

bayer becker

STORM WATER MANAGEMENT

VOICE OF AMERICA
PARK
PHASE 1

PREPARED: 4-16-12

REVISED: 5-14-12

STORM WATER MANAGEMENT
VOICE OF AMERICA PARK, PHASE 1
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VOICE OF AMERICA PARK, PHASE 1
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SUMMARY OF DATA

Method of Hydrograph Development: TR-55

Software: Hydraflow

Design Criteria: The proposed lakes/basins will be sized using the critical storm method. The post-development storms of a frequency between the one-year and the critical storm will be controlled, so as to be equal or less than the pre-development peak runoff rate for a 24-hour, one-year frequency storm. For all storm events greater than the cirtical storm, reduce the flow rate by one storm event. In addition the lakes/basins will also include volume meeting the Ohio EPA water quality regulations.

Critical Storm:

Lake #1	10 Year
Lake #2 &3	25 Year
Lake #4	25 Year
Lake #5	50 Year

Drainage Area Descriptions	Drainage Area (Acres)	CN	Tc (Min)
Pre-Developed Area #1, Onsite tributary to analyis point #1	32.57	67.2	25.2
Pre-Developed Area #2, Onsite tributary to analyis point #2	83.62	60.4	37.1
Pre-Developed Area #3, Onsite tributary to analyis point #3	32.22	61.3	31.3
Pre-Developed Area #4, Onsite tributary to analyis point #4	39.81	61.4	26.4
Offsite Miami University VOA	10.40	90.2	10.0
Post-Developed Area #1, Onsite tributary Lake #1 and analyis point #1	24.30	77.8	20.5
Post-Developed Area #2, Onsite tributary to Lake #2, then Lake #3 and analyis point #2	17.60	68.6	18.0
Post-Developed Area #3, Onsite tributary to Lake #3 and analyis point #2	63.50	82.2	17.1
Post-Developed Area #4, Onsite tributary to Lake #4 and analyis point #3	22.25	78.3	18.7
Post-Developed Area #5, Onsite tributary to Lake #5 analyis point #3	67.30	74.8	22.3

Future Lake #1 T/Dike=888.60		**Detention Basin Outlet: O.D.O.T. Type 2-4 Catch Basin, with 6" Wide Window @ 883.75 and (4) 4'-0" Wide Windows @887.00 Required Water Quality Volume = 9,924 CF, Achieved @884.62**			
Frequency	Inflow	Outflow	Storage		Elevation
(yr)	(cfs)	(cfs)	(ft^3)	(ac-ft)	(ft)
1	16.03	0.80	33,933	0.78	885.16
5	37.65	1.90	77,512	1.78	885.67
10	47.96	2.52	98,242	2.26	885.91
25	63.32	3.48	129,637	2.98	886.27
50	77.13	4.41	158,393	3.64	886.59
100	93.46	5.58	192,721	4.42	886.97

Lake #1 Release Rates (Analysis Point #1)		
Storm Frequency	Pre-Developed Allowable Release Rate	Post-Developed Release Rate
(yr)	(cfs)	(cfs)
1	5.58	0.80
5	5.58	1.90
10	5.58	2.52
25	33.39	3.48
50	48.59	4.41
100	62.80	5.58

Lake #2 T/Dike=891.00		Detention Basin Outlet: O.D.O.T. Type 2-3 Catch Basin, with 4" Wide Window @ 887.70 and (4) 3'-0" Wide Windows @888.90 Required Water Quality Volume = 6,820 CF, Achieved @887.80			
Frequency	Inflow	Outflow	Storage		Elevation
(yr)	(cfs)	(cfs)	(ft^3)	(ac-ft)	(ft)
1	4.61	0.17	14,762	0.34	888.01
5	17.22	0.45	41,397	0.95	888.29
10	23.78	0.62	54,891	1.26	888.43
25	33.83	0.91	75,293	1.73	888.64
50	43.17	1.21	94,034	2.16	888.84
100	54.70	2.46	108,504	2.49	888.99

Lake #2 Release Rates (Part of Analysis Point #2)		
Storm Frequency	Pre-Developed Allowable Release Rate	Post-Developed Release Rate
(yr)	(cfs)	(cfs)
1	(See Lake #3)	0.17
5	(See Lake #3)	0.45
10	(See Lake #3)	0.62
25	(See Lake #3)	0.91
50	(See Lake #3)	1.21
100	(See Lake #3)	2.46

