Liberty Town Square

Phase 1

Preliminary Drainage Report

November 16, 2012



SUMMARY OF DATA

Method of Hydrograph Development: TR-55

Software: Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2011 Version 8

Design Criteria: Control the post development storms of a frequency between one year and the critical storm so as to be equal to or less than the pre-development peak runoff rate for a 24 hour-one year frequency storm. Control post development storms less frequent than the critical storm so as to be equal to or less than the pre-development peak runoff rate for the next most frequent storm event.

Drainage Area Descriptions	Drainage Area (Acres)	CN	Tc (Hours)	
Area #1, Onsite Predeveloped Conditions	45.50	64.0	0.63	
Area #2, Onsite Predeveloped Conditions	20.70	63.7	0.55	
Area #1, Onsite Post-developed Conditions	45.60	92.4	0.26	
Area #2, Onsite Post-developed Conditions	20.70	92.2	0.26	

Drainage Area #1 NW Release Point	Critical Storm = 100 Year q allowable, 1 yr = 3.29 cfs Assumed basin & outlet configurations			
Frequency	Inflow	Outflow	Storage	Elevation
(yr)	(cfs)	(cfs)	(ac-ft)	(ft)
100	276.1	3.0	15.80	n/a

Drainage Area #1 Estimated Basin Volume	
	Detention Volume = 15.8 ac-ft
	Water Quality Volume = 2.7 ac-ft
	Total Volume Required in Basin = 18.5 ac.ft

Drainage Area #2 SW Release Point	Critical Storm = 100 Year q allowable, 1 yr = 1.56 cfs Assumed basin & outlet configurations			
Frequency	Inflow	Outflow	Storage	Elevation
(yr)	(cfs)	(cfs)	(ac-ft)	(ft)
100	125.0	1.4	7.11	n/a

Drainage Area #2 Estimated Basin Volume	
	Detention Volume = 7.1 ac-ft
	Water Quality Volume = 1.2 ac-ft
	Total Volume Required in Basin = 8.3 ac.ft

Phase 1 Post-Developed
Drainage Area #1
45.6 Acres
CN=92.4, Tc=15.0 min
100 Year Critical Storm
Q100 Inflow = 276.1 cfs
Q100 Release = 3.00 cfs
Detention Volume = 15.8 ac-ft
WQ Volume = 2.7 ac-ft

Pre-Developed
Drainage Area #1
45.5 Acres
CN=64.0, Tc=38.0 min
q1year = 3.29 cfs

Basis of Bearing:
0 100 200
SCALE: 1" = 100'

SR-129

EX R/W

Detention

I-75

Detention

EX R/W

EX. BC

LIBERTY WAY

TYLERS PLACE BLVD.

Phase 1 Post-Developed
Drainage Area #2
20.7 Acres
CN=92.2, Tc=16.0 min
100 Year Critical Storm
Q100 Inflow = 125.0 cfs
Q100 Release = 1.42 cfs
Detention Volume = 7.1 ac-ft
WQ Volume = 1.2 ac-ft

Pre-Developed
Drainage Area #2
20.8 Acres
CN=63.7, Tc=33.0 min
q1year = 1.56 cfs

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No.	Revision Description	Date	Dwn	Chk
1	PRELIMINARY			

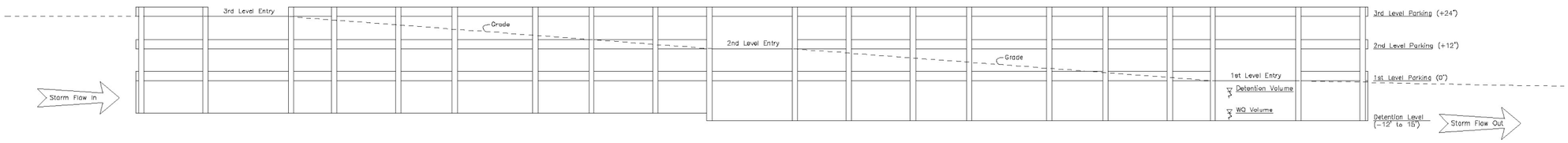
LIBERTY TOWN SQUARE
LIBERTY WAY
LIBERTY TOWNSHIP
SECTION 19 & 19, TOWN 3, RANGE 3
BUTLER COUNTY, OHIO

DRAINAGE MAP

bayer becker
Engineers | Surveyors
6888 Tylersville Road, Suite A
Mason, OH 45040 - 513.336.6600

Drawing:
Drawn by: JSD
Checked by:
Issue Date: 11-6-12
Sheet: **DR1.0**

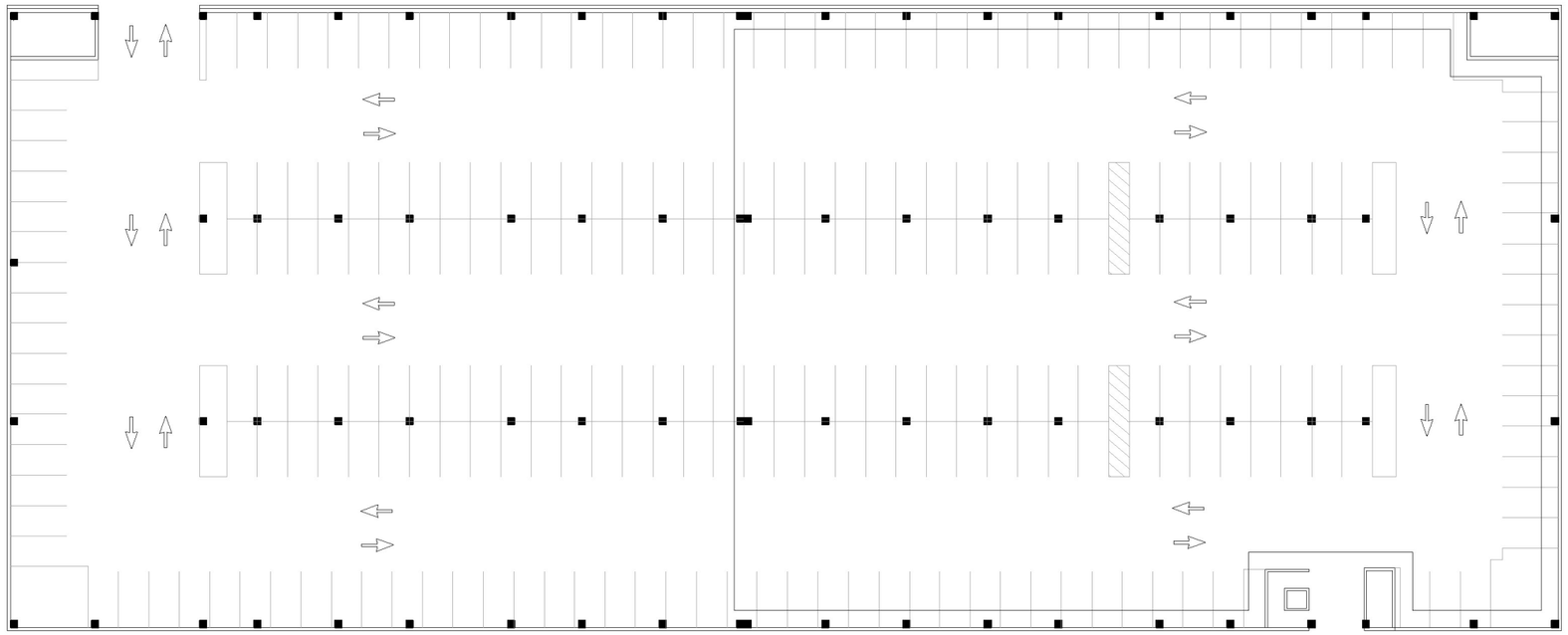
Plot time: Nov 15, 2012 - 1:18pm
Drawing name: J:\2009\09F134-089\CIVIL\Prelim Plat\09F134-005 CD Drainage Map 120726.dwg - Layout Tab: DR.0



TYPICAL PARKING GARAGE: ELEVATION VIEW

Parking Garage B
WQ Volume = 2.7 Acre-Feet
Detention Volume = 16.0 Acre-Feet

Parking Garage C
WQ Volume = 1.2 Acre-Feet
Detention Volume = 7.2 Acre-Feet



TYPICAL PARKING GARAGE: PLAN VIEW

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Item | Revision Description | Date | Drawn | Chk

PRELIMINARY

LIBERTY TOWN SQUARE
LIBERTY WAY
LIBERTY TOWNSHIP
SECTION 19 & 19, TOWN 3, RANGE 3
BUTLER COUNTY, OHIO

PARKING GARAGE EXHIBIT

bayer becker
www.bayerbecker.com
8900 Tylersville Road, Suite A
Mason, OH 45040 - 513.398.8600

Drawing:
Drawn by: JSD
Checked by:
Issue Date: 11-8-12
Project No.

