

# ENGINEERING SUCCESS

## SUPPLEMENTAL DRAINAGE REPORT FOR

Waterfront Sixth and Eighth Additions  
Sedgwick County, Kansas



411 N. Webb Rd.  
Wichita, KS 67206  
316.684.9600

PROJECT NUMBER: 02014  
DATE: March 22, 2013



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## General Information

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### ***Location***

The subject property is in the City of Wichita, Sedgwick County, Kansas. The site is east of Webb Road on the north side of 13<sup>th</sup> Street East. The site is currently platted as Waterfront Sixth and Waterfront Eighth Additions. The development is a portion of the Waterfront addition. The site is in the southwest quarter of Section 9, Township 27 South, Range 2 East of the 6<sup>th</sup> P.M. The site is shown on the USGS Map, Appendix A. The site is also shown on the aerial photograph, Appendix B.

### ***Datum***

The site is shown in NAVD 88 datum. The original hydrologic and hydraulic calculations were done in NGVD 29. The models were updated with new information but were not converted to NAVD 88. The datum is labeled on the elevations in this report. Tables contain elevations in both datums.

## Existing Development

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### ***Description***

The site has been previously platted and planned for commercial development. Since the initial planning stages, various changes have taken place in the basin. The outlet structure in the pond in the Waterfront Residential Addition that drains onto the site has been modified to provide Water Quality for other development in the basin. The Hydraflow Hydrographs model calculating flows to 13<sup>th</sup> Street was updated to reflect the changes in the basin, Appendix C. Peak flow rates from the site under pre-project, prior to any development, conditions are shown in Table 1. Table 1 also shows what the Existing flow rates with the previously planned drainage boundaries and commercial conditions. The drainage boundaries are shown on the Existing Conditions Drawing, Appendix D. The drainage boundaries shown are consistent with the Waterfront Commercial, Waterfront Residential and Greenwich Office Park Drainage Report revised August 2007.

As it is planned, Area A shown on the Existing Conditions Drawing will drain to the north, Areas B, C, and D will drain into the Waterfront Residential Detention and the Dry Commercial Detention.

Table 1. Existing Conditions Runoff Calculations.

Location	Design Storm Peak Flow Rate (cfs)				
	2-Yr	5-Yr	10-Yr	25-Yr	100-Yr
Pre-Project to 13 <sup>th</sup> Street	78.3	116.8	142.8	182.2	238.5
Exist. to 13 <sup>th</sup> Street	71.8	118.6	137.9	173.8	209.6

Table 2. Existing Conditions Pond Elevations.

Location	Datum	Design Storm Peak Elevation (ft)				
		2-Yr	5-Yr	10-Yr	25-Yr	100-Yr
Waterfront Residential	NGVD 29	1382.2	1382.7	1383.1	1383.6	1384.4
Waterfront Residential	NAVD 88	1382.7	1383.2	1383.6	1384.1	1384.9
Commercial Dry Detention	NGVD 29	1381.2	1381.5	1381.9	1382.4	1383.0
Commercial Dry Detention	NAVD 88	1381.7	1382.0	1382.4	1382.8	1383.5

### ***Stormwater Sewer***

An existing 24" stormwater sewer pipe flows from the dry commercial detention to the south into a stormwater sewer system along 13<sup>th</sup> Street North. No other storm water sewer has been constructed at this time.

### ***Lowest Opening***

The lowest opening of the only house adjacent to the Waterfront Residential Pond is constructed at 1388.3 (NGVD 29).

## **Proposed Development**

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### ***Description***

The proposed site will develop as commercial use as previously planned. The grading on the site will not maintain the drainage basins previously planned. The basins have been revised on the Proposed Conditions Drawing, Appendix E. Area A, which is approximately 0.3 acres south of Edgewood Street, will drain to the south instead of the north. Area B, which is approximately 0.3 acres that include a portion of Lindberg Street will flow to the north instead of the south. Consequently there is no net change for the basins. This change has no impact on the hotel ponds to the north.

Areas B, C, and D were intended to flow into the Commercial Dry Detention Pond under the existing plan. With the changes to the basin, Areas A, C, and D will flow directly to the south and not into the Commercial Dry Detention. This will increase the undetained runoff by 1.8 acres. The Hydraflow Hydrographs model was updated to reflect this change in drainage area. Due to the timing of the basins, the change had little effect on the peak flow rates to 13<sup>th</sup> Street North, Table 3. The flow rate in the 2-year, 5-year, and 100-year design storms is still less than under pre-project conditions due to additional detention in the Waterfront Residential Pond. The 10-year peak flow rate has increased by less than one percent. The development of the site generally reduces peak flow rates although the 10-year peak flow rates show a negligible increase. The modifications to the Waterfront Residential pond led to this decrease in flow rates.

Table 3. Proposed Conditions Runoff Calculations.

Location	Design Storm Peak Flow Rate (cfs)				
	2-Yr	5-Yr	10-Yr	25-Yr	100-Yr
Undeveloped to 13 <sup>th</sup> Street	78	117	143	n/a	239
Pre-Project to 13 <sup>th</sup> Street	78.3	116.8	142.8	182.2	238.5
Proposed. to 13 <sup>th</sup> Street	75.7	111.3	144.0	182.5	221.5
Change from Undeveloped (cfs)	-2.3	-5.7	1.0	n/a	-17.5
Change from Undeveloped (%)	-2.9%	-4.9%	0.7%	n/a	-7.3%

Table 4. Proposed Conditions Pond Elevations.

Location	Datum	Design Storm Peak Elevation (ft)				
		2-Yr	5-Yr	10-Yr	25-Yr	100-Yr
Waterfront Residential	NGVD 29	1382.2	1382.6	1383.0	1383.5	1384.3
Waterfront Residential	NAVD 88	1382.7	1383.1	1383.5	1384.0	1384.8
Commercial Dry Detention	NGVD 29	1381.2	1381.4	1381.7	1382.1	1382.7
Commercial Dry Detention	NAVD 88	1381.7	1381.9	1382.2	1382.6	1383.2

### ***Stormwater Sewer***

The proposed onsite storm water sewer system is designed to handle a 5-year design storm, Appendix P. A stormwater sewer line will flow to the north from Lindberg into the Hotel Pond. Runoff flowing to the south will flow into an existing 5-year system in 13<sup>th</sup> Street. Flow rates above the capacity of the stormsewer system will flow overland into the hotel pond, the dry commercial detention, or to 13<sup>th</sup> Street. The runoff flowing into 13<sup>th</sup> Street is reduced from existing conditions as seen in Table 3.

### ***Water Quality***

Water Quality Volume calculations for this site and the remaining undeveloped portions of the Waterfront Addition that drain into the Hotel Pond were calculated in the Waterfront Seventh Addition Drainage Report, April 2012. Approximately 1.0 acre-feet of Water Quality Volume was required for the portion of Waterfront 6<sup>th</sup> that drains to the north into the Hotel Pond. This volume of Water Quality Treatment is obtained in the Hotel Pond, in the Waterfront Lake, and in Beech Lake.

The Waterfront Lake and Beech Lake provide a permanent water quality pool volume. This pool has the capacity to remove the required 80% of post-developed total suspended solids (TSS) load from the site.

### ***Channel Protection***

The Channel Protection Volume for the site and the remaining undeveloped portions of the Waterfront Addition is provided in the regional lake complex on the Waterfront site. The Waterfront Lake and the connected Beech Lake are controlled by a downstream weir and dam. The weir includes a notch that is 1' tall and 12' in length. The 1' notch controls approximately the 1-year storm for the entire upstream 780 acre basin. The volume of water that accumulates within the Beech Lake and Waterfront ponds that is controlled by this 1' notch is approximately 40-acre-feet.

A stage-storage-discharge table for Beech lake demonstrates the time for this volume of water to discharge downstream. The time for discharging this entire volume is nearly five days to reach the normal pool elevation of Beech Lake.

A cursory review of the 780-acre basin indicates 65 to 75 acre-feet of volume would be required to control the Channel Protection Volume for the entire 780 acre basin. This available Channel Protection Volume combined with several other ponds within the watershed indicates that the Channel Protection Volume is being provided on a regional basis within existing basin conditions.

## Summary

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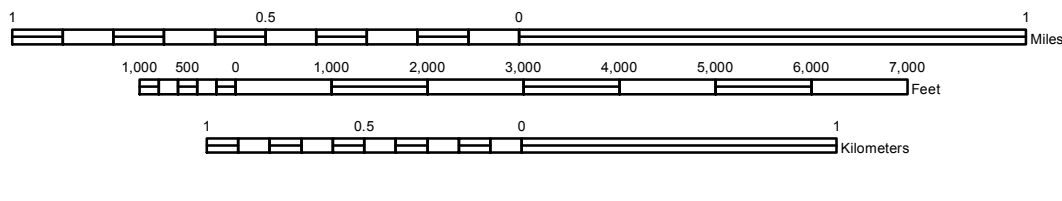
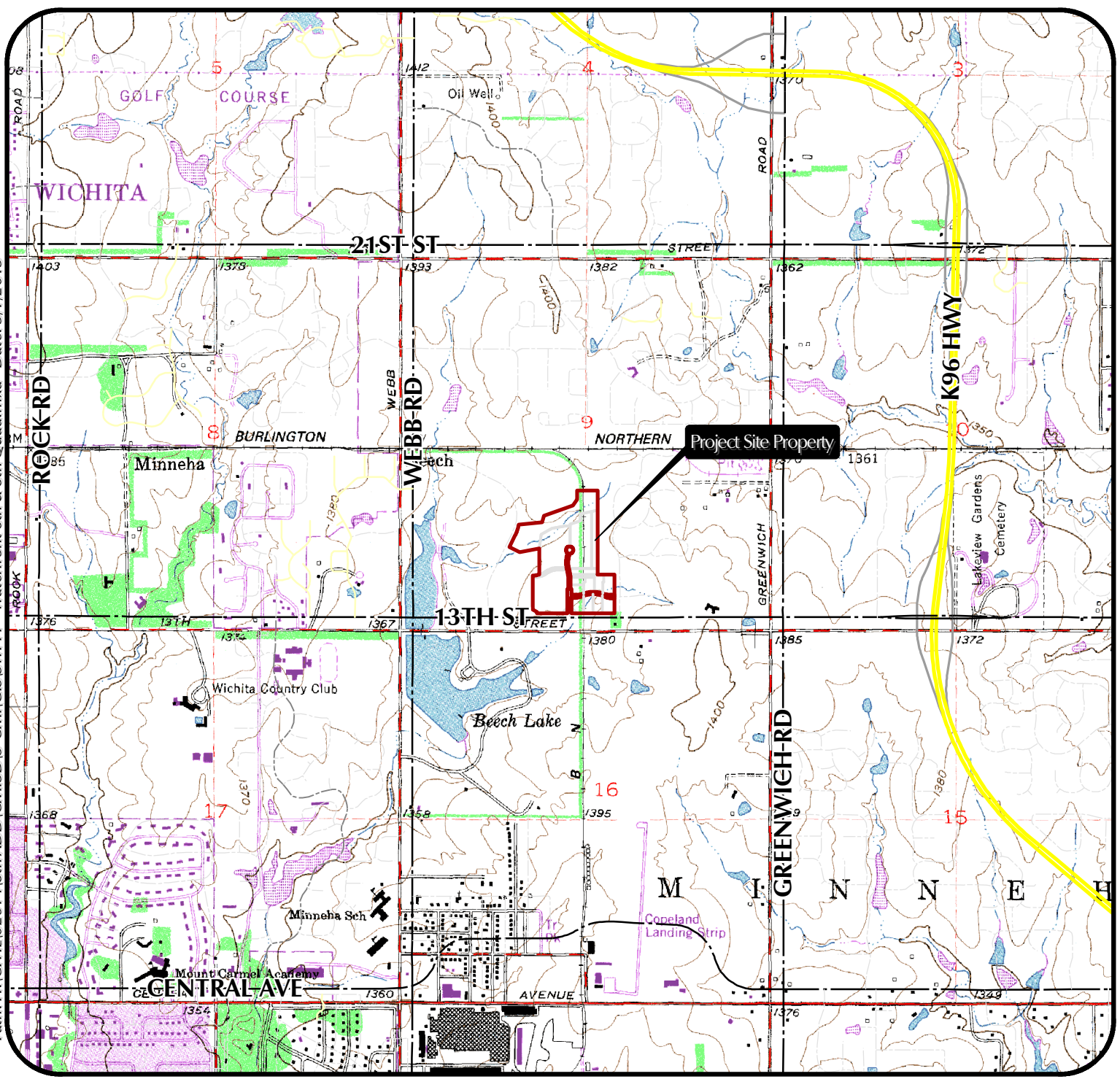
The site will develop as planned for commercial use. The drainage boundaries have changed from what was original proposed. The existing detention ponds on the site will continue to maintain flow rates from the developed project to developed conditions. Pre-and post-project design flow rates are shown in Table 3. The peak flow rates will increase in the 10-year and 25-year design events, but the increase is less than one percent in each design storm. The peak flow rates have decreased in the other design storms. The changes that have occurred since the original design if this development still meet the intentions of the design.