Lake #3 T/Dike=886.50		Detention Basin Outlet: O.D.O.T. Type 2-3 Catch Basin, with 6 3/4" Orifice @ 881.75 and (4) 4'-0" Wide Windows @885.90 Required Water Quality Volume = 25,973 CF, Achieved @881.67			
Frequency	Inflow	Outflow	Storage		Elevation
(yr)	(cfs)	(cfs)	(ft^3)	(ac-ft)	(ft)
1	63.48	1.15	163,595	3.76	882.78
5	131.78	1.81	354,778	8.14	883.93
10	163.17	2.04	448,652	10.30	884.46
25	208.71	2.34	590,097	13.55	885.23
50	249.07	2.57	720,028	16.53	885.89
100	296.32	8.21	770,471	17.69	886.14

Lake #3 Release Rates (Analysis Point #2)		
Storm Frequency	Pre-Developed Allowable Release Rate	Post-Developed Release Rate
(yr)	(cfs)	(cfs)
1	2.62	1.15
5	2.62	1.81
10	2.62	2.04
25	2.62	2.34
50	2.62	2.57
100	85.37	8.21

Lake #4 T/Dike=893.50		Detention Basin Outlet: Weir Wall, with 3" Wide Wier @ 889.50 and 6'-0" Wide Wier @892.00 Required Water Quality Volume = 8,984 CF, Achieved @889.59			
Frequency	Inflow	Outflow	Storage		Elevation
(yr)	(cfs)	(cfs)	(ft^3)	(ac-ft)	(ft)
1	16.74	0.29	44,851	1.03	890.03
5	38.45	0.73	92,728	2.13	890.48
10	48.83	0.98	115,258	2.65	890.69
25	64.13	1.38	148,286	3.40	891.00
50	77.85	1.85	177,215	4.07	891.26
100	94.05	3.61	199,116	4.57	891.45

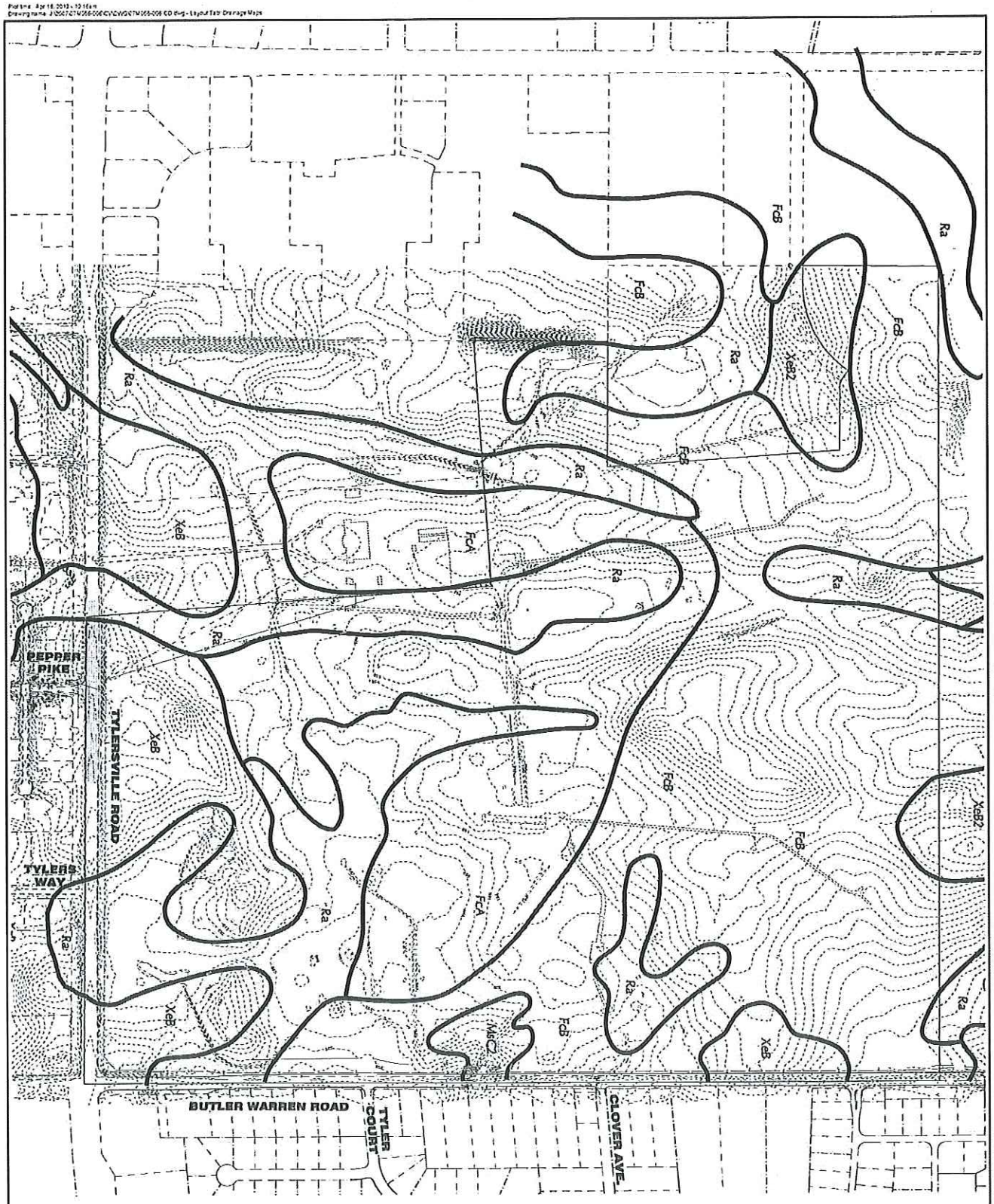
Lake #4 Release Rates (Analysis Point #3)		
Storm Frequency	Pre-Developed Allowable Release Rate	Post-Developed Release Rate
(yr)	(cfs)	(cfs)
1	1.37	0.29
5	1.87	0.73
10	1.87	0.98
25	1.87	1.38
50	28.93	1.85
100	39.73	3.61

