

PRELIMINARY HYDROLOGY STUDY

FOR

NORTHGATE WALK

San Rafael, California

Prepared For:
Empire USA Real Estate Investments
1801 Century Park E., Suite 2400
Los Angeles, CA 90067

Prepared By:
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Novato, California 94949
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Prepared:
July 1, 2016

CSW|ST2 File No.:
5.1455.00

CSW | ST2

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NORTHGATE WALK



Julia A. Harberson
R.C.E. # 76626, Exp. 12/31/2016

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1. INTRODUCTION

This Hydrology Study is prepared at the request of the Empire USA Real Estate Investments. This report analyzes the existing and proposed 25- and 100-year peak discharge rates to ensure the proposed peak discharge rate does not exceed the existing.

2. SCENARIOS ANALYZED

2.1 Existing Condition:

The Northgate Walk project is located in the City of San Rafael, California, in the county of Marin, at the intersection of Manuel T. Freitas Parkway and Highway 101. The site is bounded to the south by an office building and Manuel T. Freitas Parkway, to the east by an existing drainage channel and to the west by Highway 101. The site is relatively flat with embankments of either side leading towards the existing drainage channel and Highway 101.

The Northgate Walk site consists of two parcels, one developed as a gas station and the second developed as a hotel. The existing site is split into twelve (12) sub-watersheds. Runoff discharges from the site at six (6) points of concentration (POC #A, POC #B, POC #C, POC #D, POC #Channel and POC #E). POC #A through POC #D and POC #Channel all discharge into the existing drainage channel east of the project site. POC #E discharges towards Highway 101. See H1-Existing Conditions Hydrology Map.

2.2 Proposed Condition:

The Northgate Walk project site is a redevelopment of the existing site. The proposed redevelopment is divided into eighteen (18). Runoff discharges from the site at seven (7) points of concentration (POC #A, POC #B, POC #B' (new), POC #C, POC #D, POC #Channel and POC #E). POC #A through POC #D and POC #Channel all discharge into the existing drainage channel east of the project site. POC #E discharges towards Highway 101. See H2-Proposed Conditions Hydrology Map.

3. ANALYSIS

3.1 Criteria

This report follows the criteria contained within the "County of Marin Department of Public Works Hydrology Manual Simplified Instructions," dated 8/2/00. The analysis herein utilizes the Rational Method to calculate pre- and post-project peak flows. Rainfall Intensities for use with the Rational Method are developed from

Intensity-Duration-Frequency data available from the National Oceanic Atmospheric Administration (NOAA) specific to the geographic location of the project site.

3.2 Hydrology

- a. Rational Method: The Rational Method was utilized to calculate design peak discharge in accordance with the County of Marin Department of Public Works Hydrology Manual Simplified Instructions. The Rational Method is based on the following formula:

$$Q=CIA$$

Where: Q = Flow Rate (cubic feet per second, cfs)

C = Runoff Coefficients

I = Rainfall Intensity (inches per hour, in/hr)

A = Tributary Area (acres, ac)

- b. Time of Concentration: The time of concentration (T_c) is composed of three parts, including:

1. Overland flow travel time (length limit < 500feet) which is based on the overland flow equation:

$$T_o = \frac{1.8(1.1-C)\sqrt{L}}{\sqrt[3]{S(100)}} + 5 \text{ min}$$

Where: T_o = Overland Flow Travel Time (minutes, min)

C = Runoff Coefficient

L = Longest Run (linear feet)

S = Average Slope (ft/ft)

2. Channelized flow/shallow concentrated flow which is calculated by using:

$$T_c = L / (60*V)$$

Where: T_c = Shallow Concentrated Flow Travel Time (min)

L = Length of flow (feet)

V = Velocity (feet per second)

Where the velocity was calculated by using the computer program Hydraflow Express Extension for AutoCAD C3D 2012.

3. Pipe flow which is calculated by using:

$$T_p = L / (60 * V)$$

Where: T_p = Shallow Concentrated Flow Travel Time (min)
L = Length of flow (feet)
V = Velocity (feet per second)

Where the velocity was calculated by using the computer program Hydraflow Express Extension for AutoCAD C3D 2012.

The total time of concentration is determined by using the following equation:

$$T_c = T_o + T_c + T_p$$

- c. **Rainfall Intensity:** Intensities for Rational Method calculations were determined using the intensity-duration-frequency (IDF) curves created from the National Oceanic and Atmospheric Administration's (NOAA) Point Precipitation Frequency Estimates. See Appendix 6.1.
- d. **Basin Delineation:** The watershed basins were based on contour data a topographic field survey and supplemented with data from the Marin County Geographical Information System (GIS, Marin Maps). See Hydrology Maps.
- e. **Runoff Coefficient:** Runoff coefficients for the project were assigned based on the surface type. For permeable surfaces (landscape and natural hillside) a runoff coefficient of 0.7 was utilized. For impervious surfaces (pavement and roofs) a runoff coefficient of 0.9 was used. For areas of mixed surface types, a weighted runoff coefficient was calculated. See Appendix 6.2.
- f. **Hydrograph Analysis:** The existing and proposed watersheds were analyzed using the computer modeling program Hydraflow Hydrograph Extension for AutoCAD Civil3D 2014. Hydraflow Hydrograph utilized the rational method and the hydrologic characteristics describe above to create hydrographs of each scenario. The hydrographs were modeled for each watershed in the existing and proposed condition for the 25- and 100-year storm events. The existing and proposed conditions were compared to confirm the proposed condition 25- and 100-year peak discharge rate did not exceed the existing condition. The synthetic hydrograph was created using the rational method to determine the peak discharge rates. The National Resources Conservation Services (NRCS, formerly the Soil Conservation Survey or SCS) recommends a 8/3 time base to time to peak ratio. This results in a 1 to 1.66 lag to receding leg ratio. A conservative 1 to 2 lag to receding leg ratio was applied to the hydrographs in this analysis. See Appendix 6.3.

4. RESULTS

4.1 Existing Conditions

Table 4.1.1 –Peak Discharge Calculations for 25-Year Storm Event

Watershed	Tributary Watershed (ac)	C-Factor	Time of Concentration (minutes)	Discharge (cfs)
Channel	8.58	0.85	12	18.36
Highway 101	0.69	0.70	14	1.176

1. See Appendix 6.2 - Hydrology Calculations
2. See Appendix 6.3 – Hydrograph Model Output

Table 4.1.1 –Peak Discharge Calculations for 100-Year Storm Event

Watershed	Tributary Watershed (ac)	C-Factor	Time of Concentration (minutes)	Discharge (cfs)
Channel	8.58	0.85	12	24.01
Highway 101	0.69	0.70	14	1.539

1. See Appendix 6.2 - Hydrology Calculations
2. See Appendix 6.3 – Hydrograph Model Output

4.2 Proposed Conditions

Table 4.1.1 –Peak Discharge Calculations for 25-Year Storm Event

Watershed	Tributary Watershed (ac)	C-Factor	Time of Concentration (minutes)	Discharge (cfs)
Channel	8.72	0.87	13	18.25
Highway 101	0.55	0.75	14	1.005

1. See Appendix 6.2 - Hydrology Calculations
2. See Appendix 6.3 – Hydrograph Model Output

Table 4.1.1 –Peak Discharge Calculations for 100-Year Storm Event

Watershed	Tributary Watershed (ac)	C-Factor	Time of Concentration (minutes)	Discharge (cfs)
Channel	8.72	0.87	13	23.88
Highway 101	0.55	0.75	14	1.315

1. See Appendix 6.2 - Hydrology Calculations
2. See Appendix 6.3 – Hydrograph Model Output

5. CONCLUSIONS

The proposed redevelopment of the Northgate Walk project does not increase the peak discharge rates for the 25- and 100-year recurrence interval storm event.

6.0 APPENDICES

Appendix 6.1 – Intensity-Duration-Frequency Data



NOAA Atlas 14, Volume 6, Version 2
 Location name: San Rafael, California, US*
 Latitude: 38.0087°, Longitude: -122.5436°
 Elevation: 58 ft*
 * source: Google Maps



POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aeriels](#)

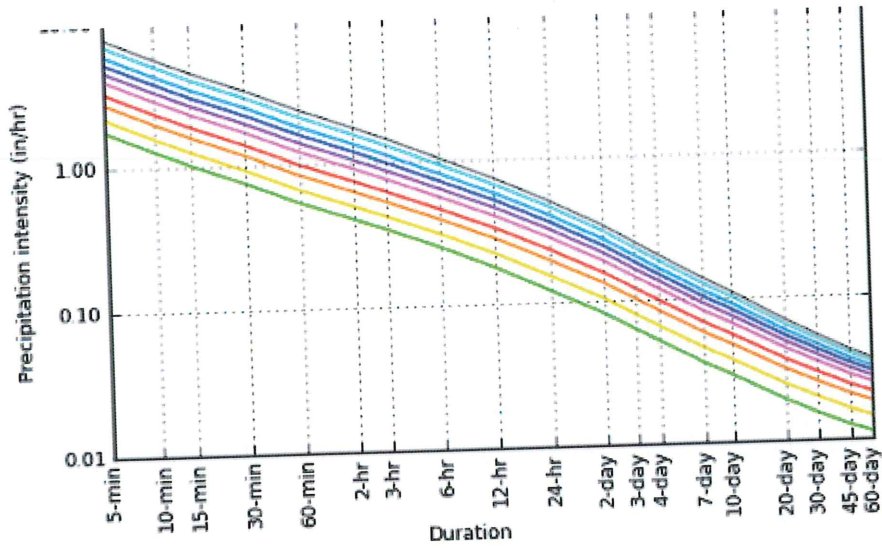
PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	1.76 (1.57-2.00)	2.17 (1.93-2.46)	2.75 (2.44-3.13)	3.24 (2.84-3.73)	3.97 (3.35-4.75)	4.56 (3.74-5.60)	5.20 (4.15-6.58)	5.88 (4.55-7.69)	6.86 (5.05-9.43)	7.68 (5.42-11.0)
10-min	1.27 (1.13-1.43)	1.55 (1.39-1.77)	1.97 (1.75-2.24)	2.32 (2.04-2.68)	2.84 (2.40-3.41)	3.27 (2.69-4.01)	3.73 (2.98-4.71)	4.22 (3.26-5.51)	4.92 (3.62-6.76)	5.50 (3.89-7.87)
15-min	1.02 (0.908-1.16)	1.26 (1.12-1.42)	1.59 (1.41-1.81)	1.88 (1.64-2.16)	2.29 (1.93-2.74)	2.64 (2.17-3.24)	3.00 (2.40-3.80)	3.40 (2.62-4.44)	3.97 (2.92-5.45)	4.44 (3.13-6.34)
30-min	0.750 (0.668-0.850)	0.924 (0.822-1.05)	1.17 (1.04-1.33)	1.38 (1.21-1.59)	1.69 (1.42-2.02)	1.94 (1.60-2.38)	2.21 (1.77-2.80)	2.50 (1.93-3.27)	2.92 (2.15-4.01)	3.27 (2.31-4.67)
60-min	0.537 (0.479-0.609)	0.662 (0.589-0.751)	0.837 (0.742-0.954)	0.988 (0.868-1.14)	1.21 (1.02-1.45)	1.39 (1.14-1.71)	1.58 (1.26-2.00)	1.79 (1.39-2.34)	2.09 (1.54-2.87)	2.34 (1.65-3.35)
2-hr	0.404 (0.360-0.458)	0.498 (0.443-0.566)	0.630 (0.558-0.717)	0.742 (0.652-0.854)	0.906 (0.764-1.09)	1.04 (0.854-1.28)	1.18 (0.944-1.49)	1.33 (1.03-1.75)	1.55 (1.14-2.13)	1.73 (1.22-2.48)
3-hr	0.342 (0.304-0.387)	0.421 (0.374-0.478)	0.531 (0.471-0.605)	0.625 (0.549-0.720)	0.762 (0.642-0.912)	0.872 (0.718-1.07)	0.990 (0.791-1.25)	1.12 (0.863-1.46)	1.30 (0.955-1.78)	1.45 (1.02-2.07)
6-hr	0.252 (0.225-0.286)	0.311 (0.277-0.354)	0.393 (0.348-0.448)	0.462 (0.405-0.532)	0.560 (0.472-0.671)	0.639 (0.526-0.785)	0.722 (0.577-0.914)	0.811 (0.627-1.06)	0.937 (0.689-1.29)	1.04 (0.733-1.49)
12-hr	0.178 (0.159-0.202)	0.224 (0.199-0.254)	0.284 (0.252-0.324)	0.335 (0.294-0.386)	0.407 (0.343-0.487)	0.463 (0.381-0.569)	0.522 (0.417-0.660)	0.584 (0.451-0.764)	0.670 (0.493-0.920)	0.738 (0.522-1.06)
24-hr	0.120 (0.108-0.136)	0.153 (0.137-0.173)	0.196 (0.176-0.223)	0.232 (0.207-0.266)	0.282 (0.244-0.333)	0.321 (0.272-0.386)	0.361 (0.299-0.444)	0.402 (0.326-0.508)	0.460 (0.358-0.602)	0.505 (0.381-0.682)
2-day	0.081 (0.073-0.092)	0.103 (0.093-0.117)	0.132 (0.119-0.151)	0.156 (0.139-0.179)	0.189 (0.163-0.223)	0.214 (0.182-0.258)	0.240 (0.199-0.295)	0.267 (0.216-0.337)	0.304 (0.237-0.397)	0.332 (0.251-0.448)
3-day	0.062 (0.056-0.071)	0.079 (0.071-0.090)	0.101 (0.091-0.115)	0.119 (0.106-0.137)	0.144 (0.125-0.170)	0.163 (0.138-0.196)	0.182 (0.151-0.224)	0.202 (0.164-0.255)	0.229 (0.179-0.300)	0.250 (0.189-0.338)
4-day	0.052 (0.047-0.059)	0.066 (0.059-0.075)	0.084 (0.075-0.096)	0.099 (0.088-0.113)	0.119 (0.103-0.140)	0.134 (0.114-0.162)	0.150 (0.124-0.184)	0.166 (0.134-0.209)	0.187 (0.146-0.245)	0.204 (0.154-0.275)
7-day	0.036 (0.032-0.041)	0.046 (0.041-0.052)	0.058 (0.052-0.066)	0.069 (0.061-0.079)	0.082 (0.071-0.097)	0.093 (0.078-0.111)	0.103 (0.085-0.126)	0.113 (0.092-0.143)	0.127 (0.099-0.167)	0.138 (0.104-0.186)
10-day	0.029 (0.026-0.033)	0.037 (0.034-0.042)	0.048 (0.043-0.054)	0.056 (0.050-0.064)	0.067 (0.058-0.079)	0.075 (0.064-0.090)	0.083 (0.069-0.102)	0.091 (0.074-0.115)	0.102 (0.079-0.134)	0.110 (0.083-0.149)
20-day	0.019 (0.017-0.022)	0.025 (0.022-0.028)	0.031 (0.028-0.036)	0.037 (0.033-0.042)	0.044 (0.038-0.052)	0.049 (0.041-0.058)	0.053 (0.044-0.066)	0.058 (0.047-0.073)	0.064 (0.050-0.084)	0.068 (0.052-0.092)
30-day	0.015 (0.014-0.018)	0.020 (0.018-0.023)	0.025 (0.023-0.029)	0.030 (0.026-0.034)	0.035 (0.030-0.041)	0.039 (0.033-0.047)	0.042 (0.035-0.052)	0.046 (0.037-0.058)	0.050 (0.039-0.066)	0.053 (0.040-0.072)
45-day	0.013 (0.011-0.014)	0.016 (0.015-0.019)	0.021 (0.019-0.024)	0.024 (0.022-0.028)	0.028 (0.024-0.033)	0.031 (0.026-0.038)	0.034 (0.028-0.042)	0.037 (0.030-0.046)	0.040 (0.031-0.052)	0.042 (0.032-0.057)
60-day	0.011 (0.010-0.013)	0.015 (0.013-0.017)	0.018 (0.017-0.021)	0.021 (0.019-0.024)	0.025 (0.021-0.029)	0.027 (0.023-0.033)	0.030 (0.025-0.036)	0.032 (0.026-0.040)	0.034 (0.027-0.045)	0.036 (0.027-0.049)

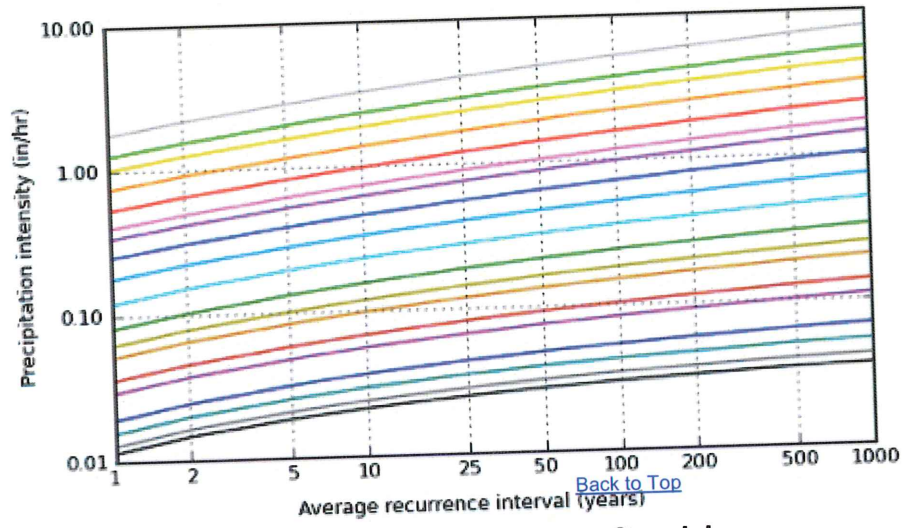
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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PF graphical



Average recurrence interval (years)
1
2
5
10
25
50
100
200
500
1000



Duration
5-min
10-min
15-min
30-min
60-min
2-hr
3-hr
6-hr
12-hr
24-hr
2-day
3-day
4-day
7-day
10-day
20-day
30-day
45-day
60-day

Maps & aeriels

Created (GMT): Wed Jun 29 22:20:21 2016

NOAA Atlas 14, Volume 6, Version 2

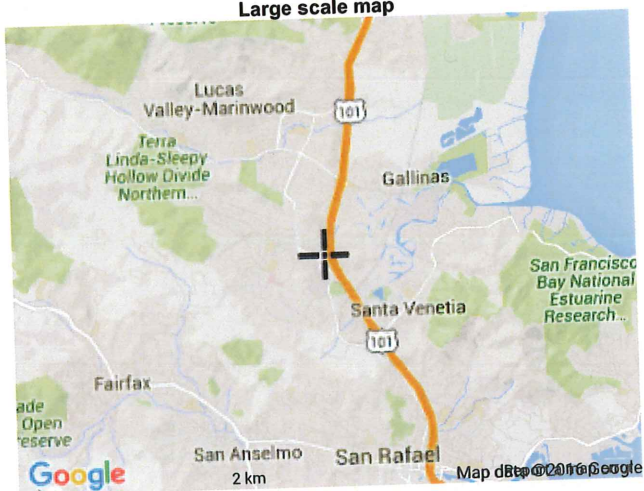
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial



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[National Weather Service](#)
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1325 East West Highway
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Appendix 6.2 – Hydrology Calculations

Northgate Walk

Date Prepared: 07/01/2016

Prepared By: JAH

Existing Conditions Hydrology Calculations										
Points of Concentration	Watershed I.D.	Area (ac)	Area (sf)	Impervious Area (sf)	Pervious Area (sf)	C _{IMP}	C _{PERV}	C _{WT}	T _c (min)	i (in)
A	1	0.28	12013	10854	1159	0.9	0.7	0.88	12.2	2
	2	0.63	27400	26030	1370	0.9	0.7	0.89		
	3	1.15	50063	47560	2503	0.9	0.7	0.89		
	4	0.76	33275	31612	1664	0.9	0.7	0.89		
	5	1.06	45991	43691	2300	0.9	0.7	0.89		
	<i>Total - A</i>	<i>3.87</i>	<i>168742</i>	<i>159747</i>	<i>8996</i>	<i>0.9</i>	<i>0.7</i>	<i>0.89</i>		
B	6	1.09	47427	35440	11988	0.9	0.7	0.85	11.4	2
	7	1.13	49389	46919	2469	0.9	0.7	0.89		
	<i>Total - B</i>	<i>2.22</i>	<i>96816</i>	<i>82359</i>	<i>14457</i>	<i>0.9</i>	<i>0.7</i>	<i>0.87</i>		
C	8	0.34	14676	13942	734	0.9	0.7	0.89	9.9	1
D	9	0.62	27162	25803	1358	0.9	0.7	0.89	9.2	1
	10	0.21	9125	6816	2309	0.9	0.7	0.85		
	<i>Total - D</i>	<i>0.83</i>	<i>36286</i>	<i>32619</i>	<i>3667</i>	<i>0.9</i>	<i>0.7</i>	<i>0.88</i>		
Channel	11	1.32	57412	0	57412	0.9	0.7	0.70	6.5	1
E	12	0.69	30071	0	30071	0.9	0.7	0.70	14.5	1

Northgate Walk

Date Prepared: 07/01/2016

Prepared By: JAH

Proposed Conditions Hydrology Calculations										
Points of Concentration	Watershed I.D.	Area (ac)	Area (sf)	Impervious Area (sf)	Pervious Area (sf)	C _{IMP}	C _{PERV}	C _{WT}	T _c (min)	i _s (in)
A	1	0.17	7324	7324	0	0.9	0.7	0.90	6.0	3
	2	0.16	6920	6920	0	0.9	0.7	0.90		
	<i>Total - A</i>	0.33	14244	14244	0	0.9	0.7	0.90		
B	3	0.16	7086	6647	439	0.9	0.7	0.89	14.9	2
	4	0.52	22834	20036	2798	0.9	0.7	0.88		
	<i>Total - B</i>	0.69	29919	26682	3237	0.9	0.7	0.88		
B' (New)	5	0.80	34702	31377	3325	0.9	0.7	0.88	8.8	3
C (New)	6	1.59	69464	65991	3473	0.9	0.7	0.89	11.3	2
D	7	0.16	6875	6013	862	0.9	0.7	0.87	12.6	2
	8	0.40	17604	16302	1301	0.9	0.7	0.89		
	9	0.08	3368	3012	356	0.9	0.7	0.88		
	10	0.06	2650	1984	666	0.9	0.7	0.85		
	11	0.38	16714	15925	789	0.9	0.7	0.89		
	12	0.28	12001	10842	1159	0.9	0.7	0.88		
	13	0.63	27400	26030	1370	0.9	0.7	0.89		
	14	1.00	43407	41237	2170	0.9	0.7	0.89		
	15	0.76	33208	31548	1660	0.9	0.7	0.89		
	<i>Total - D</i>	3.75	163227	152893	10334	0.9	0.7	0.89		
Channel	16	0.55	23919	23120	799	0.9	0.7	0.89	9.8	2
	17	1.02	44556	4498	40058	0.9	0.7	0.72		
	<i>Total - Chan.</i>	1.57	68475	27618	40857	0.9	0.7	0.78		
E	18	0.55	23980	6479	17501	0.9	0.7	0.75	13.7	2

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ation Calculations									
ow		Pipe Flow							Total T _C (min)
V (ft/s)	T _S (min)	Q _{100 EST} (cfs)	Length (ft)	Elev. Up	Elev. Dn	Slope (ft/ft)	V (ft/s)	T _P (min)	
		6.44	414	100	85.9	0.03	8.78	0.8	12.2
4.1	0.5	3.70	95	78.8	78	0.01	5.13	0.3	11.4
					n/a				9.9
		0.76	110	67.5	64.7	0.03	4.66	0.4	9.2
					n/a				6.5
					n/a				14.5

ation Calculations									
ow		Pipe Flow							Total T _C (min)
V (ft/s)	T _S (min)	Q _{100 EST} (cfs)	Length (ft)	Elev. Up	Elev. Dn	Slope (ft/ft)	V (ft/s)	T _P (min)	
		1.54	464	104.5	70.0	0.07	8.10	1.0	6.0
		1.85	118	75.2	65.5	0.08	8.85	0.2	14.9
		3.12	203	89.0	59.5	0.15	13.13	0.3	8.8
		5.20	516	87.3	59.0	0.05	10.15	0.8	11.3
		15.09	753	100.1	64.7	0.05	13.27	0.9	12.7
					n/a				9.8
2.8	1.0				n/a				13.7