DR2.0

Plot time: Nov 15, 2012 - 1:20pm
Drawing name: J:\2009\09F134-BB\SCD\DWG\Prelim Plat\09F134-005 CD Drainage Map 120726.dwg - Layout Tab: DR.0

Runoff curve number and runoff (TR-55)

Project: Liberty Town Square
Drainage Area #1

By: MPD
Checked:

Date: 5/1/2012
Date:
Job #: 06F134-005

On-site Pre-Developed

	Drainage Area:	45.5 Ac
	Curve Number:	64.0
	Year storm:	1
	Intensity:	2.33
S=(1000/CN)-10	S=	5.63
$Q=(P-0.2S)^2/(P+0.8S)$	Q=	0.21 in
V=(Q/12*43560*A)	V=	34,967 ft^3
		0.80 Ac-ft

On-site Post-Developed

	Drainage Area:	45.6 Ac
	Curve Number:	92.4
	Year storm:	1
	Intensity:	2.33
S=(1000/CN)-10	S=	0.83
$Q=(P-0.2S)^2/(P+0.8S)$	Q=	1.57 in
V=(Q/12*43560*A)	V=	259,466 ft^3
		5.96 Ac-ft

	CN	Yr Storm	S	Q (in)	V (ft^3)
Onsite Pre-developed	64.0	1	5.63	0.21	34967
Onsite Post-developed	92.4	1	0.83	1.57	259466

$((V_{post}/V_{pre})-1)*100\%$ = Runoff_Increase 642 %

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: 100 yr

Runoff curve number and runoff (TR-55)

Project: Liberty Town Square
Drainage Area #2

By: MPD
Checked:

Date: 5/1/2012
Date:
Job #: 06F134-005

On-site Pre-Developed

	Drainage Area:	20.8 Ac
	Curve Number:	63.7
	Year storm:	1
	Intensity:	2.33
S=(1000/CN)-10	S=	5.71
$Q=(P-0.2S)^2/(P+0.8S)$	Q=	0.21 in
V=(Q/12*43560*A)	V=	15,481 ft^3
		0.36 Ac-ft

On-site Post-Developed

	Drainage Area:	20.7 Ac
	Curve Number:	92.2
	Year storm:	1
	Intensity:	2.33
S=(1000/CN)-10	S=	0.84
$Q=(P-0.2S)^2/(P+0.8S)$	Q=	1.55 in
V=(Q/12*43560*A)	V=	116,760 ft^3
		2.68 Ac-ft

	CN	Yr Storm	S	Q (in)	V (ft^3)
Onsite Pre-developed	63.7	1	5.71	0.21	15481
Onsite Post-developed	92.2	1	0.84	1.55	116760

$((V_{post}/V_{pre})-1)*100\%$ = Runoff_Increase 654 %

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:	***100 yr***

Project: Liberty Town Square

Drainage Area Description:

Phase 1, Area #1: Pre-Developed

Job #: 06F134-005
Initials: MPD
Date: 5/1/2012
Revised:

Drainage Area = 45.5 Acres

Soil Types:

81 %	Type 'B'	*37.0 acres*
19 %	Type 'C'	*8.5 acres*

Land Use:

Meadow	21.8 Acres
Row Crops (SR+CR)	8.0 Acres
Gravel Surfaces	0.1 Acres
Woods, Fair	15.6 Acres

0

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	CN*Soil %*Land %
Meadow	**B**	58	81	47.9	22.60
Meadow	**C**	71	19	47.9	6.35
Row Crops (SR+CR)	**B**	75	81	17.6	10.72
Row Crops (SR+CR)	**C**	82	19	17.6	2.69
Gravel Surfaces	**B**	85	81	0.2	0.15
Gravel Surfaces	**C**	89	19	0.2	0.04
Woods, Fair	**B**	60	81	34.3	16.73
Woods, Fair	**C**	73	19	34.3	4.68

Composite CN = 64.0

Time of Concentration:

Sheet Flow: — **Tc**

Length = 100 Slope(ft/ft) = 0.0100 Manning's, n = 0.24 **0.332** *hr*

Shallow Concentrated Flow:

Length = 700 Slope(ft/ft) = 0.010 Velocity (fps) = 1.6 **0.122** *hr*

Channel Flow:

Length = 1900 Velocity (fps) = 3 **0.176** *hr*

Tc = 0.63 ***hr***
38 min

Project: Liberty Towne Square

Drainage Area Description:

Phase 1, Area #2: Pre-Developed

Job #: 06F134-005
Initials: MPD
Date: 5/1/2012
Revised:

Drainage Area = 20.7 Acres

Soil Types:

89 %	Type 'B'	*18.5 acres*
11 %	Type 'C'	*2.2 acres*

Land Use:

Meadow	16.3 Acres
Row Crops (SR+CR)	1.5 Acres
Impervious Surfaces	1.4 Acres
Gravel Surfaces	0.3 Acres
Woods, Fair	1.2 Acres

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	CN*Soil %*Land %
Meadow	**B**	58	89	78.7	40.82
Meadow	**C**	71	11	78.7	5.94
Row Crops (SR+CR)	**B**	75	89	7.2	4.86
Row Crops (SR+CR)	**C**	82	11	7.2	0.63
Impervious Surfaces	**B**	98	89	6.8	5.92
Impervious Surfaces	**C**	98	11	6.8	0.70
Gravel Surfaces	**B**	85	89	1.4	1.10
Gravel Surfaces	**C**	89	11	1.4	0.14
Woods, Fair	**B**	60	89	5.8	3.11
Woods, Fair	**C**	73	11	5.8	0.45

Composite CN = 63.7

Time of Concentration:

Sheet Flow: — **Tc**

Length = 100 Slope(ft/ft) = 0.0380 Manning's, n = 0.24 **0.195** *hr*

Shallow Concentrated Flow:

Length = 1920 Slope(ft/ft) = 0.017 Velocity (fps) = 2.1 **0.254** *hr*

Channel Flow:

Length = 1070 Velocity (fps) = 3 **0.099** *hr*

Tc = 0.55 *hr*
33 min

Project: **Liberty Towne Square**

Drainage Area Description:

Phase 1, Area #1: Post-Developed

Job #: 06F134-005
Initials: MPD
Date: 5/1/2012
Revised:

Drainage Area = 45.6 Acres

Soil Types:

81 %	Type 'B'	*37.0 acres*
19 %	Type 'C'	*8.6 acres*

Land Use: Commercial 45.6 Acres

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	CN*Soil %*Land %
Commercial	**B**	92	81	100.0	74.65
Commercial	**C**	94	19	100.0	17.73

Composite CN = 92.4

Time of Concentration:

		Tc
Sheet Flow:	Time to First Inlet: 10 minutes	**0.167** *hr*
Pipe Flow:		
Length = 1960	Velocity (fps) = 6	**0.09** *hr*

Tc = 0.26 *hr*
15 min

Project: Liberty Towne Square

Drainage Area Description:

Phase 1, Area #2: Post-Developed

Job #: 06F134-005
Initials: MPD
Date: 5/1/2012
Revised:

Drainage Area = 20.7 Acres

Soil Types:

89 %	Type 'B'	*18.5 acres*
11 %	Type 'C'	*2.2 acres*

Land Use: Commercial 20.7 Acres

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	CN*Soil %*Land %
Commercial	B	92	89	100.0	82.22
Commercial	C	94	11	100.0	9.99

Composite CN = 92.2

Time of Concentration:

		Tc
Sheet Flow:	Time to First Inlet: 10 minutes	**0.167** *hr*
Pipe Flow:		
Length = 2070	Velocity (fps) = 6	**0.10** *hr*

Tc = 0.26 *hr*
16 min

Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph Description
1	SCS Runoff	3.286	2	748	0.805	------	------	------	Area #1 Pre-Developed Onsite
2	SCS Runoff	1.555	2	742	0.359	------	------	------	Area #2 Pre-Developed Onsite
3	SCS Runoff	89.25	2	722	5.815	------	------	------	Area #1 Post-Developed Onsite
4	SCS Runoff	40.14	2	722	2.612	------	------	------	Area #2 Post-Developed Onsite
5	Reservoir	1.518	2	1142	5.492	3	858.39	4.42	Analysis Point #1
6	Reservoir	0.702	2	1134	2.428	4	850.35	1.98	Analysis Point #2

1 year pre-development peak flow rate = 100 year post-development allowable release rate