## Appendix A

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USGS Quadrangle Map

Path: H:\CIVIL\0201 418th ADD\Civil\3D\5-Civil\GIS\SWPPP - Waterfront 6th & 8th Quad.mxd - Date: 3/1/2013



**SEC: 9**  
**TWP: T27S**  
**RNG: R2E**

**Waterfront 6th and 8th Additions**

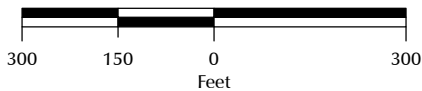
Project Name:  
**USGS Quadrangle**  
Sheet Title:



**JGD** | **3/1/2013**  
Drawn By: | Date:  
**KLA** | **02014**  
Design / Review: | Job No.:



Path: H:\CIVIL\02014\8th ADD\Civil3D\15-Civil\GIS\SWPPP - Waterfront 6th & 8th Aerial.mxd - Date: 3/1/2013



**SEC: 9**  
**TWP: T27S**  
**RNG: R2E**

**Waterfront 6th and 8th Additions**

Project Name:

**2011 Aerial Photography**

Sheet Title:



JGD | 3/1/2013

Drawn By: | Date:

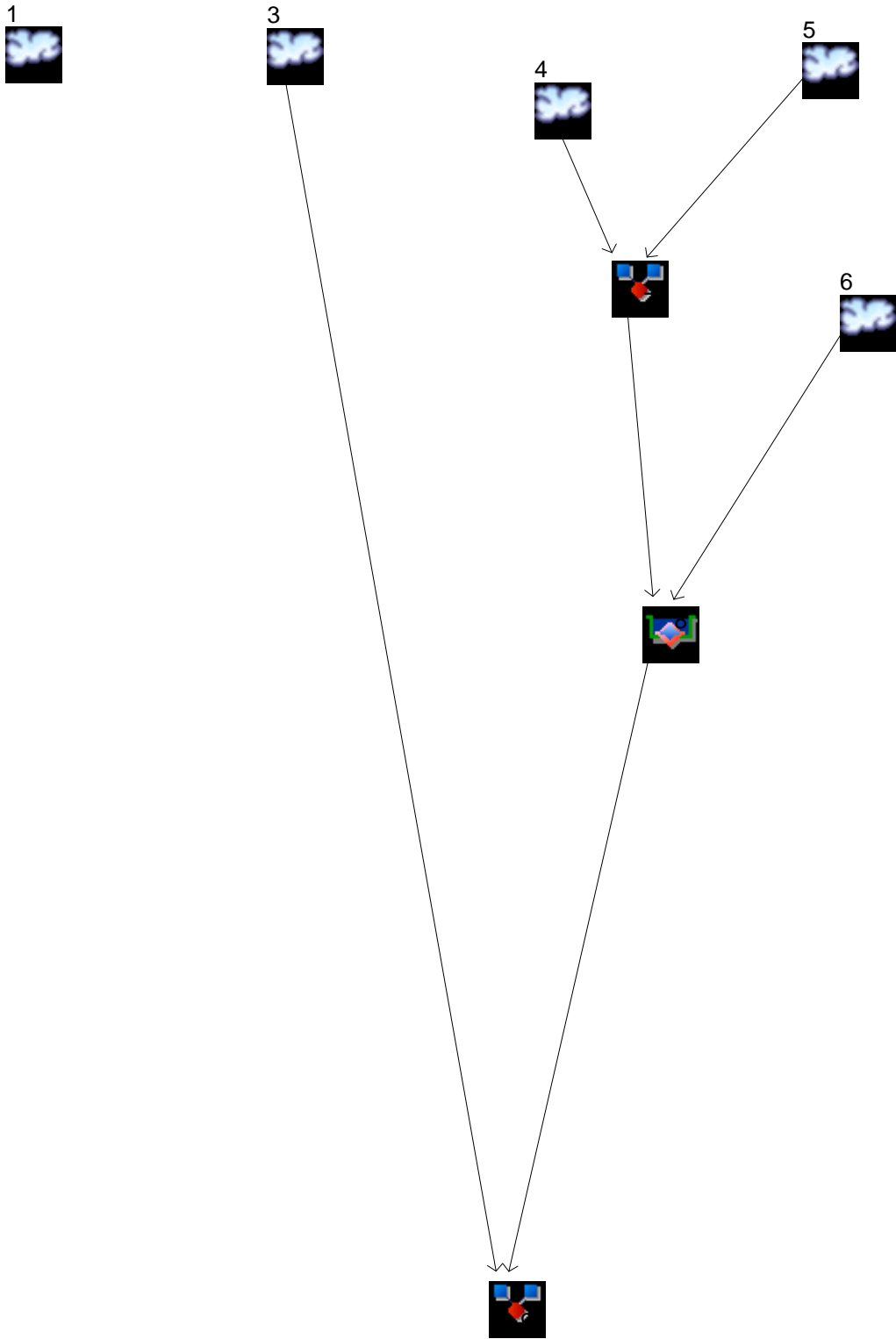
KLA | 02014

Design / Review: | Job No.:



# Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066



# Hydrograph Return Period Recap

Hydroflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	-----	-----	78.30	-----	116.81	142.82	182.16	-----	238.52	Pre-Project to 13th Street
3	SCS Runoff	-----	-----	66.98	-----	92.08	108.40	132.74	-----	167.25	Post-Project Commercial to 13th Stre
4	SCS Runoff	-----	-----	33.23	-----	46.72	55.53	68.69	-----	87.37	TR20- 065
5	SCS Runoff	-----	-----	12.08	-----	17.07	20.34	25.22	-----	32.14	TR-20 070
6	SCS Runoff	-----	-----	15.45	-----	20.70	24.12	29.21	-----	36.45	TR-20 080
7	Combine	4, 5,	-----	45.31	-----	63.79	75.87	93.91	-----	119.51	To Residential Pond
8	Reservoir(i)	7, 6	-----	28.53	-----	40.42	42.11	43.56	-----	45.21	Residential Detention
9	Combine	3, 8	-----	71.81	-----	118.59	137.90	173.80	-----	209.63	Post-Project to 13th Street
Proj. file: 13th Street_2-2013_existing.gpw									Friday, Mar 1, 2013		

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	78.30	6	738	9.039	-----	-----	-----	Pre-Project to 13th Street	
3	SCS Runoff	66.98	6	720	4.806	-----	-----	-----	Post-Project Commercial to 13th Stre	
4	SCS Runoff	33.23	6	726	3.106	-----	-----	-----	TR20- 065	
5	SCS Runoff	12.08	6	726	1.128	-----	-----	-----	TR-20 070	
6	SCS Runoff	15.45	6	720	1.140	-----	-----	-----	TR-20 080	
7	Combine	45.31	6	726	4.234	4, 5,	-----	-----	To Residential Pond	
8	Reservoir(i)	28.53	6	744	5.353	7, 6	1382.18	2.23	Residential Detention	
9	Combine	71.81	6	720	10.158	3, 8	-----	-----	Post-Project to 13th Street	
13th Street_2-2013_existing.gpw					Return Period: 2 Year			Friday, Mar 1, 2013		

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	116.81	6	732	13.476	-----	-----	-----	Pre-Project to 13th Street	
3	SCS Runoff	92.08	6	720	6.702	-----	-----	-----	Post-Project Commercial to 13th Stre	
4	SCS Runoff	46.72	6	726	4.406	-----	-----	-----	TR20- 065	
5	SCS Runoff	17.07	6	726	1.607	-----	-----	-----	TR-20 070	
6	SCS Runoff	20.70	6	720	1.552	-----	-----	-----	TR-20 080	
7	Combine	63.79	6	726	6.013	4, 5,	-----	-----	To Residential Pond	
8	Reservoir(i)	40.42	6	738	7.560	7, 6	1382.67	2.89	Residential Detention	
9	Combine	118.59	6	726	14.263	3, 8	-----	-----	Post-Project to 13th Street	
13th Street_2-2013_existing.gpw					Return Period: 5 Year			Friday, Mar 1, 2013		

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	142.82	6	732	16.482	-----	-----	-----	Pre-Project to 13th Street	
3	SCS Runoff	108.40	6	720	7.956	-----	-----	-----	Post-Project Commercial to 13th Stre	
4	SCS Runoff	55.53	6	726	5.271	-----	-----	-----	TR20- 065	
5	SCS Runoff	20.34	6	726	1.926	-----	-----	-----	TR-20 070	
6	SCS Runoff	24.12	6	720	1.823	-----	-----	-----	TR-20 080	
7	Combine	75.87	6	726	7.196	4, 5,	-----	-----	To Residential Pond	
8	Reservoir(i)	42.11	6	738	9.009	7, 6	1383.08	3.48	Residential Detention	
9	Combine	137.90	6	726	16.965	3, 8	-----	-----	Post-Project to 13th Street	
13th Street_2-2013_existing.gpw					Return Period: 10 Year			Friday, Mar 1, 2013		

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	182.16	6	732	21.089	-----	-----	-----	Pre-Project to 13th Street	
3	SCS Runoff	132.74	6	720	9.849	-----	-----	-----	Post-Project Commercial to 13th Stre	
4	SCS Runoff	68.69	6	726	6.580	-----	-----	-----	TR20- 065	
5	SCS Runoff	25.22	6	726	2.409	-----	-----	-----	TR-20 070	
6	SCS Runoff	29.21	6	720	2.230	-----	-----	-----	TR-20 080	
7	Combine	93.91	6	726	8.989	4, 5,	-----	-----	To Residential Pond	
8	Reservoir(i)	43.56	6	738	11.207	7, 6	1383.64	4.41	Residential Detention	
9	Combine	173.80	6	720	21.056	3, 8	-----	-----	Post-Project to 13th Street	
13th Street_2-2013_existing.gpw					Return Period: 25 Year			Friday, Mar 1, 2013		

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	238.52	6	732	27.801	-----	-----	-----	Pre-Project to 13th Street	
3	SCS Runoff	167.25	6	720	12.568	-----	-----	-----	Post-Project Commercial to 13th Stre	
4	SCS Runoff	87.37	6	726	8.466	-----	-----	-----	TR20- 065	
5	SCS Runoff	32.14	6	726	3.105	-----	-----	-----	TR-20 070	
6	SCS Runoff	36.45	6	720	2.813	-----	-----	-----	TR-20 080	
7	Combine	119.51	6	726	11.572	4, 5,	-----	-----	To Residential Pond	
8	Reservoir(i)	45.21	6	744	14.371	7, 6	1384.43	5.70	Residential Detention	
9	Combine	209.63	6	720	26.939	3, 8	-----	-----	Post-Project to 13th Street	
13th Street_2-2013_existing.gpw					Return Period: 100 Year			Friday, Mar 1, 2013		

# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

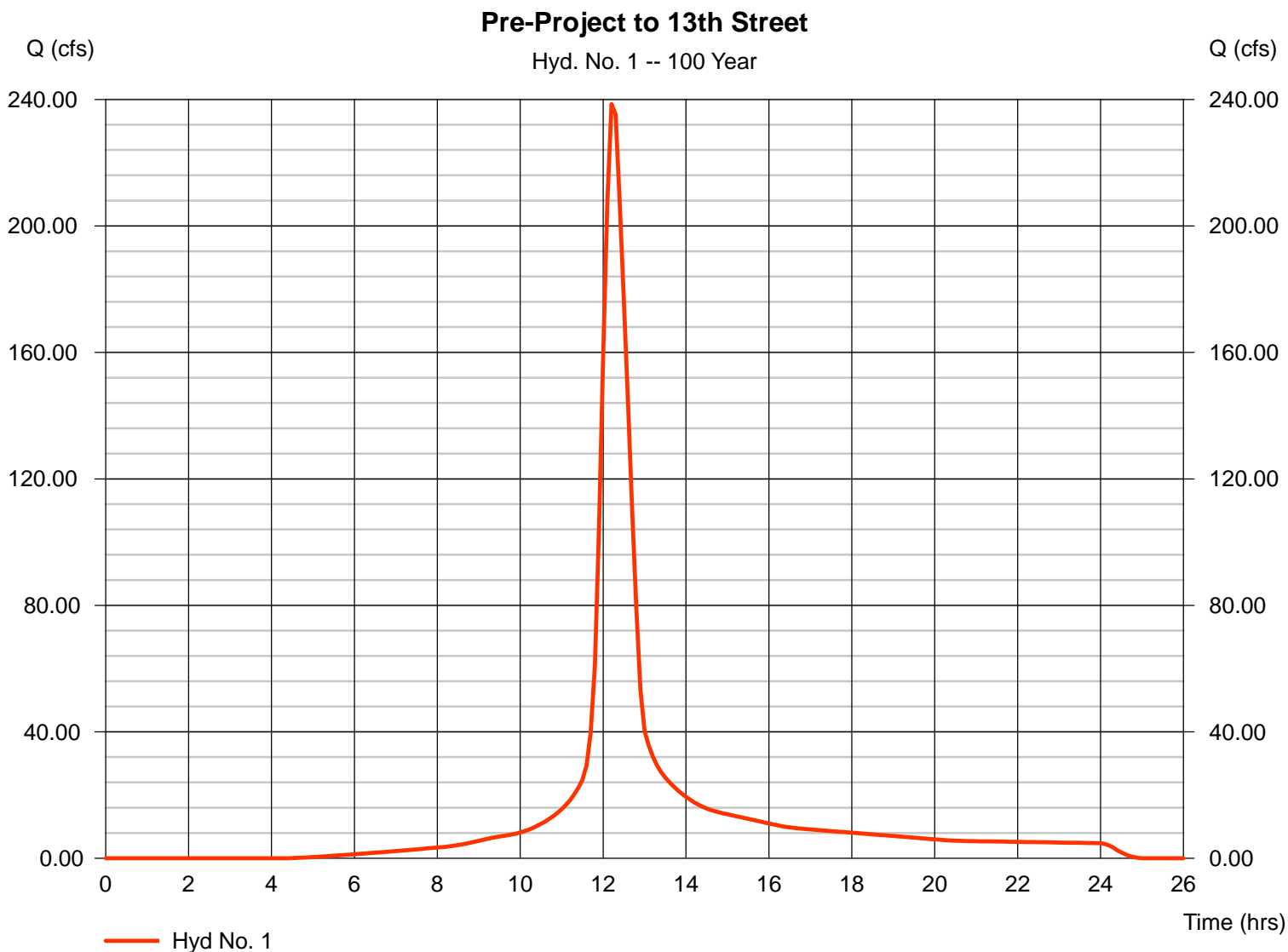
Friday, Mar 1, 2013

## Hyd. No. 1

Pre-Project to 13th Street

Hydrograph type = SCS Runoff  
 Storm frequency = 100 yrs  
 Time interval = 6 min  
 Drainage area = 54.800 ac  
 Basin Slope = 0.0 %  
 Tc method = USER  
 Total precip. = 7.80 in  
 Storm duration = 24 hrs

Peak discharge = 238.52 cfs  
 Time to peak = 12.20 hrs  
 Hyd. volume = 27.801 acft  
 Curve number = 84  
 Hydraulic length = 0 ft  
 Time of conc. (Tc) = 30.60 min  
 Distribution = Type II  
 Shape factor = 484



