 6.47 CFS				

Offsite Drainage Sub-Basins									
Sub-basin No. : A2 (D2+ LAKE 4)		Total Area =		S.F. =		66,647		1.530 Ac.	
Surface									
Structures	0 Total	2,000	S.F.	=	0	S.F. =	0.00	Ac.	0.92 0.02
Drives	0 Total	400	S.F.	=	0	S.F. =	0.00	Ac.	0.92 0.02
Pavement	0 L.F.	15	Width	=	0	S.F. =	0.00	Ac.	0.96 0.02
Patios	0 Total	200	S.F.	=	0	S.F. =	0.00	Ac.	0.92 0.02
Sidewalks	0 L.F.	4	Width	=	0	S.F. =	0.00	Ac.	0.96 0.02
Pasture (5-10%)		62,129	S.F.	=			1.43	Ac.	0.36 0.40
Woods (5-10%)		4,518	S.F.	=			0.10	Ac.	0.36 0.60
Cultivated Fields (5-10%)			S.F.	=			0.00	Ac.	0.50 0.20
Water		0	S.F.	=			0.00	Ac.	1.00 0.00
Misc.		0	S.F.	=			0.00	Ac.	
							1.53		
Weighted c =					0.360				
Weighted N =					0.414				
					L = 420 Ft.				
					H = 35.0 Ft.				
					S = 0.0833 Ft./Ft.				
					tc = 16.42 Minutes (Min. 5 minutes)				
					I(10) = 4.393 In./Hr.				
					Q(10) = 2.42 CFS				

Offsite Drainage Sub-Basins

Sub-basin No.: A3 (D3)		Total Area =		S.F. =	48,352	1.110 Ac.		
Surface								
Structures	0 Total	2,000	S.F.	=	0	S.F. =	0.00	Ac. 0.92 0.02
Drives	0 Total	400	S.F.	=	0	S.F. =	0.00	Ac. 0.92 0.02
Pavement	0 L.F.	15	Width	=	0	S.F. =	0.00	Ac. 0.96 0.02
Patios	0 Total	200	S.F.	=	0	S.F. =	0.00	Ac. 0.92 0.02
Sidewalks	0 L.F.	4	Width	=	0	S.F. =	0.00	Ac. 0.96 0.02
Pasture (5-10%)		24,195	S.F.	=			0.56	Ac. 0.36 0.40
Woods (5-10%)		24,195	S.F.	=			0.56	Ac. 0.36 0.60
Cultivated Fields (5-10%)		0	S.F.	=			0.00	Ac. 0.50 0.20
Water		0	S.F.	=			0.00	Ac. 1.00 0.00
Misc.		0	S.F.	=			0.00	Ac.
							1.11	
		Weighted c =			0.360			
		Weighted N =			0.500			
			L =	275 Ft				
			H =	31.9 Ft				
			S =	0.1160 Ft./Ft.				
			tc =	13.64 Minutes		(Min. 5 minutes)		
			I(10) =	4.750 In./Hr.				
			Q(10) :	1.90 CFS				

Developed Drainage Sub-Basins

Sub-basin No. : A1 (D1)	Total Area =	269,804 S.F. =	6.19 Ac.
Surface			
Structures	1 Total	3,500 S.F. =	3,500 S.F. = 0.08 Ac. 0.92 0.02
Drives	1 Total	1,100 S.F. =	1,100 S.F. = 0.03 Ac. 0.96 0.02
Pavement	0 L.F.	14.5 Width =	0 S.F. = 0.00 Ac. 0.96 0.02
Patios	1 Total	900 S.F. =	900 S.F. = 0.02 Ac. 0.92 0.02
Sidewalks	100 L.F.	4 Width =	400 S.F. = 0.01 Ac. 0.96 0.02
Lawn (0-2%)		21,780 S.F. =	0.50 Ac. 0.15 0.40
Lawn (2-5%)		S.F. =	0.00 Ac. 0.25 0.40
Lawn (5-10%)		S.F. =	0.00 Ac. 0.40 0.40
Woods(5-10%)	242,124	S.F. =	5.56 Ac. 0.36 0.60
Water		S.F. =	0.00 Ac. 1.00 0.00
Misc.		S.F. =	0.00 Ac.