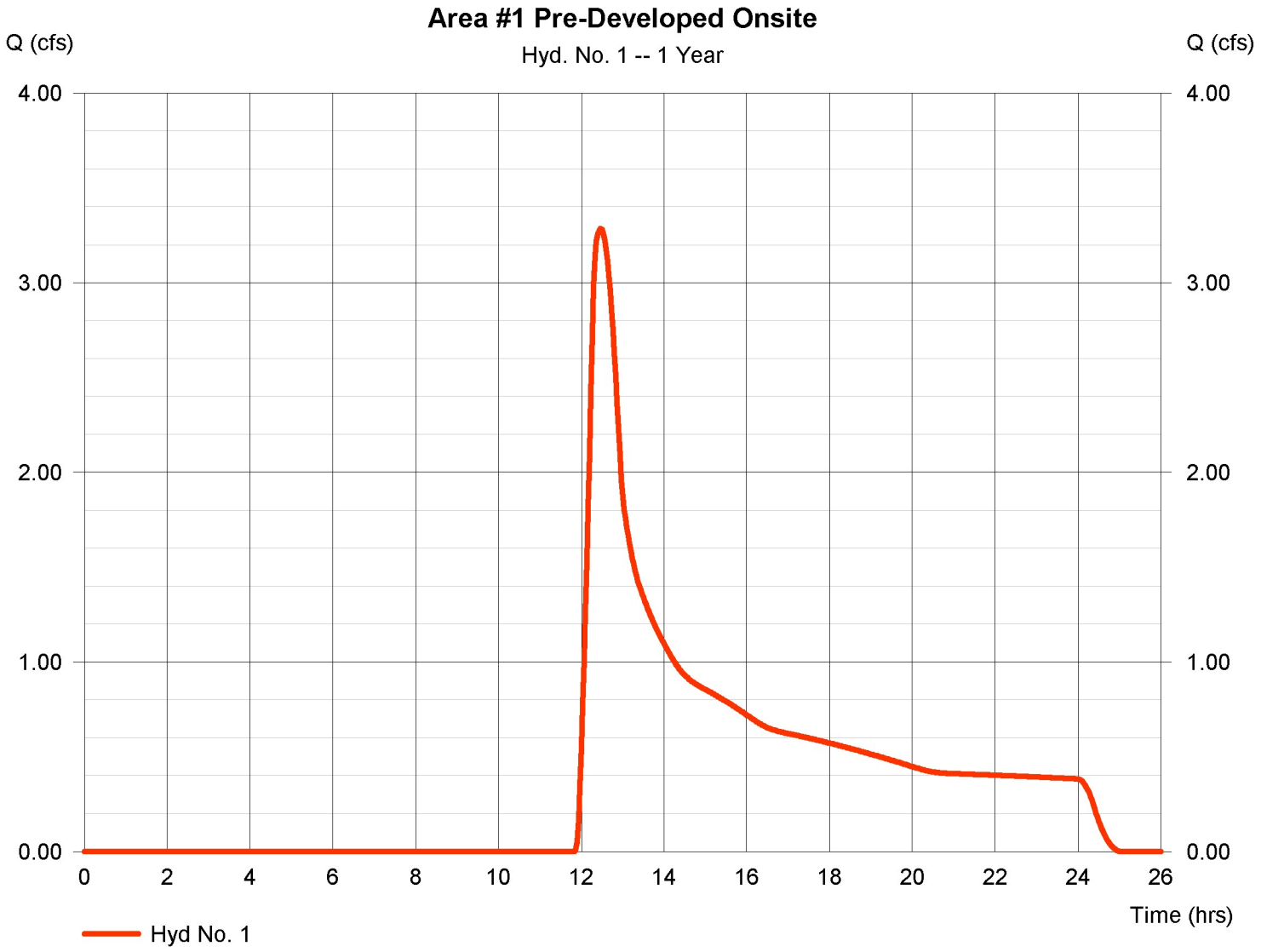
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Thursday, Nov 15, 2012

Hyd. No. 1

Area #1 Pre-Developed Onsite

Hydrograph type	= SCS Runoff	Peak discharge	= 3.286 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.47 hrs
Time interval	= 2 min	Hyd. volume	= 0.805 acft
Drainage area	= 45.500 ac	Curve number	= 64
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 38.00 min
Total precip.	= 2.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



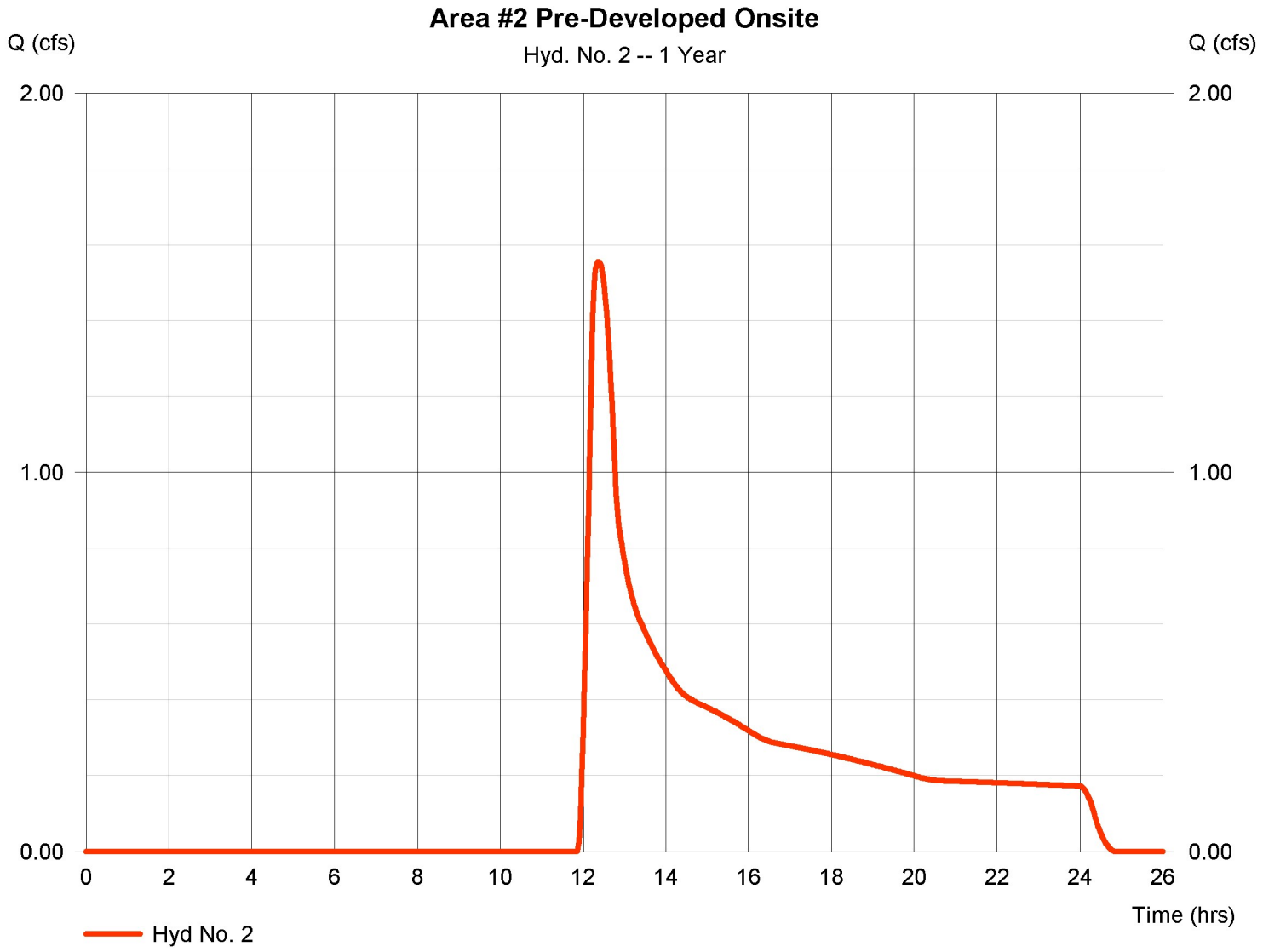
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Thursday, Nov 15, 2012

Hyd. No. 2

Area #2 Pre-Developed Onsite

Hydrograph type	= SCS Runoff	Peak discharge	= 1.555 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.37 hrs
Time interval	= 2 min	Hyd. volume	= 0.359 acft
Drainage area	= 20.700 ac	Curve number	= 63.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 33.00 min
Total precip.	= 2.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