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Friday, Mar 1, 2013

## Hyd. No. 3

Post-Project Commercial to 13th Street Undetained

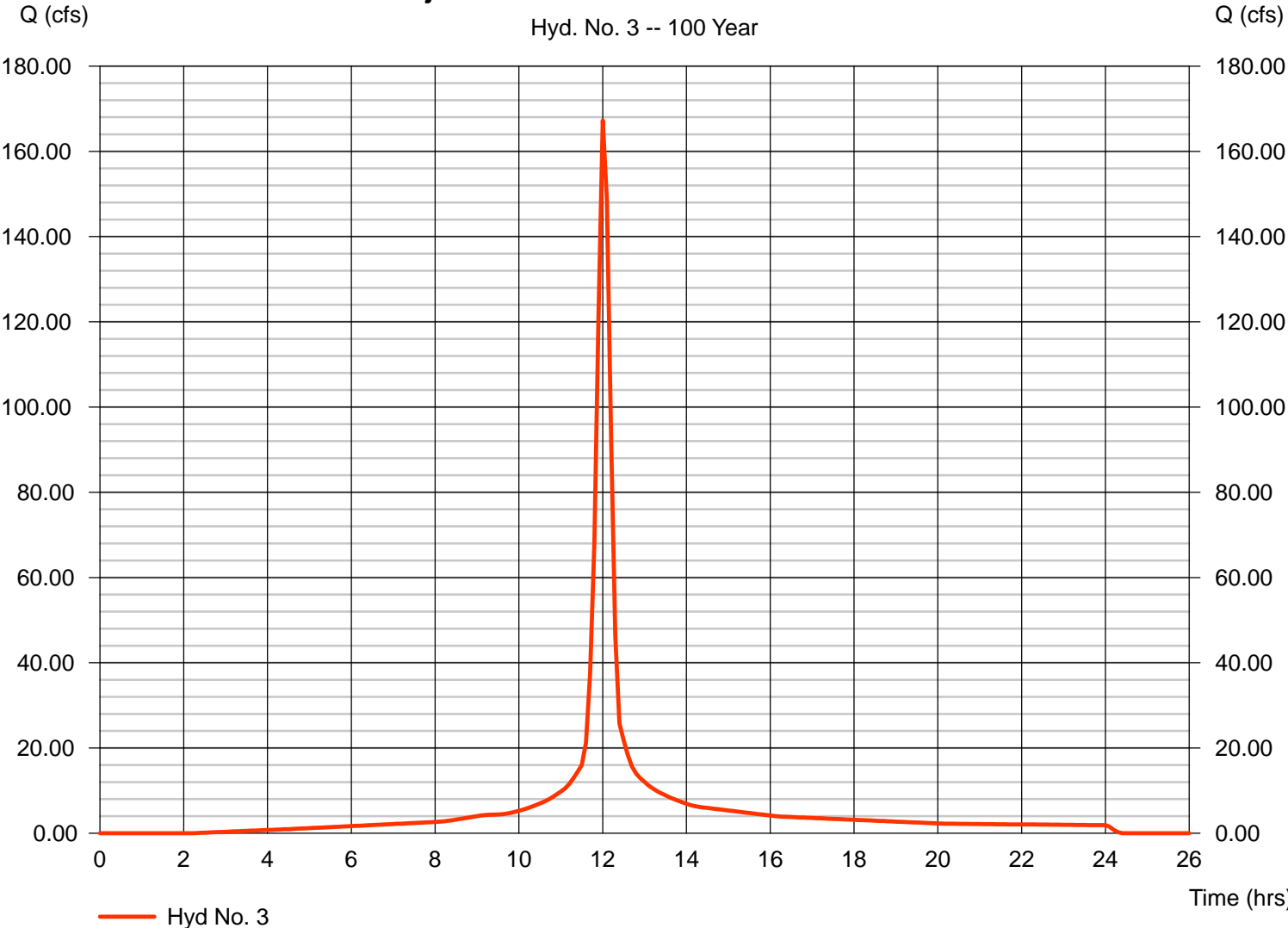
Hydrograph type = SCS Runoff  
Storm frequency = 100 yrs  
Time interval = 6 min  
Drainage area = 23.500 ac  
Basin Slope = 0.0 %  
Tc method = USER  
Total precip. = 7.80 in  
Storm duration = 24 hrs

Peak discharge = 167.25 cfs  
Time to peak = 12.00 hrs  
Hyd. volume = 12.568 acft  
Curve number = 92\*  
Hydraulic length = 0 ft  
Time of conc. (Tc) = 15.00 min  
Distribution = Type II  
Shape factor = 484

\* Composite (Area/CN) = [(21.400 x 95) + (6.600 x 84)] / 23.500

Post-Project Commercial to 13th Street Undetained

Hyd. No. 3 -- 100 Year



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

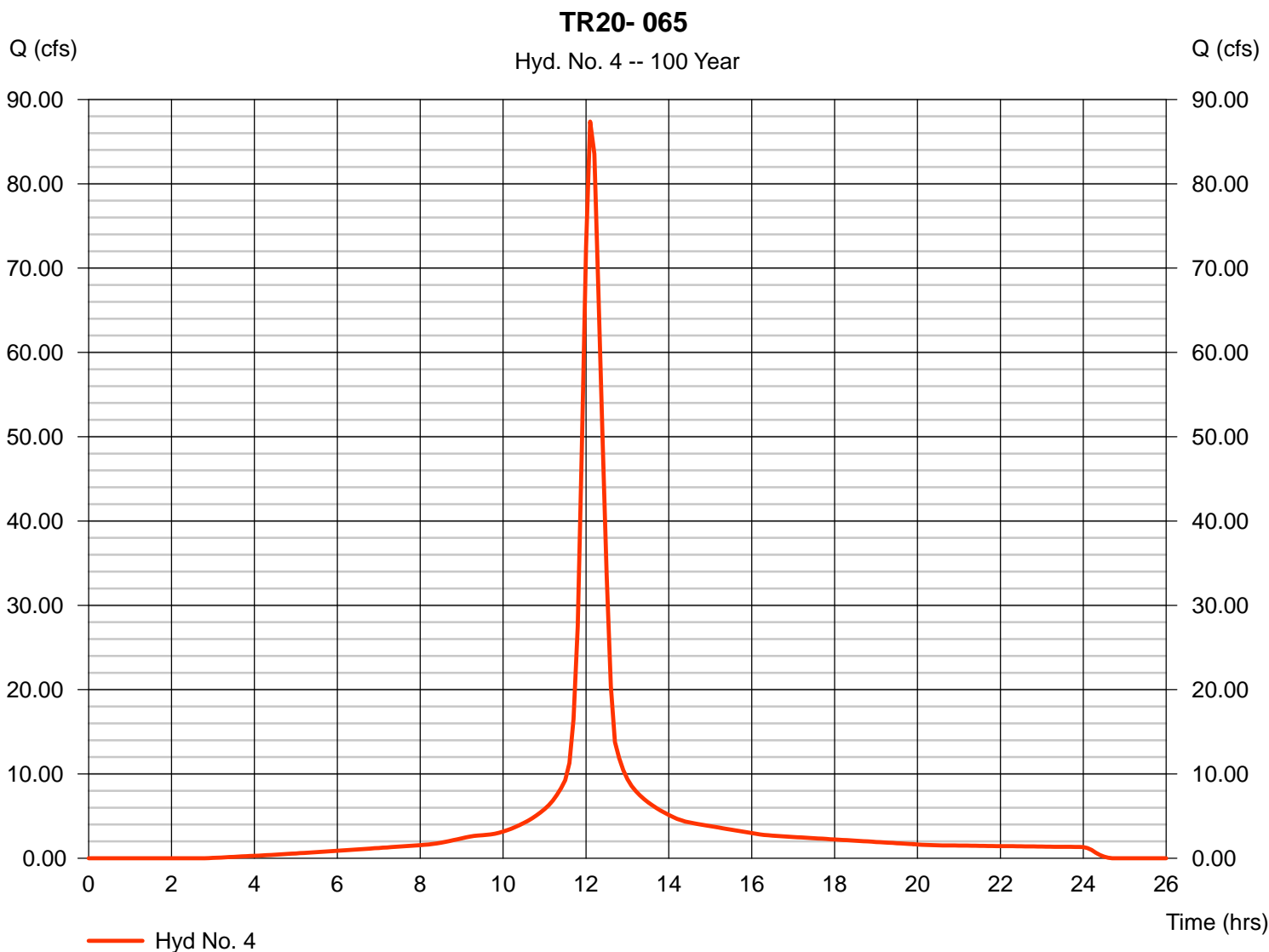
Friday, Mar 1, 2013

## Hyd. No. 4

TR20- 065

Hydrograph type = SCS Runoff  
 Storm frequency = 100 yrs  
 Time interval = 6 min  
 Drainage area = 15.400 ac  
 Basin Slope = 0.0 %  
 Tc method = USER  
 Total precip. = 7.80 in  
 Storm duration = 24 hrs

Peak discharge = 87.37 cfs  
 Time to peak = 12.10 hrs  
 Hyd. volume = 8.466 acft  
 Curve number = 89.9  
 Hydraulic length = 0 ft  
 Time of conc. (Tc) = 21.10 min  
 Distribution = Type II  
 Shape factor = 484



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

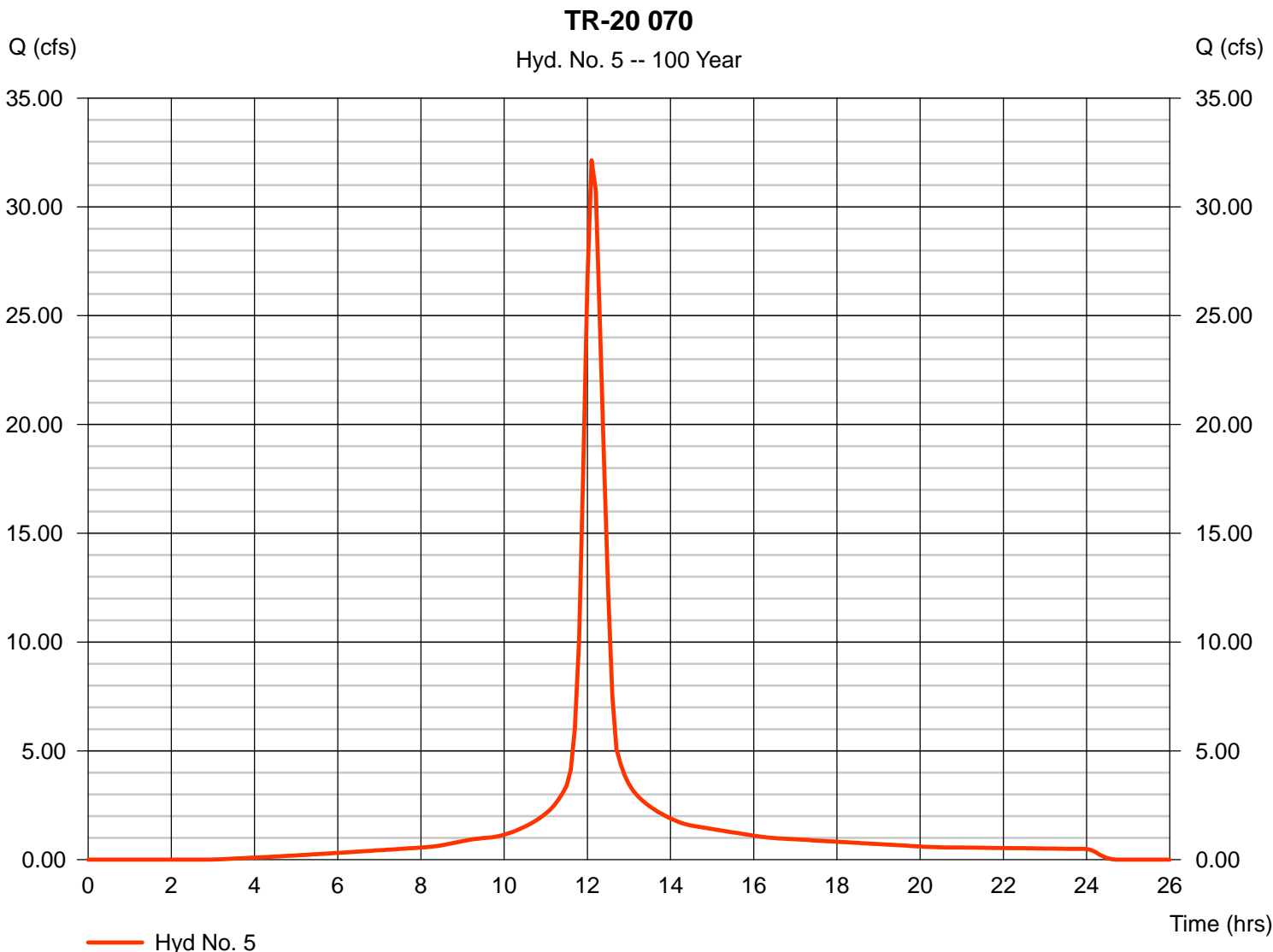
Friday, Mar 1, 2013

## Hyd. No. 5

TR-20 070

Hydrograph type = SCS Runoff  
 Storm frequency = 100 yrs  
 Time interval = 6 min  
 Drainage area = 5.700 ac  
 Basin Slope = 0.0 %  
 Tc method = USER  
 Total precip. = 7.80 in  
 Storm duration = 24 hrs

Peak discharge = 32.14 cfs  
 Time to peak = 12.10 hrs  
 Hyd. volume = 3.105 acft  
 Curve number = 89.4  
 Hydraulic length = 0 ft  
 Time of conc. (Tc) = 20.90 min  
 Distribution = Type II  
 Shape factor = 484