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

Thursday, Jun 30 2016

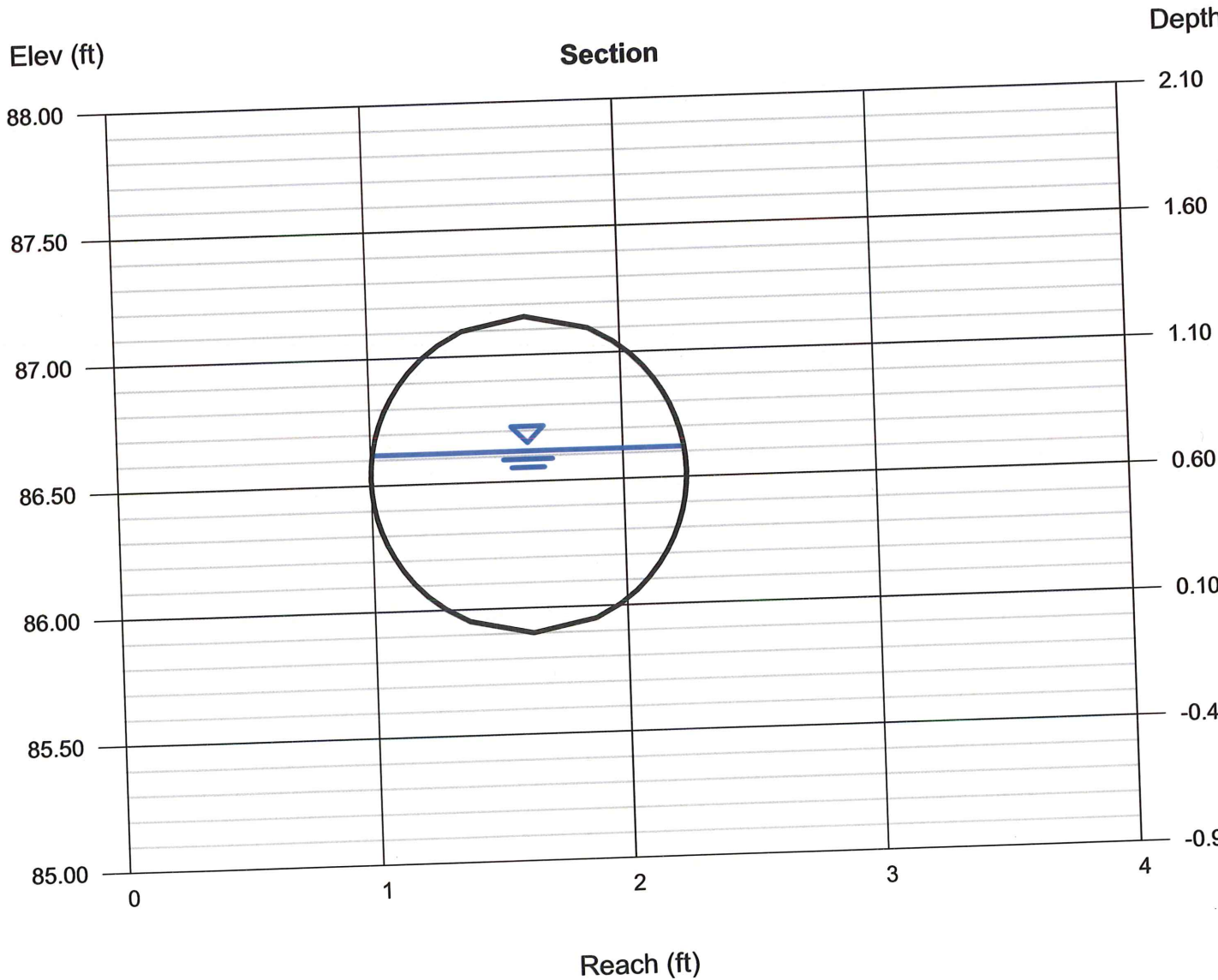
POC A - Pipe Flow (Existing)

Circular Diameter (ft) = 1.25

Invert Elev (ft) = 85.90
Slope (%) = 3.00
N-Value = 0.014

Calculations
Compute by: Known Q
Known Q (cfs) = 6.44

Highlighted
Depth (ft) = 0.72
Q (cfs) = 6.440
Area (sqft) = 0.73
Velocity (ft/s) = 8.78
Wetted Perim (ft) = 2.16
Crit Depth, Yc (ft) = 1.03
Top Width (ft) = 1.24
EGL (ft) = 1.92



Channel Report

POC B - Pipe Flow (Existing)

Circular
Diameter (ft) = 1.25

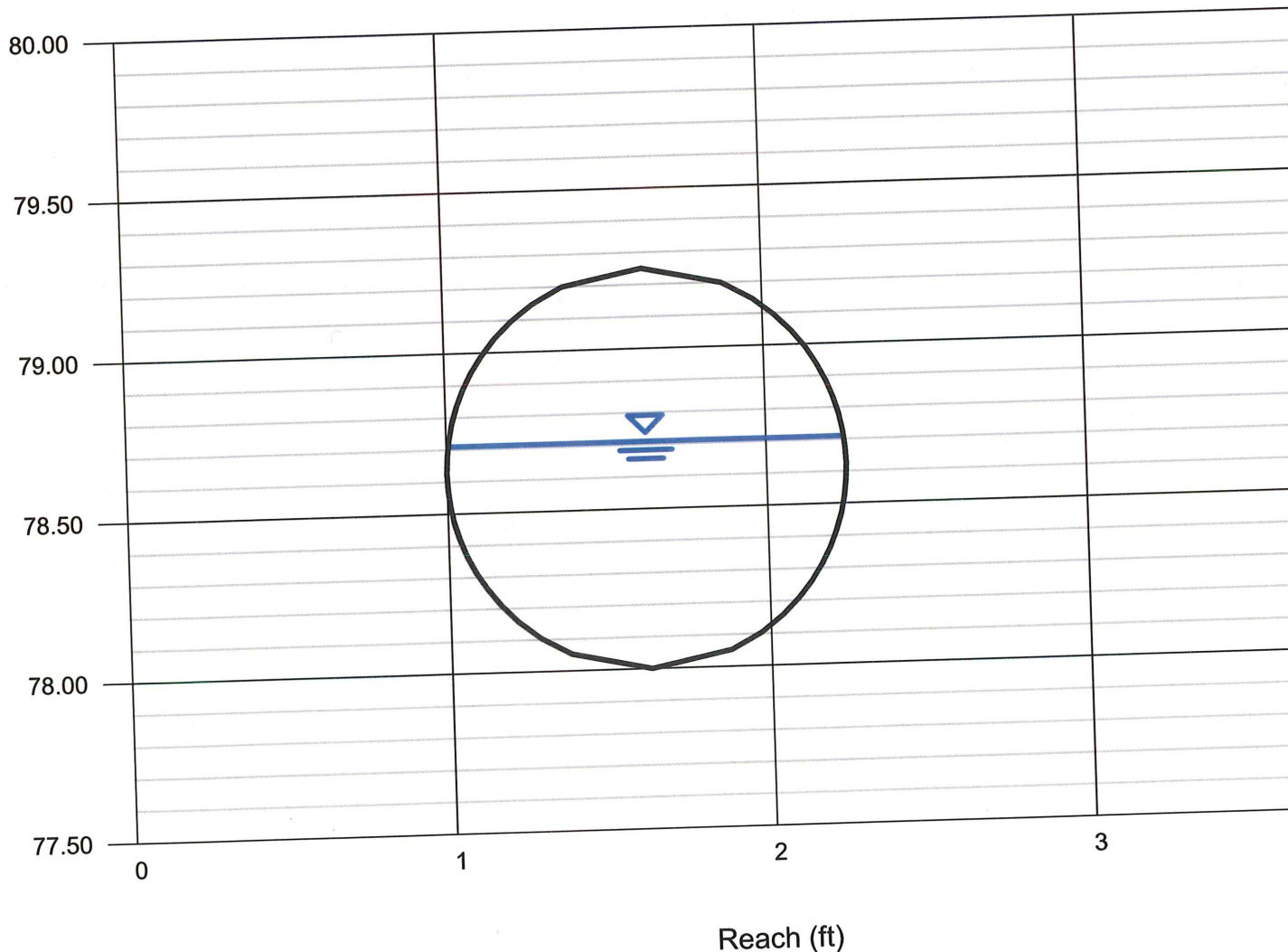
Invert Elev (ft) = 78.00
Slope (%) = 1.00
N-Value = 0.014

Calculations
Compute by: Known Q
Known Q (cfs) = 3.70

Highlighted
Depth (ft) = 0.71
Q (cfs) = 3.700
Area (sqft) = 0.72
Velocity (ft/s) = 5.13
Wetted Perim (ft) = 2.14
Crit Depth, Yc (ft) = 0.78
Top Width (ft) = 1.24
EGL (ft) = 1.12

Elev (ft)

Section



Channel Report

POC D - Pipe Flow (Existing)

Circular
Diameter (ft) = 1.50

Invert Elev (ft) = 64.70
Slope (%) = 3.00
N-Value = 0.014

Calculations
Compute by: Known Q
Known Q (cfs) = 0.76

Highlighted
Depth (ft) = 0.22
Q (cfs) = 0.760
Area (sqft) = 0.16
Velocity (ft/s) = 4.66
Wetted Perim (ft) = 1.18
Crit Depth, Y_c (ft) = 0.33
Top Width (ft) = 1.07
EGL (ft) = 0.56

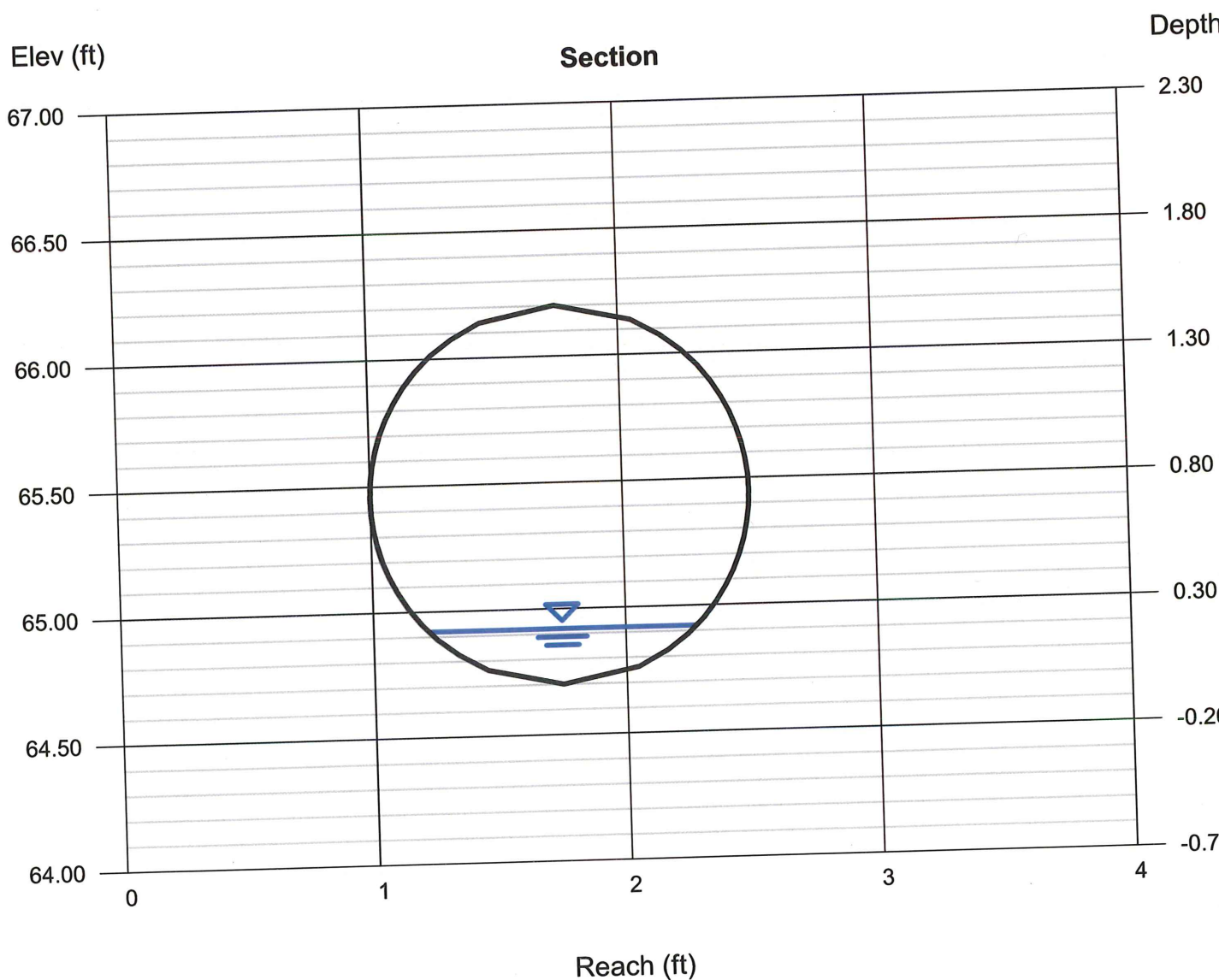
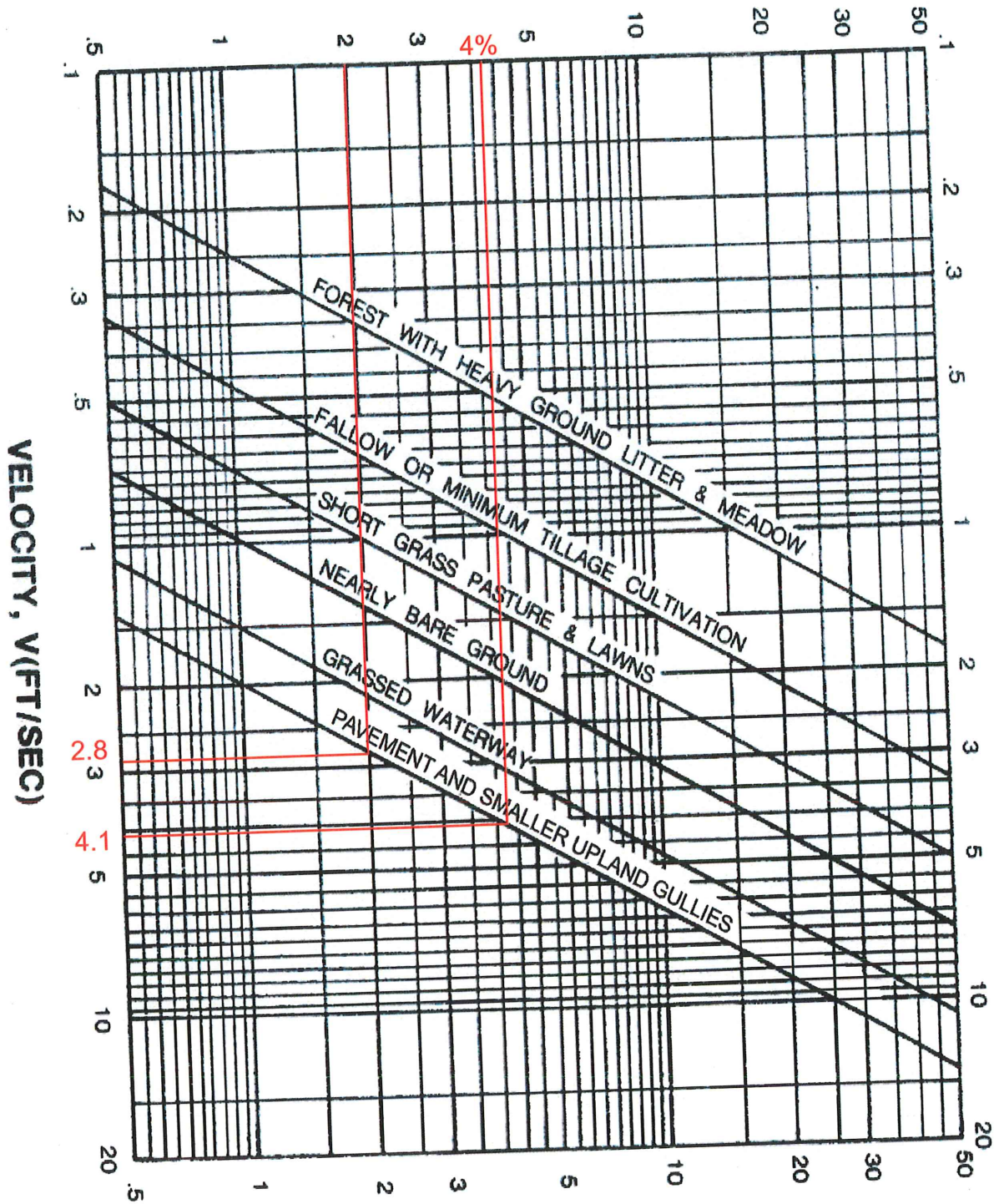


Figure 816.6
Velocities for Upland Method of
Estimating Travel Time for Shallow Concentrated Flow
WATERCOURSE SLOPE IN PERCENT



Channel Report

Friday, Jul 1 2016

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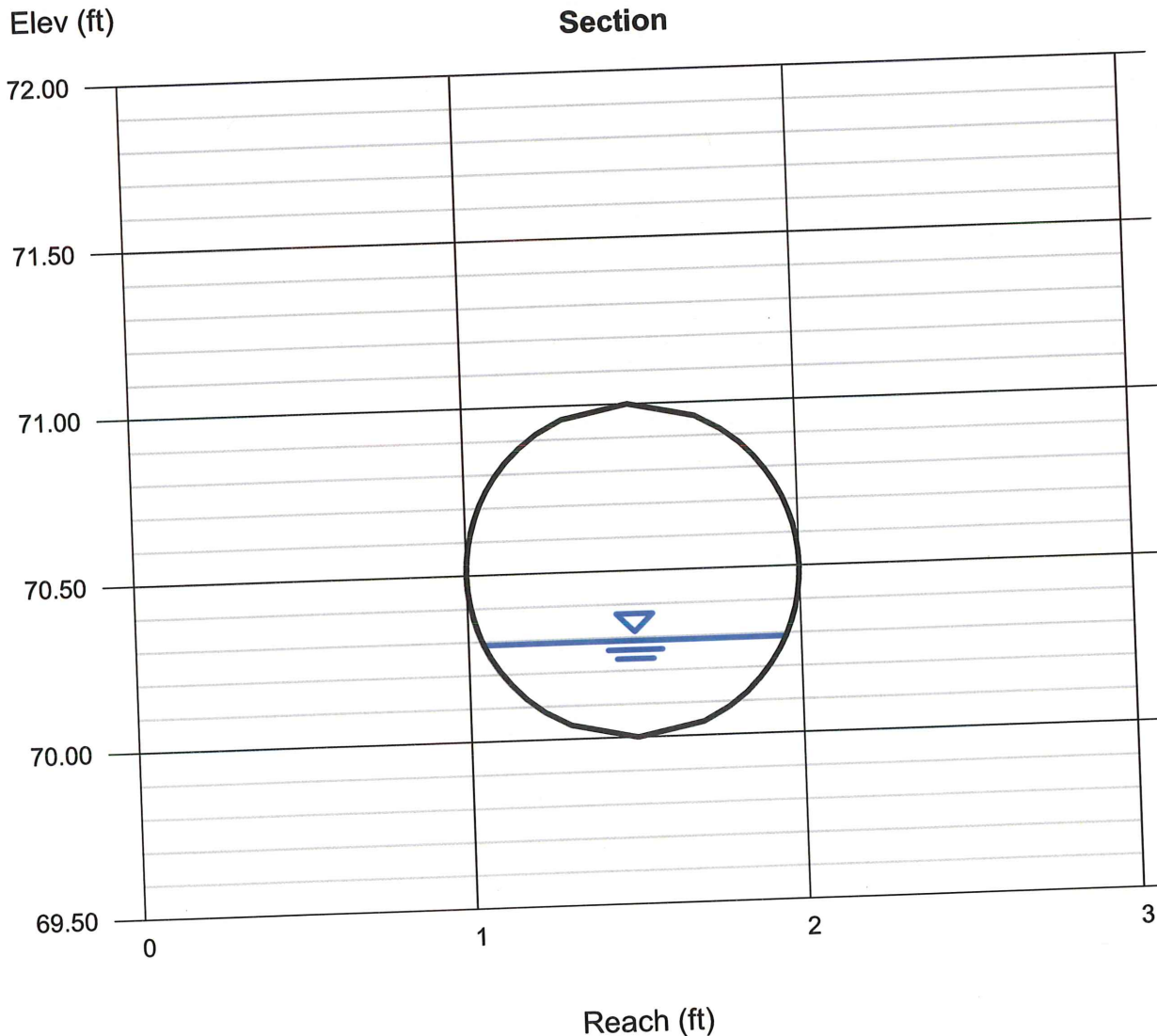
POC A - Pipe Flow (Proposed)

Circular
Diameter (ft) = 1.00

Invert Elev (ft) = 70.00
Slope (%) = 7.00
N-Value = 0.014

Calculations
Compute by: Known Q
Known Q (cfs) = 1.54

Highlighted
Depth (ft) = 0.29
Q (cfs) = 1.540
Area (sqft) = 0.19
Velocity (ft/s) = 8.10
Wetted Perim (ft) = 1.14
Crit Depth, Yc (ft) = 0.53
Top Width (ft) = 0.91
EGL (ft) = 1.31



Channel Report

Friday, Jul 1 2016

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POC B - Pipe Flow (Proposed)

Circular
Diameter (ft) = 1.00

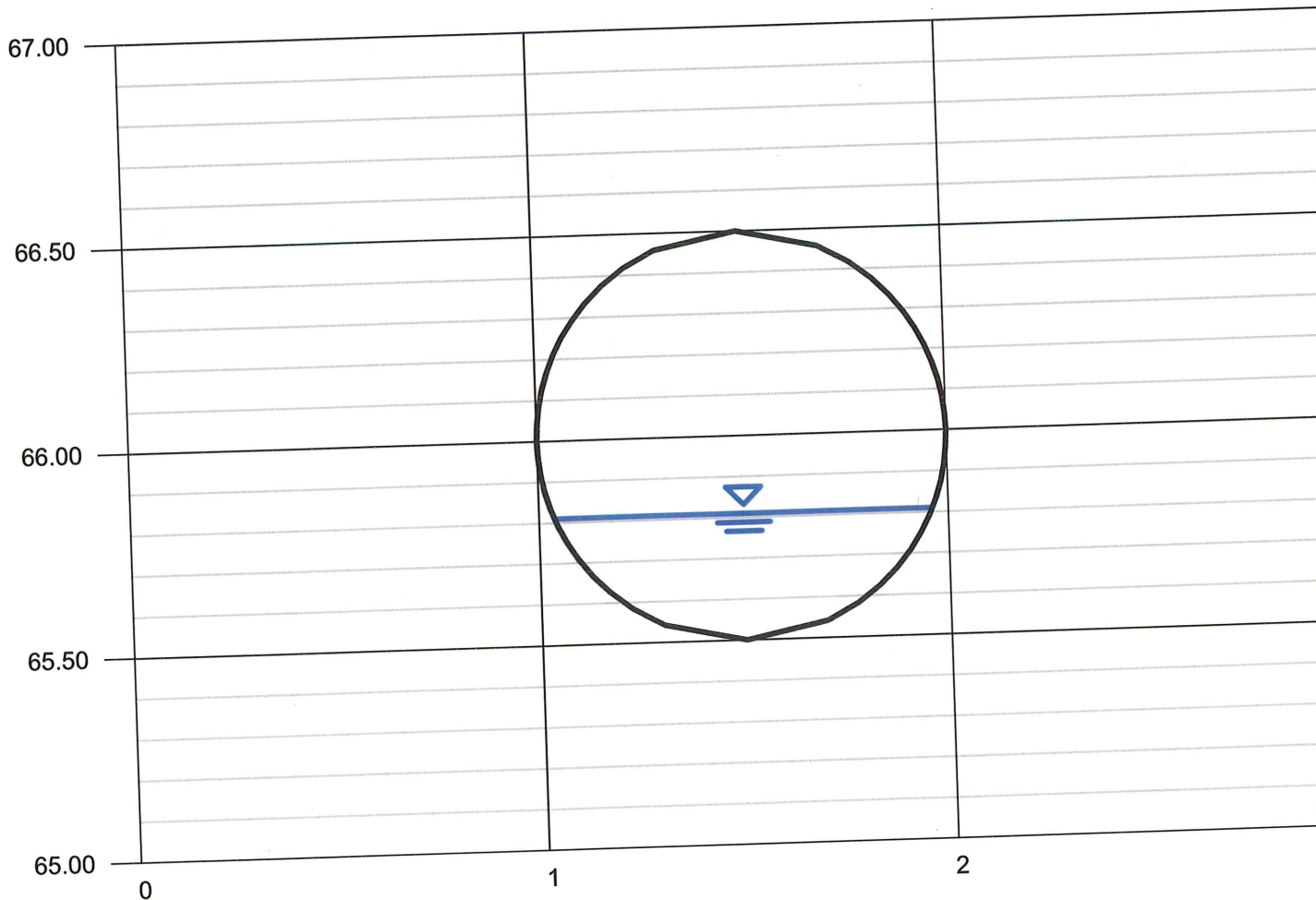
Invert Elev (ft) = 65.50
Slope (%) = 8.00
N-Value = 0.014

