

bayer becker

STORM WATER MANAGEMENT

VOICE OF AMERICA PARK PHASE 1

PREPARED: 4-16-12

REVISED: 5-14-12

needs to be updated to show/account for the proposed conditions



STORM WATER MANAGEMENT
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 CHESTER TOWNSHIP,
BUTLER COUNTY, OHIO

DRAINAGE MAP - PRE-DEVELOPED

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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 - POST-DEVELOPED
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GLOVER AVE.
BUTLER WARREN ROAD
TYLER COURT
TYLERSVILLE ROAD
TYLERS WAY
PEPPER PIKE
Analysis Point #1
Analysis Point #2
Analysis Point #3
Analysis Point #4
Post-Developed Area #1 24.30 Ac.
Post-Developed Area #2 17.60 Ac.
Post-Developed Area #3 63.35 Ac.
Post-Developed Area #4 22.25 Ac.
Post-Developed Area #5 67.30 Ac.
Future Lake/Detention BASIN #1
Proposed Lake/Detention BASIN #2
Future Lake/Detention BASIN #3
Proposed Lake/Detention BASIN #5
Future Lake Limits
Existing VOA Lake
Offsite Miami University 10.40 Ac.

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VOICE OF AMERICA PARK
ATHLETIC COMPLEX PHASE 1
SECTION 18, TOWN 3, RANGE 2,
WEST CHESTER TOWNSHIP,
BUTLER COUNTY, OHIO
DRAINAGE MAP - SOILS MAP
BUTLER WARREN ROAD
CLOVER AVE.
TYLER COURT
TYLERSVILLE ROAD
TYLERS WAY
PEPPER PIKE
XeB
XeB2
FcB
FcA
Ra
MsC2

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:

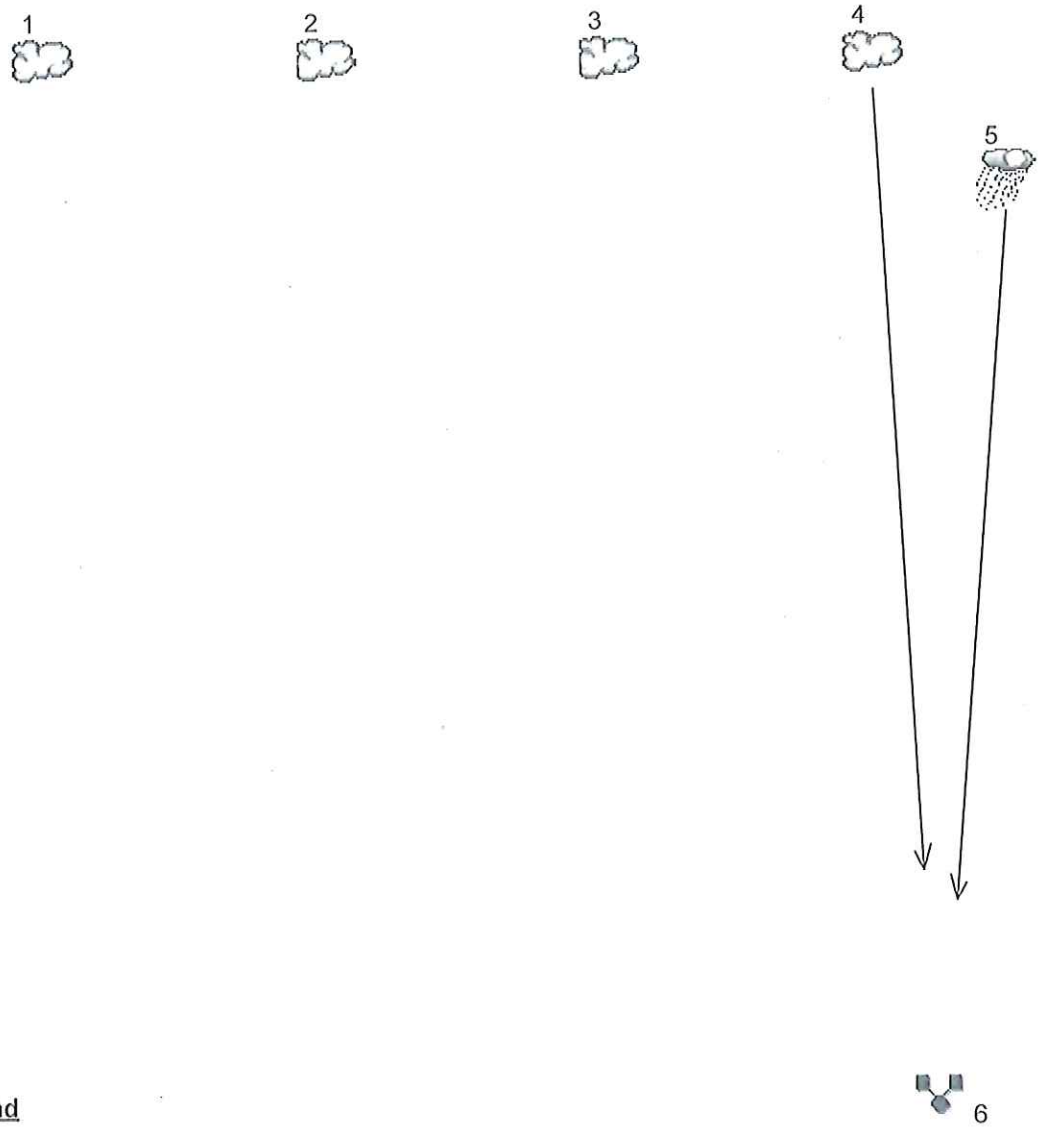
Tc = **0.17 hr**
10.0 min

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.

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8



Legend

Hyd.	Origin	Description
1	SCS Runoff	Pre-Developed Area #1 - Analysis Point #1
2	SCS Runoff	Pre-Developed Area #2 - Analysis Point #2
3	SCS Runoff	Pre-Developed Area #3 - Analysis Point #3
4	SCS Runoff	Pre-Developed Area #4 - Analysis Point #4
5	Manual	Offsite Miami University 50yr
6	Combine	Analysis Point #4 Allowable

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	SCS Runoff	------	5.576	-------	-------	-------	33.39	48.59	62.80	80.12	Pre-Developed Area #1 - Analysis Poi
2	SCS Runoff	------	2.622	-------	-------	-------	37.24	61.30	85.37	115.56	Pre-Developed Area #2 - Analysis Poi
3	SCS Runoff	------	1.366	-------	-------	-------	17.86	28.93	39.73	53.21	Pre-Developed Area #3 - Analysis Poi
4	SCS Runoff	------	1.868	-------	-------	-------	26.01	41.88	57.14	76.13	Pre-Developed Area #4 - Analysis Poi
5	Manual	------	22.70	-------	-------	-------	0.000	0.000	0.000	0.000	Offsite Miami University 50yr
6	Combine	4, 5	24.38	-------	-------	-------	26.01	41.88	57.14	76.13	Analysis Point #4 Allowable

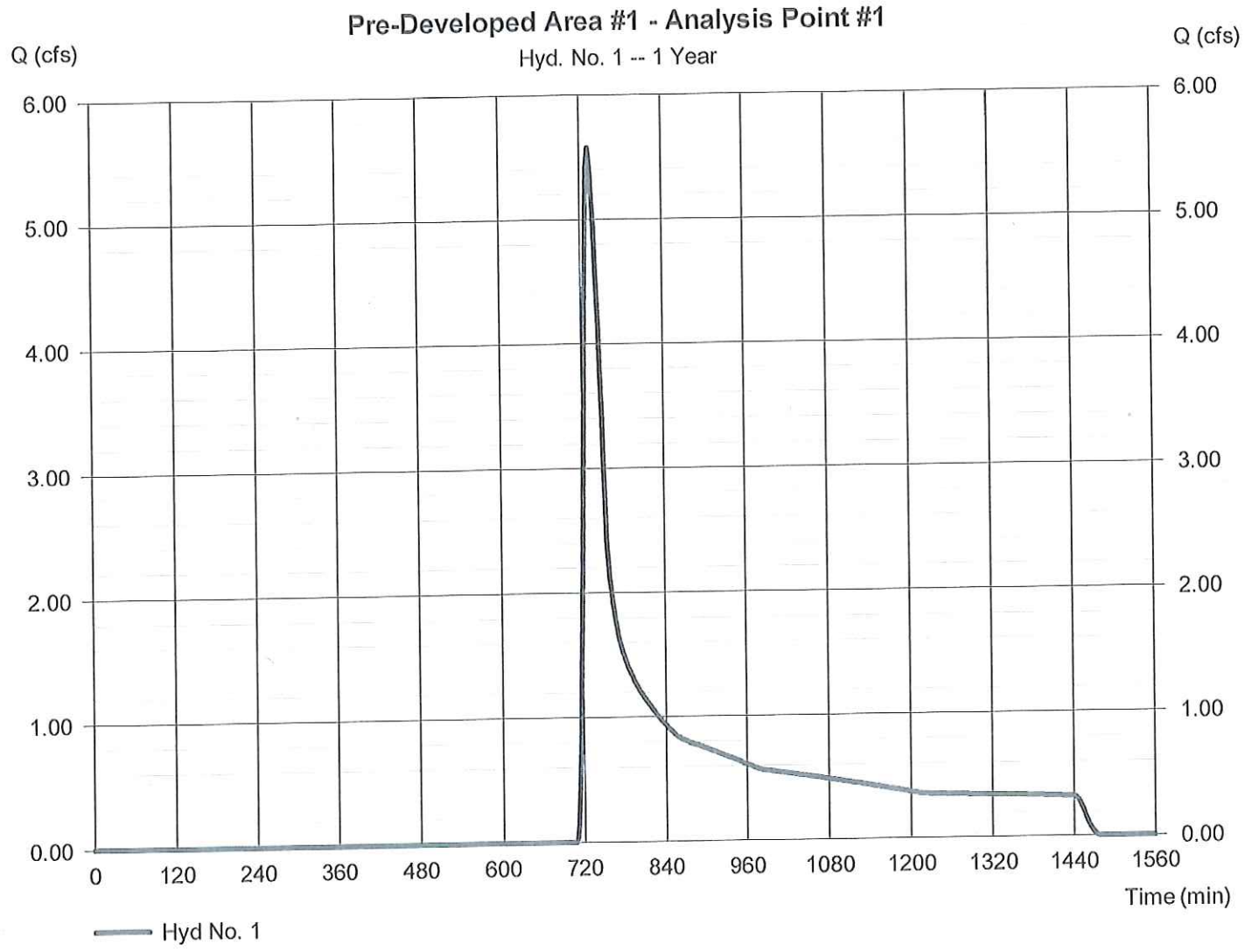
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Monday, Apr 16, 2012