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

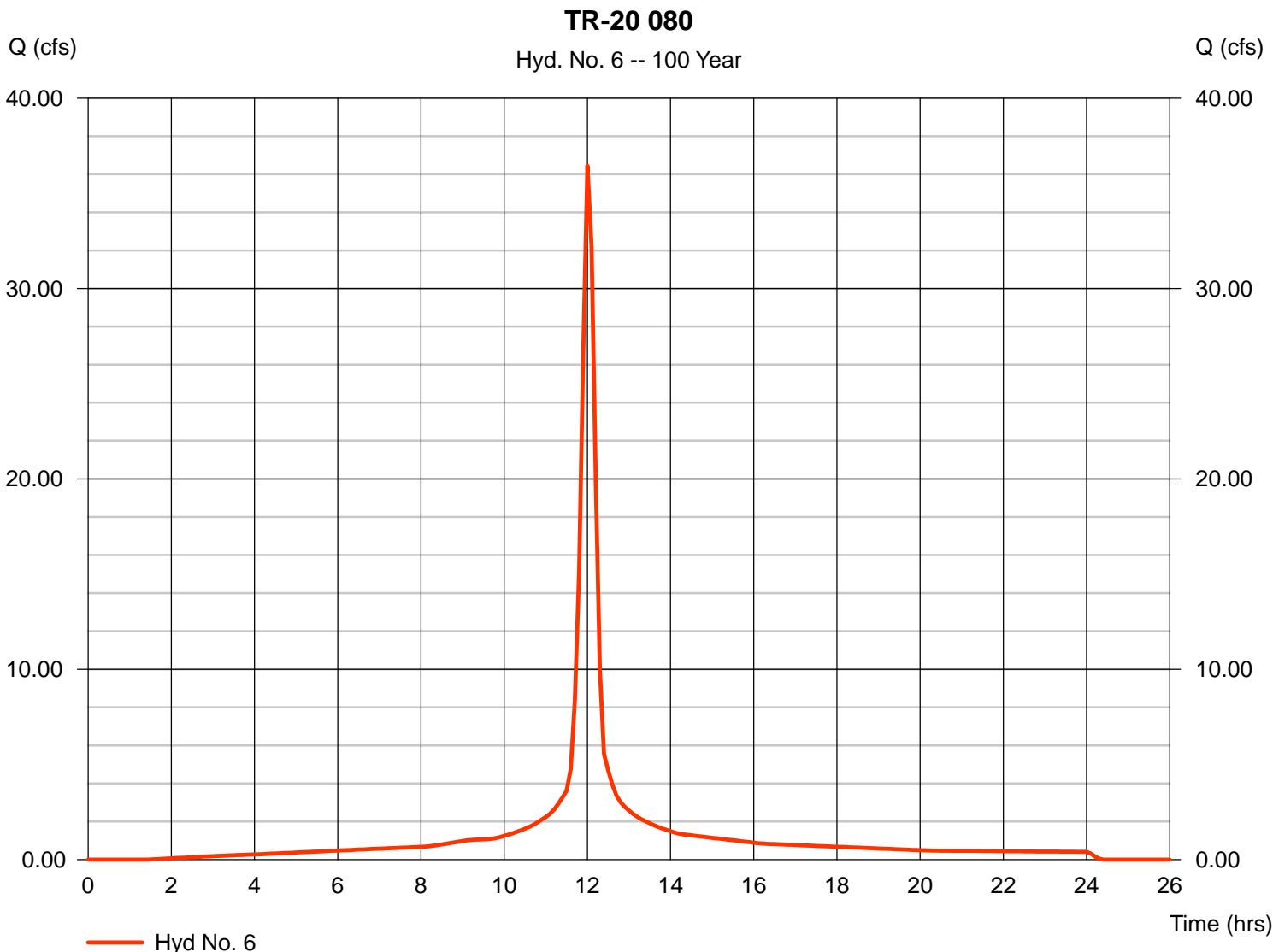
Friday, Mar 1, 2013

## Hyd. No. 6

TR-20 080

Hydrograph type = SCS Runoff  
 Storm frequency = 100 yrs  
 Time interval = 6 min  
 Drainage area = 5.000 ac  
 Basin Slope = 0.0 %  
 Tc method = USER  
 Total precip. = 7.80 in  
 Storm duration = 24 hrs

Peak discharge = 36.45 cfs  
 Time to peak = 12.00 hrs  
 Hyd. volume = 2.813 acft  
 Curve number = 95  
 Hydraulic length = 0 ft  
 Time of conc. (Tc) = 18.90 min  
 Distribution = Type II  
 Shape factor = 484



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

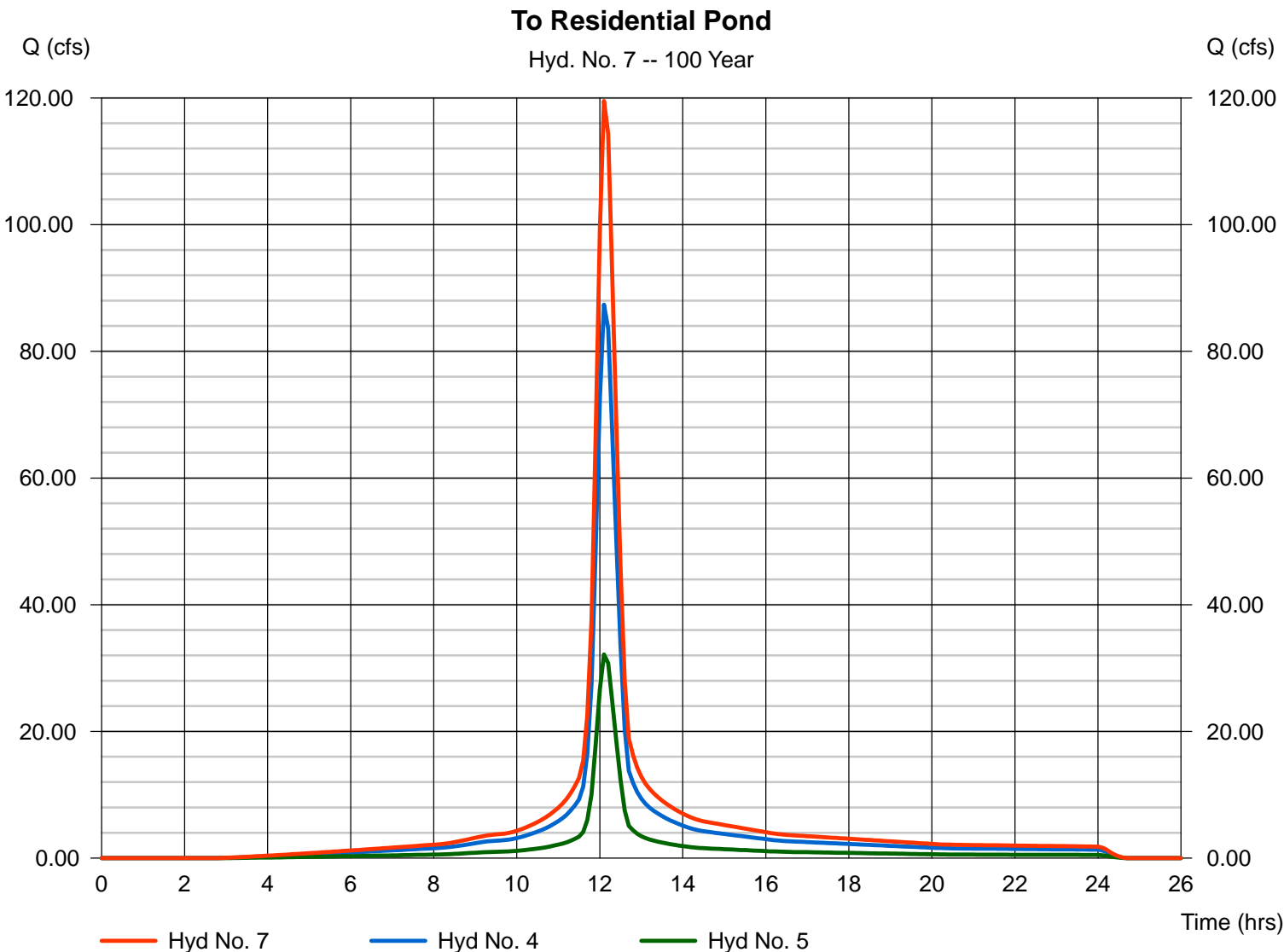
Friday, Mar 1, 2013

## Hyd. No. 7

To Residential Pond

Hydrograph type = Combine  
 Storm frequency = 100 yrs  
 Time interval = 6 min  
 Inflow hyds. = 4, 5

Peak discharge = 119.51 cfs  
 Time to peak = 12.10 hrs  
 Hyd. volume = 11.572 acft  
 Contrib. drain. area = 21.100 ac



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Friday, Mar 1, 2013

## Hyd. No. 8

### Residential Detention

Hydrograph type = Reservoir (Interconnected)  
 Storm frequency = 100 yrs  
 Time interval = 6 min

Peak discharge = 45.21 cfs  
 Time to peak = 12.40 hrs  
 Hyd. volume = 14.371 acft

#### Upper Pond

Pond name = Resid. Det.11-07  
 Inflow hyd. = 7 - To Residential Pond  
 Max. Elevation = 1384.43 ft  
 Max. Storage = 4.498 acft

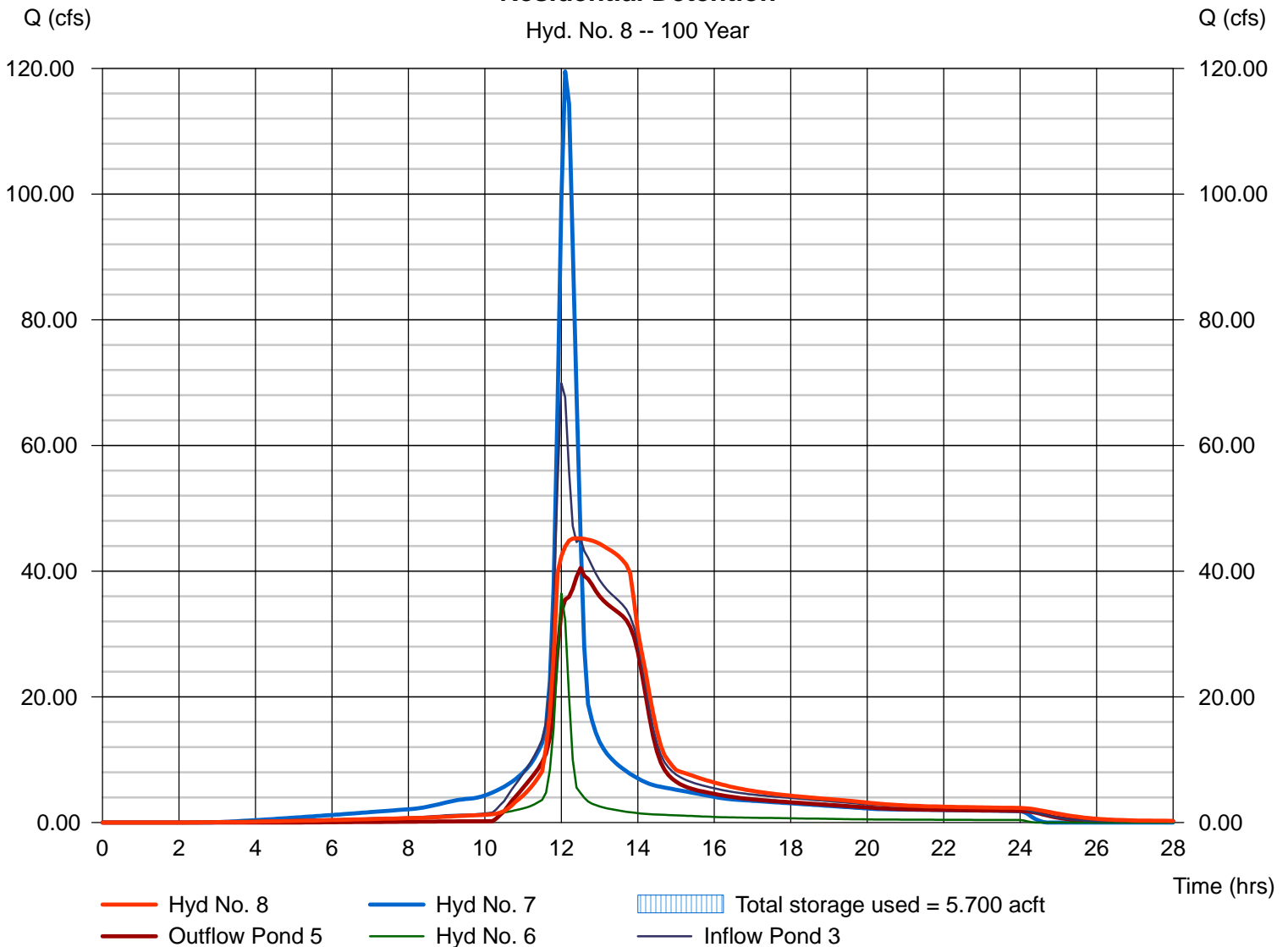
#### Lower Pond

Pond name = Comm. Det. (RES 13)  
 Other Inflow hyd. = 6 - TR-20 080  
 Max. Elevation = 1382.99 ft  
 Max. Storage = 1.202 acft

Interconnected Pond Routing. Storage Indication method used.