Calculations
Compute by: Known Q
Known Q (cfs) = 1.85

Highlighted
Depth (ft) = 0.31
Q (cfs) = 1.850
Area (sqft) = 0.21
Velocity (ft/s) = 8.85
Wetted Perim (ft) = 1.18
Crit Depth, Yc (ft) = 0.58
Top Width (ft) = 0.93
EGL (ft) = 1.53

Elev (ft)

Section



Reach (ft)

Channel Report

Friday, Jul 1 2016

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

POC B' (New) - Pipe Flow (Proposed)

Circular
Diameter (ft) = 1.00

Invert Elev (ft) = 59.50
Slope (%) = 15.00
N-Value = 0.014

Calculations
Compute by: Known Q
Known Q (cfs) = 3.12

Highlighted
Depth (ft) = 0.34
Q (cfs) = 3.120
Area (sqft) = 0.24
Velocity (ft/s) = 13.13
Wetted Perim (ft) = 1.25
Crit Depth, Yc (ft) = 0.76
Top Width (ft) = 0.95
EGL (ft) = 3.02

Elev (ft)

Section

61.00

60.50

60.00

59.50

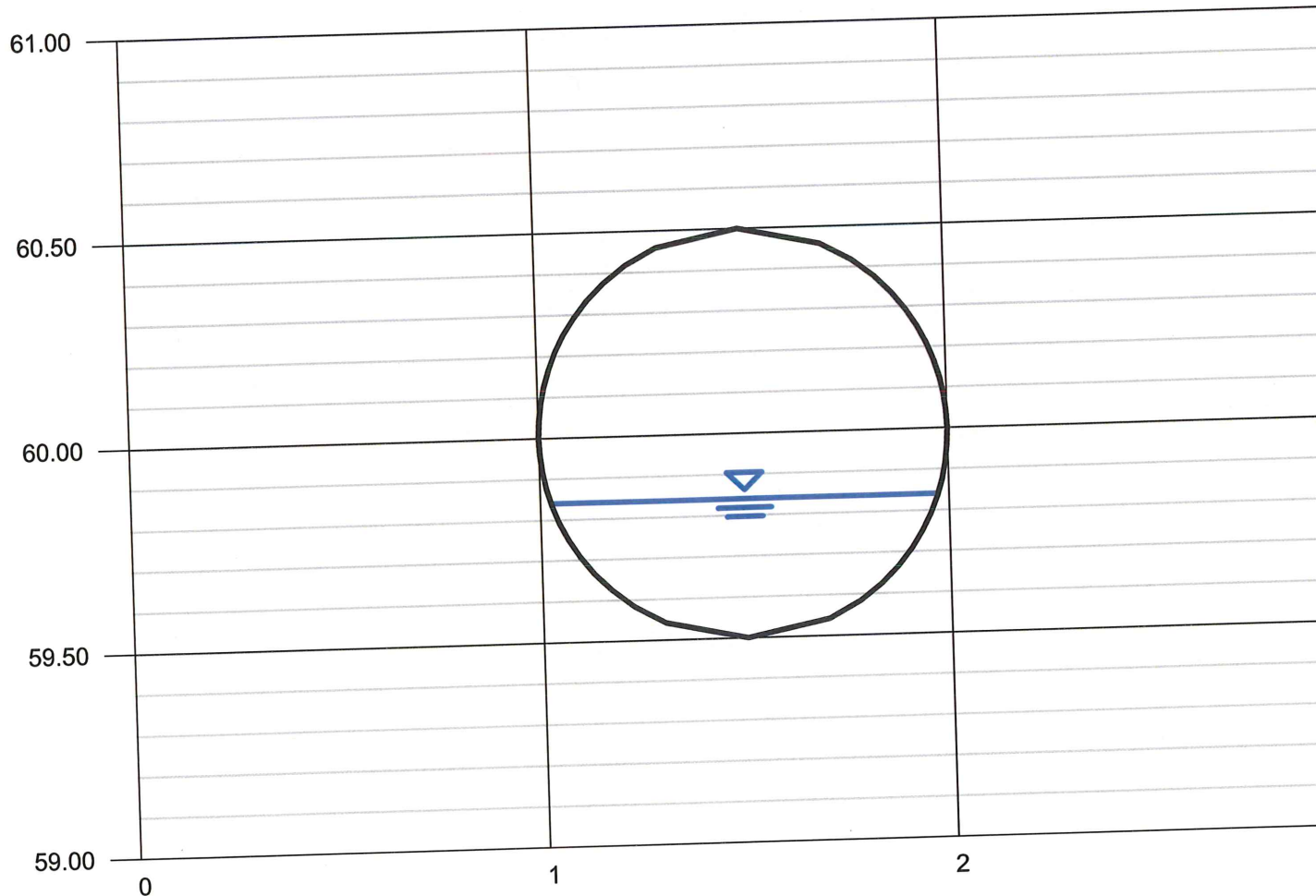
59.00

0

1

2

Reach (ft)



Channel Report

POC C - Pipe Flow (Proposed)

Circular Diameter (ft) = 1.00

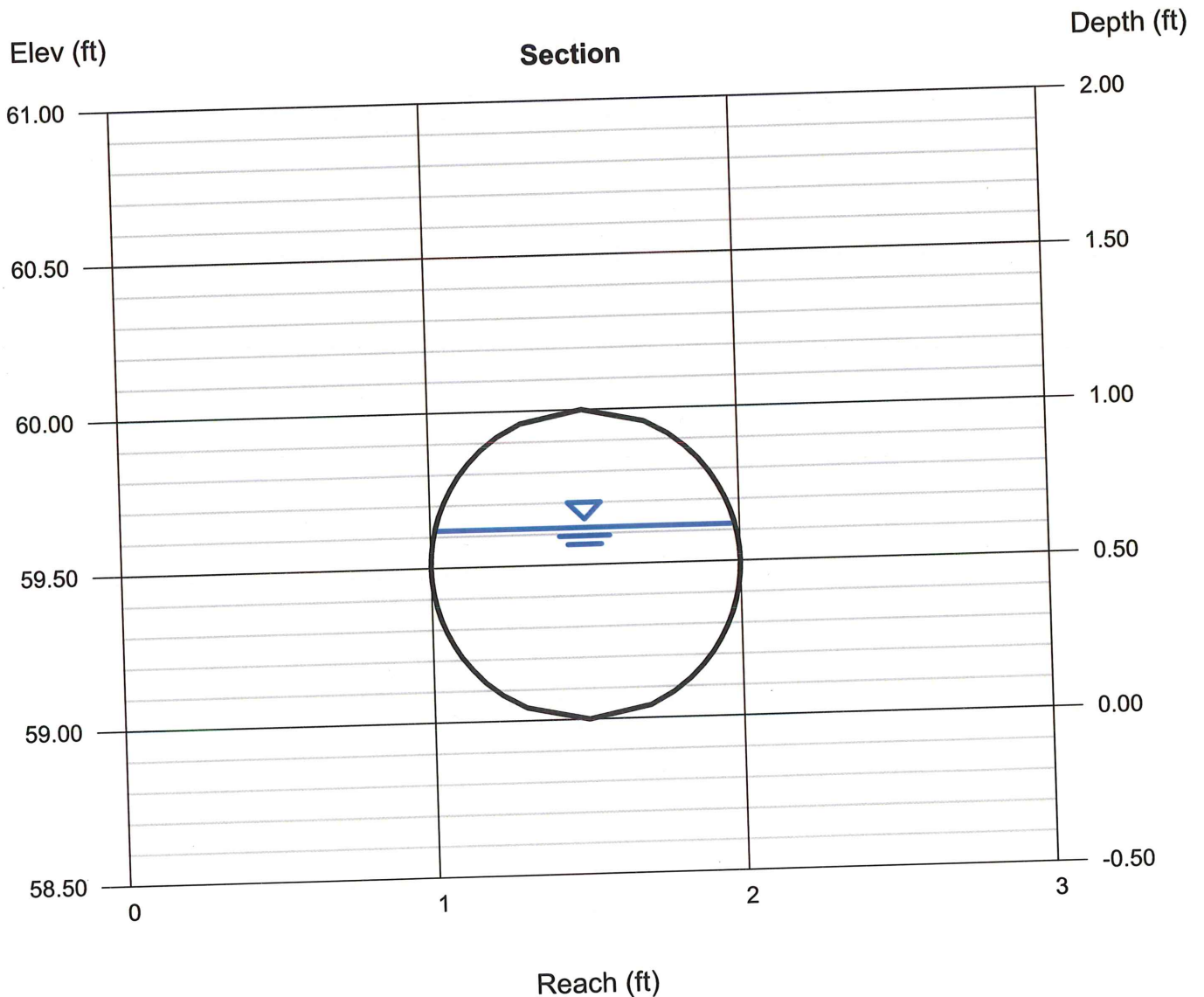
Invert Elev (ft) = 59.00
Slope (%) = 5.00
N-Value = 0.014

Calculations

Compute by: Known Q
Known Q (cfs) = 5.20

Highlighted

Depth (ft) = 0.62
Q (cfs) = 5.200
Area (sqft) = 0.51
Velocity (ft/s) = 10.15
Wetted Perim (ft) = 1.81
Crit Depth, Yc (ft) = 0.93
Top Width (ft) = 0.97
EGL (ft) = 2.22



Channel Report

Friday, Jul 1 2016

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

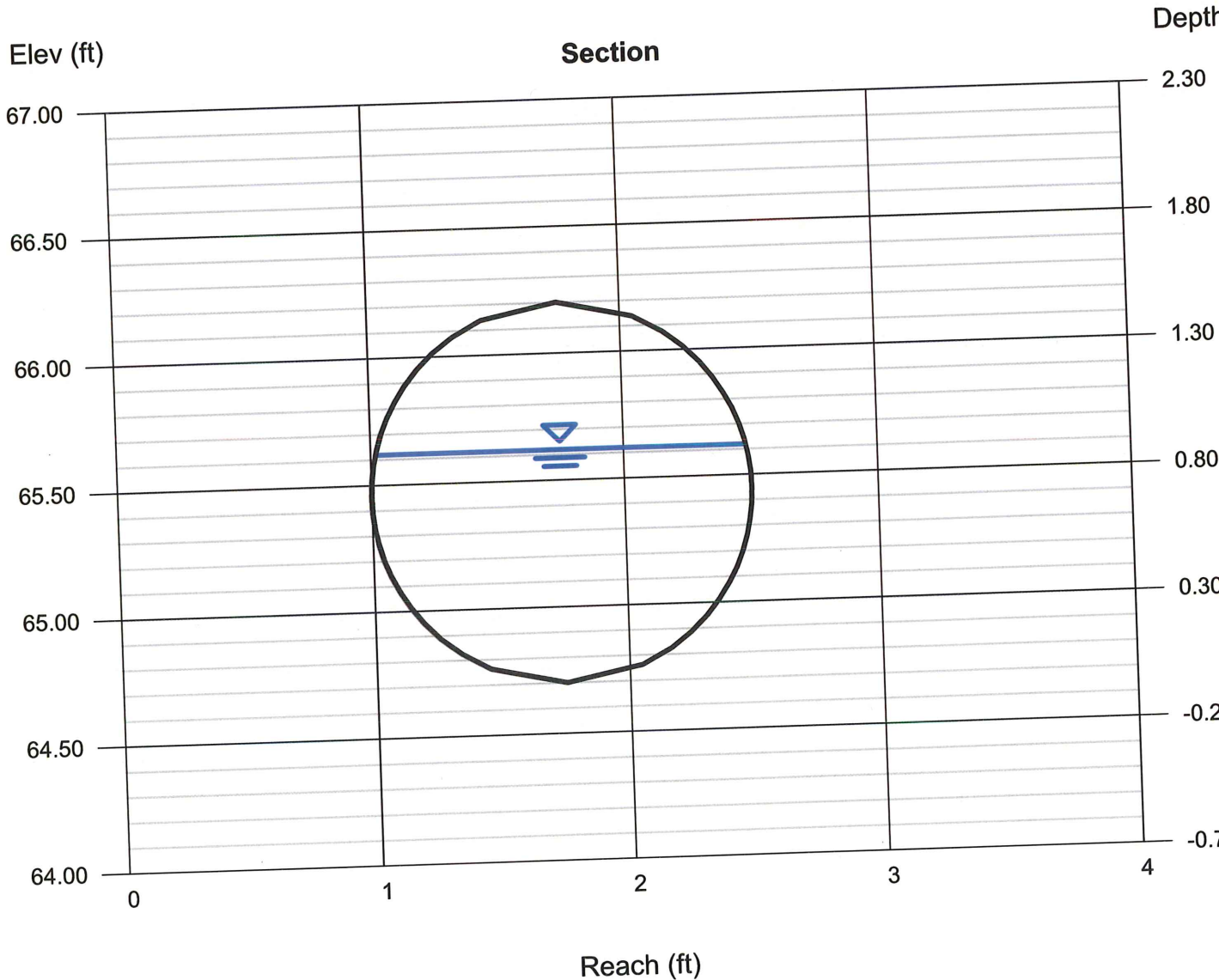
POC D - Pipe Flow (Proposed)

Circular
Diameter (ft) = 1.50

Invert Elev (ft) = 64.70
Slope (%) = 5.00
N-Value = 0.014

Calculations
Compute by: Known Q
Known Q (cfs) = 15.09

Highlighted
Depth (ft) = 0.92
Q (cfs) = 15.09
Area (sqft) = 1.14
Velocity (ft/s) = 13.27
Wetted Perim (ft) = 2.70
Crit Depth, Yc (ft) = 1.41
Top Width (ft) = 1.46
EGL (ft) = 3.66



Appendix 6.3 – Hydrograph Model Output

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Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	9.029	1	12	9,751	----	----	----	POC A - Existing
2	Rational	5.277	1	11	5,224	----	----	----	POC B - Existing
3	Rational	0.865	1	10	779	----	----	----	POC C - Existing
4	Rational	2.195	1	9	1,778	----	----	----	POC D - Existing
5	Rational	3.362	1	6	1,815	----	----	----	POC Channel - Existing
6	Combine	18.36	1	12	19,348	1, 2, 3, 4, 5	----	----	Discharge to Channel - Existing
7	Rational	1.176	1	14	1,482	----	----	----	POC E - Existing
9	Rational	1.081	1	6	584	----	----	----	POC A - Proposed
10	Rational	1.431	1	15	1,932	----	----	----	POC B - Proposed
11	Rational	2.116	1	9	1,714	----	----	----	POC B' (New) - Proposed
12	Rational	3.867	1	11	3,828	----	----	----	POC C - Proposed
13	Rational	8.422	1	13	9,853	----	----	----	POC D - Proposed
14	Rational	3.501	1	10	3,151	----	----	----	POC Channel - Proposed
15	Combine	18.25	1	13	21,061	9, 10, 11, 12, 13, 14	----	----	Discharge to Channel - Proposed
16	Rational	1.005	1	14	1,266	----	----	----	POC E - Proposed

Hydrograph Report

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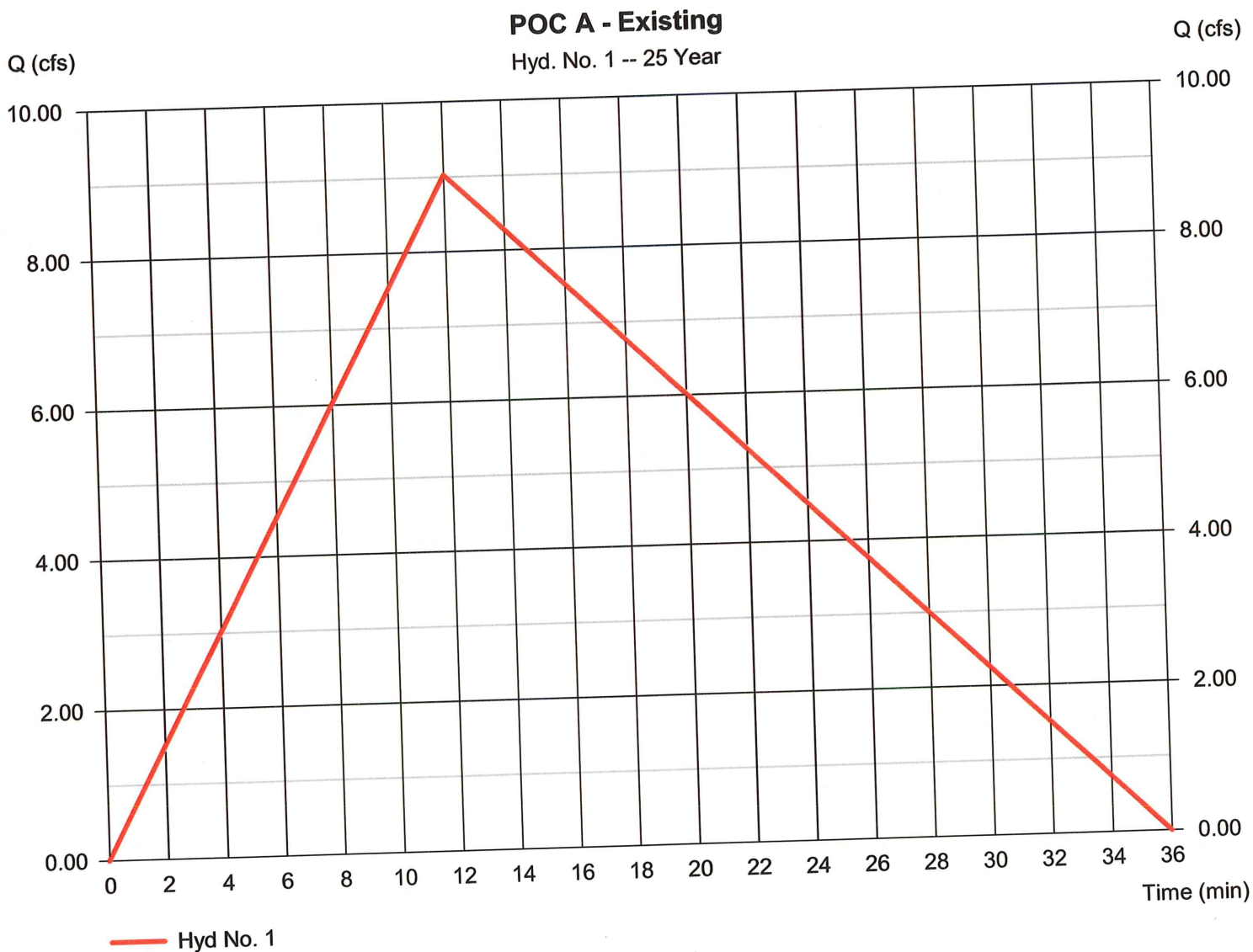
Friday, 07 / 1 / 2016

Hyd. No. 1

POC A - Existing

Hydrograph type = Rational
 Storm frequency = 25 yrs
 Time interval = 1 min
 Drainage area = 3.870 ac
 Intensity = 2.621 in/hr
 IDF Curve = Northgate Walk.IDF

Peak discharge = 9.029 cfs
 Time to peak = 12 min
 Hyd. volume = 9,751 cuft
 Runoff coeff. = 0.89
 Tc by User = 12.00 min
 Asc/Rec limb fact = 1/2



Hydrograph Report

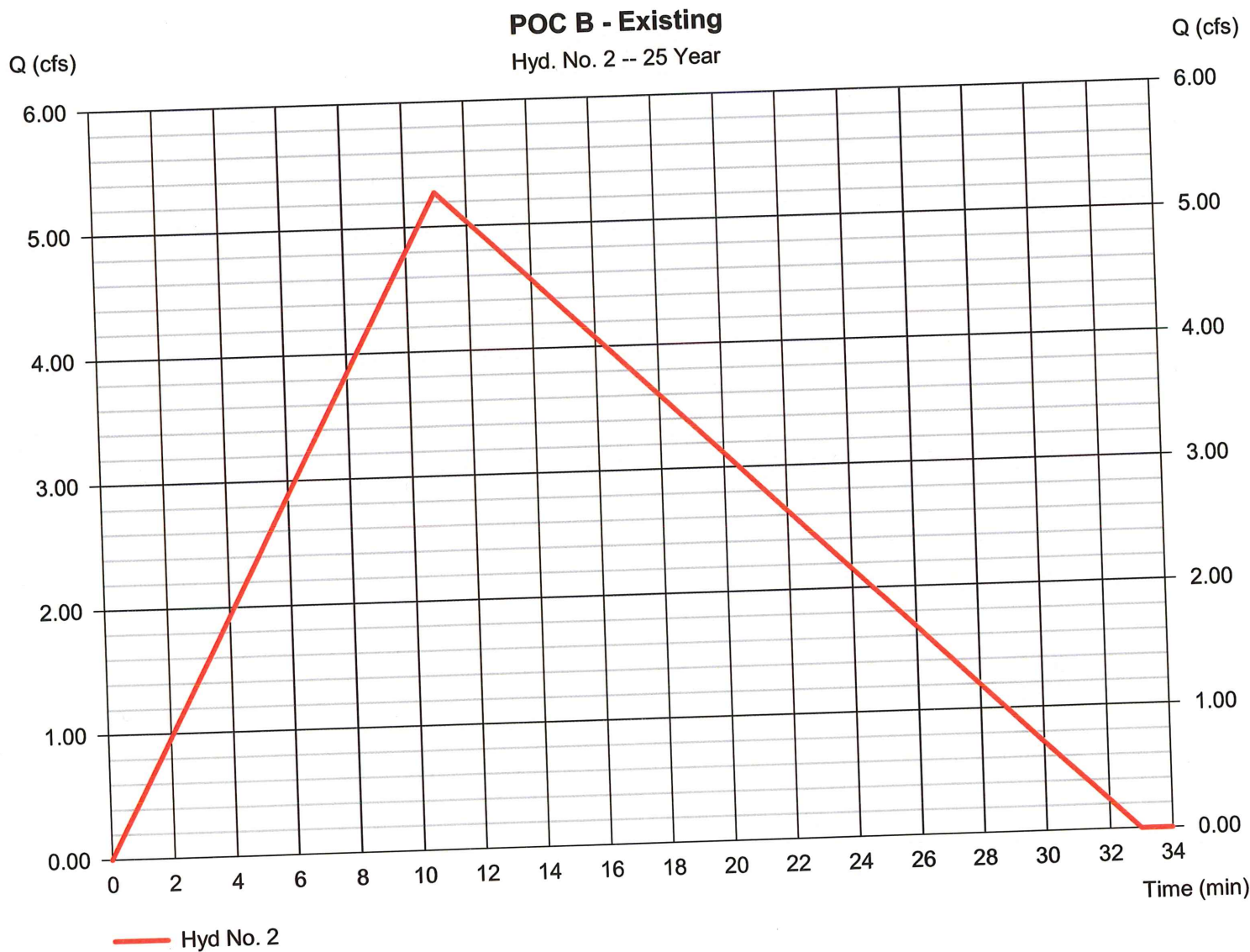
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Hyd. No. 2

POC B - Existing

Hydrograph type	= Rational	Peak discharge	= 5.277 cfs
Storm frequency	= 25 yrs	Time to peak	= 11 min
Time interval	= 1 min	Hyd. volume	= 5,224 cuft
Drainage area	= 2.220 ac	Runoff coeff.	= 0.87
Intensity	= 2.732 in/hr	Tc by User	= 11.00 min
IDF Curve	= Northgate Walk.IDF	Asc/Rec limb fact	= 1/2