Hyd. No. 1

Pre-Developed Area #1 - Analysis Point #1

Hydrograph type	= SCS Runoff	Peak discharge	= 5.576 cfs
Storm frequency	= 1 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 34,194 cuft
Drainage area	= 32.570 ac	Curve number	= 67.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 25.20 min
Total precip.	= 2.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



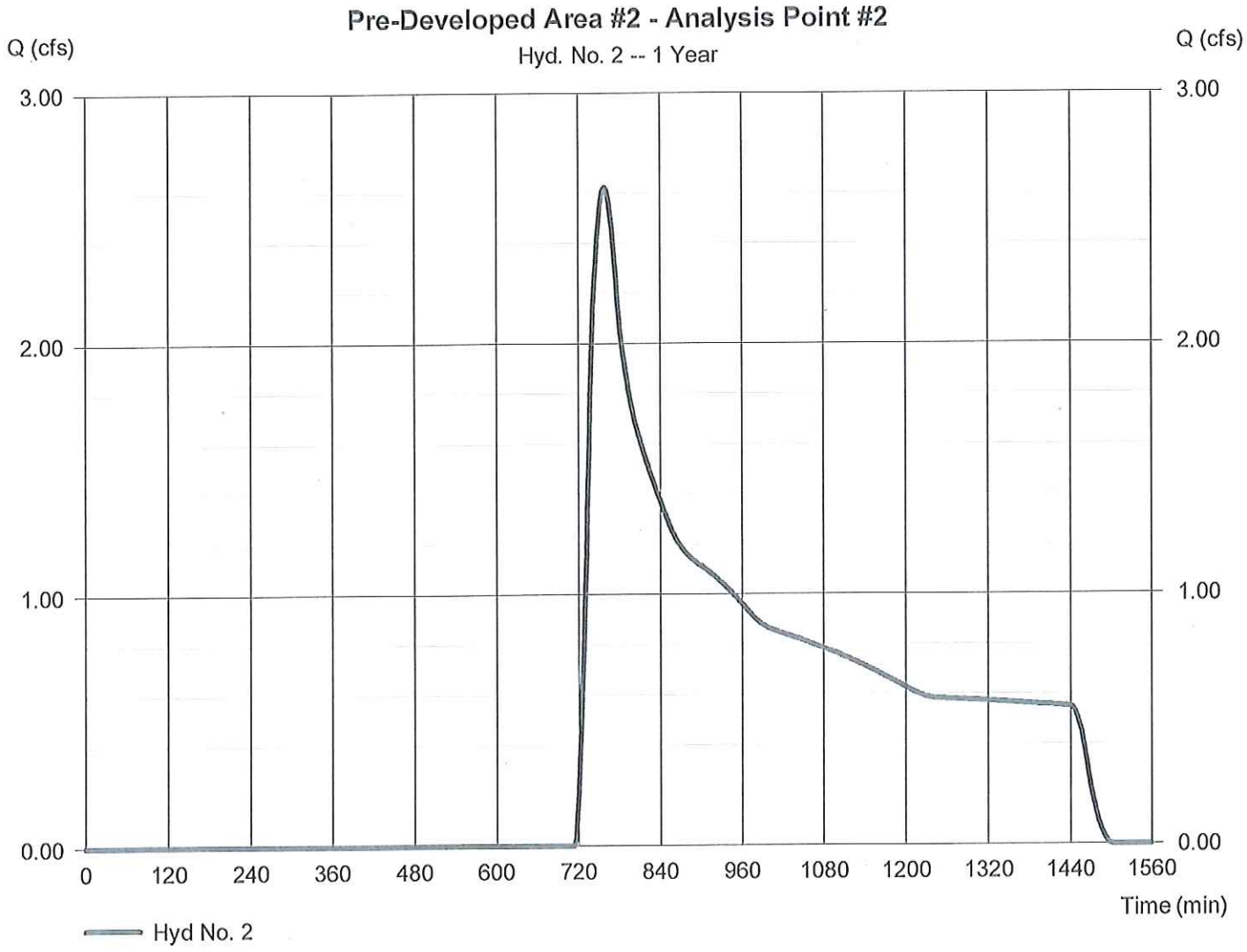
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Monday, Apr 16, 2012

Hyd. No. 2

Pre-Developed Area #2 - Analysis Point #2

Hydrograph type	= SCS Runoff	Peak discharge	= 2.622 cfs
Storm frequency	= 1 yrs	Time to peak	= 760 min
Time interval	= 2 min	Hyd. volume	= 41,581 cuft
Drainage area	= 83.620 ac	Curve number	= 60.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 37.10 min
Total precip.	= 2.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



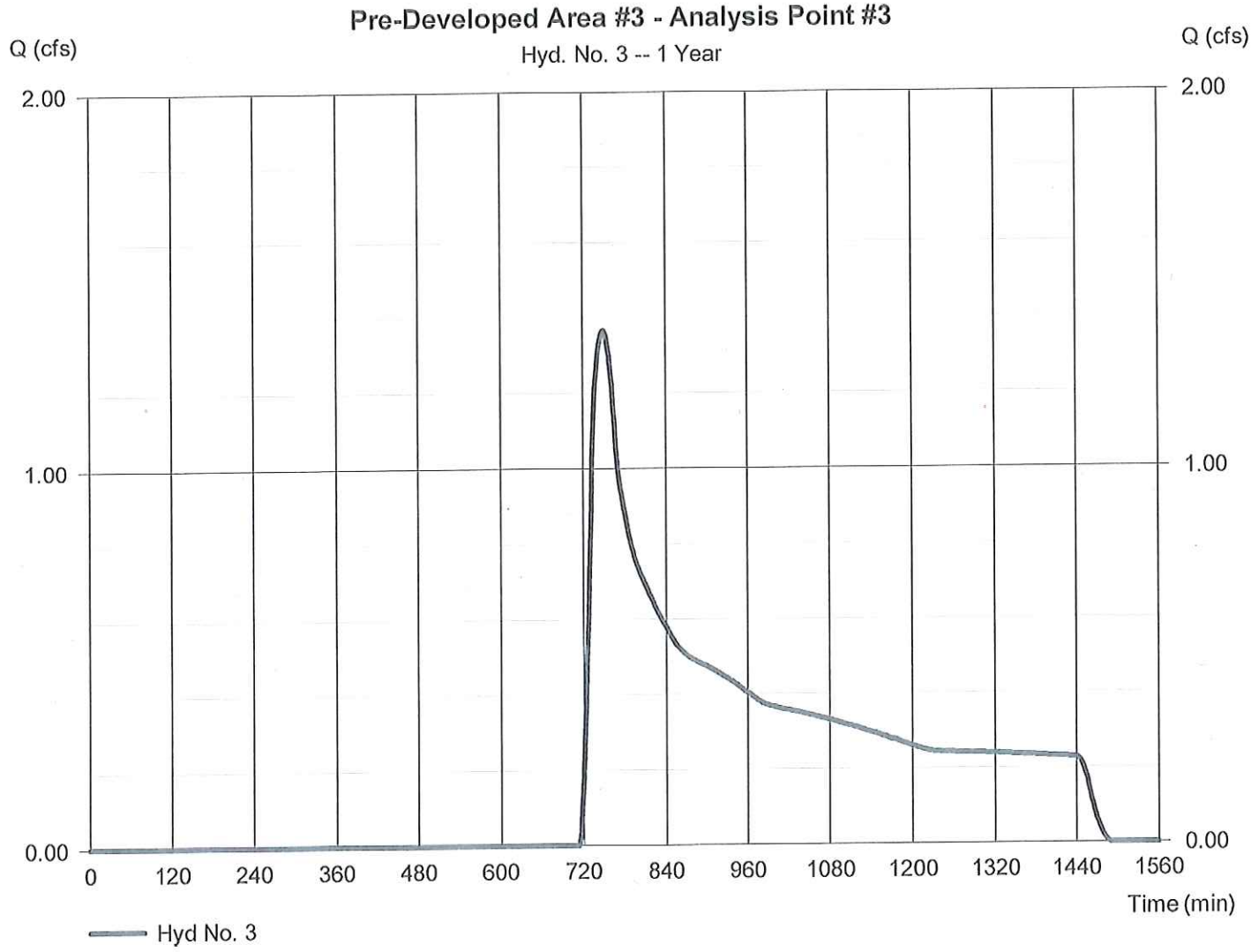
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Monday, Apr 16, 2012

Hyd. No. 3

Pre-Developed Area #3 - Analysis Point #3

Hydrograph type	= SCS Runoff	Peak discharge	= 1.366 cfs
Storm frequency	= 1 yrs	Time to peak	= 750 min
Time interval	= 2 min	Hyd. volume	= 18,211 cuft
Drainage area	= 32.220 ac	Curve number	= 61.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 31.30 min
Total precip.	= 2.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