### Residential Detention

Hyd. No. 8 -- 100 Year



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Friday, Mar 1, 2013

## Hyd. No. 9

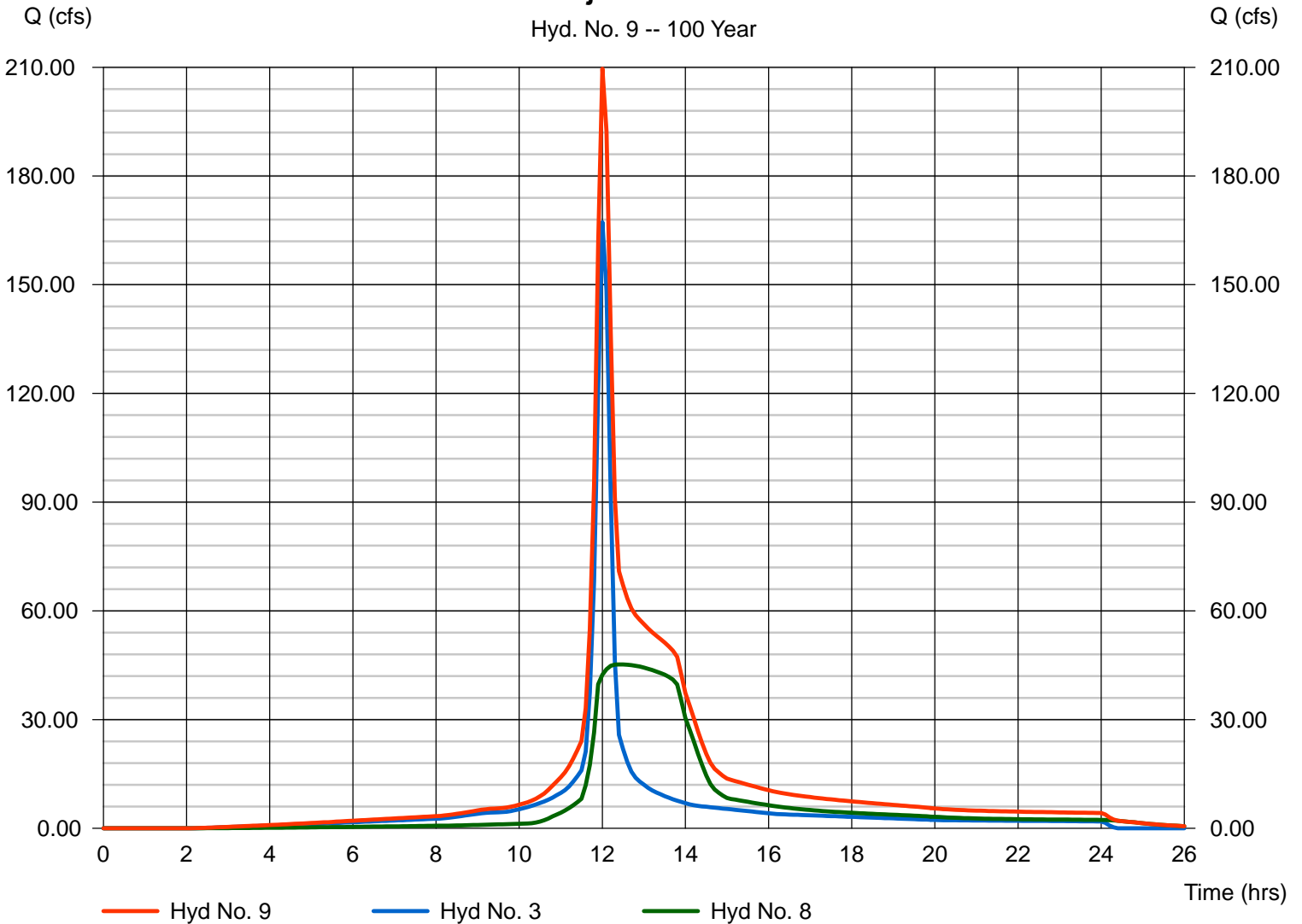
Post-Project to 13th Street

Hydrograph type = Combine  
 Storm frequency = 100 yrs  
 Time interval = 6 min  
 Inflow hyds. = 3, 8

Peak discharge = 209.63 cfs  
 Time to peak = 12.00 hrs  
 Hyd. volume = 26.939 acft  
 Contrib. drain. area = 23.500 ac

### Post-Project to 13th Street

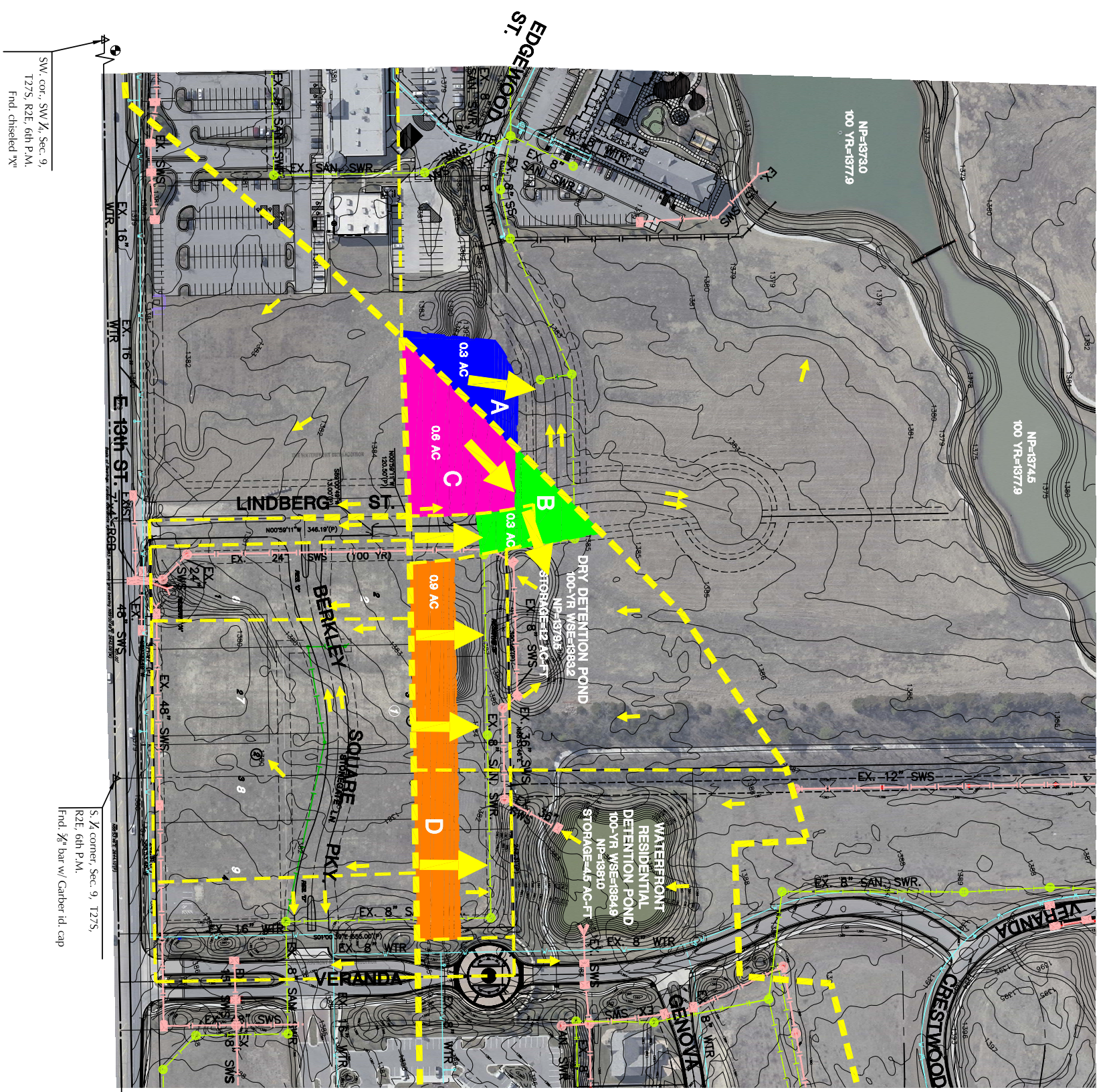
Hyd. No. 9 -- 100 Year



## Appendix D

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### Existing Conditions Drawing



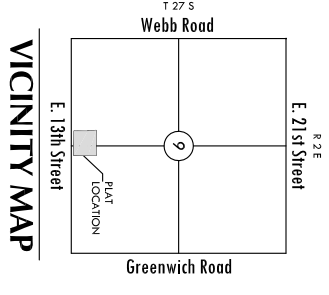
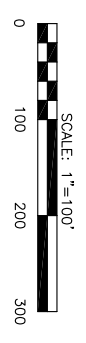
SW. cor., SW 1/4, Sec. 9,  
T27S, R2E, 6th P.M.  
Fnd. chiseled 'x'

S. 1/4 corner, Sec. 9, T27S,  
R2E, 6th P.M.  
Fnd. 3/8" bar w/ Gardner id. cap

SE. cor., SE 1/4, Sec. 9, T27S,  
R2E, 6th P.M.  
Fnd. 3/8" bar w/ Gardner id. cap

NOTE: ELEVATIONS ARE IN NAVD88

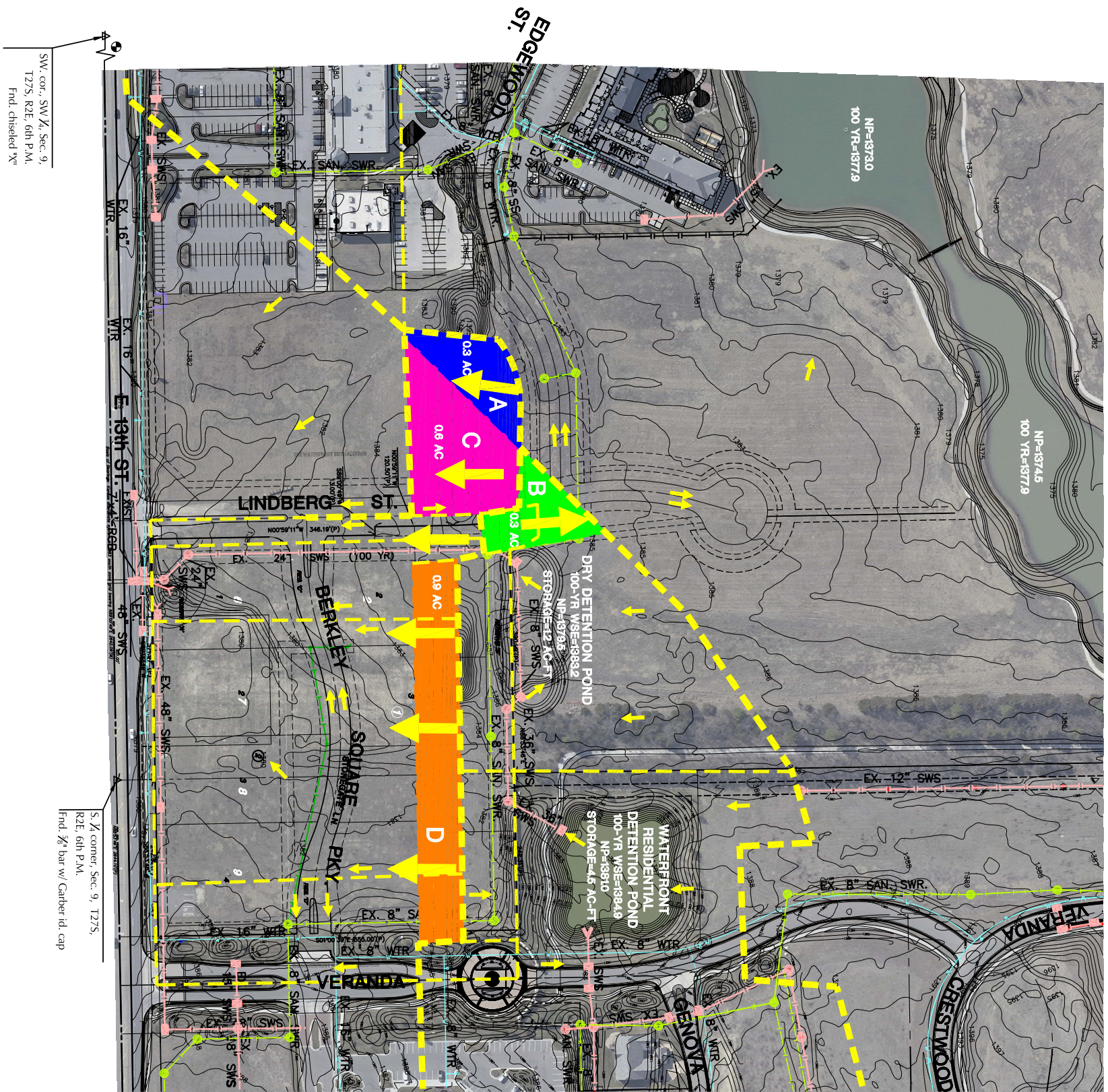
MINIMUM PAD ELEVATION LOWEST BUILDING DRAINING		
LOT	BLOCK	ELEVATION MAD 88
1, 3, 4, 6	1	1386.6



**BENCHMARK**  
 BM - Square cut on SW. corner of signal light pole base at NE. corner of Webb Rd. Elev. = 1373.845 (NAVD 88)

- LEGEND**
- IN - CONIFEROUS TREE
  - 3IN - DECIDUOUS TREE
  - SN - SIGN
  - P - POWER POLE
  - ELEC BOX - ELECTRIC BOX
  - LP - LIGHT POLE
  - FH - FIRE HYDRANT
  - WV - WATER VALVE
  - WM - WATER METER
  - WM - WATER METER
  - SECTION CORNER
  - BENCHMARK
  - EASEMENT
  - BUILDING SETBACK
  - FENCE
  - EXIST. STORM SEWER PIPE
  - EXIST. WATER LINE
  - EXIST. SANITARY SEWER LINE
  - PROP. STORM SEWER PIPE
  - PROP. WATER LINE
  - PROP. SANITARY SEWER LINE
  - GAS PIPELINE
  - GAS PIPELINE
  - TELEPHONE LINE
  - UNDERGROUND ELEC.
  - OVERHEAD ELECTRIC
  - FIBER OPTIC CABLE I
  - DRAINAGE SUB BASIN
  - FLOW ARROW





SW. cor., SW 1/4, Sec. 9,  
T27S, R2E, 6th P.M.  
Fnd. chiseled 'x'

S. 1/4 corner, Sec. 9, T27S,  
R2E, 6th P.M.  
Fnd. 3/8" bar w/ Gardner id. cap

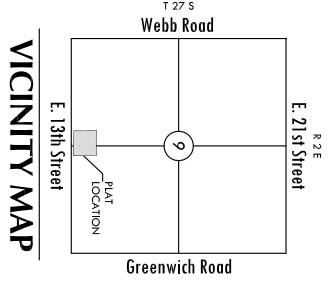
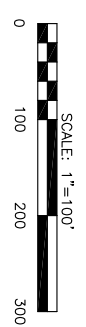
SE. cor., SE 1/4, Sec. 9, T27S,  
R2E, 6th P.M.  
Fnd. 3/8" bar w/ Gardner id. cap

NOTE: ELEVATIONS ARE IN NAVD88

MINIMUM PAD ELEVATION LOWEST BUILDING DRAINING		
LOT	BLOCK	ELEVATION MAD 88
1, 3, 4, 6	1	1386.6

**BENCHMARK**

BM - Square cut on SW. corner of signal  
light pole base at NE. corner of Webb Rd.  
Elev. = 1373.845 (NAVD 88)