Hydrograph Report

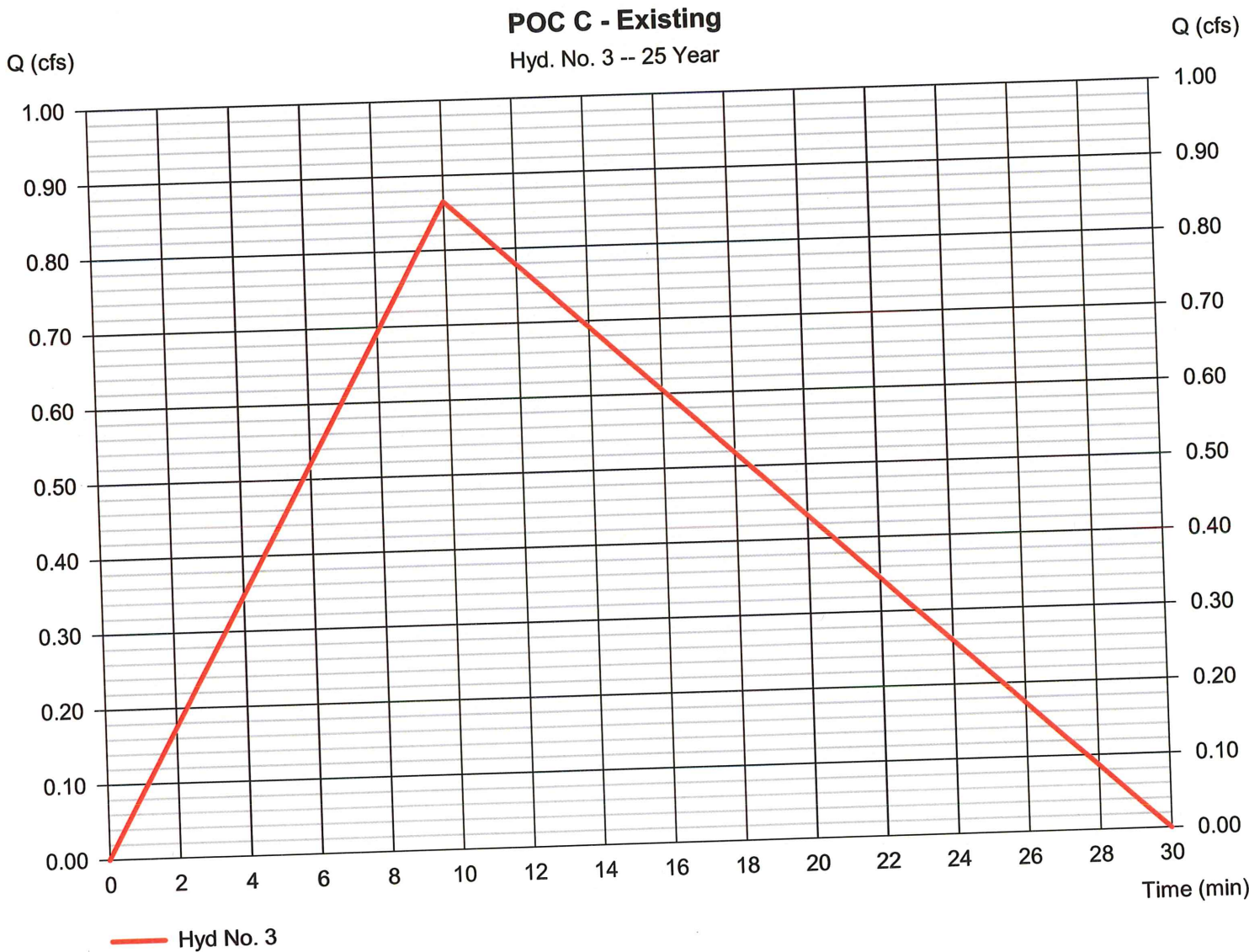
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Friday, 07 / 1 / 2016

Hyd. No. 3

POC C - Existing

Hydrograph type	= Rational	Peak discharge	= 0.865 cfs
Storm frequency	= 25 yrs	Time to peak	= 10 min
Time interval	= 1 min	Hyd. volume	= 779 cuft
Drainage area	= 0.340 ac	Runoff coeff.	= 0.89
Intensity	= 2.859 in/hr	Tc by User	= 10.00 min
IDF Curve	= Northgate Walk.IDF	Asc/Rec limb fact	= 1/2



Hydrograph Report

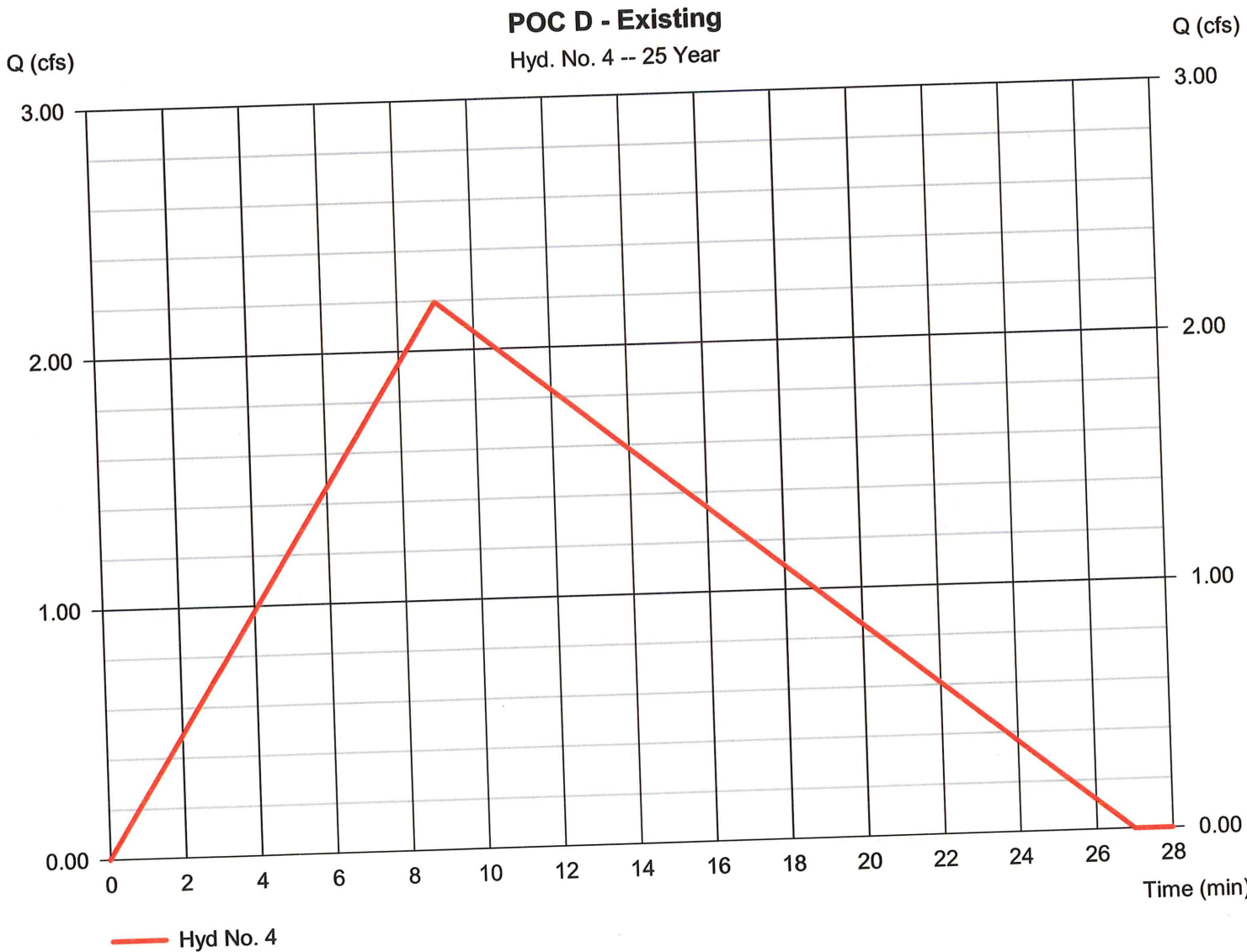
Friday, 07 / 1 / 2016

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Hyd. No. 4

POC D - Existing

Hydrograph type	= Rational	Peak discharge	= 2.195 cfs
Storm frequency	= 25 yrs	Time to peak	= 9 min
Time interval	= 1 min	Hyd. volume	= 1,778 cuft
Drainage area	= 0.830 ac	Runoff coeff.	= 0.88
Intensity	= 3.005 in/hr	Tc by User	= 9.00 min
IDF Curve	= Northgate Walk.IDF	Asc/Rec limb fact	= 1/2



Hydrograph Report

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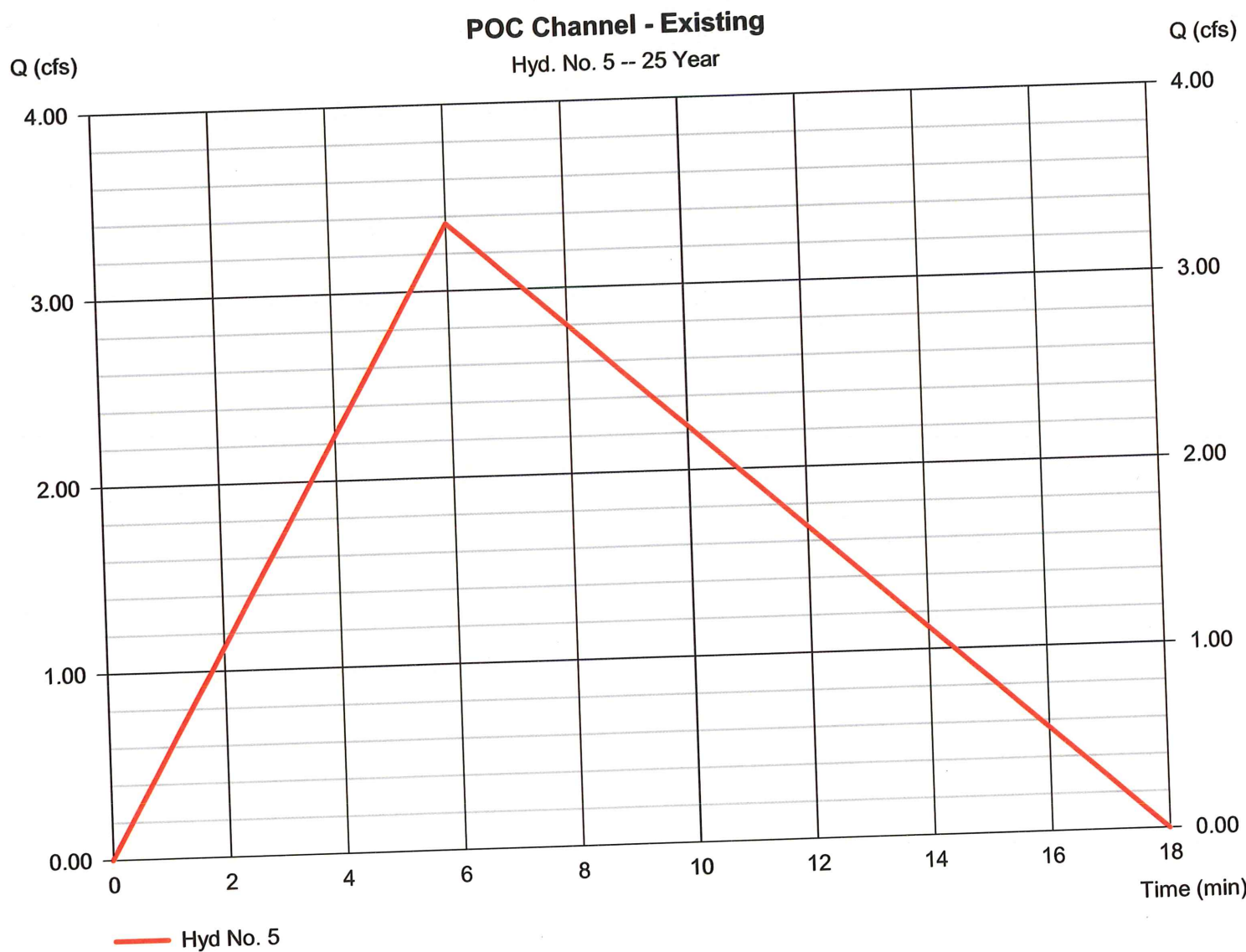
Friday, 07 / 1 / 2016

Hyd. No. 5

POC Channel - Existing

Hydrograph type = Rational
 Storm frequency = 25 yrs
 Time interval = 1 min
 Drainage area = 1.320 ac
 Intensity = 3.638 in/hr
 IDF Curve = Northgate Walk.IDF

Peak discharge = 3.362 cfs
 Time to peak = 6 min
 Hyd. volume = 1,815 cuft
 Runoff coeff. = 0.7
 Tc by User = 6.00 min
 Asc/Rec limb fact = 1/2



Hydrograph Report

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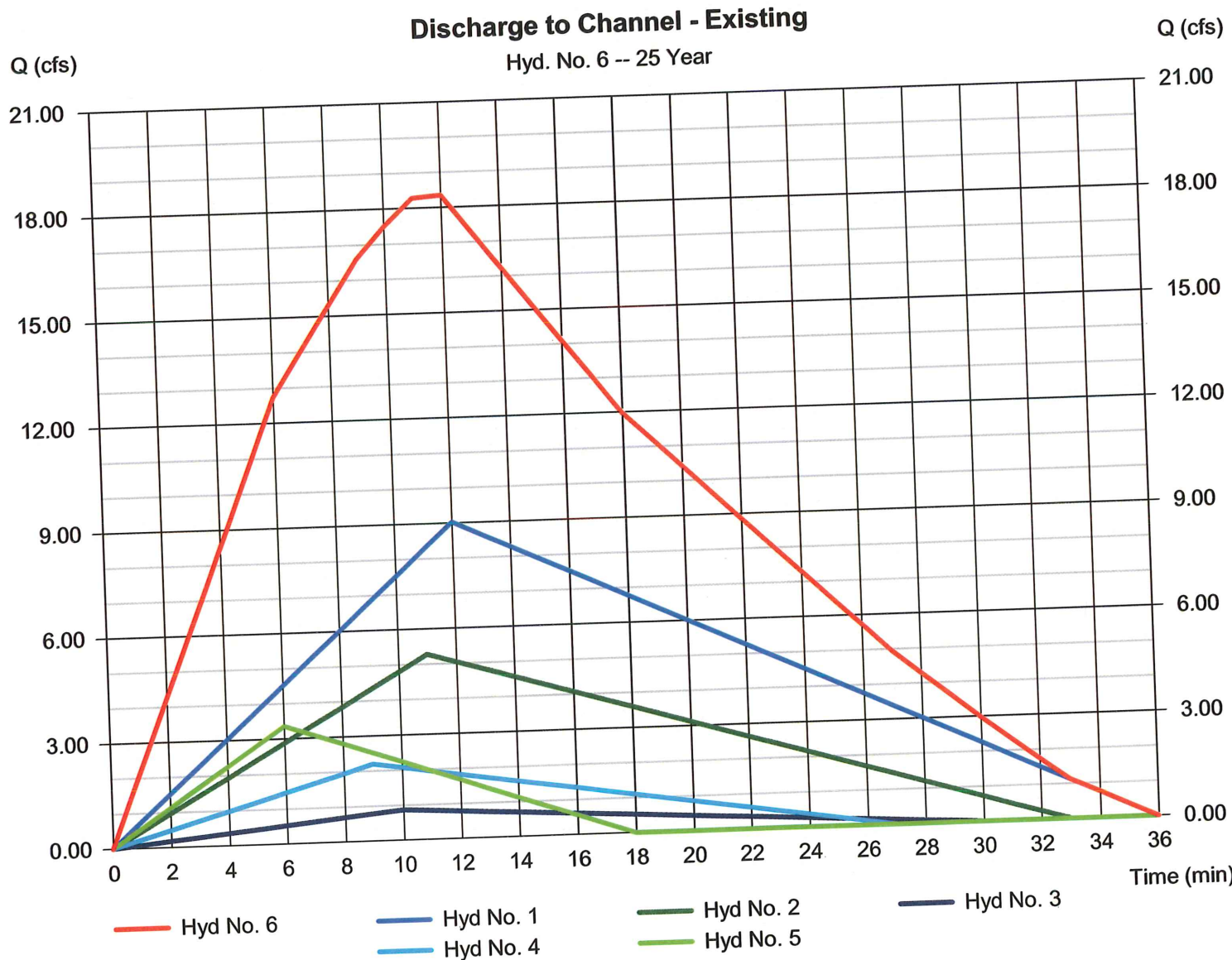
Friday, 07 / 1 / 2016

Hyd. No. 6

Discharge to Channel - Existing

Hydrograph type = Combine
 Storm frequency = 25 yrs
 Time interval = 1 min
 Inflow hyds. = 1, 2, 3, 4, 5

Peak discharge = 18.36 cfs
 Time to peak = 12 min
 Hyd. volume = 19,348 cuft
 Contrib. drain. area = 8.580 ac



Hydrograph Report

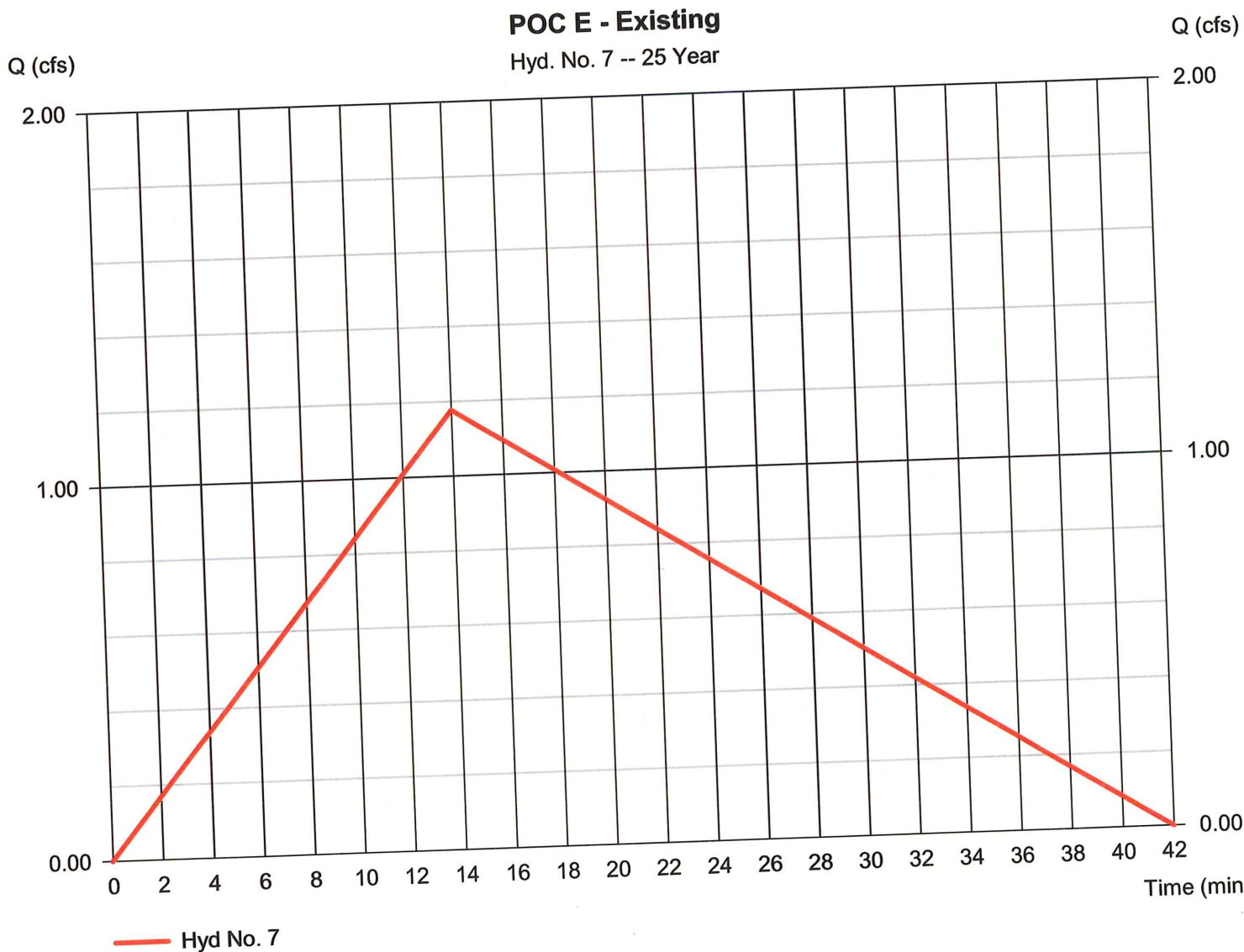
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Friday, 07 / 1 / 2016

Hyd. No. 7

POC E - Existing

Hydrograph type	= Rational	Peak discharge	= 1.176 cfs
Storm frequency	= 25 yrs	Time to peak	= 14 min
Time interval	= 1 min	Hyd. volume	= 1,482 cuft
Drainage area	= 0.690 ac	Runoff coeff.	= 0.7
Intensity	= 2.436 in/hr	Tc by User	= 14.00 min
IDF Curve	= Northgate Walk.IDF	Asc/Rec limb fact	= 1/2



Hydrograph Report

Friday, 07 / 1 / 2016

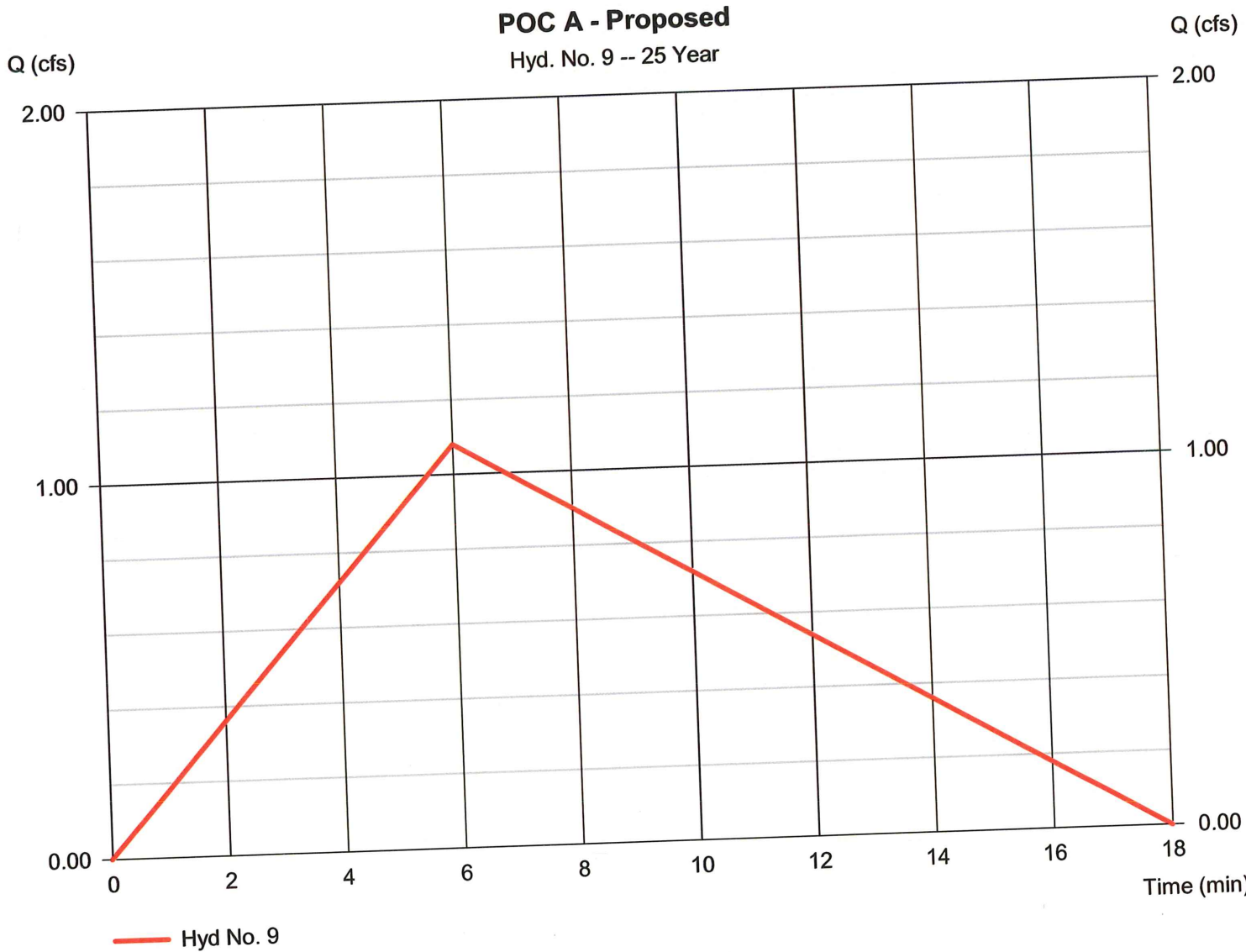
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Hyd. No. 9

POC A - Proposed

Hydrograph type = Rational
Storm frequency = 25 yrs
Time interval = 1 min
Drainage area = 0.330 ac
Intensity = 3.638 in/hr
IDF Curve = Northgate Walk.IDF

