LIBERTY CENTER PHASE 1

Detention Calculations

LIBERTY WAY

LIBERTY TOWNSHIP, BUTLER COUNTY, OHIO

JANUARY 15, 2014

UPDATED: 8/05/2014
Garage C As-Built 12/16/14
Garage B As-Built 02/17/15

PREPARED BY:

BAYER BECKER

6900 TYLERSVILLE ROAD

MASON, OHIO 45040

P (513) 336-6600

SUMMARY OF DATA

Method of Hydrograph Development: TR-55

Software: Autodesk Storm and Sanitary Stand Alone

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.

Critical Storm = 100yr

Drainage Area Descriptions	Drainage Area (Acres)	CN	Tc (Mins)	Q1 (ft^3)	% Increase	Critical Storm
On-Site Pre Developed Areas						
Pre N Liberty Center Area	44.90	64.0	38.00	38,311		
Pre N Liberty Center Future Area	3.50	64.0	12.00	2,992		
Pre S Liberty Center Area	20.68	66.9	32.00	23,487		
On-Site Post Developed Areas						
Post N Liberty Center Area	47.87	98.0	15.00	377,338	885%	100 yr
Post N Liberty Center Future Area	3.50	98.0	12.00	27,554	821%	100 yr
Post S Liberty Center Area	17.69	98.0	15.00	137,202	484%	100 yr
Off-Site Areas						
N ODOT Right of Way	0.25	69.0	12.00			
I-75 Ramp	5.33	74.0	15.00			

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DR-1

Sheet:

Issue Date: 01/15/14

Checked By: JD

Drawn by: MJL

Drawing: 06F134-005.DR

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6900 Tylersville Road, Suite A
Mason, OH 45040 - 513.336.6600

SITE BIDDING DOCUMENTS
LIBERTY CENTER PHASE 1
LIBERTY WAY
LIBERTY TOWNSHIP
SECTION 13 & 19, TOWN 3, RANGE 3
BUTLER COUNTY, OHIO
PRE-DEVELOPED CONDITIONS

Item	Revision Description	Date	Dwn.	Chk.

STEINER

Bucksbaum Retail Properties, LLC

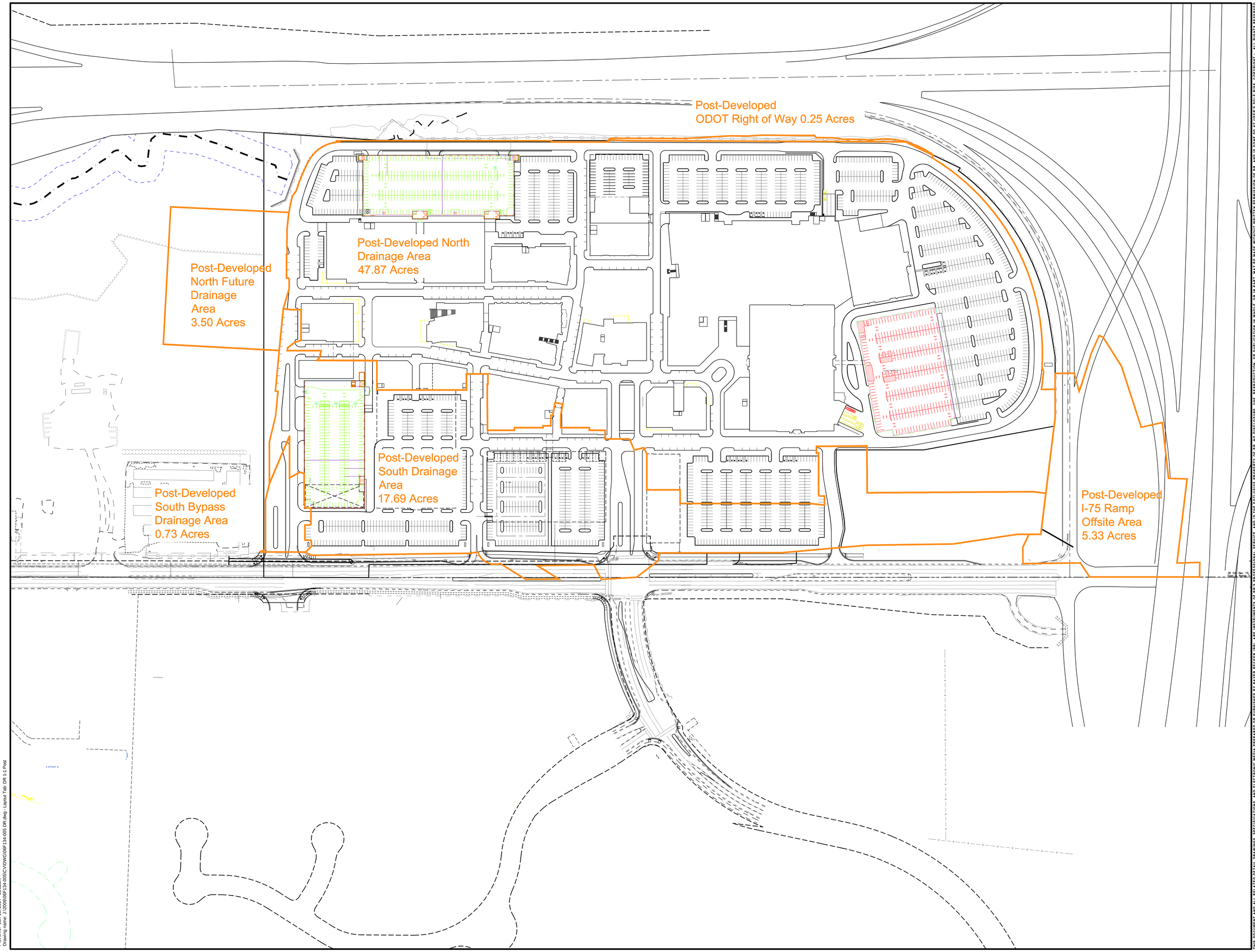
SCALE: 1" = 100'
0 100 150

Pre-Developed
North Drainage Area
44.90 Acres

Pre-Developed
South
Drainage Area
20.68 Acres

Pre-Developed
North Future
Drainage Area
3.50 Acres

Plot time: Jan 15, 2014 - 11:20am
Drawing name: J:\2006\06F134-005\CV\DWG\06F134-005 DR.dwg - Layout Tab: DR 1-0 Pre



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0 100 150
SCALE: 1" = 100'

Bucksbaum Retail Properties, LLC

STEINER

Item	Revision Description	Date	Drwn	Chk

SITE BIDDING DOCUMENTS
LIBERTY CENTER PHASE 1

LIBERTY WAY
LIBERTY TOWNSHIP
SECTION 13 & 19, TOWN 3, RANGE 3
BUTLER COUNTY, OHIO

POST-DEVELOPED CONDITIONS

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6900 Tylersville Road, Suite A
Mason, OH 45040 - 513.336.6600

Drawing: 06F134-005 DR
Drawn by: MJL
Checked By: JD
Issue Date: 01-15-14
Sheet: DR-2

Plot time: Jan 15, 2014 - 11:22am
Drawing name: J:\2006\06F134-005\CV\DWG\06F134-005 DR.dwg - Layout Tab: DR 1-1 Post

SUMMARY OF DATA

Method of Hydrograph Development: TR-55

Software: Autodesk Storm and Sanitary Stand Alone

North Liberty Center Release Point

Critical Storm = 100yr

Drainage Area Descriptions	Drainage Area (Acres)	CN	Tc (Mins)	Q1 (cfs)	Q100 (cfs)
On-Site Pre Developed Areas					
Pre N Liberty Center Area	44.90	64.0	38.00	4.03	63.74
Pre N Liberty Center Future Area	3.50	64.0	12.00	0.62	8.85
On-Site Post Developed Areas					
Post N Liberty Center Area	47.87	98.0	15.00	113.79	270.61
Post N Liberty Center Future Area	3.50	98.0	12.00	7.33	20.31
Off-Site Areas					
Post N Liberty Center ODOT Right of Way Offsite	0.25	69.0	12.00	0.09	0.78
Bypass Areas					

Allowable Release Rate=	
Q1 On-Site Pre Developed Peak + Q100 Off-Site Peak	**5.43 CFS**

Project: **Liberty Center**

Drainage Area Description:

Phase 1, North Liberty Center: Pre-Developed

Job #: 06F134-005
Initials: MJL
Date: 10/21/2013
Revised:

Drainage Area = 48.4 Acres

Soil Types:

80 %	Type 'B'	*38.6 acres*
20 %	Type 'C'	*9.8 acres*

Land Use:

Meadow	21.1 Acres
Row Crops (SR+CR)	8.0 Acres
Gravel Surfaces	0.1 Acres
Woods, Fair	19.2 Acres

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	CN*Soil %*Land %
Meadow	**B**	58	80	43.6	20.18
Meadow	**C**	71	20	43.6	6.25
Row Crops (SR+CR)	**B**	75	80	16.5	9.89
Row Crops (SR+CR)	**C**	82	20	16.5	2.74
Gravel Surfaces	**B**	85	80	0.2	0.14
Gravel Surfaces	**C**	89	20	0.2	0.04
Woods, Fair	**B**	60	80	39.7	18.99
Woods, Fair	**C**	73	20	39.7	5.85

Composite CN = 64.1

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 Center**

Drainage Area Description:

Offsite 129 Right of Way

Job #: 06F134-005
Initials: MJL
Date: 10/21/2013
Revised:

Drainage Area = 0.25 Acres

Soil Types: 100 % Type 'B' *0.3 acres*

Land Use: Open Space 0.3 Acres

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	CN*Soil %*Land %
Open Space	**B**	69	100	100.0	69.00

Composite CN = 69.0

Time of Concentration:

Sheet Flow: **Tc**

Length = 100 Slope(ft/ft) = 0.0200 Manning's, n = 0.04 **0.060** *hr*

Shallow Concentrated Flow:

Length = 300 Slope(ft/ft) = 0.020 Velocity (fps) = 3.5 **0.024** *hr*

Channel Flow:

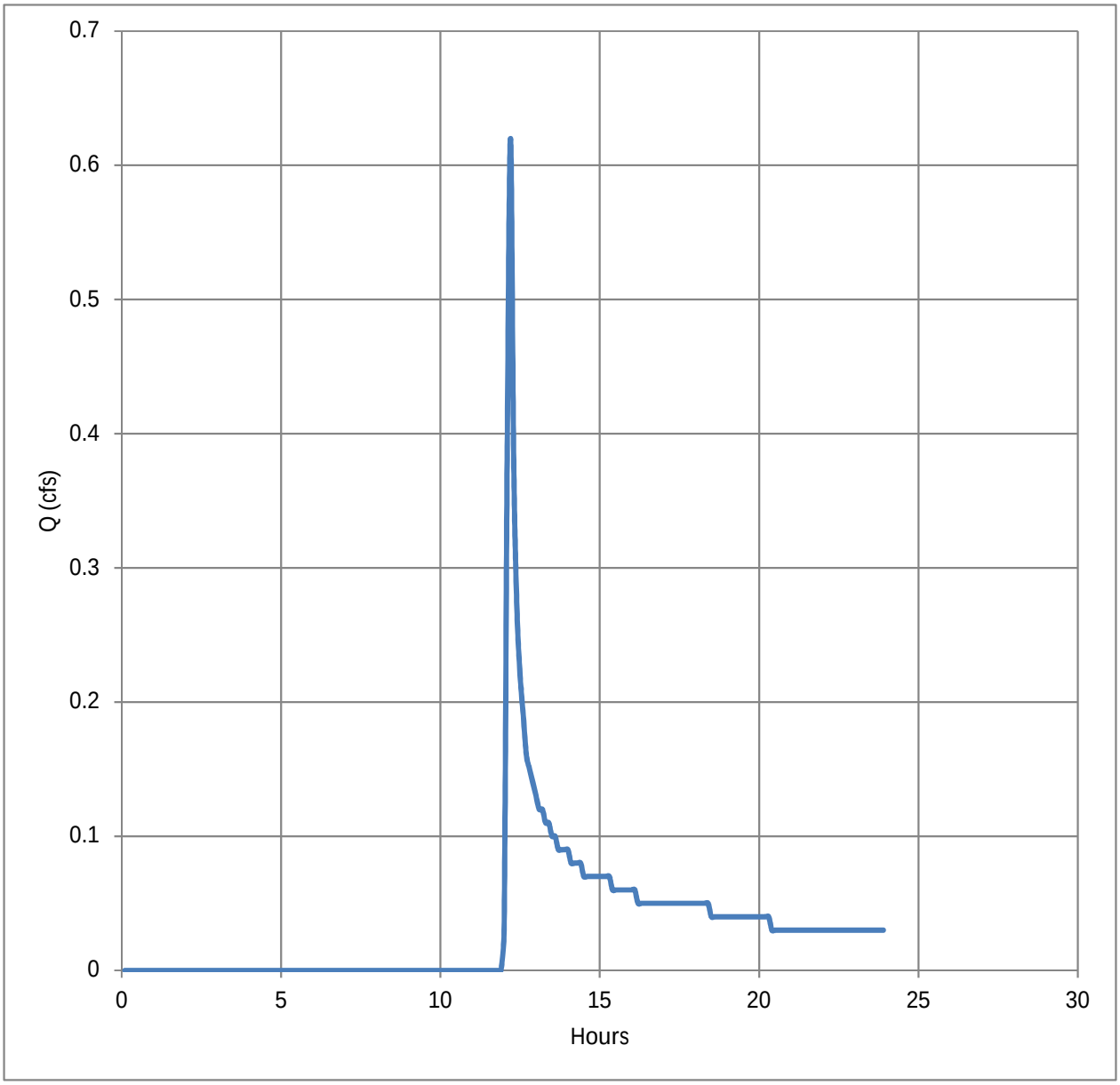
Length = 1500 Velocity (fps) = 3.5 **0.119** *hr*

Tc = 0.20 ***hr***
12 min

Predeveloped N Liberty Center Future Area

Hydrograph Type	=	SCS Runoff Type II	Peak Discharge	=	0.62
Storm Frequency	=	1 yrs	Time to Peak	=	12:12
Time Interval	=	6 min	Hyd. Volume	=	2,992 Ft^3
Drainage Area	=	3.50 Acres	Curve Number	=	64
Tc Method	=	User	Time of conc. (Tc)	=	12.00 Mins
Total precip.	=	2.4 in	Date	=	1/15/2014
Storm Duration	=	24 hrs			

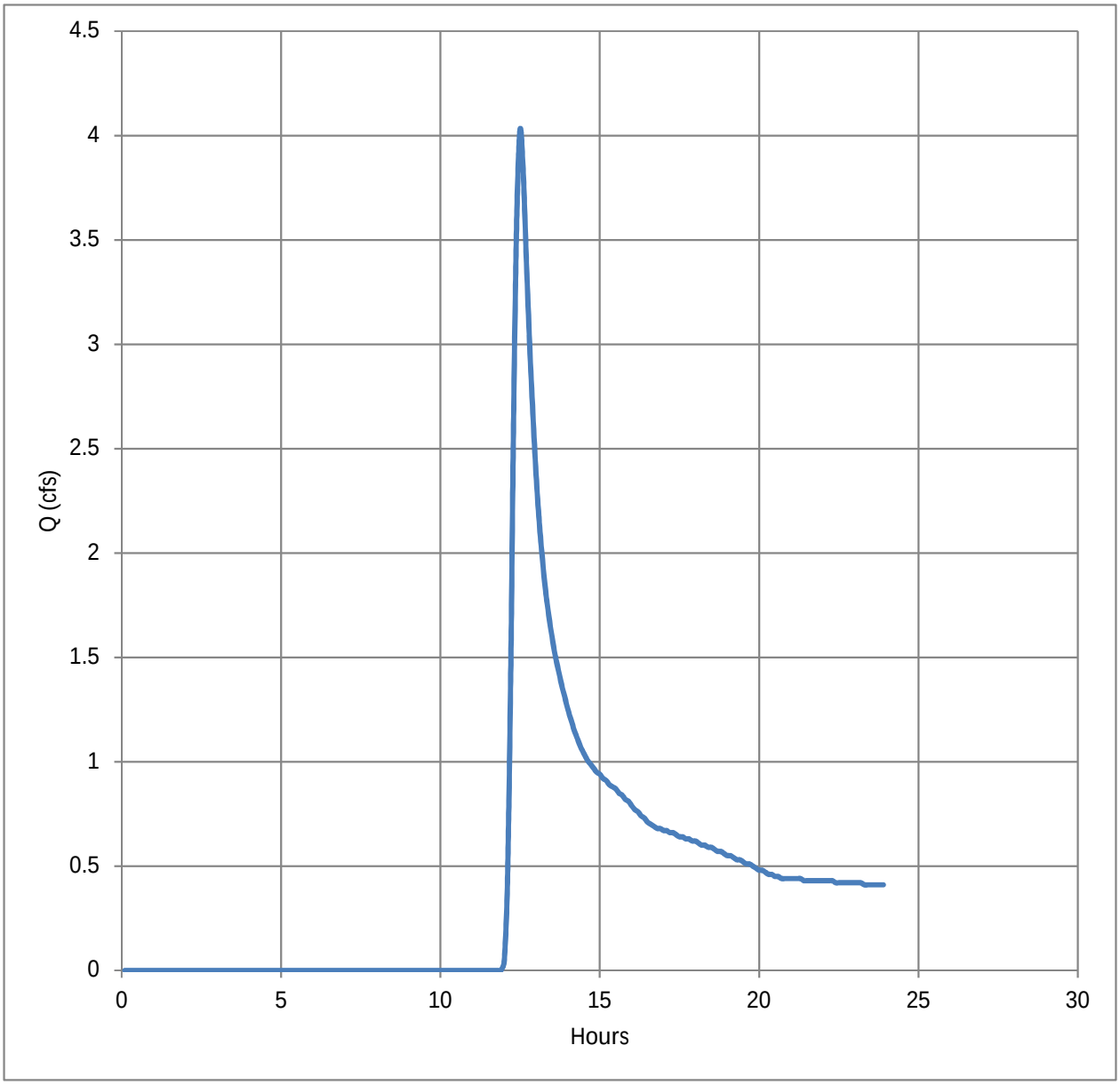
Notes:



Predeveloped N Liberty Center Area

Hydrograph Type	=	SCS Runoff Type II	Peak Discharge	=	4.03
Storm Frequency	=	1 yrs	Time to Peak	=	12:30
Time Interval	=	6 min	Hyd. Volume	=	38,311.68 Ft^3
Drainage Area	=	44.90 Acres	Curve Number	=	64
Tc Method	=	User	Time of conc. (Tc)	=	38.00 Mins
Total precip.	=	2.4 in	Date	=	1/15/2014
Storm Duration	=	24 hrs			