- LEGEND**
- IN - CONIFEROUS TREE
  - 3IN - DECIDUOUS TREE
  - SN - SIGN
  - P - POWER POLE
  - ELEC BOX - ELECTRIC BOX
  - LP - LIGHT POLE
  - FH - FIRE HYDRANT
  - WV - WATER VALVE
  - WM - WATER METER
  - - SECTION CORNER
  - △ - BENCHMARK
  - - EASEMENT
  - - BUILDING SETBACK
  - X- - FENCE
  - X- - EXIST. STORM SEWER PIPE
  - X- - EXIST. WATER LINE
  - X- - EXIST. SANITARY SEWER LINE
  - X- - PROP. STORM SEWER PIPE
  - X- - PROP. WATER LINE
  - X- - PROP. SANITARY SEWER LINE
  - X- - GAS PIPELINE
  - X- - TELEPHONE LINE
  - X- - UNDERGROUND ELEC.
  - X- - OVERHEAD ELECTRIC
  - X- - FIBER OPTIC CABLE I
  - X- - DRAINAGE SUB BASIN
  - X- - FLOW ARROW

# THE WATERFRONT

## SIXTH & EIGHTH ADDITIONS

**PROPOSED  
CONDITIONS  
PLAN**

SHEET TITLE  
02014  
PROJECT NUMBER

KLA / DM / GJA  
DISIGNED / DRAWN / CHECKED

ISSUED  
October 2012

REVISIONS

SHEET NO.  
1 of 1

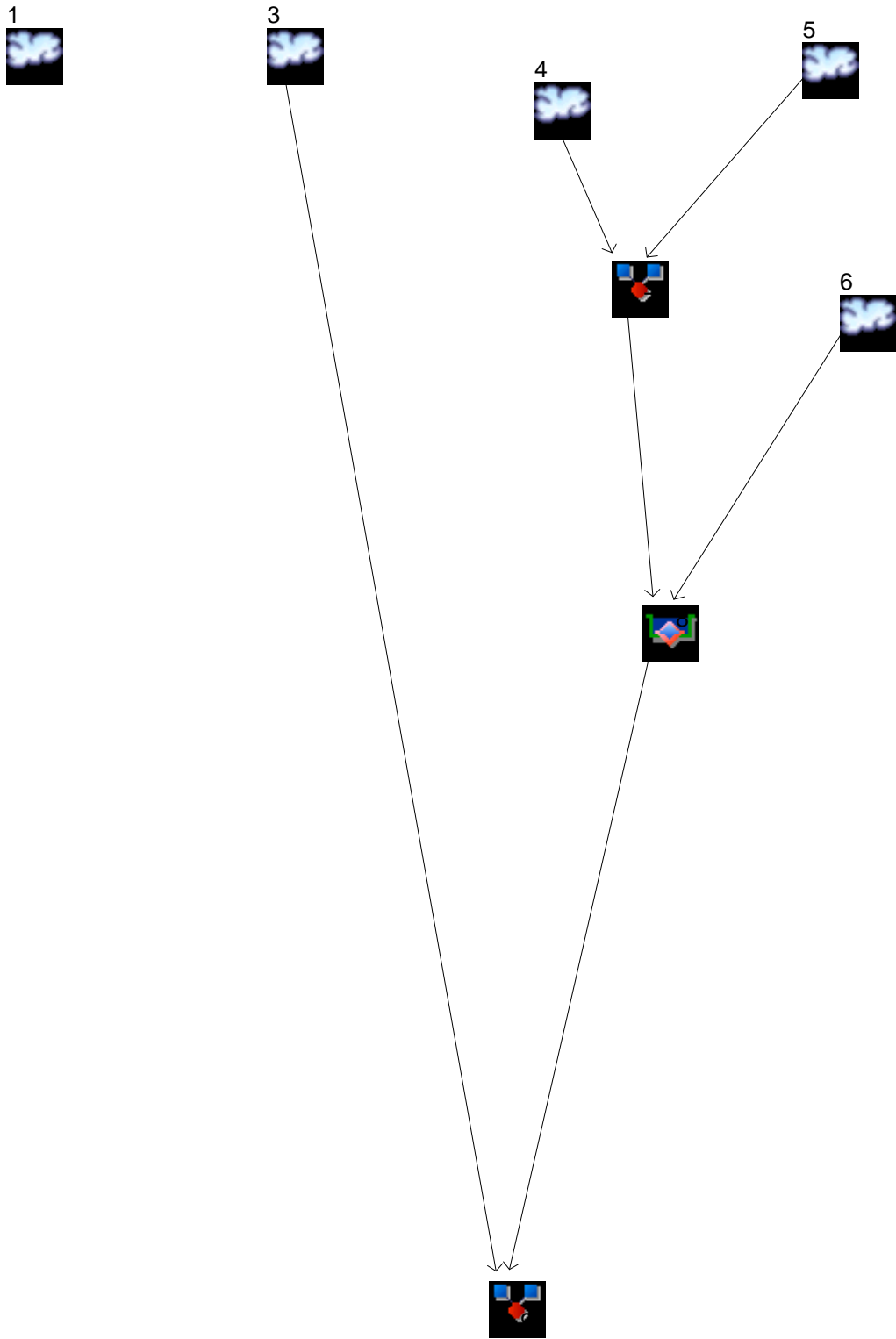
**PRELIMINARY**  
NOT FOR  
CONSTRUCTION

**MKREC**  
ENGINEERING  
CONSULTANTS, INC.  
411 N. WEBB ROAD  
WICHITA, KS. 67206  
316 - 684 - 9600



# Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066



# Hydrograph Return Period Recap

Hydroflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	-----	-----	78.30	-----	116.81	142.82	182.16	-----	238.52	Pre-Project to 13th Street
3	SCS Runoff	-----	-----	72.11	-----	99.13	116.70	142.90	-----	180.07	Post-Project Commercial to 13th Stre
4	SCS Runoff	-----	-----	32.37	-----	45.51	54.09	66.91	-----	85.10	TR20- 065
5	SCS Runoff	-----	-----	12.08	-----	17.07	20.34	25.22	-----	32.14	TR-20 070
6	SCS Runoff	-----	-----	11.13	-----	14.91	17.36	21.03	-----	26.24	TR-20 080
7	Combine	4, 5,	-----	44.45	-----	62.58	74.42	92.12	-----	117.24	To Residential Pond
8	Reservoir(i)	7, 6	-----	26.61	-----	39.18	41.19	42.77	-----	44.48	Residential Detention
9	Combine	3, 8	-----	75.74	-----	111.31	143.99	182.51	-----	221.46	Post-Project to 13th Street
Proj. file: 13th Street_2-2013_proposed.gpw									Friday, Mar 1, 2013		

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	78.30	6	738	9.039	-----	-----	-----	Pre-Project to 13th Street
3	SCS Runoff	72.11	6	720	5.174	-----	-----	-----	Post-Project Commercial to 13th Stre
4	SCS Runoff	32.37	6	726	3.025	-----	-----	-----	TR20- 065
5	SCS Runoff	12.08	6	726	1.128	-----	-----	-----	TR-20 070
6	SCS Runoff	11.13	6	720	0.821	-----	-----	-----	TR-20 080
7	Combine	44.45	6	726	4.153	4, 5,	-----	-----	To Residential Pond
8	Reservoir(i)	26.61	6	744	4.951	7, 6	1382.15	2.19	Residential Detention
9	Combine	75.74	6	720	10.125	3, 8	-----	-----	Post-Project to 13th Street
13th Street_2-2013_proposed.gpw					Return Period: 2 Year			Friday, Mar 1, 2013	

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	116.81	6	732	13.476	-----	-----	-----	Pre-Project to 13th Street	
3	SCS Runoff	99.13	6	720	7.216	-----	-----	-----	Post-Project Commercial to 13th Stre	
4	SCS Runoff	45.51	6	726	4.292	-----	-----	-----	TR20- 065	
5	SCS Runoff	17.07	6	726	1.607	-----	-----	-----	TR-20 070	
6	SCS Runoff	14.91	6	720	1.118	-----	-----	-----	TR-20 080	
7	Combine	62.58	6	726	5.899	4, 5,	-----	-----	To Residential Pond	
8	Reservoir(i)	39.18	6	738	7.003	7, 6	1382.61	2.79	Residential Detention	
9	Combine	111.31	6	726	14.219	3, 8	-----	-----	Post-Project to 13th Street	
13th Street_2-2013_proposed.gpw					Return Period: 5 Year			Friday, Mar 1, 2013		

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	142.82	6	732	16.482	-----	-----	-----	Pre-Project to 13th Street	
3	SCS Runoff	116.70	6	720	8.566	-----	-----	-----	Post-Project Commercial to 13th Stre	
4	SCS Runoff	54.09	6	726	5.134	-----	-----	-----	TR20- 065	
5	SCS Runoff	20.34	6	726	1.926	-----	-----	-----	TR-20 070	
6	SCS Runoff	17.36	6	720	1.313	-----	-----	-----	TR-20 080	
7	Combine	74.42	6	726	7.060	4, 5,	-----	-----	To Residential Pond	
8	Reservoir(i)	41.19	6	738	8.367	7, 6	1382.98	3.28	Residential Detention	
9	Combine	143.99	6	726	16.933	3, 8	-----	-----	Post-Project to 13th Street	
13th Street_2-2013_proposed.gpw					Return Period: 10 Year			Friday, Mar 1, 2013		

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	182.16	6	732	21.089	-----	-----	-----	Pre-Project to 13th Street	
3	SCS Runoff	142.90	6	720	10.603	-----	-----	-----	Post-Project Commercial to 13th Stre	
4	SCS Runoff	66.91	6	726	6.409	-----	-----	-----	TR20- 065	
5	SCS Runoff	25.22	6	726	2.409	-----	-----	-----	TR-20 070	
6	SCS Runoff	21.03	6	720	1.606	-----	-----	-----	TR-20 080	
7	Combine	92.12	6	726	8.818	4, 5,	-----	-----	To Residential Pond	
8	Reservoir(i)	42.77	6	744	10.416	7, 6	1383.51	4.12	Residential Detention	
9	Combine	182.51	6	720	21.020	3, 8	-----	-----	Post-Project to 13th Street	
13th Street_2-2013_proposed.gpw					Return Period: 25 Year			Friday, Mar 1, 2013		

# Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

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	238.52	6	732	27.801	-----	-----	-----	Pre-Project to 13th Street	
3	SCS Runoff	180.07	6	720	13.531	-----	-----	-----	Post-Project Commercial to 13th Stre	
4	SCS Runoff	85.10	6	726	8.246	-----	-----	-----	TR20- 065	
5	SCS Runoff	32.14	6	726	3.105	-----	-----	-----	TR-20 070	
6	SCS Runoff	26.24	6	720	2.026	-----	-----	-----	TR-20 080	
7	Combine	117.24	6	726	11.352	4, 5,	-----	-----	To Residential Pond	
8	Reservoir(i)	44.48	6	756	13.370	7, 6	1384.25	5.34	Residential Detention	
9	Combine	221.46	6	720	26.900	3, 8	-----	-----	Post-Project to 13th Street	
13th Street_2-2013_proposed.gpw					Return Period: 100 Year			Friday, Mar 1, 2013		

# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

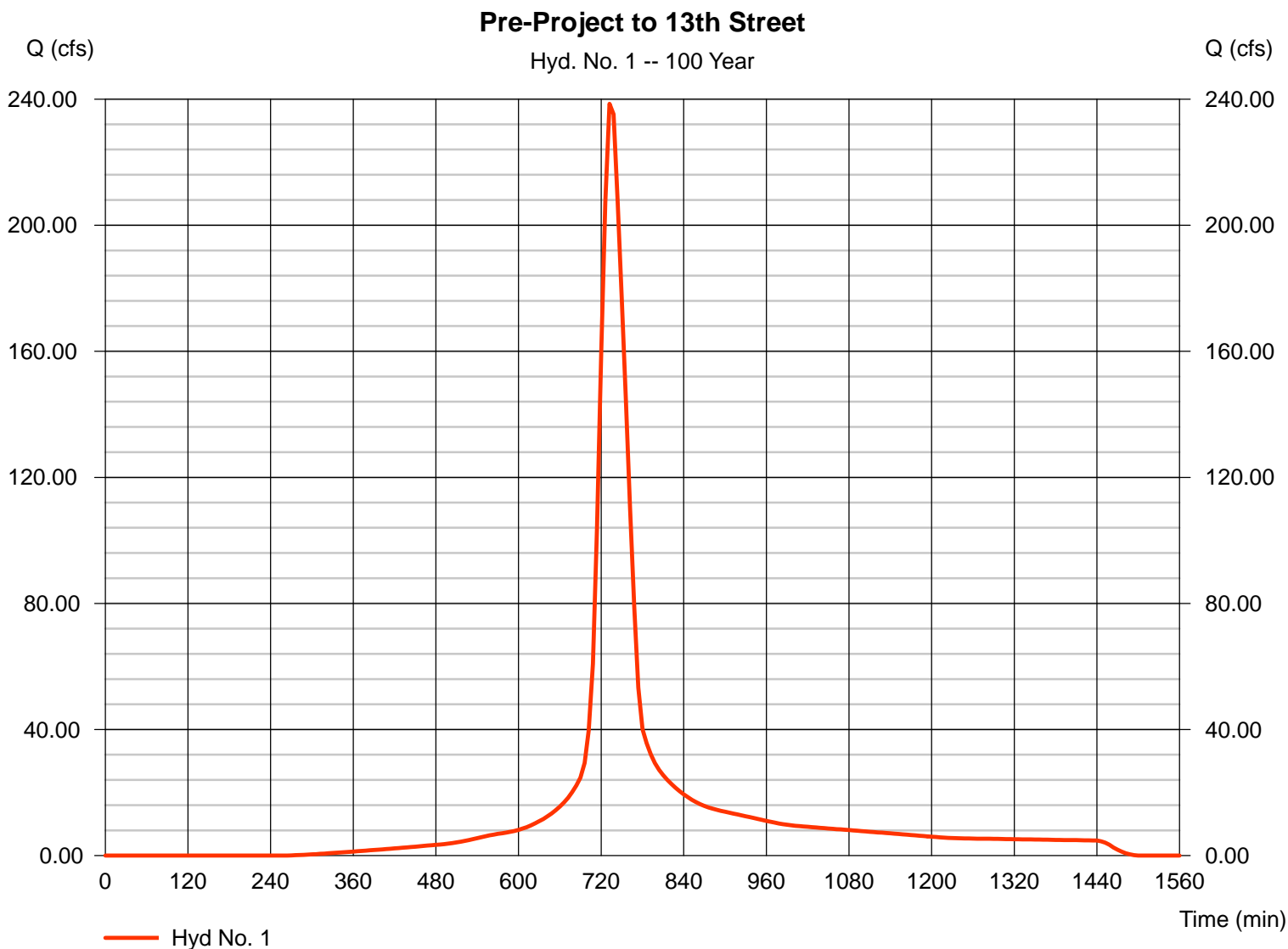
Friday, Mar 1, 2013

## Hyd. No. 1

Pre-Project to 13th Street

Hydrograph type = SCS Runoff  
 Storm frequency = 100 yrs  
 Time interval = 6 min  
 Drainage area = 54.800 ac  
 Basin Slope = 0.0 %  
 Tc method = USER  
 Total precip. = 7.80 in  
 Storm duration = 24 hrs