Peak discharge = 1.081 cfs
Time to peak = 6 min
Hyd. volume = 584 cuft
Runoff coeff. = 0.9
Tc by User = 6.00 min
Asc/Rec limb fact = 1/2



Hydrograph Report

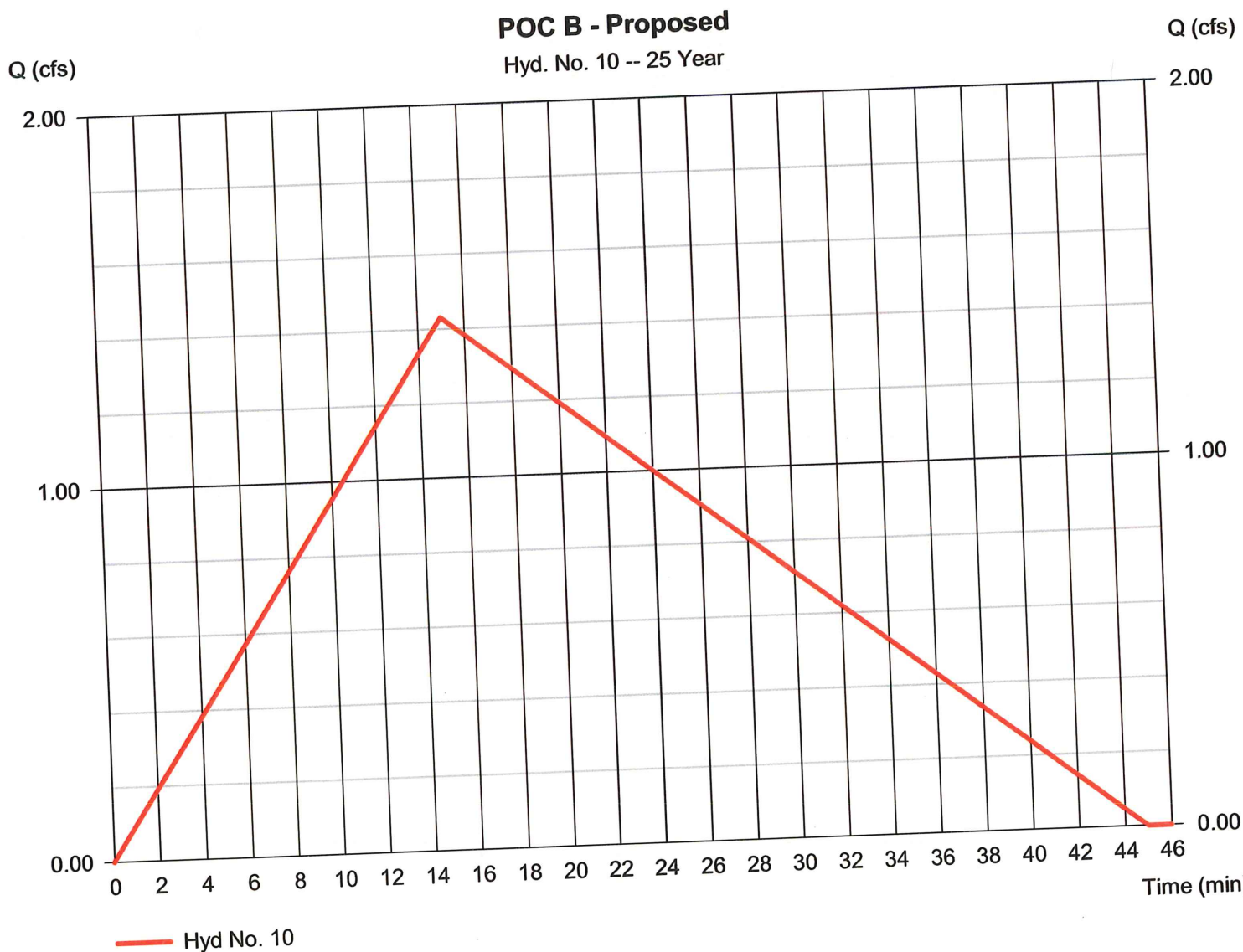
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Hyd. No. 10

POC B - Proposed

Hydrograph type	= Rational	Peak discharge	= 1.431 cfs
Storm frequency	= 25 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 1,932 cuft
Drainage area	= 0.690 ac	Runoff coeff.	= 0.88
Intensity	= 2.357 in/hr	Tc by User	= 15.00 min
IDF Curve	= Northgate Walk.IDF	Asc/Rec limb fact	= 1/2



Hydrograph Report

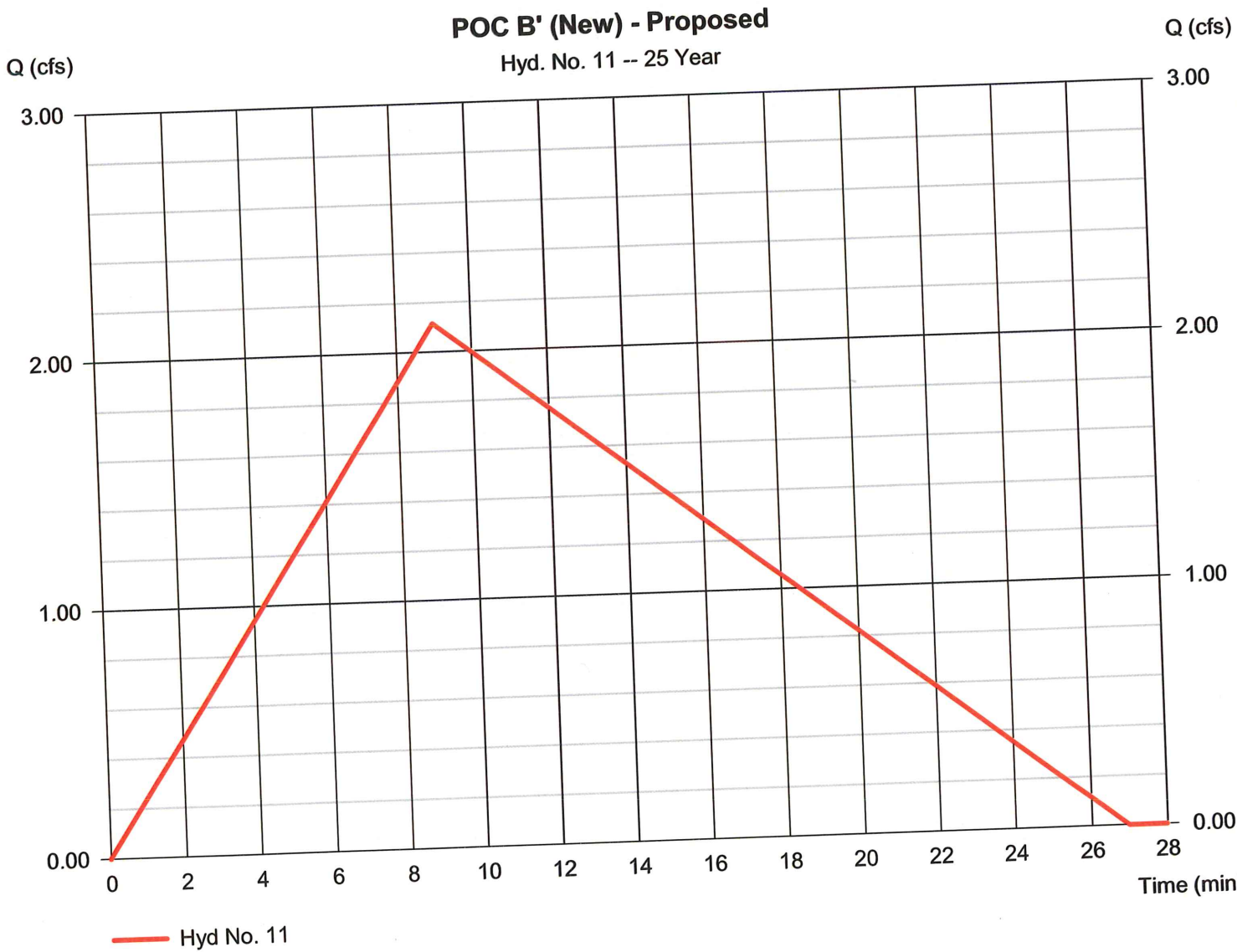
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Hyd. No. 11

POC B' (New) - Proposed

Hydrograph type	= Rational	Peak discharge	= 2.116 cfs
Storm frequency	= 25 yrs	Time to peak	= 9 min
Time interval	= 1 min	Hyd. volume	= 1,714 cuft
Drainage area	= 0.800 ac	Runoff coeff.	= 0.88
Intensity	= 3.005 in/hr	Tc by User	= 9.00 min
IDF Curve	= Northgate Walk.IDF	Asc/Rec limb fact	= 1/2



Hydrograph Report

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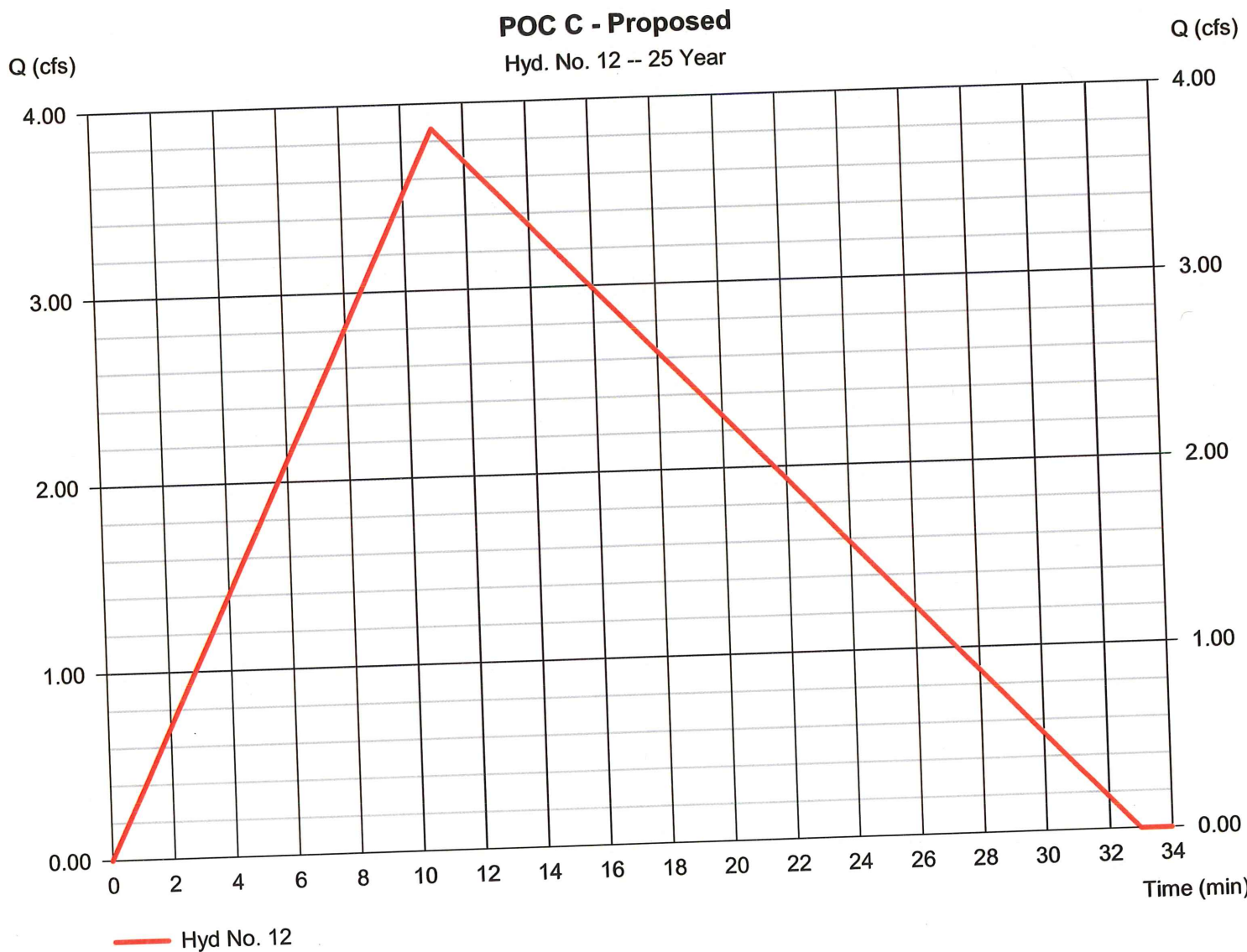
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Hyd. No. 12

POC C - Proposed

Hydrograph type = Rational
 Storm frequency = 25 yrs
 Time interval = 1 min
 Drainage area = 1.590 ac
 Intensity = 2.732 in/hr
 IDF Curve = Northgate Walk.IDF

Peak discharge = 3.867 cfs
 Time to peak = 11 min
 Hyd. volume = 3,828 cuft
 Runoff coeff. = 0.89
 Tc by User = 11.00 min
 Asc/Rec limb fact = 1/2



Hydrograph Report

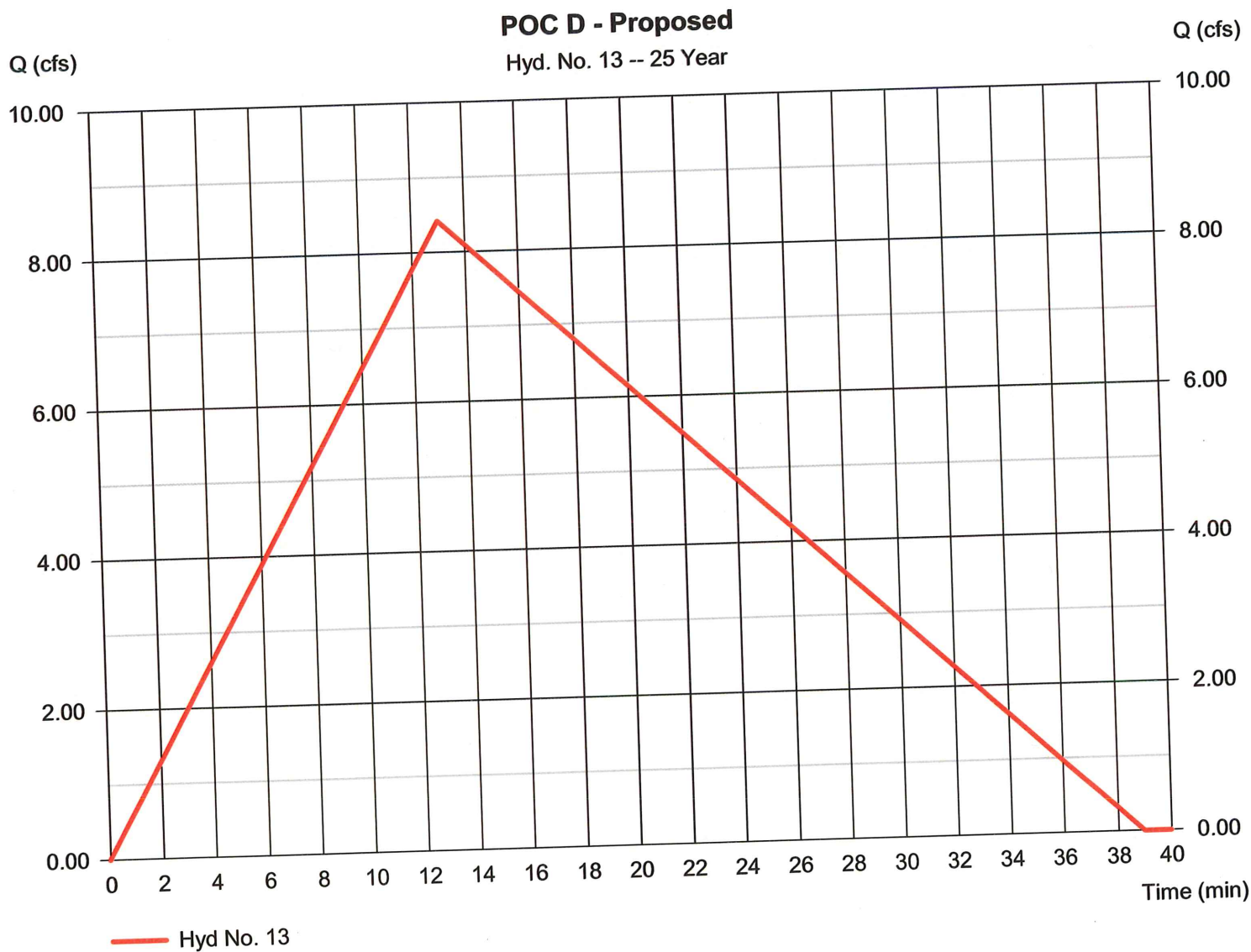
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Hyd. No. 13

POC D - Proposed

Hydrograph type	= Rational	Peak discharge	= 8.422 cfs
Storm frequency	= 25 yrs	Time to peak	= 13 min
Time interval	= 1 min	Hyd. volume	= 9,853 cuft
Drainage area	= 3.750 ac	Runoff coeff.	= 0.89
Intensity	= 2.523 in/hr	Tc by User	= 13.00 min
IDF Curve	= Northgate Walk.IDF	Asc/Rec limb fact	= 1/2



Hydrograph Report

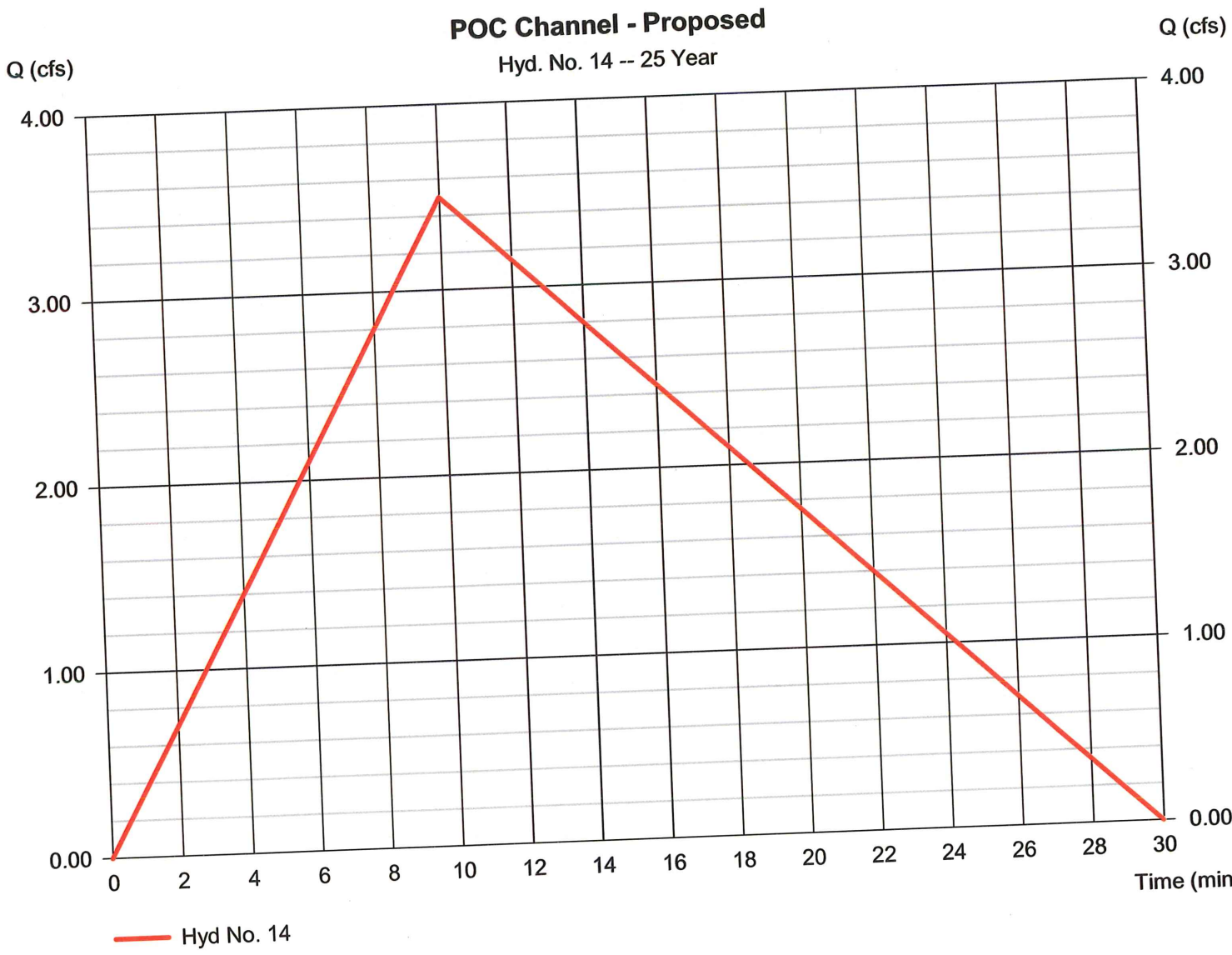
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Hyd. No. 14

POC Channel - Proposed

Hydrograph type	= Rational	Peak discharge	= 3.501 cfs
Storm frequency	= 25 yrs	Time to peak	= 10 min
Time interval	= 1 min	Hyd. volume	= 3,151 cuft
Drainage area	= 1.570 ac	Runoff coeff.	= 0.78
Intensity	= 2.859 in/hr	Tc by User	= 10.00 min
IDF Curve	= Northgate Walk.IDF	Asc/Rec limb fact	= 1/2



Hydrograph Report

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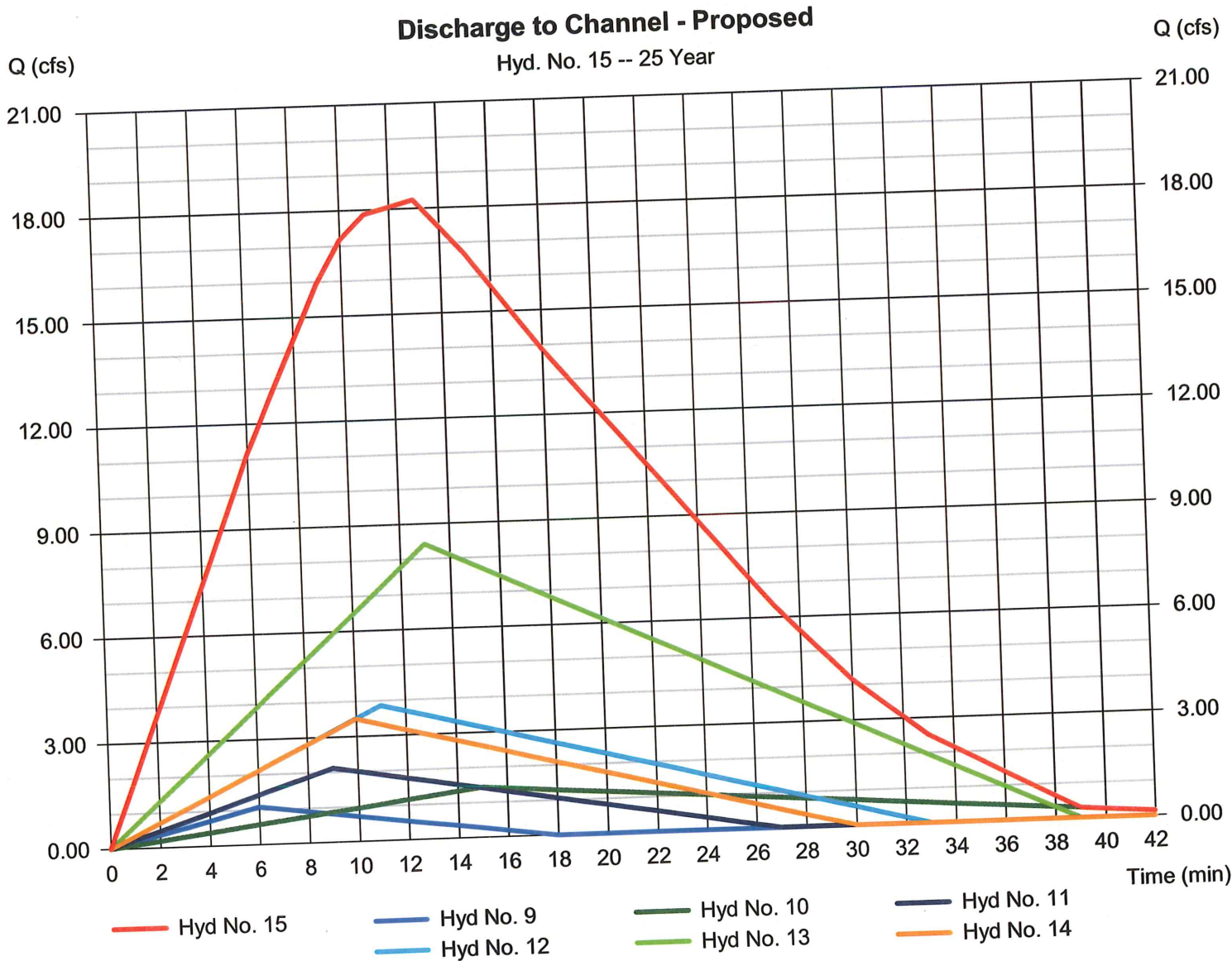
Friday, 07 / 1 / 2016