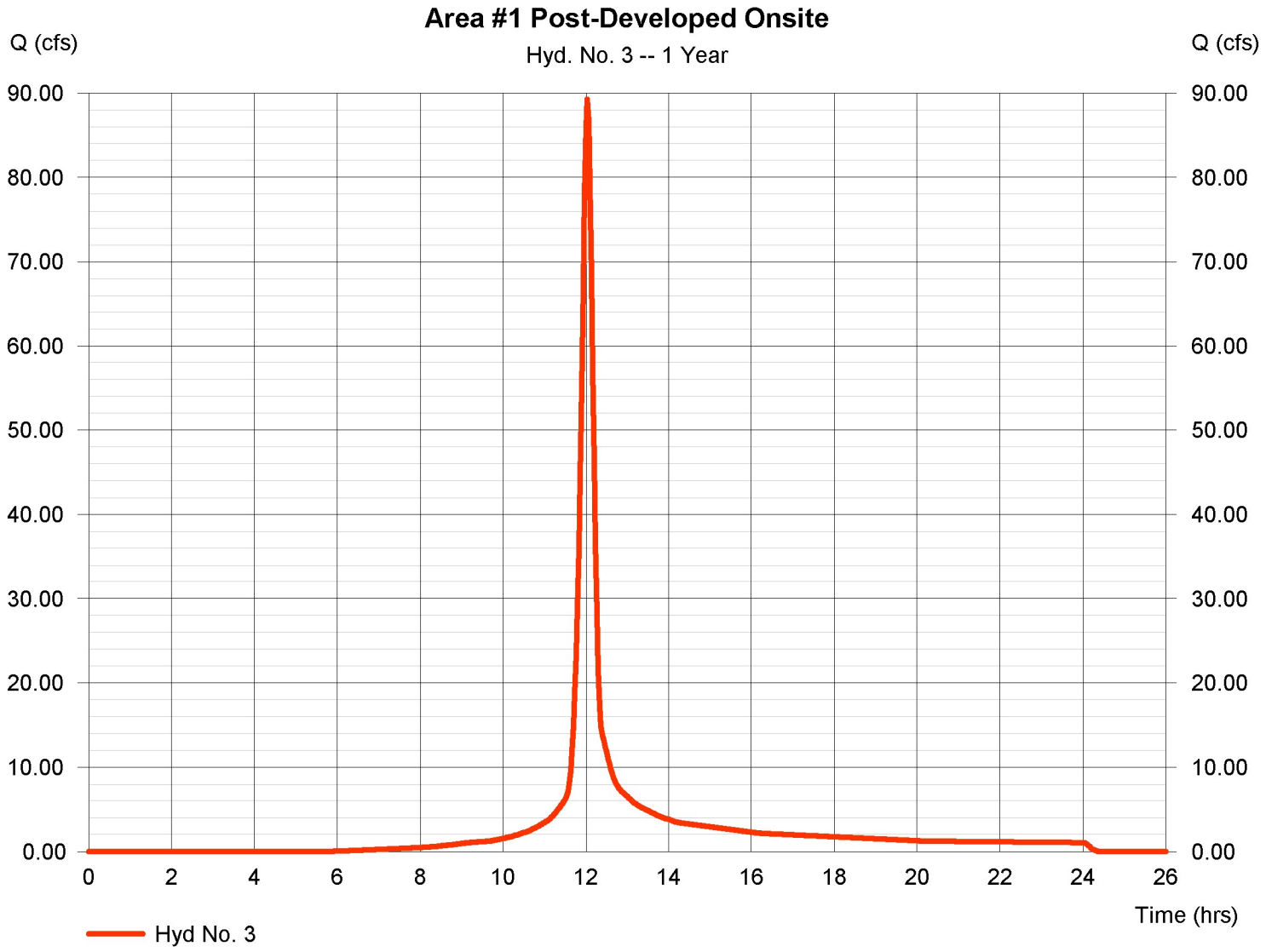
Hydrograph Report

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Hyd. No. 3

Area #1 Post-Developed Onsite

Hydrograph type	= SCS Runoff	Peak discharge	= 89.25 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 5.815 acft
Drainage area	= 45.600 ac	Curve number	= 92.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 2.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



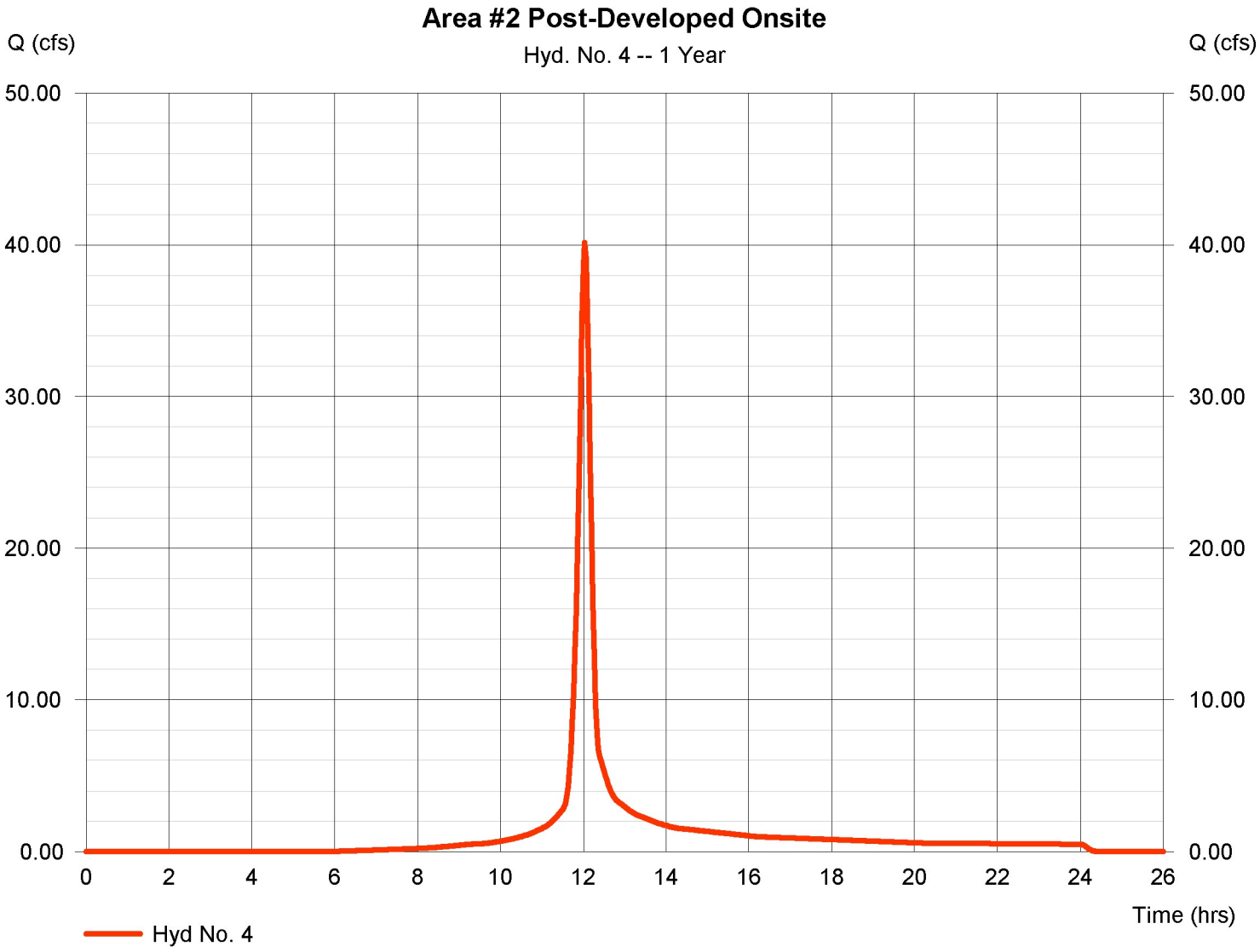
Hydrograph Report

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Hyd. No. 4

Area #2 Post-Developed Onsite

Hydrograph type	= SCS Runoff	Peak discharge	= 40.14 cfs
Storm frequency	= 1 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 2.612 acft
Drainage area	= 20.700 ac	Curve number	= 92.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.00 min
Total precip.	= 2.33 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

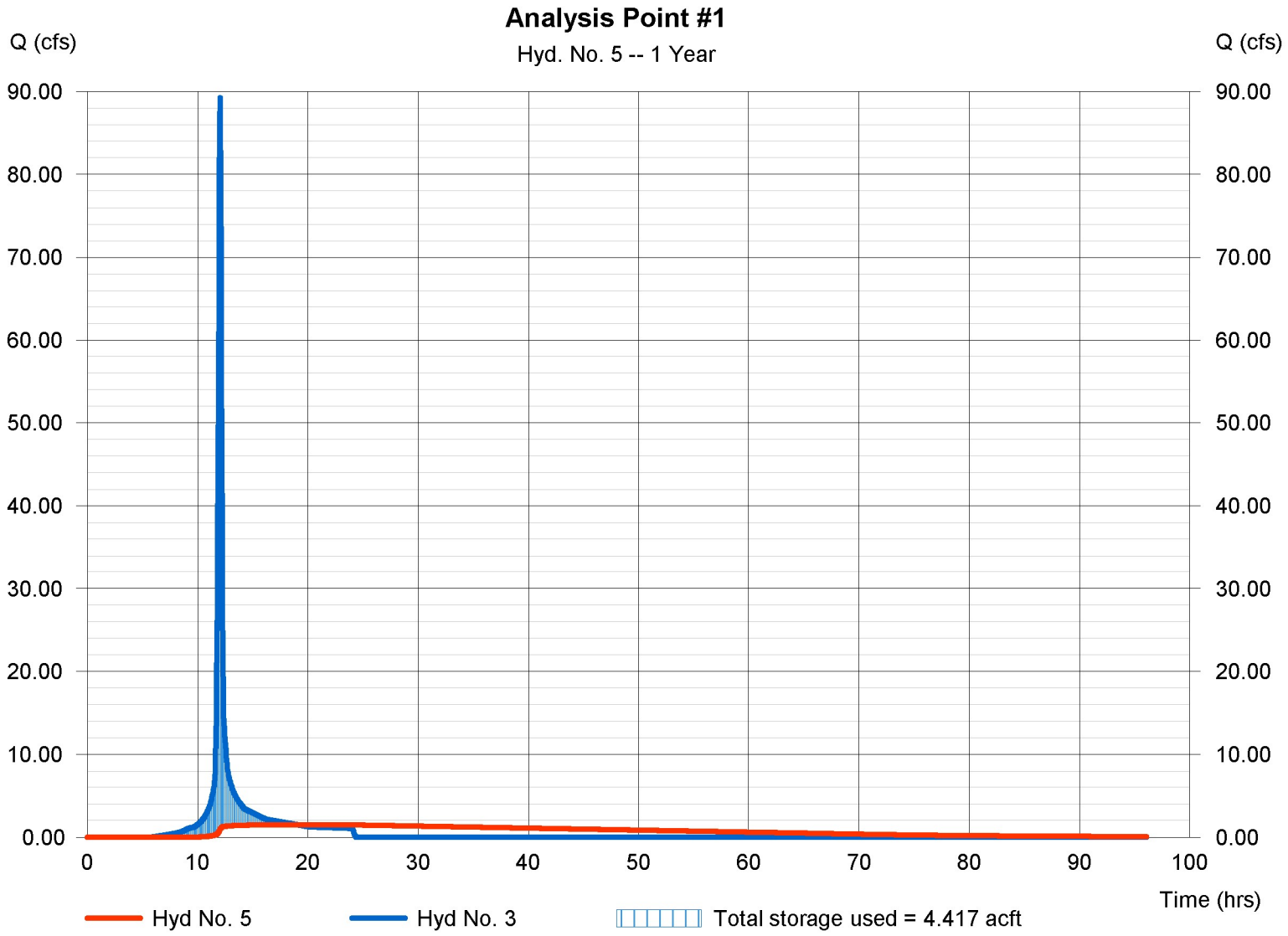
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Hyd. No. 5

Analysis Point #1

Hydrograph type	= Reservoir	Peak discharge	= 1.518 cfs
Storm frequency	= 1 yrs	Time to peak	= 19.03 hrs
Time interval	= 2 min	Hyd. volume	= 5.492 acft
Inflow hyd. No.	= 3 - Area #1 Post-Developed Onsite	Max. Elevation	= 858.39 ft
Reservoir name	= UG Basin #1	Max. Storage	= 4.417 acft

Storage Indication method used.