6.19

Weighted c =	0.356
Weighted N =	0.571
L =	1,287 Ft.
H =	66.9 Ft.
S =	0.0520 Ft./Ft.
tc =	35.97 Minutes
I(25) =	3.335 In./Hr.
Q(25) =	7.34 CFS

(Min. 5 minutes)

Developed Drainage Sub-Basins

Sub-basin No. : A2 (D2+ Lake4)	Total Area =	66,647 S.F. =	1.53 Ac.
Surface			
Structures	0 Total	3,500 S.F. =	0 S.F. = 0.00 Ac. 0.92 0.02
Drives	0 Total	400 S.F. =	0 S.F. = 0.00 Ac. 0.96 0.02
Pavement	0 L.F.	14.5 Width =	0 S.F. = 0.00 Ac. 0.92 0.02
Patios	0 Total	900 S.F. =	0 S.F. = 0.00 Ac. 0.92 0.02
Sidewalks	0 L.F.	4 Width =	0 S.F. = 0.00 Ac. 0.96 0.02
Lawn (0-2%)		S.F. =	0.00 Ac. 0.15 0.40
Lawn (2-5%)		S.F. =	0.00 Ac. 0.25 0.40
Lawn (5-10%)	17,860	S.F. =	0.41 Ac. 0.40 0.40
Lawn (>10%)		S.F. =	0.00 Ac. 0.55 0.40
Water	48,787	S.F. =	1.12 Ac. 1.00 0.00
Misc.		S.F. =	0.00 Ac.

1.53

Weighted c =	0.839
Weighted N =	0.107
L =	420 Ft.
H =	35.0 Ft.
S =	0.0833 Ft./Ft.
tc =	8.74 Minutes
I(25) =	6.248 In./Hr.
Q(25) =	8.02 CFS

(Min. 5 minutes)



Developed Drainage Sub-Basins									
Sub-basin No. : A3 (D3)		Total Area = 48,352 S.F. = 1.11 Ac.							
Surface									
Structures	1 Total	3,500 S.F.	=	3,500 S.F.	=	0.08 Ac.	0.92	0.02	
Drives	0 Total	400 S.F.	=	0 S.F.	=	0.00 Ac.	0.92	0.02	
Pavement	0 L.F.	14.5 Width	=	0 S.F.	=	0.00 Ac.	0.92	0.02	
Patios	1 Total	900 S.F.	=	900 S.F.	=	0.02 Ac.	0.92	0.02	
Sidewalks	0 L.F.	4 Width	=	0 S.F.	=	0.00 Ac.	0.92	0.02	
Lawn (0-2%)		S.F.	=		=	0.00 Ac.	0.15	0.40	
Lawn (2-5%)		S.F.	=		=	0.00 Ac.	0.25	0.40	
Lawn (5-10%)		43,952 S.F.	=		=	1.01 Ac.	0.40	0.40	
Lawn (>10%)		S.F.	=		=	0.00 Ac.	0.55	0.40	
Water		S.F.	=		=	0.00 Ac.	1.00	0.00	
Misc.		S.F.	=		=	0.00 Ac.			
						1.11			

Weighted c =	0.447
Weighted N =	0.365
L =	275 Ft.
H =	31.9 Ft.
S =	0.1160 Ft./Ft.
tc =	11.77 Minutes
I(25) =	5.609 In./Hr.
Q(25) =	2.79 CFS

(Min. 5 minutes)

<u>Subbasin</u>	<u>Ac</u>	<u>C</u>	<u>N</u>
A1	6.19	0.356	0.571
A2	1.53	0.839	0.107
A3	1.11	0.447	0.365
	<u>8.83</u>	WtC = 0.451	WtN = 0.465

Basin #4

① Pool Elevation = 453.00

Top of 30" x 30" Box = 453.00

IE of Primary Spillway = 450.85

Elevation of Emergency Spillway = 453.70

$Q_{(10)} = 12.74$  cfs

Conditions required to discharge at the 10-year Undeveloped rate.