Hyd. No. 15

Discharge to Channel - Proposed

Hydrograph type = Combine
 Storm frequency = 25 yrs
 Time interval = 1 min
 Inflow hyd. = 9, 10, 11, 12, 13, 14

Peak discharge = 18.25 cfs
 Time to peak = 13 min
 Hyd. volume = 21,061 cuft
 Contrib. drain. area = 8.730 ac



Hydrograph Report

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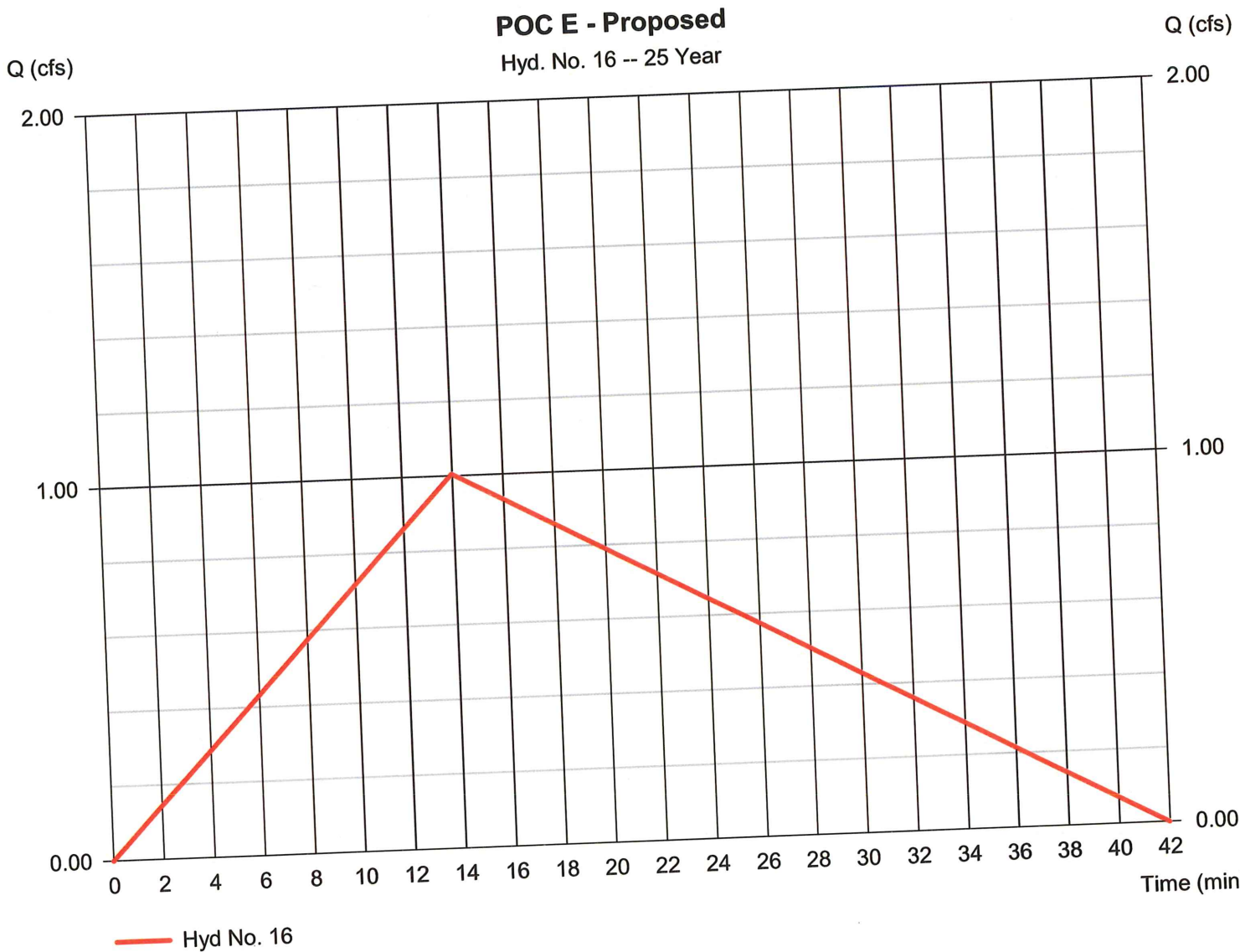
Friday, 07 / 1 / 2016

Hyd. No. 16

POC E - Proposed

Hydrograph type = Rational
 Storm frequency = 25 yrs
 Time interval = 1 min
 Drainage area = 0.550 ac
 Intensity = 2.436 in/hr
 IDF Curve = Northgate Walk.IDF

Peak discharge = 1.005 cfs
 Time to peak = 14 min
 Hyd. volume = 1,266 cuft
 Runoff coeff. = 0.75
 Tc by User = 14.00 min
 Asc/Rec limb fact = 1/2



Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	11.81	1	12	12,760	----	----	----	POC A - Existing
2	Rational	6.905	1	11	6,836	----	----	----	POC B - Existing
3	Rational	1.132	1	10	1,019	----	----	----	POC C - Existing
4	Rational	2.871	1	9	2,326	----	----	----	POC D - Existing
5	Rational	4.392	1	6	2,372	----	----	----	POC Channel - Existing
6	Combine	24.01	1	12	25,311	1, 2, 3, 4, 5	----	----	Discharge to Channel - Existing
7	Rational	1.539	1	14	1,940	----	----	----	POC E - Existing
9	Rational	1.412	1	6	762	----	----	----	POC A - Proposed
10	Rational	1.873	1	15	2,528	----	----	----	POC B - Proposed
11	Rational	2.768	1	9	2,242	----	----	----	POC B' (New) - Proposed
12	Rational	5.059	1	11	5,008	----	----	----	POC C - Proposed
13	Rational	11.02	1	13	12,893	----	----	----	POC D - Proposed
14	Rational	4.580	1	10	4,122	----	----	----	POC Channel - Proposed
15	Combine	23.88	1	13	27,556	9, 10, 11, 12, 13, 14	----	----	Discharge to Channel - Proposed
16	Rational	1.315	1	14	1,657	----	----	----	POC E - Proposed

Hydrograph Report

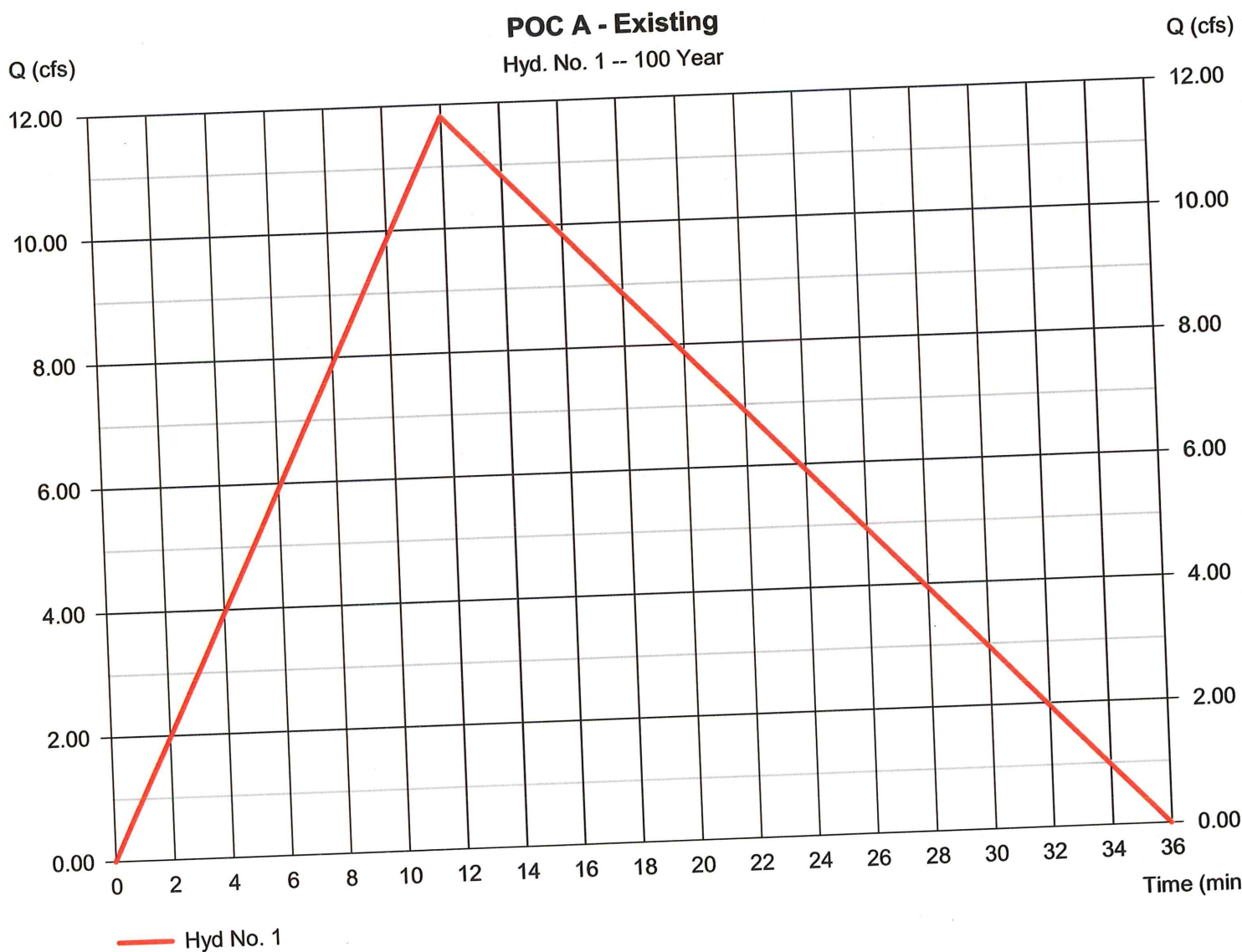
Friday, 07 / 1 / 2016

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

Hyd. No. 1

POC A - Existing

Hydrograph type	= Rational	Peak discharge	= 11.81 cfs
Storm frequency	= 100 yrs	Time to peak	= 12 min
Time interval	= 1 min	Hyd. volume	= 12,760 cuft
Drainage area	= 3.870 ac	Runoff coeff.	= 0.89
Intensity	= 3.430 in/hr	Tc by User	= 12.00 min
IDF Curve	= Northgate Walk.IDF	Asc/Rec limb fact	= 1/2



Hydrograph Report

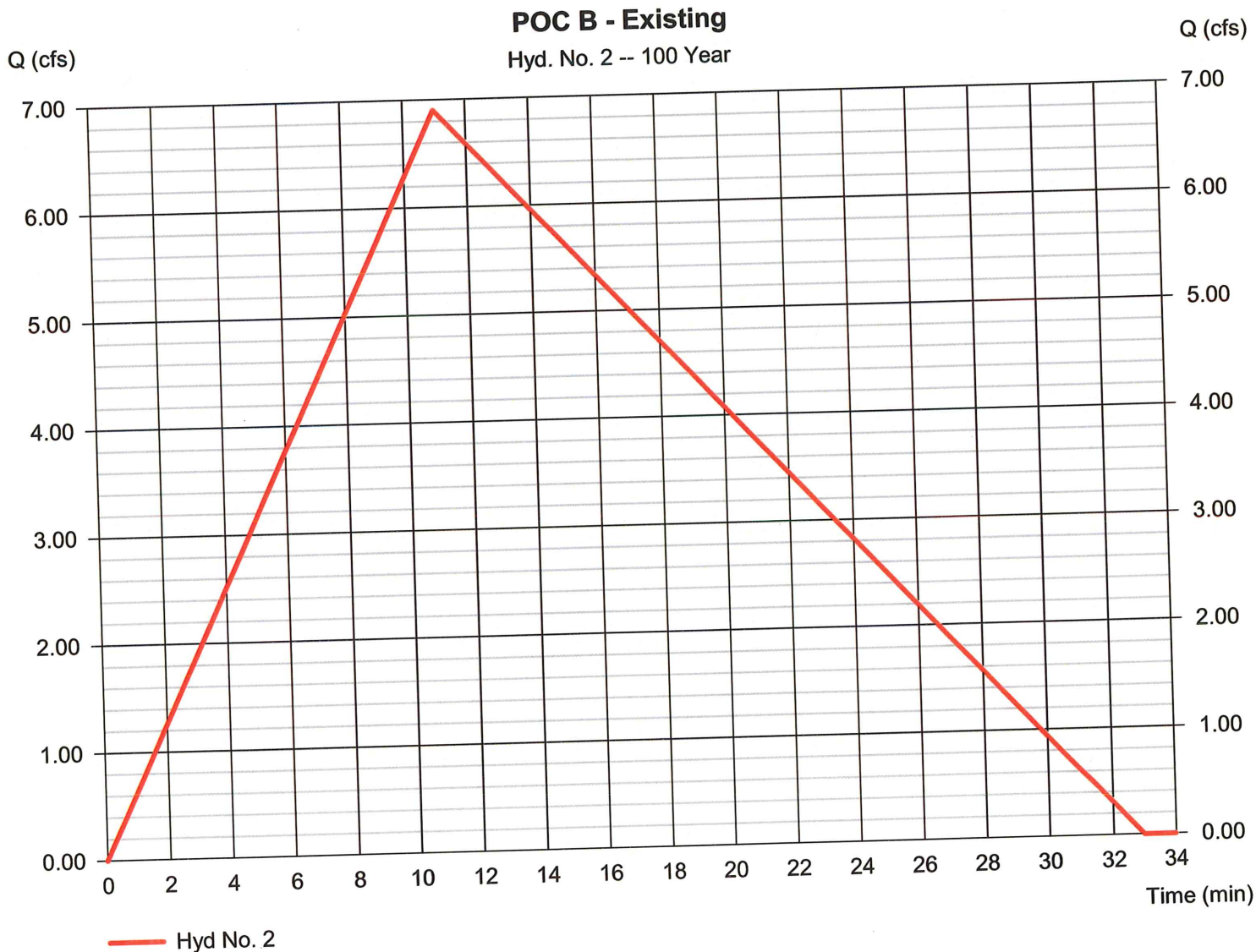
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Friday, 07 / 1 / 2016

Hyd. No. 2

POC B - Existing

Hydrograph type	= Rational	Peak discharge	= 6.905 cfs
Storm frequency	= 100 yrs	Time to peak	= 11 min
Time interval	= 1 min	Hyd. volume	= 6,836 cuft
Drainage area	= 2.220 ac	Runoff coeff.	= 0.87
Intensity	= 3.575 in/hr	Tc by User	= 11.00 min
IDF Curve	= Northgate Walk.IDF	Asc/Rec limb fact	= 1/2



Hydrograph Report

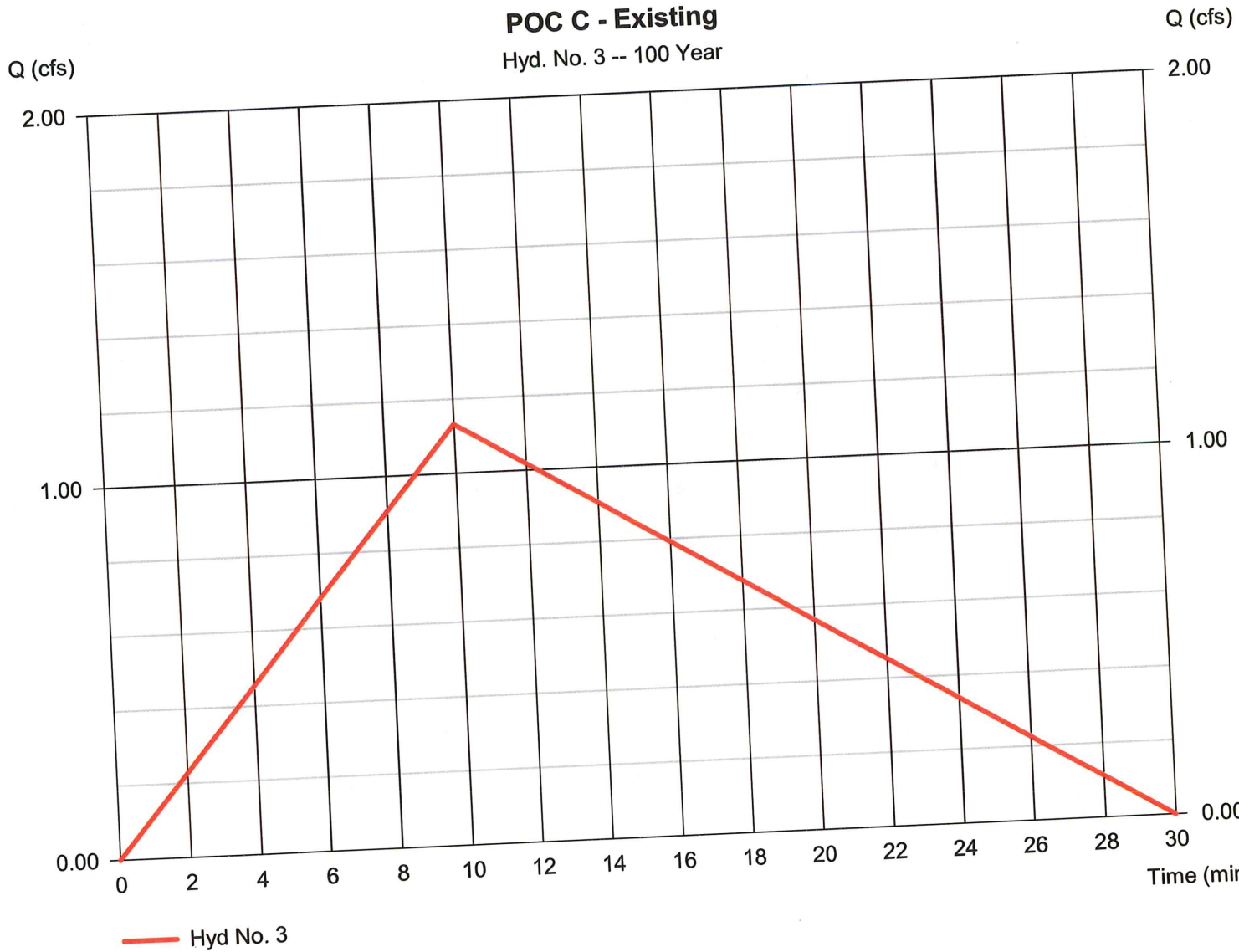
Friday, 07 / 1 / 2016

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Hyd. No. 3

POC C - Existing

Hydrograph type	= Rational	Peak discharge	= 1.132 cfs
Storm frequency	= 100 yrs	Time to peak	= 10 min
Time interval	= 1 min	Hyd. volume	= 1,019 cuft
Drainage area	= 0.340 ac	Runoff coeff.	= 0.89
Intensity	= 3.740 in/hr	Tc by User	= 10.00 min
IDF Curve	= Northgate Walk.IDF	Asc/Rec limb fact	= 1/2



Hydrograph Report

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

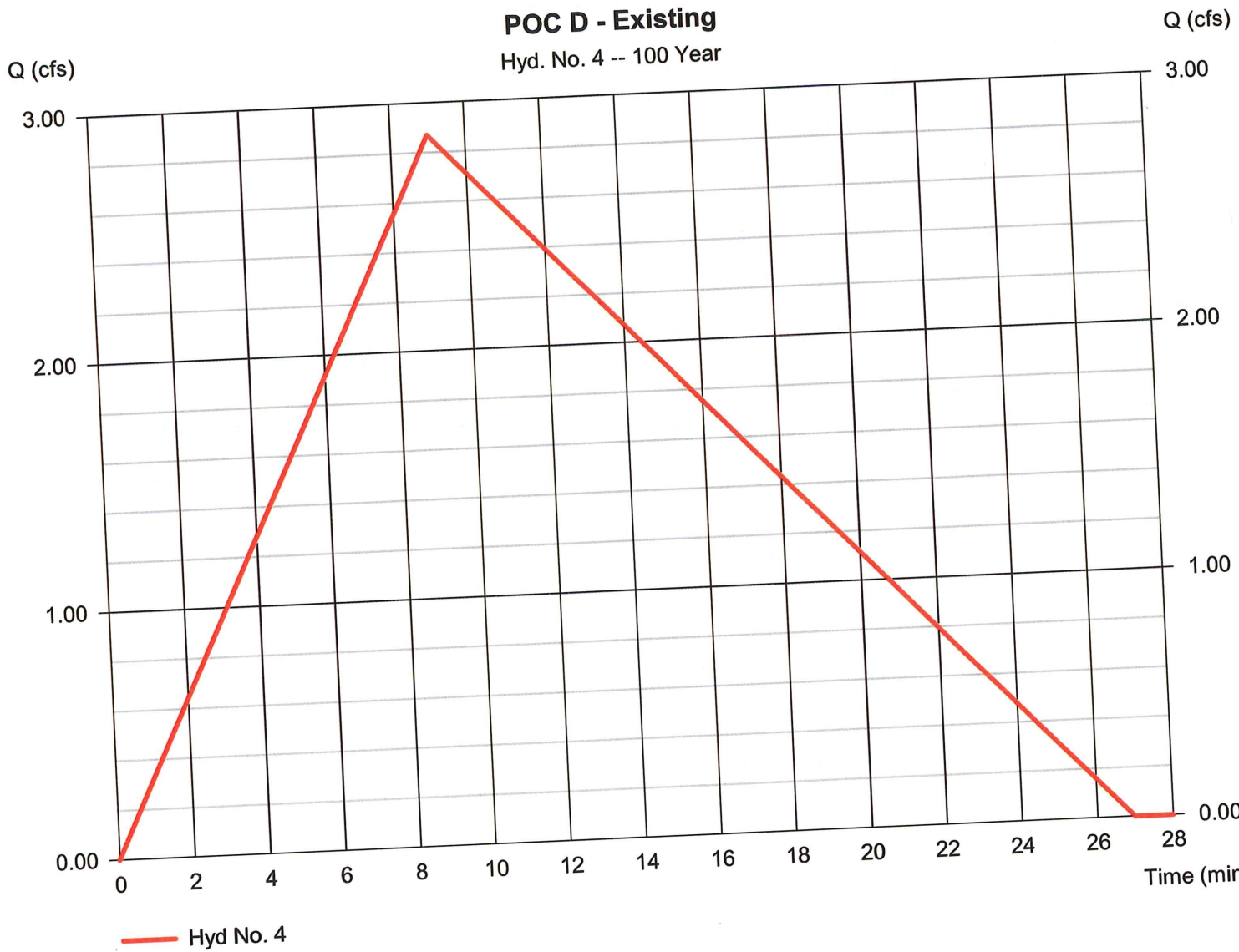
Friday, 07 / 1 / 2016

Hyd. No. 4

POC D - Existing

Hydrograph type = Rational
Storm frequency = 100 yrs
Time interval = 1 min
Drainage area = 0.830 ac
Intensity = 3.931 in/hr
IDF Curve = Northgate Walk.IDF

Peak discharge = 2.871 cfs
Time to peak = 9 min
Hyd. volume = 2,326 cuft
Runoff coeff. = 0.88
Tc by User = 9.00 min
Asc/Rec limb fact = 1/2