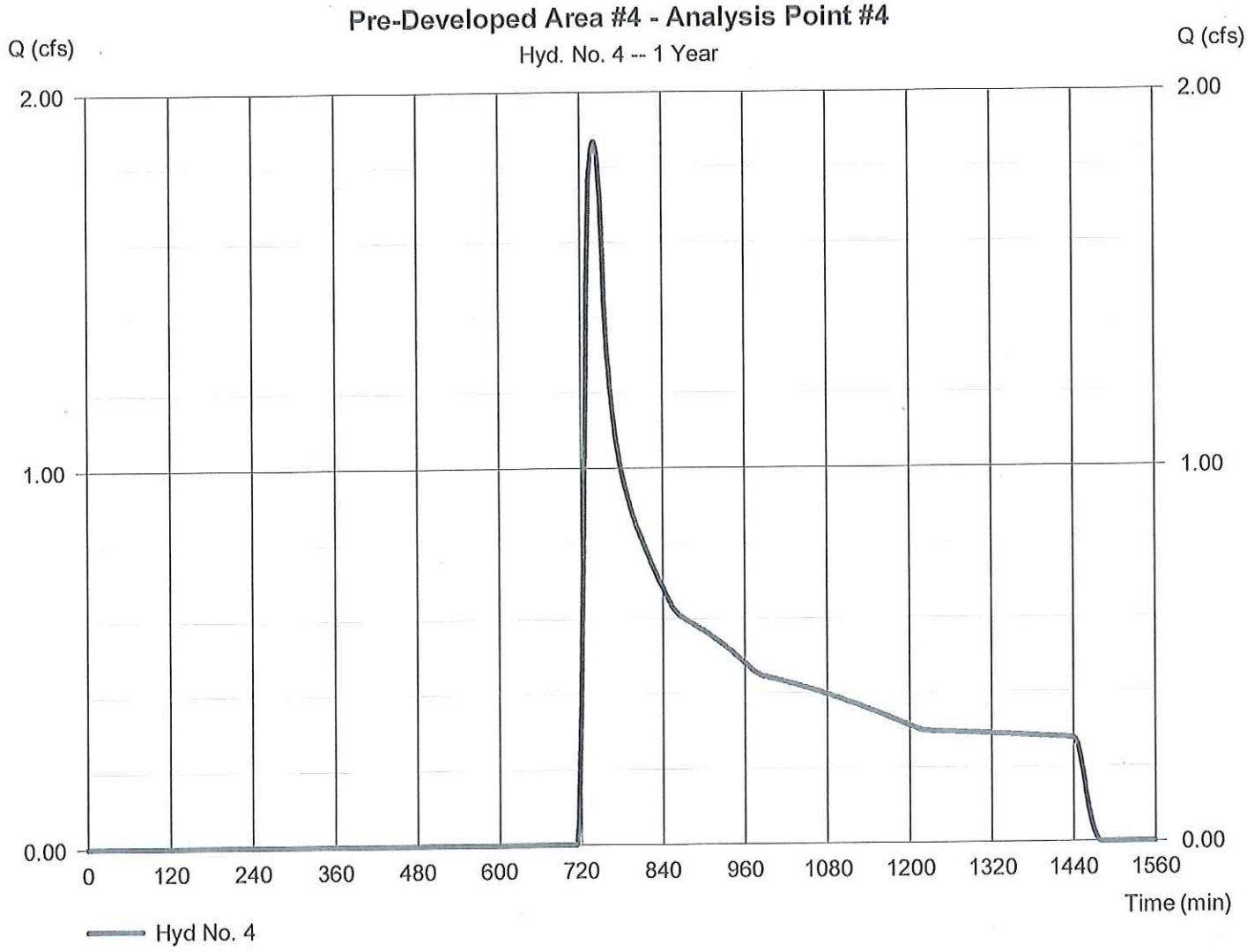
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Monday, Apr 16, 2012

Hyd. No. 4

Pre-Developed Area #4 - Analysis Point #4

Hydrograph type	= SCS Runoff	Peak discharge	= 1.868 cfs
Storm frequency	= 1 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 22,165 cuft
Drainage area	= 39.810 ac	Curve number	= 61.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 26.40 min
Total precip.	= 2.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



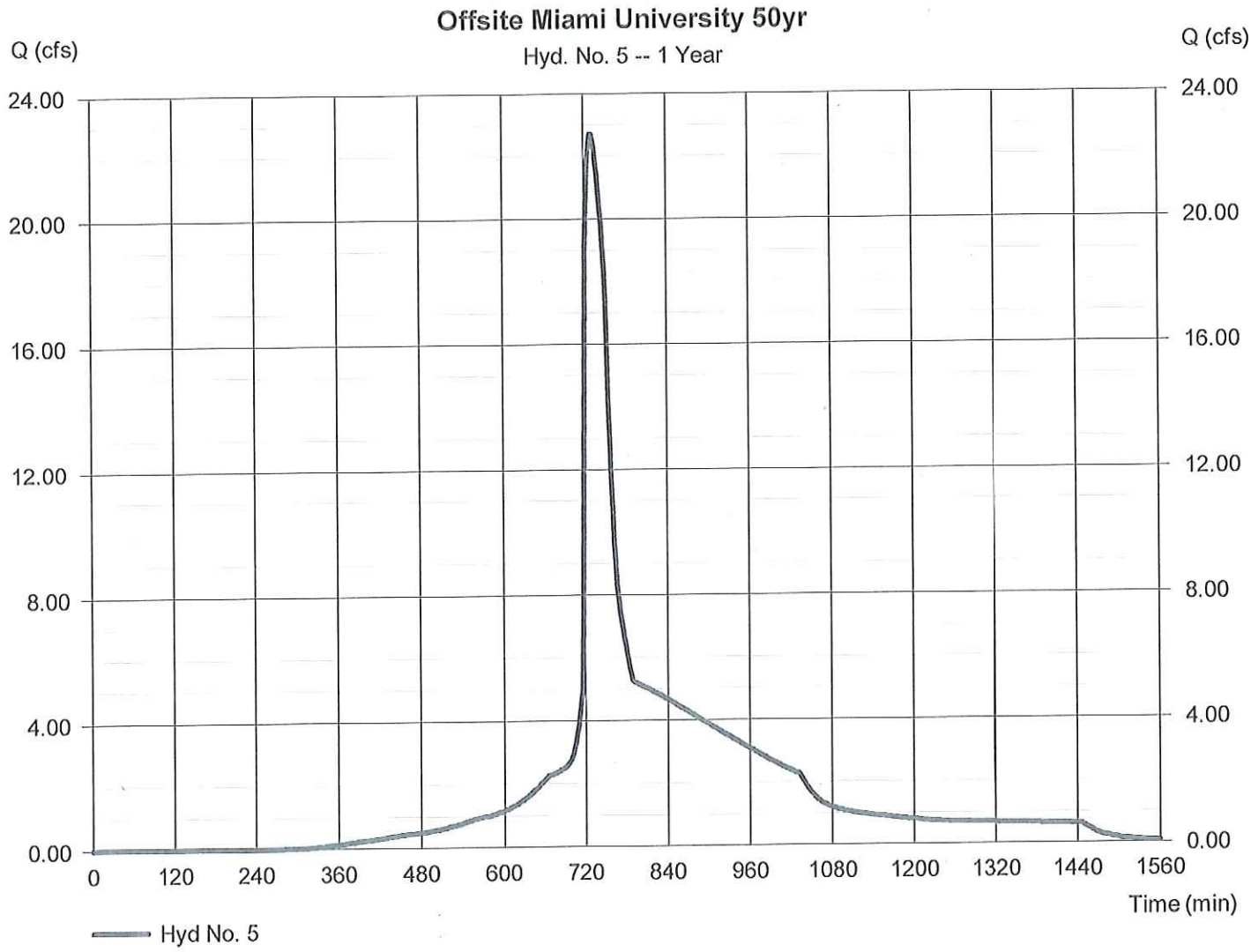
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Monday, Apr 16, 2012

Hyd. No. 5

Offsite Miami University 50yr

Hydrograph type	= Manual	Peak discharge	= 22.70 cfs
Storm frequency	= 1 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 163,737 cuft



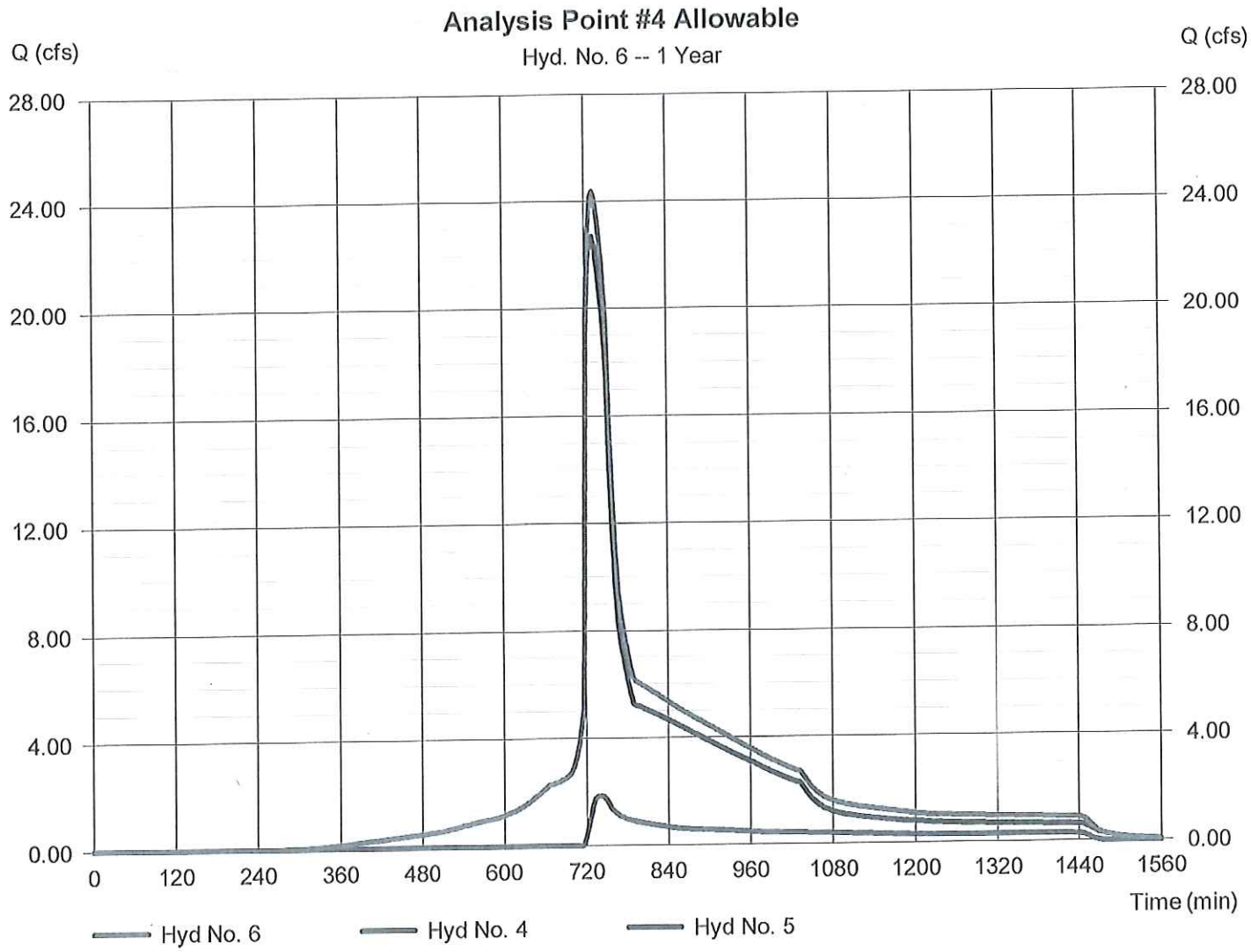
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Monday, Apr 16, 2012

Hyd. No. 6

Analysis Point #4 Allowable

Hydrograph type	= Combine	Peak discharge	= 24.38 cfs
Storm frequency	= 1 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 185,901 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 39.810 ac