② Conditions stated in drainage report date June 4, 1999 by Crane Environmental Services, LLC.

Pool Elevation = 453.00

Top of 30" x 30" Box = 453.00

IE of Primary Spillway = 450.50

Elevation of Emergency Spillway = 453.70

0.1' above 30" x 30" Box  $Q = 4.923$  cfs

0.7' above 30" x 30" Box  $Q = 5.582$  cfs

$Q = 5.582$  cfs was used as discharge rate from

Wellington Acres (Subbasin A - for Preliminary drainage Report Aspen Hill Estates)

PIPE FLOW: For a pipe flowing full, but not under pressure, Manning's Equation (Equation 4.6) may be used to calculate the flowrate. As soon as a depth of water develops above the pipe the flowrate must be calculated using a modified form of the Manning equation and must include entrance and exit losses. Equation 6.10 is used to calculate the flowrate under these conditions,

$$Q = A \left[ \frac{n}{\frac{K_e + K_o}{2g} + \frac{2.48n^2L}{D^{4/3}}} \right]^{1/2} \quad (6.10)$$

- where
- Q = flowrate in cfs,
  - $K_e$  = entrance loss coefficient (given in Table 6.3),
  - $K_o$  = outlet loss coefficient (usually taken as 1.0),
  - D = pipe diameter (ft),
  - n = Manning's roughness coefficient (Table 4.2),
  - L = length of pipe (ft) (Equation assumes a free jet @ exit),
  - h = Height of water surface above center of pipe opening (ft).

All of the equations presented may be used to calculate the flowrate Q. Often the flowrate is known and the orifice opening, weir size or pipe diameter are the parameters actually required. In these cases the equations are rearranged to solve for the unknown variable. When the computed result does not correspond to a commercially available pipe size, the type of opening, discharge coefficient, or pipe roughness are varied to obtain a readily available pipe of proper size.

Table 6.3

Value of  $K_e$  (entrance losses)  
(Portland Cement Association)

Type of Entrance	$K_e$
Concrete pipe in headwall	
Socket or beveled entrance	0.19
Rounded lip	0.10
Square edge	0.43
Concrete pipe projecting, square edge	0.46
Corrugated metal pipe in headwall, square edge	0.43

## Friction Loss Calculations

# 1

- Q= Flowrate (cfs)  
 Ke= Entrance Loss coefficient  
 Ko= Outlet Loss coefficient  
 g= Gravity (ft/sec<sup>2</sup>)  
 h= Height of water above the centerline of the pipe (ft)  
 d= Diameter of the pipe (ft)  
 A= Area of the pipe (ft<sup>2</sup>)  
 L= Length of pipe  
 n= Mannings roughness coefficient

$$Q = A \times [h \left( \frac{K_e + K_o}{2g} \right) + \left( \frac{2.87 \cdot n^2 \cdot L}{d^{4/3}} \right)]^{1/2}$$

Q= 12.739 cubic feet per second

Ke= 0.43 see table  
 Ko= 1.0 assumed  
 g= 32.20 ft<sup>2</sup> per second  
 h= 2.10 ft  
 d= 1.500 ft  
 A= 1.77 ft<sup>2</sup> (18-inch Dia. Pipe)  
 L= 90.0 ft  
 n= 0.011 (Reinforced Concrete Pipe)