Peak discharge = 238.52 cfs  
 Time to peak = 732 min  
 Hyd. volume = 27.801 acft  
 Curve number = 84  
 Hydraulic length = 0 ft  
 Time of conc. (Tc) = 30.60 min  
 Distribution = Type II  
 Shape factor = 484



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Friday, Mar 1, 2013

## Hyd. No. 3

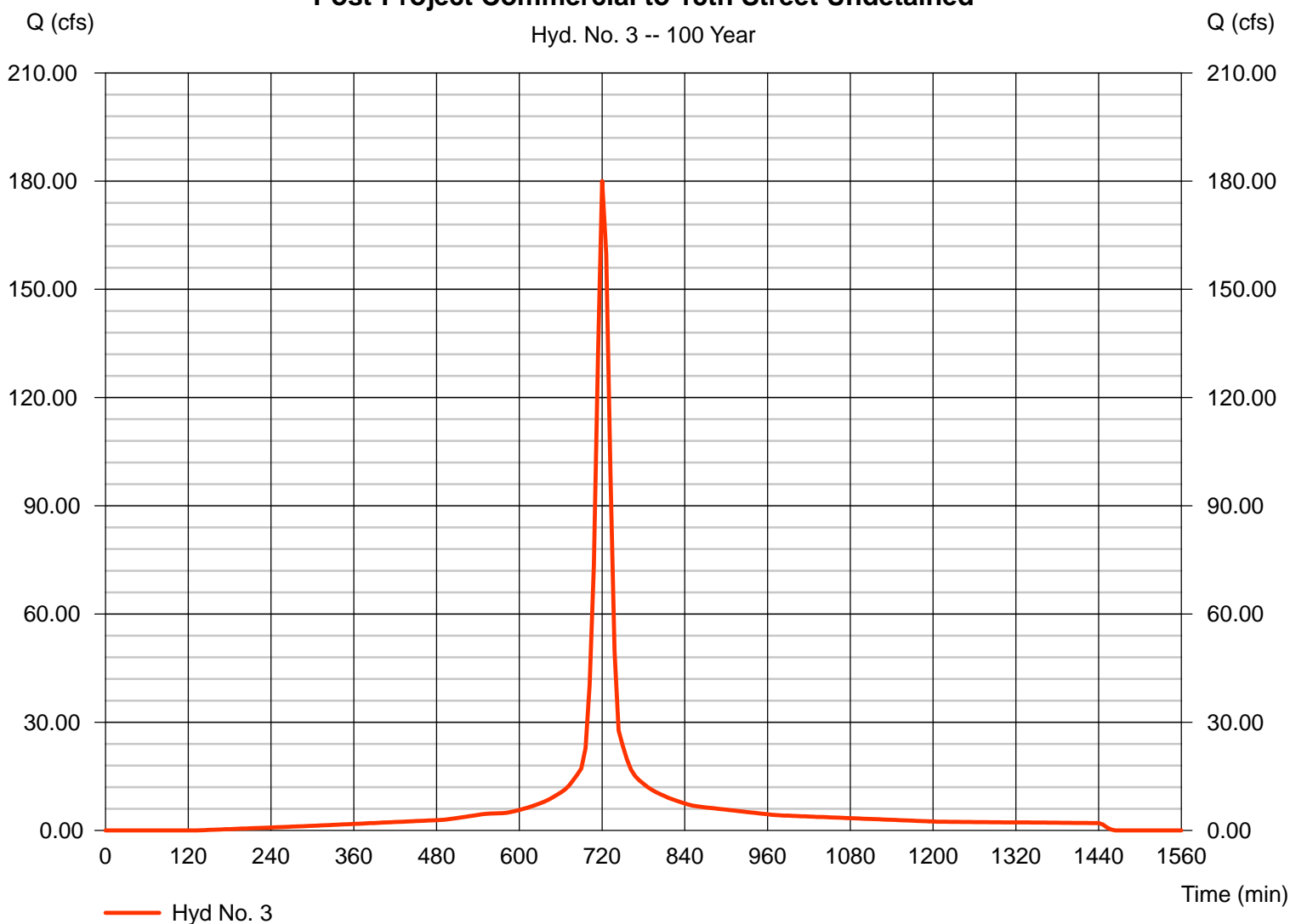
### Post-Project Commercial to 13th Street Undetained

Hydrograph type = SCS Runoff  
 Storm frequency = 100 yrs  
 Time interval = 6 min  
 Drainage area = 25.300 ac  
 Basin Slope = 0.0 %  
 Tc method = USER  
 Total precip. = 7.80 in  
 Storm duration = 24 hrs

Peak discharge = 180.07 cfs  
 Time to peak = 720 min  
 Hyd. volume = 13.531 acft  
 Curve number = 92\*  
 Hydraulic length = 0 ft  
 Time of conc. (Tc) = 15.00 min  
 Distribution = Type II  
 Shape factor = 484

\* Composite (Area/CN) = [(21.400 x 95) + (6.600 x 84)] / 25.300

### Post-Project Commercial to 13th Street Undetained



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

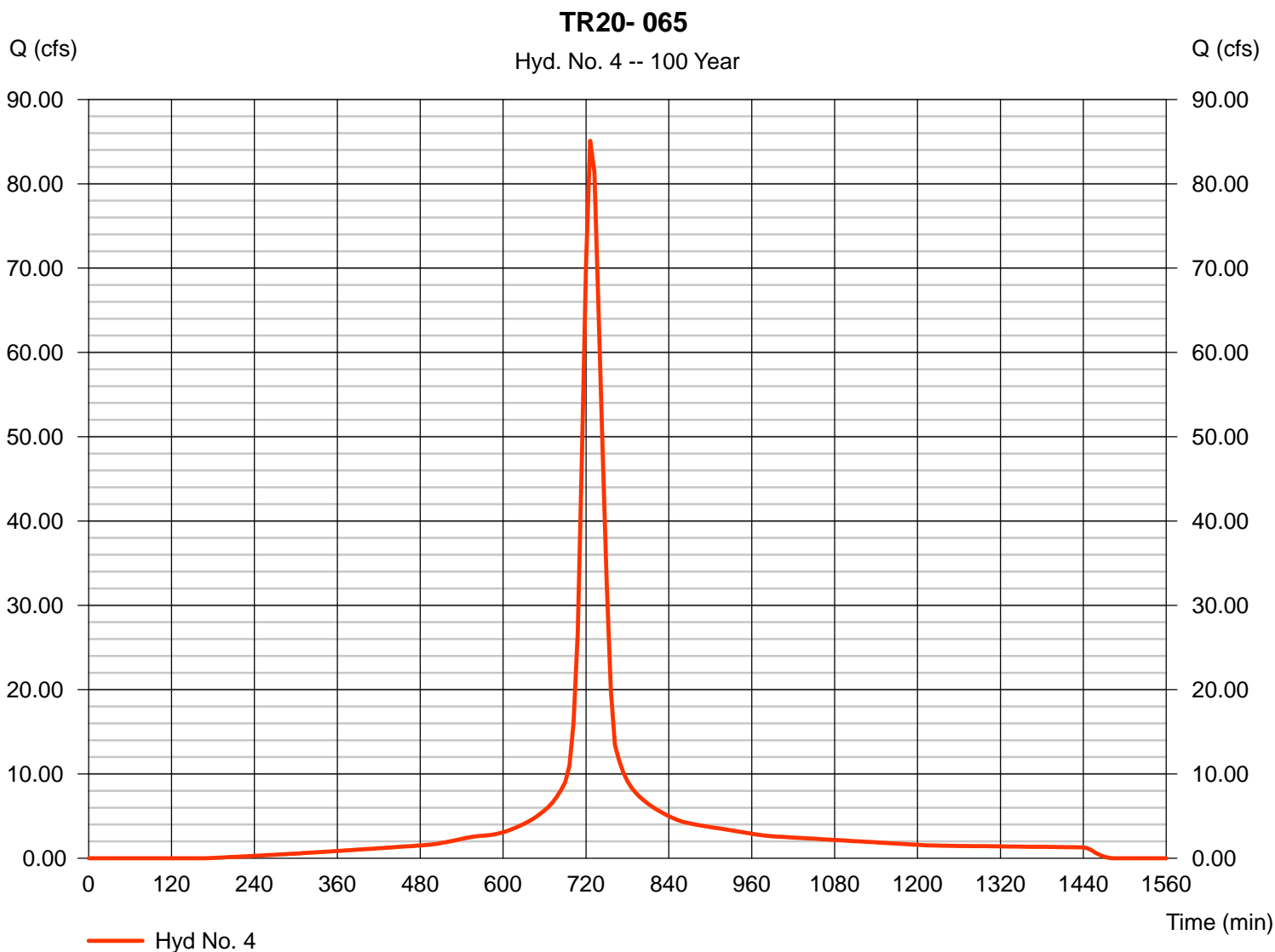
Friday, Mar 1, 2013

## Hyd. No. 4

TR20- 065

Hydrograph type = SCS Runoff  
 Storm frequency = 100 yrs  
 Time interval = 6 min  
 Drainage area = 15.000 ac  
 Basin Slope = 0.0 %  
 Tc method = USER  
 Total precip. = 7.80 in  
 Storm duration = 24 hrs

Peak discharge = 85.10 cfs  
 Time to peak = 726 min  
 Hyd. volume = 8.246 acft  
 Curve number = 89.9  
 Hydraulic length = 0 ft  
 Time of conc. (Tc) = 21.10 min  
 Distribution = Type II  
 Shape factor = 484



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

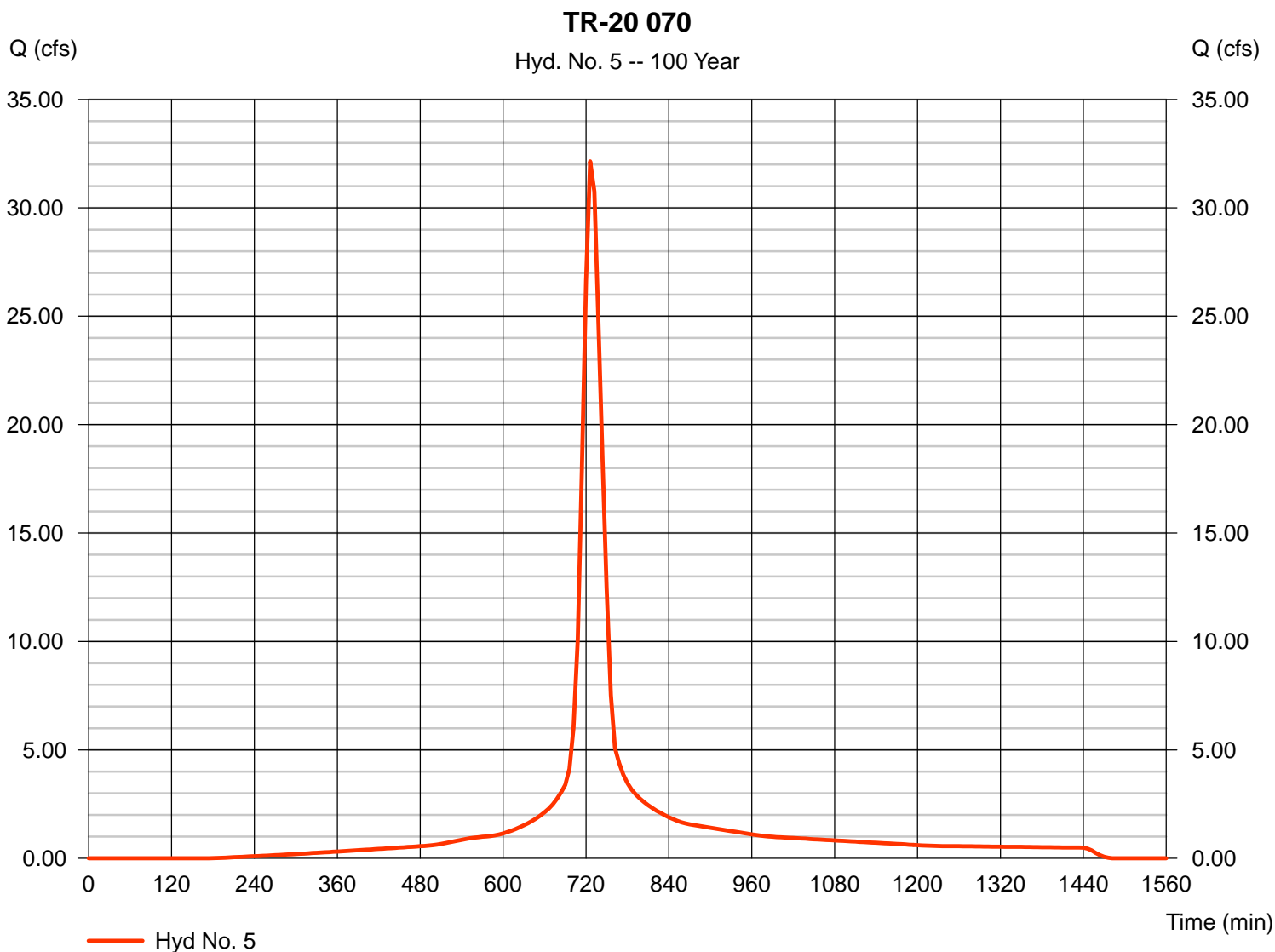
Friday, Mar 1, 2013

## Hyd. No. 5

TR-20 070

Hydrograph type = SCS Runoff  
 Storm frequency = 100 yrs  
 Time interval = 6 min  
 Drainage area = 5.700 ac  
 Basin Slope = 0.0 %  
 Tc method = USER  
 Total precip. = 7.80 in  
 Storm duration = 24 hrs