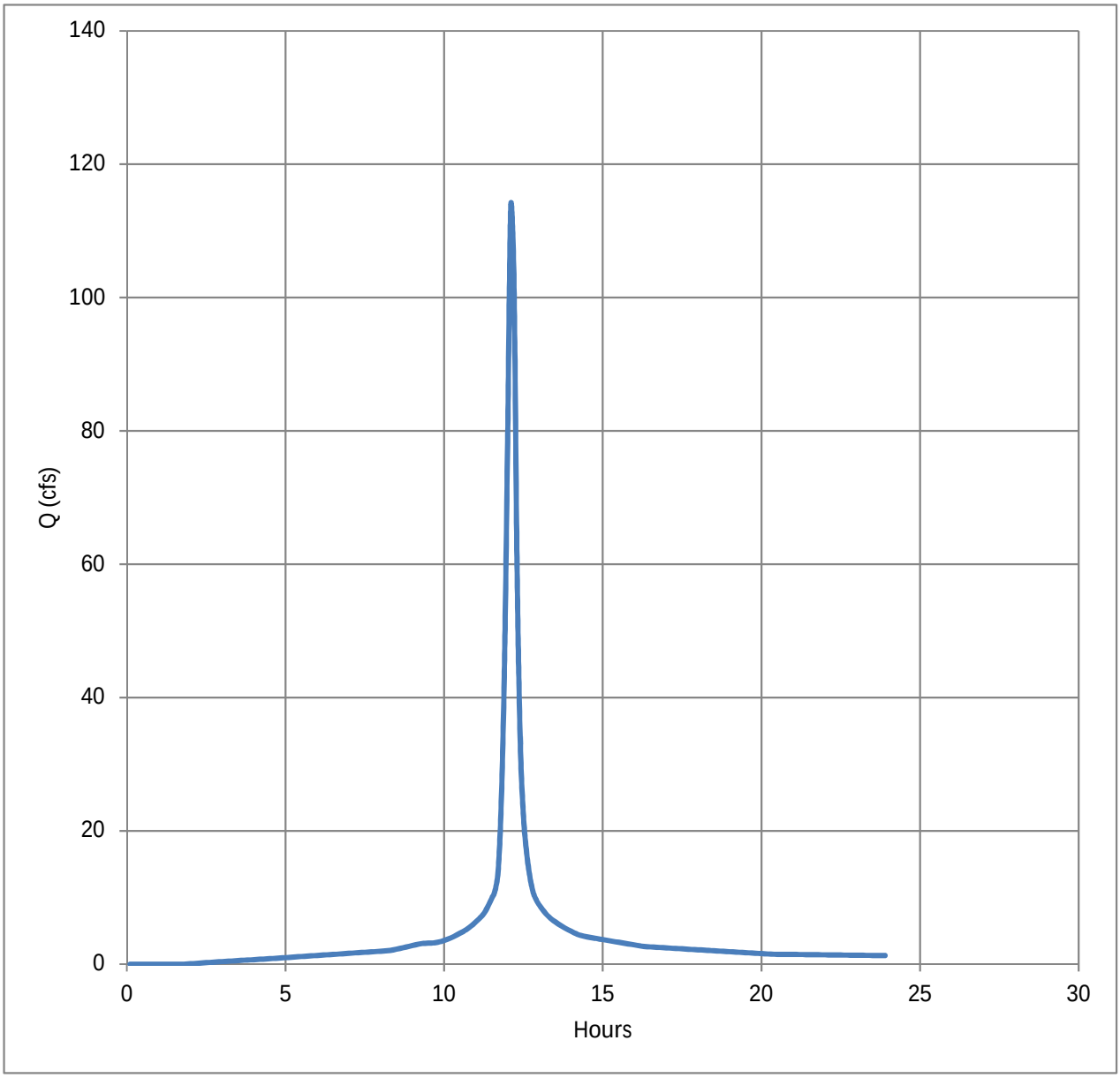
Notes:



Postdeveloped North Liberty Center Area

Hydrograph Type	=	SCS Runoff Type II	Peak Discharge	=	113.79
Storm Frequency	=	1 yrs	Time to Peak	=	12:12
Time Interval	=	6 min	Hyd. Volume	=	377,338 Ft^3
Drainage Area	=	47.87 Acres	Curve Number	=	98
Tc Method	=	User	Time of conc. (Tc)	=	15.00 Mins
Total precip.	=	2.4 in	Date	=	1/15/2014
Storm Duration	=	24 hrs			

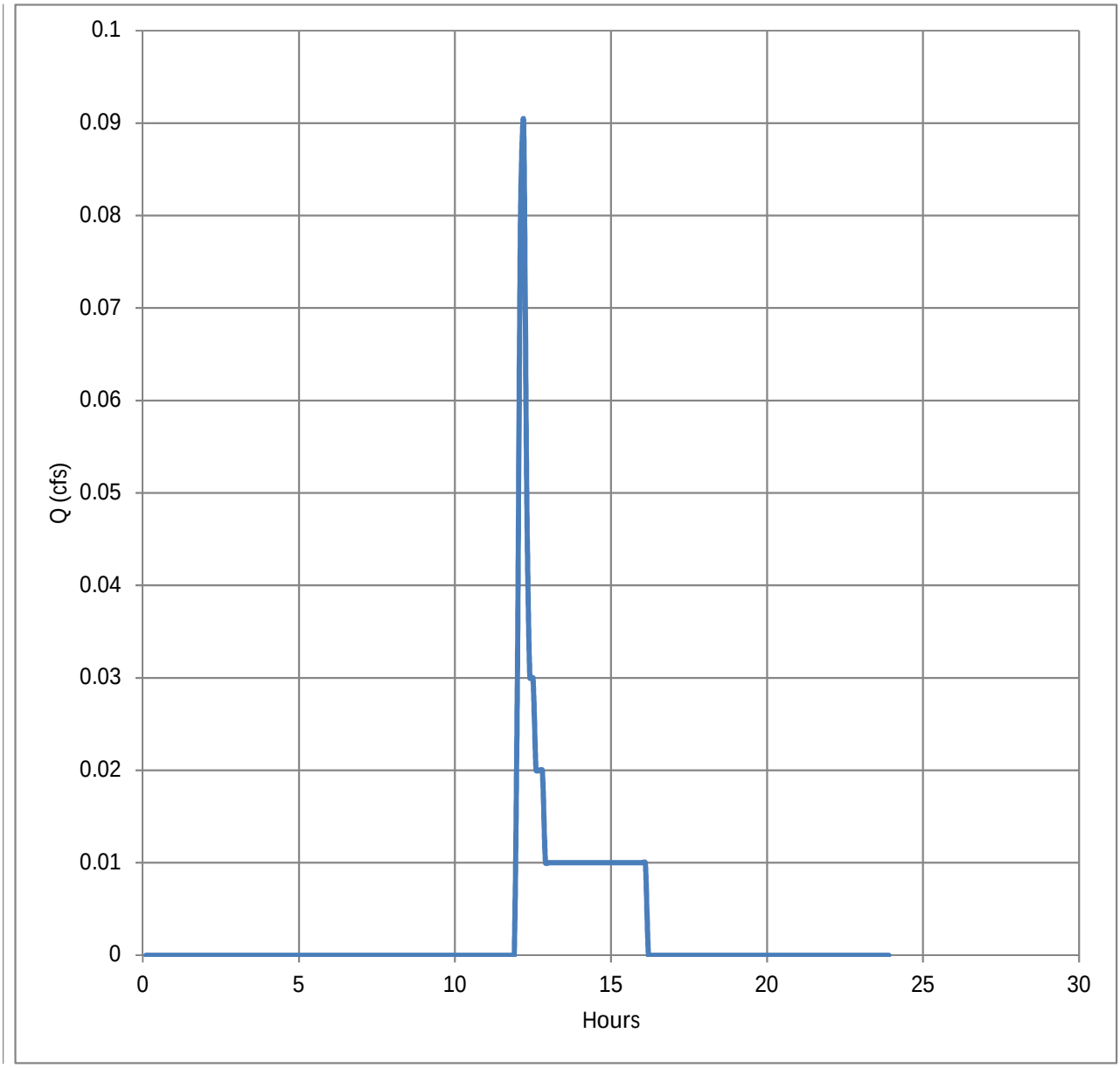
Notes:



Postdeveloped North Liberty Center ODOT Offsite Area

Hydrograph Type	=	SCS Runoff Type II	Peak Discharge	=	0.09
Storm Frequency	=	1 yrs	Time to Peak	=	12:12
Time Interval	=	6 min	Hyd. Volume	=	340 Ft^3
Drainage Area	=	0.25 Acres	Curve Number	=	69
Tc Method	=	User	Time of conc. (Tc)	=	12.00 Mins
Total precip.	=	2.4 in	Date	=	1/15/2014
Storm Duration	=	24 hrs			

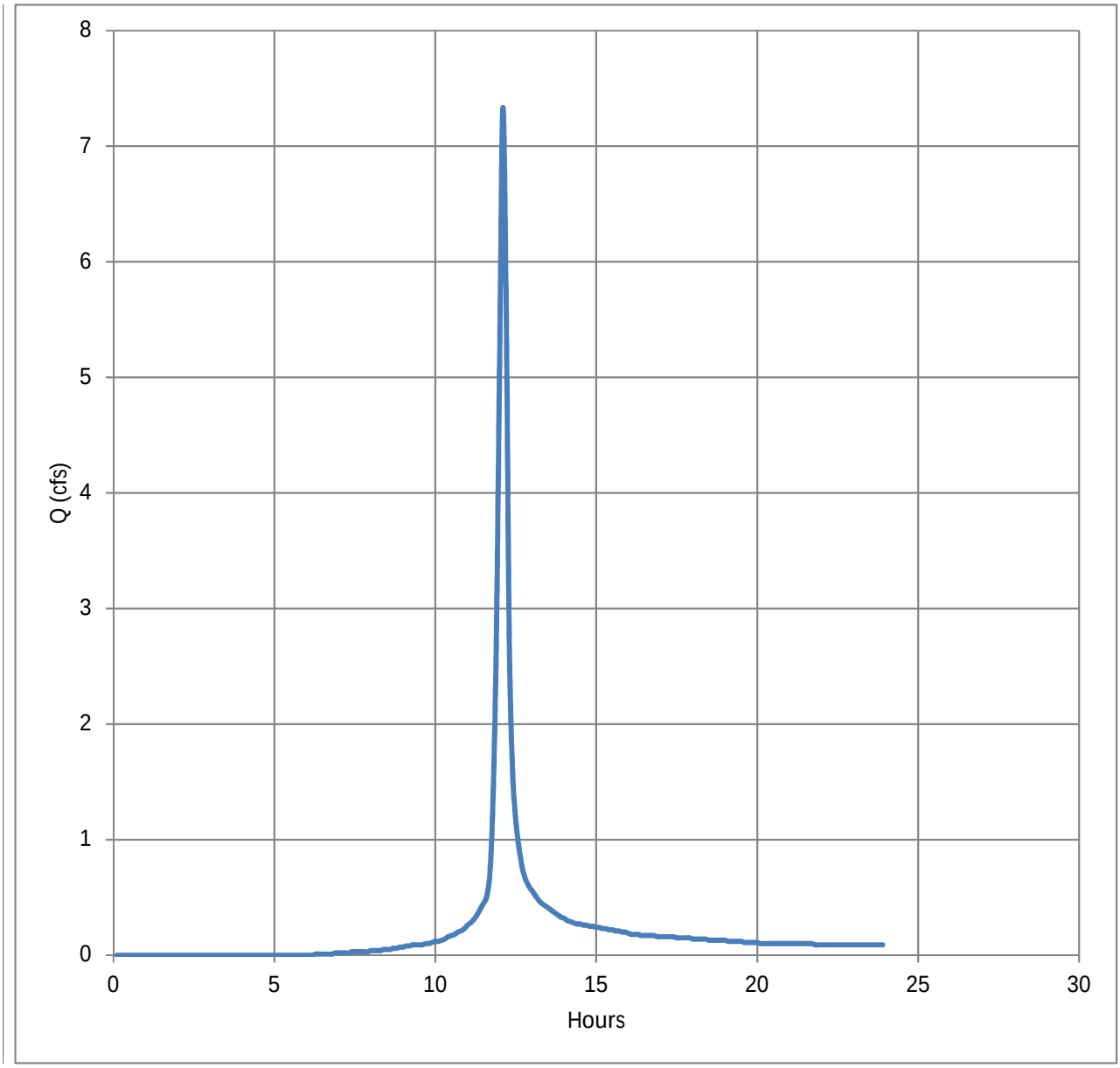
Notes:



Postdeveloped North Liberty Center Future Area

Hydrograph Type	=	SCS Runoff Type II	Peak Discharge	=	7.33
Storm Frequency	=	1 yrs	Time to Peak	=	12:12
Time Interval	=	6 min	Hyd. Volume	=	27,554 Ft^3
Drainage Area	=	3.50 Acres	Curve Number	=	98
Tc Method	=	User	Time of conc. (Tc)	=	12.00 Mins
Total precip.	=	2.4 in	Date	=	1/15/2014
Storm Duration	=	24 hrs			

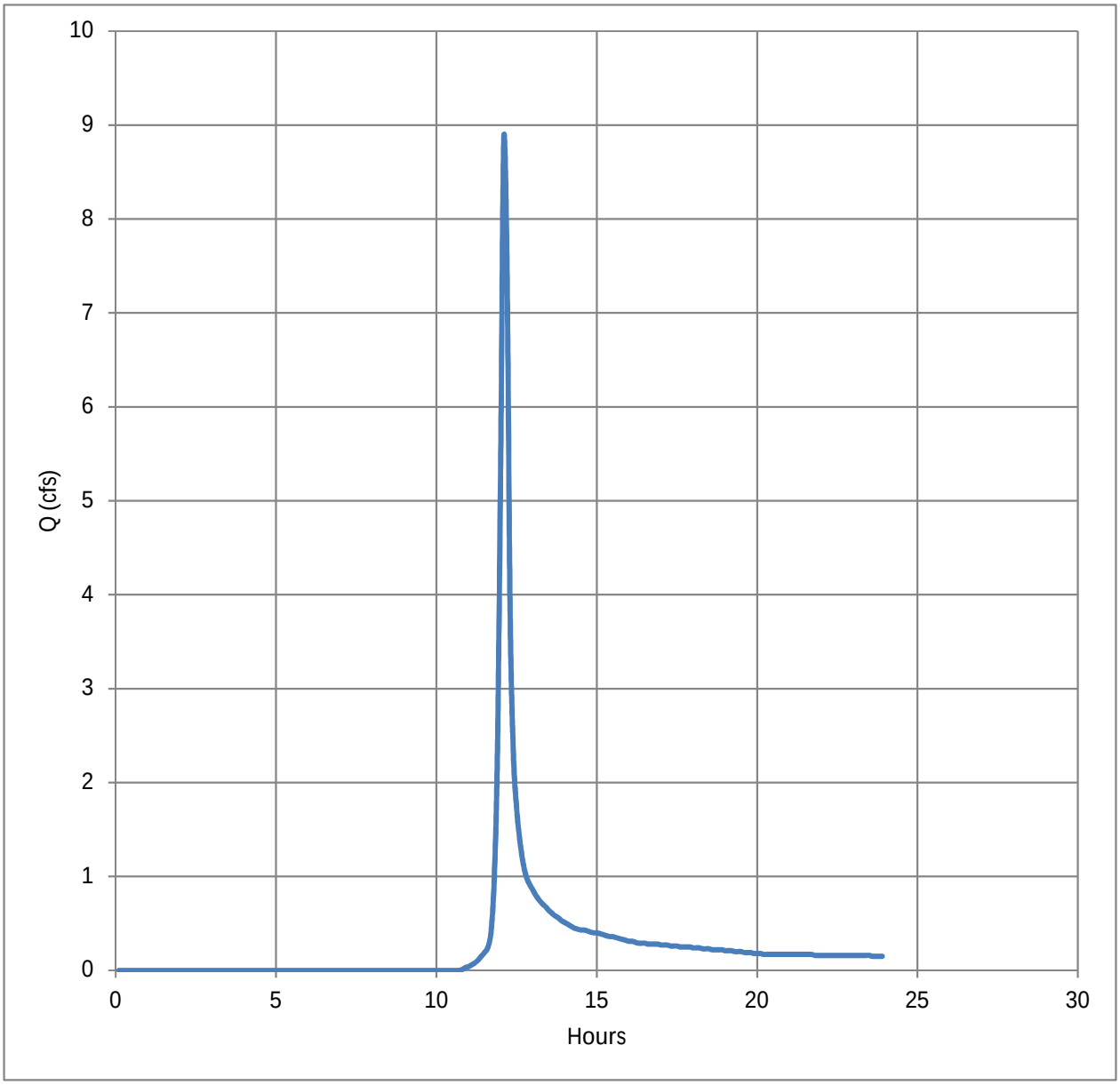
Notes:



Predeveloped N Liberty Center Future Area

Hydrograph Type	=	SCS Runoff Type II	Peak Discharge	=	8.85
Storm Frequency	=	100 yrs	Time to Peak	=	12:12
Time Interval	=	6 min	Hyd. Volume	=	25,214 Ft^3
Drainage Area	=	3.50 Acres	Curve Number	=	64
Tc Method	=	User	Time of conc. (Tc)	=	12.00 Mins
Total precip.	=	5.6 in	Date	=	1/15/2014
Storm Duration	=	24 hrs			

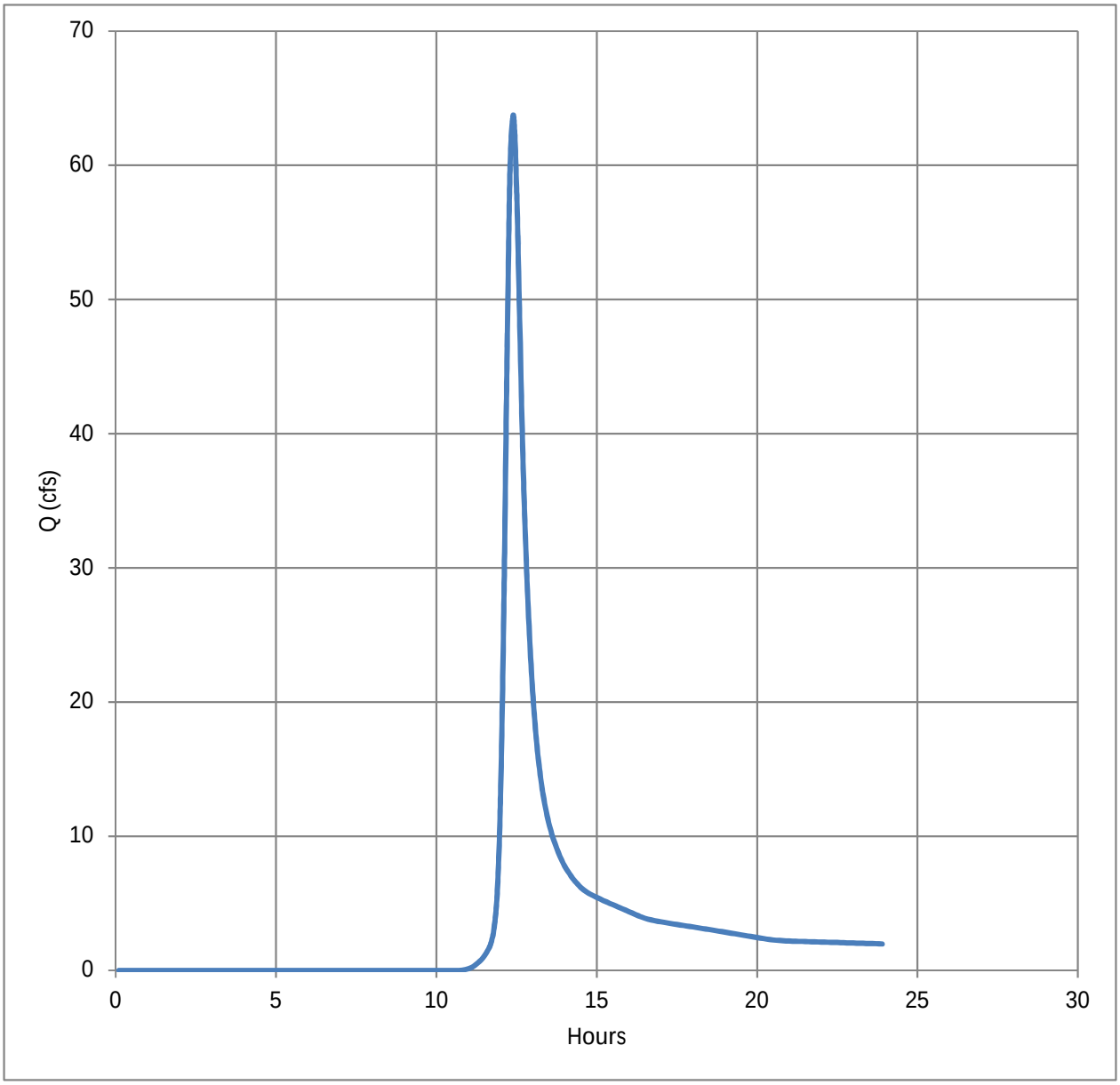
Notes:



Predeveloped N Liberty Center Area

Hydrograph Type	=	SCS Runoff Type II	Peak Discharge	=	63.74
Storm Frequency	=	100 yrs	Time to Peak	=	12:30
Time Interval	=	6 min	Hyd. Volume	=	322,447 Ft^3
Drainage Area	=	44.90 Acres	Curve Number	=	64
Tc Method	=	User	Time of conc. (Tc)	=	38.00 Mins
Total precip.	=	5.6 in	Date	=	1/15/2014
Storm Duration	=	24 hrs			

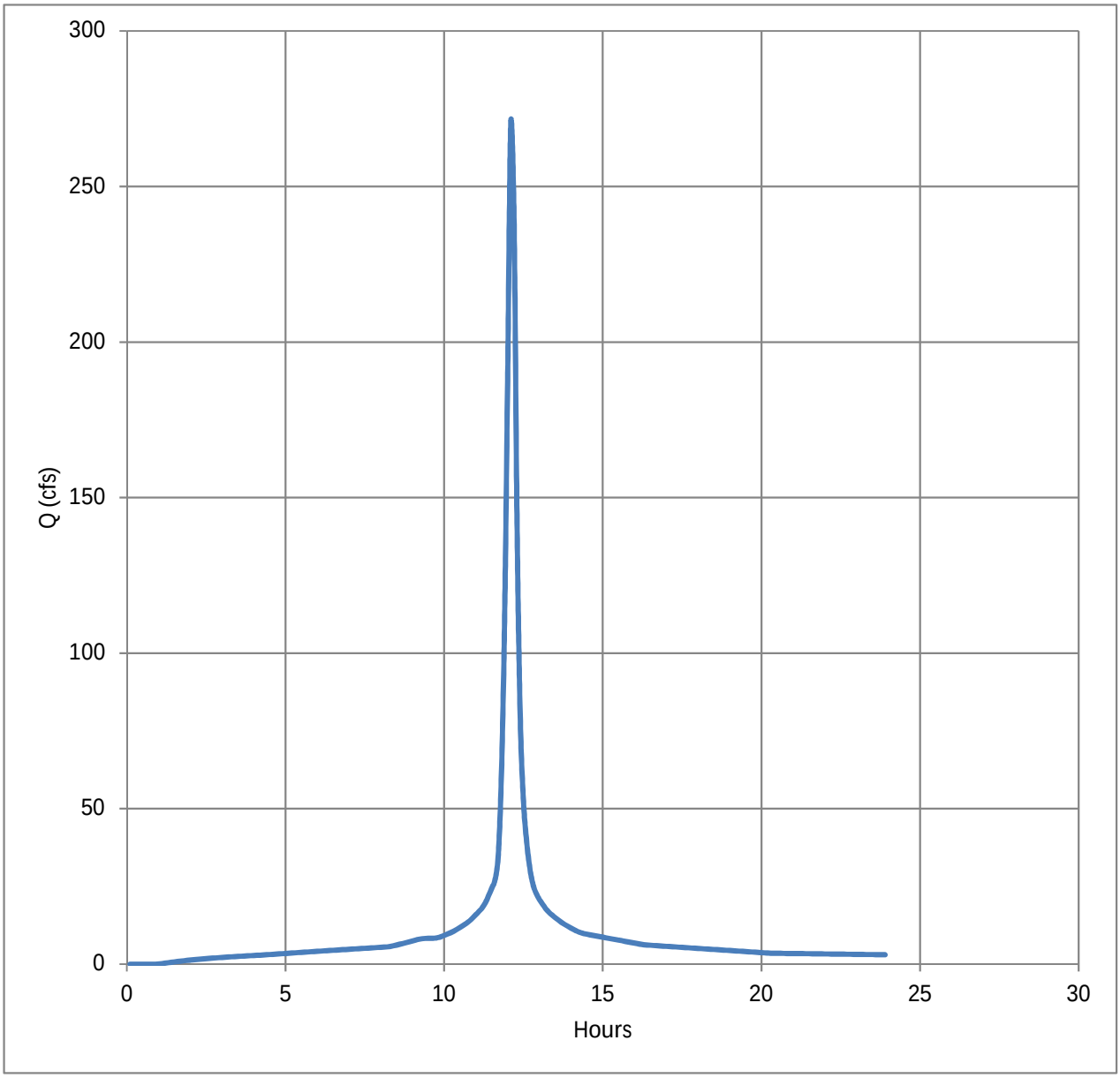
Notes:



Postdeveloped North Liberty Center Area

Hydrograph Type	=	SCS Runoff Type II	Peak Discharge	=	270.61
Storm Frequency	=	100 yrs	Time to Peak	=	12:12
Time Interval	=	6 min	Hyd. Volume	=	391,538 Ft^3
Drainage Area	=	47.87 Acres	Curve Number	=	98
Tc Method	=	User	Time of conc. (Tc)	=	15.00 Mins
Total precip.	=	5.6 in	Date	=	1/15/2014
Storm Duration	=	24 hrs			

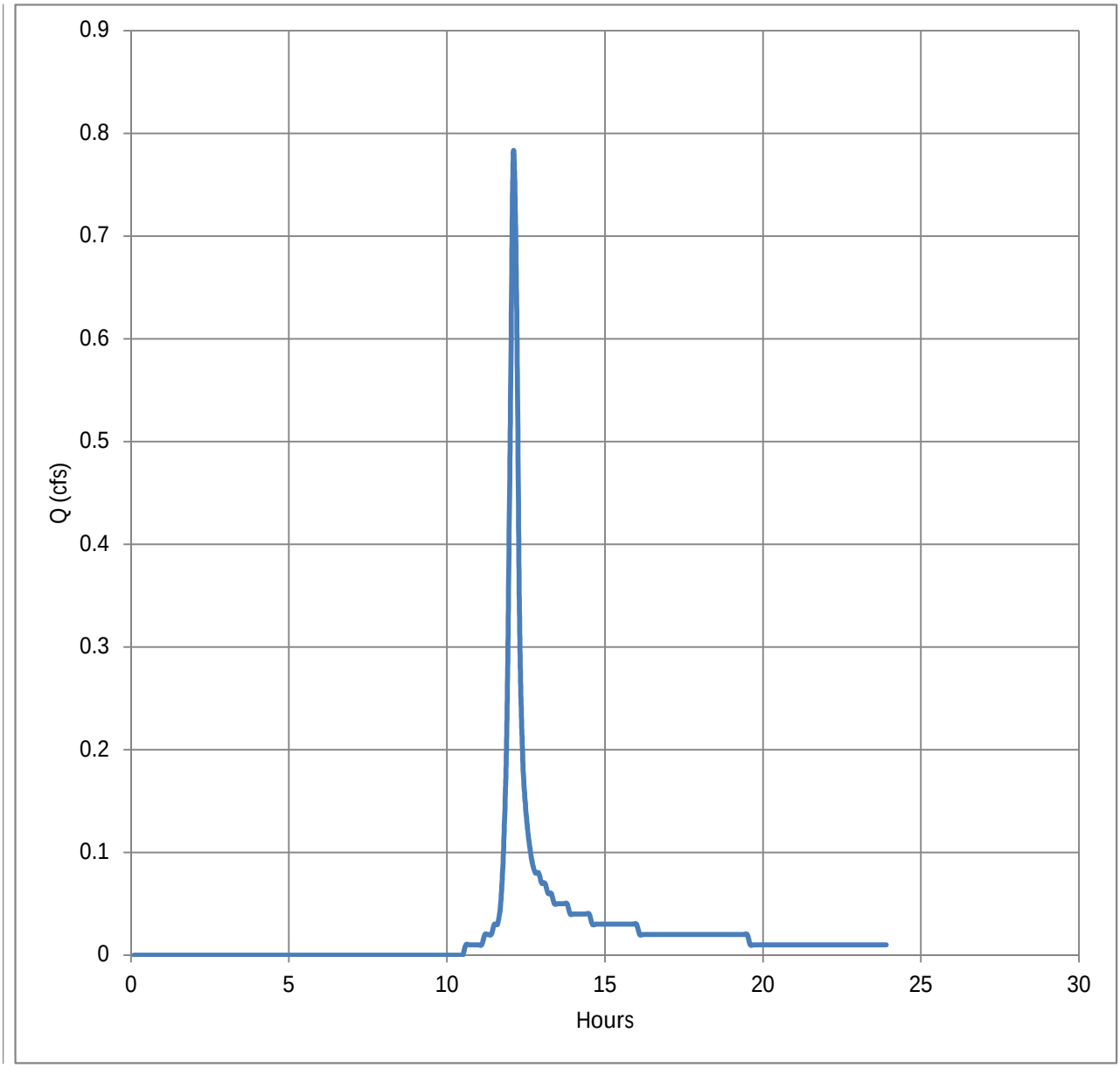
Notes:



Postdeveloped North Liberty Center ODOT Offsite Area

Hydrograph Type	=	SCS Runoff Type II	Peak Discharge	=	0.78
Storm Frequency	=	100 yrs	Time to Peak	=	12:12
Time Interval	=	6 min	Hyd. Volume	=	2179 Ft^3
Drainage Area	=	0.25 Acres	Curve Number	=	69
Tc Method	=	User	Time of conc. (Tc)	=	12.00 Mins
Total precip.	=	5.6 in	Date	=	1/15/2014
Storm Duration	=	24 hrs			

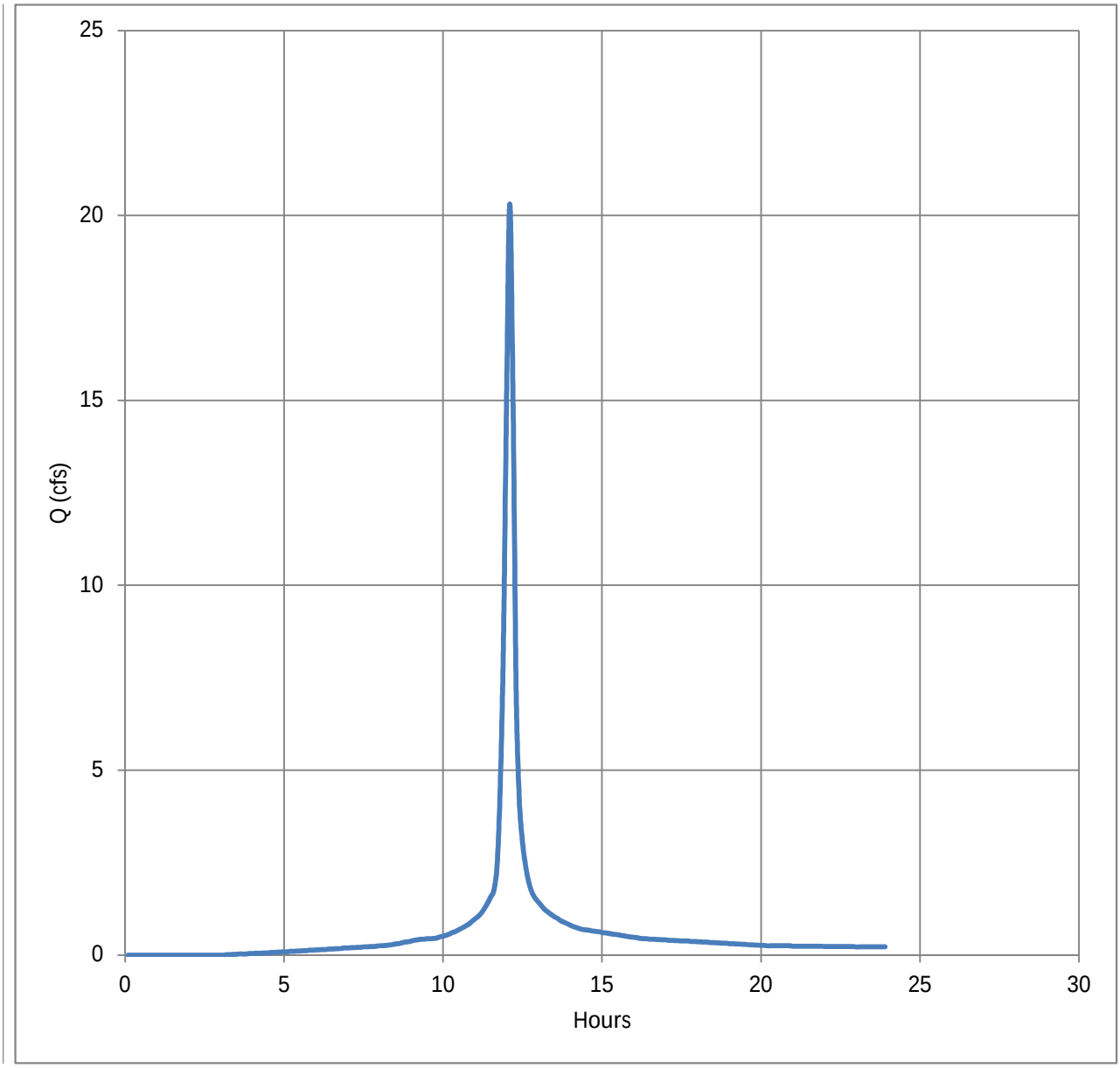
Notes:



Postdeveloped North Liberty Center Future Area

Hydrograph Type	=	SCS Runoff Type II	Peak Discharge	=	20.31
Storm Frequency	=	100 yrs	Time to Peak	=	12:12
Time Interval	=	6 min	Hyd. Volume	=	68,190 Ft^3
Drainage Area	=	3.50 Acres	Curve Number	=	98
Tc Method	=	User	Time of conc. (Tc)	=	12.00 Mins
Total precip.	=	5.6 in	Date	=	1/15/2014
Storm Duration	=	24 hrs			

Notes:



Water Quality Volume

Project:	Liberty Center	Designed By:	MJL	Date:	10/21/13
Job No.:	06F134-005	Checked By:		Date:	
Basin ID:	North Garage B Basin	Revised By:	MJL	Date:	1/15/14
			2/17/2015 As-Built		

Required Water Quality Volume

$WQ_v = P\ C\ A/12$

Site Drainage Area (A) = 51.92 acres (To Basin)

Rainfall Depth (P) = 0.75 in.

Runoff Coefficient (C) = 0.8

WQ_v = 2.596 acre-ft.

Sediment Storage Allowance = 20 %

Sediment Storage Allowance = 0.52 Ac-ft

22,616 cu.ft.

Total WQ_v = 3.115 Ac-ft

= 135,698 cu.ft.

WQv Orifice Inv 852.72

Water Quality Release Rate

Q_{wqv} = Total WQ_v/RT

Retention Time (RT) = 48 hours

Q_{wqv} = 0.79 cfs

Water Quality Outlet Orifice

Contour Areas

	Elevation ft	Area ft^2	Volume ft^3	Cum. Vol. ft^3	Elevation at V	Storage at Elev
Basin Inv. =	850.45	0.00	0.00	0.00		
Contour 1 =	850.55	608.00	30.40	30.40		
Contour 2 =	851.00	8848.00	2127.60	2158.00		
Contour 3 =	852.00	18329.00	13588.50	15746.50		
Contour 4 =	852.73	21400.00	14501.09	30247.59		
Contour 5 =	858.12	21400.00	115346.00	145593.59	857.66	
Contour 6 =	862.85	21400.00	101222.00	246815.59		151100.21
Contour 7 =	864.00	21400.00	24610.00	271425.59		
Contour 8 =						

$Q = N\ C_d\ A_o\ (2\ g\ Dh)^{1/2}$

C_d = 0.61

$A_o = p\ D^2/4$ for circular orifices; = h * w for rectangular orifices

g = 32.20 ft/sec^2

$Q = Q_{wqv}$ = 0.785 cfs

Required Volume = V = 135698 ft^3

Elevation at V = 857.66

Number of orifices = N = 1

Orifice h = 4.250 inch

Orifice w = 0.00 inch (= 0 for circular orifice)

Dh_{min}^{avg} = (Elev at V - Basin Inv)/2 - 1/2 h = 2.29 ft

$A_{trial} = Q/(N\ C_d\ (2\ g\ Dh_{min})^{1/2})$ = 15.26 in^2

Actual $A = A_o$ = 14.19 in^2

$Dh^{avg} = (Q/(N\ C_d\ A_o))^2/(2\ g)$ = 2.65 ft

Elev = 858.38 > Elevation at V = 857.66 Good

Storage = 151100.21 ft^3

Q = 0.785 cfs

Provided Retention Time = 53.45 Hours

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Tuesday, 02 / 17 / 2015

Pond No. 1 - Garage B WQ

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 850.45 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	850.45	00	0	0
0.10	850.55	608	20	20
0.55	851.00	8,848	1,766	1,786
1.55	852.00	18,329	13,303	15,089
2.28	852.73	21,400	14,485	29,574
7.67	858.12	21,400	115,335	144,909
12.40	862.85	21,400	101,212	246,121
13.55	864.00	21,400	24,608	270,728

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 4.25	0.00	0.00	0.00
Span (in)	= 4.25	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 852.72	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.61	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 200.00	0.00	0.00	0.00
Crest El. (ft)	= 858.12	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 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 cuft	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	850.45	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.01	2	850.46	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.02	4	850.47	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.03	6	850.48	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.04	8	850.49	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.05	10	850.50	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.06	12	850.51	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.07	14	850.52	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.08	16	850.53	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.09	18	850.54	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.10	20	850.55	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.14	197	850.59	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.19	373	850.64	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.23	550	850.68	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.28	727	850.73	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.32	903	850.77	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.37	1,080	850.82	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.42	1,257	850.86	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.46	1,433	850.91	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.51	1,610	850.95	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.55	1,786	851.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.65	3,117	851.10	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.75	4,447	851.20	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.85	5,777	851.30	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.95	7,107	851.40	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.05	8,438	851.50	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.15	9,768	851.60	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.25	11,098	851.70	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.35	12,428	851.80	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.45	13,759	851.90	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.55	15,089	852.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.62	16,538	852.07	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.70	17,986	852.15	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.77	19,435	852.22	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.84	20,883	852.29	0.00	---	---	---	0.00	---	---	---	---	---	0.000