#1

VANDERBURGH COUNTY DRAINAGE BOARD  
FORM 800

PROJECT: Wellington Acres Lake 4 DETENTION FACILITY DESIGN RETURN PERIOD: 25 YRS  
DESIGNER: Morley and Assoc. 4037-4B RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA: 8.834 ACRES  
TIME OF CONCENTRATION (UNDEVELOPED WATERSHED): 20.72 MINUTES  
RAINFALL INTENSITY (I<sub>u</sub>): 4.023 INCHES/HR  
UNDEVELOPED RUNOFF COEFFICIENT (C<sub>u</sub>): 0.36  
UNDEVELOPED RUNOFF RATE (O = C<sub>u</sub>\*I<sub>u</sub>\*A): 12.79 CFS  
DEVELOPED RUNOFF COEFFICIENT (C<sub>d</sub>): 0.451

STORM DURATION Td (HRS)	RAINFALL INTENSITY Id (INCH/HR)	INFLOW RATE I(Td) (Cd*Id*A) (CFS)	OUTFLOW RATE O (Cu*Iu*A) (CFS)	STORAGE RATE I(Td)-O (CFS)	REQUIRED STORAGE (Td)-O)*Td/12 (ACRE-FT)
0.08	7.208	28.72	12.79	15.92	0.111
0.17	5.925	23.61	12.79	10.81	0.150
0.25	5.033	20.05	12.79	7.26	0.151
0.33	4.571	18.21	12.79	5.42	0.150
0.42	4.108	16.37	12.79	3.57	0.124
0.50	3.646	14.53	12.79	1.73	0.072
0.58	3.385	13.48	12.79	0.69	0.034
0.67	3.123	12.44	12.79	-0.35	-0.019
0.75	2.862	11.40	12.79	-1.39	-0.087
0.83	2.601	10.36	12.79	-2.43	-0.169
0.92	2.339	9.32	12.79	-3.48	-0.265
1.00	2.078	8.28	12.79	-4.52	-0.376
1.25	1.909	7.60	12.79	-5.19	-0.541
1.50	1.739	6.93	12.79	-5.87	-0.733
1.75	1.570	6.25	12.79	-6.54	-0.954
2.00	1.400	5.58	12.79	-7.22	-1.203
2.50	1.210	4.82	12.79	-7.98	-1.662
3.00	1.019	4.06	12.79	-8.73	-2.184
4.00	0.836	3.33	12.79	-9.46	-3.154

PEAK STORAGE (ACRE/FT): 0.15  
PEAK STORAGE (CUBIC FT): 6.587

#1

VANDERBURGH COUNTY DRAINAGE BOARD FORM 800						
PROJECT: Wellington Acres Lake 4		DETENTION FACILITY DESIGN RETURN PERIOD:			100 YRS	
DESIGNER: MORLEY & ASSOC.		4037-4B		RELEASE RATE RETURN PERIOD:		10 YRS
WATERSHED AREA: 8.834 ACRES						
TIME OF CONCENTRATION (UNDEVELOPED WATERSHED): 20.72 MINUTES						
RAINFALL INTENSITY (Iu): 4.023 INCHES/HR						
UNDEVELOPED RUNOFF COEFFICIENT (Cu): 0.36						
UNDEVELOPED RUNOFF RATE (O = Cu*Iu*A): 12.794106 CFS						
DEVELOPED RUNOFF COEFFICIENT (Cd): 0.451						
STORM DURATION Td (HRS)	RAINFALL INTENSITY Id (INCH/HR)	INFLOW RATE I(Td) (Cd*Id*A) (CFS)	OUTFLOW RATE O (Cu*Iu*A) (CFS)	STORAGE RATE I(Td)-O (CFS)	REQUIRED STORAGE (Td)-O)*Td/12 (ACRE-FT)	
0.08	8.469	33.74	12.79	20.95	0.140	
0.17	7.126	28.39	12.79	15.60	0.221	
0.25	6.194	24.68	12.79	11.88	0.248	
0.33	5.665	22.57	12.79	9.78	0.269	
0.42	5.137	20.47	12.79	7.67	0.268	
0.50	4.608	18.36	12.79	5.56	0.232	
0.58	4.284	17.07	12.79	4.27	0.207	
0.67	3.960	15.78	12.79	2.98	0.166	
0.75	3.636	14.48	12.79	1.69	0.106	
0.83	3.311	13.19	12.79	0.40	0.028	
0.92	2.987	11.90	12.79	-0.89	-0.068	
1.00	2.663	10.61	12.79	-2.18	-0.182	
1.25	2.444	9.74	12.79	-3.06	-0.319	
1.50	2.224	8.86	12.79	-3.93	-0.492	
1.75	2.005	7.99	12.79	-4.81	-0.701	
2.00	1.785	7.11	12.79	-5.68	-0.947	
2.50	1.538	6.13	12.79	-6.67	-1.389	
3.00	1.291	5.14	12.79	-7.65	-1.913	
4.00	1.062	4.23	12.79	-8.56	-2.854	
PEAK STORAGE (ACRE/FT):					0.27	
PEAK STORAGE (CUBIC FT):					11,712	