Lake #5 T/Dike=892.00		Detention Basin Outlet: Weir Wall, with 3" Wide Wier @ 887.50 and 10'-0" Wide Wier @891.00 Required Water Quality Volume = 27,484 CF, Achieved @887.58			
Frequency	Inflow	Outflow	Storage		Elevation
(yr)	(cfs)	(cfs)	(ft^3)	(ac-ft)	(ft)
1	37.00	0.36	173,230	3.98	888.11
5	93.90	0.99	369,967	8.49	888.70
10	127.27	1.35	462,524	10.62	888.98
25	172.21	1.93	598,925	13.75	889.37
50	210.21	4.55	670,655	15.40	889.58
100	255.41	9.07	734,539	16.86	889.77

Lake #5 Release Rates (Analysis Point #4)		
Storm Frequency	Pre-Developed Allowable Release Rate	Post-Developed Release Rate
(yr)	(cfs)	(cfs)
1	24.38	0.36
5	24.38	0.99
10	24.38	1.35
25	24.38	1.93
50	24.38	4.55
100	57.14	9.07

VOICE OF AMERICA PARK
ATHLETIC COMPLEX PHASE 1
SECTION 12, TOWN 3, RANGE 2,
WEST CENTER TOWNSHIP,
BUTLER COUNTY, OHIO
DRAINAGE MAP - PRE-DEVELOPED
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CLOVER AVE.
Analysis Point #1
Analysis Point #2
TYLER COURT
BUTLER WARREN ROAD
TYLERSVILLE ROAD
TYLERS WAY
PEPPER PIKE
Pre-Developed Area #1 32.57 Ac.
Pre-Developed Area #2 83.62 Ac.
Pre-Developed Area #3 32.22 Ac.
Pre-Developed Area #4 39.81 Ac.
Analysis Point #3
Analysis Point #4
Offsite Miami University 10.40 Ac.

VOICE OF AMERICA PARK
ATHLETIC COMPLEX PHASE 1
SECTION 12, TOWN 3, RANGE 2,
WEST CISERTEN TOWNSHIP,
BUTLER COUNTY, OHIO
DRAINAGE MAP - POST-DEVELOPED
bayer becker
CLOVER AVE.
Analysis Point #1
Analysis Point #2
TYLER COURT
BUTLER WARREN ROAD
TYLERSVILLE ROAD
TYLERS WAY
PEPPER PIKE
Post-Developed Area #1 24.30 Ac.
Future Lake/Detention BASIN #1
Proposed Lake/Detention BASIN #3
Post-Developed Area #2 17.50 Ac.
Post-Developed Area #3 63.30 Ac.
Post-Developed Area #4 22.25 Ac.
Future Lake/Detention BASIN
Post-Developed Area #5 67.30 Ac.
Analysis Point #3
Future Lake Limits
Proposed Lake/Detention BASIN #5
Analysis Point #4
Existing VOA Lake
Offsite Miami University 10.40 Ac.