Peak discharge = 32.14 cfs  
 Time to peak = 726 min  
 Hyd. volume = 3.105 acft  
 Curve number = 89.4  
 Hydraulic length = 0 ft  
 Time of conc. (Tc) = 20.90 min  
 Distribution = Type II  
 Shape factor = 484



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

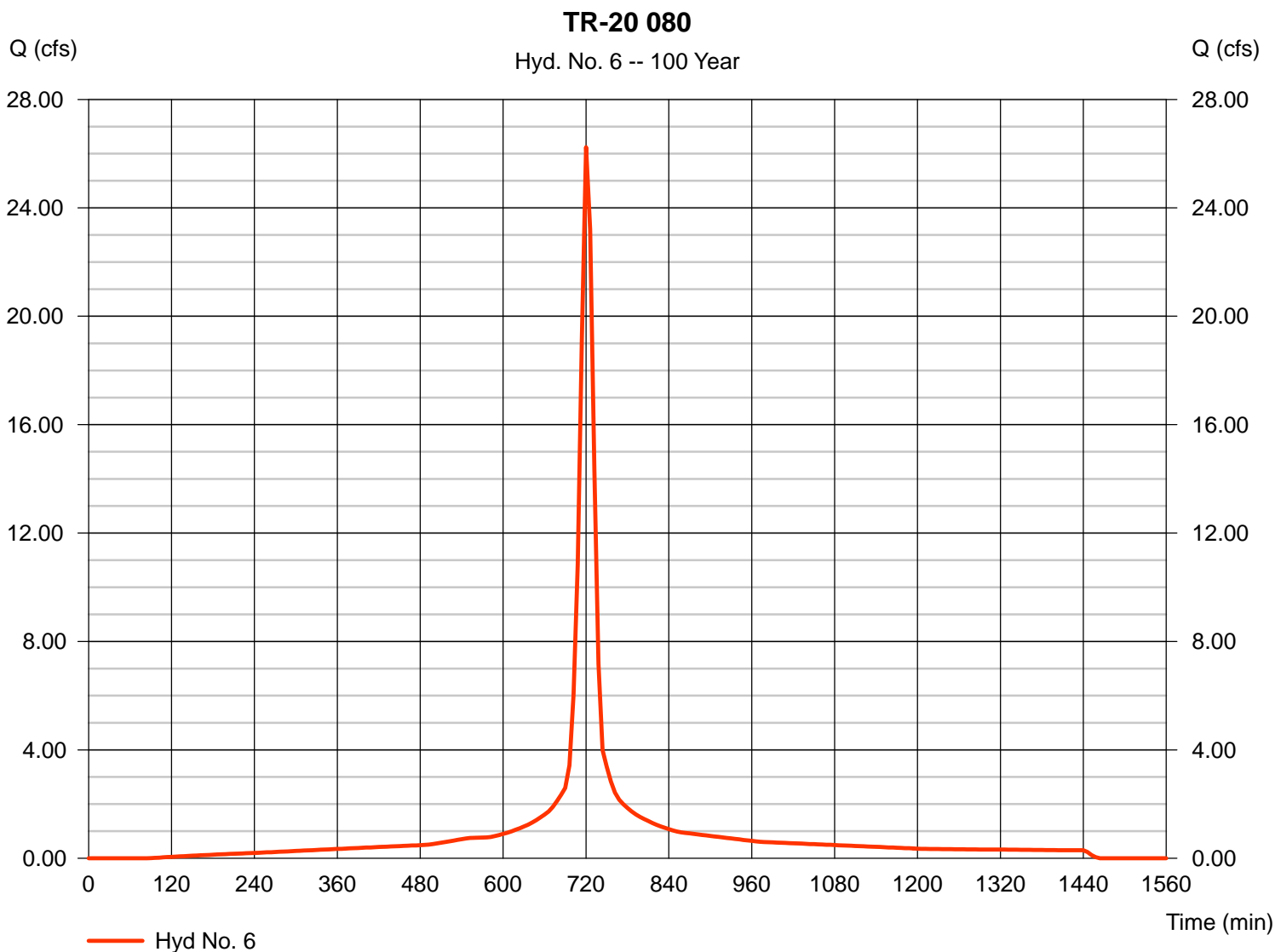
Friday, Mar 1, 2013

## Hyd. No. 6

TR-20 080

Hydrograph type = SCS Runoff  
 Storm frequency = 100 yrs  
 Time interval = 6 min  
 Drainage area = 3.600 ac  
 Basin Slope = 0.0 %  
 Tc method = USER  
 Total precip. = 7.80 in  
 Storm duration = 24 hrs

Peak discharge = 26.24 cfs  
 Time to peak = 720 min  
 Hyd. volume = 2.026 acft  
 Curve number = 95  
 Hydraulic length = 0 ft  
 Time of conc. (Tc) = 18.90 min  
 Distribution = Type II  
 Shape factor = 484



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

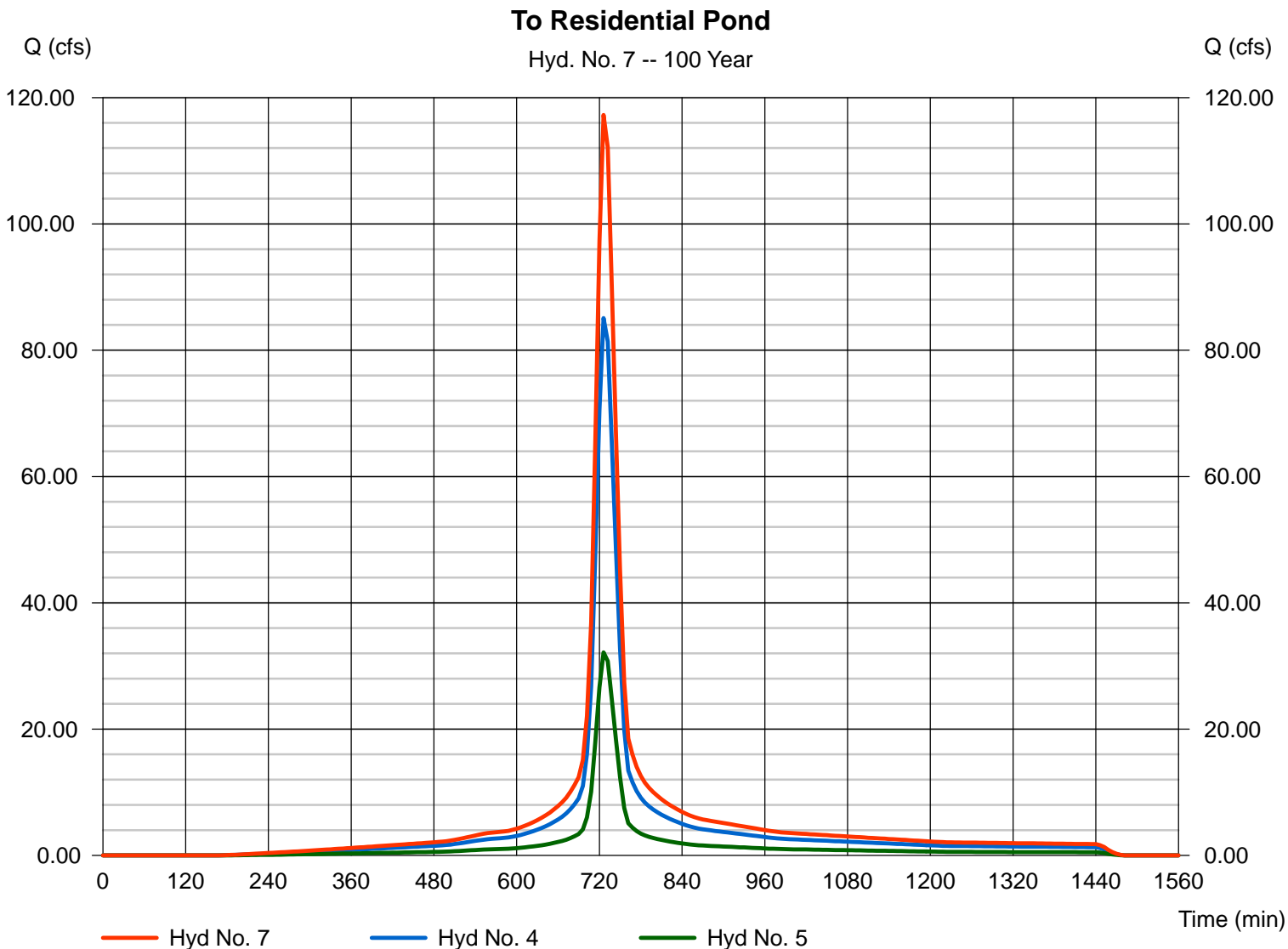
Friday, Mar 1, 2013

## Hyd. No. 7

To Residential Pond

Hydrograph type = Combine  
 Storm frequency = 100 yrs  
 Time interval = 6 min  
 Inflow hyds. = 4, 5

Peak discharge = 117.24 cfs  
 Time to peak = 726 min  
 Hyd. volume = 11.352 acft  
 Contrib. drain. area = 20.700 ac



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Friday, Mar 1, 2013

## Hyd. No. 8

### Residential Detention

Hydrograph type = Reservoir (Interconnected)  
 Storm frequency = 100 yrs  
 Time interval = 6 min

Peak discharge = 44.48 cfs  
 Time to peak = 756 min  
 Hyd. volume = 13.370 acft

#### Upper Pond

Pond name = Resid. Det.11-07  
 Inflow hyd. = 7 - To Residential Pond  
 Max. Elevation = 1384.25 ft  
 Max. Storage = 4.259 acft

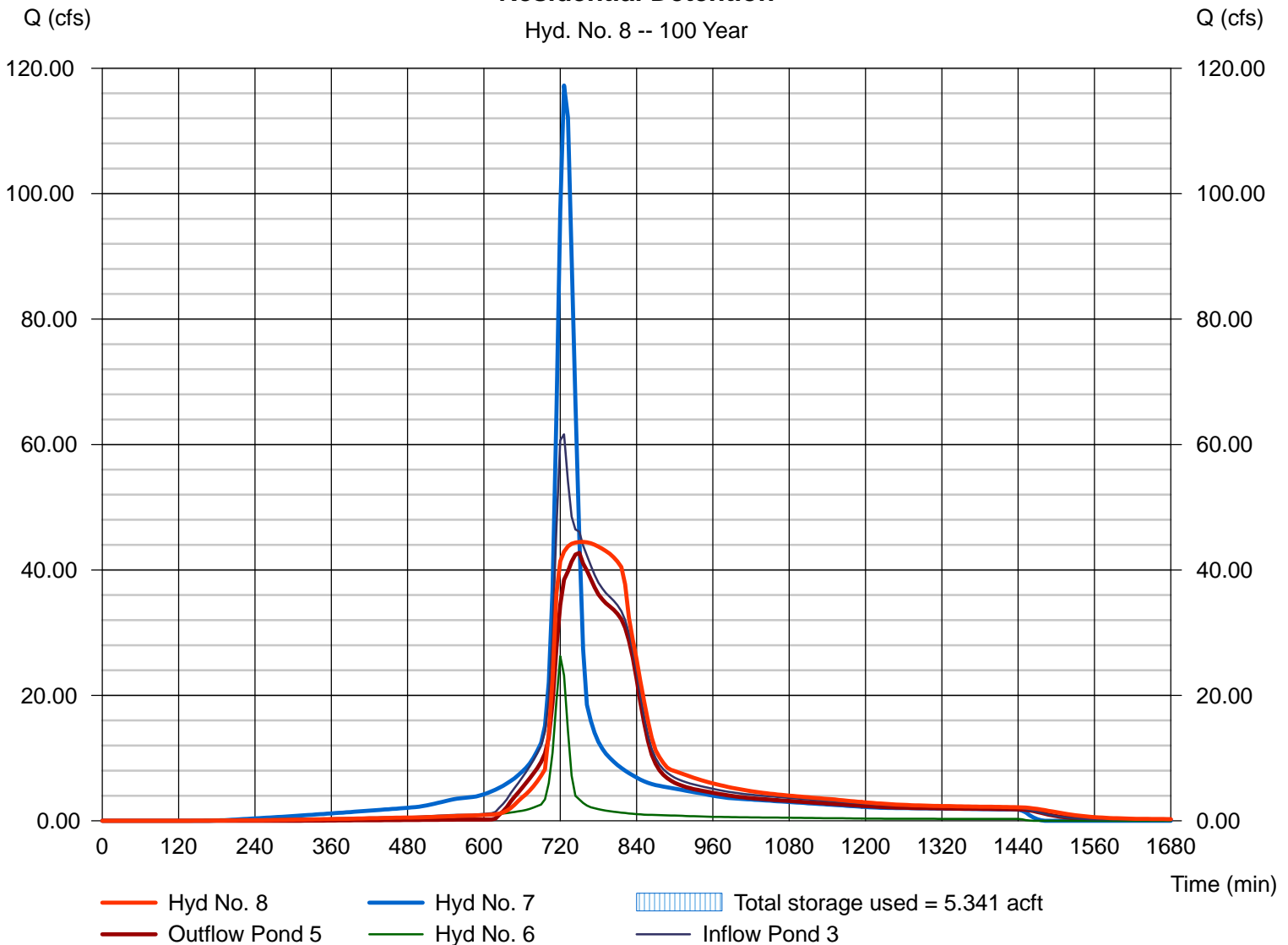
#### Lower Pond

Pond name = Comm. Det. (RES 13)  
 Other Inflow hyd. = 6 - TR-20 080  
 Max. Elevation = 1382.70 ft  
 Max. Storage = 1.082 acft

Interconnected Pond Routing. Storage Indication method used.

### Residential Detention

Hyd. No. 8 -- 100 Year



# Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. v6.066

Friday, Mar 1, 2013

## Hyd. No. 9

Post-Project to 13th Street

Hydrograph type = Combine  
Storm frequency = 100 yrs  
Time interval = 6 min  
Inflow hyds. = 3, 8

Peak discharge = 221.46 cfs  
Time to peak = 720 min  
Hyd. volume = 26.900 acft  
Contrib. drain. area = 25.300 ac

### Post-Project to 13th Street

Hyd. No. 9 -- 100 Year