**Friction Loss Calculations**

# 2

Q= Flowrate (cfs)

Ke= Entrance Loss coefficient

Ko= Outlet Loss coefficient

g= Gravity (ft/sec<sup>2</sup>)

h= Height of water above the centerline of the pipe (ft)

d= Diameter of the pipe (ft)

A= Area of the pipe (ft<sup>2</sup>)

L= Length of pipe

n= Mannings roughness coefficient

$$Q = A \times [h \left( \frac{K_e + K_o}{2g} \right) + \left( \frac{2.87 \cdot n^2 \cdot L}{d^{4/3}} \right)]^{1/2}$$

Q= 4.923 cubic feet per second

Ke= 0.43 see table

Ko= 1.0 assumed

g= 32.20 ft<sup>2</sup> per second

h= 2.10 ft

d= 1.000 ft

A= 0.79 ft<sup>2</sup> (18-inch Dia. Pipe)

L= 90.0 ft

n= 0.011 (Reinforced Concrete Pipe)

## Friction Loss Calculations

# 2

Q= Flowrate (cfs)

Ke= Entrance Loss coefficient

Ko= Outlet Loss coefficient

g= Gravity (ft/sec<sup>2</sup>)

h= Height of water above the centerline of the pipe (ft)

d= Diameter of the pipe (ft)

A= Area of the pipe (ft<sup>2</sup>)

L= Length of pipe

n= Mannings roughness coefficient

$$Q = A \times [h ((K_e + K_o)/2g) + ((2.87 * n^2 * L)/d^{4/3})]^{1/2}$$

Q= 5.582 cubic feet per second

Ke= 0.43 see table

Ko= 1.0 assumed

g= 32.20 ft<sup>2</sup> per second

h= 2.70 ft

d= 1.000 ft

A= 0.79 ft<sup>2</sup> (12-inch Dia. Pipe)

L= 90.0 ft

n= 0.011 (Reinforced Concrete Pipe)



#2

VANDERBURGH COUNTY DRAINAGE BOARD  
FORM 800

PROJECT: Wellington Acres DETENTION FACILITY DESIGN RETURN PERIOD: 25 YRS  
Lake 4  
DESIGNER: Morley and Assoc. 4037-4B RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA: 8.834 ACRES  
TIME OF CONCENTRATION (UNDEVELOPED WATERSHED): 20.72 MINUTES  
RAINFALL INTENSITY (Iu): 4.023 INCHES/HR  
UNDEVELOPED RUNOFF COEFFICIENT (Cu): 0.36  
UNDEVELOPED RUNOFF RATE - As Calculated 5.58 CFS  
DEVELOPED RUNOFF COEFFICIENT (Cd): 0.451