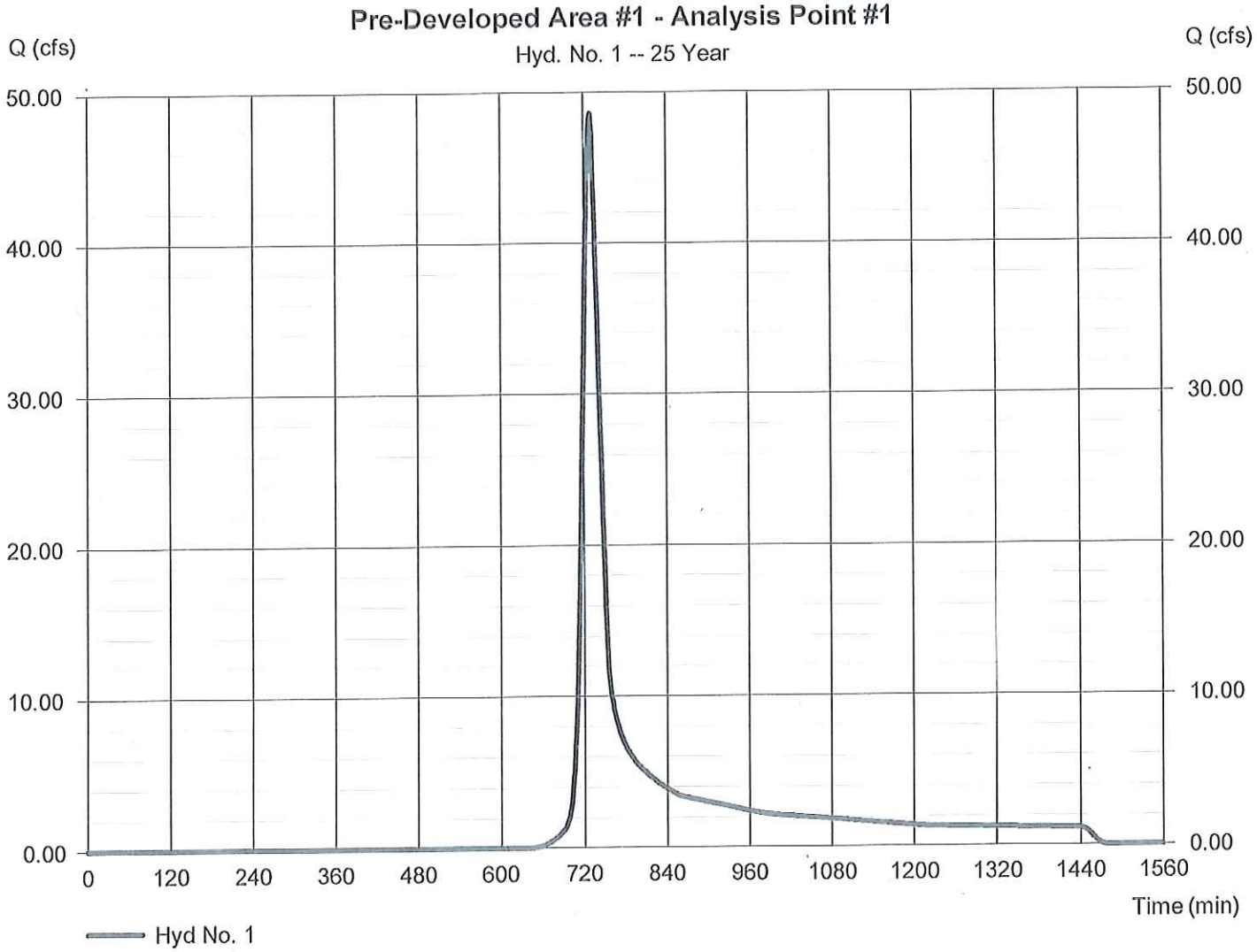
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Monday, Apr 16, 2012

Hyd. No. 1

Pre-Developed Area #1 - Analysis Point #1

Hydrograph type	= SCS Runoff	Peak discharge	= 48.59 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 187,552 cuft
Drainage area	= 32.570 ac	Curve number	= 67.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 25.20 min
Total precip.	= 4.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



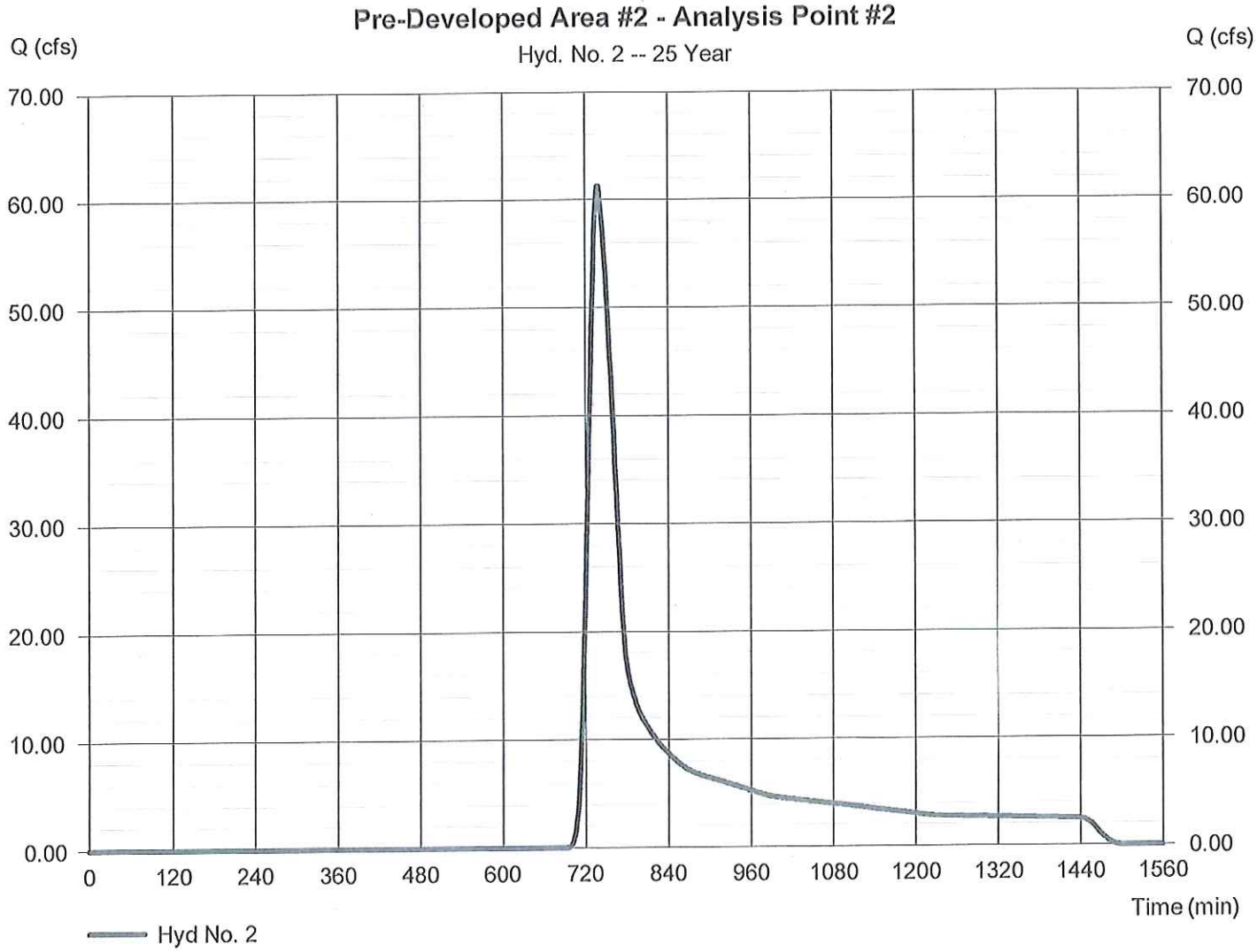
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Monday, Apr 16, 2012

Hyd. No. 2

Pre-Developed Area #2 - Analysis Point #2

Hydrograph type	= SCS Runoff	Peak discharge	= 61.30 cfs
Storm frequency	= 25 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 350,500 cuft
Drainage area	= 83.620 ac	Curve number	= 60.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 37.10 min
Total precip.	= 4.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



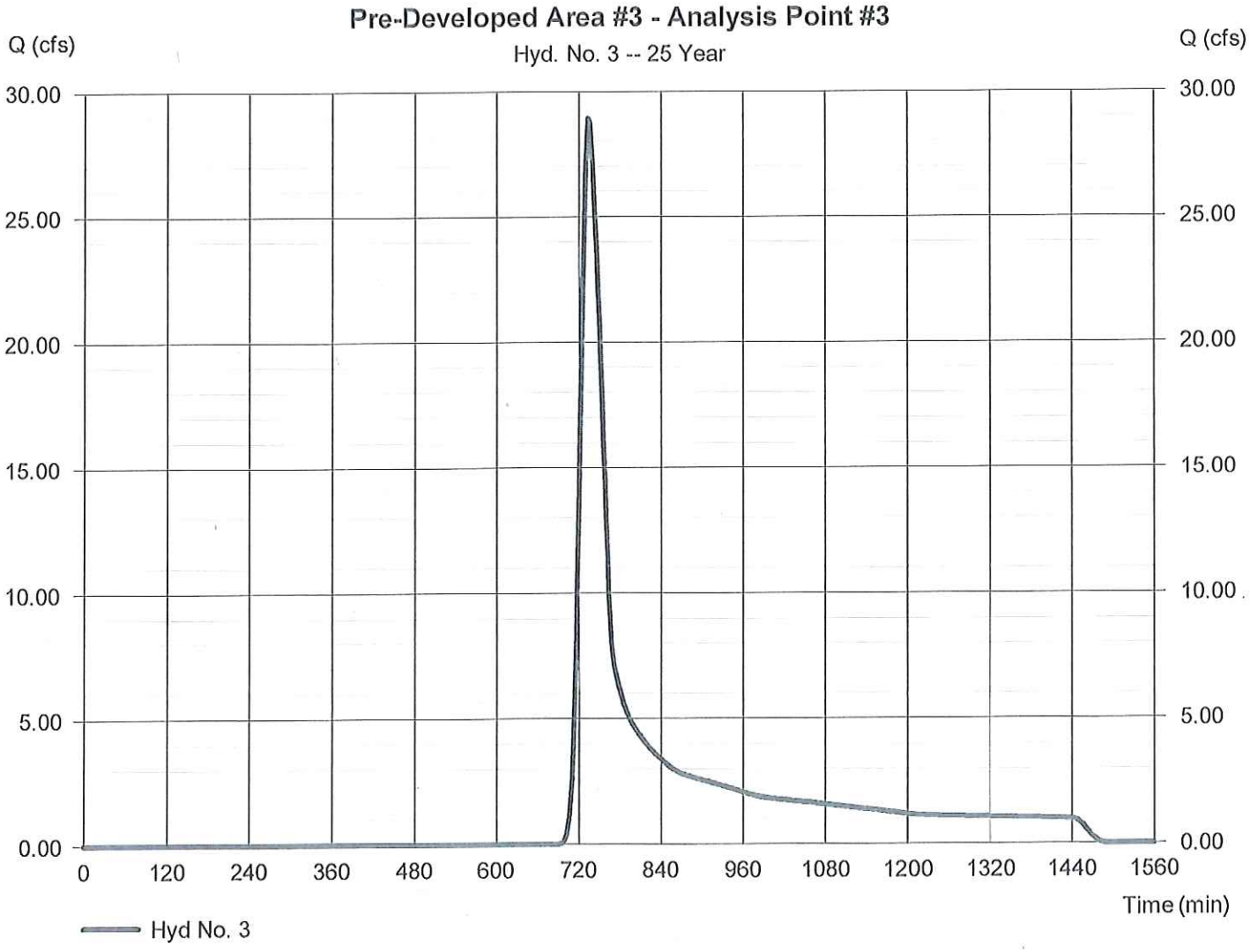
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Monday, Apr 16, 2012