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Garage B WQ

Stage / Storage / Discharge Table

Stage ft	Storage cuft	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
1.91	22,332	852.36	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.99	23,780	852.44	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.06	25,229	852.51	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.13	26,677	852.58	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.21	28,126	852.66	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.28	29,574	852.73	0.00 ic	---	---	---	0.00	---	---	---	---	---	0.000
2.82	41,108	853.27	0.30 ic	---	---	---	0.00	---	---	---	---	---	0.296
3.36	52,641	853.81	0.46 ic	---	---	---	0.00	---	---	---	---	---	0.463
3.90	64,175	854.35	0.58 ic	---	---	---	0.00	---	---	---	---	---	0.584
4.44	75,708	854.89	0.68 ic	---	---	---	0.00	---	---	---	---	---	0.684
4.97	87,241	855.42	0.77 ic	---	---	---	0.00	---	---	---	---	---	0.772
5.51	98,775	855.96	0.85 ic	---	---	---	0.00	---	---	---	---	---	0.850
6.05	110,308	856.50	0.92 ic	---	---	---	0.00	---	---	---	---	---	0.922
6.59	121,842	857.04	0.99 ic	---	---	---	0.00	---	---	---	---	---	0.988
7.13	133,375	857.58	1.05 ic	---	---	---	0.00	---	---	---	---	---	1.050
7.67	144,909	858.12	1.11 ic	---	---	---	0.00	---	---	---	---	---	1.109
8.14	155,030	858.59	1.16 ic	---	---	---	216.67	---	---	---	---	---	217.83
8.62	165,151	859.07	1.21 ic	---	---	---	612.77	---	---	---	---	---	613.98
9.09	175,272	859.54	1.25 ic	---	---	---	1125.92	---	---	---	---	---	1127.17
9.56	185,393	860.01	1.29 ic	---	---	---	1733.35	---	---	---	---	---	1734.65
10.03	195,515	860.49	1.34 ic	---	---	---	2422.43	---	---	---	---	---	2423.77
10.51	205,636	860.96	1.38 ic	---	---	---	3184.37	---	---	---	---	---	3185.75
10.98	215,757	861.43	1.42 ic	---	---	---	4012.88	---	---	---	---	---	4014.30
11.45	225,878	861.90	1.46 ic	---	---	---	4902.66	---	---	---	---	---	4904.12
11.93	235,999	862.38	1.49 ic	---	---	---	5850.06	---	---	---	---	---	5851.56
12.40	246,121	862.85	1.53 ic	---	---	---	6851.15	---	---	---	---	---	6852.68
12.52	248,581	862.97	1.54 ic	---	---	---	7102.63	---	---	---	---	---	7104.17
12.63	251,042	863.08	1.55 ic	---	---	---	7356.98	---	---	---	---	---	7358.53
12.74	253,503	863.20	1.56 ic	---	---	---	7614.30	---	---	---	---	---	7615.86
12.86	255,964	863.31	1.57 ic	---	---	---	7874.55	---	---	---	---	---	7876.11
12.98	258,424	863.42	1.57 ic	---	---	---	8137.69	---	---	---	---	---	8139.27
13.09	260,885	863.54	1.58 ic	---	---	---	8403.71	---	---	---	---	---	8405.29
13.20	263,346	863.66	1.59 ic	---	---	---	8672.71	---	---	---	---	---	8674.30
13.32	265,807	863.77	1.60 ic	---	---	---	8944.37	---	---	---	---	---	8945.97
13.44	268,267	863.88	1.61 ic	---	---	---	9218.52	---	---	---	---	---	9220.13
13.55	270,728	864.00	1.62 ic	---	---	---	9496.00	---	---	---	---	---	9497.62

...End

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Tuesday, 02 / 17 / 2015

Pond No. 2 - Garage B Detention

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 850.58 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	850.58	00	0	0
0.42	851.00	2,951	413	413
1.42	852.00	24,610	12,026	12,440
2.40	852.98	47,942	34,918	47,357
4.40	854.98	48,340	96,272	143,629
7.54	858.12	48,340	151,772	295,402
12.27	862.85	48,340	228,625	524,027
12.87	863.45	48,340	29,001	553,028
14.42	865.00	48,340	74,920	627,948

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 72.00	7.00	0.00	0.00
Span (in)	= 72.00	7.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 850.11	850.58	0.00	0.00
Length (ft)	= 23.00	0.00	0.00	0.00
Slope (%)	= 0.50	0.00	0.00	n/a
N-Value	= .015	.015	.013	n/a
Orifice Coeff.	= 0.60	0.61	0.60	0.60
Multi-Stage	= n/a	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 60.00	0.00	0.00	0.00
Crest El. (ft)	= 862.85	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= Yes	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 cuft	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	850.58	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.04	41	850.62	2.02 oc	0.01 ic	---	---	0.00	---	---	---	---	---	0.006
0.08	83	850.66	2.02 oc	0.02 ic	---	---	0.00	---	---	---	---	---	0.025
0.13	124	850.71	2.02 oc	0.05 ic	---	---	0.00	---	---	---	---	---	0.054
0.17	165	850.75	2.02 oc	0.09 ic	---	---	0.00	---	---	---	---	---	0.094
0.21	207	850.79	2.02 oc	0.14 ic	---	---	0.00	---	---	---	---	---	0.139
0.25	248	850.83	2.02 oc	0.20 ic	---	---	0.00	---	---	---	---	---	0.197
0.29	289	850.87	2.02 oc	0.26 ic	---	---	0.00	---	---	---	---	---	0.257
0.34	330	850.92	2.02 oc	0.32 ic	---	---	0.00	---	---	---	---	---	0.323
0.38	372	850.96	2.02 oc	0.40 ic	---	---	0.00	---	---	---	---	---	0.397
0.42	413	851.00	2.02 oc	0.47 ic	---	---	0.00	---	---	---	---	---	0.470
0.52	1,616	851.10	2.02 oc	0.63 ic	---	---	0.00	---	---	---	---	---	0.634
0.62	2,818	851.20	2.02 oc	0.75 ic	---	---	0.00	---	---	---	---	---	0.754
0.72	4,021	851.30	2.02 oc	0.86 ic	---	---	0.00	---	---	---	---	---	0.862
0.82	5,224	851.40	2.02 oc	0.96 ic	---	---	0.00	---	---	---	---	---	0.957
0.92	6,426	851.50	2.02 oc	1.04 ic	---	---	0.00	---	---	---	---	---	1.044
1.02	7,629	851.60	2.02 oc	1.12 ic	---	---	0.00	---	---	---	---	---	1.124
1.12	8,832	851.70	2.02 oc	1.20 ic	---	---	0.00	---	---	---	---	---	1.198
1.22	10,034	851.80	2.02 oc	1.27 ic	---	---	0.00	---	---	---	---	---	1.268
1.32	11,237	851.90	2.02 oc	1.34 ic	---	---	0.00	---	---	---	---	---	1.335
1.42	12,440	852.00	2.02 oc	1.40 ic	---	---	0.00	---	---	---	---	---	1.399
1.52	15,931	852.10	2.02 oc	1.46 ic	---	---	0.00	---	---	---	---	---	1.458
1.62	19,423	852.20	2.02 oc	1.52 ic	---	---	0.00	---	---	---	---	---	1.515
1.71	22,915	852.29	2.02 oc	1.57 ic	---	---	0.00	---	---	---	---	---	1.570
1.81	26,407	852.39	2.02 oc	1.62 ic	---	---	0.00	---	---	---	---	---	1.624
1.91	29,898	852.49	2.02 oc	1.68 ic	---	---	0.00	---	---	---	---	---	1.675
2.01	33,390	852.59	2.02 oc	1.73 ic	---	---	0.00	---	---	---	---	---	1.725
2.11	36,882	852.69	2.02 oc	1.77 ic	---	---	0.00	---	---	---	---	---	1.774
2.20	40,374	852.78	2.02 oc	1.82 ic	---	---	0.00	---	---	---	---	---	1.821
2.30	43,865	852.88	2.02 oc	1.87 ic	---	---	0.00	---	---	---	---	---	1.867
2.40	47,357	852.98	2.02 oc	1.91 ic	---	---	0.00	---	---	---	---	---	1.912
2.60	56,984	853.18	2.02 oc	2.00 ic	---	---	0.00	---	---	---	---	---	2.000
2.80	66,611	853.38	2.20 oc	2.09 ic	---	---	0.00	---	---	---	---	---	2.085
3.00	76,239	853.58	2.20 oc	2.17 ic	---	---	0.00	---	---	---	---	---	2.167

Continues on next page...

Garage B Detention

Stage / Storage / Discharge Table

Stage ft	Storage cuft	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
3.20	85,866	853.78	2.40 oc	2.25 ic	---	---	0.00	---	---	---	---	---	2.245
3.40	95,493	853.98	2.40 oc	2.32 ic	---	---	0.00	---	---	---	---	---	2.321
3.60	105,120	854.18	2.40 oc	2.39 ic	---	---	0.00	---	---	---	---	---	2.395
3.80	114,748	854.38	2.60 oc	2.47 ic	---	---	0.00	---	---	---	---	---	2.466
4.00	124,375	854.58	2.60 oc	2.54 ic	---	---	0.00	---	---	---	---	---	2.536
4.20	134,002	854.78	2.81 oc	2.60 ic	---	---	0.00	---	---	---	---	---	2.603
4.40	143,629	854.98	2.81 oc	2.67 ic	---	---	0.00	---	---	---	---	---	2.669
4.71	158,806	855.29	2.81 oc	2.77 ic	---	---	0.00	---	---	---	---	---	2.769
5.03	173,984	855.61	3.03 oc	2.87 ic	---	---	0.00	---	---	---	---	---	2.866
5.34	189,161	855.92	3.03 oc	2.96 ic	---	---	0.00	---	---	---	---	---	2.959
5.66	204,338	856.24	3.26 oc	3.05 ic	---	---	0.00	---	---	---	---	---	3.050
5.97	219,515	856.55	3.26 oc	3.14 ic	---	---	0.00	---	---	---	---	---	3.138
6.28	234,693	856.86	3.26 oc	3.22 ic	---	---	0.00	---	---	---	---	---	3.223
6.60	249,870	857.18	3.50 oc	3.31 ic	---	---	0.00	---	---	---	---	---	3.307
6.91	265,047	857.49	3.50 oc	3.39 ic	---	---	0.00	---	---	---	---	---	3.388
7.23	280,224	857.81	3.50 oc	3.47 ic	---	---	0.00	---	---	---	---	---	3.467
7.54	295,402	858.12	3.75 oc	3.54 ic	---	---	0.00	---	---	---	---	---	3.545
8.01	318,264	858.59	3.75 oc	3.66 ic	---	---	0.00	---	---	---	---	---	3.659
8.49	341,127	859.07	4.01 oc	3.77 ic	---	---	0.00	---	---	---	---	---	3.769
8.96	363,989	859.54	4.01 oc	3.88 ic	---	---	0.00	---	---	---	---	---	3.876
9.43	386,852	860.01	4.01 oc	3.98 ic	---	---	0.00	---	---	---	---	---	3.981
9.90	409,714	860.49	4.29 oc	4.08 ic	---	---	0.00	---	---	---	---	---	4.082
10.38	432,577	860.96	4.29 oc	4.18 ic	---	---	0.00	---	---	---	---	---	4.182
10.85	455,439	861.43	4.29 oc	4.28 ic	---	---	0.00	---	---	---	---	---	4.279
11.32	478,302	861.90	4.57 oc	4.37 ic	---	---	0.00	---	---	---	---	---	4.370
11.80	501,164	862.38	4.57 oc	4.46 ic	---	---	0.00	---	---	---	---	---	4.462
12.27	524,027	862.85	4.57 oc	4.55 ic	---	---	0.00	---	---	---	---	---	4.553
12.33	526,927	862.91	7.54 oc	4.51 ic	---	---	2.94	---	---	---	---	---	7.447
12.39	529,827	862.97	13.21 oc	4.42 ic	---	---	8.31	---	---	---	---	---	12.73
12.45	532,727	863.03	19.63 oc	4.33 ic	---	---	15.27	---	---	---	---	---	19.59
12.51	535,627	863.09	28.05 oc	4.21 ic	---	---	23.50	---	---	---	---	---	27.71
12.57	538,528	863.15	37.31 oc	4.07 ic	---	---	32.84	---	---	---	---	---	36.91
12.63	541,428	863.21	47.35 oc	3.91 ic	---	---	43.17	---	---	---	---	---	47.08
12.69	544,328	863.27	58.22 oc	3.67 ic	---	---	54.39	---	---	---	---	---	58.07
12.75	547,228	863.33	69.99 oc	3.53 ic	---	---	66.45	---	---	---	---	---	69.98
12.81	550,128	863.39	82.84 oc	3.53 ic	---	---	79.29	---	---	---	---	---	82.82
12.87	553,028	863.45	96.41 oc	3.53 ic	---	---	92.87	---	---	---	---	---	96.39
13.02	560,520	863.61	134.59 oc	3.50 ic	---	---	131.09	---	---	---	---	---	134.59
13.18	568,012	863.76	176.91 oc	3.43 ic	---	---	173.47	---	---	---	---	---	176.90
13.33	575,504	863.92	222.96 oc	3.33 ic	---	---	219.63	---	---	---	---	---	222.96
13.49	582,996	864.07	272.46 oc	3.17 ic	---	---	269.29	---	---	---	---	---	272.46
13.64	590,488	864.23	325.15 oc	2.94 ic	---	---	322.21	---	---	---	---	---	325.14
13.80	597,980	864.38	380.65 ic	2.45 ic	---	---	378.20	---	---	---	---	---	380.65
13.95	605,472	864.54	429.89 ic	1.59 ic	---	---	428.30 s	---	---	---	---	---	429.88
14.11	612,964	864.69	441.56 ic	1.35 ic	---	---	440.20 s	---	---	---	---	---	441.55
14.26	620,455	864.85	449.54 ic	1.20 ic	---	---	448.33 s	---	---	---	---	---	449.53
14.42	627,948	865.00	455.95 ic	1.08 ic	---	---	454.87 s	---	---	---	---	---	455.94

...End

Storm Water
Detention/Retention Summary

Date:	10/21/2013	Revised:	1/15/2014
Design By:	MJL	Revised:	2/17/2015 As-Built
Checked By:		Revised:	

Project:	Liberty Center	File No.:	06F134-005
County:	Butler	City/Township:	Liberty Twp

Basin Garage B Water Quality

On-Site Area	51.37	Acres
Off-Site Area	0.25	Acres
Bypass Area	0.00	Acres

Orifice	Number - Size	Inv Elev
T/Wall	50'	~~858.10~~ 858.12
		852.72
1	(1) 4.25" ø	~~852.50~~

Event	Basin Inflow		Basin Outflow		Retention Elev	
Q_1	~~62.61~~	59.81	~~61.54~~	59.23	858.56	~~858.55~~
Q_{10}	~~105.80~~	108.76	~~105.38~~	108.39	858.78	~~859.62~~
Q_{50}	~~153.78~~	146.15	~~166.85~~	145.54	860.34	~~861.93~~
Q_{100}	~~175.63~~	162.29	~~175.14~~	161.49	861.15	~~862.87~~

Basin Garage B Detention

On-Site Area	51.37	Acres
Off-Site Area	0.25	Acres
Bypass Area	0.00	Acres

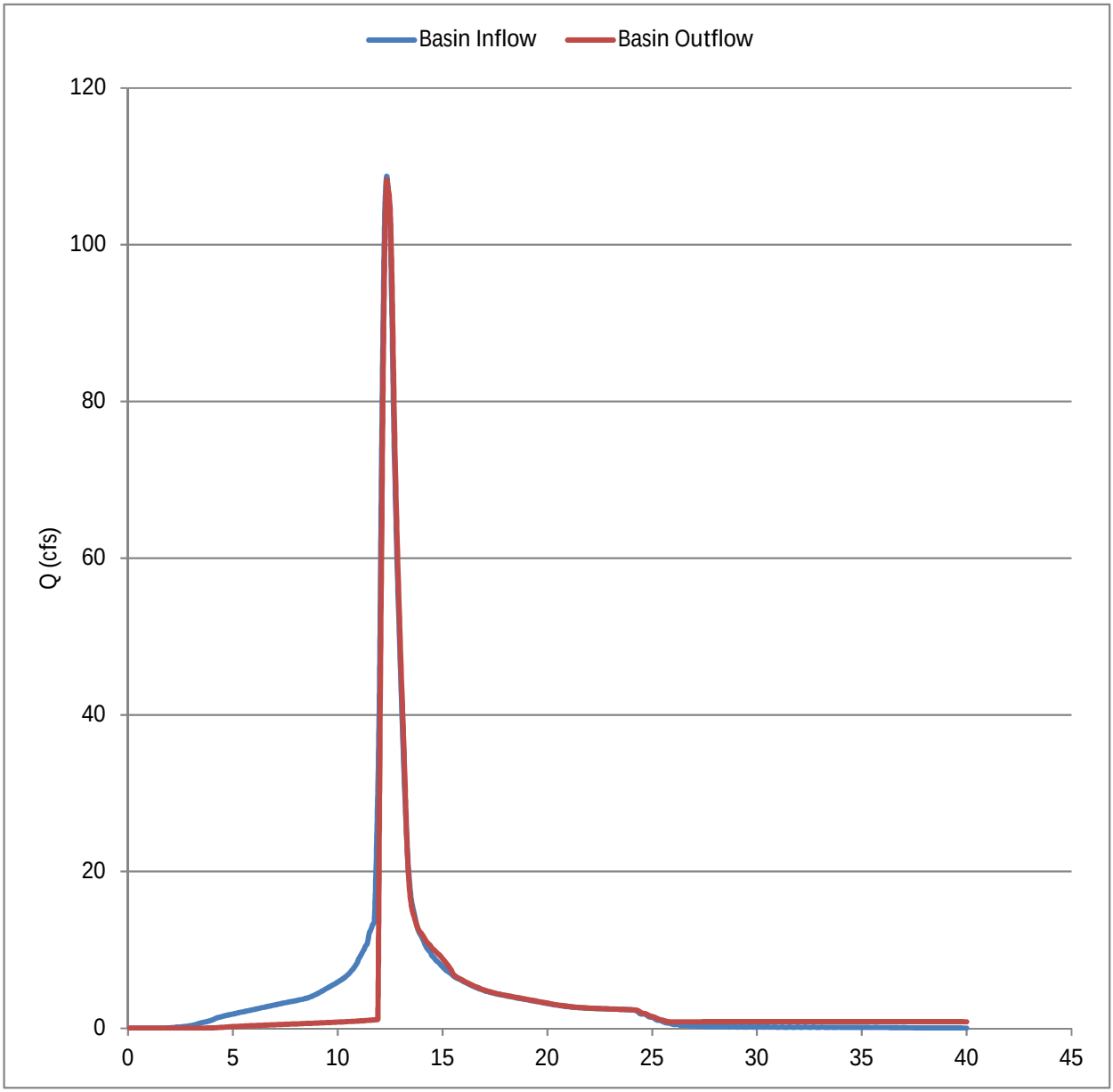
Orifice	Number - Size	Inv Elev
T/Wall	60'	~~863.50~~ 862.85
		850.58
1	(1) 7" ø	~~850.50~~
1	(1) 72" ø	~~850.00~~ 850.11

Event	Basin Inflow		Allowable Release		Basin Outflow		Retention Elev	
Q_1	~~61.54~~	59.23	5.43	2.8	~~2.91~~	855.39	~~855.67~~	
Q_{10}	~~105.38~~	108.39	5.43	3.62	~~3.91~~	858.42	~~859.59~~	
Q_{50}	~~166.85~~	145.54	5.43	4.05	~~4.40~~	860.31	~~861.97~~	
Q_{100}	~~175.14~~	161.49	5.43	4.21	~~4.58~~	861.11	~~862.92~~	

Garage B North Water Quality Basin

Hydrograph Type	=	Reservoir	Peak Discharge	=	108.14
Storm Frequency	=	10 yrs	Time to Peak	=	18.4
Time Interval	=	6 min			
			Max Elevation	=	858.78
			Max Storage	=	159,718 Ft^3
			Date	=	2/17/2015