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VOICE OF AMERICA PARK ATHLETIC COMPLEX PHASE 1

SECTION 12, TOWN 3, RANGE 2,
WEST CHESTER TOWNSHIP,
BUTLER COUNTY, OHIO

DRAINAGE MAP - SOILS MAP

Item	Revision Description	Date	Chkd	Dr'n

Runoff curve number and runoff (TR-55)

Project: VOA Park
Analysis Point #1

By: GJK
Checked:

Date: 2/4/2012
Date:
Job #: 07M056.006

On-site Pre-Developed

	Drainage Area:	32.57 Ac
	Curve Number:	67.2
	Year storm:	1
	Intensity:	2.33
S=(1000/CN)-10	S=	4.88
$Q=(P-0.2S)^2/(P+0.8S)$	Q=	0.29 in
V=(Q/12*43560*A)	V=	34,755 ft^3
		0.80 Ac-ft

On-site Post-Developed (Area 1)

	Drainage Area:	24.30 Ac
	Curve Number:	77.8
	Year storm:	1
	Intensity:	2.33
S=(1000/CN)-10	S=	2.85
$Q=(P-0.2S)^2/(P+0.8S)$	Q=	0.67 in
V=(Q/12*43560*A)	V=	59,188 ft^3
		1.36 Ac-ft

	CN	Yr Storm	S	Q (in)	V (ft^3)
Onsite Pre-developed	67.2	1	4.9	0.3	34755
Onsite Post-developed	77.8	1	2.9	0.7	59188

$((V_{post}/V_{pre})-1)*100\%$ = Runoff_Increase 70 %

Between %'s		Storm Frequency
-	10	1
10.0	20	2
20.0	50	5
50.0	100	10
100.0	250	25
250.0	500	50
500.0	-	100

Critical Storm:	***10 yr***

Project: Voice of America Park

Drainage Area Description:

Critical Storm Calculation - Areas 2 and 3 combined, Onsite tributary to analyis point #2

Job #: 07M056.006
Initials: GJK
Date: 4/4/2012

Drainage Area: 81.10 Acres

Soil Types:
45 % Type B
55 % Type C

Land Use:

Open Space	57 %	
Lake	6 %	
Impervious	15 %	
Synthetic Turf Fields	22 %	(9 Fields Total)

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Open Space	B	61	45	57	15.71
Lake	B	100	45	6	2.71
Impervious	B	98	45	15	6.64
Synthetic Turf Fields	B	90	45	22	8.92
Open Space	C	74	55	57	23.12
Lake	C	100	55	6	3.29
Impervious	C	98	55	15	8.06
Synthetic Turf Fields	C	90	55	22	10.81

Composite CN = **79.3**

Runoff curve number and runoff (TR-55)

Project: VOA Park
Analysis Point #2

By: GJK
Checked:

Date: 2/4/2012
Date:
Job #: 07M056.006

On-site Pre-Developed

	Drainage Area:	83.6 Ac
	Curve Number:	60.4
	Year storm:	1
	Intensity:	2.33
S=(1000/CN)-10	S=	6.56
$Q=(P-0.2S)^2/(P+0.8S)$	Q=	0.14 in
V=(Q/12*43560*A)	V=	41,587 ft^3
		0.95 Ac-ft

On-site Post-Developed (Areas 2 + 6)

	Drainage Area:	81.1 Ac
	Curve Number:	79.3
	Year storm:	1
	Intensity:	2.33
S=(1000/CN)-10	S=	2.62
$Q=(P-0.2S)^2/(P+0.8S)$	Q=	0.74 in
V=(Q/12*43560*A)	V=	217,269 ft^3
		4.99 Ac-ft

	CN	Yr Storm	S	Q (in)	V (ft^3)
Onsite Pre-developed	60.4	1	6.6	0.1	41587
Onsite Post-developed	79.3	1	2.6	0.7	217269