Hyd. No. 3

Pre-Developed Area #3 - Analysis Point #3

Hydrograph type	= SCS Runoff	Peak discharge	= 28.93 cfs
Storm frequency	= 25 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 143,498 cuft
Drainage area	= 32.220 ac	Curve number	= 61.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 31.30 min
Total precip.	= 4.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



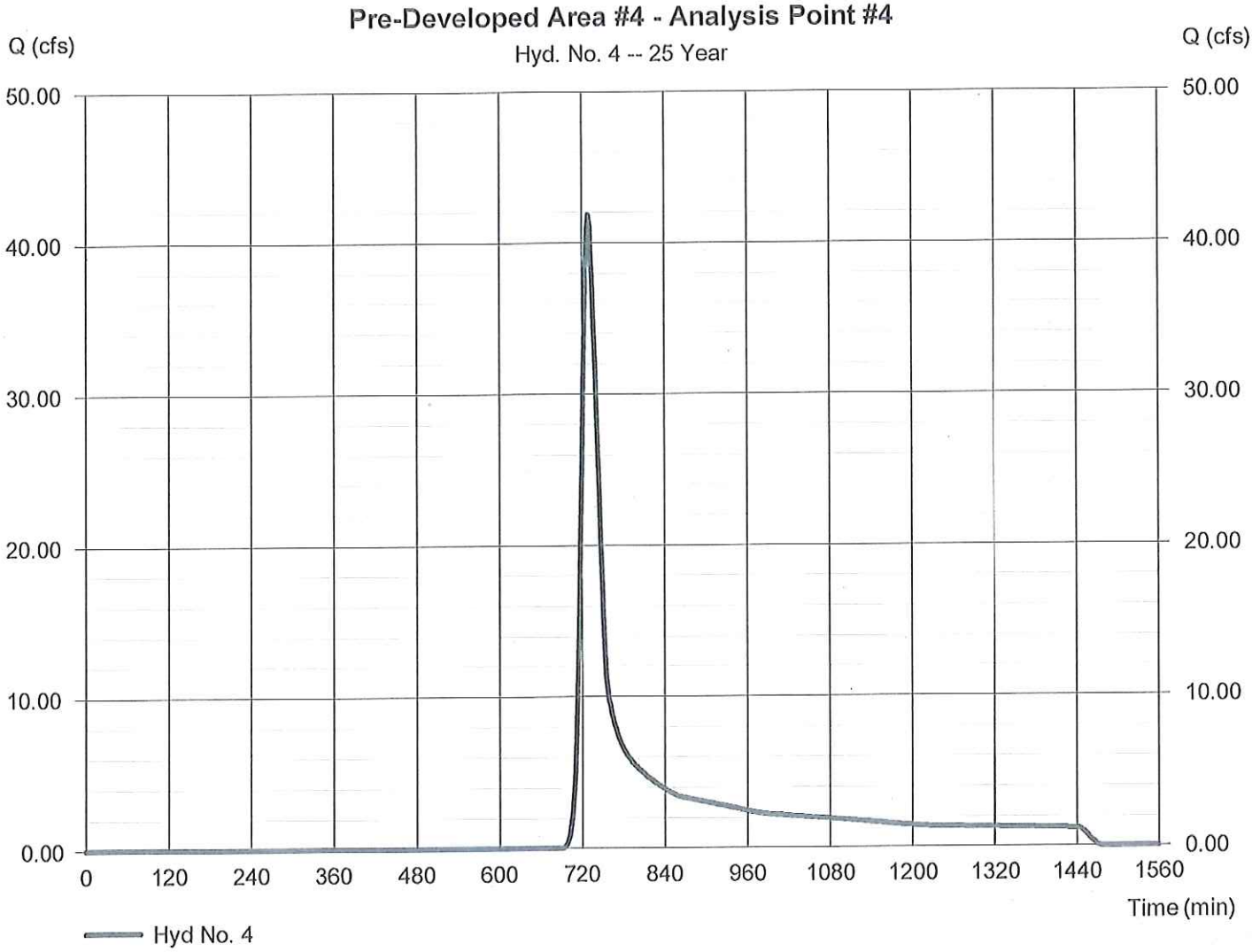
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Monday, Apr 16, 2012

Hyd. No. 4

Pre-Developed Area #4 - Analysis Point #4

Hydrograph type	= SCS Runoff	Peak discharge	= 41.88 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 173,288 cuft
Drainage area	= 39.810 ac	Curve number	= 61.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 26.40 min
Total precip.	= 4.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



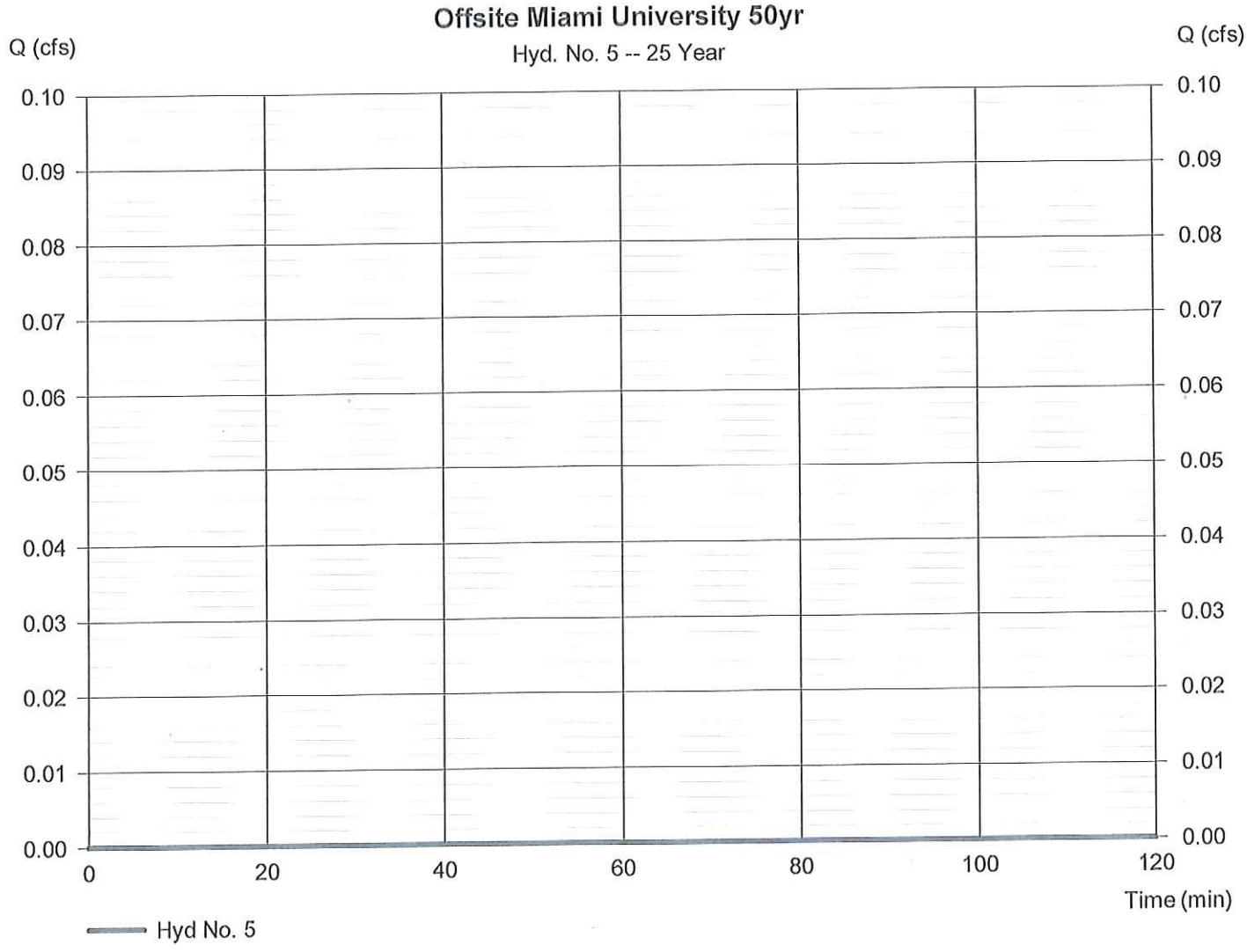
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Monday, Apr 16, 2012

Hyd. No. 5

Offsite Miami University 50yr

Hydrograph type	= Manual	Peak discharge	= 0.000 cfs
Storm frequency	= 25 yrs	Time to peak	= n/a
Time interval	= 2 min	Hyd. volume	= 0 cuft