Pond Report

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Pond No. 1 - UG Basin #1

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 856.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	856.00	80,660	0.000	0.000
1.00	857.00	80,660	1.852	1.852
2.00	858.00	80,660	1.852	3.703
3.00	859.00	80,660	1.852	5.555
4.00	860.00	80,660	1.852	7.407
5.00	861.00	80,660	1.852	9.258
6.00	862.00	80,660	1.852	11.110
7.00	863.00	80,660	1.852	12.962
8.00	864.00	80,660	1.852	14.814
9.00	865.00	80,660	1.852	16.665

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 6.30	Inactive	0.00	0.00
Span (in)	= 6.30	0.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 856.00	856.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	Inactive	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No
Exfil.(in/hr)	= 0.000 (by Wet area)			
TW Elev. (ft)	= 0.00			

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0.000	856.00	0.00	---	---	---	---	---	---	---	---	---	0.000
1.00	1.852	857.00	0.90 ic	---	---	---	---	---	---	---	---	---	0.895
2.00	3.703	858.00	1.37 ic	---	---	---	---	---	---	---	---	---	1.374
3.00	5.555	859.00	1.72 ic	---	---	---	---	---	---	---	---	---	1.724
4.00	7.407	860.00	2.01 ic	---	---	---	---	---	---	---	---	---	2.015
5.00	9.258	861.00	2.27 ic	---	---	---	---	---	---	---	---	---	2.268
6.00	11.110	862.00	2.50 ic	---	---	---	---	---	---	---	---	---	2.496
7.00	12.962	863.00	2.71 ic	---	---	---	---	---	---	---	---	---	2.705
8.00	14.814	864.00	2.90 ic	---	---	---	---	---	---	---	---	---	2.899
9.00	16.665	865.00	3.08 ic	---	---	---	---	---	---	---	---	---	3.081

Hydrograph Report

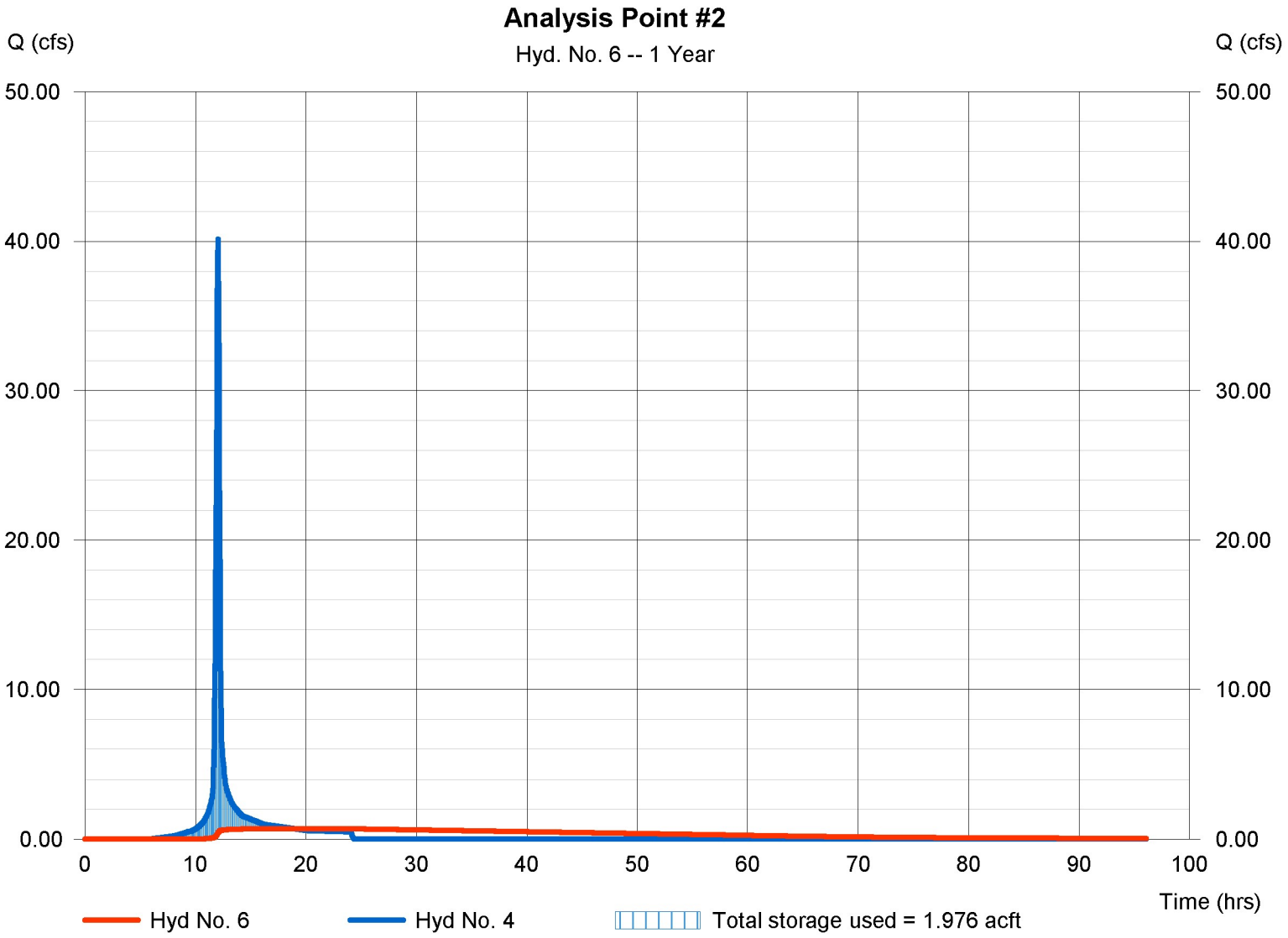
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Hyd. No. 6

Analysis Point #2

Hydrograph type	= Reservoir	Peak discharge	= 0.702 cfs
Storm frequency	= 1 yrs	Time to peak	= 18.90 hrs
Time interval	= 2 min	Hyd. volume	= 2.428 acft
Inflow hyd. No.	= 4 - Area #2 Post-Developed Onsite	Max. Elevation	= 850.35 ft
Reservoir name	= UG Basin #2	Max. Storage	= 1.976 acft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 Thursday, Nov 15, 2012

Pond No. 2 - UG Basin #2

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 849.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	849.00	63,690	0.000	0.000
1.00	850.00	63,690	1.462	1.462
2.00	851.00	63,690	1.462	2.924
3.00	852.00	63,690	1.462	4.386
4.00	853.00	63,690	1.462	5.848
5.00	854.00	63,690	1.462	7.311
6.00	855.00	63,690	1.462	8.773
7.00	856.00	63,690	1.462	10.235

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 5.00	Inactive	0.00	0.00
Span (in)	= 5.00	0.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 849.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 1.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.00	0.00	0.00
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0.000	849.00	0.00	---	---	---	---	---	---	---	---	---	0.000
1.00	1.462	850.00	0.58 ic	---	---	---	---	---	---	---	---	---	0.584
2.00	2.924	851.00	0.88 ic	---	---	---	---	---	---	---	---	---	0.879
3.00	4.386	852.00	1.10 ic	---	---	---	---	---	---	---	---	---	1.097
4.00	5.848	853.00	1.28 ic	---	---	---	---	---	---	---	---	---	1.278
5.00	7.311	854.00	1.44 ic	---	---	---	---	---	---	---	---	---	1.437
6.00	8.773	855.00	1.58 ic	---	---	---	---	---	---	---	---	---	1.580
7.00	10.235	856.00	1.71 ic	---	---	---	---	---	---	---	---	---	1.711

Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph Description
1	SCS Runoff	74.97	2	738	8.690	------	------	------	Area #1 Pre-Developed Onsite
2	SCS Runoff	38.33	2	734	3.957	------	------	------	Area #2 Pre-Developed Onsite
3	SCS Runoff	276.13	2	722	19.096	------	------	------	Area #1 Post-Developed Onsite
4	SCS Runoff	125.03	2	722	8.630	------	------	------	Area #2 Post-Developed Onsite
5	Reservoir	3.001	2	1420	15.905	3	864.55	15.8	Analysis Point #1
6	Reservoir	1.416	2	1364	7.332	4	853.86	7.11	Analysis Point #2