STORM DURATION Td (HRS)	RAINFALL INTENSITY Id (INCH/HR)	INFLOW RATE I(Td) (Cd*Id*A) (CFS)	OUTFLOW RATE O (Cu*Iu*A) (CFS)	STORAGE RATE I(Td)-O (CFS)	REQUIRED STORAGE (Td)-O)*Td/12 (ACRE-FT)
0.08	7.208	28.72	5.58	23.14	0.161
0.17	5.925	23.61	5.58	18.03	0.250
0.25	5.033	20.05	5.58	14.47	0.302
0.33	4.571	18.21	5.58	12.63	0.351
0.42	4.108	16.37	5.58	10.79	0.375
0.50	3.646	14.53	5.58	8.95	0.373
0.58	3.385	13.48	5.58	7.90	0.384
0.67	3.123	12.44	5.58	6.86	0.381
0.75	2.862	11.40	5.58	5.82	0.364
0.83	2.601	10.36	5.58	4.78	0.332
0.92	2.339	9.32	5.58	3.74	0.286
1.00	2.078	8.28	5.58	2.70	0.225
1.25	1.909	7.60	5.58	2.02	0.211
1.50	1.739	6.93	5.58	1.35	0.169
1.75	1.570	6.25	5.58	0.67	0.098
2.00	1.400	5.58	5.58	0.00	0.000
2.50	1.210	4.82	5.58	-0.76	-0.159
3.00	1.019	4.06	5.58	-1.52	-0.380
4.00	0.836	3.33	5.58	-2.25	-0.750

PEAK STORAGE (ACRE/FT): 0.38  
PEAK STORAGE (CUBIC FT): 16,738

VANDERBURGH COUNTY DRAINAGE BOARD  
FORM 800

PROJECT: Wellington Acres Lake 4 DETENTION FACILITY DESIGN RETURN PERIOD: 100 YRS  
DESIGNER: MORLEY & ASSOC. 4037-4B RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA: 8.834 ACRES  
TIME OF CONCENTRATION (UNDEVELOPED WATERSHED): 20.72 MINUTES  
RAINFALL INTENSITY (Iu): 4.023 INCHES/HR  
UNDEVELOPED RUNOFF COEFFICIENT (Cu): 0.36  
UNDEVELOPED RUNOFF RATE - As Calculated 5.58 CFS  
DEVELOPED RUNOFF COEFFICIENT (Cd): 0.451

STORM DURATION Td (HRS)	RAINFALL INTENSITY Id (INCH/HR)	INFLOW RATE I(Td) (Cd*Id*A) (CFS)	OUTFLOW RATE O (Cu*Iu*A) (CFS)	STORAGE RATE I(Td)-O (CFS)	REQUIRED STORAGE (Td)-O)*Td/12 (ACRE-FT)
0.08	8.469	33.74	5.58	28.16	0.188
0.17	7.126	28.39	5.58	22.81	0.323
0.25	6.194	24.68	5.58	19.10	0.398
0.33	5.665	22.57	5.58	16.99	0.467
0.42	5.137	20.47	5.58	14.89	0.521
0.50	4.608	18.36	5.58	12.78	0.532
0.58	4.284	17.07	5.58	11.49	0.555
0.67	3.960	15.78	5.58	10.20	0.569
0.75	3.636	14.48	5.58	8.90	0.557
0.83	3.311	13.19	5.58	7.61	0.527
0.92	2.987	11.90	5.58	6.32	0.485
1.00	2.663	10.61	5.58	5.03	0.419
1.25	2.444	9.74	5.58	4.16	0.433
1.50	2.224	8.86	5.58	3.28	0.410
1.75	2.005	7.99	5.58	2.41	0.351
2.00	1.785	7.11	5.58	1.53	0.255
2.50	1.538	6.13	5.58	0.55	0.114
3.00	1.291	5.14	5.58	-0.44	-0.109
4.00	1.062	4.23	5.58	-1.35	-0.450

PEAK STORAGE (ACRE/FT): 0.57  
PEAK STORAGE (CUBIC FT): 24,797