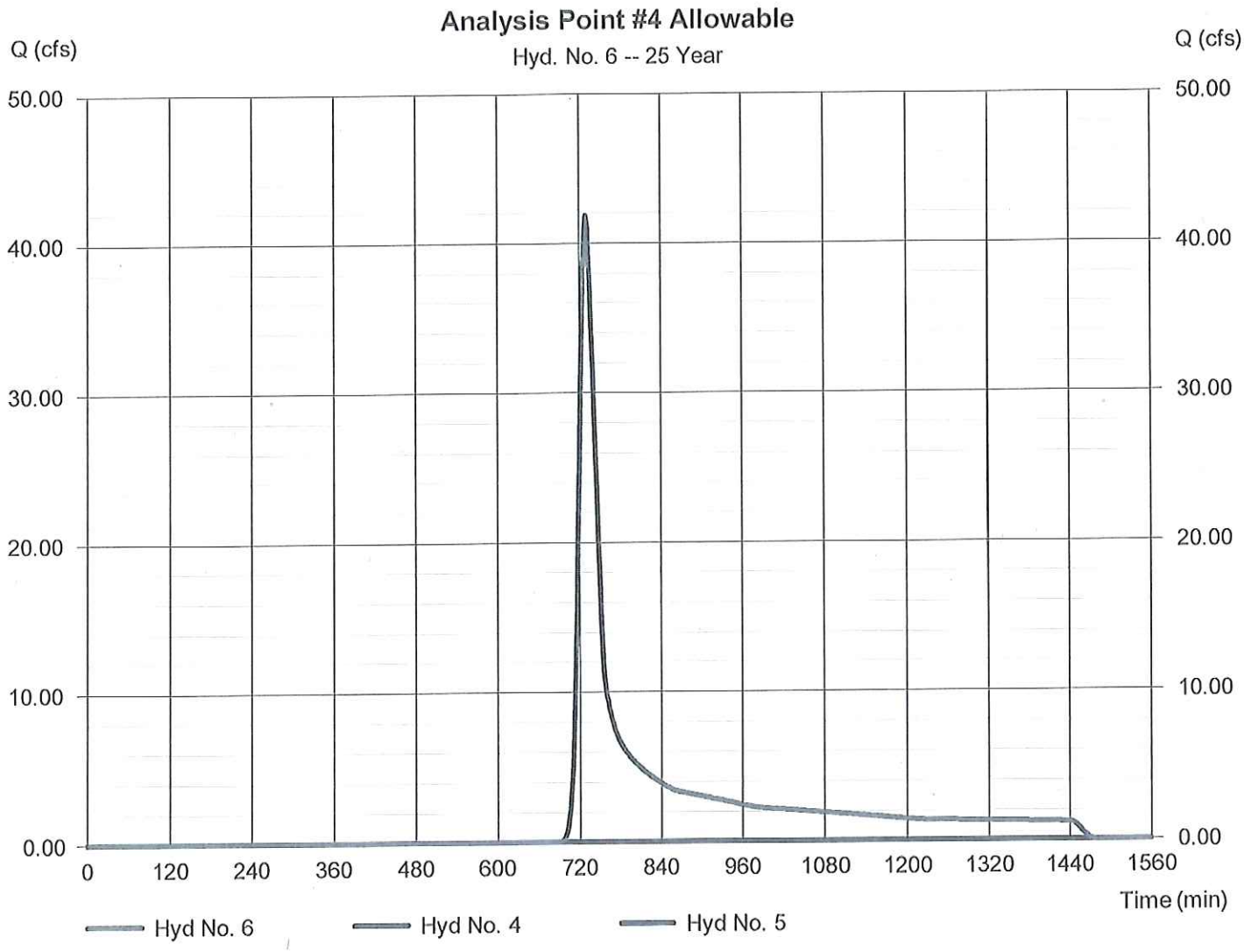
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Monday, Apr 16, 2012

Hyd. No. 6

Analysis Point #4 Allowable

Hydrograph type	= Combine	Peak discharge	= 41.88 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 173,288 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 39.810 ac



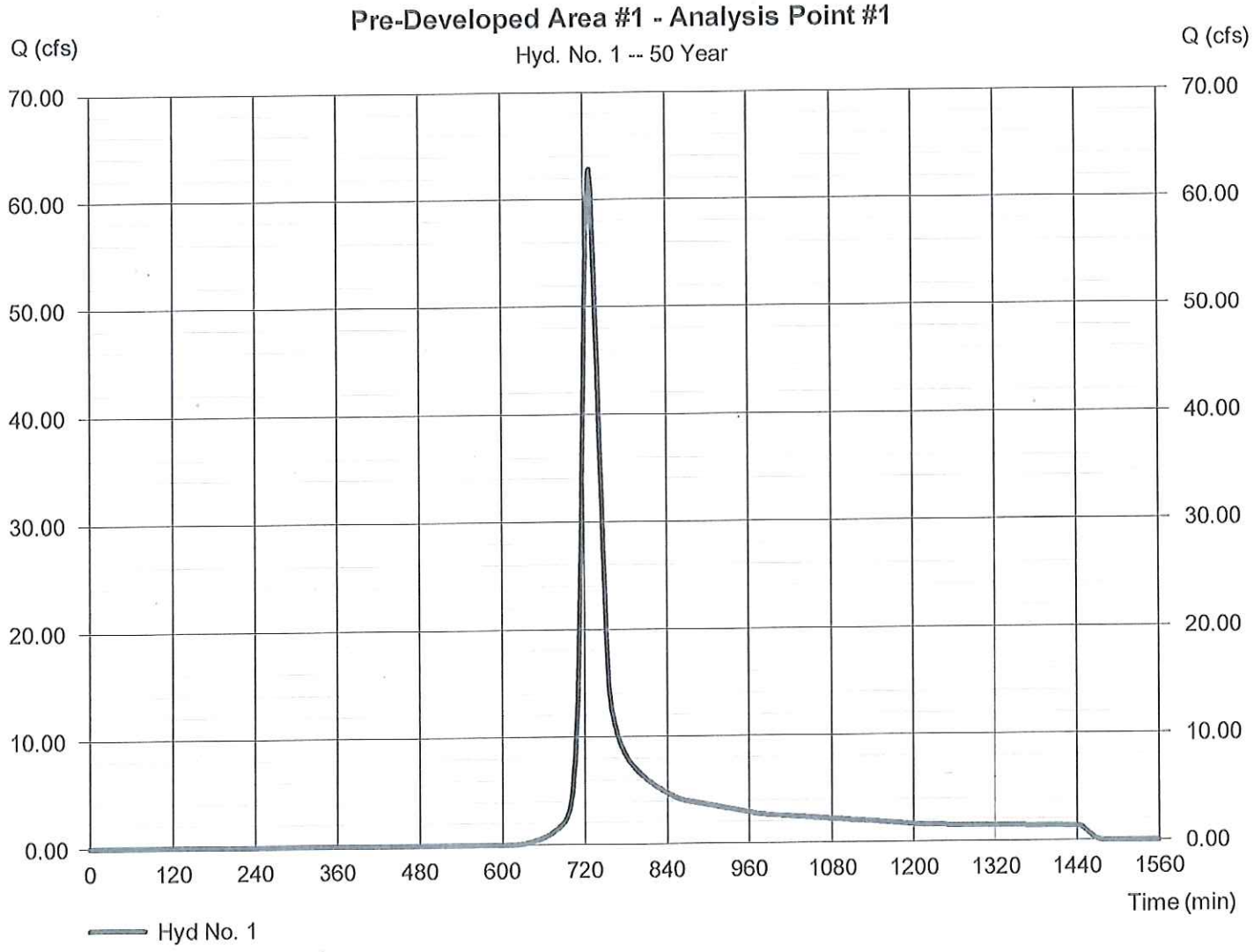
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Monday, Apr 16, 2012

Hyd. No. 1

Pre-Developed Area #1 - Analysis Point #1

Hydrograph type	= SCS Runoff	Peak discharge	= 62.80 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 238,052 cuft
Drainage area	= 32.570 ac	Curve number	= 67.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 25.20 min
Total precip.	= 5.32 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



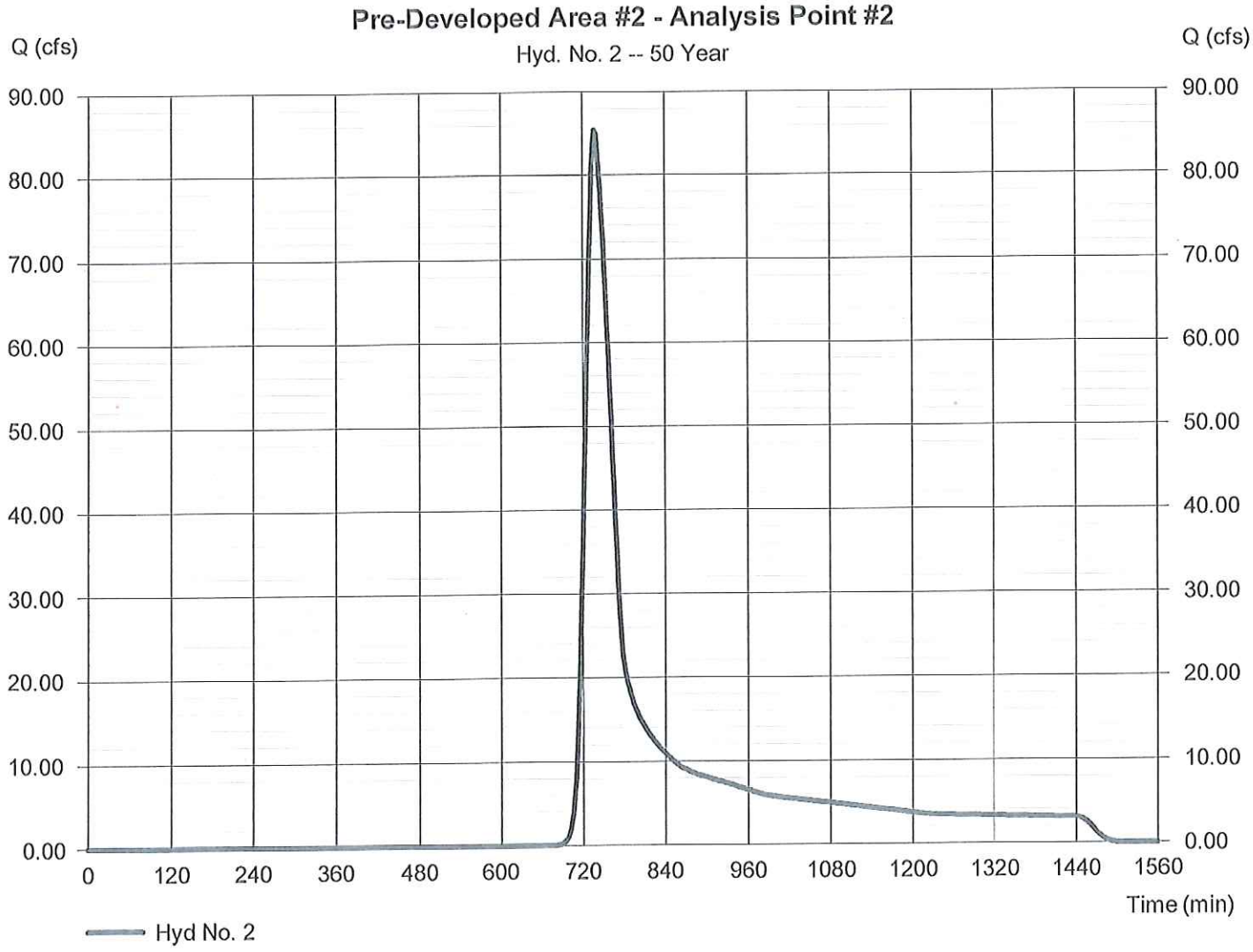
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Monday, Apr 16, 2012