Peak release rates during 100 year storm events

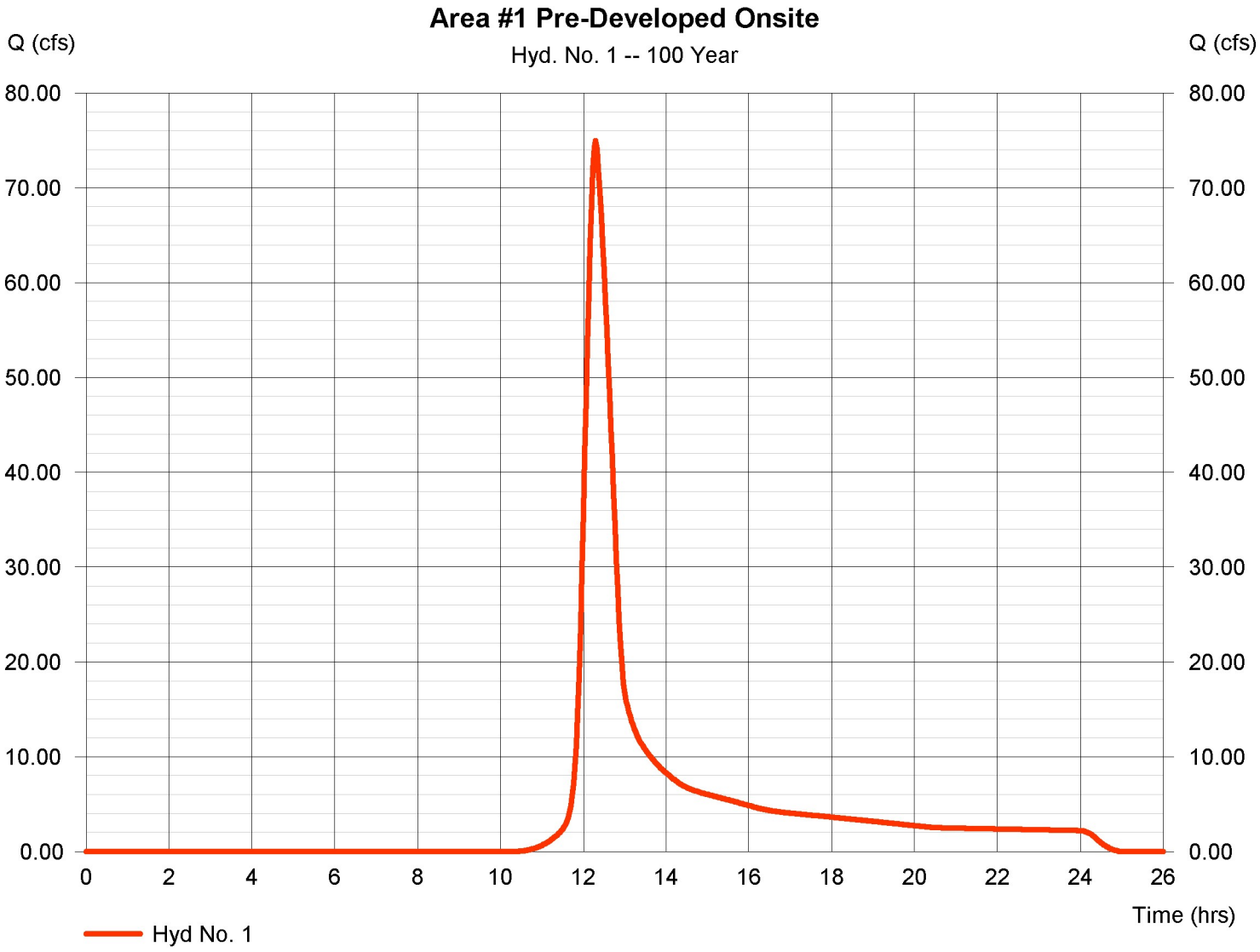
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 Thursday, Nov 15, 2012

Hyd. No. 1

Area #1 Pre-Developed Onsite

Hydrograph type	= SCS Runoff	Peak discharge	= 74.97 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.30 hrs
Time interval	= 2 min	Hyd. volume	= 8.690 acft
Drainage area	= 45.500 ac	Curve number	= 64
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 38.00 min
Total precip.	= 6.04 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



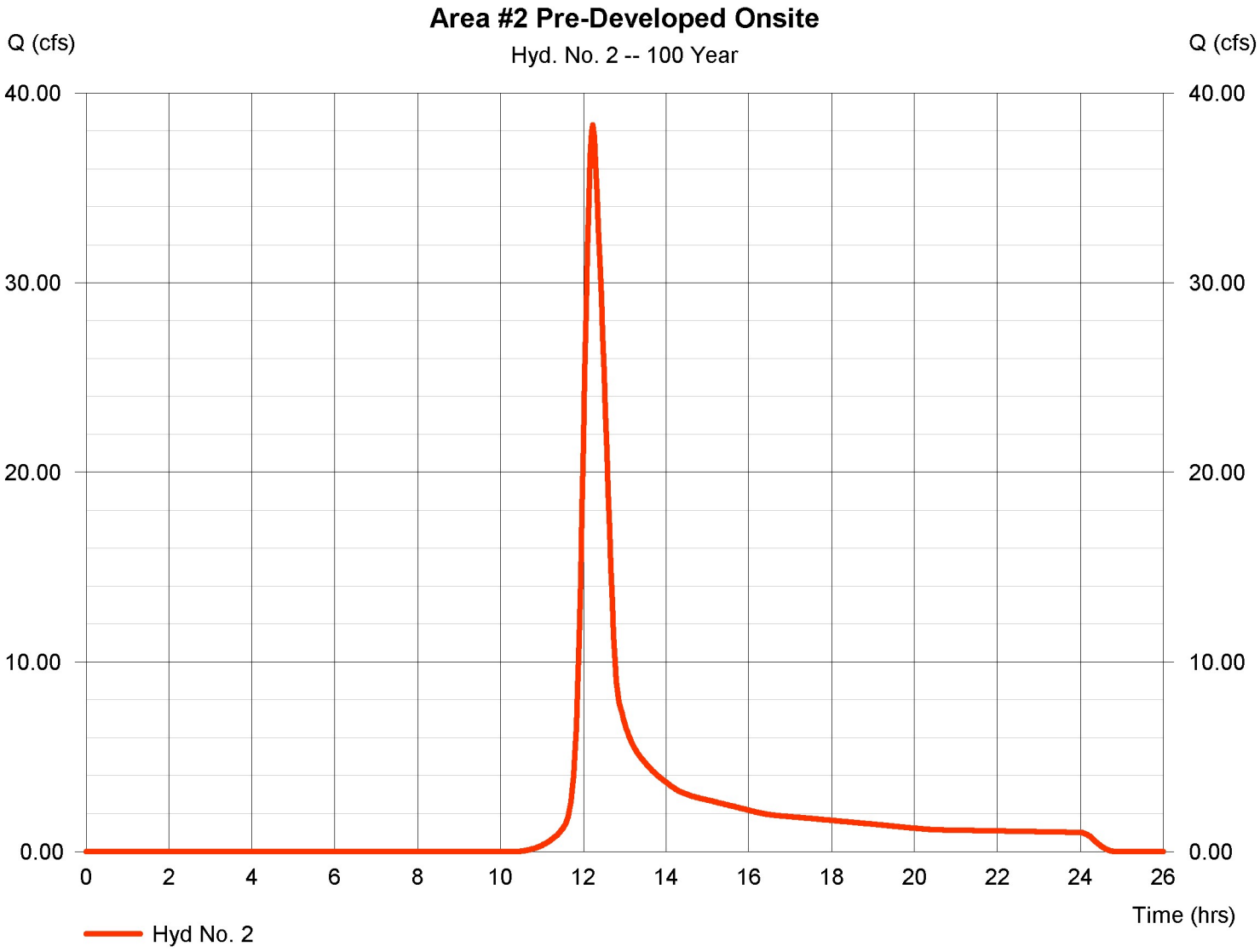
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 Thursday, Nov 15, 2012

Hyd. No. 2

Area #2 Pre-Developed Onsite

Hydrograph type	= SCS Runoff	Peak discharge	= 38.33 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 3.957 acft
Drainage area	= 20.700 ac	Curve number	= 63.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 33.00 min
Total precip.	= 6.04 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