$((V_{post}/V_{pre})-1)*100\%$ = Runoff_Increase 422 %

Between %'s		Storm Frequency
-	10	1
10.0	20	2
20.0	50	5
50.0	100	10
100.0	250	25
250.0	500	50
500.0	-	100

Critical Storm:	***50 yr***

Runoff curve number and runoff (TR-55)

Project: VOA Park
Analysis Point #3

By: GJK
Checked:

Date: 2/4/2012
Date:
Job #: 07M056.006

On-site Pre-Developed

	Drainage Area:	32.2 Ac
	Curve Number:	61.3
	Year storm:	1
	Intensity:	2.33
S=(1000/CN)-10	S=	6.31
$Q=(P-0.2S)^2/(P+0.8S)$	Q=	0.15 in
V=(Q/12*43560*A)	V=	18,054 ft^3
		0.41 Ac-ft

On-site Post-Developed (Area 3)

	Drainage Area:	22.0 Ac
	Curve Number:	78.3
	Year storm:	1
	Intensity:	2.33
S=(1000/CN)-10	S=	2.77
$Q=(P-0.2S)^2/(P+0.8S)$	Q=	0.69 in
V=(Q/12*43560*A)	V=	55,379 ft^3
		1.27 Ac-ft

	CN	Yr Storm	S	Q (in)	V (ft^3)
Onsite Pre-developed	61.3	1	6.3	0.2	18054
Onsite Post-developed	78.3	1	2.8	0.7	55379

$((V_{post}/V_{pre})-1)*100\%$ = Runoff_Increase 207 %

Between %'s		Storm Frequency
-	10	1
10.0	20	2
20.0	50	5
50.0	100	10
100.0	250	25
250.0	500	50
500.0	-	100

Critical Storm:	***25 yr***

Runoff curve number and runoff (TR-55)

Project: VOA Park
Analysis Point #4

By: GJK
Checked:

Date: 2/4/2012
Date:
Job #: 07M056.006

On-site Pre-Developed

	Drainage Area:	39.8 Ac
	Curve Number:	61.4
	Year storm:	1
	Intensity:	2.33
S=(1000/CN)-10	S=	6.29
$Q=(P-0.2S)^2/(P+0.8S)$	Q=	0.16 in
V=(Q/12*43560*A)	V=	22,594 ft^3
		0.52 Ac-ft

On-site Post-Developed (Area 4)

	Drainage Area:	67.3 Ac
	Curve Number:	74.8
	Year storm:	1
	Intensity:	2.33
S=(1000/CN)-10	S=	3.37
$Q=(P-0.2S)^2/(P+0.8S)$	Q=	0.55 in
V=(Q/12*43560*A)	V=	133,351 ft^3
		3.06 Ac-ft

	CN	Yr Storm	S	Q (in)	V (ft^3)
Onsite Pre-developed	61.4	1	6.3	0.2	22594
Onsite Post-developed	74.8	1	3.4	0.5	133351

$((V_{post}/V_{pre})-1)*100\%$ = Runoff_Increase 490 %

Between %'s		Storm Frequency
-	10	1
10.0	20	2
20.0	50	5
50.0	100	10
100.0	250	25
250.0	500	50
500.0	-	100

Critical Storm: ***50 yr***

Project: Voice of America Park

Drainage Area Description:

Pre-Developed Area #1, Onsite tributary to analyis point #1

Job #: 07M056.006
Initials: GJK
Date: 4/4/2012

Drainage Area: 32.57 Acres

Soil Types:
20 % Type B
80 % Type C

Land Use:

Meadow	75 %
Brush (Good)	23 %
Gravel	2 %

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Meadow	B	58	20	75	8.70
Brush (Good)	B	48	20	23	2.21
Gravel	B	85	20	2	0.34
Meadow	C	71	80	75	42.60
Brush (Good)	C	65	80	23	11.96
Gravel	C	89	80	2	1.42

Composite CN = **67.2**

Time of Concentration:

			Tc
Sheet Flow:			
Length = 100	Slope(ft/ft) = 0.0200	Manning's, n = 0.17	0.19 hr
Shallow Concentrated Flow:			
Length = 600	Slope(ft/ft) = 0.0120	Velocity (fps) = 1.8	0.09 hr
Channel Flow:			
Length = 1225		Velocity (fps) = 2.5	0.14 hr
		Tc =	**0.42 hr**
			25.2 min