Hyd. No. 2

Pre-Developed Area #2 - Analysis Point #2

Hydrograph type	= SCS Runoff	Peak discharge	= 85.37 cfs
Storm frequency	= 50 yrs	Time to peak	= 738 min
Time interval	= 2 min	Hyd. volume	= 461,701 cuft
Drainage area	= 83.620 ac	Curve number	= 60.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 37.10 min
Total precip.	= 5.32 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



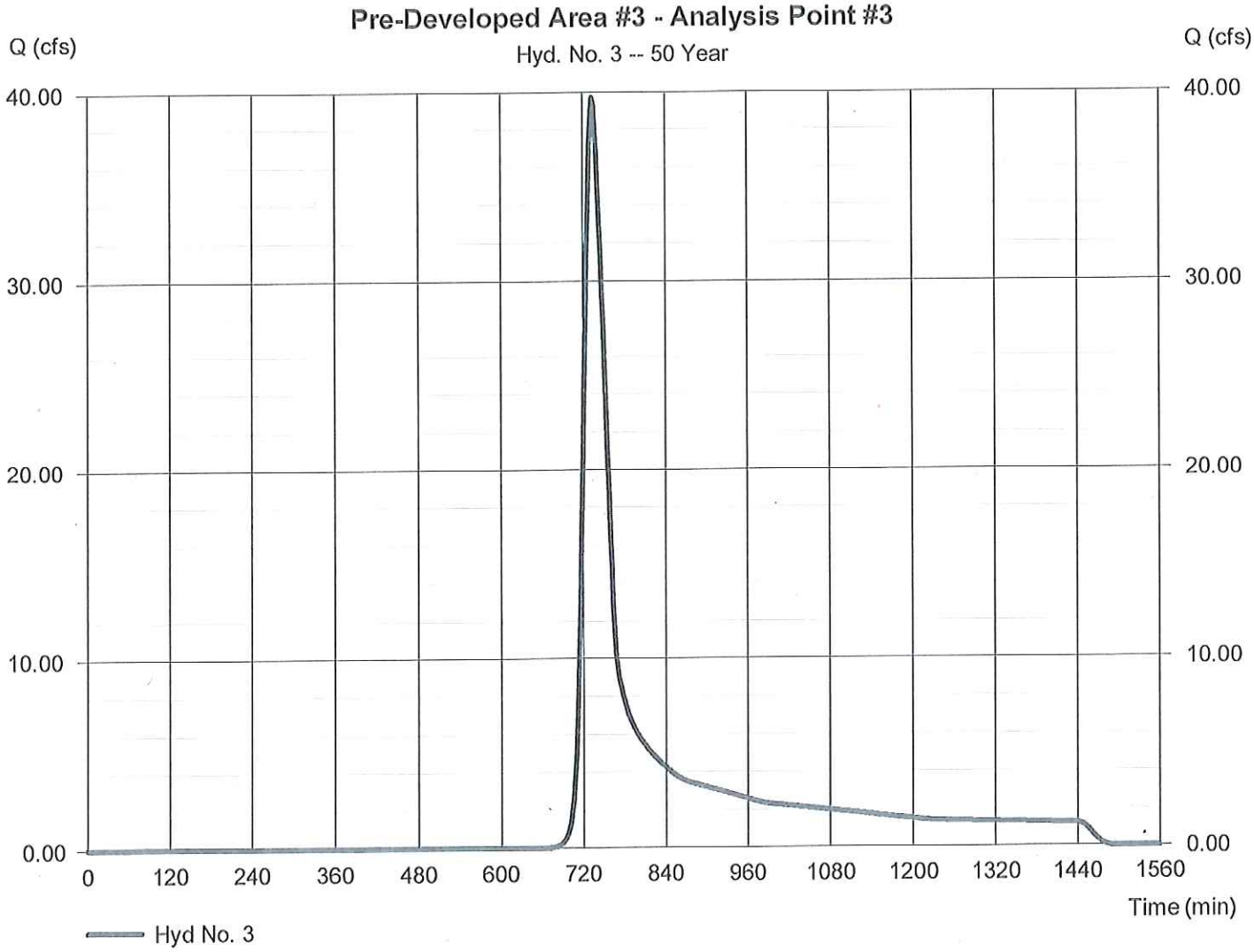
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Monday, Apr 16, 2012

Hyd. No. 3

Pre-Developed Area #3 - Analysis Point #3

Hydrograph type	= SCS Runoff	Peak discharge	= 39.73 cfs
Storm frequency	= 50 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 187,980 cuft
Drainage area	= 32.220 ac	Curve number	= 61.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 31.30 min
Total precip.	= 5.32 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



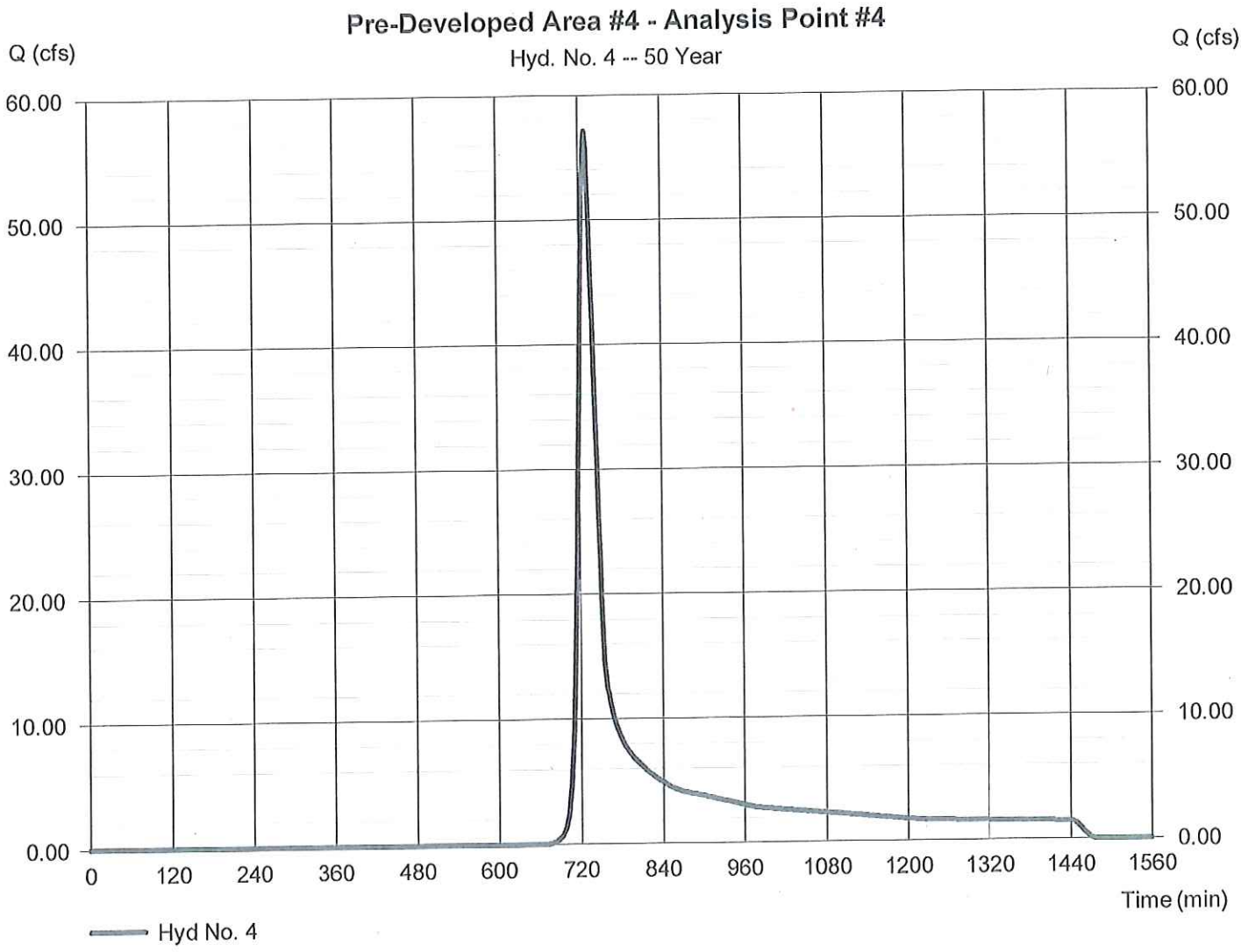
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Monday, Apr 16, 2012

Hyd. No. 4

Pre-Developed Area #4 - Analysis Point #4

Hydrograph type	= SCS Runoff	Peak discharge	= 57.14 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 226,866 cuft
Drainage area	= 39.810 ac	Curve number	= 61.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 26.40 min
Total precip.	= 5.32 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