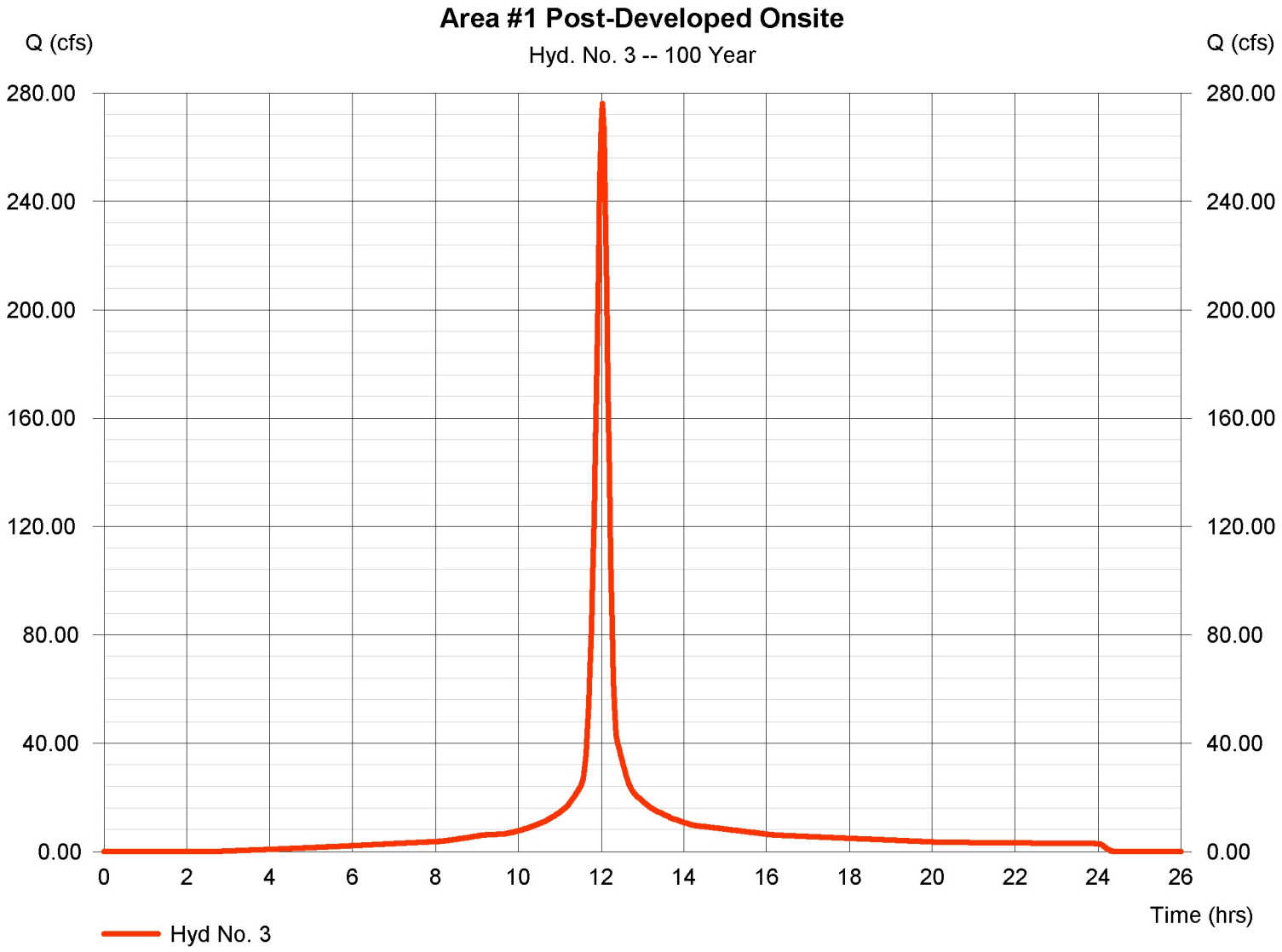
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Thursday, Nov 15, 2012

Hyd. No. 3

Area #1 Post-Developed Onsite

Hydrograph type	= SCS Runoff	Peak discharge	= 276.13 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 19.096 acft
Drainage area	= 45.600 ac	Curve number	= 92.4
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.00 min
Total precip.	= 6.04 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



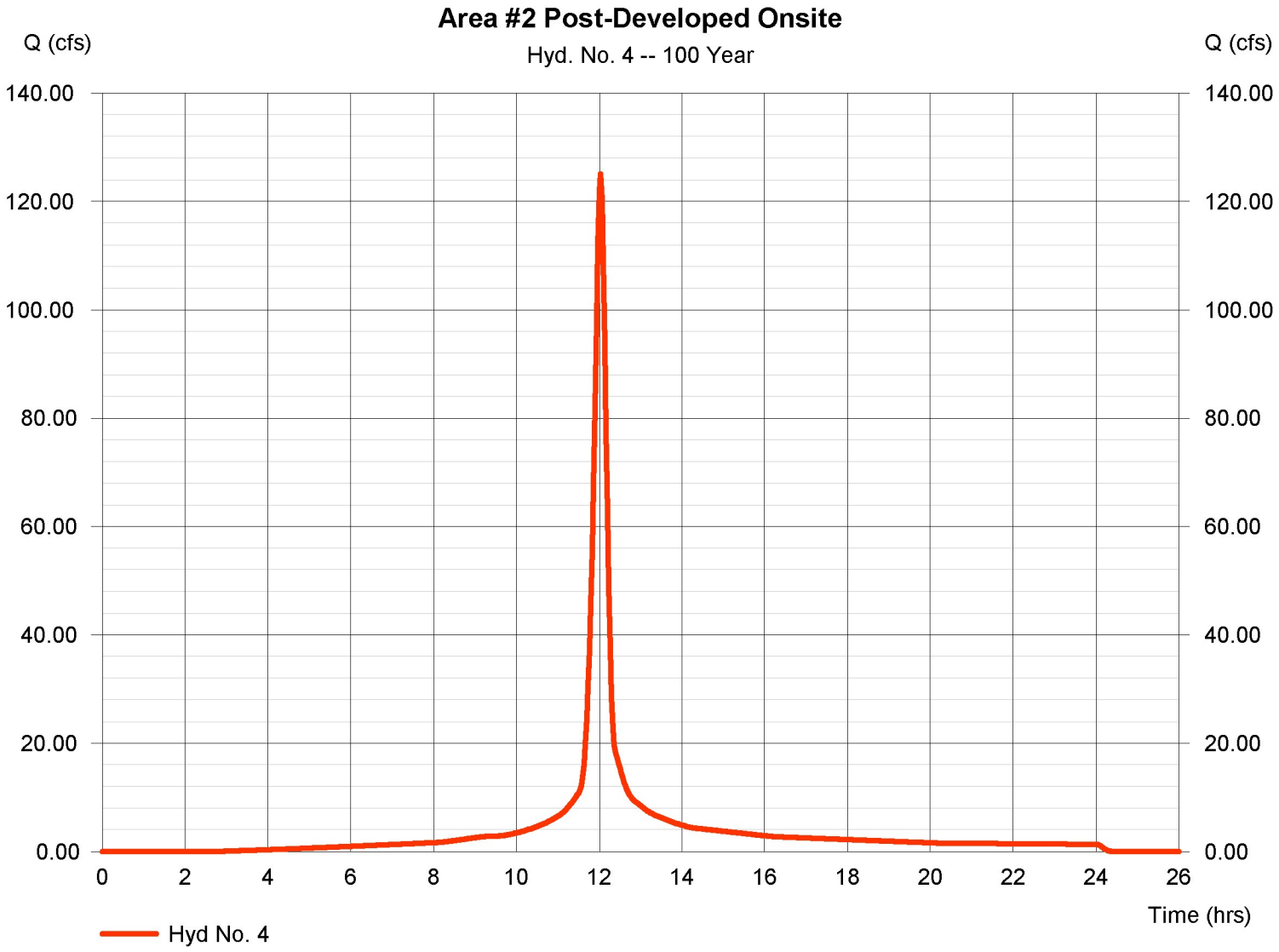
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 Thursday, Nov 15, 2012

Hyd. No. 4

Area #2 Post-Developed Onsite

Hydrograph type	= SCS Runoff	Peak discharge	= 125.03 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 8.630 acft
Drainage area	= 20.700 ac	Curve number	= 92.2
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.00 min
Total precip.	= 6.04 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

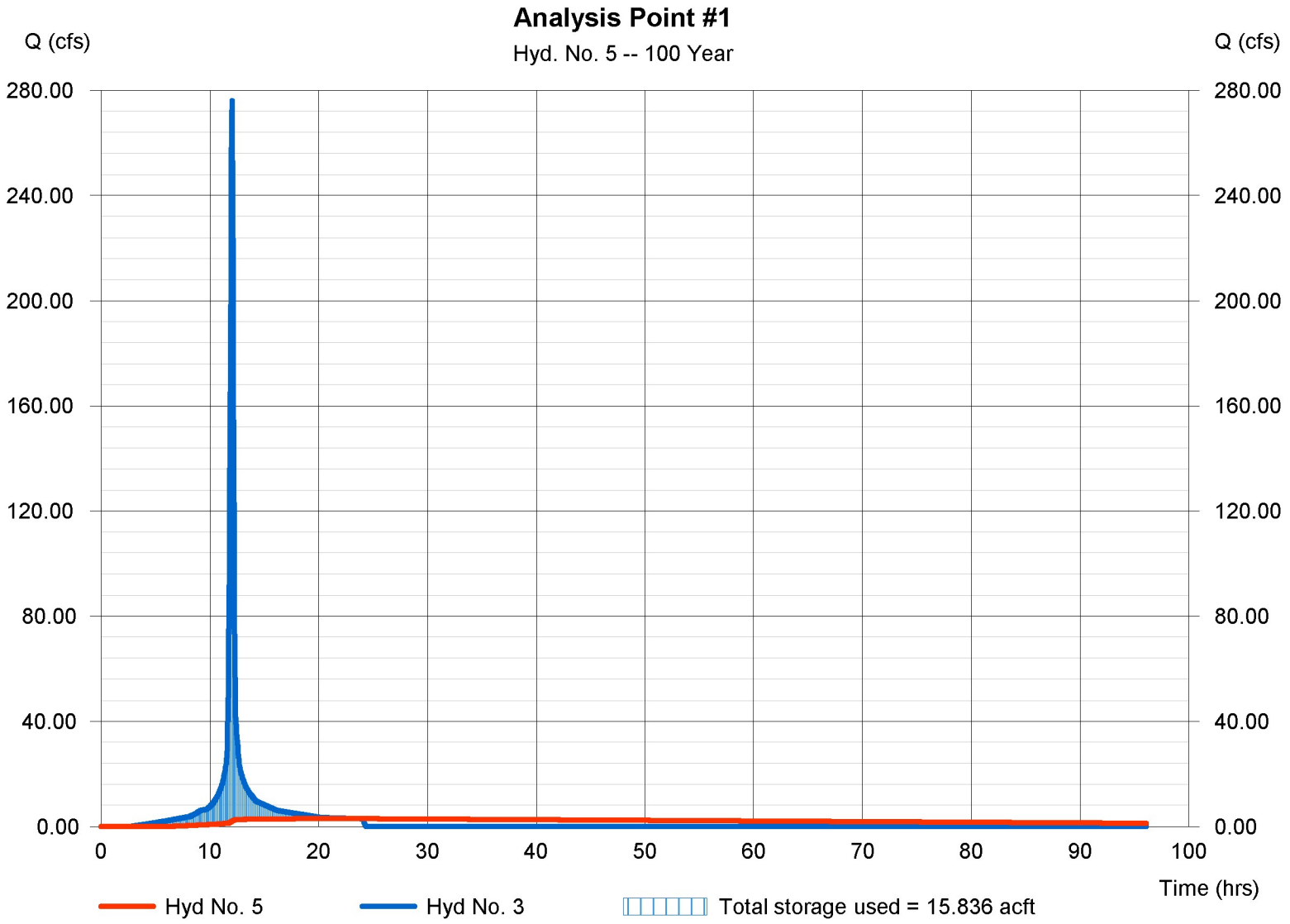
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Thursday, Nov 15, 2012