Project: Voice of America Park

Drainage Area Description:

Pre-Developed Area #2, Onsite tributary to analyis point #2

Job #: 07M056.006
Initials: GJK
Date: 4/4/2012

Drainage Area: 83.62 Acres

Soil Types:
50 % Type B
50 % Type C

Land Use:

Meadow	45 %
Brush (Good)	54 %
Gravel	1 %

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Meadow	B	58	50	45	13.05
Brush (Good)	B	48	50	54	12.96
Gravel	B	85	50	1	0.43
Meadow	C	71	50	45	15.98
Brush (Good)	C	65	50	54	17.55
Gravel	C	89	50	1	0.45

Composite CN = 60.4

Time of Concentration:

			Tc
Sheet Flow:			
Length = 100	Slope(ft/ft) = 0.0200	Manning's, n = 0.17	0.19 hr
Shallow Concentrated Flow:			
Length = 820	Slope(ft/ft) = 0.0120	Velocity (fps) = 1.8	0.13 hr
Channel Flow:			
Length = 2710		Velocity (fps) = 2.5	0.30 hr
		Tc =	**0.62 hr**
			37.1 min

Project: Voice of America Park

Drainage Area Description:

Pre-Developed Area #3, Onsite tributary to analyis point #3

Job #: 07M056.006
Initials: GJK
Date: 4/4/2012

Drainage Area: 32.22 Acres

Soil Types:
35 % Type B
65 % Type C

Land Use:

Meadow	23 %
Brush (Good)	75 %
Gravel	2 %

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Meadow	B	58	35	23	4.67
Brush (Good)	B	48	35	75	12.60
Gravel	B	85	35	2	0.60
Meadow	C	71	65	23	10.61
Brush (Good)	C	65	65	75	31.69
Gravel	C	89	65	2	1.16

Composite CN = 61.3

Time of Concentration:

			Tc
Sheet Flow:			
Length = 100	Slope(ft/ft) = 0.0150	Manning's, n = 0.17	0.21 hr
Shallow Concentrated Flow:			
Length = 570	Slope(ft/ft) = 0.0120	Velocity (fps) = 1.8	0.09 hr
Channel Flow:			
Length = 1980		Velocity (fps) = 2.5	0.22 hr
		Tc =	**0.52 hr**
			31.3 min

Project: Voice of America Park

Drainage Area Description:

Pre-Developed Area #4, Onsite tributary to analyis point #4

Job #: 07M056.006
Initials: GJK
Date: 4/4/2012

Drainage Area: 39.81 Acres

Soil Types:
45 % Type B
55 % Type C

Land Use:

Meadow	44 %
Brush (Good)	54 %
Gravel	2 %

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Meadow	B	58	45	44	11.48
Brush (Good)	B	48	45	54	11.66
Gravel	B	85	45	2	0.77
Meadow	C	71	55	44	17.18
Brush (Good)	C	65	55	54	19.31
Gravel	C	89	55	2	0.98

Composite CN = 61.4

Time of Concentration:

			Tc
Sheet Flow:			
Length = 100	Slope(ft/ft) = 0.0150	Manning's, n = 0.17	0.21 hr
Shallow Concentrated Flow:			
Length = 950	Slope(ft/ft) = 0.0120	Velocity (fps) = 1.8	0.15 hr
Channel Flow:			
Length = 720		Velocity (fps) = 2.5	0.08 hr
		Tc =	**0.44 hr**
			26.4 min

Project: Voice of America Park

Drainage Area Description:

Offsite Miami University VOA

Job #: 07M056.006
Initials: GJK
Date: 4/4/2012

Drainage Area: 10.4 Acres

Soil Types: 15 % Type B
85 % Type C

Land Use: Open Space 30 %
Impervious 70 %

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Open Space	B	61	15	30	2.75
Impervious	B	98	15	70	10.29
Open Space	C	74	85	30	18.87
Impervious	C	98	85	70	58.31

Composite CN = 90.2

Time of Concentration:

Tc = 0.17 hr
10.0 min

Notes:

Drainage area and time of concentration are from calculations by Abercrombie and Associates, Inc. dated May 16, 2007 and received by fax on February 5, 2009.