Hydrograph Report

Friday, 07 / 1 / 2016

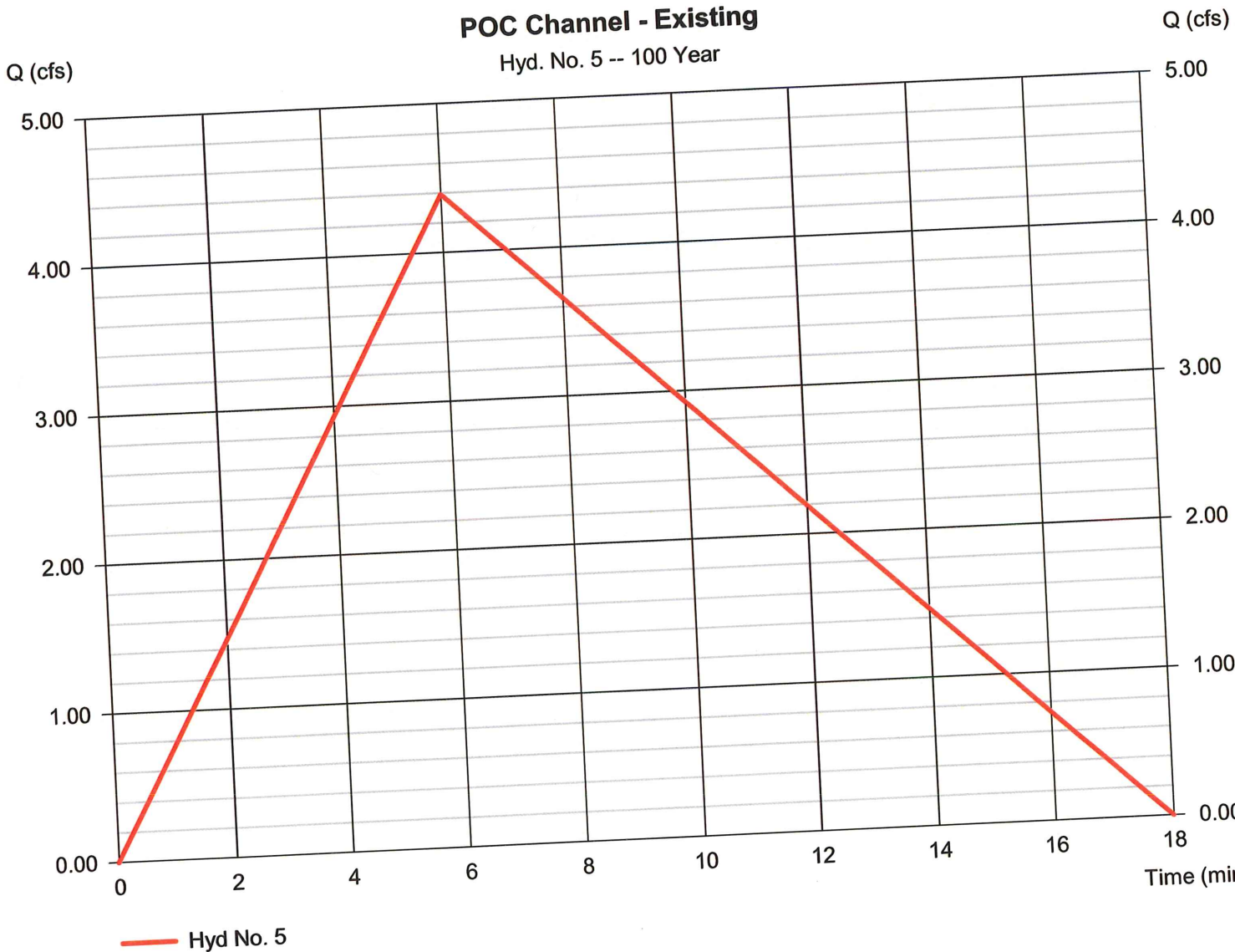
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Hyd. No. 5

POC Channel - Existing

Hydrograph type = Rational
Storm frequency = 100 yrs
Time interval = 1 min
Drainage area = 1.320 ac
Intensity = 4.753 in/hr
IDF Curve = Northgate Walk.IDF

Peak discharge = 4.392 cfs
Time to peak = 6 min
Hyd. volume = 2,372 cuft
Runoff coeff. = 0.7
Tc by User = 6.00 min
Asc/Rec limb fact = 1/2



Hydrograph Report

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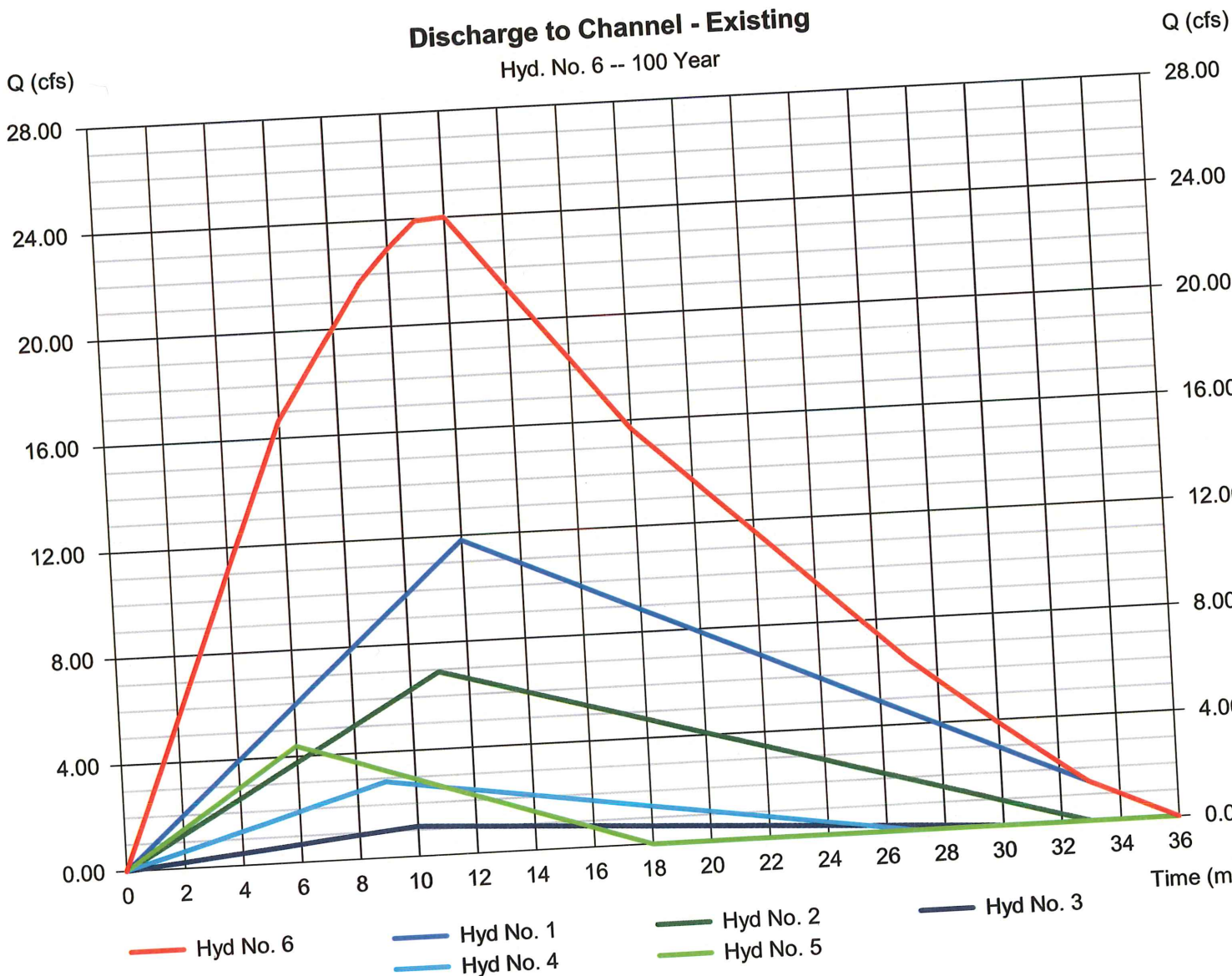
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Hyd. No. 6

Discharge to Channel - Existing

Hydrograph type = Combine
Storm frequency = 100 yrs
Time interval = 1 min
Inflow hyds. = 1, 2, 3, 4, 5

Peak discharge = 24.01 cfs
Time to peak = 12 min
Hyd. volume = 25,311 cuft
Contrib. drain. area = 8.580 ac



Hydrograph Report

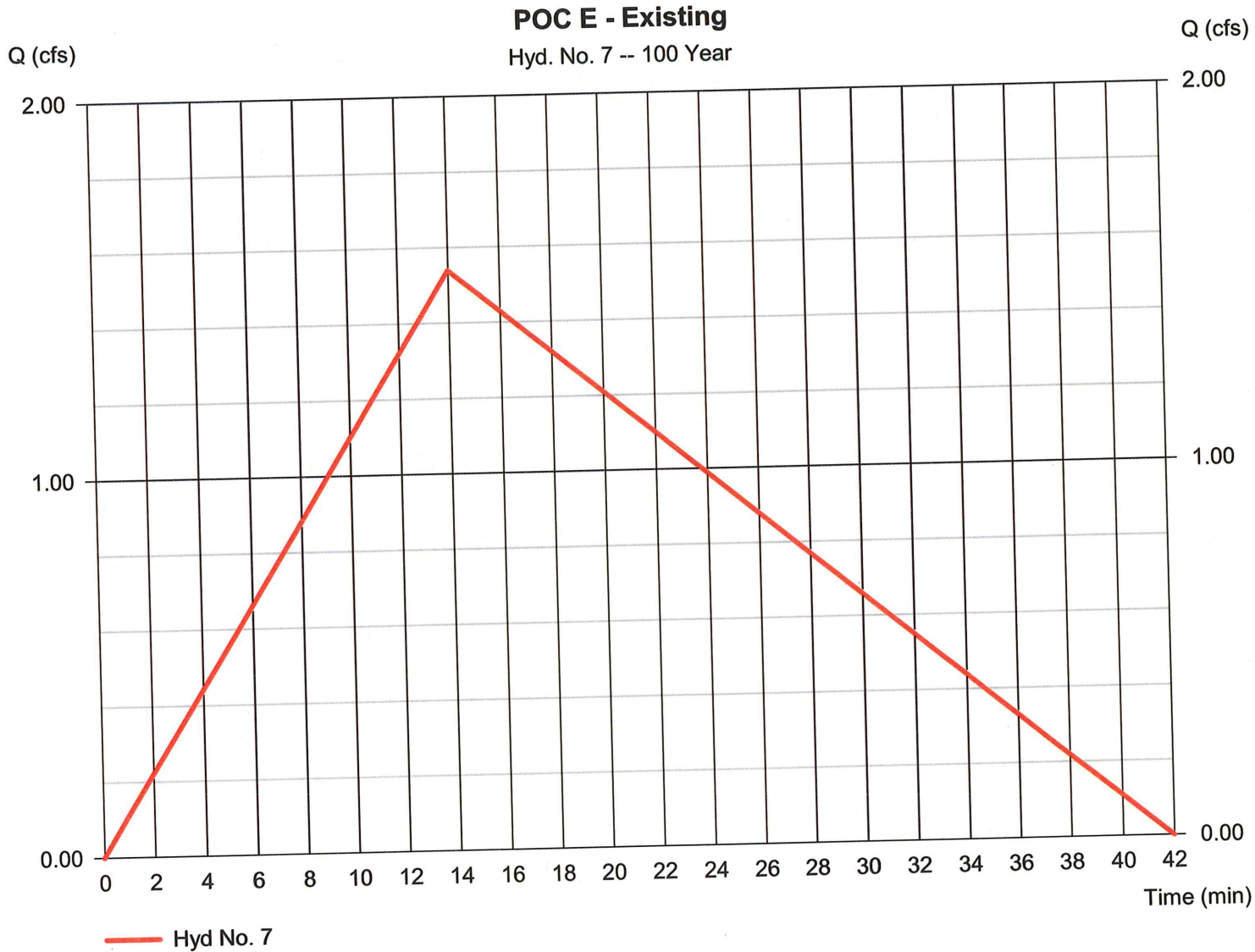
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Friday, 07 / 1 / 2016

Hyd. No. 7

POC E - Existing

Hydrograph type	= Rational	Peak discharge	= 1.539 cfs
Storm frequency	= 100 yrs	Time to peak	= 14 min
Time interval	= 1 min	Hyd. volume	= 1,940 cuft
Drainage area	= 0.690 ac	Runoff coeff.	= 0.7
Intensity	= 3.187 in/hr	Tc by User	= 14.00 min
IDF Curve	= Northgate Walk.IDF	Asc/Rec limb fact	= 1/2



Hydrograph Report

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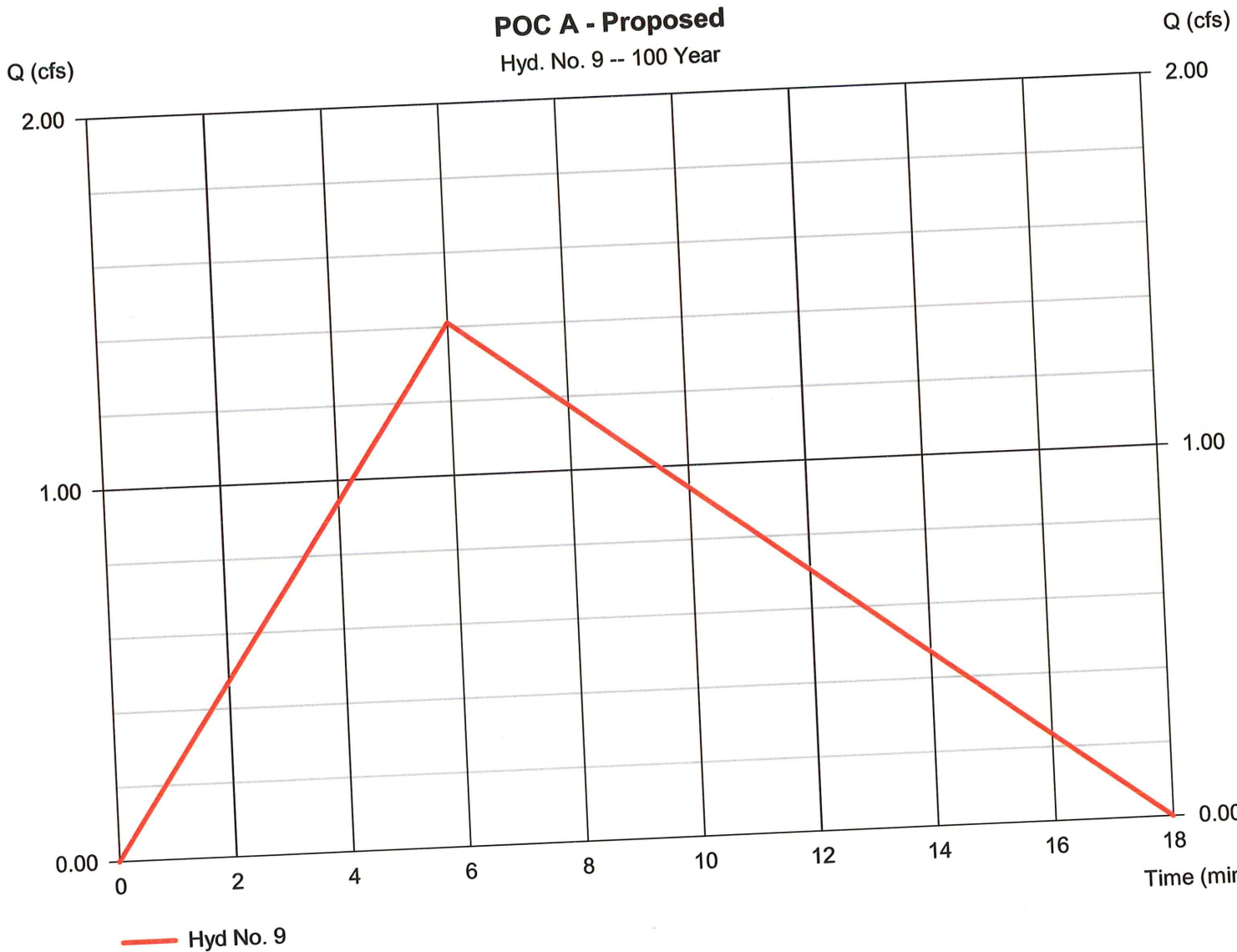
Friday, 07 / 1 / 2016

Hyd. No. 9

POC A - Proposed

Hydrograph type = Rational
 Storm frequency = 100 yrs
 Time interval = 1 min
 Drainage area = 0.330 ac
 Intensity = 4.753 in/hr
 IDF Curve = Northgate Walk.IDF

Peak discharge = 1.412 cfs
 Time to peak = 6 min
 Hyd. volume = 762 cuft
 Runoff coeff. = 0.9
 Tc by User = 6.00 min
 Asc/Rec limb fact = 1/2



Hydrograph Report

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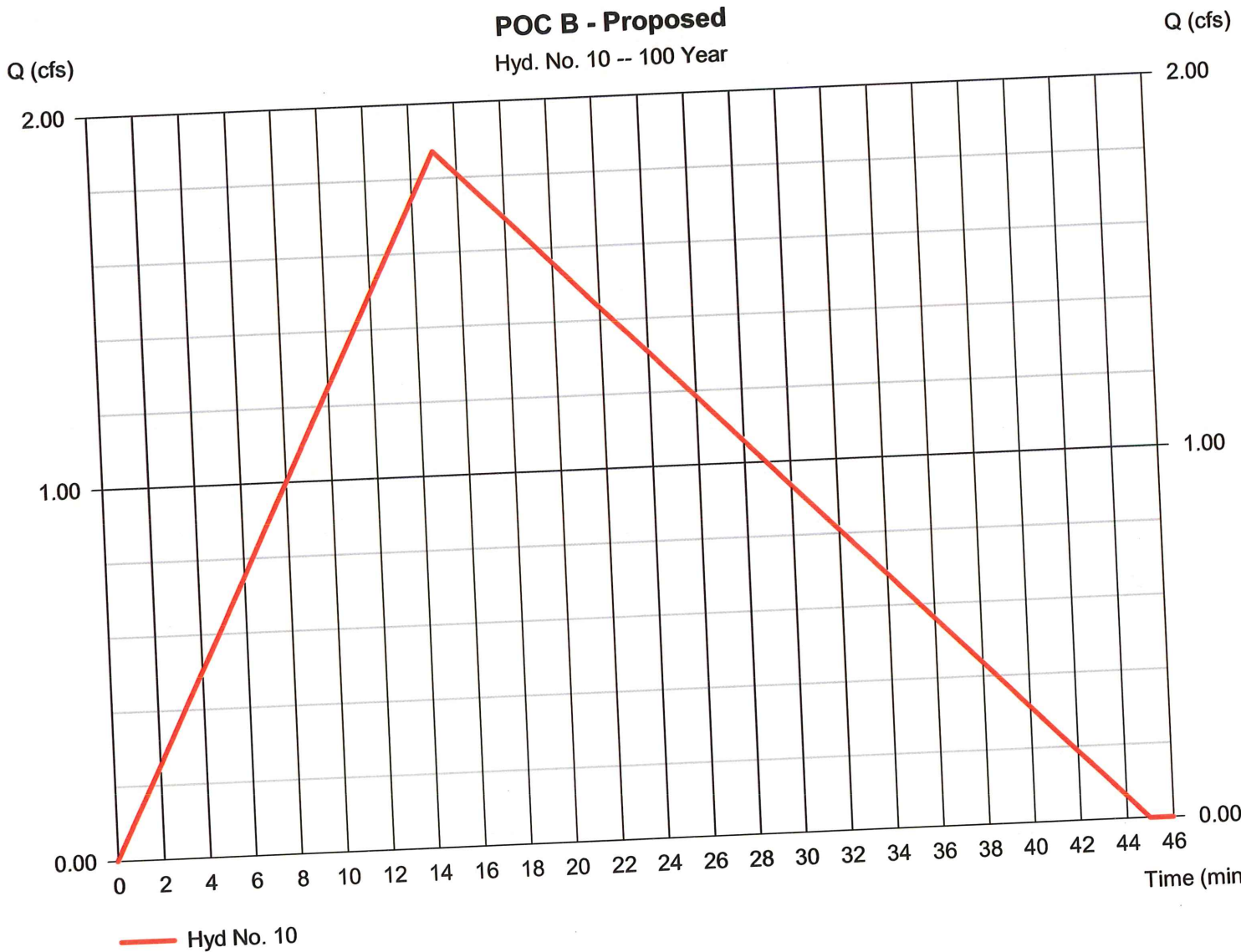
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Hyd. No. 10

POC B - Proposed

Hydrograph type = Rational
 Storm frequency = 100 yrs
 Time interval = 1 min
 Drainage area = 0.690 ac
 Intensity = 3.084 in/hr
 IDF Curve = Northgate Walk.IDF

Peak discharge = 1.873 cfs
 Time to peak = 15 min
 Hyd. volume = 2,528 cuft
 Runoff coeff. = 0.88
 Tc by User = 15.00 min
 Asc/Rec limb fact = 1/2



Hydrograph Report

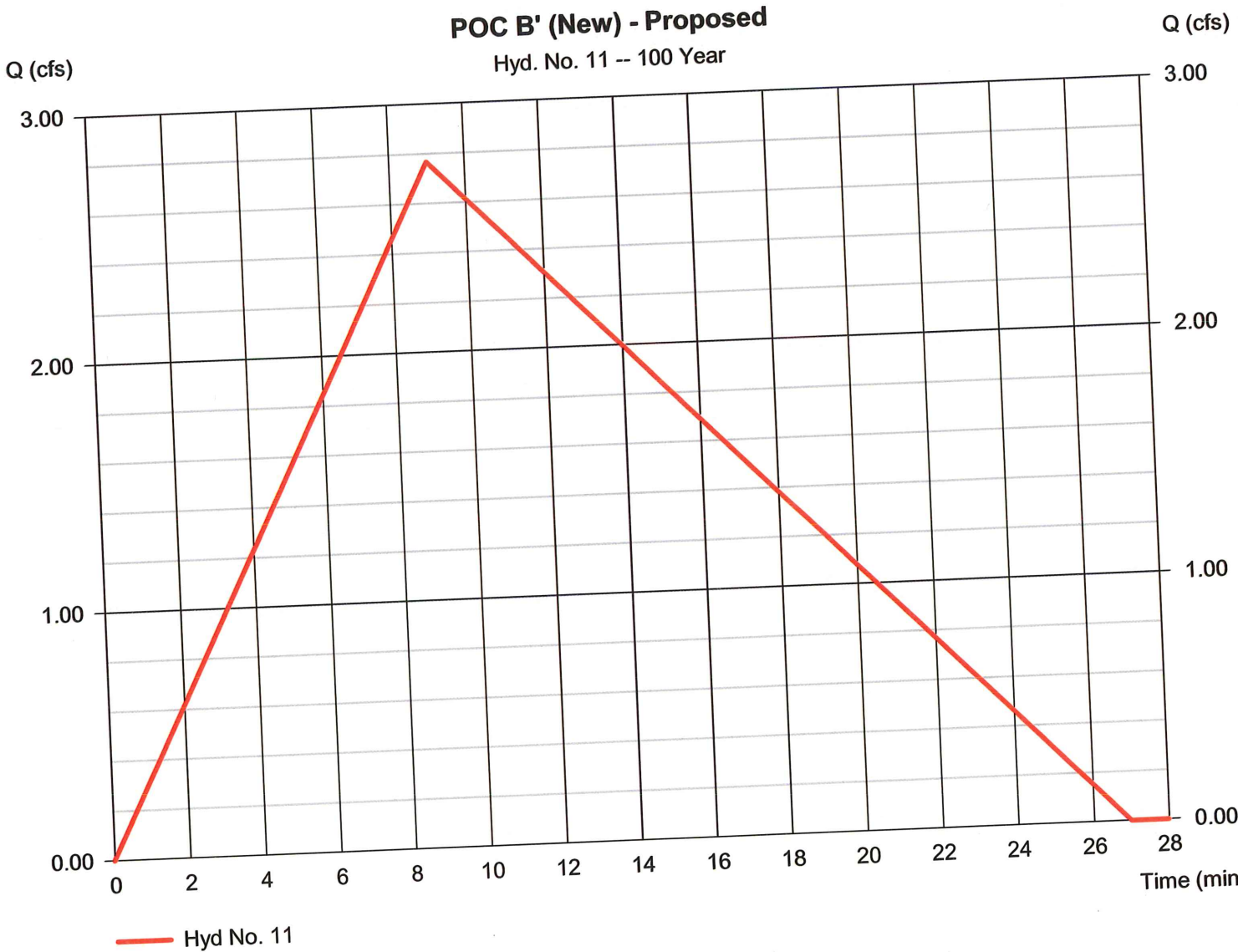
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

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Hyd. No. 11

POC B' (New) - Proposed

Hydrograph type	= Rational	Peak discharge	= 2.768 cfs
Storm frequency	= 100 yrs	Time to peak	= 9 min
Time interval	= 1 min	Hyd. volume	= 2,242 cuft
Drainage area	= 0.800 ac	Runoff coeff.	= 0.88
Intensity	= 3.931 in/hr	Tc by User	= 9.00 min
IDF Curve	= Northgate Walk.IDF	Asc/Rec limb fact	= 1/2