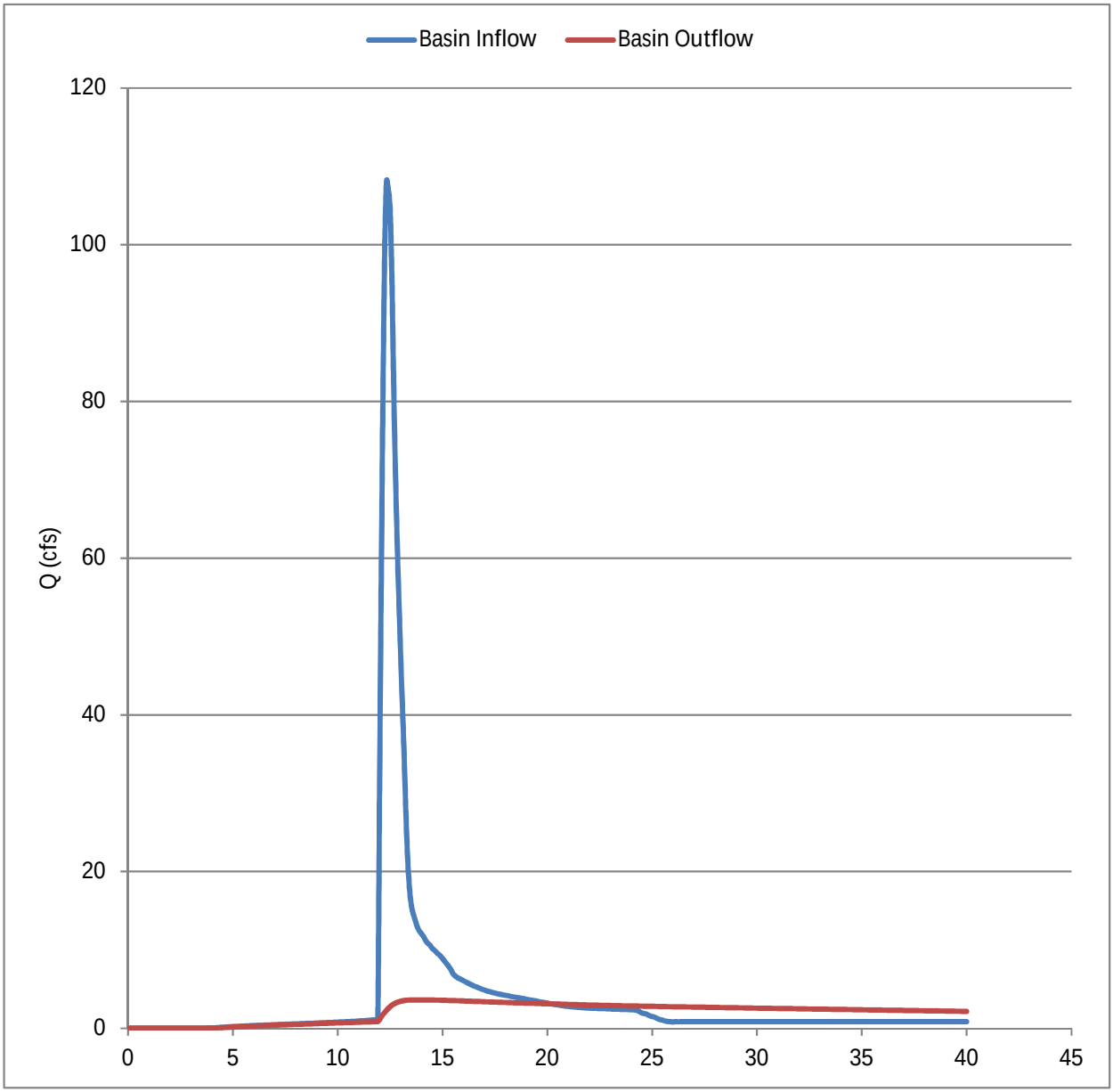
Notes:



Garage B North Basin

Hydrograph Type	=	Reservoir	Peak Discharge	=	3.62
Storm Frequency	=	10 yrs	Time to Peak	=	17.7
Time Interval	=	6 min			
			Max Elevation	=	848.42
			Max Storage	=	313,284 Ft^3
			Date	=	2/17/2015

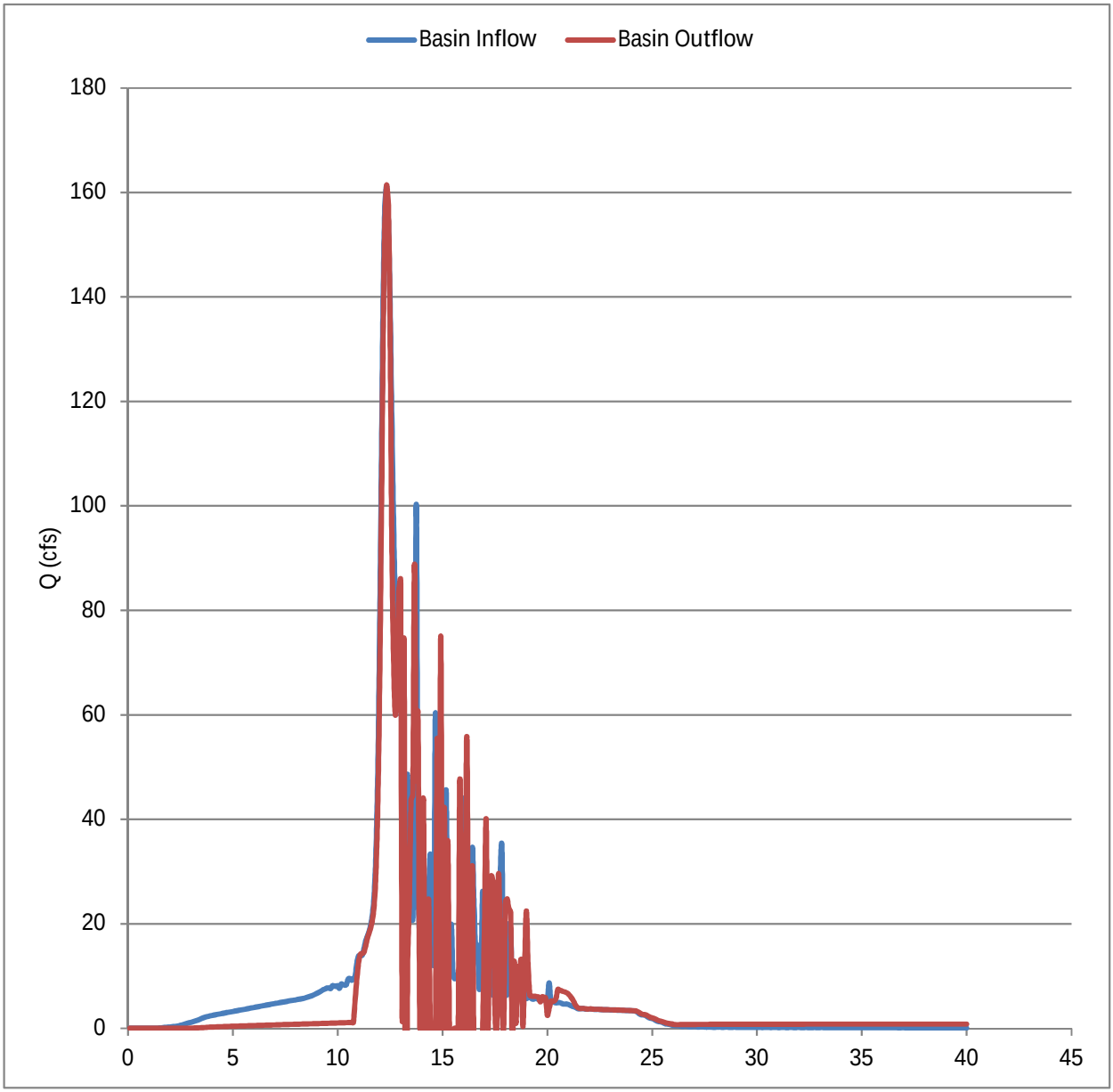
Notes:



Garage B North Water Quality Basin

Hydrograph Type	=	Reservoir	Peak Discharge	=	161.42
Storm Frequency	=	100 yrs	Time to Peak	=	12.33 hrs
Time Interval	=	6 min			
			Max Elevation	=	861.11
			Max Storage	=	209,987 Ft^3
			Date	=	2/17/2015

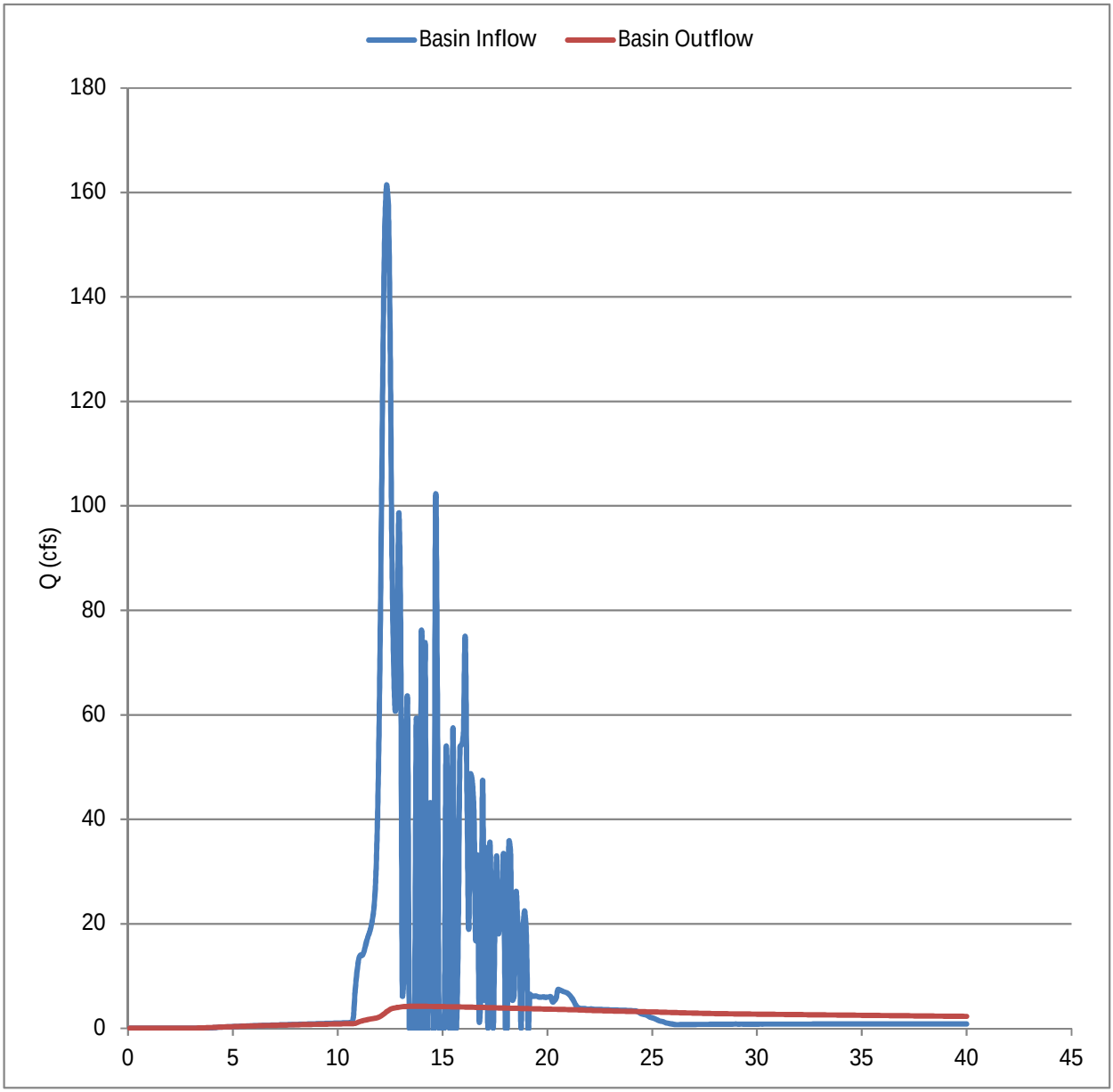
Notes:



Garage B North Basin

Hydrograph Type	=	Reservoir	Peak Discharge	=	4.21
Storm Frequency	=	100 yrs	Time to Peak	=	18.33 hrs
Time Interval	=	6 min			
			Max Elevation	=	861.15
			Max Storage	=	441,703 Ft^3
			Date	=	2/17/2015

Notes:



SUMMARY OF DATA

Method of Hydrograph Development: TR-55

Software: Autodesk Storm and Sanitary Stand Alone

South Liberty Center Release Point

Critical Storm = 100yr

Drainage Area Descriptions	Drainage Area (Acres)	CN	Tc (Mins)	Q1 (cfs)	Q100 (cfs)
On-Site Pre Developed Areas					
Pre S Liberty Center Area	20.68	66.9	32.00	3.39	37.69
On-Site Post Developed Areas					
Post S Liberty Center Area	17.69	98.0	15.00	41.38	98.40
Off-Site Areas					
Post S Liberty I-75 Ramp Offsite Area	5.33	74.0	15.00	3.18	17.78
Bypass Areas					
Post S Liberty Center Bypassing Area	0.73	98.0	10.00	1.34	3.19

Allowable Release Rate= **Q1 On-Site Pre Developed Peak + Q100 Off-Site Peak - Q100 Bypass Peak** **See Hydrographs**	**17.98 cfs**

Project: **Liberty Center**

Drainage Area Description:

Phase 1, South Liberty Center: Pre-Developed

Job #: 06F134-005
Initials: MJL
Date: 10/21/2013
Revised:

Drainage Area = 20.68 Acres

Soil Types:

94 %	Type 'B'	*19.4 acres*
6 %	Type 'C'	*1.3 acres*

Land Use:

Grassland	15.38 Acres
Row Crops (SR+CR)	1.8 Acres
Impervious Surfaces	2.14 Acres
Gravel Surfaces	0.16 Acres
Woods, Fair	1.2 Acres

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	CN*Soil %*Land %
Grassland	**B**	61	94	74.4	42.51
Grassland	**C**	74	6	74.4	3.46
Row Crops (SR+CR)	**B**	75	94	8.7	6.12
Row Crops (SR+CR)	**C**	82	6	8.7	0.45
Impervious Surfaces	**B**	98	94	10.3	9.50
Impervious Surfaces	**C**	98	6	10.3	0.64
Gravel Surfaces	**B**	85	94	0.8	0.62
Gravel Surfaces	**C**	89	6	0.8	0.04
Woods, Fair	**B**	60	94	5.8	3.26
Woods, Fair	**C**	73	6	5.8	0.27

Composite CN = 66.9

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 Center**

Drainage Area Description:

Offsite I-75 Ramps

Job #: 06F134-005
Initials: MJL
Date: 10/21/2013
Revised:

Drainage Area = 5.33 Acres

Soil Types: 100 % Type 'B' *5.3 acres*

Land Use:

Open Space	4.4	Acres
Roadway	0.9	Acres

Composite Runoff Curve Number:

Ground Cover	Soil Type	CN	Soil Type %	Land Use %	CN*Soil %*Land %
Open Space	**B**	69	100	82.9	57.22
Roadway	**B**	98	100	17.1	16.73

Composite CN = 74.0

Time of Concentration:

Sheet Flow: **Tc**

Length = 100 Slope(ft/ft) = 0.0200 Manning's, n = 0.02 **0.034** *hr*

Shallow Concentrated Flow:

Length = 500 Slope(ft/ft) = 0.020 Velocity (fps) = 3.5 **0.040** *hr*

Channel Flow:

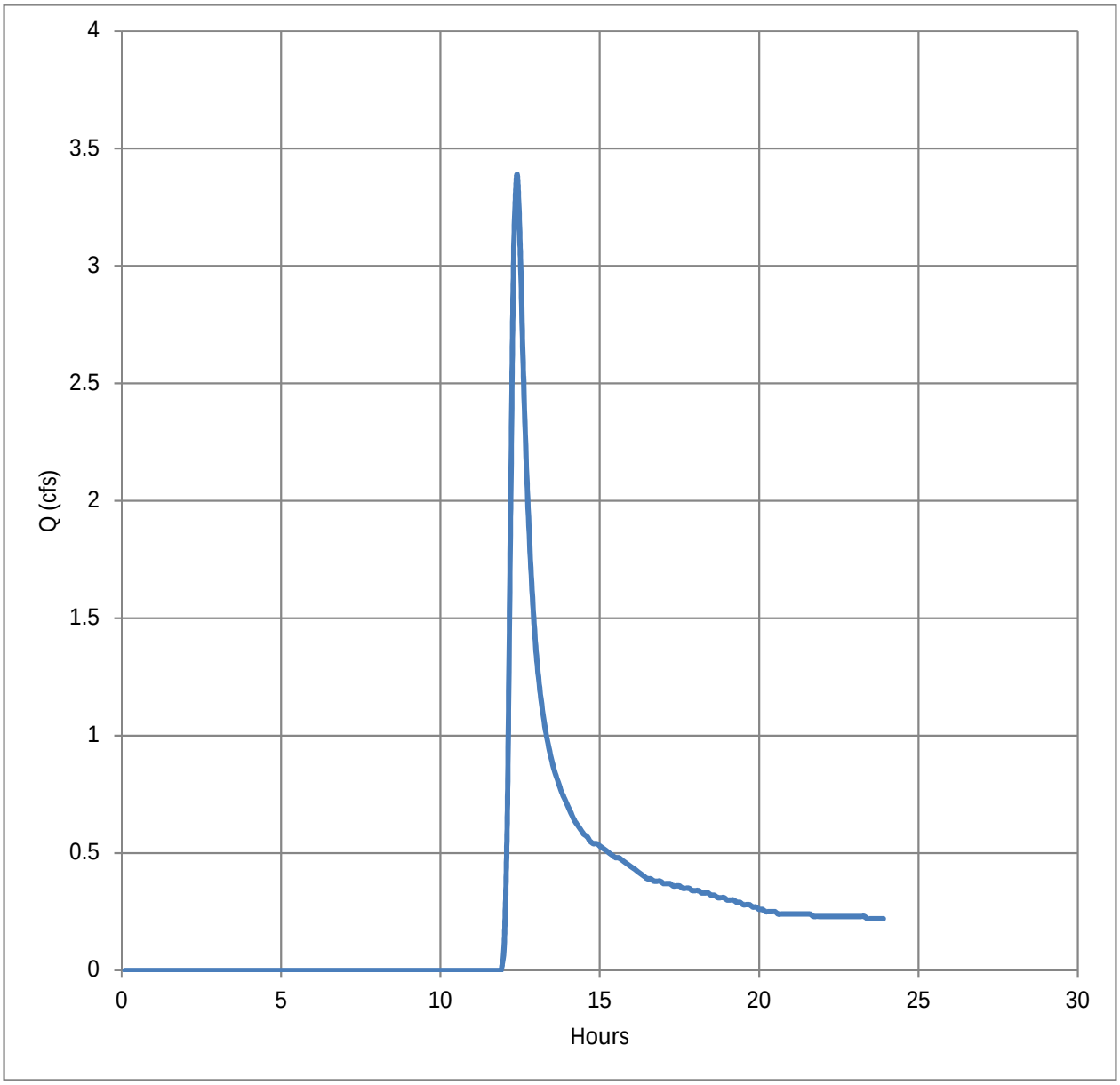
Length = 2200 Velocity (fps) = 3.5 **0.175** *hr*

Tc = 0.25 ***hr***
15 min

Predeveloped S Liberty Center Area

Hydrograph Type	=	SCS Runoff Type II	Peak Discharge	=	3.39
Storm Frequency	=	1 yrs	Time to Peak	=	12:30
Time Interval	=	6 min	Hyd. Volume	=	23,487 Ft^3
Drainage Area	=	20.68 Acres	Curve Number	=	66.9
Tc Method	=	User	Time of conc. (Tc)	=	32.00 Mins
Total precip.	=	2.4 in	Date	=	1/15/2014
Storm Duration	=	24 hrs			