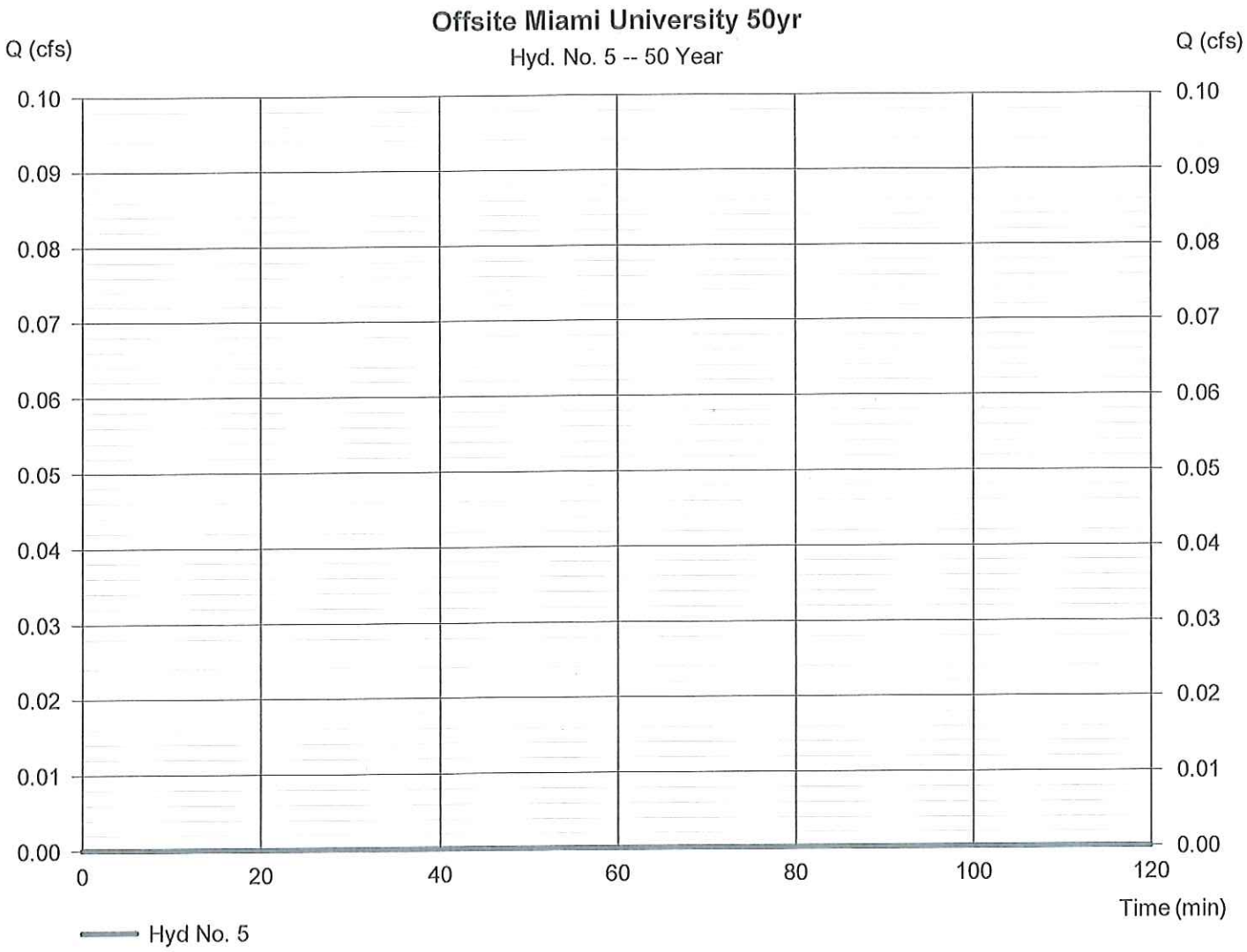
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Monday, Apr 16, 2012

Hyd. No. 5

Offsite Miami University 50yr

Hydrograph type	= Manual	Peak discharge	= 0.000 cfs
Storm frequency	= 50 yrs	Time to peak	= n/a
Time interval	= 2 min	Hyd. volume	= 0 cuft



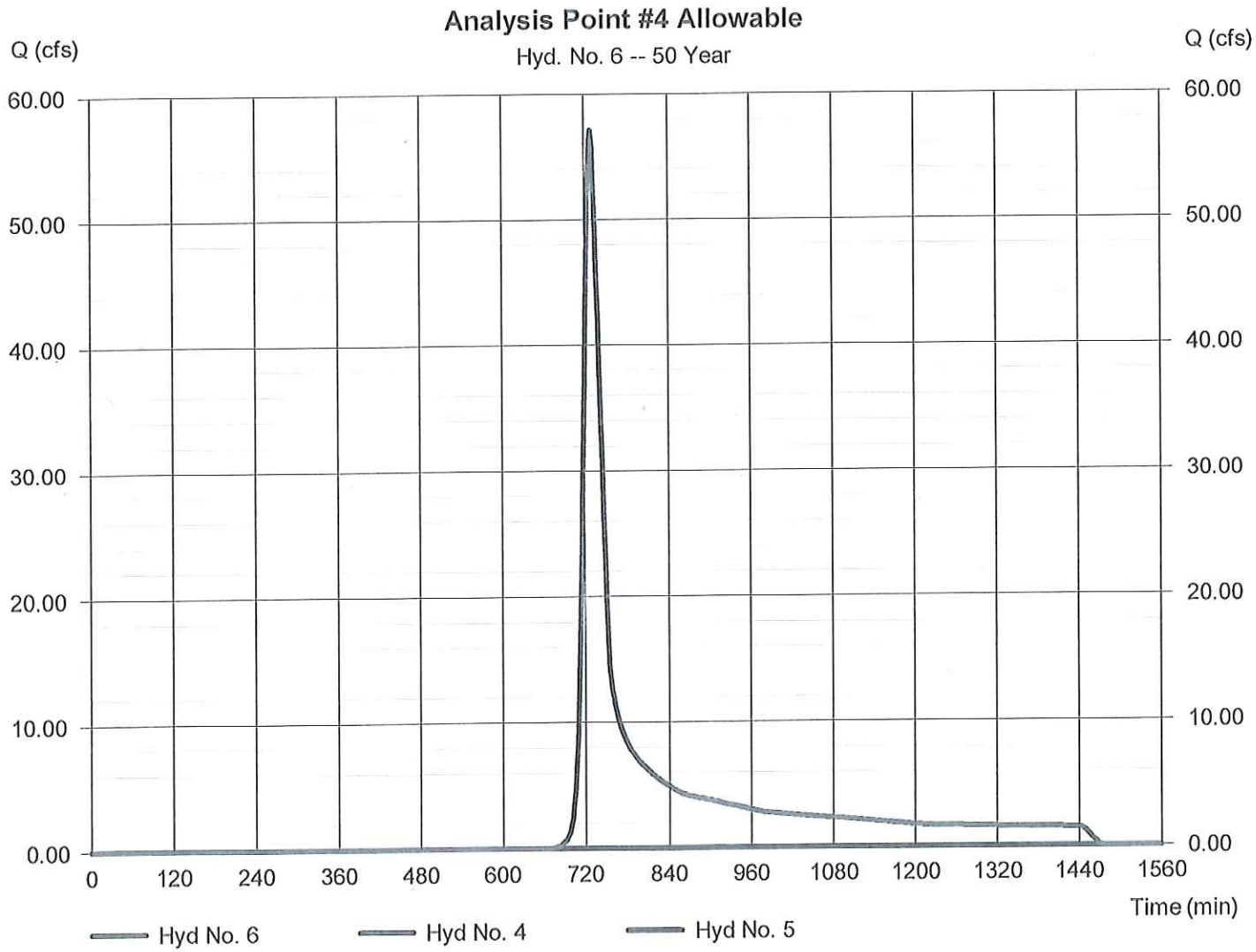
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Monday, Apr 16, 2012

Hyd. No. 6

Analysis Point #4 Allowable

Hydrograph type	= Combine	Peak discharge	= 57.14 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 226,866 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 39.810 ac



Project: Voice of America Park

Drainage Area Description:

Post-Developed Area #1, Onsite tributary Lake #1 and analyis point #1

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

Drainage Area: 24.30 Acres

Soil Types:
25 % Type B
75 % Type C

Land Use:

Open Space	75 %
Lake	10 %
Impervious	15 %

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Open Space	B	61	25	75	11.44
Lake	B	100	25	10	2.50
Impervious	B	98	25	15	3.68
Open Space	C	74	75	75	41.63
Lake	C	100	75	10	7.50
Impervious	C	98	75	15	11.03

Composite CN = **77.8**

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 = 370	Slope(ft/ft) = 0.0150	Velocity (fps) = 2	0.05 hr
Channel Flow:			
Length = 1070		Velocity (fps) = 3	0.10 hr
Pipe Flow:			
Length =		Velocity (fps) =	hr
		Tc =	**0.34 hr**
			20.5 min

Project: Voice of America Park

Drainage Area Description:

Post-Developed Area #2, Onsite tributary to Lake #2, then Lake #3 and analyis point #2

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

Drainage Area: 17.60 Acres

Soil Types:
100 % Type B
0 % Type C

Land Use:

Open Space	80 %
Lake	8 %
Impervious	12 %

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Open Space	B	61	100	80	48.80
Lake	B	100	100	8	8.00
Impervious	B	98	100	12	11.76
Open Space	C	74	0	80	0.00
Lake	C	100	0	8	0.00
Impervious	C	98	0	12	0.00

Composite CN = **68.6**

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 = 620	Slope(ft/ft) = 0.0150	Velocity (fps) = 2	0.09 hr
Channel Flow:			
Length =		Velocity (fps) =	0.00 hr
Pipe Flow:			
Length =		Velocity (fps) =	hr

Tc = **0.30 hr**
18.0 min

Project: Voice of America Park

Drainage Area Description:

Post-Developed Area #3, Onsite tributary to Lake #3 and analyis point #2

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

Drainage Area: 63.50 Acres

Soil Types:
30 % Type B
70 % Type C

Land Use:

Open Space	49 %	
Lake	5 %	
Impervious	18 %	
Synthetic Turf Fields	28 %	(9 Fields Total)

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Open Space	B	61	30	49	8.97
Lake	B	100	30	5	1.50
Impervious	B	98	30	18	5.29
Synthetic Turf Fields	B	90	30	28	7.56
Open Space	C	74	70	49	25.38
Lake	C	100	70	5	3.50
Impervious	C	98	70	18	12.35
Synthetic Turf Fields	C	90	70	28	17.64

Composite CN = 82.2

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 = 300	Slope(ft/ft) = 0.0150	Velocity (fps) = 2	0.04 hr
Channel Flow:			
Length =		Velocity (fps) =	0.00 hr
Pipe Flow:			
Length = 930		Velocity (fps) = 5	0.05 hr
		Tc =	**0.28 hr**
			17.1 min

Project: Voice of America Park

Drainage Area Description:

Post-Developed Area #4, Onsite tributary to Lake #4 and analyis point #3

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

Drainage Area: 22.25 Acres

Soil Types: 70 % Type B
30 % Type C

Land Use:

Open Space	60 %
Lake	10 %
Impervious	30 %

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Open Space	B	61	70	60	25.62
Lake	B	100	70	10	7.00
Impervious	B	98	70	30	20.58
Open Space	C	74	30	60	13.32
Lake	C	100	30	10	3.00
Impervious	C	98	30	30	8.82

Composite CN = 78.3

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 = 450	Slope(ft/ft) = 0.0150	Velocity (fps) = 2	0.06 hr
Channel Flow:			
Length = 320		Velocity (fps) = 2.5	0.04 hr
Pipe Flow:			
Length = 130		Velocity (fps) = 5	0.01 hr
		Tc =	**0.31 hr**
			18.7 min

Project: Voice of America Park

Drainage Area Description:

Post-Developed Area #5, Onsite tributary to Lake #5 analyis point #3

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

Drainage Area: 67.30 Acres

Soil Types:
35 % Type B
65 % Type C

Land Use:

Open Space	82 %
Lake	13 %
Impervious	5 %

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	
Open Space	B	61	35	82	17.51
Lake	B	100	35	13	4.55
Impervious	B	98	35	5	1.72
Open Space	C	74	65	82	39.44
Lake	C	100	65	13	8.45
Impervious	C	98	65	5	3.19

Composite CN = **74.8**

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 = 100		Velocity (fps) = 2.5	0.01 hr
		Tc =	**0.37 hr**
			22.3 min