Hyd. No. 5

Analysis Point #1

Hydrograph type	= Reservoir	Peak discharge	= 3.001 cfs
Storm frequency	= 100 yrs	Time to peak	= 23.67 hrs
Time interval	= 2 min	Hyd. volume	= 15.905 acft
Inflow hyd. No.	= 3 - Area #1 Post-Developed On-site	Max. Elevation	= 864.55 ft
Reservoir name	= UG Basin #1	Max. Storage	= 15.836 acft

Storage Indication method used.



Hydrograph Report

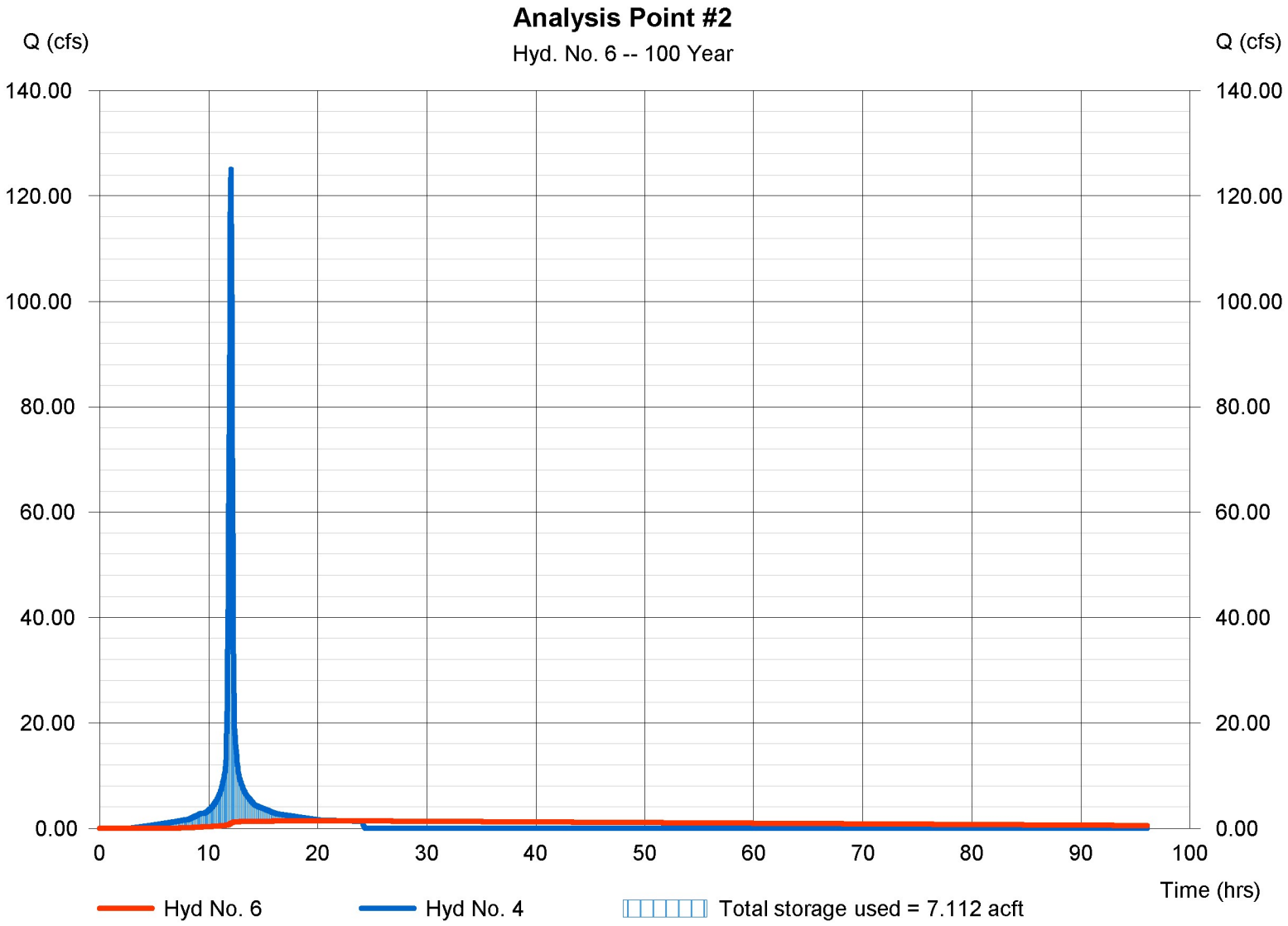
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2011 by Autodesk, Inc. v8 — Thursday, Nov 15, 2012

Hyd. No. 6

Analysis Point #2

Hydrograph type	= Reservoir	Peak discharge	= 1.416 cfs
Storm frequency	= 100 yrs	Time to peak	= 22.73 hrs
Time interval	= 2 min	Hyd. volume	= 7.332 acft
Inflow hyd. No.	= 4 - Area #2 Post-Developed On-site	Max. Elevation	= 853.86 ft
Reservoir name	= UG Basin #2	Max. Storage	= 7.112 acft

Storage Indication method used.



bayer becker

PROJECT #: 86F134-005 SHEET 1 OF 2
PROJECT: Liberty Town Square
CLIENT NAME: Steiner
SUBJECT:
DRAWN BY: MPD DATE: 5/07/12
CHECKED BY: DATE

5/07/12 - Prelim. WQ_v Calcs

Drainage Area #1

$WQ_v = cPA$

↳ $c = 0.8$ (commercial)

$P = 0.75"$

$A = 45.6$ ac

$WQ_v = (0.8)(0.75/12)(45.6\text{ ac})(43{,}560\text{ sf/ac})$

$WQ_v = 99{,}317$ CF (2.28 ac-ft)

$(WQ_v)(1.2) = (99{,}317)(1.2) = 119{,}180$ CF = 2.74 Ac-ft

Storage: 119,180 cf / 80,660 SF (garage) = 1.48' → WQ_v elev.

$Q = V/t = (99{,}317\text{ CF})/(48\text{ hr})(3600\text{ s/hr}) = 0.57$ cfs

$Q = CdA_o(2g\Delta H)^{1/2} \rightarrow 0.57\text{ cfs} = (0.61)(A_o)[2(32.2)(1.48/2)]^{1/2}$

$A_o = 0.14\text{ ft}^2 \rightarrow A_o = \pi r^2 \rightarrow 0.14 = \pi r^2 \rightarrow r = 0.21'$

d = 5"

Drainage Area #2

$WQ_v = cPA$

↳ $c = 0.8$ (commercial)

$P = 0.75"$

$A = 20.7$ ac

$WQ_v = (0.8)(0.75/12)(20.7\text{ ac})(43560\text{ sf/ac})$

$WQ_v = 45{,}085$ CF (1.04 ac-ft)

$(WQ_v)(1.2) = (45{,}085)(1.2) = 54{,}102$ CF = 1.24 Ac-ft

Storage: 54,102 cf / 63,690 SF (garage) = 0.85' → WQ_v elev.

$Q = V/t = (45{,}085\text{ cf})/(48\text{ hr})(3600\text{ s/hr}) = 0.26$ cfs

$Q = CdA_o(2g\Delta H)^{1/2} \rightarrow 0.26\text{ cfs} = (0.61)(A_o)[2(32.2)(0.85/2)]^{1/2}$

$A_o = 0.08\text{ ft}^2 \rightarrow A_o = \pi r^2 \rightarrow 0.08 = \pi r^2 \rightarrow r = 0.16'$

d = 4"