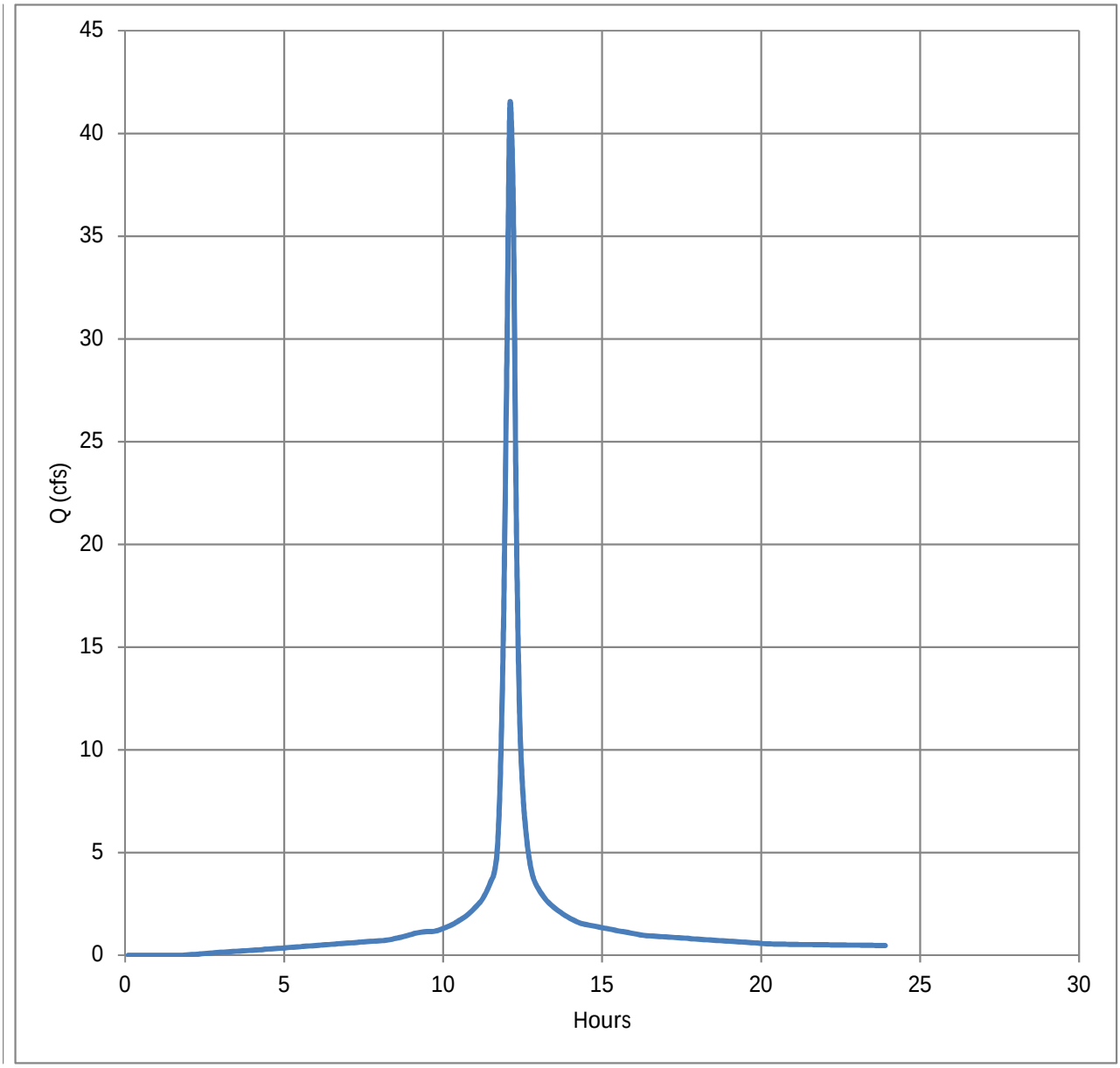
Notes:



Postdeveloped South Liberty Center Area

Hydrograph Type	=	SCS Runoff Type II	Peak Discharge	=	41.38
Storm Frequency	=	1 yrs	Time to Peak	=	12:12
Time Interval	=	6 min	Hyd. Volume	=	137,202 Ft^3
Drainage Area	=	17.69 Acres	Curve Number	=	98
Tc Method	=	User	Time of conc. (Tc)	=	15.00 Mins
Total precip.	=	2.4 in	Date	=	1/15/2014
Storm Duration	=	24 hrs			

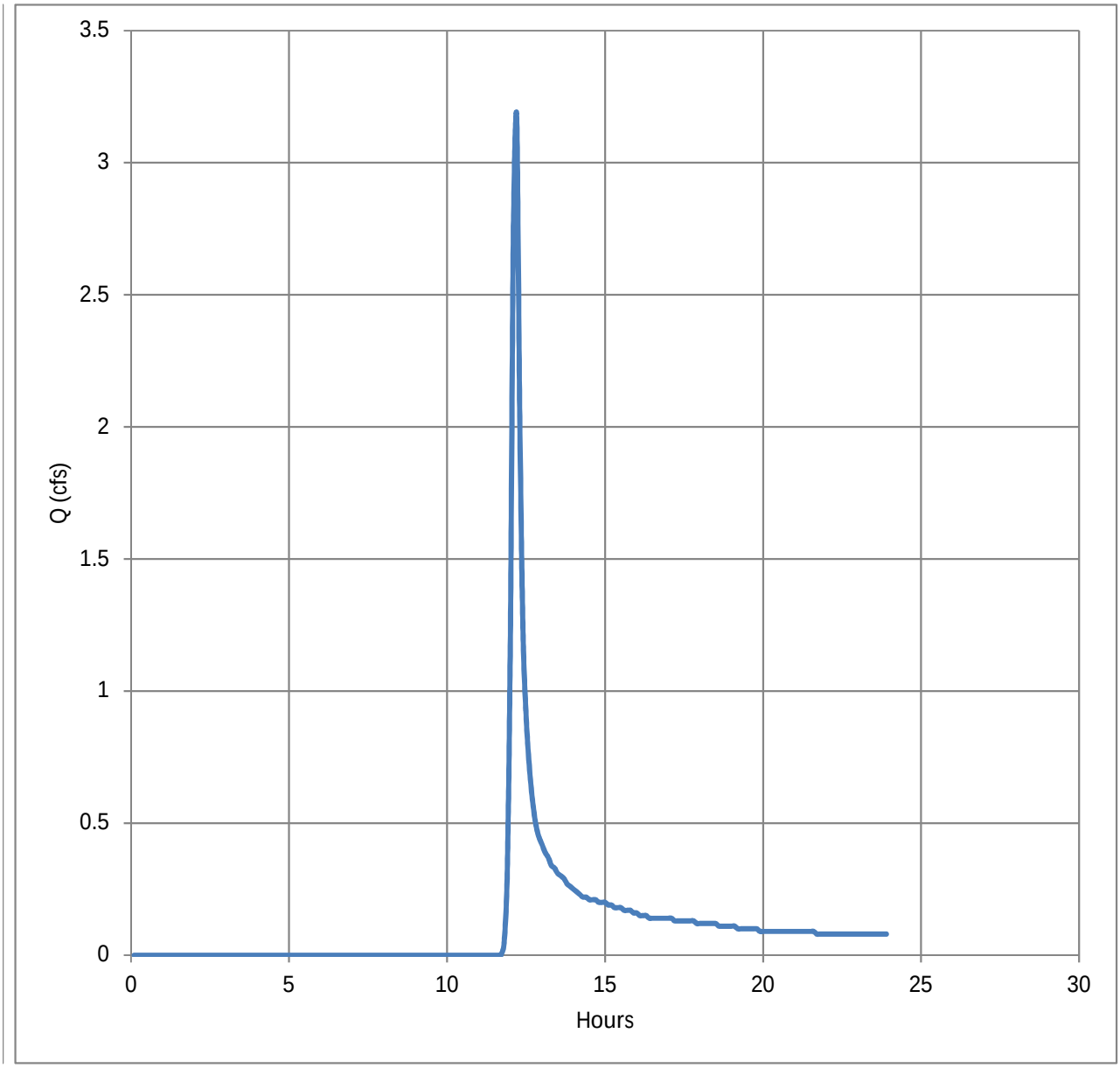
Notes:



Postdeveloped I-75 Ramp Offsite Area

Hydrograph Type	=	SCS Runoff Type II	Peak Discharge	=	3.18
Storm Frequency	=	1 yrs	Time to Peak	=	12:12
Time Interval	=	6 min	Hyd. Volume	=	10,698 Ft^3
Drainage Area	=	5.33 Acres	Curve Number	=	74
Tc Method	=	User	Time of conc. (Tc)	=	15.00 Mins
Total precip.	=	2.4 in	Date	=	1/15/2014
Storm Duration	=	24 hrs			

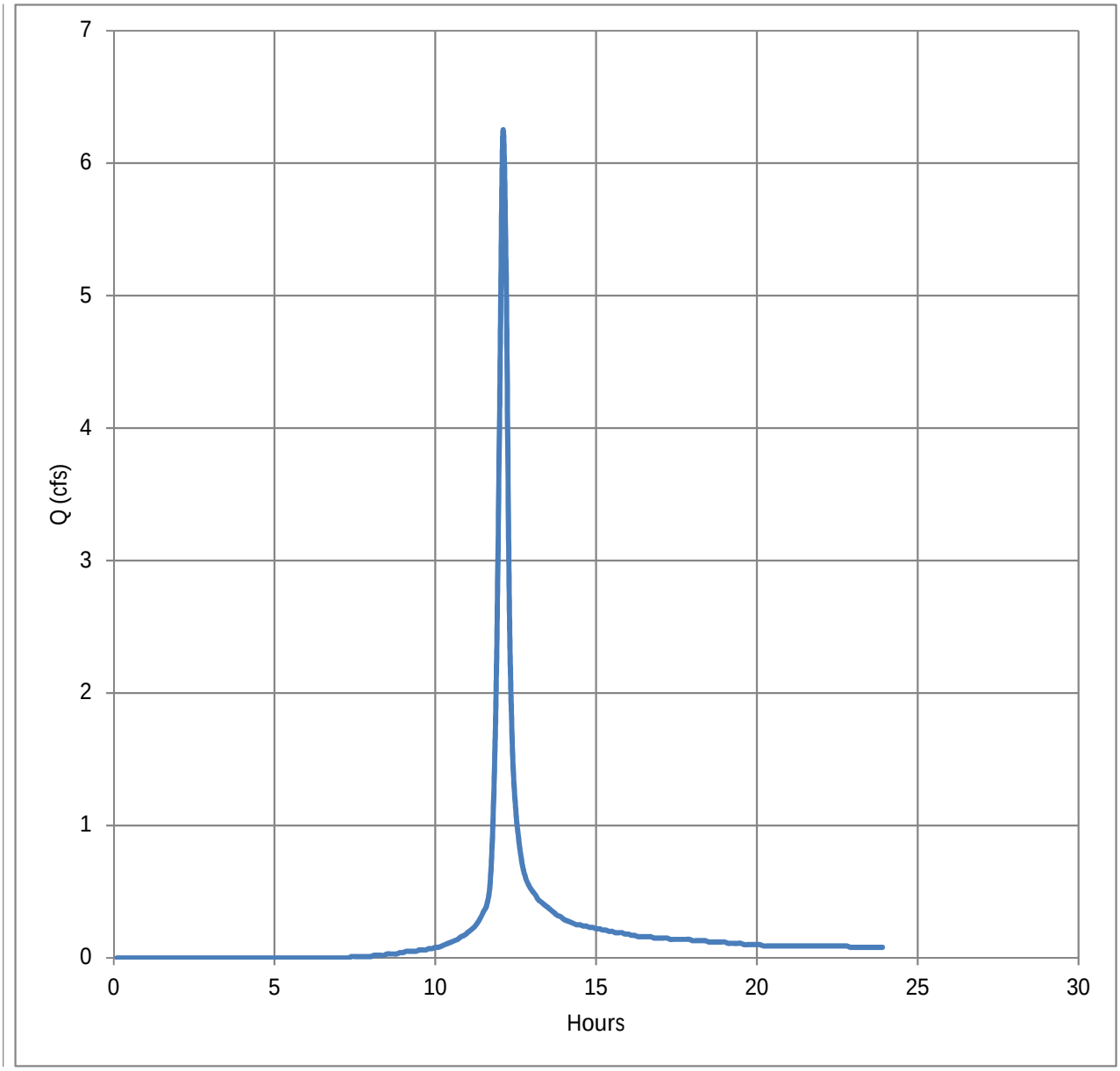
Notes:



Postdeveloped S Liberty Center Bypass Area

Hydrograph Type	=	SCS Runoff Type II	Peak Discharge	=	1.34
Storm Frequency	=	1 yrs	Time to Peak	=	12:12
Time Interval	=	6 min	Hyd. Volume	=	3,978 Ft^3
Drainage Area	=	0.73 Acres	Curve Number	=	98
Tc Method	=	User	Time of conc. (Tc)	=	10.00 Mins
Total precip.	=	2.4 in	Date	=	1/15/2014
Storm Duration	=	24 hrs			

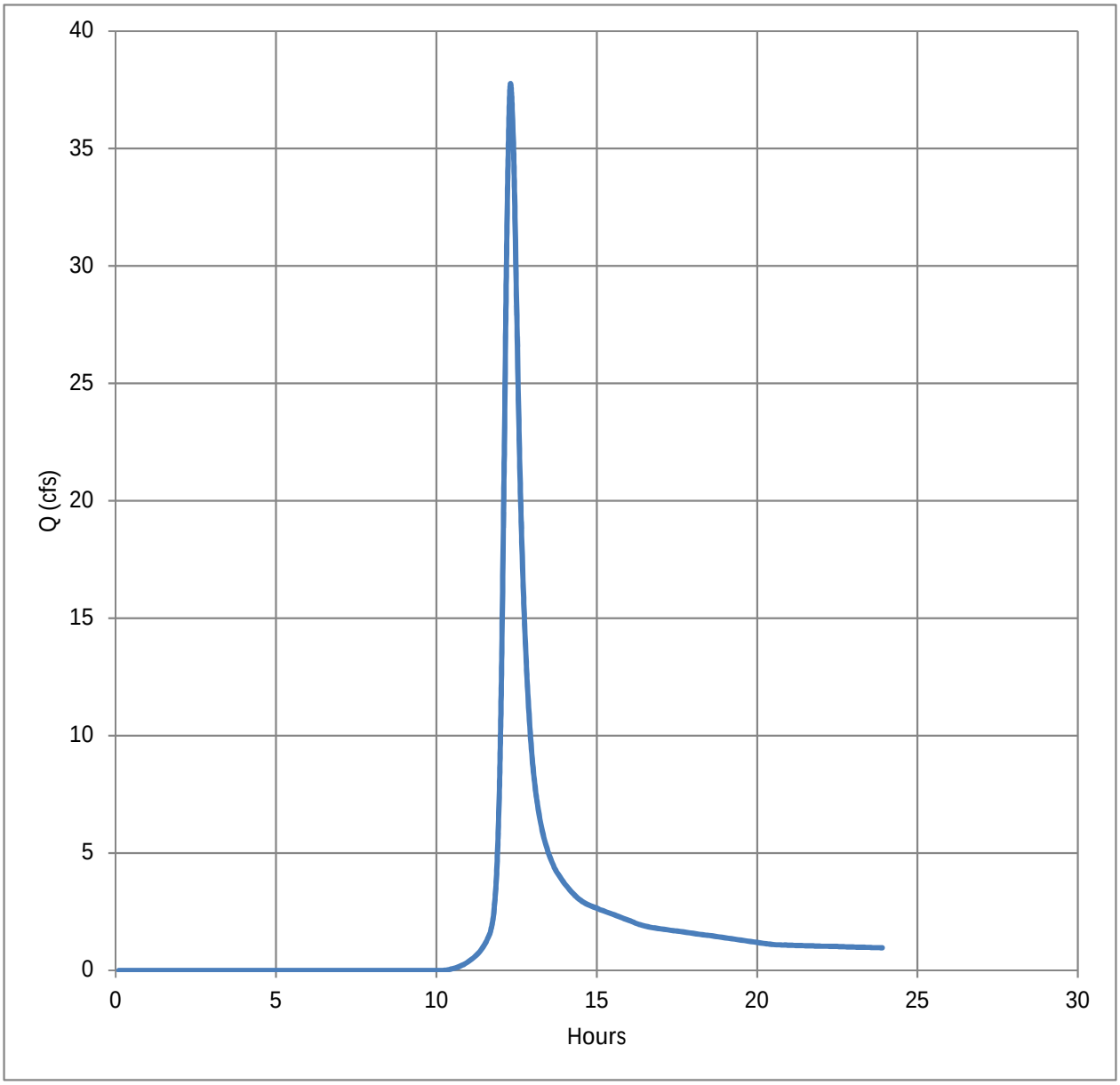
Notes:



Predeveloped S Liberty Center Area

Hydrograph Type	=	SCS Runoff Type II	Peak Discharge	=	37.69
Storm Frequency	=	100 yrs	Time to Peak	=	12:30
Time Interval	=	6 min	Hyd. Volume	=	166,859 Ft^3
Drainage Area	=	20.68 Acres	Curve Number	=	66.9
Tc Method	=	User	Time of conc. (Tc)	=	32.00 Mins
Total precip.	=	5.6 in	Date	=	1/15/2014
Storm Duration	=	24 hrs			

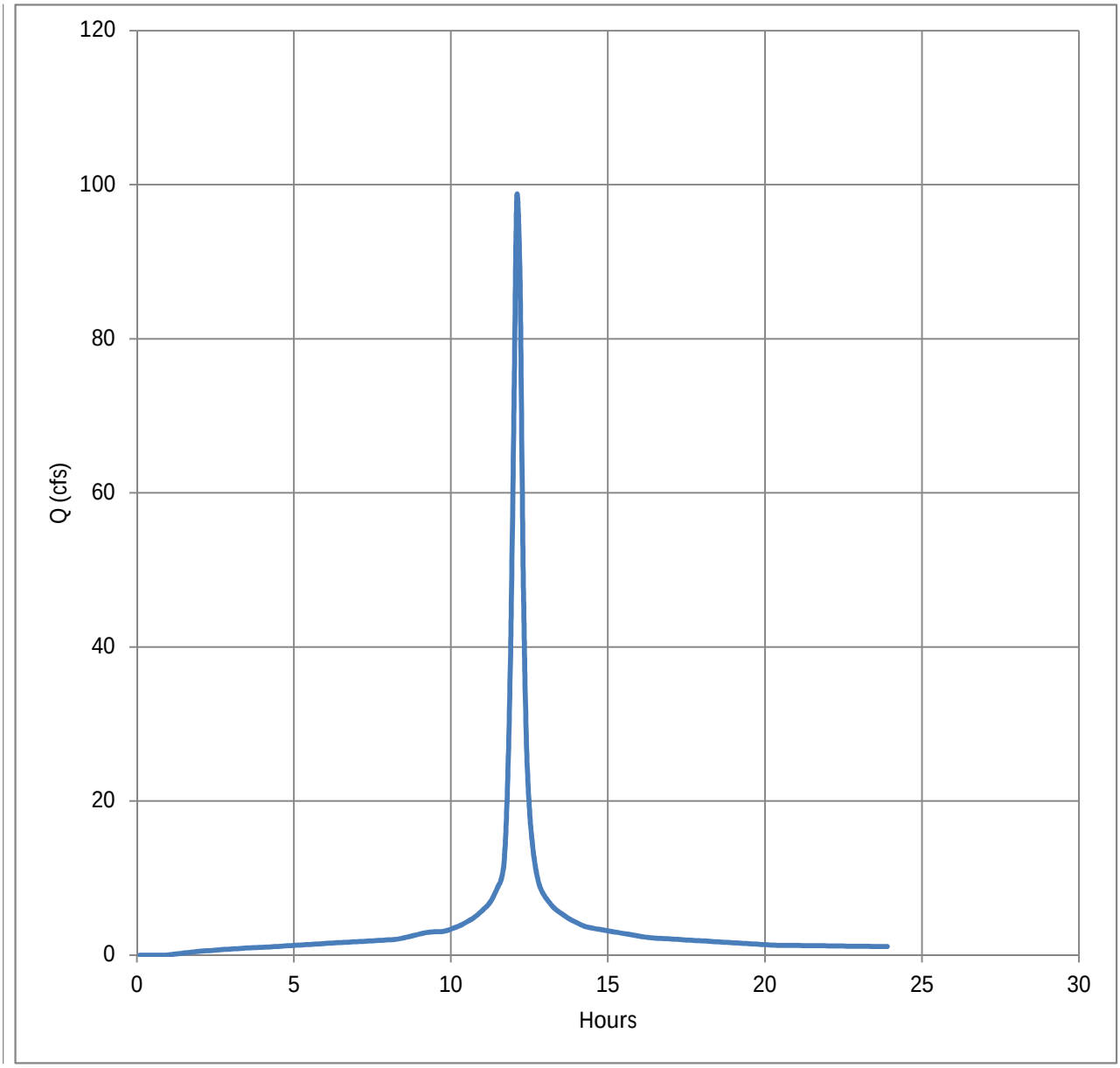
Notes:



Postdeveloped South Liberty Center Area

Hydrograph Type	=	SCS Runoff Type II	Peak Discharge	=	98.4
Storm Frequency	=	100 yrs	Time to Peak	=	12:12
Time Interval	=	6 min	Hyd. Volume	=	338,634 Ft^3
Drainage Area	=	17.69 Acres	Curve Number	=	98
Tc Method	=	User	Time of conc. (Tc)	=	15.00 Mins
Total precip.	=	5.6 in	Date	=	1/15/2014
Storm Duration	=	24 hrs			

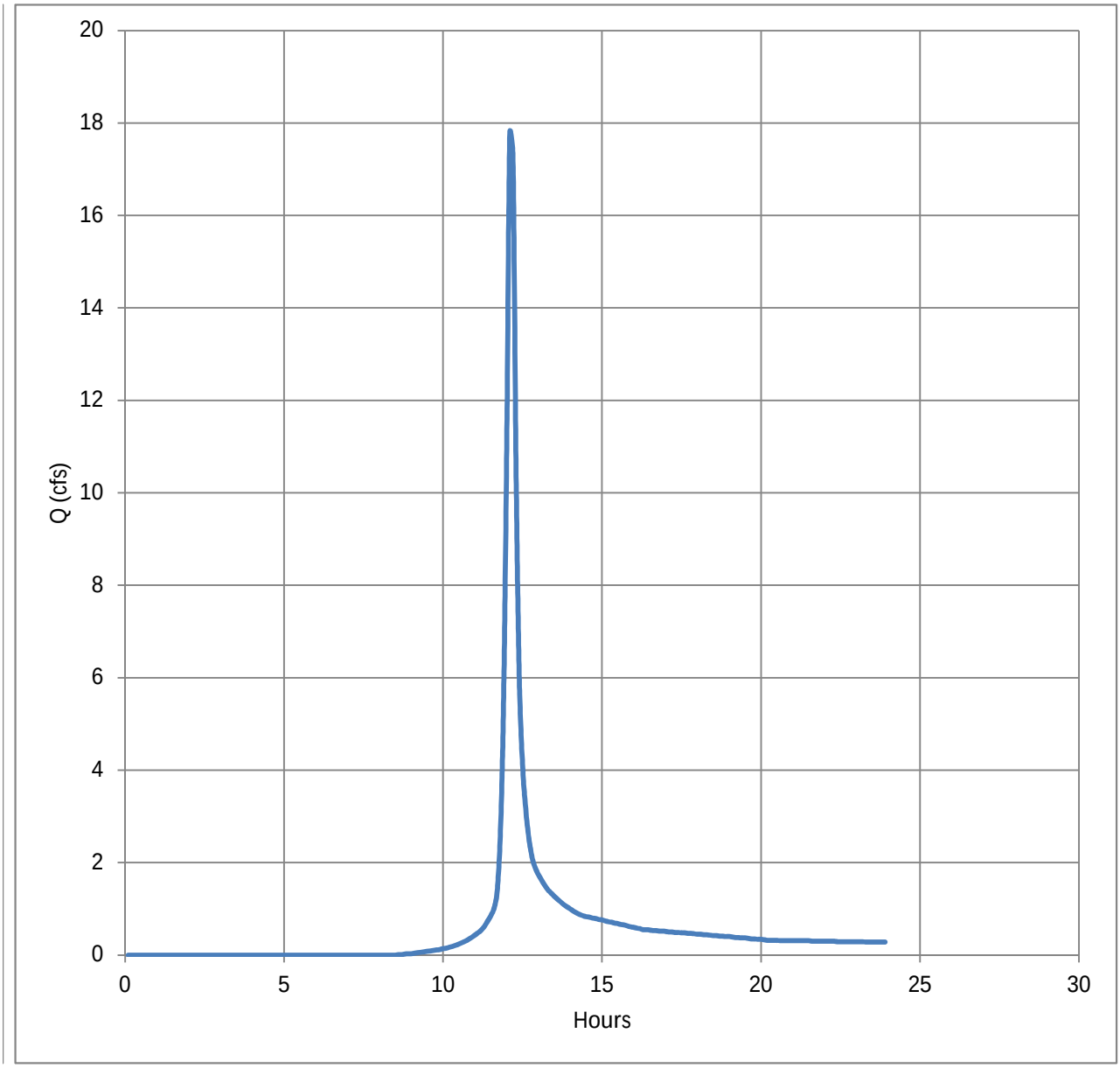
Notes:



Postdeveloped I-75 Ramp Offsite Area

Hydrograph Type	=	SCS Runoff Type II	Peak Discharge	=	17.78
Storm Frequency	=	100 yrs	Time to Peak	=	12:12
Time Interval	=	6 min	Hyd. Volume	=	55,150 Ft^3
Drainage Area	=	5.33 Acres	Curve Number	=	74
Tc Method	=	User	Time of conc. (Tc)	=	15.00 Mins
Total precip.	=	5.6 in	Date	=	1/15/2014
Storm Duration	=	24 hrs			

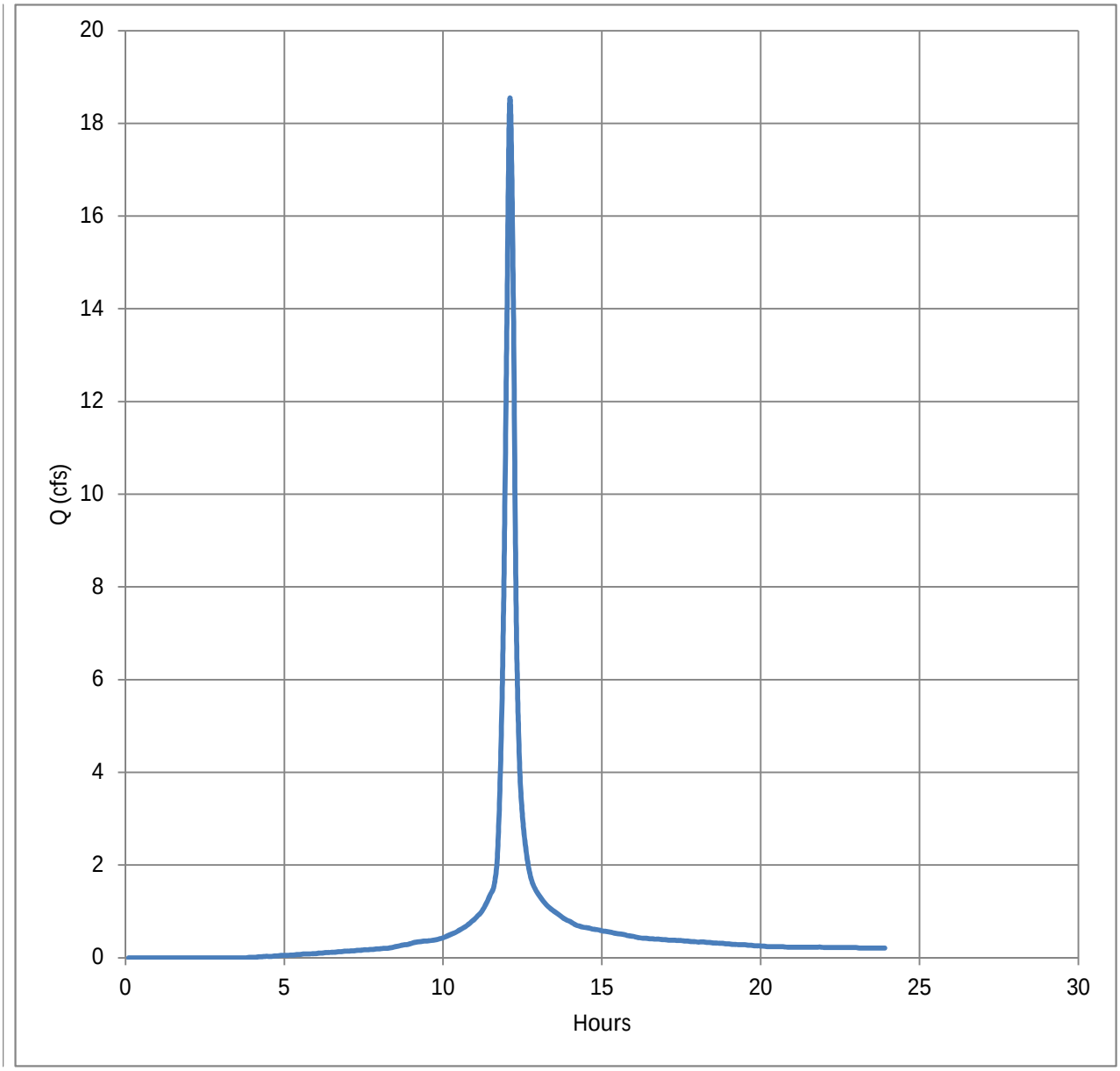
Notes:



Postdeveloped S Liberty Center Bypass Area

Hydrograph Type	=	SCS Runoff Type II	Peak Discharge	=	3.19
Storm Frequency	=	100 yrs	Time to Peak	=	12:12
Time Interval	=	6 min	Hyd. Volume	=	9,840 Ft^3
Drainage Area	=	0.73 Acres	Curve Number	=	98
Tc Method	=	User	Time of conc. (Tc)	=	10.00 Mins
Total precip.	=	5.6 in	Date	=	1/15/2014
Storm Duration	=	24 hrs			

Notes:



Water Quality Volume

Project:	Liberty Center	Designed By:	MJL	Date:	12/9/13
Job No.:	06F134-005	Checked By:		Date:	
Basin ID:	South Garage C Basin	Revised By:	MJL	Date:	6/2/13
			12/15/2014 AS-Built		

Required Water Quality Volume

$WQ_v = P\ C\ A/12$

Site Drainage Area (A) = 18.60 acres (To Basin) WQ_v = 0.930 acre-ft.
Rainfall Depth (P) = 0.75 in.
Runoff Coefficient (C) = 0.8 Sediment Storage Allowance = 20 %
Sediment Storage Allowance = 0.19 Ac-ft
8,102 cu.ft.

Water Quality Release Rate

Total WQ_v = 1.116 Ac-ft
= 48,613 cu.ft.

Q_{wqv} = Total WQ_v/RT WQv Orifice Inv 846.75

Retention Time (RT) = 48 hours Q_{wqv} = 0.28 cfs

Water Quality Outlet Orifice

Contour Areas

	Elevation ft	Area ft^2	Volume ft^3	Cum. Vol. ft^3	Elevation at V	Storage at Elev
Basin Inv. =	845.50	0.00	0.00	0.00		
Contour 1 =	846.00	2522.00	630.50	630.50		
Contour 2 =	846.97	7496.00	4858.73	5489.23		
Contour 3 =	847.00	9152.00	249.72	5738.95		
Contour 4 =	851.98	9152.00	45576.96	51315.91	851.68	
Contour 5 =	852.00	9152.00	183.04	51498.95		
Contour 6 =	856.50	9152.00	41184.00	92682.95		57381.45
Contour 7 =						
Contour 8 =						
Contour 9 =						
Contour 10 =						
Contour 11 =						
Contour 12 =						
Contour 13 =						

$Q = N\ C_d\ A_o\ (2\ g\ Dh)^{1/2}$

C_d = 0.61

A_o = p $D^2/4$ for circular orifices; = h * w for rectangular orifices

g = 32.20 ft/sec^2

Q = Q_{wqv} = 0.281 cfs

Required Volume = V = 48613 ft^3 Number of orifices = N = 1
Elevation at V = 851.68

Orifice h = 2.500 inch Orifice w = 0.00 inch (= 0 for circular orifice)
Dh_{min}^{avg} = (Elev at V - Basin Inv)/2 - 1/2 h = 2.99 ft

$A_{trial} = Q/(N\ C_d\ (2\ g\ Dh_{min})^{1/2})$ = 4.79 in^2 Actual A = A_o = 4.91 in^2

$Dh^{avg} = (Q/(N\ C_d\ A_o))^2/(2\ g)$ = 2.84 ft
Elev = 852.64 > Elevation at V = 851.68 Good

Storage = 57381.45 ft^3 Q = 0.281 cfs

Provided Retention Time = 56.66 Hours

Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3 Tuesday, 12 / 16 / 2014

Pond No. 3 - Garage C WQ

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 845.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	845.50	00	0	0
0.50	846.00	2,522	420	420
1.47	846.97	7,496	4,645	5,065
1.50	847.00	9,152	249	5,314
6.50	852.00	9,152	45,755	51,070
11.00	856.50	9,152	41,180	92,249

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 2.50	0.00	0.00	0.00
Span (in)	= 2.50	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 846.75	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .015	.013	.013	n/a
Orifice Coeff.	= 0.61	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 150.00	0.00	0.00	0.00
Crest El. (ft)	= 851.98	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 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 cuft	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	845.50	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.05	42	845.55	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.10	84	845.60	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.15	126	845.65	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.20	168	845.70	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.25	210	845.75	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.30	252	845.80	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.35	294	845.85	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.40	336	845.90	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.45	378	845.95	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.50	420	846.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.60	885	846.10	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.69	1,349	846.19	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.79	1,814	846.29	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.89	2,278	846.39	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.99	2,743	846.48	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.08	3,207	846.58	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.18	3,671	846.68	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.28	4,136	846.78	0.00 ic	---	---	---	0.00	---	---	---	---	---	0.001
1.37	4,600	846.87	0.03 ic	---	---	---	0.00	---	---	---	---	---	0.026
1.47	5,065	846.97	0.06 ic	---	---	---	0.00	---	---	---	---	---	0.057
1.47	5,090	846.97	0.06 ic	---	---	---	0.00	---	---	---	---	---	0.058
1.48	5,115	846.98	0.06 ic	---	---	---	0.00	---	---	---	---	---	0.059
1.48	5,140	846.98	0.06 ic	---	---	---	0.00	---	---	---	---	---	0.059
1.48	5,165	846.98	0.06 ic	---	---	---	0.00	---	---	---	---	---	0.060
1.49	5,189	846.98	0.06 ic	---	---	---	0.00	---	---	---	---	---	0.061
1.49	5,214	846.99	0.06 ic	---	---	---	0.00	---	---	---	---	---	0.061
1.49	5,239	846.99	0.06 ic	---	---	---	0.00	---	---	---	---	---	0.062
1.49	5,264	846.99	0.06 ic	---	---	---	0.00	---	---	---	---	---	0.063
1.50	5,289	847.00	0.06 ic	---	---	---	0.00	---	---	---	---	---	0.063
1.50	5,314	847.00	0.06 ic	---	---	---	0.00	---	---	---	---	---	0.064
2.00	9,890	847.50	0.13 ic	---	---	---	0.00	---	---	---	---	---	0.135
2.50	14,465	848.00	0.18 ic	---	---	---	0.00	---	---	---	---	---	0.180
3.00	19,041	848.50	0.22 ic	---	---	---	0.00	---	---	---	---	---	0.215
3.50	23,616	849.00	0.25 ic	---	---	---	0.00	---	---	---	---	---	0.246
4.00	28,192	849.50	0.27 ic	---	---	---	0.00	---	---	---	---	---	0.273
4.50	32,767	850.00	0.30 ic	---	---	---	0.00	---	---	---	---	---	0.298

Continues on next page...

Garage C WQ

Stage / Storage / Discharge Table

Stage ft	Storage cuft	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
5.00	37,343	850.50	0.32 ic	---	---	---	0.00	---	---	---	---	---	0.321
5.50	41,918	851.00	0.34 ic	---	---	---	0.00	---	---	---	---	---	0.342
6.00	46,494	851.50	0.36 ic	---	---	---	0.00	---	---	---	---	---	0.362
6.50	51,070	852.00	0.38 ic	---	---	---	1.41	---	---	---	---	---	1.796
6.95	55,188	852.45	0.40 ic	---	---	---	160.96	---	---	---	---	---	161.36
7.40	59,306	852.90	0.41 ic	---	---	---	440.81	---	---	---	---	---	441.22
7.85	63,424	853.35	0.43 ic	---	---	---	800.97	---	---	---	---	---	801.39
8.30	67,541	853.80	0.44 ic	---	---	---	1226.44	---	---	---	---	---	1226.88
8.75	71,659	854.25	0.46 ic	---	---	---	1708.50	---	---	---	---	---	1708.96
9.20	75,777	854.70	0.47 ic	---	---	---	2240.84	---	---	---	---	---	2241.31
9.65	79,895	855.15	0.48 ic	---	---	---	2819.33	---	---	---	---	---	2819.81
10.10	84,013	855.60	0.50 ic	---	---	---	3440.48	---	---	---	---	---	3440.98
10.55	88,131	856.05	0.51 ic	---	---	---	4101.55	---	---	---	---	---	4102.06
11.00	92,249	856.50	0.52 ic	---	---	---	4800.05	---	---	---	---	---	4800.57

...End

Pond Report

Pond No. 4 - Garage C Basin

Pond Data

Contours - User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 845.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	845.50	00	0	0
0.25	845.75	100	8	8
0.50	846.00	7,173	677	685
0.75	846.25	13,556	2,549	3,234
1.00	846.50	20,288	4,202	7,436
7.95	853.45	21,168	144,034	151,470
10.50	856.00	21,168	53,973	205,443

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 54.00	15.00	0.00	0.00
Span (in)	= 54.00	15.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 845.32	845.49	0.00	0.00
Length (ft)	= 237.00	0.00	0.00	0.00
Slope (%)	= 0.29	0.00	0.00	n/a
N-Value	= .015	.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)	= 60.00	0.00	0.00	0.00
Crest El. (ft)	= 853.45	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= Yes	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 cuft	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	845.50	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.03	1	845.53	0.28 oc	0.01 ic	---	---	0.00	---	---	---	---	---	0.007
0.05	2	845.55	0.28 oc	0.02 ic	---	---	0.00	---	---	---	---	---	0.020
0.08	2	845.58	0.28 oc	0.04 ic	---	---	0.00	---	---	---	---	---	0.037
0.10	3	845.60	0.28 oc	0.06 ic	---	---	0.00	---	---	---	---	---	0.063
0.13	4	845.63	0.28 oc	0.09 ic	---	---	0.00	---	---	---	---	---	0.092
0.15	5	845.65	0.28 oc	0.13 ic	---	---	0.00	---	---	---	---	---	0.128
0.18	6	845.68	0.28 oc	0.17 ic	---	---	0.00	---	---	---	---	---	0.172
0.20	7	845.70	0.28 oc	0.21 ic	---	---	0.00	---	---	---	---	---	0.215
0.23	7	845.73	0.28 oc	0.28 ic	---	---	0.00	---	---	---	---	---	0.275
0.25	8	845.75	0.33 oc	0.33 ic	---	---	0.00	---	---	---	---	---	0.331
0.28	76	845.78	0.45 oc	0.39 ic	---	---	0.00	---	---	---	---	---	0.393
0.30	144	845.80	0.51 oc	0.46 ic	---	---	0.00	---	---	---	---	---	0.461
0.33	211	845.83	0.58 oc	0.54 ic	---	---	0.00	---	---	---	---	---	0.535
0.35	279	845.85	0.67 oc	0.62 ic	---	---	0.00	---	---	---	---	---	0.616
0.38	347	845.88	0.75 oc	0.68 ic	---	---	0.00	---	---	---	---	---	0.681
0.40	414	845.90	0.85 oc	0.77 ic	---	---	0.00	---	---	---	---	---	0.772
0.43	482	845.93	0.95 oc	0.87 ic	---	---	0.00	---	---	---	---	---	0.870
0.45	550	845.95	1.07 oc	0.97 ic	---	---	0.00	---	---	---	---	---	0.973
0.48	617	845.98	1.07 oc	1.05 ic	---	---	0.00	---	---	---	---	---	1.054
0.50	685	846.00	1.19 oc	1.17 ic	---	---	0.00	---	---	---	---	---	1.167
0.52	940	846.03	1.32 oc	1.25 ic	---	---	0.00	---	---	---	---	---	1.255
0.55	1,195	846.05	1.46 oc	1.38 ic	---	---	0.00	---	---	---	---	---	1.376
0.57	1,450	846.08	1.61 oc	1.47 ic	---	---	0.00	---	---	---	---	---	1.470
0.60	1,704	846.10	1.61 oc	1.60 ic	---	---	0.00	---	---	---	---	---	1.599
0.62	1,959	846.13	1.78 oc	1.73 ic	---	---	0.00	---	---	---	---	---	1.731
0.65	2,214	846.15	1.95 oc	1.83 ic	---	---	0.00	---	---	---	---	---	1.833
0.67	2,469	846.18	2.13 oc	1.97 ic	---	---	0.00	---	---	---	---	---	1.970
0.70	2,724	846.20	2.13 oc	2.08 ic	---	---	0.00	---	---	---	---	---	2.075
0.72	2,979	846.23	2.33 oc	2.22 ic	---	---	0.00	---	---	---	---	---	2.216
0.75	3,234	846.25	2.33 oc	2.32 ic	---	---	0.00	---	---	---	---	---	2.323
0.77	3,654	846.28	2.53 oc	2.47 ic	---	---	0.00	---	---	---	---	---	2.466
0.80	4,074	846.30	2.75 oc	2.61 ic	---	---	0.00	---	---	---	---	---	2.608
0.82	4,494	846.33	2.75 oc	2.72 ic	---	---	0.00	---	---	---	---	---	2.716
0.85	4,915	846.35	2.98 oc	2.86 ic	---	---	0.00	---	---	---	---	---	2.858
0.87	5,335	846.38	3.22 oc	3.00 ic	---	---	0.00	---	---	---	---	---	2.998

Continues on next page...