Hydrograph Report

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

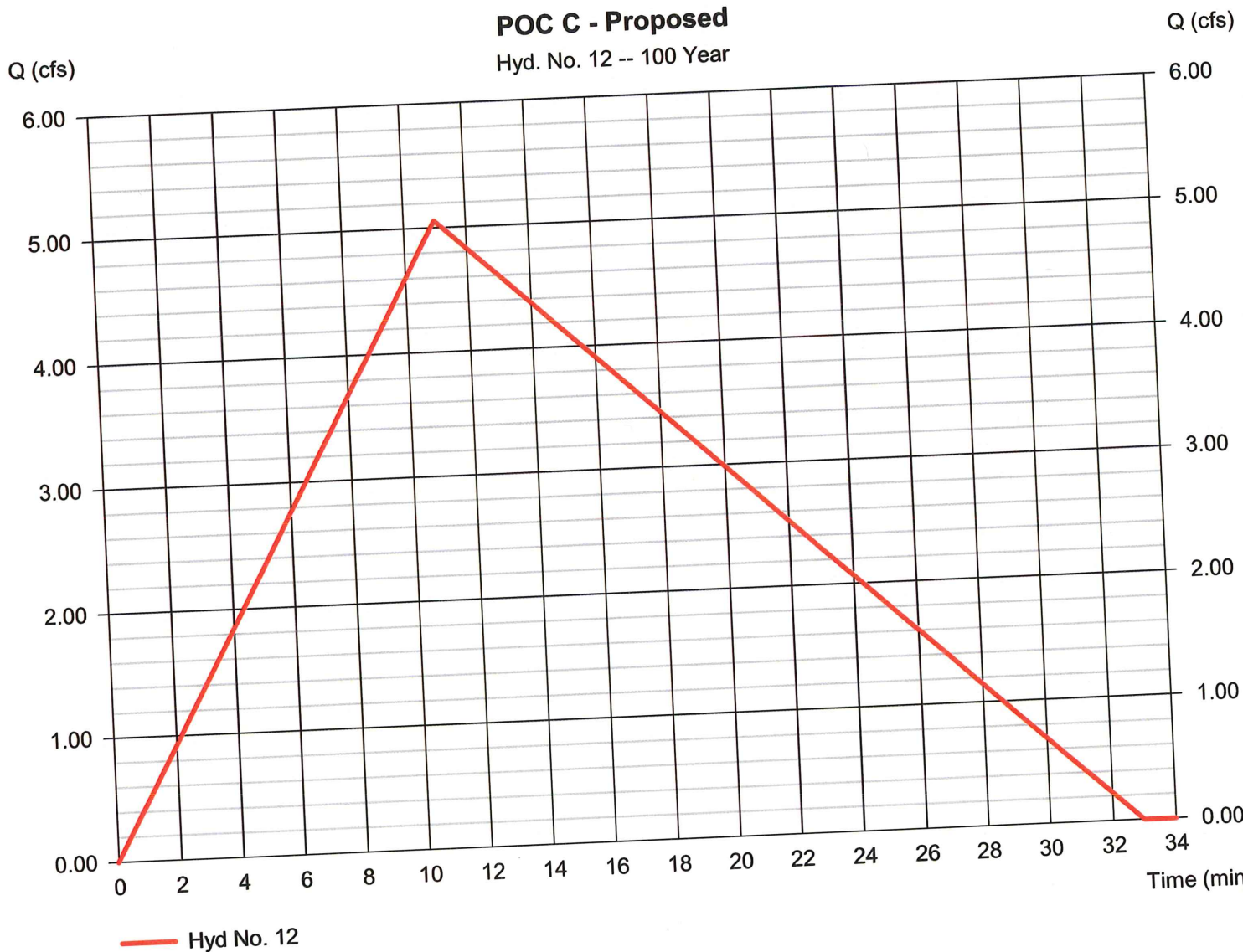
Friday, 07 / 1 / 2016

Hyd. No. 12

POC C - Proposed

Hydrograph type = Rational
 Storm frequency = 100 yrs
 Time interval = 1 min
 Drainage area = 1.590 ac
 Intensity = 3.575 in/hr
 IDF Curve = Northgate Walk.IDF

Peak discharge = 5.059 cfs
 Time to peak = 11 min
 Hyd. volume = 5,008 cuft
 Runoff coeff. = 0.89
 Tc by User = 11.00 min
 Asc/Rec limb fact = 1/2



Hydrograph Report

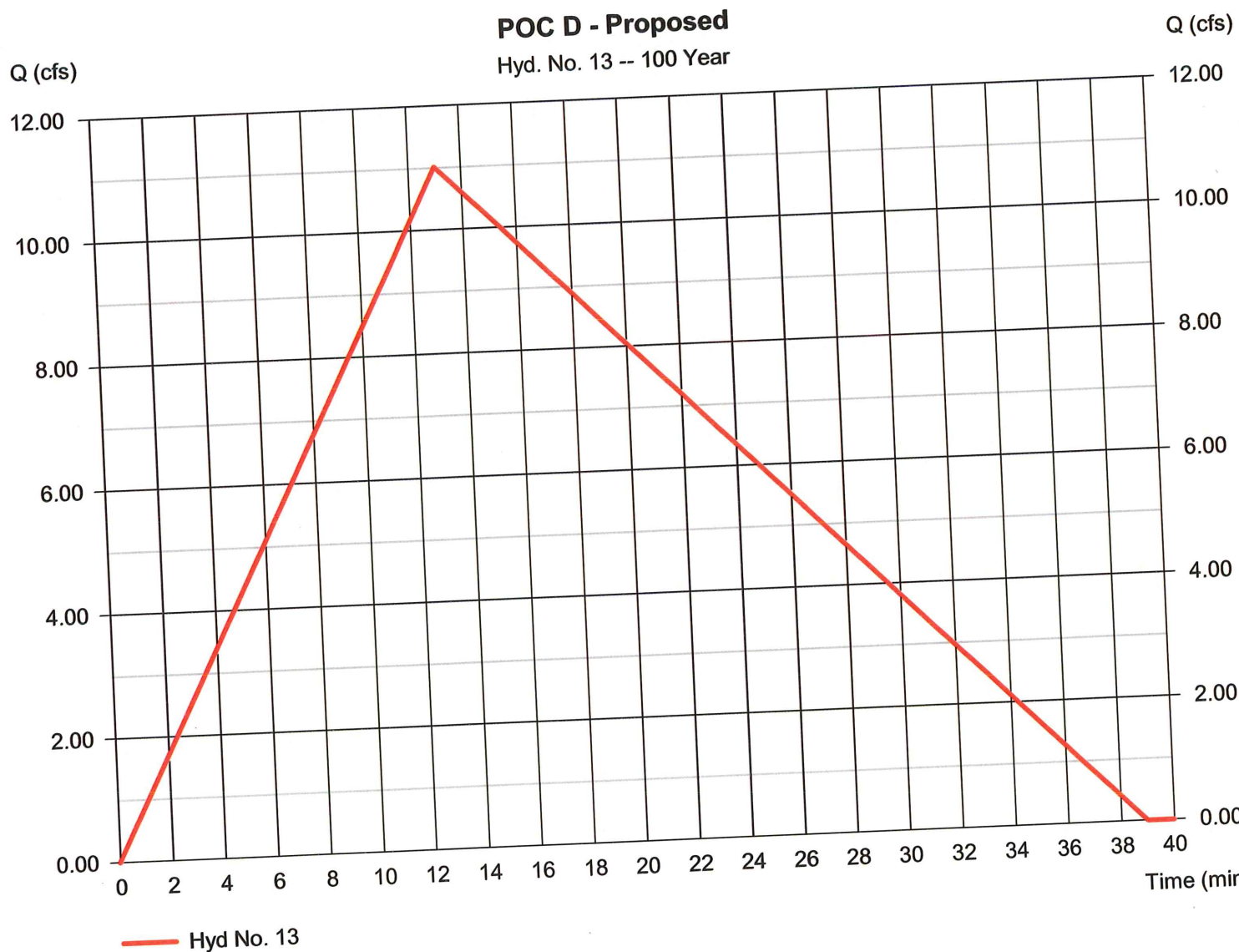
Friday, 07 / 1 / 2016

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

Hyd. No. 13

POC D - Proposed

Hydrograph type	= Rational	Peak discharge	= 11.02 cfs
Storm frequency	= 100 yrs	Time to peak	= 13 min
Time interval	= 1 min	Hyd. volume	= 12,893 cuft
Drainage area	= 3.750 ac	Runoff coeff.	= 0.89
Intensity	= 3.302 in/hr	Tc by User	= 13.00 min
IDF Curve	= Northgate Walk.IDF	Asc/Rec limb fact	= 1/2



Hydrograph Report

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

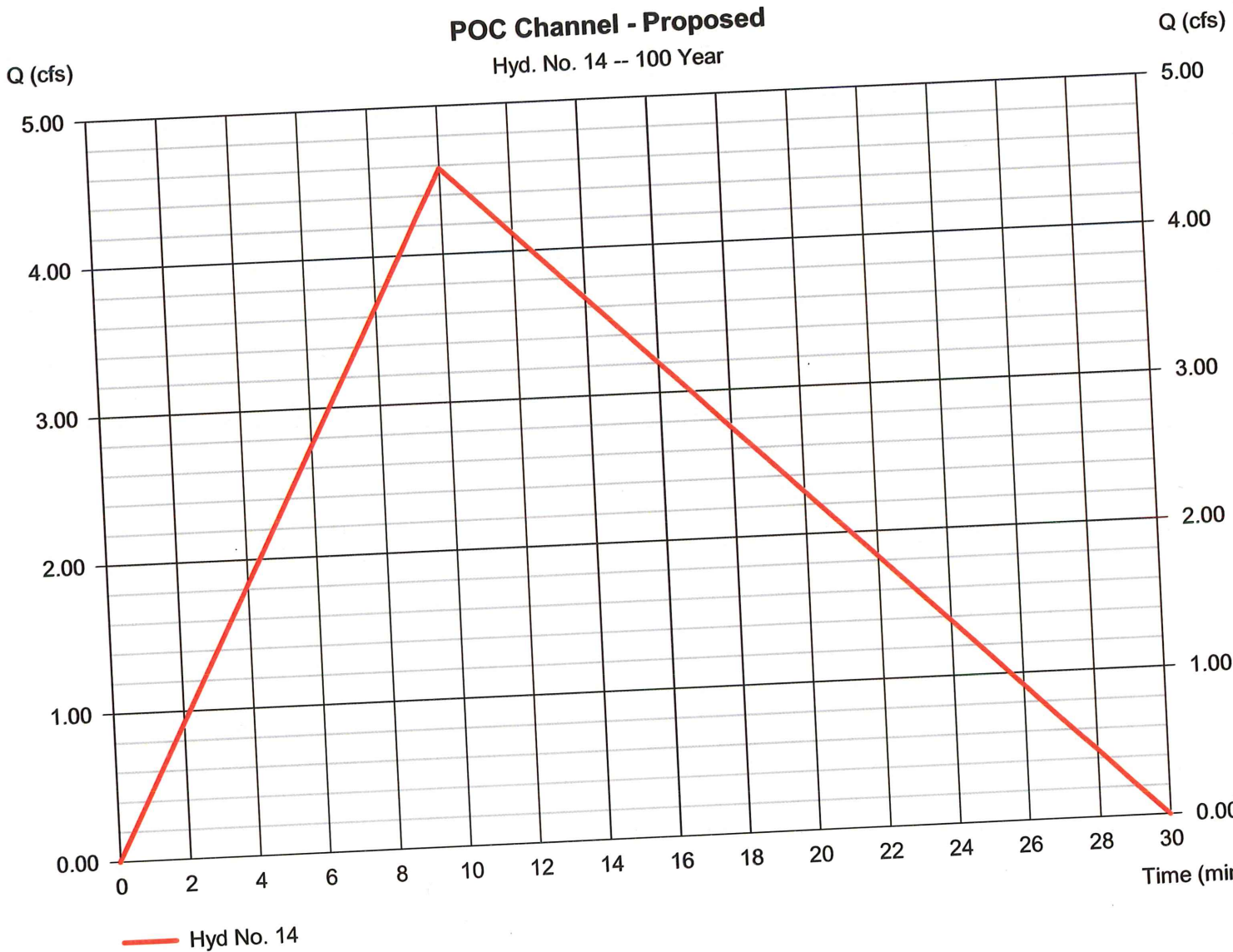
Friday, 07 / 1 / 2016

Hyd. No. 14

POC Channel - Proposed

Hydrograph type = Rational
Storm frequency = 100 yrs
Time interval = 1 min
Drainage area = 1.570 ac
Intensity = 3.740 in/hr
IDF Curve = Northgate Walk.IDF

Peak discharge = 4.580 cfs
Time to peak = 10 min
Hyd. volume = 4,122 cuft
Runoff coeff. = 0.78
Tc by User = 10.00 min
Asc/Rec limb fact = 1/2



Hydrograph Report

Friday, 07/11/2016

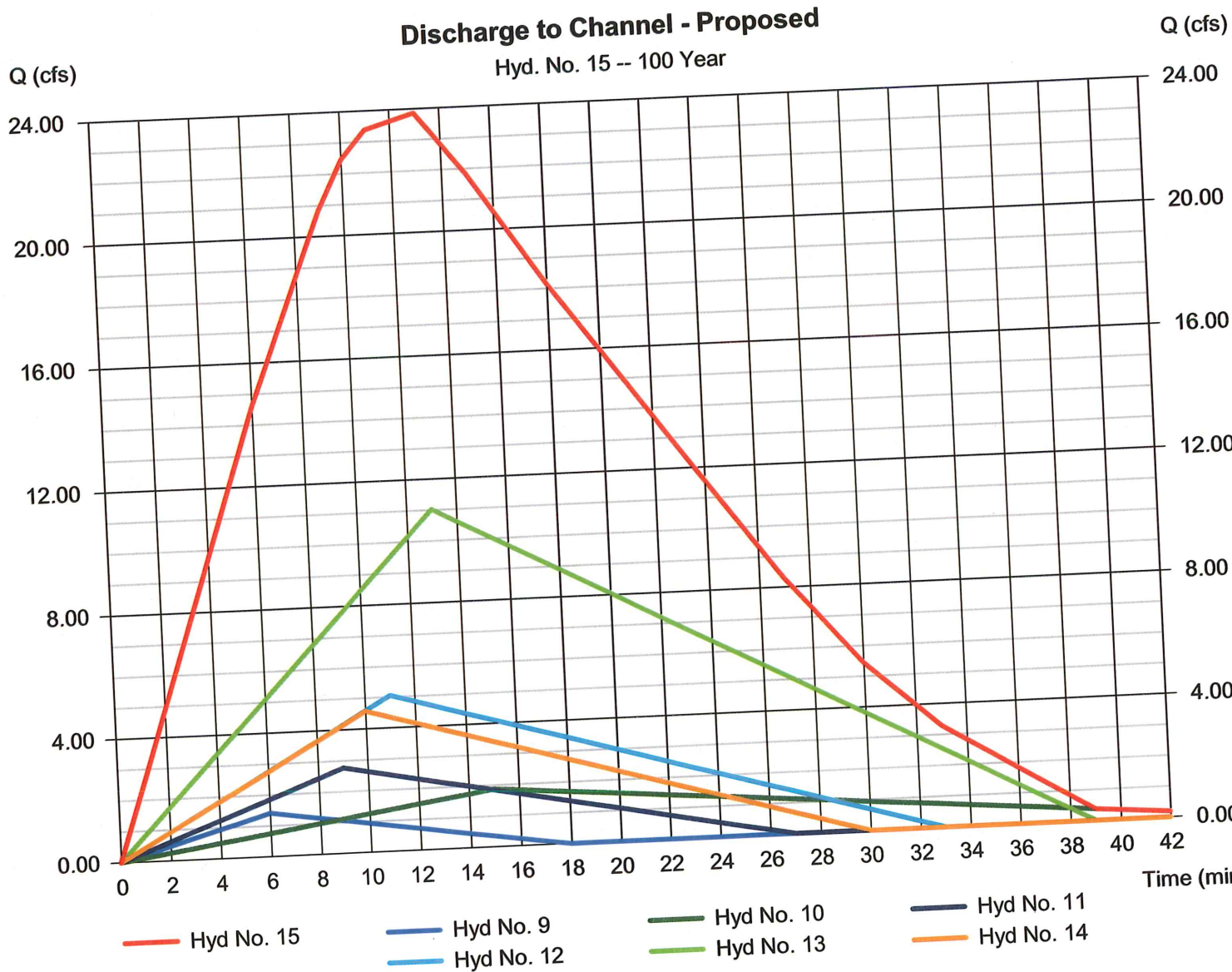
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2014 by Autodesk, Inc. v10.3

Hyd. No. 15

Discharge to Channel - Proposed

Hydrograph type = Combine
 Storm frequency = 100 yrs
 Time interval = 1 min
 Inflow hyds. = 9, 10, 11, 12, 13, 14

Peak discharge = 23.88 cfs
 Time to peak = 13 min
 Hyd. volume = 27,556 cuft
 Contrib. drain. area = 8.730 ac



Hydrograph Report

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

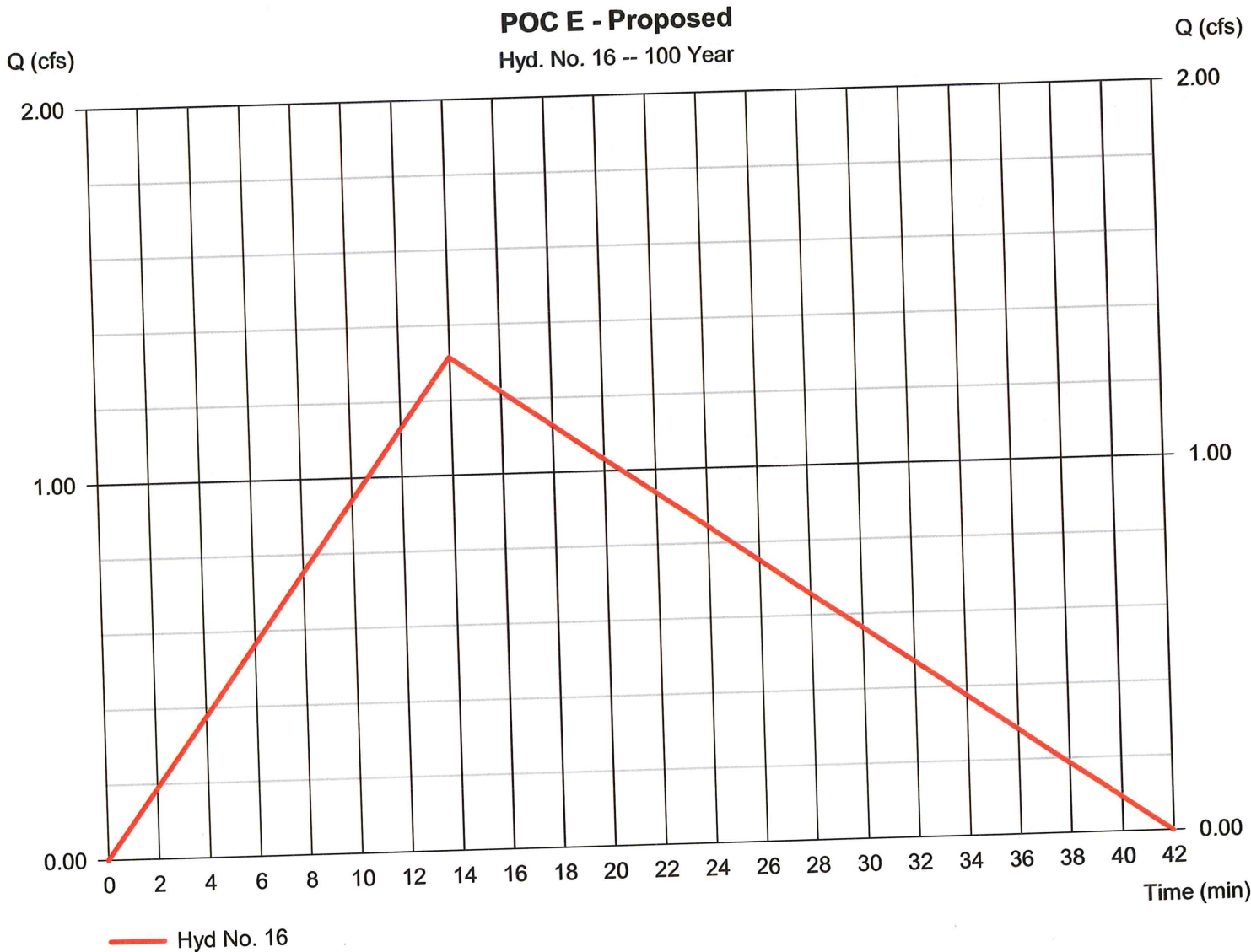
Friday, 07 / 1 / 2016

Hyd. No. 16

POC E - Proposed

Hydrograph type = Rational
 Storm frequency = 100 yrs
 Time interval = 1 min
 Drainage area = 0.550 ac
 Intensity = 3.187 in/hr
 IDF Curve = Northgate Walk.IDF

Peak discharge = 1.315 cfs
 Time to peak = 14 min
 Hyd. volume = 1,657 cuft
 Runoff coeff. = 0.75
 Tc by User = 14.00 min
 Asc/Rec limb fact = 1/2



Hydraflow Rainfall Report

Friday, 07 / 1 / 2016

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

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	-----
2	0.0000	0.0000	0.0000	-----
3	0.0000	0.0000	0.0000	-----
5	0.0000	0.0000	0.0000	-----
10	0.0000	0.0000	0.0000	-----
25	8.8045	0.2000	0.4843	-----
50	0.0000	0.0000	0.0000	-----
100	11.6617	0.3000	0.4876	-----

File name: Northgate Walk.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	3.96	2.86	2.36	2.05	1.84	1.69	1.57	1.47	1.39	1.32	1.26	1.21
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100	5.17	3.74	3.08	2.69	2.41	2.21	2.05	1.92	1.82	1.73	1.65	1.58

Tc = time in minutes. Values may exceed 60.

Precip. file name: Sample.pcp

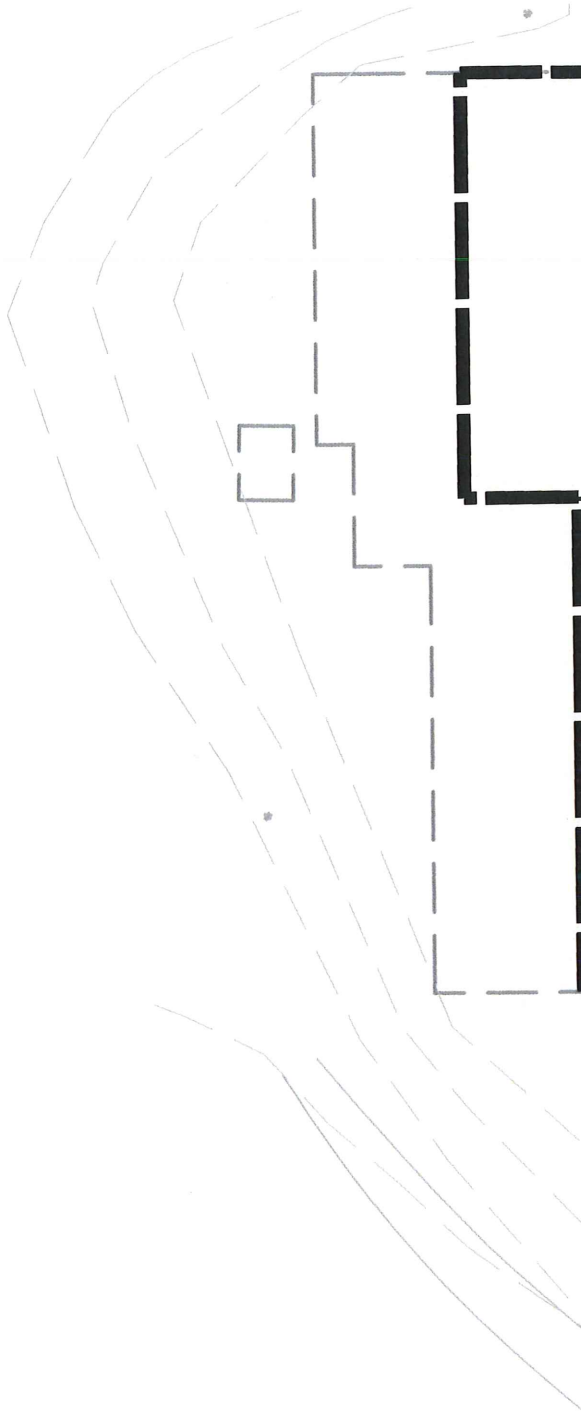
Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	2.20	0.00	3.30	4.25	5.77	6.80	7.95
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	0.00	0.00	4.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	7.10

Appendix 6.4 – Hydrology Maps
H1 – Existing Conditions Hydrology Map
H2 – Proposed Conditions Hydrology Map

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