Garage C Basin

Stage / Storage / Discharge Table

Stage ft	Storage cuft	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
0.90	5,755	846.40	3.22 oc	3.14 ic	---	---	0.00	---	---	---	---	---	3.136
0.92	6,175	846.43	3.48 oc	3.27 ic	---	---	0.00	---	---	---	---	---	3.271
0.95	6,595	846.45	3.48 oc	3.40 ic	---	---	0.00	---	---	---	---	---	3.403
0.97	7,016	846.48	3.75 oc	3.53 ic	---	---	0.00	---	---	---	---	---	3.531
1.00	7,436	846.50	3.75 oc	3.65 ic	---	---	0.00	---	---	---	---	---	3.655
1.69	21,839	847.20	6.35 oc	6.00 ic	---	---	0.00	---	---	---	---	---	6.001
2.39	36,243	847.89	7.54 oc	7.54 ic	---	---	0.00	---	---	---	---	---	7.541
3.08	50,646	848.59	8.85 oc	8.85 ic	---	---	0.00	---	---	---	---	---	8.849
3.78	65,049	849.28	10.27 oc	9.98 ic	---	---	0.00	---	---	---	---	---	9.983
4.47	79,453	849.98	11.28 oc	11.04 ic	---	---	0.00	---	---	---	---	---	11.04
5.17	93,856	850.67	12.34 oc	11.99 ic	---	---	0.00	---	---	---	---	---	11.99
5.87	108,260	851.37	12.88 oc	12.88 ic	---	---	0.00	---	---	---	---	---	12.88
6.56	122,663	852.06	14.01 oc	13.75 ic	---	---	0.00	---	---	---	---	---	13.75
7.26	137,067	852.76	14.59 oc	14.57 ic	---	---	0.00	---	---	---	---	---	14.57
7.95	151,470	853.45	15.77 oc	15.30 ic	---	---	0.00	---	---	---	---	---	15.30
8.20	156,867	853.71	40.14 oc	14.16 ic	---	---	25.73	---	---	---	---	---	39.89
8.46	162,265	853.96	83.99 oc	11.22 ic	---	---	72.77	---	---	---	---	---	83.99
8.72	167,662	854.22	141.22 oc	7.53 ic	---	---	133.69	---	---	---	---	---	141.22
8.97	173,059	854.47	168.30 oc	3.87 ic	---	---	164.44 s	---	---	---	---	---	168.30
9.23	178,457	854.73	175.77 oc	2.88 ic	---	---	172.87 s	---	---	---	---	---	175.75
9.48	183,854	854.98	181.31 oc	2.29 ic	---	---	178.99 s	---	---	---	---	---	181.28
9.74	189,251	855.24	186.07 oc	1.89 ic	---	---	184.13 s	---	---	---	---	---	186.02
9.99	194,648	855.49	190.41 oc	1.60 ic	---	---	188.78 s	---	---	---	---	---	190.39
10.25	200,046	855.75	194.51 oc	1.39 ic	---	---	193.03 s	---	---	---	---	---	194.42
10.50	205,443	856.00	198.44 oc	1.23 ic	---	---	197.21 s	---	---	---	---	---	198.43

...End

Storm Water
Detention/Retention Summary

Date:	10/21/2013	Revised:	1/15/2014
Design By:	MJL	Revised:	12/16/2014 As-Built
Checked By:		Revised:	

Project:	Liberty Center	File No.:	06F134-005
County:	Butler	City/Township:	Liberty Twp

Basin Garage C Water Quality

On-Site Area	17.69	Acres
Off-Site Area	5.33	Acres
Bypass Area	0.73	Acres

Orifice	Number - Size	Inv Elev
T/Wall	150'	~~852.00~~ 851.98
		846.75
1	(1) 2.5" ø	~~847.00~~

Event	Basin Inflow		Basin Outflow		Retention Elev	
Q_1	~~31.78~~	33.87	~~30.27~~	30.10	852.30	~~852.32~~
Q_{10}	~~69.64~~	69.85	~~69.43~~	68.82	852.54	~~852.56~~
Q_{50}	~~95.27~~	94.89	~~94.92~~	94.43	852.66	~~852.74~~
Q_{100}	~~102.77~~	101.99	~~102.44~~	101.40	853.29	~~853.43~~

Basin Garage C Detention

On-Site Area	17.69	Acres
Off-Site Area	5.33	Acres
Bypass Area	0.73	Acres

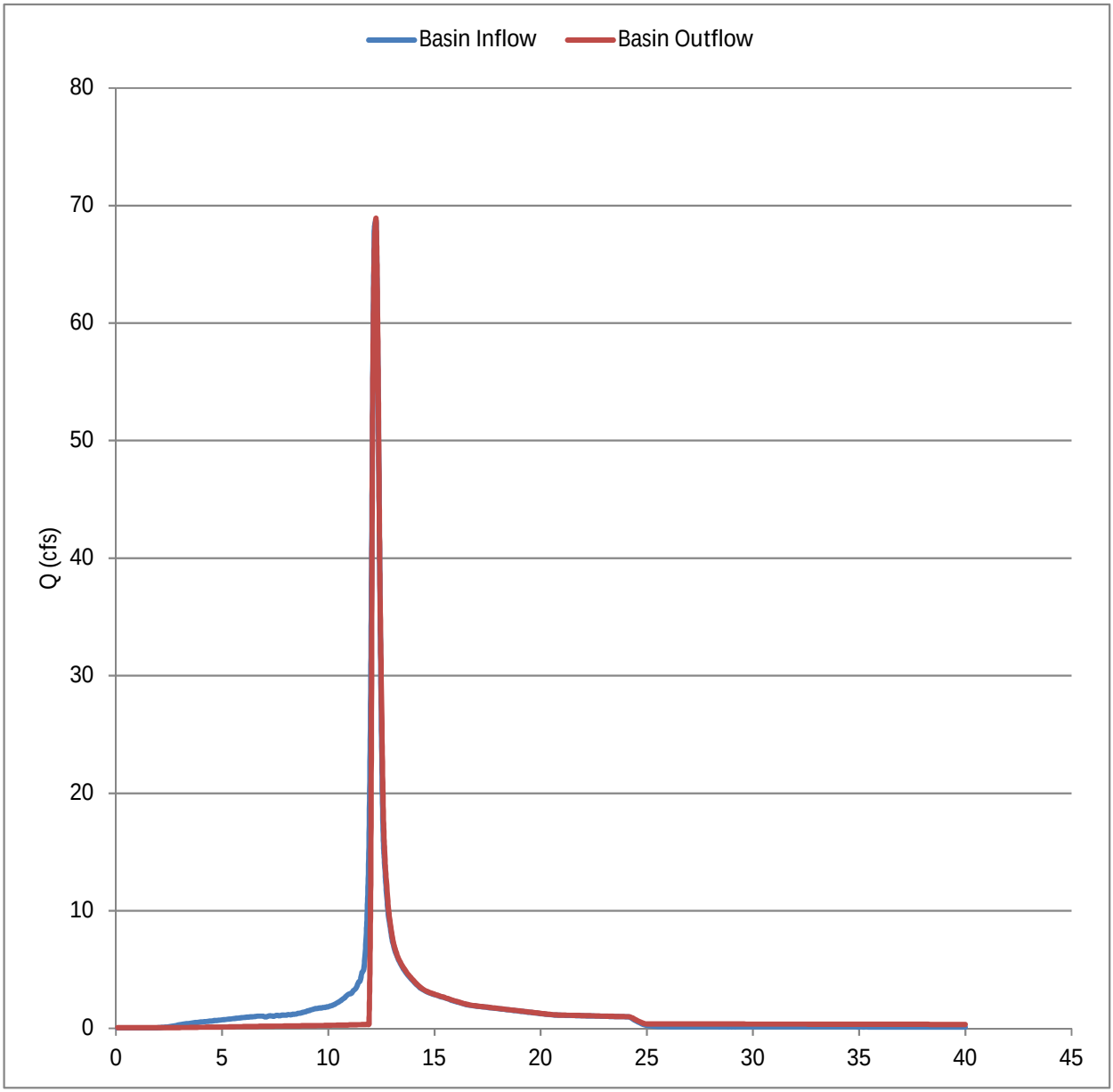
Orifice	Number - Size	Inv Elev
T/Wall	60'	~~853.50~~ 853.45
		845.49
1	(1) 15" ø	~~845.50~~
1	(1) 54" ø	~~845.38~~ 845.32

Event	Basin Inflow		Allowable Release		Basin Outflow		Retention Elev	
Q_1	~~30.32~~	30.10	17.98	6.15	~~6.36~~	847.18	~~847.23~~	
Q_{10}	~~69.51~~	68.82	17.98	11.77	~~12.14~~	850.27	~~850.35~~	
Q_{50}	~~95.01~~	94.43	17.98	14.72	~~15.14~~	852.62	~~852.74~~	
Q_{100}	~~102.55~~	101.40	17.98	15.44	~~15.89~~	853.28	~~853.42~~	

Garage C South Water Quality Basin

Hydrograph Type	=	Reservoir	Peak Discharge	=	68.82
Storm Frequency	=	10 yrs	Time to Peak	=	12.25
Time Interval	=	6 min			
			Max Elevation	=	852.54
			Max Storage	=	56,578 Ft^3
			Date	=	12/15/2014

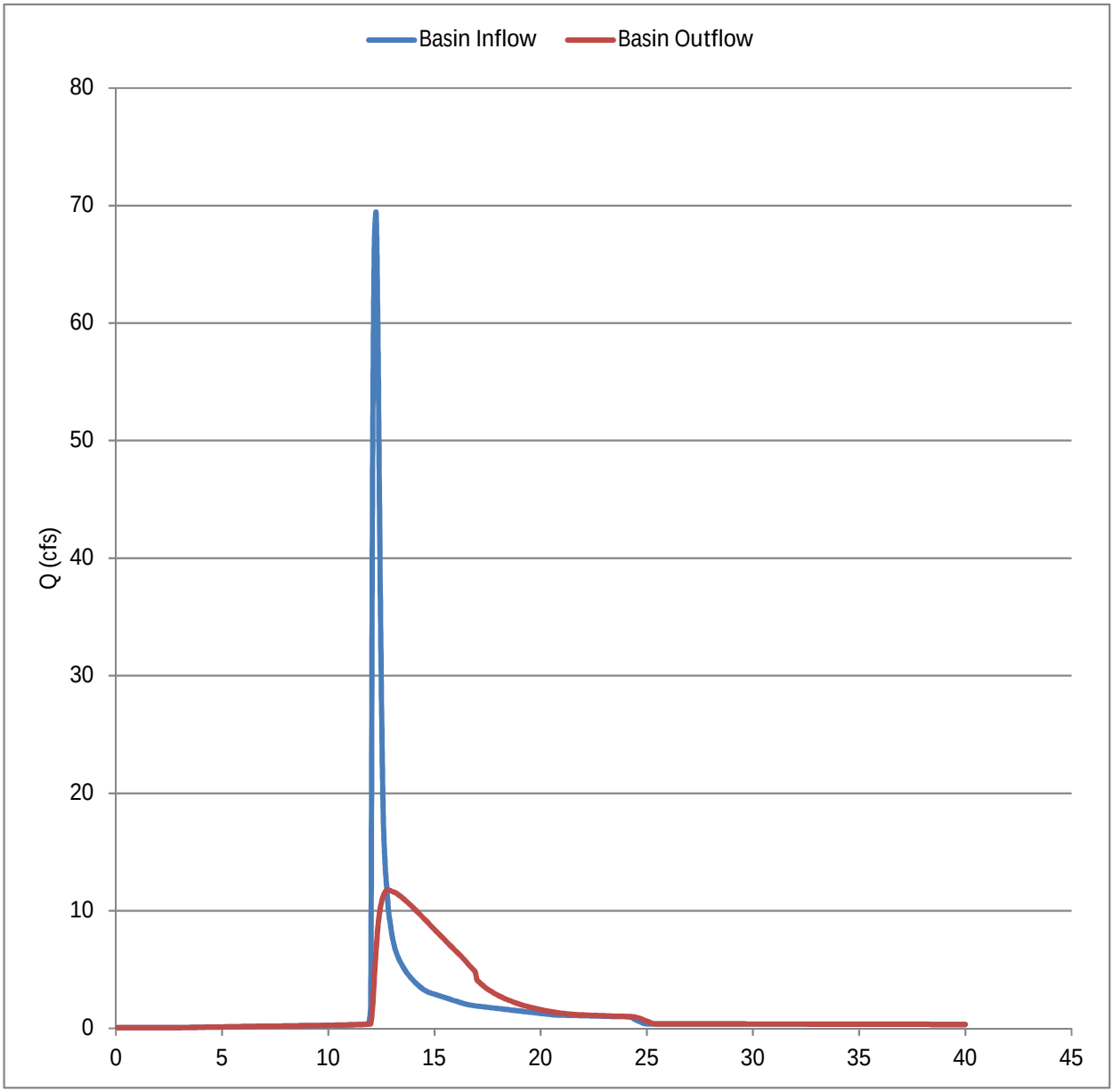
Notes:



Garage C South Basin

Hydrograph Type	=	Reservoir	Peak Discharge	=	11.77
Storm Frequency	=	10 yrs	Time to Peak	=	12.65
Time Interval	=	6 min			
			Max Elevation	=	850.27
			Max Storage	=	84,859 Ft^3
			Date	=	12/15/2014

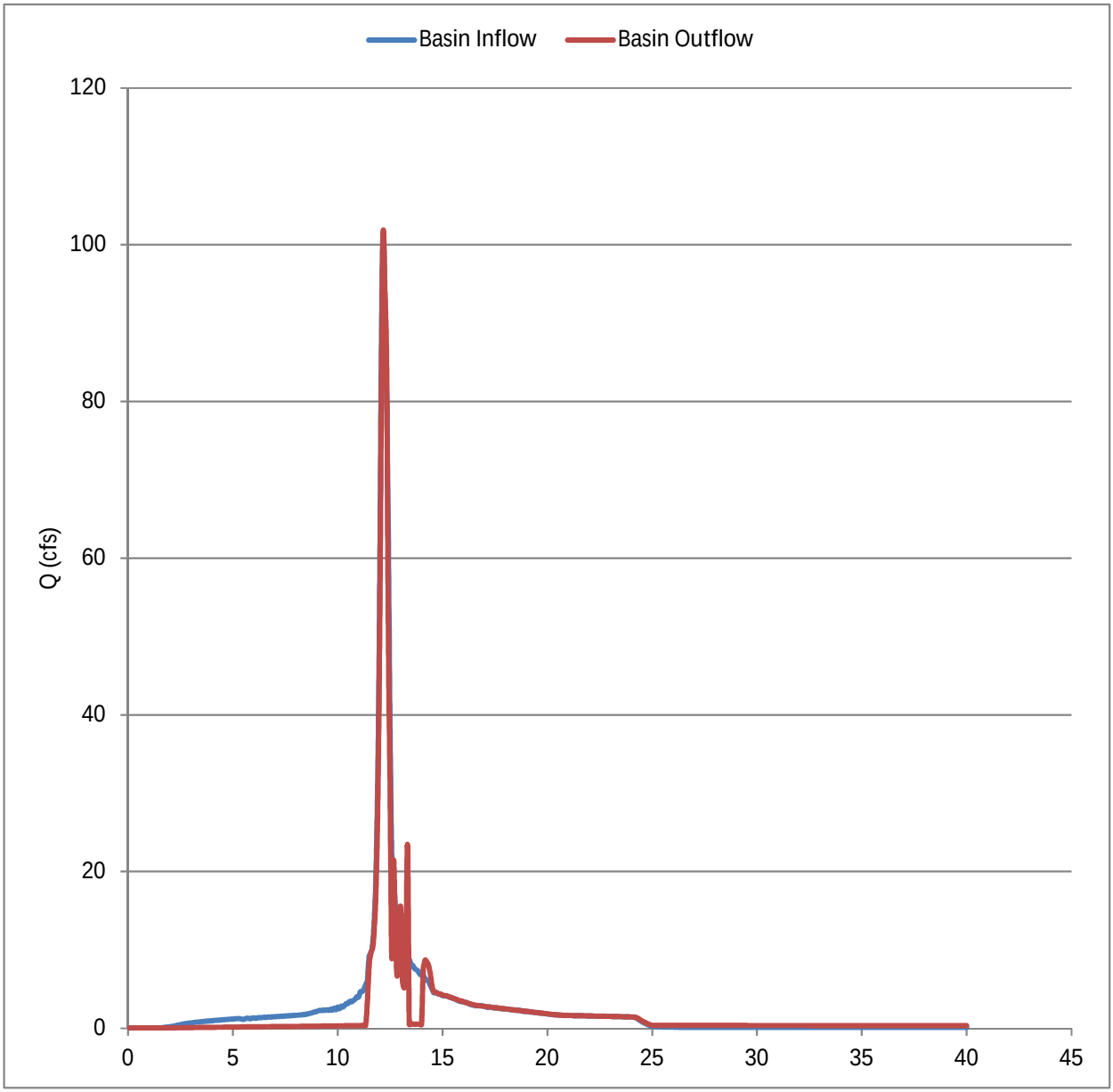
Notes:



Garage C South Water Quality Basin

Hydrograph Type	=	Reservoir	Peak Discharge	=	101.40
Storm Frequency	=	100 yrs	Time to Peak	=	12.25 hrs
Time Interval	=	6 min			
			Max Elevation	=	853.29
			Max Storage	=	63,264 Ft^3
			Date	=	12/15/2014

Notes:



Garage C South Basin

Hydrograph Type	=	Reservoir	Peak Discharge	=	15.44
Storm Frequency	=	100 yrs	Time to Peak	=	12.83 hrs
Time Interval	=	6 min			
			Max Elevation	=	853.28
			Max Storage	=	147,930 Ft^3
			Date	=	12/15/2014

Notes:

