ENGINEERING REPORT

AP-3 – SURFACE IMPOUNDMENT

PLANT HAMMOND
FLOYD COUNTY, GEORGIA

FOR

Georgia Power

MAY 2021

Stantec

Stantec Consulting Services Inc.
1110 Market Street, Suite 214A Chattanooga, TN 37402
Phone (423) 800-5350, Fax (423) 800-5351

TABLE OF CONTENTS

1. ENGINEERING REPORT

ENGINEERING REPORT

AP-3 – INACTIVE SURFACE IMPOUNDMENT

PLANT HAMMOND
FLOYD COUNTY, GEORGIA

FOR

Georgia Power

NOVEMBER 2018

GEORGIA REGISTERED NO. 028622 PROFESSIONAL ENGINEER JON A. SPARKMAN

11-16-18

Stantec

Stantec Consulting Services Inc.
1110 Market Street, Suite 214A, Chattanooga, TN 37402
Phone (423) 800-5350, Fax (423) 800-5351

TABLE OF CONTENTS

1. INTRODUCTION

The Georgia Environmental Protection Division (EPD) adopted a new Solid Waste Regulation entitled "Rule 391-3-4-.10 Coal Combustion Residuals" (State CCR Rule). This rule, effective November 22, 2016, applies to owners and operators of new and existing coal combustion residuals (CCR) disposal facilities that dispose or otherwise engage in solid waste management of CCR generated from the combustion of coal at electric utilities and independent power producers. The State CCR Rule incorporates by reference the provisions contained in the United States Environmental Protection Agency (USEPA) Title 40 of the Code of Federal Regulations (CFR) §257 (40 CFR §257) (Federal CCR Rule). Per State CCR Rule 391-3-4.10(2)(a), which incorporates the definitions of the different CCR units under the Federal CCR Rule (40 CFR § 257.53), Plant Hammond Ash Pond 3 (AP-3) meets the definition of an inactive CCR surface impoundment.

Georgia Power Company (GPC) completed the closure-in-place of AP-3 in the second quarter of 2018 in accordance with State CCR Rule 391-3-4-.10(7)(b), which incorporates the requirements of the Federal CCR Rule 40 CFR §257.102(d). Closure of AP-3 included dewatering and grading the CCR within AP-3 to promote positive stormwater drainage and installing a geomembrane cover system. AP-3 no longer impounds free water nor receives CCR or other wastestreams. This closure method has eliminated the future impoundment of water, sediment, or slurry.

Under the State CCR Rule, GPC is required to submit the following information to EPD as part of the Permit Application:

(i) Technical data and report showing compliance with 40 CFR 257.100

This Engineering Report provides the technical data and analyses performed to support AP-3 closure.

A. BACKGROUND

AP-3 was commissioned in 1977 to store CCR generated at Plant Hammond. The original 25-acre unit was designed with a maximum clay embankment height of 28 feet. The unit was placed into operation in June 1977. In the early 1980s, AP-3 was converted into a dry ash disposal area, and in the early 1990s the pond stopped receiving CCR materials.

Geomembrane cap installation began in 2016 and was completed in Q2 2018. Construction activities included grading the existing CCR slopes to drain and installing a final cover system. The cover system consisted of a 60 mil High Density Polyethylene (HDPE) liner, geocomposite drainage media, a minimum 18-inch protective soil cover, and a 6-inch vegetative layer. The final configuration does not impound free water and includes three stormwater outfalls and a surge pond for stormwater management.

2. STORMWATER DRAINAGE SYSTEM

Southern Company Services completed stormwater calculations for GPC for the closed-in-place configuration of AP-3. The only inflow to AP-3 is rainfall that is conveyed through surface ditches. The process flows to the unit from the plant have ceased and the spillways have been closed. The closed-in-place condition of AP-3 can accommodate the 25-year, 24-hour storm event. The stormwater drainage analyses are documented in the calculation *Stormwater Calculations for Ash Pond 3 Closure*, which is provided in Appendix A. Within this calculation package the site is divided into basins and inflow calculations are presented for each basin.

3. SLOPE STABILITY ANALYSES

Stantec Consulting Services Inc. (Stantec) completed slope stability calculations for the closed configuration of AP-3. These analyses are documented in the report *Slope Stability and Settlement Analysis* dated October 30, 2018. This report is provided in Appendix B. Within this calculation package, material strength properties, analysis methodologies, design criteria, and safety factor calculations are presented. The critical cross section for AP-3 slope stability analysis is in the northeast corner of the unit.

Table 1 lists the factors of safety for various slope stability loading conditions modeling the closure condition from *Slope Stability and Settlement Analysis*. The calculated factors of safety meet or exceed the target factor of safety for the analyzed conditions.

Table 1 Slope Stability Analysis Results

Loading Condition	Required Minimum Factor of Safety	Calculated Factor of Safety
Long Term (Drained)	1.5	2.2
Pseudo-static	1.0	1.2
Post-Earthquake	1.2	2.2

Sudden drawdown stability analyses were not performed for the upstream or downstream slopes of AP-3. No free water is maintained within the unit; therefore, sudden drawdown conditions are not possible on the upstream dike slopes. A portion of the downstream slope in the northeastern corner of the AP-3 embankment may be subject to inundation from the 100-year flood of the Coosa River. The downstream slopes are well vegetated and have not been impacted from past floods. The FEMA base flood elevation is Elevation 586 feet, and the top of the dike was constructed to approximate Elevation 608 feet. Approximately 5 feet of the exterior slope is inundated by the 100-year flood event. The northeastern corner of AP-3 is approximately 3,000 feet from the floodway of the Coosa River. As such, AP-3 is not subject to significant erosion velocities from the floodway of the Coosa River.

4. FINAL COVER ANALYSES

The geomembrane cap system installed during closure of AP-3 is described in Section 1.A. This system was designed to satisfy the requirements of 40 CFR 257.102(d)(3) of the Federal CCR Rule.

A. GEOCOMPOSITE DRAINAGE MEDIA SIZING

Stantec completed a geocomposite drainage media sizing calculation for the closed configuration of AP-3. This analysis is documented in the report *Geocomposite Drainage Media Sizing* dated November 12, 2018. This report is provided in Appendix C. Within this calculation package, material properties, analysis methodologies, design criteria, and the required minimum transmissivity of the geocomposite drainage layer calculation are presented.

The purpose of this calculation is to determine the size of the geocomposite drainage media needed to convey the anticipated infiltration through the cover soil. This sizing analysis concluded that the installed geocomposite drainage media is adequate to convey the anticipated infiltration through the cover soil.

B. VENEER STABILITY ANALYSIS

Stantec completed a veneer stability calculation for the closed configuration of AP-3. This analysis is documented in the report *Final Cover Veneer Stability Analyses* dated November 12, 2018. This report is provided in Appendix D. Within this calculation package, material properties, analysis methodologies, design criteria, and veneer stability calculations are presented.

The purpose of this calculation is to verify the interface shear strength properties from laboratory results of the installed geomembrane cap system meet the required factors of safety. The laboratory results are provided in Appendix D. Table 2 lists the factors of safety for various veneer stability loading conditions. The calculated factors of safety meet or exceed the target factors of safety for the analyzed conditions.

Table 2 Veneer Stability Analysis Results

Loading Condition	Required Minimum Factor of Safety	Calculated Factor of Safety
Static, Drained	1.5	22.35
Static, Saturated	1.1	22.27
Seismic	1.0	2.51
Static Residual	1.1	21.51

C. SETTLEMENT ANALYSIS

Stantec completed a settlement analysis for the closed configuration of AP-3. This analysis is documented in the report *Slope Stability and Settlement Analysis*, dated October 30, 2018. This report is provided in Appendix B. Within this calculation package, material properties, analysis methodologies, design criteria, and settlement analyses are presented.

It was estimated that the maximum total settlement is approximately 6.5 inches. This differential settlement over a length of 350 feet results in a change in slope of 0.15%, which would not prevent positive drainage of the cap system. This simplified differential settlement case would result in a minimal change in liner length, <0.01% strain, which is less than the maximum allowable strain of 4%.

APPENDICES

A. STORMWATER CALCULATIONS

SOUTHERN COMPANY

Engineering and Construction Services Calculation

Calculation Number:
DC-HM-HAM15015-001-Rev1

Project/Plant: Plant Hammond	**Unit(s):** N/A	**Discipline/Area:** Civil
Title/Subject: Stormwater Calculations for Ash Pond 3 Closure		
Purpose/Objective: Design Stormwater Conveyance Systems for Closure and Analyze Pre/Post Runoff Conditions.		
System or Equipment Tag Numbers: N/A	**Originator:** Curtis R. Upchurch	

Contents

Revision Record

Rev. No.	Description	Originator Initial / Date	Reviewer Initial / Date	Approver Initial / Date
0	Original Issue	CRU 12/9/17	RVR 1/12/18	RCB 1/17/18
1	Revised	CRU 11/14/18	THB 11/14/18	SSS 11/14/18

Notes:

GEORGIA REGISTERED No. PE37298 PROFESSIONAL ENGINEER THOMAS H. BORDELON

11/14/18

Purpose of Calculation

The purpose of the following calculations is to provide design for the final conveyance systems for stormwater runoff from the Ash Pond 3, Boiler Cleaning Waste Basin area, and overall drainage basins. Pre- and post-development peak discharge analysis is also included in this report.

Overview

Ash Pond 3 is located on GPC property northwest of the Plant bordering Georgia State Highway 20 to the north, Norfolk Southern rail lines on the east and south and Pisgah Church property on its western boundary. It is an inactive 25 acre surface impoundment constructed in 1973/74 scheduled to begin closure in 2016 in accordance with the EPA's final Coal Combustion Residuals (CCR) Rule. During construction, all ash contact water shall be pumped to Ash Pond #1 from sumps in Ash Pond 3. Hydrology/hydraulics for the sumps and pumps systems is addressed in a separate set of calculations. Pre- and post-development peak runoff conditions have been analyzed with the results listed in the "Summary of Conclusions" below.

Note that the area to the west of Ash Pond 3 (Pisgah Church property) has undergone improvements in the past 10 years increasing impervious surfaces by paving/parking lot additions as well as construction of new buildings. It is not known if reductions of peak runoff rates were addressed as detention structures or ponds do not appear visible on photos or topographic maps. Closure construction for this project does not include any work in this drainage basin, however the hydraulics of this area have been included in the following report.

Final drainage patterns for Ash Pond 3 have been directed in both north and south directions similar to that prior to pond construction with rip rap lined outfall channels excavated thru the pond dikes. The southern portion is directed into an area noted as the Surge Pond which has been graded to provide some additional detention for the peak runoff flows. Areas to the north have been directed to the Georgia Highway 20 side ditch and to an existing 18 inch reinforced concrete pipe under the Norfolk Southern railroad to the east with discharge into Cabin Creek. In addition, a new 18" diameter storm culvert is proposed to be installed (jack-and-bored) under the railroad tracks to maintain the current stormwater levels in the highway side ditch. Additional detention will be provided at the southwest corner of the site (Drainage Basin E) to reduce peak stormwater runoff from the developed site. At completion of closure construction, all pipes and ditches will be thoroughly cleaned to assure the needed capacities are available.

Summary of Conclusions

(See attached printouts for additional information)

Pre and Post-Development Peak Flow Rates at discharge points (Flows at discharge of pipes):

Basin	Return Storm (yr-24hr)	Pre-Development Peak Flow, cfs	Post-Development Peak Flow, cfs
A,B,C & E (Pre)	25	42.0	21.6 (41.9)*
A,B,C,D & E (Post)	50	44.2	29.4 (44.2)*
	100	46.0	39.1 (46.0)*

*Prior to adding detention

Basin	Return Storm (yr-24hr)	Pre-Development Peak Flow, cfs	Post-Development Peak Flow, cfs
H & J (Pre)	25	31.2	66.5
G,H & J (Post)	50	40.9	71.5
	100	49.6	75.7

Basin	Return Storm (yr-24hr)	Pre-Development Peak Flow, cfs	
J' (Pre)	25	6.8	Combined with above
F & J' (Post)	50	8.5	
	100	10.2	

Basin	Return Storm (yr-24hr)	Pre-Development Peak Flow, cfs	Post-Development Peak Flow, cfs
K,K',K"	25	8.5	6.5
	50	8.9	7.1
	100	9.2	7.7

Basin	Return Storm (yr-24hr)	Pre-Development Peak Flow, cfs	Post-Development Peak Flow, cfs
L	25	4.4	4.1
	50	5.5	5.1
	100	6.6	6.2

All Basins	Return Storm, (yr-24hr)	Pre-Development Peak Flow, cfs	Post-Development Peak Flow, cfs
Sum of above	25	92.9	98.7
Discharges	50	108.0	113.1
	100	121.6	128.7

Water Surface Elevations at Peak Flow Rates

Basin	Return Storm (yr-24hr)	Pre-Development WSEL(ft-MSL)	Post-Development WSEL(ft-MSL)
C (Pre)	25	582.1	582.2
C & D (Post)	50	582.2	582.4
	100	582.3	582.7

Basin	Return Storm (yr-24hr)	Pre-Development WSEL(ft-MSL)	Post-Development WSEL(ft-MSL)
A,B,C & E (Pre)	25	581.2	582.1
A,B,C,D, & E (Post)	50	581.8	582.3
	100	582.2	582.5

Basin	Return Storm (yr-24hr)	Pre-Development WSEL(ft-MSL)	Post-Development WSEL(ft-MSL)
H & J Pre)	25	580.3	580.3
G,H & J (Post)	50	580.9	581.0
	100	582.0	581.6

Basin	Return Storm (yr-24hr)	Pre-Development WSEL(ft-MSL)	Post-Development WSEL(ft-MSL)
J' (Pre)	25	580.3	580.3
F & J' (Post)	50	581.0	581.0
	100	581.6	581.6

Basin(s)	Return Storm (yr-24hr)	Pre-Development WSEL(ft-MSL)	Post-Development WSEL(ft-MSL)
K,K',K"	25	582.7	582.3
	50	583.0	582.6
	100	583.2	582.9

As previously noted, recent improvements to the Pisgah Church basin (H Basin) west of Ash Pond 3 have resulted in an increase in stormwater runoff volumes and peak flow rates. Calculations show that the 24 inch corrugated metal pipe in the Georgia Hwy. 20 side ditch at the AP3 NW access drive is currently undersized with peak flows from the basin overtopping into the existing concrete paved channel (C/D Basin) to the west of AP 3 and discharging into an existing detention area southwest of Ash Pond 3 designated as a Surge Pond. For this project, the Surge Pond area is being excavated to accommodate additional detention storage. The drainage ditch downstream of the Surge Pond will also be enlarged to provide additional detention. The above calculations assume that the area H peak flow rate is passed thru the side drain pipe which may be removed or replaced with a larger size pipe in the future. For this project, storage in the Surge Pond area (C Basin) is sufficient to accommodate the overtopping volumes from H Basin as well as additional volume from the D Basin. The capacity of the concrete paved channel is sufficient to convey the overtopping flows as well.

See attached calculations for ditch lining and drainage structure designs.

Methodology

NRCS soils data was used to determine the soil characteristics and hydrological soil groups. Ash Pond 3 will be covered with an HDPE liner overlain with a geo-composite drainage layer, an 18 inch protective soil layer and 6 inches of topsoil. The boiler basin area will be covered with an 18 inch clay layer and minimum of 6 inches of topsoil. SCS curve numbers were assigned to these areas as well as the other cover conditions for the basins. Soils for this site are listed as silty to sandy loams with a hydrologic soil group of B. Cover soil will be hauled from an off-site borrow pit approximately 1 mile west of the site just north of Georgia State Highway 20. Soils from this area are listed as type B soils as well. In addition, the existing dikes on the north half of the ash pond will be reduced in height and the material removed and used on site. See attached NRCS soil maps and soil unit data of the project site and borrow pit. The following curve numbers were used in the calculations:

Surface Condition	CN
Grassed	60
Wooded	55
Aggregate Surfaced	85
Paved	98
Buildings/Roof	98
Railroad	65
Grassed (Ash Pond Cover)	77*

*Clayey material was used for cover of the cap surface. This was confirmed by infiltrometer testing of the Ash Pond cap surface (see reference no. 10). Infiltration of cap cover approaches type D soil.

Storm basin calculation data was determined from the existing topography and from the Urban Hydrology for Small Watersheds Manual (TR-55). This site is located in a Type II Rainfall Distribution. 24-hour precipitation values were taken from NOAA Atlas 14 and are as follows:

Return Storm	Precipitation
2-year:	3.82 inches
10-year:	5.32 inches
25-year:	6.30 inches
50-year:	7.07 inches
100-year:	7.86 inches

Drainage basins contributing flow to discharges in the project area were modeled using Hydraflow Hydrograph software. Pre and Post-Development flows were calculated as noted in above results section and the hydrograph flows for culverts were then input into Hydraflow Express to calculate the pipe performance. Ash Pond perimeter ditches, diversion swales on the cap, discharge ditches and the CS4'x2' box culvert were designed using the rational method's peak flow rates.

Assumptions/Criteria

1. Storm Drainage Design C-7-2, Southern Company Services Engineering Standards and Guidelines Civil, Current Revision.
2. Assumptions listed on calculation sheets attached.

Design Inputs/References

1. AutoCAD Civil 3D, 2013 Autodesk, Inc.
2. NOAA Atlas 14, Volume 9, Version 2 for Rome, Georgia.
3. TR-55 – Urban Hydrology for Small Watersheds, Appendix B, National Resources Conservation Service, Conservation Engineering Division, 1986.
4. Hydraflow Hydrographs Extension for AutoCAD Civil 3D, 2013, V10 Autodesk, Inc.
5. Hydraflow Express Extension for AutoCAD Civil 3D, 2013, Autodesk, Inc.
6. Natural Resource Conservation Service (NRCS) Web Soil Survey, Site Soil and Hydrologic Information
7. Plant Hammond Ash Pond 3 Closure Project Construction Plans, 2016-Present.
8. Plant Hammond Topographic Survey Lidar by Metro Engineering and Survey Co. 2012.
9. Plant Hammond Surveys by Georgia Land Department and SCS Civil Field Services, 2015
10. Double Ring Infiltrometer Testing, Terrracon Consultants, Inc., November 5, 2018.

Body of Calculation

(See attached calculations and software output)

Attachments

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Closure	RVR/CRU	11/14/18
Subject/Title **Erosion Control/Storm Water Management Calculations for the Closure of Ash Pond 3**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-001 Rev 1	Sheet 1 of 13

Ash Pond #3 Ditch Lining, Storm Pipe & Tc Calculations

Rational Method Equation

The Rational equation was used to determine peak discharge from drainage basin runoff.

Rational Equation: Q=ciA
The Rational equation requires the following units:
Q = Peak discharge, cfs
c = Rational method runoff coefficient
i = Rainfall intensity, inch/hour
A = Drainage area, acre

Intensity = B / (Tc + D) ^ E
Use 5 minute time of concentration for more conservative estimation.

From Hammond IDF curves – 25 year storm i = 8.29 inches/hour
100 year storm i = 9.90 inches/hour
Runoff Coefficients used:

c =0.40 (Grassed - Good condition with 6" topsoil & type D cover soil)

c=0.30 (Grassed – Good Condition)

FB_{100} = Ditch freeboard 100year storm (Shown for all ditches on/leaving closed ash pond)

DITCH CALCULATIONS:

Area D (Ash Pond 3 South)

Ditch D-1 @ N 1,550,546 , E 1,942,779
3' F.B. Ditch @ 1.00%, 3' depth
Area = 4.24 Ac, c = 0.40
Q_{25} = (0.40)(8.29)(4.24) = 14.06 cfs
Q_{100} = (0.40)(9.90)(4.24) = 16.79 cfs
V_{25} = 1.73 fps, FB_{100} = 1.59'
See Channel Report for results

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Closure	RVR/CRU	11/14/18
Subject/Title **Erosion Control/Storm Water Management Calculations for the Closure of Ash Pond 3**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-001 Rev 1	Sheet 2 of 13

Ditch D-1A @ N 1,550,162 ; E 1,942,110
3' F.B. Ditch @ 2.10%, 3' depth
Area = 4.24 Ac, c = 0.40
Q_{25} = (0.40)(8.29)(4.24) = 14.06 cfs
Q_{100} = (0.40)(9.90)(4.24) = 16.79 cfs
V_{25} = 2.28 fps, FB_{100}= 1.82'
See Channel Report for results

Ditch D-2 @ 1,550,690 ; E 1,942,053
3' F.B. Ditch @ 1.00%, 3' depth
Area = 3.11 Ac, c = 0.40
Q_{25} = (0.40)(8.29)(3.11) = 10.31 cfs
Q_{100} = (0.40)(9.90)(3.11) = 12.32 cfs
V_{25} = 1.59 fps, FB_{100}= 1.78'
See Channel Report for results

Ditch D-3 @ N 1,550,428 ; E 1,942,016
3' F.B. Ditch @ 1.10%, 3' depth
Area = 3.98 Ac, c = 0.40
Q_{25} = (0.40)(8.29)(3.98) = 13.20 cfs
Q_{100} = (0.40)(9.90)(3.98) = 15.76 cfs
V_{25} = 1.77 fps, FB_{100}= 1.66'
See Channel Report for results

Ditch D-4 @ N 1 ,550,287, E 1,942,015
6' F.B. Ditch @ 5.00%, 3' depth
Q_{25} = D1A+D3 = 14.06+13.20 = 27.26 cfs
Q_{100} = D1A+D3 = 16.79+15.76 = 32.55 cfs
V_{25} = 3.52 fps, FB_{100}= 1.98'

Ditch D-5 @ N 1,550,254, E 1,941,901
6' F.B. Ditch @ 25.00%, 2' depth
Q_{25} = D1A+D3 = 14.06+13.20 = 27.26 cfs
Q_{100} = D1A+D3 = 16.79+15.76 = 32.55 cfs
V_{25} = 6.06 fps, FB_{100}= 1.34'

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Closure	RVR/CRU	11/14/18
Subject/Title **Erosion Control/Storm Water Management Calculations for the Closure of Ash Pond 3**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-001 Rev 1	Sheet 3 of 13

Ditch D-6 @ N 1,550,245, E 1,941,869

6' F.B. Ditch @ 5.00%, 3' depth

Q_{25} = D1A+D3 = 14.06+13.20 = 27.26 cfs

Q_{100} = D1A+D3 = 16.79+15.76 = 32.55 cfs

V_{25} = 3.52 fps, FB_{100}= 1.98'

Area F (Ash Pond 3 Northeast)

Ditch F-1 @ 1,550,548 ; E 1,942,777

3' F.B. Ditch @ 1.00%, 3' depth

Area = 8.62 Ac, c = 0.40

Q_{25} = (0.40)(8.29)(8.62) = 28.58 cfs

Q_{100} = (0.40)(9.90)(8.62) = 34.14 cfs

V_{25} = 2.10 fps, FB_{100}= 1.03'

See Channel Report for results

Ditch F-2 @ N 1,551,503 ; E 1,942,496

3' F.B. Ditch @ 5.37%, 3' depth

Area = 0.63 Ac, c = 0.40

Q_{25} = (0.40)(8.29)(0.63) = 2.09 cfs

Q_{100} = (0.40)(9.90)(0.63) = 2.49 cfs

V_{25} = 1.79 fps, FB_{100}= 2.66'

See Channel Report for results

Ditch F-3 @ N 1,551,517 ; E 1,942,670

4' F.B. Ditch @ 1.00%, 3' depth

Q_{25} = F1 + F2 = 28.58 + 2.09 = 30.67 cfs

Q_{100} = F1 + F2 = 34.14 + 2.49 = 36.63 cfs

V_{25} = 3.02 fps, FB_{100}= 1.26'

See Channel Report for results

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Closure	RVR/CRU	11/14/18
Subject/Title **Erosion Control/Storm Water Management Calculations for the Closure of Ash Pond 3**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-001 Rev 1	Sheet 4 of 13

Ditch F-4 @ N 1,551,579 ; E 1,942,697
4' F.B. Ditch @ 32.50%, 1.25' depth
Q_{25} = F1 + F2 = 28.58 + 2.09 = 30.67 cfs
Q_{100} = F1 + F2 = 34.14 + 2.49 = 36.63 cfs
V_{25} = 7.34 fps, FB_{100}= 0.46'
See Channel Report for results

Ditch F-5 @ N 1,551,612 ; E 1,942,713
4' F.B. Ditch @ 1.00%, 2.0' depth
Q_{25} = F1 + F2 = 28.58 + 2.09 = 30.67 cfs
Q_{100} = F1 + F2 = 34.14 + 2.49 = 36.63 cfs
V_{25} = 3.48 fps, FB_{100}= 0.65'
See Channel Report for results

Ditch F-6 @ N 1,551,640 ; E 1,942,725
4' F.B. Ditch @ 4%, 2' depth
Q_{25} = (F1 + F2)/2 = (28.58 + 2.09)/2 = 15.34 cfs
Q_{100} = (F1 + F2)/2 = (34.14 + 2.49)/2 = 18.32 cfs
V_{25} = 1.80 fps, FB_{100}= 1.44'
See Channel Report for results

Ditch F-7 @ N 1,551,640 ; E 1,942,725
6' F.B. Ditch @ 1.00%, 1.5' depth
Q_{25} = (F1 + F2)/2 = (28.58 + 2.09)/2 = 15.34 cfs
Q_{100} = (F1 + F2)/2 = (34.14 + 2.49)/2 = 18.32 cfs
V_{25} = 1.69 fps, FB_{100}= 0.34'
See Channel Report for results

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Closure	RVR/CRU	11/14/18
Subject/Title **Erosion Control/Storm Water Management Calculations for the Closure of Ash Pond 3**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-001 Rev 1	Sheet 5 of 13

Area G (Ash Pond 3 Northwest)

Ditch G-1 @ N 1,551,503 ; E 1,942,496
3' F.B. Ditch @ 1.00%, 3' depth
Area = 1.86 Ac, c = 0.40
Q_{25} = (0.40)(8.29)(1.86) = 6.17 cfs
Q_{100} = (0.40)(9.90)(1.86) = 7.37 cfs
V_{25} = 1.39 fps, FB_{100}= 2.06'
See Channel Report for results

Ditch G-2 @ N 1,550,820 ; E 1,942,070
3' F.B. Ditch @ 1.09%, 3' depth
Area = 3.43 Ac, c = 0.40
Q_{25} = (0.40)(8.29)(3.43) = 11.37 cfs
Q_{100} = (0.40)(9.90)(3.43) = 13.58 cfs
V_{25} = 1.68 fps, FB_{100}= 1.75'
See Channel Report for results

Ditch G-3 @ N 1,551,303 ; E 1,942,111
6' F.B. Ditch @ 5.50%, 1.5' depth
Q_{25} = G1 + G2 = 6.17 + 11.37 = 17.54 cfs
Q_{100} = G1 + G2 = 7.37 + 13.58 = 20.95 cfs
V_{25} = 3.18 fps, FB_{100}= 0.72'
See Channel Report for results

Ditch G-4 @ N 1,551,366 ; E 1,942,040
6' F.B. Ditch @ 25.00%, 1' depth
Q_{25} = G1 + G2 = 6.17 + 11.37 = 17.54 cfs
Q_{100} = G1 + G2 = 7.37 + 13.58 = 20.95 cfs
V_{25} = 5.33 fps, FB_{100}= 0.49'
See Channel Report for results

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Closure	RVR/CRU	11/14/18
Subject/Title **Erosion Control/Storm Water Management Calculations for the Closure of Ash Pond 3**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-001 Rev 1	Sheet 6 of 13

Ditch G-5 @ N 1,581,391 ; E 1,942,013

6' F.B. Ditch @ 3.00%, 1.5' depth
Q_{25} = G1 + G2 = 6.17 + 11.37 = 17.54 cfs
Q_{100} = G1 + G2 = 7.37 + 13.58 = 20.95 cfs
V_{25} = 2.58 fps, FB_{100}= 0.57'
See Channel Report for results

Area K (Boiler Ponds)
C=0.30 (Grassed)

Ditch K-1 @ N 1,550,001 ; E 1,942,362 – North side

5' F.B. Ditch @ 0.30%, 2' depth
Area = 3.39 Ac, c = 0.30
Q_{25} = (0.30)(8.29)(4.21) = 10.47 cfs
Q_{100} = (0.30)(9.90)(4.21) = 12.50 cfs
V_{25} = 1.73 fps
See Channel Report for results
(Note:Actual flow rate reduced due to 12" cmp restriction from K')

Ditch K-1 @ N 1,550,547 ; E 1,942,968 – North side

5' F.B. Ditch @ 0.30%, 2' depth
Area = 3.39 Ac, c = 0.30
Q_{25} = (0.30)(8.29)(5.92) = 14.72 cfs
Q_{100} = (0.30)(9.90)(5.92) = 17.58 cfs
V_{25} = 1.90 fps
See Channel Report for results
(Note:Actual flow rate reduced due to 12" cmp restrictions from K'& K'')

Ditch K-2 @ N 1,549,982 ; E 1,942,377 – South side

5' F.B. Ditch @ 0.30%, 2' depth
Area = 4.17 Ac, c = 0.30
Q_{25} = (0.30)(8.29)(4.17) = 10.37 cfs
Q_{100} = (0.30)(9.90)(4.17) = 12.38 cfs
V_{25} = 1.71 fps
See Channel Report for results

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Closure	RVR/CRU	11/14/18
Subject/Title **Erosion Control/Storm Water Management Calculations for the Closure of Ash Pond 3**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-001 Rev 1	Sheet 7 of 13

Ash Pond Cap Diversion Swales

Diversion Swale – Largest Drainage Area (Worst Case)

Swale with 33:1 & 3:1 slopes @ 1.00%, 2' depth
Area = 2.0 Ac, c = 0.40
Q_{25} = (0.40)(8.29)(2.0) = 6.63 cfs
Q_{100} = (0.40)(9.90)(2.0) = 7.92 cfs
V_{25} = 1.80 fps, FB_{100}= 1.52'
See Channel Report for results

PIPE CULVERTS

Runoff flows (Q) for pipes calculated using Hydraflow Express Extension for AutoCad Civil 3D 2013 by Autodesk, Inc. Flow rates are from Hydraflow Hydrographs with peak flow rates and hydrograph numbers as listed with exception of new box CS4'x2' box culvert where Rational Method Peak flow is listed.

Existing Pipe in Highway 20 Side Ditch (Pipe under NW Entrance Rd.)
@ N 1,551,368 ; N 1,941,869

24" CMP @ 0.50%, 68' long
Runoff from Pisgah Church property

Pre & Post-Development
Basin (Hyd. No. 12 Pre-Dev., Hyd. No. 14 Post-Dev.)
Q_{25} = 25.24 cfs
Q_{50} = 30.87 cfs
Q_{100} = 36.81 cfs
Pipe Flow* (Overtopping to C Basin)
Q_{25} = 16.0 cfs, Qo.t. = 25.24 – 16.0 = 9.24 cfs
Q_{50} = 16.0 cfs, Qo.t. = 30.87 – 16.0 = 14.87 cfs
Q_{100} = 16.0 cfs, Qo.t. = 36.81 – 16.0 = 20.81 cfs

V_{25} = 5.6 fps
See Culvert Report for results
*Overtops to C Basin's Surge Pond Detention Area at HW EL. 584.5+/- via 3' wide flume with full capacity at 15.4 cfs. - O.K. for Q_{25} and Q_{50}.

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Closure	RVR/CRU	11/14/18
Subject/Title **Erosion Control/Storm Water Management Calculations for the Closure of Ash Pond 3**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-001 Rev 1	Sheet 8 of 13

Pipes at NE area Ash Pond 3 will overtop high point at toe of ash pond and will combine to discharge:

Existing Pipe Under Railroad/Hwy 20 side ditch
@ N 1,551,813 ; E 1,942,775

24 " RCP @ 1.06% , 77.3' long*
Runoff from Pisgah Church and Ash Pond 3 (North end)

Pre-Development:
Basin (Hyd. No. 15)
Q_{25} = 33.48 cfs
Q_{50} = 41.30 cfs
Q_{100} = 49.58 cfs
Pipes (Hyd. No. 16)
Q_{25} = 31.24 cfs, HW EL. 580.3
Q_{50} = 40.90 cfs, HW EL. 580.9
Q_{100} = 49.58 cfs, HW EL. 581.0**

Post-Development:
Basin (Hyd. No. 23)
Q_{25} = 87.29 cfs
Q_{50} = 104.60 cfs
Q_{100} = 122.71 cfs**

Post-Development:
Pipe (Hyd. No. 24) Exist. 24" RCP
Q_{25} =31.2 cfs
Q_{50} =33.3 cfs
Q_{100} = 35.2 cfs**
V_{25} = 10.04 fps (Pre-Dev.)
V_{25} = 10.02 fps (Post-Dev.)
See Culvert Report for results

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Closure	RVR/CRU	11/14/18
Subject/Title **Erosion Control/Storm Water Management Calculations for the Closure of Ash Pond 3**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-001 Rev 1	Sheet 9 of 13

Existing Pipe Northeast of AP#3 @ N 1,551,703 ; E 1,942,802 Under Railroad

18 " RCP @ 1.5% , 55' long*

Runoff from NE area Ash Pond 3

Pre-Development:

Basin (Hyd. No. 25)

Q_{25} = 6.80 cfs

Q_{50} = 8.46 cfs

Q_{100} = 10.22 cfs

Pipe (Hyd. No. 25)

Q_{25} = 6.80 cfs

Q_{50} = 8.46 cfs

Q_{100} = 10.22 cfs**

Post-Development:

Basin (Hyd. No. 23)

Q_{25} = 87.29 cfs

Q_{50} = 104.60 cfs

Q_{100} = 122.71 cfs

Pipe (Hyd. No. 24) Exist. 18" RCP

Q_{25} =16.8 cfs

Q_{50} =18.4 cfs

Q_{100} = 19.6 cfs**

V_{25} = 4.31 fps (Pre-Dev.)

V_{25} = 9.56 fps (Post-Dev.)

See Culvert Report for results

Rip rap apron. Pipe to be cleaned and silt removed.

See Culvert Report for results

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Closure	RVR/CRU	11/14/18
Subject/Title **Erosion Control/Storm Water Management Calculations for the Closure of Ash Pond 3**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-001 Rev 1	Sheet 10 of 13

New Pipe Northeast of AP#3 @ N 1,551,728 ; E 1,942,802 Under Railroad

18 " RCP @ 1.0% , 60' long*
Runoff from NE area of Ash Pond 3

Post-Development:
Basin (Hyd. No. 23)
Q_{25} = 87.29 cfs
Q_{50} = 104.60 cfs
Q_{100} = 122.71 cfs

Pipe (Hyd. No. 24) New 18" RCP***
Q_{25} =18.5 cfs
Q_{50} =19.8 cfs
Q_{100} = 21.0 cfs, HW/D=3.0**
V_{25} = 10.50 fps (Post-Dev.)
Rip Rap Outlet, La=32', Do =31', D_{50} = 0.5, Use NSA R4 - or rip rap lined ditch to outfall.
See Culvert Report for results

*Pipes at NE area Ash Pond 3 will combine to convey the total flows at the outfall:

Pipe Flows (Hyd. No. 24)
Q_{25} = 66.47 cfs, HW EL. 580.3
Q_{50} = 71.49 cfs, HW EL. 581.0
Q_{100} = 75.75 cfs, HW EL. 581.6**

**Note 100 yr. FEMA flood elevation for the Coosa River is EL. 586+/- which will affect downstream water levels of the pipes listed above. Pipe results for the 100 year storm are only valid for a localized storm event.

***New storm culvert under Norfolk Southern (NS) RR track minimum size is 18" diameter and is subject to approval by the NS. Pipe casings/sizes for culvert may be altered due to railway regulations and future permit requirements.

New 4'x2' Box Culvert @ N 1,551,488 , E 1,942,656

4'x2' Culvert @ 0.50%, 30' long
Q_{25} = F1 + F2 = 28.58 + 2.09 = 30.67 cfs
Q_{100} = F1 + F2 = 34.14 + 2.49 = 36.63 cfs
V_{25} = 4.76 fps, HW/D_{100} =1.15
See Channel Report for results

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Closure	RVR/CRU	11/14/18
Subject/Title **Erosion Control/Storm Water Management Calculations for the Closure of Ash Pond 3**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-001 Rev 1	Sheet 11 of 13

Boiler Basin Pipes-

Pre-Development:
Basin (Hyd. No. 23)
Q_{25} = 41.20 cfs
Q_{50} = 48.75 cfs
Q_{100} = 56.61cfs
Pipes (Hyd. No. 24)
Q_{25} = 8.51 cfs
Q_{50} = 8.95 cfs
Q_{100} = 9.23cfs

Post-Development:
Basin (Hyd. No. 32)
Q_{25} = 22.56 cfs
Q_{50} = 28.70 cfs
Q_{100} = 35.31 cfs
Pipes (Hyd. No. 33)
Q_{25} = 6.52 cfs
Q_{50} = 7.12 cfs
Q_{100} = 7.73 cfs
(Reduced CN and increased Tc for peak flow reduction)

Existing 12" CMP Under Railroad @ N 1,550,448, E 1,943,137
12" CMP @ 0.80%, 41.2' long (Exist)
12" CMP @ 0.80%, 48.3' long (Extension)
V_{25} = 4.93 fps (Pre-Dev.)
V_{25} = 4.28 fps (Post-Dev.)
Outfall is railroad ballast and rip rap protected
See Culvert Report for results

Existing 12" CMP Under Railroad @ N 1,550,502, E 1,943,117
12' CMP @ 4.73%, 45.2' long (Exist.)

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Closure	RVR/CRU	11/14/18
Subject/Title **Erosion Control/Storm Water Management Calculations for the Closure of Ash Pond 3**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-001 Rev 1	Sheet 12 of 13

12’ CMP @ 4.73%, 49.7’ long (Extension)
V_{25} = 5.80 fps (Pre-Dev.)
V_{25} = 4.81 fps (Post-Dev.)
Outfall is railroad ballast and rip rap protected
See Culvert Report for results

AP#3 South End Pipes-

Existing Pipe @ N 1,550,135, E 1,941,896
24” CMP @ 0.97% - 141.42’ long

Pre-Development:
Basin (Hyd. No. 7)
Q_{25} = 41.51 cfs
Q_{50} = 50.52 cfs
Q_{100} = 59.98 cfs
Pipe (Hyd. No. 8)
Q_{25} = 14.82 cfs
Q_{50} = 15.16 cfs
Q_{100} = 15.53 cfs

Post-Development:
Basin (Hyd. No. 9)
Q_{25} = 71.83 cfs
Q_{50} = 86.55 cfs
Q_{100} = 102.01 cfs
Pipe (Hyd. No. 10)
Q_{25} = 15.16 cfs
Q_{50} = 15.92 cfs
Q_{100} = 16.71 cfs

(Increased detention storage)
V_{25} = 5.23 fps (Pre-Dev.)
V_{25} = 5.32 fps (Proposed)
Outfall is into a rip rap lined ditch
See Culvert Report for results

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Closure	RVR/CRU	11/14/18
Subject/Title **Erosion Control/Storm Water Management Calculations for the Closure of Ash Pond 3**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-001 Rev 1	Sheet 13 of 13

Existing Pipe Under Plant Road, Bridge & Railroad @ N 1,549,942, E 1,941,933
36" CMP @ 1.42% - 311.7' long

Pre-Development:
Basin (Hyd. No. 10)
Q_{25} = 54.18 cfs
Q_{50} = 64.41 cfs
Q_{100} = 74.70 cfs
Pipe (Hyd. No. 11)
Q_{25} = 42.01 cfs
Q_{50} = 44.22 cfs
Q_{100} = 46.02 cfs

Post-Development:
Basin (Hyd. No. 12)
Q_{25} = 53.11 cfs
Q_{50} = 63.18 cfs
Q_{100} = 73.69 cfs
Pipe (Hyd. No. 13)
Q_{25} = 41.89 cfs
Q_{50} = 44.15 cfs
Q_{100} = 46.02 cfs

(Increased detention storage & riser at exist. pipe for peak flow reduction.)

V_{25} = 6.55 fps (Pre-Dev)
V_{25} = 6.54 fps (Post-Dev)

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Closure	RVR/CRU	11/14/18
Subject/Title **Erosion Control/Storm Water Management Calculations for the Closure of Ash Pond 3**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-001 Rev 1	Sheet 14 of 13

Ash Pond Drainage Basins Tc Calculations-

Basin F	
Sheet Flow 150’ @ 3.0%, Grass	19.82 min.
Shallow Conc. Flow 305’ @ 3.0%, Grass	1.82 min.
Ditch Flow	
Cap Swale, 100’ @ 1.0%, Grass	0.76 min.
Cap Flume, 5’ F.B., 50’ @ 2.83%, Rip Rap	0.33 min.
Perimeter Ditch 3’ F.B., 407’ @ 1.0%, Rip Rap	3.90 min.
CS4’x2’, 30’ @ 0.5%, Concrete	0.09 min.
Outfall Ditch 108’ @ 1.0%, Rip Rap	1.05 min.
Outfall Ditch, 4’ F.B. 50’ @ 32.5%, Rip Rap	0.14 min.
Outfall Ditch 4’ F.B., 115’ @ 4.0%, Rip Rap	1.05 min.
Total Tc =	29.0 min.
Basin G	
Sheet Flow 150’ @ 3.0%, Grass	19.82 min.
Shallow Conc. Flow 169’ @ 3.0%, Grass	1.01 min.
Ditch Flow	
Cap Swale, 281’ @ 1.0%, Grass	2.45 min.
Cap Flume, 5’ F.B., 50’ @ 2.83%, Rip Rap	0.40 min.
Perimeter Ditch 3’ F.B., 163’ @ 1.0%, Rip Rap	1.80 min.
Outfall Ditch, 6’ F.B., 50’ @ 3.0%, Rip Rap	0.41 min.
Outfall Ditch, 6’ F.B. 42’ @ 25.0%, Rip Rap	0.17 min.
Outfall Ditch 6’ F.B., 99’ @ 5.5%, Rip Rap	0.70 min.
Total Tc =	26.8 min.
Basin D	
Sheet Flow 150’ @ 3.0%, Grass	19.82 min.
Shallow Conc. Flow 187’ @ 3.0%, Grass	1.12 min.
Ditch Flow	
Cap Swale, 88’ @ 1.0%, Grass	0.65 min.
Cap Flume, 5’ F.B., 50’ @ 2.83%, Rip Rap	0.33 min.
Perimeter Ditch 3’ F.B., 670’ @ 1.0%, Rip Rap	6.27 min..
Outfall Ditch, 6’ F.B. 120’ @ 5.0%, Rip Rap	0.72 min.
Outfall Ditch 6’ F.B., 45’ @ 25.0%, Rip Rap	0.15 min.
Total Tc =	29.1 min.

HydraFlow Express channel reports are attached for the above Tc calculations not included in HydroFlow Hydrograph reports. See attached HydraFlow Hydrograph Pre- and Post-Development reports for Tc values of other basins.

Time of Concentration
Cap Drainage Basins
(HydraFlow Express Output)

Channel Report

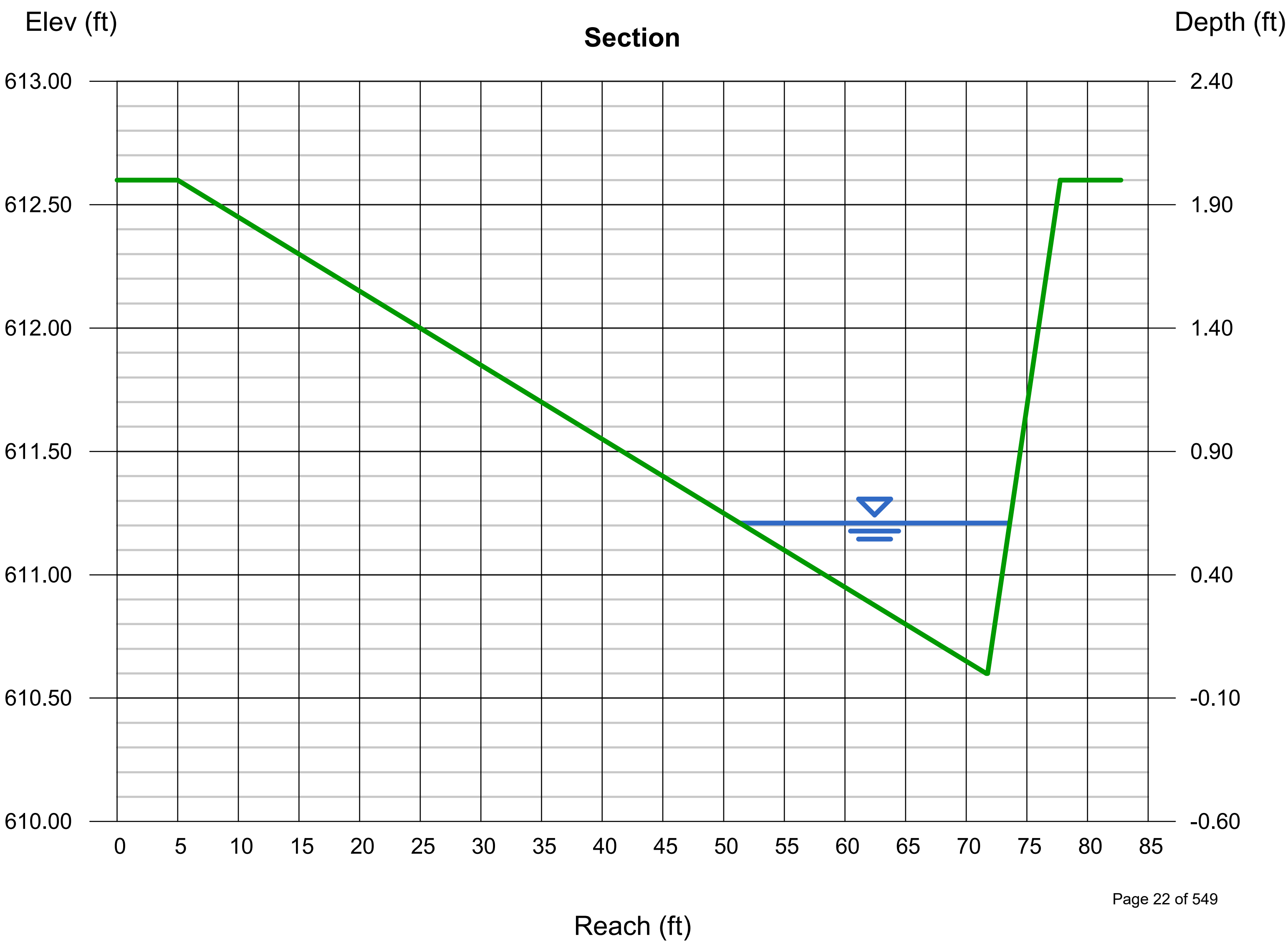
Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

DBASIN_CapSwale@1.0%-Tc2YR

Trapezoidal
Bottom Width (ft) = 0.10
Side Slopes (z:1) = 33.33, 3.00
Total Depth (ft) = 2.00
Invert Elev (ft) = 610.60
Slope (%) = 1.00
N-Value = 0.030

Calculations
Compute by: Known Q
Known Q (cfs) = 14.90

Highlighted
Depth (ft) = 0.61
Q (cfs) = 14.90
Area (sqft) = 6.82
Velocity (ft/s) = 2.18
Wetted Perim (ft) = 22.37
Crit Depth, Yc (ft) = 0.53
Top Width (ft) = 22.26
EGL (ft) = 0.68



TR-55 Tc Worksheet

Sheet Flow

	A	B	C
Manning's n-value .... =	0.33	0.011	0.011
Flow length (ft, 300 max.) =	150		
Two-yr 24-hr rain (in) .... =	3.82		
Land slope (%) .... =	3		
Sheet flow time .... =	19.82	0.00	0.00

Shallow Concentrated Flow

	A	B	C
Flow length (ft) .... =	187		
Watercourse slope (%) .... =	3		
Surface description .... =	Unpaved	Paved	Paved
Shallow conc. flow time .. =	1.12	0.00	0.00

Channel Flow

	A	B	C
X-sectional area (sqft) =	6.82	5.92	8.51
Wetted perimeter (ft) =	22.37	10.06	10.22
Channel slope (%) .... =	1	2.83	1.0
Manning's n-value ... =	0.03	0.069	0.074
Flow length (ft) .... =	88	50	670
Channel flow time .... =	0.65	0.33	6.27

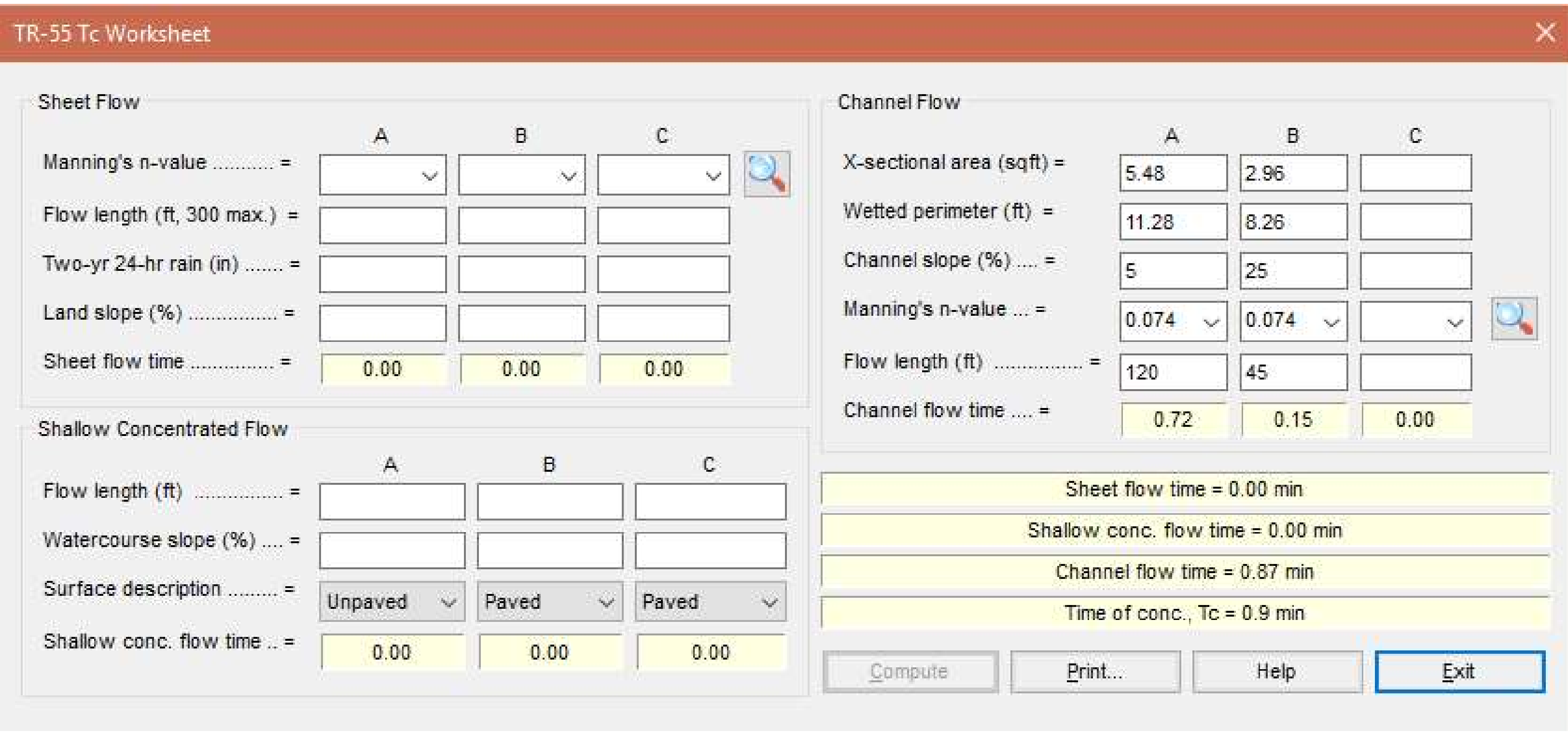
Sheet flow time = 19.82 min

Shallow conc. flow time = 1.12 min

Channel flow time = 7.25 min

Time of conc., Tc = 28.2 min

Compute | Print... | Help | Exit



TR-55 Tc Worksheet

Sheet Flow

	A	B	C
Manning's n-value .... =			
Flow length (ft, 300 max.) =			
Two-yr 24-hr rain (in) ...... =			
Land slope (%) .... =			
Sheet flow time .... =	0.00	0.00	0.00

Shallow Concentrated Flow

	A	B	C
Flow length (ft) .... =			
Watercourse slope (%) .... =			
Surface description .... =	Unpaved	Paved	Paved
Shallow conc. flow time .. =	0.00	0.00	0.00

Channel Flow

	A	B	C
X-sectional area (sqft) =	5.48	2.96	
Wetted perimeter (ft) =	11.28	8.26	
Channel slope (%) .... =	5	25	
Manning's n-value ... =	0.074	0.074	
Flow length (ft) .... =	120	45	
Channel flow time .... =	0.72	0.15	0.00

Sheet flow time = 0.00 min

Shallow conc. flow time = 0.00 min

Channel flow time = 0.87 min

Time of conc., Tc = 0.9 min

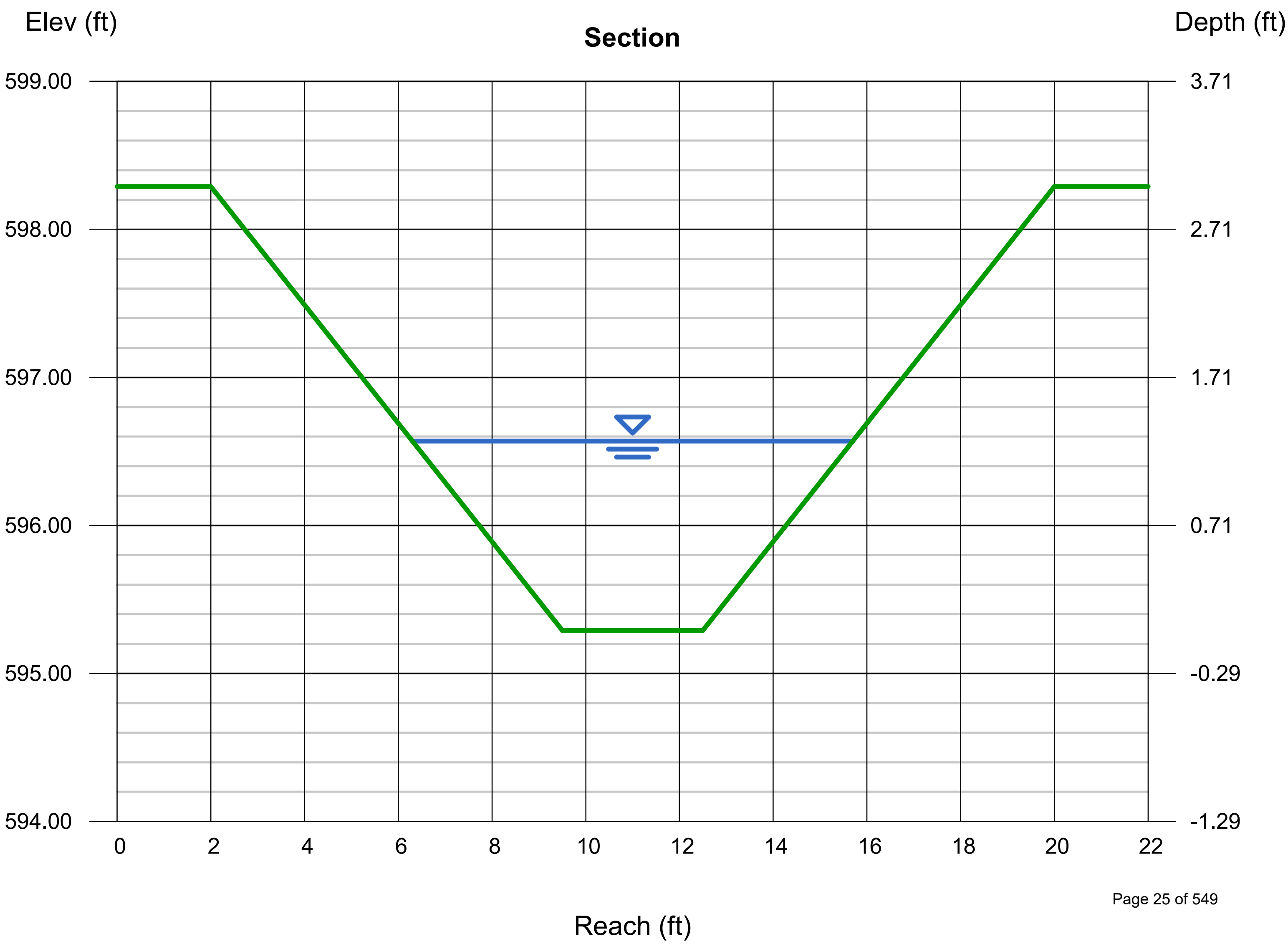
Compute | Print... | Help | Exit

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

FBASIN_3'FB@1.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.28
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 13.73
Total Depth (ft)	= 3.00	Area (sqft)	= 7.94
Invert Elev (ft)	= 595.29	Velocity (ft/s)	= 1.73
Slope (%)	= 1.00	Wetted Perim (ft)	= 9.89
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.71
		Top Width (ft)	= 9.40
Calculations		EGL (ft)	= 1.33
Compute by:	Known Q		
Known Q (cfs)	= 13.73		

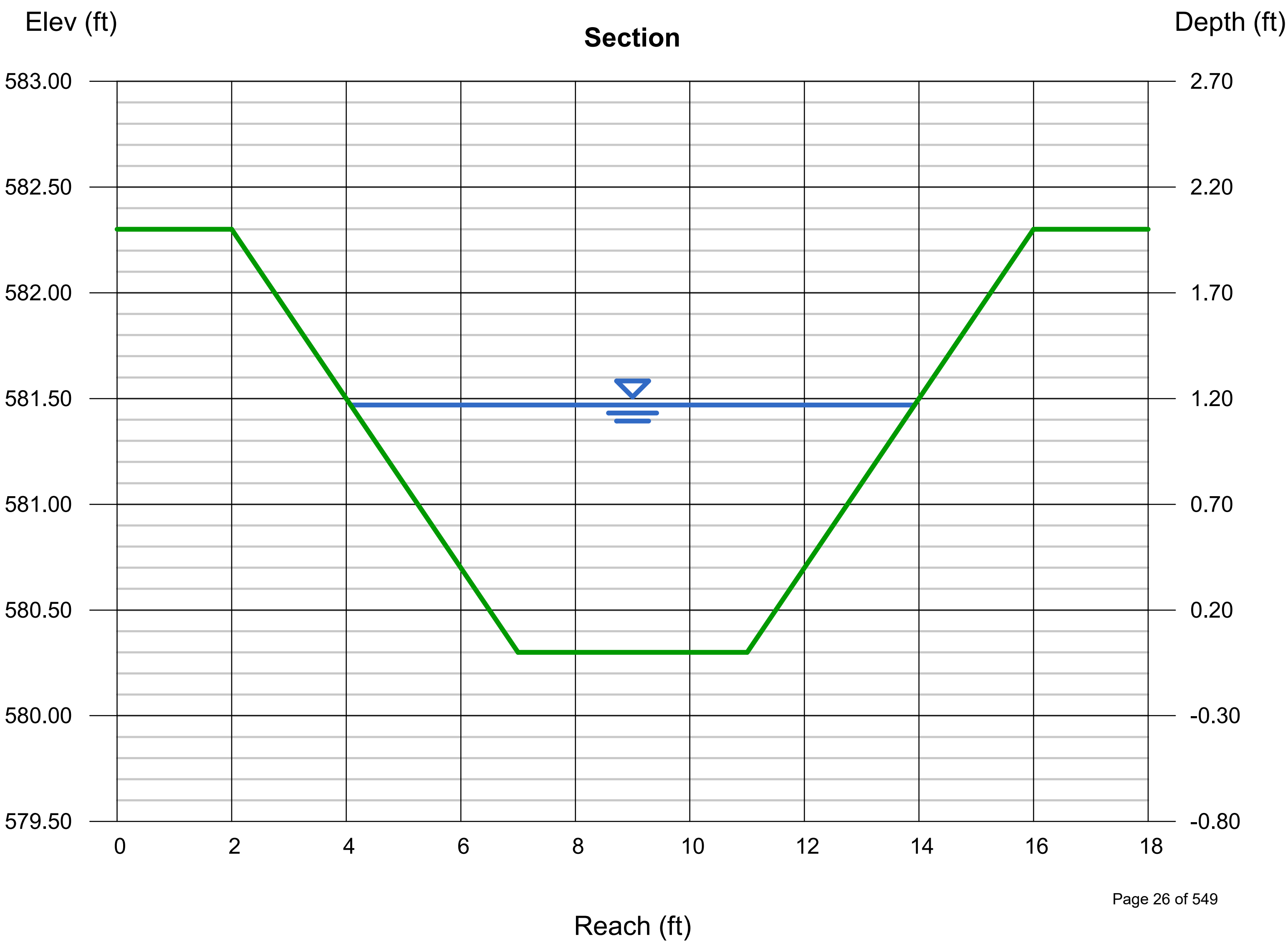


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

FBASIN_4'FB@1.00%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 1.17
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 13.73
Total Depth (ft)	= 2.00	Area (sqft)	= 8.10
Invert Elev (ft)	= 580.30	Velocity (ft/s)	= 1.69
Slope (%)	= 1.00	Wetted Perim (ft)	= 10.30
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.63
		Top Width (ft)	= 9.85
Calculations		EGL (ft)	= 1.21
Compute by:	Known Q		
Known Q (cfs)	= 13.73		

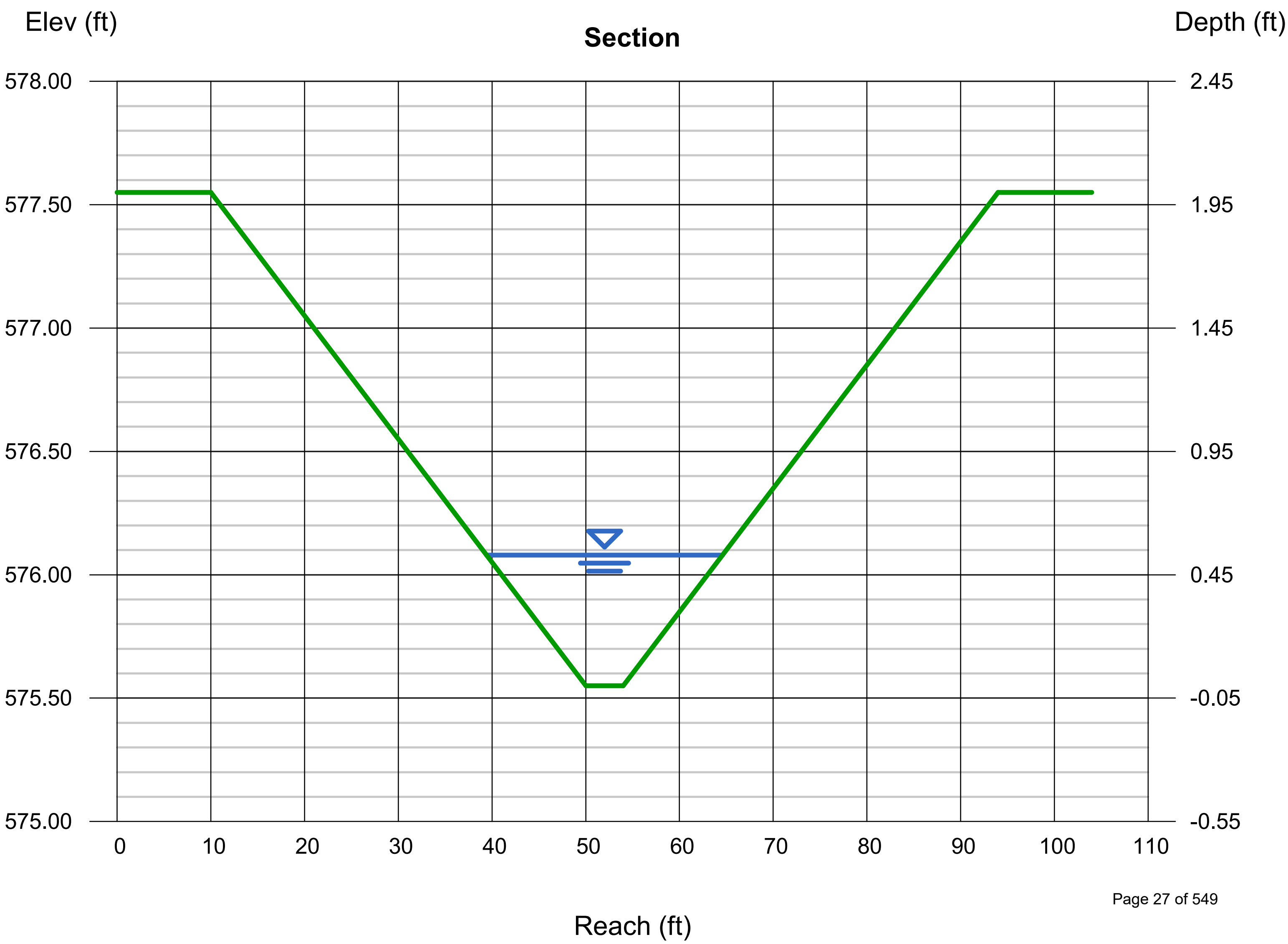


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

FBASIN_4'FB@4.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 0.53
Side Slopes (z:1)	= 20.00, 20.00	Q (cfs)	= 13.73
Total Depth (ft)	= 2.00	Area (sqft)	= 7.74
Invert Elev (ft)	= 575.55	Velocity (ft/s)	= 1.77
Slope (%)	= 4.00	Wetted Perim (ft)	= 25.23
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.41
		Top Width (ft)	= 25.20
Calculations		EGL (ft)	= 0.58
Compute by:	Known Q		
Known Q (cfs)	= 13.73		

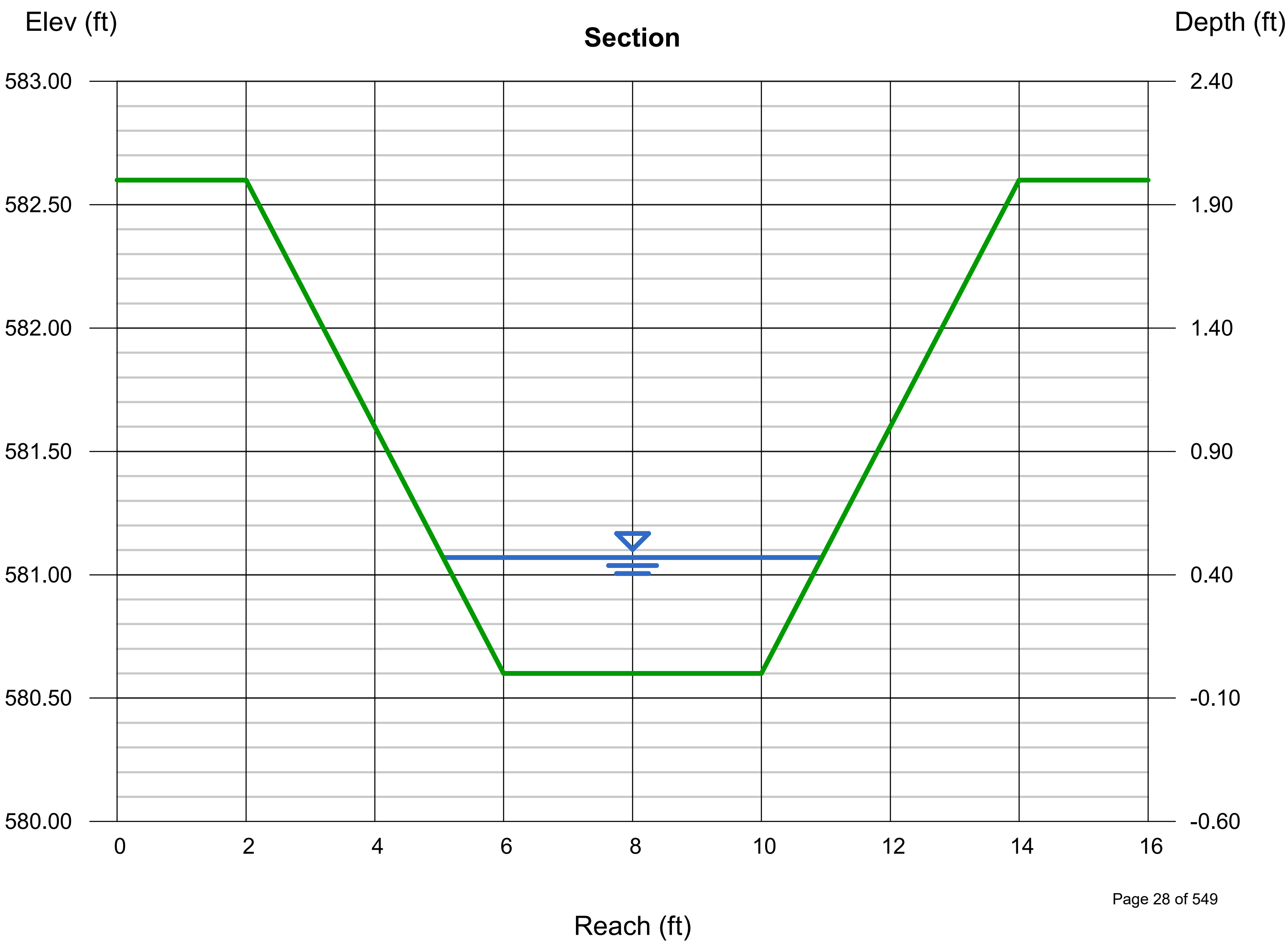


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

FBASIN_4'FB@32.5%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 0.47
Side Slopes (z:1)	= 2.00, 2.00	Q (cfs)	= 13.73
Total Depth (ft)	= 2.00	Area (sqft)	= 2.32
Invert Elev (ft)	= 580.60	Velocity (ft/s)	= 5.91
Slope (%)	= 32.50	Wetted Perim (ft)	= 6.10
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.64
		Top Width (ft)	= 5.88
Calculations		EGL (ft)	= 1.01
Compute by:	Known Q		
Known Q (cfs)	= 13.73		



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

FBASIN_5'FB@2.83%-Tc2YR

Trapezoidal

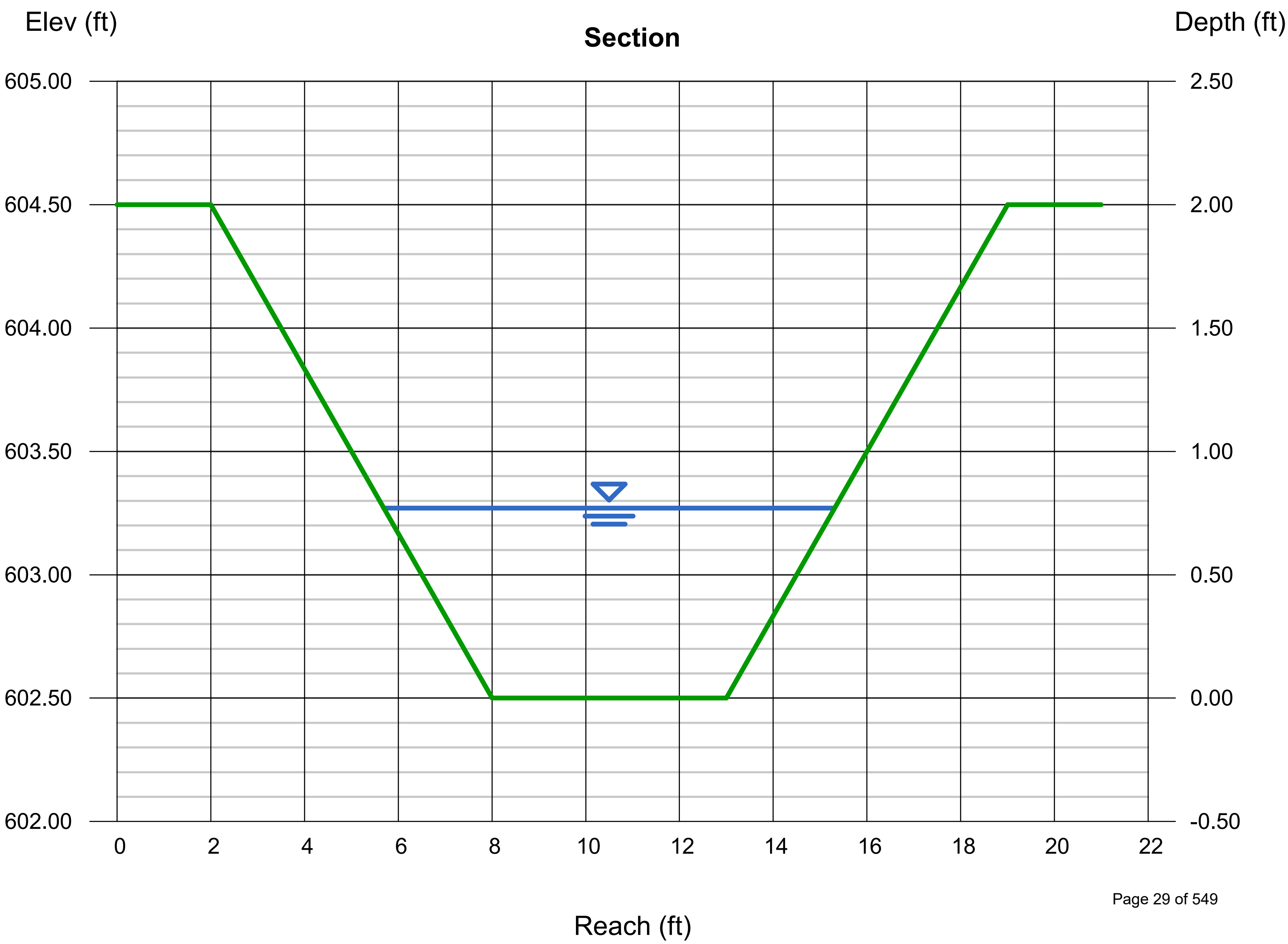
Bottom Width (ft)	= 5.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 602.50
Slope (%)	= 2.83
N-Value	= 0.069

Calculations

Compute by:	Known Q
Known Q (cfs)	= 13.73

Highlighted

Depth (ft)	= 0.77
Q (cfs)	= 13.73
Area (sqft)	= 5.63
Velocity (ft/s)	= 2.44
Wetted Perim (ft)	= 9.87
Crit Depth, Yc (ft)	= 0.55
Top Width (ft)	= 9.62
EGL (ft)	= 0.86

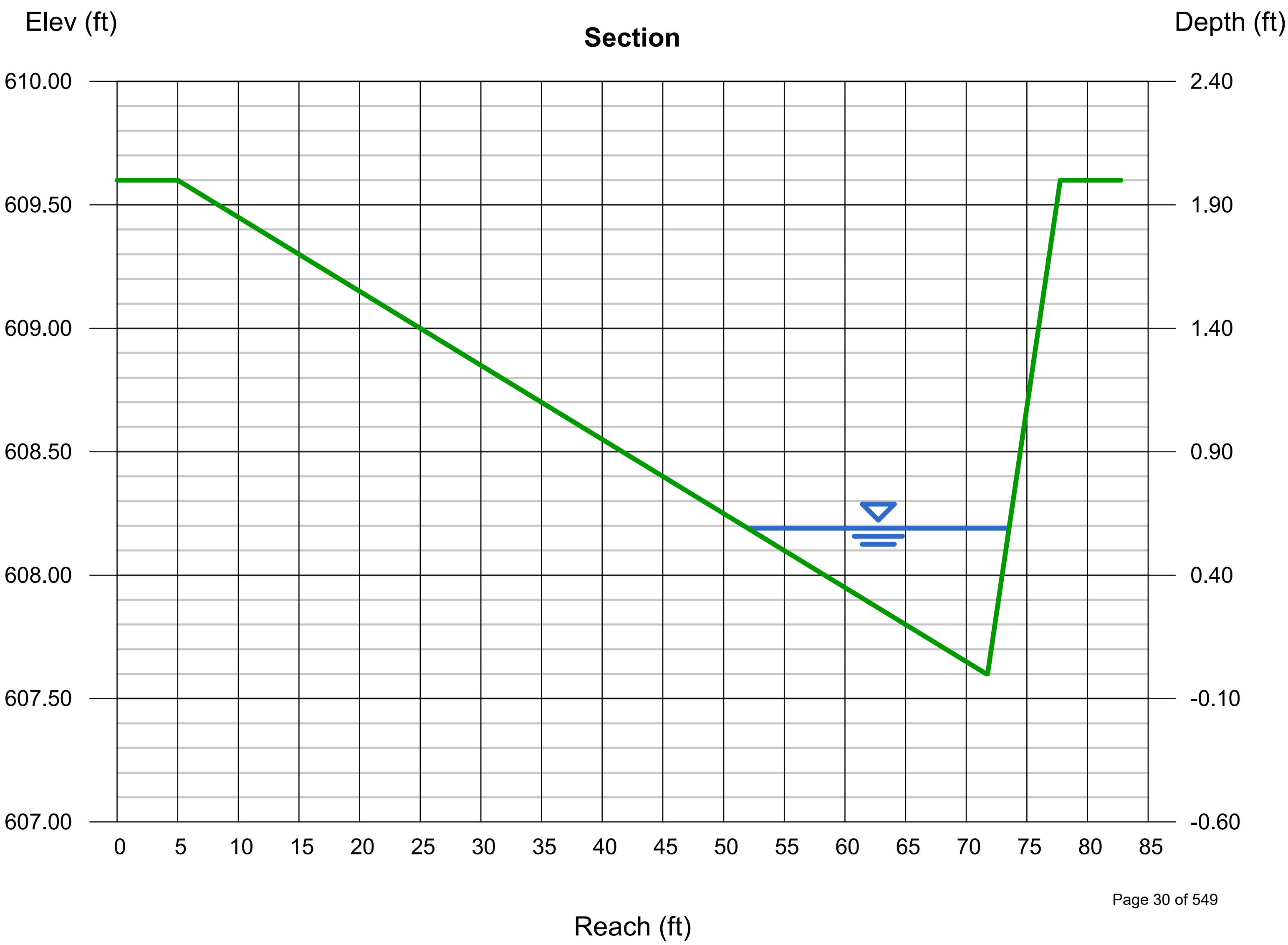


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

FBASIN_CapSwale@1.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 0.10	Depth (ft)	= 0.59
Side Slopes (z:1)	= 33.33, 3.00	Q (cfs)	= 13.73
Total Depth (ft)	= 2.00	Area (sqft)	= 6.38
Invert Elev (ft)	= 607.60	Velocity (ft/s)	= 2.15
Slope (%)	= 1.00	Wetted Perim (ft)	= 21.64
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.52
		Top Width (ft)	= 21.53
Calculations		EGL (ft)	= 0.66
Compute by:	Known Q		
Known Q (cfs)	= 13.73		

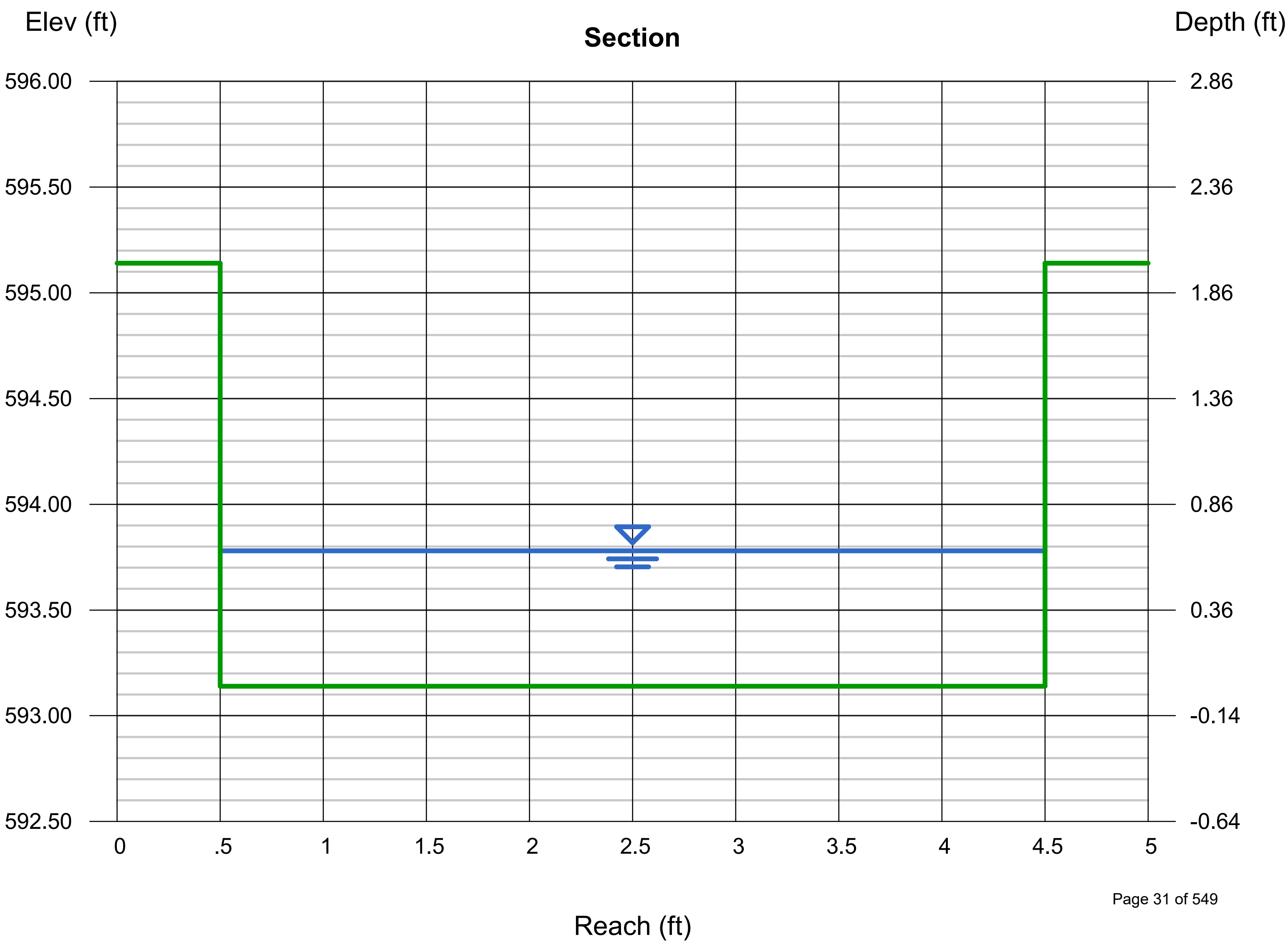


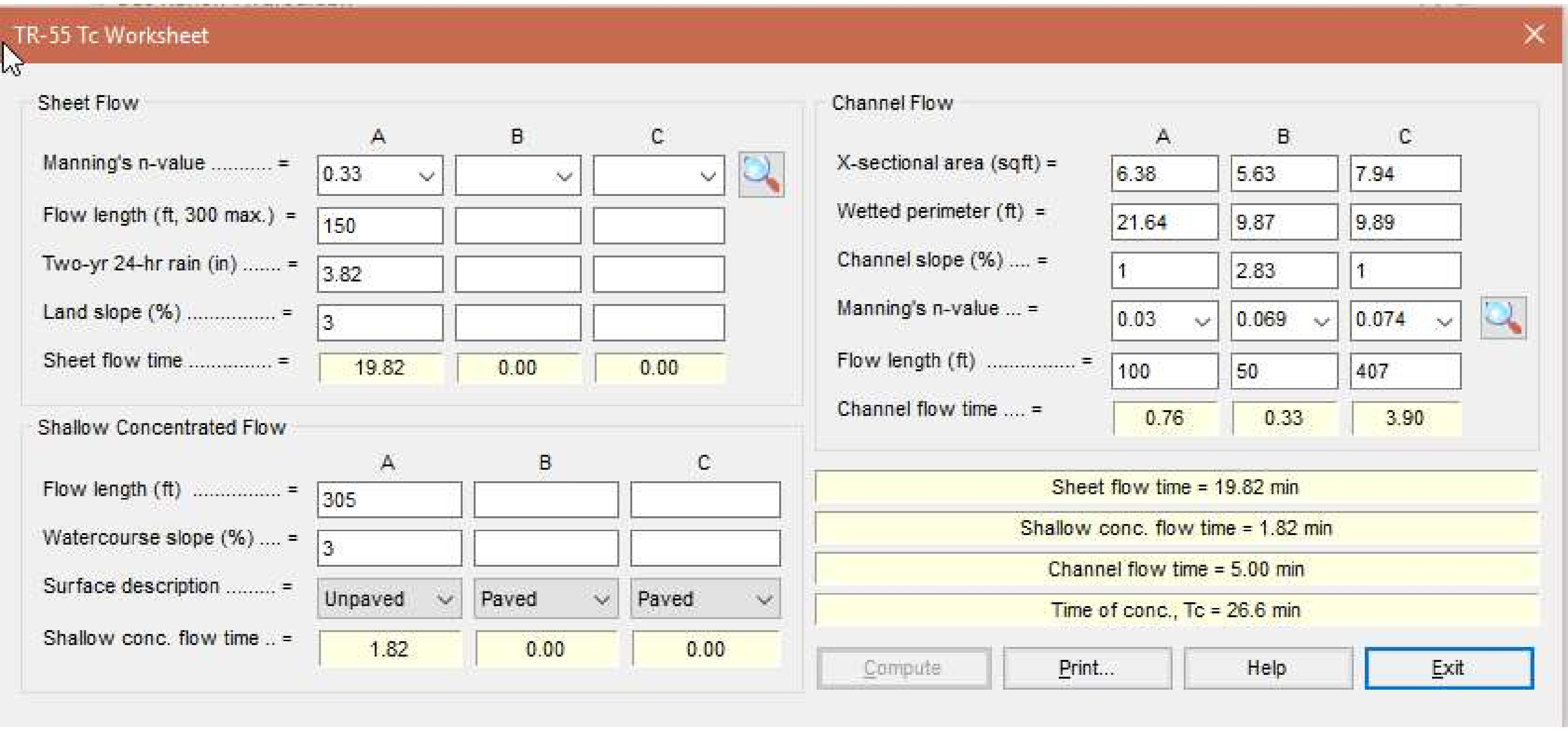
Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

FBASIN_CS4X2@0.50%-Tc2YR

Rectangular		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 0.64
Total Depth (ft)	= 2.00	Q (cfs)	= 13.73
		Area (sqft)	= 2.56
Invert Elev (ft)	= 593.14	Velocity (ft/s)	= 5.36
Slope (%)	= 0.50	Wetted Perim (ft)	= 5.28
N-Value	= 0.012	Crit Depth, Yc (ft)	= 0.72
		Top Width (ft)	= 4.00
Calculations		EGL (ft)	= 1.09
Compute by:	Known Q		
Known Q (cfs)	= 13.73		




TR-55 Tc Worksheet

Sheet Flow

	A	B	C
Manning's n-value .... =	0.33		
Flow length (ft, 300 max.) =	150		
Two-yr 24-hr rain (in) .... =	3.82		
Land slope (%) .... =	3		
Sheet flow time .... =	19.82	0.00	0.00

Shallow Concentrated Flow

	A	B	C
Flow length (ft) .... =	305		
Watercourse slope (%) .... =	3		
Surface description .... =	Unpaved	Paved	Paved
Shallow conc. flow time .. =	1.82	0.00	0.00

Channel Flow

	A	B	C
X-sectional area (sqft) =	6.38	5.63	7.94
Wetted perimeter (ft) =	21.64	9.87	9.89
Channel slope (%) .... =	1	2.83	1
Manning's n-value ... =	0.03	0.069	0.074
Flow length (ft) .... =	100	50	407
Channel flow time .... =	0.76	0.33	3.90

Sheet flow time = 19.82 min
Shallow conc. flow time = 1.82 min
Channel flow time = 5.00 min
Time of conc., Tc = 26.6 min

Compute | Print... | Help | Exit

TR-55 Tc Worksheet

Sheet Flow

	A	B	C
Manning's n-value .... =			
Flow length (ft, 300 max.) =			
Two-yr 24-hr rain (in) .... =			
Land slope (%) .... =			
Sheet flow time .... =	0.00	0.00	0.00

Shallow Concentrated Flow

	A	B	C
Flow length (ft) .... =			
Watercourse slope (%) .... =	3		
Surface description .... =	Unpaved	Paved	Paved
Shallow conc. flow time .. =	0.00	0.00	0.00

Channel Flow

	A	B	C
X-sectional area (sqft) =	2.56	8.10	2.32
Wetted perimeter (ft) =	5.28	10.30	6.10
Channel slope (%) .... =	0.50	1.0	32.5
Manning's n-value ... =	0.012	0.074	0.074
Flow length (ft) .... =	30	108	50
Channel flow time .... =	0.09	1.05	0.14

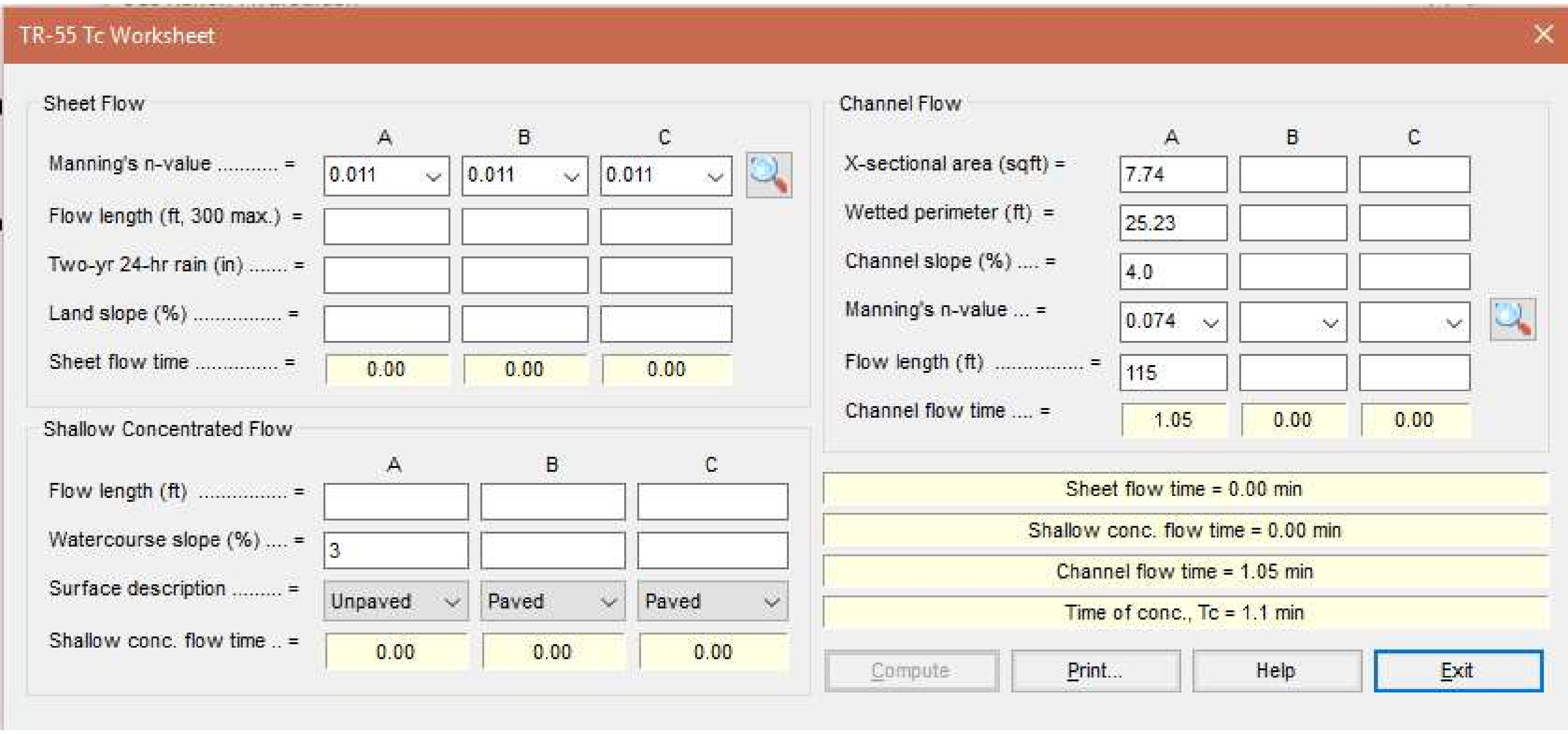
Sheet flow time = 0.00 min

Shallow conc. flow time = 0.00 min

Channel flow time = 1.28 min

Time of conc., Tc = 1.3 min

Compute | Print... | Help | Exit

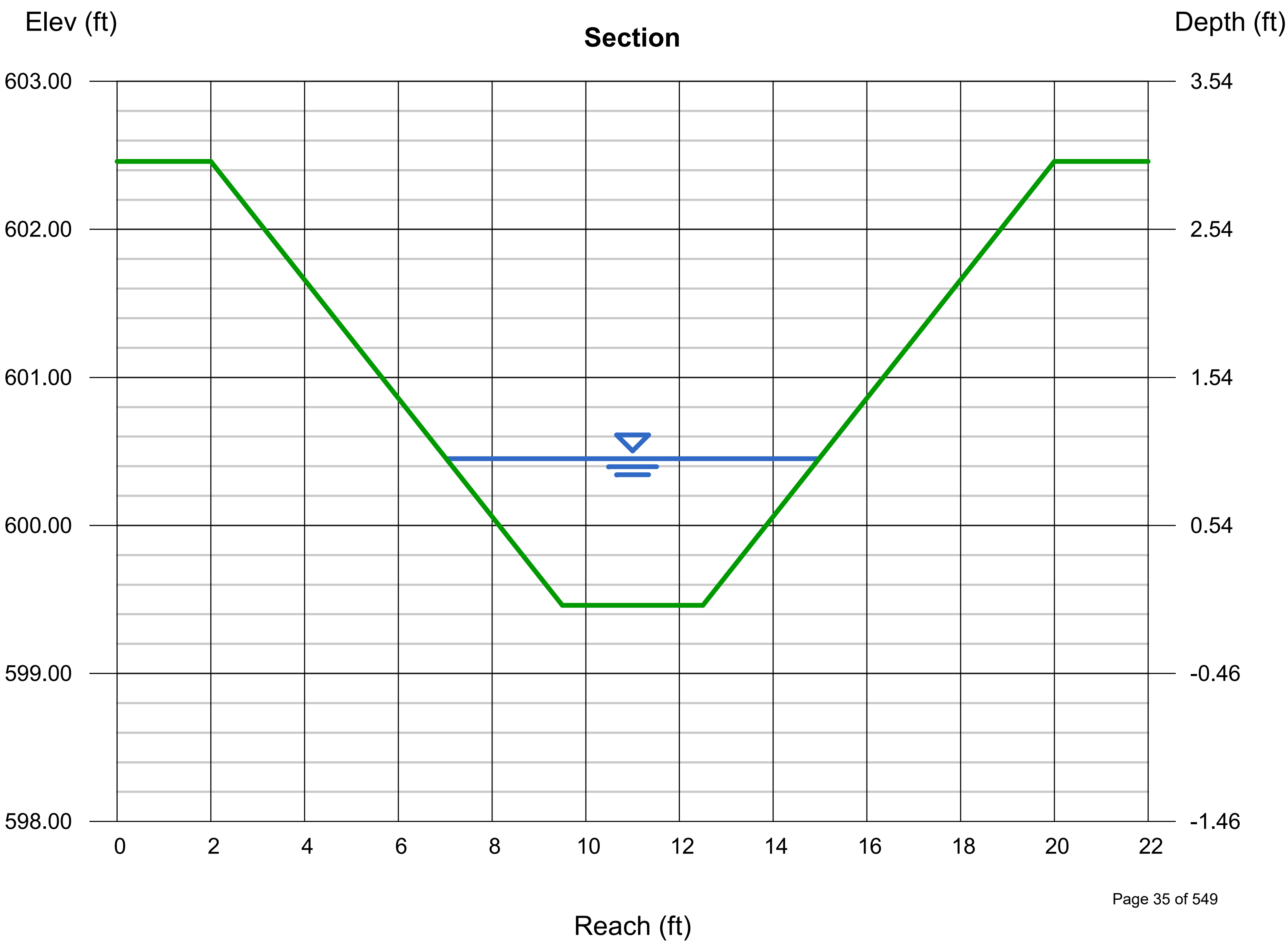

TR-55 Tc Worksheet
Sheet Flow
A
B
C
Manning's n-value .... =
0.011
0.011
0.011
Flow length (ft, 300 max.) =
Two-yr 24-hr rain (in) .... =
Land slope (%) .... =
Sheet flow time .... =
0.00
0.00
0.00
Shallow Concentrated Flow
A
B
C
Flow length (ft) .... =
Watercourse slope (%) .... =
3
Surface description .... =
Unpaved
Paved
Paved
Shallow conc. flow time .. =
0.00
0.00
0.00
Channel Flow
A
B
C
X-sectional area (sqft) =
7.74
Wetted perimeter (ft) =
25.23
Channel slope (%) .... =
4.0
Manning's n-value ... =
0.074
Flow length (ft) .... =
115
Channel flow time .... =
1.05
0.00
0.00
Sheet flow time = 0.00 min
Shallow conc. flow time = 0.00 min
Channel flow time = 1.05 min
Time of conc., Tc = 1.1 min
Compute
Print...
Help
Exit

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

GBASIN_3'FB@1.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 0.99
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 8.010
Total Depth (ft)	= 3.00	Area (sqft)	= 5.42
Invert Elev (ft)	= 599.46	Velocity (ft/s)	= 1.48
Slope (%)	= 1.00	Wetted Perim (ft)	= 8.33
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.52
		Top Width (ft)	= 7.95
Calculations		EGL (ft)	= 1.02
Compute by:	Known Q		
Known Q (cfs)	= 8.01		

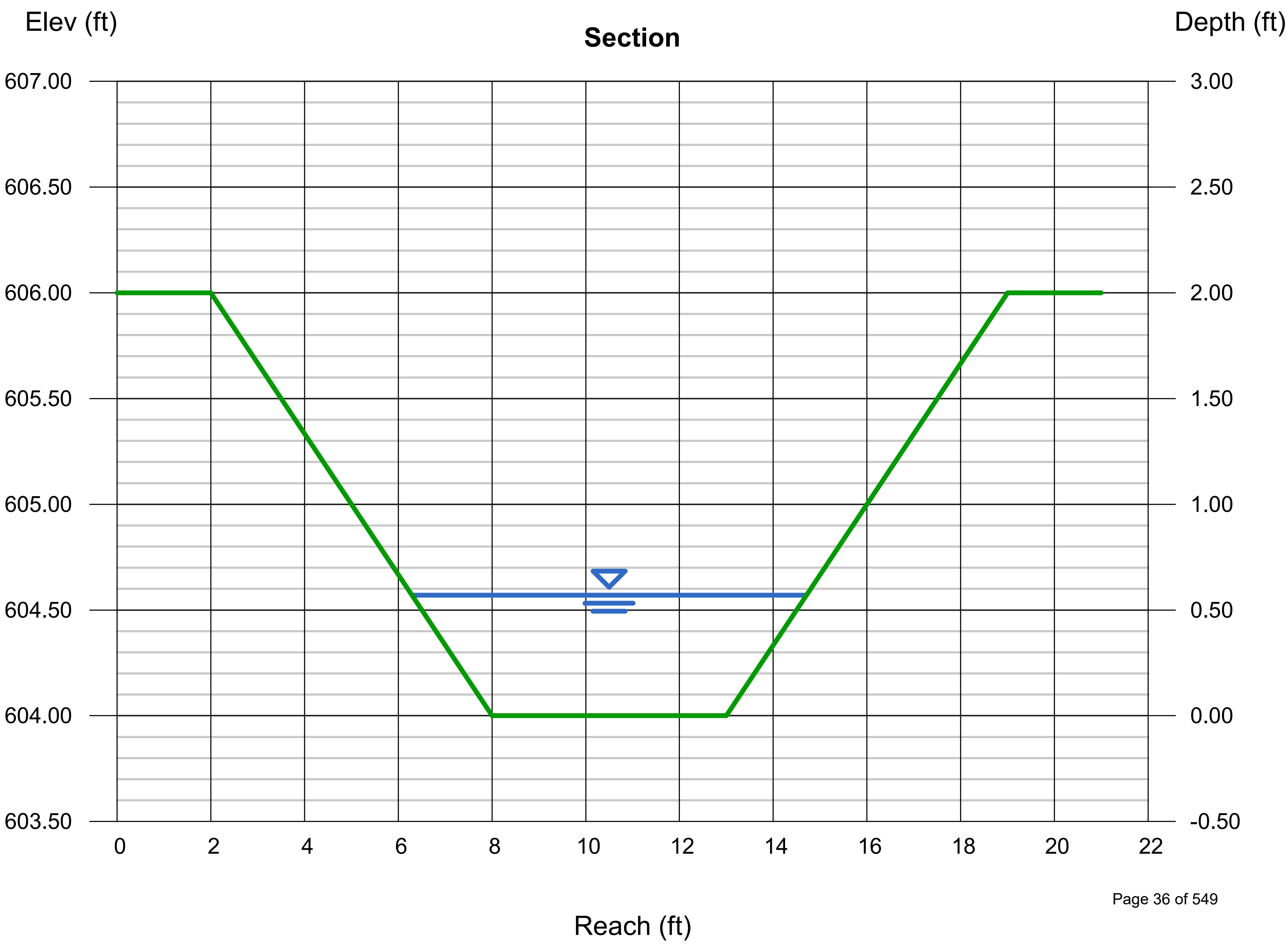


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

GBASIN_5'FB@2.83%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 5.00	Depth (ft)	= 0.57
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 8.010
Total Depth (ft)	= 2.00	Area (sqft)	= 3.82
Invert Elev (ft)	= 604.00	Velocity (ft/s)	= 2.09
Slope (%)	= 2.83	Wetted Perim (ft)	= 8.60
N-Value	= 0.069	Crit Depth, Yc (ft)	= 0.40
		Top Width (ft)	= 8.42
Calculations		EGL (ft)	= 0.64
Compute by:	Known Q		
Known Q (cfs)	= 8.01		



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

GBASIN_6'FB@3.0%-Tc2YR

Trapezoidal

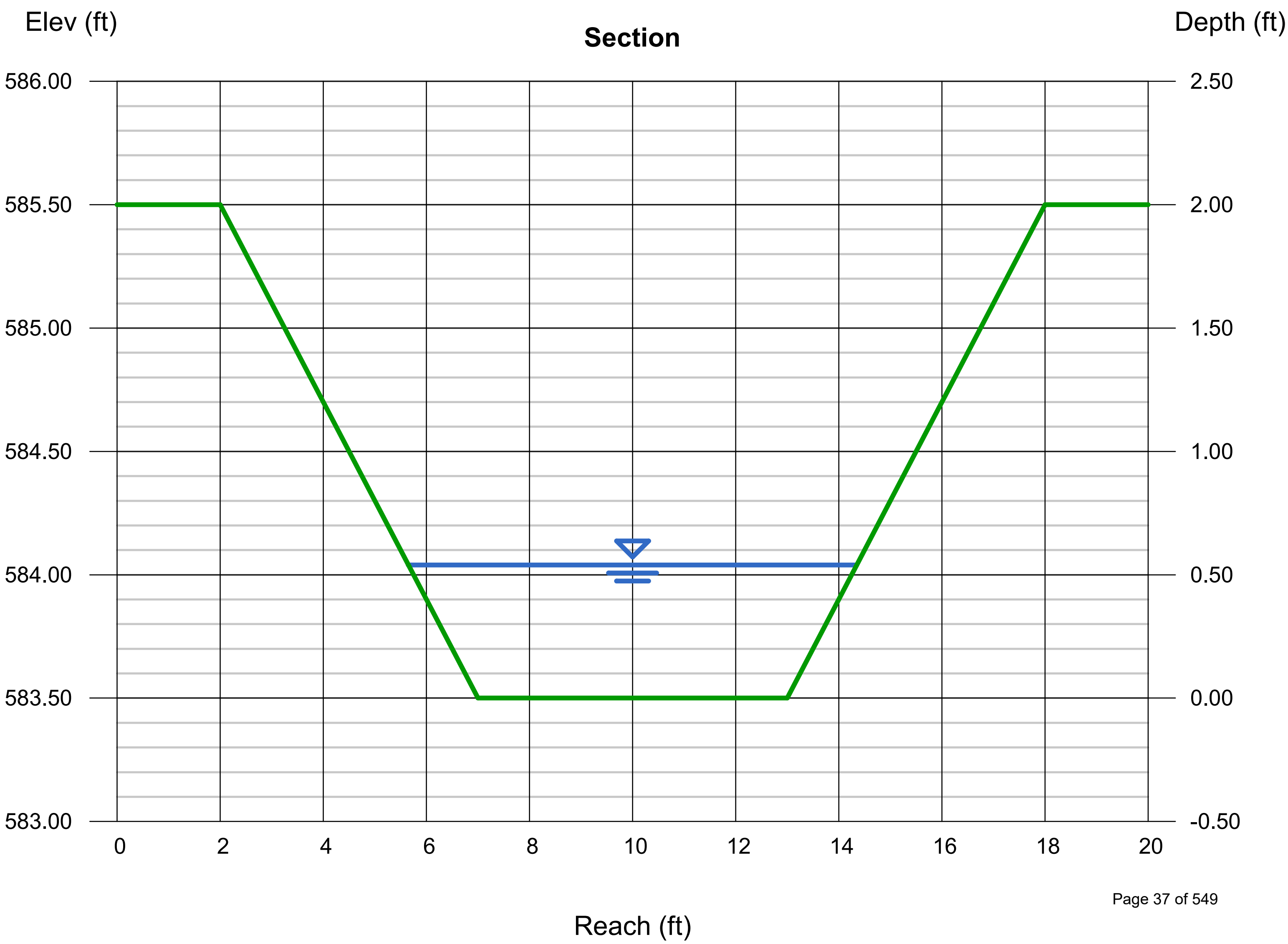
Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 2.50, 2.50
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 583.50
Slope (%)	= 3.00
N-Value	= 0.074

Calculations

Compute by:	Known Q
Known Q (cfs)	= 8.01

Highlighted

Depth (ft)	= 0.54
Q (cfs)	= 8.010
Area (sqft)	= 3.97
Velocity (ft/s)	= 2.02
Wetted Perim (ft)	= 8.91
Crit Depth, Yc (ft)	= 0.37
Top Width (ft)	= 8.70
EGL (ft)	= 0.60

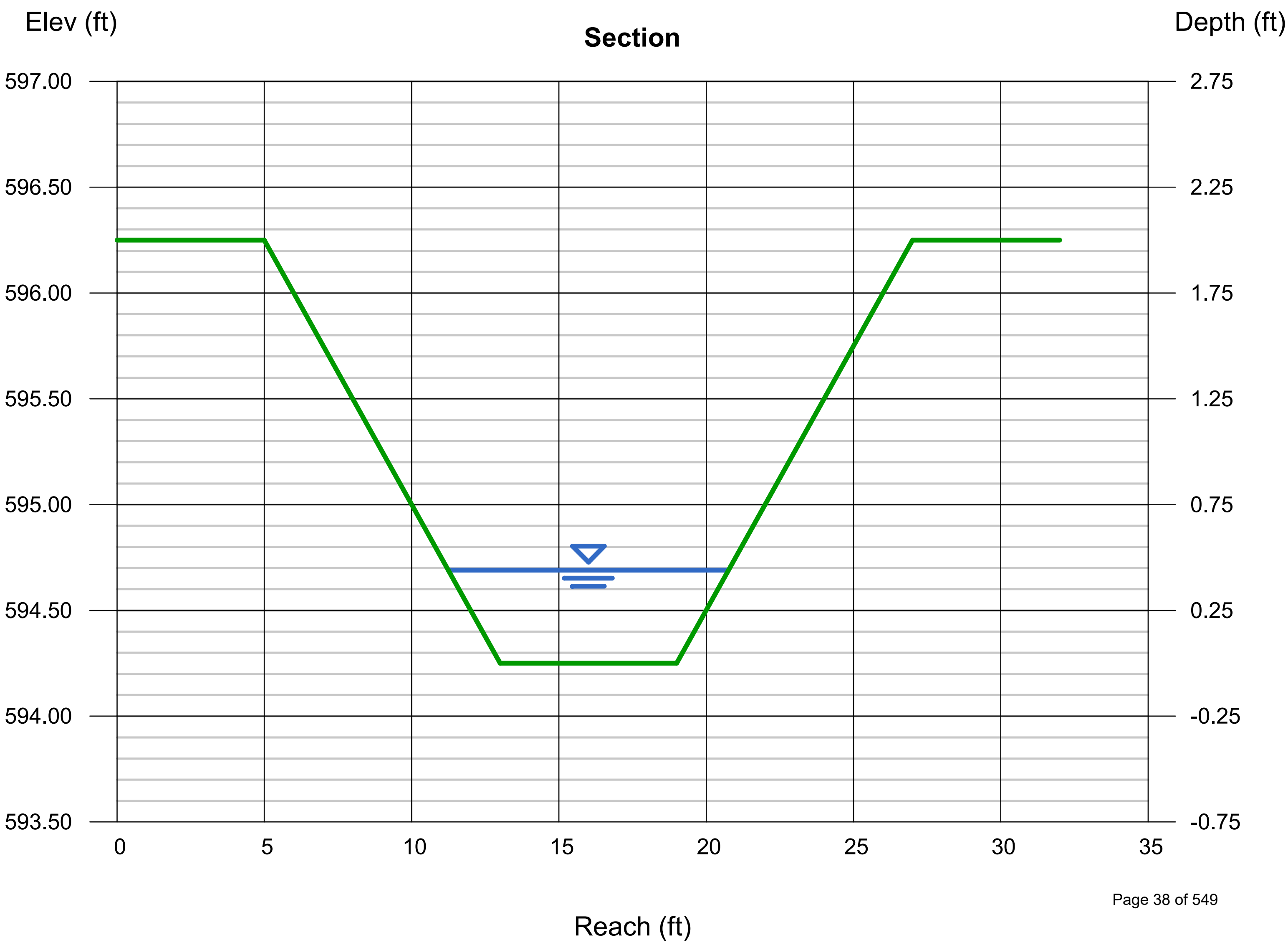


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

GBASIN_6'FB@5.5%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.44
Side Slopes (z:1)	= 4.00, 4.00	Q (cfs)	= 8.010
Total Depth (ft)	= 2.00	Area (sqft)	= 3.41
Invert Elev (ft)	= 594.25	Velocity (ft/s)	= 2.35
Slope (%)	= 5.50	Wetted Perim (ft)	= 9.63
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.36
		Top Width (ft)	= 9.52
Calculations		EGL (ft)	= 0.53
Compute by:	Known Q		
Known Q (cfs)	= 8.01		

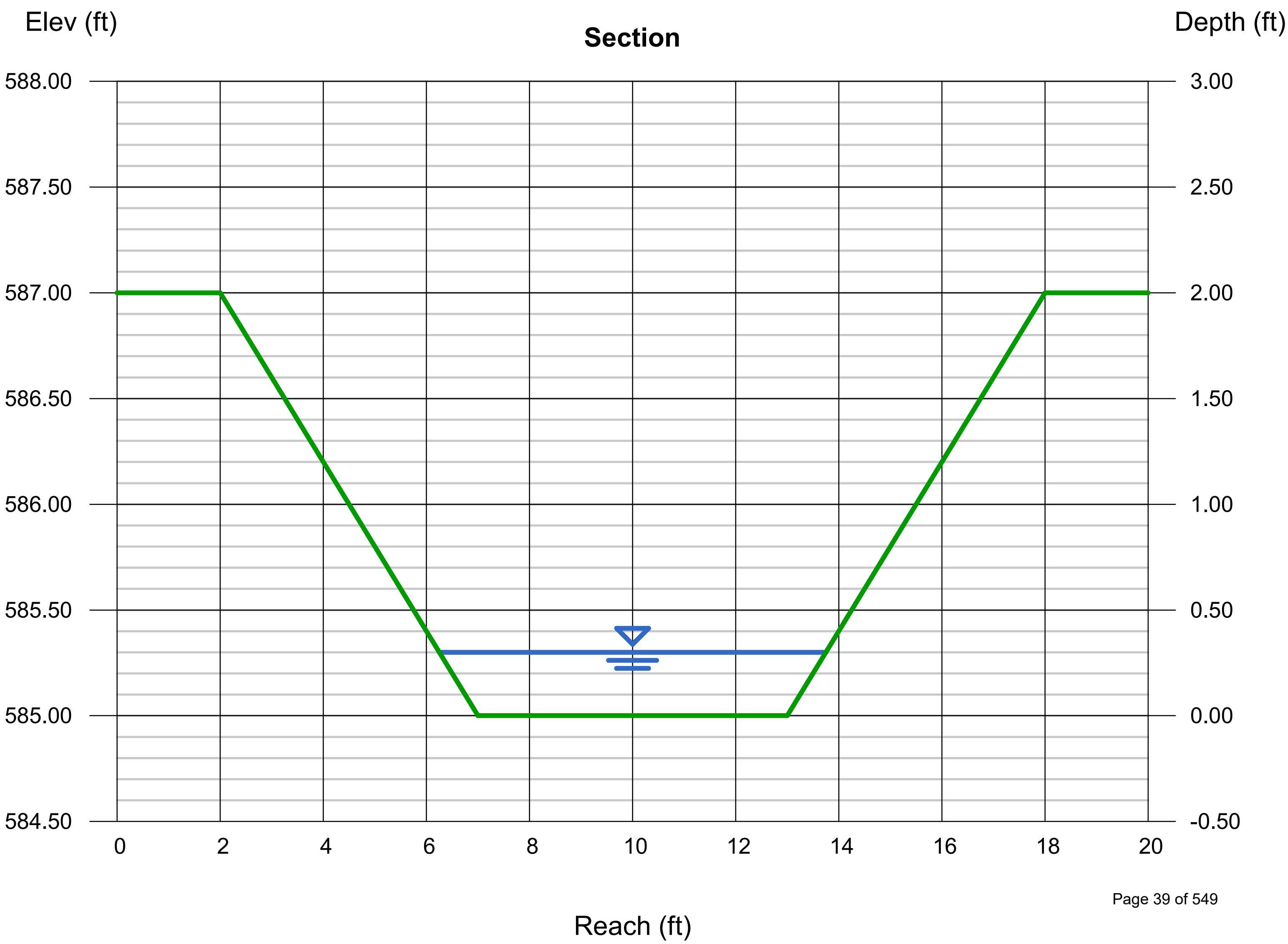


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

GBASIN_6'FB@25.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.30
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 8.010
Total Depth (ft)	= 2.00	Area (sqft)	= 2.03
Invert Elev (ft)	= 585.00	Velocity (ft/s)	= 3.96
Slope (%)	= 25.00	Wetted Perim (ft)	= 7.62
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.37
		Top Width (ft)	= 7.50
Calculations		EGL (ft)	= 0.54
Compute by:	Known Q		
Known Q (cfs)	= 8.01		

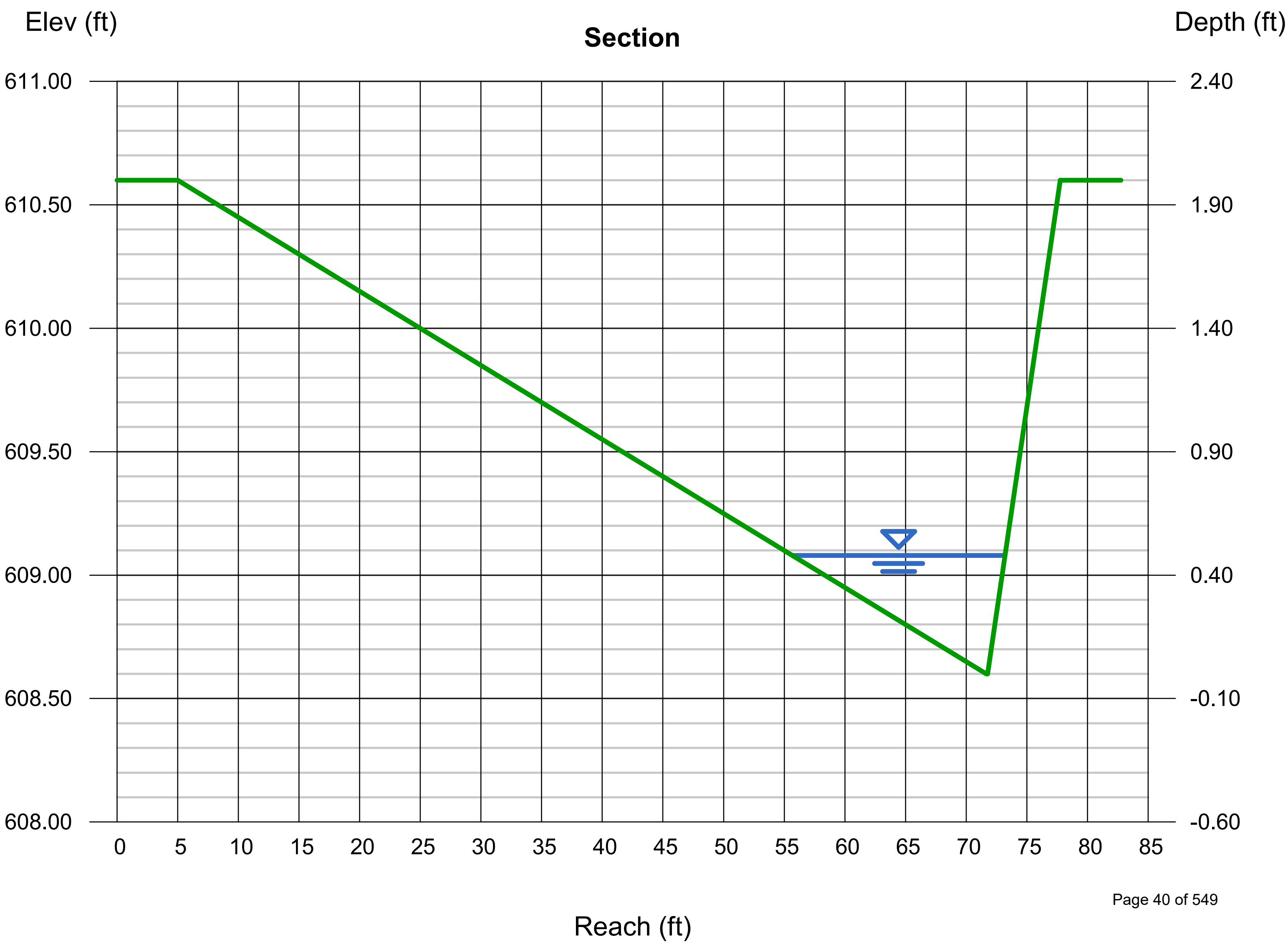


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

GBASIN_CapSwale@1.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 0.10	Depth (ft)	= 0.48
Side Slopes (z:1)	= 33.33, 3.00	Q (cfs)	= 8.010
Total Depth (ft)	= 2.00	Area (sqft)	= 4.23
Invert Elev (ft)	= 608.60	Velocity (ft/s)	= 1.89
Slope (%)	= 1.00	Wetted Perim (ft)	= 17.62
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.42
		Top Width (ft)	= 17.54
Calculations		EGL (ft)	= 0.54
Compute by:	Known Q		
Known Q (cfs)	= 8.01		



TR-55 Tc Worksheet

Sheet Flow

	A	B	C
Manning's n-value .... =	0.33	0.011	0.011
Flow length (ft, 300 max.) =	150		
Two-yr 24-hr rain (in) .... =	3.82		
Land slope (%) .... =	3		
Sheet flow time .... =	19.82	0.00	0.00

Shallow Concentrated Flow

	A	B	C
Flow length (ft) .... =	169		
Watercourse slope (%) .... =	3		
Surface description .... =	Unpaved	Paved	Paved
Shallow conc. flow time .. =	1.01	0.00	0.00

Channel Flow

	A	B	C
X-sectional area (sqft) =	4.23	3.82	5.42
Wetted perimeter (ft) =	17.62	8.6	8.33
Channel slope (%) .... =	1	2.83	1.0
Manning's n-value ... =	0.03	0.069	0.074
Flow length (ft) .... =	281	50	163
Channel flow time .... =	2.45	0.40	1.80

Sheet flow time = 19.82 min

Shallow conc. flow time = 1.01 min

Channel flow time = 4.65 min

Time of conc., Tc = 25.5 min

Compute | Print... | Help | Exit

TR-55 Tc Worksheet

Sheet Flow

	A	B	C
Manning's n-value .... =			
Flow length (ft, 300 max.) =			
Two-yr 24-hr rain (in) .... =			
Land slope (%) .... =			
Sheet flow time .... =	0.00	0.00	0.00

Shallow Concentrated Flow

	A	B	C
Flow length (ft) .... =			
Watercourse slope (%) .... =			
Surface description .... =	Unpaved	Paved	Paved
Shallow conc. flow time .. =	0.00	0.00	0.00

Channel Flow

	A	B	C
X-sectional area (sqft) =	3.97	2.03	3.41
Wetted perimeter (ft) =	8.91	7.62	9.63
Channel slope (%) .... =	3	25	5.5
Manning's n-value ... =	0.074	0.074	0.074
Flow length (ft) .... =	50	42	99
Channel flow time .... =	0.41	0.17	0.70

Sheet flow time = 0.00 min

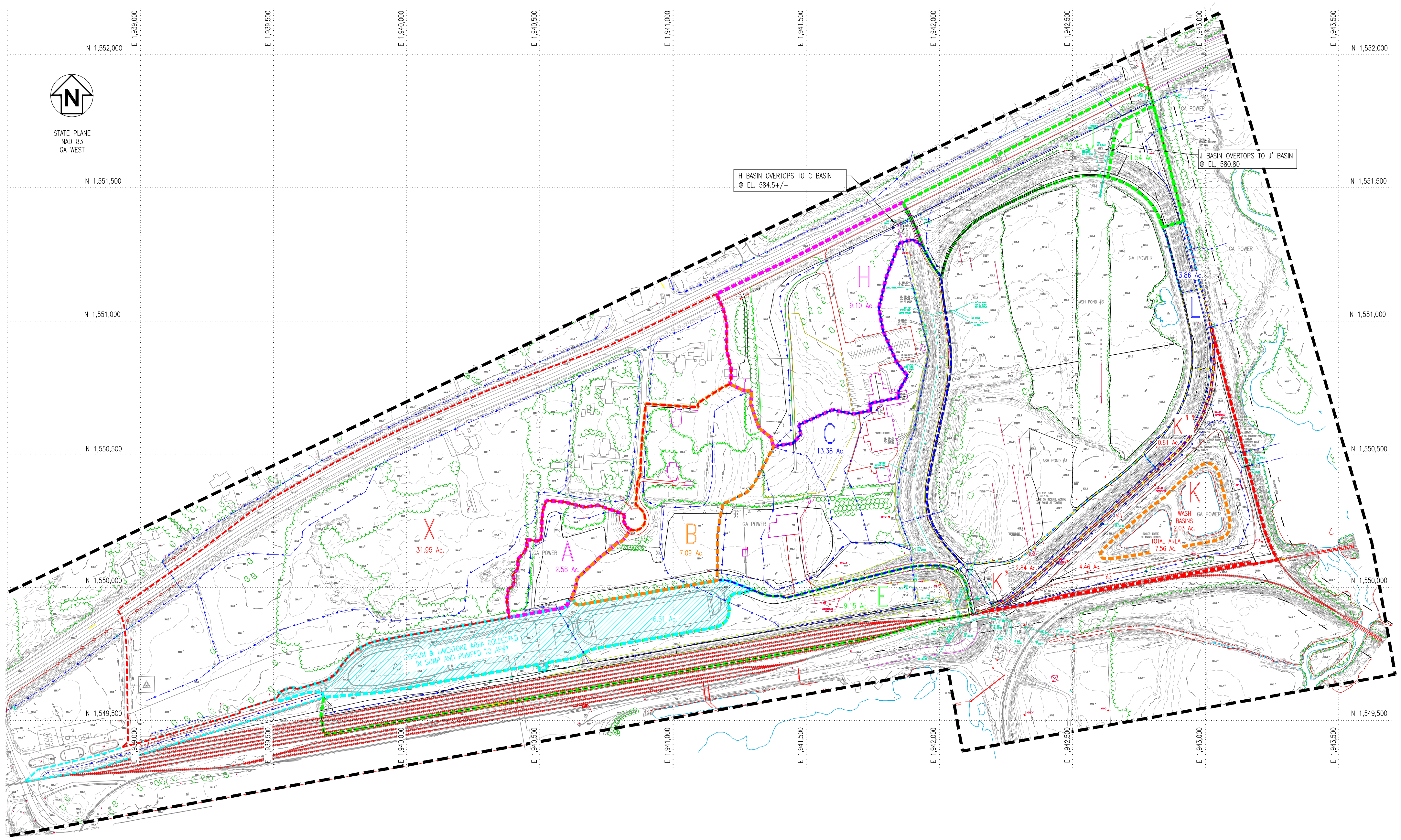
Shallow conc. flow time = 0.00 min

Channel flow time = 1.28 min

Time of conc., Tc = 1.3 min

Compute | Print... | Help | Exit

Drainage Maps
Pre- & Post-Development



SURVEY NOTES:

1. SURVEY DATA COLLECTED BY GEORGIA LAND DEPT. AND CFS SURVEY JULY 2015.
2. LIDAR TOPO FROM METRO ENGINEERING & SURVEYING CO. INC. 2012
3. CONTOUR INTERVAL 1 FOOT.
4. CONTOURS WERE PRODUCED BY DIGITAL TERRAIN MODEL.

GRAPHIC SCALE

150 0 75 150 300 600

(IN FEET)
1 inch = 150 ft.

REVISION A DATE 2/19/16

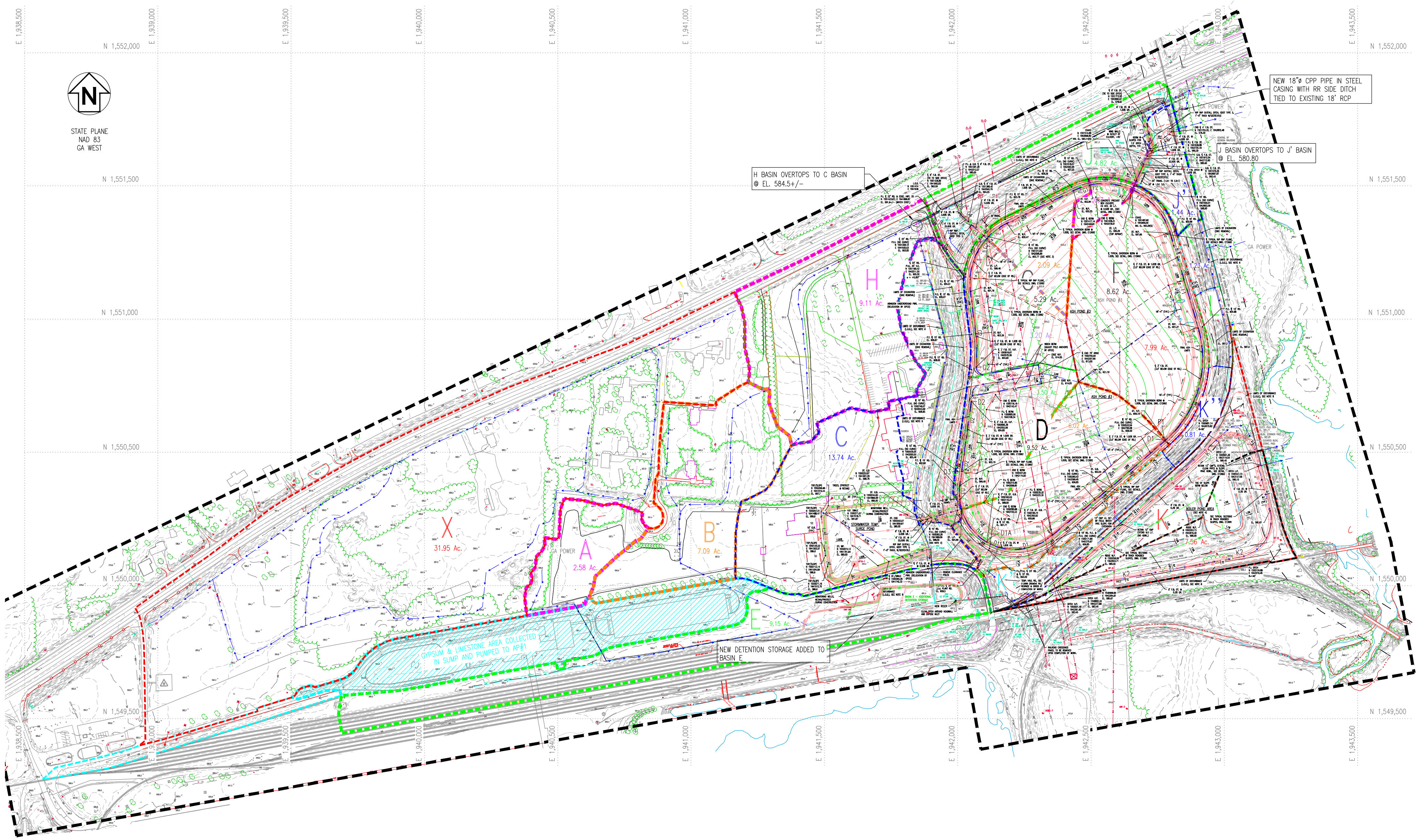
BY CRJ / RVR

Southern Company Generation
Engineering and Construction Services
FOR
Georgia Power Company

PLANT HAMMOND
PRE-DEVELOPMENT
DRAINAGE MAP

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
1" = 150'	PRE-DEV	1	FINAL	A

ANSI E: 44x34



SURVEY NOTES:

1. SURVEY DATA COLLECTED BY GEORGIA LAND DEPT. AND CFS SURVEY JULY 2015.
2. LIDAR TOPO FROM METRO ENGINEERING & SURVEYING CO. INC. 2012
3. CONTOUR INTERVAL 1 FOOT.
4. CONTOURS WERE PRODUCED BY DIGITAL TERRAIN MODEL.

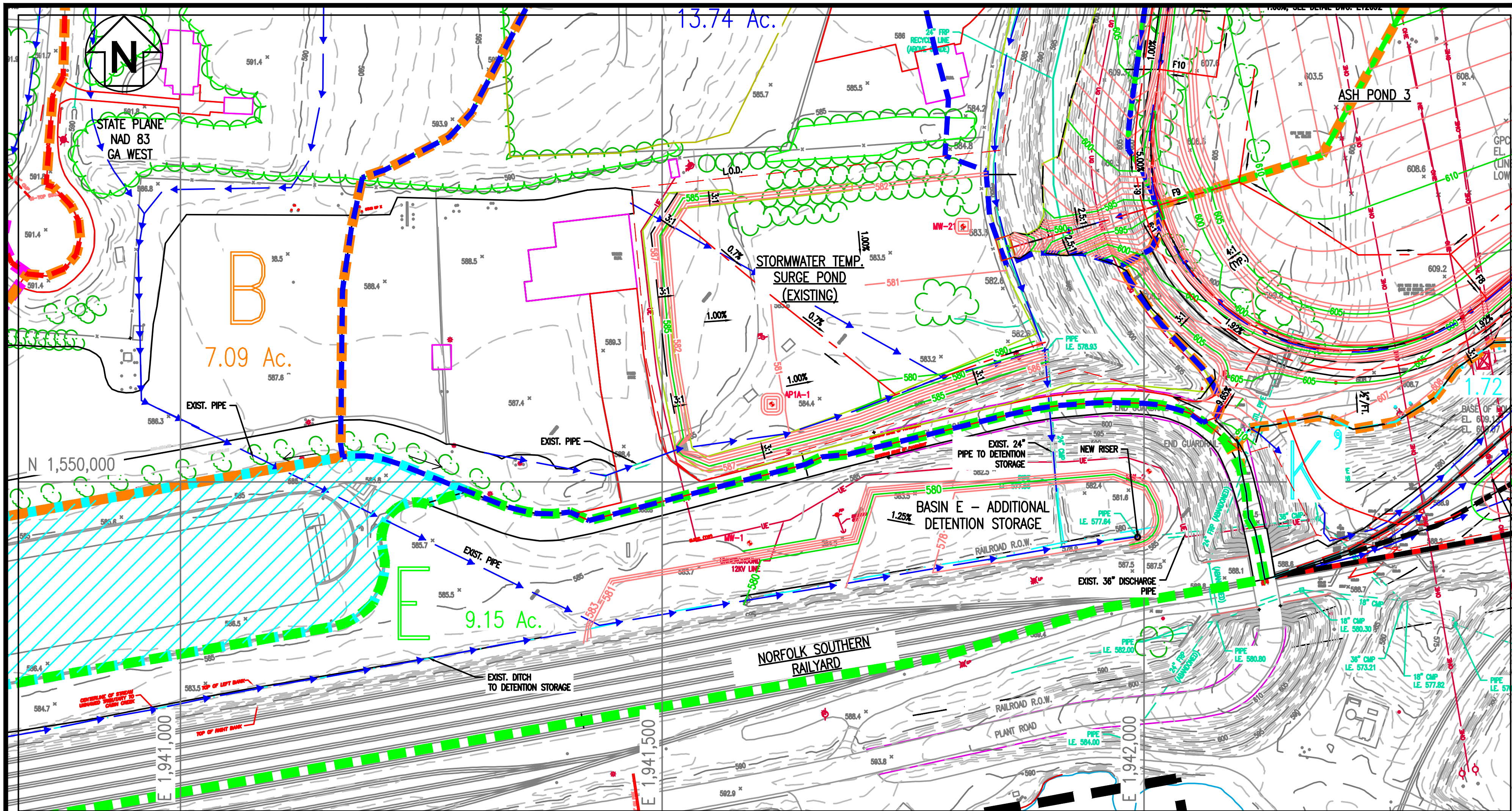
GRAPHIC SCALE
150 0 75 150 300 600
(IN FEET)
1 inch = 150 ft.

Southern Company Generation Engineering and Construction Services
FOR
Georgia Power Company

PLANT HAMMOND
POST-DEVELOPMENT
DRAINAGE MAP

REVISION	DATE	BY	SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
A	2/19/16	CRU / RVR	1" = 150'	POST-DEV	1	FINAL	A

ANSI E: 44x34



A	11-14-18	DETENTION	CRU						
REV.	DATE	DESCRIPTION	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR

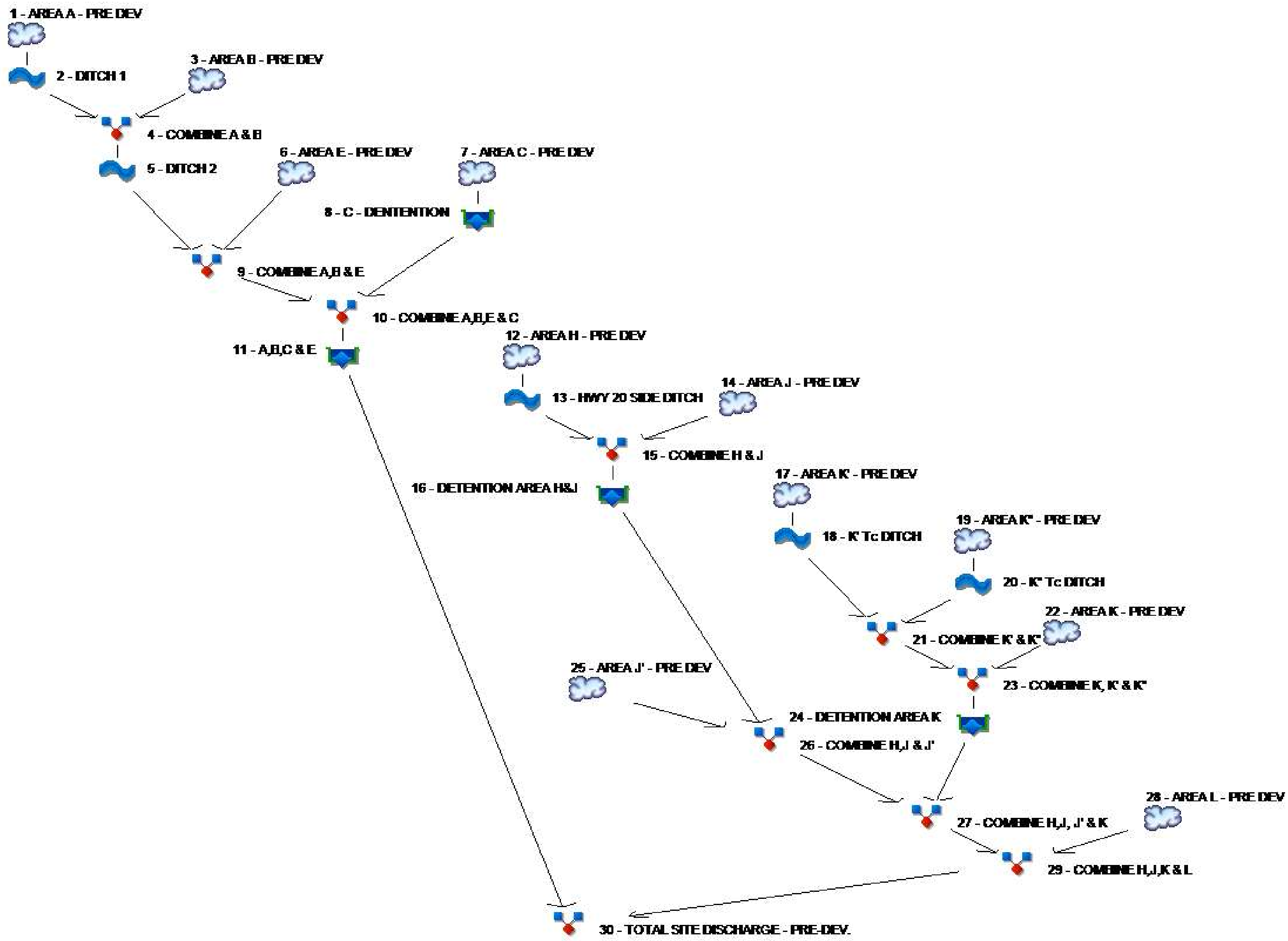
Southern Company Generation
Engineering and Construction Services
FOR
Georgia Power Company

NEW DETENTION STORAGE
DRAINAGE BASIN E

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
1"=150'	DETENTION	1	FINAL	A

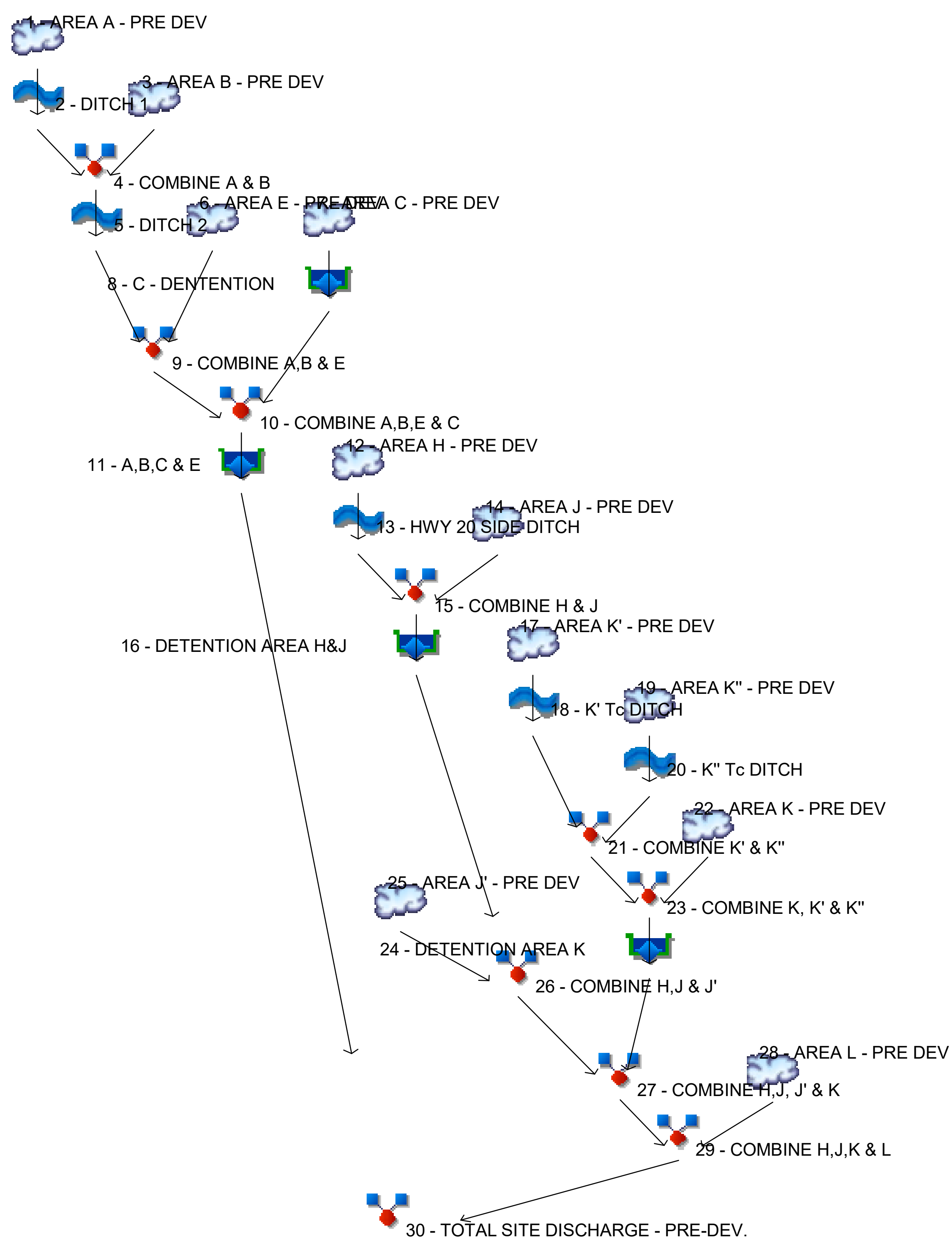
ANSI A: 11x8.5

HydraFlow Hydrographs Pre- and Post-Development Calculations


1 - AREA A - PRE DEV
2 - DITCH 1
3 - AREA B - PRE DEV
4 - COMBINE A & B
5 - DITCH 2
6 - AREA E - PRE DEV
7 - AREA C - PRE DEV
8 - C - DENTENTION
9 - COMBINE A,B & E
10 - COMBINE A,B,E & C
11 - A,B,C & E
12 - AREA H - PRE DEV
13 - HWY 20 SIDE DITCH
14 - AREA J - PRE DEV
15 - COMBINE H & J
16 - DETENTION AREA H&J
17 - AREA K' - PRE DEV
18 - K' Tc DITCH
19 - AREA K" - PRE DEV
20 - K" Tc DITCH
21 - COMBINE K' & K"
22 - AREA K - PRE DEV
23 - COMBINE K, K' & K"
24 - DETENTION AREA K
25 - AREA J' - PRE DEV
26 - COMBINE H,J & J'
27 - COMBINE H,J, J' & K
28 - AREA L - PRE DEV
29 - COMBINE H,J,K & L
30 - TOTAL SITE DISCHARGE - PRE-DEV.

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	------	-------	-------	-------	-------	-------	9.405	11.34	13.37	AREA A - PRE DEV
2	Reach	1	-------	-------	-------	-------	-------	9.020	10.92	12.91	DITCH 1
3	SCS Runoff	------	-------	-------	-------	-------	-------	21.54	26.45	31.62	AREA B - PRE DEV
4	Combine	2, 3	-------	-------	-------	-------	-------	30.48	37.25	44.38	COMBINE A & B
5	Reach	4	-------	-------	-------	-------	-------	30.02	36.76	43.84	DITCH 2
6	SCS Runoff	------	-------	-------	-------	-------	-------	14.07	17.70	21.56	AREA E - PRE DEV
7	SCS Runoff	------	-------	-------	-------	-------	-------	41.51	50.52	59.98	AREA C - PRE DEV
8	Reservoir	7	-------	-------	-------	-------	-------	14.81	15.15	15.52	C - DENTENTION
9	Combine	5, 6,	-------	-------	-------	-------	-------	40.23	49.72	59.77	COMBINE A,B & E
10	Combine	8, 9	-------	-------	-------	-------	-------	54.18	64.41	74.70	COMBINE A,B,E & C
11	Reservoir	10	-------	-------	-------	-------	-------	42.01	44.22	46.02	A,B,C & E
12	SCS Runoff	------	-------	-------	-------	-------	-------	25.24	30.87	36.81	AREA H - PRE DEV
13	Reach	12	-------	-------	-------	-------	-------	23.97	29.45	35.24	HWY 20 SIDE DITCH
14	SCS Runoff	------	-------	-------	-------	-------	-------	16.00	19.59	23.37	AREA J - PRE DEV
15	Combine	13, 14	-------	-------	-------	-------	-------	33.48	41.30	49.58	COMBINE H & J
16	Reservoir	15	-------	-------	-------	-------	-------	31.24	40.90	49.58	DETENTION AREA H&J
17	SCS Runoff	------	-------	-------	-------	-------	-------	6.615	8.234	9.952	AREA K' - PRE DEV
18	Reach	17	-------	-------	-------	-------	-------	4.463	5.715	7.065	K' Tc DITCH
19	SCS Runoff	------	-------	-------	-------	-------	-------	2.988	3.739	4.539	AREA K'' - PRE DEV
20	Reach	19	-------	-------	-------	-------	-------	2.797	3.524	4.299	K'' Tc DITCH
21	Combine	18, 20	-------	-------	-------	-------	-------	7.113	9.058	11.15	COMBINE K' & K''
22	SCS Runoff	------	-------	-------	-------	-------	-------	34.53	40.17	45.96	AREA K - PRE DEV
23	Combine	21, 22	-------	-------	-------	-------	-------	41.20	48.75	56.61	COMBINE K, K' & K''
24	Reservoir	23	-------	-------	-------	-------	-------	8.514	8.947	9.226	DETENTION AREA K
25	SCS Runoff	------	-------	-------	-------	-------	-------	6.797	8.455	10.22	AREA J' - PRE DEV
26	Combine	16, 25	-------	-------	-------	-------	-------	32.65	42.22	51.90	COMBINE H,J & J'
27	Combine	24, 26	-------	-------	-------	-------	-------	40.77	51.05	60.84	COMBINE H,J, J' & K
28	SCS Runoff	------	-------	-------	-------	-------	-------	4.403	5.477	6.618	AREA L - PRE DEV
29	Combine	27, 28	-------	-------	-------	-------	-------	43.51	51.90	62.79	COMBINE H,J,K & L
30	Combine	11, 29	-------	-------	-------	-------	-------	82.50	93.19	103.67	TOTAL SITE DISCHARGE - PRE-DE

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	SCS Runoff	9.405	1	725	29,429	------	------	------	AREA A - PRE DEV
2	Reach	9.020	1	728	29,427	1	------	------	DITCH 1
3	SCS Runoff	21.54	1	726	71,679	------	------	------	AREA B - PRE DEV
4	Combine	30.48	1	727	101,106	2, 3	------	------	COMBINE A & B
5	Reach	30.02	1	729	101,104	4	------	------	DITCH 2
6	SCS Runoff	14.07	1	742	79,687	------	------	------	AREA E - PRE DEV
7	SCS Runoff	41.51	1	727	141,941	------	------	------	AREA C - PRE DEV
8	Reservoir	14.81	1	746	141,938	7	582.05	36,647	C - DENTENTION
9	Combine	40.23	1	731	180,791	5, 6,	------	------	COMBINE A,B & E
10	Combine	54.18	1	731	322,730	8, 9	------	------	COMBINE A,B,E & C
11	Reservoir	42.01	1	745	322,699	10	581.23	18,521	A,B,C & E
12	SCS Runoff	25.24	1	730	95,092	------	------	------	AREA H - PRE DEV
13	Reach	23.97	1	734	95,089	12	------	------	HWY 20 SIDE DITCH
14	SCS Runoff	16.00	1	722	43,259	------	------	------	AREA J - PRE DEV
15	Combine	33.48	1	727	138,348	13, 14	------	------	COMBINE H & J
16	Reservoir	31.24	1	733	138,348	15	580.29	2,055	DETENTION AREA H&J
17	SCS Runoff	6.615	1	719	13,990	------	------	------	AREA K' - PRE DEV
18	Reach	4.463	1	723	13,985	17	------	------	K' Tc DITCH
19	SCS Runoff	2.988	1	719	6,332	------	------	------	AREA K'' - PRE DEV
20	Reach	2.797	1	721	6,331	19	------	------	K'' Tc DITCH
21	Combine	7.113	1	722	20,317	18, 20	------	------	COMBINE K' & K''
22	SCS Runoff	34.53	1	720	84,960	------	------	------	AREA K - PRE DEV
23	Combine	41.20	1	720	105,277	21, 22	------	------	COMBINE K, K' & K''
24	Reservoir	8.514	1	735	105,276	23	582.74	32,233	DETENTION AREA K
25	SCS Runoff	6.797	1	718	13,679	------	------	------	AREA J' - PRE DEV
26	Combine	32.65	1	724	152,027	16, 25	------	------	COMBINE H,J & J'
27	Combine	40.77	1	724	257,303	24, 26	------	------	COMBINE H,J, J' & K
28	SCS Runoff	4.403	1	718	8,861	------	------	------	AREA L - PRE DEV
29	Combine	43.51	1	720	266,164	27, 28	------	------	COMBINE H,J,K & L
30	Combine	82.50	1	735	588,865	11, 29	------	------	TOTAL SITE DISCHARGE - PRE-DE

Hydrograph Report

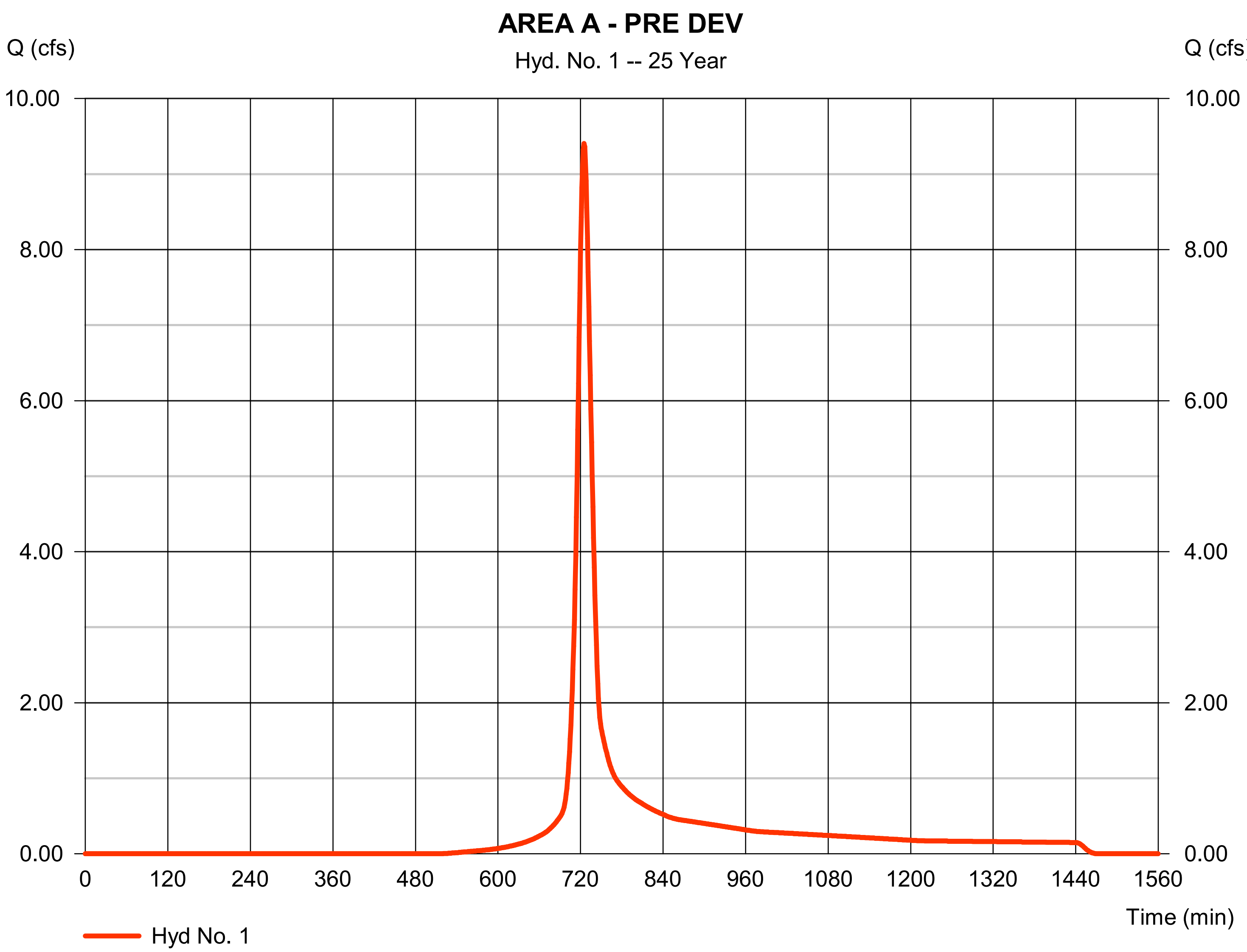
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 1

AREA A - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 9.405 cfs
Storm frequency	= 25 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 29,429 cuft
Drainage area	= 2.580 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.10 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.220 x 85) + (0.570 x 55) + (0.030 x 98) + (0.760 x 60)] / 2.580



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No. 1

AREA A - PRE DEV

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	50.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.82		0.00		0.00		
Land slope (%)	=	16.00		0.00		0.00		
Travel Time (min)	**=**	**3.27**	**+**	**0.00**	**+**	**0.00**	**=**	**3.27**
Shallow Concentrated Flow								
Flow length (ft)	=	620.00		0.00		0.00		
Watercourse slope (%)	=	0.17		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	0.67		0.00		0.00		
Travel Time (min)	**=**	**15.53**	**+**	**0.00**	**+**	**0.00**	**=**	**15.53**
Channel Flow								
X sectional flow area (sqft)	=	2.89		0.00		0.00		
Wetted perimeter (ft)	=	7.29		0.00		0.00		
Channel slope (%)	=	0.50		0.00		0.00		
Manning's n-value	=	0.030		0.015		0.015		
Velocity (ft/s)	=	1.89		0.00		0.00		
Flow length (ft)		({0})150.0		0.0		0.0		
Travel Time (min)	**=**	**1.32**	**+**	**0.00**	**+**	**0.00**	**=**	**1.32**

Total Travel Time, Tc .... 20.10 min

Hydrograph Report

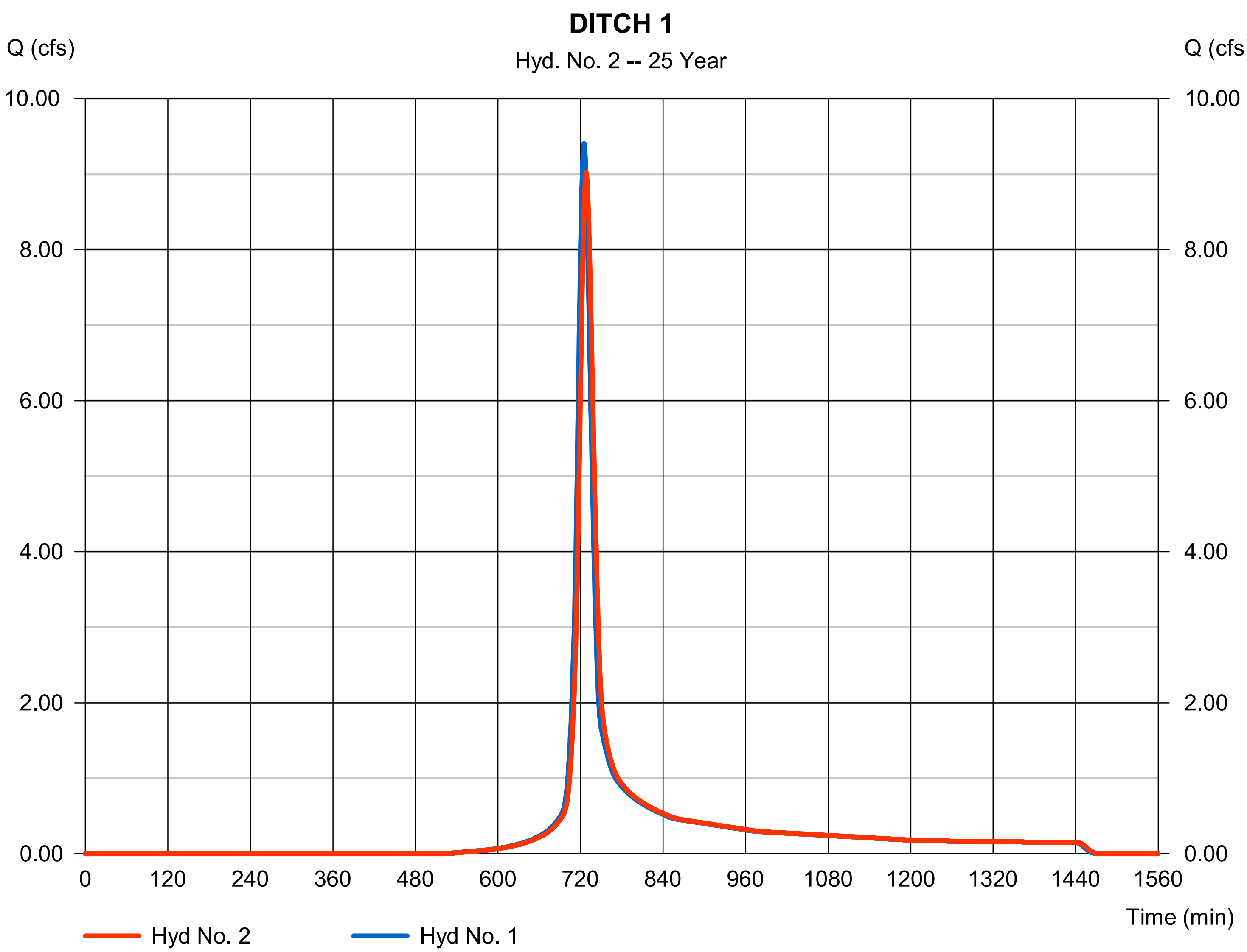
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 2

DITCH 1

Hydrograph type	= Reach	Peak discharge	= 9.020 cfs
Storm frequency	= 25 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 29,427 cuft
Inflow hyd. No.	= 1 - AREA A - PRE DEV	Section type	= Trapezoidal
Reach length	= 730.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 10.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.375
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.3038

Modified Att-Kin routing method used.



Hydrograph Report

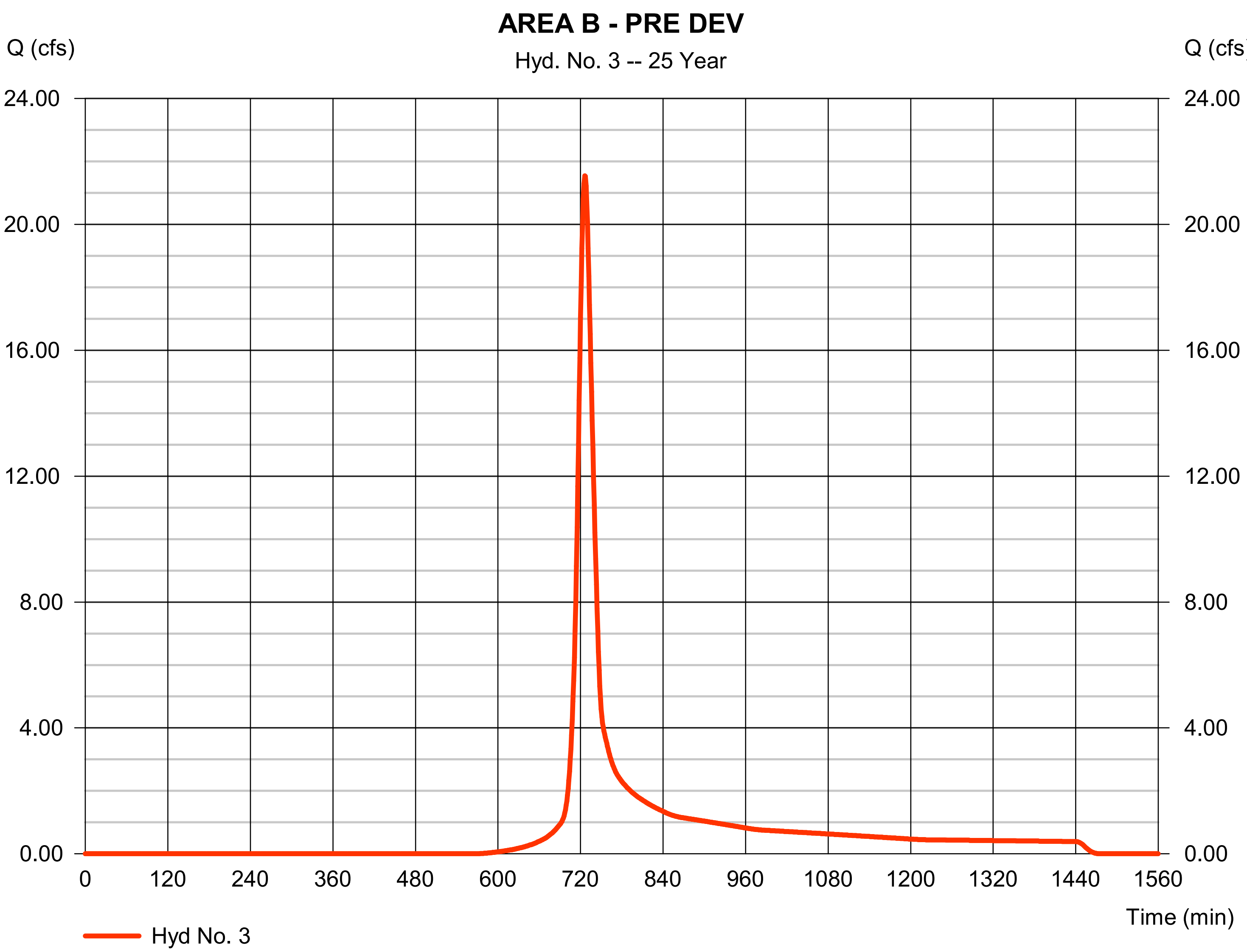
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 3

AREA B - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 21.54 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 71,679 cuft
Drainage area	= 7.090 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.80 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.930 x 85) + (2.120 x 55) + (0.250 x 98) + (2.790 x 60)] / 7.090



TR55 Tc Worksheet

Hyd. No. 3

AREA B - PRE DEV

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	150.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.82		3.82		0.00		
Land slope (%)	=	3.60		0.00		0.00		
Travel Time (min)	**=**	**14.28**	**+**	**0.00**	**+**	**0.00**	**=**	**14.28**
Shallow Concentrated Flow								
Flow length (ft)	=	0.00		0.00		0.00		
Watercourse slope (%)	=	0.00		0.00		0.00		
Surface description	=	Paved		Paved		Paved		
Average velocity (ft/s)	=	0.00		0.00		0.00		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow								
X sectional flow area (sqft)	=	5.60		5.04		0.00		
Wetted perimeter (ft)	=	18.05		14.27		0.00		
Channel slope (%)	=	0.80		0.66		0.00		
Manning's n-value	=	0.030		0.027		0.015		
Velocity (ft/s)	=	2.03		2.23		0.00		
Flow length (ft)		({0})500.0		320.0		0.0		
Travel Time (min)	**=**	**4.11**	**+**	**2.39**	**+**	**0.00**	**=**	**6.50**

Total Travel Time, Tc .... 20.80 min

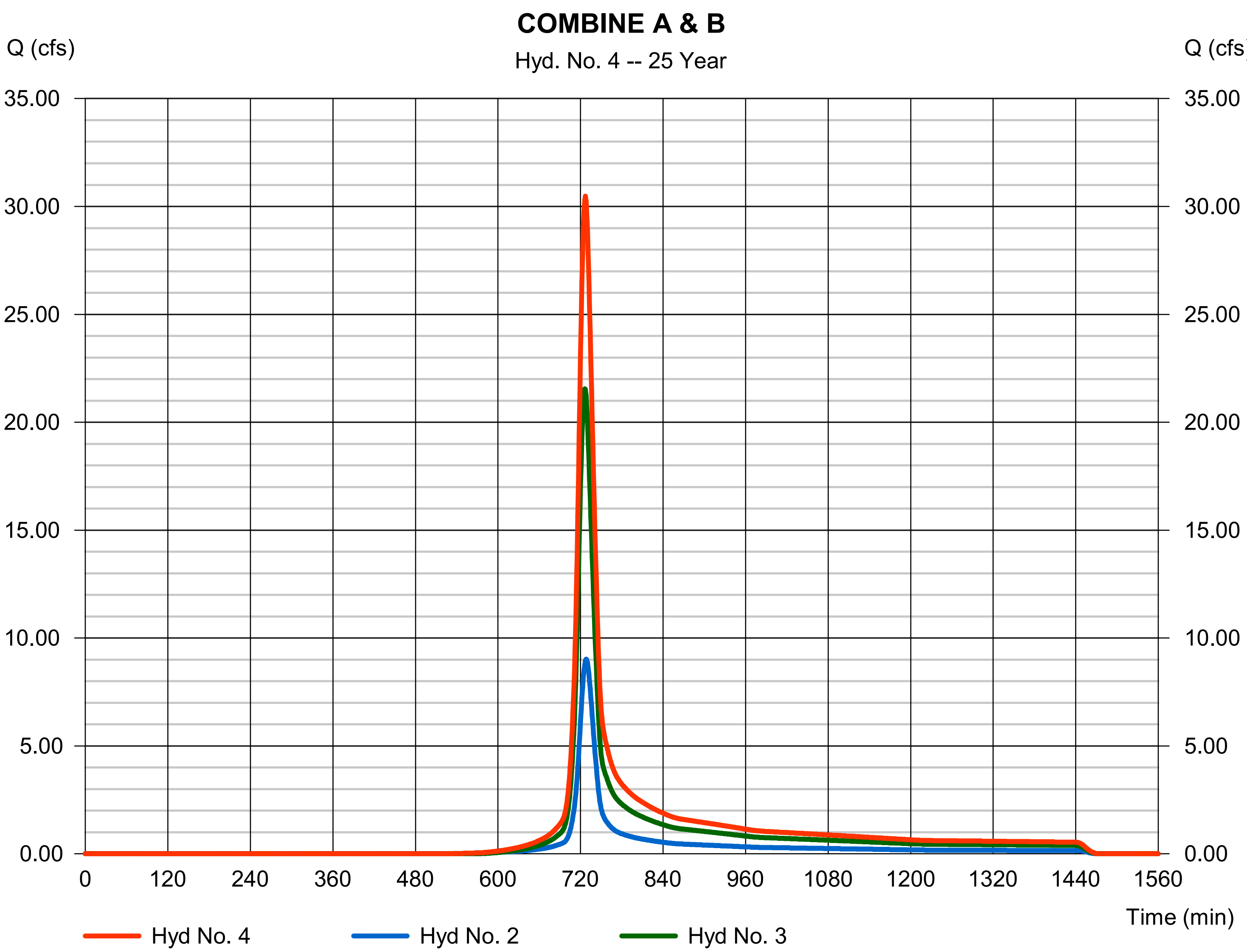
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 4

COMBINE A & B

Hydrograph type	= Combine	Peak discharge	= 30.48 cfs
Storm frequency	= 25 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 101,106 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 7.090 ac



Hydrograph Report

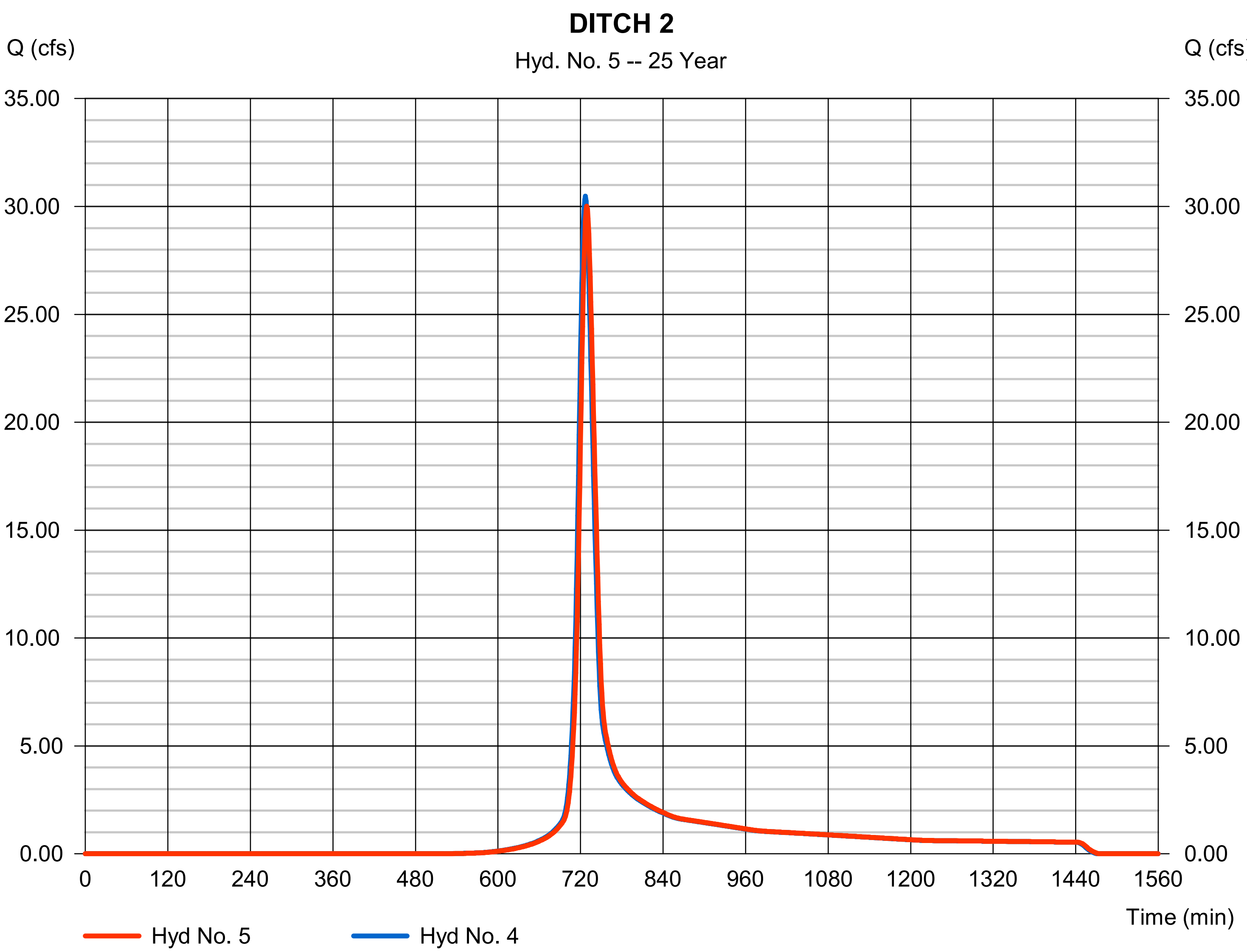
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 5

DITCH 2

Hydrograph type	= Reach	Peak discharge	= 30.02 cfs
Storm frequency	= 25 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 101,104 cuft
Inflow hyd. No.	= 4 - COMBINE A & B	Section type	= Trapezoidal
Reach length	= 610.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.373
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.4543

Modified Att-Kin routing method used.



Hydrograph Report

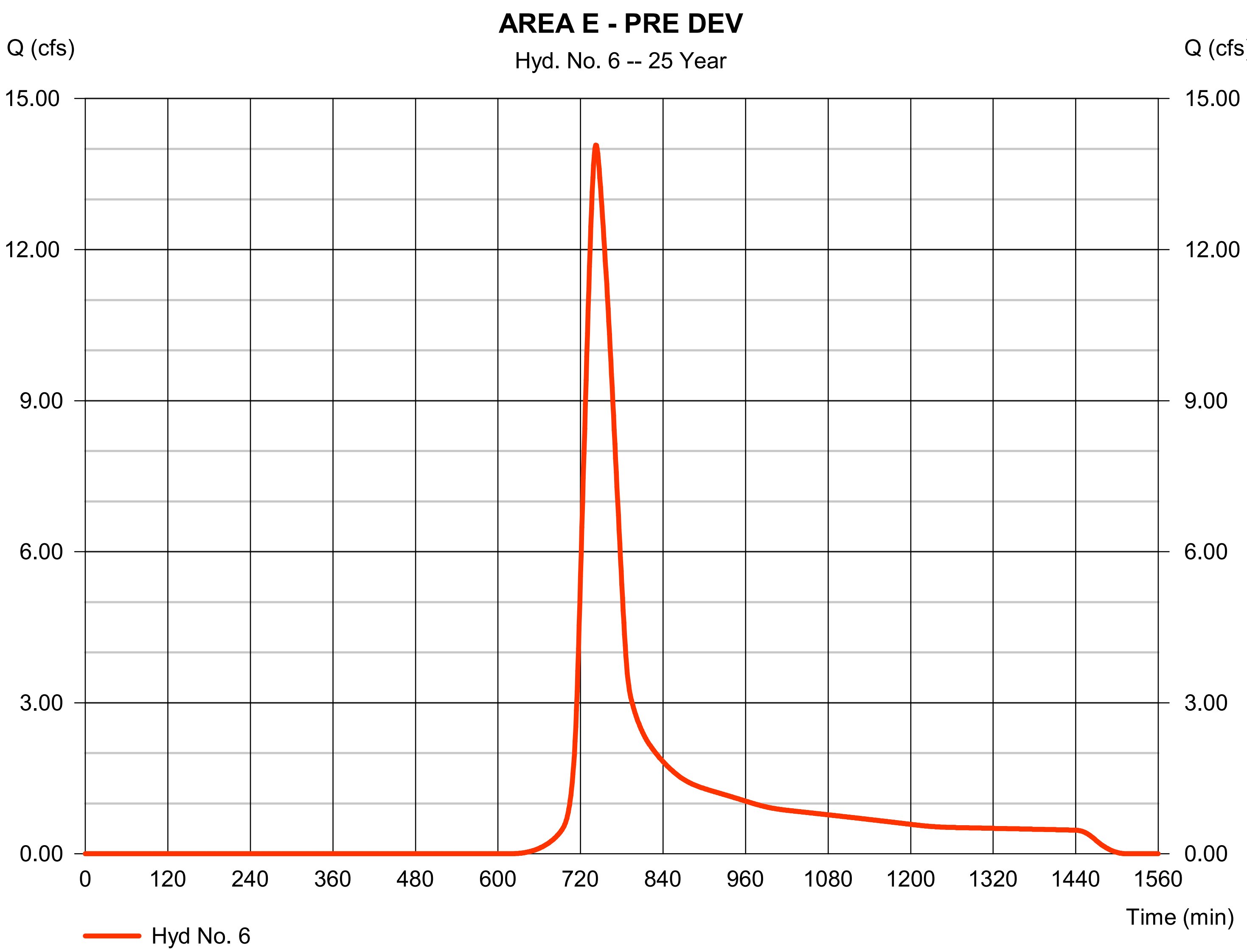
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 6

AREA E - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 14.07 cfs
Storm frequency	= 25 yrs	Time to peak	= 742 min
Time interval	= 1 min	Hyd. volume	= 79,687 cuft
Drainage area	= 9.150 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 47.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.680 x 65) + (0.330 x 98) + (5.140 x 60)] / 9.150



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No. 6

AREA E - PRE DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 80.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		0.00		0.00		
Land slope (%)	= 1.20		0.00		0.00		
Travel Time (min)	**= 13.40**	**+**	**0.00**	**+**	**0.00**	**=**	**13.40**
Shallow Concentrated Flow							
Flow length (ft)	= 0.00		0.00		0.00		
Watercourse slope (%)	= 0.00		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=0.00		0.00		0.00		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow							
X sectional flow area (sqft)	= 7.51		5.60		0.00		
Wetted perimeter (ft)	= 19.73		9.32		0.00		
Channel slope (%)	= 0.45		0.45		0.00		
Manning's n-value	= 0.065		0.065		0.015		
Velocity (ft/s)	=0.81		1.09		0.00		
Flow length (ft)	({0})520.0		1500.0		0.0		
Travel Time (min)	**= 10.76**	**+**	**22.87**	**+**	**0.00**	**=**	**33.63**

Total Travel Time, Tc .... **47.00 min**

Hydrograph Report

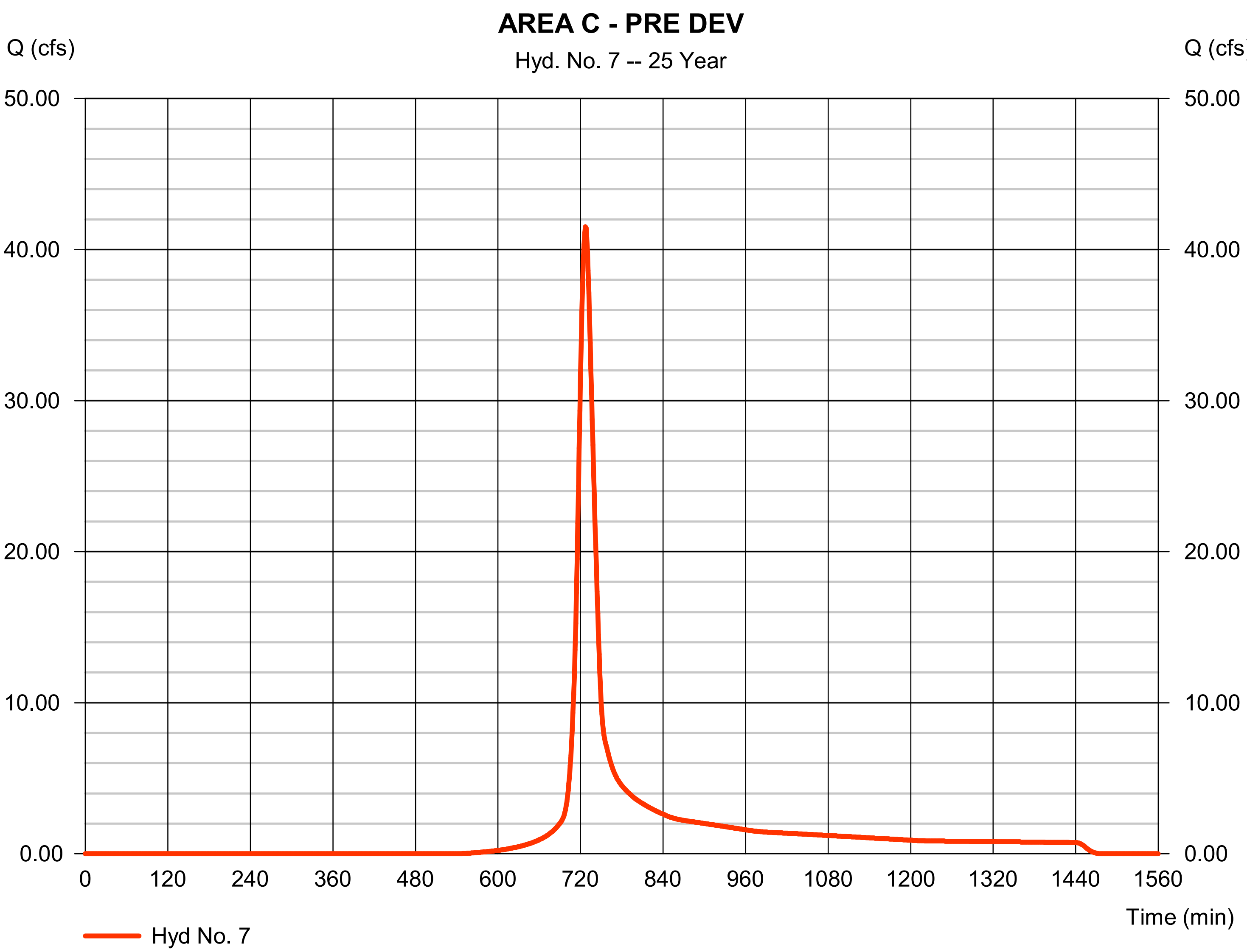
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 7

AREA C - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 41.51 cfs
Storm frequency	= 25 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 141,941 cuft
Drainage area	= 13.380 ac	Curve number	= 69*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.210 x 85) + (0.400 x 55) + (1.740 x 98) + (9.030 x 60)] / 13.380



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No. 7

AREA C - PRE DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.240		0.011		
Flow length (ft)	= 115.0		22.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		3.82		0.00		
Land slope (%)	= 2.80		13.50		0.00		
Travel Time (min)	**= 12.77**	**+**	**1.81**	**+**	**0.00**	**=**	**14.58**
Shallow Concentrated Flow							
Flow length (ft)	= 350.00		0.00		0.00		
Watercourse slope (%)	= 0.70		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.35		0.00		0.00		
Travel Time (min)	**= 4.32**	**+**	**0.00**	**+**	**0.00**	**=**	**4.32**
Channel Flow							
X sectional flow area (sqft)	= 9.78		0.00		0.00		
Wetted perimeter (ft)	= 20.48		0.00		0.00		
Channel slope (%)	= 0.60		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=2.34						
			0.00				
					0.00		
Flow length (ft)	({0})575.0		0.0		0.0		
Travel Time (min)	**= 4.09**	**+**	**0.00**	**+**	**0.00**	**=**	**4.09**

Total Travel Time, Tc .... 23.00 min

Hydrograph Report

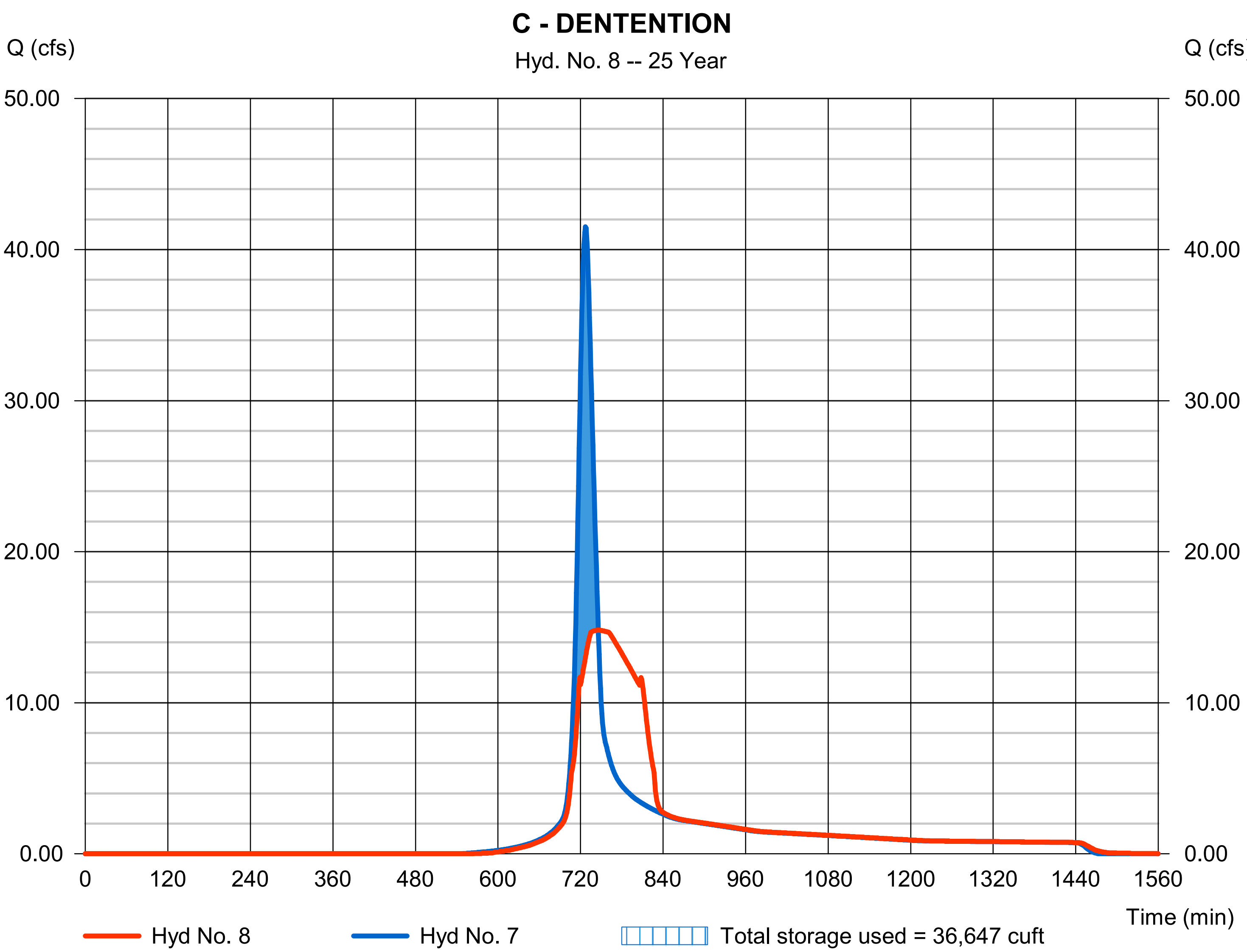
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 8

C - DENTENTION

Hydrograph type	= Reservoir	Peak discharge	= 14.81 cfs
Storm frequency	= 25 yrs	Time to peak	= 746 min
Time interval	= 1 min	Hyd. volume	= 141,938 cuft
Inflow hyd. No.	= 7 - AREA C - PRE DEV	Max. Elevation	= 582.05 ft
Reservoir name	= C DETENTION	Max. Storage	= 36,647 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Pond No. 4 - C DETENTION

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	579.00	n/a	0	0
1.00	580.00	n/a	1,590	1,590
2.00	581.00	n/a	6,975	8,565
3.00	582.00	n/a	22,614	31,179
4.00	583.00	n/a	113,247	144,426
5.00	584.00	n/a	217,742	362,168

Culvert / Orifice Structures

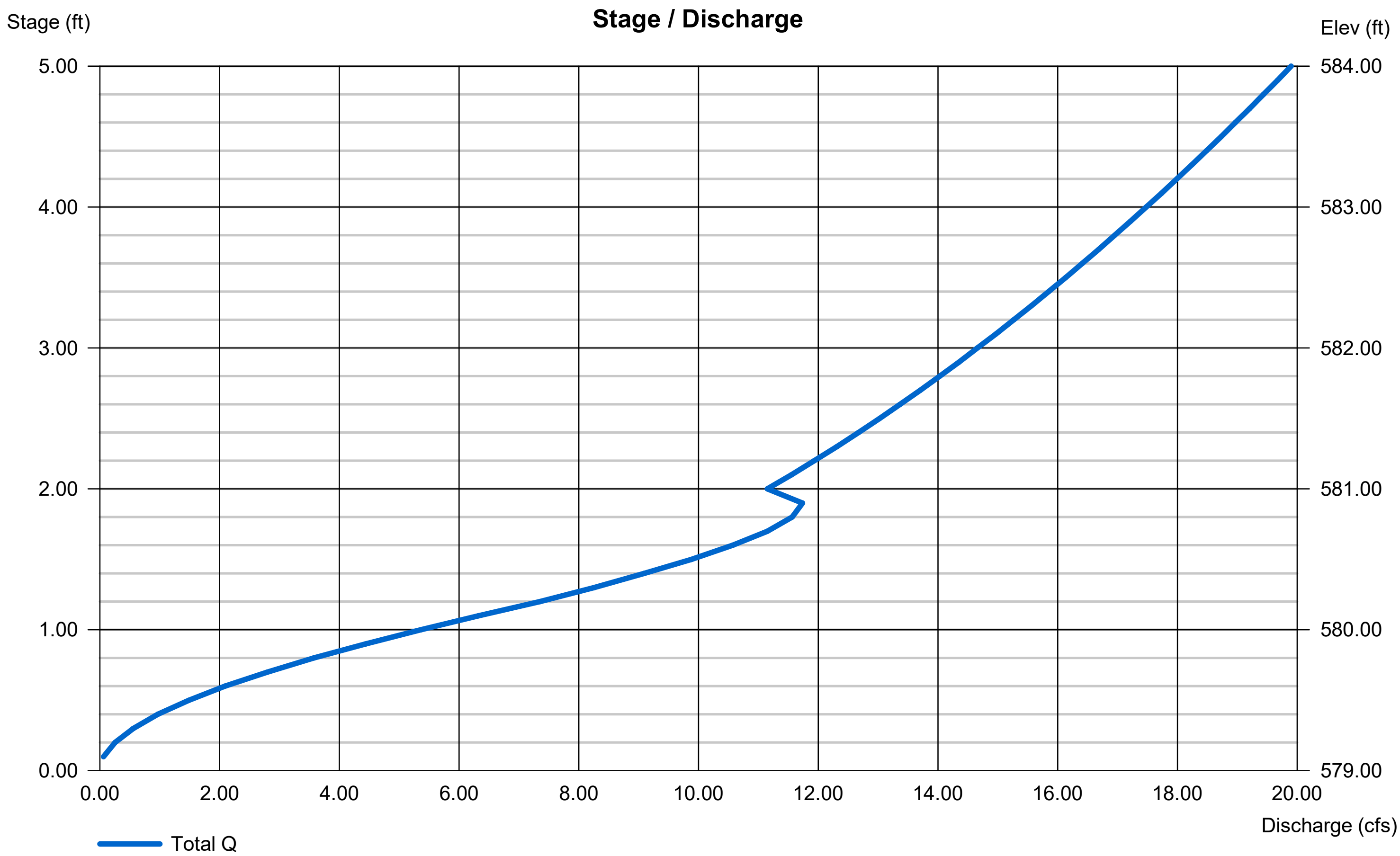
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 579.00	0.00	0.00	0.00
Length (ft)	= 143.00	0.00	0.00	0.00
Slope (%)	= 0.96	0.00	0.00	n/a
N-Value	= .023	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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



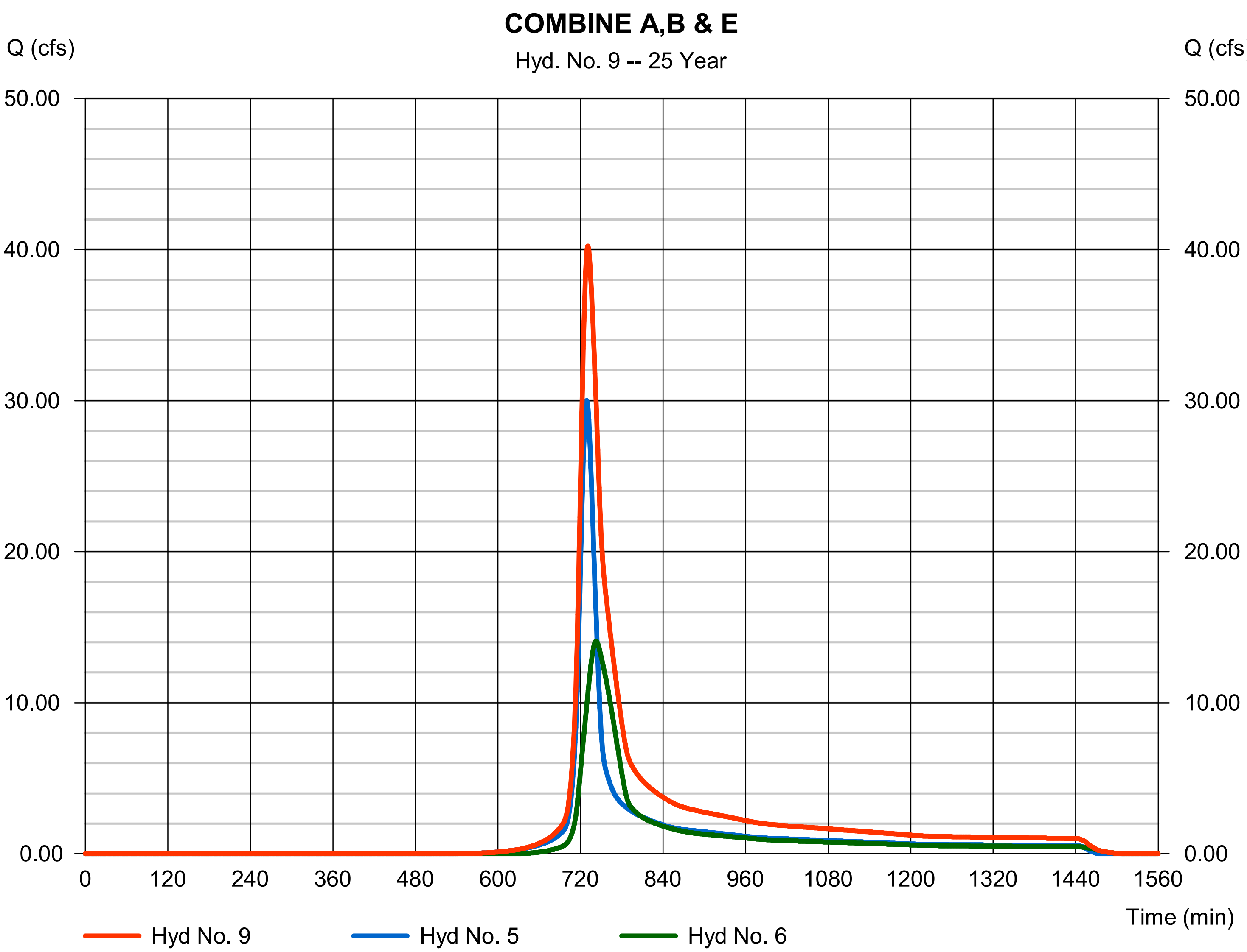
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 9

COMBINE A,B & E

Hydrograph type	= Combine	Peak discharge	= 40.23 cfs
Storm frequency	= 25 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 180,791 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 9.150 ac



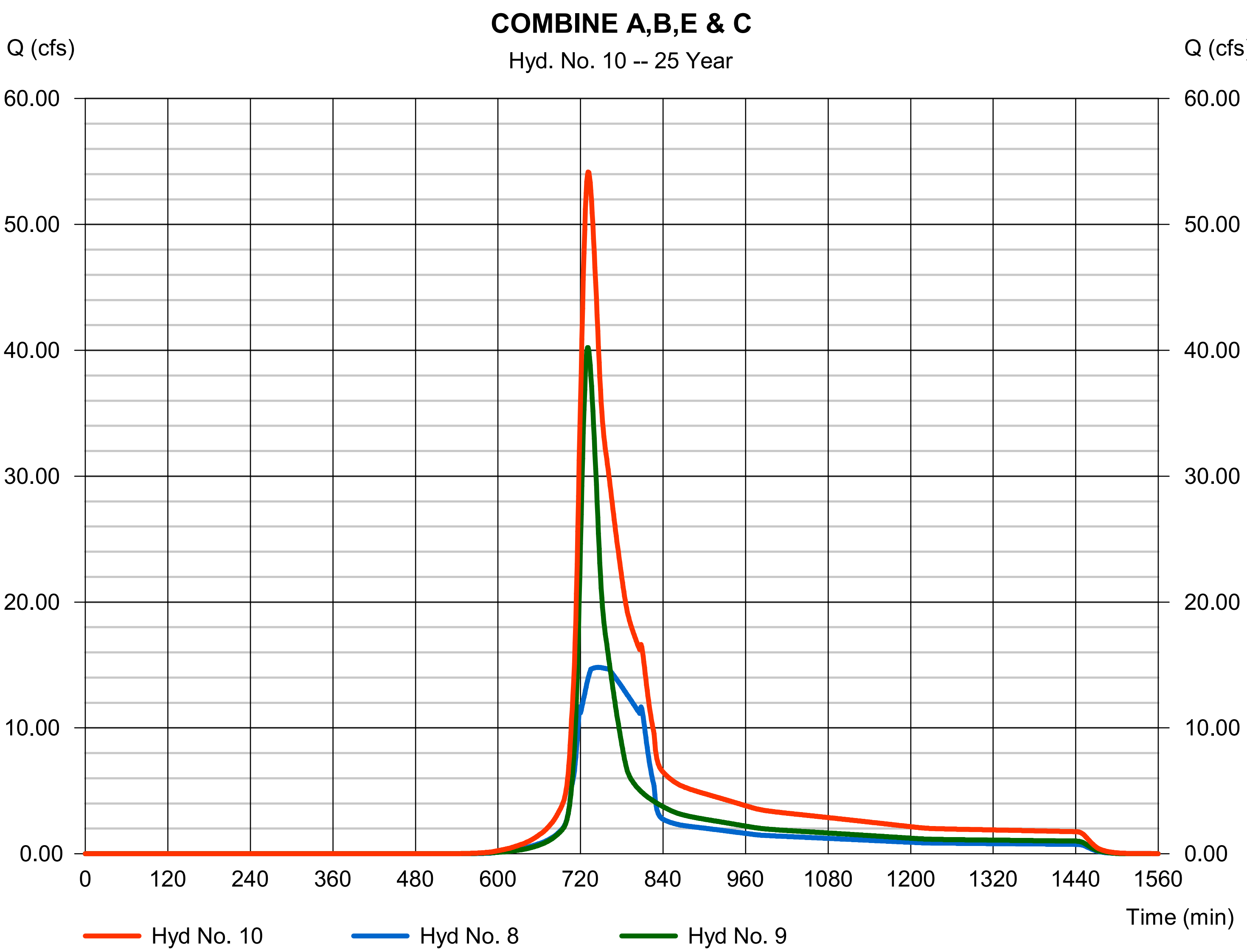
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 10

COMBINE A,B,E & C

Hydrograph type	= Combine	Peak discharge	= 54.18 cfs
Storm frequency	= 25 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 322,730 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 0.000 ac



Hydrograph Report

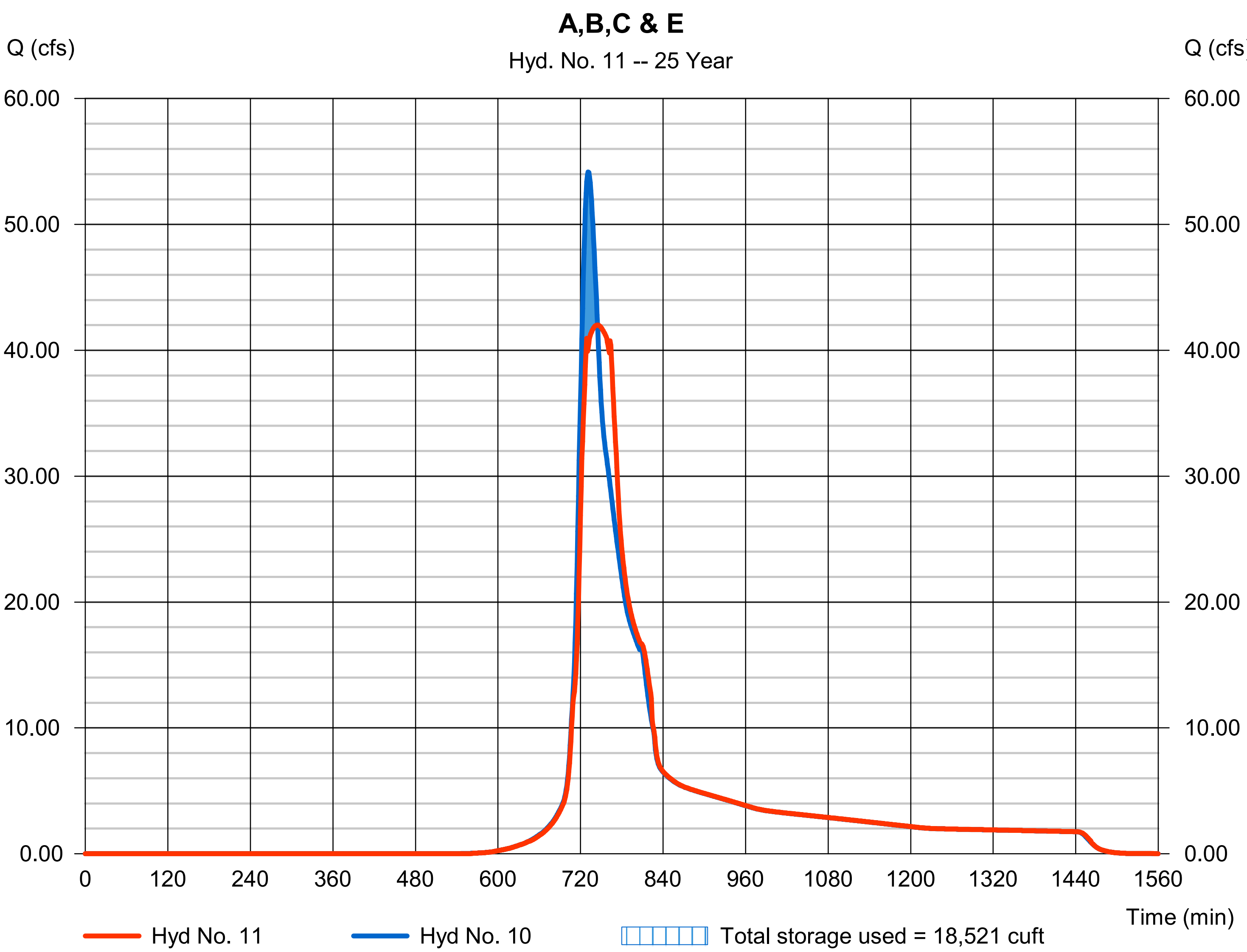
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 11 / 15 / 2018

Hyd. No. 11

A,B,C & E

Hydrograph type	= Reservoir	Peak discharge	= 42.01 cfs
Storm frequency	= 25 yrs	Time to peak	= 745 min
Time interval	= 1 min	Hyd. volume	= 322,699 cuft
Inflow hyd. No.	= 10 - COMBINE A,B,E & C	Max. Elevation	= 581.23 ft
Reservoir name	= A,B,C & E DETENTION	Max. Storage	= 18,521 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Pond No. 1 - A,B,C & E DETENTION

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	577.00	n/a	0	0
1.00	578.00	n/a	50	50
2.00	579.00	n/a	611	661
3.00	580.00	n/a	4,702	5,363
4.00	581.00	n/a	8,450	13,813
5.00	582.00	n/a	20,853	34,666
6.00	583.00	n/a	38,098	72,764
7.00	584.00	n/a	59,736	132,500
8.00	585.00	n/a	88,517	221,017
9.00	586.00	n/a	115,064	336,081

Culvert / Orifice Structures

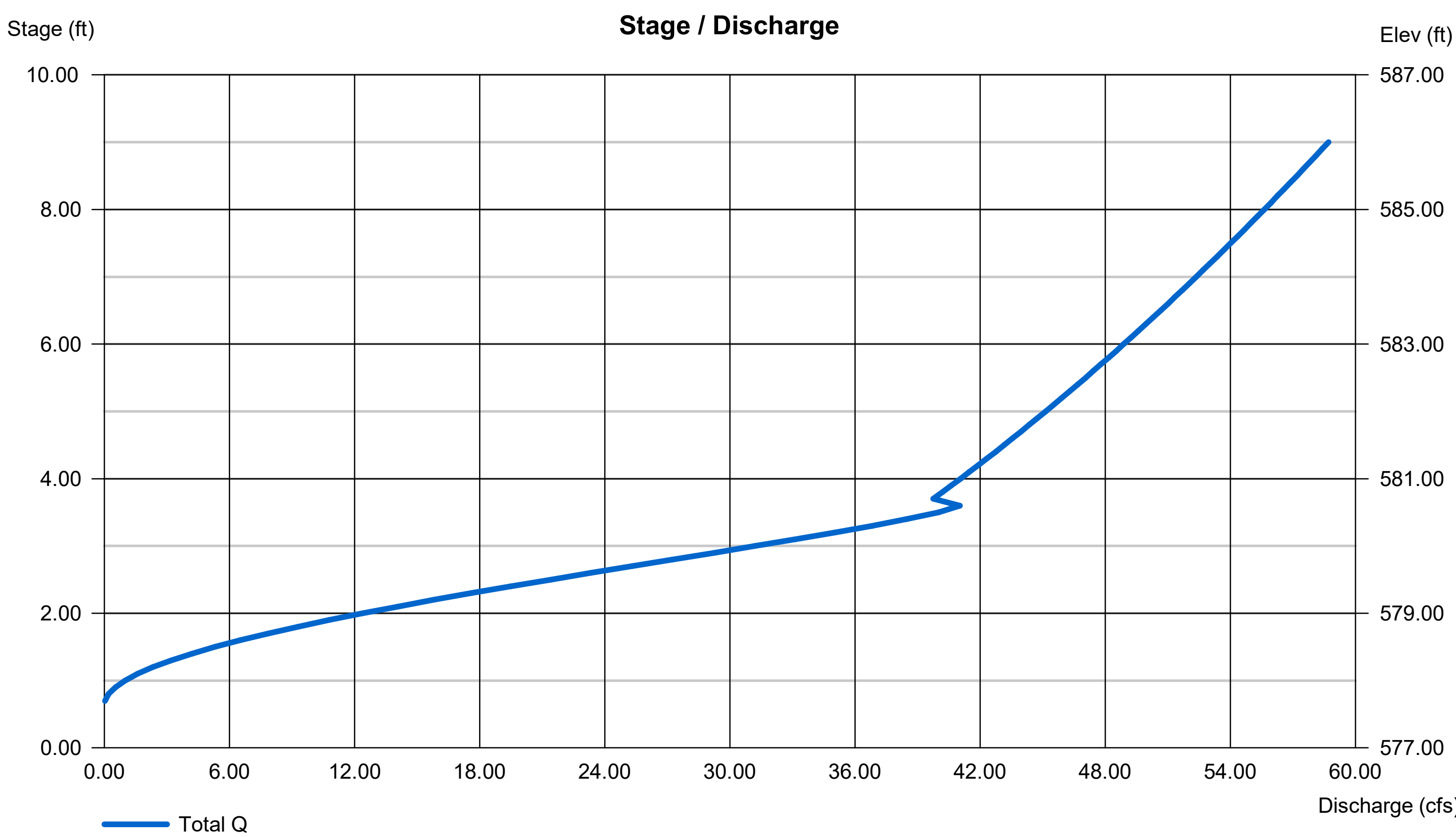
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 36.00	Inactive	Inactive	Inactive
Span (in)	= 36.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 577.64	0.00	0.00	0.00
Length (ft)	= 311.70	0.00	0.00	0.00
Slope (%)	= 1.42	0.00	0.00	n/a
N-Value	= .024	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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



Hydrograph Report

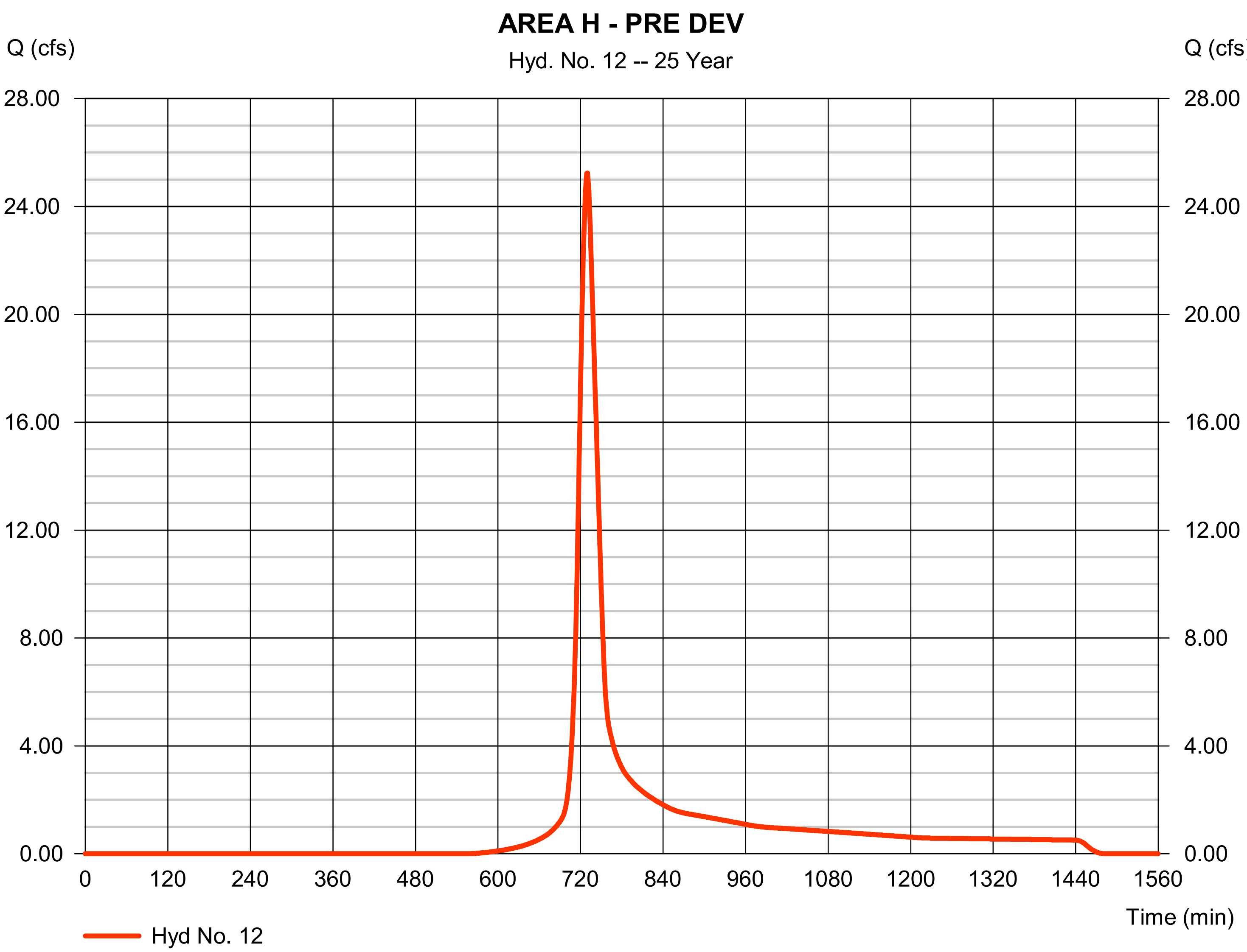
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 12

AREA H - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 25.24 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 95,092 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



TR55 Tc Worksheet

Hyd. No. 12

AREA H - PRE DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 90.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		0.00		0.00		
Land slope (%)	= 2.20		0.00		0.00		
Travel Time (min)	**= 17.39**	**+**	**0.00**	**+**	**0.00**	**=**	**17.39**
Shallow Concentrated Flow							
Flow length (ft)	= 270.00		305.00		0.00		
Watercourse slope (%)	= 2.00		0.75		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=2.28		1.40		0.00		
Travel Time (min)	**= 1.97**	**+**	**3.64**	**+**	**0.00**	**=**	**5.61**
Channel Flow							
X sectional flow area (sqft)	= 19.90		0.00		0.00		
Wetted perimeter (ft)	= 33.72		0.00		0.00		
Channel slope (%)	= 0.50		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=2.47						
			0.00				
					0.00		
Flow length (ft)	({0})470.0		0.0		0.0		
Travel Time (min)	**= 3.18**	**+**	**0.00**	**+**	**0.00**	**=**	**3.18**

Total Travel Time, Tc .... 26.20 min

Hydrograph Report

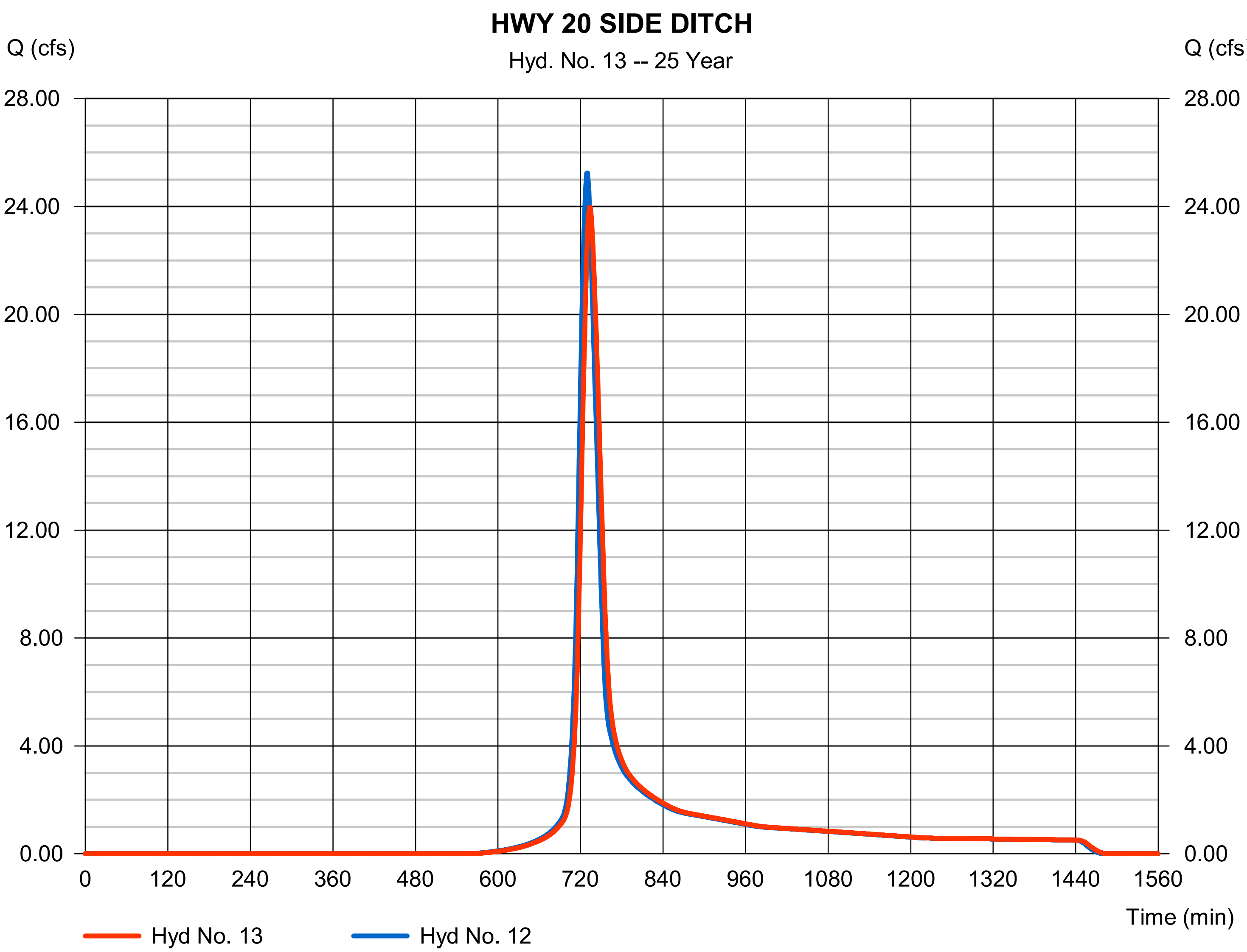
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 13

HWY 20 SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 23.97 cfs
Storm frequency	= 25 yrs	Time to peak	= 734 min
Time interval	= 1 min	Hyd. volume	= 95,089 cuft
Inflow hyd. No.	= 12 - AREA H - PRE DEV	Section type	= Trapezoidal
Reach length	= 900.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.030	Bottom width	= 3.0 ft
Side slope	= 2.0:1	Max. depth	= 3.0 ft
Rating curve x	= 1.688	Rating curve m	= 1.282
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.2312

Modified Att-Kin routing method used.



Hydrograph Report

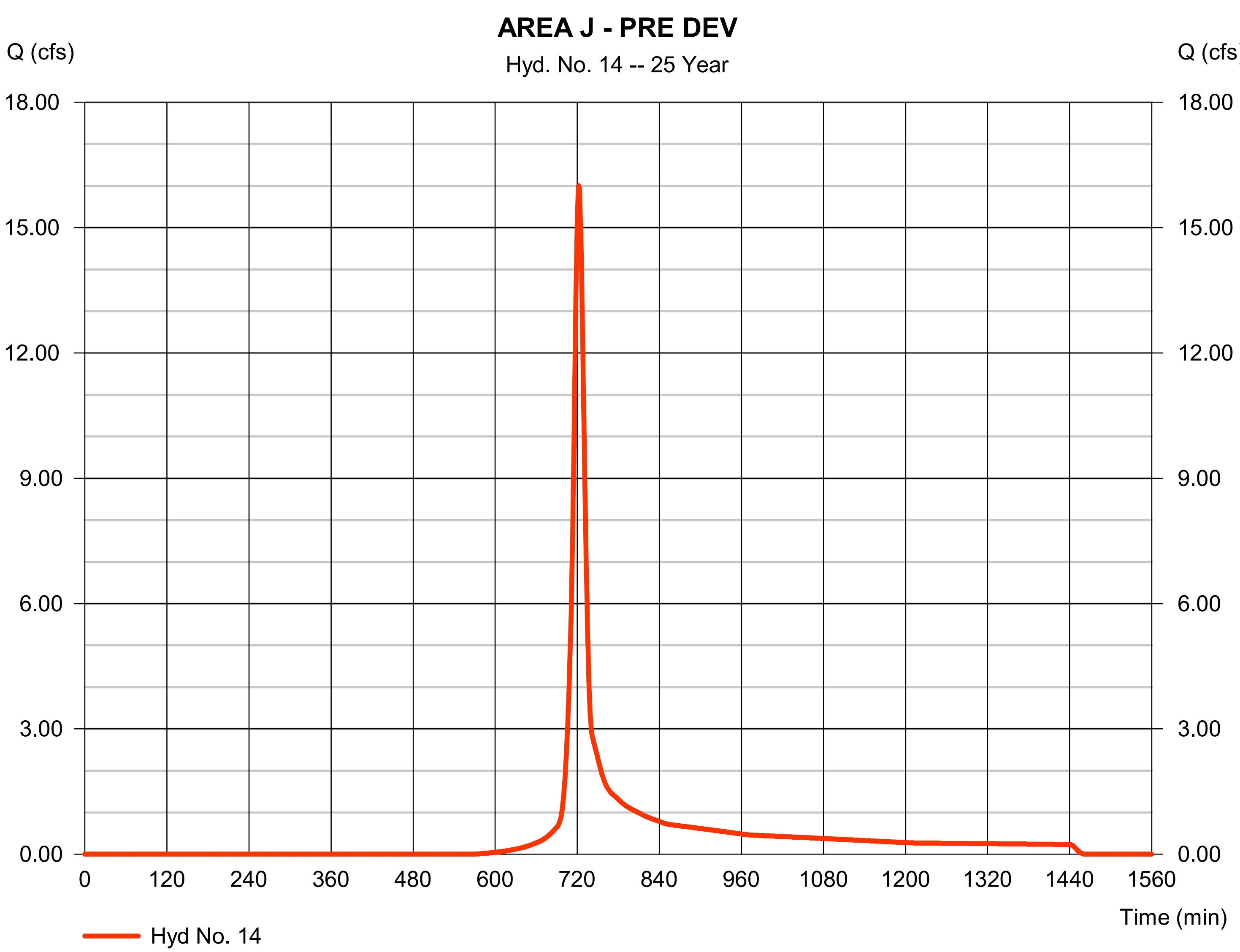
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 14

AREA J - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 16.00 cfs
Storm frequency	= 25 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 43,259 cuft
Drainage area	= 4.320 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.90 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 85) + (0.020 x 65) + (0.690 x 98) + (3.520 x 60)] / 4.320



TR55 Tc Worksheet

Hyd. No. 14

AREA J - PRE DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.011		0.240		0.011		
Flow length (ft)	= 8.0		16.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		3.82		3.82		
Land slope (%)	= 4.20		12.50		0.00		
Travel Time (min)	**= 0.11**	**+**	**1.45**	**+**	**0.00**	**=**	**1.56**
Shallow Concentrated Flow							
Flow length (ft)	= 57.00		198.00		0.00		
Watercourse slope (%)	= 11.00		6.10		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=5.35		3.98		0.00		
Travel Time (min)	**= 0.18**	**+**	**0.83**	**+**	**0.00**	**=**	**1.01**
Channel Flow							
X sectional flow area (sqft)	= 0.82		1.11		0.00		
Wetted perimeter (ft)	= 3.29		3.66		0.00		
Channel slope (%)	= 0.70		0.30		0.00		
Manning's n-value	= 0.030		0.030		0.015		
Velocity (ft/s)	=1.64		1.23		0.00		
Flow length (ft)	({0})200.0		685.0		0.0		
Travel Time (min)	**= 2.03**	**+**	**9.31**	**+**	**0.00**	**=**	**11.35**

Total Travel Time, Tc .... 13.90 min

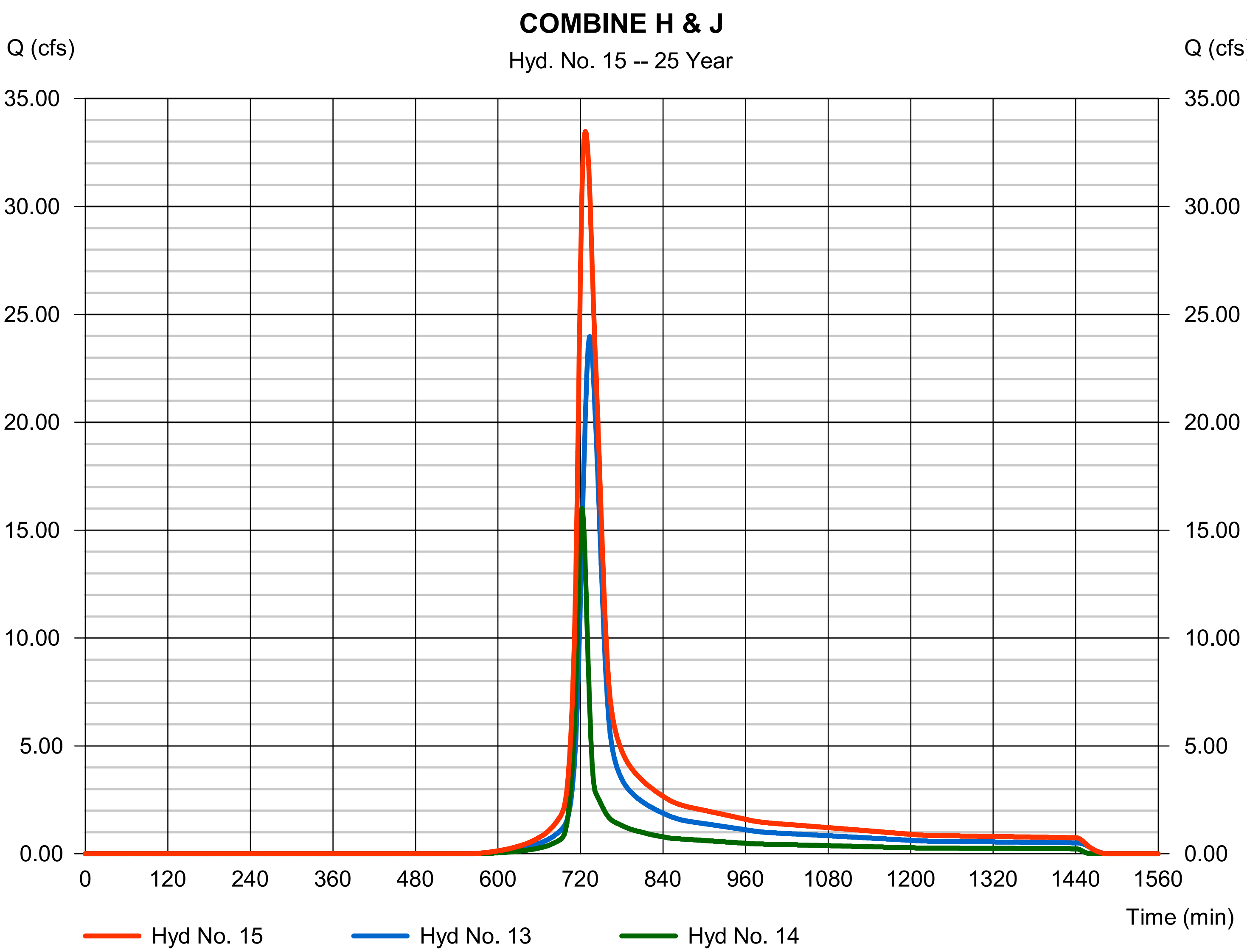
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 15

COMBINE H & J

Hydrograph type	= Combine	Peak discharge	= 33.48 cfs
Storm frequency	= 25 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 138,348 cuft
Inflow hyds.	= 13, 14	Contrib. drain. area	= 4.320 ac



Hydrograph Report

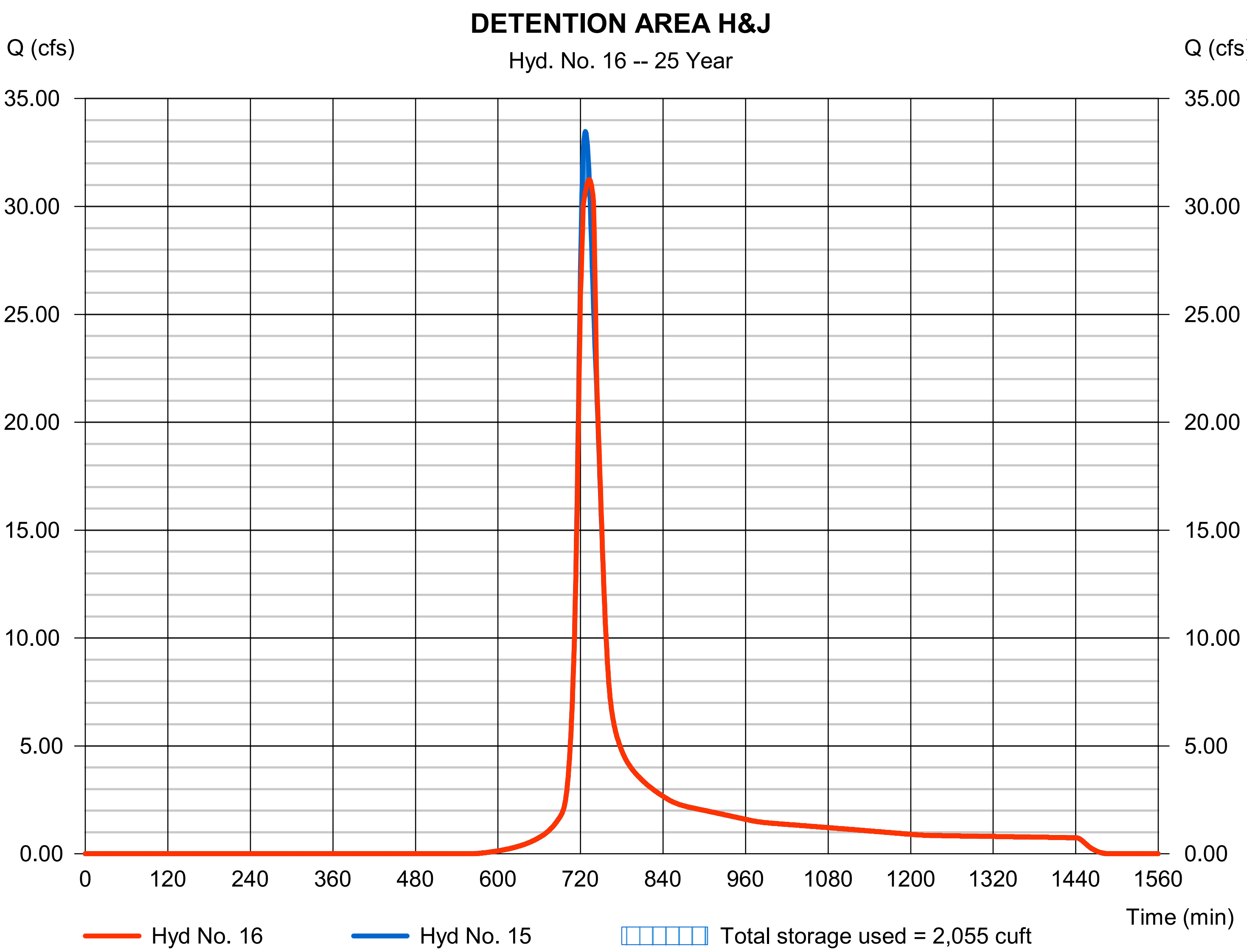
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 16

DETENTION AREA H&J

Hydrograph type	= Reservoir	Peak discharge	= 31.24 cfs
Storm frequency	= 25 yrs	Time to peak	= 733 min
Time interval	= 1 min	Hyd. volume	= 138,348 cuft
Inflow hyd. No.	= 15 - COMBINE H & J	Max. Elevation	= 580.29 ft
Reservoir name	= H&J DETENTION	Max. Storage	= 2,055 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Pond No. 2 - H&J DETENTION

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	575.00	n/a	0	0
1.00	576.00	n/a	36	36
2.00	577.00	n/a	83	119
3.00	578.00	n/a	135	254
4.00	579.00	n/a	171	425
5.00	580.00	n/a	599	1,024
6.00	581.00	n/a	3,586	4,610
7.00	582.00	n/a	39,474	44,084
8.00	583.00	n/a	53,082	97,166
9.00	584.00	n/a	62,711	159,877

Culvert / Orifice Structures

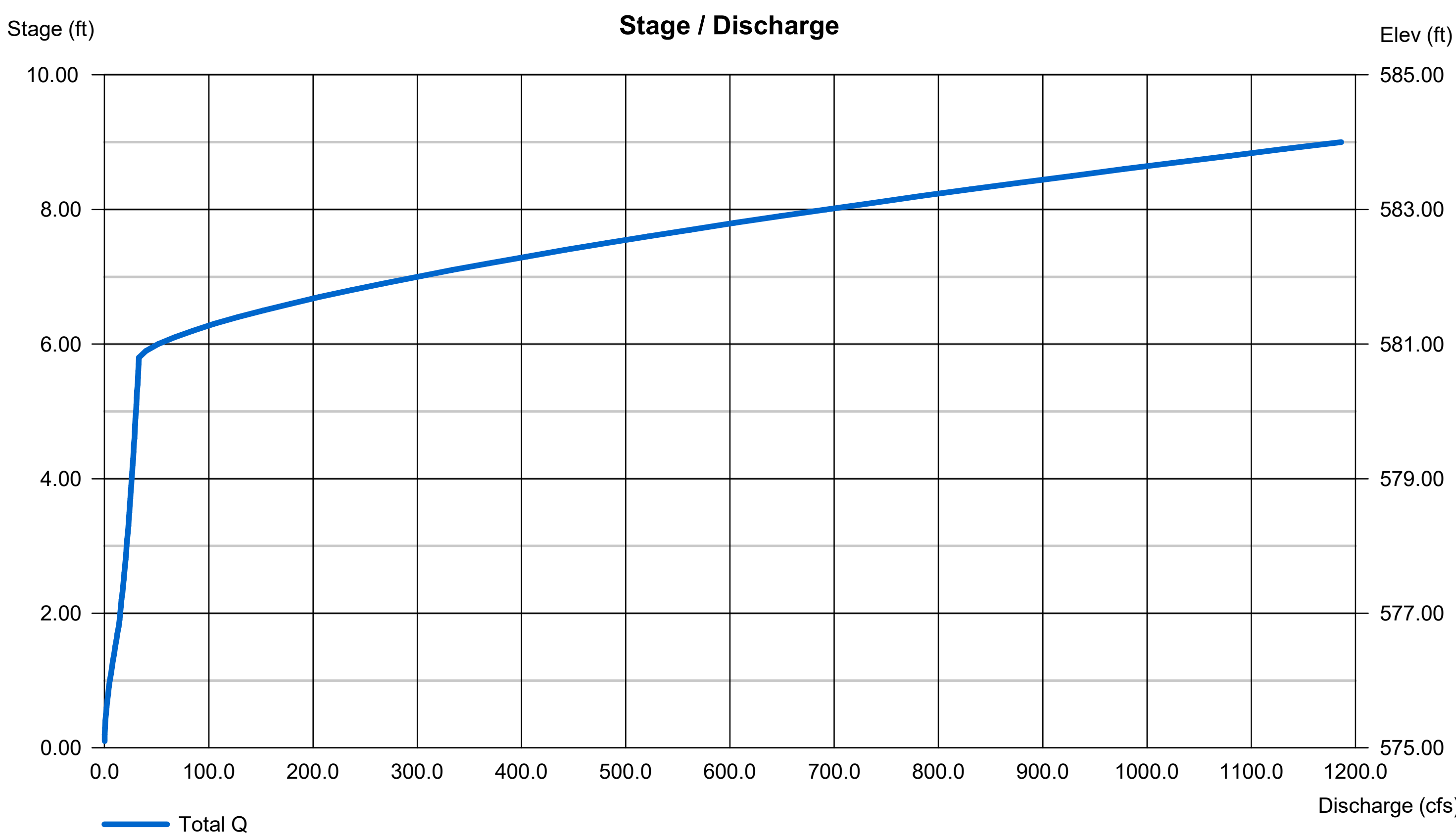
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	18.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 575.02	576.30	0.00	0.00
Length (ft)	= 77.30	55.00	0.00	0.00
Slope (%)	= 1.10	1.50	0.00	n/a
N-Value	= .012	.012	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 60.00	Inactive	Inactive	Inactive
Crest El. (ft)	= 580.80	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Ciplti	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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



Hydrograph Report

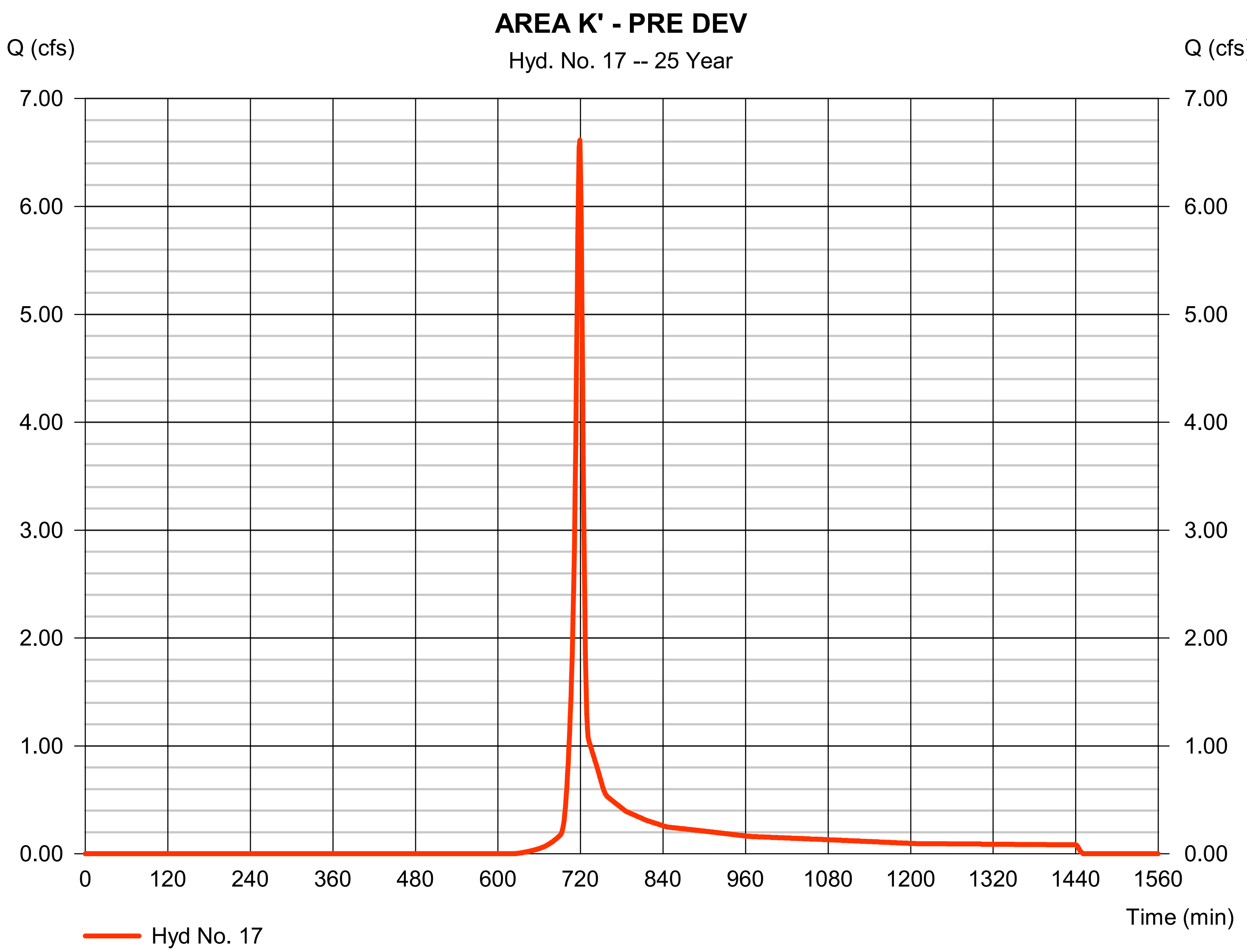
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 17

AREA K' - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 6.615 cfs
Storm frequency	= 25 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 13,990 cuft
Drainage area	= 1.720 ac	Curve number	= 62*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.20 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.350 x 60) + (0.330 x 65) + (0.040 x 98)] / 1.720



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No. 17

AREA K' - PRE DEV

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.011		0.011		0.011		
Flow length (ft)	=	20.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.82		0.00		0.00		
Land slope (%)	=	1.75		0.00		0.00		
Travel Time (min)	**=**	**0.32**	**+**	**0.00**	**+**	**0.00**	**=**	**0.32**
Shallow Concentrated Flow								
Flow length (ft)	=	160.00		154.00		0.00		
Watercourse slope (%)	=	12.50		0.28		0.00		
Surface description	=	Paved		Unpaved		Paved		
Average velocity (ft/s)	=	7.19		0.85		0.00		
Travel Time (min)	**=**	**0.37**	**+**	**3.01**	**+**	**0.00**	**=**	**3.38**
Channel Flow								
X sectional flow area (sqft)	=	2.02		0.00		0.00		
Wetted perimeter (ft)	=	5.59		0.00		0.00		
Channel slope (%)	=	0.50		0.00		0.00		
Manning's n-value	=	0.040		0.015		0.015		
Velocity (ft/s)	=	1.33		0.00		0.00		
Flow length (ft)		({0})360.0		0.0		0.0		
Travel Time (min)	**=**	**4.51**	**+**	**0.00**	**+**	**0.00**	**=**	**4.51**

Total Travel Time, Tc .... **8.20 min**

Hydrograph Report

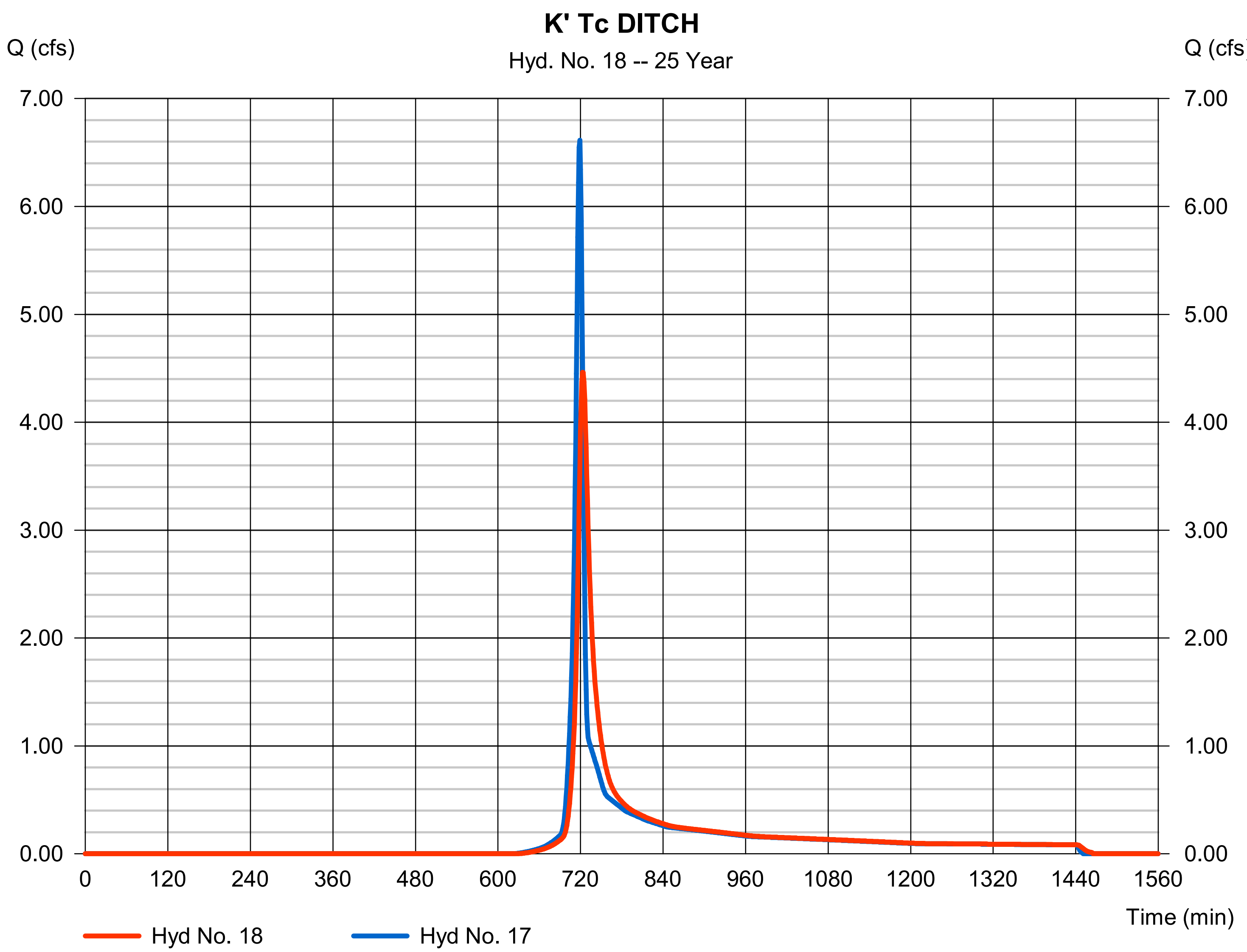
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 18

K' Tc DITCH

Hydrograph type	= Reach	Peak discharge	= 4.463 cfs
Storm frequency	= 25 yrs	Time to peak	= 723 min
Time interval	= 1 min	Hyd. volume	= 13,985 cuft
Inflow hyd. No.	= 17 - AREA K' - PRE DEV	Section type	= Trapezoidal
Reach length	= 710.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.040	Bottom width	= 5.0 ft
Side slope	= 4.0:1	Max. depth	= 2.0 ft
Rating curve x	= 0.697	Rating curve m	= 1.257
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.1108

Modified Att-Kin routing method used.



Hydrograph Report

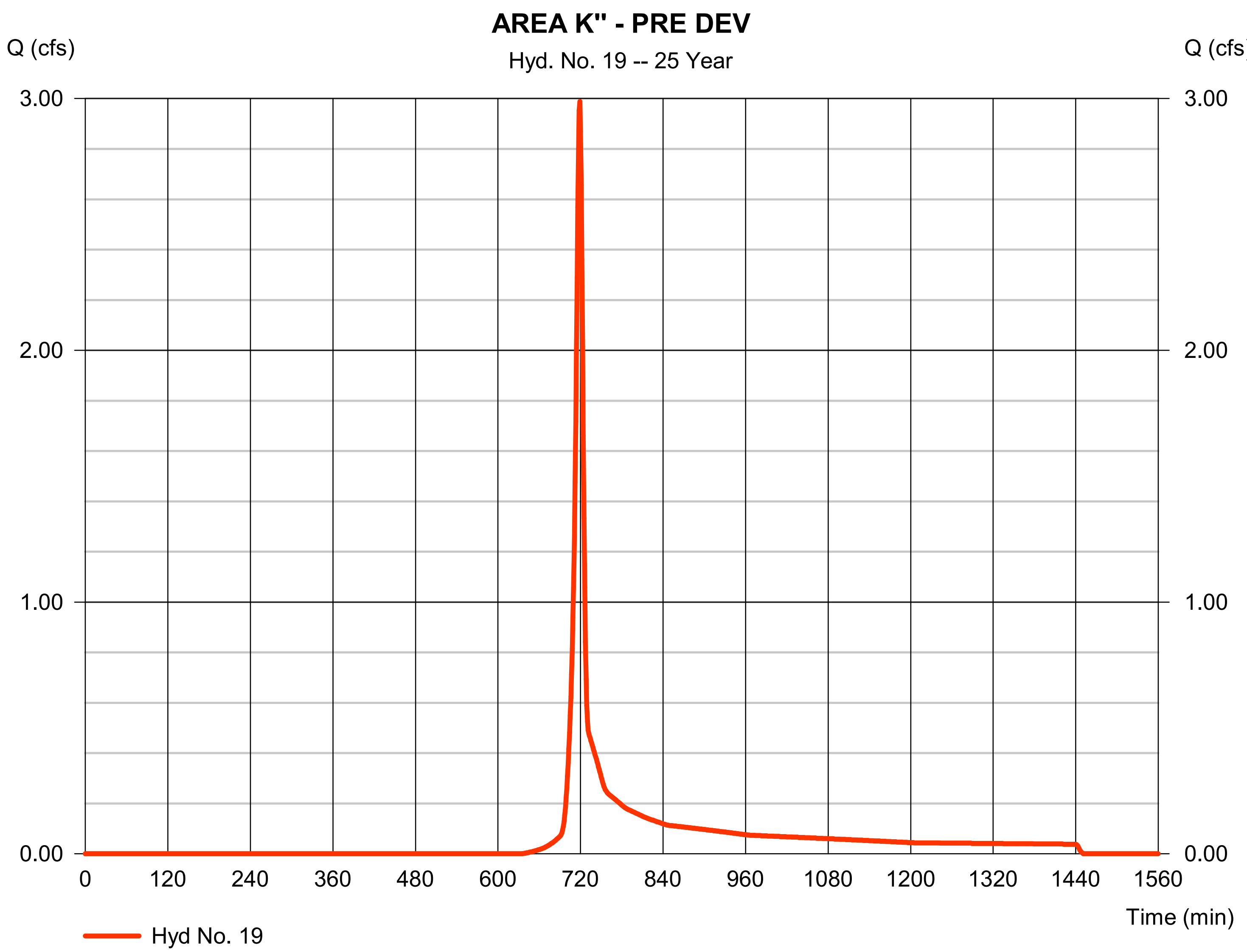
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 19

AREA K" - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 2.988 cfs
Storm frequency	= 25 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 6,332 cuft
Drainage area	= 0.810 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.10 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.170 x 65) + (0.640 x 60)] / 0.810



TR55 Tc Worksheet

Hyd. No. 19

AREA K" - PRE DEV

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.011		0.240		0.011		
Flow length (ft)	=	17.0		63.0		0.0		
Two-year 24-hr precip. (in)	=	3.82		3.82		0.00		
Land slope (%)	=	10.00		50.00		0.00		
Travel Time (min)	**=**	**0.14**	**+**	**2.49**	**+**	**0.00**	**=**	**2.63**
Shallow Concentrated Flow								
Flow length (ft)	=	0.00		0.00		0.00		
Watercourse slope (%)	=	0.00		0.00		0.00		
Surface description	=	Paved		Paved		Paved		
Average velocity (ft/s)	=	0.00		0.00		0.00		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow								
X sectional flow area (sqft)	=	2.02		0.00		0.00		
Wetted perimeter (ft)	=	5.59		0.00		0.00		
Channel slope (%)	=	0.50		0.00		0.00		
Manning's n-value	=	0.040		0.015		0.015		
Velocity (ft/s)	=	1.33		0.00		0.00		
Flow length (ft)		({0})360.0		0.0		0.0		
Travel Time (min)	**=**	**4.51**	**+**	**0.00**	**+**	**0.00**	**=**	**4.51**

Total Travel Time, Tc .... **7.10 min**

Hydrograph Report

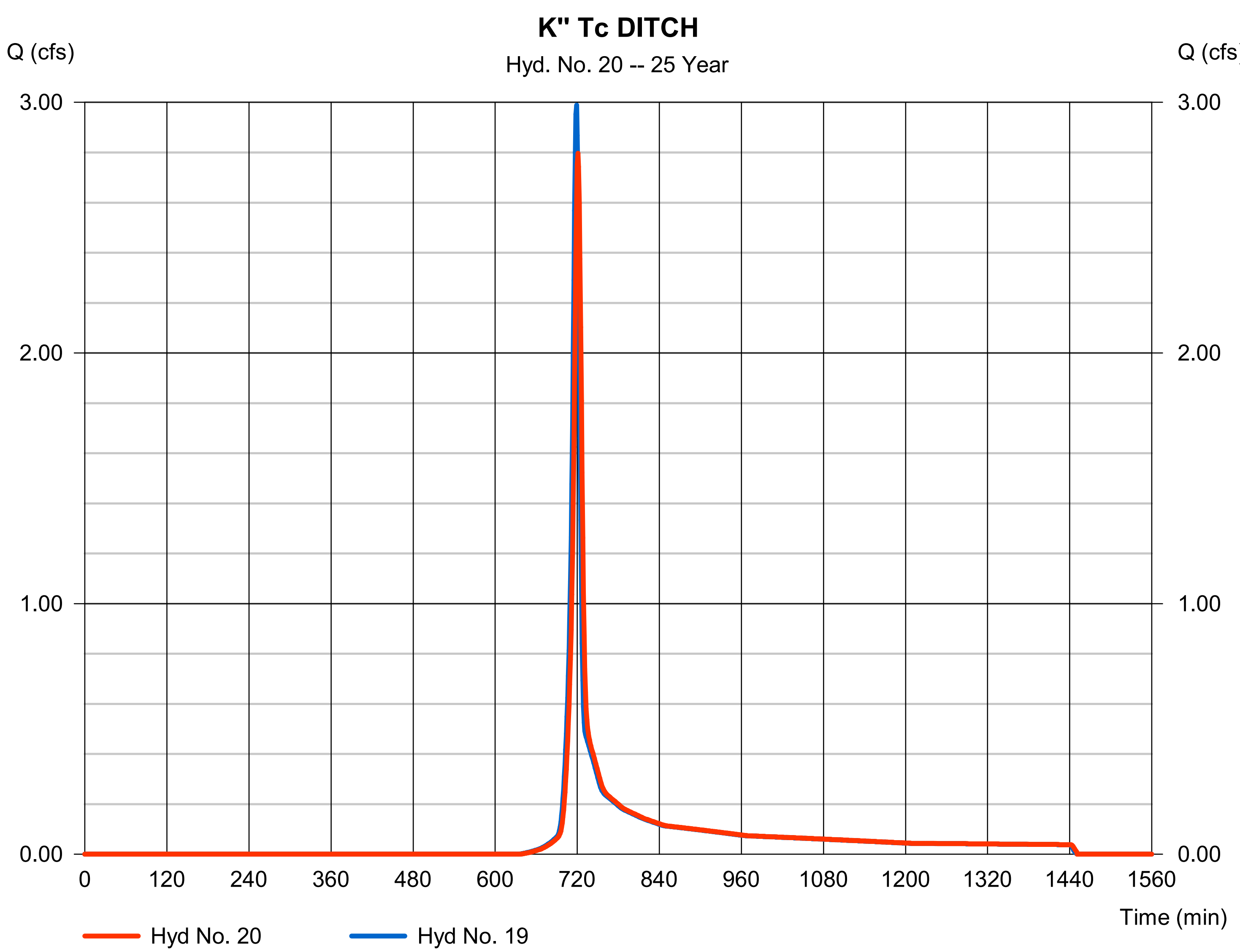
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 20

K" Tc DITCH

Hydrograph type	= Reach	Peak discharge	= 2.797 cfs
Storm frequency	= 25 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 6,331 cuft
Inflow hyd. No.	= 19 - AREA K" - PRE DEV	Section type	= Trapezoidal
Reach length	= 150.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.040	Bottom width	= 5.0 ft
Side slope	= 4.0:1	Max. depth	= 2.0 ft
Rating curve x	= 0.697	Rating curve m	= 1.257
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.3818

Modified Att-Kin routing method used.



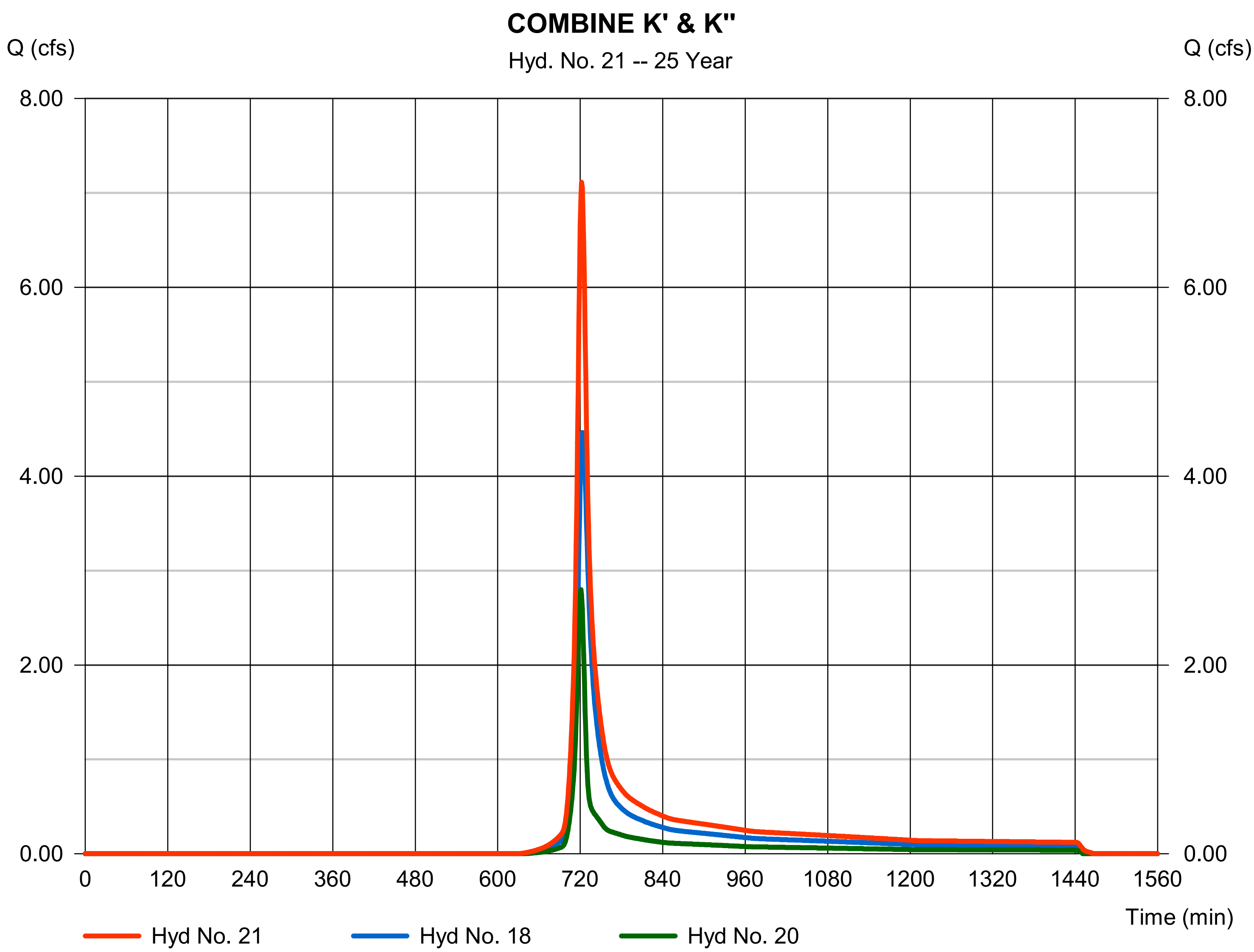
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 21

COMBINE K' & K"

Hydrograph type	= Combine	Peak discharge	= 7.113 cfs
Storm frequency	= 25 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 20,317 cuft
Inflow hyds.	= 18, 20	Contrib. drain. area	= 0.000 ac



Hydrograph Report

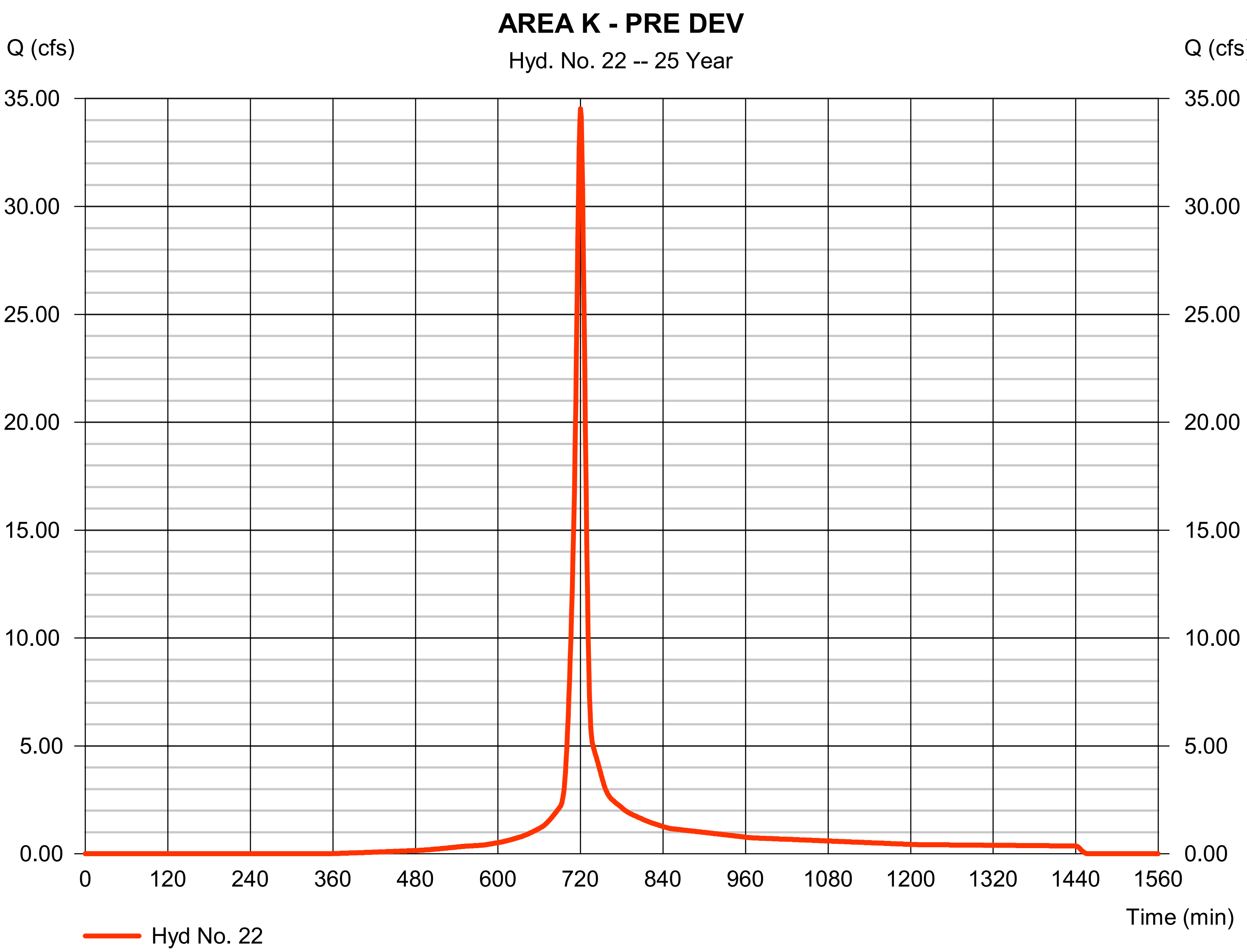
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 22

AREA K - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 34.53 cfs
Storm frequency	= 25 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 84,960 cuft
Drainage area	= 5.530 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.70 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(4.460 x 85) + (1.070 x 65)] / 5.530



TR55 Tc Worksheet

Hyd. No. 22

AREA K - PRE DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.000		0.011		0.011		
Flow length (ft)	= 0.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 0.00		0.00		0.00		
Land slope (%)	= 0.00		0.00		0.00		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Shallow Concentrated Flow							
Flow length (ft)	= 60.00		0.00		0.00		
Watercourse slope (%)	= 0.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.14		0.00		0.00		
Travel Time (min)	**= 0.88**	**+**	**0.00**	**+**	**0.00**	**=**	**0.88**
Channel Flow							
X sectional flow area (sqft)	= 3.09		0.00		0.00		
Wetted perimeter (ft)	= 16.92		0.00		0.00		
Channel slope (%)	= 0.60		0.00		0.00		
Manning's n-value	= 0.020		0.015		0.015		
Velocity (ft/s)	=1.85		0.00		0.00		
Flow length (ft)	({0})1200.0		0.0		0.0		
Travel Time (min)	**= 10.83**	**+**	**0.00**	**+**	**0.00**	**=**	**10.83**

Total Travel Time, Tc .... 11.70 min

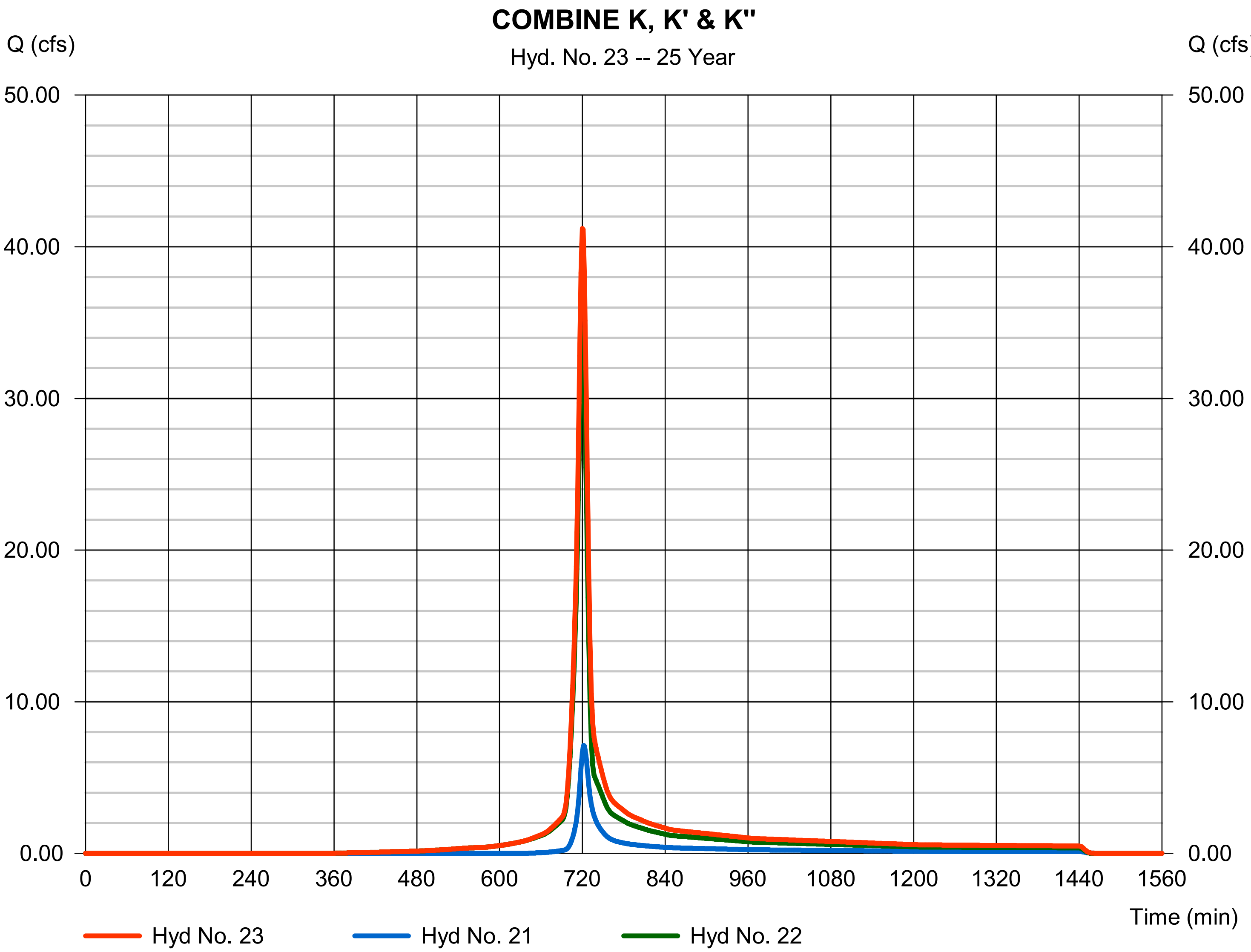
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 23

COMBINE K, K' & K''

Hydrograph type	= Combine	Peak discharge	= 41.20 cfs
Storm frequency	= 25 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 105,277 cuft
Inflow hyds.	= 21, 22	Contrib. drain. area	= 5.530 ac



Hydrograph Report

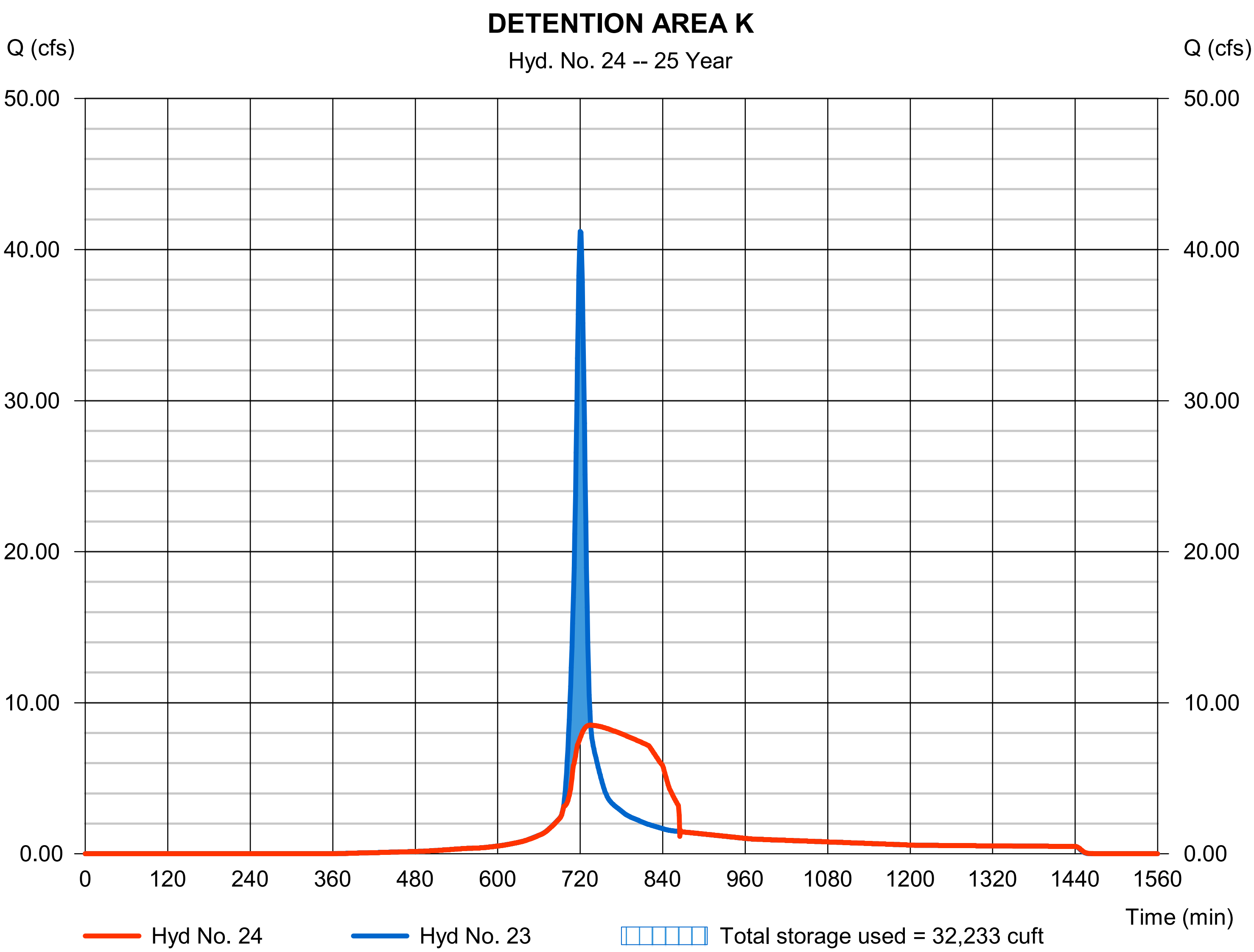
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 24

DETENTION AREA K

Hydrograph type	= Reservoir	Peak discharge	= 8.514 cfs
Storm frequency	= 25 yrs	Time to peak	= 735 min
Time interval	= 1 min	Hyd. volume	= 105,276 cuft
Inflow hyd. No.	= 23 - COMBINE K, K' & K"	Max. Elevation	= 582.74 ft
Reservoir name	= K DETENTION	Max. Storage	= 32,233 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Pond No. 6 - K DETENTION

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 580.16 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	580.16	10	0	0
0.84	581.00	185	82	82
1.84	582.00	18,854	9,520	9,601
2.84	583.00	42,508	30,681	40,282
3.84	584.00	58,499	50,503	90,786

Culvert / Orifice Structures

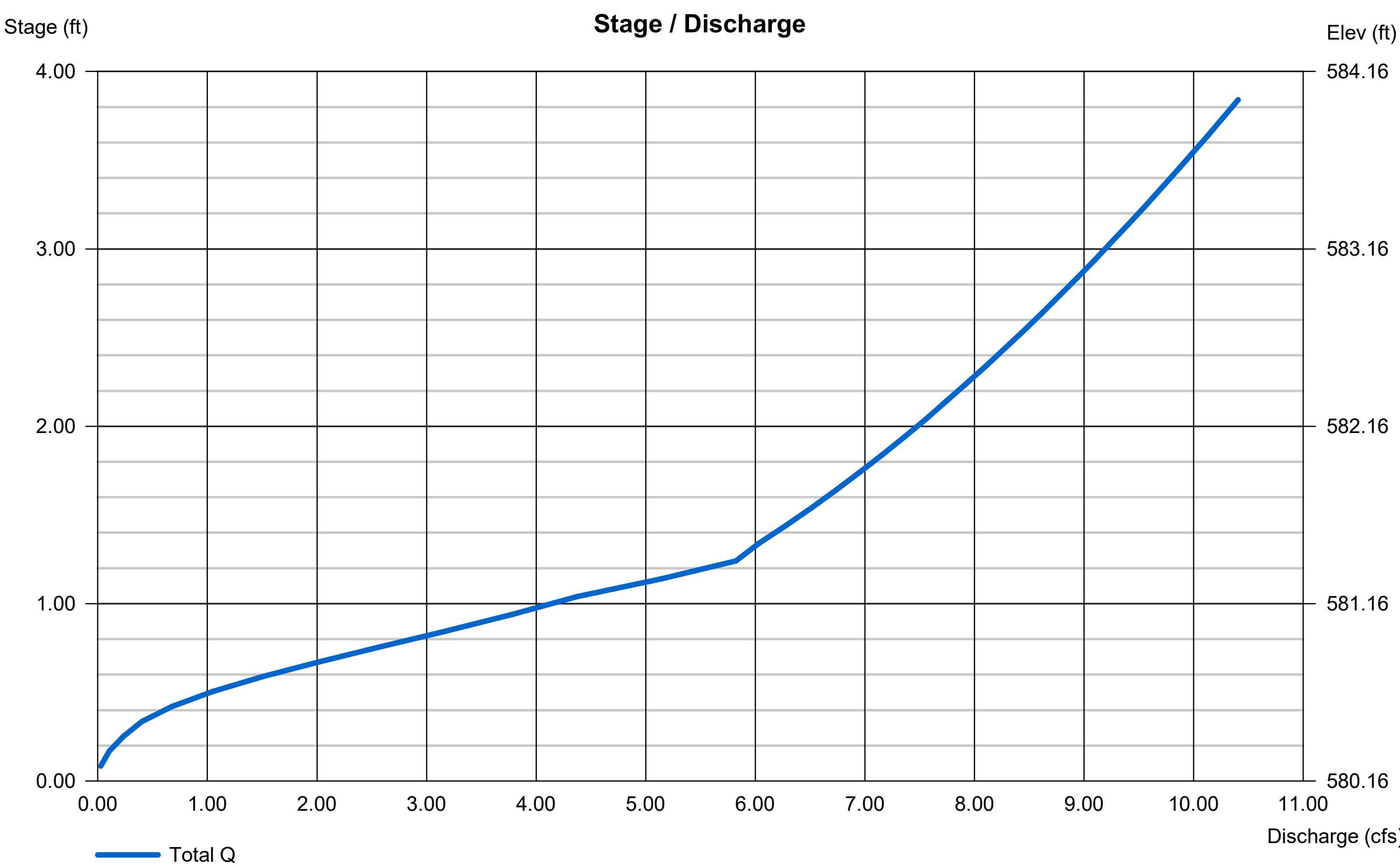
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	12.00	Inactive	Inactive
Span (in)	= 12.00	12.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 580.46	580.16	0.00	0.00
Length (ft)	= 45.20	41.20	0.00	0.00
Slope (%)	= 4.73	0.80	0.00	n/a
N-Value	= .023	.023	.013	n/a
Orifice Coeff.	= 0.90	0.90	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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



Hydrograph Report

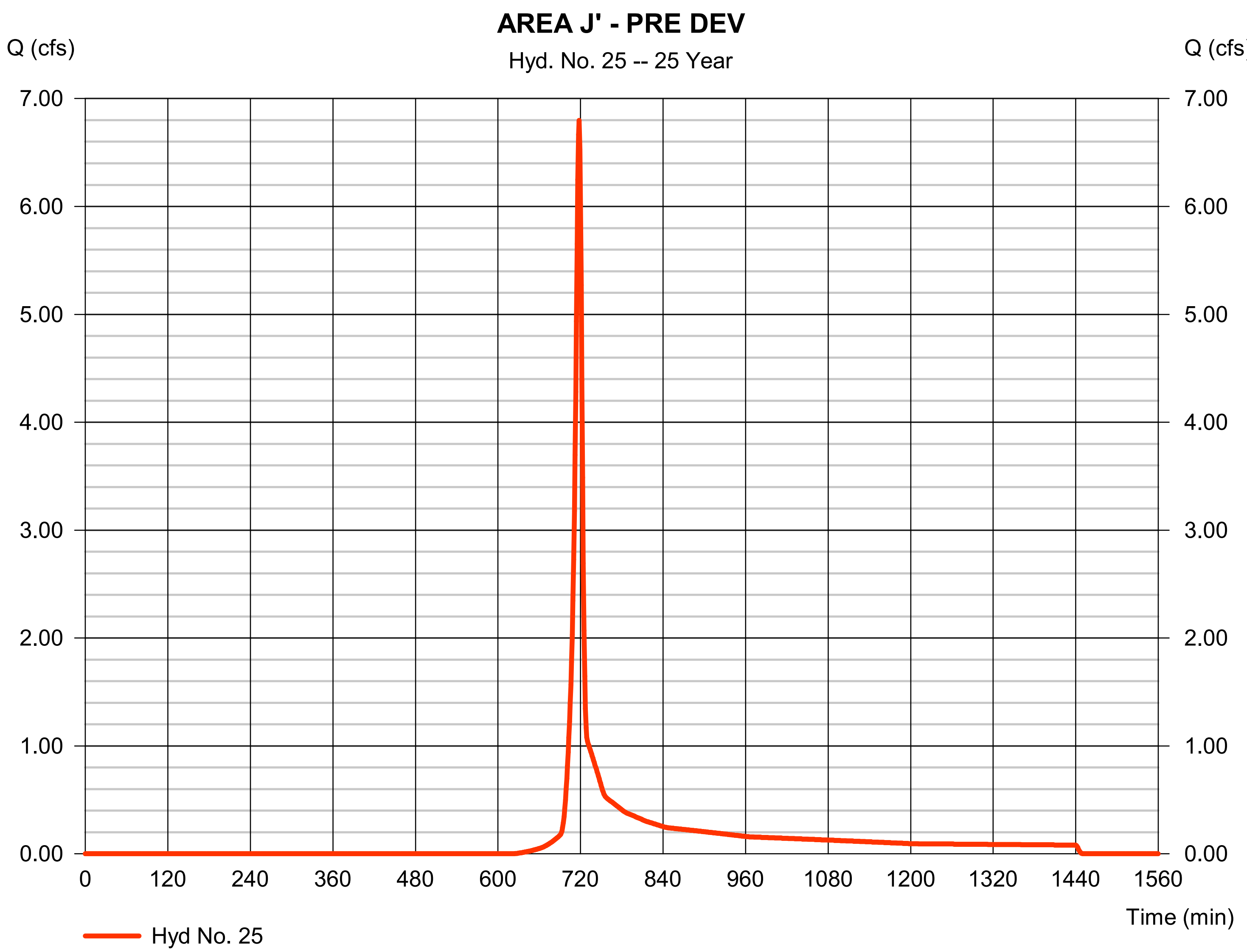
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 25

AREA J' - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 6.797 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 13,679 cuft
Drainage area	= 1.590 ac	Curve number	= 62*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.080 x 85) + (0.220 x 65) + (1.290 x 60)] / 1.590



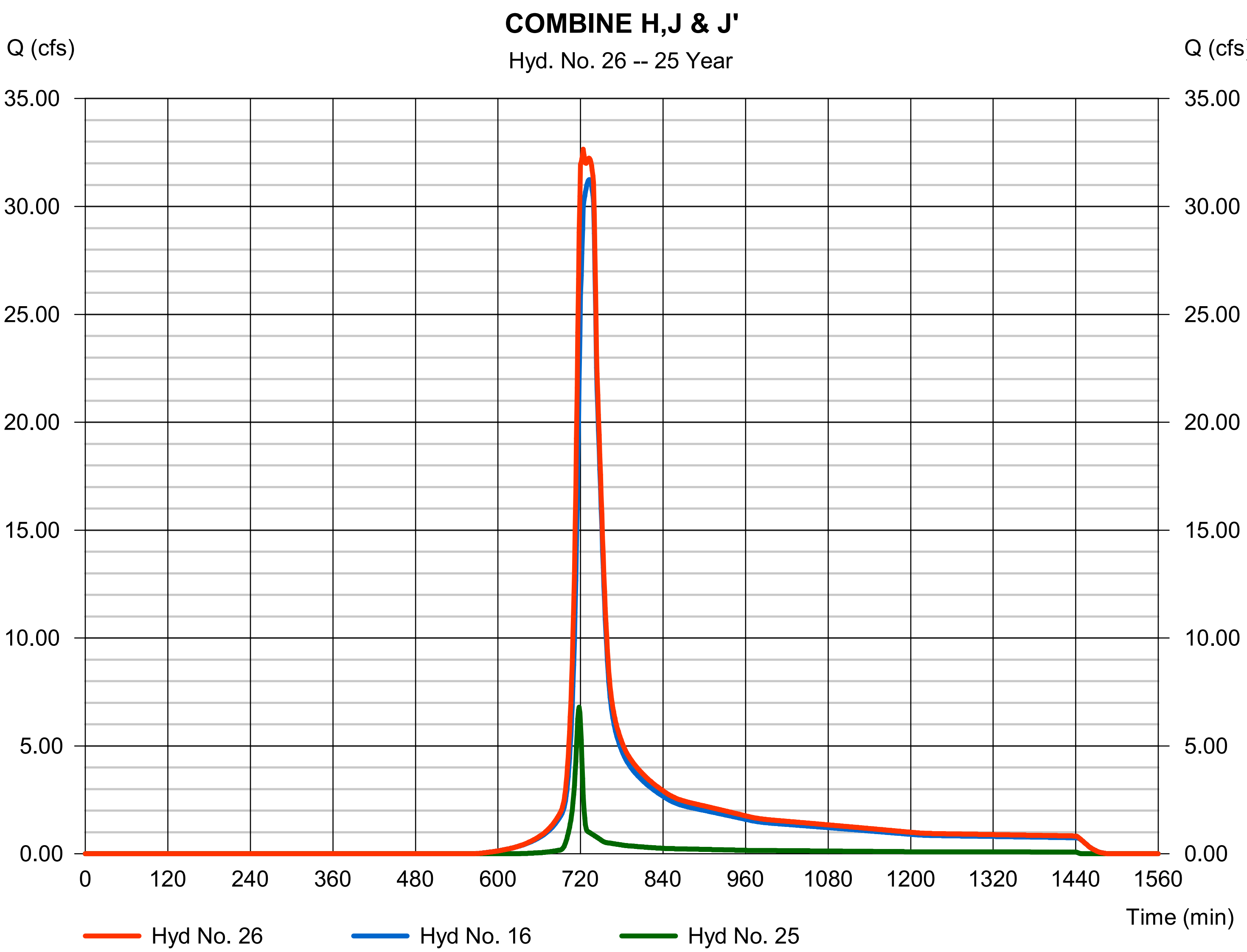
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 26

COMBINE H,J & J'

Hydrograph type	= Combine	Peak discharge	= 32.65 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 152,027 cuft
Inflow hyds.	= 16, 25	Contrib. drain. area	= 1.590 ac



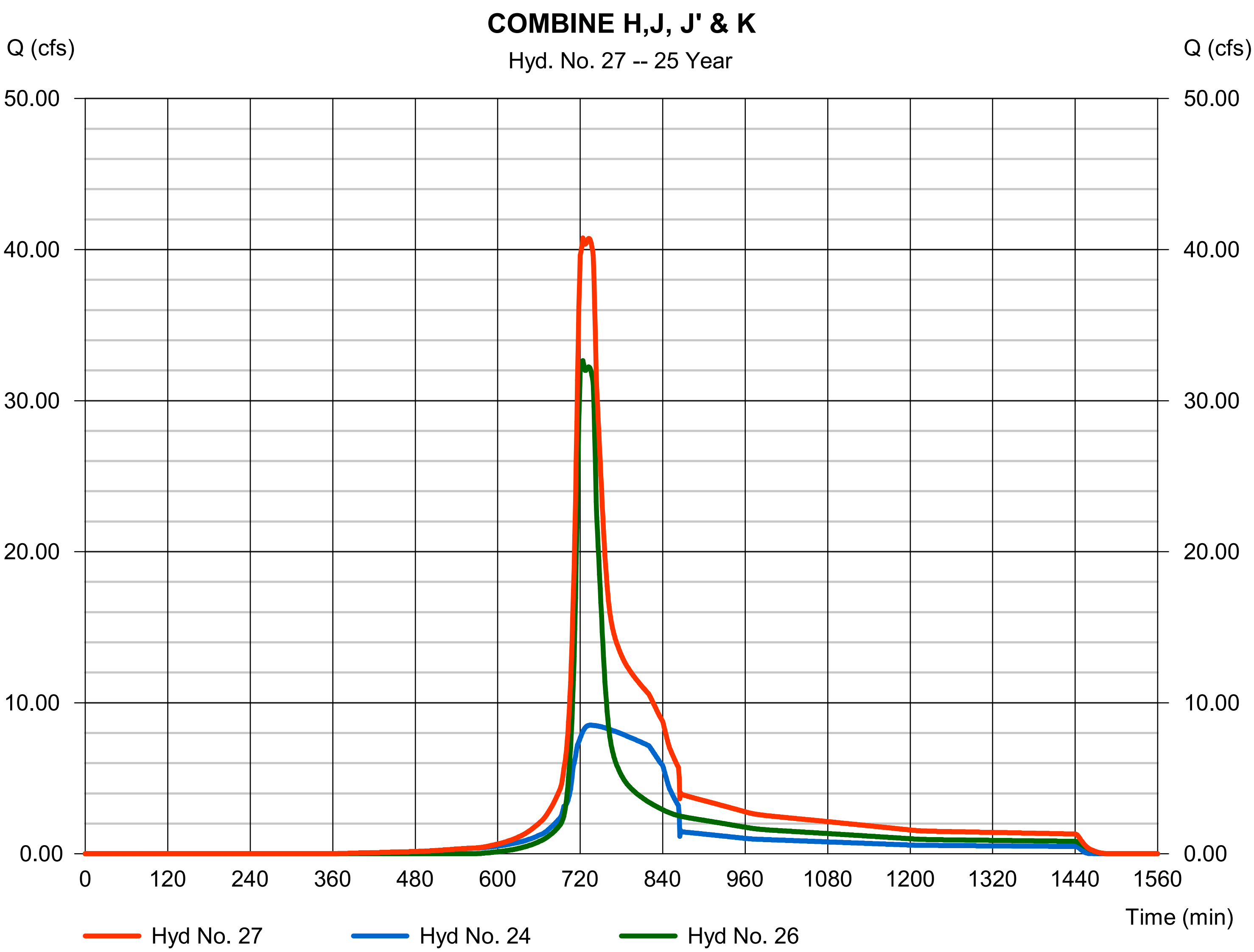
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 27

COMBINE H,J, J' & K

Hydrograph type	= Combine	Peak discharge	= 40.77 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 257,303 cuft
Inflow hyds.	= 24, 26	Contrib. drain. area	= 0.000 ac



Hydrograph Report

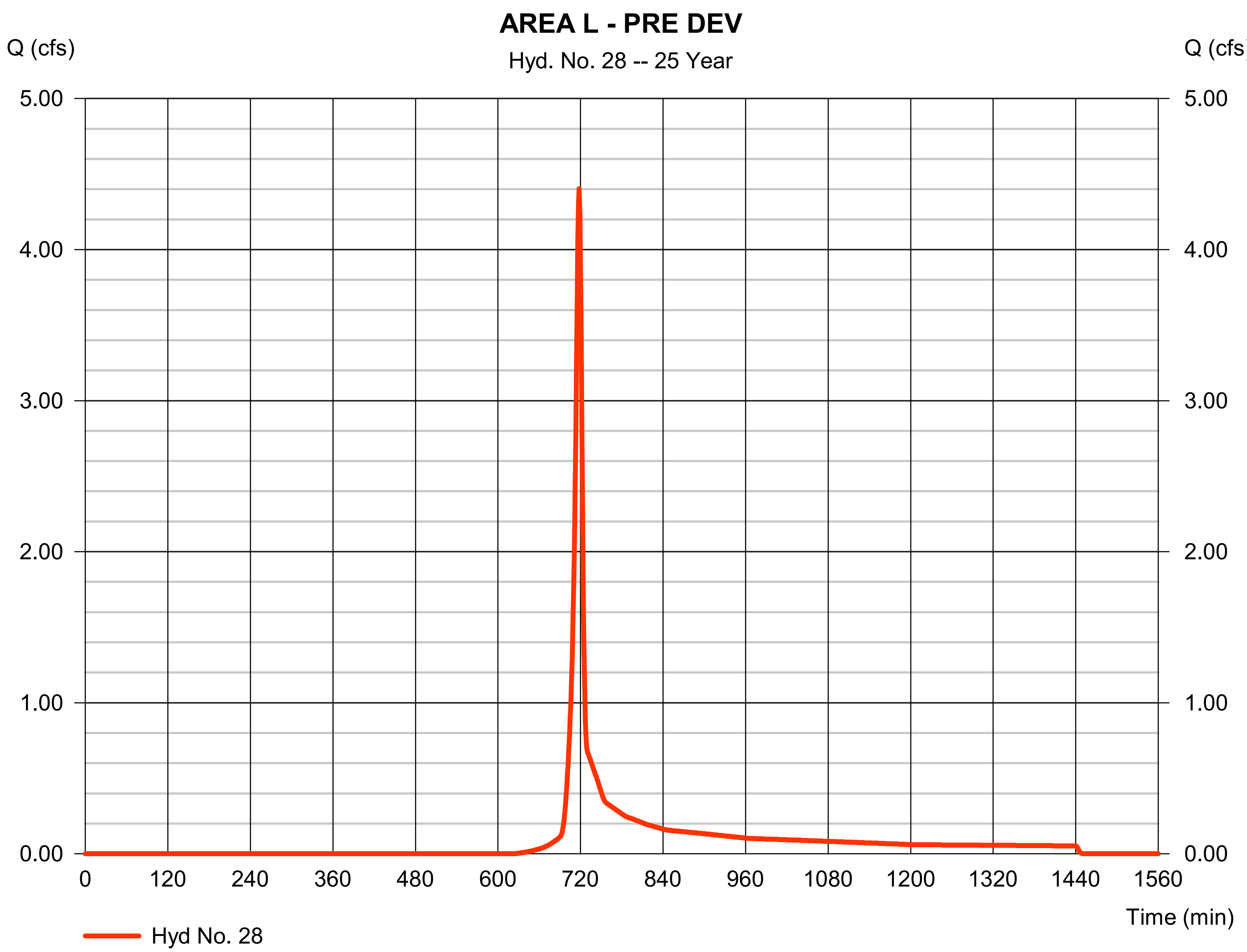
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 28

AREA L - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 4.403 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 8,861 cuft
Drainage area	= 1.030 ac	Curve number	= 62*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.230 x 65) + (0.050 x 85) + (0.750 x 60)] / 1.030



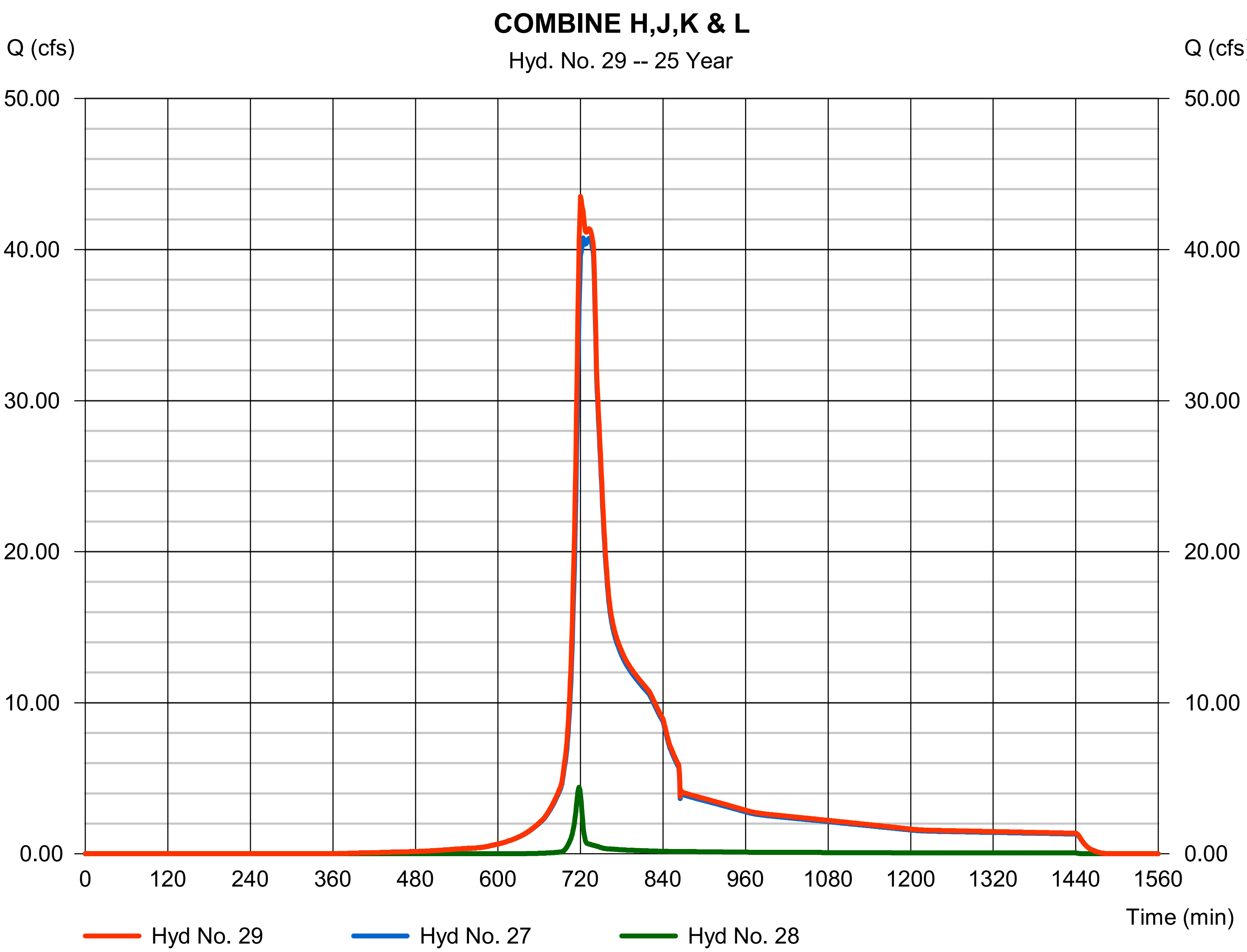
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 29

COMBINE H,J,K & L

Hydrograph type	= Combine	Peak discharge	= 43.51 cfs
Storm frequency	= 25 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 266,164 cuft
Inflow hyds.	= 27, 28	Contrib. drain. area	= 1.030 ac



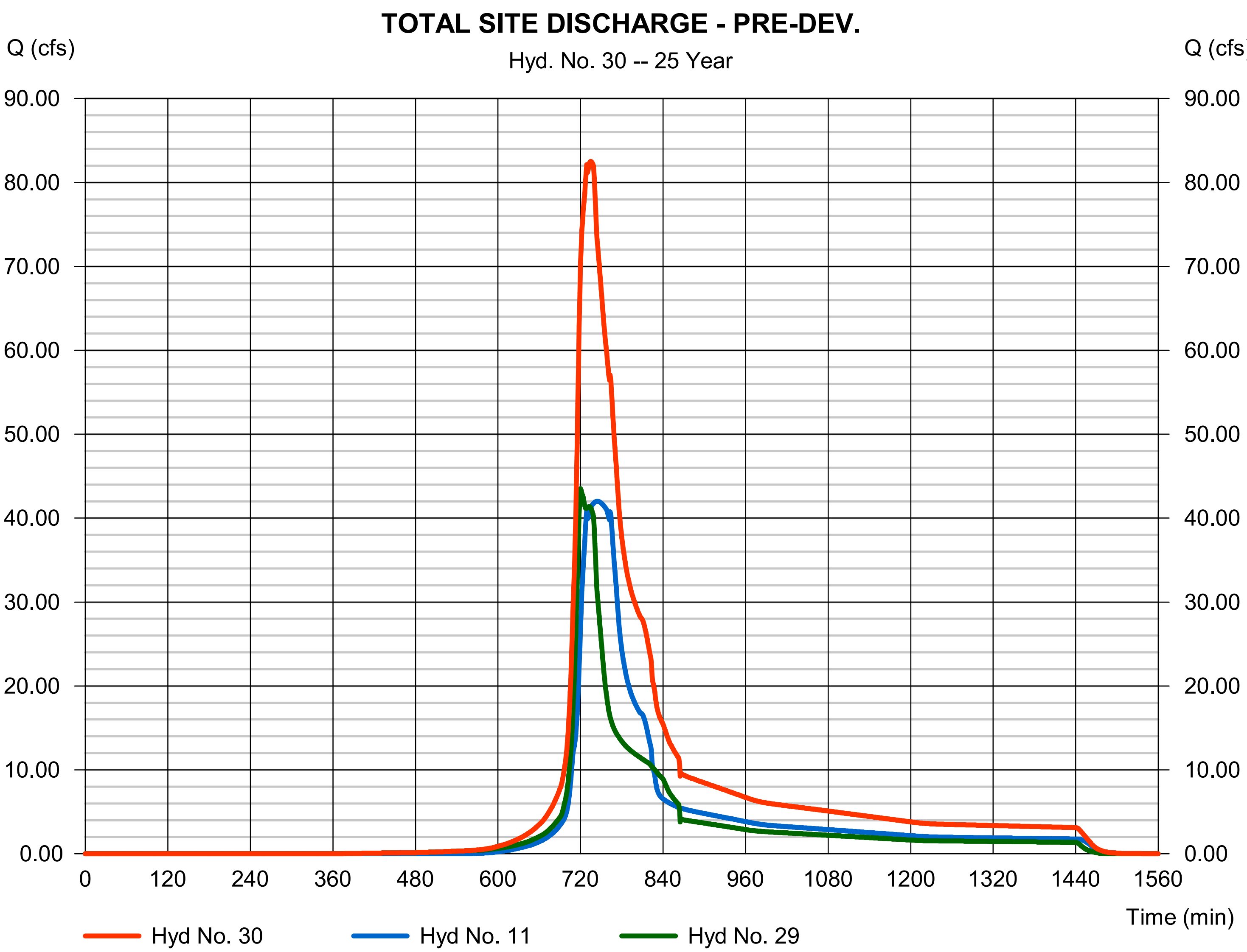
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 30

TOTAL SITE DISCHARGE - PRE-DEV.

Hydrograph type	= Combine	Peak discharge	= 82.50 cfs
Storm frequency	= 25 yrs	Time to peak	= 735 min
Time interval	= 1 min	Hyd. volume	= 588,865 cuft
Inflow hyds.	= 11, 29	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	SCS Runoff	11.34	1	725	35,424	------	------	------	AREA A - PRE DEV
2	Reach	10.92	1	728	35,423	1	------	------	DITCH 1
3	SCS Runoff	26.45	1	726	87,382	------	------	------	AREA B - PRE DEV
4	Combine	37.25	1	727	122,804	2, 3	------	------	COMBINE A & B
5	Reach	36.76	1	729	122,803	4	------	------	DITCH 2
6	SCS Runoff	17.70	1	742	98,530	------	------	------	AREA E - PRE DEV
7	SCS Runoff	50.52	1	727	171,915	------	------	------	AREA C - PRE DEV
8	Reservoir	15.15	1	747	171,912	7	582.16	49,436	C - DENTENTION
9	Combine	49.72	1	730	221,334	5, 6,	------	------	COMBINE A,B & E
10	Combine	64.41	1	730	393,246	8, 9	------	------	COMBINE A,B,E & C
11	Reservoir	44.22	1	747	393,216	10	581.77	29,805	A,B,C & E
12	SCS Runoff	30.87	1	729	115,543	------	------	------	AREA H - PRE DEV
13	Reach	29.45	1	733	115,541	12	------	------	HWY 20 SIDE DITCH
14	SCS Runoff	19.59	1	722	52,735	------	------	------	AREA J - PRE DEV
15	Combine	41.30	1	727	168,276	13, 14	------	------	COMBINE H & J
16	Reservoir	40.90	1	729	168,276	15	580.91	4,287	DETENTION AREA H&J
17	SCS Runoff	8.234	1	719	17,365	------	------	------	AREA K' - PRE DEV
18	Reach	5.715	1	723	17,360	17	------	------	K' Tc DITCH
19	SCS Runoff	3.739	1	719	7,891	------	------	------	AREA K'' - PRE DEV
20	Reach	3.524	1	721	7,890	19	------	------	K'' Tc DITCH
21	Combine	9.058	1	722	25,250	18, 20	------	------	COMBINE K' & K''
22	SCS Runoff	40.17	1	720	99,510	------	------	------	AREA K - PRE DEV
23	Combine	48.75	1	720	124,759	21, 22	------	------	COMBINE K, K' & K''
24	Reservoir	8.947	1	737	124,759	23	583.00	40,442	DETENTION AREA K
25	SCS Runoff	8.455	1	718	16,979	------	------	------	AREA J' - PRE DEV
26	Combine	42.22	1	729	185,255	16, 25	------	------	COMBINE H,J & J'
27	Combine	51.05	1	729	310,013	24, 26	------	------	COMBINE H,J, J' & K
28	SCS Runoff	5.477	1	718	10,999	------	------	------	AREA L - PRE DEV
29	Combine	51.90	1	729	321,012	27, 28	------	------	COMBINE H,J,K & L
30	Combine	93.19	1	729	714,229	11, 29	------	------	TOTAL SITE DISCHARGE - PRE-DE

AP3_PREDEV.gpw	Return Period: 50 Year	Thursday, 11 / 15 / 2018

Hydrograph Report

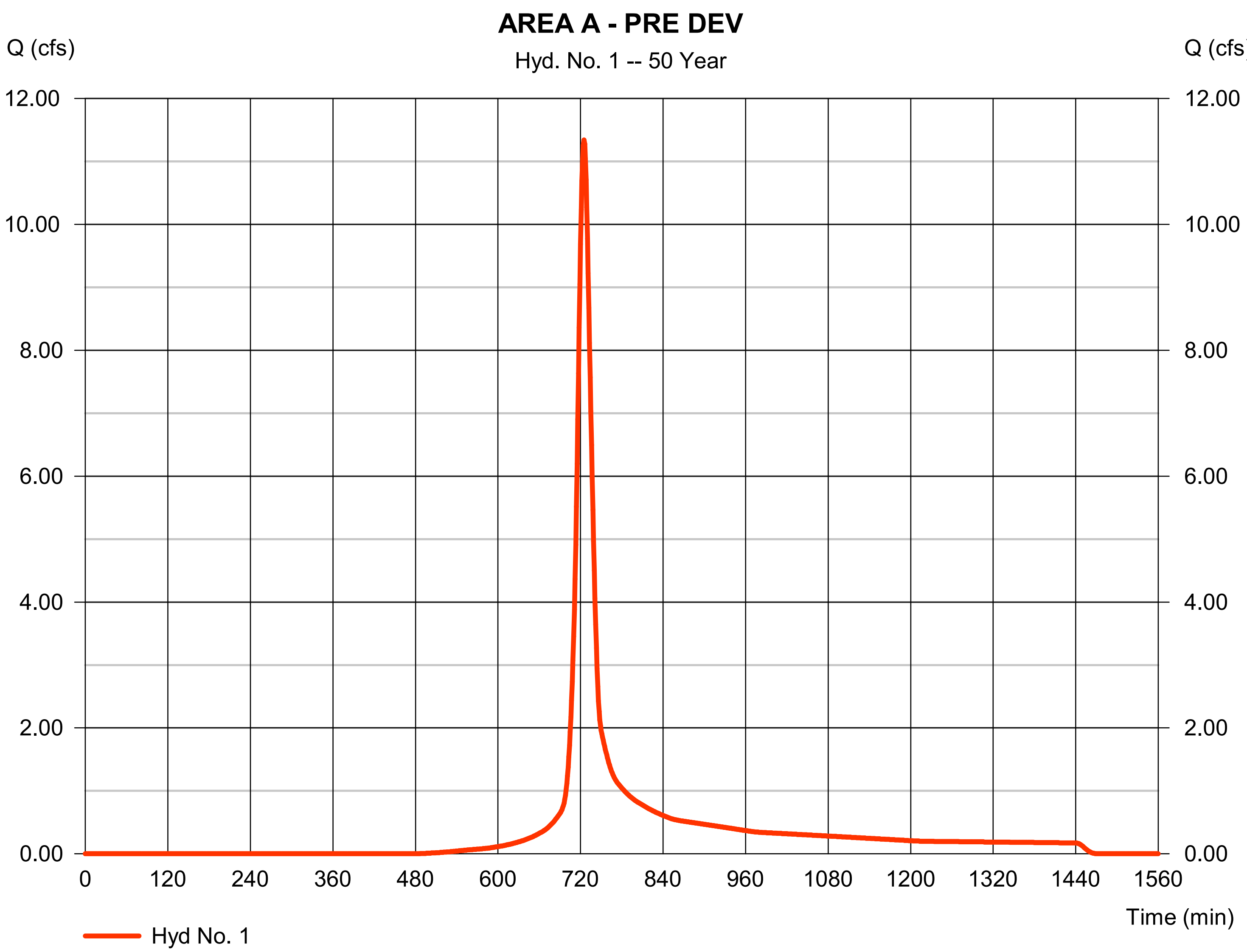
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 1

AREA A - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 11.34 cfs
Storm frequency	= 50 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 35,424 cuft
Drainage area	= 2.580 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.10 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.220 x 85) + (0.570 x 55) + (0.030 x 98) + (0.760 x 60)] / 2.580



Hydrograph Report

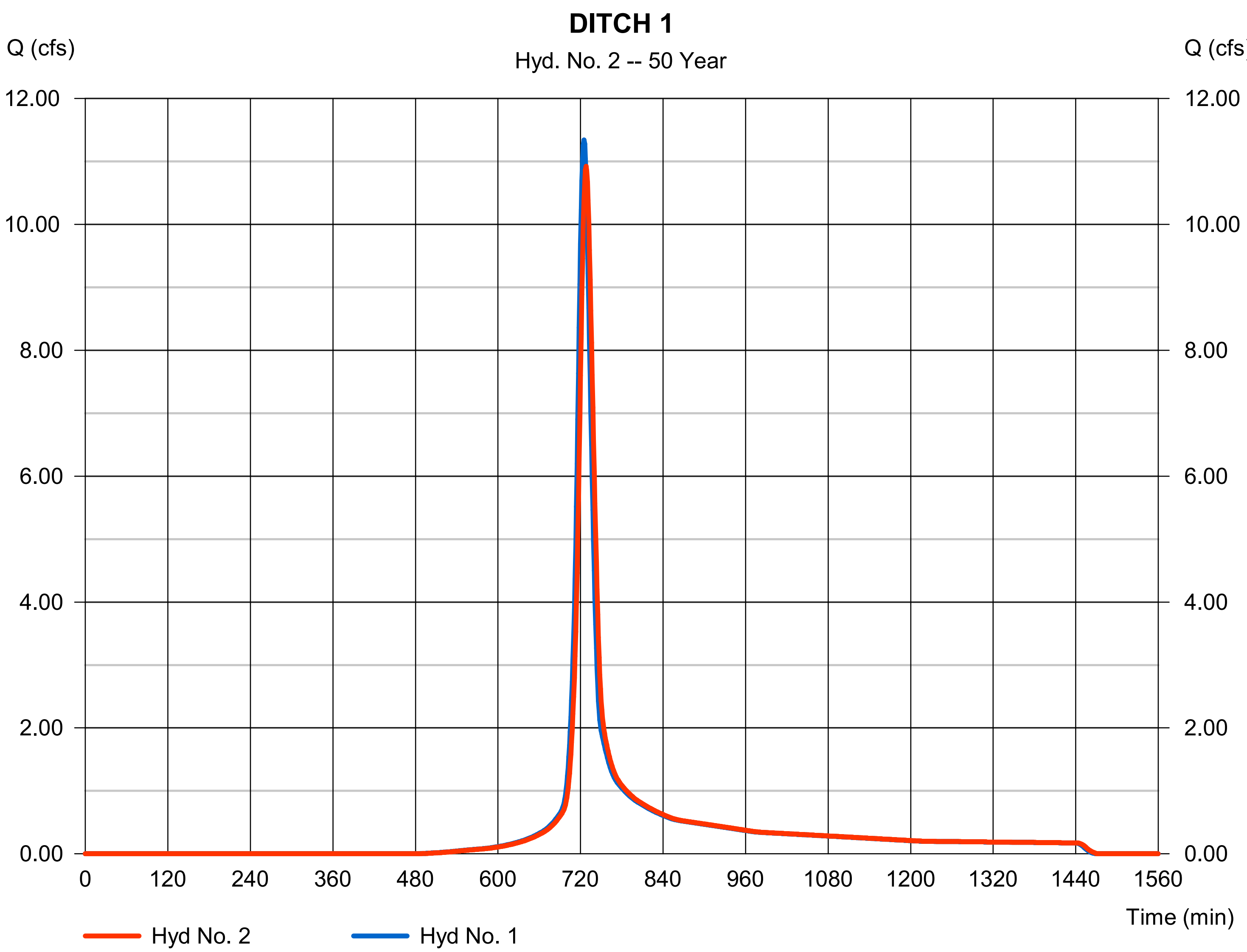
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 2

DITCH 1

Hydrograph type	= Reach	Peak discharge	= 10.92 cfs
Storm frequency	= 50 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 35,423 cuft
Inflow hyd. No.	= 1 - AREA A - PRE DEV	Section type	= Trapezoidal
Reach length	= 730.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 10.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.375
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.3172

Modified Att-Kin routing method used.



Hydrograph Report

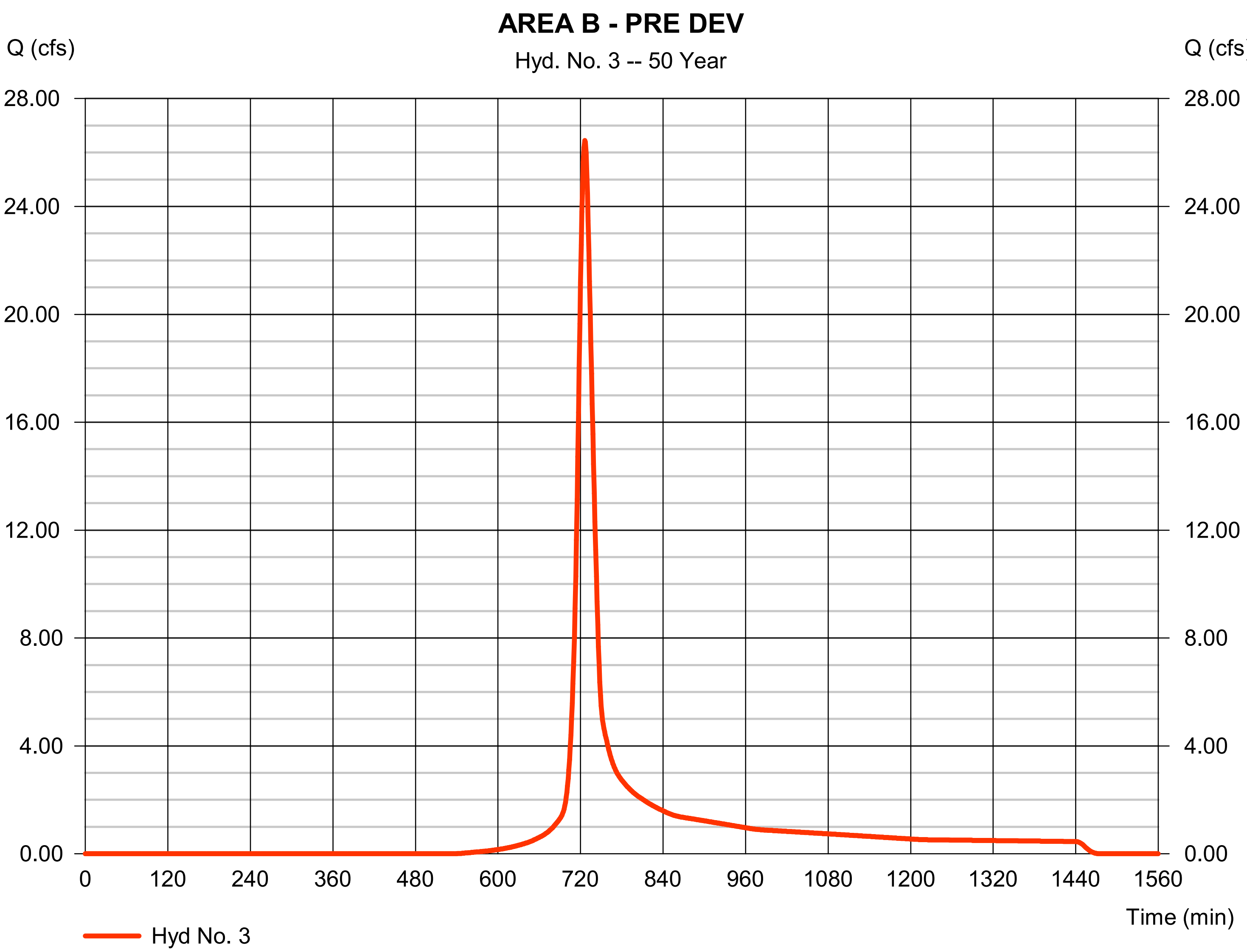
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 3

AREA B - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 26.45 cfs
Storm frequency	= 50 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 87,382 cuft
Drainage area	= 7.090 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.80 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.930 x 85) + (2.120 x 55) + (0.250 x 98) + (2.790 x 60)] / 7.090



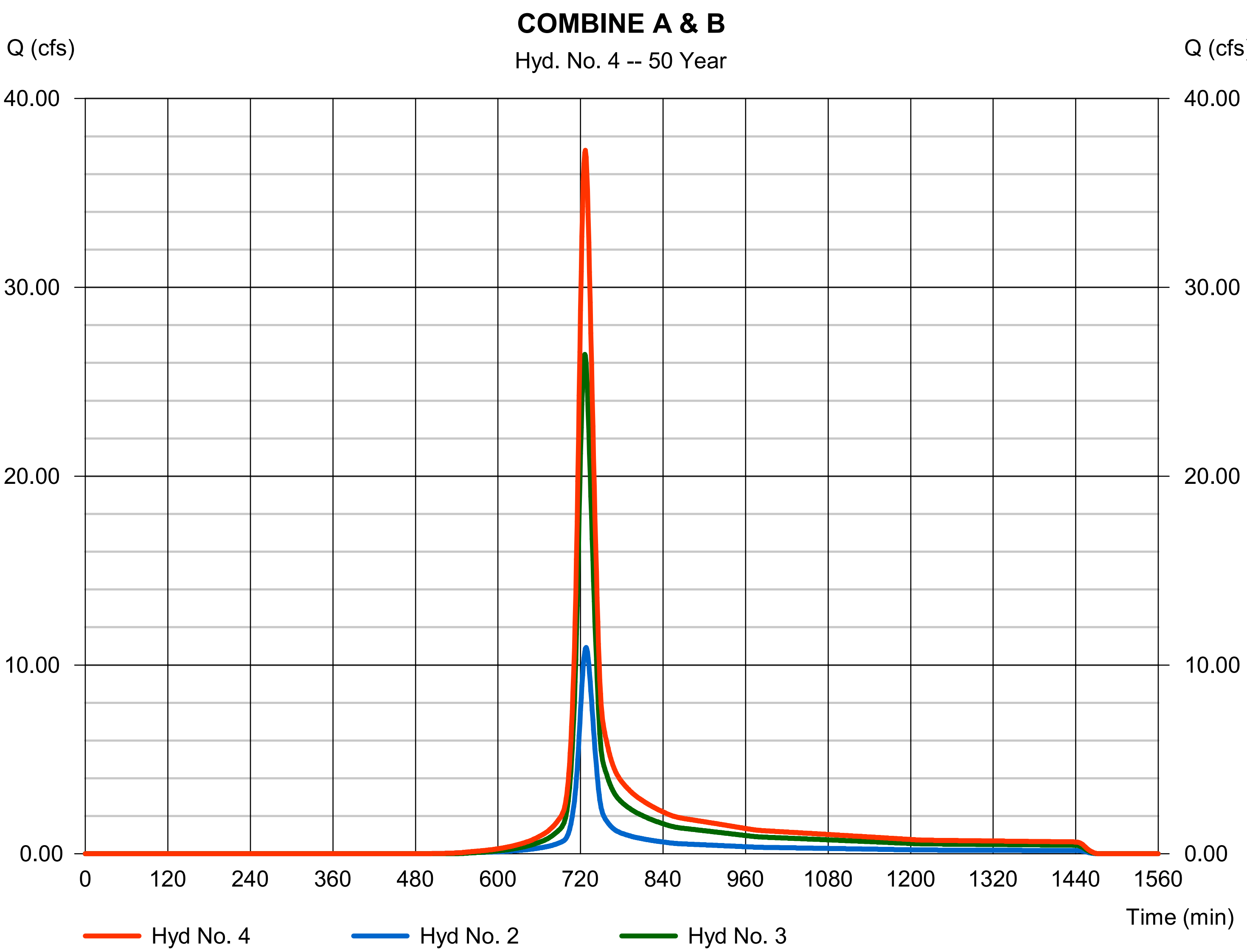
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 11 / 15 / 2018

Hyd. No. 4

COMBINE A & B

Hydrograph type	= Combine	Peak discharge	= 37.25 cfs
Storm frequency	= 50 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 122,804 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 7.090 ac



Hydrograph Report

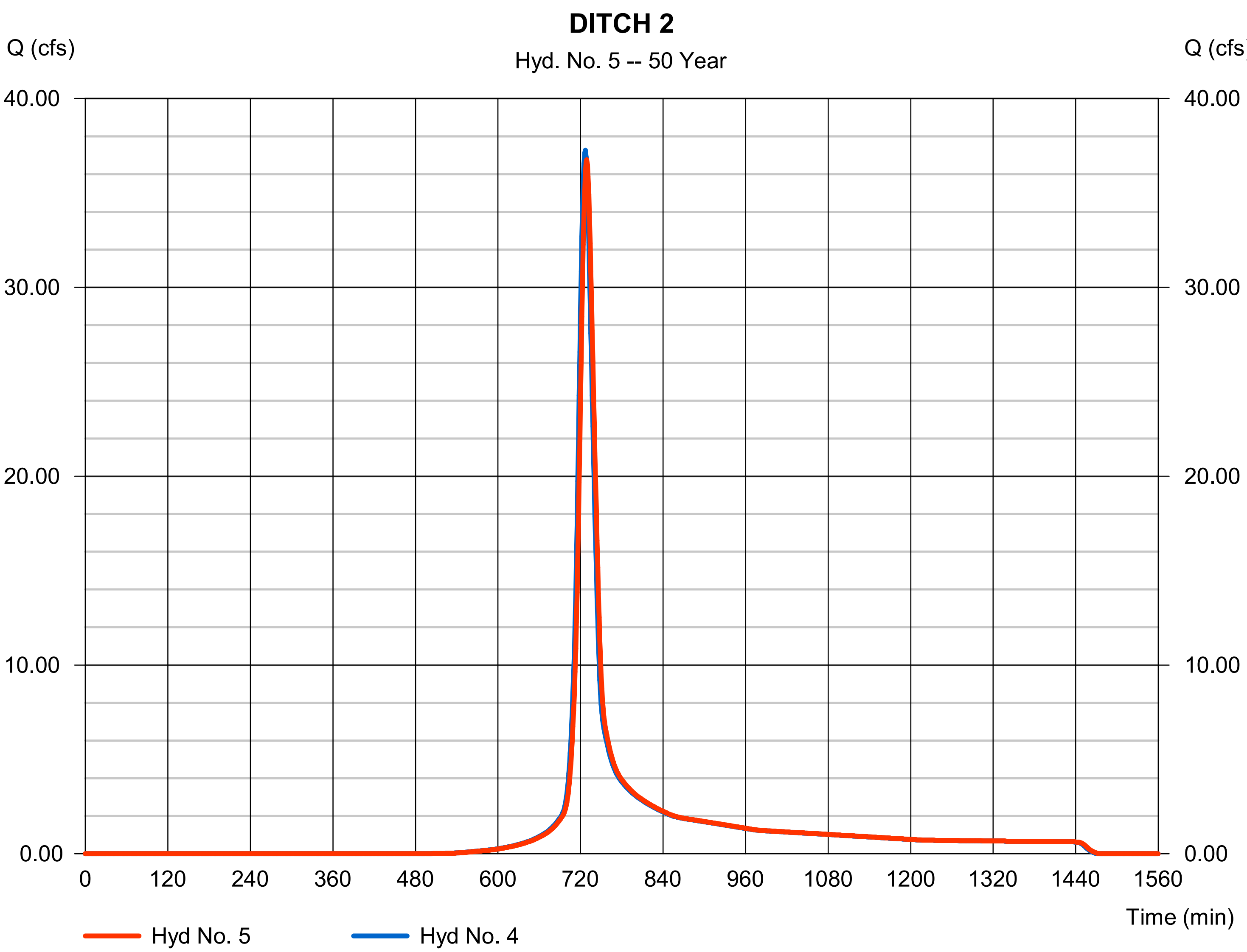
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 5

DITCH 2

Hydrograph type	= Reach	Peak discharge	= 36.76 cfs
Storm frequency	= 50 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 122,803 cuft
Inflow hyd. No.	= 4 - COMBINE A & B	Section type	= Trapezoidal
Reach length	= 610.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.373
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.4738

Modified Att-Kin routing method used.



Hydrograph Report

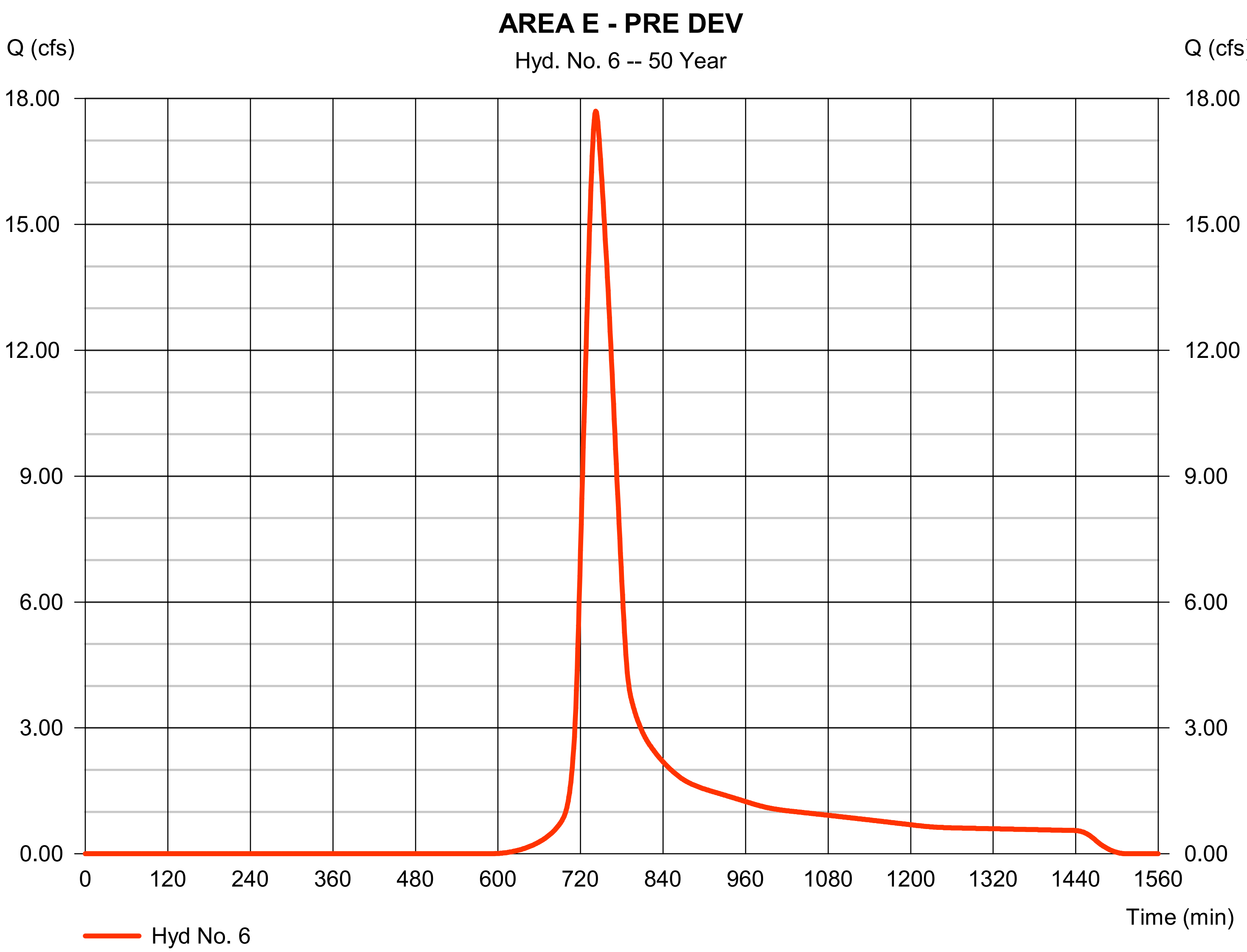
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 6

AREA E - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 17.70 cfs
Storm frequency	= 50 yrs	Time to peak	= 742 min
Time interval	= 1 min	Hyd. volume	= 98,530 cuft
Drainage area	= 9.150 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 47.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.680 x 65) + (0.330 x 98) + (5.140 x 60)] / 9.150



Hydrograph Report

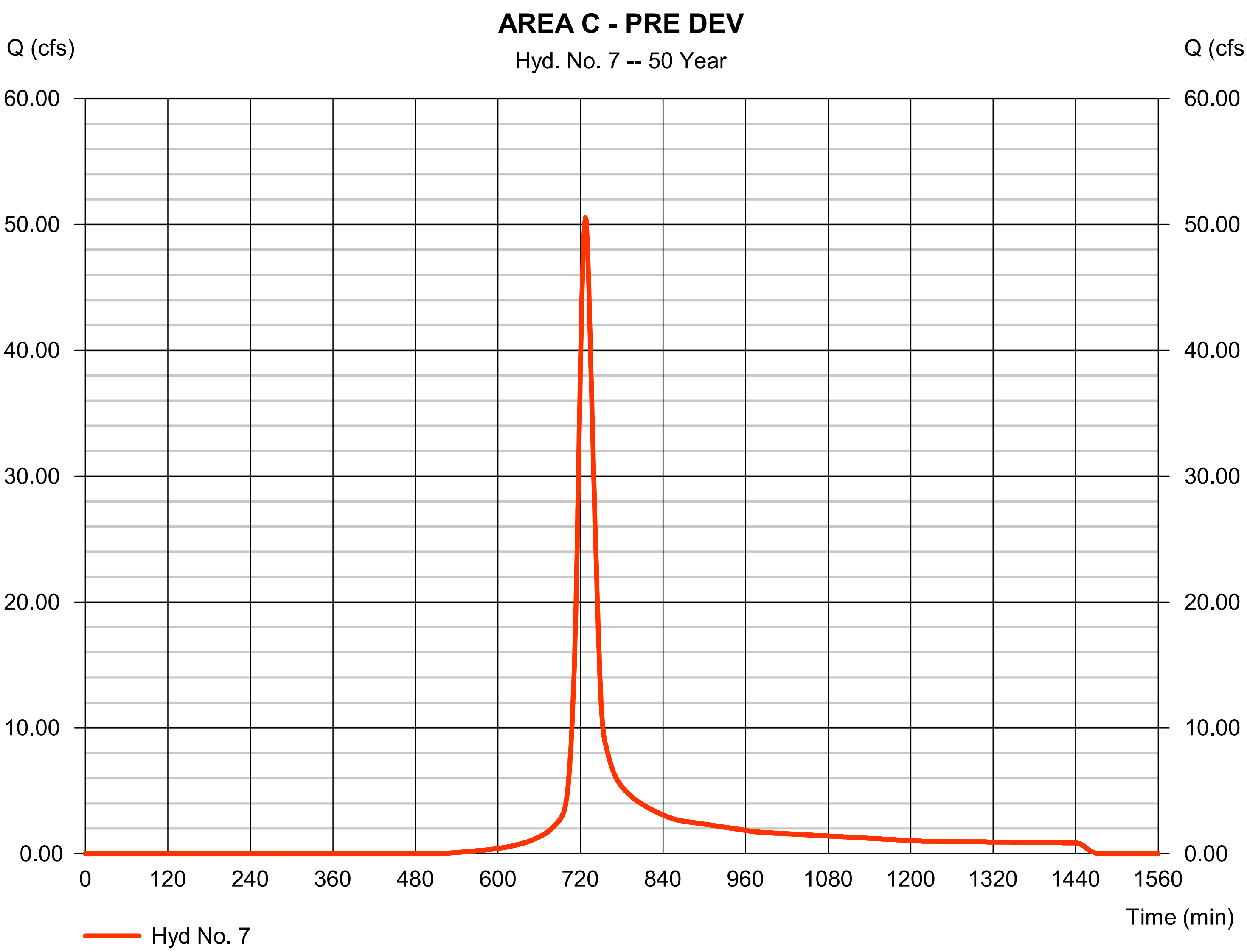
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 7

AREA C - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 50.52 cfs
Storm frequency	= 50 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 171,915 cuft
Drainage area	= 13.380 ac	Curve number	= 69*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.210 x 85) + (0.400 x 55) + (1.740 x 98) + (9.030 x 60)] / 13.380



Hydrograph Report

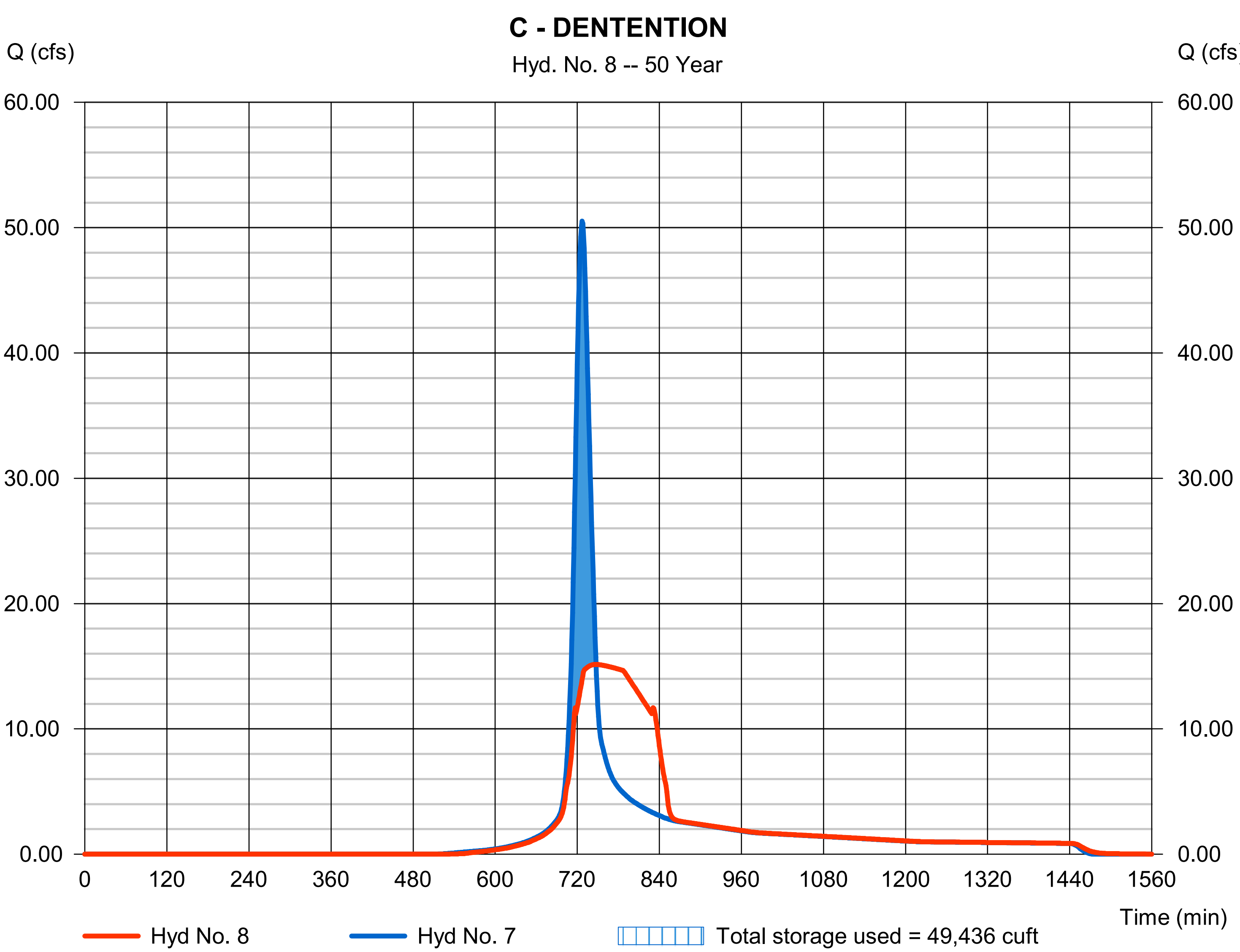
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 8

C - DENTENTION

Hydrograph type	= Reservoir	Peak discharge	= 15.15 cfs
Storm frequency	= 50 yrs	Time to peak	= 747 min
Time interval	= 1 min	Hyd. volume	= 171,912 cuft
Inflow hyd. No.	= 7 - AREA C - PRE DEV	Max. Elevation	= 582.16 ft
Reservoir name	= C DETENTION	Max. Storage	= 49,436 cuft

Storage Indication method used.



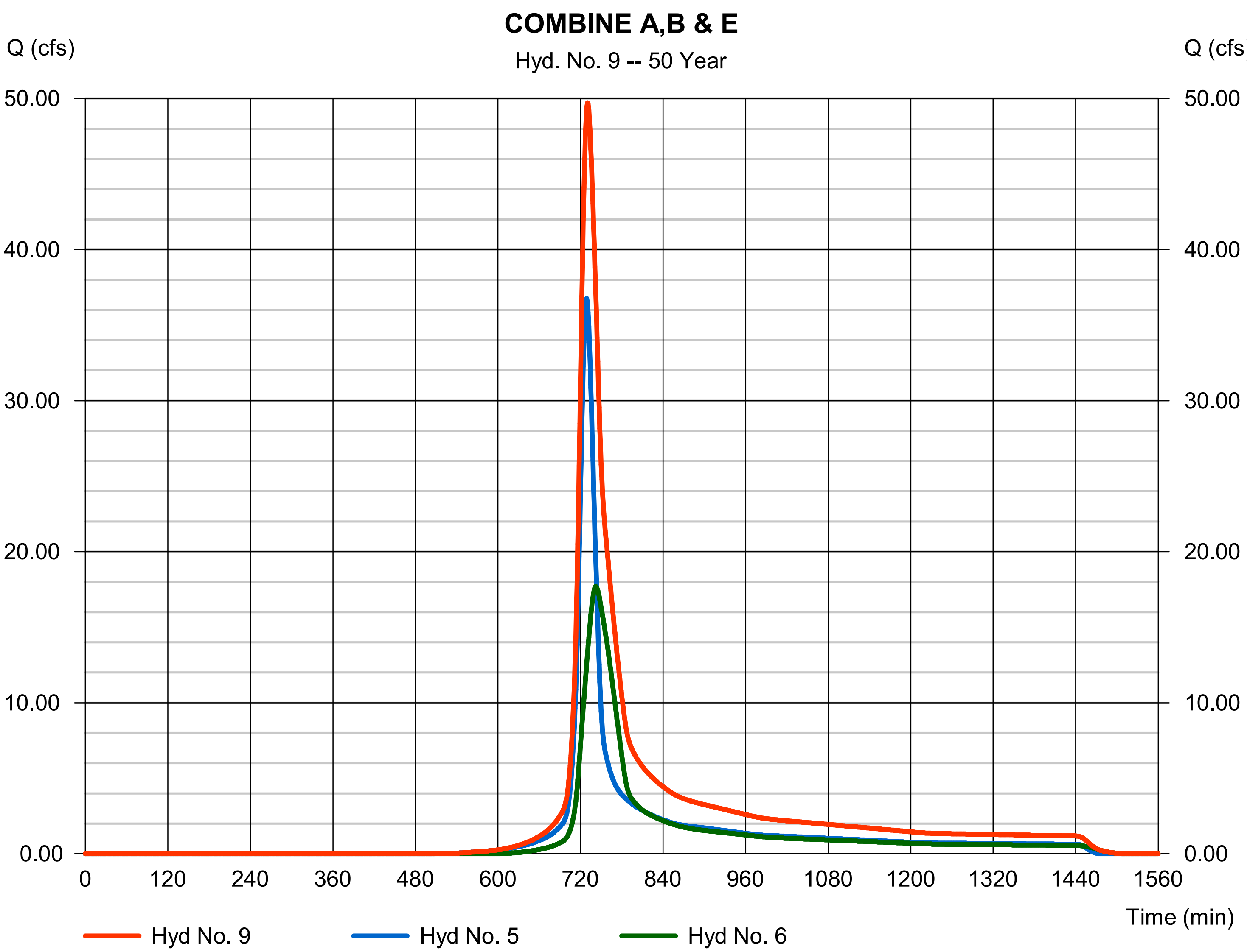
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 9

COMBINE A,B & E

Hydrograph type	= Combine	Peak discharge	= 49.72 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 221,334 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 9.150 ac



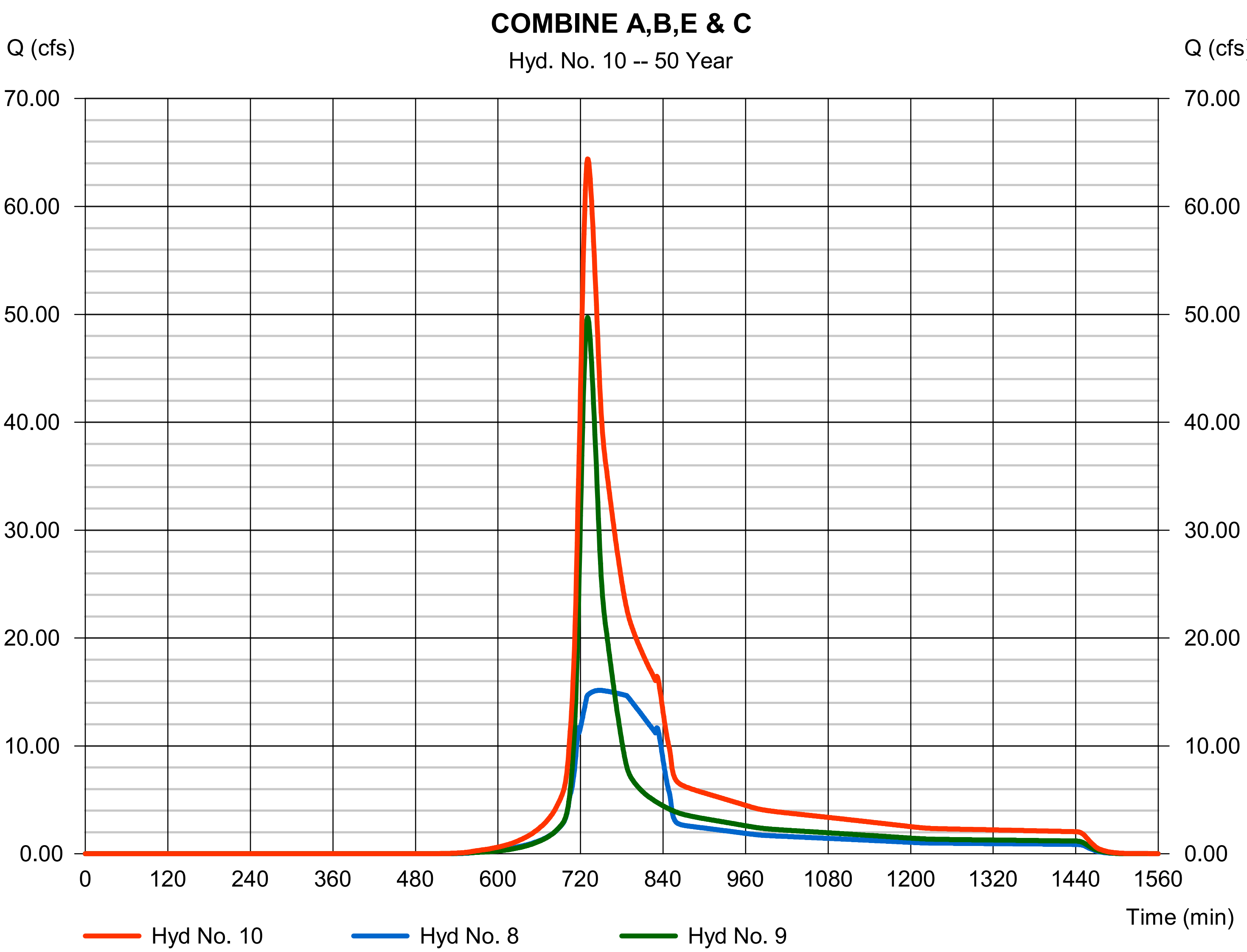
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 10

COMBINE A,B,E & C

Hydrograph type	= Combine	Peak discharge	= 64.41 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 393,246 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 0.000 ac



Hydrograph Report

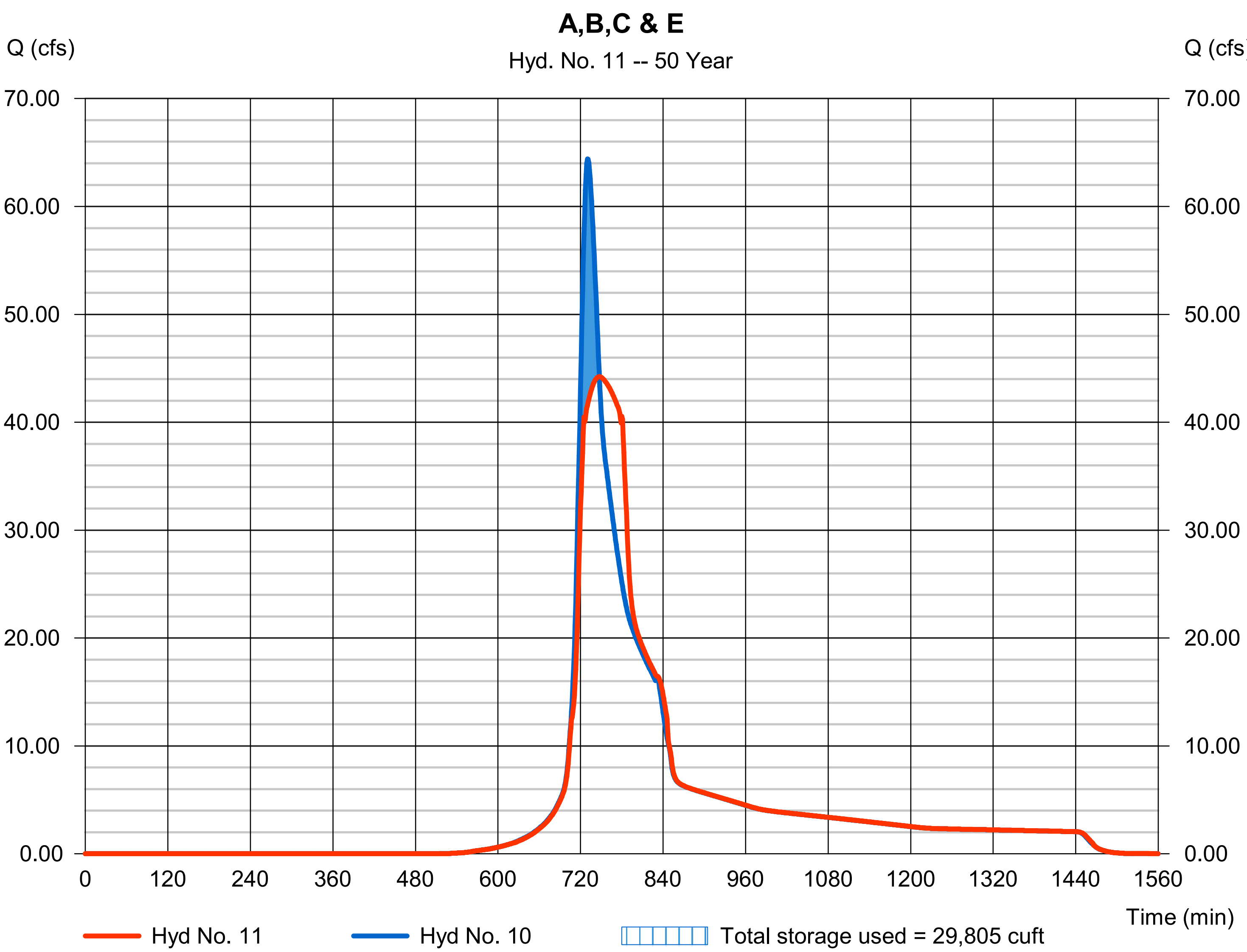
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 11

A,B,C & E

Hydrograph type	= Reservoir	Peak discharge	= 44.22 cfs
Storm frequency	= 50 yrs	Time to peak	= 747 min
Time interval	= 1 min	Hyd. volume	= 393,216 cuft
Inflow hyd. No.	= 10 - COMBINE A,B,E & C	Max. Elevation	= 581.77 ft
Reservoir name	= A,B,C & E DETENTION	Max. Storage	= 29,805 cuft

Storage Indication method used.



Hydrograph Report

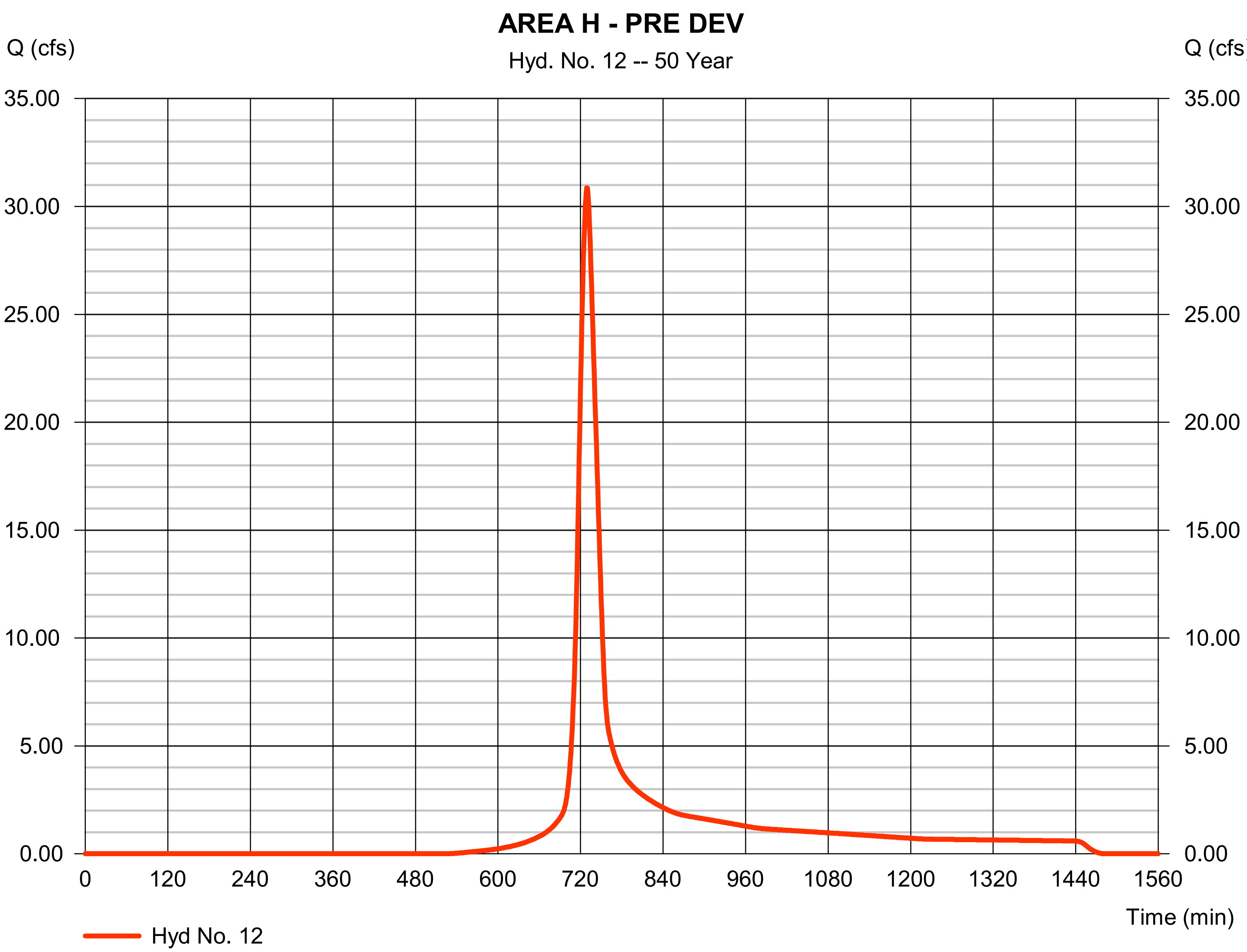
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 12

AREA H - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 30.87 cfs
Storm frequency	= 50 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 115,543 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



Hydrograph Report

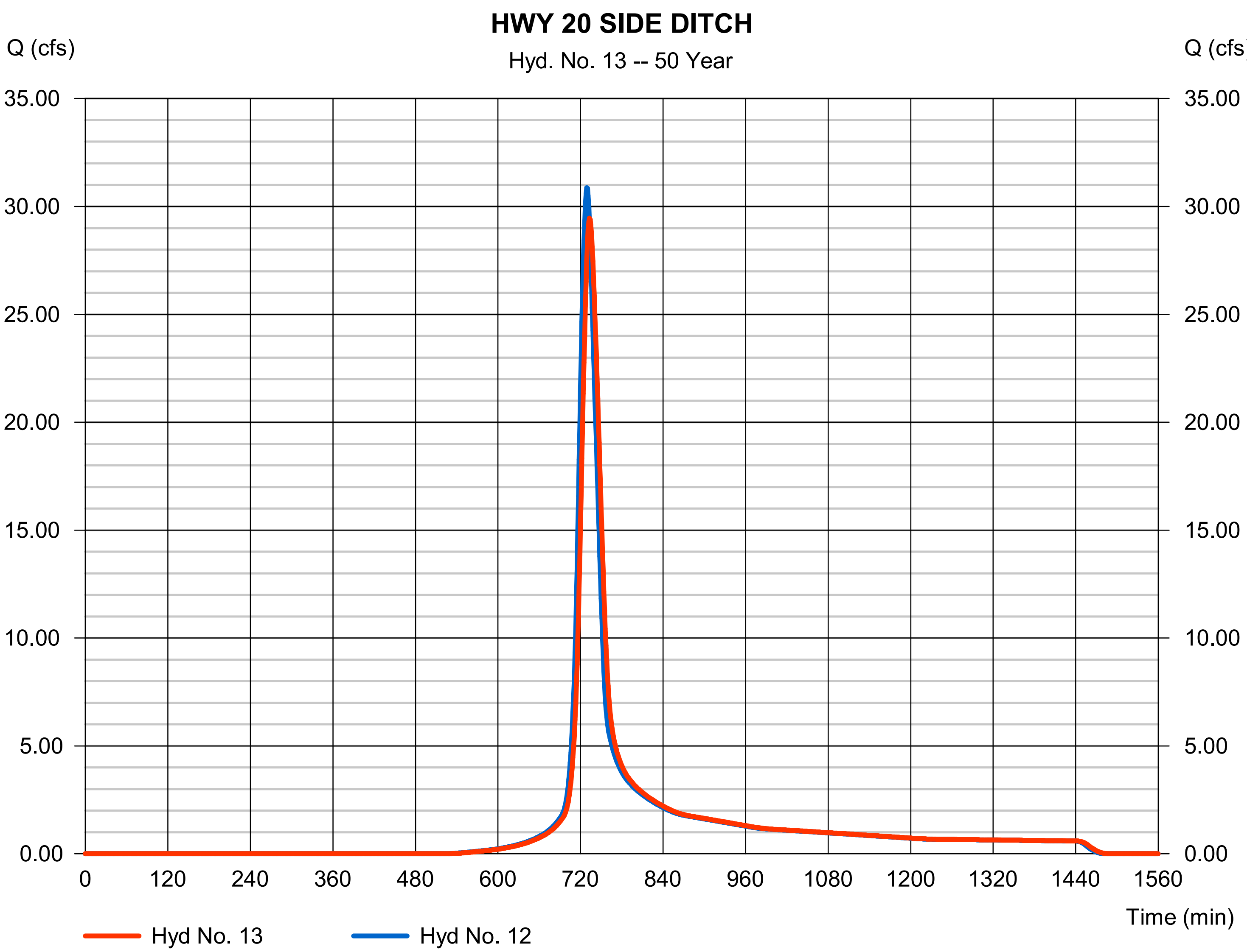
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 13

HWY 20 SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 29.45 cfs
Storm frequency	= 50 yrs	Time to peak	= 733 min
Time interval	= 1 min	Hyd. volume	= 115,541 cuft
Inflow hyd. No.	= 12 - AREA H - PRE DEV	Section type	= Trapezoidal
Reach length	= 900.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.030	Bottom width	= 3.0 ft
Side slope	= 2.0:1	Max. depth	= 3.0 ft
Rating curve x	= 1.688	Rating curve m	= 1.282
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.2404

Modified Att-Kin routing method used.



Hydrograph Report

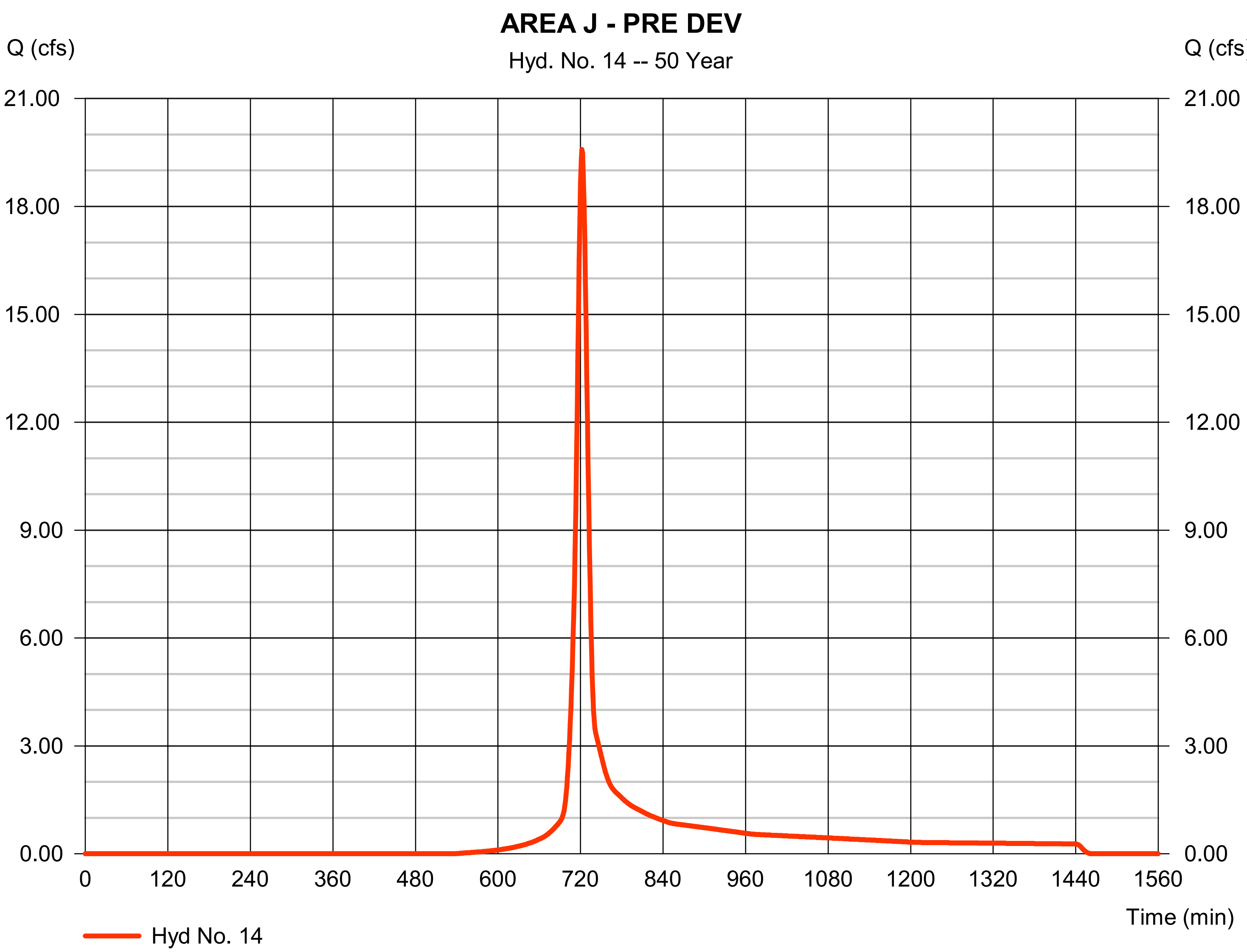
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 14

AREA J - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 19.59 cfs
Storm frequency	= 50 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 52,735 cuft
Drainage area	= 4.320 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.90 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 85) + (0.020 x 65) + (0.690 x 98) + (3.520 x 60)] / 4.320



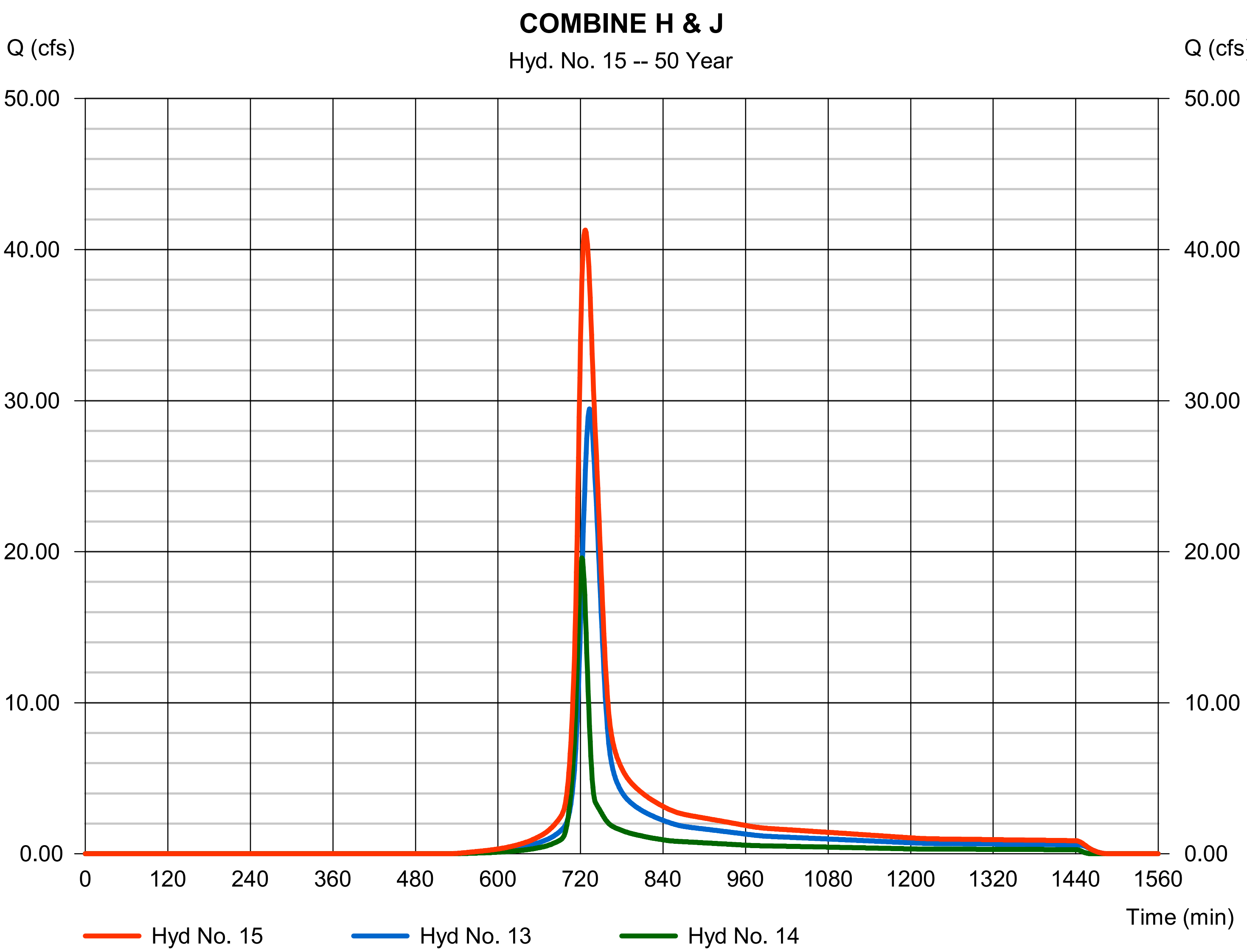
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 15

COMBINE H & J

Hydrograph type	= Combine	Peak discharge	= 41.30 cfs
Storm frequency	= 50 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 168,276 cuft
Inflow hyds.	= 13, 14	Contrib. drain. area	= 4.320 ac



Hydrograph Report

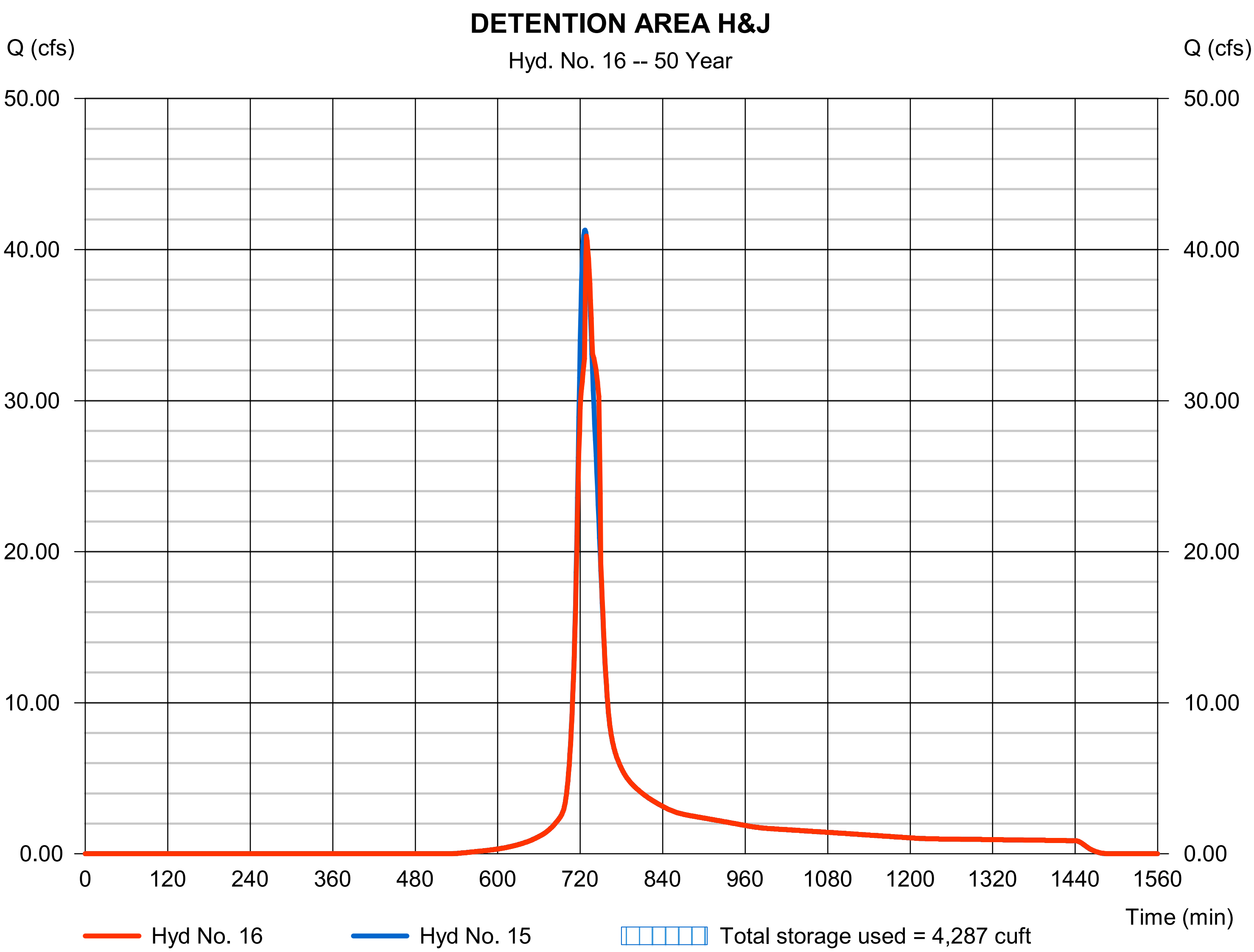
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 16

DETENTION AREA H&J

Hydrograph type	= Reservoir	Peak discharge	= 40.90 cfs
Storm frequency	= 50 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 168,276 cuft
Inflow hyd. No.	= 15 - COMBINE H & J	Max. Elevation	= 580.91 ft
Reservoir name	= H&J DETENTION	Max. Storage	= 4,287 cuft

Storage Indication method used.



Hydrograph Report

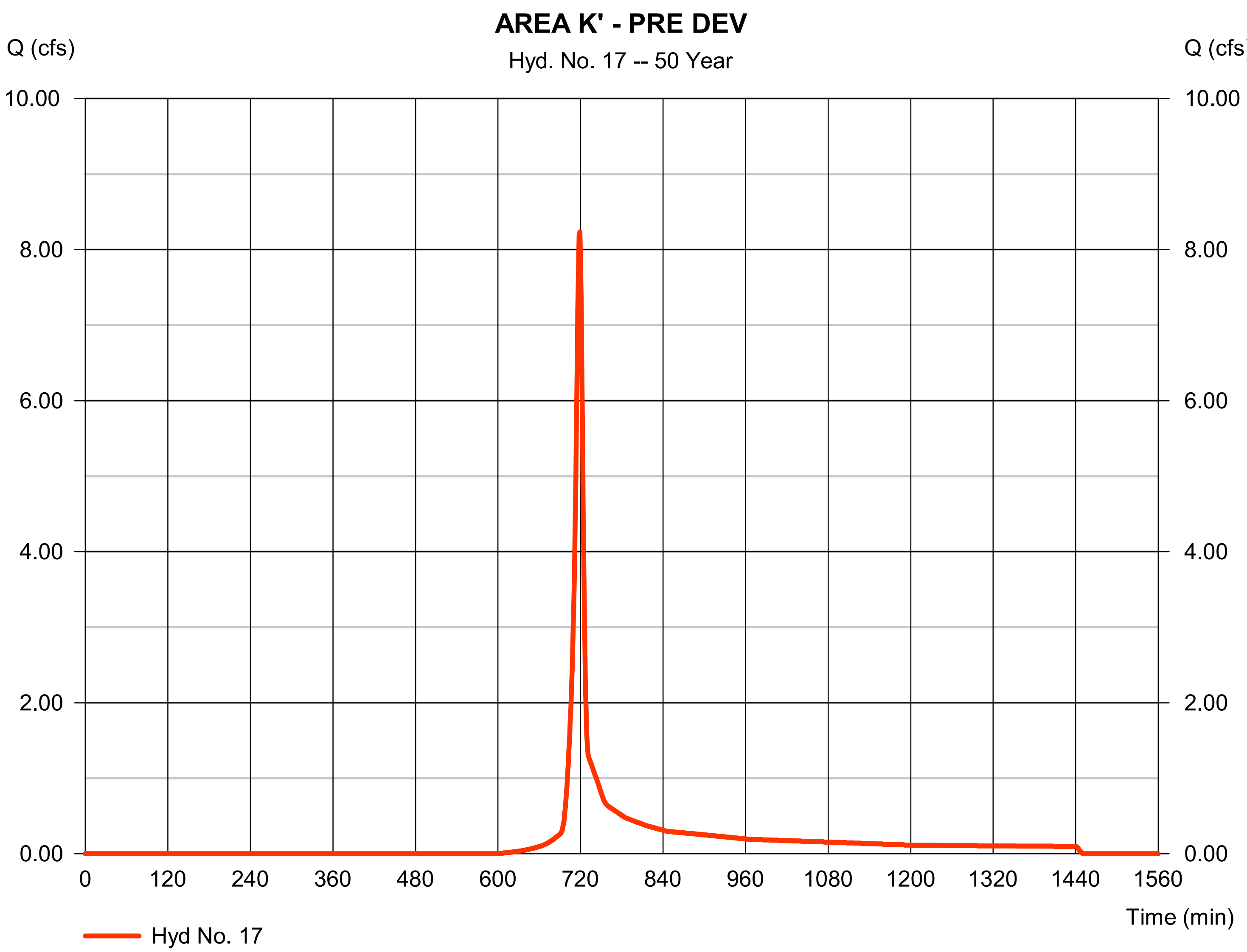
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 17

AREA K' - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 8.234 cfs
Storm frequency	= 50 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 17,365 cuft
Drainage area	= 1.720 ac	Curve number	= 62*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.20 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.350 x 60) + (0.330 x 65) + (0.040 x 98)] / 1.720



Hydrograph Report

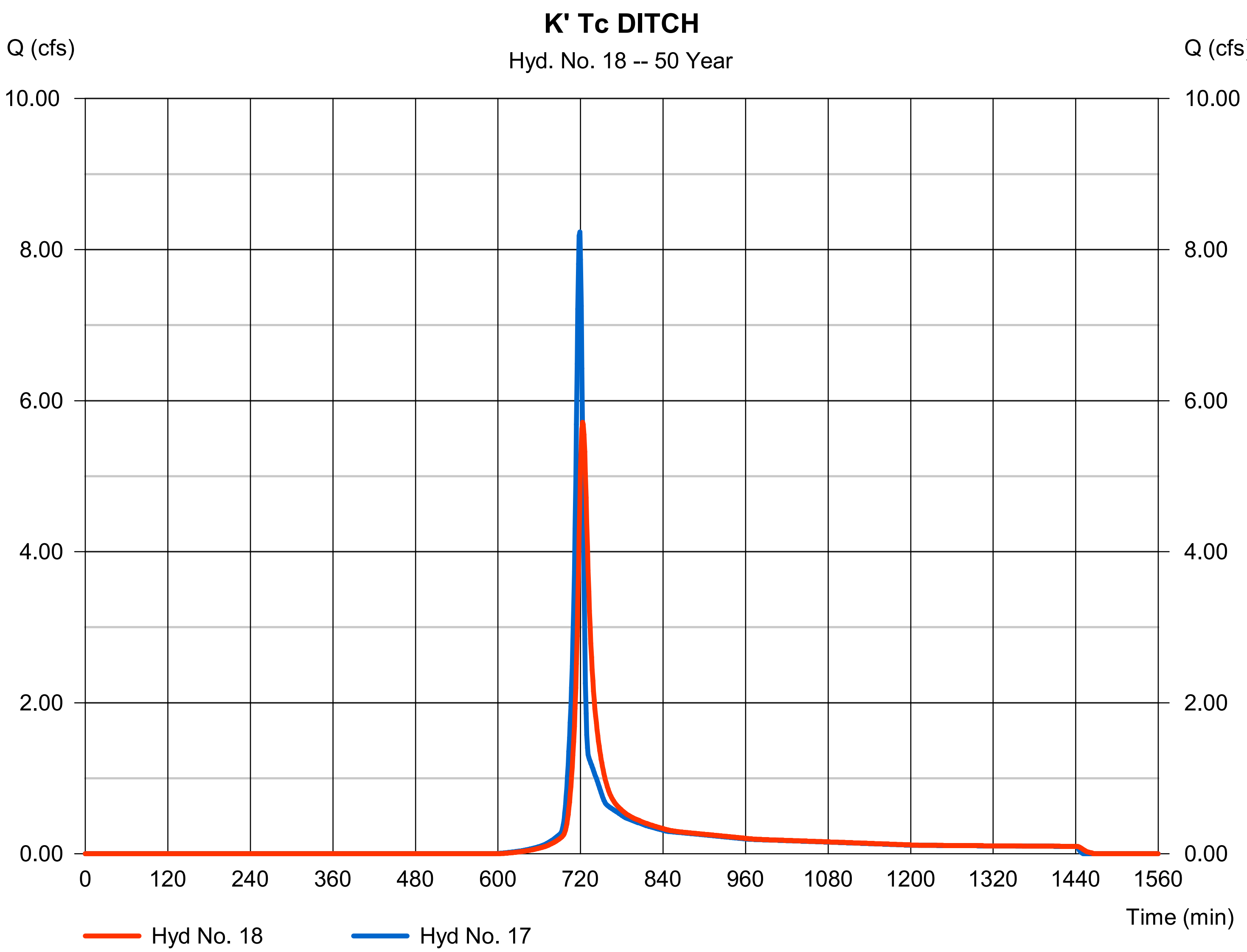
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 18

K' Tc DITCH

Hydrograph type	= Reach	Peak discharge	= 5.715 cfs
Storm frequency	= 50 yrs	Time to peak	= 723 min
Time interval	= 1 min	Hyd. volume	= 17,360 cuft
Inflow hyd. No.	= 17 - AREA K' - PRE DEV	Section type	= Trapezoidal
Reach length	= 710.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.040	Bottom width	= 5.0 ft
Side slope	= 4.0:1	Max. depth	= 2.0 ft
Rating curve x	= 0.697	Rating curve m	= 1.257
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.1155

Modified Att-Kin routing method used.



Hydrograph Report

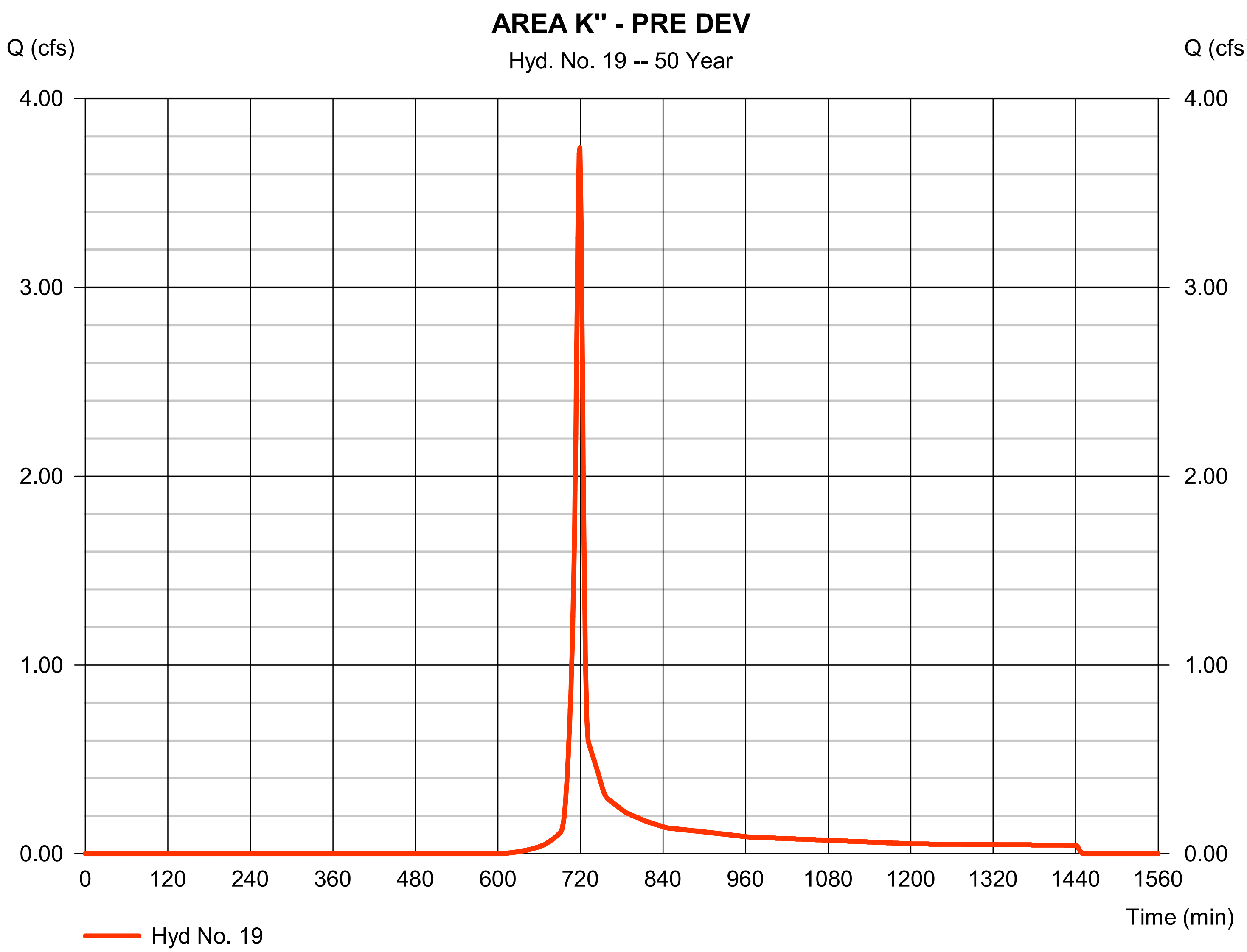
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 19

AREA K" - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 3.739 cfs
Storm frequency	= 50 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 7,891 cuft
Drainage area	= 0.810 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.10 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.170 x 65) + (0.640 x 60)] / 0.810



Hydrograph Report

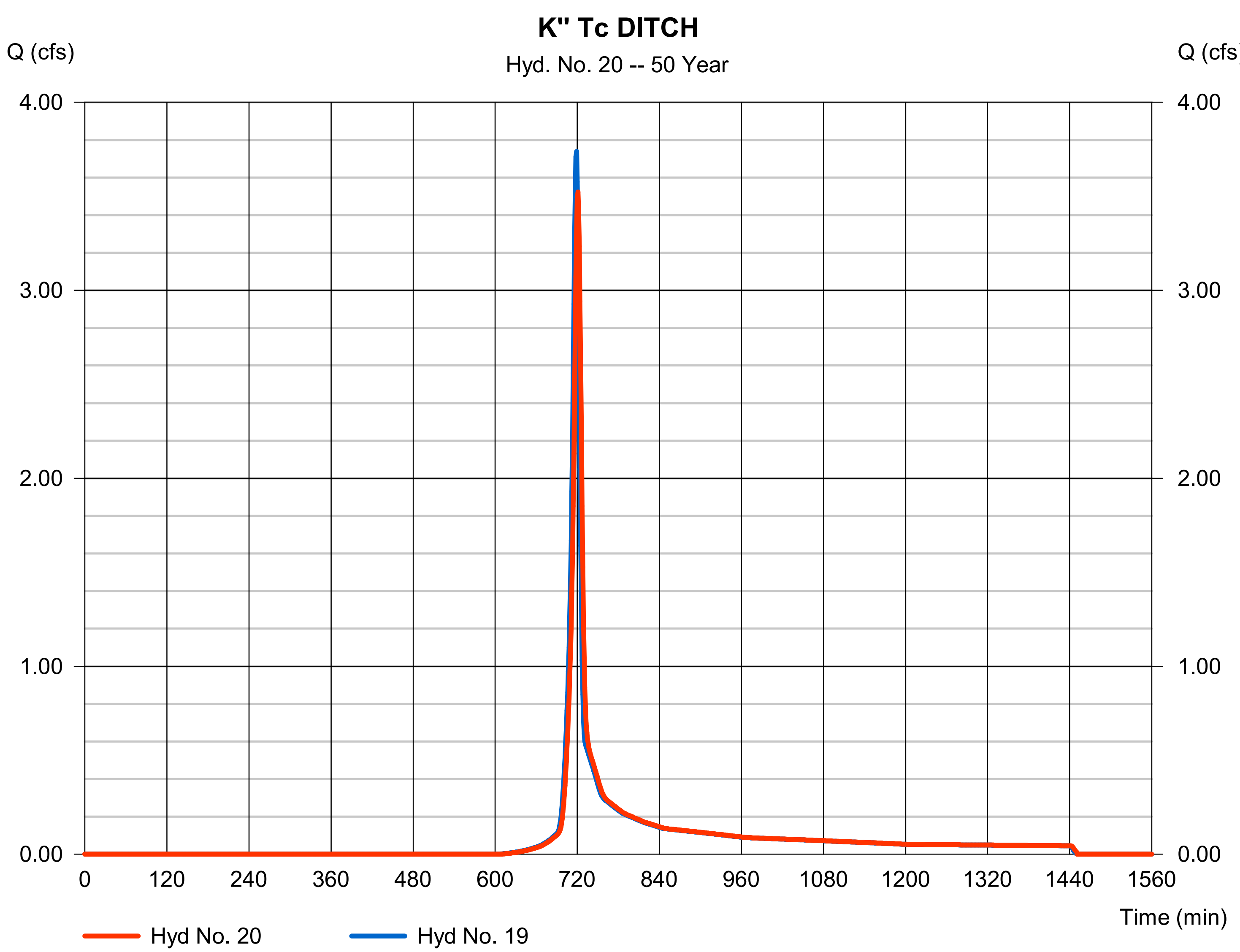
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 20

K" Tc DITCH

Hydrograph type	= Reach	Peak discharge	= 3.524 cfs
Storm frequency	= 50 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 7,890 cuft
Inflow hyd. No.	= 19 - AREA K" - PRE DEV	Section type	= Trapezoidal
Reach length	= 150.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.040	Bottom width	= 5.0 ft
Side slope	= 4.0:1	Max. depth	= 2.0 ft
Rating curve x	= 0.697	Rating curve m	= 1.257
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.3961

Modified Att-Kin routing method used.



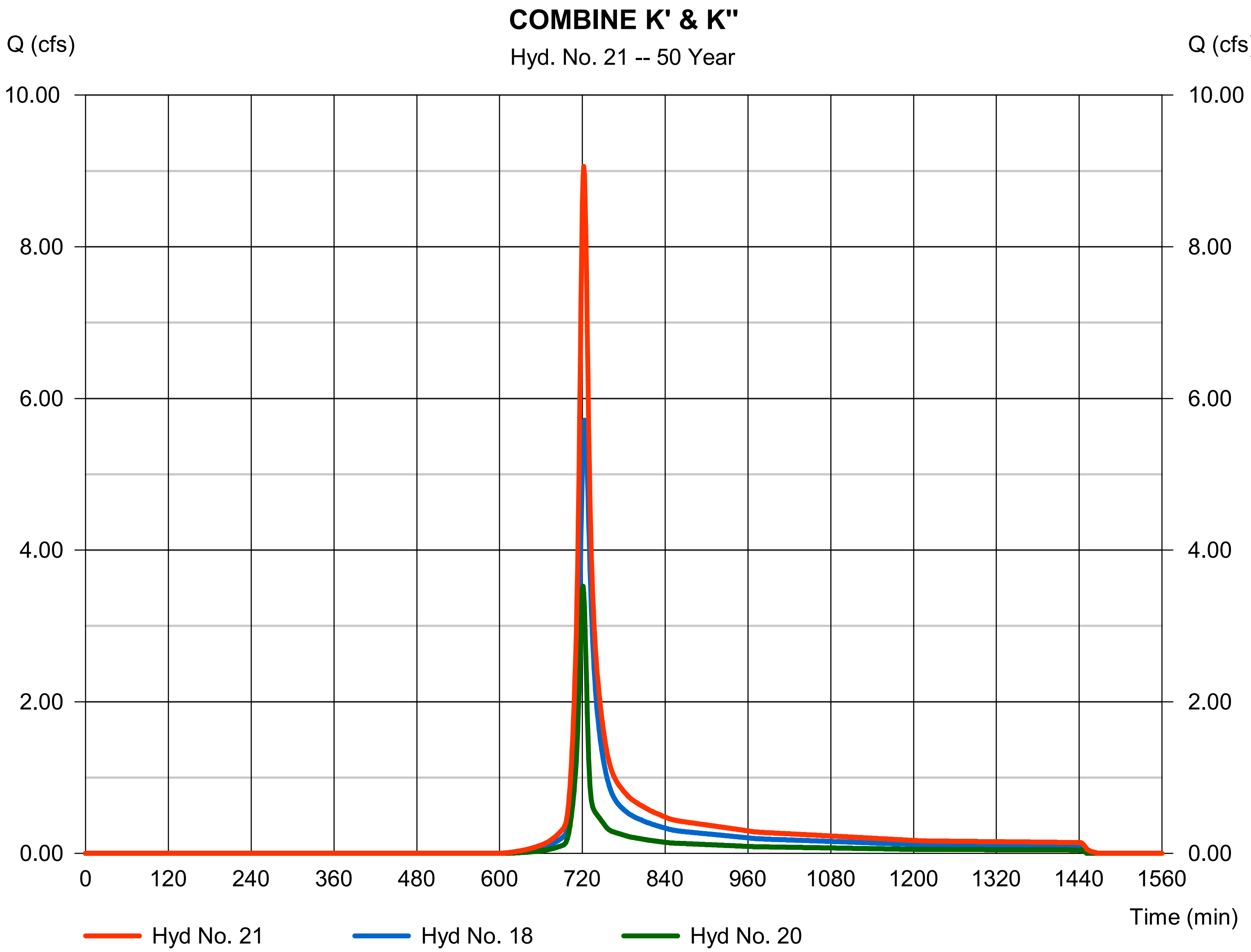
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 11 / 15 / 2018

Hyd. No. 21

COMBINE K' & K''

Hydrograph type	= Combine	Peak discharge	= 9.058 cfs
Storm frequency	= 50 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 25,250 cuft
Inflow hyds.	= 18, 20	Contrib. drain. area	= 0.000 ac



Hydrograph Report

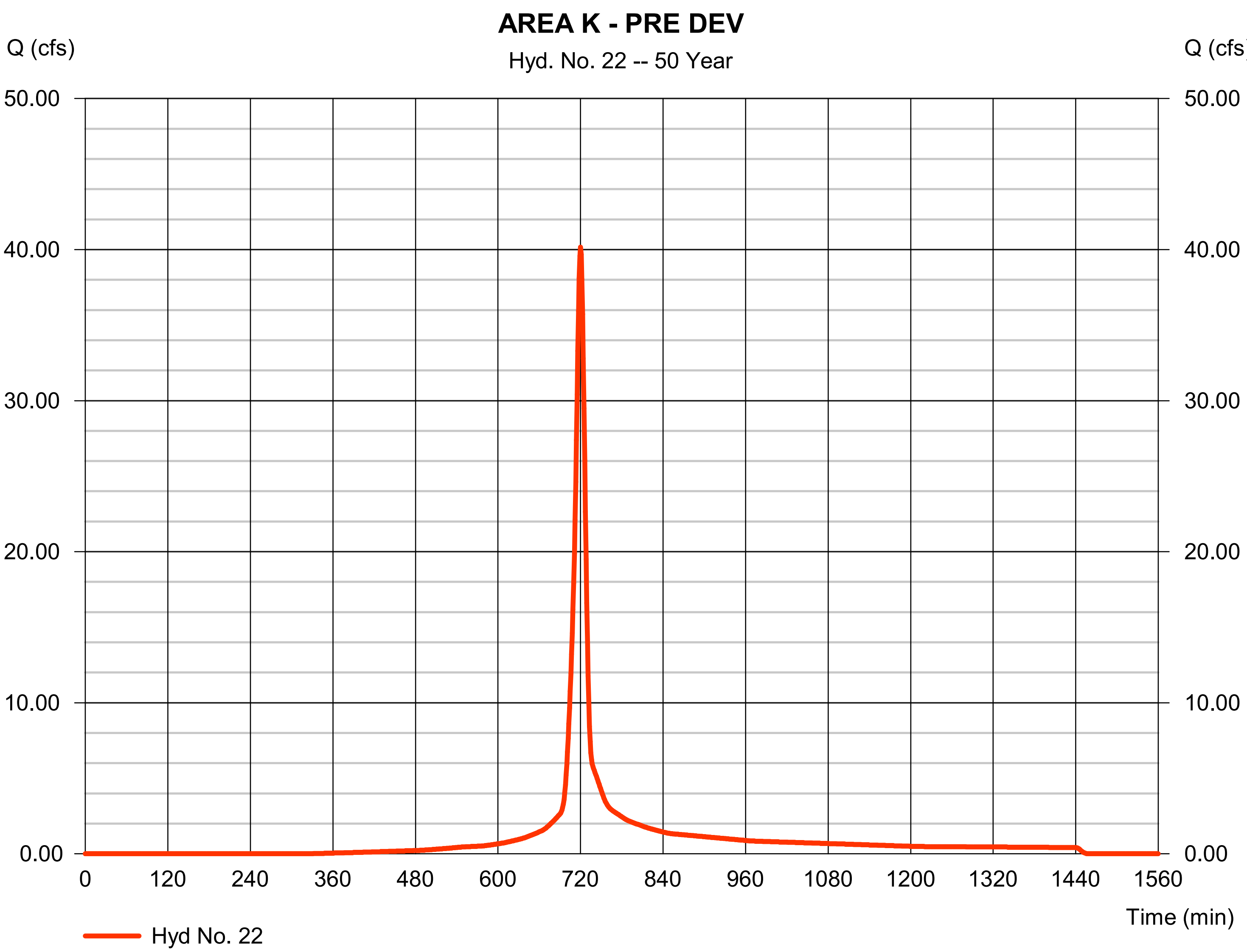
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 11 / 15 / 2018

Hyd. No. 22

AREA K - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 40.17 cfs
Storm frequency	= 50 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 99,510 cuft
Drainage area	= 5.530 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.70 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(4.460 x 85) + (1.070 x 65)] / 5.530



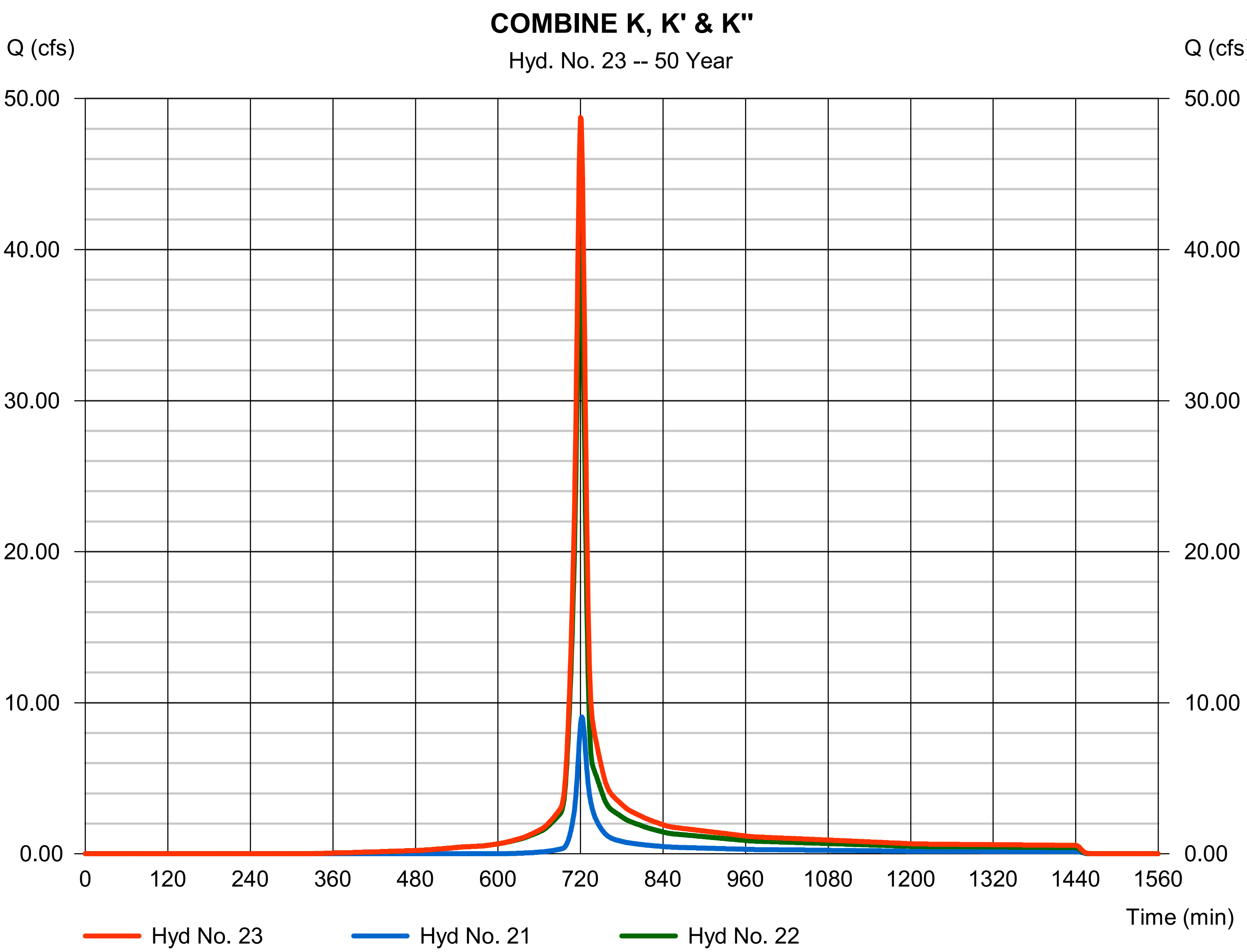
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 23

COMBINE K, K' & K"

Hydrograph type	= Combine	Peak discharge	= 48.75 cfs
Storm frequency	= 50 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 124,759 cuft
Inflow hyds.	= 21, 22	Contrib. drain. area	= 5.530 ac



Hydrograph Report

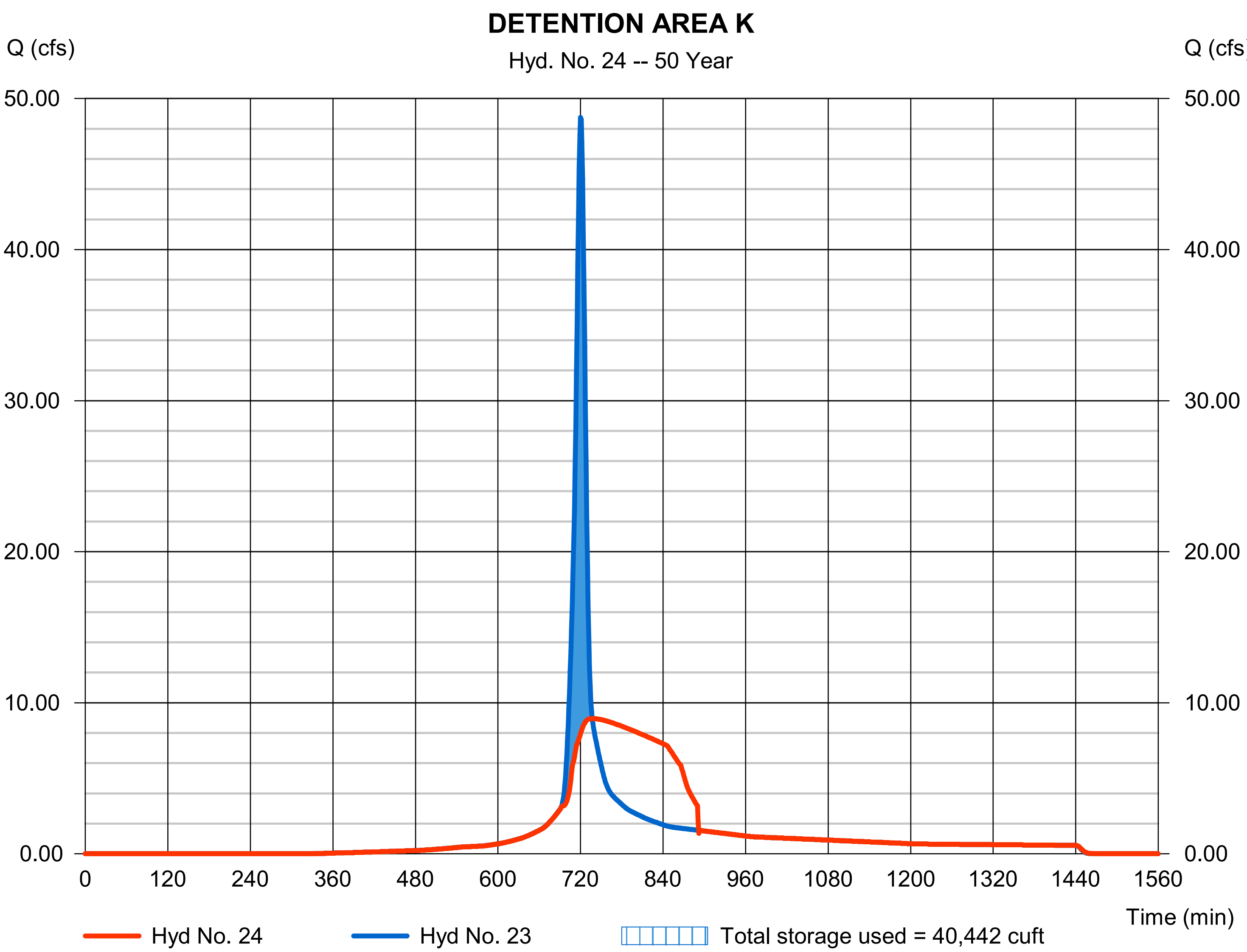
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 24

DETENTION AREA K

Hydrograph type	= Reservoir	Peak discharge	= 8.947 cfs
Storm frequency	= 50 yrs	Time to peak	= 737 min
Time interval	= 1 min	Hyd. volume	= 124,759 cuft
Inflow hyd. No.	= 23 - COMBINE K, K' & K''	Max. Elevation	= 583.00 ft
Reservoir name	= K DETENTION	Max. Storage	= 40,442 cuft

Storage Indication method used.



Hydrograph Report

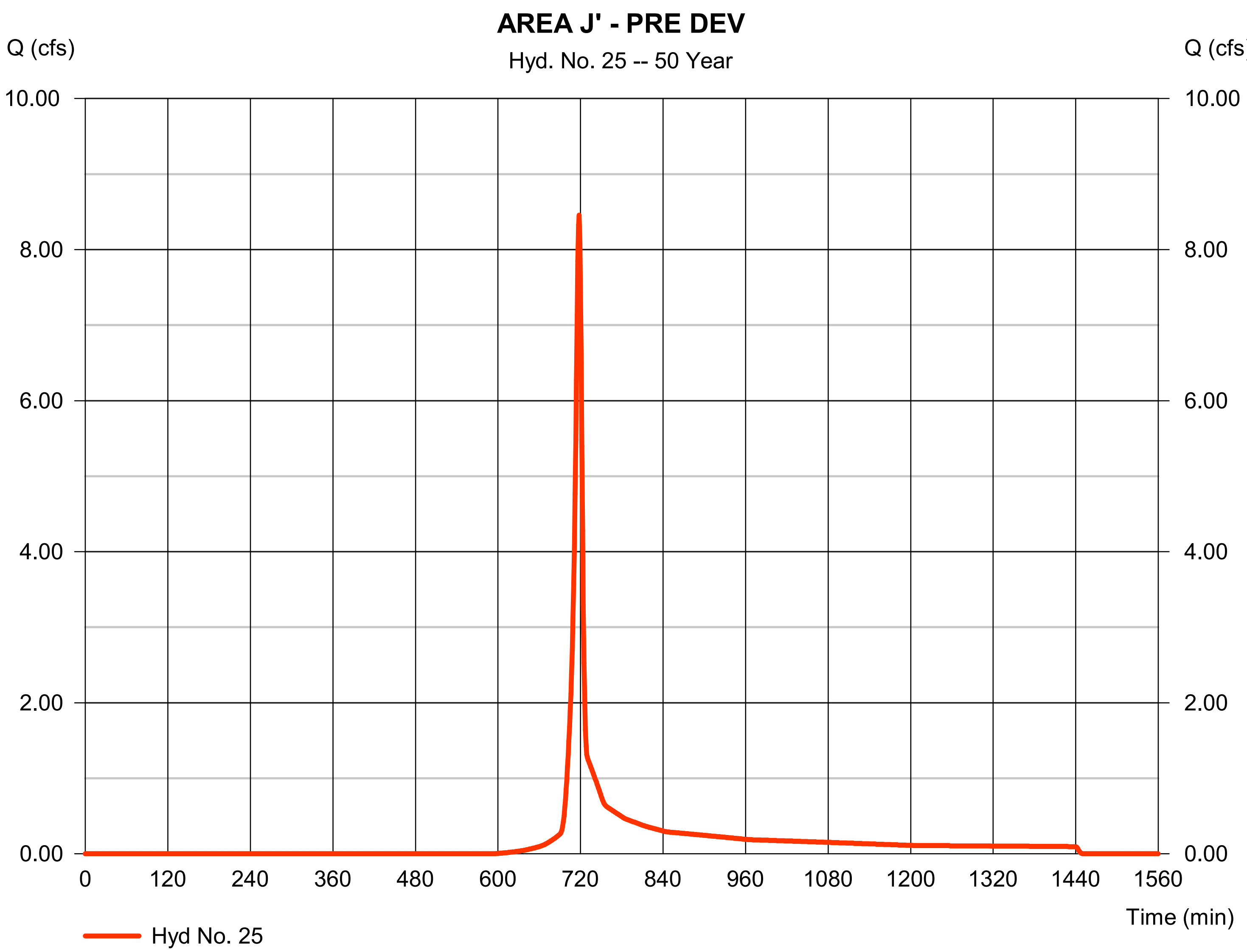
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 11 / 15 / 2018

Hyd. No. 25

AREA J' - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 8.455 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 16,979 cuft
Drainage area	= 1.590 ac	Curve number	= 62*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.080 x 85) + (0.220 x 65) + (1.290 x 60)] / 1.590



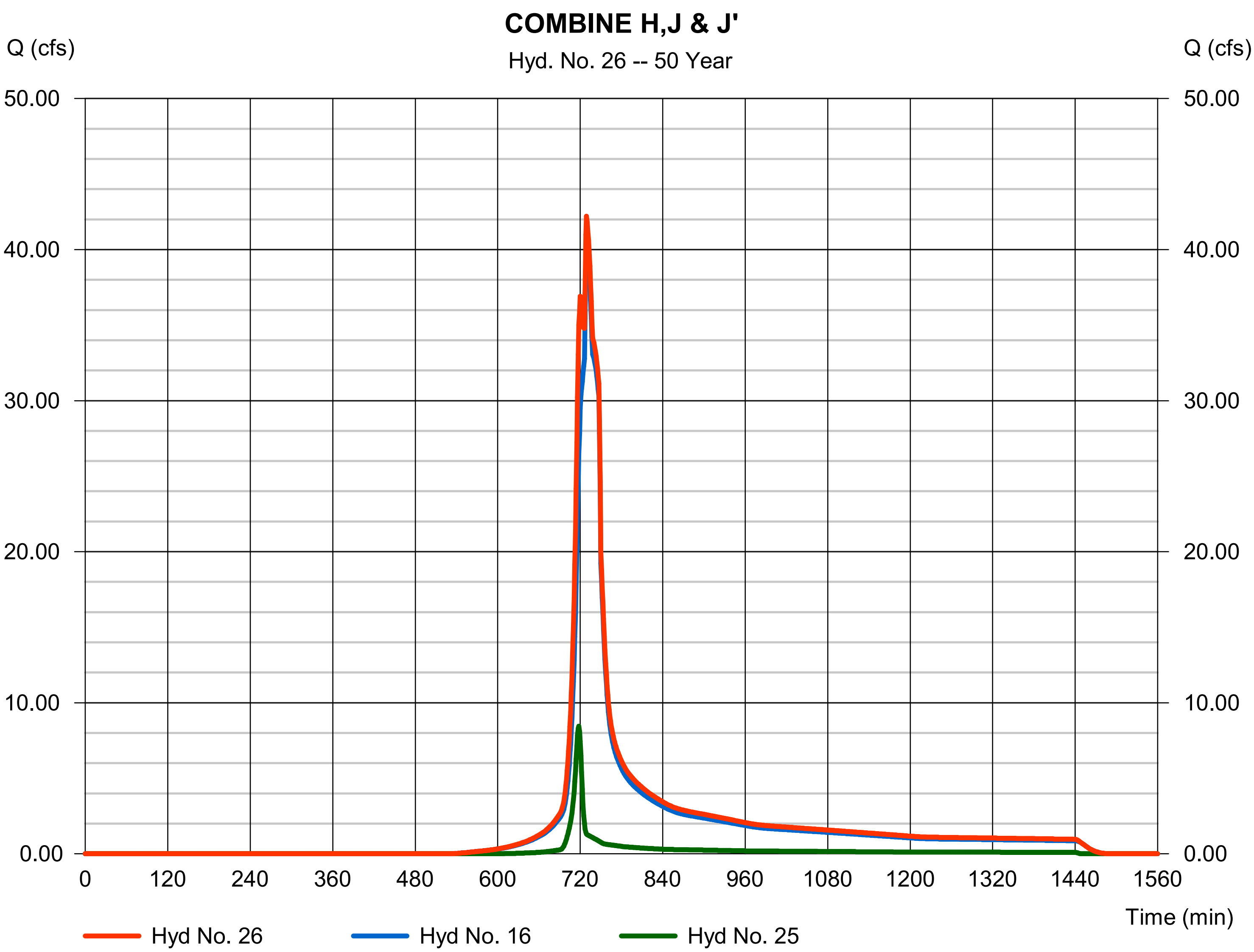
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 26

COMBINE H,J & J'

Hydrograph type	= Combine	Peak discharge	= 42.22 cfs
Storm frequency	= 50 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 185,255 cuft
Inflow hyds.	= 16, 25	Contrib. drain. area	= 1.590 ac



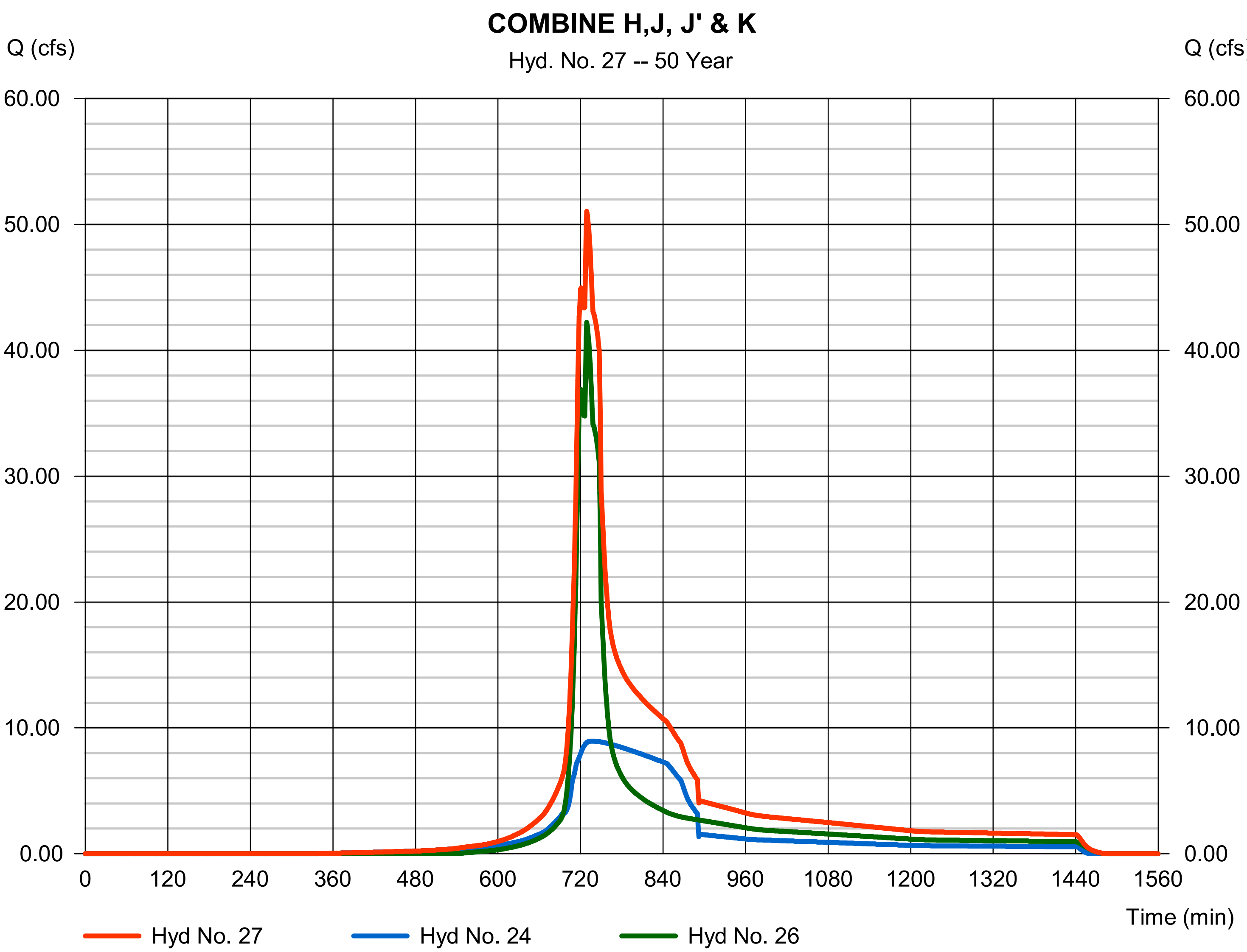
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 27

COMBINE H,J, J' & K

Hydrograph type	= Combine	Peak discharge	= 51.05 cfs
Storm frequency	= 50 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 310,013 cuft
Inflow hyds.	= 24, 26	Contrib. drain. area	= 0.000 ac



Hydrograph Report

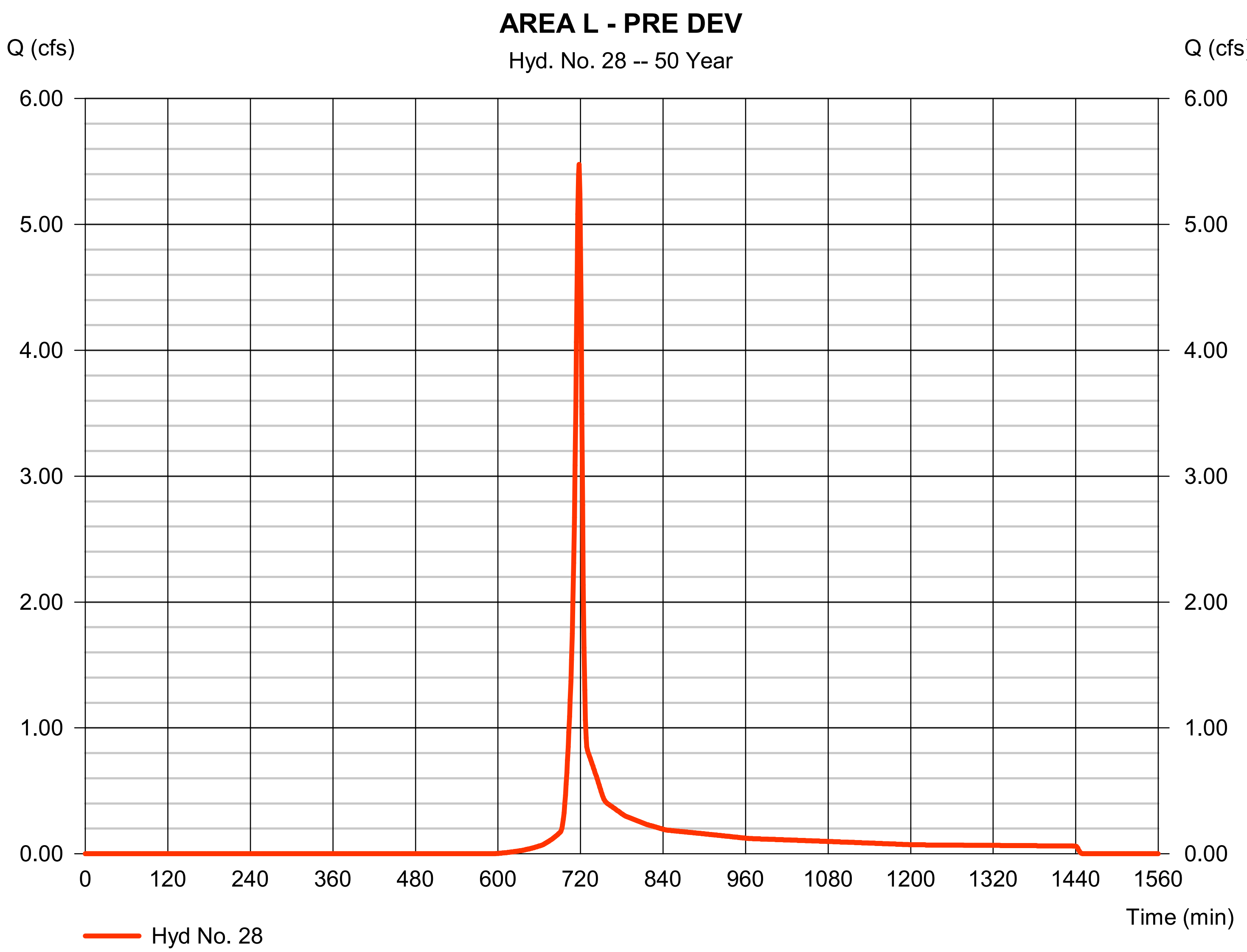
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 28

AREA L - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 5.477 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 10,999 cuft
Drainage area	= 1.030 ac	Curve number	= 62*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.230 x 65) + (0.050 x 85) + (0.750 x 60)] / 1.030



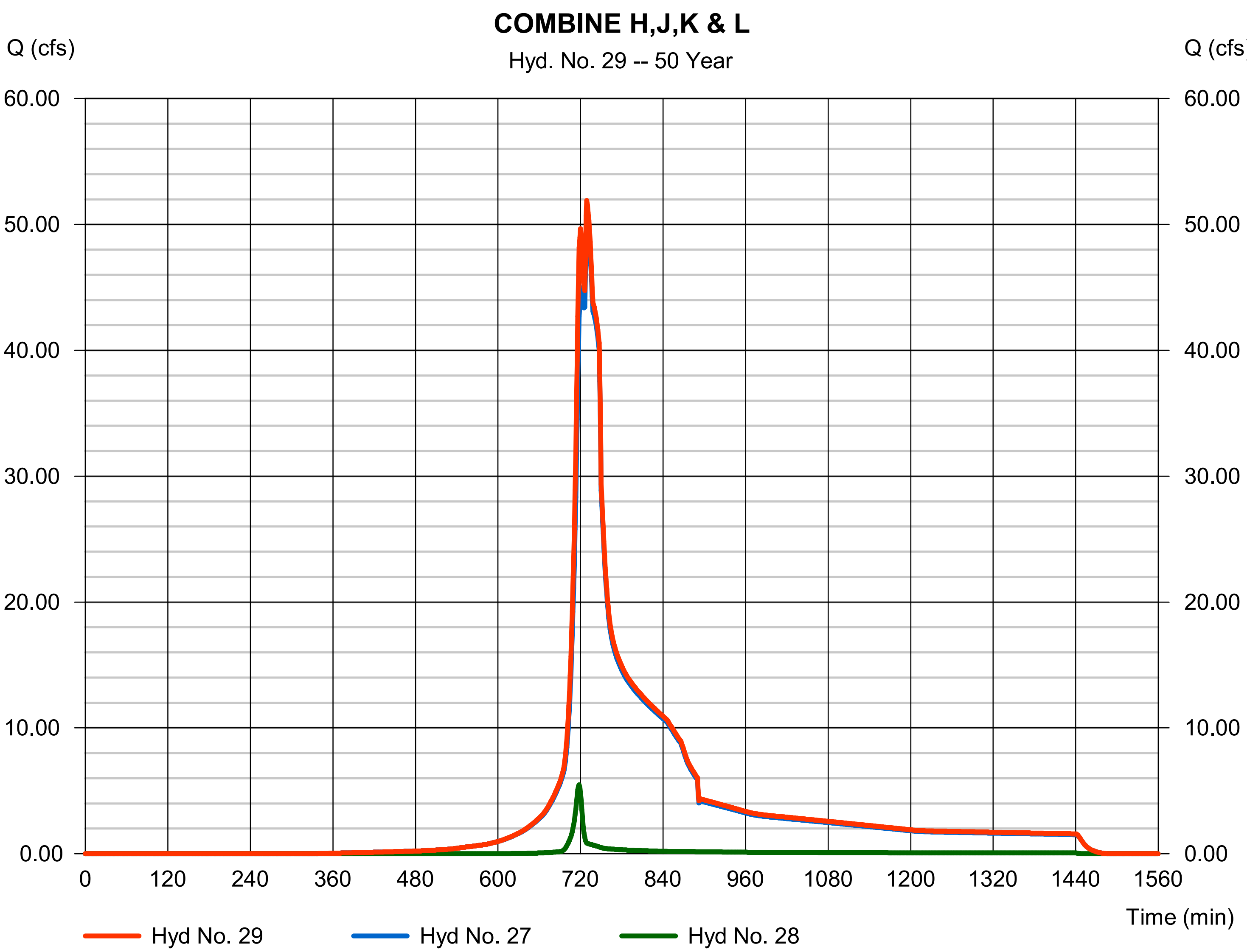
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 29

COMBINE H,J,K & L

Hydrograph type	= Combine	Peak discharge	= 51.90 cfs
Storm frequency	= 50 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 321,012 cuft
Inflow hyds.	= 27, 28	Contrib. drain. area	= 1.030 ac



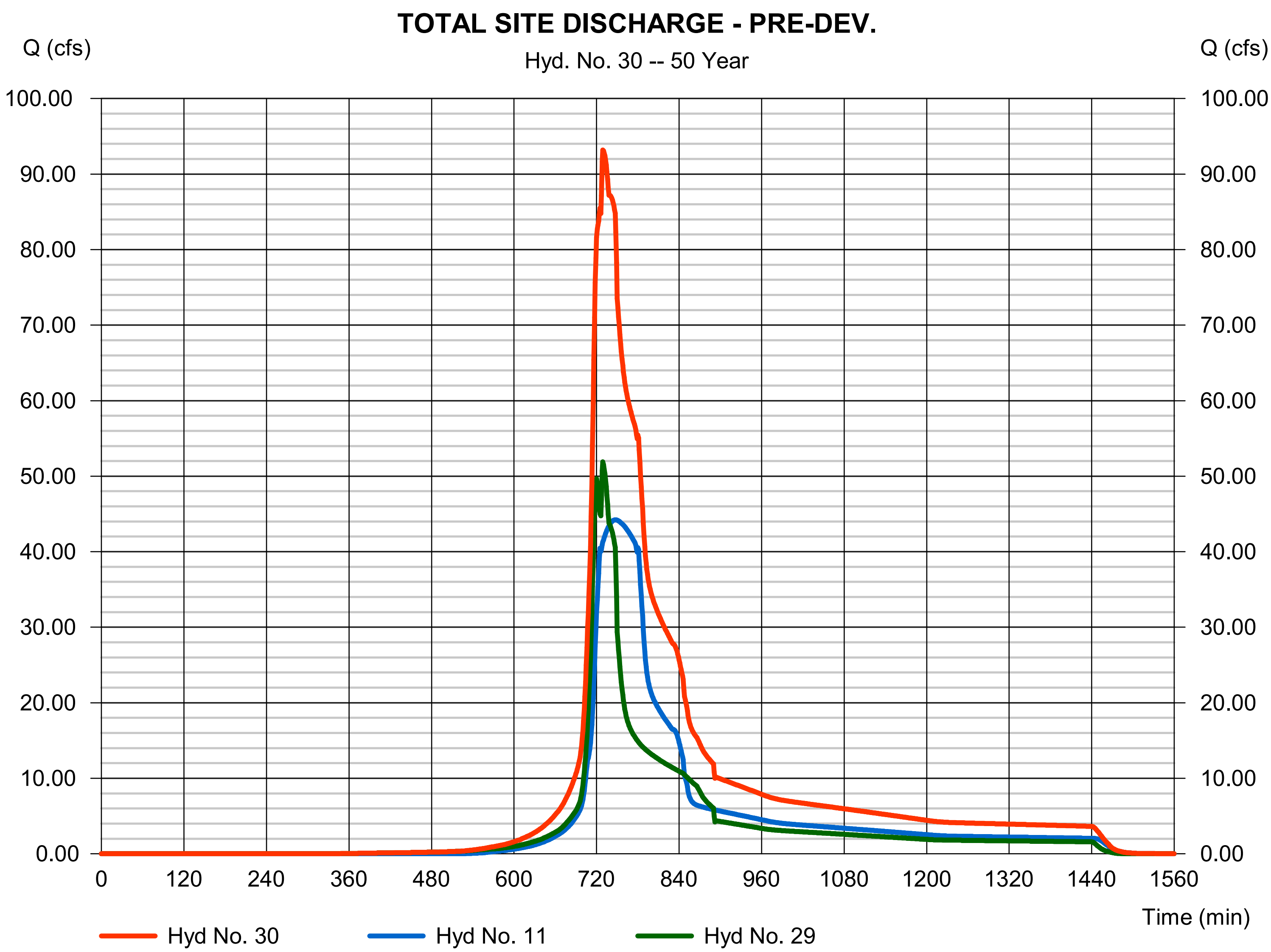
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 11 / 15 / 2018

Hyd. No. 30

TOTAL SITE DISCHARGE - PRE-DEV.

Hydrograph type	= Combine	Peak discharge	= 93.19 cfs
Storm frequency	= 50 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 714,229 cuft
Inflow hyds.	= 11, 29	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	SCS Runoff	13.37	1	725	41,750	------	------	------	AREA A - PRE DEV
2	Reach	12.91	1	728	41,748	1	------	------	DITCH 1
3	SCS Runoff	31.62	1	726	104,076	------	------	------	AREA B - PRE DEV
4	Combine	44.38	1	727	145,824	2, 3	------	------	COMBINE A & B
5	Reach	43.84	1	729	145,824	4	------	------	DITCH 2
6	SCS Runoff	21.56	1	742	118,736	------	------	------	AREA E - PRE DEV
7	SCS Runoff	59.98	1	727	203,658	------	------	------	AREA C - PRE DEV
8	Reservoir	15.52	1	749	203,656	7	582.29	63,579	C - DENTENTION
9	Combine	59.77	1	730	264,559	5, 6,	------	------	COMBINE A,B & E
10	Combine	74.70	1	730	468,215	8, 9	------	------	COMBINE A,B,E & C
11	Reservoir	46.02	1	750	468,185	10	582.23	43,311	A,B,C & E
12	SCS Runoff	36.81	1	729	137,242	------	------	------	AREA H - PRE DEV
13	Reach	35.24	1	733	137,240	12	------	------	HWY 20 SIDE DITCH
14	SCS Runoff	23.37	1	722	62,811	------	------	------	AREA J - PRE DEV
15	Combine	49.58	1	727	200,051	13, 14	------	------	COMBINE H & J
16	Reservoir	49.58	1	727	200,051	15	580.98	4,548	DETENTION AREA H&J
17	SCS Runoff	9.952	1	719	20,992	------	------	------	AREA K' - PRE DEV
18	Reach	7.065	1	723	20,987	17	------	------	K' Tc DITCH
19	SCS Runoff	4.539	1	719	9,570	------	------	------	AREA K'' - PRE DEV
20	Reach	4.299	1	721	9,569	19	------	------	K'' Tc DITCH
21	Combine	11.15	1	722	30,556	18, 20	------	------	COMBINE K' & K''
22	SCS Runoff	45.96	1	720	114,632	------	------	------	AREA K - PRE DEV
23	Combine	56.61	1	720	145,188	21, 22	------	------	COMBINE K, K' & K''
24	Reservoir	9.226	1	740	145,187	23	583.18	49,431	DETENTION AREA K
25	SCS Runoff	10.22	1	718	20,525	------	------	------	AREA J' - PRE DEV
26	Combine	51.90	1	725	220,576	16, 25	------	------	COMBINE H,J & J'
27	Combine	60.84	1	725	365,763	24, 26	------	------	COMBINE H,J, J' & K
28	SCS Runoff	6.618	1	718	13,296	------	------	------	AREA L - PRE DEV
29	Combine	62.79	1	725	379,060	27, 28	------	------	COMBINE H,J,K & L
30	Combine	103.67	1	726	847,244	11, 29	------	------	TOTAL SITE DISCHARGE - PRE-DE

AP3_PREDEV.gpw | Return Period: 100 Year | Thursday, 11 / 15 / 2018

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

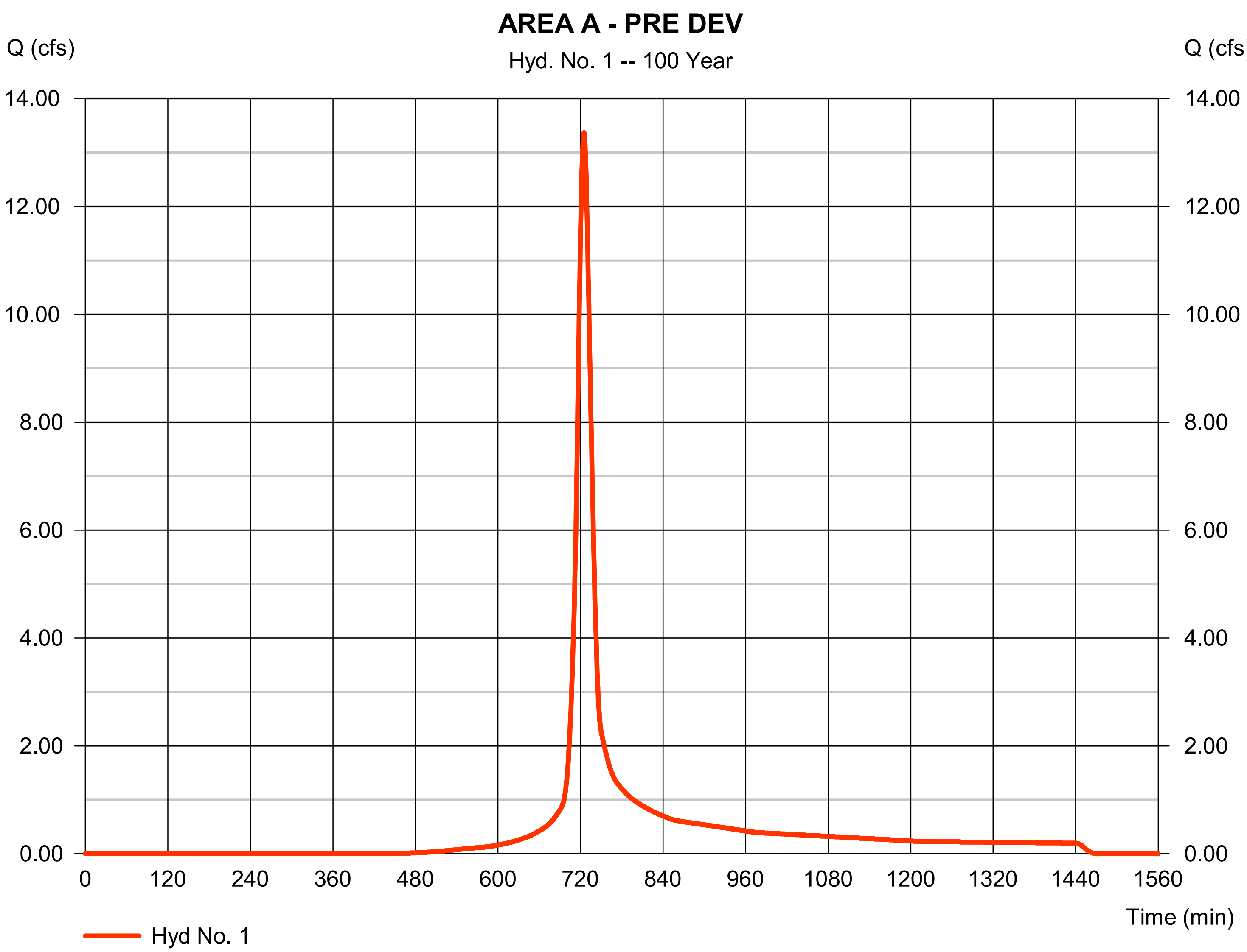
Thursday, 11 / 15 / 2018

Hyd. No. 1

AREA A - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 13.37 cfs
Storm frequency	= 100 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 41,750 cuft
Drainage area	= 2.580 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.10 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.220 x 85) + (0.570 x 55) + (0.030 x 98) + (0.760 x 60)] / 2.580



Hydrograph Report

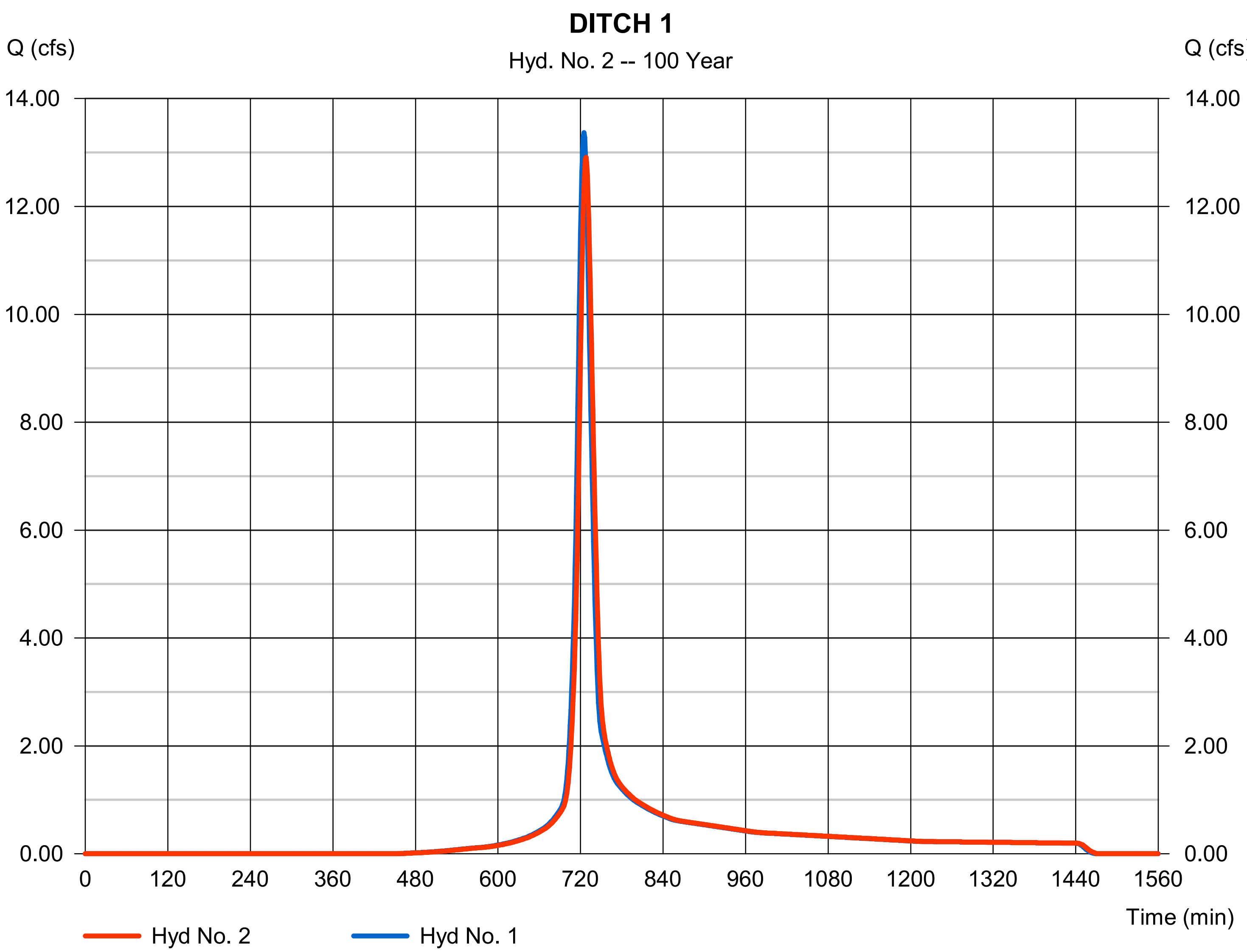
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 2

DITCH 1

Hydrograph type	= Reach	Peak discharge	= 12.91 cfs
Storm frequency	= 100 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 41,748 cuft
Inflow hyd. No.	= 1 - AREA A - PRE DEV	Section type	= Trapezoidal
Reach length	= 730.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 10.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.375
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.3294

Modified Att-Kin routing method used.



Hydrograph Report

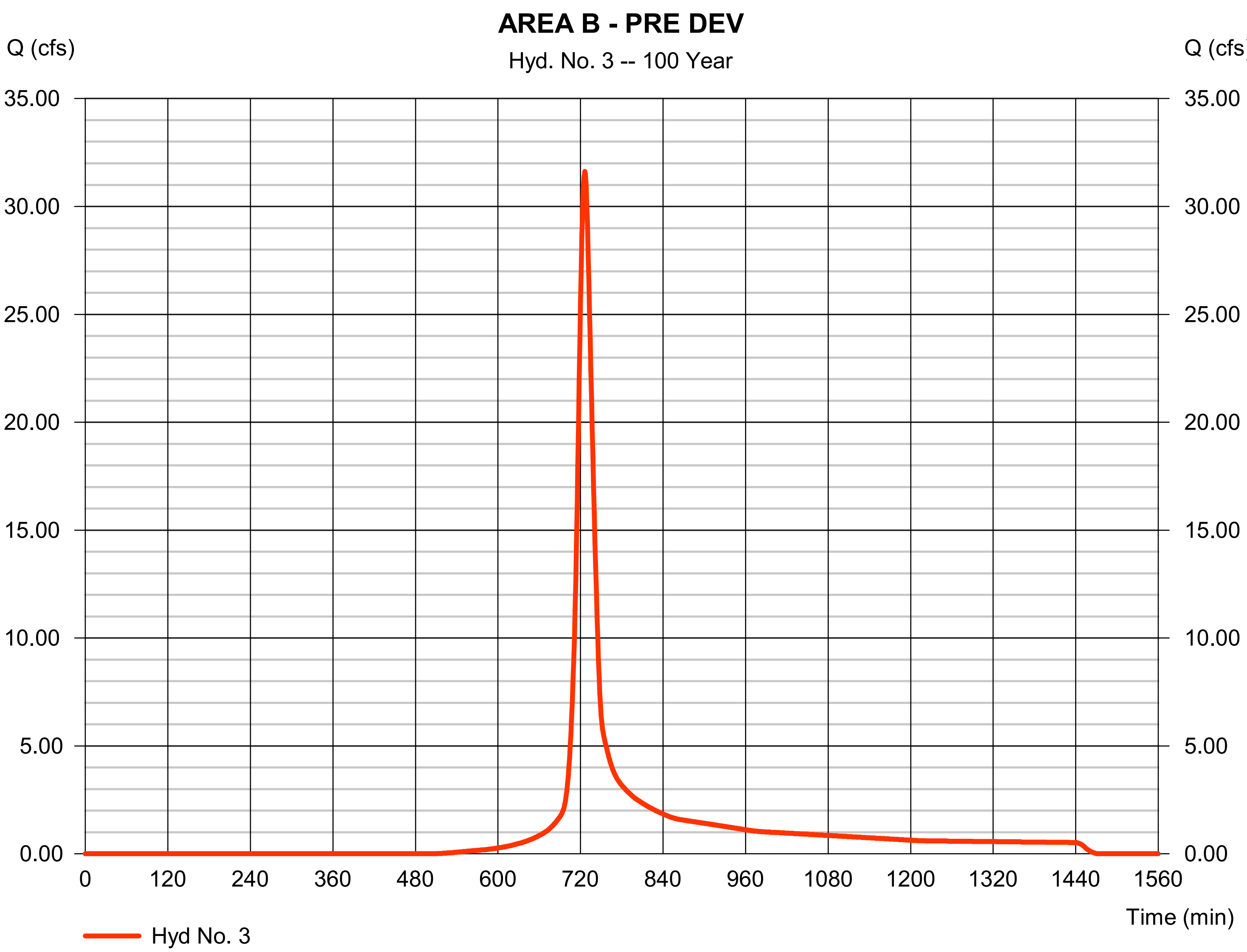
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 3

AREA B - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 31.62 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 104,076 cuft
Drainage area	= 7.090 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.80 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.930 x 85) + (2.120 x 55) + (0.250 x 98) + (2.790 x 60)] / 7.090



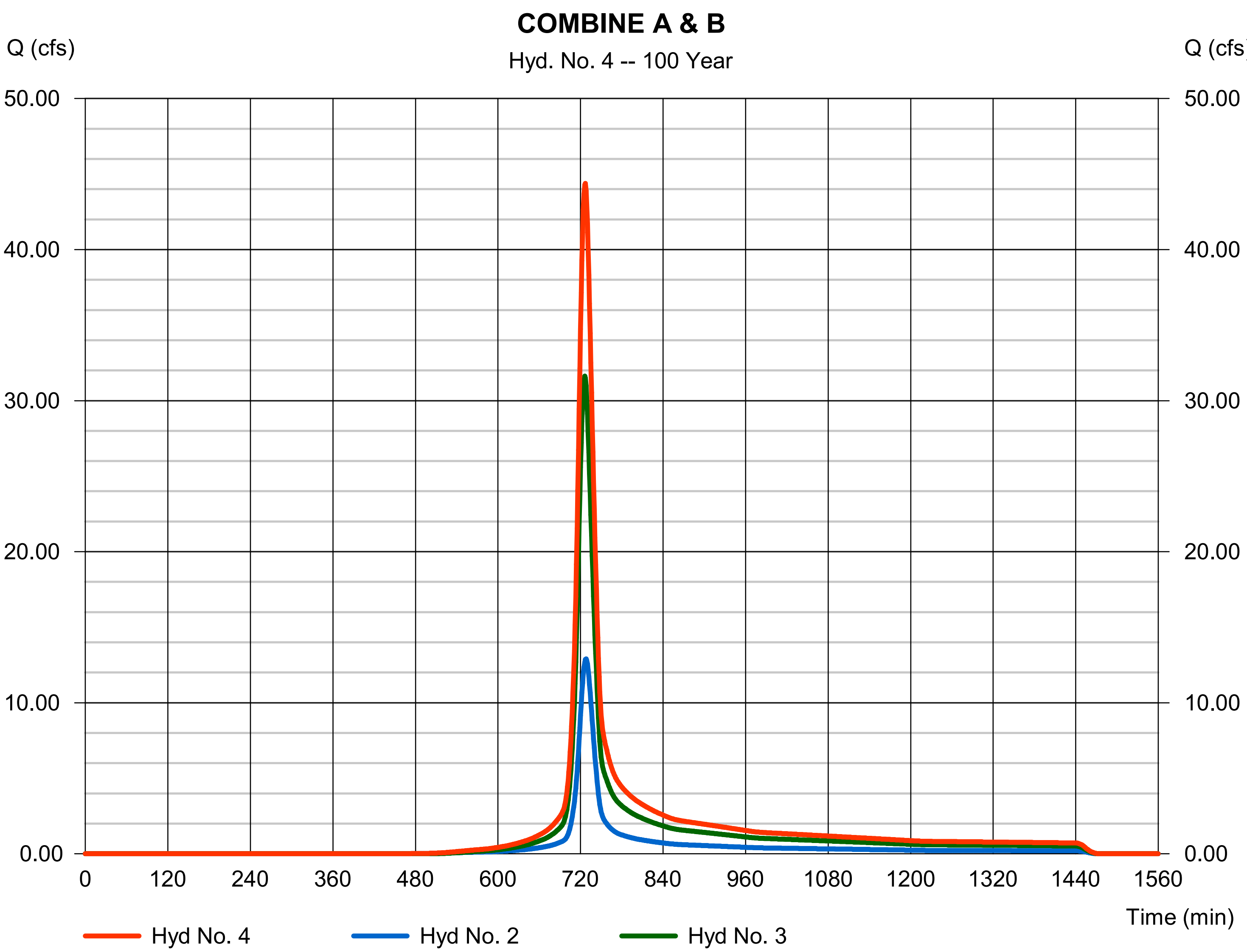
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 4

COMBINE A & B

Hydrograph type	= Combine	Peak discharge	= 44.38 cfs
Storm frequency	= 100 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 145,824 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 7.090 ac



Hydrograph Report

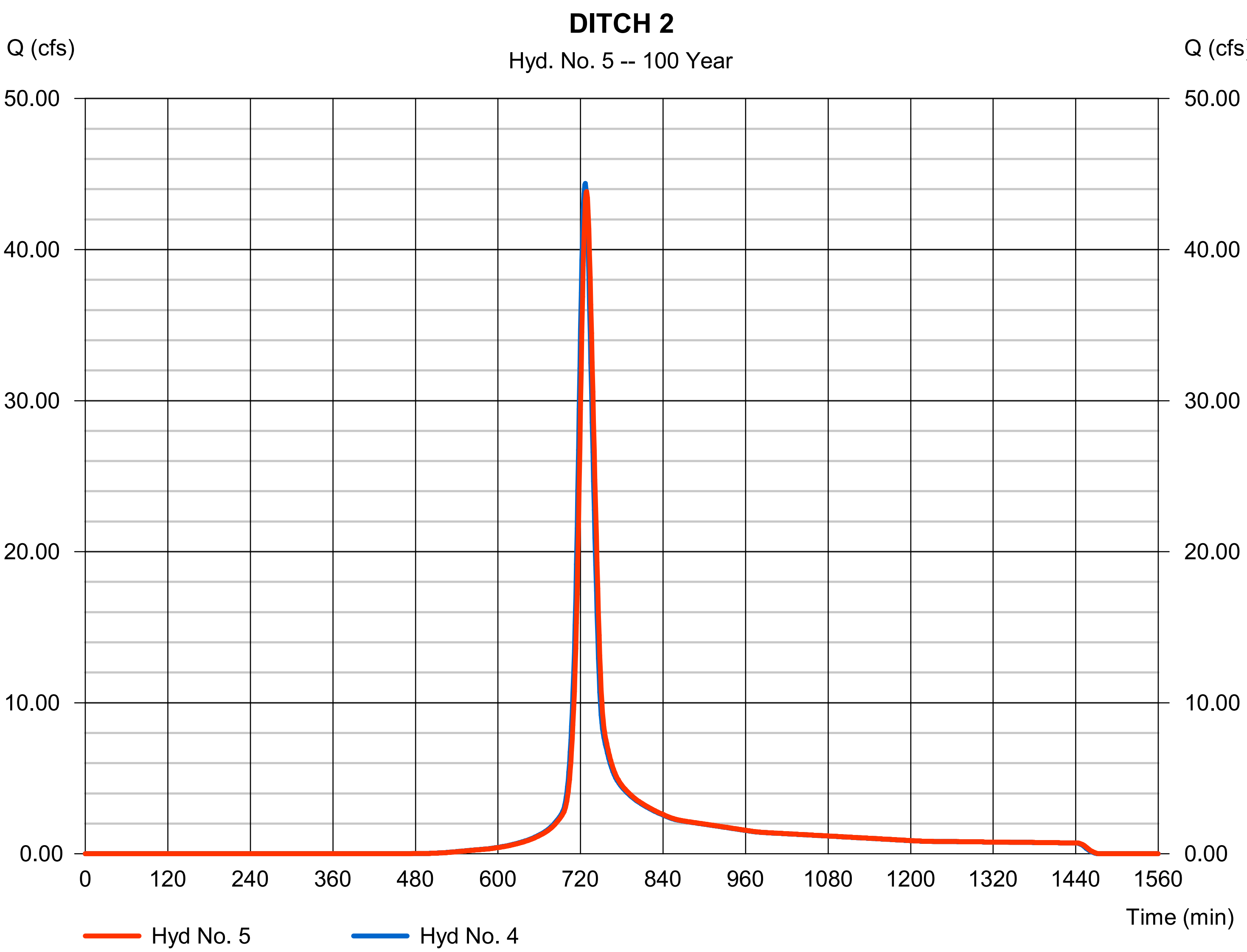
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 5

DITCH 2

Hydrograph type	= Reach	Peak discharge	= 43.84 cfs
Storm frequency	= 100 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 145,824 cuft
Inflow hyd. No.	= 4 - COMBINE A & B	Section type	= Trapezoidal
Reach length	= 610.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.373
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.4912

Modified Att-Kin routing method used.



Hydrograph Report

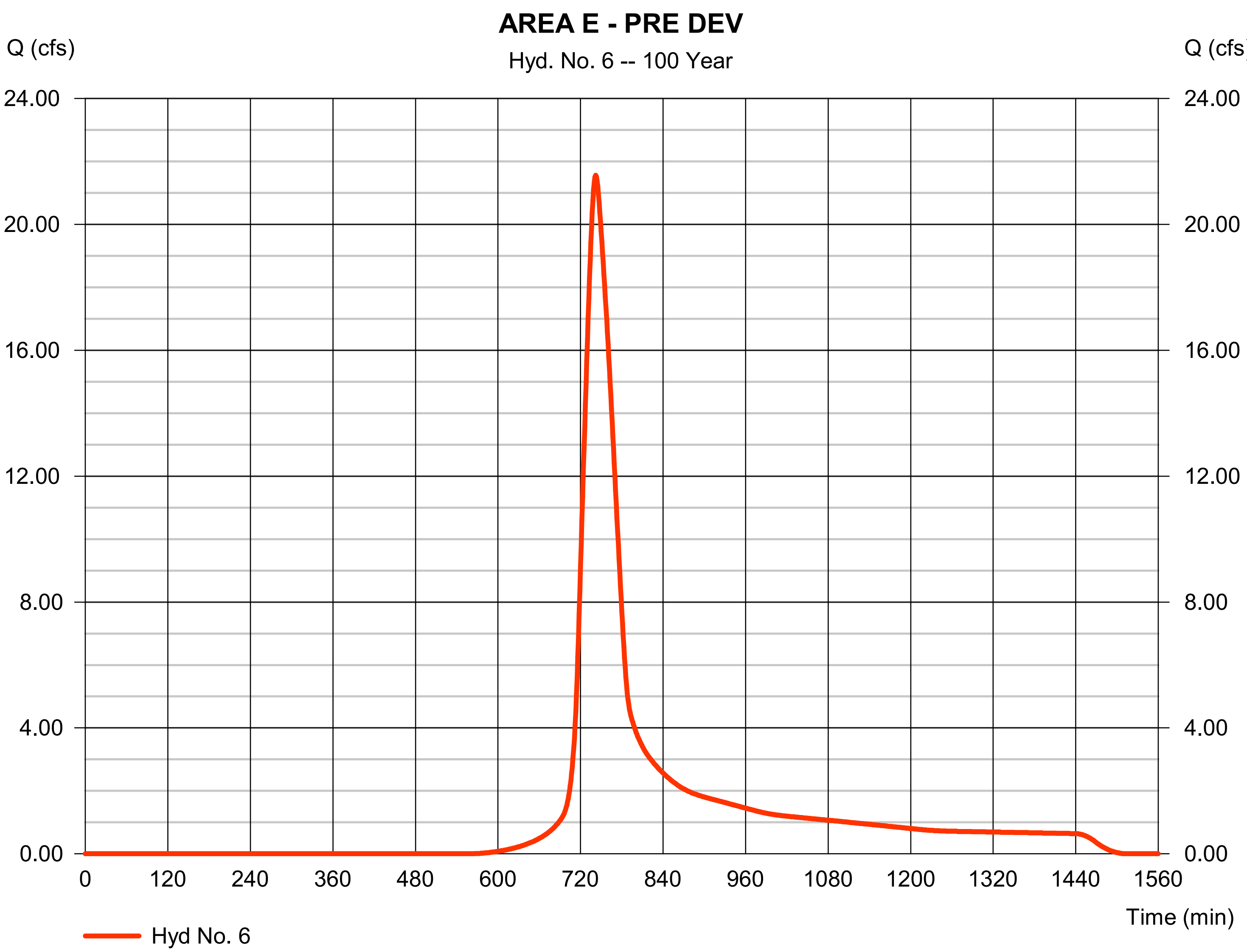
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 6

AREA E - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 21.56 cfs
Storm frequency	= 100 yrs	Time to peak	= 742 min
Time interval	= 1 min	Hyd. volume	= 118,736 cuft
Drainage area	= 9.150 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 47.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.680 x 65) + (0.330 x 98) + (5.140 x 60)] / 9.150



Hydrograph Report

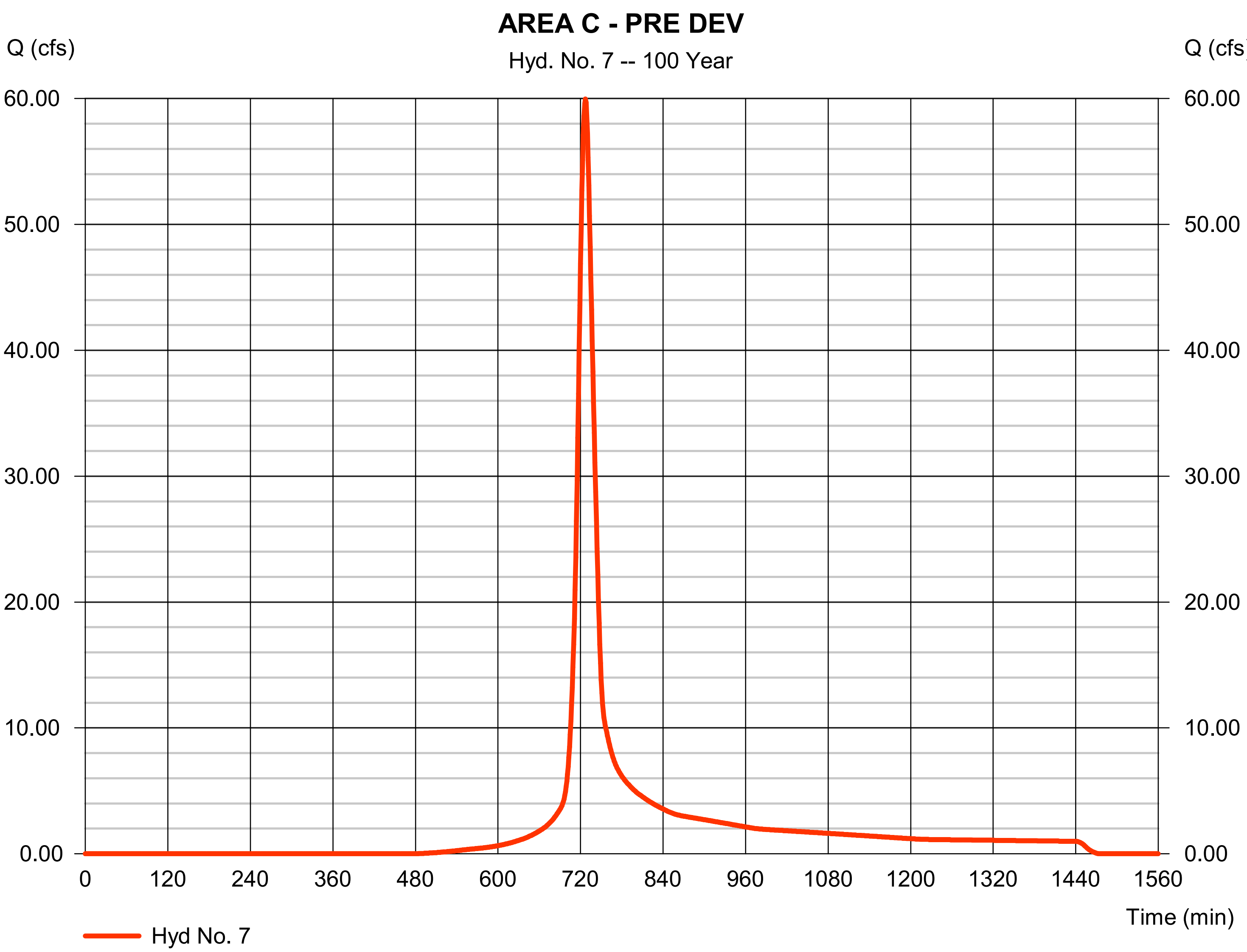
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 7

AREA C - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 59.98 cfs
Storm frequency	= 100 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 203,658 cuft
Drainage area	= 13.380 ac	Curve number	= 69*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.210 x 85) + (0.400 x 55) + (1.740 x 98) + (9.030 x 60)] / 13.380



Hydrograph Report

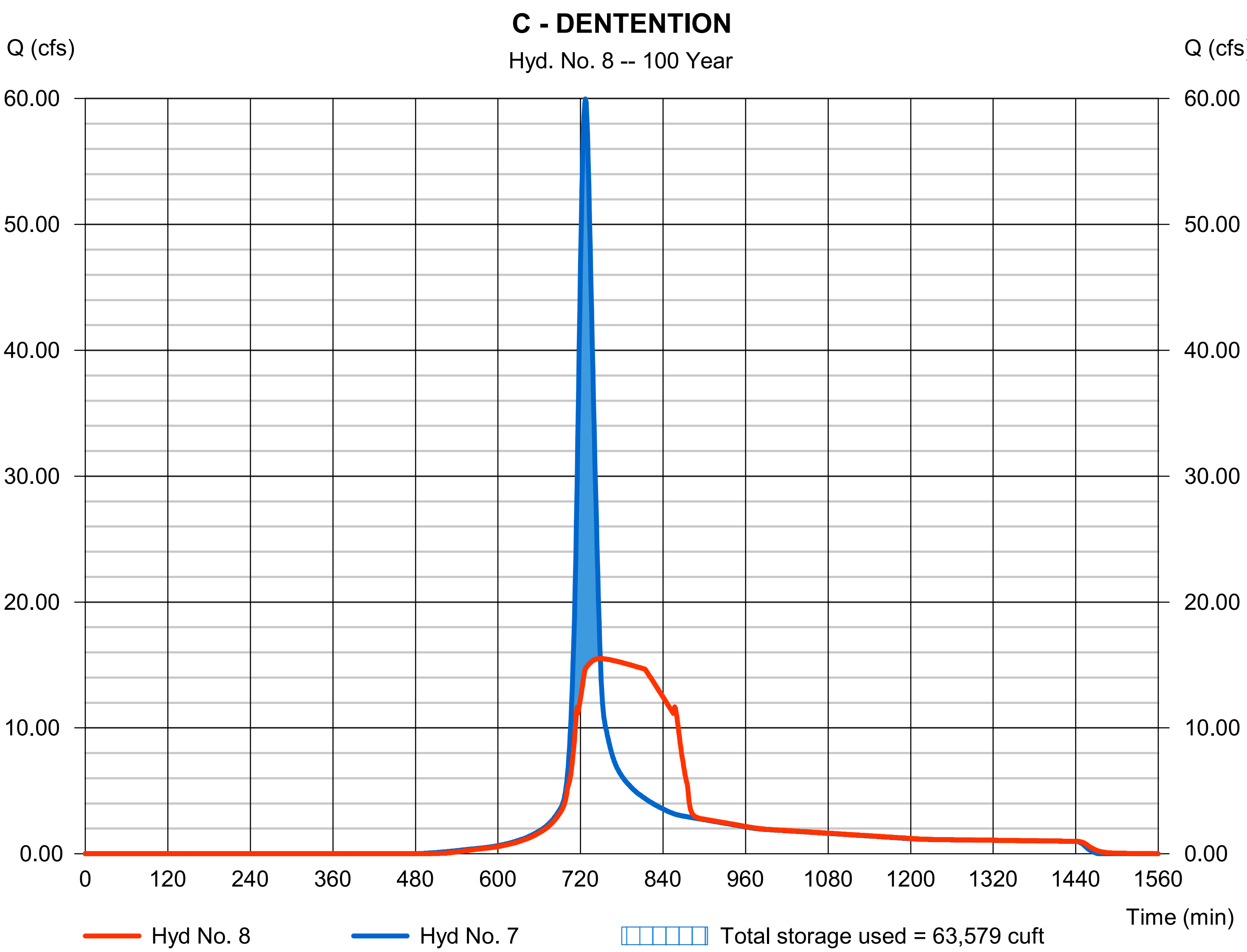
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 8

C - DENTENTION

Hydrograph type	= Reservoir	Peak discharge	= 15.52 cfs
Storm frequency	= 100 yrs	Time to peak	= 749 min
Time interval	= 1 min	Hyd. volume	= 203,656 cuft
Inflow hyd. No.	= 7 - AREA C - PRE DEV	Max. Elevation	= 582.29 ft
Reservoir name	= C DETENTION	Max. Storage	= 63,579 cuft

Storage Indication method used.



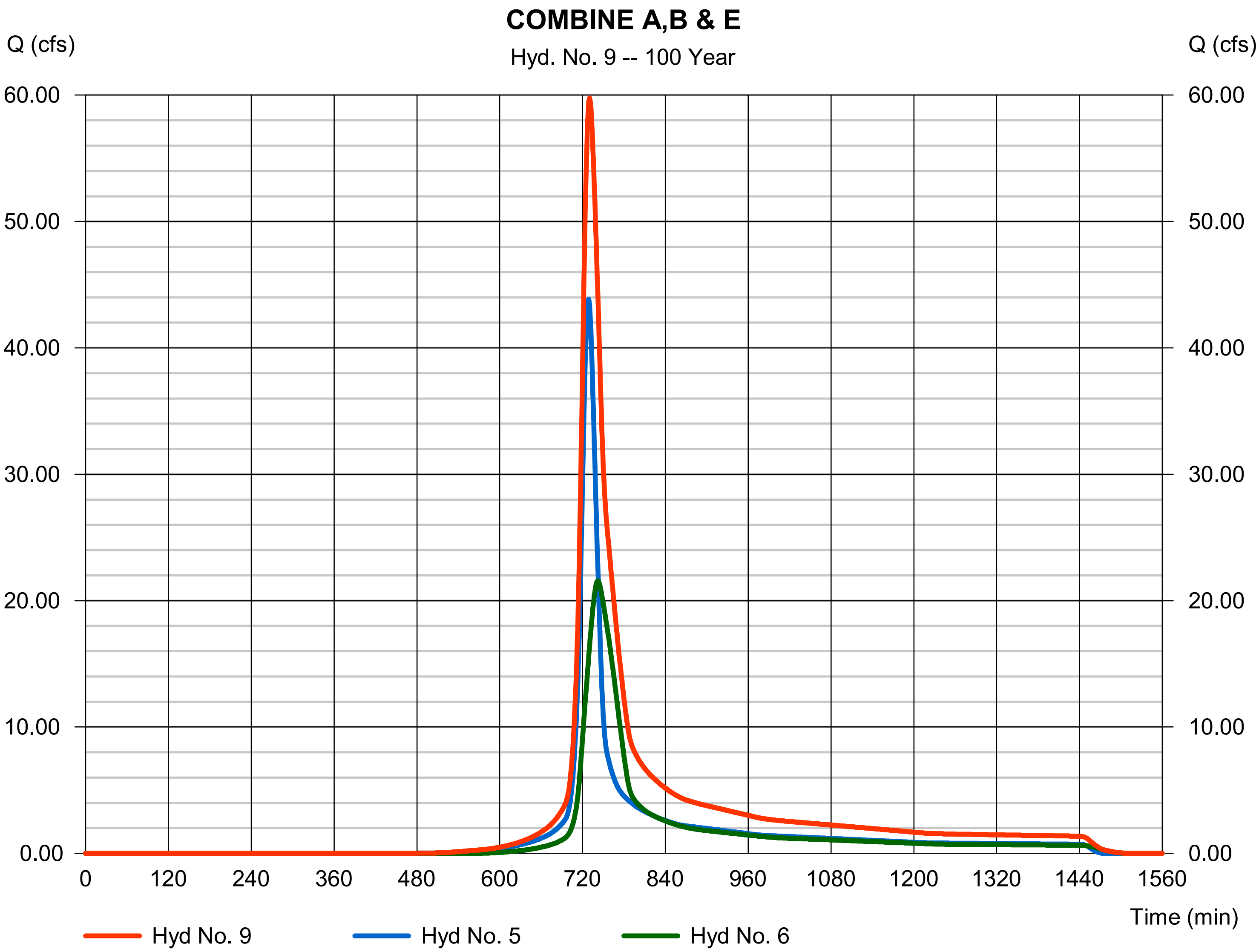
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 9

COMBINE A,B & E

Hydrograph type	= Combine	Peak discharge	= 59.77 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 264,559 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 9.150 ac



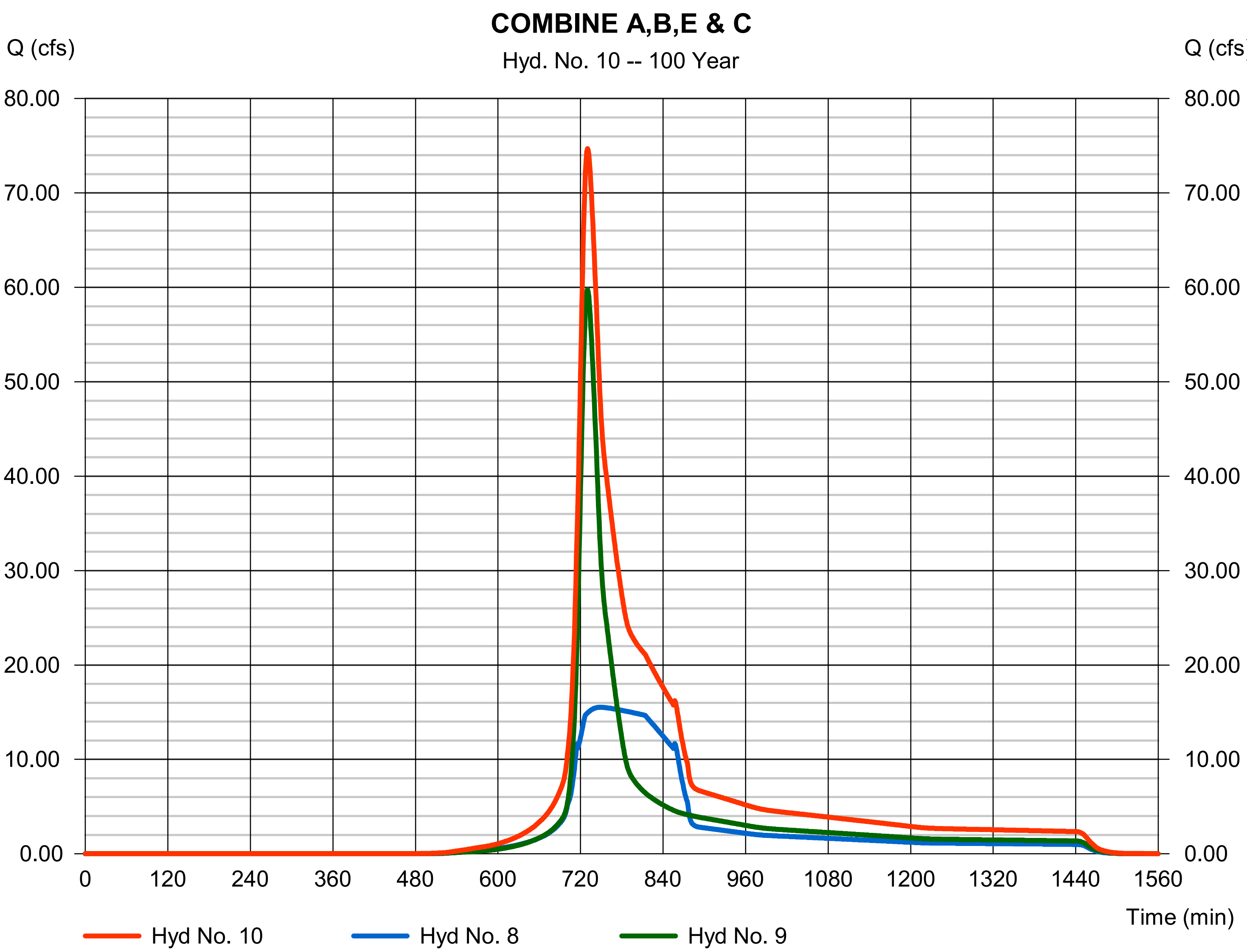
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 11 / 15 / 2018

Hyd. No. 10

COMBINE A,B,E & C

Hydrograph type	= Combine	Peak discharge	= 74.70 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 468,215 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 0.000 ac



Hydrograph Report

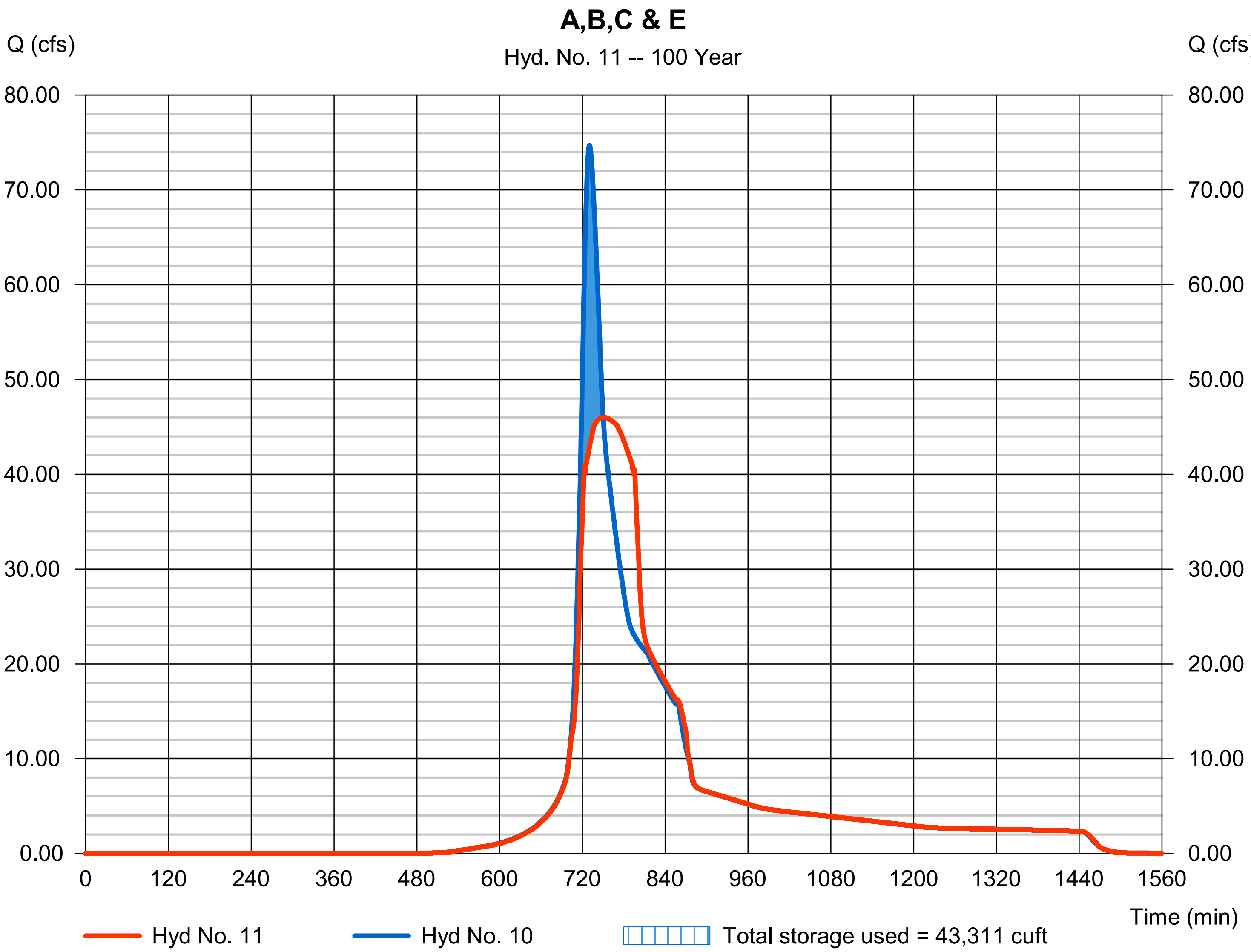
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 11

A,B,C & E

Hydrograph type	= Reservoir	Peak discharge	= 46.02 cfs
Storm frequency	= 100 yrs	Time to peak	= 750 min
Time interval	= 1 min	Hyd. volume	= 468,185 cuft
Inflow hyd. No.	= 10 - COMBINE A,B,E & C	Max. Elevation	= 582.23 ft
Reservoir name	= A,B,C & E DETENTION	Max. Storage	= 43,311 cuft

Storage Indication method used.



Hydrograph Report

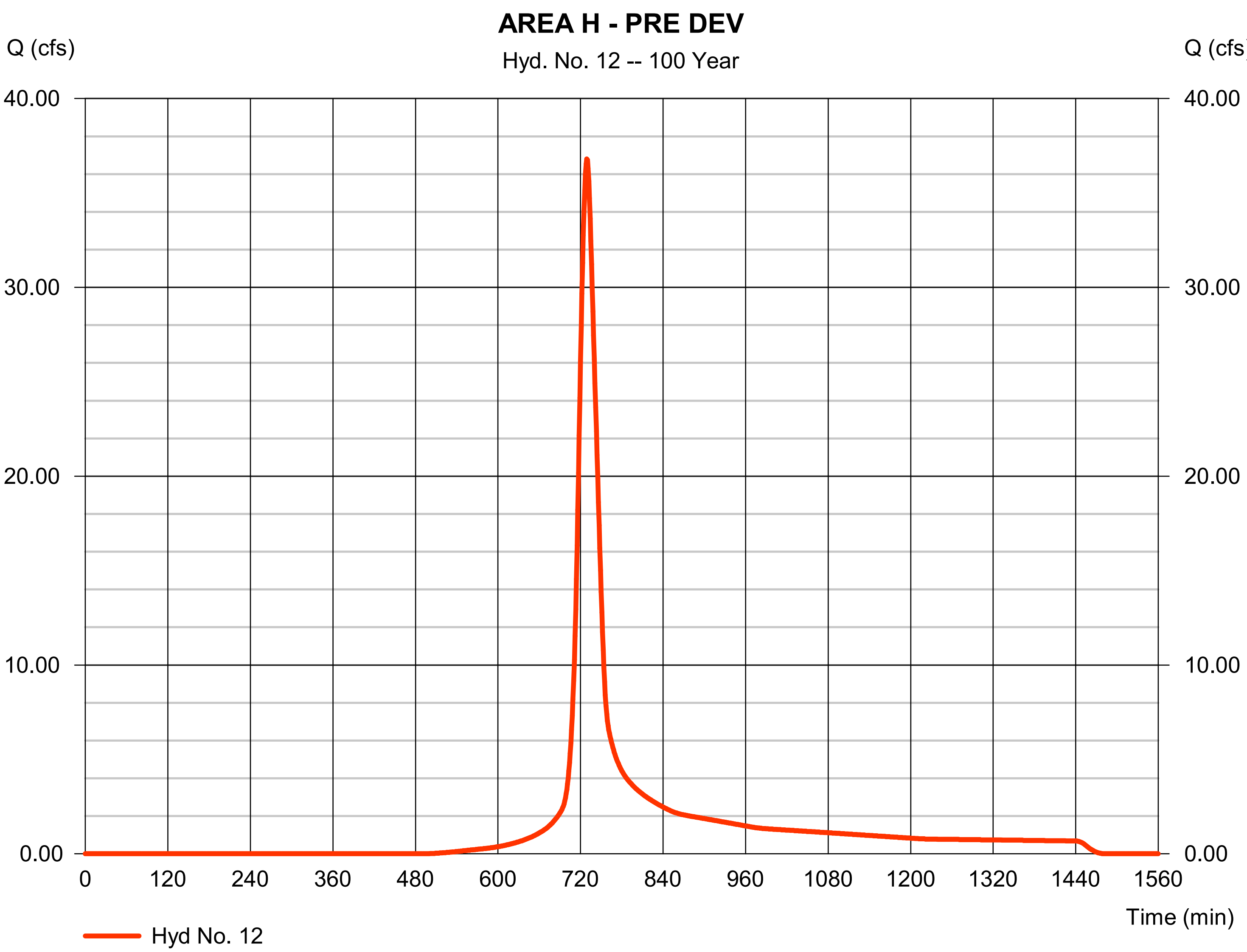
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 12

AREA H - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 36.81 cfs
Storm frequency	= 100 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 137,242 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.20 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



Hydrograph Report

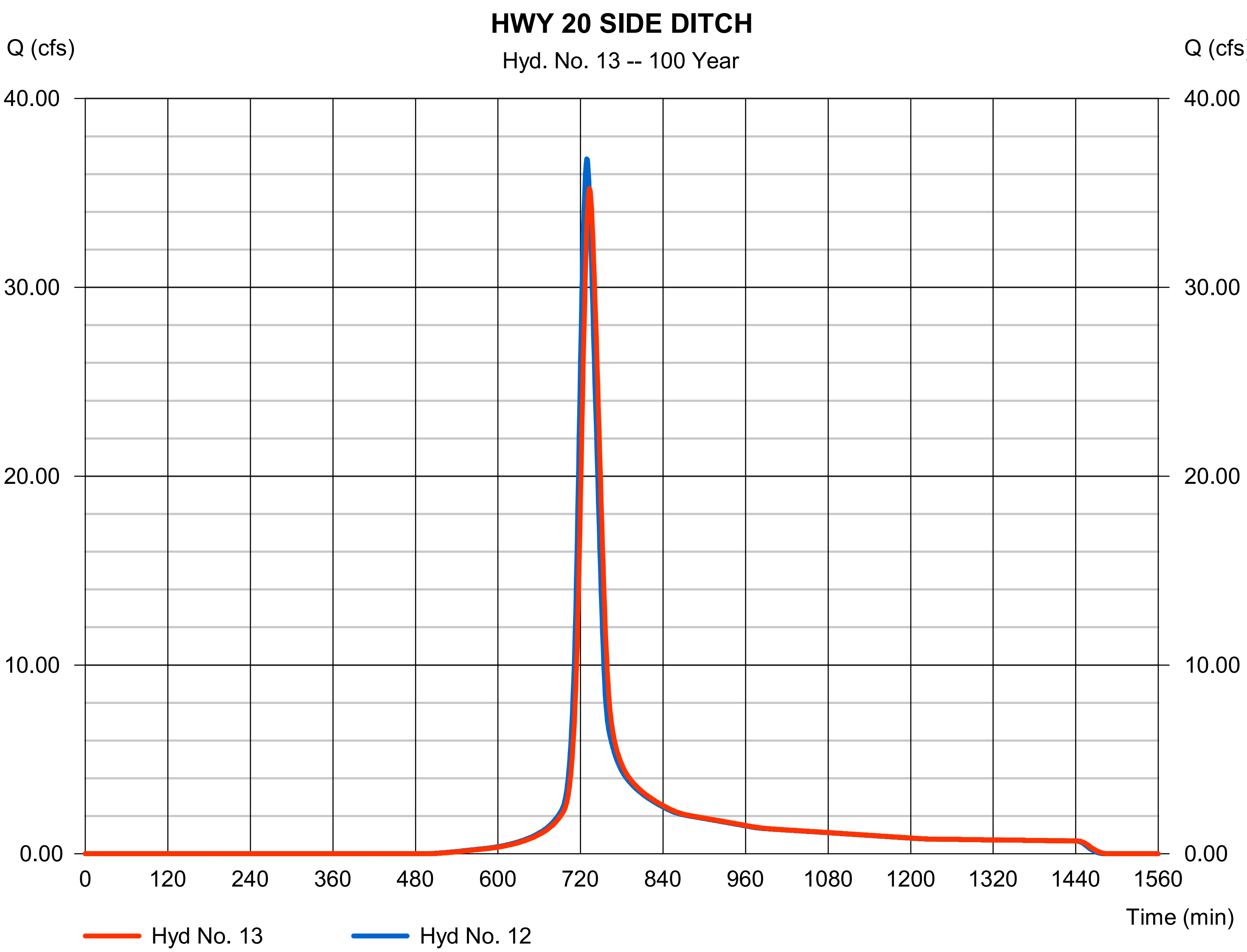
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 13

HWY 20 SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 35.24 cfs
Storm frequency	= 100 yrs	Time to peak	= 733 min
Time interval	= 1 min	Hyd. volume	= 137,240 cuft
Inflow hyd. No.	= 12 - AREA H - PRE DEV	Section type	= Trapezoidal
Reach length	= 900.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.030	Bottom width	= 3.0 ft
Side slope	= 2.0:1	Max. depth	= 3.0 ft
Rating curve x	= 1.688	Rating curve m	= 1.282
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.2487

Modified Att-Kin routing method used.



Hydrograph Report

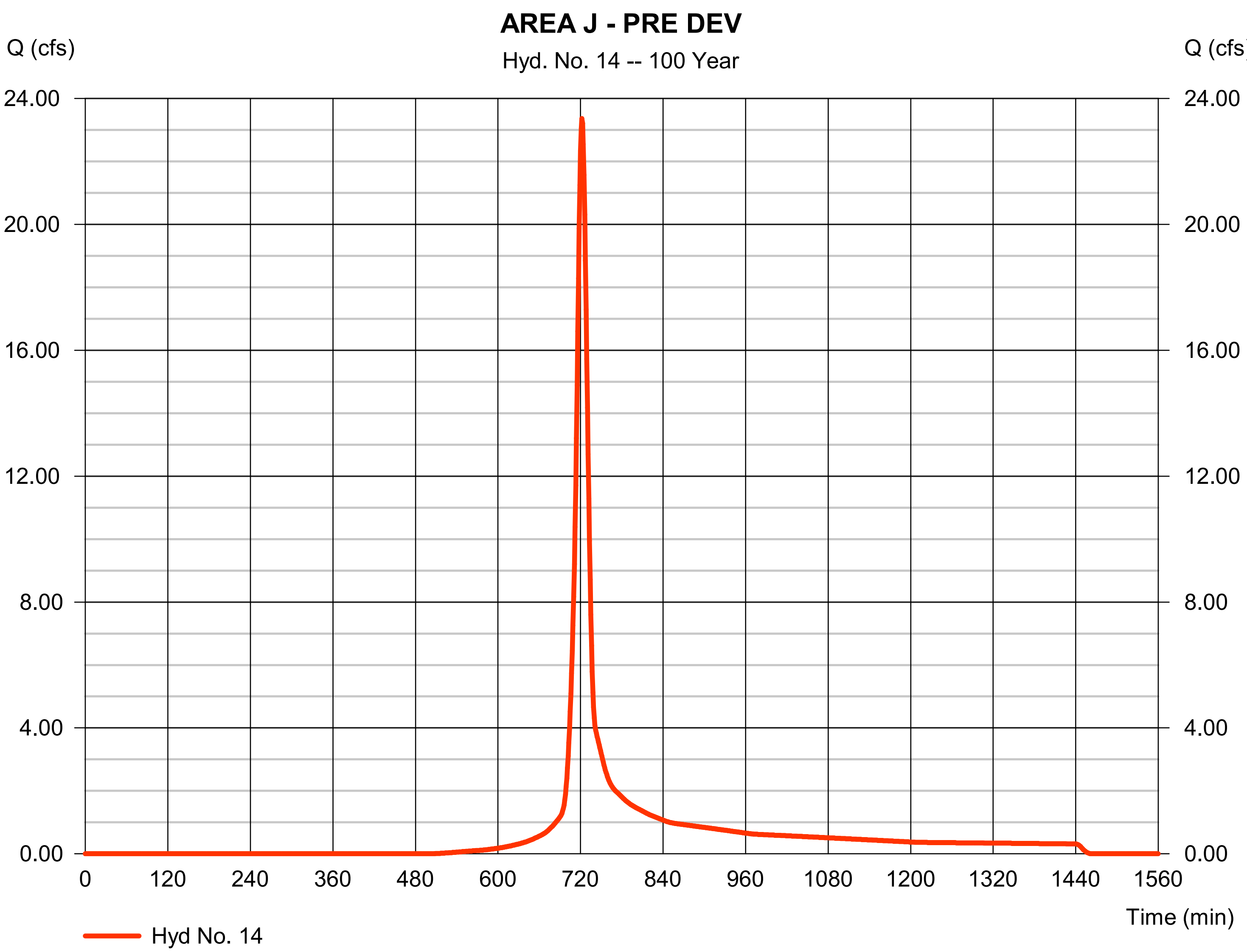
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 14

AREA J - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 23.37 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 62,811 cuft
Drainage area	= 4.320 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.90 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 85) + (0.020 x 65) + (0.690 x 98) + (3.520 x 60)] / 4.320



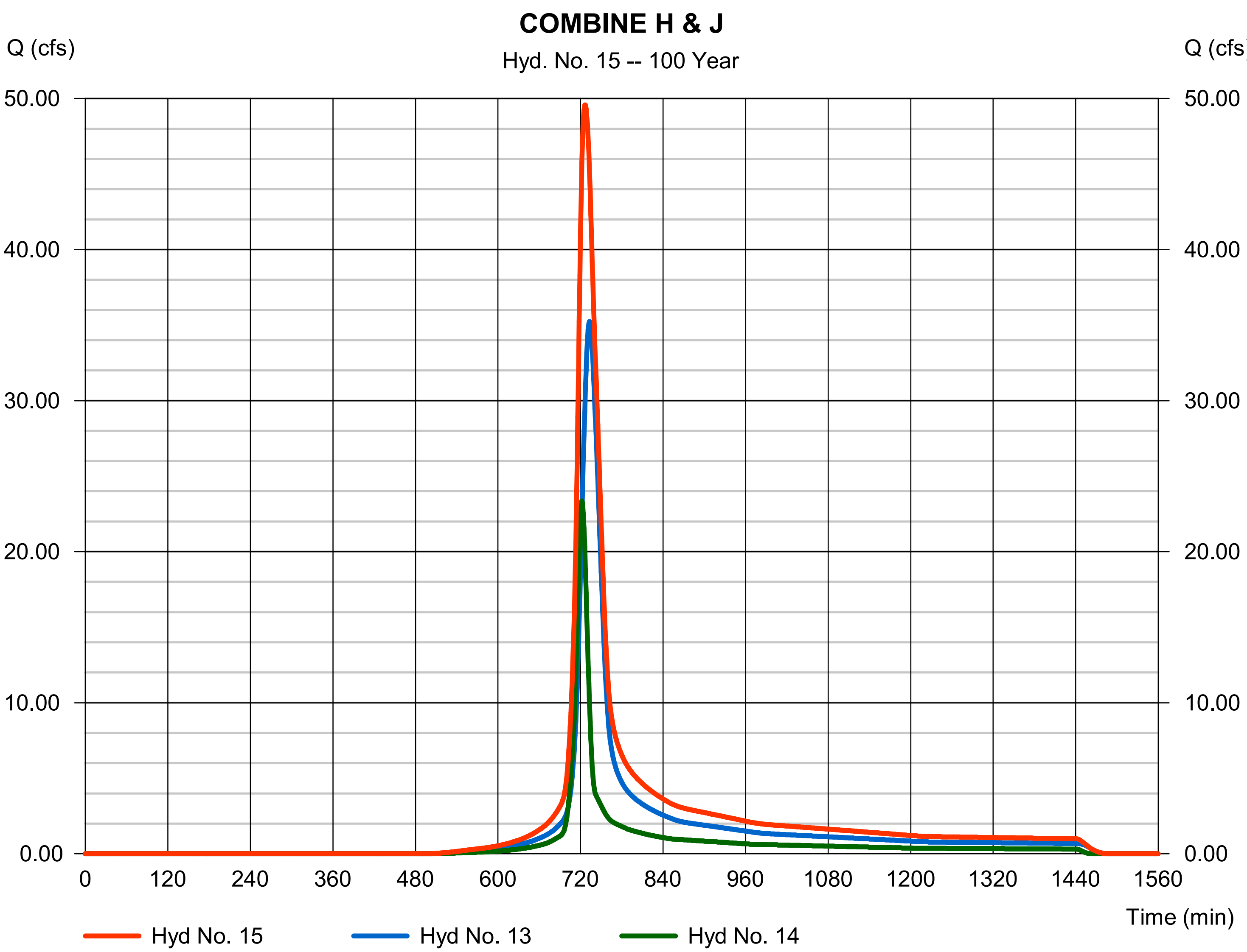
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 15

COMBINE H & J

Hydrograph type	= Combine	Peak discharge	= 49.58 cfs
Storm frequency	= 100 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 200,051 cuft
Inflow hyds.	= 13, 14	Contrib. drain. area	= 4.320 ac



Hydrograph Report

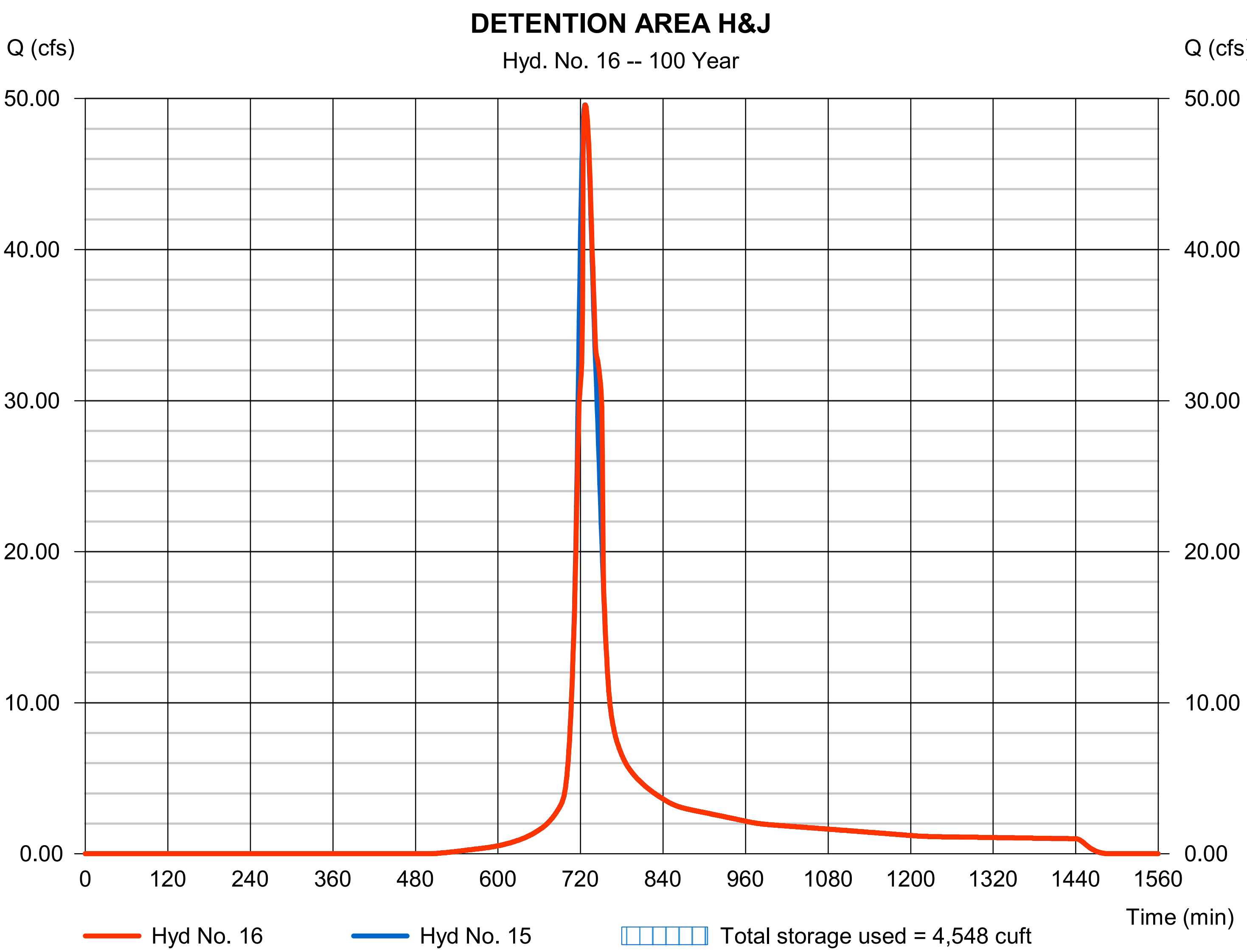
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 16

DETENTION AREA H&J

Hydrograph type	= Reservoir	Peak discharge	= 49.58 cfs
Storm frequency	= 100 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 200,051 cuft
Inflow hyd. No.	= 15 - COMBINE H & J	Max. Elevation	= 580.98 ft
Reservoir name	= H&J DETENTION	Max. Storage	= 4,548 cuft

Storage Indication method used.



Hydrograph Report

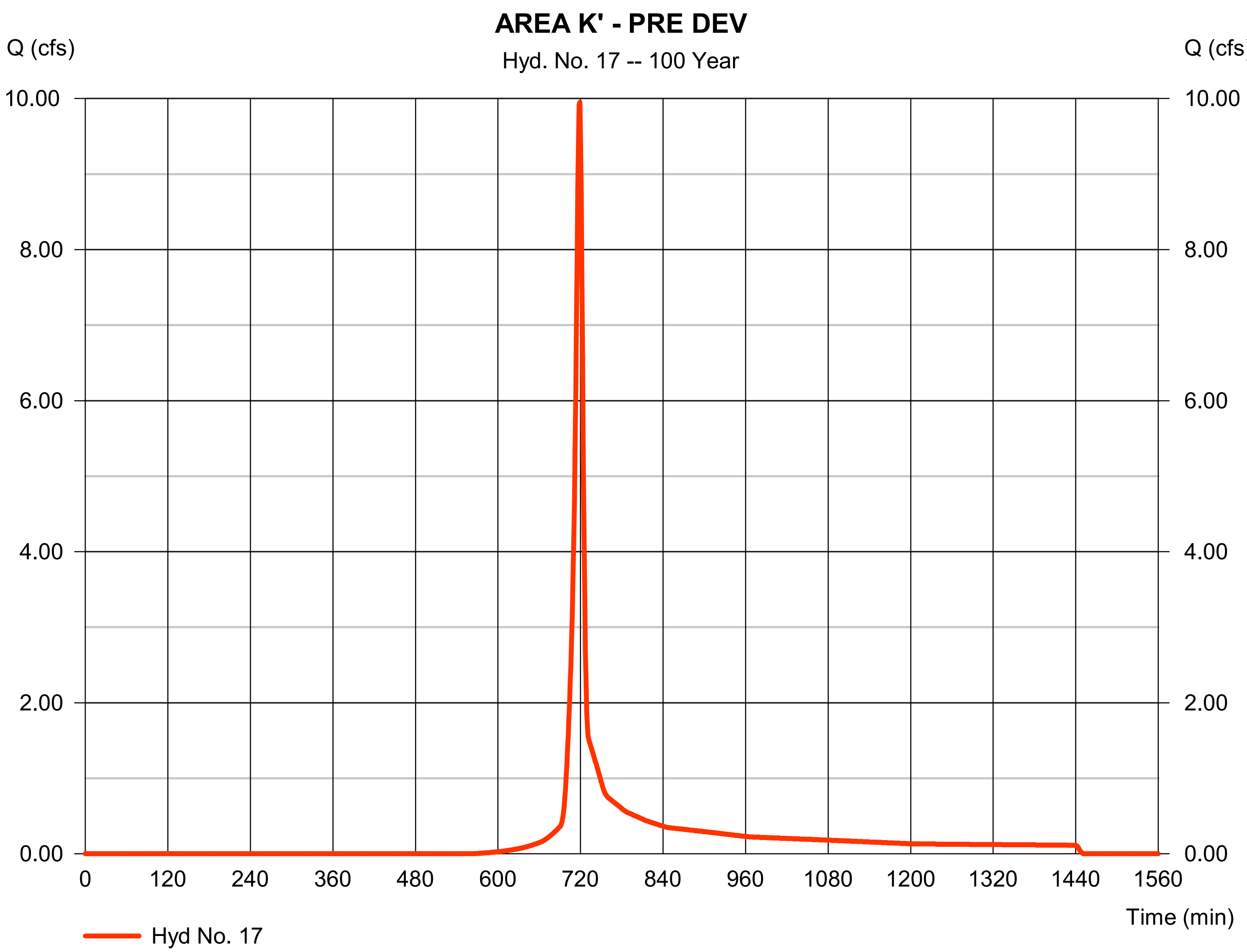
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 17

AREA K' - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 9.952 cfs
Storm frequency	= 100 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 20,992 cuft
Drainage area	= 1.720 ac	Curve number	= 62*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 8.20 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.350 x 60) + (0.330 x 65) + (0.040 x 98)] / 1.720



Hydrograph Report

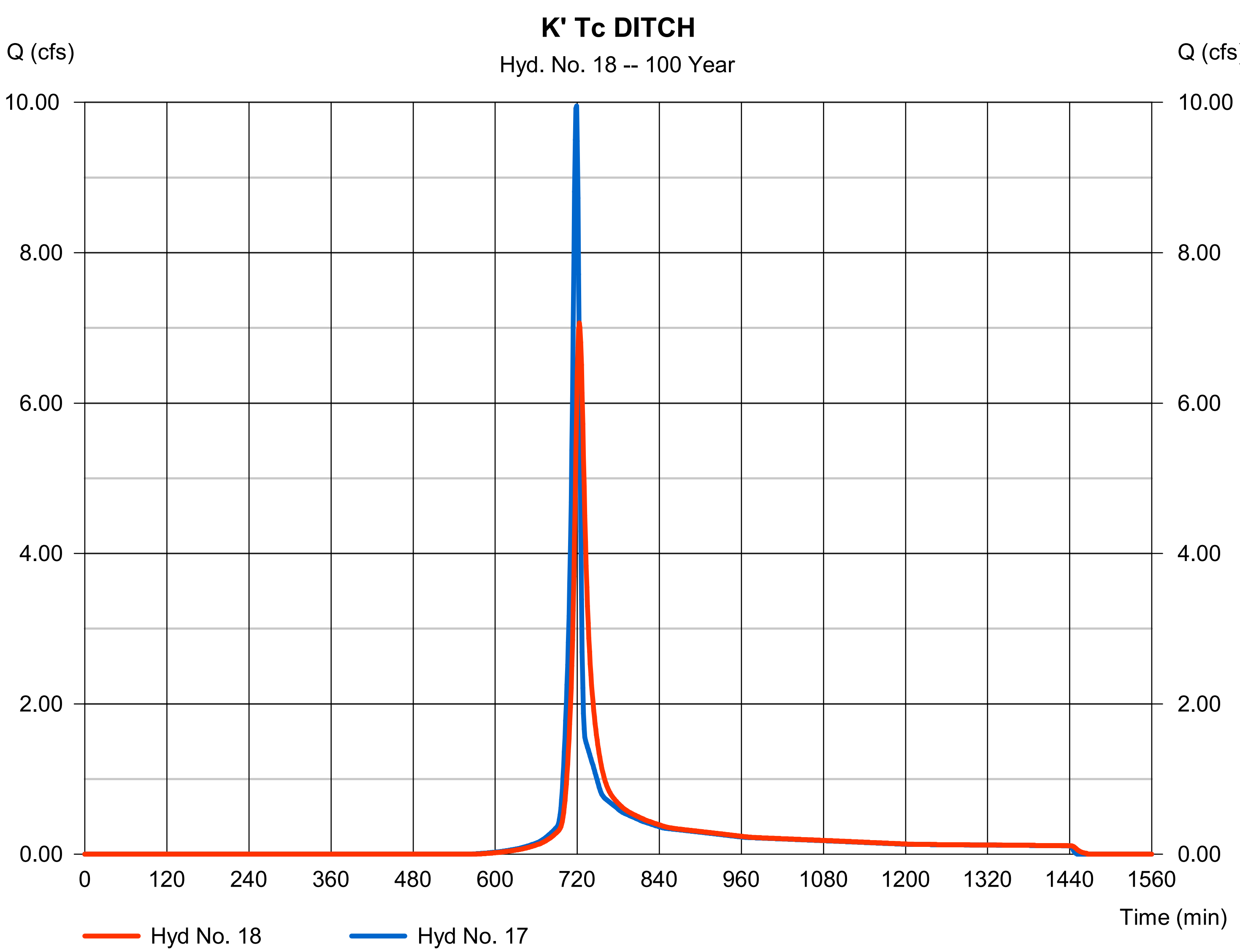
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 18

K' Tc DITCH

Hydrograph type	= Reach	Peak discharge	= 7.065 cfs
Storm frequency	= 100 yrs	Time to peak	= 723 min
Time interval	= 1 min	Hyd. volume	= 20,987 cuft
Inflow hyd. No.	= 17 - AREA K' - PRE DEV	Section type	= Trapezoidal
Reach length	= 710.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.040	Bottom width	= 5.0 ft
Side slope	= 4.0:1	Max. depth	= 2.0 ft
Rating curve x	= 0.697	Rating curve m	= 1.257
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.1198

Modified Att-Kin routing method used.



Hydrograph Report

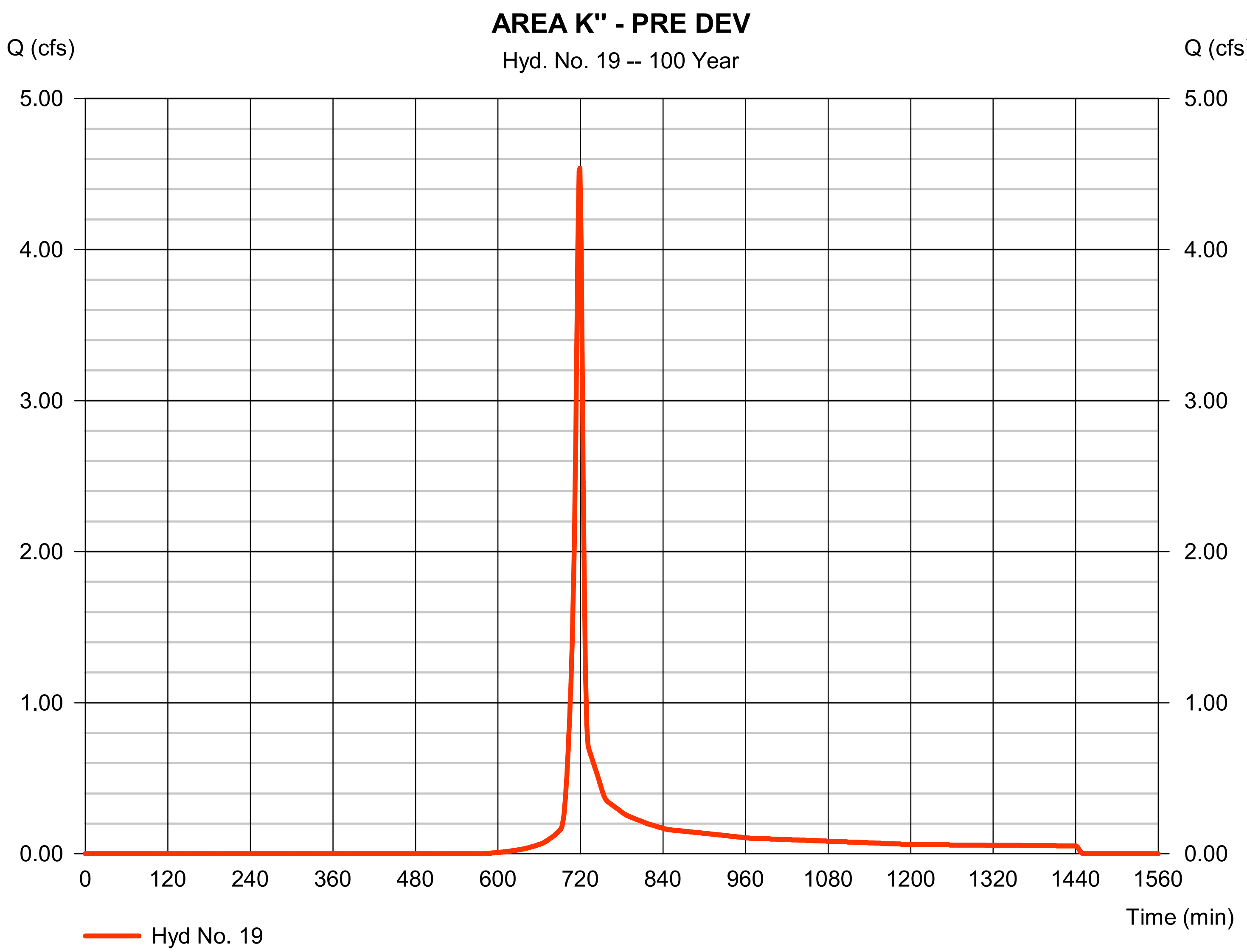
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 19

AREA K" - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 4.539 cfs
Storm frequency	= 100 yrs	Time to peak	= 719 min
Time interval	= 1 min	Hyd. volume	= 9,570 cuft
Drainage area	= 0.810 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.10 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.170 x 65) + (0.640 x 60)] / 0.810



Hydrograph Report

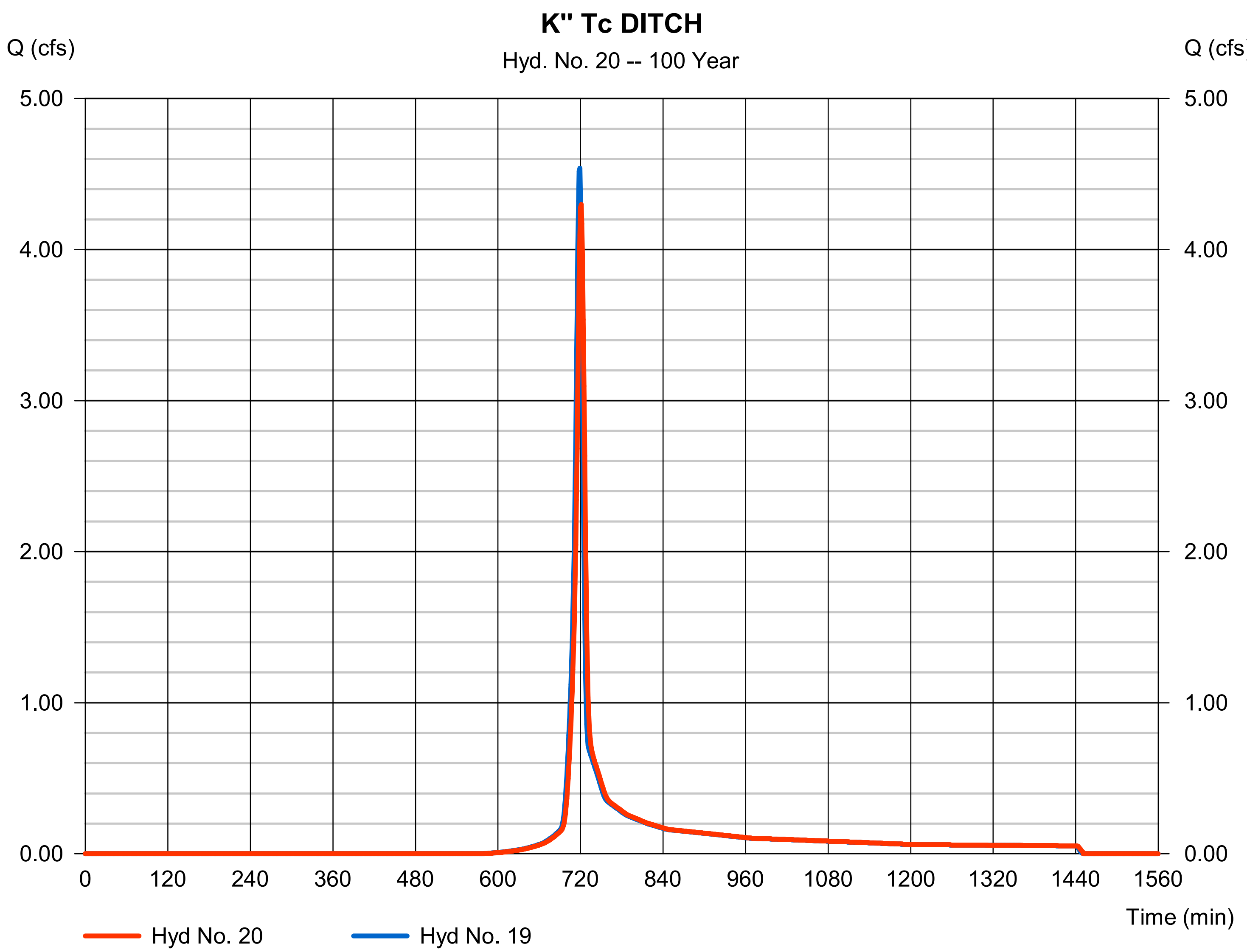
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 20

K" Tc DITCH

Hydrograph type	= Reach	Peak discharge	= 4.299 cfs
Storm frequency	= 100 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 9,569 cuft
Inflow hyd. No.	= 19 - AREA K" - PRE DEV	Section type	= Trapezoidal
Reach length	= 150.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.040	Bottom width	= 5.0 ft
Side slope	= 4.0:1	Max. depth	= 2.0 ft
Rating curve x	= 0.697	Rating curve m	= 1.257
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.4089

Modified Att-Kin routing method used.



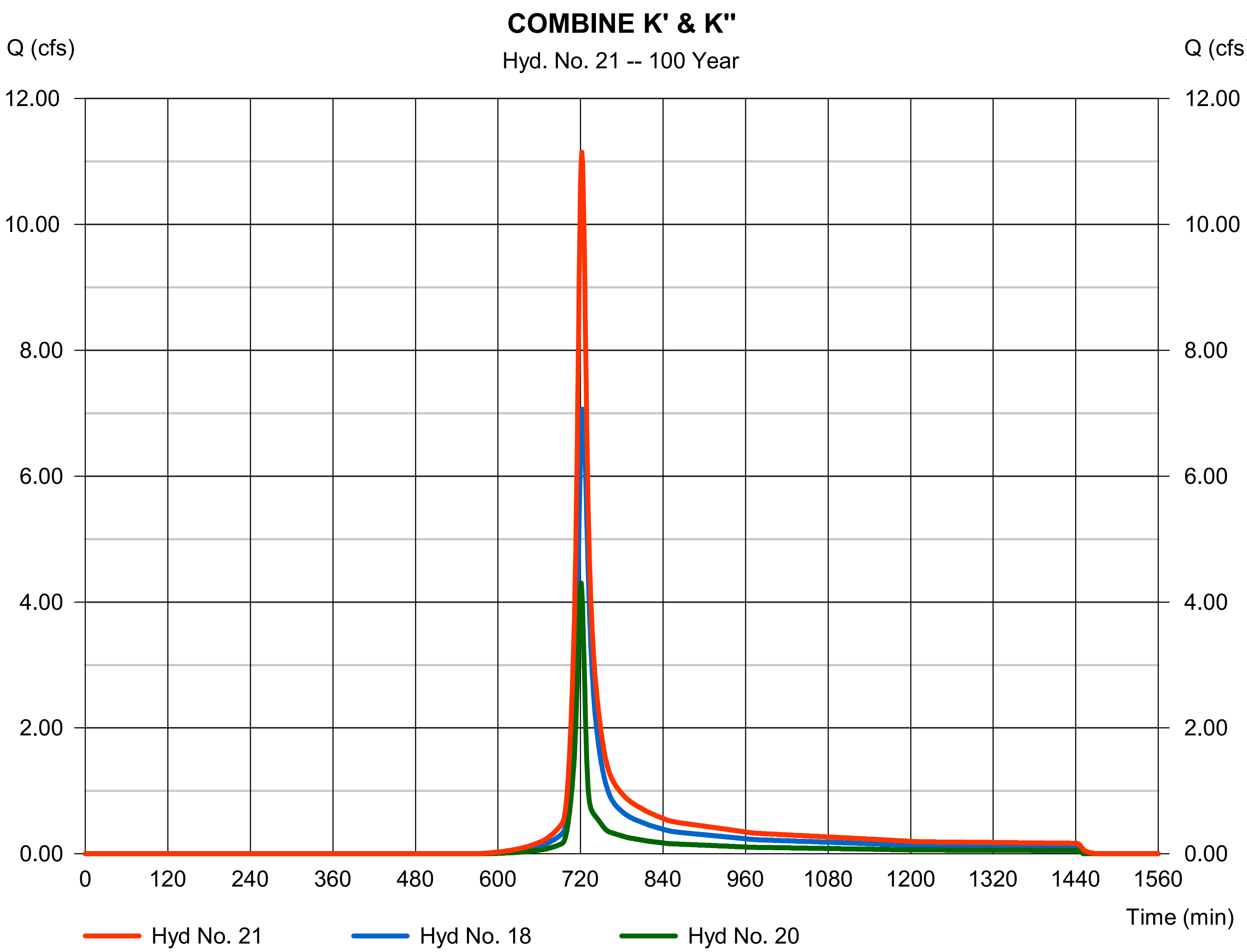
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 21

COMBINE K' & K''

Hydrograph type	= Combine	Peak discharge	= 11.15 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 30,556 cuft
Inflow hyds.	= 18, 20	Contrib. drain. area	= 0.000 ac



Hydrograph Report

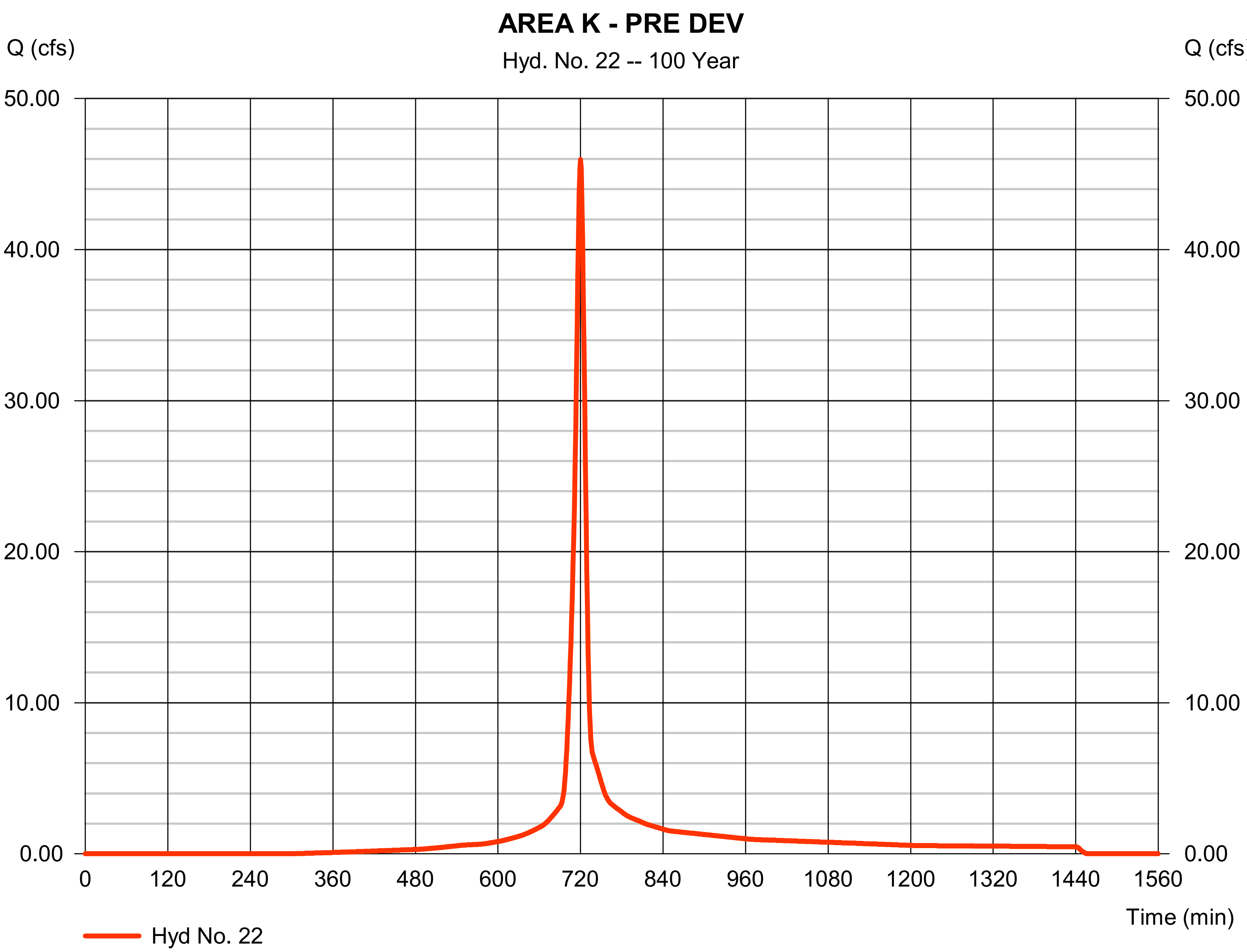
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 22

AREA K - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 45.96 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 114,632 cuft
Drainage area	= 5.530 ac	Curve number	= 81*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 11.70 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(4.460 x 85) + (1.070 x 65)] / 5.530



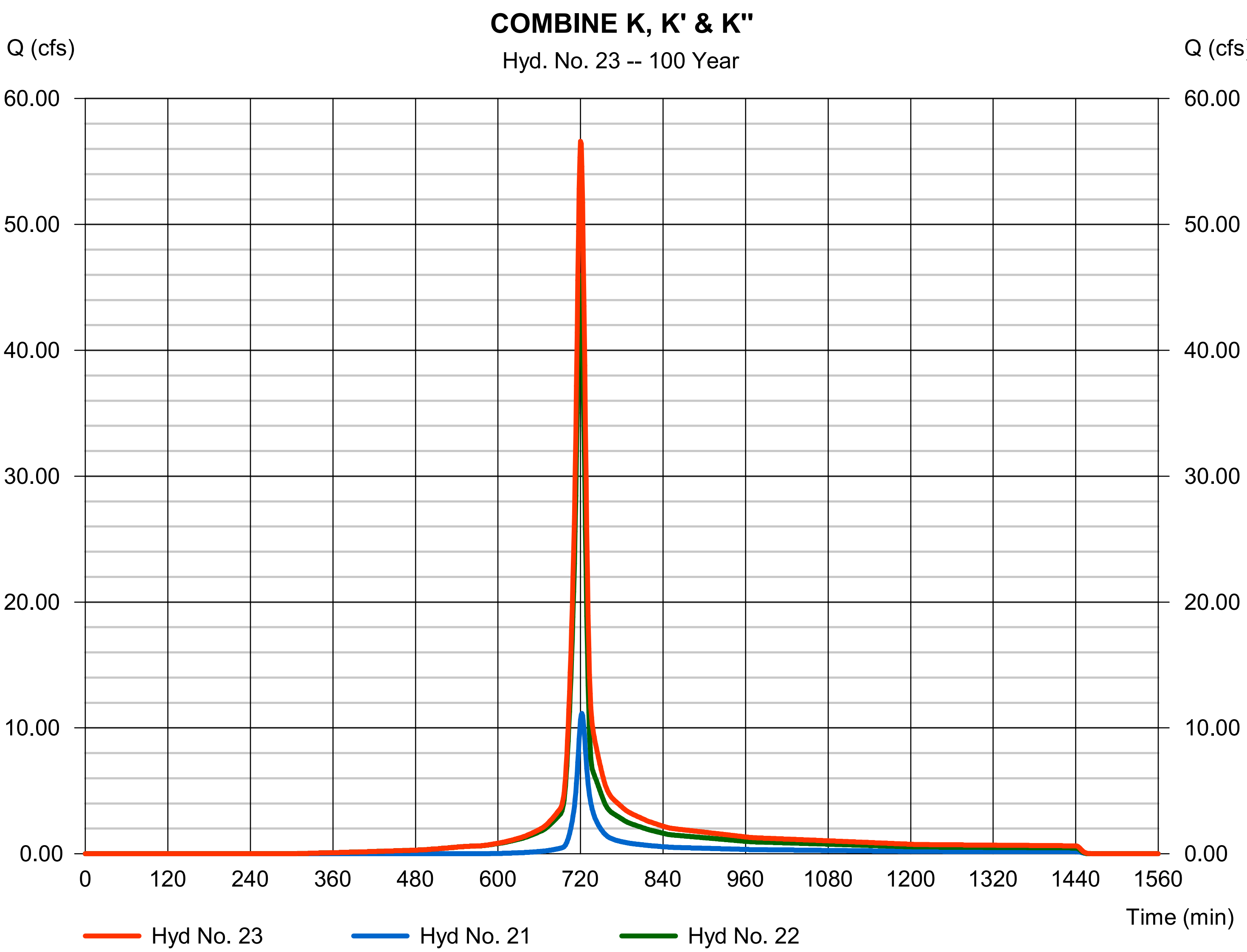
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 23

COMBINE K, K' & K''

Hydrograph type	= Combine	Peak discharge	= 56.61 cfs
Storm frequency	= 100 yrs	Time to peak	= 720 min
Time interval	= 1 min	Hyd. volume	= 145,188 cuft
Inflow hyds.	= 21, 22	Contrib. drain. area	= 5.530 ac



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

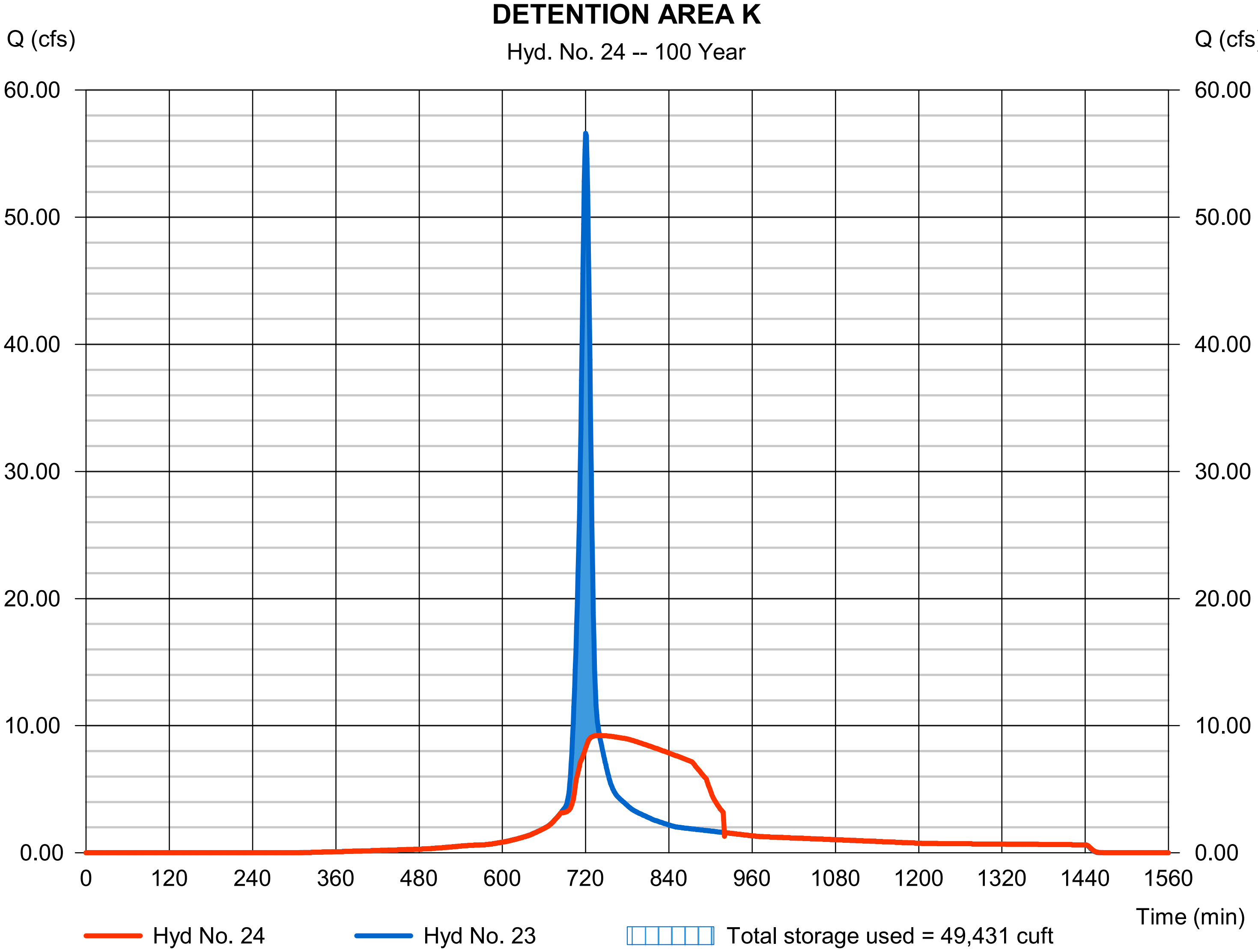
Hyd. No. 24

DETENTION AREA K

Hydrograph type	= Reservoir	Peak discharge	= 9.226 cfs
Storm frequency	= 100 yrs	Time to peak	= 740 min
Time interval	= 1 min	Hyd. volume	= 145,187 cuft
Inflow hyd. No.	= 23 - COMBINE K, K' & K"	Max. Elevation	= 583.18 ft
Reservoir name	= K DETENTION	Max. Storage	= 49,431 cuft

Storage Indication method used.

DETENTION AREA K



Hydrograph Report

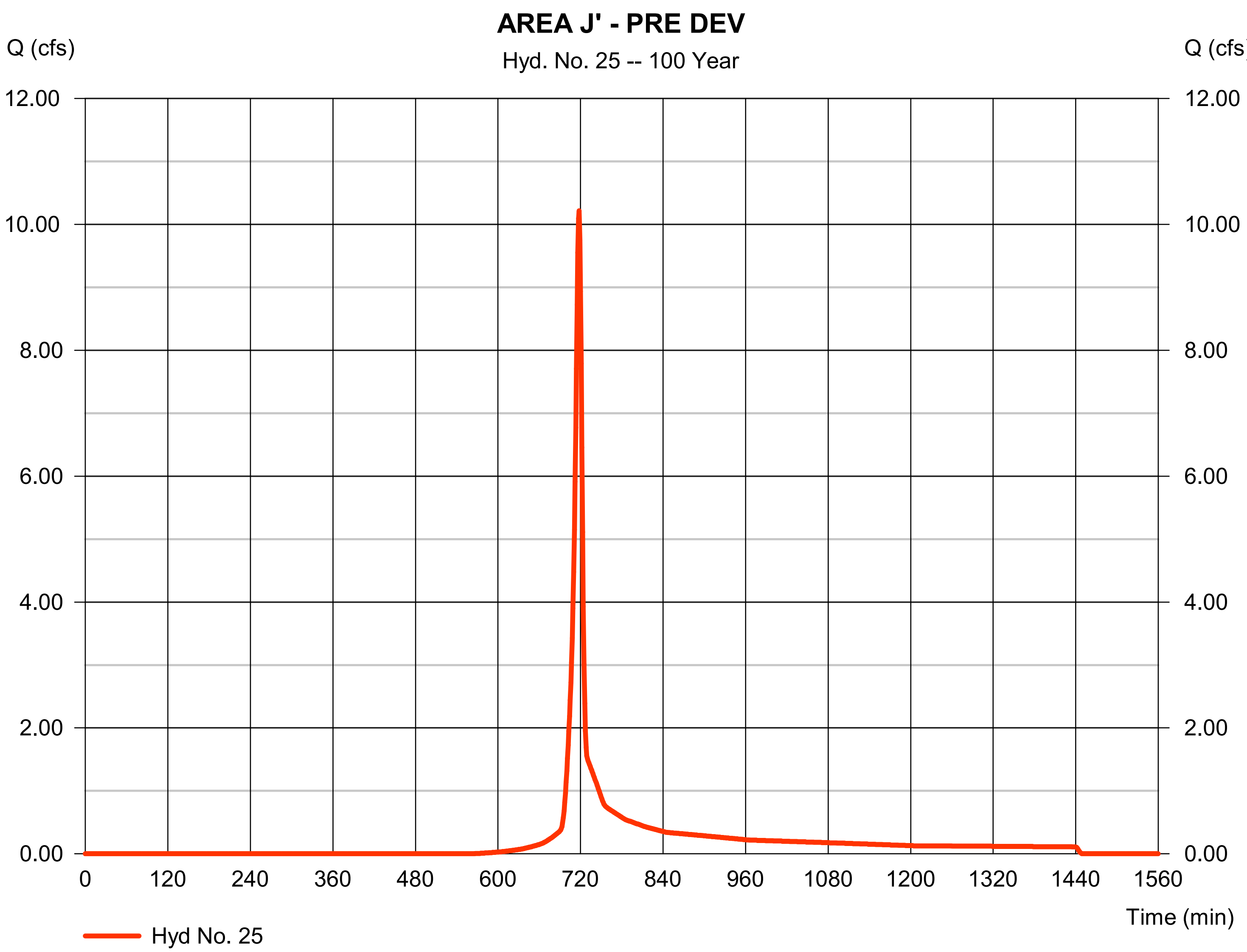
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 25

AREA J' - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 10.22 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 20,525 cuft
Drainage area	= 1.590 ac	Curve number	= 62*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.080 x 85) + (0.220 x 65) + (1.290 x 60)] / 1.590



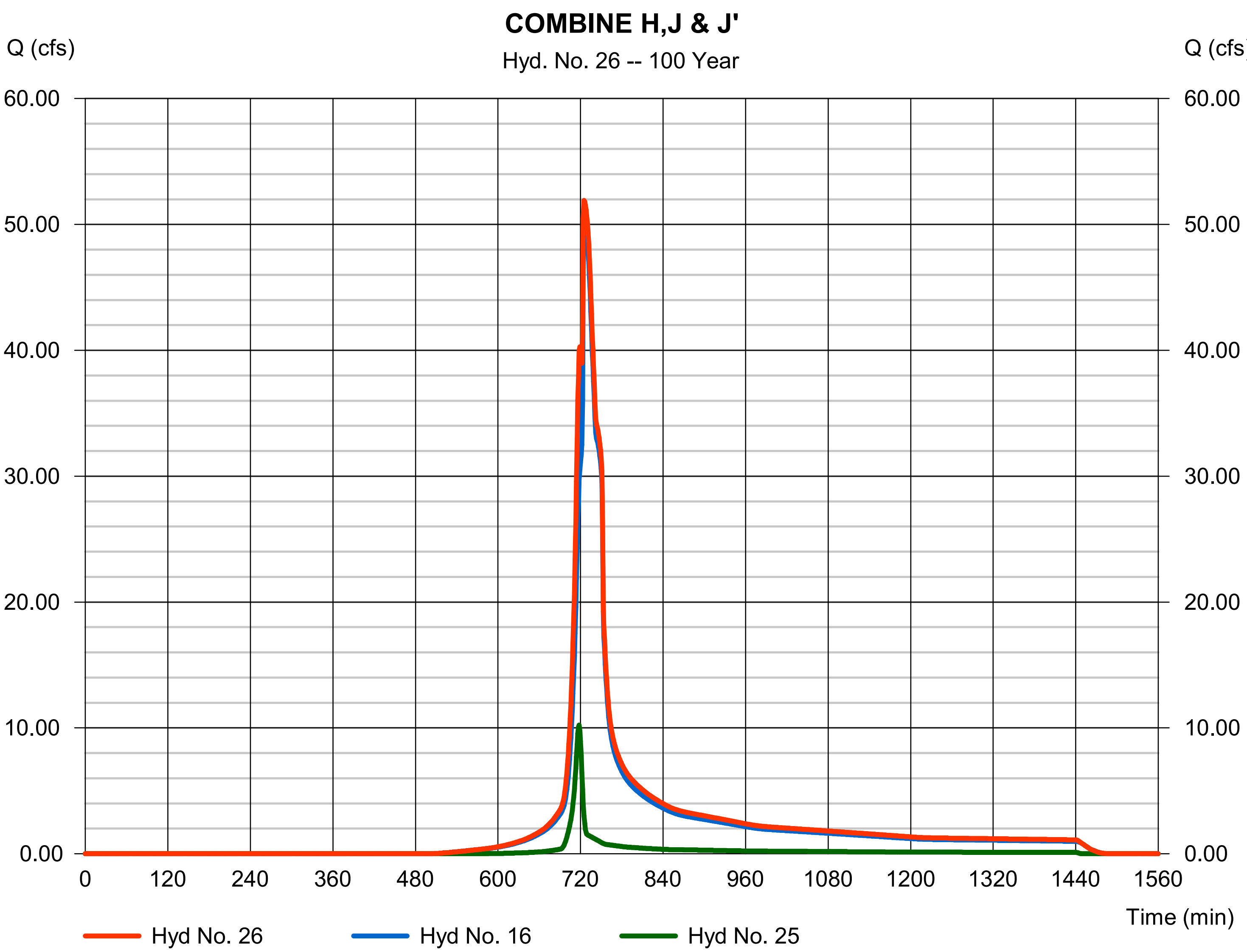
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 26

COMBINE H,J & J'

Hydrograph type	= Combine	Peak discharge	= 51.90 cfs
Storm frequency	= 100 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 220,576 cuft
Inflow hyds.	= 16, 25	Contrib. drain. area	= 1.590 ac



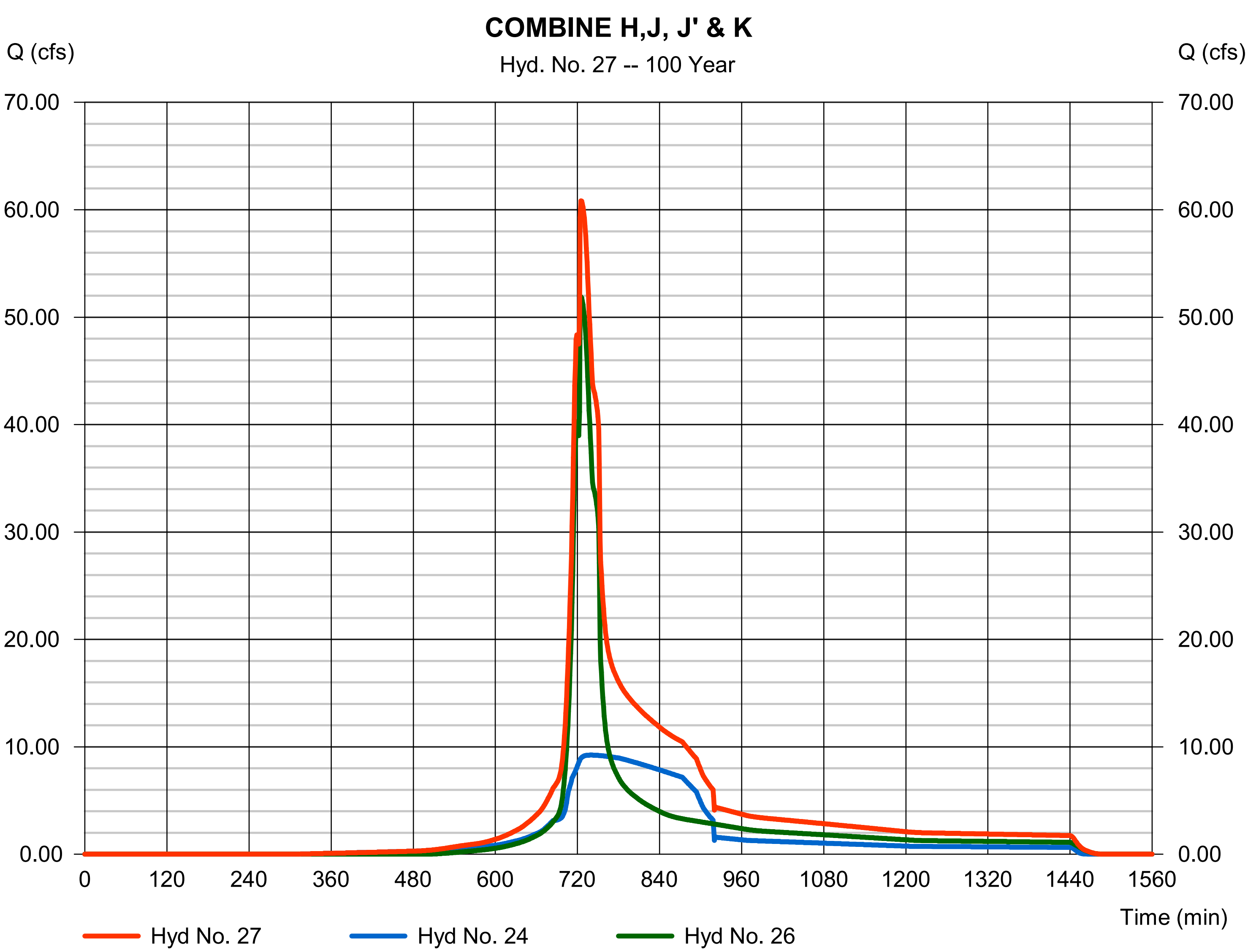
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 27

COMBINE H,J, J' & K

Hydrograph type	= Combine	Peak discharge	= 60.84 cfs
Storm frequency	= 100 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 365,763 cuft
Inflow hyds.	= 24, 26	Contrib. drain. area	= 0.000 ac



Hydrograph Report

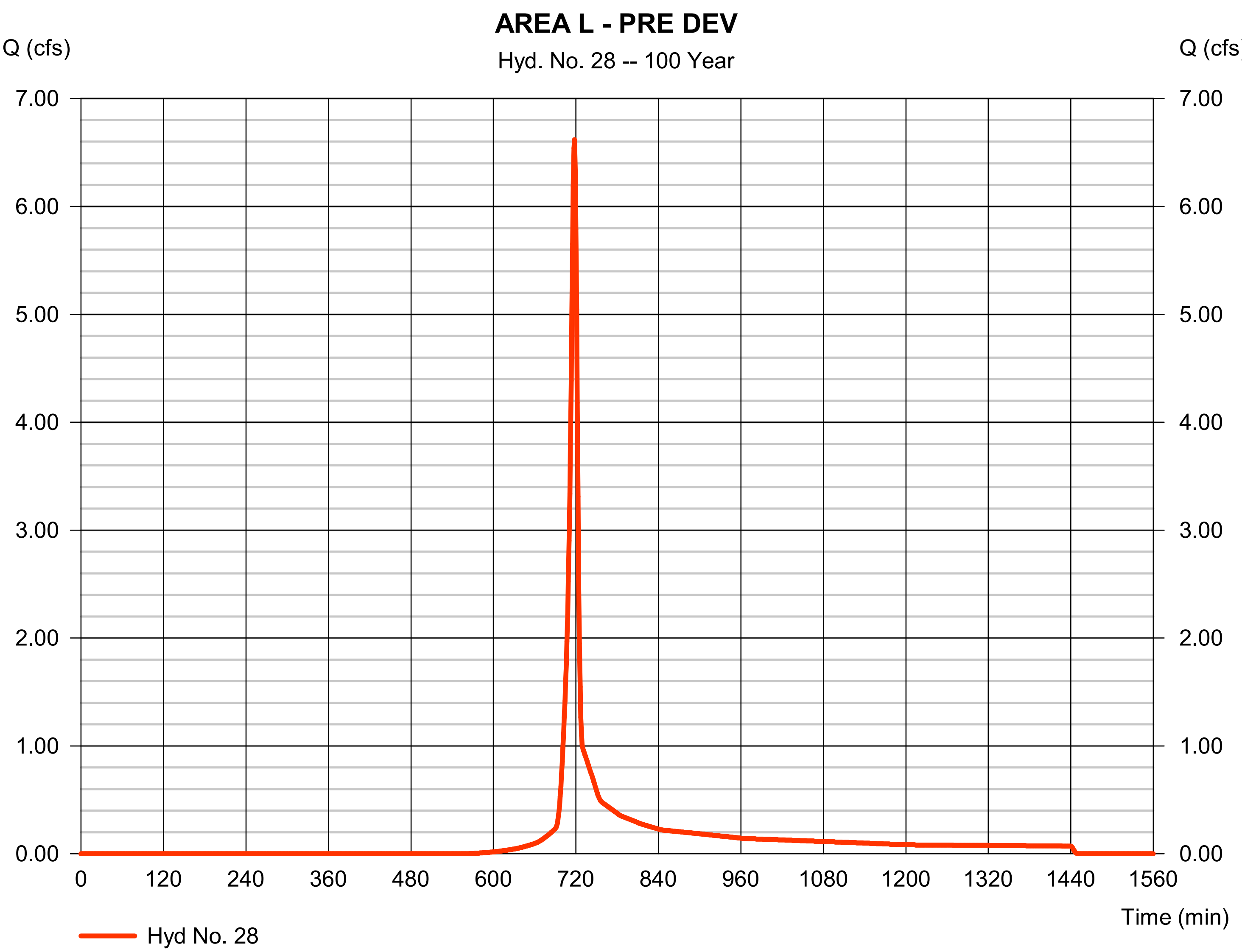
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 28

AREA L - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 6.618 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 13,296 cuft
Drainage area	= 1.030 ac	Curve number	= 62*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.230 x 65) + (0.050 x 85) + (0.750 x 60)] / 1.030



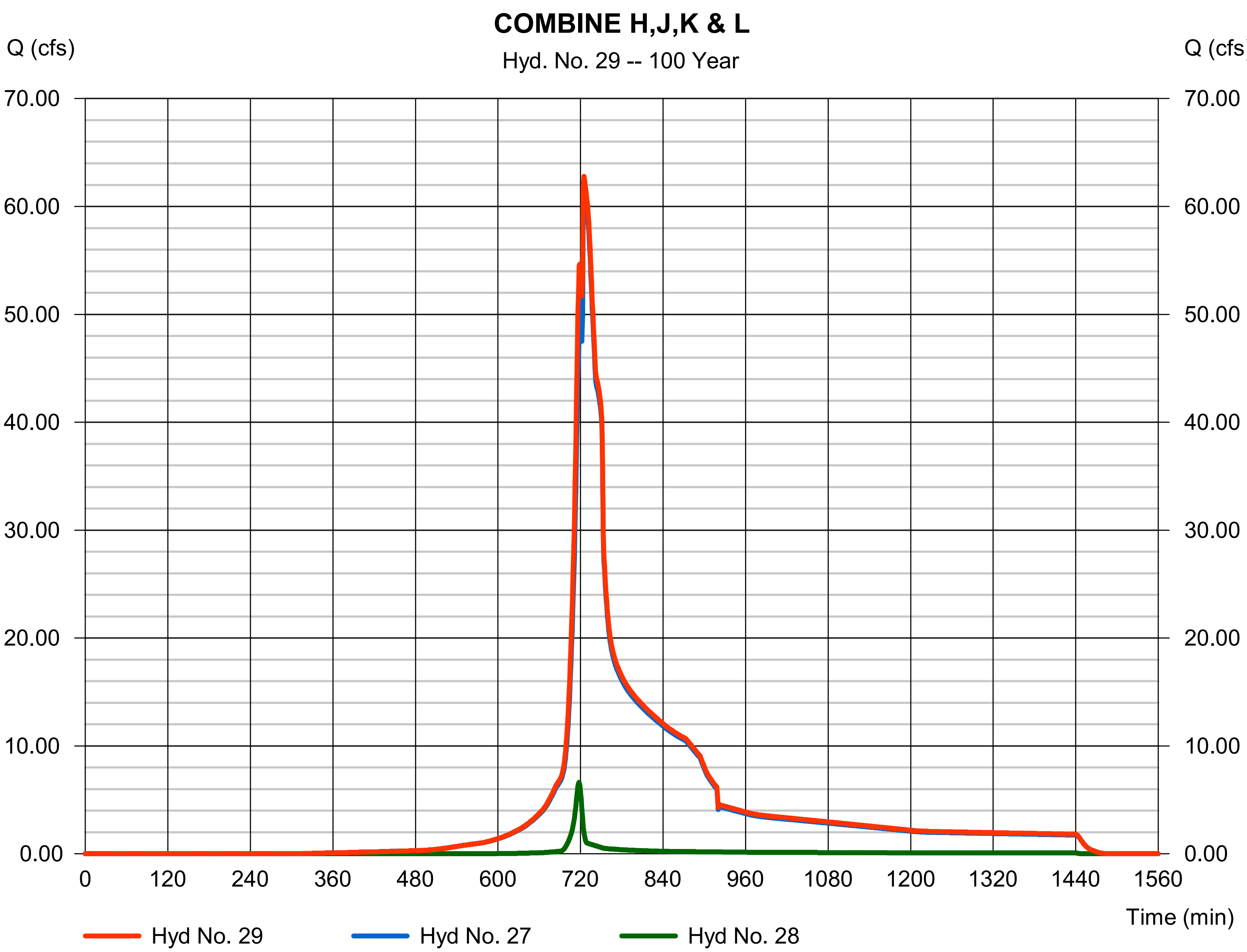
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 11 / 15 / 2018

Hyd. No. 29

COMBINE H,J,K & L

Hydrograph type	= Combine	Peak discharge	= 62.79 cfs
Storm frequency	= 100 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 379,060 cuft
Inflow hyds.	= 27, 28	Contrib. drain. area	= 1.030 ac



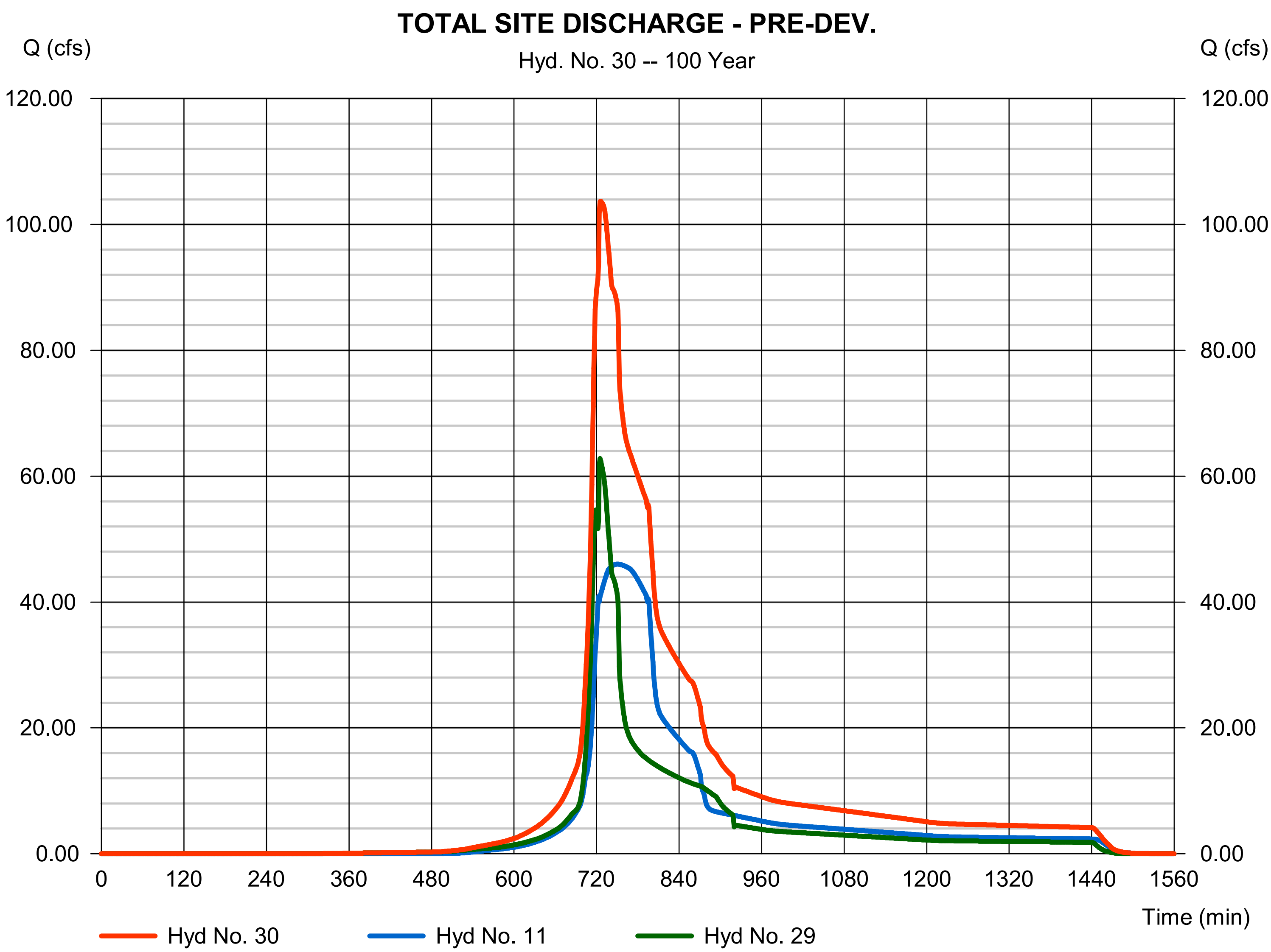
Hydrograph Report

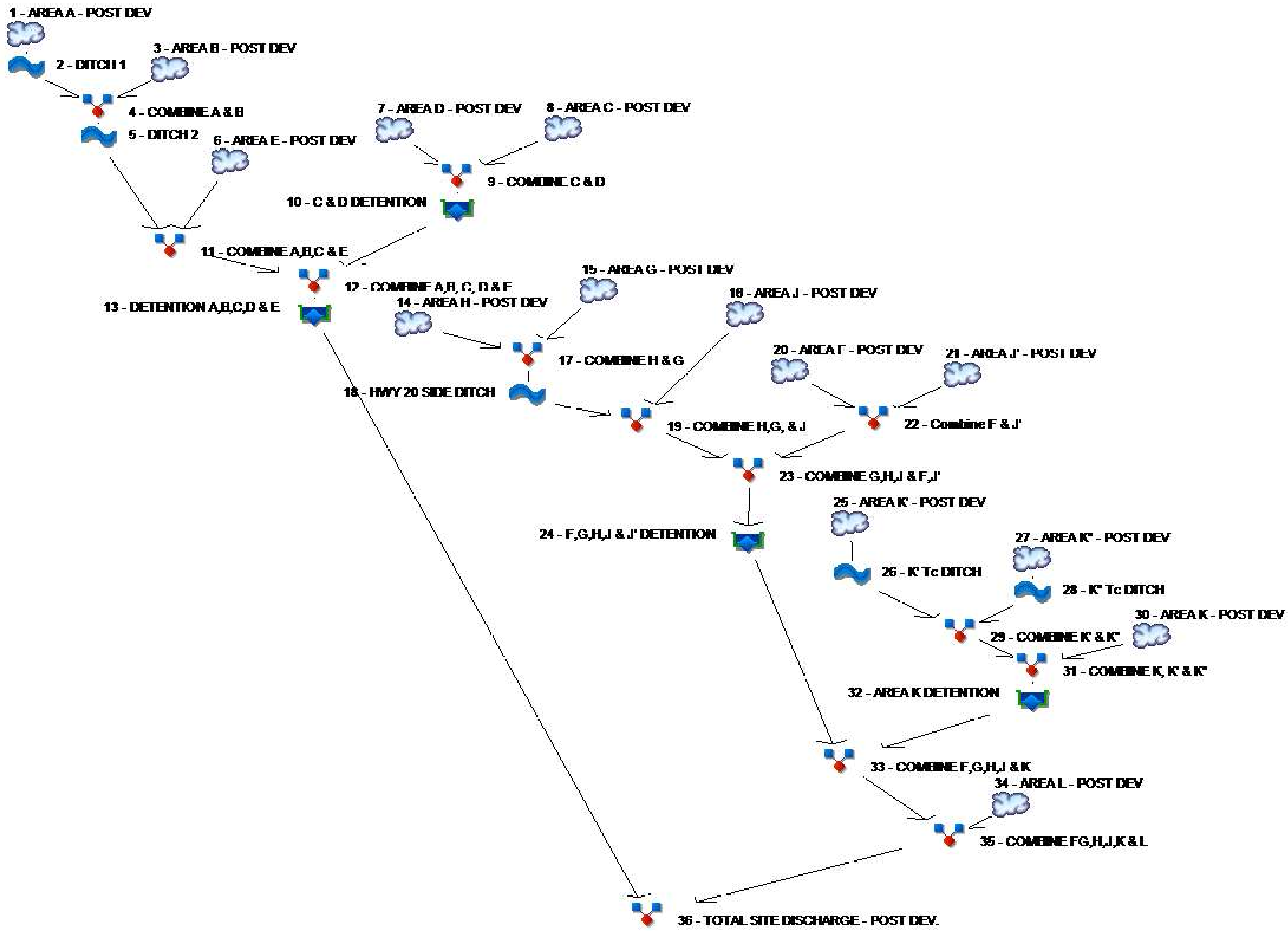
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 11 / 15 / 2018

Hyd. No. 30

TOTAL SITE DISCHARGE - PRE-DEV.

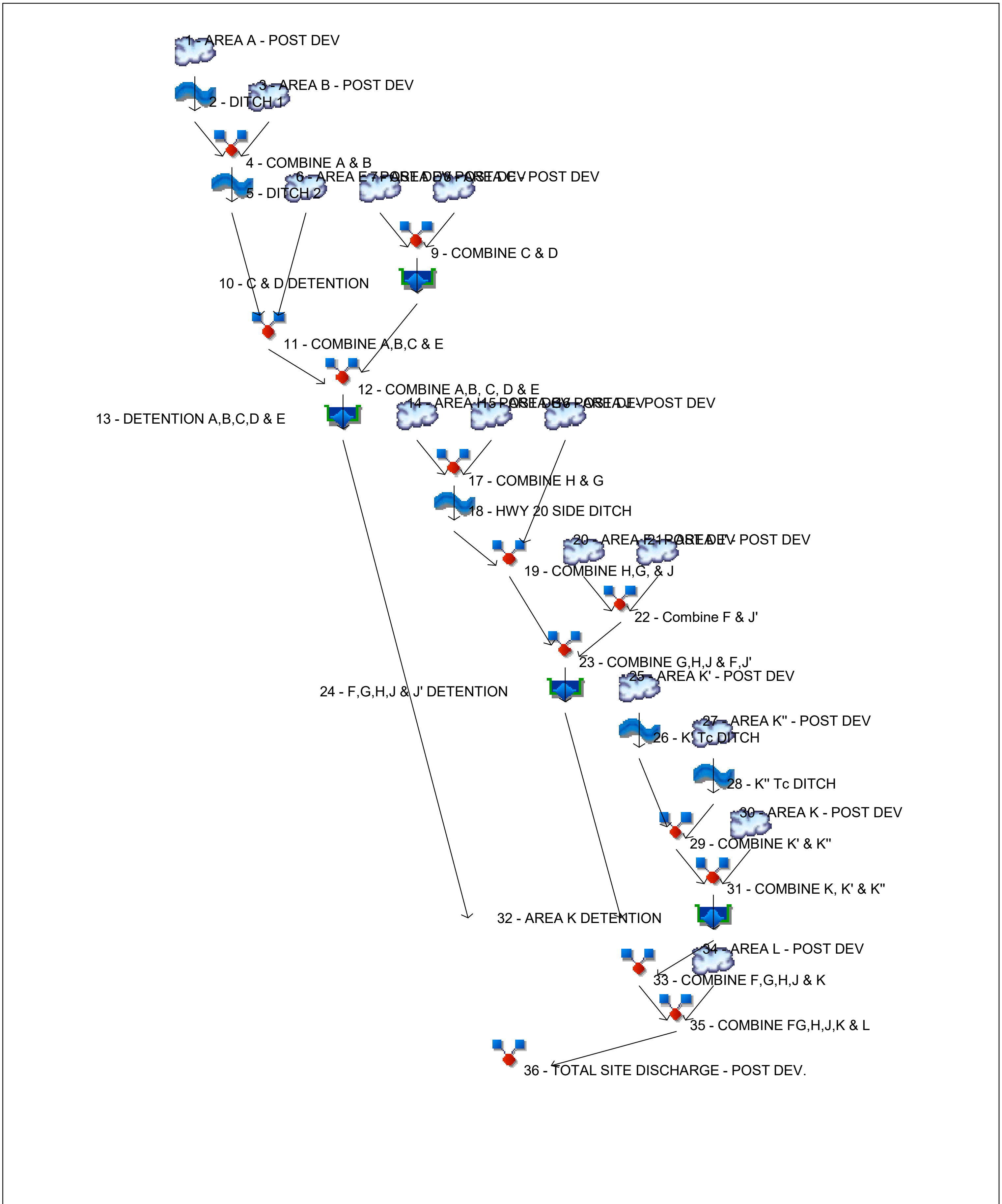
Hydrograph type	= Combine	Peak discharge	= 103.67 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 847,244 cuft
Inflow hyds.	= 11, 29	Contrib. drain. area	= 0.000 ac




1 - AREA A - POST DEV
2 - DITCH 1
3 - AREA B - POST DEV
4 - COMBINE A & B
5 - DITCH 2
6 - AREA E - POST DEV
7 - AREA D - POST DEV
8 - AREA C - POST DEV
9 - COMBINE C & D
10 - C & D DETENTION
11 - COMBINE A,B,C & E
12 - COMBINE A,B, C, D & E
13 - DETENTION A,B,C,D & E
14 - AREA H - POST DEV
15 - AREA G - POST DEV
16 - AREA J - POST DEV
17 - COMBINE H & G
18 - HWY 20 SIDE DITCH
19 - COMBINE H,G, & J
20 - AREA F - POST DEV
21 - AREA J' - POST DEV
22 - Combine F & J'
23 - COMBINE G,H,J & F,J'
24 - F,G,H,J & J' DETENTION
25 - AREA K' - POST DEV
26 - K' Tc DITCH
27 - AREA K" - POST DEV
28 - K" Tc DITCH
29 - COMBINE K' & K"
30 - AREA K - POST DEV
31 - COMBINE K, K' & K"
32 - AREA K DETENTION
33 - COMBINE F,G,H,J & K
34 - AREA L - POST DEV
35 - COMBINE FG,H,J,K & L
36 - TOTAL SITE DISCHARGE - POST DEV.

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	------	-------	-------	-------	-------	-------	9.405	11.34	13.37	AREA A - POST DEV
2	Reach	1	-------	-------	-------	-------	-------	9.020	10.92	12.91	DITCH 1
3	SCS Runoff	------	-------	-------	-------	-------	-------	20.45	25.11	30.03	AREA B - POST DEV
4	Combine	2, 3	-------	-------	-------	-------	-------	29.45	35.98	42.91	COMBINE A & B
5	Reach	4	-------	-------	-------	-------	-------	29.04	35.52	42.43	DITCH 2
6	SCS Runoff	------	-------	-------	-------	-------	-------	14.07	17.70	21.56	AREA E - POST DEV
7	SCS Runoff	------	-------	-------	-------	-------	-------	33.28	39.22	45.34	AREA D - POST DEV
8	SCS Runoff	------	-------	-------	-------	-------	-------	39.67	48.71	58.24	AREA C - POST DEV
9	Combine	7, 8	-------	-------	-------	-------	-------	71.83	86.55	102.01	COMBINE C & D
10	Reservoir	9	-------	-------	-------	-------	-------	15.16	15.92	16.71	C & D DETENTION
11	Combine	5, 6,	-------	-------	-------	-------	-------	39.62	48.96	58.84	COMBINE A,B,C & E
12	Combine	10, 11	-------	-------	-------	-------	-------	53.11	63.18	73.69	COMBINE A,B, C, D & E
13	Reservoir	12	-------	-------	-------	-------	-------	41.89	44.15	46.02	DETENTION A,B,C,D & E
14	SCS Runoff	------	-------	-------	-------	-------	-------	25.24	30.87	36.81	AREA H - POST DEV
15	SCS Runoff	------	-------	-------	-------	-------	-------	19.99	23.55	27.22	AREA G - POST DEV
16	SCS Runoff	------	-------	-------	-------	-------	-------	15.39	18.95	22.71	AREA J - POST DEV
17	Combine	14, 15,	-------	-------	-------	-------	-------	45.22	54.41	64.03	COMBINE H & G
18	Reach	17	-------	-------	-------	-------	-------	43.60	52.59	62.06	HWY 20 SIDE DITCH
19	Combine	16, 18	-------	-------	-------	-------	-------	54.75	66.49	78.80	COMBINE H,G, & J
20	SCS Runoff	------	-------	-------	-------	-------	-------	31.71	37.12	42.69	AREA F - POST DEV
21	SCS Runoff	------	-------	-------	-------	-------	-------	5.906	7.386	8.961	AREA J' - POST DEV
22	Combine	20, 21	-------	-------	-------	-------	-------	32.60	38.21	44.00	Combine F & J'
23	Combine	19, 22	-------	-------	-------	-------	-------	87.29	104.60	122.71	COMBINE G,H,J & F,J'
24	Reservoir	23	-------	-------	-------	-------	-------	52.79	56.14	58.90	F,G,H,J & J' DETENTION
25	SCS Runoff	------	-------	-------	-------	-------	-------	4.453	5.594	6.822	AREA K' - POST DEV
26	Reach	25	-------	-------	-------	-------	-------	3.466	4.429	5.475	K' Tc DITCH
27	SCS Runoff	------	-------	-------	-------	-------	-------	2.004	2.532	3.101	AREA K'' - POST DEV
28	Reach	27	-------	-------	-------	-------	-------	1.337	1.732	2.162	K'' Tc DITCH
29	Combine	26, 28	-------	-------	-------	-------	-------	4.784	6.145	7.611	COMBINE K' & K''
30	SCS Runoff	------	-------	-------	-------	-------	-------	18.71	23.63	28.94	AREA K - POST DEV
31	Combine	29, 30	-------	-------	-------	-------	-------	22.56	28.70	35.31	COMBINE K, K' & K''
32	Reservoir	31	-------	-------	-------	-------	-------	6.523	7.119	7.727	AREA K DETENTION
33	Combine	24, 32	-------	-------	-------	-------	-------	59.30	63.24	66.60	COMBINE F,G,H,J & K
34	SCS Runoff	------	-------	-------	-------	-------	-------	4.086	5.133	6.249	AREA L - POST DEV

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	
35	Combine	33, 34	-------	-------	-------	-------	-------	59.90	63.94	67.39	COMBINE FG,H,J,K & L
36	Combine	13, 35	-------	-------	-------	-------	-------	101.79	108.07	113.38	TOTAL SITE DISCHARGE - POST D

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	SCS Runoff	9.405	1	725	29,429	------	------	------	AREA A - POST DEV
2	Reach	9.020	1	728	29,427	1	------	------	DITCH 1
3	SCS Runoff	20.45	1	727	70,362	------	------	------	AREA B - POST DEV
4	Combine	29.45	1	728	99,789	2, 3	------	------	COMBINE A & B
5	Reach	29.04	1	730	99,788	4	------	------	DITCH 2
6	SCS Runoff	14.07	1	742	79,687	------	------	------	AREA E - POST DEV
7	SCS Runoff	33.28	1	731	132,879	------	------	------	AREA D - POST DEV
8	SCS Runoff	39.67	1	727	136,457	------	------	------	AREA C - POST DEV
9	Combine	71.83	1	729	269,336	7, 8	------	------	COMBINE C & D
10	Reservoir	15.16	1	759	269,335	9	582.16	94,511	C & D DETENTION
11	Combine	39.62	1	731	179,475	5, 6,	------	------	COMBINE A,B,C & E
12	Combine	53.11	1	732	448,810	10, 11	------	------	COMBINE A,B, C, D & E
13	Reservoir	41.89	1	746	448,781	12	581.20	17,932	DETENTION A,B,C,D & E
14	SCS Runoff	25.24	1	730	95,092	------	------	------	AREA H - POST DEV
15	SCS Runoff	19.99	1	729	74,414	------	------	------	AREA G - POST DEV
16	SCS Runoff	15.39	1	724	46,094	------	------	------	AREA J - POST DEV
17	Combine	45.22	1	729	169,506	14, 15,	------	------	COMBINE H & G
18	Reach	43.60	1	733	169,504	17	------	------	HWY 20 SIDE DITCH
19	Combine	54.75	1	730	215,598	16, 18	------	------	COMBINE H,G, & J
20	SCS Runoff	31.71	1	731	126,821	------	------	------	AREA F - POST DEV
21	SCS Runoff	5.906	1	718	11,907	------	------	------	AREA J' - POST DEV
22	Combine	32.60	1	731	138,728	20, 21	------	------	Combine F & J'
23	Combine	87.29	1	731	354,326	19, 22	------	------	COMBINE G,H,J & F,J'
24	Reservoir	52.79	1	745	354,326	23	581.11	46,121	F,G,H,J & J' DETENTION
25	SCS Runoff	4.453	1	726	14,349	------	------	------	AREA K' - POST DEV
26	Reach	3.466	1	733	14,343	25	------	------	K' Tc DITCH
27	SCS Runoff	2.004	1	726	6,495	------	------	------	AREA K'' - POST DEV
28	Reach	1.337	1	735	6,486	27	------	------	K'' Tc DITCH
29	Combine	4.784	1	734	20,829	26, 28	------	------	COMBINE K' & K''
30	SCS Runoff	18.71	1	726	60,617	------	------	------	AREA K - POST DEV
31	Combine	22.56	1	726	81,447	29, 30	------	------	COMBINE K, K' & K''
32	Reservoir	6.523	1	750	81,312	31	582.34	24,329	AREA K DETENTION
33	Combine	59.30	1	746	435,635	24, 32	------	------	COMBINE F,G,H,J & K
34	SCS Runoff	4.086	1	721	10,038	------	------	------	AREA L - POST DEV

AP3_POSTDEV.gpw	Return Period: 25 Year	Thursday, 11 / 15 / 2018

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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
35	Combine	59.90	1	745	445,674	33, 34	------	------	COMBINE FG,H,J,K & L
36	Combine	101.79	1	745	894,452	13, 35	------	------	TOTAL SITE DISCHARGE - POST D

Hydrograph Report

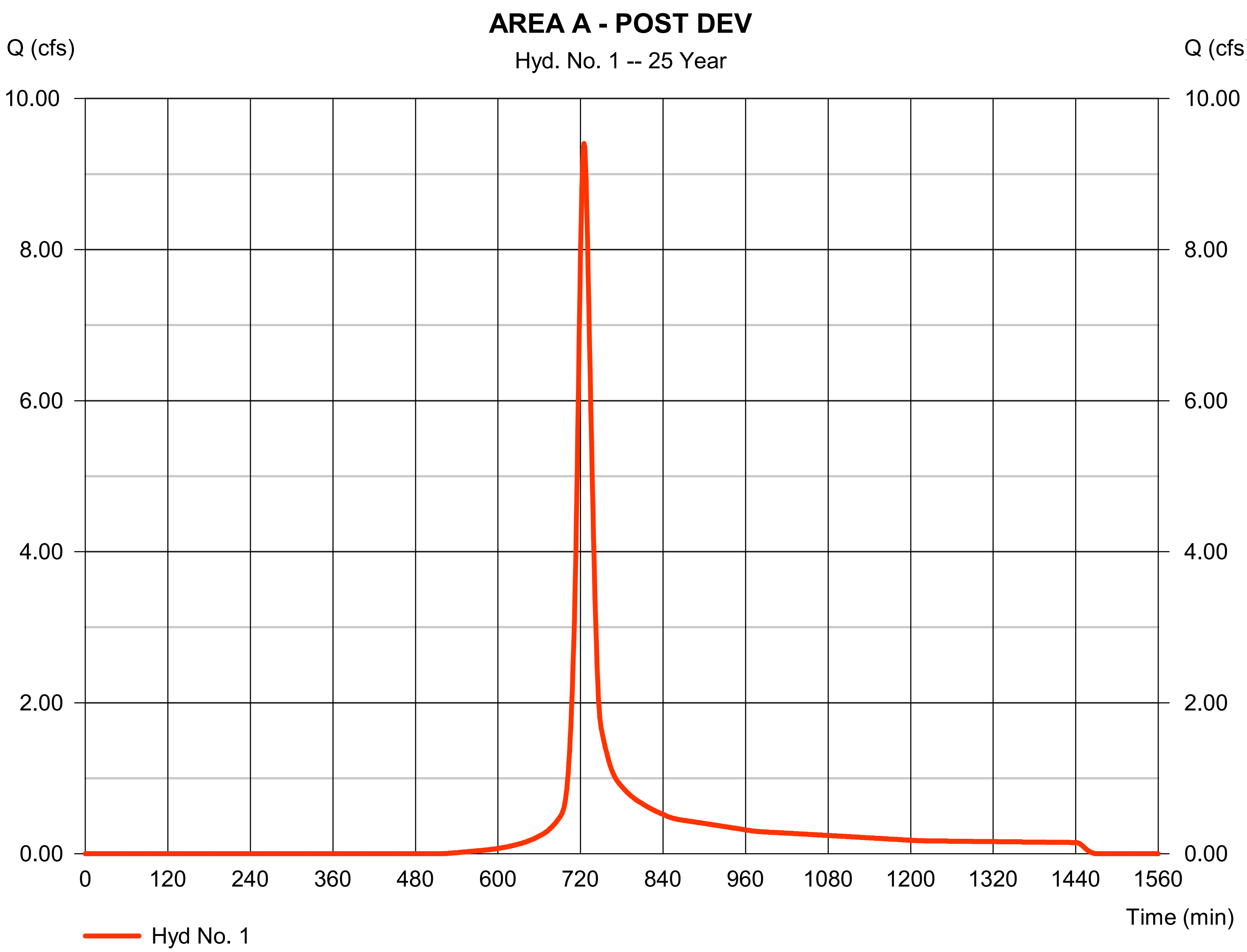
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 1

AREA A - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 9.405 cfs
Storm frequency	= 25 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 29,429 cuft
Drainage area	= 2.580 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.10 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.220 x 85) + (0.570 x 55) + (0.030 x 98) + (0.760 x 60)] / 2.580



TR55 Tc Worksheet

Hyd. No. 1

AREA A - POST DEV

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	50.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.82		0.00		0.00		
Land slope (%)	=	16.00		0.00		0.00		
Travel Time (min)	**=**	**3.27**	**+**	**0.00**	**+**	**0.00**	**=**	**3.27**
Shallow Concentrated Flow								
Flow length (ft)	=	620.00		0.00		0.00		
Watercourse slope (%)	=	0.17		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	0.67		0.00		0.00		
Travel Time (min)	**=**	**15.53**	**+**	**0.00**	**+**	**0.00**	**=**	**15.53**
Channel Flow								
X sectional flow area (sqft)	=	2.89		0.00		0.00		
Wetted perimeter (ft)	=	7.29		0.00		0.00		
Channel slope (%)	=	0.50		0.00		0.00		
Manning's n-value	=	0.030		0.015		0.015		
Velocity (ft/s)	=	1.89		0.00		0.00		
Flow length (ft)		({0})150.0		0.0		0.0		
Travel Time (min)	**=**	**1.32**	**+**	**0.00**	**+**	**0.00**	**=**	**1.32**

Total Travel Time, Tc .... 20.10 min

Hydrograph Report

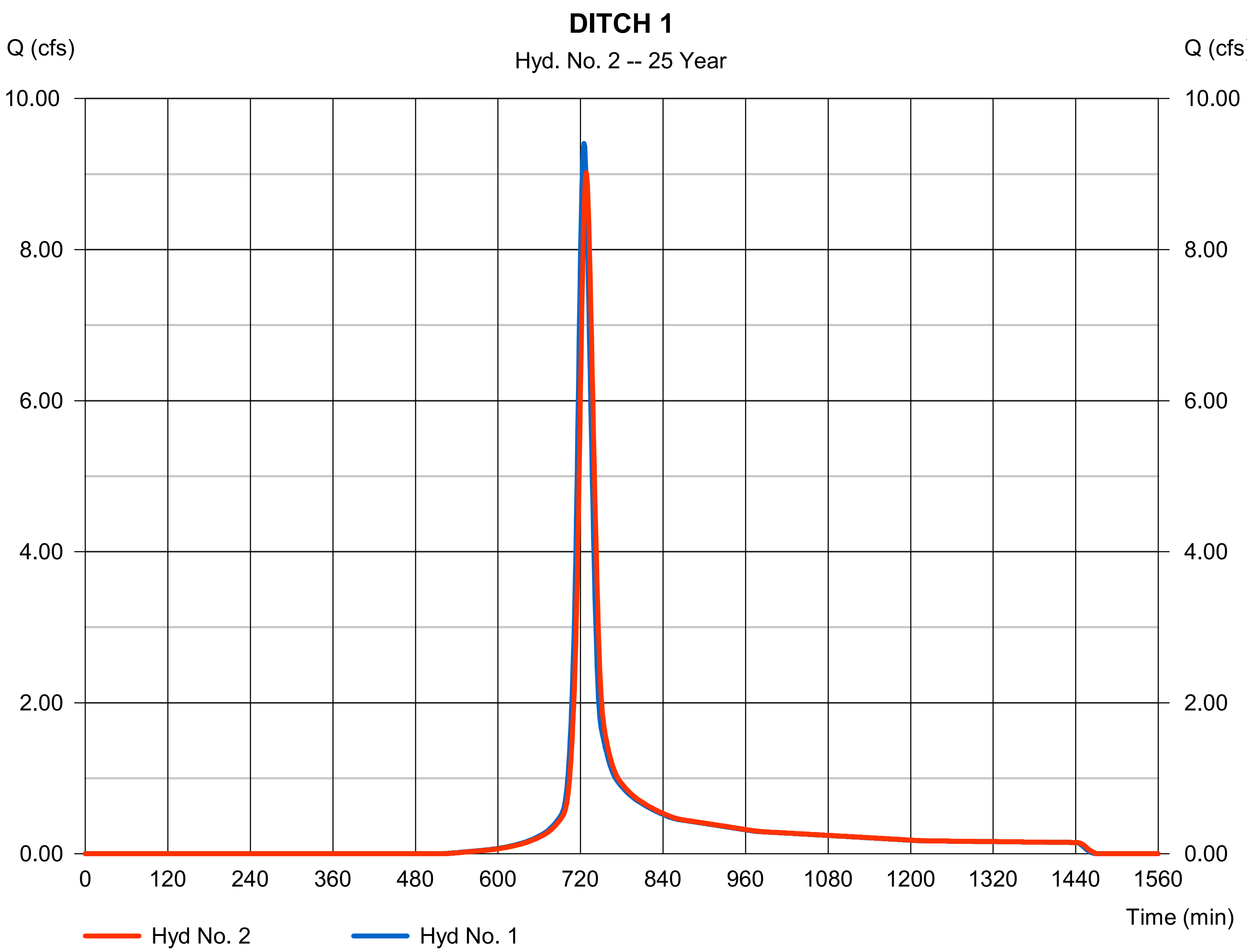
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 2

DITCH 1

Hydrograph type	= Reach	Peak discharge	= 9.020 cfs
Storm frequency	= 25 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 29,427 cuft
Inflow hyd. No.	= 1 - AREA A - POST DEV	Section type	= Trapezoidal
Reach length	= 730.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 10.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.375
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.3038

Modified Att-Kin routing method used.



Hydrograph Report

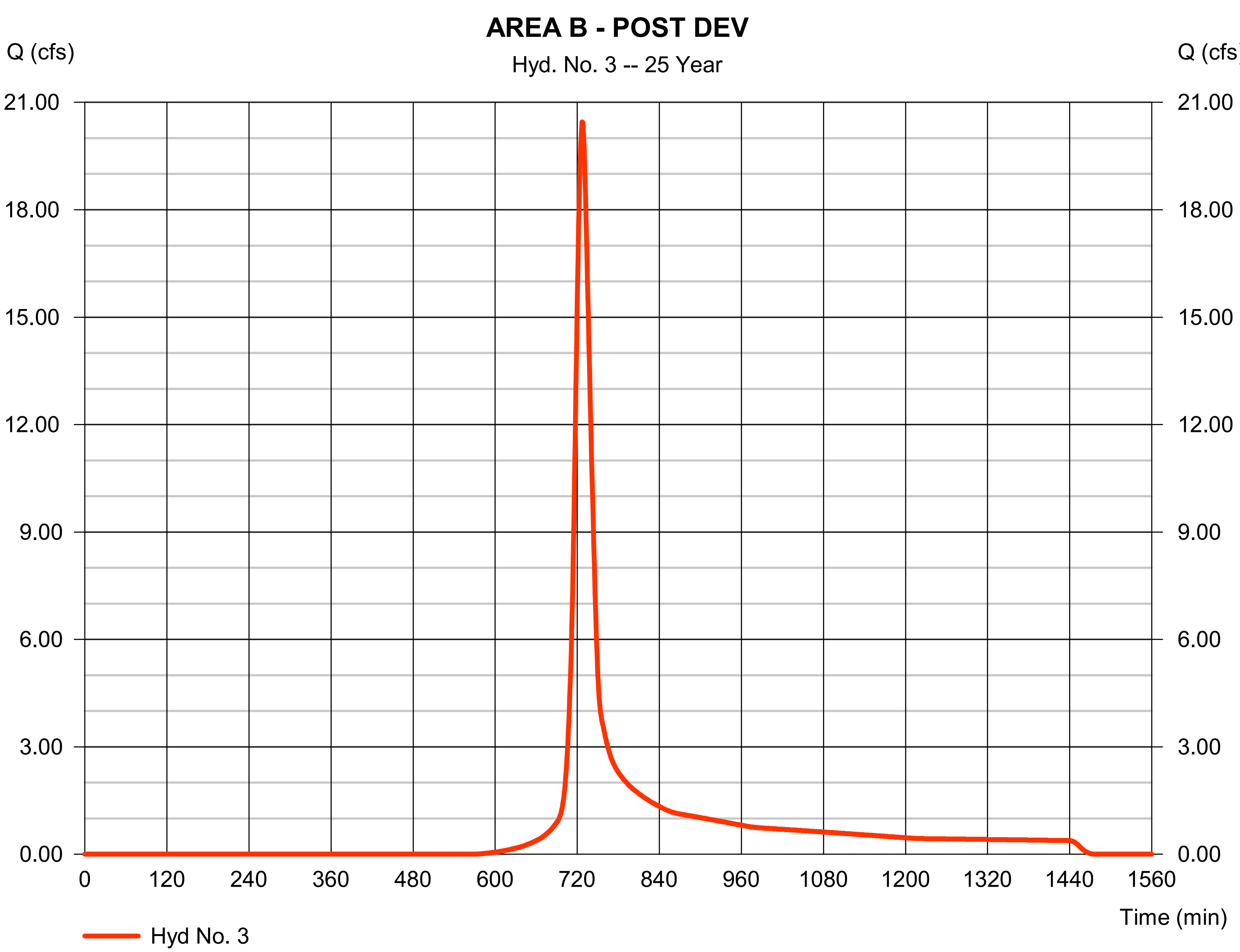
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 11 / 15 / 2018

Hyd. No. 3

AREA B - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 20.45 cfs
Storm frequency	= 25 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 70,362 cuft
Drainage area	= 7.090 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.60 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.930 x 85) + (2.120 x 55) + (0.250 x 98) + (2.790 x 60)] / 7.090



TR55 Tc Worksheet

Hyd. No. 3

AREA B - POST DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.300		0.011		0.011		
Flow length (ft)	= 150.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		0.00		0.00		
Land slope (%)	= 3.60		0.00		0.00		
Travel Time (min)	**= 17.07**	**+**	**0.00**	**+**	**0.00**	**=**	**17.07**
Shallow Concentrated Flow							
Flow length (ft)	= 0.00		0.00		0.00		
Watercourse slope (%)	= 0.00		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=0.00		0.00		0.00		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow							
X sectional flow area (sqft)	= 5.60		5.04		0.00		
Wetted perimeter (ft)	= 18.05		14.27		0.00		
Channel slope (%)	= 0.80		0.66		0.00		
Manning's n-value	= 0.030		0.027		0.015		
Velocity (ft/s)	=2.03		2.23		0.00		
Flow length (ft)	({0})500.0		320.0		0.0		
Travel Time (min)	**= 4.11**	**+**	**2.39**	**+**	**0.00**	**=**	**6.50**

Total Travel Time, Tc .... 23.60 min

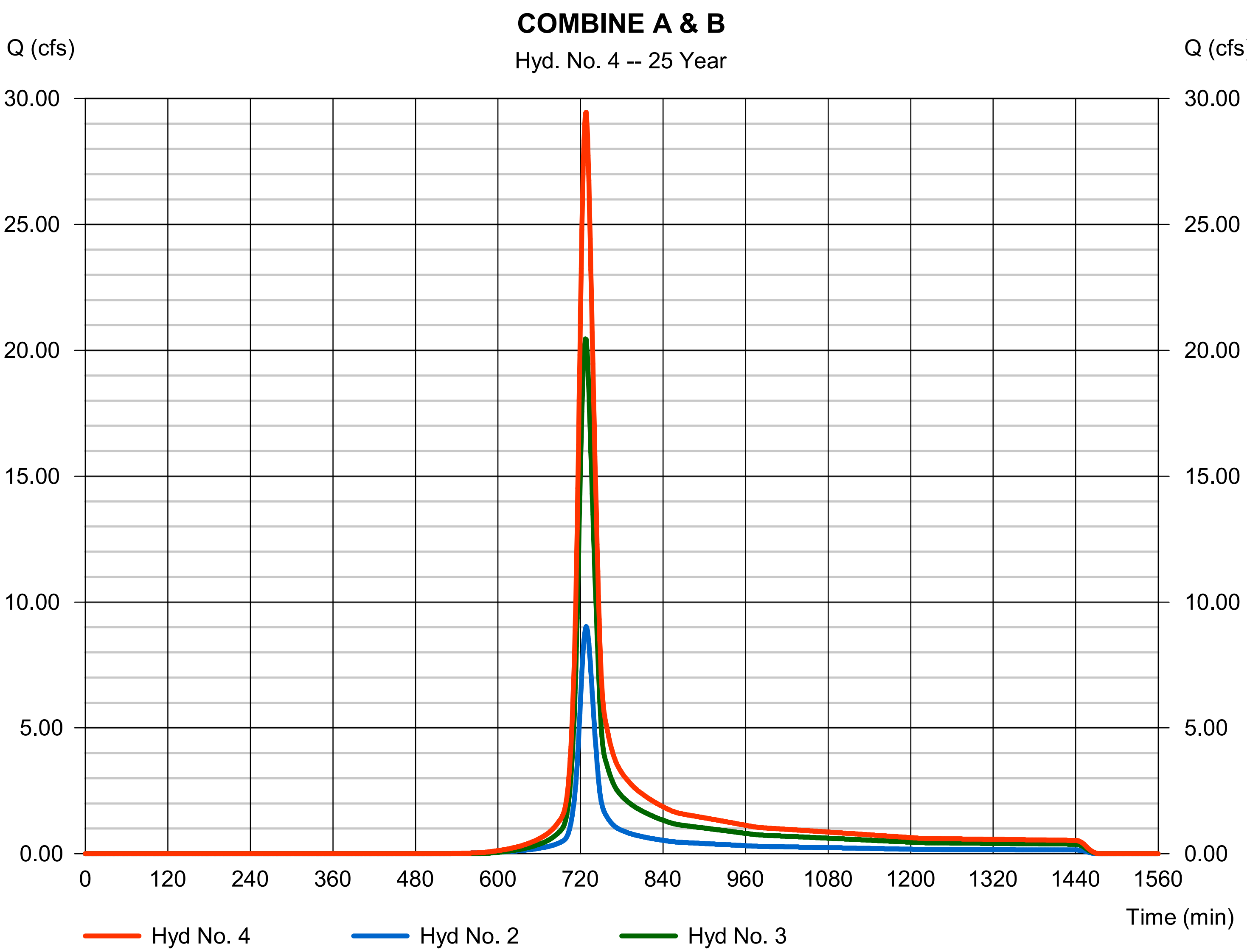
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 4

COMBINE A & B

Hydrograph type	= Combine	Peak discharge	= 29.45 cfs
Storm frequency	= 25 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 99,789 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 7.090 ac



Hydrograph Report

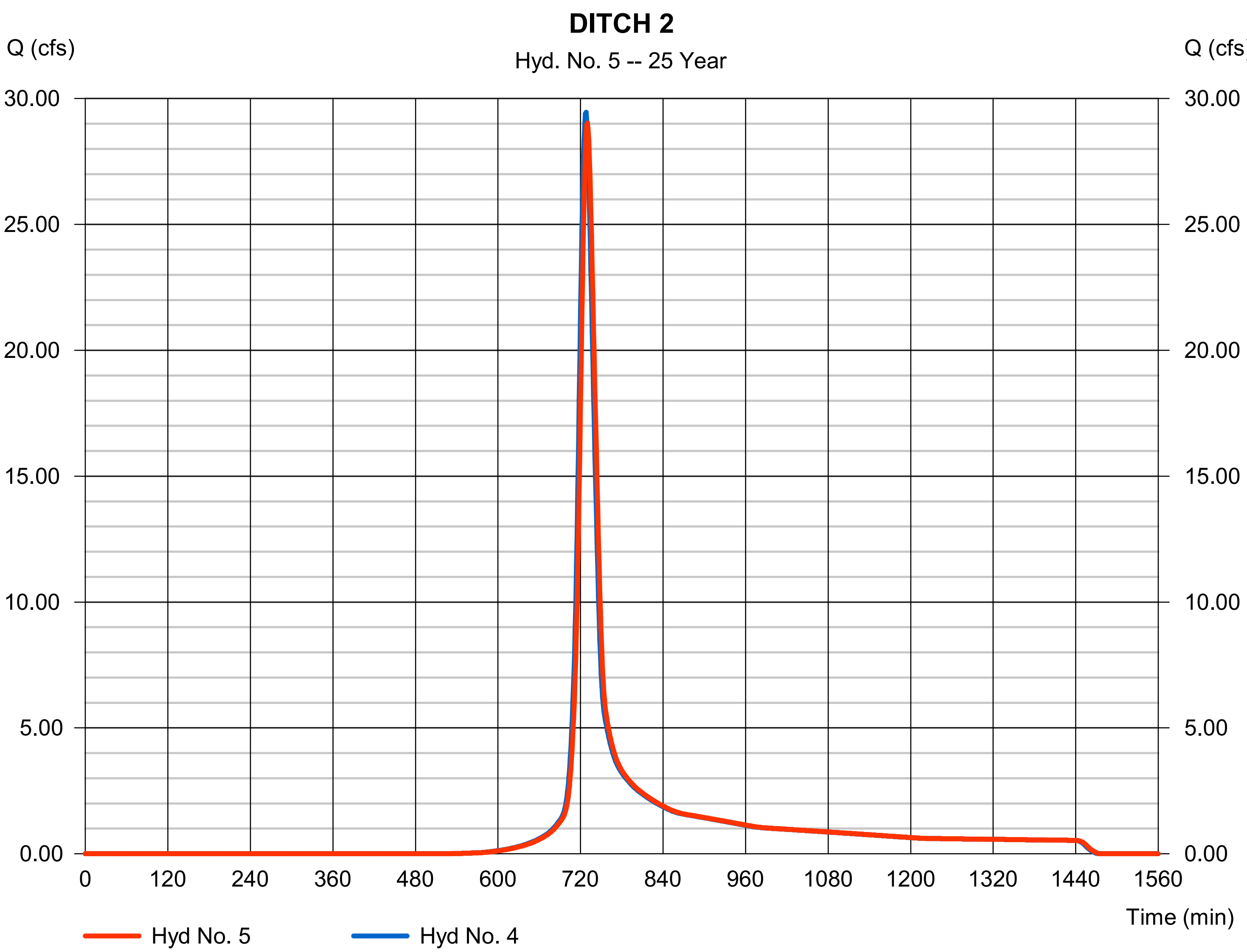
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 5

DITCH 2

Hydrograph type	= Reach	Peak discharge	= 29.04 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 99,788 cuft
Inflow hyd. No.	= 4 - COMBINE A & B	Section type	= Trapezoidal
Reach length	= 610.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.373
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.4511

Modified Att-Kin routing method used.



Hydrograph Report

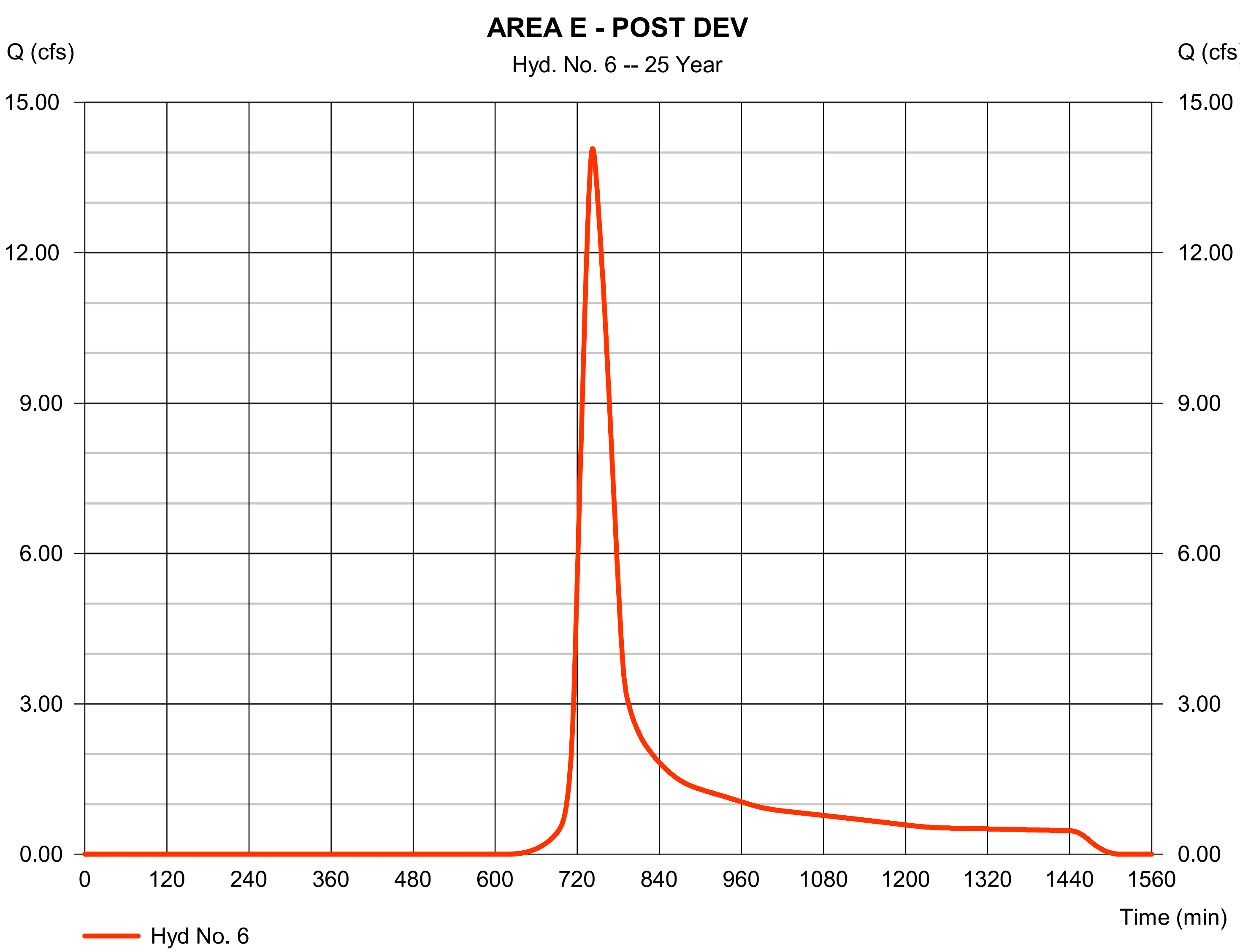
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 6

AREA E - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 14.07 cfs
Storm frequency	= 25 yrs	Time to peak	= 742 min
Time interval	= 1 min	Hyd. volume	= 79,687 cuft
Drainage area	= 9.150 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 47.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.680 x 65) + (0.330 x 98) + (5.140 x 60)] / 9.150



TR55 Tc Worksheet

Hyd. No. 6

AREA E - POST DEV

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	80.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.82		0.00		0.00		
Land slope (%)	=	1.20		0.00		0.00		
Travel Time (min)	**=**	**13.40**	**+**	**0.00**	**+**	**0.00**	**=**	**13.40**
Shallow Concentrated Flow								
Flow length (ft)	=	0.00		0.00		0.00		
Watercourse slope (%)	=	0.00		0.00		0.00		
Surface description	=	Paved		Paved		Paved		
Average velocity (ft/s)	=	0.00		0.00		0.00		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow								
X sectional flow area (sqft)	=	7.51		5.60		0.00		
Wetted perimeter (ft)	=	19.73		9.32		0.00		
Channel slope (%)	=	0.45		0.45		0.00		
Manning's n-value	=	0.065		0.065		0.015		
Velocity (ft/s)	=	0.81		1.09		0.00		
Flow length (ft)	({0})	520.0		1500.0		0.0		
Travel Time (min)	**=**	**10.76**	**+**	**22.87**	**+**	**0.00**	**=**	**33.63**

Total Travel Time, Tc .... **47.00 min**

Hydrograph Report

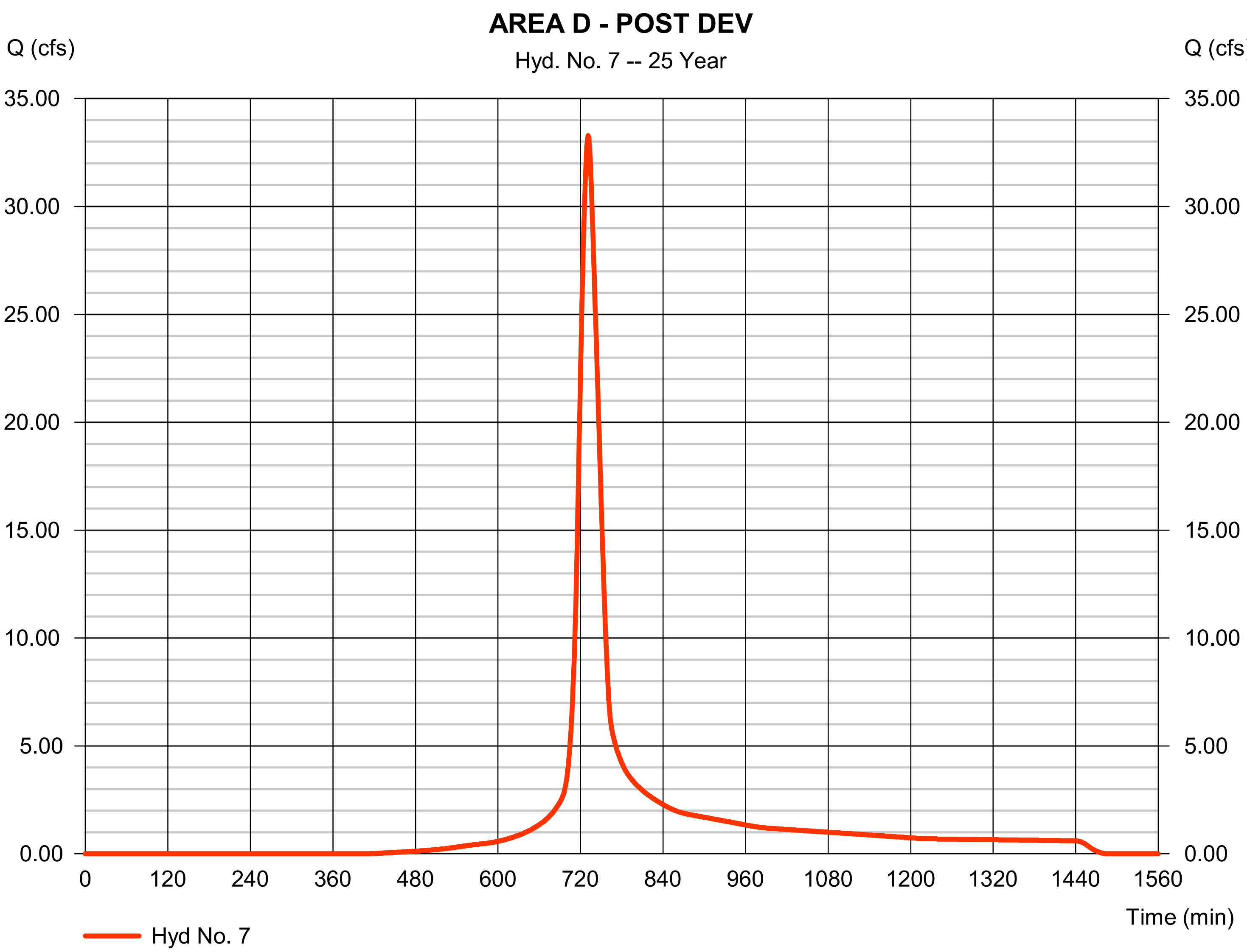
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 7

AREA D - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 33.28 cfs
Storm frequency	= 25 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 132,879 cuft
Drainage area	= 9.520 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.10 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.910 x 85) + (8.610 x 77)] / 9.520



Hydrograph Report

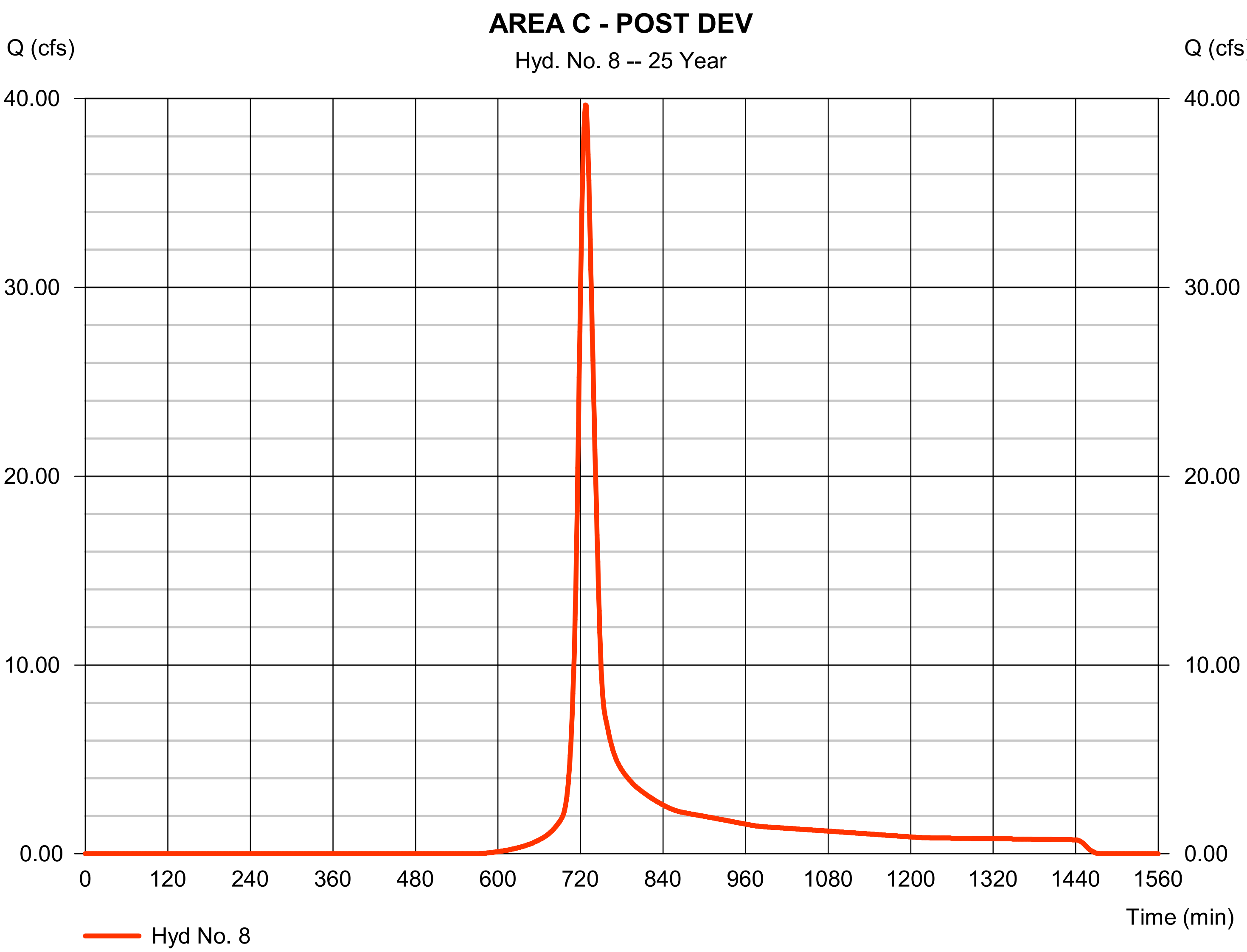
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 8

AREA C - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 39.67 cfs
Storm frequency	= 25 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 136,457 cuft
Drainage area	= 13.750 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.460 x 85) + (0.400 x 55) + (1.740 x 98) + (10.150 x 60)] / 13.750



TR55 Tc Worksheet

Hyd. No. 8

AREA C - POST DEV

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.240		0.011		
Flow length (ft)	=	115.0		22.0		0.0		
Two-year 24-hr precip. (in)	=	3.82		3.82		0.00		
Land slope (%)	=	2.80		13.50		0.00		
Travel Time (min)	**=**	**12.77**	**+**	**1.81**	**+**	**0.00**	**=**	**14.58**
Shallow Concentrated Flow								
Flow length (ft)	=	350.00		0.00		0.00		
Watercourse slope (%)	=	0.70		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	1.35		0.00		0.00		
Travel Time (min)	**=**	**4.32**	**+**	**0.00**	**+**	**0.00**	**=**	**4.32**
Channel Flow								
X sectional flow area (sqft)	=	9.78		0.00		0.00		
Wetted perimeter (ft)	=	20.48		0.00		0.00		
Channel slope (%)	=	0.60		0.00		0.00		
Manning's n-value	=	0.030		0.015		0.015		
Velocity (ft/s)	=	2.34		0.00		0.00		
Flow length (ft)		({0})575.0		0.0		0.0		
Travel Time (min)	**=**	**4.09**	**+**	**0.00**	**+**	**0.00**	**=**	**4.09**

Total Travel Time, Tc .... 23.00 min

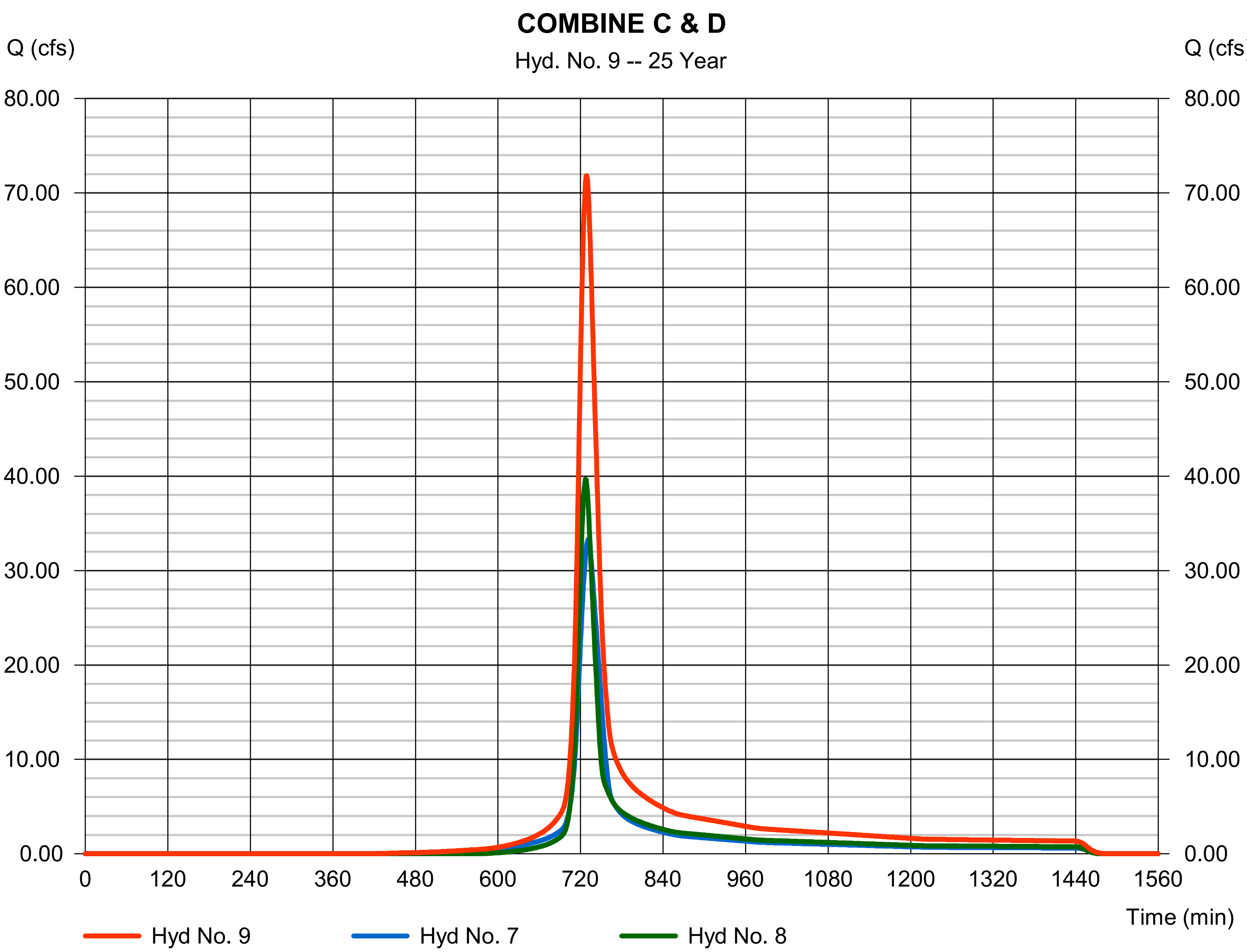
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 9

COMBINE C & D

Hydrograph type	= Combine	Peak discharge	= 71.83 cfs
Storm frequency	= 25 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 269,336 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 23.270 ac



Hydrograph Report

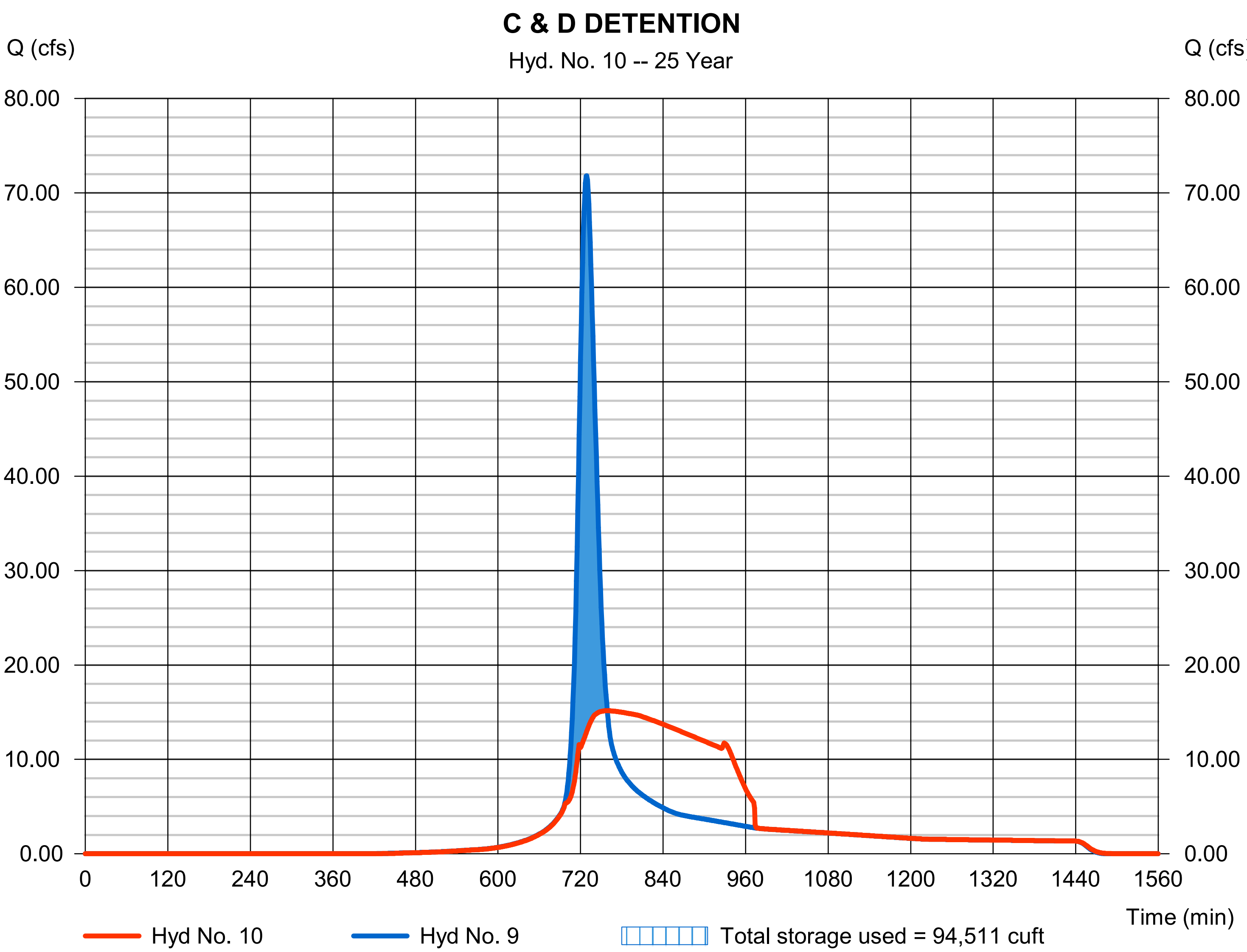
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 10

C & D DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 15.16 cfs
Storm frequency	= 25 yrs	Time to peak	= 759 min
Time interval	= 1 min	Hyd. volume	= 269,335 cuft
Inflow hyd. No.	= 9 - COMBINE C & D	Max. Elevation	= 582.16 ft
Reservoir name	= C&D DETENTION	Max. Storage	= 94,511 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Thursday, 11 / 15 / 2018

Pond No. 7 - C&D DETENTION

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	579.00	n/a	0	0
1.00	580.00	n/a	368	368
2.00	581.00	n/a	16,012	16,380
3.00	582.00	n/a	61,831	78,211
4.00	583.00	n/a	99,795	178,006
5.00	584.00	n/a	169,576	347,582

Culvert / Orifice Structures

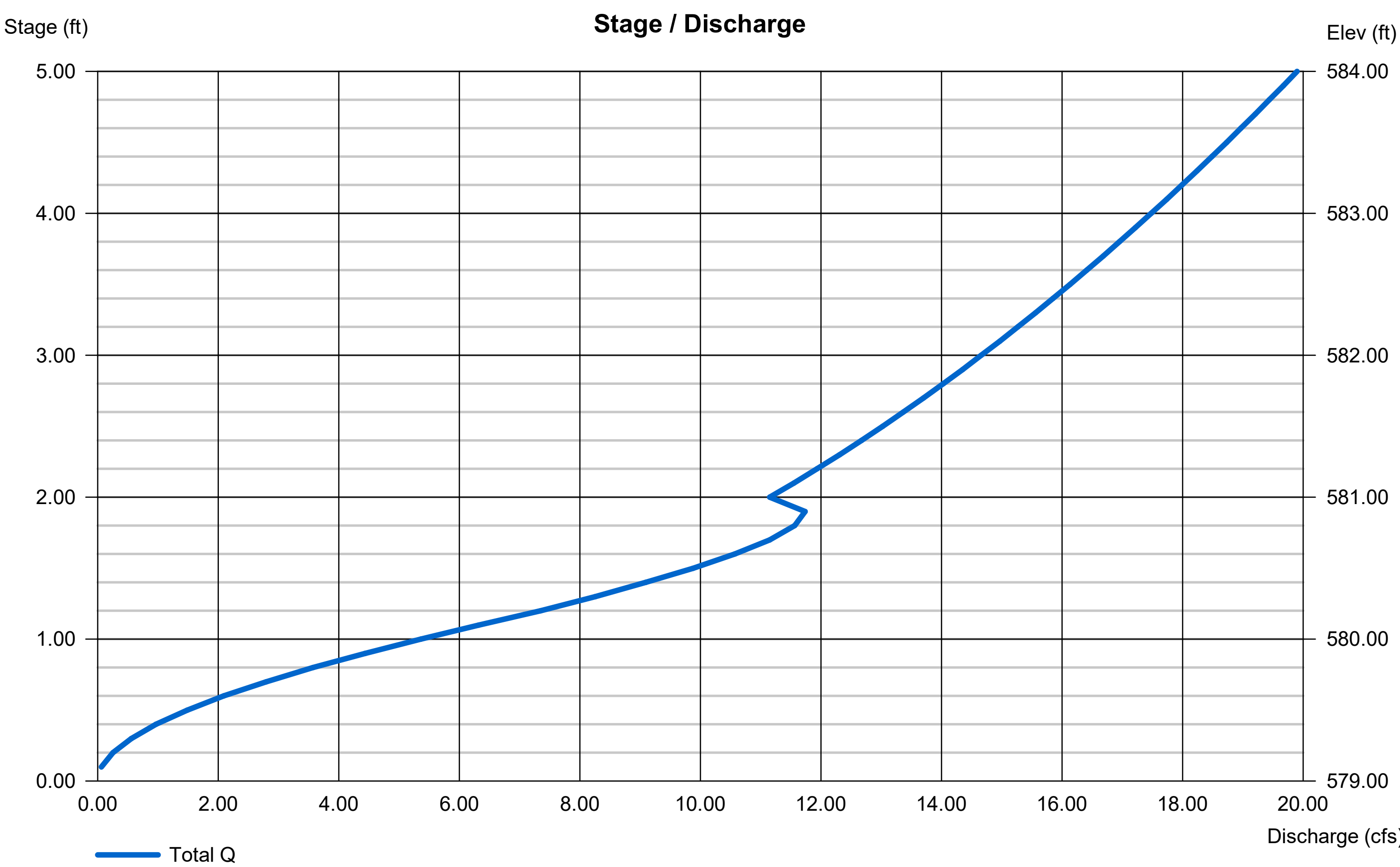
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 579.00	0.00	0.00	0.00
Length (ft)	= 143.00	0.00	0.00	0.00
Slope (%)	= 0.96	0.00	0.00	n/a
N-Value	= .023	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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



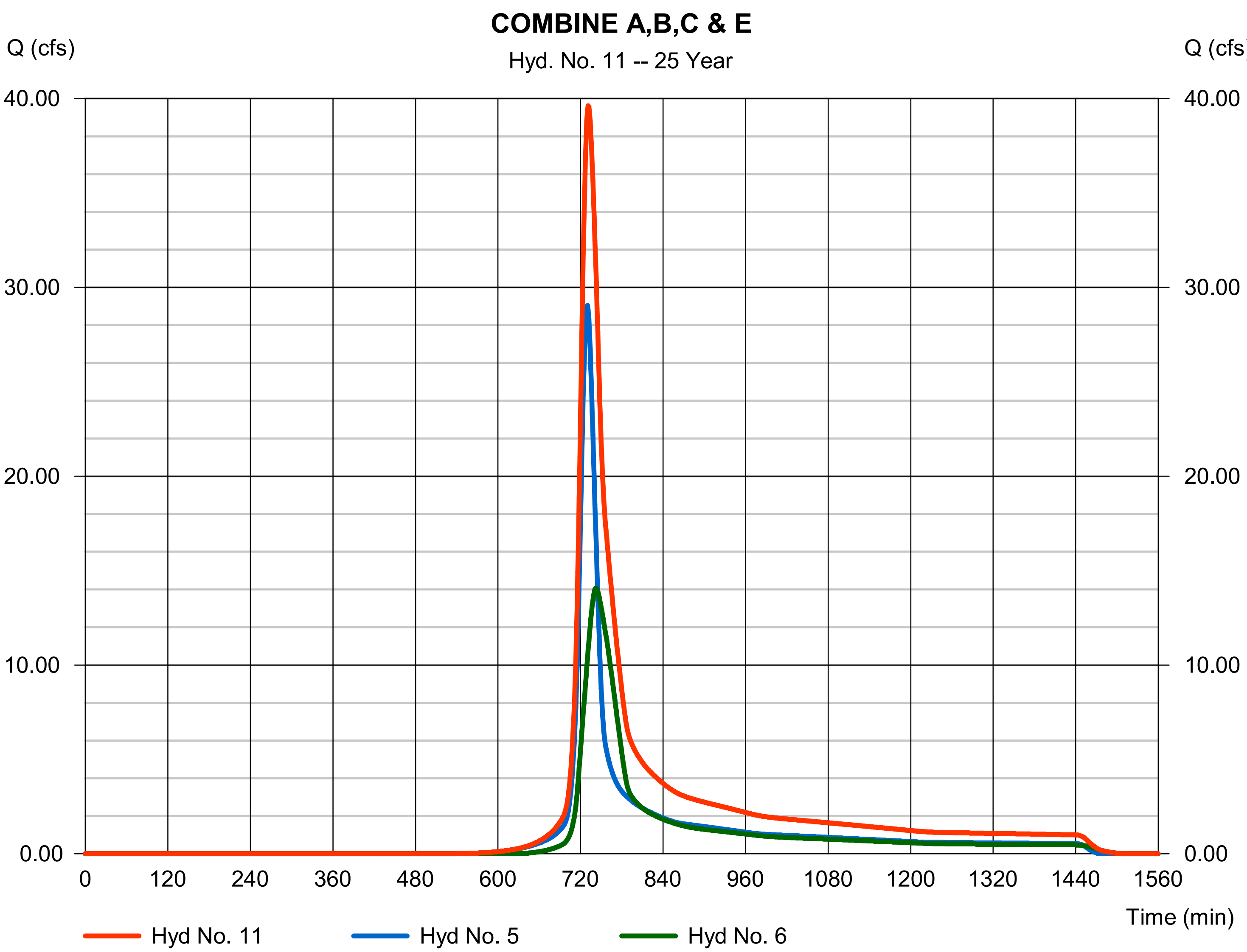
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 11 / 15 / 2018

Hyd. No. 11

COMBINE A,B,C & E

Hydrograph type	= Combine	Peak discharge	= 39.62 cfs
Storm frequency	= 25 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 179,475 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 9.150 ac



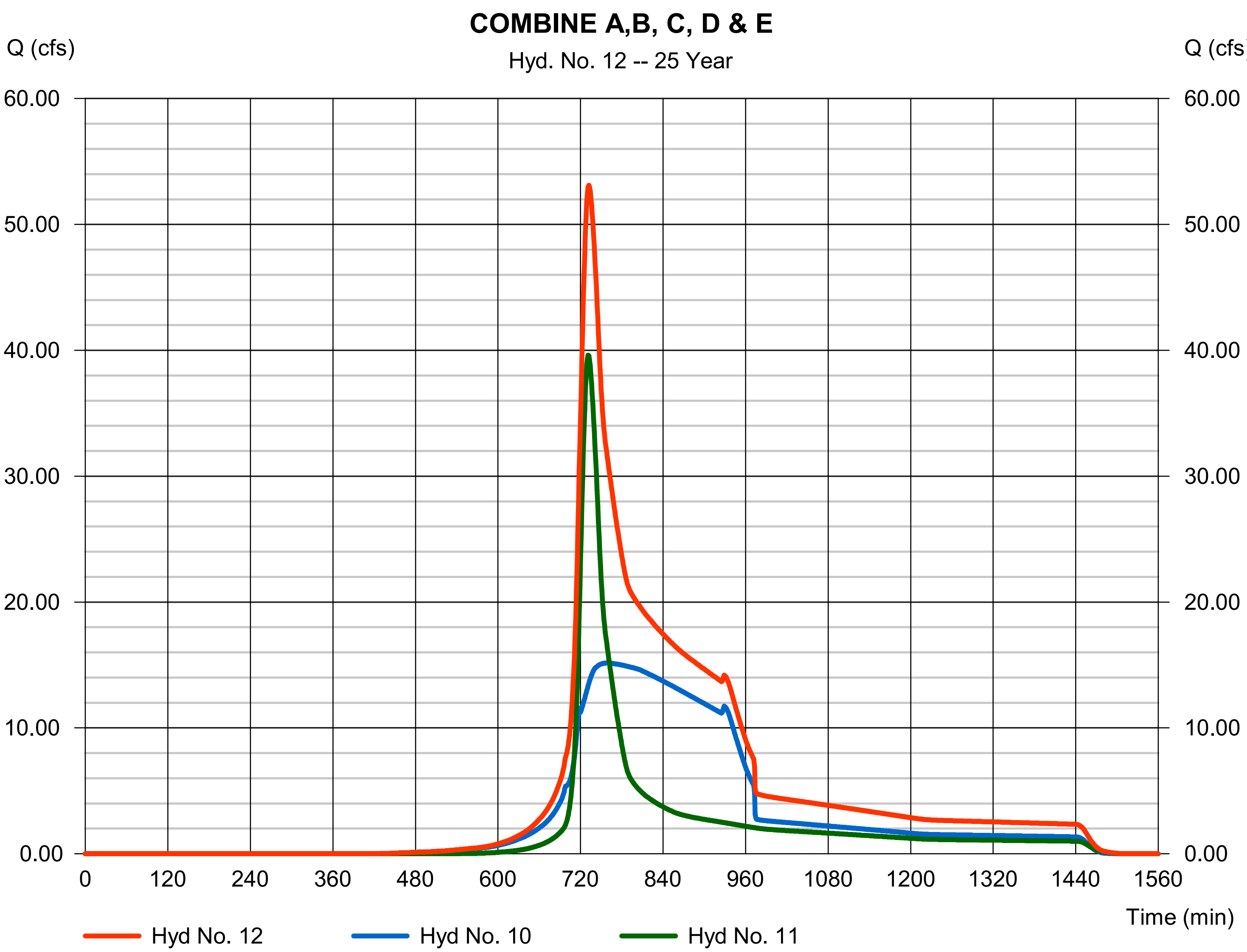
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 12

COMBINE A,B, C, D & E

Hydrograph type	= Combine	Peak discharge	= 53.11 cfs
Storm frequency	= 25 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 448,810 cuft
Inflow hyds.	= 10, 11	Contrib. drain. area	= 0.000 ac



Hydrograph Report

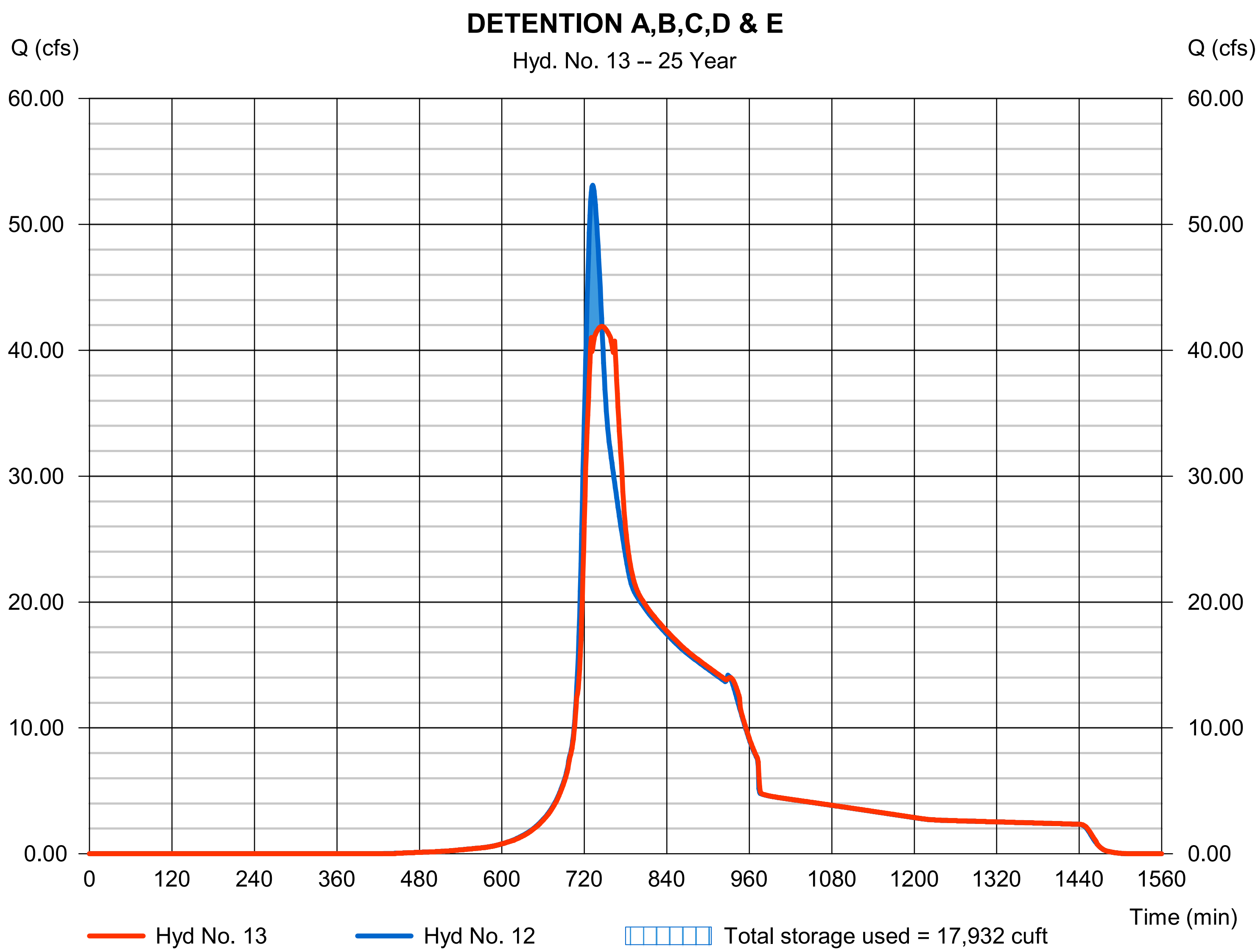
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 13

DETENTION A,B,C,D & E

Hydrograph type	= Reservoir	Peak discharge	= 41.89 cfs
Storm frequency	= 25 yrs	Time to peak	= 746 min
Time interval	= 1 min	Hyd. volume	= 448,781 cuft
Inflow hyd. No.	= 12 - COMBINE A,B, C, D & E	Max. Elevation	= 581.20 ft
Reservoir name	= A,B,C,D & E DETENTION	Max. Storage	= 17,932 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Pond No. 1 - A,B,C,D & E DETENTION

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	577.00	n/a	0	0
1.00	578.00	n/a	50	50
2.00	579.00	n/a	611	661
3.00	580.00	n/a	4,702	5,363
4.00	581.00	n/a	8,450	13,813
5.00	582.00	n/a	20,853	34,666
6.00	583.00	n/a	38,098	72,764
7.00	584.00	n/a	59,736	132,500
8.00	585.00	n/a	88,517	221,017
9.00	586.00	n/a	115,064	336,081

Culvert / Orifice Structures

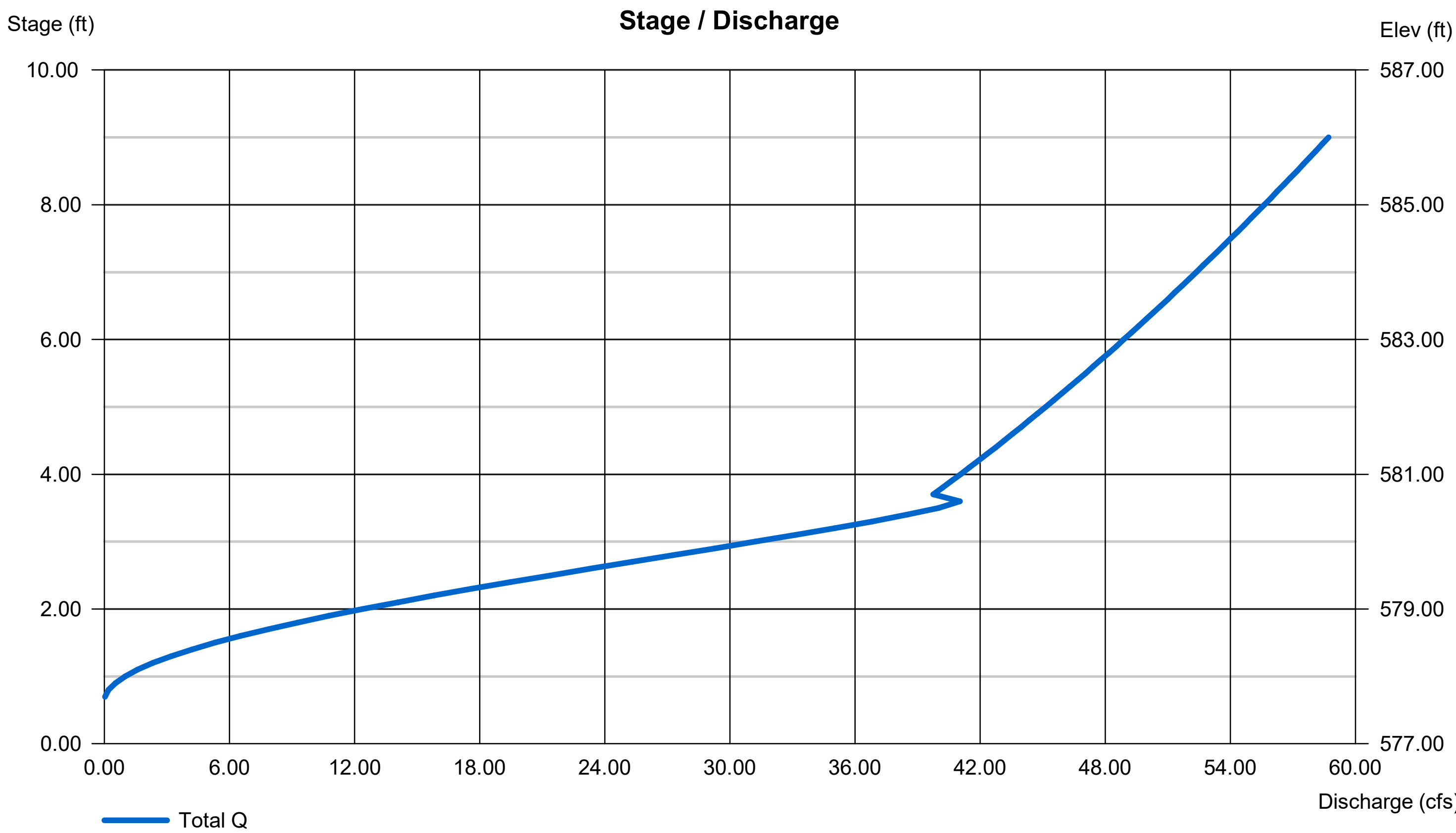
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 36.00	Inactive	Inactive	Inactive
Span (in)	= 36.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 577.64	0.00	0.00	0.00
Length (ft)	= 311.70	0.00	0.00	0.00
Slope (%)	= 1.42	0.00	0.00	n/a
N-Value	= .024	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	Inactive	Inactive	Inactive	Inactive
Crest El. (ft)	= 581.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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



Hydrograph Report

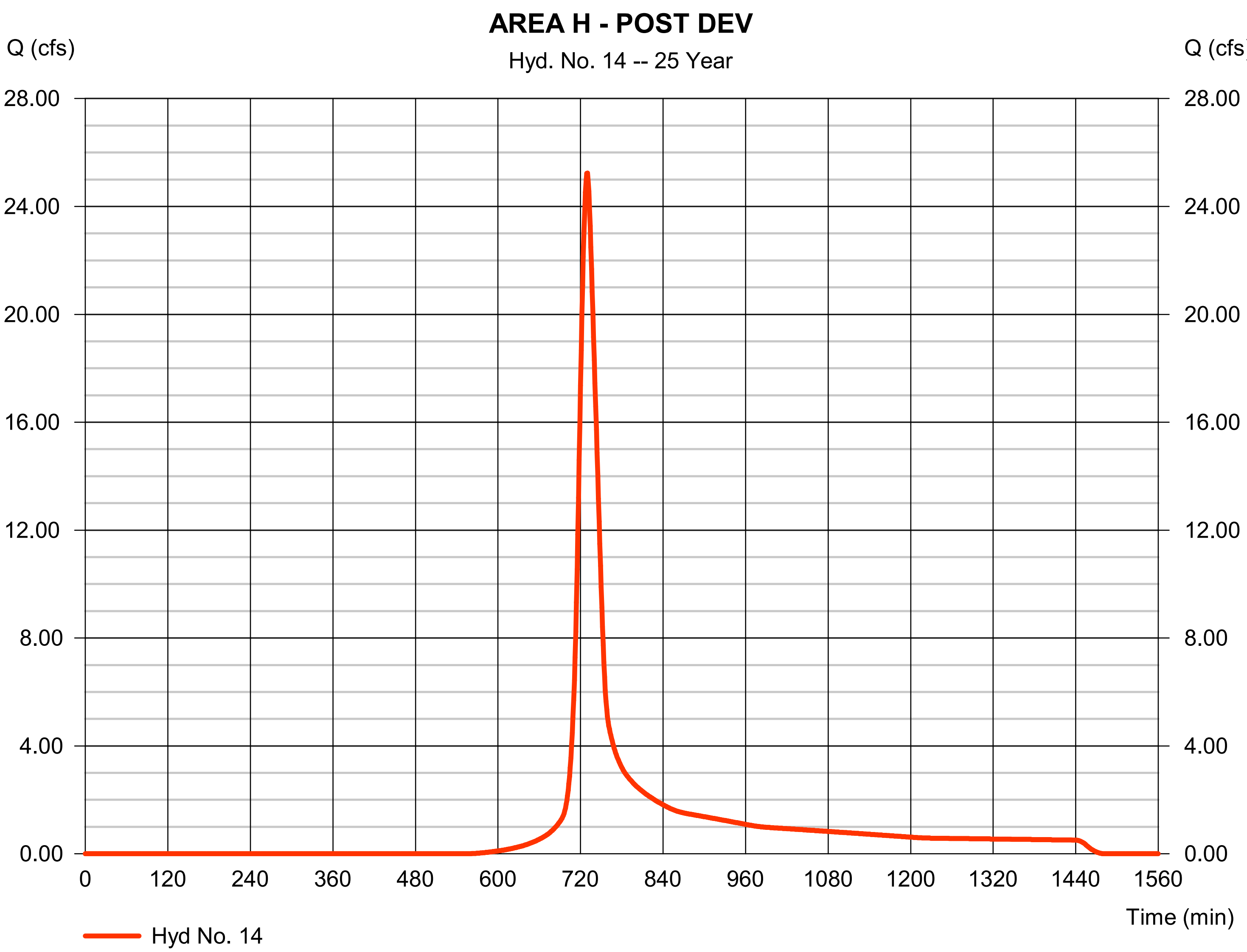
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 14

AREA H - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 25.24 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 95,092 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.50 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



TR55 Tc Worksheet

Hyd. No. 14

AREA H - POST DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.410		0.011		0.011		
Flow length (ft)	= 90.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		0.00		0.00		
Land slope (%)	= 2.20		0.00		0.00		
Travel Time (min)	**= 17.74**	**+**	**0.00**	**+**	**0.00**	**=**	**17.74**
Shallow Concentrated Flow							
Flow length (ft)	= 270.00		305.00		0.00		
Watercourse slope (%)	= 2.00		0.75		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=2.28		1.40		0.00		
Travel Time (min)	**= 1.97**	**+**	**3.64**	**+**	**0.00**	**=**	**5.61**
Channel Flow							
X sectional flow area (sqft)	= 19.90		0.00		0.00		
Wetted perimeter (ft)	= 33.72		0.00		0.00		
Channel slope (%)	= 0.50		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=2.47		0.00		0.00		
Flow length (ft)	({0})470.0		0.0		0.0		
Travel Time (min)	**= 3.18**	**+**	**0.00**	**+**	**0.00**	**=**	**3.18**

Total Travel Time, Tc .... 26.50 min

Hydrograph Report

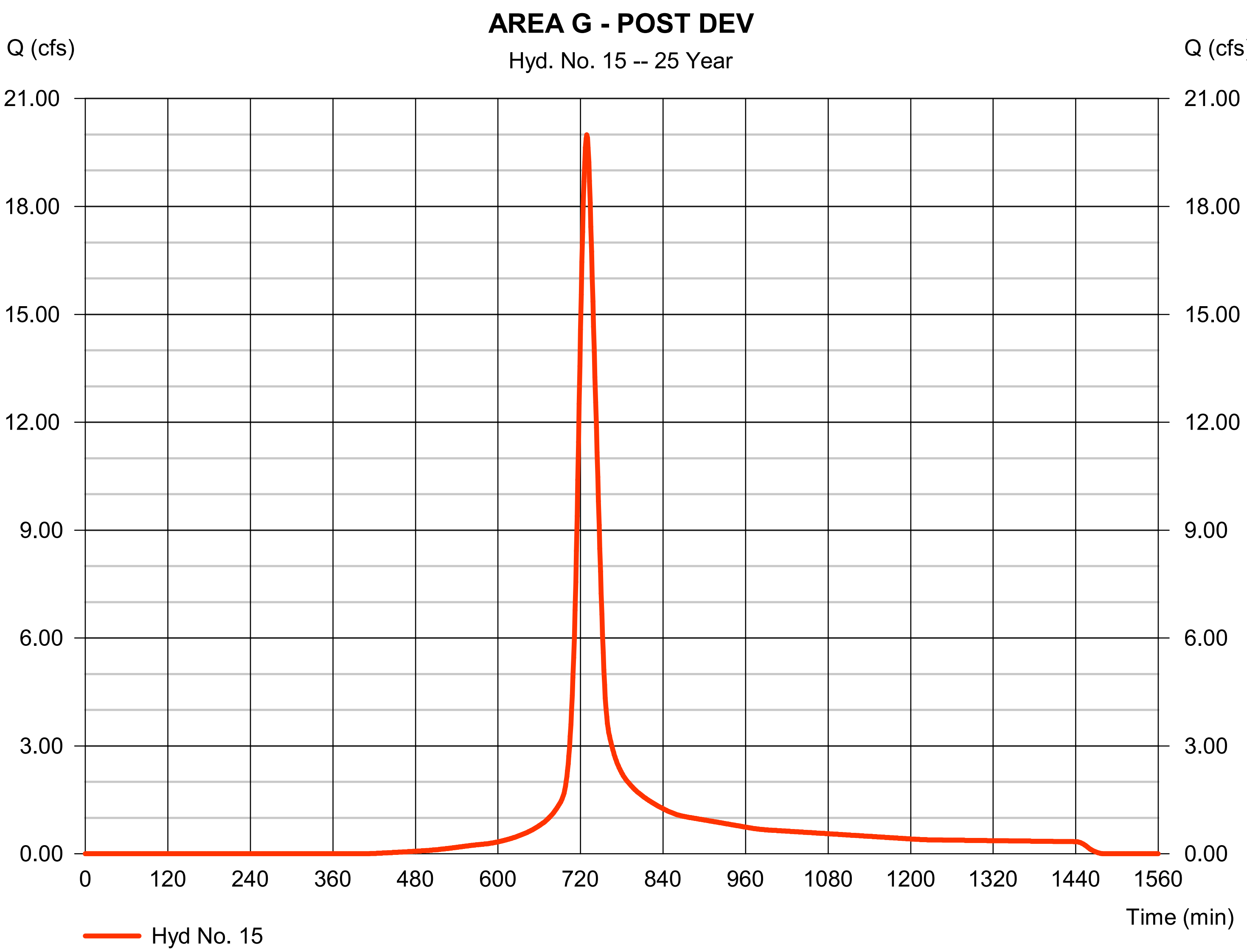
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 15

AREA G - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 19.99 cfs
Storm frequency	= 25 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 74,414 cuft
Drainage area	= 5.290 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 26.80 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.330 x 85) + (4.960 x 77)] / 5.290



Hydrograph Report

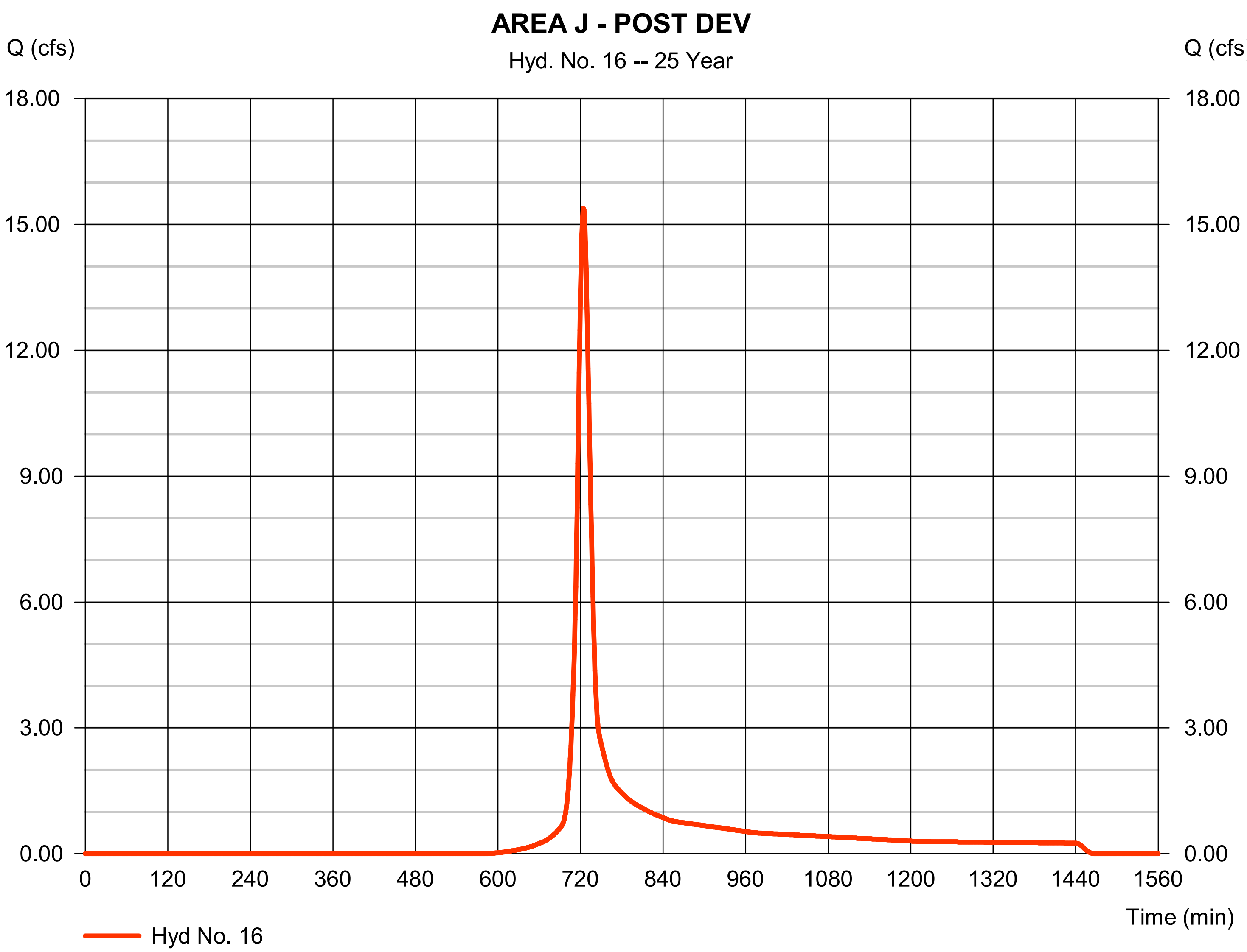
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 16

AREA J - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 15.39 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 46,094 cuft
Drainage area	= 4.820 ac	Curve number	= 66*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 85) + (0.020 x 65) + (0.680 x 98) + (4.030 x 60)] / 4.820



TR55 Tc Worksheet

Hyd. No. 16

AREA J - POST DEV

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.011		0.350		0.011		
Flow length (ft)	=	8.0		30.0		0.0		
Two-year 24-hr precip. (in)	=	3.82		3.82		0.00		
Land slope (%)	=	4.20		4.20		0.00		
Travel Time (min)	**=**	**0.11**	**+**	**5.01**	**+**	**0.00**	**=**	**5.12**
Shallow Concentrated Flow								
Flow length (ft)	=	21.00		155.00		0.00		
Watercourse slope (%)	=	7.75		6.60		0.00		
Surface description	=	Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=	4.49		4.15		0.00		
Travel Time (min)	**=**	**0.08**	**+**	**0.62**	**+**	**0.00**	**=**	**0.70**
Channel Flow								
X sectional flow area (sqft)	=	0.82		1.11		0.00		
Wetted perimeter (ft)	=	3.29		3.66		0.00		
Channel slope (%)	=	0.70		0.30		0.00		
Manning's n-value	=	0.030		0.030		0.015		
Velocity (ft/s)	=	1.64		1.23		0.00		
Flow length (ft)		({0})181.0		685.0		0.0		
Travel Time (min)	**=**	**1.84**	**+**	**9.31**	**+**	**0.00**	**=**	**11.15**

Total Travel Time, Tc .... **17.00 min**

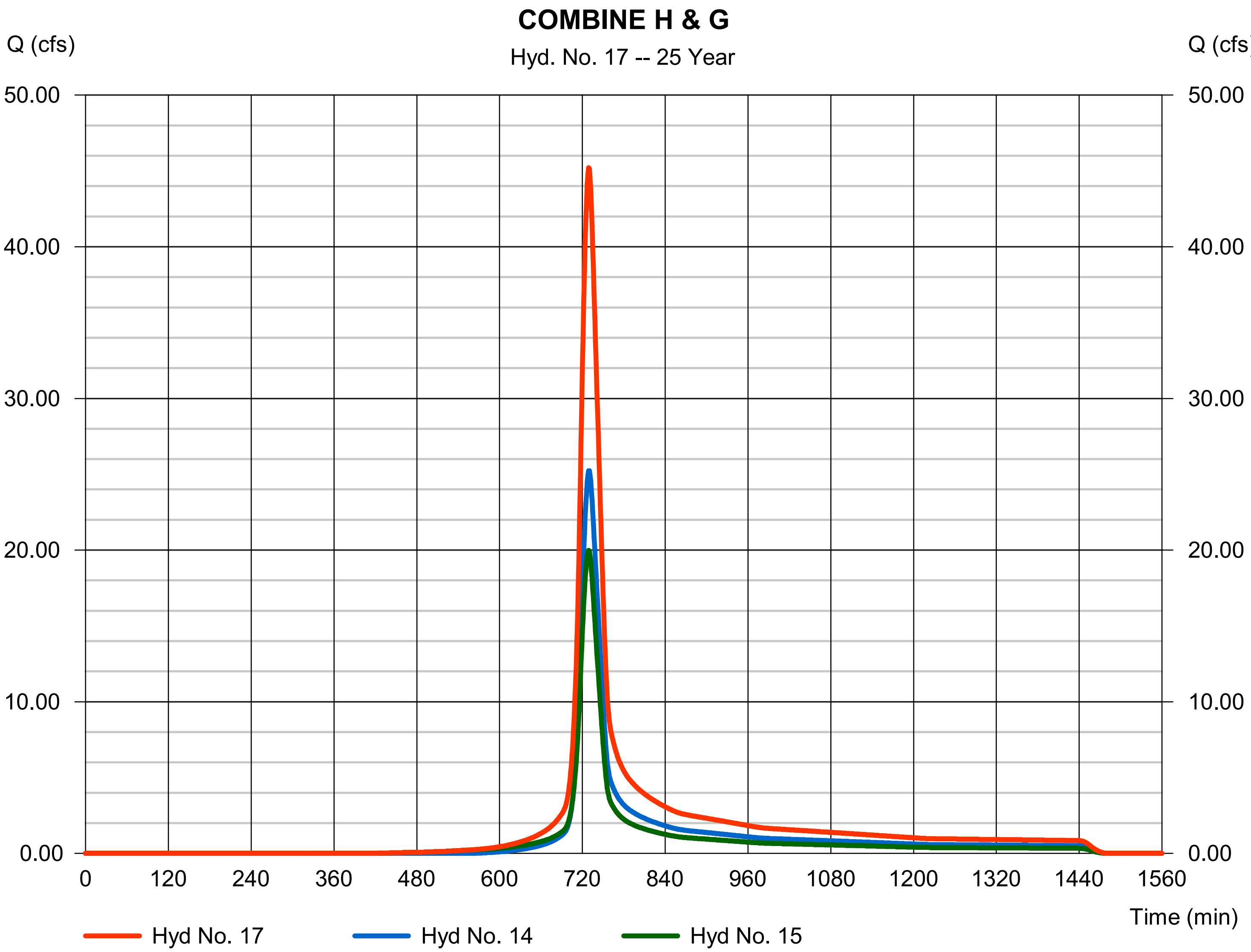
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 17

COMBINE H & G

Hydrograph type	= Combine	Peak discharge	= 45.22 cfs
Storm frequency	= 25 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 169,506 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 14.400 ac



Hydrograph Report

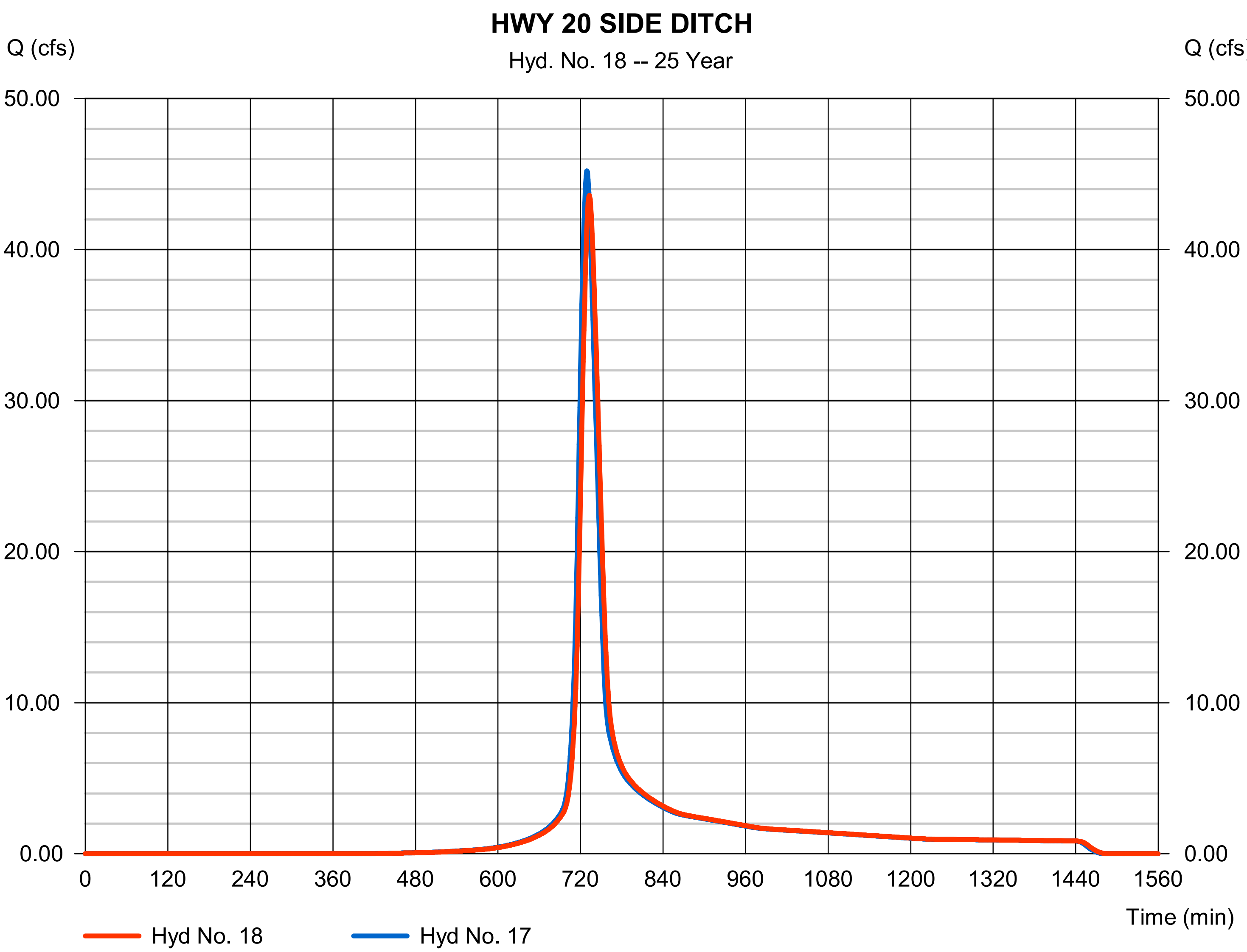
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 18

HWY 20 SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 43.60 cfs
Storm frequency	= 25 yrs	Time to peak	= 733 min
Time interval	= 1 min	Hyd. volume	= 169,504 cuft
Inflow hyd. No.	= 17 - COMBINE H & G	Section type	= Trapezoidal
Reach length	= 900.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.030	Bottom width	= 3.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 1.688	Rating curve m	= 1.304
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.2728

Modified Att-Kin routing method used.



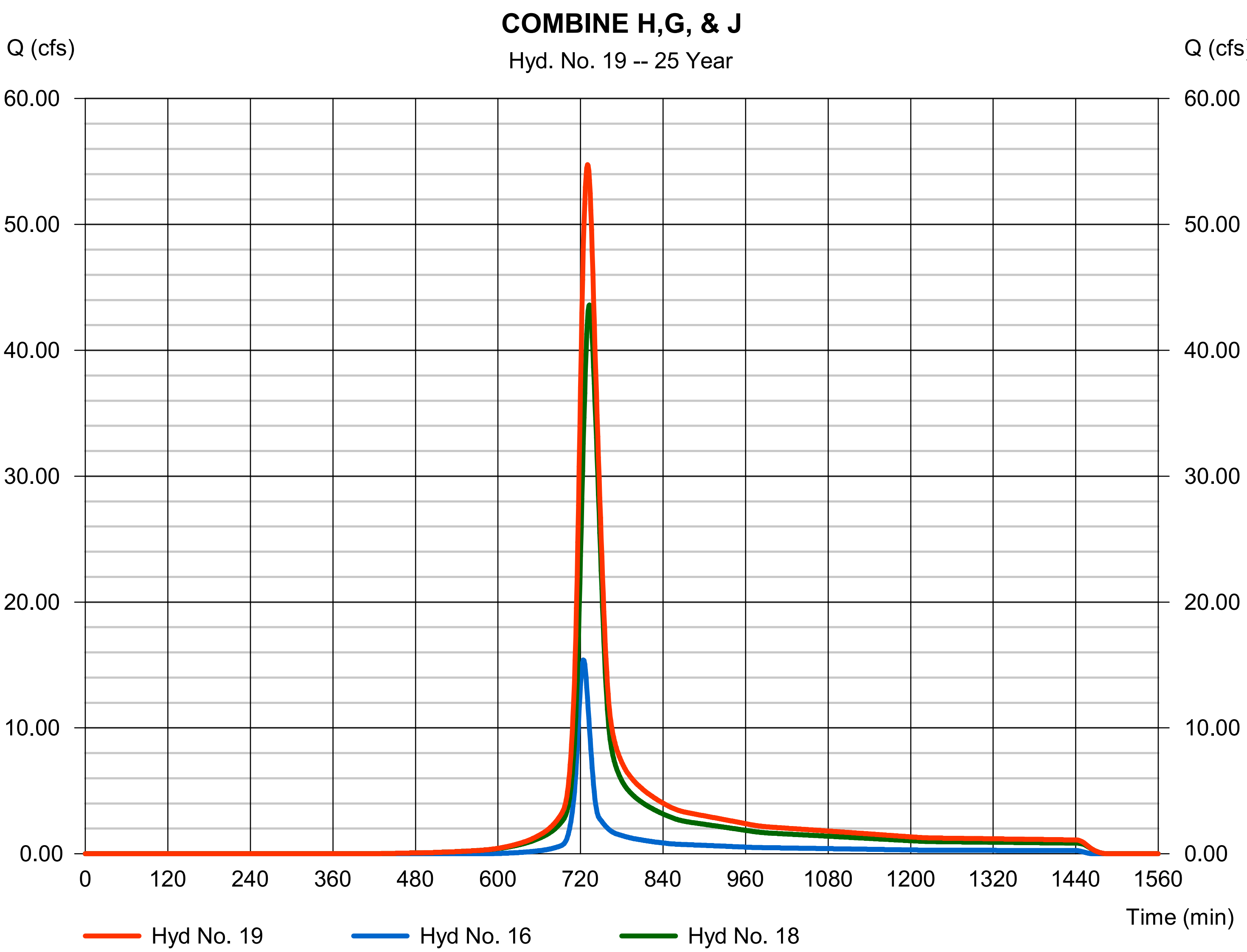
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 19

COMBINE H,G, & J

Hydrograph type	= Combine	Peak discharge	= 54.75 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 215,598 cuft
Inflow hyds.	= 16, 18	Contrib. drain. area	= 4.820 ac



Hydrograph Report

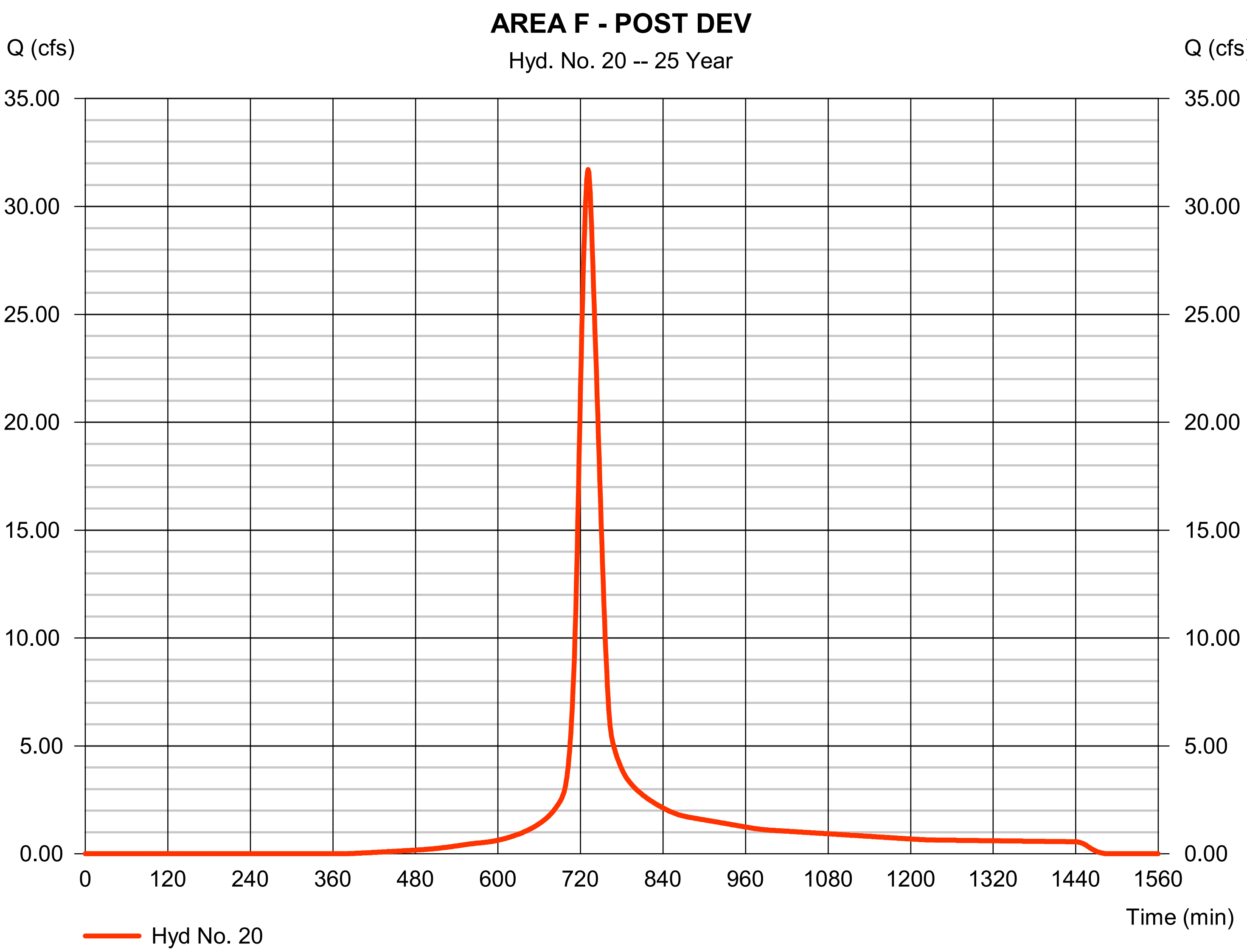
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 11 / 15 / 2018

Hyd. No. 20

AREA F - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 31.71 cfs
Storm frequency	= 25 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 126,821 cuft
Drainage area	= 8.620 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.440 x 85) + (8.180 x 77)] / 8.620



Hydrograph Report

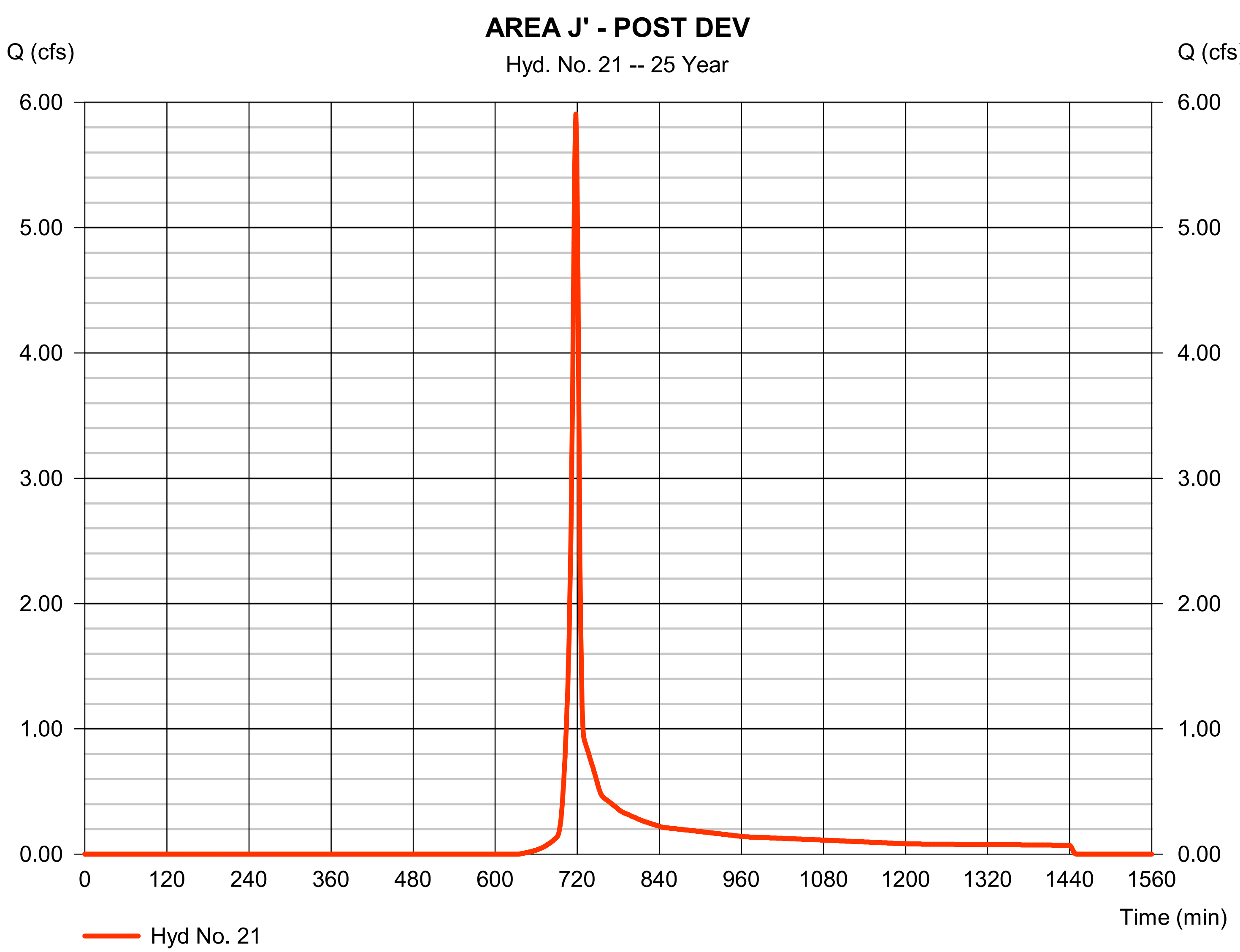
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 21

AREA J' - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 5.906 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 11,907 cuft
Drainage area	= 1.440 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.220 x 65) + (1.220 x 60)] / 1.440



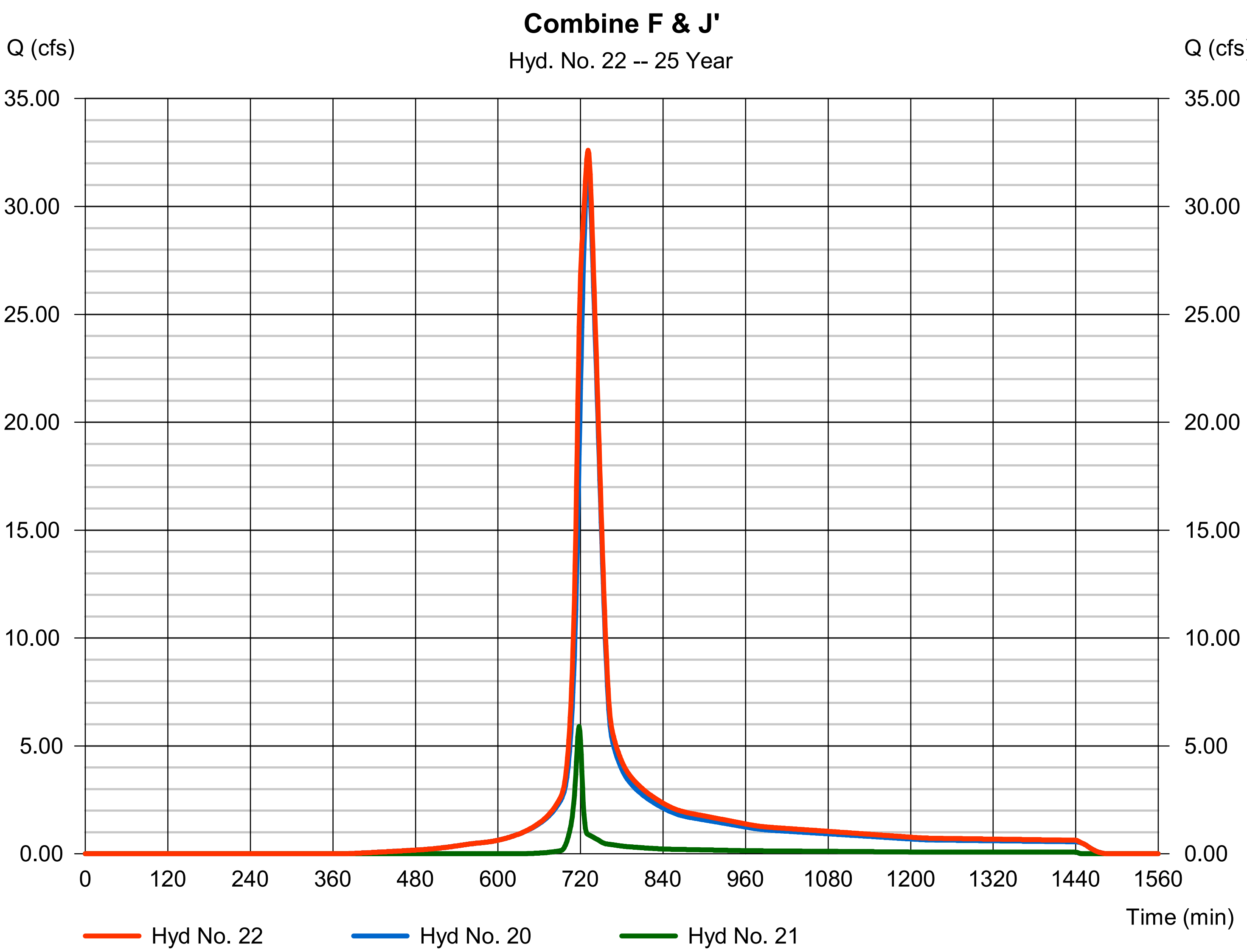
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 22

Combine F & J'

Hydrograph type	= Combine	Peak discharge	= 32.60 cfs
Storm frequency	= 25 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 138,728 cuft
Inflow hyds.	= 20, 21	Contrib. drain. area	= 10.060 ac



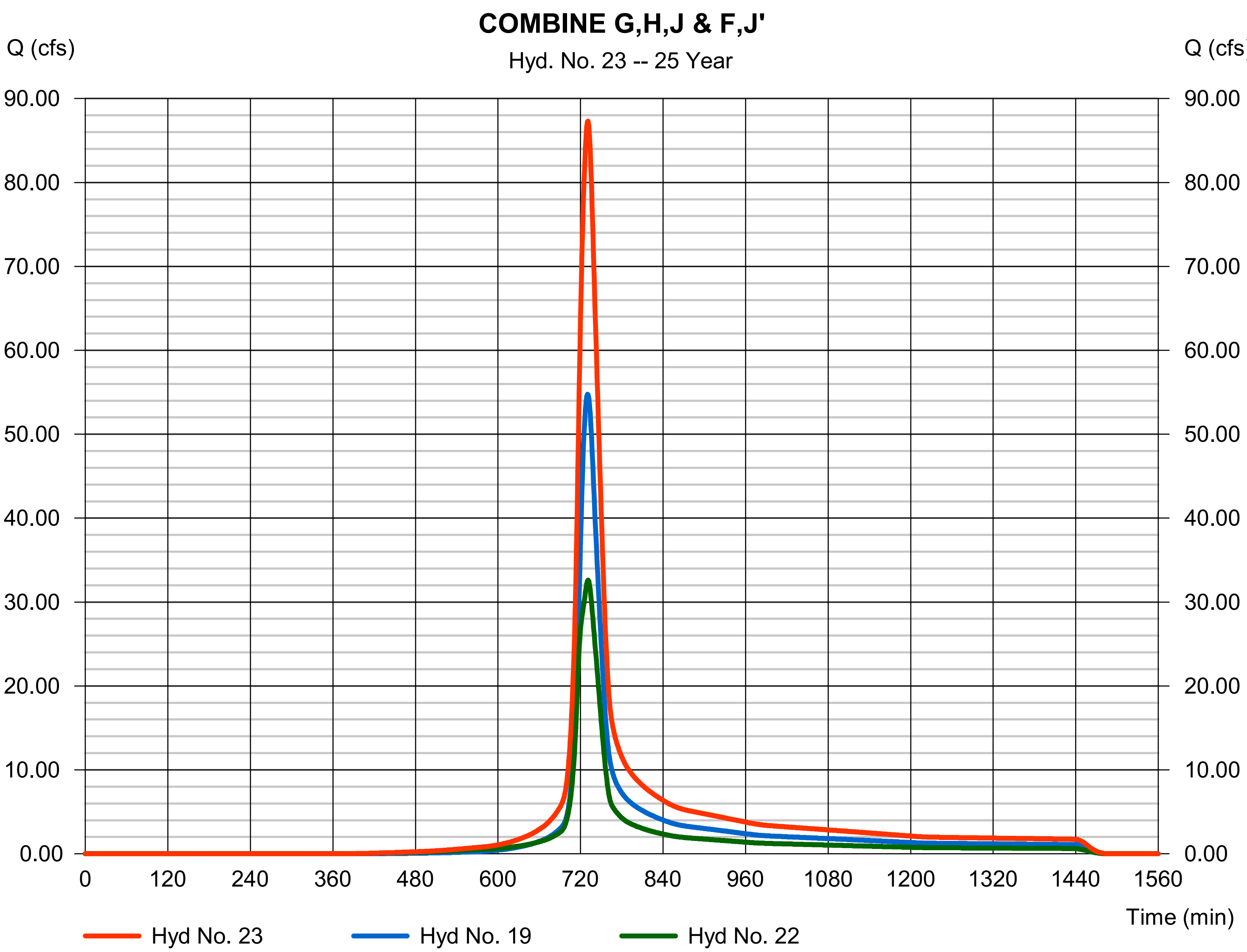
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 23

COMBINE G,H,J & F,J'

Hydrograph type	= Combine	Peak discharge	= 87.29 cfs
Storm frequency	= 25 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 354,326 cuft
Inflow hyds.	= 19, 22	Contrib. drain. area	= 0.000 ac



Hydrograph Report

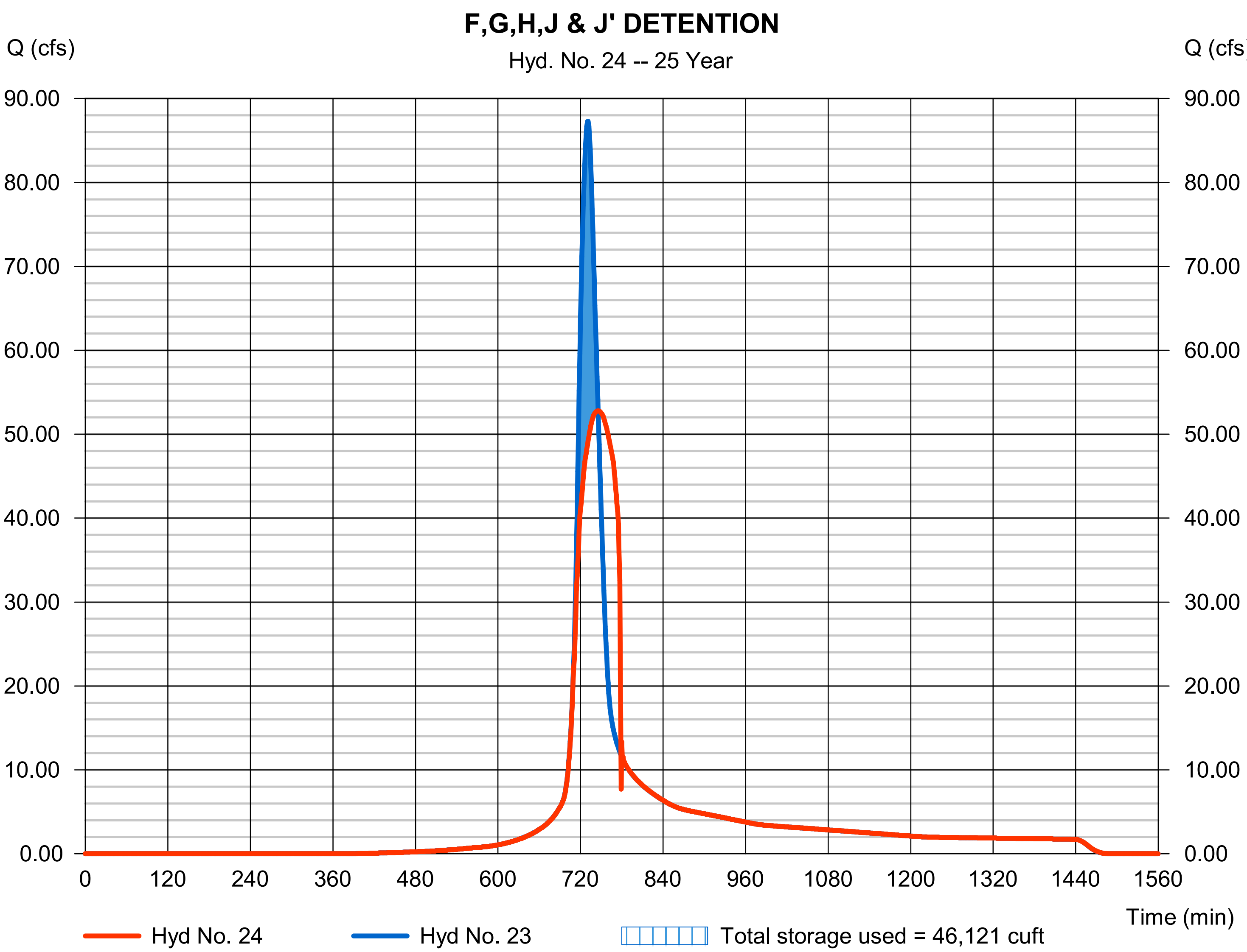
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 24

F,G,H,J & J' DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 52.79 cfs
Storm frequency	= 25 yrs	Time to peak	= 745 min
Time interval	= 1 min	Hyd. volume	= 354,326 cuft
Inflow hyd. No.	= 23 - COMBINE G,H,J & F,J'	Max. Elevation	= 581.11 ft
Reservoir name	= F,G,H,J & J' DETENTION	Max. Storage	= 46,121 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Pond No. 2 - F,G,H,J & J' DETENTION

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	575.00	n/a	0	0
1.00	576.00	n/a	66	66
2.00	577.00	n/a	197	263
3.00	578.00	n/a	805	1,068
4.00	579.00	n/a	3,266	4,334
5.00	580.00	n/a	11,856	16,190
6.00	581.00	n/a	26,087	42,277
7.00	582.00	n/a	34,733	77,010
8.00	583.00	n/a	53,090	130,100
9.00	584.00	n/a	63,299	193,399

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	18.00	Inactive	Inactive
Span (in)	= 24.00	18.00	18.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 575.02	575.55	575.00	0.00
Length (ft)	= 77.00	55.00	60.00	0.00
Slope (%)	= 1.10	1.50	1.00	n/a
N-Value	= .012	.012	.012	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

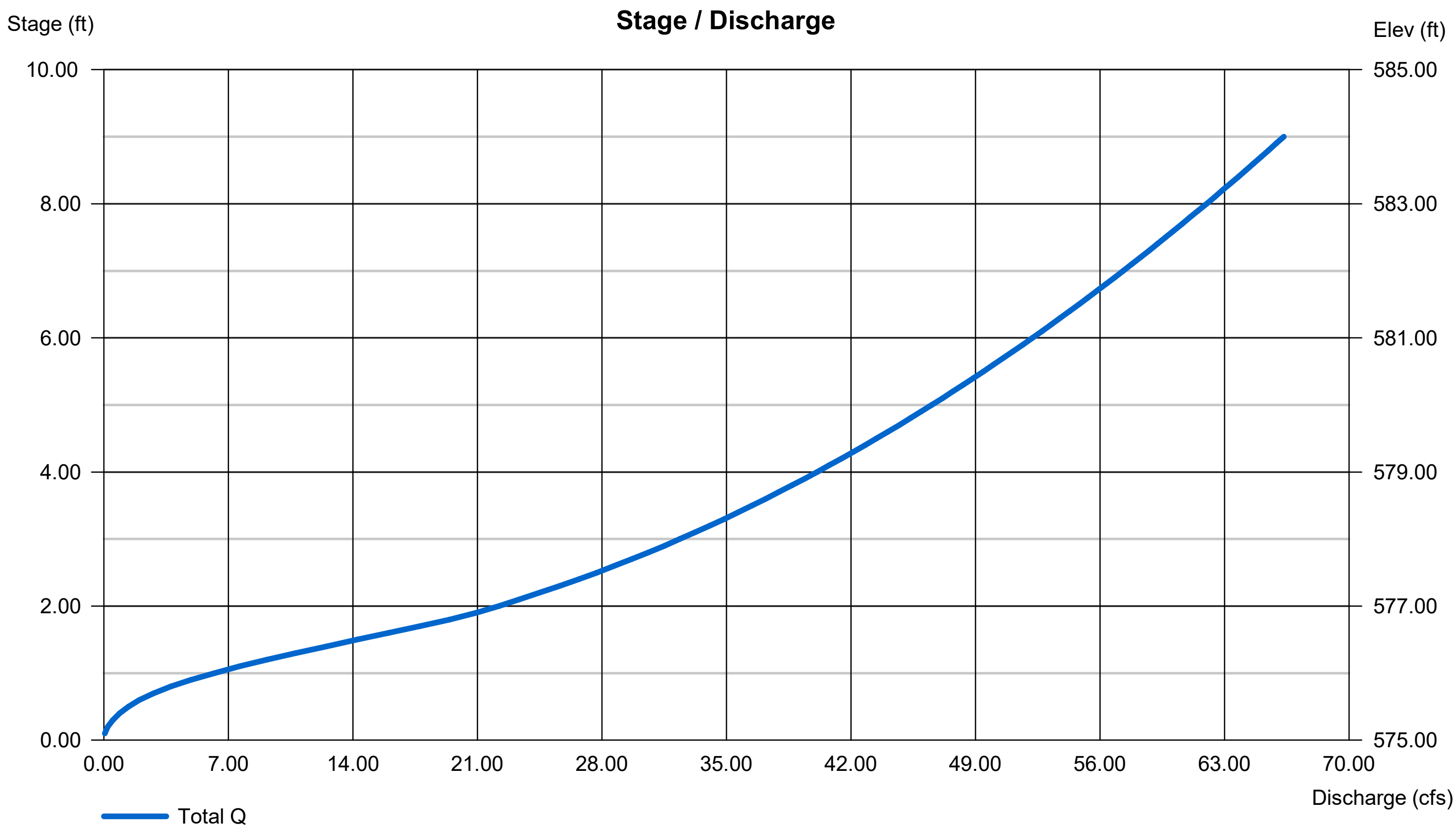
Weir Structures

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

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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

Stage / Discharge



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	SCS Runoff	11.34	1	725	35,424	------	------	------	AREA A - POST DEV
2	Reach	10.92	1	728	35,423	1	------	------	DITCH 1
3	SCS Runoff	25.11	1	727	85,777	------	------	------	AREA B - POST DEV
4	Combine	35.98	1	727	121,199	2, 3	------	------	COMBINE A & B
5	Reach	35.52	1	730	121,198	4	------	------	DITCH 2
6	SCS Runoff	17.70	1	742	98,530	------	------	------	AREA E - POST DEV
7	SCS Runoff	39.22	1	731	156,835	------	------	------	AREA D - POST DEV
8	SCS Runoff	48.71	1	727	166,351	------	------	------	AREA C - POST DEV
9	Combine	86.55	1	728	323,186	7, 8	------	------	COMBINE C & D
10	Reservoir	15.92	1	761	323,186	9	582.43	120,743	C & D DETENTION
11	Combine	48.96	1	731	219,728	5, 6,	------	------	COMBINE A,B,C & E
12	Combine	63.18	1	732	542,914	10, 11	------	------	COMBINE A,B, C, D & E
13	Reservoir	44.15	1	749	542,884	12	581.75	29,421	DETENTION A,B,C,D & E
14	SCS Runoff	30.87	1	729	115,543	------	------	------	AREA H - POST DEV
15	SCS Runoff	23.55	1	729	87,830	------	------	------	AREA G - POST DEV
16	SCS Runoff	18.95	1	724	56,382	------	------	------	AREA J - POST DEV
17	Combine	54.41	1	729	203,372	14, 15,	------	------	COMBINE H & G
18	Reach	52.59	1	732	203,371	17	------	------	HWY 20 SIDE DITCH
19	Combine	66.49	1	730	259,753	16, 18	------	------	COMBINE H,G, & J
20	SCS Runoff	37.12	1	731	148,915	------	------	------	AREA F - POST DEV
21	SCS Runoff	7.386	1	718	14,838	------	------	------	AREA J' - POST DEV
22	Combine	38.21	1	731	163,753	20, 21	------	------	Combine F & J'
23	Combine	104.60	1	730	423,506	19, 22	------	------	COMBINE G,H,J & F,J'
24	Reservoir	56.14	1	747	423,506	23	581.77	68,863	F,G,H,J & J' DETENTION
25	SCS Runoff	5.594	1	725	17,810	------	------	------	AREA K' - POST DEV
26	Reach	4.429	1	732	17,805	25	------	------	K' Tc DITCH
27	SCS Runoff	2.532	1	726	8,093	------	------	------	AREA K'' - POST DEV
28	Reach	1.732	1	735	8,085	27	------	------	K'' Tc DITCH
29	Combine	6.145	1	733	25,890	26, 28	------	------	COMBINE K' & K''
30	SCS Runoff	23.63	1	726	75,538	------	------	------	AREA K - POST DEV
31	Combine	28.70	1	726	101,428	29, 30	------	------	COMBINE K, K' & K''
32	Reservoir	7.119	1	753	101,294	31	582.59	33,217	AREA K DETENTION
33	Combine	63.24	1	748	524,794	24, 32	------	------	COMBINE F,G,H,J & K
34	SCS Runoff	5.133	1	721	12,509	------	------	------	AREA L - POST DEV

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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
35	Combine	63.94	1	747	537,304	33, 34	------	------	COMBINE FG,H,J,K & L
36	Combine	108.07	1	748	1,080,233	13, 35	------	------	TOTAL SITE DISCHARGE - POST D

Hydrograph Report

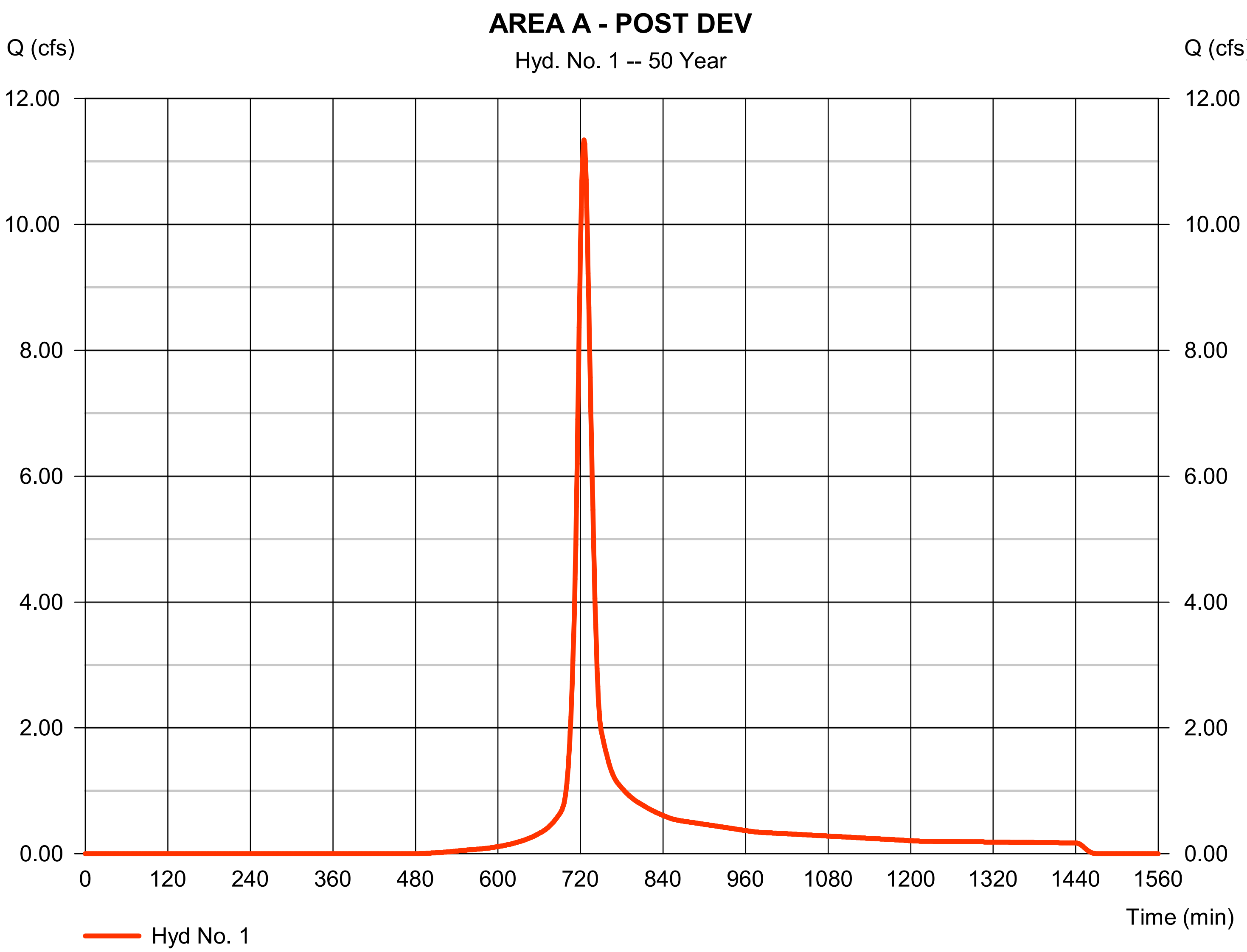
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 1

AREA A - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 11.34 cfs
Storm frequency	= 50 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 35,424 cuft
Drainage area	= 2.580 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.10 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.220 x 85) + (0.570 x 55) + (0.030 x 98) + (0.760 x 60)] / 2.580



Hydrograph Report

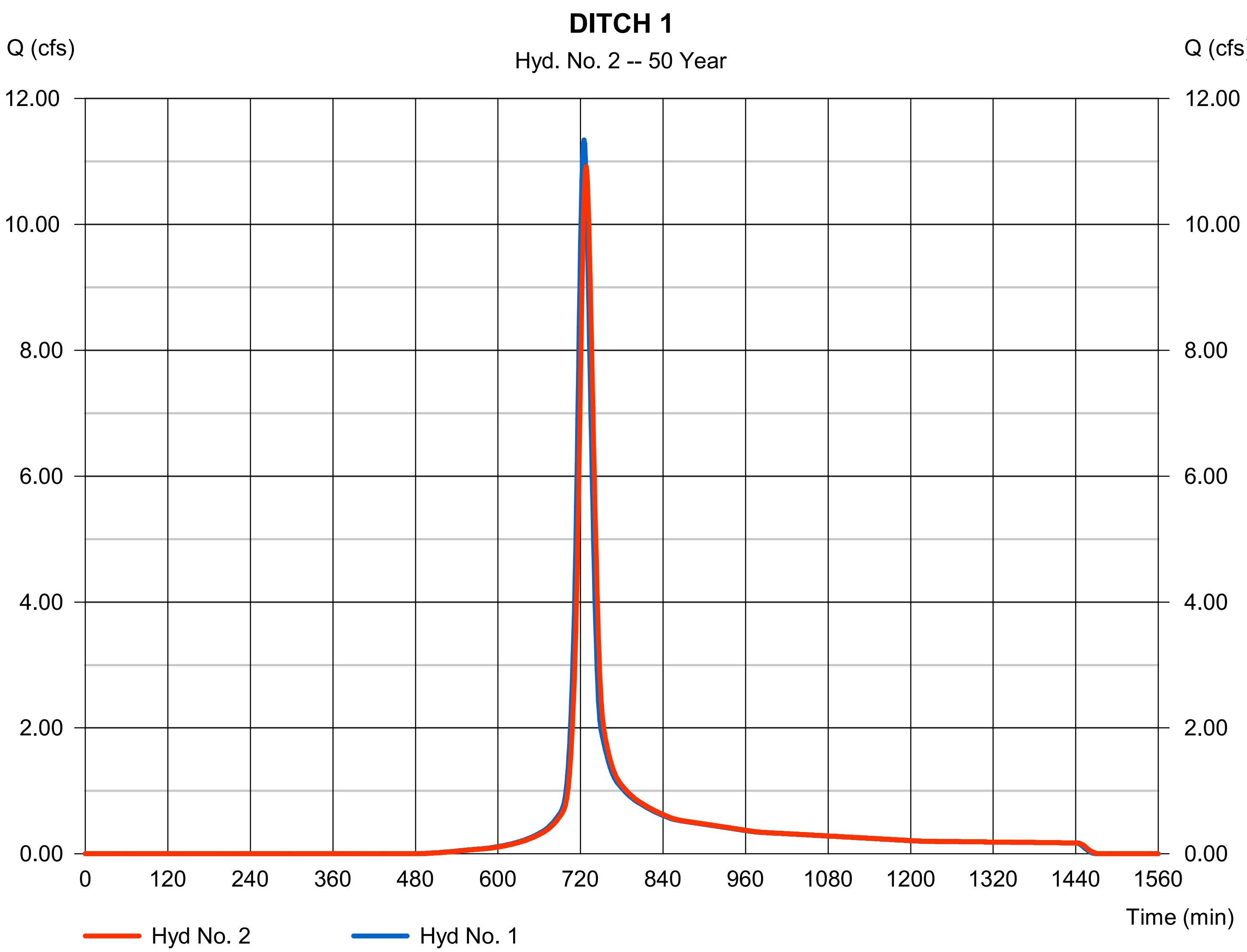
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 2

DITCH 1

Hydrograph type	= Reach	Peak discharge	= 10.92 cfs
Storm frequency	= 50 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 35,423 cuft
Inflow hyd. No.	= 1 - AREA A - POST DEV	Section type	= Trapezoidal
Reach length	= 730.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 10.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.375
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.3172

Modified Att-Kin routing method used.



Hydrograph Report

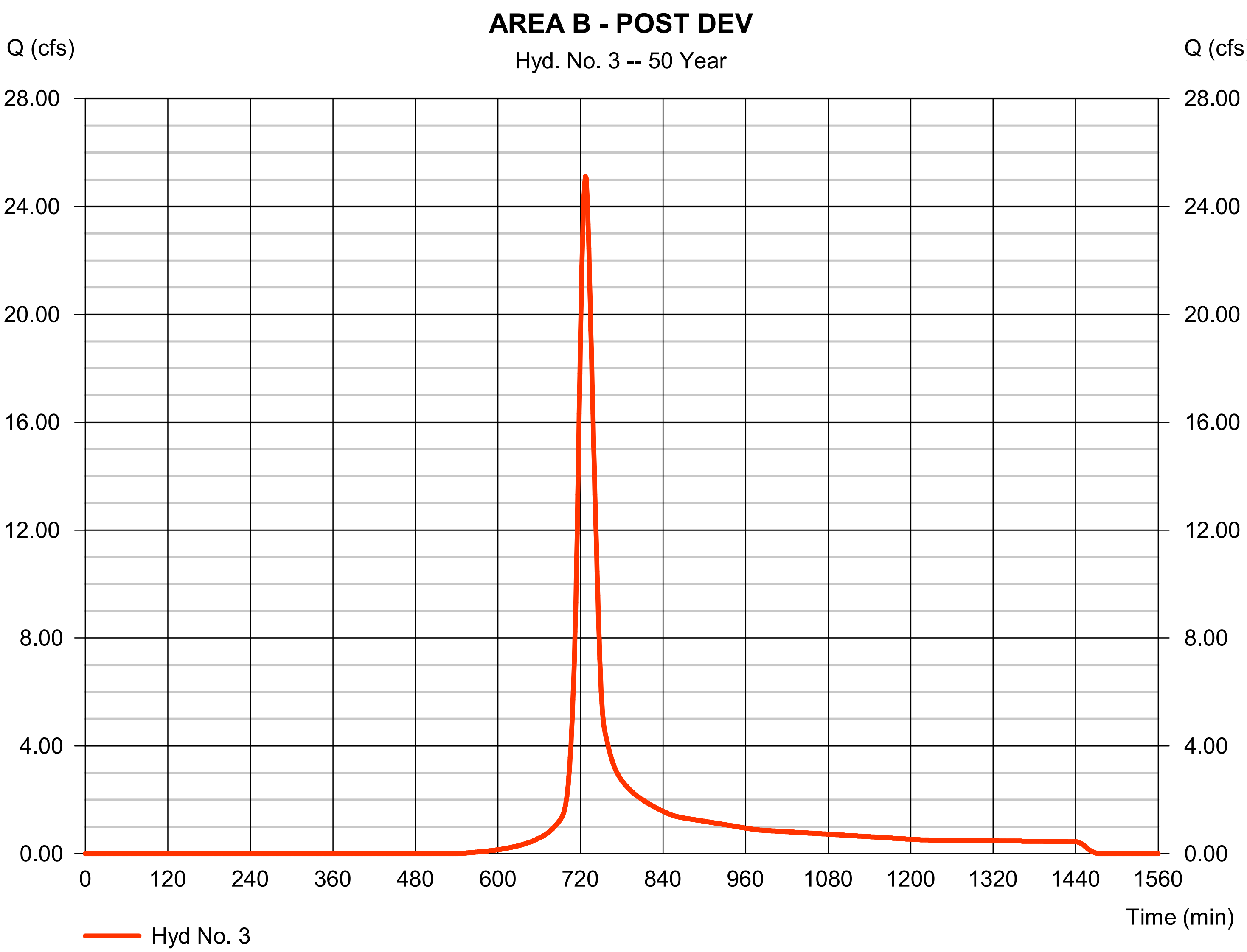
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 3

AREA B - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 25.11 cfs
Storm frequency	= 50 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 85,777 cuft
Drainage area	= 7.090 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.60 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.930 x 85) + (2.120 x 55) + (0.250 x 98) + (2.790 x 60)] / 7.090



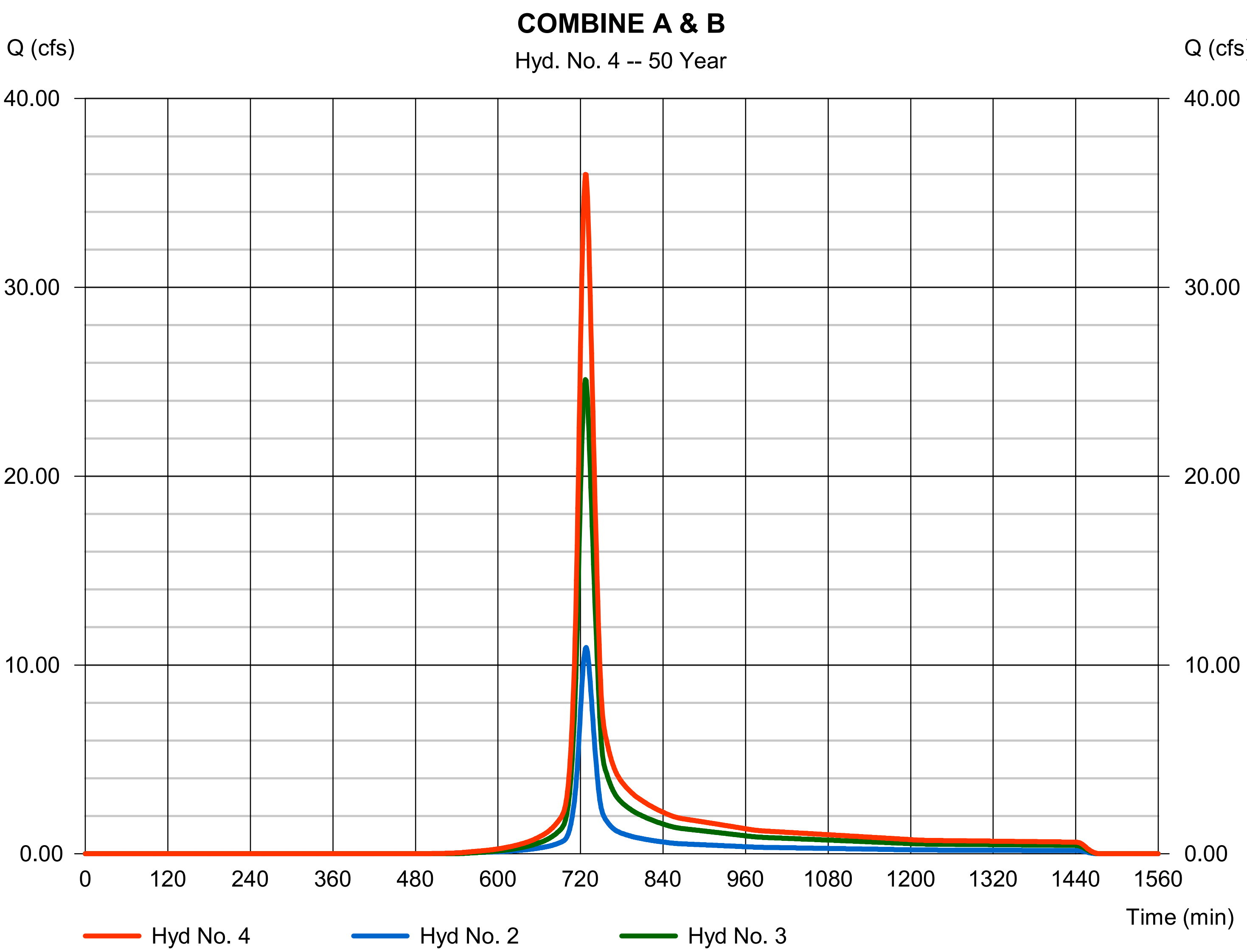
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 4

COMBINE A & B

Hydrograph type	= Combine	Peak discharge	= 35.98 cfs
Storm frequency	= 50 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 121,199 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 7.090 ac



Hydrograph Report

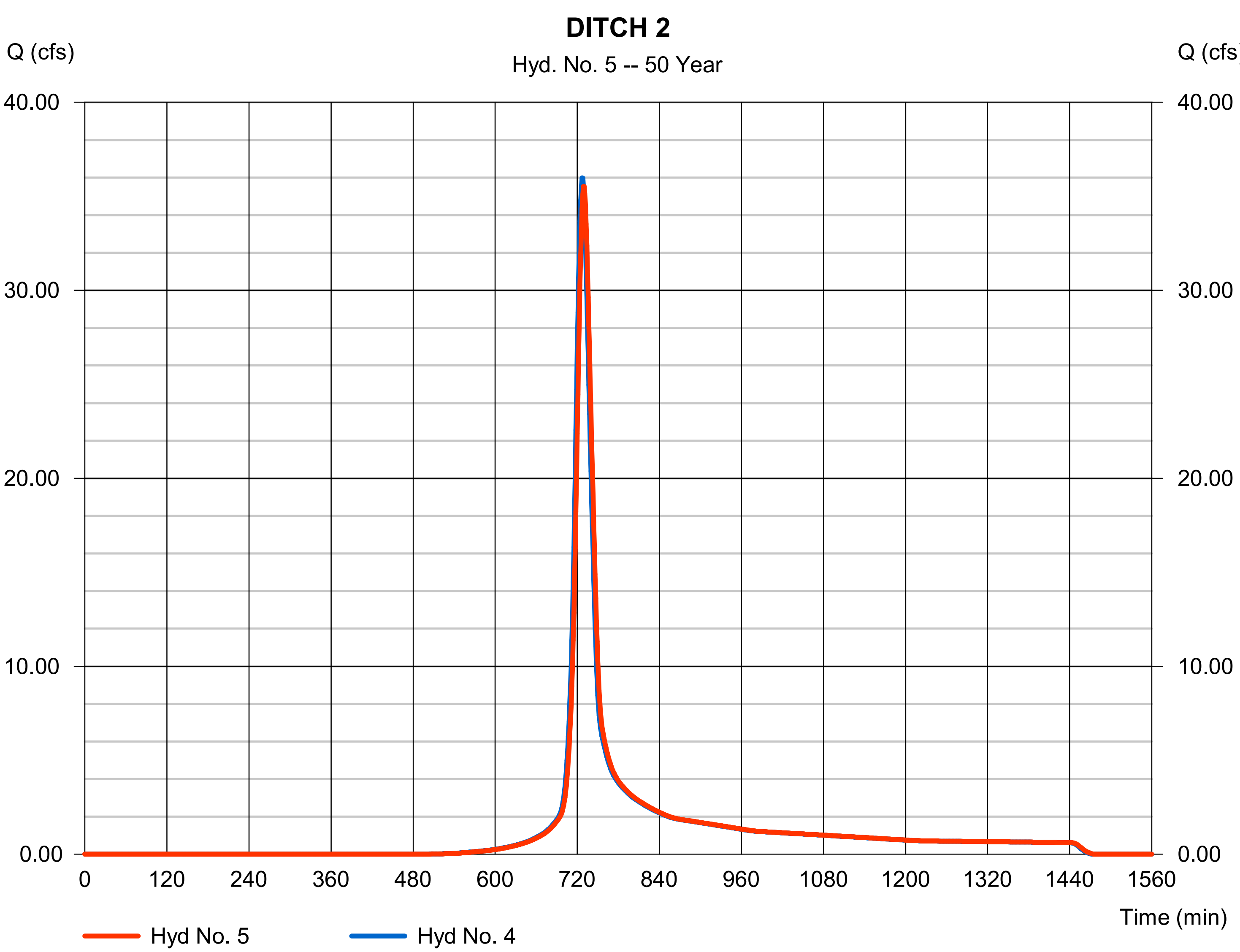
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 5

DITCH 2

Hydrograph type	= Reach	Peak discharge	= 35.52 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 121,198 cuft
Inflow hyd. No.	= 4 - COMBINE A & B	Section type	= Trapezoidal
Reach length	= 610.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.373
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.4704

Modified Att-Kin routing method used.



Hydrograph Report

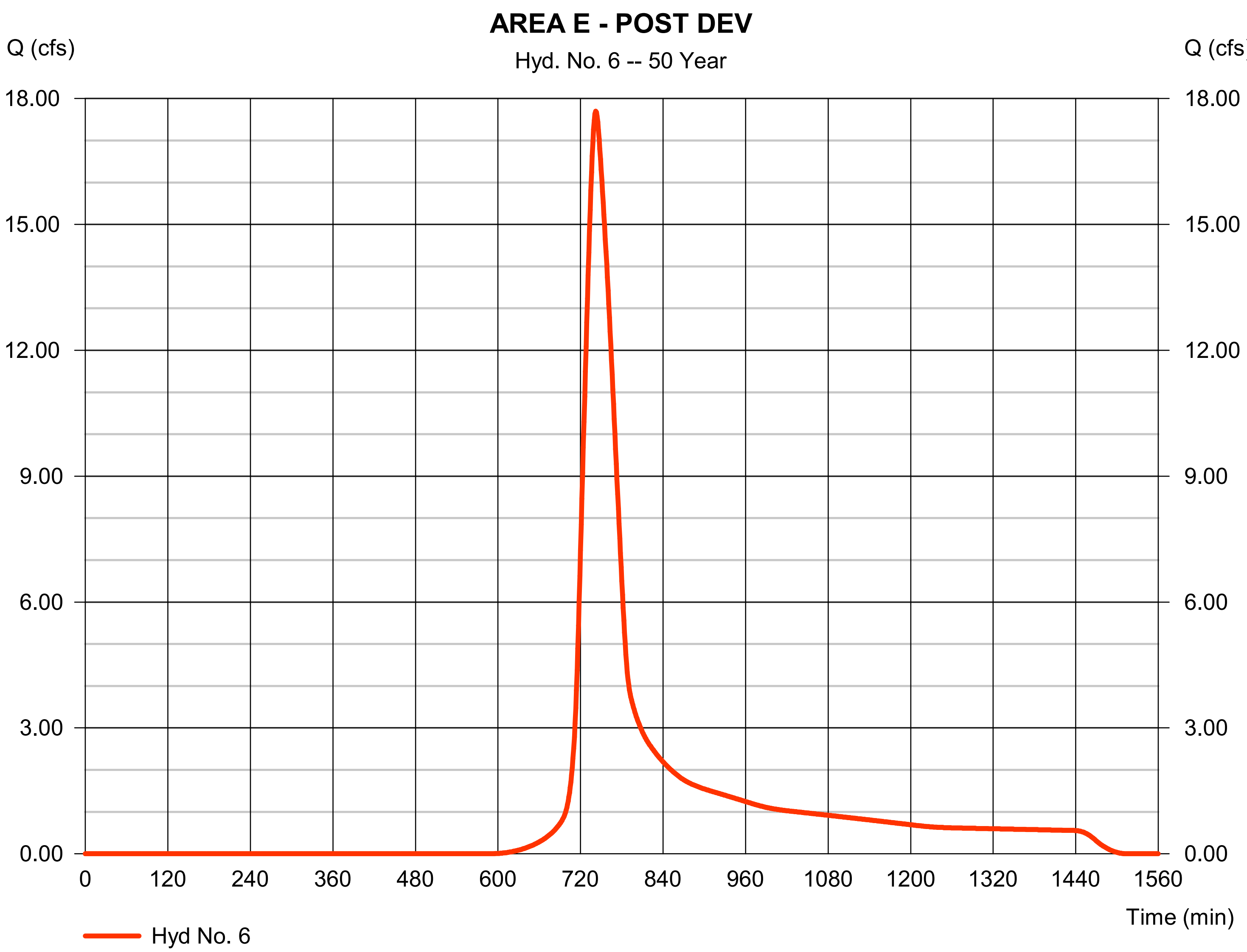
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 6

AREA E - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 17.70 cfs
Storm frequency	= 50 yrs	Time to peak	= 742 min
Time interval	= 1 min	Hyd. volume	= 98,530 cuft
Drainage area	= 9.150 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 47.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.680 x 65) + (0.330 x 98) + (5.140 x 60)] / 9.150



Hydrograph Report

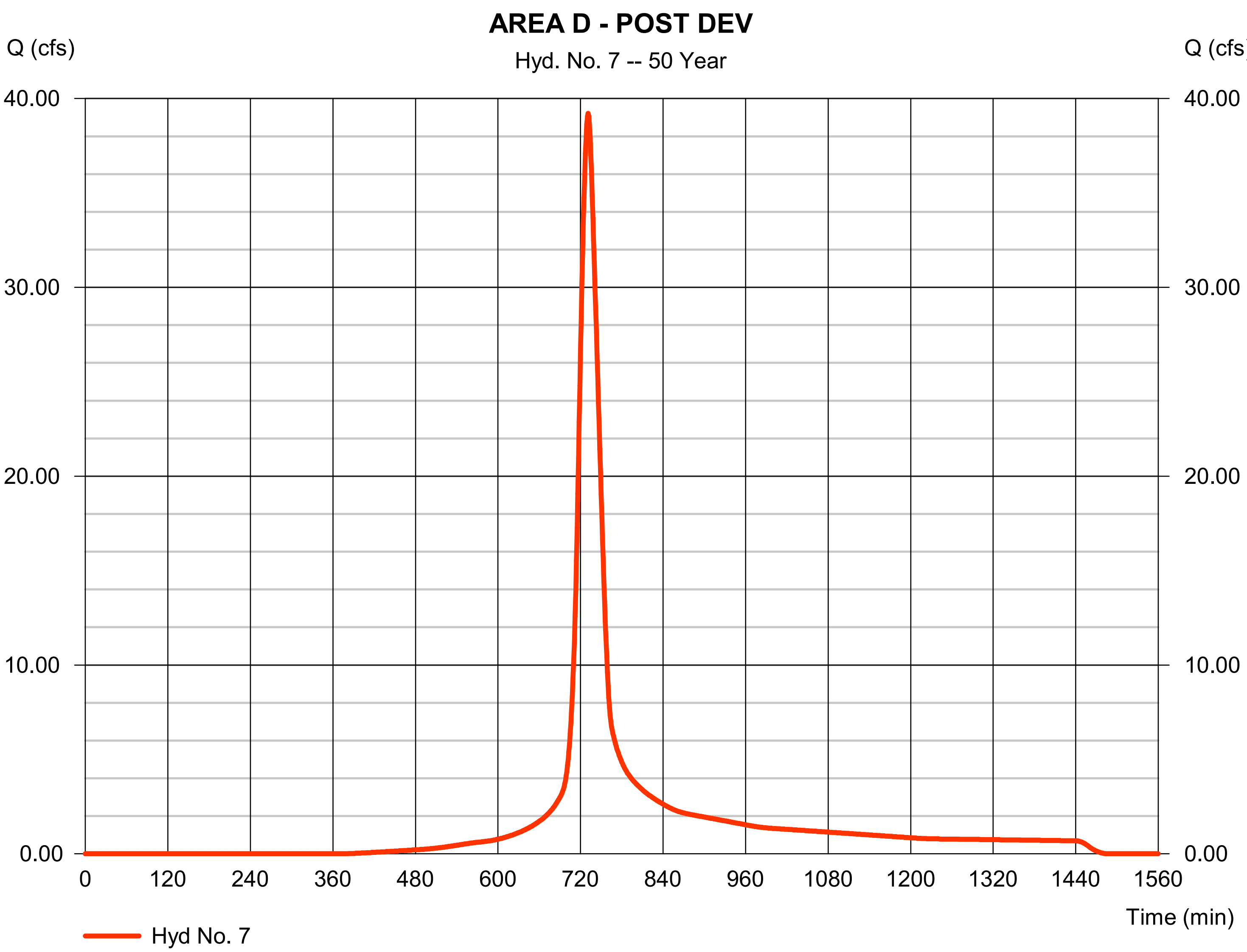
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 7

AREA D - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 39.22 cfs
Storm frequency	= 50 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 156,835 cuft
Drainage area	= 9.520 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.10 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.910 x 85) + (8.610 x 77)] / 9.520



Hydrograph Report

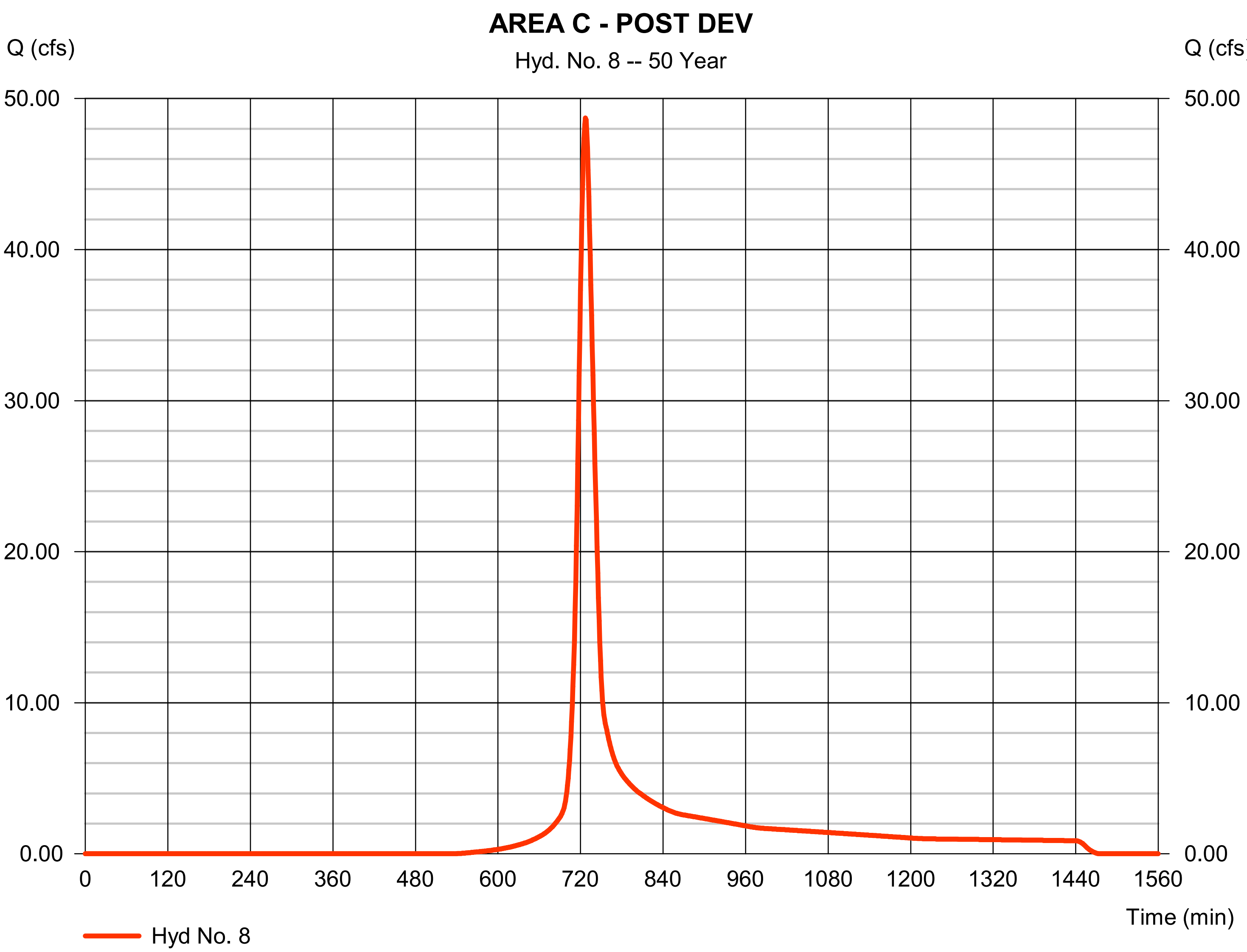
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 8

AREA C - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 48.71 cfs
Storm frequency	= 50 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 166,351 cuft
Drainage area	= 13.750 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.460 x 85) + (0.400 x 55) + (1.740 x 98) + (10.150 x 60)] / 13.750



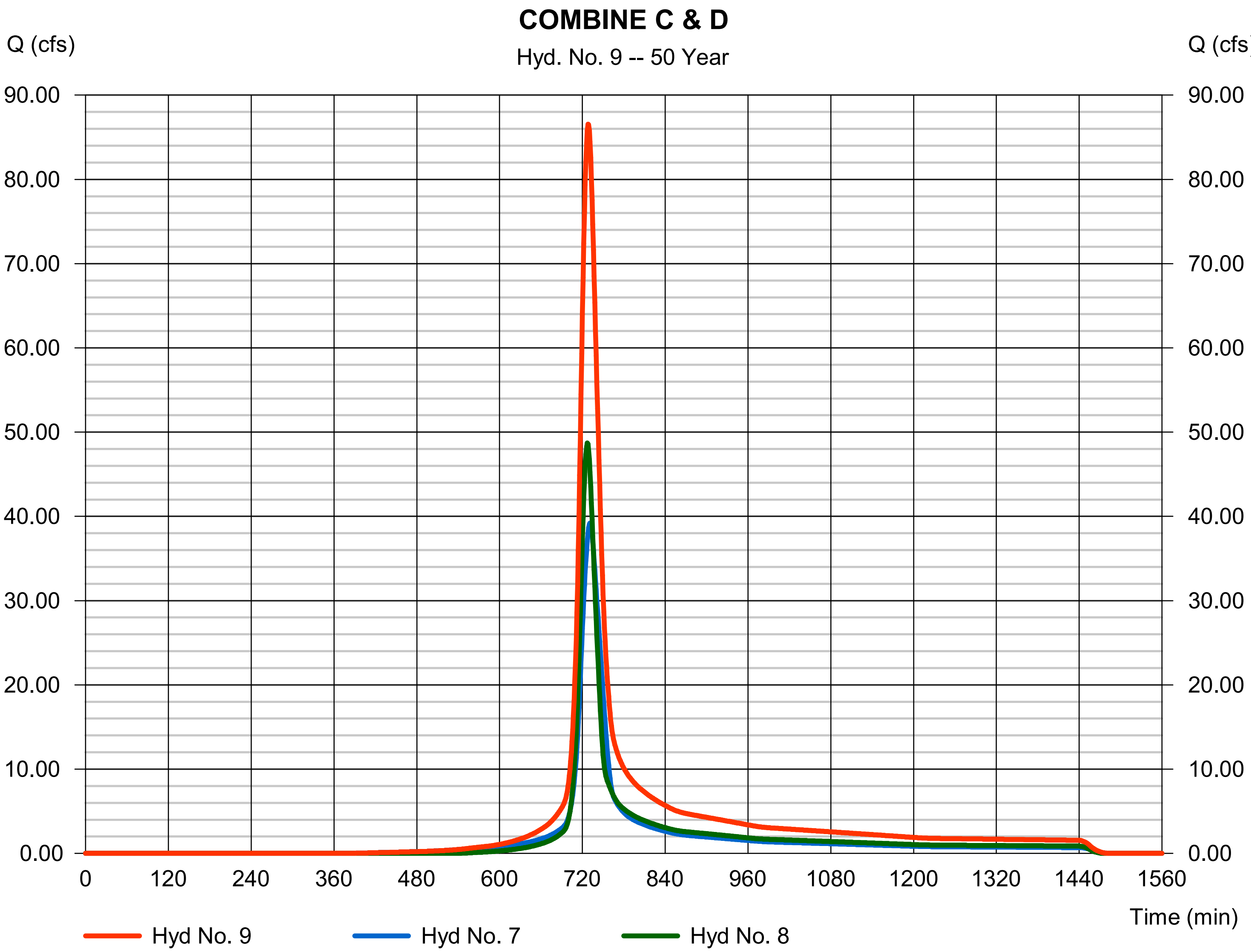
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 9

COMBINE C & D

Hydrograph type	= Combine	Peak discharge	= 86.55 cfs
Storm frequency	= 50 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 323,186 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 23.270 ac



Hydrograph Report

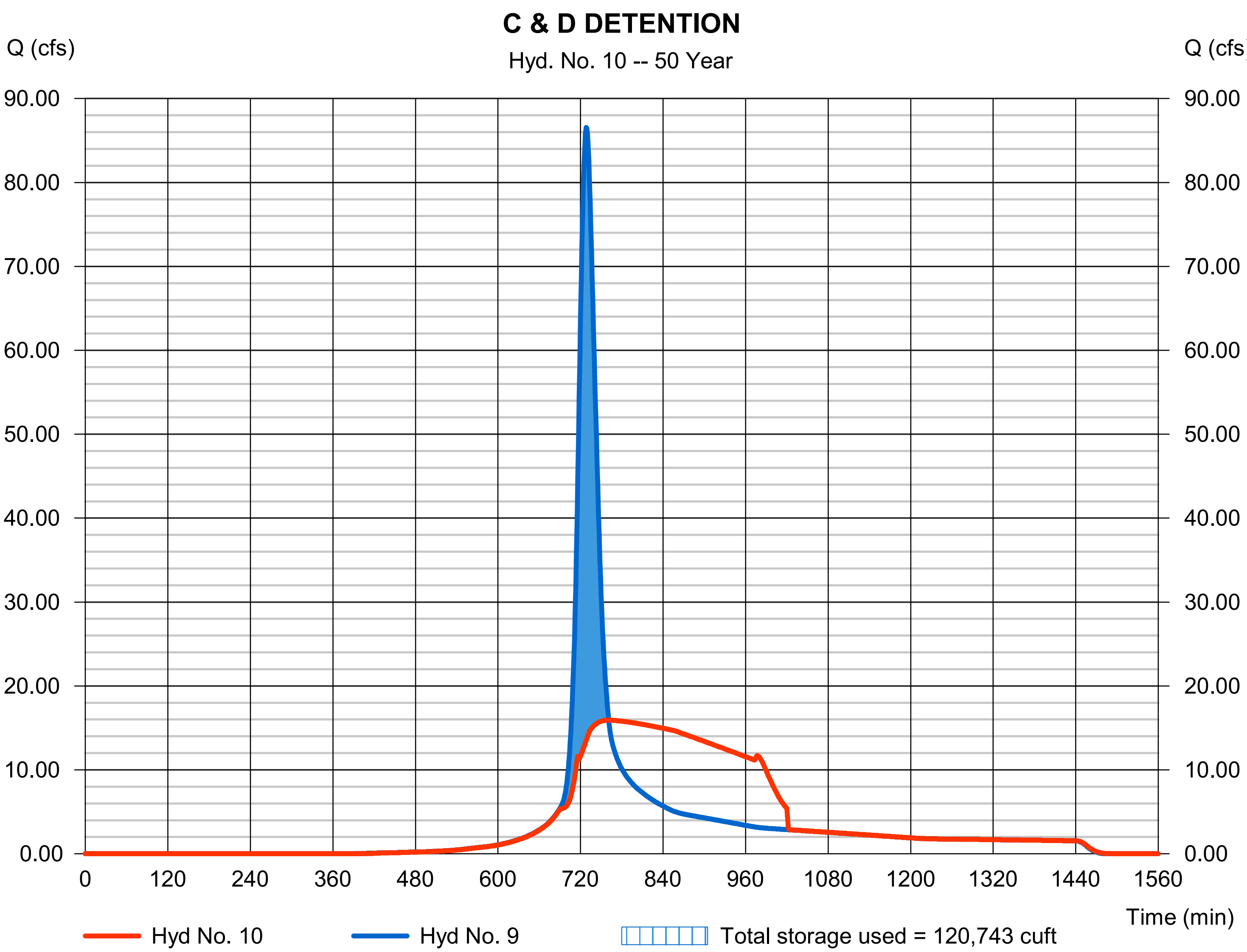
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 10

C & D DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 15.92 cfs
Storm frequency	= 50 yrs	Time to peak	= 761 min
Time interval	= 1 min	Hyd. volume	= 323,186 cuft
Inflow hyd. No.	= 9 - COMBINE C & D	Max. Elevation	= 582.43 ft
Reservoir name	= C&D DETENTION	Max. Storage	= 120,743 cuft

Storage Indication method used.



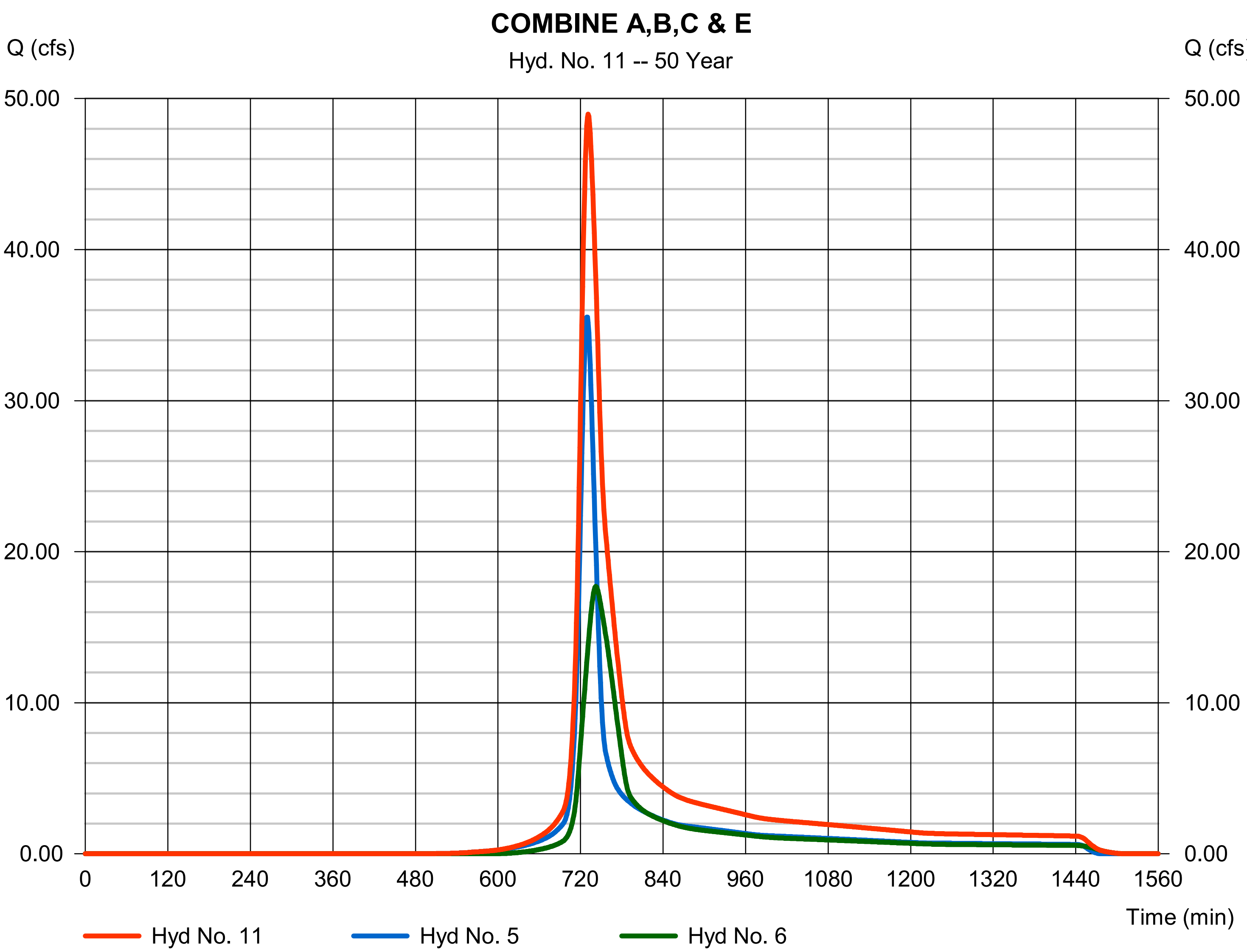
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 11

COMBINE A,B,C & E

Hydrograph type	= Combine	Peak discharge	= 48.96 cfs
Storm frequency	= 50 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 219,728 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 9.150 ac



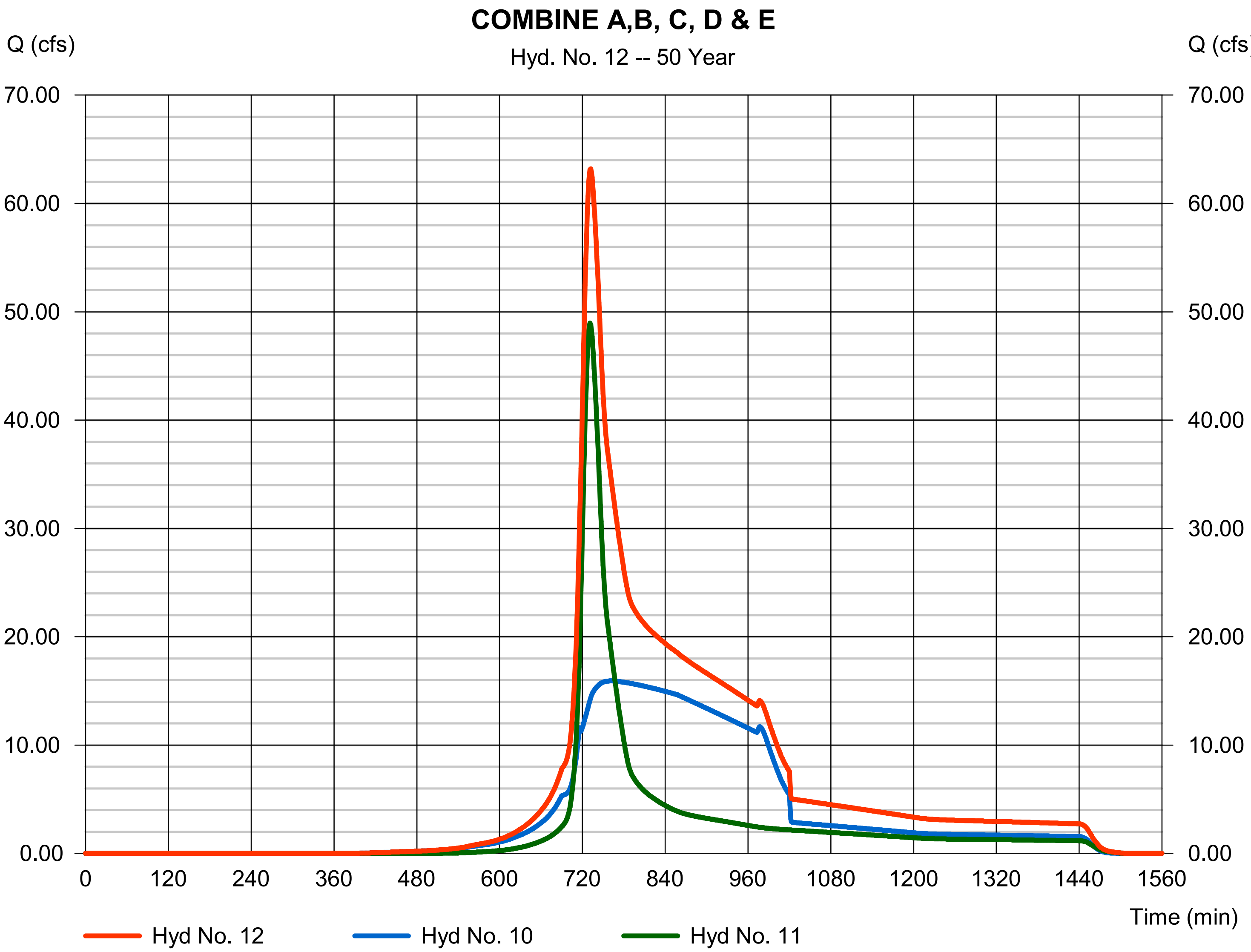
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 12

COMBINE A,B, C, D & E

Hydrograph type	= Combine	Peak discharge	= 63.18 cfs
Storm frequency	= 50 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 542,914 cuft
Inflow hyds.	= 10, 11	Contrib. drain. area	= 0.000 ac



Hydrograph Report

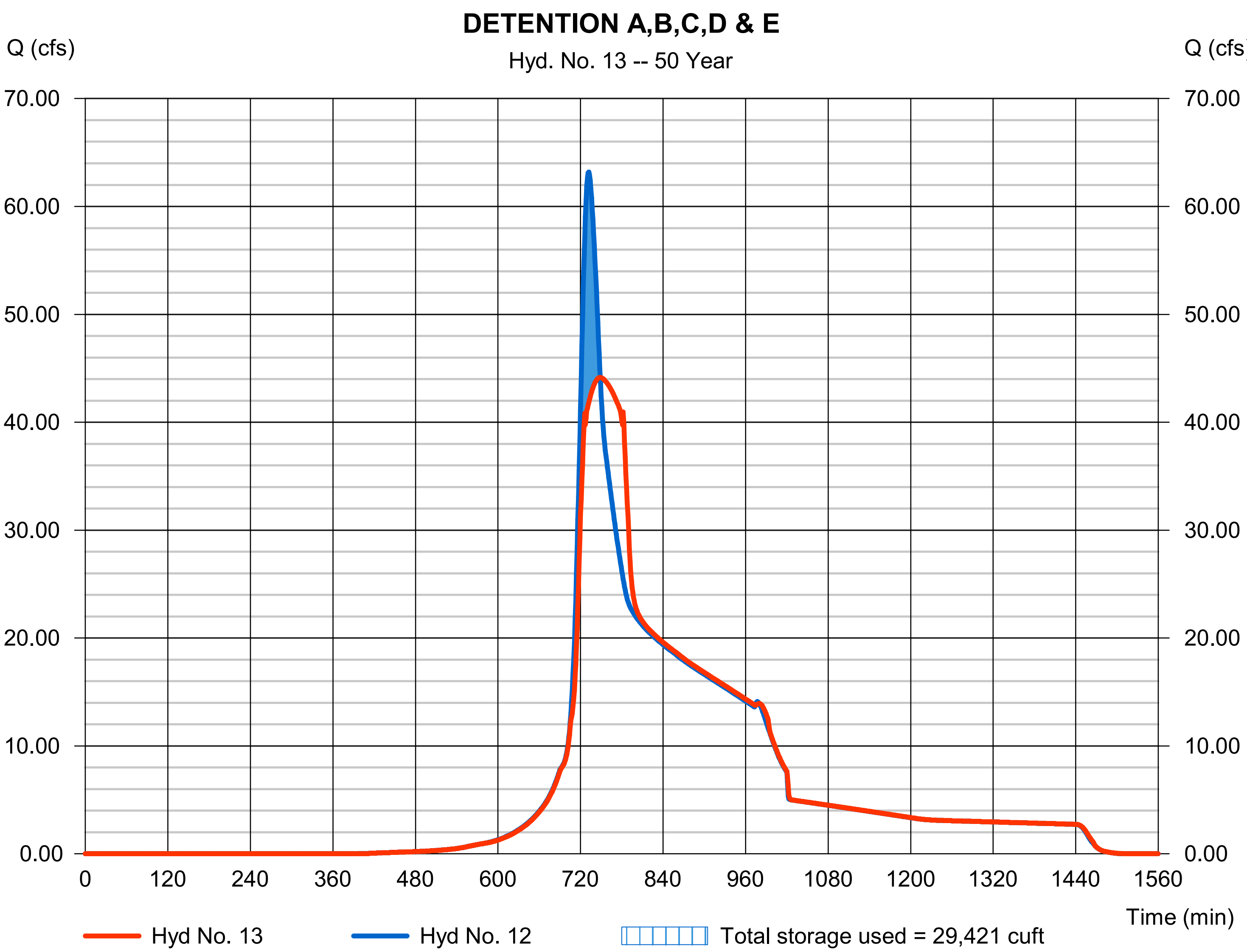
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 13

DETENTION A,B,C,D & E

Hydrograph type	= Reservoir	Peak discharge	= 44.15 cfs
Storm frequency	= 50 yrs	Time to peak	= 749 min
Time interval	= 1 min	Hyd. volume	= 542,884 cuft
Inflow hyd. No.	= 12 - COMBINE A,B, C, D & E	Max. Elevation	= 581.75 ft
Reservoir name	= A,B,C,D & E DETENTION	Max. Storage	= 29,421 cuft

Storage Indication method used.



Hydrograph Report

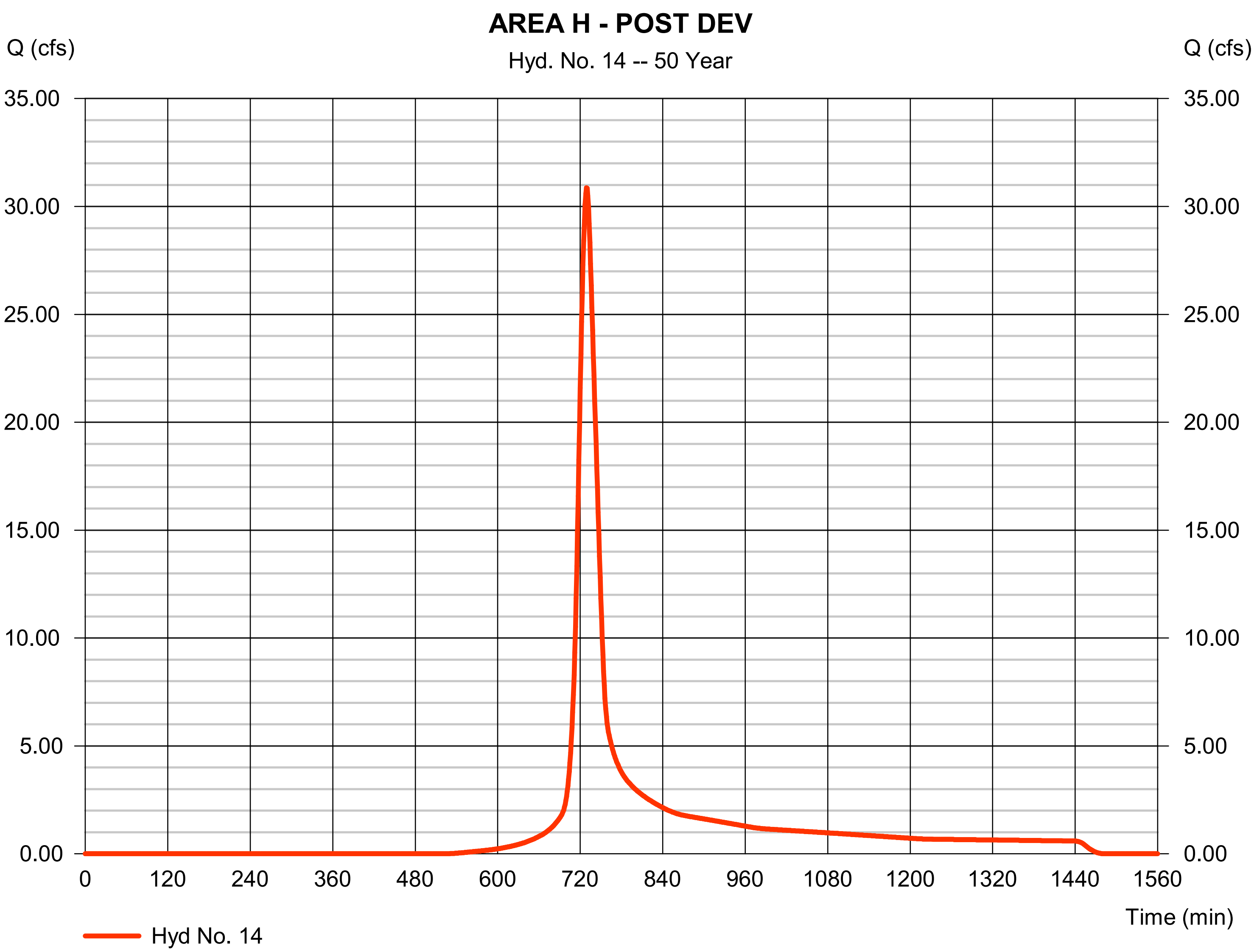
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 14

AREA H - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 30.87 cfs
Storm frequency	= 50 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 115,543 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.50 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



Hydrograph Report

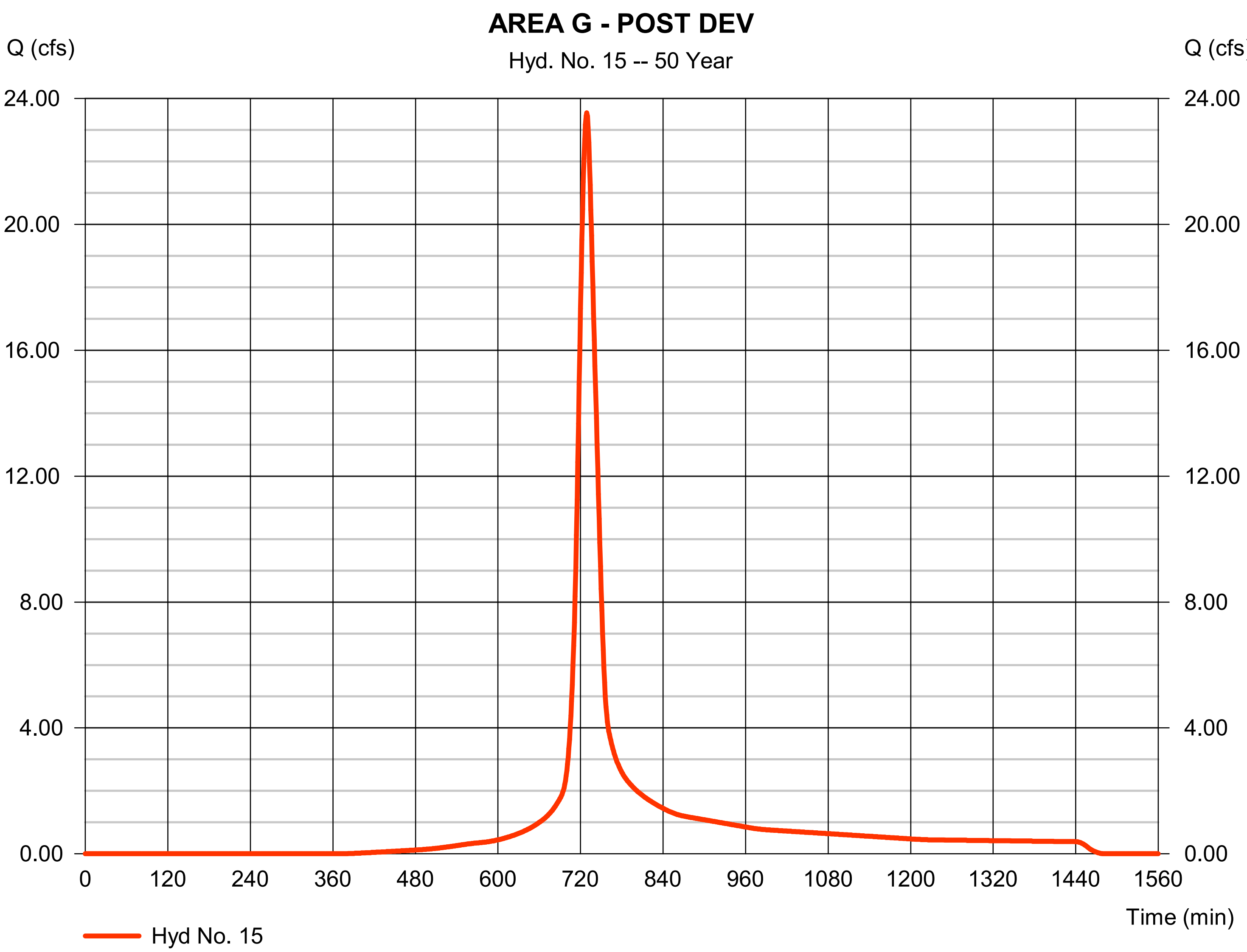
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 15

AREA G - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 23.55 cfs
Storm frequency	= 50 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 87,830 cuft
Drainage area	= 5.290 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 26.80 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.330 x 85) + (4.960 x 77)] / 5.290



Hydrograph Report

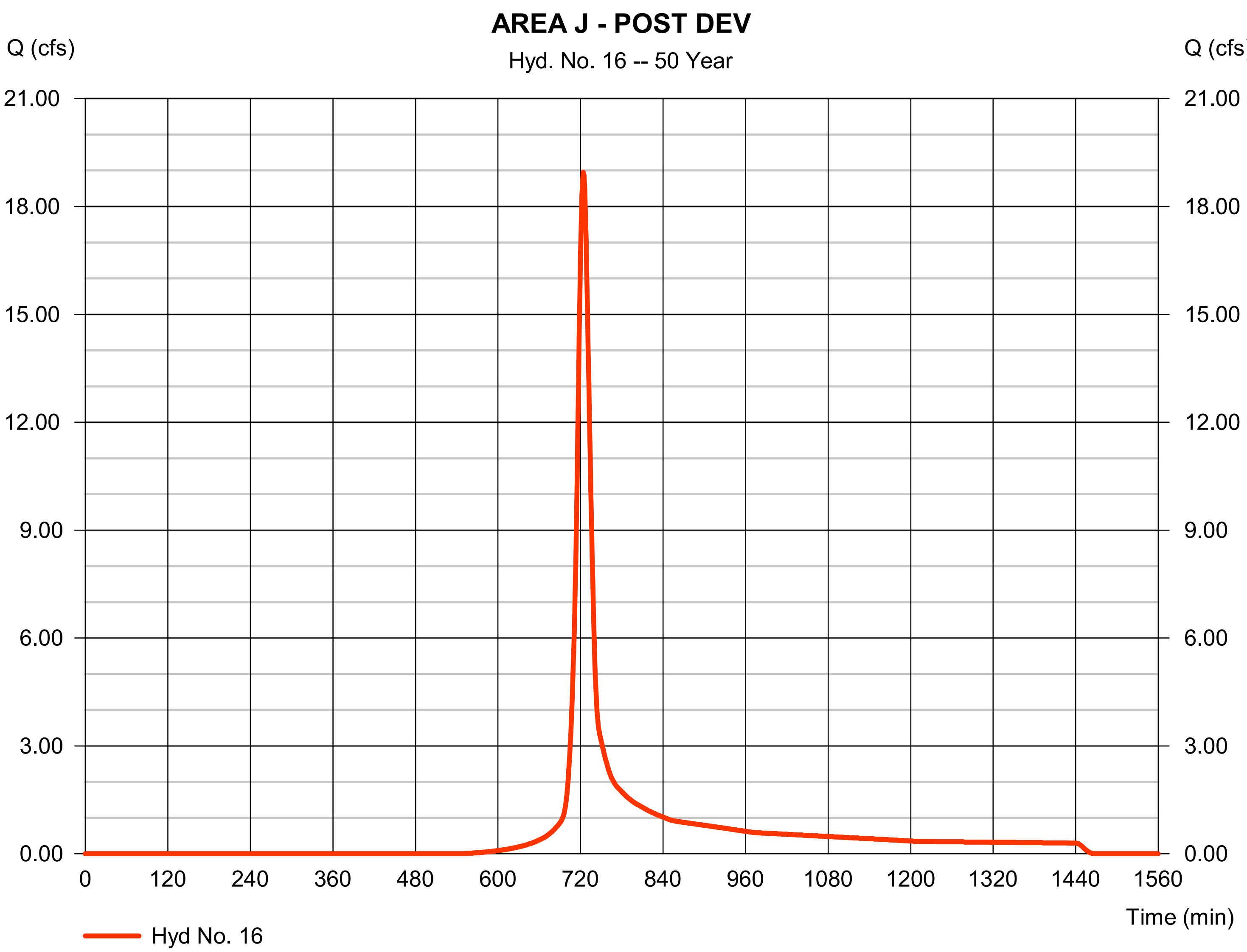
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 16

AREA J - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 18.95 cfs
Storm frequency	= 50 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 56,382 cuft
Drainage area	= 4.820 ac	Curve number	= 66*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 85) + (0.020 x 65) + (0.680 x 98) + (4.030 x 60)] / 4.820



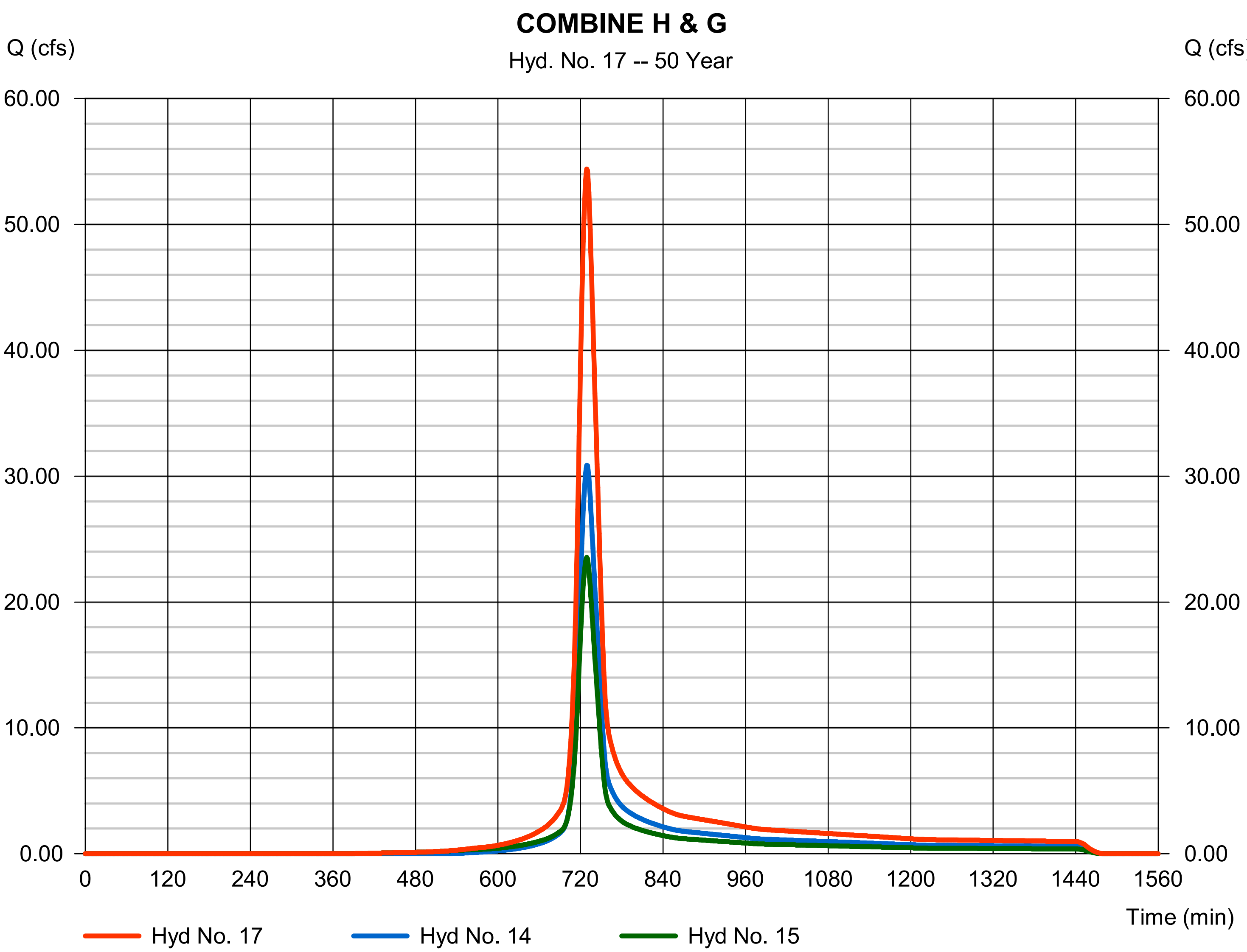
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 17

COMBINE H & G

Hydrograph type	= Combine	Peak discharge	= 54.41 cfs
Storm frequency	= 50 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 203,372 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 14.400 ac



Hydrograph Report

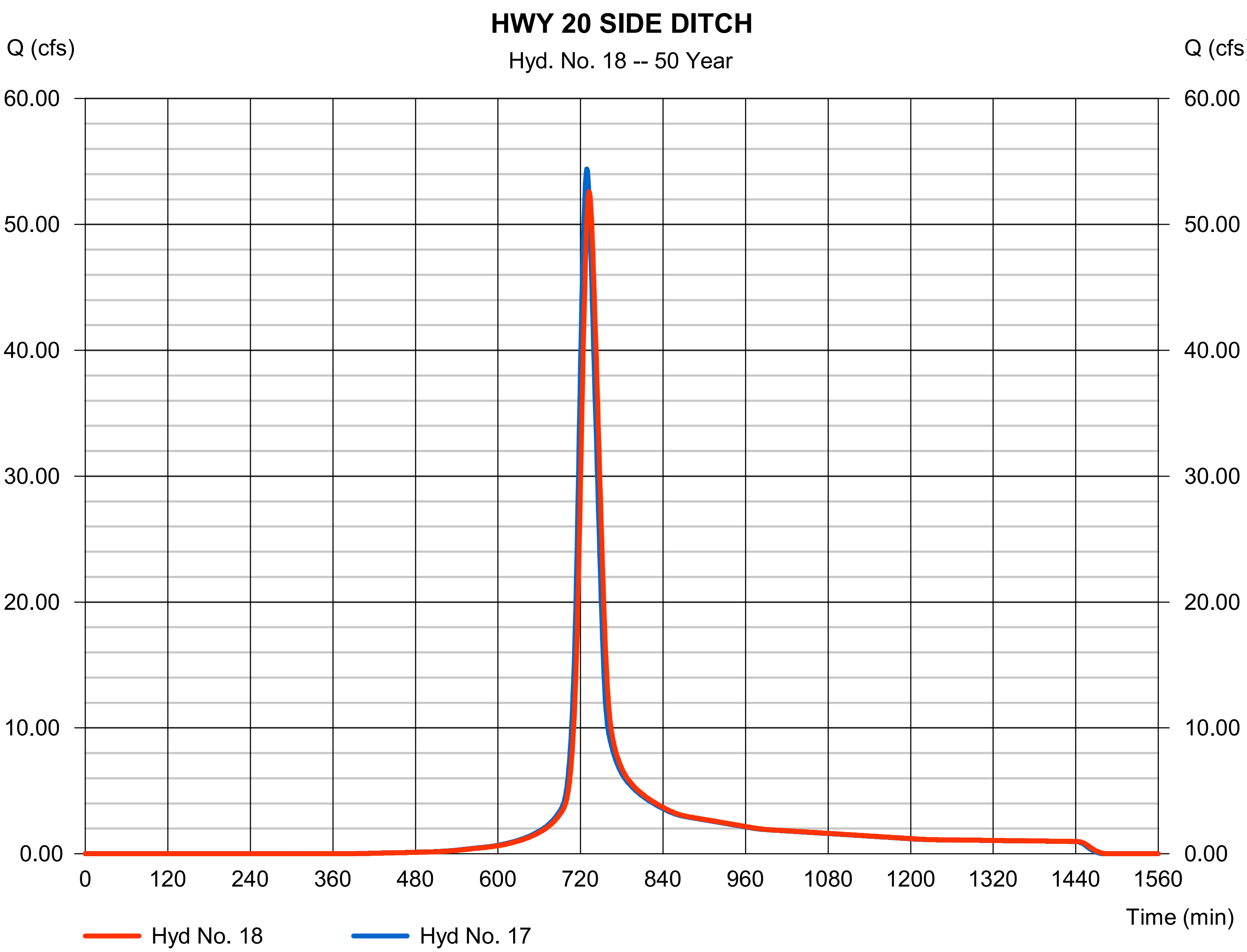
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 18

HWY 20 SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 52.59 cfs
Storm frequency	= 50 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 203,371 cuft
Inflow hyd. No.	= 17 - COMBINE H & G	Section type	= Trapezoidal
Reach length	= 900.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.030	Bottom width	= 3.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 1.688	Rating curve m	= 1.304
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.2831

Modified Att-Kin routing method used.



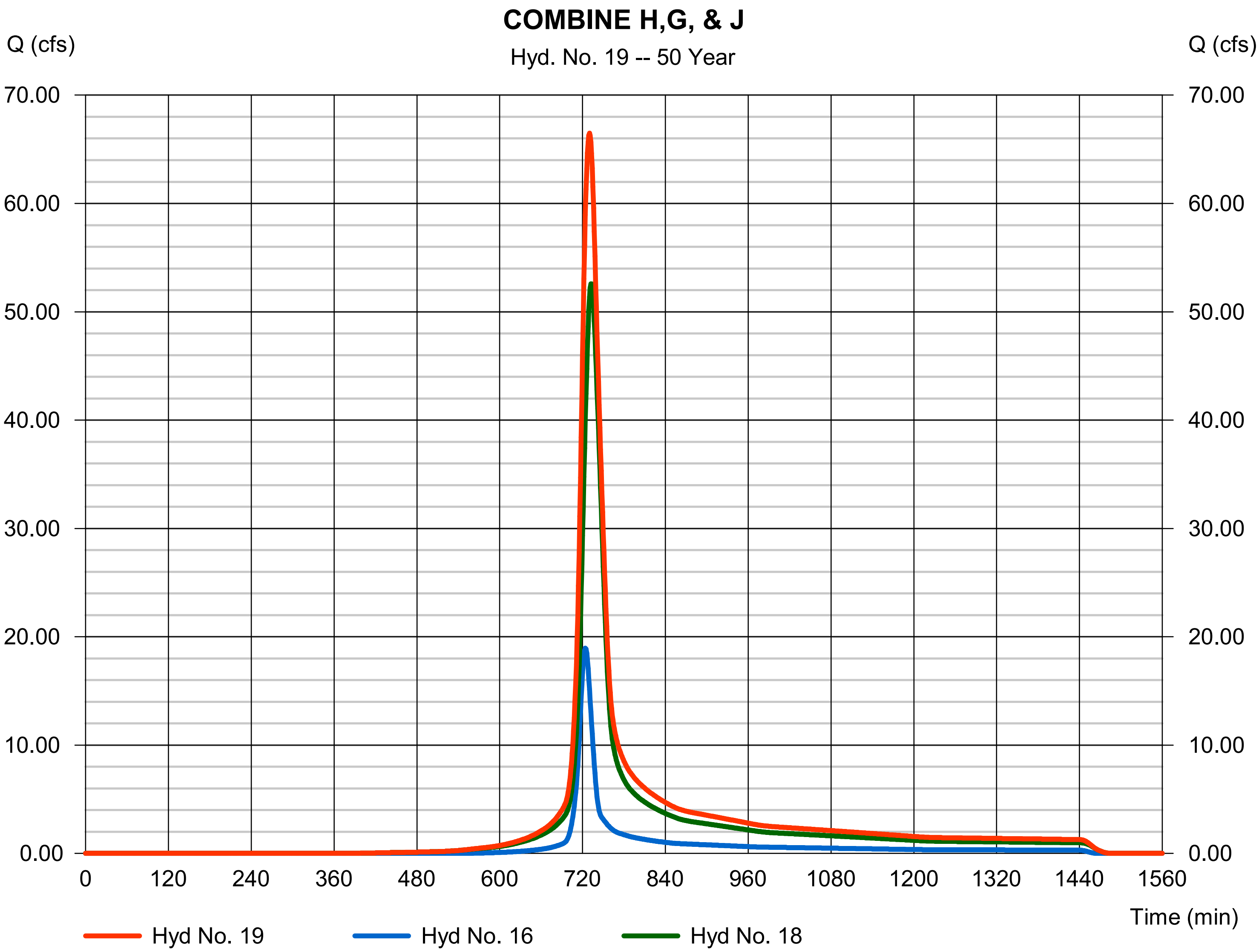
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 19

COMBINE H,G, & J

Hydrograph type	= Combine	Peak discharge	= 66.49 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 259,753 cuft
Inflow hyds.	= 16, 18	Contrib. drain. area	= 4.820 ac



Hydrograph Report

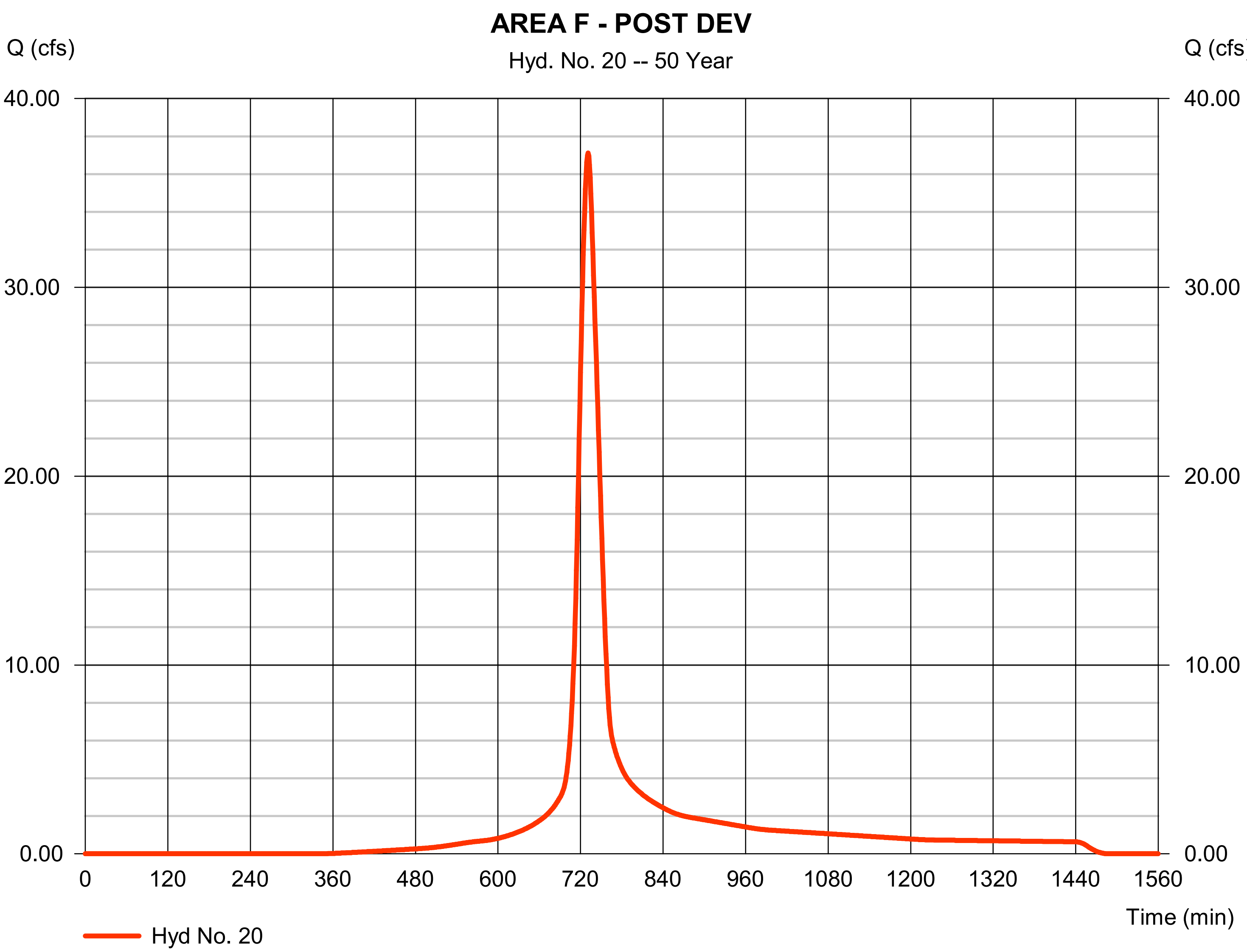
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 20

AREA F - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 37.12 cfs
Storm frequency	= 50 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 148,915 cuft
Drainage area	= 8.620 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.440 x 85) + (8.180 x 77)] / 8.620



Hydrograph Report

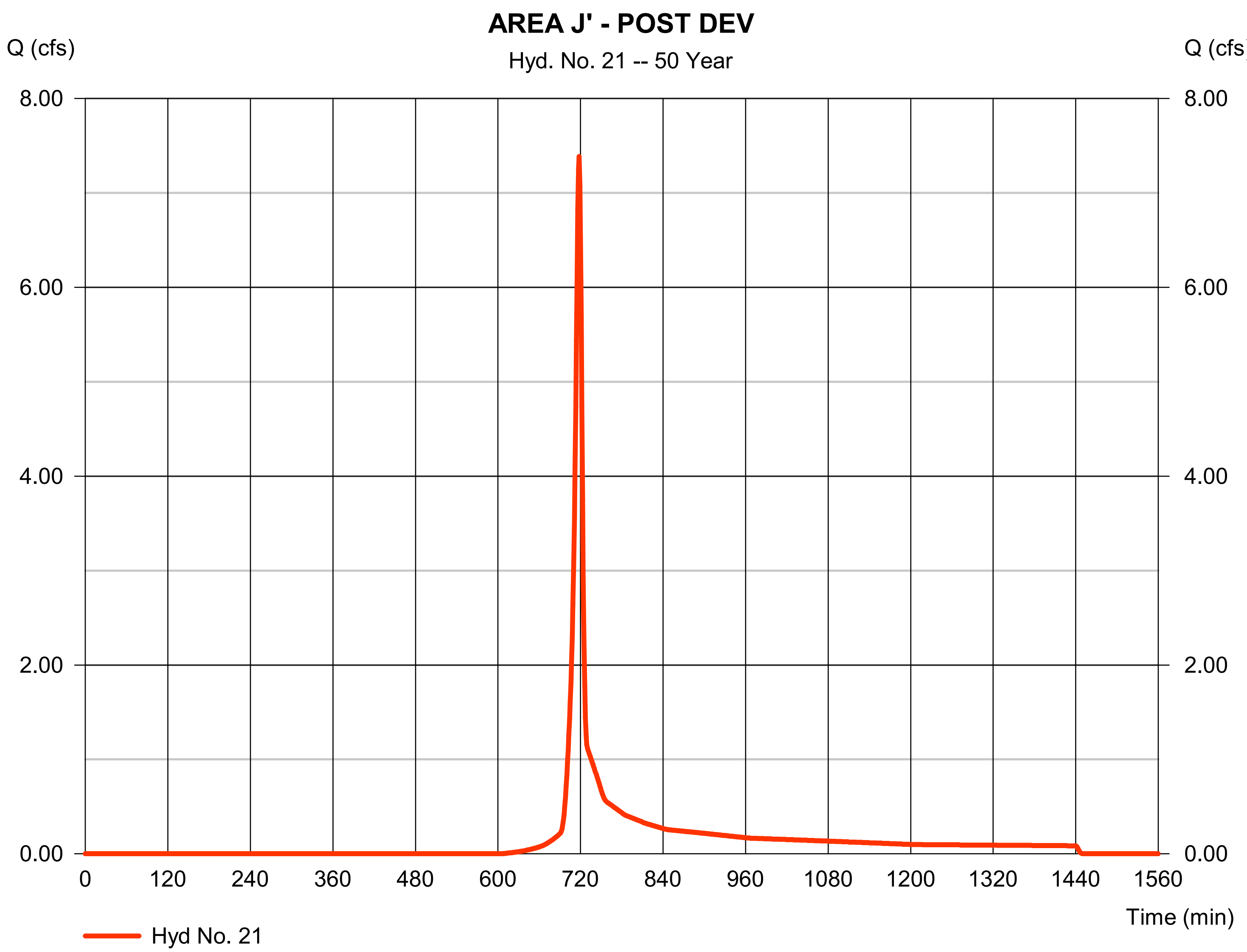
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 21

AREA J' - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 7.386 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 14,838 cuft
Drainage area	= 1.440 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.220 x 65) + (1.220 x 60)] / 1.440



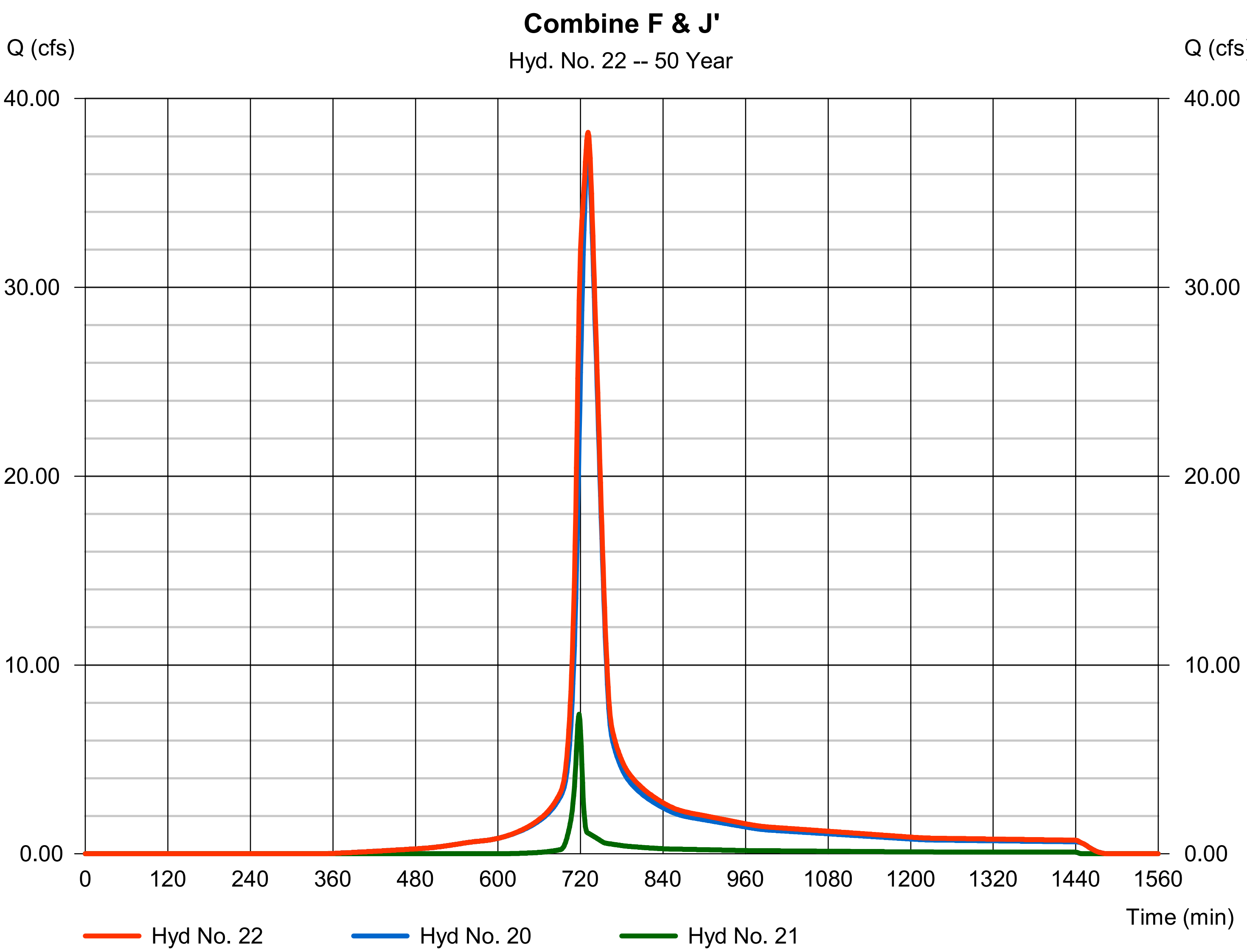
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 22

Combine F & J'

Hydrograph type	= Combine	Peak discharge	= 38.21 cfs
Storm frequency	= 50 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 163,753 cuft
Inflow hyds.	= 20, 21	Contrib. drain. area	= 10.060 ac



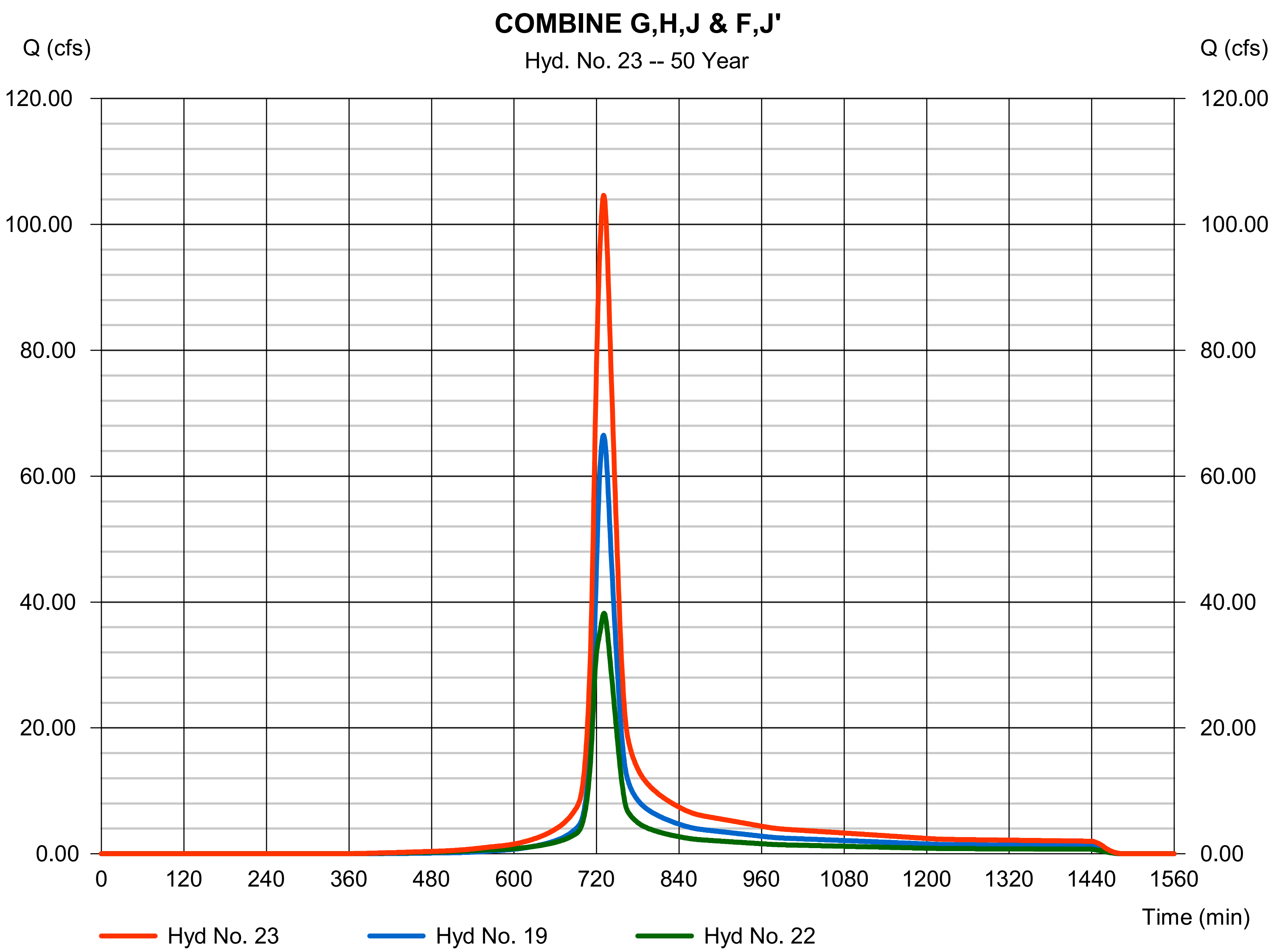
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 23

COMBINE G,H,J & F,J'

Hydrograph type	= Combine	Peak discharge	= 104.60 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 423,506 cuft
Inflow hyds.	= 19, 22	Contrib. drain. area	= 0.000 ac



Hydrograph Report

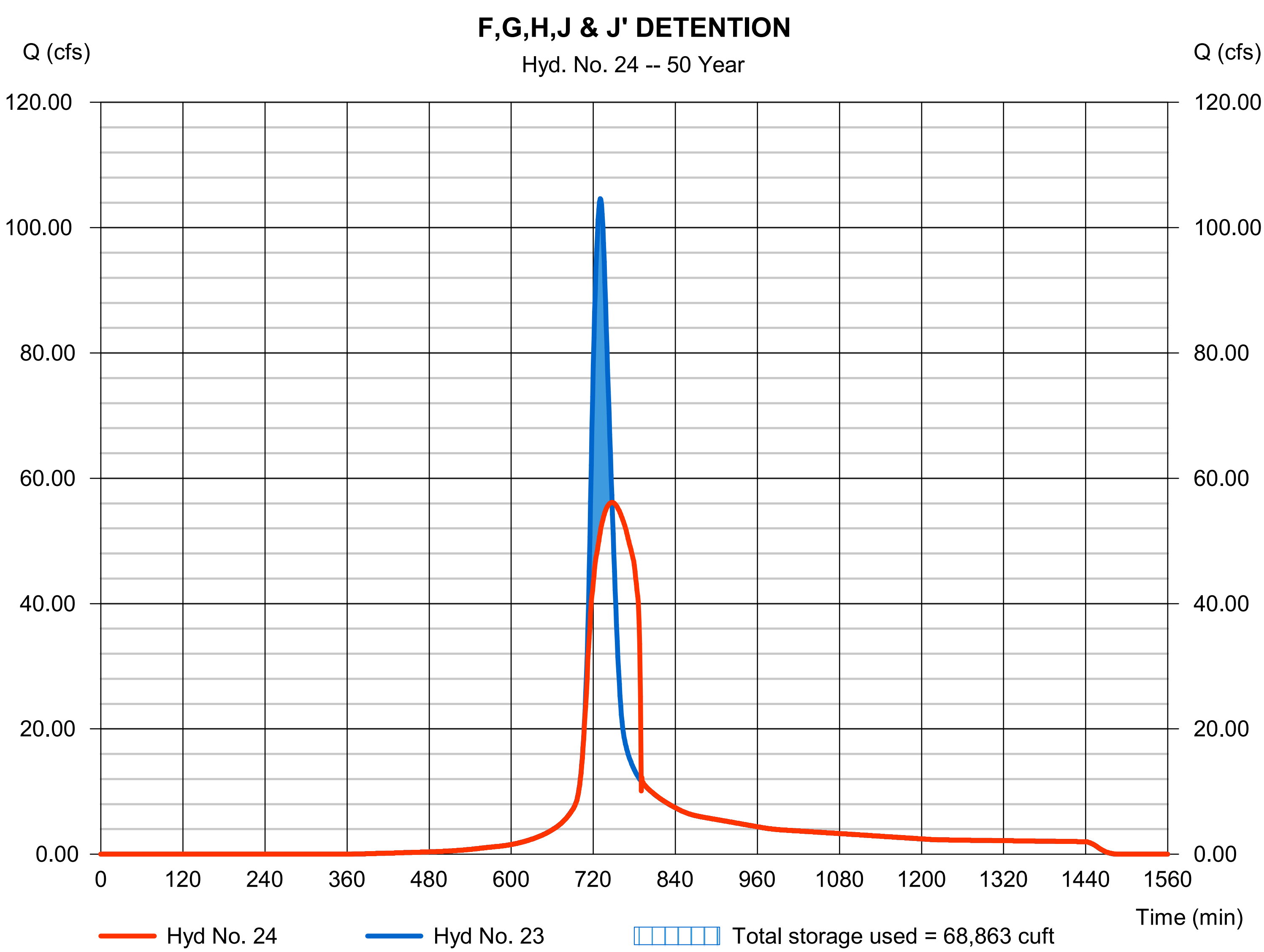
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 24

F,G,H,J & J' DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 56.14 cfs
Storm frequency	= 50 yrs	Time to peak	= 747 min
Time interval	= 1 min	Hyd. volume	= 423,506 cuft
Inflow hyd. No.	= 23 - COMBINE G,H,J & F,J'	Max. Elevation	= 581.77 ft
Reservoir name	= F,G,H,J & J' DETENTION	Max. Storage	= 68,863 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	SCS Runoff	13.37	1	725	41,750	------	------	------	AREA A - POST DEV
2	Reach	12.91	1	728	41,748	1	------	------	DITCH 1
3	SCS Runoff	30.03	1	727	102,165	------	------	------	AREA B - POST DEV
4	Combine	42.91	1	727	143,913	2, 3	------	------	COMBINE A & B
5	Reach	42.43	1	729	143,911	4	------	------	DITCH 2
6	SCS Runoff	21.56	1	742	118,736	------	------	------	AREA E - POST DEV
7	SCS Runoff	45.34	1	731	181,834	------	------	------	AREA D - POST DEV
8	SCS Runoff	58.24	1	727	198,133	------	------	------	AREA C - POST DEV
9	Combine	102.01	1	728	379,967	7, 8	------	------	COMBINE C & D
10	Reservoir	16.71	1	763	379,967	9	582.71	149,068	C & D DETENTION
11	Combine	58.84	1	731	262,648	5, 6,	------	------	COMBINE A,B,C & E
12	Combine	73.69	1	731	642,614	10, 11	------	------	COMBINE A,B, C, D & E
13	Reservoir	46.02	1	752	642,584	12	582.23	43,386	DETENTION A,B,C,D & E
14	SCS Runoff	36.81	1	729	137,242	------	------	------	AREA H - POST DEV
15	SCS Runoff	27.22	1	729	101,829	------	------	------	AREA G - POST DEV
16	SCS Runoff	22.71	1	724	67,343	------	------	------	AREA J - POST DEV
17	Combine	64.03	1	729	239,071	14, 15,	------	------	COMBINE H & G
18	Reach	62.06	1	732	239,070	17	------	------	HWY 20 SIDE DITCH
19	Combine	78.80	1	730	306,413	16, 18	------	------	COMBINE H,G, & J
20	SCS Runoff	42.69	1	731	171,907	------	------	------	AREA F - POST DEV
21	SCS Runoff	8.961	1	718	17,995	------	------	------	AREA J' - POST DEV
22	Combine	44.00	1	731	189,902	20, 21	------	------	Combine F & J'
23	Combine	122.71	1	730	496,315	19, 22	------	------	COMBINE G,H,J & F,J'
24	Reservoir	58.90	1	749	496,315	23	582.33	94,657	F,G,H,J & J' DETENTION
25	SCS Runoff	6.822	1	725	21,530	------	------	------	AREA K' - POST DEV
26	Reach	5.475	1	732	21,526	25	------	------	K' Tc DITCH
27	SCS Runoff	3.101	1	725	9,816	------	------	------	AREA K'' - POST DEV
28	Reach	2.162	1	734	9,808	27	------	------	K'' Tc DITCH
29	Combine	7.611	1	733	31,333	26, 28	------	------	COMBINE K' & K''
30	SCS Runoff	28.94	1	725	91,612	------	------	------	AREA K - POST DEV
31	Combine	35.31	1	726	122,946	29, 30	------	------	COMBINE K, K' & K''
32	Reservoir	7.727	1	755	122,811	31	582.87	43,112	AREA K DETENTION
33	Combine	66.60	1	749	619,122	24, 32	------	------	COMBINE F,G,H,J & K
34	SCS Runoff	6.249	1	721	15,171	------	------	------	AREA L - POST DEV

AP3_POSTDEV.gpw	Return Period: 100 Year	Thursday, 11 / 15 / 2018

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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
35	Combine	67.39	1	748	634,292	33, 34	------	------	COMBINE FG,H,J,K & L
36	Combine	113.38	1	749	1,276,921	13, 35	------	------	TOTAL SITE DISCHARGE - POST D

Hydrograph Report

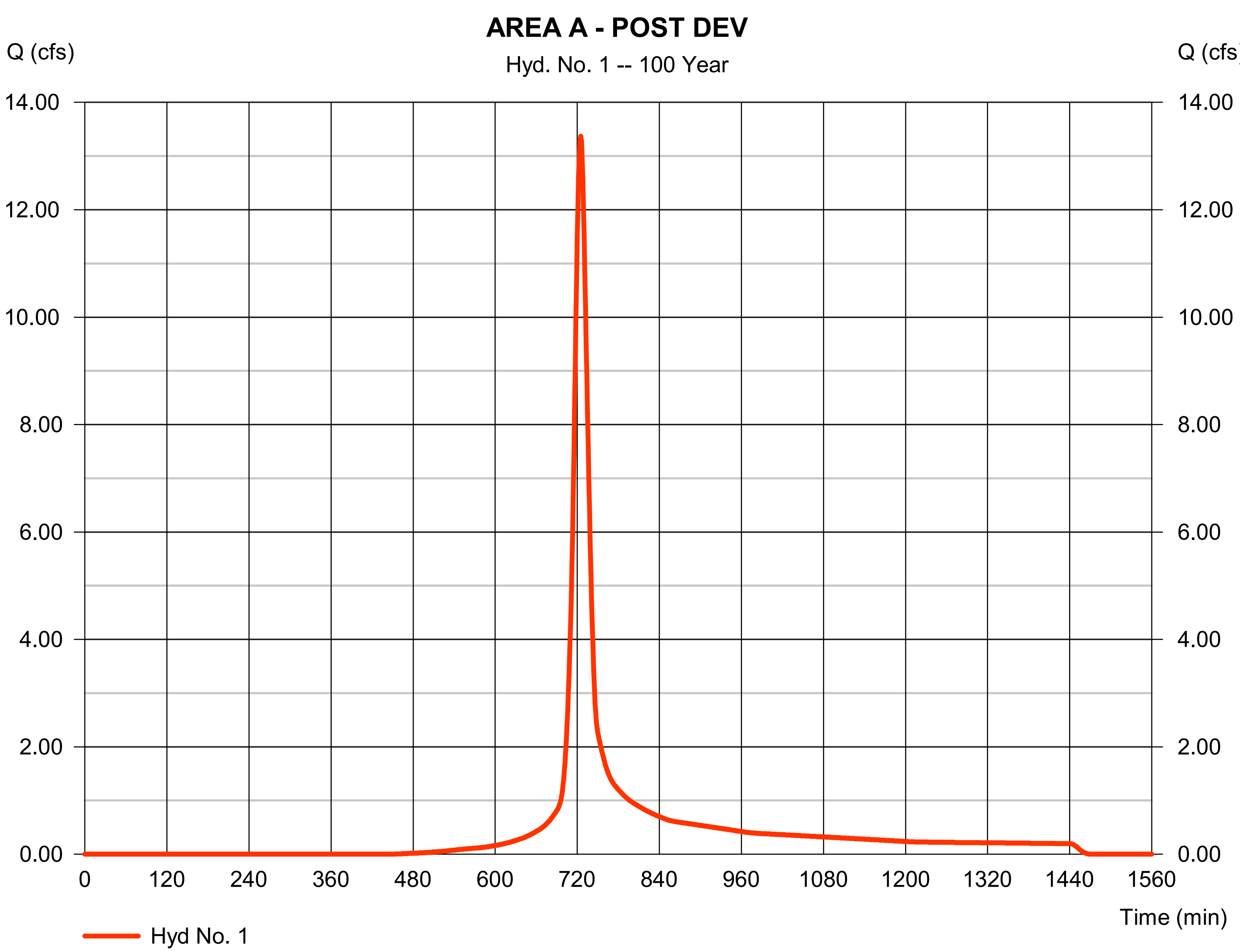
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 1

AREA A - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 13.37 cfs
Storm frequency	= 100 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 41,750 cuft
Drainage area	= 2.580 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.10 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.220 x 85) + (0.570 x 55) + (0.030 x 98) + (0.760 x 60)] / 2.580



Hydrograph Report

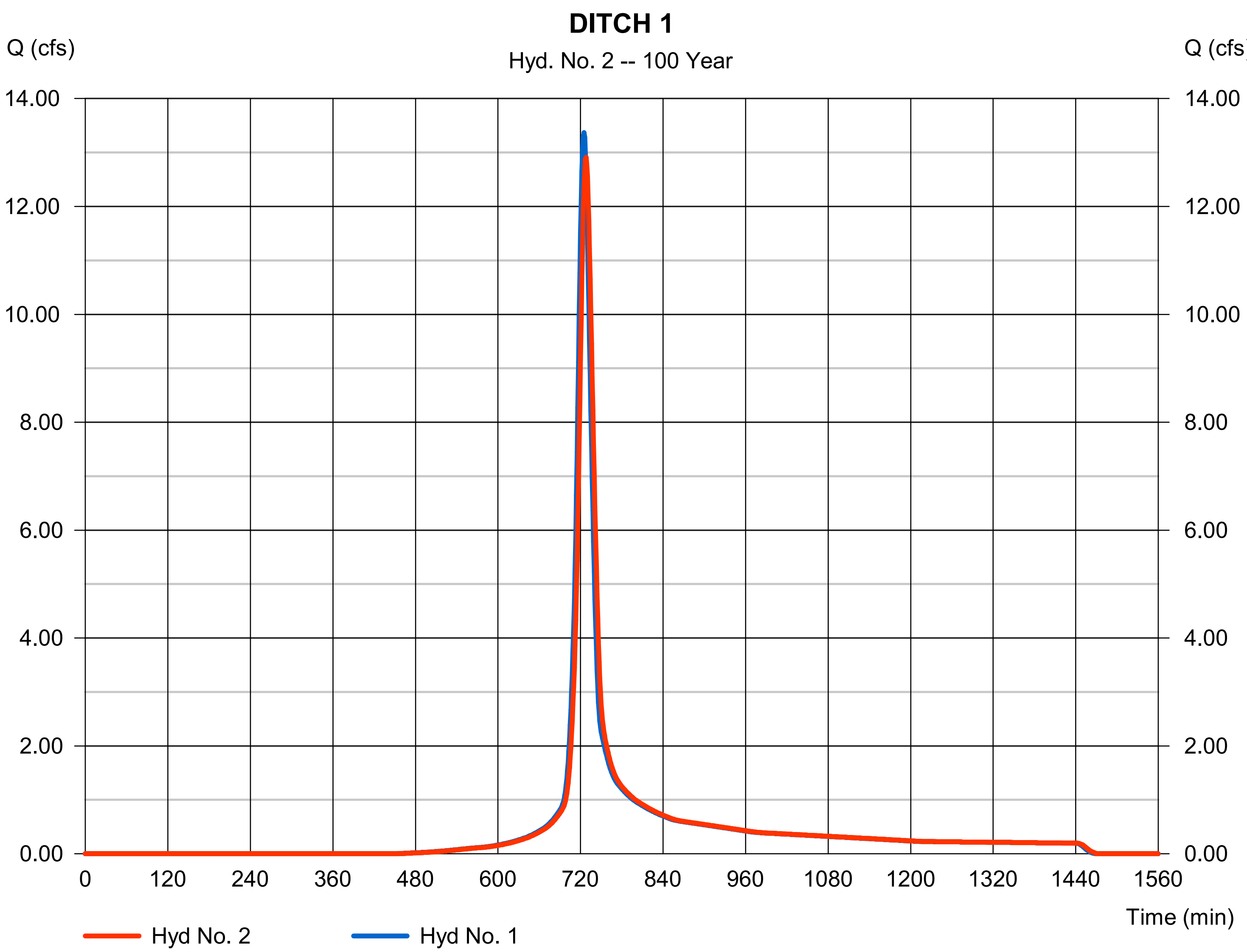
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 2

DITCH 1

Hydrograph type	= Reach	Peak discharge	= 12.91 cfs
Storm frequency	= 100 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 41,748 cuft
Inflow hyd. No.	= 1 - AREA A - POST DEV	Section type	= Trapezoidal
Reach length	= 730.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 10.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.375
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.3294

Modified Att-Kin routing method used.



Hydrograph Report

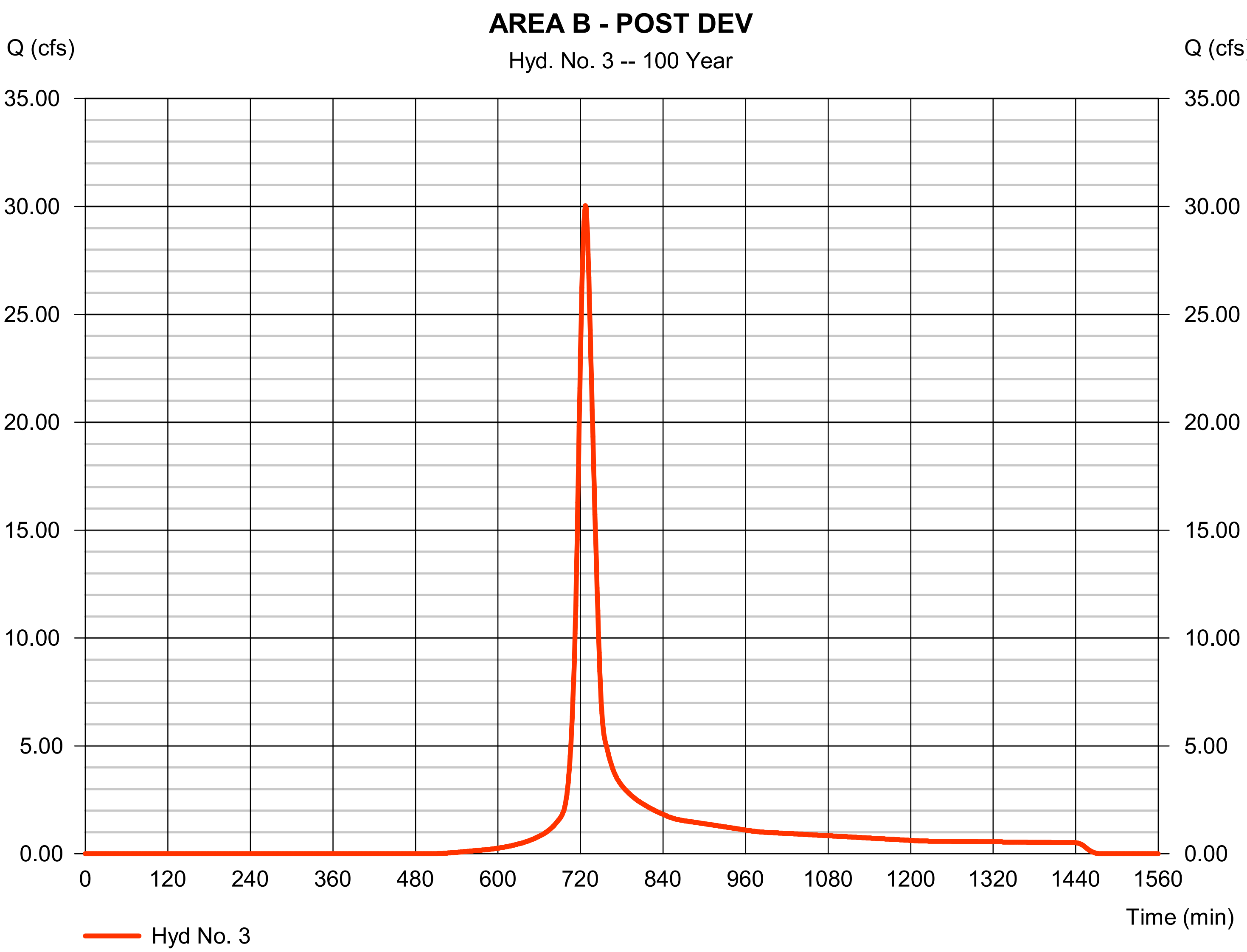
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 3

AREA B - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 30.03 cfs
Storm frequency	= 100 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 102,165 cuft
Drainage area	= 7.090 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.60 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.930 x 85) + (2.120 x 55) + (0.250 x 98) + (2.790 x 60)] / 7.090



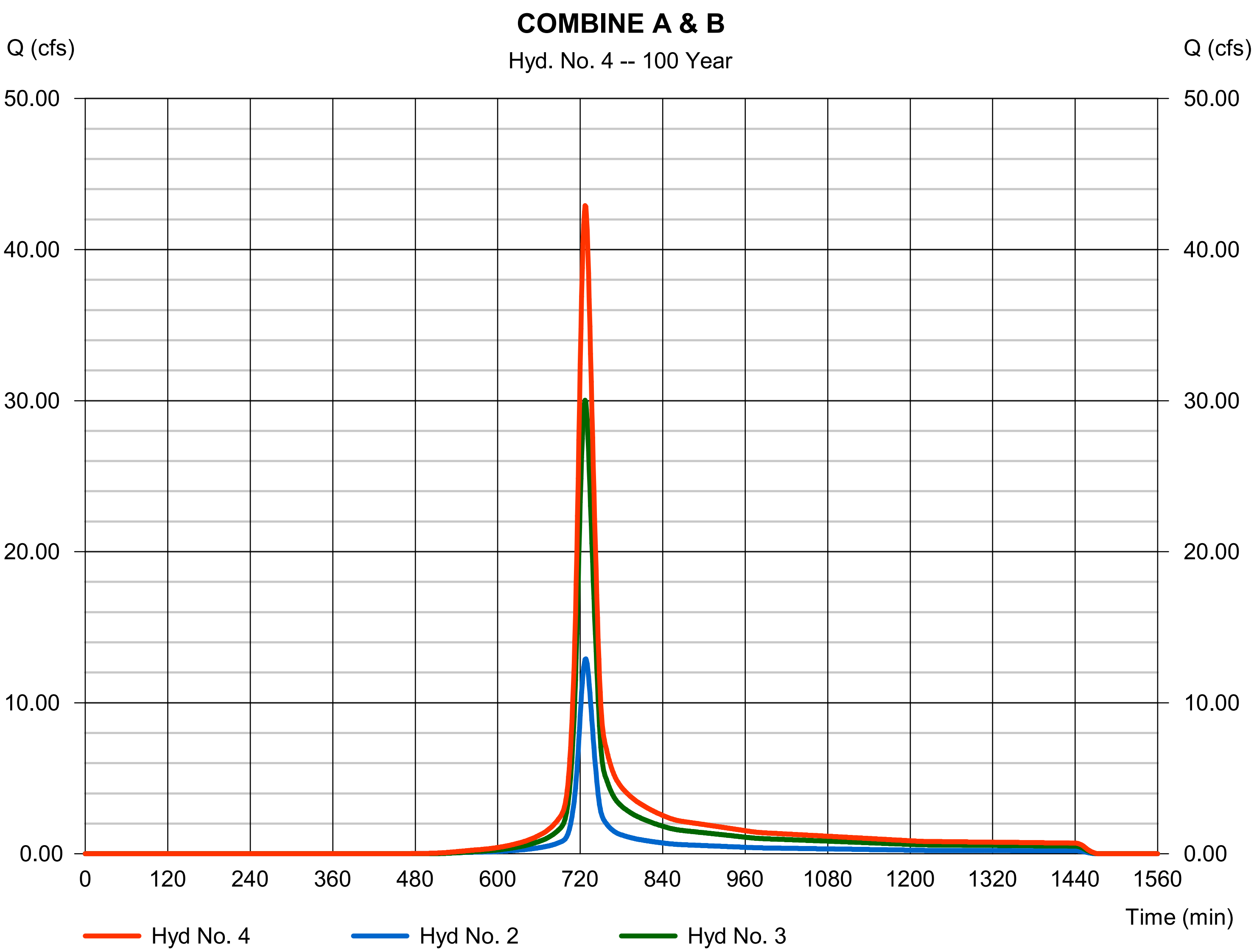
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 4

COMBINE A & B

Hydrograph type	= Combine	Peak discharge	= 42.91 cfs
Storm frequency	= 100 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 143,913 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 7.090 ac



Hydrograph Report

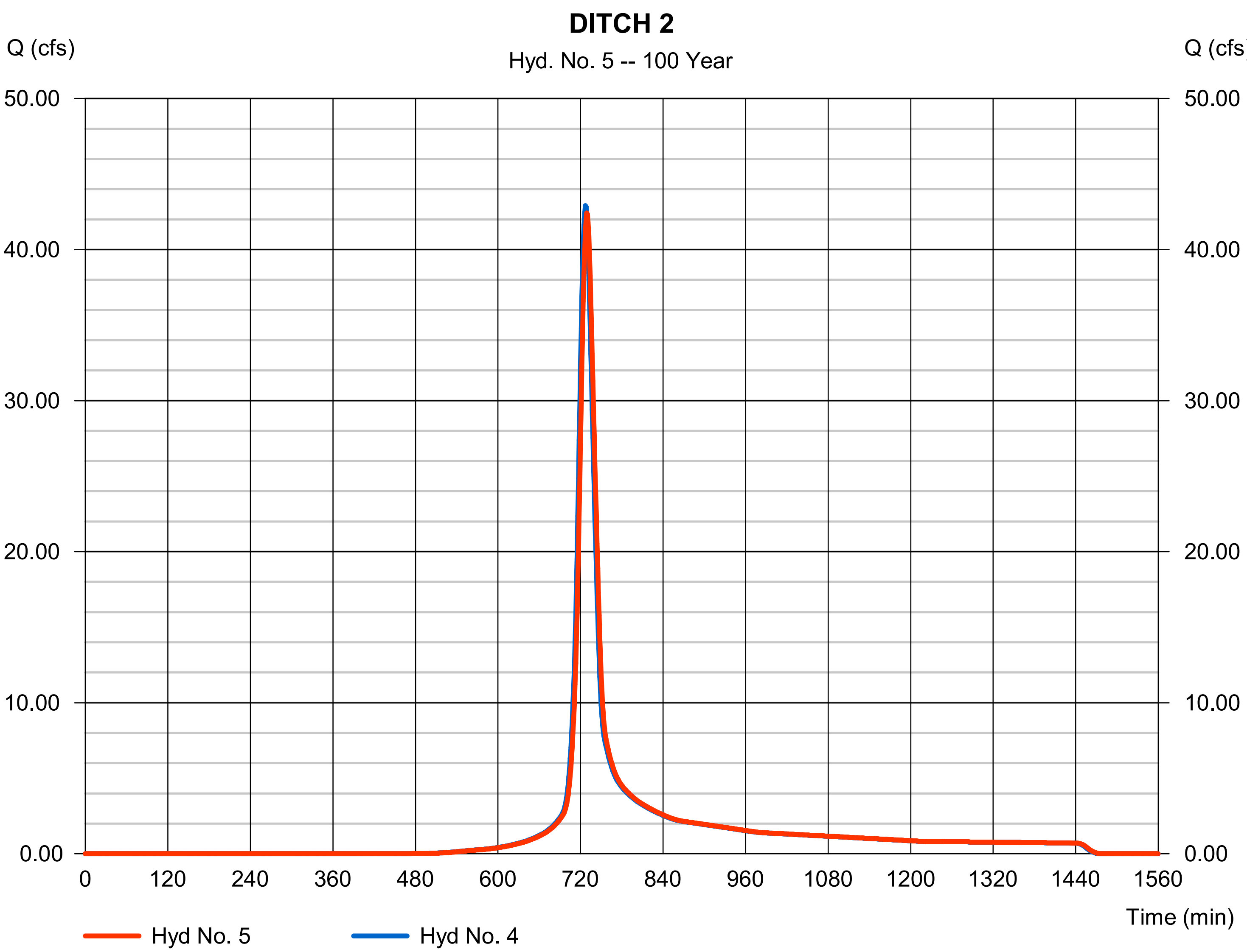
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 5

DITCH 2

Hydrograph type	= Reach	Peak discharge	= 42.43 cfs
Storm frequency	= 100 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 143,911 cuft
Inflow hyd. No.	= 4 - COMBINE A & B	Section type	= Trapezoidal
Reach length	= 610.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.373
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.4878

Modified Att-Kin routing method used.



Hydrograph Report

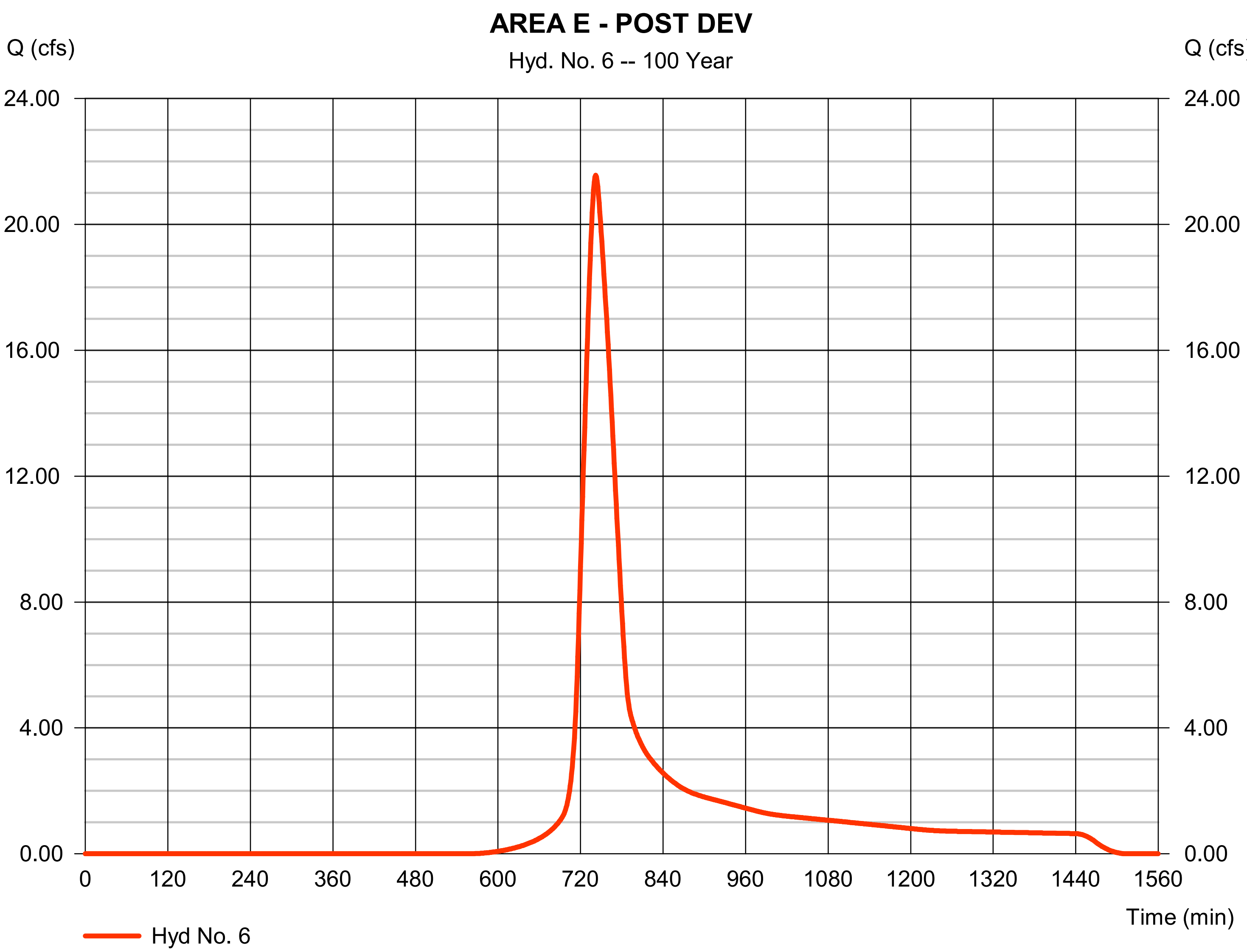
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 6

AREA E - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 21.56 cfs
Storm frequency	= 100 yrs	Time to peak	= 742 min
Time interval	= 1 min	Hyd. volume	= 118,736 cuft
Drainage area	= 9.150 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 47.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.680 x 65) + (0.330 x 98) + (5.140 x 60)] / 9.150



Hydrograph Report

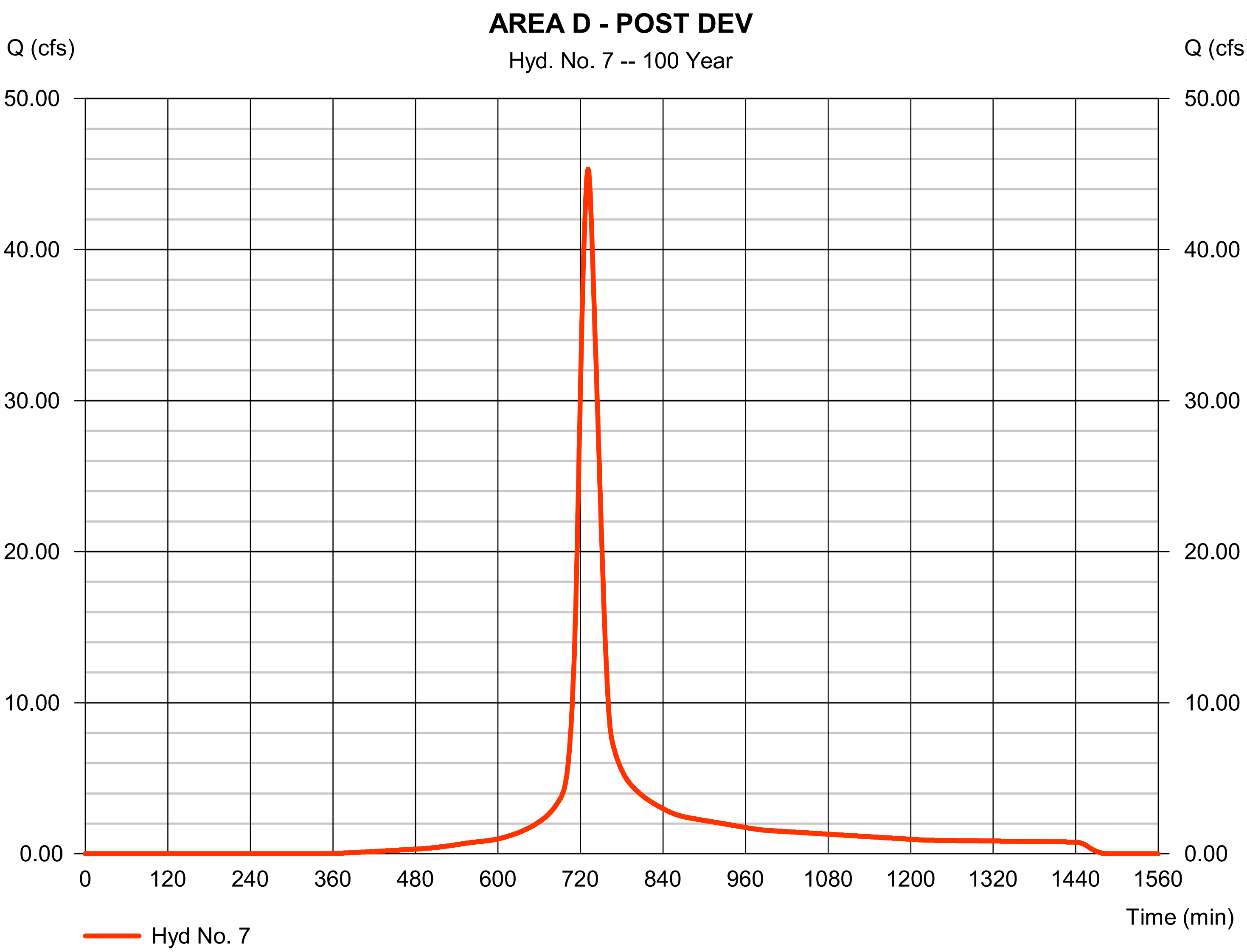
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 7

AREA D - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 45.34 cfs
Storm frequency	= 100 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 181,834 cuft
Drainage area	= 9.520 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.10 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.910 x 85) + (8.610 x 77)] / 9.520



Hydrograph Report

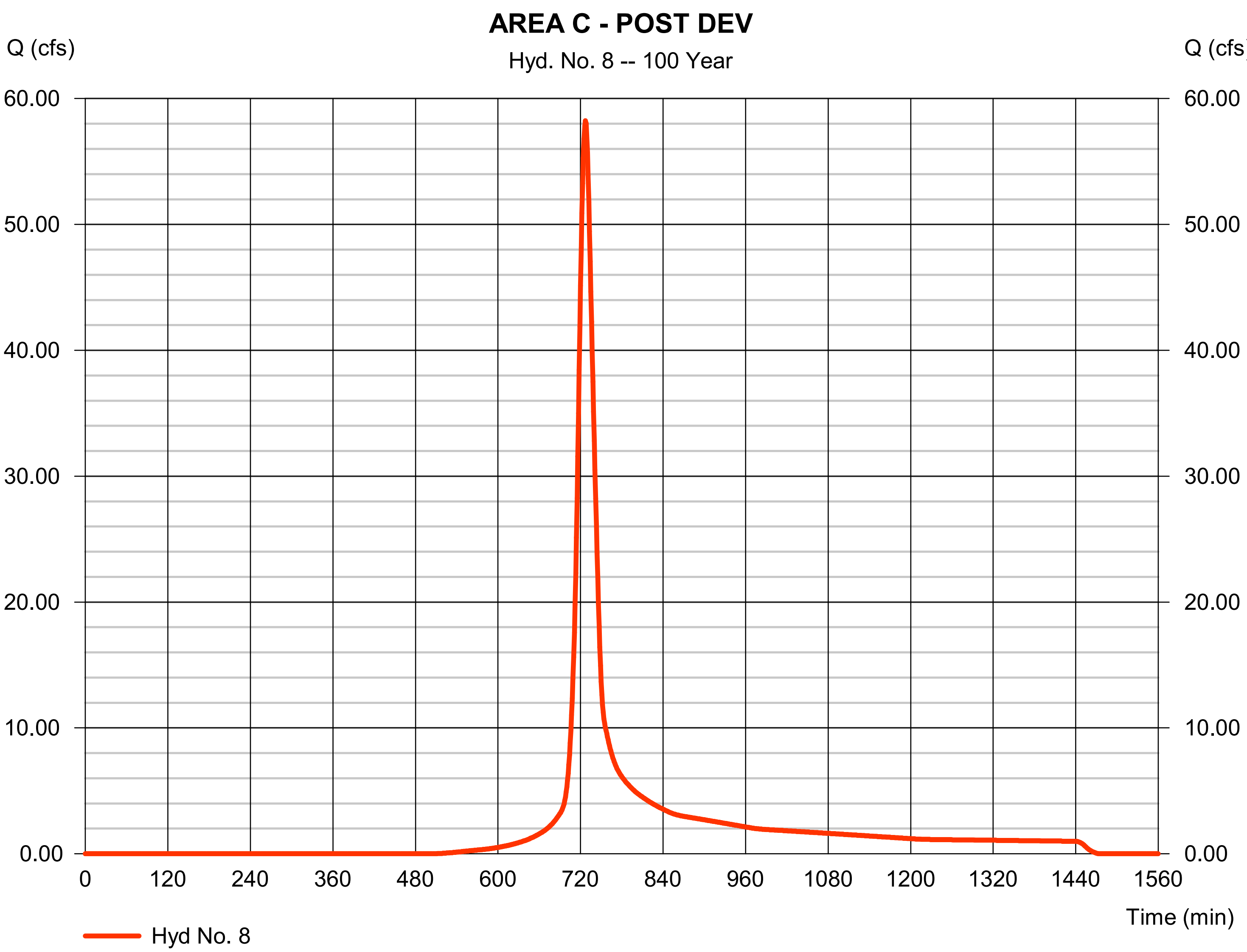
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 8

AREA C - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 58.24 cfs
Storm frequency	= 100 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 198,133 cuft
Drainage area	= 13.750 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.460 x 85) + (0.400 x 55) + (1.740 x 98) + (10.150 x 60)] / 13.750



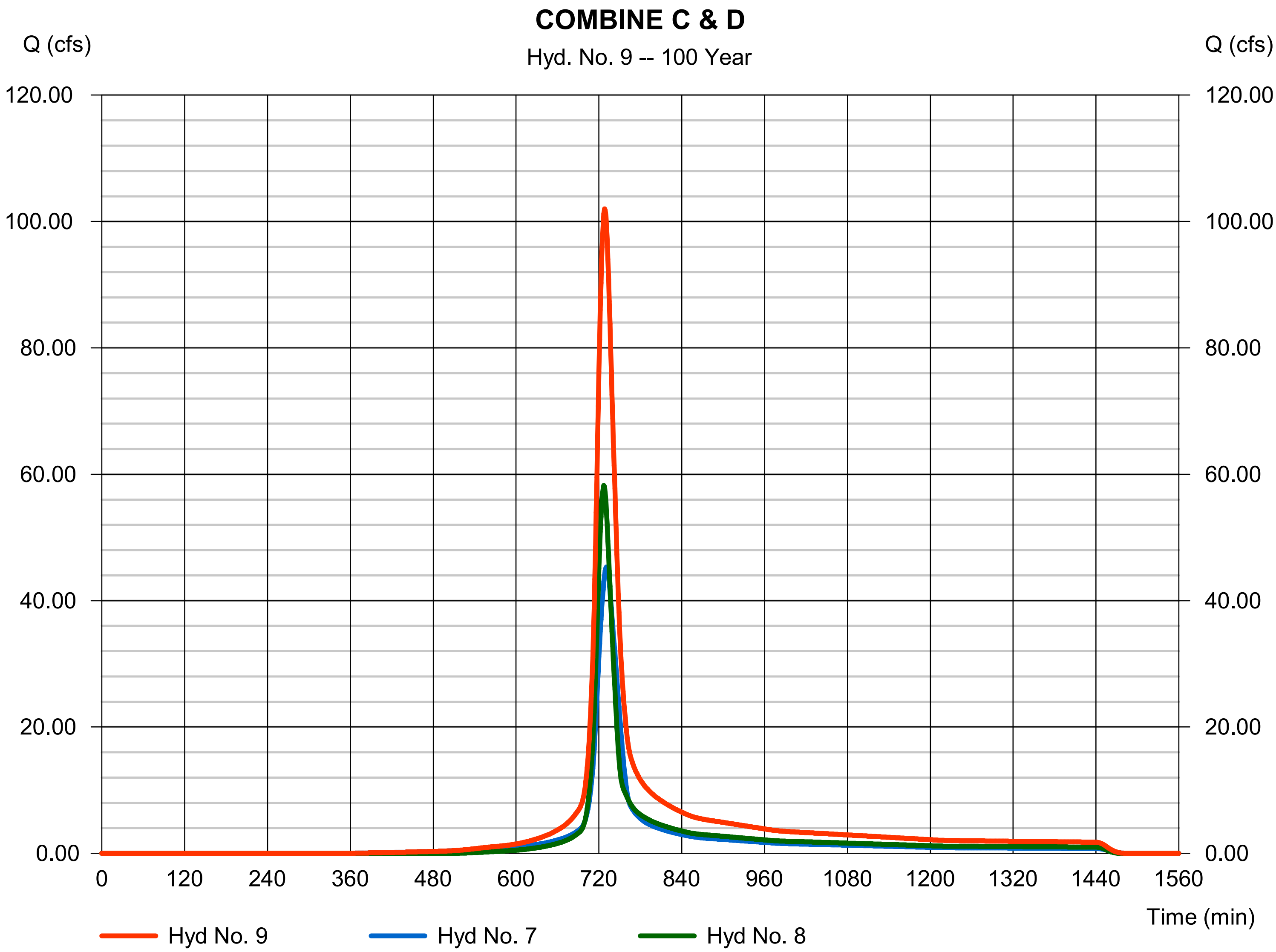
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 9

COMBINE C & D

Hydrograph type	= Combine	Peak discharge	= 102.01 cfs
Storm frequency	= 100 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 379,967 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 23.270 ac



Hydrograph Report

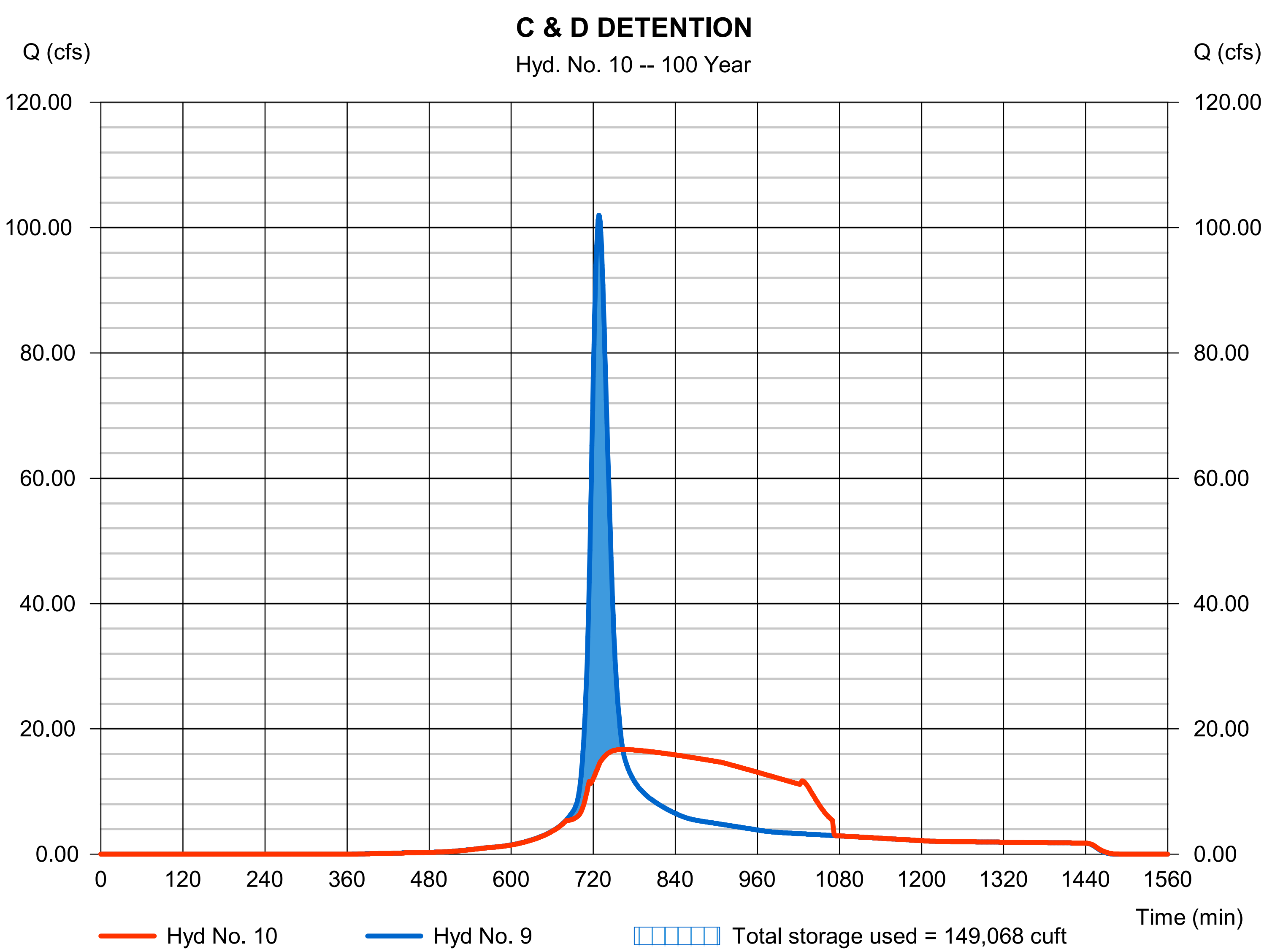
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 10

C & D DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 16.71 cfs
Storm frequency	= 100 yrs	Time to peak	= 763 min
Time interval	= 1 min	Hyd. volume	= 379,967 cuft
Inflow hyd. No.	= 9 - COMBINE C & D	Max. Elevation	= 582.71 ft
Reservoir name	= C&D DETENTION	Max. Storage	= 149,068 cuft

Storage Indication method used.



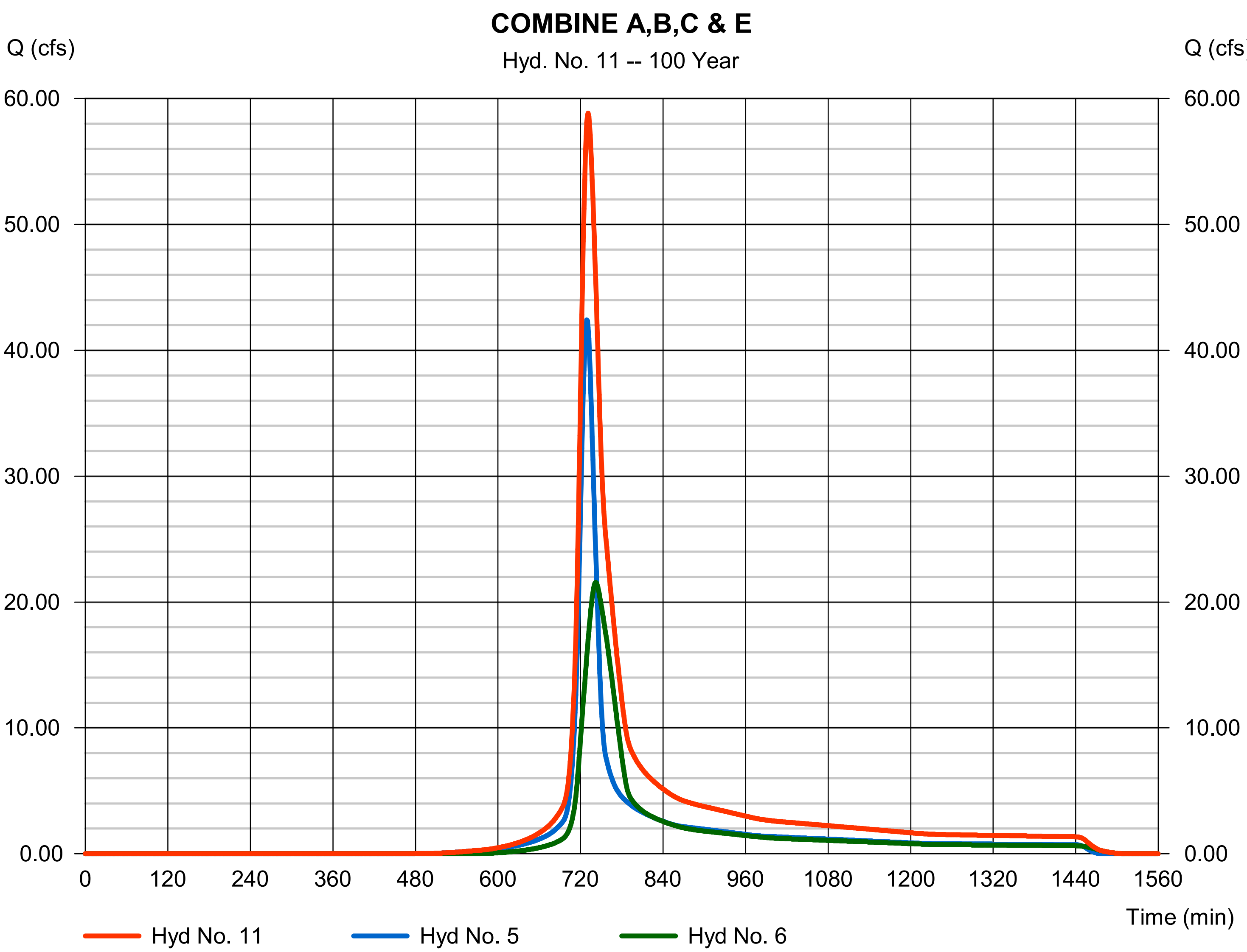
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 11

COMBINE A,B,C & E

Hydrograph type	= Combine	Peak discharge	= 58.84 cfs
Storm frequency	= 100 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 262,648 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 9.150 ac



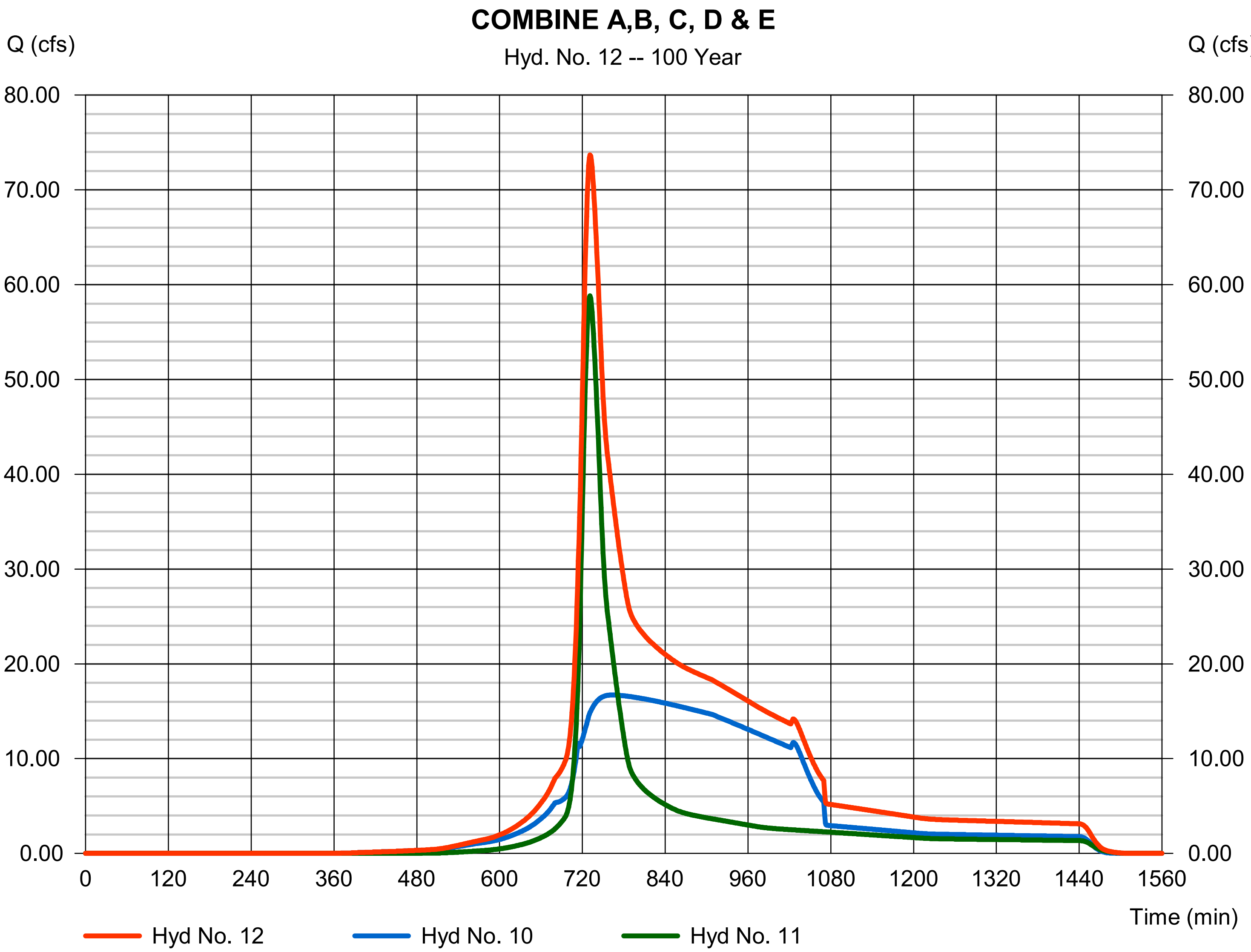
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 12

COMBINE A,B, C, D & E

Hydrograph type	= Combine	Peak discharge	= 73.69 cfs
Storm frequency	= 100 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 642,614 cuft
Inflow hyds.	= 10, 11	Contrib. drain. area	= 0.000 ac



Hydrograph Report

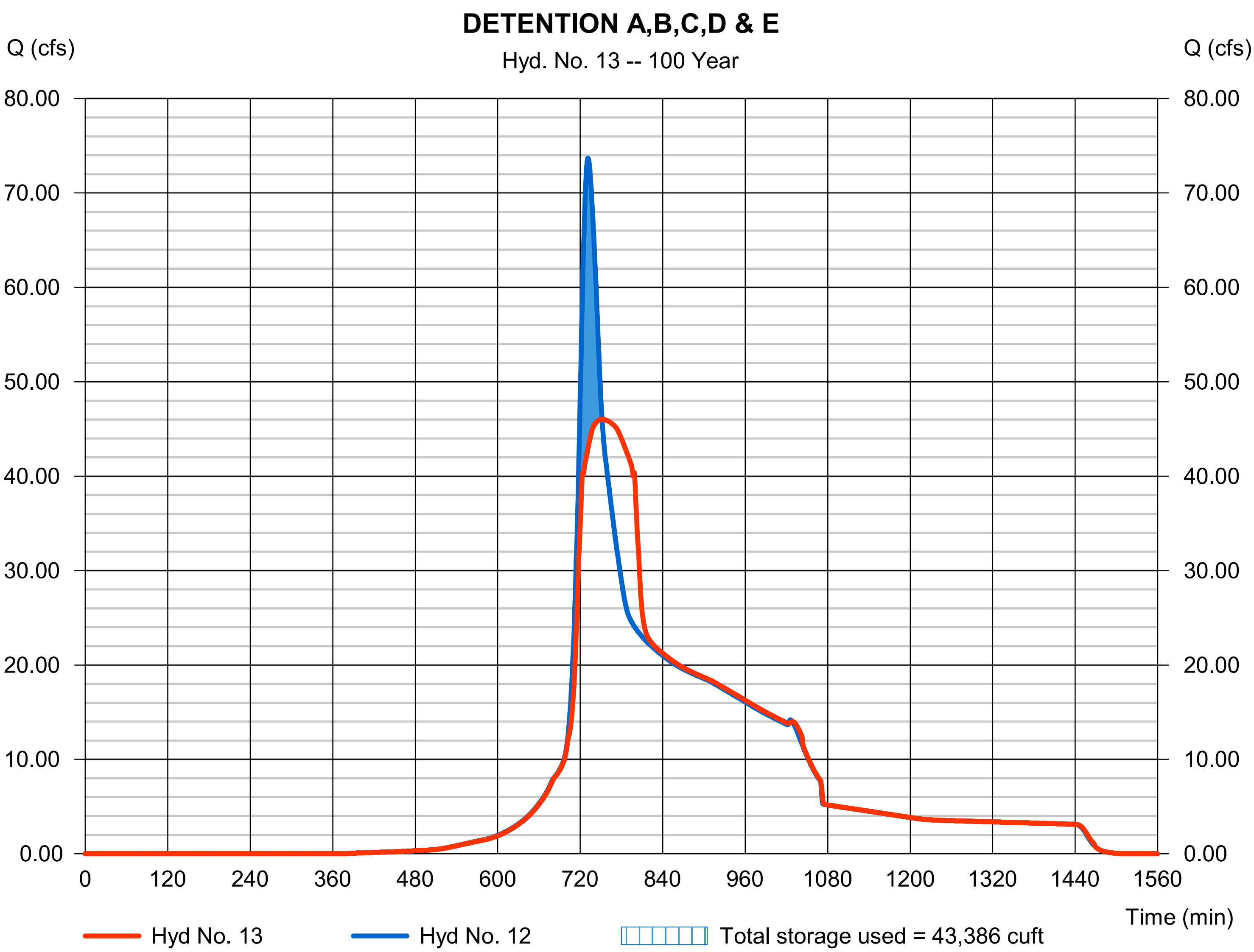
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 13

DETENTION A,B,C,D & E

Hydrograph type	= Reservoir	Peak discharge	= 46.02 cfs
Storm frequency	= 100 yrs	Time to peak	= 752 min
Time interval	= 1 min	Hyd. volume	= 642,584 cuft
Inflow hyd. No.	= 12 - COMBINE A,B, C, D & E	Max. Elevation	= 582.23 ft
Reservoir name	= A,B,C,D & E DETENTION	Max. Storage	= 43,386 cuft

Storage Indication method used.



Hydrograph Report

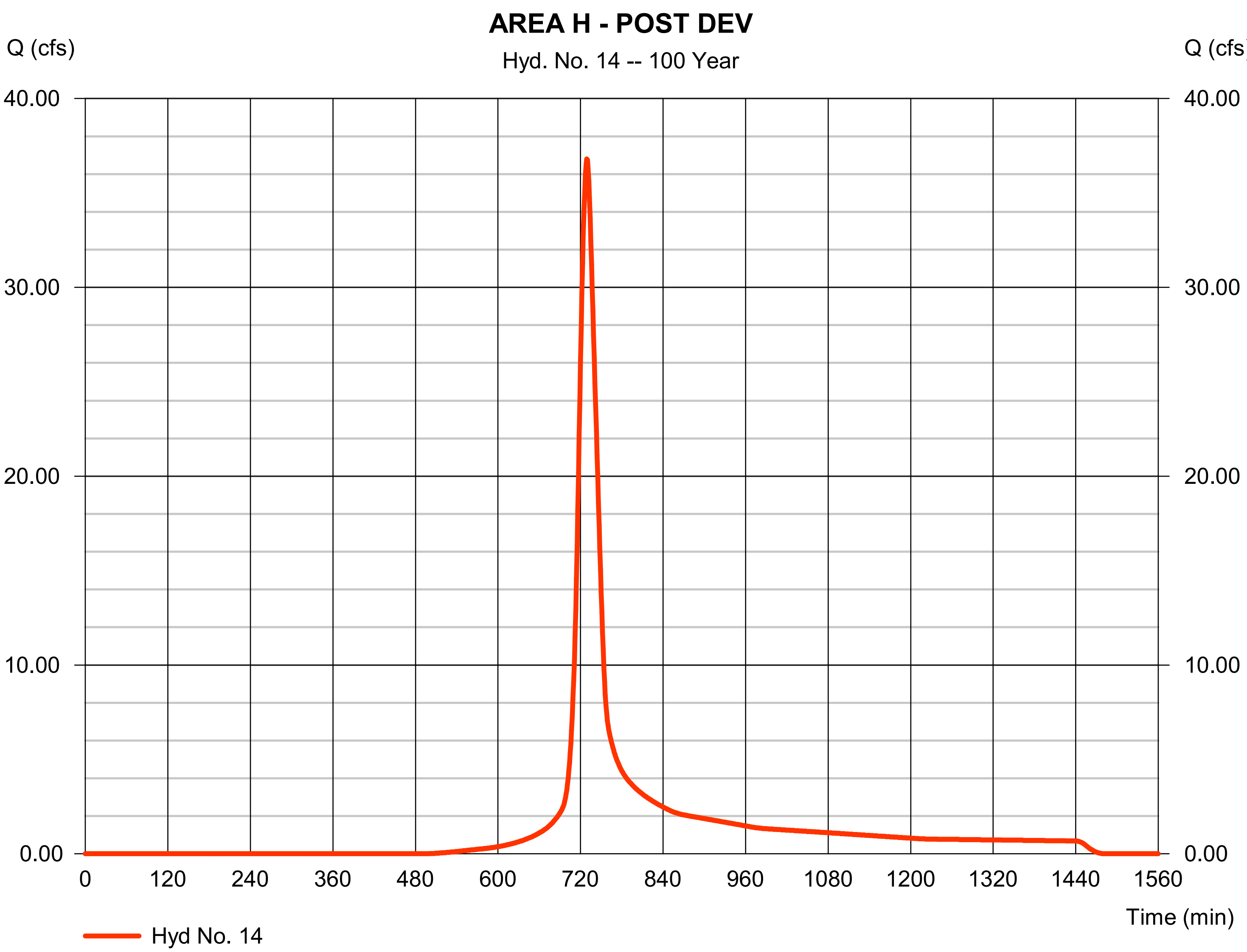
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 14

AREA H - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 36.81 cfs
Storm frequency	= 100 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 137,242 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.50 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



Hydrograph Report

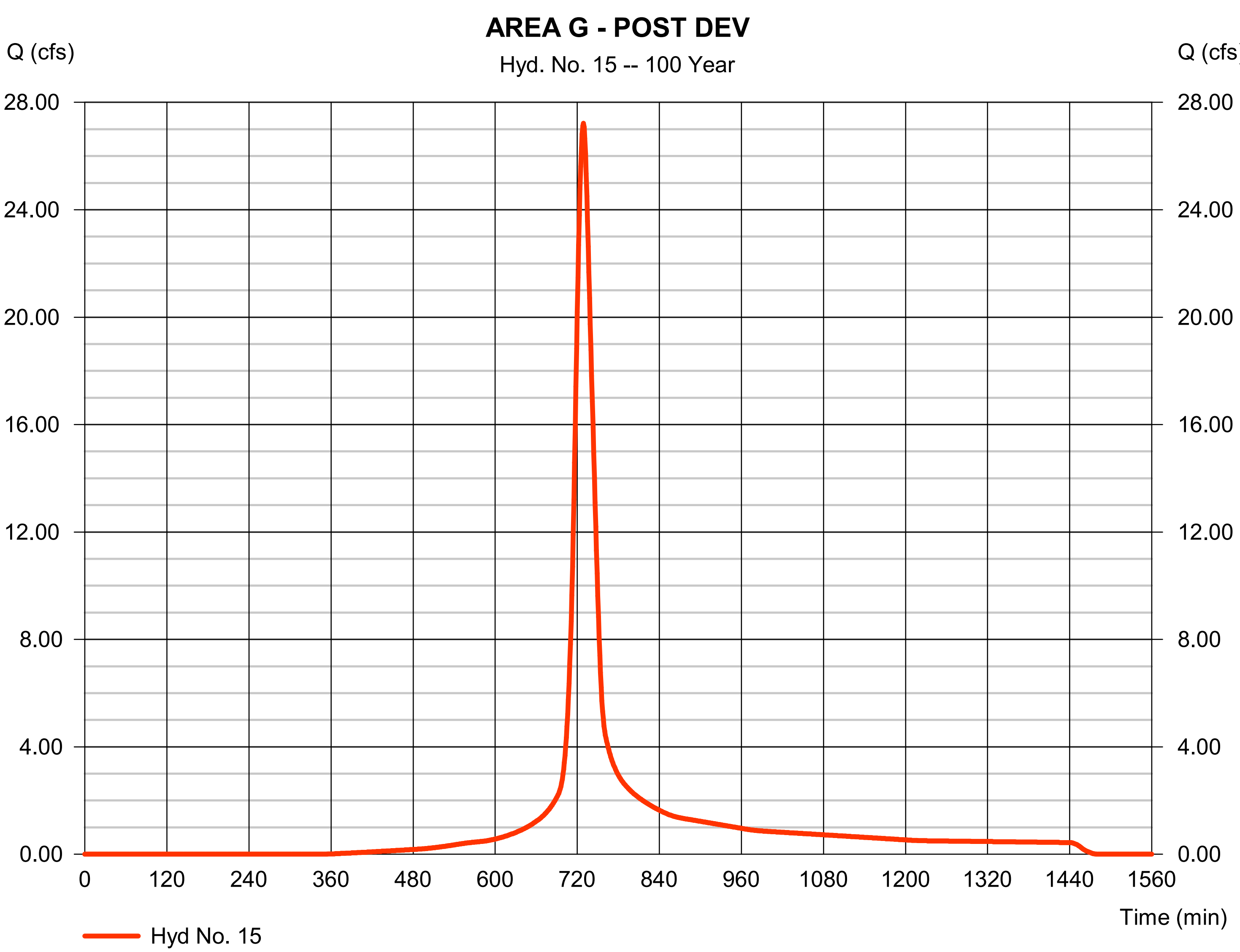
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 15

AREA G - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 27.22 cfs
Storm frequency	= 100 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 101,829 cuft
Drainage area	= 5.290 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 26.80 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.330 x 85) + (4.960 x 77)] / 5.290



Hydrograph Report

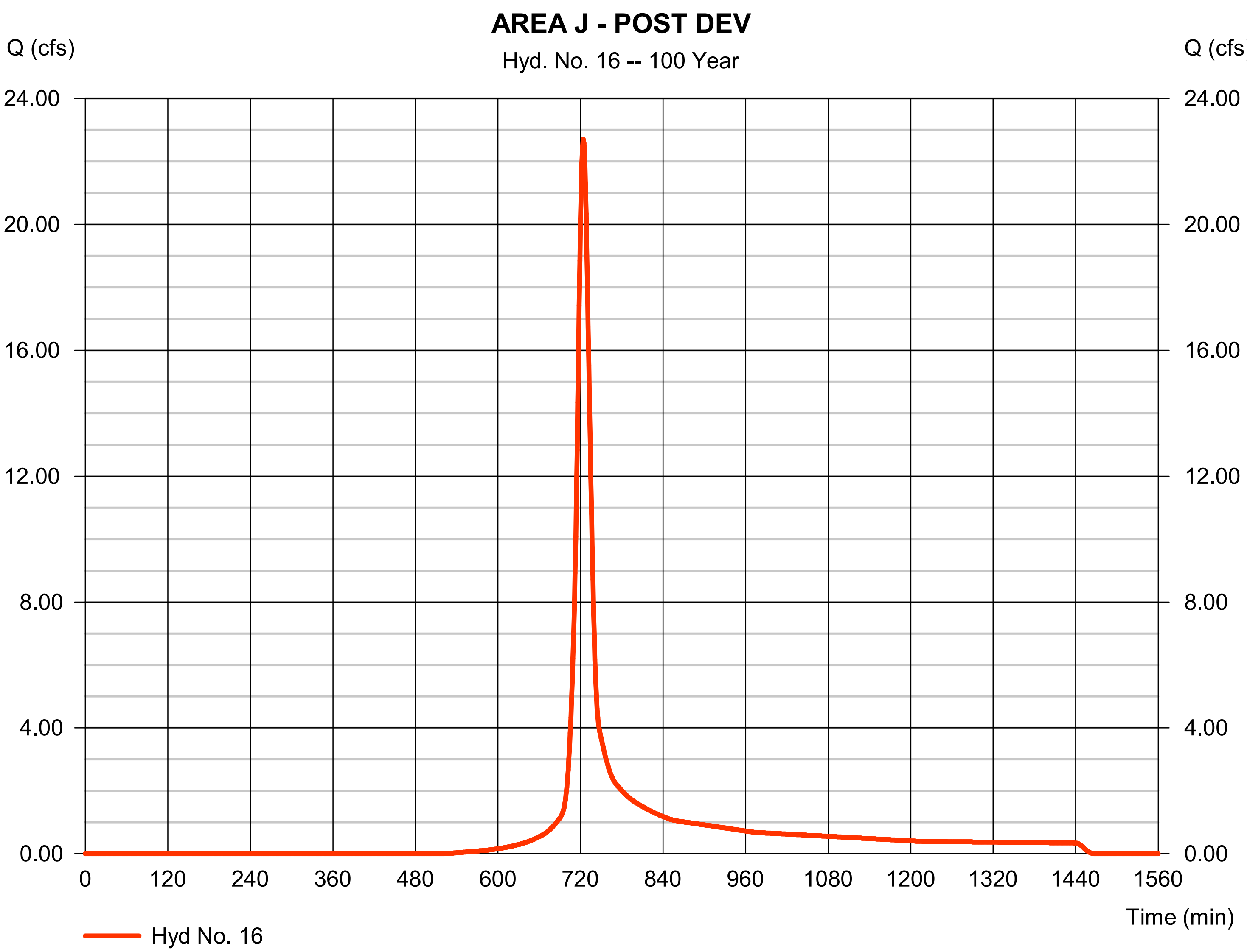
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 16

AREA J - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 22.71 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 67,343 cuft
Drainage area	= 4.820 ac	Curve number	= 66*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 85) + (0.020 x 65) + (0.680 x 98) + (4.030 x 60)] / 4.820



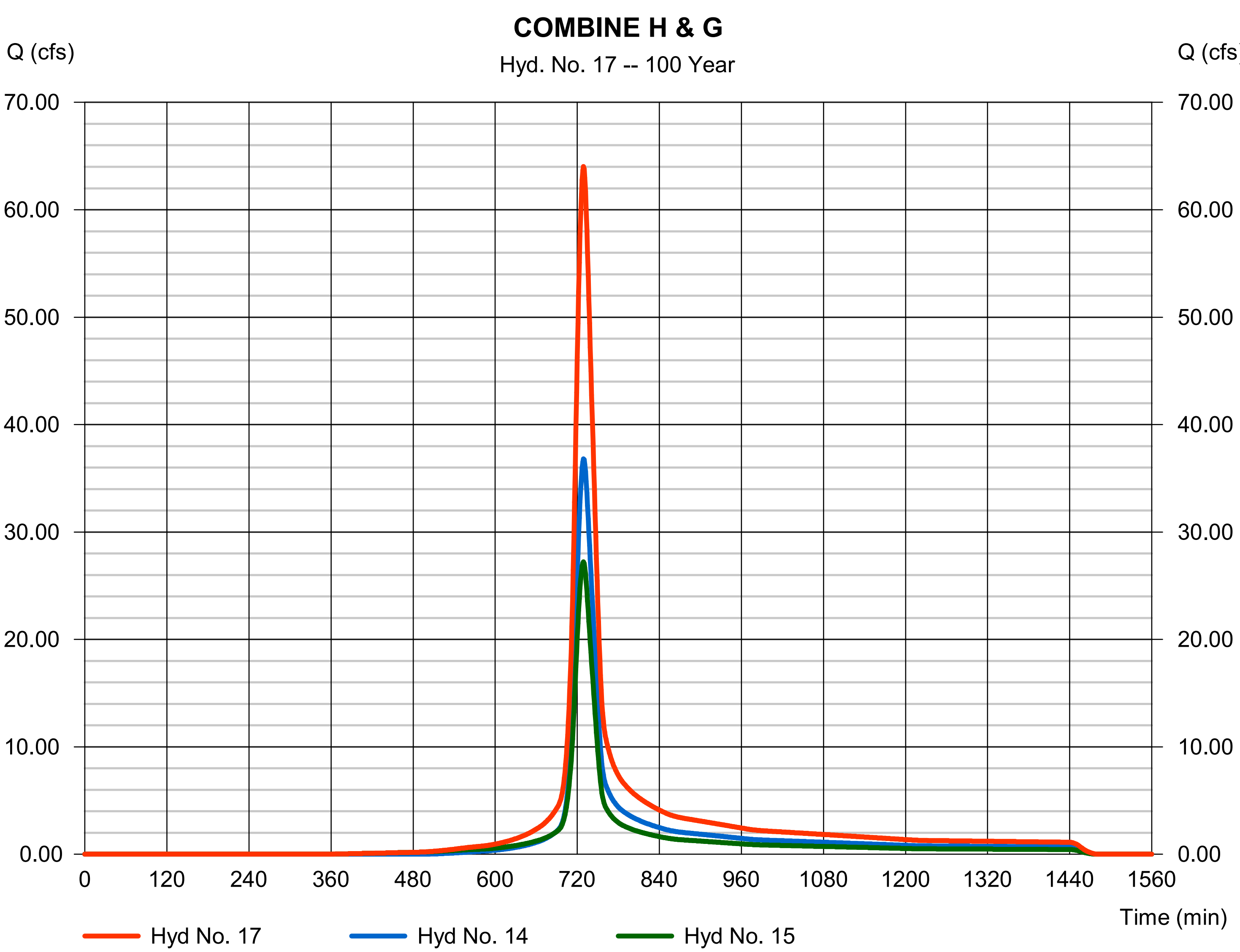
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 17

COMBINE H & G

Hydrograph type	= Combine	Peak discharge	= 64.03 cfs
Storm frequency	= 100 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 239,071 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 14.400 ac



Hydrograph Report

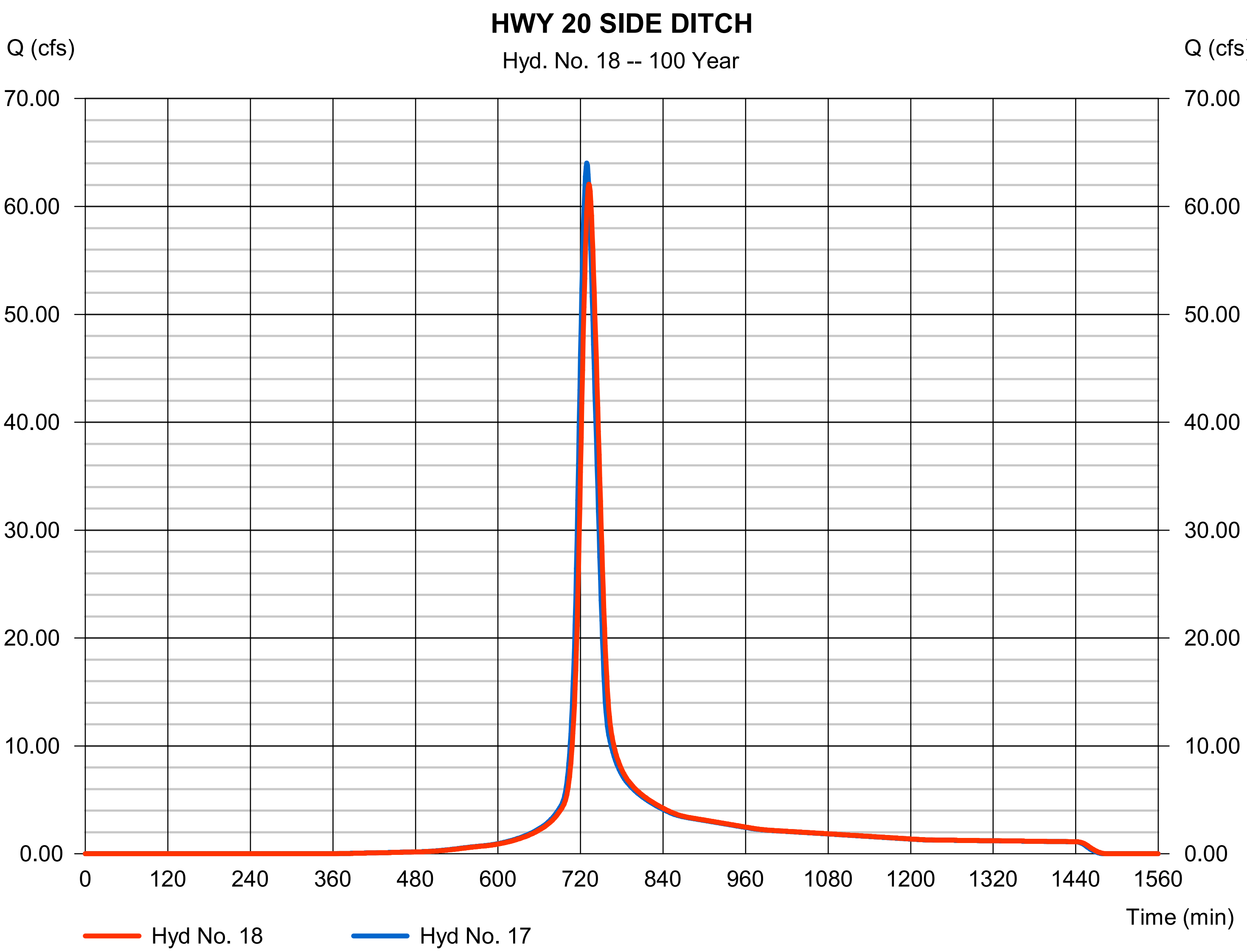
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 18

HWY 20 SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 62.06 cfs
Storm frequency	= 100 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 239,070 cuft
Inflow hyd. No.	= 17 - COMBINE H & G	Section type	= Trapezoidal
Reach length	= 900.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.030	Bottom width	= 3.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 1.688	Rating curve m	= 1.304
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.2925

Modified Att-Kin routing method used.



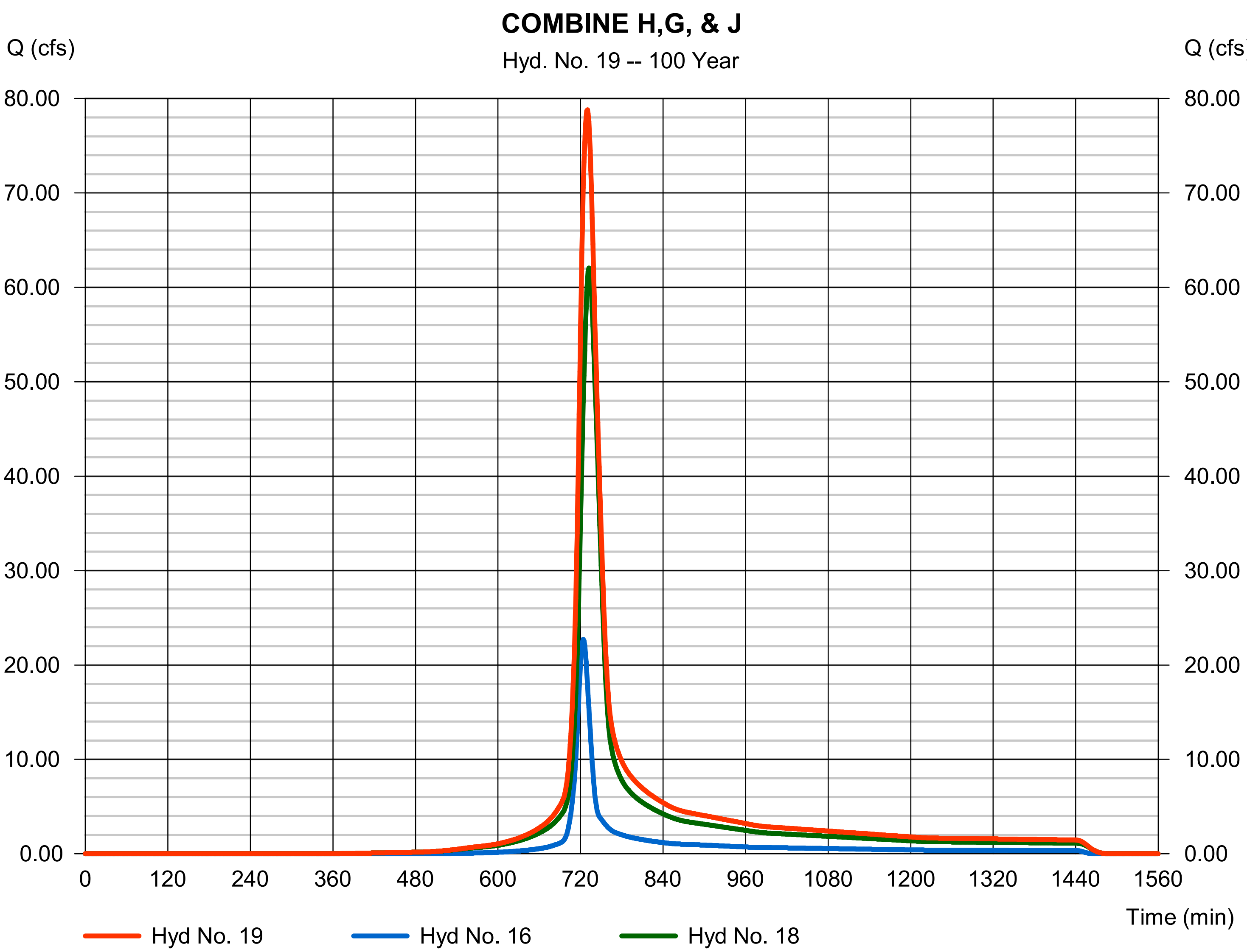
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 19

COMBINE H,G, & J

Hydrograph type	= Combine	Peak discharge	= 78.80 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 306,413 cuft
Inflow hyds.	= 16, 18	Contrib. drain. area	= 4.820 ac



Hydrograph Report

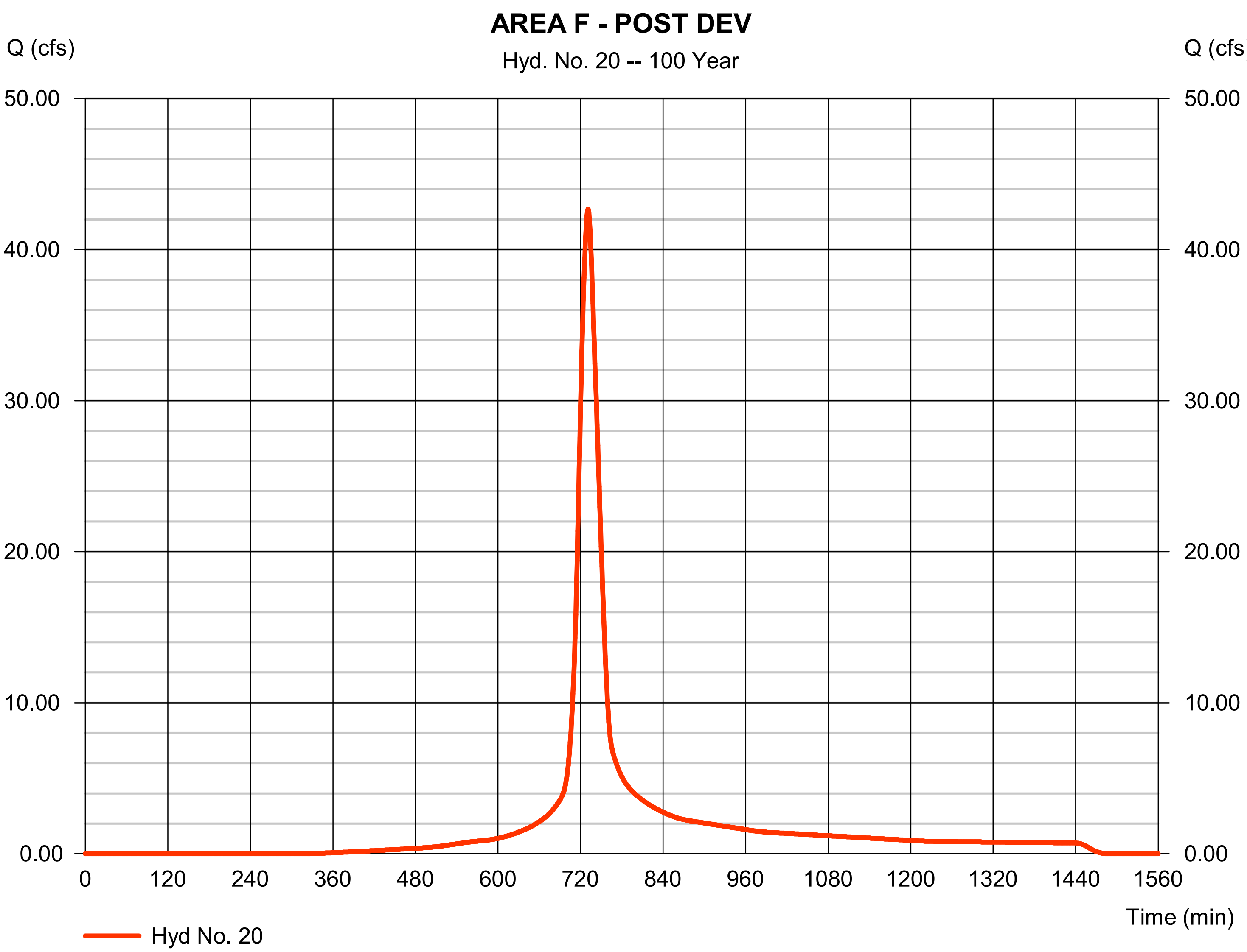
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 20

AREA F - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 42.69 cfs
Storm frequency	= 100 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 171,907 cuft
Drainage area	= 8.620 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.440 x 85) + (8.180 x 77)] / 8.620



Hydrograph Report

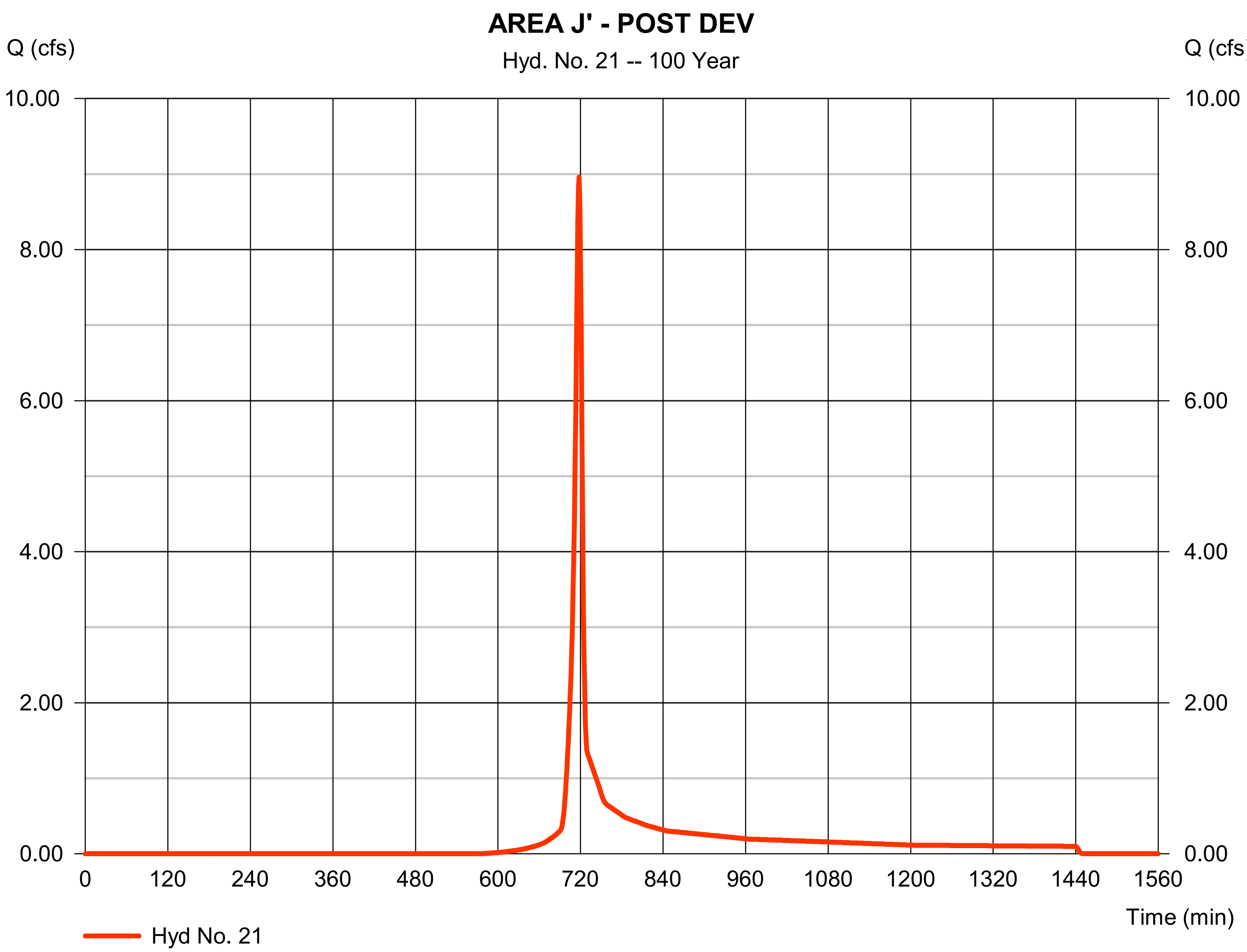
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 21

AREA J' - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 8.961 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 17,995 cuft
Drainage area	= 1.440 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.220 x 65) + (1.220 x 60)] / 1.440



Hydrograph Report

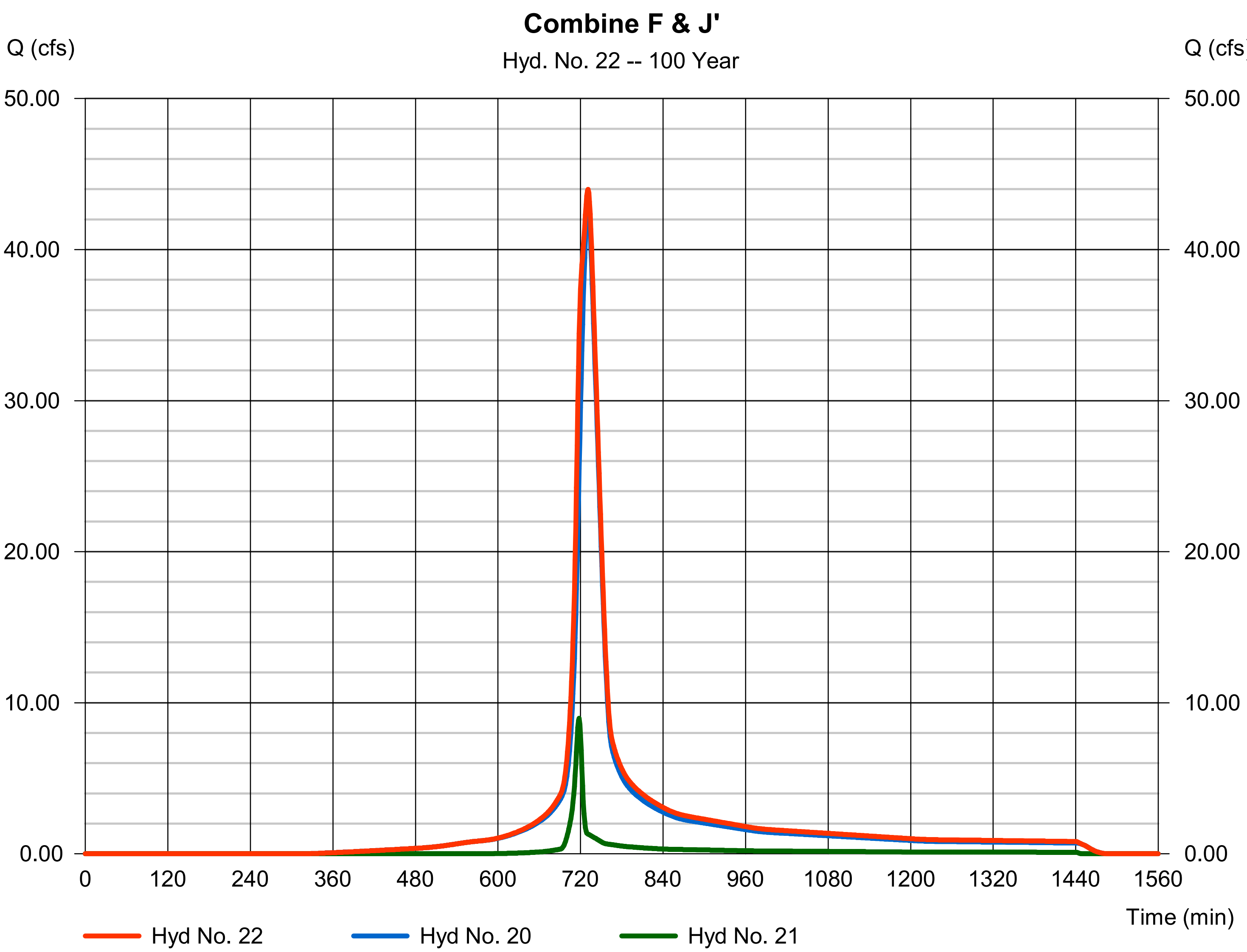
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Thursday, 11 / 15 / 2018

Hyd. No. 22

Combine F & J'

Hydrograph type	= Combine	Peak discharge	= 44.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 189,902 cuft
Inflow hyds.	= 20, 21	Contrib. drain. area	= 10.060 ac



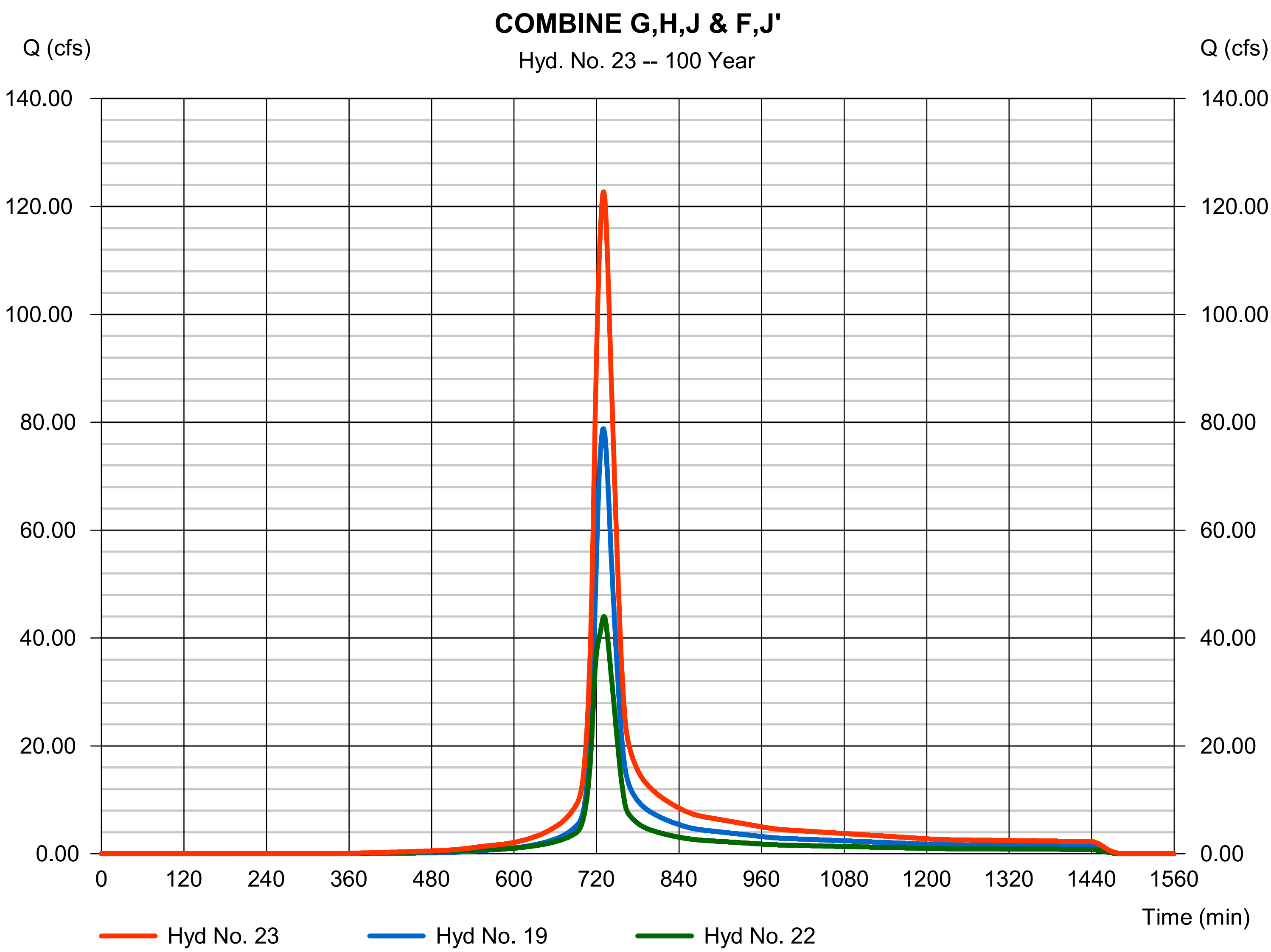
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 11 / 15 / 2018

Hyd. No. 23

COMBINE G,H,J & F,J'

Hydrograph type	= Combine	Peak discharge	= 122.71 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 496,315 cuft
Inflow hyds.	= 19, 22	Contrib. drain. area	= 0.000 ac



Hydrograph Report

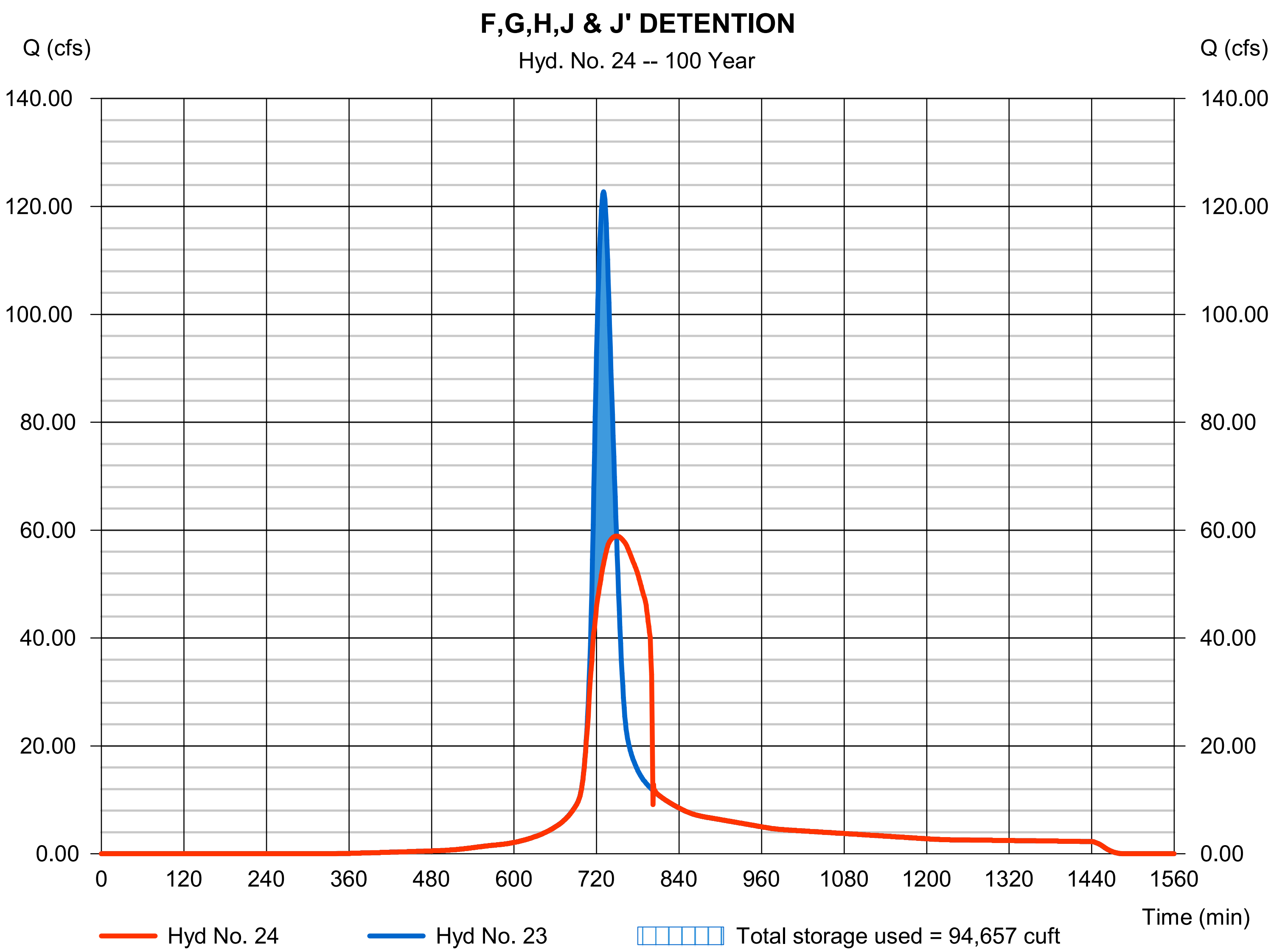
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 24

F,G,H,J & J' DETENTION

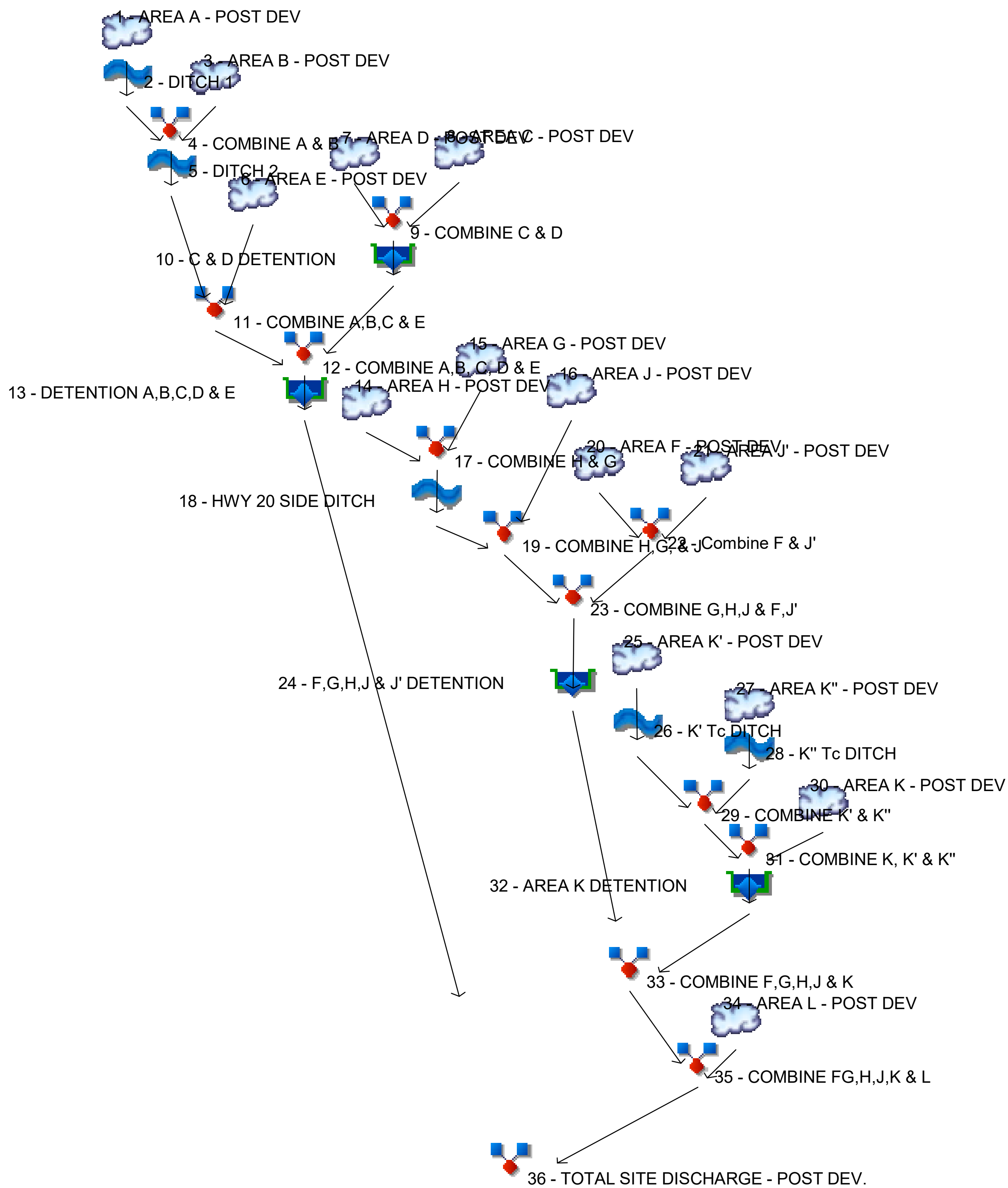
Hydrograph type	= Reservoir	Peak discharge	= 58.90 cfs
Storm frequency	= 100 yrs	Time to peak	= 749 min
Time interval	= 1 min	Hyd. volume	= 496,315 cuft
Inflow hyd. No.	= 23 - COMBINE G,H,J & F,J'	Max. Elevation	= 582.33 ft
Reservoir name	= F,G,H,J & J' DETENTION	Max. Storage	= 94,657 cuft

Storage Indication method used.



Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Project: AP3_POSTDEV_ADD_DET.gpw	Thursday, 11 / 15 / 2018

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	------	-------	-------	-------	-------	-------	9.405	11.34	13.37	AREA A - POST DEV
2	Reach	1	-------	-------	-------	-------	-------	9.020	10.92	12.91	DITCH 1
3	SCS Runoff	------	-------	-------	-------	-------	-------	20.45	25.11	30.03	AREA B - POST DEV
4	Combine	2, 3	-------	-------	-------	-------	-------	29.45	35.98	42.91	COMBINE A & B
5	Reach	4	-------	-------	-------	-------	-------	29.04	35.52	42.43	DITCH 2
6	SCS Runoff	------	-------	-------	-------	-------	-------	14.07	17.70	21.56	AREA E - POST DEV
7	SCS Runoff	------	-------	-------	-------	-------	-------	33.28	39.22	45.34	AREA D - POST DEV
8	SCS Runoff	------	-------	-------	-------	-------	-------	39.67	48.71	58.24	AREA C - POST DEV
9	Combine	7, 8	-------	-------	-------	-------	-------	71.83	86.55	102.01	COMBINE C & D
10	Reservoir	9	-------	-------	-------	-------	-------	15.16	15.92	16.71	C & D DETENTION
11	Combine	5, 6,	-------	-------	-------	-------	-------	39.62	48.96	58.84	COMBINE A,B,C & E
12	Combine	10, 11	-------	-------	-------	-------	-------	53.11	63.18	73.69	COMBINE A,B, C, D & E
13	Reservoir	12	-------	-------	-------	-------	-------	21.57	29.41	39.14	DETENTION A,B,C,D & E
14	SCS Runoff	------	-------	-------	-------	-------	-------	25.24	30.87	36.81	AREA H - POST DEV
15	SCS Runoff	------	-------	-------	-------	-------	-------	19.99	23.55	27.22	AREA G - POST DEV
16	SCS Runoff	------	-------	-------	-------	-------	-------	15.39	18.95	22.71	AREA J - POST DEV
17	Combine	14, 15,	-------	-------	-------	-------	-------	45.22	54.41	64.03	COMBINE H & G
18	Reach	17	-------	-------	-------	-------	-------	43.60	52.59	62.06	HWY 20 SIDE DITCH
19	Combine	16, 18	-------	-------	-------	-------	-------	54.75	66.49	78.80	COMBINE H,G, & J
20	SCS Runoff	------	-------	-------	-------	-------	-------	31.71	37.12	42.69	AREA F - POST DEV
21	SCS Runoff	------	-------	-------	-------	-------	-------	5.906	7.386	8.961	AREA J' - POST DEV
22	Combine	20, 21	-------	-------	-------	-------	-------	32.60	38.21	44.00	Combine F & J'
23	Combine	19, 22	-------	-------	-------	-------	-------	87.29	104.60	122.71	COMBINE G,H,J & F,J'
24	Reservoir	23	-------	-------	-------	-------	-------	66.47	71.49	75.75	F,G,H,J & J' DETENTION
25	SCS Runoff	------	-------	-------	-------	-------	-------	4.453	5.594	6.822	AREA K' - POST DEV
26	Reach	25	-------	-------	-------	-------	-------	3.466	4.429	5.475	K' Tc DITCH
27	SCS Runoff	------	-------	-------	-------	-------	-------	2.004	2.532	3.101	AREA K'' - POST DEV
28	Reach	27	-------	-------	-------	-------	-------	1.337	1.732	2.162	K'' Tc DITCH
29	Combine	26, 28	-------	-------	-------	-------	-------	4.784	6.145	7.611	COMBINE K' & K''
30	SCS Runoff	------	-------	-------	-------	-------	-------	18.71	23.63	28.94	AREA K - POST DEV
31	Combine	29, 30	-------	-------	-------	-------	-------	22.56	28.70	35.31	COMBINE K, K' & K''
32	Reservoir	31	-------	-------	-------	-------	-------	6.523	7.119	7.727	AREA K DETENTION
33	Combine	24, 32	-------	-------	-------	-------	-------	72.92	78.53	83.41	COMBINE F,G,H,J & K
34	SCS Runoff	------	-------	-------	-------	-------	-------	4.086	5.133	6.249	AREA L - POST DEV

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	
35	Combine	33, 34	-------	-------	-------	-------	-------	73.59	79.30	84.28	COMBINE FG,H,J,K & L
36	Combine	13, 35	-------	-------	-------	-------	-------	73.59	96.80	119.63	TOTAL SITE DISCHARGE - POST D

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	SCS Runoff	9.405	1	725	29,429	------	------	------	AREA A - POST DEV
2	Reach	9.020	1	728	29,427	1	------	------	DITCH 1
3	SCS Runoff	20.45	1	727	70,362	------	------	------	AREA B - POST DEV
4	Combine	29.45	1	728	99,789	2, 3	------	------	COMBINE A & B
5	Reach	29.04	1	730	99,788	4	------	------	DITCH 2
6	SCS Runoff	14.07	1	742	79,687	------	------	------	AREA E - POST DEV
7	SCS Runoff	33.28	1	731	132,879	------	------	------	AREA D - POST DEV
8	SCS Runoff	39.67	1	727	136,457	------	------	------	AREA C - POST DEV
9	Combine	71.83	1	729	269,336	7, 8	------	------	COMBINE C & D
10	Reservoir	15.16	1	759	269,335	9	582.16	94,511	C & D DETENTION
11	Combine	39.62	1	731	179,475	5, 6,	------	------	COMBINE A,B,C & E
12	Combine	53.11	1	732	448,810	10, 11	------	------	COMBINE A,B, C, D & E
13	Reservoir	21.57	1	788	305,768	12	582.14	160,171	DETENTION A,B,C,D & E
14	SCS Runoff	25.24	1	730	95,092	------	------	------	AREA H - POST DEV
15	SCS Runoff	19.99	1	729	74,414	------	------	------	AREA G - POST DEV
16	SCS Runoff	15.39	1	724	46,094	------	------	------	AREA J - POST DEV
17	Combine	45.22	1	729	169,506	14, 15,	------	------	COMBINE H & G
18	Reach	43.60	1	733	169,504	17	------	------	HWY 20 SIDE DITCH
19	Combine	54.75	1	730	215,598	16, 18	------	------	COMBINE H,G, & J
20	SCS Runoff	31.71	1	731	126,821	------	------	------	AREA F - POST DEV
21	SCS Runoff	5.906	1	718	11,907	------	------	------	AREA J' - POST DEV
22	Combine	32.60	1	731	138,728	20, 21	------	------	Combine F & J'
23	Combine	87.29	1	731	354,326	19, 22	------	------	COMBINE G,H,J & F,J'
24	Reservoir	66.47	1	741	354,326	23	580.30	24,089	F,G,H,J & J' DETENTION
25	SCS Runoff	4.453	1	726	14,349	------	------	------	AREA K' - POST DEV
26	Reach	3.466	1	733	14,343	25	------	------	K' Tc DITCH
27	SCS Runoff	2.004	1	726	6,495	------	------	------	AREA K'' - POST DEV
28	Reach	1.337	1	735	6,486	27	------	------	K'' Tc DITCH
29	Combine	4.784	1	734	20,829	26, 28	------	------	COMBINE K' & K''
30	SCS Runoff	18.71	1	726	60,617	------	------	------	AREA K - POST DEV
31	Combine	22.56	1	726	81,447	29, 30	------	------	COMBINE K, K' & K''
32	Reservoir	6.523	1	750	81,312	31	582.34	24,329	AREA K DETENTION
33	Combine	72.92	1	741	435,636	24, 32	------	------	COMBINE F,G,H,J & K
34	SCS Runoff	4.086	1	721	10,038	------	------	------	AREA L - POST DEV

AP3_POSTDEV_ADD_DET.gpw	Return Period: 25 Year	Thursday, 11 / 15 / 2018

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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
35	Combine	73.59	1	741	445,674	33, 34	------	------	COMBINE FG,H,J,K & L
36	Combine	73.59	1	741	751,440	13, 35	------	------	TOTAL SITE DISCHARGE - POST D

Hydrograph Report

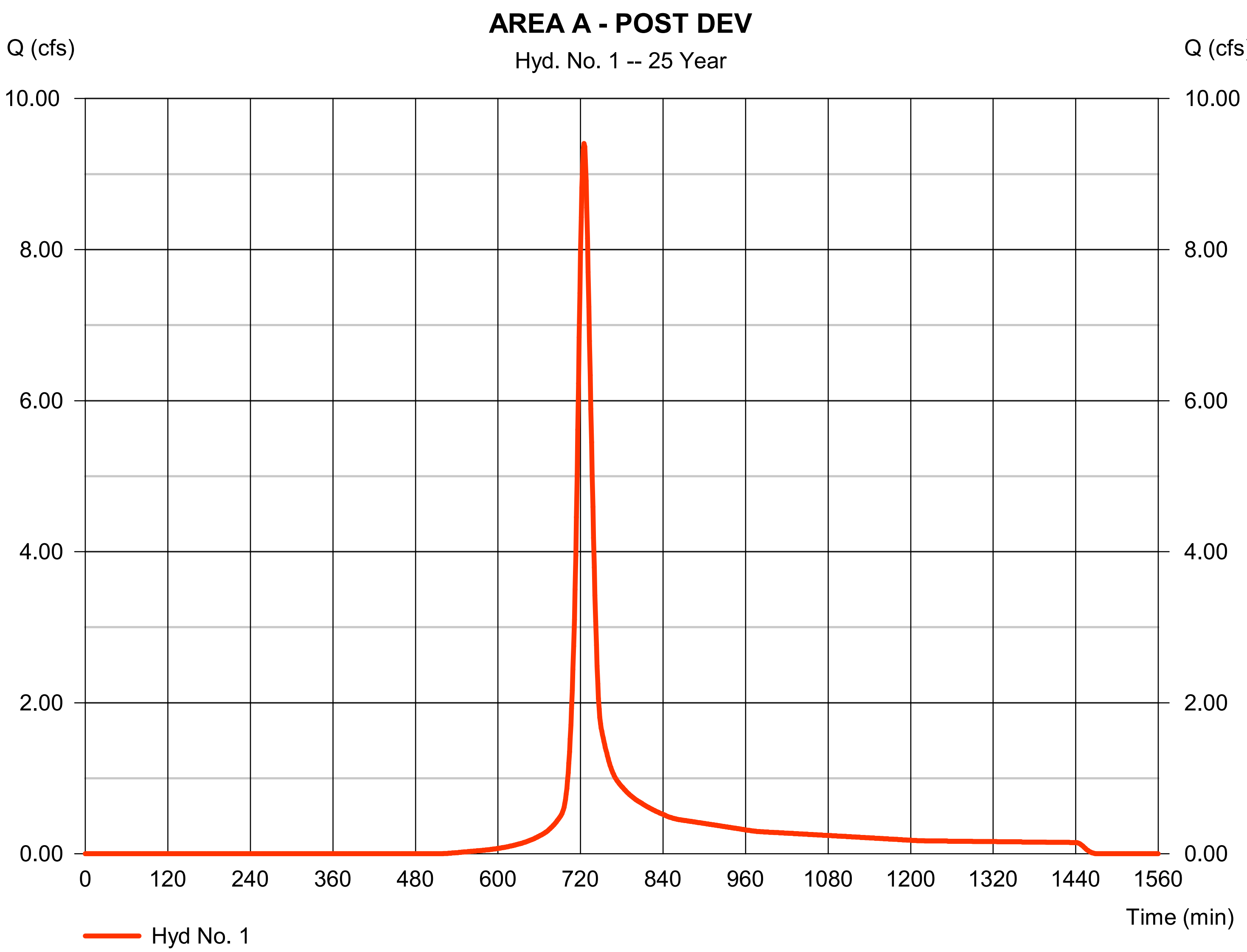
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 1

AREA A - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 9.405 cfs
Storm frequency	= 25 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 29,429 cuft
Drainage area	= 2.580 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.10 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.220 x 85) + (0.570 x 55) + (0.030 x 98) + (0.760 x 60)] / 2.580



TR55 Tc Worksheet

Hyd. No. 1

AREA A - POST DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		0.00		0.00		
Land slope (%)	= 16.00		0.00		0.00		
Travel Time (min)	**= 3.27**	**+**	**0.00**	**+**	**0.00**	**=**	**3.27**
Shallow Concentrated Flow							
Flow length (ft)	= 620.00		0.00		0.00		
Watercourse slope (%)	= 0.17		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=0.67		0.00		0.00		
Travel Time (min)	**= 15.53**	**+**	**0.00**	**+**	**0.00**	**=**	**15.53**
Channel Flow							
X sectional flow area (sqft)	= 2.89		0.00		0.00		
Wetted perimeter (ft)	= 7.29		0.00		0.00		
Channel slope (%)	= 0.50		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=1.89		0.00		0.00		
Flow length (ft)	({0})150.0		0.0		0.0		
Travel Time (min)	**= 1.32**	**+**	**0.00**	**+**	**0.00**	**=**	**1.32**

Total Travel Time, Tc .... **20.10 min**

Hydrograph Report

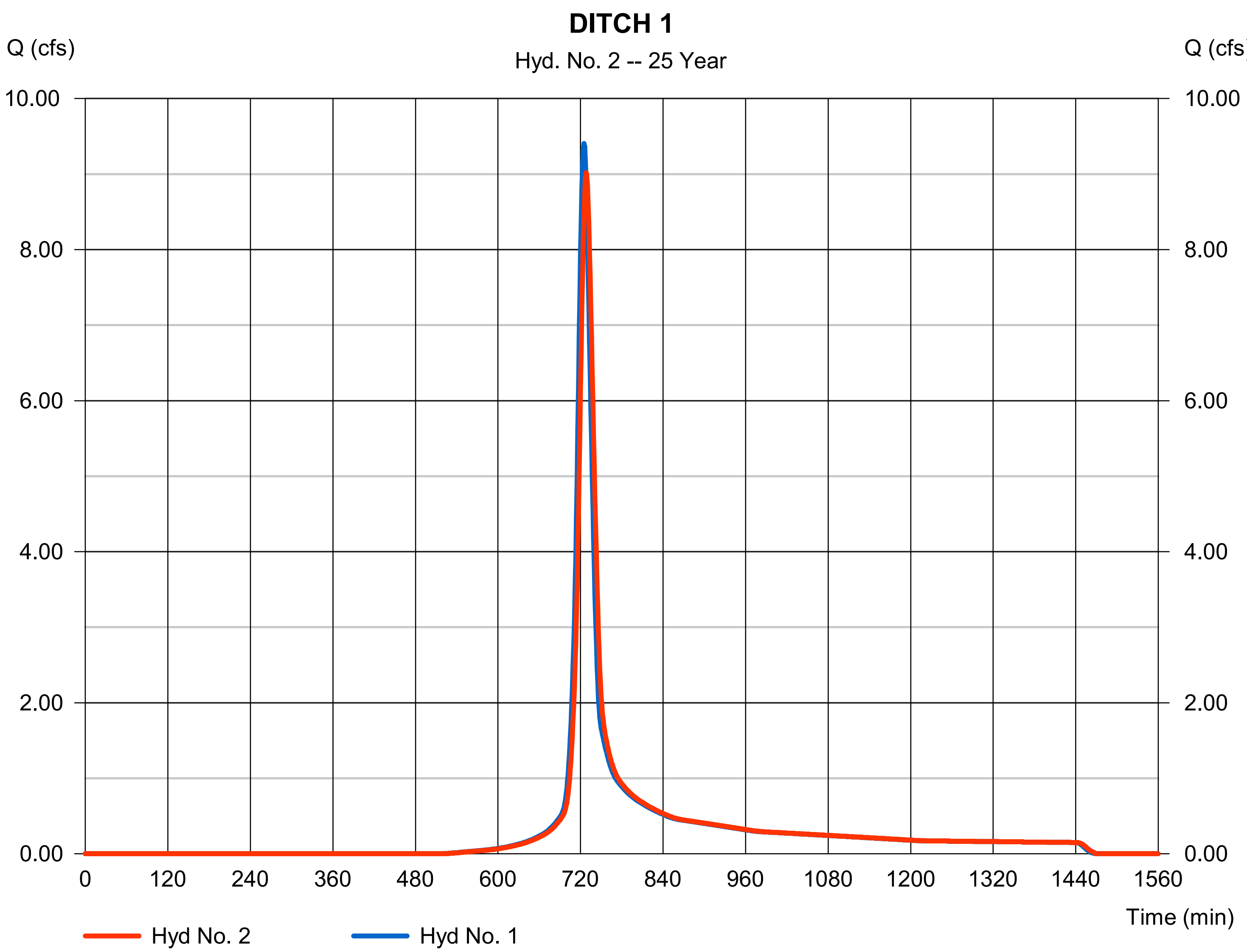
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 2

DITCH 1

Hydrograph type	= Reach	Peak discharge	= 9.020 cfs
Storm frequency	= 25 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 29,427 cuft
Inflow hyd. No.	= 1 - AREA A - POST DEV	Section type	= Trapezoidal
Reach length	= 730.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 10.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.375
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.3038

Modified Att-Kin routing method used.



Hydrograph Report

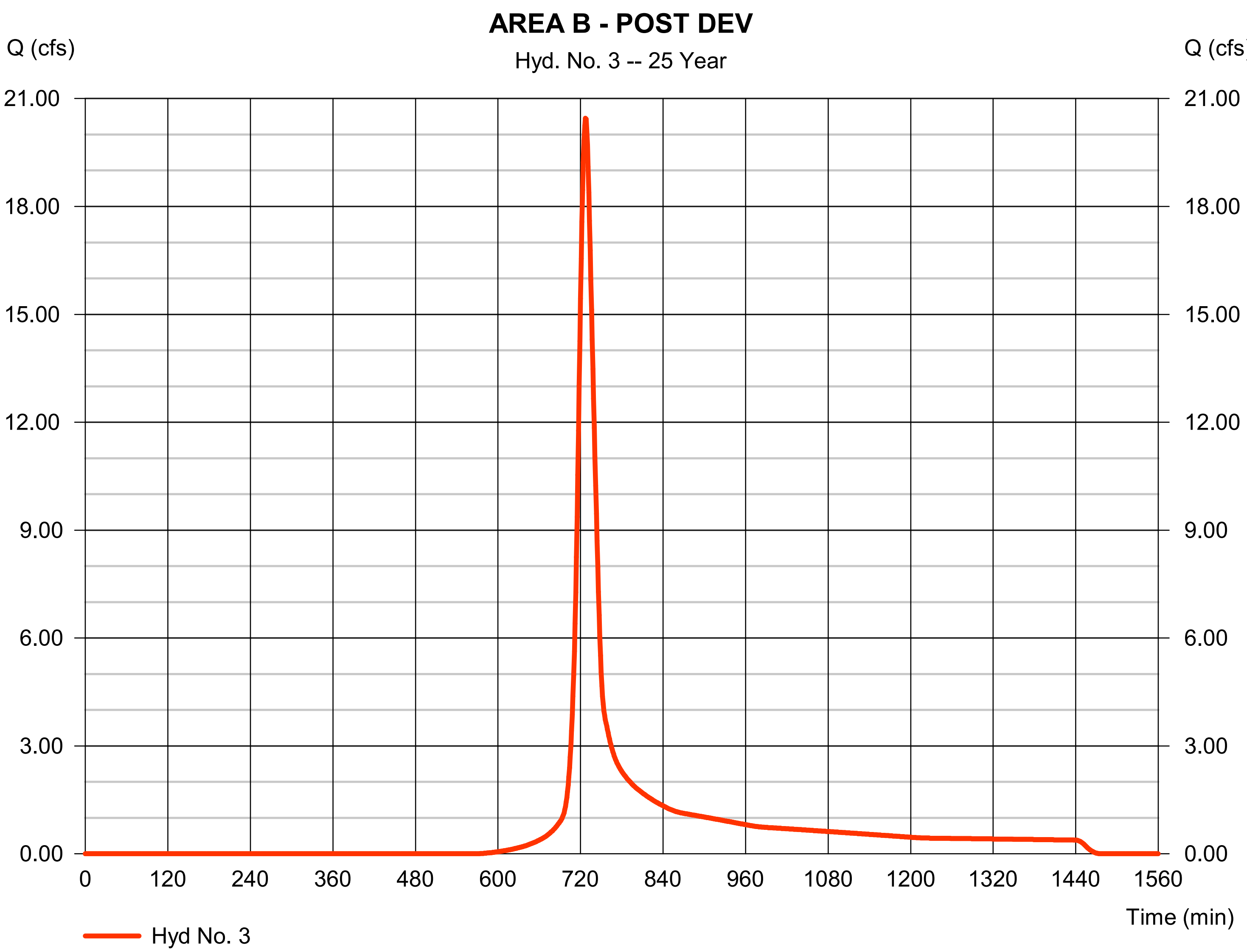
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 3

AREA B - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 20.45 cfs
Storm frequency	= 25 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 70,362 cuft
Drainage area	= 7.090 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.60 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.930 x 85) + (2.120 x 55) + (0.250 x 98) + (2.790 x 60)] / 7.090



TR55 Tc Worksheet

Hyd. No. 3

AREA B - POST DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.300		0.011		0.011		
Flow length (ft)	= 150.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		0.00		0.00		
Land slope (%)	= 3.60		0.00		0.00		
Travel Time (min)	**= 17.07**	**+**	**0.00**	**+**	**0.00**	**=**	**17.07**
Shallow Concentrated Flow							
Flow length (ft)	= 0.00		0.00		0.00		
Watercourse slope (%)	= 0.00		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=0.00		0.00		0.00		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow							
X sectional flow area (sqft)	= 5.60		5.04		0.00		
Wetted perimeter (ft)	= 18.05		14.27		0.00		
Channel slope (%)	= 0.80		0.66		0.00		
Manning's n-value	= 0.030		0.027		0.015		
Velocity (ft/s)	=2.03		2.23		0.00		
Flow length (ft)	({0})500.0		320.0		0.0		
Travel Time (min)	**= 4.11**	**+**	**2.39**	**+**	**0.00**	**=**	**6.50**

Total Travel Time, Tc .... 23.60 min

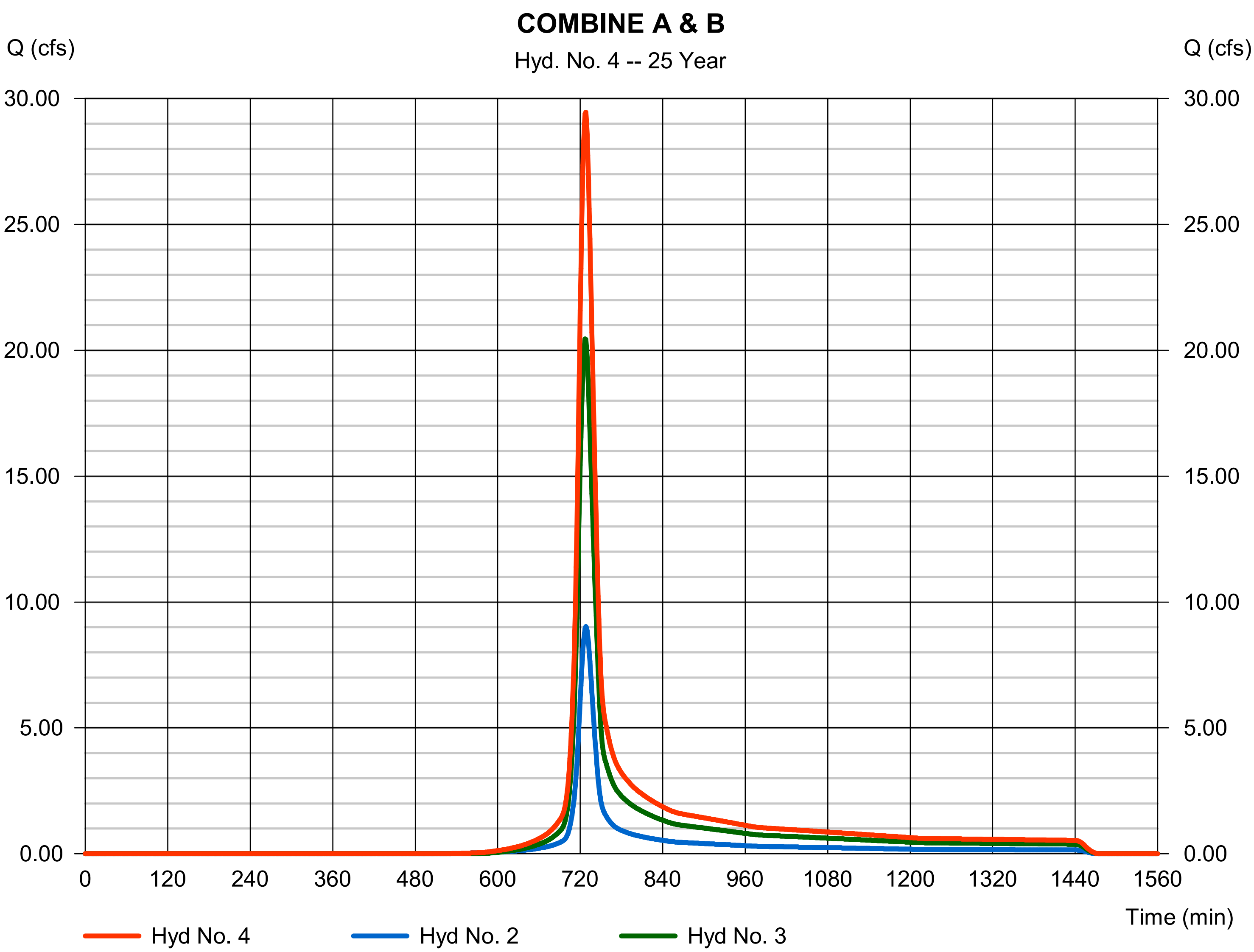
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 4

COMBINE A & B

Hydrograph type	= Combine	Peak discharge	= 29.45 cfs
Storm frequency	= 25 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 99,789 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 7.090 ac



Hydrograph Report

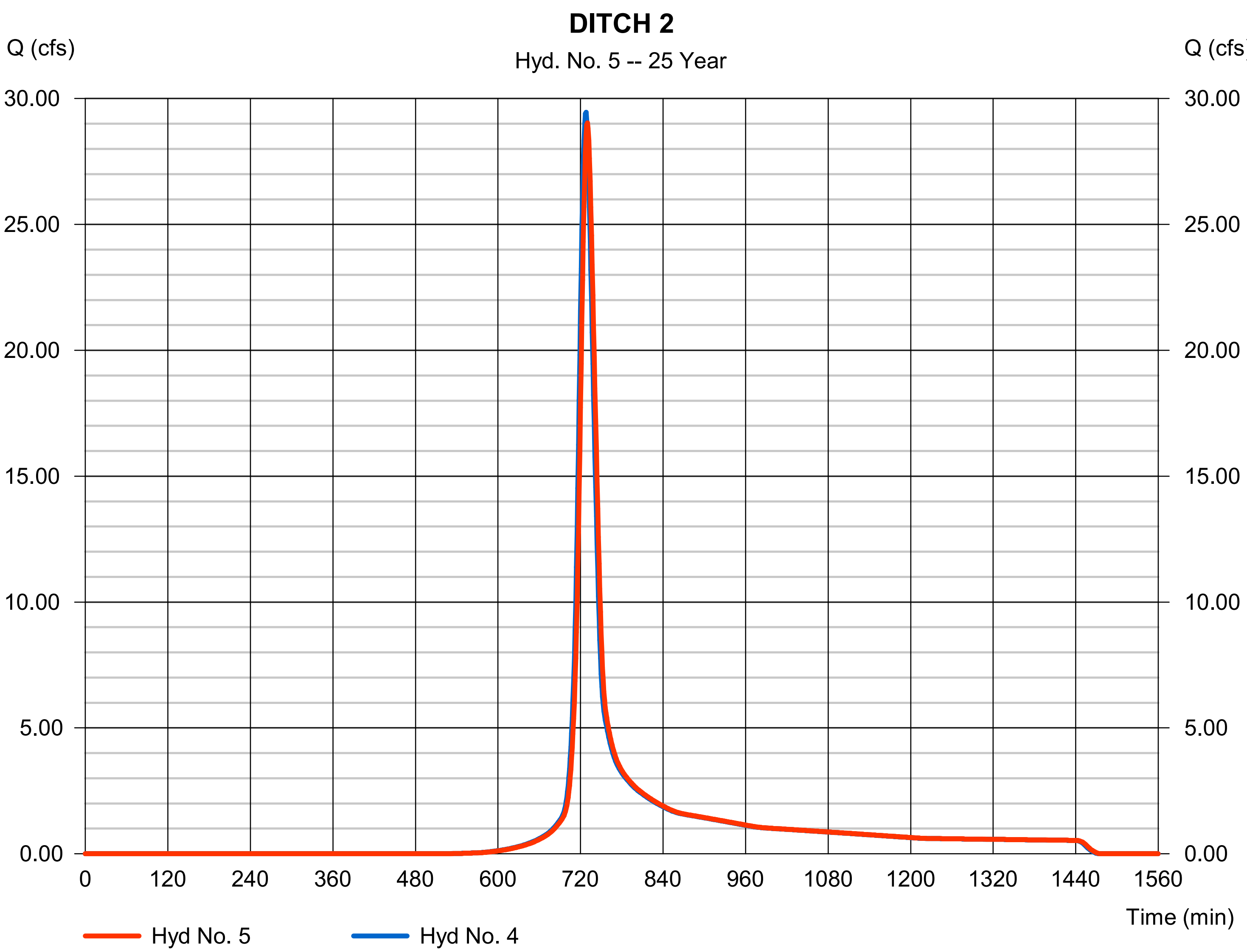
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 5

DITCH 2

Hydrograph type	= Reach	Peak discharge	= 29.04 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 99,788 cuft
Inflow hyd. No.	= 4 - COMBINE A & B	Section type	= Trapezoidal
Reach length	= 610.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.373
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.4511

Modified Att-Kin routing method used.



Hydrograph Report

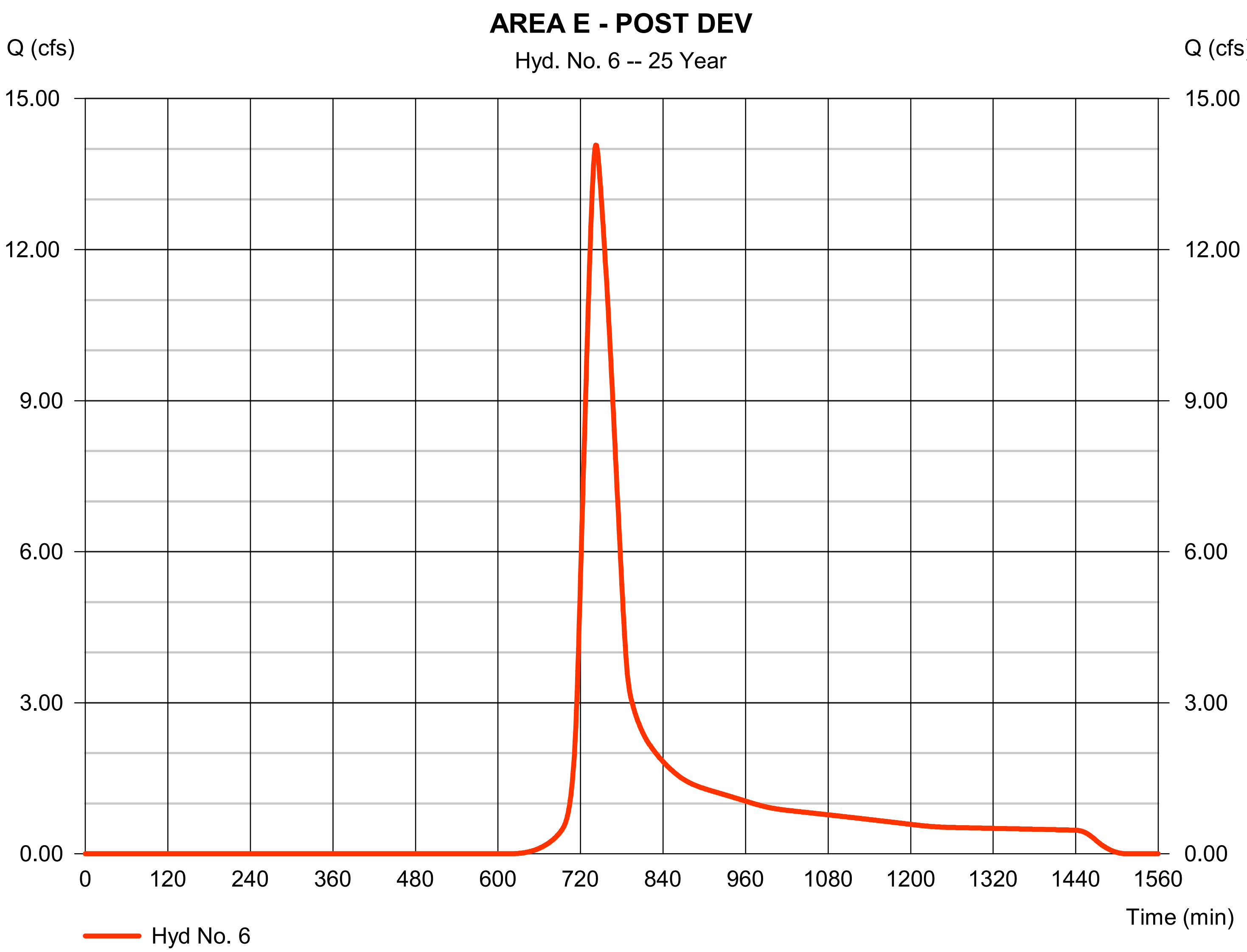
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 6

AREA E - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 14.07 cfs
Storm frequency	= 25 yrs	Time to peak	= 742 min
Time interval	= 1 min	Hyd. volume	= 79,687 cuft
Drainage area	= 9.150 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 47.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.680 x 65) + (0.330 x 98) + (5.140 x 60)] / 9.150



TR55 Tc Worksheet

Hyd. No. 6

AREA E - POST DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 80.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		0.00		0.00		
Land slope (%)	= 1.20		0.00		0.00		
Travel Time (min)	**= 13.40**	**+**	**0.00**	**+**	**0.00**	**=**	**13.40**
Shallow Concentrated Flow							
Flow length (ft)	= 0.00		0.00		0.00		
Watercourse slope (%)	= 0.00		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=0.00		0.00		0.00		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow							
X sectional flow area (sqft)	= 7.51		5.60		0.00		
Wetted perimeter (ft)	= 19.73		9.32		0.00		
Channel slope (%)	= 0.45		0.45		0.00		
Manning's n-value	= 0.065		0.065		0.015		
Velocity (ft/s)	=0.81		1.09		0.00		
Flow length (ft)	({0})520.0		1500.0		0.0		
Travel Time (min)	**= 10.76**	**+**	**22.87**	**+**	**0.00**	**=**	**33.63**

Total Travel Time, Tc .... 47.00 min

Hydrograph Report

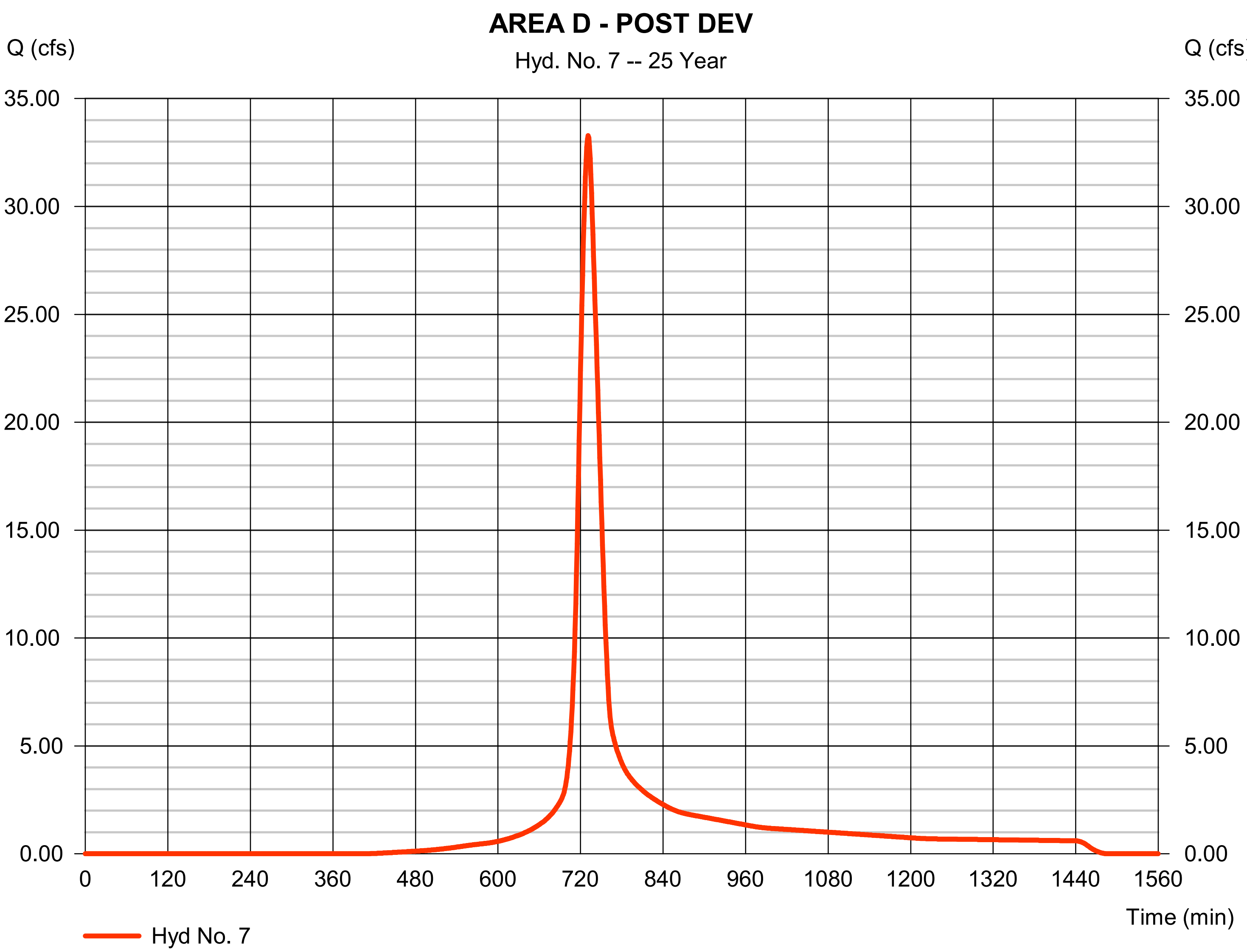
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 7

AREA D - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 33.28 cfs
Storm frequency	= 25 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 132,879 cuft
Drainage area	= 9.520 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.10 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.910 x 85) + (8.610 x 77)] / 9.520



Hydrograph Report

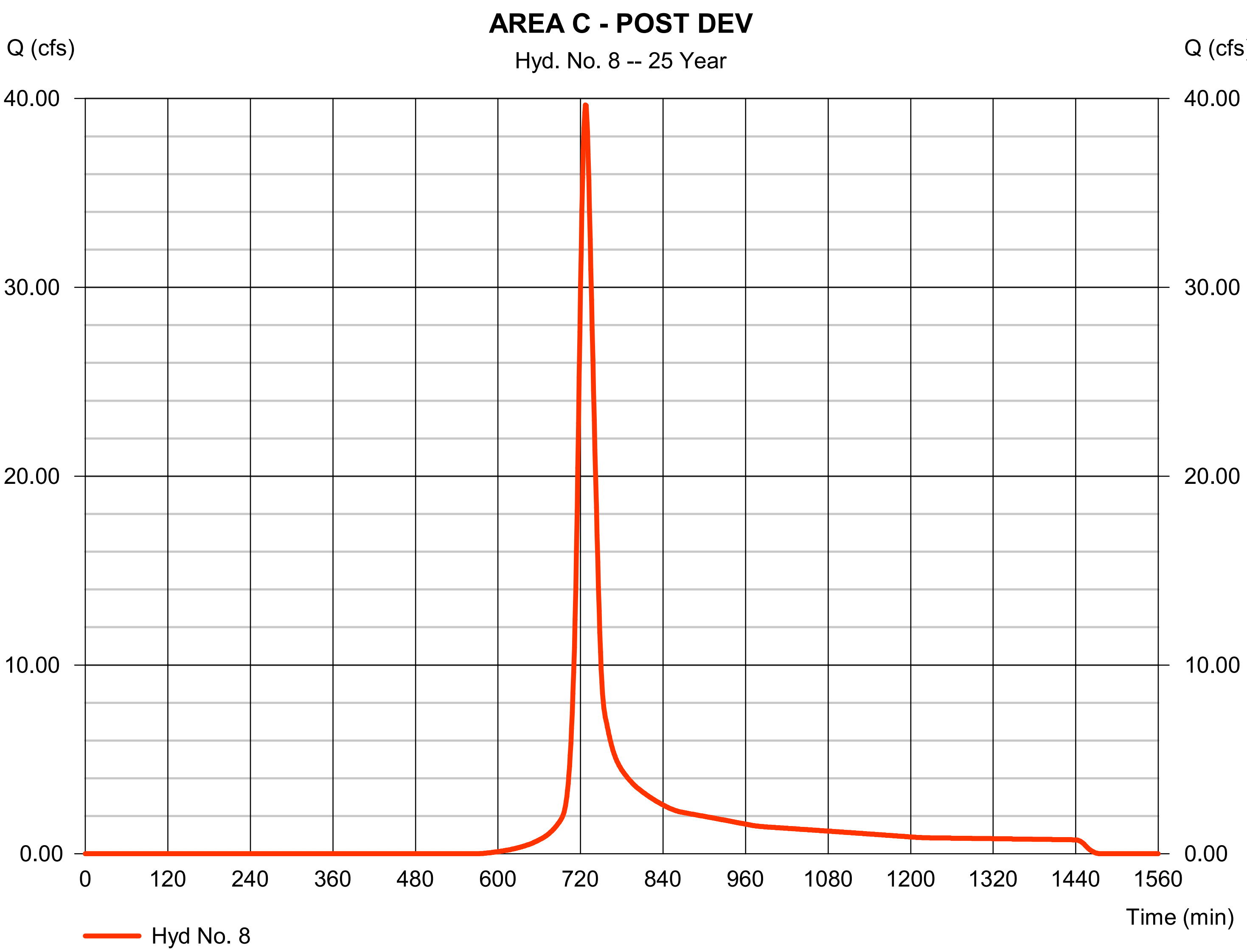
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 8

AREA C - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 39.67 cfs
Storm frequency	= 25 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 136,457 cuft
Drainage area	= 13.750 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.460 x 85) + (0.400 x 55) + (1.740 x 98) + (10.150 x 60)] / 13.750



TR55 Tc Worksheet

Hyd. No. 8

AREA C - POST DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.240		0.011		
Flow length (ft)	= 115.0		22.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		3.82		0.00		
Land slope (%)	= 2.80		13.50		0.00		
Travel Time (min)	**= 12.77**	**+**	**1.81**	**+**	**0.00**	**=**	**14.58**
Shallow Concentrated Flow							
Flow length (ft)	= 350.00		0.00		0.00		
Watercourse slope (%)	= 0.70		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.35		0.00		0.00		
Travel Time (min)	**= 4.32**	**+**	**0.00**	**+**	**0.00**	**=**	**4.32**
Channel Flow							
X sectional flow area (sqft)	= 9.78		0.00		0.00		
Wetted perimeter (ft)	= 20.48		0.00		0.00		
Channel slope (%)	= 0.60		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=2.34		0.00		0.00		
Flow length (ft)	({0})575.0		0.0		0.0		
Travel Time (min)	**= 4.09**	**+**	**0.00**	**+**	**0.00**	**=**	**4.09**

Total Travel Time, Tc .... **23.00 min**

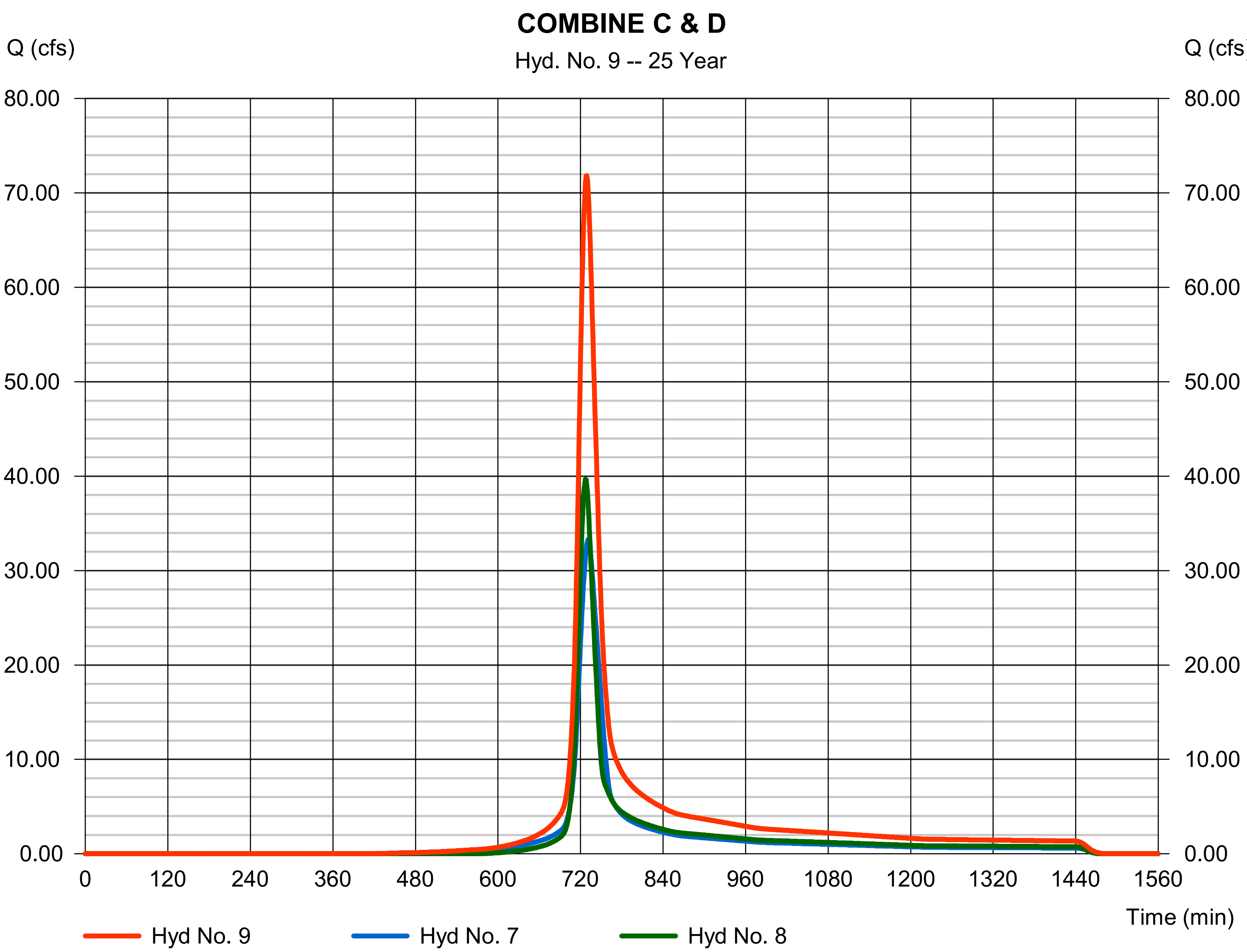
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 9

COMBINE C & D

Hydrograph type	= Combine	Peak discharge	= 71.83 cfs
Storm frequency	= 25 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 269,336 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 23.270 ac



Hydrograph Report

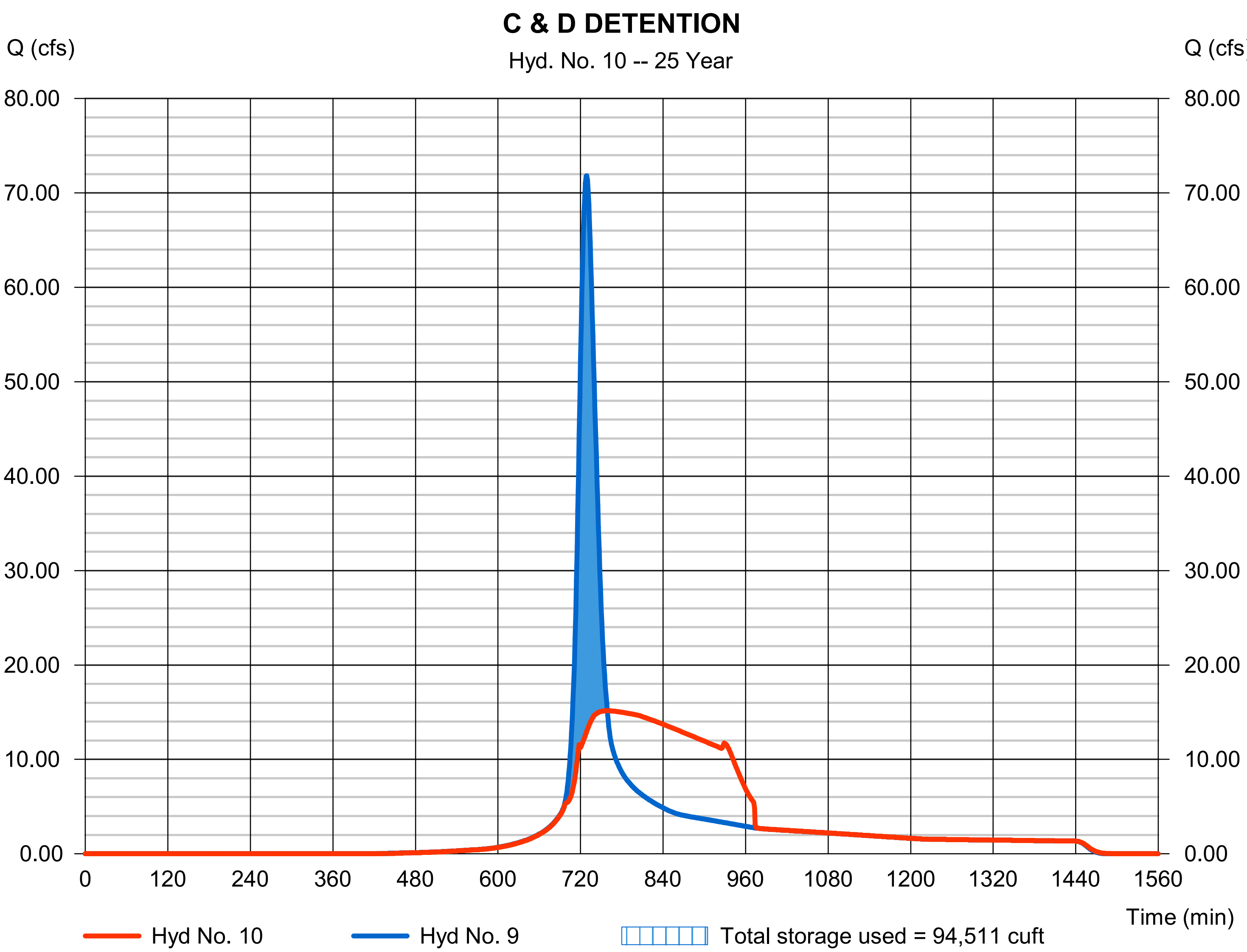
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 10

C & D DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 15.16 cfs
Storm frequency	= 25 yrs	Time to peak	= 759 min
Time interval	= 1 min	Hyd. volume	= 269,335 cuft
Inflow hyd. No.	= 9 - COMBINE C & D	Max. Elevation	= 582.16 ft
Reservoir name	= C&D DETENTION	Max. Storage	= 94,511 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Pond No. 7 - C&D DETENTION

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	579.00	n/a	0	0
1.00	580.00	n/a	368	368
2.00	581.00	n/a	16,012	16,380
3.00	582.00	n/a	61,831	78,211
4.00	583.00	n/a	99,795	178,006
5.00	584.00	n/a	169,576	347,582

Culvert / Orifice Structures

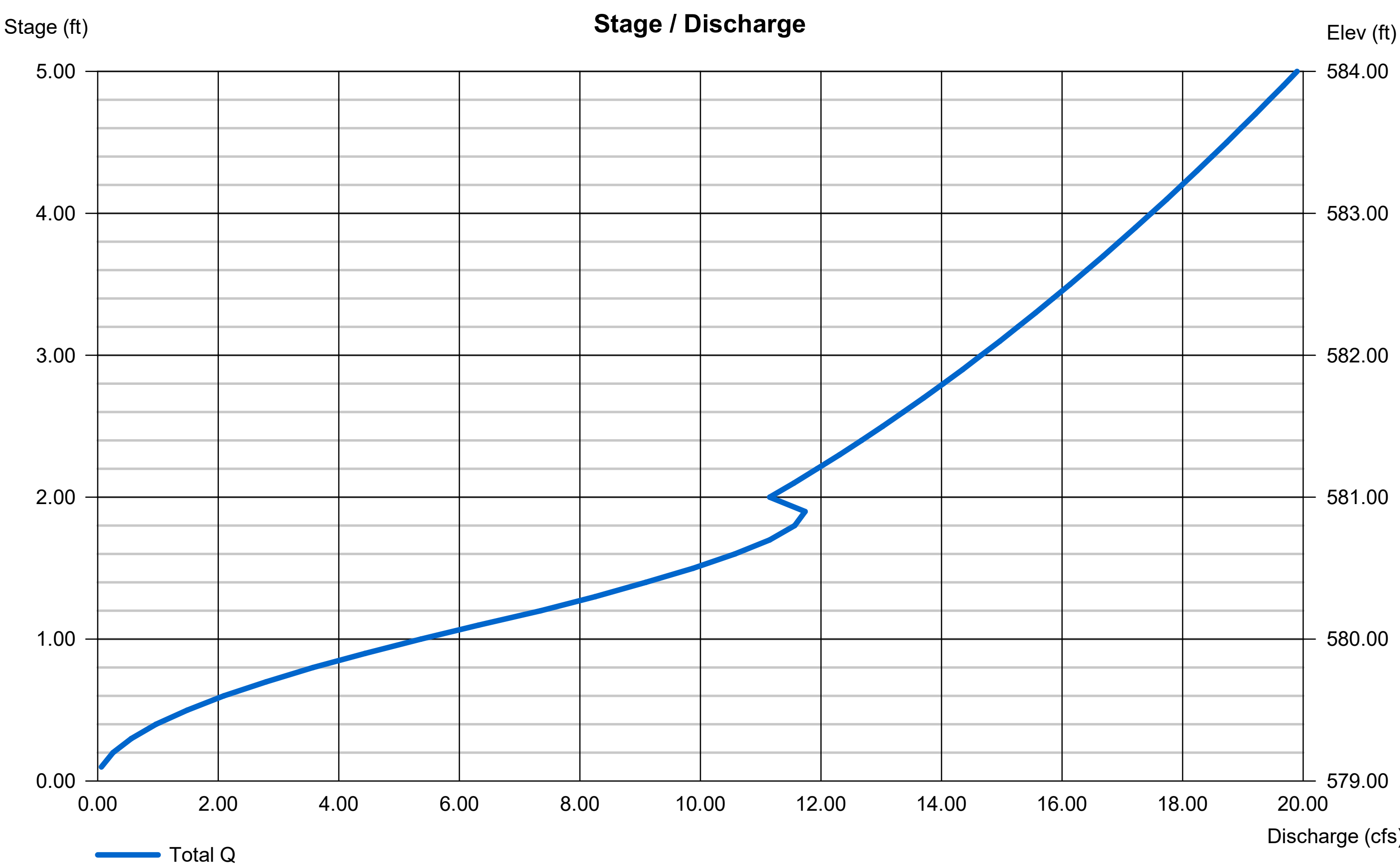
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 579.00	0.00	0.00	0.00
Length (ft)	= 143.00	0.00	0.00	0.00
Slope (%)	= 0.96	0.00	0.00	n/a
N-Value	= .023	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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



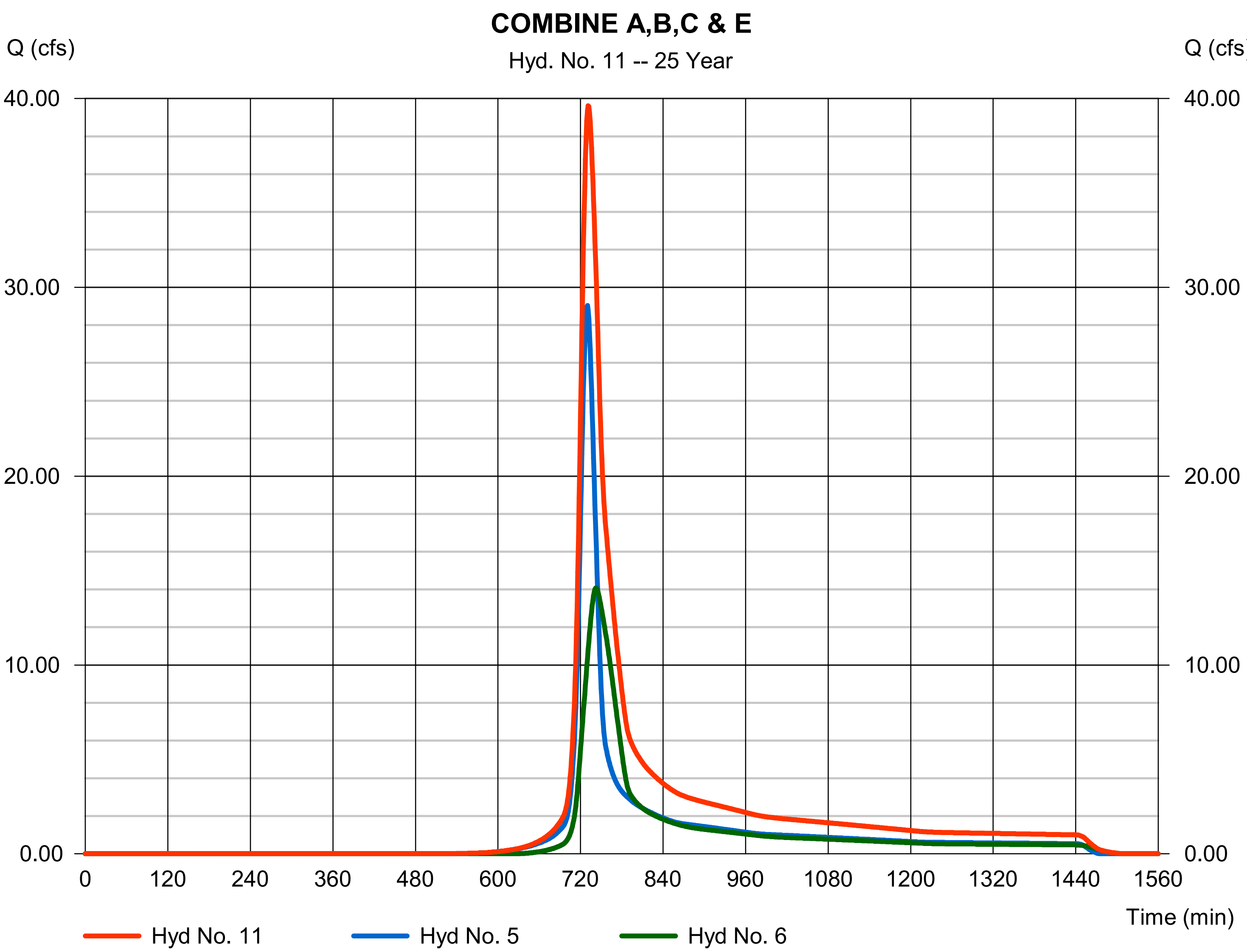
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 11

COMBINE A,B,C & E

Hydrograph type	= Combine	Peak discharge	= 39.62 cfs
Storm frequency	= 25 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 179,475 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 9.150 ac



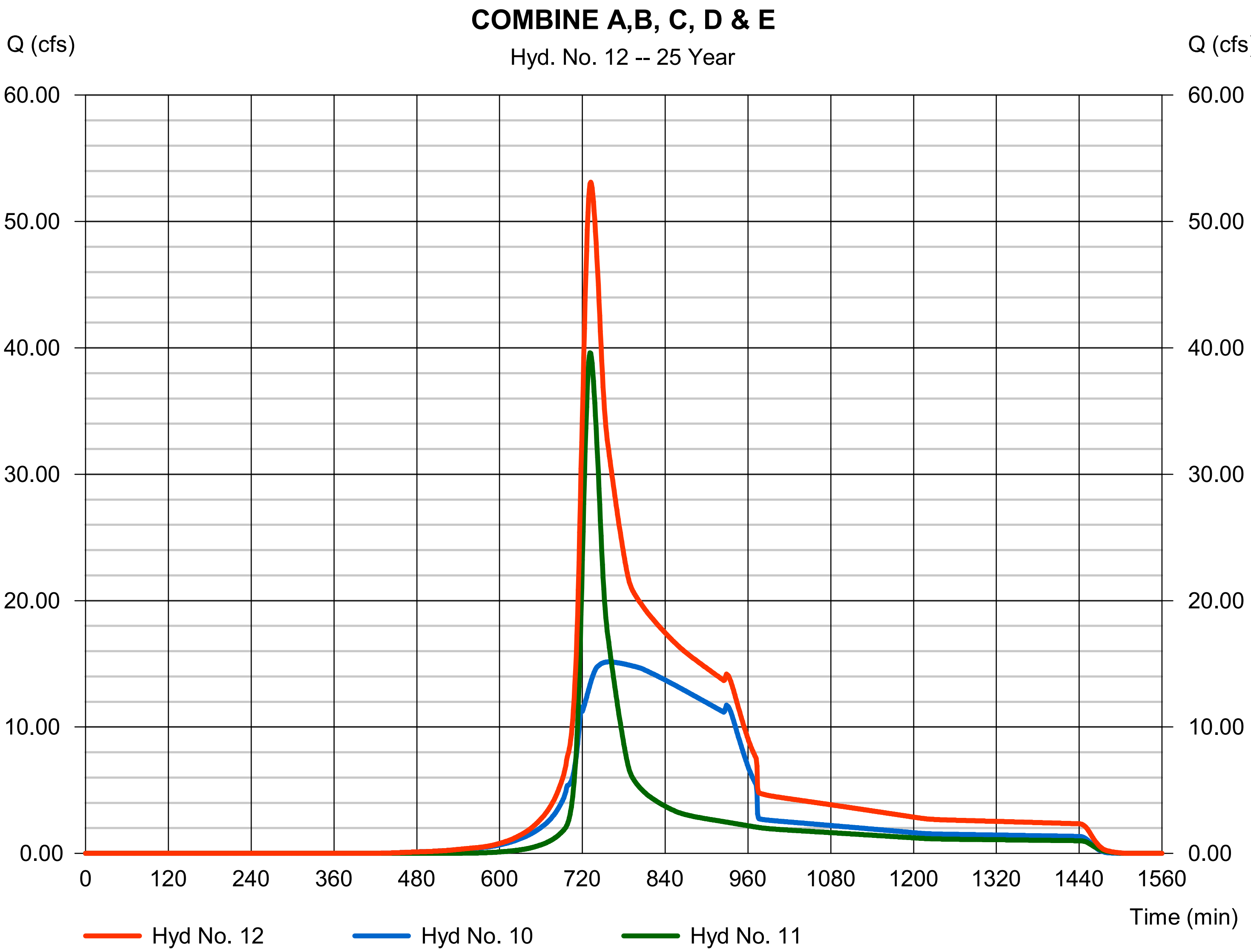
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 12

COMBINE A,B, C, D & E

Hydrograph type	= Combine	Peak discharge	= 53.11 cfs
Storm frequency	= 25 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 448,810 cuft
Inflow hyds.	= 10, 11	Contrib. drain. area	= 0.000 ac



Hydrograph Report

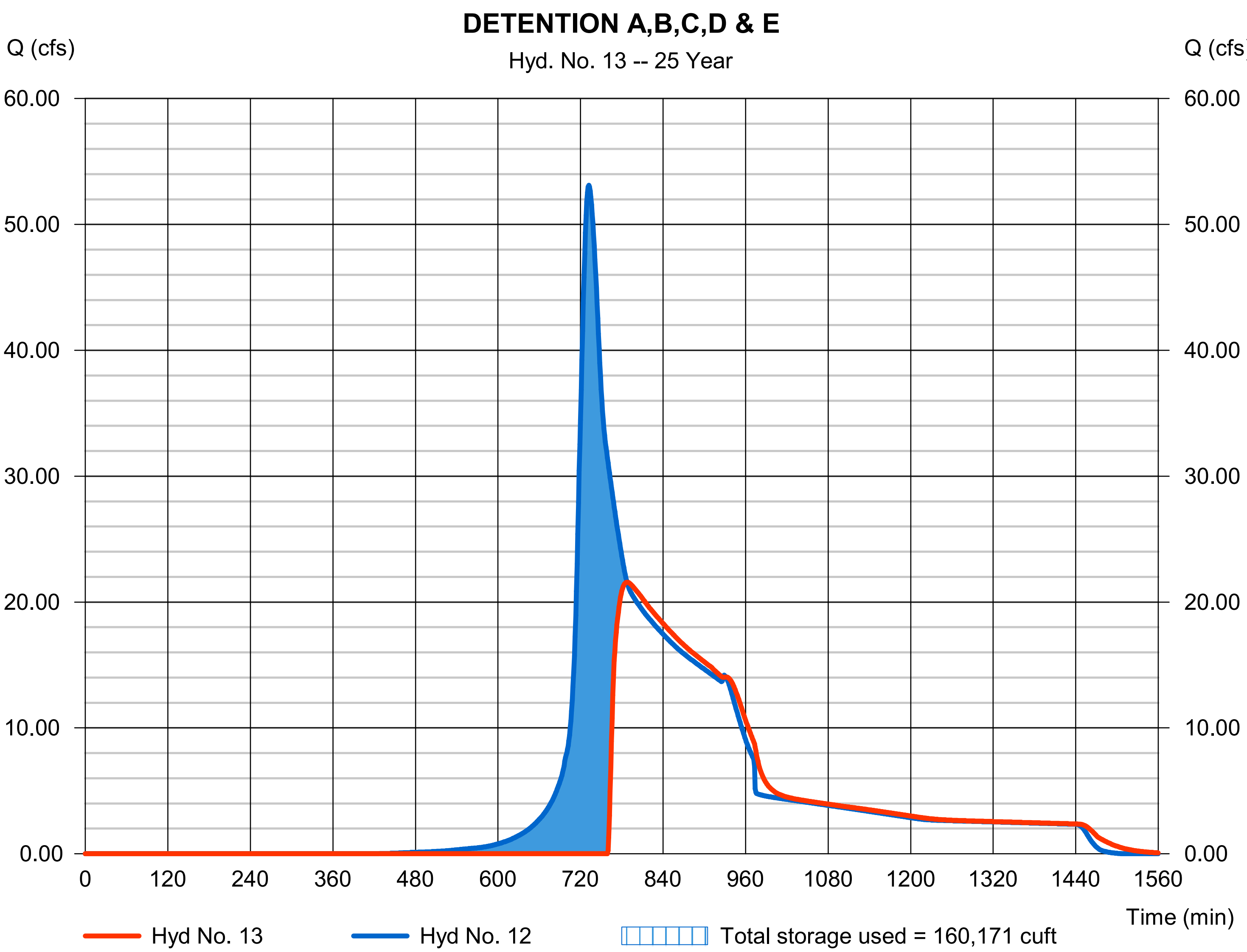
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 13

DETENTION A,B,C,D & E

Hydrograph type	= Reservoir	Peak discharge	= 21.57 cfs
Storm frequency	= 25 yrs	Time to peak	= 788 min
Time interval	= 1 min	Hyd. volume	= 305,768 cuft
Inflow hyd. No.	= 12 - COMBINE A,B, C, D & E	Max. Elevation	= 582.14 ft
Reservoir name	= A,B,C,D & E DETENTION	Max. Storage	= 160,171 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Pond No. 1 - A,B,C,D & E DETENTION

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	577.00	n/a	0	0
1.00	578.00	n/a	46,004	46,004
2.00	579.00	n/a	33,011	79,015
3.00	580.00	n/a	28,300	107,315
4.00	581.00	n/a	24,110	131,425
5.00	582.00	n/a	23,229	154,654
6.00	583.00	n/a	38,881	193,535
7.00	584.00	n/a	59,736	253,271
8.00	585.00	n/a	88,517	341,788
9.00	586.00	n/a	115,069	456,857

Culvert / Orifice Structures

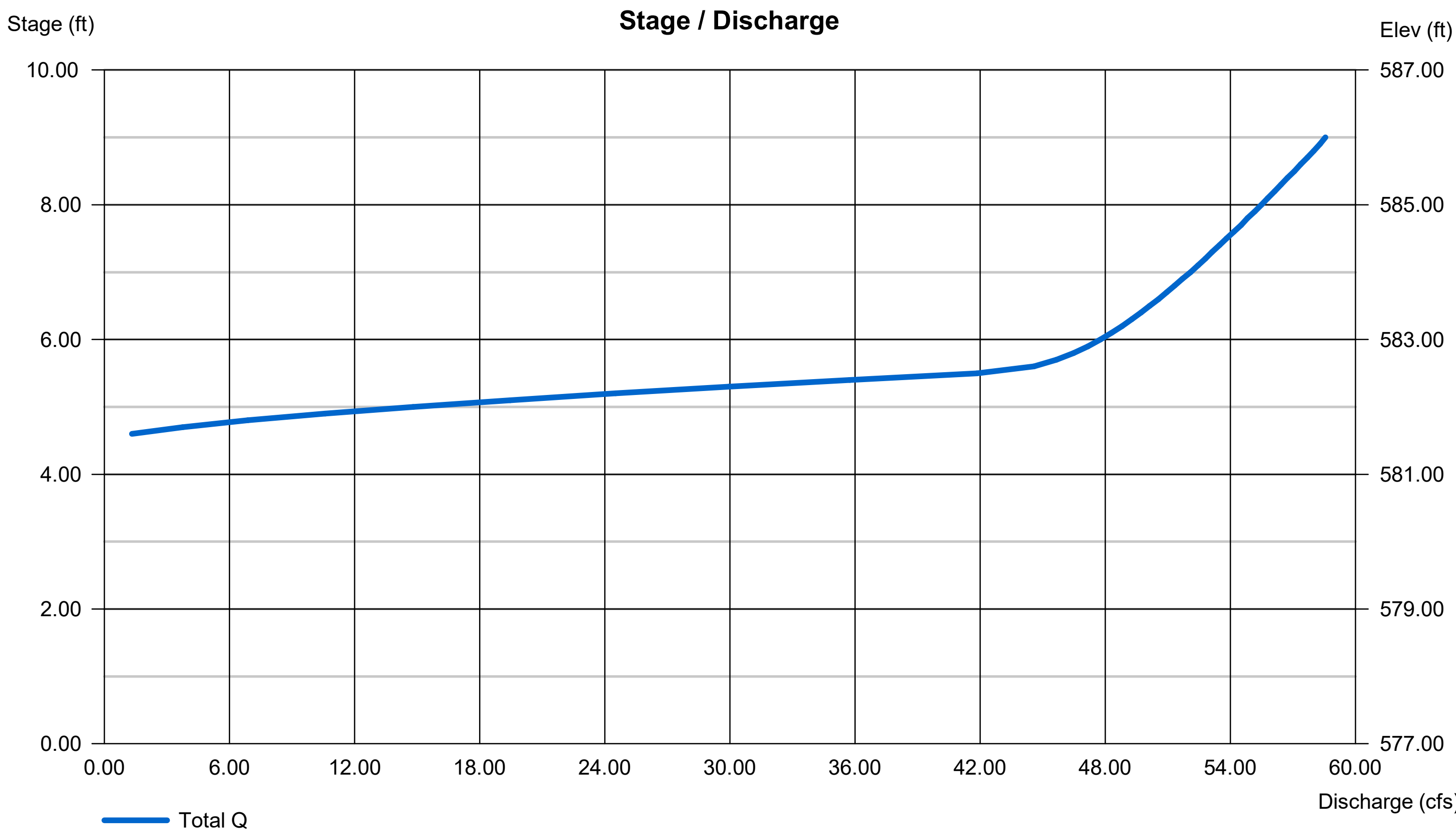
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 36.00	Inactive	Inactive	Inactive
Span (in)	= 36.00	0.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 577.64	0.00	0.00	0.00
Length (ft)	= 311.70	0.00	0.00	0.00
Slope (%)	= 1.42	0.00	0.00	n/a
N-Value	= .024	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.57	Inactive	Inactive	Inactive
Crest El. (ft)	= 581.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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



Hydrograph Report

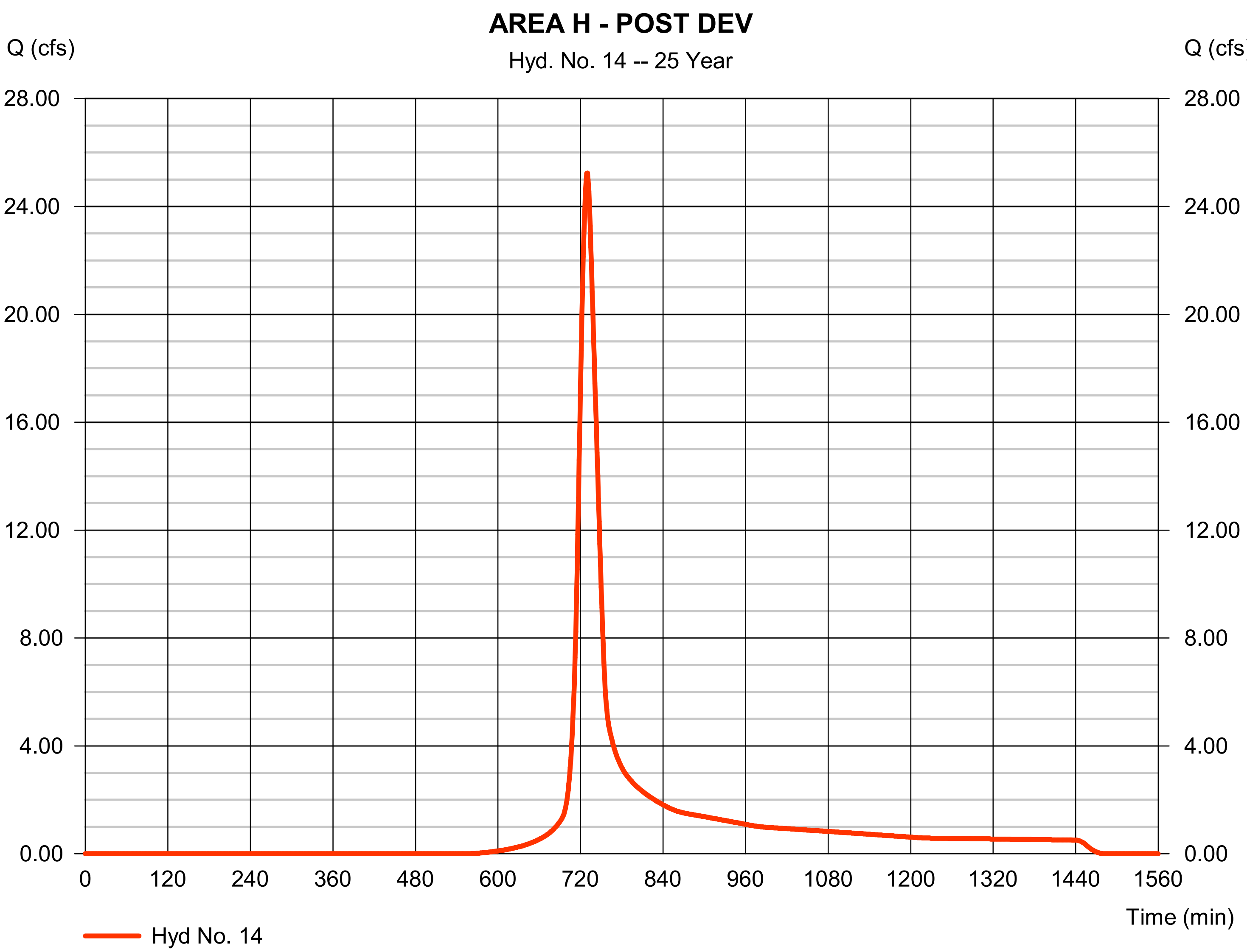
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 14

AREA H - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 25.24 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 95,092 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.50 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



TR55 Tc Worksheet

Hyd. No. 14

AREA H - POST DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.410		0.011		0.011		
Flow length (ft)	= 90.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		0.00		0.00		
Land slope (%)	= 2.20		0.00		0.00		
Travel Time (min)	**= 17.74**	**+**	**0.00**	**+**	**0.00**	**=**	**17.74**
Shallow Concentrated Flow							
Flow length (ft)	= 270.00		305.00		0.00		
Watercourse slope (%)	= 2.00		0.75		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=2.28		1.40		0.00		
Travel Time (min)	**= 1.97**	**+**	**3.64**	**+**	**0.00**	**=**	**5.61**
Channel Flow							
X sectional flow area (sqft)	= 19.90		0.00		0.00		
Wetted perimeter (ft)	= 33.72		0.00		0.00		
Channel slope (%)	= 0.50		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=2.47						
			0.00				
					0.00		
Flow length (ft)	({0})470.0		0.0		0.0		
Travel Time (min)	**= 3.18**	**+**	**0.00**	**+**	**0.00**	**=**	**3.18**

Total Travel Time, Tc .... 26.50 min

Hydrograph Report

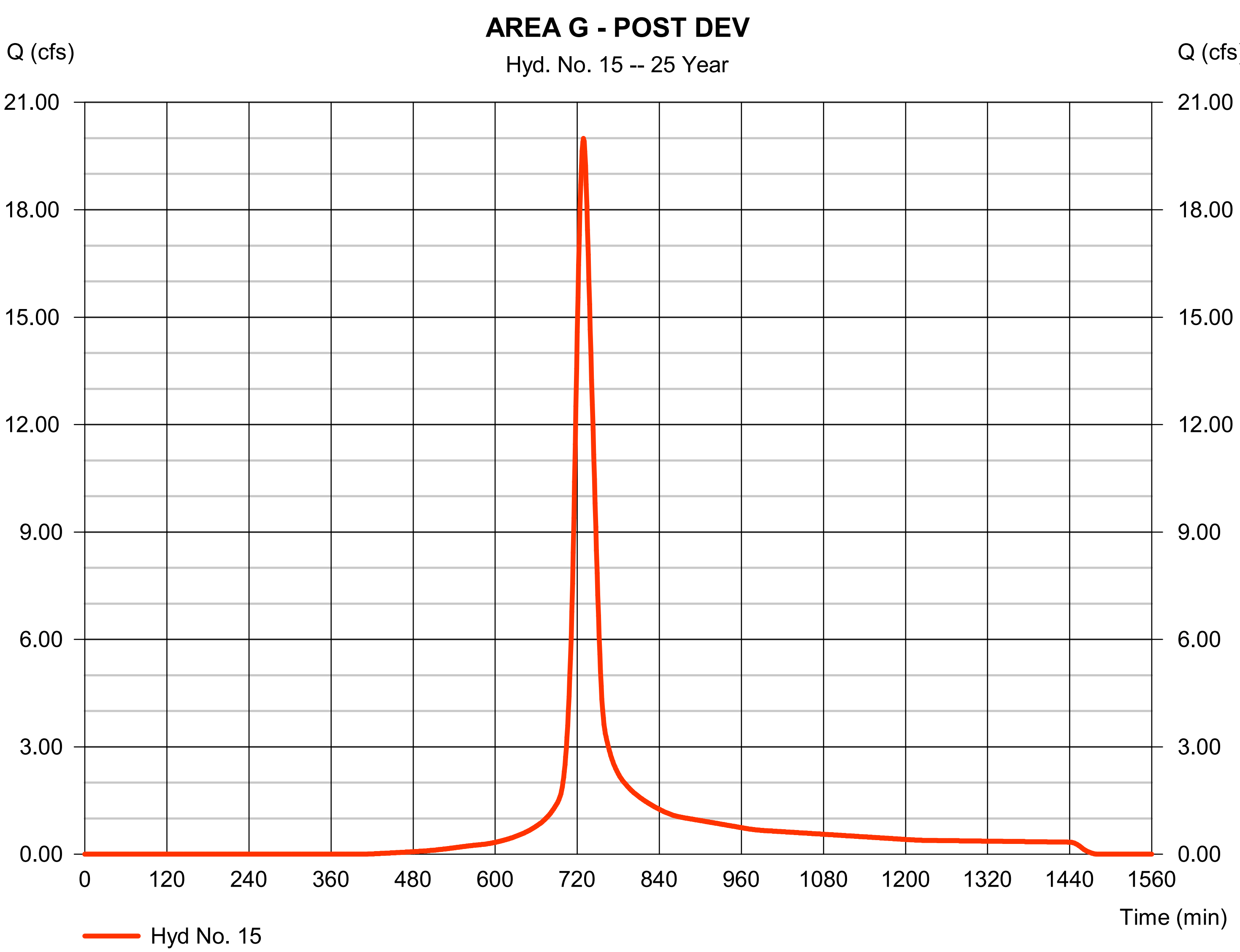
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 11 / 15 / 2018

Hyd. No. 15

AREA G - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 19.99 cfs
Storm frequency	= 25 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 74,414 cuft
Drainage area	= 5.290 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 26.80 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.330 x 85) + (4.960 x 77)] / 5.290



Hydrograph Report

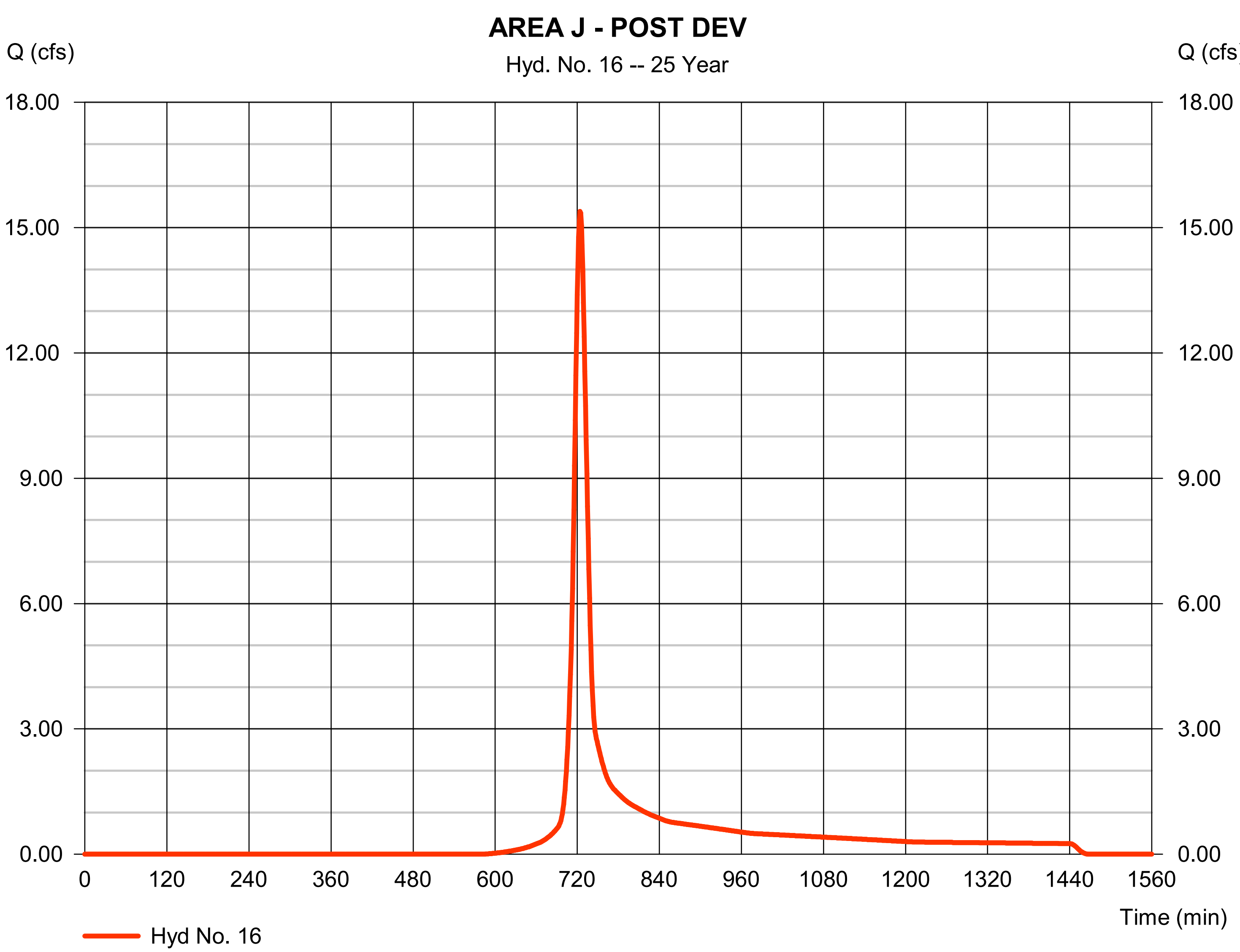
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 11 / 15 / 2018

Hyd. No. 16

AREA J - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 15.39 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 46,094 cuft
Drainage area	= 4.820 ac	Curve number	= 66*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 85) + (0.020 x 65) + (0.680 x 98) + (4.030 x 60)] / 4.820



TR55 Tc Worksheet

Hyd. No. 16

AREA J - POST DEV

Description	**A**		**B**		**C**		**Totals**
Sheet Flow							
Manning's n-value	= 0.011		0.350		0.011		
Flow length (ft)	= 8.0		30.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		3.82		0.00		
Land slope (%)	= 4.20		4.20		0.00		
Travel Time (min)	**= 0.11**	**+**	**5.01**	**+**	**0.00**	**=**	**5.12**
Shallow Concentrated Flow							
Flow length (ft)	= 21.00		155.00		0.00		
Watercourse slope (%)	= 7.75		6.60		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=4.49		4.15		0.00		
Travel Time (min)	**= 0.08**	**+**	**0.62**	**+**	**0.00**	**=**	**0.70**
Channel Flow							
X sectional flow area (sqft)	= 0.82		1.11		0.00		
Wetted perimeter (ft)	= 3.29		3.66		0.00		
Channel slope (%)	= 0.70		0.30		0.00		
Manning's n-value	= 0.030		0.030		0.015		
Velocity (ft/s)	=1.64		1.23		0.00		
Flow length (ft)	({0})181.0		685.0		0.0		
Travel Time (min)	**= 1.84**	**+**	**9.31**	**+**	**0.00**	**=**	**11.15**

Total Travel Time, Tc .... 17.00 min

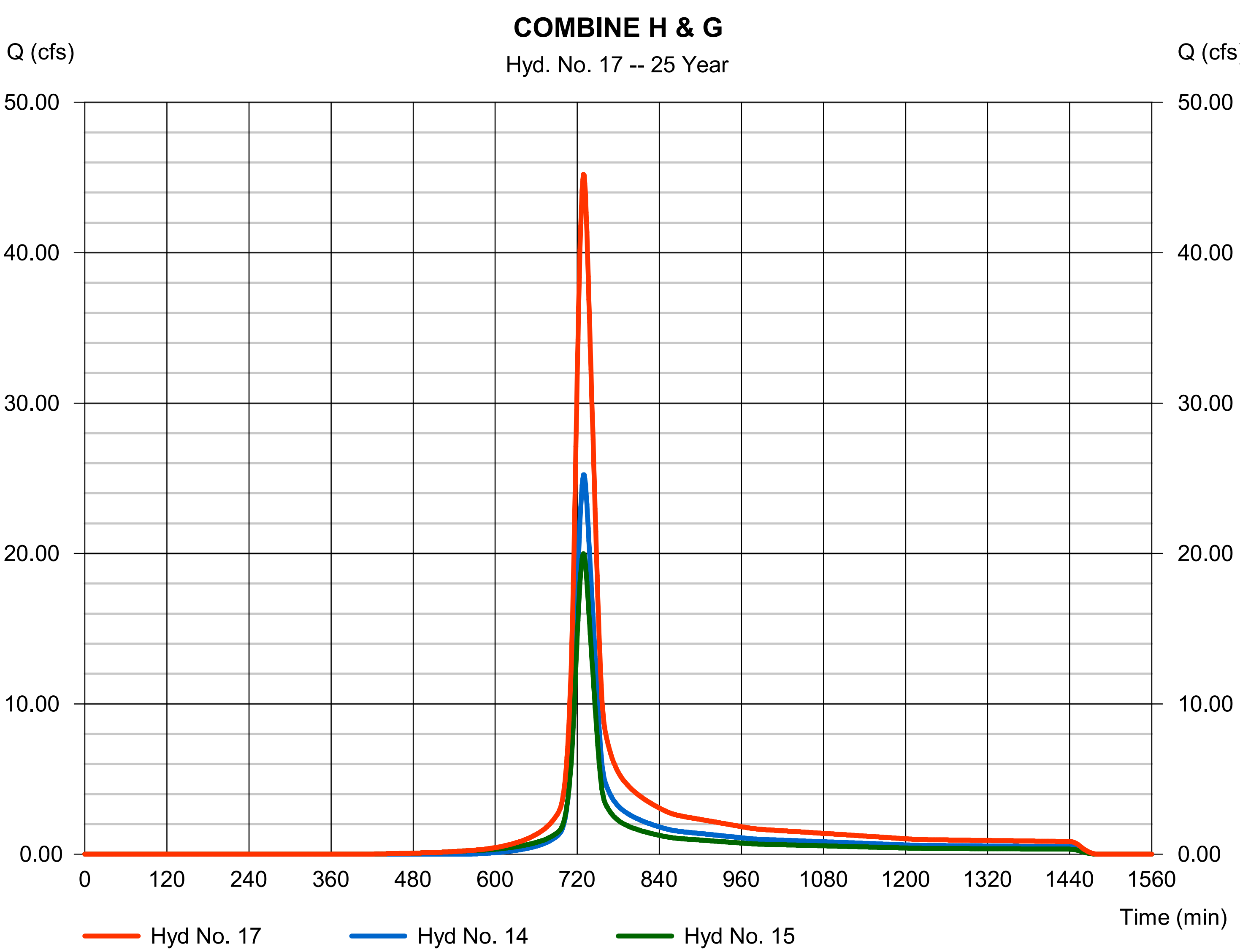
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 17

COMBINE H & G

Hydrograph type	= Combine	Peak discharge	= 45.22 cfs
Storm frequency	= 25 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 169,506 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 14.400 ac



Hydrograph Report

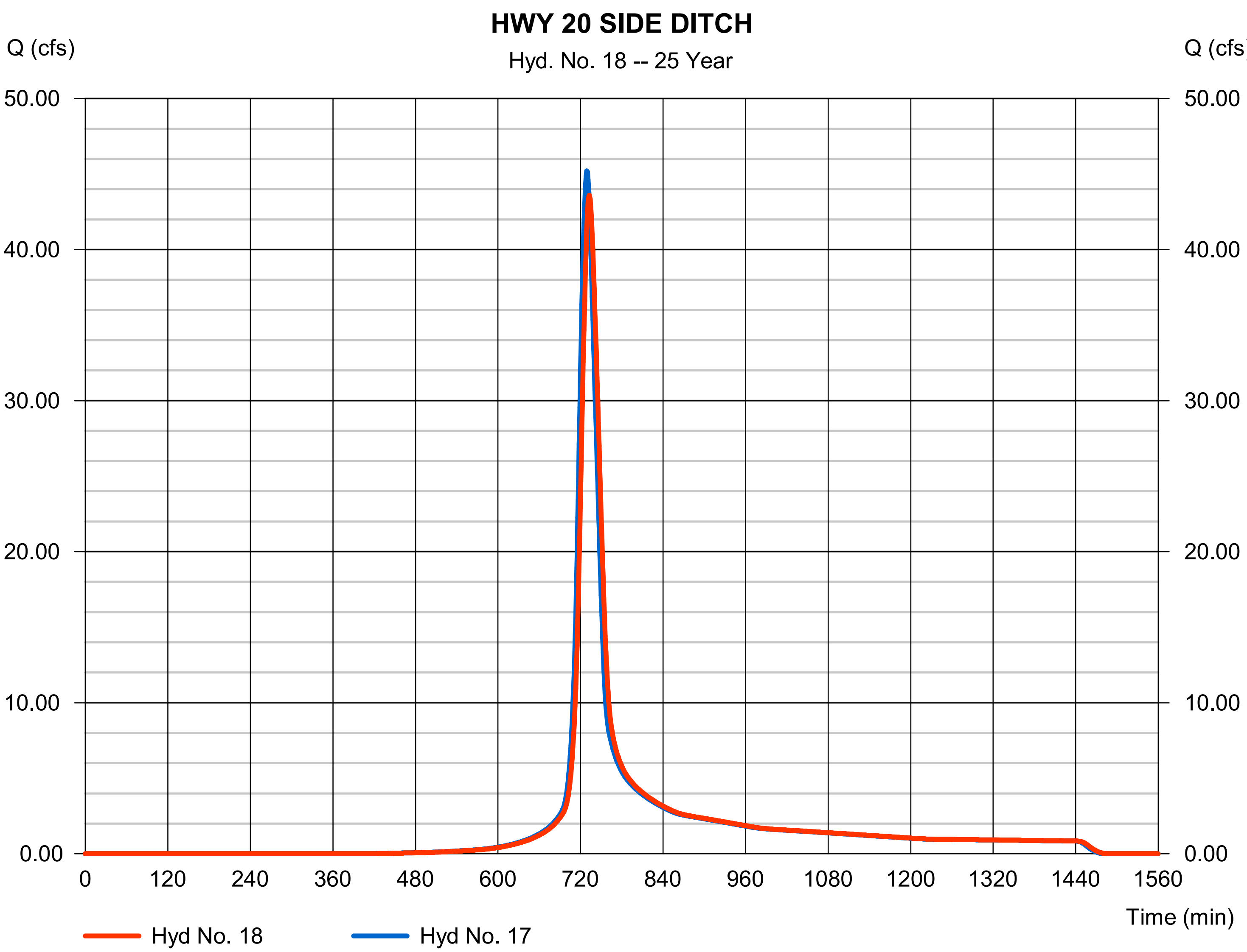
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 18

HWY 20 SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 43.60 cfs
Storm frequency	= 25 yrs	Time to peak	= 733 min
Time interval	= 1 min	Hyd. volume	= 169,504 cuft
Inflow hyd. No.	= 17 - COMBINE H & G	Section type	= Trapezoidal
Reach length	= 900.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.030	Bottom width	= 3.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 1.688	Rating curve m	= 1.304
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.2728

Modified Att-Kin routing method used.



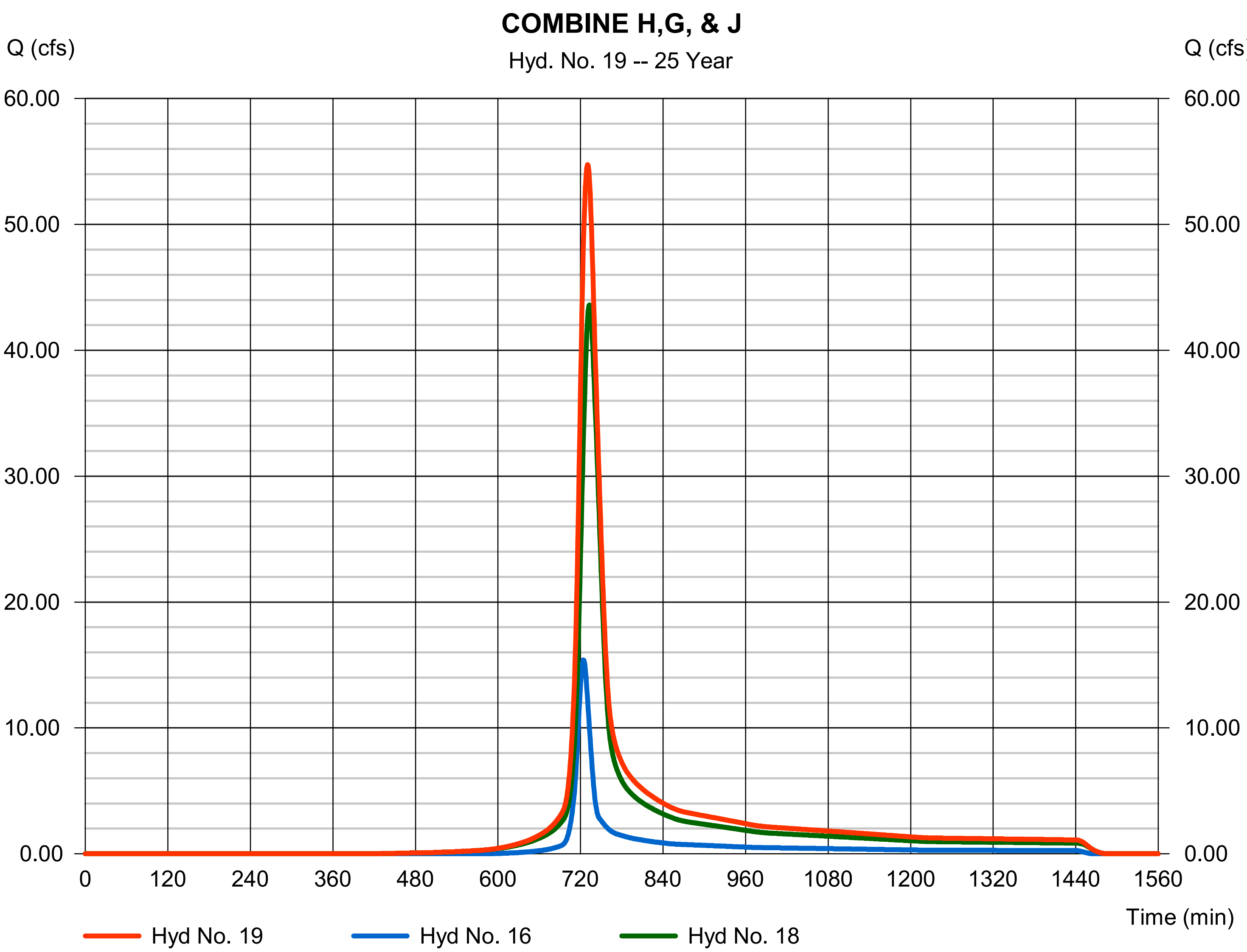
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 19

COMBINE H,G, & J

Hydrograph type	= Combine	Peak discharge	= 54.75 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 215,598 cuft
Inflow hyds.	= 16, 18	Contrib. drain. area	= 4.820 ac



Hydrograph Report

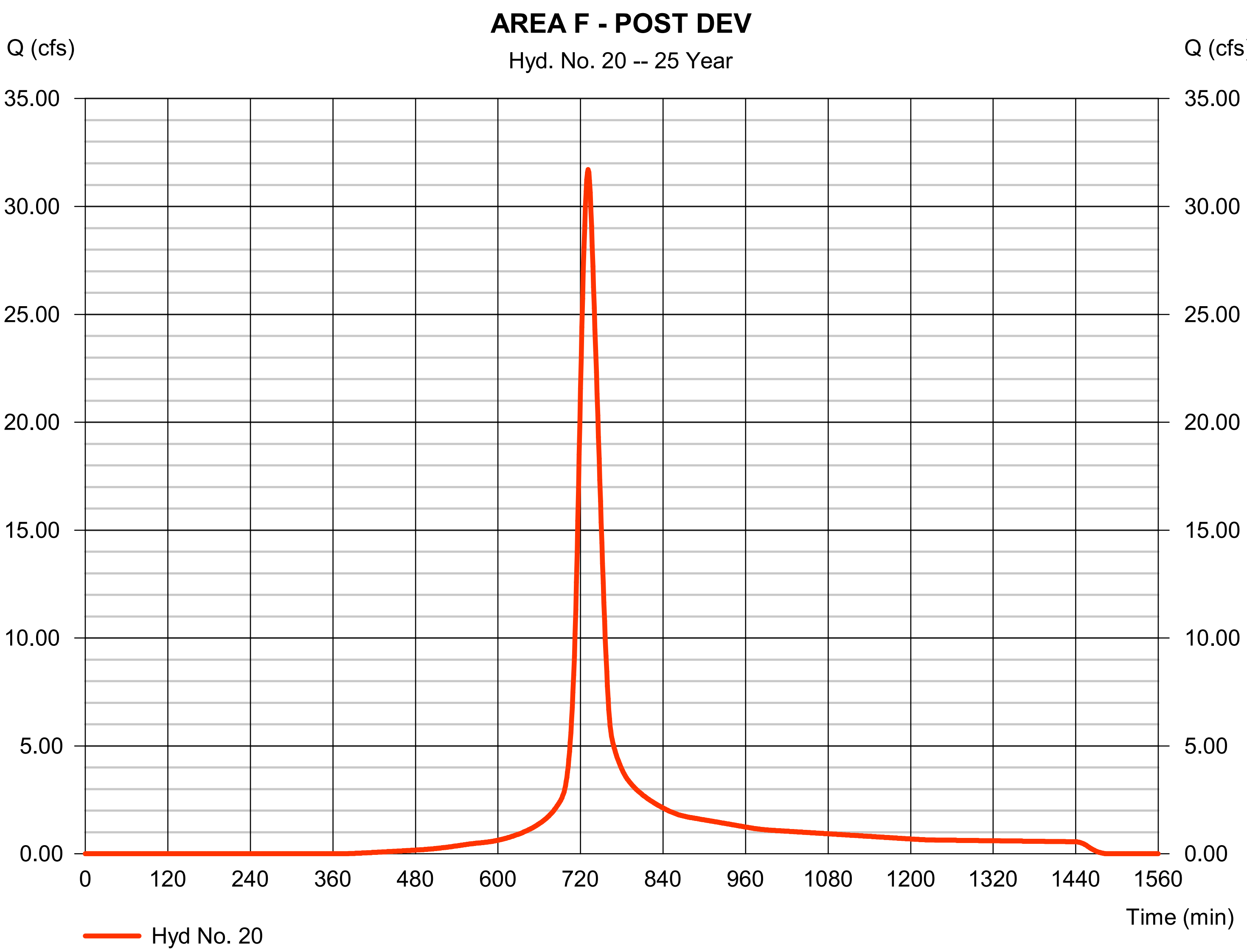
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 20

AREA F - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 31.71 cfs
Storm frequency	= 25 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 126,821 cuft
Drainage area	= 8.620 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.440 x 85) + (8.180 x 77)] / 8.620



Hydrograph Report

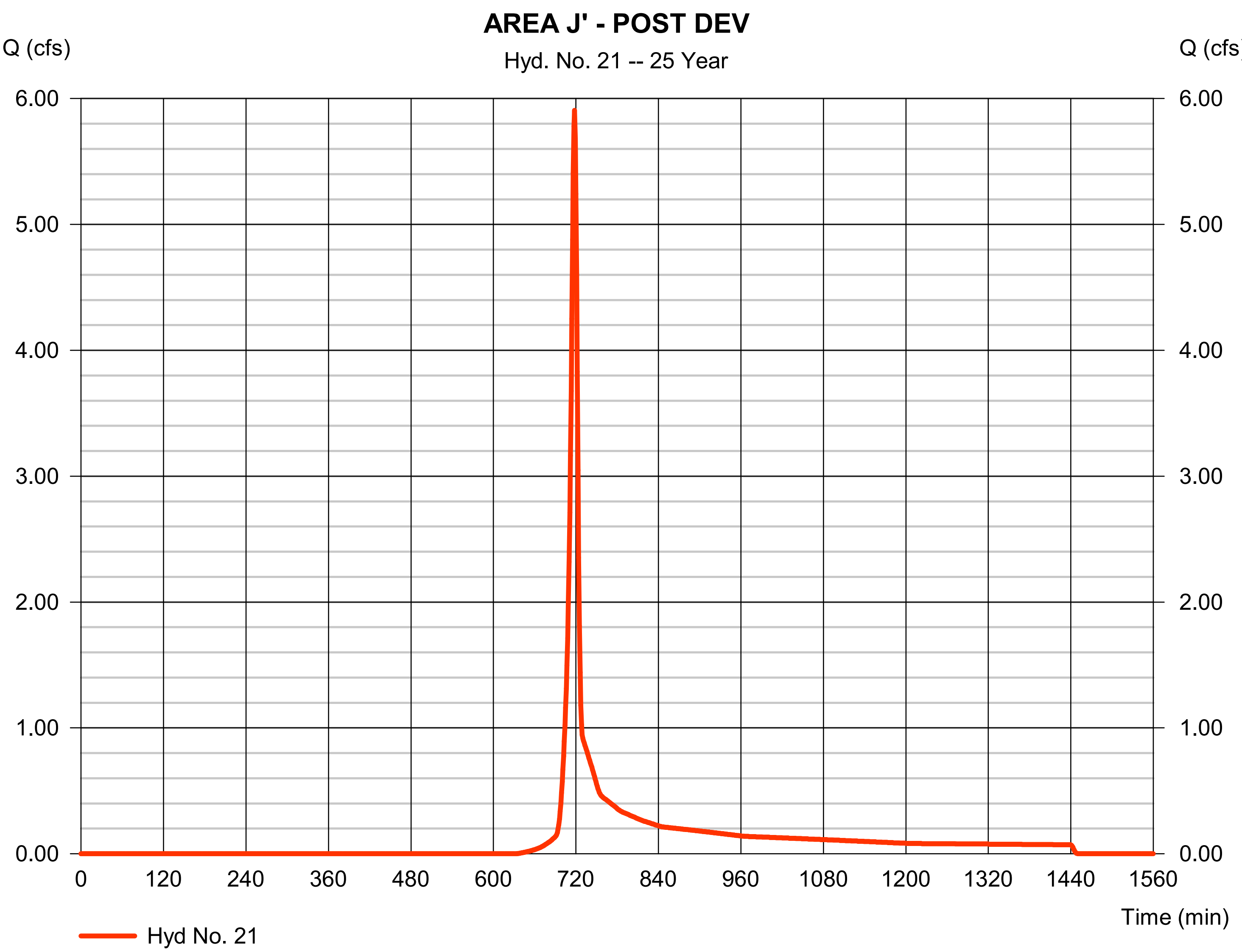
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 21

AREA J' - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 5.906 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 11,907 cuft
Drainage area	= 1.440 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.220 x 65) + (1.220 x 60)] / 1.440



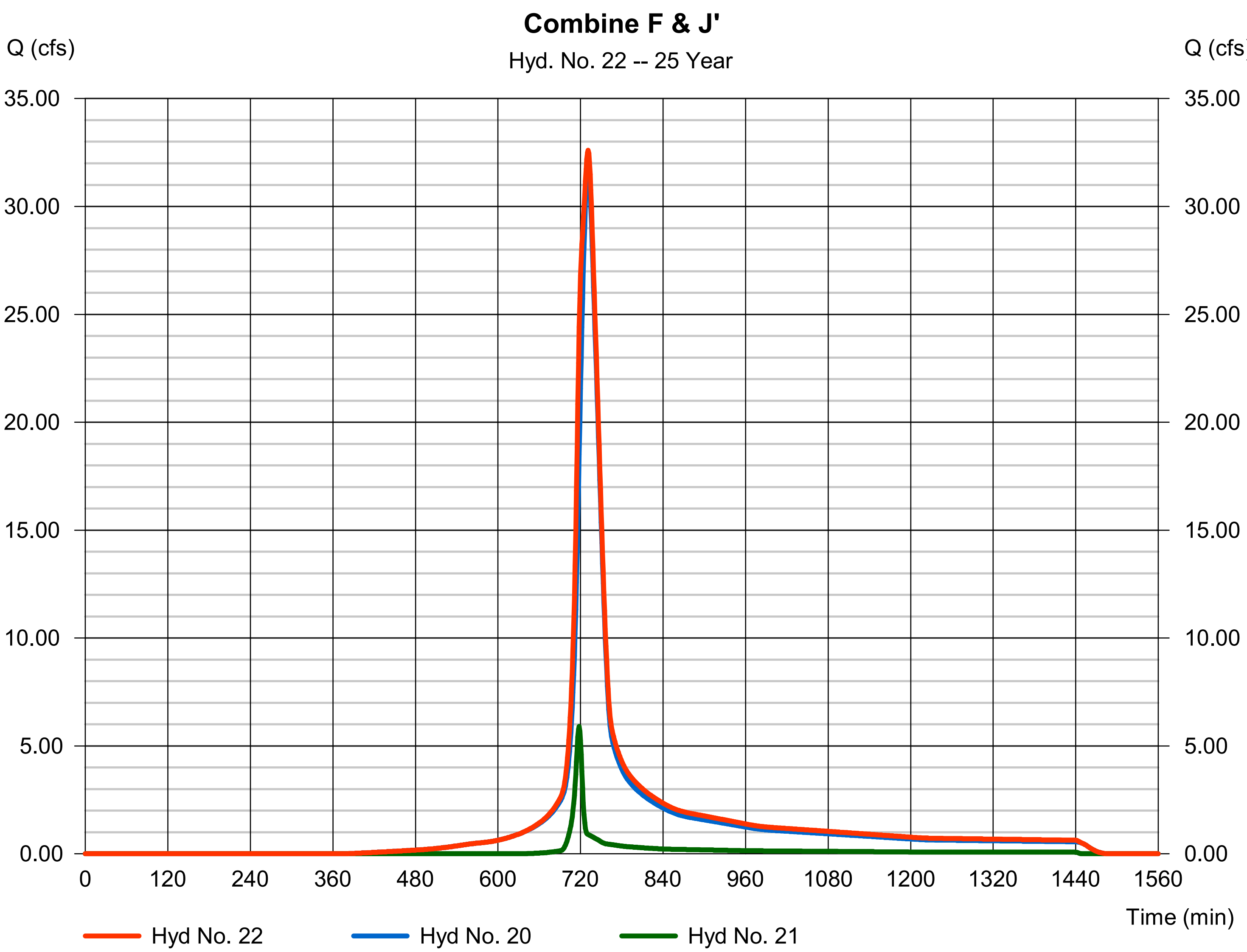
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 22

Combine F & J'

Hydrograph type	= Combine	Peak discharge	= 32.60 cfs
Storm frequency	= 25 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 138,728 cuft
Inflow hyds.	= 20, 21	Contrib. drain. area	= 10.060 ac



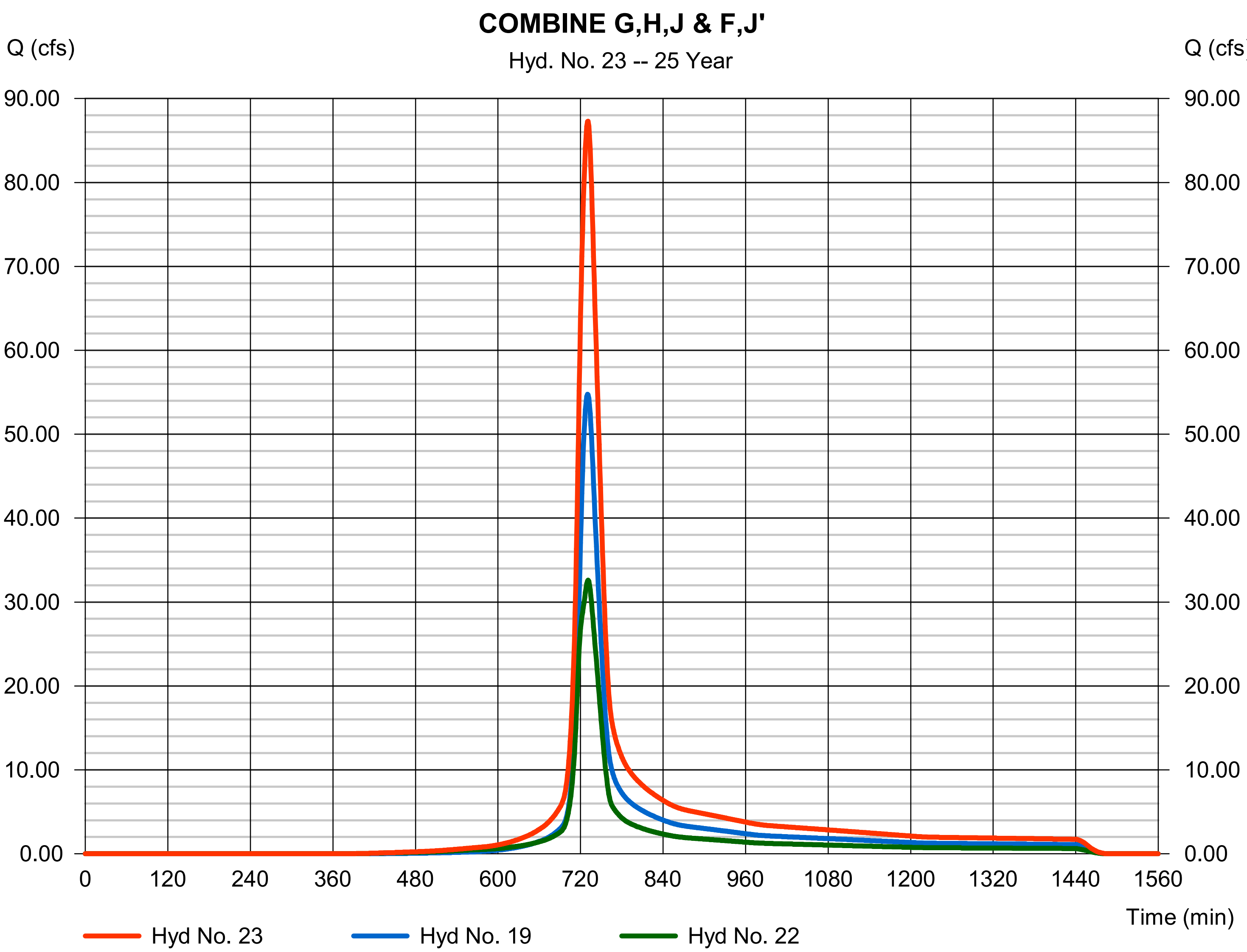
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 23

COMBINE G,H,J & F,J'

Hydrograph type	= Combine	Peak discharge	= 87.29 cfs
Storm frequency	= 25 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 354,326 cuft
Inflow hyds.	= 19, 22	Contrib. drain. area	= 0.000 ac



Hydrograph Report

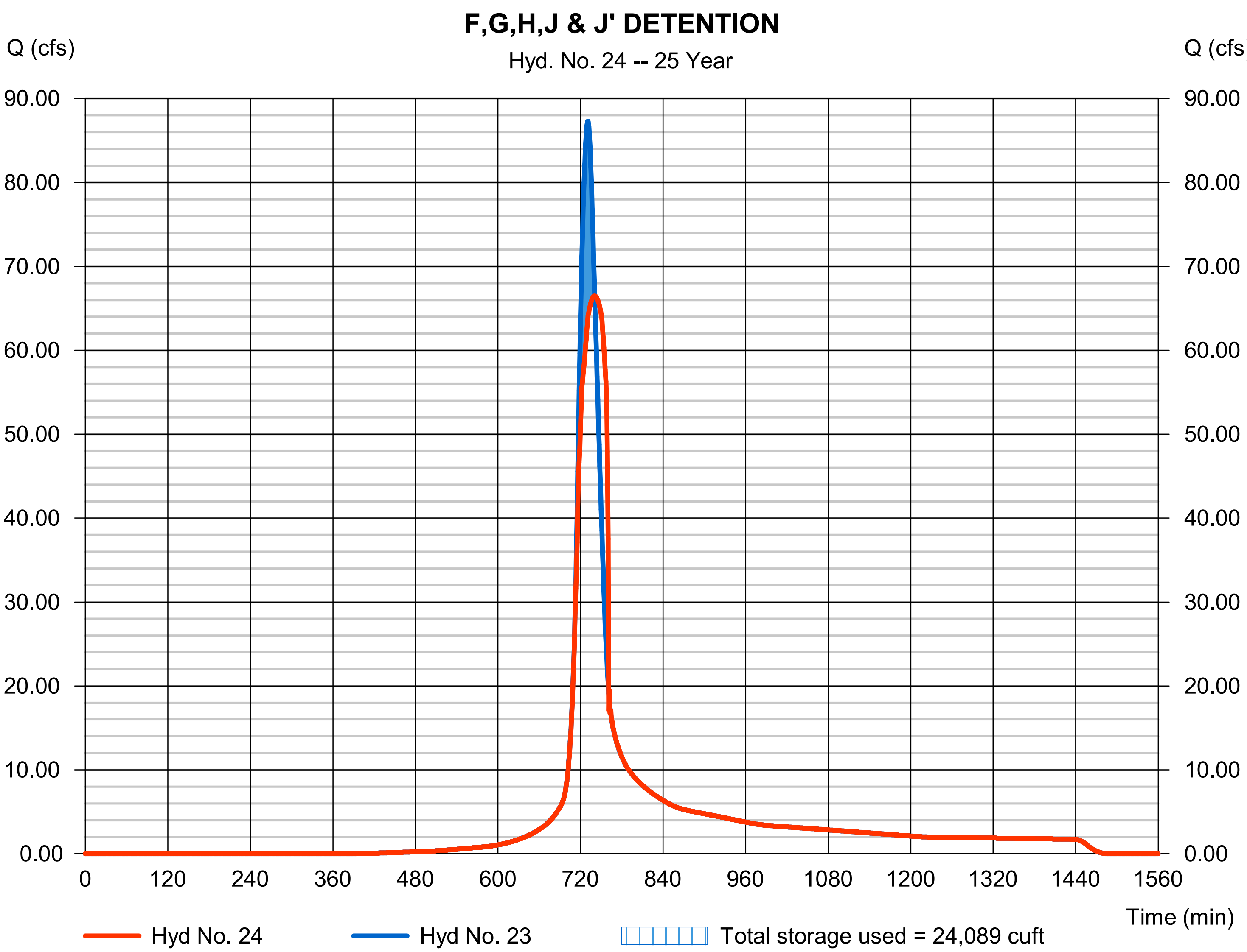
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 24

F,G,H,J & J' DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 66.47 cfs
Storm frequency	= 25 yrs	Time to peak	= 741 min
Time interval	= 1 min	Hyd. volume	= 354,326 cuft
Inflow hyd. No.	= 23 - COMBINE G,H,J & F,J'	Max. Elevation	= 580.30 ft
Reservoir name	= F,G,H,J & J' DETENTION	Max. Storage	= 24,089 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 11 / 15 / 2018

Pond No. 2 - F,G,H,J & J' DETENTION

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	575.00	n/a	0	0
1.00	576.00	n/a	66	66
2.00	577.00	n/a	197	263
3.00	578.00	n/a	805	1,068
4.00	579.00	n/a	3,266	4,334
5.00	580.00	n/a	11,856	16,190
6.00	581.00	n/a	26,087	42,277
7.00	582.00	n/a	34,733	77,010
8.00	583.00	n/a	53,090	130,100
9.00	584.00	n/a	63,299	193,399

Culvert / Orifice Structures

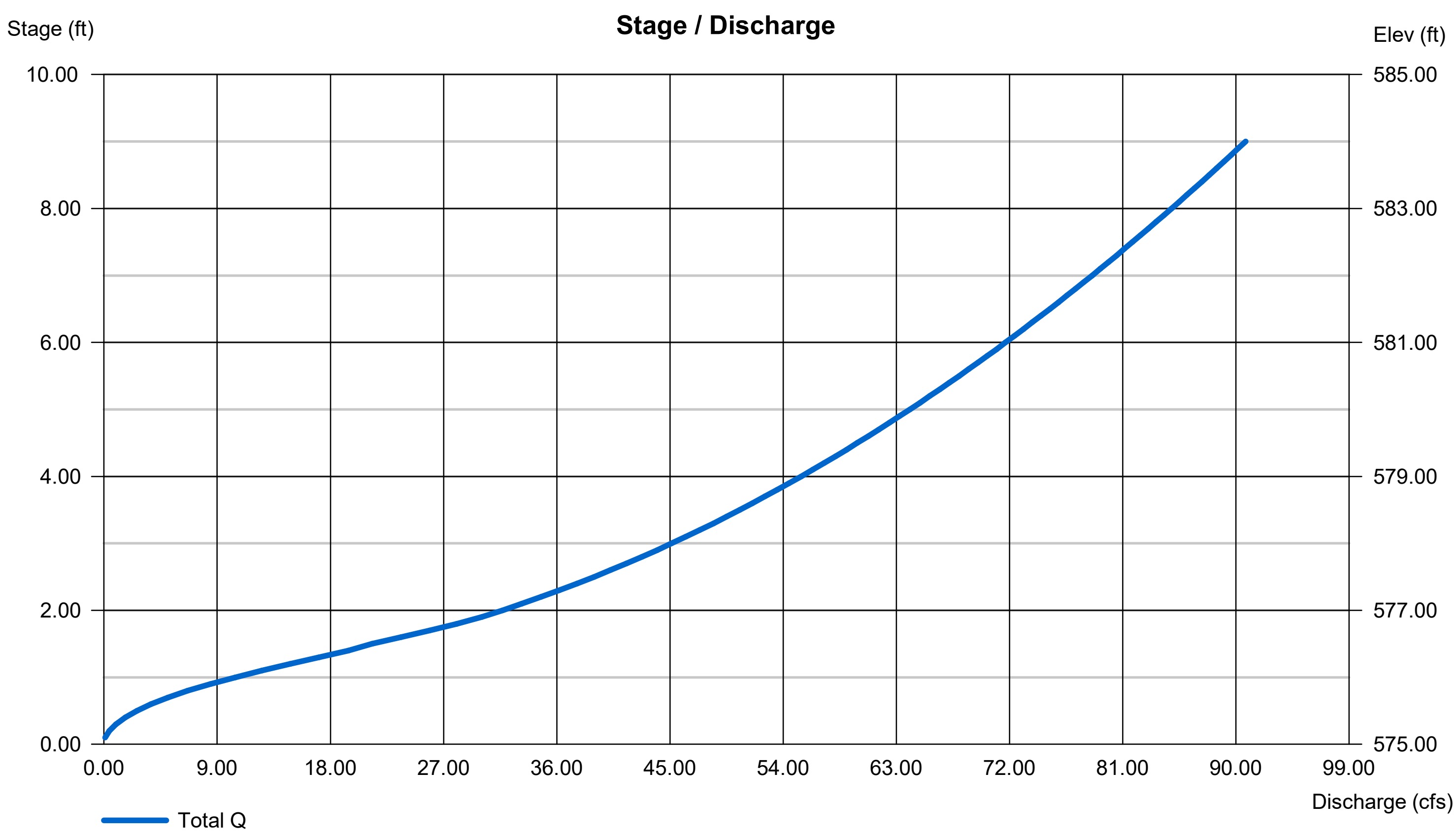
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	18.00	18.00	Inactive
Span (in)	= 24.00	18.00	18.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 575.02	575.55	575.00	0.00
Length (ft)	= 77.00	55.00	60.00	0.00
Slope (%)	= 1.10	1.50	1.00	n/a
N-Value	= .012	.012	.012	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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



Hydrograph Report

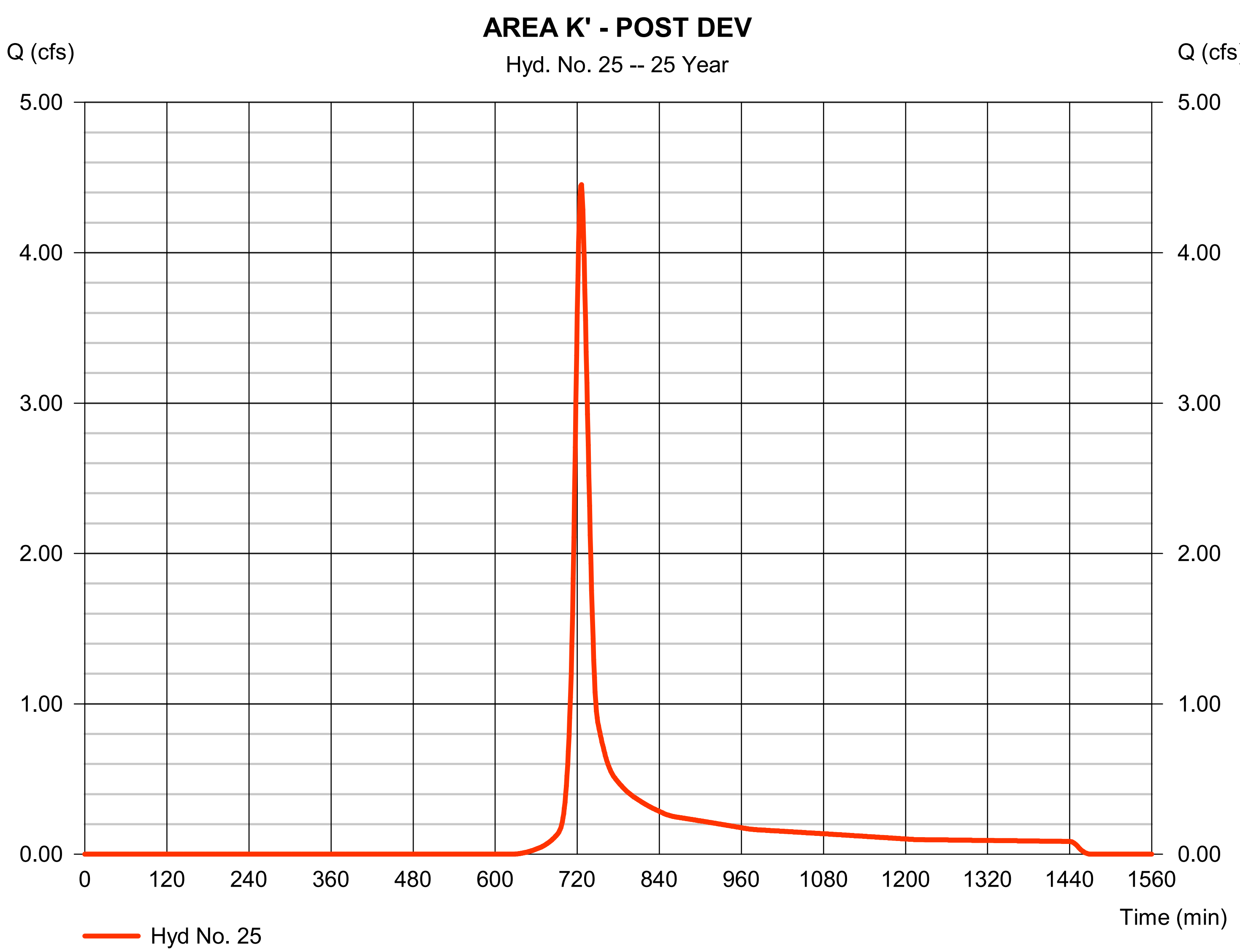
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 25

AREA K' - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 4.453 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 14,349 cuft
Drainage area	= 1.720 ac	Curve number	= 62*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 19.20 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.350 x 60) + (0.330 x 65) + (0.040 x 98)] / 1.720



TR55 Tc Worksheet

Hyd. No. 25

AREA K' - POST DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.011		0.011		0.011		
Flow length (ft)	= 0.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 0.00		0.00		0.00		
Land slope (%)	= 0.00		0.00		0.00		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Shallow Concentrated Flow							
Flow length (ft)	= 200.00		40.00		0.00		
Watercourse slope (%)	= 0.50		6.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=1.14		3.95		0.00		
Travel Time (min)	**= 2.92**	**+**	**0.17**	**+**	**0.00**	**=**	**3.09**
Channel Flow							
X sectional flow area (sqft)	= 2.22		0.00		0.00		
Wetted perimeter (ft)	= 8.14		0.00		0.00		
Channel slope (%)	= 0.30		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=1.14						
			0.00				
					0.00		
Flow length (ft)	({0})1100.0		0.0		0.0		
Travel Time (min)	**= 16.09**	**+**	**0.00**	**+**	**0.00**	**=**	**16.09**

Total Travel Time, Tc .... 19.20 min

Hydrograph Report

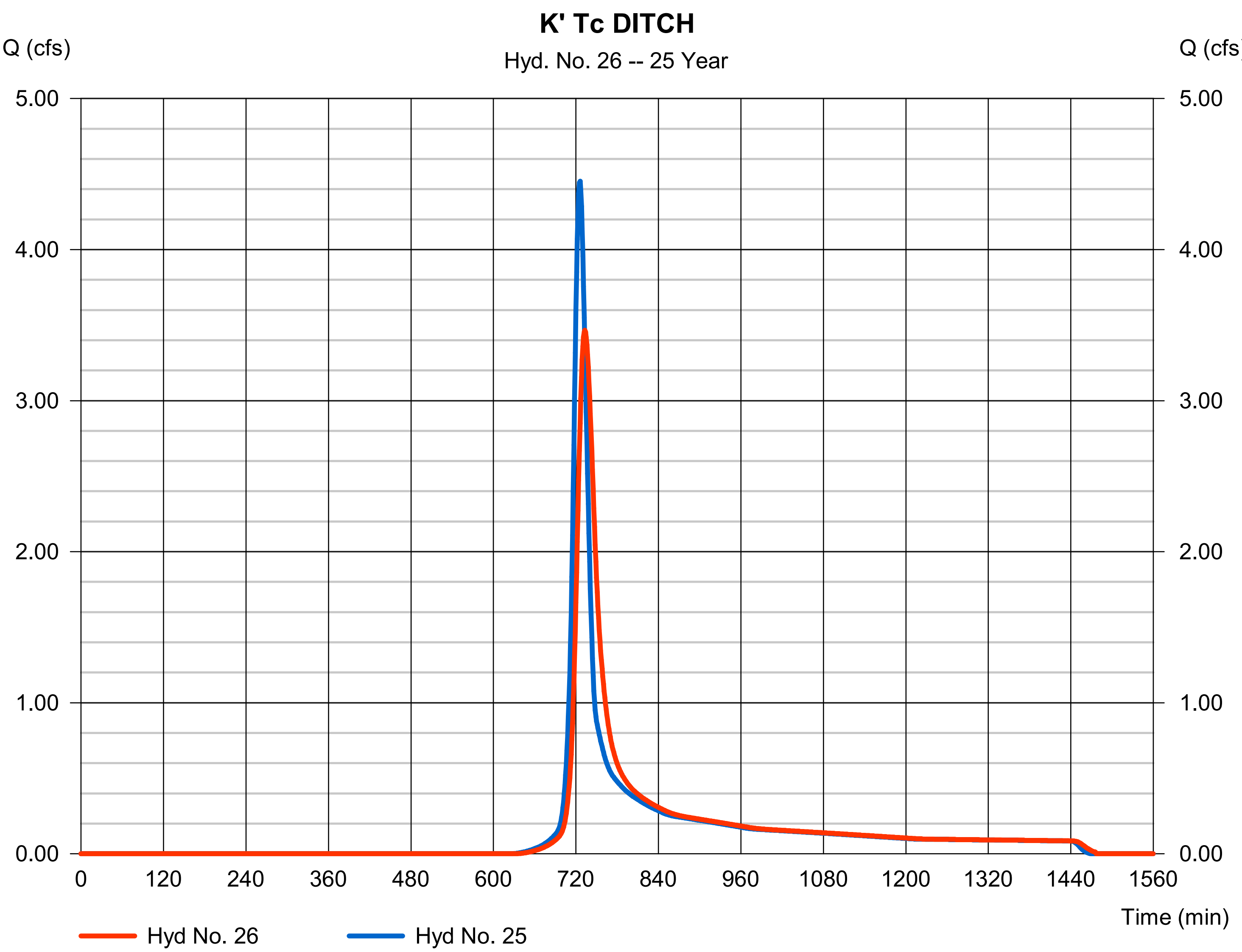
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 26

K' Tc DITCH

Hydrograph type	= Reach	Peak discharge	= 3.466 cfs
Storm frequency	= 25 yrs	Time to peak	= 733 min
Time interval	= 1 min	Hyd. volume	= 14,343 cuft
Inflow hyd. No.	= 25 - AREA K' - POST DEV	Section type	= Trapezoidal
Reach length	= 710.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.040	Bottom width	= 5.0 ft
Side slope	= 4.0:1	Max. depth	= 2.0 ft
Rating curve x	= 0.697	Rating curve m	= 1.257
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.1026

Modified Att-Kin routing method used.



Hydrograph Report

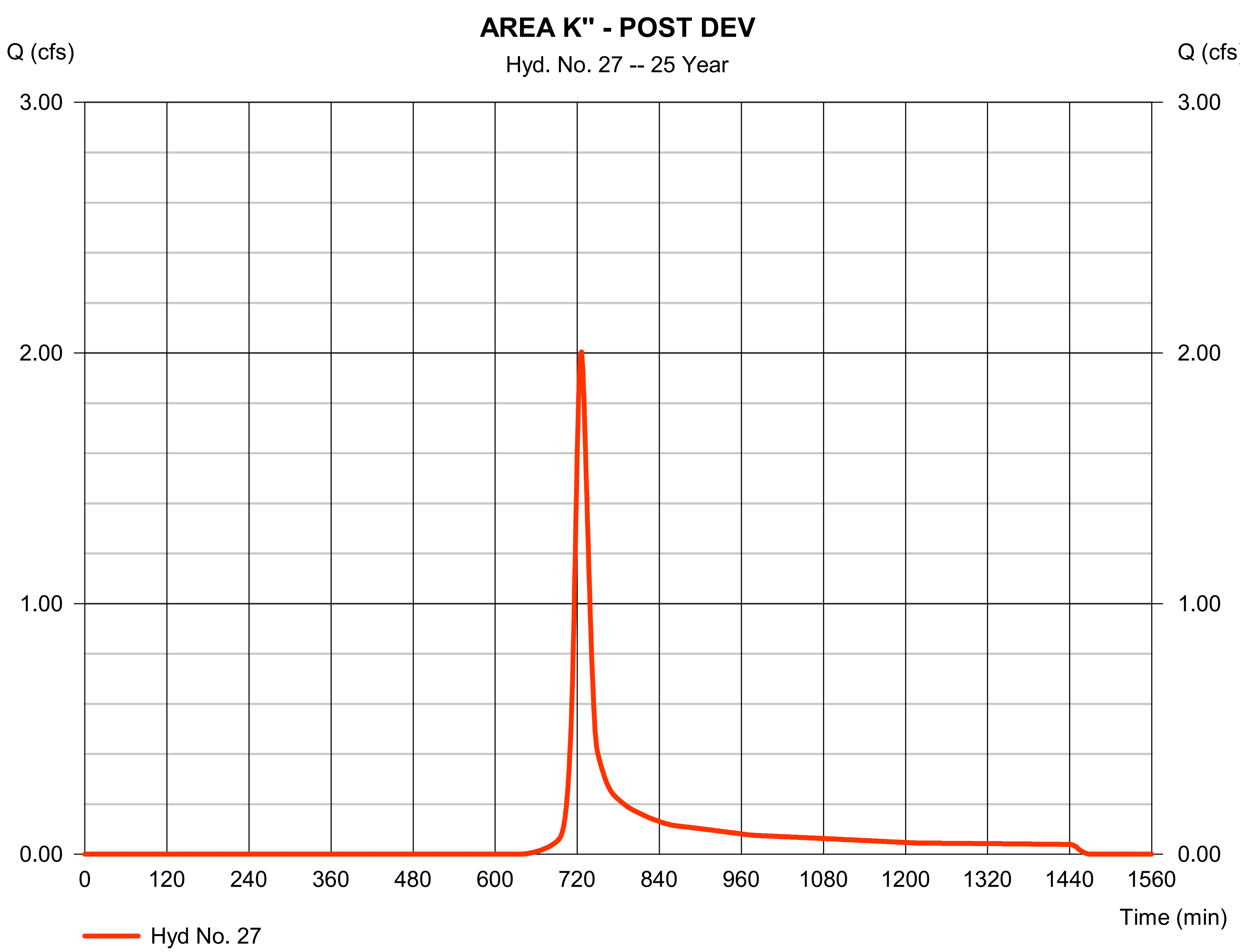
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 27

AREA K" - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 2.004 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 6,495 cuft
Drainage area	= 0.810 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 19.20 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.170 x 65) + (0.640 x 60)] / 0.810



TR55 Tc Worksheet

Hyd. No. 27

AREA K" - POST DEV

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.011		0.011		0.011		
Flow length (ft)	=	0.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	0.00		0.00		0.00		
Land slope (%)	=	0.00		0.00		0.00		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Shallow Concentrated Flow								
Flow length (ft)	=	200.00		40.00		0.00		
Watercourse slope (%)	=	0.50		6.00		0.00		
Surface description	=	Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=	1.14		3.95		0.00		
Travel Time (min)	**=**	**2.92**	**+**	**0.17**	**+**	**0.00**	**=**	**3.09**
Channel Flow								
X sectional flow area (sqft)	=	2.22		0.00		0.00		
Wetted perimeter (ft)	=	8.14		0.00		0.00		
Channel slope (%)	=	0.30		0.00		0.00		
Manning's n-value	=	0.030		0.015		0.015		
Velocity (ft/s)	=	1.14		0.00		0.00		
Flow length (ft)		({0})1100.0		0.0		0.0		
Travel Time (min)	**=**	**16.09**	**+**	**0.00**	**+**	**0.00**	**=**	**16.09**

Total Travel Time, Tc .... 19.20 min

Hydrograph Report

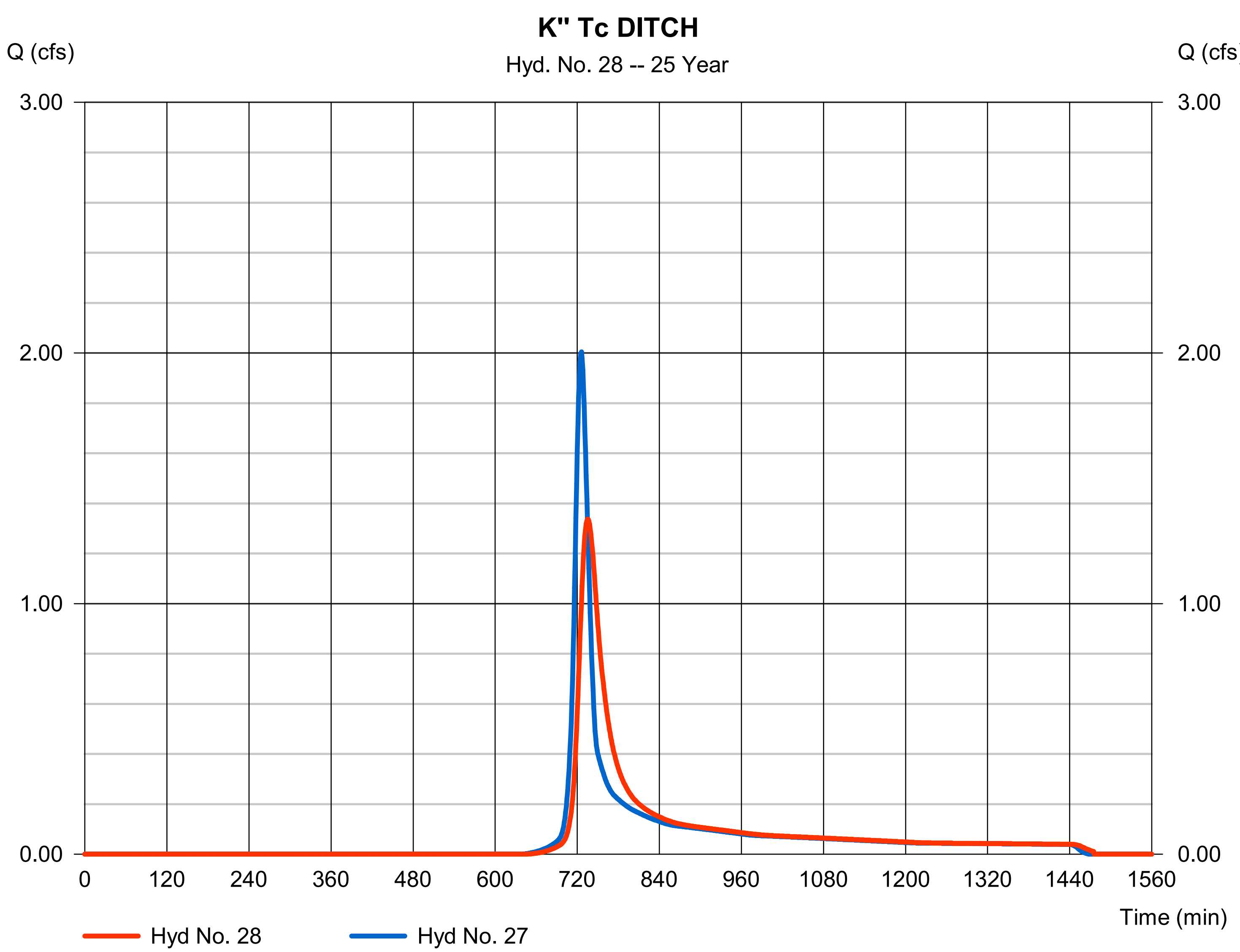
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 28

K" Tc DITCH

Hydrograph type	= Reach	Peak discharge	= 1.337 cfs
Storm frequency	= 25 yrs	Time to peak	= 735 min
Time interval	= 1 min	Hyd. volume	= 6,486 cuft
Inflow hyd. No.	= 27 - AREA K" - POST DEV	Section type	= Trapezoidal
Reach length	= 150.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.400	Bottom width	= 5.0 ft
Side slope	= 4.0:1	Max. depth	= 2.0 ft
Rating curve x	= 0.070	Rating curve m	= 1.257
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.0673

Modified Att-Kin routing method used.



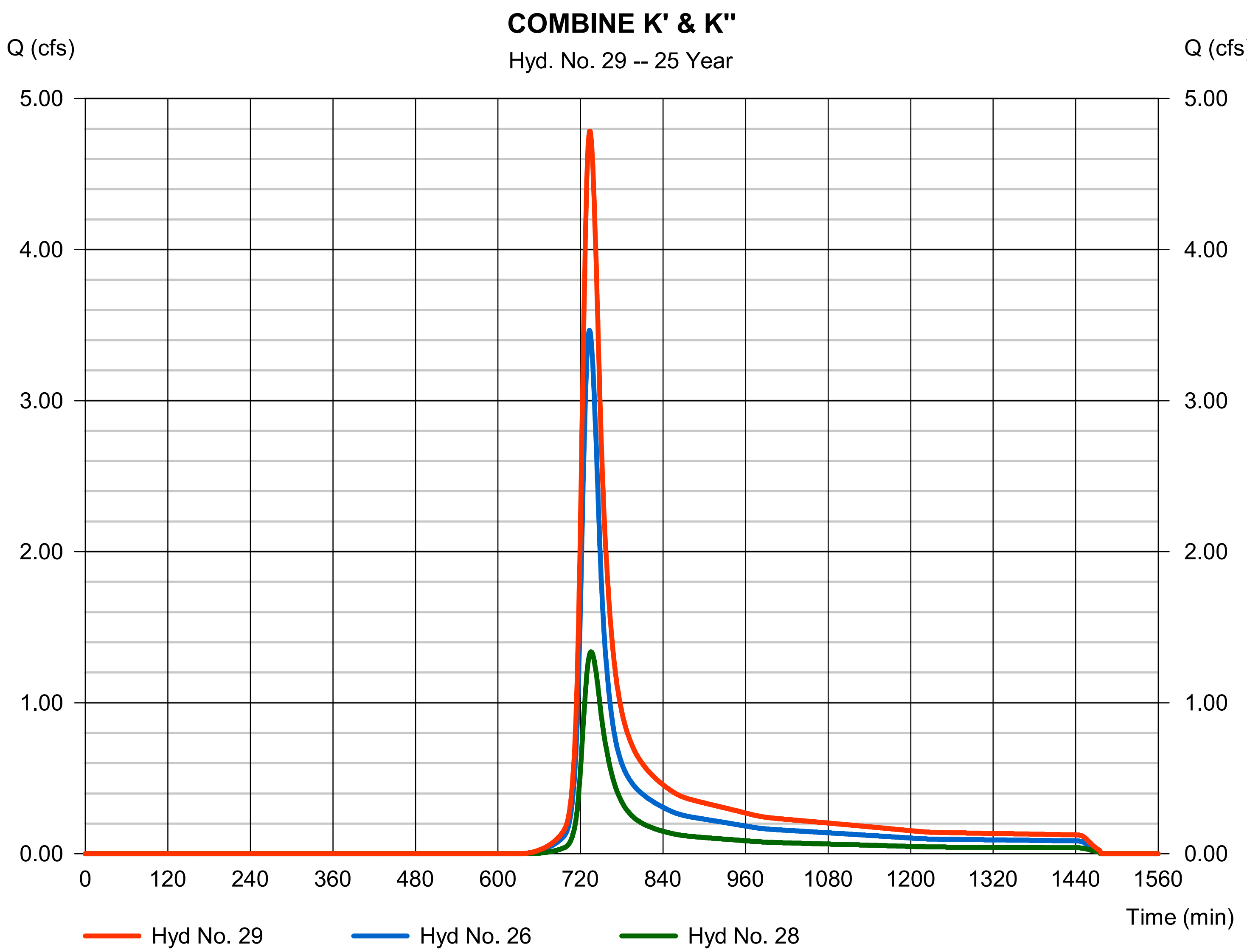
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 29

COMBINE K' & K''

Hydrograph type	= Combine	Peak discharge	= 4.784 cfs
Storm frequency	= 25 yrs	Time to peak	= 734 min
Time interval	= 1 min	Hyd. volume	= 20,829 cuft
Inflow hyds.	= 26, 28	Contrib. drain. area	= 0.000 ac



Hydrograph Report

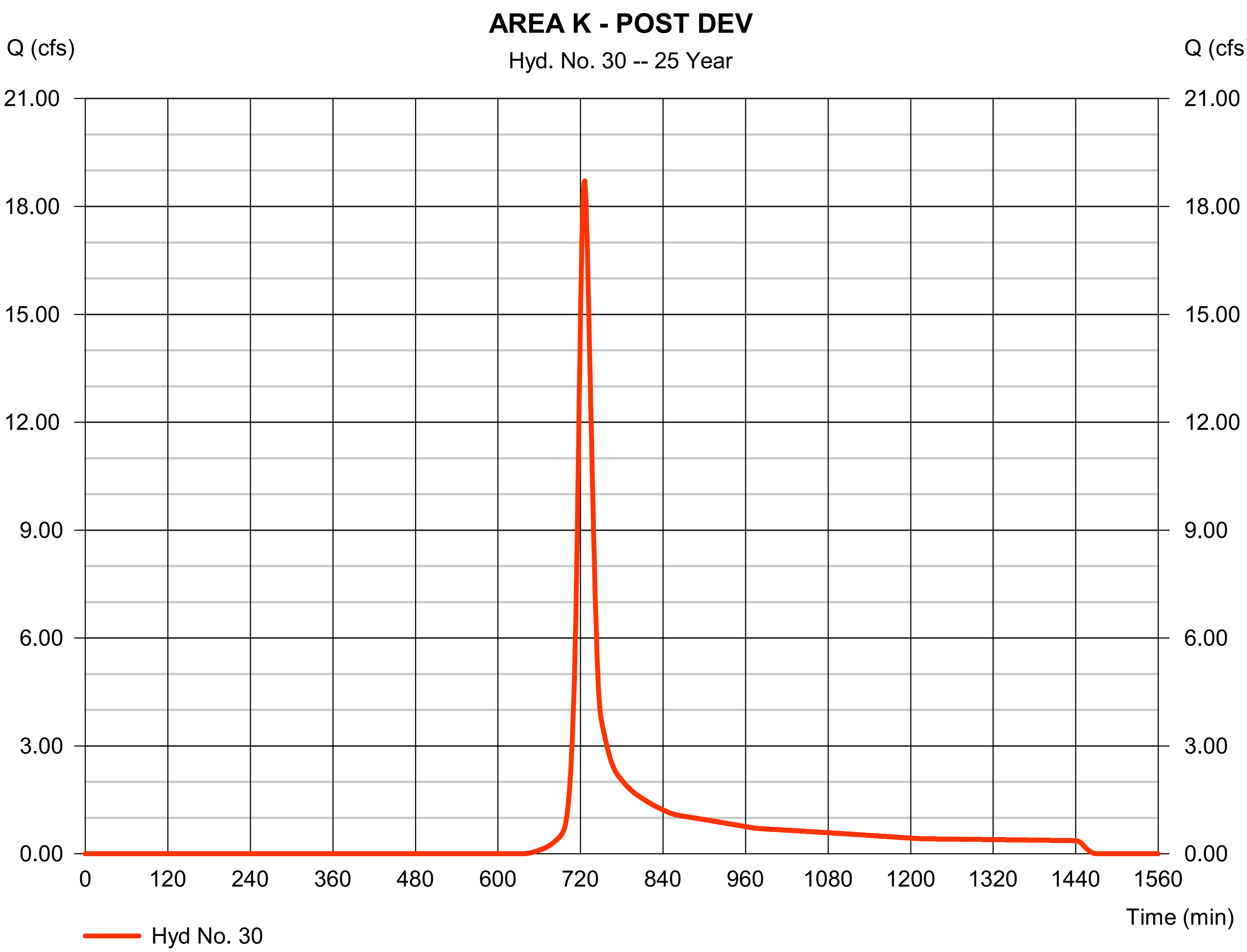
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 30

AREA K - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 18.71 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 60,617 cuft
Drainage area	= 7.560 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 19.20 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.070 x 65) + (6.490 x 60)] / 7.560



TR55 Tc Worksheet

Hyd. No. 30

AREA K - POST DEV

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.011		0.011		0.011		
Flow length (ft)	=	0.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	0.00		0.00		0.00		
Land slope (%)	=	0.00		0.00		0.00		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Shallow Concentrated Flow								
Flow length (ft)	=	200.00		40.00		0.00		
Watercourse slope (%)	=	0.50		6.00		0.00		
Surface description	=	Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=	1.14		3.95		0.00		
Travel Time (min)	**=**	**2.92**	**+**	**0.17**	**+**	**0.00**	**=**	**3.09**
Channel Flow								
X sectional flow area (sqft)	=	2.22		0.00		0.00		
Wetted perimeter (ft)	=	8.14		0.00		0.00		
Channel slope (%)	=	0.30		0.00		0.00		
Manning's n-value	=	0.030		0.015		0.015		
Velocity (ft/s)	=	1.14		0.00		0.00		
Flow length (ft)		({0})1100.0		0.0		0.0		
Travel Time (min)	**=**	**16.09**	**+**	**0.00**	**+**	**0.00**	**=**	**16.09**

Total Travel Time, Tc .... 19.20 min

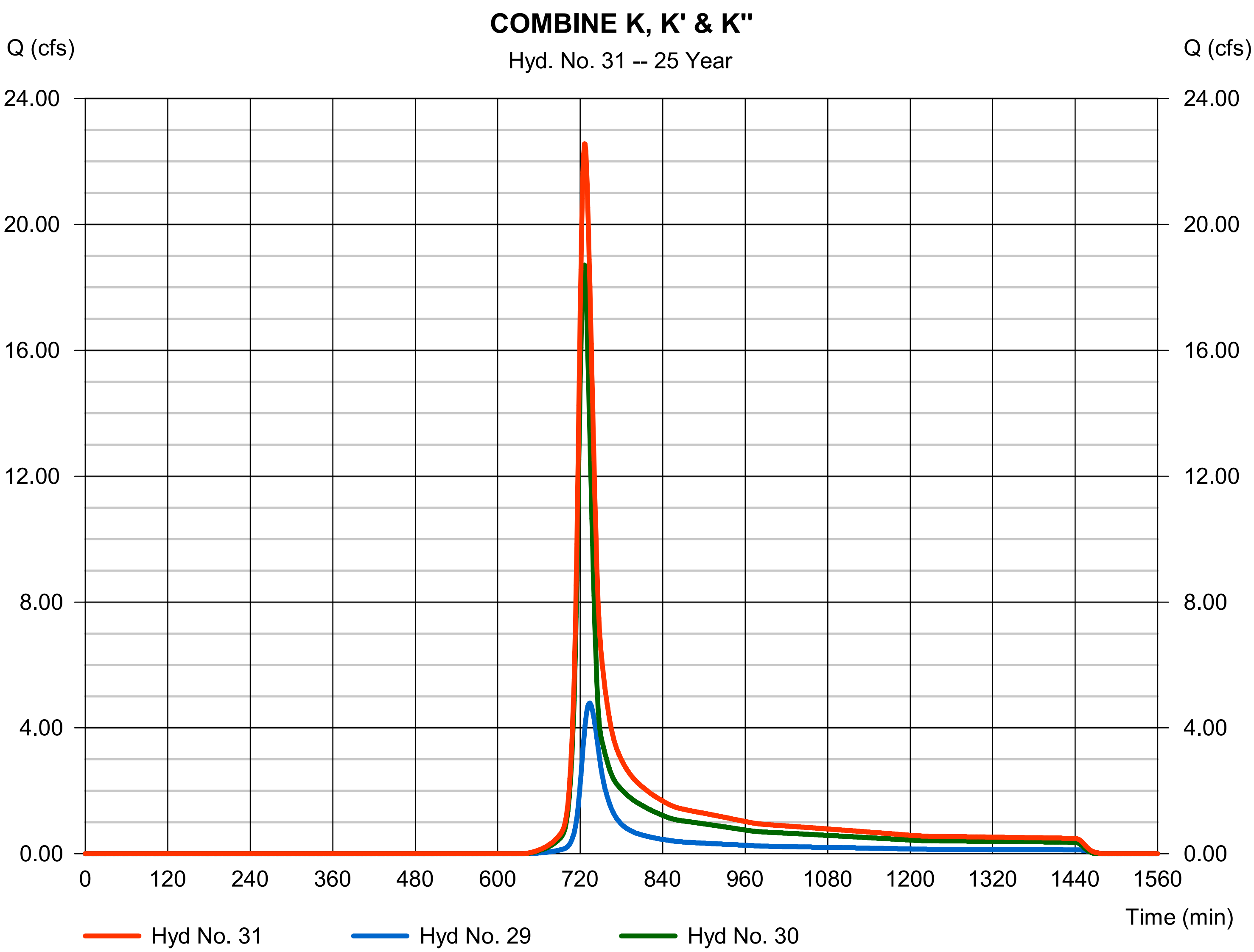
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 31

COMBINE K, K' & K"

Hydrograph type	= Combine	Peak discharge	= 22.56 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 81,447 cuft
Inflow hyds.	= 29, 30	Contrib. drain. area	= 7.560 ac



Hydrograph Report

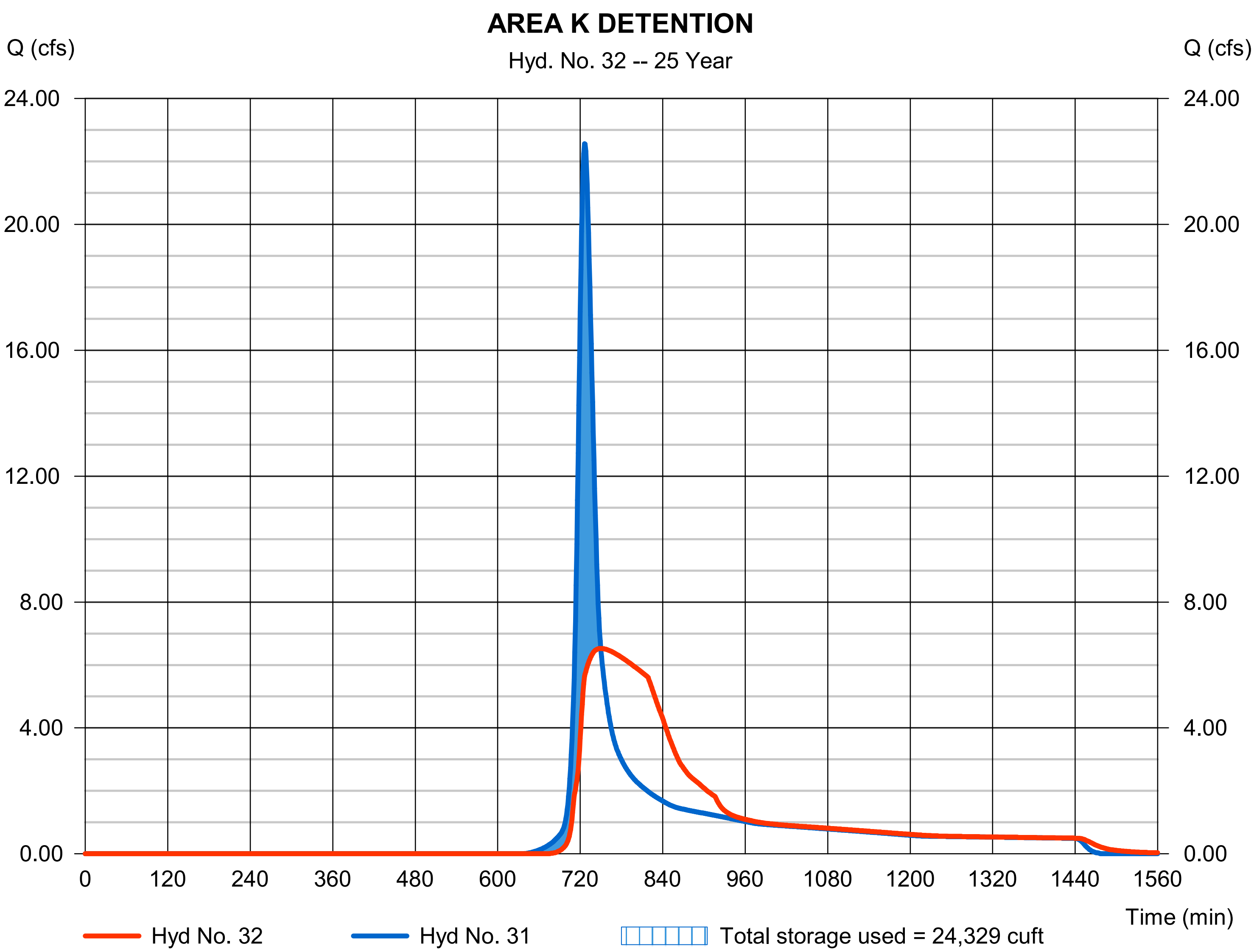
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 32

AREA K DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 6.523 cfs
Storm frequency	= 25 yrs	Time to peak	= 750 min
Time interval	= 1 min	Hyd. volume	= 81,312 cuft
Inflow hyd. No.	= 31 - COMBINE K, K' & K"	Max. Elevation	= 582.34 ft
Reservoir name	= K DETENTION	Max. Storage	= 24,329 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Pond No. 9 - K DETENTION

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	580.16	n/a	0	0
0.84	581.00	n/a	2,255	2,255
1.84	582.00	n/a	9,924	12,179
2.84	583.00	n/a	35,490	47,669
3.84	584.00	n/a	86,698	134,367

Culvert / Orifice Structures

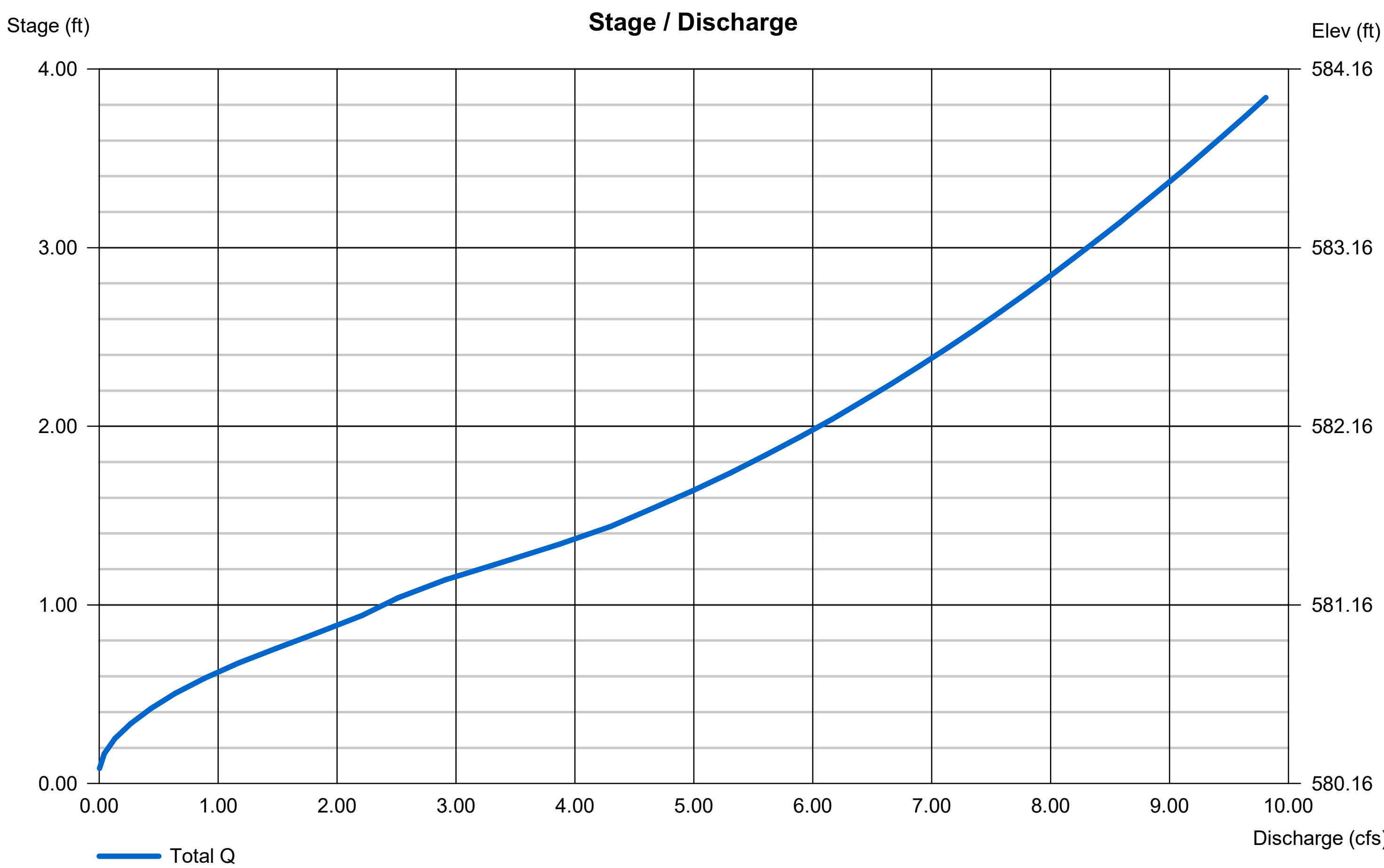
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	12.00	Inactive	Inactive
Span (in)	= 12.00	12.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 580.67	580.22	0.00	0.00
Length (ft)	= 49.70	48.30	0.00	0.00
Slope (%)	= 4.73	0.80	0.00	n/a
N-Value	= .023	.023	.013	n/a
Orifice Coeff.	= 0.50	0.50	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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



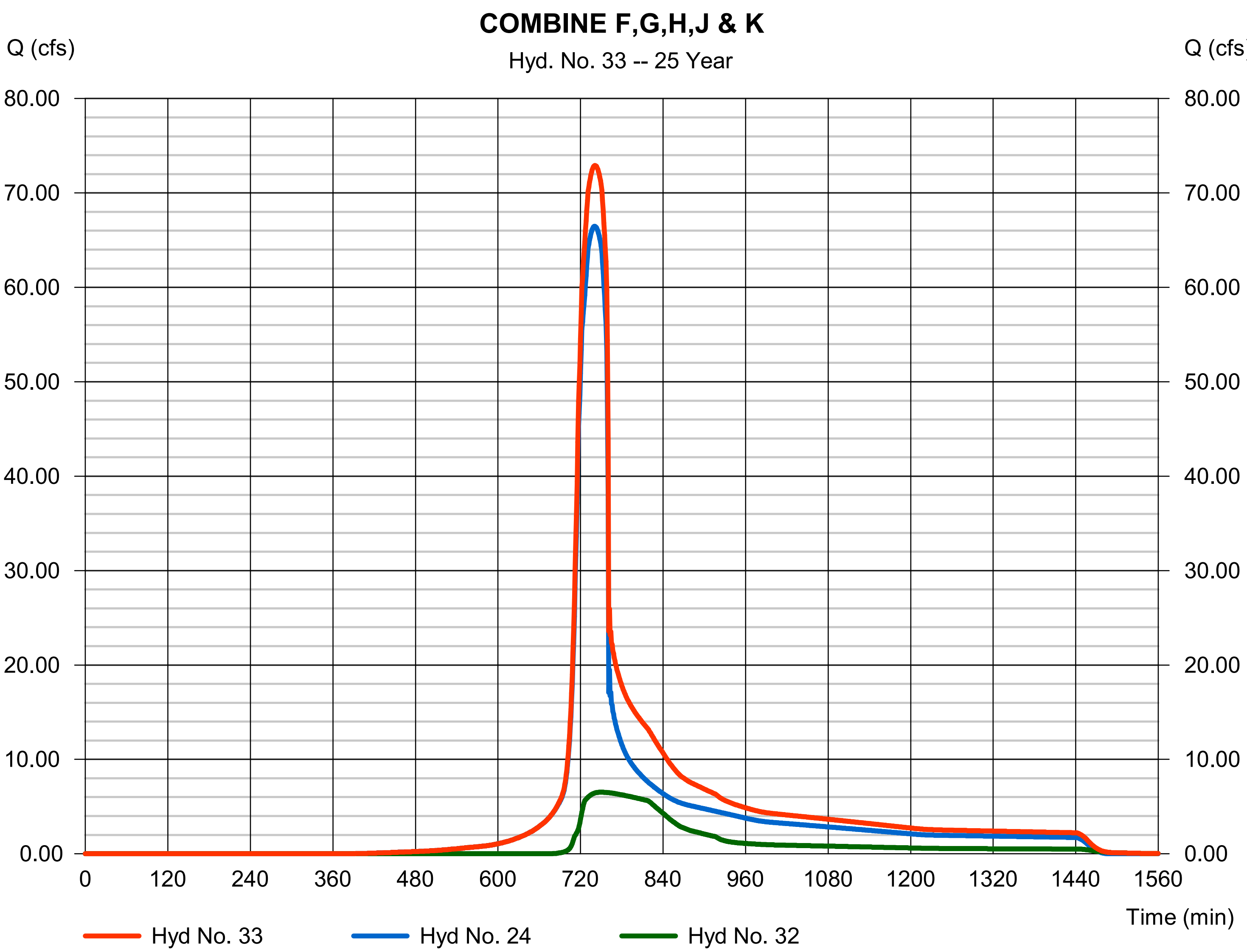
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 33

COMBINE F,G,H,J & K

Hydrograph type	= Combine	Peak discharge	= 72.92 cfs
Storm frequency	= 25 yrs	Time to peak	= 741 min
Time interval	= 1 min	Hyd. volume	= 435,636 cuft
Inflow hyds.	= 24, 32	Contrib. drain. area	= 0.000 ac



Hydrograph Report

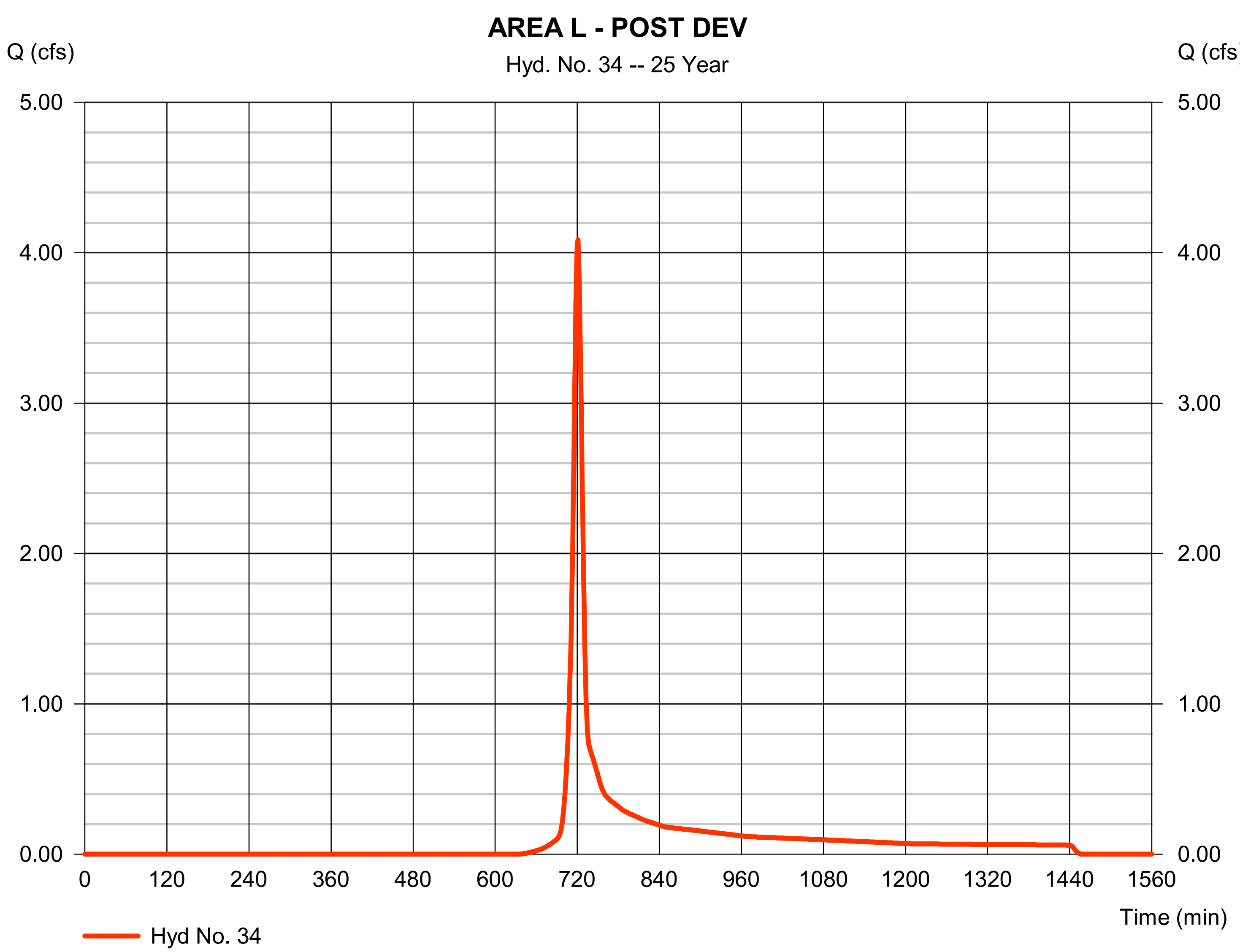
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 34

AREA L - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 4.086 cfs
Storm frequency	= 25 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 10,038 cuft
Drainage area	= 1.230 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 10.20 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.230 x 65) + (1.000 x 60)] / 1.230



TR55 Tc Worksheet

Hyd. No. 34

AREA L - POST DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.350		0.011		0.011		
Flow length (ft)	= 48.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		0.00		0.00		
Land slope (%)	= 4.20		0.00		0.00		
Travel Time (min)	**= 7.30**	**+**	**0.00**	**+**	**0.00**	**=**	**7.30**
Shallow Concentrated Flow							
Flow length (ft)	= 45.00		0.00		0.00		
Watercourse slope (%)	= 50.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=11.41		0.00		0.00		
Travel Time (min)	**= 0.07**	**+**	**0.00**	**+**	**0.00**	**=**	**0.07**
Channel Flow							
X sectional flow area (sqft)	= 1.51		0.00		0.00		
Wetted perimeter (ft)	= 5.05		0.00		0.00		
Channel slope (%)	= 0.30		0.00		0.00		
Manning's n-value	= 0.040		0.015		0.015		
Velocity (ft/s)	=0.91		0.00		0.00		
Flow length (ft)	({0})157.0		0.0		0.0		
Travel Time (min)	**= 2.88**	**+**	**0.00**	**+**	**0.00**	**=**	**2.88**

Total Travel Time, Tc .... 10.20 min

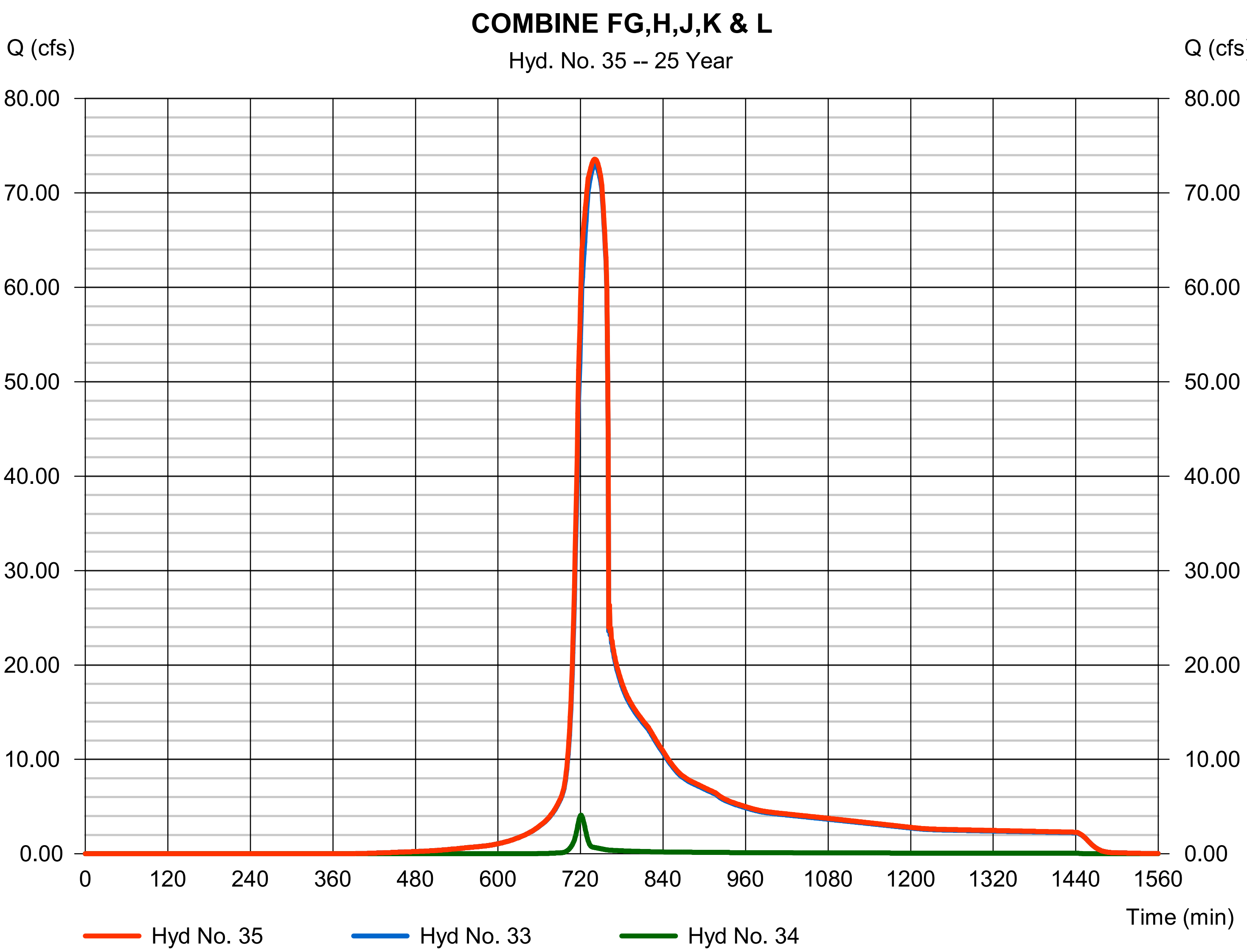
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 35

COMBINE FG,H,J,K & L

Hydrograph type	= Combine	Peak discharge	= 73.59 cfs
Storm frequency	= 25 yrs	Time to peak	= 741 min
Time interval	= 1 min	Hyd. volume	= 445,674 cuft
Inflow hyds.	= 33, 34	Contrib. drain. area	= 1.230 ac



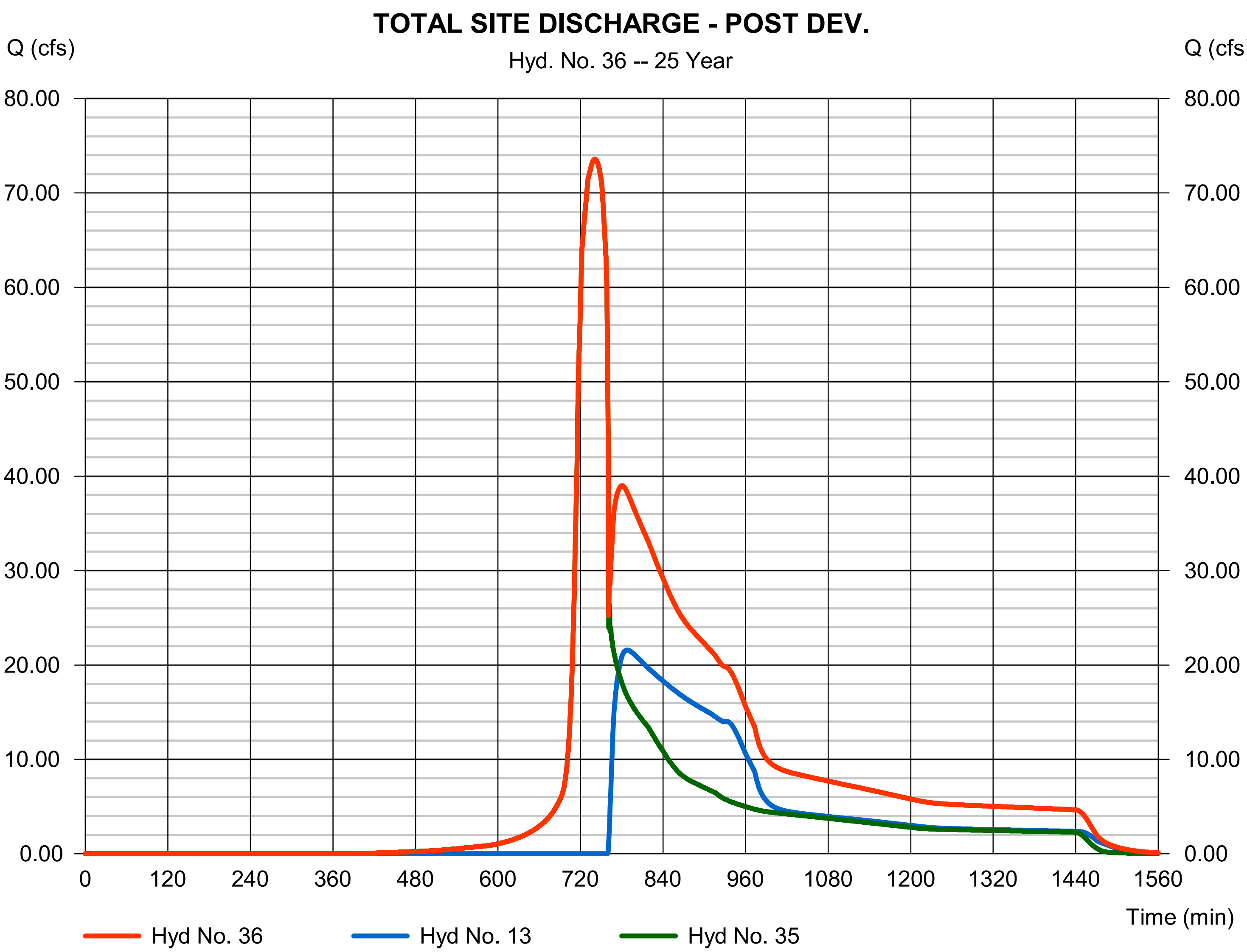
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 36

TOTAL SITE DISCHARGE - POST DEV.

Hydrograph type	= Combine	Peak discharge	= 73.59 cfs
Storm frequency	= 25 yrs	Time to peak	= 741 min
Time interval	= 1 min	Hyd. volume	= 751,440 cuft
Inflow hyds.	= 13, 35	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	SCS Runoff	11.34	1	725	35,424	------	------	------	AREA A - POST DEV
2	Reach	10.92	1	728	35,423	1	------	------	DITCH 1
3	SCS Runoff	25.11	1	727	85,777	------	------	------	AREA B - POST DEV
4	Combine	35.98	1	727	121,199	2, 3	------	------	COMBINE A & B
5	Reach	35.52	1	730	121,198	4	------	------	DITCH 2
6	SCS Runoff	17.70	1	742	98,530	------	------	------	AREA E - POST DEV
7	SCS Runoff	39.22	1	731	156,835	------	------	------	AREA D - POST DEV
8	SCS Runoff	48.71	1	727	166,351	------	------	------	AREA C - POST DEV
9	Combine	86.55	1	728	323,186	7, 8	------	------	COMBINE C & D
10	Reservoir	15.92	1	761	323,186	9	582.43	120,743	C & D DETENTION
11	Combine	48.96	1	731	219,728	5, 6,	------	------	COMBINE A,B,C & E
12	Combine	63.18	1	732	542,914	10, 11	------	------	COMBINE A,B, C, D & E
13	Reservoir	29.41	1	772	399,874	12	582.29	165,933	DETENTION A,B,C,D & E
14	SCS Runoff	30.87	1	729	115,543	------	------	------	AREA H - POST DEV
15	SCS Runoff	23.55	1	729	87,830	------	------	------	AREA G - POST DEV
16	SCS Runoff	18.95	1	724	56,382	------	------	------	AREA J - POST DEV
17	Combine	54.41	1	729	203,372	14, 15,	------	------	COMBINE H & G
18	Reach	52.59	1	732	203,371	17	------	------	HWY 20 SIDE DITCH
19	Combine	66.49	1	730	259,753	16, 18	------	------	COMBINE H,G, & J
20	SCS Runoff	37.12	1	731	148,915	------	------	------	AREA F - POST DEV
21	SCS Runoff	7.386	1	718	14,838	------	------	------	AREA J' - POST DEV
22	Combine	38.21	1	731	163,753	20, 21	------	------	Combine F & J'
23	Combine	104.60	1	730	423,506	19, 22	------	------	COMBINE G,H,J & F,J'
24	Reservoir	71.49	1	743	423,506	23	580.97	41,541	F,G,H,J & J' DETENTION
25	SCS Runoff	5.594	1	725	17,810	------	------	------	AREA K' - POST DEV
26	Reach	4.429	1	732	17,805	25	------	------	K' Tc DITCH
27	SCS Runoff	2.532	1	726	8,093	------	------	------	AREA K'' - POST DEV
28	Reach	1.732	1	735	8,085	27	------	------	K'' Tc DITCH
29	Combine	6.145	1	733	25,890	26, 28	------	------	COMBINE K' & K''
30	SCS Runoff	23.63	1	726	75,538	------	------	------	AREA K - POST DEV
31	Combine	28.70	1	726	101,428	29, 30	------	------	COMBINE K, K' & K''
32	Reservoir	7.119	1	753	101,294	31	582.59	33,217	AREA K DETENTION
33	Combine	78.53	1	743	524,795	24, 32	------	------	COMBINE F,G,H,J & K
34	SCS Runoff	5.133	1	721	12,509	------	------	------	AREA L - POST DEV

AP3_POSTDEV_ADD_DET.gpw	Return Period: 50 Year	Thursday, 11 / 15 / 2018

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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
35	Combine	79.30	1	743	537,304	33, 34	------	------	COMBINE FG,H,J,K & L
36	Combine	96.80	1	760	937,178	13, 35	------	------	TOTAL SITE DISCHARGE - POST D

Hydrograph Report

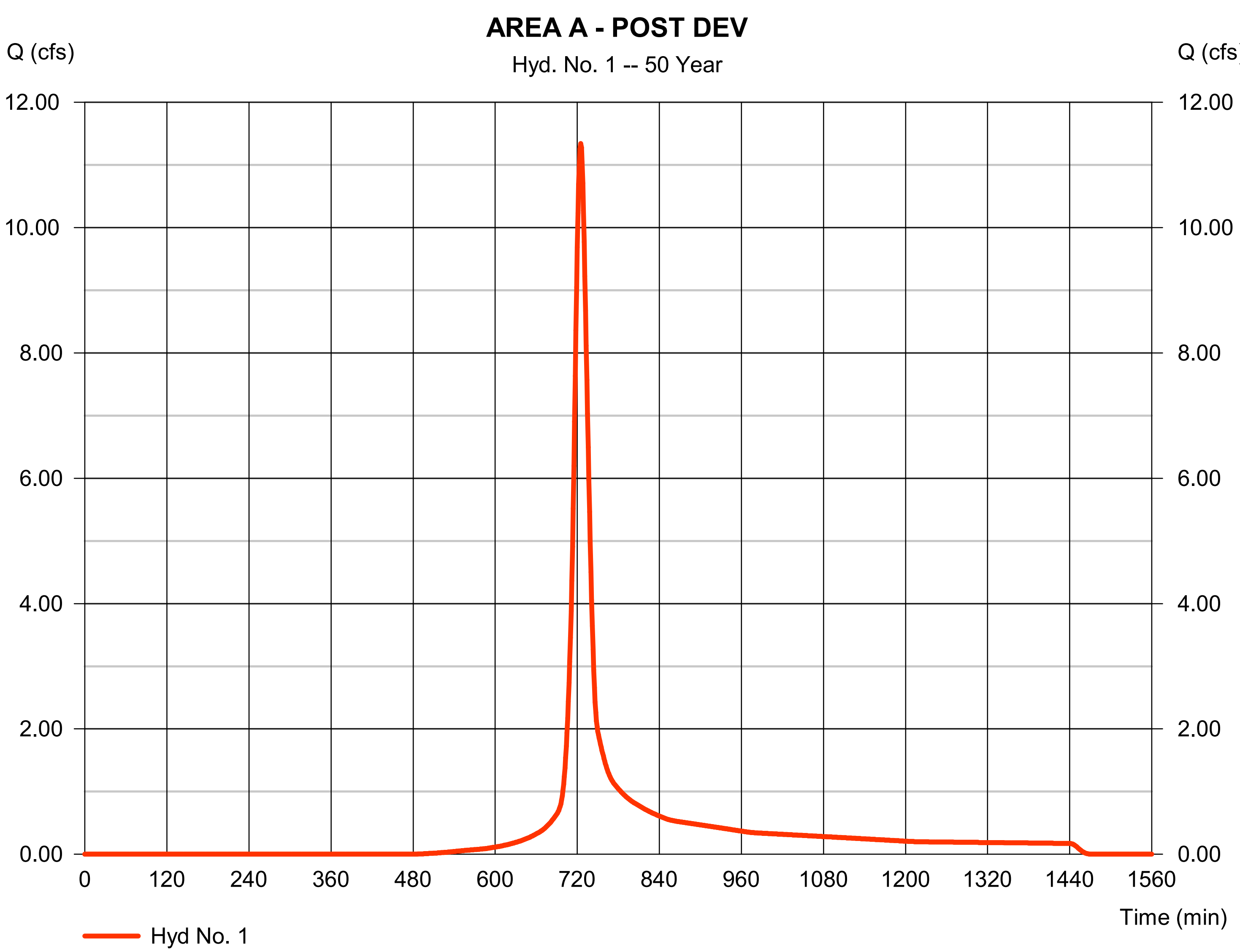
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 1

AREA A - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 11.34 cfs
Storm frequency	= 50 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 35,424 cuft
Drainage area	= 2.580 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.10 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.220 x 85) + (0.570 x 55) + (0.030 x 98) + (0.760 x 60)] / 2.580



Hydrograph Report

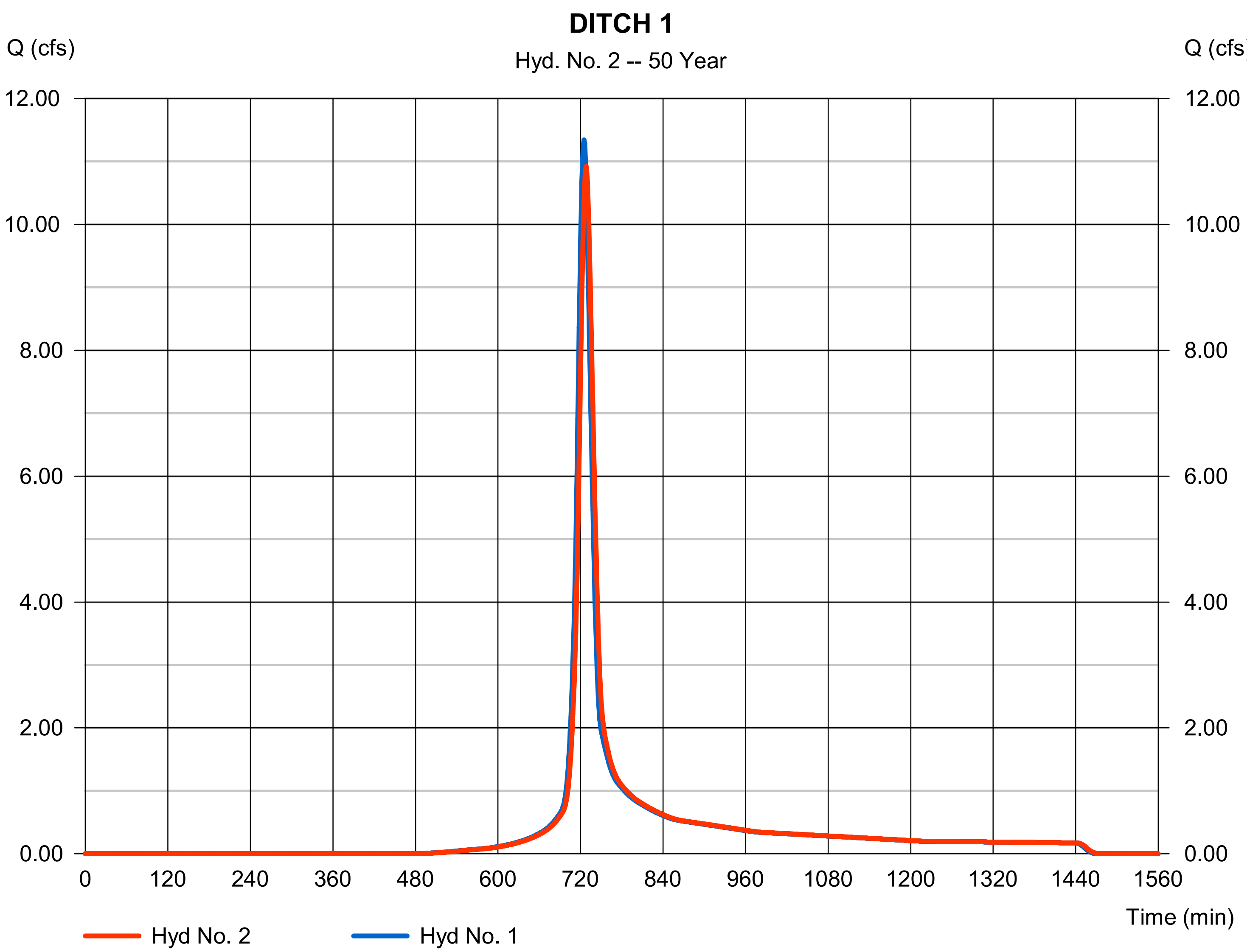
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 2

DITCH 1

Hydrograph type	= Reach	Peak discharge	= 10.92 cfs
Storm frequency	= 50 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 35,423 cuft
Inflow hyd. No.	= 1 - AREA A - POST DEV	Section type	= Trapezoidal
Reach length	= 730.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 10.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.375
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.3172

Modified Att-Kin routing method used.



Hydrograph Report

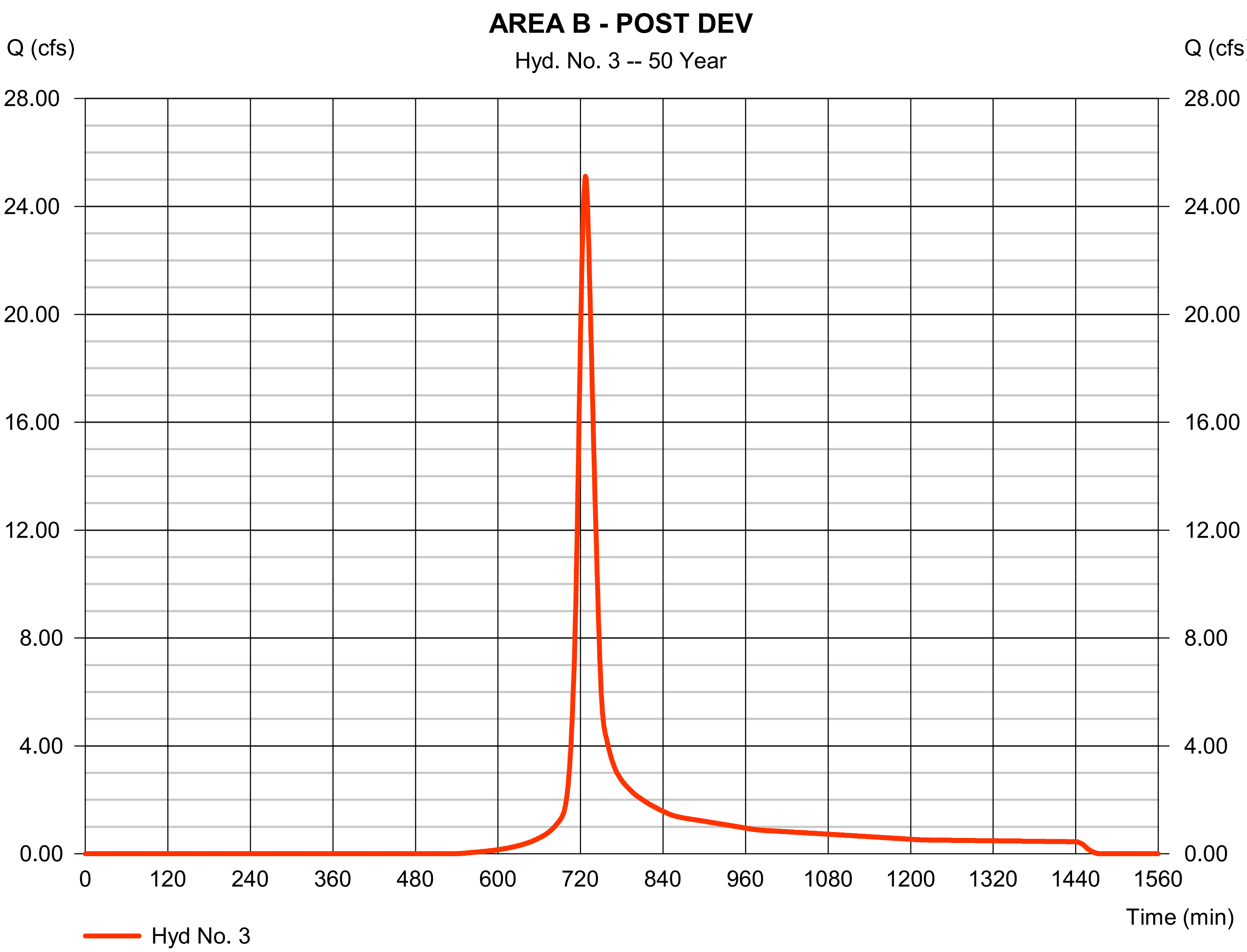
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 3

AREA B - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 25.11 cfs
Storm frequency	= 50 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 85,777 cuft
Drainage area	= 7.090 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.60 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.930 x 85) + (2.120 x 55) + (0.250 x 98) + (2.790 x 60)] / 7.090



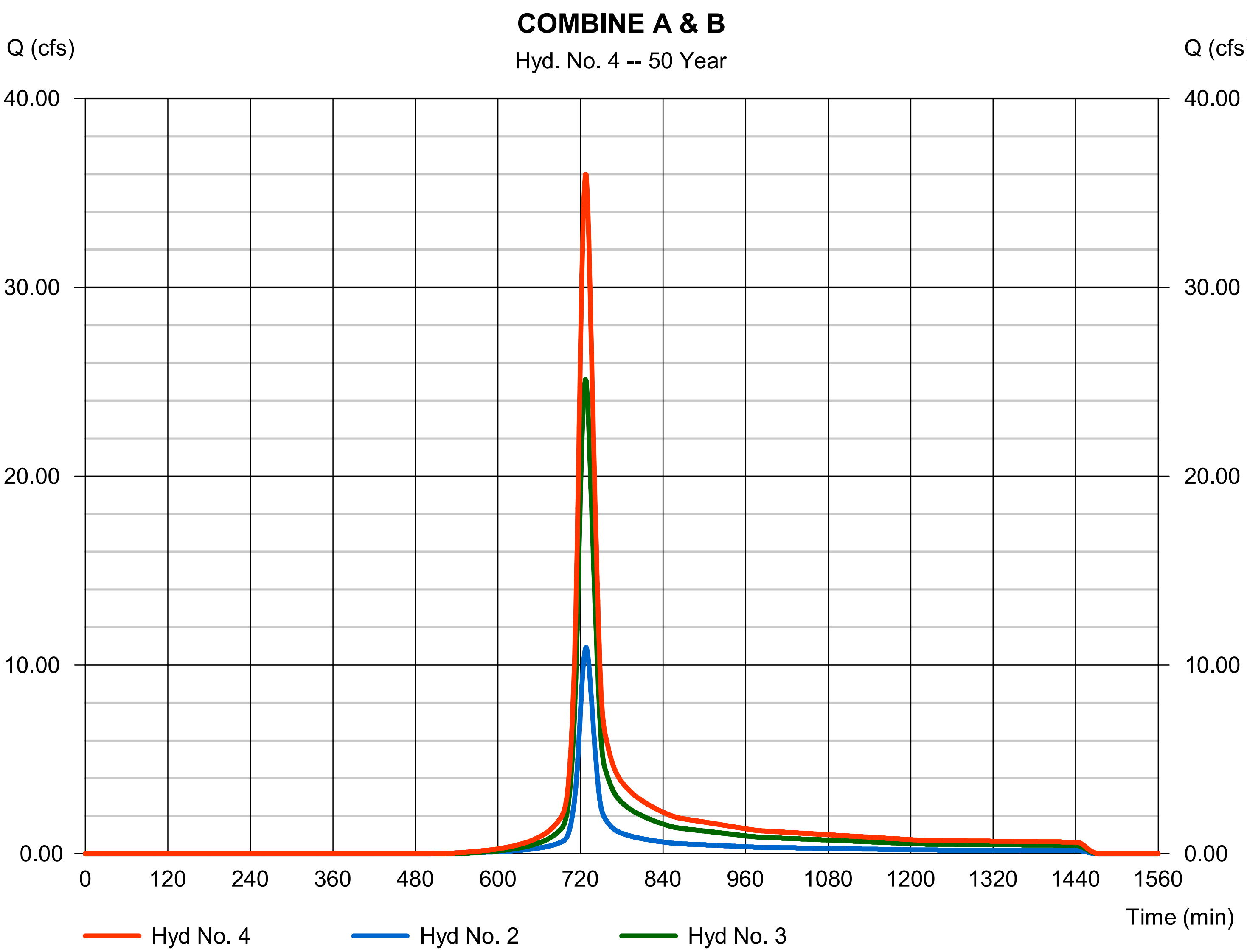
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 4

COMBINE A & B

Hydrograph type	= Combine	Peak discharge	= 35.98 cfs
Storm frequency	= 50 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 121,199 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 7.090 ac



Hydrograph Report

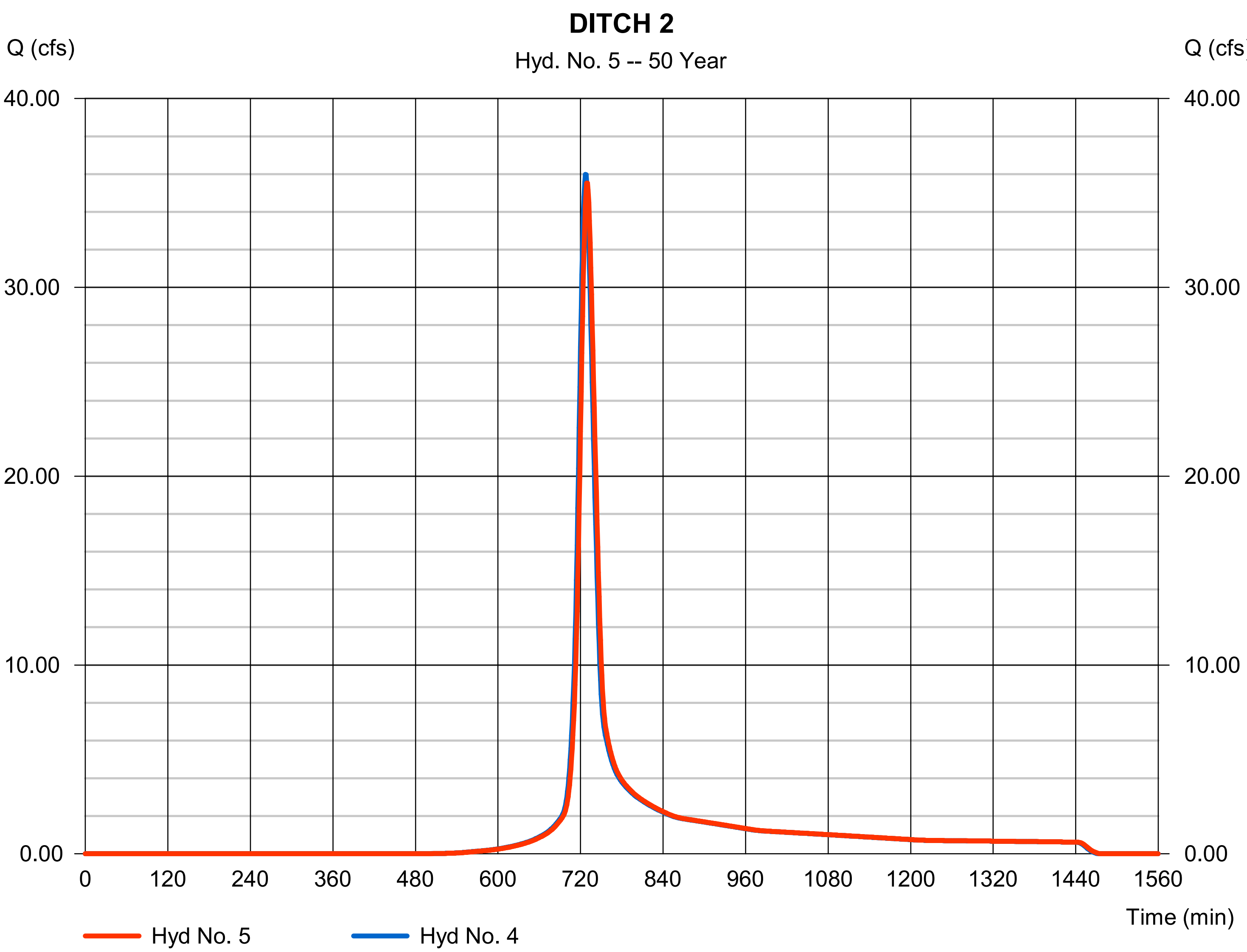
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 5

DITCH 2

Hydrograph type	= Reach	Peak discharge	= 35.52 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 121,198 cuft
Inflow hyd. No.	= 4 - COMBINE A & B	Section type	= Trapezoidal
Reach length	= 610.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.373
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.4704

Modified Att-Kin routing method used.



Hydrograph Report

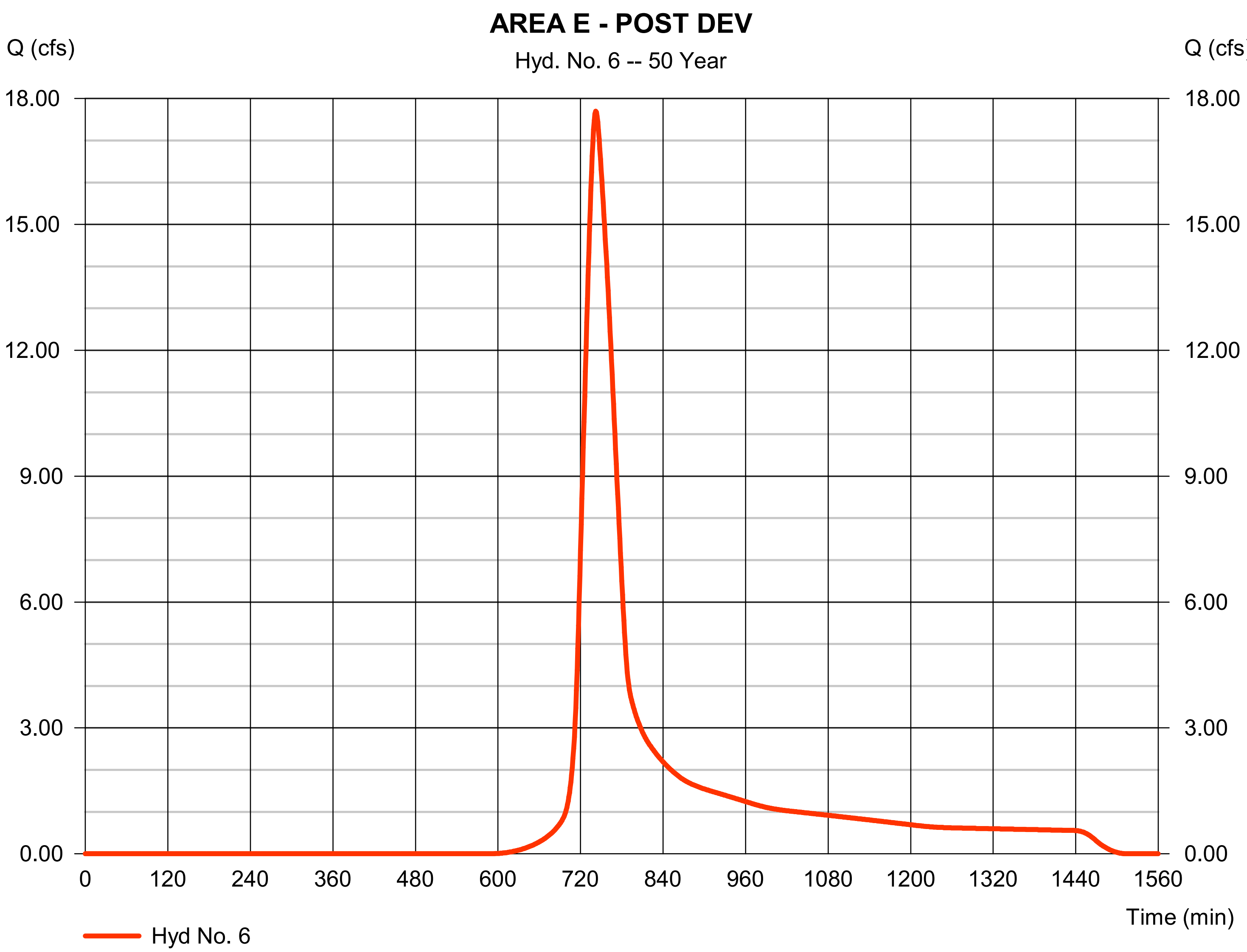
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 6

AREA E - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 17.70 cfs
Storm frequency	= 50 yrs	Time to peak	= 742 min
Time interval	= 1 min	Hyd. volume	= 98,530 cuft
Drainage area	= 9.150 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 47.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.680 x 65) + (0.330 x 98) + (5.140 x 60)] / 9.150



Hydrograph Report

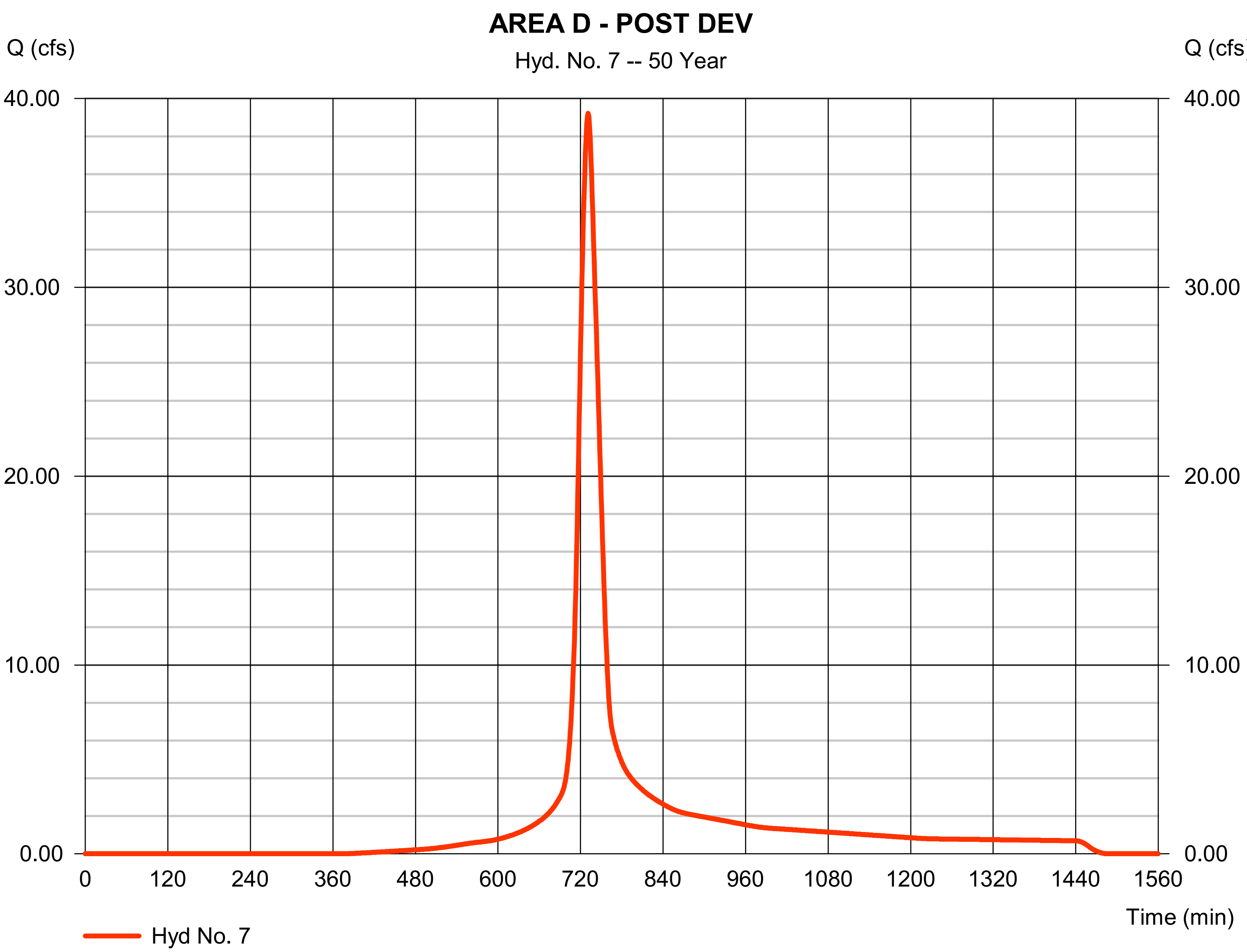
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 7

AREA D - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 39.22 cfs
Storm frequency	= 50 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 156,835 cuft
Drainage area	= 9.520 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.10 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.910 x 85) + (8.610 x 77)] / 9.520



Hydrograph Report

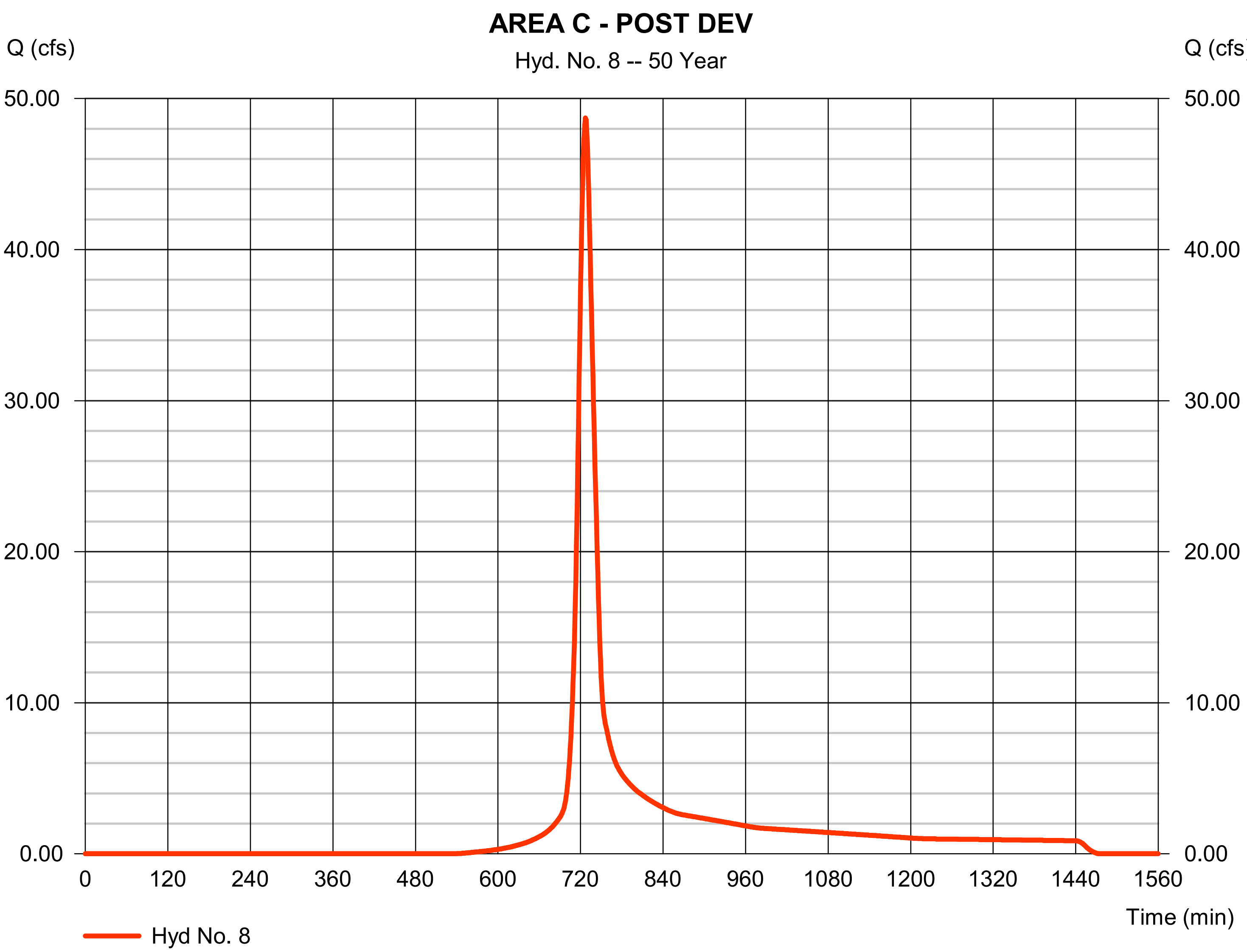
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 11 / 15 / 2018

Hyd. No. 8

AREA C - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 48.71 cfs
Storm frequency	= 50 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 166,351 cuft
Drainage area	= 13.750 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.460 x 85) + (0.400 x 55) + (1.740 x 98) + (10.150 x 60)] / 13.750



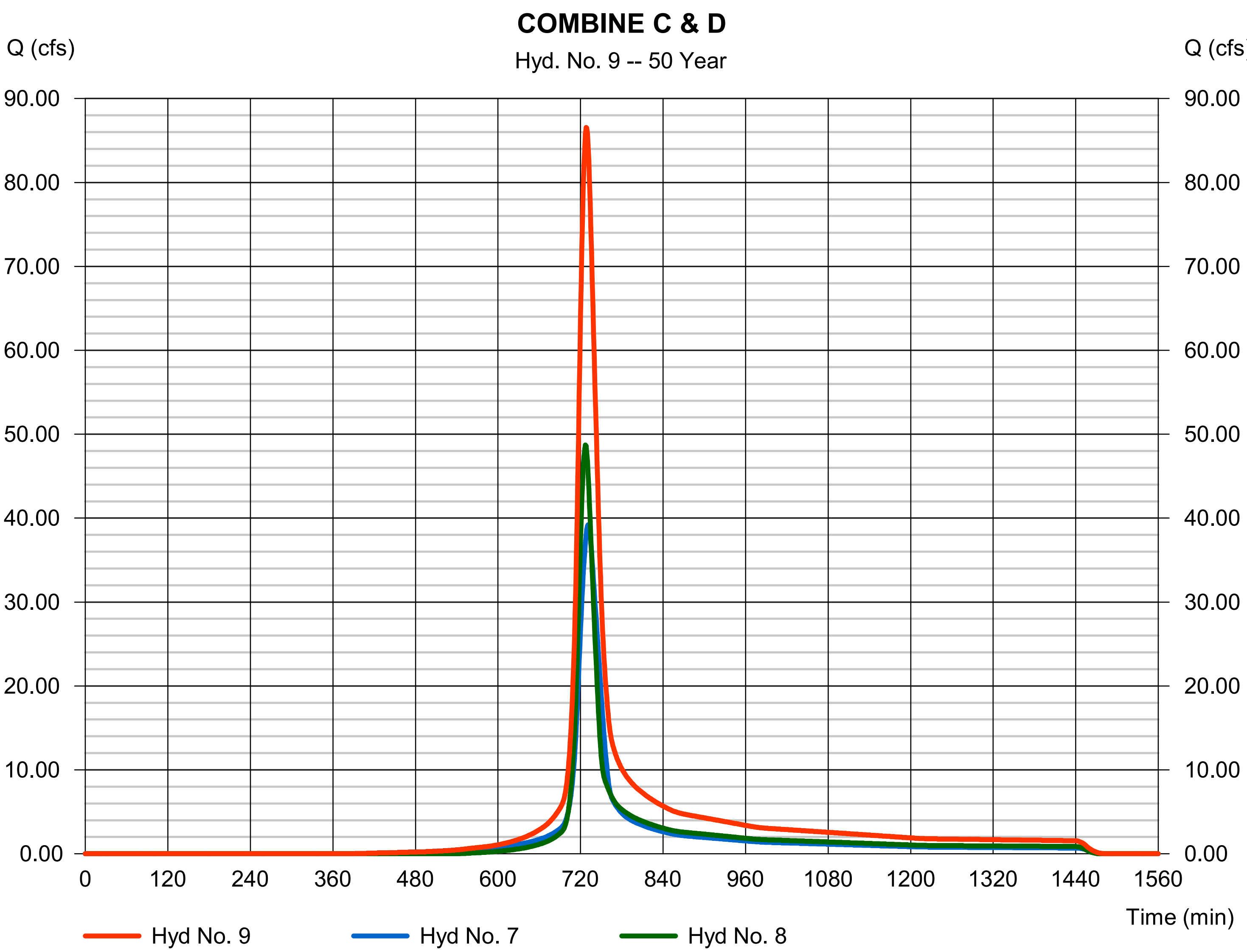
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 11 / 15 / 2018

Hyd. No. 9

COMBINE C & D

Hydrograph type	= Combine	Peak discharge	= 86.55 cfs
Storm frequency	= 50 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 323,186 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 23.270 ac



Hydrograph Report

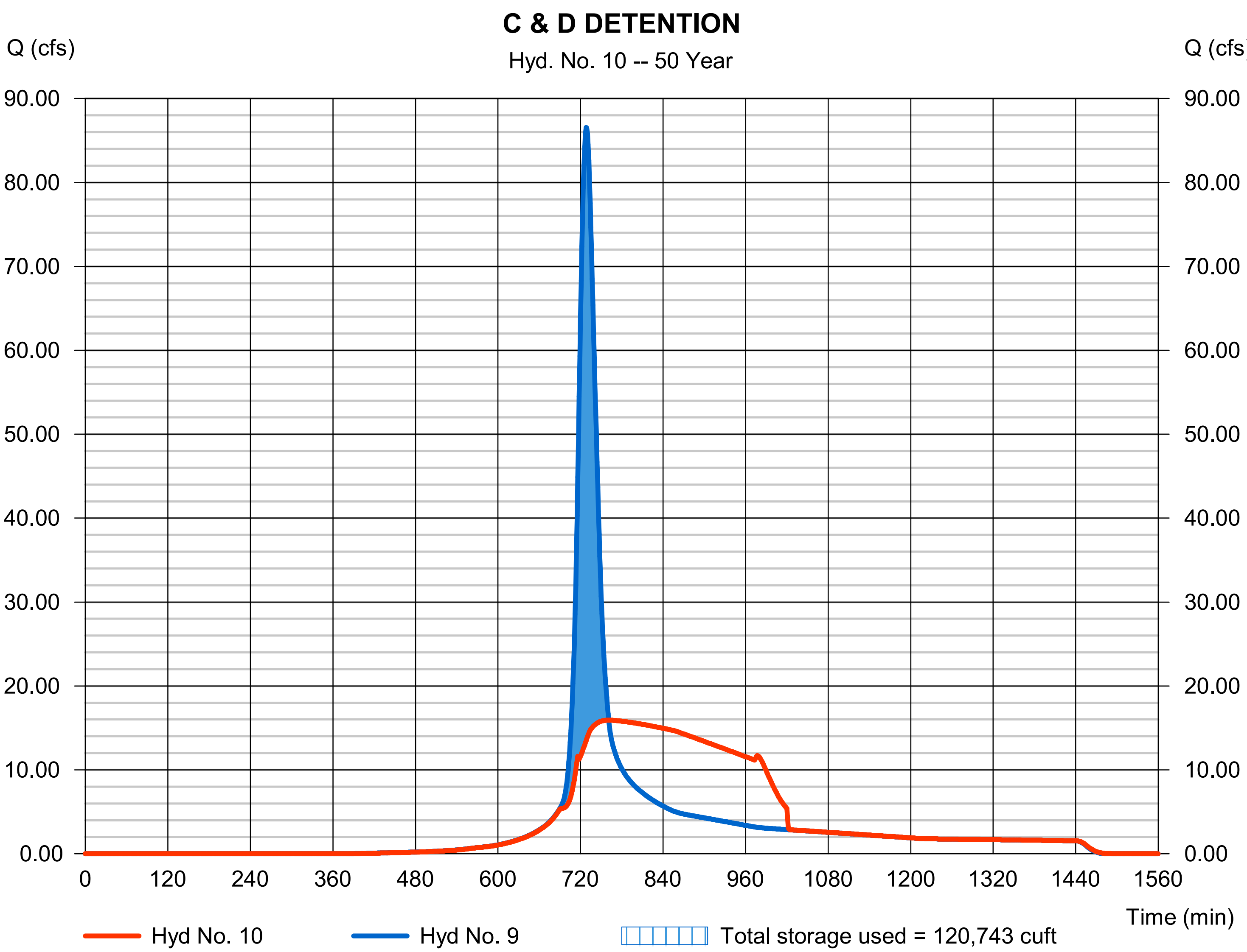
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 10

C & D DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 15.92 cfs
Storm frequency	= 50 yrs	Time to peak	= 761 min
Time interval	= 1 min	Hyd. volume	= 323,186 cuft
Inflow hyd. No.	= 9 - COMBINE C & D	Max. Elevation	= 582.43 ft
Reservoir name	= C&D DETENTION	Max. Storage	= 120,743 cuft

Storage Indication method used.



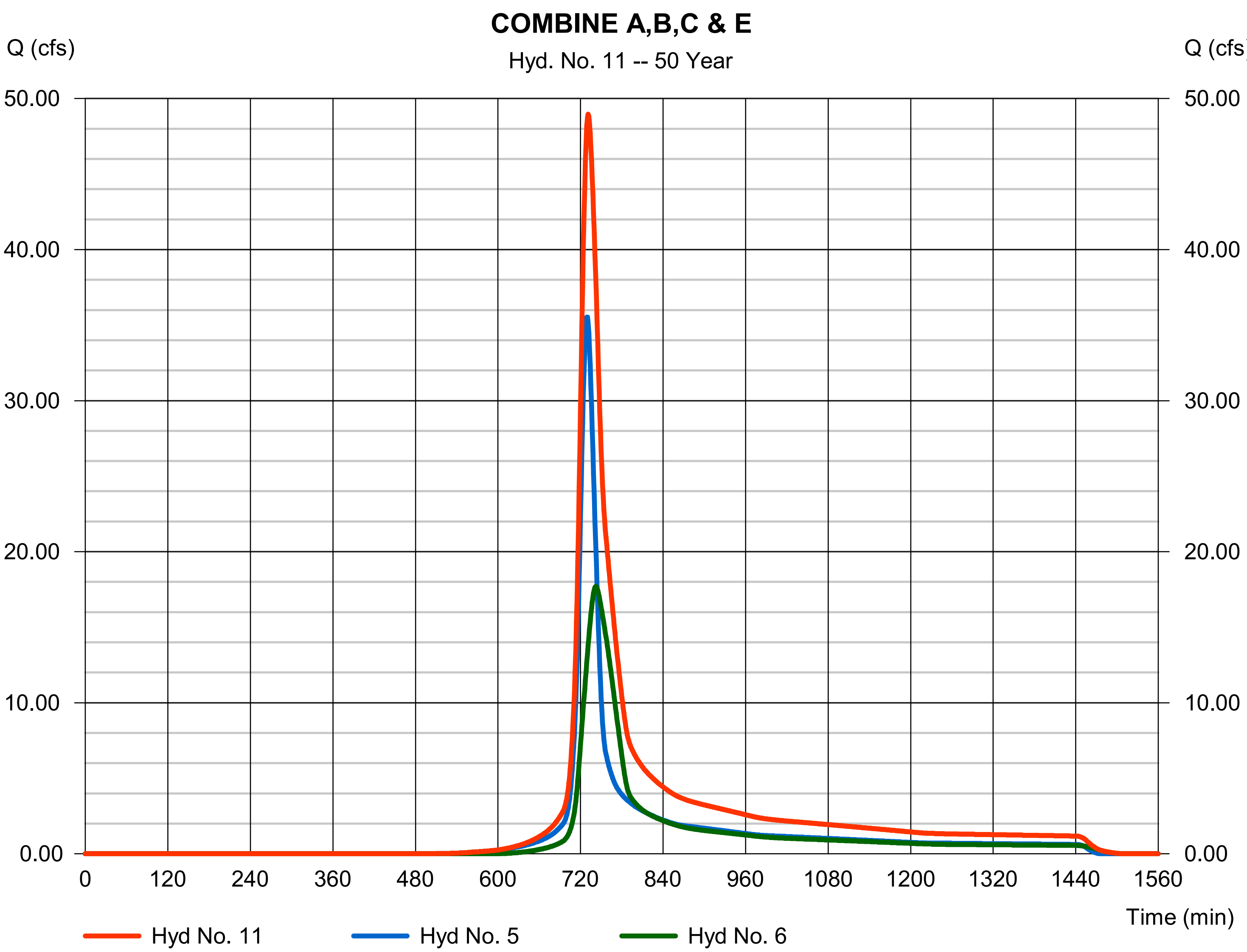
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 11

COMBINE A,B,C & E

Hydrograph type	= Combine	Peak discharge	= 48.96 cfs
Storm frequency	= 50 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 219,728 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 9.150 ac



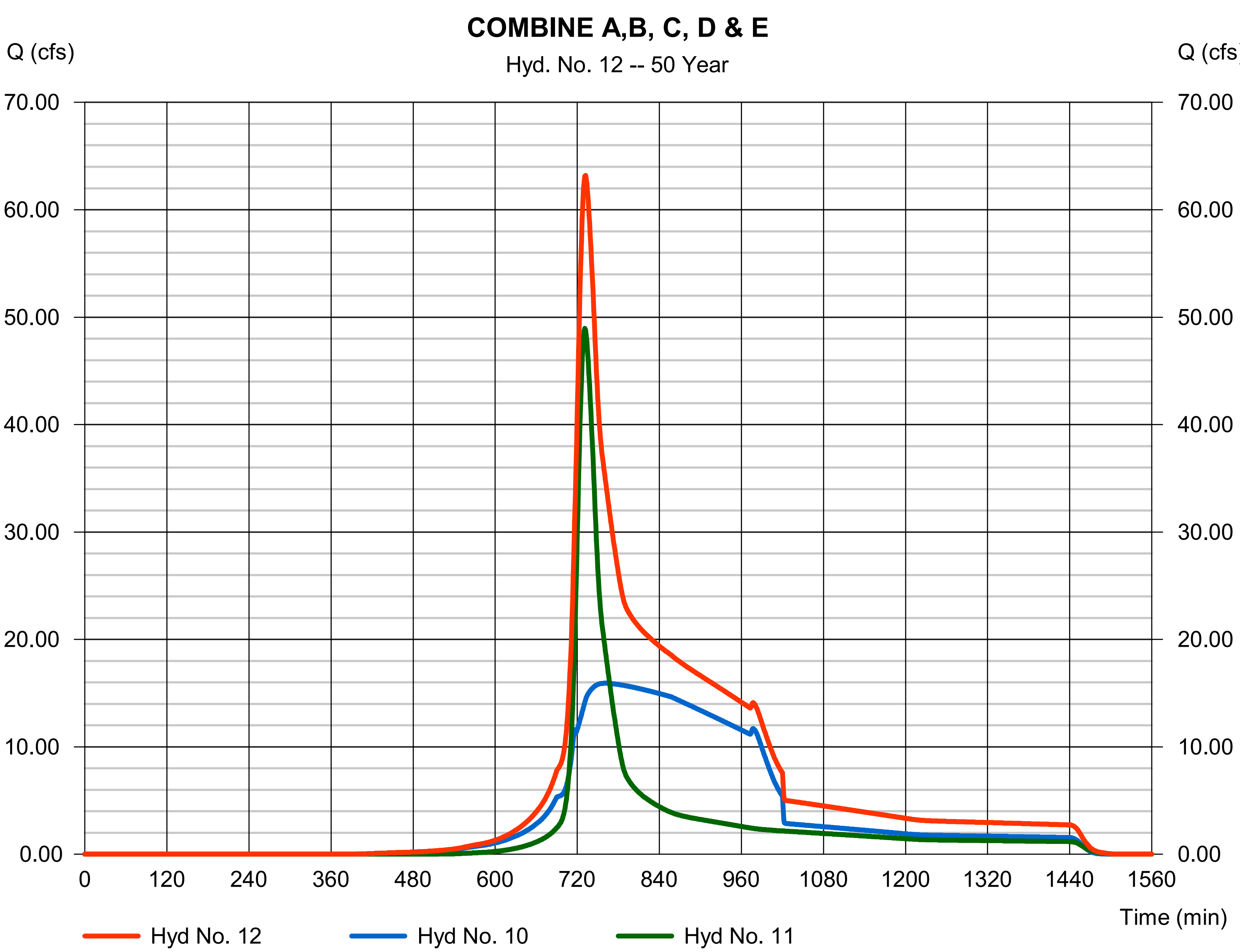
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 11 / 15 / 2018

Hyd. No. 12

COMBINE A,B, C, D & E

Hydrograph type	= Combine	Peak discharge	= 63.18 cfs
Storm frequency	= 50 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 542,914 cuft
Inflow hyds.	= 10, 11	Contrib. drain. area	= 0.000 ac



Hydrograph Report

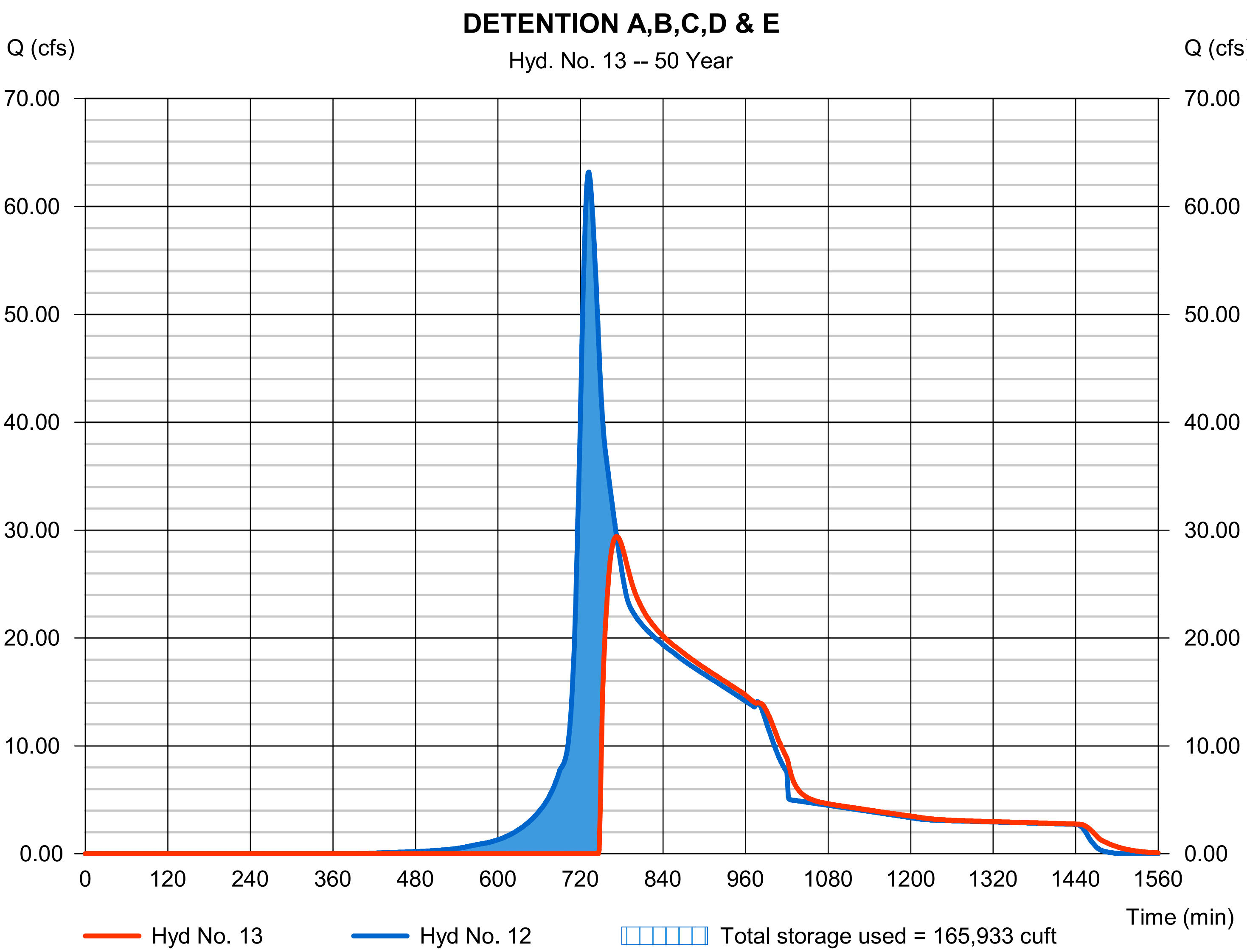
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 13

DETENTION A,B,C,D & E

Hydrograph type	= Reservoir	Peak discharge	= 29.41 cfs
Storm frequency	= 50 yrs	Time to peak	= 772 min
Time interval	= 1 min	Hyd. volume	= 399,874 cuft
Inflow hyd. No.	= 12 - COMBINE A,B, C, D & E	Max. Elevation	= 582.29 ft
Reservoir name	= A,B,C,D & E DETENTION	Max. Storage	= 165,933 cuft

Storage Indication method used.



Hydrograph Report

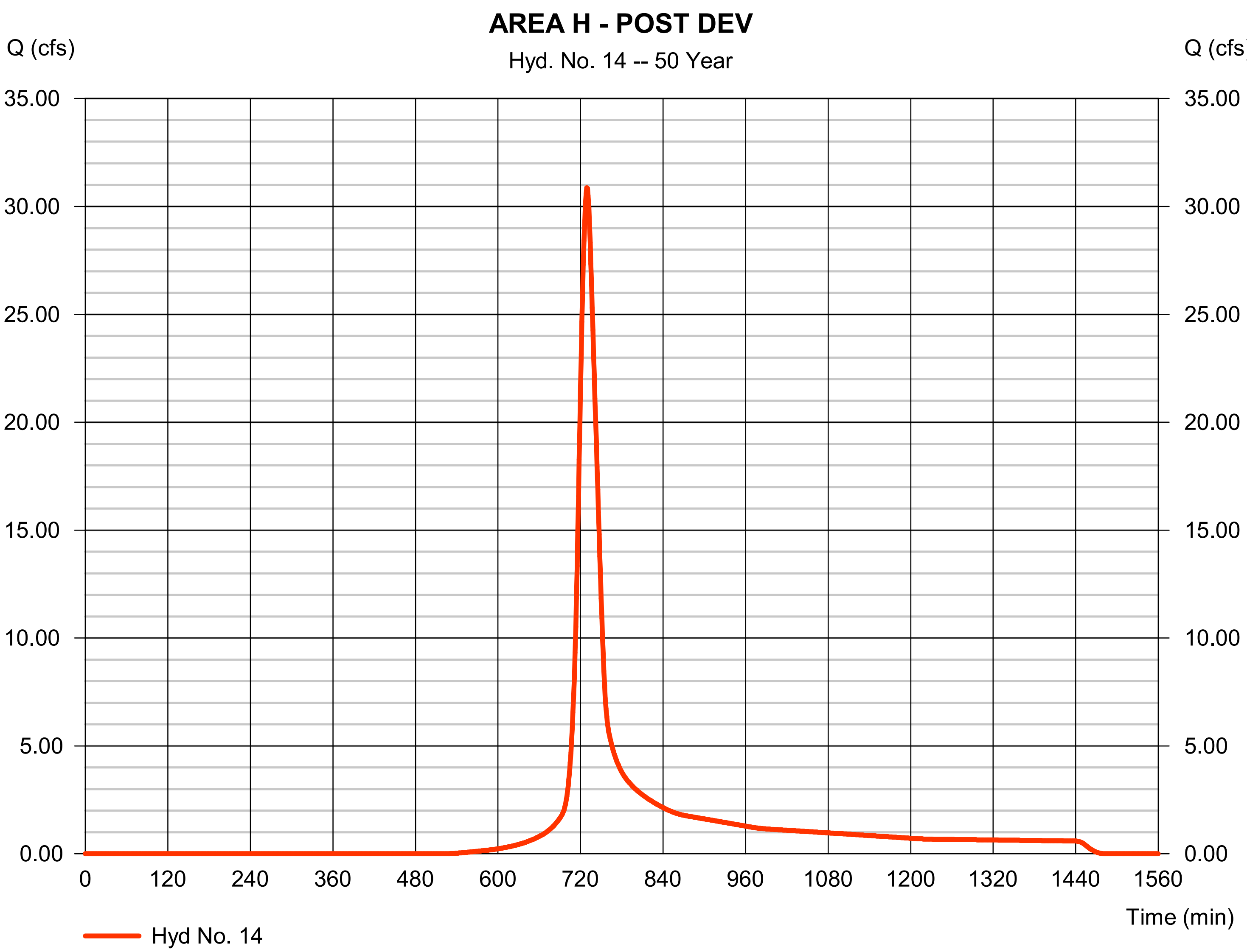
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 14

AREA H - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 30.87 cfs
Storm frequency	= 50 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 115,543 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.50 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



Hydrograph Report

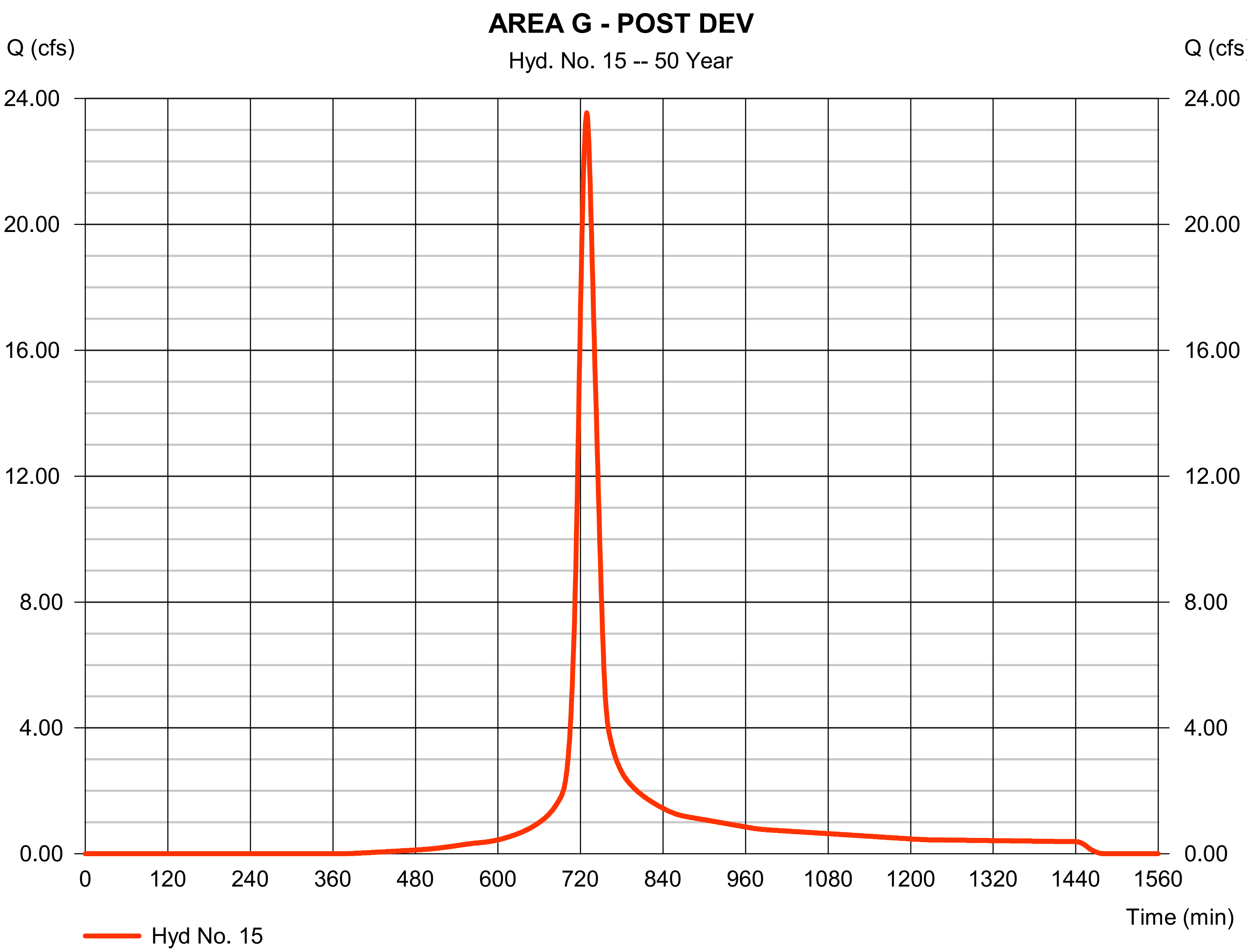
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 15

AREA G - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 23.55 cfs
Storm frequency	= 50 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 87,830 cuft
Drainage area	= 5.290 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 26.80 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.330 x 85) + (4.960 x 77)] / 5.290



Hydrograph Report

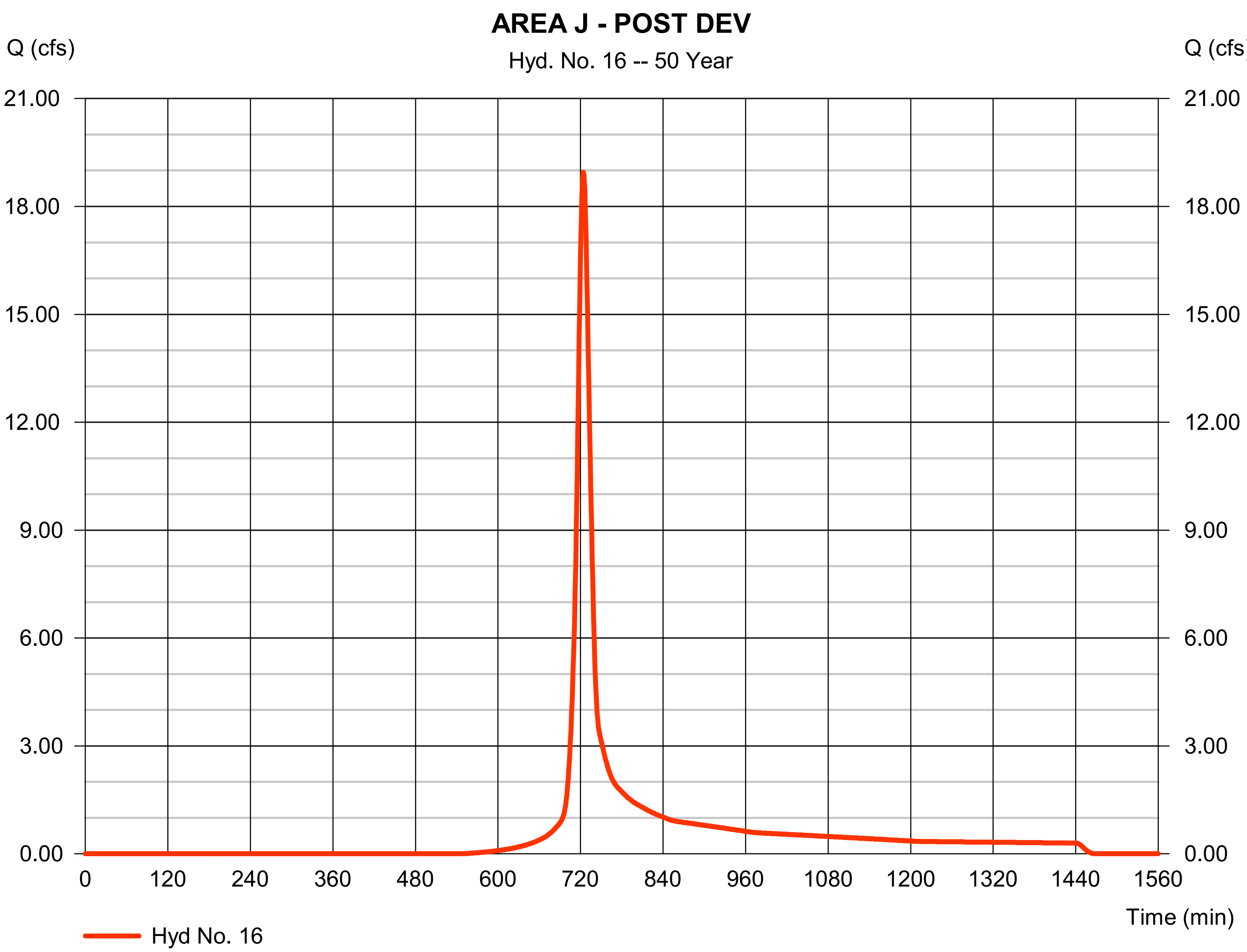
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 16

AREA J - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 18.95 cfs
Storm frequency	= 50 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 56,382 cuft
Drainage area	= 4.820 ac	Curve number	= 66*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 85) + (0.020 x 65) + (0.680 x 98) + (4.030 x 60)] / 4.820



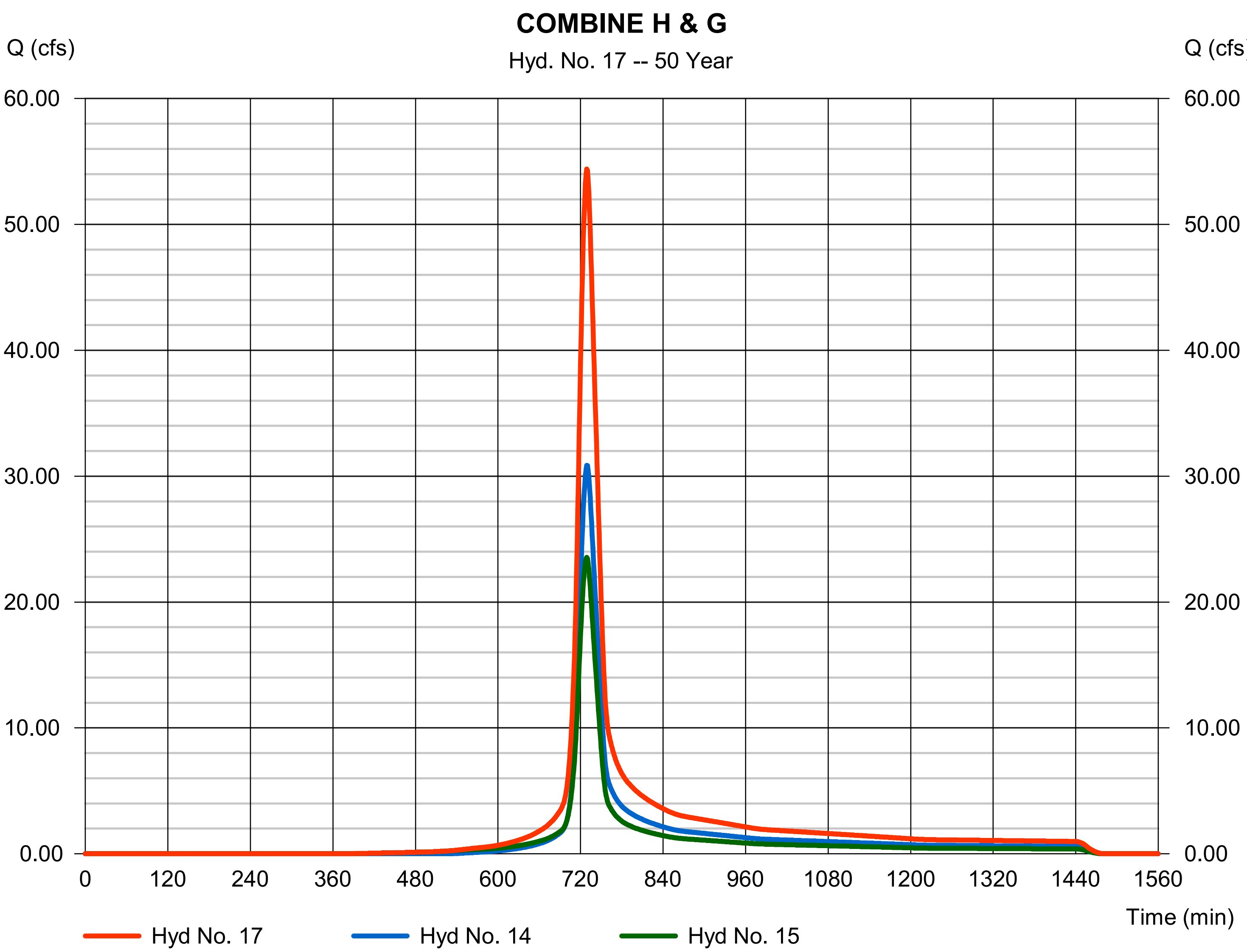
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 17

COMBINE H & G

Hydrograph type	= Combine	Peak discharge	= 54.41 cfs
Storm frequency	= 50 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 203,372 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 14.400 ac



Hydrograph Report

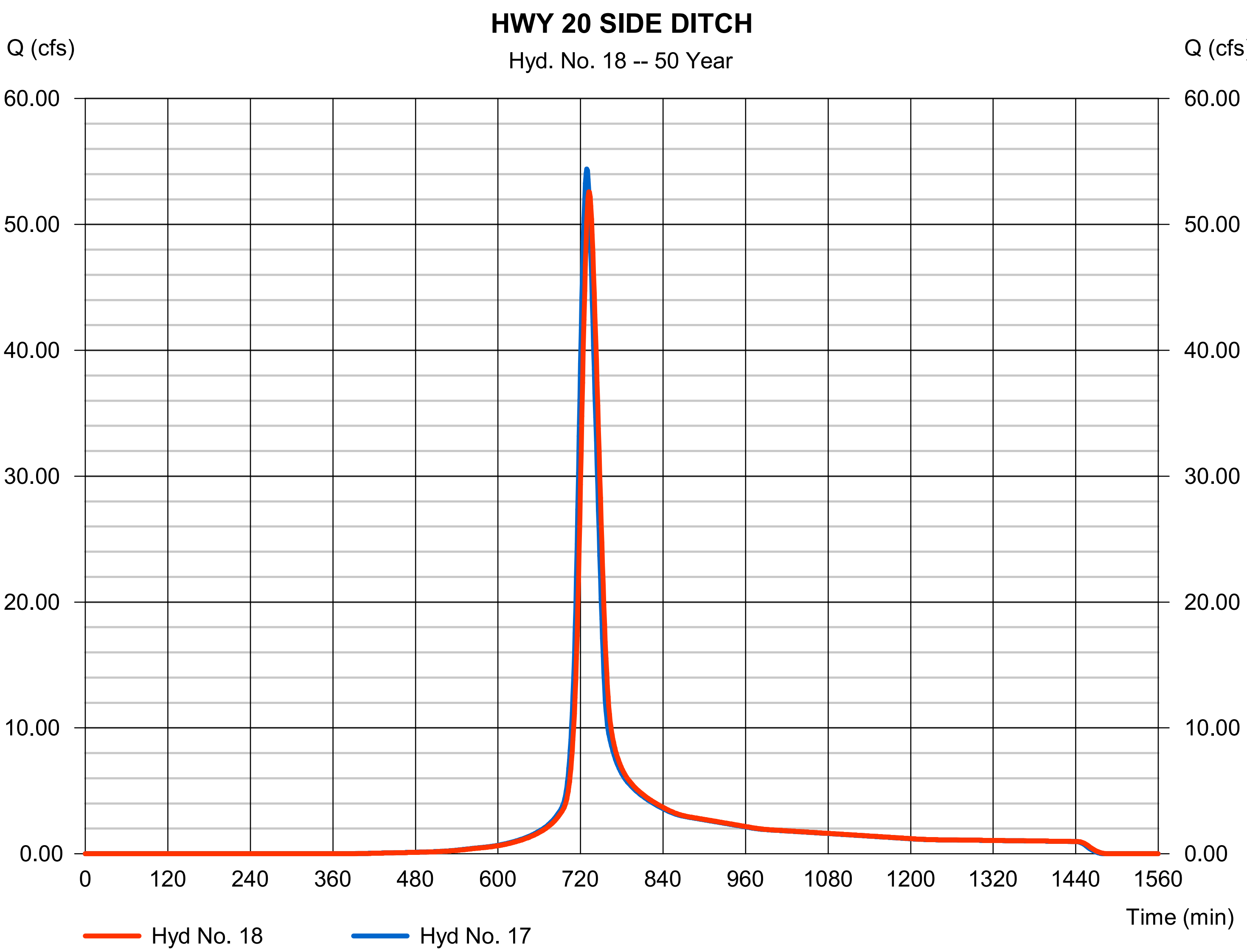
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 18

HWY 20 SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 52.59 cfs
Storm frequency	= 50 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 203,371 cuft
Inflow hyd. No.	= 17 - COMBINE H & G	Section type	= Trapezoidal
Reach length	= 900.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.030	Bottom width	= 3.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 1.688	Rating curve m	= 1.304
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.2831

Modified Att-Kin routing method used.



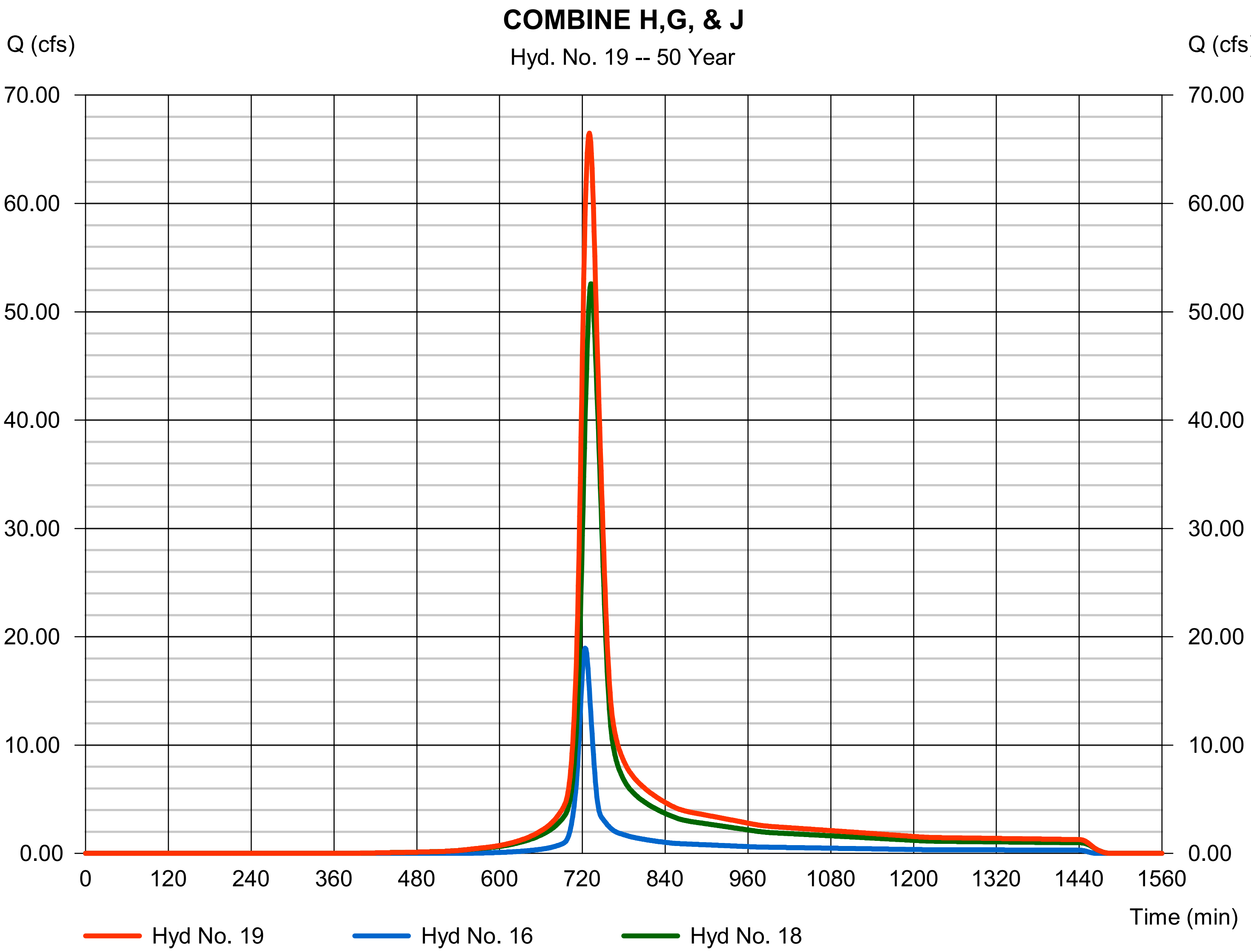
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 19

COMBINE H,G, & J

Hydrograph type	= Combine	Peak discharge	= 66.49 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 259,753 cuft
Inflow hyds.	= 16, 18	Contrib. drain. area	= 4.820 ac



Hydrograph Report

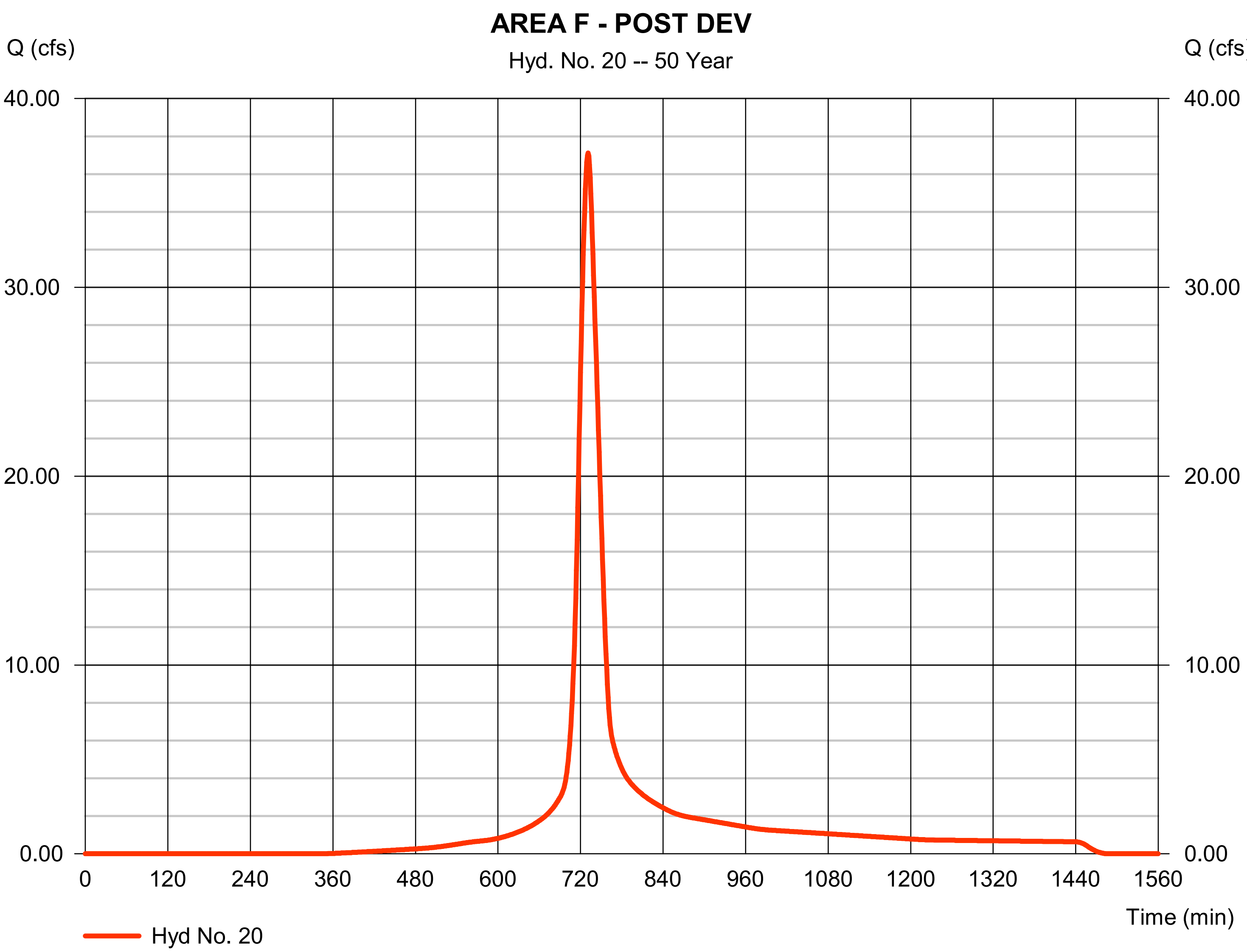
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 20

AREA F - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 37.12 cfs
Storm frequency	= 50 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 148,915 cuft
Drainage area	= 8.620 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.440 x 85) + (8.180 x 77)] / 8.620



Hydrograph Report

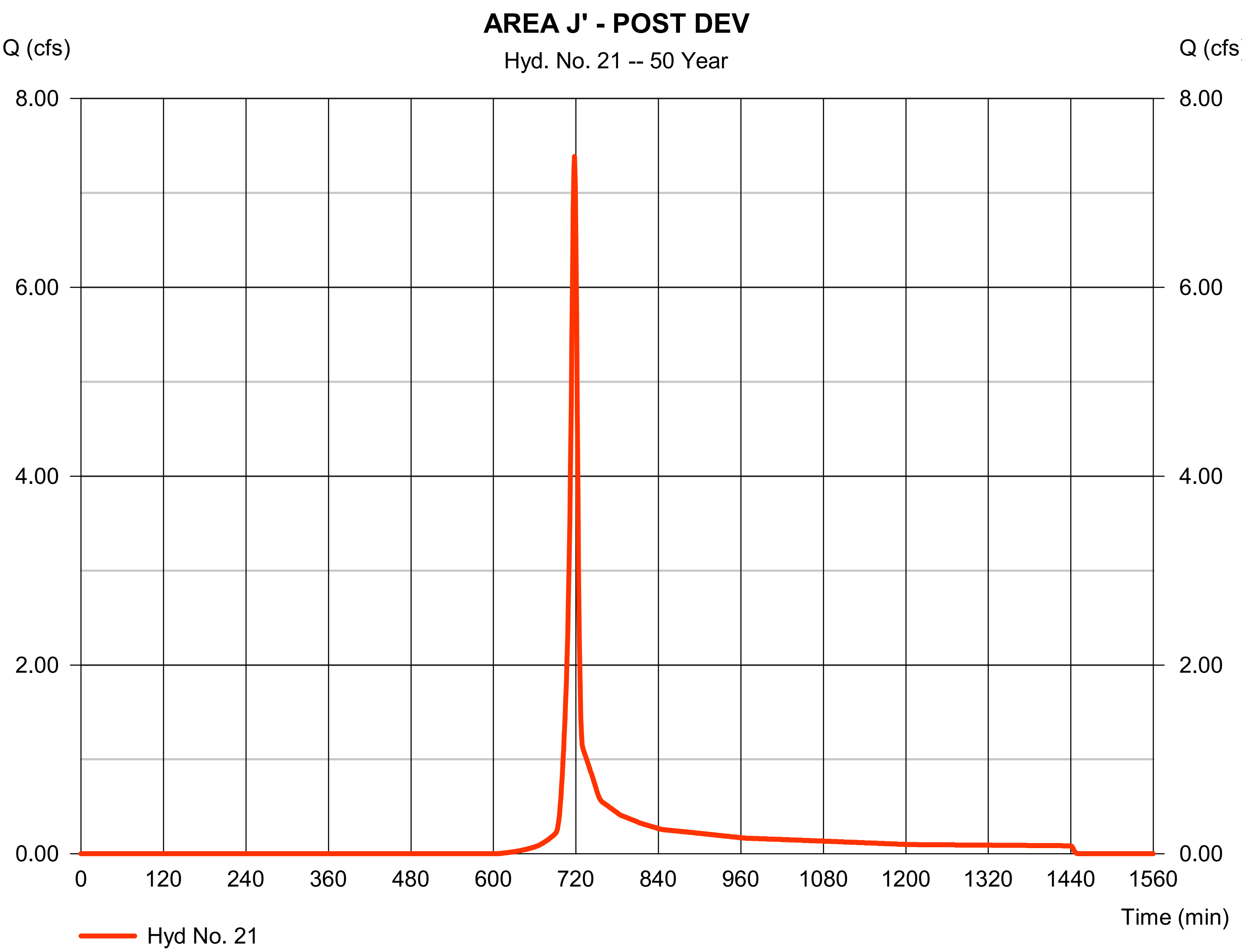
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 21

AREA J' - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 7.386 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 14,838 cuft
Drainage area	= 1.440 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.220 x 65) + (1.220 x 60)] / 1.440



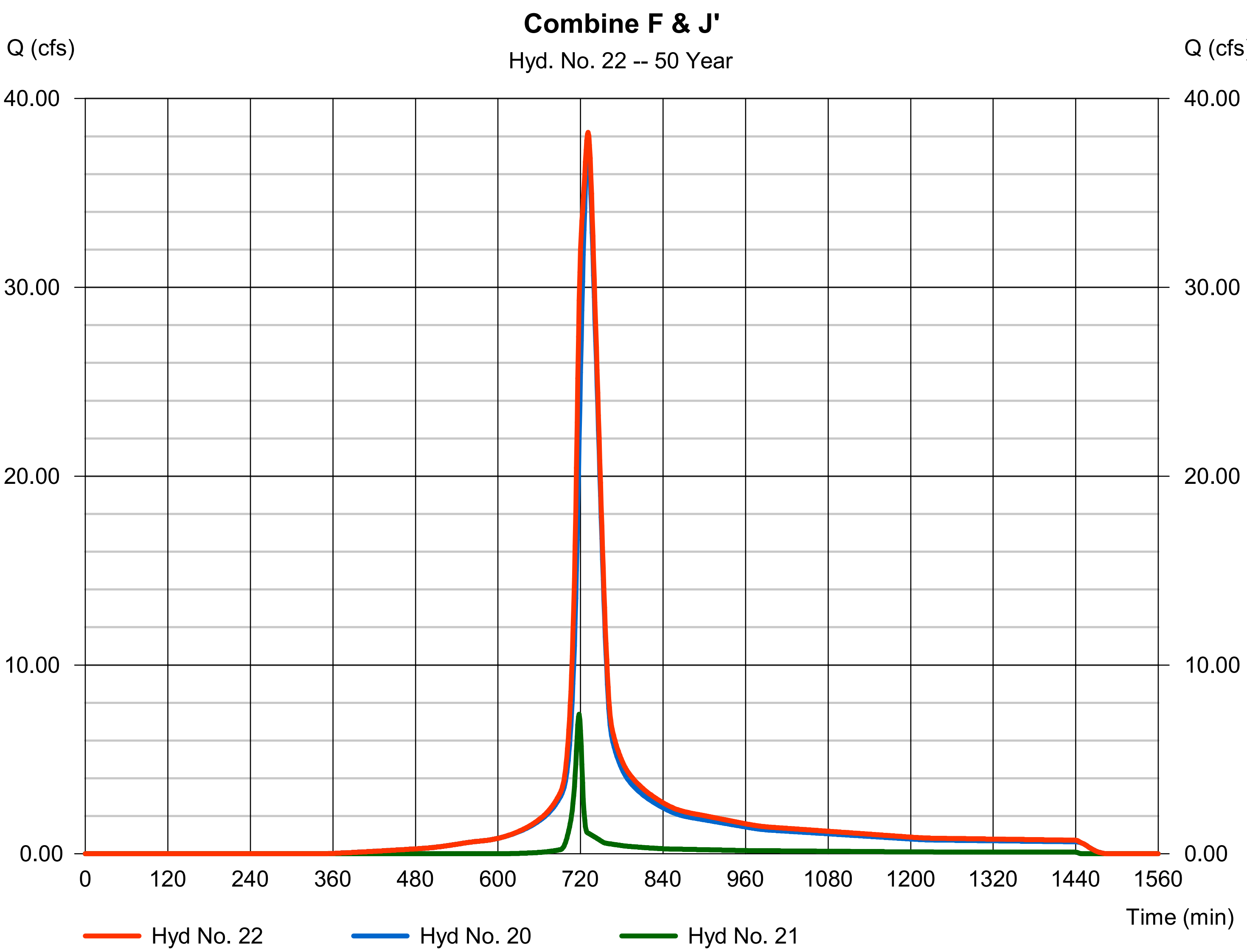
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 22

Combine F & J'

Hydrograph type	= Combine	Peak discharge	= 38.21 cfs
Storm frequency	= 50 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 163,753 cuft
Inflow hyds.	= 20, 21	Contrib. drain. area	= 10.060 ac



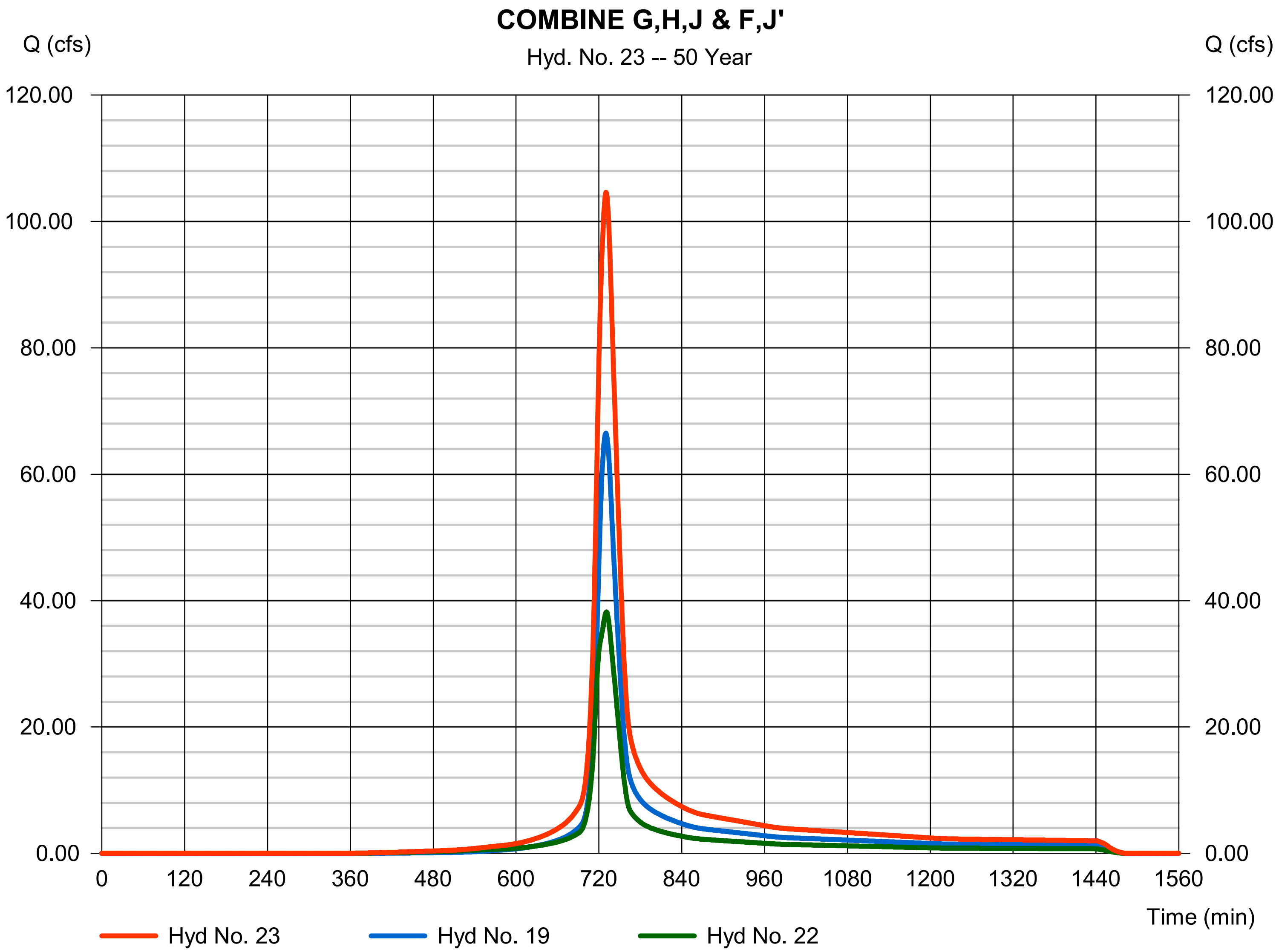
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 11 / 15 / 2018

Hyd. No. 23

COMBINE G,H,J & F,J'

Hydrograph type	= Combine	Peak discharge	= 104.60 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 423,506 cuft
Inflow hyds.	= 19, 22	Contrib. drain. area	= 0.000 ac



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

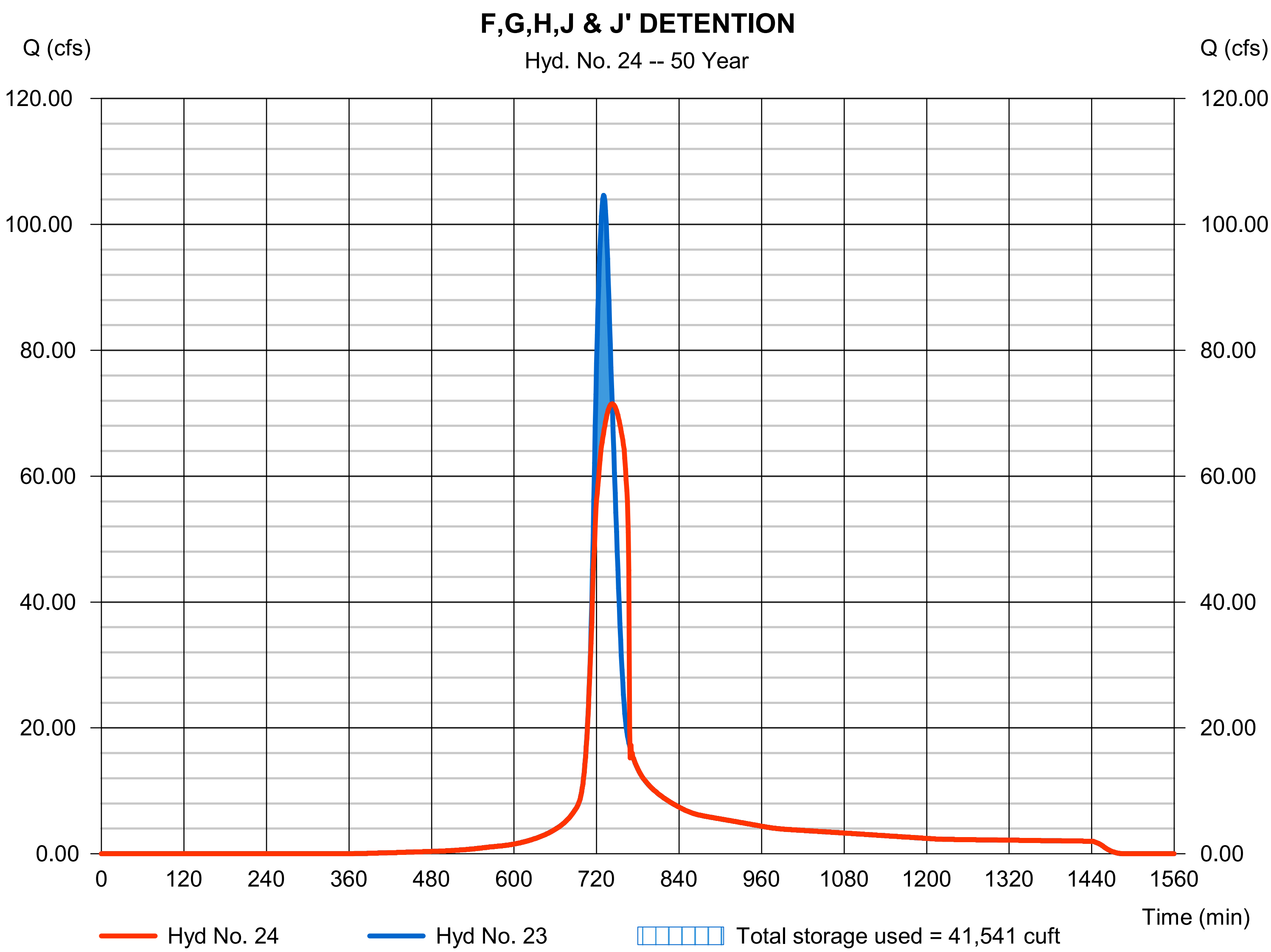
Thursday, 11 / 15 / 2018

Hyd. No. 24

F,G,H,J & J' DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 71.49 cfs
Storm frequency	= 50 yrs	Time to peak	= 743 min
Time interval	= 1 min	Hyd. volume	= 423,506 cuft
Inflow hyd. No.	= 23 - COMBINE G,H,J & F,J'	Max. Elevation	= 580.97 ft
Reservoir name	= F,G,H,J & J' DETENTION	Max. Storage	= 41,541 cuft

Storage Indication method used.



Hydrograph Report

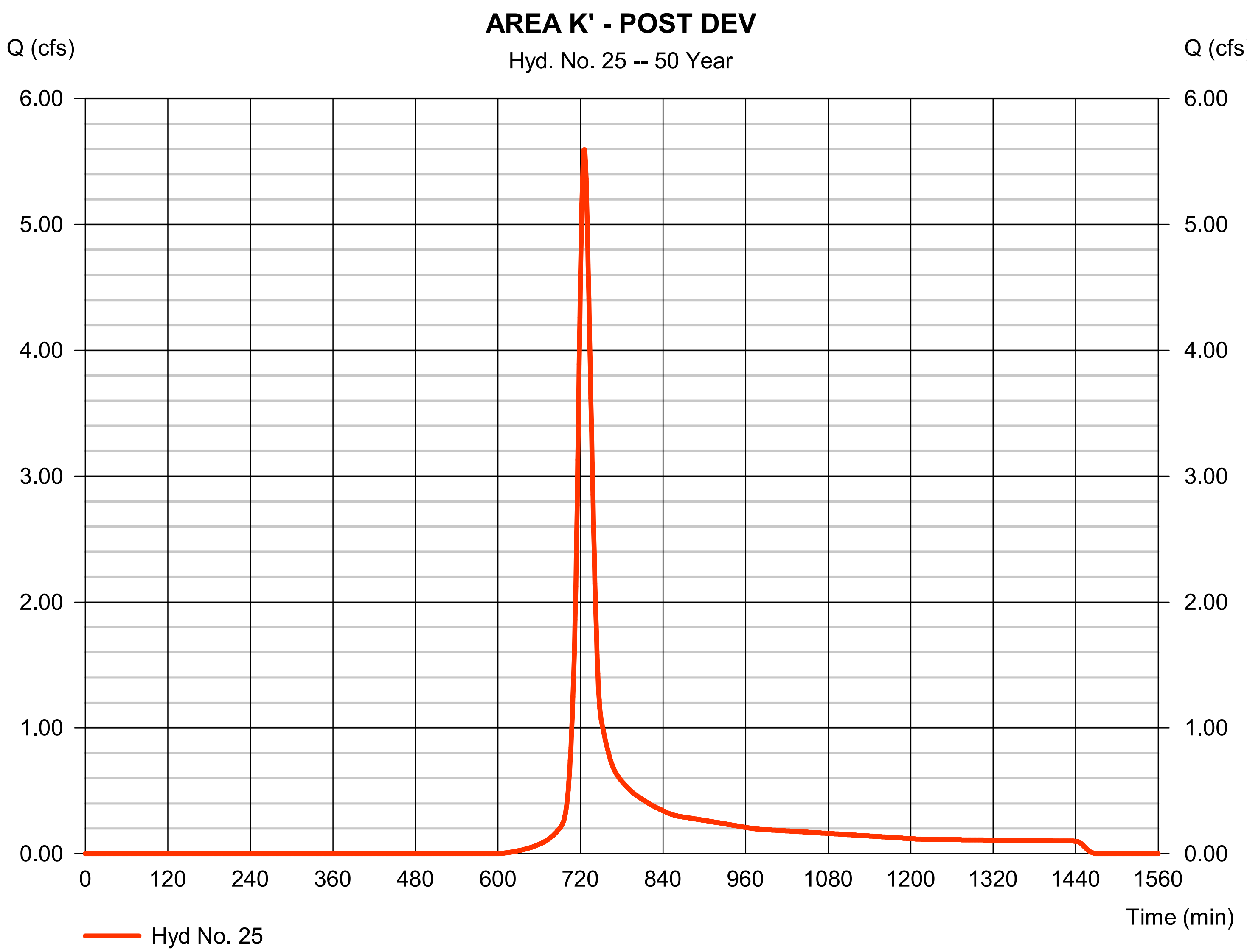
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 25

AREA K' - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 5.594 cfs
Storm frequency	= 50 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 17,810 cuft
Drainage area	= 1.720 ac	Curve number	= 62*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 19.20 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.350 x 60) + (0.330 x 65) + (0.040 x 98)] / 1.720



Hydrograph Report

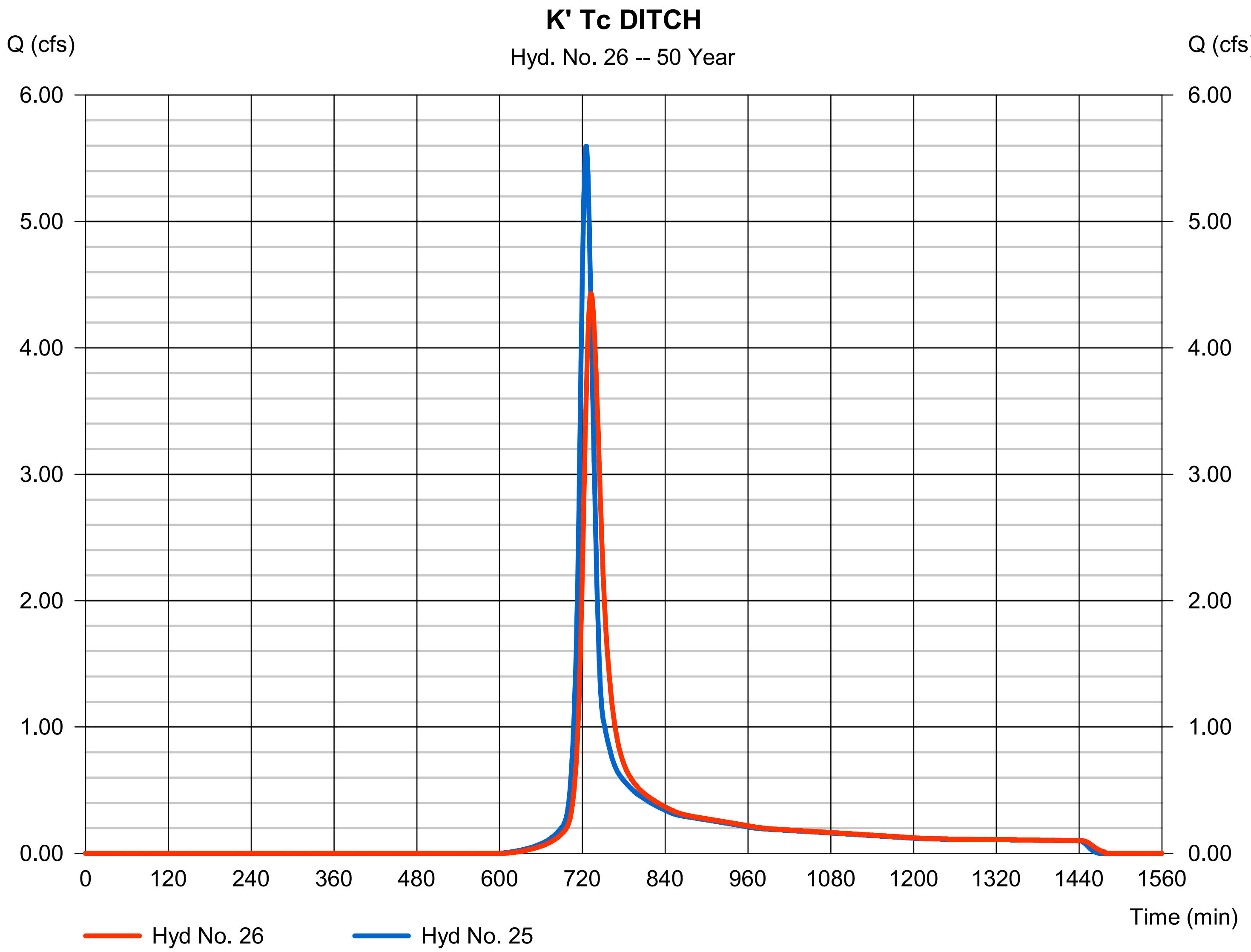
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 26

K' Tc DITCH

Hydrograph type	= Reach	Peak discharge	= 4.429 cfs
Storm frequency	= 50 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 17,805 cuft
Inflow hyd. No.	= 25 - AREA K' - POST DEV	Section type	= Trapezoidal
Reach length	= 710.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.040	Bottom width	= 5.0 ft
Side slope	= 4.0:1	Max. depth	= 2.0 ft
Rating curve x	= 0.697	Rating curve m	= 1.257
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.1072

Modified Att-Kin routing method used.



Hydrograph Report

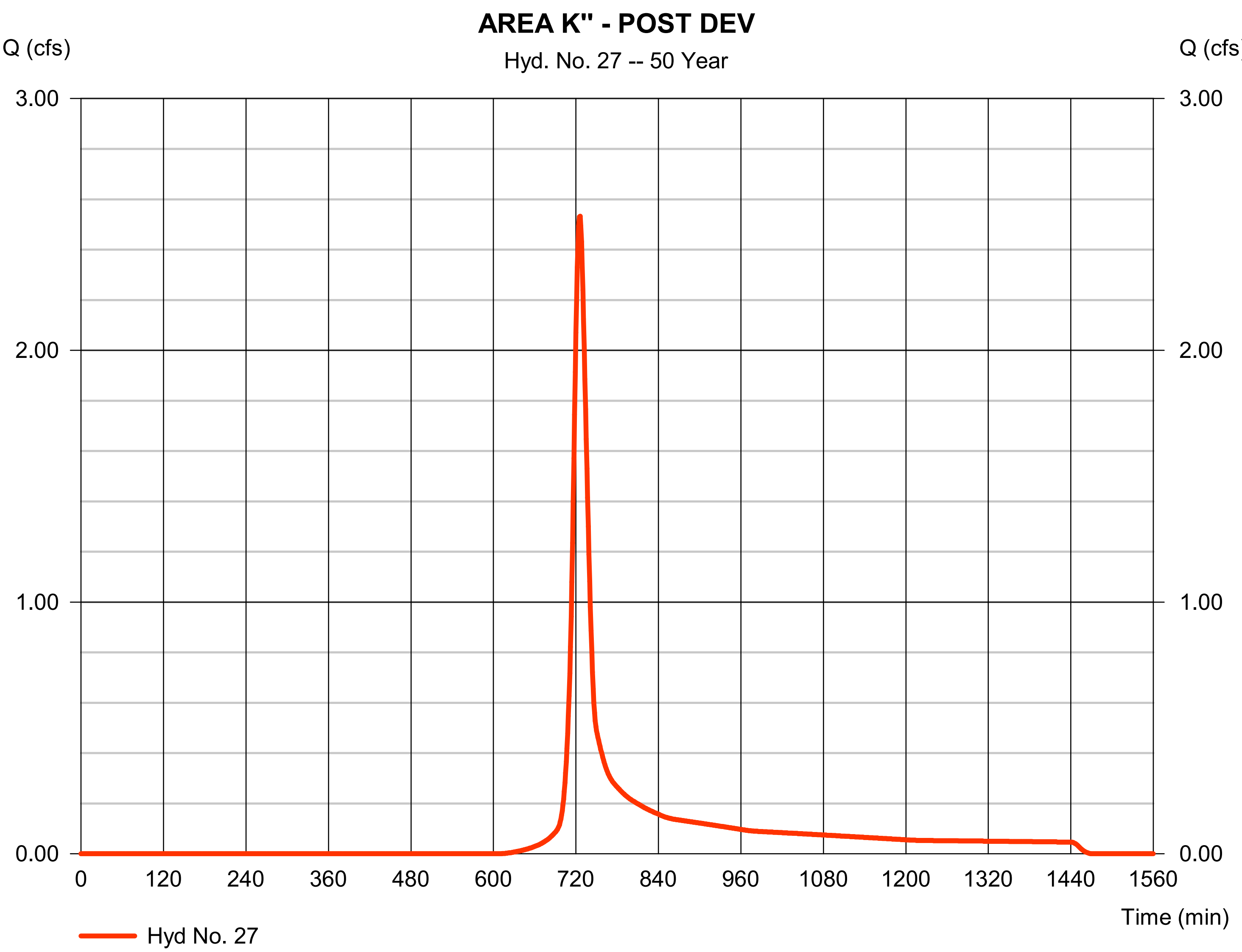
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 27

AREA K" - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 2.532 cfs
Storm frequency	= 50 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 8,093 cuft
Drainage area	= 0.810 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 19.20 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.170 x 65) + (0.640 x 60)] / 0.810



Hydrograph Report

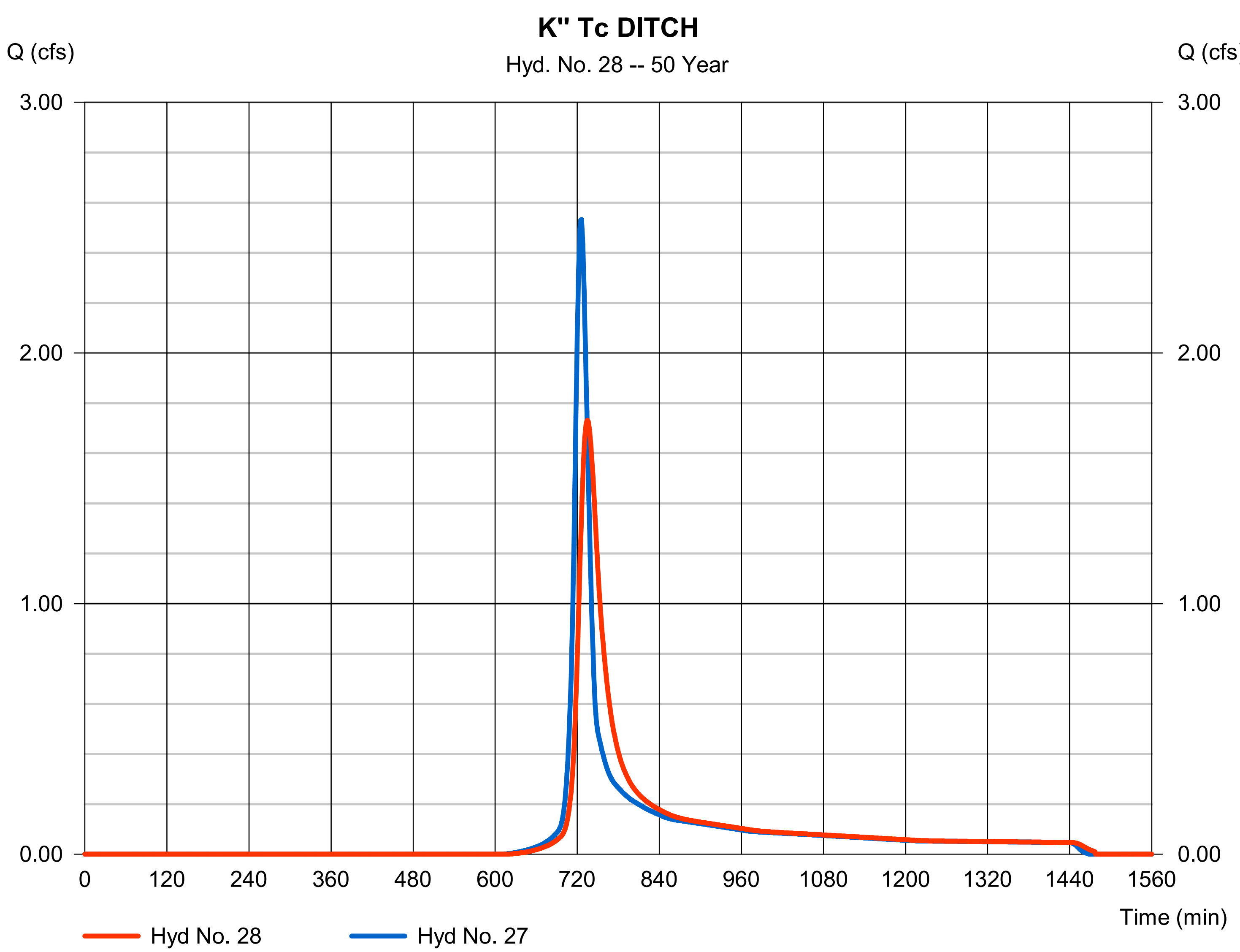
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 28

K" Tc DITCH

Hydrograph type	= Reach	Peak discharge	= 1.732 cfs
Storm frequency	= 50 yrs	Time to peak	= 735 min
Time interval	= 1 min	Hyd. volume	= 8,085 cuft
Inflow hyd. No.	= 27 - AREA K" - POST DEV	Section type	= Trapezoidal
Reach length	= 150.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.400	Bottom width	= 5.0 ft
Side slope	= 4.0:1	Max. depth	= 2.0 ft
Rating curve x	= 0.070	Rating curve m	= 1.257
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.0704

Modified Att-Kin routing method used.



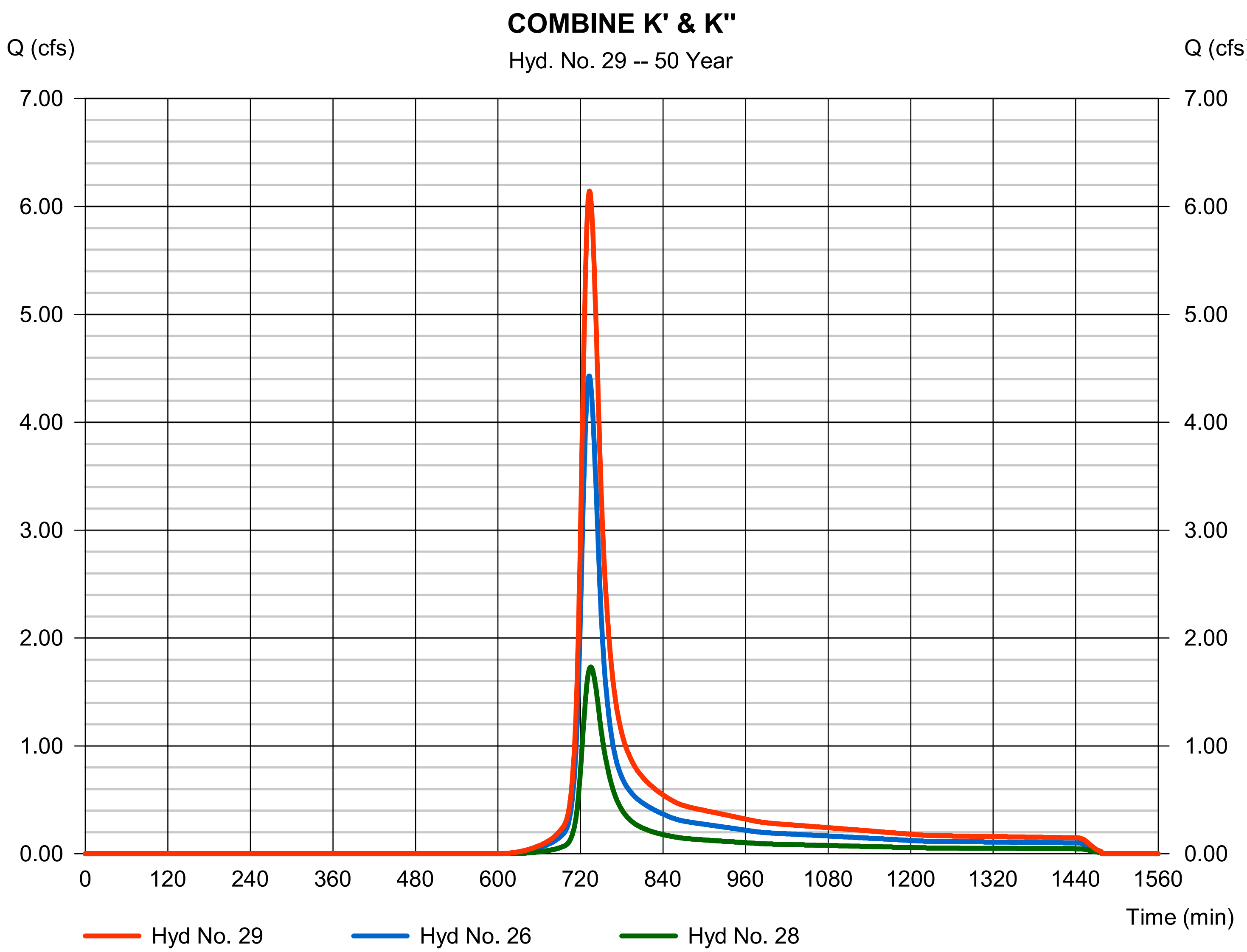
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 29

COMBINE K' & K''

Hydrograph type	= Combine	Peak discharge	= 6.145 cfs
Storm frequency	= 50 yrs	Time to peak	= 733 min
Time interval	= 1 min	Hyd. volume	= 25,890 cuft
Inflow hyds.	= 26, 28	Contrib. drain. area	= 0.000 ac



Hydrograph Report

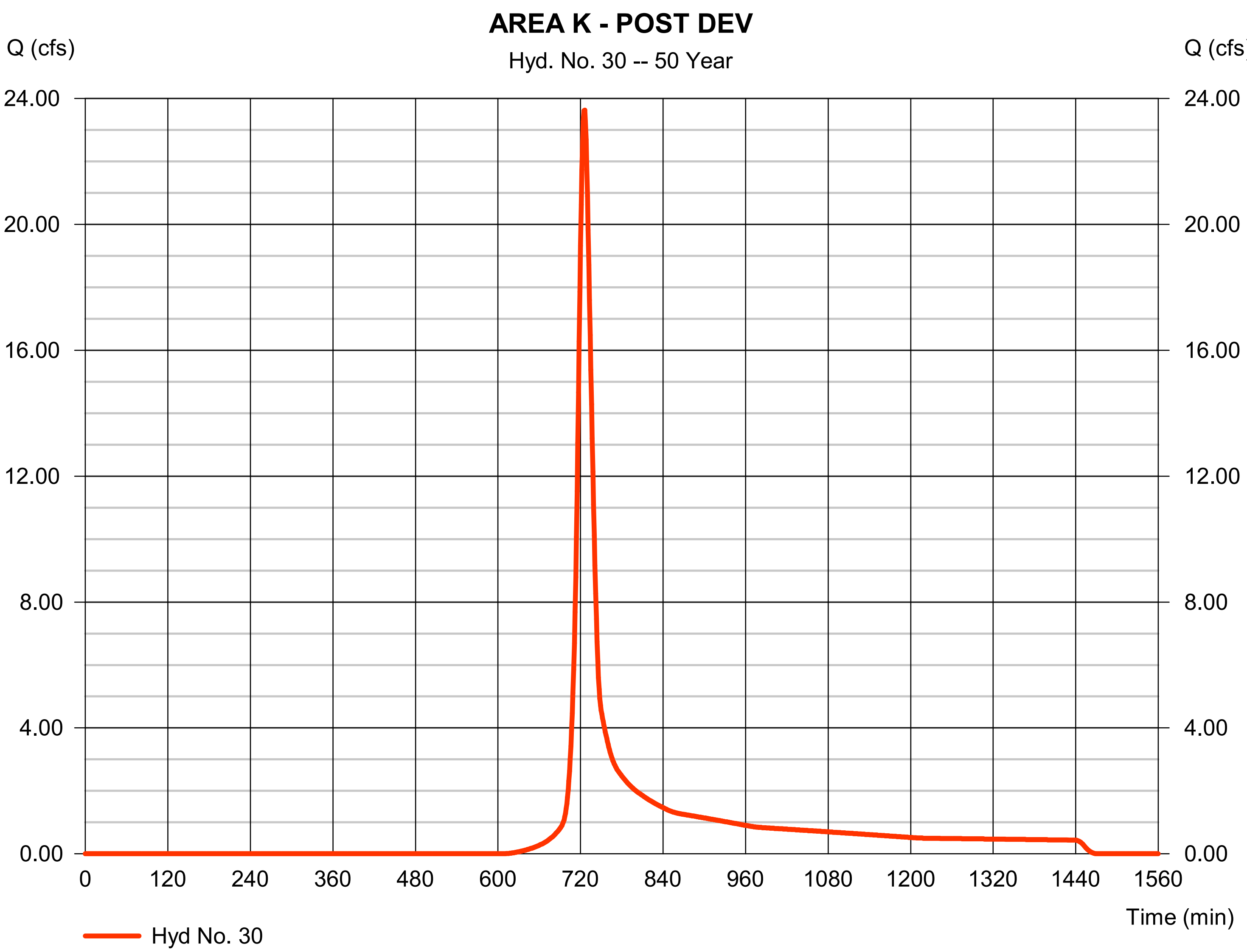
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 30

AREA K - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 23.63 cfs
Storm frequency	= 50 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 75,538 cuft
Drainage area	= 7.560 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 19.20 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.070 x 65) + (6.490 x 60)] / 7.560



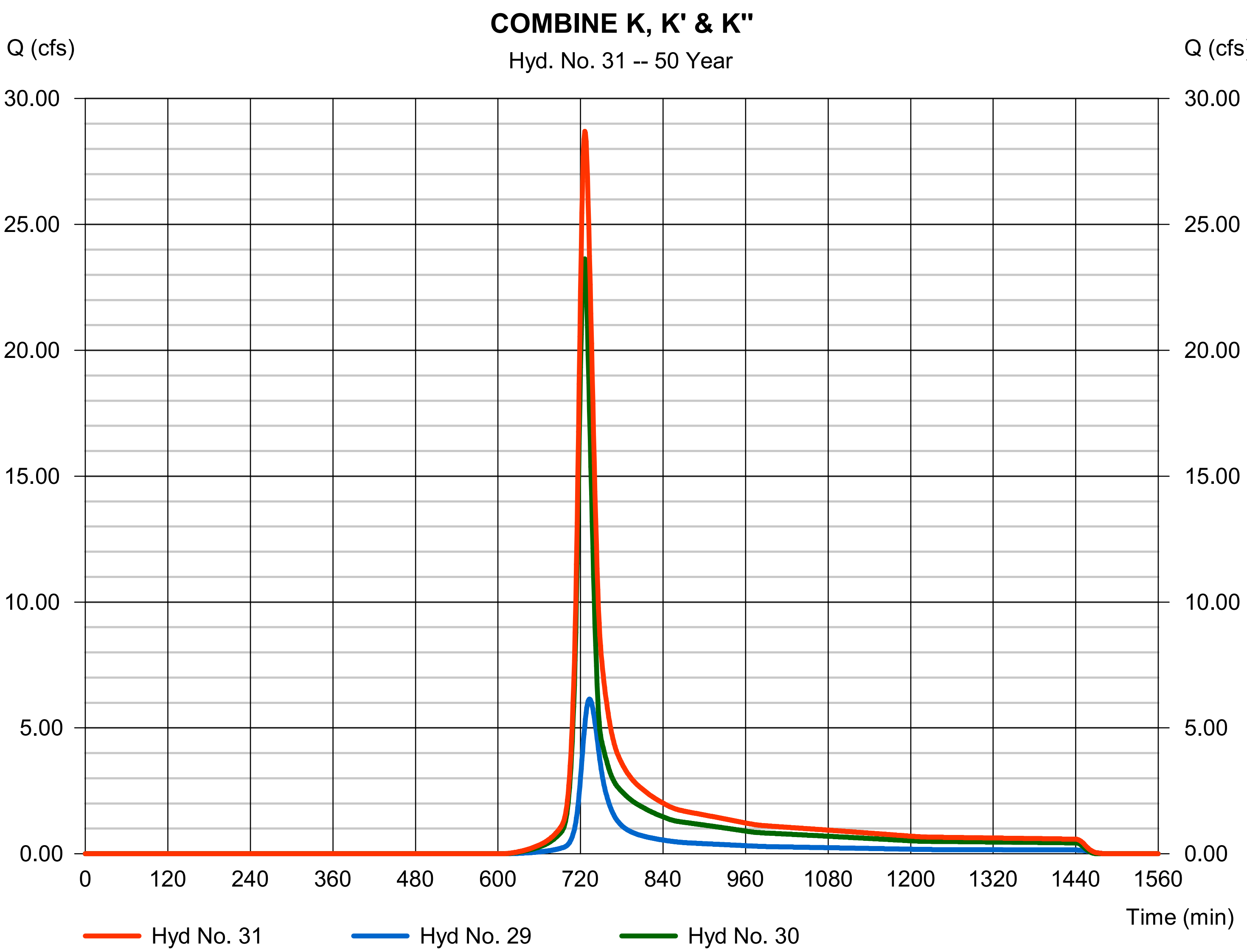
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 31

COMBINE K, K' & K"

Hydrograph type	= Combine	Peak discharge	= 28.70 cfs
Storm frequency	= 50 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 101,428 cuft
Inflow hyds.	= 29, 30	Contrib. drain. area	= 7.560 ac



Hydrograph Report

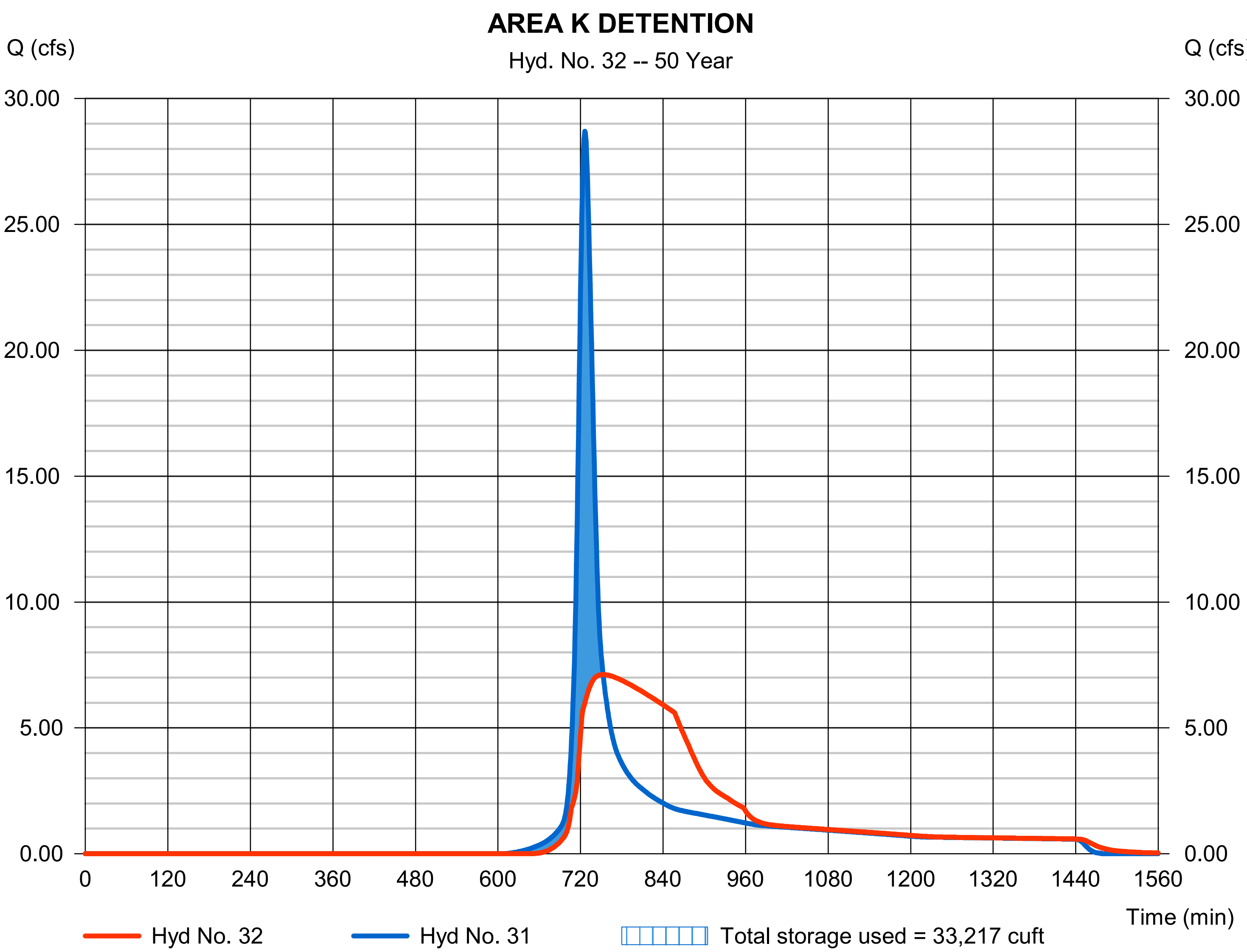
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 32

AREA K DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 7.119 cfs
Storm frequency	= 50 yrs	Time to peak	= 753 min
Time interval	= 1 min	Hyd. volume	= 101,294 cuft
Inflow hyd. No.	= 31 - COMBINE K, K' & K"	Max. Elevation	= 582.59 ft
Reservoir name	= K DETENTION	Max. Storage	= 33,217 cuft

Storage Indication method used.



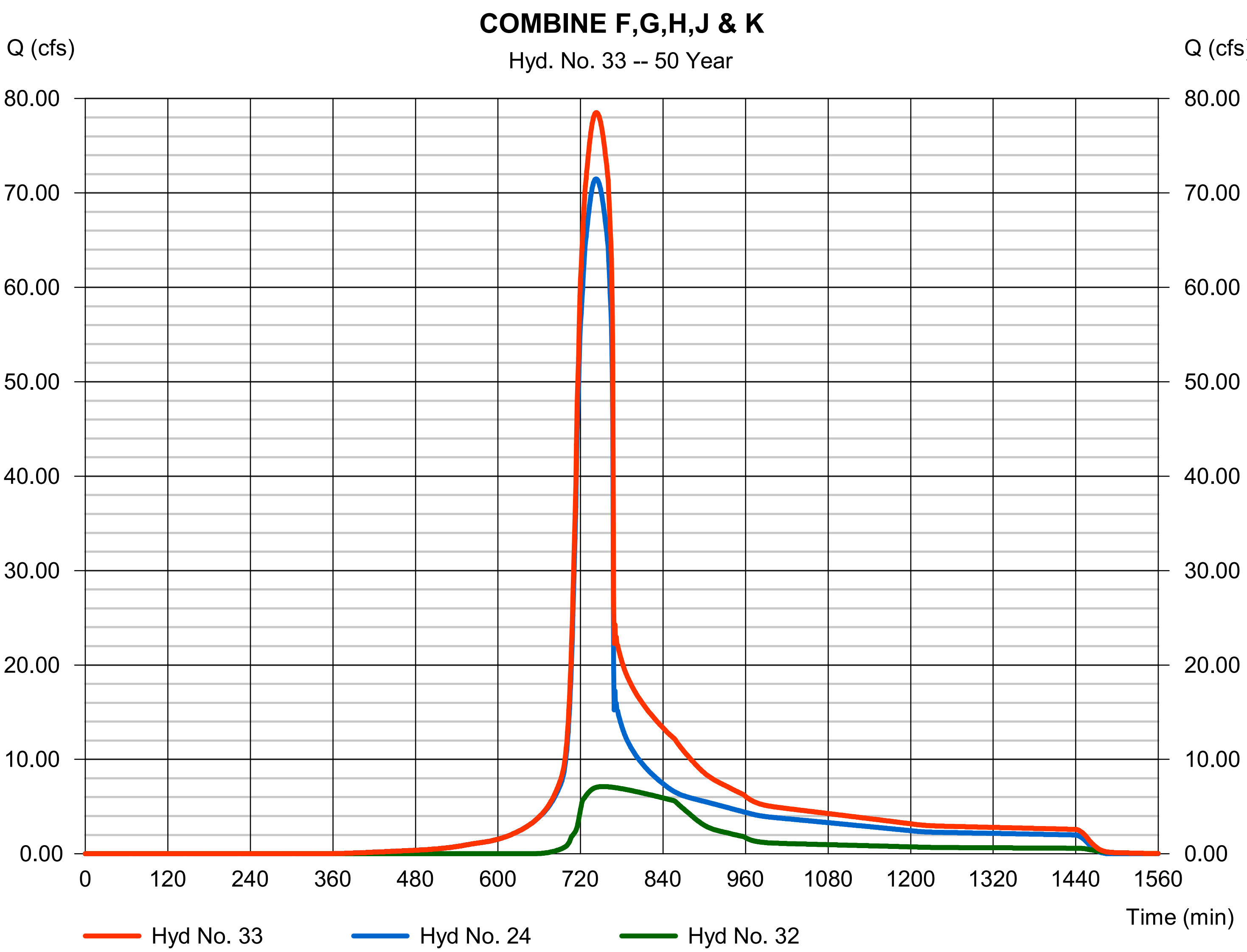
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 33

COMBINE F,G,H,J & K

Hydrograph type	= Combine	Peak discharge	= 78.53 cfs
Storm frequency	= 50 yrs	Time to peak	= 743 min
Time interval	= 1 min	Hyd. volume	= 524,795 cuft
Inflow hyds.	= 24, 32	Contrib. drain. area	= 0.000 ac



Hydrograph Report

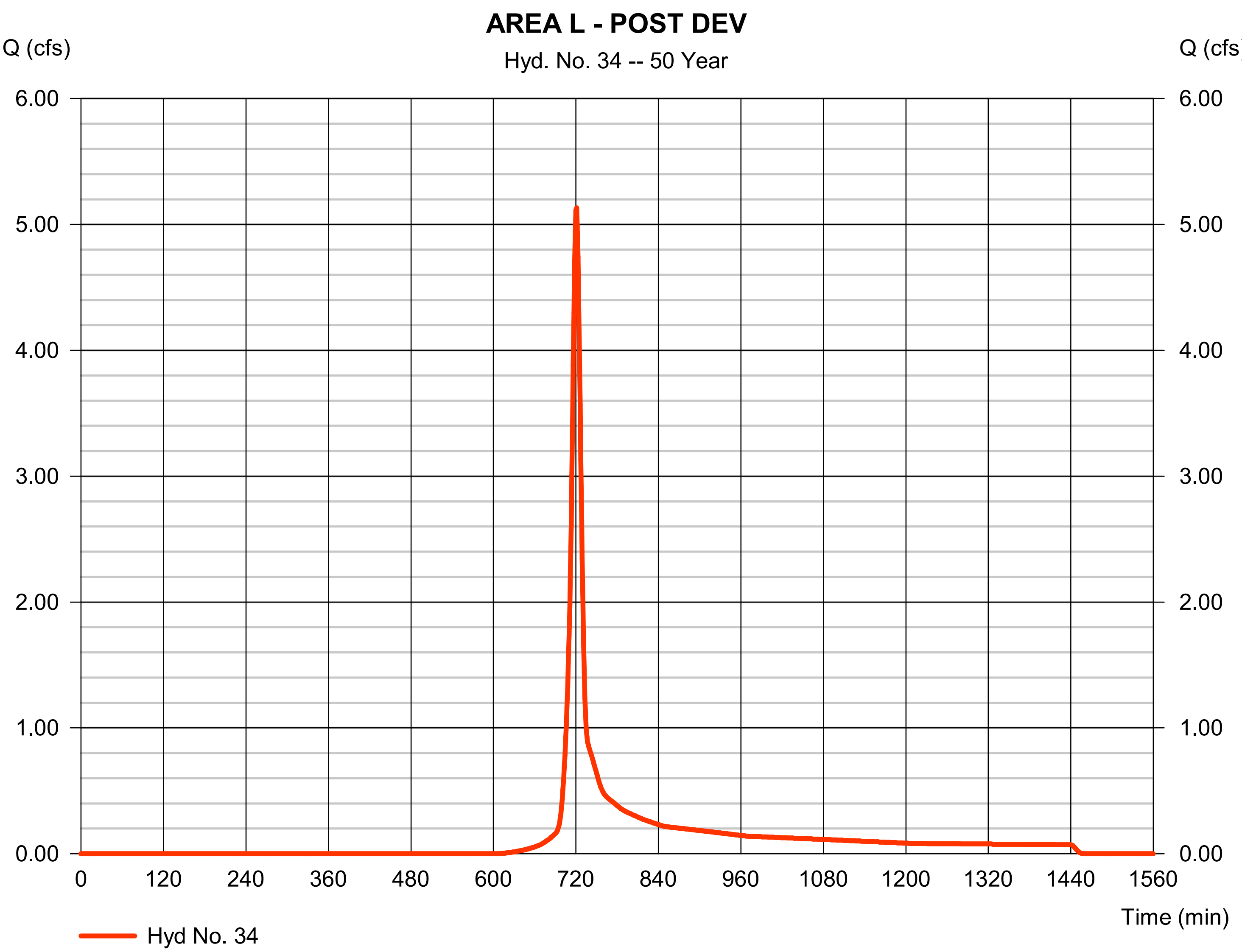
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 34

AREA L - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 5.133 cfs
Storm frequency	= 50 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 12,509 cuft
Drainage area	= 1.230 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 10.20 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.230 x 65) + (1.000 x 60)] / 1.230



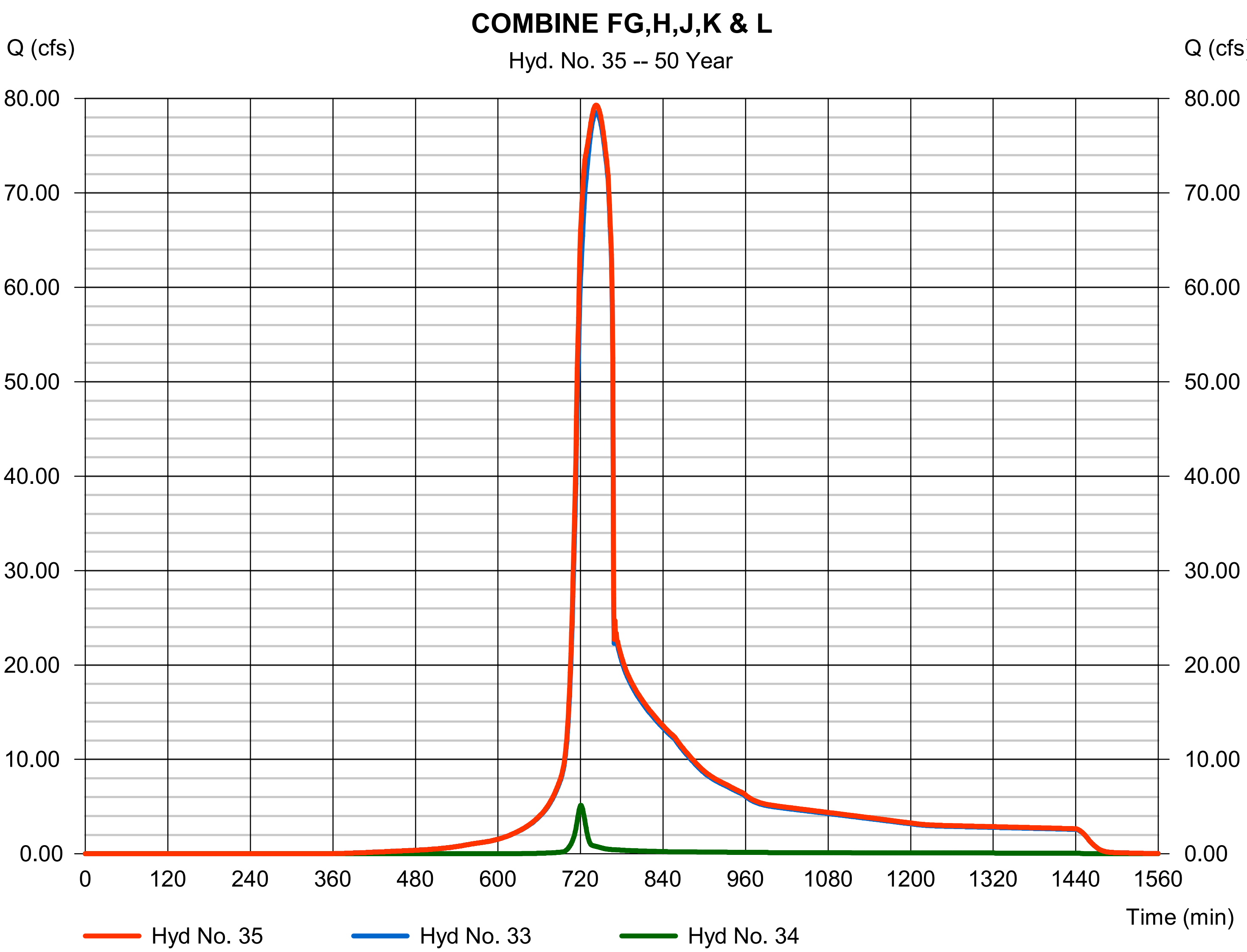
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 35

COMBINE FG,H,J,K & L

Hydrograph type	= Combine	Peak discharge	= 79.30 cfs
Storm frequency	= 50 yrs	Time to peak	= 743 min
Time interval	= 1 min	Hyd. volume	= 537,304 cuft
Inflow hyds.	= 33, 34	Contrib. drain. area	= 1.230 ac



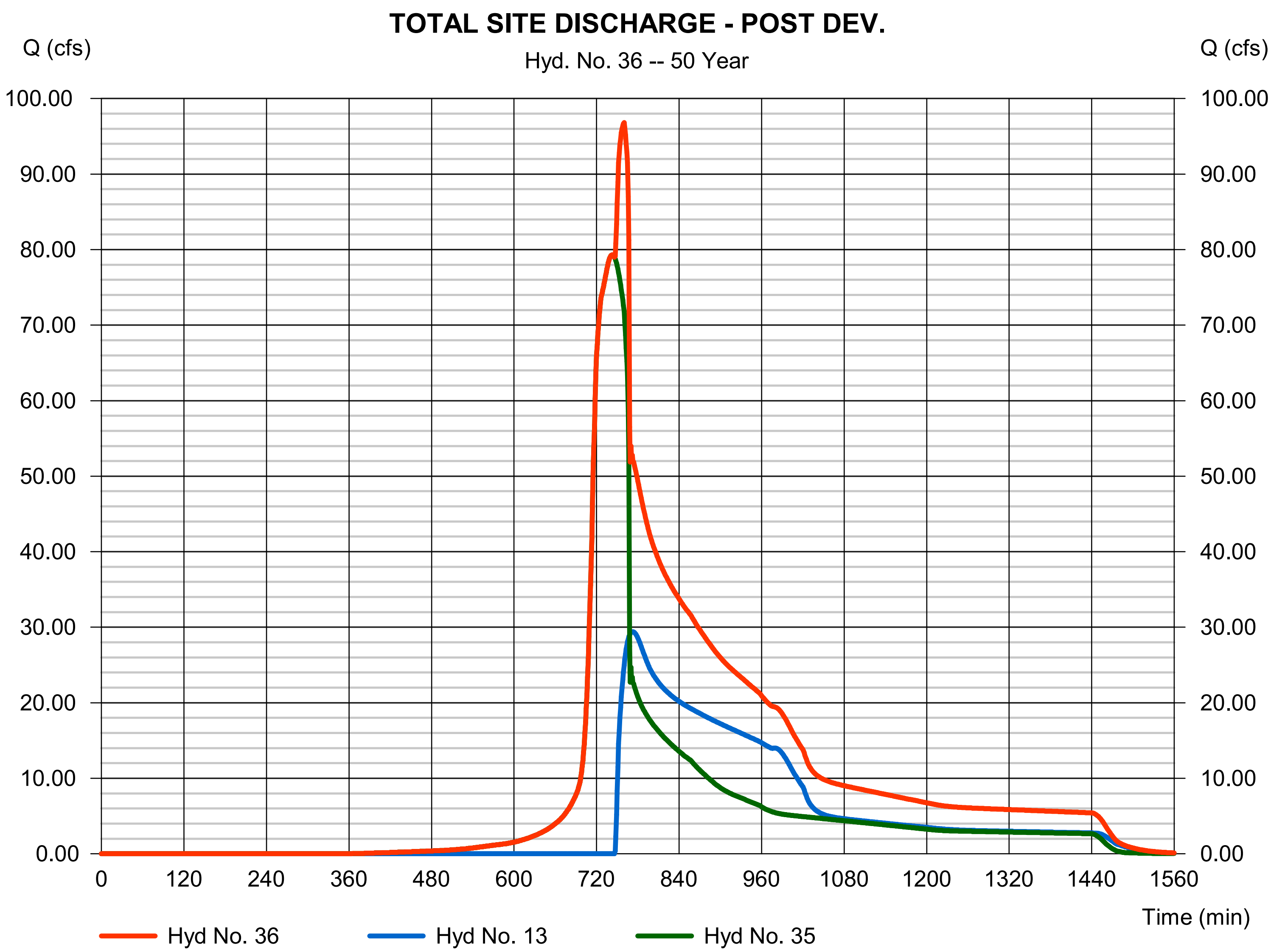
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 36

TOTAL SITE DISCHARGE - POST DEV.

Hydrograph type	= Combine	Peak discharge	= 96.80 cfs
Storm frequency	= 50 yrs	Time to peak	= 760 min
Time interval	= 1 min	Hyd. volume	= 937,178 cuft
Inflow hyds.	= 13, 35	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	SCS Runoff	13.37	1	725	41,750	------	------	------	AREA A - POST DEV
2	Reach	12.91	1	728	41,748	1	------	------	DITCH 1
3	SCS Runoff	30.03	1	727	102,165	------	------	------	AREA B - POST DEV
4	Combine	42.91	1	727	143,913	2, 3	------	------	COMBINE A & B
5	Reach	42.43	1	729	143,911	4	------	------	DITCH 2
6	SCS Runoff	21.56	1	742	118,736	------	------	------	AREA E - POST DEV
7	SCS Runoff	45.34	1	731	181,834	------	------	------	AREA D - POST DEV
8	SCS Runoff	58.24	1	727	198,133	------	------	------	AREA C - POST DEV
9	Combine	102.01	1	728	379,967	7, 8	------	------	COMBINE C & D
10	Reservoir	16.71	1	763	379,967	9	582.71	149,068	C & D DETENTION
11	Combine	58.84	1	731	262,648	5, 6,	------	------	COMBINE A,B,C & E
12	Combine	73.69	1	731	642,614	10, 11	------	------	COMBINE A,B, C, D & E
13	Reservoir	39.14	1	761	499,573	12	582.46	172,374	DETENTION A,B,C,D & E
14	SCS Runoff	36.81	1	729	137,242	------	------	------	AREA H - POST DEV
15	SCS Runoff	27.22	1	729	101,829	------	------	------	AREA G - POST DEV
16	SCS Runoff	22.71	1	724	67,343	------	------	------	AREA J - POST DEV
17	Combine	64.03	1	729	239,071	14, 15,	------	------	COMBINE H & G
18	Reach	62.06	1	732	239,070	17	------	------	HWY 20 SIDE DITCH
19	Combine	78.80	1	730	306,413	16, 18	------	------	COMBINE H,G, & J
20	SCS Runoff	42.69	1	731	171,907	------	------	------	AREA F - POST DEV
21	SCS Runoff	8.961	1	718	17,995	------	------	------	AREA J' - POST DEV
22	Combine	44.00	1	731	189,902	20, 21	------	------	Combine F & J'
23	Combine	122.71	1	730	496,315	19, 22	------	------	COMBINE G,H,J & F,J'
24	Reservoir	75.75	1	744	496,315	23	581.58	62,404	F,G,H,J & J' DETENTION
25	SCS Runoff	6.822	1	725	21,530	------	------	------	AREA K' - POST DEV
26	Reach	5.475	1	732	21,526	25	------	------	K' Tc DITCH
27	SCS Runoff	3.101	1	725	9,816	------	------	------	AREA K'' - POST DEV
28	Reach	2.162	1	734	9,808	27	------	------	K'' Tc DITCH
29	Combine	7.611	1	733	31,333	26, 28	------	------	COMBINE K' & K''
30	SCS Runoff	28.94	1	725	91,612	------	------	------	AREA K - POST DEV
31	Combine	35.31	1	726	122,946	29, 30	------	------	COMBINE K, K' & K''
32	Reservoir	7.727	1	755	122,811	31	582.87	43,112	AREA K DETENTION
33	Combine	83.41	1	745	619,122	24, 32	------	------	COMBINE F,G,H,J & K
34	SCS Runoff	6.249	1	721	15,171	------	------	------	AREA L - POST DEV

AP3_POSTDEV_ADD_DET.gpw	Return Period: 100 Year	Thursday, 11 / 15 / 2018

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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
35	Combine	84.28	1	744	634,292	33, 34	------	------	COMBINE FG,H,J,K & L
36	Combine	119.63	1	755	1,133,910	13, 35	------	------	TOTAL SITE DISCHARGE - POST D

Hydrograph Report

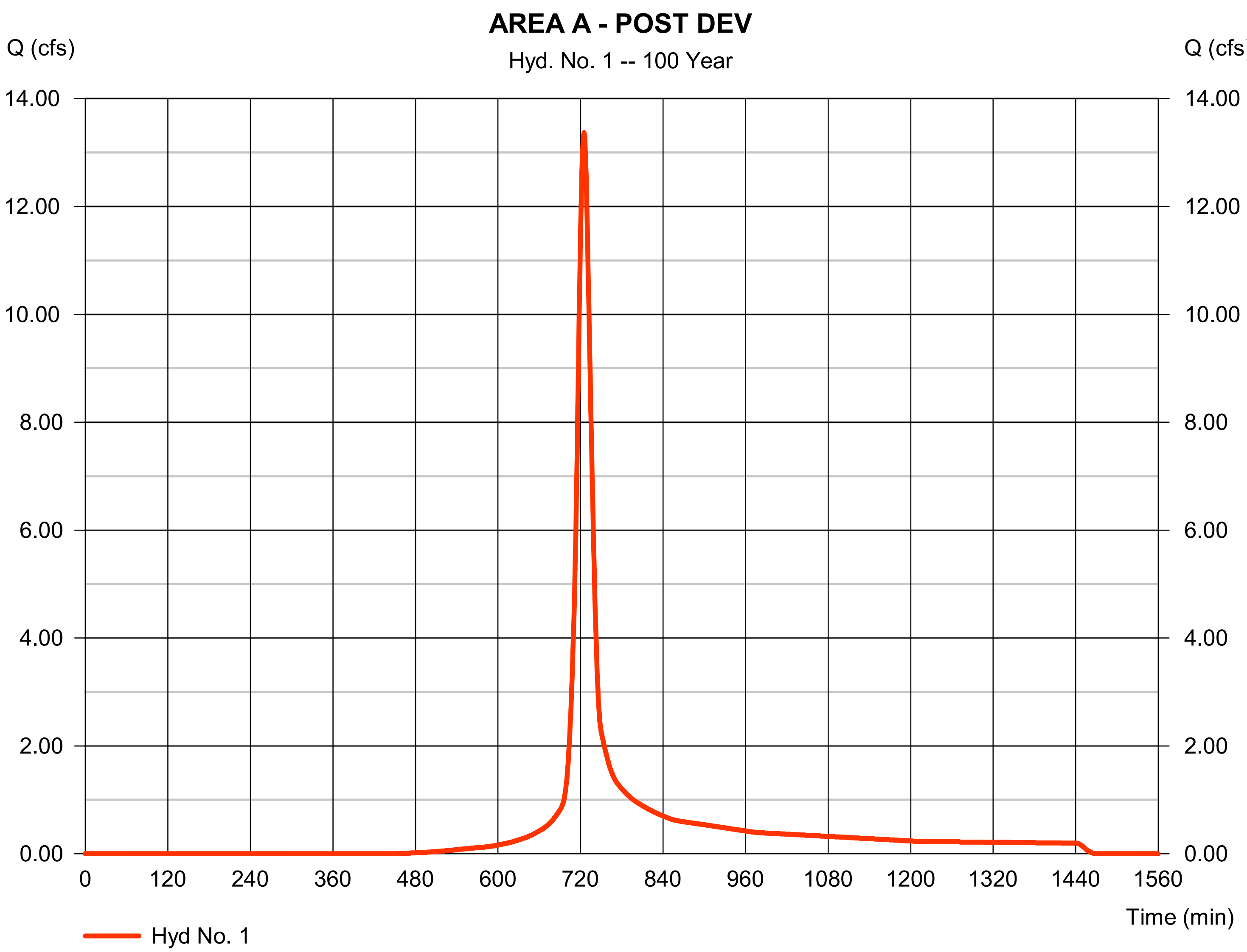
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 1

AREA A - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 13.37 cfs
Storm frequency	= 100 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 41,750 cuft
Drainage area	= 2.580 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.10 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.220 x 85) + (0.570 x 55) + (0.030 x 98) + (0.760 x 60)] / 2.580



Hydrograph Report

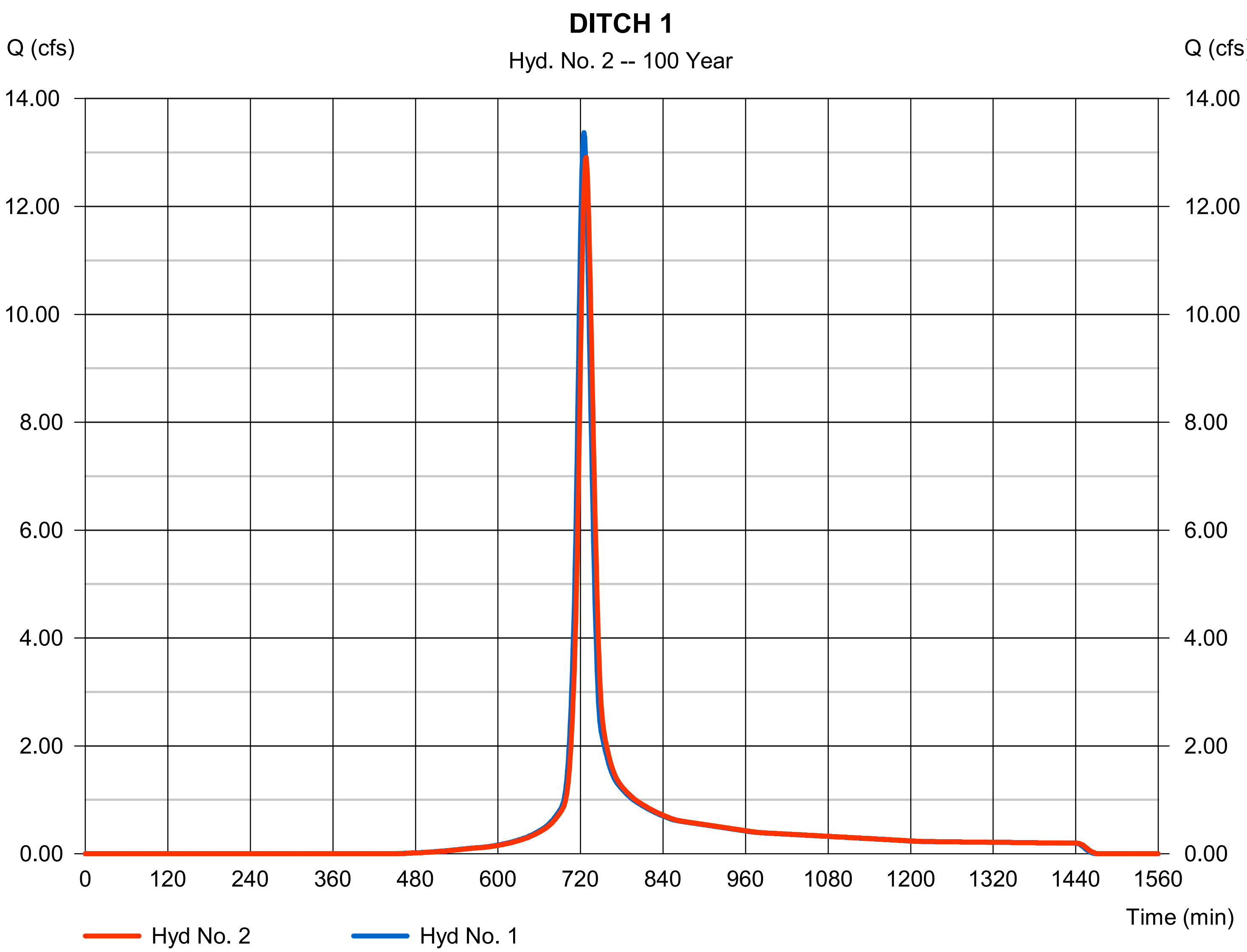
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 2

DITCH 1

Hydrograph type	= Reach	Peak discharge	= 12.91 cfs
Storm frequency	= 100 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 41,748 cuft
Inflow hyd. No.	= 1 - AREA A - POST DEV	Section type	= Trapezoidal
Reach length	= 730.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 10.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.375
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.3294

Modified Att-Kin routing method used.



Hydrograph Report

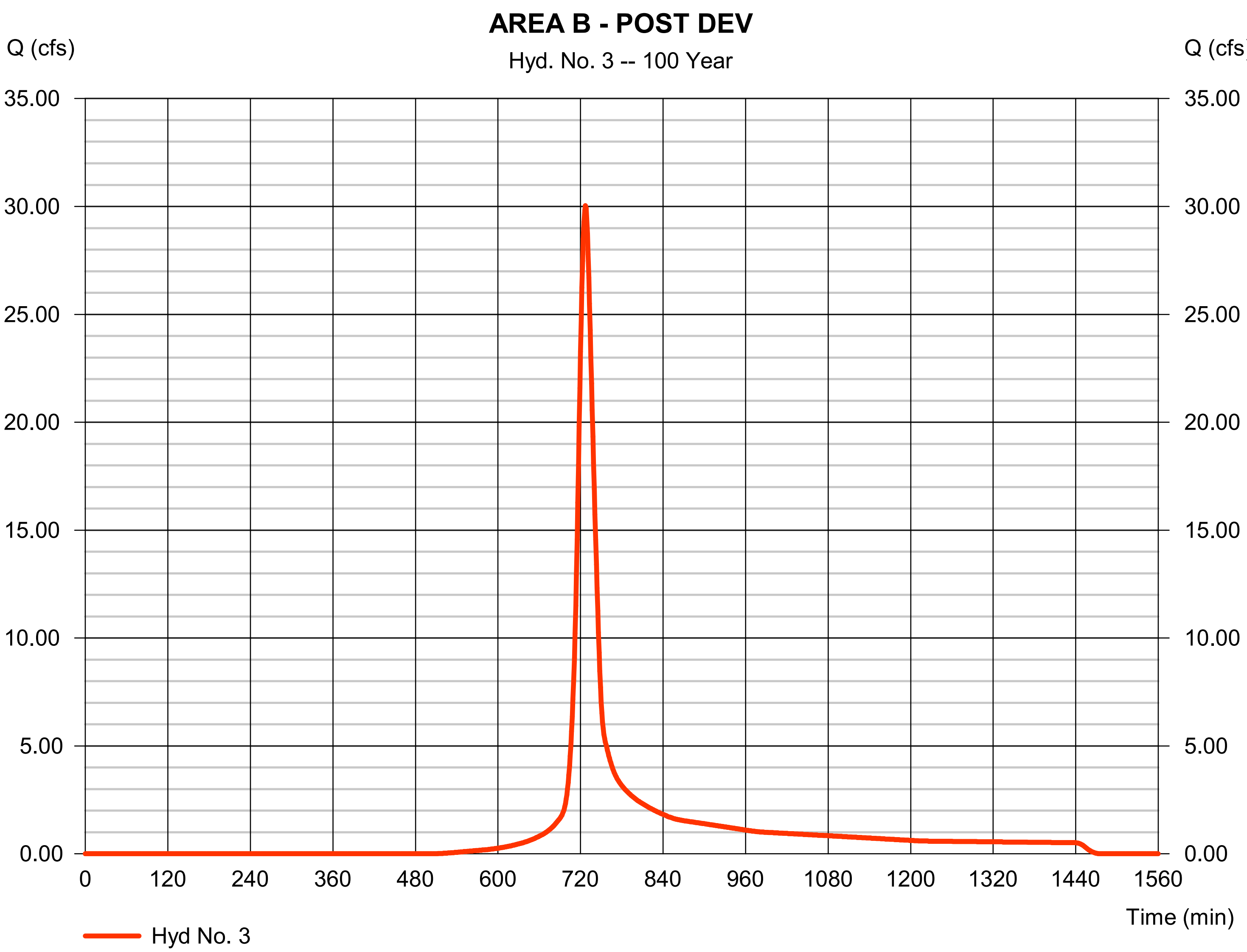
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 3

AREA B - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 30.03 cfs
Storm frequency	= 100 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 102,165 cuft
Drainage area	= 7.090 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.60 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.930 x 85) + (2.120 x 55) + (0.250 x 98) + (2.790 x 60)] / 7.090



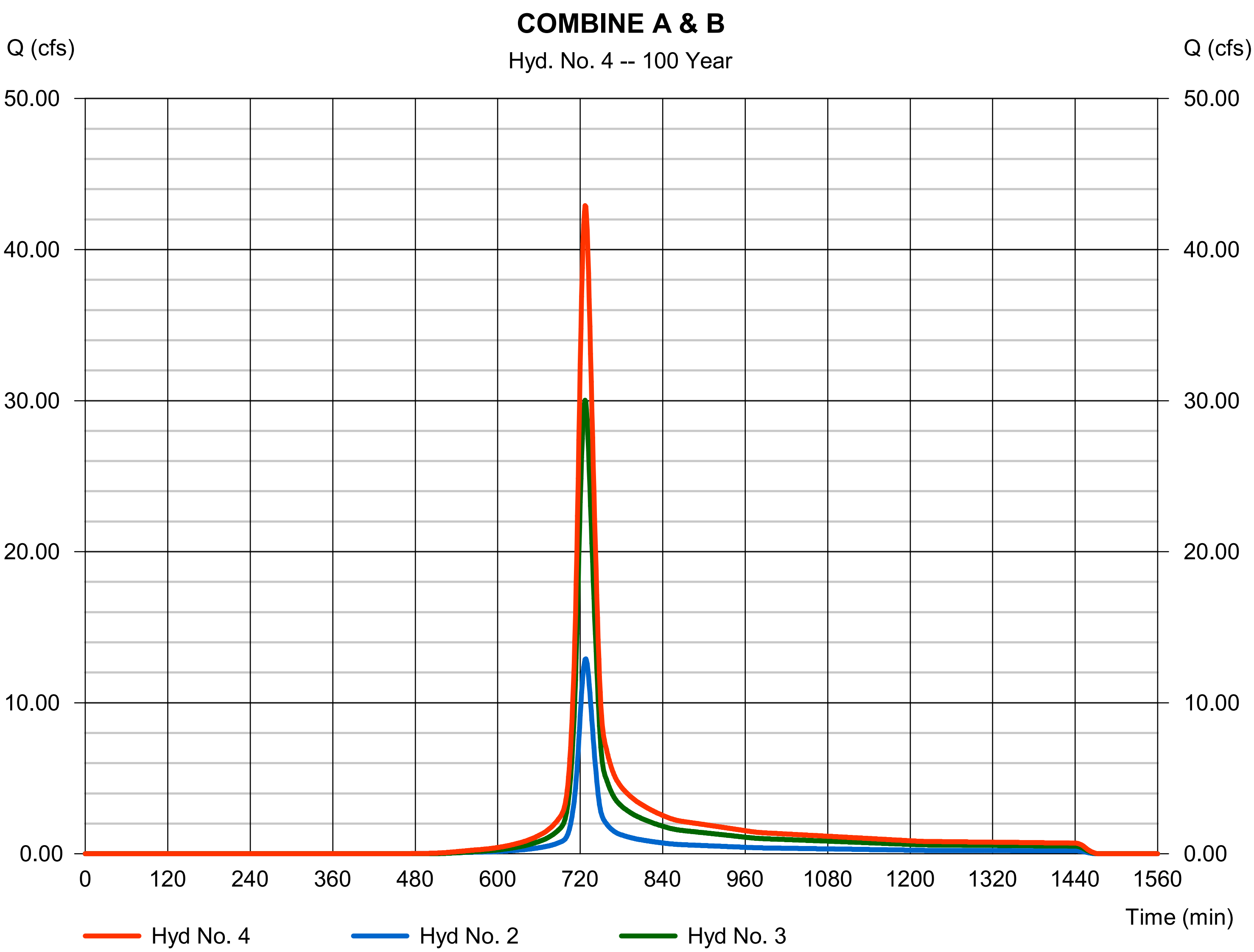
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 4

COMBINE A & B

Hydrograph type	= Combine	Peak discharge	= 42.91 cfs
Storm frequency	= 100 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 143,913 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 7.090 ac



Hydrograph Report

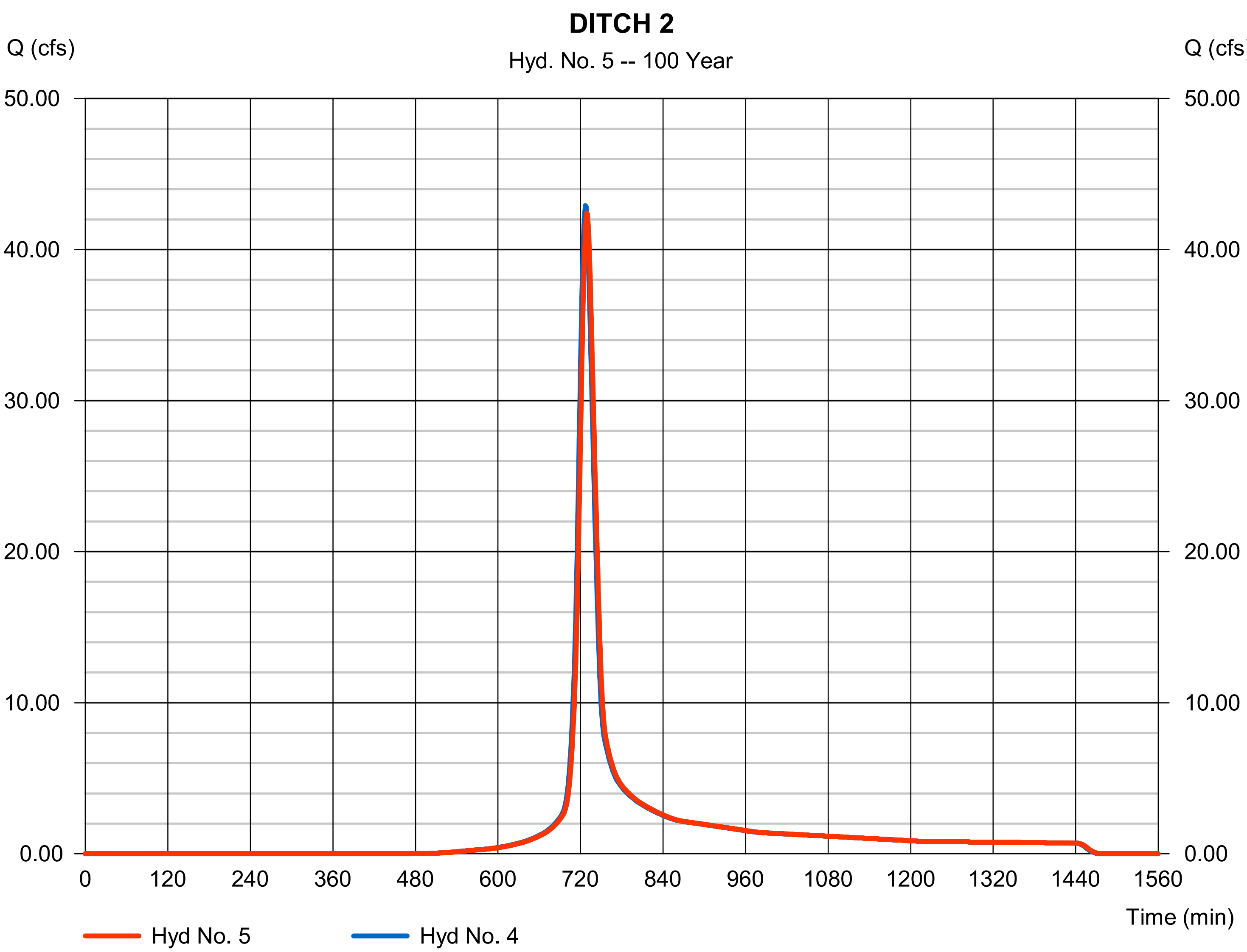
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 5

DITCH 2

Hydrograph type	= Reach	Peak discharge	= 42.43 cfs
Storm frequency	= 100 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 143,911 cuft
Inflow hyd. No.	= 4 - COMBINE A & B	Section type	= Trapezoidal
Reach length	= 610.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.373
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.4878

Modified Att-Kin routing method used.



Hydrograph Report

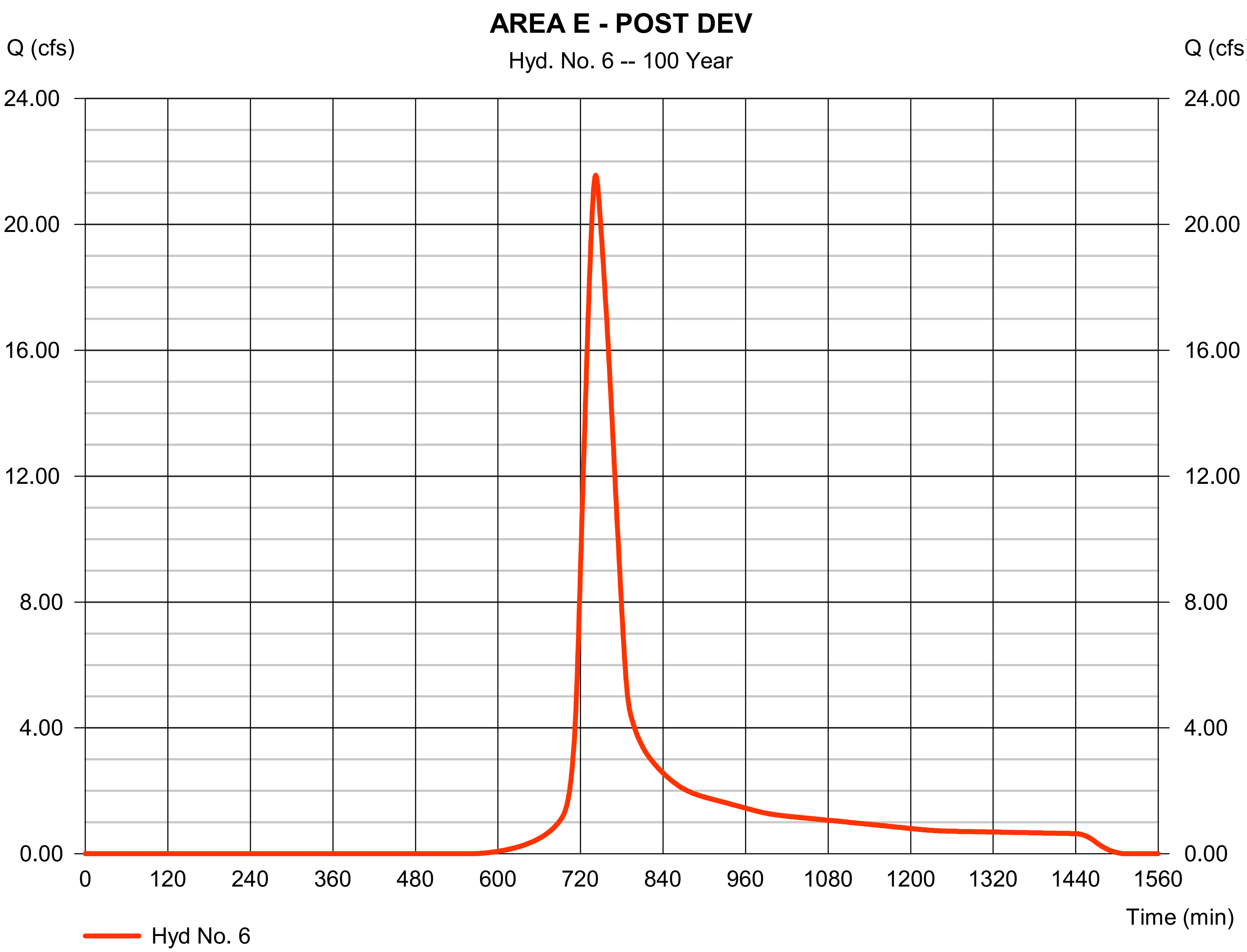
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 6

AREA E - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 21.56 cfs
Storm frequency	= 100 yrs	Time to peak	= 742 min
Time interval	= 1 min	Hyd. volume	= 118,736 cuft
Drainage area	= 9.150 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 47.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.680 x 65) + (0.330 x 98) + (5.140 x 60)] / 9.150



Hydrograph Report

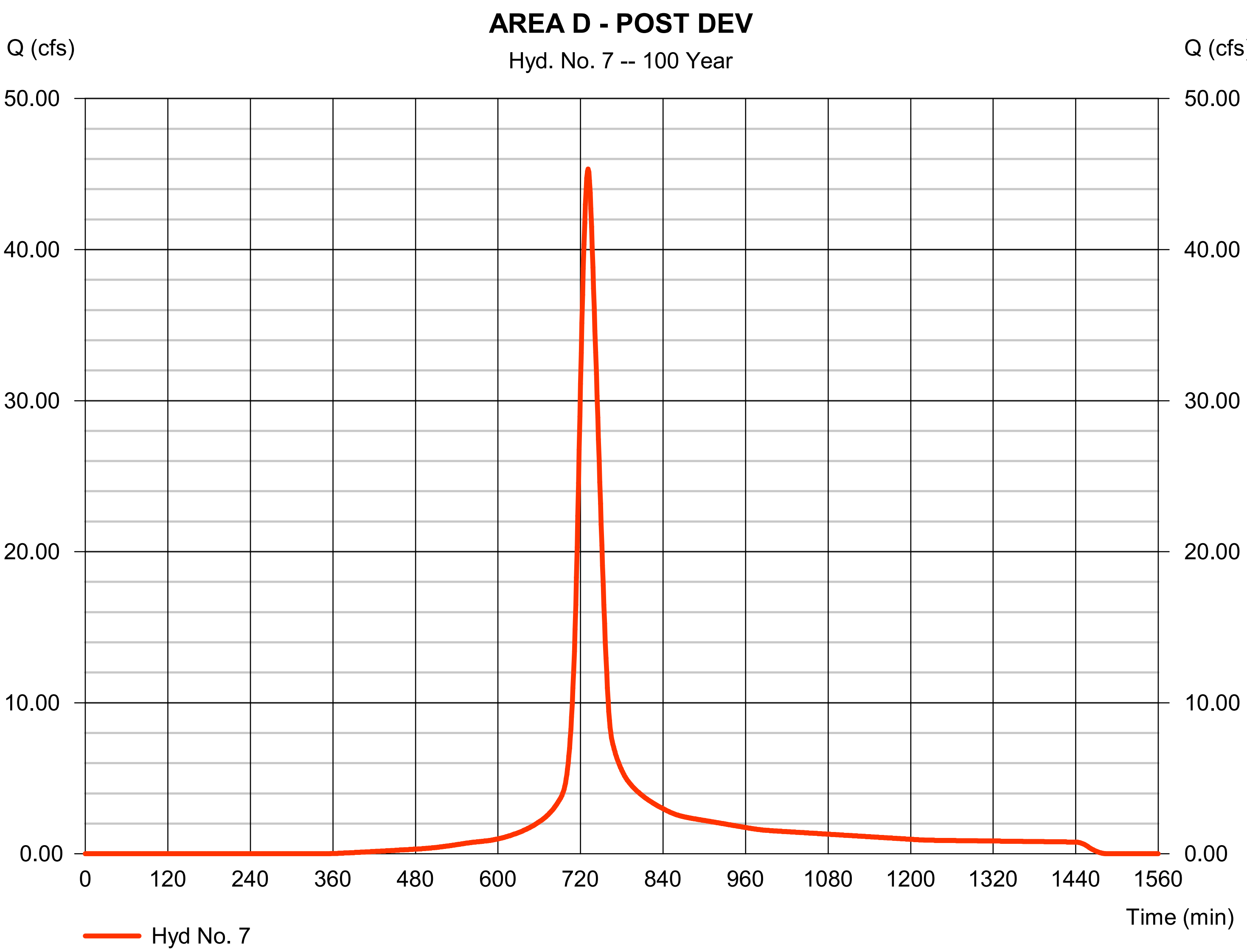
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 7

AREA D - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 45.34 cfs
Storm frequency	= 100 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 181,834 cuft
Drainage area	= 9.520 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.10 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.910 x 85) + (8.610 x 77)] / 9.520



Hydrograph Report

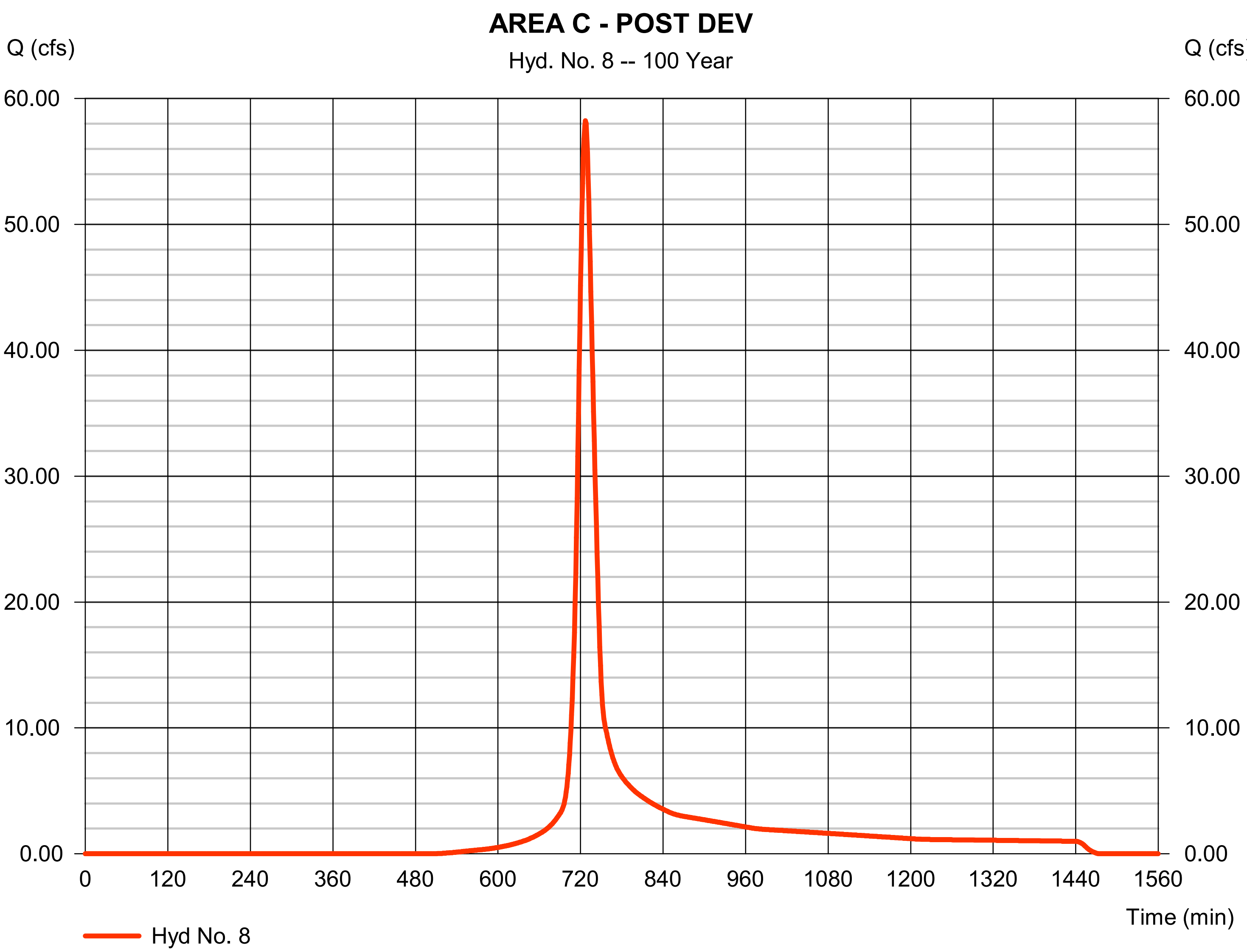
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 8

AREA C - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 58.24 cfs
Storm frequency	= 100 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 198,133 cuft
Drainage area	= 13.750 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.460 x 85) + (0.400 x 55) + (1.740 x 98) + (10.150 x 60)] / 13.750



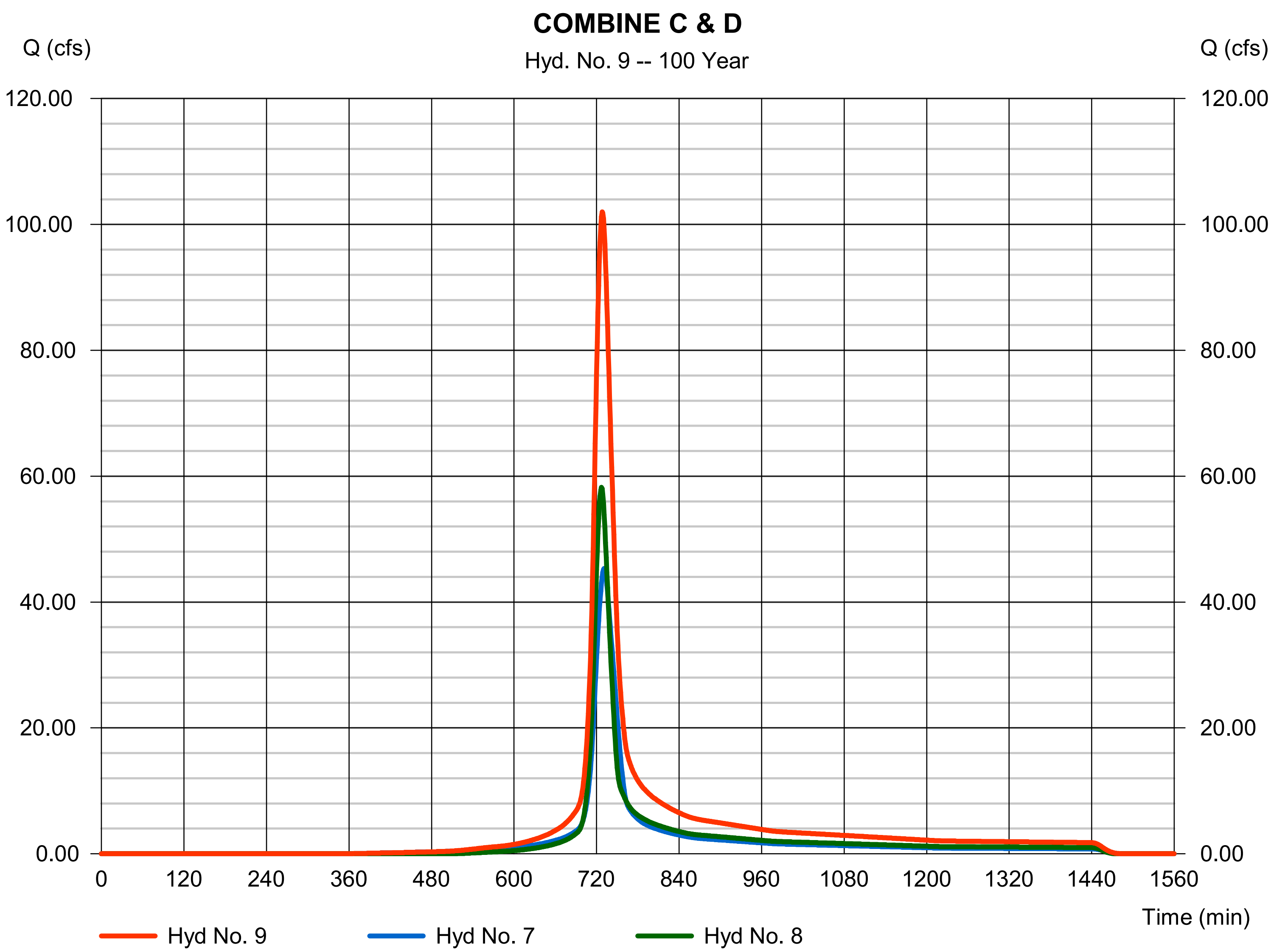
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 9

COMBINE C & D

Hydrograph type	= Combine	Peak discharge	= 102.01 cfs
Storm frequency	= 100 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 379,967 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 23.270 ac



Hydrograph Report

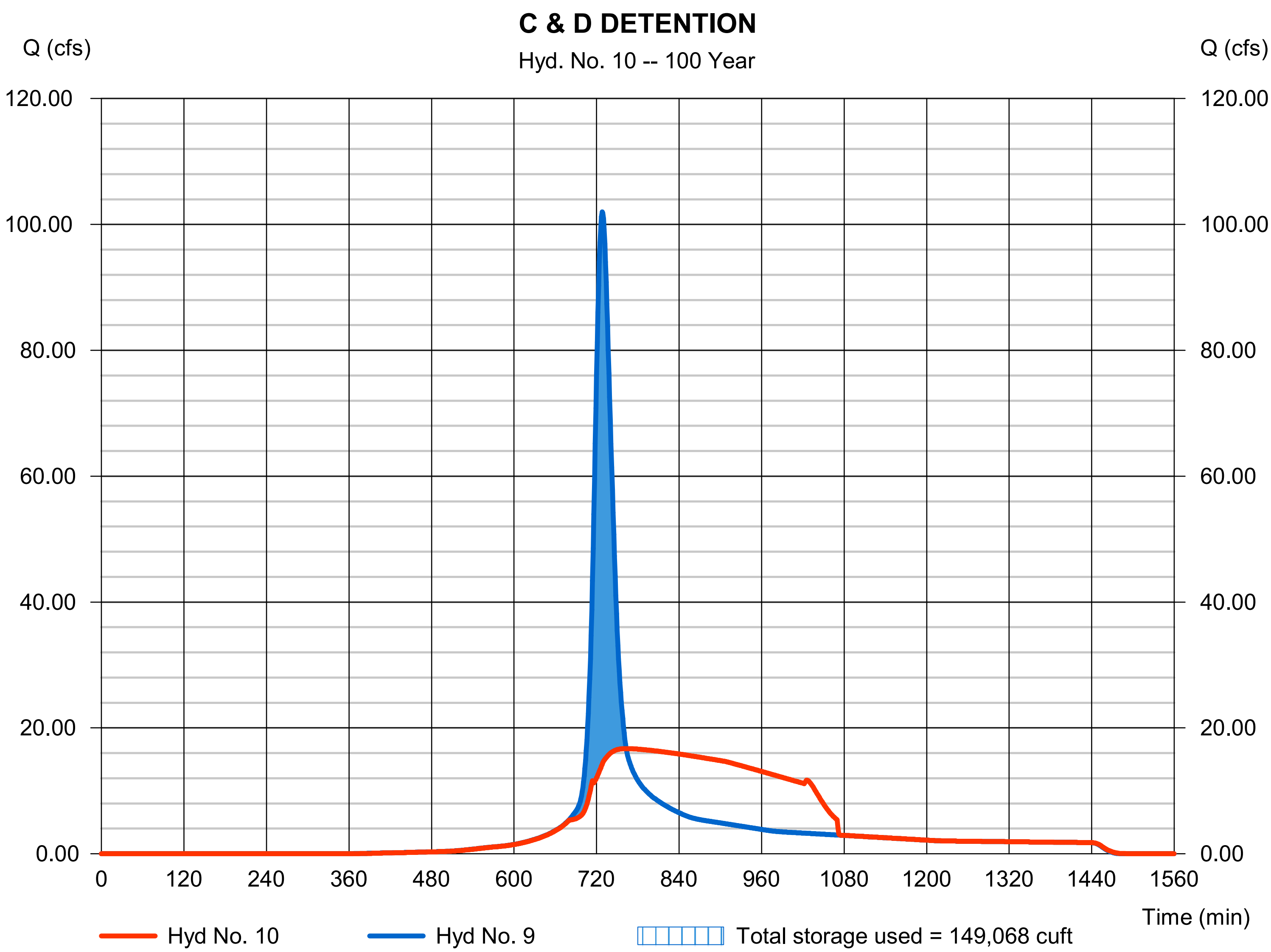
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 10

C & D DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 16.71 cfs
Storm frequency	= 100 yrs	Time to peak	= 763 min
Time interval	= 1 min	Hyd. volume	= 379,967 cuft
Inflow hyd. No.	= 9 - COMBINE C & D	Max. Elevation	= 582.71 ft
Reservoir name	= C&D DETENTION	Max. Storage	= 149,068 cuft

Storage Indication method used.



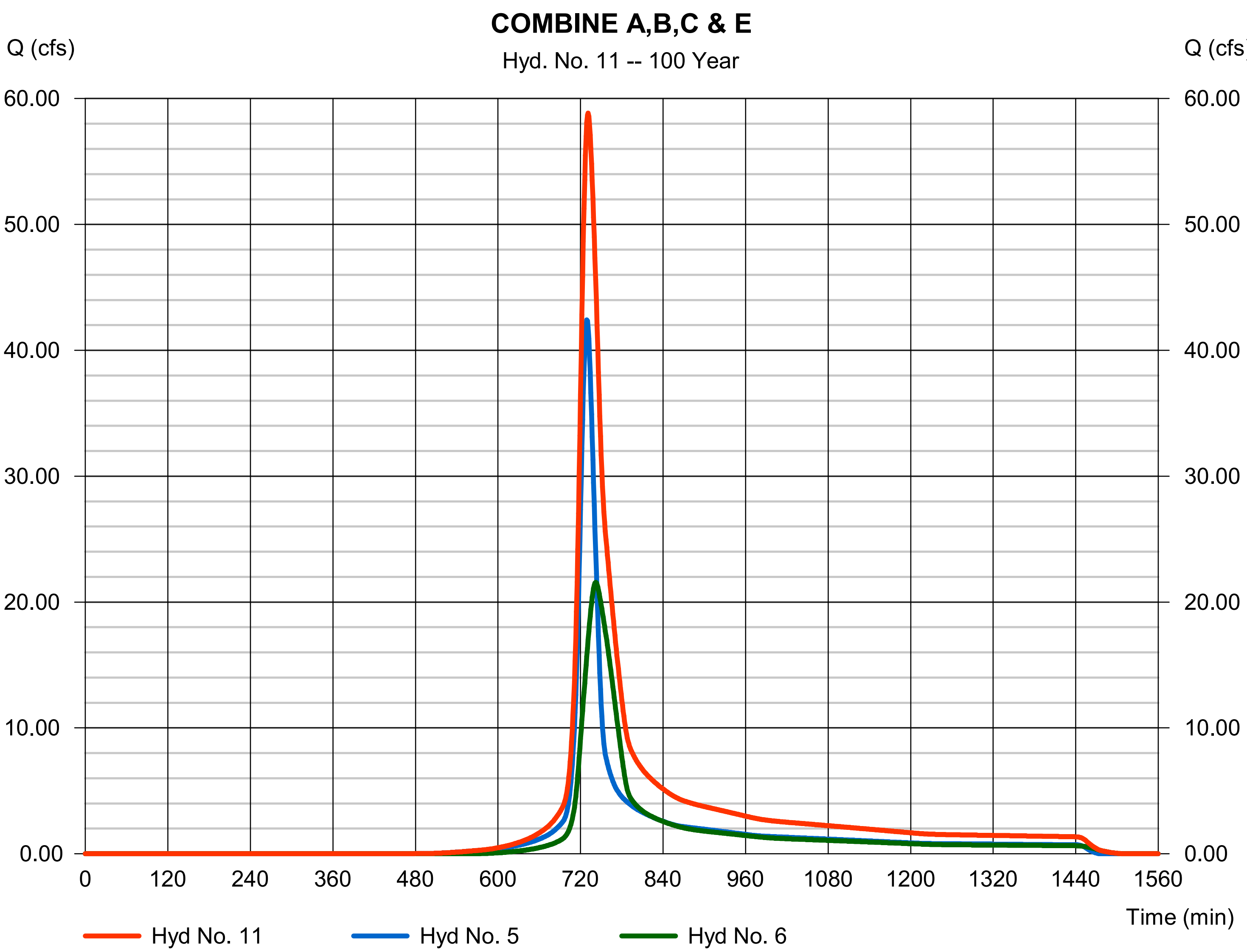
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 11

COMBINE A,B,C & E

Hydrograph type	= Combine	Peak discharge	= 58.84 cfs
Storm frequency	= 100 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 262,648 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 9.150 ac



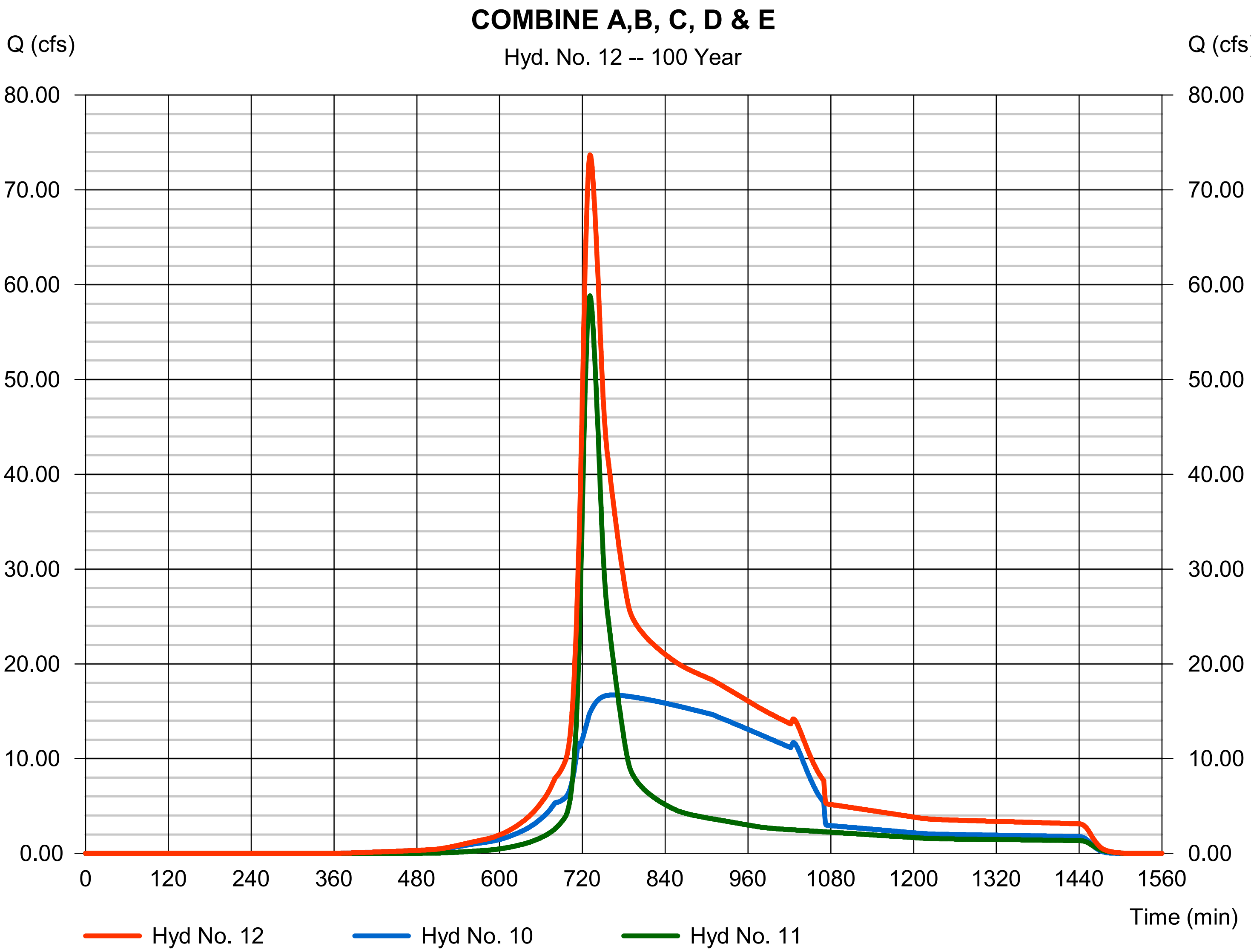
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 12

COMBINE A,B, C, D & E

Hydrograph type	= Combine	Peak discharge	= 73.69 cfs
Storm frequency	= 100 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 642,614 cuft
Inflow hyds.	= 10, 11	Contrib. drain. area	= 0.000 ac



Hydrograph Report

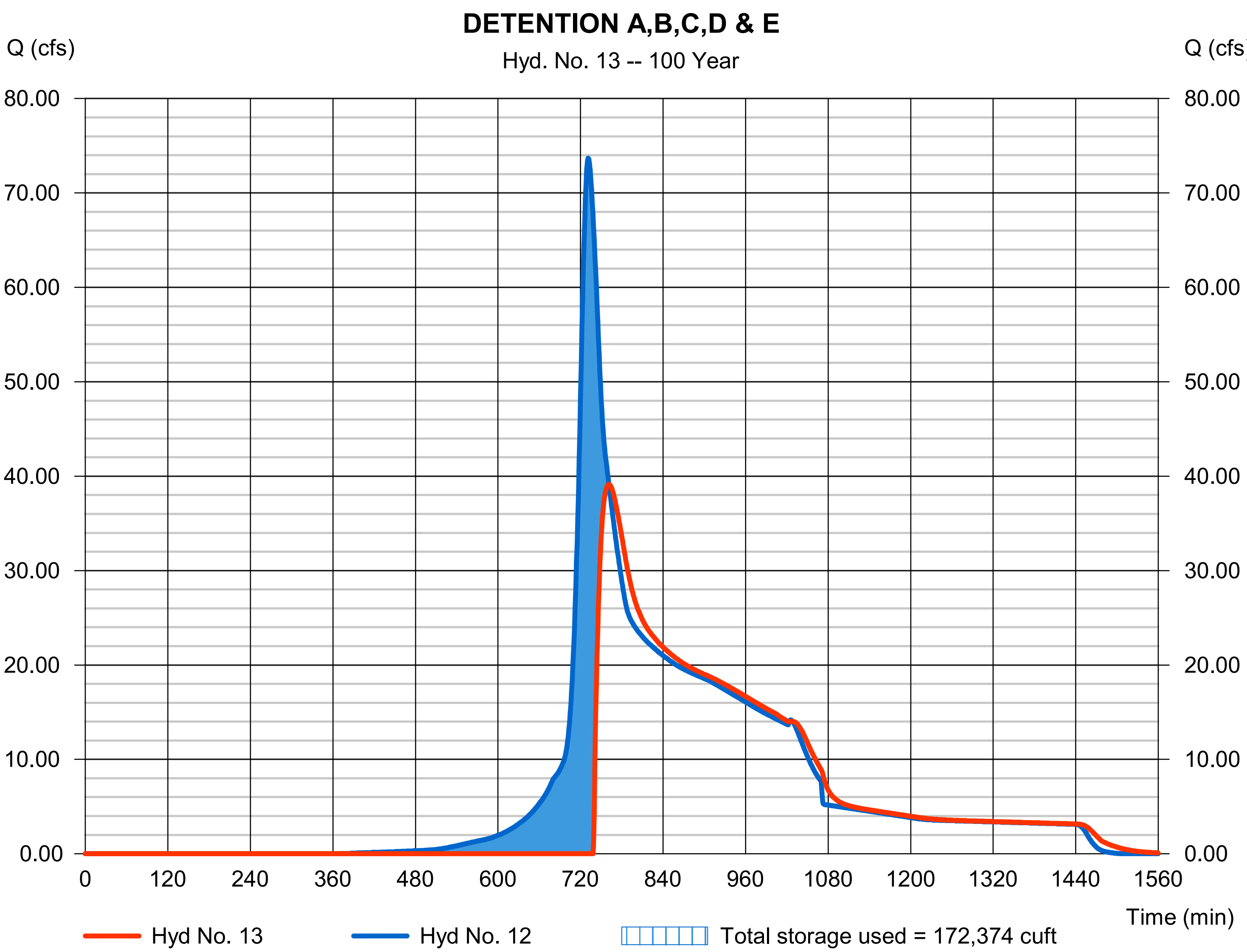
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 13

DETENTION A,B,C,D & E

Hydrograph type	= Reservoir	Peak discharge	= 39.14 cfs
Storm frequency	= 100 yrs	Time to peak	= 761 min
Time interval	= 1 min	Hyd. volume	= 499,573 cuft
Inflow hyd. No.	= 12 - COMBINE A,B, C, D & E	Max. Elevation	= 582.46 ft
Reservoir name	= A,B,C,D & E DETENTION	Max. Storage	= 172,374 cuft

Storage Indication method used.



Hydrograph Report

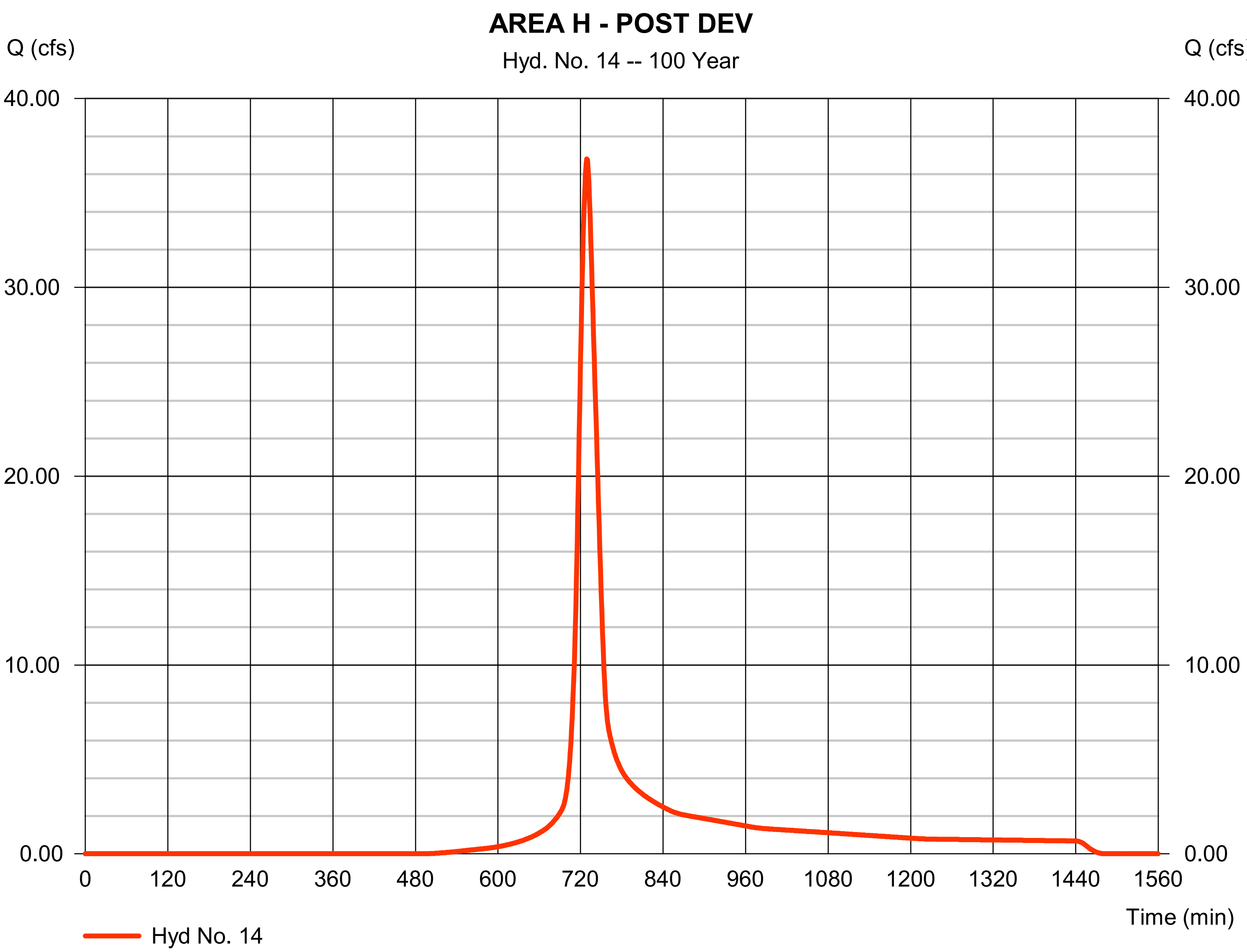
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 14

AREA H - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 36.81 cfs
Storm frequency	= 100 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 137,242 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.50 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



Hydrograph Report

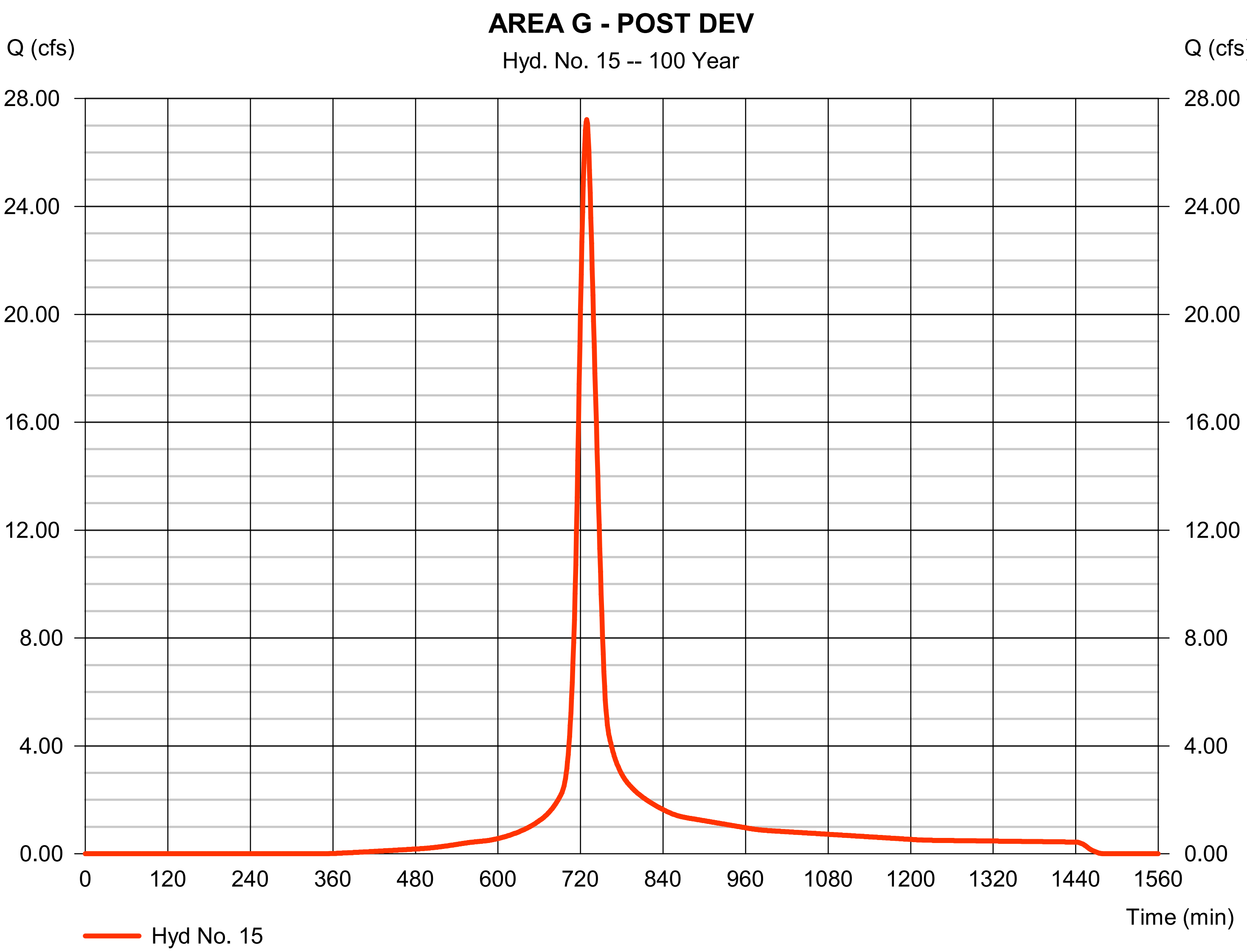
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 15

AREA G - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 27.22 cfs
Storm frequency	= 100 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 101,829 cuft
Drainage area	= 5.290 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 26.80 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.330 x 85) + (4.960 x 77)] / 5.290



Hydrograph Report

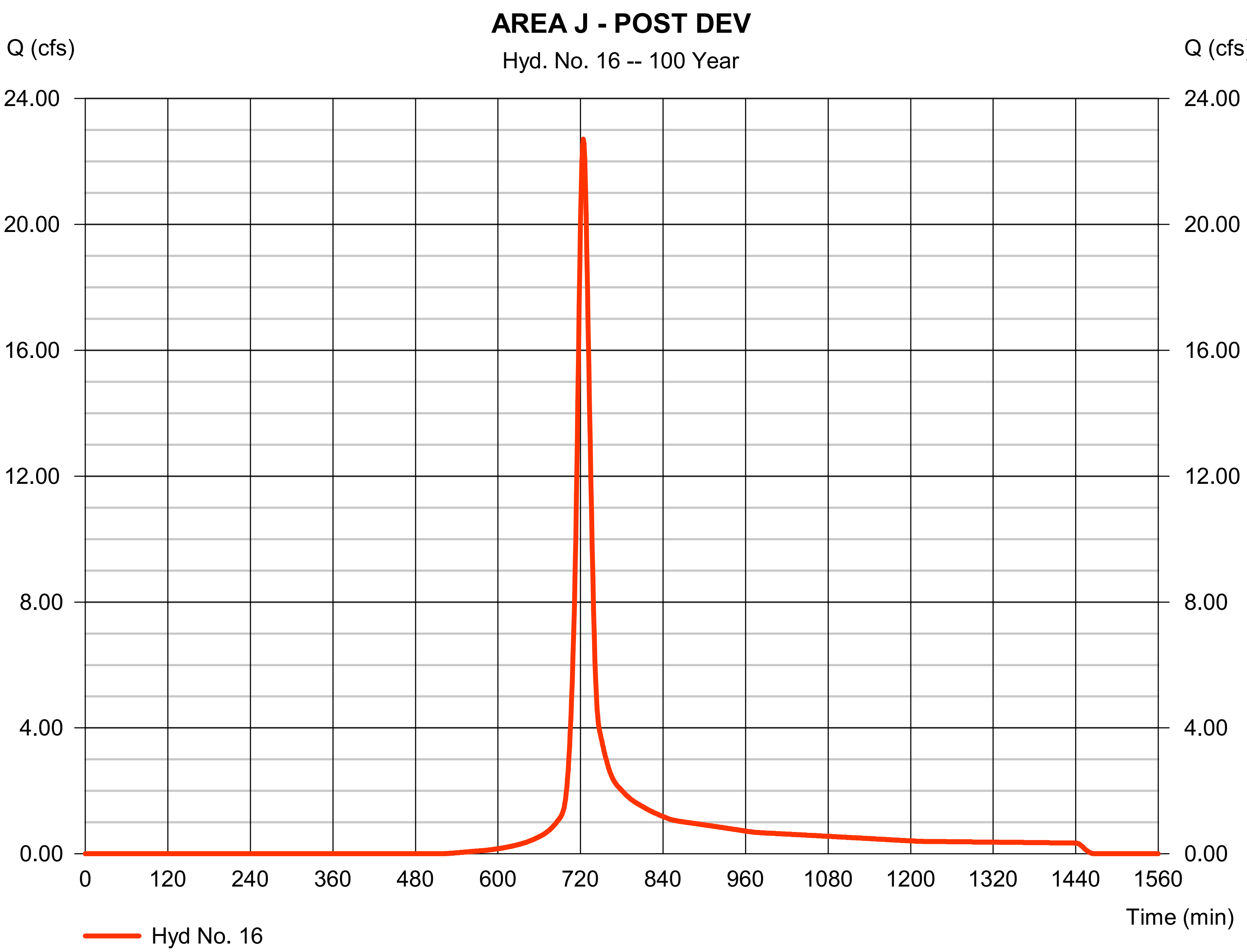
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 16

AREA J - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 22.71 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 67,343 cuft
Drainage area	= 4.820 ac	Curve number	= 66*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 85) + (0.020 x 65) + (0.680 x 98) + (4.030 x 60)] / 4.820



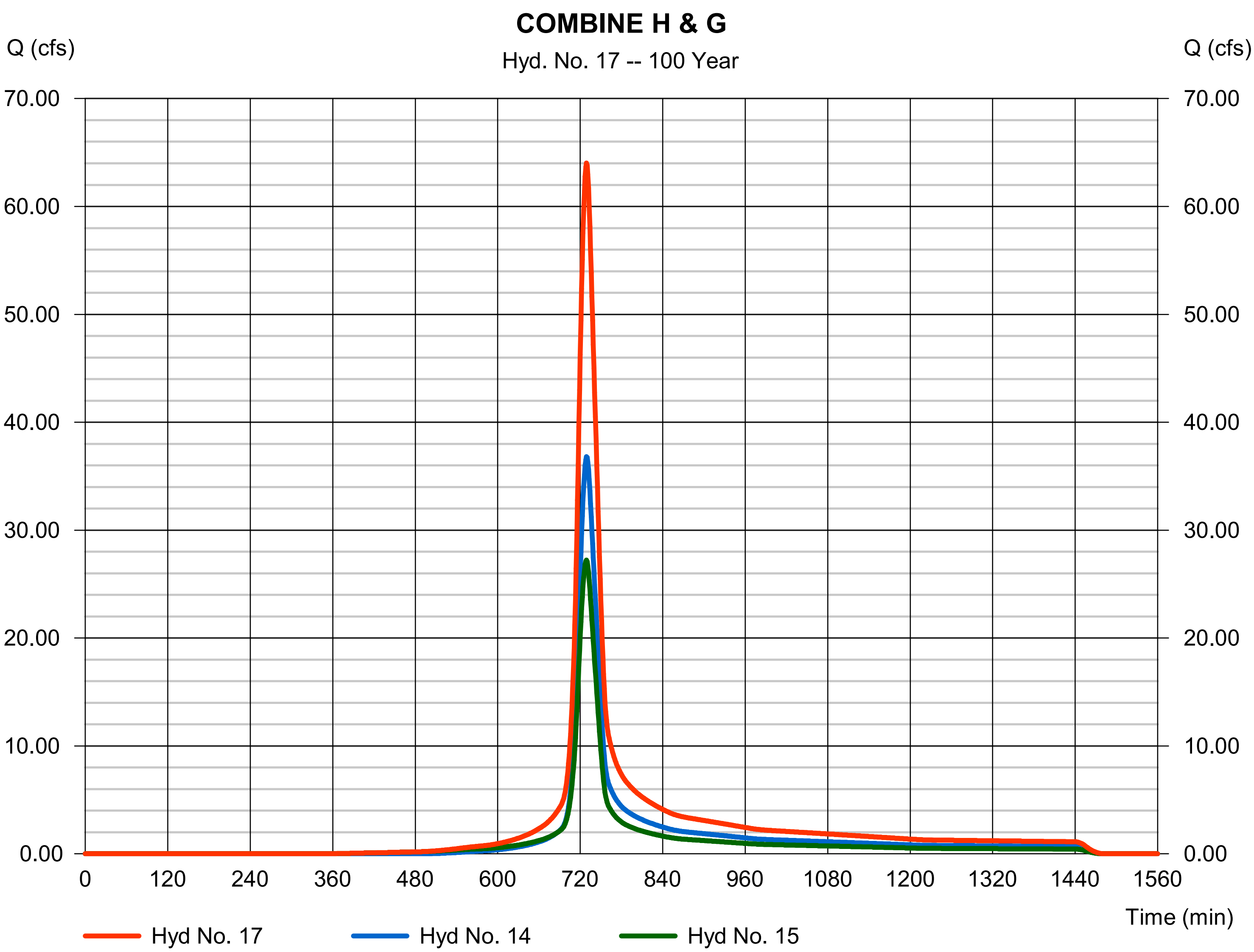
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 17

COMBINE H & G

Hydrograph type	= Combine	Peak discharge	= 64.03 cfs
Storm frequency	= 100 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 239,071 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 14.400 ac



Hydrograph Report

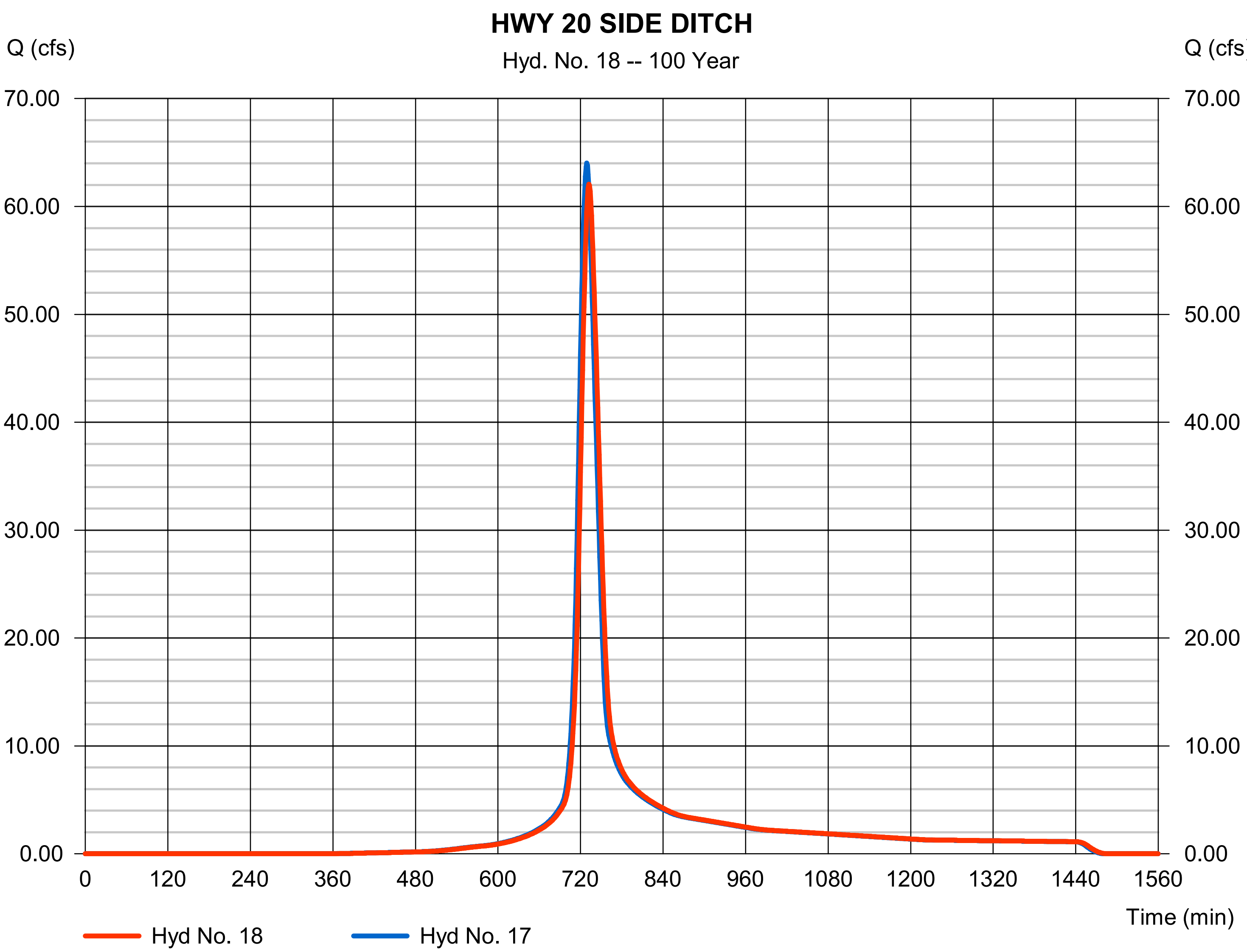
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 18

HWY 20 SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 62.06 cfs
Storm frequency	= 100 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 239,070 cuft
Inflow hyd. No.	= 17 - COMBINE H & G	Section type	= Trapezoidal
Reach length	= 900.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.030	Bottom width	= 3.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 1.688	Rating curve m	= 1.304
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.2925

Modified Att-Kin routing method used.



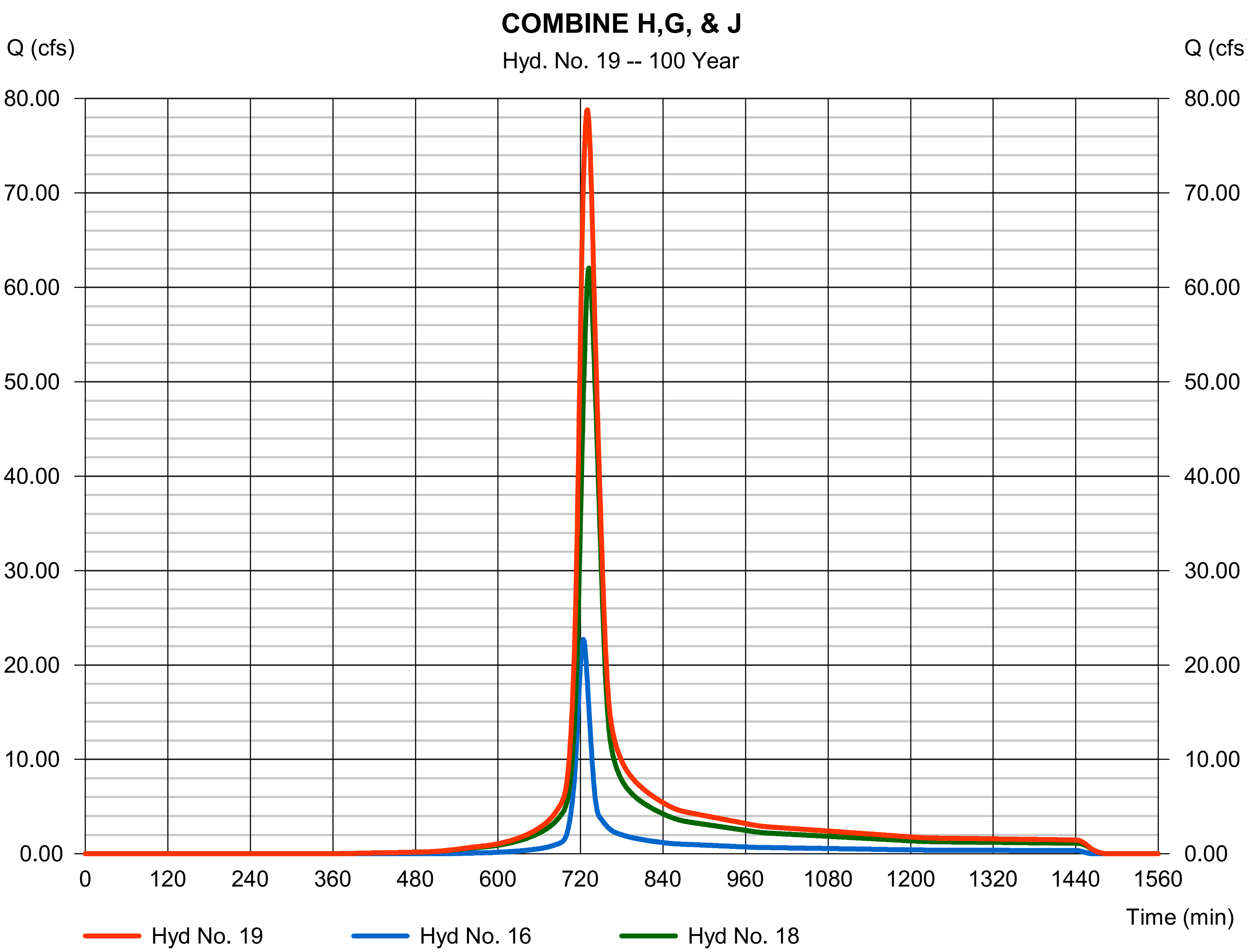
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 19

COMBINE H,G, & J

Hydrograph type	= Combine	Peak discharge	= 78.80 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 306,413 cuft
Inflow hyds.	= 16, 18	Contrib. drain. area	= 4.820 ac



Hydrograph Report

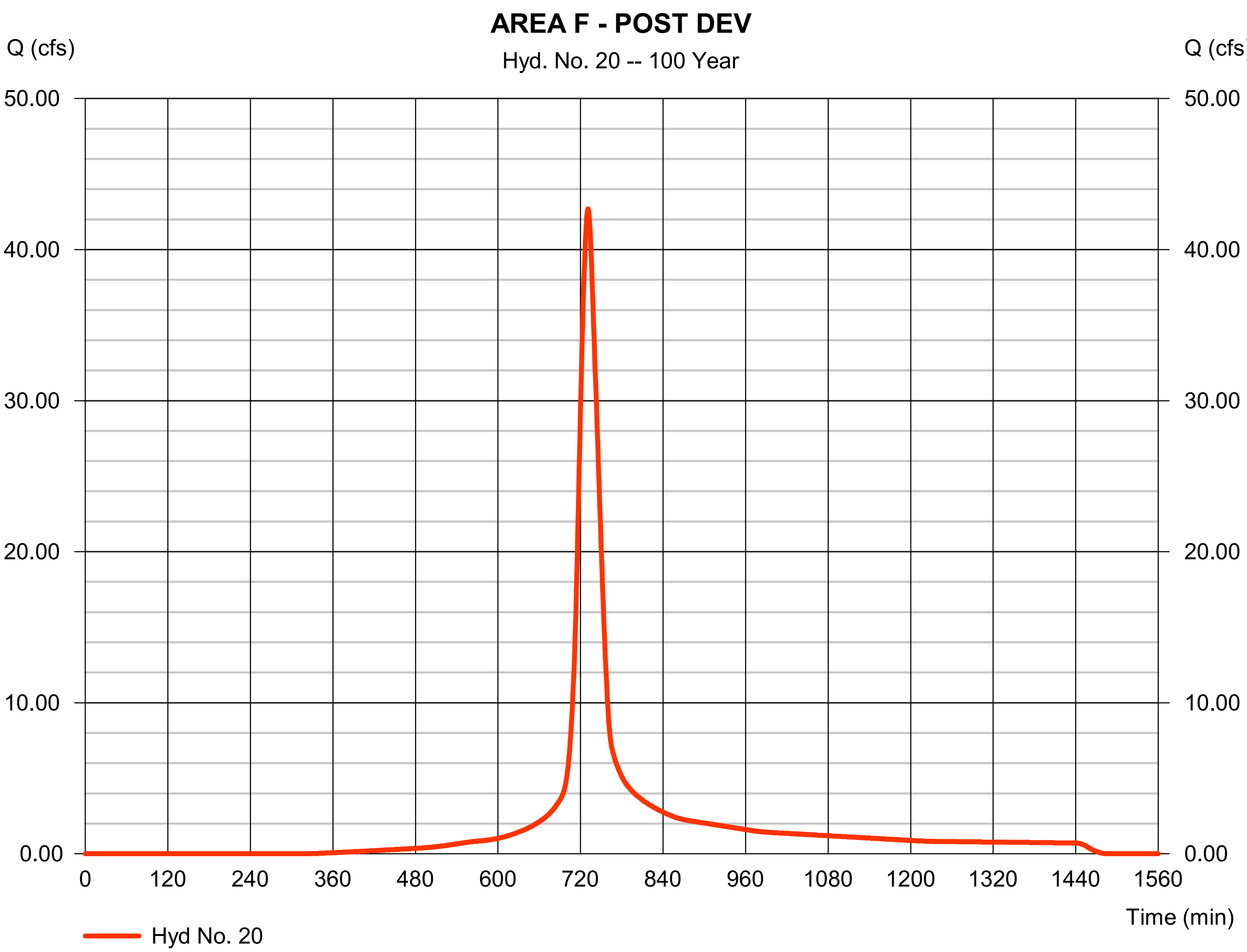
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 11 / 15 / 2018

Hyd. No. 20

AREA F - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 42.69 cfs
Storm frequency	= 100 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 171,907 cuft
Drainage area	= 8.620 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.440 x 85) + (8.180 x 77)] / 8.620



Hydrograph Report

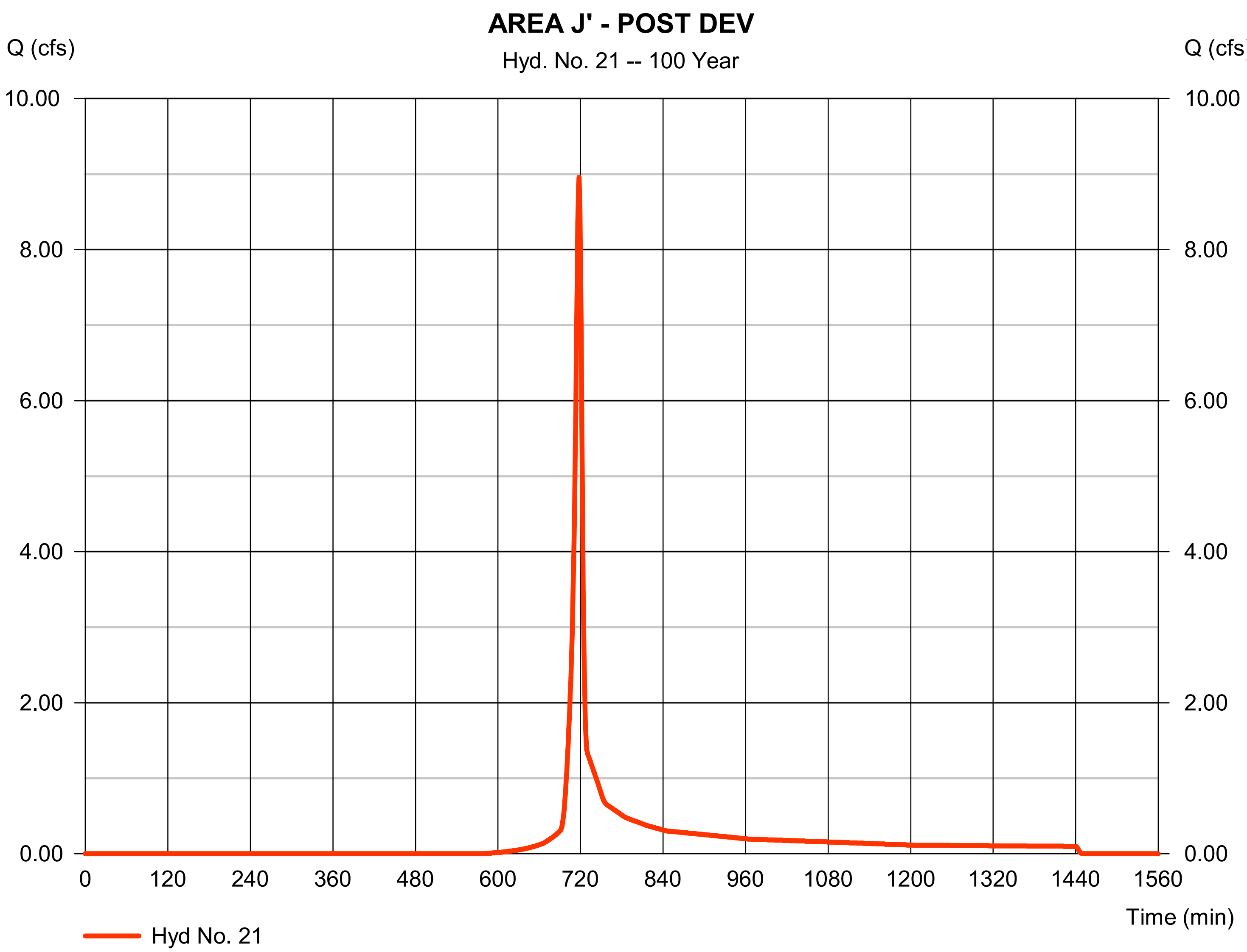
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 21

AREA J' - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 8.961 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 17,995 cuft
Drainage area	= 1.440 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.220 x 65) + (1.220 x 60)] / 1.440



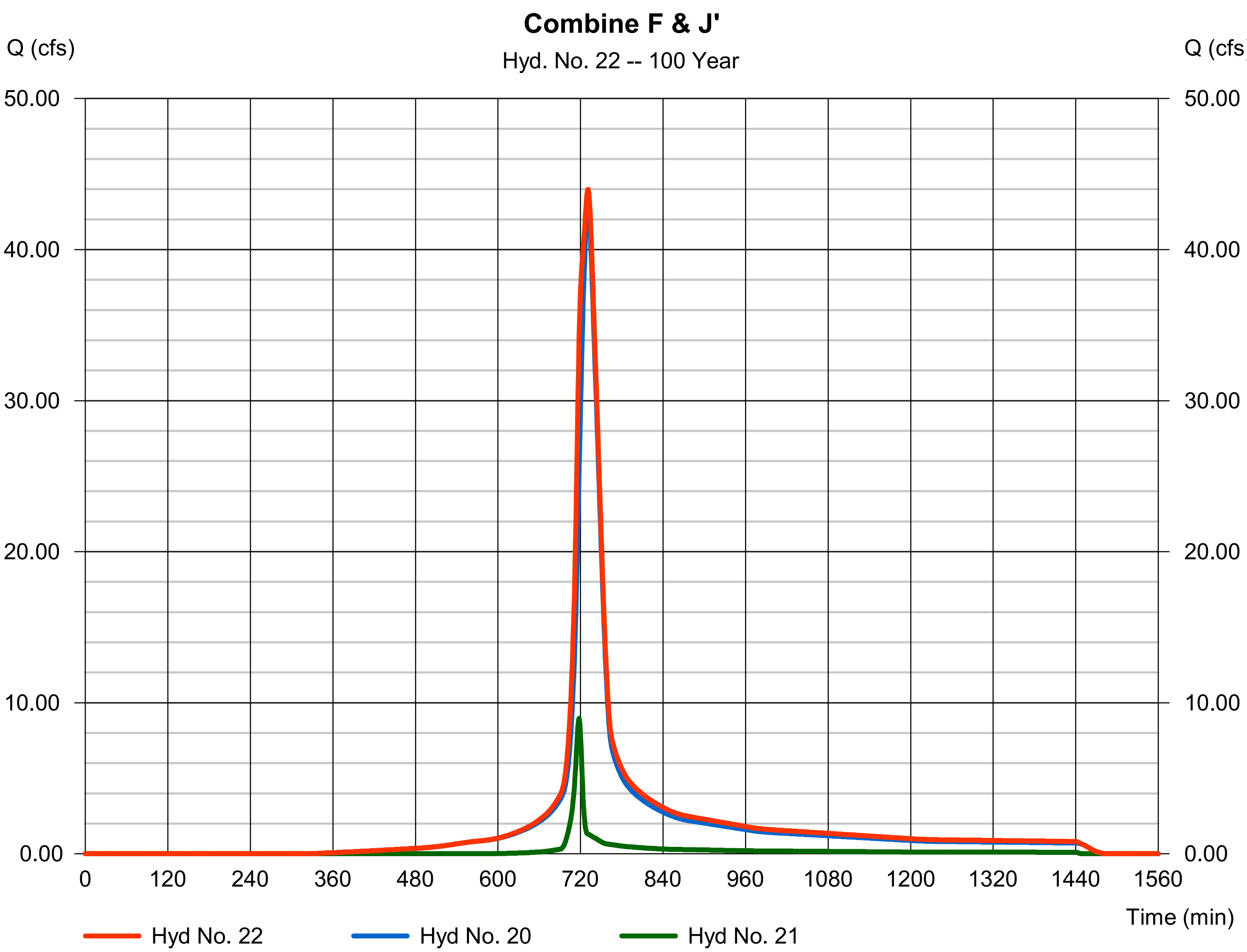
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 22

Combine F & J'

Hydrograph type	= Combine	Peak discharge	= 44.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 189,902 cuft
Inflow hyds.	= 20, 21	Contrib. drain. area	= 10.060 ac



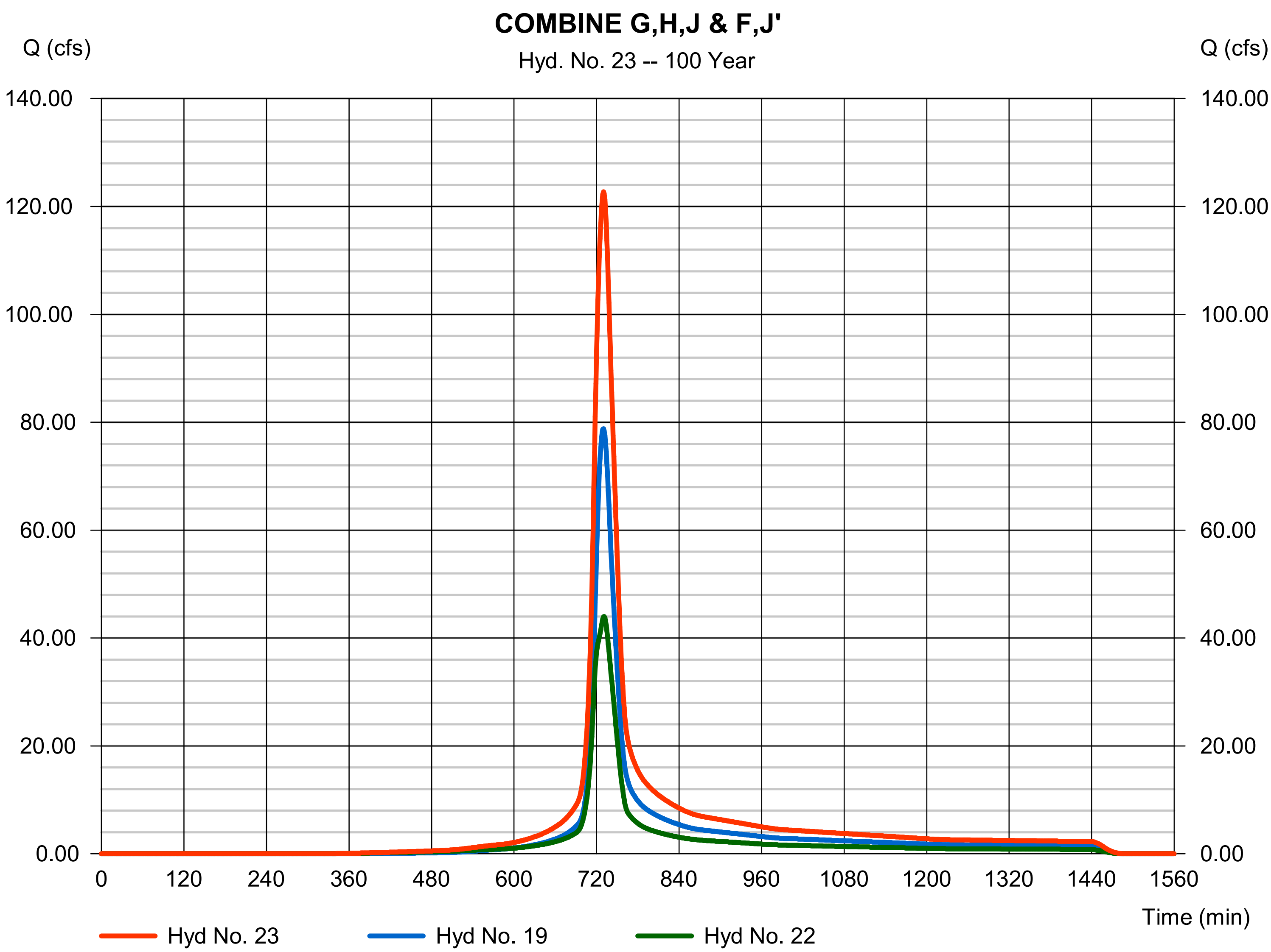
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 23

COMBINE G,H,J & F,J'

Hydrograph type	= Combine	Peak discharge	= 122.71 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 496,315 cuft
Inflow hyds.	= 19, 22	Contrib. drain. area	= 0.000 ac



Hydrograph Report

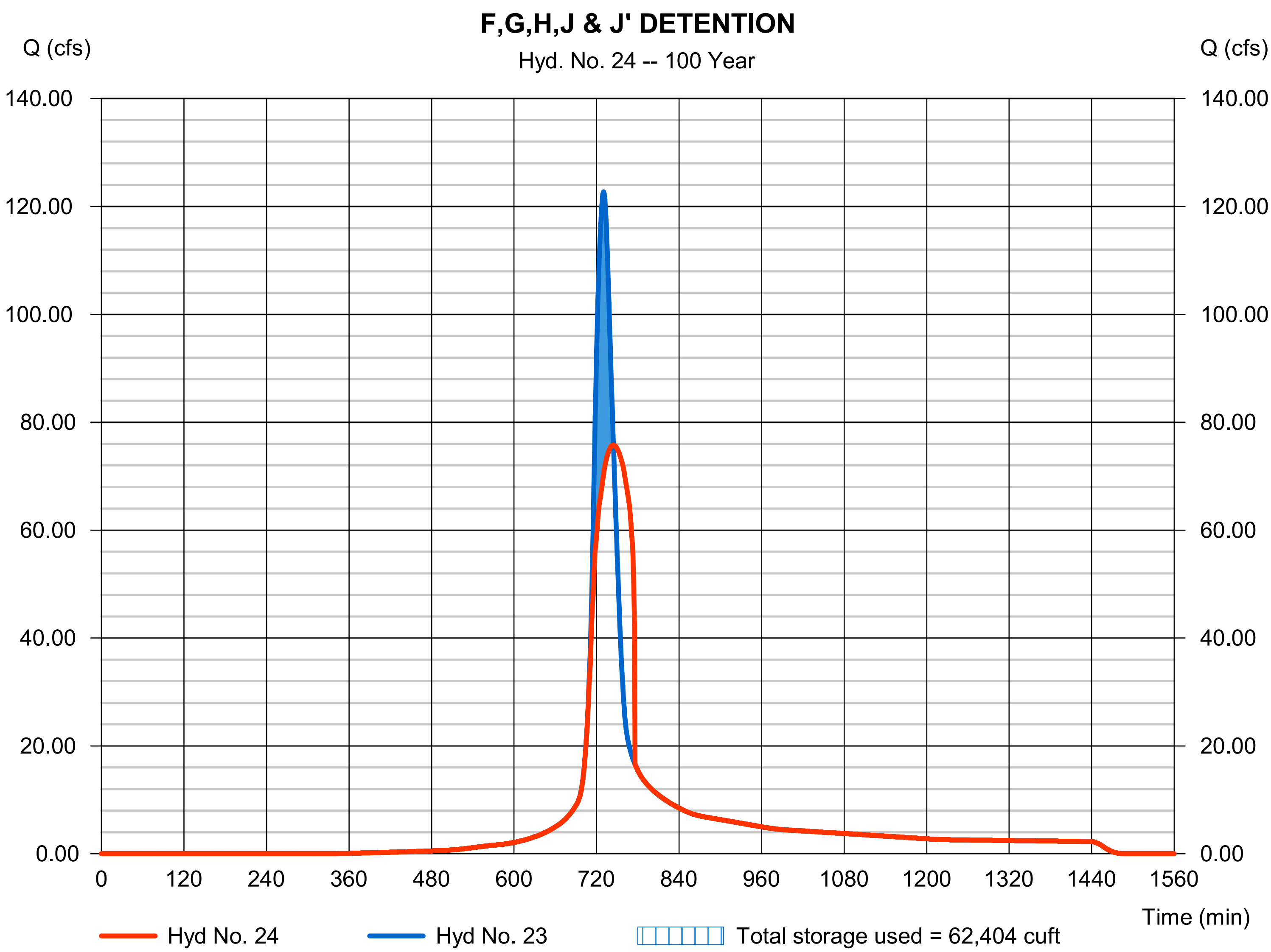
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 24

F,G,H,J & J' DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 75.75 cfs
Storm frequency	= 100 yrs	Time to peak	= 744 min
Time interval	= 1 min	Hyd. volume	= 496,315 cuft
Inflow hyd. No.	= 23 - COMBINE G,H,J & F,J'	Max. Elevation	= 581.58 ft
Reservoir name	= F,G,H,J & J' DETENTION	Max. Storage	= 62,404 cuft

Storage Indication method used.



Hydrograph Report

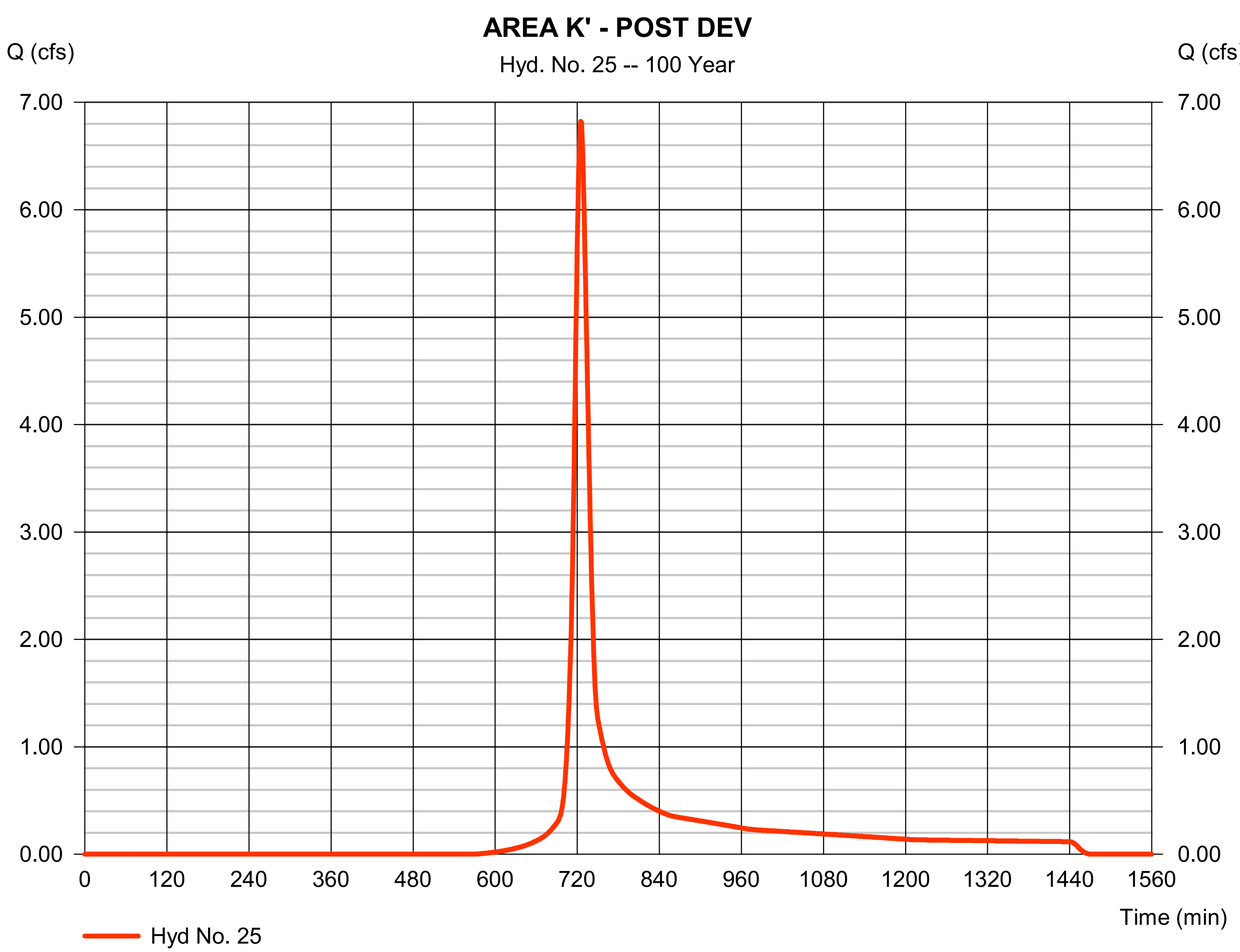
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 11 / 15 / 2018

Hyd. No. 25

AREA K' - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 6.822 cfs
Storm frequency	= 100 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 21,530 cuft
Drainage area	= 1.720 ac	Curve number	= 62*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 19.20 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.350 x 60) + (0.330 x 65) + (0.040 x 98)] / 1.720



Hydrograph Report

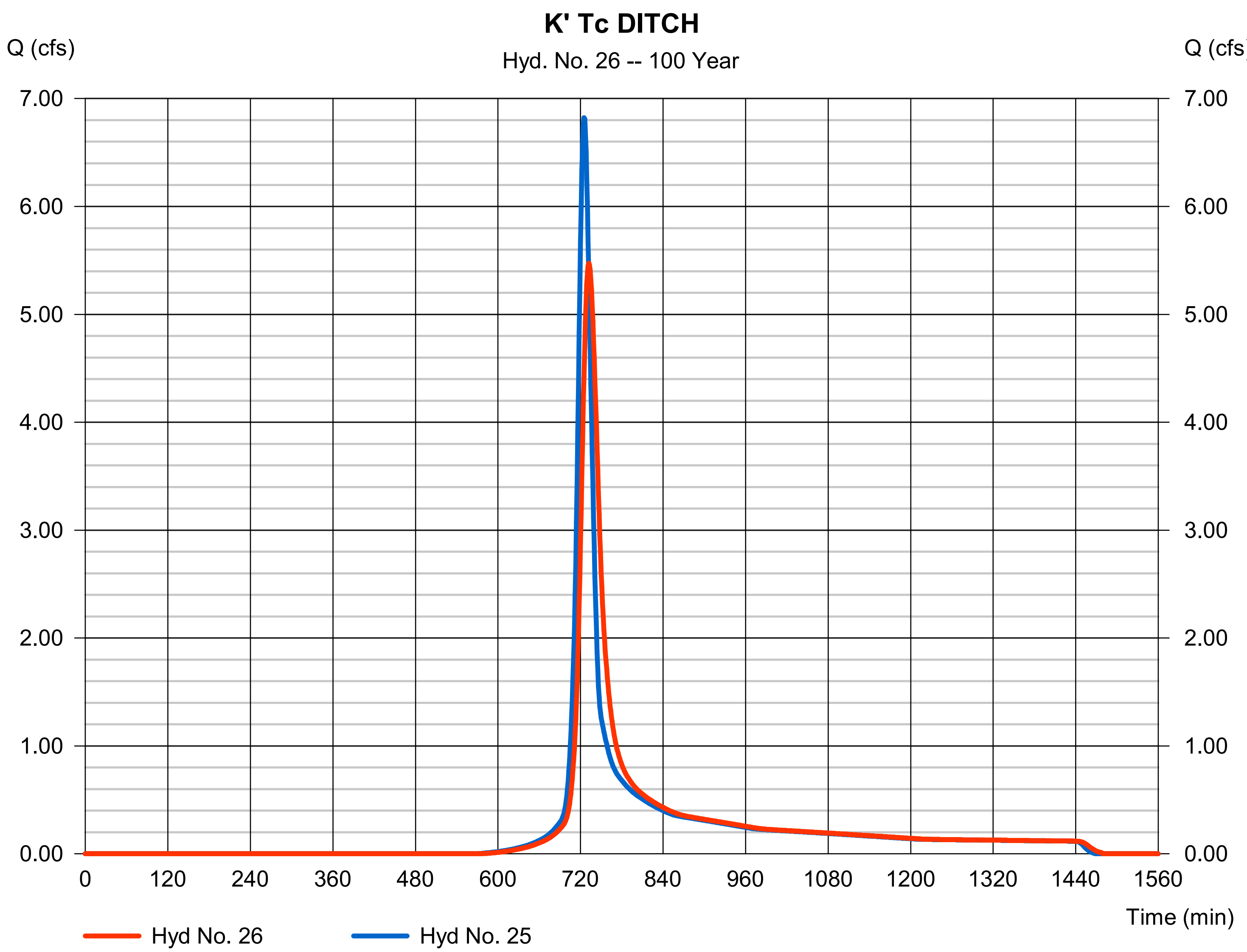
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 26

K' Tc DITCH

Hydrograph type	= Reach	Peak discharge	= 5.475 cfs
Storm frequency	= 100 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 21,526 cuft
Inflow hyd. No.	= 25 - AREA K' - POST DEV	Section type	= Trapezoidal
Reach length	= 710.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.040	Bottom width	= 5.0 ft
Side slope	= 4.0:1	Max. depth	= 2.0 ft
Rating curve x	= 0.697	Rating curve m	= 1.257
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.1114

Modified Att-Kin routing method used.



Hydrograph Report

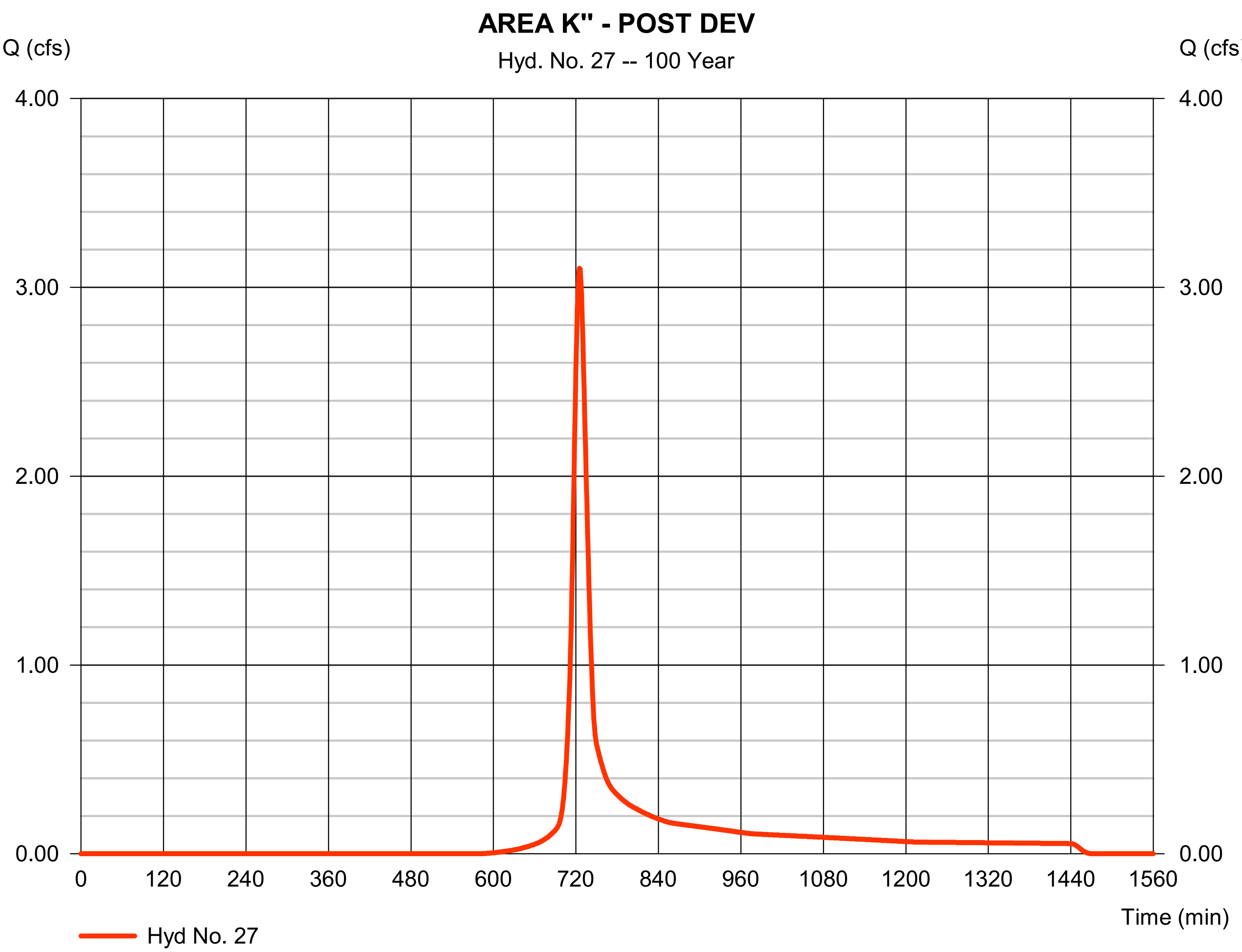
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 27

AREA K" - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 3.101 cfs
Storm frequency	= 100 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 9,816 cuft
Drainage area	= 0.810 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 19.20 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.170 x 65) + (0.640 x 60)] / 0.810



Hydrograph Report

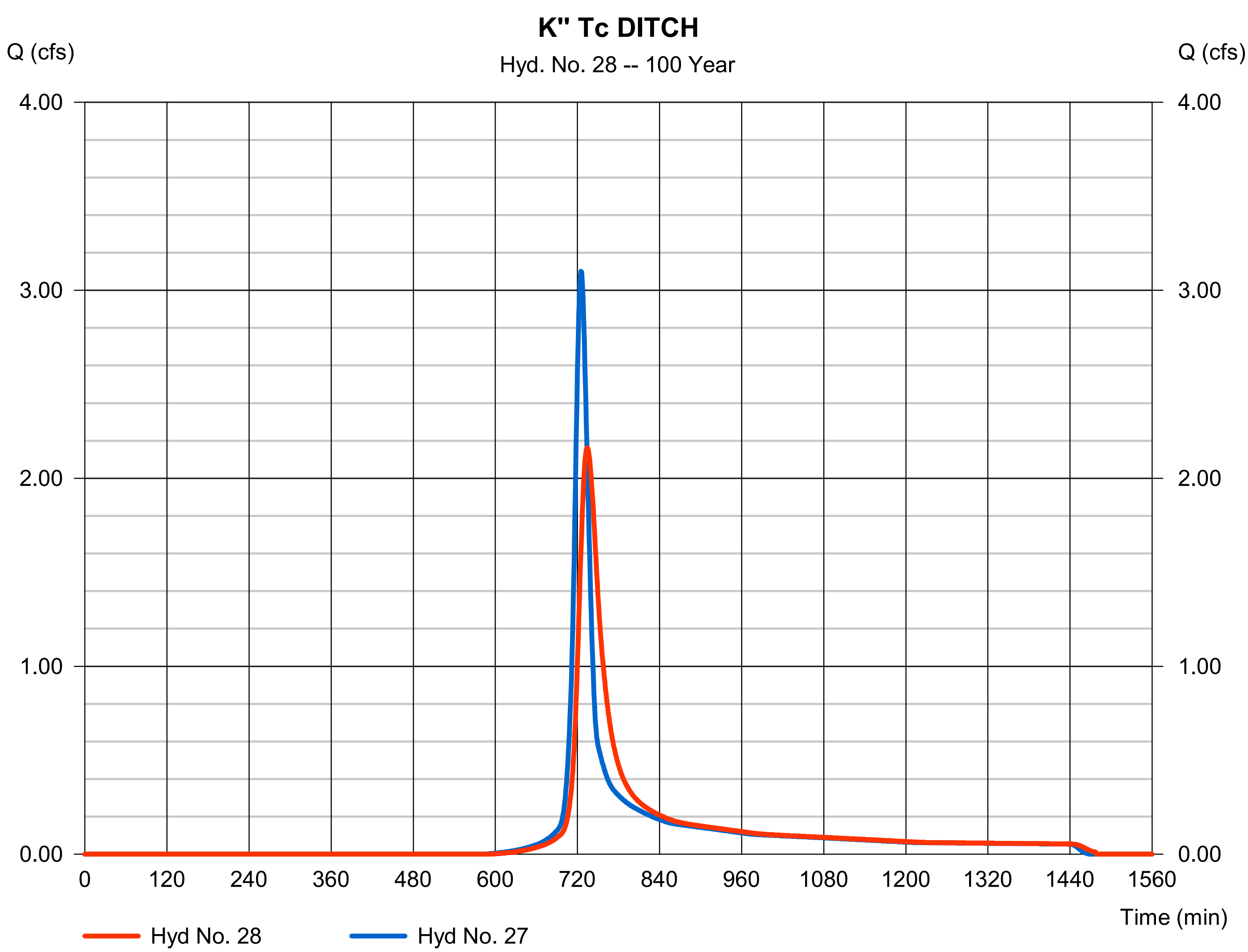
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 28

K" Tc DITCH

Hydrograph type	= Reach	Peak discharge	= 2.162 cfs
Storm frequency	= 100 yrs	Time to peak	= 734 min
Time interval	= 1 min	Hyd. volume	= 9,808 cuft
Inflow hyd. No.	= 27 - AREA K" - POST DEV	Section type	= Trapezoidal
Reach length	= 150.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.400	Bottom width	= 5.0 ft
Side slope	= 4.0:1	Max. depth	= 2.0 ft
Rating curve x	= 0.070	Rating curve m	= 1.257
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.0733

Modified Att-Kin routing method used.



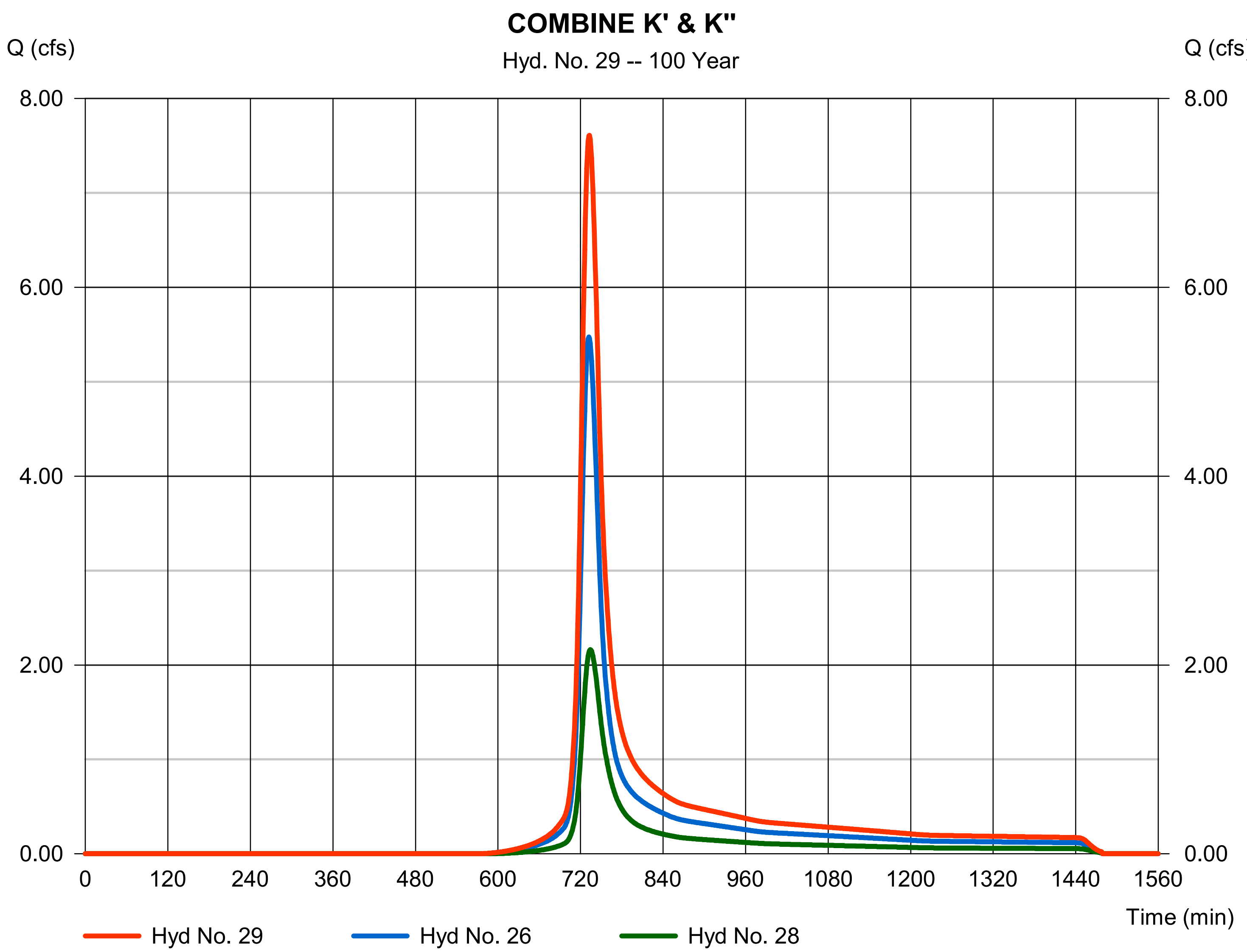
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 29

COMBINE K' & K''

Hydrograph type	= Combine	Peak discharge	= 7.611 cfs
Storm frequency	= 100 yrs	Time to peak	= 733 min
Time interval	= 1 min	Hyd. volume	= 31,333 cuft
Inflow hyds.	= 26, 28	Contrib. drain. area	= 0.000 ac



Hydrograph Report

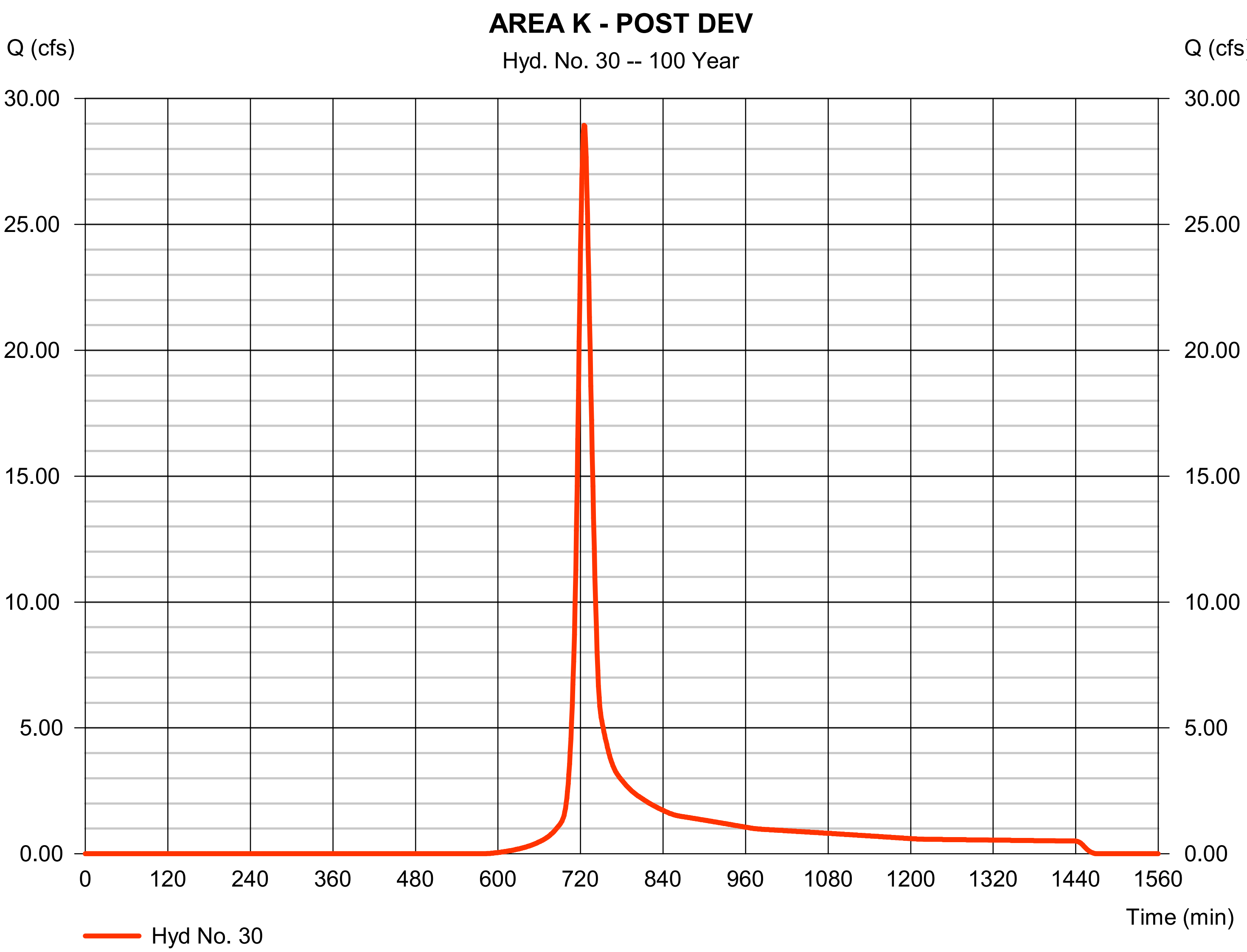
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 30

AREA K - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 28.94 cfs
Storm frequency	= 100 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 91,612 cuft
Drainage area	= 7.560 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 19.20 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.070 x 65) + (6.490 x 60)] / 7.560



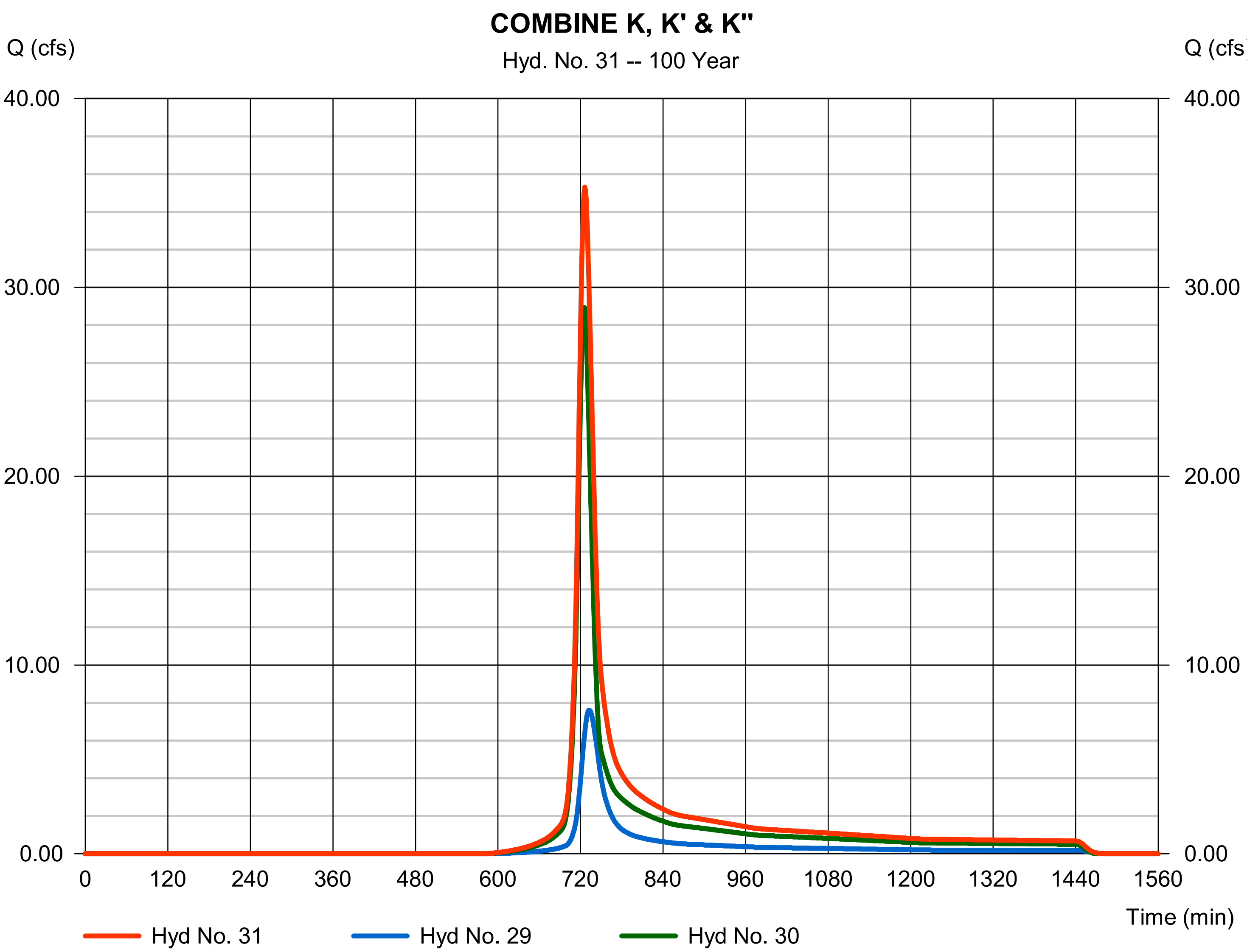
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 31

COMBINE K, K' & K"

Hydrograph type	= Combine	Peak discharge	= 35.31 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 1 min	Hyd. volume	= 122,946 cuft
Inflow hyds.	= 29, 30	Contrib. drain. area	= 7.560 ac



Hydrograph Report

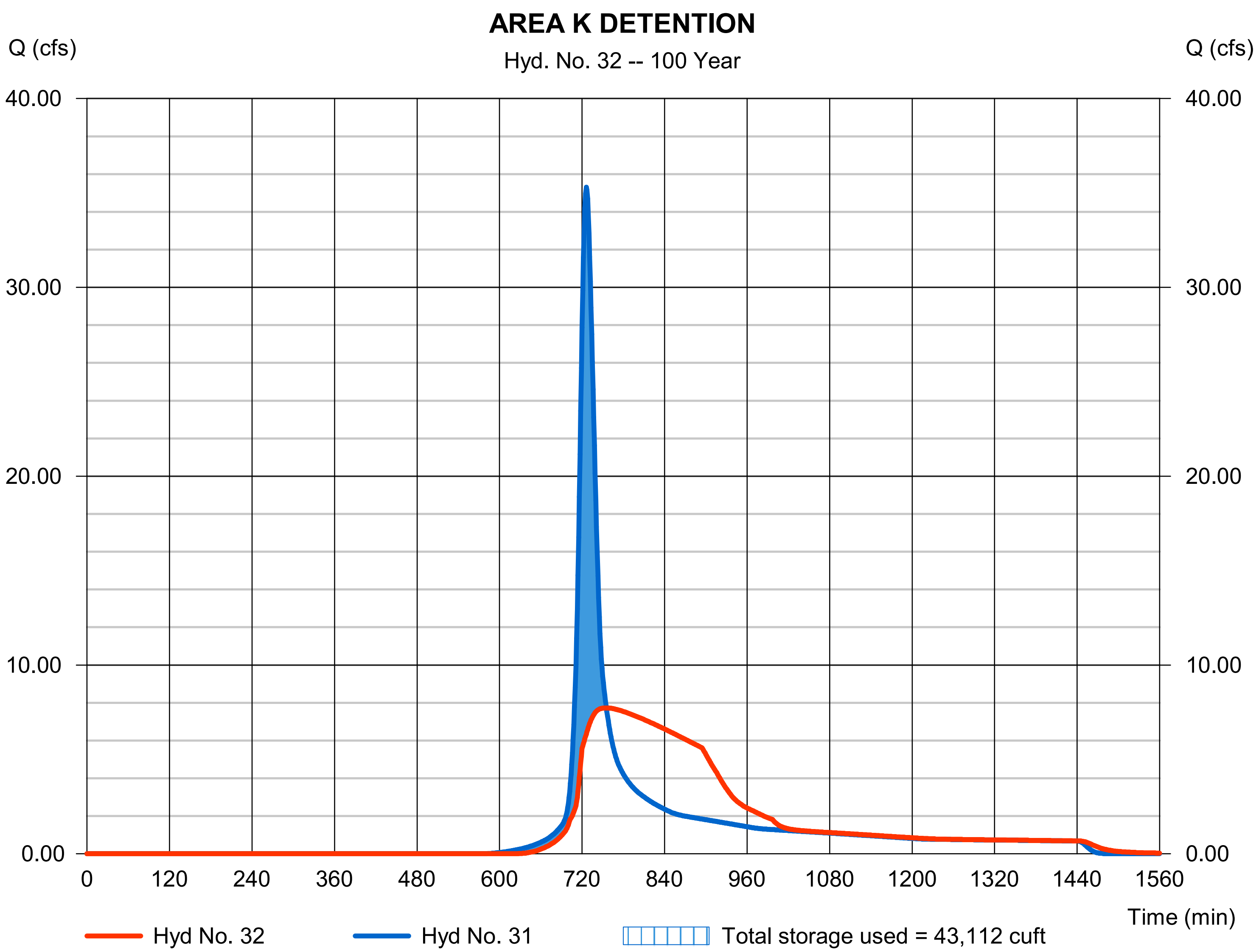
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 11 / 15 / 2018

Hyd. No. 32

AREA K DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 7.727 cfs
Storm frequency	= 100 yrs	Time to peak	= 755 min
Time interval	= 1 min	Hyd. volume	= 122,811 cuft
Inflow hyd. No.	= 31 - COMBINE K, K' & K"	Max. Elevation	= 582.87 ft
Reservoir name	= K DETENTION	Max. Storage	= 43,112 cuft

Storage Indication method used.



Hydrograph Report

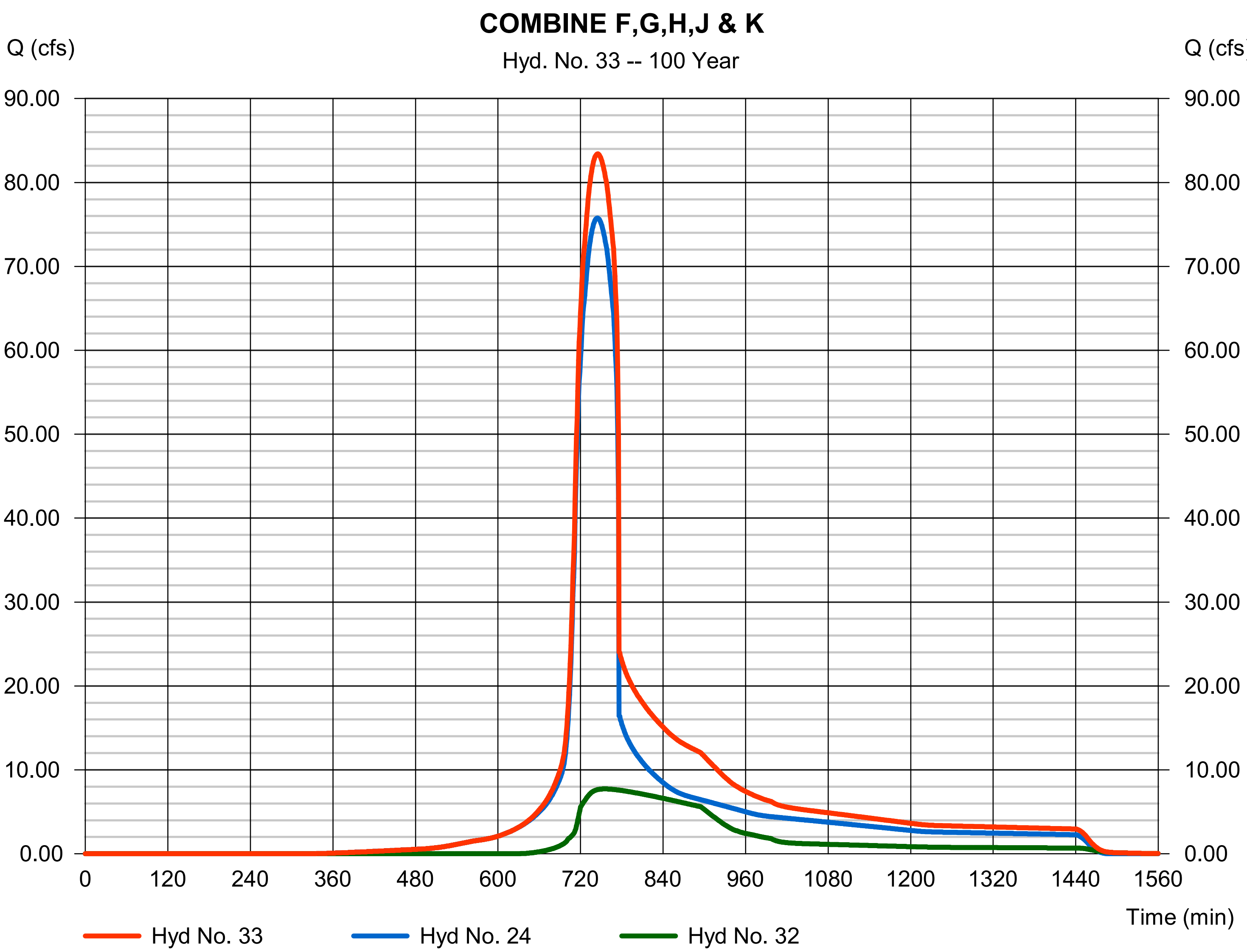
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Thursday, 11 / 15 / 2018

Hyd. No. 33

COMBINE F,G,H,J & K

Hydrograph type	= Combine	Peak discharge	= 83.41 cfs
Storm frequency	= 100 yrs	Time to peak	= 745 min
Time interval	= 1 min	Hyd. volume	= 619,122 cuft
Inflow hyds.	= 24, 32	Contrib. drain. area	= 0.000 ac



Hydrograph Report

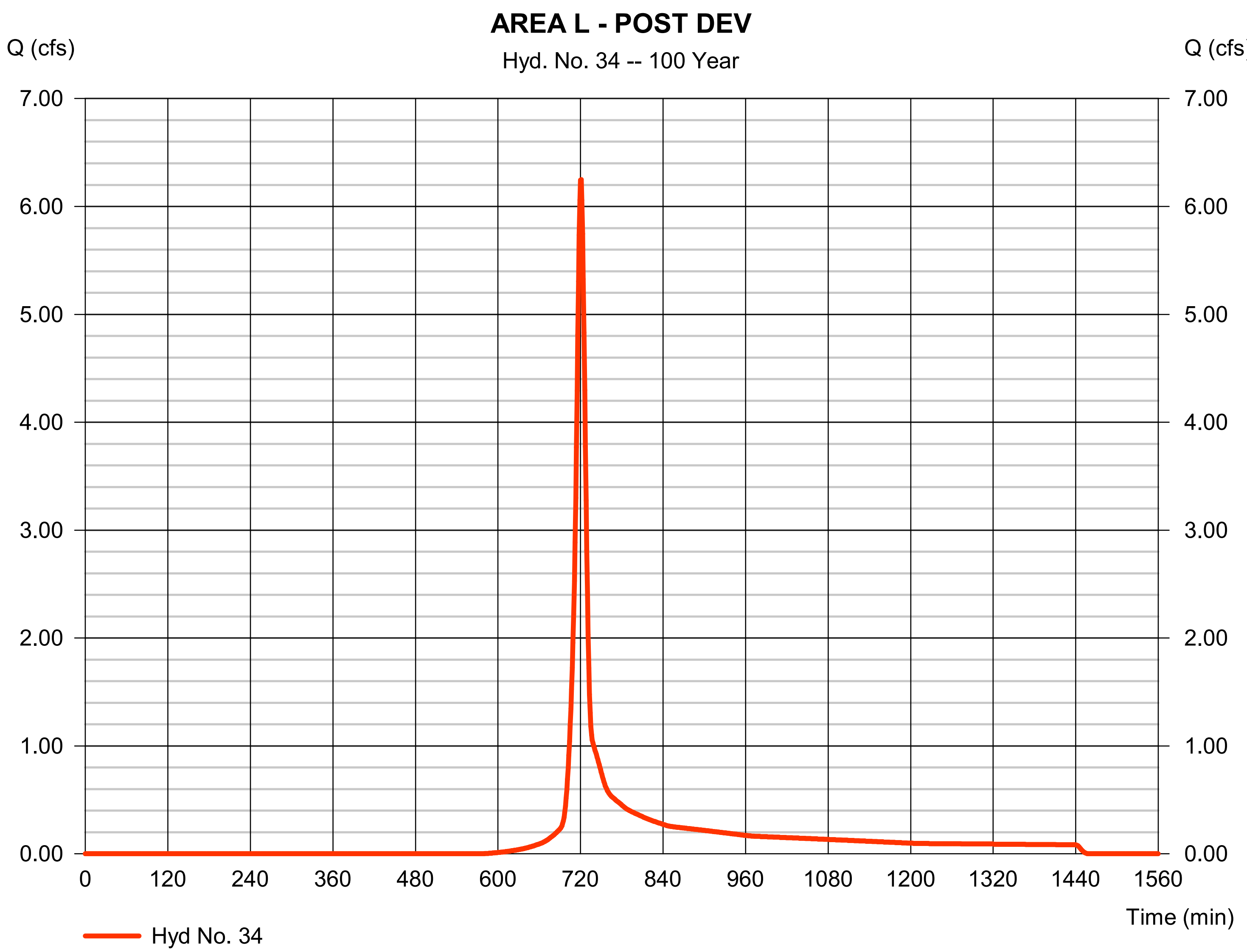
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 34

AREA L - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 6.249 cfs
Storm frequency	= 100 yrs	Time to peak	= 721 min
Time interval	= 1 min	Hyd. volume	= 15,171 cuft
Drainage area	= 1.230 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 10.20 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.230 x 65) + (1.000 x 60)] / 1.230



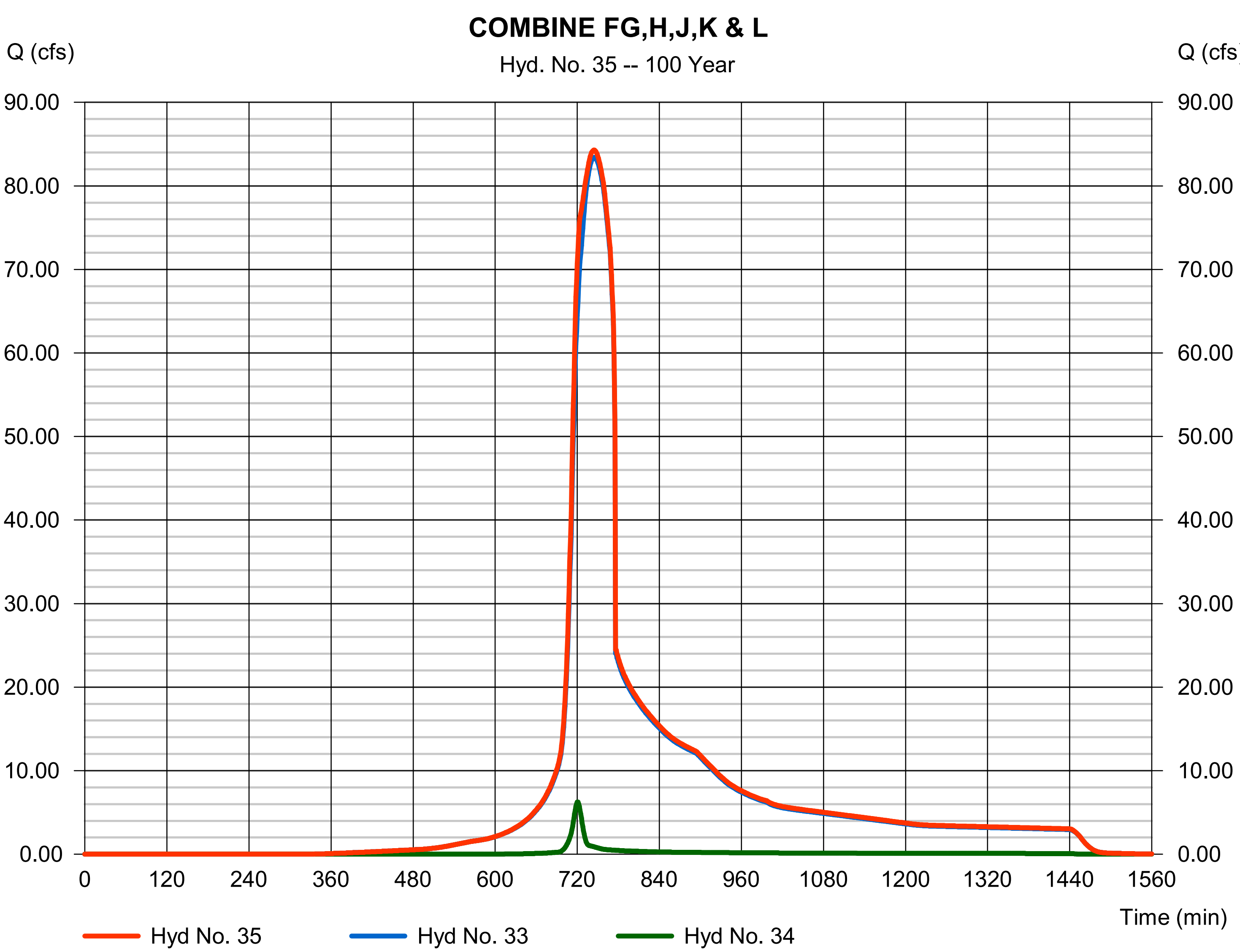
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 35

COMBINE FG,H,J,K & L

Hydrograph type	= Combine	Peak discharge	= 84.28 cfs
Storm frequency	= 100 yrs	Time to peak	= 744 min
Time interval	= 1 min	Hyd. volume	= 634,292 cuft
Inflow hyds.	= 33, 34	Contrib. drain. area	= 1.230 ac



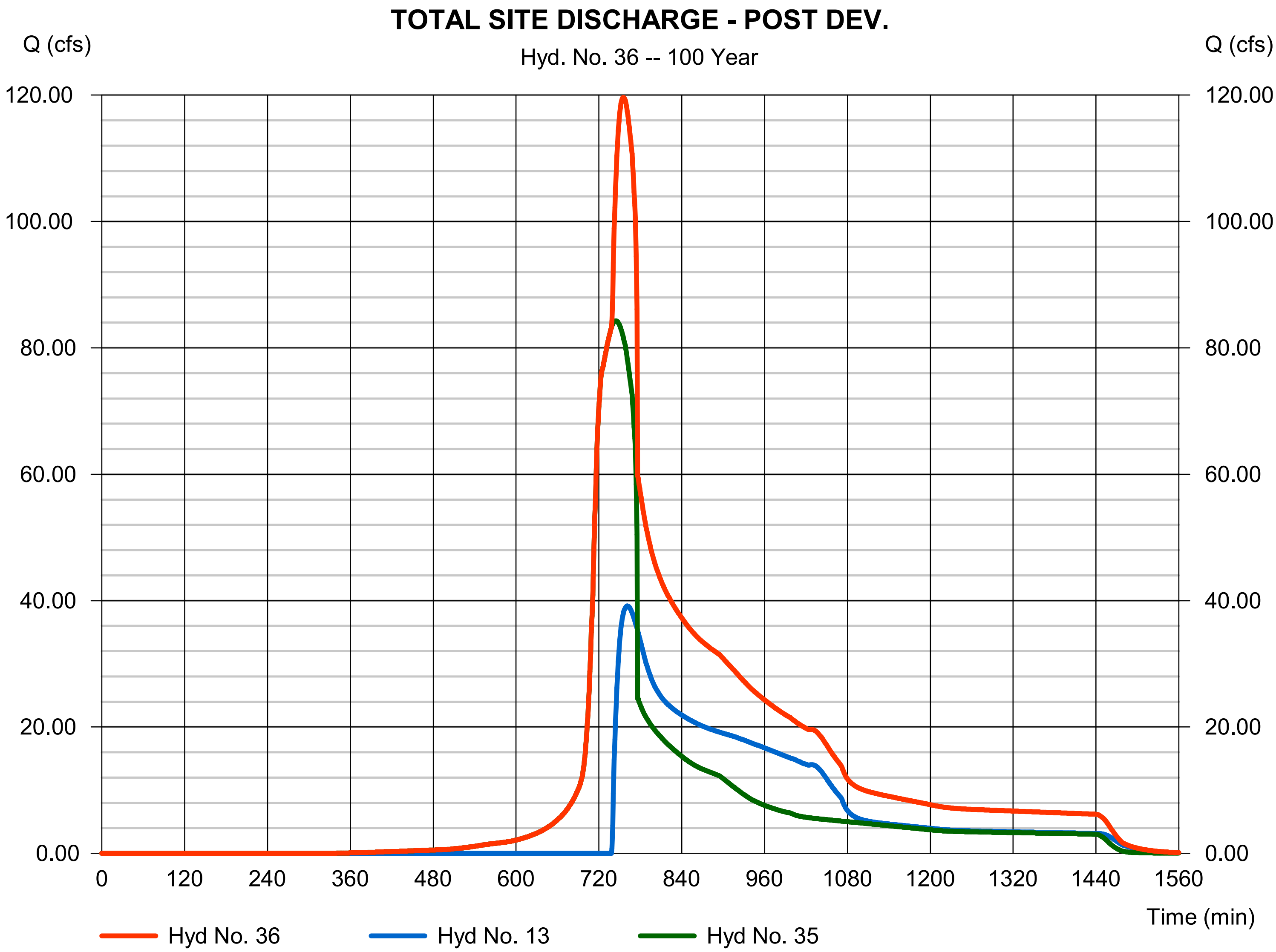
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 36

TOTAL SITE DISCHARGE - POST DEV.

Hydrograph type	= Combine	Peak discharge	= 119.63 cfs
Storm frequency	= 100 yrs	Time to peak	= 755 min
Time interval	= 1 min	Hyd. volume	= 1,133,910 cuft
Inflow hyds.	= 13, 35	Contrib. drain. area	= 0.000 ac



Pre- and Post-Development Ditch Calculations (HydraFlow Express)

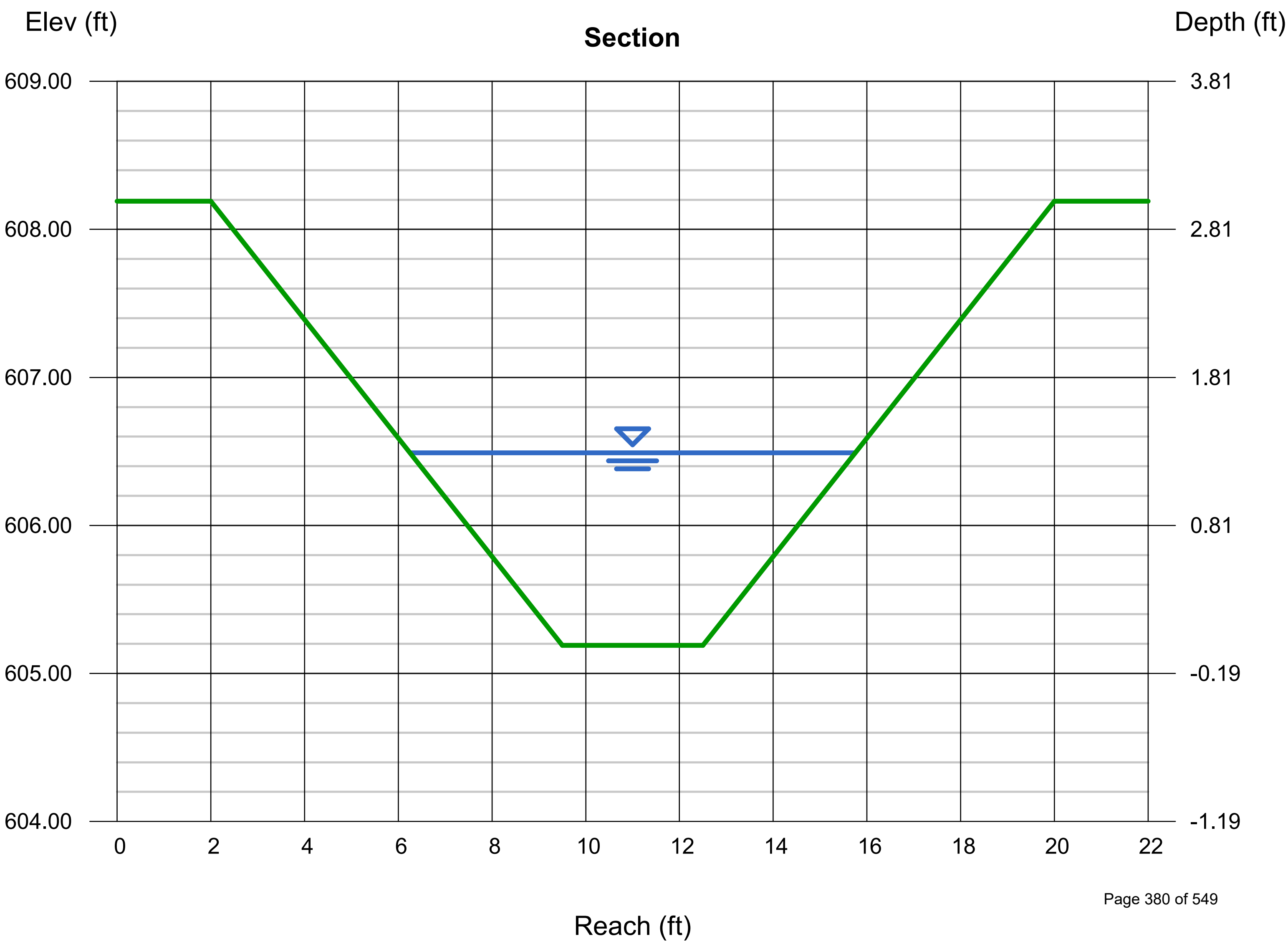
Channel Report

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

Saturday, Nov 10 2018

DITCH D-1 @ N 1550546, E 1942779 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.30
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 14.06
Total Depth (ft)	= 3.00	Area (sqft)	= 8.12
Invert Elev (ft)	= 605.19	Velocity (ft/s)	= 1.73
Slope (%)	= 1.00	Wetted Perim (ft)	= 10.00
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.72
		Top Width (ft)	= 9.50
Calculations		EGL (ft)	= 1.35
Compute by:	Known Q		
Known Q (cfs)	= 14.06		

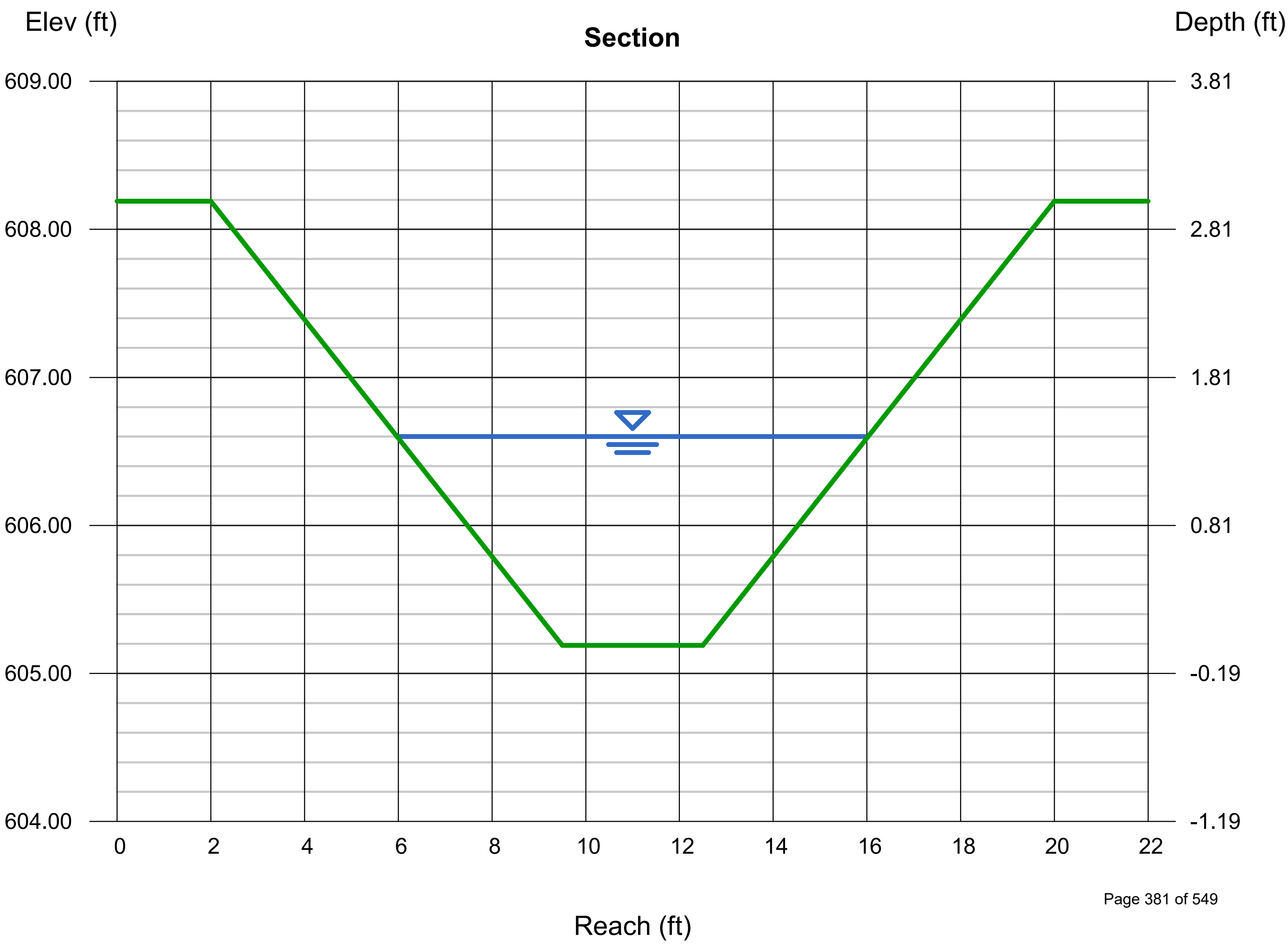


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH D-1 @ N 1550546, E 1942779 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.41
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 16.79
Total Depth (ft)	= 3.00	Area (sqft)	= 9.20
Invert Elev (ft)	= 605.19	Velocity (ft/s)	= 1.82
Slope (%)	= 1.00	Wetted Perim (ft)	= 10.59
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.80
		Top Width (ft)	= 10.05
Calculations		EGL (ft)	= 1.46
Compute by:	Known Q		
Known Q (cfs)	= 16.79		

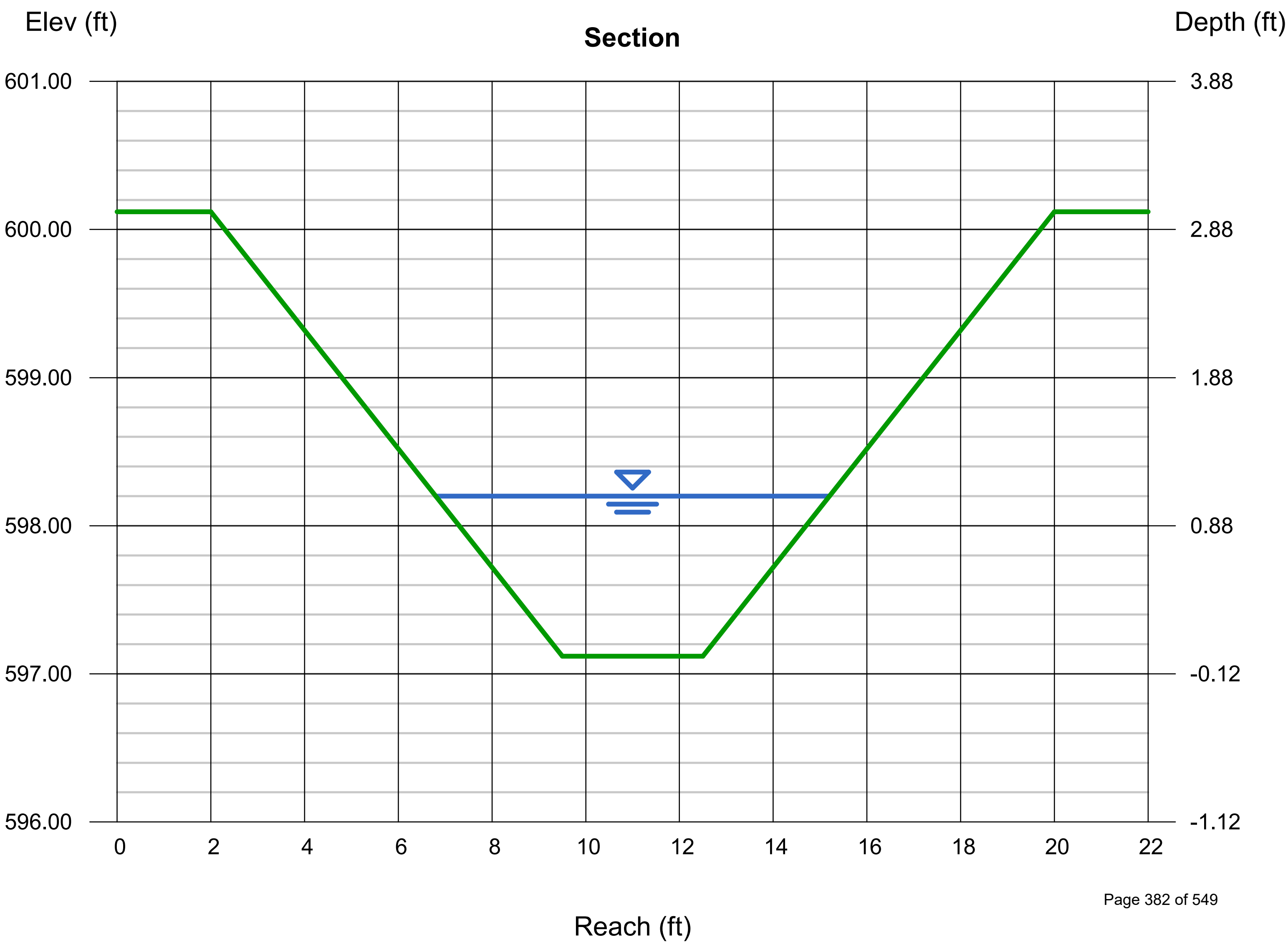


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH D-1A @ N 1550162, E 1942110 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.08
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 14.06
Total Depth (ft)	= 3.00	Area (sqft)	= 6.16
Invert Elev (ft)	= 597.12	Velocity (ft/s)	= 2.28
Slope (%)	= 2.10	Wetted Perim (ft)	= 8.82
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.72
		Top Width (ft)	= 8.40
Calculations		EGL (ft)	= 1.16
Compute by:	Known Q		
Known Q (cfs)	= 14.06		

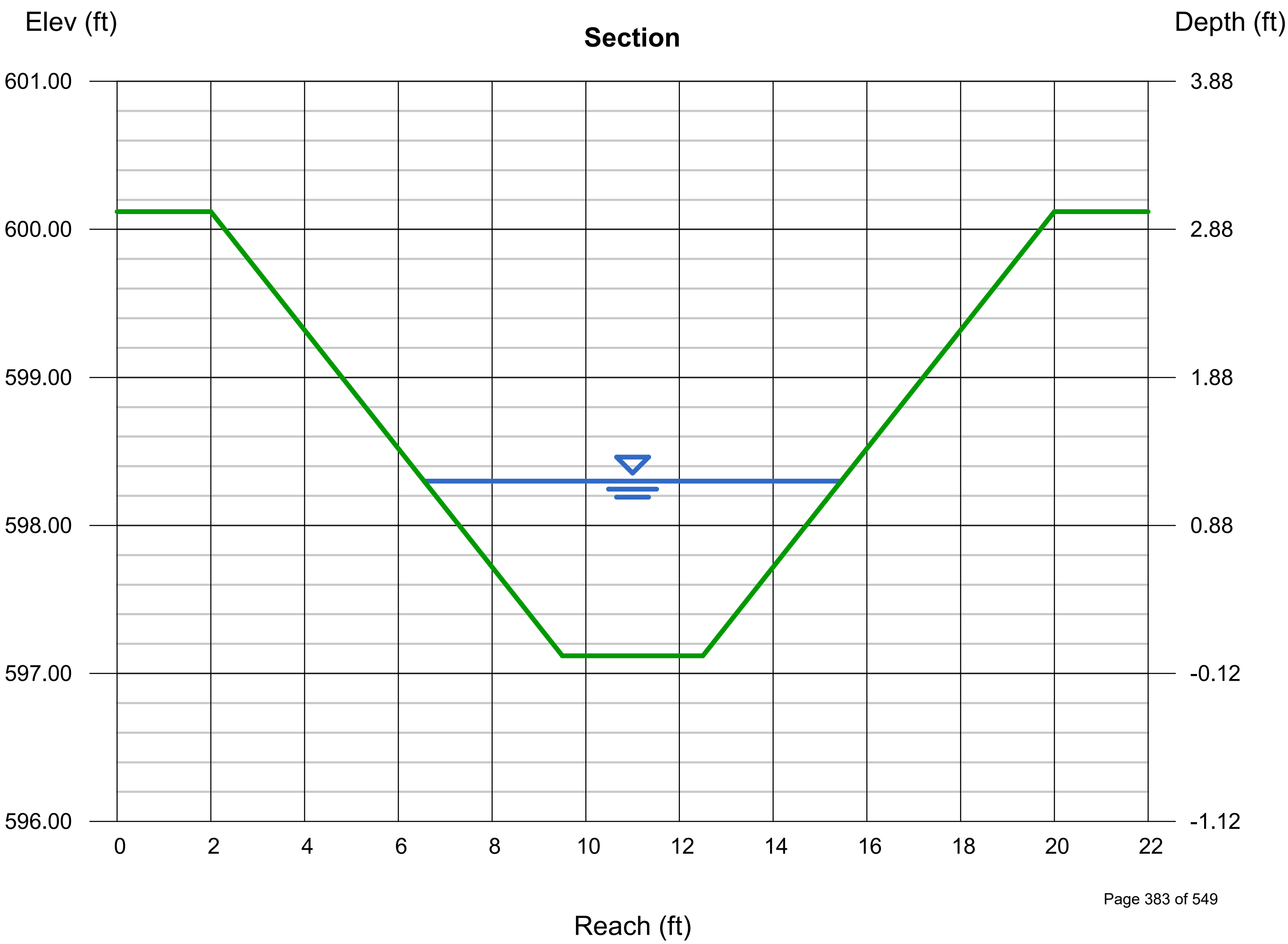


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH D-1A @ N 1550162, E 1942110 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.18
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 16.79
Total Depth (ft)	= 3.00	Area (sqft)	= 7.02
Invert Elev (ft)	= 597.12	Velocity (ft/s)	= 2.39
Slope (%)	= 2.10	Wetted Perim (ft)	= 9.35
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.80
		Top Width (ft)	= 8.90
Calculations		EGL (ft)	= 1.27
Compute by:	Known Q		
Known Q (cfs)	= 16.79		

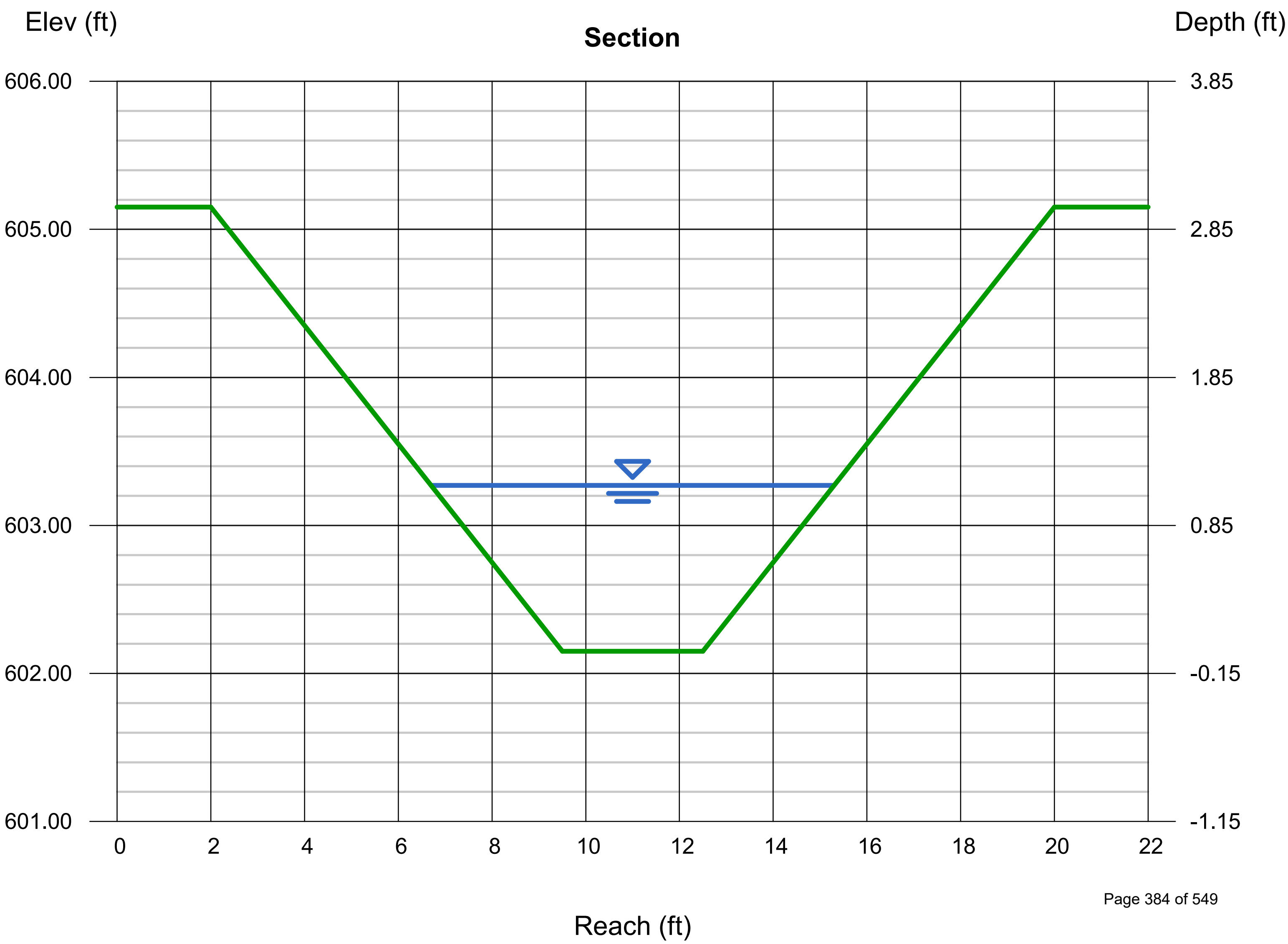


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH D-2 @ N 1550690, E 1942053 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.12
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 10.31
Total Depth (ft)	= 3.00	Area (sqft)	= 6.50
Invert Elev (ft)	= 602.15	Velocity (ft/s)	= 1.59
Slope (%)	= 1.00	Wetted Perim (ft)	= 9.03
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.61
		Top Width (ft)	= 8.60
Calculations		EGL (ft)	= 1.16
Compute by:	Known Q		
Known Q (cfs)	= 10.31		

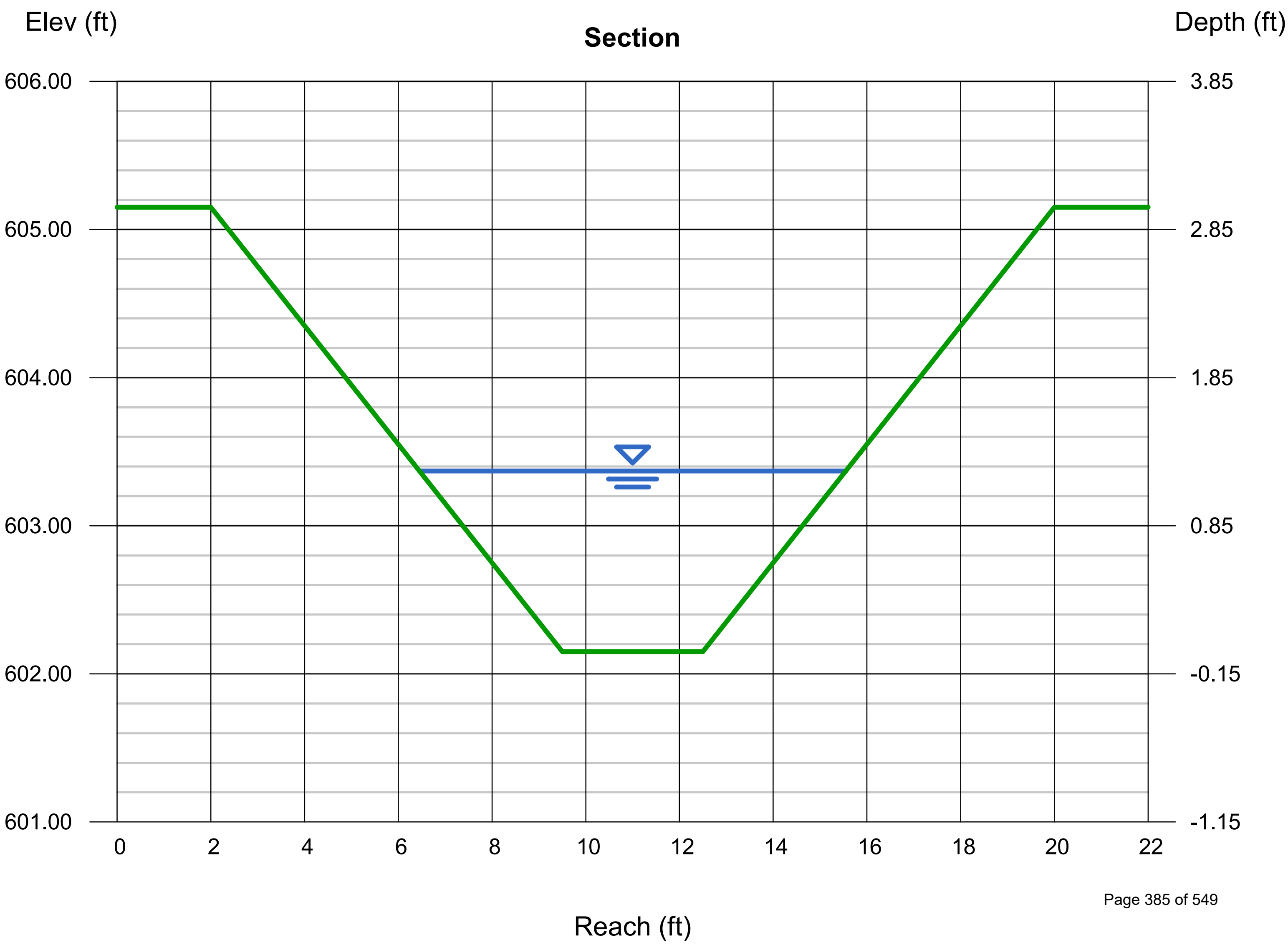


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH D-2 @ N 1550690, E 1942053 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.22
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 12.32
Total Depth (ft)	= 3.00	Area (sqft)	= 7.38
Invert Elev (ft)	= 602.15	Velocity (ft/s)	= 1.67
Slope (%)	= 1.00	Wetted Perim (ft)	= 9.57
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.67
		Top Width (ft)	= 9.10
Calculations		EGL (ft)	= 1.26
Compute by:	Known Q		
Known Q (cfs)	= 12.32		

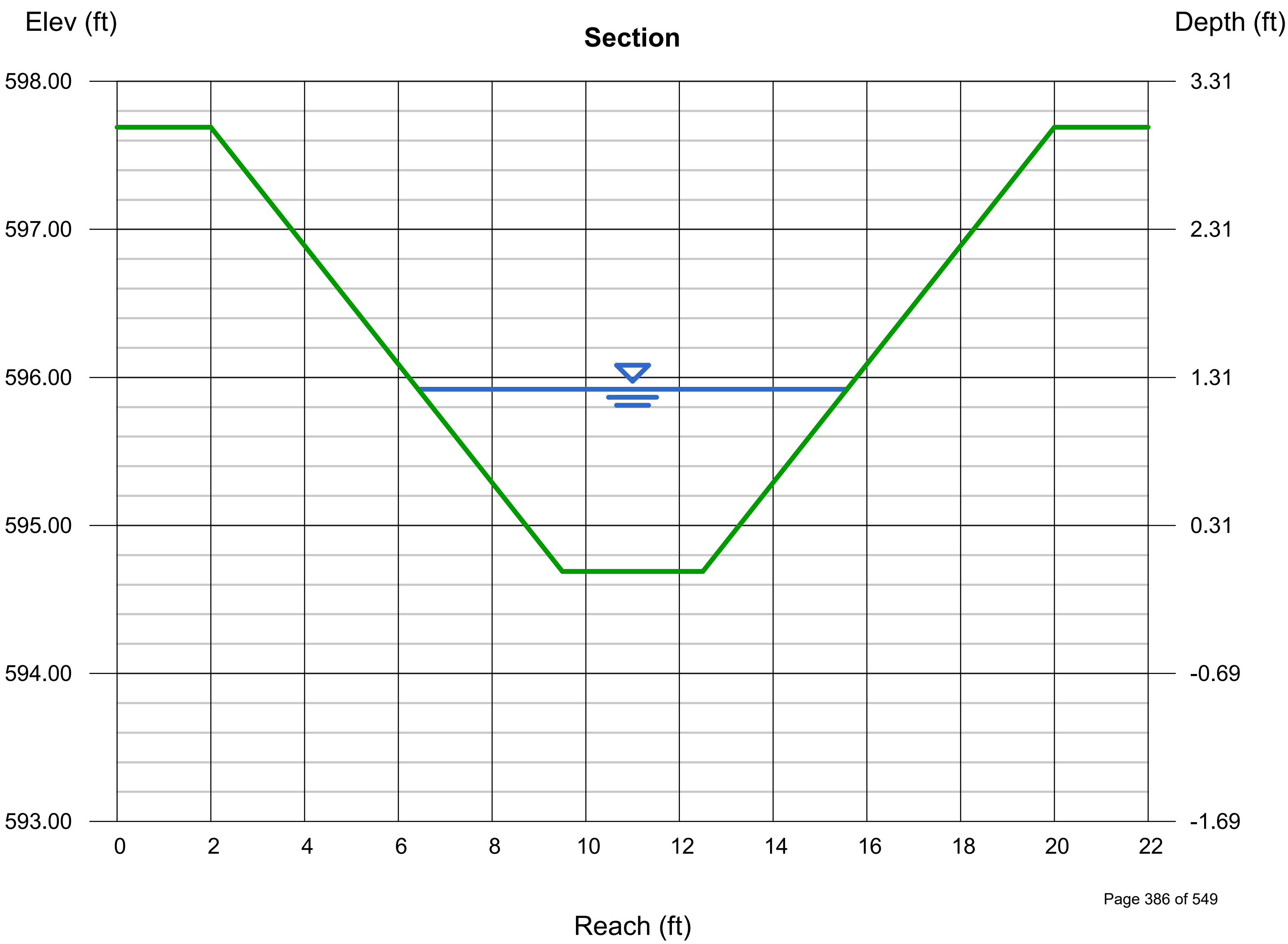


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH D-3 @ N 1550428, E 1942016 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.23
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 13.20
Total Depth (ft)	= 3.00	Area (sqft)	= 7.47
Invert Elev (ft)	= 594.69	Velocity (ft/s)	= 1.77
Slope (%)	= 1.10	Wetted Perim (ft)	= 9.62
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.70
		Top Width (ft)	= 9.15
Calculations		EGL (ft)	= 1.28
Compute by:	Known Q		
Known Q (cfs)	= 13.20		

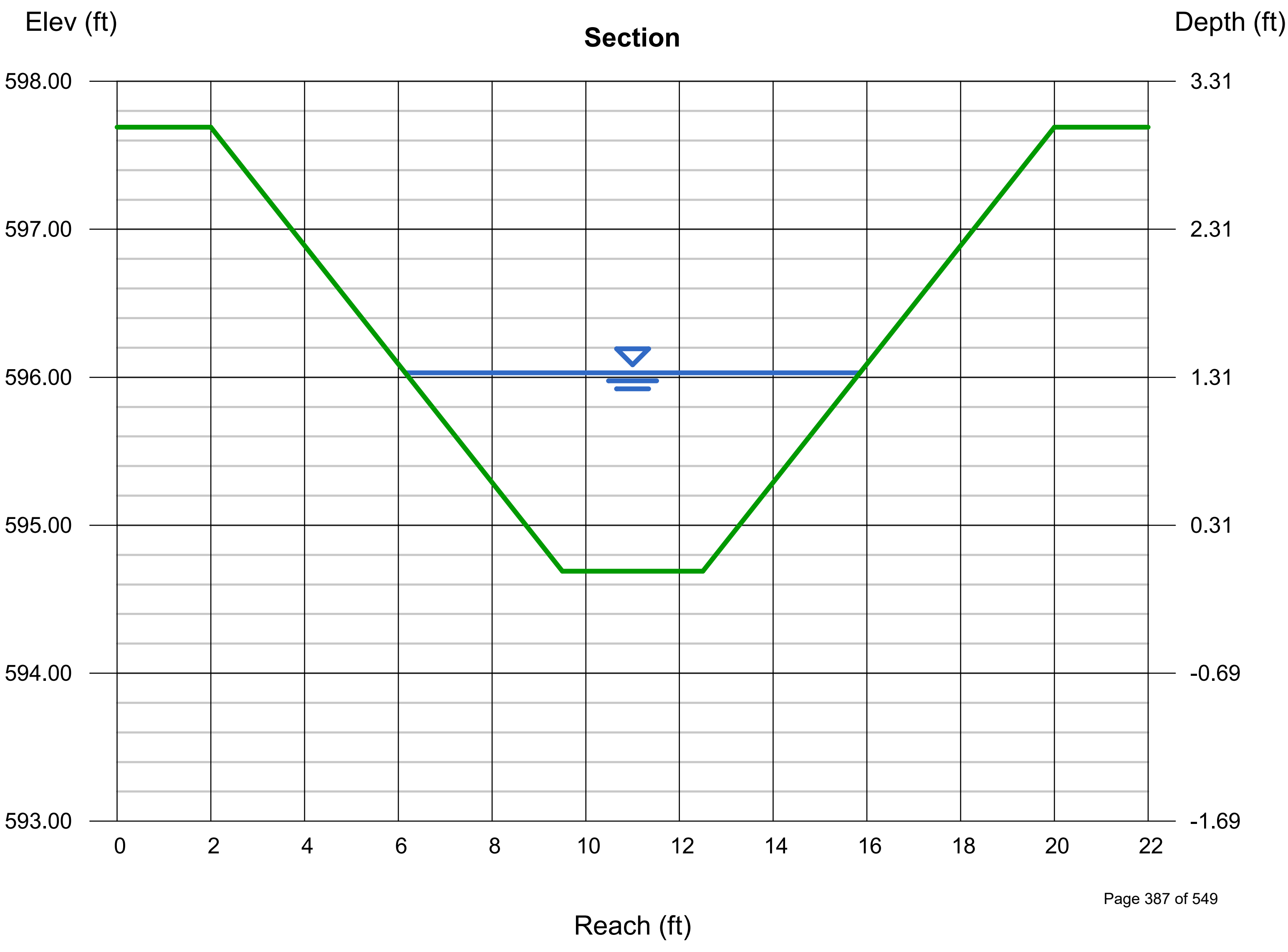


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH D-3 @ N 1550428, E 1942016 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.34
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 15.76
Total Depth (ft)	= 3.00	Area (sqft)	= 8.51
Invert Elev (ft)	= 594.69	Velocity (ft/s)	= 1.85
Slope (%)	= 1.10	Wetted Perim (ft)	= 10.22
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.77
		Top Width (ft)	= 9.70
Calculations		EGL (ft)	= 1.39
Compute by:	Known Q		
Known Q (cfs)	= 15.76		

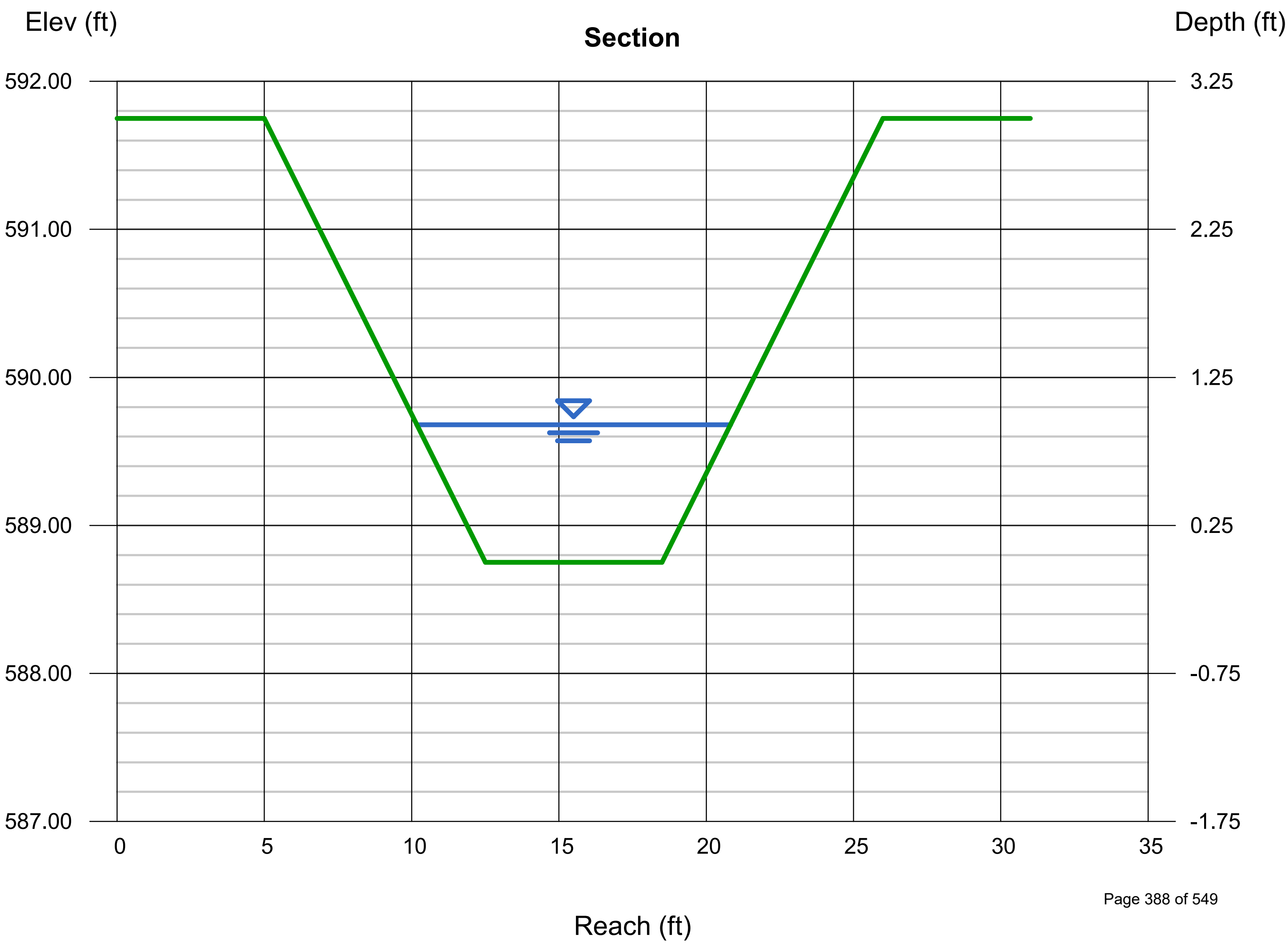


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

Ditch D-4 @ N 1550287, E 1942015 (25 YR)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.93
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 27.26
Total Depth (ft)	= 3.00	Area (sqft)	= 7.74
Invert Elev (ft)	= 588.75	Velocity (ft/s)	= 3.52
Slope (%)	= 5.00	Wetted Perim (ft)	= 11.01
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.78
		Top Width (ft)	= 10.65
Calculations		EGL (ft)	= 1.12
Compute by:	Known Q		
Known Q (cfs)	= 27.26		

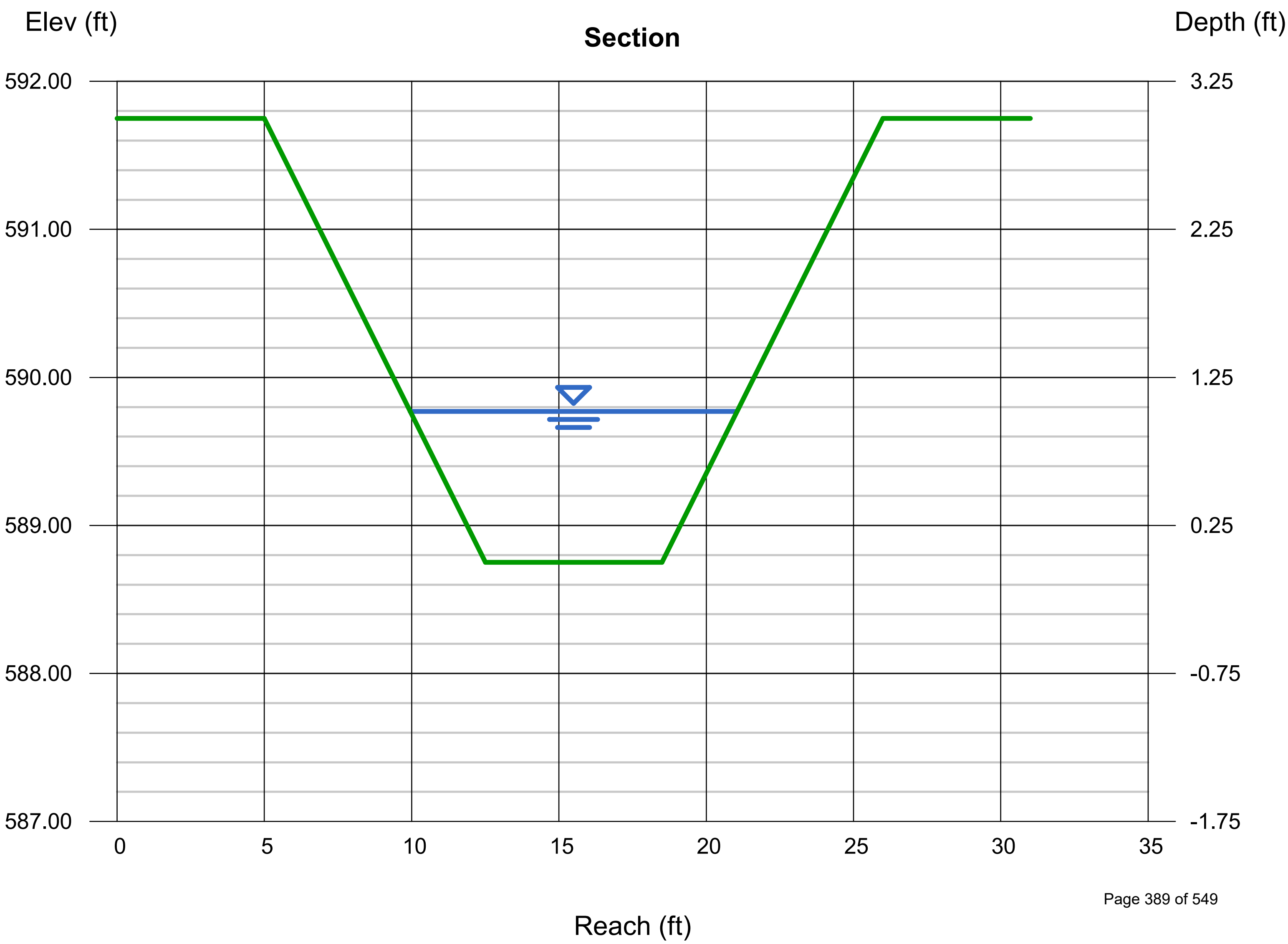


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

Ditch D-4 @ N 1550287, E 1942015 (100 YR)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 1.02
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 32.55
Total Depth (ft)	= 3.00	Area (sqft)	= 8.72
Invert Elev (ft)	= 588.75	Velocity (ft/s)	= 3.73
Slope (%)	= 5.00	Wetted Perim (ft)	= 11.49
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.86
		Top Width (ft)	= 11.10
Calculations		EGL (ft)	= 1.24
Compute by:	Known Q		
Known Q (cfs)	= 32.55		



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

Ditch D-5 @ N 1,550,254, E 1,941,901 (25 YR.)

Trapezoidal

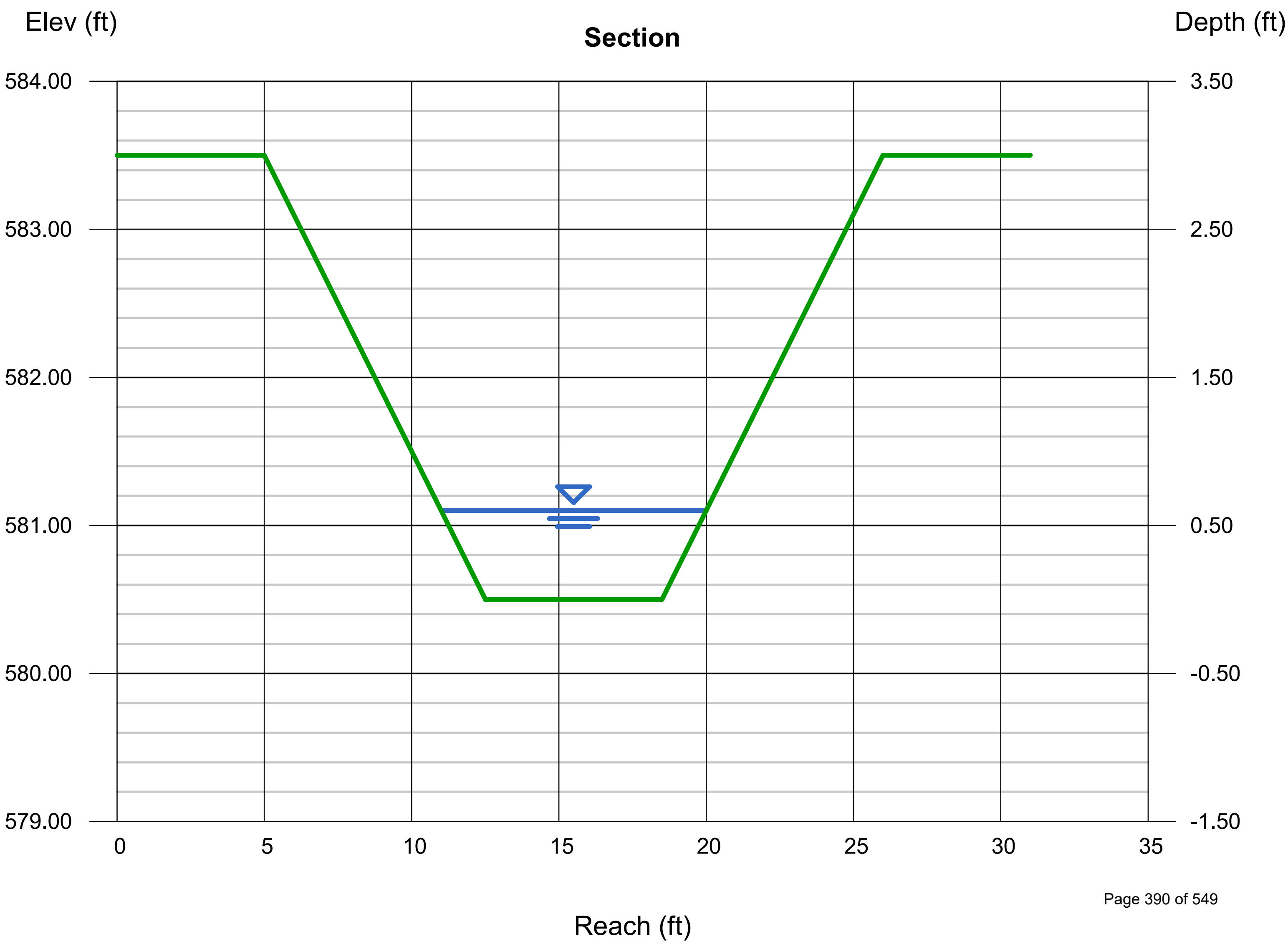
Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 2.50, 2.50
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 580.50
Slope (%)	= 25.00
N-Value	= 0.074

Calculations

Compute by:	Known Q
Known Q (cfs)	= 27.26

Highlighted

Depth (ft)	= 0.60
Q (cfs)	= 27.26
Area (sqft)	= 4.50
Velocity (ft/s)	= 6.06
Wetted Perim (ft)	= 9.23
Crit Depth, Yc (ft)	= 0.78
Top Width (ft)	= 9.00
EGL (ft)	= 1.17



Channel Report

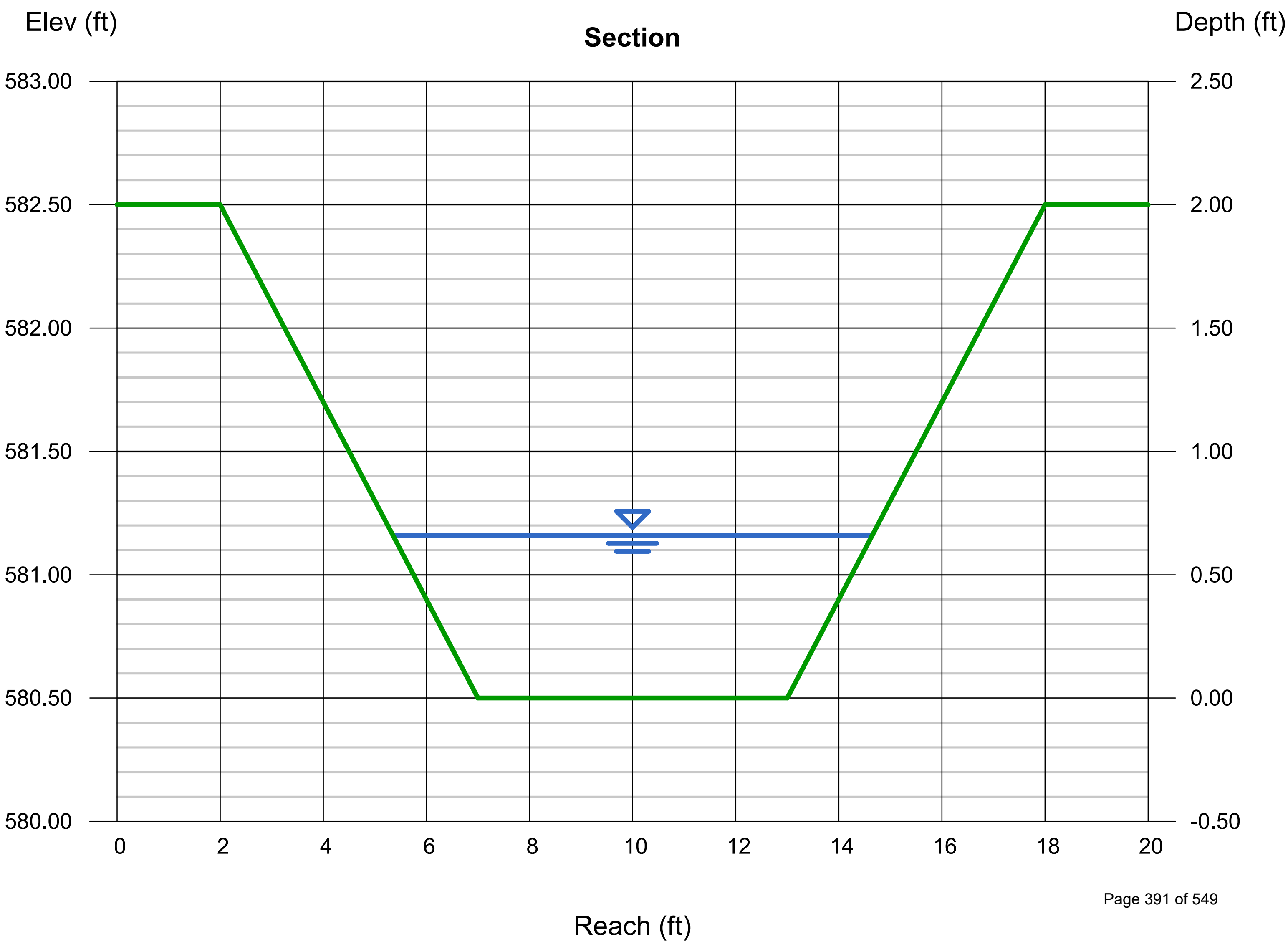
Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Nov 14 2018

Ditch D-5 @ N 1,550,254, E 1,941,901 (100 YR.)

Trapezoidal	
Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 2.50, 2.50
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 580.50
Slope (%)	= 25.00
N-Value	= 0.074

Calculations	
Compute by:	Known Q
Known Q (cfs)	= 32.55

Highlighted	
Depth (ft)	= 0.66
Q (cfs)	= 32.55
Area (sqft)	= 5.05
Velocity (ft/s)	= 6.45
Wetted Perim (ft)	= 9.55
Crit Depth, Yc (ft)	= 0.86
Top Width (ft)	= 9.30
EGL (ft)	= 1.31



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

Ditch D-6 @ N 1550245, E 1941869 (25 YR.)

Trapezoidal

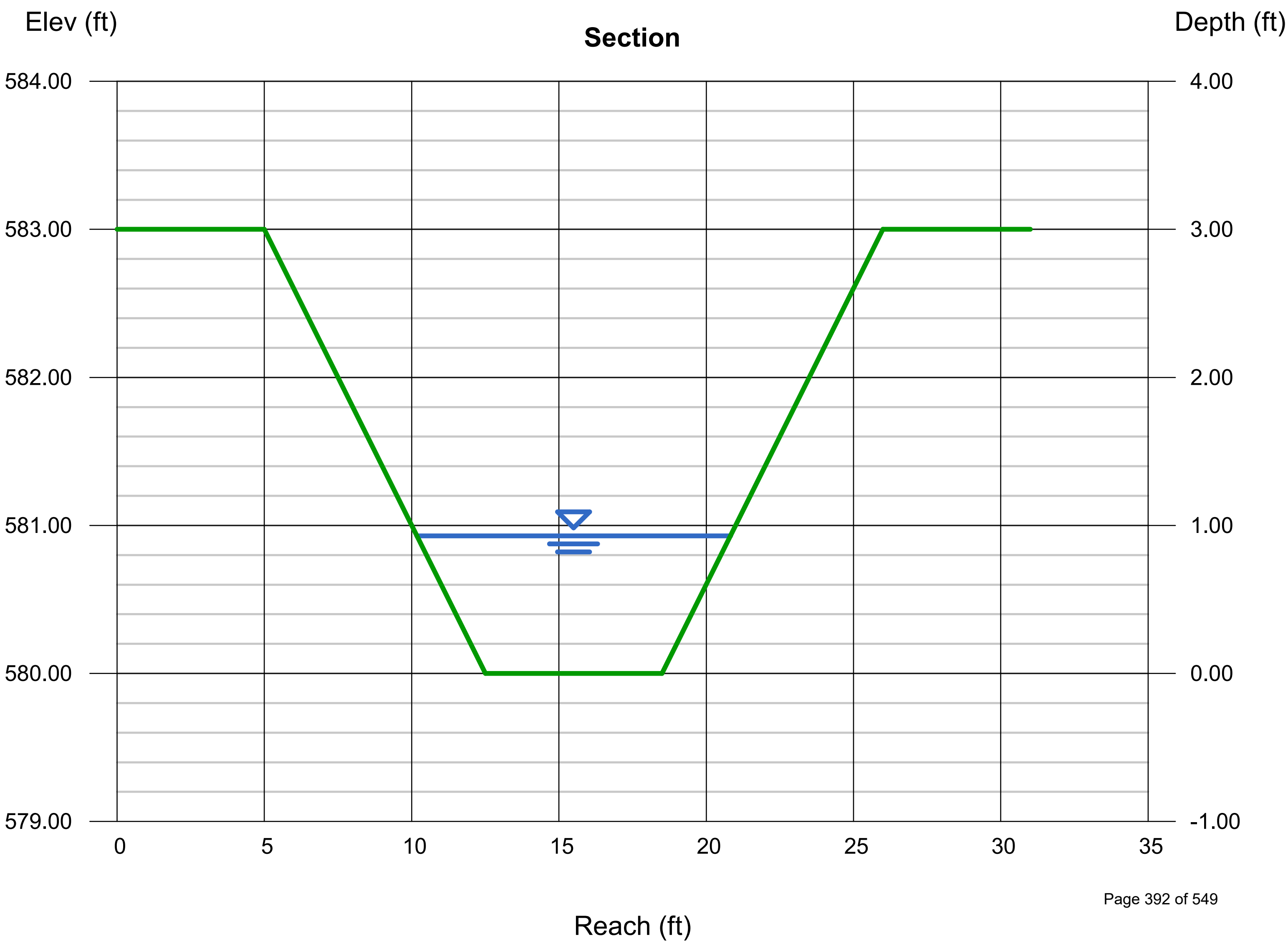
Bottom Width (ft)	=	6.00
Side Slopes (z:1)	=	2.50, 2.50
Total Depth (ft)	=	3.00
Invert Elev (ft)	=	580.00
Slope (%)	=	5.00
N-Value	=	0.074

Calculations

Compute by:		Known Q
Known Q (cfs)	=	27.26

Highlighted

Depth (ft)	=	0.93
Q (cfs)	=	27.26
Area (sqft)	=	7.74
Velocity (ft/s)	=	3.52
Wetted Perim (ft)	=	11.01
Crit Depth, Yc (ft)	=	0.78
Top Width (ft)	=	10.65
EGL (ft)	=	1.12

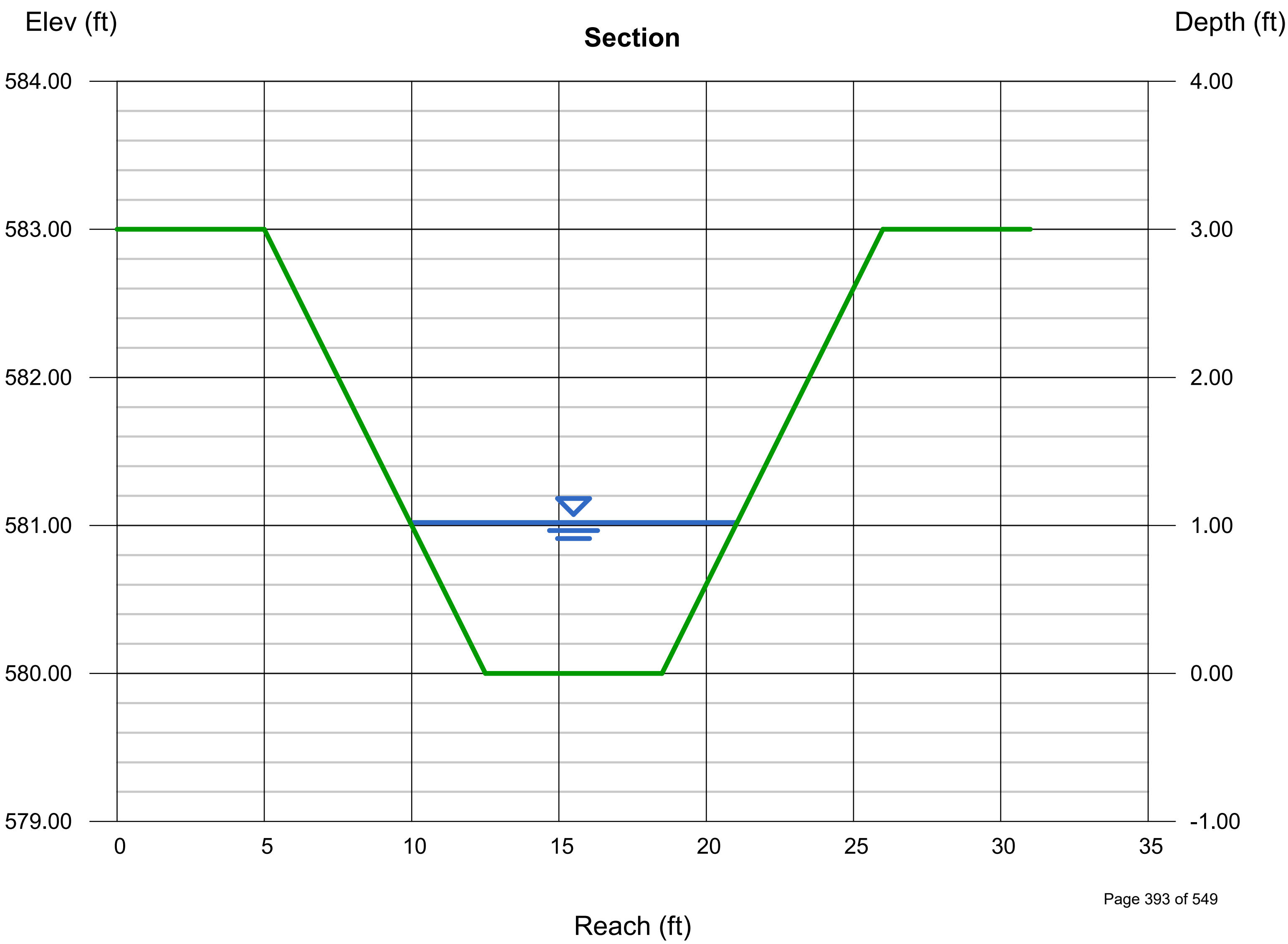


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

Ditch D-6 @ N 1550245, E 1941869 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 1.02
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 32.55
Total Depth (ft)	= 3.00	Area (sqft)	= 8.72
Invert Elev (ft)	= 580.00	Velocity (ft/s)	= 3.73
Slope (%)	= 5.00	Wetted Perim (ft)	= 11.49
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.86
		Top Width (ft)	= 11.10
Calculations		EGL (ft)	= 1.24
Compute by:	Known Q		
Known Q (cfs)	= 32.55		

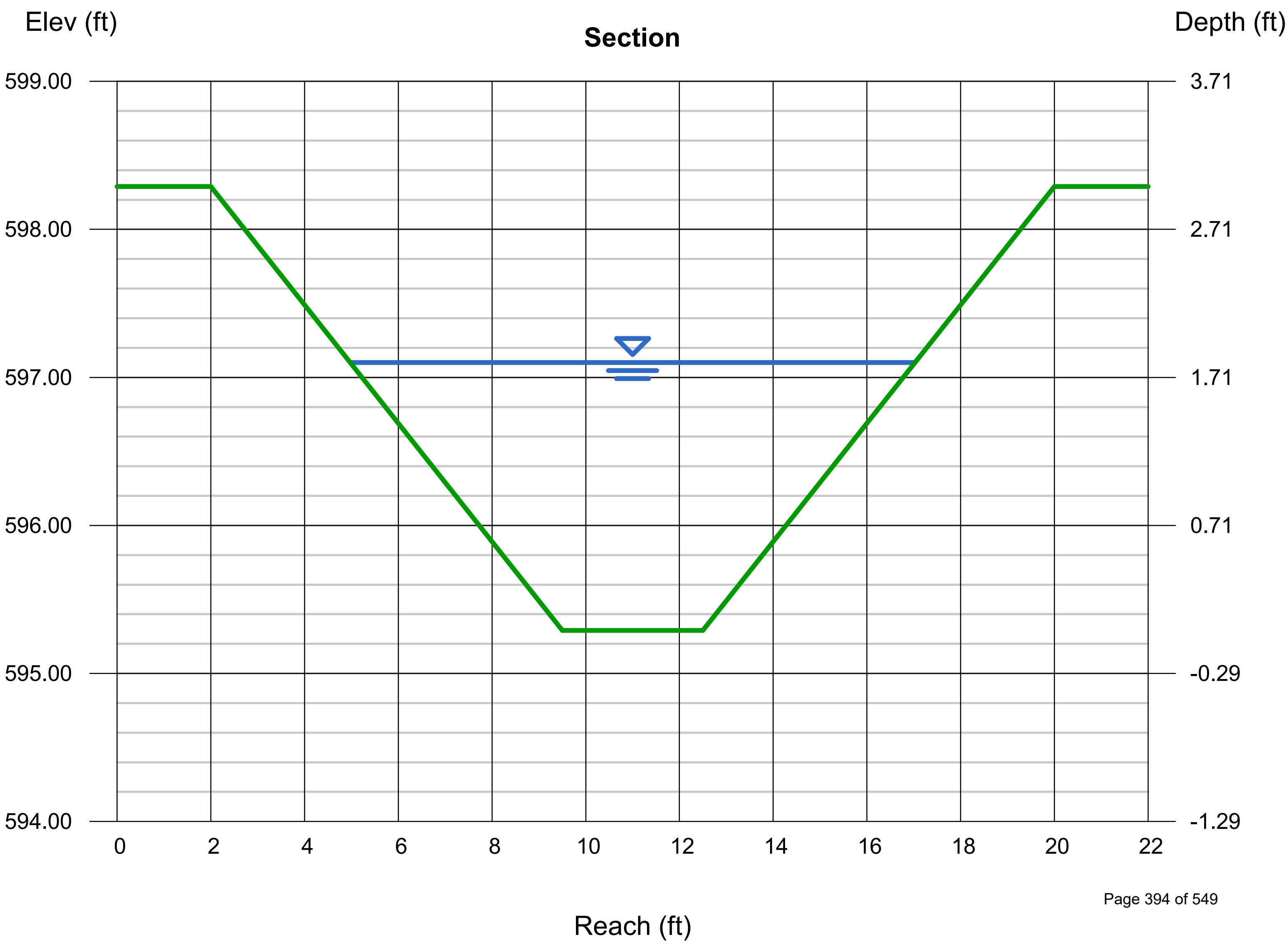


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-1 @ N 1550548, E 1942777 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.81
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 28.58
Total Depth (ft)	= 3.00	Area (sqft)	= 13.62
Invert Elev (ft)	= 595.29	Velocity (ft/s)	= 2.10
Slope (%)	= 1.00	Wetted Perim (ft)	= 12.75
N-Value	= 0.074	Crit Depth, Yc (ft)	= 1.06
		Top Width (ft)	= 12.05
Calculations		EGL (ft)	= 1.88
Compute by:	Known Q		
Known Q (cfs)	= 28.58		



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-1 @ N 1550548, E 1942777 (100 YR.)

Trapezoidal

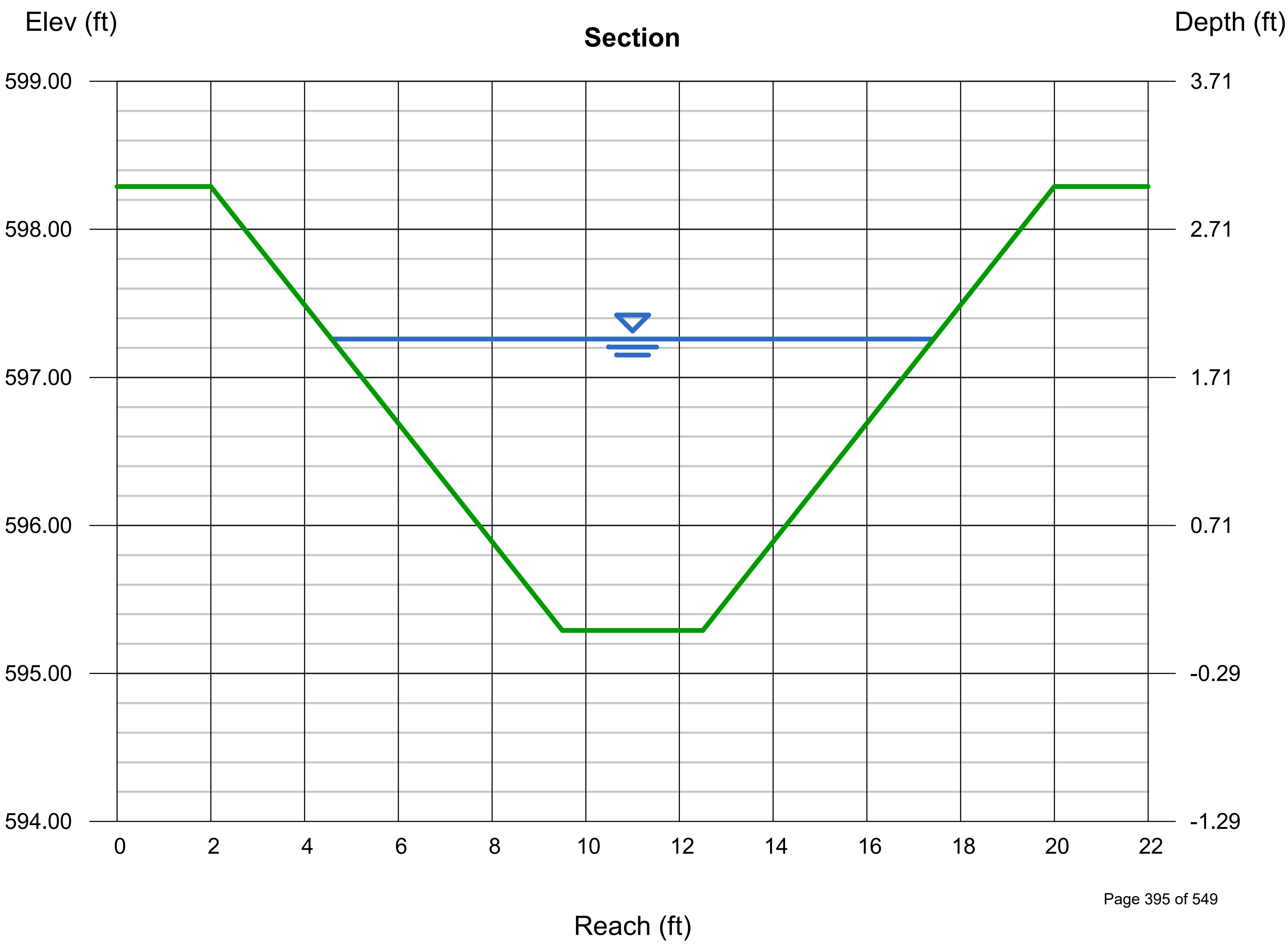
Bottom Width (ft)	= 3.00
Side Slopes (z:1)	= 2.50, 2.50
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 595.29
Slope (%)	= 1.00
N-Value	= 0.074

Calculations

Compute by:	Known Q
Known Q (cfs)	= 34.14

Highlighted

Depth (ft)	= 1.97
Q (cfs)	= 34.14
Area (sqft)	= 15.61
Velocity (ft/s)	= 2.19
Wetted Perim (ft)	= 13.61
Crit Depth, Yc (ft)	= 1.16
Top Width (ft)	= 12.85
EGL (ft)	= 2.04

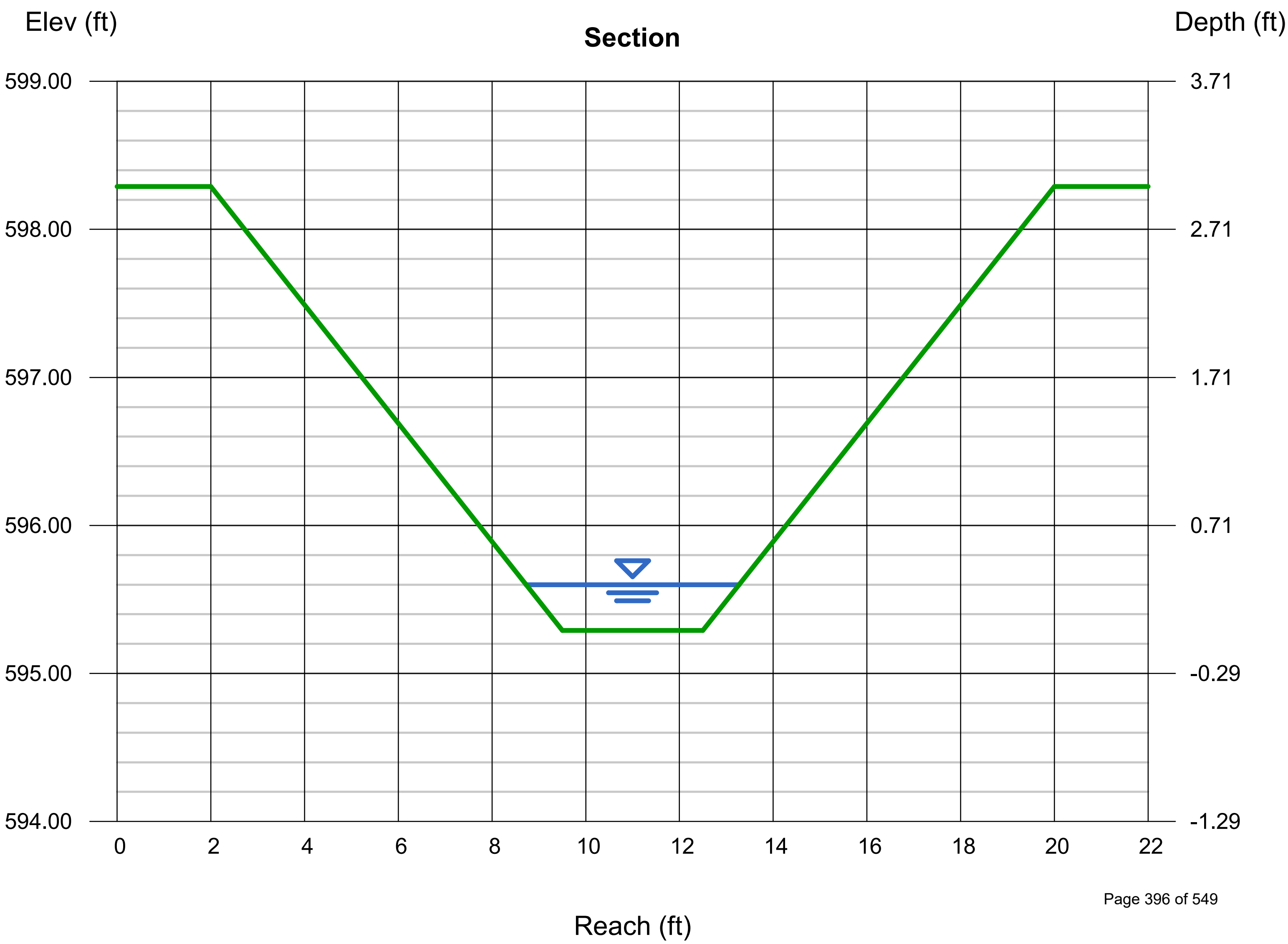


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.   Saturday, Nov 10 2018

DITCH F-2 @ N 1551498, E 1942496 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 0.31
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 2.090
Total Depth (ft)	= 3.00	Area (sqft)	= 1.17
Invert Elev (ft)	= 595.29	Velocity (ft/s)	= 1.79
Slope (%)	= 5.37	Wetted Perim (ft)	= 4.67
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.24
		Top Width (ft)	= 4.55
Calculations		EGL (ft)	= 0.36
Compute by:	Known Q		
Known Q (cfs)	= 2.09		

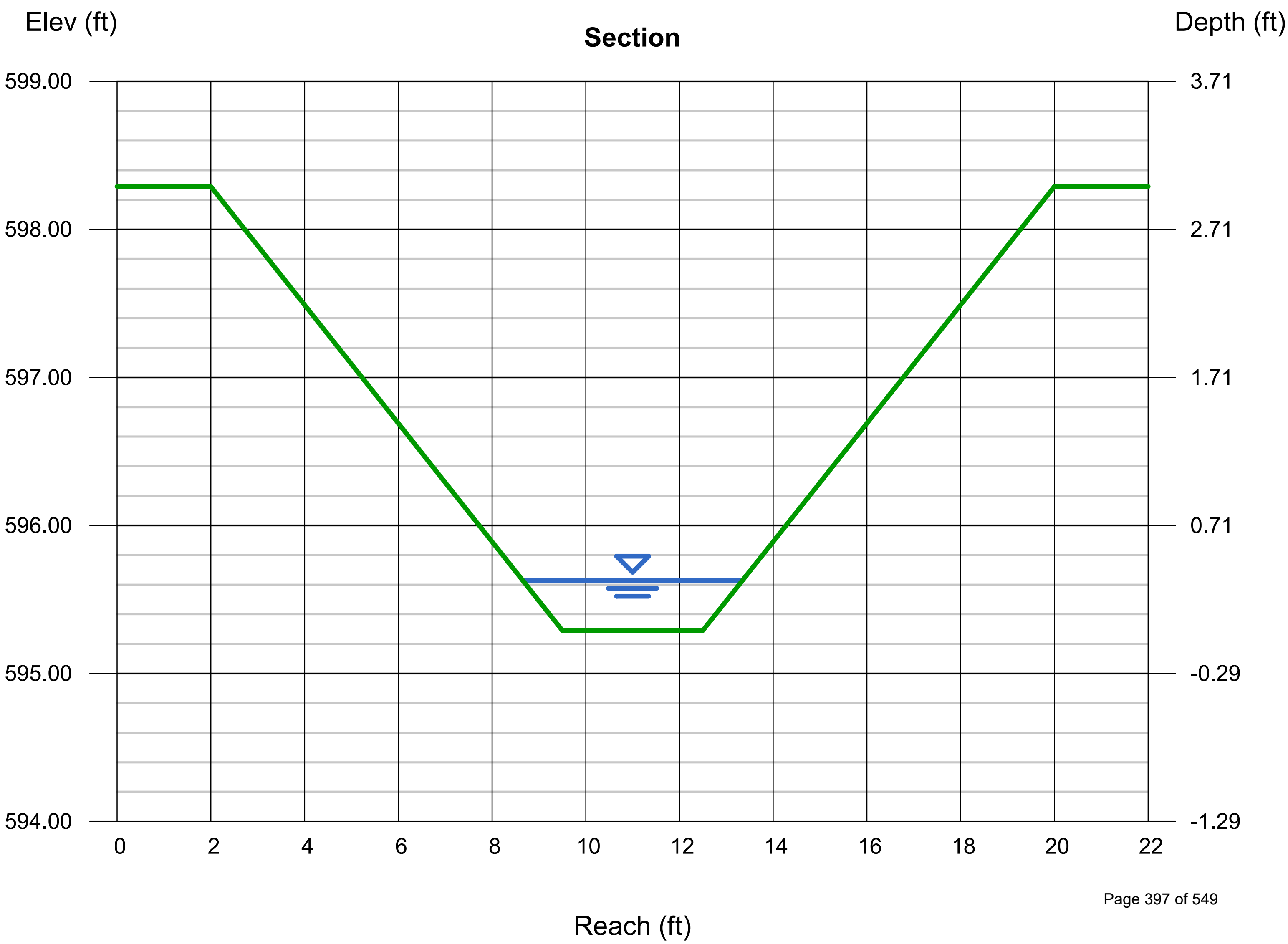


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-2 @ N 1551498, E 1942496 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 0.34
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 2.490
Total Depth (ft)	= 3.00	Area (sqft)	= 1.31
Invert Elev (ft)	= 595.29	Velocity (ft/s)	= 1.90
Slope (%)	= 5.37	Wetted Perim (ft)	= 4.83
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.26
		Top Width (ft)	= 4.70
Calculations		EGL (ft)	= 0.40
Compute by:	Known Q		
Known Q (cfs)	= 2.49		

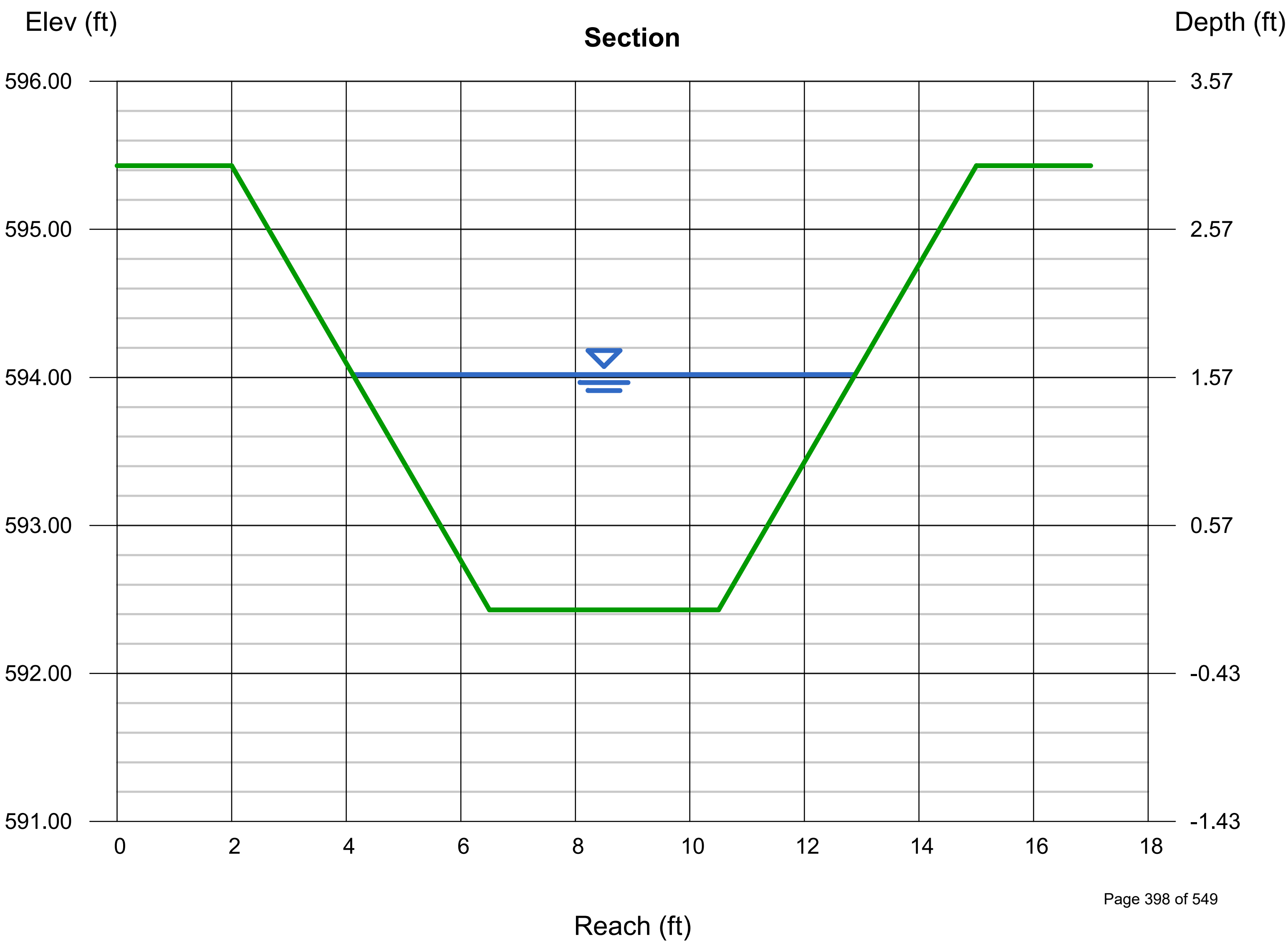


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-3 @ N 1551517, E 1942670 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 1.59
Side Slopes (z:1)	= 1.50, 1.50	Q (cfs)	= 30.67
Total Depth (ft)	= 3.00	Area (sqft)	= 10.15
Invert Elev (ft)	= 592.43	Velocity (ft/s)	= 3.02
Slope (%)	= 1.00	Wetted Perim (ft)	= 9.73
N-Value	= 0.050	Crit Depth, Yc (ft)	= 1.07
		Top Width (ft)	= 8.77
Calculations		EGL (ft)	= 1.73
Compute by:	Known Q		
Known Q (cfs)	= 30.67		

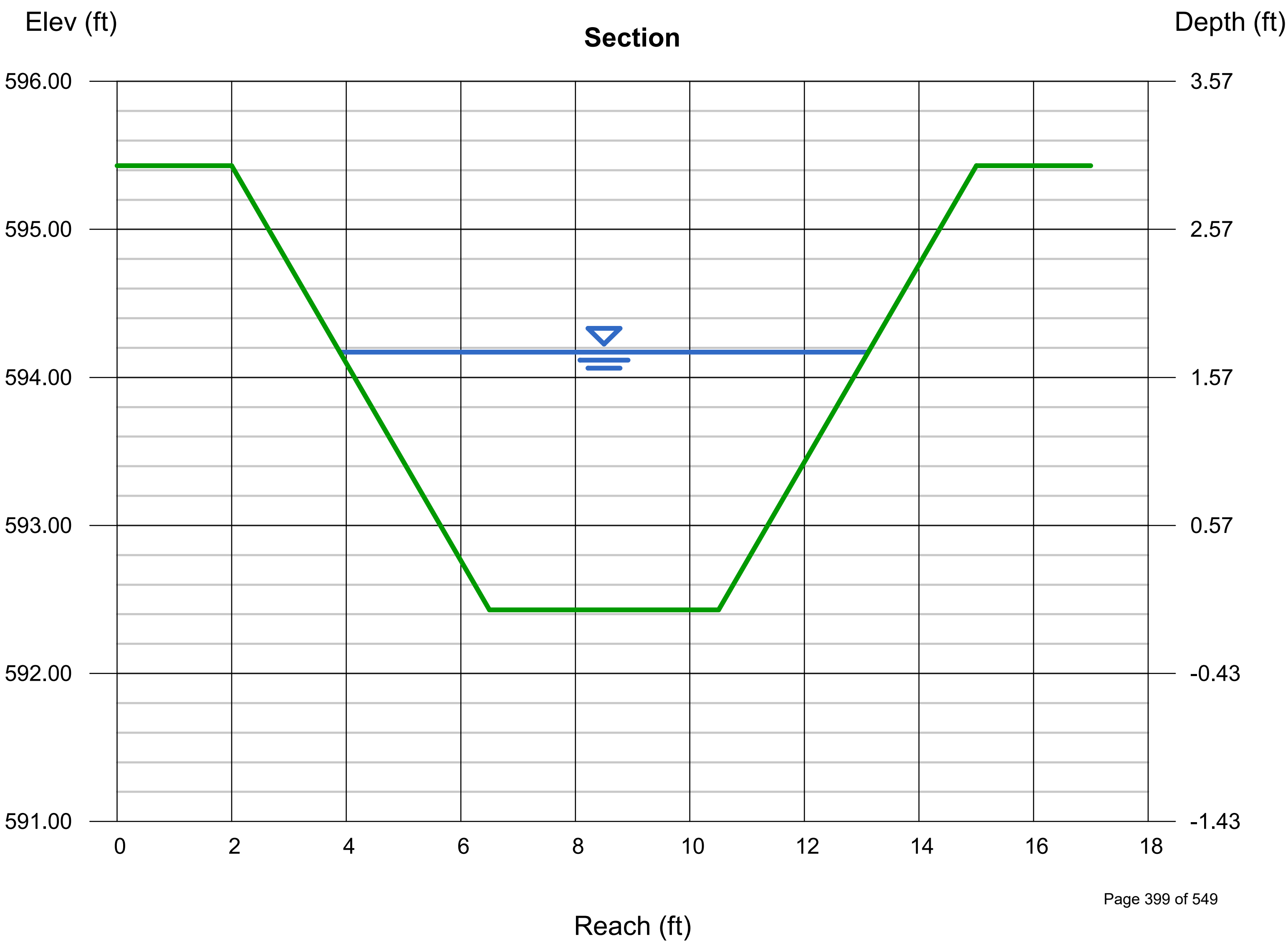


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-3 @ N 1551517, E 1942670 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 1.74
Side Slopes (z:1)	= 1.50, 1.50	Q (cfs)	= 36.63
Total Depth (ft)	= 3.00	Area (sqft)	= 11.50
Invert Elev (ft)	= 592.43	Velocity (ft/s)	= 3.18
Slope (%)	= 1.00	Wetted Perim (ft)	= 10.27
N-Value	= 0.050	Crit Depth, Yc (ft)	= 1.18
		Top Width (ft)	= 9.22
Calculations		EGL (ft)	= 1.90
Compute by:	Known Q		
Known Q (cfs)	= 36.63		

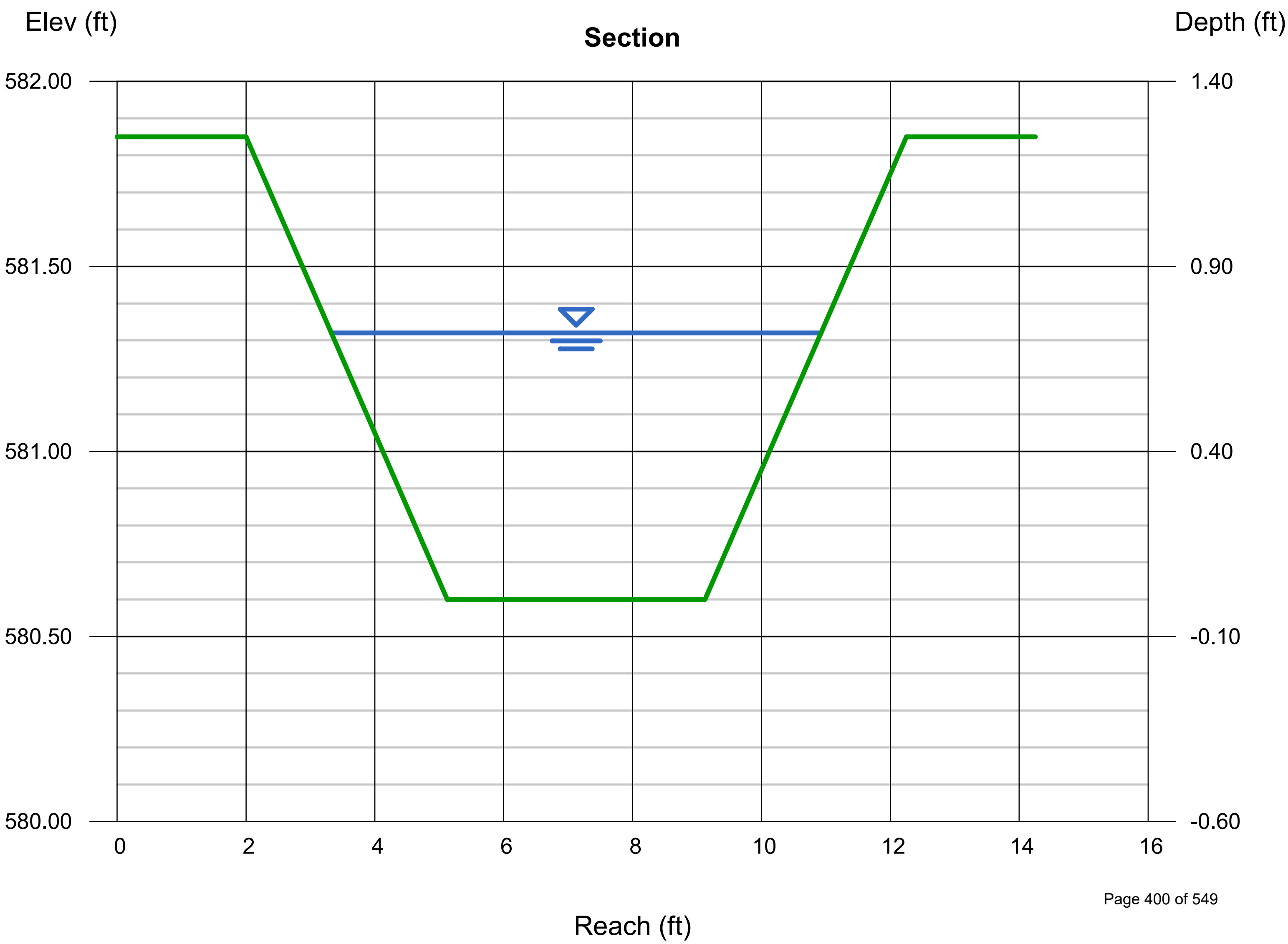


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Saturday, Nov 10 2018

DITCH F-4 @ N 1551579, E 1942697 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 0.72
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 30.67
Total Depth (ft)	= 1.25	Area (sqft)	= 4.18
Invert Elev (ft)	= 580.60	Velocity (ft/s)	= 7.34
Slope (%)	= 32.50	Wetted Perim (ft)	= 7.88
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.99
		Top Width (ft)	= 7.60
Calculations		EGL (ft)	= 1.56
Compute by:	Known Q		
Known Q (cfs)	= 30.67		

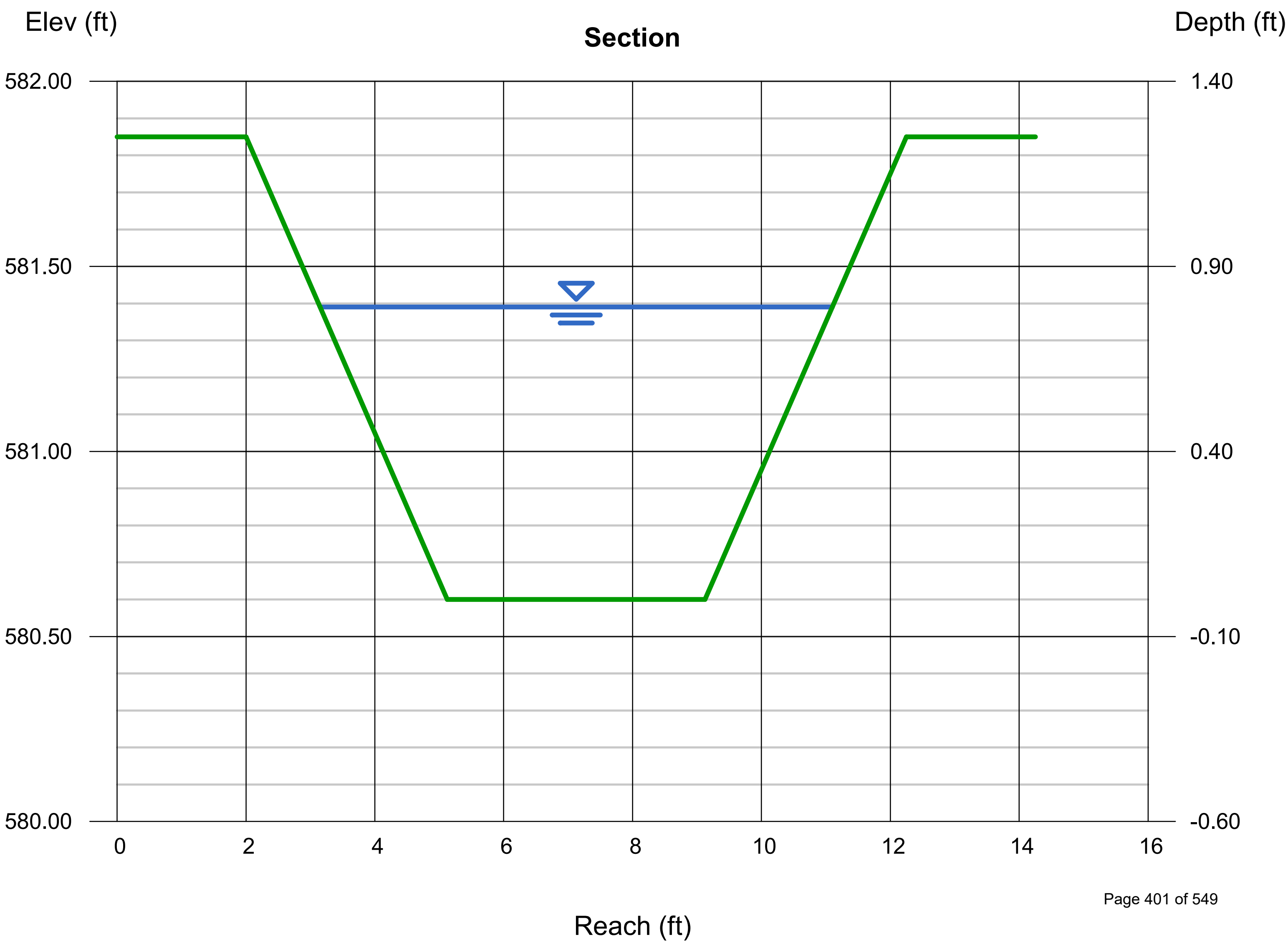


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-4 @ N 1551579, E 1942697 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 0.79
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 36.63
Total Depth (ft)	= 1.25	Area (sqft)	= 4.72
Invert Elev (ft)	= 580.60	Velocity (ft/s)	= 7.76
Slope (%)	= 32.50	Wetted Perim (ft)	= 8.25
N-Value	= 0.074	Crit Depth, Yc (ft)	= 1.10
		Top Width (ft)	= 7.95
Calculations		EGL (ft)	= 1.73
Compute by:	Known Q		
Known Q (cfs)	= 36.63		

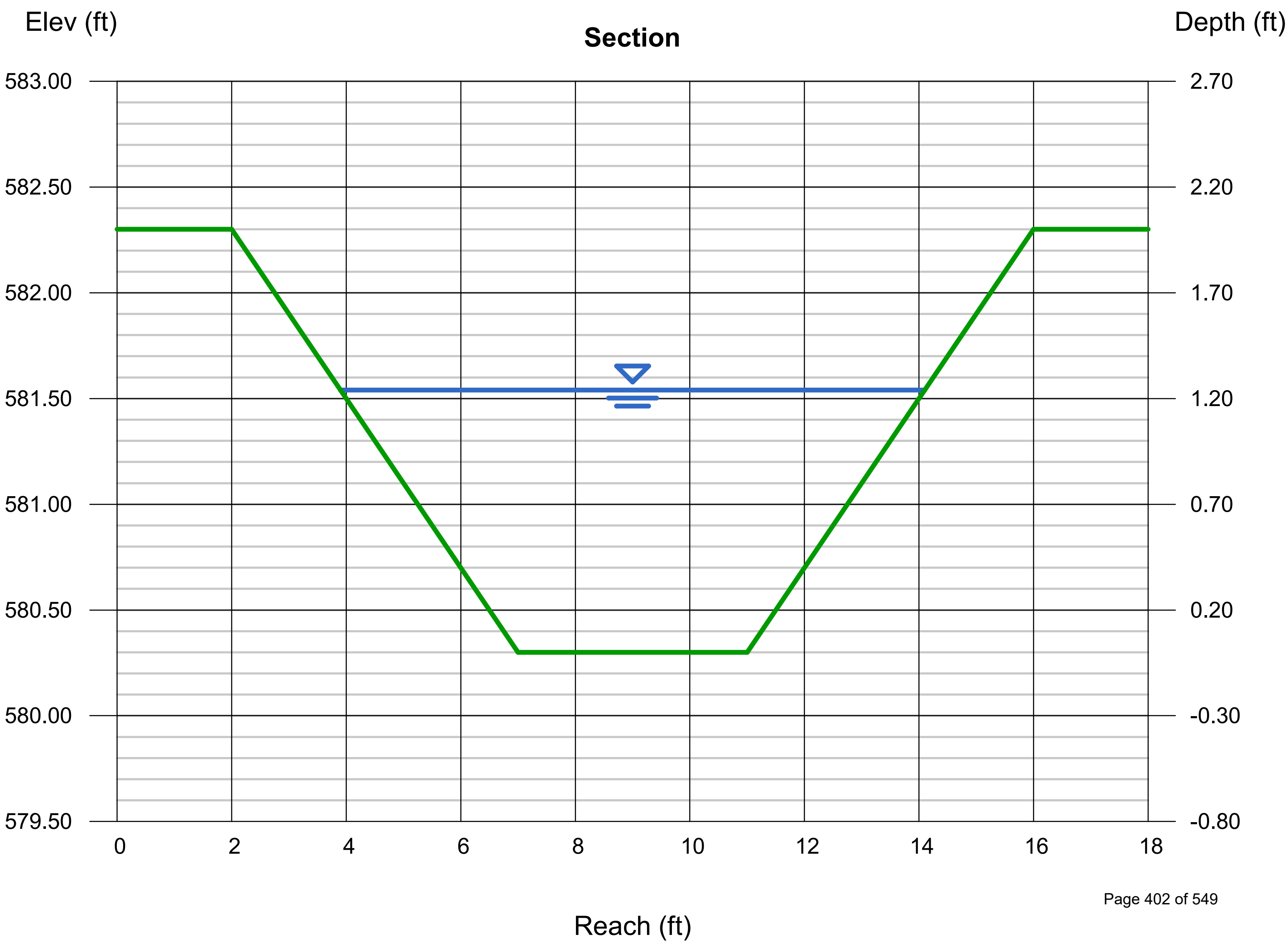


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-5 @ N 1551612, E 1942713 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 1.24
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 30.67
Total Depth (ft)	= 2.00	Area (sqft)	= 8.80
Invert Elev (ft)	= 580.30	Velocity (ft/s)	= 3.48
Slope (%)	= 1.00	Wetted Perim (ft)	= 10.68
N-Value	= 0.037	Crit Depth, Yc (ft)	= 0.99
		Top Width (ft)	= 10.20
Calculations		EGL (ft)	= 1.43
Compute by:	Known Q		
Known Q (cfs)	= 30.67		

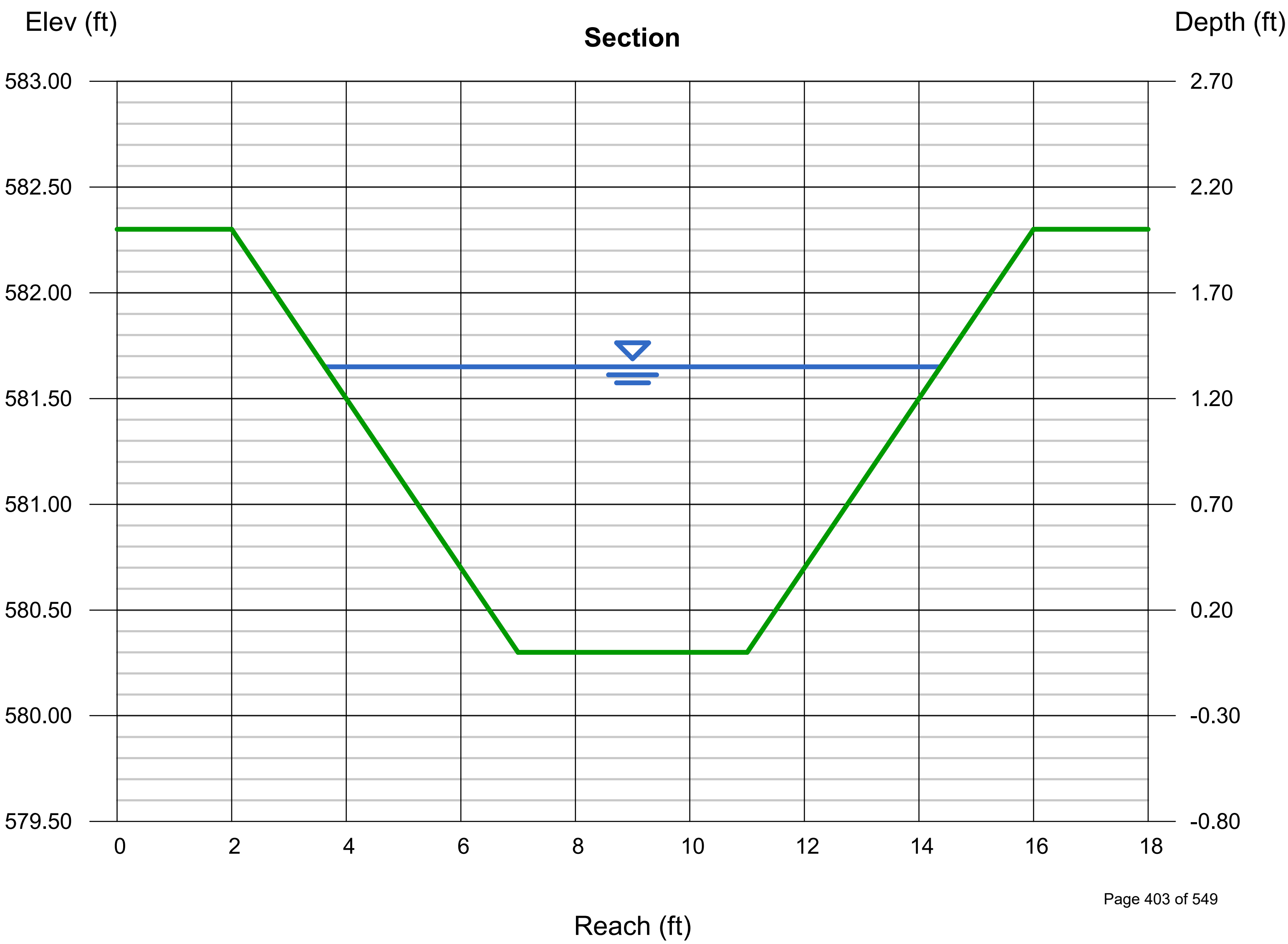


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-5 @ N 1551612, E 1942713 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 1.35
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 36.63
Total Depth (ft)	= 2.00	Area (sqft)	= 9.96
Invert Elev (ft)	= 580.30	Velocity (ft/s)	= 3.68
Slope (%)	= 1.00	Wetted Perim (ft)	= 11.27
N-Value	= 0.037	Crit Depth, Yc (ft)	= 1.10
		Top Width (ft)	= 10.75
Calculations		EGL (ft)	= 1.56
Compute by:	Known Q		
Known Q (cfs)	= 36.63		

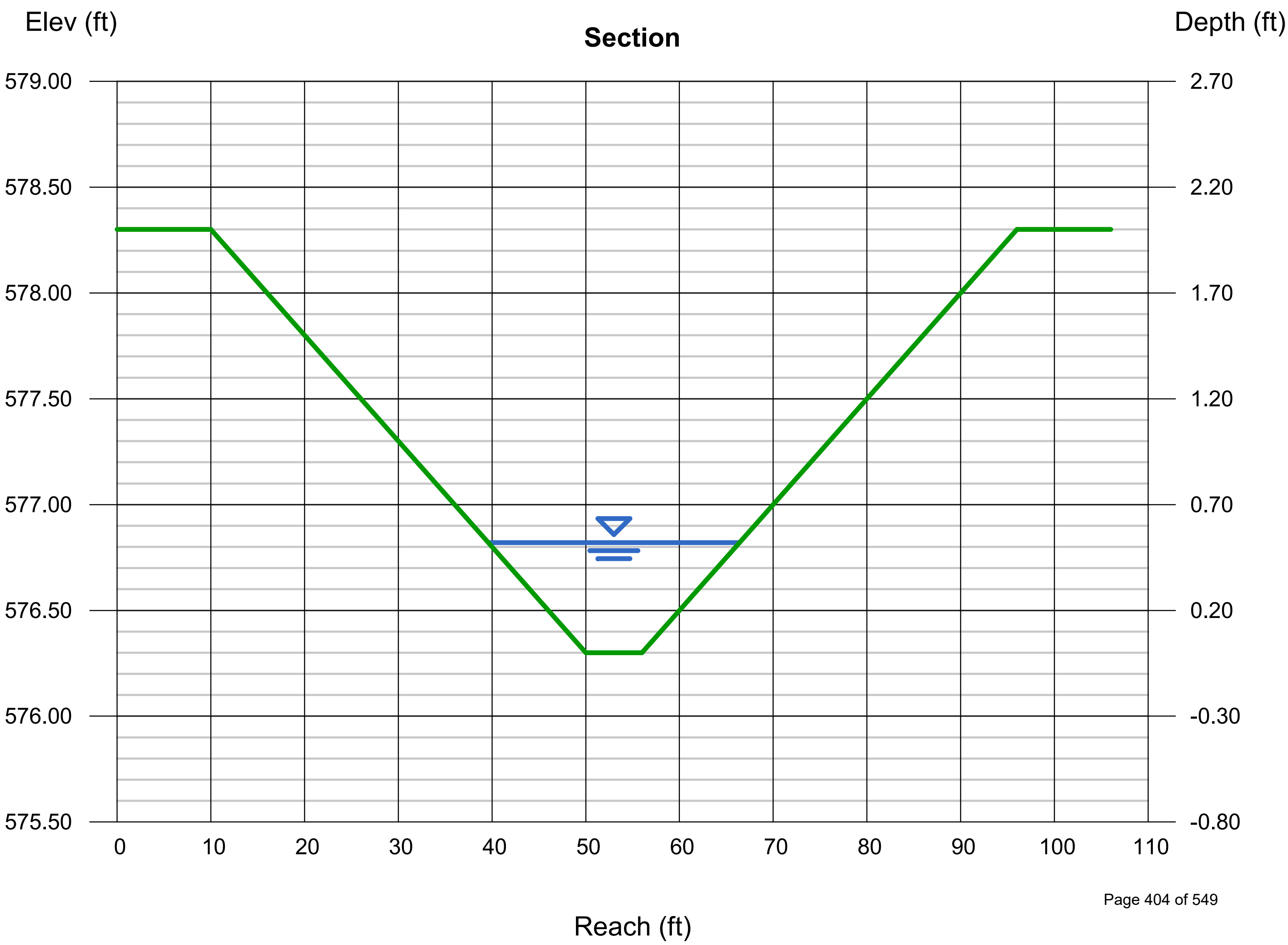


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-6 @ N 1551640, E 1942725 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.52
Side Slopes (z:1)	= 20.00, 20.00	Q (cfs)	= 15.34
Total Depth (ft)	= 2.00	Area (sqft)	= 8.53
Invert Elev (ft)	= 576.30	Velocity (ft/s)	= 1.80
Slope (%)	= 4.00	Wetted Perim (ft)	= 26.83
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.40
		Top Width (ft)	= 26.80
Calculations		EGL (ft)	= 0.57
Compute by:	Known Q		
Known Q (cfs)	= 15.34		

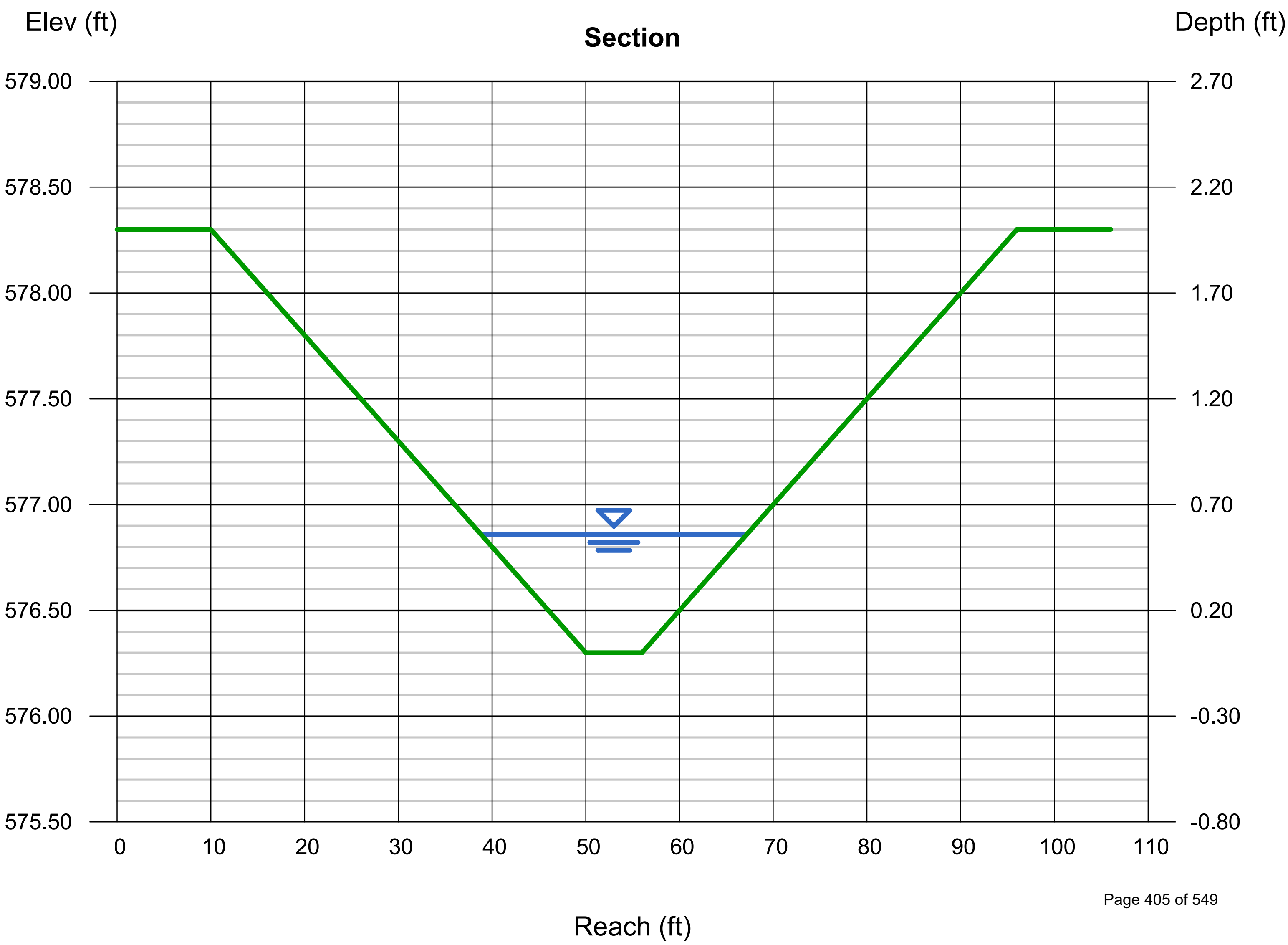


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-6 @ N 1551640, E 1942725 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.56
Side Slopes (z:1)	= 20.00, 20.00	Q (cfs)	= 18.32
Total Depth (ft)	= 2.00	Area (sqft)	= 9.63
Invert Elev (ft)	= 576.30	Velocity (ft/s)	= 1.90
Slope (%)	= 4.00	Wetted Perim (ft)	= 28.43
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.43
		Top Width (ft)	= 28.40
Calculations		EGL (ft)	= 0.62
Compute by:	Known Q		
Known Q (cfs)	= 18.32		

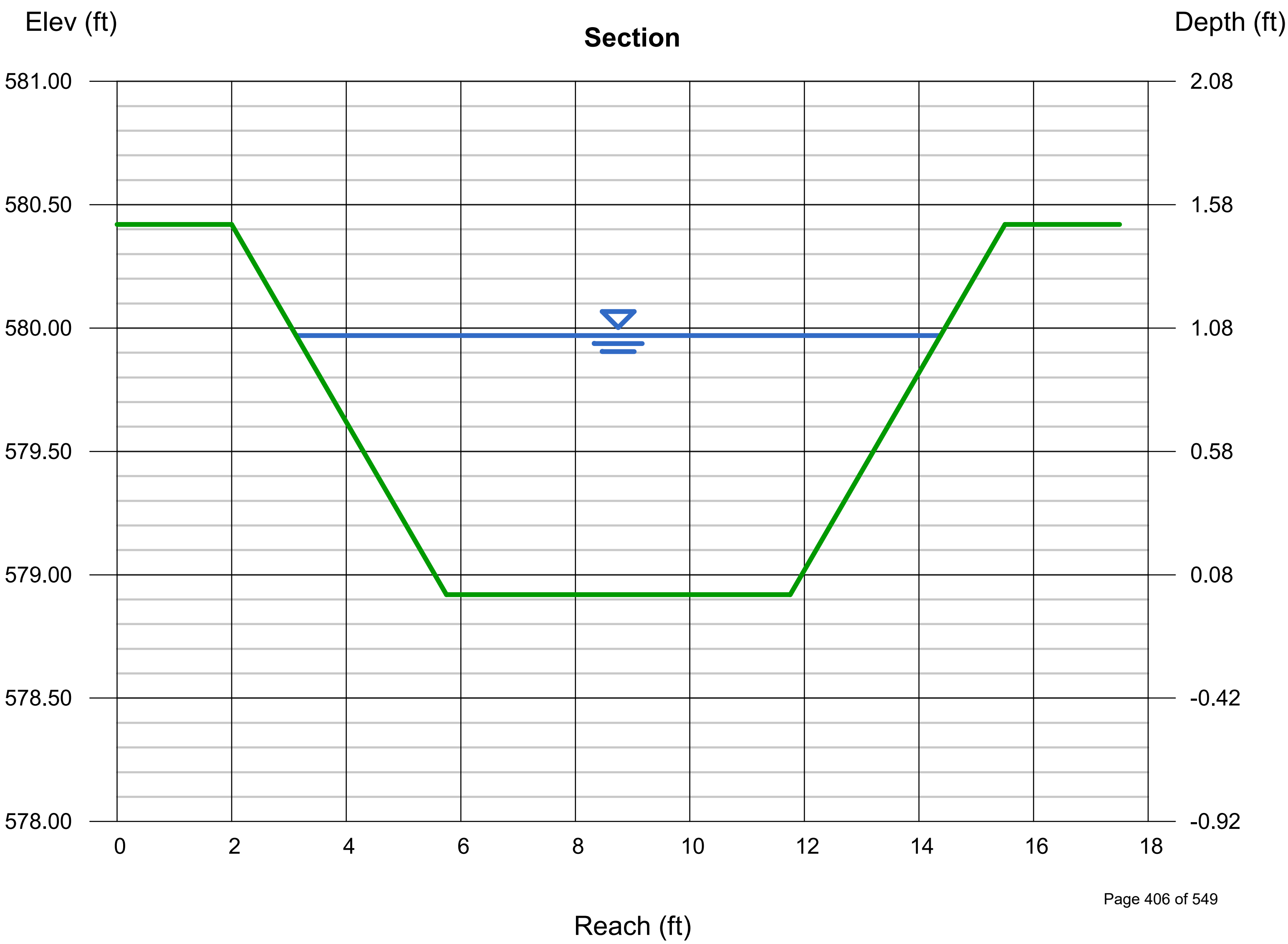


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-7 @ N 1551640, E 1942725 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 1.05
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 15.34
Total Depth (ft)	= 1.50	Area (sqft)	= 9.06
Invert Elev (ft)	= 578.92	Velocity (ft/s)	= 1.69
Slope (%)	= 1.00	Wetted Perim (ft)	= 11.65
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.55
		Top Width (ft)	= 11.25
Calculations		EGL (ft)	= 1.09
Compute by:	Known Q		
Known Q (cfs)	= 15.34		



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-7 @ N 1551640, E 1942725 (100 YR.)

Trapezoidal

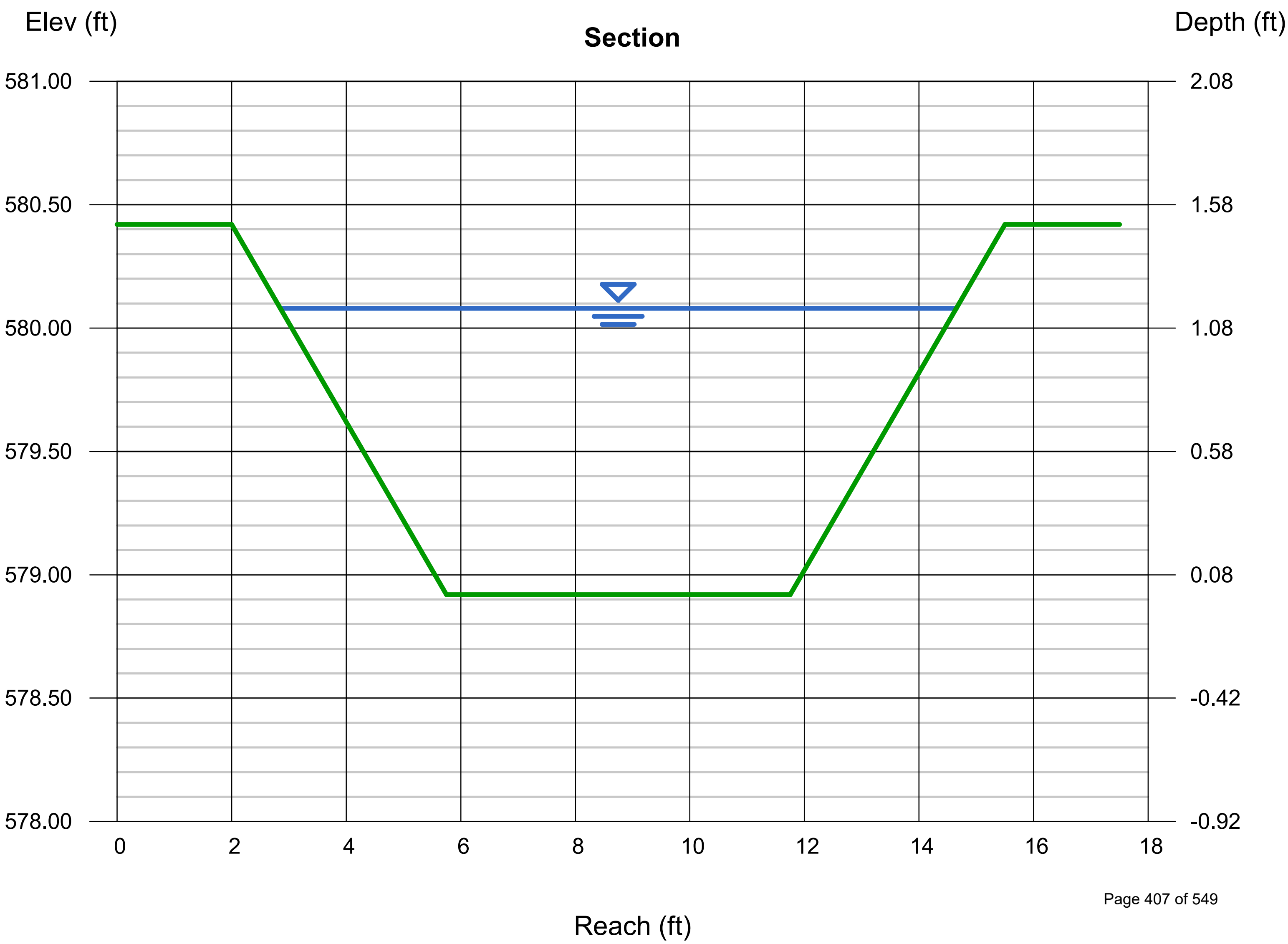
Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 2.50, 2.50
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 578.92
Slope (%)	= 1.00
N-Value	= 0.074

Calculations

Compute by:	Known Q
Known Q (cfs)	= 18.32

Highlighted

Depth (ft)	= 1.16
Q (cfs)	= 18.32
Area (sqft)	= 10.32
Velocity (ft/s)	= 1.77
Wetted Perim (ft)	= 12.25
Crit Depth, Yc (ft)	= 0.61
Top Width (ft)	= 11.80
EGL (ft)	= 1.21

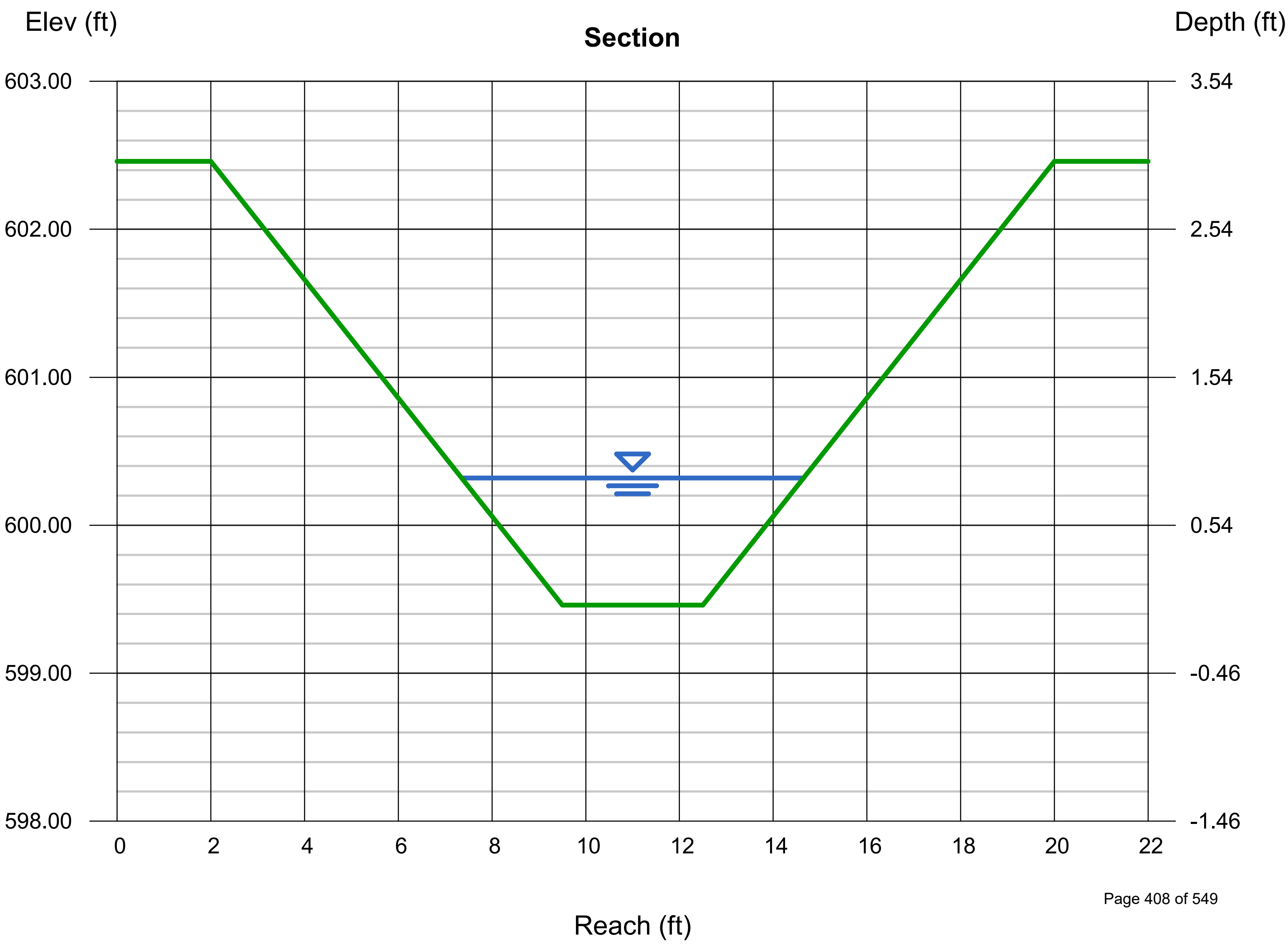


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.　　Saturday, Nov 10 2018

DITCH G-1 @ N 1551502, E 1942496 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 0.86
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 6.170
Total Depth (ft)	= 3.00	Area (sqft)	= 4.43
Invert Elev (ft)	= 599.46	Velocity (ft/s)	= 1.39
Slope (%)	= 1.00	Wetted Perim (ft)	= 7.63
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.45
		Top Width (ft)	= 7.30
Calculations		EGL (ft)	= 0.89
Compute by:	Known Q		
Known Q (cfs)	= 6.17		



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. | Saturday, Nov 10 2018

DITCH G-1 @ N 1551502, E 1942496 (100 YR.)

Trapezoidal

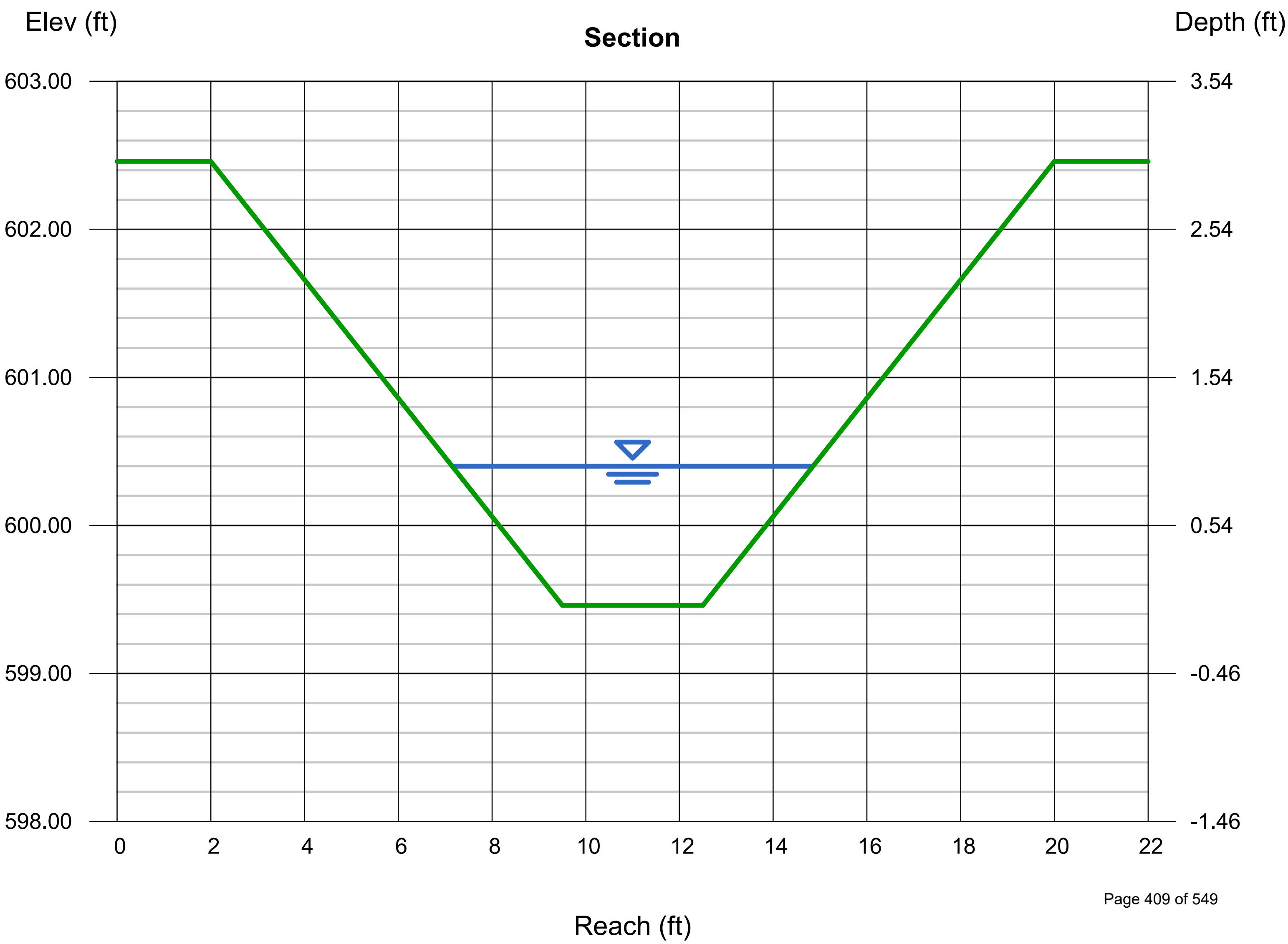
Bottom Width (ft)	= 3.00
Side Slopes (z:1)	= 2.50, 2.50
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 599.46
Slope (%)	= 1.00
N-Value	= 0.074

Calculations

Compute by:	Known Q
Known Q (cfs)	= 7.37

Highlighted

Depth (ft)	= 0.94
Q (cfs)	= 7.370
Area (sqft)	= 5.03
Velocity (ft/s)	= 1.47
Wetted Perim (ft)	= 8.06
Crit Depth, Yc (ft)	= 0.50
Top Width (ft)	= 7.70
EGL (ft)	= 0.97

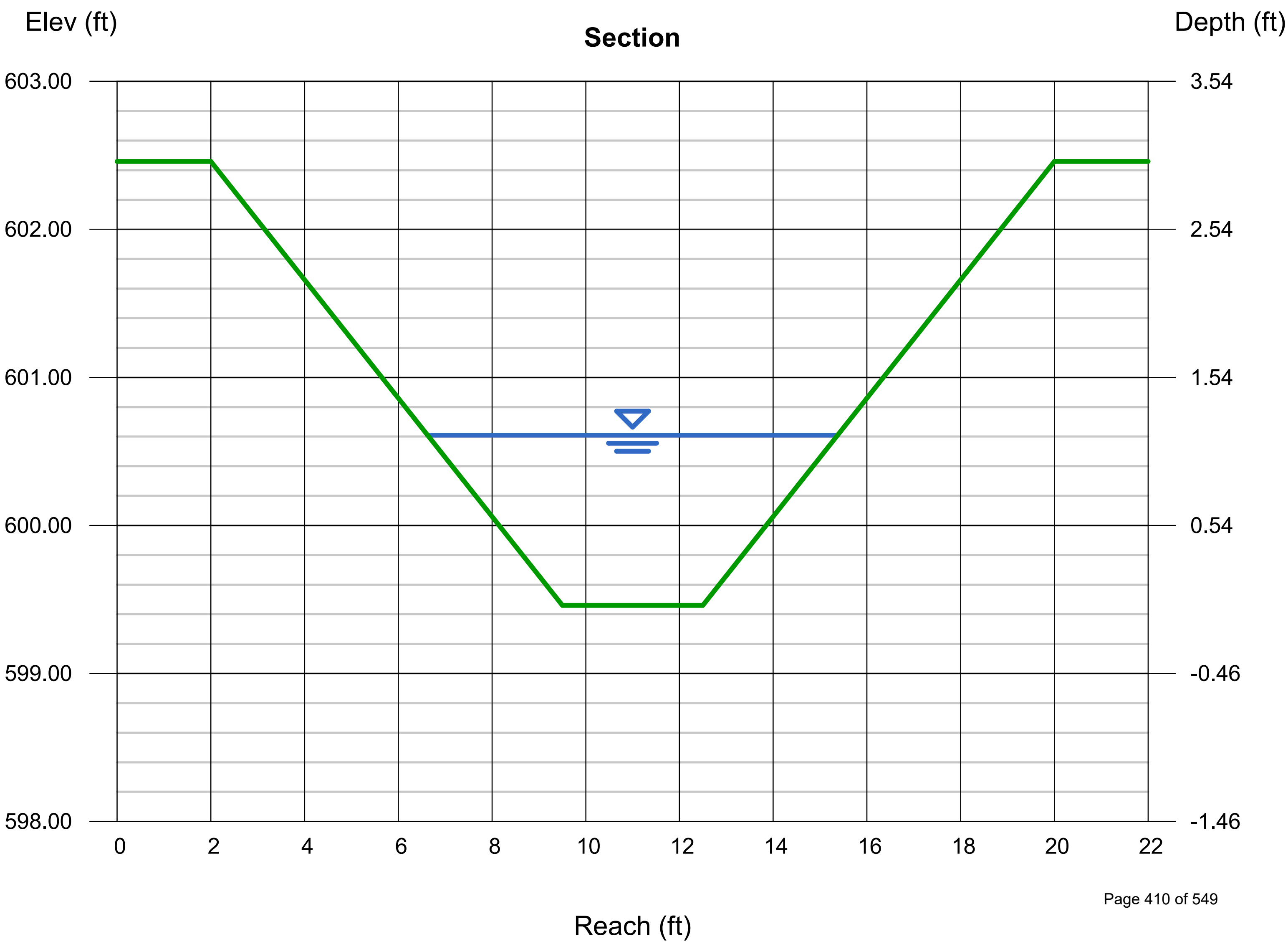


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH G-2 @ N 1550820, E 1942070 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.15
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 11.37
Total Depth (ft)	= 3.00	Area (sqft)	= 6.76
Invert Elev (ft)	= 599.46	Velocity (ft/s)	= 1.68
Slope (%)	= 1.09	Wetted Perim (ft)	= 9.19
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.64
		Top Width (ft)	= 8.75
Calculations		EGL (ft)	= 1.19
Compute by:	Known Q		
Known Q (cfs)	= 11.37		

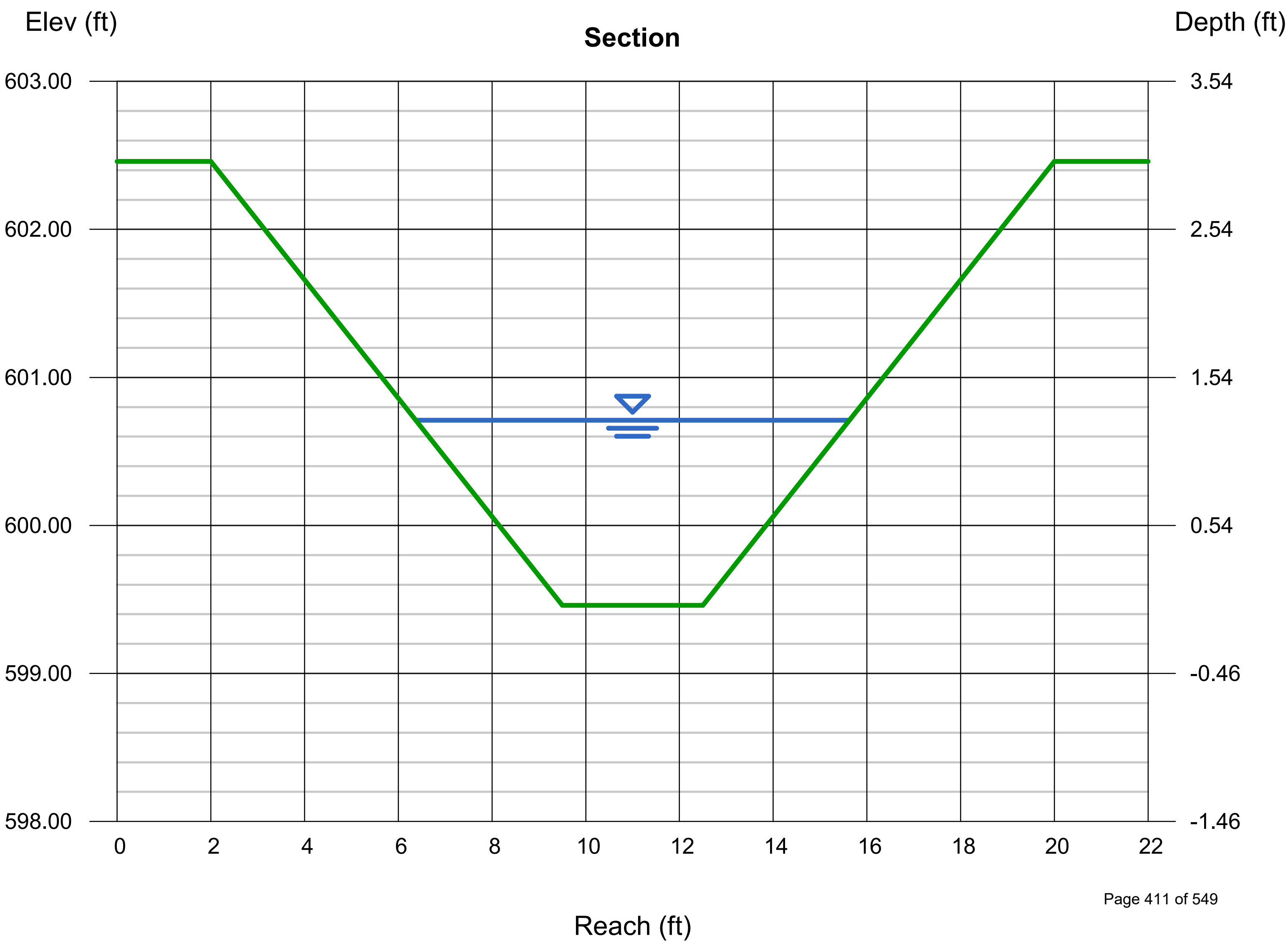


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Saturday, Nov 10 2018

DITCH G-2 @ N 1550820, E 1942070 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.25
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 13.58
Total Depth (ft)	= 3.00	Area (sqft)	= 7.66
Invert Elev (ft)	= 599.46	Velocity (ft/s)	= 1.77
Slope (%)	= 1.09	Wetted Perim (ft)	= 9.73
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.71
		Top Width (ft)	= 9.25
Calculations		EGL (ft)	= 1.30
Compute by:	Known Q		
Known Q (cfs)	= 13.58		

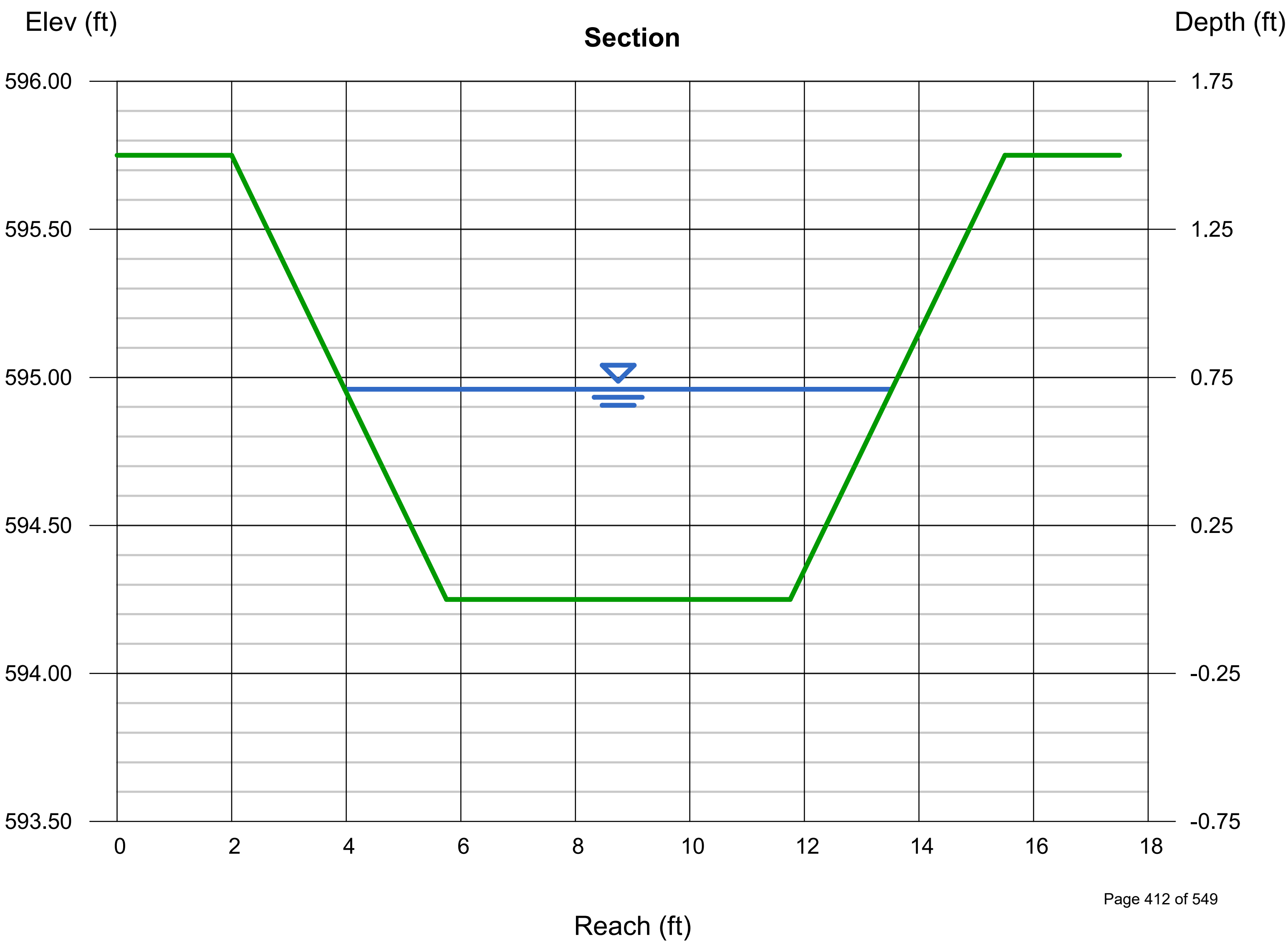


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH G-3 @ N 1551303, E 1942111 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.71
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 17.54
Total Depth (ft)	= 1.50	Area (sqft)	= 5.52
Invert Elev (ft)	= 594.25	Velocity (ft/s)	= 3.18
Slope (%)	= 5.50	Wetted Perim (ft)	= 9.82
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.59
		Top Width (ft)	= 9.55
Calculations		EGL (ft)	= 0.87
Compute by:	Known Q		
Known Q (cfs)	= 17.54		

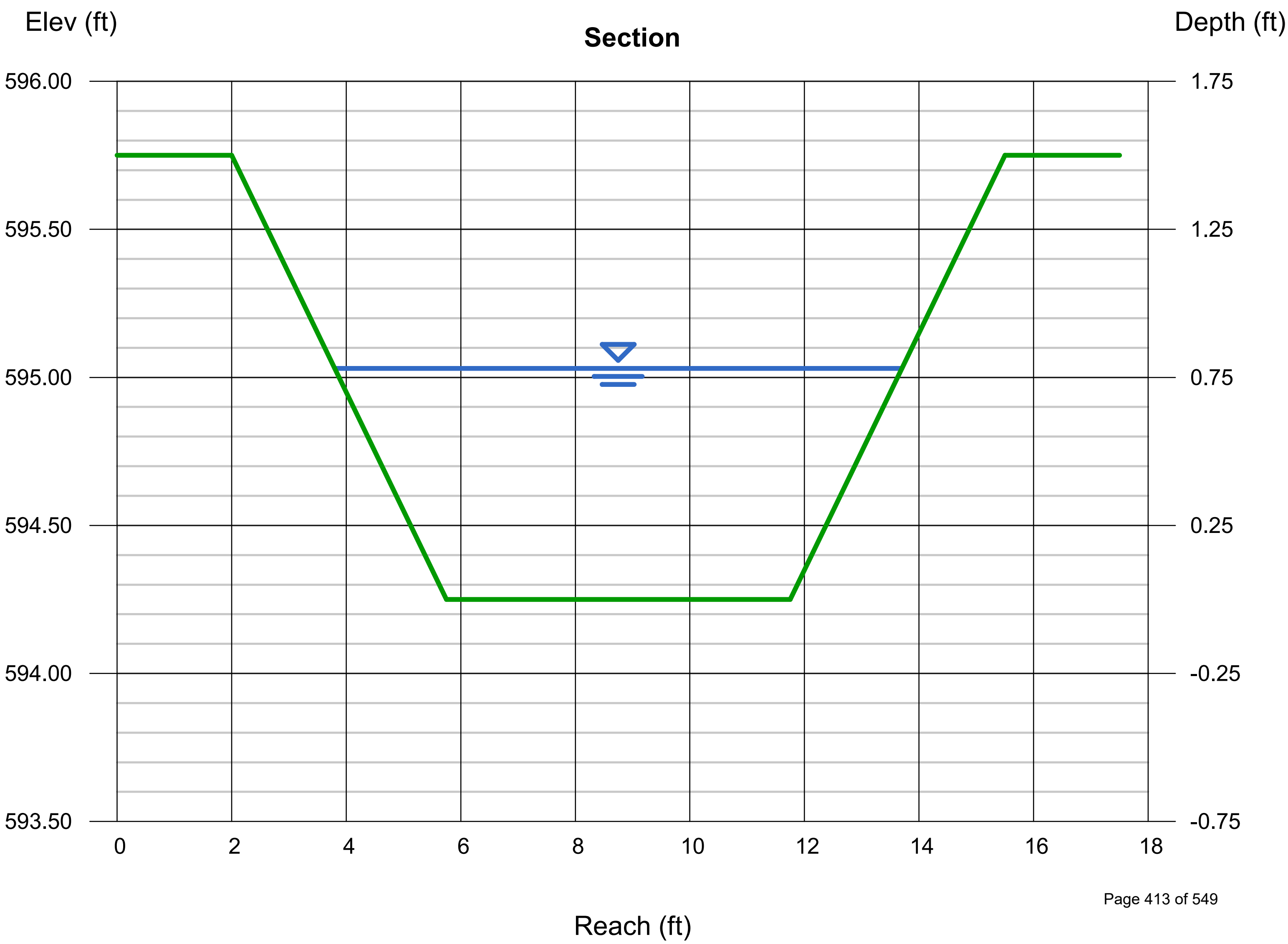


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH G-3 @ N 1551303, E 1942111 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.78
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 20.95
Total Depth (ft)	= 1.50	Area (sqft)	= 6.20
Invert Elev (ft)	= 594.25	Velocity (ft/s)	= 3.38
Slope (%)	= 5.50	Wetted Perim (ft)	= 10.20
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.66
		Top Width (ft)	= 9.90
Calculations		EGL (ft)	= 0.96
Compute by:	Known Q		
Known Q (cfs)	= 20.95		

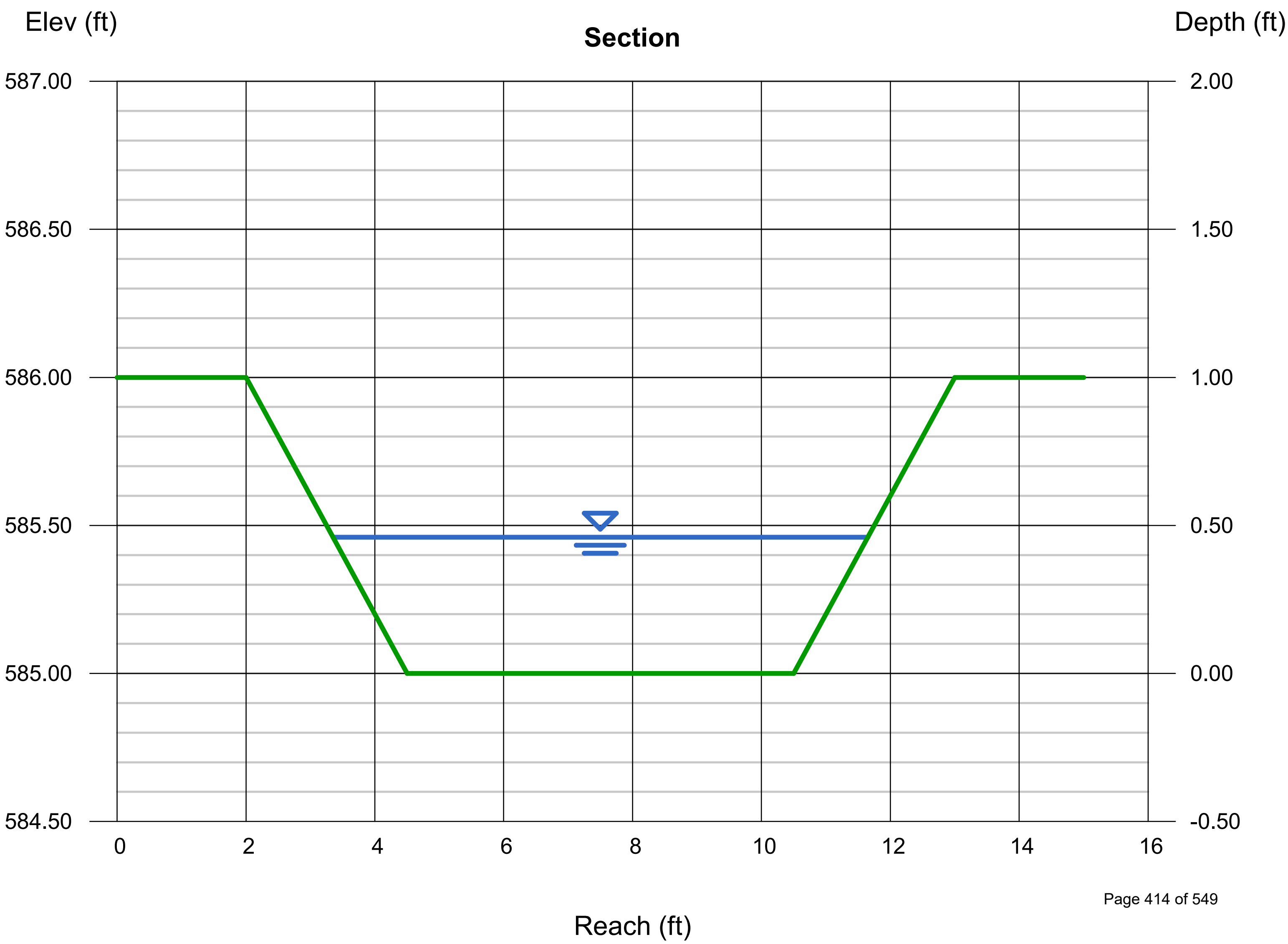


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH G-4 @ N 1551366, E 1942040 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.46
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 17.54
Total Depth (ft)	= 1.00	Area (sqft)	= 3.29
Invert Elev (ft)	= 585.00	Velocity (ft/s)	= 5.33
Slope (%)	= 25.00	Wetted Perim (ft)	= 8.48
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.59
		Top Width (ft)	= 8.30
Calculations		EGL (ft)	= 0.90
Compute by:	Known Q		
Known Q (cfs)	= 17.54		

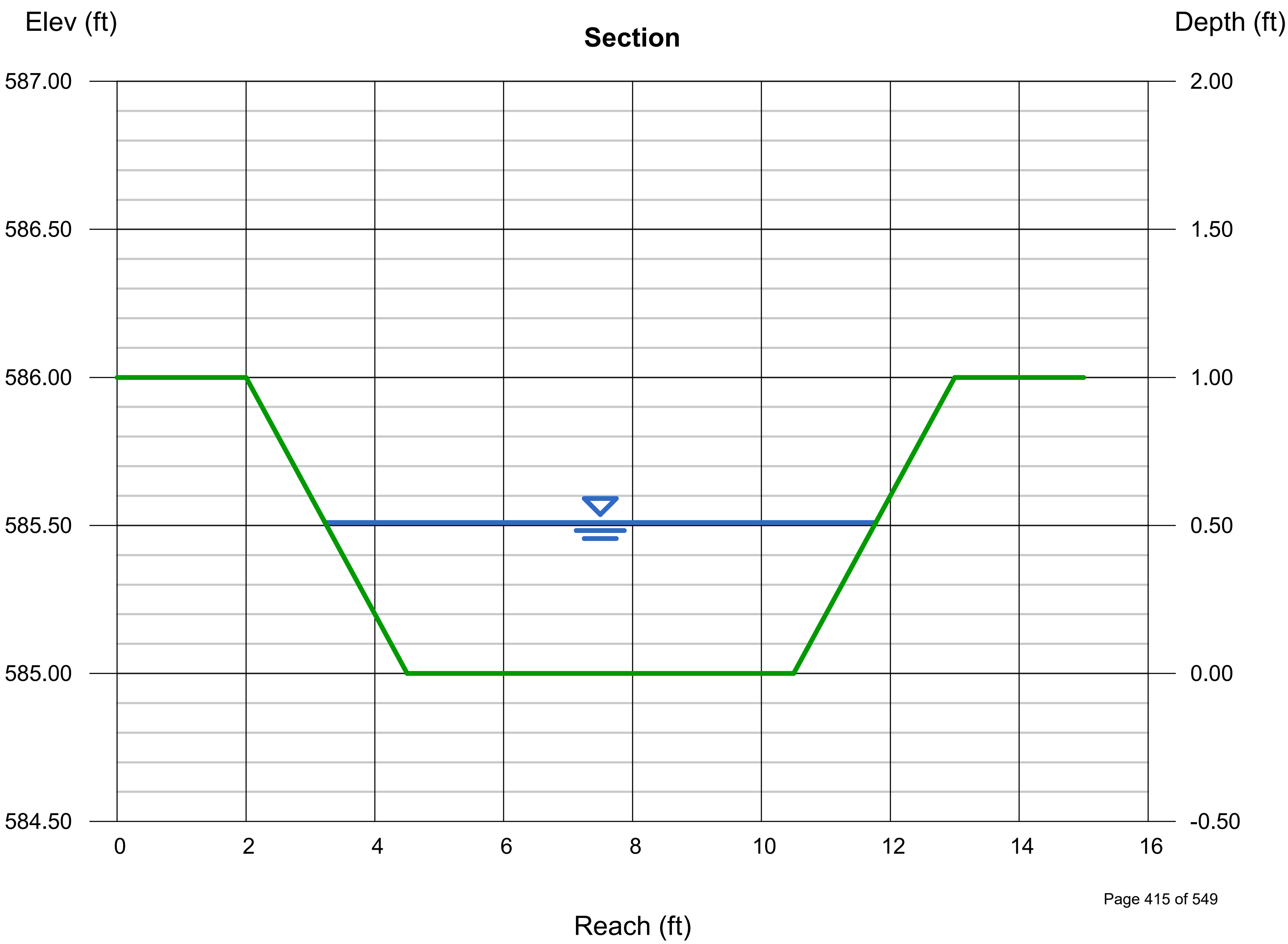


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH G-4 @ N 1551366, E 1942040 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.51
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 20.95
Total Depth (ft)	= 1.00	Area (sqft)	= 3.71
Invert Elev (ft)	= 585.00	Velocity (ft/s)	= 5.65
Slope (%)	= 25.00	Wetted Perim (ft)	= 8.75
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.66
		Top Width (ft)	= 8.55
Calculations		EGL (ft)	= 1.01
Compute by:	Known Q		
Known Q (cfs)	= 20.95		



Channel Report

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

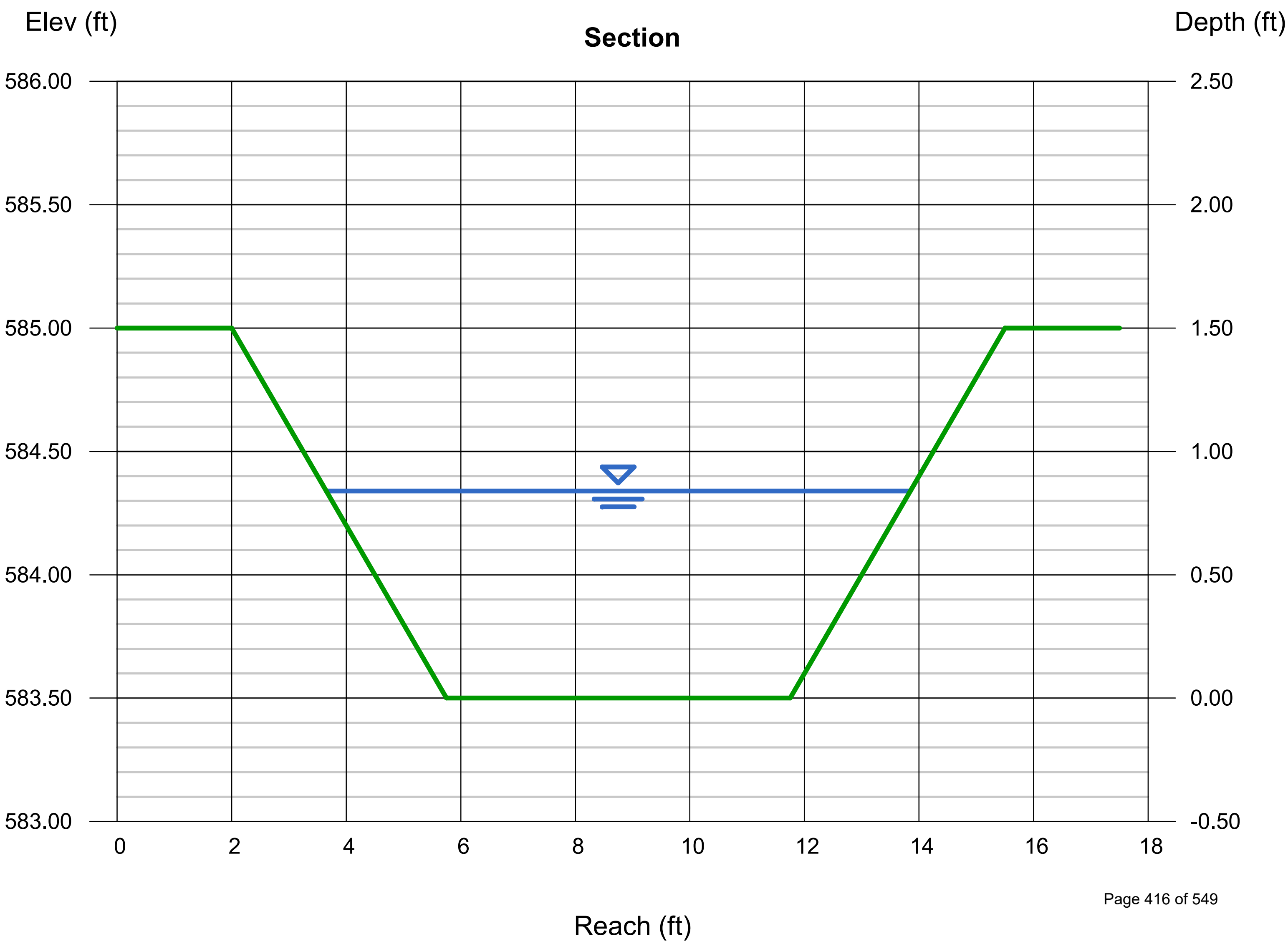
Saturday, Nov 10 2018

DITCH G-5 @ N 1551391, E 1942013 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.84
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 17.54
Total Depth (ft)	= 1.50	Area (sqft)	= 6.80
Invert Elev (ft)	= 583.50	Velocity (ft/s)	= 2.58
Slope (%)	= 3.00	Wetted Perim (ft)	= 10.52
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.59
		Top Width (ft)	= 10.20
		EGL (ft)	= 0.94

Calculations

Compute by:	Known Q
Known Q (cfs)	= 17.54

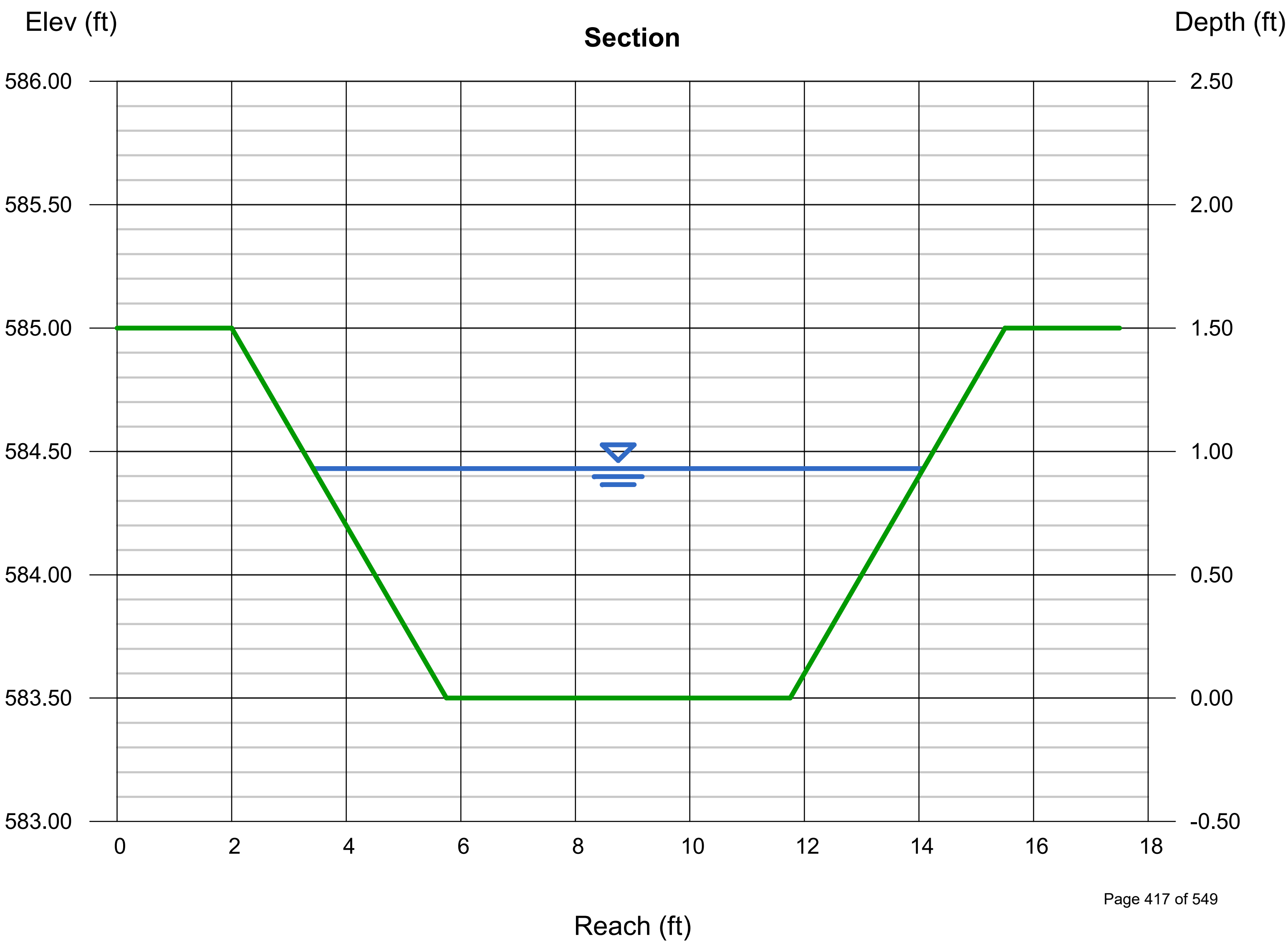


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH G-5 @ N 1551391, E 1942013 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.93
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 20.95
Total Depth (ft)	= 1.50	Area (sqft)	= 7.74
Invert Elev (ft)	= 583.50	Velocity (ft/s)	= 2.71
Slope (%)	= 3.00	Wetted Perim (ft)	= 11.01
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.66
		Top Width (ft)	= 10.65
Calculations		EGL (ft)	= 1.04
Compute by:	Known Q		
Known Q (cfs)	= 20.95		

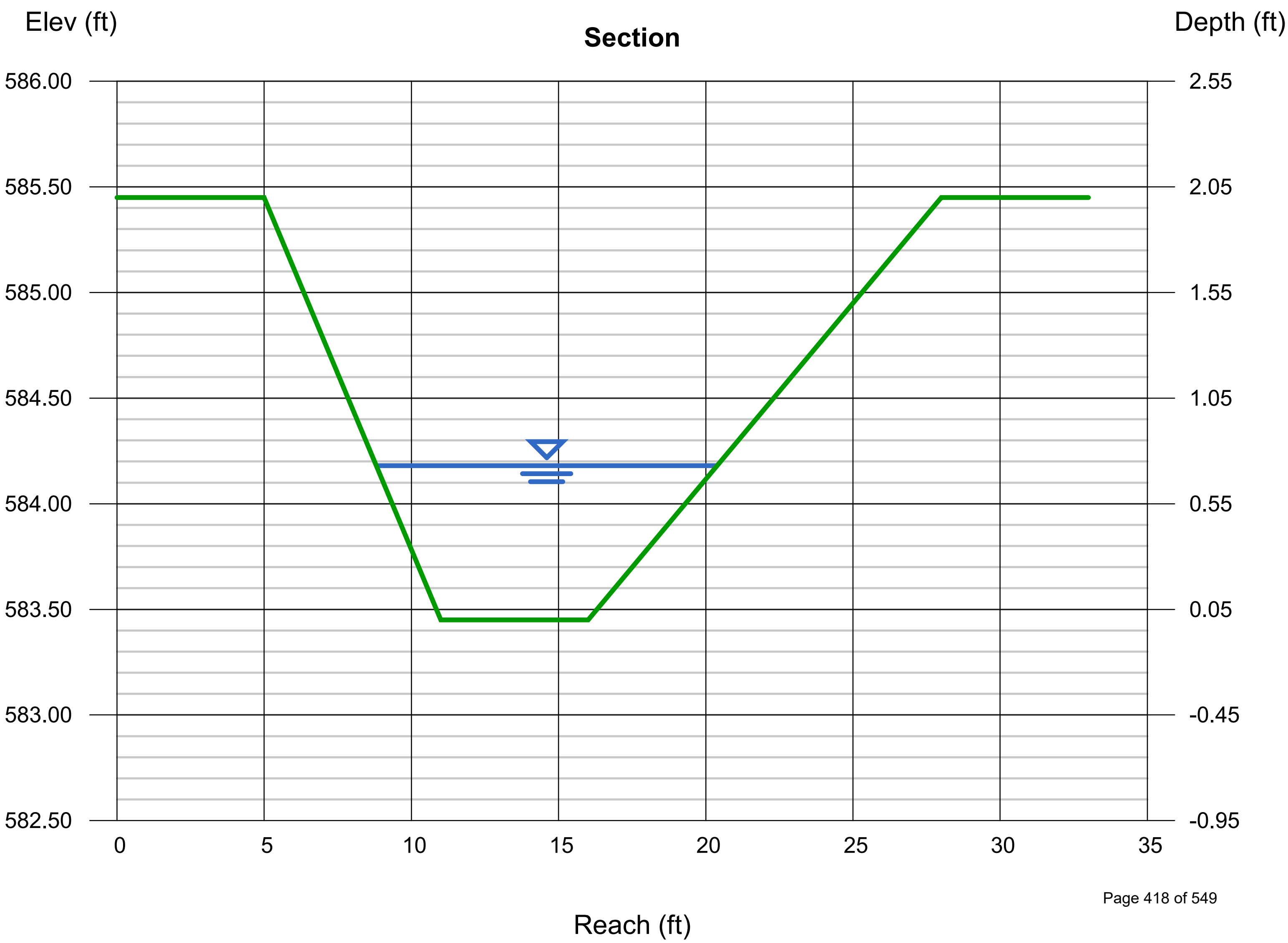


Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. Saturday, Nov 11 2017

Ditch K-1 @ N 1550001, E 1942362

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 5.00	Depth (ft)	= 0.73
Side Slopes (z:1)	= 3.00, 6.00	Q (cfs)	= 10.47
Total Depth (ft)	= 2.00	Area (sqft)	= 6.05
Invert Elev (ft)	= 583.45	Velocity (ft/s)	= 1.73
Slope (%)	= 0.30	Wetted Perim (ft)	= 11.75
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.45
		Top Width (ft)	= 11.57
Calculations		EGL (ft)	= 0.78
Compute by:	Known Q		
Known Q (cfs)	= 10.47		

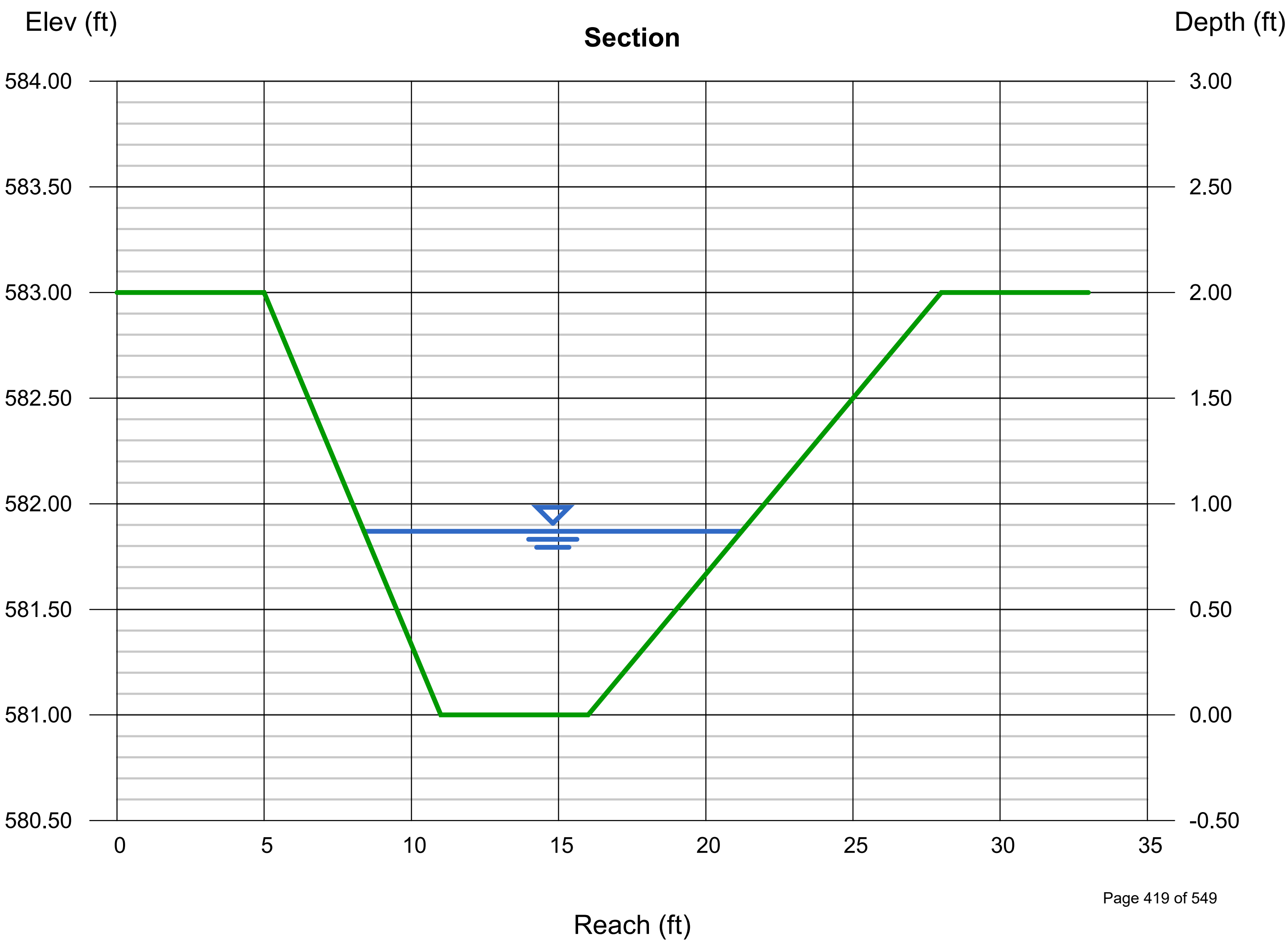


Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. Saturday, Nov 11 2017

Ditch K-1 @ N 1550547, E 1942968

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 5.00	Depth (ft)	= 0.87
Side Slopes (z:1)	= 3.00, 6.00	Q (cfs)	= 14.72
Total Depth (ft)	= 2.00	Area (sqft)	= 7.76
Invert Elev (ft)	= 581.00	Velocity (ft/s)	= 1.90
Slope (%)	= 0.30	Wetted Perim (ft)	= 13.04
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.55
		Top Width (ft)	= 12.83
Calculations		EGL (ft)	= 0.93
Compute by:	Known Q		
Known Q (cfs)	= 14.72		



Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. Monday, Oct 23 2017

Ditch K-2 @ N 1549982, E 1942377

Trapezoidal

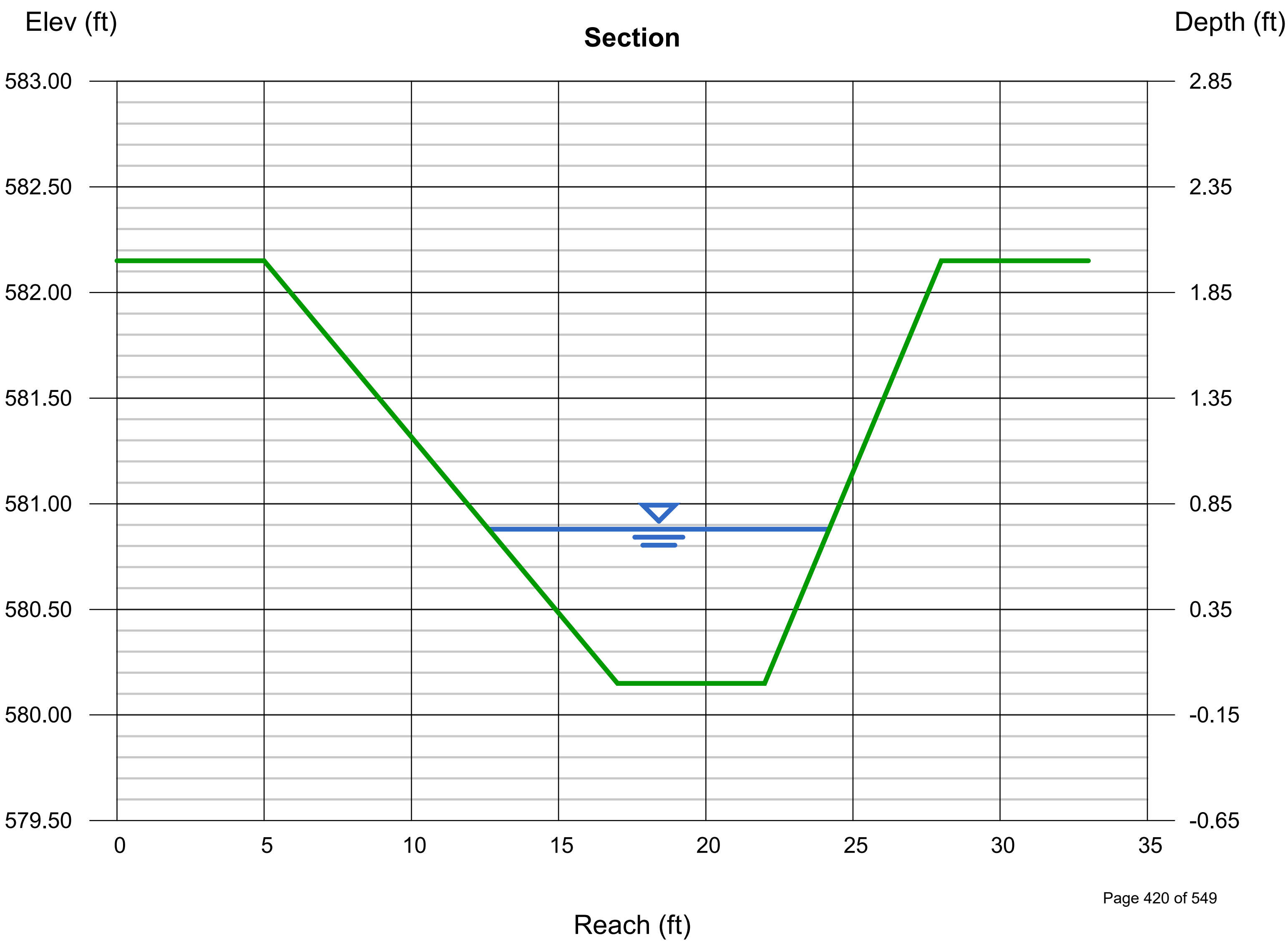
Bottom Width (ft)	= 5.00
Side Slopes (z:1)	= 6.00, 3.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 580.15
Slope (%)	= 0.30
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 10.37

Highlighted

Depth (ft)	= 0.73
Q (cfs)	= 10.37
Area (sqft)	= 6.05
Velocity (ft/s)	= 1.71
Wetted Perim (ft)	= 11.75
Crit Depth, Yc (ft)	= 0.45
Top Width (ft)	= 11.57
EGL (ft)	= 0.78

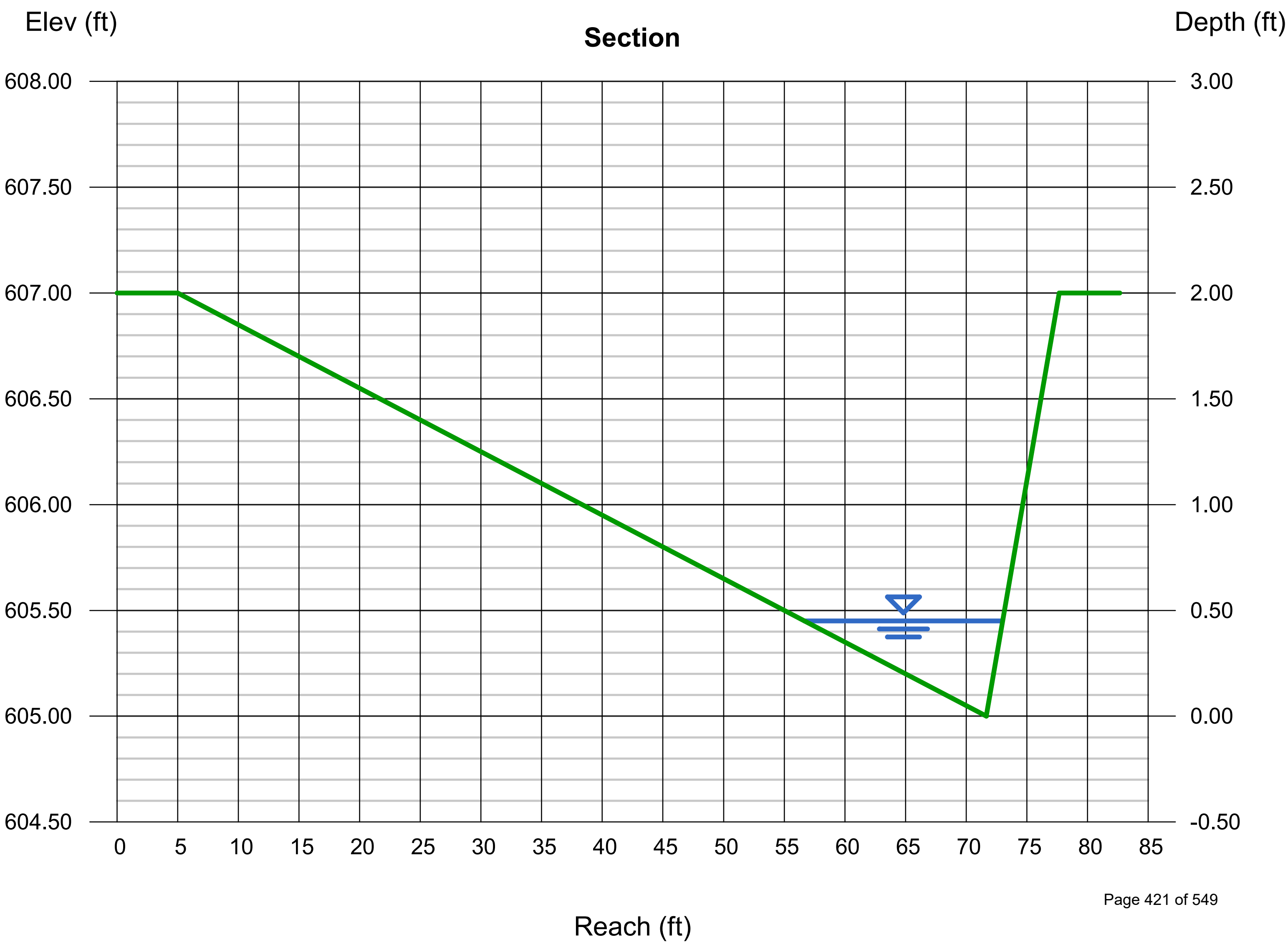


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

Typical Diversion Berm Ditch on Cap (25 YR.)

Triangular		**Highlighted**	
Side Slopes (z:1)	= 33.33, 3.00	Depth (ft)	= 0.45
Total Depth (ft)	= 2.00	Q (cfs)	= 6.630
		Area (sqft)	= 3.68
Invert Elev (ft)	= 605.00	Velocity (ft/s)	= 1.80
Slope (%)	= 1.00	Wetted Perim (ft)	= 16.43
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.39
		Top Width (ft)	= 16.35
Calculations		EGL (ft)	= 0.50
Compute by:	Known Q		
Known Q (cfs)	= 6.63		

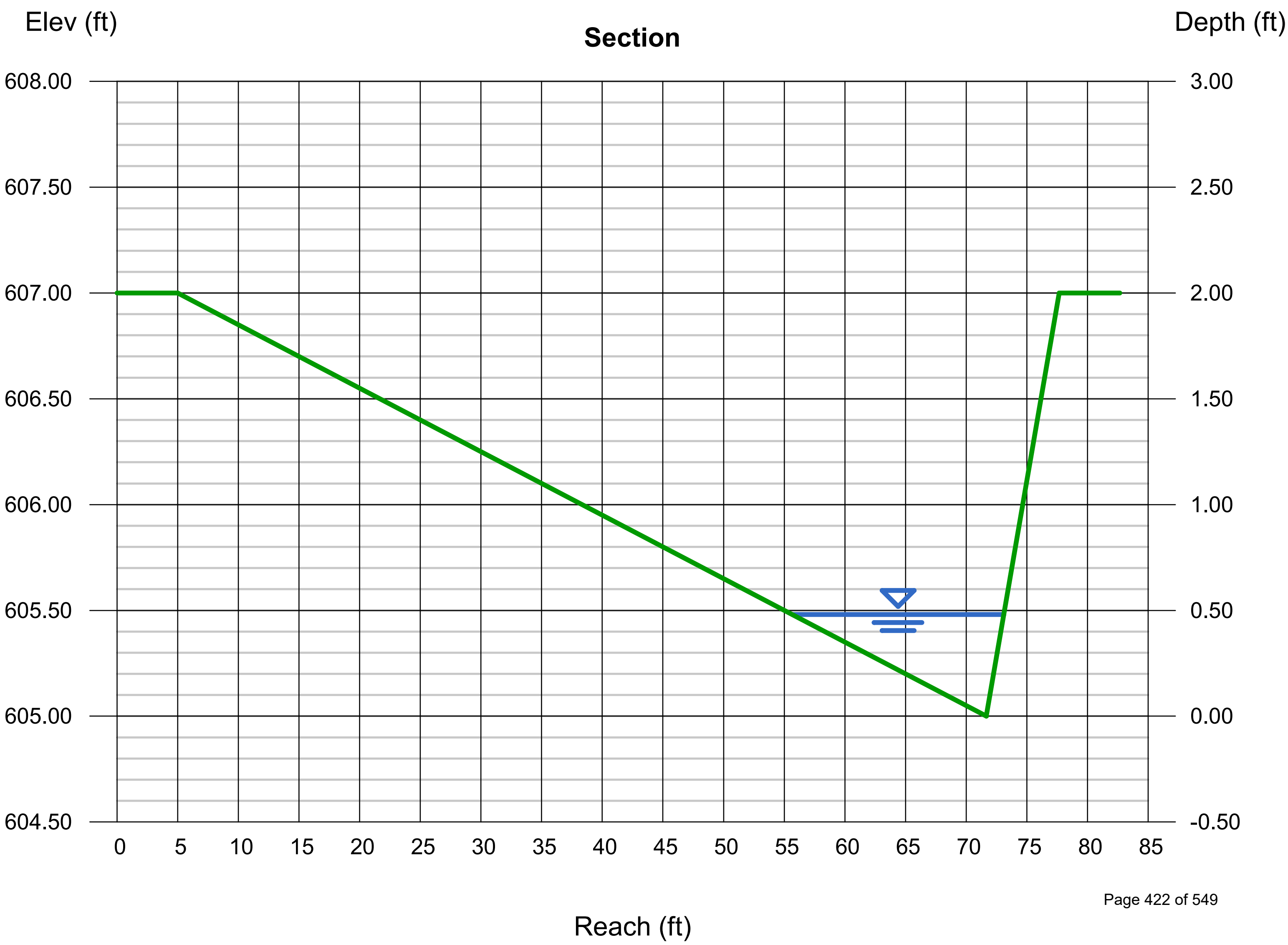


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

Typical Diversion Berm Ditch on Cap (100 YR.)

Triangular		**Highlighted**	
Side Slopes (z:1)	= 33.33, 3.00	Depth (ft)	= 0.48
Total Depth (ft)	= 2.00	Q (cfs)	= 7.920
		Area (sqft)	= 4.19
Invert Elev (ft)	= 605.00	Velocity (ft/s)	= 1.89
Slope (%)	= 1.00	Wetted Perim (ft)	= 17.52
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.42
		Top Width (ft)	= 17.44
Calculations		EGL (ft)	= 0.54
Compute by:	Known Q		
Known Q (cfs)	= 7.92		



Pre- and Post-Development Pipe Calculations (HydraFlow Express)

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Nov 12 2018

Exist. 24 CMP Hwy 20 @ N 1551368, E 1941869

Invert Elev Dn (ft)	=	581.11
Pipe Length (ft)	=	68.42
Slope (%)	=	0.50
Invert Elev Up (ft)	=	581.45
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.023
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Projecting
Coeff. K,M,c,Y,k	=	0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

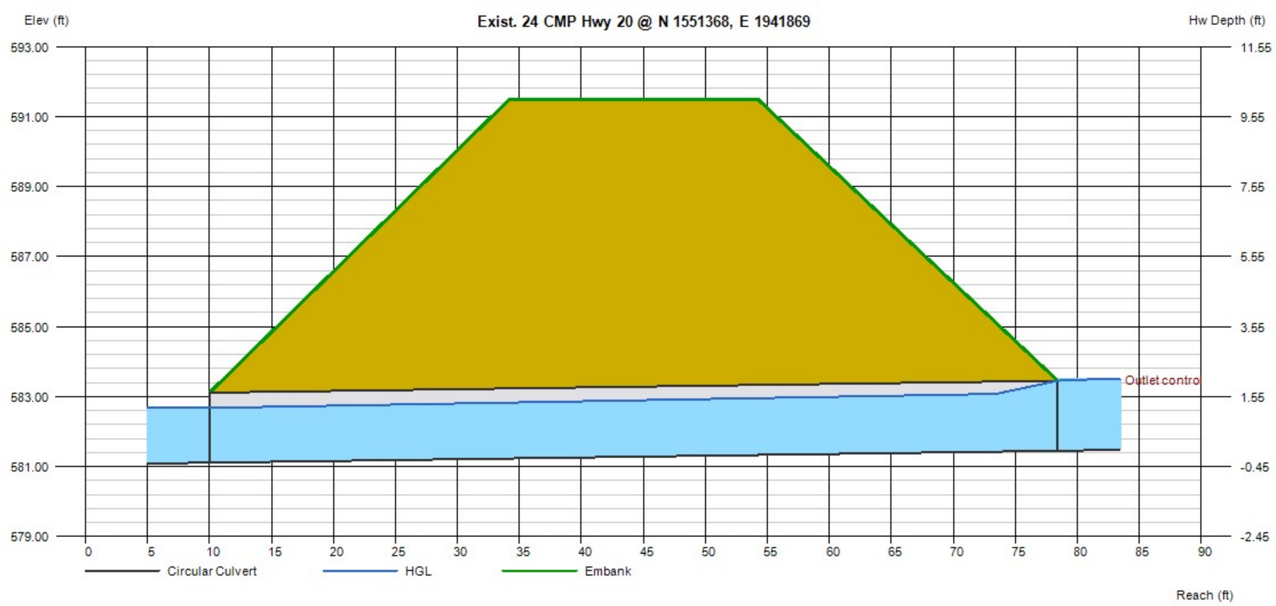
Top Elevation (ft)	=	591.50
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	10.00
Qmax (cfs)	=	36.81
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	10.00
Qpipe (cfs)	=	10.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	3.79
Veloc Up (ft/s)	=	3.59
HGL Dn (ft)	=	582.68
HGL Up (ft)	=	583.11
Hw Elev (ft)	=	583.49
Hw/D (ft)	=	1.02
Flow Regime	=	Outlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
10.00	10.00	0.00	3.79	3.59	18.78	19.88
11.00	11.00	0.00	4.10	5.66	19.13	14.26
12.00	12.00	0.00	4.40	5.85	19.46	14.92
13.00	13.00	0.00	4.69	4.14	19.78	24.00
14.00	14.00	0.00	4.99	4.46	20.08	24.00
15.00	15.00	0.00	5.28	4.77	20.37	24.00
16.00	16.00	0.00	5.57	5.09	20.65	24.00
17.00	17.00	0.00	5.85	5.41	20.91	24.00
18.00	18.00	0.00	6.14	5.73	21.16	24.00
19.00	19.00	0.00	6.42	6.05	21.40	24.00
20.00	20.00	0.00	6.71	6.37	21.63	24.00
21.00	21.00	0.00	7.00	6.68	21.84	24.00
22.00	22.00	0.00	7.28	7.00	22.04	24.00
23.00	23.00	0.00	7.57	7.32	22.23	24.00
24.00	24.00	0.00	7.86	7.64	22.40	24.00
25.00	25.00	0.00	8.16	7.96	22.56	24.00
26.00	26.00	0.00	8.45	8.28	22.71	24.00
27.00	27.00	0.00	8.75	8.59	22.84	24.00
28.00	28.00	0.00	9.05	8.91	22.96	24.00
29.00	29.00	0.00	9.35	9.23	23.07	24.00
30.00	30.00	0.00	9.65	9.55	23.17	24.00
31.00	31.00	0.00	9.96	9.87	23.26	24.00
32.00	32.00	0.00	10.27	10.19	23.33	24.00

Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
33.00	33.00	0.00	10.57	10.50	23.40	24.00
34.00	34.00	0.00	10.88	10.82	23.46	24.00
35.00	34.82	0.18	11.14	11.08	23.51	24.00
36.00	34.91	1.09	11.17	11.11	23.51	24.00

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
582.68	583.11	583.49	1.02
582.70	582.64	583.40	0.97
582.73	582.69	583.52	1.04
582.76	583.54	584.04	1.30
582.78	583.67	584.25	1.40
582.81	583.80	584.47	1.51
582.83	583.94	584.71	1.63
582.85	584.09	584.95	1.75
582.87	584.24	585.21	1.88
582.89	584.39	585.47	2.01
582.91	584.56	585.75	2.15
582.93	584.73	586.05	2.30
582.95	584.90	586.35	2.45
582.96	585.09	586.67	2.61
582.98	585.28	587.00	2.78
582.99	585.48	587.35	2.95
583.00	585.69	587.71	3.13
583.01	585.90	588.09	3.32
583.02	586.13	588.48	3.51
583.03	586.36	588.88	3.71
583.04	586.61	589.30	3.92
583.05	586.86	589.73	4.14
583.05	587.12	590.18	4.37

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
583.06	587.39	590.65	4.60
583.07	587.66	591.12	4.84
583.07	587.90	591.53	5.04
583.07	587.92	591.57	5.06

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Tuesday, 11 / 13 / 2018

Pond No. 2 - F,G,H,J & J' DETENTION

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	575.00	n/a	0	0
1.00	576.00	n/a	66	66
2.00	577.00	n/a	197	263
3.00	578.00	n/a	805	1,068
4.00	579.00	n/a	3,266	4,334
5.00	580.00	n/a	11,856	16,190
6.00	581.00	n/a	26,087	42,277
7.00	582.00	n/a	34,733	77,010
8.00	583.00	n/a	53,090	130,100
9.00	584.00	n/a	63,299	193,399

Culvert / Orifice Structures

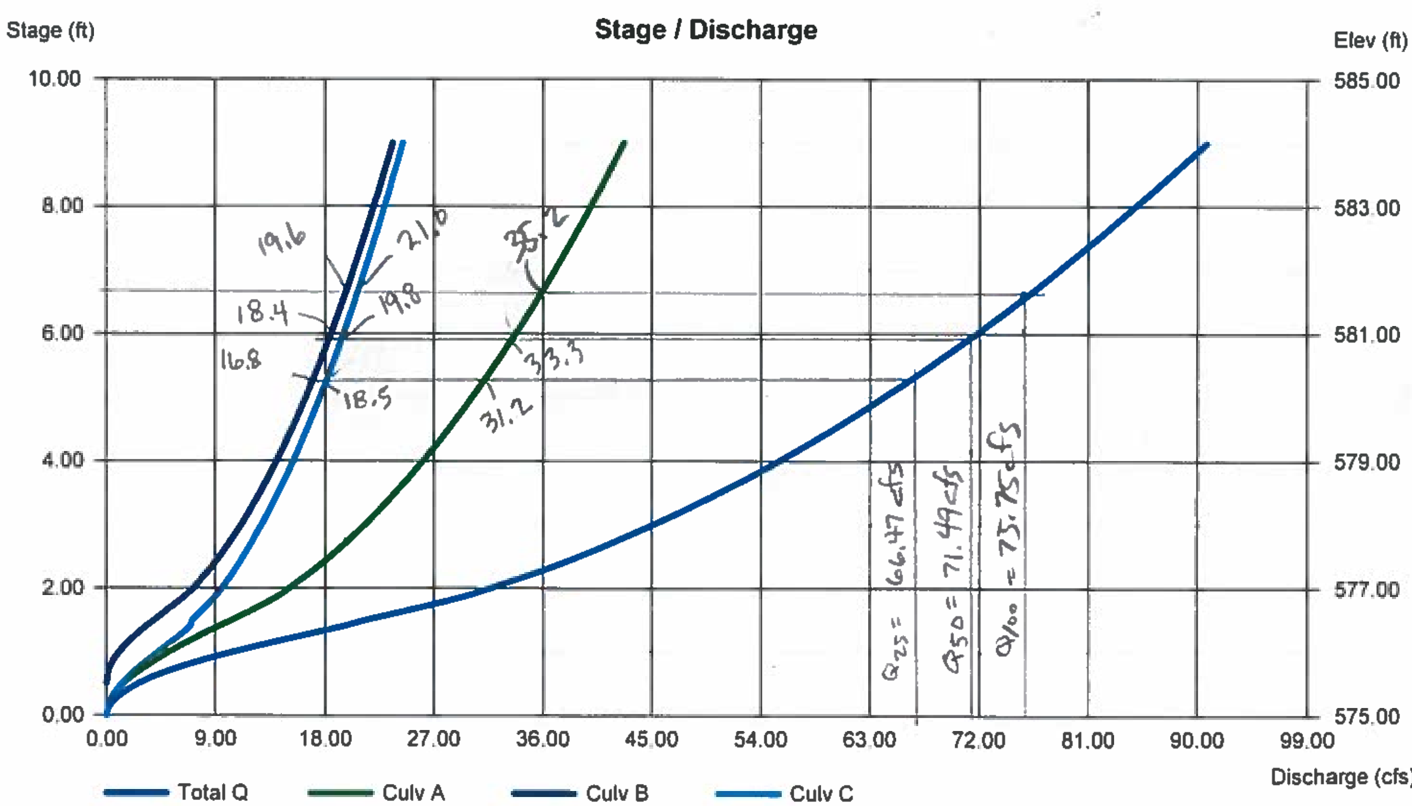
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	18.00	18.00	Inactive
Span (in)	= 24.00	18.00	18.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 575.02	575.55	575.00	0.00
Length (ft)	= 77.00	55.00	60.00	0.00
Slope (%)	= 1.10	1.50	1.00	n/a
N-Value	= .012	.012	.012	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Nov 13 2018

24 RCP @ N 1551813, E 1942775 - HWY 20 (POST-DEV)

Invert Elev Dn (ft)	=	574.20
Pipe Length (ft)	=	77.30
Slope (%)	=	1.06
Invert Elev Up (ft)	=	575.02
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

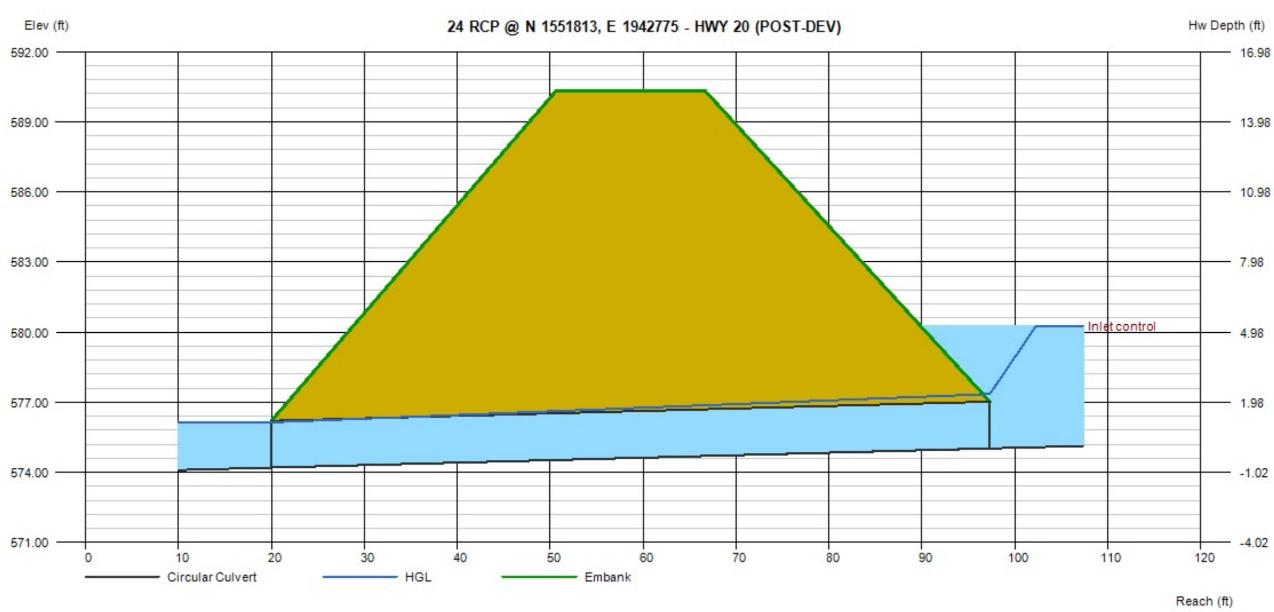
Top Elevation (ft)	=	590.33
Top Width (ft)	=	16.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	31.20
Qmax (cfs)	=	35.20
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	31.20
Qpipe (cfs)	=	31.20
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.02
Veloc Up (ft/s)	=	9.93
HGL Dn (ft)	=	576.14
HGL Up (ft)	=	577.35
Hw Elev (ft)	=	580.27
Hw/D (ft)	=	2.63
Flow Regime	=	Inlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
31.20	31.20	0.00	10.02	9.93	23.27	24.00
31.70	31.70	0.00	10.17	10.09	23.31	24.00
32.20	32.20	0.00	10.33	10.25	23.35	24.00
32.70	32.70	0.00	10.48	10.41	23.38	24.00
33.20	33.20	0.00	10.64	10.57	23.42	24.00
33.70	33.70	0.00	10.79	10.73	23.45	24.00
34.20	34.20	0.00	10.95	10.89	23.48	24.00
34.70	34.70	0.00	11.10	11.05	23.50	24.00
35.20	35.20	0.00	11.26	11.20	23.53	24.00

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
576.14	577.35	580.27	2.63
576.14	577.39	580.40	2.69
576.15	577.43	580.53	2.76
576.15	577.47	580.66	2.82
576.15	577.51	580.79	2.89
576.15	577.56	580.93	2.95
576.16	577.60	581.07	3.02
576.16	577.65	581.21	3.09
576.16	577.69	581.35	3.16

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Nov 13 2018

24 RCP @ N 1551813, E 1942775 - HWY 20 (PRE-DEV)

Invert Elev Dn (ft)	=	574.20
Pipe Length (ft)	=	77.30
Slope (%)	=	1.06
Invert Elev Up (ft)	=	575.02
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

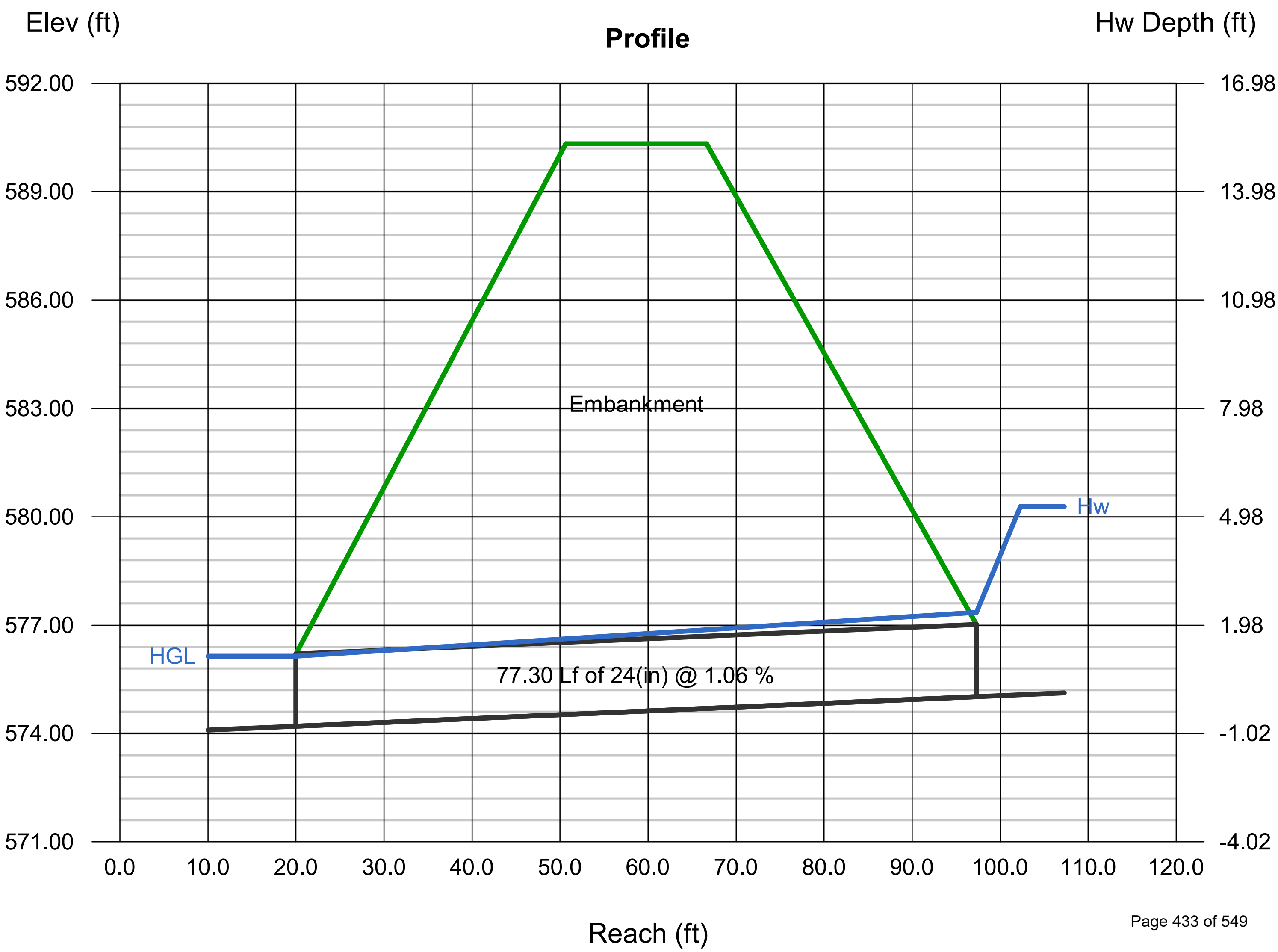
Top Elevation (ft)	=	590.33
Top Width (ft)	=	16.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	31.25
Qmax (cfs)	=	49.60
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	31.25
Qpipe (cfs)	=	31.25
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.04
Veloc Up (ft/s)	=	9.95
HGL Dn (ft)	=	576.14
HGL Up (ft)	=	577.35
Hw Elev (ft)	=	580.29
Hw/D (ft)	=	2.63
Flow Regime	=	Inlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
31.25	31.25	0.00	10.04	9.95	23.28	24.00
31.55	31.55	0.00	10.13	10.04	23.30	24.00
31.85	31.85	0.00	10.22	10.14	23.32	24.00
32.15	32.15	0.00	10.31	10.23	23.34	24.00
32.45	32.45	0.00	10.40	10.33	23.37	24.00
32.75	32.75	0.00	10.50	10.42	23.39	24.00
33.05	33.05	0.00	10.59	10.52	23.41	24.00
33.35	33.35	0.00	10.68	10.62	23.43	24.00
33.65	33.65	0.00	10.78	10.71	23.44	24.00
33.95	33.95	0.00	10.87	10.81	23.46	24.00
34.25	34.25	0.00	10.96	10.90	23.48	24.00
34.55	34.55	0.00	11.05	11.00	23.50	24.00
34.85	34.85	0.00	11.15	11.09	23.51	24.00
35.15	35.15	0.00	11.24	11.19	23.53	24.00
35.45	35.45	0.00	11.33	11.28	23.54	24.00
35.75	35.75	0.00	11.43	11.38	23.55	24.00
36.05	36.05	0.00	11.52	11.48	23.57	24.00
36.35	36.35	0.00	11.62	11.57	23.58	24.00
36.65	36.65	0.00	11.71	11.67	23.59	24.00
36.95	36.95	0.00	11.80	11.76	23.61	24.00
37.25	37.25	0.00	11.90	11.86	23.62	24.00
37.55	37.55	0.00	11.99	11.95	23.63	24.00
37.85	37.85	0.00	12.09	12.05	23.64	24.00

Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
38.15	38.15	0.00	12.18	12.14	23.65	24.00
38.45	38.45	0.00	12.27	12.24	23.66	24.00
38.75	38.75	0.00	12.37	12.33	23.67	24.00
39.05	39.05	0.00	12.46	12.43	23.68	24.00
39.35	39.35	0.00	12.56	12.53	23.69	24.00
39.65	39.65	0.00	12.65	12.62	23.70	24.00
39.95	39.95	0.00	12.75	12.72	23.71	24.00
40.25	40.25	0.00	12.84	12.81	23.72	24.00
40.55	40.55	0.00	12.93	12.91	23.73	24.00
40.85	40.85	0.00	13.03	13.00	23.73	24.00
41.15	41.15	0.00	13.12	13.10	23.74	24.00
41.45	41.45	0.00	13.22	13.19	23.75	24.00
41.75	41.75	0.00	13.31	13.29	23.76	24.00
42.05	42.05	0.00	13.41	13.38	23.76	24.00
42.35	42.35	0.00	13.50	13.48	23.77	24.00
42.65	42.65	0.00	13.60	13.58	23.77	24.00
42.95	42.95	0.00	13.69	13.67	23.78	24.00
43.25	43.25	0.00	13.79	13.77	23.79	24.00
43.55	43.55	0.00	13.88	13.86	23.79	24.00
43.85	43.85	0.00	13.98	13.96	23.80	24.00
44.15	44.15	0.00	14.07	14.05	23.80	24.00
44.45	44.45	0.00	14.17	14.15	23.81	24.00
44.75	44.75	0.00	14.26	14.24	23.81	24.00

Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
45.05	45.05	0.00	14.36	14.34	23.82	24.00
45.35	45.35	0.00	14.45	14.44	23.82	24.00
45.65	45.65	0.00	14.55	14.53	23.83	24.00
45.95	45.95	0.00	14.64	14.63	23.83	24.00
46.25	46.25	0.00	14.74	14.72	23.84	24.00
46.55	46.55	0.00	14.83	14.82	23.84	24.00
46.85	46.85	0.00	14.93	14.91	23.84	24.00
47.15	47.15	0.00	15.02	15.01	23.85	24.00
47.45	47.45	0.00	15.12	15.10	23.85	24.00
47.75	47.75	0.00	15.21	15.20	23.86	24.00
48.05	48.05	0.00	15.31	15.29	23.86	24.00
48.35	48.35	0.00	15.40	15.39	23.86	24.00
48.65	48.65	0.00	15.50	15.49	23.87	24.00
48.95	48.95	0.00	15.59	15.58	23.87	24.00
49.25	49.25	0.00	15.69	15.68	23.87	24.00
49.55	49.55	0.00	15.78	15.77	23.88	24.00

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
576.14	577.35	580.29	2.63
576.14	577.37	580.36	2.67
576.14	577.40	580.44	2.71
576.15	577.42	580.52	2.75
576.15	577.45	580.60	2.79
576.15	577.47	580.67	2.83
576.15	577.50	580.75	2.87
576.15	577.53	580.83	2.91
576.15	577.55	580.92	2.95
576.16	577.58	581.00	2.99
576.16	577.61	581.08	3.03
576.16	577.63	581.16	3.07
576.16	577.66	581.25	3.11
576.16	577.69	581.33	3.16
576.16	577.71	581.42	3.20
576.16	577.74	581.50	3.24
576.16	577.77	581.59	3.29
576.17	577.80	581.68	3.33
576.17	577.83	581.77	3.37
576.17	577.86	581.86	3.42
576.17	577.88	581.94	3.46
576.17	577.91	582.04	3.51
576.17	577.94	582.13	3.55

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
576.17	577.97	582.22	3.60
576.17	578.00	582.31	3.65
576.17	578.03	582.40	3.69
576.17	578.06	582.50	3.74
576.17	578.09	582.59	3.79
576.18	578.12	582.69	3.83
576.18	578.15	582.79	3.88
576.18	578.19	582.88	3.93
576.18	578.22	582.98	3.98
576.18	578.25	583.08	4.03
576.18	578.28	583.18	4.08
576.18	578.31	583.28	4.13
576.18	578.34	583.38	4.18
576.18	578.38	583.48	4.23
576.18	578.41	583.58	4.28
576.18	578.44	583.68	4.33
576.18	578.48	583.79	4.38
576.18	578.51	583.89	4.44
576.18	578.54	584.00	4.49
576.18	578.58	584.10	4.54
576.18	578.61	584.21	4.59
576.18	578.64	584.32	4.65
576.18	578.68	584.42	4.70

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
576.18	578.71	584.53	4.76
576.19	578.75	584.64	4.81
576.19	578.78	584.75	4.87
576.19	578.82	584.86	4.92
576.19	578.86	584.98	4.98
576.19	578.89	585.09	5.03
576.19	578.93	585.20	5.09
576.19	578.96	585.31	5.15
576.19	579.00	585.43	5.20
576.19	579.04	585.54	5.26
576.19	579.07	585.66	5.32
576.19	579.11	585.78	5.38
576.19	579.15	585.89	5.44
576.19	579.19	586.01	5.50
576.19	579.22	586.13	5.56
576.19	579.26	586.25	5.62

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Jan 13 2018

Pipe Northeast of AP#3 @ N 1,551,703; E 1,942,802 Under Railroad (Pre-Dev)

Invert Elev Dn (ft)	=	574.72
Pipe Length (ft)	=	55.00
Slope (%)	=	1.51
Invert Elev Up (ft)	=	575.55
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

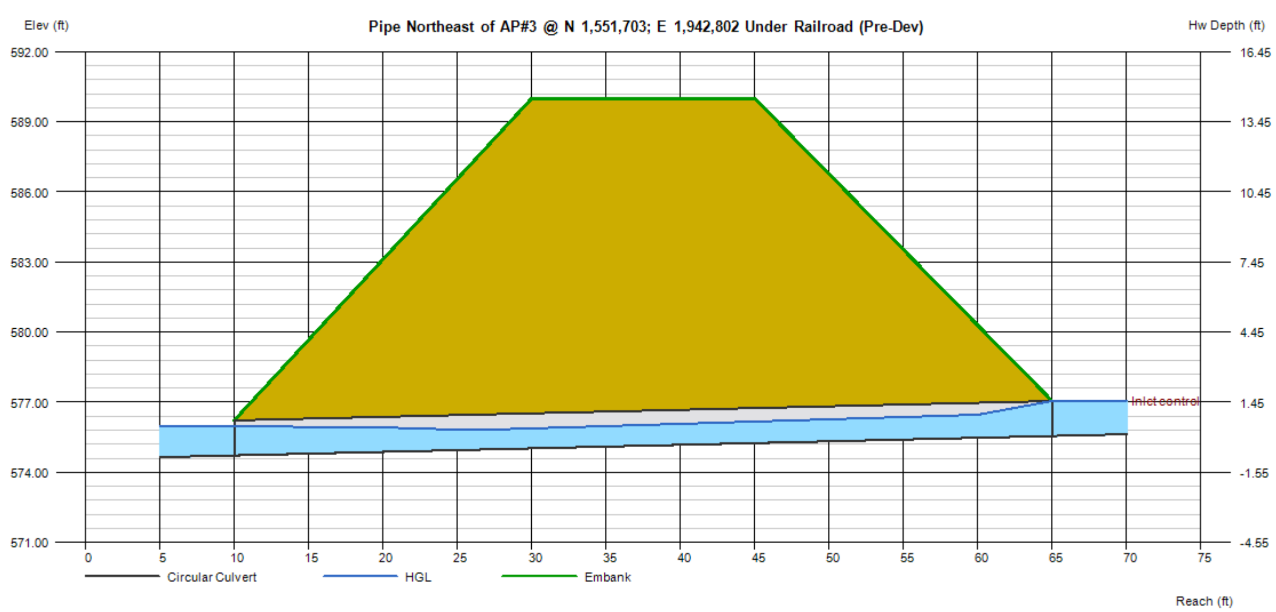
Top Elevation (ft)	=	590.00
Top Width (ft)	=	15.00
Crest Width (ft)	=	0.00

Calculations

Qmin (cfs)	=	6.80
Qmax (cfs)	=	10.20
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	6.80
Qpipe (cfs)	=	6.80
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.31
Veloc Up (ft/s)	=	5.38
HGL Dn (ft)	=	575.97
HGL Up (ft)	=	576.56
Hw Elev (ft)	=	577.06
Hw/D (ft)	=	1.01
Flow Regime	=	Inlet Control



Q			Veloc		Depth
Total	Pipe	Over	Dn	Up	Dn
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)
6.80	6.80	0.00	4.31	5.38	15.05
7.00	7.00	0.00	4.41	5.45	15.14
7.20	7.20	0.00	4.52	5.52	15.23
7.40	7.40	0.00	4.62	5.58	15.32
7.60	7.60	0.00	4.72	5.65	15.40
7.80	7.80	0.00	4.82	5.72	15.49
8.00	8.00	0.00	4.92	5.79	15.57
8.20	8.20	0.00	5.03	5.86	15.65
8.40	8.40	0.00	5.13	5.93	15.73
8.60	8.60	0.00	5.23	6.00	15.81
8.80	8.80	0.00	5.33	6.07	15.88
9.00	9.00	0.00	5.43	6.14	15.96
9.20	9.20	0.00	5.53	6.21	16.03
9.40	9.40	0.00	5.64	6.28	16.10
9.60	9.60	0.00	5.74	6.36	16.17
9.80	9.80	0.00	5.84	6.43	16.24
10.00	10.00	0.00	5.94	6.51	16.31
10.20	10.20	0.00	6.04	6.58	16.37

Depth	HGL			
Up	Dn	Up	Hw	Hw/D
(in)	(ft)	(ft)	(ft)	
12.10	575.97	576.56	577.06	1.01
12.28	575.98	576.57	577.09	1.03
12.46	575.99	576.59	577.12	1.05
12.63	576.00	576.60	577.16	1.07
12.81	576.00	576.62	577.19	1.09
12.97	576.01	576.63	577.22	1.11
13.14	576.02	576.64	577.25	1.13
13.30	576.02	576.66	577.28	1.15
13.46	576.03	576.67	577.31	1.17
13.61	576.04	576.68	577.34	1.19
13.77	576.04	576.70	577.37	1.21
13.91	576.05	576.71	577.40	1.23
14.06	576.06	576.72	577.43	1.26
14.20	576.06	576.73	577.47	1.28
14.34	576.07	576.75	577.51	1.31
14.48	576.07	576.76	577.55	1.33
14.61	576.08	576.77	577.59	1.36
14.74	576.08	576.78	577.63	1.39

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Nov 13 2018

Pipe Northeast of AP#3 @ N 1,551,703; E 1,942,802 Under Railroad (Post-Dev)

Invert Elev Dn (ft)	=	574.72
Pipe Length (ft)	=	55.00
Slope (%)	=	1.51
Invert Elev Up (ft)	=	575.55
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

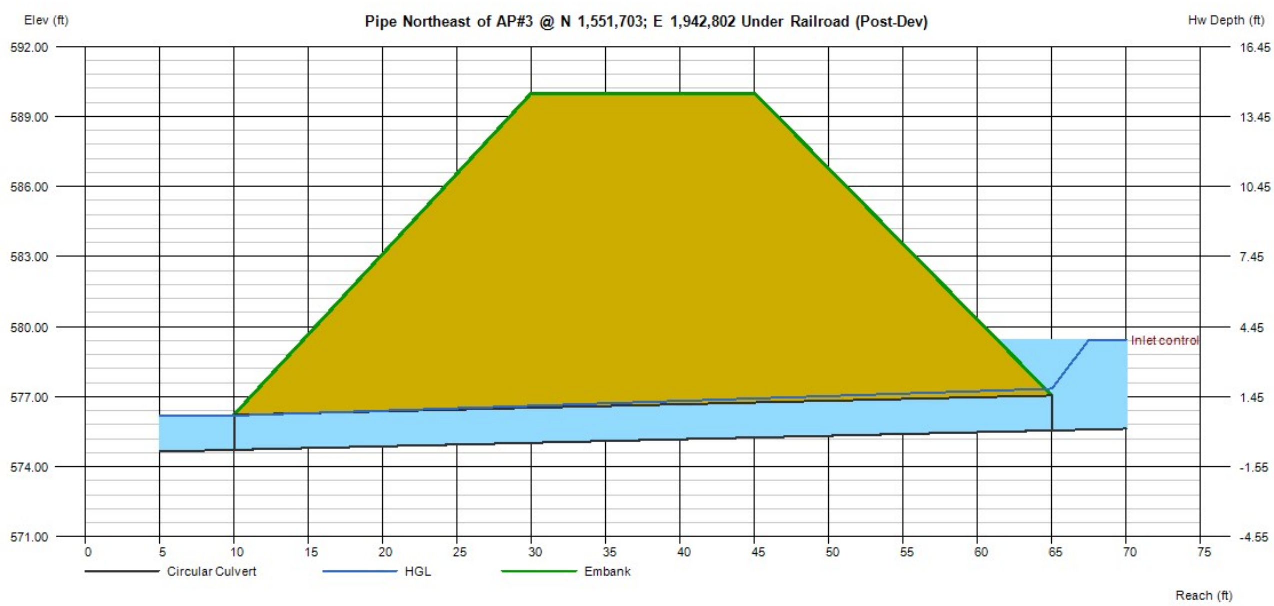
Top Elevation (ft)	=	590.00
Top Width (ft)	=	15.00
Crest Width (ft)	=	0.00

Calculations

Qmin (cfs)	=	16.80
Qmax (cfs)	=	19.60
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	16.80
Qpipe (cfs)	=	16.80
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.56
Veloc Up (ft/s)	=	9.51
HGL Dn (ft)	=	576.19
HGL Up (ft)	=	577.34
Hw Elev (ft)	=	579.44
Hw/D (ft)	=	2.59
Flow Regime	=	Inlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
16.80	16.80	0.00	9.56	9.51	17.62	18.00
17.05	17.05	0.00	9.69	9.65	17.64	18.00
17.30	17.30	0.00	9.83	9.79	17.66	18.00
17.55	17.55	0.00	9.97	9.93	17.68	18.00
17.80	17.80	0.00	10.11	10.07	17.69	18.00
18.05	18.05	0.00	10.25	10.21	17.71	18.00
18.30	18.30	0.00	10.39	10.36	17.72	18.00
18.55	18.55	0.00	10.53	10.50	17.74	18.00
18.80	18.80	0.00	10.67	10.64	17.75	18.00
19.05	19.05	0.00	10.81	10.78	17.76	18.00
19.30	19.30	0.00	10.95	10.92	17.78	18.00
19.55	19.55	0.00	11.09	11.06	17.79	18.00

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
576.19	577.34	579.44	2.59
576.19	577.37	579.52	2.65
576.19	577.41	579.61	2.71
576.19	577.45	579.70	2.77
576.19	577.49	579.79	2.83
576.20	577.52	579.88	2.89
576.20	577.56	579.97	2.95
576.20	577.60	580.07	3.01
576.20	577.64	580.16	3.07
576.20	577.68	580.26	3.14
576.20	577.72	580.35	3.20
576.20	577.77	580.45	3.27

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Nov 13 2018

NEW 18 RCP @ N 1,551,728 ; E 1,942,802 UNDER RR (POST-DEV)

Invert Elev Dn (ft)	=	574.72
Pipe Length (ft)	=	55.00
Slope (%)	=	1.51
Invert Elev Up (ft)	=	575.55
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

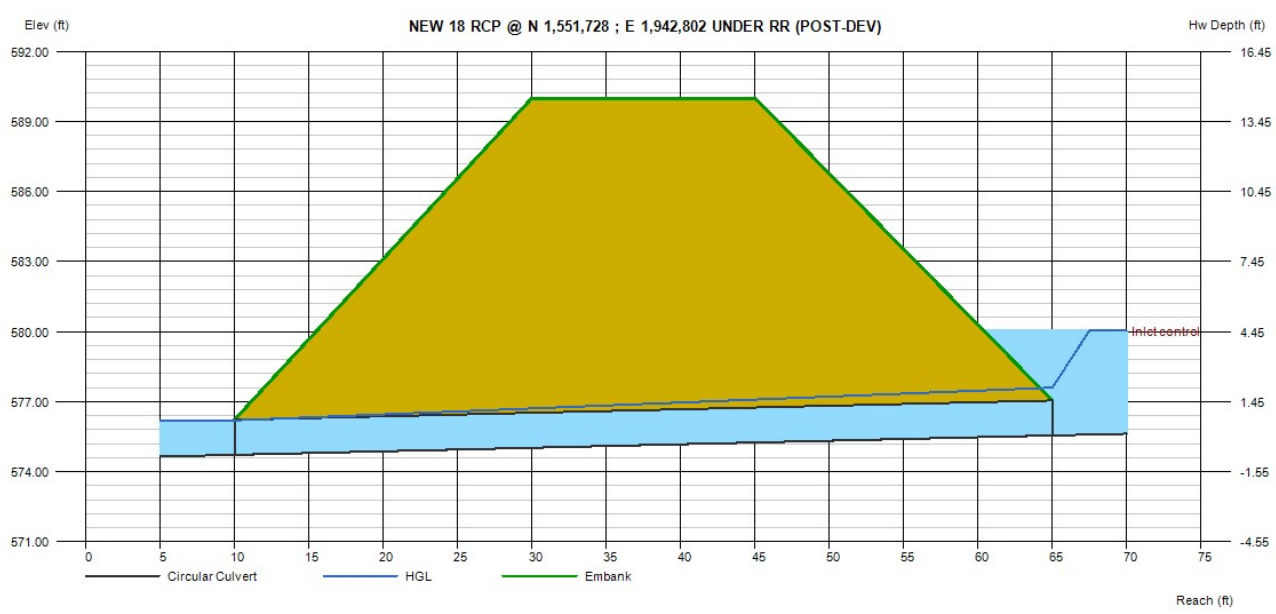
Top Elevation (ft)	=	590.00
Top Width (ft)	=	15.00
Crest Width (ft)	=	0.00

Calculations

Qmin (cfs)	=	18.50
Qmax (cfs)	=	21.00
Tailwater Elev (ft)	=	(dc+D)/2

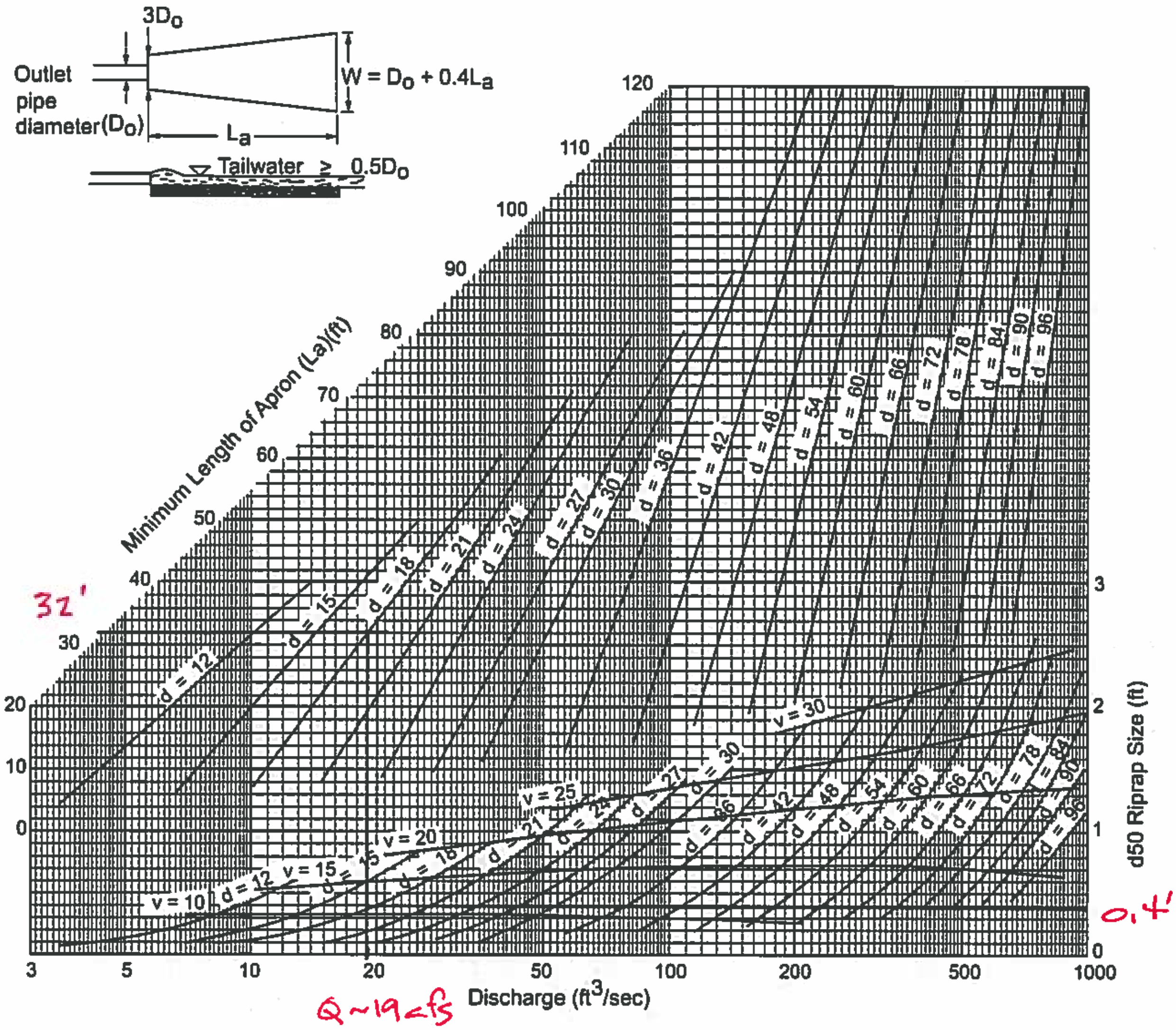
Highlighted

Qtotal (cfs)	=	18.50
Qpipe (cfs)	=	18.50
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.50
Veloc Up (ft/s)	=	10.47
HGL Dn (ft)	=	576.20
HGL Up (ft)	=	577.60
Hw Elev (ft)	=	580.05
Hw/D (ft)	=	3.00
Flow Regime	=	Inlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
18.50	18.50	0.00	10.50	10.47	17.73	18.00
18.75	18.75	0.00	10.64	10.61	17.75	18.00
19.00	19.00	0.00	10.78	10.75	17.76	18.00
19.25	19.25	0.00	10.92	10.89	17.77	18.00
19.50	19.50	0.00	11.06	11.03	17.78	18.00
19.75	19.75	0.00	11.20	11.18	17.79	18.00
20.00	20.00	0.00	11.34	11.32	17.80	18.00
20.25	20.25	0.00	11.48	11.46	17.81	18.00
20.50	20.50	0.00	11.62	11.60	17.82	18.00
20.75	20.75	0.00	11.76	11.74	17.83	18.00
21.00	21.00	0.00	11.90	11.88	17.84	18.00

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
576.20	577.60	580.05	3.00
576.20	577.63	580.14	3.06
576.20	577.68	580.24	3.13
576.20	577.72	580.34	3.19
576.20	577.76	580.43	3.26
576.20	577.80	580.53	3.32
576.20	577.84	580.63	3.39
576.20	577.88	580.74	3.46
576.21	577.93	580.84	3.53
576.21	577.97	580.94	3.60
576.21	578.02	581.05	3.67



Curves may not be extrapolated.

Figure 6-34.2 - Design of Outlet Protection From a Round Pipe Flowing Full, Maximum Tailwater Condition (Tw > 0.5 Diameter)

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Nov 13 2018

4'x2' Box Culvert @ N 1551488, E 1942656 - 25yr & 100 yr.

Invert Elev Dn (ft)	=	593.14
Pipe Length (ft)	=	30.00
Slope (%)	=	0.50
Invert Elev Up (ft)	=	593.29
Rise (in)	=	24.0
Shape	=	Box
Span (in)	=	48.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

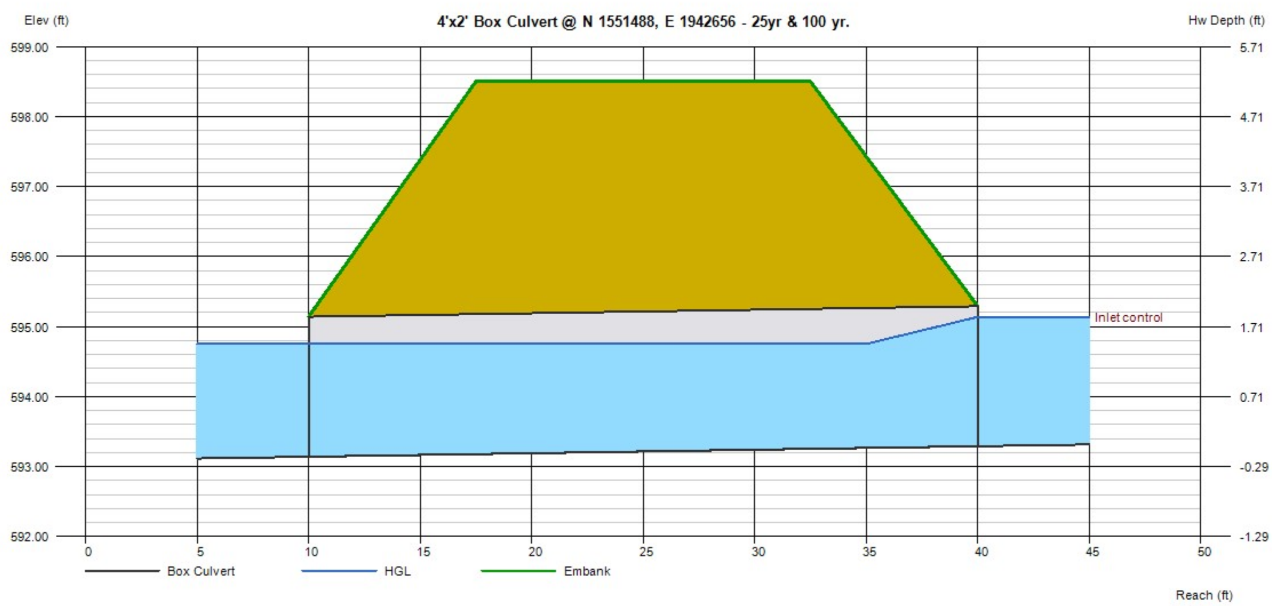
Top Elevation (ft)	=	598.50
Top Width (ft)	=	15.00
Crest Width (ft)	=	15.00

Calculations

Qmin (cfs)	=	30.67
Qmax (cfs)	=	36.63
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	30.67
Qpipe (cfs)	=	30.67
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.76
Veloc Up (ft/s)	=	5.24
HGL Dn (ft)	=	594.75
HGL Up (ft)	=	594.75
Hw Elev (ft)	=	595.14
Hw/D (ft)	=	0.92
Flow Regime	=	Inlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
30.67	30.67	0.00	4.76	5.24	19.34	17.55
30.92	30.92	0.00	4.79	5.27	19.37	17.59
31.17	31.17	0.00	4.82	5.31	19.41	17.63
31.42	31.42	0.00	4.85	5.34	19.45	17.67
31.67	31.67	0.00	4.87	5.37	19.49	17.71
31.92	31.92	0.00	4.90	5.40	19.53	17.75
32.17	32.17	0.00	4.93	5.43	19.57	17.78
32.42	32.42	0.00	4.96	5.46	19.61	17.82
32.67	32.67	0.00	4.99	5.49	19.65	17.86
32.92	32.92	0.00	5.02	5.52	19.69	17.90
33.17	33.17	0.00	5.04	5.55	19.73	17.94
33.42	33.42	0.00	5.07	5.58	19.77	17.98
33.67	33.67	0.00	5.10	5.61	19.81	18.02
33.92	33.92	0.00	5.13	5.64	19.84	18.06
34.17	34.17	0.00	5.16	5.67	19.88	18.09
34.42	34.42	0.00	5.18	5.69	19.92	18.13
34.67	34.67	0.00	5.21	5.72	19.96	18.17
34.92	34.92	0.00	5.24	5.75	20.00	18.21
35.17	35.17	0.00	5.27	5.78	20.04	18.25
35.42	35.42	0.00	5.29	5.81	20.07	18.29
35.67	35.67	0.00	5.32	5.84	20.11	18.32
35.92	35.92	0.00	5.35	5.87	20.15	18.36
36.17	36.17	0.00	5.38	5.90	20.19	18.40
36.42	36.42	0.00	5.40	5.93	20.22	18.44

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
594.75	594.75	595.14	0.92
594.75	594.76	595.15	0.93
594.76	594.76	595.16	0.93
594.76	594.76	595.17	0.94
594.76	594.77	595.18	0.94
594.77	594.77	595.19	0.95
594.77	594.77	595.20	0.95
594.77	594.78	595.21	0.96
594.78	594.78	595.22	0.96
594.78	594.78	595.23	0.97
594.78	594.79	595.24	0.97
594.79	594.79	595.25	0.98
594.79	594.79	595.26	0.98
594.79	594.79	595.27	0.99
594.80	594.80	595.55	1.13
594.80	594.80	595.56	1.13
594.80	594.80	595.56	1.14
594.81	594.81	595.57	1.14
594.81	594.81	595.57	1.14
594.81	594.81	595.58	1.14
594.82	594.82	595.58	1.15
594.82	594.82	595.59	1.15
594.82	594.82	595.59	1.15
594.83	594.83	595.60	1.15

Culvert Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. Tuesday, Dec 12 2017

12 in CMP (EXIST) @ N 1550448, E 1943137 UNDER RAILROAD

Invert Elev Dn (ft)	=	579.83
Pipe Length (ft)	=	41.20
Slope (%)	=	0.80
Invert Elev Up (ft)	=	580.16
Rise (in)	=	12.0
Shape	=	Circular
Span (in)	=	12.0
No. Barrels	=	1
n-Value	=	0.023
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Projecting
Coeff. K,M,c,Y,k	=	0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

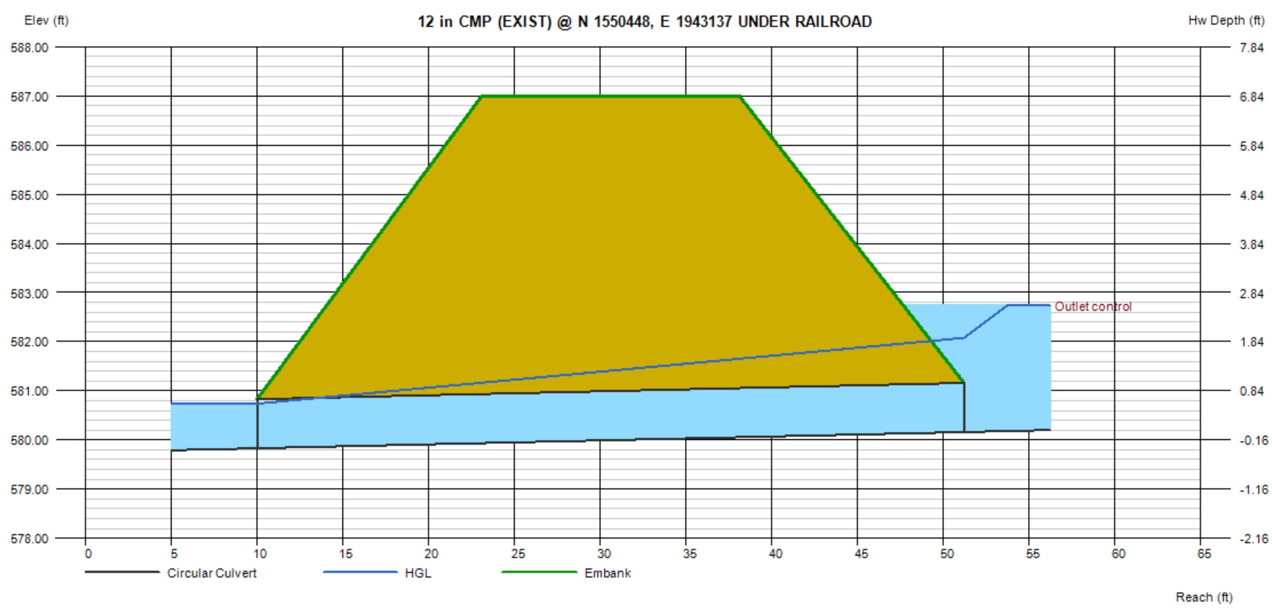
Top Elevation (ft)	=	587.00
Top Width (ft)	=	15.00
Crest Width (ft)	=	15.00

Calculations

Qmin (cfs)	=	3.70
Qmax (cfs)	=	4.10
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	3.70
Qpipe (cfs)	=	3.70
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.93
Veloc Up (ft/s)	=	4.71
HGL Dn (ft)	=	580.74
HGL Up (ft)	=	582.08
Hw Elev (ft)	=	582.73
Hw/D (ft)	=	2.57
Flow Regime	=	Outlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
3.70	3.70	0.00	4.93	4.71	10.91	12.00
3.71	3.71	0.00	4.94	4.72	10.92	12.00
3.72	3.72	0.00	4.96	4.74	10.93	12.00
3.73	3.73	0.00	4.97	4.75	10.93	12.00
3.74	3.74	0.00	4.98	4.76	10.94	12.00
3.75	3.75	0.00	4.99	4.77	10.94	12.00
3.76	3.76	0.00	5.00	4.79	10.95	12.00
3.77	3.77	0.00	5.01	4.80	10.95	12.00
3.78	3.78	0.00	5.02	4.81	10.96	12.00
3.79	3.79	0.00	5.04	4.83	10.97	12.00
3.80	3.80	0.00	5.05	4.84	10.97	12.00
3.81	3.81	0.00	5.06	4.85	10.98	12.00
3.82	3.82	0.00	5.07	4.86	10.98	12.00
3.83	3.83	0.00	5.08	4.88	10.99	12.00
3.84	3.84	0.00	5.09	4.89	10.99	12.00
3.85	3.85	0.00	5.11	4.90	11.00	12.00
3.86	3.86	0.00	5.12	4.91	11.01	12.00
3.87	3.87	0.00	5.13	4.93	11.01	12.00
3.88	3.88	0.00	5.14	4.94	11.02	12.00
3.89	3.89	0.00	5.15	4.95	11.02	12.00
3.90	3.90	0.00	5.16	4.97	11.03	12.00
3.91	3.91	0.00	5.17	4.98	11.03	12.00
3.92	3.92	0.00	5.19	4.99	11.04	12.00

Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
3.93	3.93	0.00	5.20	5.00	11.04	12.00
3.94	3.94	0.00	5.21	5.02	11.05	12.00
3.95	3.95	0.00	5.22	5.03	11.05	12.00
3.96	3.96	0.00	5.23	5.04	11.06	12.00
3.97	3.97	0.00	5.24	5.05	11.06	12.00
3.98	3.98	0.00	5.26	5.07	11.07	12.00
3.99	3.99	0.00	5.27	5.08	11.08	12.00
4.00	4.00	0.00	5.28	5.09	11.08	12.00
4.01	4.01	0.00	5.29	5.11	11.09	12.00
4.02	4.02	0.00	5.30	5.12	11.09	12.00
4.03	4.03	0.00	5.31	5.13	11.10	12.00
4.04	4.04	0.00	5.32	5.14	11.10	12.00
4.05	4.05	0.00	5.34	5.16	11.11	12.00
4.06	4.06	0.00	5.35	5.17	11.11	12.00
4.07	4.07	0.00	5.36	5.18	11.12	12.00
4.08	4.08	0.00	5.37	5.19	11.12	12.00
4.09	4.09	0.00	5.38	5.21	11.13	12.00

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
580.74	582.08	582.73	2.57
580.74	582.08	582.74	2.58
580.74	582.09	582.75	2.59
580.74	582.10	582.76	2.60
580.74	582.11	582.78	2.62
580.74	582.11	582.79	2.63
580.74	582.12	582.80	2.64
580.74	582.13	582.81	2.65
580.74	582.14	582.82	2.66
580.74	582.14	582.83	2.67
580.74	582.15	582.84	2.68
580.74	582.16	582.85	2.69
580.75	582.16	582.86	2.70
580.75	582.17	582.87	2.71
580.75	582.18	582.89	2.73
580.75	582.19	582.90	2.74
580.75	582.19	582.91	2.75
580.75	582.20	582.92	2.76
580.75	582.21	582.93	2.77
580.75	582.22	582.94	2.78
580.75	582.23	582.95	2.79
580.75	582.23	582.96	2.80
580.75	582.24	582.98	2.82

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
580.75	582.25	582.99	2.83
580.75	582.26	583.00	2.84
580.75	582.26	583.01	2.85
580.75	582.27	583.02	2.86
580.75	582.28	583.03	2.87
580.75	582.29	583.05	2.89
580.75	582.29	583.06	2.90
580.75	582.30	583.07	2.91
580.75	582.31	583.08	2.92
580.75	582.32	583.09	2.93
580.75	582.33	583.10	2.94
580.76	582.33	583.11	2.95
580.76	582.34	583.13	2.97
580.76	582.35	583.14	2.98
580.76	582.36	583.15	2.99
580.76	582.36	583.16	3.00
580.76	582.37	583.17	3.01

Culvert Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. Tuesday, Dec 12 2017

12 in CMP (EXTEN) @ N 1550448, E 1943137 UNDER RAILROAD

Invert Elev Dn (ft)	=	579.83
Pipe Length (ft)	=	48.30
Slope (%)	=	0.81
Invert Elev Up (ft)	=	580.22
Rise (in)	=	12.0
Shape	=	Circular
Span (in)	=	12.0
No. Barrels	=	1
n-Value	=	0.023
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Projecting
Coeff. K,M,c,Y,k	=	0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

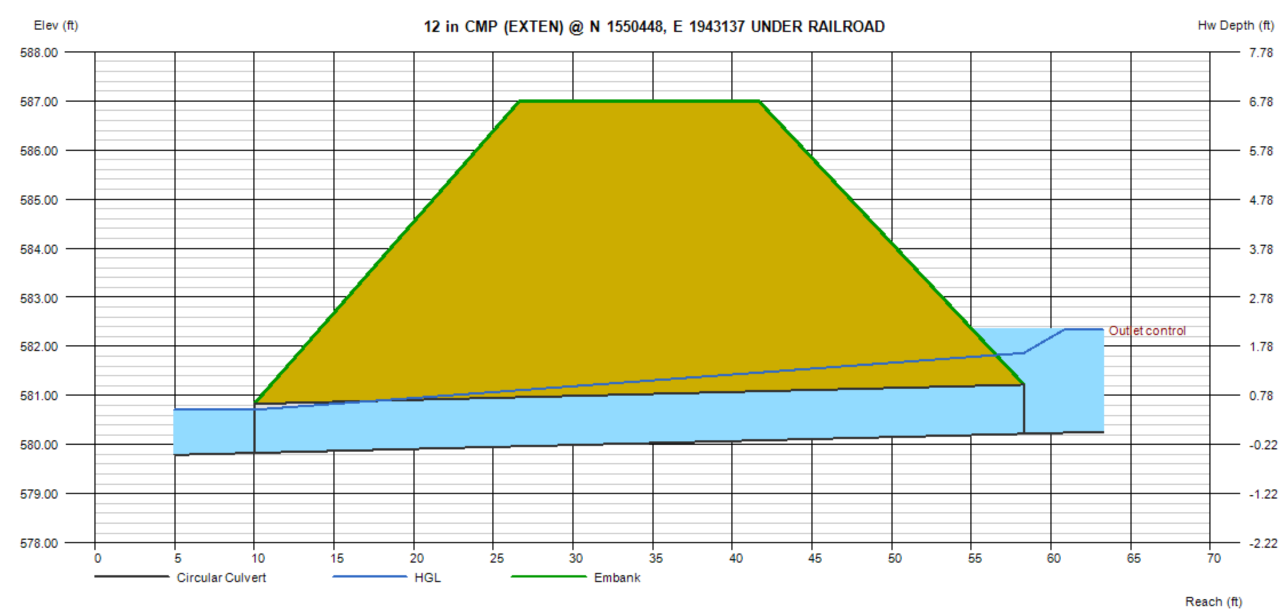
Top Elevation (ft)	=	587.00
Top Width (ft)	=	15.00
Crest Width (ft)	=	15.00

Calculations

Qmin (cfs)	=	3.14
Qmax (cfs)	=	3.63
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	3.14
Qpipe (cfs)	=	3.14
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.29
Veloc Up (ft/s)	=	4.00
HGL Dn (ft)	=	580.71
HGL Up (ft)	=	581.86
Hw Elev (ft)	=	582.34
Hw/D (ft)	=	2.12
Flow Regime	=	Outlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
3.14	3.14	0.00	4.29	4.00	10.55	12.00
3.17	3.17	0.00	4.33	4.04	10.57	12.00
3.20	3.20	0.00	4.36	4.07	10.59	12.00
3.23	3.23	0.00	4.39	4.11	10.61	12.00
3.26	3.26	0.00	4.43	4.15	10.63	12.00
3.29	3.29	0.00	4.46	4.19	10.65	12.00
3.32	3.32	0.00	4.50	4.23	10.68	12.00
3.35	3.35	0.00	4.53	4.27	10.70	12.00
3.38	3.38	0.00	4.57	4.30	10.72	12.00
3.41	3.41	0.00	4.60	4.34	10.74	12.00
3.44	3.44	0.00	4.64	4.38	10.75	12.00
3.47	3.47	0.00	4.67	4.42	10.77	12.00
3.50	3.50	0.00	4.70	4.46	10.79	12.00
3.53	3.53	0.00	4.74	4.49	10.81	12.00
3.56	3.56	0.00	4.77	4.53	10.83	12.00
3.59	3.59	0.00	4.81	4.57	10.85	12.00
3.62	3.62	0.00	4.84	4.61	10.87	12.00

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
580.71	581.86	582.34	2.12
580.71	581.89	582.37	2.15
580.71	581.91	582.40	2.18
580.71	581.93	582.43	2.21
580.72	581.95	582.46	2.24
580.72	581.98	582.49	2.27
580.72	582.00	582.53	2.31
580.72	582.02	582.56	2.34
580.72	582.04	582.59	2.37
580.72	582.07	582.62	2.40
580.73	582.09	582.66	2.44
580.73	582.11	582.69	2.47
580.73	582.14	582.72	2.50
580.73	582.16	582.76	2.54
580.73	582.19	582.79	2.57
580.73	582.21	582.83	2.61
580.74	582.24	582.86	2.64

Culvert Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. Tuesday, Dec 12 2017

12 in CMP (EXIST) @ N 1550502, E 1943117 UNDER RAILROAD

Invert Elev Dn (ft)	= 578.32
Pipe Length (ft)	= 45.20
Slope (%)	= 4.73
Invert Elev Up (ft)	= 580.46
Rise (in)	= 12.0
Shape	= Circular
Span (in)	= 12.0
No. Barrels	= 1
n-Value	= 0.023
Culvert Type	= Circular Corrugate Metal Pipe
Culvert Entrance	= Projecting
Coeff. K,M,c,Y,k	= 0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

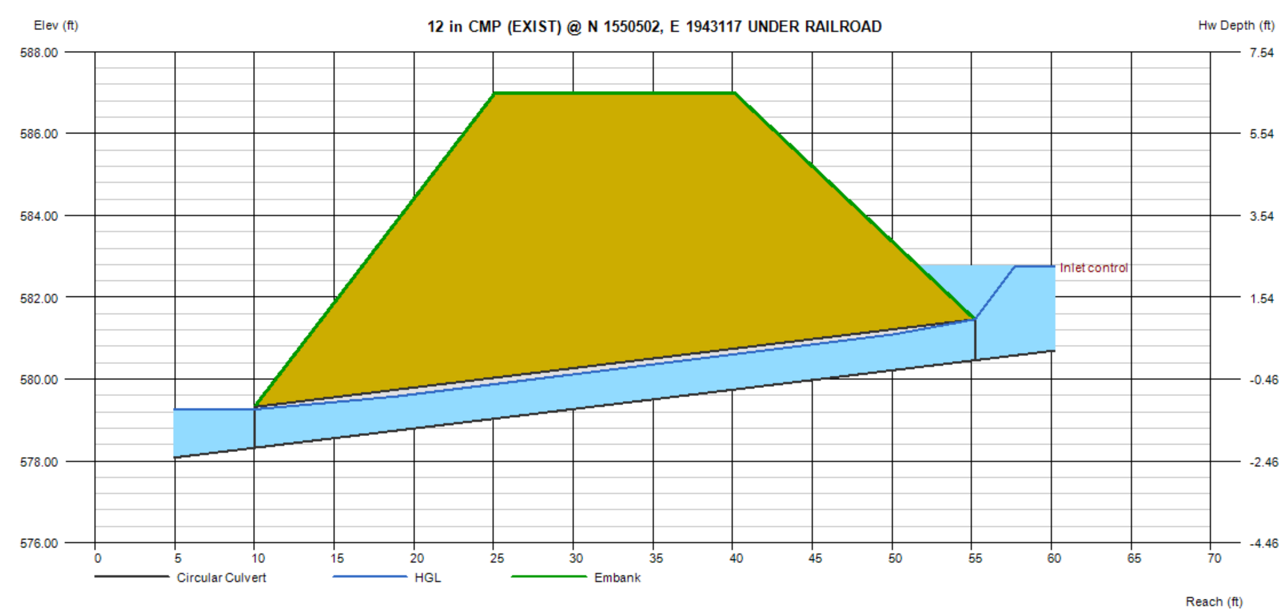
Top Elevation (ft)	= 587.00
Top Width (ft)	= 15.00
Crest Width (ft)	= 15.00

Calculations

Qmin (cfs)	= 4.45
Qmax (cfs)	= 5.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 4.45
Qpipe (cfs)	= 4.45
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 5.80
Veloc Up (ft/s)	= 6.07
HGL Dn (ft)	= 579.26
HGL Up (ft)	= 581.34
Hw Elev (ft)	= 582.75
Hw/D (ft)	= 2.29
Flow Regime	= Inlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
4.45	4.45	0.00	5.80	6.07	11.30	10.59
4.48	4.48	0.00	5.84	6.10	11.31	10.61
4.51	4.51	0.00	5.87	6.13	11.32	10.64
4.54	4.54	0.00	5.91	5.78	11.33	12.00
4.57	4.57	0.00	5.95	5.82	11.34	12.00
4.60	4.60	0.00	5.98	5.86	11.36	11.99
4.63	4.63	0.00	6.02	5.90	11.37	11.95
4.66	4.66	0.00	6.05	5.94	11.38	11.87
4.69	4.69	0.00	6.09	6.01	11.39	11.71
4.72	4.72	0.00	6.12	6.13	11.40	11.37
4.75	4.75	0.00	6.16	6.17	11.41	11.36
4.78	4.78	0.00	6.20	6.09	11.42	12.00
4.81	4.81	0.00	6.23	6.12	11.43	12.00
4.84	4.84	0.00	6.27	6.16	11.44	12.00
4.87	4.87	0.00	6.30	6.20	11.46	12.00
4.90	4.90	0.00	6.34	6.24	11.47	12.00
4.93	4.93	0.00	6.37	6.28	11.48	12.00
4.96	4.96	0.00	6.41	6.32	11.49	12.00
4.99	4.99	0.00	6.45	6.35	11.50	12.00

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
579.26	581.34	582.75	2.29
579.26	581.34	582.78	2.32
579.26	581.35	582.80	2.34
579.26	581.46	582.82	2.36
579.27	581.46	582.85	2.39
579.27	581.46	582.87	2.41
579.27	581.46	582.90	2.44
579.27	581.45	582.92	2.46
579.27	581.44	582.95	2.49
579.27	581.41	582.97	2.51
579.27	581.41	583.00	2.54
579.27	581.67	583.02	2.56
579.27	581.70	583.05	2.59
579.27	581.73	583.08	2.62
579.27	581.77	583.10	2.64
579.28	581.80	583.13	2.67
579.28	581.83	583.16	2.70
579.28	581.86	583.18	2.72
579.28	581.89	583.21	2.75

Culvert Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. — Tuesday, Dec 12 2017

12 in CMP (EXTEN) @ N 1550502, E 1943117 UNDER RAILROAD

Invert Elev Dn (ft)	=	578.32
Pipe Length (ft)	=	49.70
Slope (%)	=	4.73
Invert Elev Up (ft)	=	580.67
Rise (in)	=	12.0
Shape	=	Circular
Span (in)	=	12.0
No. Barrels	=	1
n-Value	=	0.023
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Projecting
Coeff. K,M,c,Y,k	=	0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

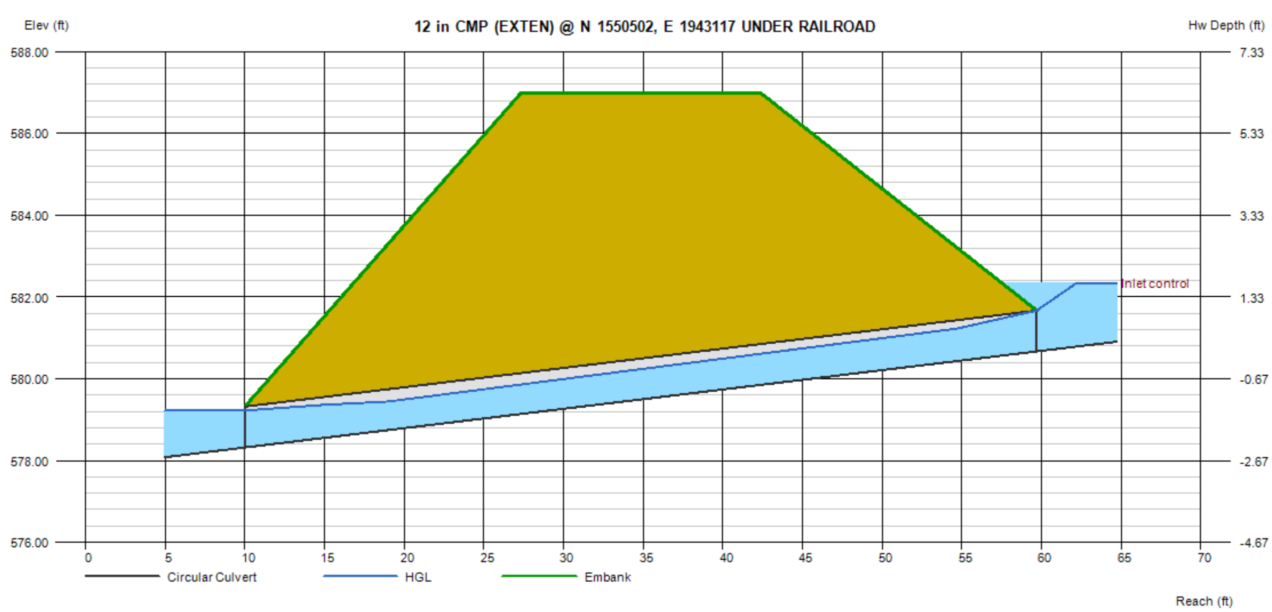
Top Elevation (ft)	=	587.00
Top Width (ft)	=	15.00
Crest Width (ft)	=	15.00

Calculations

Qmin (cfs)	=	3.59
Qmax (cfs)	=	4.34
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	3.59
Qpipe (cfs)	=	3.59
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.81
Veloc Up (ft/s)	=	5.28
HGL Dn (ft)	=	579.22
HGL Up (ft)	=	581.48
Hw Elev (ft)	=	582.34
Hw/D (ft)	=	1.67
Flow Regime	=	Inlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
3.59	3.59	0.00	4.81	5.28	10.85	9.70
3.61	3.61	0.00	4.83	5.30	10.86	9.72
3.63	3.63	0.00	4.85	5.31	10.87	9.75
3.65	3.65	0.00	4.88	5.33	10.88	9.77
3.67	3.67	0.00	4.90	5.35	10.90	9.79
3.69	3.69	0.00	4.92	5.37	10.91	9.82
3.71	3.71	0.00	4.94	5.38	10.92	9.84
3.73	3.73	0.00	4.97	5.40	10.93	9.86
3.75	3.75	0.00	4.99	5.42	10.94	9.89
3.77	3.77	0.00	5.01	5.43	10.95	9.91
3.79	3.79	0.00	5.04	5.45	10.97	9.93
3.81	3.81	0.00	5.06	5.47	10.98	9.95
3.83	3.83	0.00	5.08	5.49	10.99	9.98
3.85	3.85	0.00	5.11	5.51	11.00	10.00
3.87	3.87	0.00	5.13	5.52	11.01	10.02
3.89	3.89	0.00	5.15	5.54	11.02	10.04
3.91	3.91	0.00	5.17	5.56	11.03	10.07
3.93	3.93	0.00	5.20	5.58	11.04	10.09
3.95	3.95	0.00	5.22	5.60	11.05	10.11
3.97	3.97	0.00	5.24	5.61	11.06	10.13
3.99	3.99	0.00	5.27	5.63	11.08	10.15
4.01	4.01	0.00	5.29	5.65	11.09	10.17
4.03	4.03	0.00	5.31	5.67	11.10	10.19

Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
4.05	4.05	0.00	5.34	5.69	11.11	10.21
4.07	4.07	0.00	5.36	5.70	11.12	10.23
4.09	4.09	0.00	5.38	5.72	11.13	10.25
4.11	4.11	0.00	5.41	5.74	11.14	10.28
4.13	4.13	0.00	5.43	5.76	11.15	10.29
4.15	4.15	0.00	5.45	5.78	11.16	10.32
4.17	4.17	0.00	5.48	5.80	11.17	10.33
4.19	4.19	0.00	5.50	5.82	11.18	10.35
4.21	4.21	0.00	5.52	5.83	11.19	10.37
4.23	4.23	0.00	5.55	5.85	11.20	10.39
4.25	4.25	0.00	5.57	5.87	11.20	10.41
4.27	4.27	0.00	5.59	5.89	11.21	10.43
4.29	4.29	0.00	5.62	5.91	11.22	10.45
4.31	4.31	0.00	5.64	5.93	11.23	10.47
4.33	4.33	0.00	5.66	5.95	11.24	10.48

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
579.22	581.48	582.34	1.67
579.23	581.48	582.35	1.68
579.23	581.48	582.37	1.70
579.23	581.48	582.38	1.71
579.23	581.49	582.39	1.72
579.23	581.49	582.41	1.74
579.23	581.49	582.42	1.75
579.23	581.49	582.43	1.76
579.23	581.49	582.45	1.78
579.23	581.50	582.46	1.79
579.23	581.50	582.47	1.80
579.23	581.50	582.49	1.82
579.24	581.50	582.50	1.83
579.24	581.50	582.52	1.85
579.24	581.51	582.53	1.86
579.24	581.51	582.54	1.87
579.24	581.51	582.56	1.89
579.24	581.51	582.57	1.90
579.24	581.51	582.59	1.92
579.24	581.51	582.60	1.93
579.24	581.52	582.61	1.94
579.24	581.52	582.63	1.96
579.24	581.52	582.64	1.97

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
579.25	581.52	582.66	1.99
579.25	581.52	582.67	2.00
579.25	581.52	582.69	2.02
579.25	581.53	582.70	2.03
579.25	581.53	582.72	2.05
579.25	581.53	582.73	2.06
579.25	581.53	582.75	2.08
579.25	581.53	582.76	2.09
579.25	581.53	582.78	2.11
579.25	581.54	582.79	2.12
579.25	581.54	582.81	2.14
579.25	581.54	582.82	2.15
579.26	581.54	582.84	2.17
579.26	581.54	582.85	2.18
579.26	581.54	582.87	2.20

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Nov 13 2018

EXISTING 24 CMP @ N 1550135, E 1941896 PLANT ROAD (POST-DEV)

Invert Elev Dn (ft)	=	577.56
Pipe Length (ft)	=	141.42
Slope (%)	=	0.97
Invert Elev Up (ft)	=	578.93
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.023
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

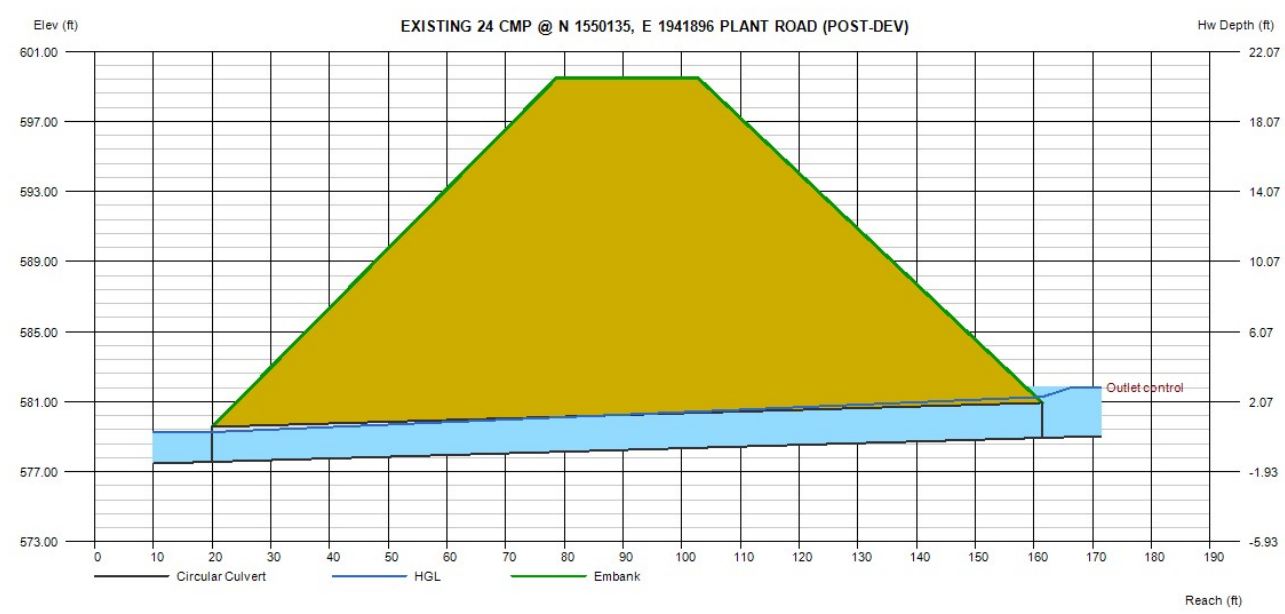
Top Elevation (ft)	=	599.50
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	15.16
Qmax (cfs)	=	16.71
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	15.16
Qpipe (cfs)	=	15.16
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.32
Veloc Up (ft/s)	=	4.83
HGL Dn (ft)	=	579.26
HGL Up (ft)	=	581.27
Hw Elev (ft)	=	581.81
Hw/D (ft)	=	1.44
Flow Regime	=	Outlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
15.16	15.16	0.00	5.32	4.83	20.41	24.00
15.31	15.31	0.00	5.37	4.87	20.46	24.00
15.46	15.46	0.00	5.41	4.92	20.50	24.00
15.61	15.61	0.00	5.45	4.97	20.54	24.00
15.76	15.76	0.00	5.50	5.02	20.58	24.00
15.91	15.91	0.00	5.54	5.06	20.62	24.00
16.06	16.06	0.00	5.58	5.11	20.66	24.00
16.21	16.21	0.00	5.63	5.16	20.70	24.00
16.36	16.36	0.00	5.67	5.21	20.74	24.00
16.51	16.51	0.00	5.71	5.26	20.78	24.00
16.66	16.66	0.00	5.75	5.30	20.82	24.00

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
579.26	581.27	581.81	1.44
579.26	581.31	581.86	1.47
579.27	581.35	581.91	1.49
579.27	581.39	581.96	1.52
579.28	581.43	582.01	1.54
579.28	581.47	582.07	1.57
579.28	581.51	582.12	1.59
579.29	581.55	582.17	1.62
579.29	581.59	582.22	1.65
579.29	581.63	582.28	1.67
579.30	581.67	582.33	1.70

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Jan 5 2018

EXISTING 24 CMP @ N 1550135, E 1941896 PLANT ROAD (PRE-DEV)

Invert Elev Dn (ft)	=	577.56
Pipe Length (ft)	=	141.42
Slope (%)	=	0.97
Invert Elev Up (ft)	=	578.93
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.023
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

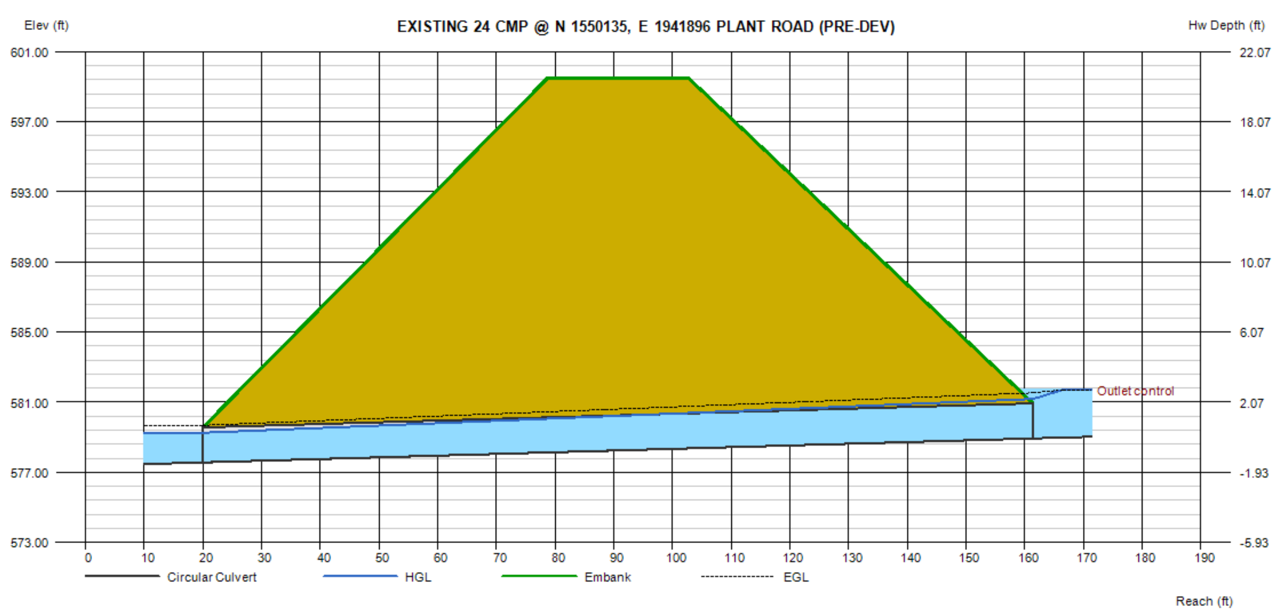
Top Elevation (ft)	=	599.50
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	14.82
Qmax (cfs)	=	15.53
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	14.82
Qpipe (cfs)	=	14.82
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.23
Veloc Up (ft/s)	=	4.72
HGL Dn (ft)	=	579.25
HGL Up (ft)	=	581.18
Hw Elev (ft)	=	581.70
Hw/D (ft)	=	1.39
Flow Regime	=	Outlet Control



Q			Veloc		Depth
Total	Pipe	Over	Dn	Up	Dn
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)
14.82	14.82	0.00	5.23	4.72	20.32
14.92	14.92	0.00	5.25	4.75	20.35
15.02	15.02	0.00	5.28	4.78	20.37
15.12	15.12	0.00	5.31	4.81	20.40
15.22	15.22	0.00	5.34	4.84	20.43
15.32	15.32	0.00	5.37	4.88	20.46
15.42	15.42	0.00	5.40	4.91	20.49
15.52	15.52	0.00	5.43	4.94	20.51

Depth	HGL			
Up	Dn	Up	Hw	Hw/D
(in)	(ft)	(ft)	(ft)	
24.00	579.25	581.18	581.70	1.39
24.00	579.26	581.21	581.73	1.40
24.00	579.26	581.23	581.77	1.42
24.00	579.26	581.26	581.80	1.43
24.00	579.26	581.29	581.83	1.45
24.00	579.26	581.31	581.87	1.47
24.00	579.27	581.34	581.90	1.48
24.00	579.27	581.36	581.93	1.50

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Nov 13 2018

Exist 36 CMP @ N 1,549,942, E 1,941,933 Under Bridge, RR (Post-Dev)

Invert Elev Dn (ft)	=	573.21
Pipe Length (ft)	=	311.72
Slope (%)	=	1.42
Invert Elev Up (ft)	=	577.64
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

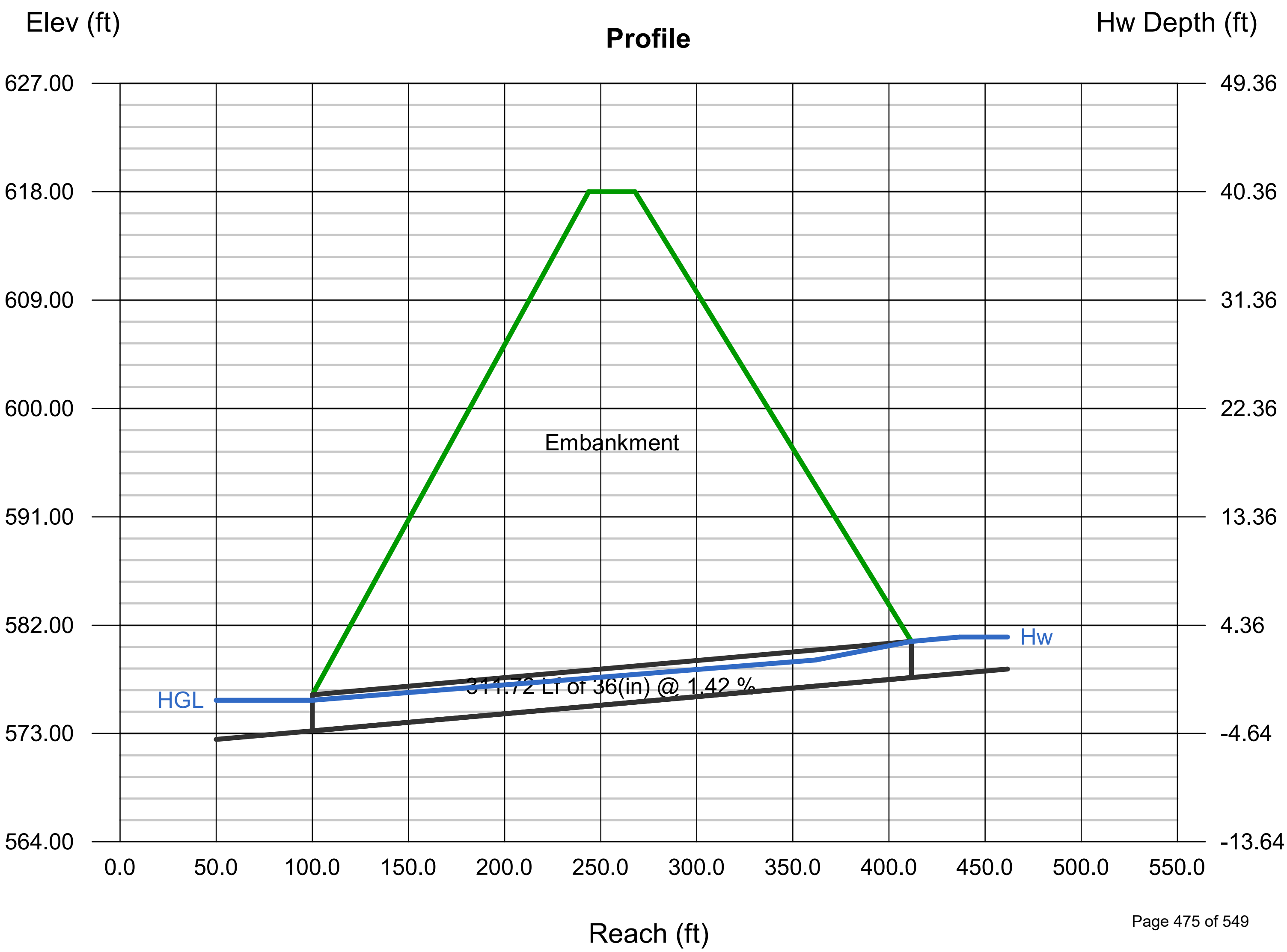
Top Elevation (ft)	=	618.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	24.00

Calculations

Qmin (cfs)	=	41.90
Qmax (cfs)	=	46.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	41.90
Qpipe (cfs)	=	41.90
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	6.54
Veloc Up (ft/s)	=	7.90
HGL Dn (ft)	=	575.76
HGL Up (ft)	=	579.75
Hw Elev (ft)	=	581.02
Hw/D (ft)	=	1.13
Flow Regime	=	Inlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
41.90	41.90	0.00	6.54	7.90	30.64	25.28
42.05	42.05	0.00	6.56	7.91	30.66	25.33
42.20	42.20	0.00	6.57	7.93	30.68	25.37
42.35	42.35	0.00	6.59	7.94	30.71	25.42
42.50	42.50	0.00	6.61	7.95	30.73	25.46
42.65	42.65	0.00	6.63	7.96	30.75	25.51
42.80	42.80	0.00	6.65	7.98	30.78	25.55
42.95	42.95	0.00	6.67	7.99	30.80	25.60
43.10	43.10	0.00	6.69	8.00	30.82	25.65
43.25	43.25	0.00	6.71	8.02	30.84	25.69
43.40	43.40	0.00	6.73	8.03	30.87	25.73
43.55	43.55	0.00	6.75	8.04	30.89	25.78
43.70	43.70	0.00	6.77	8.05	30.91	25.82
43.85	43.85	0.00	6.79	8.07	30.93	25.86
44.00	44.00	0.00	6.80	8.08	30.96	25.91
44.15	44.15	0.00	6.82	8.09	30.98	25.95
44.30	44.30	0.00	6.84	8.10	31.00	26.00
44.45	44.45	0.00	6.86	8.12	31.02	26.04
44.60	44.60	0.00	6.88	8.13	31.04	26.08
44.75	44.75	0.00	6.90	8.14	31.06	26.13
44.90	44.90	0.00	6.92	8.16	31.09	26.17
45.05	45.05	0.00	6.94	8.17	31.11	26.22
45.20	45.20	0.00	6.96	8.18	31.13	26.26

Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
45.35	45.35	0.00	6.98	8.19	31.15	26.31
45.50	45.50	0.00	7.00	6.44	31.17	36.00
45.65	45.65	0.00	7.02	6.46	31.19	36.00
45.80	45.80	0.00	7.03	6.48	31.22	36.00
45.95	45.95	0.00	7.05	6.75	31.24	33.15

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
575.76	579.75	581.02	1.13
575.77	579.75	581.03	1.13
575.77	579.75	581.04	1.13
575.77	579.76	581.05	1.14
575.77	579.76	581.06	1.14
575.77	579.77	581.07	1.14
575.77	579.77	581.08	1.15
575.78	579.77	581.09	1.15
575.78	579.78	581.10	1.15
575.78	579.78	581.11	1.16
575.78	579.78	581.12	1.16
575.78	579.79	581.13	1.16
575.79	579.79	581.14	1.17
575.79	579.80	581.15	1.17
575.79	579.80	581.16	1.17
575.79	579.80	581.17	1.18
575.79	579.81	581.18	1.18
575.80	579.81	581.19	1.18
575.80	579.81	581.20	1.19
575.80	579.82	581.21	1.19
575.80	579.82	581.22	1.19
575.80	579.82	581.23	1.20
575.80	579.83	581.24	1.20

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
575.81	579.83	581.25	1.20
575.81	580.67	581.26	1.21
575.81	580.70	581.27	1.21
575.81	580.73	581.28	1.21
575.81	580.40	581.29	1.22

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Nov 13 2018

Exist 36 CMP @ N 1,549,942, E 1,941,933 Under Bridge, RR (Pre-Dev)

Invert Elev Dn (ft)	=	573.21
Pipe Length (ft)	=	311.72
Slope (%)	=	1.42
Invert Elev Up (ft)	=	577.64
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

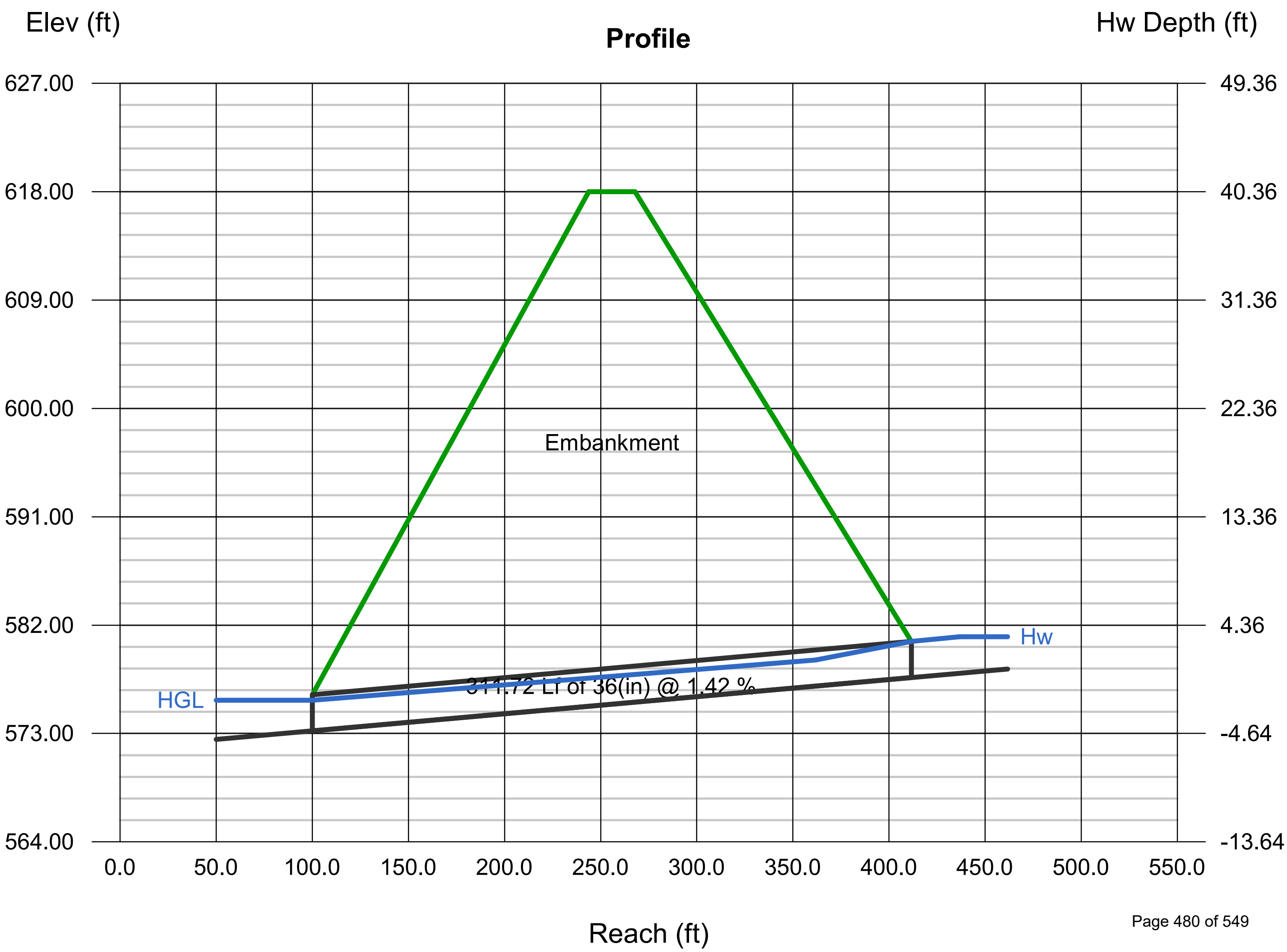
Top Elevation (ft)	=	618.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	24.00

Calculations

Qmin (cfs)	=	42.01
Qmax (cfs)	=	46.02
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	42.01
Qpipe (cfs)	=	42.01
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	6.55
Veloc Up (ft/s)	=	7.91
HGL Dn (ft)	=	575.76
HGL Up (ft)	=	579.75
Hw Elev (ft)	=	581.03
Hw/D (ft)	=	1.13
Flow Regime	=	Inlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
42.01	42.01	0.00	6.55	7.91	30.65	25.31
42.31	42.31	0.00	6.59	7.94	30.70	25.40
42.61	42.61	0.00	6.63	7.96	30.75	25.50
42.91	42.91	0.00	6.67	7.99	30.79	25.59
43.21	43.21	0.00	6.70	8.01	30.84	25.68
43.51	43.51	0.00	6.74	8.04	30.88	25.77
43.81	43.81	0.00	6.78	8.06	30.93	25.86
44.11	44.11	0.00	6.82	8.09	30.97	25.95
44.41	44.41	0.00	6.86	8.11	31.02	26.03
44.71	44.71	0.00	6.90	8.14	31.06	26.11
45.01	45.01	0.00	6.93	8.17	31.10	26.20
45.31	45.31	0.00	6.97	8.19	31.15	26.29
45.61	45.61	0.00	7.01	6.45	31.19	36.00
45.91	45.91	0.00	7.05	6.74	31.23	33.19

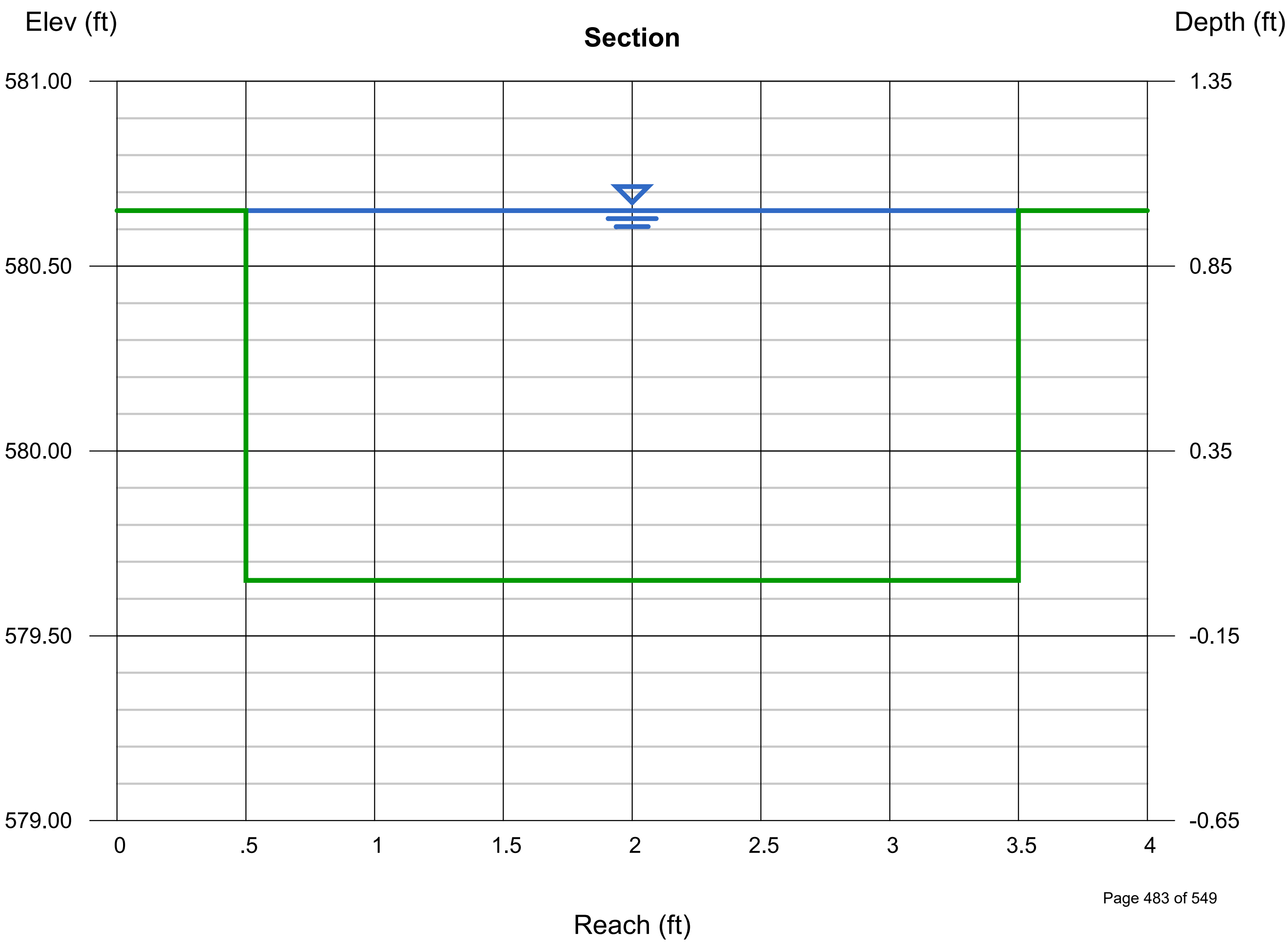
HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
575.76	579.75	581.03	1.13
575.77	579.76	581.05	1.14
575.77	579.76	581.07	1.14
575.78	579.77	581.09	1.15
575.78	579.78	581.11	1.15
575.78	579.79	581.12	1.16
575.79	579.79	581.14	1.17
575.79	579.80	581.16	1.17
575.79	579.81	581.18	1.18
575.80	579.82	581.21	1.19
575.80	579.82	581.23	1.20
575.81	579.83	581.25	1.20
575.81	580.69	581.27	1.21
575.81	580.41	581.29	1.22

Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2013 by Autodesk, Inc. Tuesday, Dec 12 2017

Basins H & C - 3' Concrete Flume

Rectangular		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.00
Total Depth (ft)	= 1.00	Q (cfs)	= 15.41
		Area (sqft)	= 3.00
Invert Elev (ft)	= 579.65	Velocity (ft/s)	= 5.14
Slope (%)	= 0.34	Wetted Perim (ft)	= 5.00
N-Value	= 0.012	Crit Depth, Yc (ft)	= 0.94
		Top Width (ft)	= 3.00
Calculations		EGL (ft)	= 1.41
Compute by:	Known Depth		
Known Depth (ft)	= 1.00		



Rainfall Data
NOAA Atlas 14 Precipitation
SCS Rainfall Distribution

NOAA Atlas 14, Volume 9, Version 2
Location name: Rome, Georgia, USA*
Latitude: 34.2577°, Longitude: -85.3388°
Elevation: 578.84 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.407 (0.330–0.504)	0.465 (0.377–0.577)	0.570 (0.461–0.709)	0.666 (0.534–0.831)	0.811 (0.632–1.05)	0.933 (0.705–1.22)	1.07 (0.773–1.42)	1.21 (0.834–1.64)	1.41 (0.931–1.96)	1.58 (1.00–2.20)
10-min	0.596 (0.484–0.738)	0.681 (0.552–0.845)	0.834 (0.674–1.04)	0.975 (0.783–1.22)	1.19 (0.925–1.54)	1.37 (1.03–1.79)	1.56 (1.13–2.08)	1.77 (1.22–2.41)	2.07 (1.36–2.87)	2.31 (1.47–3.22)
15-min	0.726 (0.590–0.901)	0.830 (0.674–1.03)	1.02 (0.822–1.26)	1.19 (0.954–1.48)	1.45 (1.13–1.88)	1.67 (1.26–2.18)	1.90 (1.38–2.54)	2.16 (1.49–2.94)	2.52 (1.66–3.50)	2.81 (1.79–3.93)
30-min	1.03 (0.835–1.27)	1.17 (0.951–1.46)	1.44 (1.16–1.79)	1.68 (1.35–2.09)	2.05 (1.59–2.66)	2.36 (1.78–3.08)	2.69 (1.95–3.59)	3.06 (2.11–4.17)	3.58 (2.36–4.98)	4.00 (2.55–5.59)
60-min	1.34 (1.09–1.66)	1.53 (1.24–1.90)	1.87 (1.51–2.32)	2.18 (1.75–2.72)	2.65 (2.06–3.43)	3.04 (2.30–3.97)	3.46 (2.51–4.61)	3.92 (2.71–5.33)	4.57 (3.02–6.35)	5.09 (3.25–7.11)
2-hr	1.65 (1.35–2.03)	1.89 (1.54–2.32)	2.30 (1.88–2.84)	2.68 (2.17–3.31)	3.25 (2.55–4.17)	3.72 (2.84–4.82)	4.23 (3.10–5.58)	4.78 (3.34–6.44)	5.55 (3.71–7.64)	6.18 (4.00–8.56)
3-hr	1.86 (1.53–2.28)	2.13 (1.75–2.60)	2.60 (2.13–3.18)	3.02 (2.45–3.71)	3.64 (2.87–4.63)	4.15 (3.18–5.34)	4.70 (3.46–6.16)	5.28 (3.72–7.07)	6.11 (4.11–8.35)	6.77 (4.41–9.32)
6-hr	2.29 (1.90–2.77)	2.61 (2.17–3.17)	3.18 (2.62–3.86)	3.68 (3.02–4.48)	4.40 (3.49–5.54)	4.99 (3.86–6.34)	5.61 (4.17–7.26)	6.26 (4.45–8.28)	7.17 (4.89–9.69)	7.89 (5.21–10.8)
12-hr	2.79 (2.34–3.35)	3.20 (2.67–3.84)	3.88 (3.23–4.67)	4.47 (3.69–5.39)	5.31 (4.25–6.60)	5.99 (4.67–7.52)	6.69 (5.03–8.56)	7.42 (5.34–9.71)	8.43 (5.82–11.3)	9.22 (6.18–12.5)
24-hr	3.34 (2.82–3.97)	3.82 (3.22–4.55)	4.63 (3.89–5.52)	5.32 (4.44–6.36)	6.30 (5.08–7.74)	7.07 (5.57–8.78)	7.86 (5.97–9.95)	8.68 (6.32–11.2)	9.79 (6.84–13.0)	10.7 (7.24–14.3)
2-day	3.91 (3.32–4.60)	4.46 (3.79–5.26)	5.39 (4.56–6.36)	6.17 (5.19–7.31)	7.27 (5.92–8.83)	8.13 (6.47–9.99)	9.01 (6.92–11.3)	9.91 (7.30–12.7)	11.1 (7.89–14.6)	12.1 (8.33–16.0)
3-day	4.32 (3.69–5.05)	4.89 (4.17–5.73)	5.85 (4.97–6.87)	6.67 (5.64–7.85)	7.82 (6.40–9.45)	8.72 (6.99–10.7)	9.65 (7.47–12.0)	10.6 (7.88–13.5)	11.9 (8.52–15.5)	12.9 (8.99–17.0)
4-day	4.67 (4.00–5.44)	5.25 (4.50–6.13)	6.24 (5.32–7.29)	7.08 (6.01–8.30)	8.26 (6.80–9.96)	9.21 (7.40–11.2)	10.2 (7.91–12.6)	11.2 (8.34–14.2)	12.5 (9.01–16.3)	13.6 (9.51–17.8)
7-day	5.55 (4.79–6.42)	6.19 (5.34–7.17)	7.26 (6.24–8.42)	8.17 (6.99–9.51)	9.46 (7.85–11.3)	10.5 (8.50–12.6)	11.5 (9.04–14.2)	12.6 (9.50–15.8)	14.0 (10.2–18.1)	15.2 (10.7–19.8)
10-day	6.32 (5.48–7.27)	7.01 (6.08–8.08)	8.17 (7.05–9.42)	9.14 (7.85–10.6)	10.5 (8.76–12.5)	11.6 (9.46–13.9)	12.7 (10.0–15.5)	13.8 (10.5–17.3)	15.4 (11.2–19.6)	16.5 (11.8–21.4)
20-day	8.51 (7.44–9.70)	9.35 (8.17–10.7)	10.7 (9.36–12.3)	11.9 (10.3–13.7)	13.5 (11.4–15.9)	14.8 (12.2–17.6)	16.1 (12.8–19.5)	17.4 (13.4–21.5)	19.1 (14.2–24.2)	20.4 (14.8–26.2)
30-day	10.4 (9.15–11.8)	11.4 (10.0–12.9)	13.0 (11.4–14.8)	14.4 (12.5–16.4)	16.2 (13.7–18.9)	17.6 (14.6–20.8)	19.0 (15.3–22.9)	20.5 (15.9–25.1)	22.3 (16.7–28.0)	23.7 (17.3–30.2)
45-day	12.9 (11.4–14.5)	14.1 (12.5–15.9)	16.1 (14.2–18.2)	17.7 (15.5–20.1)	19.9 (16.9–22.9)	21.5 (17.9–25.1)	23.0 (18.6–27.4)	24.6 (19.1–29.9)	26.5 (20.0–33.0)	27.9 (20.6–35.4)
60-day	15.1 (13.4–17.0)	16.6 (14.7–18.6)	18.9 (16.7–21.3)	20.7 (18.2–23.4)	23.2 (19.7–26.6)	24.9 (20.8–28.9)	26.6 (21.6–31.5)	28.2 (22.1–34.1)	30.1 (22.8–37.3)	31.5 (23.4–39.8)

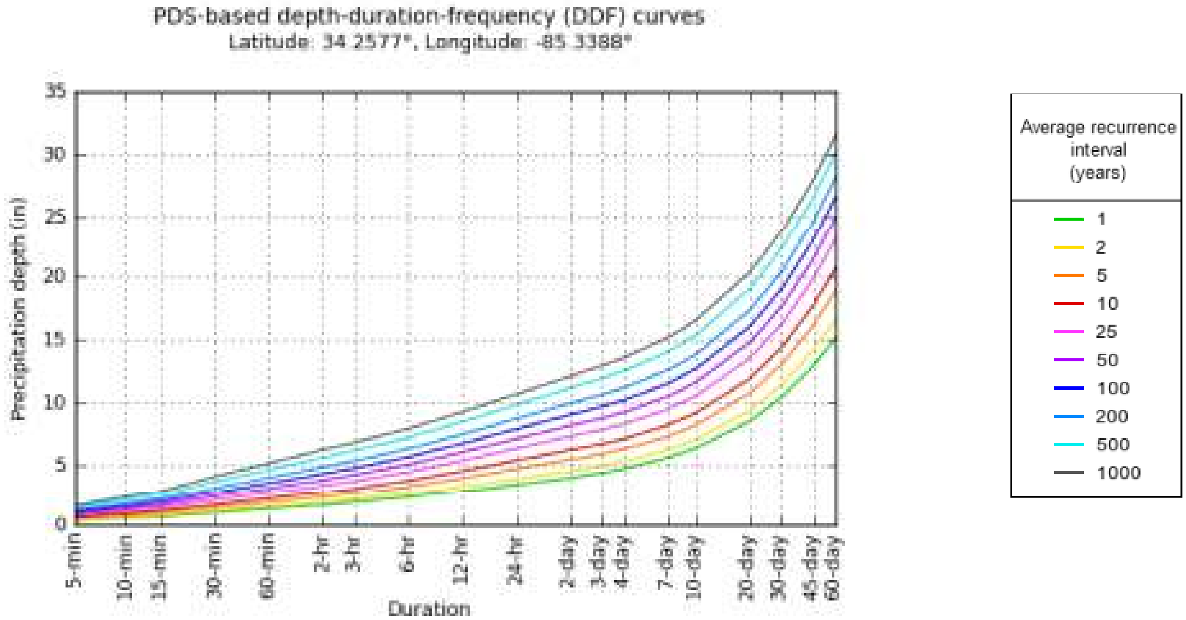
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

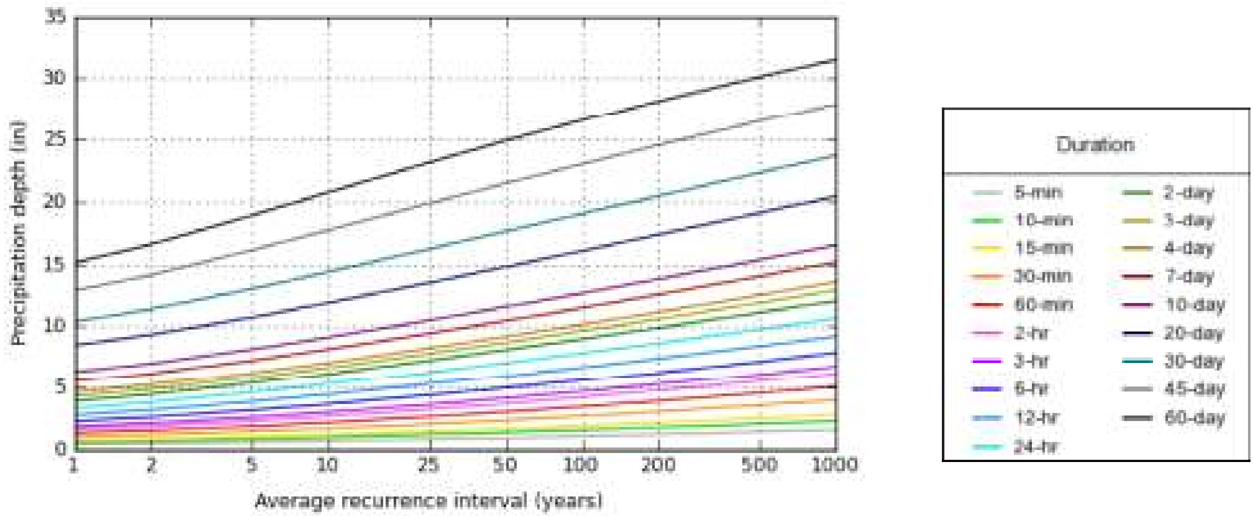
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper 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.

Back to Top

PF graphical





NOAA Atlas 14, Volume 9, Version 2

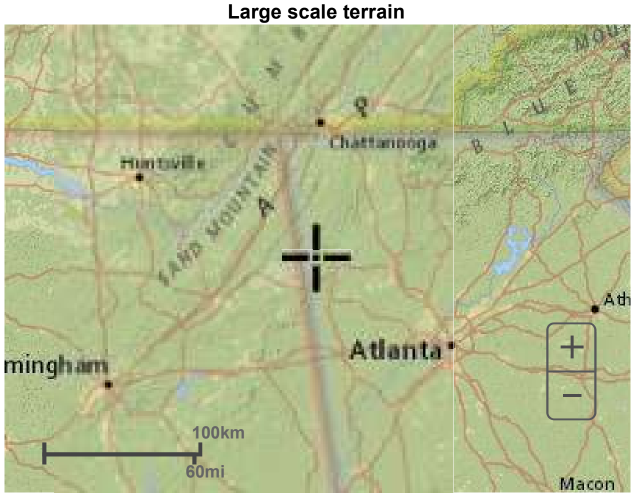
Created (GMT): Tue Jun 20 13:12:27 2017

Back to Top

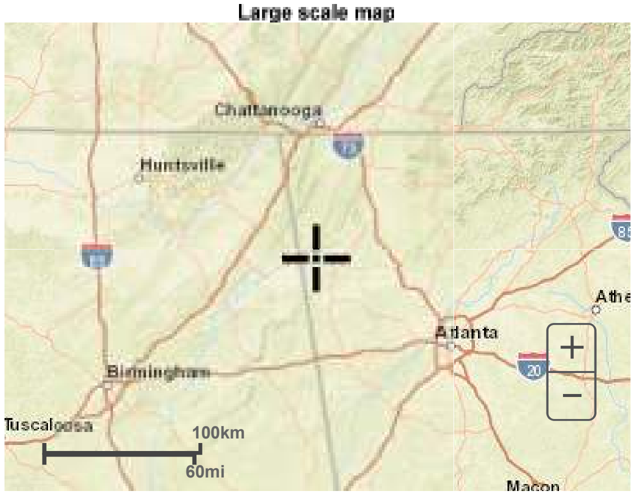
Maps & aerials

Small scale terrain

Large scale terrain



Large scale map



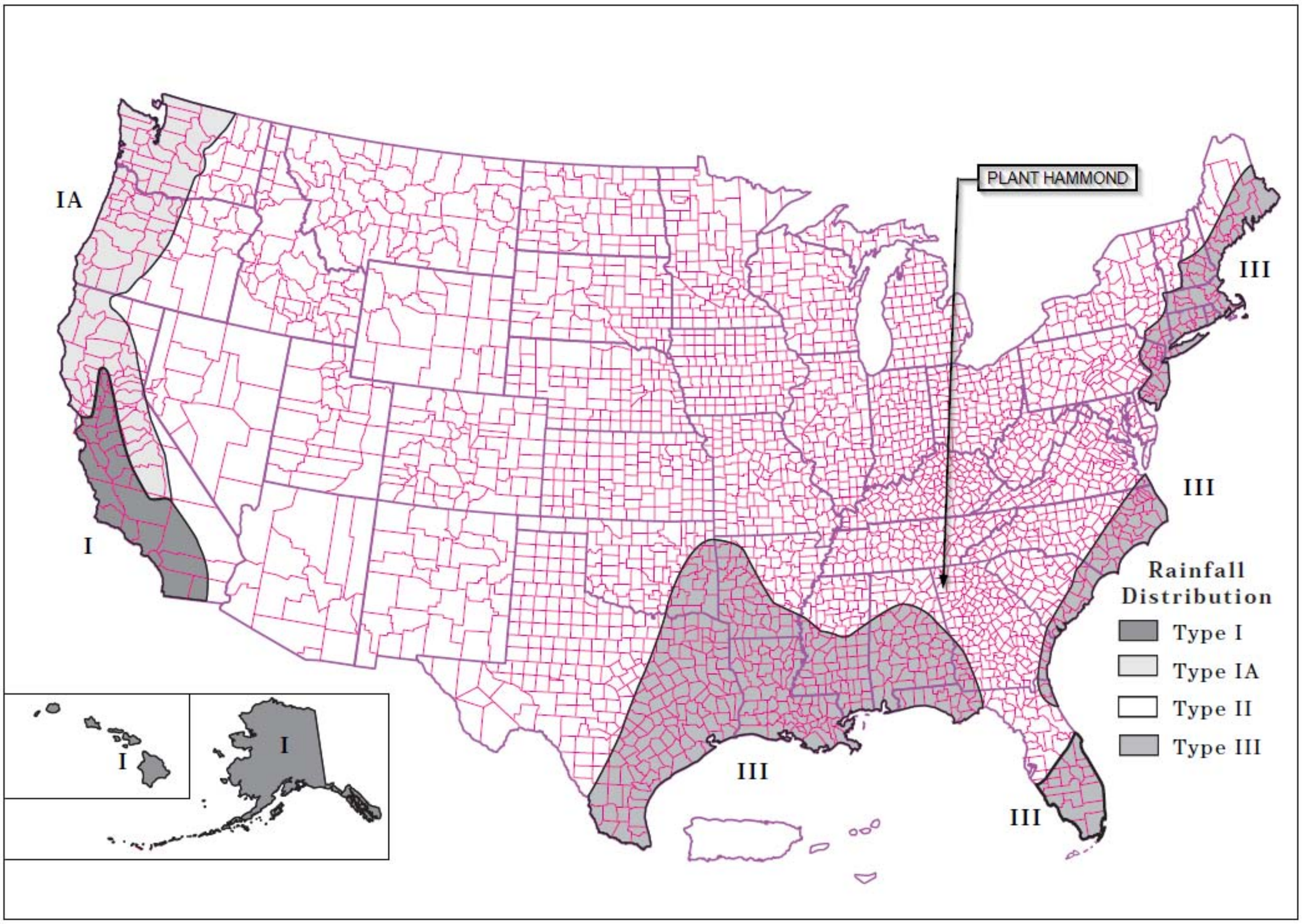
Large scale aerial

Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

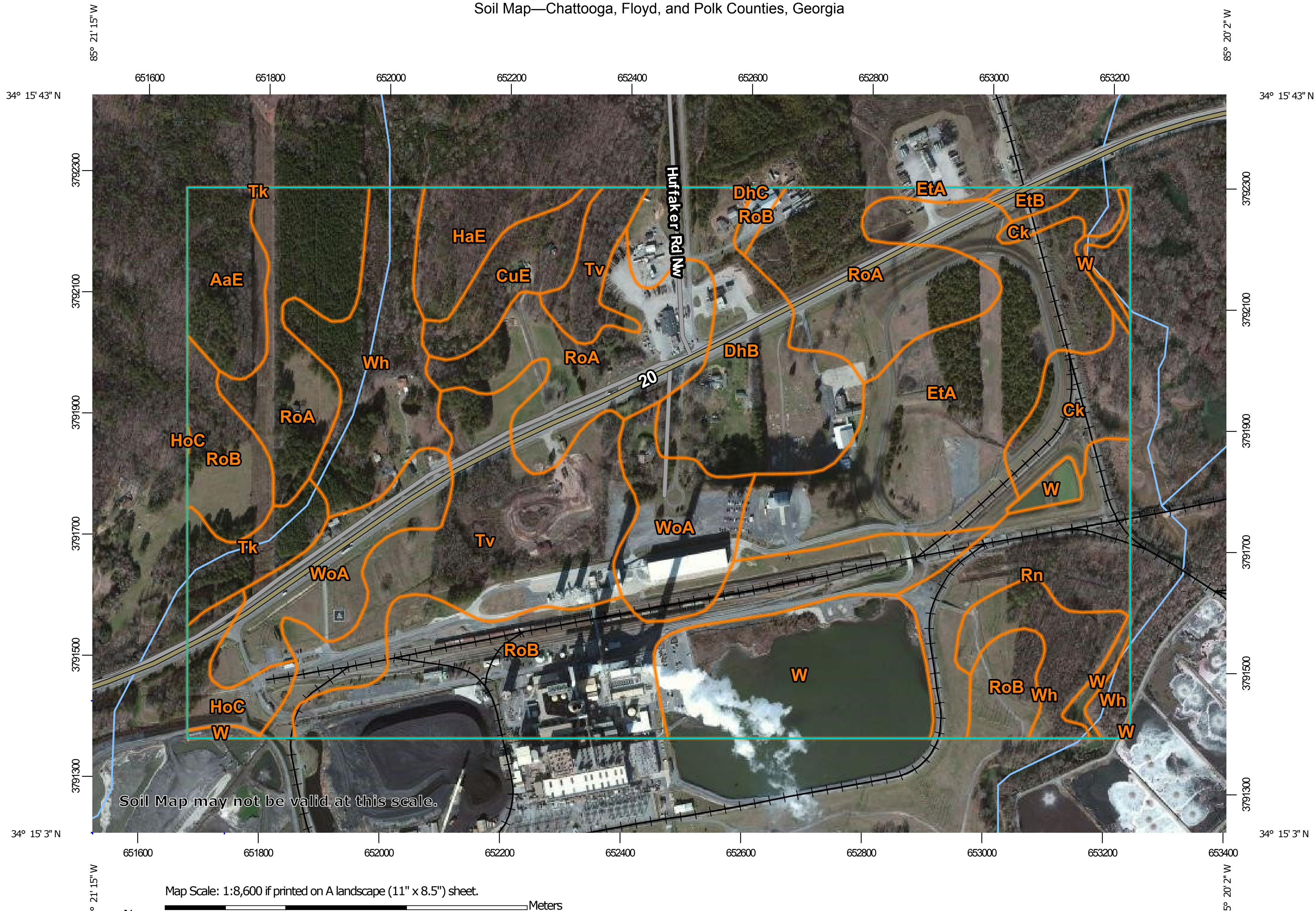
Disclaimer

Figure B-2 Approximate geographic boundaries for NRCS (SCS) rainfall distributions



NRCS Soils Data

Soil Map—Chattooga, Floyd, and Polk Counties, Georgia



Map Scale: 1:8,600 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 100, 200, 400, 600

N

Feet: 0, 400, 800, 1600, 2400

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

Soil Map—Chattooga, Floyd, and Polk Counties, Georgia

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2011—Jan 4, 2012

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Chattooga, Floyd, and Polk Counties, Georgia (GA621)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AaE	Allen fine sandy loam, 15 to 25 percent slopes	9.1	2.6%
Ck	Chewacla silt loam, 0 to 2 percent slopes, frequently flooded	11.8	3.3%
CuE	Cunningham loam, 15 to 25 percent slopes	7.5	2.1%
DhB	Dewey silt loam, 2 to 6 percent slopes	25.0	7.1%
DhC	Dewey silt loam, 6 to 10 percent slopes	0.1	0.0%
EtA	Etowah loam, 0 to 2 percent slopes	40.3	11.4%
EtB	Etowah loam, 2 to 6 percent slopes	1.3	0.4%
HaE	Hartsells fine sandy loam, 15 to 25 percent slopes	7.4	2.1%
HoC	Holston fine sandy loam, 6 to 10 percent slopes	5.2	1.5%
Rn	Roanoke silt loam	16.7	4.7%
RoA	Rome fine sandy loam, 0 to 2 percent slopes	55.4	15.7%
RoB	Rome fine sandy loam, 2 to 6 percent slopes	49.8	14.1%
Tk	Toccoa fine sandy loam	6.2	1.8%
Tv	Tupelo clay loam, frequently flooded	36.6	10.4%
W	Water	27.2	7.7%
Wh	Whitwell silt loam	28.1	7.9%
WoA	Wolftever silt loam, 0 to 2 percent slopes	25.4	7.2%
Totals for Area of Interest		**352.9**	**100.0%**

Chattooga, Floyd, and Polk Counties, Georgia

Ck—Chewacla silt loam, 0 to 2 percent slopes, frequently flooded

Map Unit Setting

National map unit symbol: 2tg8j
Elevation: 510 to 1,750 feet
Mean annual precipitation: 51 to 63 inches
Mean annual air temperature: 48 to 71 degrees F
Frost-free period: 150 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Chewacla and similar soils: 89 percent
Minor components: 11 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chewacla

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium derived from interbedded sedimentary rock

Typical profile

Ap - 0 to 9 inches: silt loam
Bw - 9 to 50 inches: silt loam
C - 50 to 79 inches: sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: High (about 10.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Hydric soil rating: No

Minor Components

Roanoke

Percent of map unit: 5 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Wehadkee

Percent of map unit: 3 percent
Landform: Drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Guthrie

Percent of map unit: 3 percent
Landform: Drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

DhB—Dewey silt loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2v4ft
Elevation: 800 to 1,700 feet
Mean annual precipitation: 44 to 65 inches
Mean annual air temperature: 56 to 61 degrees F
Frost-free period: 171 to 209 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Dewey and similar soils: 86 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dewey

Setting

Landform: Stream terraces, ridges
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Clayey residuum weathered from limestone

Typical profile

Ap - 0 to 9 inches: silt loam
Bt - 9 to 72 inches: clay

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

EtA—Etowah loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2szhr
Elevation: 570 to 880 feet
Mean annual precipitation: 54 to 58 inches
Mean annual air temperature: 57 to 60 degrees F
Frost-free period: 155 to 218 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Etowah and similar soils: 94 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Etowah

Setting

Landform: Stream terraces
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Loamy alluvium derived from limestone, sandstone, and shale

Typical profile

Ap - 0 to 8 inches: loam
Bt1 - 8 to 13 inches: clay loam
Bt2 - 13 to 83 inches: clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

EtB—Etowah loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2szhs
Elevation: 690 to 1,190 feet
Mean annual precipitation: 45 to 59 inches
Mean annual air temperature: 57 to 60 degrees F
Frost-free period: 155 to 218 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Etowah and similar soils: 94 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Etowah

Setting

Landform: Stream terraces
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Loamy alluvium and/or colluvium derived from limestone, sandstone, and shale

Typical profile

A - 0 to 11 inches: loam
Bt1 - 11 to 36 inches: clay loam
Bt2 - 36 to 83 inches: silty clay loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

RoA—Rome fine sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: ktvd
Elevation: 500 to 1,200 feet
Mean annual precipitation: 48 to 55 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Rome and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rome

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 9 inches: fine sandy loam
H2 - 9 to 53 inches: sandy clay loam
H3 - 53 to 66 inches: sandy clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

RoB—Rome fine sandy loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: ktvf
Elevation: 500 to 1,200 feet
Mean annual precipitation: 48 to 55 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Rome and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rome

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 9 inches: fine sandy loam
H2 - 9 to 53 inches: sandy clay loam
H3 - 53 to 66 inches: sandy clay loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: High (about 9.9 inches)

Interpretive groups

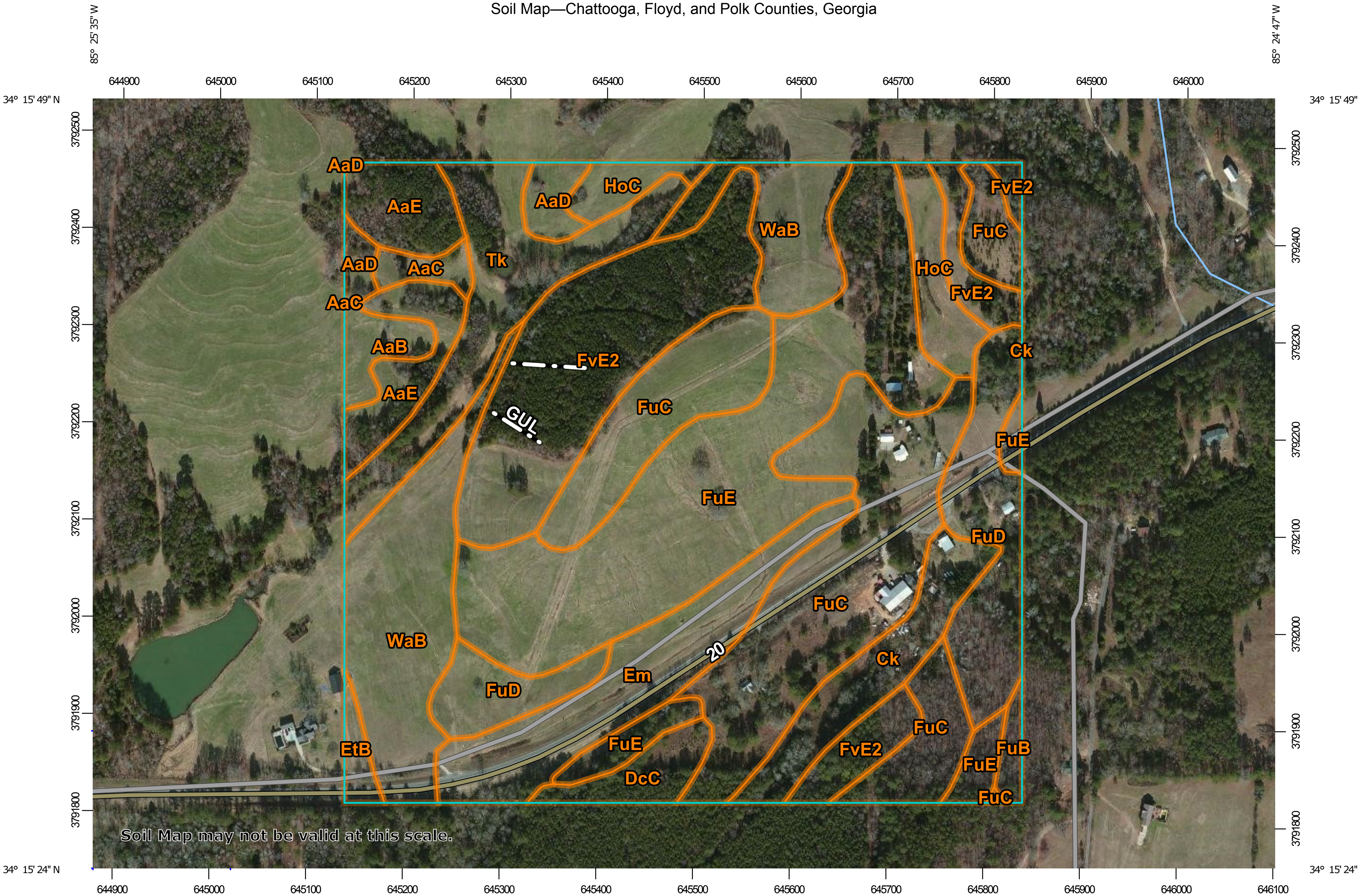
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Soil Map—Chattooga, Floyd, and Polk Counties, Georgia



Map Scale: 1:5,590 if printed on A landscape (11" x 8.5") sheet.

Meters: 0 50 100 200 300

N

Feet: 0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

Soil Map—Chattooga, Floyd, and Polk Counties, Georgia

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 11, Oct 5, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2011—Jan 4, 2012

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AaB	Allen fine sandy loam, 2 to 6 percent slopes	1.4	1.2%
AaC	Allen fine sandy loam, 6 to 10 percent slopes	0.9	0.7%
AaD	Allen fine sandy loam, 10 to 15 percent slopes	1.6	1.4%
AaE	Allen fine sandy loam, 15 to 25 percent slopes	5.1	4.4%
Ck	Chewacla silt loam, 0 to 2 percent slopes, frequently flooded	4.3	3.8%
DcC	Decatur loam, 6 to 10 percent slopes	1.8	1.6%
Em	Emory silt loam, 0 to 4 percent slopes, rarely flooded	7.3	6.4%
EtB	Etowah loam, 2 to 6 percent slopes	0.7	0.6%
FuB	Fullerton gravelly silt loam, 2 to 6 percent slopes	0.6	0.5%
FuC	Fullerton cherty silt loam, 6 to 10 percent slopes	22.3	19.5%
FuD	Fullerton cherty silt loam, 10 to 15 percent slopes	8.1	7.1%
FuE	Fullerton cherty silt loam, 15 to 25 percent slopes	21.9	19.1%
FvE2	Fullerton gravelly silty clay loam, 10 to 25 percent slopes, eroded	15.2	13.2%
HoC	Holston fine sandy loam, 6 to 10 percent slopes	3.5	3.1%
Tk	Toccoa fine sandy loam	7.4	6.4%
WaB	Wax loam, 2 to 6 percent slopes	12.4	10.8%
Totals for Area of Interest		**114.5**	**100.0%**

Chattooga, Floyd, and Polk Counties, Georgia

Tv—Tupelo clay loam, frequently flooded

Map Unit Setting

National map unit symbol: ktw0
Elevation: 450 to 800 feet
Mean annual precipitation: 48 to 55 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Tupelo and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tupelo

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 12 inches: clay loam
H2 - 12 to 62 inches: silty clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Dowellton

Percent of map unit: 5 percent
Landform: Depressions on stream terraces

Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

WoA—Wolftever silt loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: ktw5
Elevation: 350 to 1,000 feet
Mean annual precipitation: 48 to 55 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Wolftever and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wolftever

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 6 inches: silt loam
H2 - 6 to 12 inches: silty clay loam
H3 - 12 to 58 inches: silty clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 30 to 42 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: High (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

FuC—Fullerton cherty silt loam, 6 to 10 percent slopes

Map Unit Setting

National map unit symbol: kttc
Mean annual precipitation: 48 to 55 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 200 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Fullerton and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fullerton

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Residuum

Typical profile

H1 - 0 to 17 inches: gravelly silt loam
H2 - 17 to 24 inches: gravelly silty clay loam
H3 - 24 to 88 inches: gravelly silty clay

Properties and qualities

Slope: 6 to 10 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Thermic Cherty Dolomite Upland Oak-Hickory Forest (F128XY001TN)

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 11, Oct 5, 2017

Chattooga, Floyd, and Polk Counties, Georgia

FuE—Fullerton cherty silt loam, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: kttf
Mean annual precipitation: 48 to 55 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Fullerton and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fullerton

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum

Typical profile

H1 - 0 to 17 inches: gravelly silt loam
H2 - 17 to 24 inches: gravelly silty clay loam
H3 - 24 to 88 inches: gravelly silty clay

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Thermic Cherty Dolomite Upland Oak-Hickory Forest (F128XY001TN)

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 11, Oct 5, 2017

Chattooga, Floyd, and Polk Counties, Georgia

FvE2—Fullerton gravelly silty clay loam, 10 to 25 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2szjc
Elevation: 670 to 1,100 feet
Mean annual precipitation: 52 to 56 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 219 days
Farmland classification: Not prime farmland

Map Unit Composition

Fullerton and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fullerton

Setting

Landform: Ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy creep deposits derived from cherty limestone over clayey residuum weathered from cherty limestone

Typical profile

A - 0 to 2 inches: gravelly silty clay loam
BE - 2 to 13 inches: gravelly silty clay loam
Bt1 - 13 to 21 inches: gravelly clay
Bt2 - 21 to 60 inches: gravelly clay
Bt3 - 60 to 90 inches: gravelly clay

Properties and qualities

Slope: 10 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: B
Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 11, Oct 5, 2017

Pre- and Post-Development Drainage Structure Summary

Hammond AP#3
Pre- and Post-Development Drainage Structure Summary

NW Corner of AP#3, Hwy 20 Side Drain/AP#3 Aggregate Drive (Pre & Post)
24" Dia. CMP, L= 68.42 LF
Inv. In. EL. 581.45
Inv. Out EL. 581.11
Slope = 0.50%
Manning's n = 0.023

NE Corner of AP#3, Hwy 20 Side Drain/NS RR X-Drain Aggregate Drive (Pre & Post)
24" Dia. RCP, L= 77.3 LF
Inv. In. EL. 575.02
Inv. Out EL. 574.20
Slope = 1.06%
Manning's n = 0.012

NE Corner of AP#3, NS RR X-Drain (Pre & Post)
18" Dia. RCP, L= 55 LF (Approx.)
Inv. In. ~~EL. 576.30~~ EL. 575.55 (Per Survey 11/17)
Inv. Out EL. 575.50
Slope = 1.5%
Manning's n = 0.012

SW Corner AP#3 (Pre & Post)
24" Dia. CMP, L= 143.0 LF
Inv. In. EL. 578.93
Inv. Out EL. 577.56
Slope = 1.5%
Manning's n = 0.023

SW Corner of AP#3, Plant Road/NS RR & Bridge X-Drain (Pre & Post)
36" Dia. CMP, L= 311.7 LF
Inv. In. EL. 577.64
Inv. Out EL. 573.21
Slope = 1.42%
Manning's n = 0.024

Boiler Waste Cleaning Basin Area (East RR X-Drains)
North Pipe
Pre-Development
12" Dia. CMP, L= 45.20 LF
Inv. In. EL. 580.46
Inv. Out EL. 578.32
Slope = 4.73%
Manning's n = 0.023
Post-Development (Inlet Extension)

12" Dia. CMP, L=49.70 LF
Inv. In. EL. 580.67
Inv. Out EL. 578.32
Slope = 4.73%
Manning's n = 0.023

South Pipe X-Drain
Pre-Development
12" Dia. CMP, L= 41.20 LF
Inv. In. EL. 580.16
Inv. Out EL. 579.83
Slope = 0.80%
Manning's n = 0.023
Post-Development (Inlet Extension)
12" Dia. CMP, L=48.30 LF
Inv. In. EL. 580.22
Inv. Out EL. 579.83
Slope = 0.80%
Manning's n = 0.023

Ash Pond Box Culvert (New)
CS 4'x2', L=30.00 LF
Inv. In. EL. 593.29
Inv. Out EL. 593.14
Slope = 0.50%
Manning's n = 0.012

NE Corner of AP#3,NS RR X-Drain Aggregate Drive (New)
18" Dia. RCP, L= 60.0 LF
Inv. In. EL. 575.00
Inv. Out EL. 574.40
Slope = 1.00%
Manning's n = 0.012

Reference Documents

November 5, 2018

Southern Company Services
42 Inverness Center Parkway
Birmingham, Alabama 35242

Attn: Mr. Stacy Sprayberry
E: sssprayb@southernco.com

Re: Double Ring Infiltrometer Testing
Plant Hammond, Rome, Georgia
Terracon Project No. E1185284

Dear Stacy:

Terracon has completed the double ring infiltrometer testing services for the above referenced project. These services were performed in general accordance with our proposal number PE1185284 dated October 23, 2018. This report presents the results of the testing.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Matthew S. McCullough, P.E.
Senior Engineer

Jerome A. Smith, P.E.
Geotechnical Department Manager
Georgia PE No. 22454

Attachments: Site Location Map (Exhibit A-1)
Test Location Plan (Exhibit A-2)
Graphs of Infiltration Velocity vs. Time (Exhibits A-3 through A-6)

1.0 PROJECT INFORMATION

Double ring infiltrometer tests were requested at 4 locations on an existing landfill cover at Plant Hammond in Rome, Georgia. The project vicinity is shown on the attached Exhibit A-1, Site Location Map. The approximate location of each test is shown on the attached Exhibit A-2, Infiltrometer Test Location Plan. The tests were conducted at the existing surface grade.

2.0 TESTING PROCEDURES

The tests were performed in general accordance with ASTM D 3385. To conduct the tests, two open cylinders (12-inch and 24-inch I.D.) were driven into the ground, one inside the other. The inner and outer rings were driven to depths ranging from about 2 to 4 inches below the existing grade. Hard driving conditions were encountered due to the stiff consistency of the surface soils. Therefore, the depth of driving was less than the planned depth of 4 to 6 inches.

After driving, the cylinders were partially filled with water. A constant head of water (above the existing ground surface) was maintained in both rings during the test, and the volume of water required to maintain the level in the inner and outer rings was recorded periodically over a total time period ranging from 3 to 4 hours. The volume of water added to the inner ring to maintain the water level constant was recorded as the measure of the volume of water that infiltrated the soil at each test location. This value was then used to calculate the infiltration velocity in cm/sec.

3.0 DOUBLE RING INFILTROMETER TEST RESULTS

The test results are summarized in the tables below. No recordable infiltration could be noted within the inner ring at Test Location 1 and Test Location 2. Graphs of the infiltration velocity vs. time are included in the attached Exhibits A-3 through A-6.

Table 3.1: Infiltrometer Results for Test Location 1

Elapsed Time (minutes)	Inner Ring		Outer Ring	
	Volume of Water Added (cm^3)	Incremental Infiltration Rate (cm/sec)	Volume of Water Added (cm^3)	Incremental Infiltration Rate (cm/sec)
15	0	0	1,457	8.0×10^{-2}
30	0	0	1,249	6.9×10^{-2}
45	0	0	937	5.2×10^{-2}
60	0	0	625	3.5×10^{-2}
90	0	0	1,874	5.2×10^{-2}
120	0	0	1,353	3.7×10^{-2}
180	0	0	3,955	5.5×10^{-2}
240	0	0	3,227	4.5×10^{-2}

Table 3.2: Infiltrometer Results for Test Location 2

Elapsed Time (minutes)	Inner Ring		Outer Ring	
	Volume of Water Added (cm^3)	Incremental Infiltration Rate (cm/sec)	Volume of Water Added (cm^3)	Incremental Infiltration Rate (cm/sec)
15	0	0	1,353	7.4×10^{-2}
30	0	0	1,457	8.0×10^{-2}
45	0	0	833	4.6×10^{-2}
60	0	0	1,249	6.9×10^{-2}
90	0	0	1,769	4.9×10^{-2}
120	0	0	1,353	3.7×10^{-2}
180	0	0	3,227	4.4×10^{-2}
240	0	0	1,561	2.1×10^{-2}
300	0	0	2,082	2.9×10^{-2}

Table 3.3: Infiltrometer Results for Test Location 3

Elapsed Time (minutes)	Inner Ring		Outer Ring	
	Volume of Water Added (cm^3)	Incremental Infiltration Rate (cm/sec)	Volume of Water Added (cm^3)	Incremental Infiltration Rate (cm/sec)
15	104	6.6×10^{-5}	520	2.9×10^{-2}
30	104	6.6×10^{-5}	625	3.4×10^{-2}
45	104	6.6×10^{-5}	729	4.0×10^{-2}
60	208	1.3×10^{-4}	625	3.4×10^{-2}
90	104	3.3×10^{-5}	937	2.6×10^{-2}
120	104	3.3×10^{-5}	729	2.0×10^{-2}
180	0	0	1,769	2.4×10^{-2}
240	0	0	1,769	2.4×10^{-2}

Table 3.4: Infiltrometer Results for Test Location 4

Elapsed Time (minutes)	Inner Ring		Outer Ring	
	Volume of Water Added (cm^3)	Incremental Infiltration Rate (cm/sec)	Volume of Water Added (cm^3)	Incremental Infiltration Rate (cm/sec)
15	729	4.6×10^{-4}	2,082	1.2×10^{-1}
30	0	0	1,145	6.3×10^{-2}
45	0	0	1,145	6.3×10^{-2}
60	0	0	1,665	9.2×10^{-2}
90	0	0	3,122	8.6×10^{-2}
120	0	0	3,018	8.3×10^{-2}
180	833	1.3×10^{-4}	4,163	5.7×10^{-2}
240	833	1.3×10^{-4}	4,476	6.2×10^{-2}

The incremental infiltration rates for the inner ring at each test location are represented on the Graphs of Infiltration Velocity vs. Time attached to this report as Exhibits A-3 through A-6.

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: MSM	Project No. E1185294	Terracon 2147 Riverchase Office Road Birmingham, AL 35244	SITE LOCATION MAP	EXHIBIT
Drawn by: MSM	Scale: NTS		Double Ring Infiltrometer Testing Plant Hammond Rome, Georgia	A-1
Checked by: JAS	File Name:			
Approved by: JAS	Date: 11/5/2018			

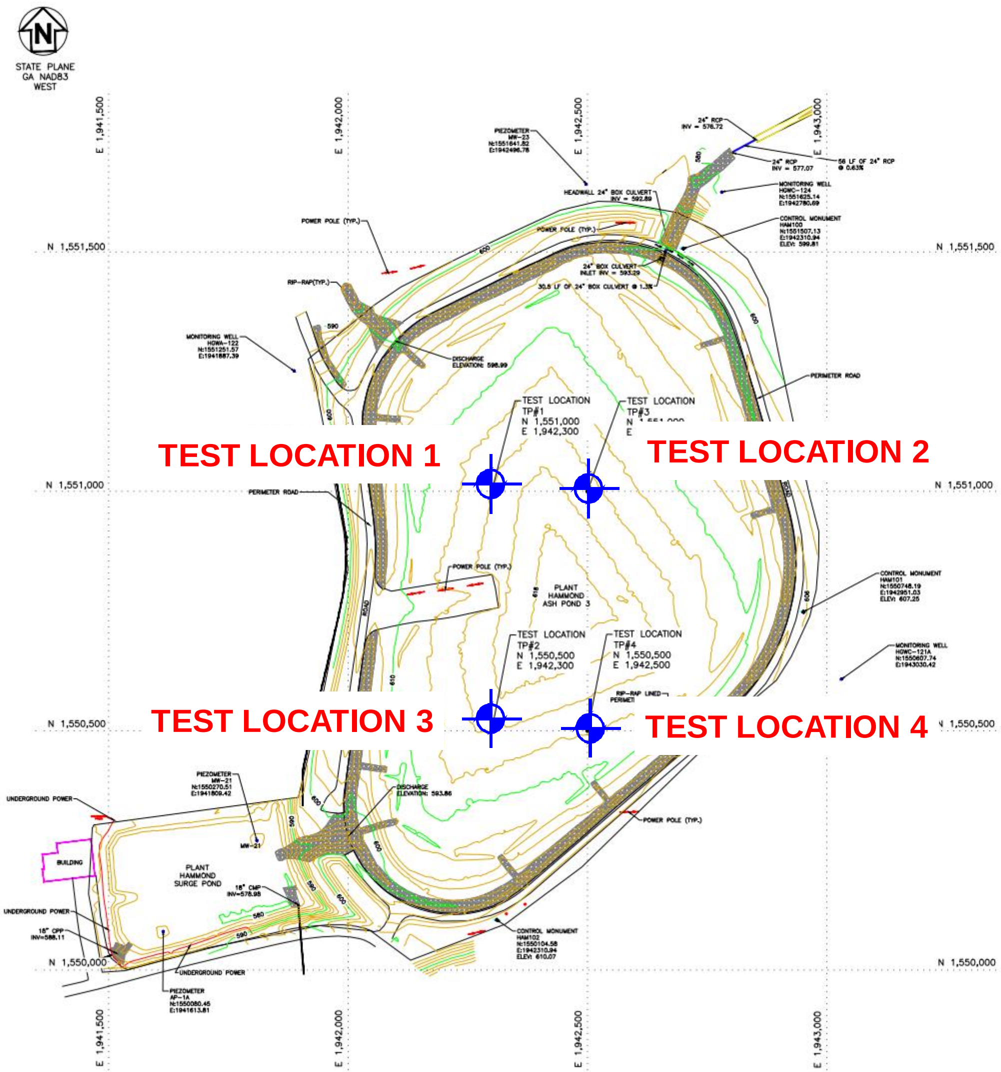


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: MSM	Project No. E1185294	Terracon 2147 Riverchase Office Road Birmingham, AL 35244	TEST LOCATION PLAN	EXHIBIT
Drawn by: MSM	Scale: NTS		Double Ring Infiltrometer Testing Plant Hammond Rome, Georgia	A-2
Checked by: JAS	File Name:			
Approved by: JAS	Date: 11/5/2018			

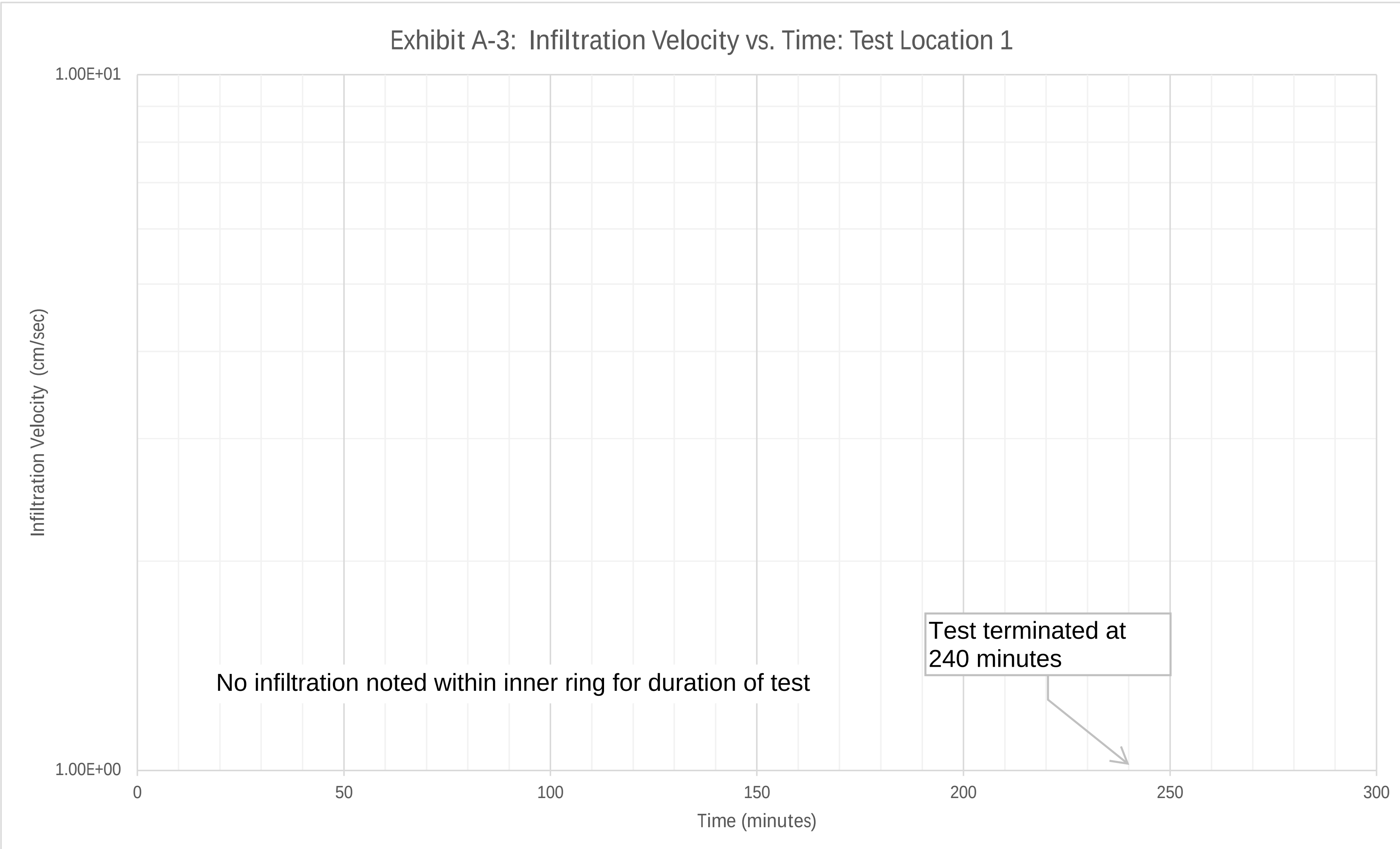


Exhibit A-3: Infiltration Velocity vs. Time: Test Location 1
1.00E+01
1.00E+00
Infiltration Velocity (cm/sec)
0
50
100
150
200
250
300
Time (minutes)
No infiltration noted within inner ring for duration of test
Test terminated at
240 minutes

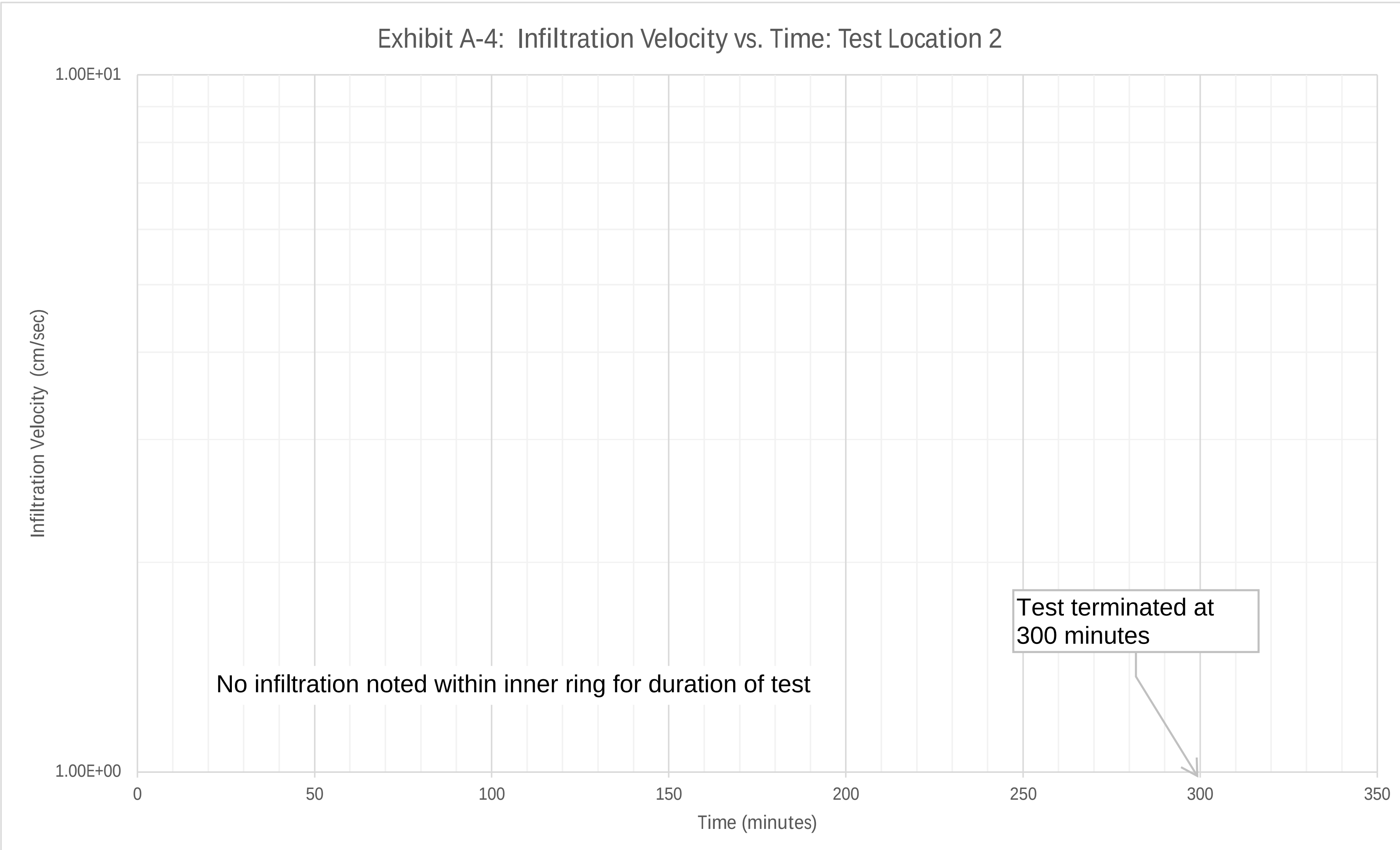


Exhibit A-4: Infiltration Velocity vs. Time: Test Location 2
Infiltration Velocity (cm/sec)
1.00E+01
1.00E+00
0
50
100
150
200
250
300
350
Time (minutes)
Test terminated at 300 minutes
No infiltration noted within inner ring for duration of test

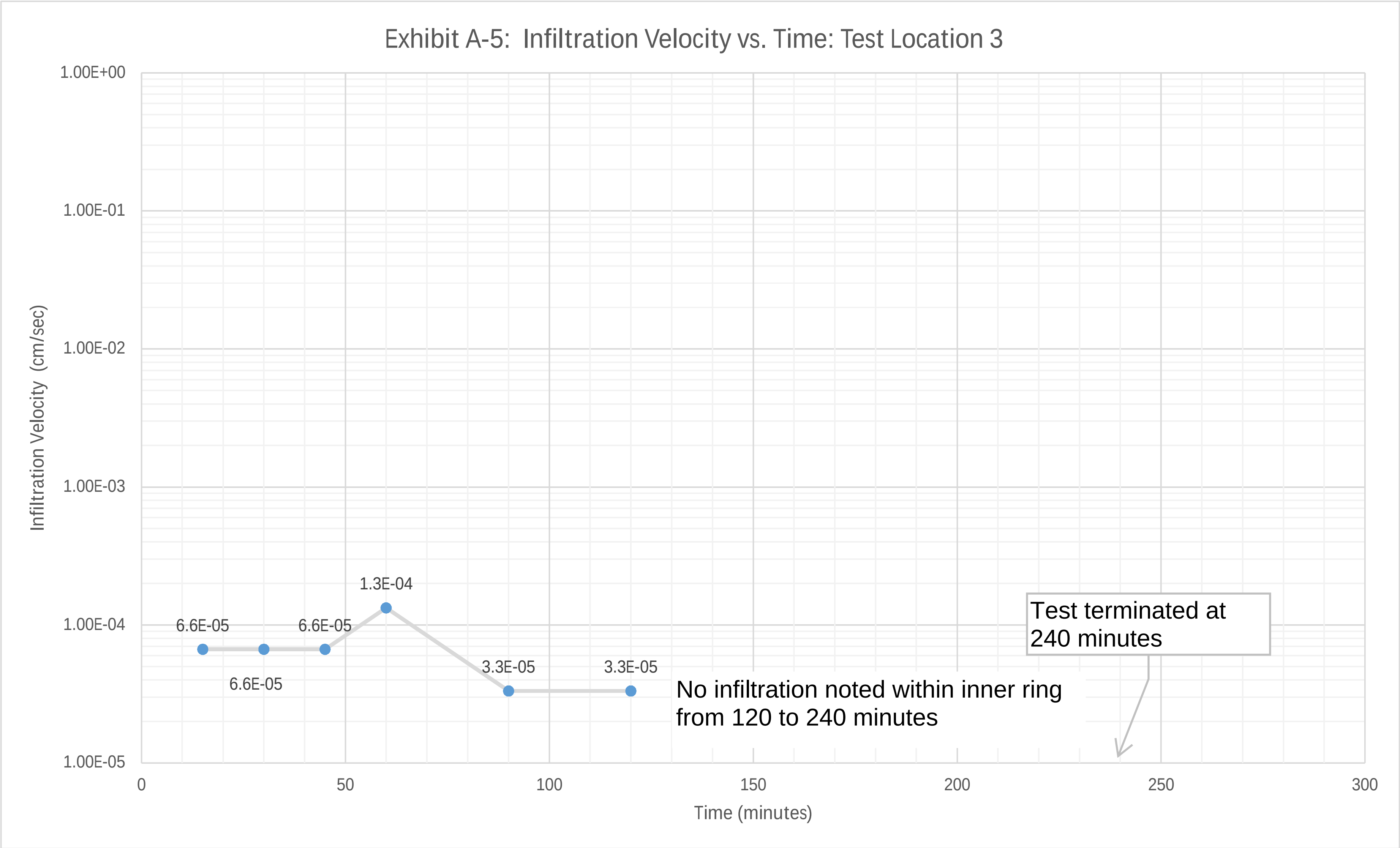


Exhibit A-5: Infiltration Velocity vs. Time: Test Location 3
Infiltration Velocity (cm/sec)
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
6.6E-05
6.6E-05
6.6E-05
1.3E-04
3.3E-05
3.3E-05
Test terminated at 240 minutes
No infiltration noted within inner ring from 120 to 240 minutes
0
50
100
150
200
250
300
Time (minutes)

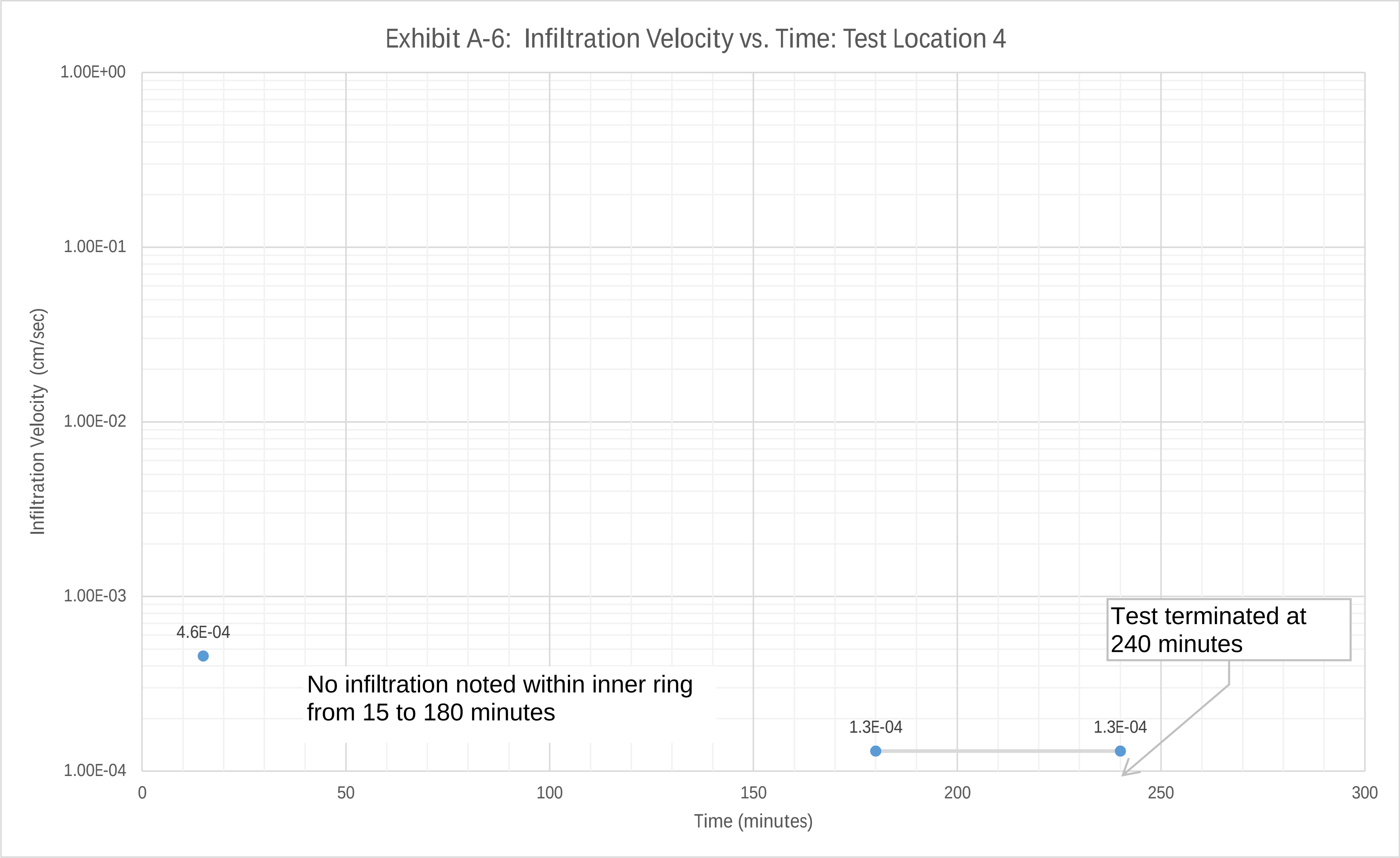


Exhibit A-6: Infiltration Velocity vs. Time: Test Location 4
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
Infiltration Velocity (cm/sec)
4.6E-04
No infiltration noted within inner ring from 15 to 180 minutes
1.3E-04
1.3E-04
Test terminated at 240 minutes
0
50
100
150
200
250
300
Time (minutes)

				Orig issue:
				Rev date: 8/15/07
	REV 0	**REV 1**	**REV 2**	**REV 3**
Prep By:	Frank D. Brizendine	J. David Merritt		
Rev'd By:	Frank Crisp	Ronald c. Bryan		
RAT App'd:	James A. Hartin			
App'd By:	Ozen Batum	Carl K. Toner		

STORM DRAINAGE DESIGN

1.0 GENERAL

1.1 Scope

This guideline presents design information for storm sewer systems and roadside culverts. The guideline is primarily intended to cover sites located in Southern Company's four-state area — Alabama, Florida, Georgia, and Mississippi. This guideline presents one method of hydrology (the rational method) for determining design flows and various concepts used for hydraulic analysis of pipe flow commonly accepted in design of storm sewer systems and culverts.

1.2 Objective

Storm water drainage structures are necessary to conduct runoff from places where it is not wanted to the nearest acceptable discharge point, all in sufficient time to avoid unacceptable amounts of damage and inconvenience. The design of storm drainage facilities involves many factors, interpretation of field data, and engineering judgement.

1.3 Specifications and Standards

For materials and construction requirements, the designs shall be prepared in accordance with the standards and specifications of the four states mentioned in section 1.1. These are as follows:

Alabama - Alabama Highway Department Standard Specifications for Highway Construction, latest edition.

Florida - Florida Department of Transportation Standard Specifications for Road and Bridge Construction, Latest Edition.

Georgia - Georgia Department of Transportation Standard Specifications-Construction of Transportation Systems, Latest Edition.

Mississippi - Mississippi Highway Department Standard Specification for Road and Bridge Construction, Latest Edition.

There are also many Southern Company Services (SCS) project specifications that describe materials and construction requirements recommended for storm sewer systems and culverts.

2.0 DEFINITIONS

storm sewer system — A series or group of inlets, catch basins, junction boxes, and pipes designed to carry precipitation runoff, surface waters, and, in some instances, groundwater. Storm water flow is analyzed on the basis of having flow characteristics of water.

culvert — A pipe or box structure used to carry water flow by gravity under a road, railroad, or other structure. Culverts normally have concrete headwalls at each end with either paved or unpaved ditches at the entrance and exit headwall locations.

storm pipe materials commonly used — CMP: corrugated metal pipe (steel or aluminum). BCCMP: Bituminous-coated corrugated-metal pipe (steel). RCP CLIII: reinforced concrete pipe (roadways). RCP CLV: reinforced concrete pipe (railroads).

storm runoff — Almost wholly that part of rainfall which is not lost by infiltration into the soil or left in surface depressions and on plant surfaces to evaporate.

3.0 DESIGN CRITERIA

For each plant site, during the early stages of preliminary design, the following design criteria items shall be established and concurred with by the associated operating company and/or the specific plant operations personnel.

- Storm frequency.
- Allowable pending for various areas (such as parking lots, switchyard, powerhouse, and so forth).
- Rate of discharge before development vs. rate of discharge after development (for outfall

systems discharging offsite).

- The possibility of any pollutants collecting in the storm runoff (ash, coal, chemicals, and so forth). This is further addressed in section 7.0, Environmental Considerations.

- Maximum discharge velocity - usually between 15 and 20 ft/s. For high outfall velocities, various types of energy dissipators may be required. This may vary from using riprap, to rock gabions, to concrete structures with baffles.

- Minimum discharge velocity - usually 2 to 5 ft/s. For low outfall velocities, sediment may build up in the storm pipe invert. The storm drain slope and selection of pipe materials can be effective when low velocities are encountered.

4.0 HYDROLOGY

Many facets are involved in the hydrologic cycle and the science of hydrology. These are addressed in the Hydrology section of the SCS Design Guide.

For the storm sewer design presented in this guideline, hydrology shall include determining the peak storm runoff for a chosen frequency at any point in a waterway channel in order to select the proper size and shape of structure and appurtenances to best handle that amount of runoff.

In using the peak discharge for sizing storm drain systems and culverts, an economic balance is necessary between the cost of the drain structures and the various costs of potential damage to property or inconvenience during storms.

The method presented in this guideline is commonly referred to as the rational method.

4.1 Other Methods

Other methods may be used for determining peak discharge. Hydrographs shall be produced which give the peak discharge, along with volume at runoff and the relationship of time to the rate and volume of runoff.

Commonly used methods are:

- SCS (Soil Conservation Service) TR-20 and TR-55 computer analysis programs.

- U.S. Corps of Engineers HEC-1 computer analysis program.

- Rational-method hydrographs.

There are several engineering texts that address the use of these methods and SCS has various computer software programs that use these methods.

4.2 Rational Method

The rational method is a common and accepted method of determining design flows for storm sewer systems and culverts. Good results can be expected from this method if it is used properly.

This method is recommended by the Federal Highway Administration for roadside culverts draining less than 200 acres. This method uses an empirical equation that relates the quantity of runoff from a given area to the total rainfall falling at a uniform rate on the same area and is expressed as:

$$Q = C\,i\,A$$

where:

Q = peak rate of runoff, in cfs (cubic feet per second)

C = runoff coefficient, weighted

i = average intensity of rainfall (in/hr)

A = drainage area (acres)

4.2.1 Assumptions for the Rational Method

- The maximum rate of runoff for a particular rainfall intensity occurs if the duration of rainfall is equal to or greater than the time of concentration. (The duration is the time of concentration.)

- The maximum rate of runoff from a specific rainfall intensity whose duration is equal to or greater than the time of concentration is directly proportional to the rainfall intensity.

- The frequency of occurrence of the peak discharge is the same as that of the rainfall intensity from which it was calculated.

- The peak discharge per unit area decreases as the drainage area increases, and the intensity of rainfall decreases as its duration increases.

- The coefficient of runoff remains constant for all storms on a given watershed.

The runoff coefficient C and the drainage area A are both constant for a given area at a given time. Rainfall intensity, *i*, however, is determined by using an appropriate storm frequency and duration which are selected on the basis of economics and engineering judgment. Storm sewers are designed on the basis they will flow full during storms occurring at certain intervals. Between those intervals, the flow in the storm drains will be partial flows.

4.2.2 Watershed Characteristics

Some of the primary watershed characteristics that influence the amount and rate of runoff for a particular drainage area are as follows:

- Area and shape.
- Steepness and length of slopes.
- Kind and extend of vegetation or cultivation.
- Condition of the surface—dry, saturated, frozen—pervious or impervious soil.
- Number, arrangement, and condition of drainage channels on the drainage area.

4.2.3 Time of Concentration

The time of concentration, *Tc*, is the time required for runoff from the most remote part of a drainage area to reach the collection point under design. The most remote portion of the drainage area means that which provides the longest time for overland flow to the design point, but the longest time for overland flow to the design point, is not necessarily the most distant point in the drainage area. For storm sewer systems, the time of concentration consists of the first inlet time plus the time of flow in the remaining sewers (*Tp*) from the first inlet to the point under design consideration. The minimum time of concentration recommended is 5 minutes, and the time of concentration is used as the storm duration in calculating the rainfall intensity values.
For most projects, a table with values of *Tc* up to 30 minutes and corresponding storm intensities should be adequate. Several methods or charts have been established for determining the time of concentration for a given drainage area, such as the SCS (Soil Conservation Service) overland method. Figure 1 shows a commonly used chart, the Kirpich nomograph, for determining time of concentration (reference 1).

4.2.4 Drainage Area

The drainage area, *A*, is the runoff area in acres served by the storm sewer system or culvert. This area can be accurately determined from topographic maps, aerial photos, or field surveys. It is the only element of the rational method subject to precise determination. For storm sewer systems, the complete drainage area is subdivided into component parts, each tributary to be a point of inlet.

Drainage area information shall include the following:

- Land use considering its degree of protection to be provided and percentage of imperviousness.
- The character of the soil and cover and how it affects the runoff coefficient.
- The magnitude of ground slopes and the shape of the area that will affect the time of concentration.

4.2.5 Runoff Coefficient

The runoff coefficient, *C*, is the least susceptible to precise determination. It implies it is a fixed ratio for any given drainage area, when actually the coefficient accounts for losses between rainfall and runoff, which may vary for different drainage subareas. These losses are influenced by soil characteristics, such as porosity and permeability. Other factors to consider in the coefficient are ground cover, such as paved, grassy, or wooded, and retention in depressed areas with accounting for evaporation. The values for the coefficient normally range from zero to unity. A list of commonly used values for *C* is shown in table 1, Runoff Coefficients (reference 2). Several other engineering texts address this subject. It is often desirable to develop a composite or weighted runoff coefficient based on the percentage of different types of surfaces encountered in the drainage area. Table 1 gives values for both description of areas and the character of surface. The coefficients presented in table 1 are good to use for storms of 2-, 5-, and 10-year frequencies. For less frequent, higher intensity storms, the higher side of the coefficients shall be used.

4.2.6 Rainfall Intensity

Rainfall intensity, *i*, is defined as the amount of rainfall measured in inches per hour that would be expected to occur during a storm of a certain duration. The storm frequency is the time in years in which a certain storm would be expected to occur again, determined from available rainfall statistics. U.S. Weather Bureau technical paper maps TP-40 and TP-25 show expected maximum rainfall intensities, *A*, for various frequency storms for the United States. Figure 2 shows the rainfall intensity map for the 2-year frequency, 30-minute duration storm (reference 3). For use with the rational methods the values from the TP-40 rainfall maps may be converted to storms of other durations and frequencies. There are methods, not addressed in this guideline, but presented in engineering texts on this subject, that explain how to develop a table of intensity vs. time of concentration for use in the rational method formula. Table 2 shows an example of the required table.

5.0 APPURTENANCES

Appurtenances are commonly referred to when designing structures which are necessary for proper functioning of storm sewer systems and culverts. These may include headwalls, inlets, junction boxes, catch basins, tide gates, and other devices of special design. The design of these structures is not presented in detail in this guideline. Several engineering texts discuss the hydraulics of gutters; various inlet type friction losses encountered; and the sizes, types, and construction requirements for appurtenances. The design standards for the four states listed in section 1.3 explain established criteria which govern the design and construction of these appurtenances. Commonly used inlets for storm sewer systems are (a) curb and gutter inlets with openings in the curb, (b) valley gutter inlets with grates, and (c) yard inlets with grates. Concrete headwalls are normally used at the entrance and exit locations of culverts to direct the flow of effluent and to stabilize embankments and reduce erosion around the culvert. Reinforced concrete function boxes are used for connecting two or more pipes and may be poured-in-place construction or precast concrete construction.

6.0 HYDRAULICS

A common and widely accepted method for determining flow characteristics in pipes, conduits, and channels is Manning's equation for open channels. This expresses the average velocity and discharge in pipes or culverts, as follows:

Velocity $V = (1.486/n)(R^{2/3})(S^{1/2})$
in feet per second (average or mean velocity)

and R = Hydraulic radius, ft
S = Hydraulic gradient, ft per ft
n = Manning's coefficient of surface roughness for various pipe materials or channels

Discharge $Q = VA$
in cubic feet per second

and A = Cross sectional area of flow, ft^2

This formula for discharge capacity of pipes, culverts, and open ditches can be used to size each, along with considerations of two very important items, inlet control and outlet control. Considering the many factors involved in field data and hydrology, the engineer shall use judgement and experience in the design of storm sewer systems and culverts. One cannot just use Manning's equation for sizing alone. A good rule of thumb for sizing pipes is to allow the design flow as determined from the rational method to be approximately 2/3 of the flowing-full pipe capacity determined from Manning's formula, and then to check the inlet and outlet conditions and pipe sizes by trial and error. Conventional storm sewers and culverts are circular pipes, arch-pipes, and box culverts, all with uniform cross-sectional areas throughout. The portion of design of these sections using Manning's formula is commonly referred to as barrel flow.

6.1 Open-Channel Flow Analysis

Many texts and computer programs are available on open-channel flow characteristics, factors, and analysis to consider, which will not be addressed in detail in this guideline. Some of the characteristics and factors covered elsewhere are as follows; uniform flow, nonuniform flow, and the effect on hydraulic gradient; critical flow, depth, slope, and Fraude number; energy grade line, friction losses, and head losses (velocity and static); and normal depth (d_n), supercritical, and subcritical flows. Figure 3 shows sketches of uniform and nonuniform open-channel flow sections (reference 2).

6.2 Inlet and Outlet Control Factors

D = Inside diameter of circular pipe or height of arch pipe or box culvert, in.

H = Head, ft

L = Length of culvert, ft

n = Manning's definition for roughness coefficient

S_o = Slope of culvert or pipe, ft per ft

Hw = Headwater depth at culvert entrance, ft

Tw = Tailwater depth at culvert outlet, ft

The headwater depth, *Hw*, shall be computed or determined using textbook charts or computer programs for both inlet and outlet control conditions. Partial flows, as well as full flow conditions, may be desired depending on storm frequency being analyzed. For various sketches of inlet and outlet control conditions, see figures 4 and 5 (reference 1).

The headwater depth is the vertical distance from the culvert invert at the entrance to the energy line of the headwater pool (depth + velocity head). The water surface and energy line at the entrance are assumed to coincide. It most cases, the Hw depth either for inlet control or outlet control will govern over barrel flow in selection of sizes and materials for storm drains and culverts.

6.3 Inlet Control

The inlet control condition occurs when the control section is located at or near the culvert entrance, affected by the size and given shape, and the pipe discharge is dependent on the inlet geometry and headwater depth. It will determine flow values in the culvert and usually govern size selection over barrel-flow capacities determined from Manning's equation. The inlet control condition will exist when water can flow through the barrel of the culvert at a rate greater than water can enter the inlet. Since the control section is at the inlet, the flow capacity is not affected by any hydraulic factors beyond the culvert entrance such as slope, length, or surface roughness. Culverts and pipes operating under inlet control will always flow partially full. The *Hw* depth and amount of ponding allowed for the storm sewer system or culvert are of primary importance.

6.4 Outlet Control

The outlet control condition occurs when the control section is located at or near the culvert outlet, and for any given shape and size of culvert, the discharge is dependent on all of the hydraulic factors upstream from the outlet such as shape, slope, surface roughness, tailwater depth, headwater depth, and inlet geometry. Basically, the outlet control condition will exist as long as water can enter the culvert at a greater rate than it can flow through it. Culverts and pipes operating under outlet control can flow either full or partially full.

7.0 STRUCTURAL REQUIREMENTS

7.1 Construction Installation

Storm drain system pipes and culverts are normally installed in relatively narrow trenches on uniform granular beds. Care in installation for proper horizontal and vertical alignment shall be observed to avoid joint displacements. The pipe trenches then shall be backfilled with compacted earth or crushed stone, with compaction requirements under roadways and railroads specified to reduce undesired settlement. Care must be taken in backfilling over pipes, especially corrugated metal pipes, to avoid unnecessary damage to the pipe walls.

7.2 Loads and Supporting Strengths

Storm drain system pipes and culverts are subjected to a variety of loading conditions, including highway, railroad, and airport live loads and earth and backfill loads. The design handbook for concrete pipe and steel pipe has several allowable loading tables and charts for different pipe installation depths. This guideline describes the procedures for selection of pipe strength for design, factors of safety to be applied, jacked or tunneled procedures, and live load distribution through the backfill induced on the pipe. For reinforced box culverts, an individual design for the top slab, walls, and footings shall be required for each independent project.

8.0 ENVIRONMENTAL CONSIDERATION

In design of storm sewer system and culverts, the engineer shall give consideration to federal, state, and local regulations, which address both the quality and quantity of water discharged from a system. The primary concern is for the outfall points that discharge offsite into classified U.S. navigable streams, rivers, and lakes. Most counties and cities have regulations governing increases in rate of flow, usually from an undeveloped portion of a plant site that is being developed. They also have regulations governing sedimentation and erosion.

The Environmental Protection Agency (EPA) has set federal regulations that address the discharge of pollutants into the waters offsite at a given power plant location. The EPA and the four system states have regulatory agencies that monitor storm water pollutants and discharges under the NPDES (National Pollutant Discharge Elimination System) permitting program. Each power company headquarters and plant site has environmental personnel familiar with these regulations and each site's existing permit situation. The engineer shall coordinate storm drain design with these personnel.

In the Southern Company territories, the following are the state regulatory agencies that enforce the EPA (or more stringent of their own) regulations concerning storm water pollution, discharge, and the NPDES permitting program:

Alabama - ADEM	Alabama Department of Environmental Management, Montgomery, AL
Georgia - GEPD	Georgia Environmental Protection Division, Atlanta, GA
Gulf - FDER	Florida Department of Environmental Regulations, Tallahassee, FL
Mississippi - MEQD	Mississippi Environmental Quality Department, Jackson, MS

8.0 REFERENCES

1. SG-861, Handbook of Steel Drainage and Highway Construction Products. American Iron and Steel Institute, Washington, D.C., 1983.

2. Design and Construction of Sanitary and Storm Sewers. M&R No. 37 NPCF MOP 9, American Society of Civil Engineers, New York, 1986.

3. Concrete Pipe Design Manual. American Concrete Pipe Association, [City and State] 1980.

TABLE 1
RUNOFF COEFFICIENTS, C

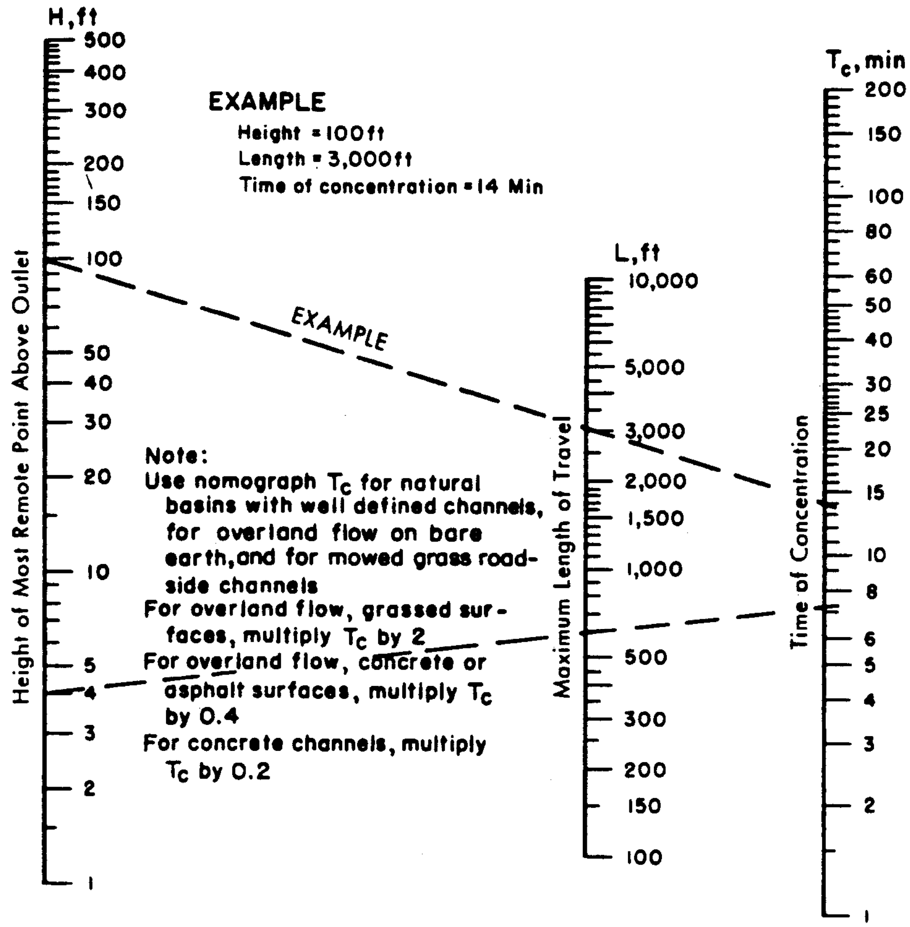
Description of Area	Runoff Coefficients
Business	
Downtown	0.70 to 0.95
Neighborhood	0.50 to 0.70
Residential	
Single-family	0.30 to 0.50
Multi-units, detached	0.40 to 0.60
Multi-units, attached	0.60 to 0.75
Residential (suburban)	0.25 to 0.40
Apartment	0.50 to 0.70
Industrial	
Light	0.50 to 0.80
Heavy	0.60 to 0.90
Parks, cemeteries	0.10 to 0.25
Playgrounds	0.20 to 0.35
Railroad yard	0.20 to 0.35
Unimproved	0.10 to 0.30

Character of Surface	Runoff Coefficients
Pavement	
Asphaltic and Concrete	0.70 to 0.95
Brick	0.70 to 0.85
Roofs	0.75 to 0.95
Lawns, sandy soil	
Flat, 2 percent	0.05 to 0.10
Average, 2 to 7 percent	0.10 to 0.15
Steep, 7 percent	0.15 to 0.20
Lawns, heavy soil	
Flat, 2 percent	0.13 to 0.17
Average, 2 to 7 percent	0.18 to 0.22
Steep, 7 percent	0.25 to 0.35

TABLE 2

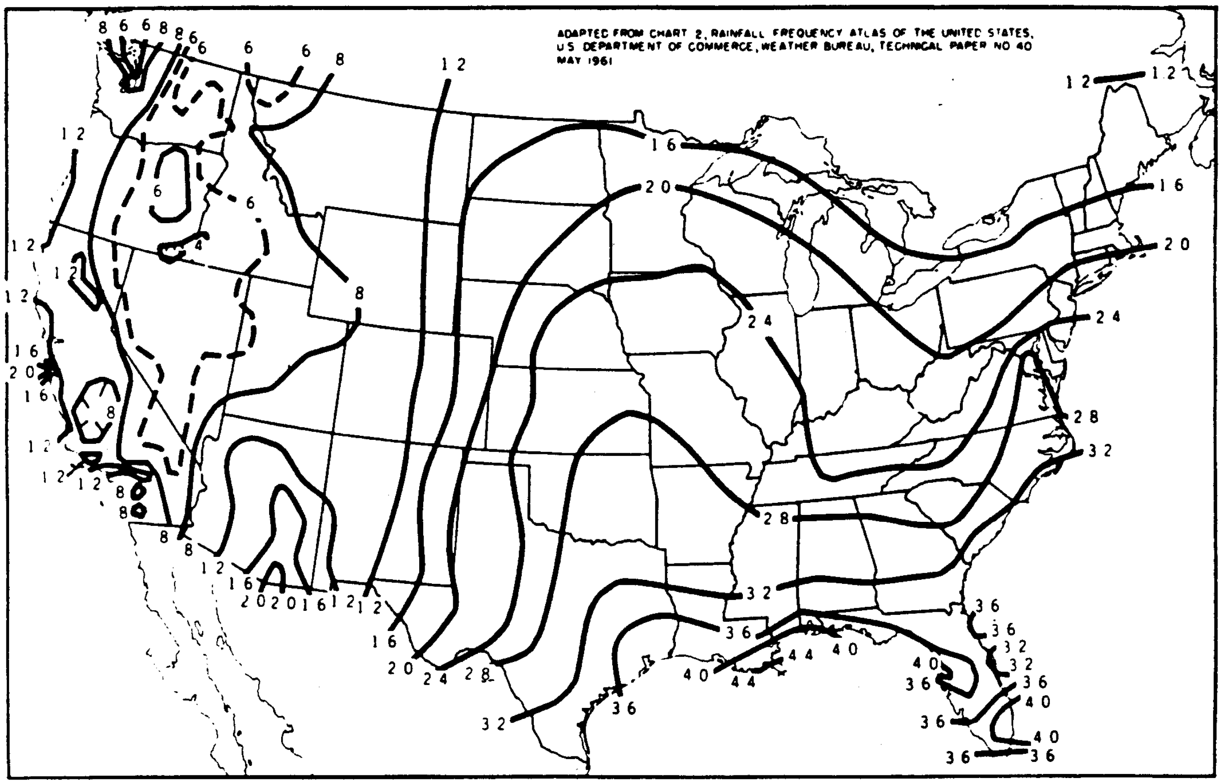
100 YEAR RAINFALL
(YARD)

Time (min)	Maximum Rainfall (in.)	Corresponding Intensity (in./hr)
5	1.1	12.8
6	1.2	12.2
8	1.5	11.1
10	1.7	10.1
12	1.9	9.4
14	2.1	8.8
15	2.2	8.6
16	2.3	8.4
18	2.4	7.9
20	2.5	7.6
22	2.6	7.2
24	2.8	6.9
26	2.9	6.6
28	3.0	6.4
30	3.1	6.1
35	3.3	5.6
40	3.5	5.2
60	4.0	4.0
120	4.8	2.4
180	5.1	1.7
360	6.0	1.0



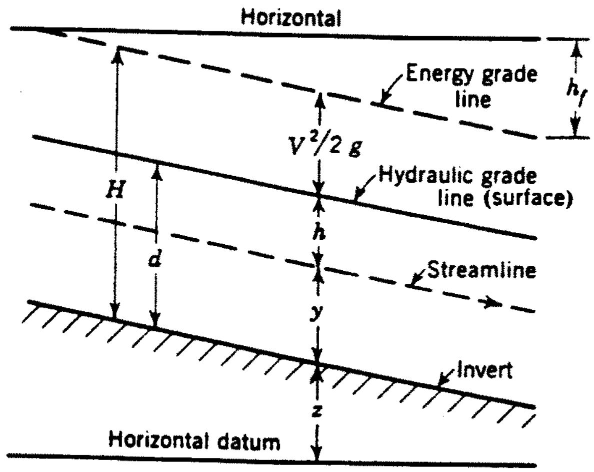
From *Handbook of Steel Drainage and Highway Construction Products, 1983*
Used by permission of American Iron and Steel Institute.

Figure 1
Kirpich Nomograph for
Time of Concentration of Rainfall on Small Drainage Basins



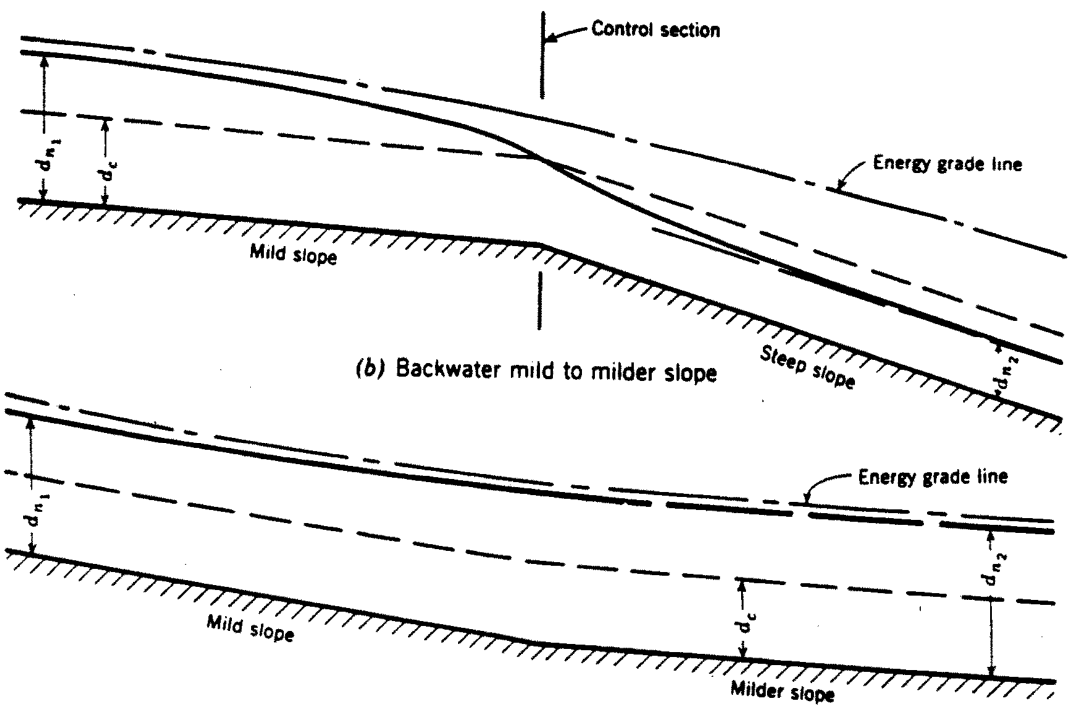
From *Concrete Pipe Design Manual*
Used by permission of American Concrete Pipe Association

Figure 2
Map of the United States
2-Year, 30-Minute Rainfall Intensity



Non-Uniform Flow - Open Channel

***(a)* Drawdown mild to steep slope**



From *Design and Construction of Sanitary and Storm Sewers, 1986.*
Used by permission of the American Society of Civil Engineers
and the Water Environment Federation

Figure 3
Uniform and Nonuniform
Open-Channel Flow

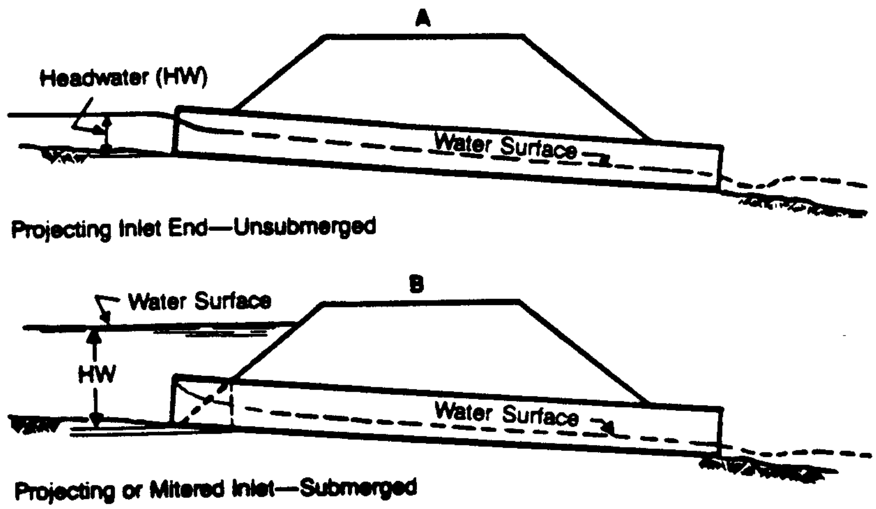
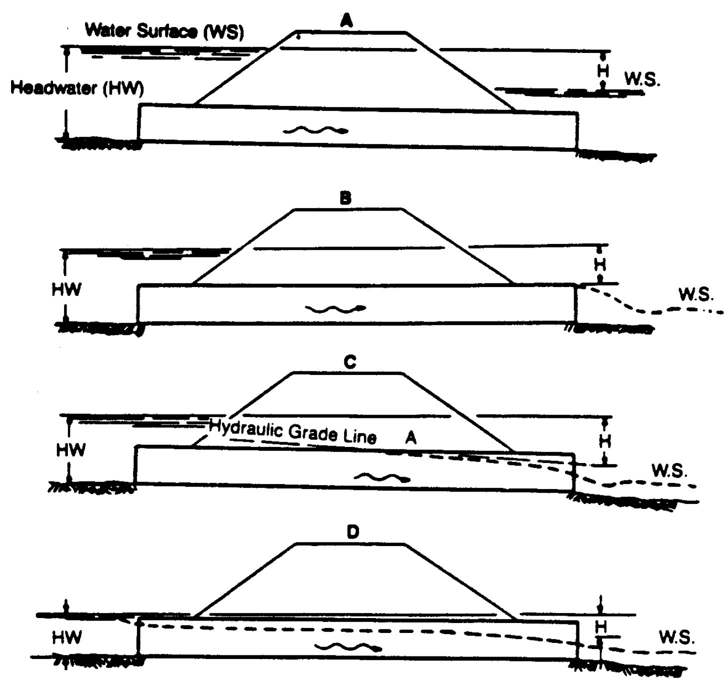


Figure 4
Inlet Control Conditions



From *Handbook of Steel Drainage and Highway Construction Products, 1983*
Used by permission of American Iron and Steel Institute.

Figure 5
Outlet Control Conditions

B. SLOPE STABILITY AND SETTLEMENT ASSESSMENT

Slope Stability and Settlement Assessment

AP-3, Plant Hammond
Rome, Floyd County, Georgia

Stantec

Prepared for:
Georgia Power Company
Atlanta, Georgia

Prepared by:
Stantec Consulting Services Inc.
Lexington, Kentucky

GEORGIA
REGISTERED
No. PE037892
PROFESSIONAL
ENGINEER
GENE KIP ANDERSON

Kip Anderson
10/30/2018

October 30, 2018

Table of Contents

1.0 PURPOSE OF CALCULATION

At Georgia Power Company's (GPC) Plant Hammond, construction to close the Ash Pond 3 (AP-3) facility is scheduled for completion in Q2 of 2018. The AP-3 unit is currently managed under the Extension Rule for inactive surface impoundments under the Federal Coal Combustion Residuals (CCR) Rule (EPA 2015).

The most recent slope stability analysis of AP-3 was performed by Southern Company Services (SCS) in 2010. The two load cases (steady state and seismic) analyzed during the 2010 evaluation met the minimum criteria established by the Georgia Environmental Protection Department (EPD). Those results were used to support an assessment of surface impoundments (AMEC 2010), for the United States Environmental Protection Agency (EPA).

However, the 2010 stability analyses did not model the final closed configuration for AP-3. The impoundment was modeled based on the 1980 design configuration, when wet sluicing was discontinued and the facility was modified to a dry handling operation. The potential for soil liquefaction and post-earthquake instability were also not evaluated in 2010, as required by the current Extension Rule Section 257.100(e)(3).

The slope stability and settlement analyses presented here were performed for the final closed configuration of the AP-3 facility, as part of the closure requirements for Plant Hammond set by the Georgia EPD. Stability analyses for the final cap/liner system are presented under a separate cover.

2.0 SUMMARY OF CONCLUSIONS

2.1 SLOPE STABILITY

Results from the slope stability analyses are summarized in Table 2-1**Error! Reference source not found.**. The analyzed slopes meet the defined criteria for long-term (drained), pseudo-static, and post-earthquake stability. Veneer stability was not considered in this calculation.

Table 2-1. Slope Stability Analysis Results

Loading Condition	Required Minimum Factor of Safety	Calculated Factor of Safety
Long Term (Drained)	1.5	2.2
Pseudo-static	1.0	1.2
Post-Earthquake	1.2	2.2

2.2 SETTLEMENT

The maximum calculated settlement at the center of the CCR unit is approximately 6.5 inches. This differential settlement over a length of 350 feet results in a change in slope of 0.15%, which will not prevent positive drainage of the cap system. This simplified differential settlement case would result in a minimal change in liner length, <0.01% strain, which is less than the maximum allowable strain of 4%.

3.0 CRITERIA

The following subsections detail the criteria used in evaluating the slope stability and settlement results.

3.1 SLOPE STABILITY

The required minimum factor of safety for slope stability is presented for each loading condition in Table 3-1.

Table 3-1. Slope Stability Criteria (from EPA 2015)

Loading Condition	Required Minimum Factor of Safety
Long-Term (Drained)	1.5
Pseudo-static	1.0
Post-Earthquake	1.2

3.2 SETTLEMENT

The calculated settlements are used for comparison to allowable strains within the final geosynthetic cover system. The allowable strain in the geosynthetic liner is 4% (Peggs et al. 2005).

4.0 REFERENCES

AMEC (2010). "Report of Safety Assessment Coal Combustion Surface Impoundments, Georgia Power, Plant Hammond, Rome, Georgia." December.

GEO-SLOPE International Ltd. (2017). *Stability Modeling with SLOPE/W: An Engineering Methodology*. June 2015 Edition, Calgary, Alberta, Canada.

Hynes-Griffin M. E., Franklin A. G. (1984). "Rationalizing the seismic coefficient method." U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi, Miscellaneous Paper GL-84-13, 21 pp.

Environmental Protection Agency (EPA) (2015). "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule". 40 CFR Parts 257 and 261. Federal Register Vol. 80, No. 74. April 17.

Nagaraj, T. and Srinivasa Murthy, B. (1985) "Prediction of the Preconsolidation Pressure and Recompression Index of Soils." Geotechnical Testing Journal, Vol. 8, No. 4. pp. 199-202

Peggs, I.D., Schmucker, B., Carey, P. (2005) "Assessment of Maximum Allowable Strains in Polyethylene and Polypropylene Geomembranes". Geo-Frontiers Congress.

U.S. Army Corps of Engineers (2003). "Slope Stability." EM 1110-2-1902, October 31.

5.0 ASSUMPTIONS

This evaluation was limited to the assessment of settlements and slope stability for the closed AP-3 facility. The stability of ancillary facilities at the site were not included in this scope of work.

This evaluation considered only the specific conditions documented herein. The analyses do not consider future conditions or site modifications. Unknown conditions may exist within or under the facility, and assumed conditions may change over time. Per the scope of work, slope stability analyses only considered the embankment and foundation soils, and settlement analyses only considered consolidation in the foundation soils. The results of the evaluation are dependent on the methods employed, inherent assumptions, and the input parameters. These factors and others contribute to the uncertainty associated with the results.

5.1 SLOPE STABILITY

5.1.1 Section Geometry

Slope stability was evaluated for one representative cross section of the closed AP-3 facility. The selected cross-section (Section C-C', Figure 1) is at approximately the same location as modeled in the 2010 analysis.

The current analysis models the configuration depicted in the closure construction drawings, with dry fly ash material stacked above the sluiced ash. The surface topography is based on the as-built survey (dated October 19, 2017) of the installed geomembrane liner provided by GPC, and assuming two feet of protective cover and vegetated soil will be placed over the geomembrane liner to reach final closure grade.

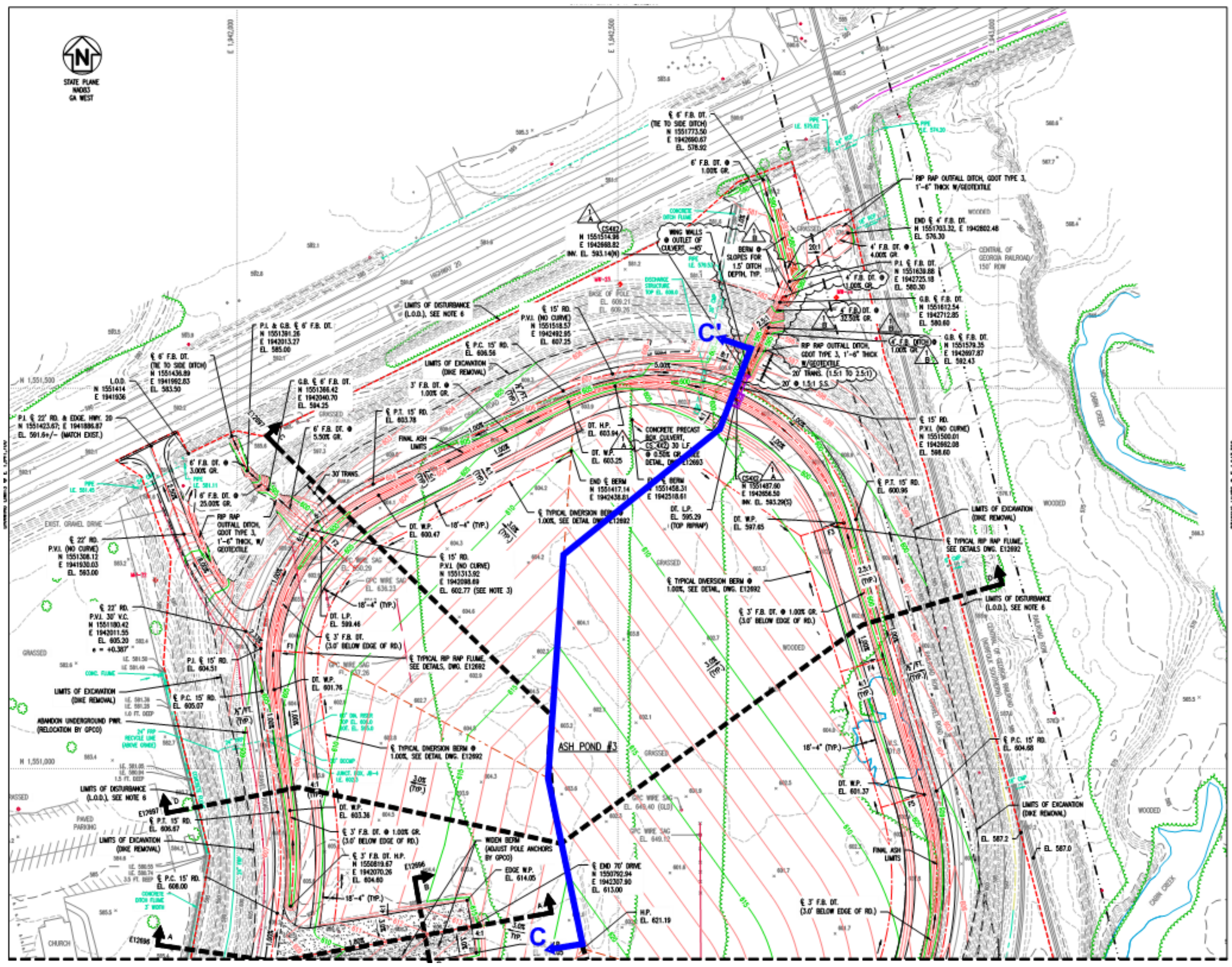


Figure 1. Approximate location of the analyzed cross section

5.1.2 Material Parameters

The analyzed cross section includes five materials: Dike Fill, Cover Material, Foundation, Sluiced Ash, and Stacked Ash. Table 5-1 summarizes material parameters used in the slope stability analyses. Laboratory data to support material parameter derivations were provided by GPC.

Table 5-1. Material Parameters for Slope Stability Analysis

Material	Moist Unit Wt. (pcf)	Saturated Unit Weight (pcf)	Drained Strength Parameters	Pseudo-static Strength Parameters	Post-Earthquake Strength Parameters
Dike Fill[1]	130	133	φ' = 36˚ c' = 0 psf	φ = 32˚ c = 0 psf	φ = 32˚ c = 0 psf
Cover Material[2]	115	N/A	φ' = 20˚ c' = 0 psf	φ' = 20˚ c' = 0 psf	φ' = 20˚ c' = 0 psf
Foundation[1]	122	123	φ' = 34˚ c' = 0 psf	φ = 20˚ c = 320 psf	φ = 20˚ c = 320 psf
Sluiced Ash[1]	95	100	φ' = 20˚ c' = 0 psf	c/p = 0.15	c/p = 0.05
Stacked Ash[2]	105	N/A	φ' = 30˚ c' = 0 psf	φ' = 30˚ c' = 0 psf	φ' = 30˚ c' = 0 psf

[1]In unsaturated portions of this material, the drained strength parameters are used in the pseudo-static and post-earthquake analyses. In saturated portions, the lesser of the drained and Pseudo-static or post-earthquake strengths are used.
[2]Material is always unsaturated in model; drained strength parameters are used in the pseudo-static and post-earthquake analyses.

The Foundation material is typically clayey sand/sandy lean clay. It consists of two units, an alluvial terrace material and a lower residual material. However, the units have similar classifications and strength characteristics and are represented as a single layer in the stability analysis. The Dike Fill is primarily composed of compacted Foundation material. Both materials were judged to be clay-like and unliquefiable, based on the available laboratory classifications.

Strength parameters for the Foundation and Dike Fill materials were derived from consolidated, undrained (CU) triaxial tests provided by GPC. Shear strength fits to the CU data, for drained and undrained conditions, are shown in Attachment A. To account for pore pressures that may accumulate during dynamic loading in these materials, the undrained shear strength was reduced by 20% for the pseudo-static and post-earthquake stability analyses.

Strength parameters for the Cover Material parameters were conservatively estimated, assuming that the cover soil would receive limited compaction. However, the assumed parameters for the Cover Material (friction angle of 20 degrees) may be overly conservative for evaluating veneer stability in the cap.

No field or laboratory density or strength data were available for the ash material. For the Stacked Ash, a drained friction angle of 30 degrees was assumed, representing a typical value for loose silts or sands. For the Sluiced Ash, parameters were estimated assuming the material would behave as a very loose silt that liquefies in the design earthquake. Typical drained strengths – friction angle of 20 degrees – and undrained strength ratios – c/p = 0.2 (static), c/p = 0.15 (seismic, 20% reduction of static) – were selected for this material. A residual strength ratio of c/p = 0.05, or about half of a typical value for liquefied sand, was selected for liquefied ash.

5.1.3 Pore Water Pressure

Reportedly, no water has been impounded in AP-3 since the 1980's when the facility was converted to dry operations. Recent piezometric readings were used to estimate the current phreatic conditions under the ash stack, for use in the stability analyses. This surface is depicted in the stability results in Attachment C.

This assessment does not include any predictions or assessments regarding the current or future groundwater levels at AP-3.

5.1.4 Slip Surfaces

Circular and noncircular slip surfaces were considered when searching for the critical (lowest safety factor) failure mechanism. Slip surfaces that were less than 10 feet deep were ignored, on the assumption that shallow, surficial sliding in the dikes would not represent a facility failure.

Veneer stability (shallow sliding) modes were considered under a separate analysis.

5.1.5 Load Cases

Three load cases were analyzed under this scope of work.

- Long-term, static conditions, with drained soil strengths
- Pseudo-static stability analysis representing a seismic load, with undrained soil strengths
- Post-earthquake stability, considering the potential for soil liquefaction.

5.1.6 Seismic Inputs

Seismic inputs were generated using the United States Geological Survey Unified Hazard Tool (https://earthquake.usgs.gov/hazards/interactive), accessed on May 11, 2018 and documented in Attachment B. The site bedrock was assumed to have a shear wave velocity of 2,500 ft/s (Site Class B/C boundary. A 2,475-year return period was selected for the design event. PGA at the top of rock is 0.22 g.

5.2 SETTLEMENT

The one-dimensional settlement analysis only considers consolidation of the saturated foundation soils due to the added weight of the dry-stacked and cover material. Compression of the sluiced ash and stacked ash is expected to occur as the additional material is stacked, prior to placement of the geomembrane cover. Hence, liner strains should result primarily from longer-term consolidation of the foundation soils. Elastic settlements and secondary compression are assumed to be negligible.

5.2.1 Profile Geometry

Assumptions regarding analysis profile geometry are included in Attachment C. Maximum settlements are predicted for the high point (at elevation 621.19 feet) of the closed facility. At this location, 2 feet of cover soil and 17.4 feet of ash will be stacked above the current grade at elevation 601.8 feet. The added weight of material will cause consolidation settlements in the underlying Foundation soil (about 15 feet thick).

The horizontal distance between the maximum settlement profile (at the center of the facility) and the minimum settlement profile (at the dike) is approximately 350 feet. This distance is necessary to calculate differential settlement in the cap.

5.2.2 Material Parameters

The analyzed profile includes four materials: Foundation, Sluiced Ash, Stacked Ash, and Cover Material. Table 5-2 summarizes the parameters for each, as needed for the settlement analysis. Laboratory data to support material parameter derivations were provided by GPC.

Table 5-2. Material Parameters for Settlement Analysis

Material	Moist Unit Wt. (pcf)	$e_{,o}$	C_c	Cr
Foundation	125	0.73	0.26	0.05
Stacked Ash	105	N/A	N/A	N/A
Sluiced Ash	95	N/A	N/A	N/A
Cover Material	115	N/A	N/A	N/A

N/A: Compression of these layers assumed to have no impact on the geomembrane liner.

Compression parameters are needed only for the Foundation soil. The saturated, sluiced ash has a higher permeability and is expected to consolidate concurrently with ash stacking. The unsaturated ash materials will also compress as the landfill is raised as the ash is stacked within the CCR unit. Hence, only the post-construction consolidation in the Foundation soil is expected to cause settlement of the final cover.

The void ratio (e_o = 0.73) for the Foundation soil is the average of laboratory measurements on samples from the site provided by GPC. The compression index (C_c) was estimated based on empirical correlations (Nagaraj and Murthy, 1985) and typical values for similar soils. The Foundation soil was conservatively assumed to be normally consolidated, resulting in larger estimates of potential settlements. See the calculations in Attachment C for more information.

5.2.3 Pore Water Pressure

The elevation of the phreatic surface used in the settlement analysis matches the surface used in the stability analysis (see Section 5.1.3).

6.0 MAJOR EQUATION SOURCES/DERIVATION OF METHODS

6.1 SLOPE STABILITY

6.1.1 Software

Slope stability was evaluated using conventional, two-dimensional, limit equilibrium methods as implemented in the GeoStudio SLOPE/W 2018 software (GEO-SLOPE 2017). Spencer's Method was chosen for the analysis.

6.1.2 Critical Slip Surface

Factors of safety for failure along specific slip or failure surfaces are computed in the SLOPE/W code. To assess the overall stability of an earth slope, the analysis involves a search for a critical slip surface, for which a minimum FS_{slope} is computed. Both circular and noncircular surfaces are considered.

SLOPE/W includes several options and trial routines to facilitate the search for the critical failure surface (GEO-SLOPE 2017). The final failure surface, representing the critical slip surface associated with the reported FS_{slope}, is selected by the engineer based on the analytical results, the automated search outcomes, and knowledge of the geotechnical conditions.

6.1.3 Drained versus Undrained Analyses

Conventional, geotechnical stability is evaluated for two bounding conditions:

- Drained conditions, where the pore pressures are assumed to be unchanged, shear strengths are computed based on the effective stress at failure, and effective stress stability analyses are used.
- Undrained conditions, where the final pore pressures (including pore pressures induced by shearing) are unknown, shear strengths are constant or computed based on the effective consolidation stress, and total stress analyses are used.

Undrained conditions may develop in low permeability (generally less than about 10^{-4} cm/sec), saturated soils during changing external loading conditions. In relatively permeable soil zones (generally 10^{-4} cm/sec or greater), excess pore pressures are expected to dissipate quickly (USACE 2003). In practice, suction pore pressures and potential excess pore pressures are neglected in unsaturated materials. The type of analysis to be used for each load case is defined in Section 5.1.5.

6.1.4 Seismic Slope Stability

Seismic performance was evaluated using a pseudo-static slope stability analysis, following the methodology outlined by Hynes-Griffin and Franklin (1984). Saturated materials were assigned 80% of their undrained shear strengths, to account for dynamic pore pressures. A horizontal seismic coefficient, k_h, equal to one half of the acceleration at bedrock (k_h = 0.5*0.22 g = 0.11 g) was assumed. Embankment deformations should be tolerable if the computed pseudo-static factor of safety is greater than one.

6.2 SETTLEMENT

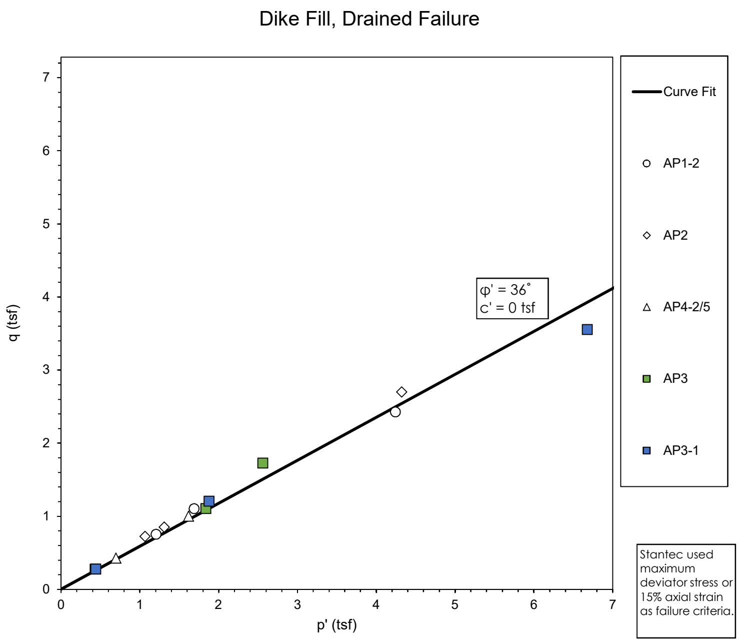
The settlement analysis consists of a one-dimensional consolidation calculation at the middle (maximum cross-section height) of the closed facility, as documented in Attachment C. The maximum differential settlement occurs between this location (maximum settlement) and the facility perimeter (zero settlement). Liner strain on the cap is calculated as the difference between the length of liner before and after settlement divided by the length of liner before settlement.

7.0 BODY OF CALCULATIONS

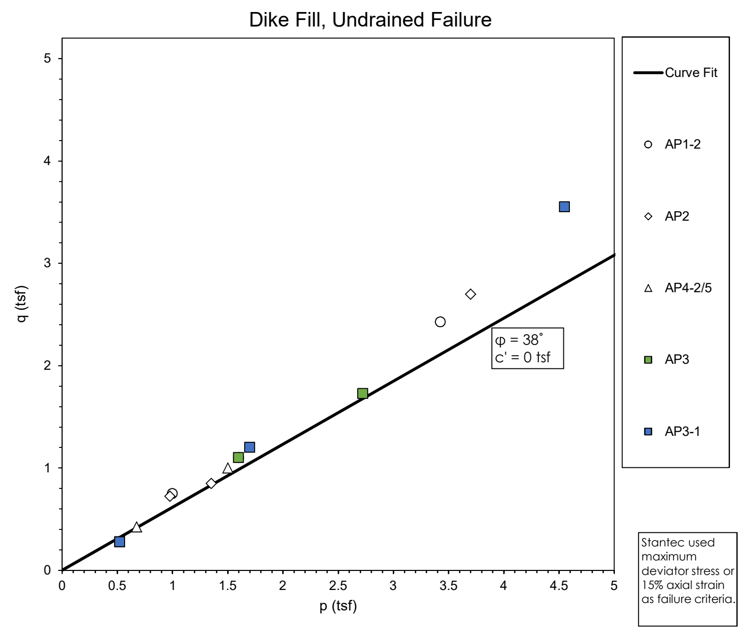
Graphical results and input/output files for the slope stability analyses are provided in Attachment A. Seismic inputs are detailed in Attachment B. The settlement calculations are in Attachment C.

ATTACHMENT A
STABILITY ANLAYSIS OUTPUTS

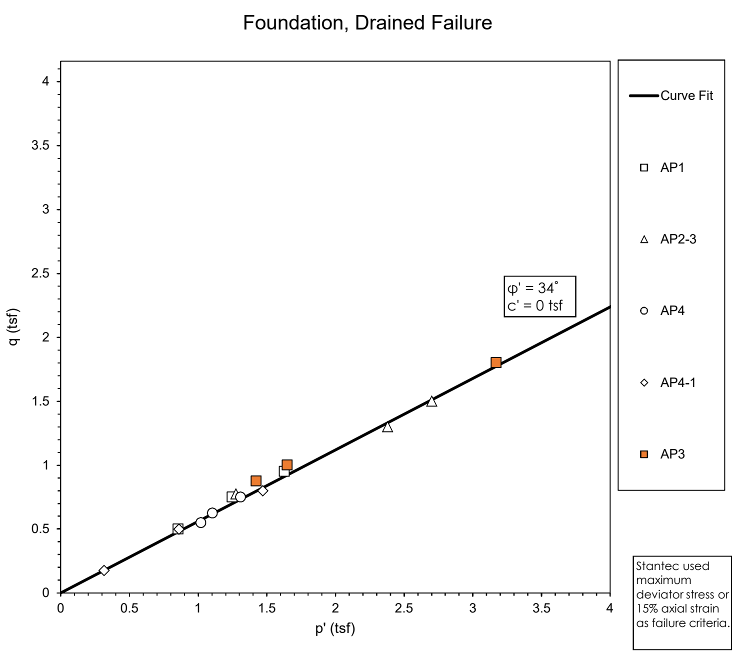
Attachment A
TABLE OF CONTENTS



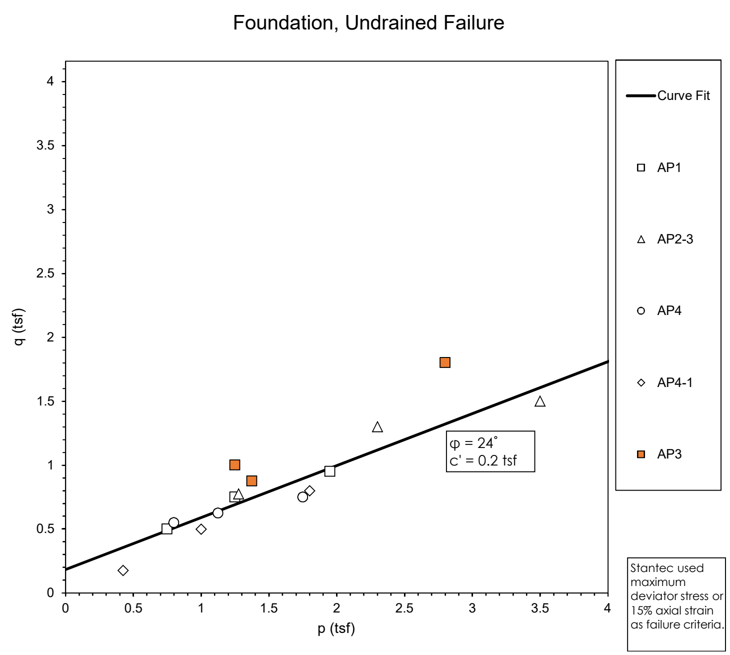
Dike Fill, Drained Failure
q (tsf)
p' (tsf)
φ' = 36°
c' = 0 tsf
Curve Fit
AP1-2
AP2
AP4-2/5
AP3
AP3-1
Stantec used maximum deviator stress or 15% axial strain as failure criteria.



Dike Fill, Undrained Failure
q (tsf)
p (tsf)
φ = 38°
c' = 0 tsf
Curve Fit
AP1-2
AP2
AP4-2/5
AP3
AP3-1
Stantec used maximum deviator stress or 15% axial strain as failure criteria.

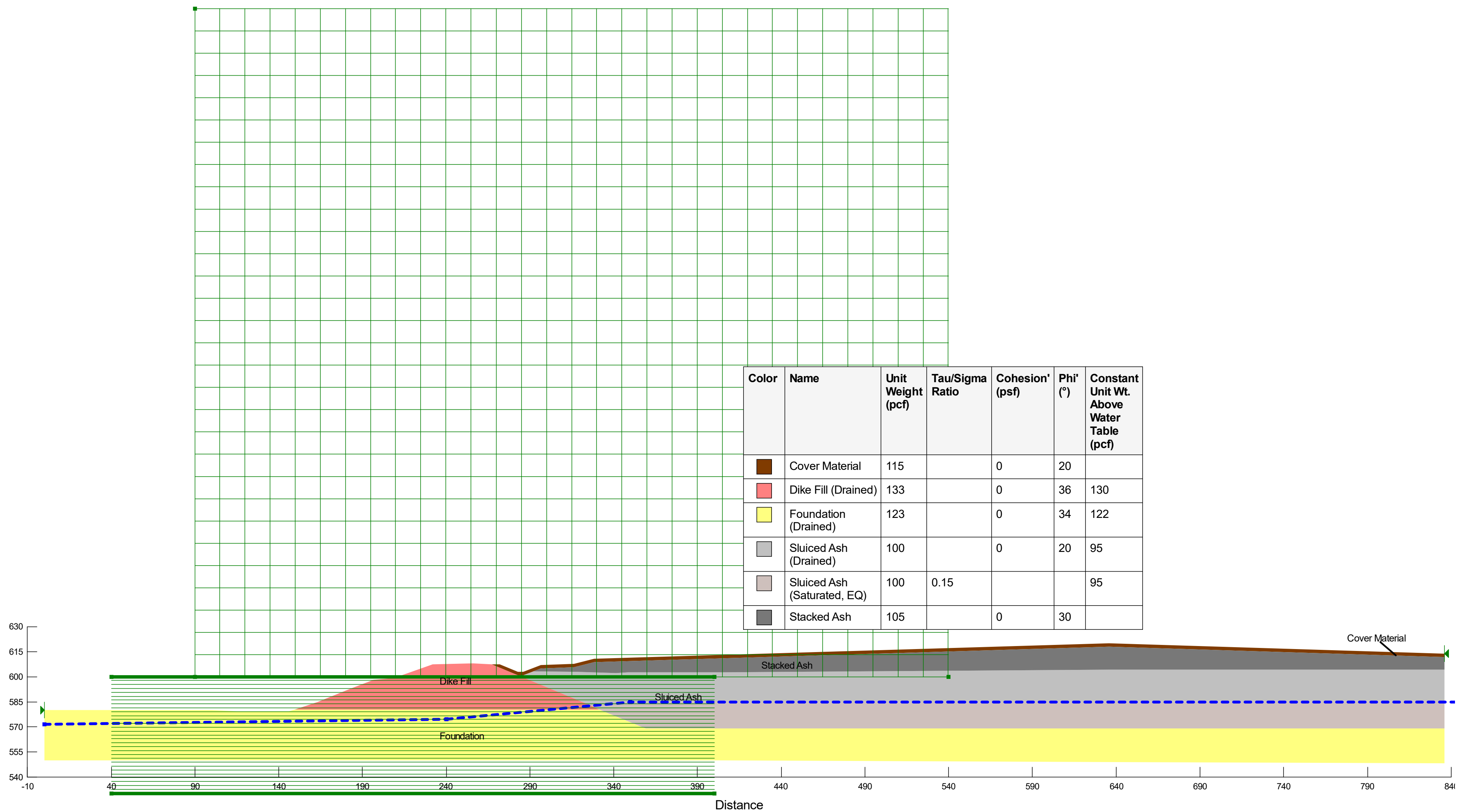


Foundation, Drained Failure
q (tsf)
p' (tsf)
φ' = 34°
c' = 0 tsf
Curve Fit
AP1
AP2-3
AP4
AP4-1
AP3
Stantec used maximum deviator stress or 15% axial strain as failure criteria.



Foundation, Undrained Failure
q (tsf)
p (tsf)
φ = 24°
c' = 0.2 tsf
Curve Fit
AP1
AP2-3
AP4
AP4-1
AP3
Stantec used maximum deviator stress or 15% axial strain as failure criteria.

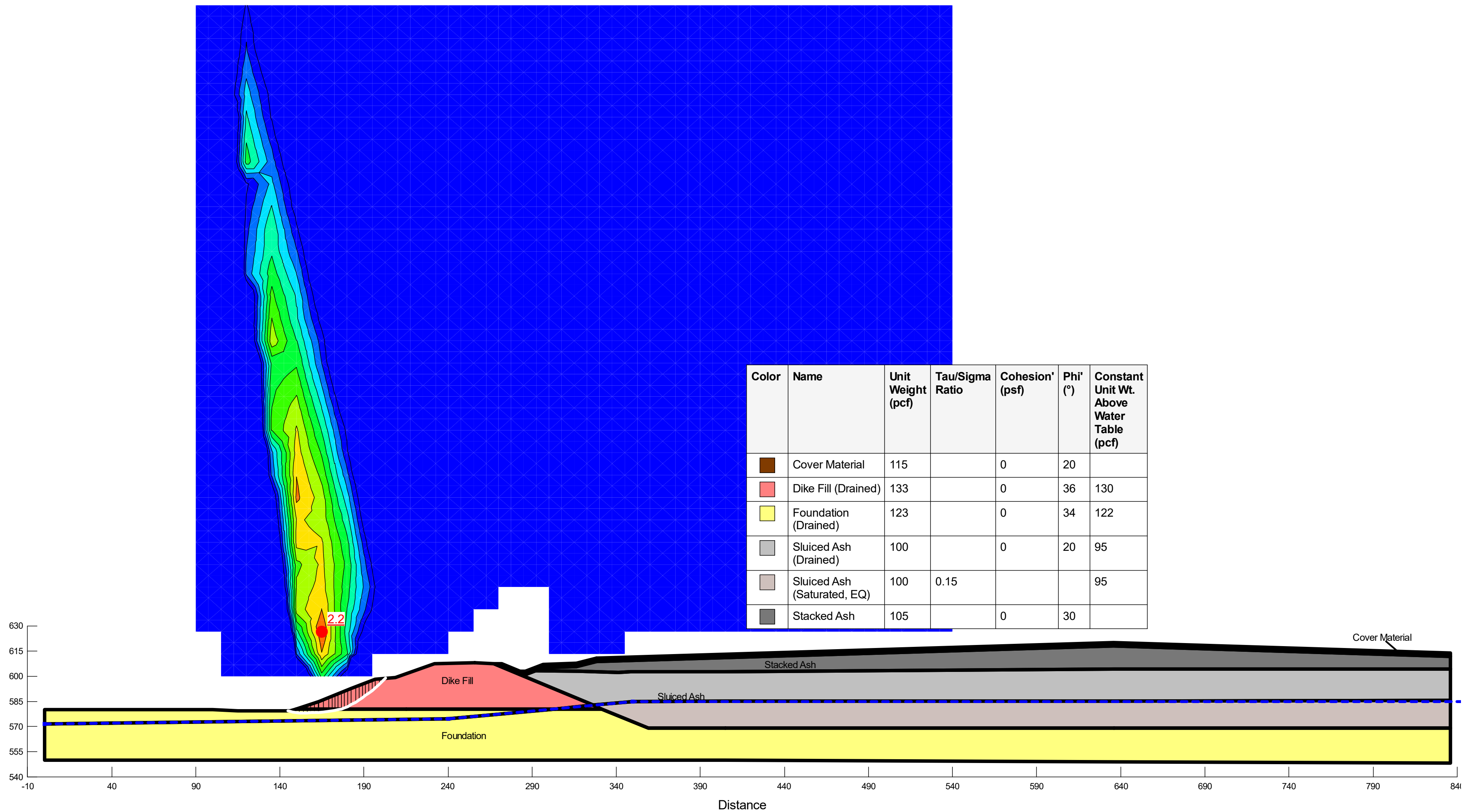
Georgia Power - Plant Hammond
Ash Pond 3
Rome, Floyd County, Georgia
Drained Analysis
Section C-C'
Spencer



Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion' (psf)	Phi' (°)	Constant Unit Wt. Above Water Table (pcf)
	Cover Material	115		0	20	
	Dike Fill (Drained)	133		0	36	130
	Foundation (Drained)	123		0	34	122
	Sluiced Ash (Drained)	100		0	20	95
	Sluiced Ash (Saturated, EQ)	100	0.15			95
	Stacked Ash	105		0	30	

Georgia Power - Plant Hammond
Ash Pond 3
Rome, Floyd County, Georgia
Drained Analysis
Section C-C'
Spencer

FS = 2.2



Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion' (psf)	Phi' (°)	Constant Unit Wt. Above Water Table (pcf)
	Cover Material	115		0	20	
	Dike Fill (Drained)	133		0	36	130
	Foundation (Drained)	123		0	34	122
	Sluiced Ash (Drained)	100		0	20	95
	Sluiced Ash (Saturated, EQ)	100	0.15			95
	Stacked Ash	105		0	30	

Drained

File Information

File Version: 9.00
Created By: Hartsfield, Terri H.
Last Edited By: Jenkins, Kirk
Revision Number: 68
Date: 05/25/2018
Time: 03:13:15 PM
Tool Version: 9.0.4.15639
File Name: Hammond Ash Pond 3.gsz
Directory: \\Us1243-f01\shared_projects\175618707\technical_production\analysis\Stability\

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Drained

- Kind: SLOPE/W
- Method: Spencer
- Settings
  - PWP Conditions from: Piezometric Line
    - Apply Phreatic Correction: No
    - Use Staged Rapid Drawdown: No
  - Unit Weight of Water: 62.4 pcf
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Grid and Radius
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: Yes
  - Optimizations Settings
    - Maximum Iterations: 2,000
    - Convergence Tolerance: 1e-07
    - Starting Points: 8
    - Ending Points: 16
    - Complete Passes per Insertion: 1
    - Driving Side Maximum Convex Angle: 5 °
    - Resisting Side Maximum Convex Angle: 1 °
  - Tension Crack Option: (none)

Distribution
    F of S Calculation Option: Constant
Advanced
    Geometry Settings
        Minimum Slip Surface Depth: 10 ft
        Number of Slices: 30
    Factor of Safety Convergence Settings
        Maximum Number of Iterations: 100
        Tolerable difference in F of S: 0.01
    Solution Settings
        Search Method: Root Finder
        Tolerable difference between starting and converged F of S: 3
        Maximum iterations to calculate converged lambda: 20
        Max Absolute Lambda: 2

Materials

Sluiced Ash (Drained)

Model: Mohr-Coulomb
Unit Weight: 100 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 95 pcf
Pore Water Pressure
    Piezometric Line: 1

Dike Fill (Drained)

Model: Mohr-Coulomb
Unit Weight: 133 pcf
Cohesion': 0 psf
Phi': 36 °
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 130 pcf
Pore Water Pressure
    Piezometric Line: 1

Foundation (Drained)

Model: Mohr-Coulomb
Unit Weight: 123 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 122 pcf
Pore Water Pressure
    Piezometric Line: 1

Stacked Ash

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Cover Material

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Sluiced Ash (Saturated, EQ)

Model: SHANSEP
Unit Weight: 100 pcf
Minimum Strength: 0 psf
Tau/Sigma Ratio: 0.15
Constant Unit Wt. Above Water Table: 95 pcf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (90, 1,000) ft
Lower Left: (90, 600) ft
Lower Right: (540, 600) ft
Grid Horizontal Increment: 30
Grid Vertical Increment: 30

Slip Surface Radius

Upper Left Coordinate: (40, 600) ft
Upper Right Coordinate: (400, 600) ft
Lower Left Coordinate: (40, 530) ft
Lower Right Coordinate: (400, 530) ft
Number of Increments: 30
Use Left Projection: No
Left Projection Angle: 135 °
Use Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (0, 580) ft
Right Coordinate: (836, 614) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X	Y
Coordinate 1	0 ft	571.5 ft
Coordinate 2	240 ft	574.5 ft
Coordinate 3	350 ft	585 ft
Coordinate 4	1,500 ft	585 ft

Points

	X	Y
Point 1	100 ft	580.172 ft
Point 2	115.033 ft	579.268 ft
Point 3	134.498 ft	579.482 ft
Point 4	149.566 ft	580.486 ft
Point 5	165.618 ft	585.613 ft
Point 6	182.444 ft	592.61 ft
Point 7	196.601 ft	598.279 ft
Point 8	208.647 ft	599.248 ft
Point 9	317.959 ft	602.91 ft
Point 10	341.424 ft	602.372 ft
Point 11	348.5 ft	602.67 ft
Point 12	360.019 ft	602.583 ft
Point 13	382.371 ft	602.601 ft
Point 14	405 ft	602.722 ft
Point 15	215 ft	580.5 ft
Point 16	146 ft	579.486 ft
Point 17	359.091 ft	569 ft
Point 18	163.2034 ft	584.8848 ft

Point 19	405 ft	569 ft
Point 20	0 ft	580 ft
Point 21	0 ft	550 ft
Point 22	405 ft	550 ft
Point 23	331.5 ft	580.5 ft
Point 24	350 ft	585 ft
Point 25	405 ft	585 ft
Point 26	836 ft	604.2 ft
Point 27	836 ft	569.0371 ft
Point 28	836 ft	548.2497 ft
Point 29	836 ft	585.4791 ft
Point 30	405 ft	585.0555 ft
Point 31	326.3031 ft	582.6935 ft
Point 32	256 ft	608 ft
Point 33	282.931 ft	601 ft
Point 34	286 ft	601 ft
Point 35	282.931 ft	603 ft
Point 36	231.7814 ft	607.295 ft
Point 37	286 ft	603 ft
Point 38	292.1199 ft	603.3885 ft
Point 39	267.1944 ft	607.5653 ft
Point 40	271.981 ft	607.3794 ft
Point 41	296.4645 ft	607.1787 ft
Point 42	296.4645 ft	605.179 ft
Point 43	316.4468 ft	607.7843 ft
Point 44	316.4504 ft	605.78 ft
Point 45	328.44 ft	610.78 ft
Point 46	328.44 ft	608.78 ft
Point 47	635.77 ft	620 ft
Point 48	635.7687 ft	618 ft
Point 49	635.8372 ft	604.1997 ft
Point 50	635.9176 ft	585.2884 ft
Point 51	635.9868 ft	569.0204 ft
Point 52	636.0718 ft	549.037 ft
Point 53	836 ft	614 ft
Point 54	836 ft	612 ft

Point 55	303.1987 ft	580.5 ft
Point 56	0 ft	571.5623 ft
Point 57	239.9317 ft	574.4814 ft

Regions

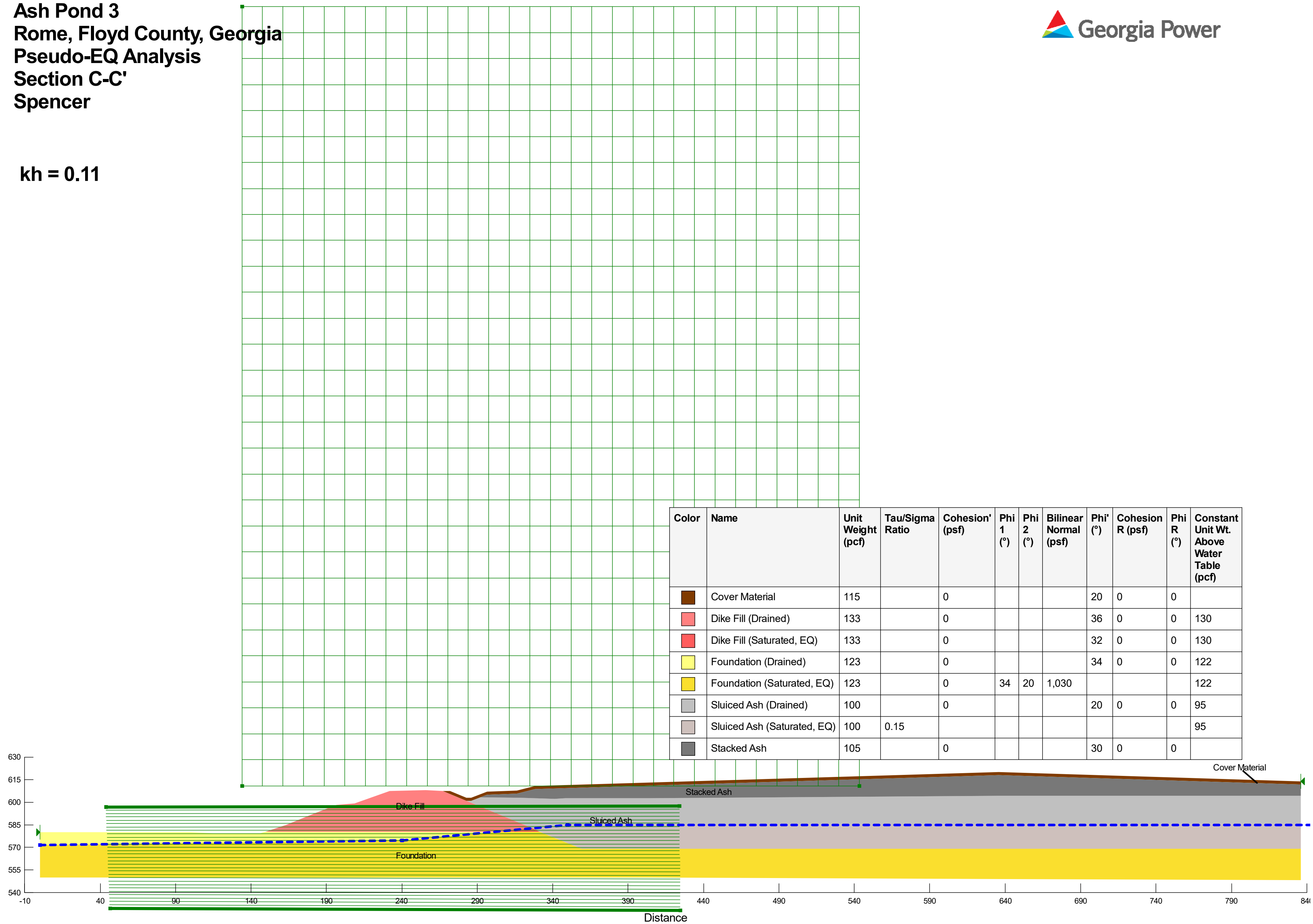
	Material	Points	Area
Region 1	Foundation (Drained)	19,17,23,55,57,56,21,22,52,28,27,51	18,261 ft^2
Region 2	Sluiced Ash (Drained)	14,13,12,11,10,9,38,34,33,31,24,30,50,29,26,49	9,874 ft^2
Region 3	Dike Fill (Drained)	32,36,8,7,6,18,4,15,55,31,33,39	2,951.3 ft^2
Region 4	Cover Material	45,43,41,37,35,40,39,33,34,38,42,44,46,48,54,53,47	1,131.7 ft^2
Region 5	Stacked Ash	26,54,48,46,44,42,38,9,10,11,12,13,14,49	5,384.9 ft^2
Region 6	Sluiced Ash (Saturated, EQ)	51,27,29,50,30,24,31,23,17,19	8,013.6 ft^2
Region 7	Dike Fill (Drained)	23,31,55	31.039 ft^2
Region 8	Foundation (Drained)	15,4,16,3,2,1,20,56,57,55	1,895.6 ft^2

Georgia Power - Plant Hammond
Ash Pond 3
Rome, Floyd County, Georgia
Pseudo-EQ Analysis
Section C-C'
Spencer

kh = 0.11

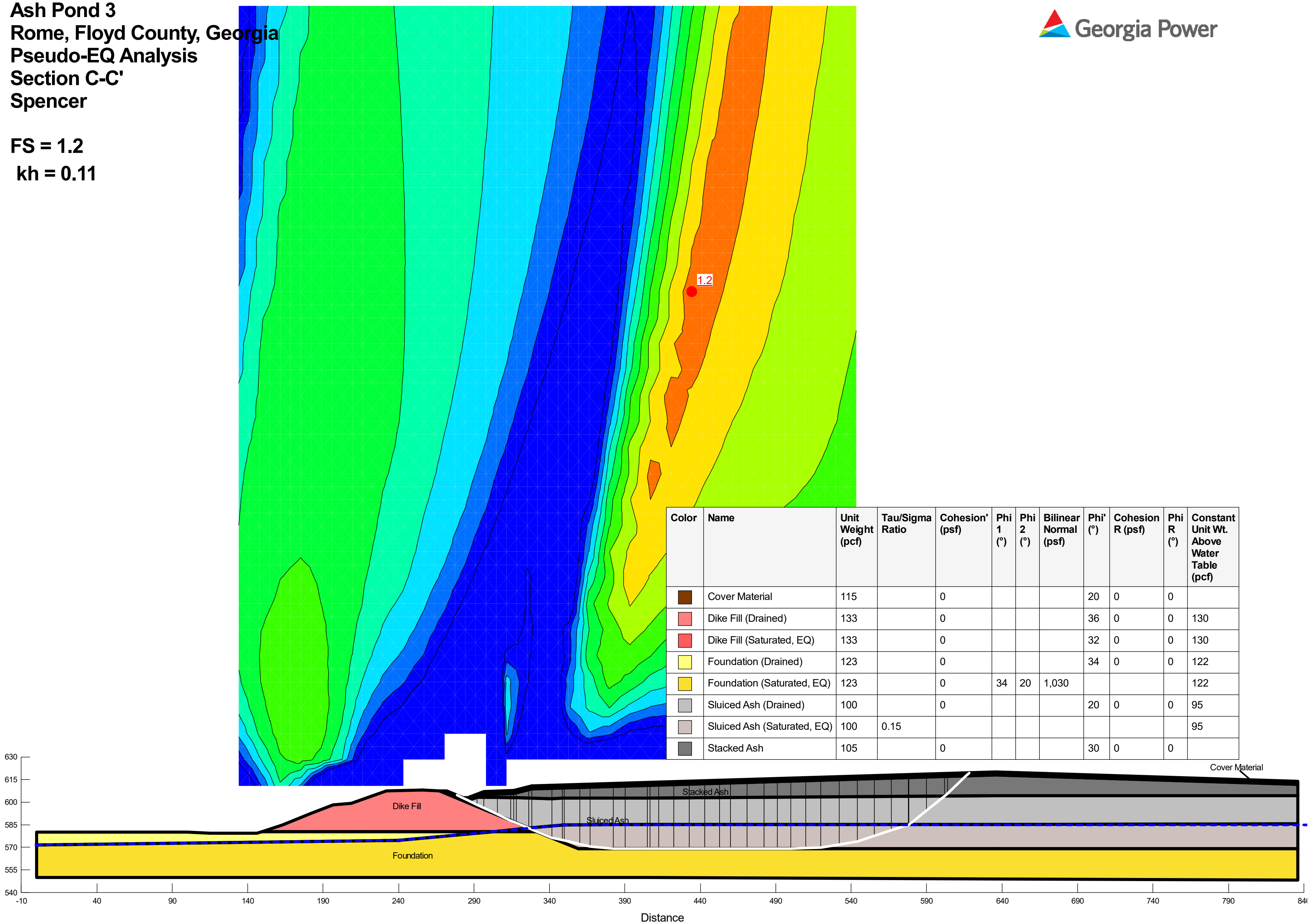
Georgia Power

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion' (psf)	Phi 1 (°)	Phi 2 (°)	Bilinear Normal (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Constant Unit Wt. Above Water Table (pcf)
	Cover Material	115		0				20	0	0	
	Dike Fill (Drained)	133		0				36	0	0	130
	Dike Fill (Saturated, EQ)	133		0				32	0	0	130
	Foundation (Drained)	123		0				34	0	0	122
	Foundation (Saturated, EQ)	123		0	34	20	1,030				122
	Sluiced Ash (Drained)	100		0				20	0	0	95
	Sluiced Ash (Saturated, EQ)	100	0.15								95
	Stacked Ash	105		0				30	0	0	



Georgia Power - Plant Hammond
Ash Pond 3
Rome, Floyd County, Georgia
Pseudo-EQ Analysis
Section C-C'
Spencer

FS = 1.2
kh = 0.11



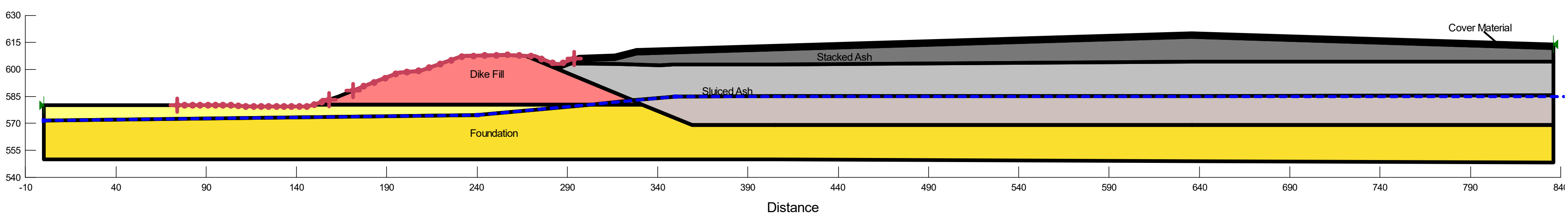
Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion' (psf)	Phi 1 (°)	Phi 2 (°)	Bilinear Normal (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Constant Unit Wt. Above Water Table (pcf)
	Cover Material	115		0				20	0	0	
	Dike Fill (Drained)	133		0				36	0	0	130
	Dike Fill (Saturated, EQ)	133		0				32	0	0	130
	Foundation (Drained)	123		0				34	0	0	122
	Foundation (Saturated, EQ)	123		0	34	20	1,030				122
	Sluiced Ash (Drained)	100		0				20	0	0	95
	Sluiced Ash (Saturated, EQ)	100	0.15								95
	Stacked Ash	105		0				30	0	0	

Georgia Power - Plant Hammond
Ash Pond 3
Rome, Floyd County, Georgia
Pseudo-EQ (Dike) Analysis
Section C-C'
Spencer

Georgia Power

kh = 0.11

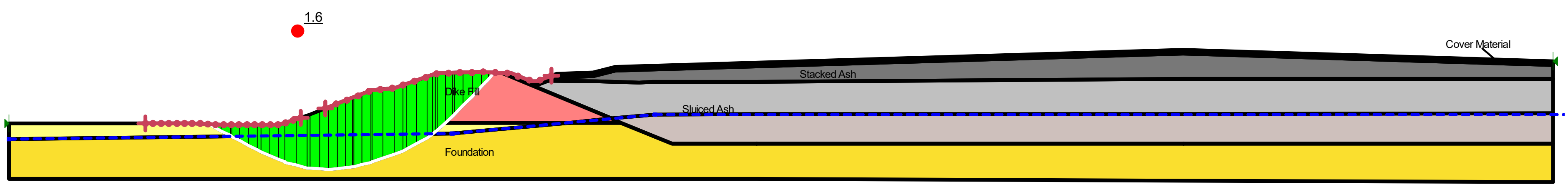
Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion' (psf)	Phi 1 (°)	Phi 2 (°)	Bilinear Normal (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Constant Unit Wt. Above Water Table (pcf)
	Cover Material	115		0				20	0	0	
	Dike Fill (Drained)	133		0				36	0	0	130
	Dike Fill (Saturated, EQ)	133		0				32	0	0	130
	Foundation (Drained)	123		0				34	0	0	122
	Foundation (Saturated, EQ)	123		0	34	20	1,030				122
	Sluiced Ash (Drained)	100		0				20	0	0	95
	Sluiced Ash (Saturated, EQ)	100	0.15								95
	Stacked Ash	105		0				30	0	0	



Georgia Power - Plant Hammond
Ash Pond 3
Rome, Floyd County, Georgia
Pseudo-EQ (Dike) Analysis
Section C-C'
Spencer

kh = 0.11

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion' (psf)	Phi 1 (°)	Phi 2 (°)	Bilinear Normal (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Constant Unit Wt. Above Water Table (pcf)
	Cover Material	115		0				20	0	0	
	Dike Fill (Drained)	133		0				36	0	0	130
	Dike Fill (Saturated, EQ)	133		0				32	0	0	130
	Foundation (Drained)	123		0				34	0	0	122
	Foundation (Saturated, EQ)	123		0	34	20	1,030				122
	Sluiced Ash (Drained)	100		0				20	0	0	95
	Sluiced Ash (Saturated, EQ)	100	0.15								95
	Stacked Ash	105		0				30	0	0	



Pseudo-EQ

File Information

File Version: 9.00
Created By: Hartsfield, Terri H.
Last Edited By: Jenkins, Kirk
Revision Number: 68
Date: 05/25/2018
Time: 03:13:15 PM
Tool Version: 9.0.4.15639
File Name: Hammond Ash Pond 3.gsz
Directory: \\Us1243-f01\shared_projects\175618707\technical_production\analysis\Stability\

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Pseudo-EQ

- Kind: SLOPE/W
- Method: Spencer
- Settings
  - PWP Conditions from: Piezometric Line
    - Apply Phreatic Correction: No
    - Use Staged Rapid Drawdown: No
  - Staged Pseudo Static Analysis Option: Effective Stress Strengths
  - Unit Weight of Water: 62.4 pcf
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Grid and Radius
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: Yes
  - Optimizations Settings
    - Maximum Iterations: 2,000
    - Convergence Tolerance: 1e-07
    - Starting Points: 8
    - Ending Points: 16
    - Complete Passes per Insertion: 1
    - Driving Side Maximum Convex Angle: 5 °
    - Resisting Side Maximum Convex Angle: 1 °

Tension Crack Option: (none)

Distribution

F of S Calculation Option: Constant

Advanced

Geometry Settings

Minimum Slip Surface Depth: 10 ft

Number of Slices: 30

Factor of Safety Convergence Settings

Maximum Number of Iterations: 100

Tolerable difference in F of S: 0.01

Solution Settings

Search Method: Root Finder

Tolerable difference between starting and converged F of S: 3

Maximum iterations to calculate converged lambda: 20

Max Absolute Lambda: 2

Materials

Sluiced Ash (Drained)

Model: Mohr-Coulomb

Unit Weight: 100 pcf

Cohesion': 0 psf

Phi': 20 °

Phi-B: 0 °

Cohesion R: 0 psf

Phi R: 0 °

Constant Unit Wt. Above Water Table: 95 pcf

Pore Water Pressure

Piezometric Line: 1

Dike Fill (Drained)

Model: Mohr-Coulomb

Unit Weight: 133 pcf

Cohesion': 0 psf

Phi': 36 °

Phi-B: 0 °

Cohesion R: 0 psf

Phi R: 0 °

Constant Unit Wt. Above Water Table: 130 pcf

Pore Water Pressure

Piezometric Line: 1

Foundation (Drained)

Model: Mohr-Coulomb

Unit Weight: 123 pcf

Cohesion': 0 psf

Phi': 34 °
Phi-B: 0 °
Cohesion R: 0 psf
Phi R: 0 °
Constant Unit Wt. Above Water Table: 122 pcf
Pore Water Pressure
Piezometric Line: 1

Stacked Ash

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °
Cohesion R: 0 psf
Phi R: 0 °
Pore Water Pressure
Piezometric Line: 1

Cover Material

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Cohesion R: 0 psf
Phi R: 0 °
Pore Water Pressure
Piezometric Line: 1

Foundation (Saturated, EQ)

Model: Bilinear
Unit Weight: 123 pcf
Cohesion': 0 psf
Phi 1: 34 °
Phi 2: 20 °
Bilinear Normal: 1,030 psf
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 122 pcf
Pore Water Pressure
Piezometric Line: 1

Sluiced Ash (Saturated, EQ)

Model: SHANSEP
Unit Weight: 100 pcf
Minimum Strength: 0 psf
Tau/Sigma Ratio: 0.15
Constant Unit Wt. Above Water Table: 95 pcf

Pore Water Pressure
Piezometric Line: 1

Dike Fill (Saturated, EQ)

Model: Mohr-Coulomb
Unit Weight: 133 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °
Cohesion R: 0 psf
Phi R: 0 °
Constant Unit Wt. Above Water Table: 130 pcf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (134.1556, 1,128.7609) ft
Lower Left: (134.1556, 610.9186) ft
Lower Right: (543.4415, 610.9186) ft
Grid Horizontal Increment: 30
Grid Vertical Increment: 30

Slip Surface Radius

Upper Left Coordinate: (43.7356, 596.9564) ft
Upper Right Coordinate: (424.0506, 597.4951) ft
Lower Left Coordinate: (46.6884, 529.6262) ft
Lower Right Coordinate: (424.6411, 528.2796) ft
Number of Increments: 30
Use Left Projection: No
Left Projection Angle: 135 °
Use Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (0, 580) ft
Right Coordinate: (836, 614) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X	Y
Coordinate 1	0 ft	571.5 ft
Coordinate 2	240 ft	574.5 ft
Coordinate 3	350 ft	585 ft
Coordinate 4	1,500 ft	585 ft

Seismic Coefficients

Horz Seismic Coef.: 0.11

Points

	X	Y
Point 1	100 ft	580.172 ft
Point 2	115.033 ft	579.268 ft
Point 3	134.498 ft	579.482 ft
Point 4	149.566 ft	580.486 ft
Point 5	165.618 ft	585.613 ft
Point 6	182.444 ft	592.61 ft
Point 7	196.601 ft	598.279 ft
Point 8	208.647 ft	599.248 ft
Point 9	317.959 ft	602.91 ft
Point 10	341.424 ft	602.372 ft
Point 11	348.5 ft	602.67 ft
Point 12	360.019 ft	602.583 ft
Point 13	382.371 ft	602.601 ft
Point 14	405 ft	602.722 ft
Point 15	215 ft	580.5 ft
Point 16	146 ft	579.486 ft
Point 17	359.091 ft	569 ft
Point 18	163.2034 ft	584.8848 ft
Point 19	405 ft	569 ft

Point 20	0 ft	580 ft
Point 21	0 ft	550 ft
Point 22	405 ft	550 ft
Point 23	331.5 ft	580.5 ft
Point 24	350 ft	585 ft
Point 25	405 ft	585 ft
Point 26	836 ft	604.2 ft
Point 27	836 ft	569.0371 ft
Point 28	836 ft	548.2497 ft
Point 29	836 ft	585.4791 ft
Point 30	405 ft	585.0555 ft
Point 31	326.3031 ft	582.6935 ft
Point 32	256 ft	608 ft
Point 33	282.931 ft	601 ft
Point 34	286 ft	601 ft
Point 35	282.931 ft	603 ft
Point 36	231.7814 ft	607.295 ft
Point 37	286 ft	603 ft
Point 38	292.1199 ft	603.3885 ft
Point 39	267.1944 ft	607.5653 ft
Point 40	271.981 ft	607.3794 ft
Point 41	296.4645 ft	607.1787 ft
Point 42	296.4645 ft	605.179 ft
Point 43	316.4468 ft	607.7843 ft
Point 44	316.4504 ft	605.78 ft
Point 45	328.44 ft	610.78 ft
Point 46	328.44 ft	608.78 ft
Point 47	635.77 ft	620 ft
Point 48	635.7687 ft	618 ft
Point 49	635.8372 ft	604.1997 ft
Point 50	635.9176 ft	585.2884 ft
Point 51	635.9868 ft	569.0204 ft
Point 52	636.0718 ft	549.037 ft
Point 53	836 ft	614 ft
Point 54	836 ft	612 ft
Point 55	303.1987 ft	580.5 ft

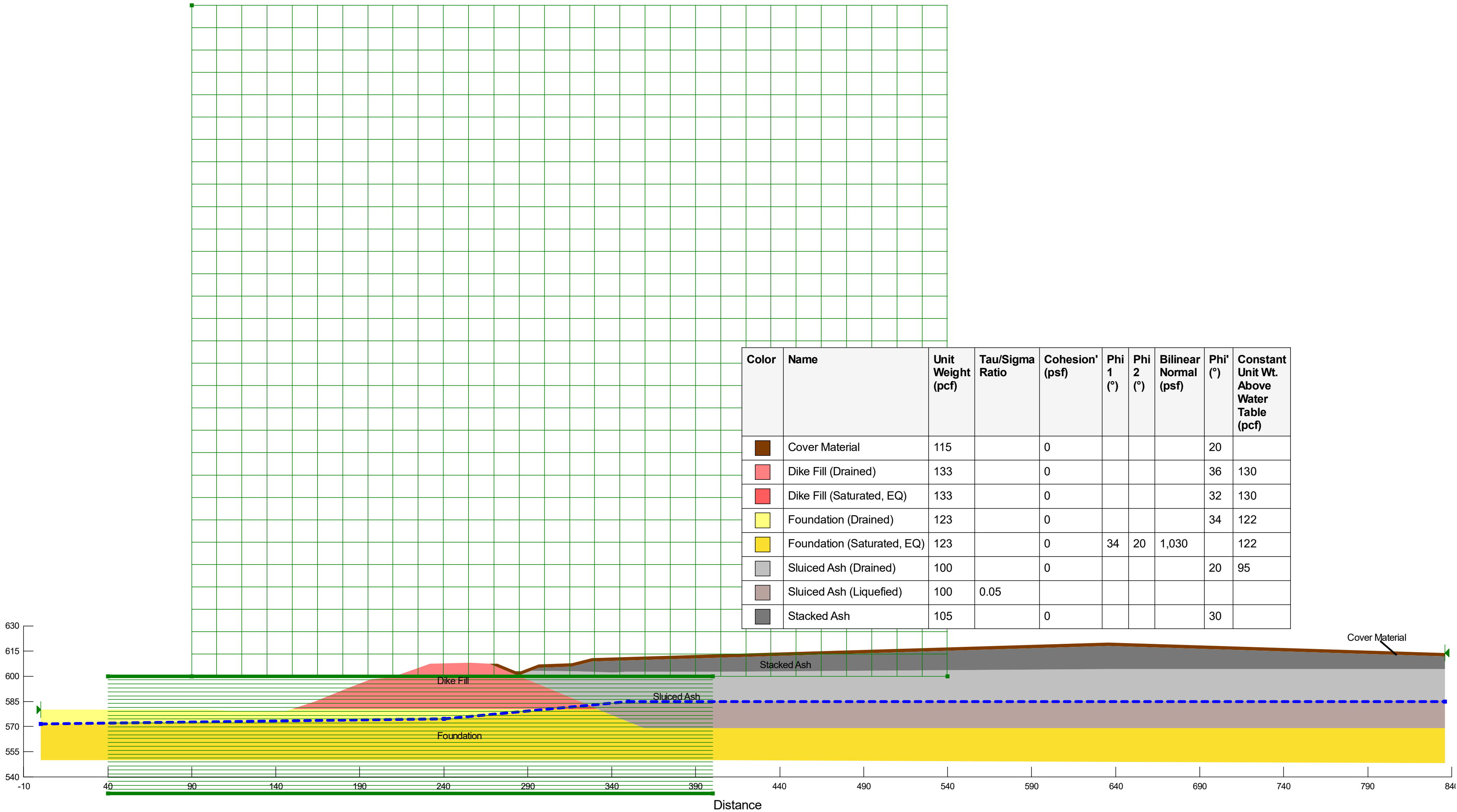
Point 56	0 ft	571.5623 ft
Point 57	239.9317 ft	574.4814 ft

Regions

	Material	Points	Area
Region 1	Foundation (Saturated, EQ)	19,17,23,55,57,56,21,22,52,28,27,51	18,261 ft^2
Region 2	Sluiced Ash (Drained)	14,13,12,11,10,9,38,34,33,31,24,30,50,29,26,49	9,874 ft^2
Region 3	Dike Fill (Drained)	32,36,8,7,6,18,4,15,55,31,33,39	2,951.3 ft^2
Region 4	Cover Material	45,43,41,37,35,40,39,33,34,38,42,44,46,48,54,53,47	1,131.7 ft^2
Region 5	Stacked Ash	26,54,48,46,44,42,38,9,10,11,12,13,14,49	5,384.9 ft^2
Region 6	Sluiced Ash (Saturated, EQ)	51,27,29,50,30,24,31,23,17,19	8,013.6 ft^2
Region 7	Dike Fill (Saturated, EQ)	23,31,55	31.039 ft^2
Region 8	Foundation (Drained)	15,4,16,3,2,1,20,56,57,55	1,895.6 ft^2

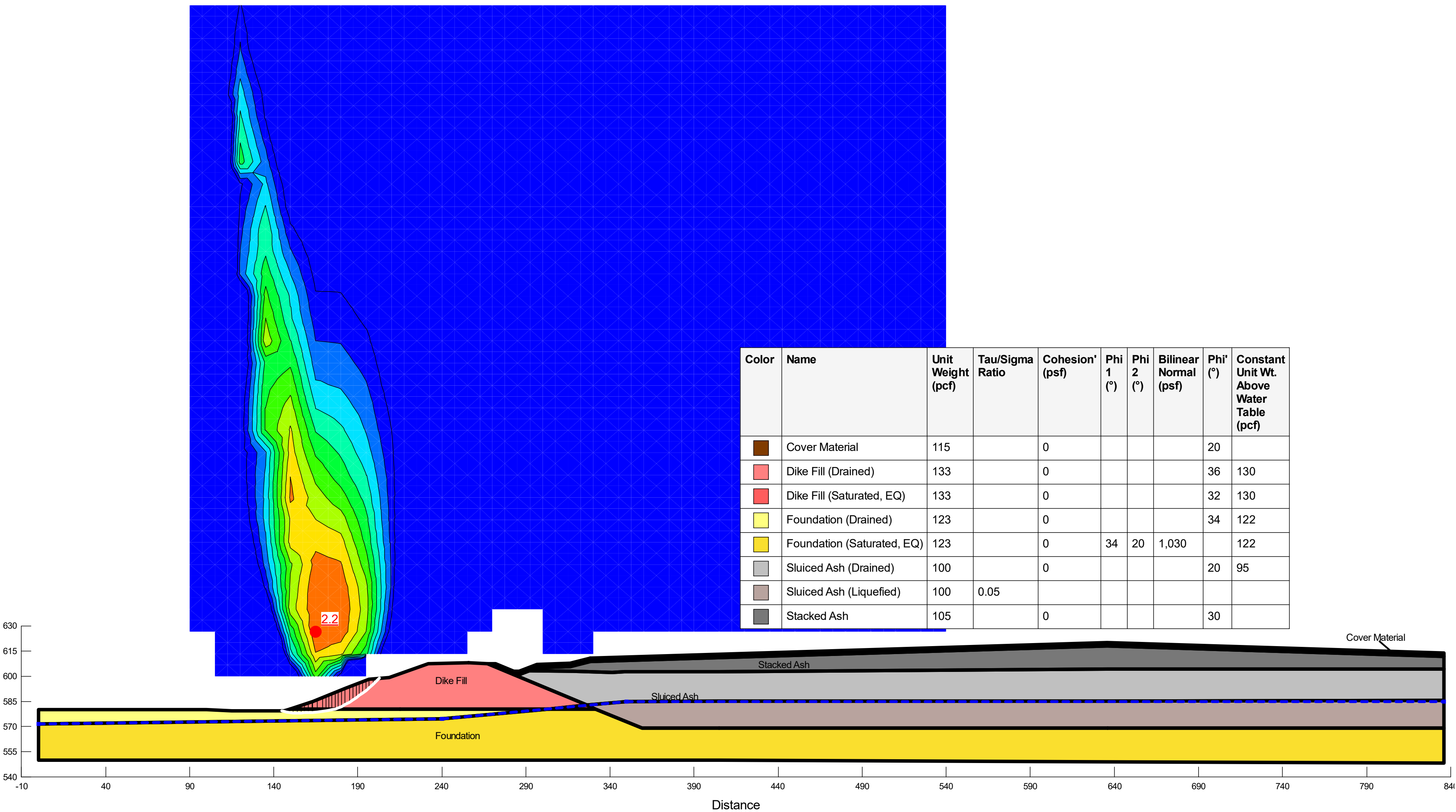
Georgia Power - Plant Hammond
Ash Pond 3
Rome, Floyd County, Georgia
Post-EQ Analysis
Section C-C'
Spencer

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion' (psf)	Phi 1 (°)	Phi 2 (°)	Bilinear Normal (psf)	Phi' (°)	Constant Unit Wt. Above Water Table (pcf)
	Cover Material	115		0				20	
	Dike Fill (Drained)	133		0				36	130
	Dike Fill (Saturated, EQ)	133		0				32	130
	Foundation (Drained)	123		0				34	122
	Foundation (Saturated, EQ)	123		0	34	20	1,030		122
	Sluiced Ash (Drained)	100		0				20	95
	Sluiced Ash (Liquefied)	100	0.05						
	Stacked Ash	105		0				30	



Georgia Power - Plant Hammond
Ash Pond 3
Rome, Floyd County, Georgia
Post-EQ Analysis
Section C-C'
Spencer

FS = 2.2



Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion' (psf)	Phi 1 (°)	Phi 2 (°)	Bilinear Normal (psf)	Phi' (°)	Constant Unit Wt. Above Water Table (pcf)
	Cover Material	115		0				20	
	Dike Fill (Drained)	133		0				36	130
	Dike Fill (Saturated, EQ)	133		0				32	130
	Foundation (Drained)	123		0				34	122
	Foundation (Saturated, EQ)	123		0	34	20	1,030		122
	Sluiced Ash (Drained)	100		0				20	95
	Sluiced Ash (Liquefied)	100	0.05						
	Stacked Ash	105		0				30	

Post-EQ

File Information

File Version: 9.00
Created By: Hartsfield, Terri H.
Last Edited By: Jenkins, Kirk
Revision Number: 68
Date: 05/25/2018
Time: 03:13:15 PM
Tool Version: 9.0.4.15639
File Name: Hammond Ash Pond 3.gsz
Directory: \\Us1243-f01\shared_projects\175618707\technical_production\analysis\Stability\

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Post-EQ

- Kind: SLOPE/W
- Method: Spencer
- Settings
  - PWP Conditions from: Piezometric Line
    - Apply Phreatic Correction: No
    - Use Staged Rapid Drawdown: No
  - Unit Weight of Water: 62.4 pcf
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Grid and Radius
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: Yes
  - Optimizations Settings
    - Maximum Iterations: 2,000
    - Convergence Tolerance: 1e-07
    - Starting Points: 8
    - Ending Points: 16
    - Complete Passes per Insertion: 1
    - Driving Side Maximum Convex Angle: 5 °
    - Resisting Side Maximum Convex Angle: 1 °
  - Tension Crack Option: (none)

Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 10 ft
Number of Slices: 30
Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.01
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Sluiced Ash (Drained)
Model: Mohr-Coulomb
Unit Weight: 100 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 95 pcf
Pore Water Pressure
Piezometric Line: 1

Dike Fill (Drained)
Model: Mohr-Coulomb
Unit Weight: 133 pcf
Cohesion': 0 psf
Phi': 36 °
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 130 pcf
Pore Water Pressure
Piezometric Line: 1

Foundation (Drained)
Model: Mohr-Coulomb
Unit Weight: 123 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 122 pcf
Pore Water Pressure
Piezometric Line: 1

Sluiced Ash (Liquefied)

Model: SHANSEP
Unit Weight: 100 pcf
Minimum Strength: 0 psf
Tau/Sigma Ratio: 0.05
Pore Water Pressure
Piezometric Line: 1

Stacked Ash

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Cover Material

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Foundation (Saturated, EQ)

Model: Bilinear
Unit Weight: 123 pcf
Cohesion': 0 psf
Phi 1: 34 °
Phi 2: 20 °
Bilinear Normal: 1,030 psf
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 122 pcf
Pore Water Pressure
Piezometric Line: 1

Dike Fill (Saturated, EQ)

Model: Mohr-Coulomb
Unit Weight: 133 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 130 pcf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (90, 1,000) ft
Lower Left: (90, 600) ft
Lower Right: (540, 600) ft
Grid Horizontal Increment: 30
Grid Vertical Increment: 30

Slip Surface Radius

Upper Left Coordinate: (40, 600) ft
Upper Right Coordinate: (400, 600) ft
Lower Left Coordinate: (40, 530) ft
Lower Right Coordinate: (400, 530) ft
Number of Increments: 30
Use Left Projection: No
Left Projection Angle: 135 °
Use Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (0, 580) ft
Right Coordinate: (836, 614) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X	Y
Coordinate 1	0 ft	571.5 ft
Coordinate 2	240 ft	574.5 ft
Coordinate 3	350 ft	585 ft
Coordinate 4	836 ft	585 ft

Points

	X	Y
Point 1	100 ft	580.172 ft
Point 2	115.033 ft	579.268 ft
Point 3	134.498 ft	579.482 ft

Point 4	149.566 ft	580.486 ft
Point 5	165.618 ft	585.613 ft
Point 6	182.444 ft	592.61 ft
Point 7	196.601 ft	598.279 ft
Point 8	208.647 ft	599.248 ft
Point 9	317.959 ft	602.91 ft
Point 10	341.424 ft	602.372 ft
Point 11	348.5 ft	602.67 ft
Point 12	360.019 ft	602.583 ft
Point 13	382.371 ft	602.601 ft
Point 14	405 ft	602.722 ft
Point 15	215 ft	580.5 ft
Point 16	146 ft	579.486 ft
Point 17	359.091 ft	569 ft
Point 18	163.2034 ft	584.8848 ft
Point 19	405 ft	569 ft
Point 20	0 ft	580 ft
Point 21	0 ft	550 ft
Point 22	405 ft	550 ft
Point 23	331.5 ft	580.5 ft
Point 24	350 ft	585 ft
Point 25	405 ft	585 ft
Point 26	836 ft	604.2 ft
Point 27	836 ft	569.0371 ft
Point 28	836 ft	548.2497 ft
Point 29	836 ft	585.4791 ft
Point 30	405 ft	585.0555 ft
Point 31	326.3031 ft	582.6935 ft
Point 32	256 ft	608 ft
Point 33	282.931 ft	601 ft
Point 34	286 ft	601 ft
Point 35	282.931 ft	603 ft
Point 36	231.7814 ft	607.295 ft
Point 37	286 ft	603 ft
Point 38	292.1199 ft	603.3885 ft
Point 39	267.1944 ft	607.5653 ft

Point 40	271.981 ft	607.3794 ft
Point 41	296.4645 ft	607.1787 ft
Point 42	296.4645 ft	605.179 ft
Point 43	316.4468 ft	607.7843 ft
Point 44	316.4504 ft	605.78 ft
Point 45	328.44 ft	610.78 ft
Point 46	328.44 ft	608.78 ft
Point 47	635.77 ft	620 ft
Point 48	635.7687 ft	618 ft
Point 49	635.8372 ft	604.1997 ft
Point 50	635.9176 ft	585.2884 ft
Point 51	635.9868 ft	569.0204 ft
Point 52	636.0718 ft	549.037 ft
Point 53	836 ft	614 ft
Point 54	836 ft	612 ft
Point 55	303.1987 ft	580.5 ft
Point 56	0 ft	571.5623 ft
Point 57	239.9317 ft	574.4814 ft

Regions

	Material	Points	Area
Region 1	Foundation (Saturated, EQ)	19,17,23,55,57,56,21,22,52,28,27,51	18,261 ft^2
Region 2	Sluiced Ash (Drained)	14,13,12,11,10,9,38,34,33,31,24,30,50,29,26,49	9,874 ft^2
Region 3	Dike Fill (Drained)	32,36,8,7,6,18,4,15,55,31,33,39	2,951.3 ft^2
Region 4	Cover Material	45,43,41,37,35,40,39,33,34,38,42,44,46,48,54,53,47	1,131.7 ft^2
Region 5	Stacked Ash	26,54,48,46,44,42,38,9,10,11,12,13,14,49	5,384.9 ft^2
Region 6	Sluiced Ash (Liquefied)	51,27,29,50,30,24,31,23,17,19	8,013.6 ft^2
Region 7	Dike Fill (Saturated, EQ)	23,31,55	31.039 ft^2

Region 8	Foundation (Drained)	15,4,16,3,2,1,20,56,57,55	1,895.6 ft^2

ATTACHMENT B
UHRS DATA

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 2014 (v4.1.

Spectral Period

Peak ground acceleration

Latitude

Decimal degrees

34.257884

Time Horizon

Return period in years

2475

Longitude

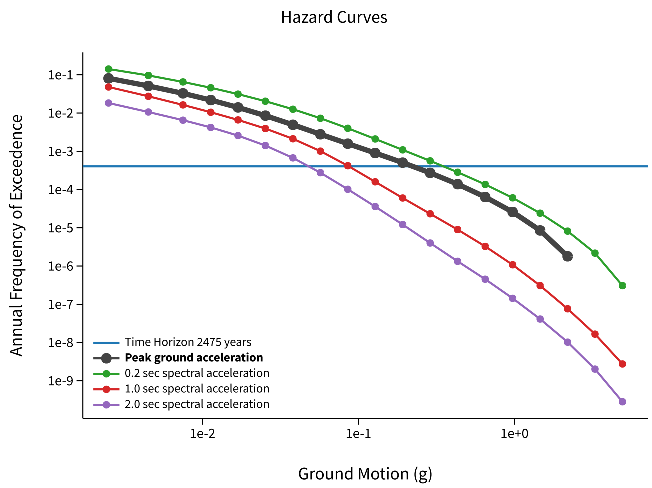
Decimal degrees, negative values for western longitudes

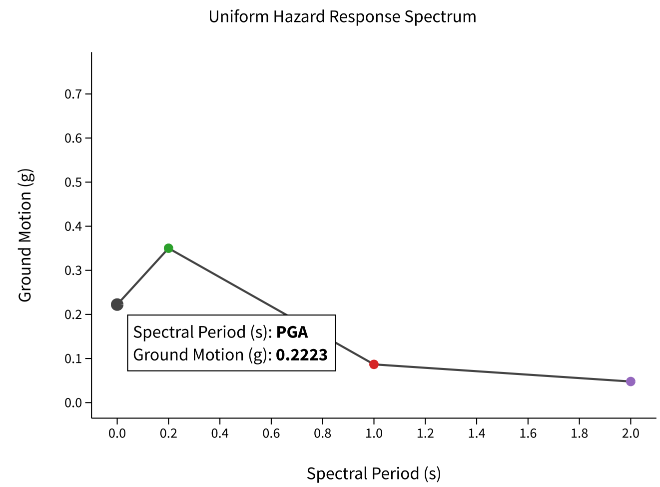
-85.338607

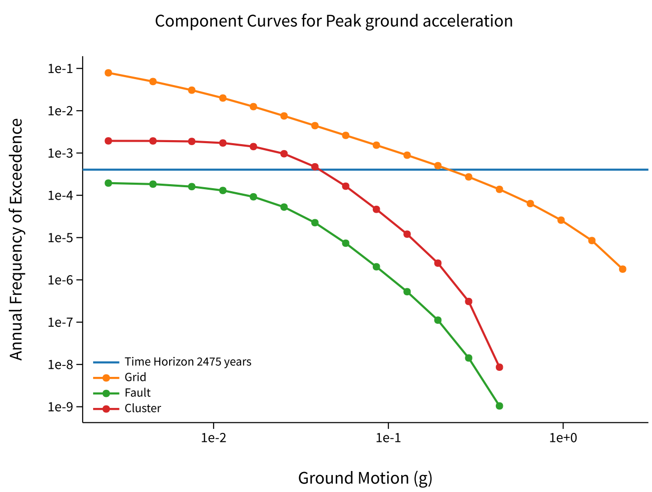
Site Class

760 m/s (B/C boundary)

Hazard Curve





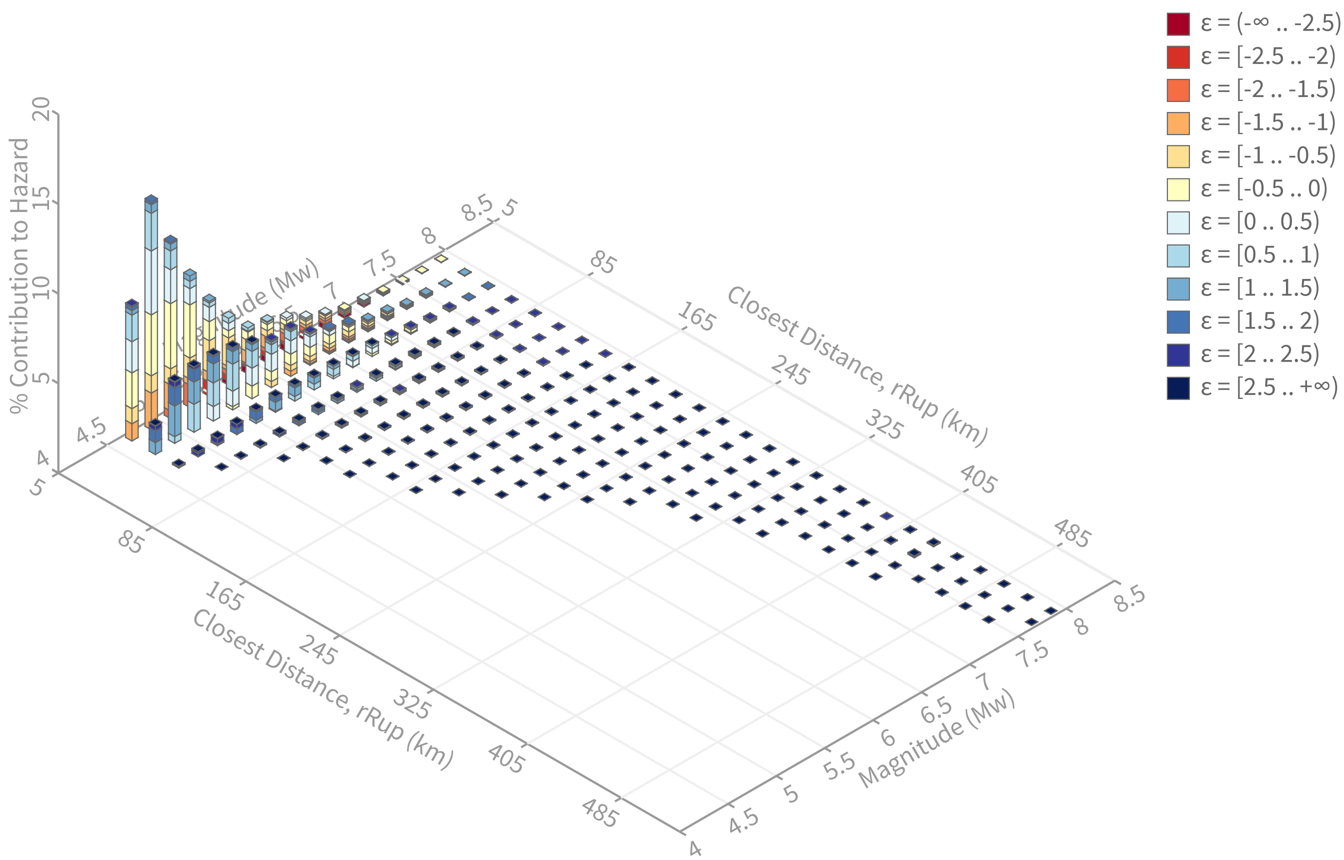


[View Raw Data](#)

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.22234803 g

Recovered targets

Return period: 2462.4451 yrs
Exceedance rate: 0.00040610043 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.96 %

Mean (for all sources)

r: 26.02 km
m: 5.55
ε_0: 0.07 σ

Mode (largest r-m bin)

r: 11.97 km
m: 4.9
ε_0: -0.06 σ
Contribution: 12.7 %

Mode (largest ε_0 bin)

r: 10.27 km
m: 5.1
ε_0: -0.24 σ
Contribution: 3.64 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
USGS Fixed Smoothing Zone 2 (opt)	Grid							40.07
PointSourceFinite: -85.339, 34.325		8.87	5.20	-0.81	85.339°W	34.325°N	0.00	11.86
PointSourceFinite: -85.339, 34.415		17.64	5.39	0.07	85.339°W	34.415°N	0.00	6.72
PointSourceFinite: -85.339, 34.460		22.17	5.51	0.32	85.339°W	34.460°N	0.00	5.07
PointSourceFinite: -85.339, 34.370		13.14	5.28	-0.30	85.339°W	34.370°N	0.00	3.80
PointSourceFinite: -85.339, 34.505		26.67	5.64	0.50	85.339°W	34.505°N	0.00	3.61
PointSourceFinite: -85.339, 34.550		31.13	5.77	0.62	85.339°W	34.550°N	0.00	2.09
PointSourceFinite: -85.339, 34.640		39.98	6.02	0.77	85.339°W	34.640°N	0.00	1.62
PointSourceFinite: -85.339, 34.595		35.56	5.90	0.70	85.339°W	34.595°N	0.00	1.28
SSCn Fixed Smoothing Zone 7 (opt)	Grid							40.04
PointSourceFinite: -85.339, 34.325		8.87	5.20	-0.80	85.339°W	34.325°N	0.00	11.85
PointSourceFinite: -85.339, 34.415		17.65	5.39	0.08	85.339°W	34.415°N	0.00	6.71
PointSourceFinite: -85.339, 34.460		22.19	5.51	0.33	85.339°W	34.460°N	0.00	5.05
PointSourceFinite: -85.339, 34.370		13.14	5.28	-0.29	85.339°W	34.370°N	0.00	3.79
PointSourceFinite: -85.339, 34.505		26.71	5.63	0.51	85.339°W	34.505°N	0.00	3.59
PointSourceFinite: -85.339, 34.550		31.19	5.76	0.63	85.339°W	34.550°N	0.00	2.07
PointSourceFinite: -85.339, 34.640		40.08	6.00	0.80	85.339°W	34.640°N	0.00	1.59
PointSourceFinite: -85.339, 34.595		35.64	5.88	0.72	85.339°W	34.595°N	0.00	1.26
USGS Adaptive Smoothing Zone 2 (opt)	Grid							9.46
PointSourceFinite: -85.339, 34.325		8.87	5.20	-0.81	85.339°W	34.325°N	0.00	2.42
PointSourceFinite: -85.339, 34.415		17.64	5.39	0.07	85.339°W	34.415°N	0.00	1.51
PointSourceFinite: -85.339, 34.460		22.17	5.51	0.32	85.339°W	34.460°N	0.00	1.06
SSCn Adaptive Smoothing Zone 7 (opt)	Grid							9.43
PointSourceFinite: -85.339, 34.325		8.87	5.20	-0.80	85.339°W	34.325°N	0.00	2.41
PointSourceFinite: -85.339, 34.415		17.65	5.39	0.08	85.339°W	34.415°N	0.00	1.51
PointSourceFinite: -85.339, 34.460		22.19	5.51	0.33	85.339°W	34.460°N	0.00	1.06

ATTACHMENT C
SETTLEMENT ANALYSIS

Plant, Hammond AP-3
Settlement Calculations

Geometry

Based on proposed grading contours, high point is at elevation 621.19 feet. (Drawing E12689)
Existing contour prior to closure was approximately elevation 601.8 feet (Drawing E12685)
Base of ash/top of clay is approximately elevation 570 feet
Top of weathered rock is approximately elevation 555 feet
Water elevation assumed as 574 feet at the center of AP3 from potentiometric map (2017)

Post-construction consolidation settlement is only anticipated to occur in the foundation clay material. Due to the high permeability of the ash and the compaction of the soil cover, settlement is anticipated to occur during construction of the soil cover. Thus, the foundation soil is the layer most likely to impact the integrity of the geomembrane liner.

Parameters used:

Unit weights

$\gamma_{ash} := 100 \ \frac{lb}{ft^3}$ Stacked Ash; $\gamma_{ashs} := 80 \ \frac{lb}{ft^3}$ Sluiced Ash; $\gamma_c := 125 \ \frac{lb}{ft^3}$ Foundation Clay;

$\gamma_w := 62.4 \ \frac{lb}{ft^3}$ Water; $\gamma_{cs} := 115 \ \frac{lb}{ft^3}$ Cover Soil

Layer Heights

$H_{cs} := 2.0 \ ft$ Cover Soil $H_{ash} := 17.4 \ ft$ Stacked Ash; $H_{ashs} := 31.8 \ ft$ Sluiced Ash;
$H_c := 15 \ ft$ Foundation Clay

Void ratio

$e_{0c} := 0.73$ Foundation Clay

*Foundation clay is based upon site-wide average value.

Compression Indices

One-dimensional consolidation settlement data was not provided for this project. Thus, settlement criteria for compression and recompression/swell had to be estimated using empirical methods (Nagaraj and Murthy, 1985) based upon site-wide average liquid limit and specific gravity (42% and 2.69)

$LL := 42 ; \ G_s := 2.69$

$$C_c := 0.2343 \cdot \frac{LL}{100} \cdot G_s = 0.26$$

$$C_r := 0.0463 \cdot \frac{LL}{100} \cdot G_s = 0.05$$

Overburden Pressure in Clay layer (full layer thickness)

$$\sigma_0 := \gamma_{ashs} \cdot H_{ashs} + \gamma_c \cdot \frac{H_c}{2} - \gamma_w \cdot \left(\frac{H_c}{2} + 4 \ ft\right) = \left(2.764 \cdot 10^3\right) \frac{lb}{ft^2}$$

$$\sigma_1 := \sigma_0 + \gamma_{ash} \cdot H_{ash} + \gamma_{cs} \cdot H_{cs} = \left(4.734 \cdot 10^3\right) \frac{lb}{ft^2}$$

Calculations Performed by:
Travis Greenwell
Calculations Reviewed by:
Kirk Jenkins

Date: May 30, 2018

Plant, Hammond AP-3
Settlement Calculations

Consolidation Settlement in Clay layer (using full layer thickness method)

$$S_c := \frac{H_c \cdot C_c}{1+e_{0c}} \cdot \log\left(\frac{\sigma_1}{\sigma_0}\right) = 6.437 \ in$$

Overburden Pressure in Clay layer (analyzing top, mid, and bottom 1/3 intervals of layer)

$$\sigma_{0T} := \gamma_{ashs} \cdot H_{ashs} + \gamma_c \cdot \frac{H_c}{6} - \gamma_w \cdot \left(\frac{H_c}{6} + 4 \ ft\right) = \left(2.451 \cdot 10^3\right) \frac{lb}{ft^2}$$

$$\sigma_{1T} := \sigma_{0T} + \gamma_{ash} \cdot H_{ash} + \gamma_{cs} \cdot H_{cs} = \left(4.421 \cdot 10^3\right) \frac{lb}{ft^2}$$

$$\sigma_{0M} := \gamma_{ashs} \cdot H_{ashs} + \gamma_c \cdot \frac{H_c}{2} - \gamma_w \cdot \left(\frac{H_c}{2} + 4 \ ft\right) = \left(2.764 \cdot 10^3\right) \frac{lb}{ft^2}$$

$$\sigma_{1M} := \sigma_{0M} + \gamma_{ash} \cdot H_{ash} + \gamma_{cs} \cdot H_{cs} = \left(4.734 \cdot 10^3\right) \frac{lb}{ft^2}$$

$$\sigma_{0B} := \gamma_{ashs} \cdot H_{ashs} + \gamma_c \cdot \frac{H_c}{1.2} - \gamma_w \cdot \left(\frac{H_c}{1.2} + 4 \ ft\right) = \left(3.077 \cdot 10^3\right) \frac{lb}{ft^2}$$

$$\sigma_{1B} := \sigma_{0B} + \gamma_{ash} \cdot H_{ash} + \gamma_{cs} \cdot H_{cs} = \left(5.047 \cdot 10^3\right) \frac{lb}{ft^2}$$

Consolidation Settlement in Clay layer (top, mid, and bottom 1/3 intervals of layer)

$$S_{cT} := \frac{\left(\frac{1}{3} H_c\right) \cdot C_c}{1+e_{0c}} \cdot \log\left(\frac{\sigma_{1T}}{\sigma_{0T}}\right) = 2.352 \ in$$

$$S_{cM} := \frac{\left(\frac{1}{3} H_c\right) \cdot C_c}{1+e_{0c}} \cdot \log\left(\frac{\sigma_{1M}}{\sigma_{0M}}\right) = 2.146 \ in$$

$$S_{cB} := \frac{\left(\frac{1}{3} H_c\right) \cdot C_c}{1+e_{0c}} \cdot \log\left(\frac{\sigma_{1B}}{\sigma_{0B}}\right) = 1.973 \ in$$

$$S_c := S_{cT} + S_{cM} + S_{cB} = 6.471 \ in$$

Assuming that no additional fill has been placed on the perimeter dike, additional settlement should not be anticipated. Thus, the maximum differential settlement from the peak of the closed ash pond AP-3 to the embankment dike would occur along the shortest slope length, estimated as 350 feet.

Maximum Anticipated Differential Settlement

$$\Delta S_c := \frac{S_c}{350 \ ft} = 0.0015 \ \frac{in}{in}$$ *Rounded to 2 significant digits and represents 0.15%

C. GEOCOMPOSITE DRAINAGE MEDIA SIZING

Geocomposite Drainage Media Sizing

AP-3, Plant Hammond
Rome, Floyd County, Georgia

Prepared for:
Georgia Power Company
Atlanta, Georgia

Prepared by:
Stantec Consulting Services Inc.
Chattanooga, Tennessee

GEORGIA
REGISTERED
NO. 028622
PROFESSIONAL
ENGINEER
JON A. SPARKMAN
11-15-18

November 12, 2018

1.0 PURPOSE OF CALCULATION

At Georgia Power Company's (GPC) Plant Hammond, construction to close Ash Pond 3 (AP-3) was completed in Q2 of 2018. AP-3 has been covered with an engineered cap system that includes a geocomposite drainage layer. A hydraulic evaluation of the geocomposite drainage layer in relation to the anticipated infiltration through the overlying cover soil was conducted to determine if the geocomposite is adequately sized to convey the anticipated infiltration.

2.0 SUMMARY OF CONCLUSIONS

The geocomposite drainage layer used in the cap system must have a minimum transmissivity of 8.03×10^{-3} ft^2/s (7.46×10^{-4} m^2/s) based on anticipated infiltration through the cap system. From the geocomposite specification from construction, the minimum transmissivity of the geocomposite is 9.0×10^{-4} m^2/s, which is greater than the required minimum transmissivity. Therefore, the geocomposite is adequately sized to convey the anticipated infiltration.

3.0 CRITERIA

The unit gradient method was used to determine the ultimate transmissivity required for the geocomposite drainage layer. In this method, Darcy's Law is used to determine the inflow of water from the overlying cover soil to the geocomposite to determine the required transmissivity. Reduction factors and factors of safety are applied to the required transmissivity to determine the ultimate transmissivity.

4.0 REFERENCES

Giroud, J.P., Zornberg, J.G., and Zhao, A., 2000, "Hydraulic Design of Geosynthetic and Granular Liquid Collection Layers", *Geosynthetics International,* Special Issue on Liquid Collection Systems, Vol. 7, Nos. 4-6, pp. 285-380.

Thiel, Richard. "Landfill Drainage Layers: Part 3 of 4." GFR Magazine Apr. 2005: 22-27.Gfrmagazine.info. Web. 06 Feb. 2017.

landfilldesign.com

5.0 ASSUMPTIONS

Design Assumptions:

- Assume 3% typical cross-slope.
- Assume 550 feet maximum geocomposite drainage length.
- Assume cover soil permeability of 5.0×10^{-6} cm/s (1.64×10^{-7} ft/s).
- The highest permeability obtained from laboratory testing of material in the Roberts Borrow Site and the L2/North East Berm Structure was chosen and increased by half an order-of-

magnitude to account for minimum compaction effort exerted on the cover soils as indicated in the project specifications.

6.0 MAJOR EQUATION SOURCES/DERIVATION OF METHODS

The required transmissivity was calculated by using the following equation:

$$\theta_{REQUIRED} = \frac{k * L}{\sin\beta} \text{(Eq. 1)}$$

Where θ_{REQ} = required transmissivity (ft^2/s)
k = permeability of the cover soil (ft/s)
L = max. drainage length (ft)
β = slope angle

An overall design factor of safety of 2 was assumed to determine an allowable transmissivity, as shown in Equation 2 below.

$$\theta_{ALLOW} = \theta_{DESIGN} \times FS_D \quad \text{(Eq. 2)}$$

The design should account for reduction factors due to intrusion, creep, chemical, and biological clogging which affect the transmissivity of the geocomposite over time (Giroud, Zornberg, & Zhao, 2000). The specified transmissivity is calculated by multiplying the allowable transmissivity by the assumed reduction factors.

$$\theta_{SPEC} = \theta_{ALLOW} \times RF_{IN} \times RF_{CR} \times RF_{CC} \times RF_{BC} \qquad \text{(Eq. 3)}$$

The specified transmissivity was then compared to product specifications of geocomposite materials to determine if the geocomposite has the appropriate transmissivity.

7.0 BODY OF CALCULATIONS

The transmissivity of the geocomposite computed using Equation 1 is:

$$\theta_{DESIGN} = \frac{k \, * \, L}{\sin\beta} = \frac{(1.64x10^{-7}) \times (550)}{\sin 1.7°} = 3.04 \times 10^{-3} \text{ ft}^2\text{/s}$$

Reduction Factors and Safety Factors were selected from literature and input as follows:

RF_{IN} (intrusion) = 1.0

RF_{CR} (creep) = 1.1

RF_{CC} (chemical clogging) = 1.0

RF_{BC} (biological clogging) = 1.2

FS (factor of safety) = 2.0

$$\theta_{ALLOW} = \theta_{DESIGN} \times FS_D = 3.04 \times 10^{-3} \times 2 = 6.08 \times 10^{-3} \text{ ft}^2/\text{s}$$

$$\theta_{SPEC} = \theta_{ALLOW} \times (1.0) \times (1.1) \times (1.0) \times (1.2) = 1.32 \times \theta_{ALLOW}$$

$$\theta_{SPEC} = 1.32 \times \theta_{ALLOW} = 1.32 \times (6.08 \times 10^{-3}) = 8.03 \times 10^{-3} \text{ ft}^2/\text{s}$$

The specified minimum transmissivity of the geocomposite for the cap system is 8.03×10^{-3} ft2/s (7.46×10^{-4} m2/s).

D. VENEER STABILITY ANALYSIS

Final Cover Veneer Stability Analysis

AP-3, Plant Hammond
Rome, Floyd County, Georgia

Stantec

Prepared for:
Georgia Power Company
Atlanta, Georgia

Prepared by:
Stantec Consulting Services Inc.
Chattanooga, Tennessee

GEORGIA
REGISTERED
No. 042016
PROFESSIONAL
ENGINEER
JASON CURTSINGER

11/14/18

November 12, 2018

1.0 PURPOSE OF CALCULATION

A high-density polyethylene (HDPE) geomembrane cap system was installed during AP-3 closure. The components of this cap system from bottom to top include: 60 mil textured HDPE geomembrane, double-sided geocomposite drainage media, 18 inches of protective cover soil, and 6 inches of vegetative cover (topsoil). The geocomposite consists of a biaxial geonet structure with thermally bonded non-woven geotextiles on both sides. The clay cover soil was imported from the nearby Roberts Borrow Site.

Low shear strengths are typically present at the interfaces of soil to geosynthetic and/or geosynthetic to geosynthetic. In addition, the final cover is oriented in the direction of potential sliding and the potential shear plane is essentially uninterrupted along the slope. Therefore, shallow, translational (veneer-type) failures parallel to the slopes must be evaluated. Forces driving the veneer-type failures typically include the gravity load of the cover, seismic forces, and hydrostatic forces due to collection of water along the interfaces. Resisting forces typically include friction and adhesion between the materials along the critical slip plane. The veneer-type stability analysis is also based on the limit equilibrium concept. The factor of safety is defined as the ratio of the total resisting forces to the total driving forces.

2.0 SUMMARY OF CONCLUSIONS

When compared to the calculated interface friction angle and adhesion values, the direct shear strength laboratory test results for these parameters exceeded the target factors of safety for each load condition. This illustrates a veneer-type failure is not anticipated to occur. Table 1 summarizes the results and shows the calculated factors of safety for each of the four loading conditions analyzed.

Table 1 Veneer Stability Analysis Results

Loading Condition	Lab Test Results		Calculated Factor of Safety	Target Factor of Safety
	Interface Friction Angle (°)	Interface Adhesion (psf)		
Static, Drained	16.8	78	22.35	1.5
Static, Saturated	16.8	78	22.27	1.1
Seismic	16.8	78	2.51	1.0
Static Residual	18.0	67	21.51	1.1

3.0 CRITERIA

The cap system was analyzed under four loading conditions in accordance with general industry practice. Each loading condition and corresponding target factors of safety is described below:

- For static, drained conditions, the factor of safety for stability shall be no less than 1.5. This loading condition does not account for the effects from seepage or groundwater.
- For static, saturated conditions, the factor of safety for stability shall be no less than 1.1. This loading condition adds the effects of seepage forces to the static, drained conditions.
- For seismic conditions, the factor of safety for stability shall be greater than 1.0. This loading condition includes the seismic forces corresponding to the design earthquake.
- For static, residual shear strength conditions, the factor of safety for stability shall be no less than 1.1. This loading condition considers the potential for a large-scale failure following an earthquake event that generates large displacements in the final cover.

4.0 REFERENCES

Datta M. (2008) "Cover Systems for High Waste Dumps – Stability Aspects.", the 12th International Conference of International Association for Computer Methods and Advances in Geomechanics (IACMAG), Goa, India, 2008.

Dixon N., Jones D. R. V., Fowmes G. J. (2006) "Interface Shear Strength Variability and Its Use in Reliability-Based Landfill Stability Analysis." Geosynthetics International, Vol. 13, No. 1.

Environmental Protection Agency (EPA) (2015). "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule". 40 CFR Parts 257 and 261. Federal Register Vol. 80, No. 74. April 17.

Hillman R. P., Stark T. D. (2001) "Shear Strength Characteristics of PVC Geomembrane-Geosynthetic Interfaces." Geosynthetics International, Vol. 8, No. 2.

Koerner R. M. and Soong T. –Y. (2005). "Analysis and Design of Veneer Cover Soils." Geosynthetics International, Vol. 12, No. 1.

Stark T.D., Williamson T. A., Eid H. T. (1996) "HDPE Geomembrane/Geotextile Interface Shear Strength." Journal of Geotechnical Engineering, Vol. 122, No. 3, March.

5.0 ASSUMPTIONS

The assumptions described below were used when completing this calculation.

5.1 CROSS SECTION

Analyses were carried out for four loading conditions on the most critical slope (longest slope) configuration. The analyzed cross-section was sloped at a 3% grade and approximately 16.5 feet in height. These parameters were determined from AP-3 Closure Construction Drawings.

5.2 MATERIAL PARAMETERS

Soil parameters were developed from available laboratory testing provided by Georgia Power Company. The cover soil was imported from the nearby Roberts Borrow site and laboratory test results of these materials were reviewed. Based on the available laboratory testing, strengths of the clay cover soil were ϕ' = 20 degrees and *c'* = 0 psf. The wet unit weight of this soil type was determined to be 115 pcf and the saturated unit weight was determined to be 120 pcf.

5.3 PHREATIC CONDITIONS

Based on the results presented in *Geocomposite Drainage Media Sizing* dated November 12, 2018, the specified product for the cap system adequately conveys the anticipated infiltration through the cover system. Therefore, a phreatic level is not modeled within the cover soil. For the static, saturated loading condition, it was assumed the water level was parallel to the slope and up to the thickness of the geocomposite drainage media. The geocomposite is assumed to be the only portion of the cover system subjected to uplift pressures from the seepage because the geocomposite drainage media is designed to convey all the infiltration that percolates through the cover soil. Buoyant forces from the seepage are not developed within the material because the geocomposite drainage media drains the water and dissipates the excess pore water pressures.

5.4 SEISMIC CONDITIONS

Consistent with Stantec's report *Slope Stability and Settlement Analysis* dated October 30, 2018, a horizontal seismic coefficient of Kh = 0.22g was used to represent the 2,500-year return period for a seismic event at AP-3. The horizontal seismic coefficient was selected using the United States Geological Survey Unified Hazard Tool (https://earthquake.usgs.gov/hazards/interactive), accessed on May 11, 2018.

5.5 LABORATORY TEST RESULTS

Samples of the installed geomembrane cap components were obtained and subjected to a direct shear test (ASTM D5321). The results of this test are provided in Attachment B. The direct shear test resulted in a peak adhesion value of 78 psf and interface friction angle of 16.8° and a large displacement adhesion value of 67 psf and interface friction angle of 18.0°.

The results of this direct shear test indicate this cap system functions as expected based on published literature. Peak interface friction angles ranging from 20 to over 30 degrees between textured geomembrane and nonwoven geotextile were reported by Dixon et al. (2006), Stark et al. (1996), and Hillman and Stark (2001). Peak interface friction angle of 18 degrees between textured geomembrane and saturated clay was reported by Datta (2008). Dixon et al. (2006) stated that for design cases with low normal stresses such as design of cap systems, it would be too conservative to assume no adhesion.

6.0 MAJOR EQUATION SOURCES/DERIVATION OF METHODS

The analyses were performed using a spreadsheet tool. Equations used in the analyses were derived generally following the procedures outlined in Koerner and Soong (2005). The results of the analyses are presented in Attachment A.

7.0 BODY OF CALCULATIONS

The calculation sheet and interface strength envelope plot for the static, saturated conditions are included in Attachment A.

ATTACHMENT A
STABILITY ANLAYSIS OUTPUTS

Final Cover Veneer Type Stability Analysis
Plant Hammond AP-3 Closure

Input Parameters:

Cover Thickness, h, ft.	2
Slope Height, H, ft.	16.5
Slope Angle, β, deg.	1.7
Water Height, h_w, ft.	0
Hori. Acceleration, a (g)	0
Unit Weight of Water, γ_w, pcf	62.4
Cover Soil Unit Weight, γ, pcf	115
Cover Soil Sat. Unit Weight, γ_{sat}, pcf	120
Cover Soil Friction Angle, ϕ, deg.	20
Cover Soil Cohesion, c, psf	0

Veneer Reinforcement, T, lb/ft: 0

Calculations:

Active Wedge	
Total Weight, W_A, lb/ft	127923.17
Uplift Force, U_A, lb/ft	0.00
Effective Normal Force, N_A, lb/ft	127866.87
Passive Wedge	
Total Weight, W_p, lb/ft	7756.33
Uplift Force, U_p, lb/ft	0.00
Interface P.W.P Force, U_{ph}, lb/ft	0.00

Static, Drained Conditions (Target F.S. = 1.5)

Interface Friction Angle, δ, deg.	Interface Adhesion, c_a, psf	R_A, lb/ft	A	B	C1	D	L	M	N	Factor of Safety
16.8	78.0	81987.92	3795.00	2823.07	0.00	0.01	3793.33	84815.89	885.28	22.35

Final Cover Veneer Type Stability Analysis
Plant Hammond AP-3 Closure

Input Parameters:

Cover Thickness, h, ft.	2
Slope Height, H, ft.	16.5
Slope Angle, β, deg.	1.7
Water Height, h_w, ft.	0.025
Hori. Acceleration, a (g)	0
Unit Weight of Water, γ_w, pcf	62.4
Cover Soil Unit Weight, γ, pcf	115
Cover Soil Sat. Unit Weight, γ_{sat}, pcf	120
Cover Soil Friction Angle, ϕ, deg.	20
Cover Soil Cohesion, c, psf	0

Veneer Reinforcement, T, lb/ft 0

Calculations:

Active Wedge	
Total Weight, W_A, lb/ft	127992.69
Uplift Force, U_A, lb/ft	867.27
Effective Normal Force, N_A, lb/ft	127069.09
Passive Wedge	
Total Weight, W_p, lb/ft	7756.39
Uplift Force, U_p, lb/ft	0.66
Interface P.W.P Force, U_{ph}, lb/ft	0.02

Static, Saturated Conditions (Target F.S. = 1.1)

Interface Friction Angle, δ, deg.	Interface Adhesion, c_a, psf	R_A, lb/ft	A	B	C1	D	L	M	N	Factor of Safety
16.8	78.0	81747.06	3797.06	2822.85	0.02	0.01	3795.41	84574.93	882.67	22.27

Final Cover Veneer Type Stability Analysis
Plant Hammond AP-3 Closure

Input Parameters:

Cover Thickness, h, ft.	2
Slope Height, H, ft.	16.5
Slope Angle, β, deg.	1.7
Water Height, h_w, ft.	0
Hori. Acceleration, a (g)	0.22
Unit Weight of Water, γ_w, pcf	62.4
Cover Soil Unit Weight, γ, pcf	115
Cover Soil Sat. Unit Weight, γ_{sat}, pcf	120
Cover Soil Friction Angle, ϕ, deg.	20
Cover Soil Cohesion, c, psf	0

Veneer Reinforcement, T, lb/ft 0

Calculations:

Active Wedge	
Total Weight, W_A, lb/ft	127923.17
Uplift Force, U_A, lb/ft	0.00
Effective Normal Force, N_A, lb/ft	127031.97
Passive Wedge	
Total Weight, W_p, lb/ft	7756.33
Uplift Force, U_p, lb/ft	0.00
Interface P.W.P Force, U_{ph}, lb/ft	0.00

Seismic Conditions (Target F.S. = 1.0)

Interface Friction Angle, δ, deg.	Interface Adhesion, c_a, psf	R_A, lb/ft	A	B	C1	D	L	M	N	Factor of Safety
16.8	78.0	81735.85	31925.71	2823.07	1706.39	0.01	33618.05	84867.67	882.55	2.51

Final Cover Veneer Type Stability Analysis
Plant Hammond AP-3 Closure

Input Parameters:

Cover Thickness, h, ft.	2
Slope Height, H, ft.	16.5
Slope Angle, β, deg.	1.7
Water Height, h_w, ft.	0
Hori. Acceleration, a (g)	0
Unit Weight of Water, γ_w, pcf	62.4
Cover Soil Unit Weight, γ, pcf	115
Cover Soil Sat. Unit Weight, γ_{sat}, pcf	120
Cover Soil Friction Angle, ϕ, deg.	20
Cover Soil Cohesion, c, psf	0

Veneer Reinforcement, T, lb/ft 0

Calculations:

Active Wedge	
Total Weight, W_A, lb/ft	127923.17
Uplift Force, U_A, lb/ft	0.00
Effective Normal Force, N_A, lb/ft	127866.87
Passive Wedge	
Total Weight, W_p, lb/ft	7756.33
Uplift Force, U_p, lb/ft	0.00
Interface P.W.P Force, U_{ph}, lb/ft	0.00

Static Residual Conditions (Target F.S. = 1.1)

Interface Friction Angle, δ, deg.	Interface Adhesion, c_a, psf	R_A, lb/ft	A	B	C1	D	L	M	N	Factor of Safety
18	67.0	78811.04	3795.00	2823.07	0.00	0.01	3793.33	81640.40	850.97	21.51

ATTACHMENT B
DIRECT SHEAR TEST RESULTS

Shear Strength of Soil-Geosynthetic Interface by Direct Shear (ASTM D5321)

Client: Brantley Engineering LLC

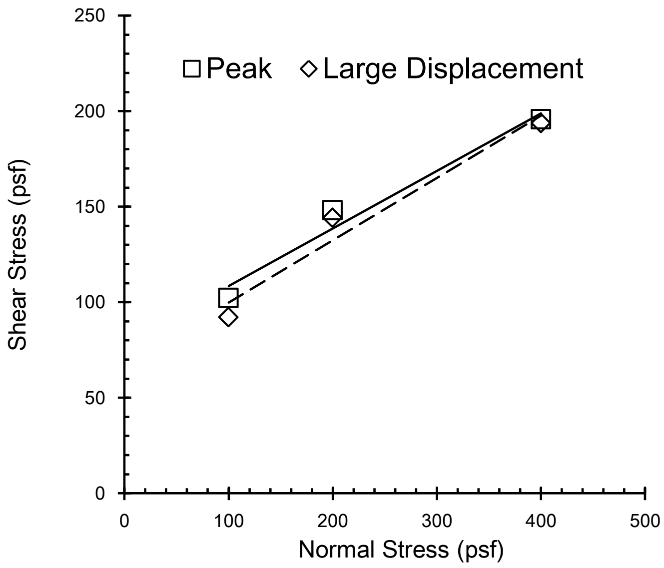
Project: Plant Hammond Ash Pond 3 Closure Cover System Repair

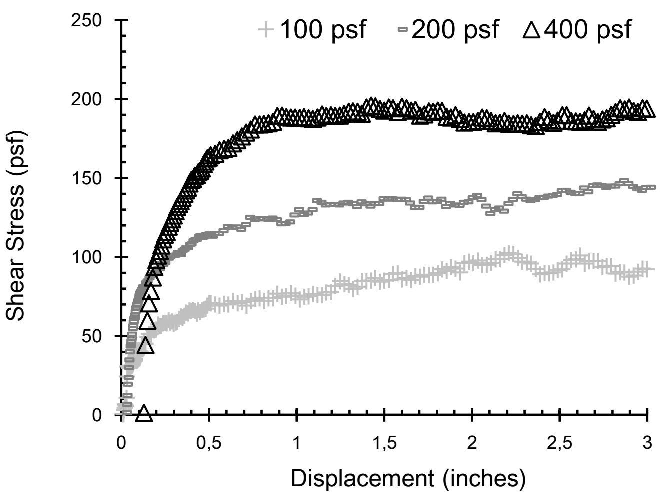
TRI Log #: G180017-1

Richard S. Lacey, P.E. 1/22/2018

Analysis & Quality Review/Date

PC-1 Protective Cover Soil vs AGRU 300mil DS Geocomposite vs AGRU 60mil HDPE Microspike vs AF-1 Existing Ash Material





Test Results, Linear Regression			
Mohr-Coulomb Parameters		Peak	Large Displacement
Friction Angle	Degrees	16.8	18.0
Y-intercept or Adhesion	psf	78	67
Minimum Secant Angle	Degrees	26.1	25.8

Note - Large Displacement Values Reported for 3.0 inches of Displacement

Test Conditions		
Upper Box	PC-1 Protective Cover Soil (hand-tamped) AGRU 300mil DS Geocomposite	
Lower Box	AGRU 60mil DS HDPE Microspike (shiny side down) AF-1 Existing Ash Material ω = 19.5 % γ_d = 102.1 pcf	
Conditioning	Wet - Loading applied and Interface flooded for a minimum of 24 hours prior to shear.	
Shearing Rate	inches/minute	0.04

Test Notes
Sliding occured between HDPE and ash at all stresses.

Specimen No.		-	1	2	3
Normal Stress		psf	100	200	400
Box Edge Dimension		in	12	12	12
Bearing Slide Resistance		lbs	9	10	12
Peak	Shear Stress	psf	102	148	196
	Secant Angle	deg.	45.6	36.5	26.1
Large Displacement	Shear Stress	psf	92	144	194
	Secant Angle	deg.	42.6	35.8	25.8
Asperity Height*	Shiny Side	mils	34	35	35
	Dull Side	mils	34	34	34

*Average of five measurements.

2. POST-CLOSURE SOLAR DEVELOPMENT FOR ASH POND CLOSURE

POST-CLOSURE SOLAR DEVELOPMENT FOR ASH POND CLOSURE

AP-3 – INACTIVE SURFACE IMPOUNDMENT

PLANT HAMMOND
FLOYD COUNTY, GEORGIA

FOR

Georgia Power

NOVEMBER 2018

GEORGIA
REGISTERED
No. 27159
PROFESSIONAL
ENGINEER
RAJENDRA S. GONDHALEKAR

11/15/2018

Southern Company

Technical Services – Environmental Systems and Field Support
Southern Company Services

TABLE OF CONTENTS

LIST OF ATTACHMENTS

1. INTRODUCTION

Georgia Power is developing plans to install solar panels and associated equipment on top of the closed Ash Pond 3 (AP-3) at Plant Hammond as part of its continued commitment to renewable energy generation. This document addresses the engineering and design demonstrations necessary to ensure that the solar installation does not affect the integrity of the final cover system or the stability of the closed surface impoundment.

Georgia Power is currently evaluating two different racking systems and layouts for the solar project. As the details of the design have not yet been finalized, we have taken a conservative approach in the development of our engineering calculations by choosing the more challenging design parameters from each system as appropriate for calculation. In this manner, we are presenting a “worst-case” scenario for each calculation. The final design will be as protective or more protective than the scenarios presented here.

2. BALLASTED ANCHOR SYSTEM

The solar panels will be supported by a non-penetrating ballasted anchor system that rests on top of the final cover system. Two systems are currently being evaluated, one using pour-in-place plastic ballast tubs filled with concrete and one using precast concrete ballast blocks. Details of the systems, including conceptual panel layouts, are shown in Attachment A and Attachment B. Note that these layouts are preliminary and are subject to change prior to installation.

Both systems are designed to hold the panels securely in place at a wind load of 105 mph in accordance with ASCE 7-10 and IBC 2012 for wind exposure category C. The maximum dead load for either system is approximately 400 psf, and both systems place the ballast on top of a leveling layer of sand or fine gravel. This lowers the ground surface bearing pressure and reduces the risk of a punching shear failure along the edge of the ballast.

3. EFFECT ON DRAINAGE

The addition of impermeable solar panels to the ash pond cap will change the hydraulic characteristics of the cover system by increasing stormwater runoff and reducing water storage in the cover soil. As indicated by the stormwater runoff calculation given as Attachment C, this results in a rise of approximately 2 inches in the headwater elevation at the northeast discharge point during a 25 year storm event. An additional 18-inch diameter pipe at the northeast discharge point and additional storage capacity in the downgradient basins are already planned to be provided to address higher runoff from the cap as the result of the recent soil infiltration testing of the cap cover material indicating lower infiltration rates. No additional modifications to the surface water management featured are anticipated to be necessary because of the addition of solar panels.

Erosion control measures will also be addressed as part of the solar development. The existing grass mix, composed primarily of Bermuda, Kentucky Fescue, and Serecia Lespedeza, will be monitored for health and amended as needed in accordance with the vegetative plan section of the Post-Closure Care Plan. Natural vegetation may be augmented with artificial turf or matting if needed to stabilize select areas. Regions of concentrated flow will be addressed through energy dissipaters or engineered conveyances to control erosion and maintain the integrity of the cover system. Any areas of erosion will be noted during routine inspections and repaired as needed.

4. GLOBAL STABILITY

The global stability calculation of the closed ash pond with the additional loading of the solar panels is given in Attachment D. The results are summarized in Table 4-1 below. Due to the light weight of the solar infrastructure, the factors of safety remain relatively unchanged from the pre-solar calculations included in the Engineering Report accompanying this application package.

Table 4-1: Global Slope Stability Analysis Results

Loading Condition	Required Minimum Factor of Safety	Calculated Factor of Safety without Solar	Calculated Factor of Safety with Solar
Long Term (Drained)	1.5	2.2	2.2
Pseudo-Static	1.0	1.2	1.2
Post-Earthquake	1.2	2.2	2.2

5. VENEER STABILITY

A veneer stability calculation is included as Attachment E. The results are summarized in Table 5-1 below. This calculation indicates that the cover system, when loaded with the solar panels and ballast blocks located in the central portion of the footprint with gentle slopes, has an acceptable factor of safety against a veneer sliding failure for all analyzed loading conditions.

Table 5-1: Veneer Stability Analysis Results

Analysis Case	Calculated Factor of Safety
Case I – Drained	18.6
Case II – Saturated	18.6
Case III – Seismic	2.5
Case IV – Static Residual	18.6

6. SETTLEMENT

A calculation of the anticipated settlement due to the weight of the solar panels and ballast blocks is given as Attachment F. A comparison of the anticipated settlement with and without solar development is shown in Table 6-1 below. The analysis indicates that the anticipated additional foundation settlement as a result of solar development is less than 0.1 inches, and localized settlement in the cover soil and ash directly beneath the ballast blocks is less than 0.2 inches. Indications of settlement will be observed during the routine post-closure inspections of the ash pond, and any settled areas that do not have positive drainage will be amended to re-establish design grades.

Table 6-1: Settlement Analysis Results

Analysis Case	Total Settlement	Liner Strain
Foundation Soil Without Solar	6.471"	0.15%
Foundation Soil With Solar	6.505"	0.15%
Local Settlement With Solar	0.16"	0.0003%

ATTACHMENT A

RBI SOLAR RACKING SYSTEM

PHOTOVOLTAIC MODULE GROUND MOUNT SYSTEM
RBI SOLAR RACK MODEL: GM-2

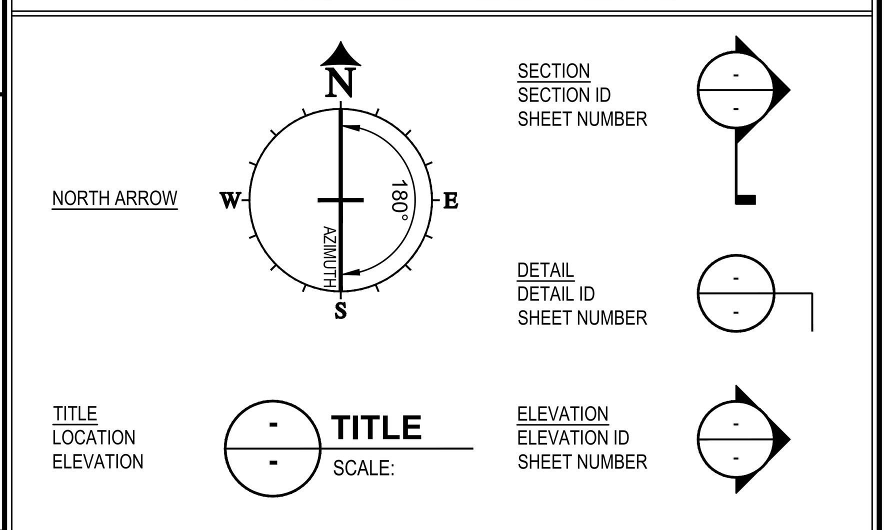
FOR

Georgia Power

AT

PLANT HAMMOND
5963 ALABAMA HWY, SW
ROME, GA 30165

SYMBOLS LEGEND



GOVERNING CODE

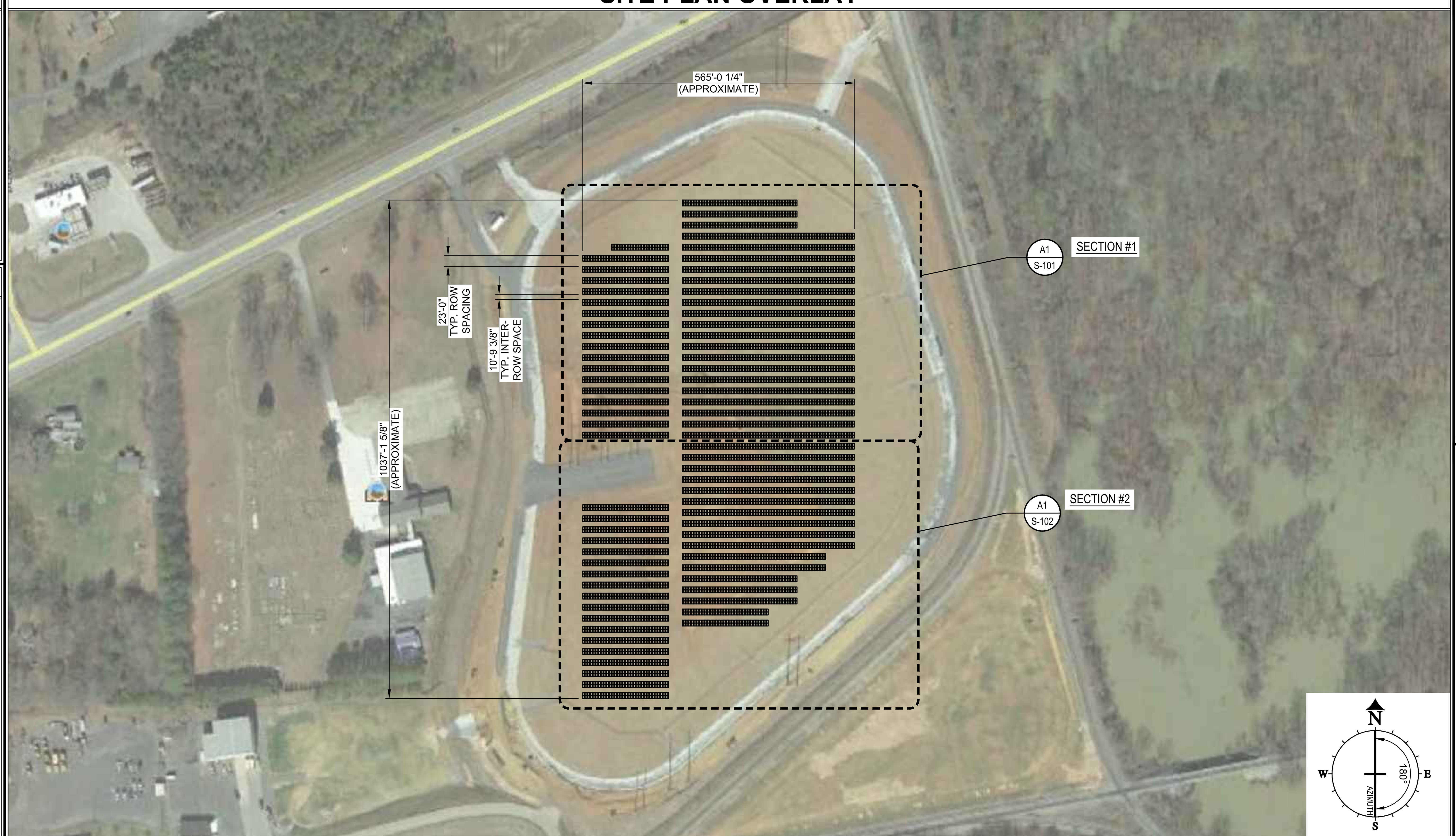
INTERNATIONAL BUILDING CODE (IBC 2012)

RISK CATEGORY: I

DESIGN LOADS:

1. DEAD LOADS:
   - STRUCTURE: 2.0 PSF
   - GLAZING: 3.0 PSF
     Σ = 5.0 PSF
2. ROOF LIVE LOAD = 0 PSF
3. SNOW LOAD:
   - P_g = 5.0 PSF (GROUND SNOW)
   - P_f = 3.0 PSF (FLAT ROOF SNOW)
   - P_s = 2.7 PSF (SLOPED ROOF SNOW)
   - C_e = 0.90
   - C_t = 1.20
   - C_s = 0.91
   - I_s = 0.80
4. WIND LOAD: (MAIN WIND FORCE RESISTING SYSTEM)
   - V = 105 MPH
   - EXPOSURE: C
5. SEISMIC:
   - S_s = 0.312
   - S_1 = 0.111
   - S_{ds} = 0.322
   - S_{d1} = 0.174
   - I_{eq} = 1.00
   - SITE CLASS: D
   - SEISMIC DESIGN CATEGORY: C
   - SEISMIC FORCE RESISTING SYSTEM = CANTILEVERED COLUMN SYSTEM
   - DESIGN BASE SHEAR: V = 0.161*W
     C_s = 0.161
     R = 2.00
   - EQUIVALENT LATERAL FORCE ANALYSIS

SITE PLAN OVERLAY



NOTE: GOOGLE EARTH© IMAGE IS FOR REFERENCE ONLY.

SHEET INDEX

SHEET	SHEET DESCRIPTION
G-001	COVER SHEET
G-002	GENERAL NOTES/MODULE SPECIFICATION SHEETS
S-101	COMPONENT LAYOUT SECTION #1
S-102	COMPONENT LAYOUT SECTION #2
S-301	RACK SECTION & BAY PLAN VIEWS
S-501	DETAILS
S-502	BALLAST BLOCK DETAILS AND SCHEDULE

SYSTEM SPECIFICATIONS

NOTE:
THIS SUBMITTAL/CONSTRUCTION SET WAS PRODUCED FROM DOCUMENTS RECEIVED FROM CUSTOMER ON 07/30/2018.

PV MODULE MANUFACTURER	REC
PV MODULE MODEL #	REC315PE72
PV MODULE WATTAGE	315
# OF PV MODULES/STRING	TO BE PROVIDED TO RBI BY CUSTOMER
# OF ACTIVE PV MODULES	11556
# OF SPARE PV MODULES	0
TOTAL # OF PV MODULES	11556
TOTAL PV SYSTEM WATTS	3.6401 MW DC
ARRAY TYPE	FIXED TILT
ARRAY TILT	20° +/- 2°
TOTAL # OF RACKING BALLAST	1075
TOTAL # OF EQUIPMENT POSTS	0
ARRAY ROW SPACING (PITCH)	23'-0"
INTER-ROW SPACE	10'-9 3/8"
MINIMUM MODULE CLEARANCE	2'-8"
ARRAY AZIMUTH	180° (NOT ADJUSTED FOR MAGNETIC DECLINATION)

RBI SOLAR
Total Solar Service: Design * Fabrication
Installation * Parts * Repair Service
5513 VINE STREET
CINCINNATI, OH 45217
513.242.2051
FAX: 513.242.0816

PROFESSIONAL SEAL

ENGINEER'S SEAL APPLIES TO DESIGN OF STRUCTURAL COMPONENTS ONLY

NOT FOR CONSTRUCTION

RBI SOLAR IS NOT RESPONSIBLE FOR CONSTRUCTION THAT IS BUILT FROM SET LABELED "NOT FOR CONSTRUCTION"

GROUND MOUNT FOR GEORGIA POWER

RELEASE RECORD

MARK	DATE	DESCRIPTION
03	08/06/18	90% REVIEW
02	07/31/18	75% REVIEW
01	07/24/18	50% REVIEW

PROJECT INFORMATION

TITLE & ADDRESS:
PLANT HAMMOND

5963 ALABAMA HWY, SW
ROME, GA 30165

RBI SOLAR PROJECT No.:
1835017

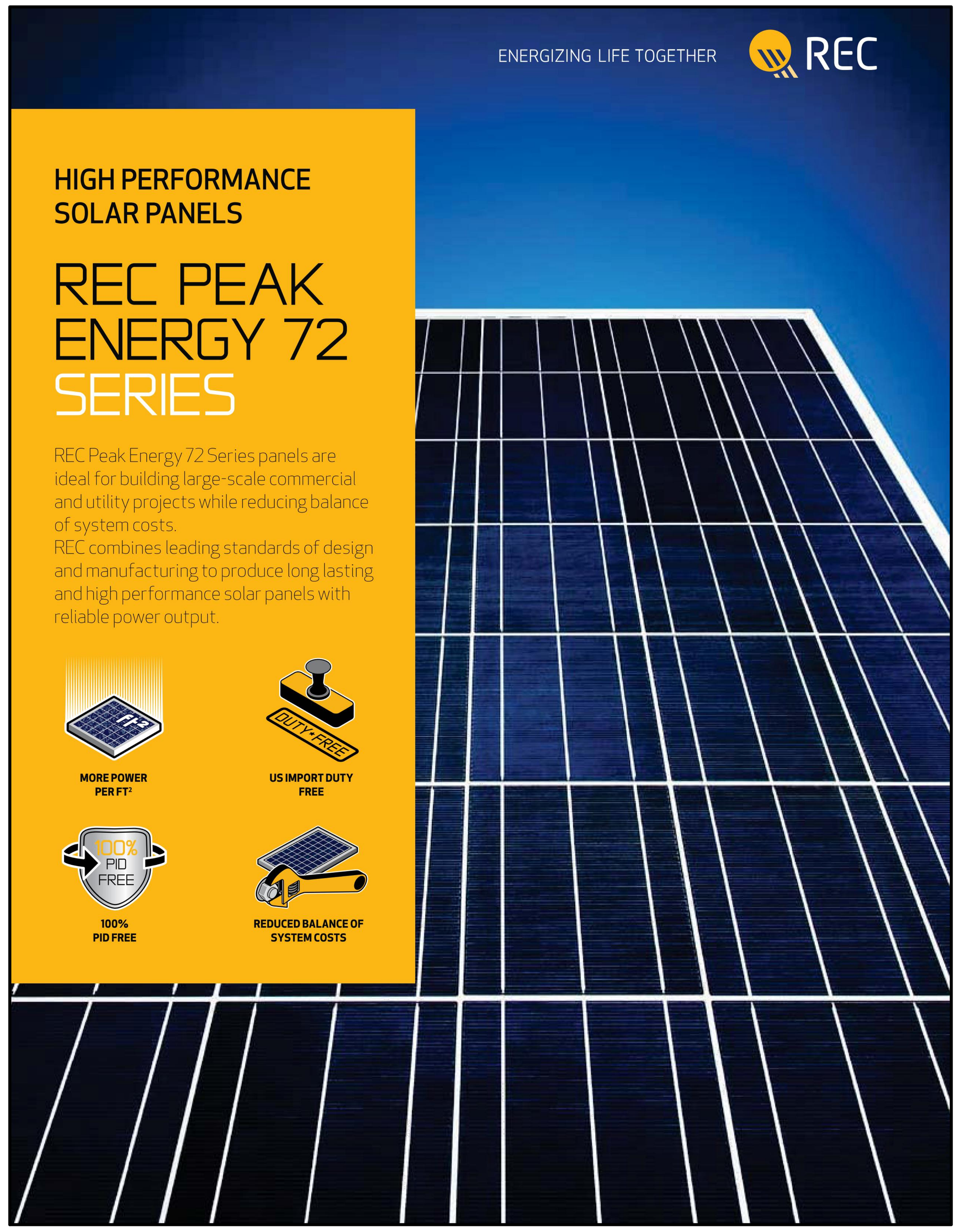
DRAWN BY:	REVIEWED BY:
CTN	KEJ/BDS

SHEET TITLE:
COVER SHEET

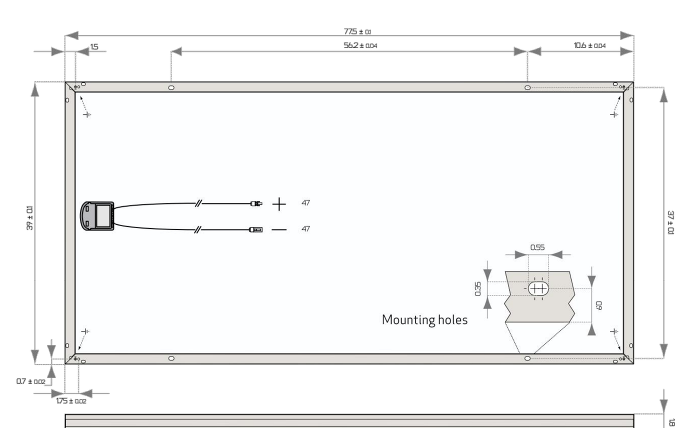
SHEET No.:
G-001

USER: CNORTON PLOTTED: 8/6/2018 - 2:55 PM S:\RBI Solar\Design\2018 Jobs\1835017 - Southern Company-Plant Hammond\Drawings\1835017 - R0.dwg LAYOUT: G-001

MODULE SPECIFICATION SHEETS



REC PEAK ENERGY 72 SERIES



All measurements in inches

16.2%	EFFICIENCY
10	YEAR PRODUCT WARRANTY
25	YEAR LINEAR POWER OUTPUT WARRANTY
DUTY★FREE	US IMPORT DUTY FREE

ELECTRICAL DATA @ STC	REC300PE72	REC305PE72	REC310PE72	REC315PE72	REC320PE72
Nominal Power - P_{MPP} (Wp)	300	305	310	315	320
Watt Class Sorting - (W)	0/+5	0/+5	0/+5	0/+5	0/+5
Nominal Power Voltage - V_{MPP} (V)	36.5	36.9	37.2	37.5	37.9
Nominal Power Current - I_{MPP} (A)	8.22	8.27	8.34	8.40	8.45
Open Circuit Voltage - V_{OC} (V)	44.9	45.2	45.5	45.8	46.1
Short Circuit Current - I_{SC} (A)	8.76	8.82	8.88	8.93	8.99
Panel Efficiency (%)	15.4	15.6	15.9	16.2	16.4

Measurement tolerance of ±3% from nominal values; values at standard test conditions STC (airmass AM1.5, irradiance 1000 W/m², 25°C cell temperature). At low irradiance of 200 W/m² (AM1.5 and cell temperature 25°C) at least 95.5% of the STC module efficiency will be achieved.

ELECTRICAL DATA @ NOCT	REC300PE72	REC305PE72	REC310PE72	REC315PE72	REC320PE72
Nominal Power - P_{MPP} (Wp)	217	221	225	229	232
Nominal Power Voltage - V_{MPP} (V)	29.9	30.1	30.4	30.6	30.8
Nominal Power Current - I_{MPP} (A)	7.27	7.34	7.41	7.48	7.54
Open Circuit Voltage - V_{OC} (V)	36.9	37.2	37.4	37.6	37.9
Short Circuit Current - I_{SC} (A)	7.67	7.72	7.77	7.83	7.88

Nominal cell operating temperature NOCT (800 W/m², AM 1.5, windspeed 1 m/s, ambient temperature 20°C).

TEMPERATURE RATINGS	
Nominal Operating Cell Temperature (NOCT)	46.6°C (±2°C)
Temperature Coefficient of P_{MPP}	-0.4 %/°C
Temperature Coefficient of V_{OC}	-0.27 %/°C
Temperature Coefficient of I_{SC}	0.013 %/°C

GENERAL DATA	
Cell Type:	72 multicrystalline 3 strings of 24 cells with bypass diodes
Glass:	0.16" solar glass with anti-reflection surface treatment
Back Sheet:	Double layer highly resistant polyester
Frame:	Anodized aluminum (silver)
Junction Box:	IP67 rated 4 mm² solar cable, 47" + 47"
Connectors:	MC4 connectable (4 mm²)

MAXIMUM RATINGS	
Operational Temperature:	-40 ... +85°C
Maximum System Voltage:	1000 V
Design Load:	75.2 lbs/ft² (3600 Pa)* 33.4 lbs/ft² (1600 Pa)* *Refer to installation manual
Max Series Fuse Rating:	20 A
Max Reverse Current:	20 A

MECHANICAL DATA	
Dimensions:	77.5 x 39 x 1.8 in
Area:	21 ft²
Weight:	59.5 lbs

Note! All specifications are subject to change without notice at any time.

Ref: NE-05-05-06 - Rev.I - 02.2016

CERTIFICATION

c UL us LISTED   C SP US   DVE

Certified according to UL 1703, CEC listed
Certified according to IEC 61215 & IEC 61730;
IEC 61701 Salt Mist Corrosion Resistance &
IEC 62716 Ammonia Corrosion Resistance

WARRANTY

10 year product warranty.
25 year linear power output warranty
(max. degression in performance of 0.7% p.a.).

Celebrating its 20th anniversary in 2016, REC is a leading European brand of solar panels. Through integrated manufacturing from polysilicon to wafers, cells, panels and turnkey solar solutions, REC strives to help meet the world's growing energy needs. Founded in 1996, REC is a Bluestar Elkem company with headquarters in Norway and operational headquarters in Singapore. REC concluded 2015 with 2,000 employees worldwide, 1.3 GW solar panel production capacity, and annual revenues of USD 755 million.

REC
www.recgroup.com

GENERAL NOTES

GENERAL/CONSTRUCTION/SAFETY:

1. ALL WORK SHALL CONFORM TO THE REQUIREMENTS OF THE APPLICABLE CONSTRUCTION CODE AND THE PROJECT SPECIFICATIONS.
2. LOCATION OF UNDERGROUND UTILITIES SHALL BE VERIFIED PRIOR TO COMMENCEMENT OF CONSTRUCTION.
3. DIMENSIONS SHOWN ON PLAN SHALL BE VERIFIED IN FIELD.
4. LAYOUT IS SUBJECT TO CHANGE PER REQUEST AND/OR EXISTING CONDITIONS IN THE FIELD.
5. ENGINEER SHALL NOT BE RESPONSIBLE FOR THE MEANS, METHODS, TECHNIQUES, SEQUENCES OR PROCEDURES OF CONSTRUCTION SELECTED BY CONTRACTOR.
6. CONTRACTOR SHALL FIELD MEASURE AND VERIFY ALL EXISTING CONDITIONS AND DIMENSIONS. ANY UNEXPECTED CONDITIONS OR DISCREPANCIES WITH THE DESIGN DOCUMENTS SHALL BE REPORTED TO THE ENGINEER PRIOR TO INSTALLATION OR ERECTION OF MATERIALS.
7. THE CONTRACTOR WILL BE SOLELY AND COMPLETELY RESPONSIBLE FOR CONDITIONS OF THE JOB SITE INCLUDING SAFETY OF ALL PERSONS AND PROPERTY DURING PERFORMANCE OF THE WORK. THIS REQUIREMENT WILL APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS. WHEN ON SITE, THE ENGINEER IS RESPONSIBLE FOR HIS OWN SAFETY BUT HAS NO RESPONSIBILITY FOR THE SAFETY OF OTHER PERSONNEL OR SAFETY CONDITIONS AT THE SITE.
8. NO PERSONNEL SHALL STEP OR STAND ON PHOTOVOLTAIC (PV) MODULES (SOLAR PANELS) AT ANY TIME. RACK STRUCTURE AND PV MODULES ARE NOT DESIGNED FOR LIVE LOADS AND MAY VOID WARRANTY.
9. THIS RBI SOLAR CONSTRUCTION SET IS DESIGNED FROM PV MODULE DATA SHEET(S) PROVIDED BY THE CUSTOMER. CUSTOMER IS RESPONSIBLE FOR VERIFYING THAT THE PV MODULE(S) DELIVERED TO SITE MATCH DATA SHEET(S) PROVIDED TO RBI SOLAR. RBI SOLAR IS NOT RESPONSIBLE FOR PV MODULE DIMENSIONAL DISCREPANCIES DUE TO FURNISHED PV MODULES NOT MATCHING CUSTOMER FURNISHED PV MODULE DATA SHEETS.

SPECIAL FIELD INSPECTIONS:

SPECIAL INSPECTION NOT REQUIRED BY RBI SOLAR. AS REQUIRED BY OWNER/CUSTOMER AND/OR AUTHORITY HAVING JURISDICTION, MINIMUM INSPECTION SHALL INCLUDE THE FOLLOWING NOTES AND TABLE:

1. ALL SPECIAL INSPECTORS SHALL BE RETAINED BY OWNER/CUSTOMER. THE EXTENT OF THE INSPECTION SHALL COMPLY WITH THE CONTRACT DOCUMENTS, THE BUILDING CODE REQUIREMENTS, AND LOCAL JURISDICTION. IT IS THE OWNER/CUSTOMER'S RESPONSIBILITY TO GIVE PROPER NOTIFICATION TO THE SPECIAL INSPECTOR AND PROCEED WITH THE WORK ONLY AFTER THE SPECIAL INSPECTOR'S APPROVAL.
2. FAILURE TO NOTIFY THE SPECIAL INSPECTOR MAY RESULT IN OWNER/CUSTOMER HAVING TO REMOVE WORK FOR THE PURPOSE OF INSPECTION AT THE OWNER'S/CUSTOMER'S EXPENSE.
3. PREMATURE NOTIFICATION FOR INSPECTION WILL RESULT IN AN ADDITIONAL INSPECTION WITH ALL EXPENSES AND FEES PAID BY THE OWNER/CUSTOMER.
4. SPECIAL INSPECTORS SHALL KEEP RECORDS OF ALL INSPECTIONS. RECORDS SHALL BE FURNISHED TO THE OWNER, ENGINEER OF RECORD, AND LOCAL JURISDICTION AS REQUIRED. ANY AND ALL DISCREPANCIES SHALL IMMEDIATELY BE BROUGHT TO THE ATTENTION OF THE CONTRACTOR. CORRECTIONS SHALL BE MADE AND A FINAL REPORT OF INSPECTIONS SHALL BE PROVIDED NOTING COMPLETION OF INSPECTIONS AND CORRECTIONS OF DISCREPANCIES. FAILURE TO CORRECT DISCREPANCIES SHALL BE REPORTED TO THE ENGINEER OF RECORD AND THE LOCAL JURISDICTION AND MAY RESULT IN REMOVAL OF COMPLETED WORK AND ADDITIONAL WORK TO CORRECT DISCREPANCIES AT THE CONTRACTOR'S EXPENSE.

IBC TABLE 1705

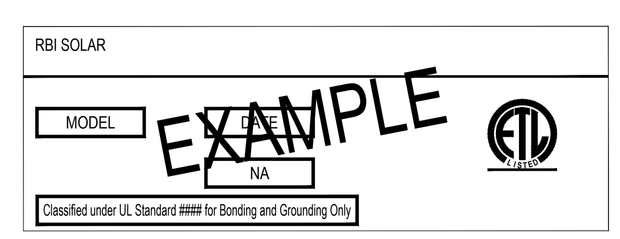
STRUCTURAL STEEL/ALUMINUM FABRICATION	CONTINUOUS	PERIODIC
MATERIAL IDENTIFICATION		X
HIGH STRENGTH BOLTS - MATERIAL IDENTIFICATION OF BOLTS, NUTS AND WASHERS		X
WELD FILLER MATERIALS - IDENTIFICATION AND CONFIRMATION OF COMPLIANCE WITH DESIGN DOCUMENTS		X
STRUCTURAL STEEL/ALUMINUM ERECTION		
MATERIAL IDENTIFICATION		X
INSTALLATION OF HIGH STRENGTH BOLTS		X
WELDED CONNECTIONS		X
MEMBER SIZES AND PLACEMENT		X
GENERAL CONFORMANCE WITH DESIGN DOCUMENTS		X
CONCRETE CONSTRUCTION		
MATERIAL IDENTIFICATION		X
MIX DESIGN VERIFICATION		X
SIZE AND PLACEMENT OF REINFORCING STEEL		X
PLACEMENT OF CONCRETE USING PROPER TECHNIQUES		X
CONCRETE SAMPLES FOR SLUMP, AIR CONTENT, TEMPERATURE, STRENGTH TESTS, ETC. IN ACCORDANCE WITH ACI 318		X
PROPER MAINTENANCE OF SPECIFIED CURING TEMPERATURE AND TECHNIQUES		X
FOUNDATIONS		
SIZE AND LOCATION OF FOUNDATION EXCAVATIONS		X
PLACEMENT OF REINFORCING STEEL AS REQUIRED		X

WORK BY OTHERS:

1. SITE WORK AND DEVELOPMENT.
2. ALL ELECTRICAL WORK INCLUDING WIRING, CONDUIT, PANELS AND LIGHTS TO BE FURNISHED AND INSTALLED BY ELECTRICAL CONTRACTOR.
3. GROUNDING REQUIREMENTS.
4. ALL SHADING ANALYSIS AND/OR PRODUCTION ANALYSIS SHALL BE PERFORMED AND VERIFIED BY OTHERS. RBI SOLAR IS NOT RESPONSIBLE FOR PV SYSTEM DESIGN AS IT PERTAINS TO ELECTRICAL OR PV SYSTEM PRODUCTION.

ETL CLASSIFIED:

THIS PROJECT CONTAINS RACKING LABELED AS ETL CLASSIFIED UNDER UL SUBJECT 2703 OR UL STANDARD 2703. LABELS ARE APPLIED AT THE FACTORY ON COMPONENTS THAT MAY BE ASSEMBLED AT THE FACTORY OR IN THE FIELD. SEE DETAIL SHEET IN THIS DRAWING SET FOR MORE INFORMATION.



STRUCTURAL STEEL:

1. ALL STRUCTURAL STEEL SHALL BE DESIGNED, FABRICATED AND ERECTED IN ACCORDANCE WITH THE LATEST VERSION OF AISC "MANUAL OF STEEL CONSTRUCTION." LIGHT GAGE COLD-FORMED SECTIONS SHALL CONFORM TO LATEST VERSION OF AISI SPECIFICATIONS FOR COLD-FORMED STEEL STRUCTURAL MEMBERS.
2. MATERIALS:
   A. ROLLED SHAPES: ASTM A992 OR A572 GRADE 55, F_Y = 55 KSI MINIMUM
   B. PLATES: ASTM A36
   C. TUBULAR SHAPES: ASTM A500 GRADE C, F_Y = 50 KSI MINIMUM
   D. FIELD BOLTS (TYP. U.N.O): SAE J429 GRADE 5
   E. SCREWS: #12 TEKS - GALVANIZED
   F. COLD-FORMED/LIGHT GAGE ASTM A653 GRADE 55
   G. ANCHOR RODS ASTM A307 (TYPICAL U.N.O.)
3. TEK SCREWS ARE TO BE INSTALLED USING A 2500 RPM MAX. NON-IMPACTING VARIABLE SPEED DRILL WITH CLUTCH OUT.
4. REFER TO THE LATEST RBI SOLAR MODEL GM-I OR GM-2 INSTALLATION GUIDE FOR STRUCTURAL CONNECTION TORQUE VALUES.
5. ALL WELDING OF STEEL SHALL BE DONE IN ACCORDANCE WITH THE LATEST VERSION OF THE AMERICAN WELD SOCIETY'S SPECIFICATIONS - AWS D1.1. ELECTRODES SHALL BE E70 SERIES UNLESS NOTED OTHERWISE.
6. GALVANIZING SPECIFICATIONS
   A. STRUCTURAL SHAPES: HOT-DIPPED GALVANIZING SHALL BE PER ASTM A123.
   B. PRE-GALVANIZED MATERIALS SHALL COMPLY WITH ASTM A653 - G90 MINIMUM.
   C. ALL STRUCTURAL HARDWARE (NOT MODULE MOUNTING HARDWARE): HOT-DIPPED GALVANIZING SHALL BE PER ASTM F2329 UNLESS NOTED OTHERWISE.

MISCELLANEOUS FASTENERS:

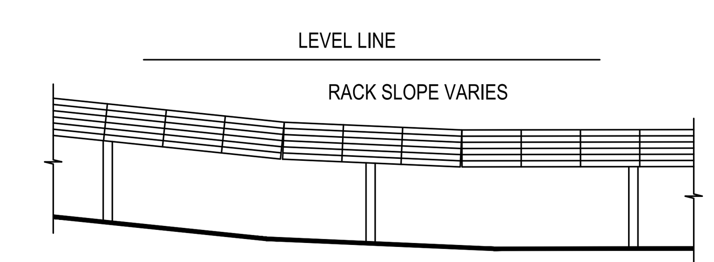
1. ALL BOLTS SHALL BE THE TYPE AND SIZE INDICATED ON DRAWINGS.
2. ALL HARDWARE USED FOR MOUNTING PV MODULES SHALL BE STAINLESS STEEL UNLESS NOTED OTHERWISE.
3. ALL PV MODULE MOUNTING HARDWARE SHALL BE INSTALLED AND TORQUED PER THE LATEST RBI SOLAR MODEL GM-I OR GM-2 INSTALLATION GUIDE.

FOUNDATIONS/CONCRETE:

1. THE FOUNDATION DESIGN IS BASED ON ASSUMED MINIMUM CODE ALLOWABLE VALUES PERFORMED BY RBI SOLAR.
2. CONCRETE SPECIFICATIONS:
   STRENGTH: 4000 PSI MINIMUM @ 28 DAYS FOR BALLASTS
   AIR CONTENT: 4-6%   AGGREGATE SIZE: 3/4" MAXIMUM   MINIMUM COVER: 3" UNLESS NOTED OTHERWISE
3. GROUT SPECIFICATIONS: 8000 PSI MINIMUM, NON-SHRINK
4. REINFORCING STEEL: ASTM A615 GRADE 60 BILLET STEEL
5. CUSTOMER IS RESPONSIBLE FOR VERIFYING FINAL SOIL CONDITIONS DURING CONSTRUCTION HAVE NOT BEEN PURPOSELY ALTERED IN ANY WAY TO ENSURE THE SOIL IS CONSISTENT WITH FINDINGS INCLUDED IN GEOTECHNICAL REPORT, IF APPLICABLE, AND OR FIELD TESTS PERFORMED BY RBI SOLAR. VARIATIONS IN SOIL CONDITIONS SHALL BE REPORTED TO GEOTECHNICAL ENGINEER AND/OR ENGINEER OF RECORD RESPONSIBLE FOR FOUNDATION DESIGN PRIOR TO INSTALLATION OF ANY FOUNDATION MATERIALS.
6. CUSTOMER IS RESPONSIBLE FOR VERIFYING CORROSION COMPATIBILITY WITH FOUNDATIONS AND/OR DRIVEN POSTS.
7. INSTALLER/CONTRACTOR SHALL COORDINATE PLACEMENT OF FOUNDATIONS AND/OR ANCHOR BOLTS PER DESIGN DRAWINGS AND/OR MANUFACTURER'S SPECIFICATIONS.
8. RBI SOLAR, INC. DESIGNS DRIVEN-PILE AND ALTERNATIVE FOUNDATIONS BASED ON SOIL PROPERTIES OUTLINED IN CERTIFIED GEOTECHNICAL REPORTS AND/OR DATA FROM FIELD TESTING. ALL DESIGNS ASSUME UNDISTURBED SOIL CONDITIONS, AND DO NOT TAKE INTO ACCOUNT TRENCHING NEAR FOUNDATIONS. FOR CASES WHERE TRENCHING FOR ELECTRICAL WORK IS AT OR NEAR A FOUNDATION, RBI SOLAR RECOMMENDS A MINIMUM OF 3'-0" CLEAR FROM THE EDGE OF THE TRENCH TO THE EDGE OF THE FOUNDATION FOR "NORMAL GOOD SOIL CONDITIONS." IN CASES OF "POOR SOIL" CONDITIONS, RBI SOLAR RECOMMENDS A MINIMUM CLEAR DISTANCE EQUAL TO OR GREATER THAN THE DEPTH OF THE FOUNDATION. IF IN DOUBT OF SOIL CONDITIONS, RBI SOLAR RECOMMENDS CONSULTING A QUALIFIED GEOTECHNICAL ENGINEER TO ASSESS SOIL CONDITIONS AT THE SITE.

   NOTE: TRENCHING/EXCAVATION WITHIN 3'-0" OF ANY RACK SUPPORT POST REQUIRES REPLACING THE ORIGINAL SOIL AND COMPACTION TO 95% STANDARD PROCTOR DENSITY. FOR FURTHER CLARIFICATION ON COMPACTION REQUIREMENTS, RBI SOLAR RECOMMENDS CONSULTING A QUALIFIED GEOTECHNICAL ENGINEER.

RACK SYSTEM TOPOGRAPHIC RELATIONSHIP



KEY POINTS
1. RACK STRUCTURE IS PARALLEL TO SITE GRADE
2. COLUMN LENGTHS ARE EQUAL THROUGHOUT
3. TOPS OF PIERS FOLLOW SITE GRADE
4. EXPOSED PIER HEIGHTS MAY VARY

FOLLOW GRADE

RBI SOLAR
Total Solar Service: Design * Fabrication
Installation * Parts * Repair Service
5513 VINE STREET
CINCINNATI, OH 45217
513.242.2051
FAX: 513.242.0816

PROFESSIONAL SEAL

ENGINEER'S SEAL APPLIES TO DESIGN OF STRUCTURAL COMPONENTS ONLY

NOT FOR CONSTRUCTION

RBI SOLAR IS NOT RESPONSIBLE FOR CONSTRUCTION THAT IS BUILT FROM SET LABELED "NOT FOR CONSTRUCTION"

GROUND MOUNT FOR GEORGIA POWER

RELEASE RECORD

MARK	DATE	DESCRIPTION
03	08/06/18	90% REVIEW
02	07/31/18	75% REVIEW
01	07/24/18	50% REVIEW

PROJECT INFORMATION

TITLE & ADDRESS:
PLANT HAMMOND

5963 ALABAMA HWY, SW
ROME, GA 30165

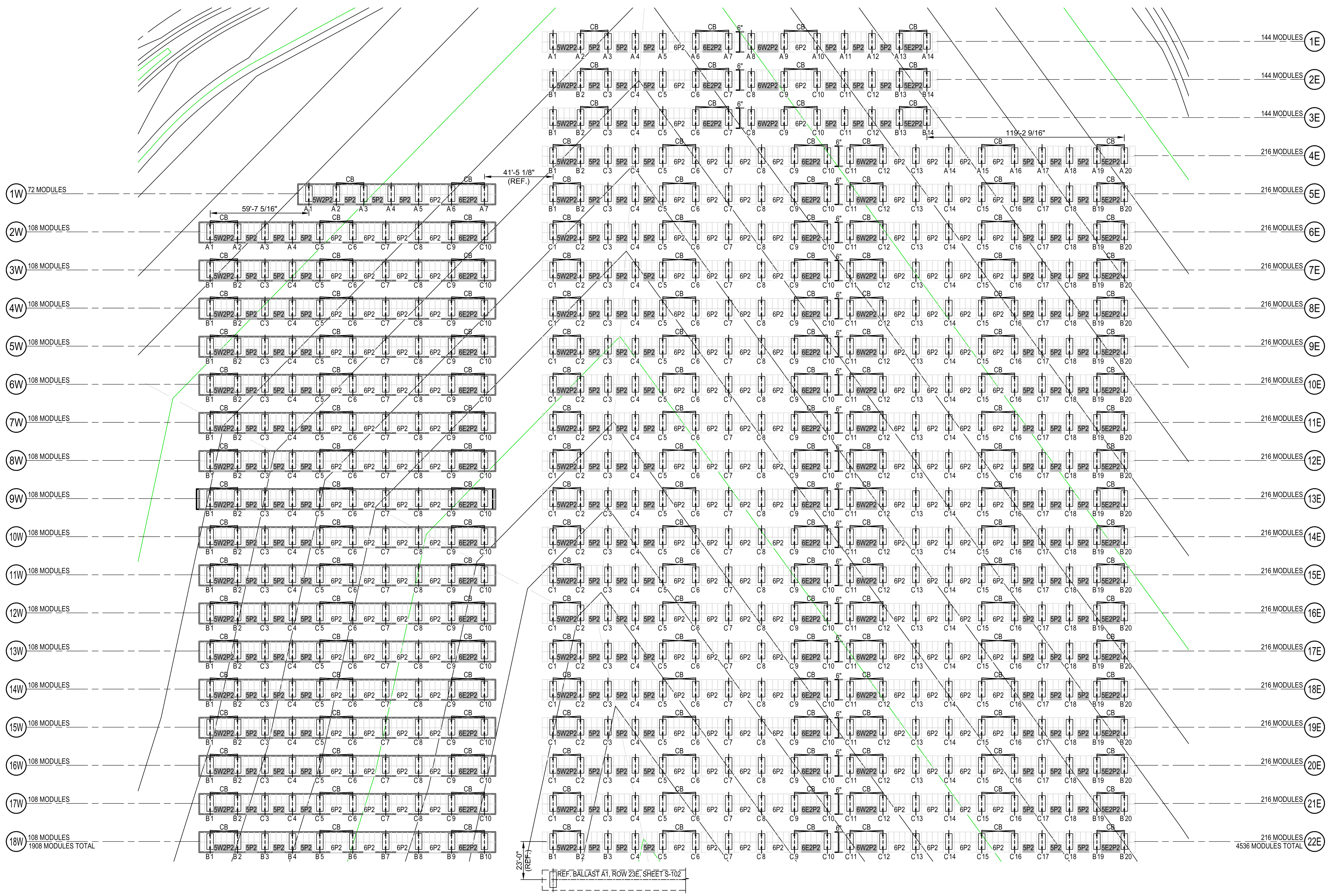
RBI SOLAR PROJECT No.: 1835017

DRAWN BY:	REVIEWED BY:
CTN	KEJ/BDS

SHEET TITLE: GENERAL NOTES/ MODULE SPECIFICATION SHEETS

SHEET No.: G-002

USER: CNORTON PLOTTED: 8/6/2018 - 2:55 PM S:\RBI Solar\Design\2018 Jobs\1835017 - Southern Company-Plant Hammond\Drawings\1835017 - R0.dwg LAYOUT: G-002



BAY SCHEDULE

BAYS				PURLINS			DETAIL
TYPE	QTY.	POST-POST	DESCRIPTION	MARK	#/BAY	PCS.	
5E2P2	22	SEE BAY PLAN	REC315PE72 PORTRAIT MODULES 5 WIDE x 2 HIGH WITH 2 CANTILEVER EAST SIDE AND 20.0° TILT	Z5E2	4	88	A9/S-301
5P2	186	SEE BAY PLAN	REC315PE72 PORTRAIT MODULES 5 WIDE x 2 HIGH AND 20.0° TILT	Z5	4	744	C9/S-301
5W2P2	40	SEE BAY PLAN	REC315PE72 PORTRAIT MODULES 5 WIDE x 2 HIGH WITH 2 CANTILEVER WEST SIDE AND 20.0° TILT	Z5W2	4	160	E9/S-301
6E2P2	40	SEE BAY PLAN	REC315PE72 PORTRAIT MODULES 6 WIDE x 2 HIGH WITH 2 CANTILEVER EAST SIDE AND 20.0° TILT	Z6E2	4	160	G9/S-301
6P2	227	SEE BAY PLAN	REC315PE72 PORTRAIT MODULES 6 WIDE x 2 HIGH AND 20.0° TILT	Z6	4	908	G6/S-301
6W2P2	22	SEE BAY PLAN	REC315PE72 PORTRAIT MODULES 6 WIDE x 2 HIGH WITH 2 CANTILEVER WEST SIDE AND 20.0° TILT	Z6W2	4	88	G3/S-301

NOTES THIS BAY:
1. PURLINS ARE 2 3/4" x 7" x 2 3/4" ZEE 16 GA. GALVANIZED UNLESS NOTED OTHERWISE.
2. TOP CHORDS ARE 140 11/16" x 4" x 4 3/4" CEE 14 GA. GALVANIZED UNLESS NOTED OTHERWISE.
3. KNEE BRACES ARE 54 7/8" x 2" SQ. 15 GA. GALVANIZED UNLESS NOTED OTHERWISE.

BALLAST SCHEDULE

SYMBOL	MARK	DESCRIPTION	WEIGHT (LBS.)	PIECES	DETAIL
'X' #	A	9'-6" L. x 4'-0" W. x 1'-0" H. REINFORCED CONCRETE BALLAST BLOCK W/ ONE (P1) 3'-11 1/2" & ONE (P2) 1'-2 9/16" CEE 8X3 POST	5700	32	A1/S-301 A9/S-502
	B	9'-6" L. x 3'-9" W. x 1'-0" H. REINFORCED CONCRETE BALLAST BLOCK W/ ONE (P1) 3'-11 1/2" & ONE (P2) 1'-2 9/16" CEE 8X3 POST	5344	91	A1/S-301 A9/S-502
	C	9'-6" L. x 3'-0" W. x 1'-0" H. REINFORCED CONCRETE BALLAST BLOCK W/ ONE (P1) 3'-11 1/2" & ONE (P2) 1'-2 9/16" CEE 8X3 POST	4275	476	A1/S-301 A9/S-502

BALLAST SETTING NOTES:
1. ALL BALLAST DIMENSIONS SHOWN ARE CENTERLINE TO CENTERLINE OF BALLAST
2. REFERENCE SHEET S-502 FOR ADDITIONAL INFORMATION ON REQUIRED BALLASTS

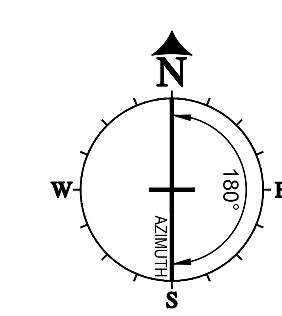
X-BRACE SCHEDULE

SYMBOL	DESCRIPTION	SETS	DETAIL
CB	2 STRANDS OF 22'-0" LONG 3/16" GALV. 7x19 WIRE ROPE WITH 2 GRIPPLE D4 WIRE CLAMPS	179	C7/S-501

NOTES:
1. X-BRACING MAY BE MOVED EAST OR WEST ONE (1) BAY AS NEEDED

LEGEND

X"	SYMBOL REPRESENTS X" WIDE ROW BREAK PER DETAIL G1/S-301



A1
SCALE: ######
COMPONENT LAYOUT

RBI SOLAR
Total Solar Service: Design * Fabrication Installation * Parts * Repair Service
5513 VINE STREET
CINCINNATI, OH 45217
513.242.2051
FAX: 513.242.0816

PROFESSIONAL SEAL

ENGINEER'S SEAL APPLIES TO DESIGN OF STRUCTURAL COMPONENTS ONLY

NOT FOR CONSTRUCTION

RBI SOLAR IS NOT RESPONSIBLE FOR CONSTRUCTION THAT IS BUILT FROM SET LABELED "NOT FOR CONSTRUCTION"

GROUND MOUNT FOR GEORGIA POWER

RELEASE RECORD

MARK	DATE	DESCRIPTION
03	08/06/18	90% REVIEW
02	07/31/18	75% REVIEW
01	07/24/18	50% REVIEW

PROJECT INFORMATION

TITLE & ADDRESS:
PLANT HAMMOND

5963 ALABAMA HWY, SW
ROME, GA 30165

RBI SOLAR PROJECT No.: 1835017

DRAWN BY: CTN
REVIEWED BY: KEJ/BDS

SHEET TITLE:
COMPONENT LAYOUT SECTION #1

SHEET No.:
S-101

USER: CNORTON PLOTTED: 8/6/2018 - 2:55 PM S:\RBI Solar\Design\2018 Jobs\1835017 - Southern Company-Plant Hammond\Drawings\1835017 - R0.dwg LAYOUT: S-101

BALLAST SCHEDULE

SYMBOL	MARK	DESCRIPTION	WEIGHT (LBS.)	PIECES	DETAIL
'X' #	A	9'-6" L. x 4'-0" W. x 1'-0" H. REINFORCED CONCRETE BALLAST BLOCK W/ ONE (P1) 3'-11 1/2" & ONE (P2) 1'-2 9/16" CEE 8X3 POST	5700	10	A1/S-301 A9/S-502
	B	9'-6" L. x 3'-9" W. x 1'-0" H. REINFORCED CONCRETE BALLAST BLOCK W/ ONE (P1) 3'-11 1/2" & ONE (P2) 1'-2 9/16" CEE 8X3 POST	5344	114	A1/S-301 A9/S-502
	C	9'-6" L. x 3'-0" W. x 1'-0" H. REINFORCED CONCRETE BALLAST BLOCK W/ ONE (P1) 3'-11 1/2" & ONE (P2) 1'-2 9/16" CEE 8X3 POST	4275	352	A1/S-301 A9/S-502

BALLAST SETTING NOTES:
1. ALL BALLAST DIMENSIONS SHOWN ARE CENTERLINE TO CENTERLINE OF BALLAST
2. REFERENCE SHEET S-502 FOR ADDITIONAL INFORMATION ON REQUIRED BALLASTS

LEGEND

X" SYMBOL REPRESENTS X" WIDE ROW BREAK PER DETAIL G1/S-301

BAY SCHEDULE

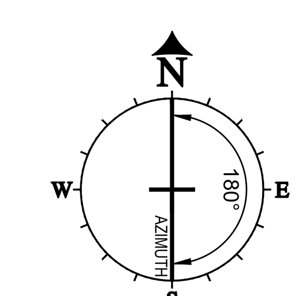
BAYS				PURLINS			DETAIL
TYPE	QTY.	POST-POST	DESCRIPTION	MARK	#/BAY	PCS.	
5E2P2	17	SEE BAY PLAN	REC315PE72 PORTRAIT MODULES 5 WIDE x 2 HIGH WITH 2 CANTILEVER EAST SIDE AND 20.0° TILT	Z5E2	4	68	A9/S-301
5P2	148	SEE BAY PLAN	REC315PE72 PORTRAIT MODULES 5 WIDE x 2 HIGH AND 20.0° TILT	Z5	4	592	C9/S-301
5W2P2	35	SEE BAY PLAN	REC315PE72 PORTRAIT MODULES 5 WIDE x 2 HIGH WITH 2 CANTILEVER WEST SIDE AND 20.0° TILT	Z5W2	4	140	E9/S-301
6E2P2	33	SEE BAY PLAN	REC315PE72 PORTRAIT MODULES 6 WIDE x 2 HIGH WITH 2 CANTILEVER EAST SIDE AND 20.0° TILT	Z6E2	4	132	G9/S-301
6P2	178	SEE BAY PLAN	REC315PE72 PORTRAIT MODULES 6 WIDE x 2 HIGH AND 20.0° TILT	Z6	4	712	G6/S-301
6W2P2	15	SEE BAY PLAN	REC315PE72 PORTRAIT MODULES 6 WIDE x 2 HIGH WITH 2 CANTILEVER WEST SIDE AND 20.0° TILT	Z6W2	4	60	G3/S-301

NOTES THIS BAY:
1. PURLINS ARE 2 3/4" x 7" x 2 3/4" ZEE 16 GA. GALVANIZED UNLESS NOTED OTHERWISE.
2. TOP CHORDS ARE 140 11/16" x 4" x 4 3/4" CEE 14 GA. GALVANIZED UNLESS NOTED OTHERWISE.
3. KNEE BRACES ARE 54 7/8" x 2" SQ. 15 GA. GALVANIZED UNLESS NOTED OTHERWISE.

X-BRACE SCHEDULE

SYMBOL	DESCRIPTION	SETS	DETAIL
CB	2 STRANDS OF 22'-0" LONG 3/16" GALV. 7x19 WIRE ROPE WITH 2 GRIPPLE D4 WIRE CLAMPS	142	C7/S-501

NOTES:
1. X-BRACING MAY BE MOVED EAST OR WEST ONE (1) BAY AS NEEDED



A1 SCALE: 1/32" = 1'-0"
COMPONENT LAYOUT

RBI SOLAR
Total Solar Service: Design * Fabrication Installation * Parts * Repair Service
5513 VINE STREET
CINCINNATI, OH 45217
513.242.2051
FAX: 513.242.0816

PROFESSIONAL SEAL

ENGINEER'S SEAL APPLIES TO DESIGN OF STRUCTURAL COMPONENTS ONLY

NOT FOR CONSTRUCTION

RBI SOLAR IS NOT RESPONSIBLE FOR CONSTRUCTION THAT IS BUILT FROM SET LABELED "NOT FOR CONSTRUCTION"

GROUND MOUNT FOR GEORGIA POWER

RELEASE RECORD

MARK	DATE	DESCRIPTION
03	08/06/18	90% REVIEW
02	07/31/18	75% REVIEW
01	07/24/18	50% REVIEW

PROJECT INFORMATION

TITLE & ADDRESS:
PLANT HAMMOND

5963 ALABAMA HWY, SW
ROME, GA 30165

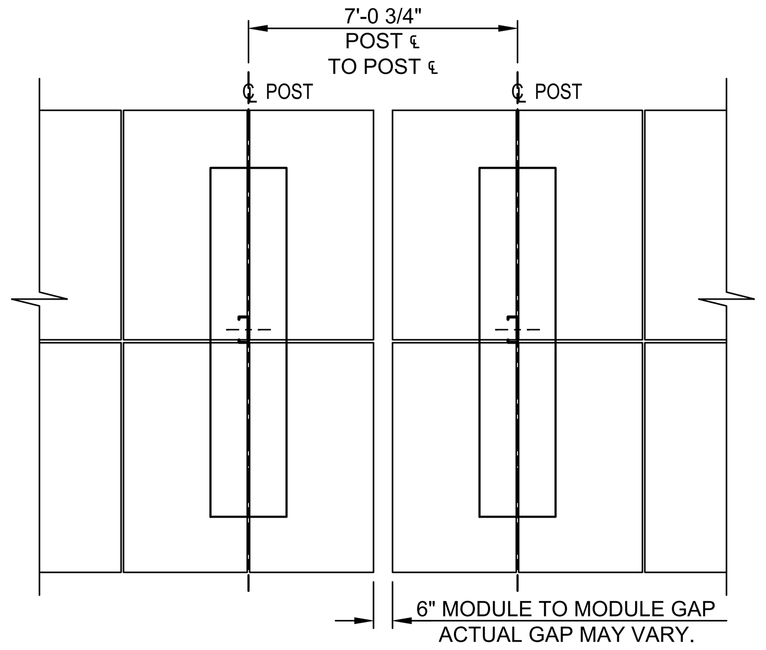
RBI SOLAR PROJECT No.: 1835017

DRAWN BY: CTN
REVIEWED BY: KEJ/BDS

SHEET TITLE:
COMPONENT LAYOUT SECTION #2

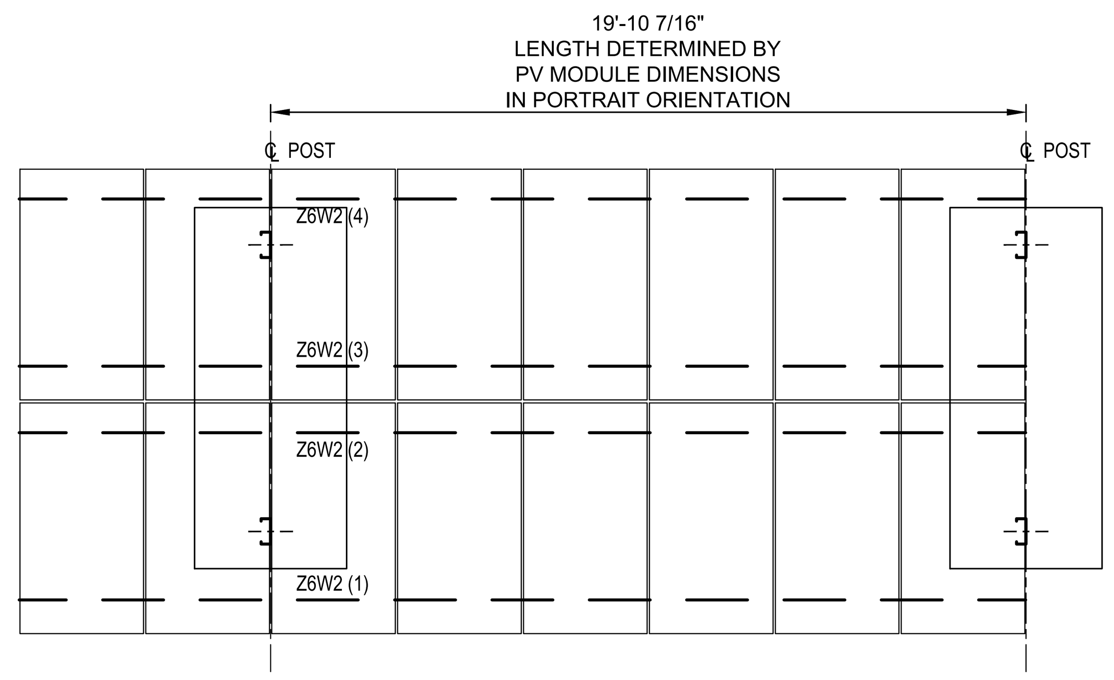
SHEET No.: S-102

USER: CNORTON PLOTTED: 8/6/2018 - 2:56 PM S:\RBI Solar\Design\2018 Jobs\1835017 - Southern Company-Plant Hammond\Drawings\1835017 - R0.dwg LAYOUT: S-102

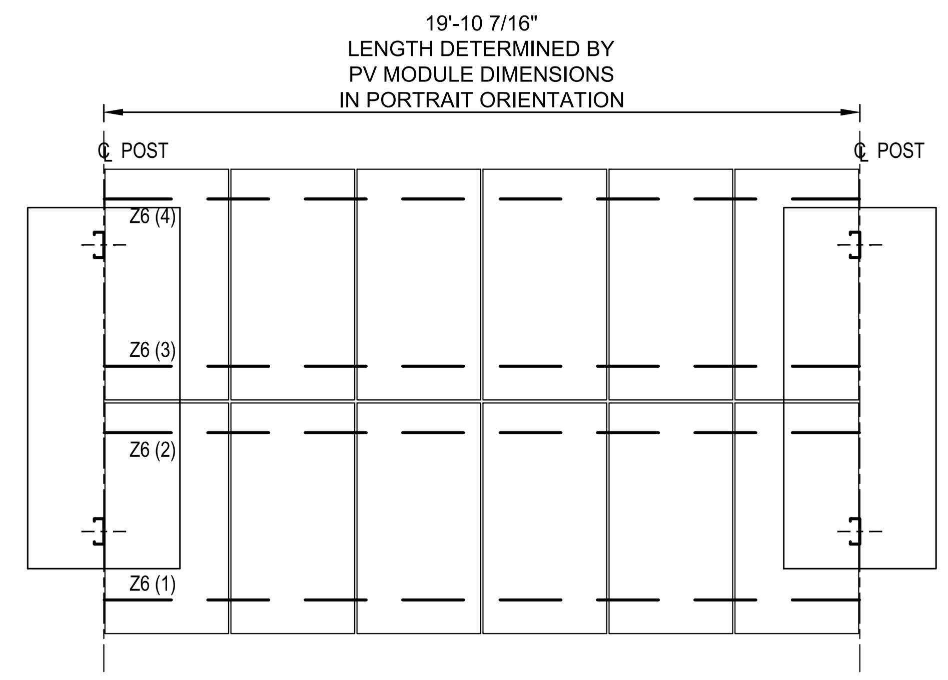


NOTE: COMPONENTS SHOWN MAY VARY FROM ACTUAL CONFIGURATION.
SEE INDIVIDUAL BAY PLANS THIS SHEET FOR MORE DETAILED PLANS.

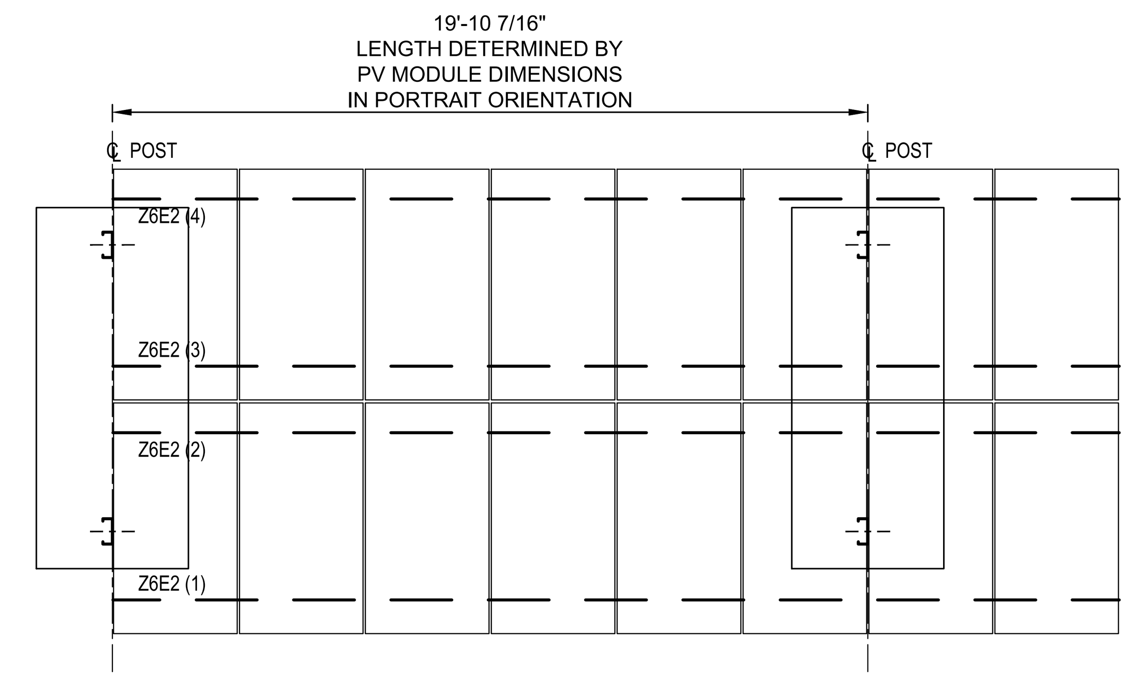
G1 SCALE: NONE — **TYPICAL ROW BREAK DETAIL**



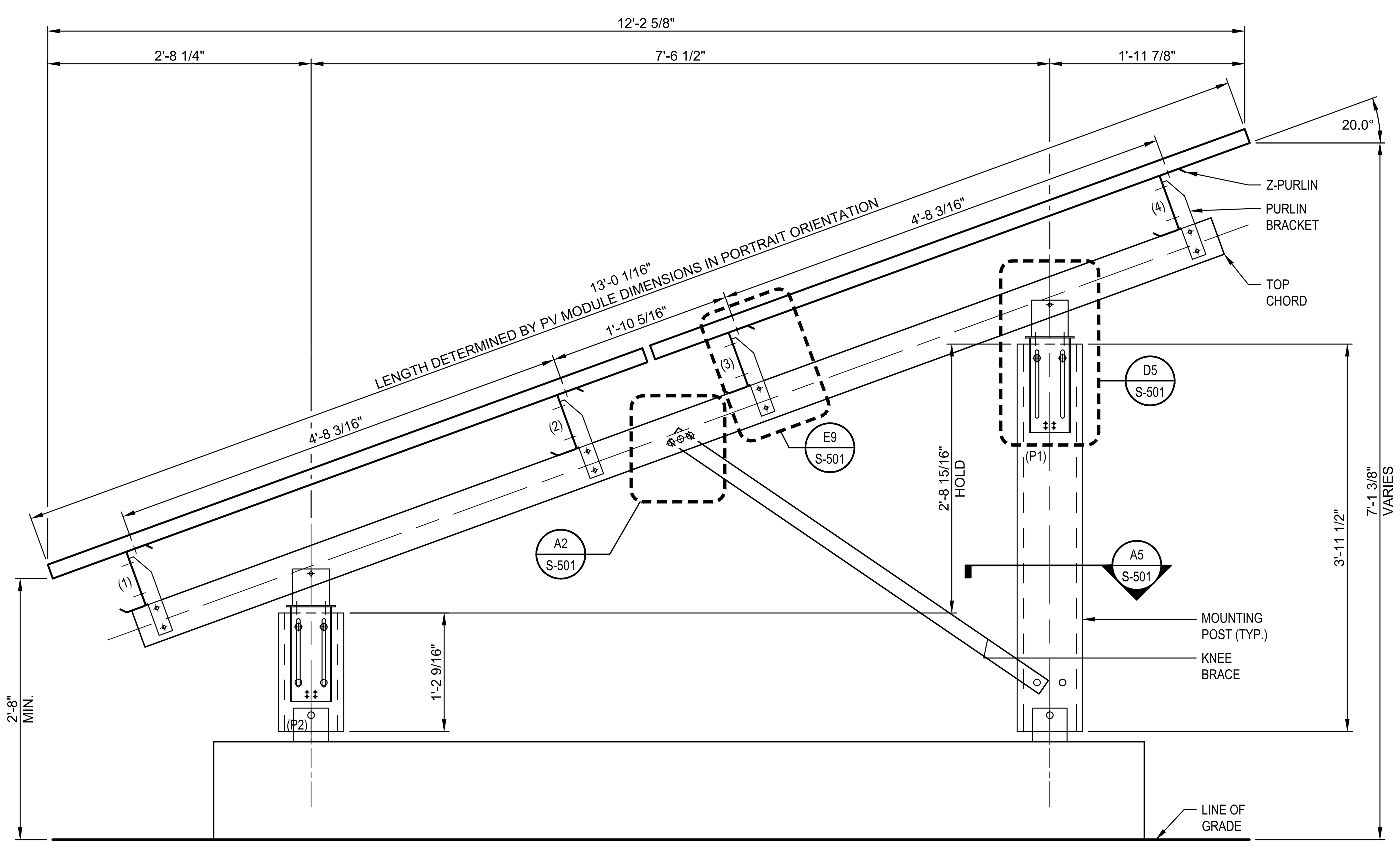
G3 SCALE: 1/4" = 1'-0" — **6W2P2 BAY PLAN VIEW**



G6 SCALE: 1/4" = 1'-0" — **6P2 BAY PLAN VIEW**



G9 SCALE: 1/4" = 1'-0" — **6E2P2 BAY PLAN VIEW**



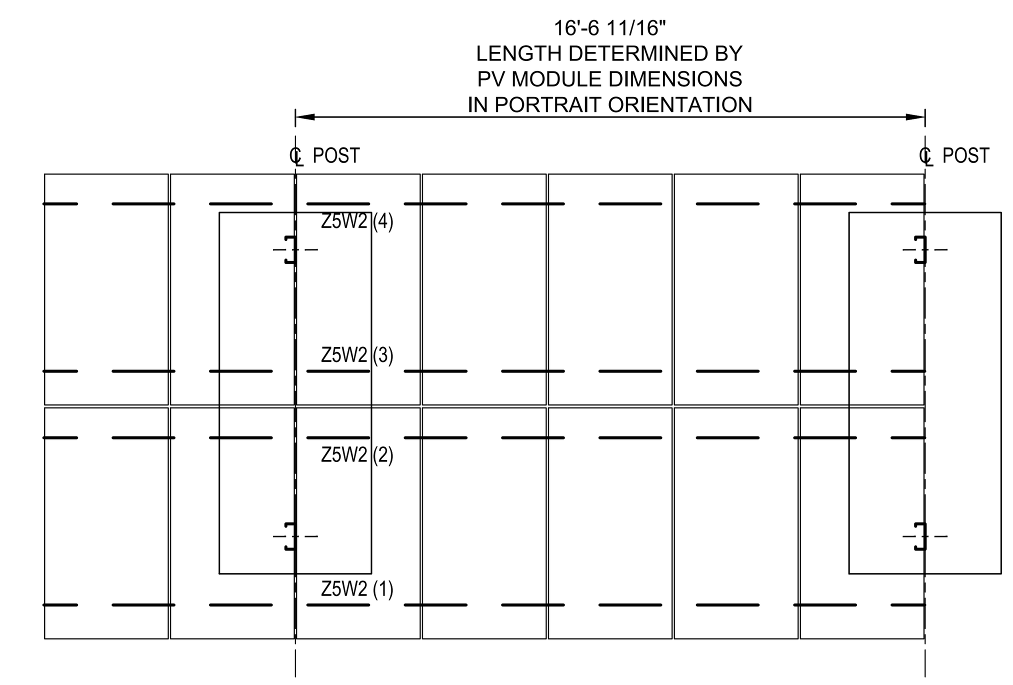
NOTE:
1. Z-PURLINS #1 & #4 HAVE RAISED MODULE MOUNTING SLOTS. (REF. E7/S-501)
2. Z-PURLINS #2 & #3 HAVE FLAT MODULE MOUNTING SLOTS. (REF. E7/S-501)

BALLAST INSTALLATION SCHEDULE

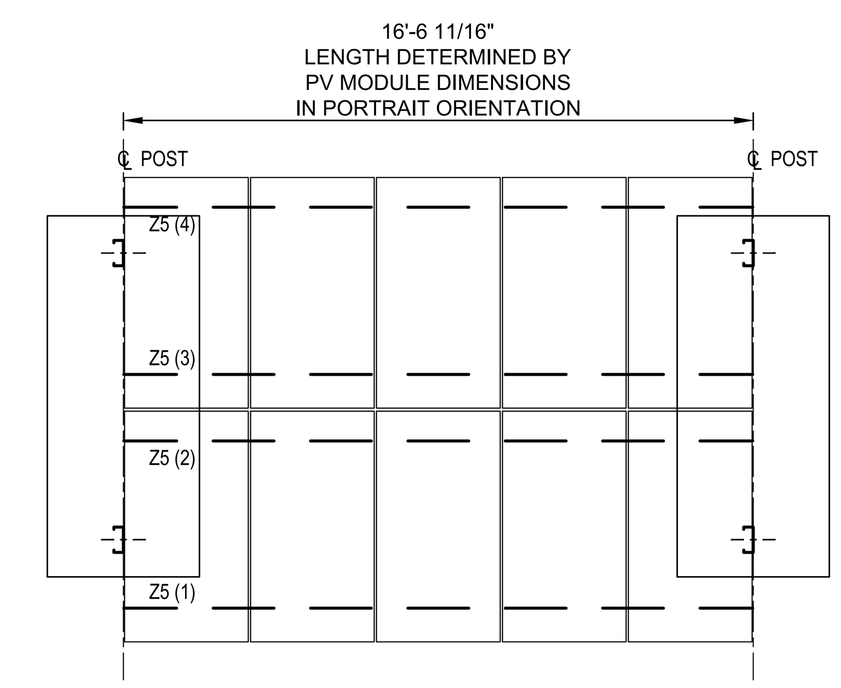
PERCENT SLOPE	ADDITIONAL GRAVEL FOR SETTING BALLAST
SLOPE <= 5%	NONE REQUIRED
5% < SLOPE <= 10%	AS REQUIRED TO LEVEL UNDULATING SLOPES
SLOPE > 10%	LEVELING PAD REQUIRED

NOTE:
GRAVEL PAD AS NEEDED WHERE BALLAST LEVELING IS REQUIRED DUE TO SLOPE OF GRADE. APPROVED COMPACTION METHODS INCLUDE 1 TO 2 PASSES WITH THE BACK OF AN EXCAVATOR BUCKET, A VIBRATING COMPACTOR PLATE, OR A WHACKER PLATE COMPACTOR

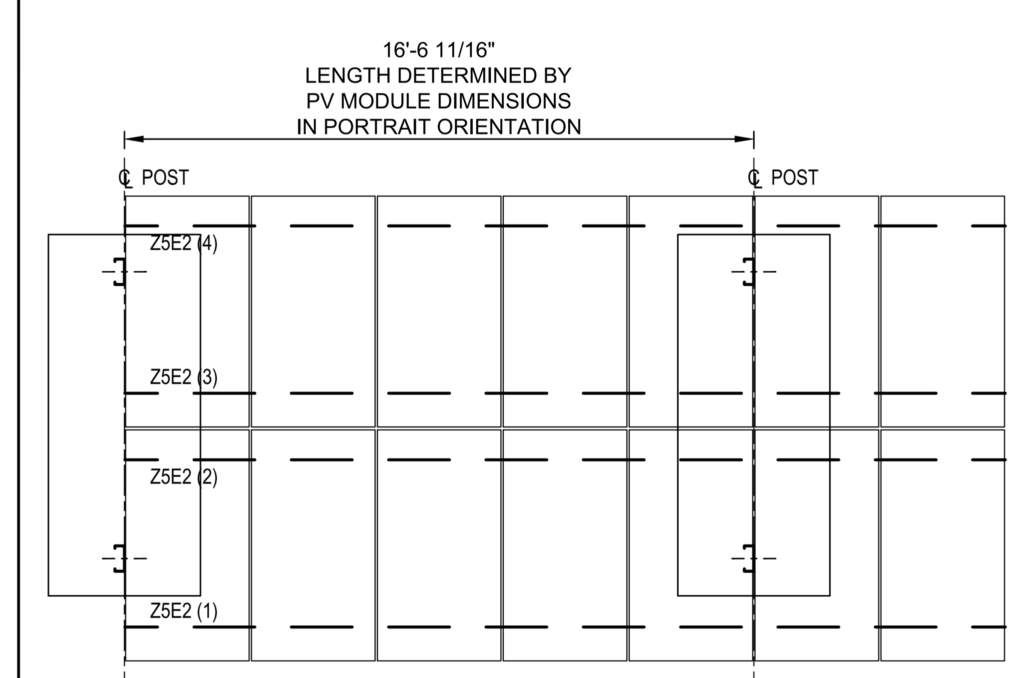
A1 SCALE: 1" = 1'-0" — **DESIGN RACK SECTION**



E9 SCALE: 1/4" = 1'-0" — **5W2P2 BAY PLAN VIEW**



C9 SCALE: 1/4" = 1'-0" — **5P2 BAY PLAN VIEW**



A9 SCALE: 1/4" = 1'-0" — **5E2P2 BAY PLAN VIEW**

RBI SOLAR
Total Solar Service: Design * Fabrication
Installation * Parts * Repair Service
5513 VINE STREET
CINCINNATI, OH 45217
513.242.2051
FAX: 513.242.0816

PROFESSIONAL SEAL

ENGINEER'S SEAL APPLIES TO DESIGN OF STRUCTURAL COMPONENTS ONLY

NOT FOR CONSTRUCTION

RBI SOLAR IS NOT RESPONSIBLE FOR CONSTRUCTION THAT IS BUILT FROM SET LABELED "NOT FOR CONSTRUCTION"

GROUND MOUNT FOR GEORGIA POWER

RELEASE RECORD

MARK	DATE	DESCRIPTION
03	08/06/18	90% REVIEW
02	07/31/18	75% REVIEW
01	07/24/18	50% REVIEW

PROJECT INFORMATION

TITLE & ADDRESS:
PLANT HAMMOND
5963 ALABAMA HWY, SW
ROME, GA 30165

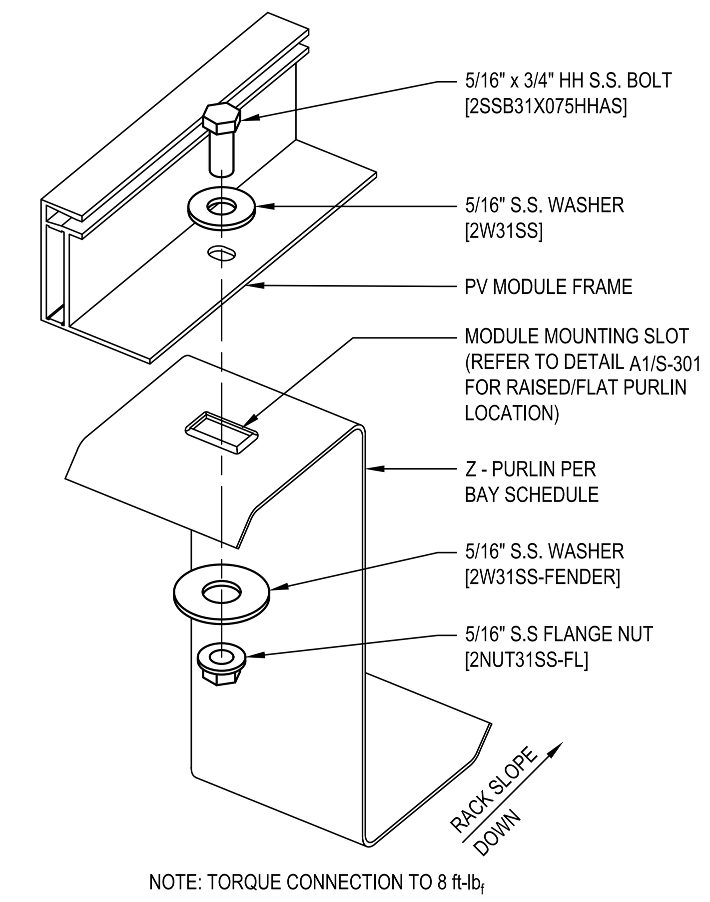
RBI SOLAR PROJECT No.: 1835017

DRAWN BY: CTN — REVIEWED BY: KEJ/BDS

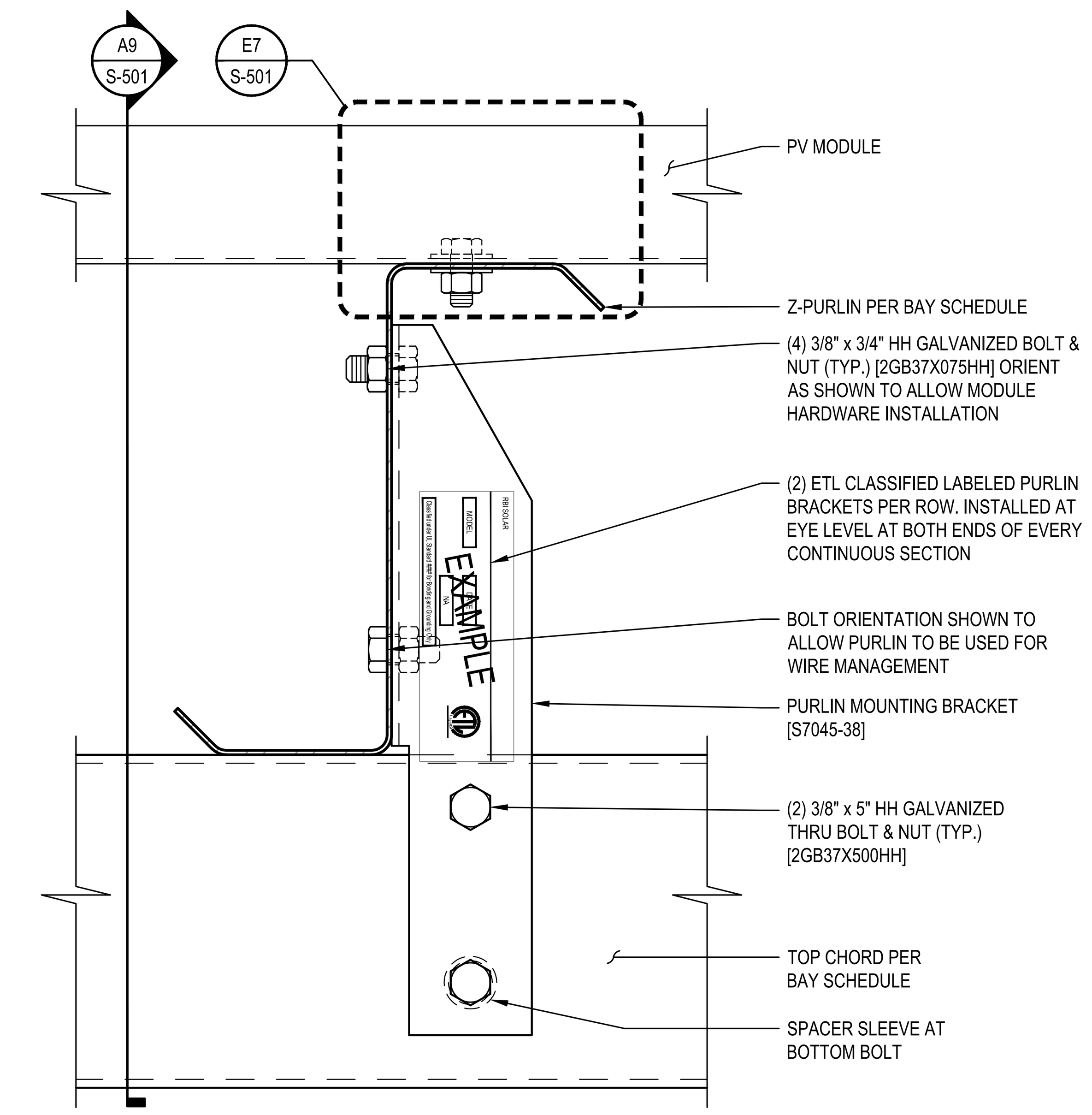
SHEET TITLE: RACK SECTION & BAY PLAN VIEWS

SHEET No.: S-301

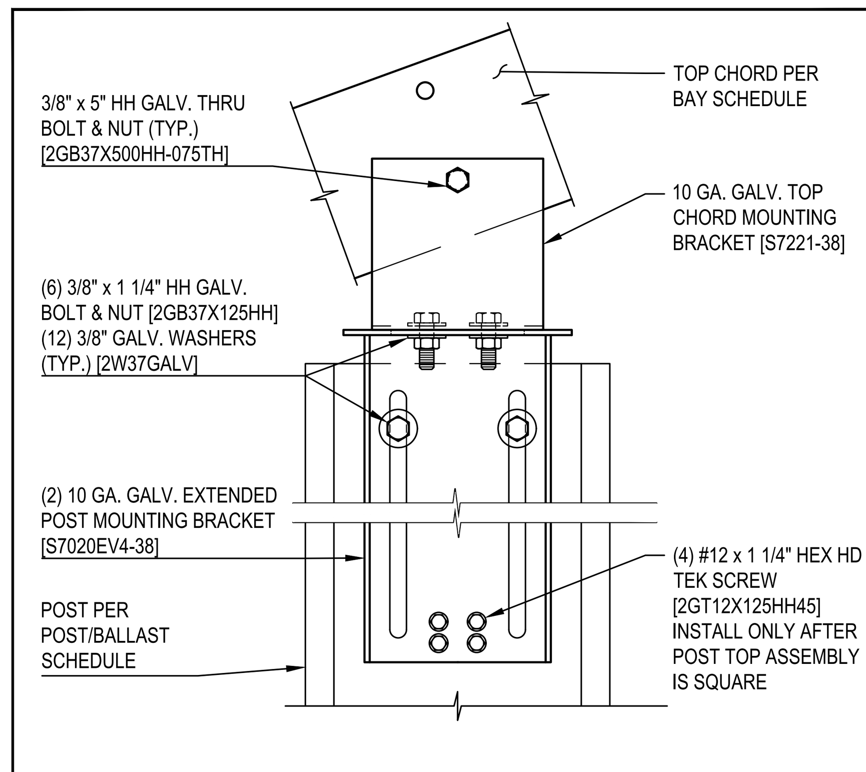
USER: CNORTON PLOTTED: 8/6/2018 - 2:56 PM S:\RBI Solar\Design\2018 Jobs\1835017 - Southern Company-Plant Hammond\Drawings\1835017 - R0.dwg LAYOUT: S-301



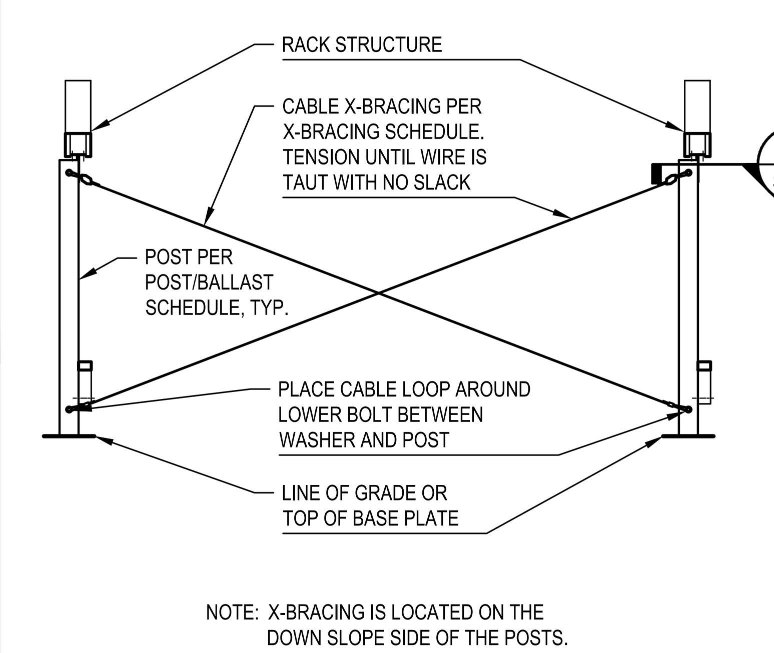
E7 SCALE: NONE
PV MODULE TO PURLIN CONNECTION DETAIL



E9 SCALE: 6" = 1'-0"
TRANSVERSE PURLIN CONNECTION DETAIL

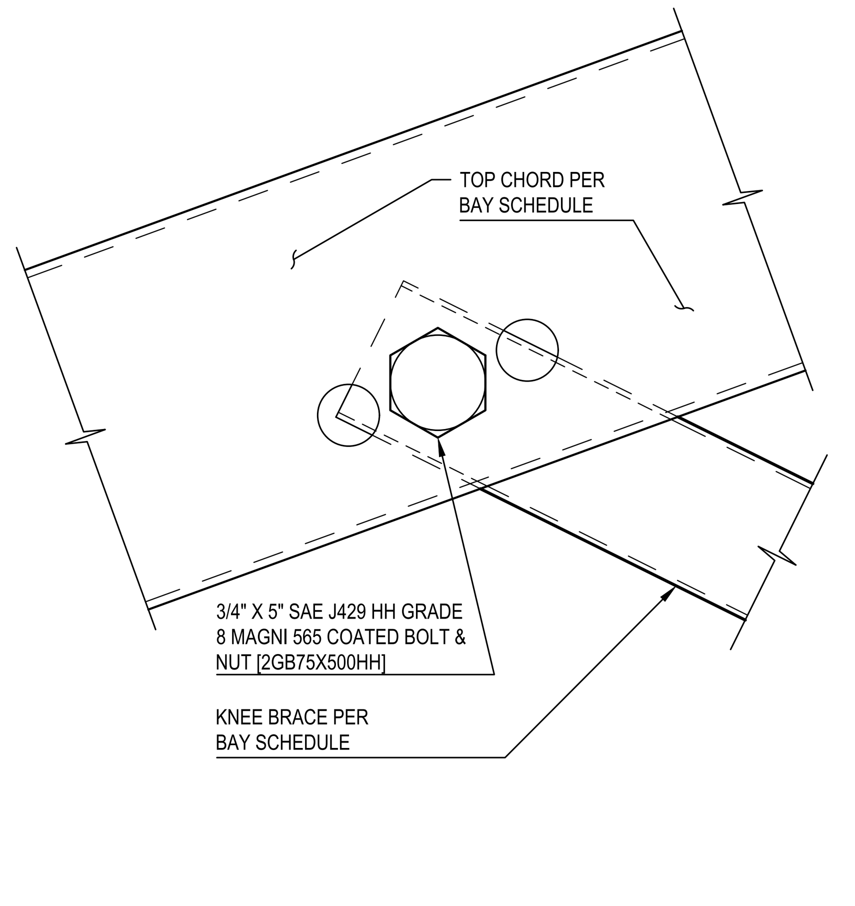


D5 SCALE: 3" = 1'-0"
TOP CHORD TO POST CONNECTION DETAIL

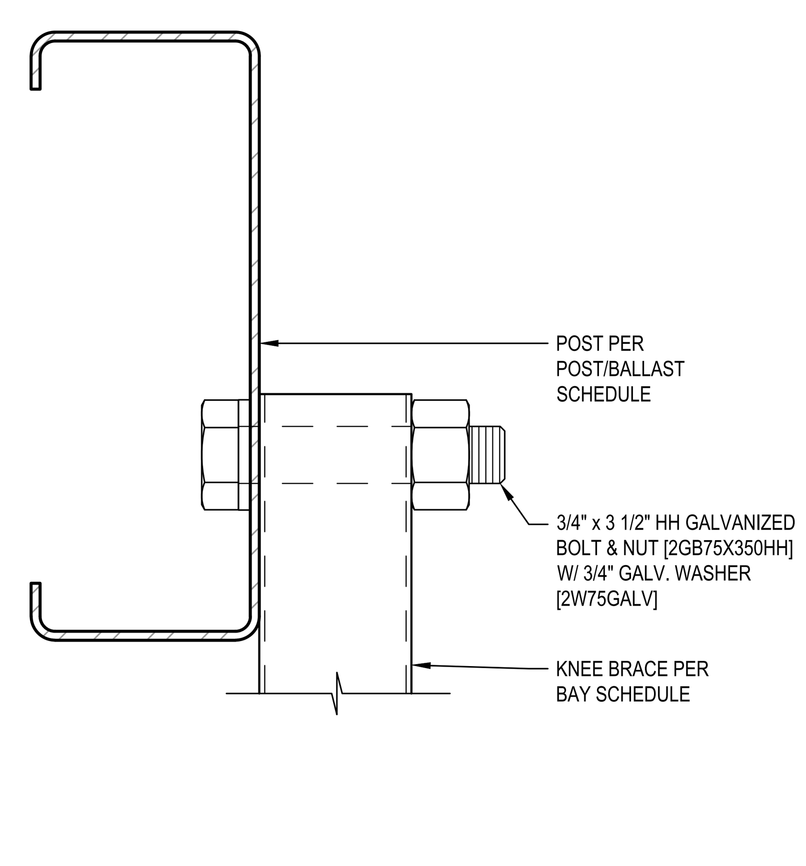


NOTE: X-BRACING IS LOCATED ON THE DOWN SLOPE SIDE OF THE POSTS.

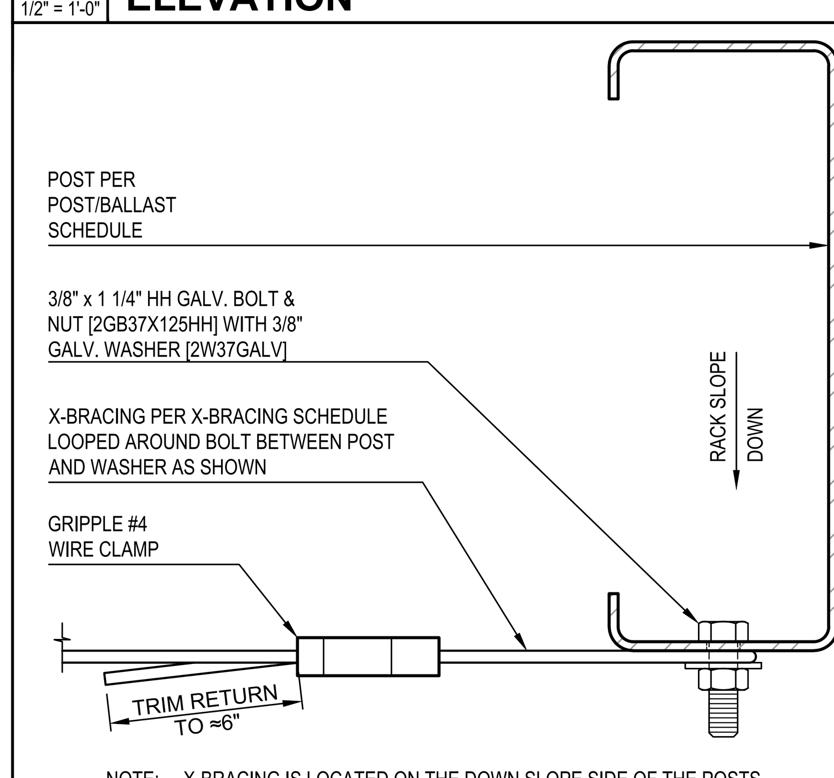
C7 SCALE: 1/2" = 1'-0"
X-BRACING ELEVATION



A2 SCALE: 6" = 1'-0"
LOWER KNEE BRACE TO TOP CHORD CONNECTION DETAIL

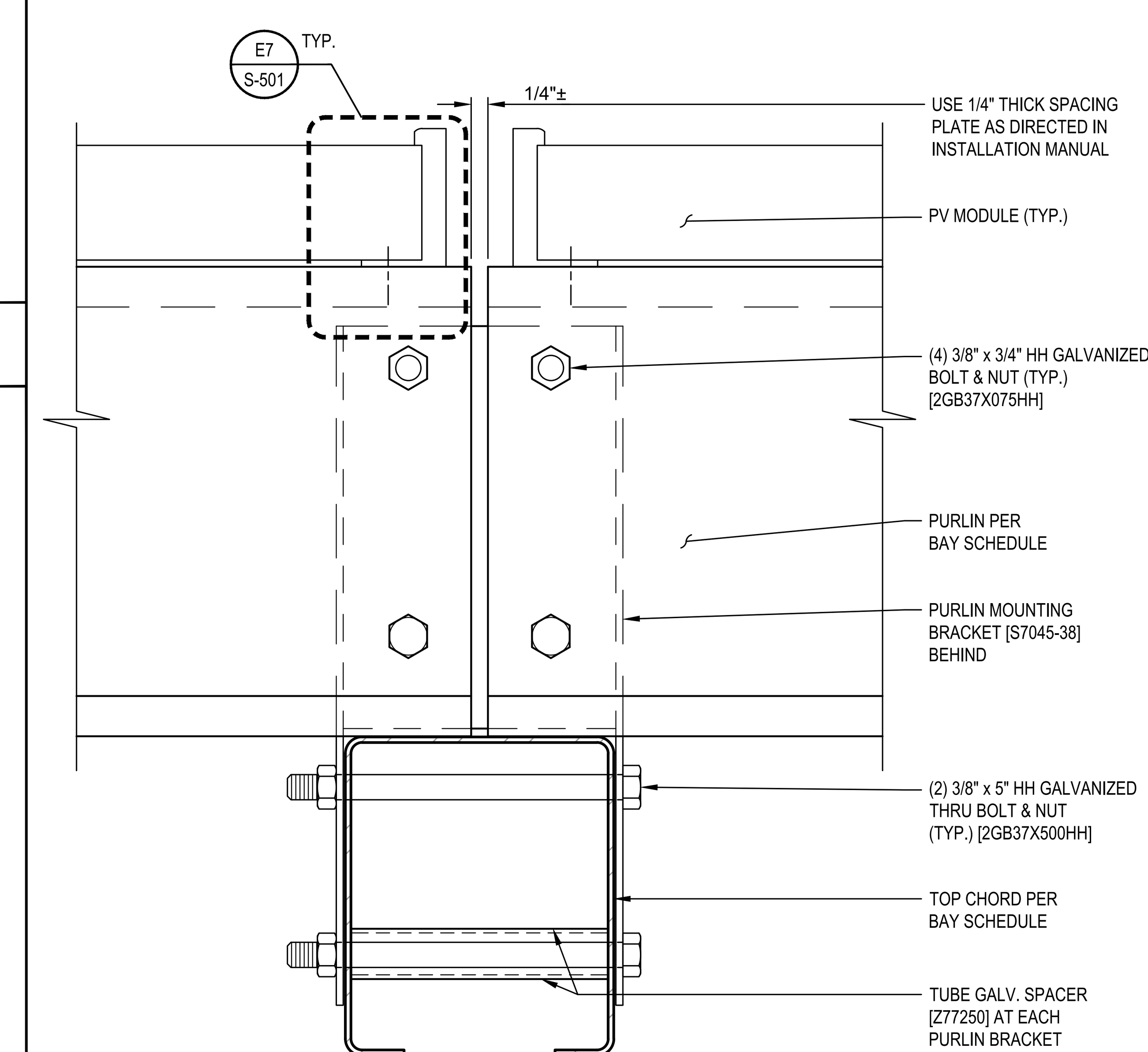


A5 SCALE: 6" = 1'-0"
KNEE BRACE TO POST CONNECTION DETAIL



NOTE: X-BRACING IS LOCATED ON THE DOWN SLOPE SIDE OF THE POSTS

A7 SCALE: 6" = 1'-0"
X-BRACE TO POST CONNECTION DETAIL



A9 SCALE: 6" = 1'-0"
LONGITUDINAL PURLIN CONNECTION DETAIL

RBI SOLAR
Total Solar Service: Design * Fabrication Installation * Parts * Repair Service
5513 VINE STREET
CINCINNATI, OH 45217
513.242.2051
FAX: 513.242.0816

PROFESSIONAL SEAL

ENGINEER'S SEAL APPLIES TO DESIGN OF STRUCTURAL COMPONENTS ONLY

NOT FOR CONSTRUCTION

RBI SOLAR IS NOT RESPONSIBLE FOR CONSTRUCTION THAT IS BUILT FROM SET LABELED "NOT FOR CONSTRUCTION"

GROUND MOUNT FOR GEORGIA POWER

RELEASE RECORD

MARK	DATE	DESCRIPTION
03	08/06/18	90% REVIEW
02	07/31/18	75% REVIEW
01	07/24/18	50% REVIEW

PROJECT INFORMATION

TITLE & ADDRESS:
PLANT HAMMOND

5963 ALABAMA HWY, SW
ROME, GA 30165

RBI SOLAR PROJECT No.: 1835017

DRAWN BY:	REVIEWED BY:
CTN	KEJ/BDS

SHEET TITLE: DETAILS

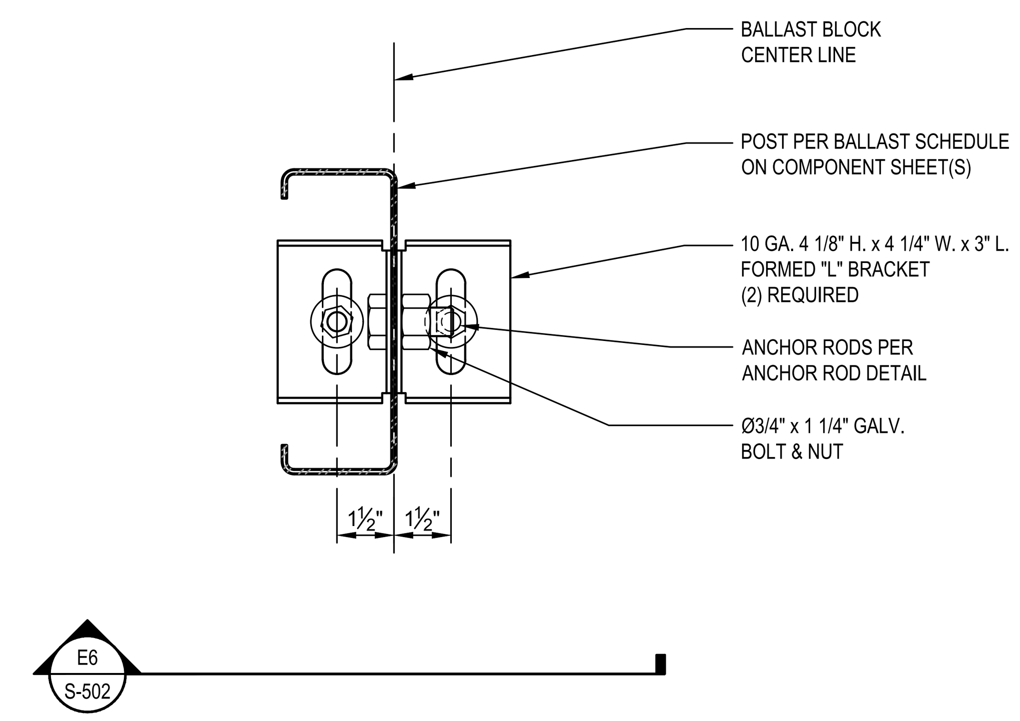
SHEET No.: **S-501**

USER: CNORTON PLOTTED: 8/6/2018 - 2:56 PM S:\RBI Solar\Design\2018 Jobs\1835017 - Southern Company-Plant Hammond\Drawings\1835017 - R0.dwg LAYOUT: S-501

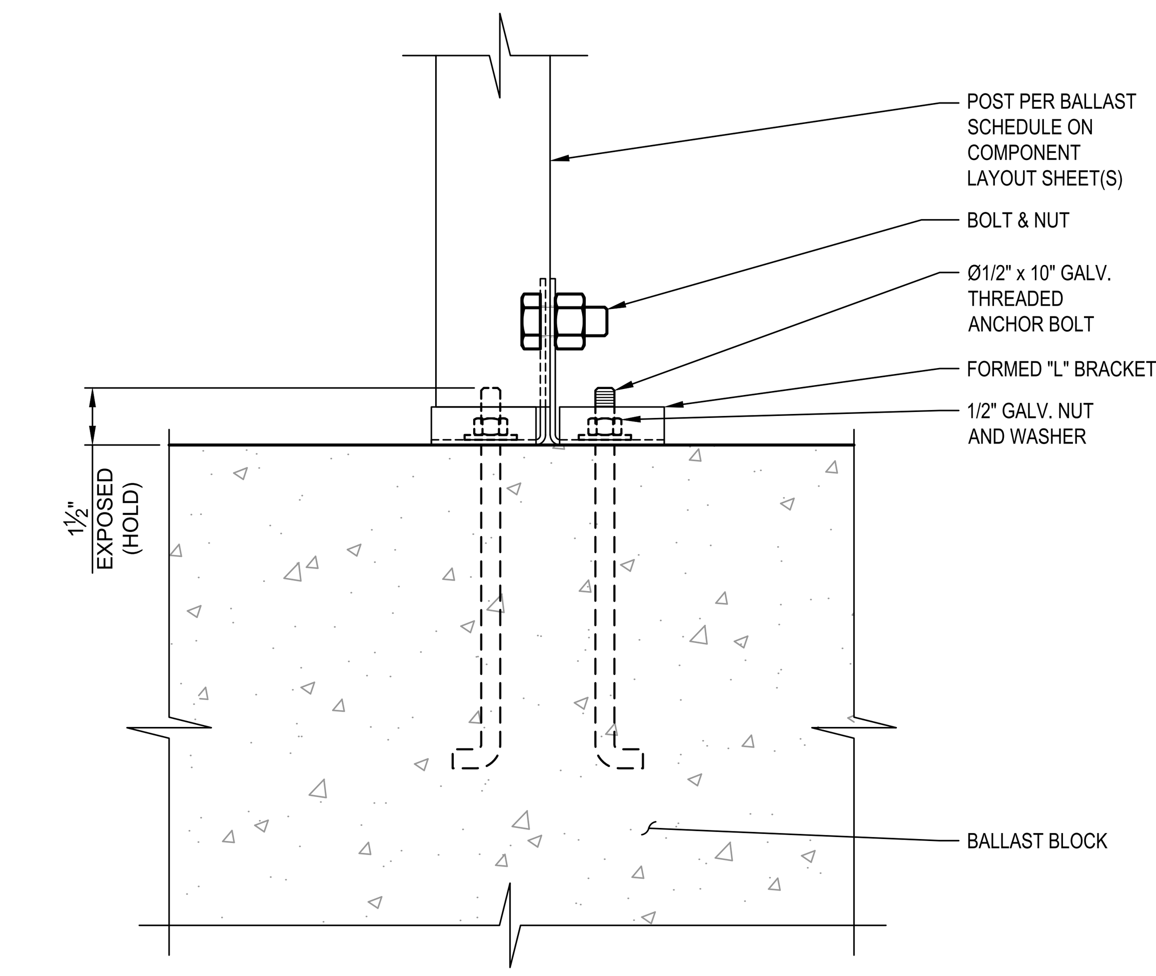
BALLAST CONSTRUCTION SCHEDULE						
TYPE	QUANTITY	LENGTH	WIDTH	HEIGHT	POST SPACING	WEIGHT (≈ LBS.)
A	42	9'-6"	4'-0"	1'-0"	7'-6 1/2"	5700
B	205	9'-6"	3'-9"	1'-0"	7'-6 1/2"	5344
C	828	9'-6"	3'-0"	1'-0"	7'-6 1/2"	4275

BALLAST INSTALLATION SCHEDULE	
PERCENT SLOPE	ADDITIONAL GRAVEL FOR SETTING BALLAST
SLOPE <= 5%	NONE REQUIRED
5% < SLOPE <= 10%	AS REQUIRED TO LEVEL UNDULATING SLOPES
SLOPE > 10%	LEVELING PAD REQUIRED

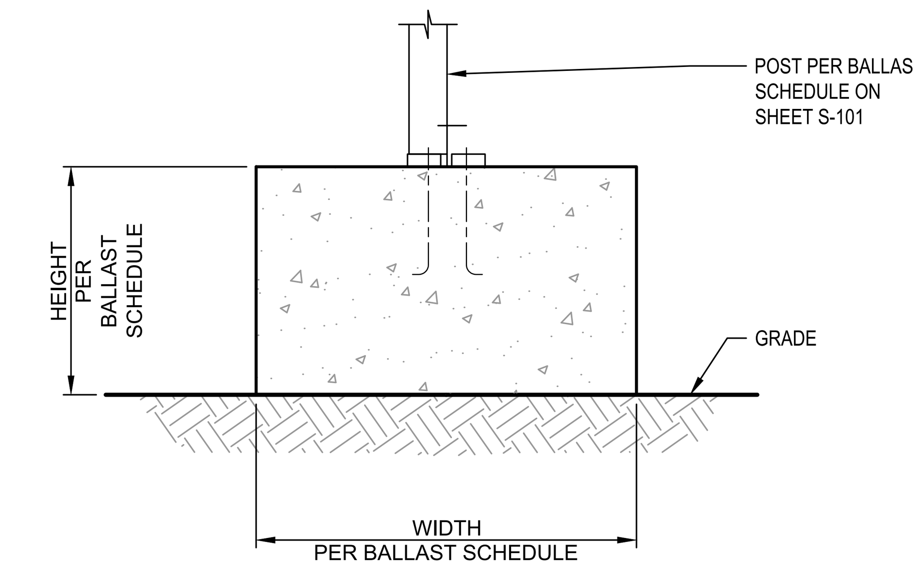
NOTE:
GRAVEL PAD AS NEEDED WHERE BALLAST LEVELING IS REQUIRED DUE TO SLOPE OF GRADE - SEE SECTION C6/S-502. APPROVED COMPACTION METHODS INCLUDE 1 TO 2 PASSES WITH THE BACK OF AN EXCAVATOR BUCKET, A VIBRATING COMPACTOR PLATE, OR A WHACKER PLATE COMPACTOR



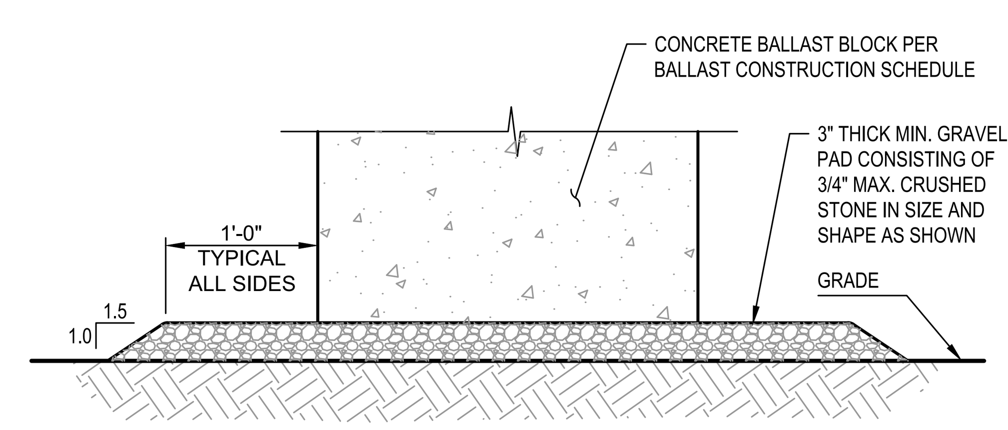
G9 SCALE: 3" = 1'-0"
BALLAST BLOCK BASE PLATE DETAIL



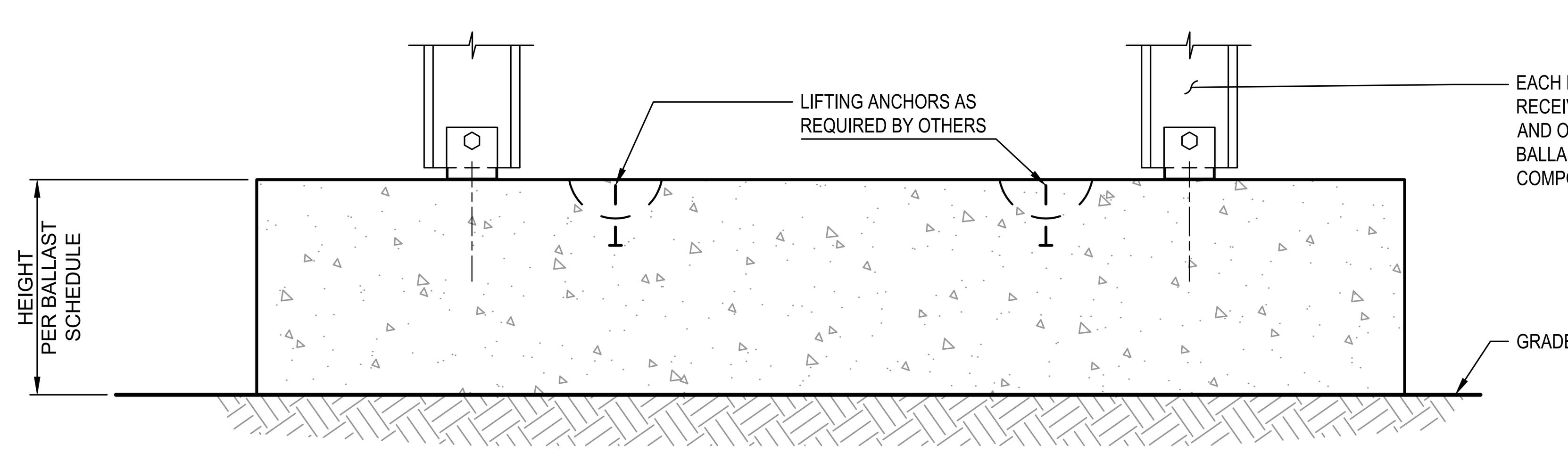
E6 SCALE: 3" = 1'-0"
BALLAST BLOCK ANCHOR ROD DETAIL



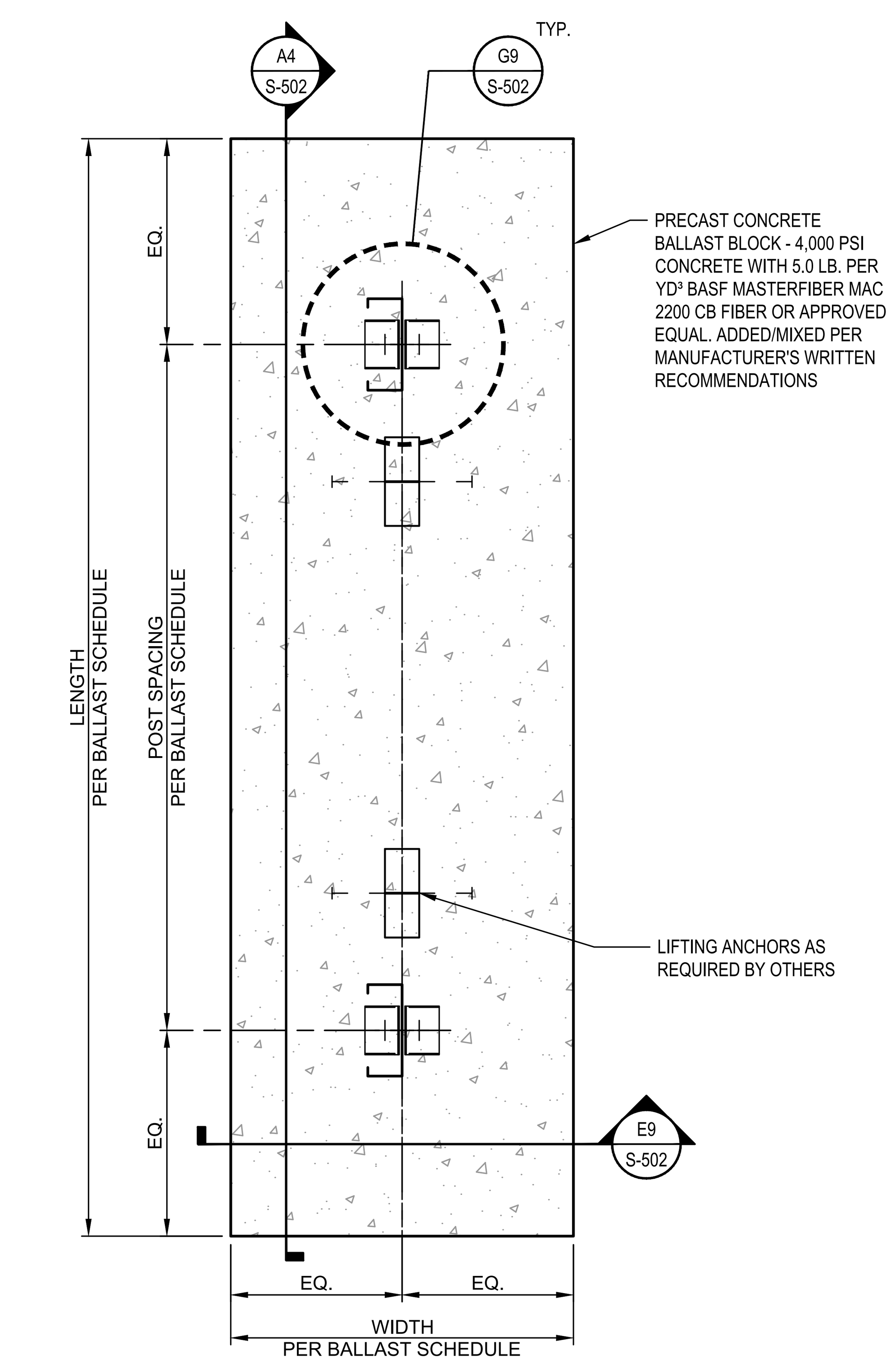
E9 SCALE: 1" = 1'-0"
BALLAST BLOCK SECTION



C6 SCALE: 1" = 1'-0"
BALLAST GRAVEL PAD SECTION



A4 SCALE: 1" = 1'-0"
BALLAST BLOCK SECTION



A9 SCALE: 1" = 1'-0"
BALLAST BLOCK PLAN

RBI SOLAR
Total Solar Service: Design * Fabrication Installation * Parts * Repair Service
5513 VINE STREET
CINCINNATI, OH 45217
513.242.2051
FAX: 513.242.0816

PROFESSIONAL SEAL

ENGINEER'S SEAL APPLIES TO DESIGN OF STRUCTURAL COMPONENTS ONLY

NOT FOR CONSTRUCTION

RBI SOLAR IS NOT RESPONSIBLE FOR CONSTRUCTION THAT IS BUILT FROM SET LABELED "NOT FOR CONSTRUCTION"

GROUND MOUNT FOR GEORGIA POWER

RELEASE RECORD

MARK	DATE	DESCRIPTION
03	08/06/18	90% REVIEW
02	07/31/18	75% REVIEW
01	07/24/18	50% REVIEW

PROJECT INFORMATION

TITLE & ADDRESS:
PLANT HAMMOND

5963 ALABAMA HWY, SW
ROME, GA 30165

RBI SOLAR PROJECT No.: 1835017

DRAWN BY: CTN | REVIEWED BY: KEJ/BDS

SHEET TITLE:
BALLAST BLOCK DETAILS AND SCHEDULE

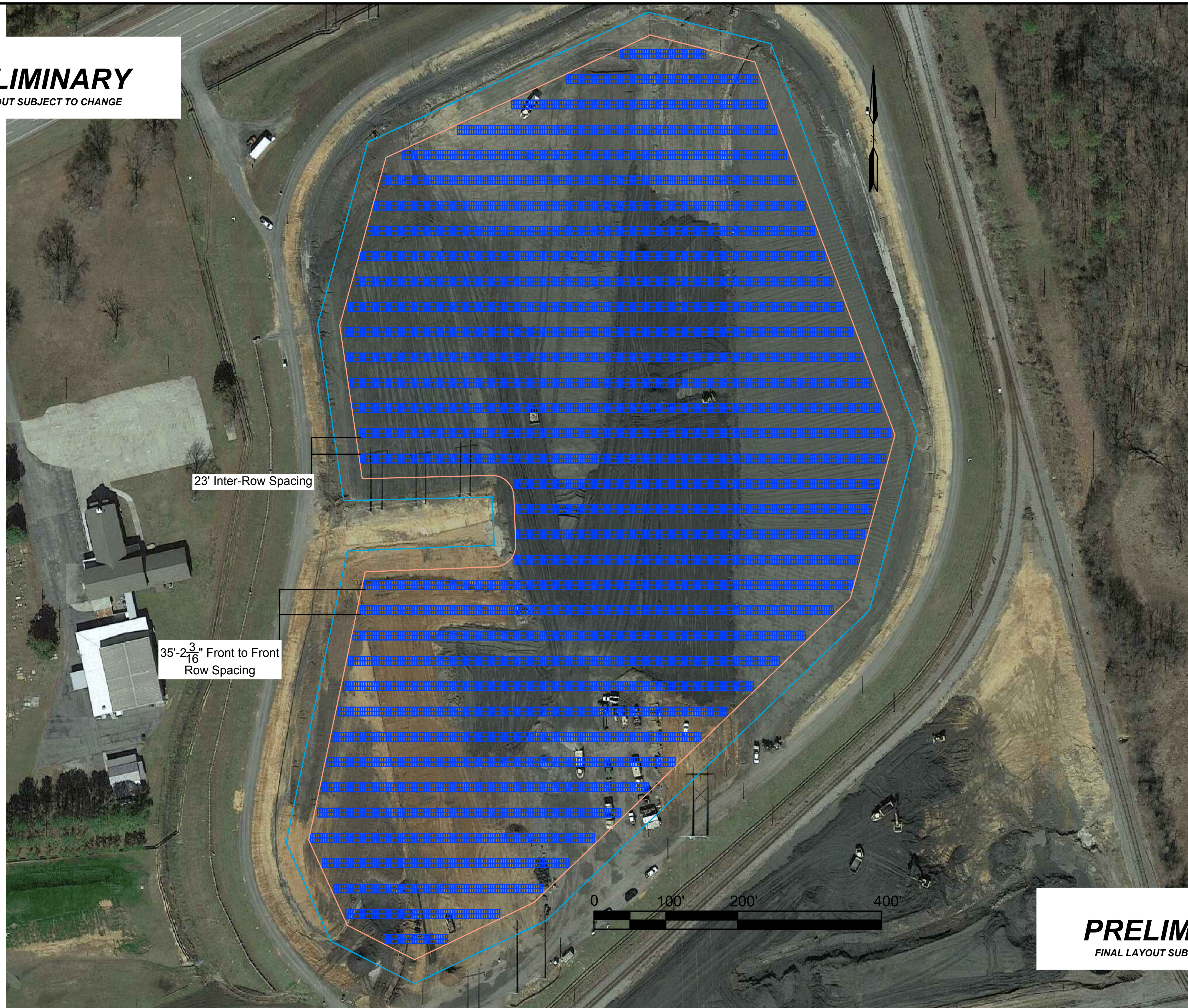
SHEET No.: **S-502**

USER: CNORTON PLOTTED: 8/6/2018 - 2:56 PM S:\RBI Solar\Design\2018 Jobs\1835017 - Southern Company-Plant Hammond\Drawings\1835017 - R0.dwg LAYOUT: S-502

ATTACHMENT B

GAMECHANGE SOLAR RACKING SYSTEM

PRELIMINARY
FINAL LAYOUT SUBJECT TO CHANGE



PRELIMINARY
FINAL LAYOUT SUBJECT TO CHANGE

AERIAL VIEW

GAMECHANGE SOLAR
REPOWERING THE PLANET

152 West 57th St, Fl 17, New York, NY 10019
Tel:212-388-5160
www.gamechangesolar.com

Engineer's Seal:

Site Key Plan:

Rev:	By:	Date:	Description:
1	**GF**	**03-07-2018**	**Original Layout**

Array Information

	PV Modules	Racking
Manufacturer	REC	Gamechange Solar
Model	REC320PE72	20-Degree Pour-In-Place
Dimensions	77.5" x 39.06" x 1.77"	
Weight	59.5 lbs	
Quantity	11368	
Ground Clearance	24 in	

11368 modules at 320W

3.638 MW

Customer: **Southern Company**

Project: **Hammond Ash Pond**

Project #: **----**

Location: **Rome, Georgia 30165**

GENERAL NOTES

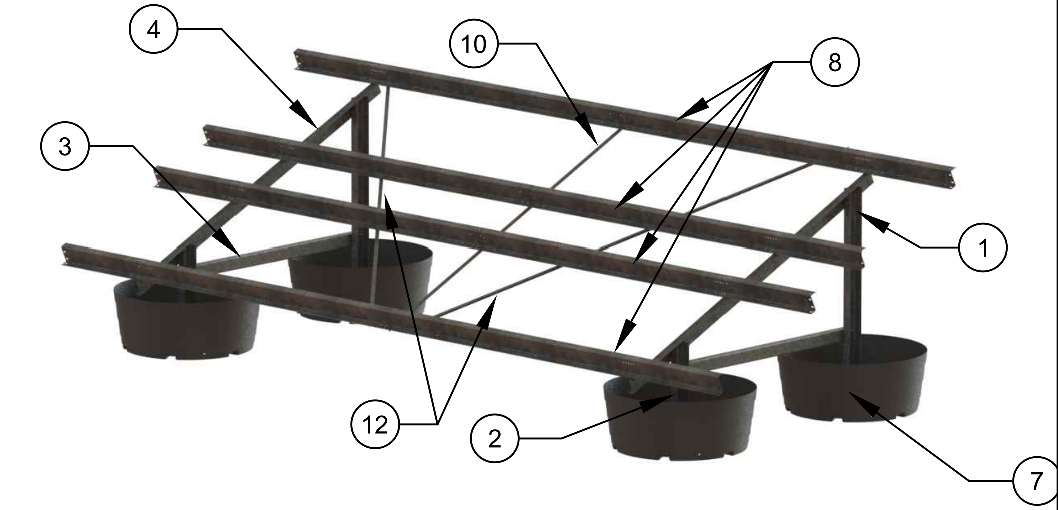
- The layout shown herein is based on site layout geometry provided to GameChange Solar by the customer.
- Any changes to the site that may affect the solar PV arrays depicted herein shall be notified to GameChange Solar.
- The layouts and details shown herein are a custom design for this project and are specific to the PV module(s) shown in the Array Information table.
- GameChange Solar cannot be responsible for errors during installation caused by changes that impact the layout as shown
- Install foundations at specified distances along slope line, Not by plane view. See Detail Sheets for additional info

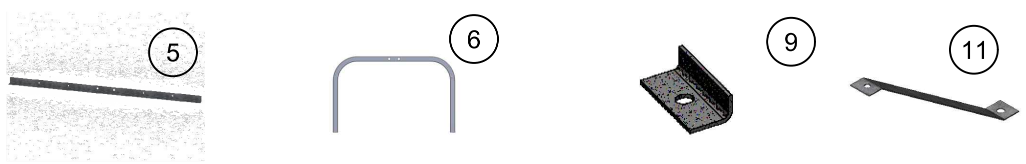
Design Information

Building Occupancy Category	I	Area of Array	18.2 acres	Dead Load	TBD
Wind Exposure Category	C	No. of rows	36	Seismic Site Class	D
Design Wind Speed	105 mph ASCE7-10	Distance to Saltwater	>20 miles	S_S	0.309 g
Design Snow Load	5 psf	Years Since Landfill Capped	TBD	S_1	0.110 g

SITE PLAN

Sheet #: 1 of 5





PARTS LIST

Item No.	Description	Part No.	Material
1	North Post	GC361WP-N	Galvanized Steel G90
2	South Post	GC361WP-S	Galvanized Steel G90
3	Horizontal Channel	GC361WP-H	Galvanized Steel G90
4	NS Beam	GC862MT	Galvanized Steel G90
5	Horizontal Angle	GC275	Galvanized Steel G90
6	Base Bracket	GC999T	Galvanized Steel G90
7	Round Tub	GC281	HMWPE
8	EW Purlin	GC63 / GC63N	Galvanized Steel G90
9	Purlin Washer	GC126	Galvanized Steel G90
10	Bend Strap	GC871	Galvanized Steel G90
11	Roll Strap	GC873	Galvanized Steel G90
12	Purlin Angle	GC874	Galvanized Steel G90
13a	3/8-16 x 1" Hex Bolt		Magnicoat
13b	3/8-16 x 1½" Hex Bolt		Magnicoat
13c	3/8 ID x 1" OD Washer		HDG or Magnicoat
13d	3/8 ID x 1½" OD Washer		HDG or Magnicoat
13e	3/8-16 Serrated Flange Nut		Magnicoat
14a	1/4-20 Hex Bolt		Stainless Steel or Magnicoat
14b	1/4 Washer		HDG or Magnicoat
14c	1/4-20 Hex Nut		Stainless Steel or Magnicoat
15	Star Washer		Stainless Steel

TOP TIPS:

1. **Use vertical adjustability provided to make Mounting Purlins level, and the site install look great.**
2. **If pouring concrete in areas with freezing winters, make sure to use freeze thaw additives and frost blankets if possible. If accelerators are used, they shall NOT contain calcium chloride.**

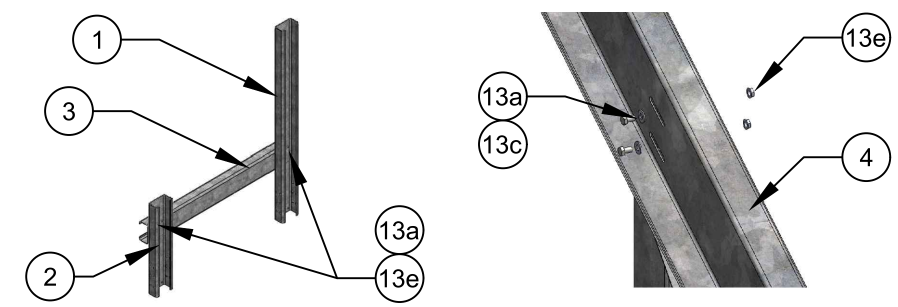
1) Make sure ground is free from debris.

2) Existing soil must have a minimum soil bearing capacity of at least 1,000 pounds per square foot. Installation of the System on very loose soil which will have substantial movement over time could result in structural damage to the racks if this movement is not countered by adjusting racking to compensate. This could lead to voiding the warranty. See Installation Manual for recommended remediation options for loose soils.

3) If ground slopes from east to west or from north to south so that amount of concrete in tub will not meet the requirement specified in install manual, then place crushed stone or gravel to level the area directly under where Tub will be placed as well as 6 inches outside of this footprint. If the AHJ or DEP has determined that materials coming onto the site must be controlled, it is recommended that crushed stone or gravel fill for local leveling under the tubs be approved prior to the start of construction.

4) Attach Horizontal Channel to North and South Posts using two 3/8"-16 x 1" bolts and 3/8 flange nuts per connection. Make sure Horizontal Channel is perpendicular to posts. Torque to Spec.

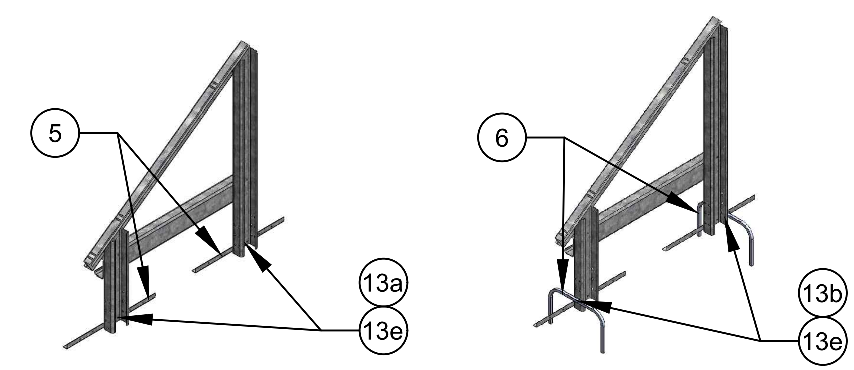
5) Attach NS Beam to posts midway on slots both vertically and horizontally using 3/8-16 x1" hex bolt with 3/8 x 1" OD washers on NS Beam side and 3/8 flange nuts on Post side. Make sure NS Beam is at propper tilt angle. Torque to Spec



6) Attach Horizontal Angle using two 3/8-16 x 1" hex bolt and flange nuts per connection. Toque to spec.

7) Install Base Brackets to the middle set of holes approximately 4 inches up from bottom of North Post and South Post using 3/8"-16 x 1-1/2" long hex bolts and serrated flange nuts. Leave hardware finger tight.

As an alternative, the Base Brackets may be installed after the purlin support assemblies are positioned within the tubs.



8) Find the edges of the array according to project the layout sheets. Drop a string line on the southern edge of the row to be installed. The string line should align with the south edge of the south tubs in the row. Place Round Tubs per spacing shown in layout sheets with the south end of the south Round Tub touching the string for North-South alignment.

GAMECHANGE SOLAR
REPOWERING THE PLANET

152 West 57th St, Fl 17, New York, NY 10019
Tel:212-388-5160
www.gamechangesolar.com

Engineer's Seal:

Site Key Plan:

Rev:	By:	Date:	Description:
1	GF	03-07-2018	Original Layout

Array Information

	PV Modules	Racking
Manufacturer	REC	Gamechange Solar
Model	REC320PE72	20-Degree Pour-In-Place
Dimensions	77.5" x 39.06" x 1.77"	
Weight	59.5 lbs	
Quantity	11368	
Ground Clearance	24 in	

11368 modules at 320W

3.638 MW

GC Pour-in-Place (Steel) System

- Use only GameChange parts. Use of other parts to complete the installation as substitutes may void the warranty.
- Make sure the ground structure (notably in the case of a capped landfill) is inspected and can support the loading resulting from the GC Pour-n-Place Ground System and provided PV modules.
- Comply with all relevant local, state and national safety laws and standards for both for mechanical and electrical aspects of the solar PV array installation.
- When encountering undocumented or unexpected obstacles requiring a work around, work arounds should be brought to the attention of GameChange personnel prior to being attempted. If approved by GameChange, work arounds shall be noted on project as-built drawings. Work arounds should be completed in a manner that ensures that the remainder of the array is not affected.
- Customers are responsible for grade variations.and making sure slope tolerances support GameChange System. GC Pour-in-Place Ground System ideally should be installed on flat, level and pre-compacted ground. This is to avoid system settlement over time. Topsoil with loam content and organics should be removed, and soil scraped down to subsoil level. If the system is installed on new fill, the soil should be compacted with a compacting roller prior to installation. However, due to vertical adjustability of the NS Beams on the Posts, the GC Pour-in-Place System may be erected on less than ideally prepared grounds when site conditions preclude removal of topsoil. In that scenario, the rails should be adjusted to appropriate heights on Posts during periods of operation and maintenance visits.
- Reference Install Manual for installation. Not following Install Manual may result in voiding warranty.
- Ballast forms (tubs) are provided for each site by GameChange. See installation manual for concrete specifications.

It is a requirement for installation crews including EPC, installer, foundation installation vendor and surveyor to be trained by GameChange personnel (complete page turn review of install manual and construction drawing, building the golden row, as well as walking the site prior to foundation surveying) in person or at a minimum via video conference.

Tool Required

- String line
- 48 inch long level
- 30 foot tape measure
- Inclinometer with digital degree read out
- Impact Drill with interchangeable drivers
- 1/4" Drill Bit
- Wrenches and driver sockets, both standard and deep, in the following sizes:
  - 7/16 inch (for 1/4-inch hex bolts and nuts),
  - 9/16 inch (for 3/8-inch hex bolts and nuts),
- Torque Wrench. Torque bolt to appropriate torque range
  - 1/4" Stainless hardware use 6-7 ft-lbs (72-84 in-lbs)
  - 1/4" Magni hardware use 9-10 ft-lbs (108-120 in-lbs)
  - 3/8" hardware use 29-31 ft-lbs
- Concrete mixture (weather and freeze-thaw resistant if required). See Pour-in-Place Installation Manual for concrete specifications
- Rack assembly jig made of plywood and 2"x4" wood.

Preventative Maintenance

- It is best practice to unbundle loads and install parts within several weeks of delivery so air is able to flow around parts and thus prevent white rust formation. In order to maintain the longest life possible for the protective zinc coating under the warranty, it is important to monitor for any severe white rust developments prior to installation and if this condition appears to take proper maintenance steps to remediate it. See the Pour-in-Place Installation Manual for more information.
- After Installation, installer must annually monitor for any surface rust that may occur over time. Identify any rust areas, wire brush area to remove rust, and coat with 80% zinc rich paint, or equivalent field life paint. This step is not required if rust is limited to edges which were cut during fabrication.
- Maintenance checks should be performed annually or after severe wind events. Please refer to Install Manual for more details.
- Proper preventative maintenance must be conducted or warranty may be voided. The Install Manual provides required maintenance steps and diagnostic procedure for malfunctions. Follow steps and consult with GameChange in case of maintenance issues.

CRITICAL INFORMATION INDICATOR

This icon indicates critical and important information that MUST be followed for proper installation. Disregarding it may lead to serious injury and/or irreparable damage to equipment, tools, or componenets; it will compromise GameChange warranty. Information indicated with this icon must be followed to meet quality requirements.

Customer: **Southern Company**

Project: **Hammond Ash Pond**

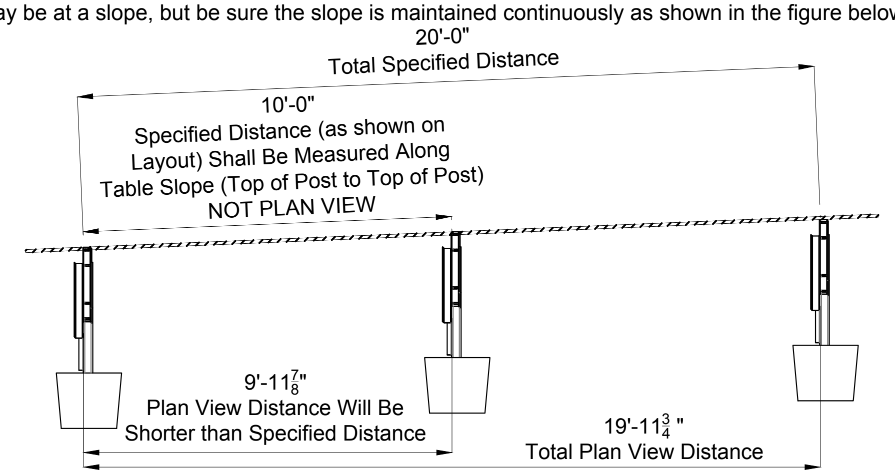
Project #: ----

Location: **Rome, Georgia 30165**

Pour-In-Place™ Ballasted Ground

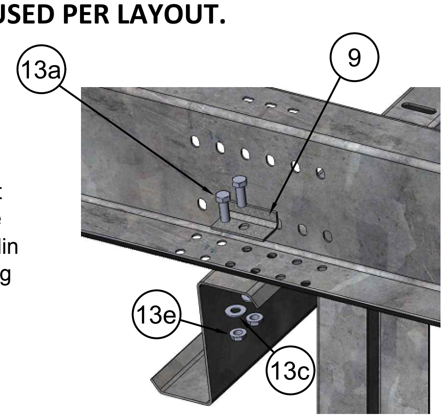
Sheet #: 2 of 5

10) When placing Purlin Support Assemblies at specific distances away from each other to match the positions on the layout, it is important that the tops of the assemblies are in a straight line. The line may be at a slope, but be sure the slope is maintained continuously as shown in the figure below.



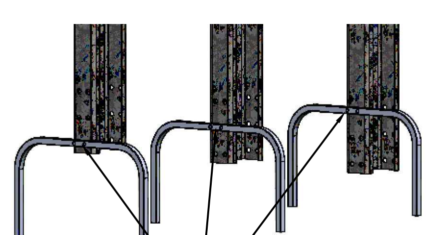
PURLIN SUPPORT ASSEMBLIES MUST BE AT SPECIFIED DISTANCE ALONG THE SLOPE LINE, NOT BY PLAN VIEW, OTHERWISE PURLINS MAY NOT FIT. DIMENSIONS SHOWN ABOVE ARE EXAMPLE DIMENSIONS TO ILLUSTRATE DIFFERENCE BETWEEN SPECIFIED DISTANCE AND PLAN VIEW DISTANCE. PROJECT SPECIFIC DIMENSIONS SHALL BE USED PER LAYOUT.

11) Attach first table EW Purlins at southernmost position on the NS Beams using center set of holes for Table Purlin to NS Beam attachment. Attach EW Purlins to NS Beams using two 3/8" bolts. Under the bolt closest to the NS Purlin wall, place a Purlin Washer under the bolt head with the bent flange bearing against the Purlin wall. Both bolts will be attached on the underside using a 1" OD washer and a flange nut. Finger tight on hardware. Once Panels are mounted torque all hardware to specifications.



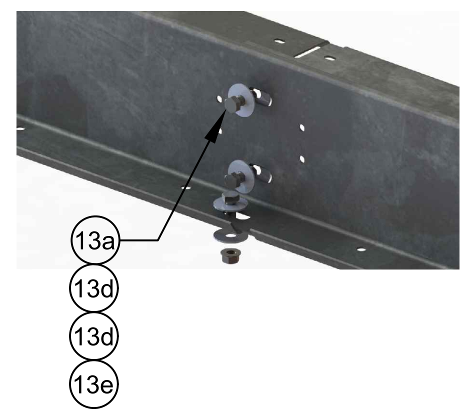
12) Repeat Purlin Support Assembly and installation for adjacent Round Tubs. Position Purlin Support Assembly and Round Tubs to the appropriate distance apart as required by layout

13) For leveling, after EW Purlins have been installed, choose 1 of 3 sets of holes on the posts to attach the Base Brackets to in order to set the height of the system at each post location to even out ups and downs in the system caused by uneven ground conditions. Once preferable height has been obtained, tighten hardware to spec.



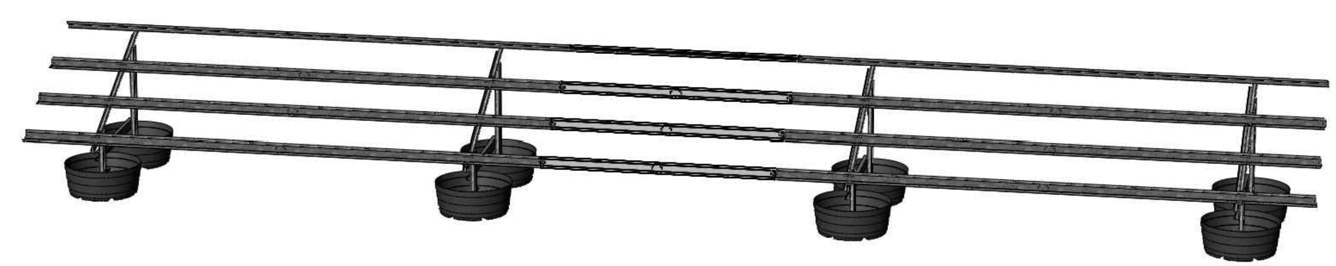
Use different sets of holes to level posts

14) For continuous configurations, Connector Purlin are connected to Table Purlins using three sets of 3/8" flange bolt, washers (1-1/2" OD), and serrated flange nuts at each end of the Purlins. Torque to specifications. **It is important that the correct washers are used.**



PARTS LIST			
Item No.	Description	Part No.	Material
1	North Post	GC361WP-N	Galvanized Steel G90
2	South Post	GC361WP-S	Galvanized Steel G90
3	Horizontal Channel	GC361WP-H	Galvanized Steel G90
4	NS Beam	GC862MT	Galvanized Steel G90
5	Horizontal Angle	GC275	Galvanized Steel G90
6	Base Bracket	GC999T	Galvanized Steel G90
7	Round Tub	GC281	HMWPE
8	EW Purlin	GC63 / GC63N	Galvanized Steel G90
9	Purlin Washer	GC126	Galvanized Steel G90
10	Bend Strap	GC871	Galvanized Steel G90
11	Roll Strap	GC873	Galvanized Steel G90
12	Purlin Angle	GC874	Galvanized Steel G90
13a	3/8-16 x 1" Hex Bolt		Magnicoat
13b	3/8-16 x $1\frac{1}{2}$" Hex Bolt		Magnicoat
13c	3/8 ID x 1" OD Washer		HDG or Magnicoat
13d	3/8 ID x $1\frac{1}{2}$" OD Washer		HDG or Magnicoat
13e	3/8-16 Serrated Flange Nut		Magnicoat
14a	1/4-20 Hex Bolt		Stainless Steel or Magnicoat
14b	1/4 Washer		HDG or Magnicoat
14c	1/4-20 Hex Nut		Stainless Steel or Magnicoat
15	Star Washer		Stainless Steel

15) Attach the alternating table EW Purlins and connector EW Purlins starting at one end of the row and continue to the other end of the row.



GAMECHANGE SOLAR
REPOWERING THE PLANET

152 West 57th St, Fl 17, New York, NY 10019
Tel:212-388-5160
www.gamechangesolar.com

Engineer's Seal:

Site Key Plan:

Rev:	By:	Date:	Description:
1	GF	03-07-2018	Original Layout

Array Information

	PV Modules	Racking
Manufacturer	REC	Gamechange Solar
Model	REC320PE72	20-Degree Pour-In-Place
Dimensions	77.5" x 39.06" x 1.77"	
Weight	59.5 lbs	
Quantity	11368	
Ground Clearance	24 in	

11368 modules at 320W

3.638 MW

GC Pour-in-Place (Steel) System

- Use only GameChange parts. Use of other parts to complete the installation as substitutes may void the warranty.
- Make sure the ground structure (notably in the case of a capped landfill) is inspected and can support the loading resulting from the GC Pour-n-Place Ground System and provided PV modules.
- Comply with all relevant local, state and national safety laws and standards for both for mechanical and electrical aspects of the solar PV array installation.
- When encountering undocumented or unexpected obstacles requiring a work around, work arounds should be brought to the attention of GameChange personnel prior to being attempted. If approved by GameChange, work arounds shall be noted on project as-built drawings. Work arounds should be completed in a manner that ensures that the remainder of the array is not affected.
- Customers are responsible for grade variations.and making sure slope tolerances support GameChange System. GC Pour-in-Place Ground System ideally should be installed on flat, level and pre-compacted ground. This is to avoid system settlement over time. Topsoil with loam content and organics should be removed, and soil scraped down to subsoil level. If the system is installed on new fill, the soil should be compacted with a compacting roller prior to installation. However, due to vertical adjustability of the NS Beams on the Posts, the GC Pour-in-Place System may be erected on less than ideally prepared grounds when site conditions preclude removal of topsoil. In that scenario, the rails should be adjusted to appropriate heights on Posts during periods of operation and maintenance visits.
- Reference Install Manual for installation. Not following Install Manual may result in voiding warranty.
- Ballast forms (tubs) are provided for each site by GameChange. See installation manual for concrete specifications.

It is a requirement for installation crews including EPC, installer, foundation installation vendor and surveyor to be trained by GameChange personnel (complete page turn review of install manual and construction drawing, building the golden row, as well as walking the site prior to foundation surveying) in person or at a minimum via video conference.

Tool Required

- String line
- 48 inch long level
- 30 foot tape measure
- Inclinometer with digital degree read out
- Impact Drill with interchangeable drivers
- 1/4" Drill Bit
- Wrenches and driver sockets, both standard and deep, in the following sizes:
  - o 7/16 inch (for 1/4-inch hex bolts and nuts),
  - o 9/16 inch (for 3/8-inch hex bolts and nuts),
- Torque Wrench. Torque bolt to appropriate torque range
  - o 1/4" Stainless hardware use 6-7 ft-lbs (72-84 in-lbs)
  - o 1/4" Magni hardware use 9-10 ft-lbs (108-120 in-lbs)
  - o 3/8" hardware use 29-31 ft-lbs
- Concrete mixture (weather and freeze-thaw resistant if required). See Pour-in-Place Installation Manual for concrete specifications
- Rack assembly jig made of plywood and 2"x4" wood.

Preventative Maintenance

- It is best practice to unbundle loads and install parts within several weeks of delivery so air is able to flow around parts and thus prevent white rust formation. In order to maintain the longest life possible for the protective zinc coating under the warranty, it is important to monitor for any severe white rust developments prior to installation and if this condition appears to take proper maintenance steps to remediate it. See the Pour-in-Place Installation Manual for more information.
- After Installation, installer must annually monitor for any surface rust that may occur over time. Identify any rust areas, wire brush area to remove rust, and coat with 80% zinc rich paint, or equivalent field life paint. This step is not required if rust is limited to edges which were cut during fabrication.
- Maintenance checks should be performed annually or after severe wind events. Please refer to Install Manual for more details.
- Proper preventative maintenance must be conducted or warranty may be voided. The Install Manual provides required maintenance steps and diagnostic procedure for malfunctions. Follow steps and consult with GameChange in case of maintenance issues.

CRITICAL INFORMATION INDICATOR

This icon indicates critical and important information that MUST be followed for proper installation. Disregarding it may lead to serious injury and/or irreparable damage to equipment, tools, or componenets; it will compromise GameChange warranty. Information indicated with this icon must be followed to meet quality requirements.

Customer: **Southern Company**

Project: **Hammond Ash Pond**

Project #: ----

Location: **Rome, Georgia 30165**

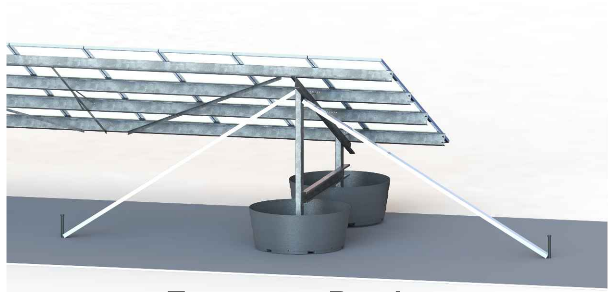
Pour-In-Place™ Ballasted Ground

Sheet #:

16) **Required Temporary Staking and Ballasting as Precautionary Safety Measure**

At the end of each row, install temporary manual bracing to keep the posts plumb and also to allow for a sturdy foundation. Temporary manual bracing shall consist of 2x4's jammed between the nooks of the Purlin Support Assembly and stakes in the ground (or 50+ lb ballast blocks for sites where stakes will not hold or penetration is not allowed).

- Install temporary bracing on the first Purlin Support Assembly of each row.
- Pour concrete into tubs under the first 2 tables (4 pairs of tubs) of each row.
- Add temporary bracing on every 8th Purlin Support Assembly as the row is installed.
- When done with each row, add temporary bracing on the last Purlin Support Assembly.



Temporary Bracing with Stakes

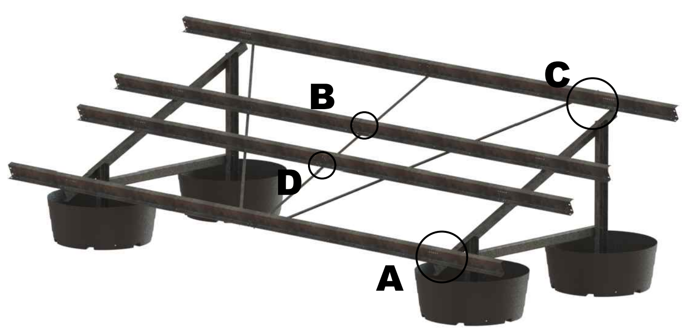
Temporary Bracing with Ballast Blocks

17) Make sure to pour concrete immediately if heavy wind (over 22mph) expected as it may blow assembled Purlins and Purlin Support Assemblies over and may be a safety hazard as well as causing damage or wasting time to set up again. At a minimum, make sure to pour a few Round Tubs (or place heavy rocks to hold the Horizontal Angles and Base Brackets) at the end of each row to prevent heavy wind (over 22 mph) from tipping over unfilled Round Tubs/racking.

18) After installation of Purlins has been completed, run a string along Upper and Lower Purlins from east to west across array, or use visual line of sight method to check for flatness of row. Elevate the Purlin Support Assemblies to level purlins where required by either of the following options:

- Adjusting Base Brackets (connect Base Bracket to Bottom sets of holes to raise Purlin Support Assembly, connect Base Bracket to top sets of holes to lower Purlin Support Assembly)
- Placing handfuls of additional riprap or 1 $\frac{1}{2}$ inch minus stone under tub to raise tub and Purlin Support Assembly.

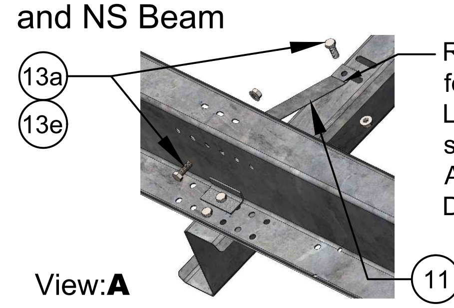
19) Install Bend Strap, Roll Straps, and Purlin Angles using 3/8" bolts and flange nuts. Racks should "square up" when Purlin Angles are installed. Torque to specifications.
It is very important that Roll Straps are taut.



PARTS LIST

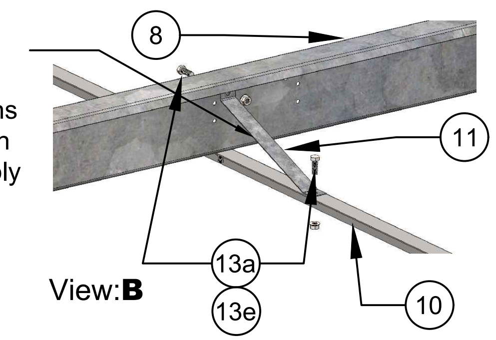
Item No.	Description	Part No.	Material
1	North Post	GC361WP-N	Galvanized Steel G90
2	South Post	GC361WP-S	Galvanized Steel G90
3	Horizontal Channel	GC361WP-H	Galvanized Steel G90
4	NS Beam	GC862MT	Galvanized Steel G90
5	Horizontal Angle	GC275	Galvanized Steel G90
6	Base Bracket	GC999T	Galvanized Steel G90
7	Round Tub	GC281	HMWPE
8	EW Purlin	GC63 / GC63N	Galvanized Steel G90
9	Purlin Washer	GC126	Galvanized Steel G90
10	Bend Strap	GC871	Galvanized Steel G90
11	Roll Strap	GC873	Galvanized Steel G90
12	Purlin Angle	GC874	Galvanized Steel G90
13a	3/8-16 x 1" Hex Bolt		Magnicoat
13b	3/8-16 x 1$\frac{1}{2}$" Hex Bolt		Magnicoat
13c	3/8 ID x 1" OD Washer		HDG or Magnicoat
13d	3/8 ID x 1$\frac{1}{2}$" OD Washer		HDG or Magnicoat
13e	3/8-16 Serrated Flange Nut		Magnicoat
14a	1/4-20 Hex Bolt		Stainless Steel or Magnicoat
14b	1/4 Washer		HDG or Magnicoat
14c	1/4-20 Hex Nut		Stainless Steel or Magnicoat
15	Star Washer		Stainless Steel

Roll Strap to EW Purlin and NS Beam



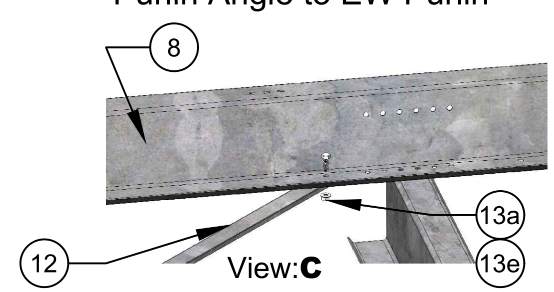
View:**A**

Roll Strap to Bend Strap/EW Purlin



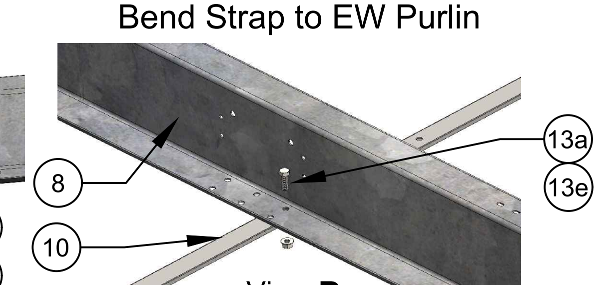
View:**B**

Purlin Angle to EW Purlin



View:**C**

Bend Strap to EW Purlin



View:**D**

GC Pour-in-Place (Steel) System

- Use only GameChange parts. Use of other parts to complete the installation as substitutes may void the warranty.
- Make sure the ground structure (notably in the case of a capped landfill) is inspected and can support the loading resulting from the GC Pour-n-Place Ground System and provided PV modules.
- Comply with all relevant local, state and national safety laws and standards for both for mechanical and electrical aspects of the solar PV array installation.
- When encountering undocumented or unexpected obstacles requiring a work around, work arounds should be brought to the attention of GameChange personnel prior to being attempted. If approved by GameChange, work arounds shall be noted on project as-built drawings. Work arounds should be completed in a manner that ensures that the remainder of the array is not affected.
- Customers are responsible for grade variations.and making sure slope tolerances support GameChange System. GC Pour-in-Place Ground System ideally should be installed on flat, level and pre-compacted ground. This is to avoid system settlement over time. Topsoil with loam content and organics should be removed, and soil scraped down to subsoil level. If the system is installed on new fill, the soil should be compacted with a compacting roller prior to installation. However, due to vertical adjustability of the NS Beams on the Posts, the GC Pour-in-Place System may be erected on less than ideally prepared grounds when site conditions preclude removal of topsoil. In that scenario, the rails should be adjusted to appropriate heights on Posts during periods of operation and maintenance visits.
- Reference Install Manual for installation. Not following Install Manual may result in voiding warranty.
- Ballast forms (tubs) are provided for each site by GameChange. See installation manual for concrete specifications.

It is a requirement for installation crews including EPC, installer, foundation installation vendor and surveyor to be trained by GameChange personnel (complete page turn review of install manual and construction drawing, building the golden row, as well as walking the site prior to foundation surveying) in person or at a minimum via video conference.

Tool Required

- String line
- 48 inch long level
- 30 foot tape measure
- Inclinometer with digital degree read out
- Impact Drill with interchangeable drivers
- 1/4" Drill Bit
- Wrenches and driver sockets, both standard and deep, in the following sizes:
  - 7/16 inch (for 1/4-inch hex bolts and nuts),
  - 9/16 inch (for 3/8-inch hex bolts and nuts),
- Torque Wrench. Torque bolt to appropriate torque range
  - 1/4" Stainless hardware use 6-7 ft-lbs (72-84 in-lbs)
  - 1/4" Magni hardware use 9-10 ft-lbs (108-120 in-lbs)
  - 3/8" hardware use 29-31 ft-lbs
- Concrete mixture (weather and freeze-thaw resistant if required). See Pour-in-Place Installation Manual for concrete specifications
- Rack assembly jig made of plywood and 2"x4" wood.

Preventative Maintenance

- It is best practice to unbundle loads and install parts within several weeks of delivery so air is able to flow around parts and thus prevent white rust formation. In order to maintain the longest life possible for the protective zinc coating under the warranty, it is important to monitor for any severe white rust developments prior to installation and if this condition appears to take proper maintenance steps to remediate it. See the Pour-in-Place Installation Manual for more information.
- After Installation, installer must annually monitor for any surface rust that may occur over time. Identify any rust areas, wire brush area to remove rust, and coat with 80% zinc rich paint, or equivalent field life paint. This step is not required if rust is limited to edges which were cut during fabrication.
- Maintenance checks should be performed annually or after severe wind events. Please refer to Install Manual for more details.
- Proper preventative maintenance must be conducted or warranty may be voided. The Install Manual provides required maintenance steps and diagnostic procedure for malfunctions. Follow steps and consult with GameChange in case of maintenance issues.

CRITICAL INFORMATION INDICATOR

This icon indicates critical and important information that MUST be followed for proper installation. Disregarding it may lead to serious injury and/or irreparable damage to equipment, tools, or componenets; it will compromise GameChange warranty. Information indicated with this icon must be followed to meet quality requirements.

GAMECHANGE SOLAR
REPOWERING THE PLANET
152 West 57th St, Fl 17, New York, NY 10019
Tel:212-388-5160
www.gamechangesolar.com

Engineer's Seal:

Site Key Plan:

Rev:	By:	Date:	Description:
1	GF	03-07-2018	Original Layout

Array Information

	PV Modules	Racking
Manufacturer	REC	Gamechange Solar
Model	REC320PE72	20-Degree Pour-In-Place
Dimensions	77.5" x 39.06" x 1.77"	
Weight	59.5 lbs	
Quantity	11368	
Ground Clearance	24 in	

11368 modules at 320W

3.638 MW

Customer: **Southern Company**

Project: **Hammond Ash Pond**

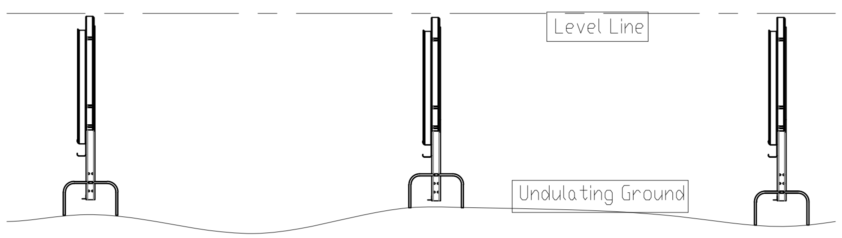
Project #: ----

Location: **Rome, Georgia 30165**

Pour-In-Place™ Ballasted Ground

Sheet #:

20) Vertical adjustability is set prior to pouring concrete. After Purlin installation is complete run a string along Upper and Lower Purlins, in the east west direction. Evaluate Purlin level.



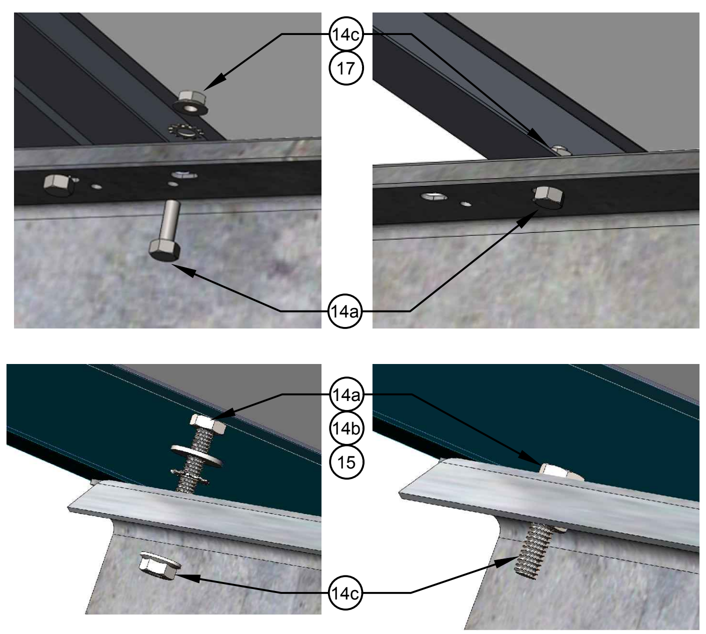
21) Pour Concrete. Concrete should first be poured in the center of the Round Tub, then use shovels to push to the ends. See Installation Manual for concrete specifications and best practices when pouring concrete. Use vibrator per industry standards to ensure concrete does not contain voids. **Do not allow vibrator or anything else touch the sides of the tub.** Use magnesium trowel to trowel wash around Posts so precipitation does not collect.

For best pouring results, it is recommeneded that tub locations be as close to level as practical. Make sure Round Tubs are lelvel with +/- 3% N-S and +/- 3% E-W.

22) Once tubs are filled, true up Posts and Purlins. Check tilt angle of NS Beam. Use vertical and lateral tolerance in Post to NS Beam connections to correct tilt angle as required.

23) Attach first panel to EW Purlin through mounting holes nearest to NS Beam. Place a star washer at one mounting location per panel. Insert hex bolt through the EW Purlin, the mounting hole on the back of the panel, and then through the star washer. Attach with a serrated flange nuts on the bolt end inside the panel. Check again to make sure star washer is still in place. Torque to specifications. Repeat for all panels.

As an alternative, insert hex bolt through a 1/4" washer, the star washer, the mounting hole on the back of the panel, and then through the Purlin. Place a star washer at one mounting location per panel. Attach with a serrated flange nut. The bolt head should be on top and the serrated flange nut should be below the Purlin. Check again to make sure star washer is still in place. Torque to specifications. Repeat for all panels.



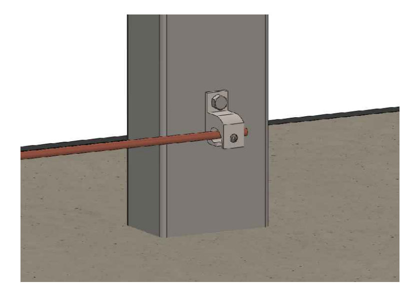
Check the install manual for the module you are installing to make sure that the panel mounting hardware and installation methodology recommended by GameChange mentioned below is acceptable. Otherwise you may risk voiding the warranty for your modules. It is also recommended to check that the panels are listed per UL 1703.

PARTS LIST

Item No.	Description	Part No.	Material
1	North Post	GC361WP-N	Galvanized Steel G90
2	South Post	GC361WP-S	Galvanized Steel G90
3	Horizontal Channel	GC361WP-H	Galvanized Steel G90
4	NS Beam	GC862MT	Galvanized Steel G90
5	Horizontal Angle	GC275	Galvanized Steel G90
6	Base Bracket	GC999T	Galvanized Steel G90
7	Round Tub	GC281	HMWPE
8	EW Purlin	GC63 / GC63N	Galvanized Steel G90
9	Purlin Washer	GC126	Galvanized Steel G90
10	Bend Strap	GC871	Galvanized Steel G90
11	Roll Strap	GC873	Galvanized Steel G90
12	Purlin Angle	GC874	Galvanized Steel G90
13a	3/8-16 x 1" Hex Bolt		Magnicoat
13b	3/8-16 x 1½" Hex Bolt		Magnicoat
13c	3/8 ID x 1" OD Washer		HDG or Magnicoat
13d	3/8 ID x 1½" OD Washer		HDG or Magnicoat
13e	3/8-16 Serrated Flange Nut		Magnicoat
14a	1/4-20 Hex Bolt		Stainless Steel or Magnicoat
14b	1/4 Washer		HDG or Magnicoat
14c	1/4-20 Hex Nut		Stainless Steel or Magnicoat
15	Star Washer		Stainless Steel

24) If weep holes are not present in tub walls, at least three days after concrete is poured, drill half inch (1/2") diameter weep holes on each side of the Tub, centered 2" above the ground level. This enables water to drain out.

25) The modules, EW Purlins and NS Beams are all bonded together, left to right, so that each row form one single structure. To achieve grounding of the system, GameChange recommends installing Cooper, Burndy, or Eaton UL approved grounding lug(s) with 1/4-inch bolts as in accordance with NEC Article 690 to the Post below the last EW Purlin which has panels attached to it which are to be bonded, using 8 gauge copper wire or larger.



The Purlin to Purlin bonded connection is rated for up to 30 amps. Therefore, conductors with expected currents greater than 30 amps may not be installed on the racking system without installing additional grounding measures.

The entire system needs to be grounded from a single point to an appropriate grounding source.

Please confirm with an electrician, as this is their responsibility

GAMECHANGE SOLAR
REPOWERING THE PLANET

152 West 57th St, Fl 17, New York, NY 10019
Tel:212-388-5160
www.gamechangesolar.com

Engineer's Seal:

Site Key Plan:

Rev:	By:	Date:	Description:
1	GF	03-07-2018	Original Layout

Array Information

	PV Modules	Racking
Manufacturer	REC	Gamechange Solar
Model	REC320PE72	20-Degree Pour-In-Place
Dimensions	77.5" x 39.06" x 1.77"	
Weight	59.5 lbs	
Quantity	11368	
Ground Clearance	24 in	

11368 modules at 320W

3.638 MW

GC Pour-in-Place (Steel) System

- Use only GameChange parts. Use of other parts to complete the installation as substitutes may void the warranty.
- Make sure the ground structure (notably in the case of a capped landfill) is inspected and can support the loading resulting from the GC Pour-n-Place Ground System and provided PV modules.
- Comply with all relevant local, state and national safety laws and standards for both for mechanical and electrical aspects of the solar PV array installation.
- When encountering undocumented or unexpected obstacles requiring a work around, work arounds should be brought to the attention of GameChange personnel prior to being attempted. If approved by GameChange, work arounds shall be noted on project as-built drawings. Work arounds should be completed in a manner that ensures that the remainder of the array is not affected.
- Customers are responsible for grade variations.and making sure slope tolerances support GameChange System. GC Pour-in-Place Ground System ideally should be installed on flat, level and pre-compacted ground. This is to avoid system settlement over time. Topsoil with loam content and organics should be removed, and soil scraped down to subsoil level. If the system is installed on new fill, the soil should be compacted with a compacting roller prior to installation. However, due to vertical adjustability of the NS Beams on the Posts, the GC Pour-in-Place System may be erected on less than ideally prepared grounds when site conditions preclude removal of topsoil. In that scenario, the rails should be adjusted to appropriate heights on Posts during periods of operation and maintenance visits.
- Reference Install Manual for installation. Not following Install Manual may result in voiding warranty.
- Ballast forms (tubs) are provided for each site by GameChange. See installation manual for concrete specifications.

It is a requirement for installation crews including EPC, installer, foundation installation vendor and surveyor to be trained by GameChange personnel (complete page turn review of install manual and construction drawing, building the golden row, as well as walking the site prior to foundation surveying) in person or at a minimum via video conference.

Tool Required

- String line
- 48 inch long level
- 30 foot tape measure
- Inclinometer with digital degree read out
- Impact Drill with interchangeable drivers
- 1/4" Drill Bit
- Wrenches and driver sockets, both standard and deep, in the following sizes:
  - 7/16 inch (for 1/4-inch hex bolts and nuts),
  - 9/16 inch (for 3/8-inch hex bolts and nuts),
- Torque Wrench. Torque bolt to appropriate torque range
  - 1/4" Stainless hardware use 6-7 ft-lbs (72-84 in-lbs)
  - 1/4" Magni hardware use 9-10 ft-lbs (108-120 in-lbs)
  - 3/8" hardware use 29-31 ft-lbs
- Concrete mixture (weather and freeze-thaw resistant if required). See Pour-in-Place Installation Manual for concrete specifications
- Rack assembly jig made of plywood and 2"x4" wood.

Preventative Maintenance

- It is best practice to unbundle loads and install parts within several weeks of delivery so air is able to flow around parts and thus prevent white rust formation. In order to maintain the longest life possible for the protective zinc coating under the warranty, it is important to monitor for any severe white rust developments prior to installation and if this condition appears to take proper maintenance steps to remediate it. See the Pour-in-Place Installation Manual for more information.
- After Installation, installer must annually monitor for any surface rust that may occur over time. Identify any rust areas, wire brush area to remove rust, and coat with 80% zinc rich paint, or equivalent field life paint. This step is not required if rust is limited to edges which were cut during fabrication.
- Maintenance checks should be performed annually or after severe wind events. Please refer to Install Manual for more details.
- Proper preventative maintenance must be conducted or warranty may be voided. The Install Manual provides required maintenance steps and diagnostic procedure for malfunctions. Follow steps and consult with GameChange in case of maintenance issues.

CRITICAL INFORMATION INDICATOR

This icon indicates critical and important information that MUST be followed for proper installation. Disregarding it may lead to serious injury and/or irreparable damage to equipment, tools, or componenets; it will compromise GameChange warranty. Information indicated with this icon must be followed to meet quality requirements.

Customer: **Southern Company**

Project: **Hammond Ash Pond** | Project #: ----

Location: **Rome, Georgia 30165**

Pour-In-Place™ Ballasted Ground

Sheet #:

ATTACHMENT C

STORMWATER CALCULATIONS FOR ASH POND 3 CLOSURE WITH SOLAR FACILITY

SOUTHERN COMPANY

Engineering and Construction Services Calculation

Calculation Number:
DC-HM-HAM15015-002

Project/Plant:	**Unit(s):**	**Discipline/Area:**
Plant Hammond	N/A	Civil

Title/Subject:
Stormwater Calculations for Ash Pond 3 Closure with Solar Facility

Purpose/Objective:
Design Stormwater Conveyance Systems for Ash Pond Cap and Discharge and Analyze Pre/Post Runoff Conditions.

System or Equipment Tag Numbers:	**Originator:**
N/A	Curtis R. Upchurch

Contents

Revision Record

Rev. No.	Description	Originator Initial / Date	Reviewer Initial / Date	Approver Initial / Date
0	Original Issue	CRU 11/14/18	THB 11/15/18	SSS 11/15/18

Notes:

GEORGIA
REGISTERED
No. PE [illegible]
PROFESSIONAL
ENGINEER
THOMAS H. BORDELON
11/15/18

Purpose of Calculation

The purpose of the following calculations is to provide stormwater design for the conveyance systems on the Ash Pond 3 cap and outfalls as the result of adding solar panels and associated equipment. Pre- and post-development peak discharge analysis is also included in this report. These calculations are an addendum to the closure calculations previously issued. See SCS design calculation DC-HM-HAM15015-001 (Stormwater Calculations for Ash Pond 3 Closure).

Overview

Ash Pond 3 is located on GPC property northwest of the Plant bordering Georgia State Highway 20 to the north, Norfolk Southern rail lines on the east and south and Pisgah Church property on its western boundary. It is a closed 25 acre surface impoundment constructed in 1973/74 with final closure completed in 2018 in accordance with the EPA's final Coal Combustion Residuals (CCR) Rule. The closure cap for the ash pond consists of a 60 mil textured hdpe liner overlaid with a geo-composite drainage net, 18 inches of protective soil cover and 6 inches of topsoil with grassed cover. The grass mix consists of Bermuda, Kentucky Fescue, Serecia Lespedeza and other cool season species. The plans for the solar facility include panel arrays support on the final soil surface with concrete ballast blocks approximately 9'-6" long by 3'-0" to 4'-0" wide by 12 inches tall. Due to the addition of the solar panels with the concrete ballast blocks, the hydraulic characteristics of the cap stormwater runoff will change and the following calculations address this as well as the downstream affects.

Summary of Conclusions

(See attached printouts for additional information)

Pre and Post-Development Peak Flow Rates at discharge points (Flows at discharge of pipes):

Basin No. 1	Return Storm, (yr-24hr)	Pre-Solar Peak Flow, cfs	Post-Solar Peak Flow, cfs
A, B, C, D & E	25	21.6	22.0
	50	29.4	30.0
	100	39.1	40.0

Basin No. 2	Return Storm, (yr-24hr)	Pre-Solar Peak Flow, cfs	Post-Solar Peak Flow, cfs
C & D	25	15.2	15.2
	50	15.9	15.9
	100	16.7	16.7

Basin No.3	Return Storm, (yr-24hr)	Pre-Solar Peak Flow, cfs	Post-Solar Peak Flow, cfs
F, G, H, J & J'	25	66.5	68.3
	50	71.5	73.0
	100	75.8	77.2

Basins 1&3	Return Storm, (yr-24hr)	Pre-Solar Peak Flow, cfs	Post-Solar Peak Flow, cfs
Sum of	25	88.1	90.3
discharges	50	100.9	103.0
	100	114.9	117.2

Note - Peak flow rates for the above basins are added and adjustments made (detention) to compensate for increased flow rates since hydrograph lag time for the above basins are approximately the same reaching the Coosa River.

Water Surface Elevations at Peak Flow Rates

Basin No. 1	Return Storm, (yr-24hr)	Pre-Solar WSEL(ft-MSL)	Post-Solar WSEL(ft-MSL)
C & D	25	582.2	582.2
	50	582.4	582.4
	100	582.7	582.7

Basin No. 2	Return Storm, (yr-24hr)	Pre-Solar WSEL(ft-MSL)	Post-Solar WSEL(ft-MSL)
A, B, C, D & E	25	582.1	582.2
	50	582.3	582.3
	100	582.5	582.5

Basin No. 3	Return Storm, (yr-24hr)	Pre-Solar WSEL(ft-MSL)	Post-Solar WSEL(ft-MSL)
F, G, H, J & J'	25	580.3	580.5
	50	581.0	581.2
	100	581.6	581.8

Note that all assumptions addressed in the previous referenced closure stormwater calculations are valid for this set of calculations. The cap areas and their associated drainage basins are the only areas included in this report as other basins are not affected by the solar panel installation.

Stormwater calculations for the ash pond closure have been revised to address recent soil infiltration testing of the cap cover material. Runoff from the cap as the result of the lower infiltration rates from the tests, result in water levels at the northeast discharge increasing and therefore an additional pipe (18” min. diameter) is needed (jack-and-bored under Norfolk Southern tracks) to maintain pre-development levels. This modification has been included in the pre-development analysis of this report. With the addition of the new pipe, these calculations show that the addition of the solar panels with ballast blocks increases the stormwater runoff from the cap at the northeast discharge point (Basins F, G, H, J & J’) raising the pipe inlet headwater elevations slightly (0.2’+/- feet) for the Q-25 year storm. Norfolk Southern design permitting may warrant a larger pipe due to current headwater conditions. This will aid in further reducing the water surface elevation.

See attached calculations for ditch lining and drainage structure analysis and design.

Methodology

NRCS soils data and field testing were used to determine the soil characteristics and hydrological soil groups. Ash Pond 3 is covered with an HDPE liner overlain with a geo-composite drainage layer, an 18 inch protective soil layer and 6 inches of topsoil. SCS curve numbers were assigned to these areas as well as the other cover conditions for the basins. Soils for this site are listed as silty to sandy loams with a hydrologic soil group of B. Cover soil was hauled from an off-site borrow pit approximately 1 mile west of the site, just north of Georgia State Highway 20. Soils from this area are listed as type B soils as well. In addition, the existing dikes on the north half of the ash pond were reduced in height and the material removed and used on site. See attached NRCS soil maps and soil unit data of the project site and borrow pit. The following curve numbers were used in the calculations:

Surface Condition	CN
Grassed	60
Wooded	55
Aggregate Surfaced	85
Concrete Solar Panel Ballasts	98
Paved	98
Buildings/Roof	98
Railroad	65
Grassed (Cap Ash Pond-PreDev.)	77*
Grassed (Cap with Solar-PostDev)	78**

*Clayey material was used for cover of the cap surface. This was confirmed by infiltrometer testing of the Ash Pond cap surface (see reference no. 10). Infiltration of cap cover approaches type D soil.

**With the addition of solar panels, the curve number for grass cover has been increased for the post-development calculations as coverage may be affected due to shading. The impervious concrete ballast area was totaled and weighted along with the grass cover resulting in a higher curve number CN ~ 78 for the cap.

Time of concentrations for the basin areas on the ash pond cap have changed as a result of adding the ballasts. Sheet flow has been reduced and drainage from the cap surface to the perimeter berm/swales is primarily shallow concentrated flow.

Storm basin calculation data was determined from the existing topography and from the Urban Hydrology for Small Watersheds Manual (TR-55). This site is located in a Type II Rainfall Distribution. 24-hour precipitation values were taken from NOAA Atlas 14 and are as follows:

Return Storm	Precipitation
2-year:	3.82 inches
10-year:	5.32 inches
25-year:	6.30 inches
50-year:	7.07 inches
100-year:	7.86 inches

Drainage basins contributing flow to discharges in the project area were modeled using Hydraflow Hydrograph software. Pre and Post-Development flows were calculated as noted in above results section and the hydrograph flows for culverts were then input into Hydraflow Express to calculate the pipe performance. Ash Pond perimeter ditches, diversion swales on the cap, discharge ditches and the CS4'x2' box culvert were analyzed using the rational method's peak flow rates.

Assumptions/Criteria

1. Storm Drainage Design C-7-2, Southern Company Services Engineering Standards and Guidelines Civil, Current Revision.
2. Assumptions listed on calculation sheets attached.

Design Inputs/References

1. AutoCAD Civil 3D, 2013 Autodesk, Inc.
2. NOAA Atlas 14, Volume 9, Version 2 for Rome, Georgia.
3. TR-55 – Urban Hydrology for Small Watersheds, Appendix B, National Resources Conservation Service, Conservation Engineering Division, 1986.
4. Hydraflow Hydrographs Extension for AutoCAD Civil 3D, 2013, V10 Autodesk, Inc.
5. Hydraflow Express Extension for AutoCAD Civil 3D, 2013, Autodesk, Inc.

6. Natural Resource Conservation Service (NRCS) Web Soil Survey, Site Soil and Hydrologic Information
7. Plant Hammond Ash Pond 3 Closure Project Construction Plans, 2016-Present.
8. Plant Hammond Topographic Survey Lidar by Metro Engineering and Survey Co. 2012.
9. Plant Hammond Surveys by Georgia Land Department and SCS Civil Field Services, 2015
10. Double Ring Infiltrometer Testing, Terracon Consultants, Inc., November 5, 2018
11. Storm Drainage Design C-7-2, Southern Company Services Engineering Standards and Guidelines Civil, Current Revision.

Body of Calculation

(See attached calculations and software output)

Attachments

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Solar	CRU	11/14/18
Subject/Title **Storm Water Management Calculations for the Ash Pond 3 Closure with Solar**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-002	Sheet 1 of 13

Ash Pond #3 Ditch Lining, Storm Pipe & Tc Calculations

Rational Method Equation

The Rational equation was used to determine peak discharge from drainage basin runoff.

Rational Equation: Q=ciA
The Rational equation requires the following units:
Q = Peak discharge, cfs
c = Rational method runoff coefficient
i = Rainfall intensity, inch/hour
A = Drainage area, acre

Intensity = B / (Tc + D) ^ E
Use 5 minute time of concentration for more conservative estimation.

From Hammond IDF curves – 25 year storm i = 8.29 inches/hour
100 year storm i = 9.90 inches/hour
Runoff Coefficients used:

c =0.50 (Grassed - Good condition with 6” topsoil & type D cover soil & solar panels)

FB_{100} = Ditch freeboard 100year storm (Shown for all ditches on/leaving closed ash pond)

DITCH CALCULATIONS:

Area D (Ash Pond 3 South)

Ditch D-1 @ N 1,550,546 , E 1,942,779
3’ F.B. Ditch @ 1.00%, 3’ depth
Area = 4.24 Ac, c = 0.50
Q_{25} = (0.50)(8.29)(4.24) = 17.57 cfs
Q_{100} = (0.50)(9.90)(4.24) = 20.99 cfs
V_{25} = 1.85 fps, FB_{100} = 1.85’
See Channel Report for results

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Solar	CRU	11/14/18
Subject/Title **Storm Water Management Calculations for the Ash Pond 3 Closure with Solar**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-002	Sheet 2 of 13

Ditch D-1A @ N 1,550,162 ; E 1,942,110
3' F.B. Ditch @ 2.10%, 3' depth
Area = 4.24 Ac, c = 0.50
Q_{25} = (0.50)(8.29)(4.24) = 17.57 cfs
Q_{100} = (0.50)(9.90)(4.24) = 20.99 cfs
V_{25} = 2.41 fps, FB_{100} = 1.68'
See Channel Report for results

Ditch D-2 @ 1,550,690 ; E 1,942,053
3' F.B. Ditch @ 1.00%, 3' depth
Area = 3.11 Ac, c = 0.50
Q_{25} = (0.50)(8.29)(3.11) = 12.89 cfs
Q_{100} = (0.50)(9.90)(3.11) = 15.39 cfs
V_{25} = 1.68 fps, FB_{100} = 1.64'
See Channel Report for results

Ditch D-3 @ N 1,550,428 ; E 1,942,016
3' F.B. Ditch @ 1.10%, 3' depth
Area = 3.98 Ac, c = 0.50
Q_{25} = (0.50)(8.29)(3.98) = 16.50 cfs
Q_{100} = (0.50)(9.90)(3.98) = 19.70 cfs
V_{25} = 1.87 fps, FB_{100} = 1.51'
See Channel Report for results

Ditch D-4 @ N 1 ,550,287, E 1,942,015
6' F.B. Ditch @ 5.00%, 3' depth
Q_{25} = D1A+D3 = 17.57+16.50 = 34.07 cfs
Q_{100} = D1A+D3 = 20.99+19.70 = 40.69 cfs
V_{25} = 3.76 fps, FB_{100} = 1.85'

Ditch D-5 @ N 1,550,254, E 1,941,901
6' F.B. Ditch @ 25.00%, 2' depth
Q_{25} = D1A+D3 = 17.57+16.50 = 34.07 cfs
Q_{100} = D1A+D3 = 20.99+19.70 = 40.69 cfs
V_{25} = 6.51 fps, FB_{100} = 1.25'

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Solar	CRU	11/14/18
Subject/Title **Storm Water Management Calculations for the Ash Pond 3 Closure with Solar**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-002	Sheet 3 of 13

Ditch D-6 @ N 1,550,245, E 1,941,869

6' F.B. Ditch @ 5.00%, 3' depth

Q_{25} = D1A+D3 = 17.57+16.50 = 34.07 cfs

Q_{100} = D1A+D3 = 20.99+19.70 = 40.69 cfs

V_{25} = 3.76 fps, FB_{100} = 1.85'

Area F (Ash Pond 3 Northeast)

Ditch F-1 @ 1,550,548 ; E 1,942,777

3' F.B. Ditch @ 1.00%, 3' depth

Area = 8.62 Ac, c = 0.50

Q_{25} = (0.50)(8.29)(8.62) = 35.73 cfs

Q_{100} = (0.50)(9.90)(8.62) = 42.67 cfs

V_{25} = 2.22 fps, FB_{100} = 0.82'

See Channel Report for results

Ditch F-2 @ N 1,551,503 ; E 1,942,496

3' F.B. Ditch @ 5.37%, 3' depth

Area = 0.63 Ac, c = 0.50

Q_{25} = (0.50)(8.29)(0.63) = 2.61 cfs

Q_{100} = (0.50)(9.90)(0.63) = 3.12 cfs

V_{25} = 1.92 fps, FB_{100} = 2.61'

See Channel Report for results

Ditch F-3 @ N 1,551,517 ; E 1,942,670

4' F.B. Ditch @ 1.00%, 3' depth

Q_{25} = F1 + F2 = 35.73 + 2.61 = 38.34 cfs

Q_{100} = F1 + F2 = 42.67 + 3.12 = 45.79 cfs

V_{25} = 3.23 fps, FB_{100} = 1.05'

See Channel Report for results

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Solar	CRU	11/14/18
Subject/Title **Storm Water Management Calculations for the Ash Pond 3 Closure with Solar**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-002	Sheet 4 of 13

Ditch F-4 @ N 1,551,579 ; E 1,942,697

4' F.B. Ditch @ 32.50%, 1.25' depth
Q_{25} = F1 + F2 = 35.73 + 2.61 = 38.34 cfs
Q_{100} = F1 + F2 = 42.67 + 3.12 = 45.79 cfs
V_{25} = 7.86 fps, FB_{100} = 0.36'
See Channel Report for results

Ditch F-5 @ N 1,551,612 ; E 1,942,713

4' F.B. Ditch @ 1.00%, 2.0' depth
Q_{25} = F1 + F2 = 35.73 + 2.61 = 38.34 cfs
Q_{100} = F1 + F2 = 42.67 + 3.12 = 45.79 cfs
V_{25} = 3.73 fps, FB_{100} = 0.49'
See Channel Report for results

Ditch F-6 @ N 1,551,640 ; E 1,942,725

4' F.B. Ditch @ 4%, 2' depth
Q_{25} = (F1 + F2)/2 = (35.73 + 2.61)/2 = 19.17 cfs
Q_{100} = (F1 + F2)/2 = (42.67 + 3.12)/2 = 22.90 cfs
V_{25} = 1.93 fps, FB_{100} = 1.38'
See Channel Report for results

Ditch F-7 @ N 1,551,640 ; E 1,942,725

6' F.B. Ditch @ 1.00%, 1.5' depth
Q_{25} = (F1 + F2)/2 = (35.73 + 2.61)/2 = 19.17 cfs
Q_{100} = (F1 + F2)/2 = (42.67 + 3.12)/2 = 22.90 cfs
V_{25} = 1.79 fps, FB_{100} = 0.20'
See Channel Report for results

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Solar	CRU	11/14/18
Subject/Title **Storm Water Management Calculations for the Ash Pond 3 Closure with Solar**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-002	Sheet 5 of 13

Area G (Ash Pond 3 Northwest)

Ditch G-1 @ N 1,551,503 ; E 1,942,496
3' F.B. Ditch @ 1.00%, 3' depth
Area = 1.86 Ac, c = 0.50
Q_{25} = (0.50)(8.29)(1.86) = 7.71 cfs
Q_{100} = (0.50)(9.90)(1.86) = 9.21 cfs
V_{25} = 1.47 fps, FB_{100} = 1.94'
See Channel Report for results

Ditch G-2 @ N 1,550,820 ; E 1,942,070
3' F.B. Ditch @ 1.09%, 3' depth
Area = 3.43 Ac, c = 0.50
Q_{25} = (0.50)(8.29)(3.43) = 14.22 cfs
Q_{100} = (0.50)(9.90)(3.43) = 16.98 cfs
V_{25} = 1.79 fps, FB_{100} = 1.61'
See Channel Report for results

Ditch G-3 @ N 1,551,303 ; E 1,942,111
6' F.B. Ditch @ 5.50%, 1.5' depth
Q_{25} = G1 + G2 = 7.71 + 14.22 = 21.93 cfs
Q_{100} = G1 + G2 = 9.21 + 16.98 = 26.19 cfs
V_{25} = 3.43 fps, FB_{100} = 0.61'
See Channel Report for results

Ditch G-4 @ N 1,551,366 ; E 1,942,040
6' F.B. Ditch @ 25.00%, 1' depth
Q_{25} = G1 + G2 = 7.71 + 14.22 = 21.93 cfs
Q_{100} = G1 + G2 = 9.21 + 16.98 = 26.19 cfs
V_{25} = 5.65 fps, FB_{100} = 0.42'
See Channel Report for results

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Solar	CRU	11/14/18
Subject/Title **Storm Water Management Calculations for the Ash Pond 3 Closure with Solar**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-002	Sheet 6 of 13

Ditch G-5 @ N 1,581,391 ; E 1,942,013

6’ F.B. Ditch @ 3.00%, 1.5’ depth
Q_{25} = G1 + G2 = 7.71 + 14.22 = 21.93 cfs
Q_{100} = G1 + G2 = 9.21 + 16.98 = 26.19 cfs
V_{25} = 2.76 fps, FB_{100} = 0.45’
See Channel Report for results

Ash Pond Cap Diversion Swales

Diversion Swale – Largest Drainage Area (Worst Case)

Swale with 33:1 & 3:1 slopes @ 1.00%, 2’ depth
Area = 2.0 Ac, c = 0.50
Q_{25} = (0.50)(8.29)(2.0) = 8.29 cfs
Q_{100} = (0.50)(9.90)(2.0) = 9.90 cfs
V_{25} = 1.90 fps, FB_{100} = 1.47’
See Channel Report for results

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Solar	CRU	11/14/18
Subject/Title **Storm Water Management Calculations for the Ash Pond 3 Closure with Solar**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-002	Sheet 7 of 13

PIPE CULVERTS

Runoff flows (Q) for pipes calculated using Hydraflow Express Extension for AutoCad Civil 3D 2013 by Autodesk, Inc. Flow rates are from Hydraflow Hydrographs with peak flow rates and hydrograph numbers as listed.

Pipes at NE area Ash Pond 3 will overtop high point at toe of ash pond and will combine to discharge:

Existing Pipe Under Railroad/Hwy 20 side ditch
@ N 1,551,813 ; E 1,942,775
24 " RCP @ 1.06% , 77.3' long*
Runoff from Pisgah Church and Ash Pond 3 (North end)

Pre-Solar:
Basin (Hyd. No. 23)
Q_{25} =87.29 cfs
Q_{50} =104.60 cfs
Q_{100} = 122.71 cfs
Pipe (Hyd. No. 20)
Q_{25} = 31.2 cfs
Q_{50} = 33.3 cfs
Q_{100} = 35.2 cfs

Post-Solar Pipes:
Basin (Hyd. No. 23)
Q_{25} = 100.23 cfs
Q_{50} = 120.30 cfs
Q_{100} = 141.26 cfs
Pipe (Hyd. No. 24) Exist. 24" RCP
Q_{25} = 31.9 cfs
Q_{50} = 34.0 cfs
Q_{100} = 35.9 cfs

V_{25} = 10.02 fps (Pre-Solar)
V_{25} = 10.24 fps (Post-Dev.)
See Culvert Report for results

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Solar	CRU	11/14/18
Subject/Title **Storm Water Management Calculations for the Ash Pond 3 Closure with Solar**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-002	Sheet 8 of 13

Existing Pipe Northeast of AP#3 @ N 1,551,703 ; E 1,942,802 Under Railroad
18 " RCP @ 1.5% , 55' long*
Runoff from NE area Ash Pond 3

Pre-Solar:
Basin (Hyd. No. 23)
Q_{25} = 87.29 cfs
Q_{50} = 104.60 cfs
Q_{100} = 122.71 cfs
Pipe (Hyd. No. 24) Exist. 18" RCP
Q_{25} = 16.8 cfs
Q_{50} = 18.4 cfs
Q_{100} = 19.6 cfs**

Post-Solar Pipes:
Basin (Hyd. No. 23)
Q_{25} = 100.23 cfs
Q_{50} = 120.30 cfs
Q_{100} = 141.26 cfs
Pipe (Hyd. No. 24) Exist. 18" RCP
Q_{25} = 17.6 cfs
Q_{50} = 18.6 cfs
Q_{100} = 20.0 cfs**

V_{25} = 9.56 fps (Pre-Solar)
V_{25} = 10.0 fps (Post-Solar)
Outfall is into a rip rap lined apron
See Culvert Report for results

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Solar	CRU	11/14/18
Subject/Title **Storm Water Management Calculations for the Ash Pond 3 Closure with Solar**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-002	Sheet 9 of 13

New Pipe Northeast of AP#3 @ N 1,551,728 ; E 1,942,802 Under Railroad

18" RCP @ 1.0% , 60' long*
Runoff from NE area of Ash Pond
Pre-Solar:
Basin (Hyd. No. 23)
Q_{25} = 87.29 cfs
Q_{50} = 104.60 cfs
Q_{100} = 122.71 cfs
Pipe (Hyd. No. 24) Exist. 18" RCP
Q_{25} = 18.5 cfs
Q_{50} = 19.8 cfs
Q_{100} = 21.0 cfs**

Post-Solar Pipes:
Basin (Hyd. No. 23)
Q_{25} = 100.23 cfs
Q_{50} = 120.30 cfs
Q_{100} = 141.26 cfs
Pipe (Hyd. No. 24), New 18" RCP***
Q_{25} = 18.8 cfs
Q_{50} = 20.4 cfs
Q_{100} = 21.3 cfs, HW/D = 3.7**
V_{25} = 10.50 fps (Pre-Solar)
V_{25} = 10.67 fps (Post-Solar)
Outfall is into a rip rap lined apron
See Culvert Report for results

*Pipes at NE area Ash Pond 3 will combine to convey the total flows at the outfall:

Pipe Flows (Hyd. No. 24)
Q_{25} = 68.32 cfs, HW EL. 580.5
Q_{50} = 72.98 cfs, HW EL. 581.2
Q_{100} = 77.19 cfs, HW EL. 581.8**

**Note 100 yr. FEMA flood elevation for the Coosa River is EL. 586+/- which will affect downstream water levels of the pipes listed above. Pipe results for the 100 year storm are only valid for a localized storm event.

***New storm culvert under Norfolk Southern (NS) RR track minimum size is 18" diameter and is subject to approval by the NS. Pipe casings/sizes for culvert may be altered due to railway regulations and future permit requirements.

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Solar	CRU	11/14/18
Subject/Title **Storm Water Management Calculations for the Ash Pond 3 Closure with Solar**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-002	Sheet 10 of 13

New 4’x2’ Box Culvert @ N 1,551,488 , E 1,942,656

4’x2’ Culvert @ 0.50%, 30’ long

Pre-Solar:
Basin (Hyd. No. 20)
Q_{25} = 31.71 cfs, HW/D = 0.94
Q_{50} = 37.12 cfs, HW/D = 1.16
Q_{100} = 42.69 cfs, HW/D = 1.22

Post-Solar:
Basin (Hyd. No. 20)
Q_{25} = 40.03 cfs, HW/D = 1.19, F.B. = 1.81
Q_{50} = 47.07 cfs, HW/D = 1.28, F.B. = 1.72
Q_{100} = 54.33 cfs, HW/D = 1.38, F.B. = 1.62
V_{25} = 4.87 fps (Pre-Solar)
V_{25} = 5.78 fps (Post-Solar)
Outfall is into a rip rap lined ditch
See Culvert Report for results

AP#3 South End Pipes-

Existing Pipe @ N 1,550,135, E 1,941,896

24” CMP @ 0.97% - 141.42’ long

Pre-Solar:
Basin (Hyd. No. 9)
Q_{25} = 71.83 cfs
Q_{50} = 86.55 cfs
Q_{100} = 102.01 cfs
Pipe (Hyd. No. 10)
Q_{25} = 15.16 cfs
Q_{50} = 15.92 cfs
Q_{100} = 16.71 cfs

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Solar	CRU	11/14/18
Subject/Title **Storm Water Management Calculations for the Ash Pond 3 Closure with Solar**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-002	Sheet 11 of 13

Post-Solar:
Basin (Hyd. No. 9)
Q_{25} = 82.22 cfs
Q_{50} = 98.78 cfs
Q_{100} = 116.09 cfs
Pipe (Hyd. No. 10)
Q_{25} = 15.16 cfs
Q_{50} = 15.92 cfs
Q_{100} = 16.70 cfs

(Increased detention storage)
V_{25} = 5.32 fps (Pre-Solar)
V_{25} = 5.32 fps (Post-Solar)
Outfall is into a rip rap lined ditch
See Culvert Report for results

Existing Pipe Under Plant Road, Bridge & Railroad @ N 1,549,942, E 1,941,933
36" CMP @ 1.42% - 311.7' long

Pre-Solar:
Basin (Hyd. No. 12)
Q_{25} = 53.11 cfs
Q_{50} = 63.18 cfs
Q_{100} = 73.69 cfs
Pipe (Hyd. No. 13)
Q_{25} = 21.57 cfs
Q_{50} = 29.41 cfs
Q_{100} = 39.14 cfs

Post-Solar:
Basin (Hyd. No. 12)
Q_{25} = 53.94 cfs
Q_{50} = 63.90 cfs
Q_{100} = 74.36 cfs

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Solar	CRU	11/14/18
Subject/Title **Storm Water Management Calculations for the Ash Pond 3 Closure with Solar**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-002	Sheet 12 of 13

Post-Solar with Riser & Detention:
Pipe (Hyd. No. 13)
Q_{25} = 22.02 cfs
Q_{50} = 29.99 cfs
Q_{100} = 39.98 cfs

V_{25} = 3.80 fps (Pre-Solar)
V_{25} = 3.80 fps (Post-Solar)

SOUTHERN COMPANY
Energy to Serve Your World℠

Design Calculations

Project	Prepared by	Date
Plant Hammond – Ash Pond 3 Solar	CRU	11/14/18
Subject/Title **Storm Water Management Calculations for the Ash Pond 3 Closure with Solar**	Reviewed by THB	Date 11/14/18
	Calculation Number DC-HM-HAM15015-002	Sheet 13 of 13

Ash Pond Drainage Basins Tc Calculations-

Basin F

Sheet Flow 50’ @ 3.0%, Grass	8.23 min.*
Shallow Conc. Flow 405’ @ 3.0%, Grass	2.42 min.
Ditch Flow	
Cap Swale, 100’ @ 1.0%, Grass	0.76 min.
Cap Flume, 5’ F.B., 50’ @ 2.83%, Rip Rap	0.33 min.
Perimeter Ditch 3’ F.B., 407’ @ 1.0%, Rip Rap	3.90 min.
CS4’x2’, 30’ @ 0.5%, Concrete	0.09 min.
Outfall Ditch 108’ @ 1.0%, Rip Rap	1.05 min.
Outfall Ditch, 4’ F.B. 50’ @ 32.5%, Rip Rap	0.14 min.
Outfall Ditch 4’ F.B., 115’ @ 4.0%, Rip Rap	1.05 min.
Total Tc =	18.0 min.

Basin G

Sheet Flow 50’ @ 3.0%, Grass	8.23 min.*
Shallow Conc. Flow 269’ @ 3.0%, Grass	1.60 min.
Ditch Flow	
Cap Swale, 281’ @ 1.0%, Grass	2.45 min.
Cap Flume, 5’ F.B., 50’ @ 2.83%, Rip Rap	0.40 min.
Perimeter Ditch 3’ F.B., 163’ @ 1.0%, Rip Rap	1.80 min.
Outfall Ditch, 6’ F.B., 50’ @ 3.0%, Rip Rap	0.41 min.
Outfall Ditch, 6’ F.B. 42’ @ 25.0%, Rip Rap	0.17 min.
Outfall Ditch 6’ F.B., 99’ @ 5.5%, Rip Rap	0.70 min.
Total Tc =	15.8 min.

Basin D

Sheet Flow 50’ @ 3.0%, Grass	8.23 min.*
Shallow Conc. Flow 337’ @ 3.0%, Grass	1.71 min.
Ditch Flow	
Cap Swale, 88’ @ 1.0%, Grass	0.65 min.
Cap Flume, 5’ F.B., 50’ @ 2.83%, Rip Rap	0.33 min.
Perimeter Ditch 3’ F.B., 670’ @ 1.0%, Rip Rap	6.27 min..
Outfall Ditch, 6’ F.B. 120’ @ 5.0%, Rip Rap	0.72 min.
Outfall Ditch 6’ F.B., 45’ @ 25.0%, Rip Rap	0.15 min.
Total Tc =	18.1 min.

*Sheet flow has been reduced in the Tc calculations due to the addition of the concrete ballast blocks. It is assumed that most of the flow from the cap to the perimeter swales will occur as shallow concentrate flow. See attached HydraFlow Hydrograph Pre- and Post-Development reports for Tc values of other basins.

Time of Concentration
Cap Drainage Basins
(HydraFlow Express Output)

Hydrograph Report

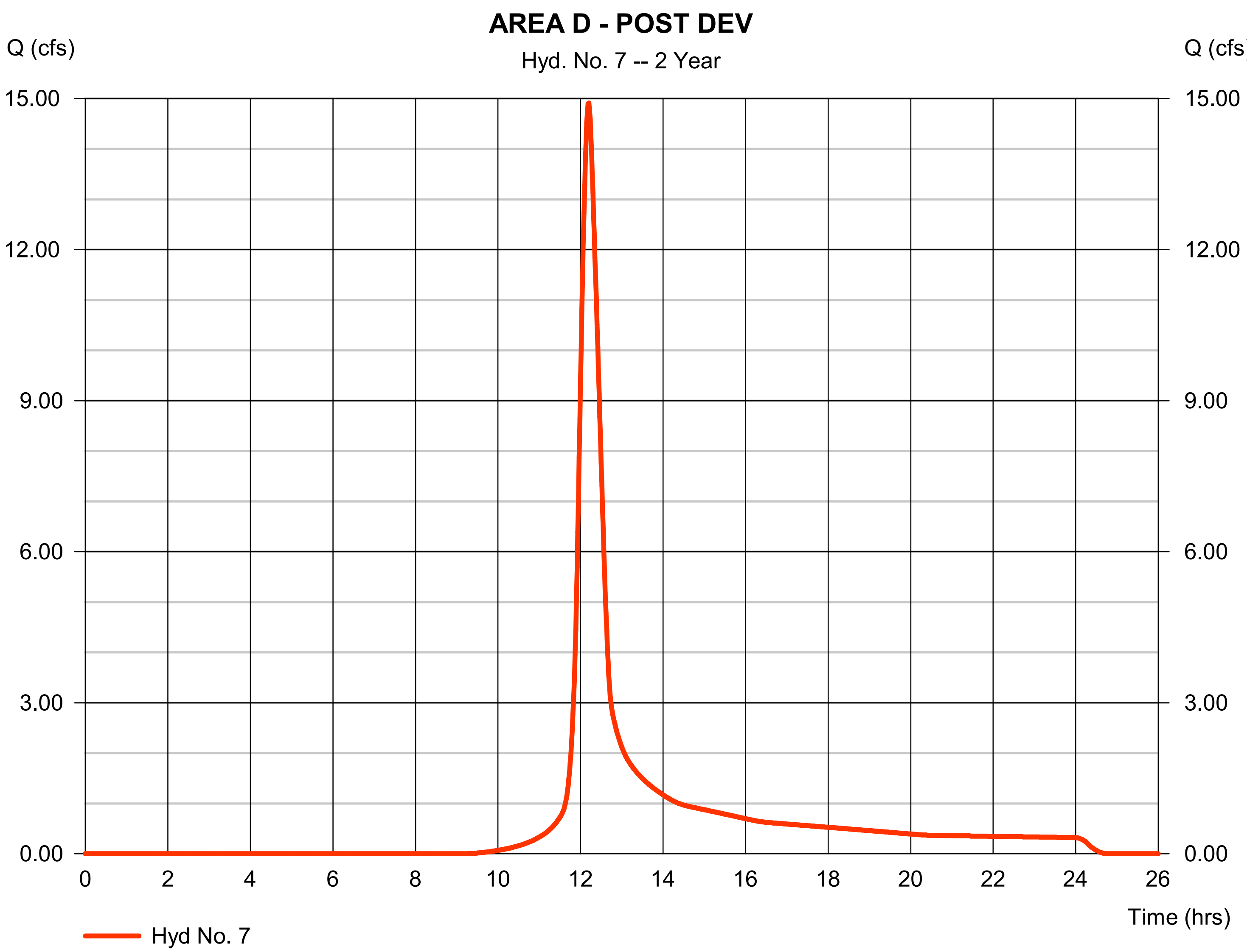
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5 Friday, 11 / 9 / 2018

Hyd. No. 7

AREA D - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 14.91 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 1 min	Hyd. volume	= 60,289 cuft
Drainage area	= 9.520 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 29.10 min
Total precip.	= 3.82 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.910 x 85) + (8.610 x 77)] / 9.520



Hydrograph Report

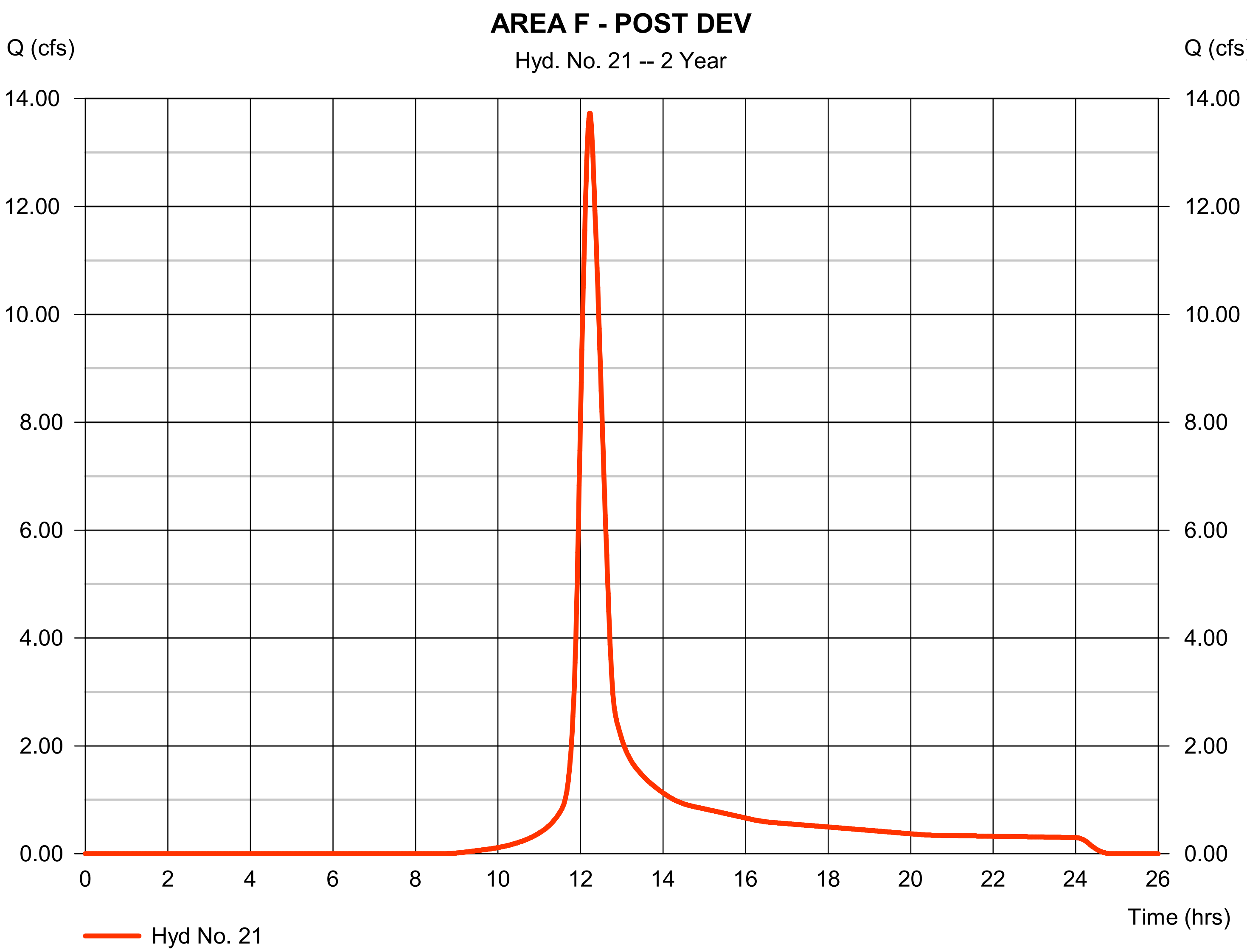
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5 Friday, 11 / 9 / 2018

Hyd. No. 21

AREA F - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 13.73 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.23 hrs
Time interval	= 1 min	Hyd. volume	= 58,890 cuft
Drainage area	= 8.620 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 32.70 min
Total precip.	= 3.82 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.440 x 85) + (8.180 x 77)] / 8.620



Hydrograph Report

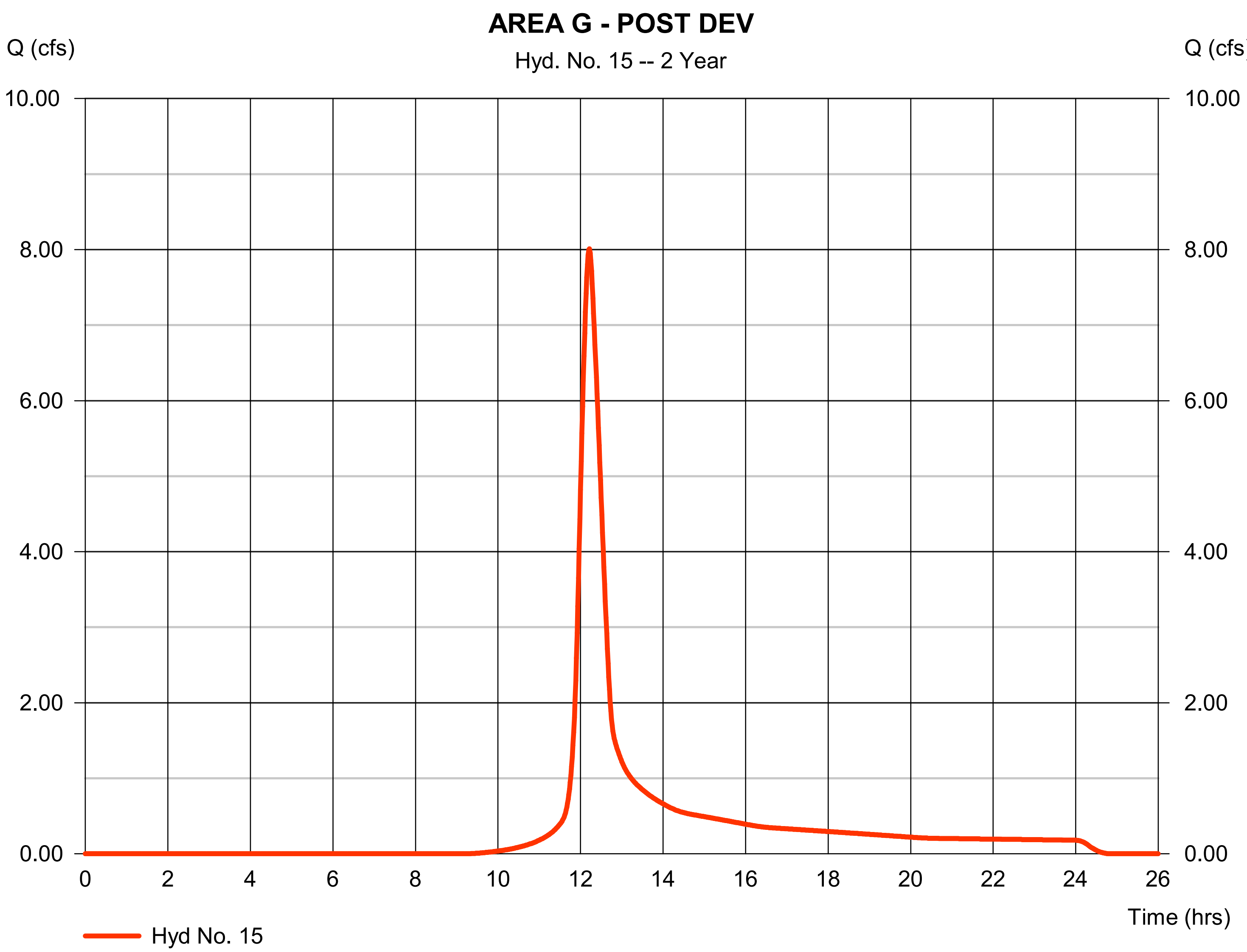
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v10.5 Friday, 11 / 9 / 2018

Hyd. No. 15

AREA G - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 8.010 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.22 hrs
Time interval	= 1 min	Hyd. volume	= 33,721 cuft
Drainage area	= 5.290 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 31.50 min
Total precip.	= 3.82 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.330 x 85) + (4.960 x 77)] / 5.290

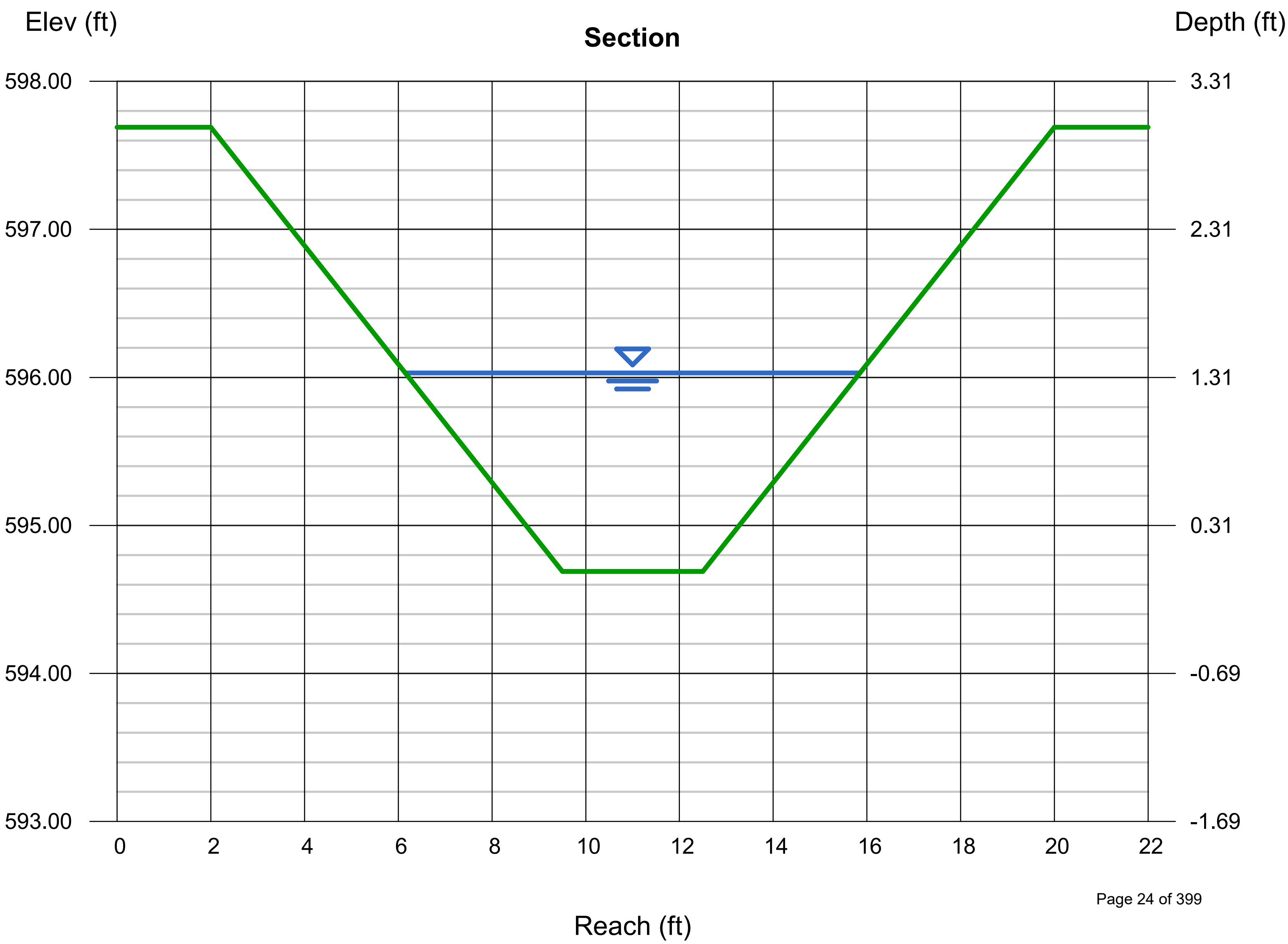


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

DBASIN_3'FB@1.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.34
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 14.90
Total Depth (ft)	= 3.00	Area (sqft)	= 8.51
Invert Elev (ft)	= 594.69	Velocity (ft/s)	= 1.75
Slope (%)	= 1.00	Wetted Perim (ft)	= 10.22
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.75
		Top Width (ft)	= 9.70
Calculations		EGL (ft)	= 1.39
Compute by:	Known Q		
Known Q (cfs)	= 14.90		



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

DBASIN_5'FB@2.83%-Tc2YR

Trapezoidal

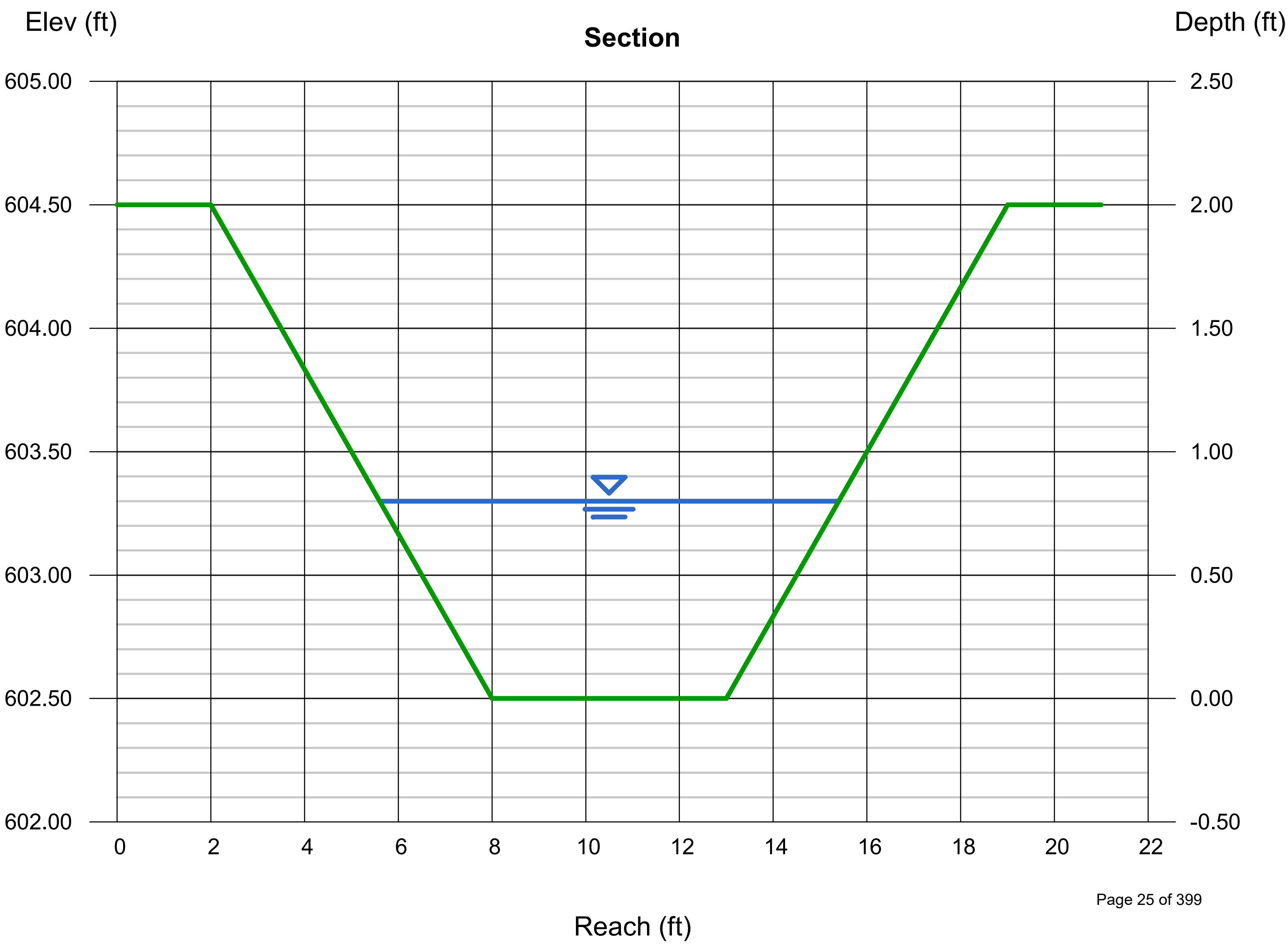
Bottom Width (ft)	= 5.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 602.50
Slope (%)	= 2.83
N-Value	= 0.069

Calculations

Compute by:	Known Q
Known Q (cfs)	= 14.90

Highlighted

Depth (ft)	= 0.80
Q (cfs)	= 14.90
Area (sqft)	= 5.92
Velocity (ft/s)	= 2.52
Wetted Perim (ft)	= 10.06
Crit Depth, Yc (ft)	= 0.58
Top Width (ft)	= 9.80
EGL (ft)	= 0.90

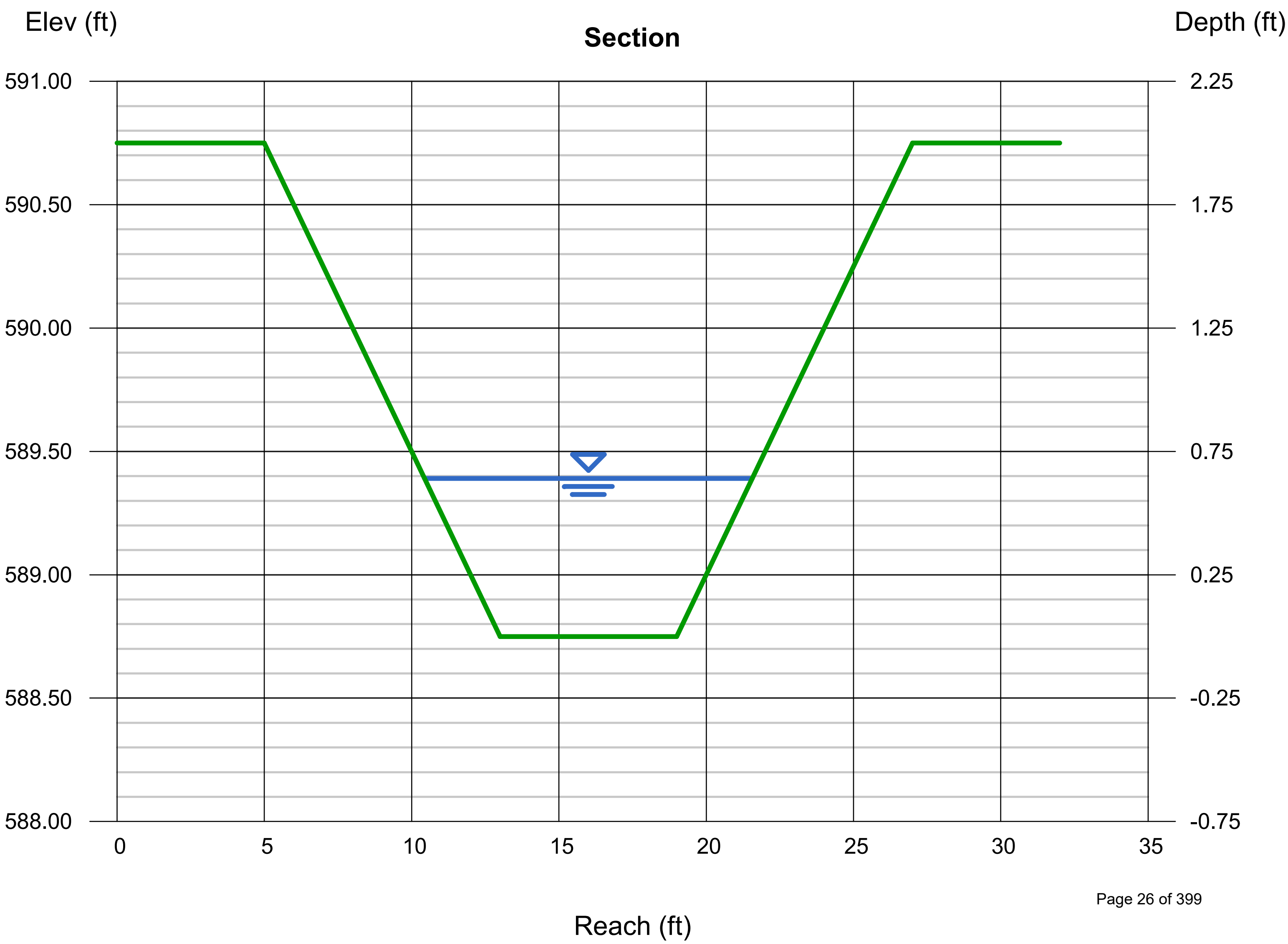


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

DBASIN_6'FB@5.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.64
Side Slopes (z:1)	= 4.00, 4.00	Q (cfs)	= 14.90
Total Depth (ft)	= 2.00	Area (sqft)	= 5.48
Invert Elev (ft)	= 588.75	Velocity (ft/s)	= 2.72
Slope (%)	= 5.00	Wetted Perim (ft)	= 11.28
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.52
		Top Width (ft)	= 11.12
Calculations		EGL (ft)	= 0.76
Compute by:	Known Q		
Known Q (cfs)	= 14.90		

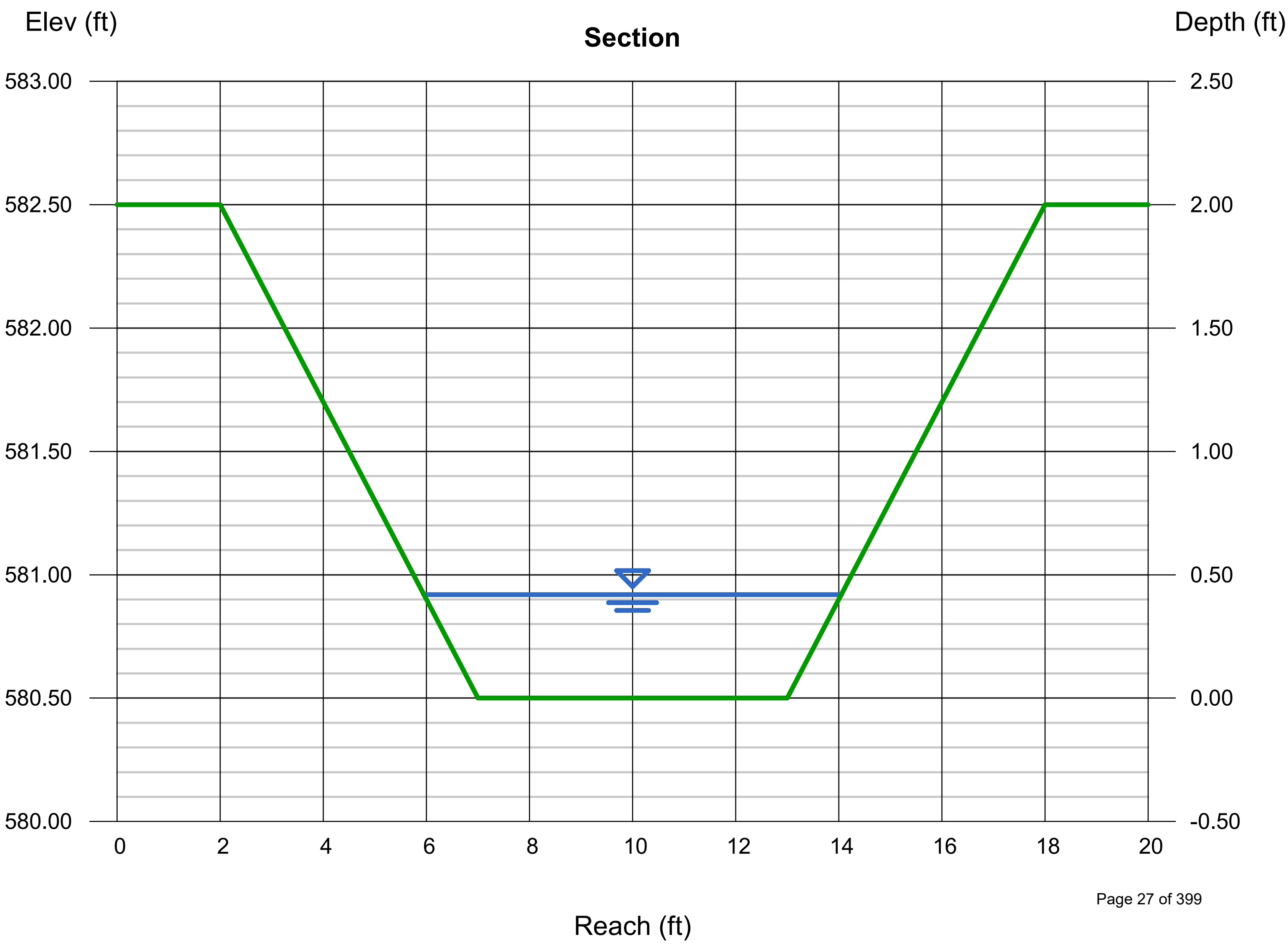


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

DBASIN_6'FB@25%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.42
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 14.90
Total Depth (ft)	= 2.00	Area (sqft)	= 2.96
Invert Elev (ft)	= 580.50	Velocity (ft/s)	= 5.03
Slope (%)	= 25.00	Wetted Perim (ft)	= 8.26
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.54
		Top Width (ft)	= 8.10
Calculations		EGL (ft)	= 0.81
Compute by:	Known Q		
Known Q (cfs)	= 14.90		

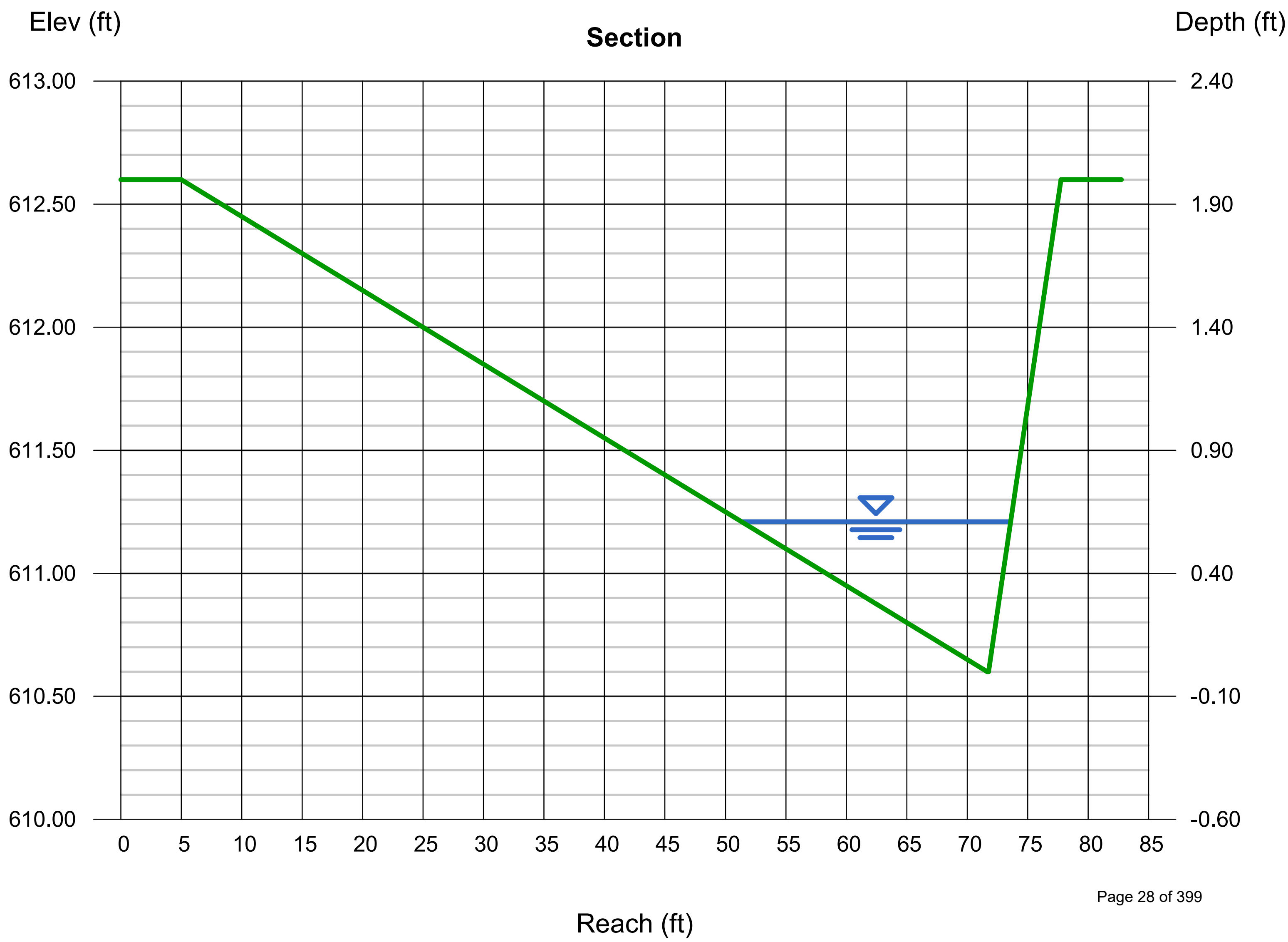


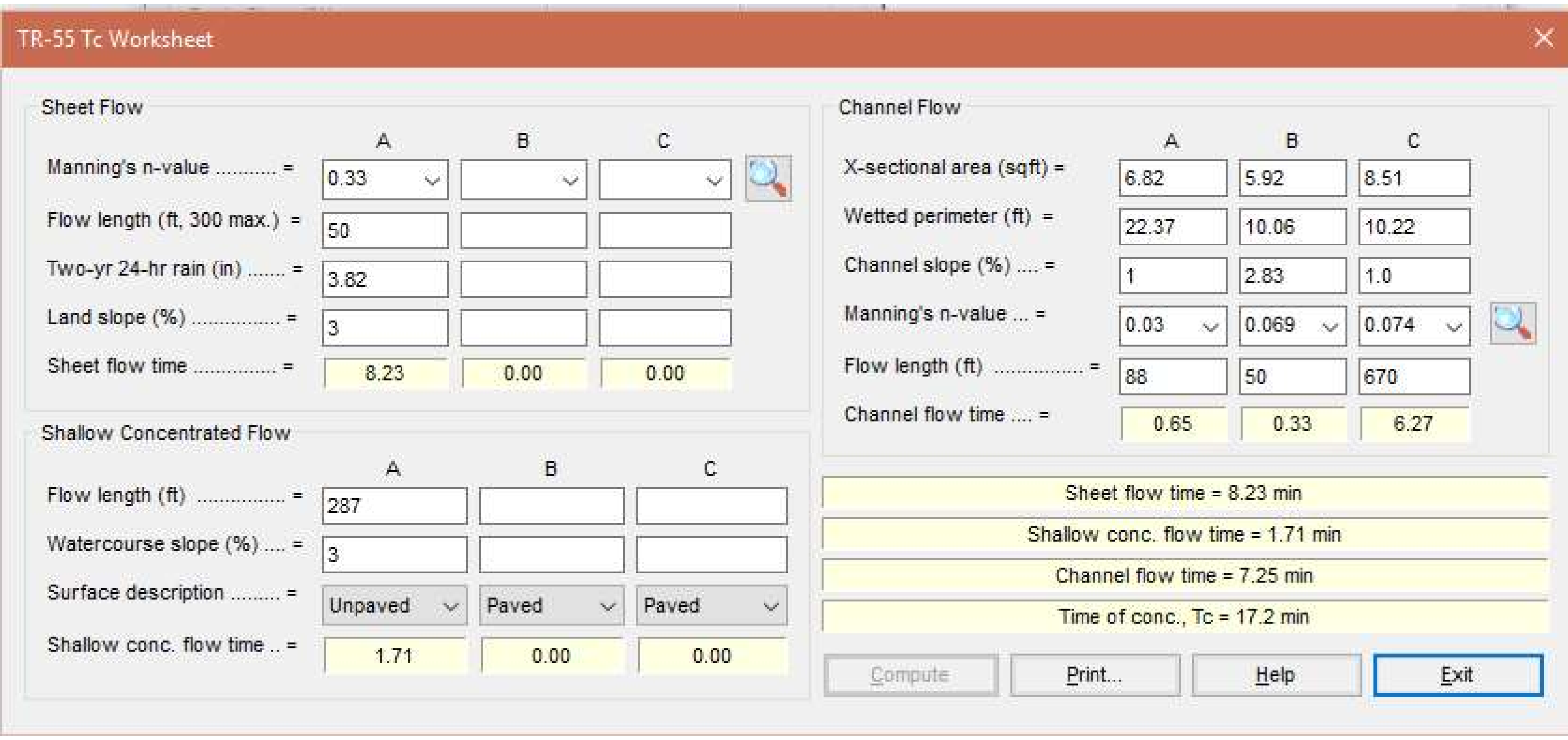
Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

DBASIN_CapSwale@1.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 0.10	Depth (ft)	= 0.61
Side Slopes (z:1)	= 33.33, 3.00	Q (cfs)	= 14.90
Total Depth (ft)	= 2.00	Area (sqft)	= 6.82
Invert Elev (ft)	= 610.60	Velocity (ft/s)	= 2.18
Slope (%)	= 1.00	Wetted Perim (ft)	= 22.37
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.53
		Top Width (ft)	= 22.26
Calculations		EGL (ft)	= 0.68
Compute by:	Known Q		
Known Q (cfs)	= 14.90		





TR-55 Tc Worksheet

Sheet Flow

	A	B	C
Manning's n-value .... =	0.33		
Flow length (ft, 300 max.) =	50		
Two-yr 24-hr rain (in) .... =	3.82		
Land slope (%) .... =	3		
Sheet flow time .... =	8.23	0.00	0.00

Shallow Concentrated Flow

	A	B	C
Flow length (ft) .... =	287		
Watercourse slope (%) .... =	3		
Surface description .... =	Unpaved	Paved	Paved
Shallow conc. flow time .. =	1.71	0.00	0.00

Channel Flow

	A	B	C
X-sectional area (sqft) =	6.82	5.92	8.51
Wetted perimeter (ft) =	22.37	10.06	10.22
Channel slope (%) .... =	1	2.83	1.0
Manning's n-value ... =	0.03	0.069	0.074
Flow length (ft) .... =	88	50	670
Channel flow time .... =	0.65	0.33	6.27

Sheet flow time = 8.23 min
Shallow conc. flow time = 1.71 min
Channel flow time = 7.25 min
Time of conc., Tc = 17.2 min

Compute | Print... | Help | Exit

TR-55 Tc Worksheet

Sheet Flow

	A	B	C
Manning's n-value .... =			
Flow length (ft, 300 max.) =			
Two-yr 24-hr rain (in) .... =			
Land slope (%) .... =			
Sheet flow time .... =	0.00	0.00	0.00

Shallow Concentrated Flow

	A	B	C
Flow length (ft) .... =			
Watercourse slope (%) .... =			
Surface description .... =	Unpaved	Paved	Paved
Shallow conc. flow time .. =	0.00	0.00	0.00

Channel Flow

	A	B	C
X-sectional area (sqft) =	5.48	2.96	
Wetted perimeter (ft) =	11.28	8.26	
Channel slope (%) .... =	5	25	
Manning's n-value ... =	0.074	0.074	0.015
Flow length (ft) .... =	120	45	
Channel flow time .... =	0.72	0.15	0.00

Sheet flow time = 0.00 min

Shallow conc. flow time = 0.00 min

Channel flow time = 0.87 min

Time of conc., Tc = 0.9 min

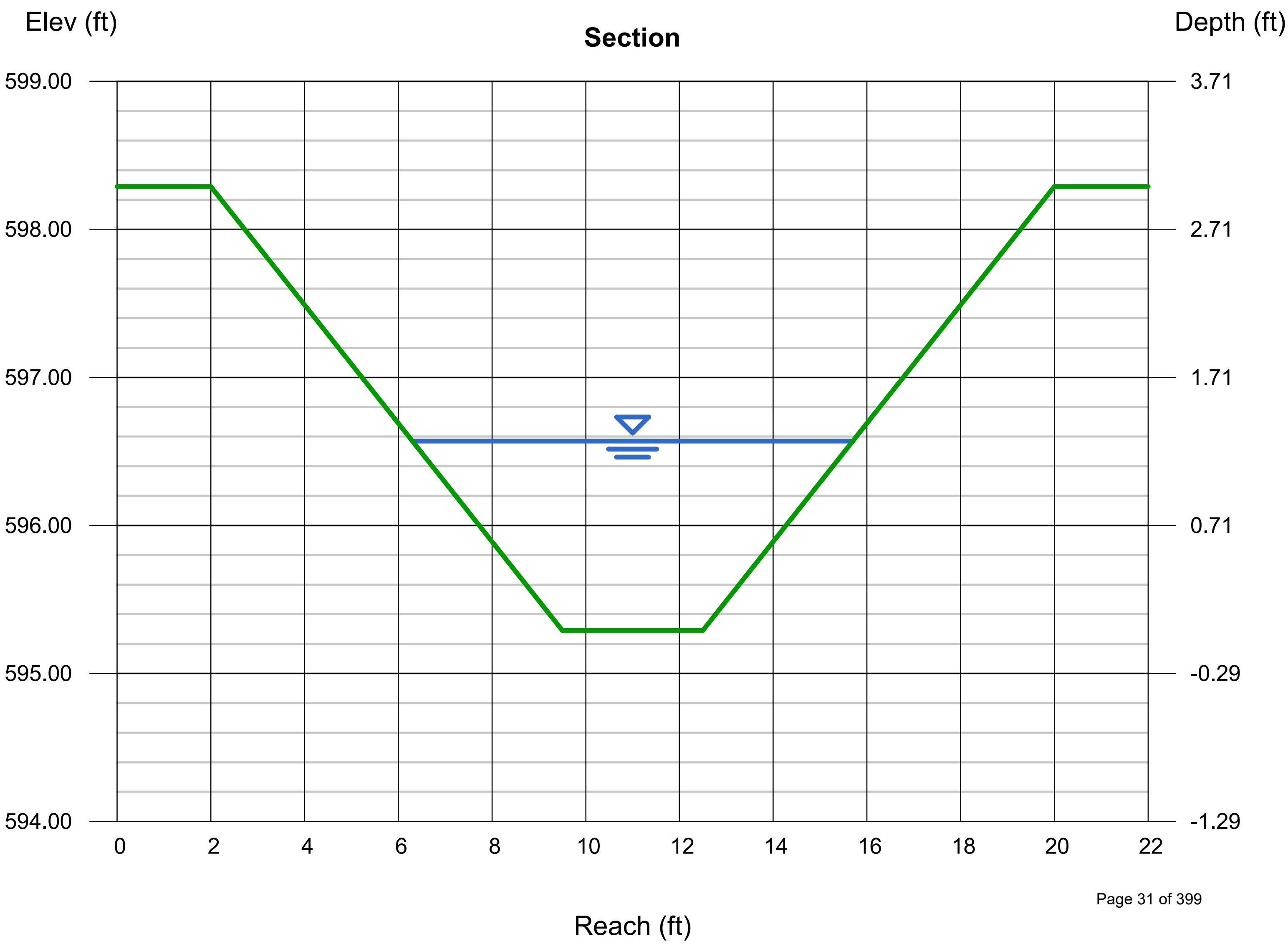
Compute | Print... | Help | Exit

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

FBASIN_3'FB@1.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.28
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 13.73
Total Depth (ft)	= 3.00	Area (sqft)	= 7.94
Invert Elev (ft)	= 595.29	Velocity (ft/s)	= 1.73
Slope (%)	= 1.00	Wetted Perim (ft)	= 9.89
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.71
		Top Width (ft)	= 9.40
Calculations		EGL (ft)	= 1.33
Compute by:	Known Q		
Known Q (cfs)	= 13.73		

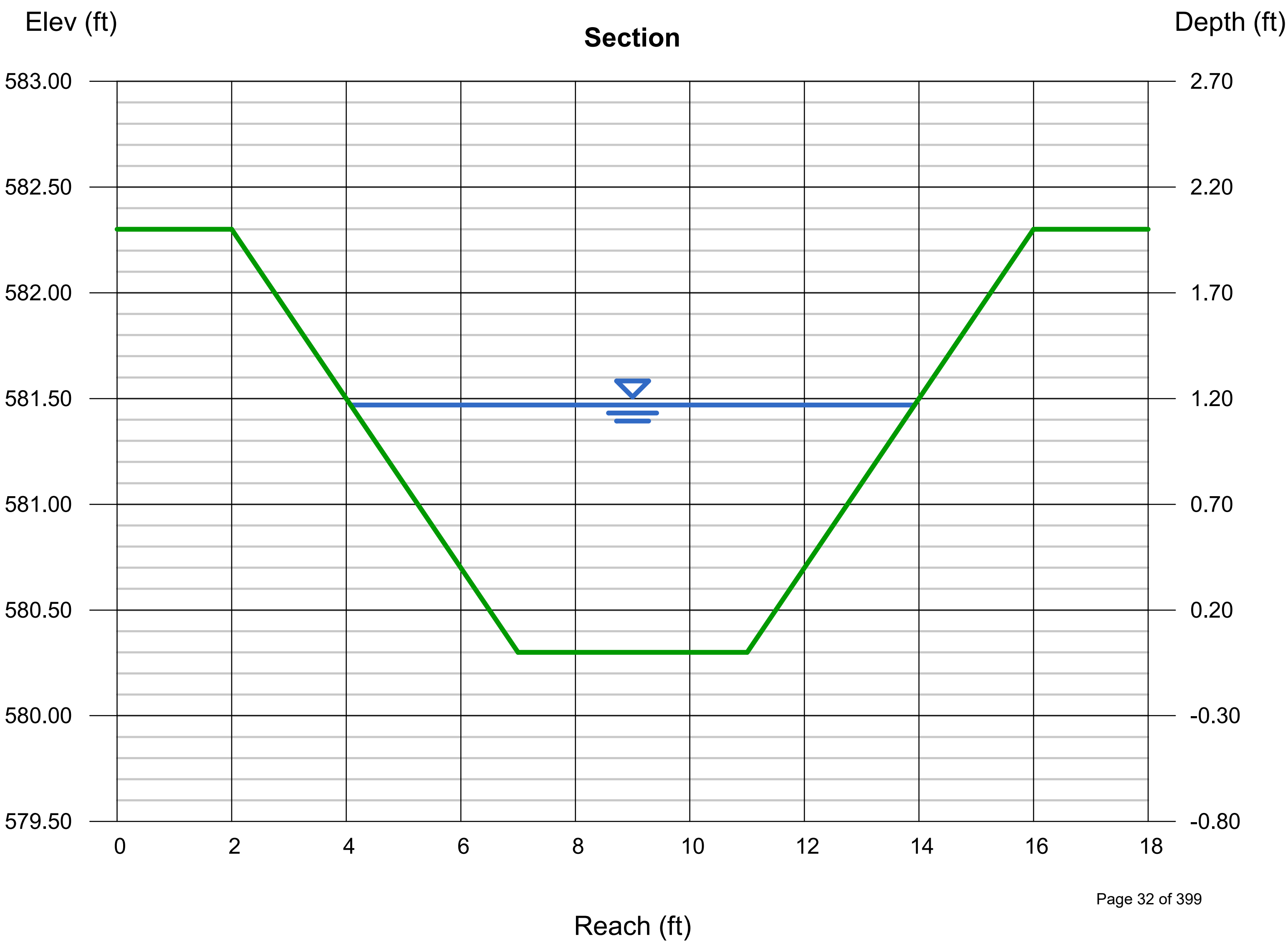


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

FBASIN_4'FB@1.00%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 1.17
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 13.73
Total Depth (ft)	= 2.00	Area (sqft)	= 8.10
Invert Elev (ft)	= 580.30	Velocity (ft/s)	= 1.69
Slope (%)	= 1.00	Wetted Perim (ft)	= 10.30
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.63
		Top Width (ft)	= 9.85
Calculations		EGL (ft)	= 1.21
Compute by:	Known Q		
Known Q (cfs)	= 13.73		

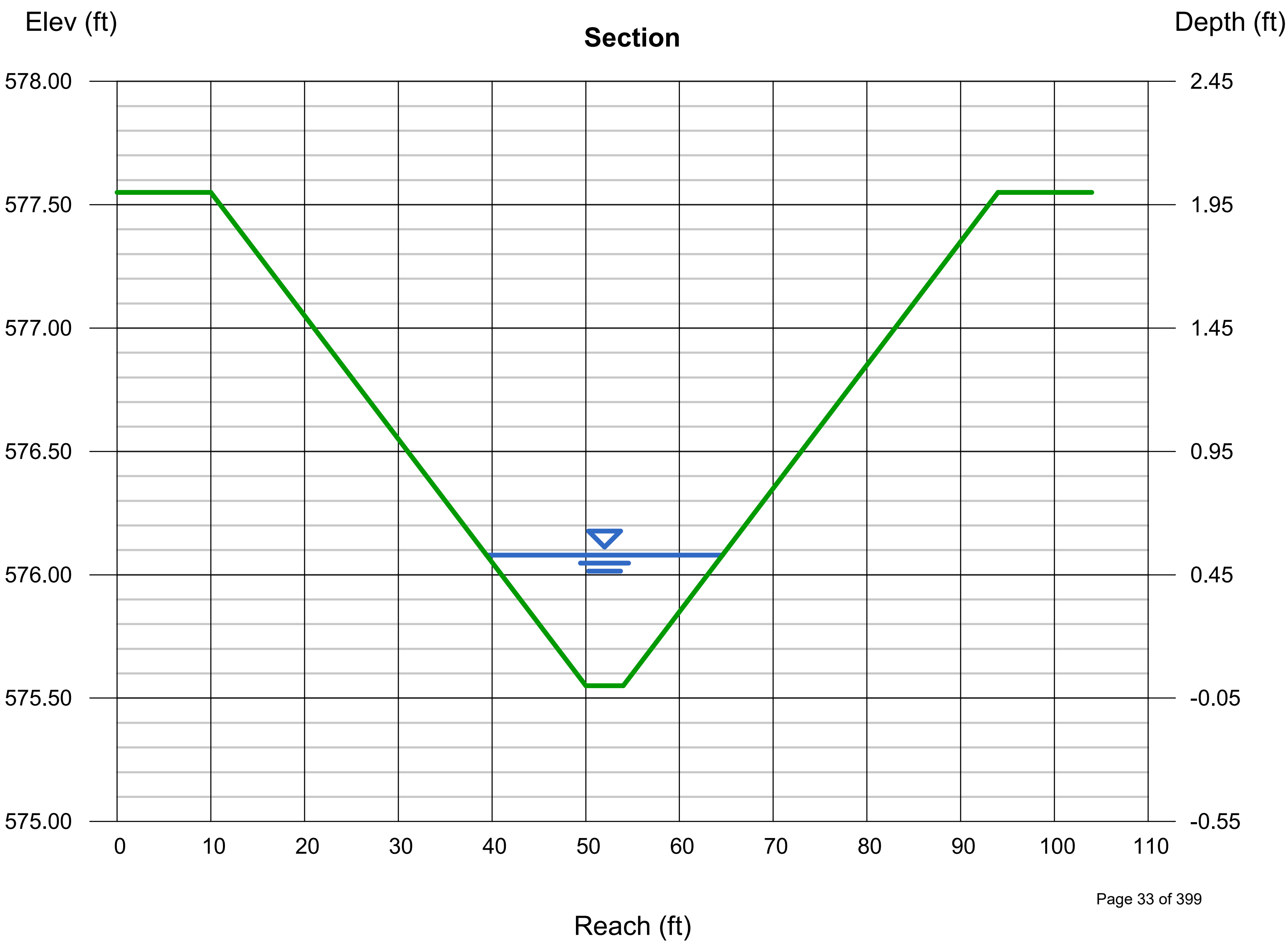


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

FBASIN_4'FB@4.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 0.53
Side Slopes (z:1)	= 20.00, 20.00	Q (cfs)	= 13.73
Total Depth (ft)	= 2.00	Area (sqft)	= 7.74
Invert Elev (ft)	= 575.55	Velocity (ft/s)	= 1.77
Slope (%)	= 4.00	Wetted Perim (ft)	= 25.23
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.41
		Top Width (ft)	= 25.20
Calculations		EGL (ft)	= 0.58
Compute by:	Known Q		
Known Q (cfs)	= 13.73		

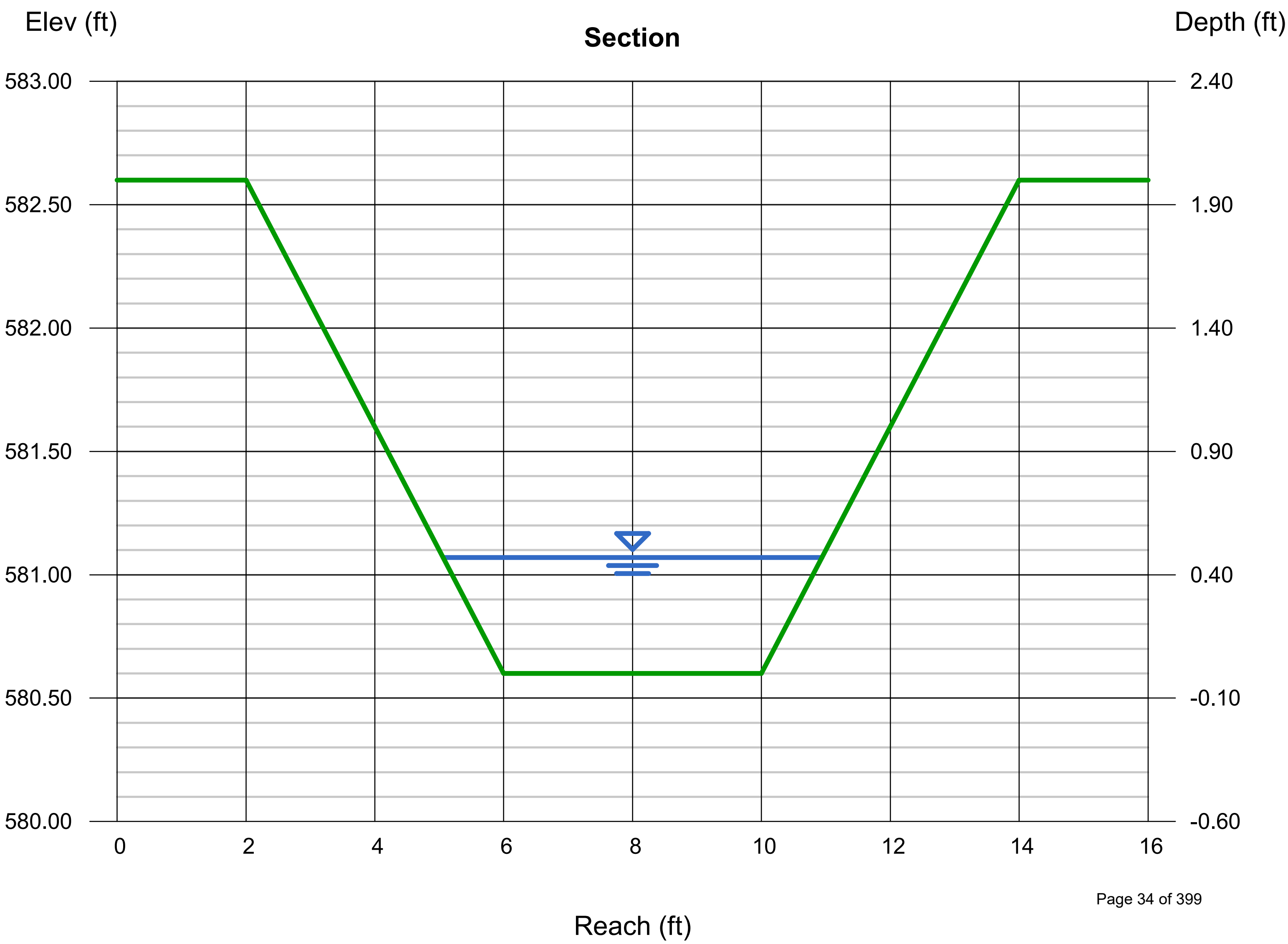


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

FBASIN_4'FB@32.5%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 0.47
Side Slopes (z:1)	= 2.00, 2.00	Q (cfs)	= 13.73
Total Depth (ft)	= 2.00	Area (sqft)	= 2.32
Invert Elev (ft)	= 580.60	Velocity (ft/s)	= 5.91
Slope (%)	= 32.50	Wetted Perim (ft)	= 6.10
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.64
		Top Width (ft)	= 5.88
Calculations		EGL (ft)	= 1.01
Compute by:	Known Q		
Known Q (cfs)	= 13.73		

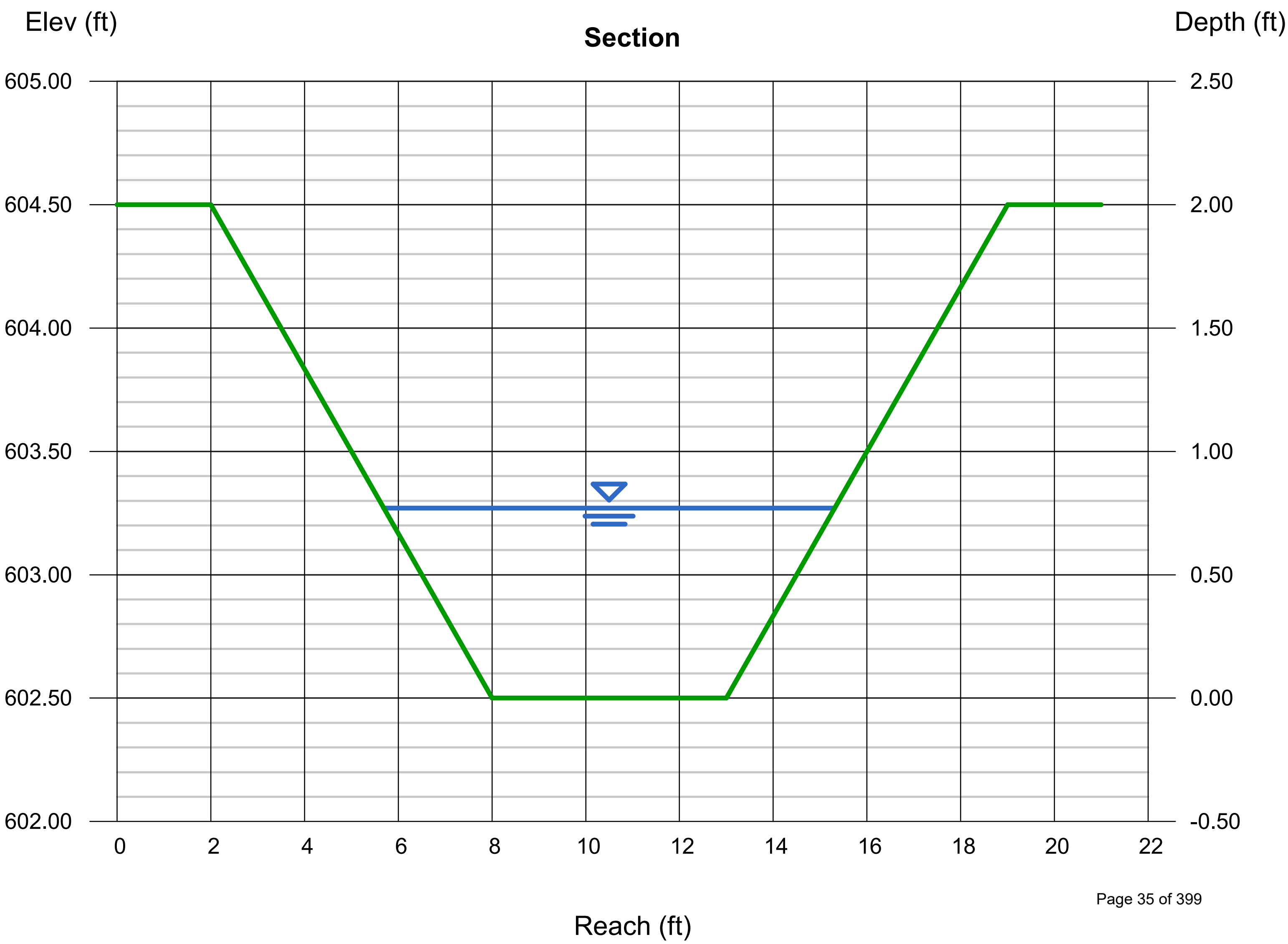


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

FBASIN_5'FB@2.83%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 5.00	Depth (ft)	= 0.77
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 13.73
Total Depth (ft)	= 2.00	Area (sqft)	= 5.63
Invert Elev (ft)	= 602.50	Velocity (ft/s)	= 2.44
Slope (%)	= 2.83	Wetted Perim (ft)	= 9.87
N-Value	= 0.069	Crit Depth, Yc (ft)	= 0.55
		Top Width (ft)	= 9.62
Calculations		EGL (ft)	= 0.86
Compute by:	Known Q		
Known Q (cfs)	= 13.73		

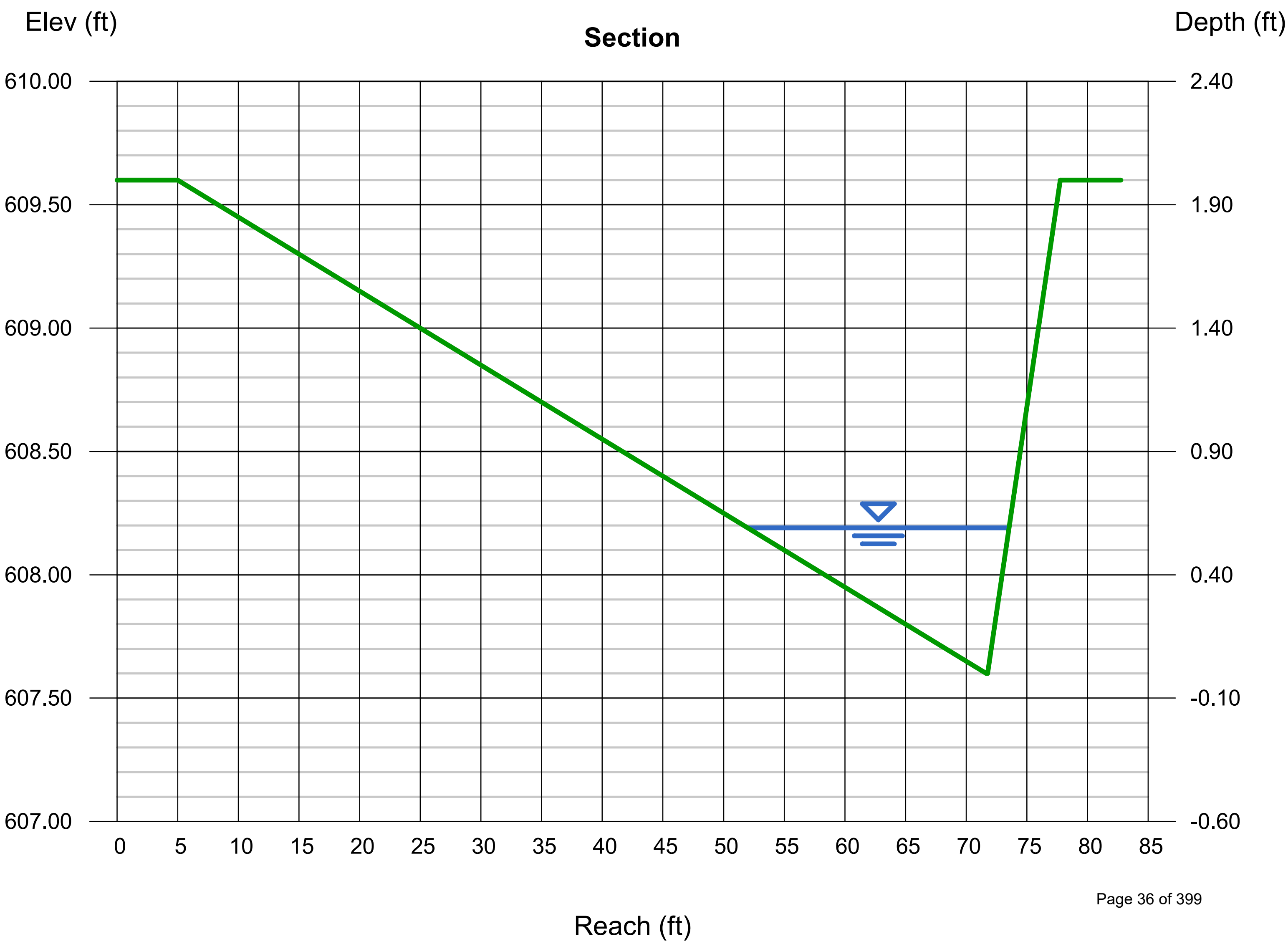


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

FBASIN_CapSwale@1.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 0.10	Depth (ft)	= 0.59
Side Slopes (z:1)	= 33.33, 3.00	Q (cfs)	= 13.73
Total Depth (ft)	= 2.00	Area (sqft)	= 6.38
Invert Elev (ft)	= 607.60	Velocity (ft/s)	= 2.15
Slope (%)	= 1.00	Wetted Perim (ft)	= 21.64
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.52
		Top Width (ft)	= 21.53
Calculations		EGL (ft)	= 0.66
Compute by:	Known Q		
Known Q (cfs)	= 13.73		

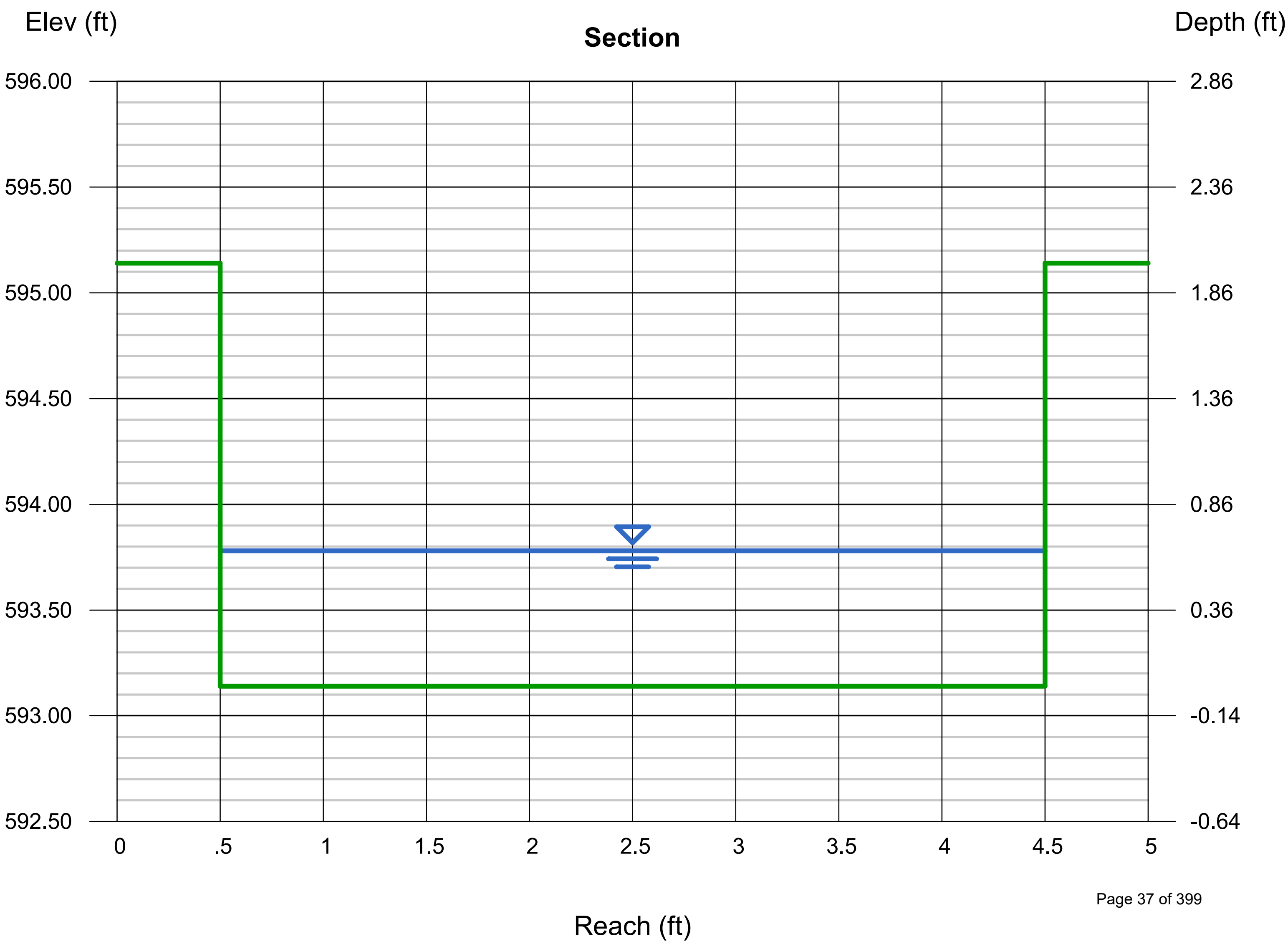


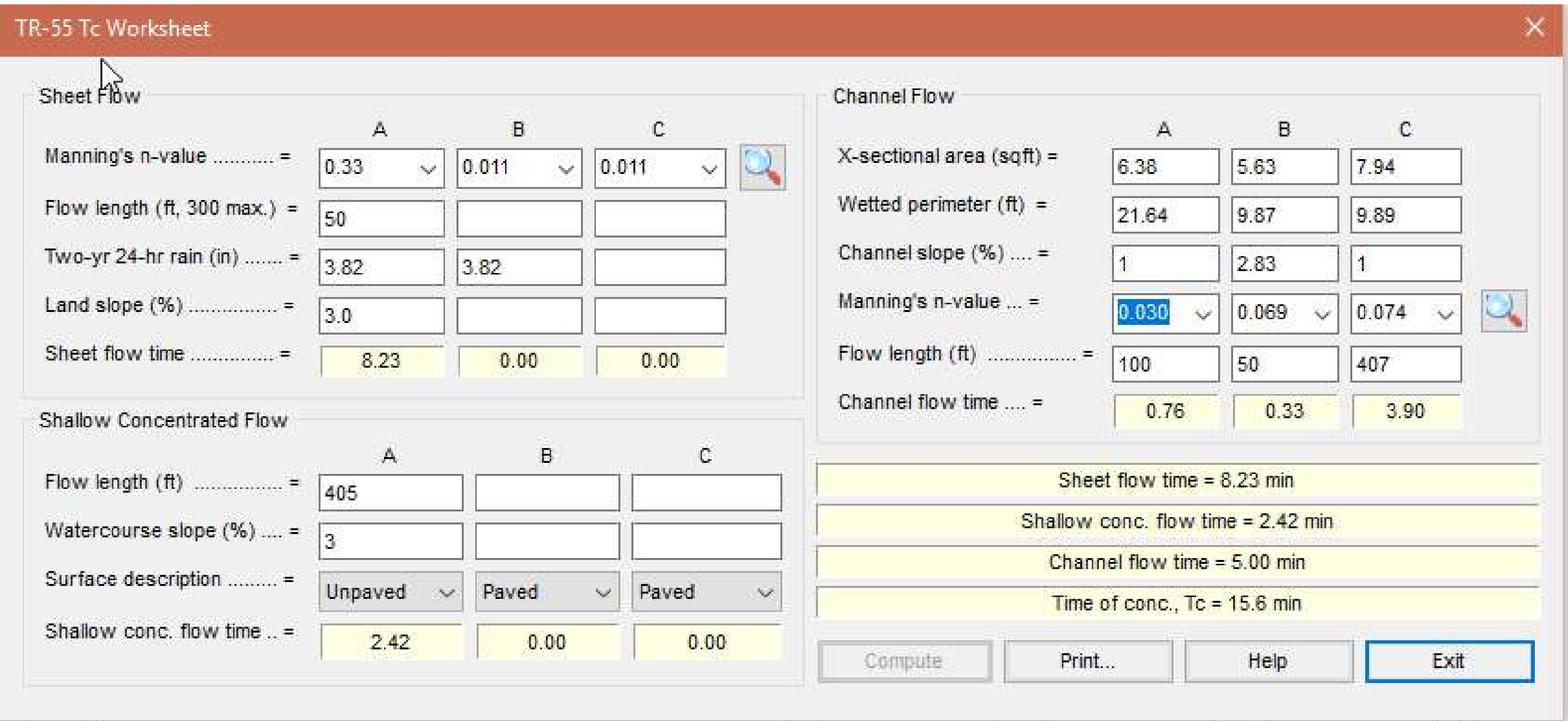
Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

FBASIN_CS4X2@0.50%-Tc2YR

Rectangular		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 0.64
Total Depth (ft)	= 2.00	Q (cfs)	= 13.73
		Area (sqft)	= 2.56
Invert Elev (ft)	= 593.14	Velocity (ft/s)	= 5.36
Slope (%)	= 0.50	Wetted Perim (ft)	= 5.28
N-Value	= 0.012	Crit Depth, Yc (ft)	= 0.72
		Top Width (ft)	= 4.00
Calculations		EGL (ft)	= 1.09
Compute by:	Known Q		
Known Q (cfs)	= 13.73		





TR-55 Tc Worksheet

Sheet Flow

	A	B	C
Manning's n-value .... =	0.33	0.011	0.011
Flow length (ft, 300 max.) =	50		
Two-yr 24-hr rain (in) .... =	3.82	3.82	
Land slope (%) .... =	3.0		
Sheet flow time .... =	8.23	0.00	0.00

Shallow Concentrated Flow

	A	B	C
Flow length (ft) .... =	405		
Watercourse slope (%) .... =	3		
Surface description .... =	Unpaved	Paved	Paved
Shallow conc. flow time .. =	2.42	0.00	0.00

Channel Flow

	A	B	C
X-sectional area (sqft) =	6.38	5.63	7.94
Wetted perimeter (ft) =	21.64	9.87	9.89
Channel slope (%) .... =	1	2.83	1
Manning's n-value ... =	0.030	0.069	0.074
Flow length (ft) .... =	100	50	407
Channel flow time .... =	0.76	0.33	3.90

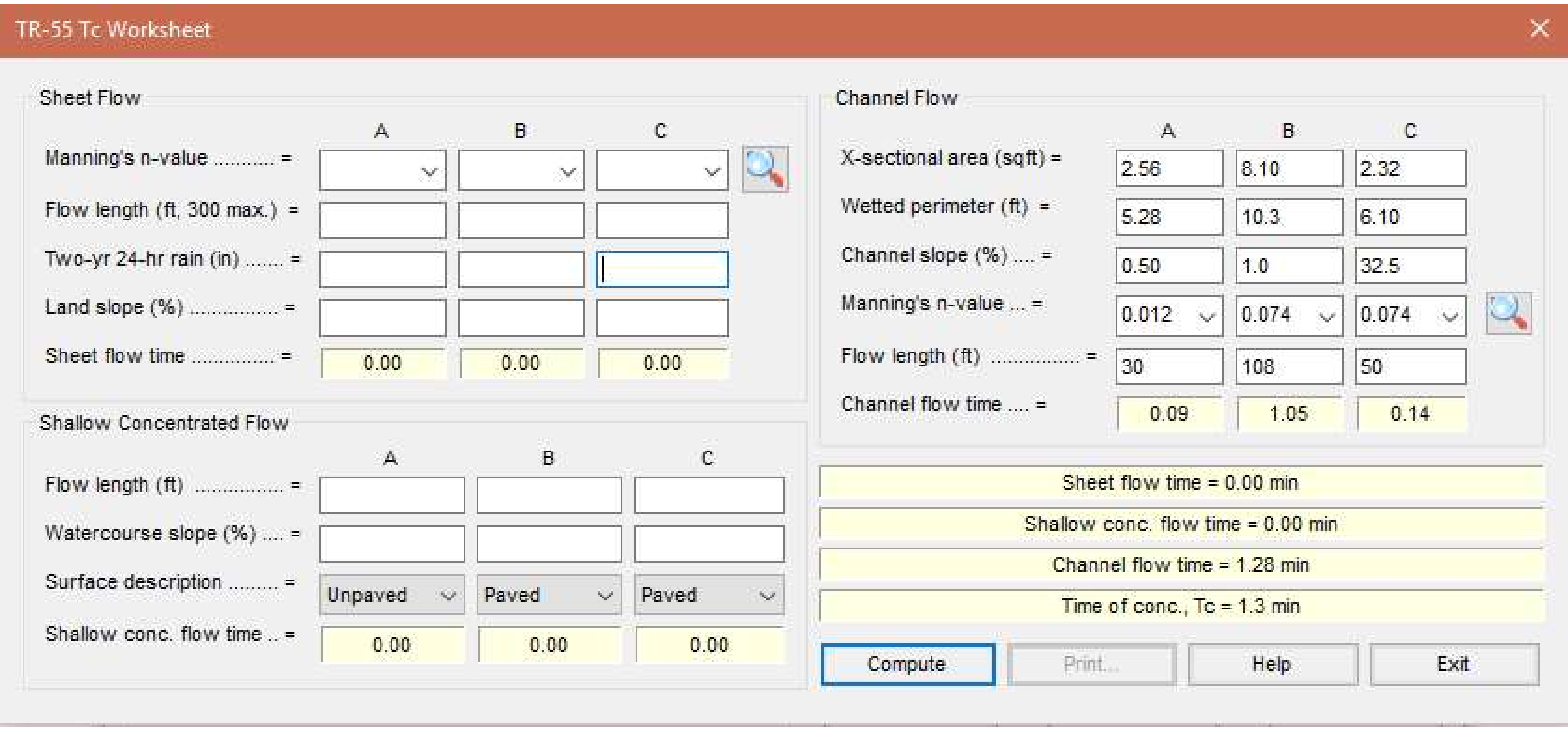
Sheet flow time = 8.23 min

Shallow conc. flow time = 2.42 min

Channel flow time = 5.00 min

Time of conc., Tc = 15.6 min

Compute | Print... | Help | Exit



TR-55 Tc Worksheet

Sheet Flow

	A	B	C
Manning's n-value .... =			
Flow length (ft, 300 max.) =			
Two-yr 24-hr rain (in) .... =			
Land slope (%) .... =			
Sheet flow time .... =	0.00	0.00	0.00

Shallow Concentrated Flow

	A	B	C
Flow length (ft) .... =			
Watercourse slope (%) .... =			
Surface description .... =	Unpaved	Paved	Paved
Shallow conc. flow time .. =	0.00	0.00	0.00

Channel Flow

	A	B	C
X-sectional area (sqft) =	2.56	8.10	2.32
Wetted perimeter (ft) =	5.28	10.3	6.10
Channel slope (%) .... =	0.50	1.0	32.5
Manning's n-value ... =	0.012	0.074	0.074
Flow length (ft) .... =	30	108	50
Channel flow time .... =	0.09	1.05	0.14

Sheet flow time = 0.00 min

Shallow conc. flow time = 0.00 min

Channel flow time = 1.28 min

Time of conc., Tc = 1.3 min

Compute | Print... | Help | Exit

TR-55 Tc Worksheet

Sheet Flow

	A	B	C
Manning's n-value .... =			
Flow length (ft, 300 max.) =			
Two-yr 24-hr rain (in) .... =			
Land slope (%) .... =			
Sheet flow time .... =	0.00	0.00	0.00

Shallow Concentrated Flow

	A	B	C
Flow length (ft) .... =			
Watercourse slope (%) .... =			
Surface description .... =	Unpaved	Paved	Paved
Shallow conc. flow time .. =	0.00	0.00	0.00

Channel Flow

	A	B	C
X-sectional area (sqft) =	7.74		
Wetted perimeter (ft) =	25.23		
Channel slope (%) .... =	4.0		
Manning's n-value ... =	0.074		
Flow length (ft) .... =	115		
Channel flow time .... =	1.05	0.00	0.00

Sheet flow time = 0.00 min

Shallow conc. flow time = 0.00 min

Channel flow time = 1.05 min

Time of conc., Tc = 1.1 min

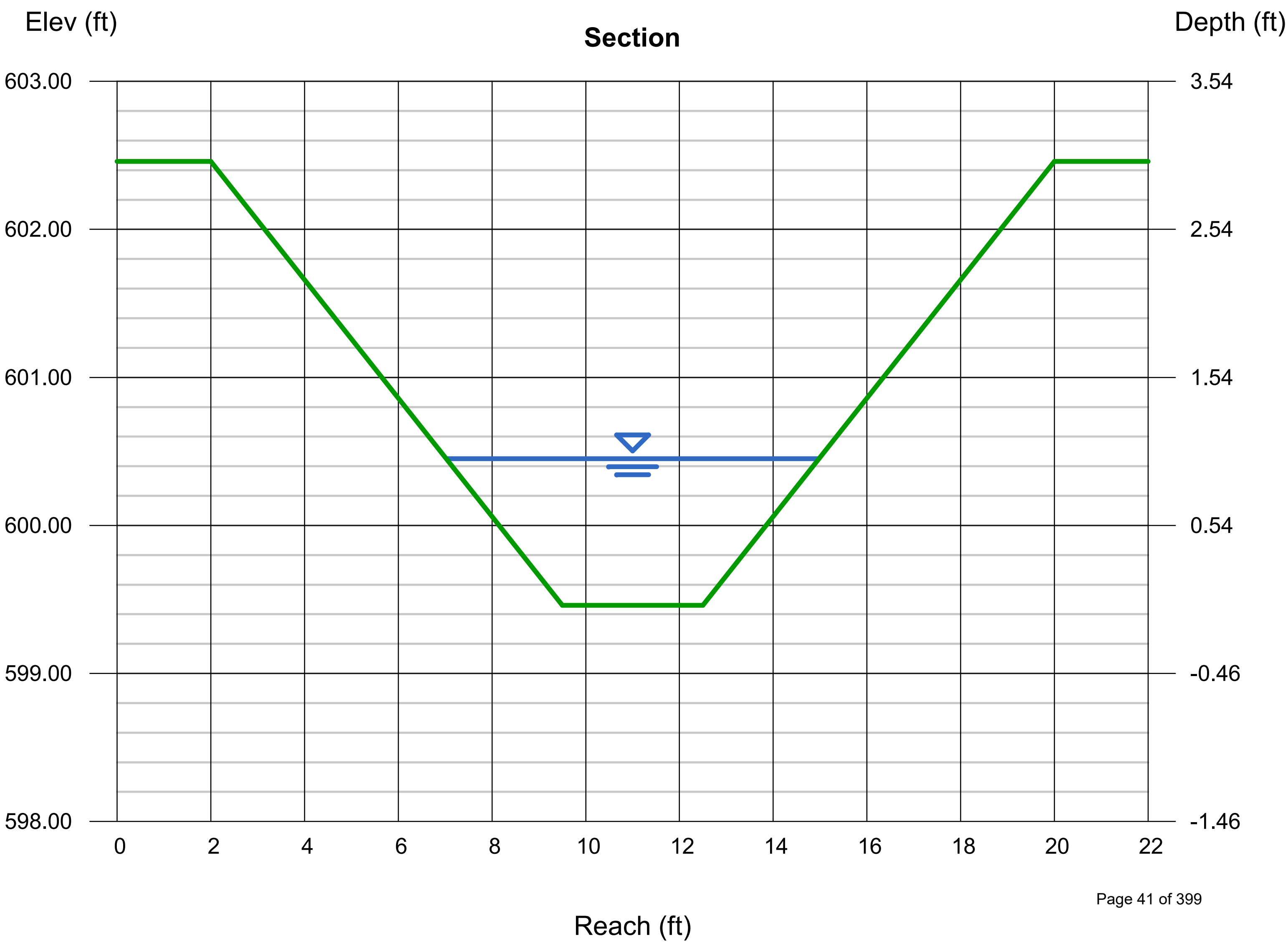
Compute | Print... | Help | Exit

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

GBASIN_3'FB@1.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 0.99
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 8.010
Total Depth (ft)	= 3.00	Area (sqft)	= 5.42
Invert Elev (ft)	= 599.46	Velocity (ft/s)	= 1.48
Slope (%)	= 1.00	Wetted Perim (ft)	= 8.33
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.52
		Top Width (ft)	= 7.95
Calculations		EGL (ft)	= 1.02
Compute by:	Known Q		
Known Q (cfs)	= 8.01		

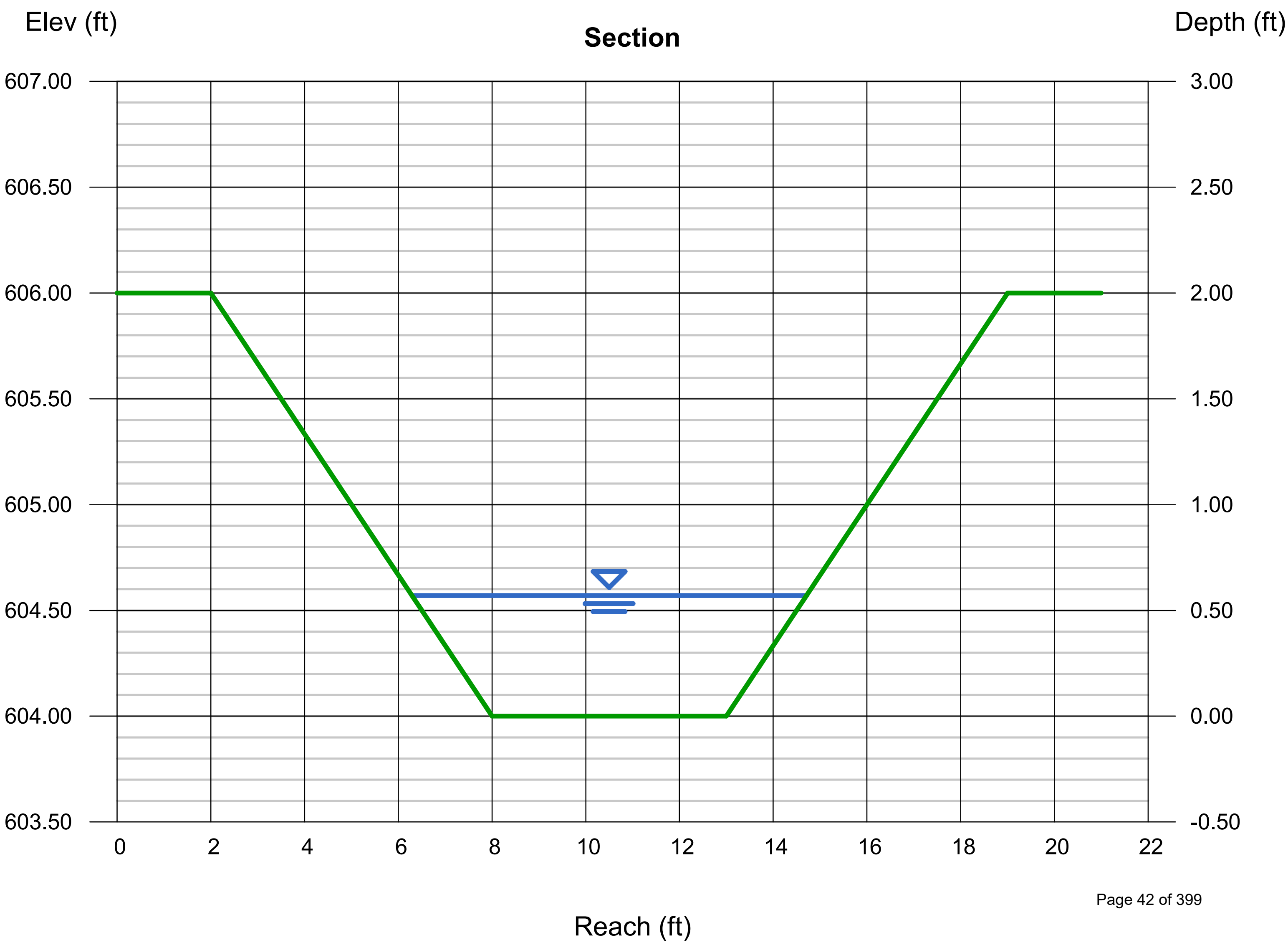


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

GBASIN_5'FB@2.83%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 5.00	Depth (ft)	= 0.57
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 8.010
Total Depth (ft)	= 2.00	Area (sqft)	= 3.82
Invert Elev (ft)	= 604.00	Velocity (ft/s)	= 2.09
Slope (%)	= 2.83	Wetted Perim (ft)	= 8.60
N-Value	= 0.069	Crit Depth, Yc (ft)	= 0.40
		Top Width (ft)	= 8.42
Calculations		EGL (ft)	= 0.64
Compute by:	Known Q		
Known Q (cfs)	= 8.01		

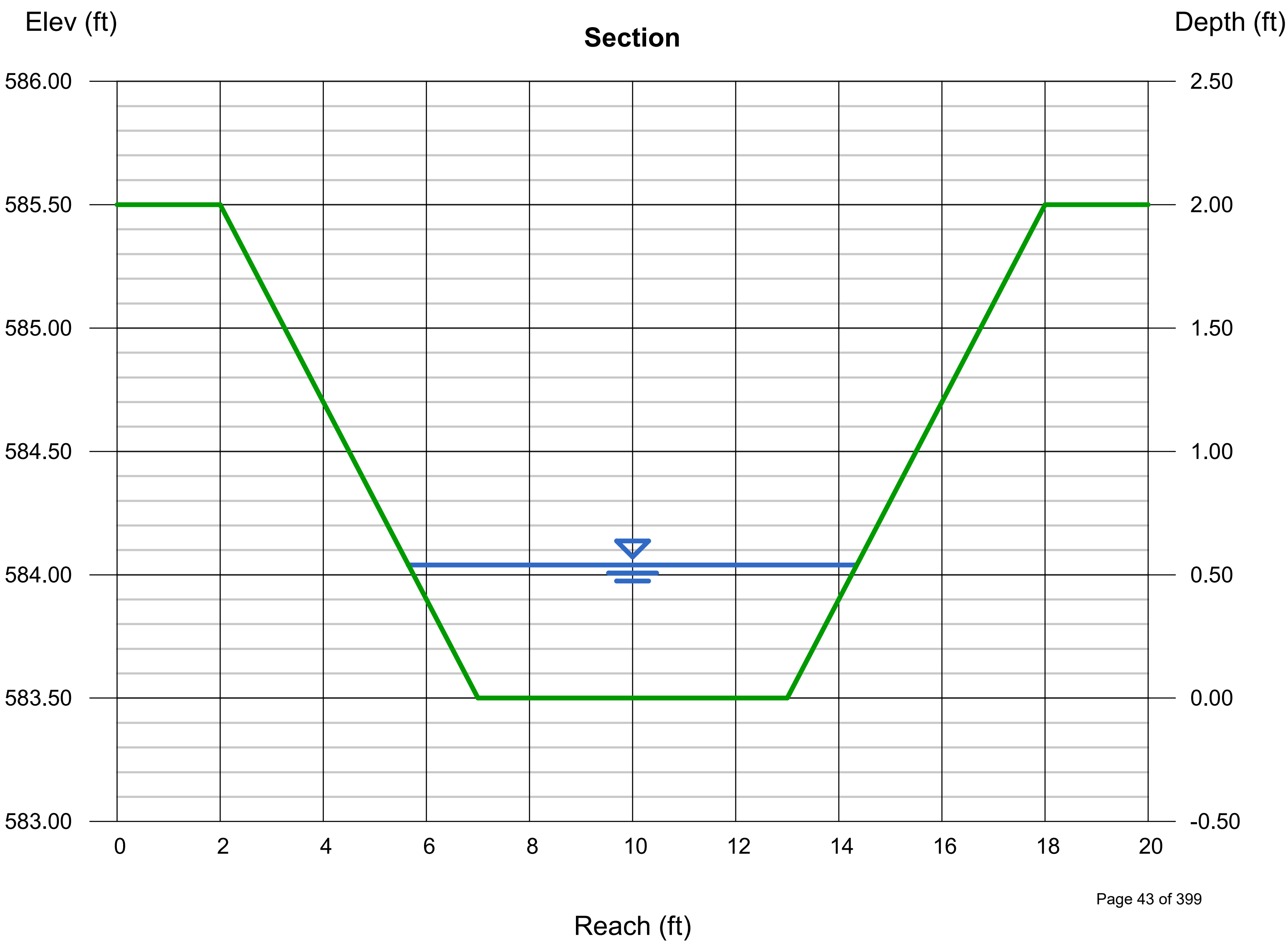


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

GBASIN_6'FB@3.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.54
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 8.010
Total Depth (ft)	= 2.00	Area (sqft)	= 3.97
Invert Elev (ft)	= 583.50	Velocity (ft/s)	= 2.02
Slope (%)	= 3.00	Wetted Perim (ft)	= 8.91
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.37
		Top Width (ft)	= 8.70
Calculations		EGL (ft)	= 0.60
Compute by:	Known Q		
Known Q (cfs)	= 8.01		

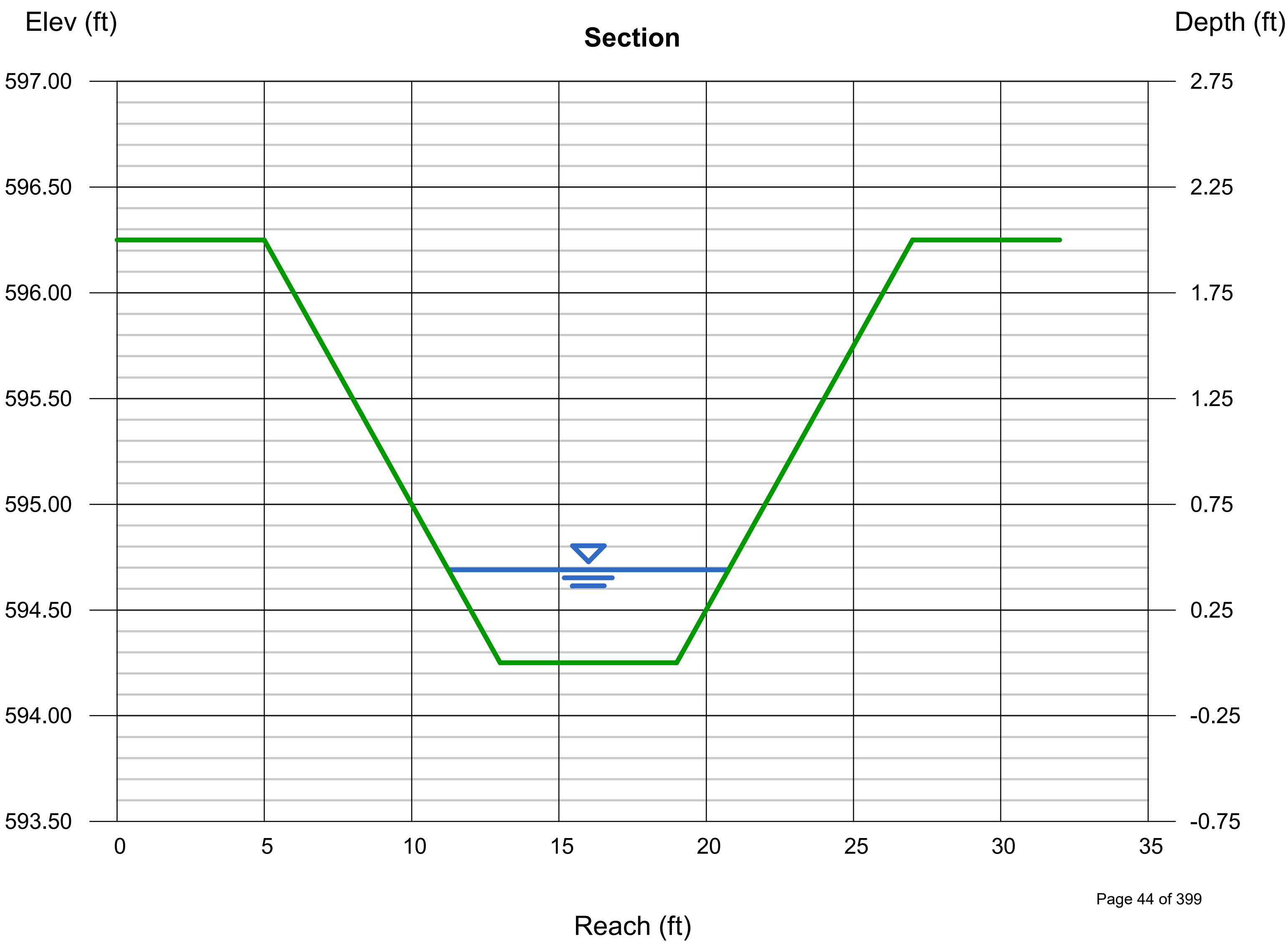


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

GBASIN_6'FB@5.5%-Tc2YR

Trapezoidal			**Highlighted**	
Bottom Width (ft)	= 6.00		Depth (ft)	= 0.44
Side Slopes (z:1)	= 4.00, 4.00		Q (cfs)	= 8.010
Total Depth (ft)	= 2.00		Area (sqft)	= 3.41
Invert Elev (ft)	= 594.25		Velocity (ft/s)	= 2.35
Slope (%)	= 5.50		Wetted Perim (ft)	= 9.63
N-Value	= 0.074		Crit Depth, Yc (ft)	= 0.36
			Top Width (ft)	= 9.52
Calculations			EGL (ft)	= 0.53
Compute by:	Known Q			
Known Q (cfs)	= 8.01			

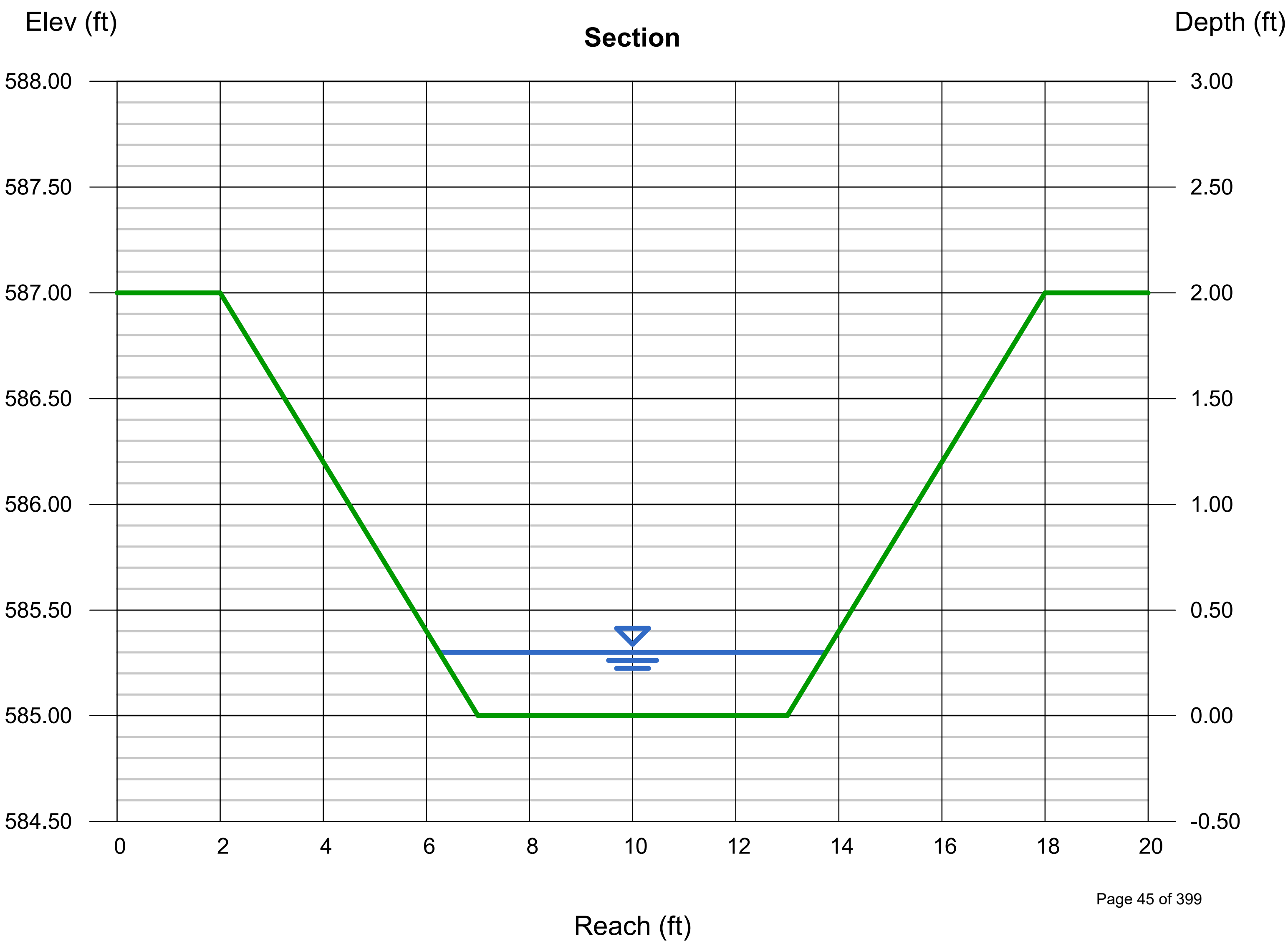


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

GBASIN_6'FB@25.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.30
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 8.010
Total Depth (ft)	= 2.00	Area (sqft)	= 2.03
Invert Elev (ft)	= 585.00	Velocity (ft/s)	= 3.96
Slope (%)	= 25.00	Wetted Perim (ft)	= 7.62
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.37
		Top Width (ft)	= 7.50
Calculations		EGL (ft)	= 0.54
Compute by:	Known Q		
Known Q (cfs)	= 8.01		

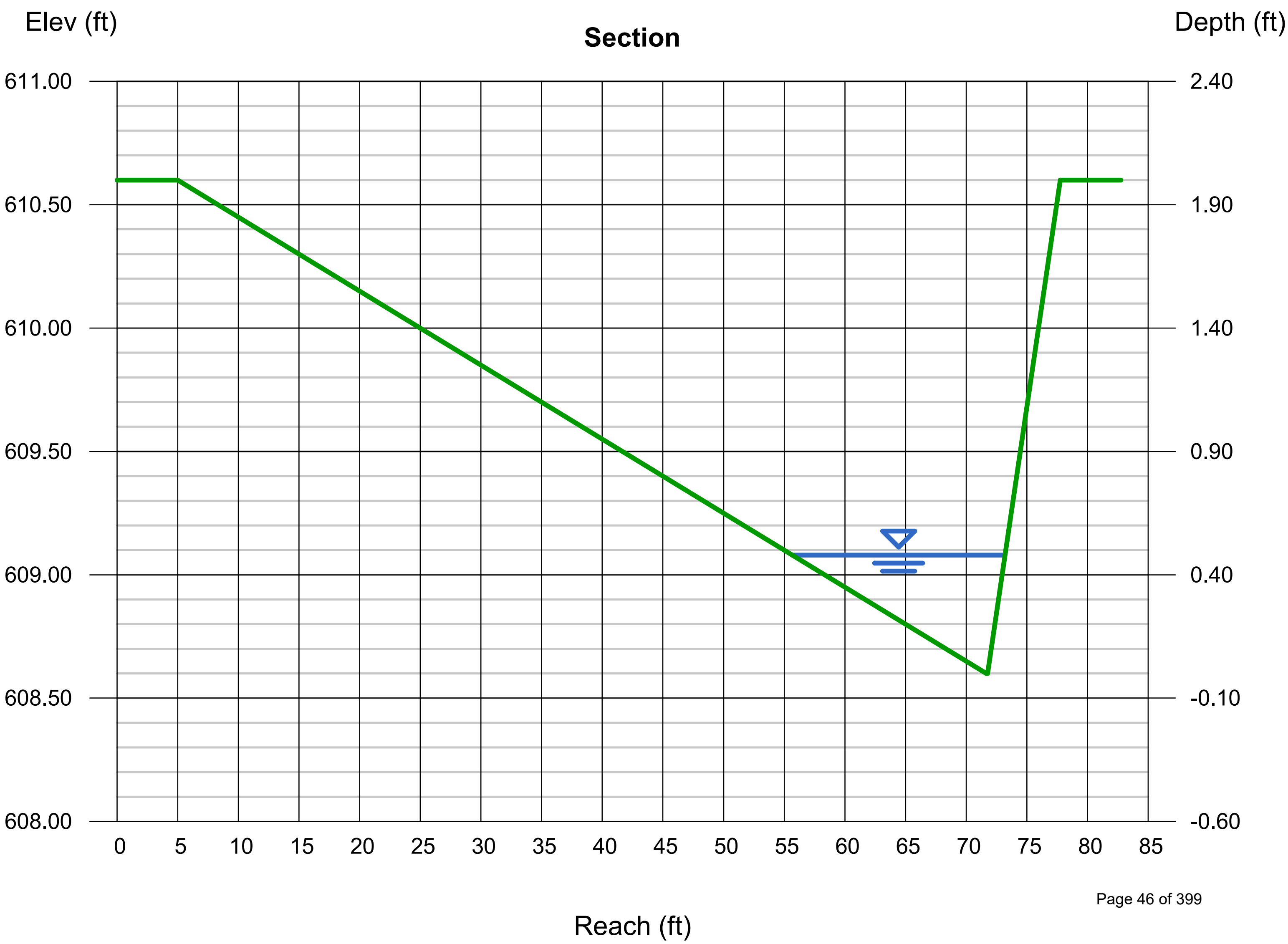


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

GBASIN_CapSwale@1.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 0.10	Depth (ft)	= 0.48
Side Slopes (z:1)	= 33.33, 3.00	Q (cfs)	= 8.010
Total Depth (ft)	= 2.00	Area (sqft)	= 4.23
Invert Elev (ft)	= 608.60	Velocity (ft/s)	= 1.89
Slope (%)	= 1.00	Wetted Perim (ft)	= 17.62
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.42
		Top Width (ft)	= 17.54
Calculations		EGL (ft)	= 0.54
Compute by:	Known Q		
Known Q (cfs)	= 8.01		



TR-55 Tc Worksheet

Sheet Flow

	A	B	C
Manning's n-value .... =	0.33		
Flow length (ft, 300 max.) =	50		
Two-yr 24-hr rain (in) .... =	3.82		
Land slope (%) .... =	3		
Sheet flow time .... =	8.23	0.00	0.00

Shallow Concentrated Flow

	A	B	C
Flow length (ft) .... =	269		
Watercourse slope (%) .... =	3		
Surface description .... =	Unpaved	Paved	Paved
Shallow conc. flow time .. =	1.60	0.00	0.00

Channel Flow

	A	B	C
X-sectional area (sqft) =	4.23	3.82	5.42
Wetted perimeter (ft) =	17.62	8.6	8.33
Channel slope (%) .... =	1	2.83	1.0
Manning's n-value ... =	0.03	0.069	0.074
Flow length (ft) .... =	281	50	163
Channel flow time .... =	2.45	0.40	1.80

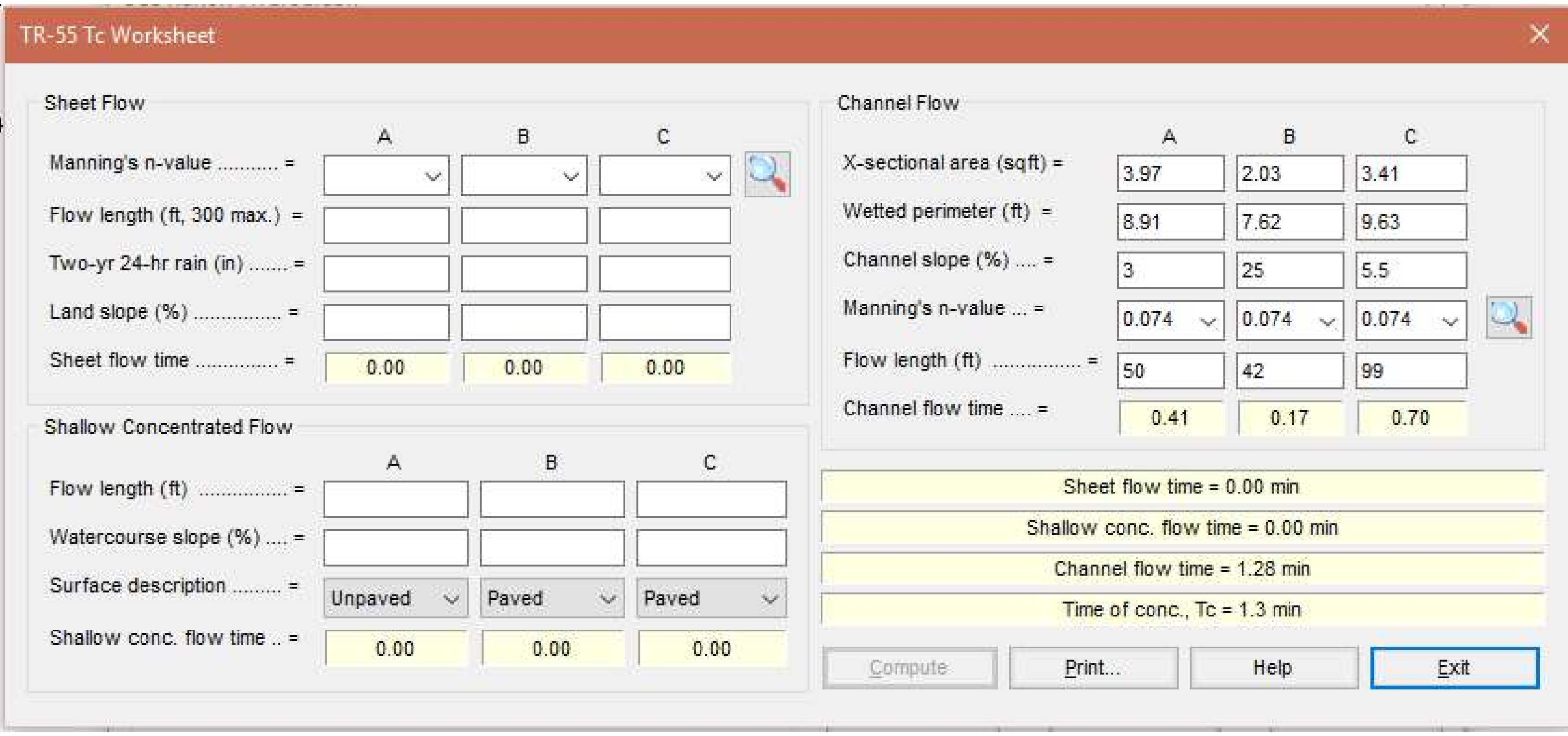
Sheet flow time = 8.23 min

Shallow conc. flow time = 1.60 min

Channel flow time = 4.65 min

Time of conc., Tc = 14.5 min

Compute | Print... | Help | Exit



TR-55 Tc Worksheet

Sheet Flow

	A	B	C
Manning's n-value .... =			
Flow length (ft, 300 max.) =			
Two-yr 24-hr rain (in) .... =			
Land slope (%) .... =			
Sheet flow time .... =	0.00	0.00	0.00

Shallow Concentrated Flow

	A	B	C
Flow length (ft) .... =			
Watercourse slope (%) .... =			
Surface description .... =	Unpaved	Paved	Paved
Shallow conc. flow time .. =	0.00	0.00	0.00

Channel Flow

	A	B	C
X-sectional area (sqft) =	3.97	2.03	3.41
Wetted perimeter (ft) =	8.91	7.62	9.63
Channel slope (%) .... =	3	25	5.5
Manning's n-value ... =	0.074	0.074	0.074
Flow length (ft) .... =	50	42	99
Channel flow time .... =	0.41	0.17	0.70

Sheet flow time = 0.00 min

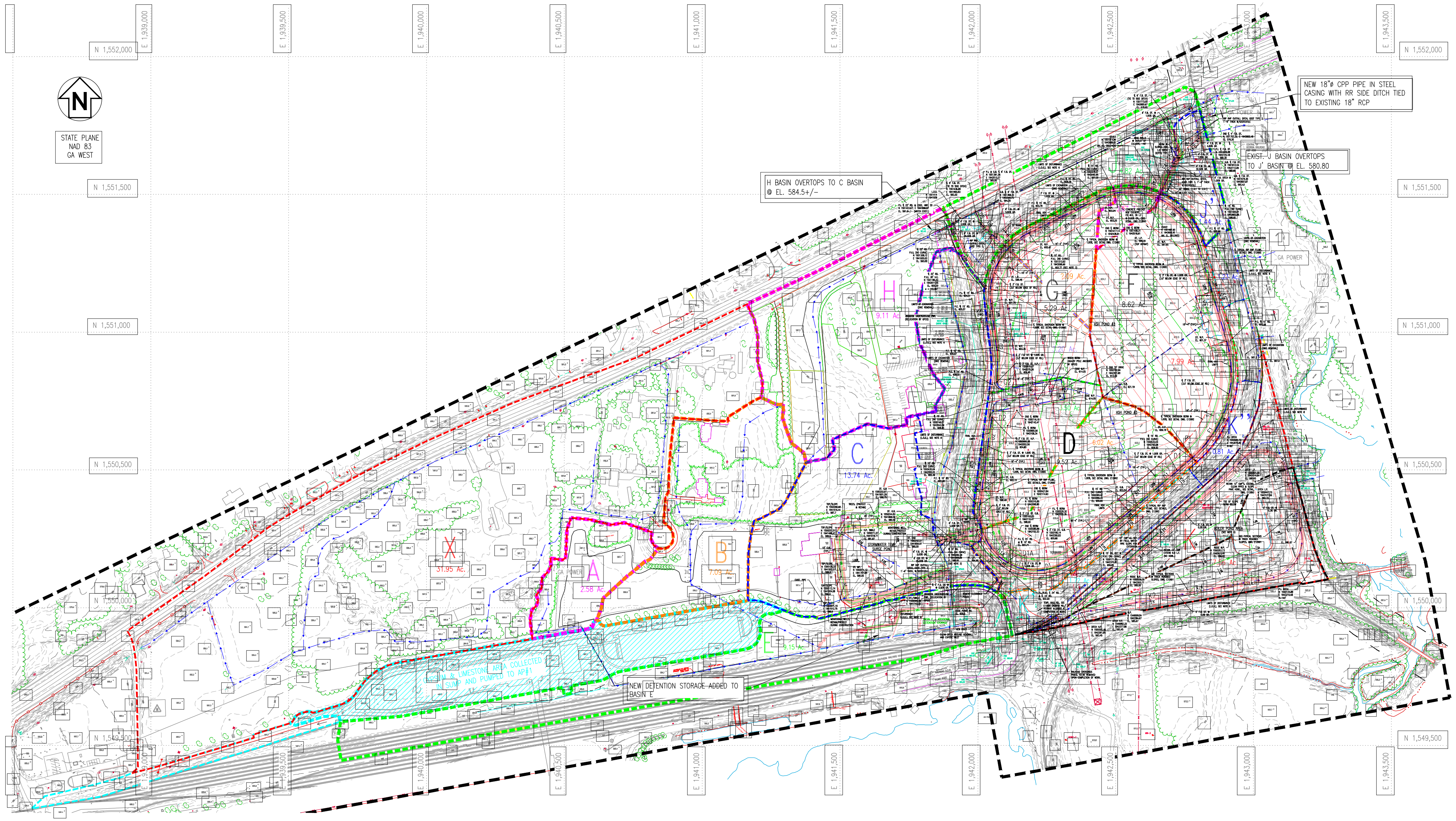
Shallow conc. flow time = 0.00 min

Channel flow time = 1.28 min

Time of conc., Tc = 1.3 min

Compute | Print... | Help | Exit

Drainage Maps
Pre- & Post-Development



SURVEY NOTES:

1. SURVEY DATA COLLECTED BY GEORGIA LAND DEPT. AND CFS SURVEY JULY 2015.
2. LIDAR TOPO FROM METRO ENGINEERING & SURVEYING CO. INC. 2012
3. CONTOUR INTERVAL 1 FOOT.
4. CONTOURS WERE PRODUCED BY DIGITAL TERRAIN MODEL.

Southern Company Generation
Engineering and Construction Services
FOR
Georgia Power Company

PLANT HAMMOND
SITE DEVELOPMENT
DRAINAGE MAP

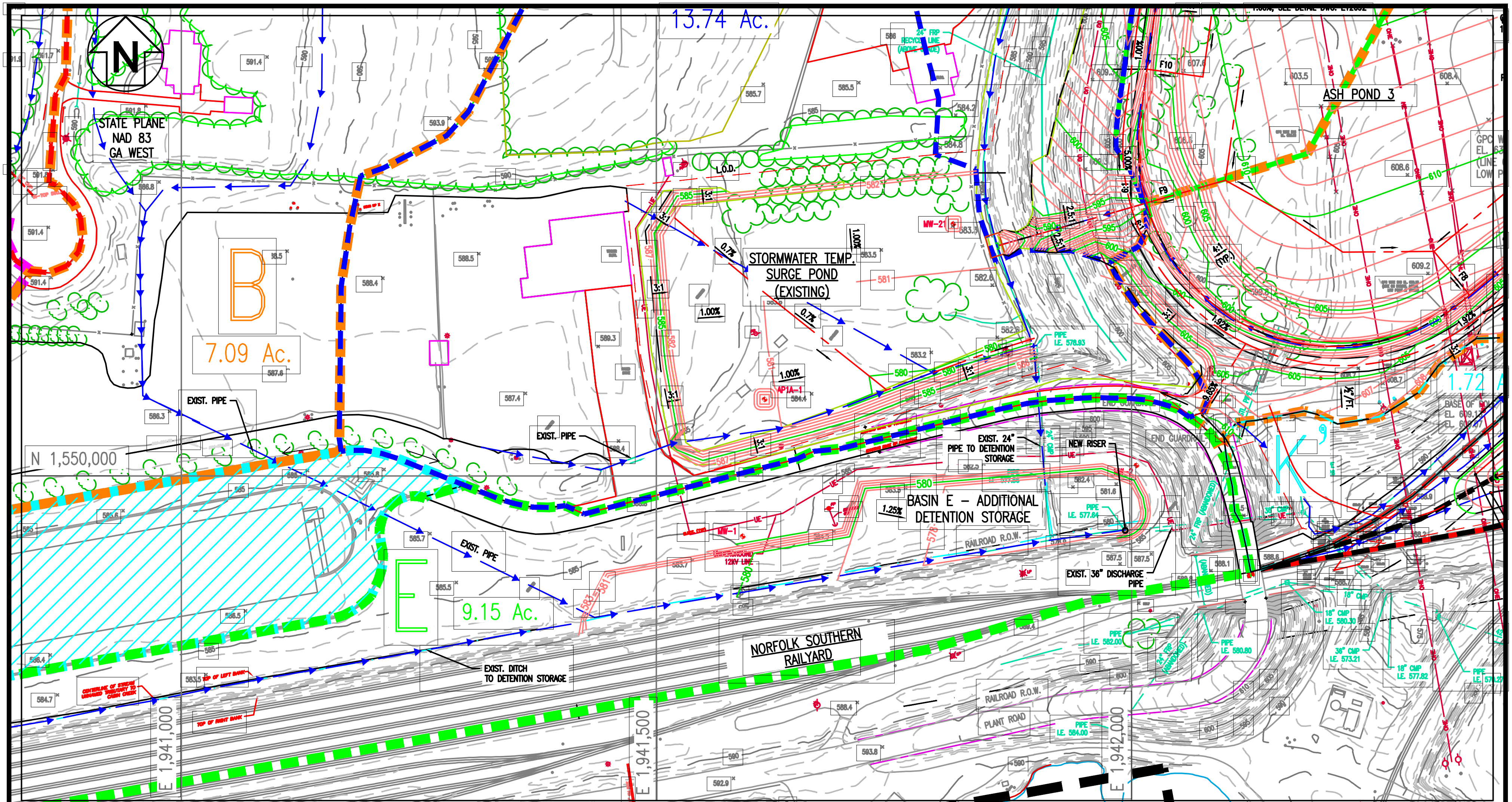
REVISION	DATE	BY	SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
A	8/7/18	CRU	1" = 150'	DRAINAGE MAP	1	FINAL	A

ANSI E: 44x34

target ZERO
Every day, every job, safely.

target ZERO
Every day, every job, safely.

target ZERO
Every day, every job, safely.



REV.	DATE	DESCRIPTION	BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR
A	11-14-18	DETENTION	CRU						

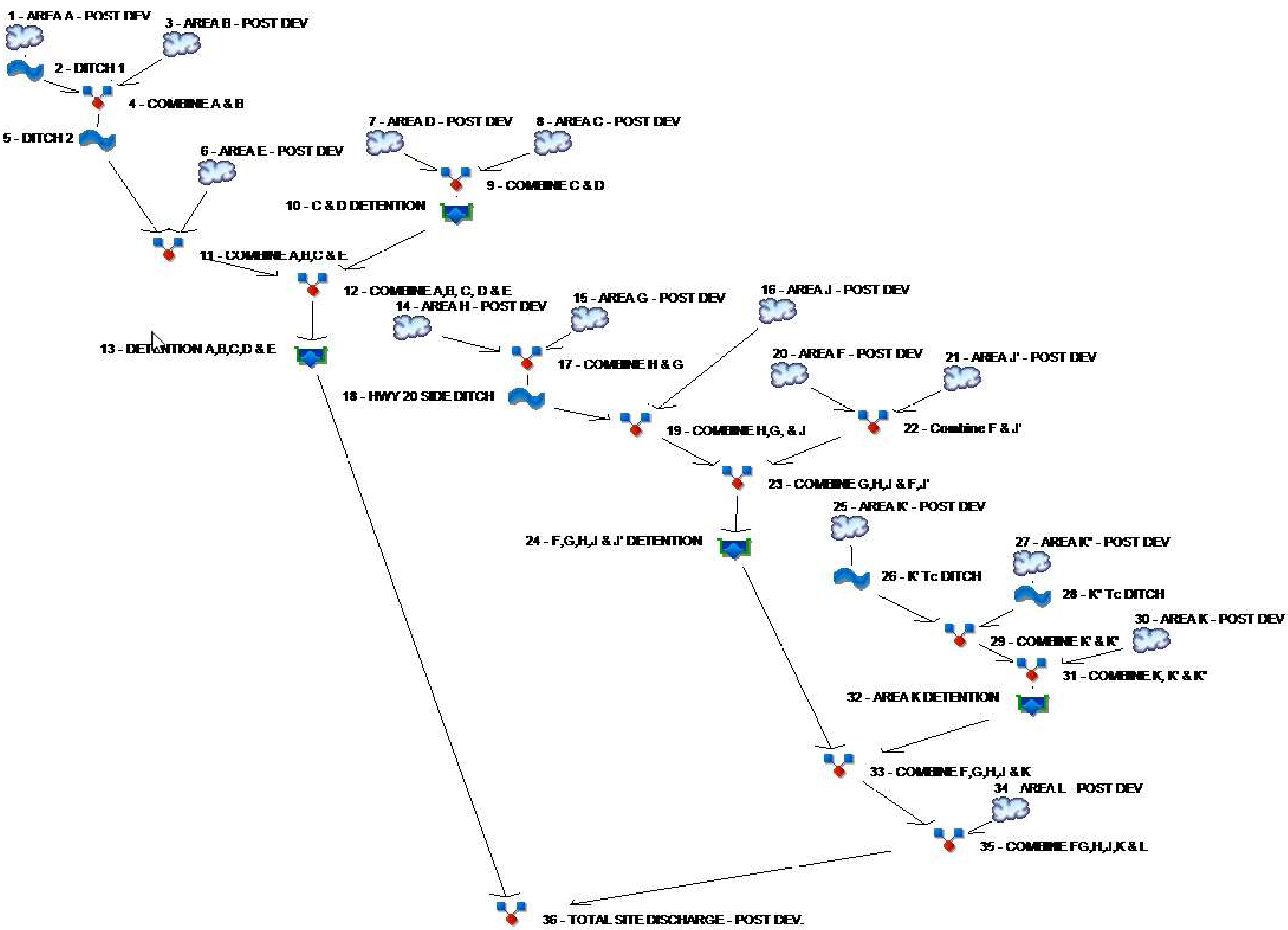
Southern Company Generation
Engineering and Construction Services
FOR
Georgia Power Company

NEW DETENTION STORAGE
DRAINAGE BASIN E

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
1"=150'	DETENTION	1	FINAL	A

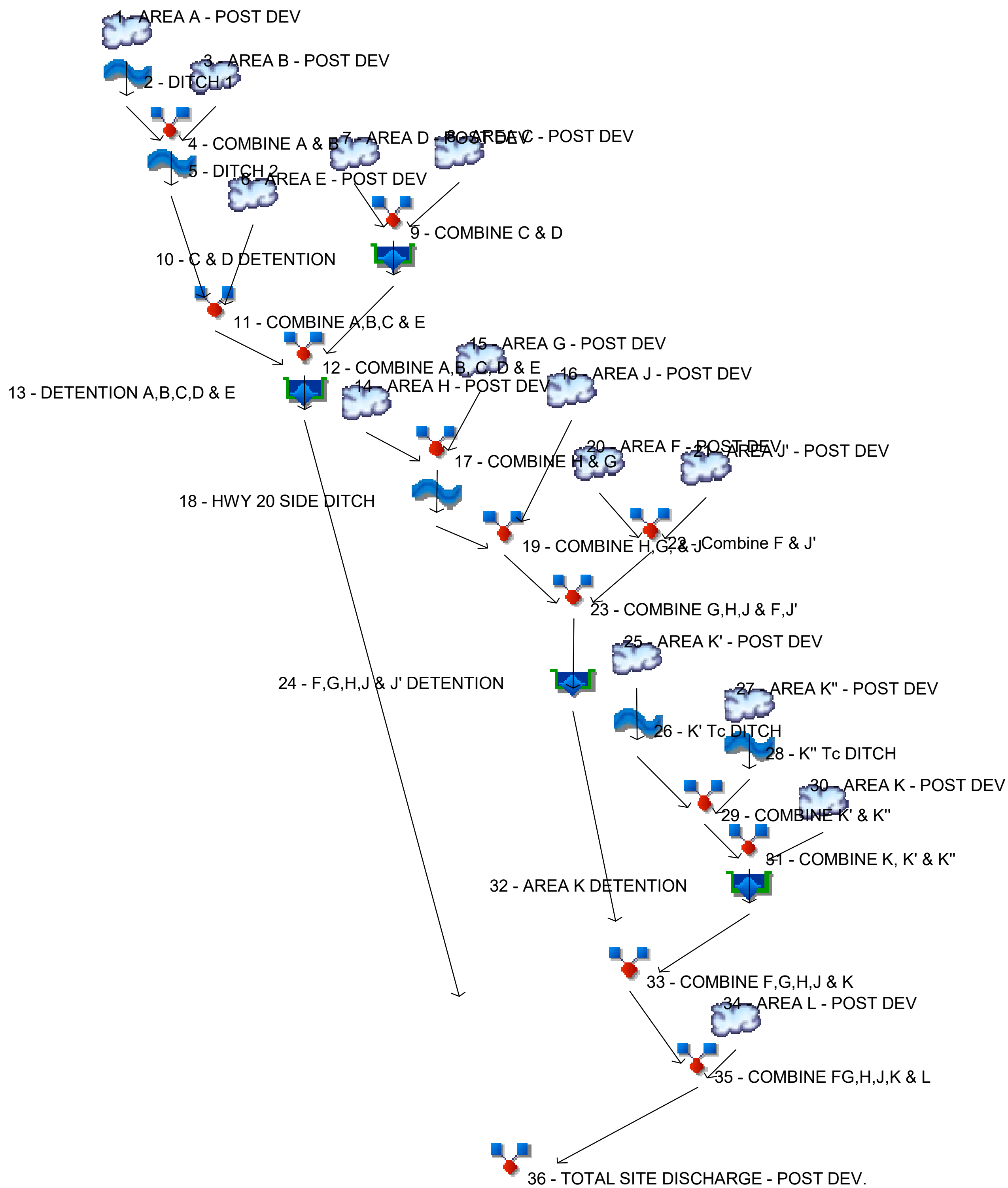
ANSI A: 11x8.5

HydraFlow Hydrographs Pre- and Post-Development Calculations


1 - AREA A - POST DEV
3 - AREA B - POST DEV
2 - DITCH 1
4 - COMBINE A & B
5 - DITCH 2
7 - AREA D - POST DEV
8 - AREA C - POST DEV
6 - AREA E - POST DEV
9 - COMBINE C & D
10 - C & D DETENTION
11 - COMBINE A,B,C & E
12 - COMBINE A,B, C, D & E
14 - AREA H - POST DEV
15 - AREA G - POST DEV
16 - AREA J - POST DEV
13 - DETENTION A,B,C,D & E
17 - COMBINE H & G
20 - AREA F - POST DEV
21 - AREA J' - POST DEV
18 - HWY 20 SIDE DITCH
19 - COMBINE H,G, & J
22 - Combine F & J'
23 - COMBINE G,H,J & F,J'
25 - AREA K' - POST DEV
24 - F,G,H,J & J' DETENTION
27 - AREA K" - POST DEV
26 - K' Tc DITCH
28 - K" Tc DITCH
30 - AREA K - POST DEV
29 - COMBINE K' & K"
31 - COMBINE K, K' & K"
32 - AREA K DETENTION
33 - COMBINE F,G,H,J & K
34 - AREA L - POST DEV
35 - COMBINE FG,H,J,K & L
36 - TOTAL SITE DISCHARGE - POST DEV.

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Project: AP3_PREDEV_SOLAR.gpw

Thursday, 11 / 15 / 2018

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	------	-------	-------	-------	-------	-------	9.405	11.34	13.37	AREA A - POST DEV
2	Reach	1	-------	-------	-------	-------	-------	9.020	10.92	12.91	DITCH 1
3	SCS Runoff	------	-------	-------	-------	-------	-------	20.45	25.11	30.03	AREA B - POST DEV
4	Combine	2, 3	-------	-------	-------	-------	-------	29.45	35.98	42.91	COMBINE A & B
5	Reach	4	-------	-------	-------	-------	-------	29.04	35.52	42.43	DITCH 2
6	SCS Runoff	------	-------	-------	-------	-------	-------	14.07	17.70	21.56	AREA E - POST DEV
7	SCS Runoff	------	-------	-------	-------	-------	-------	33.28	39.22	45.34	AREA D - POST DEV
8	SCS Runoff	------	-------	-------	-------	-------	-------	39.67	48.71	58.24	AREA C - POST DEV
9	Combine	7, 8	-------	-------	-------	-------	-------	71.83	86.55	102.01	COMBINE C & D
10	Reservoir	9	-------	-------	-------	-------	-------	15.16	15.92	16.71	C & D DETENTION
11	Combine	5, 6,	-------	-------	-------	-------	-------	39.62	48.96	58.84	COMBINE A,B,C & E
12	Combine	10, 11	-------	-------	-------	-------	-------	53.11	63.18	73.69	COMBINE A,B, C, D & E
13	Reservoir	12	-------	-------	-------	-------	-------	21.57	29.41	39.14	DETENTION A,B,C,D & E
14	SCS Runoff	------	-------	-------	-------	-------	-------	25.24	30.87	36.81	AREA H - POST DEV
15	SCS Runoff	------	-------	-------	-------	-------	-------	19.99	23.55	27.22	AREA G - POST DEV
16	SCS Runoff	------	-------	-------	-------	-------	-------	15.39	18.95	22.71	AREA J - POST DEV
17	Combine	14, 15,	-------	-------	-------	-------	-------	45.22	54.41	64.03	COMBINE H & G
18	Reach	17	-------	-------	-------	-------	-------	43.60	52.59	62.06	HWY 20 SIDE DITCH
19	Combine	16, 18	-------	-------	-------	-------	-------	54.75	66.49	78.80	COMBINE H,G, & J
20	SCS Runoff	------	-------	-------	-------	-------	-------	31.71	37.12	42.69	AREA F - POST DEV
21	SCS Runoff	------	-------	-------	-------	-------	-------	5.906	7.386	8.961	AREA J' - POST DEV
22	Combine	20, 21	-------	-------	-------	-------	-------	32.60	38.21	44.00	Combine F & J'
23	Combine	19, 22	-------	-------	-------	-------	-------	87.29	104.60	122.71	COMBINE G,H,J & F,J'
24	Reservoir	23	-------	-------	-------	-------	-------	66.47	71.49	75.75	F,G,H,J & J' DETENTION
25	SCS Runoff	------	-------	-------	-------	-------	-------	4.453	5.594	6.822	AREA K' - POST DEV
26	Reach	25	-------	-------	-------	-------	-------	3.466	4.429	5.475	K' Tc DITCH
27	SCS Runoff	------	-------	-------	-------	-------	-------	2.004	2.532	3.101	AREA K'' - POST DEV
28	Reach	27	-------	-------	-------	-------	-------	1.337	1.732	2.162	K'' Tc DITCH
29	Combine	26, 28	-------	-------	-------	-------	-------	4.784	6.145	7.611	COMBINE K' & K''
30	SCS Runoff	------	-------	-------	-------	-------	-------	18.71	23.63	28.94	AREA K - POST DEV
31	Combine	29, 30	-------	-------	-------	-------	-------	22.56	28.70	35.31	COMBINE K, K' & K''
32	Reservoir	31	-------	-------	-------	-------	-------	6.523	7.119	7.727	AREA K DETENTION
33	Combine	24, 32	-------	-------	-------	-------	-------	72.92	78.53	83.41	COMBINE F,G,H,J & K
34	SCS Runoff	------	-------	-------	-------	-------	-------	4.086	5.133	6.249	AREA L - POST DEV

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	
35	Combine	33, 34	-------	-------	-------	-------	-------	73.59	79.30	84.28	COMBINE FG,H,J,K & L
36	Combine	13, 35	-------	-------	-------	-------	-------	73.59	96.80	119.63	TOTAL SITE DISCHARGE - POST D

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	SCS Runoff	9.405	1	725	29,429	------	------	------	AREA A - POST DEV
2	Reach	9.020	1	728	29,427	1	------	------	DITCH 1
3	SCS Runoff	20.45	1	727	70,362	------	------	------	AREA B - POST DEV
4	Combine	29.45	1	728	99,789	2, 3	------	------	COMBINE A & B
5	Reach	29.04	1	730	99,788	4	------	------	DITCH 2
6	SCS Runoff	14.07	1	742	79,687	------	------	------	AREA E - POST DEV
7	SCS Runoff	33.28	1	731	132,879	------	------	------	AREA D - POST DEV
8	SCS Runoff	39.67	1	727	136,457	------	------	------	AREA C - POST DEV
9	Combine	71.83	1	729	269,335	7, 8	------	------	COMBINE C & D
10	Reservoir	15.16	1	759	269,335	9	582.16	94,511	C & D DETENTION
11	Combine	39.62	1	731	179,475	5, 6,	------	------	COMBINE A,B,C & E
12	Combine	53.11	1	732	448,810	10, 11	------	------	COMBINE A,B, C, D & E
13	Reservoir	21.57	1	788	305,768	12	582.14	160,171	DETENTION A,B,C,D & E
14	SCS Runoff	25.24	1	730	95,092	------	------	------	AREA H - POST DEV
15	SCS Runoff	19.99	1	729	74,414	------	------	------	AREA G - POST DEV
16	SCS Runoff	15.39	1	724	46,094	------	------	------	AREA J - POST DEV
17	Combine	45.22	1	729	169,506	14, 15,	------	------	COMBINE H & G
18	Reach	43.60	1	733	169,504	17	------	------	HWY 20 SIDE DITCH
19	Combine	54.75	1	730	215,598	16, 18	------	------	COMBINE H,G, & J
20	SCS Runoff	31.71	1	731	126,821	------	------	------	AREA F - POST DEV
21	SCS Runoff	5.906	1	718	11,907	------	------	------	AREA J' - POST DEV
22	Combine	32.60	1	731	138,728	20, 21	------	------	Combine F & J'
23	Combine	87.29	1	731	354,326	19, 22	------	------	COMBINE G,H,J & F,J'
24	Reservoir	66.47	1	741	354,326	23	580.30	24,089	F,G,H,J & J' DETENTION
25	SCS Runoff	4.453	1	726	14,349	------	------	------	AREA K' - POST DEV
26	Reach	3.466	1	733	14,343	25	------	------	K' Tc DITCH
27	SCS Runoff	2.004	1	726	6,495	------	------	------	AREA K'' - POST DEV
28	Reach	1.337	1	735	6,486	27	------	------	K'' Tc DITCH
29	Combine	4.784	1	734	20,829	26, 28	------	------	COMBINE K' & K''
30	SCS Runoff	18.71	1	726	60,617	------	------	------	AREA K - POST DEV
31	Combine	22.56	1	726	81,447	29, 30	------	------	COMBINE K, K' & K''
32	Reservoir	6.523	1	750	81,312	31	582.34	24,329	AREA K DETENTION
33	Combine	72.92	1	741	435,635	24, 32	------	------	COMBINE F,G,H,J & K
34	SCS Runoff	4.086	1	721	10,038	------	------	------	AREA L - POST DEV

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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
35	Combine	73.59	1	741	445,674	33, 34	------	------	COMBINE FG,H,J,K & L
36	Combine	73.59	1	741	751,440	13, 35	------	------	TOTAL SITE DISCHARGE - POST D

Hydrograph Report

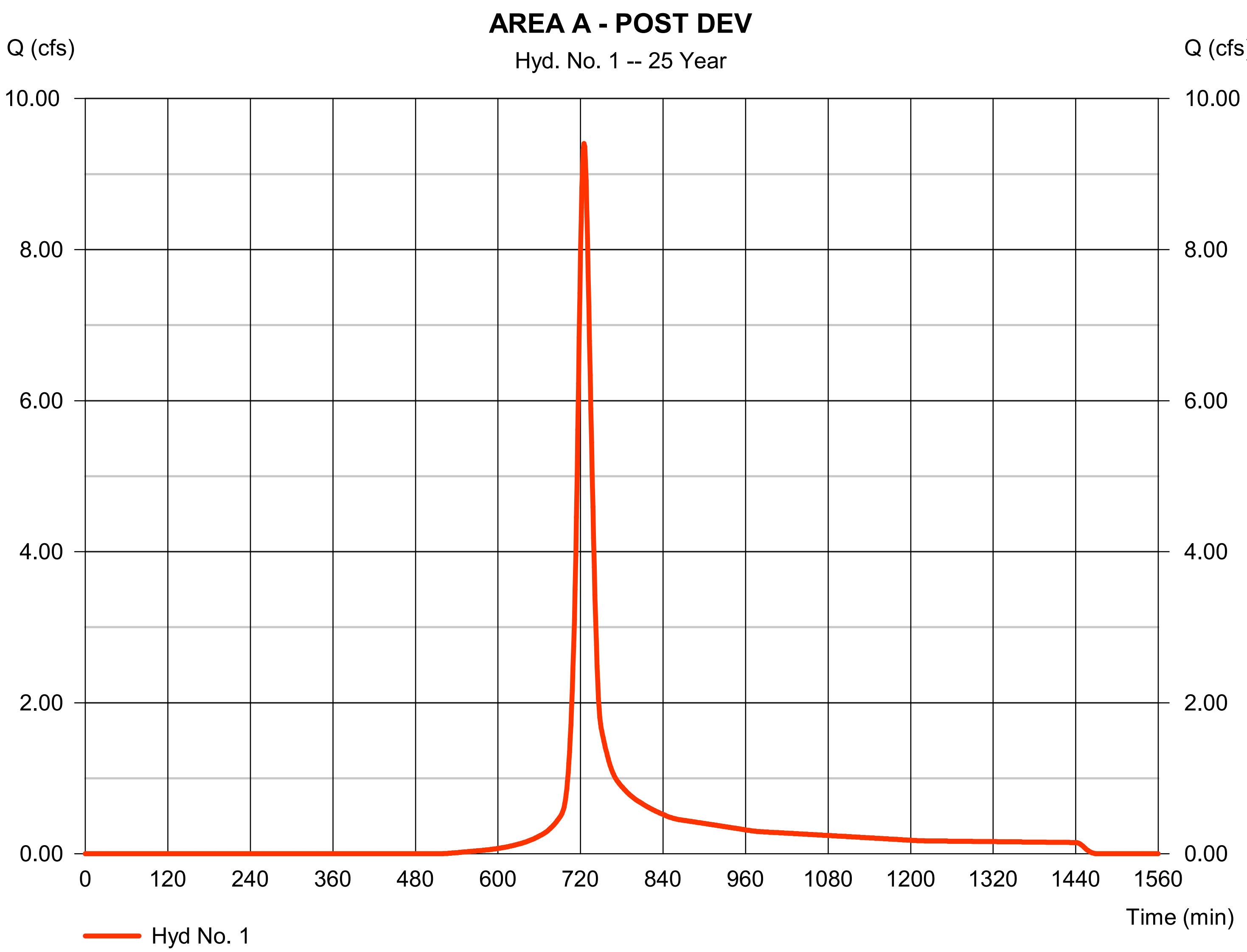
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 1

AREA A - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 9.405 cfs
Storm frequency	= 25 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 29,429 cuft
Drainage area	= 2.580 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.10 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.220 x 85) + (0.570 x 55) + (0.030 x 98) + (0.760 x 60)] / 2.580



TR55 Tc Worksheet

Hyd. No. 1

AREA A - POST DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 50.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		0.00		0.00		
Land slope (%)	= 16.00		0.00		0.00		
Travel Time (min)	**= 3.27**	**+**	**0.00**	**+**	**0.00**	**=**	**3.27**
Shallow Concentrated Flow							
Flow length (ft)	= 620.00		0.00		0.00		
Watercourse slope (%)	= 0.17		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=0.67		0.00		0.00		
Travel Time (min)	**= 15.53**	**+**	**0.00**	**+**	**0.00**	**=**	**15.53**
Channel Flow							
X sectional flow area (sqft)	= 2.89		0.00		0.00		
Wetted perimeter (ft)	= 7.29		0.00		0.00		
Channel slope (%)	= 0.50		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=1.89		0.00		0.00		
Flow length (ft)	({0})150.0		0.0		0.0		
Travel Time (min)	**= 1.32**	**+**	**0.00**	**+**	**0.00**	**=**	**1.32**
Total Travel Time, Tc							**20.10 min**

Hydrograph Report

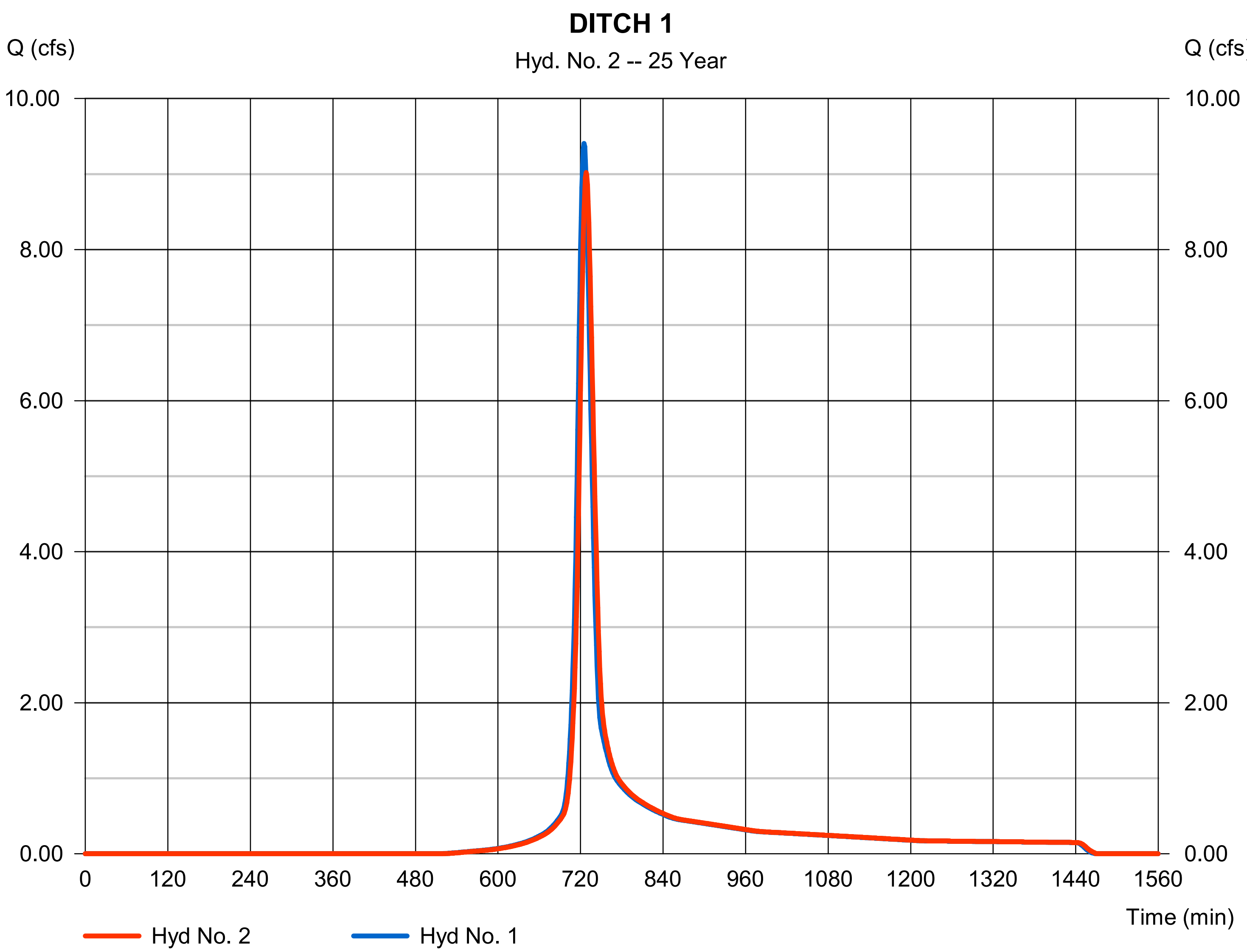
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 2

DITCH 1

Hydrograph type	= Reach	Peak discharge	= 9.020 cfs
Storm frequency	= 25 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 29,427 cuft
Inflow hyd. No.	= 1 - AREA A - POST DEV	Section type	= Trapezoidal
Reach length	= 730.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 10.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.375
Ave. velocity	= 3.17 ft/s	Routing coeff.	= 0.3038

Modified Att-Kin routing method used.



Hydrograph Report

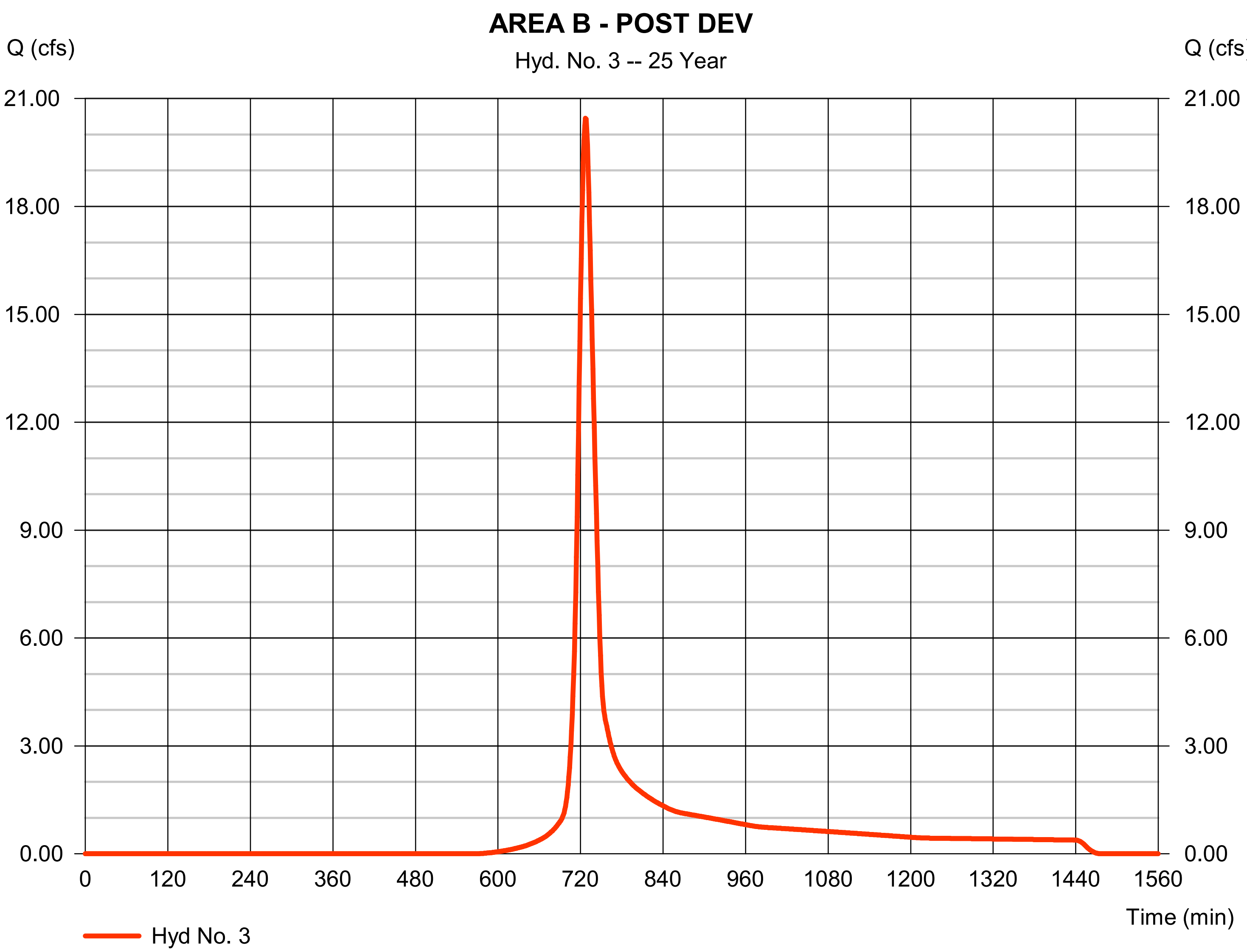
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 3

AREA B - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 20.45 cfs
Storm frequency	= 25 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 70,362 cuft
Drainage area	= 7.090 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.60 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.930 x 85) + (2.120 x 55) + (0.250 x 98) + (2.790 x 60)] / 7.090



TR55 Tc Worksheet

Hyd. No. 3

AREA B - POST DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.300		0.011		0.011		
Flow length (ft)	= 150.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		0.00		0.00		
Land slope (%)	= 3.60		0.00		0.00		
Travel Time (min)	**= 17.07**	**+**	**0.00**	**+**	**0.00**	**=**	**17.07**
Shallow Concentrated Flow							
Flow length (ft)	= 0.00		0.00		0.00		
Watercourse slope (%)	= 0.00		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=0.00		0.00		0.00		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow							
X sectional flow area (sqft)	= 5.60		5.04		0.00		
Wetted perimeter (ft)	= 18.05		14.27		0.00		
Channel slope (%)	= 0.80		0.66		0.00		
Manning's n-value	= 0.030		0.027		0.015		
Velocity (ft/s)	=2.03		2.23		0.00		
Flow length (ft)	({0})500.0		320.0		0.0		
Travel Time (min)	**= 4.11**	**+**	**2.39**	**+**	**0.00**	**=**	**6.50**

Total Travel Time, Tc .... 23.60 min

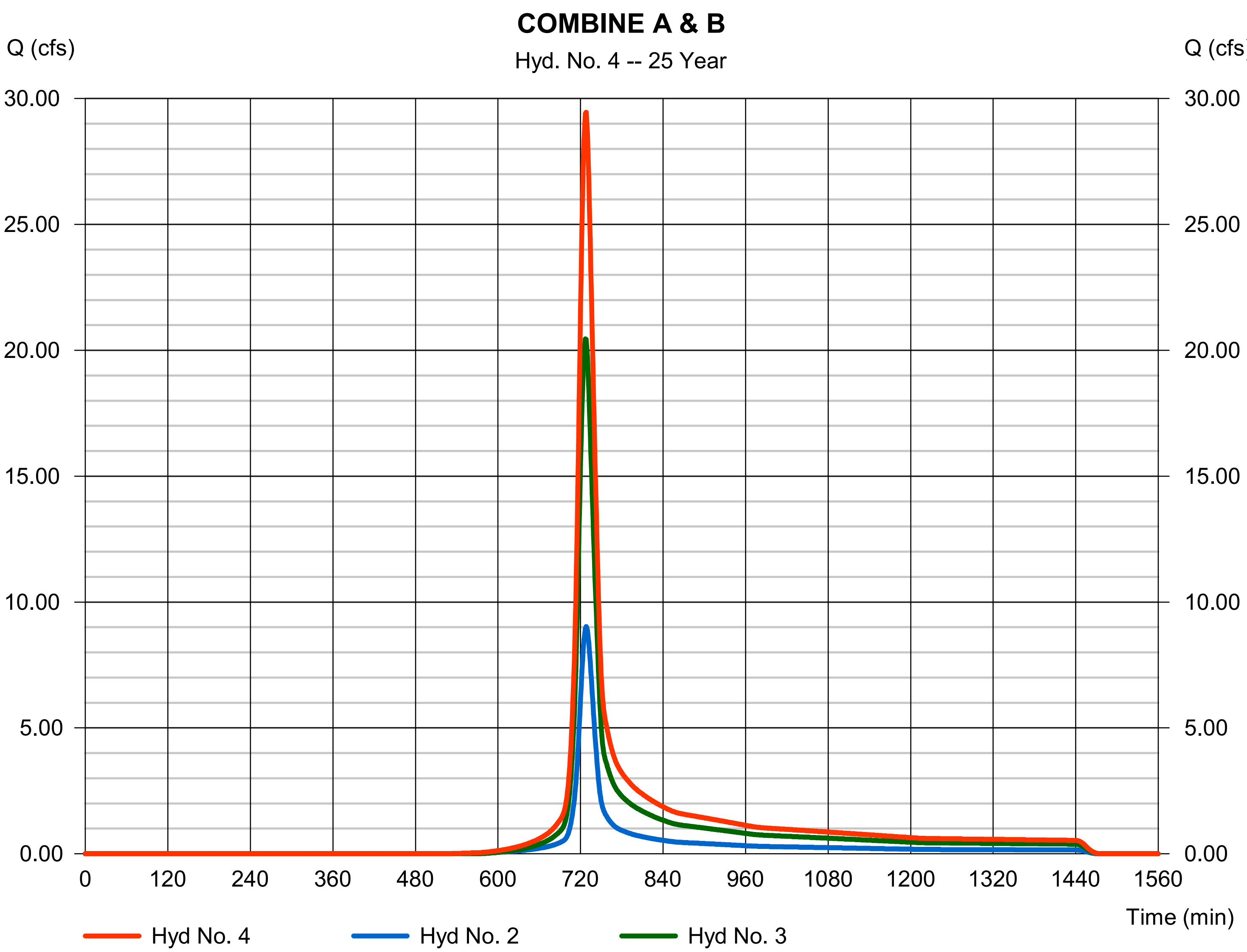
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 4

COMBINE A & B

Hydrograph type	= Combine	Peak discharge	= 29.45 cfs
Storm frequency	= 25 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 99,789 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 7.090 ac



Hydrograph Report

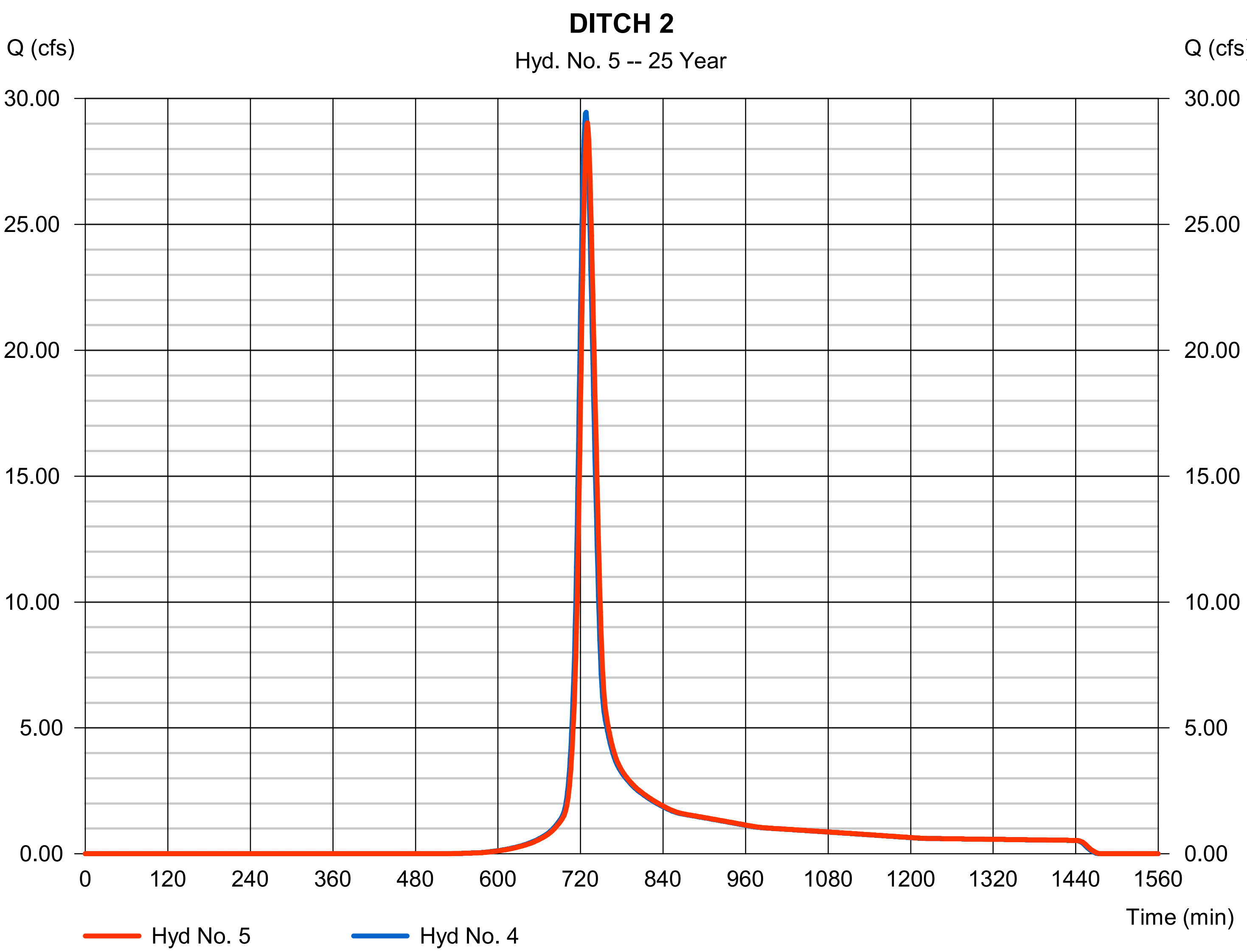
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 5

DITCH 2

Hydrograph type	= Reach	Peak discharge	= 29.04 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 99,788 cuft
Inflow hyd. No.	= 4 - COMBINE A & B	Section type	= Trapezoidal
Reach length	= 610.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.373
Ave. velocity	= 4.31 ft/s	Routing coeff.	= 0.4511

Modified Att-Kin routing method used.



Hydrograph Report

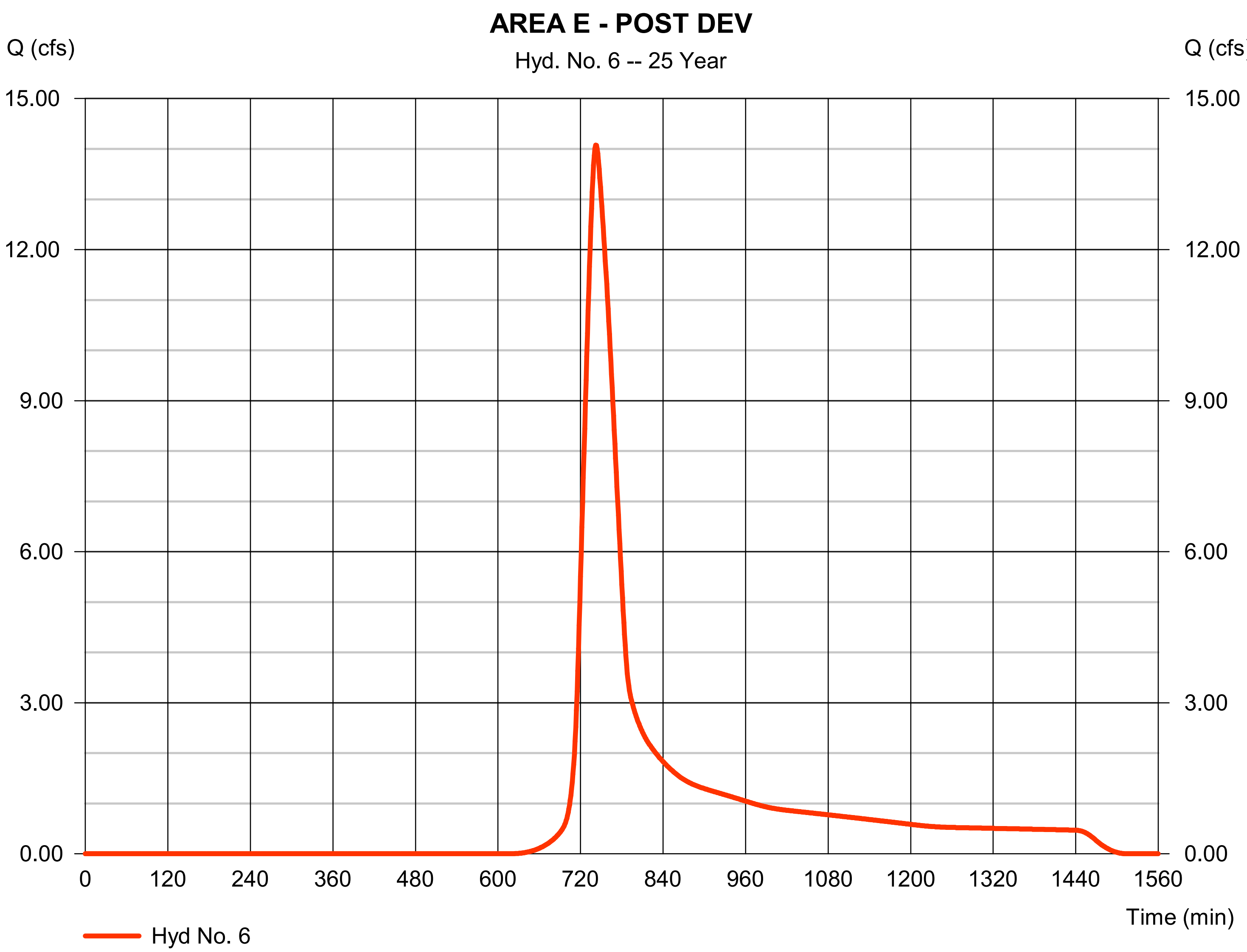
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 6

AREA E - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 14.07 cfs
Storm frequency	= 25 yrs	Time to peak	= 742 min
Time interval	= 1 min	Hyd. volume	= 79,687 cuft
Drainage area	= 9.150 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 47.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.680 x 65) + (0.330 x 98) + (5.140 x 60)] / 9.150



TR55 Tc Worksheet

Hyd. No. 6

AREA E - POST DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 80.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		0.00		0.00		
Land slope (%)	= 1.20		0.00		0.00		
Travel Time (min)	**= 13.40**	**+**	**0.00**	**+**	**0.00**	**=**	**13.40**
Shallow Concentrated Flow							
Flow length (ft)	= 0.00		0.00		0.00		
Watercourse slope (%)	= 0.00		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=0.00		0.00		0.00		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow							
X sectional flow area (sqft)	= 7.51		5.60		0.00		
Wetted perimeter (ft)	= 19.73		9.32		0.00		
Channel slope (%)	= 0.45		0.45		0.00		
Manning's n-value	= 0.065		0.065		0.015		
Velocity (ft/s)	=0.81		1.09		0.00		
Flow length (ft)	({0})520.0		1500.0		0.0		
Travel Time (min)	**= 10.76**	**+**	**22.87**	**+**	**0.00**	**=**	**33.63**

Total Travel Time, Tc .... 47.00 min

Hydrograph Report

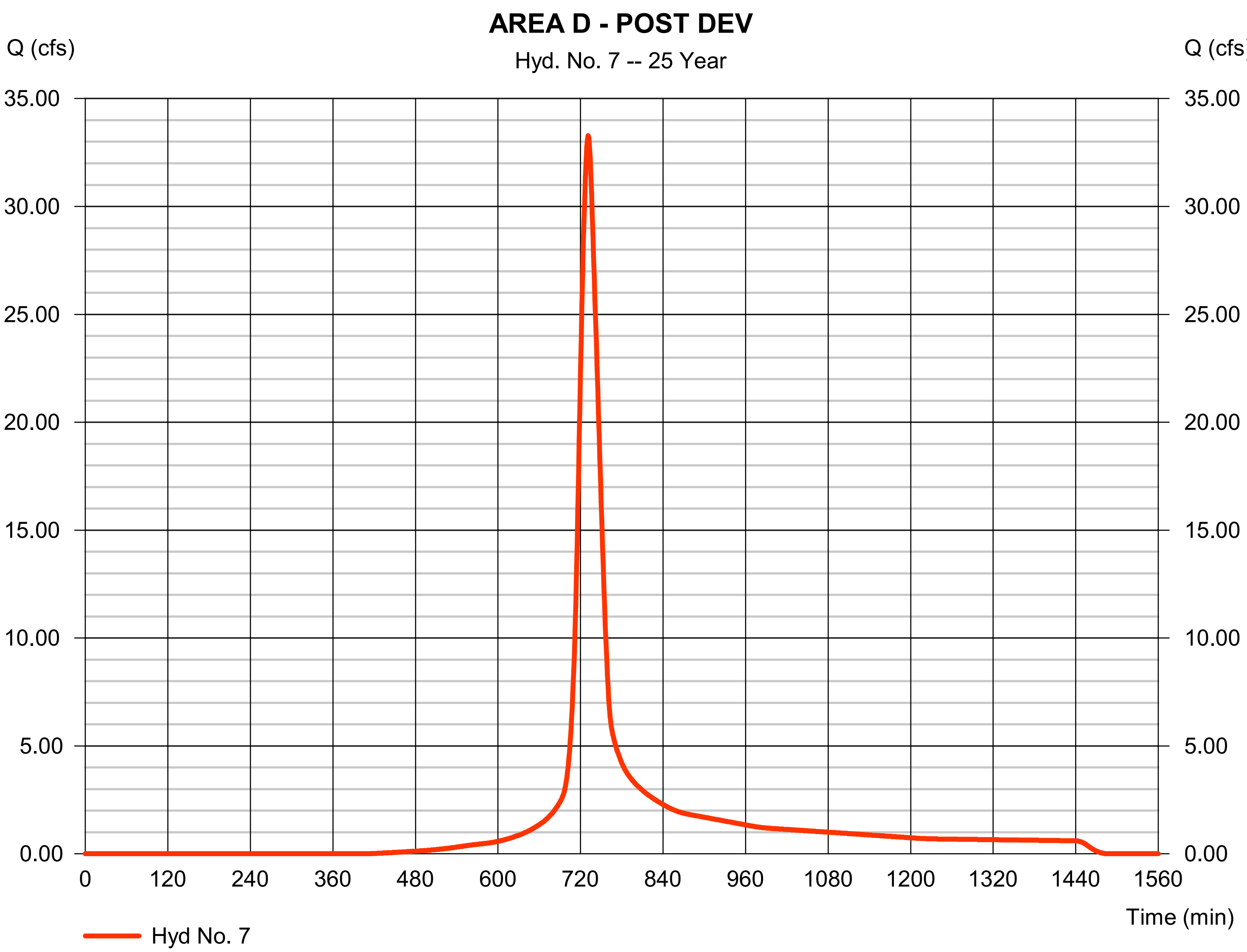
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 7

AREA D - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 33.28 cfs
Storm frequency	= 25 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 132,879 cuft
Drainage area	= 9.520 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.10 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.910 x 85) + (8.610 x 77)] / 9.520



Hydrograph Report

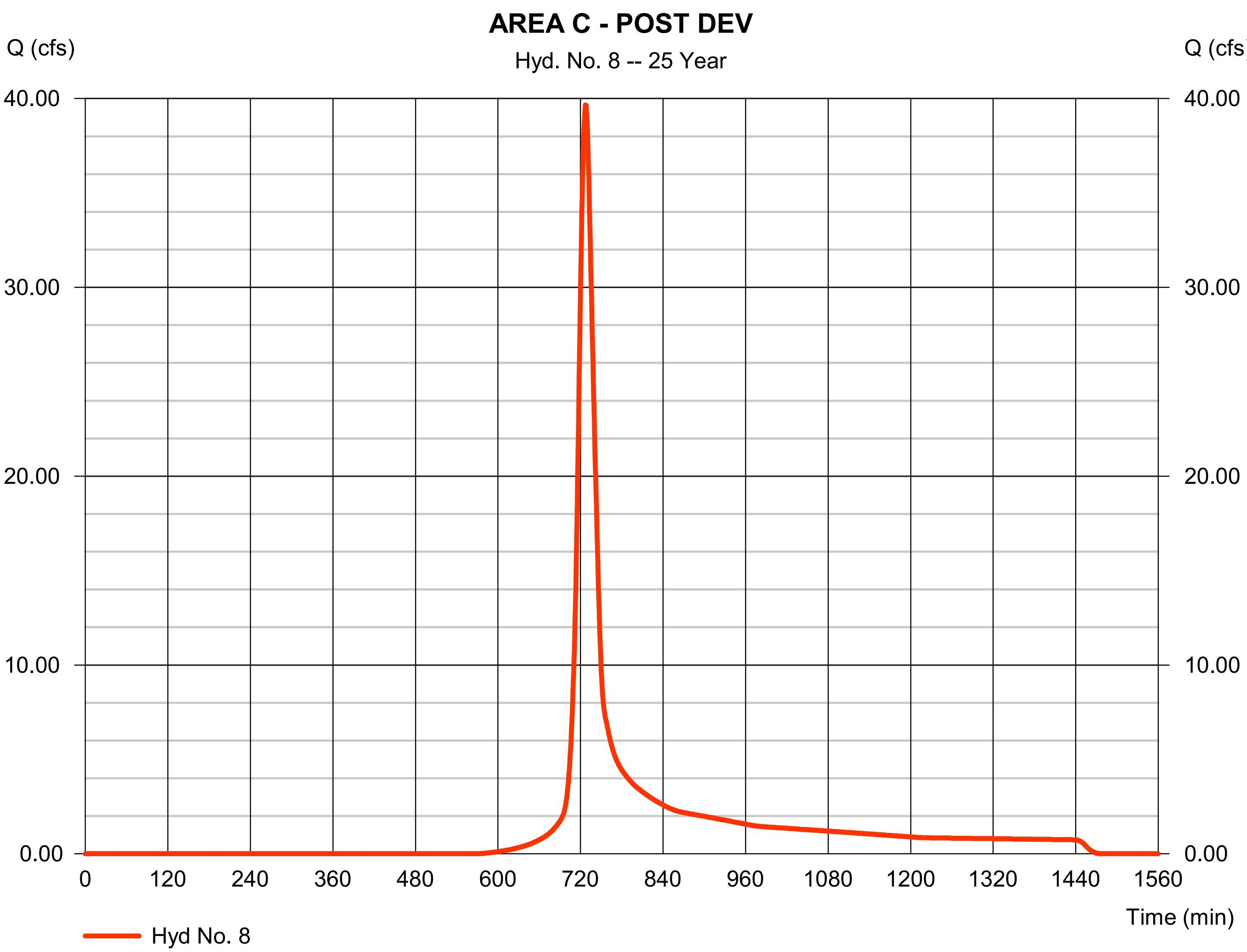
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 8

AREA C - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 39.67 cfs
Storm frequency	= 25 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 136,457 cuft
Drainage area	= 13.750 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.460 x 85) + (0.400 x 55) + (1.740 x 98) + (10.150 x 60)] / 13.750



TR55 Tc Worksheet

Hyd. No. 8

AREA C - POST DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.240		0.011		
Flow length (ft)	= 115.0		22.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		3.82		0.00		
Land slope (%)	= 2.80		13.50		0.00		
Travel Time (min)	**= 12.77**	**+**	**1.81**	**+**	**0.00**	**=**	**14.58**
Shallow Concentrated Flow							
Flow length (ft)	= 350.00		0.00		0.00		
Watercourse slope (%)	= 0.70		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.35		0.00		0.00		
Travel Time (min)	**= 4.32**	**+**	**0.00**	**+**	**0.00**	**=**	**4.32**
Channel Flow							
X sectional flow area (sqft)	= 9.78		0.00		0.00		
Wetted perimeter (ft)	= 20.48		0.00		0.00		
Channel slope (%)	= 0.60		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=2.34		0.00		0.00		
Flow length (ft)	({0})575.0		0.0		0.0		
Travel Time (min)	**= 4.09**	**+**	**0.00**	**+**	**0.00**	**=**	**4.09**

Total Travel Time, Tc .... **23.00 min**

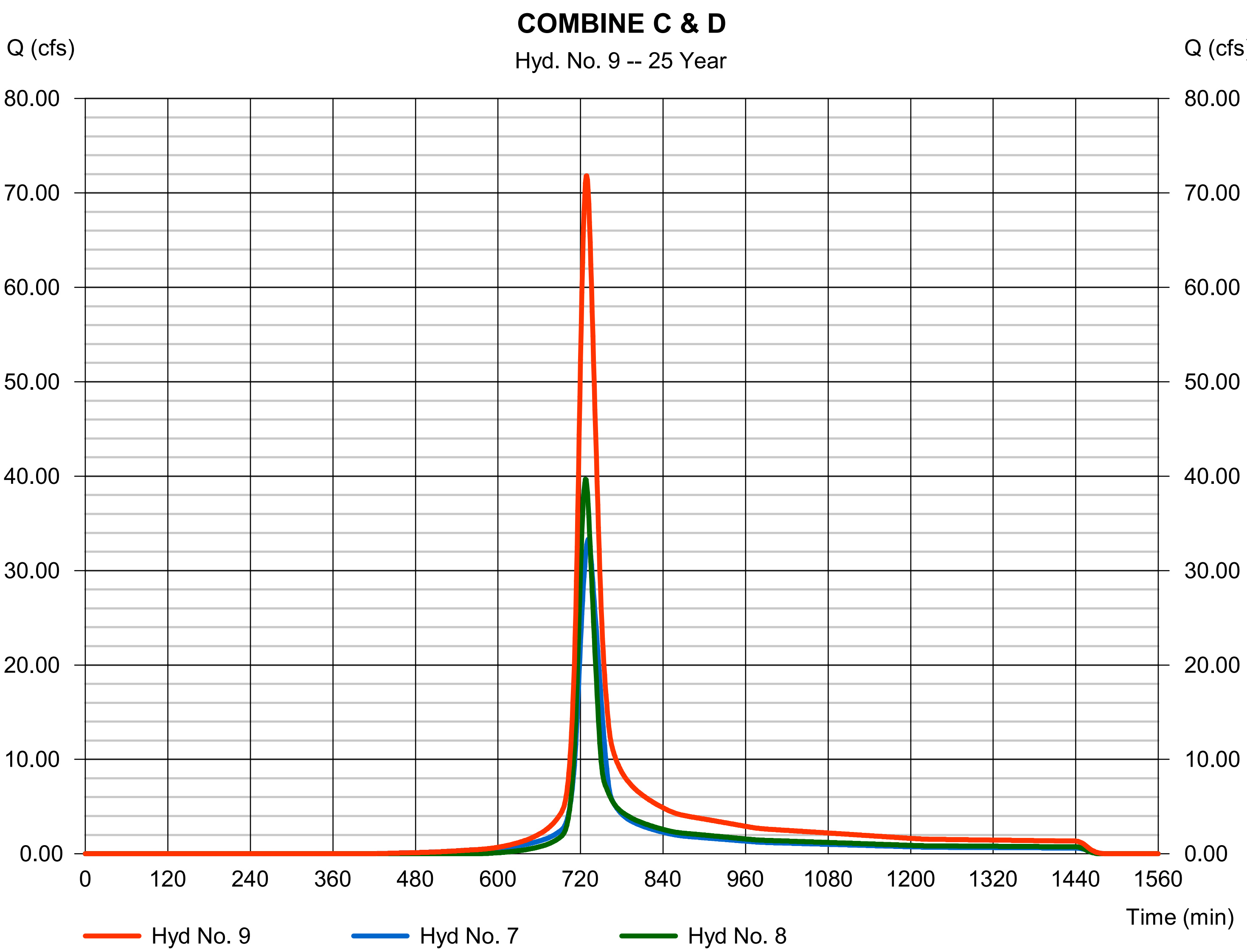
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 9

COMBINE C & D

Hydrograph type	= Combine	Peak discharge	= 71.83 cfs
Storm frequency	= 25 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 269,335 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 23.270 ac



Hydrograph Report

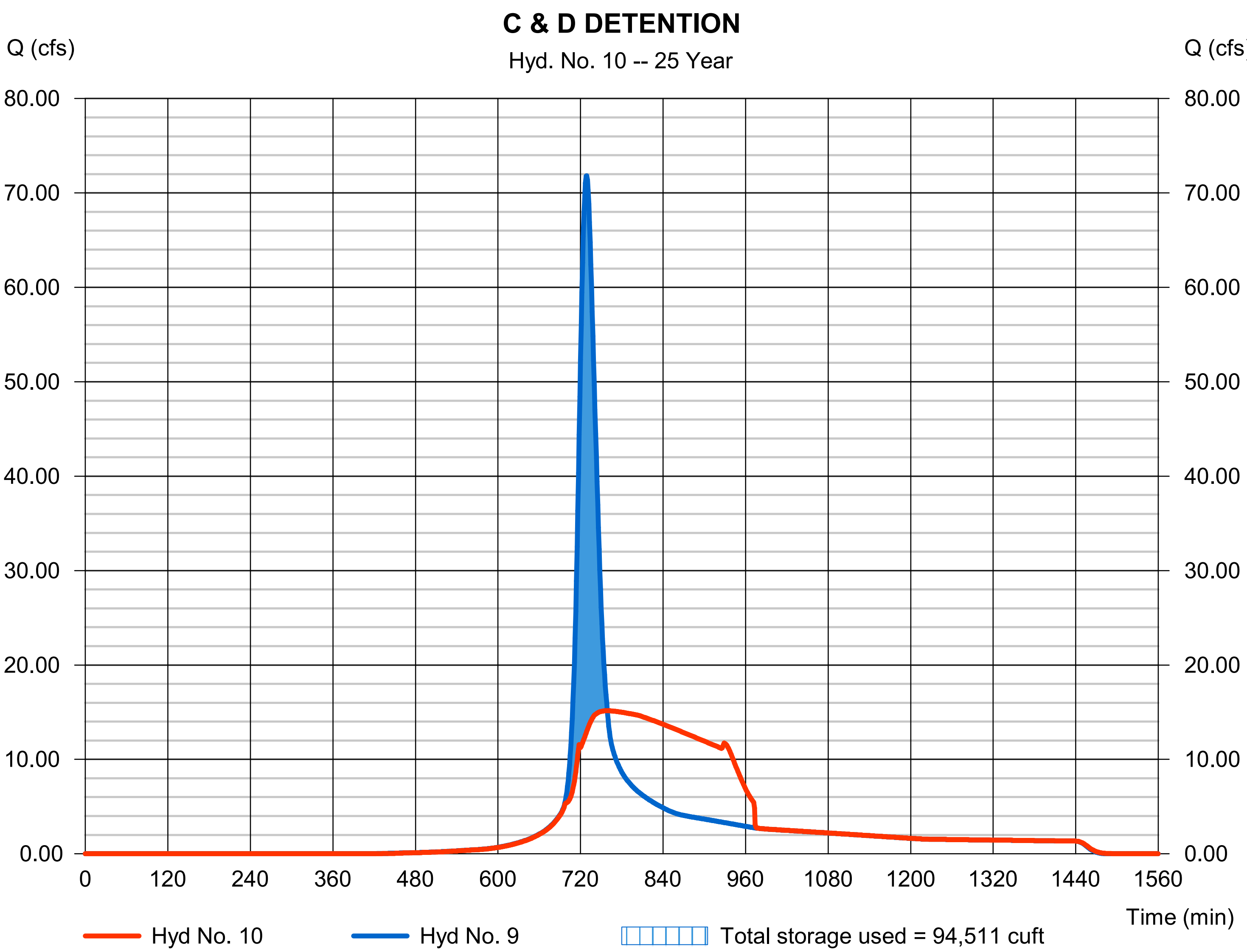
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 10

C & D DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 15.16 cfs
Storm frequency	= 25 yrs	Time to peak	= 759 min
Time interval	= 1 min	Hyd. volume	= 269,335 cuft
Inflow hyd. No.	= 9 - COMBINE C & D	Max. Elevation	= 582.16 ft
Reservoir name	= C&D DETENTION	Max. Storage	= 94,511 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Pond No. 7 - C&D DETENTION

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	579.00	n/a	0	0
1.00	580.00	n/a	368	368
2.00	581.00	n/a	16,012	16,380
3.00	582.00	n/a	61,831	78,211
4.00	583.00	n/a	99,795	178,006
5.00	584.00	n/a	169,576	347,582

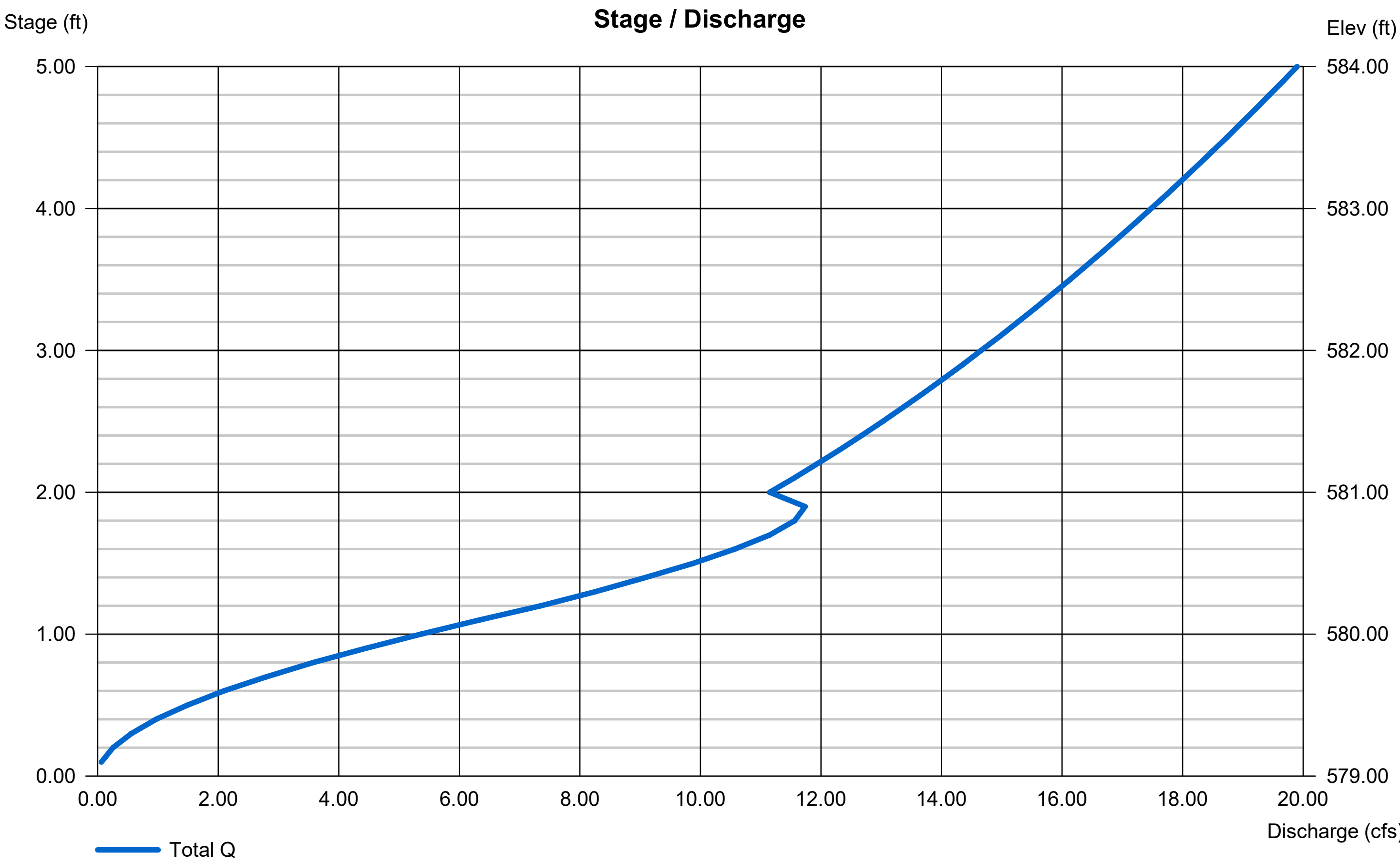
Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 579.00	0.00	0.00	0.00
Length (ft)	= 143.00	0.00	0.00	0.00
Slope (%)	= 0.96	0.00	0.00	n/a
N-Value	= .023	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

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



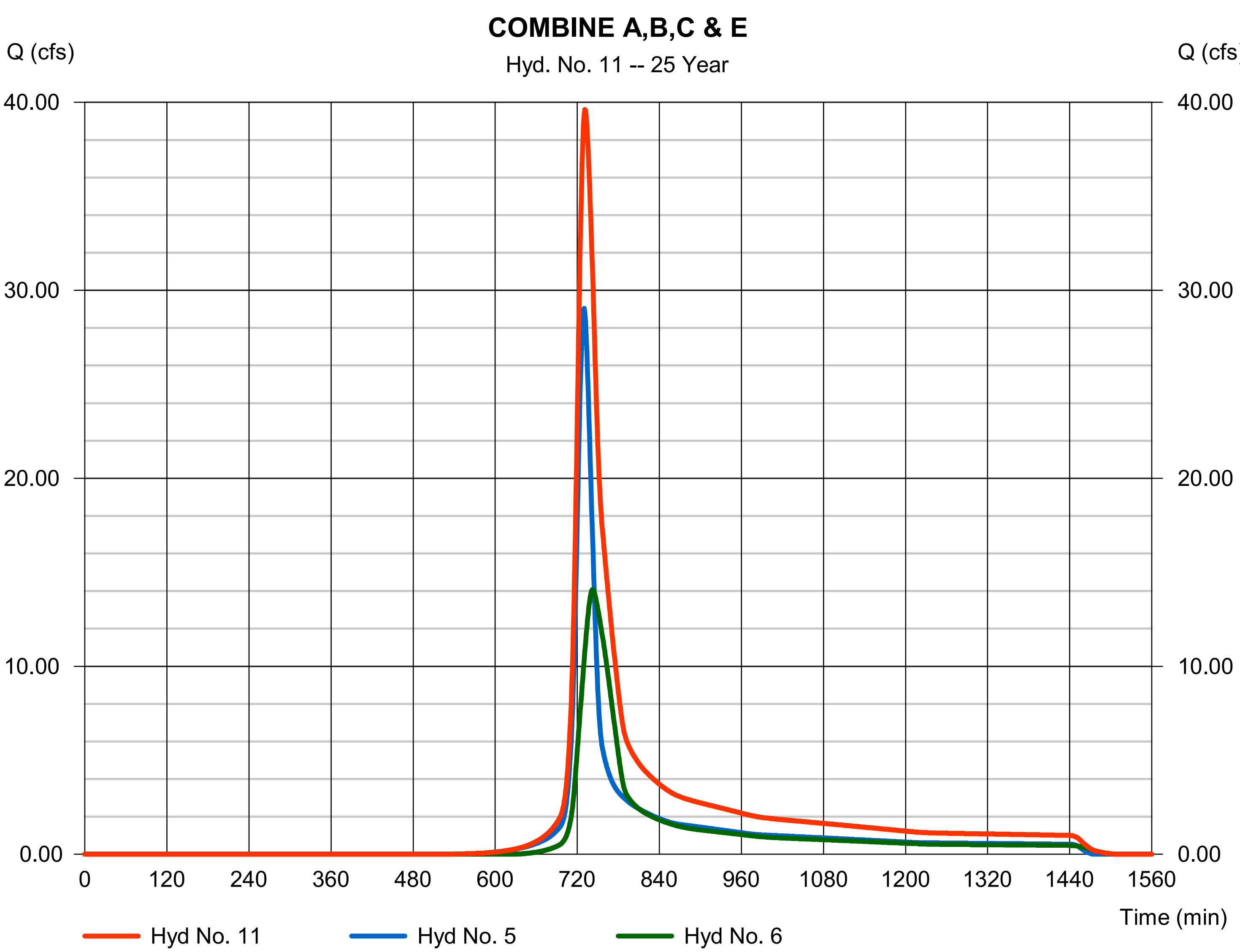
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 11

COMBINE A,B,C & E

Hydrograph type	= Combine	Peak discharge	= 39.62 cfs
Storm frequency	= 25 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 179,475 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 9.150 ac



Hydrograph Report

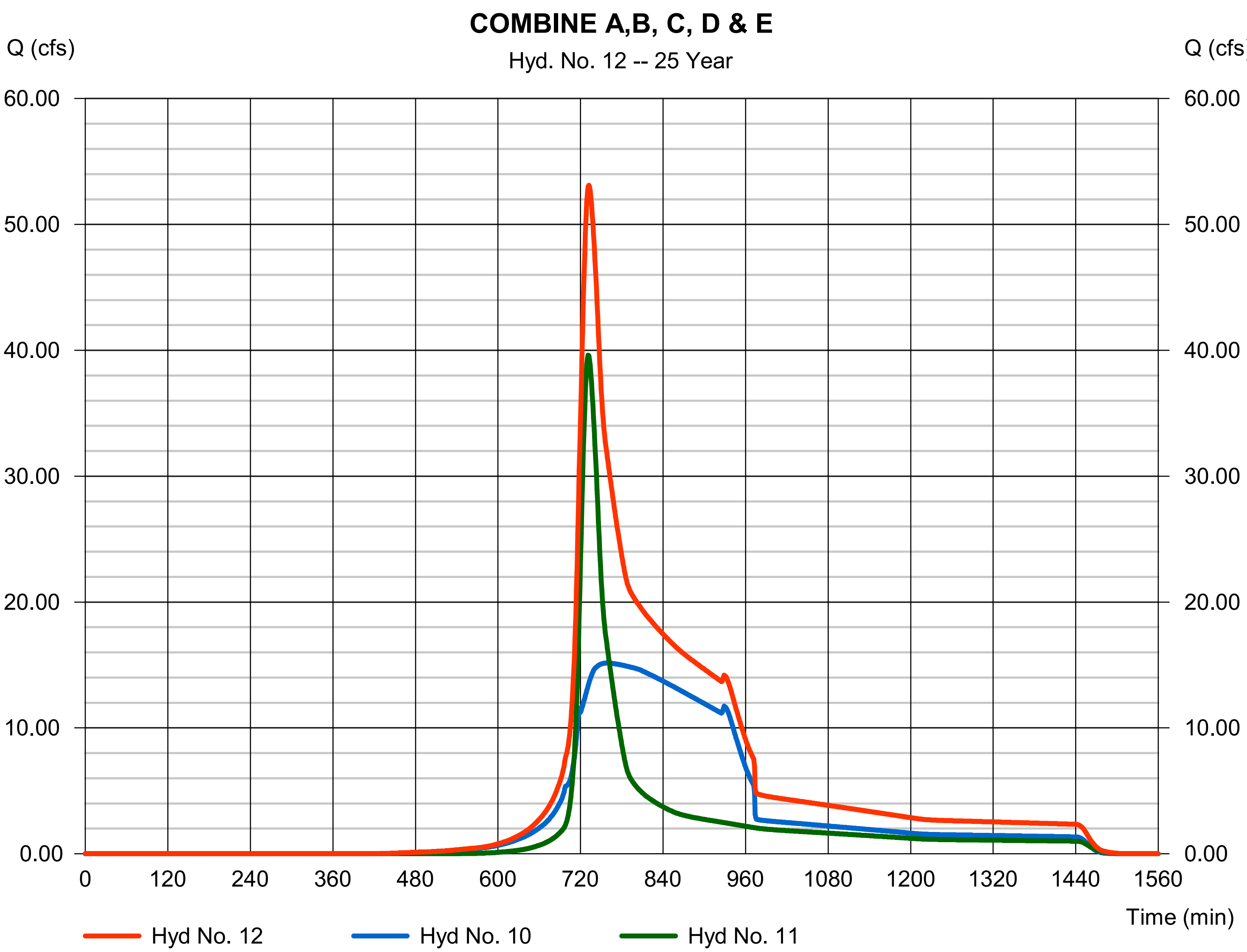
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Thursday, 11 / 15 / 2018

Hyd. No. 12

COMBINE A,B, C, D & E

Hydrograph type	= Combine	Peak discharge	= 53.11 cfs
Storm frequency	= 25 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 448,810 cuft
Inflow hyds.	= 10, 11	Contrib. drain. area	= 0.000 ac



Hydrograph Report

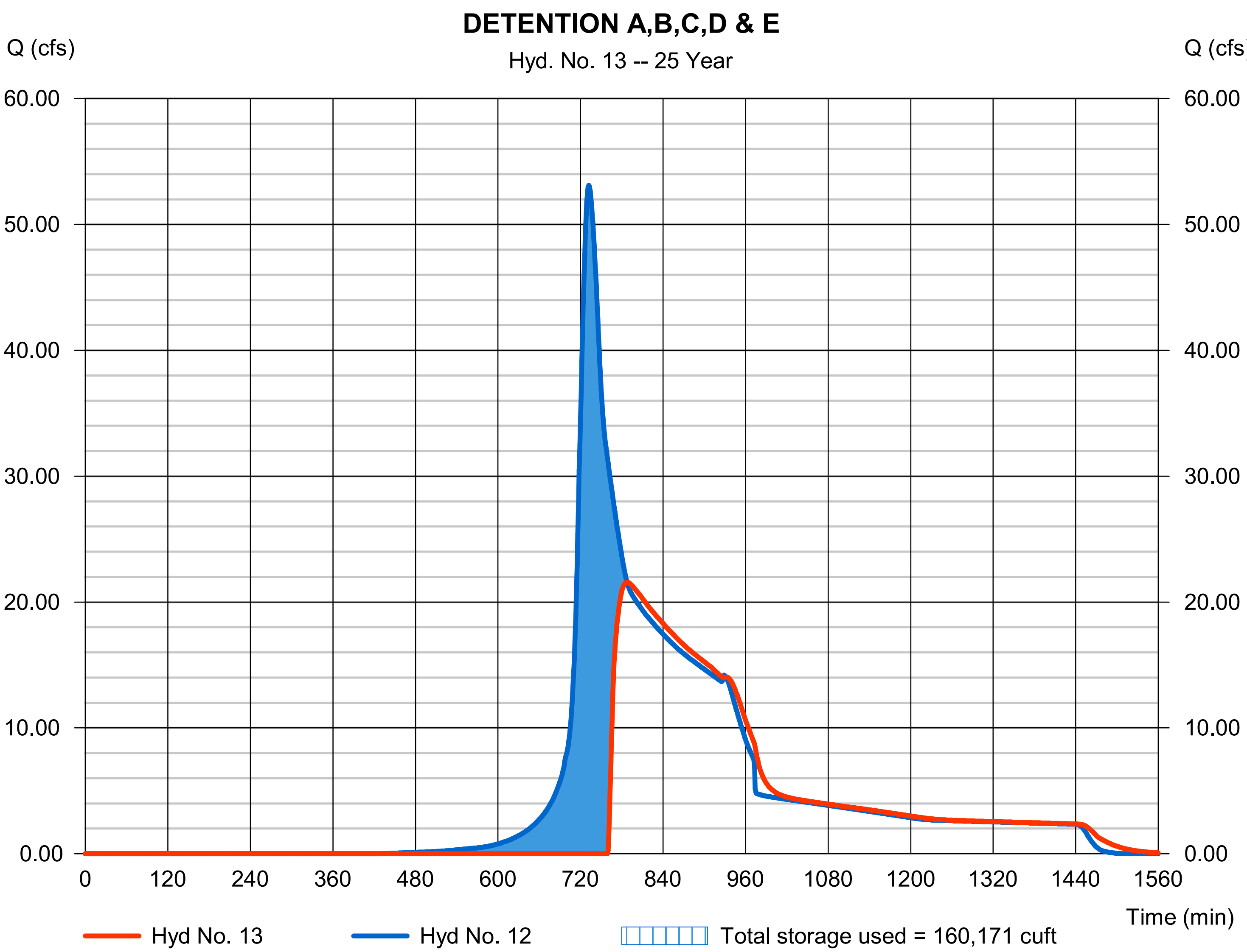
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 13

DETENTION A,B,C,D & E

Hydrograph type	= Reservoir	Peak discharge	= 21.57 cfs
Storm frequency	= 25 yrs	Time to peak	= 788 min
Time interval	= 1 min	Hyd. volume	= 305,768 cuft
Inflow hyd. No.	= 12 - COMBINE A,B, C, D & E	Max. Elevation	= 582.14 ft
Reservoir name	= A,B,C,D & E DETENTION	Max. Storage	= 160,171 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Pond No. 1 - A,B,C,D & E DETENTION

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	577.00	n/a	0	0
1.00	578.00	n/a	46,004	46,004
2.00	579.00	n/a	33,011	79,015
3.00	580.00	n/a	28,300	107,315
4.00	581.00	n/a	24,110	131,425
5.00	582.00	n/a	23,229	154,654
6.00	583.00	n/a	38,881	193,535
7.00	584.00	n/a	59,736	253,271
8.00	585.00	n/a	88,517	341,788
9.00	586.00	n/a	115,069	456,857

Culvert / Orifice Structures

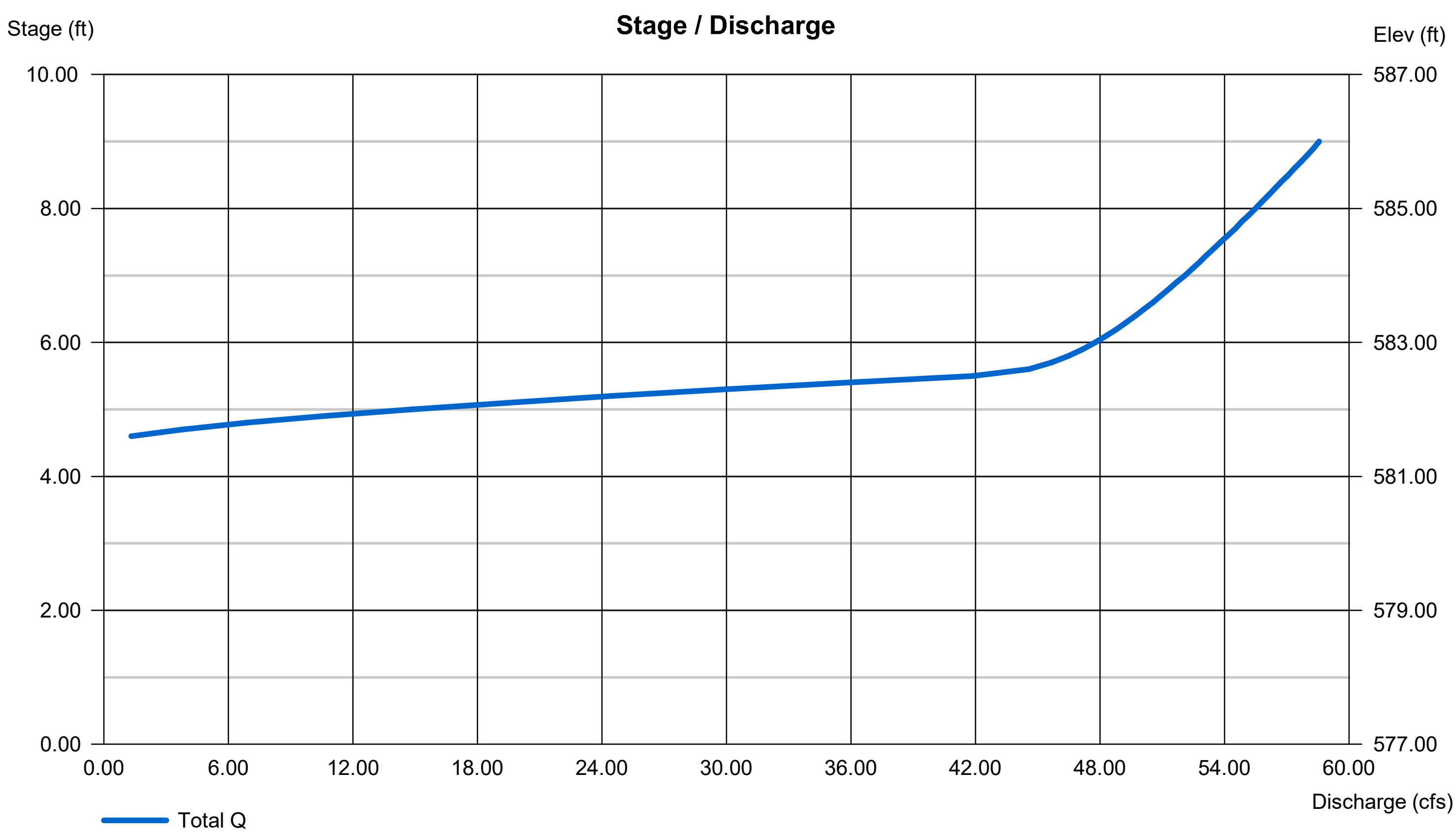
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 36.00	Inactive	Inactive	Inactive
Span (in)	= 36.00	0.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 577.64	0.00	0.00	0.00
Length (ft)	= 311.70	0.00	0.00	0.00
Slope (%)	= 1.42	0.00	0.00	n/a
N-Value	= .024	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.57	Inactive	Inactive	Inactive
Crest El. (ft)	= 581.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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



Hydrograph Report

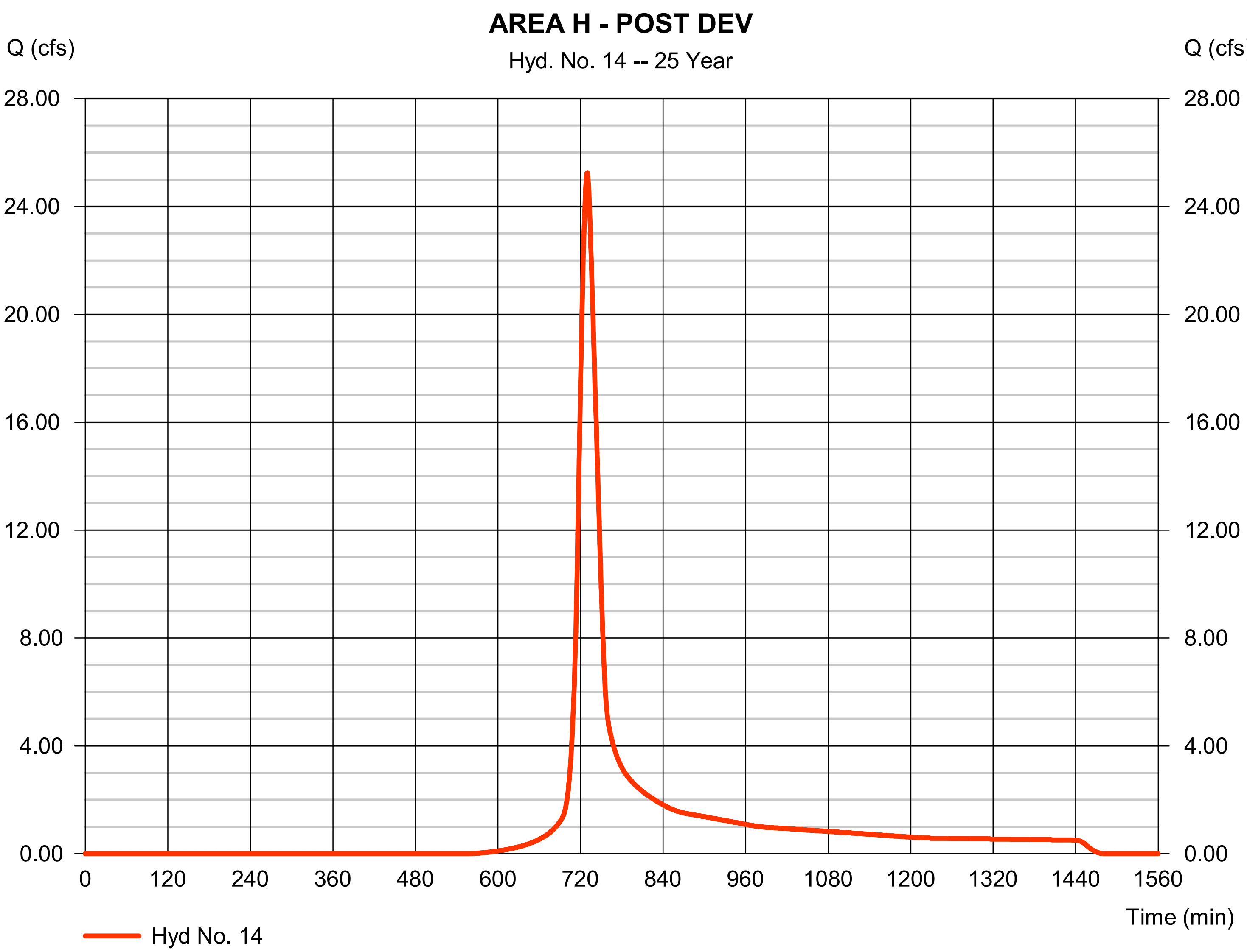
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 14

AREA H - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 25.24 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 95,092 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.50 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



TR55 Tc Worksheet

Hyd. No. 14

AREA H - POST DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.410		0.011		0.011		
Flow length (ft)	= 90.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		0.00		0.00		
Land slope (%)	= 2.20		0.00		0.00		
Travel Time (min)	**= 17.74**	**+**	**0.00**	**+**	**0.00**	**=**	**17.74**
Shallow Concentrated Flow							
Flow length (ft)	= 270.00		305.00		0.00		
Watercourse slope (%)	= 2.00		0.75		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=2.28		1.40		0.00		
Travel Time (min)	**= 1.97**	**+**	**3.64**	**+**	**0.00**	**=**	**5.61**
Channel Flow							
X sectional flow area (sqft)	= 19.90		0.00		0.00		
Wetted perimeter (ft)	= 33.72		0.00		0.00		
Channel slope (%)	= 0.50		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=2.47		0.00		0.00		
Flow length (ft)	({0})470.0		0.0		0.0		
Travel Time (min)	**= 3.18**	**+**	**0.00**	**+**	**0.00**	**=**	**3.18**

Total Travel Time, Tc .... 26.50 min

Hydrograph Report

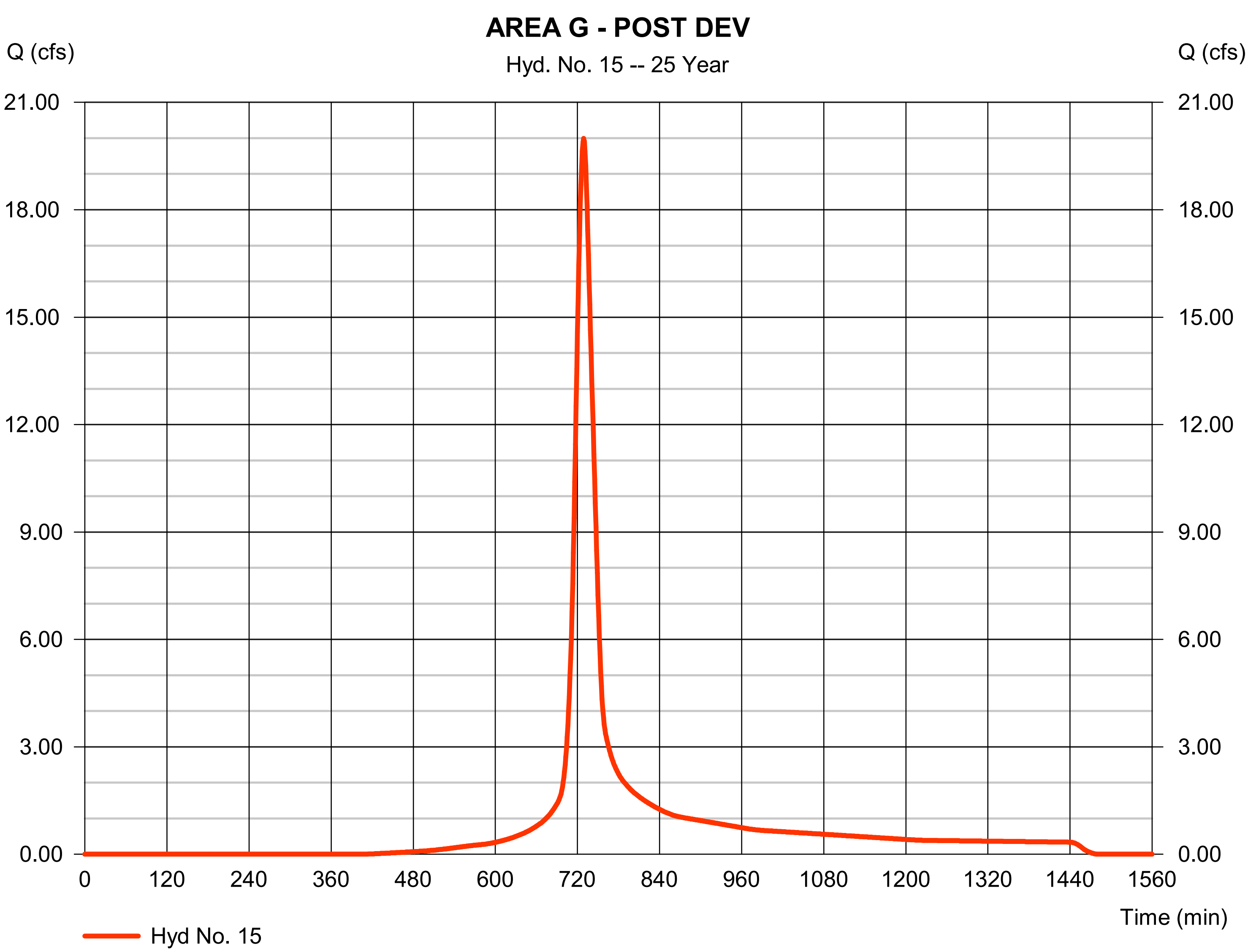
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 15

AREA G - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 19.99 cfs
Storm frequency	= 25 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 74,414 cuft
Drainage area	= 5.290 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 26.80 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.330 x 85) + (4.960 x 77)] / 5.290



Hydrograph Report

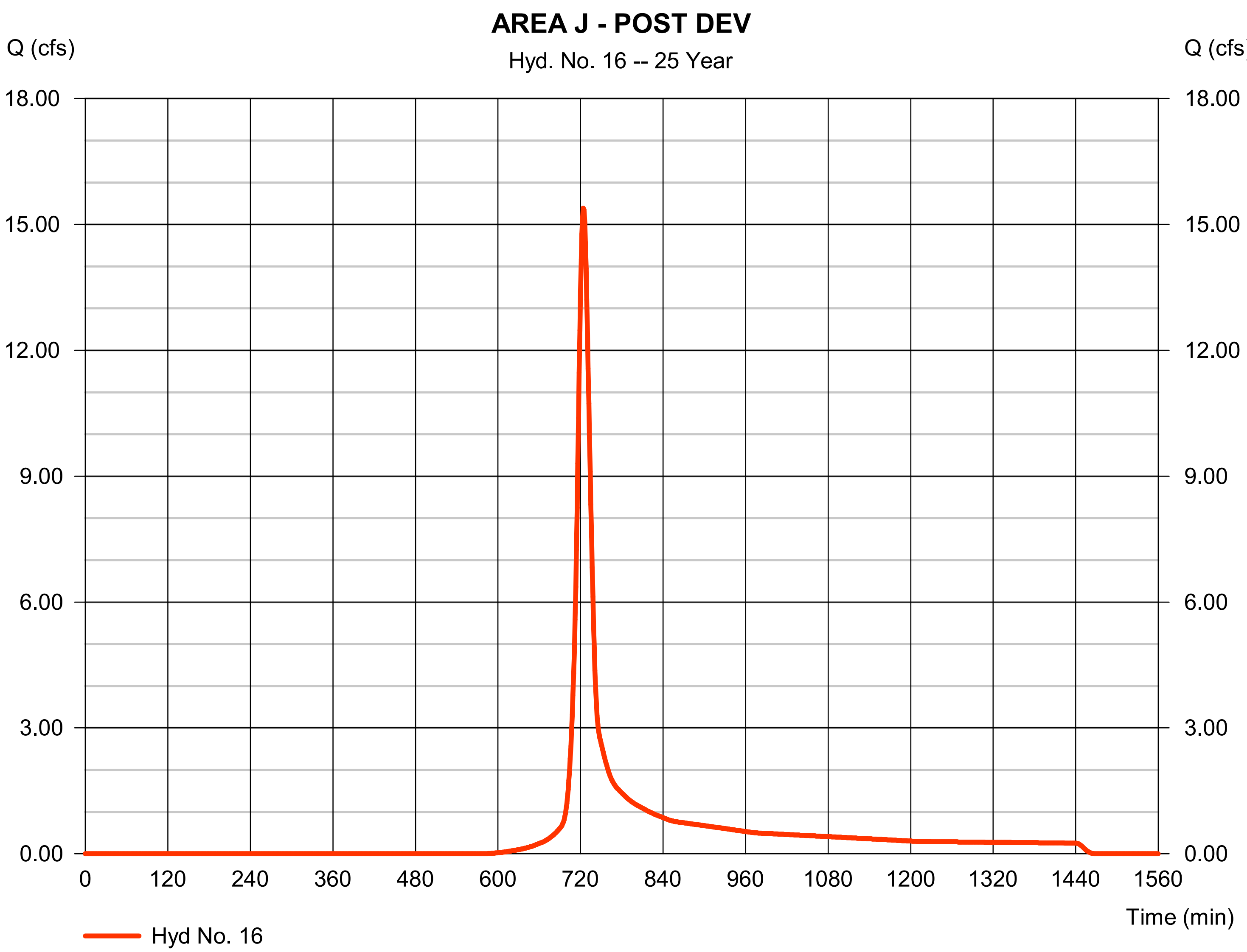
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 16

AREA J - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 15.39 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 46,094 cuft
Drainage area	= 4.820 ac	Curve number	= 66*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 85) + (0.020 x 65) + (0.680 x 98) + (4.030 x 60)] / 4.820



TR55 Tc Worksheet

Hyd. No. 16

AREA J - POST DEV

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.011		0.350		0.011		
Flow length (ft)	=	8.0		30.0		0.0		
Two-year 24-hr precip. (in)	=	3.82		3.82		0.00		
Land slope (%)	=	4.20		4.20		0.00		
Travel Time (min)	**=**	**0.11**	**+**	**5.01**	**+**	**0.00**	**=**	**5.12**
Shallow Concentrated Flow								
Flow length (ft)	=	21.00		155.00		0.00		
Watercourse slope (%)	=	7.75		6.60		0.00		
Surface description	=	Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=	4.49		4.15		0.00		
Travel Time (min)	**=**	**0.08**	**+**	**0.62**	**+**	**0.00**	**=**	**0.70**
Channel Flow								
X sectional flow area (sqft)	=	0.82		1.11		0.00		
Wetted perimeter (ft)	=	3.29		3.66		0.00		
Channel slope (%)	=	0.70		0.30		0.00		
Manning's n-value	=	0.030		0.030		0.015		
Velocity (ft/s)	=	1.64		1.23		0.00		
Flow length (ft)		({0})181.0		685.0		0.0		
Travel Time (min)	**=**	**1.84**	**+**	**9.31**	**+**	**0.00**	**=**	**11.15**

Total Travel Time, Tc .... 17.00 min

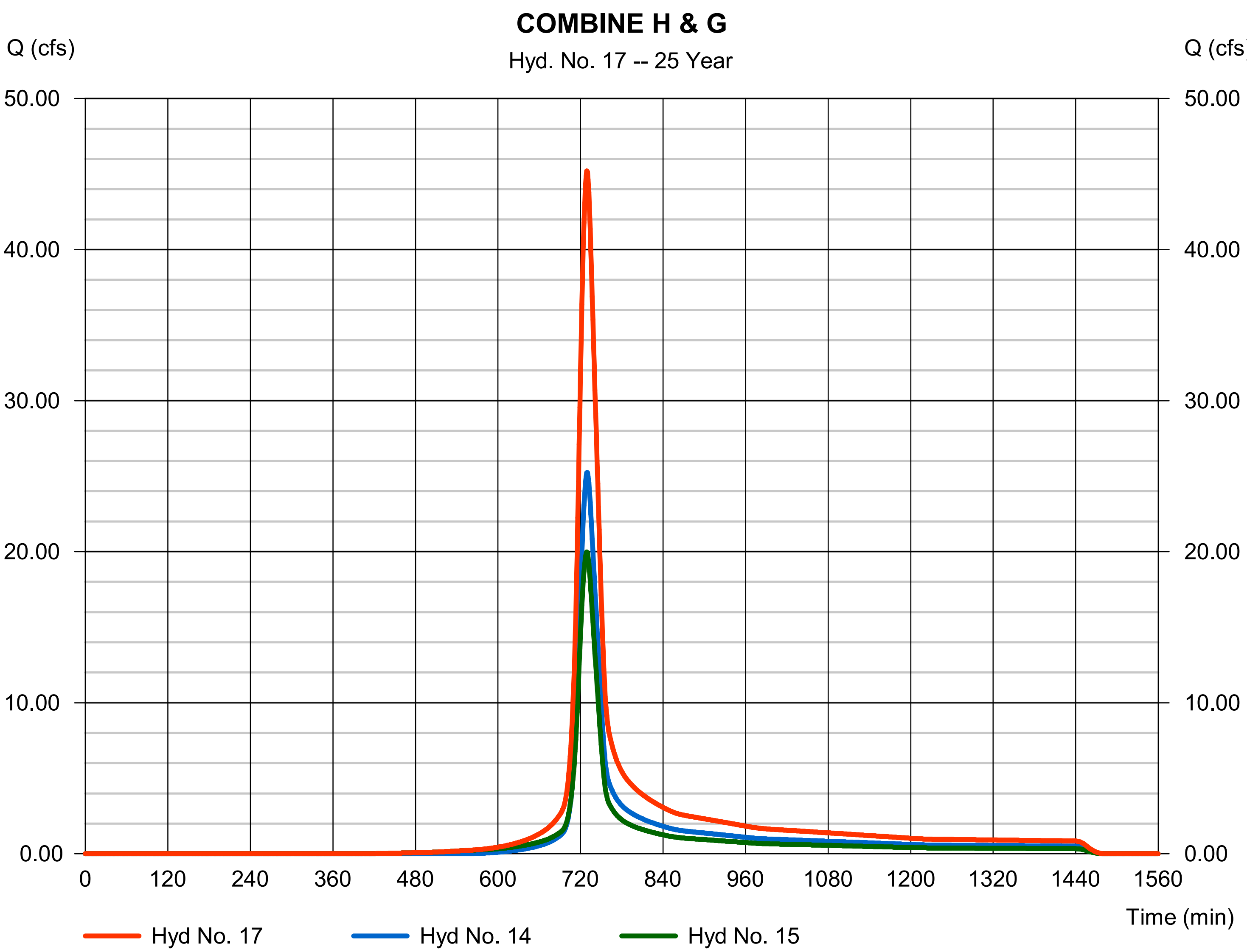
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 17

COMBINE H & G

Hydrograph type	= Combine	Peak discharge	= 45.22 cfs
Storm frequency	= 25 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 169,506 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 14.400 ac



Hydrograph Report

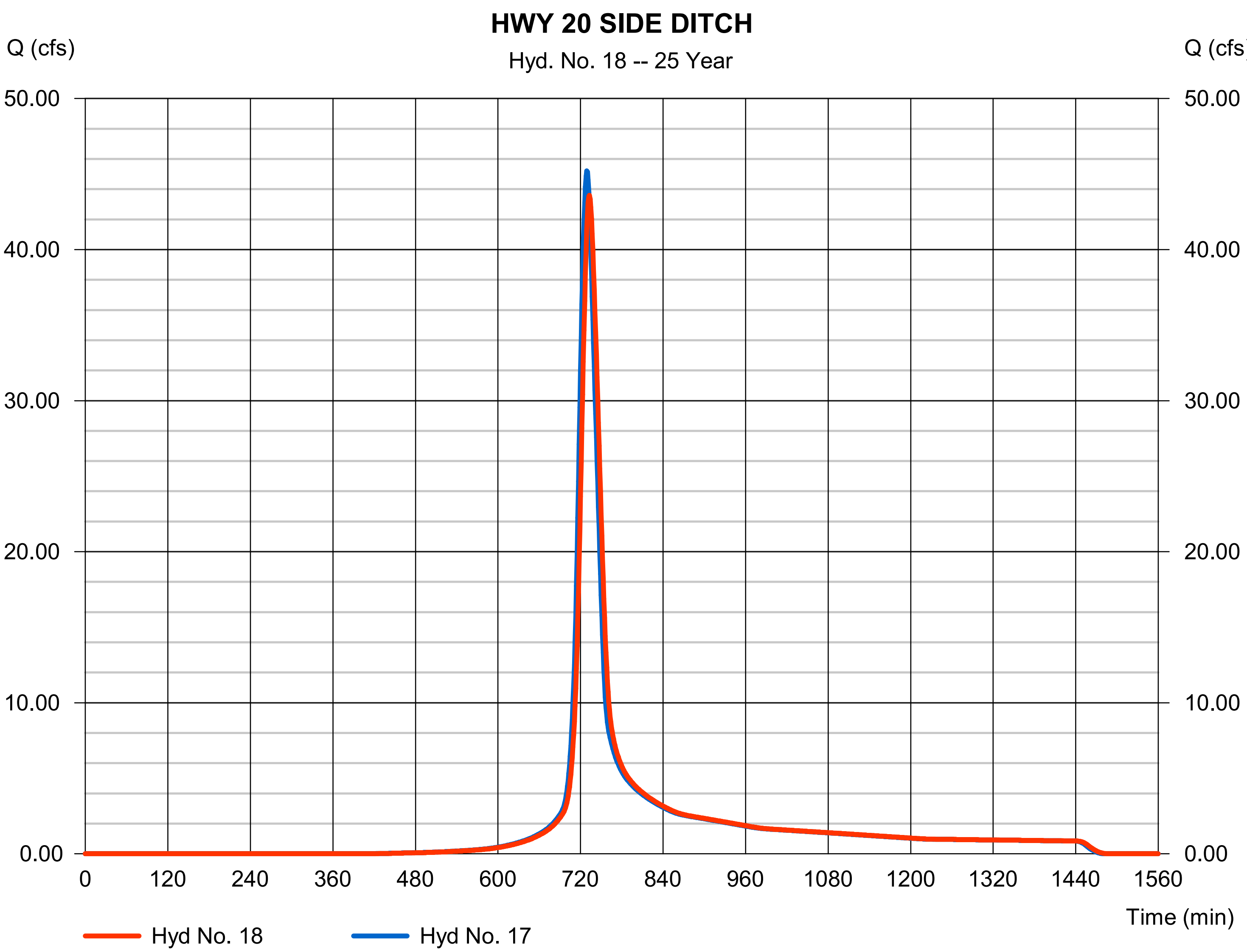
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 18

HWY 20 SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 43.60 cfs
Storm frequency	= 25 yrs	Time to peak	= 733 min
Time interval	= 1 min	Hyd. volume	= 169,504 cuft
Inflow hyd. No.	= 17 - COMBINE H & G	Section type	= Trapezoidal
Reach length	= 900.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.030	Bottom width	= 3.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 1.688	Rating curve m	= 1.304
Ave. velocity	= 3.63 ft/s	Routing coeff.	= 0.2728

Modified Att-Kin routing method used.



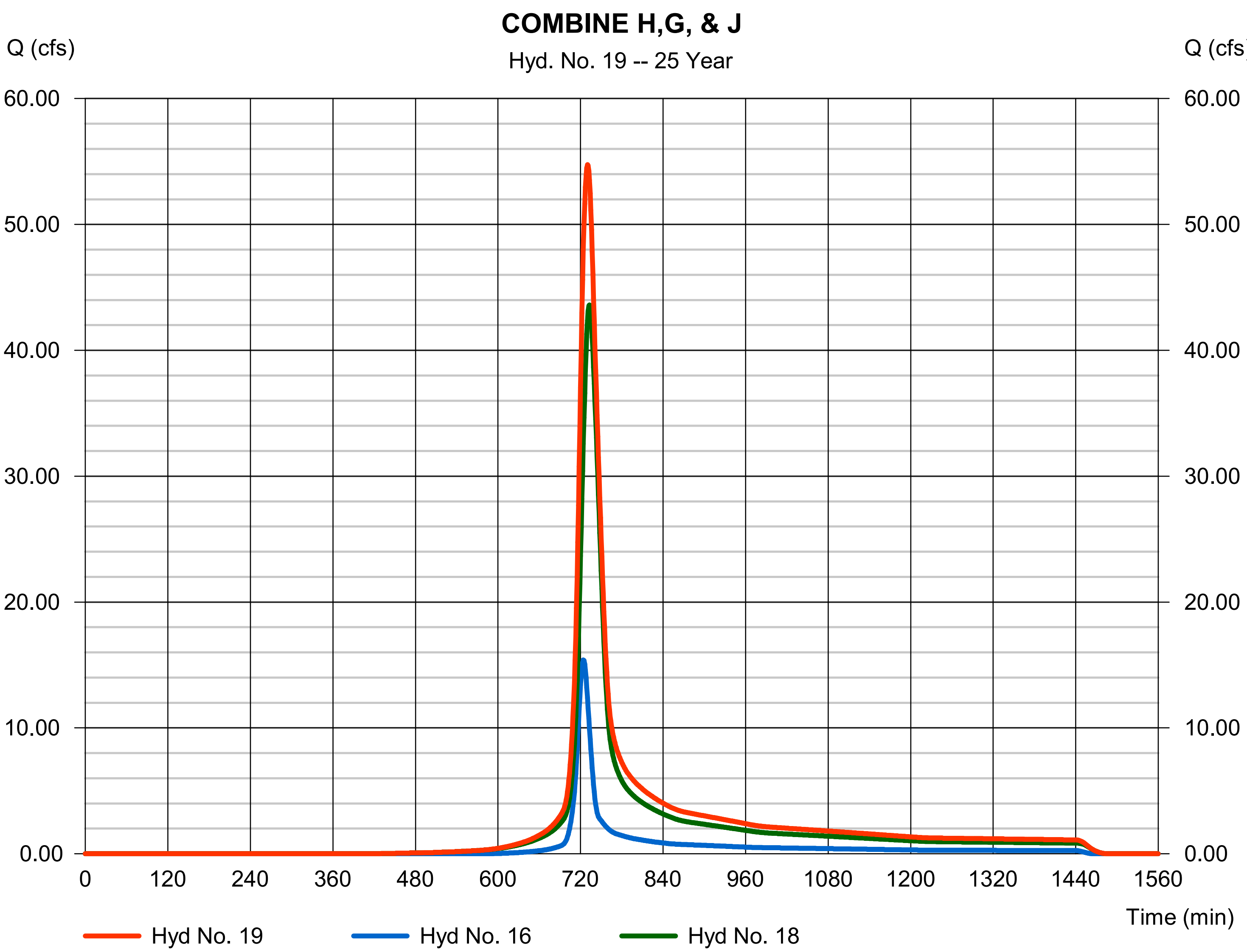
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 19

COMBINE H,G, & J

Hydrograph type	= Combine	Peak discharge	= 54.75 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 215,598 cuft
Inflow hyds.	= 16, 18	Contrib. drain. area	= 4.820 ac



Hydrograph Report

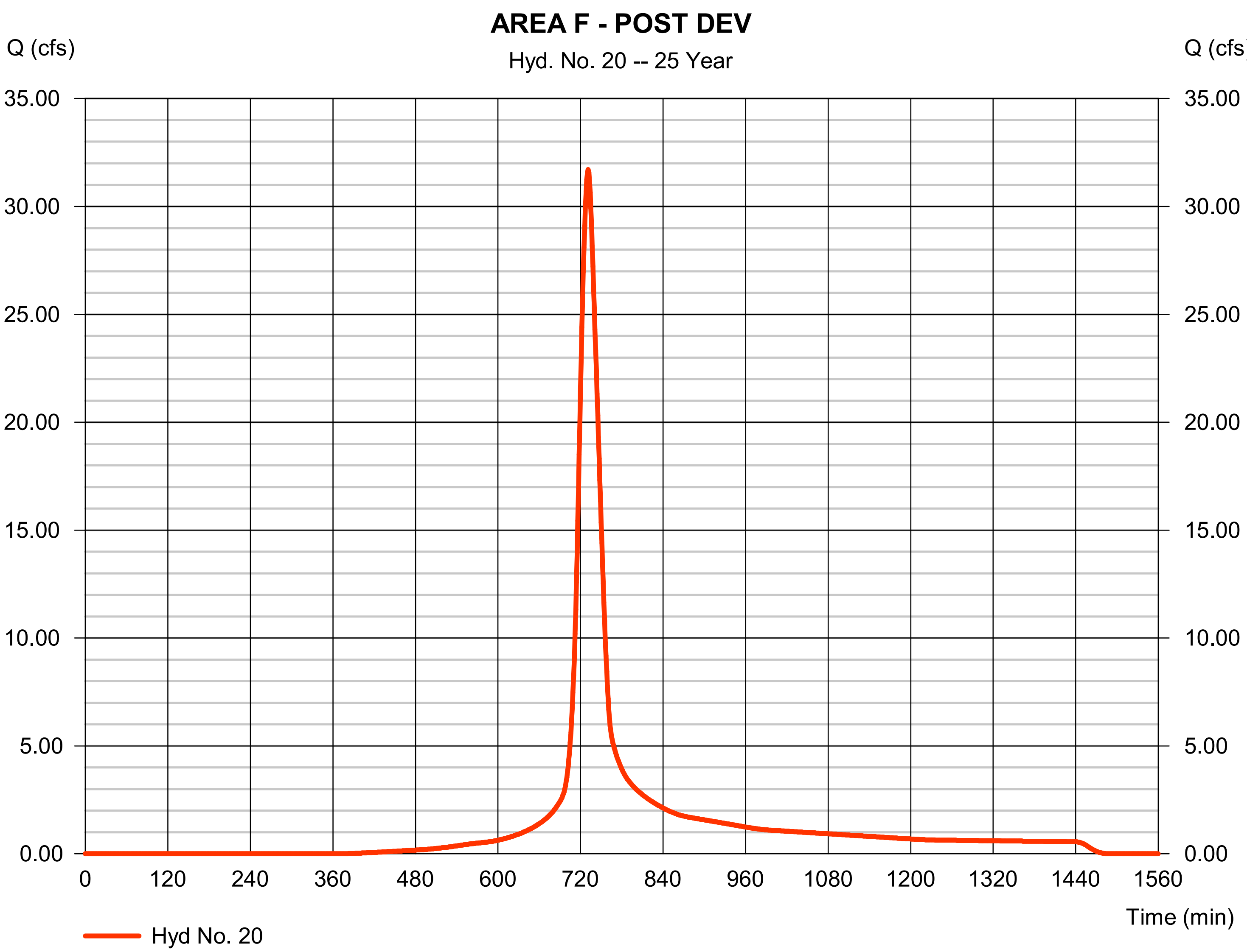
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 20

AREA F - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 31.71 cfs
Storm frequency	= 25 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 126,821 cuft
Drainage area	= 8.620 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.440 x 85) + (8.180 x 77)] / 8.620



Hydrograph Report

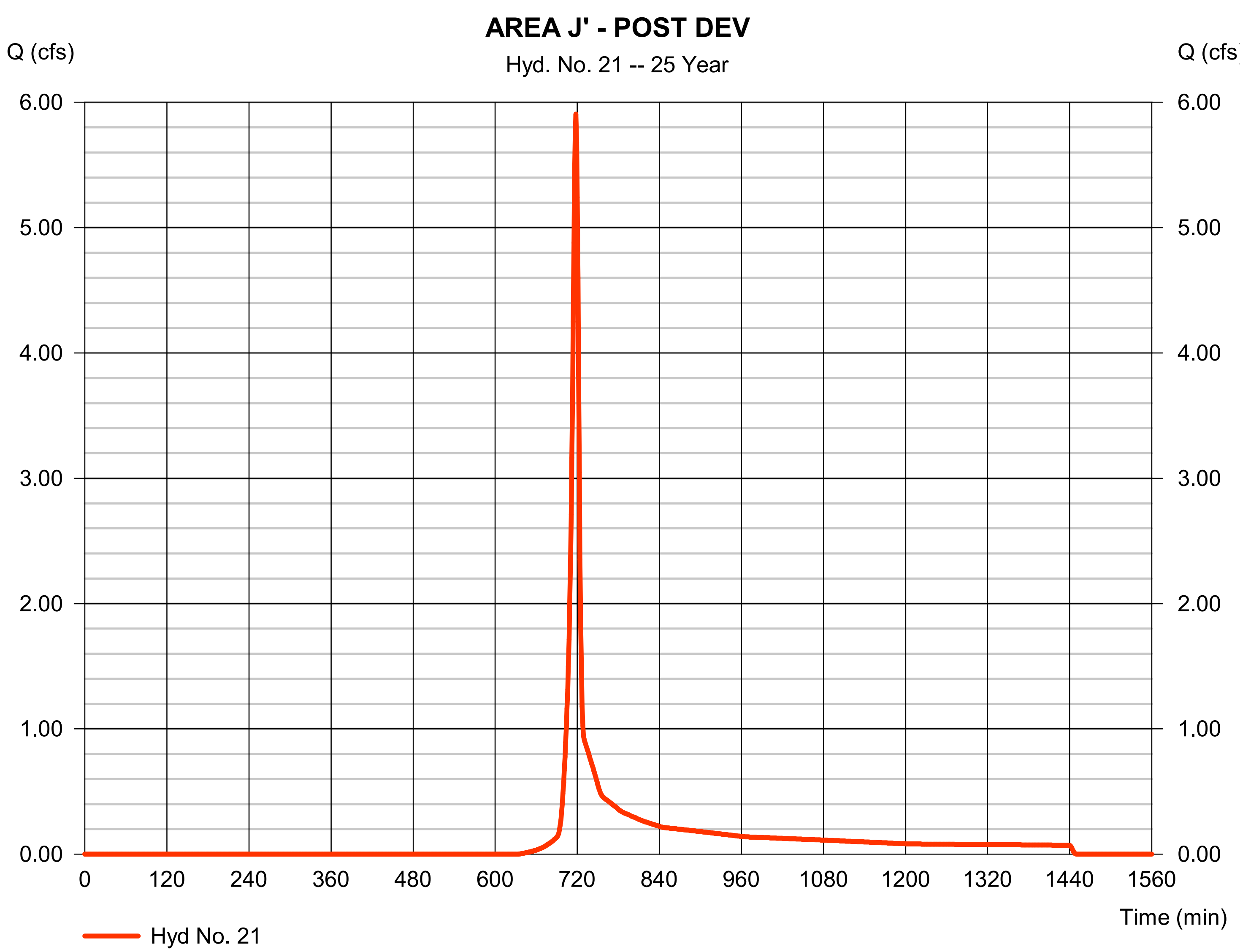
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 21

AREA J' - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 5.906 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 11,907 cuft
Drainage area	= 1.440 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.220 x 65) + (1.220 x 60)] / 1.440



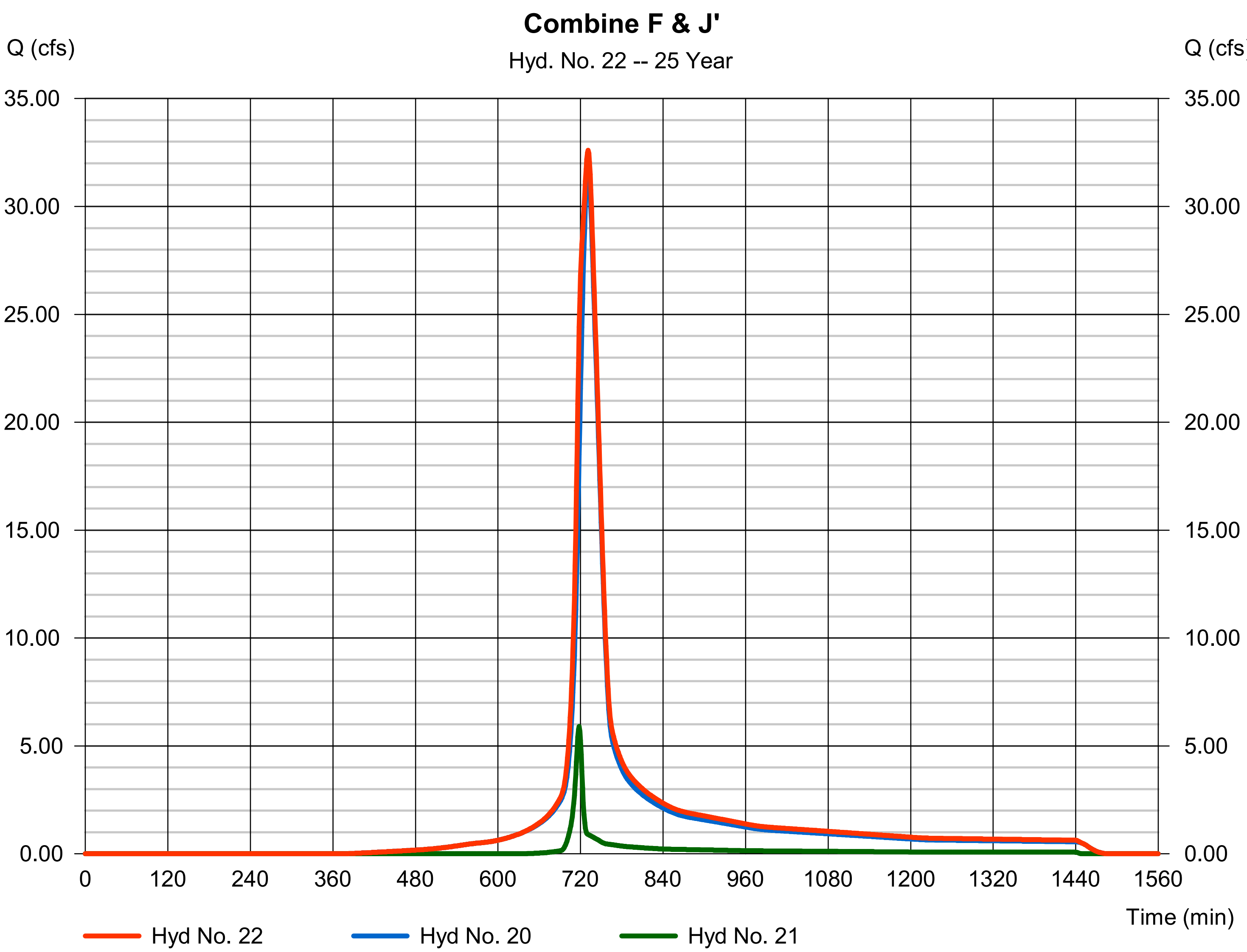
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 22

Combine F & J'

Hydrograph type	= Combine	Peak discharge	= 32.60 cfs
Storm frequency	= 25 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 138,728 cuft
Inflow hyds.	= 20, 21	Contrib. drain. area	= 10.060 ac



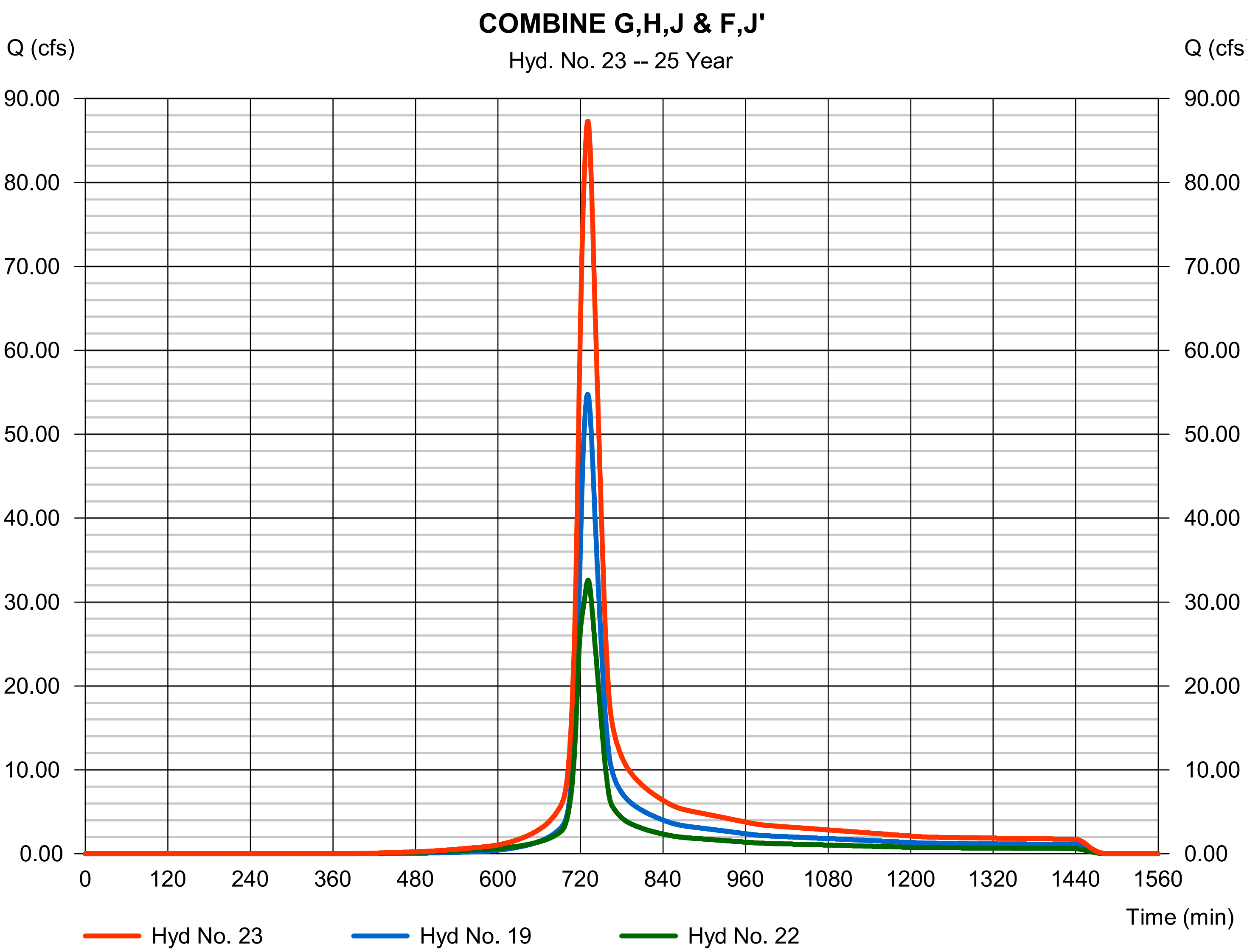
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 23

COMBINE G,H,J & F,J'

Hydrograph type	= Combine	Peak discharge	= 87.29 cfs
Storm frequency	= 25 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 354,326 cuft
Inflow hyds.	= 19, 22	Contrib. drain. area	= 0.000 ac



Hydrograph Report

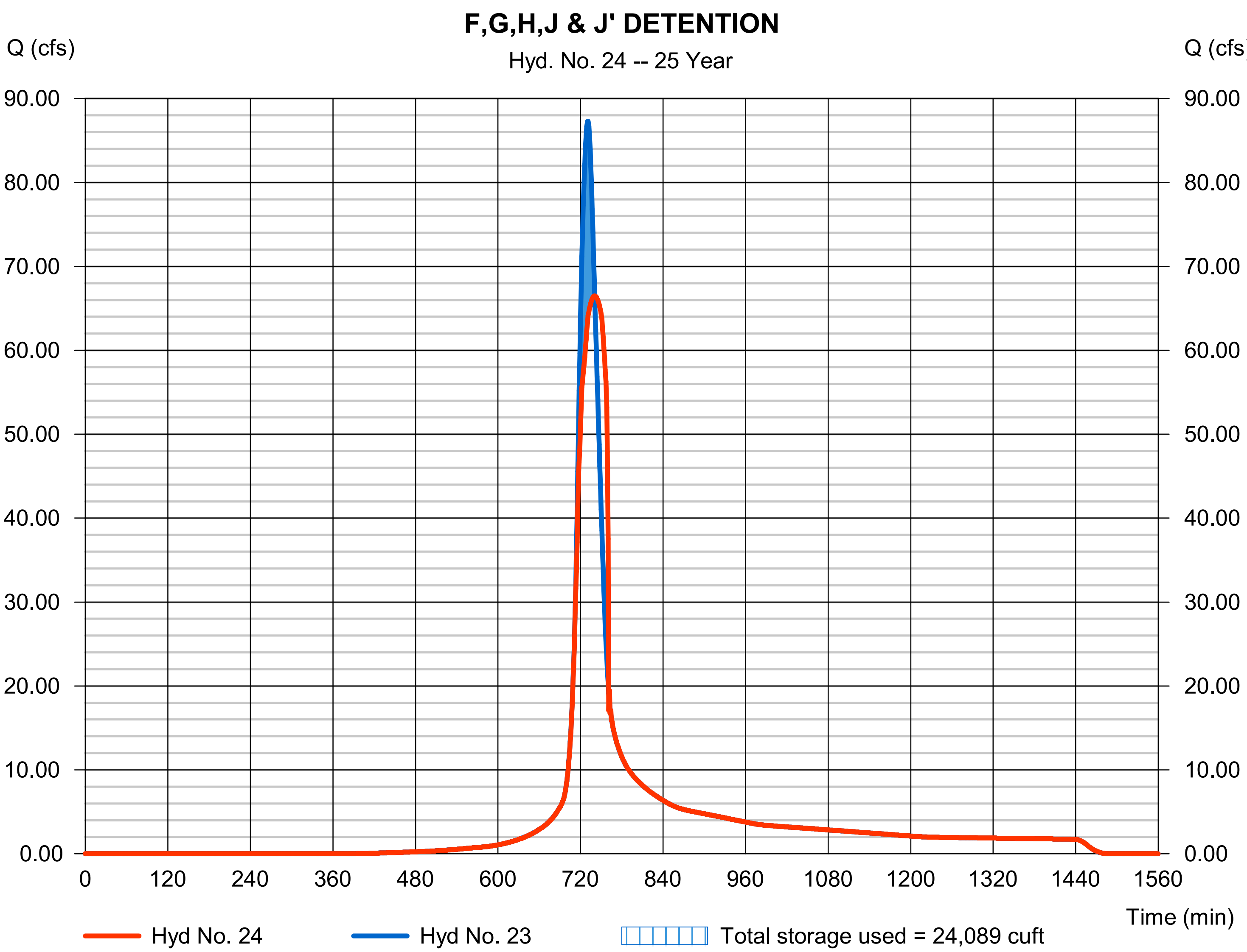
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 24

F,G,H,J & J' DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 66.47 cfs
Storm frequency	= 25 yrs	Time to peak	= 741 min
Time interval	= 1 min	Hyd. volume	= 354,326 cuft
Inflow hyd. No.	= 23 - COMBINE G,H,J & F,J'	Max. Elevation	= 580.30 ft
Reservoir name	= F,G,H,J & J' DETENTION	Max. Storage	= 24,089 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Pond No. 2 - F,G,H,J & J' DETENTION

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	575.00	n/a	0	0
1.00	576.00	n/a	66	66
2.00	577.00	n/a	197	263
3.00	578.00	n/a	805	1,068
4.00	579.00	n/a	3,266	4,334
5.00	580.00	n/a	11,856	16,190
6.00	581.00	n/a	26,087	42,277
7.00	582.00	n/a	34,733	77,010
8.00	583.00	n/a	53,090	130,100
9.00	584.00	n/a	63,299	193,399

Culvert / Orifice Structures

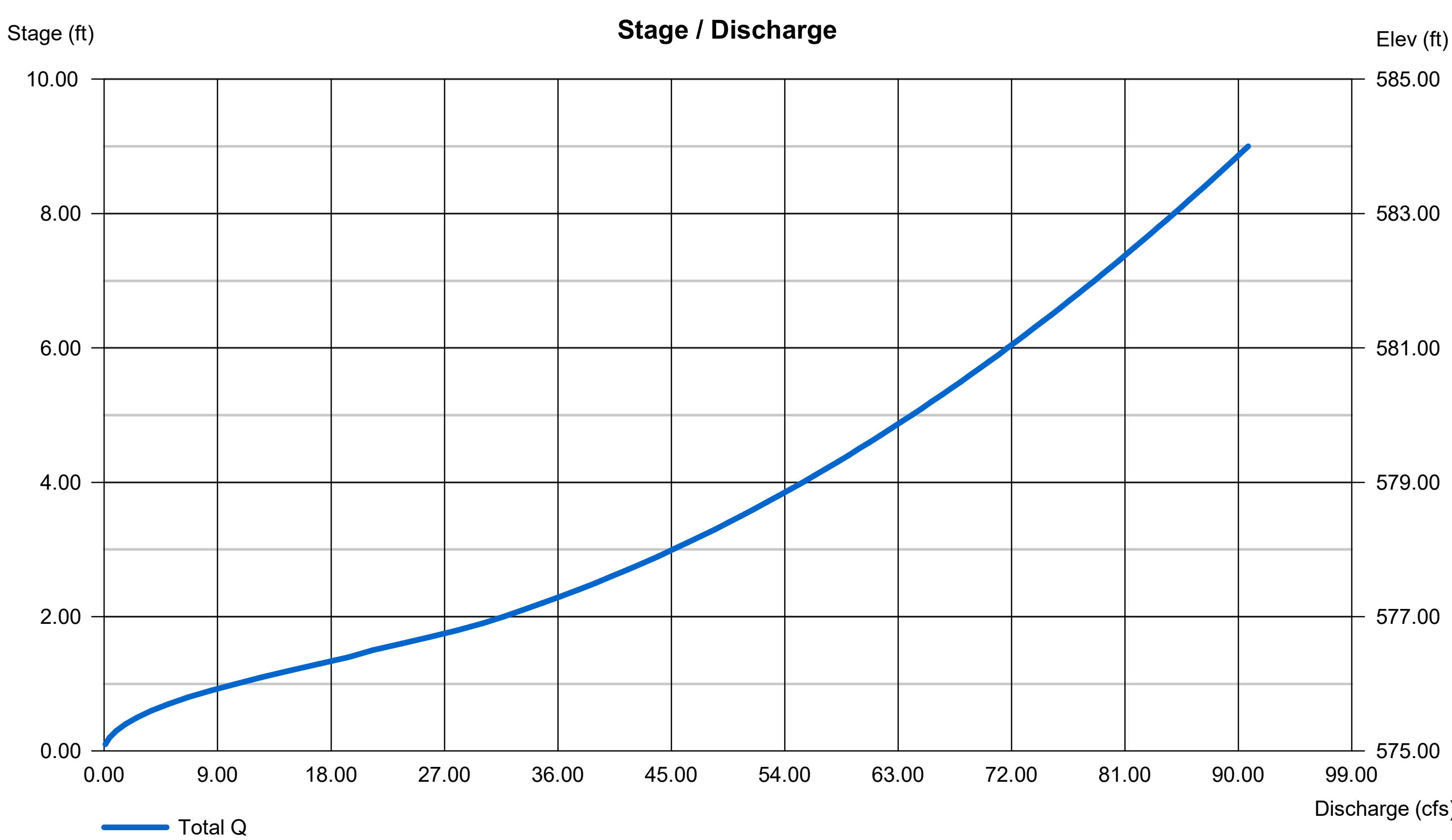
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	18.00	18.00	Inactive
Span (in)	= 24.00	18.00	18.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 575.02	575.55	575.00	0.00
Length (ft)	= 77.00	55.00	60.00	0.00
Slope (%)	= 1.10	1.50	1.00	n/a
N-Value	= .012	.012	.012	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	SCS Runoff	11.34	1	725	35,424	------	------	------	AREA A - POST DEV
2	Reach	10.92	1	728	35,423	1	------	------	DITCH 1
3	SCS Runoff	25.11	1	727	85,777	------	------	------	AREA B - POST DEV
4	Combine	35.98	1	727	121,199	2, 3	------	------	COMBINE A & B
5	Reach	35.52	1	730	121,198	4	------	------	DITCH 2
6	SCS Runoff	17.70	1	742	98,530	------	------	------	AREA E - POST DEV
7	SCS Runoff	39.22	1	731	156,835	------	------	------	AREA D - POST DEV
8	SCS Runoff	48.71	1	727	166,351	------	------	------	AREA C - POST DEV
9	Combine	86.55	1	728	323,186	7, 8	------	------	COMBINE C & D
10	Reservoir	15.92	1	761	323,186	9	582.43	120,743	C & D DETENTION
11	Combine	48.96	1	731	219,728	5, 6,	------	------	COMBINE A,B,C & E
12	Combine	63.18	1	732	542,914	10, 11	------	------	COMBINE A,B, C, D & E
13	Reservoir	29.41	1	772	399,874	12	582.29	165,933	DETENTION A,B,C,D & E
14	SCS Runoff	30.87	1	729	115,543	------	------	------	AREA H - POST DEV
15	SCS Runoff	23.55	1	729	87,830	------	------	------	AREA G - POST DEV
16	SCS Runoff	18.95	1	724	56,382	------	------	------	AREA J - POST DEV
17	Combine	54.41	1	729	203,372	14, 15,	------	------	COMBINE H & G
18	Reach	52.59	1	732	203,371	17	------	------	HWY 20 SIDE DITCH
19	Combine	66.49	1	730	259,753	16, 18	------	------	COMBINE H,G, & J
20	SCS Runoff	37.12	1	731	148,914	------	------	------	AREA F - POST DEV
21	SCS Runoff	7.386	1	718	14,838	------	------	------	AREA J' - POST DEV
22	Combine	38.21	1	731	163,753	20, 21	------	------	Combine F & J'
23	Combine	104.60	1	730	423,506	19, 22	------	------	COMBINE G,H,J & F,J'
24	Reservoir	71.49	1	743	423,506	23	580.97	41,541	F,G,H,J & J' DETENTION
25	SCS Runoff	5.594	1	725	17,810	------	------	------	AREA K' - POST DEV
26	Reach	4.429	1	732	17,805	25	------	------	K' Tc DITCH
27	SCS Runoff	2.532	1	726	8,093	------	------	------	AREA K'' - POST DEV
28	Reach	1.732	1	735	8,085	27	------	------	K'' Tc DITCH
29	Combine	6.145	1	733	25,890	26, 28	------	------	COMBINE K' & K''
30	SCS Runoff	23.63	1	726	75,538	------	------	------	AREA K - POST DEV
31	Combine	28.70	1	726	101,428	29, 30	------	------	COMBINE K, K' & K''
32	Reservoir	7.119	1	753	101,294	31	582.59	33,217	AREA K DETENTION
33	Combine	78.53	1	743	524,795	24, 32	------	------	COMBINE F,G,H,J & K
34	SCS Runoff	5.133	1	721	12,509	------	------	------	AREA L - POST DEV

AP3_PREDEV_SOLAR.gpw	Return Period: 50 Year	Thursday, 11 / 15 / 2018

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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
35	Combine	79.30	1	743	537,304	33, 34	------	------	COMBINE FG,H,J,K & L
36	Combine	96.80	1	760	937,178	13, 35	------	------	TOTAL SITE DISCHARGE - POST D

Hydrograph Report

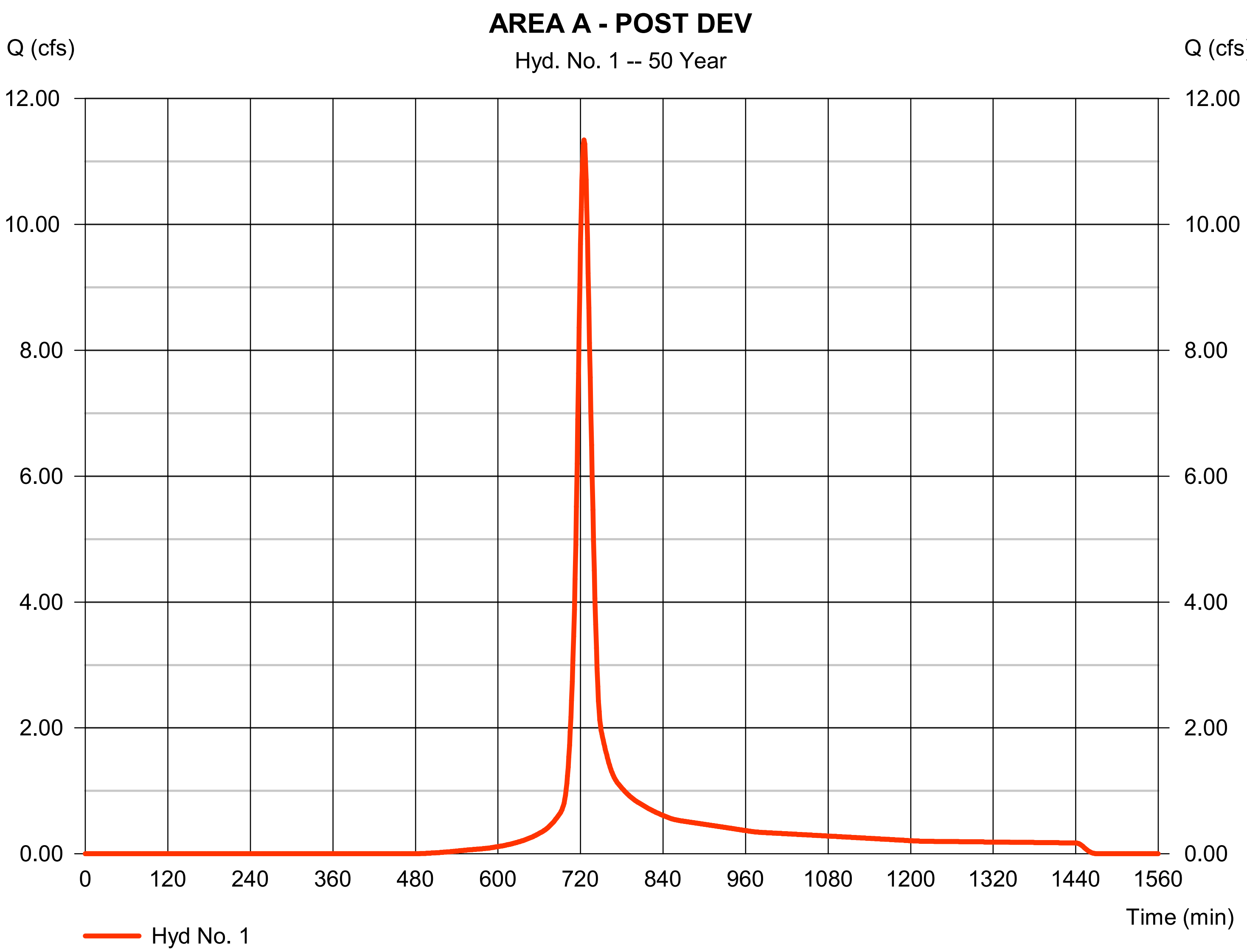
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 1

AREA A - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 11.34 cfs
Storm frequency	= 50 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 35,424 cuft
Drainage area	= 2.580 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.10 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.220 x 85) + (0.570 x 55) + (0.030 x 98) + (0.760 x 60)] / 2.580



Hydrograph Report

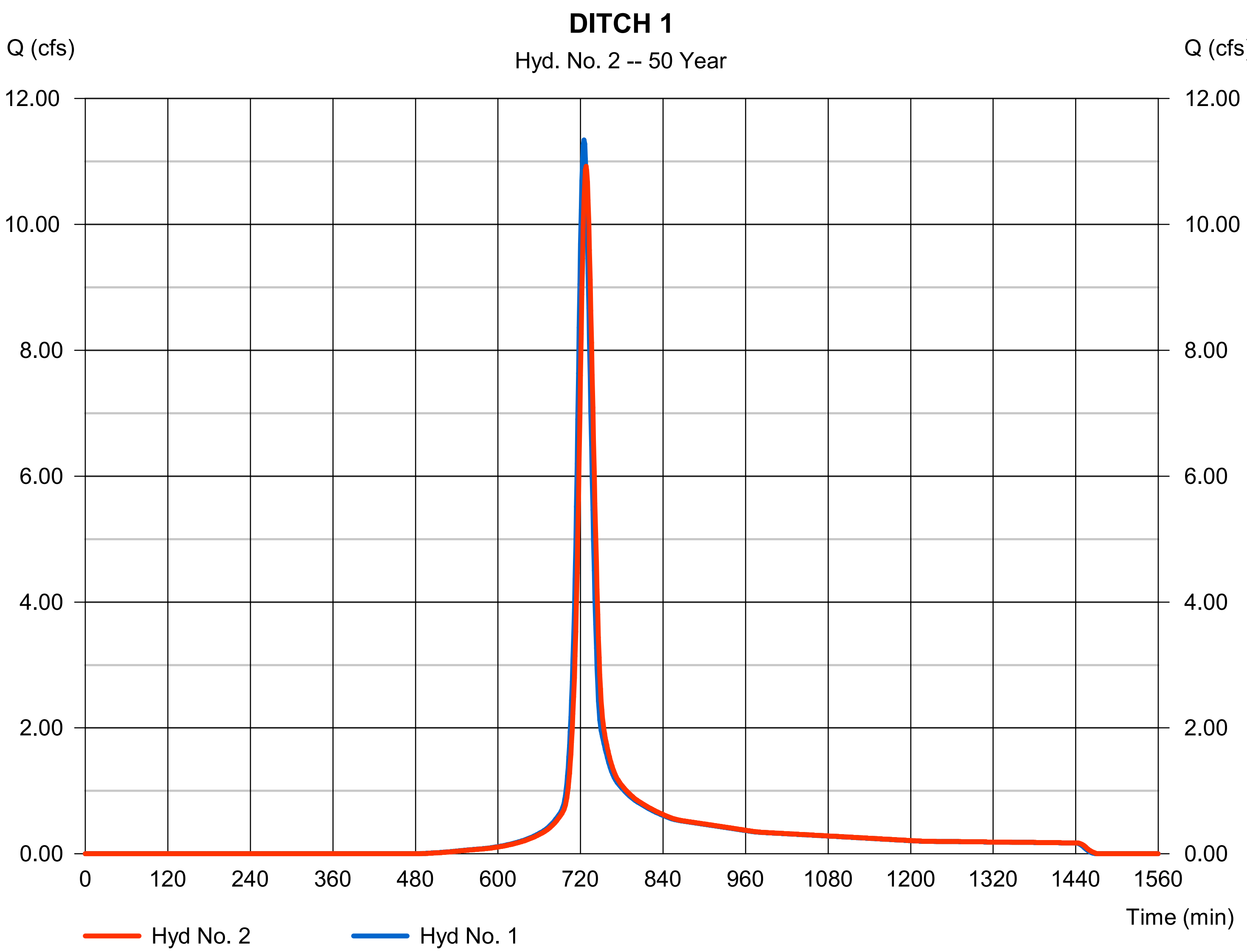
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 2

DITCH 1

Hydrograph type	= Reach	Peak discharge	= 10.92 cfs
Storm frequency	= 50 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 35,423 cuft
Inflow hyd. No.	= 1 - AREA A - POST DEV	Section type	= Trapezoidal
Reach length	= 730.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 10.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.375
Ave. velocity	= 3.34 ft/s	Routing coeff.	= 0.3172

Modified Att-Kin routing method used.



Hydrograph Report

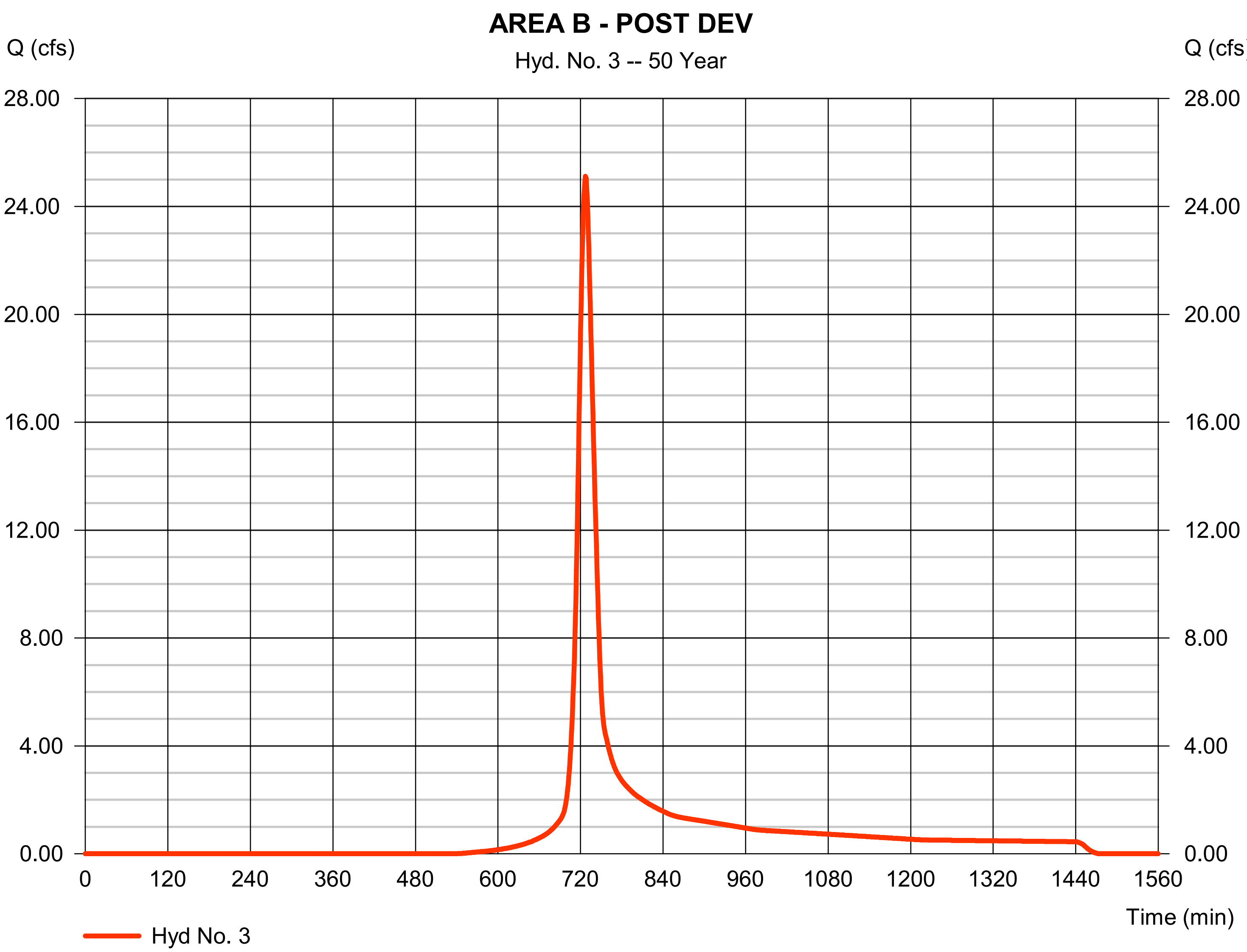
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 3

AREA B - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 25.11 cfs
Storm frequency	= 50 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 85,777 cuft
Drainage area	= 7.090 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.60 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.930 x 85) + (2.120 x 55) + (0.250 x 98) + (2.790 x 60)] / 7.090



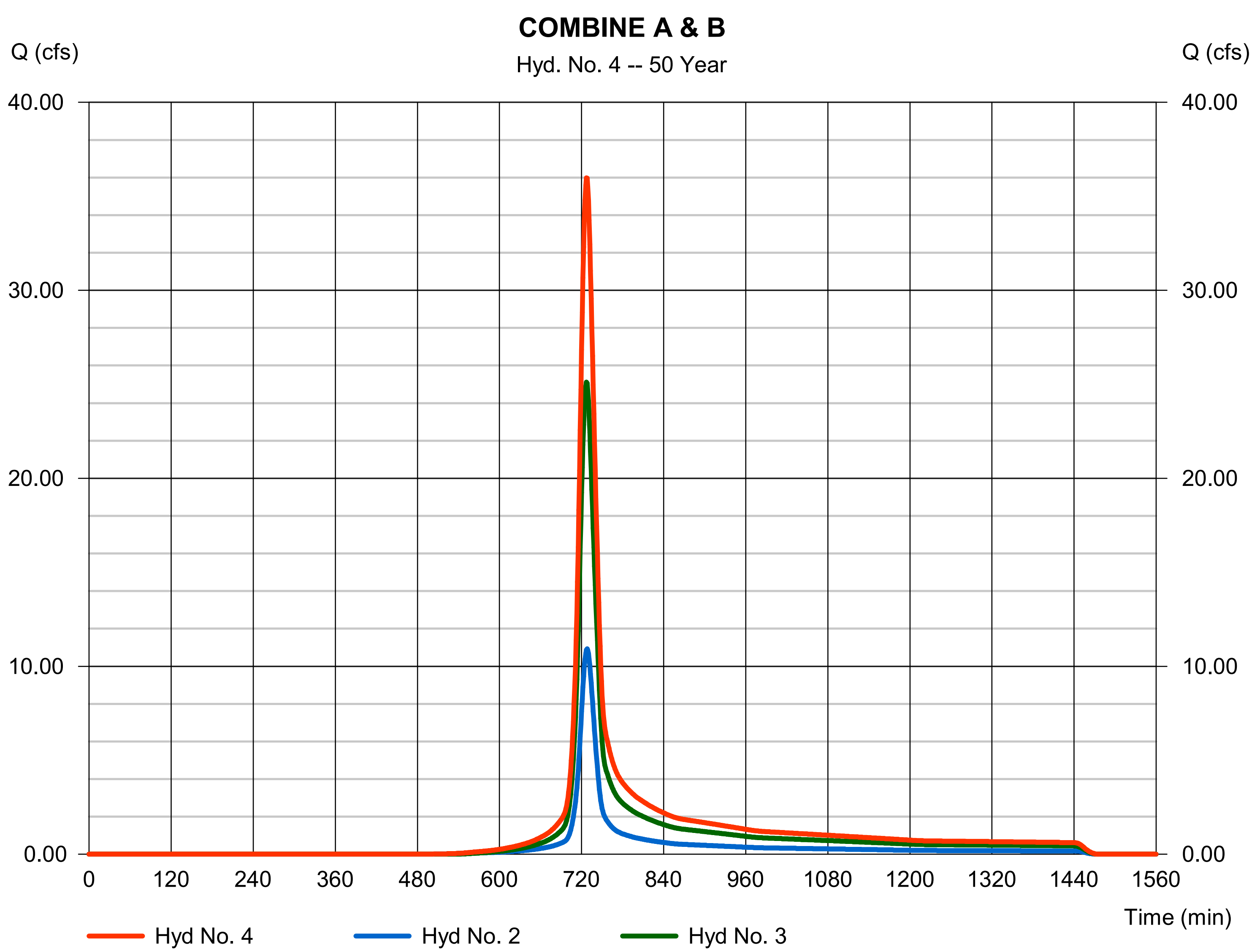
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 4

COMBINE A & B

Hydrograph type	= Combine	Peak discharge	= 35.98 cfs
Storm frequency	= 50 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 121,199 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 7.090 ac



Hydrograph Report

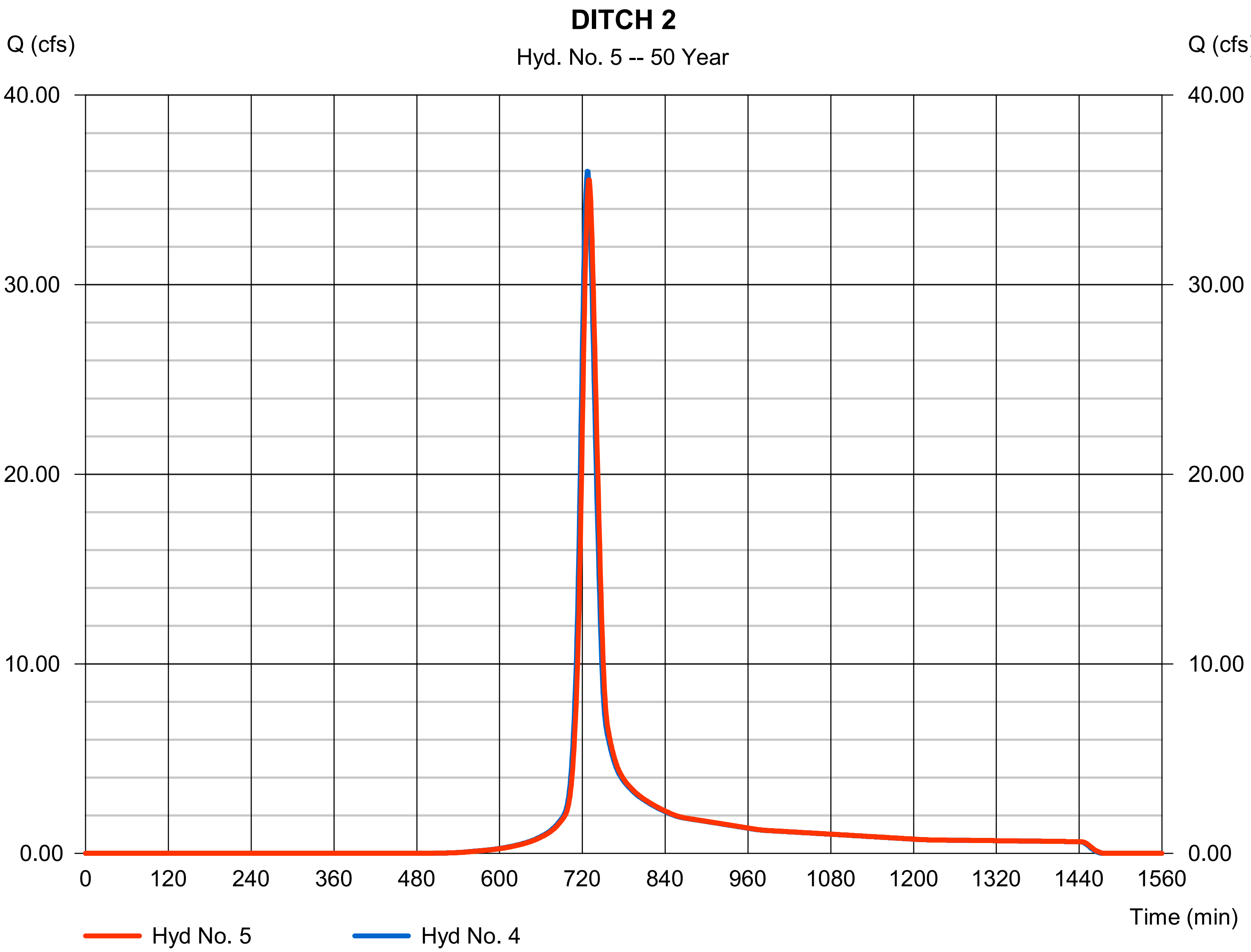
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 5

DITCH 2

Hydrograph type	= Reach	Peak discharge	= 35.52 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 121,198 cuft
Inflow hyd. No.	= 4 - COMBINE A & B	Section type	= Trapezoidal
Reach length	= 610.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.373
Ave. velocity	= 4.55 ft/s	Routing coeff.	= 0.4704

Modified Att-Kin routing method used.



Hydrograph Report

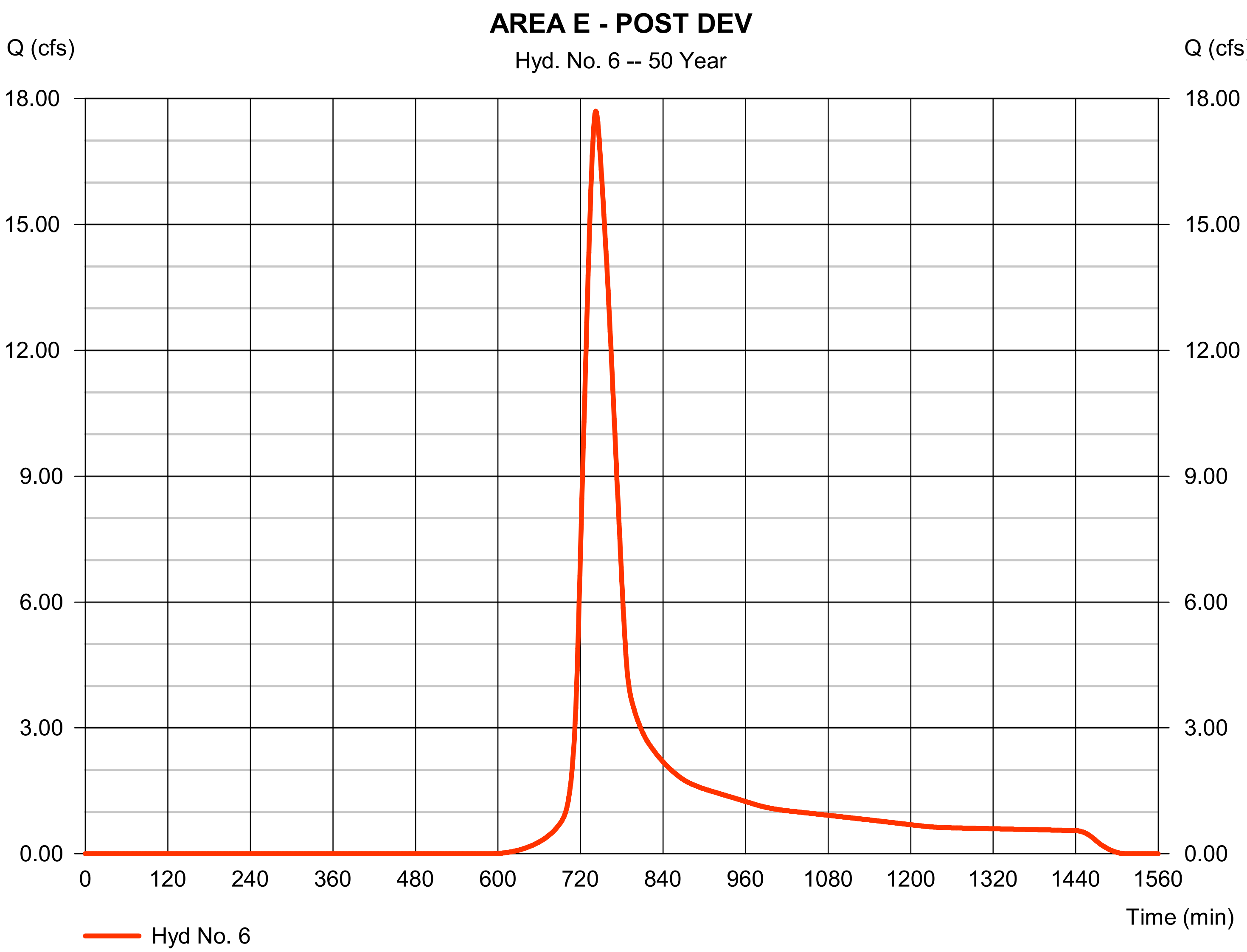
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 6

AREA E - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 17.70 cfs
Storm frequency	= 50 yrs	Time to peak	= 742 min
Time interval	= 1 min	Hyd. volume	= 98,530 cuft
Drainage area	= 9.150 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 47.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.680 x 65) + (0.330 x 98) + (5.140 x 60)] / 9.150



Hydrograph Report

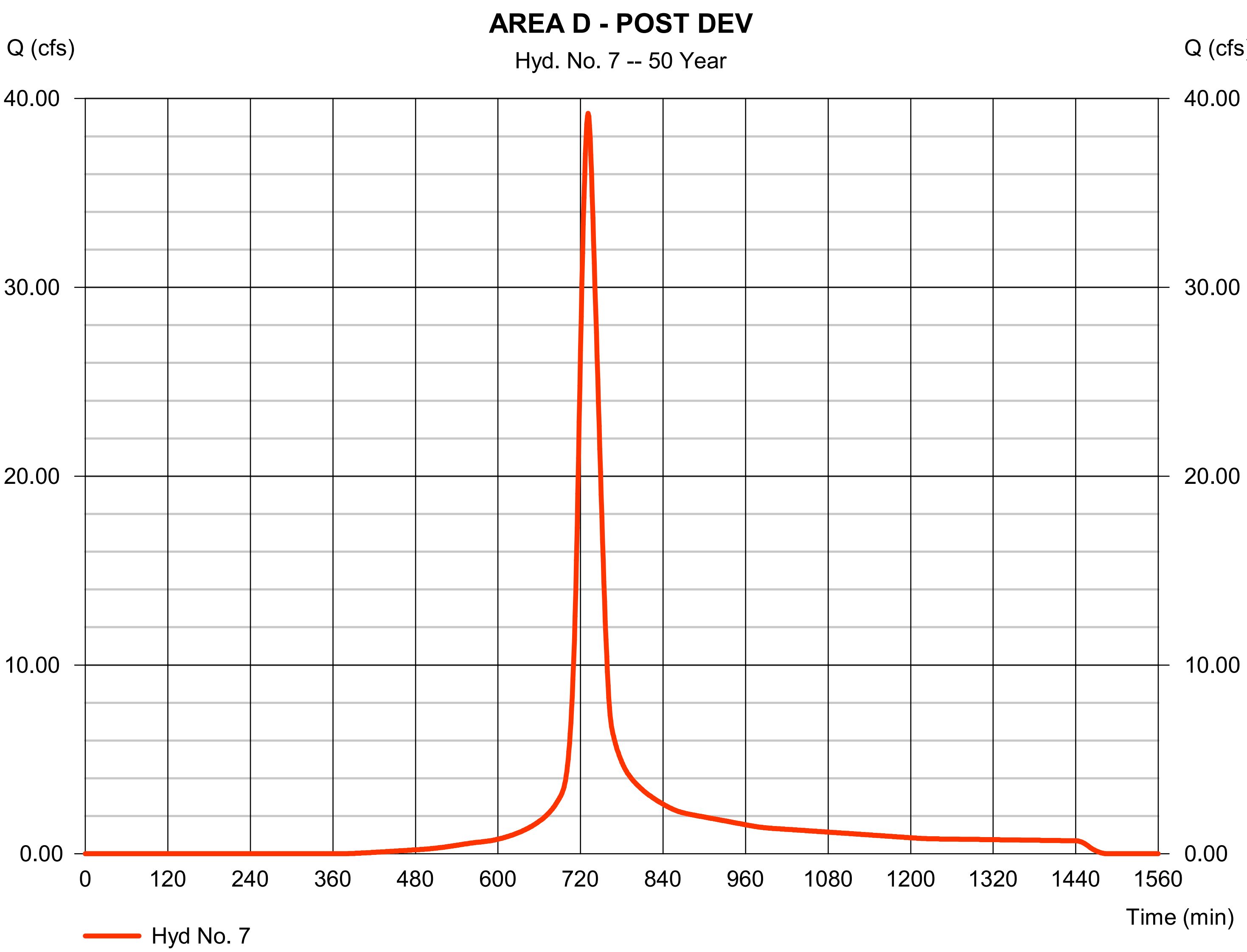
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 7

AREA D - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 39.22 cfs
Storm frequency	= 50 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 156,835 cuft
Drainage area	= 9.520 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.10 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.910 x 85) + (8.610 x 77)] / 9.520



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

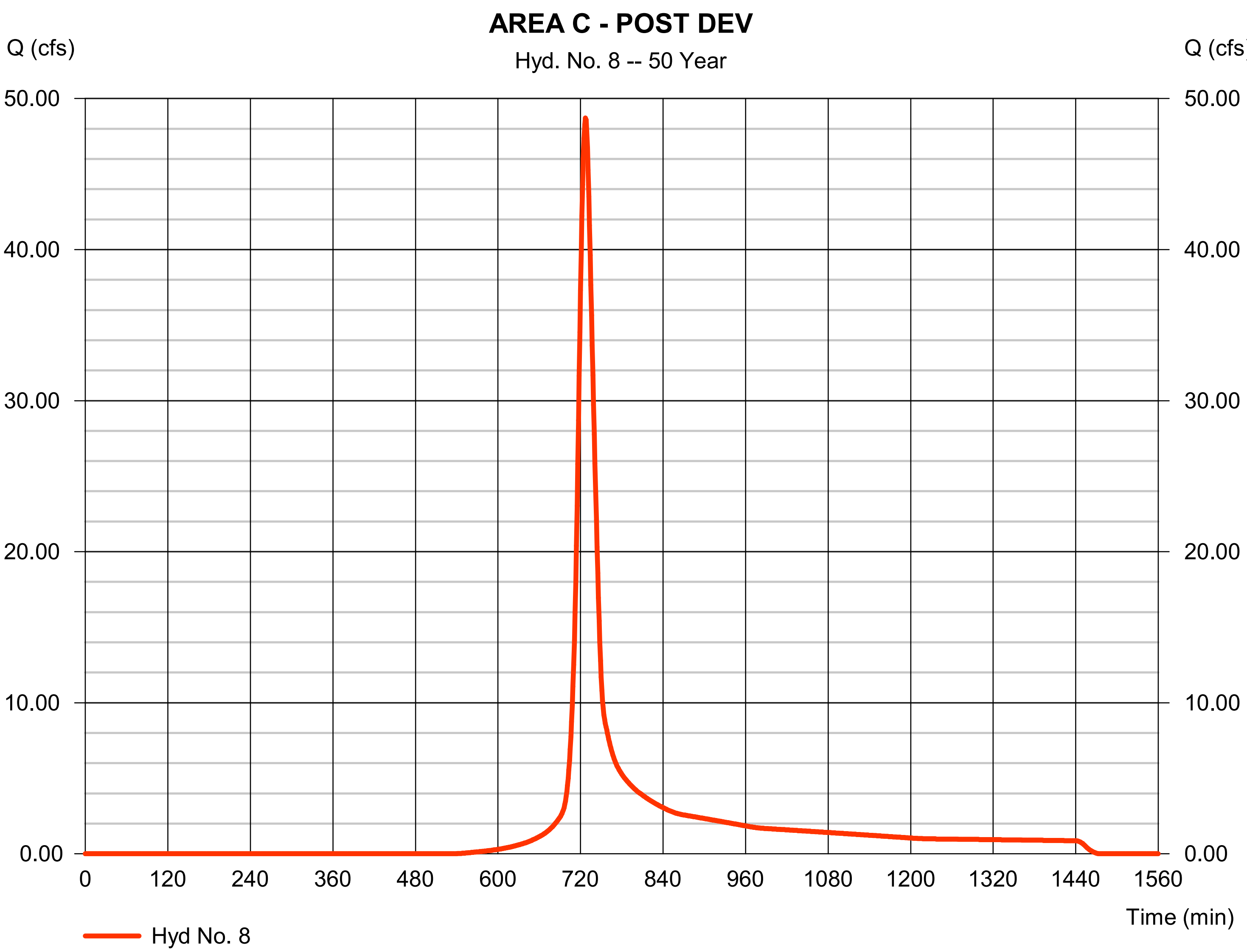
Thursday, 11 / 15 / 2018

Hyd. No. 8

AREA C - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 48.71 cfs
Storm frequency	= 50 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 166,351 cuft
Drainage area	= 13.750 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.460 x 85) + (0.400 x 55) + (1.740 x 98) + (10.150 x 60)] / 13.750



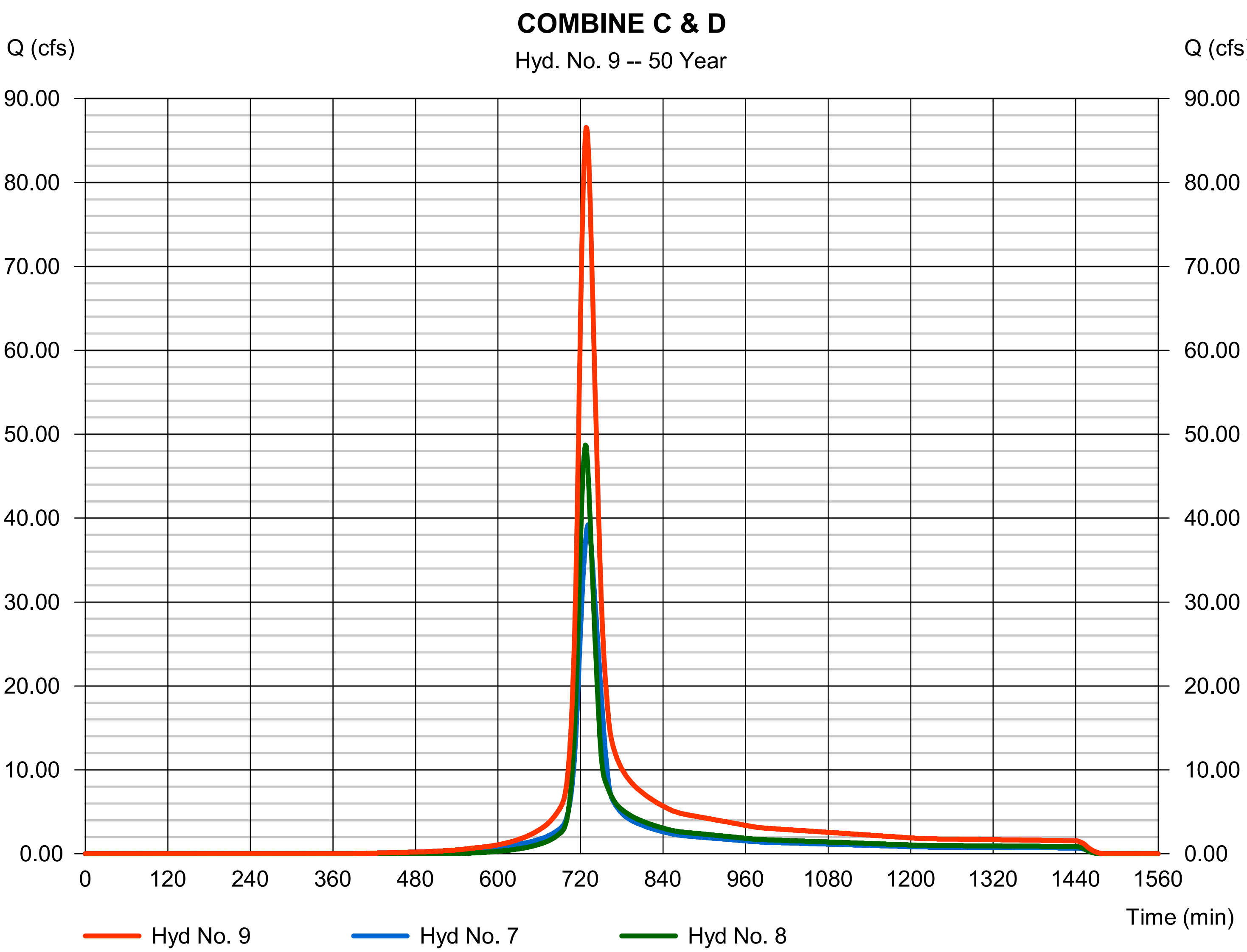
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 11 / 15 / 2018

Hyd. No. 9

COMBINE C & D

Hydrograph type	= Combine	Peak discharge	= 86.55 cfs
Storm frequency	= 50 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 323,186 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 23.270 ac



Hydrograph Report

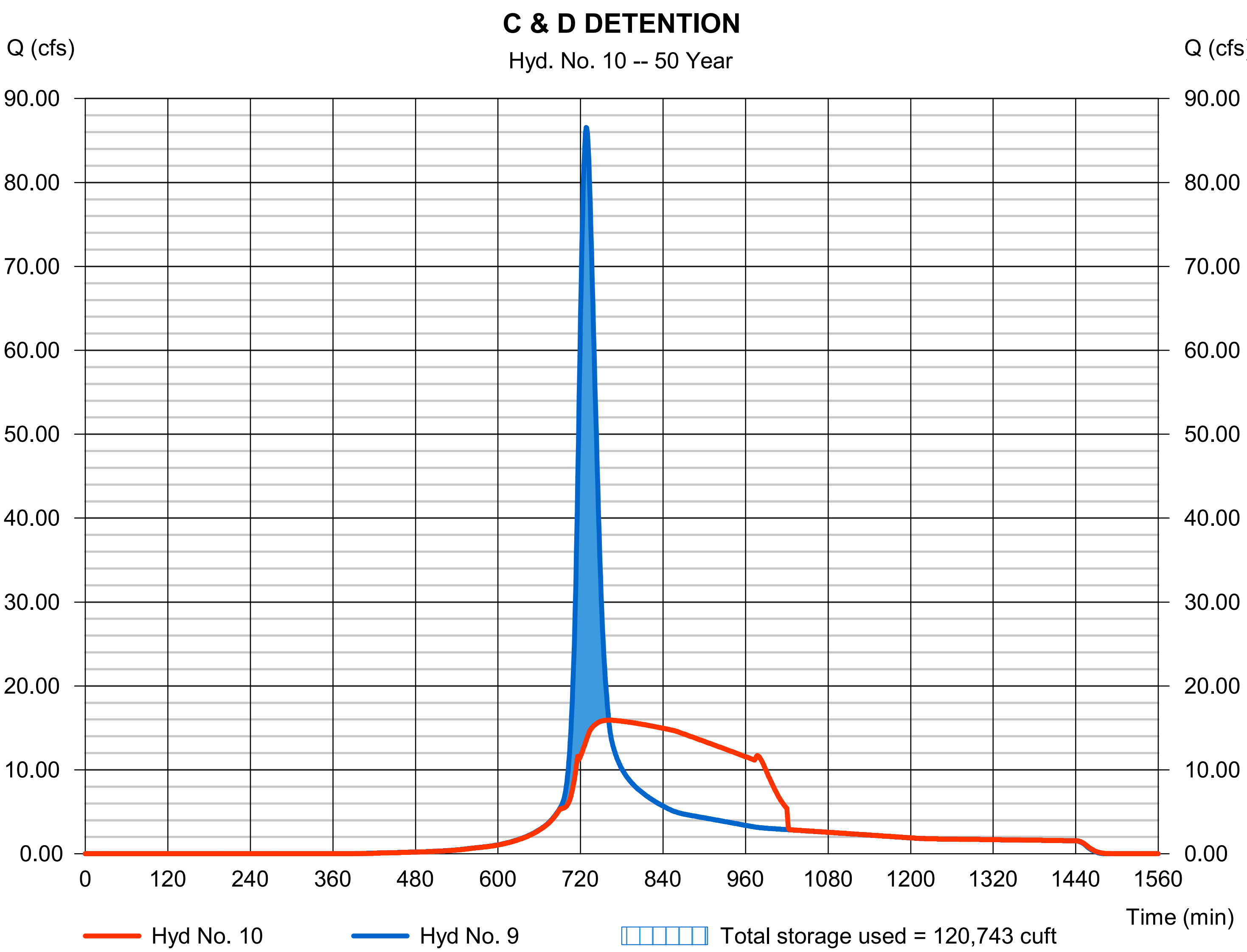
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 10

C & D DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 15.92 cfs
Storm frequency	= 50 yrs	Time to peak	= 761 min
Time interval	= 1 min	Hyd. volume	= 323,186 cuft
Inflow hyd. No.	= 9 - COMBINE C & D	Max. Elevation	= 582.43 ft
Reservoir name	= C&D DETENTION	Max. Storage	= 120,743 cuft

Storage Indication method used.



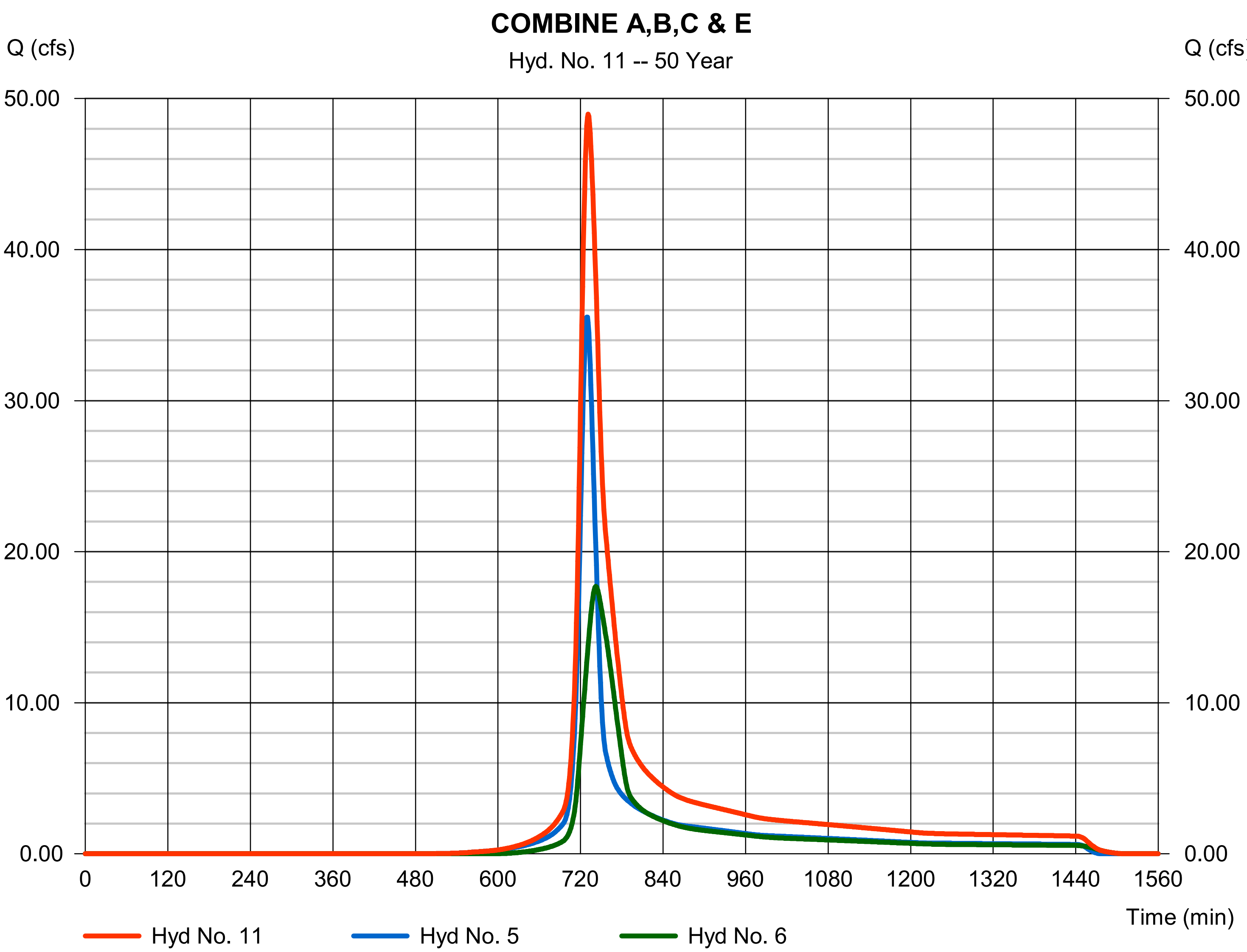
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 11 / 15 / 2018

Hyd. No. 11

COMBINE A,B,C & E

Hydrograph type	= Combine	Peak discharge	= 48.96 cfs
Storm frequency	= 50 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 219,728 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 9.150 ac



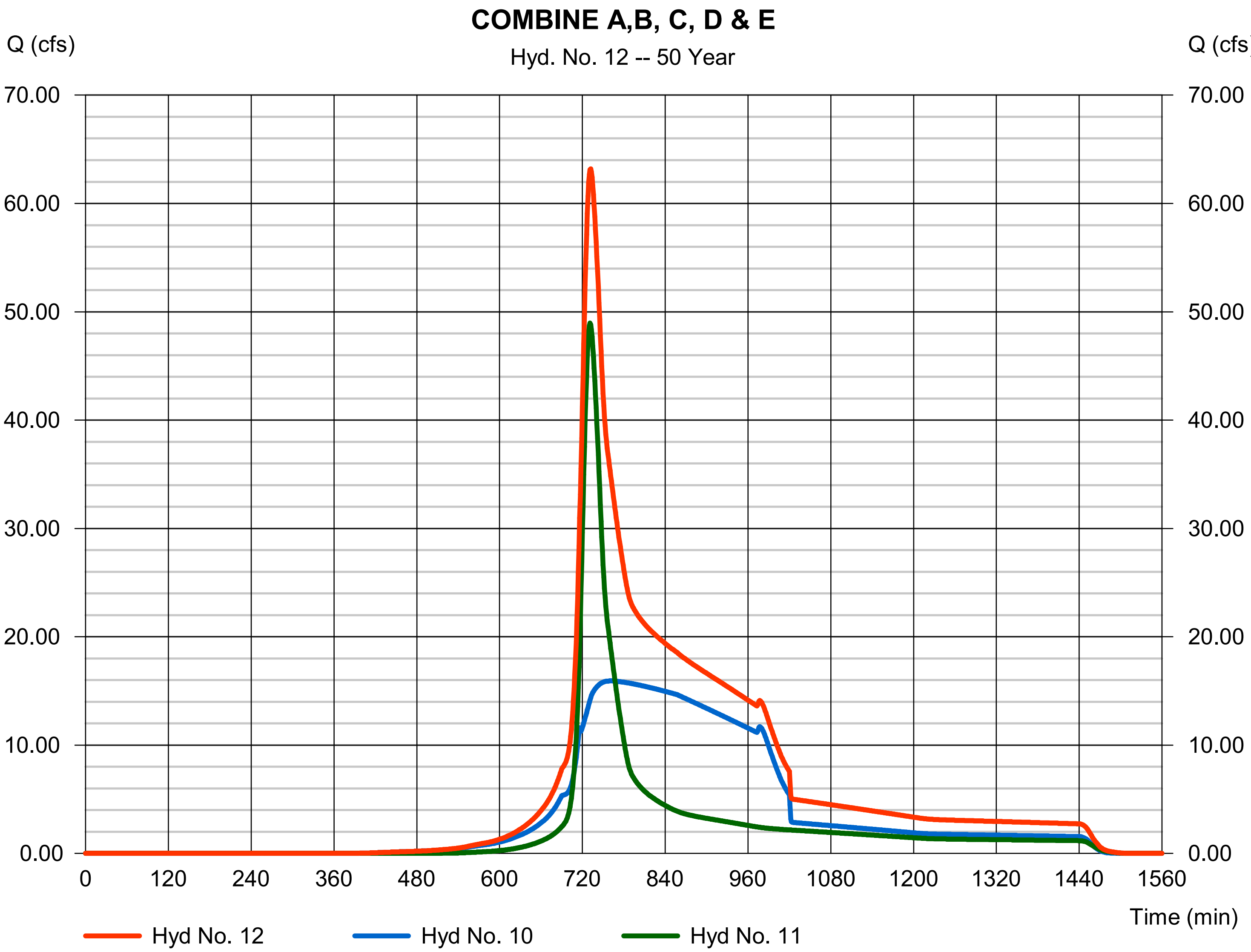
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 12

COMBINE A,B, C, D & E

Hydrograph type	= Combine	Peak discharge	= 63.18 cfs
Storm frequency	= 50 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 542,914 cuft
Inflow hyds.	= 10, 11	Contrib. drain. area	= 0.000 ac



Hydrograph Report

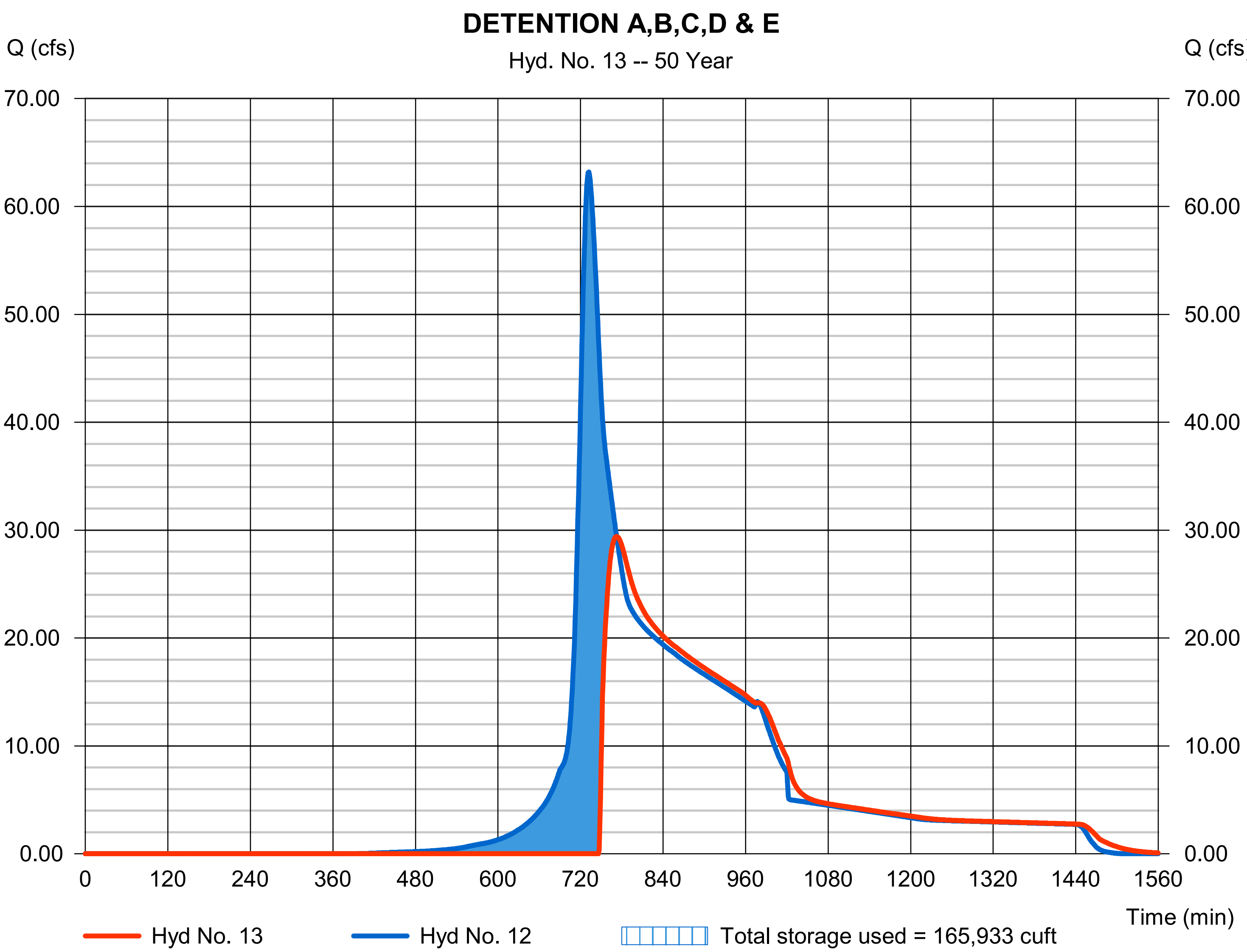
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 11 / 15 / 2018

Hyd. No. 13

DETENTION A,B,C,D & E

Hydrograph type	= Reservoir	Peak discharge	= 29.41 cfs
Storm frequency	= 50 yrs	Time to peak	= 772 min
Time interval	= 1 min	Hyd. volume	= 399,874 cuft
Inflow hyd. No.	= 12 - COMBINE A,B, C, D & E	Max. Elevation	= 582.29 ft
Reservoir name	= A,B,C,D & E DETENTION	Max. Storage	= 165,933 cuft

Storage Indication method used.



Hydrograph Report

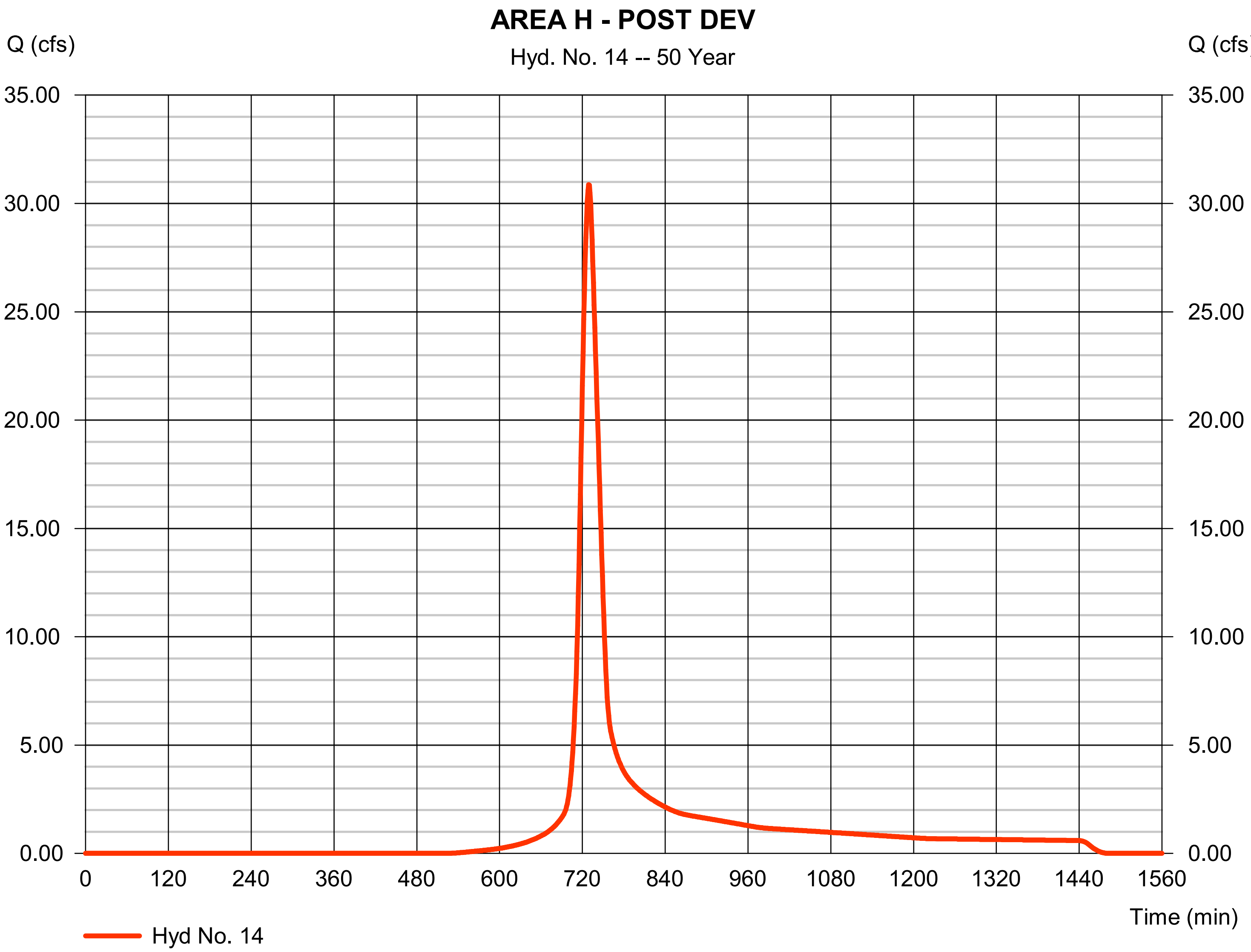
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 14

AREA H - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 30.87 cfs
Storm frequency	= 50 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 115,543 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.50 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



Hydrograph Report

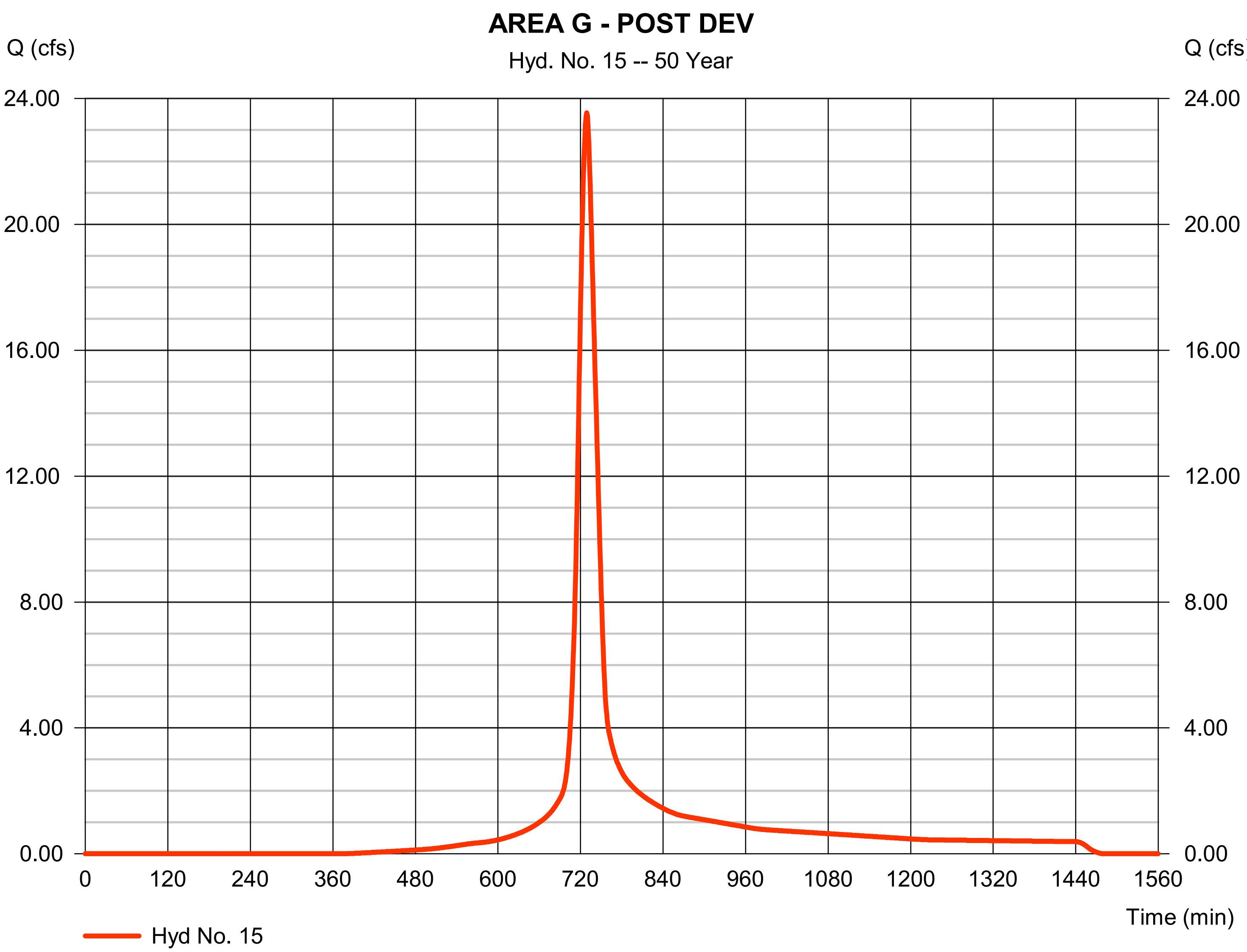
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 15

AREA G - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 23.55 cfs
Storm frequency	= 50 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 87,830 cuft
Drainage area	= 5.290 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 26.80 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.330 x 85) + (4.960 x 77)] / 5.290



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

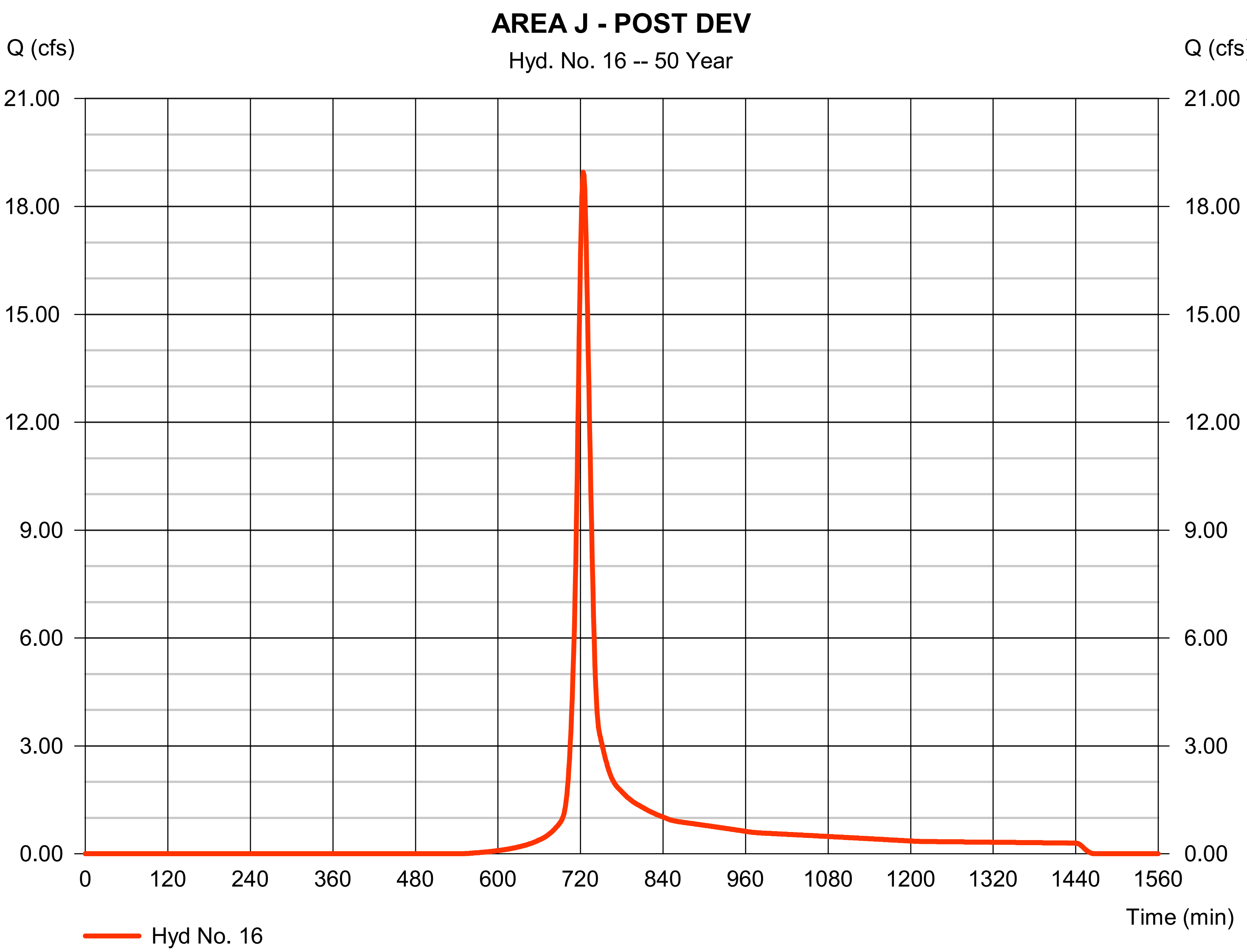
Thursday, 11 / 15 / 2018

Hyd. No. 16

AREA J - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 18.95 cfs
Storm frequency	= 50 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 56,382 cuft
Drainage area	= 4.820 ac	Curve number	= 66*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 85) + (0.020 x 65) + (0.680 x 98) + (4.030 x 60)] / 4.820



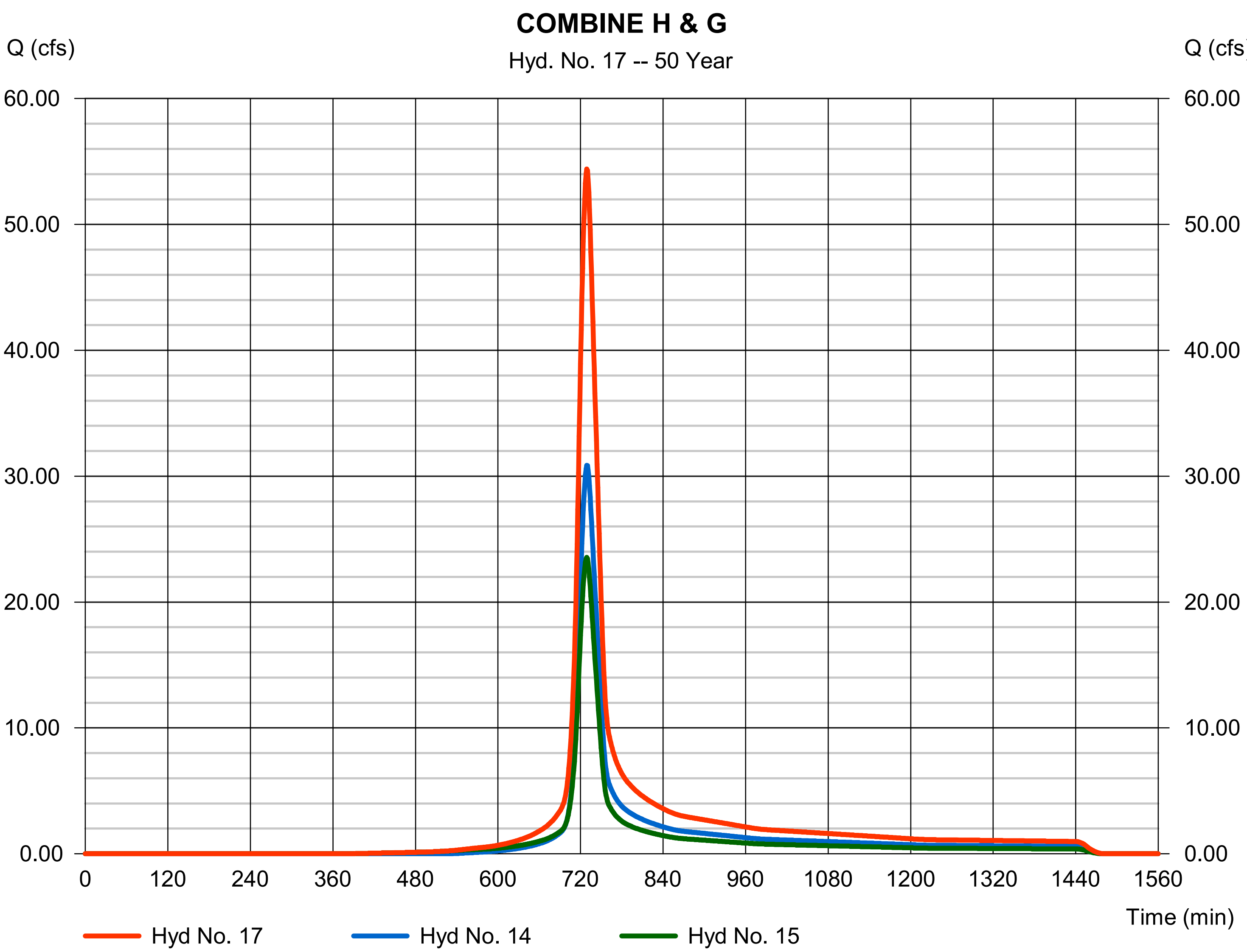
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 17

COMBINE H & G

Hydrograph type	= Combine	Peak discharge	= 54.41 cfs
Storm frequency	= 50 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 203,372 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 14.400 ac



Hydrograph Report

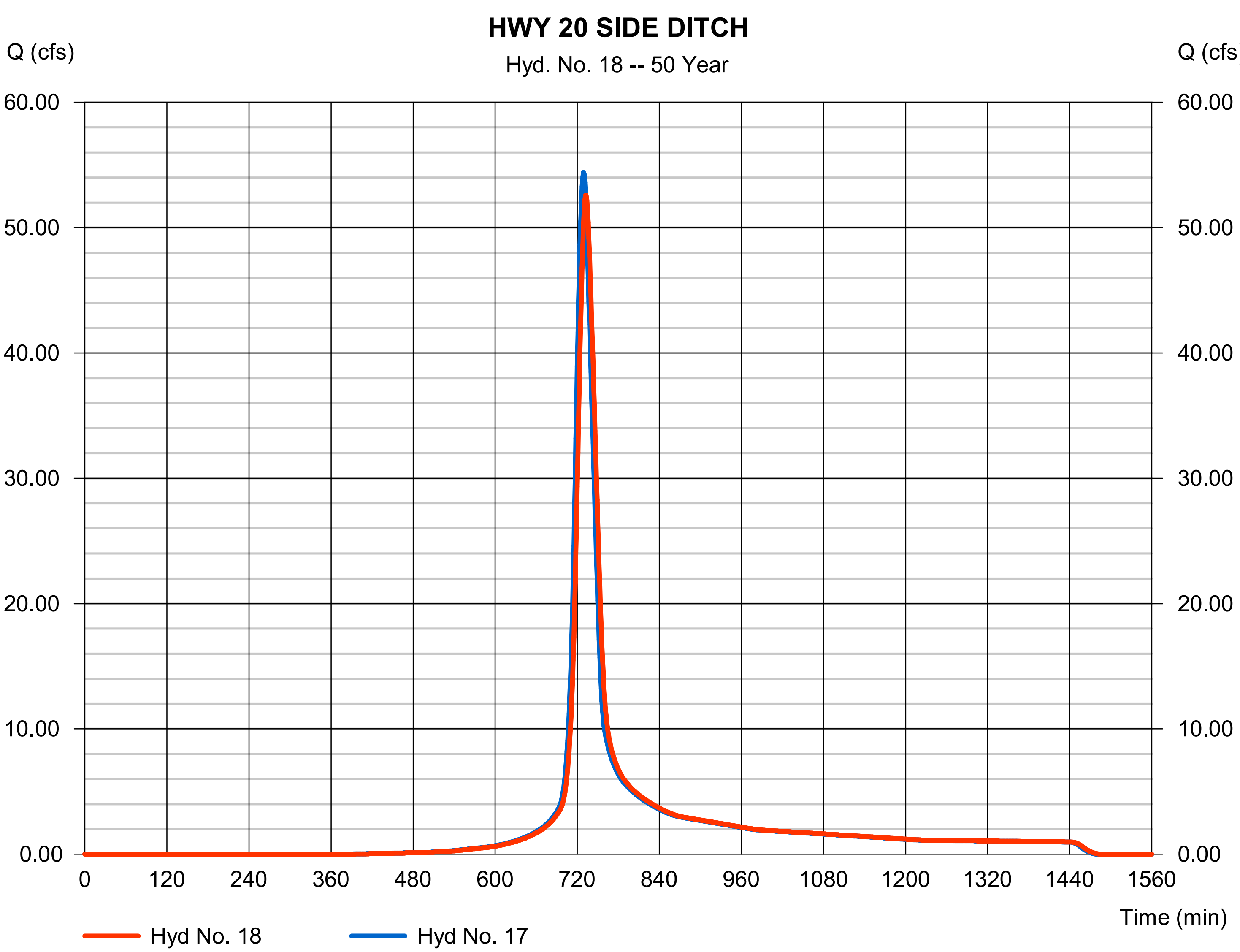
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 18

HWY 20 SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 52.59 cfs
Storm frequency	= 50 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 203,371 cuft
Inflow hyd. No.	= 17 - COMBINE H & G	Section type	= Trapezoidal
Reach length	= 900.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.030	Bottom width	= 3.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 1.688	Rating curve m	= 1.304
Ave. velocity	= 3.79 ft/s	Routing coeff.	= 0.2831

Modified Att-Kin routing method used.



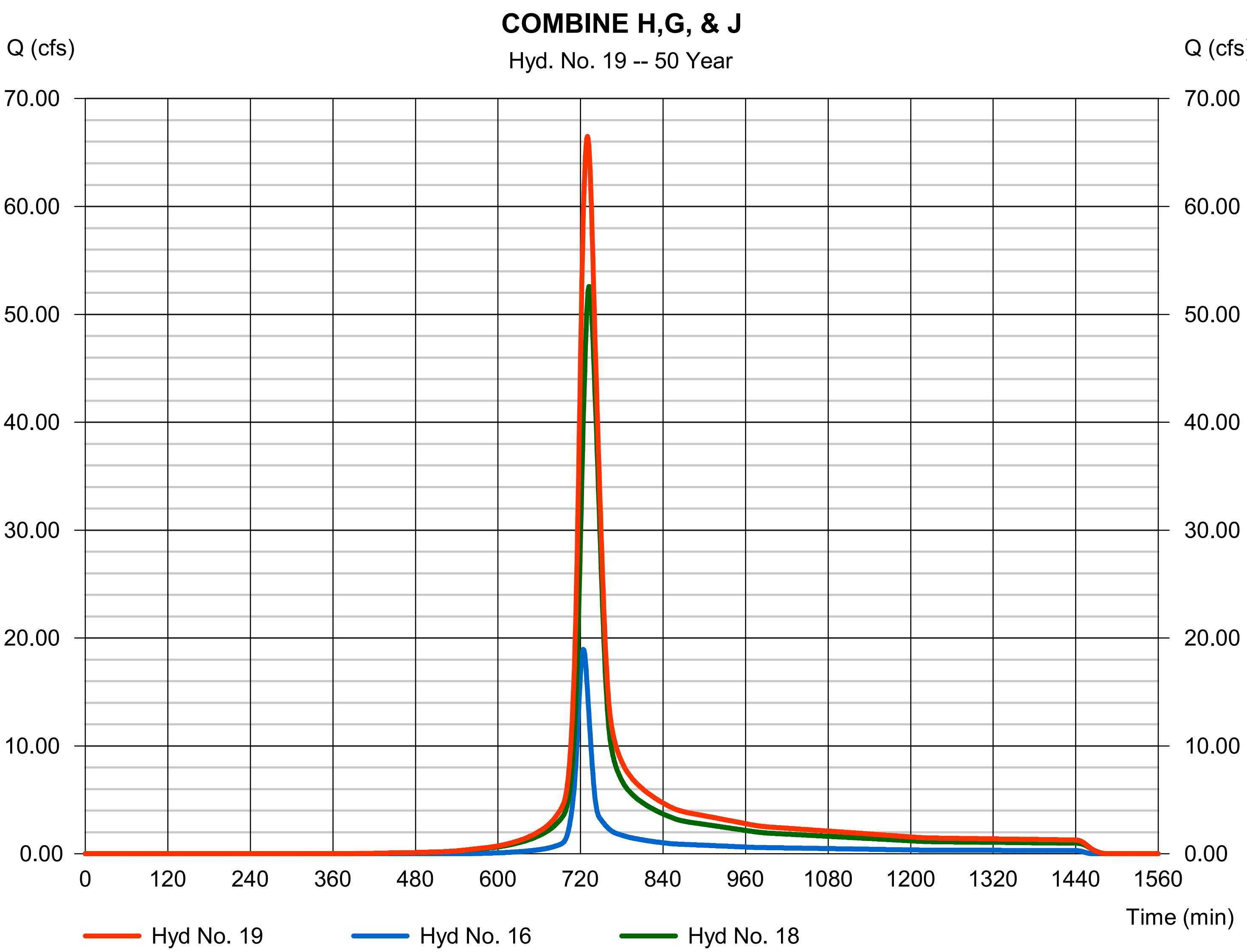
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 | Thursday, 11 / 15 / 2018

Hyd. No. 19

COMBINE H,G, & J

Hydrograph type	= Combine	Peak discharge	= 66.49 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 259,753 cuft
Inflow hyds.	= 16, 18	Contrib. drain. area	= 4.820 ac



Hydrograph Report

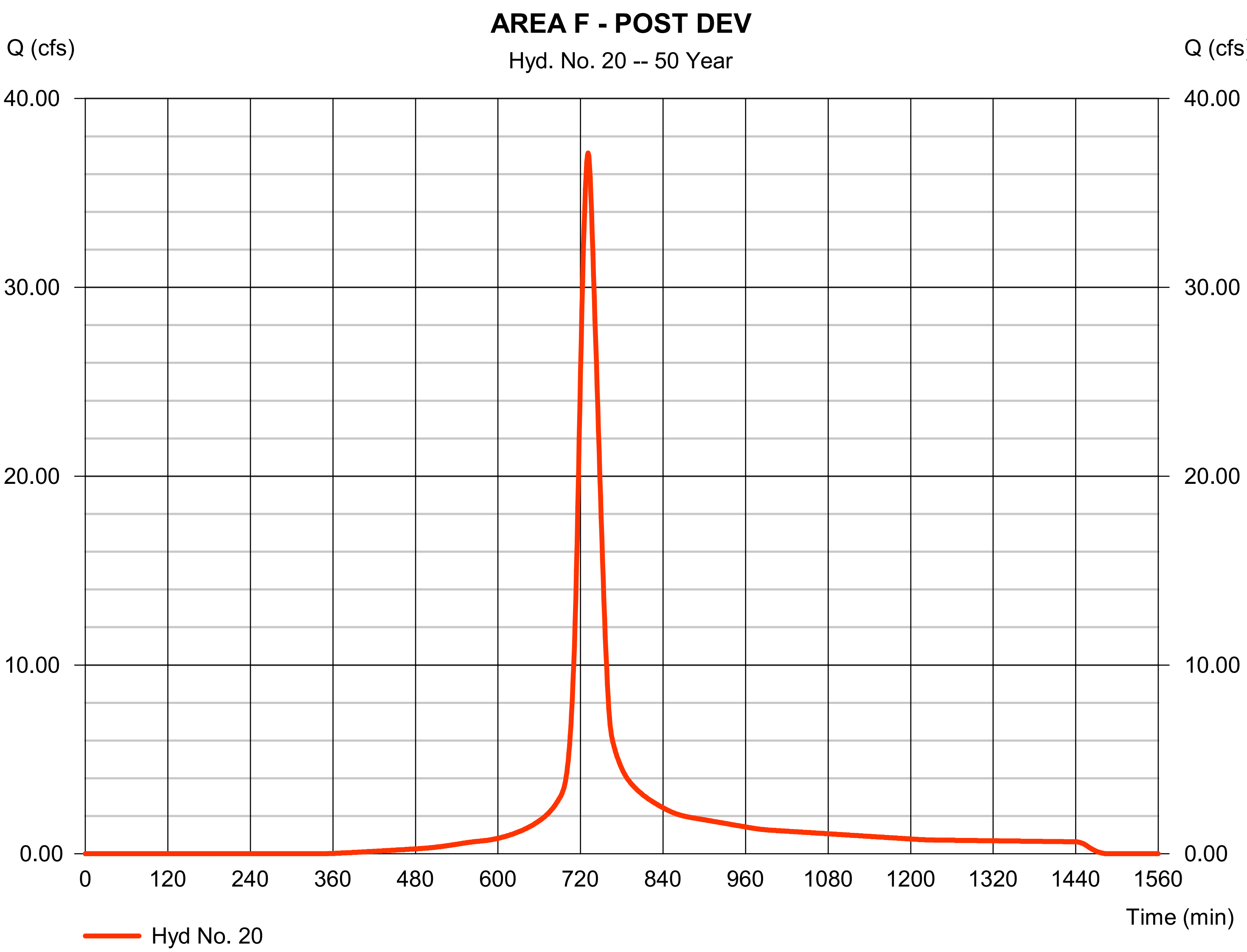
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 20

AREA F - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 37.12 cfs
Storm frequency	= 50 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 148,914 cuft
Drainage area	= 8.620 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.440 x 85) + (8.180 x 77)] / 8.620



Hydrograph Report

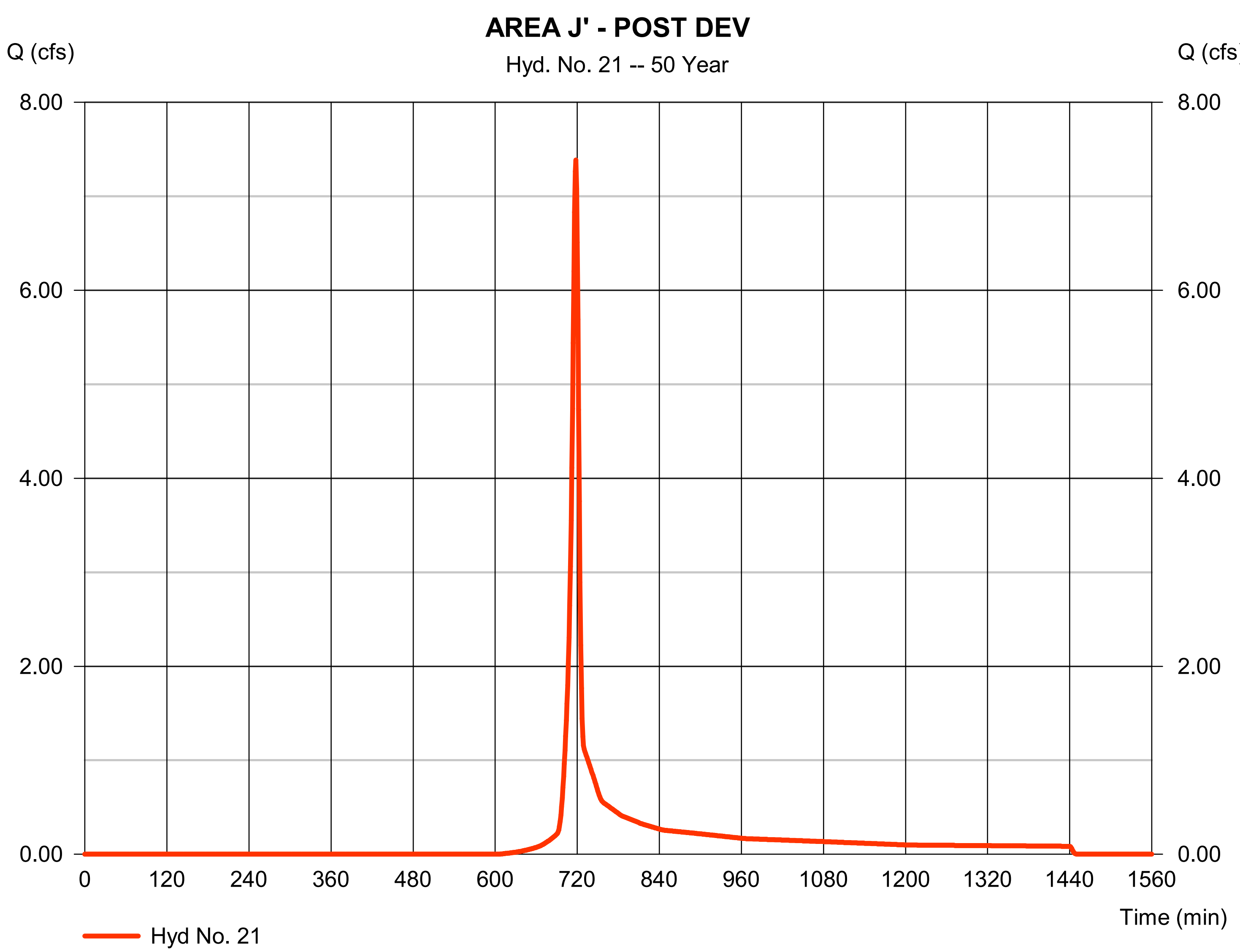
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 21

AREA J' - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 7.386 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 14,838 cuft
Drainage area	= 1.440 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.220 x 65) + (1.220 x 60)] / 1.440



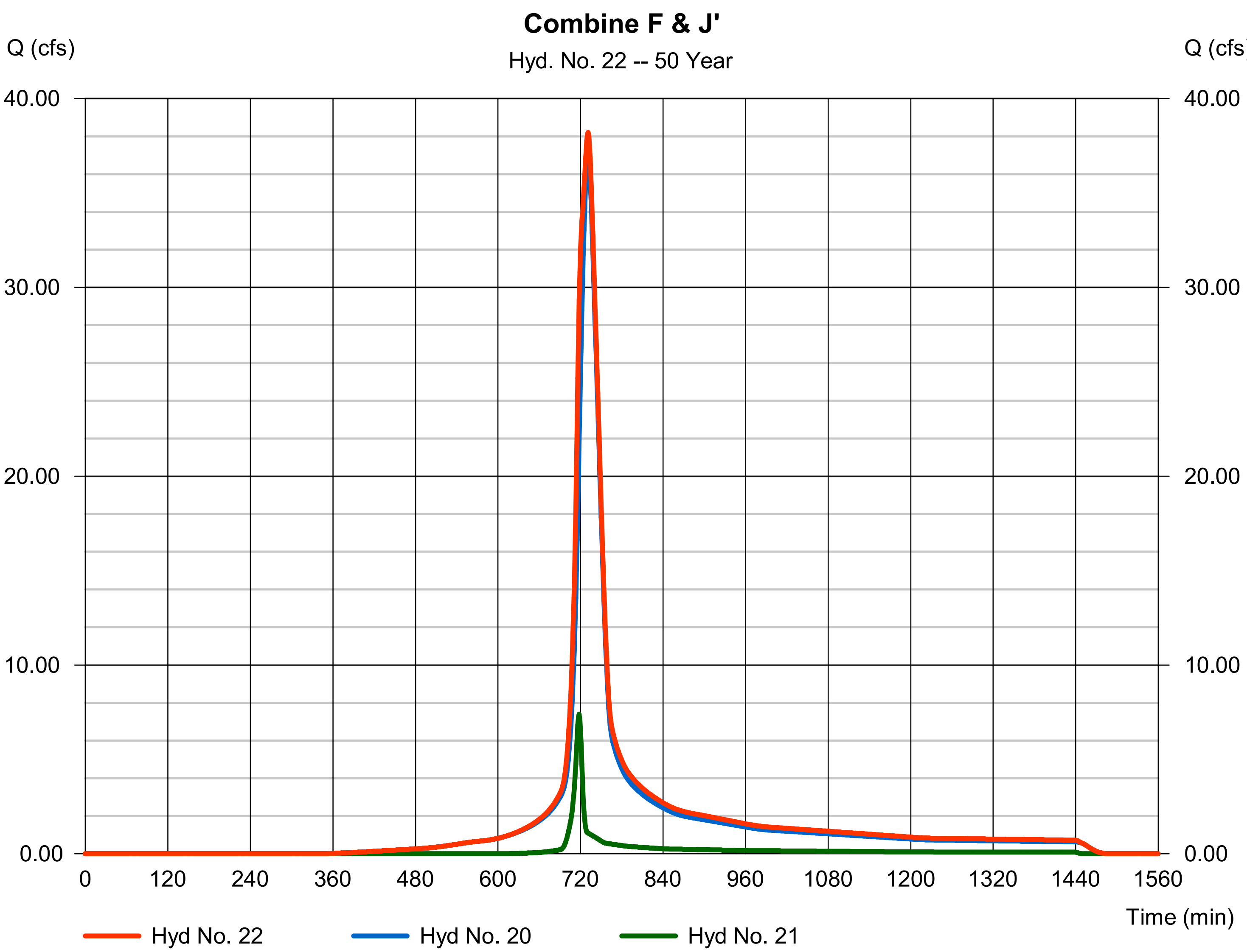
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 22

Combine F & J'

Hydrograph type	= Combine	Peak discharge	= 38.21 cfs
Storm frequency	= 50 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 163,753 cuft
Inflow hyds.	= 20, 21	Contrib. drain. area	= 10.060 ac



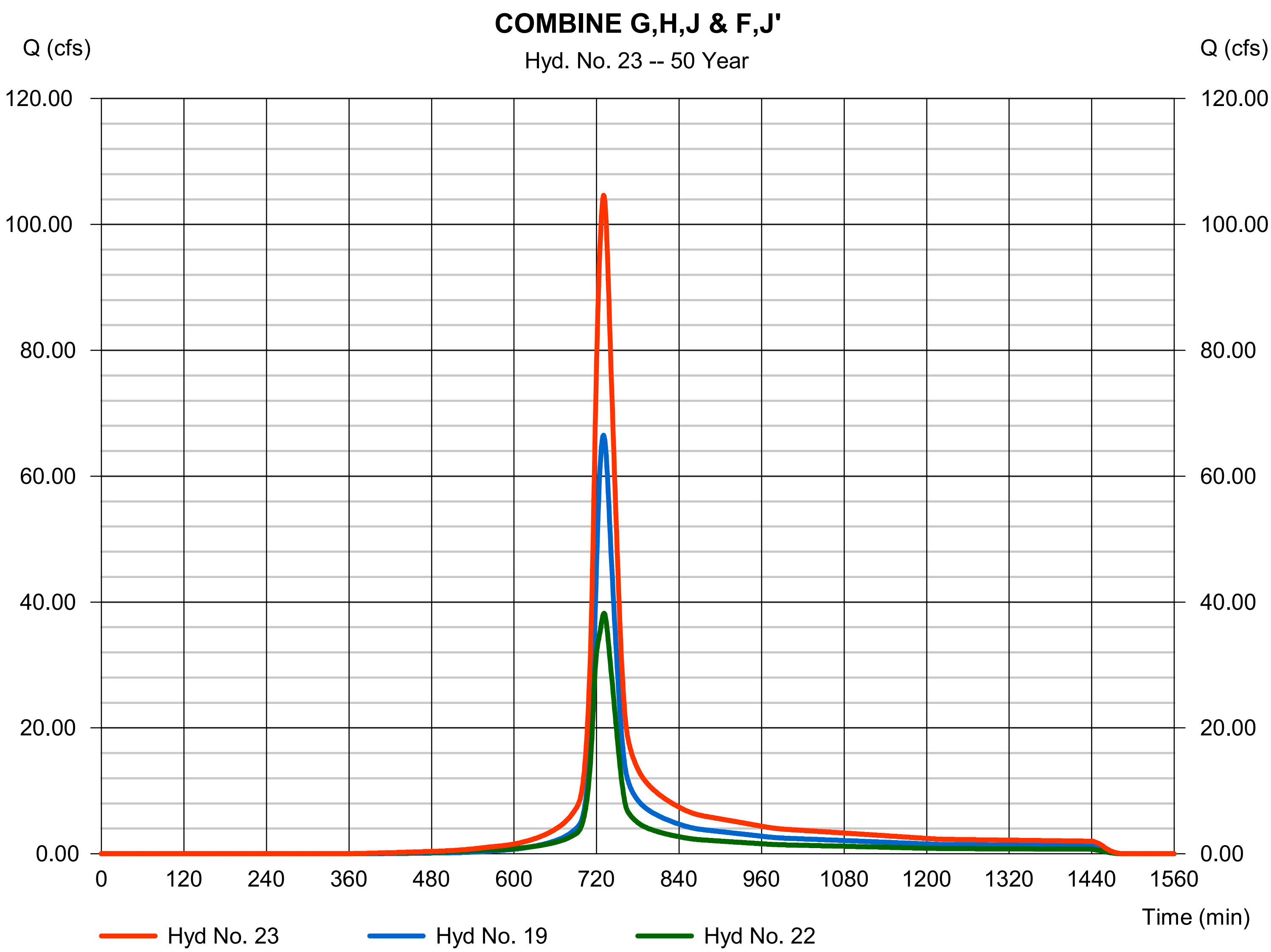
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 23

COMBINE G,H,J & F,J'

Hydrograph type	= Combine	Peak discharge	= 104.60 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 423,506 cuft
Inflow hyds.	= 19, 22	Contrib. drain. area	= 0.000 ac



Hydrograph Report

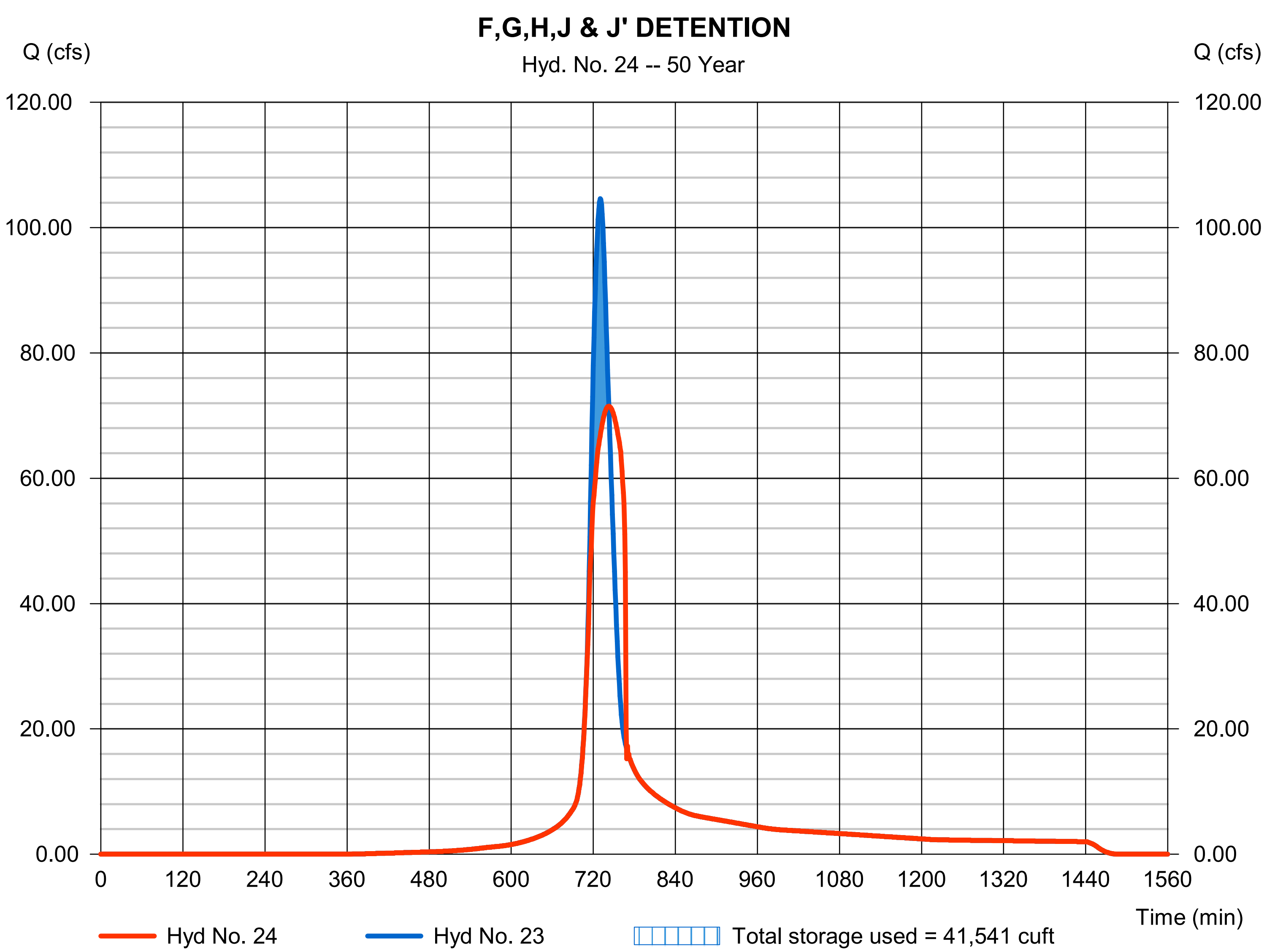
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 24

F,G,H,J & J' DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 71.49 cfs
Storm frequency	= 50 yrs	Time to peak	= 743 min
Time interval	= 1 min	Hyd. volume	= 423,506 cuft
Inflow hyd. No.	= 23 - COMBINE G,H,J & F,J'	Max. Elevation	= 580.97 ft
Reservoir name	= F,G,H,J & J' DETENTION	Max. Storage	= 41,541 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	SCS Runoff	13.37	1	725	41,750	------	------	------	AREA A - POST DEV
2	Reach	12.91	1	728	41,748	1	------	------	DITCH 1
3	SCS Runoff	30.03	1	727	102,165	------	------	------	AREA B - POST DEV
4	Combine	42.91	1	727	143,913	2, 3	------	------	COMBINE A & B
5	Reach	42.43	1	729	143,911	4	------	------	DITCH 2
6	SCS Runoff	21.56	1	742	118,736	------	------	------	AREA E - POST DEV
7	SCS Runoff	45.34	1	731	181,834	------	------	------	AREA D - POST DEV
8	SCS Runoff	58.24	1	727	198,133	------	------	------	AREA C - POST DEV
9	Combine	102.01	1	728	379,967	7, 8	------	------	COMBINE C & D
10	Reservoir	16.71	1	763	379,967	9	582.71	149,068	C & D DETENTION
11	Combine	58.84	1	731	262,647	5, 6,	------	------	COMBINE A,B,C & E
12	Combine	73.69	1	731	642,614	10, 11	------	------	COMBINE A,B, C, D & E
13	Reservoir	39.14	1	761	499,573	12	582.46	172,374	DETENTION A,B,C,D & E
14	SCS Runoff	36.81	1	729	137,242	------	------	------	AREA H - POST DEV
15	SCS Runoff	27.22	1	729	101,829	------	------	------	AREA G - POST DEV
16	SCS Runoff	22.71	1	724	67,343	------	------	------	AREA J - POST DEV
17	Combine	64.03	1	729	239,071	14, 15,	------	------	COMBINE H & G
18	Reach	62.06	1	732	239,070	17	------	------	HWY 20 SIDE DITCH
19	Combine	78.80	1	730	306,413	16, 18	------	------	COMBINE H,G, & J
20	SCS Runoff	42.69	1	731	171,907	------	------	------	AREA F - POST DEV
21	SCS Runoff	8.961	1	718	17,995	------	------	------	AREA J' - POST DEV
22	Combine	44.00	1	731	189,902	20, 21	------	------	Combine F & J'
23	Combine	122.71	1	730	496,315	19, 22	------	------	COMBINE G,H,J & F,J'
24	Reservoir	75.75	1	744	496,315	23	581.58	62,404	F,G,H,J & J' DETENTION
25	SCS Runoff	6.822	1	725	21,530	------	------	------	AREA K' - POST DEV
26	Reach	5.475	1	732	21,526	25	------	------	K' Tc DITCH
27	SCS Runoff	3.101	1	725	9,816	------	------	------	AREA K'' - POST DEV
28	Reach	2.162	1	734	9,808	27	------	------	K'' Tc DITCH
29	Combine	7.611	1	733	31,333	26, 28	------	------	COMBINE K' & K''
30	SCS Runoff	28.94	1	725	91,612	------	------	------	AREA K - POST DEV
31	Combine	35.31	1	726	122,946	29, 30	------	------	COMBINE K, K' & K''
32	Reservoir	7.727	1	755	122,811	31	582.87	43,112	AREA K DETENTION
33	Combine	83.41	1	745	619,122	24, 32	------	------	COMBINE F,G,H,J & K
34	SCS Runoff	6.249	1	721	15,171	------	------	------	AREA L - POST DEV

AP3_PREDEV_SOLAR.gpw | Return Period: 100 Year | Thursday, 11 / 15 / 2018

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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
35	Combine	84.28	1	744	634,292	33, 34	------	------	COMBINE FG,H,J,K & L
36	Combine	119.63	1	755	1,133,910	13, 35	------	------	TOTAL SITE DISCHARGE - POST D

Hydrograph Report

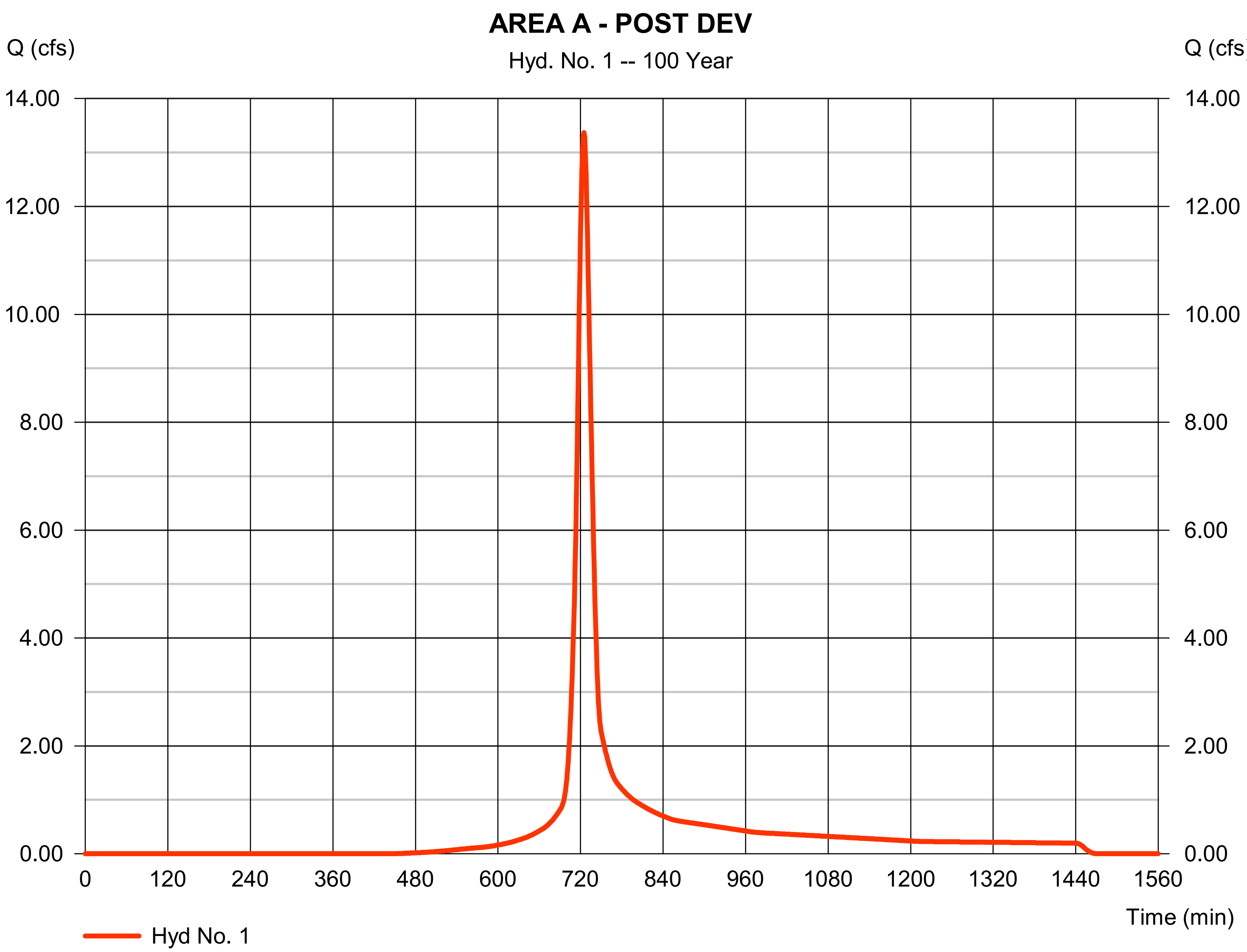
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 1

AREA A - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 13.37 cfs
Storm frequency	= 100 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 41,750 cuft
Drainage area	= 2.580 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.10 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.220 x 85) + (0.570 x 55) + (0.030 x 98) + (0.760 x 60)] / 2.580



Hydrograph Report

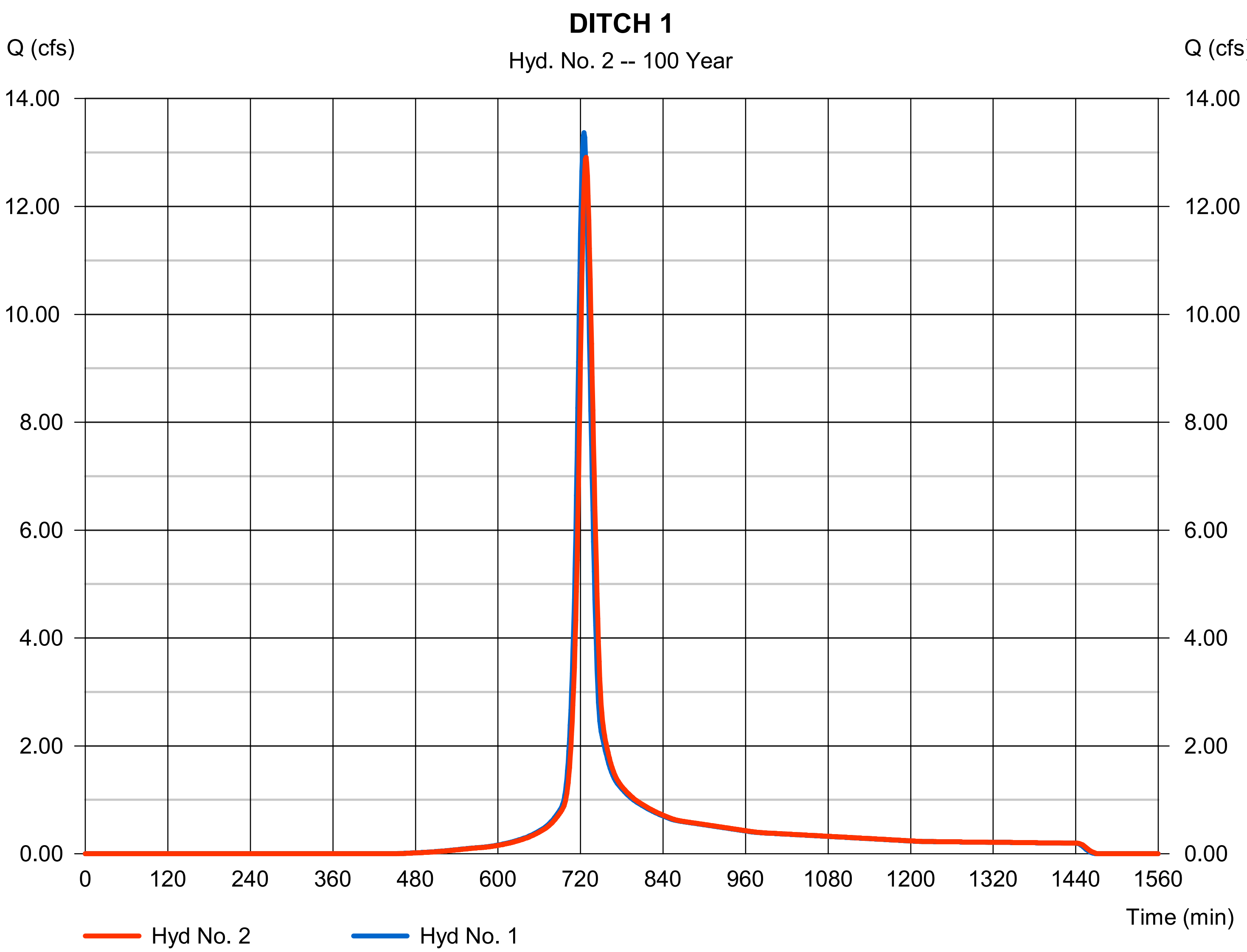
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 2

DITCH 1

Hydrograph type	= Reach	Peak discharge	= 12.91 cfs
Storm frequency	= 100 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 41,748 cuft
Inflow hyd. No.	= 1 - AREA A - POST DEV	Section type	= Trapezoidal
Reach length	= 730.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 10.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.375
Ave. velocity	= 3.49 ft/s	Routing coeff.	= 0.3294

Modified Att-Kin routing method used.



Hydrograph Report

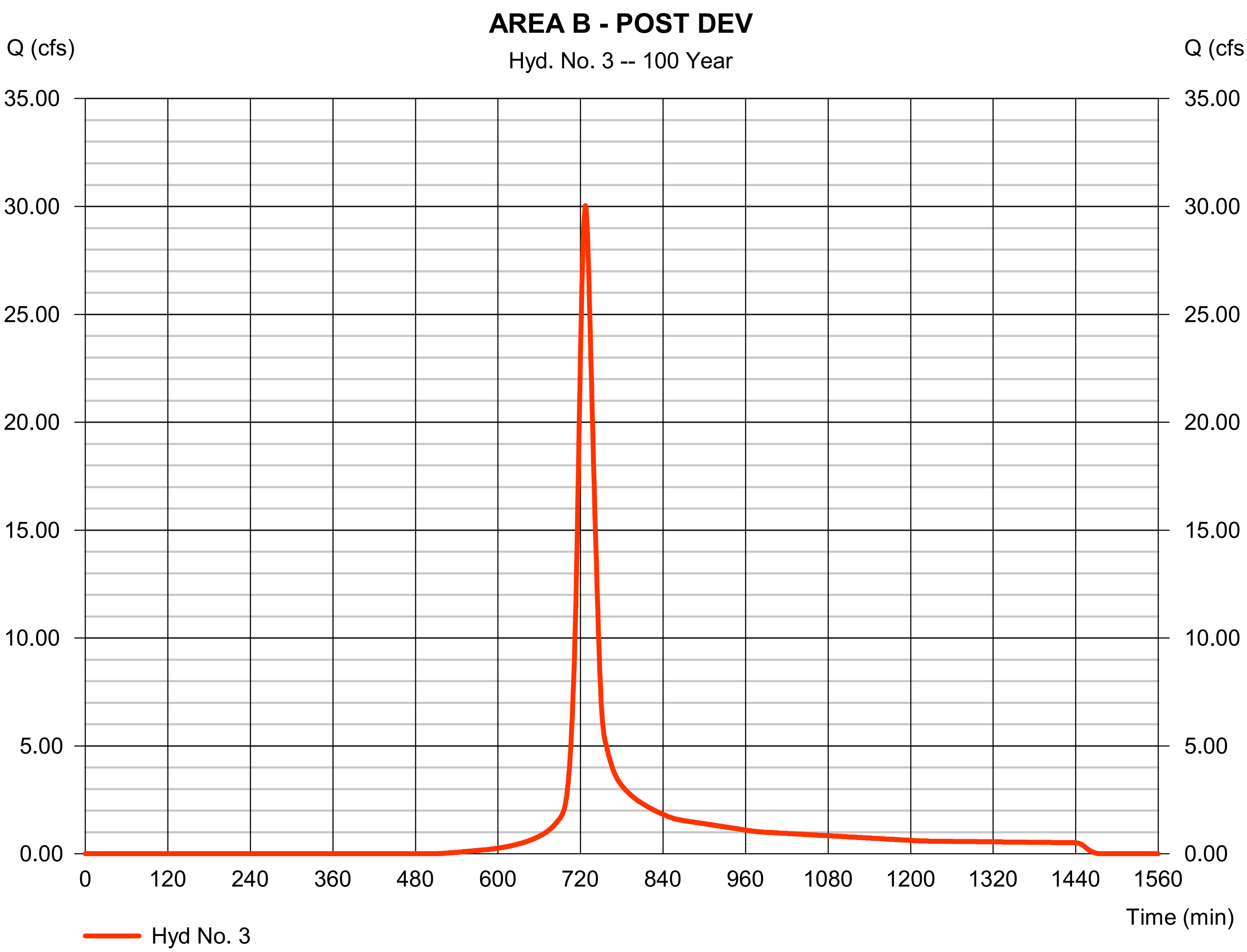
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 3

AREA B - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 30.03 cfs
Storm frequency	= 100 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 102,165 cuft
Drainage area	= 7.090 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.60 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.930 x 85) + (2.120 x 55) + (0.250 x 98) + (2.790 x 60)] / 7.090



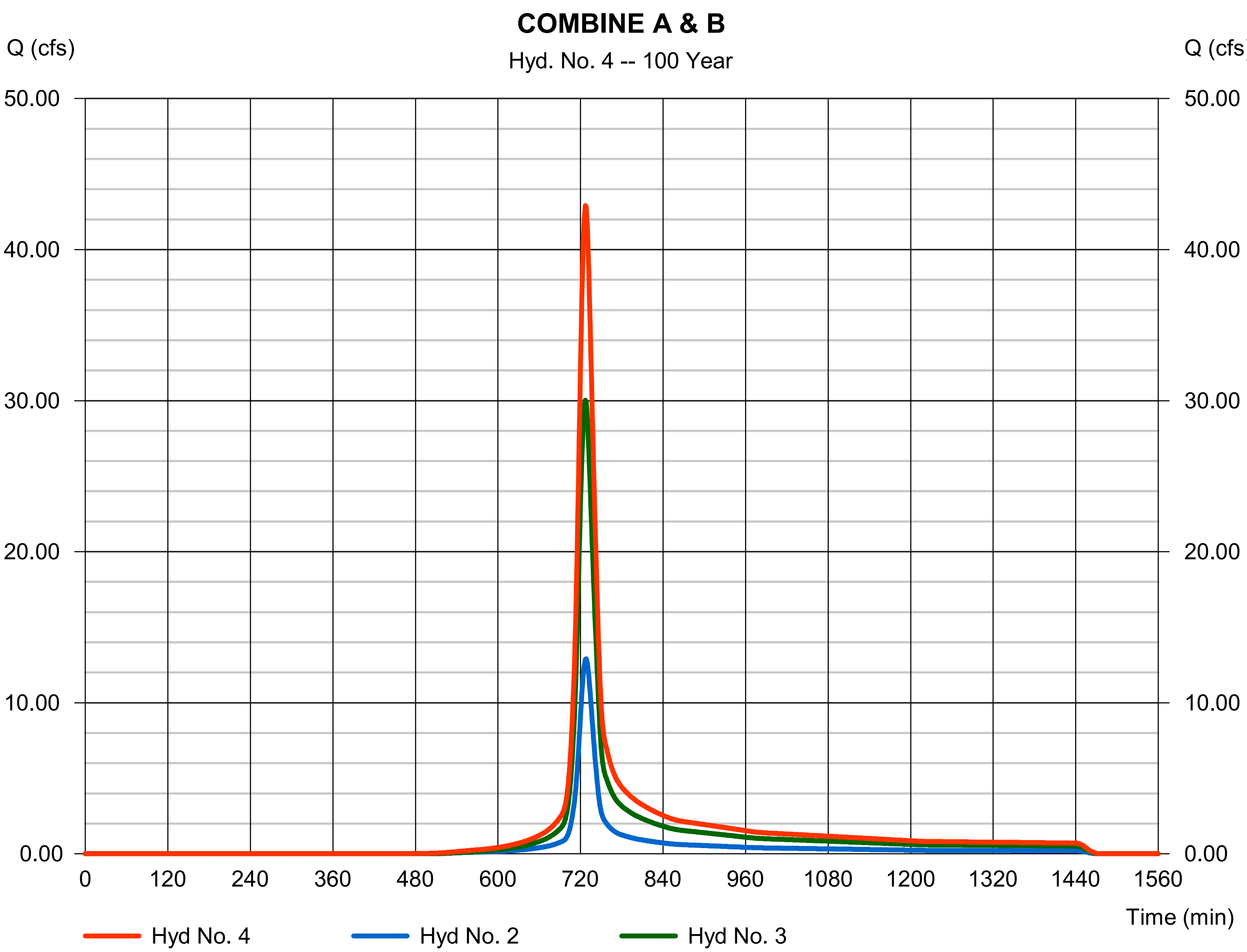
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 4

COMBINE A & B

Hydrograph type	= Combine	Peak discharge	= 42.91 cfs
Storm frequency	= 100 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 143,913 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 7.090 ac



Hydrograph Report

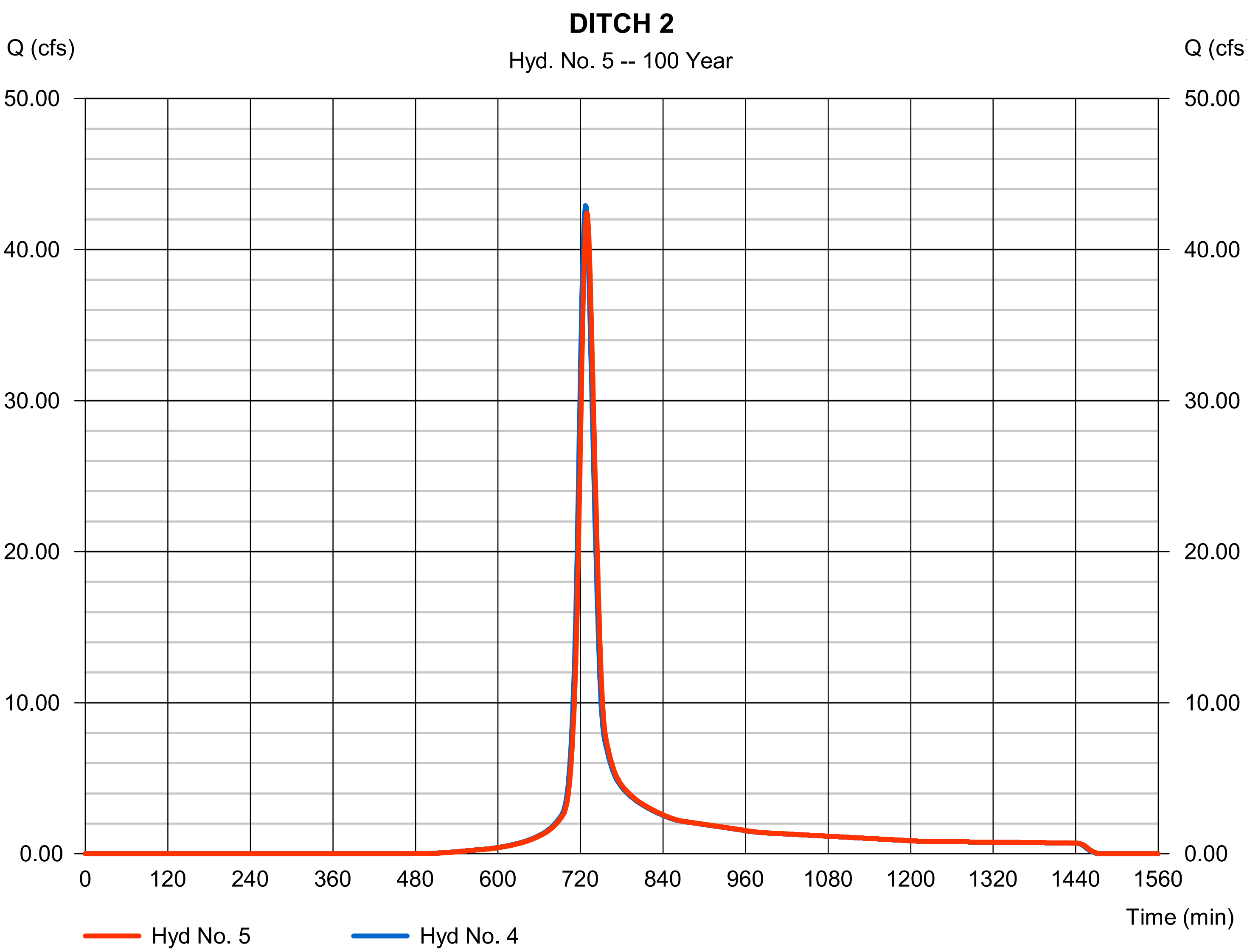
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 5

DITCH 2

Hydrograph type	= Reach	Peak discharge	= 42.43 cfs
Storm frequency	= 100 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 143,911 cuft
Inflow hyd. No.	= 4 - COMBINE A & B	Section type	= Trapezoidal
Reach length	= 610.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.373
Ave. velocity	= 4.78 ft/s	Routing coeff.	= 0.4878

Modified Att-Kin routing method used.



Hydrograph Report

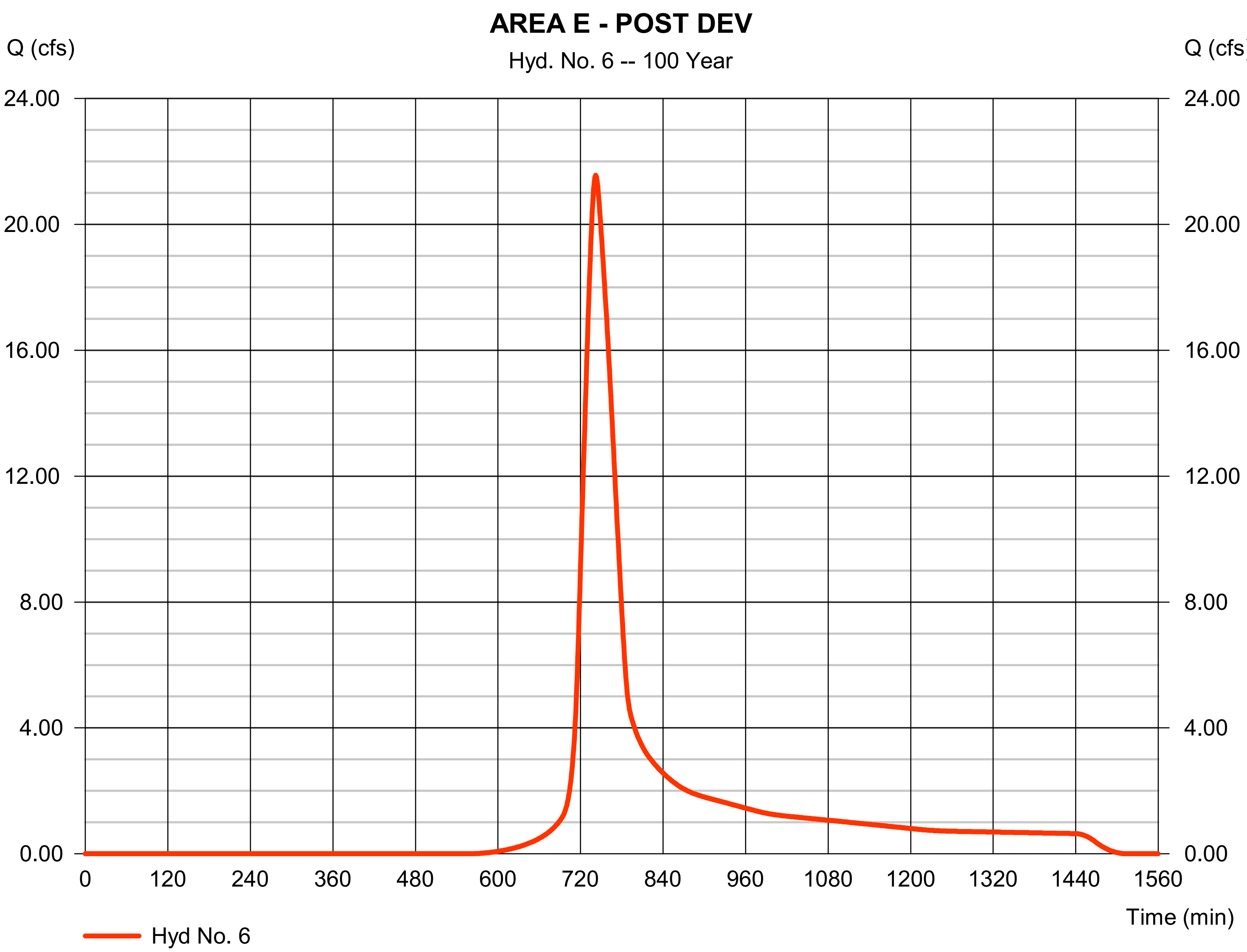
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 6

AREA E - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 21.56 cfs
Storm frequency	= 100 yrs	Time to peak	= 742 min
Time interval	= 1 min	Hyd. volume	= 118,736 cuft
Drainage area	= 9.150 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 47.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.680 x 65) + (0.330 x 98) + (5.140 x 60)] / 9.150



Hydrograph Report

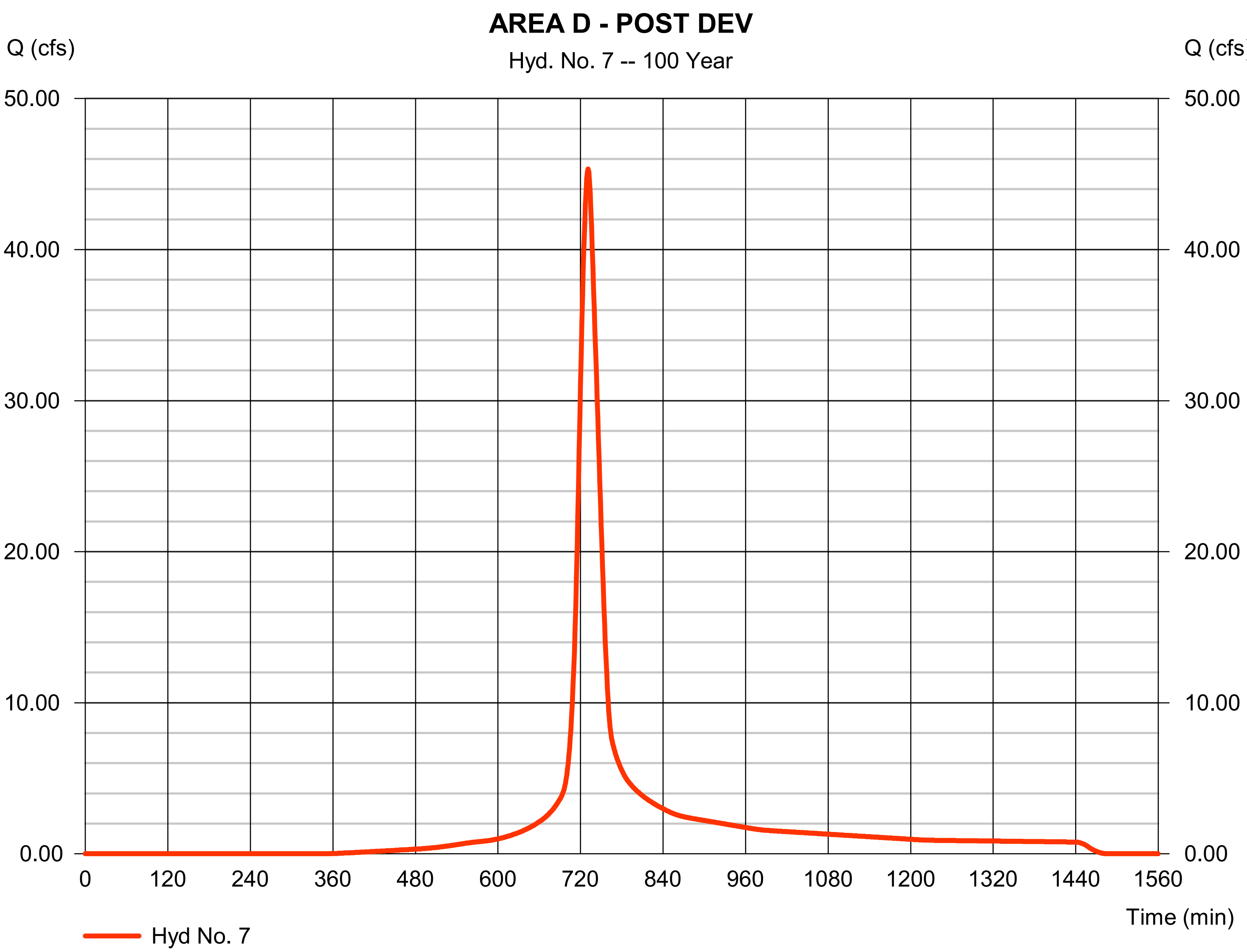
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 7

AREA D - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 45.34 cfs
Storm frequency	= 100 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 181,834 cuft
Drainage area	= 9.520 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.10 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.910 x 85) + (8.610 x 77)] / 9.520



Hydrograph Report

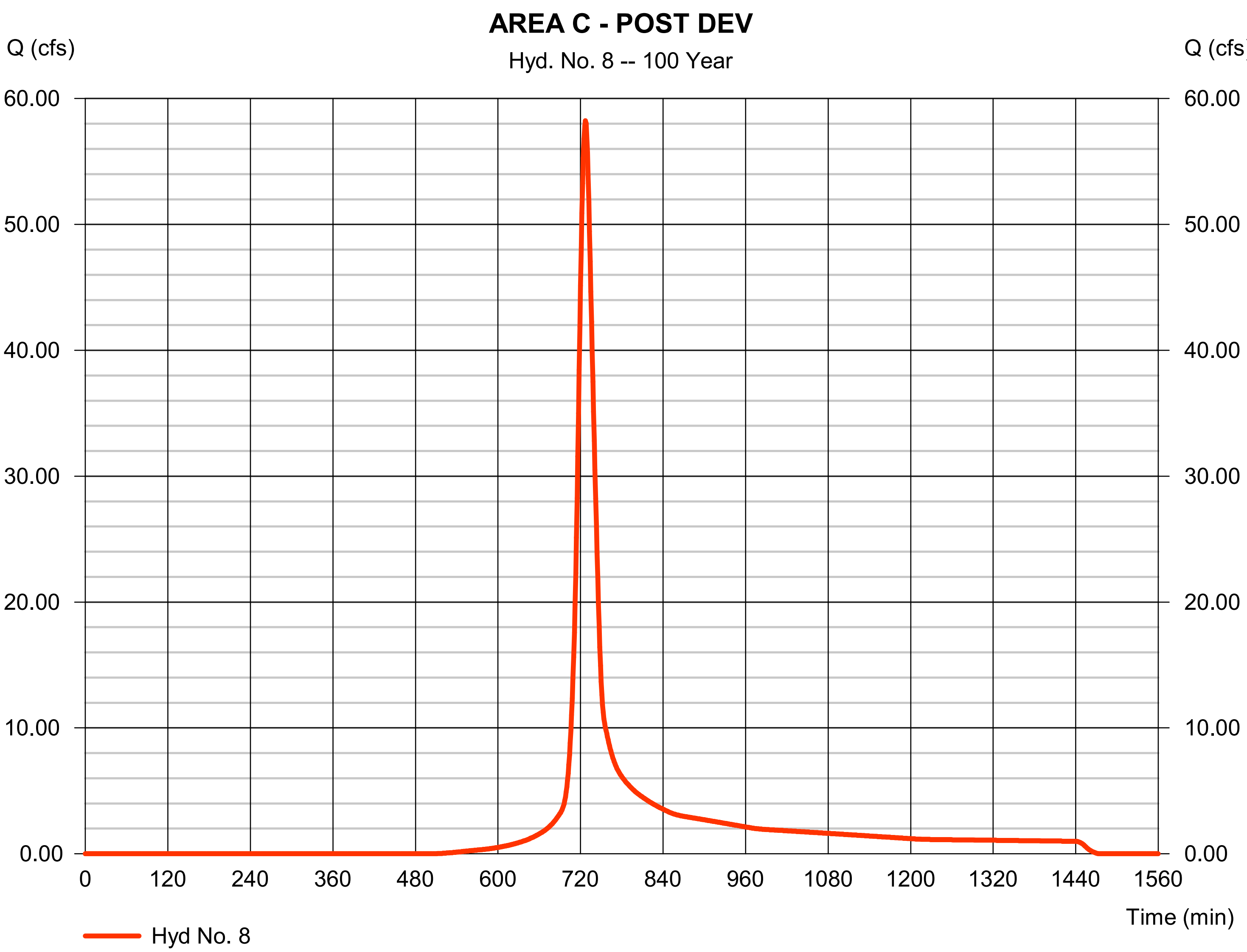
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 8

AREA C - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 58.24 cfs
Storm frequency	= 100 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 198,133 cuft
Drainage area	= 13.750 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.460 x 85) + (0.400 x 55) + (1.740 x 98) + (10.150 x 60)] / 13.750



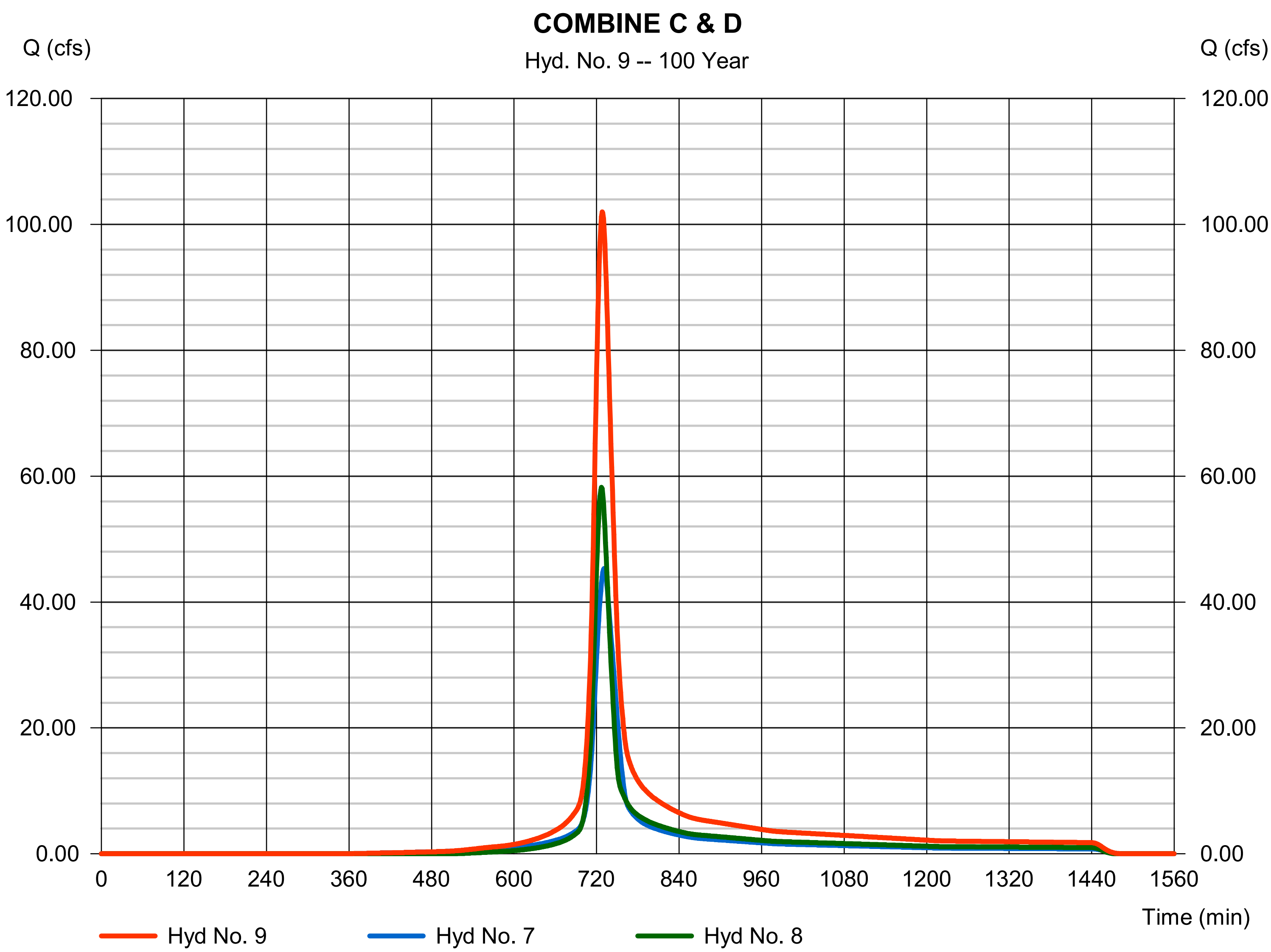
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 9

COMBINE C & D

Hydrograph type	= Combine	Peak discharge	= 102.01 cfs
Storm frequency	= 100 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 379,967 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 23.270 ac



Hydrograph Report

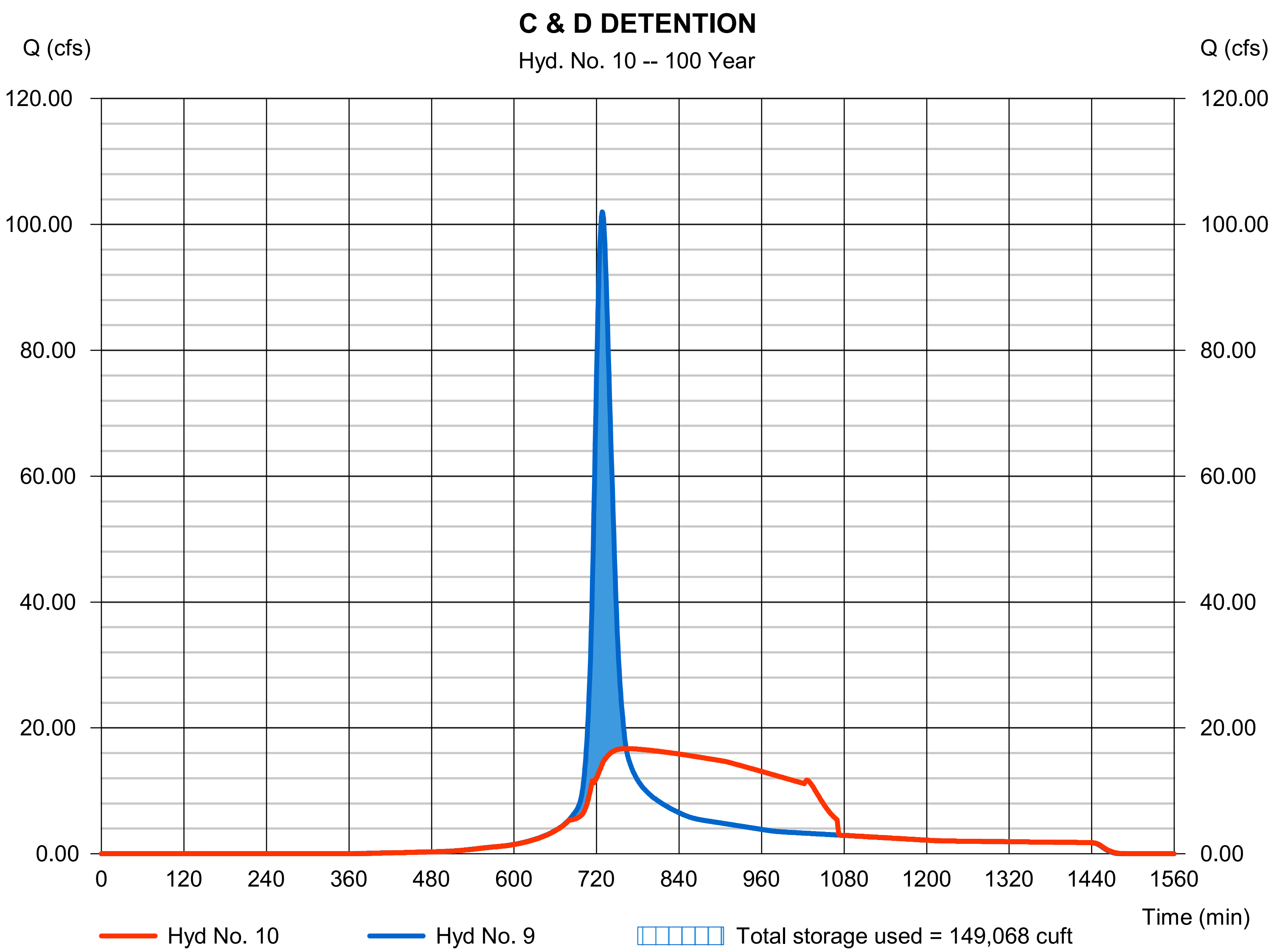
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 10

C & D DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 16.71 cfs
Storm frequency	= 100 yrs	Time to peak	= 763 min
Time interval	= 1 min	Hyd. volume	= 379,967 cuft
Inflow hyd. No.	= 9 - COMBINE C & D	Max. Elevation	= 582.71 ft
Reservoir name	= C&D DETENTION	Max. Storage	= 149,068 cuft

Storage Indication method used.



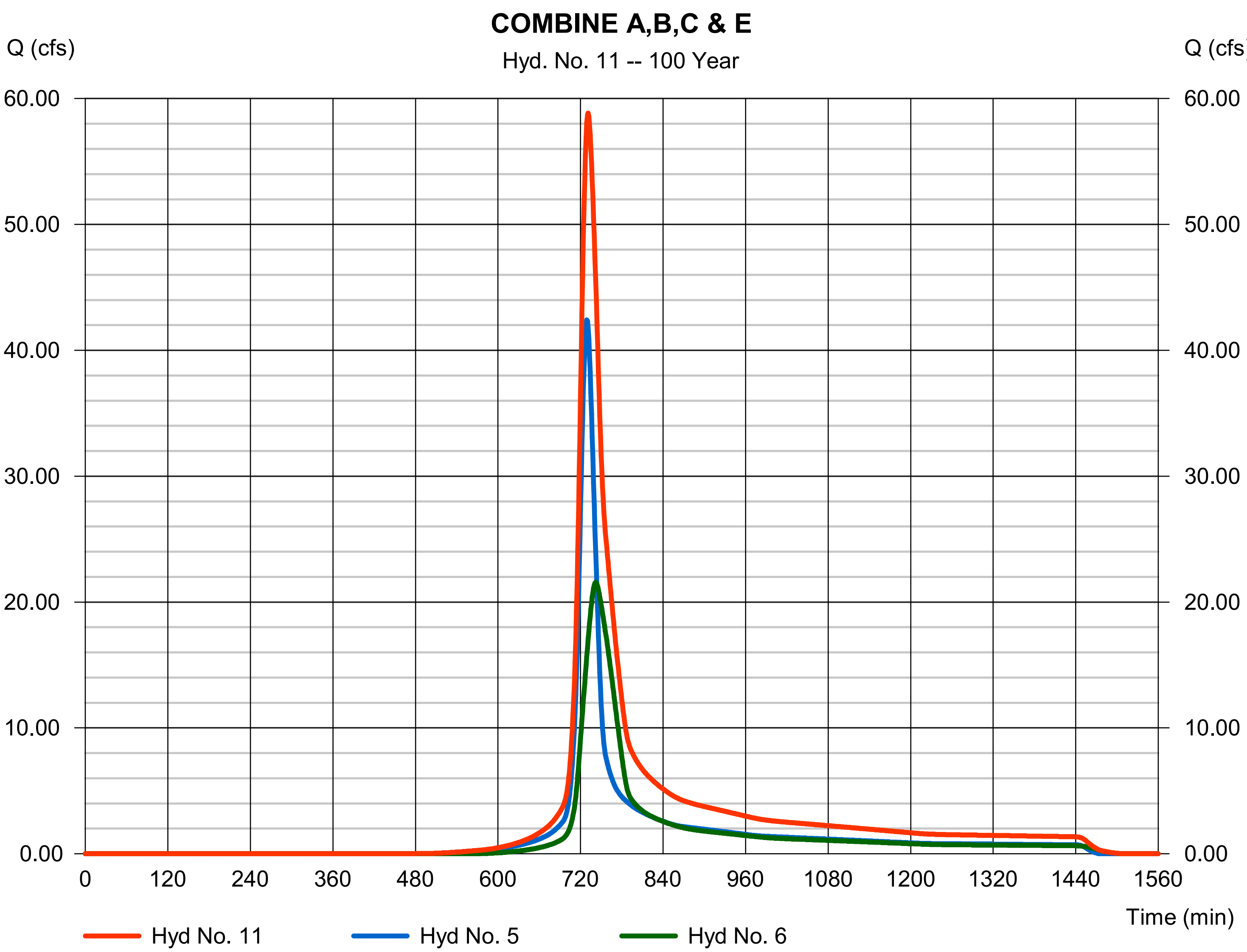
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 11

COMBINE A,B,C & E

Hydrograph type	= Combine	Peak discharge	= 58.84 cfs
Storm frequency	= 100 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 262,647 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 9.150 ac



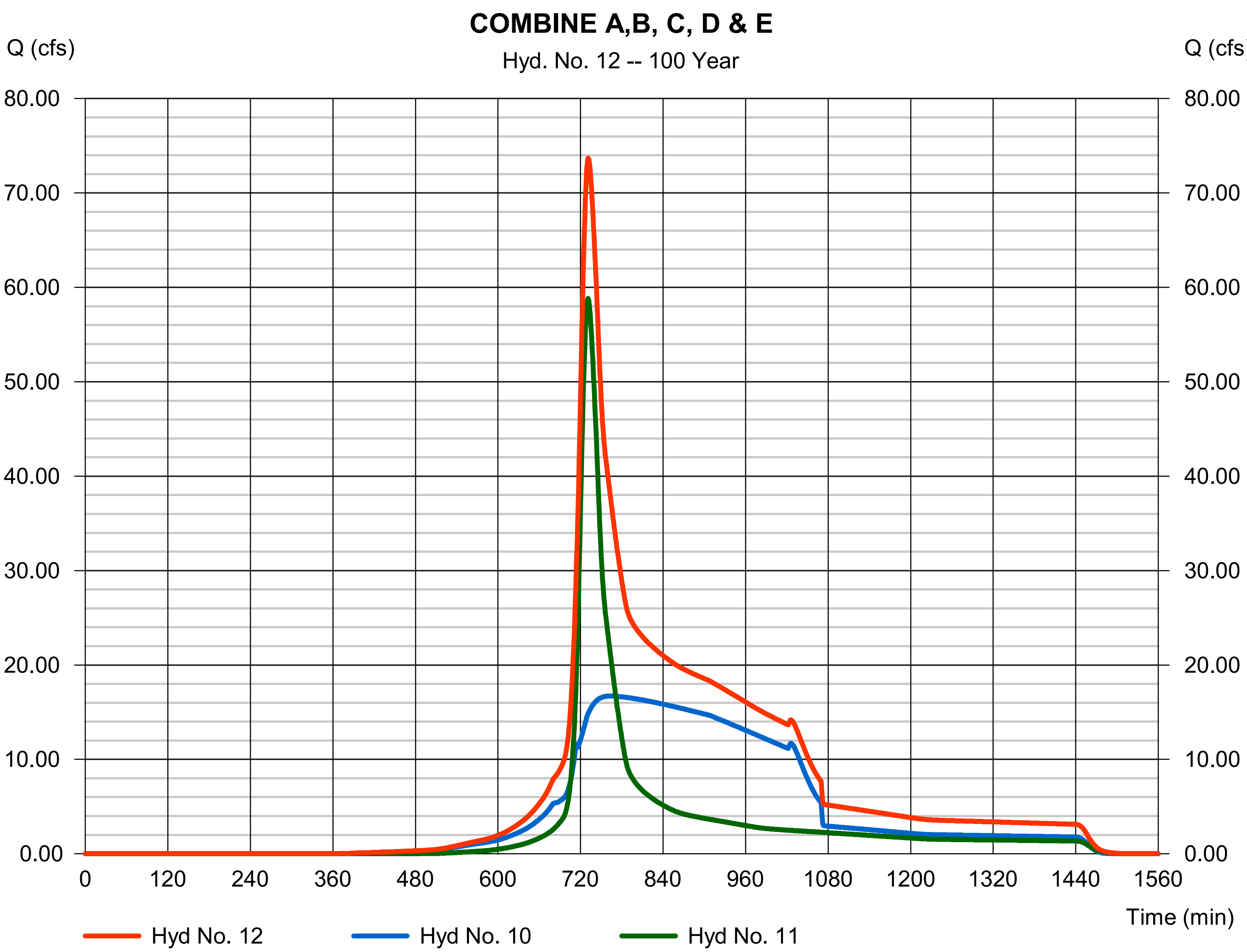
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 12

COMBINE A,B, C, D & E

Hydrograph type	= Combine	Peak discharge	= 73.69 cfs
Storm frequency	= 100 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 642,614 cuft
Inflow hyds.	= 10, 11	Contrib. drain. area	= 0.000 ac



Hydrograph Report

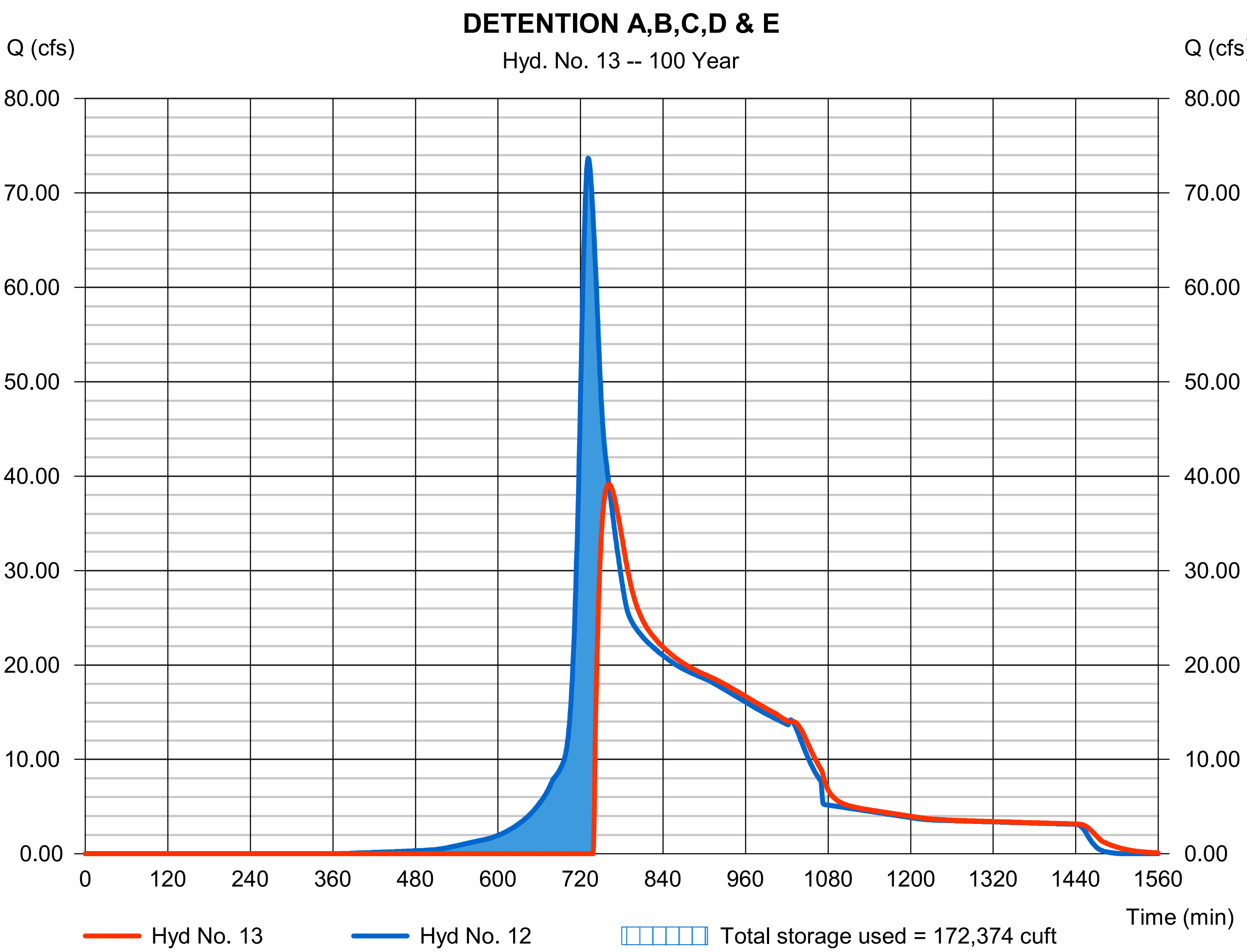
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 13

DETENTION A,B,C,D & E

Hydrograph type	= Reservoir	Peak discharge	= 39.14 cfs
Storm frequency	= 100 yrs	Time to peak	= 761 min
Time interval	= 1 min	Hyd. volume	= 499,573 cuft
Inflow hyd. No.	= 12 - COMBINE A,B, C, D & E	Max. Elevation	= 582.46 ft
Reservoir name	= A,B,C,D & E DETENTION	Max. Storage	= 172,374 cuft

Storage Indication method used.



Hydrograph Report

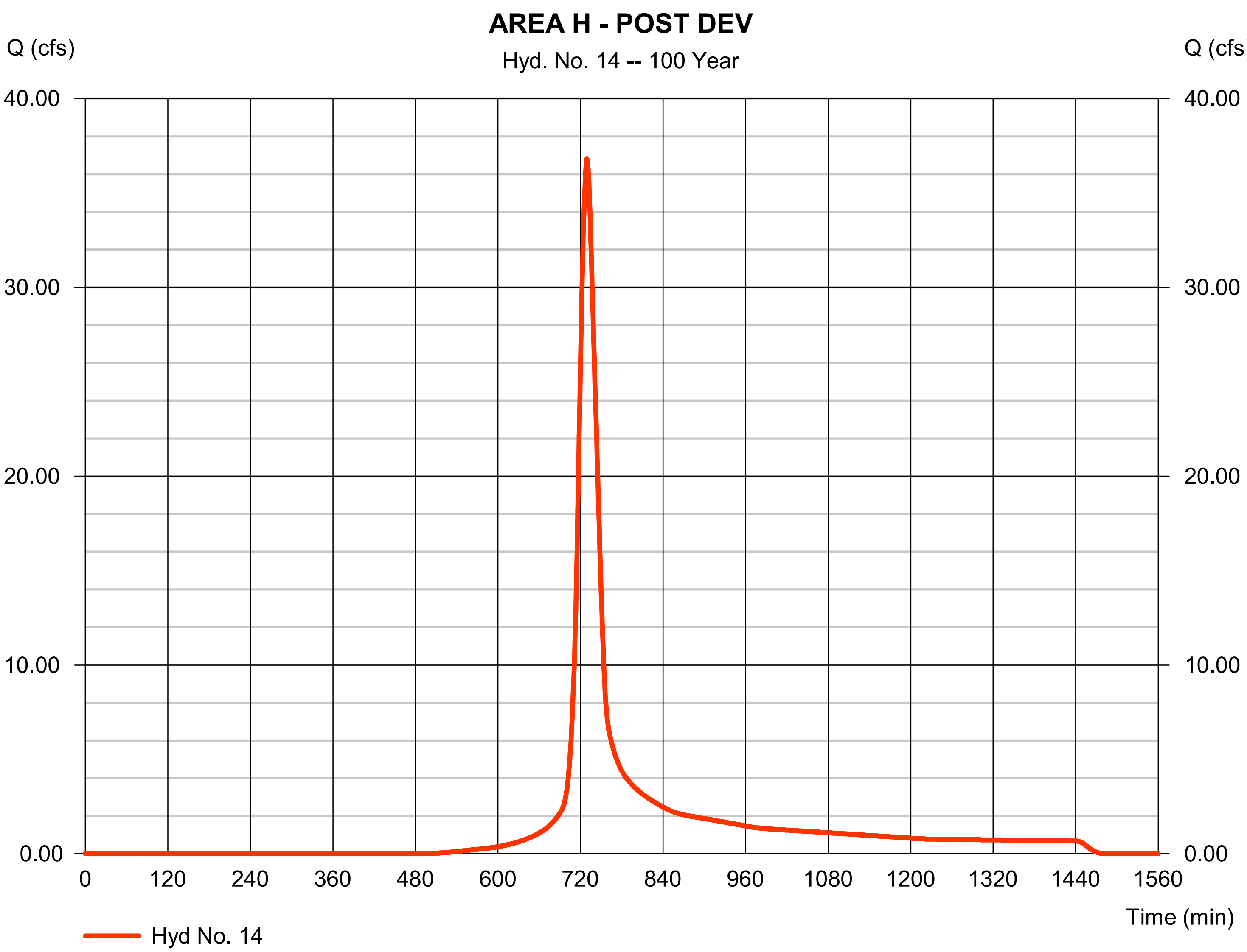
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 11 / 15 / 2018

Hyd. No. 14

AREA H - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 36.81 cfs
Storm frequency	= 100 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 137,242 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.50 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



Hydrograph Report

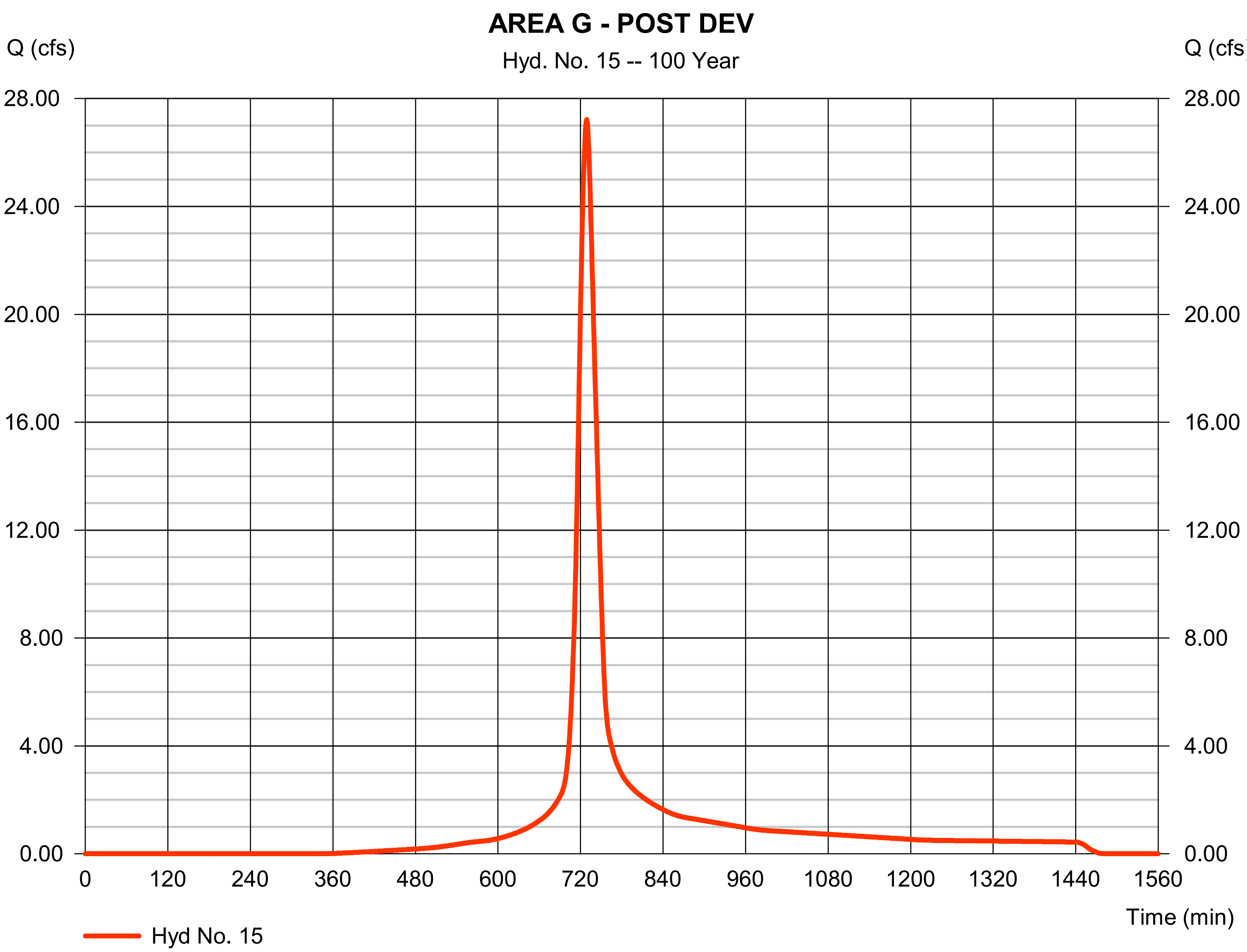
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 15

AREA G - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 27.22 cfs
Storm frequency	= 100 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 101,829 cuft
Drainage area	= 5.290 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 26.80 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.330 x 85) + (4.960 x 77)] / 5.290



Hydrograph Report

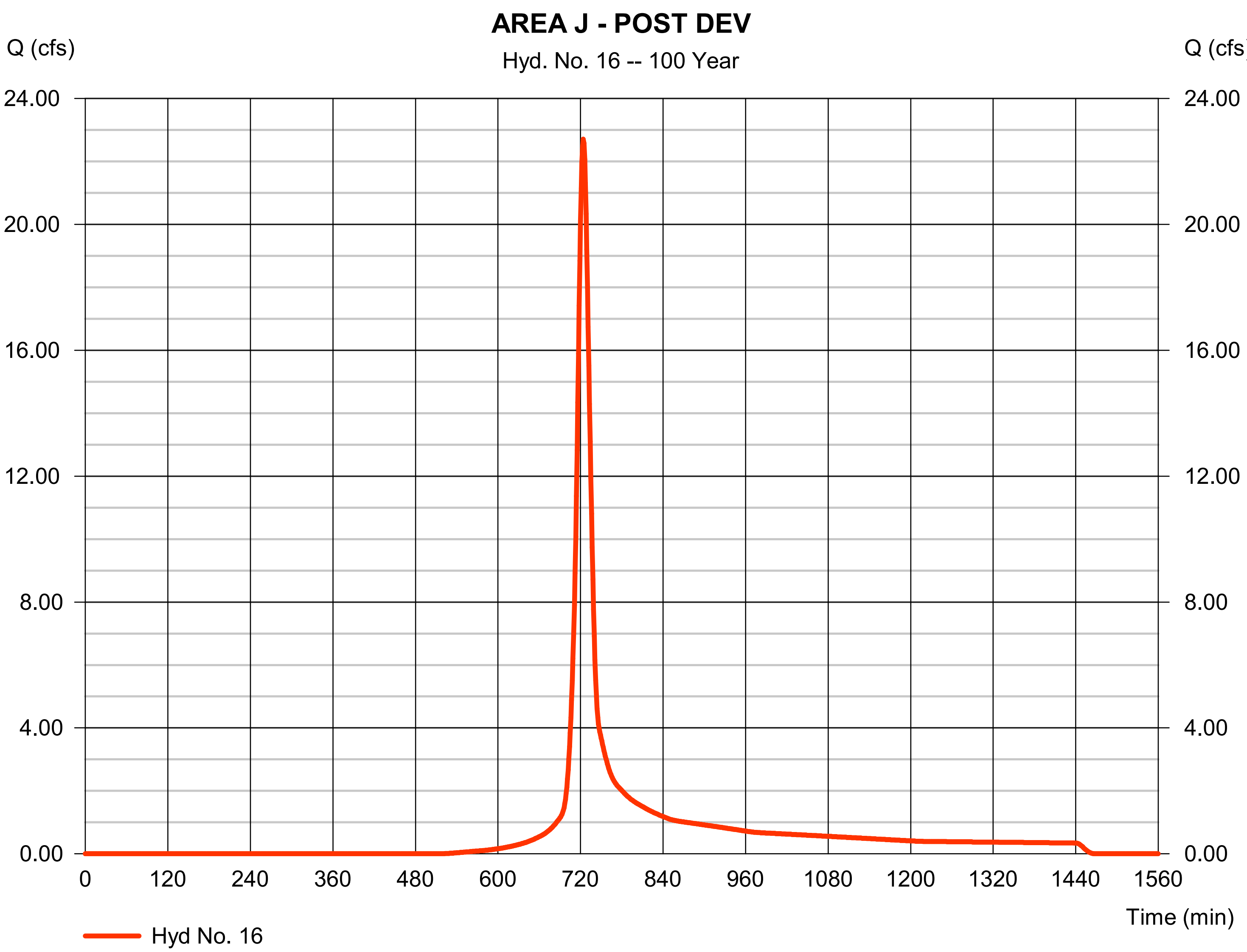
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 16

AREA J - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 22.71 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 67,343 cuft
Drainage area	= 4.820 ac	Curve number	= 66*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 85) + (0.020 x 65) + (0.680 x 98) + (4.030 x 60)] / 4.820



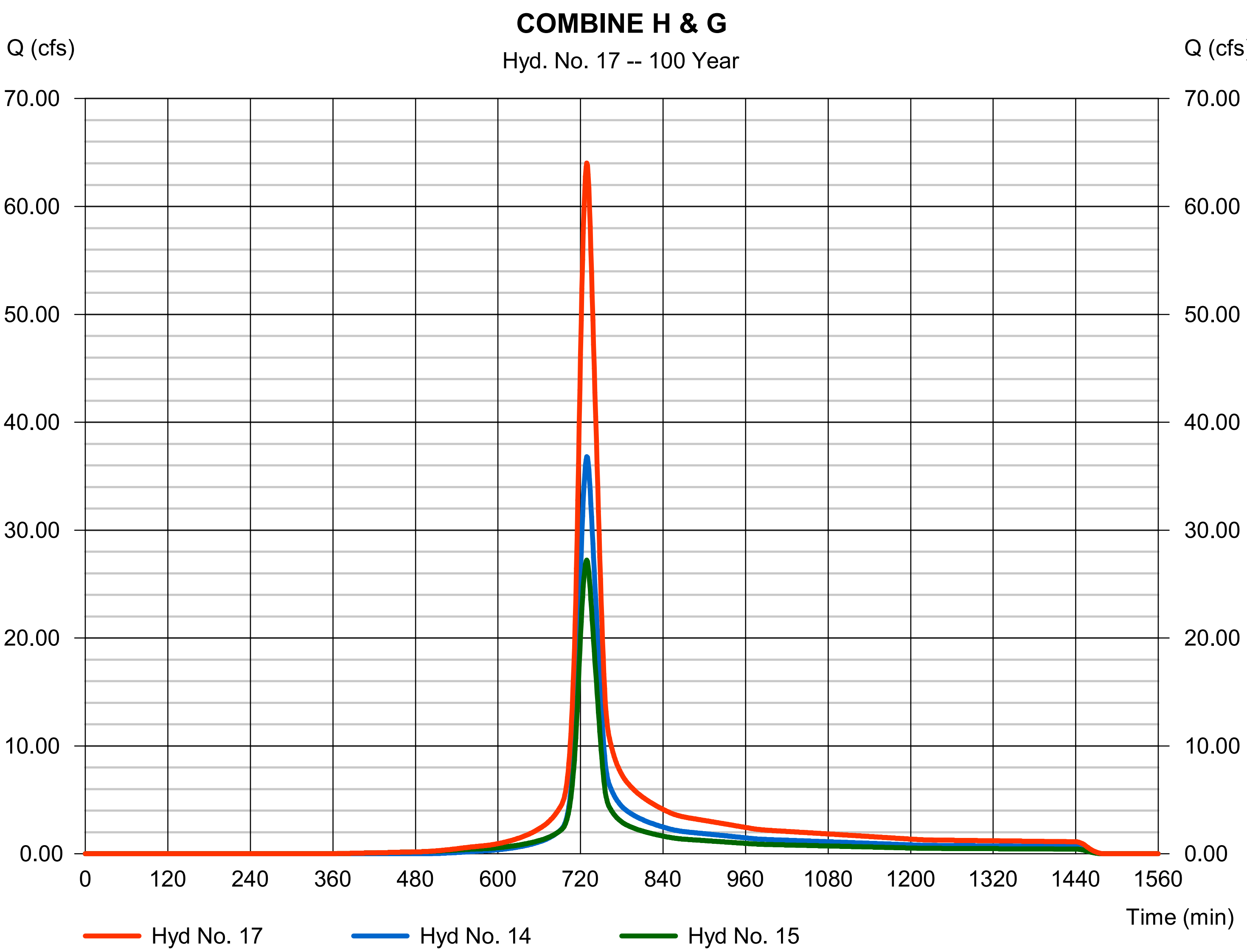
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 17

COMBINE H & G

Hydrograph type	= Combine	Peak discharge	= 64.03 cfs
Storm frequency	= 100 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 239,071 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 14.400 ac



Hydrograph Report

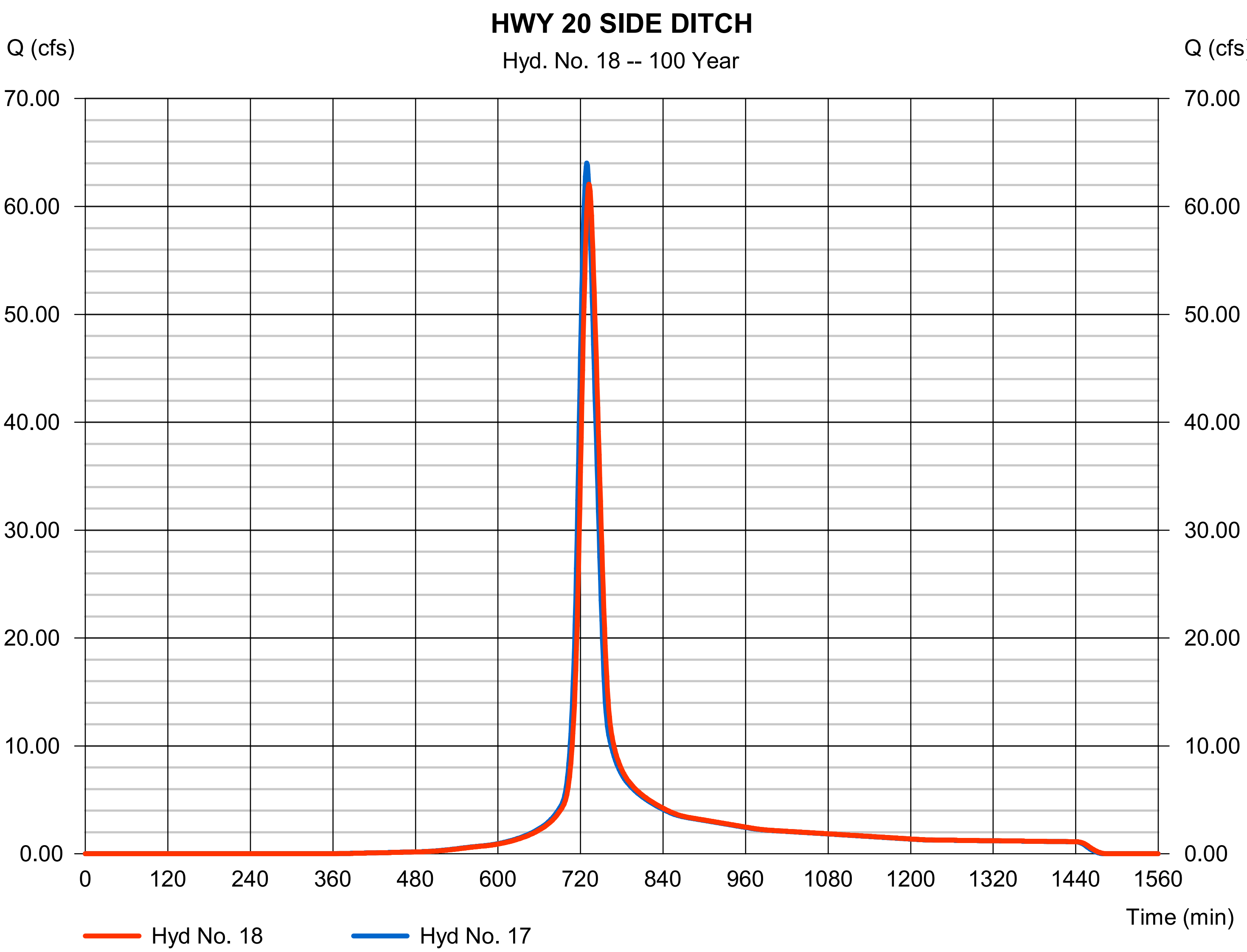
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 18

HWY 20 SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 62.06 cfs
Storm frequency	= 100 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 239,070 cuft
Inflow hyd. No.	= 17 - COMBINE H & G	Section type	= Trapezoidal
Reach length	= 900.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.030	Bottom width	= 3.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 1.688	Rating curve m	= 1.304
Ave. velocity	= 3.94 ft/s	Routing coeff.	= 0.2925

Modified Att-Kin routing method used.



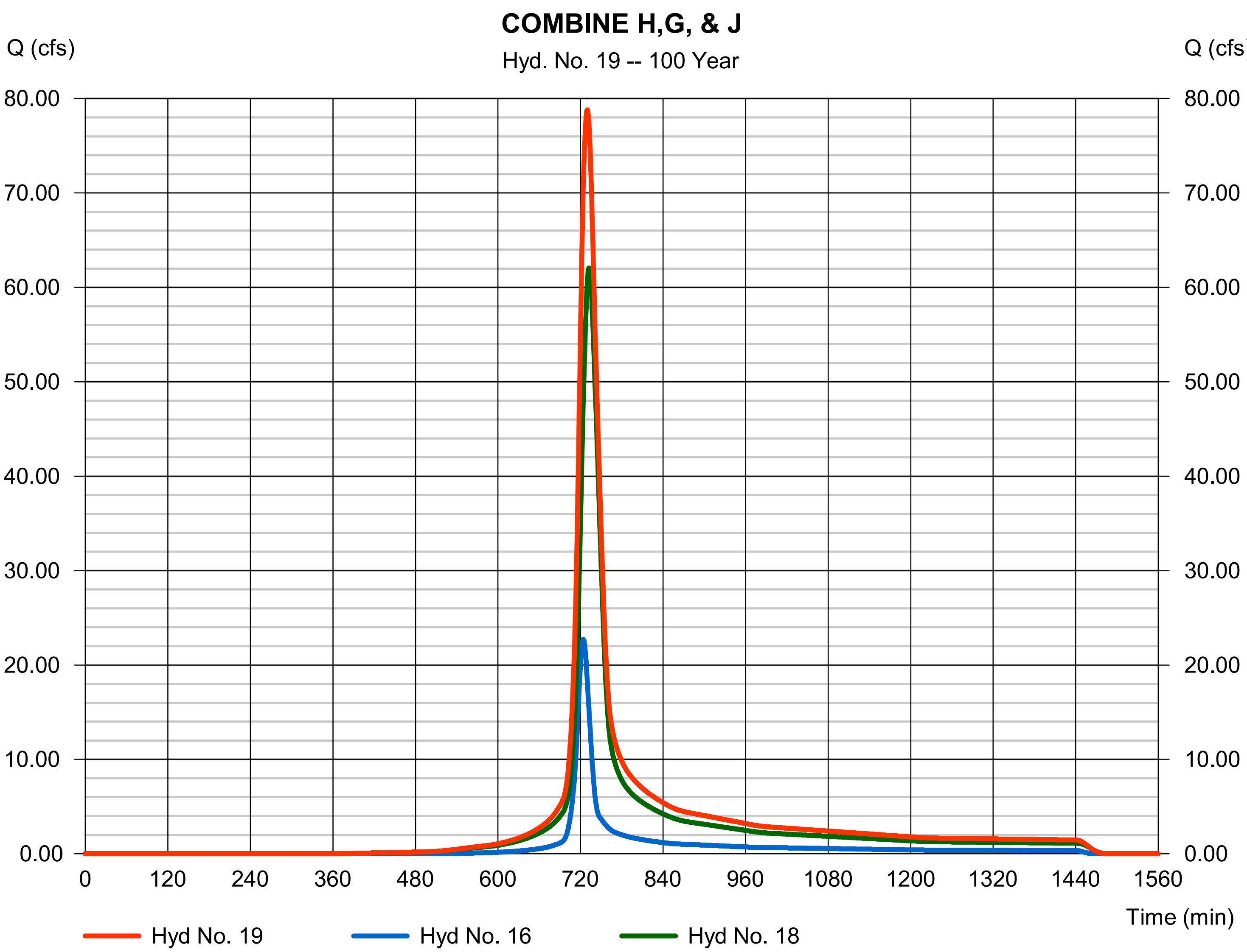
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 19

COMBINE H,G, & J

Hydrograph type	= Combine	Peak discharge	= 78.80 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 306,413 cuft
Inflow hyds.	= 16, 18	Contrib. drain. area	= 4.820 ac



Hydrograph Report

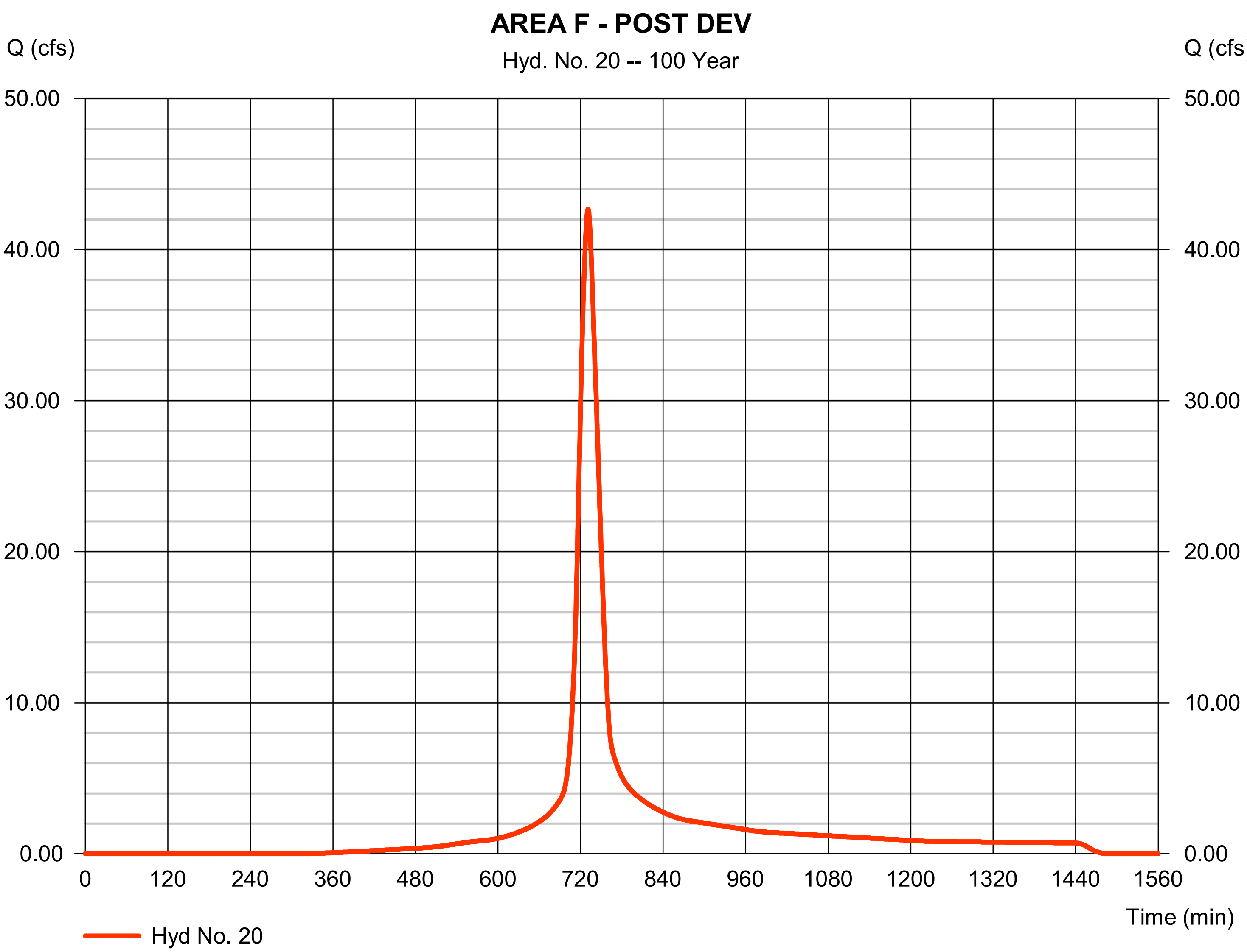
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 20

AREA F - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 42.69 cfs
Storm frequency	= 100 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 171,907 cuft
Drainage area	= 8.620 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 29.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.440 x 85) + (8.180 x 77)] / 8.620



Hydrograph Report

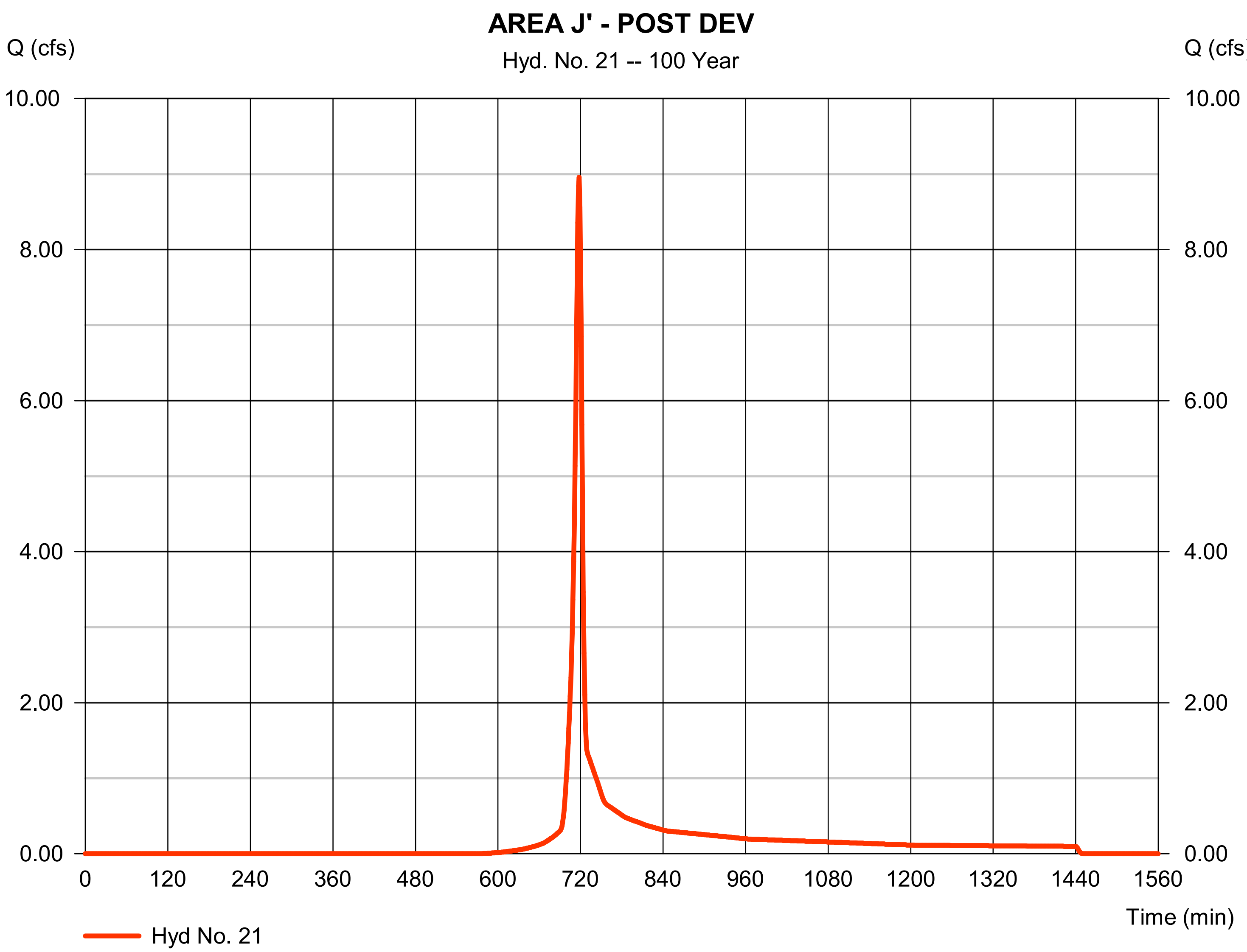
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 21

AREA J' - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 8.961 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 17,995 cuft
Drainage area	= 1.440 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.220 x 65) + (1.220 x 60)] / 1.440



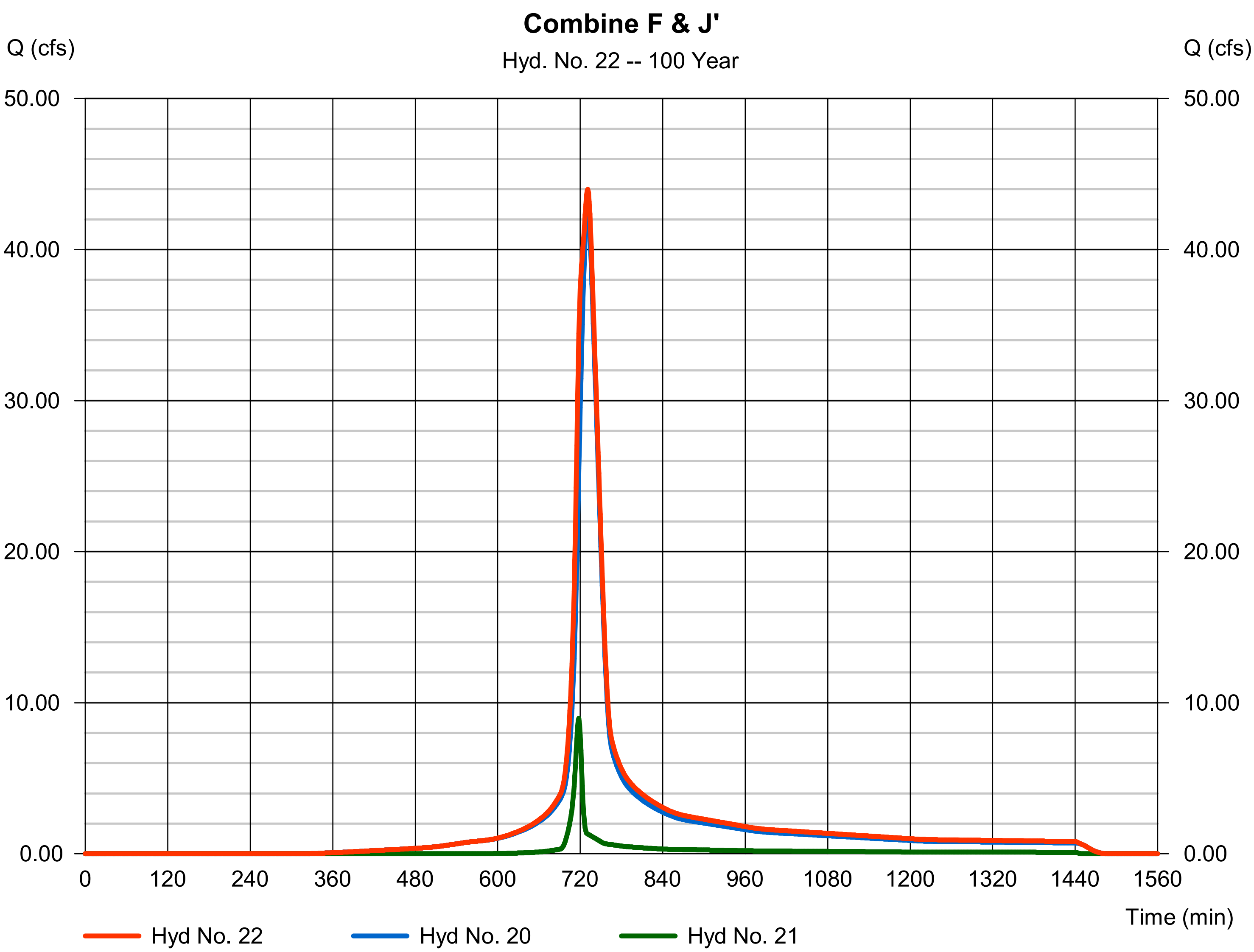
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 22

Combine F & J'

Hydrograph type	= Combine	Peak discharge	= 44.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 189,902 cuft
Inflow hyds.	= 20, 21	Contrib. drain. area	= 10.060 ac



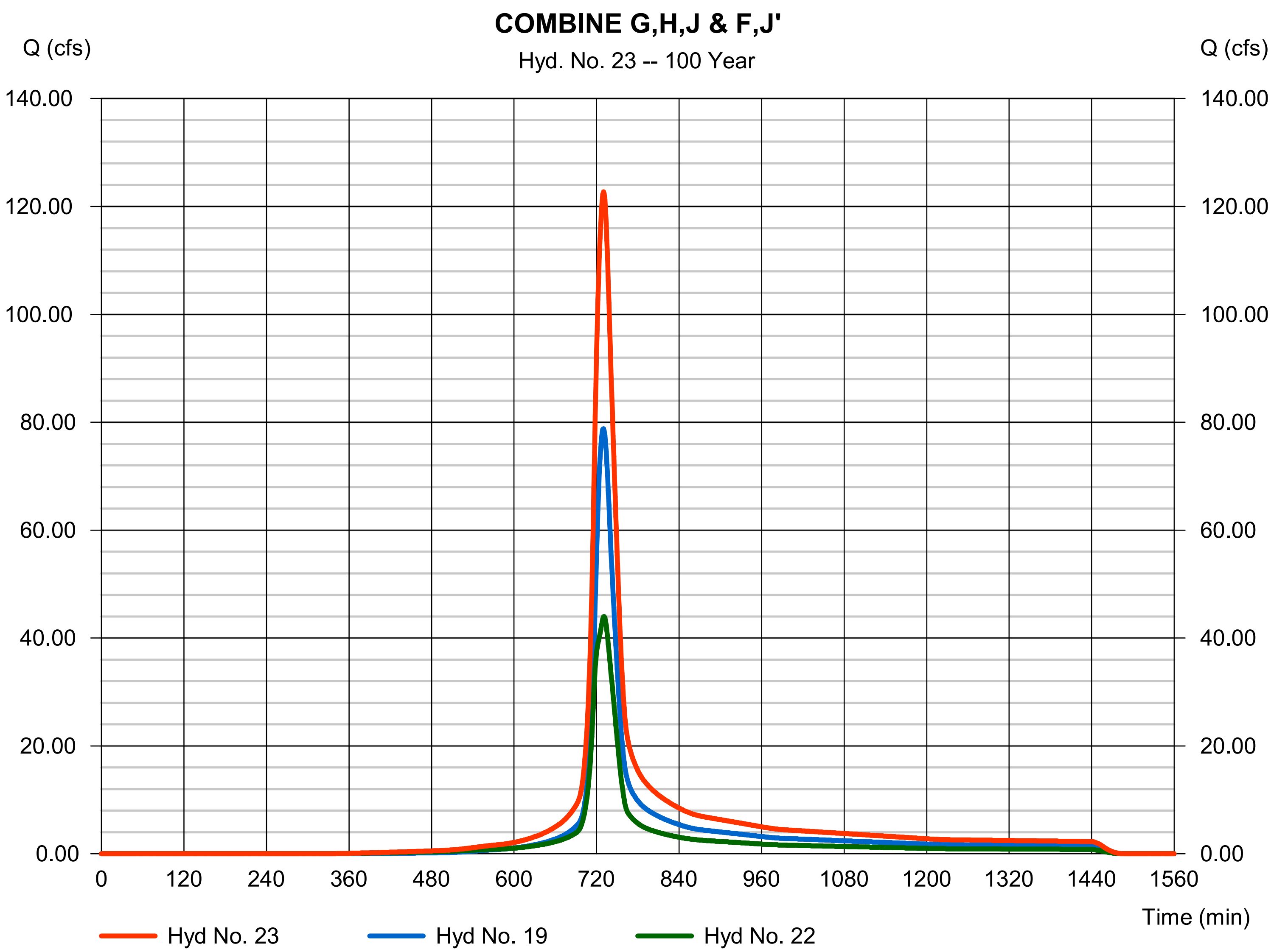
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 23

COMBINE G,H,J & F,J'

Hydrograph type	= Combine	Peak discharge	= 122.71 cfs
Storm frequency	= 100 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 496,315 cuft
Inflow hyds.	= 19, 22	Contrib. drain. area	= 0.000 ac



Hydrograph Report

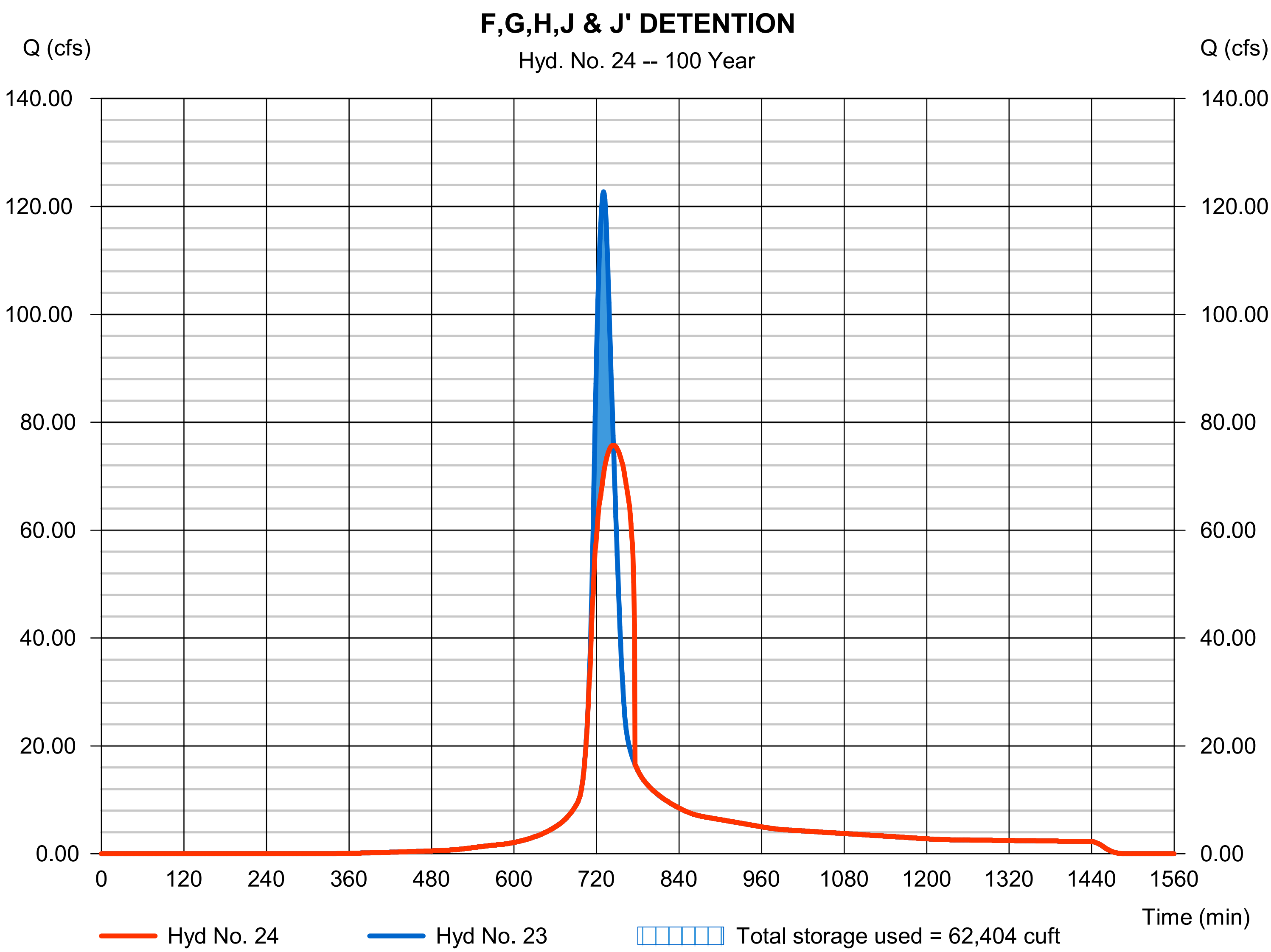
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 24

F,G,H,J & J' DETENTION

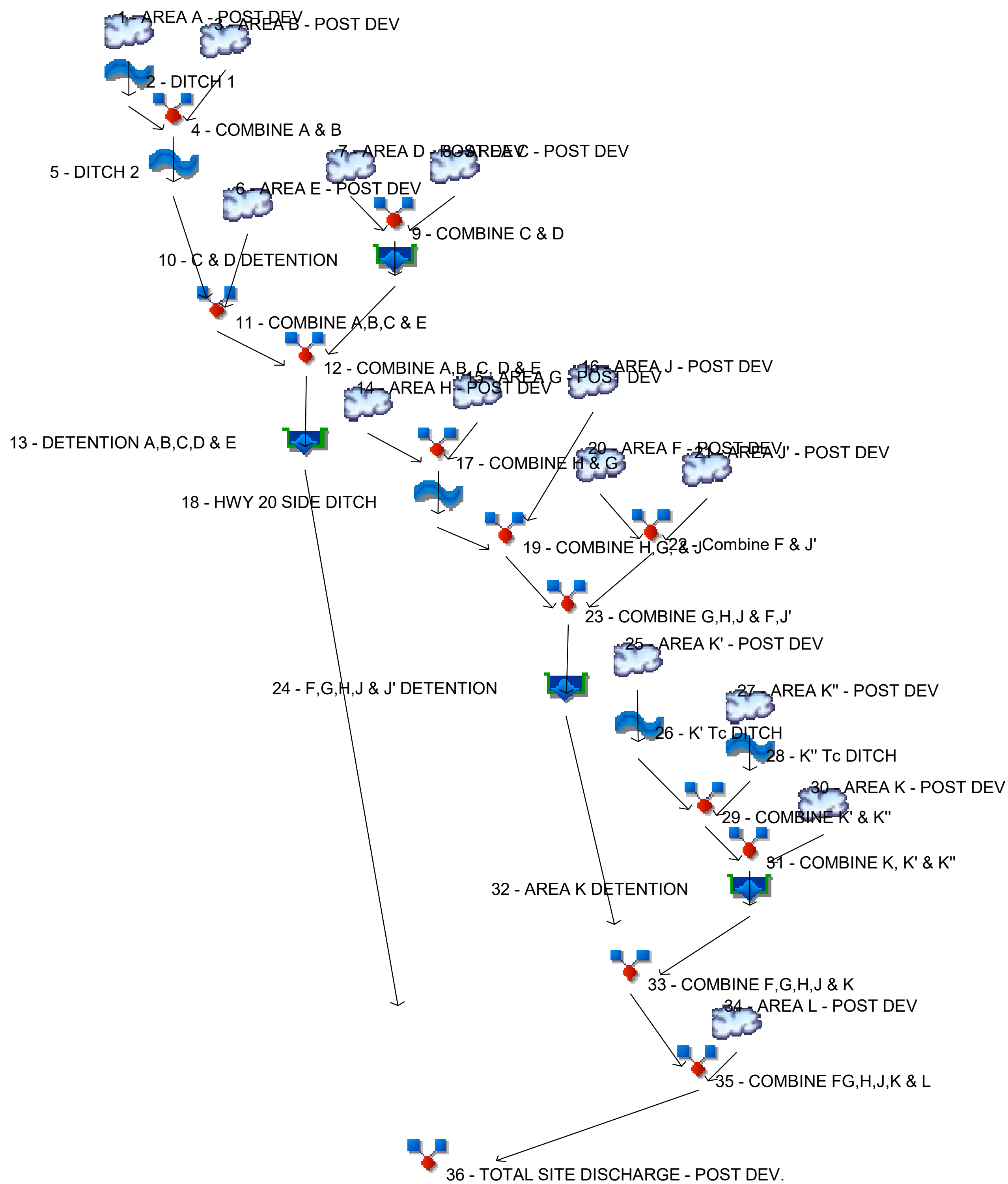
Hydrograph type	= Reservoir	Peak discharge	= 75.75 cfs
Storm frequency	= 100 yrs	Time to peak	= 744 min
Time interval	= 1 min	Hyd. volume	= 496,315 cuft
Inflow hyd. No.	= 23 - COMBINE G,H,J & F,J'	Max. Elevation	= 581.58 ft
Reservoir name	= F,G,H,J & J' DETENTION	Max. Storage	= 62,404 cuft

Storage Indication method used.



Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020



Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	------	-------	-------	-------	-------	-------	9.405	11.34	13.37	AREA A - POST DEV
2	Reach	1	-------	-------	-------	-------	-------	9.020	10.92	12.91	DITCH 1
3	SCS Runoff	------	-------	-------	-------	-------	-------	20.45	25.11	30.03	AREA B - POST DEV
4	Combine	2, 3	-------	-------	-------	-------	-------	29.45	35.98	42.91	COMBINE A & B
5	Reach	4	-------	-------	-------	-------	-------	29.04	35.52	42.43	DITCH 2
6	SCS Runoff	------	-------	-------	-------	-------	-------	14.07	17.70	21.56	AREA E - POST DEV
7	SCS Runoff	------	-------	-------	-------	-------	-------	44.21	51.98	60.00	AREA D - POST DEV
8	SCS Runoff	------	-------	-------	-------	-------	-------	39.67	48.71	58.24	AREA C - POST DEV
9	Combine	7, 8	-------	-------	-------	-------	-------	82.22	98.78	116.09	COMBINE C & D
10	Reservoir	9	-------	-------	-------	-------	-------	15.16	15.92	16.70	C & D DETENTION
11	Combine	5, 6,	-------	-------	-------	-------	-------	39.62	48.96	58.84	COMBINE A,B,C & E
12	Combine	10, 11	-------	-------	-------	-------	-------	53.94	63.90	74.36	COMBINE A,B, C, D & E
13	Reservoir	12	-------	-------	-------	-------	-------	22.02	29.99	39.98	DETENTION A,B,C,D & E
14	SCS Runoff	------	-------	-------	-------	-------	-------	25.24	30.87	36.81	AREA H - POST DEV
15	SCS Runoff	------	-------	-------	-------	-------	-------	26.12	30.71	35.44	AREA G - POST DEV
16	SCS Runoff	------	-------	-------	-------	-------	-------	15.39	18.95	22.71	AREA J - POST DEV
17	Combine	14, 15,	-------	-------	-------	-------	-------	48.24	57.94	68.06	COMBINE H & G
18	Reach	17	-------	-------	-------	-------	-------	46.23	55.69	65.64	HWY 20 SIDE DITCH
19	Combine	16, 18	-------	-------	-------	-------	-------	60.25	73.03	86.44	COMBINE H,G, & J
20	SCS Runoff	------	-------	-------	-------	-------	-------	40.03	47.07	54.33	AREA F - POST DEV
21	SCS Runoff	------	-------	-------	-------	-------	-------	5.906	7.386	8.961	AREA J' - POST DEV
22	Combine	20, 21	-------	-------	-------	-------	-------	42.93	50.81	58.97	Combine F & J'
23	Combine	19, 22	-------	-------	-------	-------	-------	100.23	120.30	141.26	COMBINE G,H,J & F,J'
24	Reservoir	23	-------	-------	-------	-------	-------	68.32	72.98	77.19	F,G,H,J & J' DETENTION
25	SCS Runoff	------	-------	-------	-------	-------	-------	4.453	5.594	6.822	AREA K' - POST DEV
26	Reach	25	-------	-------	-------	-------	-------	3.466	4.429	5.475	K' Tc DITCH
27	SCS Runoff	------	-------	-------	-------	-------	-------	2.004	2.532	3.101	AREA K'' - POST DEV
28	Reach	27	-------	-------	-------	-------	-------	1.337	1.732	2.162	K'' Tc DITCH
29	Combine	26, 28	-------	-------	-------	-------	-------	4.784	6.145	7.611	COMBINE K' & K''
30	SCS Runoff	------	-------	-------	-------	-------	-------	18.71	23.63	28.94	AREA K - POST DEV
31	Combine	29, 30	-------	-------	-------	-------	-------	22.56	28.70	35.31	COMBINE K, K' & K''
32	Reservoir	31	-------	-------	-------	-------	-------	6.523	7.119	7.727	AREA K DETENTION
33	Combine	24, 32	-------	-------	-------	-------	-------	74.58	79.82	84.63	COMBINE F,G,H,J & K
34	SCS Runoff	------	-------	-------	-------	-------	-------	4.086	5.133	6.249	AREA L - POST DEV

Proj. file: AP3_POSTDEV_SOLAR.gpw | Thursday, 11 / 15 / 2018

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	
35	Combine	33, 34	-------	-------	-------	-------	-------	75.37	80.71	85.64	COMBINE FG,H,J,K & L
36	Combine	13, 35	-------	-------	-------	-------	-------	75.37	93.91	118.97	TOTAL SITE DISCHARGE - POST D

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	SCS Runoff	9.405	1	725	29,429	------	------	------	AREA A - POST DEV
2	Reach	9.020	1	728	29,427	1	------	------	DITCH 1
3	SCS Runoff	20.45	1	727	70,362	------	------	------	AREA B - POST DEV
4	Combine	29.45	1	728	99,789	2, 3	------	------	COMBINE A & B
5	Reach	29.04	1	730	99,788	4	------	------	DITCH 2
6	SCS Runoff	14.07	1	742	79,687	------	------	------	AREA E - POST DEV
7	SCS Runoff	44.21	1	724	131,368	------	------	------	AREA D - POST DEV
8	SCS Runoff	39.67	1	727	136,457	------	------	------	AREA C - POST DEV
9	Combine	82.22	1	725	267,825	7, 8	------	------	COMBINE C & D
10	Reservoir	15.16	1	752	267,825	9	582.17	94,786	C & D DETENTION
11	Combine	39.62	1	731	179,475	5, 6,	------	------	COMBINE A,B,C & E
12	Combine	53.94	1	732	447,300	10, 11	------	------	COMBINE A,B, C, D & E
13	Reservoir	22.02	1	785	304,259	12	582.15	160,513	DETENTION A,B,C,D & E
14	SCS Runoff	25.24	1	730	95,092	------	------	------	AREA H - POST DEV
15	SCS Runoff	26.12	1	723	74,760	------	------	------	AREA G - POST DEV
16	SCS Runoff	15.39	1	724	46,094	------	------	------	AREA J - POST DEV
17	Combine	48.24	1	725	169,852	14, 15,	------	------	COMBINE H & G
18	Reach	46.23	1	729	169,850	17	------	------	HWY 20 SIDE DITCH
19	Combine	60.25	1	727	215,944	16, 18	------	------	COMBINE H,G, & J
20	SCS Runoff	40.03	1	724	118,949	------	------	------	AREA F - POST DEV
21	SCS Runoff	5.906	1	718	11,907	------	------	------	AREA J' - POST DEV
22	Combine	42.93	1	722	130,856	20, 21	------	------	Combine F & J'
23	Combine	100.23	1	725	346,800	19, 22	------	------	COMBINE G,H,J & F,J'
24	Reservoir	68.32	1	735	346,800	23	580.54	30,363	F,G,H,J & J' DETENTION
25	SCS Runoff	4.453	1	726	14,349	------	------	------	AREA K' - POST DEV
26	Reach	3.466	1	733	14,343	25	------	------	K' Tc DITCH
27	SCS Runoff	2.004	1	726	6,495	------	------	------	AREA K'' - POST DEV
28	Reach	1.337	1	735	6,486	27	------	------	K'' Tc DITCH
29	Combine	4.784	1	734	20,829	26, 28	------	------	COMBINE K' & K''
30	SCS Runoff	18.71	1	726	60,617	------	------	------	AREA K - POST DEV
31	Combine	22.56	1	726	81,447	29, 30	------	------	COMBINE K, K' & K''
32	Reservoir	6.523	1	750	81,312	31	582.34	24,329	AREA K DETENTION
33	Combine	74.58	1	736	428,110	24, 32	------	------	COMBINE F,G,H,J & K
34	SCS Runoff	4.086	1	721	10,038	------	------	------	AREA L - POST DEV

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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
35	Combine	75.37	1	735	438,148	33, 34	------	------	COMBINE FG,H,J,K & L
36	Combine	75.37	1	735	742,406	13, 35	------	------	TOTAL SITE DISCHARGE - POST D

Hydrograph Report

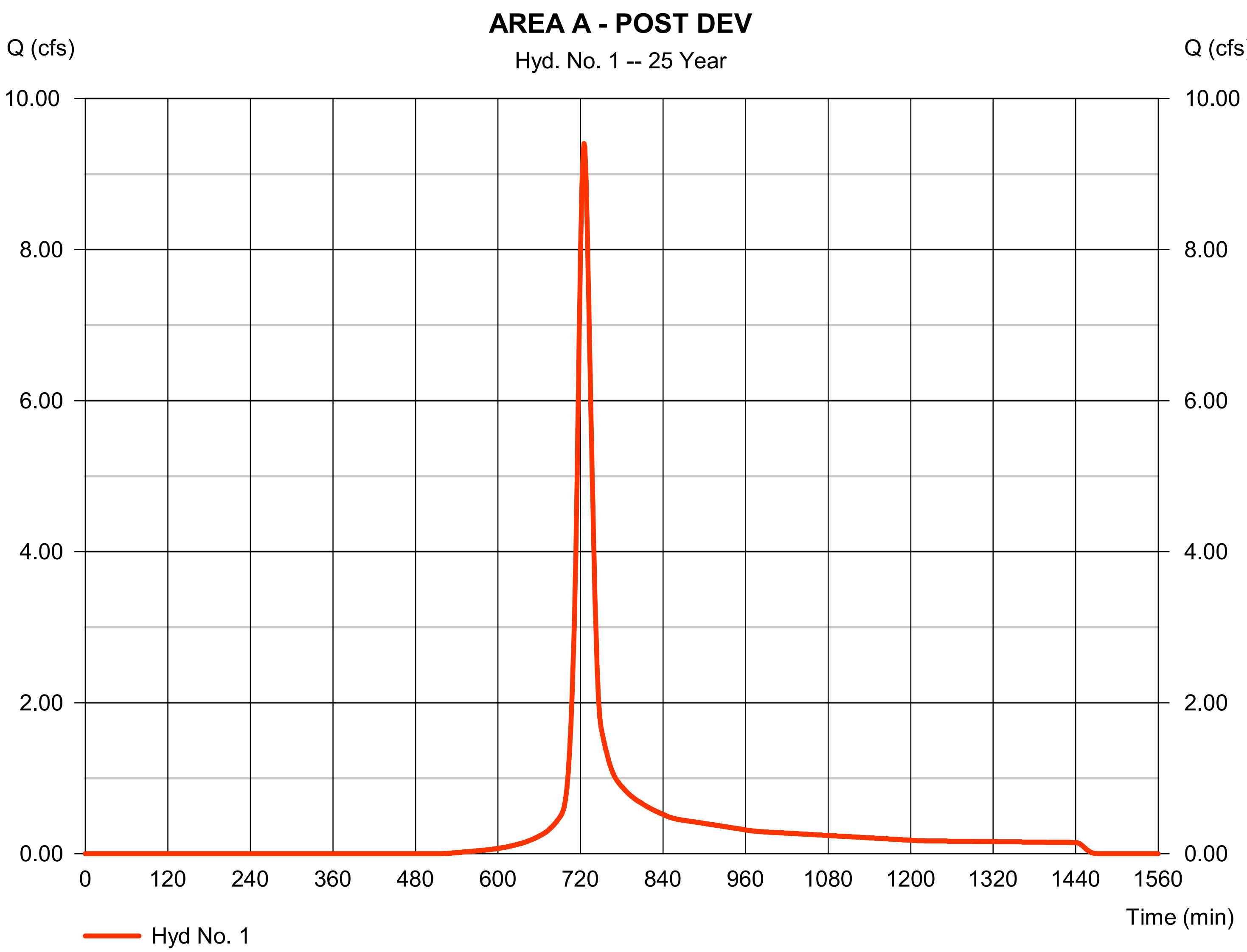
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 1

AREA A - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 9.405 cfs
Storm frequency	= 25 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 29,429 cuft
Drainage area	= 2.580 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.10 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.220 x 85) + (0.570 x 55) + (0.030 x 98) + (0.760 x 60)] / 2.580



TR55 Tc Worksheet

Hyd. No. 1

AREA A - POST DEV

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	50.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.82		0.00		0.00		
Land slope (%)	=	16.00		0.00		0.00		
Travel Time (min)	**=**	**3.27**	**+**	**0.00**	**+**	**0.00**	**=**	**3.27**
Shallow Concentrated Flow								
Flow length (ft)	=	620.00		0.00		0.00		
Watercourse slope (%)	=	0.17		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=0.67			0.00		0.00		
Travel Time (min)	**=**	**15.53**	**+**	**0.00**	**+**	**0.00**	**=**	**15.53**
Channel Flow								
X sectional flow area (sqft)	=	2.89		0.00		0.00		
Wetted perimeter (ft)	=	7.29		0.00		0.00		
Channel slope (%)	=	0.50		0.00		0.00		
Manning's n-value	=	0.030		0.015		0.015		
Velocity (ft/s)	=1.89			0.00		0.00		
Flow length (ft)	({0})150.0			0.0		0.0		
Travel Time (min)	**=**	**1.32**	**+**	**0.00**	**+**	**0.00**	**=**	**1.32**

Total Travel Time, Tc .... 20.10 min

Hydrograph Report

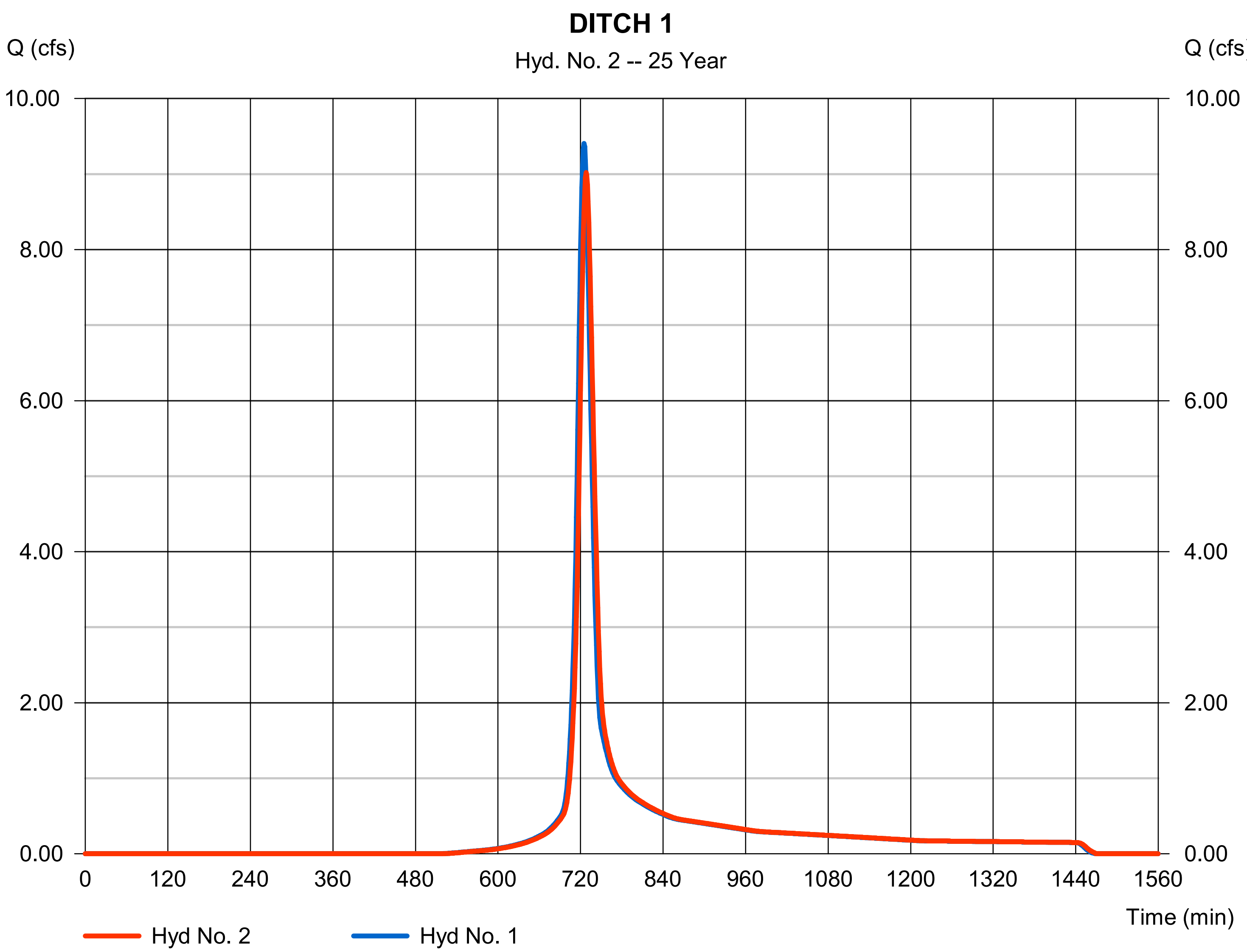
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 2

DITCH 1

Hydrograph type	= Reach	Peak discharge	= 9.020 cfs
Storm frequency	= 25 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 29,427 cuft
Inflow hyd. No.	= 1 - AREA A - POST DEV	Section type	= Trapezoidal
Reach length	= 730.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 10.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.375
Ave. velocity	= 3.17 ft/s	Routing coeff.	= 0.3038

Modified Att-Kin routing method used.



Hydrograph Report

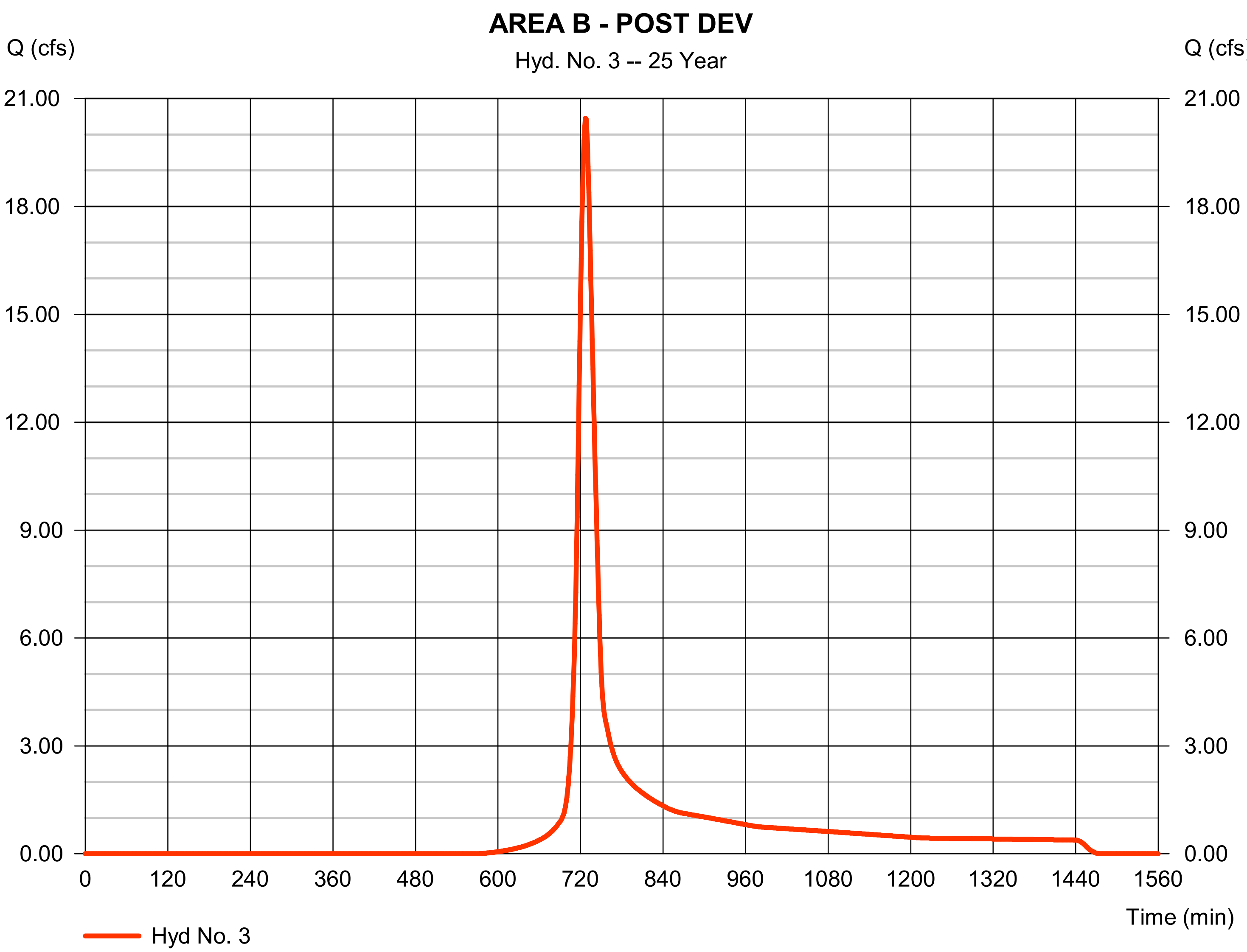
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 3

AREA B - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 20.45 cfs
Storm frequency	= 25 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 70,362 cuft
Drainage area	= 7.090 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.60 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.930 x 85) + (2.120 x 55) + (0.250 x 98) + (2.790 x 60)] / 7.090



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Hyd. No. 3

AREA B - POST DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.300		0.011		0.011		
Flow length (ft)	= 150.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		0.00		0.00		
Land slope (%)	= 3.60		0.00		0.00		
Travel Time (min)	**= 17.07**	**+**	**0.00**	**+**	**0.00**	**=**	**17.07**
Shallow Concentrated Flow							
Flow length (ft)	= 0.00		0.00		0.00		
Watercourse slope (%)	= 0.00		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=0.00		0.00		0.00		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow							
X sectional flow area (sqft)	= 5.60		5.04		0.00		
Wetted perimeter (ft)	= 18.05		14.27		0.00		
Channel slope (%)	= 0.80		0.66		0.00		
Manning's n-value	= 0.030		0.027		0.015		
Velocity (ft/s)	=2.03		2.23		0.00		
Flow length (ft)	({0})500.0		320.0		0.0		
Travel Time (min)	**= 4.11**	**+**	**2.39**	**+**	**0.00**	**=**	**6.50**

Total Travel Time, Tc .... 23.60 min

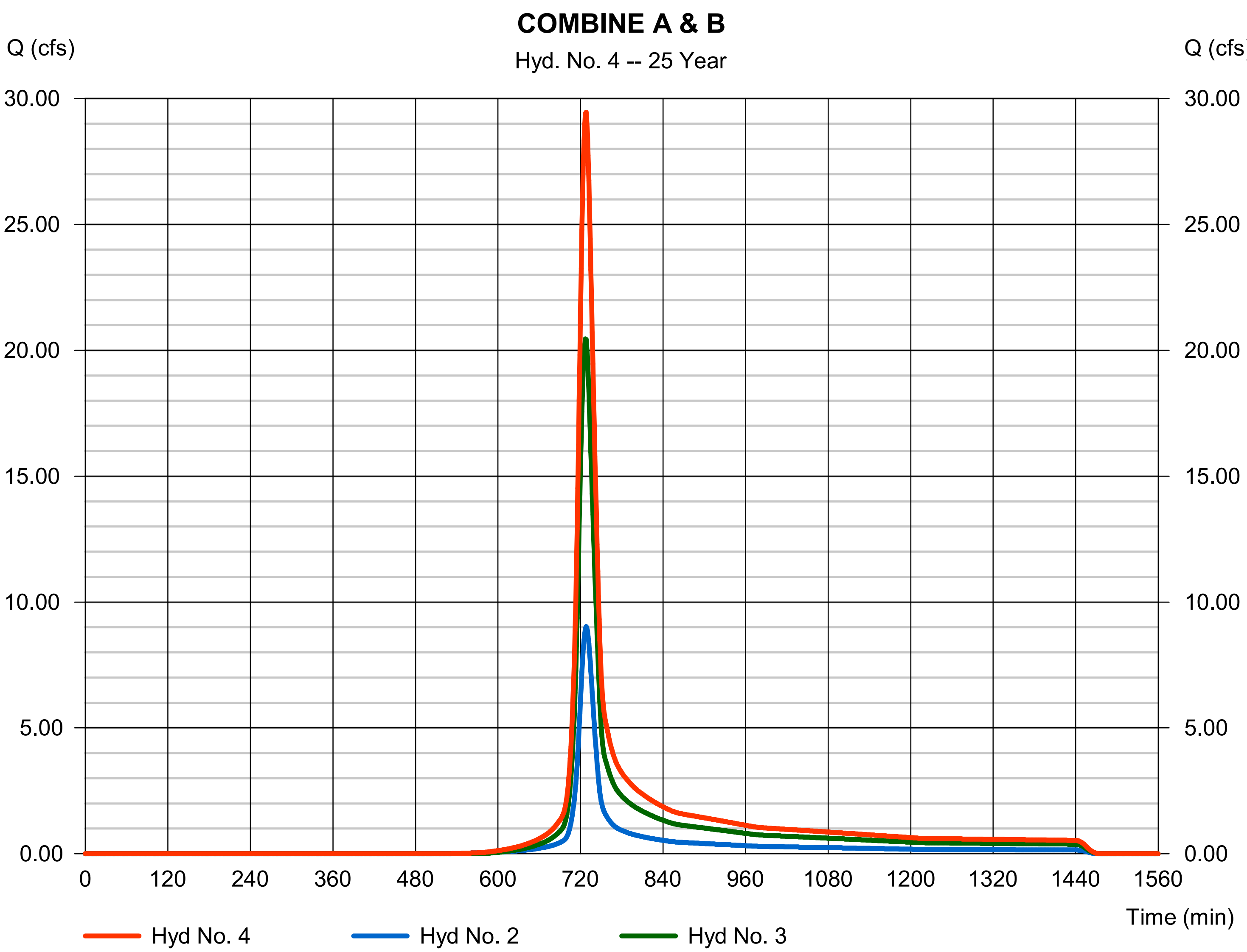
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 4

COMBINE A & B

Hydrograph type	= Combine	Peak discharge	= 29.45 cfs
Storm frequency	= 25 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 99,789 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 7.090 ac



Hydrograph Report

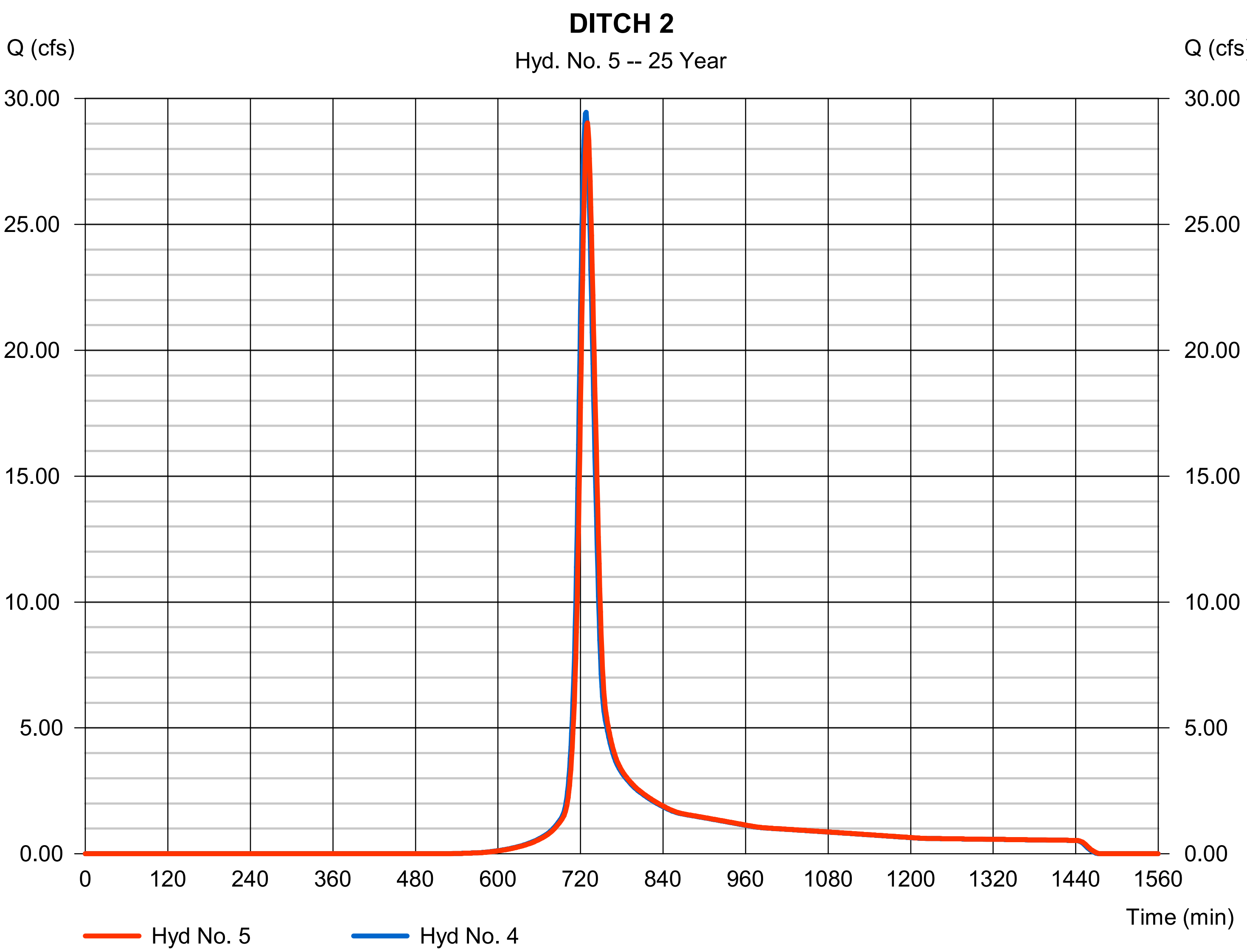
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 5

DITCH 2

Hydrograph type	= Reach	Peak discharge	= 29.04 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 99,788 cuft
Inflow hyd. No.	= 4 - COMBINE A & B	Section type	= Trapezoidal
Reach length	= 610.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.373
Ave. velocity	= 4.31 ft/s	Routing coeff.	= 0.4511

Modified Att-Kin routing method used.



Hydrograph Report

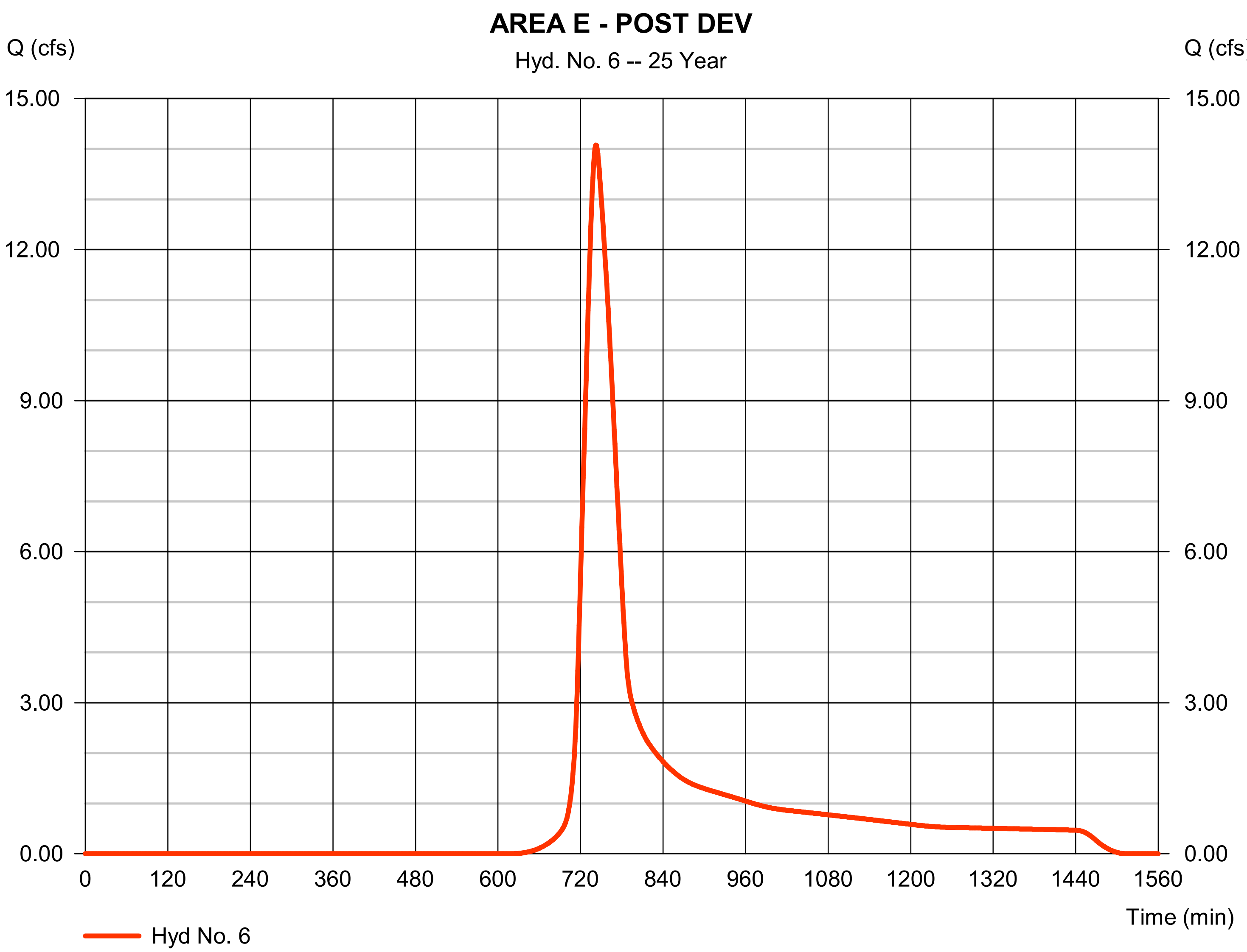
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 6

AREA E - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 14.07 cfs
Storm frequency	= 25 yrs	Time to peak	= 742 min
Time interval	= 1 min	Hyd. volume	= 79,687 cuft
Drainage area	= 9.150 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 47.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.680 x 65) + (0.330 x 98) + (5.140 x 60)] / 9.150



TR55 Tc Worksheet

Hyd. No. 6

AREA E - POST DEV

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.011		0.011		
Flow length (ft)	=	80.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.82		0.00		0.00		
Land slope (%)	=	1.20		0.00		0.00		
Travel Time (min)	**=**	**13.40**	**+**	**0.00**	**+**	**0.00**	**=**	**13.40**
Shallow Concentrated Flow								
Flow length (ft)	=	0.00		0.00		0.00		
Watercourse slope (%)	=	0.00		0.00		0.00		
Surface description	=	Paved		Paved		Paved		
Average velocity (ft/s)	=	0.00		0.00		0.00		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow								
X sectional flow area (sqft)	=	7.51		5.60		0.00		
Wetted perimeter (ft)	=	19.73		9.32		0.00		
Channel slope (%)	=	0.45		0.45		0.00		
Manning's n-value	=	0.065		0.065		0.015		
Velocity (ft/s)	=	0.81		1.09		0.00		
Flow length (ft)	({0})	520.0		1500.0		0.0		
Travel Time (min)	**=**	**10.76**	**+**	**22.87**	**+**	**0.00**	**=**	**33.63**

Total Travel Time, Tc .... **47.00 min**

Hydrograph Report

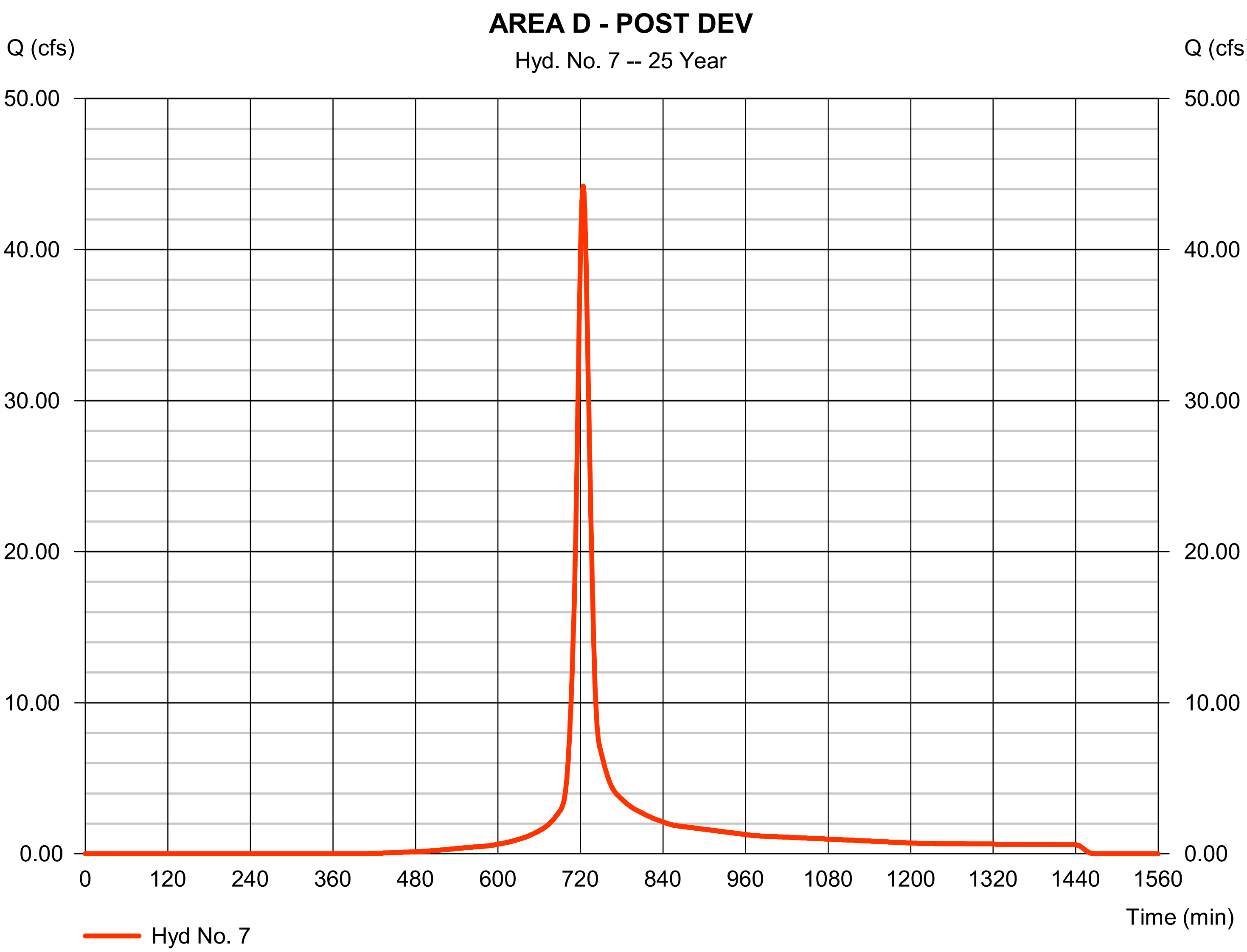
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 7

AREA D - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 44.21 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 131,368 cuft
Drainage area	= 9.520 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.10 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.910 x 85) + (8.290 x 77) + (0.320 x 98)] / 9.520



Hydrograph Report

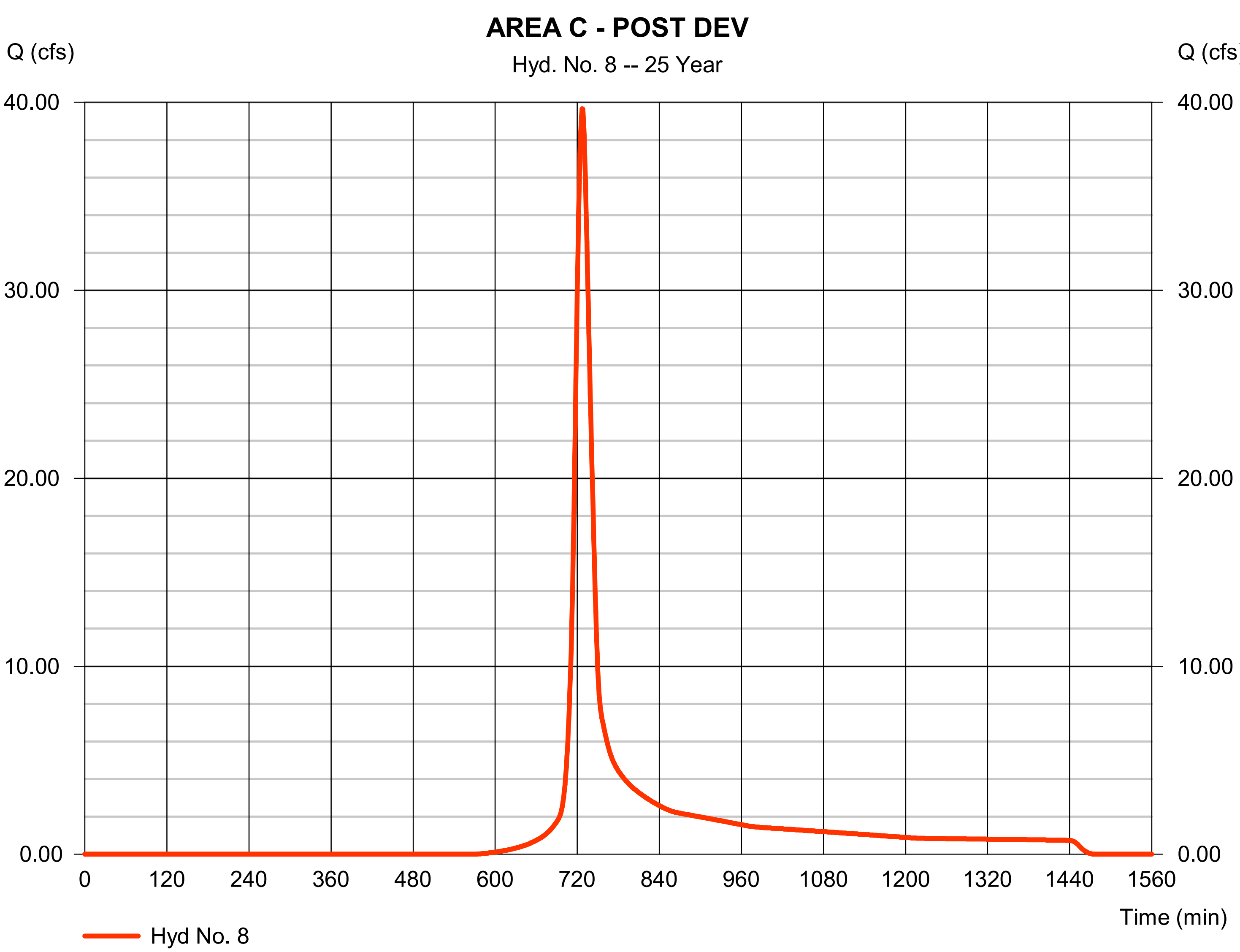
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 8

AREA C - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 39.67 cfs
Storm frequency	= 25 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 136,457 cuft
Drainage area	= 13.750 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.460 x 85) + (0.400 x 55) + (1.740 x 98) + (10.150 x 60)] / 13.750



TR55 Tc Worksheet

Hyd. No. 8

AREA C - POST DEV

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.240		0.240		0.011		
Flow length (ft)	=	115.0		22.0		0.0		
Two-year 24-hr precip. (in)	=	3.82		3.82		0.00		
Land slope (%)	=	2.80		13.50		0.00		
Travel Time (min)	**=**	**12.77**	**+**	**1.81**	**+**	**0.00**	**=**	**14.58**
Shallow Concentrated Flow								
Flow length (ft)	=	350.00		0.00		0.00		
Watercourse slope (%)	=	0.70		0.00		0.00		
Surface description	=	Unpaved		Paved		Paved		
Average velocity (ft/s)	=	1.35		0.00		0.00		
Travel Time (min)	**=**	**4.32**	**+**	**0.00**	**+**	**0.00**	**=**	**4.32**
Channel Flow								
X sectional flow area (sqft)	=	9.78		0.00		0.00		
Wetted perimeter (ft)	=	20.48		0.00		0.00		
Channel slope (%)	=	0.60		0.00		0.00		
Manning's n-value	=	0.030		0.015		0.015		
Velocity (ft/s)	=	2.34		0.00		0.00		
Flow length (ft)	({0})	575.0		0.0		0.0		
Travel Time (min)	**=**	**4.09**	**+**	**0.00**	**+**	**0.00**	**=**	**4.09**

Total Travel Time, Tc .... 23.00 min

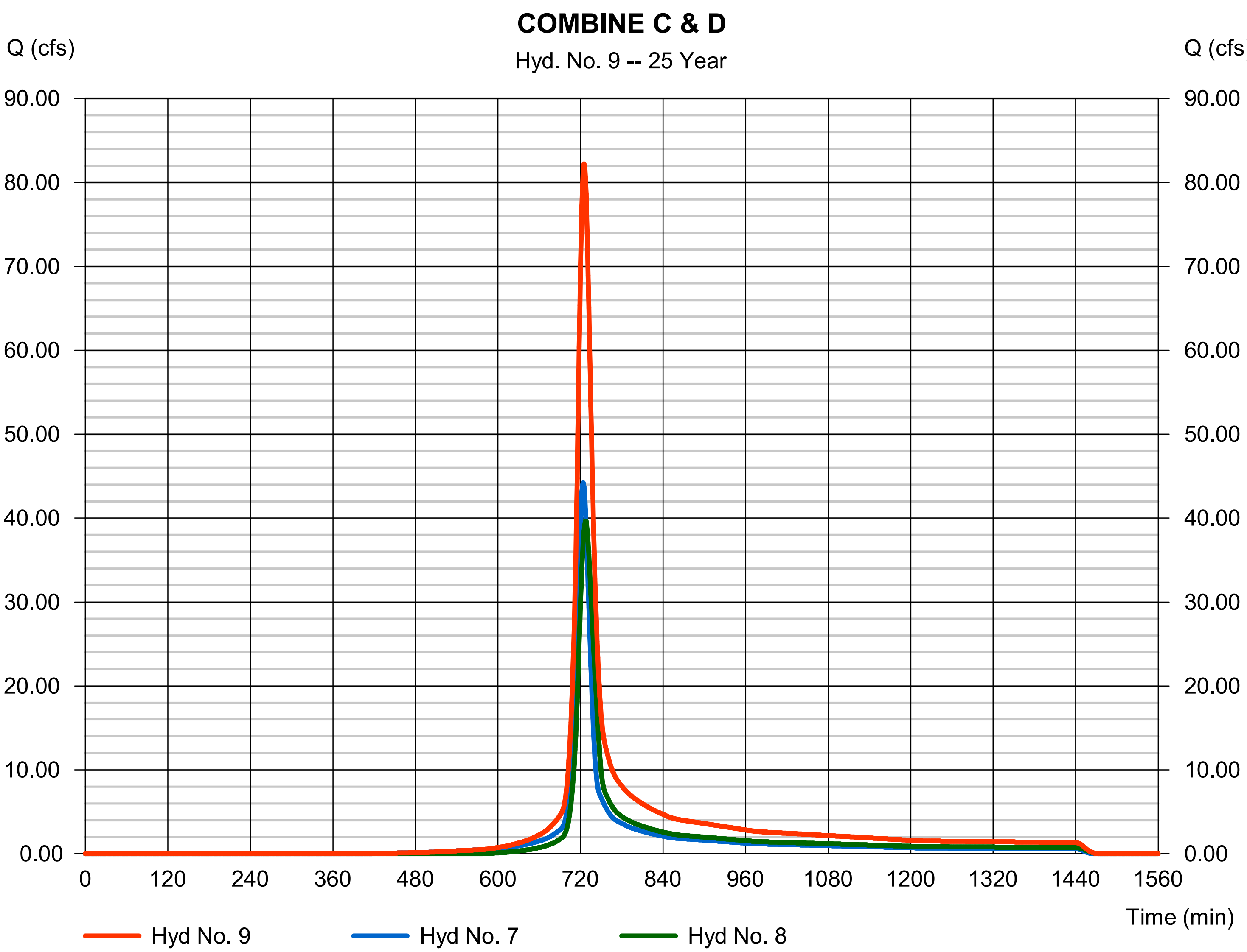
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 9

COMBINE C & D

Hydrograph type	= Combine	Peak discharge	= 82.22 cfs
Storm frequency	= 25 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 267,825 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 23.270 ac



Hydrograph Report

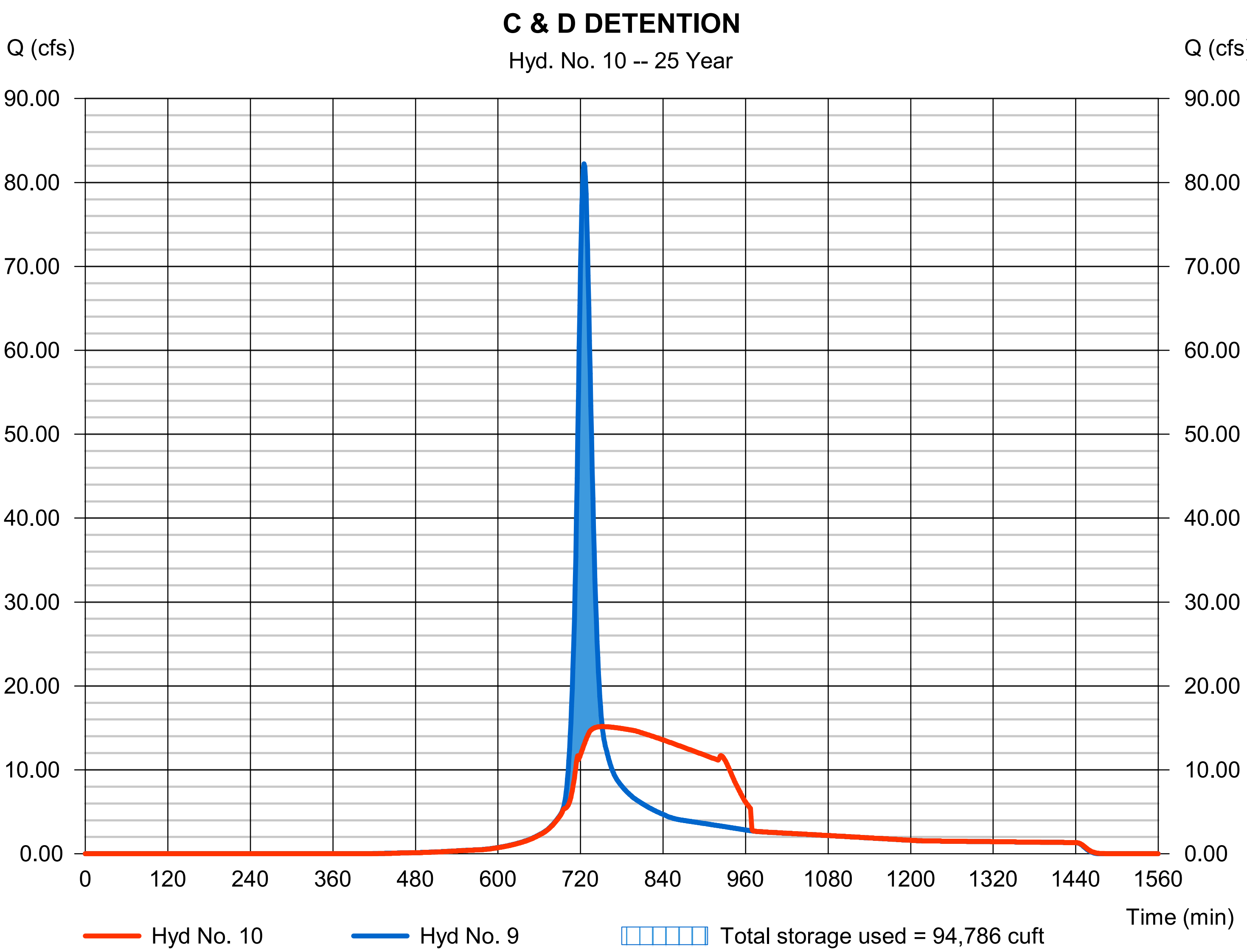
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 10

C & D DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 15.16 cfs
Storm frequency	= 25 yrs	Time to peak	= 752 min
Time interval	= 1 min	Hyd. volume	= 267,825 cuft
Inflow hyd. No.	= 9 - COMBINE C & D	Max. Elevation	= 582.17 ft
Reservoir name	= C&D DETENTION	Max. Storage	= 94,786 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Pond No. 7 - C&D DETENTION

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	579.00	n/a	0	0
1.00	580.00	n/a	368	368
2.00	581.00	n/a	16,012	16,380
3.00	582.00	n/a	61,831	78,211
4.00	583.00	n/a	99,795	178,006
5.00	584.00	n/a	169,576	347,582

Culvert / Orifice Structures

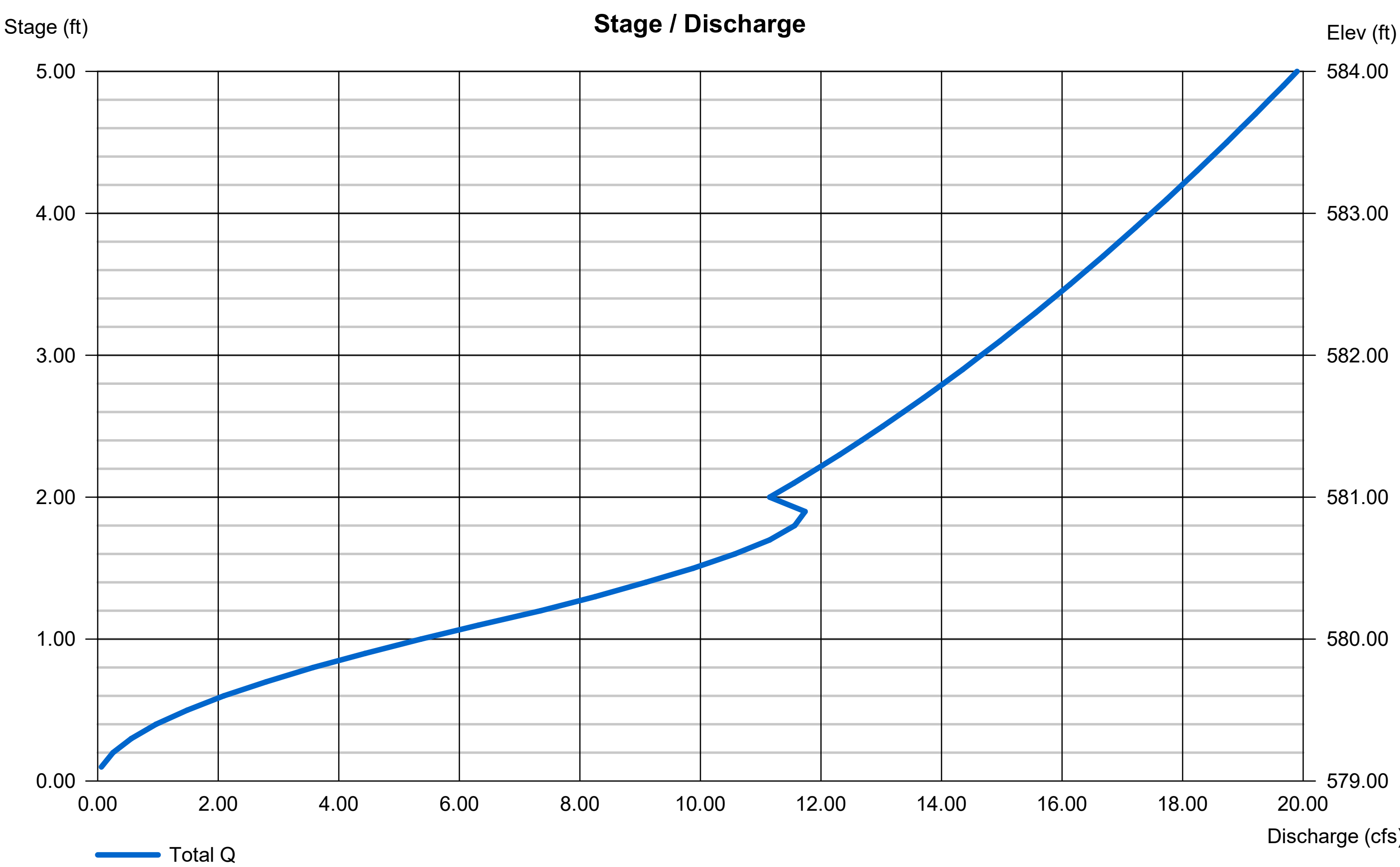
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 579.00	0.00	0.00	0.00
Length (ft)	= 143.00	0.00	0.00	0.00
Slope (%)	= 0.96	0.00	0.00	n/a
N-Value	= .023	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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



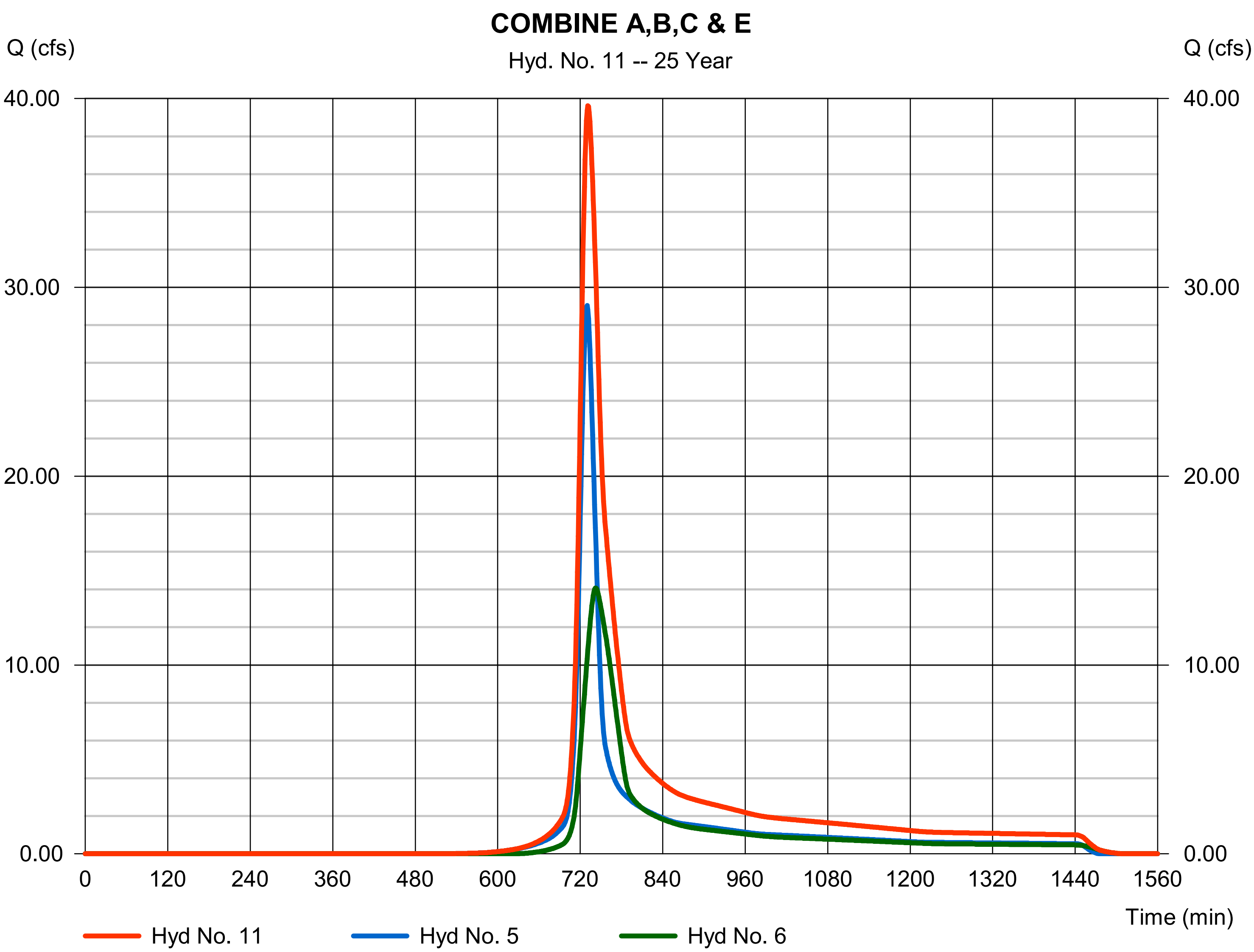
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 11

COMBINE A,B,C & E

Hydrograph type	= Combine	Peak discharge	= 39.62 cfs
Storm frequency	= 25 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 179,475 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 9.150 ac



Hydrograph Report

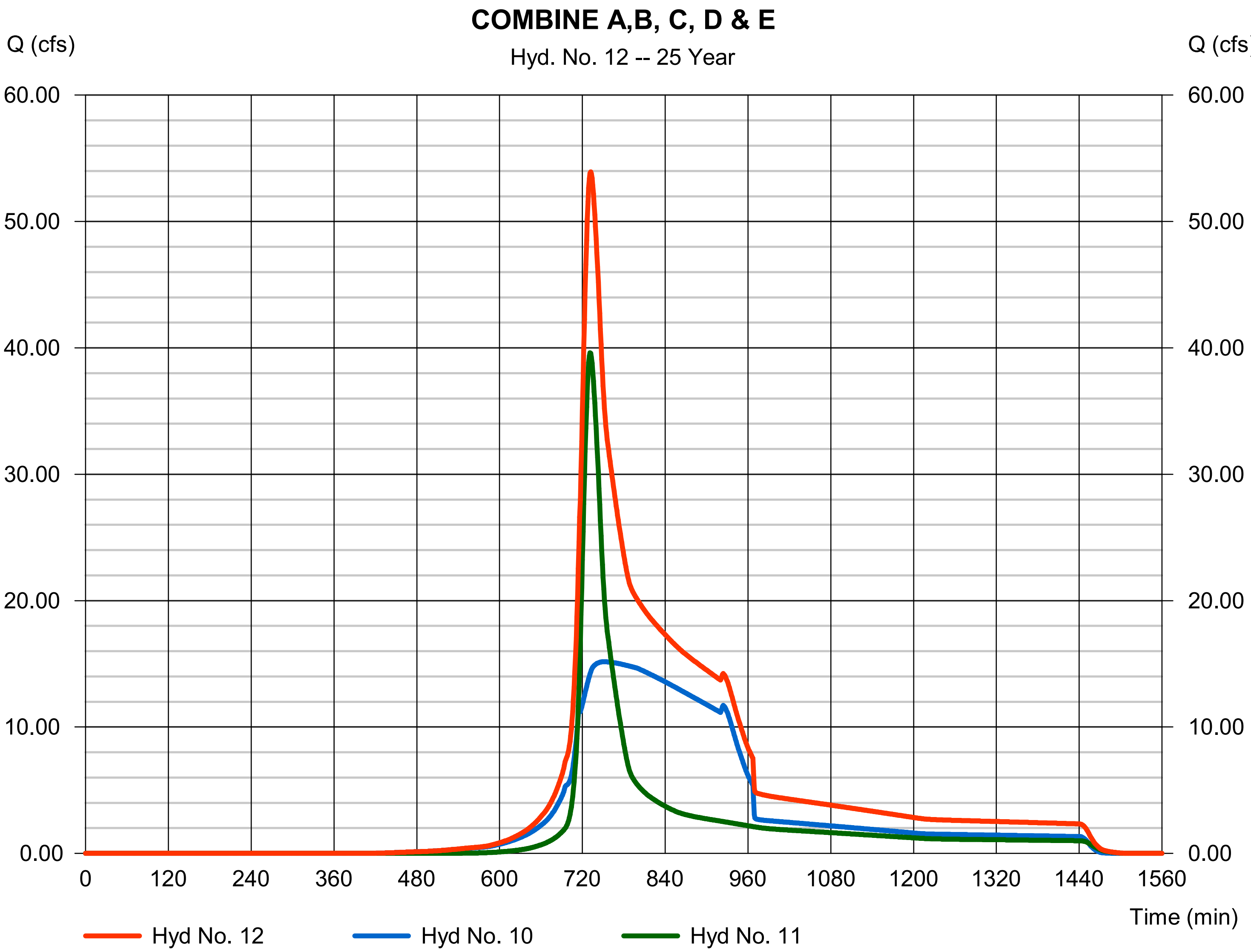
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Thursday, 11 / 15 / 2018

Hyd. No. 12

COMBINE A,B, C, D & E

Hydrograph type	= Combine	Peak discharge	= 53.94 cfs
Storm frequency	= 25 yrs	Time to peak	= 732 min
Time interval	= 1 min	Hyd. volume	= 447,300 cuft
Inflow hyds.	= 10, 11	Contrib. drain. area	= 0.000 ac



Hydrograph Report

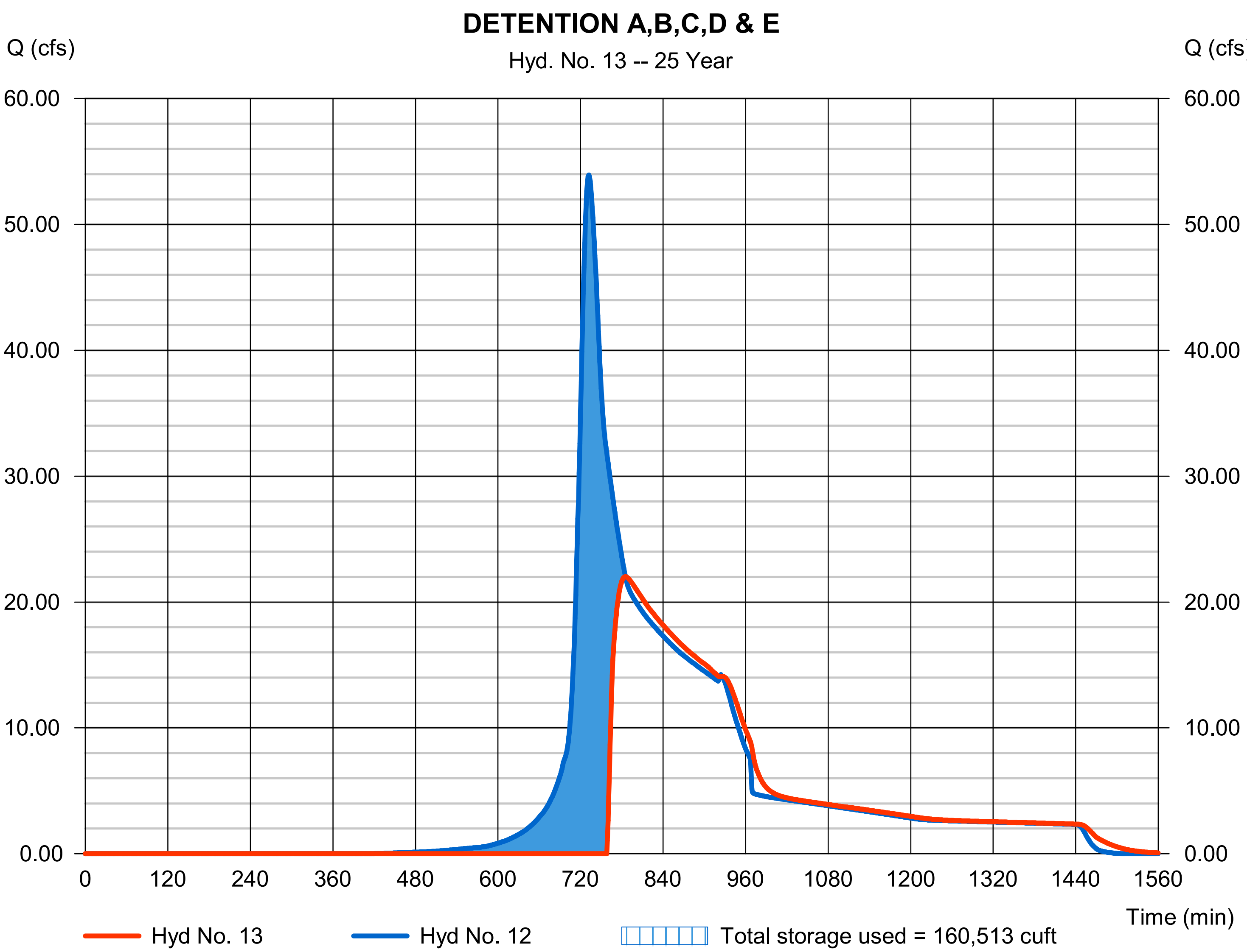
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 13

DETENTION A,B,C,D & E

Hydrograph type	= Reservoir	Peak discharge	= 22.02 cfs
Storm frequency	= 25 yrs	Time to peak	= 785 min
Time interval	= 1 min	Hyd. volume	= 304,259 cuft
Inflow hyd. No.	= 12 - COMBINE A,B, C, D & E	Max. Elevation	= 582.15 ft
Reservoir name	= A,B,C,D & E DETENTION	Max. Storage	= 160,513 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Pond No. 1 - A,B,C,D & E DETENTION

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	577.00	n/a	0	0
1.00	578.00	n/a	46,004	46,004
2.00	579.00	n/a	33,011	79,015
3.00	580.00	n/a	28,300	107,315
4.00	581.00	n/a	24,110	131,425
5.00	582.00	n/a	23,229	154,654
6.00	583.00	n/a	38,881	193,535
7.00	584.00	n/a	59,736	253,271
8.00	585.00	n/a	88,517	341,788
9.00	586.00	n/a	115,069	456,857

Culvert / Orifice Structures

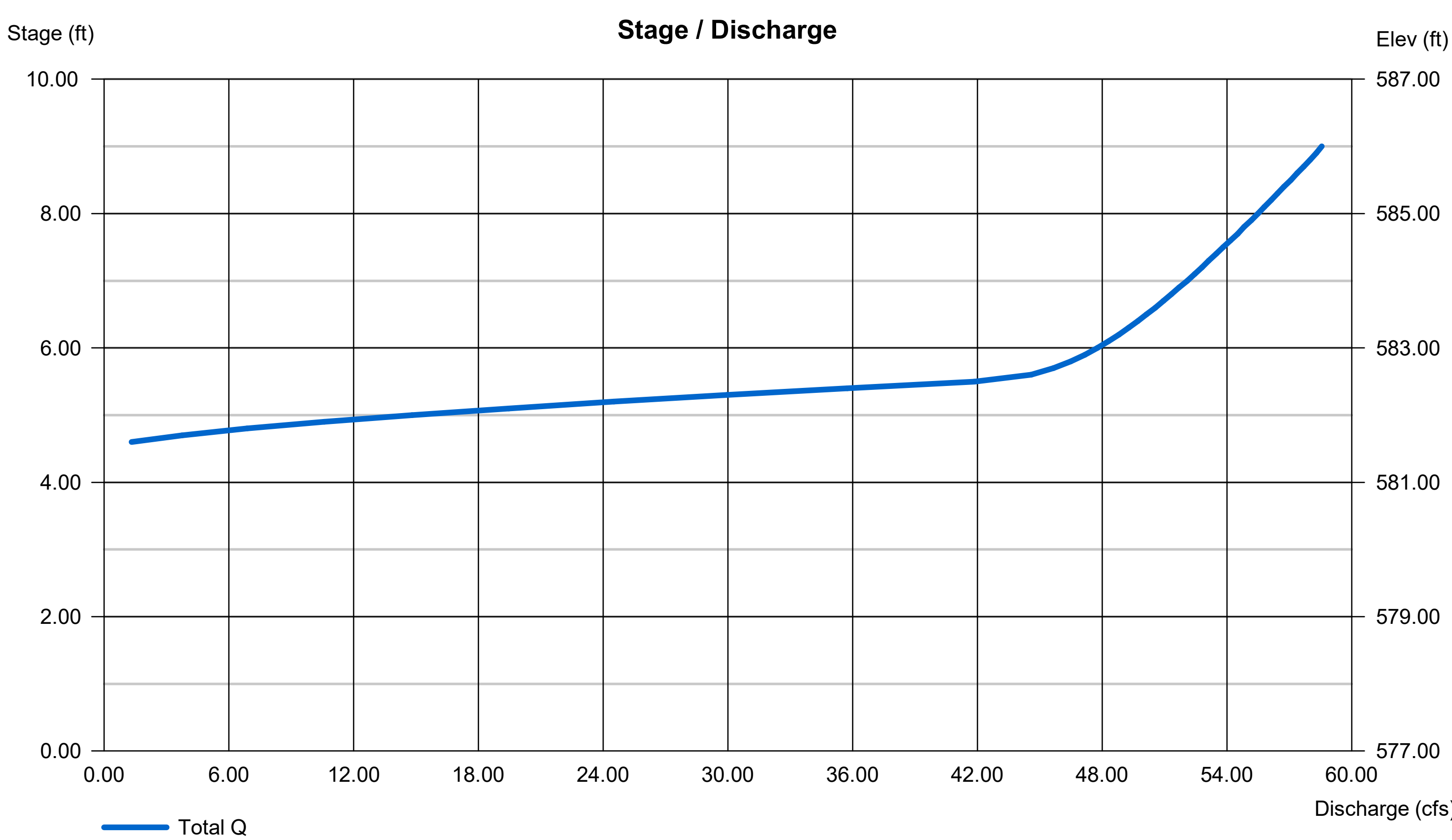
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 36.00	Inactive	Inactive	Inactive
Span (in)	= 36.00	0.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 577.64	0.00	0.00	0.00
Length (ft)	= 311.70	0.00	0.00	0.00
Slope (%)	= 1.42	0.00	0.00	n/a
N-Value	= .024	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.57	Inactive	Inactive	Inactive
Crest El. (ft)	= 581.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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



Hydrograph Report

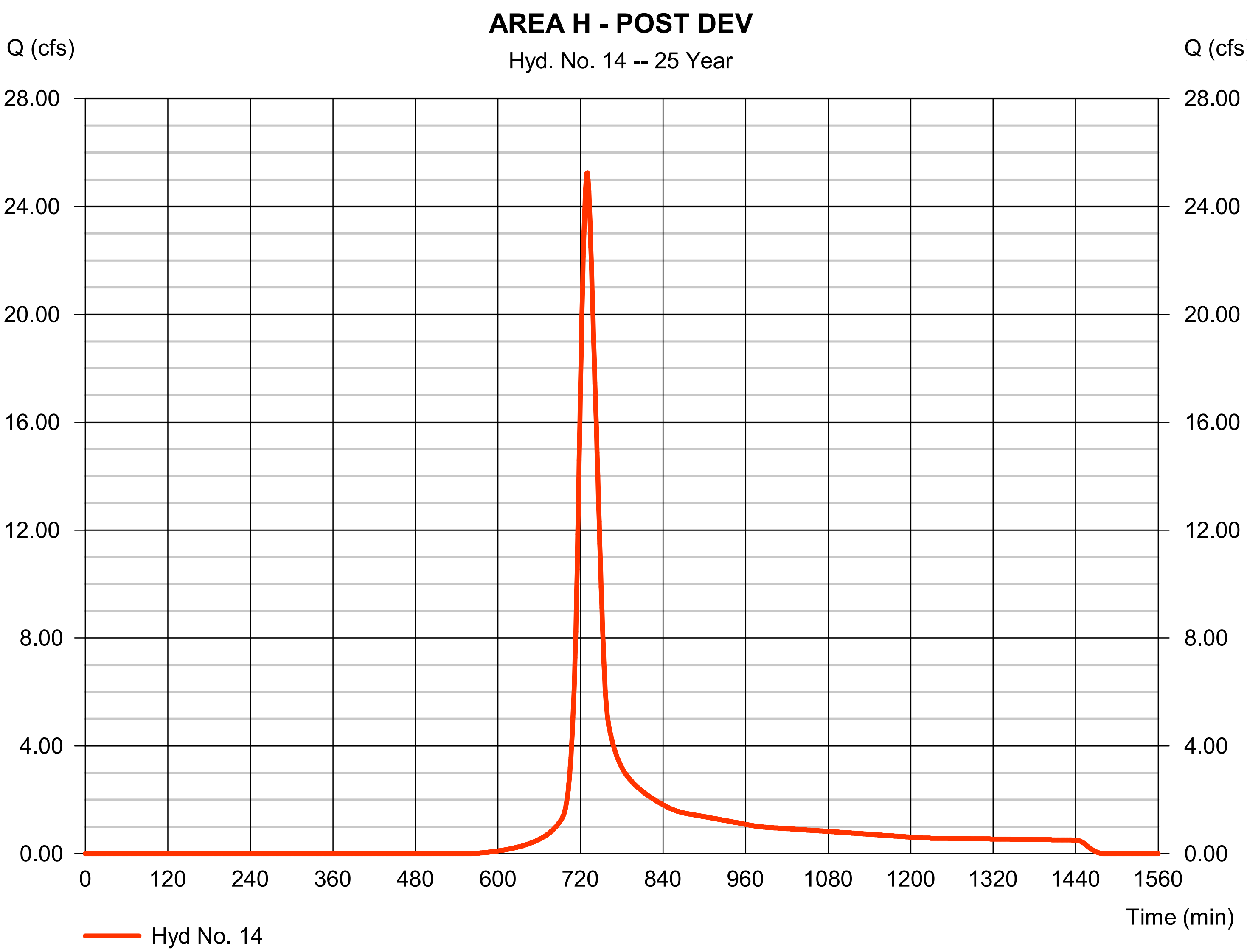
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 14

AREA H - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 25.24 cfs
Storm frequency	= 25 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 95,092 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.50 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



TR55 Tc Worksheet

Hyd. No. 14

AREA H - POST DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.410		0.011		0.011		
Flow length (ft)	= 90.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		0.00		0.00		
Land slope (%)	= 2.20		0.00		0.00		
Travel Time (min)	**= 17.74**	**+**	**0.00**	**+**	**0.00**	**=**	**17.74**
Shallow Concentrated Flow							
Flow length (ft)	= 270.00		305.00		0.00		
Watercourse slope (%)	= 2.00		0.75		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=2.28		1.40		0.00		
Travel Time (min)	**= 1.97**	**+**	**3.64**	**+**	**0.00**	**=**	**5.61**
Channel Flow							
X sectional flow area (sqft)	= 19.90		0.00		0.00		
Wetted perimeter (ft)	= 33.72		0.00		0.00		
Channel slope (%)	= 0.50		0.00		0.00		
Manning's n-value	= 0.030		0.015		0.015		
Velocity (ft/s)	=2.47						
			0.00				
					0.00		
Flow length (ft)	({0})470.0		0.0		0.0		
Travel Time (min)	**= 3.18**	**+**	**0.00**	**+**	**0.00**	**=**	**3.18**

Total Travel Time, Tc .... 26.50 min

Hydrograph Report

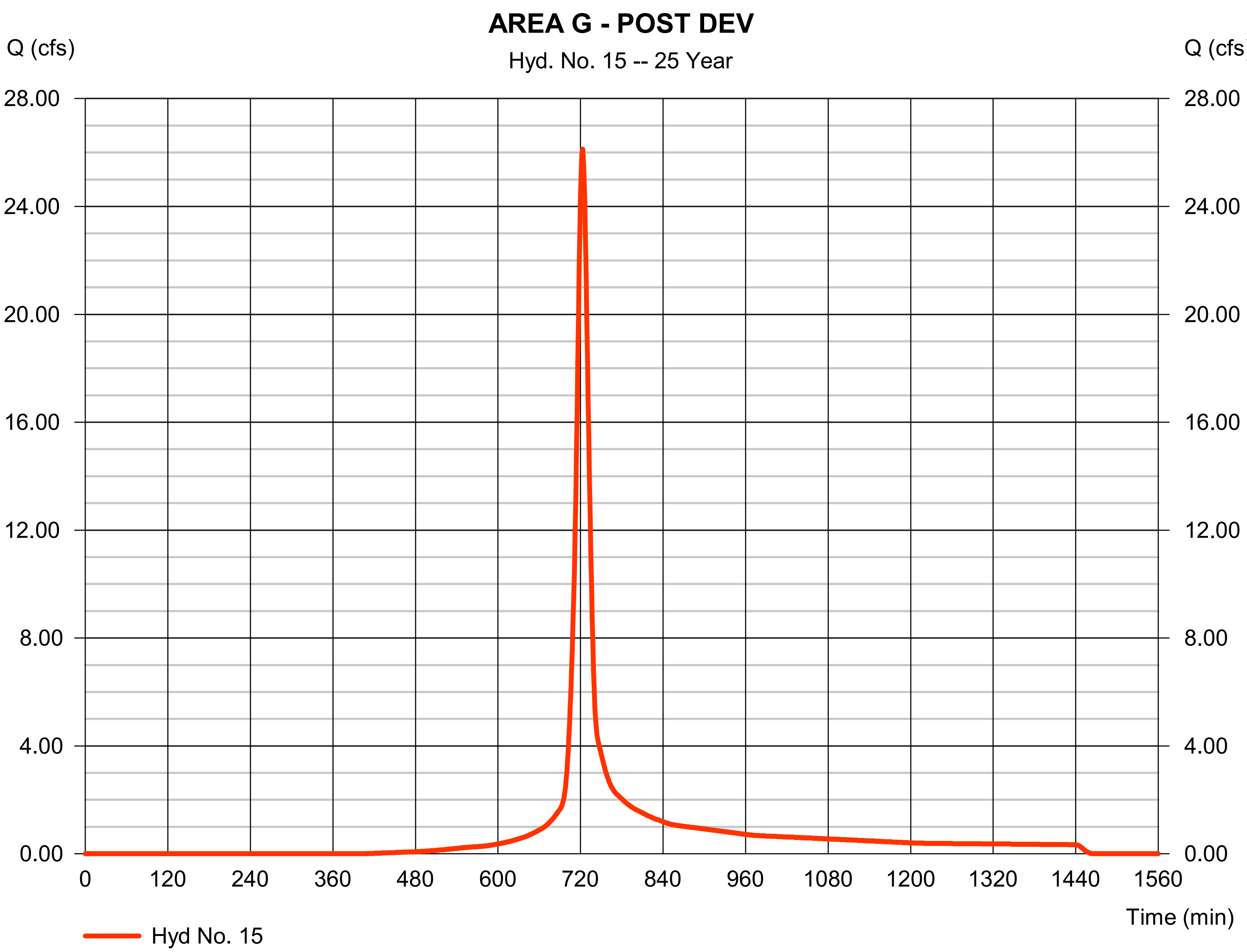
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 15

AREA G - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 26.12 cfs
Storm frequency	= 25 yrs	Time to peak	= 723 min
Time interval	= 1 min	Hyd. volume	= 74,760 cuft
Drainage area	= 5.290 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.80 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.330 x 85) + (4.740 x 77) + (0.220 x 98)] / 5.290



Hydrograph Report

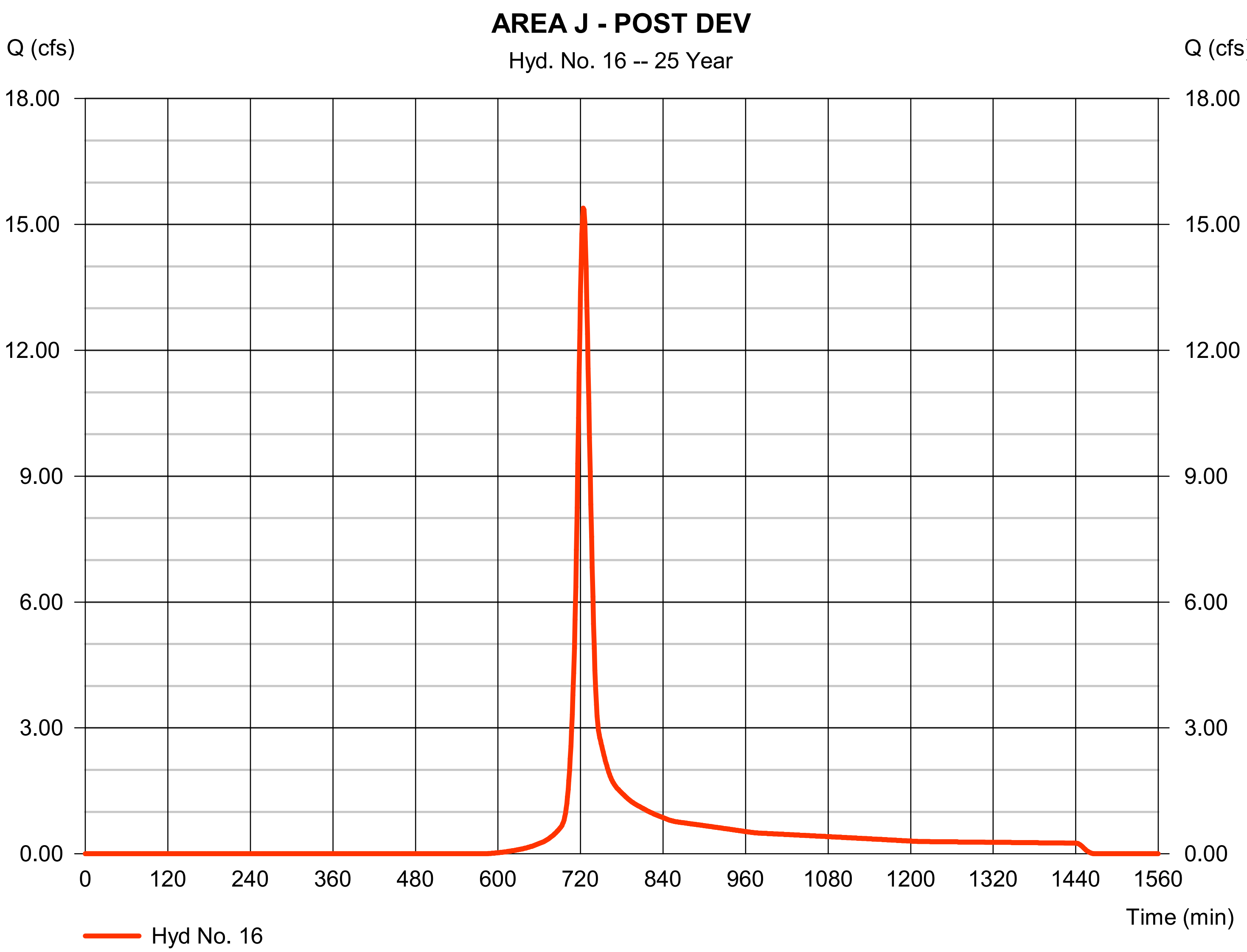
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 16

AREA J - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 15.39 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 46,094 cuft
Drainage area	= 4.820 ac	Curve number	= 66*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 85) + (0.020 x 65) + (0.680 x 98) + (4.030 x 60)] / 4.820



TR55 Tc Worksheet

Hyd. No. 16

AREA J - POST DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.011		0.350		0.011		
Flow length (ft)	= 8.0		30.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		3.82		0.00		
Land slope (%)	= 4.20		4.20		0.00		
Travel Time (min)	**= 0.11**	**+**	**5.01**	**+**	**0.00**	**=**	**5.12**
Shallow Concentrated Flow							
Flow length (ft)	= 21.00		155.00		0.00		
Watercourse slope (%)	= 7.75		6.60		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=4.49		4.15		0.00		
Travel Time (min)	**= 0.08**	**+**	**0.62**	**+**	**0.00**	**=**	**0.70**
Channel Flow							
X sectional flow area (sqft)	= 0.82		1.11		0.00		
Wetted perimeter (ft)	= 3.29		3.66		0.00		
Channel slope (%)	= 0.70		0.30		0.00		
Manning's n-value	= 0.030		0.030		0.015		
Velocity (ft/s)	=1.64		1.23		0.00		
Flow length (ft)	({0})181.0		685.0		0.0		
Travel Time (min)	**= 1.84**	**+**	**9.31**	**+**	**0.00**	**=**	**11.15**

Total Travel Time, Tc .... 17.00 min

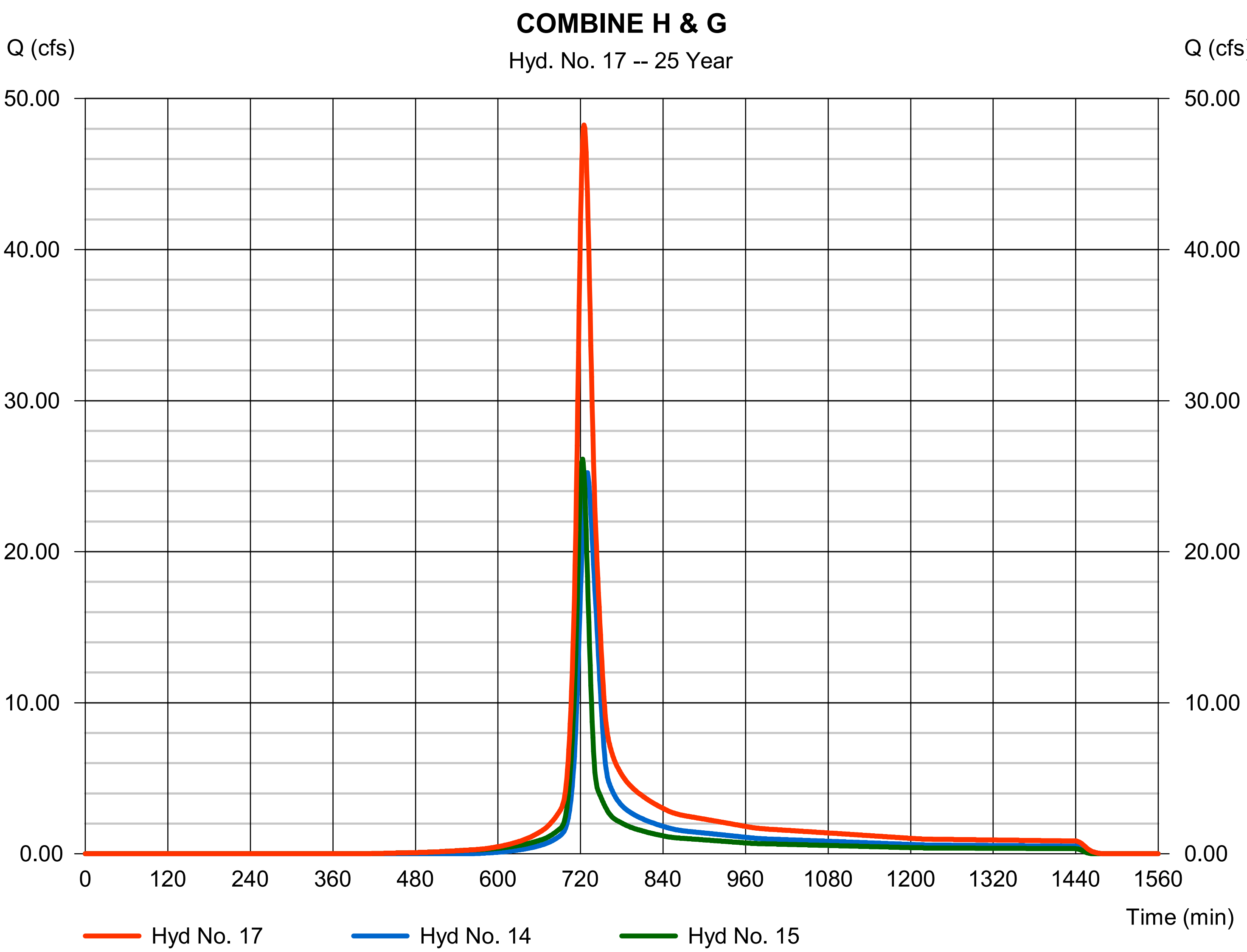
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 17

COMBINE H & G

Hydrograph type	= Combine	Peak discharge	= 48.24 cfs
Storm frequency	= 25 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 169,852 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 14.400 ac



Hydrograph Report

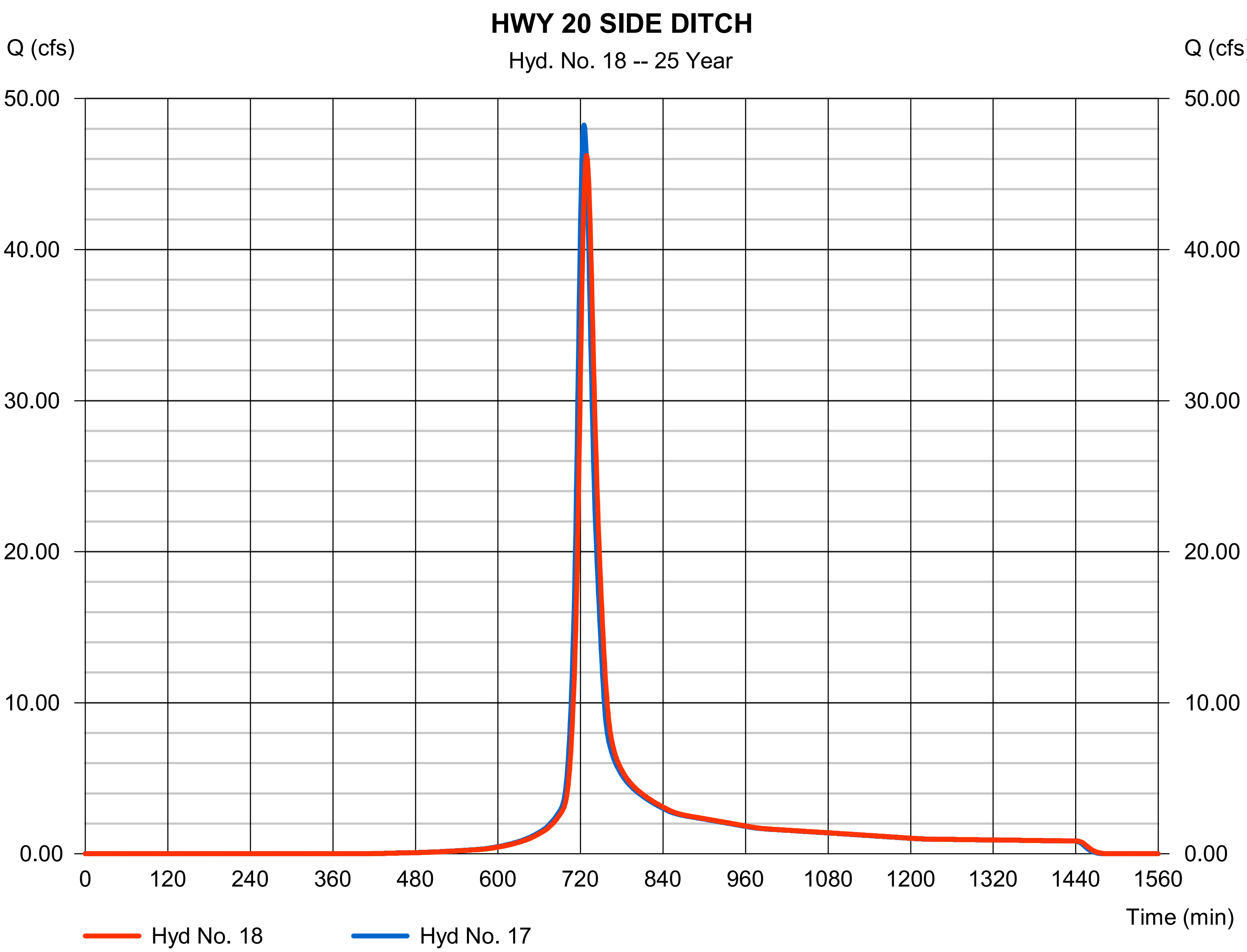
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 18

HWY 20 SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 46.23 cfs
Storm frequency	= 25 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 169,850 cuft
Inflow hyd. No.	= 17 - COMBINE H & G	Section type	= Trapezoidal
Reach length	= 900.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.030	Bottom width	= 3.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 1.688	Rating curve m	= 1.304
Ave. velocity	= 3.69 ft/s	Routing coeff.	= 0.2764

Modified Att-Kin routing method used.



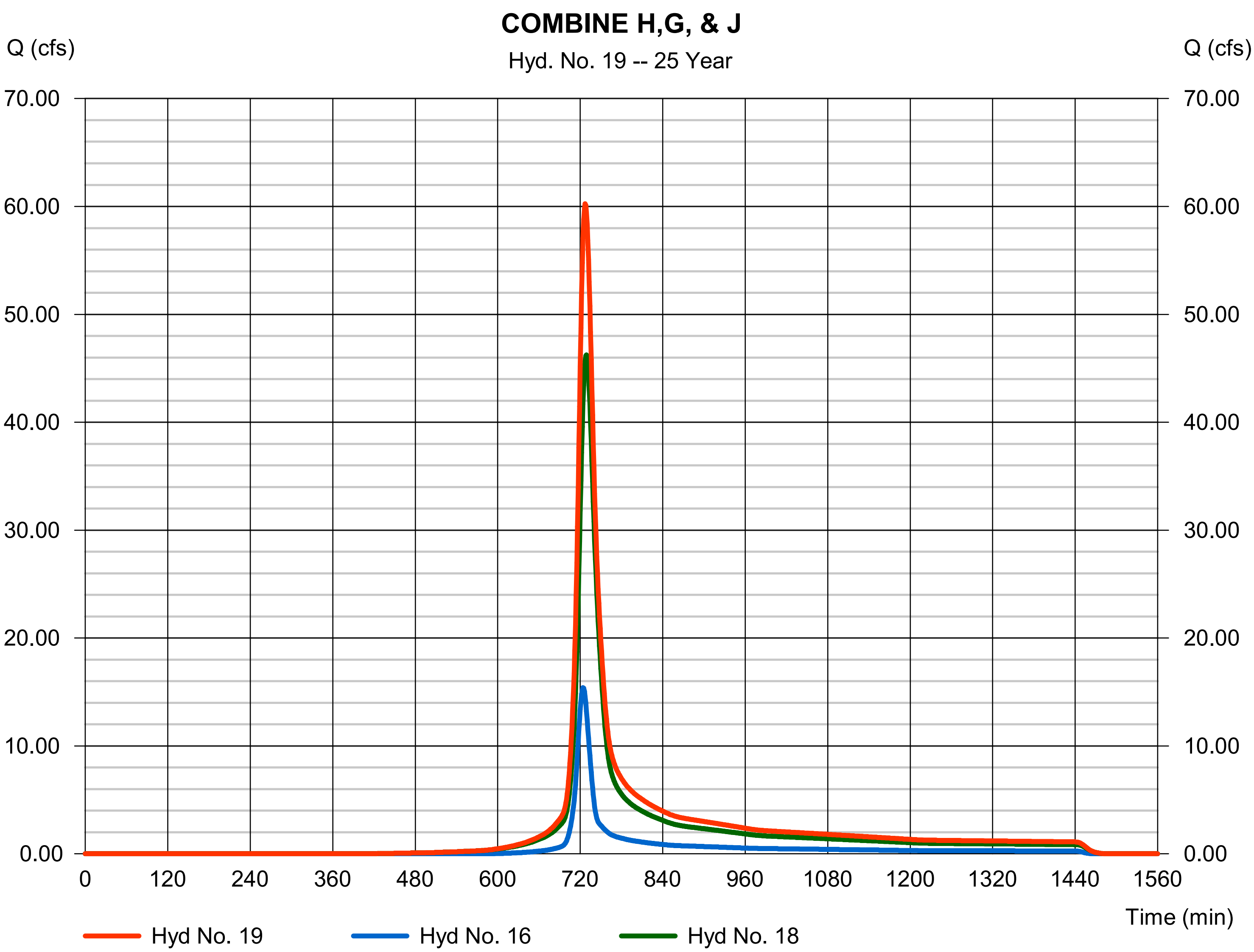
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 19

COMBINE H,G, & J

Hydrograph type	= Combine	Peak discharge	= 60.25 cfs
Storm frequency	= 25 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 215,944 cuft
Inflow hyds.	= 16, 18	Contrib. drain. area	= 4.820 ac



Hydrograph Report

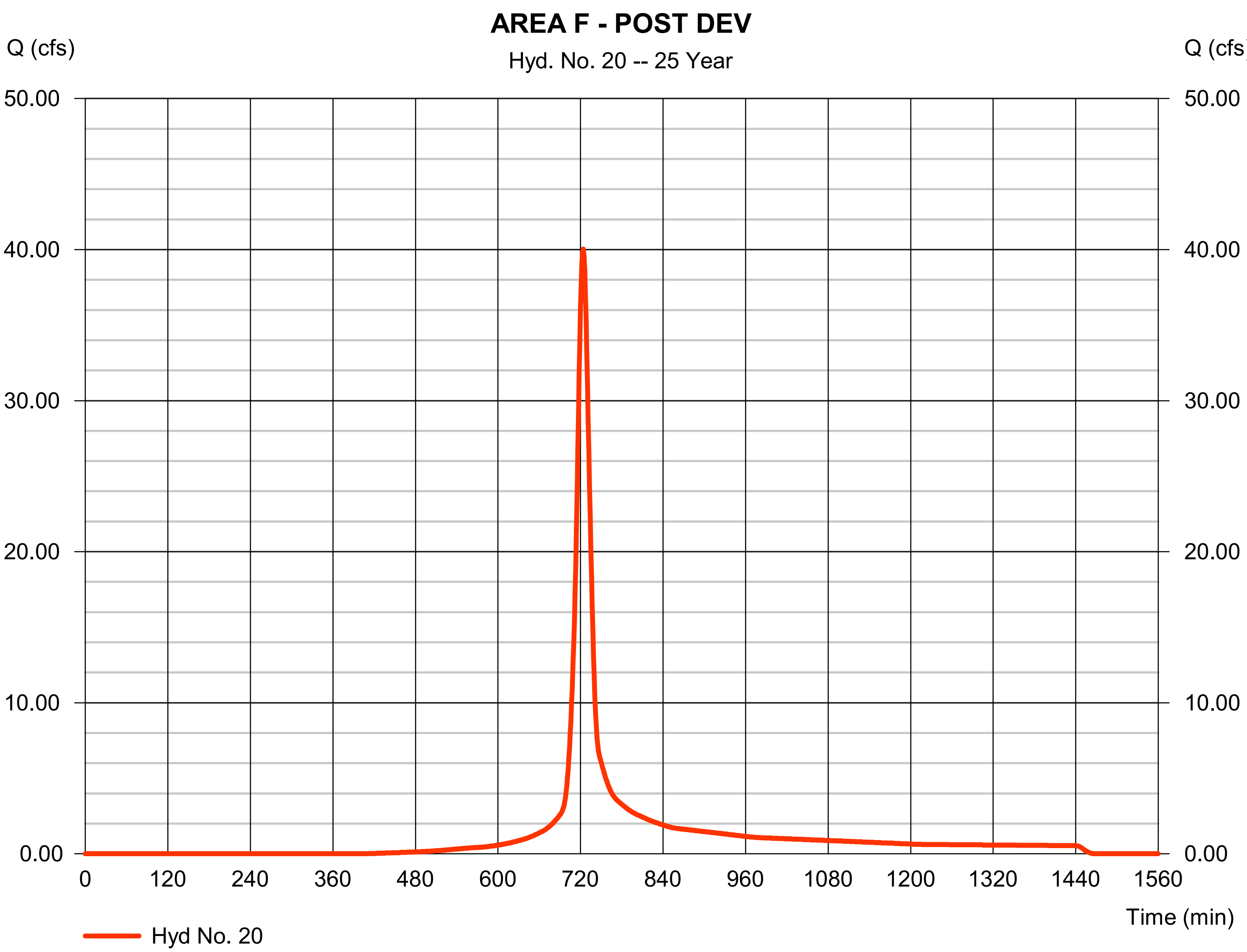
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 20

AREA F - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 40.03 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 118,949 cuft
Drainage area	= 8.620 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.440 x 85) + (7.810 x 77) + (0.370 x 98)] / 8.620



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

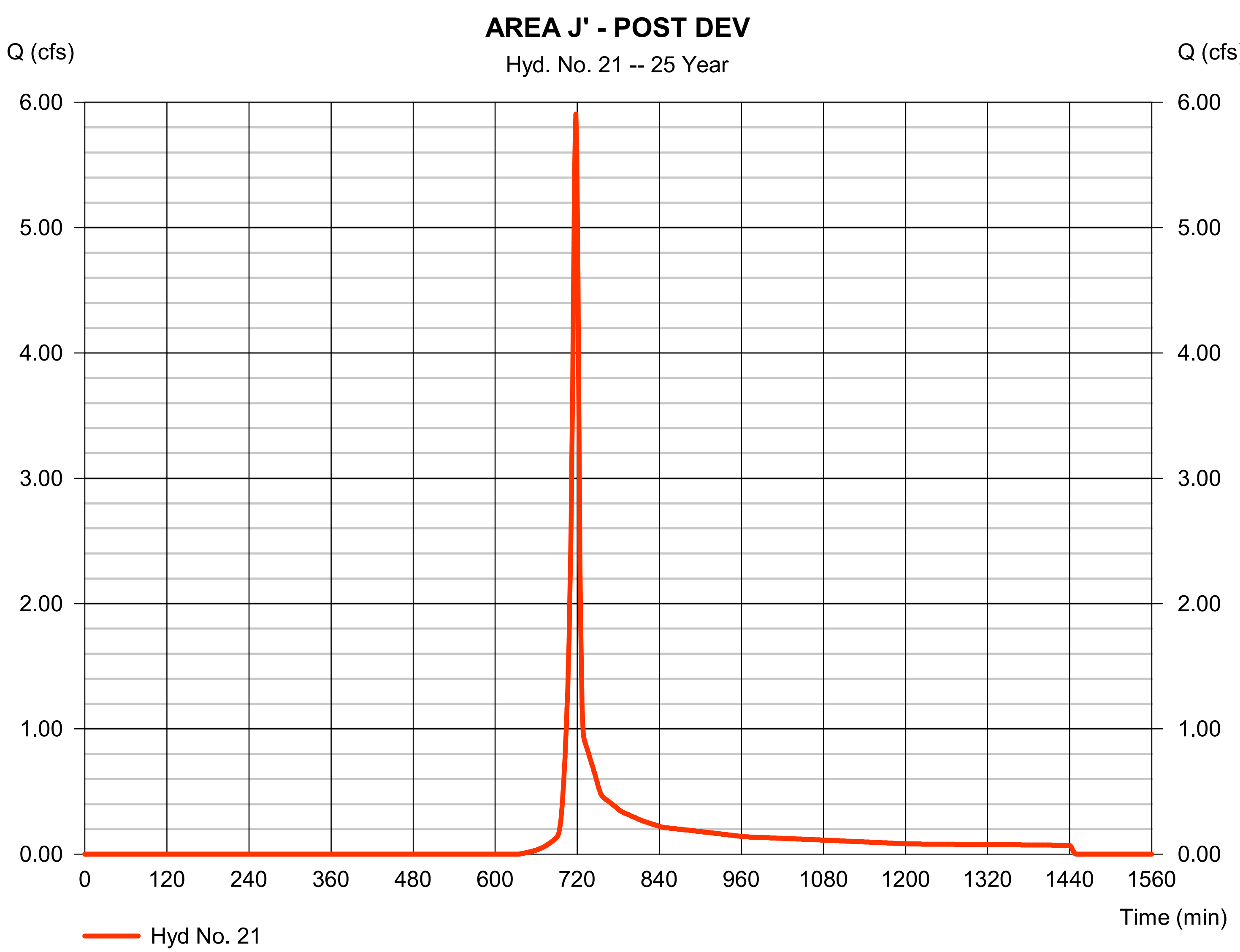
Thursday, 11 / 15 / 2018

Hyd. No. 21

AREA J' - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 5.906 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 11,907 cuft
Drainage area	= 1.440 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.220 x 65) + (1.220 x 60)] / 1.440



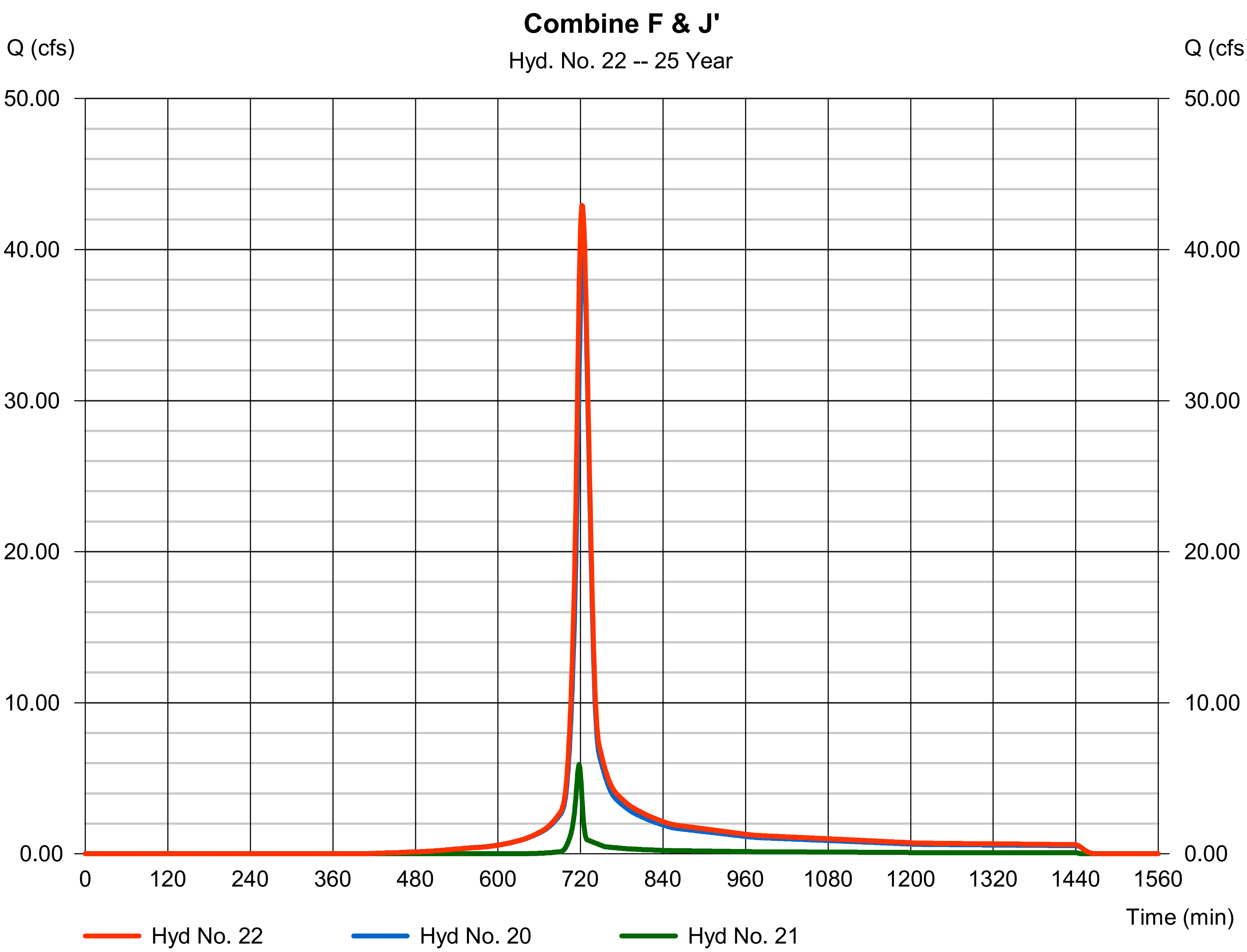
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 22

Combine F & J'

Hydrograph type	= Combine	Peak discharge	= 42.93 cfs
Storm frequency	= 25 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 130,856 cuft
Inflow hyds.	= 20, 21	Contrib. drain. area	= 10.060 ac



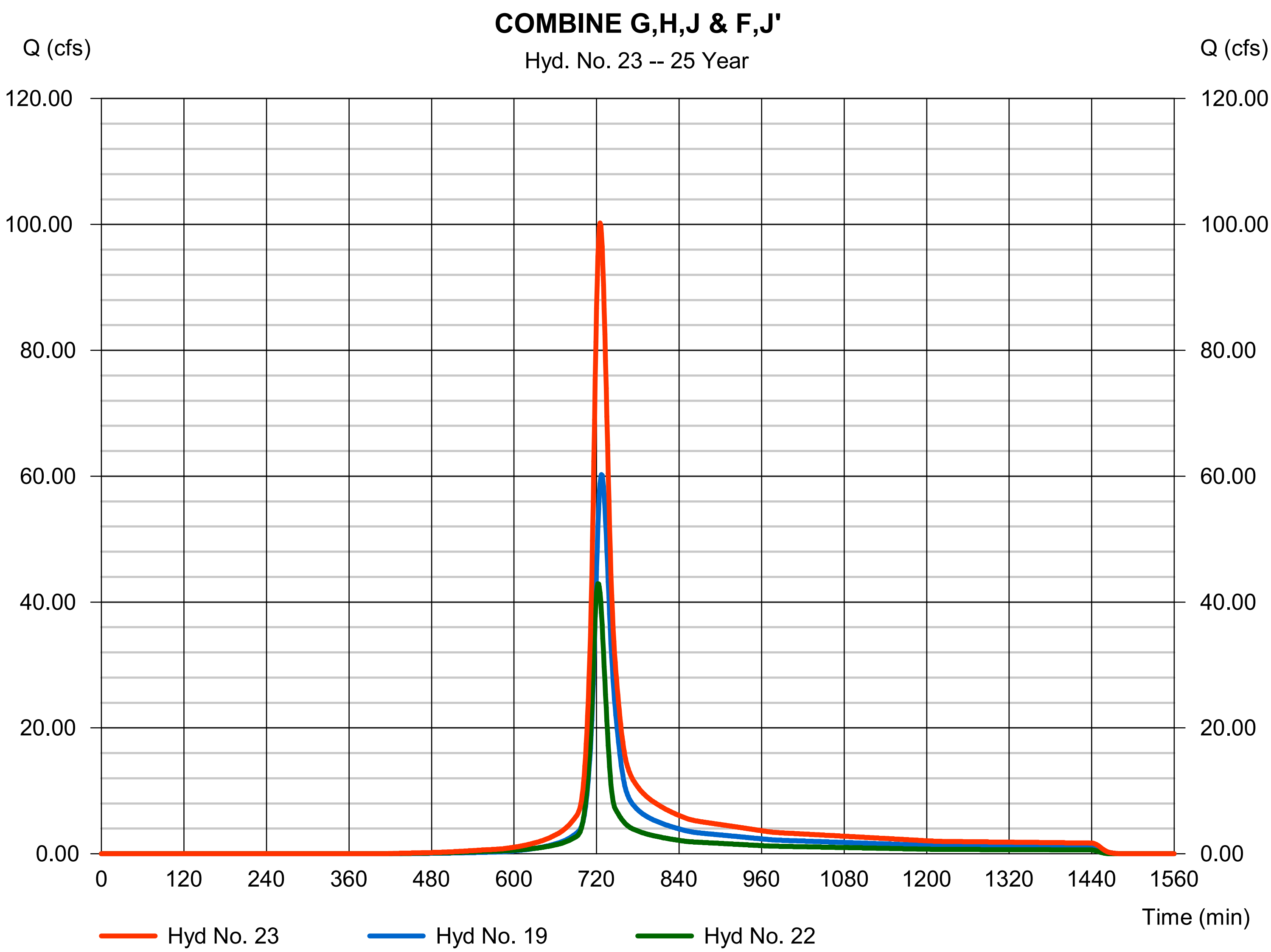
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 23

COMBINE G,H,J & F,J'

Hydrograph type	= Combine	Peak discharge	= 100.23 cfs
Storm frequency	= 25 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 346,800 cuft
Inflow hyds.	= 19, 22	Contrib. drain. area	= 0.000 ac



Hydrograph Report

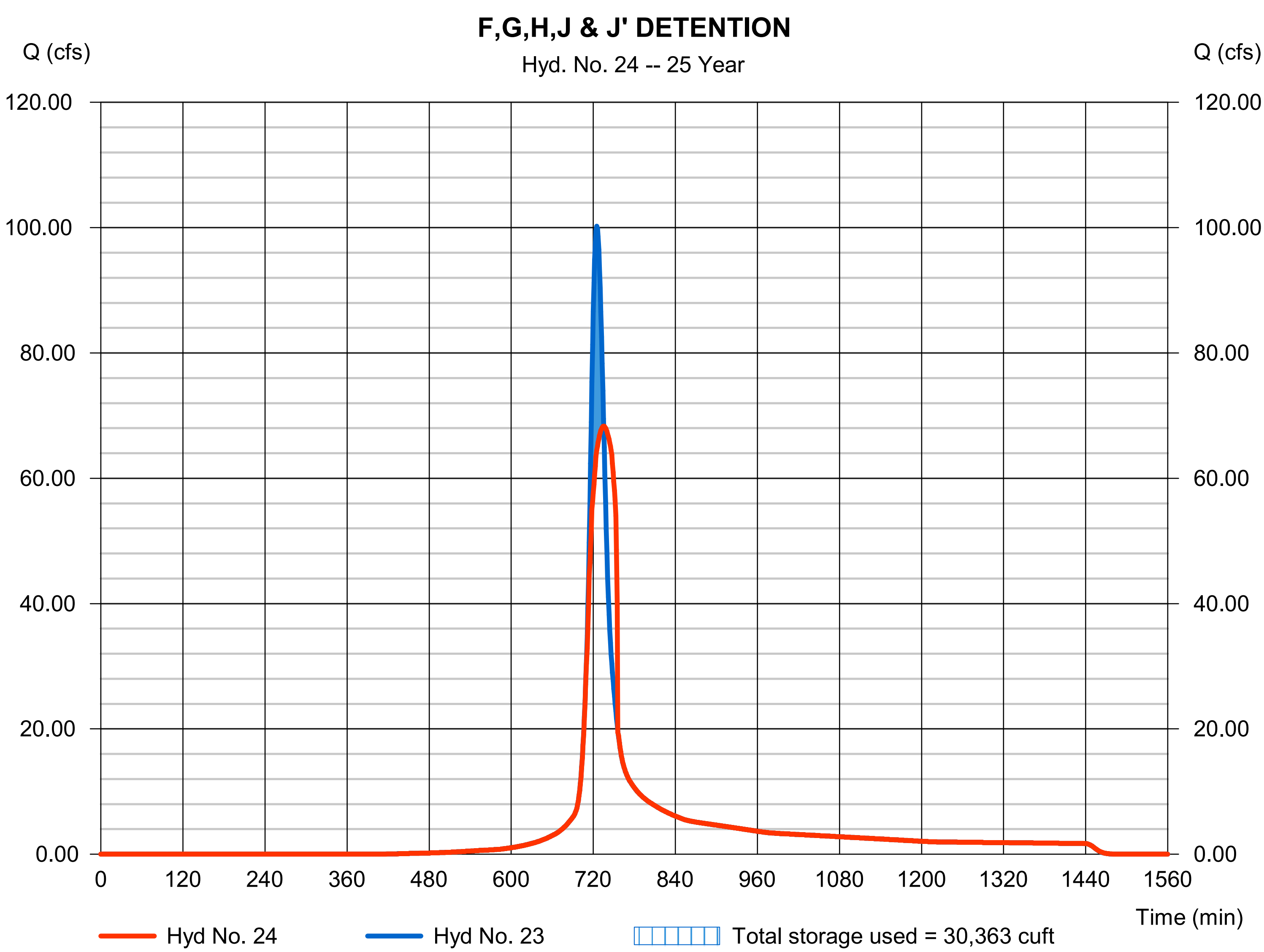
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 24

F,G,H,J & J' DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 68.32 cfs
Storm frequency	= 25 yrs	Time to peak	= 735 min
Time interval	= 1 min	Hyd. volume	= 346,800 cuft
Inflow hyd. No.	= 23 - COMBINE G,H,J & F,J'	Max. Elevation	= 580.54 ft
Reservoir name	= F,G,H,J & J' DETENTION	Max. Storage	= 30,363 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Pond No. 2 - F,G,H,J & J' DETENTION

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	575.00	n/a	0	0
1.00	576.00	n/a	66	66
2.00	577.00	n/a	197	263
3.00	578.00	n/a	805	1,068
4.00	579.00	n/a	3,266	4,334
5.00	580.00	n/a	11,856	16,190
6.00	581.00	n/a	26,087	42,277
7.00	582.00	n/a	34,733	77,010
8.00	583.00	n/a	53,090	130,100
9.00	584.00	n/a	63,299	193,399

Culvert / Orifice Structures

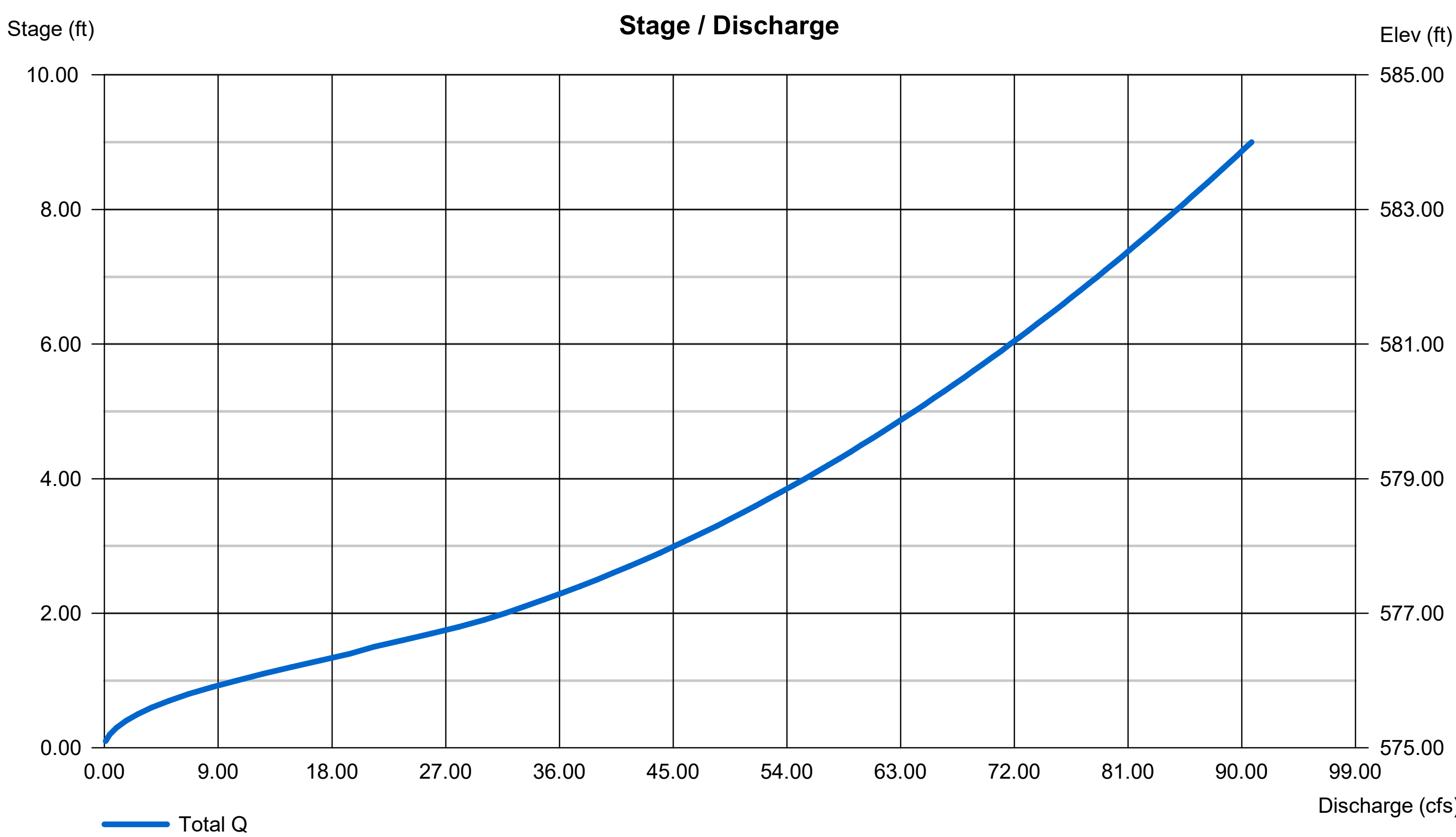
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	18.00	18.00	Inactive
Span (in)	= 24.00	18.00	18.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 575.02	575.55	575.00	0.00
Length (ft)	= 77.00	55.00	60.00	0.00
Slope (%)	= 1.10	1.50	1.00	n/a
N-Value	= .012	.012	.012	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

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

Exfil.(in/hr) = 0.000 (by Wet area)
TW Elev. (ft) = 0.00

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



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	SCS Runoff	11.34	1	725	35,424	------	------	------	AREA A - POST DEV
2	Reach	10.92	1	728	35,423	1	------	------	DITCH 1
3	SCS Runoff	25.11	1	727	85,777	------	------	------	AREA B - POST DEV
4	Combine	35.98	1	727	121,199	2, 3	------	------	COMBINE A & B
5	Reach	35.52	1	730	121,198	4	------	------	DITCH 2
6	SCS Runoff	17.70	1	742	98,530	------	------	------	AREA E - POST DEV
7	SCS Runoff	51.98	1	724	155,053	------	------	------	AREA D - POST DEV
8	SCS Runoff	48.71	1	727	166,351	------	------	------	AREA C - POST DEV
9	Combine	98.78	1	725	321,404	7, 8	------	------	COMBINE C & D
10	Reservoir	15.92	1	754	321,404	9	582.43	120,632	C & D DETENTION
11	Combine	48.96	1	731	219,728	5, 6,	------	------	COMBINE A,B,C & E
12	Combine	63.90	1	731	541,132	10, 11	------	------	COMBINE A,B, C, D & E
13	Reservoir	29.99	1	771	398,091	12	582.30	166,350	DETENTION A,B,C,D & E
14	SCS Runoff	30.87	1	729	115,543	------	------	------	AREA H - POST DEV
15	SCS Runoff	30.71	1	723	88,238	------	------	------	AREA G - POST DEV
16	SCS Runoff	18.95	1	724	56,382	------	------	------	AREA J - POST DEV
17	Combine	57.94	1	725	203,781	14, 15,	------	------	COMBINE H & G
18	Reach	55.69	1	729	203,779	17	------	------	HWY 20 SIDE DITCH
19	Combine	73.03	1	727	260,161	16, 18	------	------	COMBINE H,G, & J
20	SCS Runoff	47.07	1	724	140,395	------	------	------	AREA F - POST DEV
21	SCS Runoff	7.386	1	718	14,838	------	------	------	AREA J' - POST DEV
22	Combine	50.81	1	722	155,232	20, 21	------	------	Combine F & J'
23	Combine	120.30	1	725	415,394	19, 22	------	------	COMBINE G,H,J & F,J'
24	Reservoir	72.98	1	737	415,393	23	581.18	48,556	F,G,H,J & J' DETENTION
25	SCS Runoff	5.594	1	725	17,810	------	------	------	AREA K' - POST DEV
26	Reach	4.429	1	732	17,805	25	------	------	K' Tc DITCH
27	SCS Runoff	2.532	1	726	8,093	------	------	------	AREA K'' - POST DEV
28	Reach	1.732	1	735	8,085	27	------	------	K'' Tc DITCH
29	Combine	6.145	1	733	25,890	26, 28	------	------	COMBINE K' & K''
30	SCS Runoff	23.63	1	726	75,538	------	------	------	AREA K - POST DEV
31	Combine	28.70	1	726	101,428	29, 30	------	------	COMBINE K, K' & K''
32	Reservoir	7.119	1	753	101,294	31	582.59	33,217	AREA K DETENTION
33	Combine	79.82	1	738	516,685	24, 32	------	------	COMBINE F,G,H,J & K
34	SCS Runoff	5.133	1	721	12,509	------	------	------	AREA L - POST DEV

AP3_POSTDEV_SOLAR.gpw	Return Period: 50 Year	Thursday, 11 / 15 / 2018

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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
35	Combine	80.71	1	737	529,193	33, 34	------	------	COMBINE FG,H,J,K & L
36	Combine	93.91	1	756	927,283	13, 35	------	------	TOTAL SITE DISCHARGE - POST D

Hydrograph Report

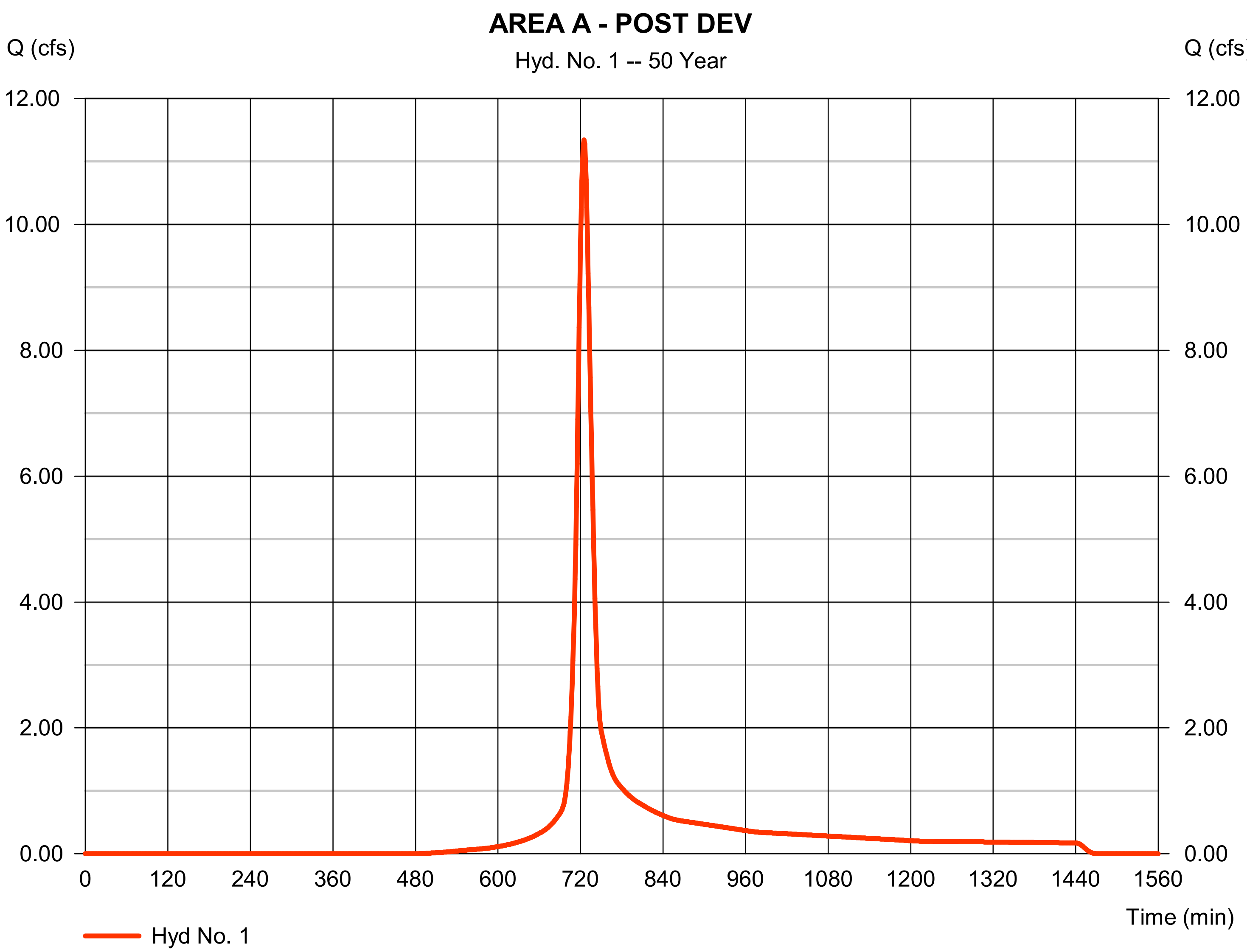
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 1

AREA A - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 11.34 cfs
Storm frequency	= 50 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 35,424 cuft
Drainage area	= 2.580 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.10 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.220 x 85) + (0.570 x 55) + (0.030 x 98) + (0.760 x 60)] / 2.580



Hydrograph Report

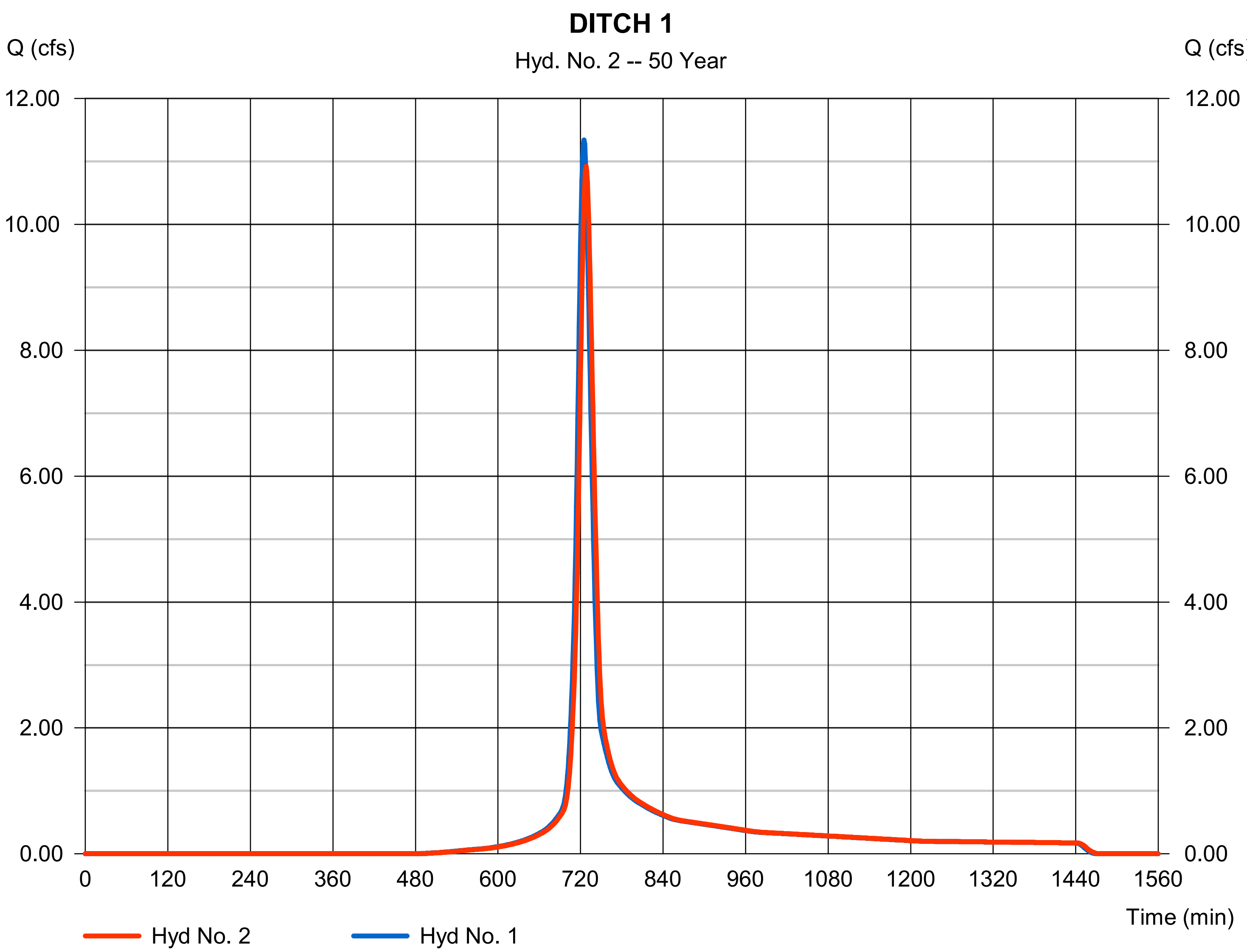
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 2

DITCH 1

Hydrograph type	= Reach	Peak discharge	= 10.92 cfs
Storm frequency	= 50 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 35,423 cuft
Inflow hyd. No.	= 1 - AREA A - POST DEV	Section type	= Trapezoidal
Reach length	= 730.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 10.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.375
Ave. velocity	= 3.34 ft/s	Routing coeff.	= 0.3172

Modified Att-Kin routing method used.



Hydrograph Report

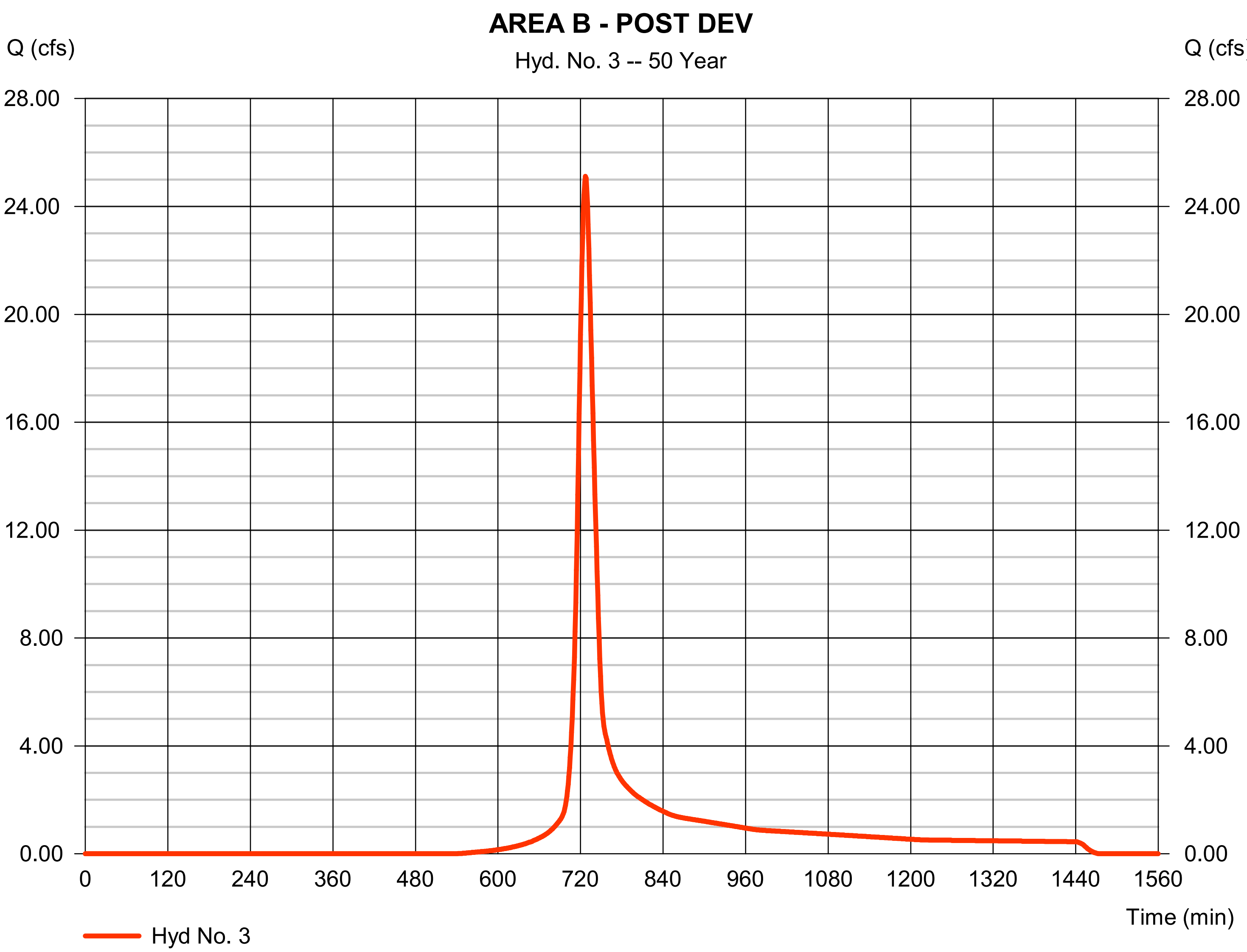
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 3

AREA B - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 25.11 cfs
Storm frequency	= 50 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 85,777 cuft
Drainage area	= 7.090 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.60 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.930 x 85) + (2.120 x 55) + (0.250 x 98) + (2.790 x 60)] / 7.090



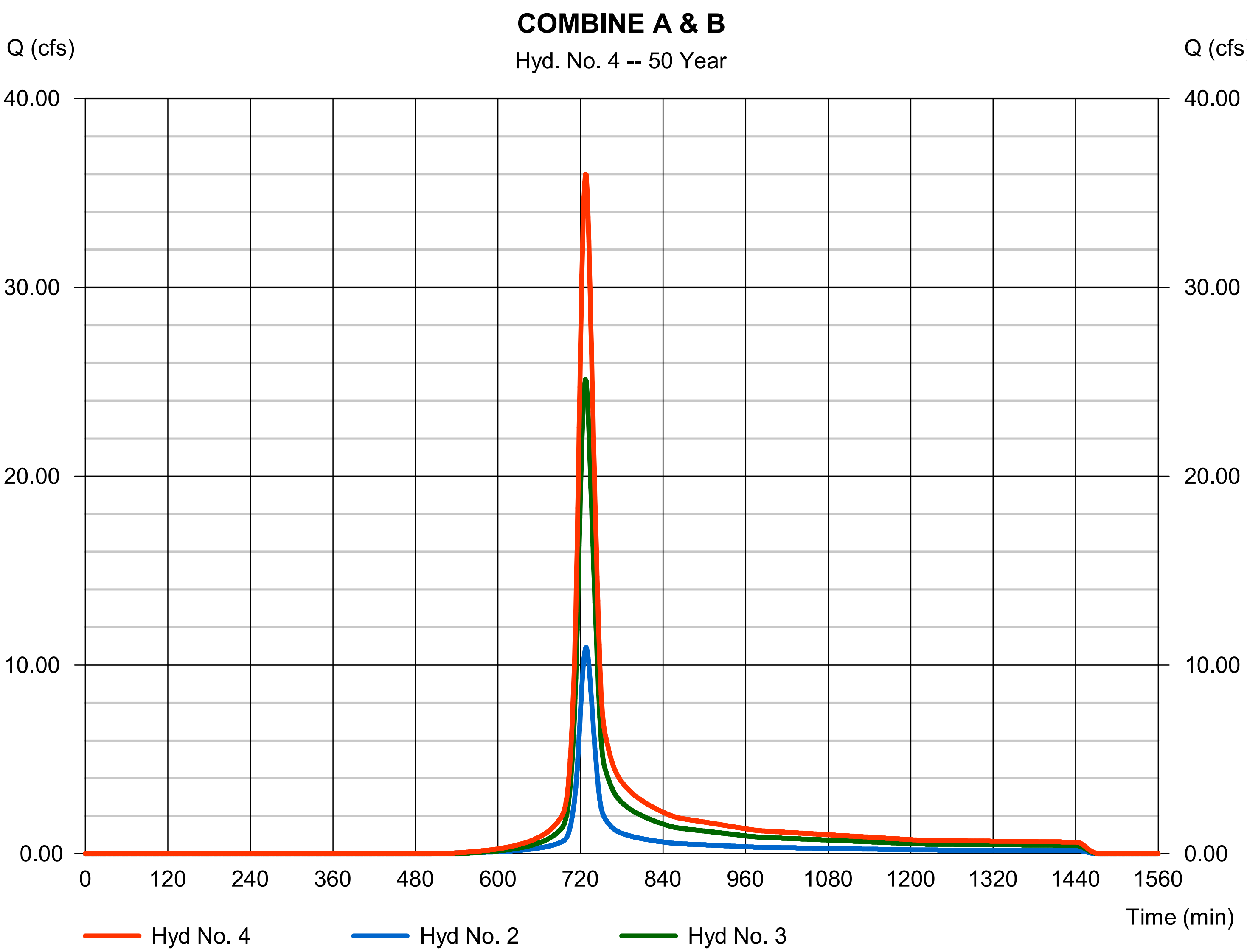
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 4

COMBINE A & B

Hydrograph type	= Combine	Peak discharge	= 35.98 cfs
Storm frequency	= 50 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 121,199 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 7.090 ac



Hydrograph Report

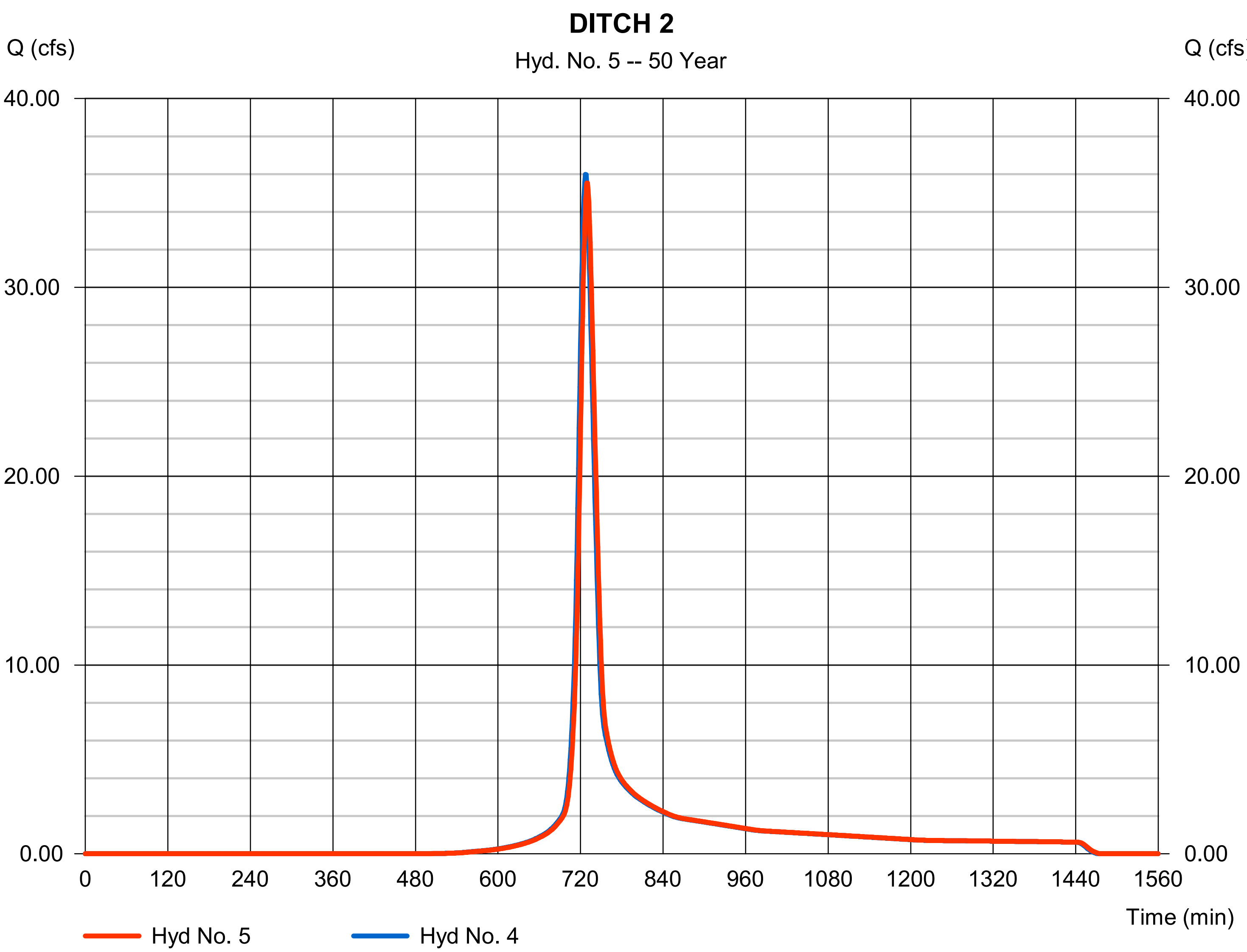
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 5

DITCH 2

Hydrograph type	= Reach	Peak discharge	= 35.52 cfs
Storm frequency	= 50 yrs	Time to peak	= 730 min
Time interval	= 1 min	Hyd. volume	= 121,198 cuft
Inflow hyd. No.	= 4 - COMBINE A & B	Section type	= Trapezoidal
Reach length	= 610.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.373
Ave. velocity	= 4.55 ft/s	Routing coeff.	= 0.4704

Modified Att-Kin routing method used.



Hydrograph Report

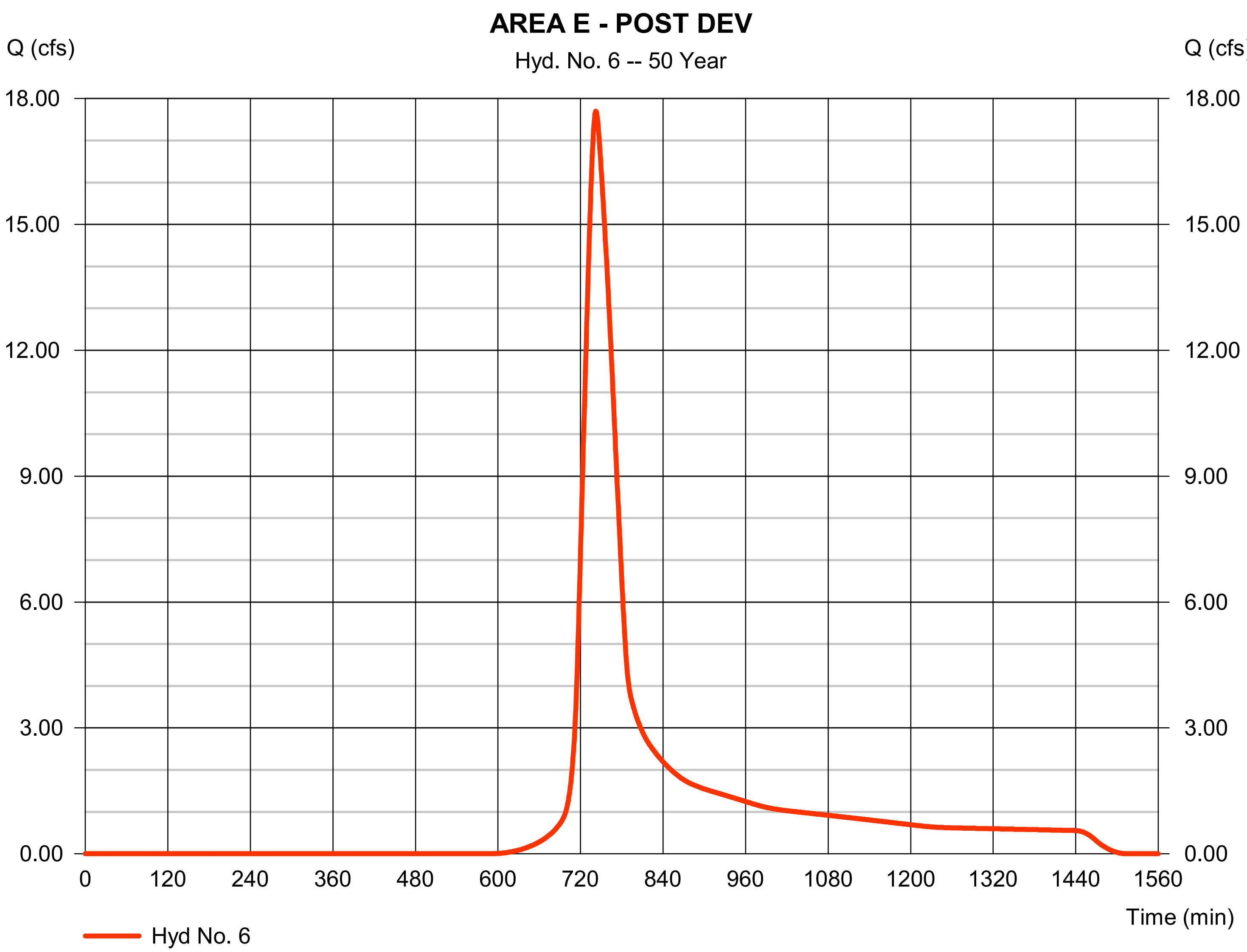
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 6

AREA E - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 17.70 cfs
Storm frequency	= 50 yrs	Time to peak	= 742 min
Time interval	= 1 min	Hyd. volume	= 98,530 cuft
Drainage area	= 9.150 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 47.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.680 x 65) + (0.330 x 98) + (5.140 x 60)] / 9.150



Hydrograph Report

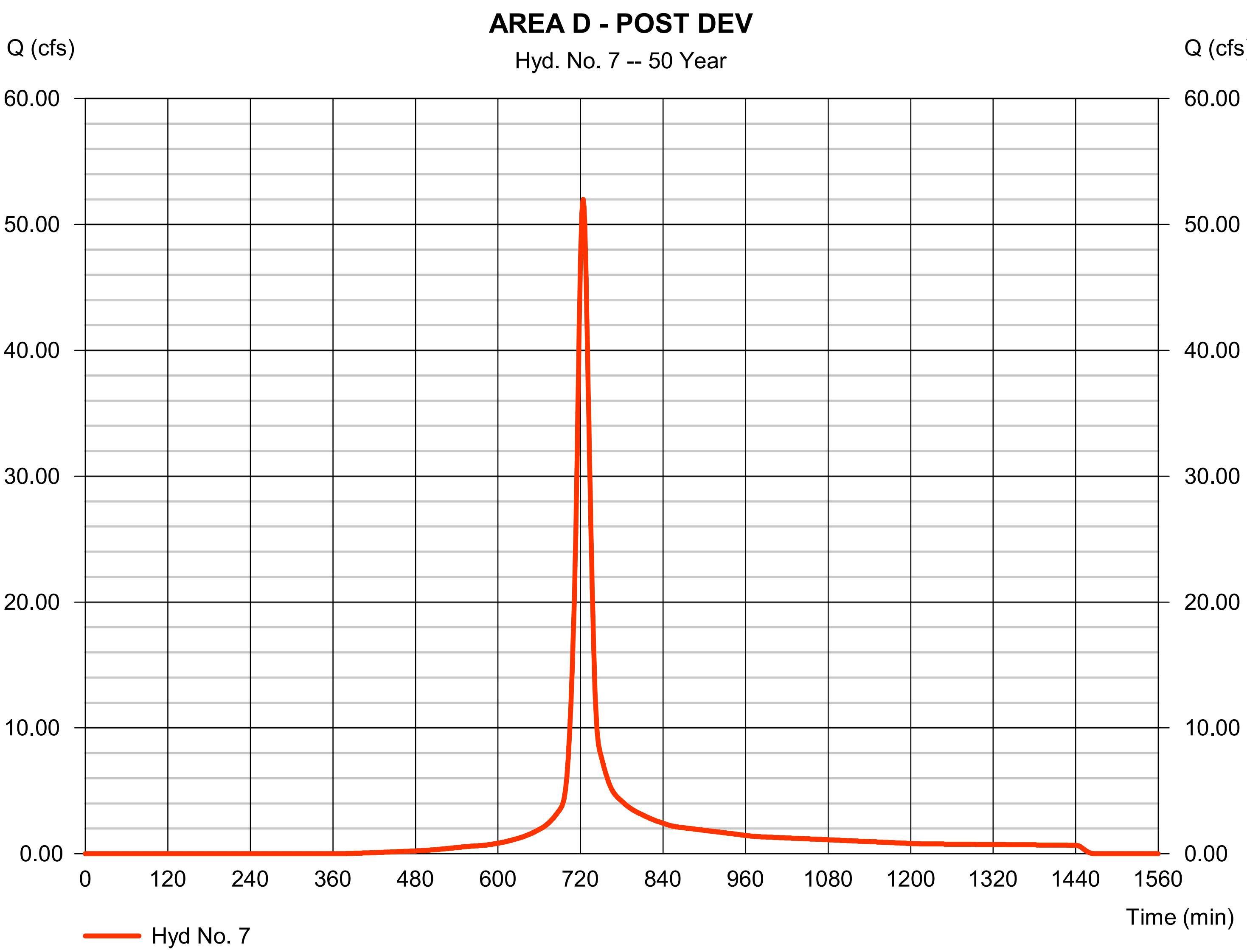
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 11 / 15 / 2018

Hyd. No. 7

AREA D - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 51.98 cfs
Storm frequency	= 50 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 155,053 cuft
Drainage area	= 9.520 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.10 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.910 x 85) + (8.290 x 77) + (0.320 x 98)] / 9.520



Hydrograph Report

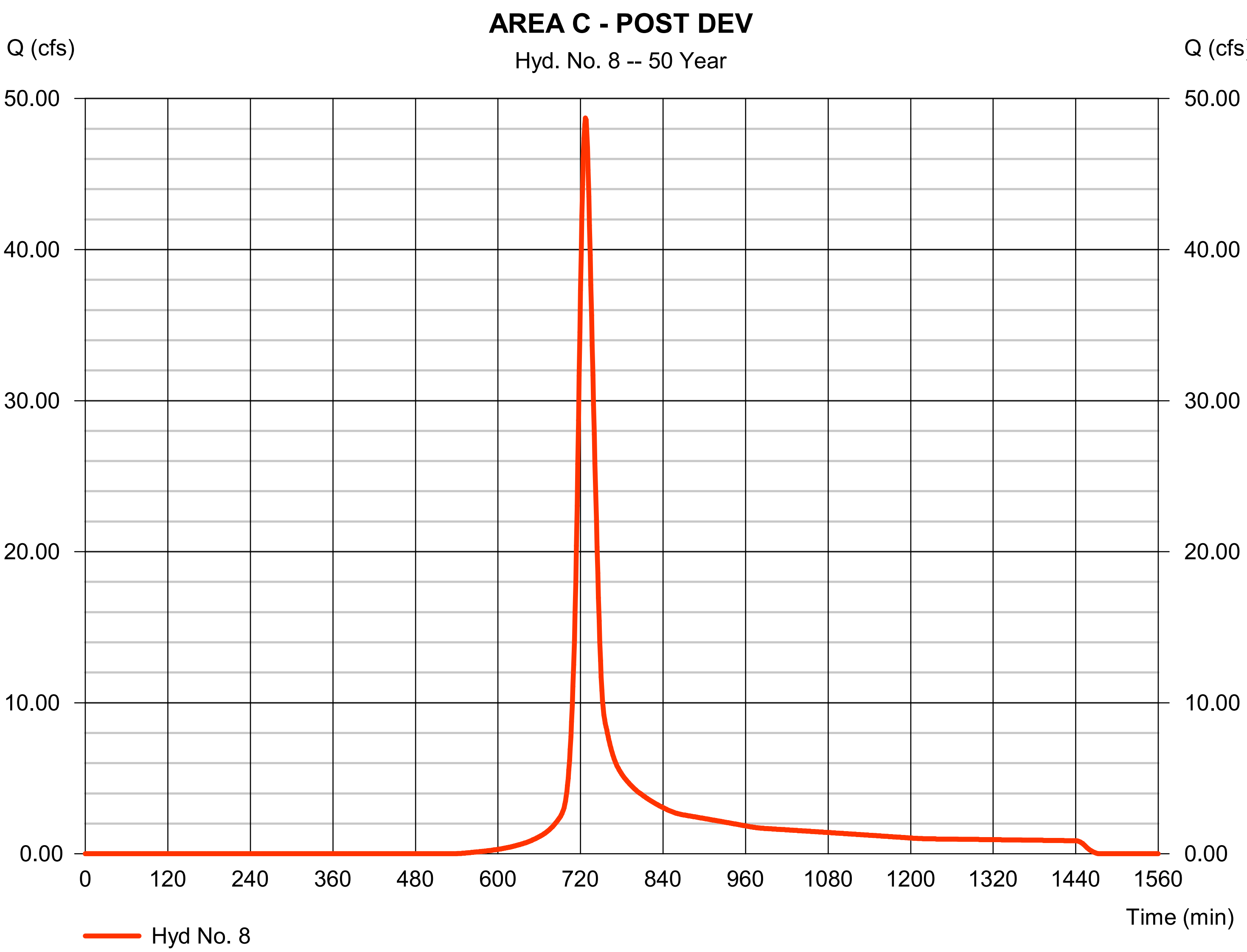
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 8

AREA C - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 48.71 cfs
Storm frequency	= 50 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 166,351 cuft
Drainage area	= 13.750 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.460 x 85) + (0.400 x 55) + (1.740 x 98) + (10.150 x 60)] / 13.750



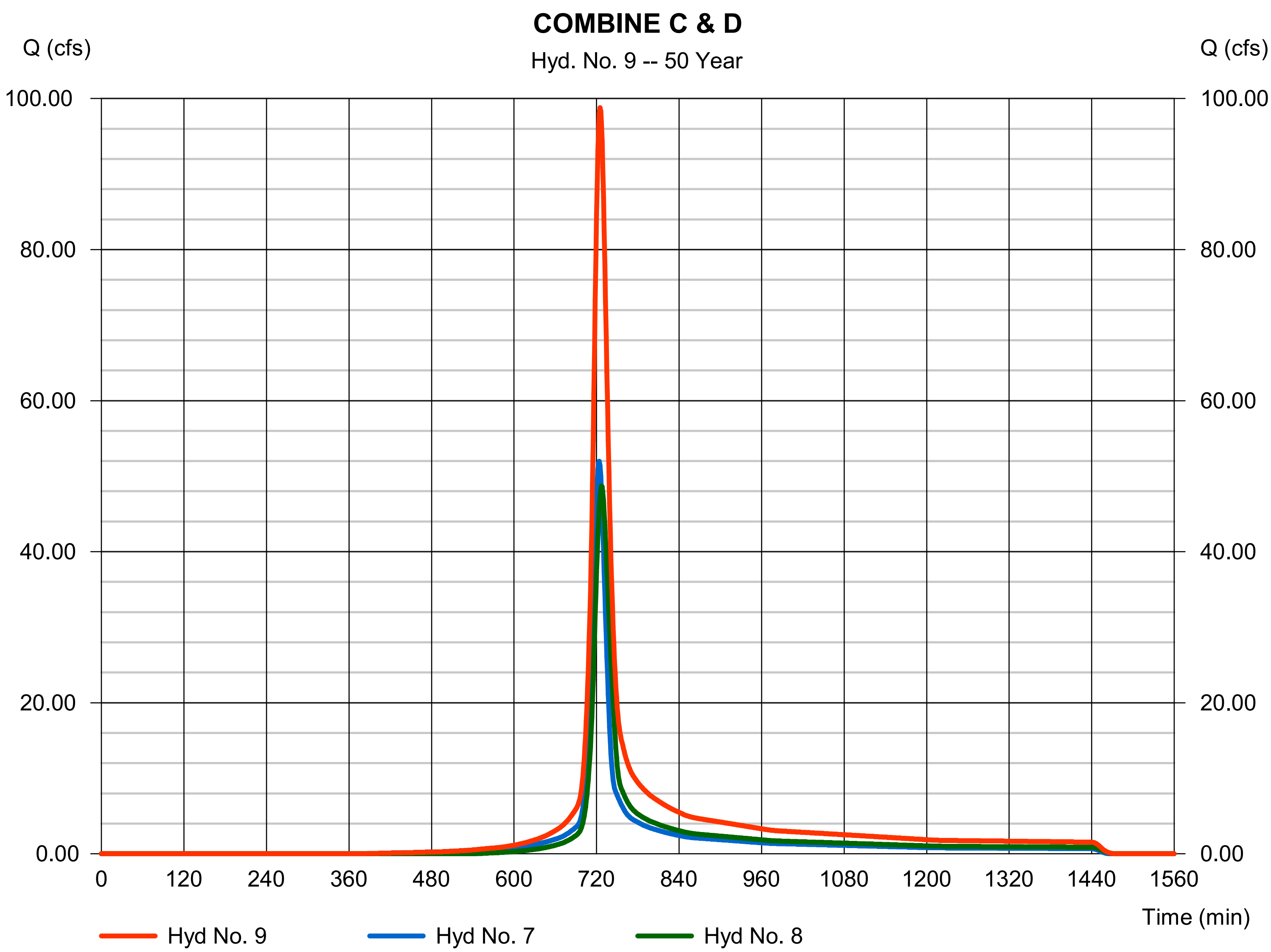
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 9

COMBINE C & D

Hydrograph type	= Combine	Peak discharge	= 98.78 cfs
Storm frequency	= 50 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 321,404 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 23.270 ac



Hydrograph Report

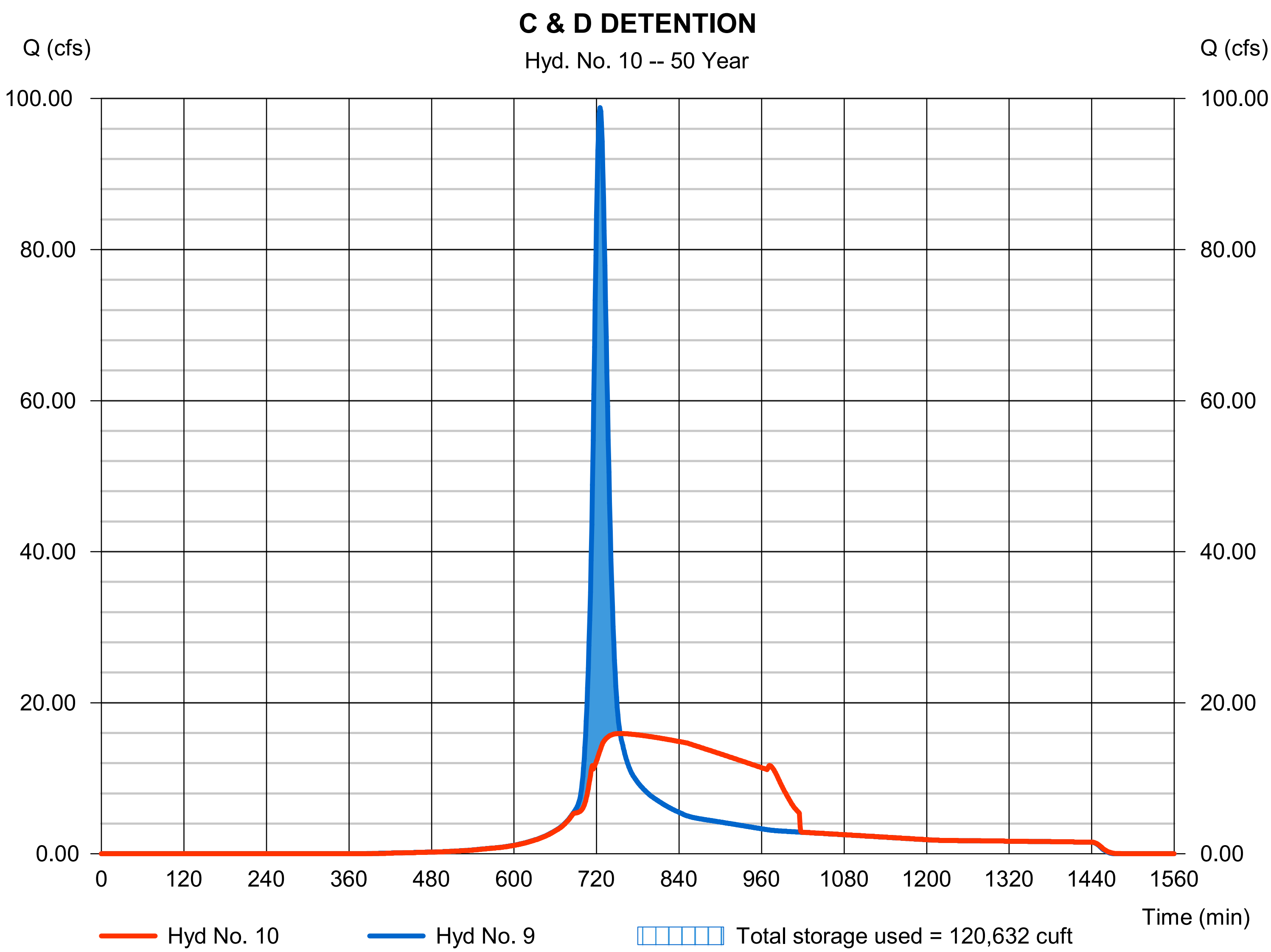
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 10

C & D DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 15.92 cfs
Storm frequency	= 50 yrs	Time to peak	= 754 min
Time interval	= 1 min	Hyd. volume	= 321,404 cuft
Inflow hyd. No.	= 9 - COMBINE C & D	Max. Elevation	= 582.43 ft
Reservoir name	= C&D DETENTION	Max. Storage	= 120,632 cuft

Storage Indication method used.



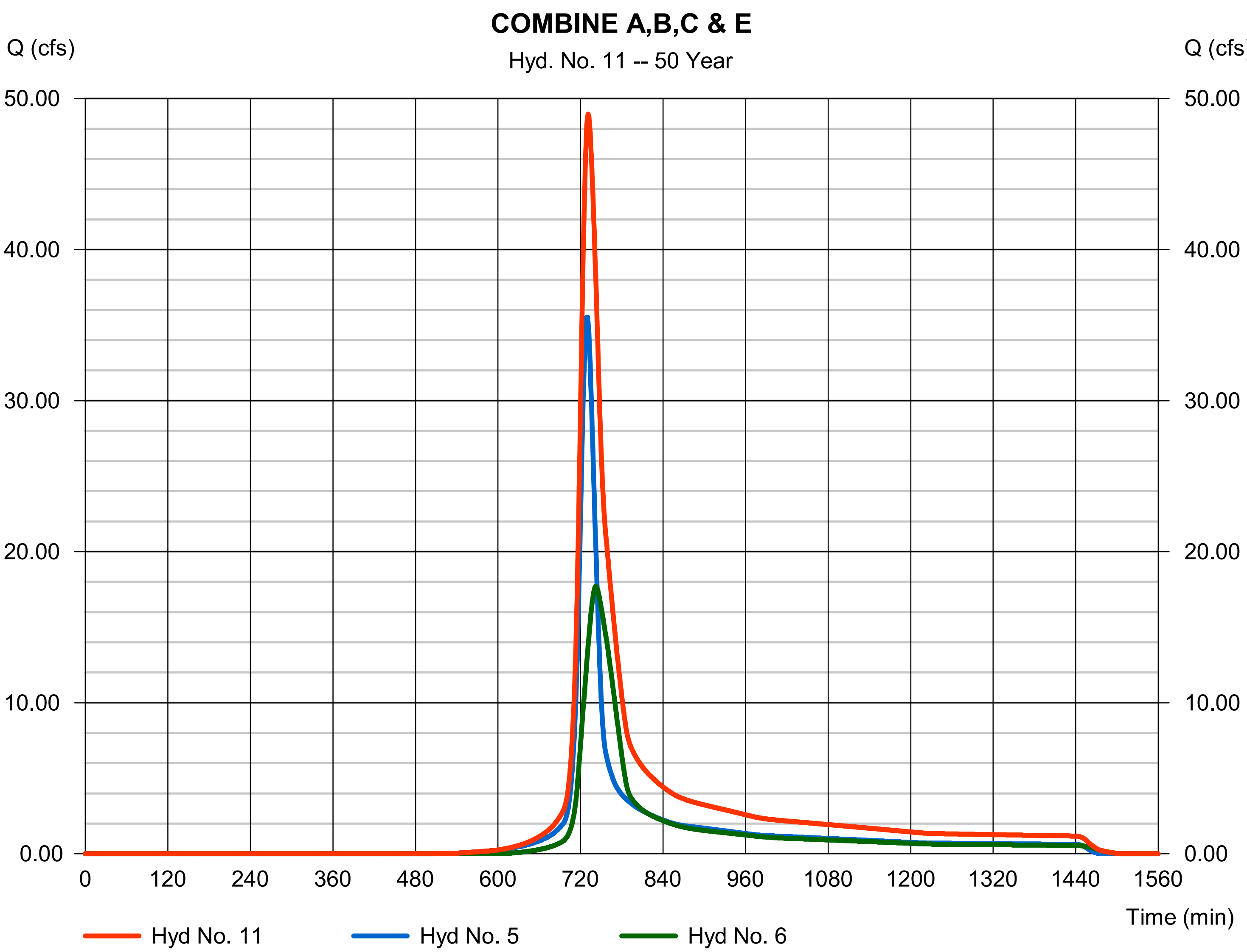
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 11

COMBINE A,B,C & E

Hydrograph type	= Combine	Peak discharge	= 48.96 cfs
Storm frequency	= 50 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 219,728 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 9.150 ac



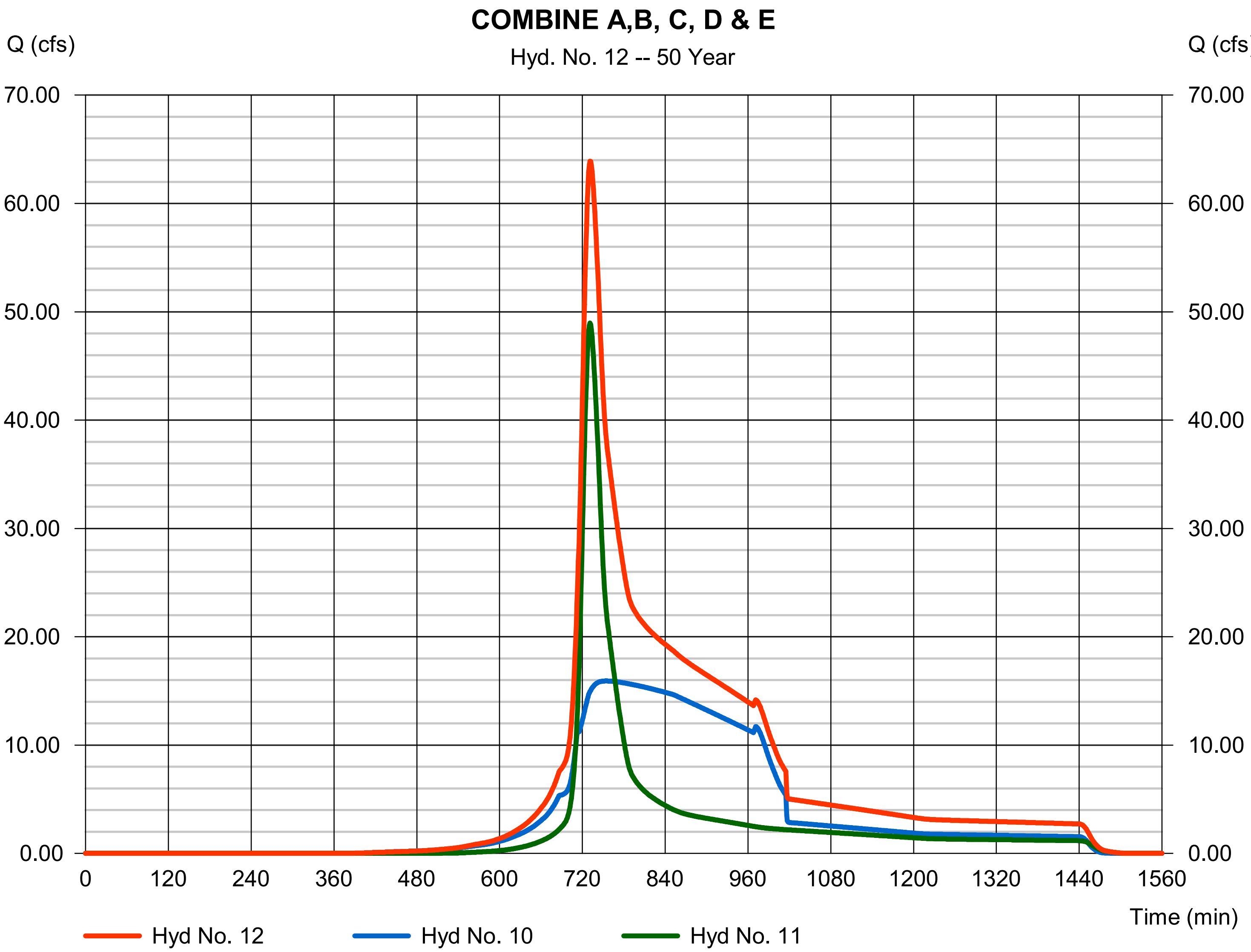
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 12

COMBINE A,B, C, D & E

Hydrograph type	= Combine	Peak discharge	= 63.90 cfs
Storm frequency	= 50 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 541,132 cuft
Inflow hyds.	= 10, 11	Contrib. drain. area	= 0.000 ac



Hydrograph Report

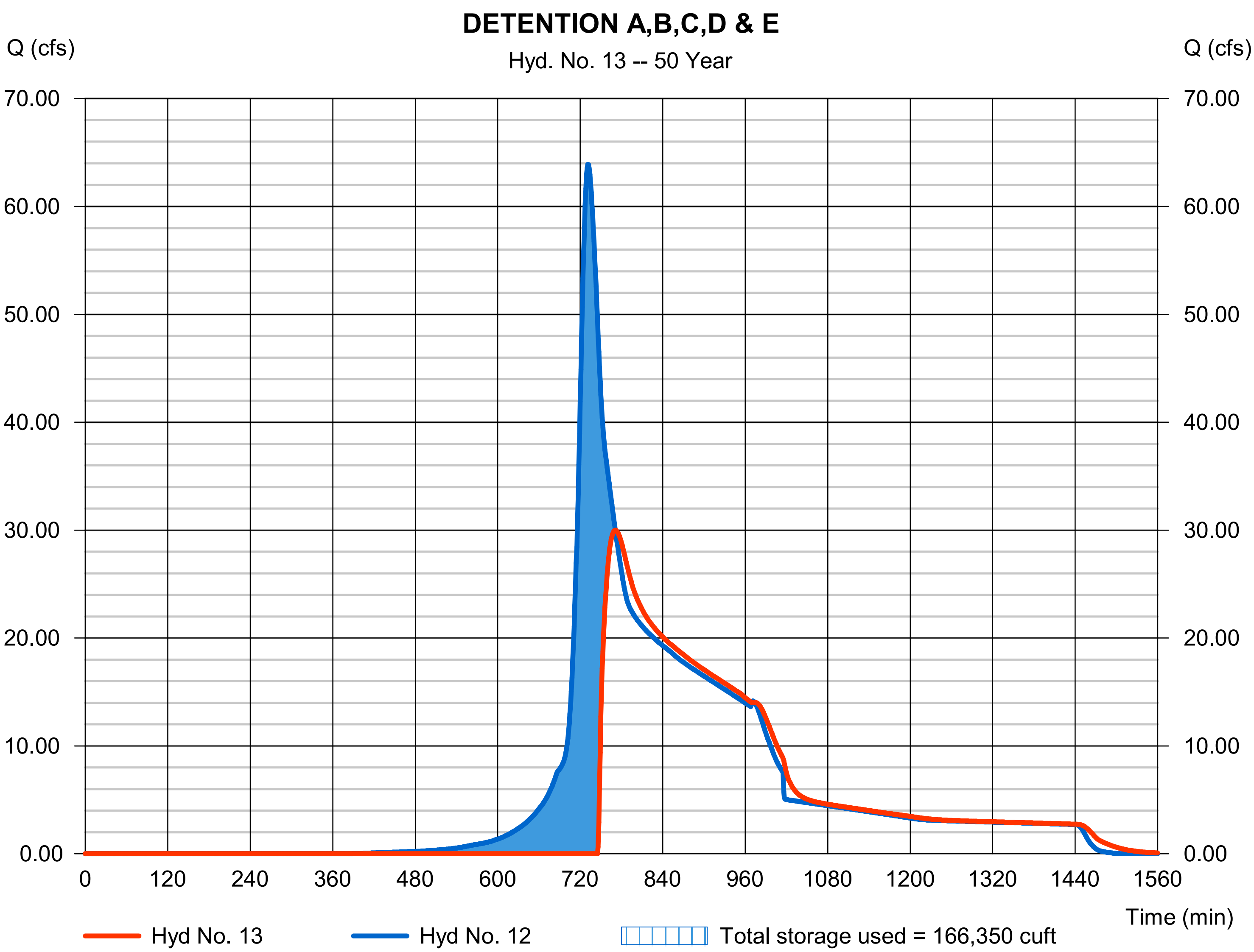
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 13

DETENTION A,B,C,D & E

Hydrograph type	= Reservoir	Peak discharge	= 29.99 cfs
Storm frequency	= 50 yrs	Time to peak	= 771 min
Time interval	= 1 min	Hyd. volume	= 398,091 cuft
Inflow hyd. No.	= 12 - COMBINE A,B, C, D & E	Max. Elevation	= 582.30 ft
Reservoir name	= A,B,C,D & E DETENTION	Max. Storage	= 166,350 cuft

Storage Indication method used.



Hydrograph Report

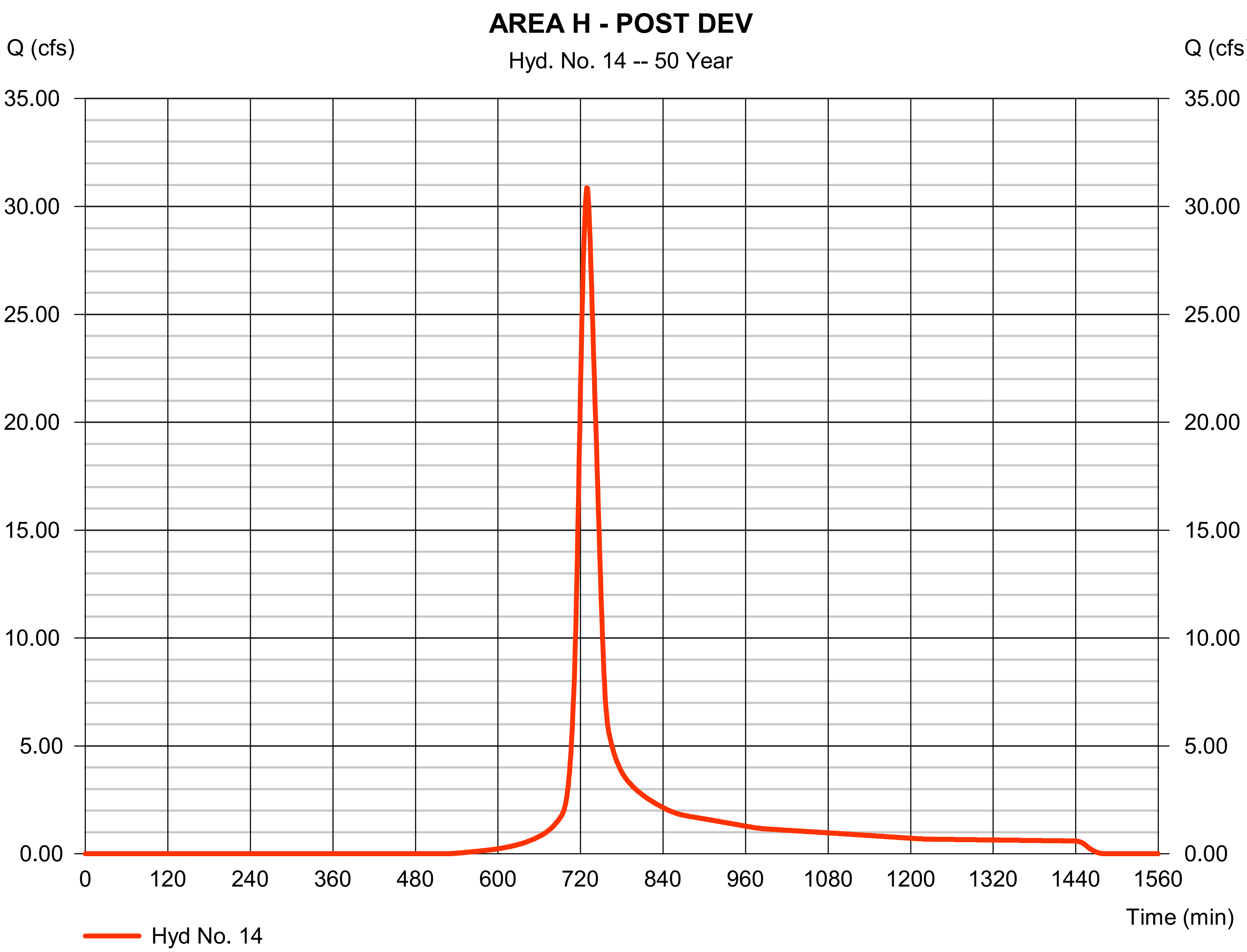
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 14

AREA H - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 30.87 cfs
Storm frequency	= 50 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 115,543 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.50 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



Hydrograph Report

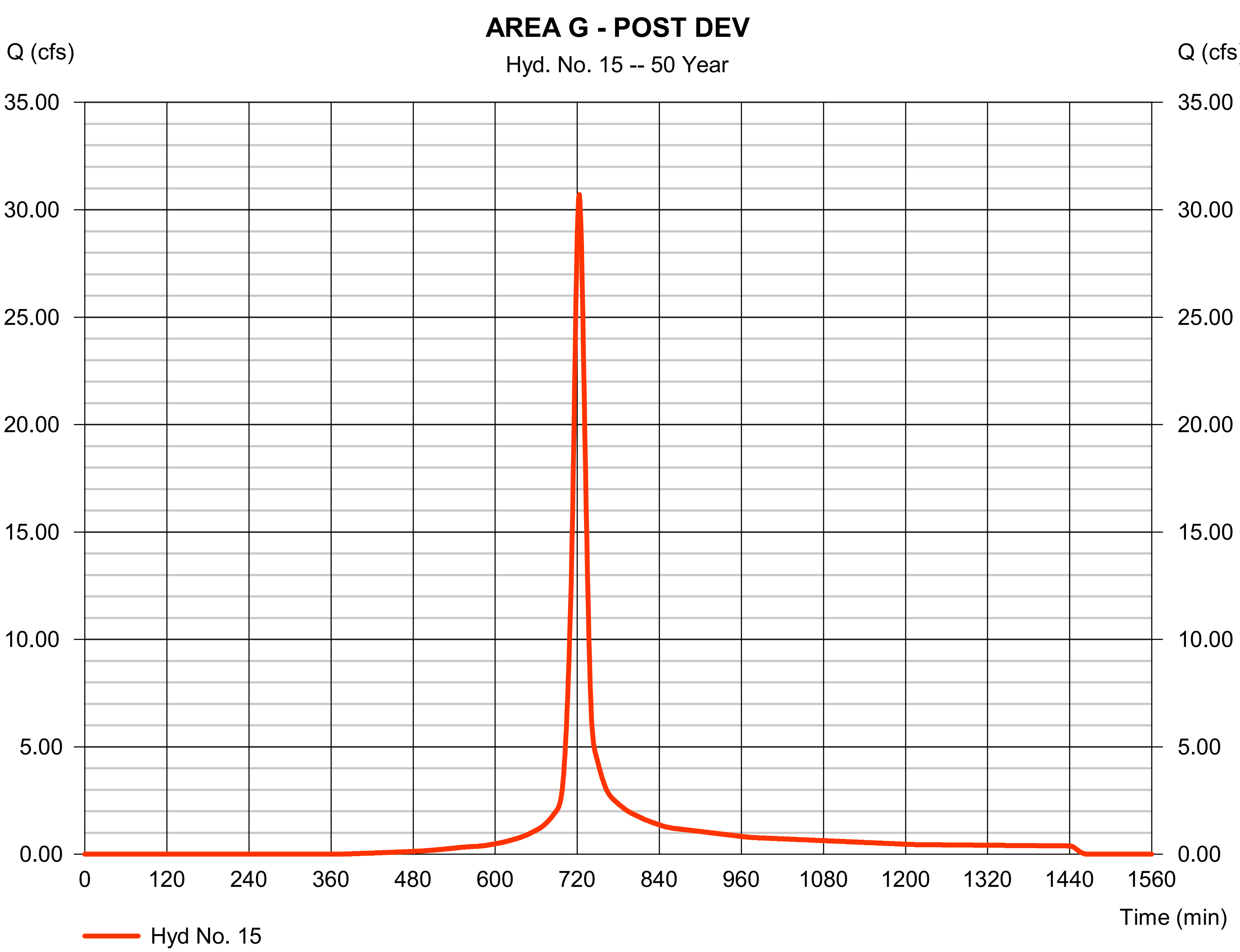
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 15

AREA G - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 30.71 cfs
Storm frequency	= 50 yrs	Time to peak	= 723 min
Time interval	= 1 min	Hyd. volume	= 88,238 cuft
Drainage area	= 5.290 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.80 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.330 x 85) + (4.740 x 77) + (0.220 x 98)] / 5.290



Hydrograph Report

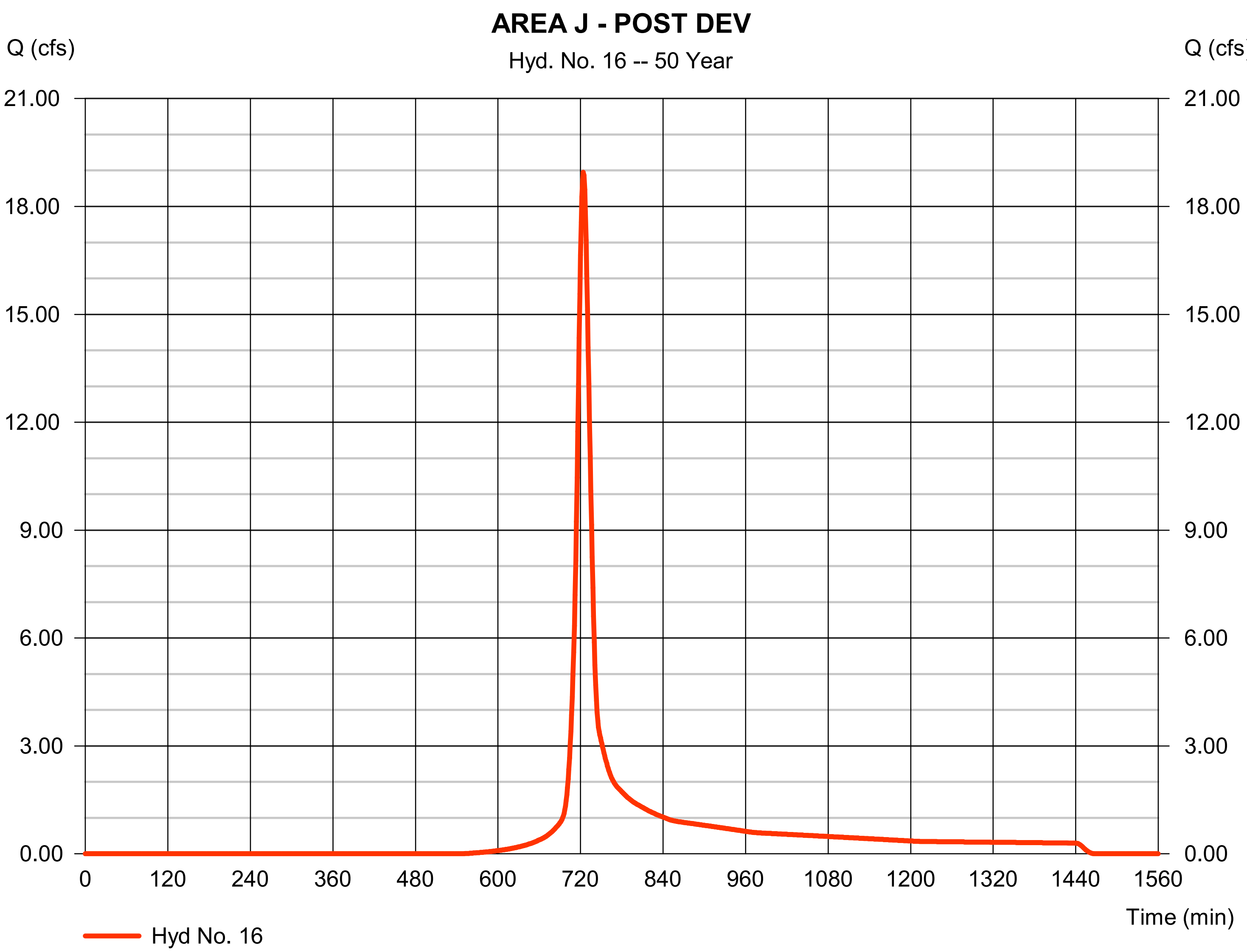
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 16

AREA J - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 18.95 cfs
Storm frequency	= 50 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 56,382 cuft
Drainage area	= 4.820 ac	Curve number	= 66*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 85) + (0.020 x 65) + (0.680 x 98) + (4.030 x 60)] / 4.820



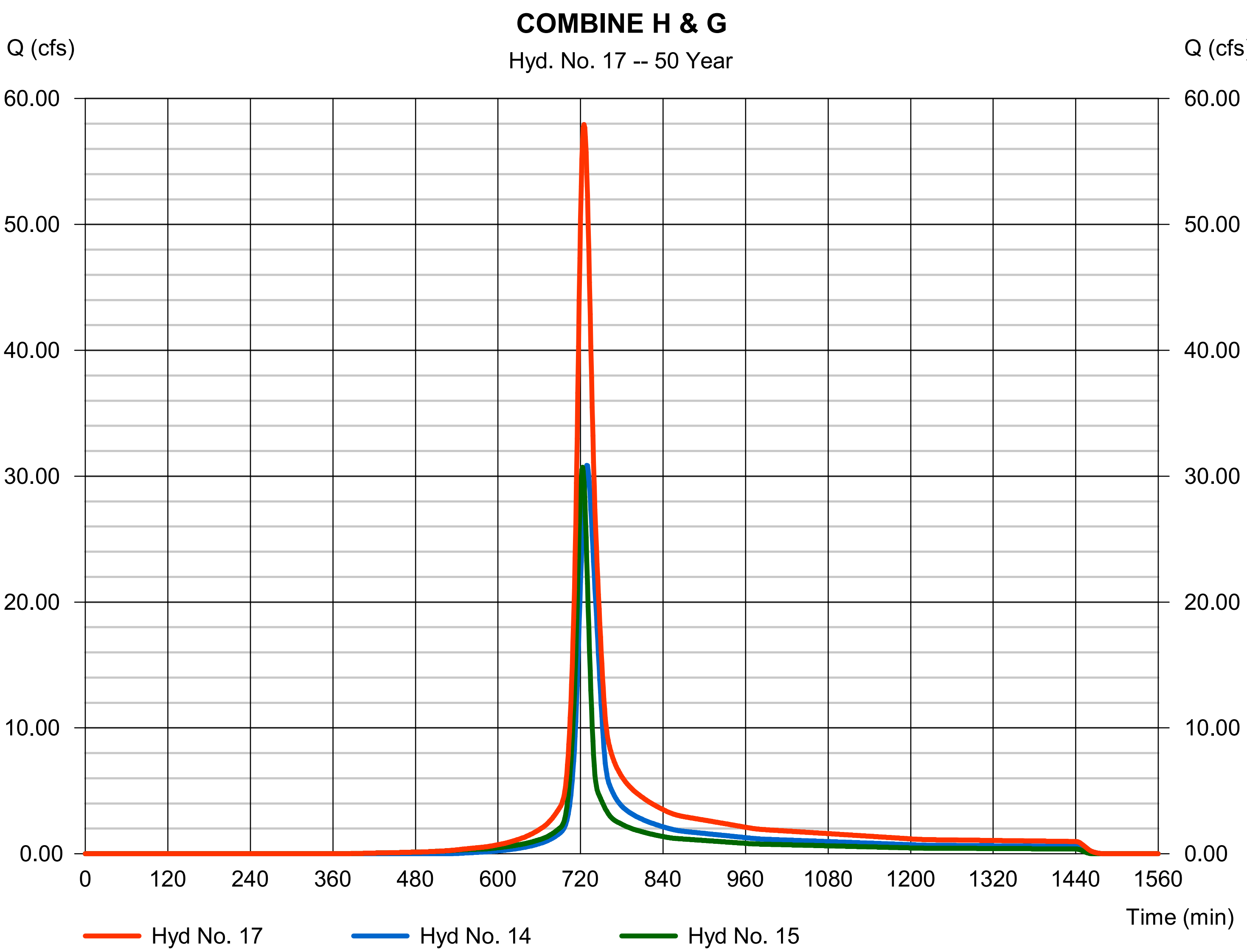
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 17

COMBINE H & G

Hydrograph type	= Combine	Peak discharge	= 57.94 cfs
Storm frequency	= 50 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 203,781 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 14.400 ac



Hydrograph Report

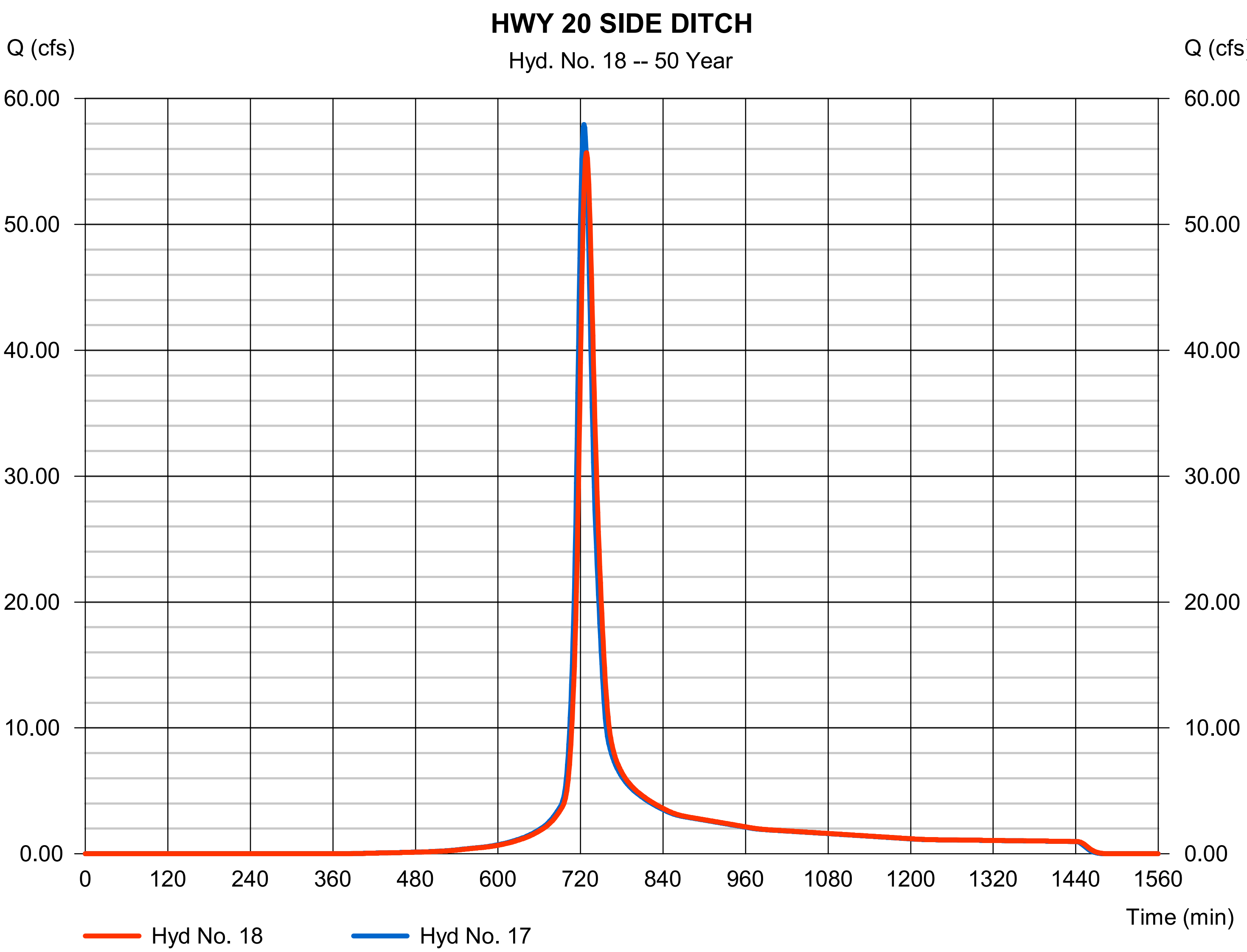
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 18

HWY 20 SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 55.69 cfs
Storm frequency	= 50 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 203,779 cuft
Inflow hyd. No.	= 17 - COMBINE H & G	Section type	= Trapezoidal
Reach length	= 900.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.030	Bottom width	= 3.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 1.688	Rating curve m	= 1.304
Ave. velocity	= 3.85 ft/s	Routing coeff.	= 0.2867

Modified Att-Kin routing method used.



Hydrograph Report

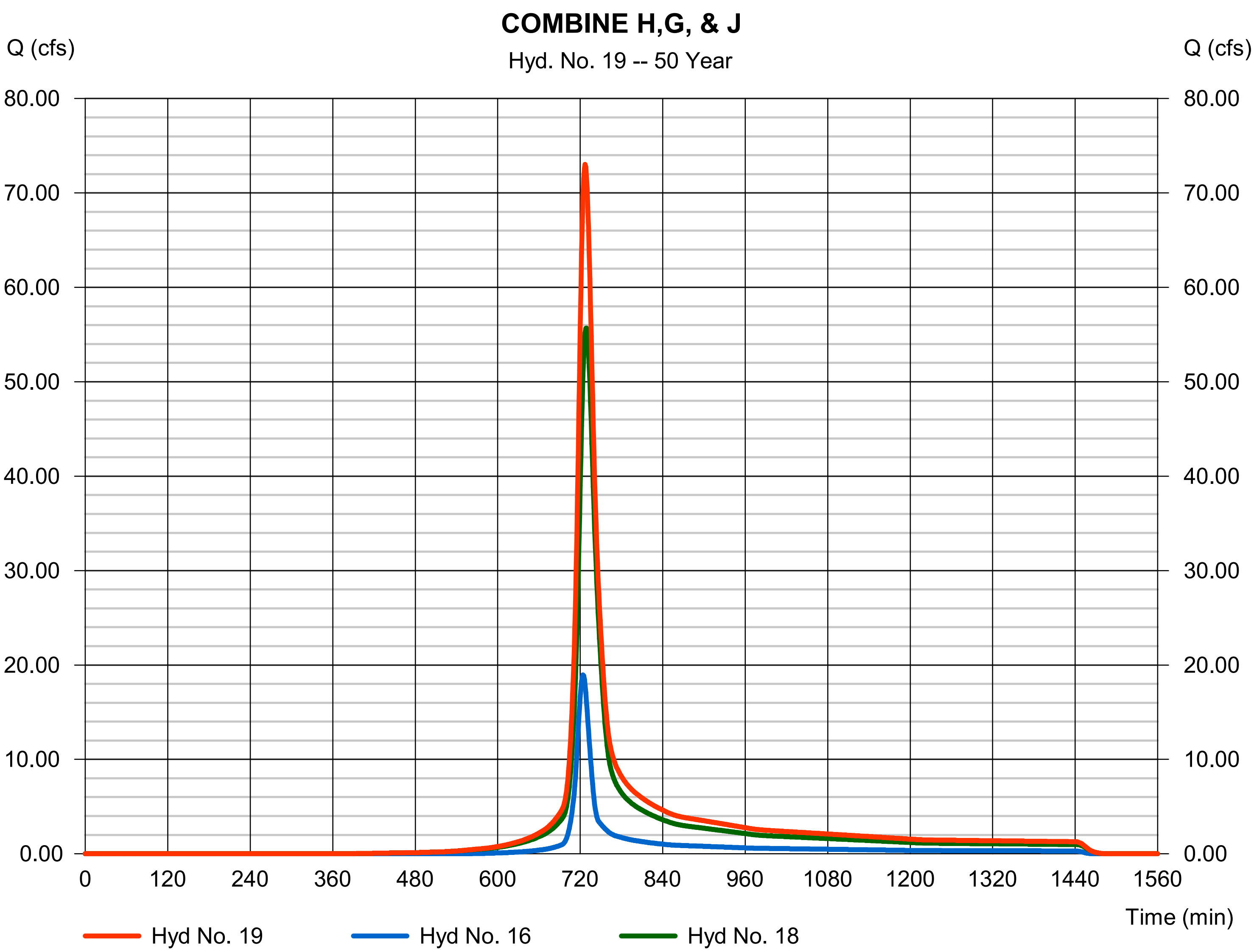
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Thursday, 11 / 15 / 2018

Hyd. No. 19

COMBINE H,G, & J

Hydrograph type	= Combine	Peak discharge	= 73.03 cfs
Storm frequency	= 50 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 260,161 cuft
Inflow hyds.	= 16, 18	Contrib. drain. area	= 4.820 ac



Hydrograph Report

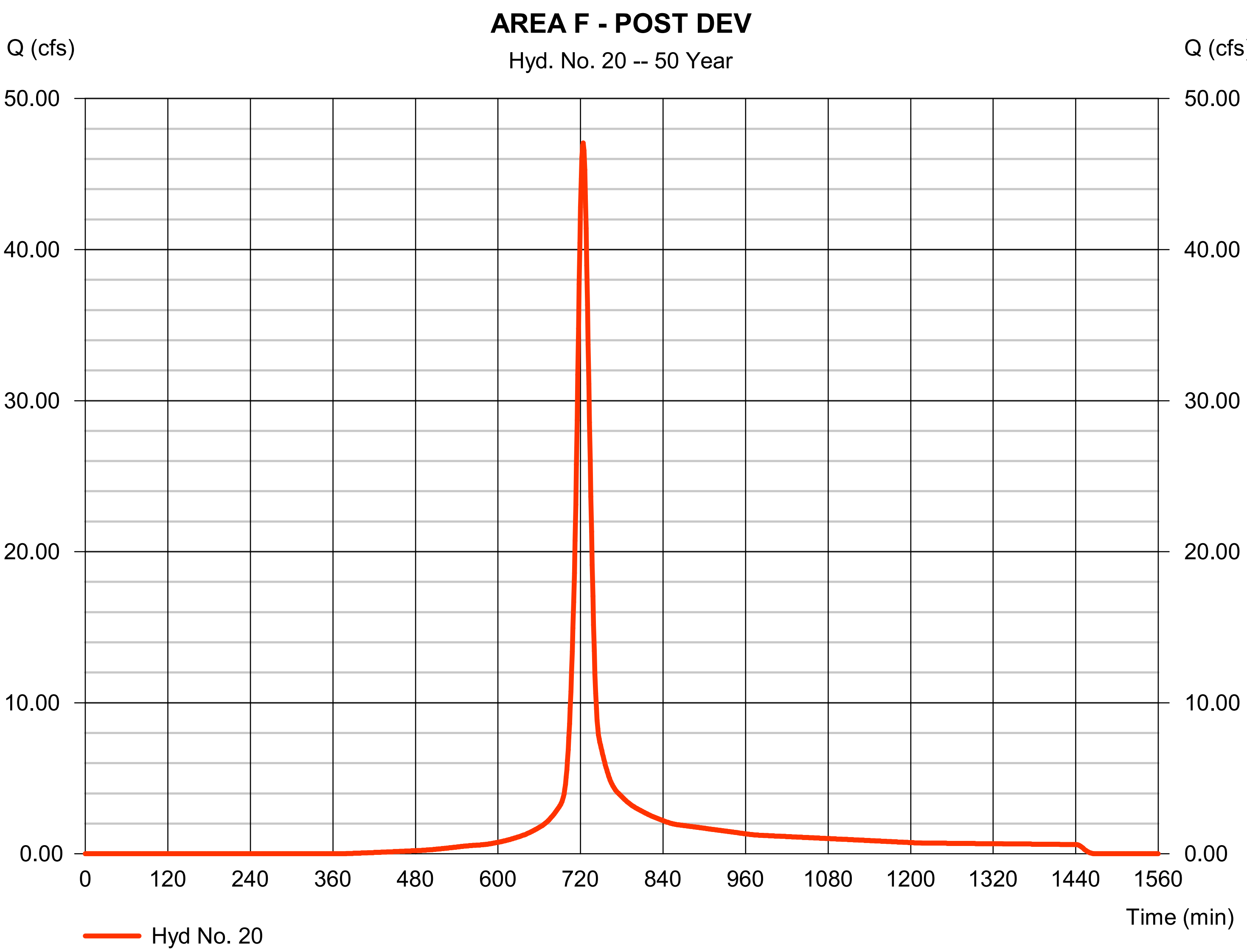
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 20

AREA F - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 47.07 cfs
Storm frequency	= 50 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 140,395 cuft
Drainage area	= 8.620 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.440 x 85) + (7.810 x 77) + (0.370 x 98)] / 8.620



Hydrograph Report

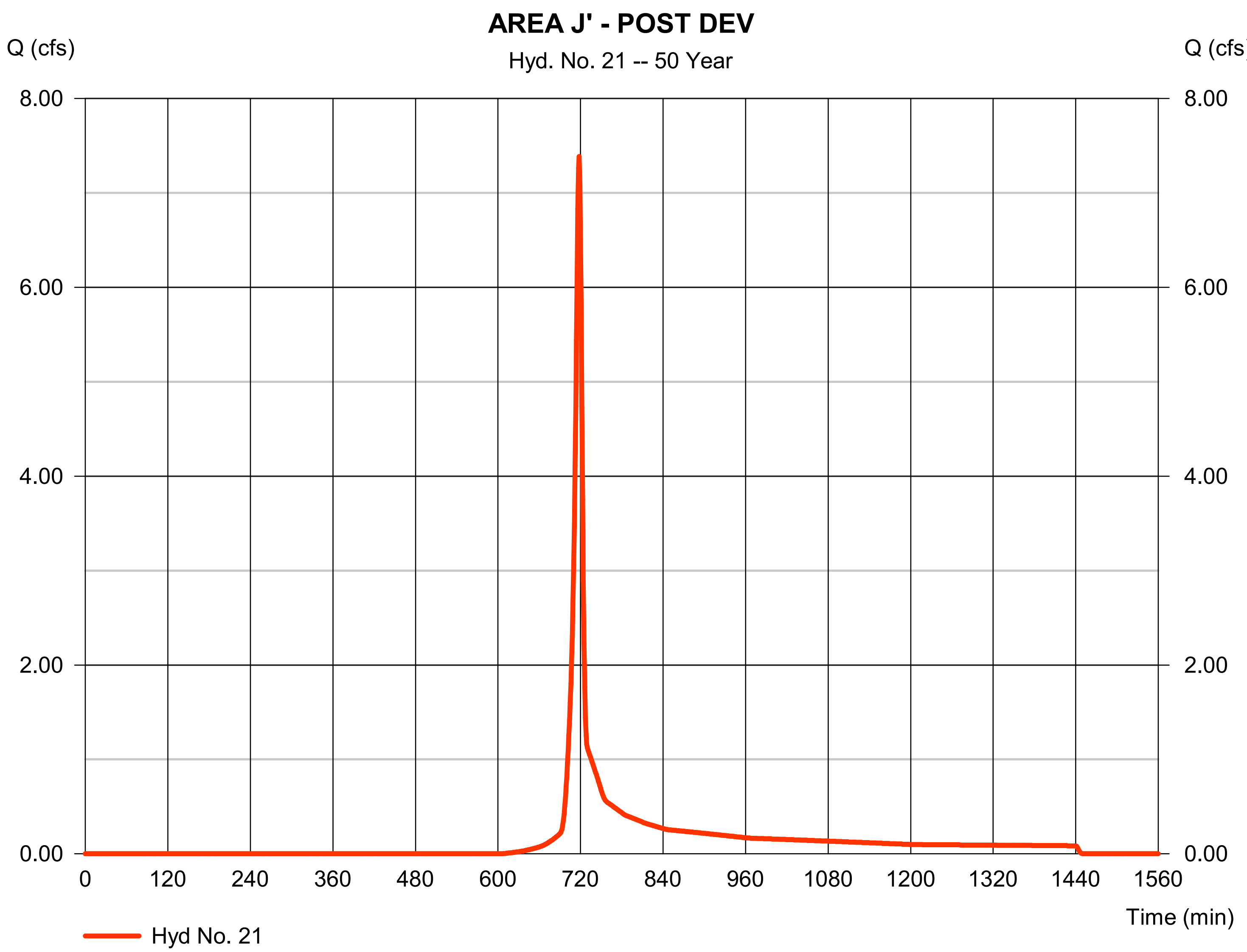
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 21

AREA J' - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 7.386 cfs
Storm frequency	= 50 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 14,838 cuft
Drainage area	= 1.440 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.07 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.220 x 65) + (1.220 x 60)] / 1.440



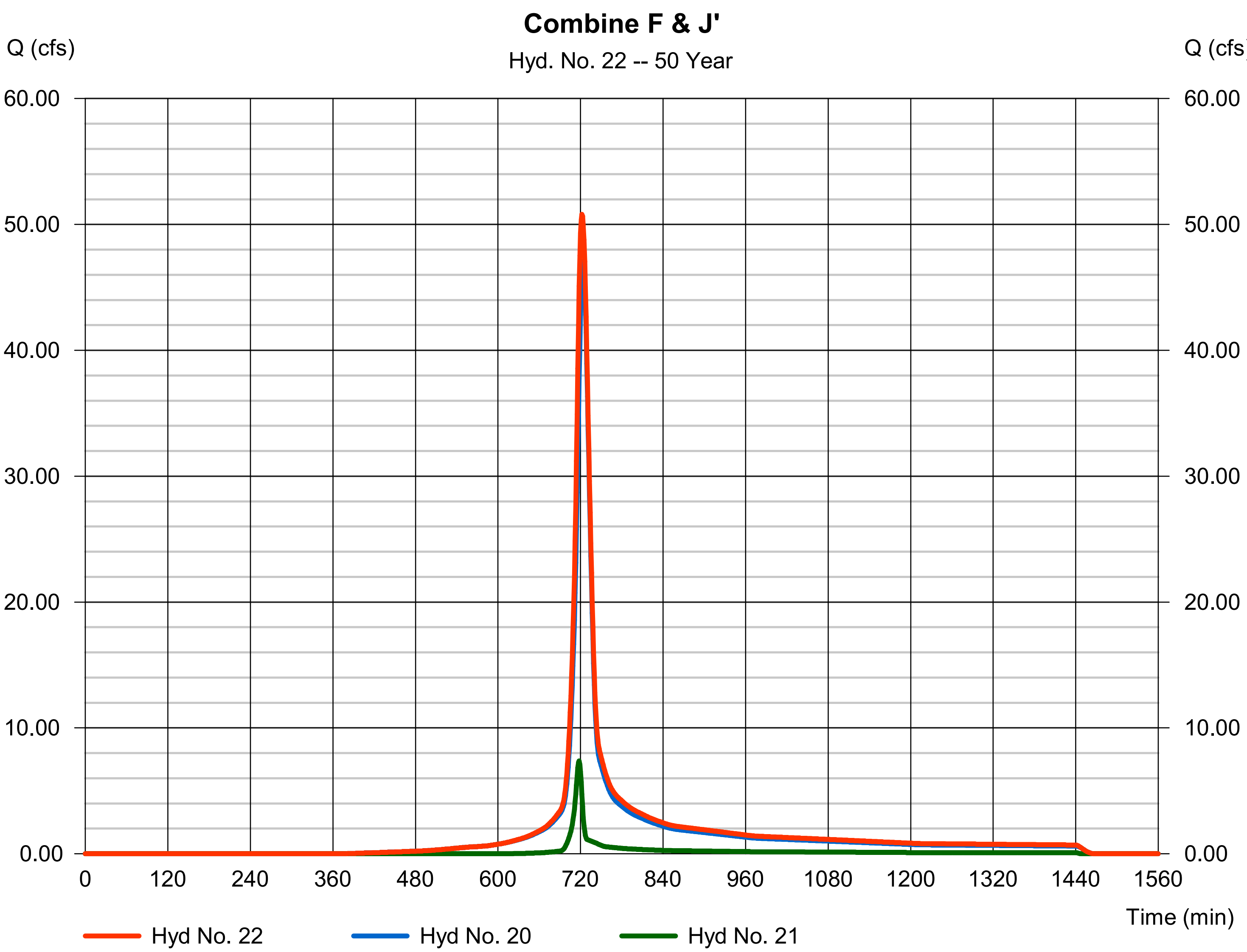
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 22

Combine F & J'

Hydrograph type	= Combine	Peak discharge	= 50.81 cfs
Storm frequency	= 50 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 155,232 cuft
Inflow hyds.	= 20, 21	Contrib. drain. area	= 10.060 ac



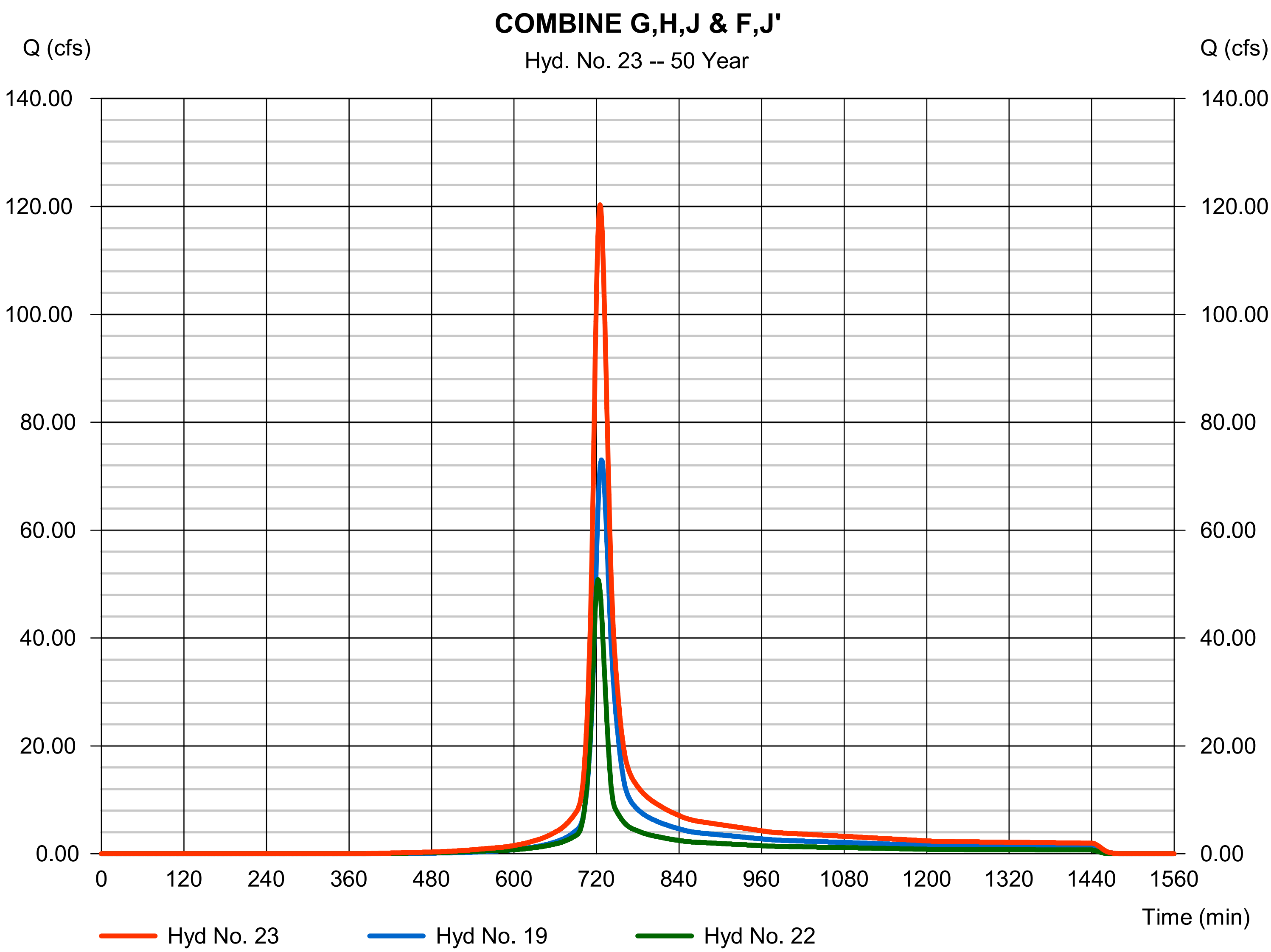
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 23

COMBINE G,H,J & F,J'

Hydrograph type	= Combine	Peak discharge	= 120.30 cfs
Storm frequency	= 50 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 415,394 cuft
Inflow hyds.	= 19, 22	Contrib. drain. area	= 0.000 ac



Hydrograph Report

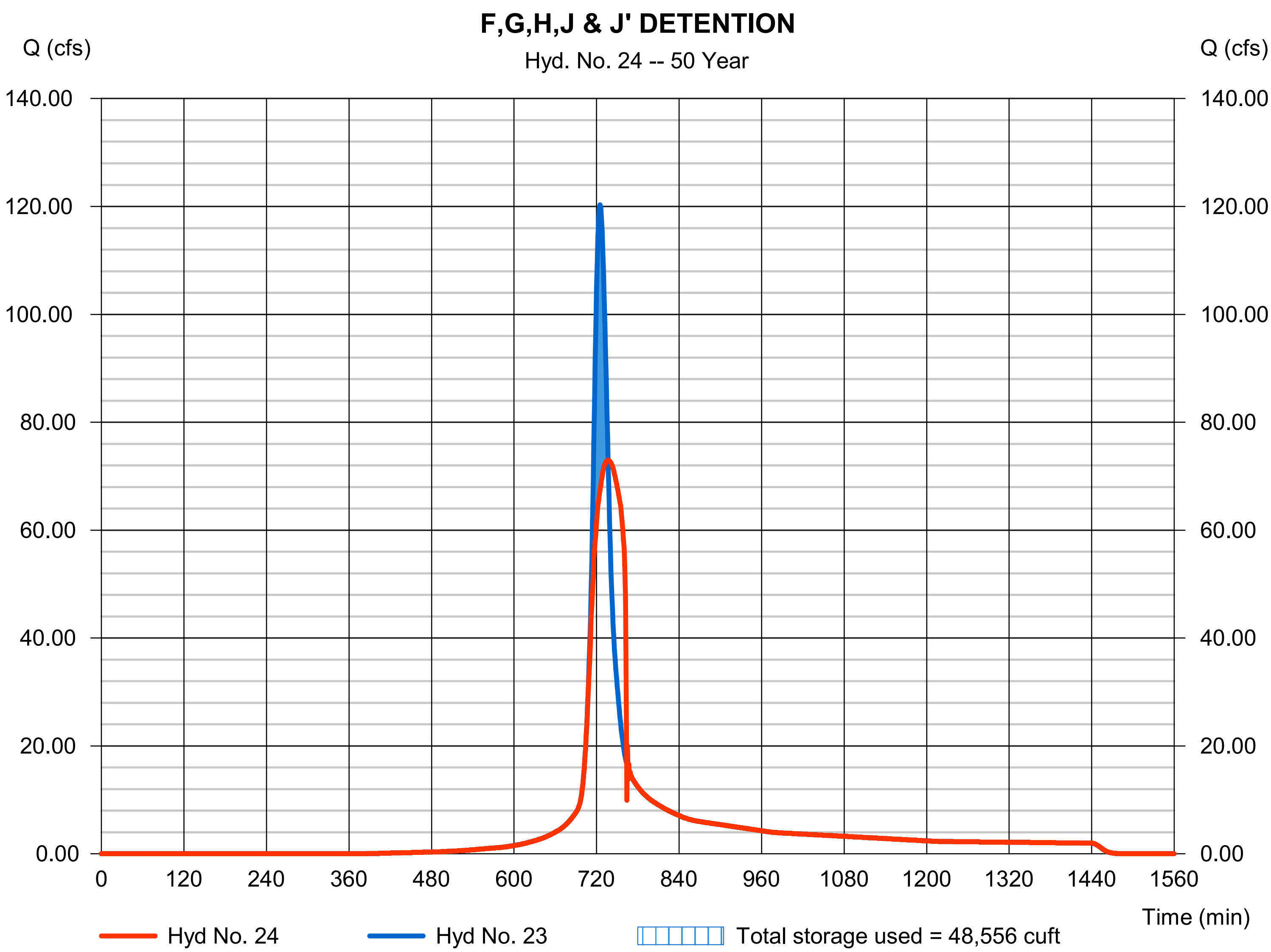
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 24

F,G,H,J & J' DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 72.98 cfs
Storm frequency	= 50 yrs	Time to peak	= 737 min
Time interval	= 1 min	Hyd. volume	= 415,393 cuft
Inflow hyd. No.	= 23 - COMBINE G,H,J & F,J'	Max. Elevation	= 581.18 ft
Reservoir name	= F,G,H,J & J' DETENTION	Max. Storage	= 48,556 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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	SCS Runoff	13.37	1	725	41,750	------	------	------	AREA A - POST DEV
2	Reach	12.91	1	728	41,748	1	------	------	DITCH 1
3	SCS Runoff	30.03	1	727	102,165	------	------	------	AREA B - POST DEV
4	Combine	42.91	1	727	143,913	2, 3	------	------	COMBINE A & B
5	Reach	42.43	1	729	143,911	4	------	------	DITCH 2
6	SCS Runoff	21.56	1	742	118,736	------	------	------	AREA E - POST DEV
7	SCS Runoff	60.00	1	724	179,768	------	------	------	AREA D - POST DEV
8	SCS Runoff	58.24	1	727	198,133	------	------	------	AREA C - POST DEV
9	Combine	116.09	1	725	377,901	7, 8	------	------	COMBINE C & D
10	Reservoir	16.70	1	758	377,900	9	582.71	148,656	C & D DETENTION
11	Combine	58.84	1	731	262,647	5, 6,	------	------	COMBINE A,B,C & E
12	Combine	74.36	1	731	640,548	10, 11	------	------	COMBINE A,B, C, D & E
13	Reservoir	39.98	1	760	497,506	12	582.47	172,904	DETENTION A,B,C,D & E
14	SCS Runoff	36.81	1	729	137,242	------	------	------	AREA H - POST DEV
15	SCS Runoff	35.44	1	723	102,303	------	------	------	AREA G - POST DEV
16	SCS Runoff	22.71	1	724	67,343	------	------	------	AREA J - POST DEV
17	Combine	68.06	1	725	239,545	14, 15,	------	------	COMBINE H & G
18	Reach	65.64	1	728	239,543	17	------	------	HWY 20 SIDE DITCH
19	Combine	86.44	1	727	306,886	16, 18	------	------	COMBINE H,G, & J
20	SCS Runoff	54.33	1	724	162,773	------	------	------	AREA F - POST DEV
21	SCS Runoff	8.961	1	718	17,995	------	------	------	AREA J' - POST DEV
22	Combine	58.97	1	722	180,768	20, 21	------	------	Combine F & J'
23	Combine	141.26	1	725	487,654	19, 22	------	------	COMBINE G,H,J & F,J'
24	Reservoir	77.19	1	738	487,655	23	581.79	69,791	F,G,H,J & J' DETENTION
25	SCS Runoff	6.822	1	725	21,530	------	------	------	AREA K' - POST DEV
26	Reach	5.475	1	732	21,526	25	------	------	K' Tc DITCH
27	SCS Runoff	3.101	1	725	9,816	------	------	------	AREA K'' - POST DEV
28	Reach	2.162	1	734	9,808	27	------	------	K'' Tc DITCH
29	Combine	7.611	1	733	31,333	26, 28	------	------	COMBINE K' & K''
30	SCS Runoff	28.94	1	725	91,612	------	------	------	AREA K - POST DEV
31	Combine	35.31	1	726	122,946	29, 30	------	------	COMBINE K, K' & K''
32	Reservoir	7.727	1	755	122,811	31	582.87	43,112	AREA K DETENTION
33	Combine	84.63	1	739	610,461	24, 32	------	------	COMBINE F,G,H,J & K
34	SCS Runoff	6.249	1	721	15,171	------	------	------	AREA L - POST DEV

AP3_POSTDEV_SOLAR.gpw	Return Period: 100 Year	Thursday, 11 / 15 / 2018

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

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
35	Combine	85.64	1	738	625,633	33, 34	------	------	COMBINE FG,H,J,K & L
36	Combine	118.97	1	754	1,123,182	13, 35	------	------	TOTAL SITE DISCHARGE - POST D

Hydrograph Report

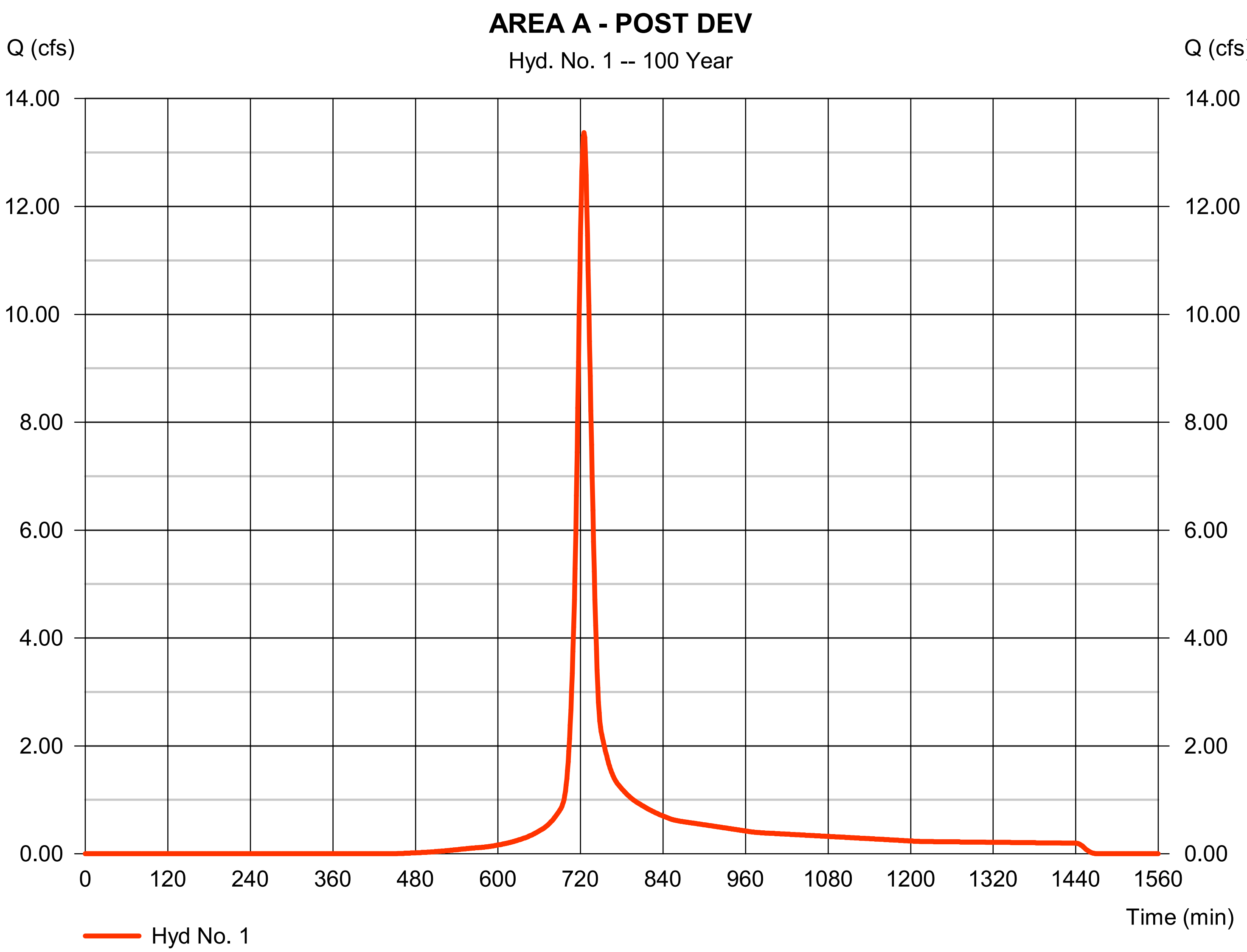
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 1

AREA A - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 13.37 cfs
Storm frequency	= 100 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 41,750 cuft
Drainage area	= 2.580 ac	Curve number	= 71*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 20.10 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.220 x 85) + (0.570 x 55) + (0.030 x 98) + (0.760 x 60)] / 2.580



Hydrograph Report

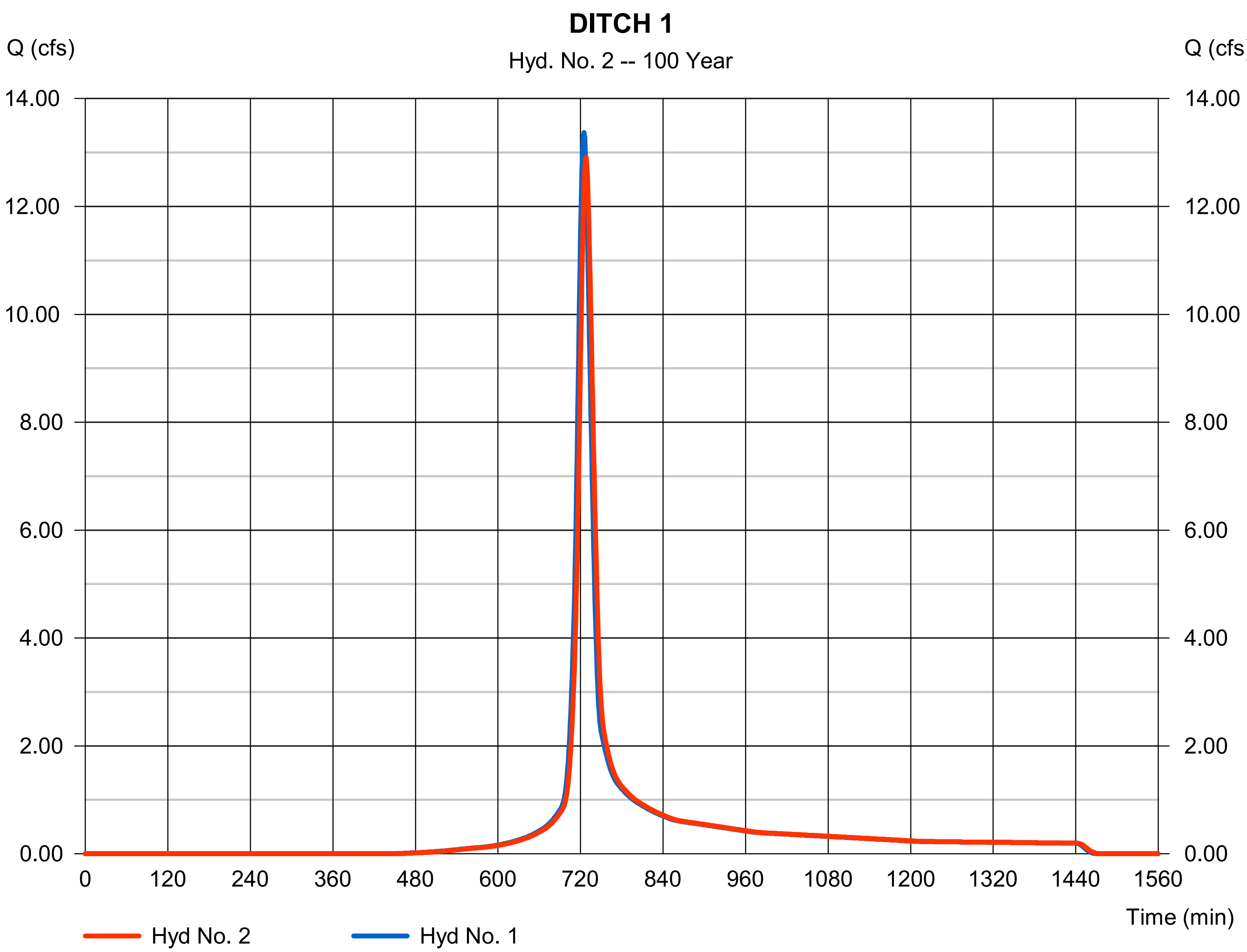
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 2

DITCH 1

Hydrograph type	= Reach	Peak discharge	= 12.91 cfs
Storm frequency	= 100 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 41,748 cuft
Inflow hyd. No.	= 1 - AREA A - POST DEV	Section type	= Trapezoidal
Reach length	= 730.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 10.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.375
Ave. velocity	= 3.49 ft/s	Routing coeff.	= 0.3294

Modified Att-Kin routing method used.



Hydrograph Report

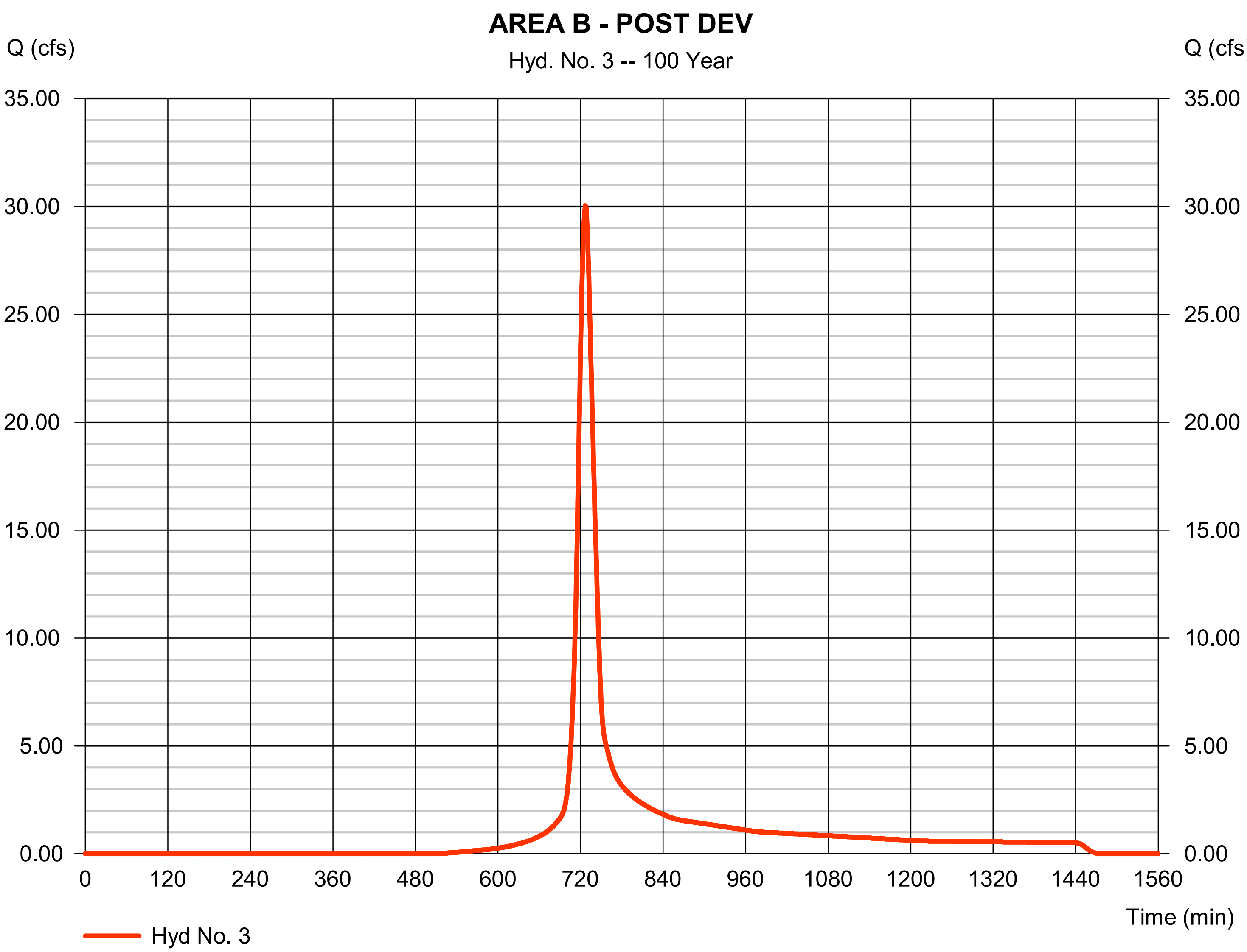
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 3

AREA B - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 30.03 cfs
Storm frequency	= 100 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 102,165 cuft
Drainage area	= 7.090 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.60 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.930 x 85) + (2.120 x 55) + (0.250 x 98) + (2.790 x 60)] / 7.090



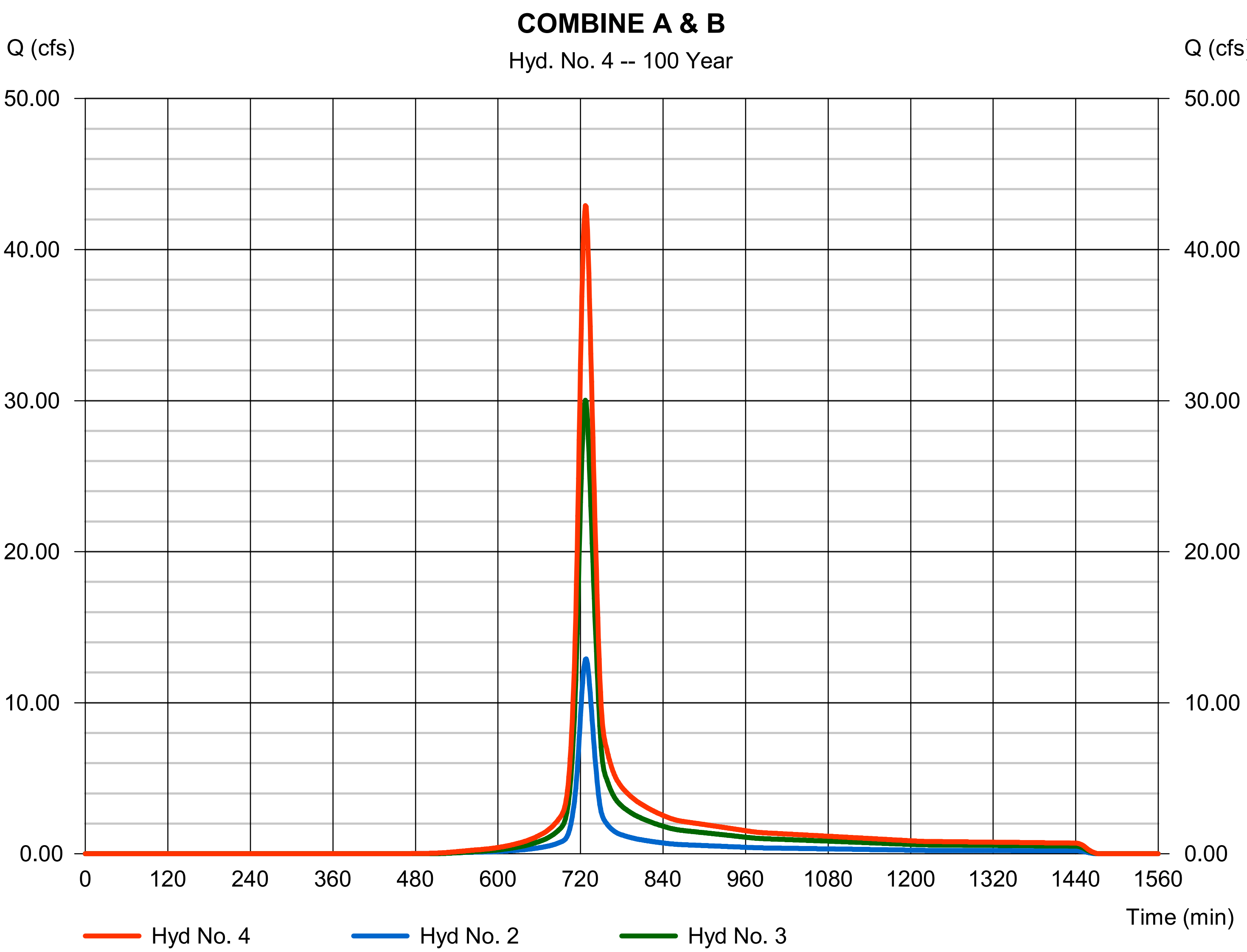
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 4

COMBINE A & B

Hydrograph type	= Combine	Peak discharge	= 42.91 cfs
Storm frequency	= 100 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 143,913 cuft
Inflow hyds.	= 2, 3	Contrib. drain. area	= 7.090 ac



Hydrograph Report

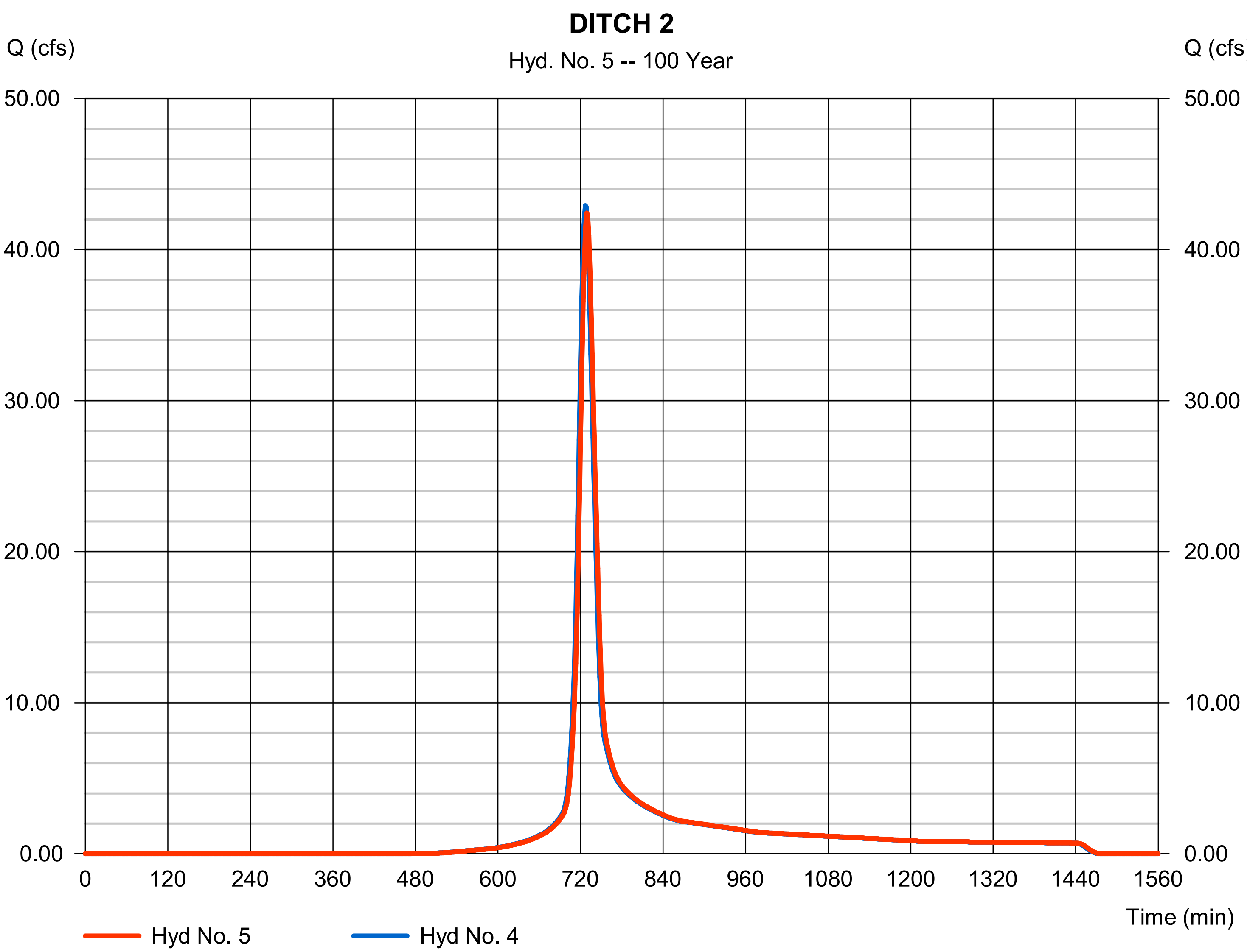
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 5

DITCH 2

Hydrograph type	= Reach	Peak discharge	= 42.43 cfs
Storm frequency	= 100 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 143,911 cuft
Inflow hyd. No.	= 4 - COMBINE A & B	Section type	= Trapezoidal
Reach length	= 610.0 ft	Channel slope	= 1.5 %
Manning's n	= 0.030	Bottom width	= 5.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 2.107	Rating curve m	= 1.373
Ave. velocity	= 4.78 ft/s	Routing coeff.	= 0.4878

Modified Att-Kin routing method used.



Hydrograph Report

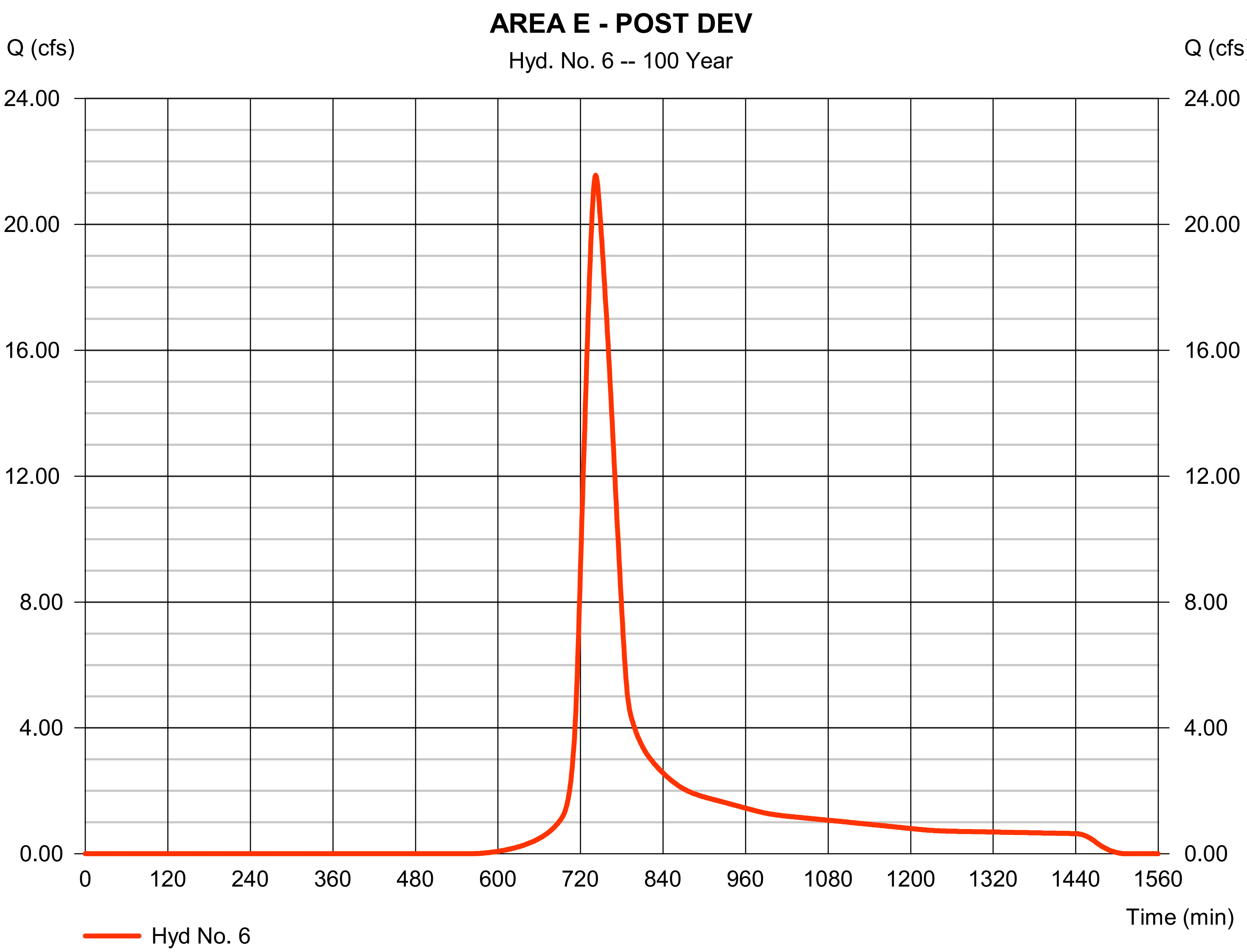
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 6

AREA E - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 21.56 cfs
Storm frequency	= 100 yrs	Time to peak	= 742 min
Time interval	= 1 min	Hyd. volume	= 118,736 cuft
Drainage area	= 9.150 ac	Curve number	= 63*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 47.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.680 x 65) + (0.330 x 98) + (5.140 x 60)] / 9.150



Hydrograph Report

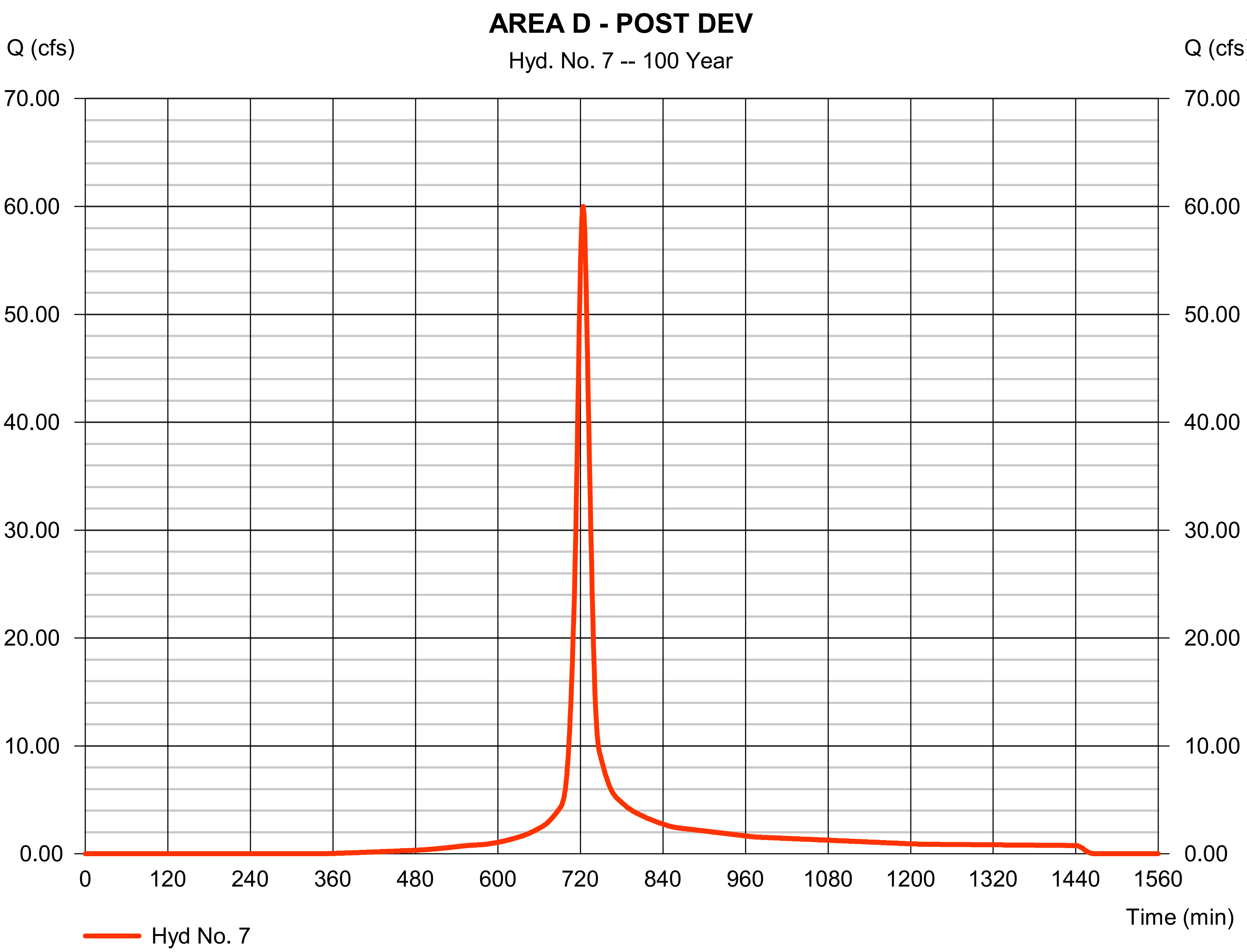
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 7

AREA D - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 60.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 179,768 cuft
Drainage area	= 9.520 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.10 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.910 x 85) + (8.290 x 77) + (0.320 x 98)] / 9.520



Hydrograph Report

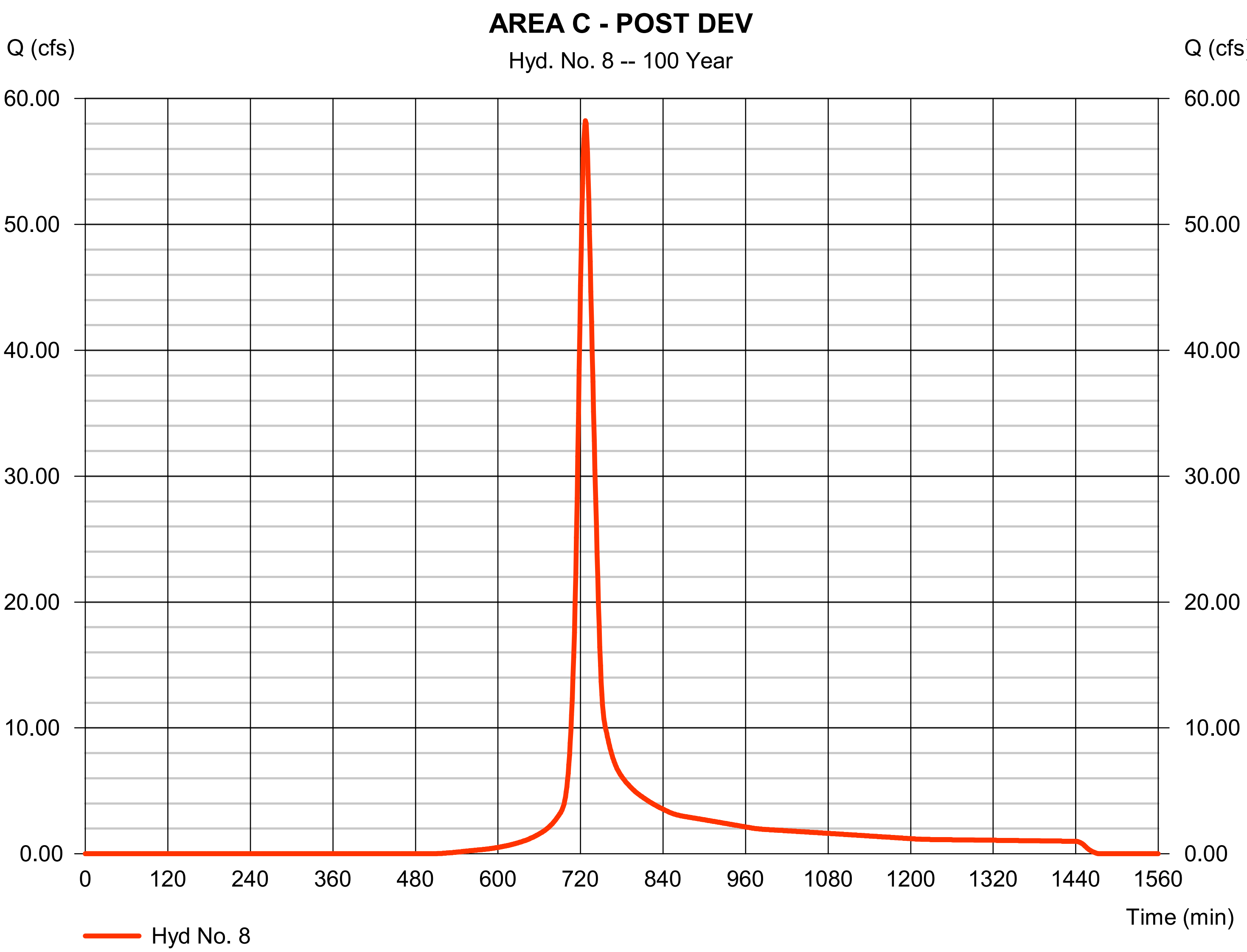
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 8

AREA C - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 58.24 cfs
Storm frequency	= 100 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 198,133 cuft
Drainage area	= 13.750 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 23.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.460 x 85) + (0.400 x 55) + (1.740 x 98) + (10.150 x 60)] / 13.750



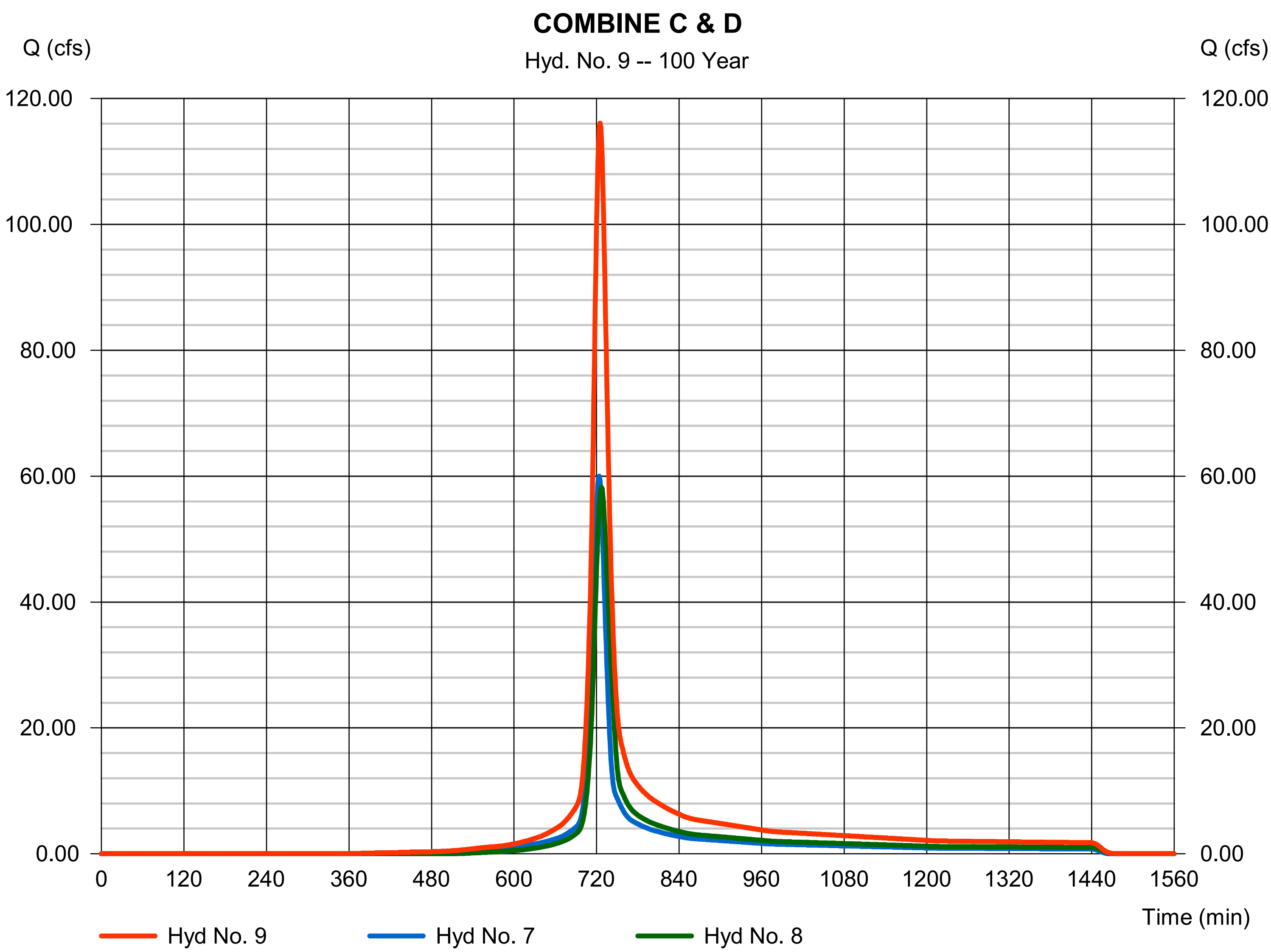
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 11 / 15 / 2018

Hyd. No. 9

COMBINE C & D

Hydrograph type	= Combine	Peak discharge	= 116.09 cfs
Storm frequency	= 100 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 377,901 cuft
Inflow hyds.	= 7, 8	Contrib. drain. area	= 23.270 ac



Hydrograph Report

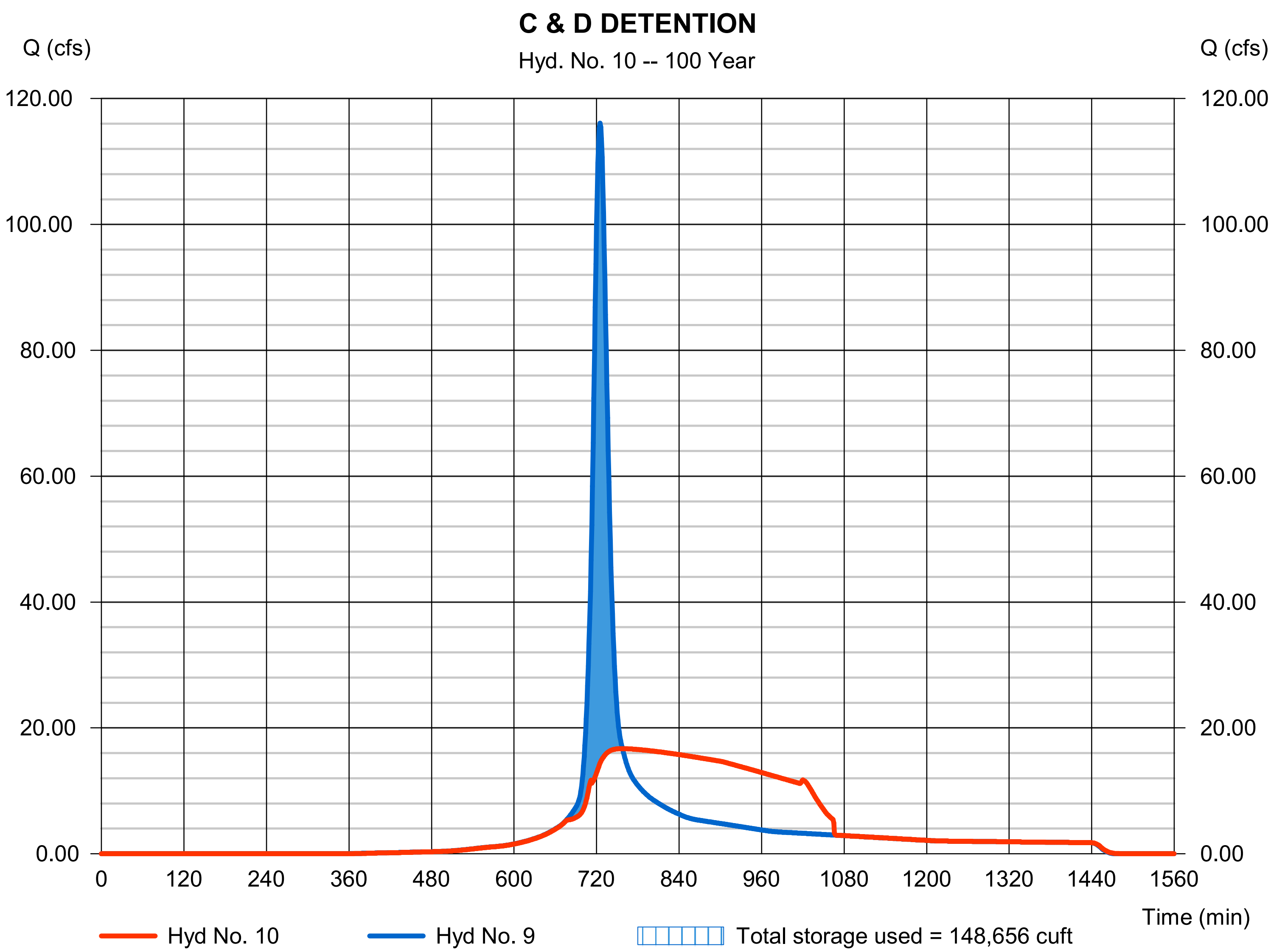
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 10

C & D DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 16.70 cfs
Storm frequency	= 100 yrs	Time to peak	= 758 min
Time interval	= 1 min	Hyd. volume	= 377,900 cuft
Inflow hyd. No.	= 9 - COMBINE C & D	Max. Elevation	= 582.71 ft
Reservoir name	= C&D DETENTION	Max. Storage	= 148,656 cuft

Storage Indication method used.



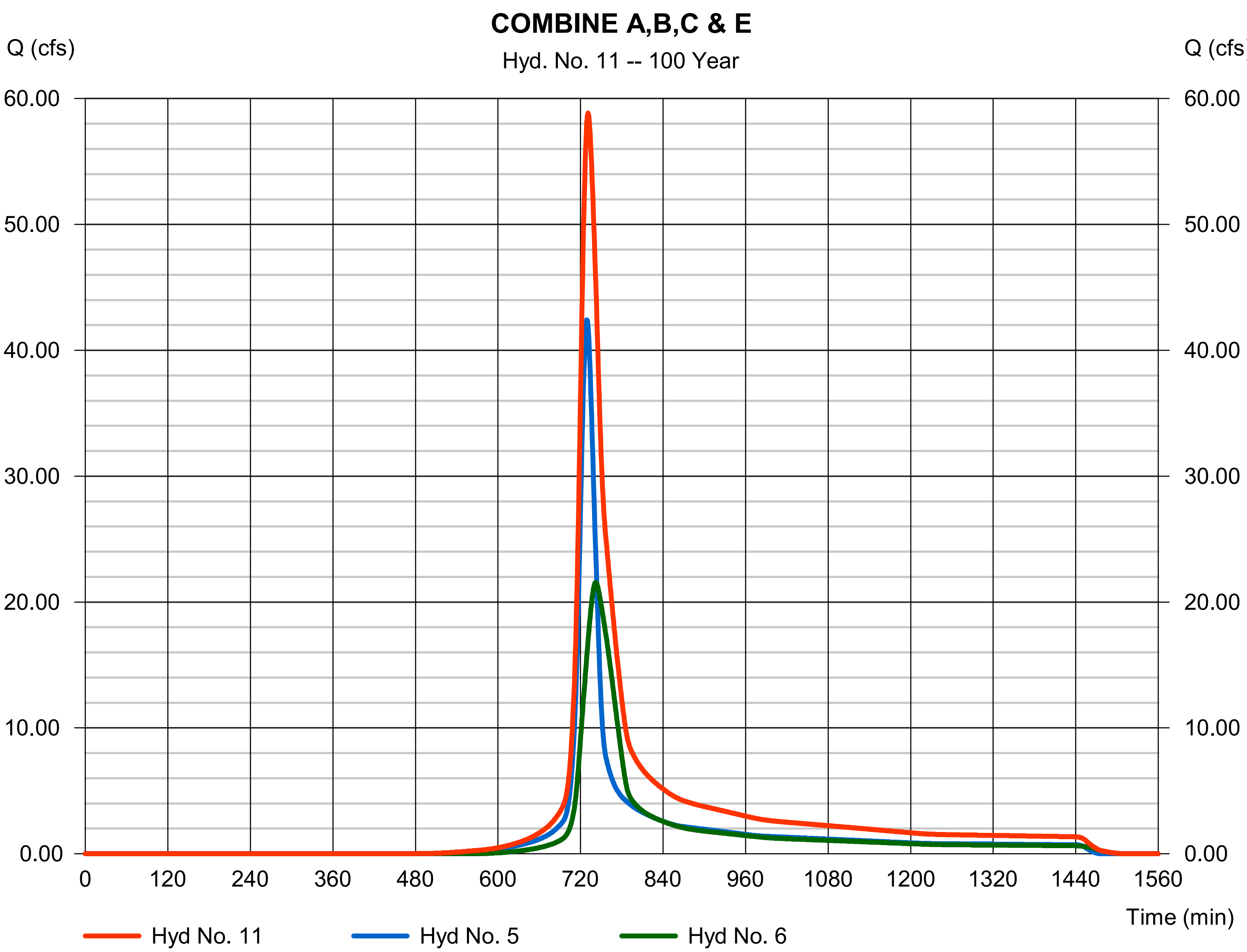
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 11

COMBINE A,B,C & E

Hydrograph type	= Combine	Peak discharge	= 58.84 cfs
Storm frequency	= 100 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 262,647 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 9.150 ac



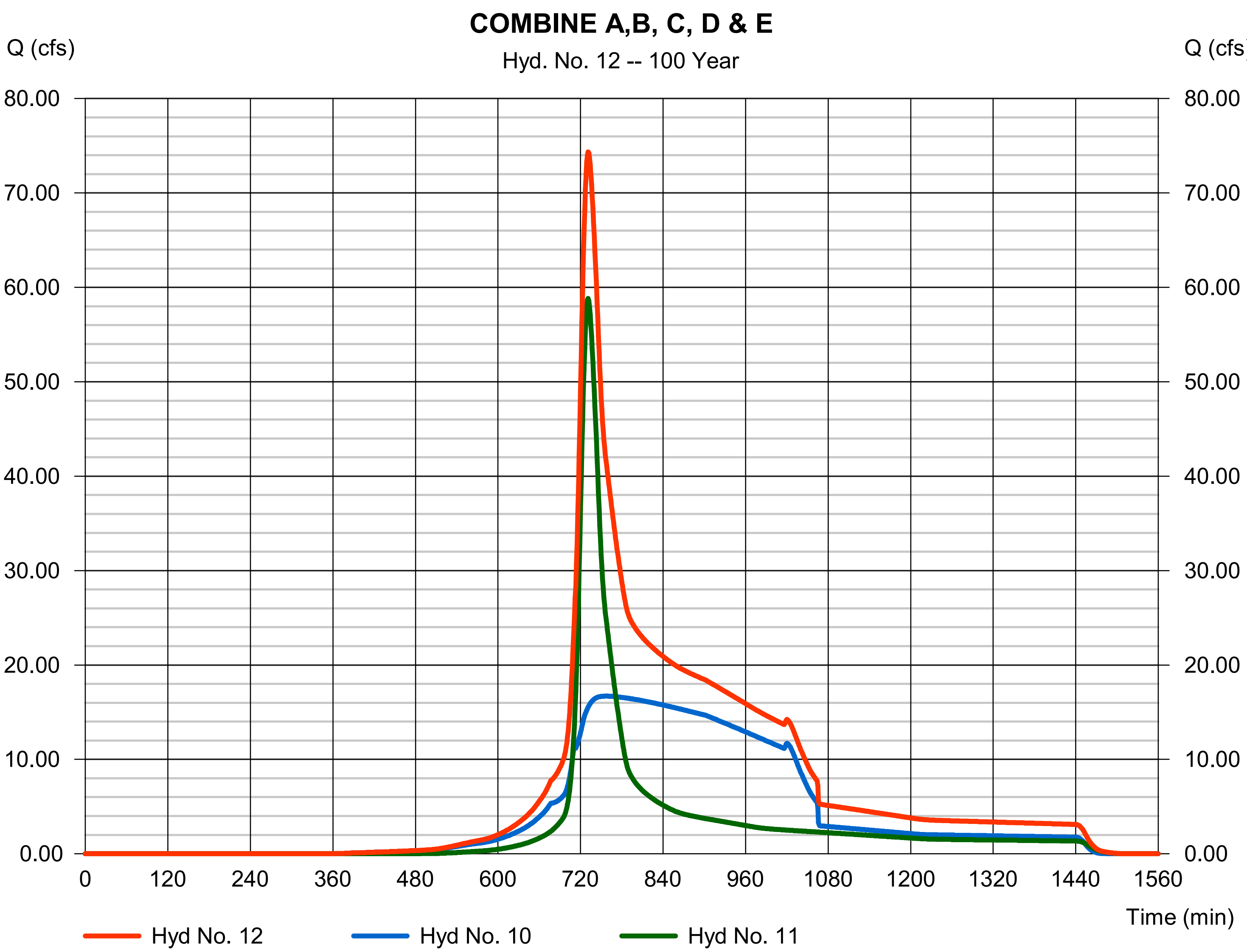
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 12

COMBINE A,B, C, D & E

Hydrograph type	= Combine	Peak discharge	= 74.36 cfs
Storm frequency	= 100 yrs	Time to peak	= 731 min
Time interval	= 1 min	Hyd. volume	= 640,548 cuft
Inflow hyds.	= 10, 11	Contrib. drain. area	= 0.000 ac



Hydrograph Report

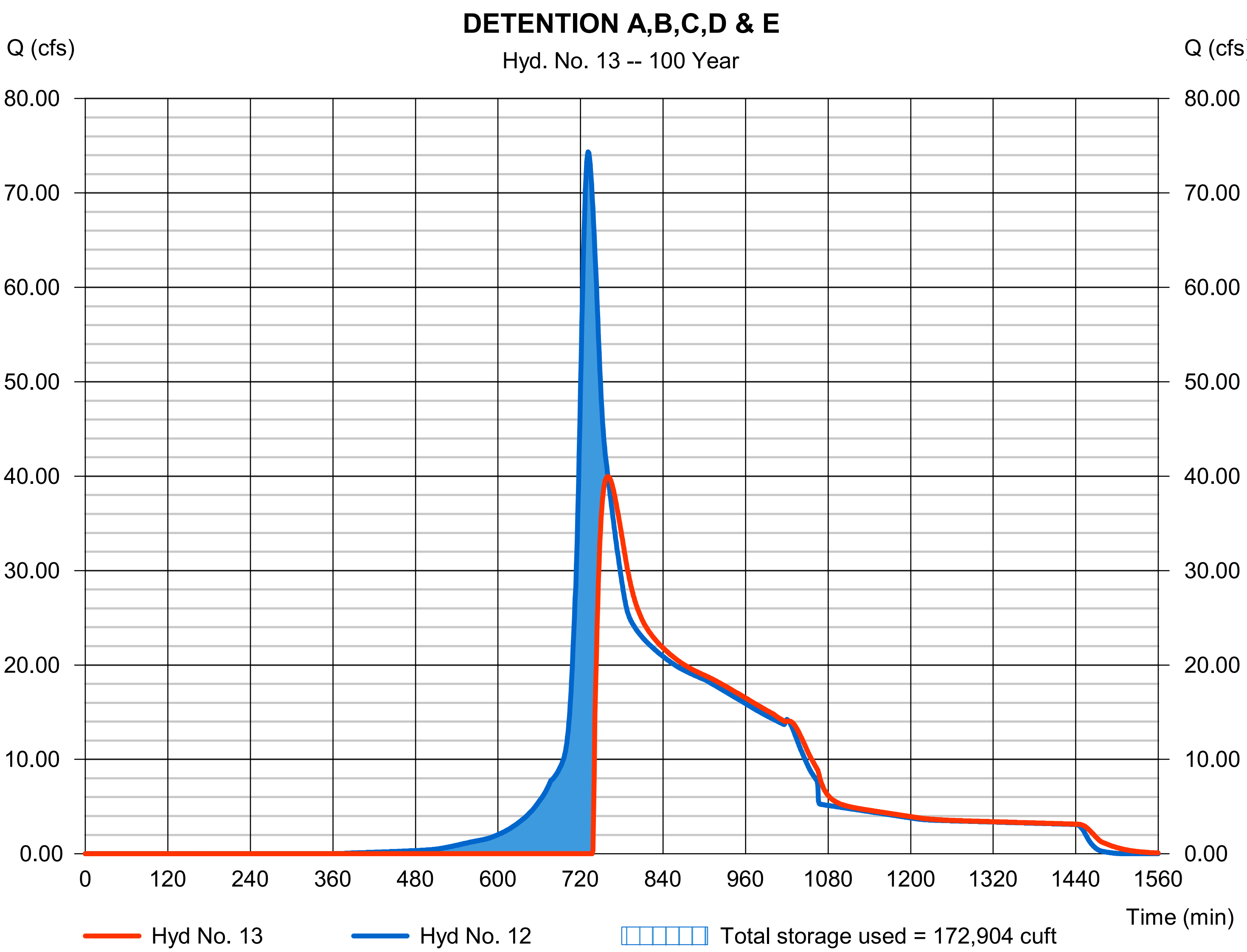
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 13

DETENTION A,B,C,D & E

Hydrograph type	= Reservoir	Peak discharge	= 39.98 cfs
Storm frequency	= 100 yrs	Time to peak	= 760 min
Time interval	= 1 min	Hyd. volume	= 497,506 cuft
Inflow hyd. No.	= 12 - COMBINE A,B, C, D & E	Max. Elevation	= 582.47 ft
Reservoir name	= A,B,C,D & E DETENTION	Max. Storage	= 172,904 cuft

Storage Indication method used.



Hydrograph Report

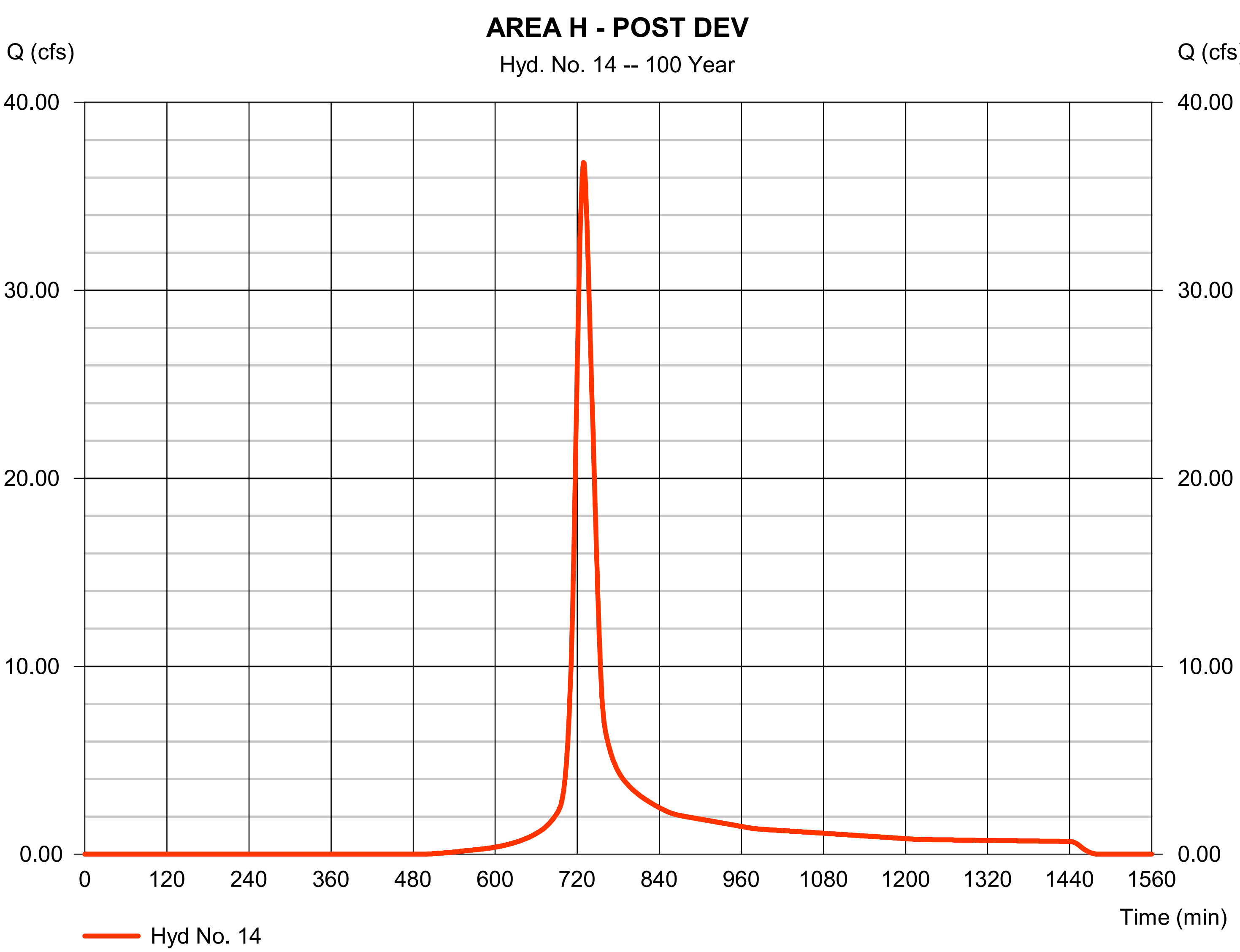
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 14

AREA H - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 36.81 cfs
Storm frequency	= 100 yrs	Time to peak	= 729 min
Time interval	= 1 min	Hyd. volume	= 137,242 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 26.50 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



Hydrograph Report

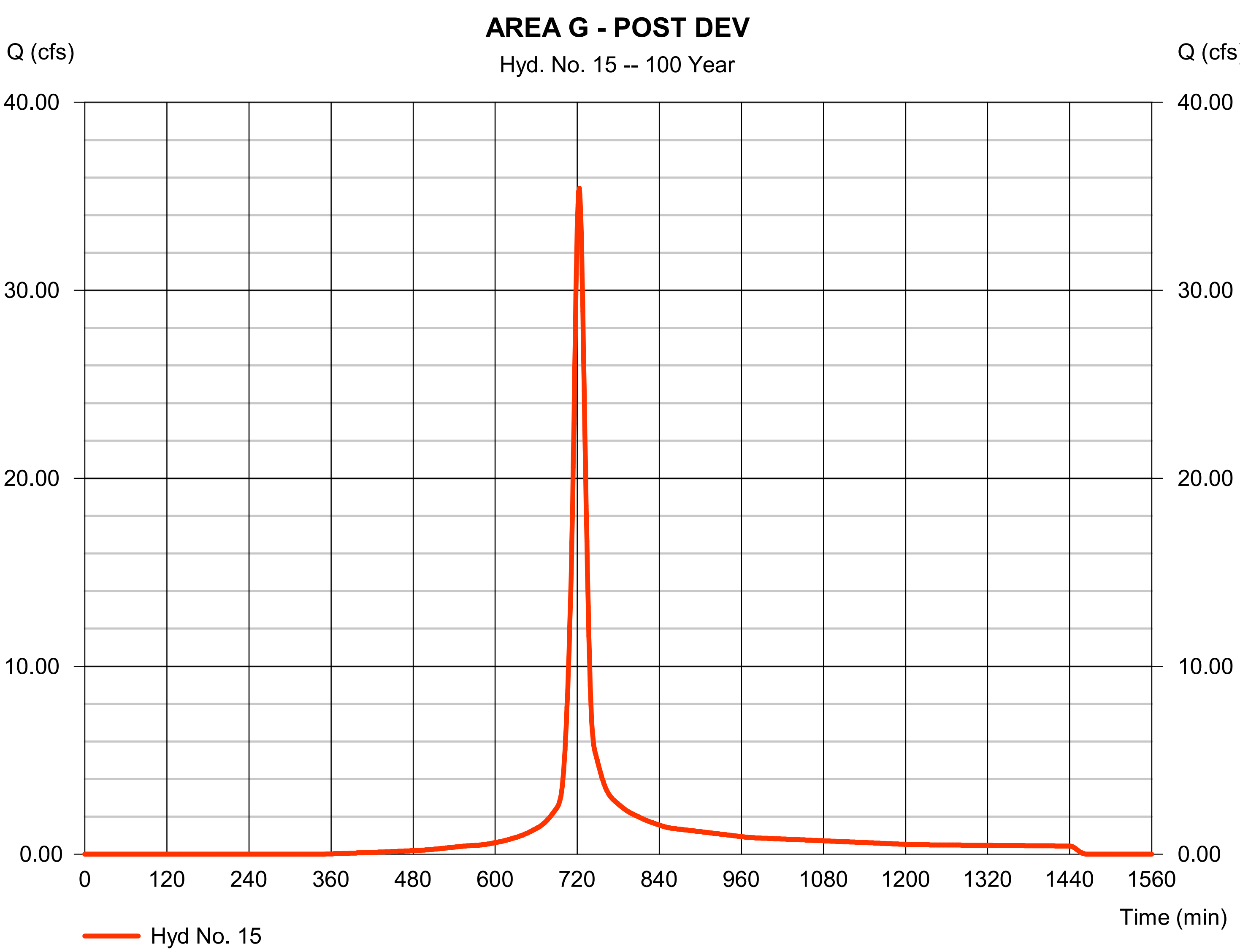
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 15

AREA G - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 35.44 cfs
Storm frequency	= 100 yrs	Time to peak	= 723 min
Time interval	= 1 min	Hyd. volume	= 102,303 cuft
Drainage area	= 5.290 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.80 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.330 x 85) + (4.740 x 77) + (0.220 x 98)] / 5.290



Hydrograph Report

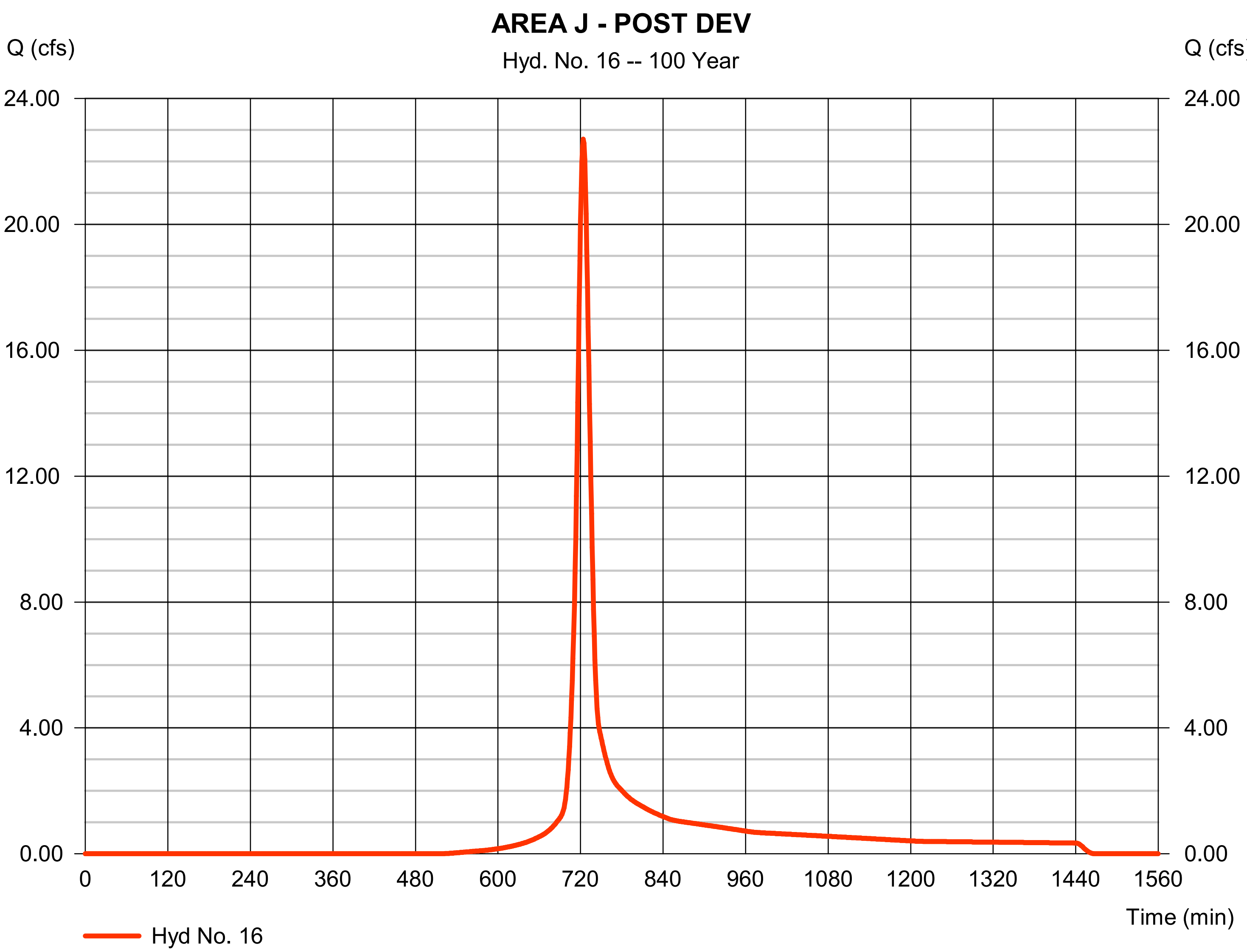
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 16

AREA J - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 22.71 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 67,343 cuft
Drainage area	= 4.820 ac	Curve number	= 66*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 17.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 85) + (0.020 x 65) + (0.680 x 98) + (4.030 x 60)] / 4.820



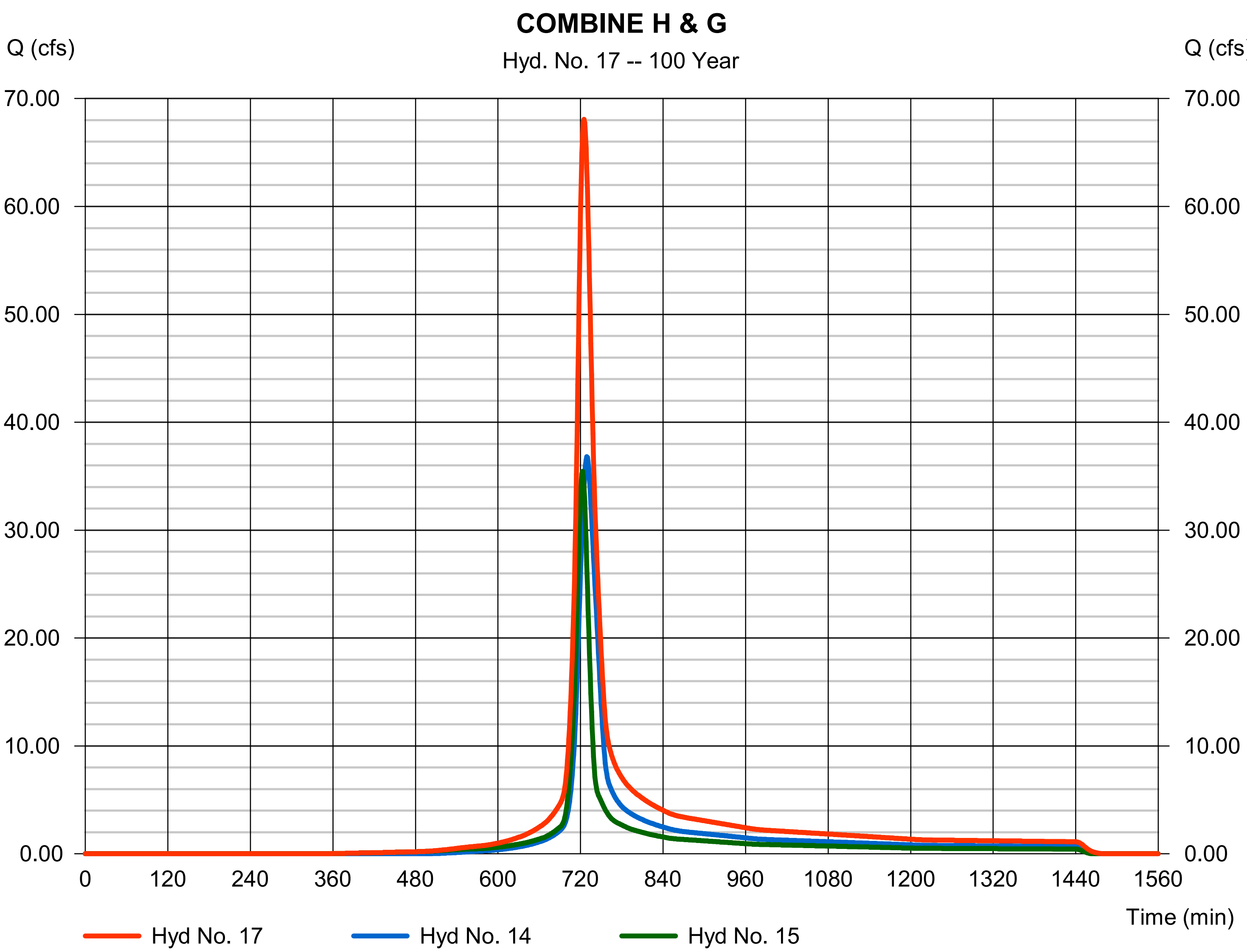
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 17

COMBINE H & G

Hydrograph type	= Combine	Peak discharge	= 68.06 cfs
Storm frequency	= 100 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 239,545 cuft
Inflow hyds.	= 14, 15	Contrib. drain. area	= 14.400 ac



Hydrograph Report

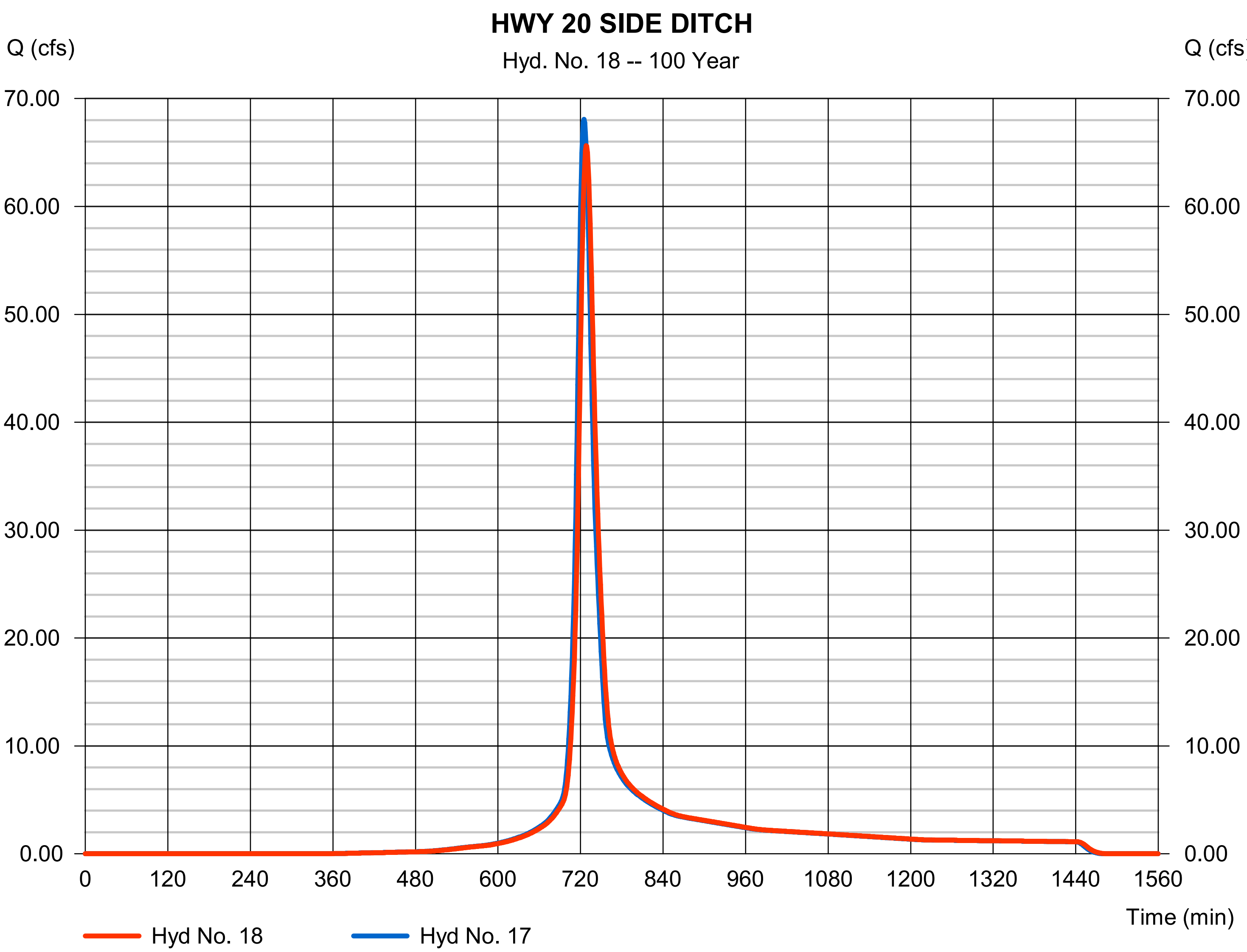
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 18

HWY 20 SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 65.64 cfs
Storm frequency	= 100 yrs	Time to peak	= 728 min
Time interval	= 1 min	Hyd. volume	= 239,543 cuft
Inflow hyd. No.	= 17 - COMBINE H & G	Section type	= Trapezoidal
Reach length	= 900.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.030	Bottom width	= 3.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 1.688	Rating curve m	= 1.304
Ave. velocity	= 4.00 ft/s	Routing coeff.	= 0.2961

Modified Att-Kin routing method used.



Hydrograph Report

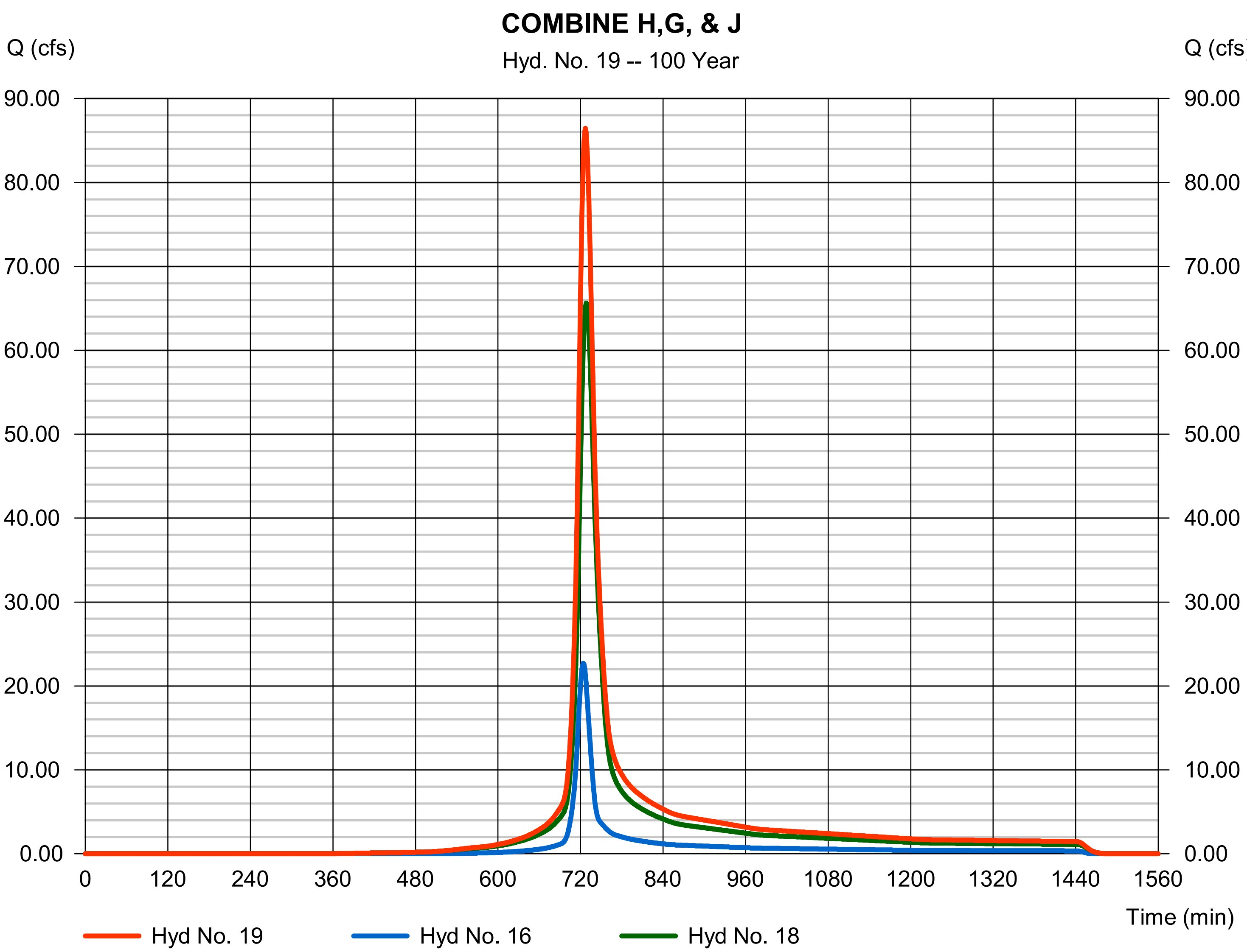
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020

Thursday, 11 / 15 / 2018

Hyd. No. 19

COMBINE H,G, & J

Hydrograph type	= Combine	Peak discharge	= 86.44 cfs
Storm frequency	= 100 yrs	Time to peak	= 727 min
Time interval	= 1 min	Hyd. volume	= 306,886 cuft
Inflow hyds.	= 16, 18	Contrib. drain. area	= 4.820 ac



Hydrograph Report

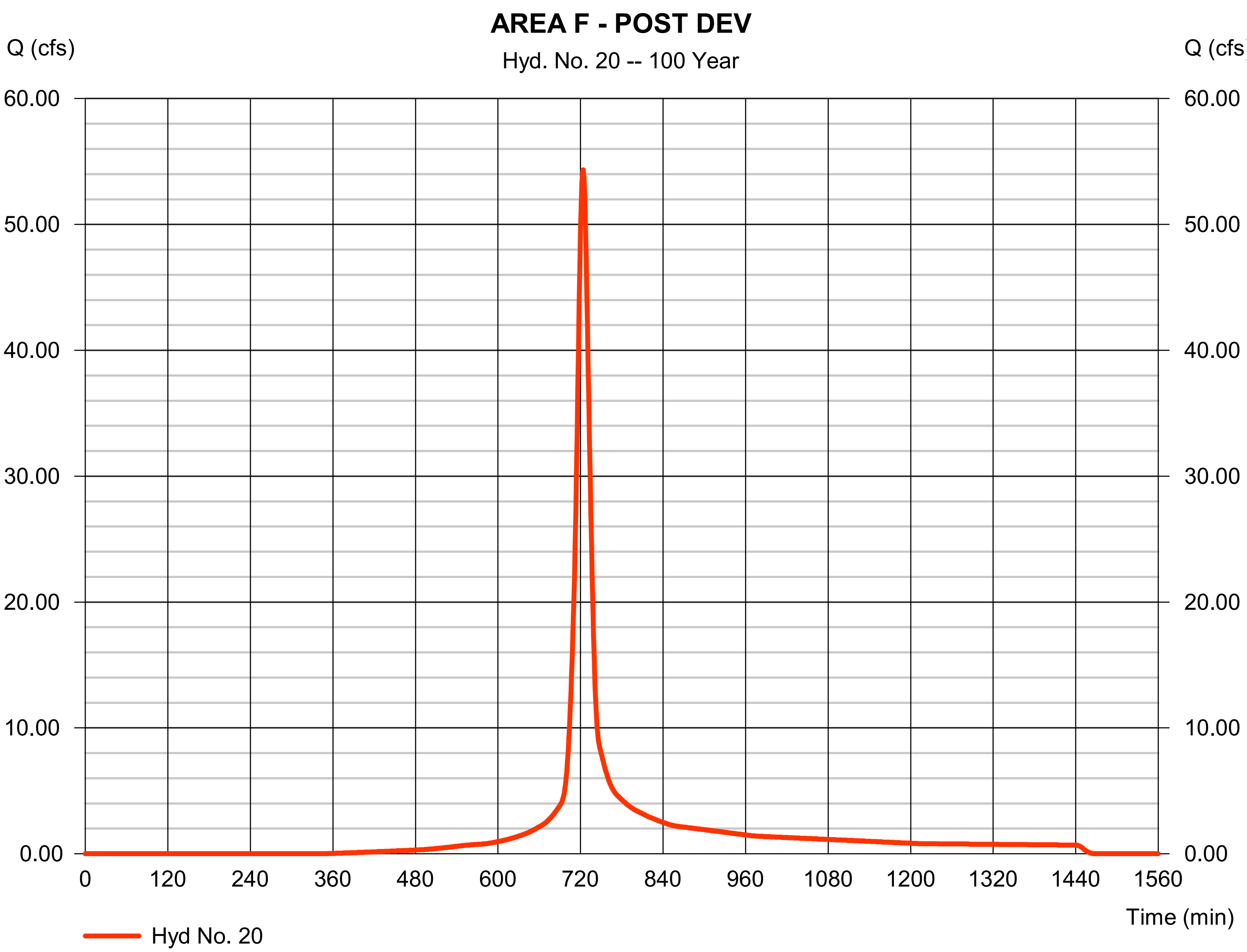
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 20

AREA F - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 54.33 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 1 min	Hyd. volume	= 162,773 cuft
Drainage area	= 8.620 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.440 x 85) + (7.810 x 77) + (0.370 x 98)] / 8.620



Hydrograph Report

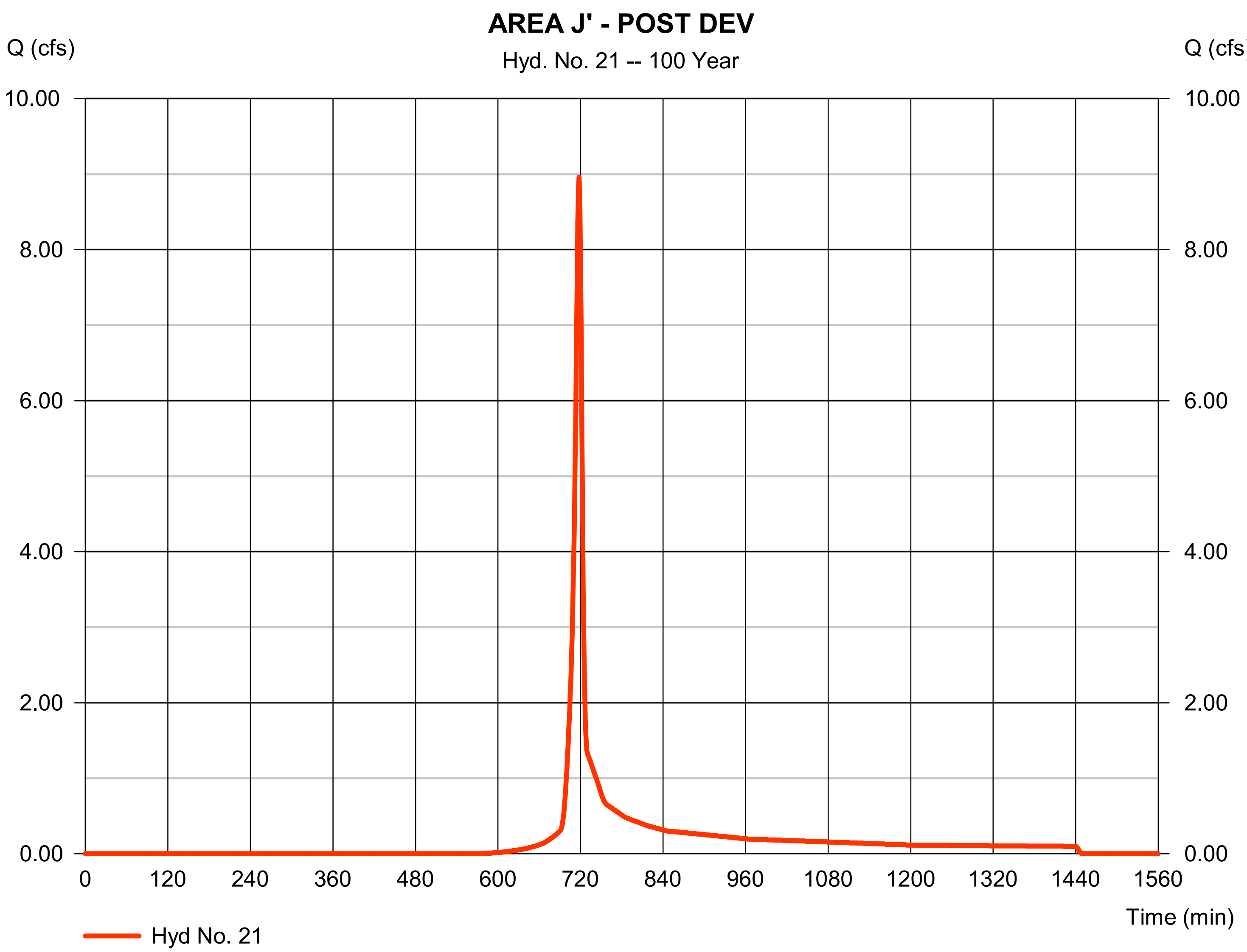
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 21

AREA J' - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 8.961 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 1 min	Hyd. volume	= 17,995 cuft
Drainage area	= 1.440 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.220 x 65) + (1.220 x 60)] / 1.440



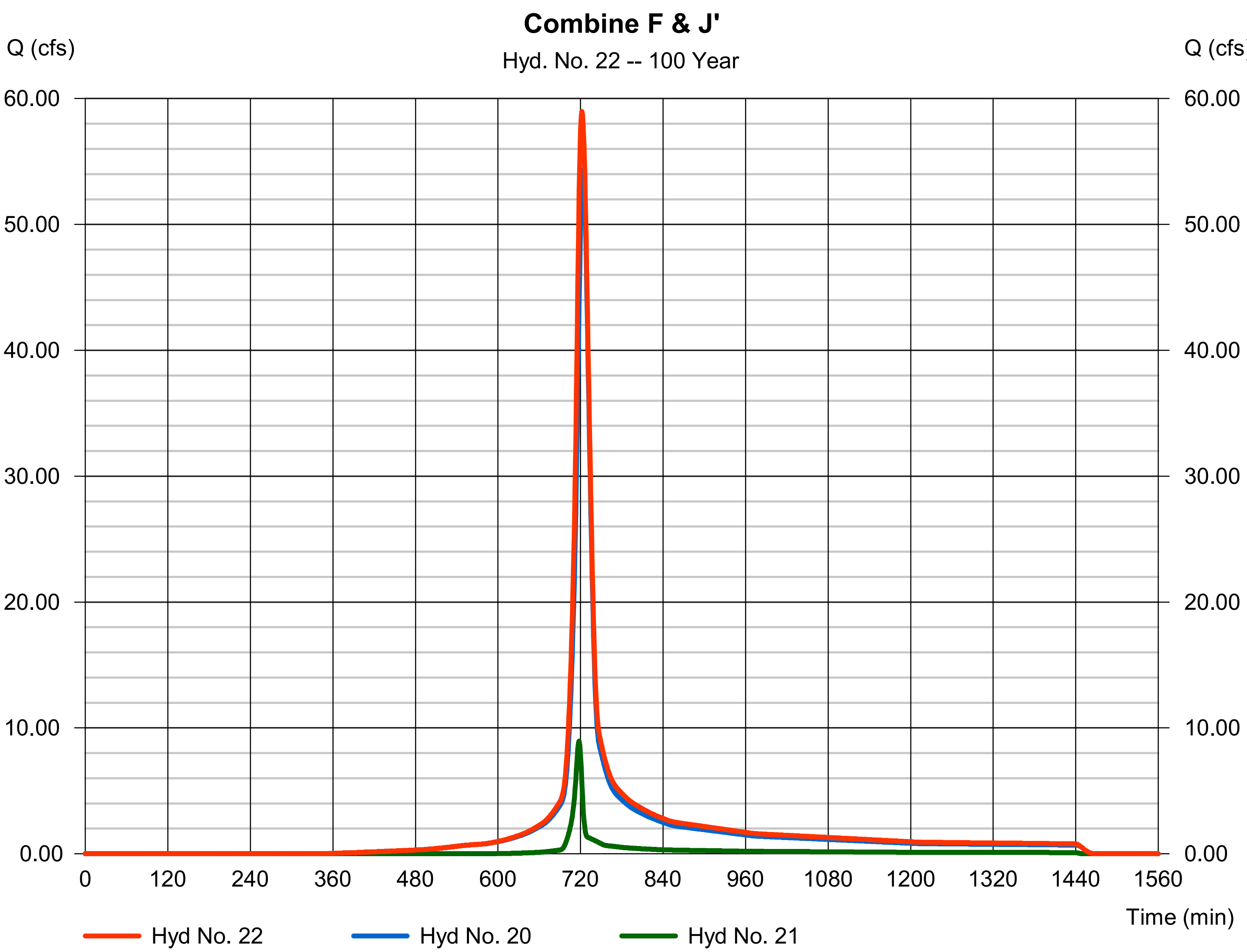
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 22

Combine F & J'

Hydrograph type	= Combine	Peak discharge	= 58.97 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 1 min	Hyd. volume	= 180,768 cuft
Inflow hyds.	= 20, 21	Contrib. drain. area	= 10.060 ac



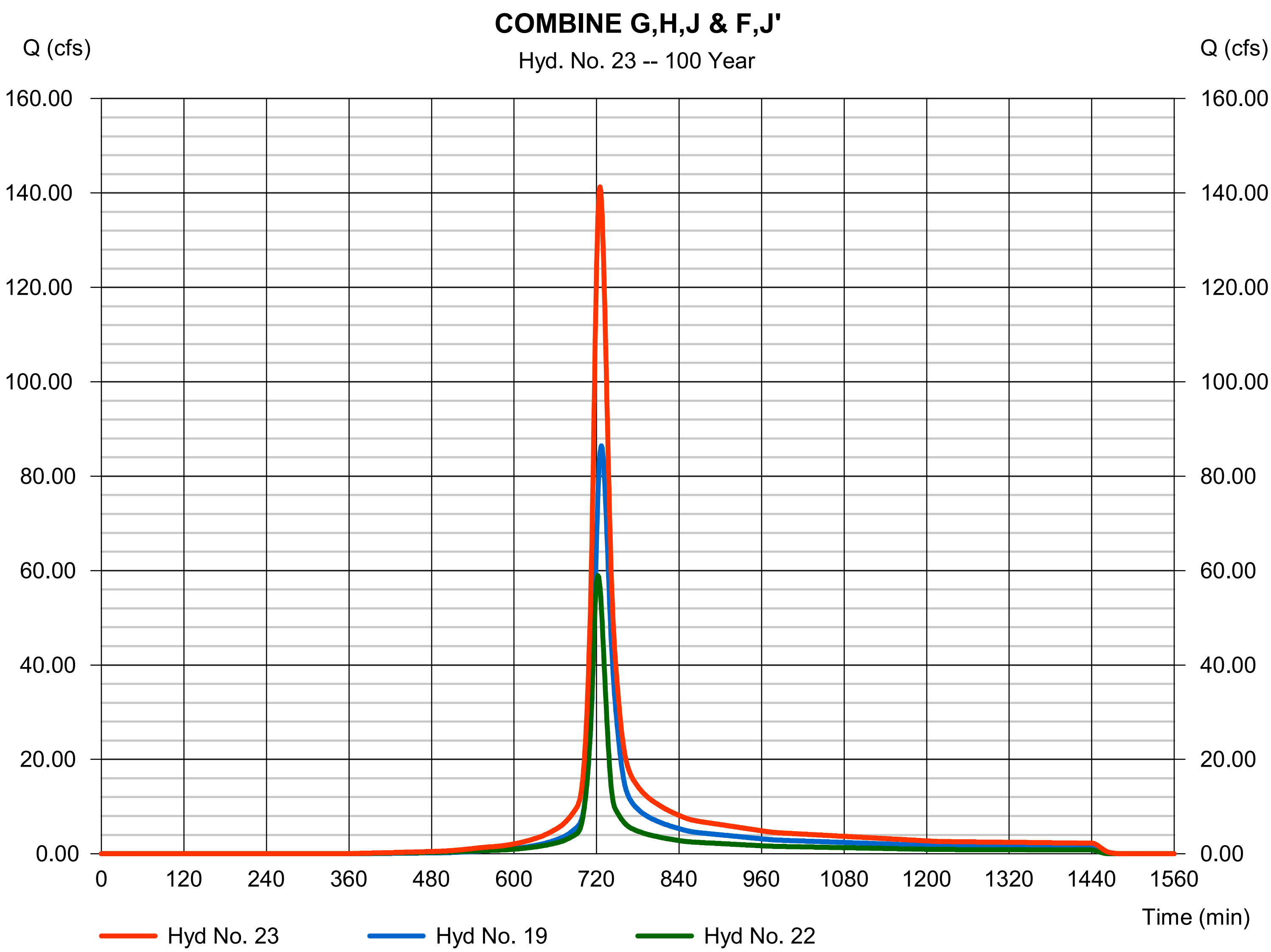
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 23

COMBINE G,H,J & F,J'

Hydrograph type	= Combine	Peak discharge	= 141.26 cfs
Storm frequency	= 100 yrs	Time to peak	= 725 min
Time interval	= 1 min	Hyd. volume	= 487,654 cuft
Inflow hyds.	= 19, 22	Contrib. drain. area	= 0.000 ac



Hydrograph Report

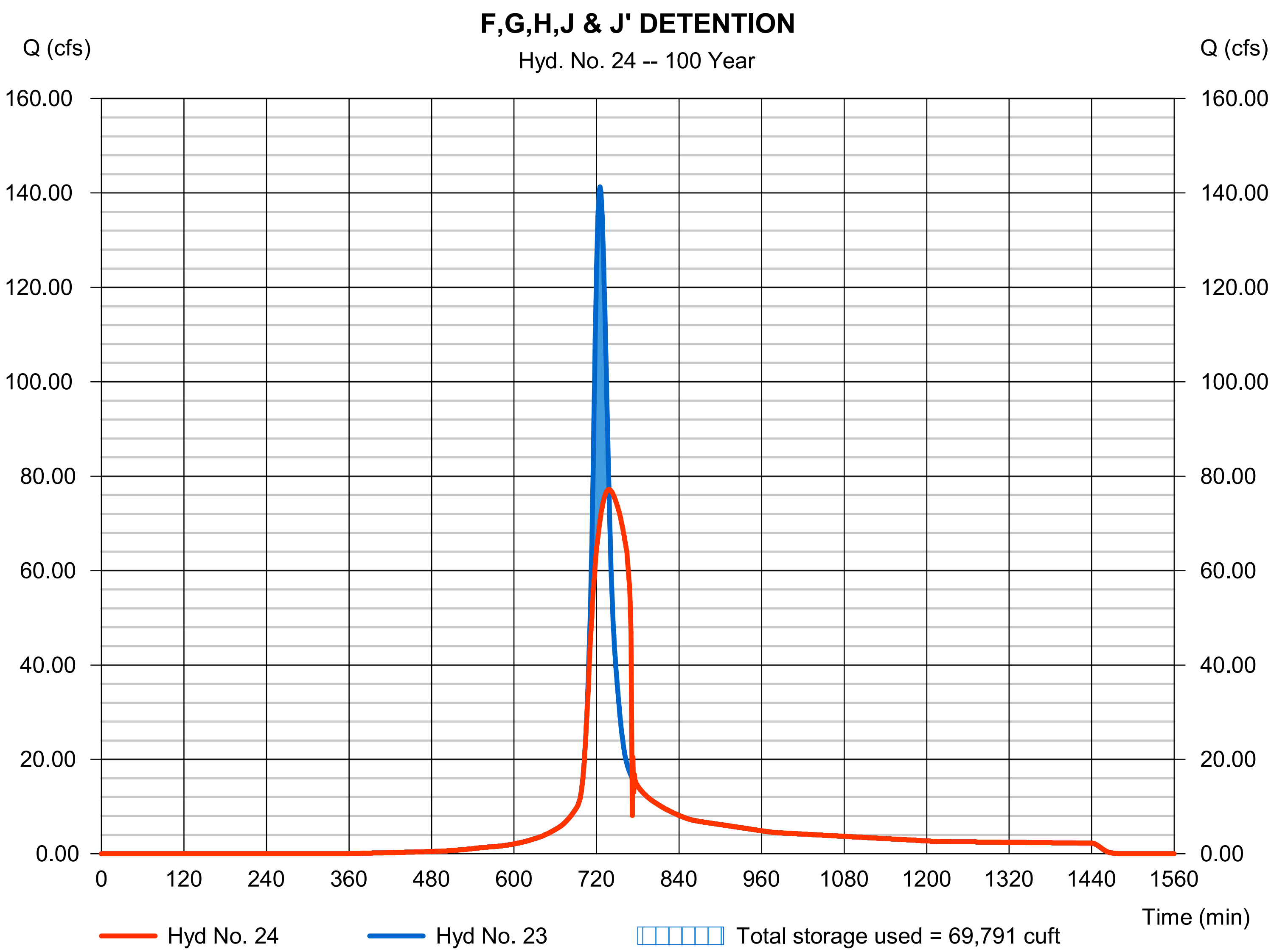
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 11 / 15 / 2018

Hyd. No. 24

F,G,H,J & J' DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 77.19 cfs
Storm frequency	= 100 yrs	Time to peak	= 738 min
Time interval	= 1 min	Hyd. volume	= 487,655 cuft
Inflow hyd. No.	= 23 - COMBINE G,H,J & F,J'	Max. Elevation	= 581.79 ft
Reservoir name	= F,G,H,J & J' DETENTION	Max. Storage	= 69,791 cuft

Storage Indication method used.



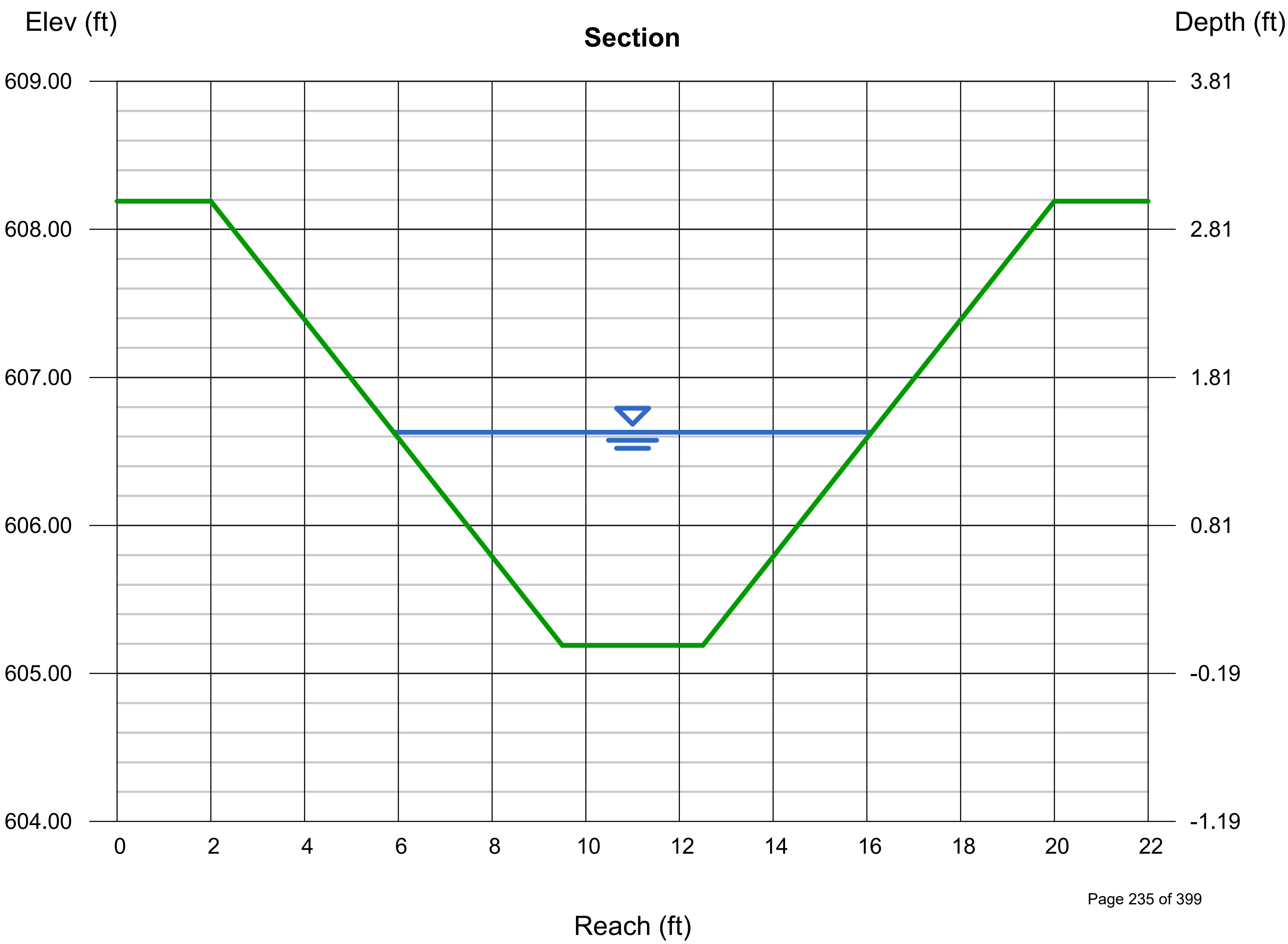
Pre- and Post-Development Ditch Calculations (HydraFlow Express)

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH D-1 @ N 1550546, E 1942779 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.44
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 17.57
Total Depth (ft)	= 3.00	Area (sqft)	= 9.50
Invert Elev (ft)	= 605.19	Velocity (ft/s)	= 1.85
Slope (%)	= 1.00	Wetted Perim (ft)	= 10.75
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.82
		Top Width (ft)	= 10.20
Calculations		EGL (ft)	= 1.49
Compute by:	Known Q		
Known Q (cfs)	= 17.57		

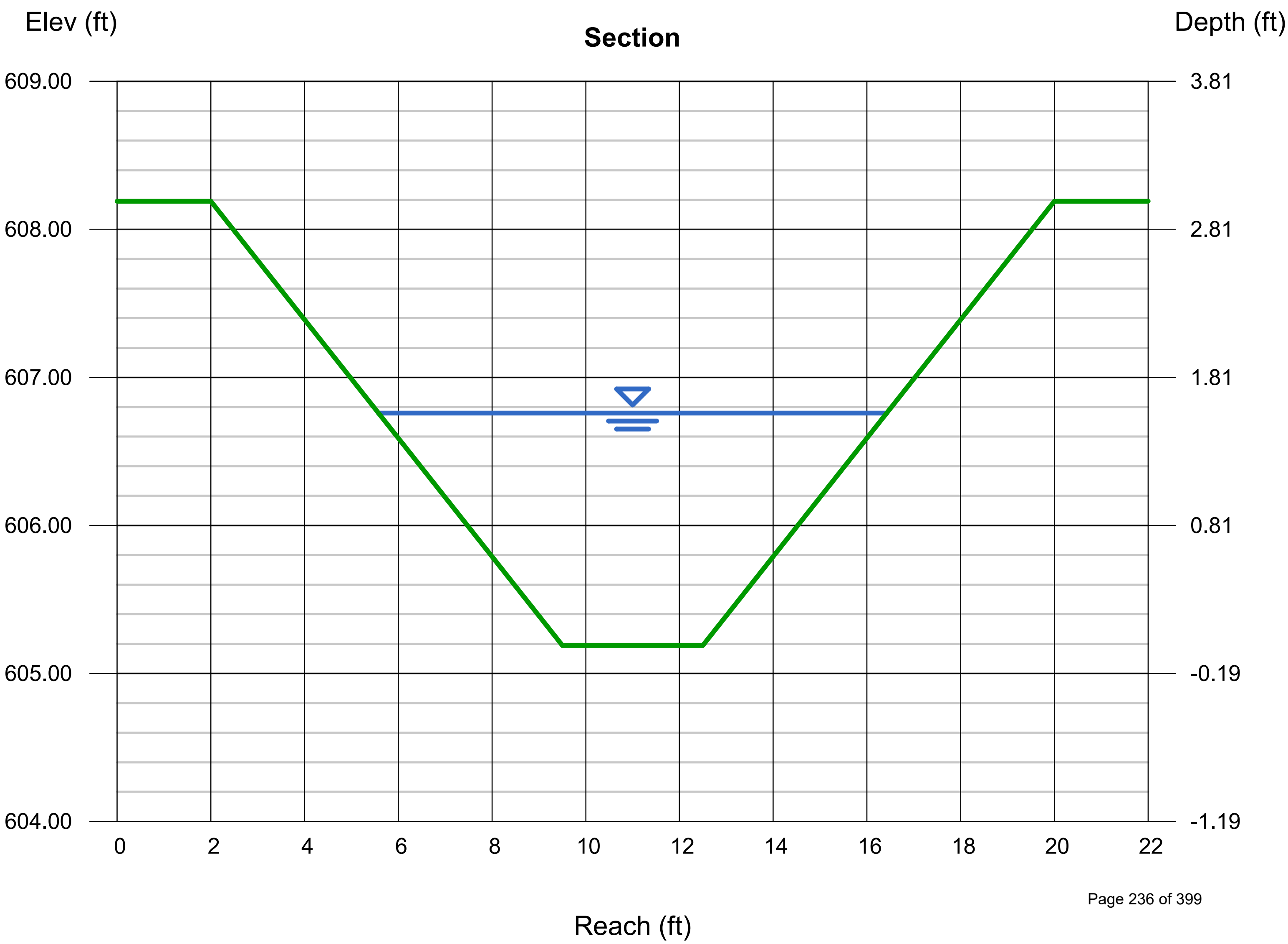


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH D-1 @ N 1550546, E 1942779 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.57
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 20.99
Total Depth (ft)	= 3.00	Area (sqft)	= 10.87
Invert Elev (ft)	= 605.19	Velocity (ft/s)	= 1.93
Slope (%)	= 1.00	Wetted Perim (ft)	= 11.45
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.90
		Top Width (ft)	= 10.85
Calculations		EGL (ft)	= 1.63
Compute by:	Known Q		
Known Q (cfs)	= 20.99		



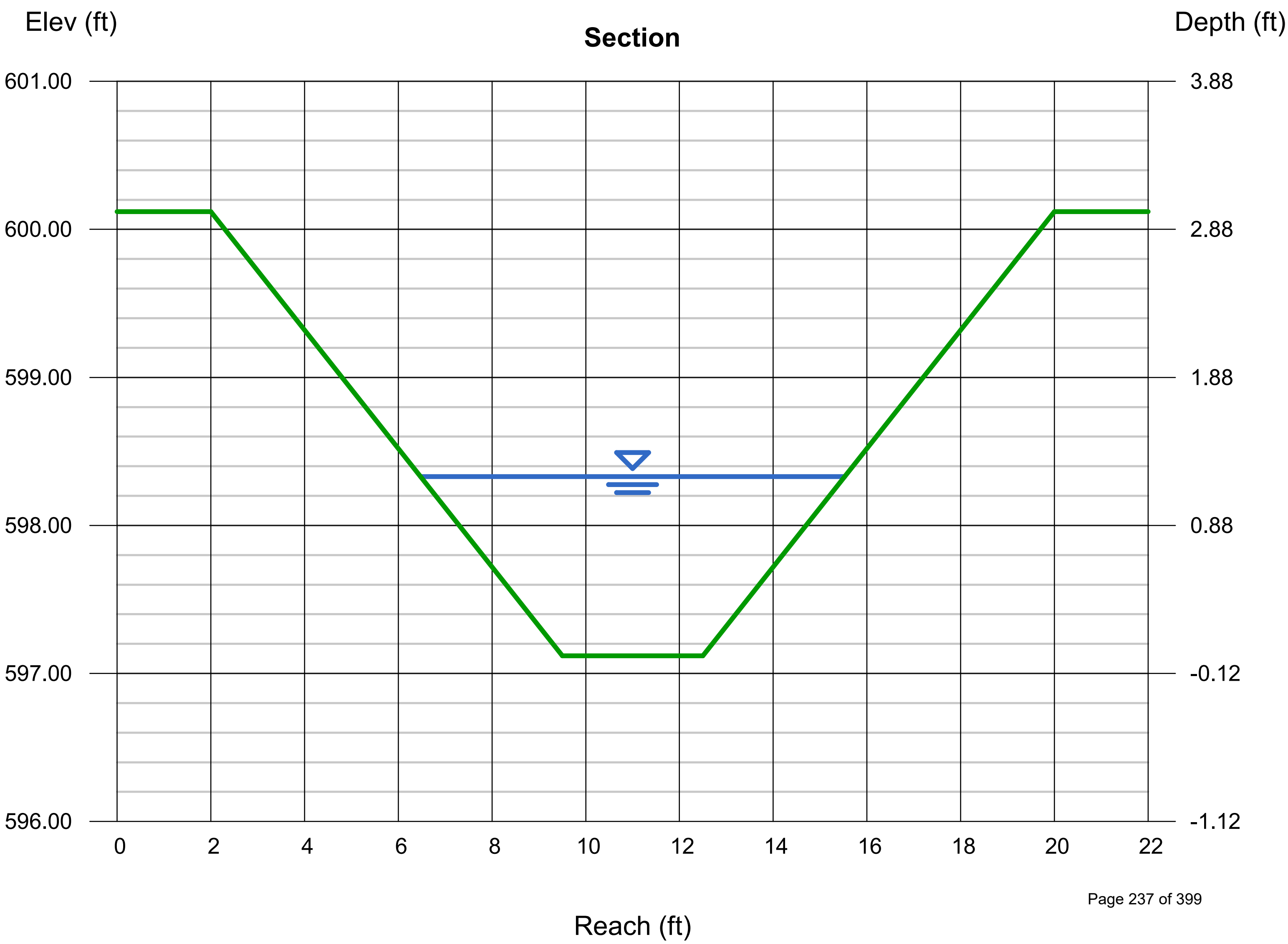
Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH D-1A @ N 1550162, E 1942110 (25 YR.)

Trapezoidal	
Bottom Width (ft)	= 3.00
Side Slopes (z:1)	= 2.50, 2.50
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 597.12
Slope (%)	= 2.10
N-Value	= 0.074
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 17.57

Highlighted	
Depth (ft)	= 1.21
Q (cfs)	= 17.57
Area (sqft)	= 7.29
Velocity (ft/s)	= 2.41
Wetted Perim (ft)	= 9.52
Crit Depth, Yc (ft)	= 0.82
Top Width (ft)	= 9.05
EGL (ft)	= 1.30

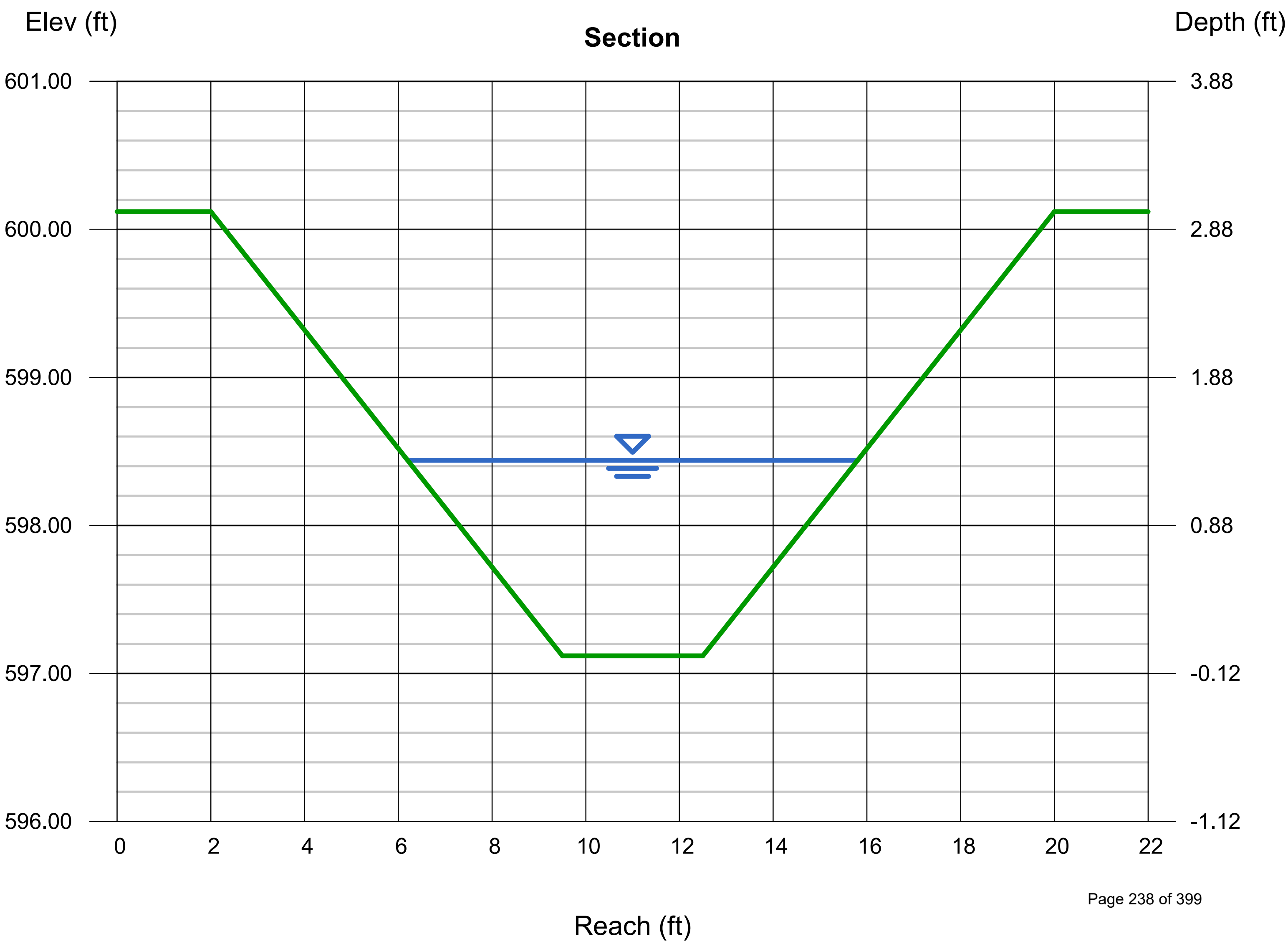


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH D-1A @ N 1550162, E 1942110 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.32
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 20.99
Total Depth (ft)	= 3.00	Area (sqft)	= 8.32
Invert Elev (ft)	= 597.12	Velocity (ft/s)	= 2.52
Slope (%)	= 2.10	Wetted Perim (ft)	= 10.11
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.90
		Top Width (ft)	= 9.60
Calculations		EGL (ft)	= 1.42
Compute by:	Known Q		
Known Q (cfs)	= 20.99		

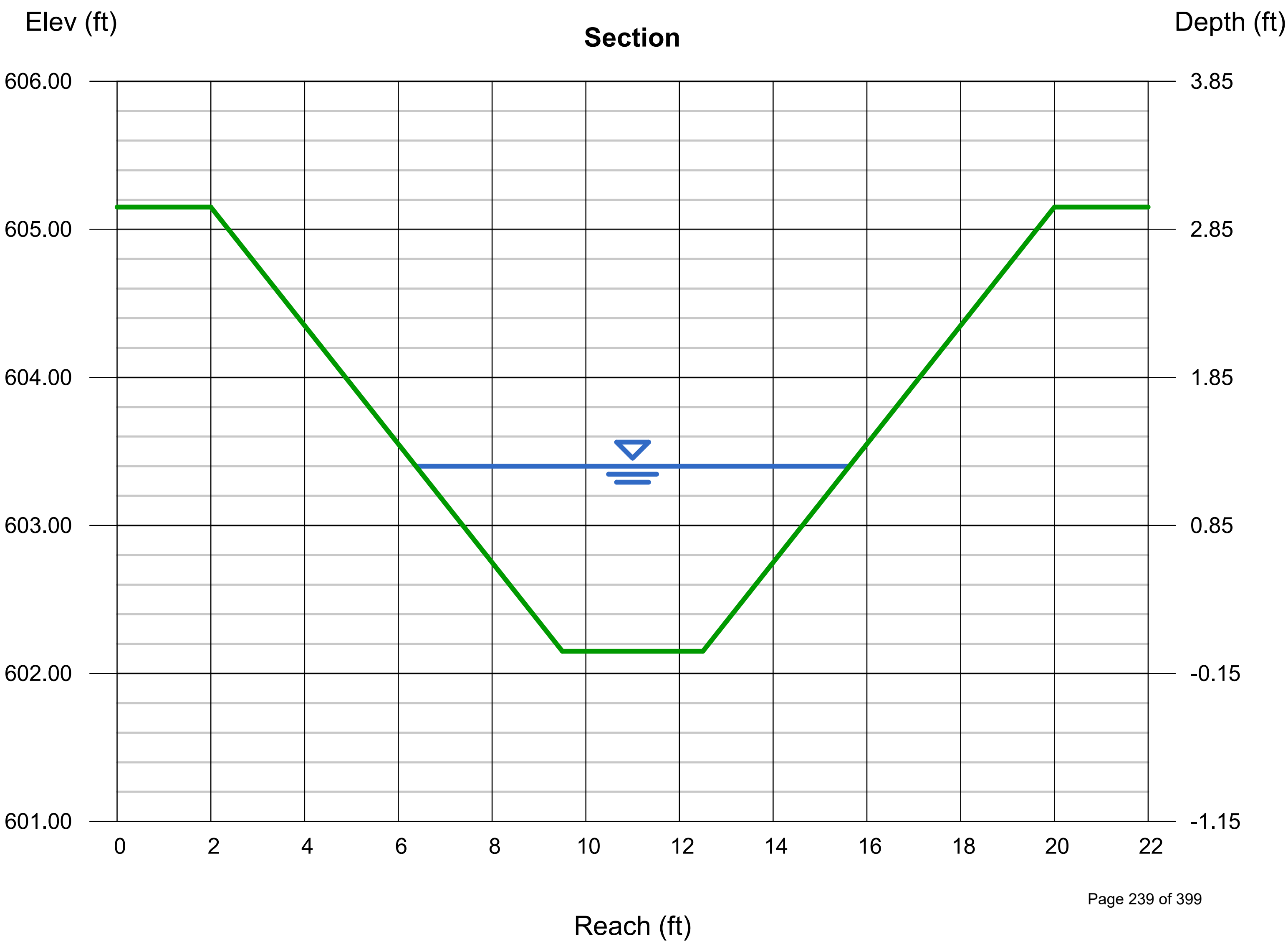


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH D-2 @ N 1550690, E 1942053 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.25
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 12.89
Total Depth (ft)	= 3.00	Area (sqft)	= 7.66
Invert Elev (ft)	= 602.15	Velocity (ft/s)	= 1.68
Slope (%)	= 1.00	Wetted Perim (ft)	= 9.73
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.69
		Top Width (ft)	= 9.25
Calculations		EGL (ft)	= 1.29
Compute by:	Known Q		
Known Q (cfs)	= 12.89		

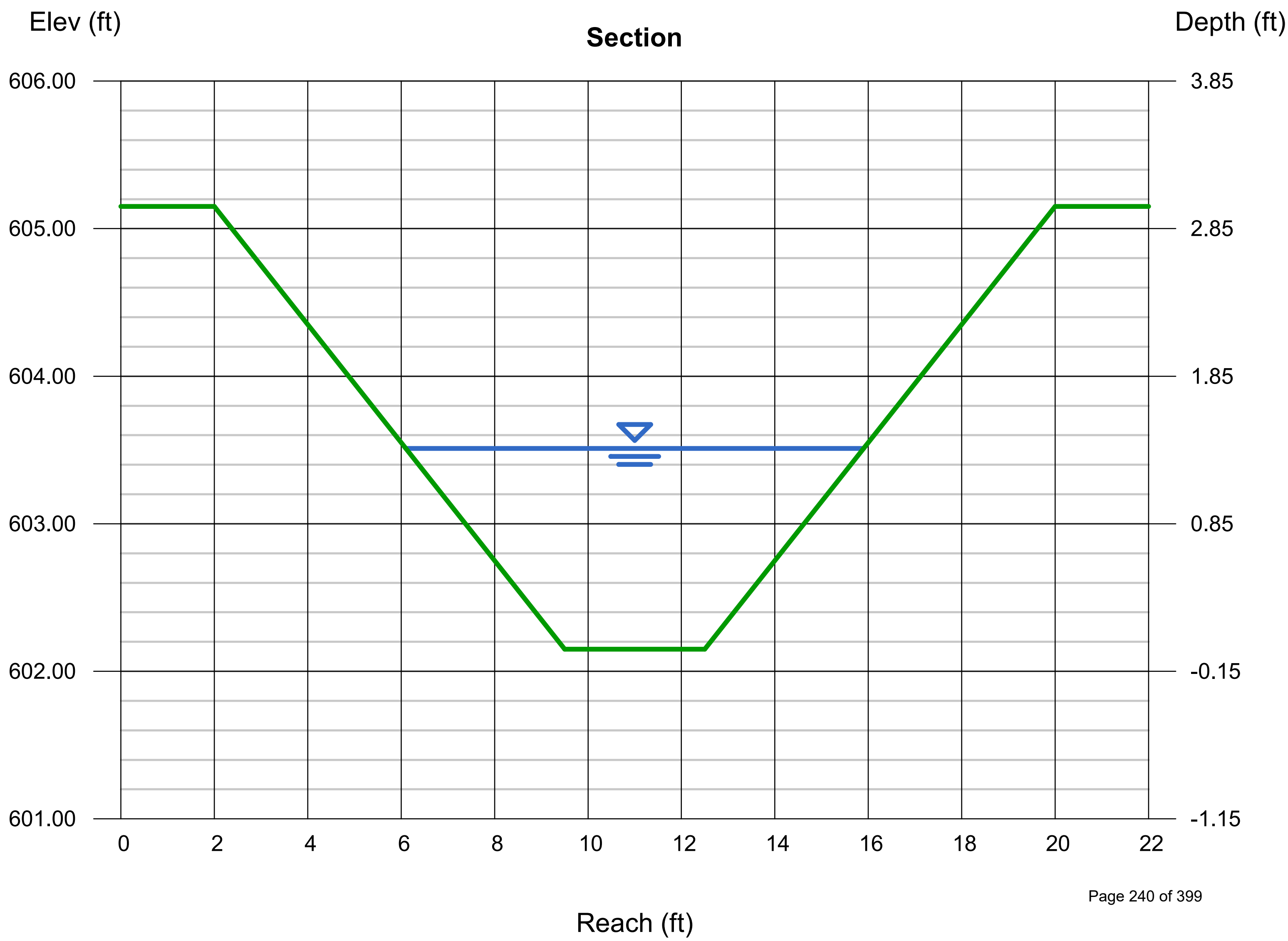


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH D-2 @ N 1550690, E 1942053 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.36
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 15.39
Total Depth (ft)	= 3.00	Area (sqft)	= 8.70
Invert Elev (ft)	= 602.15	Velocity (ft/s)	= 1.77
Slope (%)	= 1.00	Wetted Perim (ft)	= 10.32
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.76
		Top Width (ft)	= 9.80
Calculations		EGL (ft)	= 1.41
Compute by:	Known Q		
Known Q (cfs)	= 15.39		

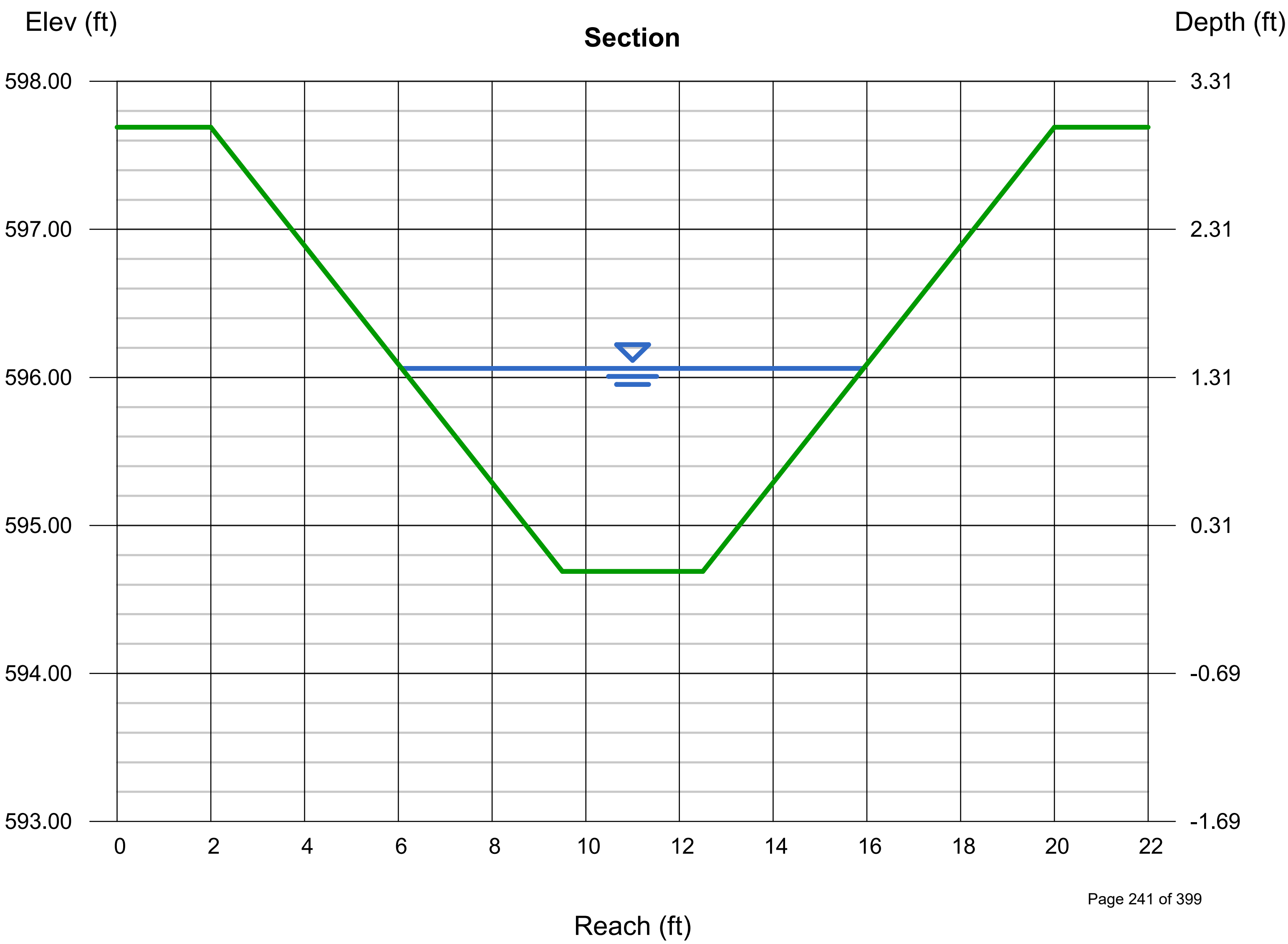


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH D-3 @ N 1550428, E 1942016 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.37
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 16.50
Total Depth (ft)	= 3.00	Area (sqft)	= 8.80
Invert Elev (ft)	= 594.69	Velocity (ft/s)	= 1.87
Slope (%)	= 1.10	Wetted Perim (ft)	= 10.38
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.79
		Top Width (ft)	= 9.85
Calculations		EGL (ft)	= 1.42
Compute by:	Known Q		
Known Q (cfs)	= 16.50		



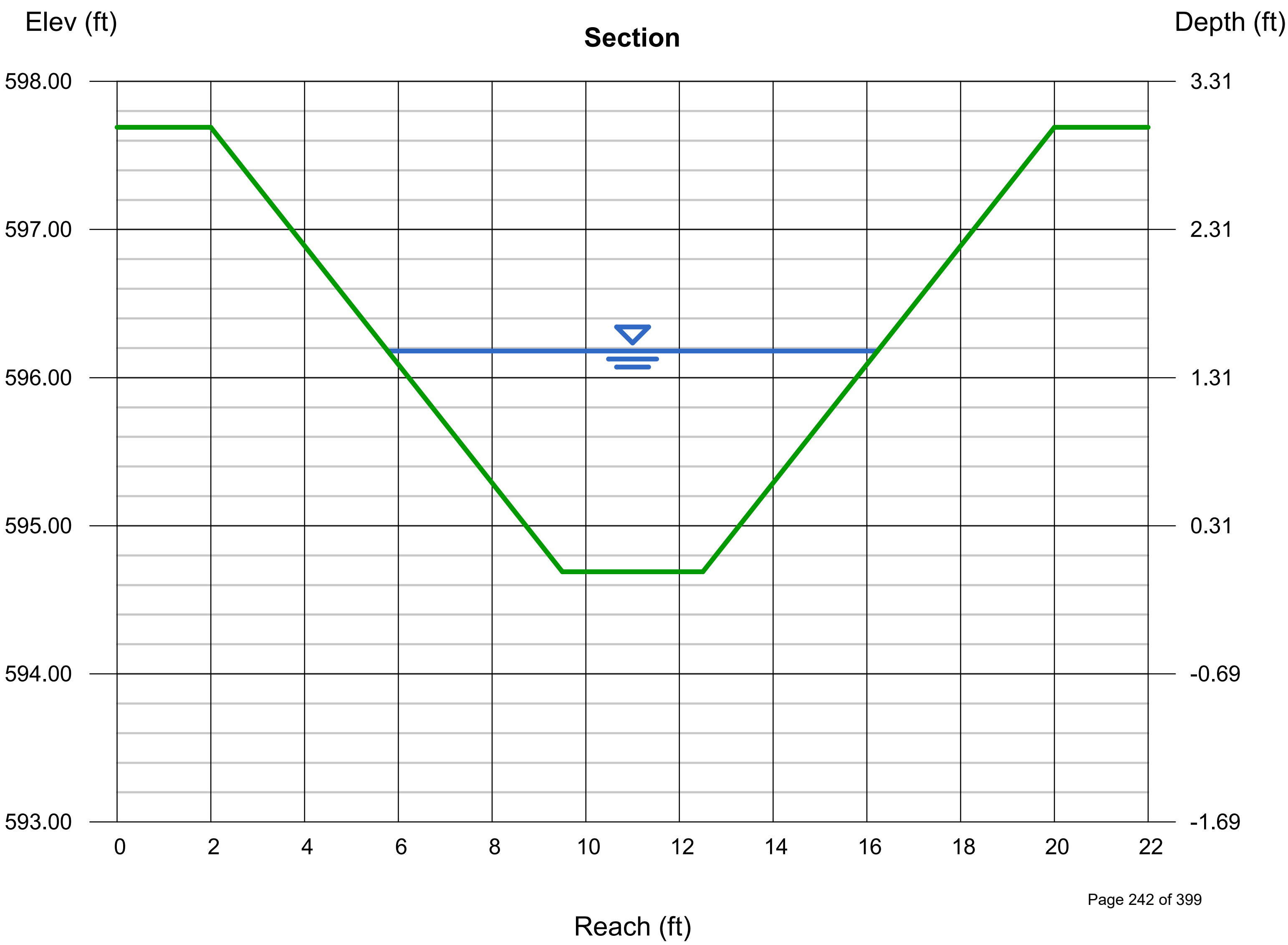
Channel Report

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

Saturday, Nov 10 2018

DITCH D-3 @ N 1550428, E 1942016 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.49
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 19.70
Total Depth (ft)	= 3.00	Area (sqft)	= 10.02
Invert Elev (ft)	= 594.69	Velocity (ft/s)	= 1.97
Slope (%)	= 1.10	Wetted Perim (ft)	= 11.02
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.87
		Top Width (ft)	= 10.45
Calculations		EGL (ft)	= 1.55
Compute by:	Known Q		
Known Q (cfs)	= 19.70		

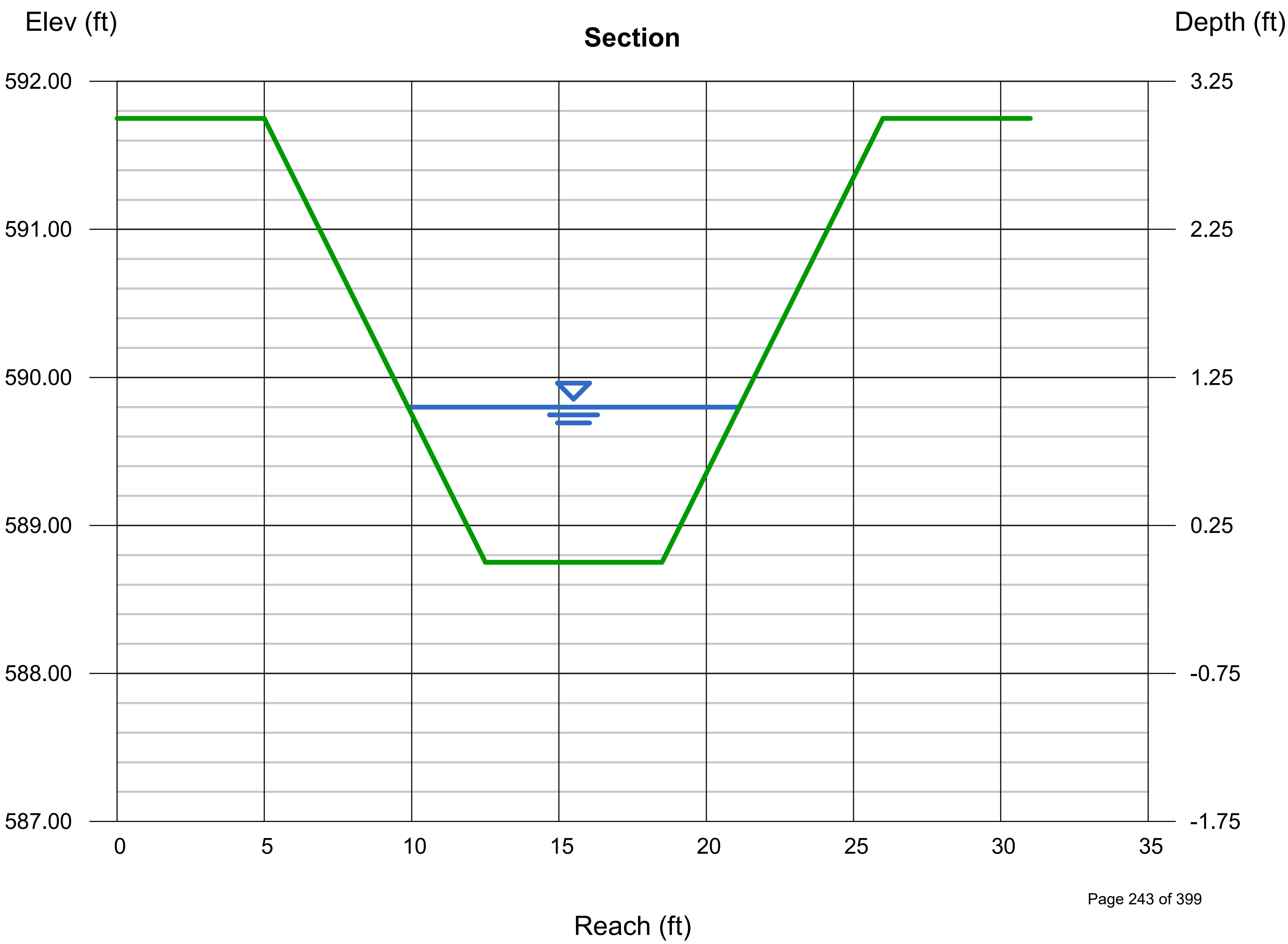


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

Ditch D-4 @ N 1550287, E 1942015 (25 YR)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 1.05
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 34.07
Total Depth (ft)	= 3.00	Area (sqft)	= 9.06
Invert Elev (ft)	= 588.75	Velocity (ft/s)	= 3.76
Slope (%)	= 5.00	Wetted Perim (ft)	= 11.65
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.88
		Top Width (ft)	= 11.25
Calculations		EGL (ft)	= 1.27
Compute by:	Known Q		
Known Q (cfs)	= 34.07		



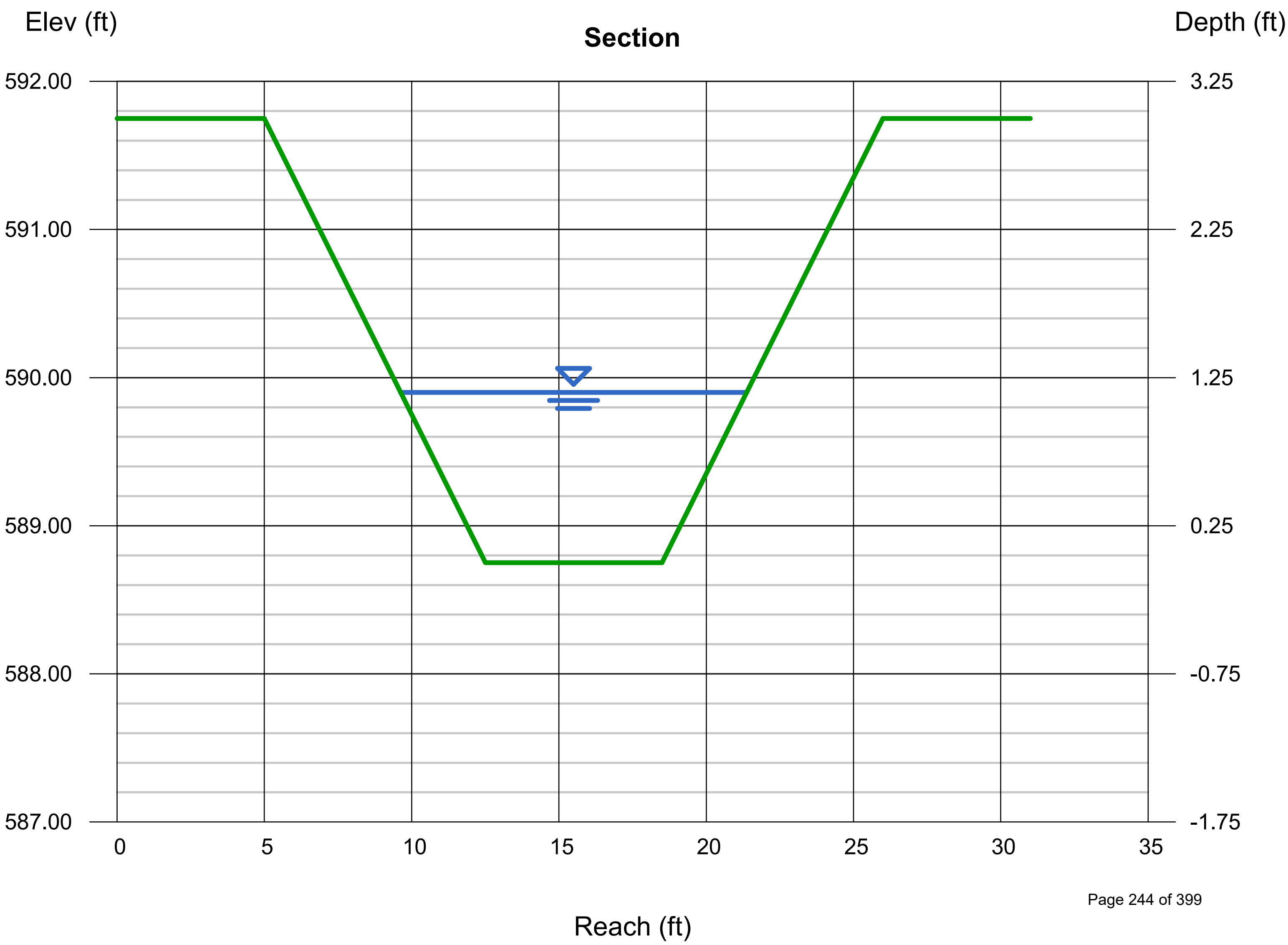
Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

Ditch D-4 @ N 1550287, E 1942015 (100 YR)

Trapezoidal	
Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 2.50, 2.50
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 588.75
Slope (%)	= 5.00
N-Value	= 0.074
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 40.69

Highlighted	
Depth (ft)	= 1.15
Q (cfs)	= 40.69
Area (sqft)	= 10.21
Velocity (ft/s)	= 3.99
Wetted Perim (ft)	= 12.19
Crit Depth, Yc (ft)	= 0.98
Top Width (ft)	= 11.75
EGL (ft)	= 1.40

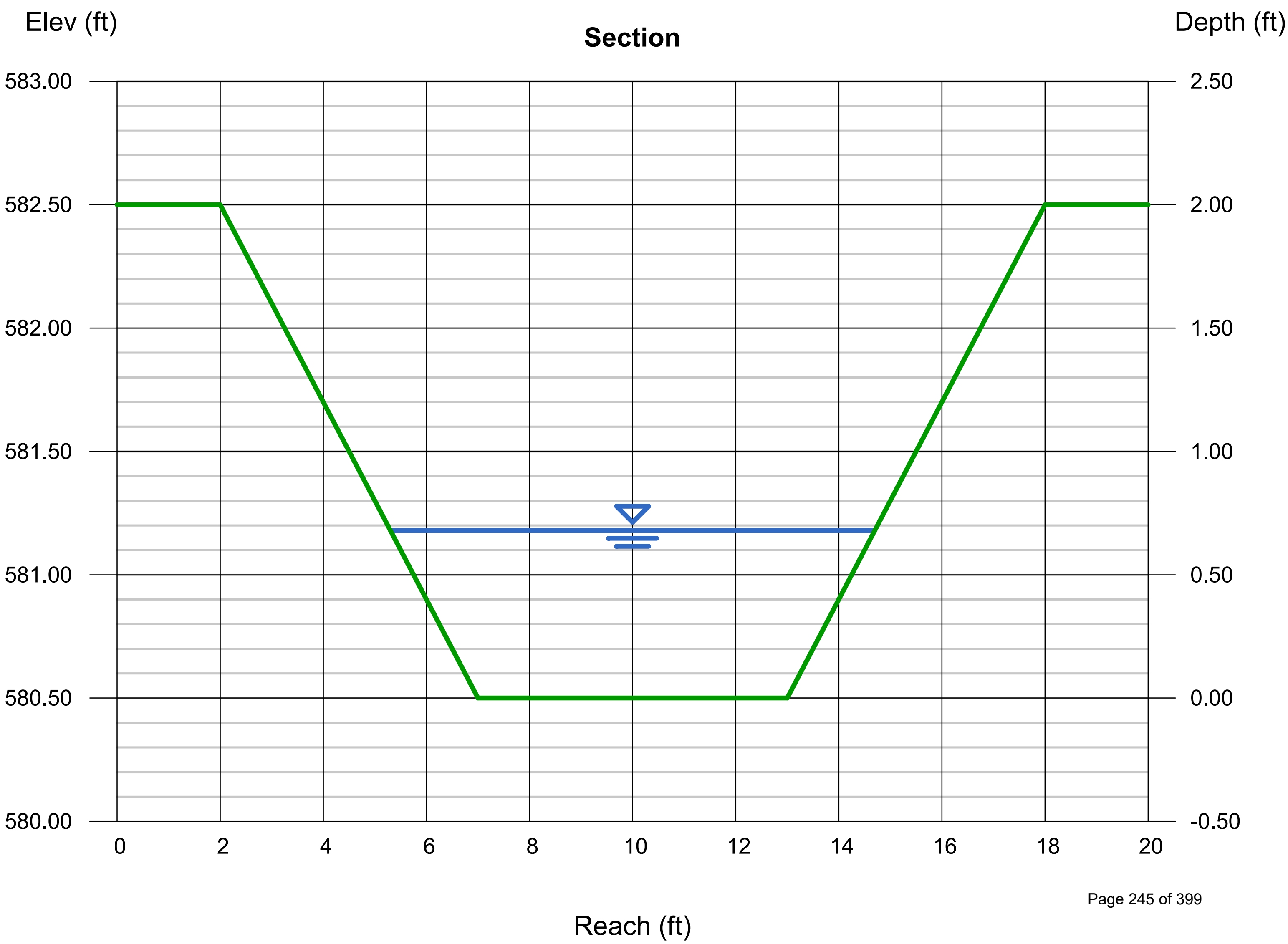


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

Ditch D-5 @ N 1,550,254, E 1,941,901 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.68
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 34.07
Total Depth (ft)	= 2.00	Area (sqft)	= 5.24
Invert Elev (ft)	= 580.50	Velocity (ft/s)	= 6.51
Slope (%)	= 25.00	Wetted Perim (ft)	= 9.66
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.88
		Top Width (ft)	= 9.40
Calculations		EGL (ft)	= 1.34
Compute by:	Known Q		
Known Q (cfs)	= 34.07		

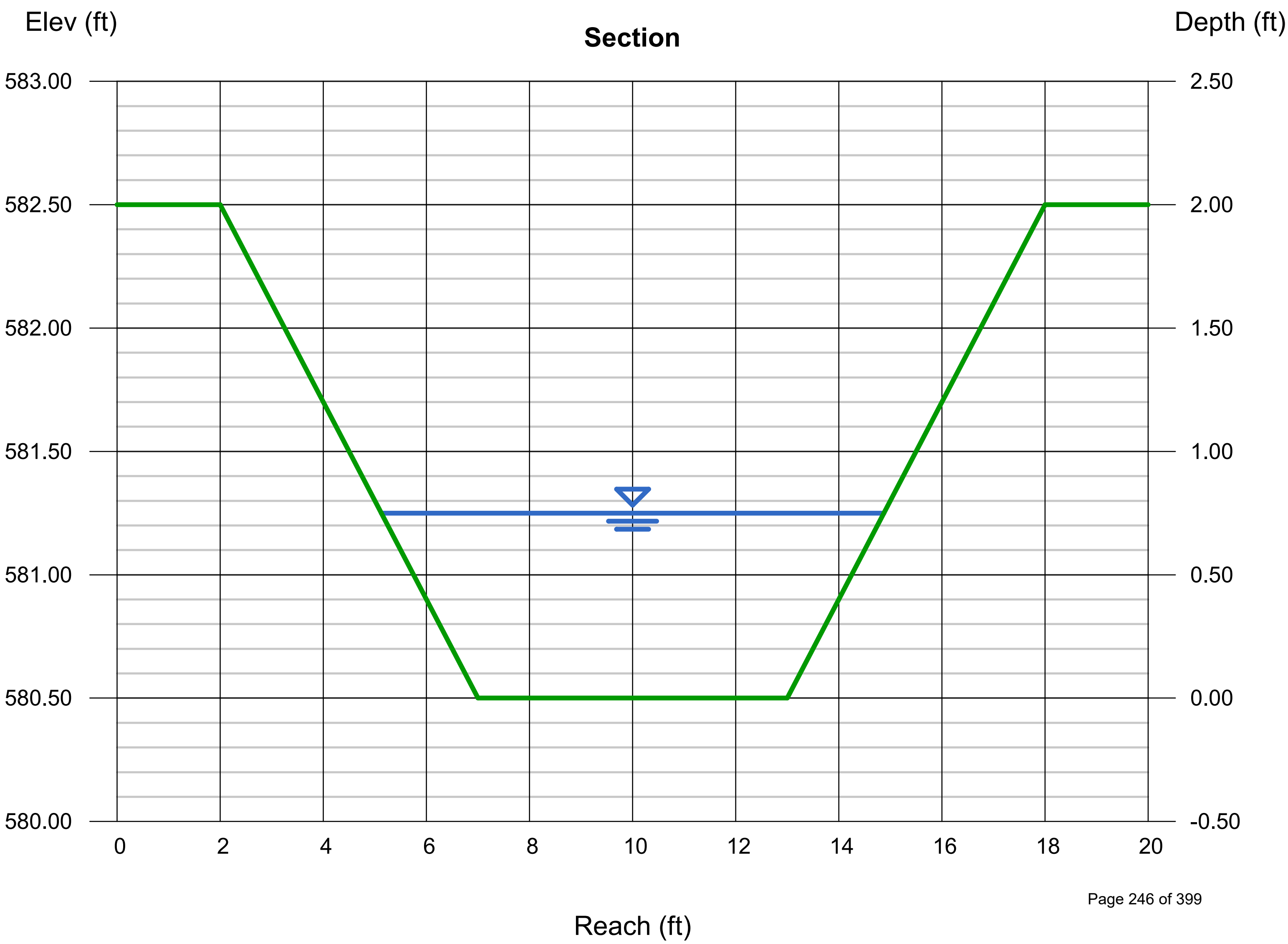


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. | Saturday, Nov 10 2018

Ditch D-5 @ N 1,550,254, E 1,941,901 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.75
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 40.69
Total Depth (ft)	= 2.00	Area (sqft)	= 5.91
Invert Elev (ft)	= 580.50	Velocity (ft/s)	= 6.89
Slope (%)	= 25.00	Wetted Perim (ft)	= 10.04
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.98
		Top Width (ft)	= 9.75
Calculations		EGL (ft)	= 1.49
Compute by:	Known Q		
Known Q (cfs)	= 40.69		

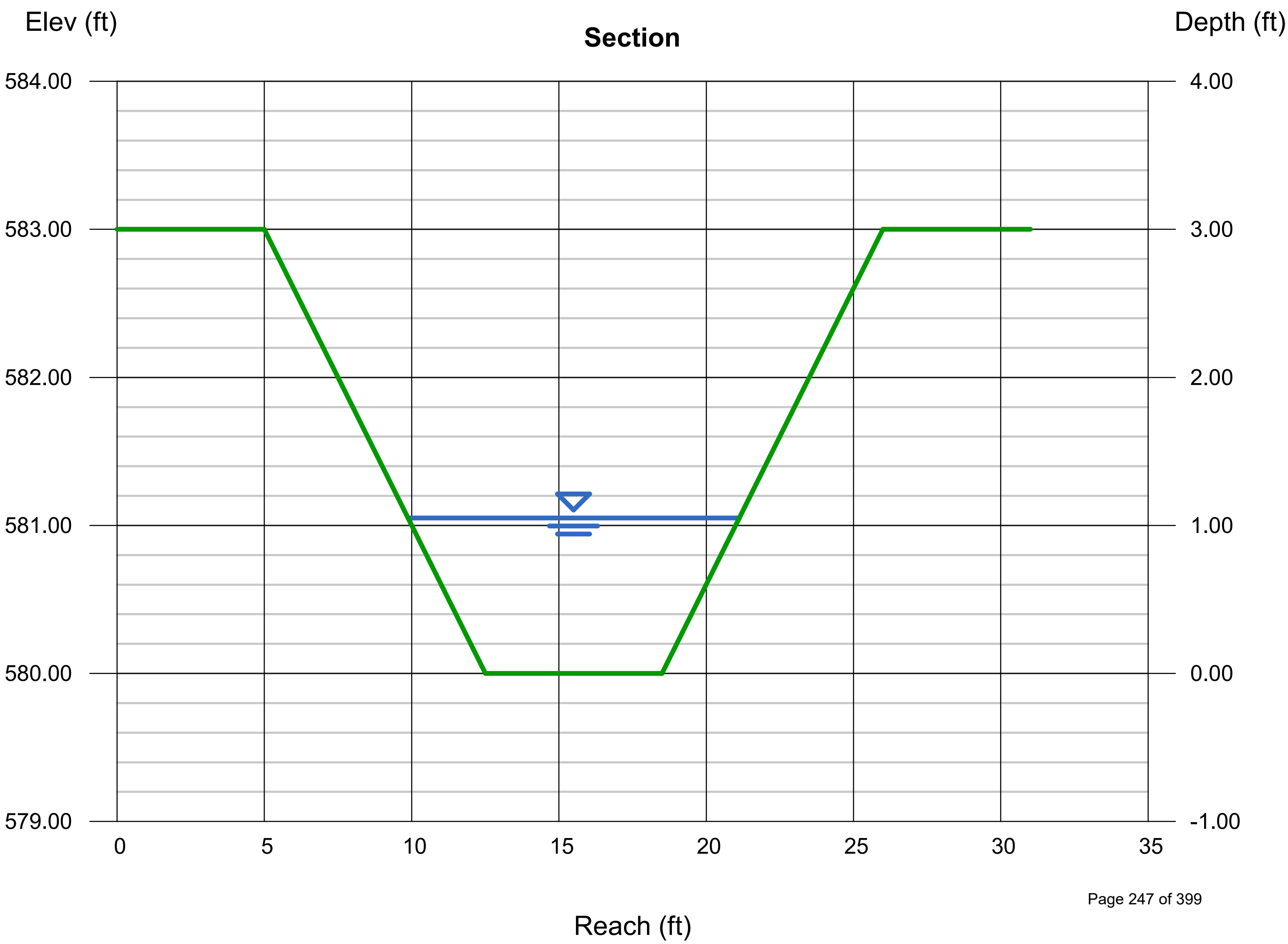


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

Ditch D-6 @ N 1550245, E 1941869 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 1.05
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 34.07
Total Depth (ft)	= 3.00	Area (sqft)	= 9.06
Invert Elev (ft)	= 580.00	Velocity (ft/s)	= 3.76
Slope (%)	= 5.00	Wetted Perim (ft)	= 11.65
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.88
		Top Width (ft)	= 11.25
Calculations		EGL (ft)	= 1.27
Compute by:	Known Q		
Known Q (cfs)	= 34.07		



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

Ditch D-6 @ N 1550245, E 1941869 (100 YR.)

Trapezoidal

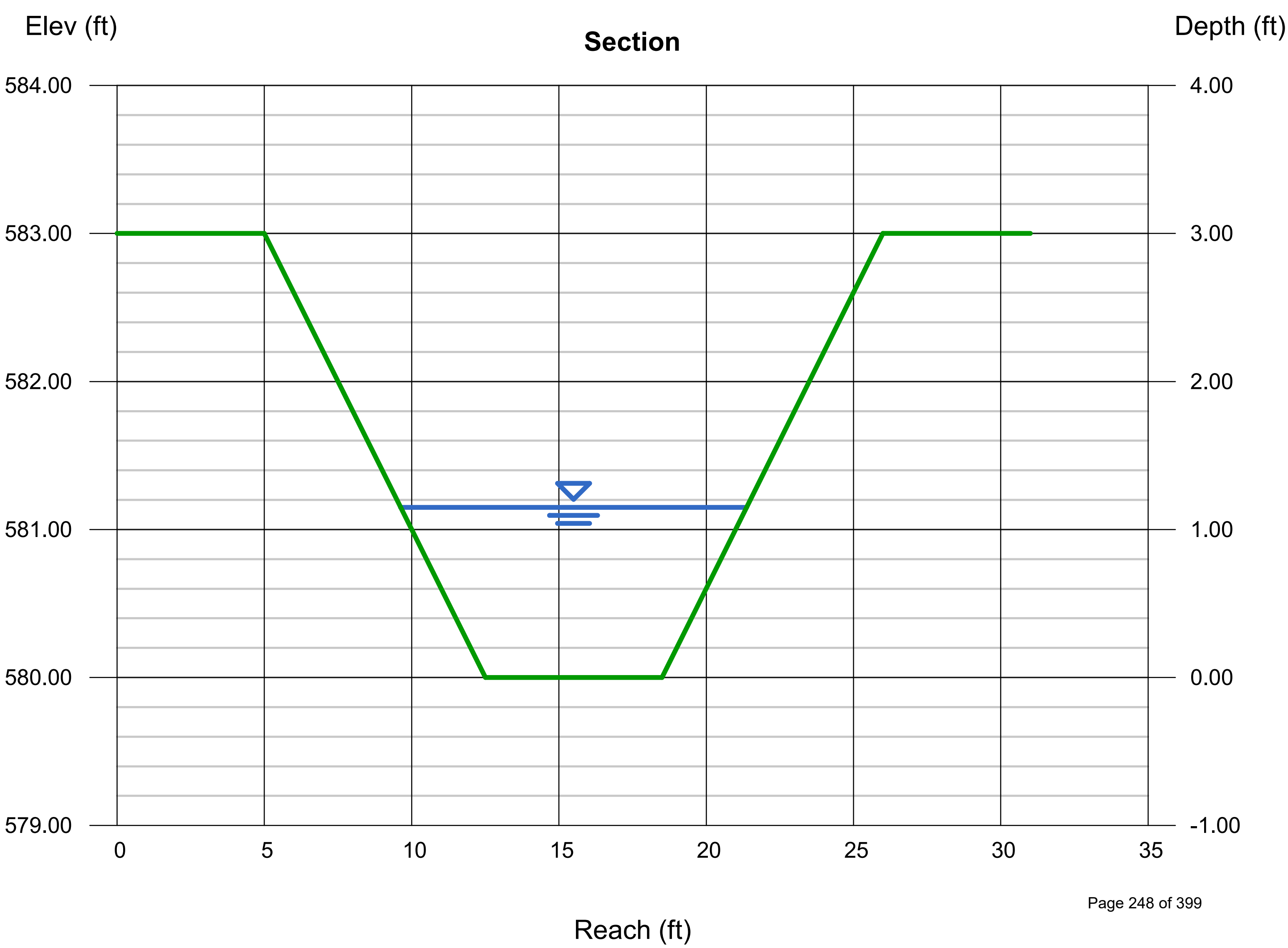
Bottom Width (ft)	=	6.00
Side Slopes (z:1)	=	2.50, 2.50
Total Depth (ft)	=	3.00
Invert Elev (ft)	=	580.00
Slope (%)	=	5.00
N-Value	=	0.074

Calculations

Compute by:		Known Q
Known Q (cfs)	=	40.69

Highlighted

Depth (ft)	=	1.15
Q (cfs)	=	40.69
Area (sqft)	=	10.21
Velocity (ft/s)	=	3.99
Wetted Perim (ft)	=	12.19
Crit Depth, Yc (ft)	=	0.98
Top Width (ft)	=	11.75
EGL (ft)	=	1.40



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-1 @ N 1550548, E 1942777 (25 YR.)

Trapezoidal

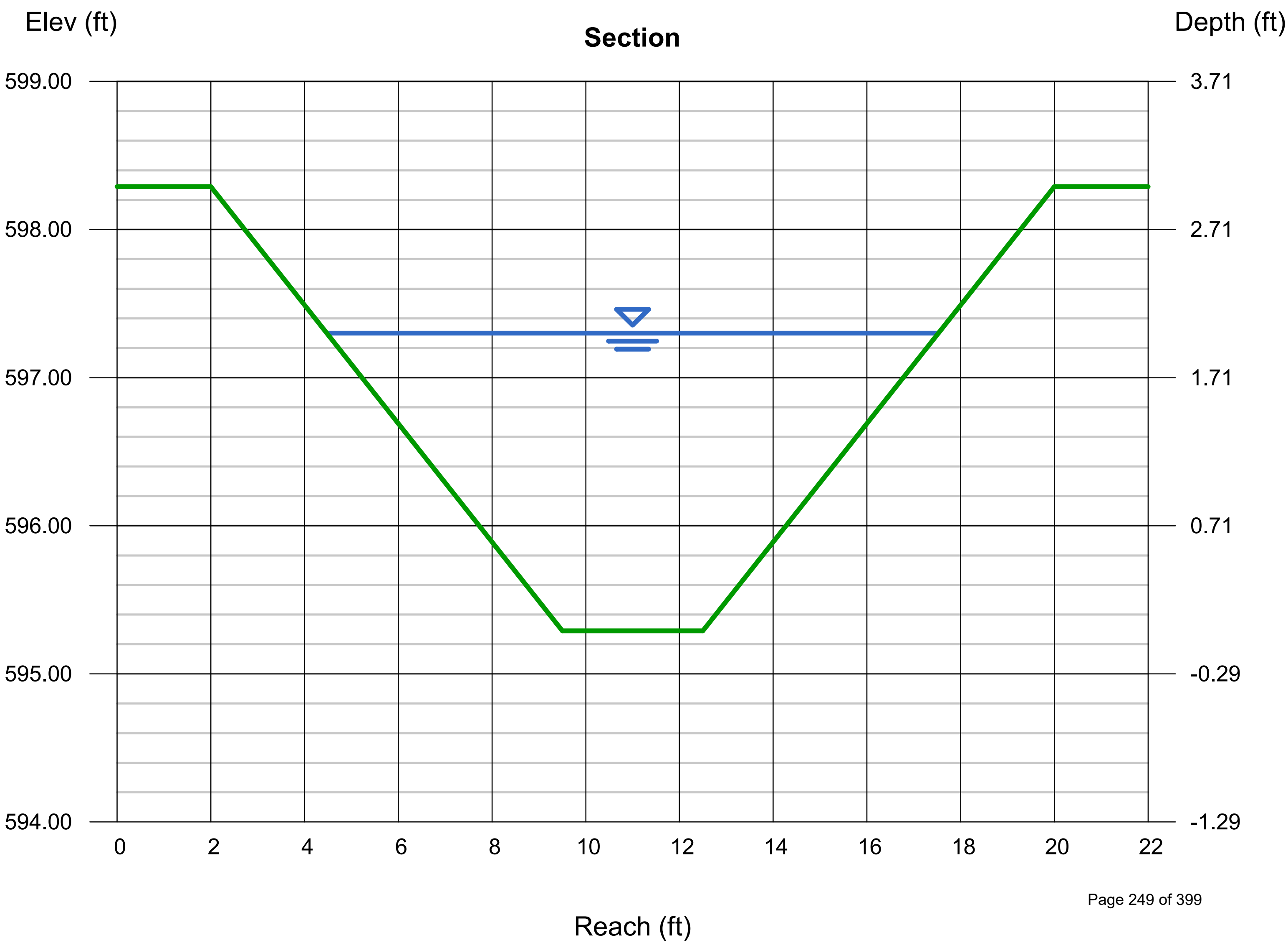
Bottom Width (ft)	= 3.00
Side Slopes (z:1)	= 2.50, 2.50
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 595.29
Slope (%)	= 1.00
N-Value	= 0.074

Calculations

Compute by:	Known Q
Known Q (cfs)	= 35.73

Highlighted

Depth (ft)	= 2.01
Q (cfs)	= 35.73
Area (sqft)	= 16.13
Velocity (ft/s)	= 2.22
Wetted Perim (ft)	= 13.82
Crit Depth, Yc (ft)	= 1.19
Top Width (ft)	= 13.05
EGL (ft)	= 2.09



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. | Saturday, Nov 10 2018

DITCH F-1 @ N 1550548, E 1942777 (100 YR.)

Trapezoidal

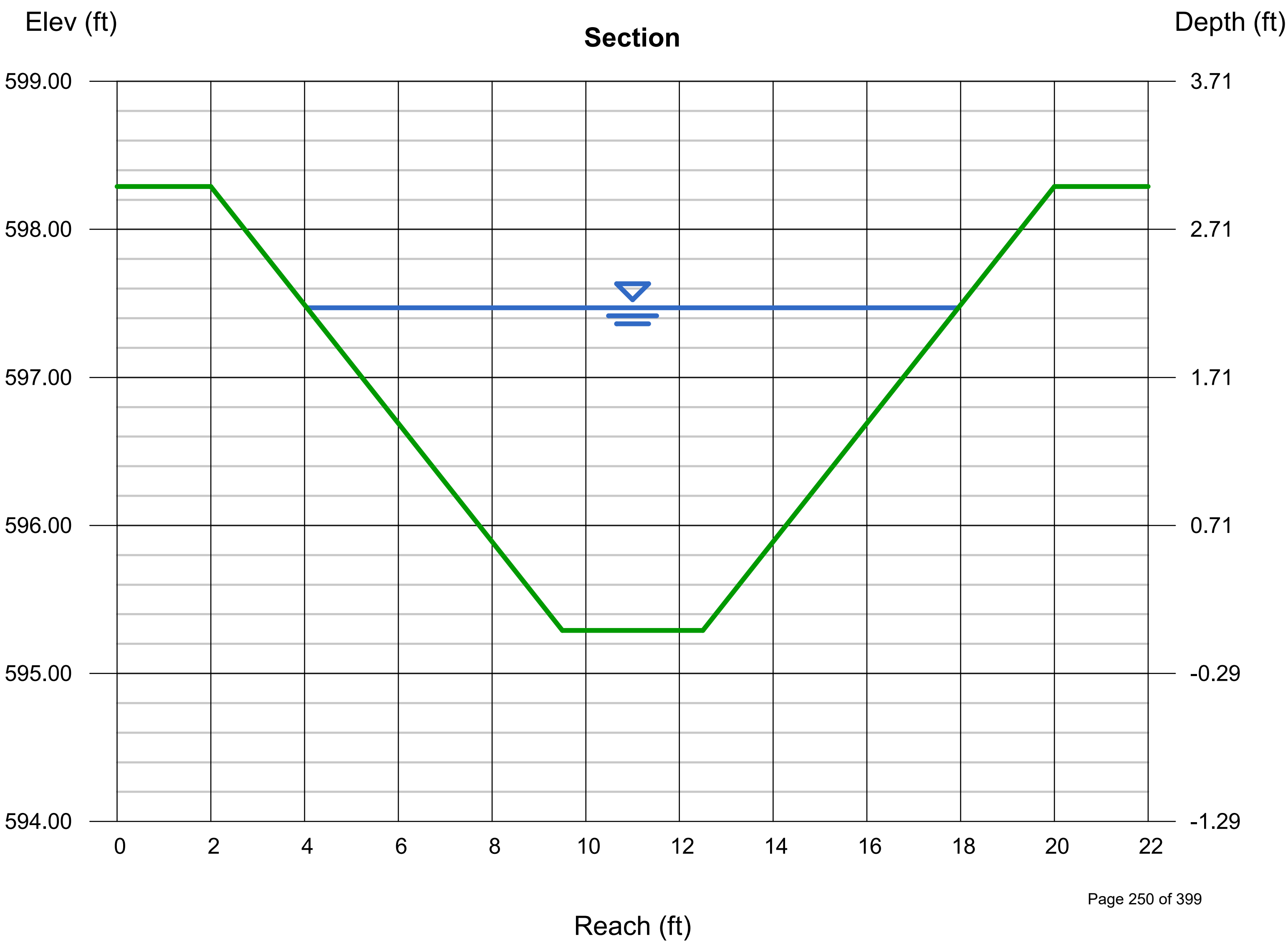
Bottom Width (ft)	= 3.00
Side Slopes (z:1)	= 2.50, 2.50
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 595.29
Slope (%)	= 1.00
N-Value	= 0.074

Calculations

Compute by:	Known Q
Known Q (cfs)	= 42.67

Highlighted

Depth (ft)	= 2.18
Q (cfs)	= 42.67
Area (sqft)	= 18.42
Velocity (ft/s)	= 2.32
Wetted Perim (ft)	= 14.74
Crit Depth, Yc (ft)	= 1.31
Top Width (ft)	= 13.90
EGL (ft)	= 2.26



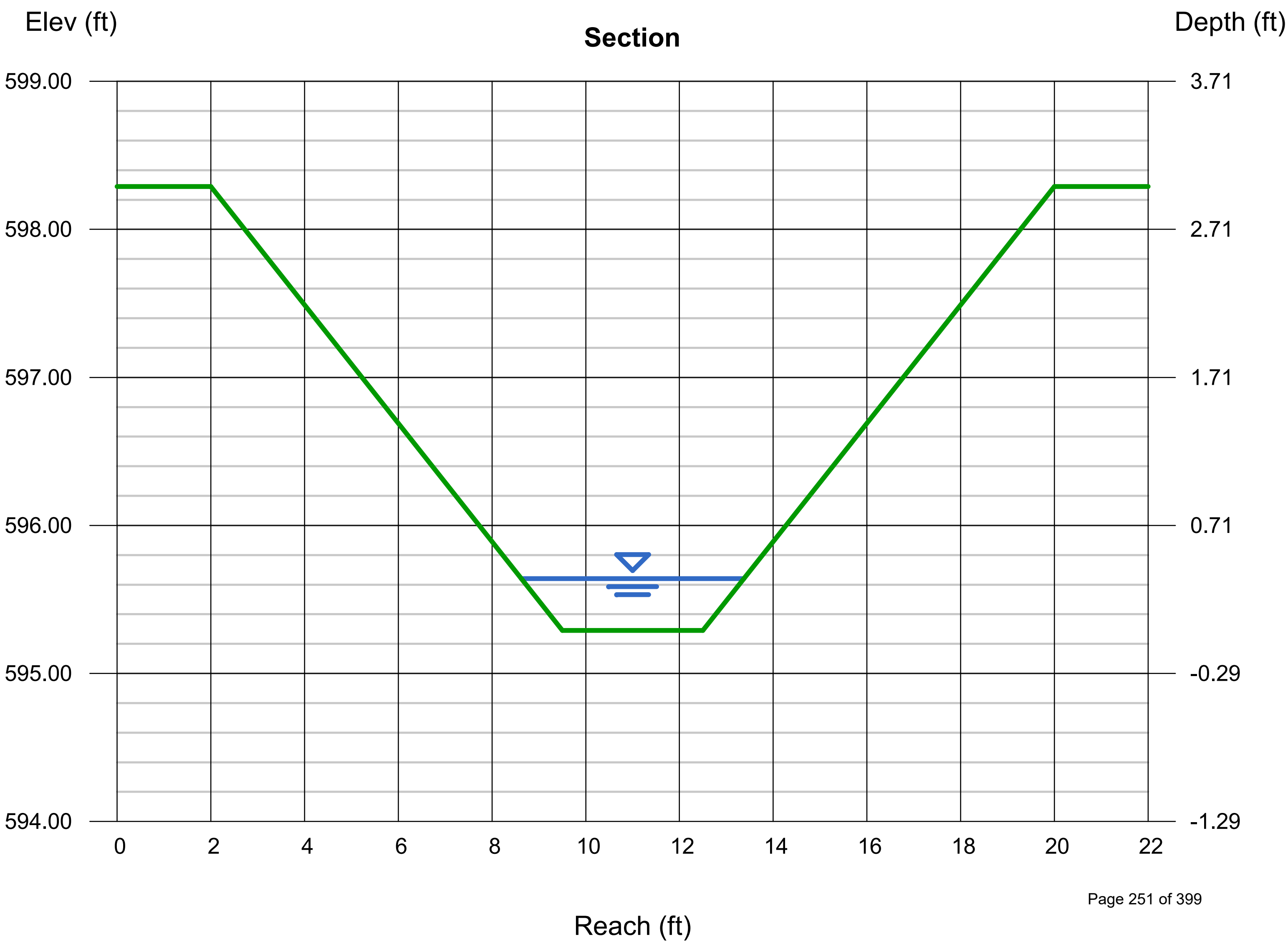
Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-2 @ N 1551498, E 1942496 (25 YR.)

Trapezoidal	
Bottom Width (ft)	= 3.00
Side Slopes (z:1)	= 2.50, 2.50
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 595.29
Slope (%)	= 5.37
N-Value	= 0.074
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 2.61

Highlighted	
Depth (ft)	= 0.35
Q (cfs)	= 2.610
Area (sqft)	= 1.36
Velocity (ft/s)	= 1.92
Wetted Perim (ft)	= 4.88
Crit Depth, Yc (ft)	= 0.27
Top Width (ft)	= 4.75
EGL (ft)	= 0.41

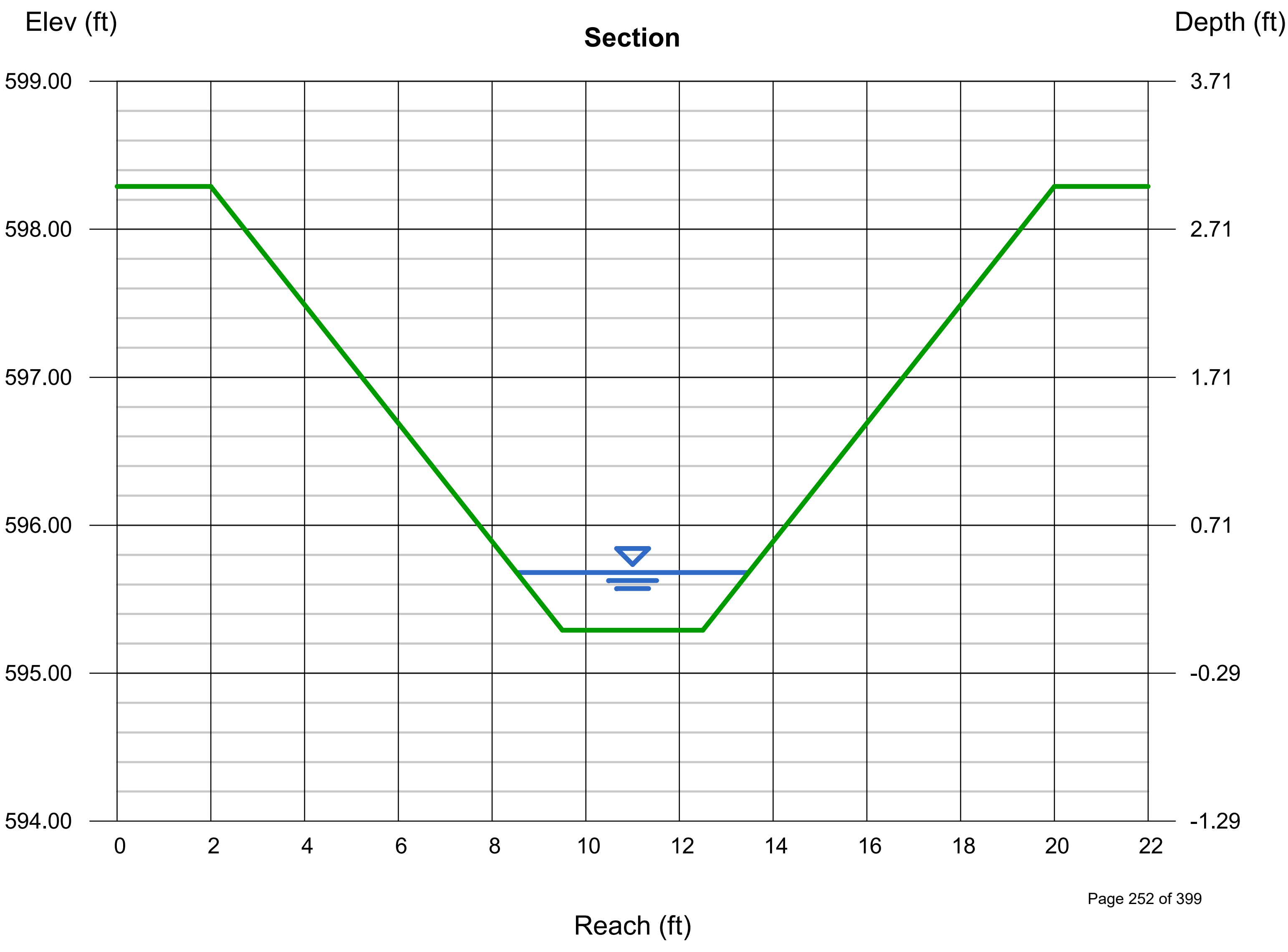


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-2 @ N 1551498, E 1942496 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 0.39
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 3.120
Total Depth (ft)	= 3.00	Area (sqft)	= 1.55
Invert Elev (ft)	= 595.29	Velocity (ft/s)	= 2.01
Slope (%)	= 5.37	Wetted Perim (ft)	= 5.10
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.30
		Top Width (ft)	= 4.95
Calculations		EGL (ft)	= 0.45
Compute by:	Known Q		
Known Q (cfs)	= 3.12		

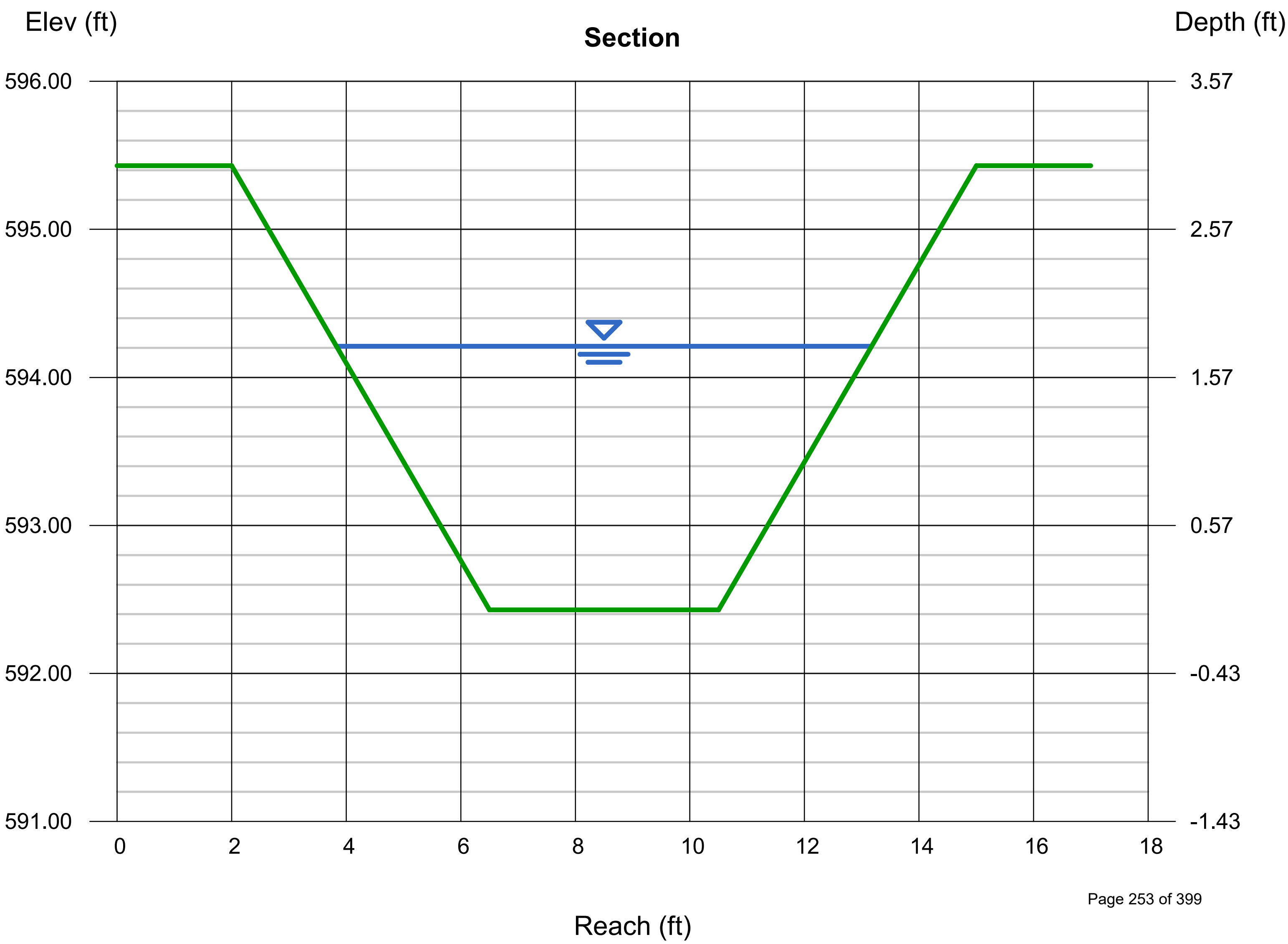


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-3 @ N 1551517, E 1942670 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 1.78
Side Slopes (z:1)	= 1.50, 1.50	Q (cfs)	= 38.34
Total Depth (ft)	= 3.00	Area (sqft)	= 11.87
Invert Elev (ft)	= 592.43	Velocity (ft/s)	= 3.23
Slope (%)	= 1.00	Wetted Perim (ft)	= 10.42
N-Value	= 0.050	Crit Depth, Yc (ft)	= 1.22
		Top Width (ft)	= 9.34
Calculations		EGL (ft)	= 1.94
Compute by:	Known Q		
Known Q (cfs)	= 38.34		

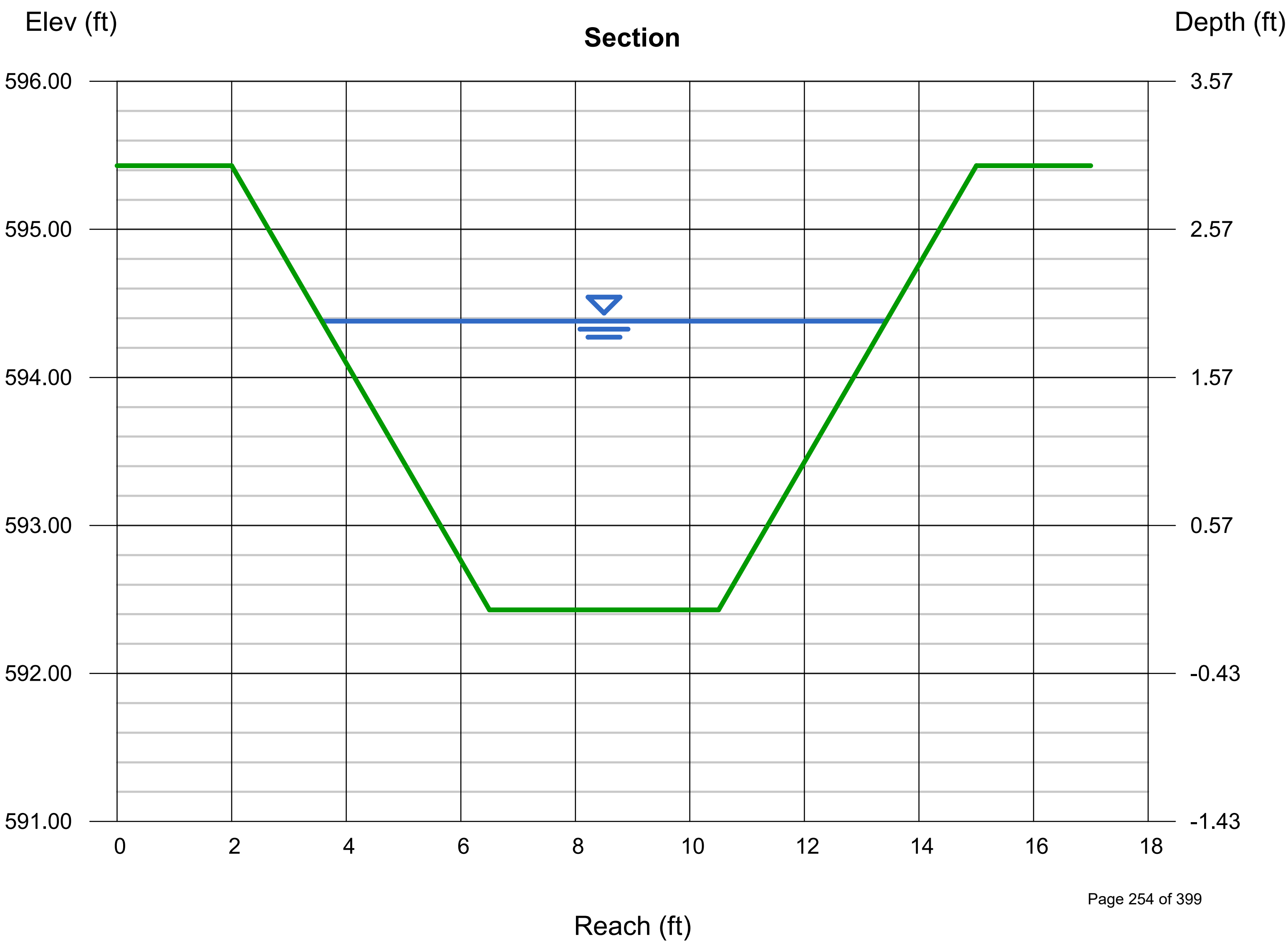


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-3 @ N 1551517, E 1942670 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 1.95
Side Slopes (z:1)	= 1.50, 1.50	Q (cfs)	= 45.79
Total Depth (ft)	= 3.00	Area (sqft)	= 13.50
Invert Elev (ft)	= 592.43	Velocity (ft/s)	= 3.39
Slope (%)	= 1.00	Wetted Perim (ft)	= 11.03
N-Value	= 0.050	Crit Depth, Yc (ft)	= 1.35
		Top Width (ft)	= 9.85
Calculations		EGL (ft)	= 2.13
Compute by:	Known Q		
Known Q (cfs)	= 45.79		



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-4 @ N 1551579, E 1942697 (25 YR.)

Trapezoidal

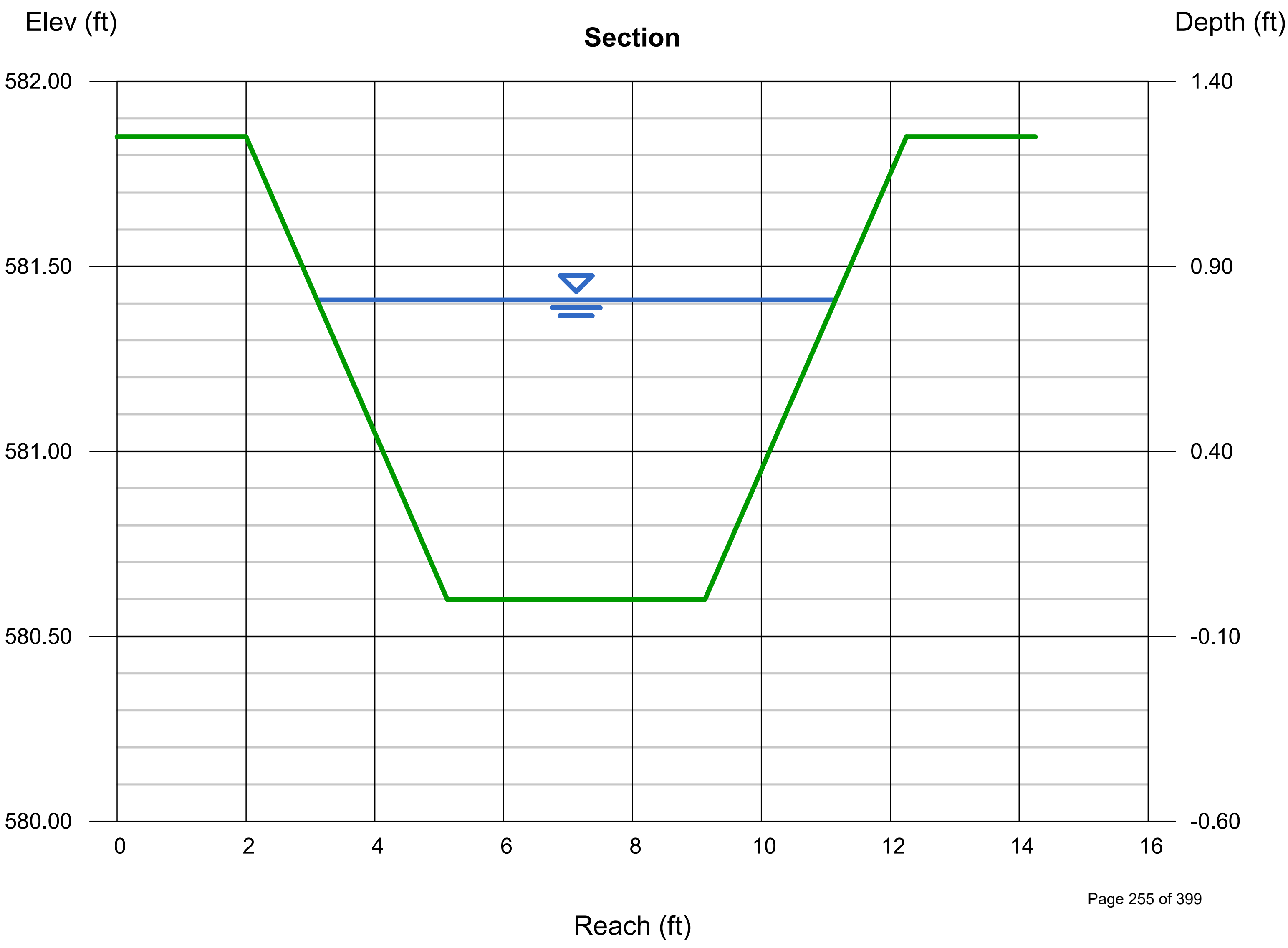
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 2.50, 2.50
Total Depth (ft)	= 1.25
Invert Elev (ft)	= 580.60
Slope (%)	= 32.50
N-Value	= 0.074

Calculations

Compute by:	Known Q
Known Q (cfs)	= 38.34

Highlighted

Depth (ft)	= 0.81
Q (cfs)	= 38.34
Area (sqft)	= 4.88
Velocity (ft/s)	= 7.86
Wetted Perim (ft)	= 8.36
Crit Depth, Yc (ft)	= 1.12
Top Width (ft)	= 8.05
EGL (ft)	= 1.77



Channel Report

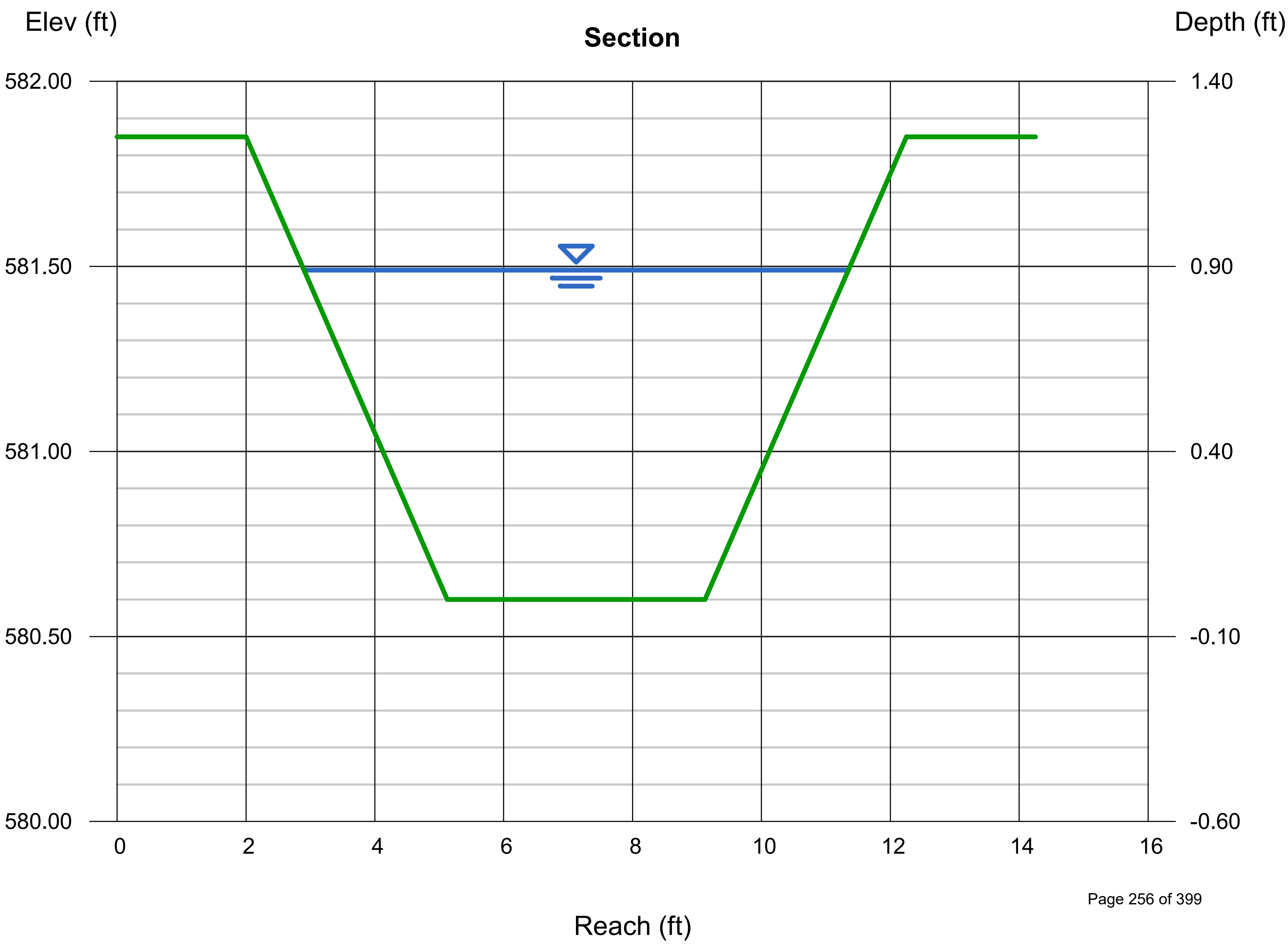
Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-4 @ N 1551579, E 1942697 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 0.89
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 45.79
Total Depth (ft)	= 1.25	Area (sqft)	= 5.54
Invert Elev (ft)	= 580.60	Velocity (ft/s)	= 8.26
Slope (%)	= 32.50	Wetted Perim (ft)	= 8.79
N-Value	= 0.074	Crit Depth, Yc (ft)	= 1.24
		Top Width (ft)	= 8.45
		EGL (ft)	= 1.95

Calculations

Compute by:	Known Q
Known Q (cfs)	= 45.79



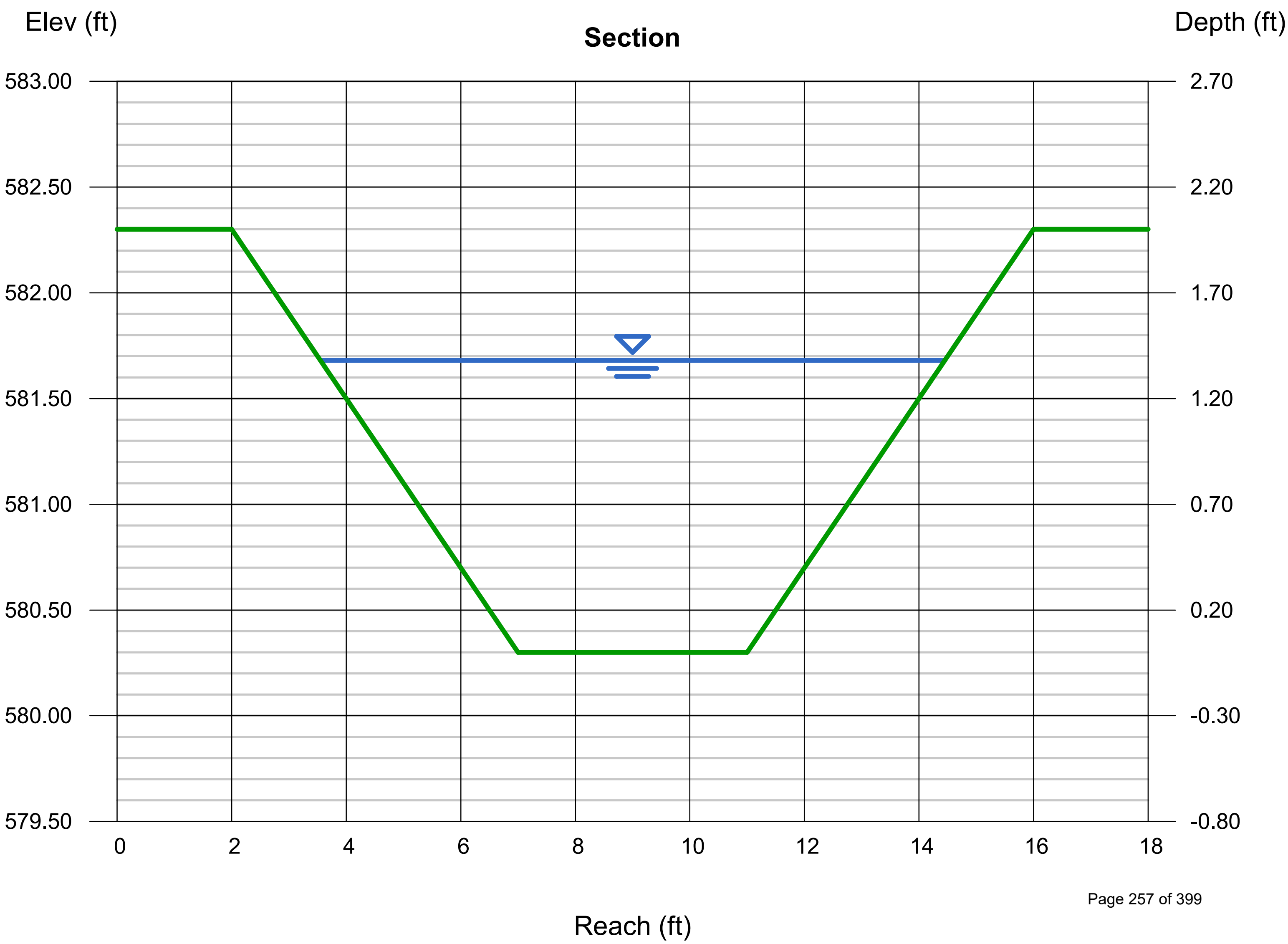
Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-5 @ N 1551612, E 1942713 (25 YR.)

Trapezoidal	
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 2.50, 2.50
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 580.30
Slope (%)	= 1.00
N-Value	= 0.037
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 38.34

Highlighted	
Depth (ft)	= 1.38
Q (cfs)	= 38.34
Area (sqft)	= 10.28
Velocity (ft/s)	= 3.73
Wetted Perim (ft)	= 11.43
Crit Depth, Yc (ft)	= 1.12
Top Width (ft)	= 10.90
EGL (ft)	= 1.60

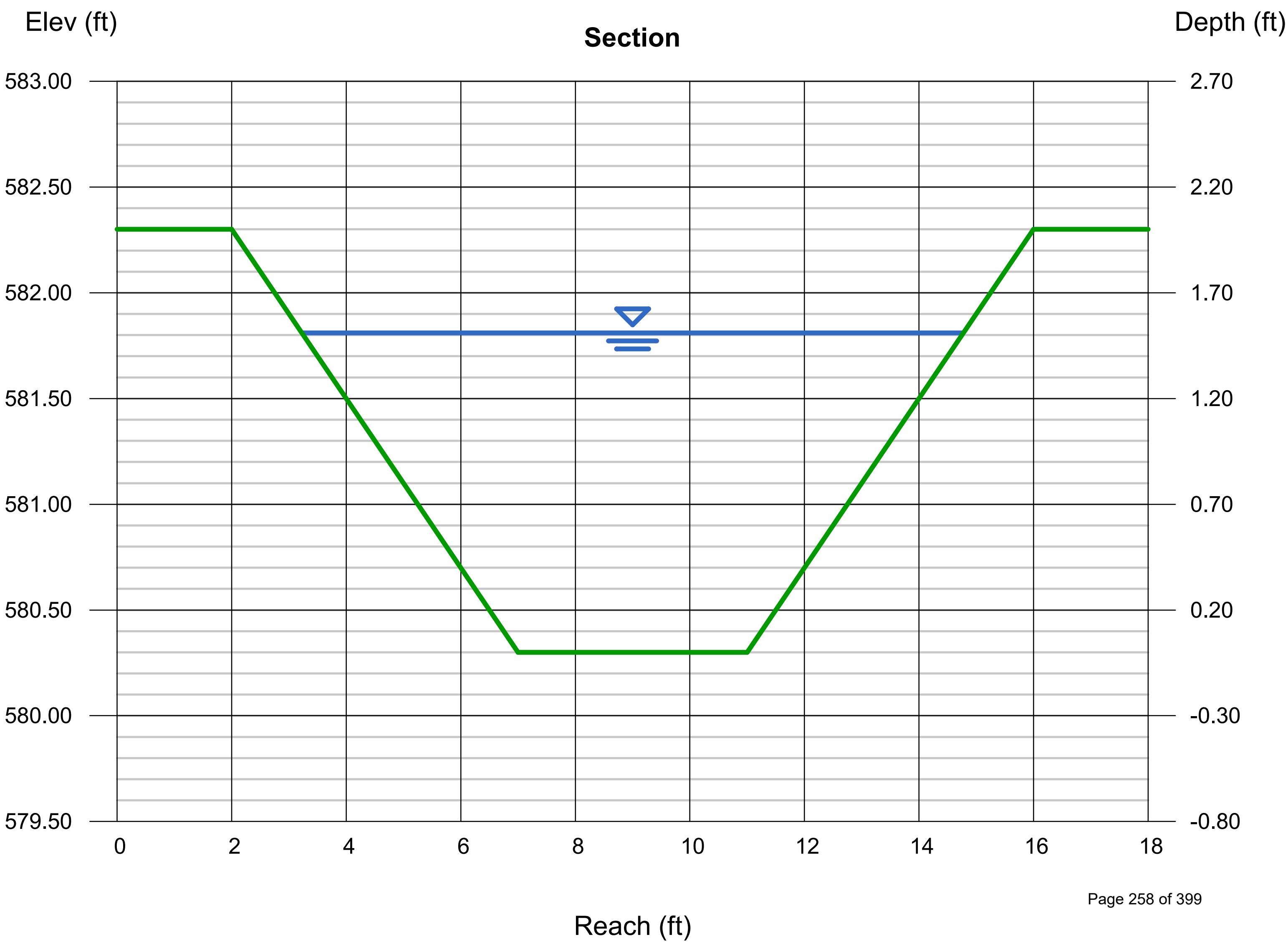


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-5 @ N 1551612, E 1942713 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 1.51
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 45.79
Total Depth (ft)	= 2.00	Area (sqft)	= 11.74
Invert Elev (ft)	= 580.30	Velocity (ft/s)	= 3.90
Slope (%)	= 1.00	Wetted Perim (ft)	= 12.13
N-Value	= 0.037	Crit Depth, Yc (ft)	= 1.24
		Top Width (ft)	= 11.55
Calculations		EGL (ft)	= 1.75
Compute by:	Known Q		
Known Q (cfs)	= 45.79		



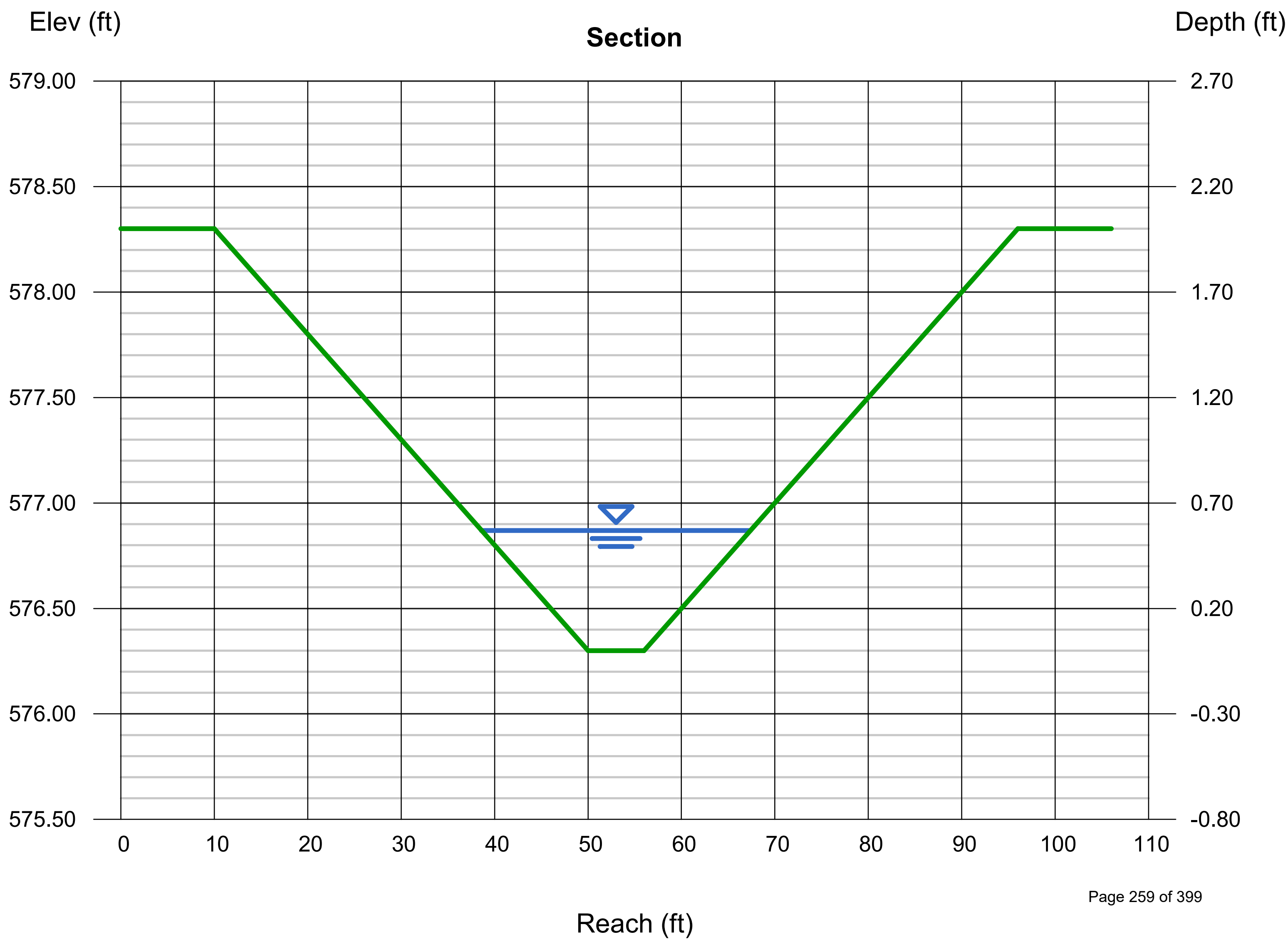
Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-6 @ N 1551640, E 1942725 (25 YR.)

Trapezoidal	
Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 20.00, 20.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 576.30
Slope (%)	= 4.00
N-Value	= 0.074
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 19.17

Highlighted	
Depth (ft)	= 0.57
Q (cfs)	= 19.17
Area (sqft)	= 9.92
Velocity (ft/s)	= 1.93
Wetted Perim (ft)	= 28.83
Crit Depth, Yc (ft)	= 0.44
Top Width (ft)	= 28.80
EGL (ft)	= 0.63



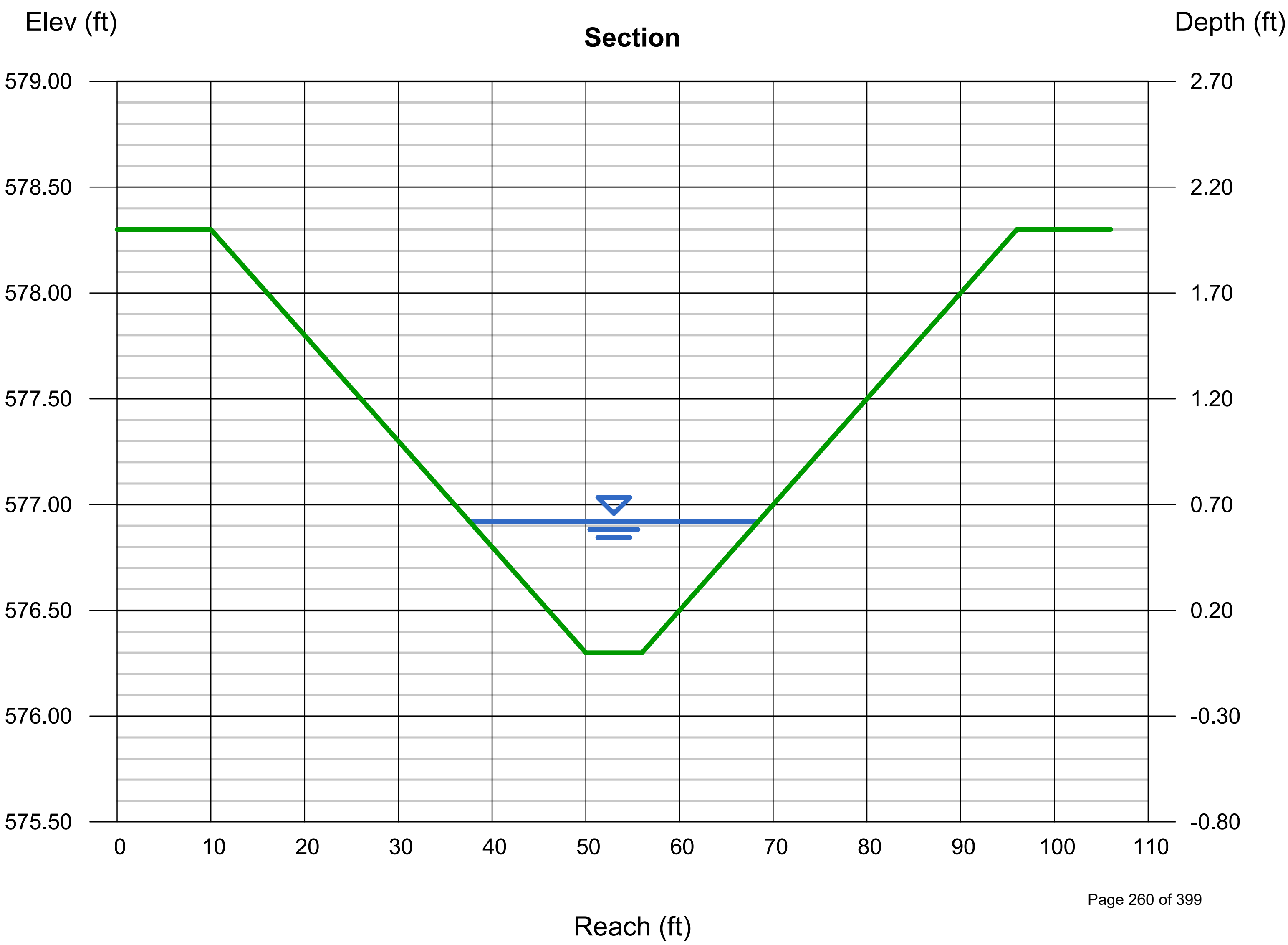
Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-6 @ N 1551640, E 1942725 (100 YR.)

Trapezoidal	
Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 20.00, 20.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 576.30
Slope (%)	= 4.00
N-Value	= 0.074
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 22.90

Highlighted	
Depth (ft)	= 0.62
Q (cfs)	= 22.90
Area (sqft)	= 11.41
Velocity (ft/s)	= 2.01
Wetted Perim (ft)	= 30.83
Crit Depth, Yc (ft)	= 0.48
Top Width (ft)	= 30.80
EGL (ft)	= 0.68

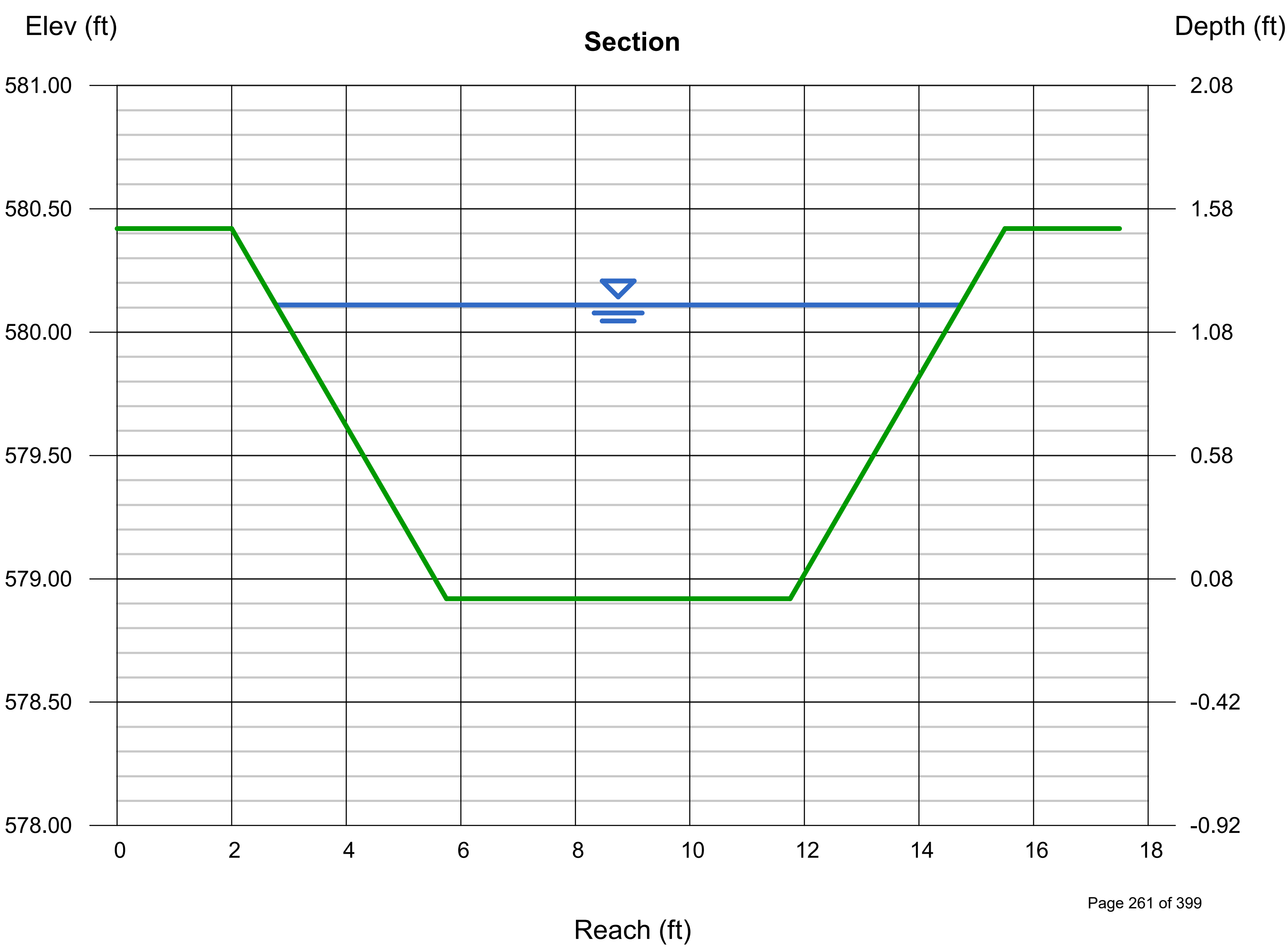


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-7 @ N 1551640, E 1942725 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 1.19
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 19.17
Total Depth (ft)	= 1.50	Area (sqft)	= 10.68
Invert Elev (ft)	= 578.92	Velocity (ft/s)	= 1.79
Slope (%)	= 1.00	Wetted Perim (ft)	= 12.41
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.63
		Top Width (ft)	= 11.95
Calculations		EGL (ft)	= 1.24
Compute by:	Known Q		
Known Q (cfs)	= 19.17		



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH F-7 @ N 1551640, E 1942725 (100 YR.)

Trapezoidal

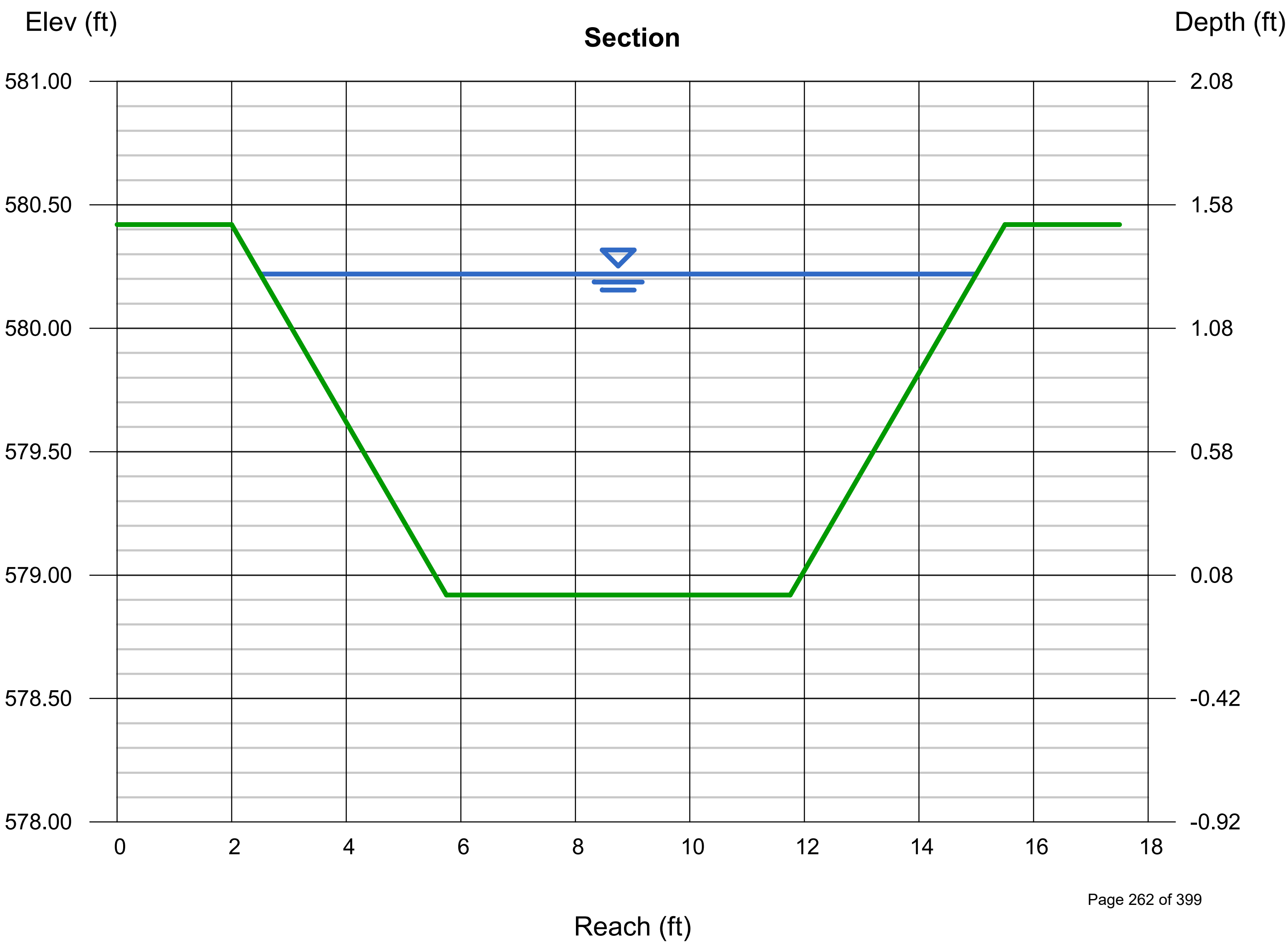
Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 2.50, 2.50
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 578.92
Slope (%)	= 1.00
N-Value	= 0.074

Calculations

Compute by:	Known Q
Known Q (cfs)	= 22.90

Highlighted

Depth (ft)	= 1.30
Q (cfs)	= 22.90
Area (sqft)	= 12.02
Velocity (ft/s)	= 1.90
Wetted Perim (ft)	= 13.00
Crit Depth, Yc (ft)	= 0.70
Top Width (ft)	= 12.50
EGL (ft)	= 1.36

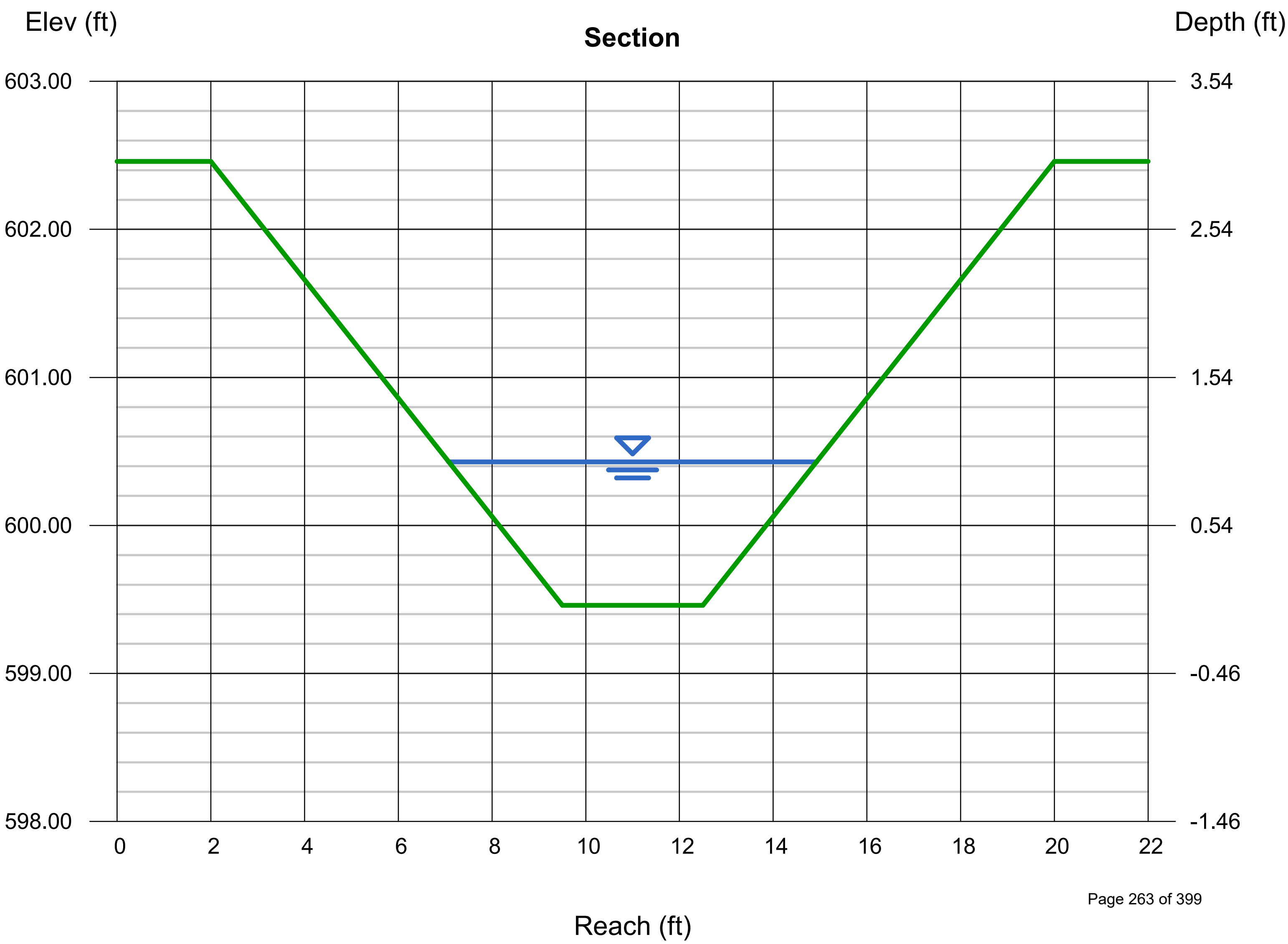


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH G-1 @ N 1551502, E 1942496 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 0.97
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 7.710
Total Depth (ft)	= 3.00	Area (sqft)	= 5.26
Invert Elev (ft)	= 599.46	Velocity (ft/s)	= 1.47
Slope (%)	= 1.00	Wetted Perim (ft)	= 8.22
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.51
		Top Width (ft)	= 7.85
Calculations		EGL (ft)	= 1.00
Compute by:	Known Q		
Known Q (cfs)	= 7.71		

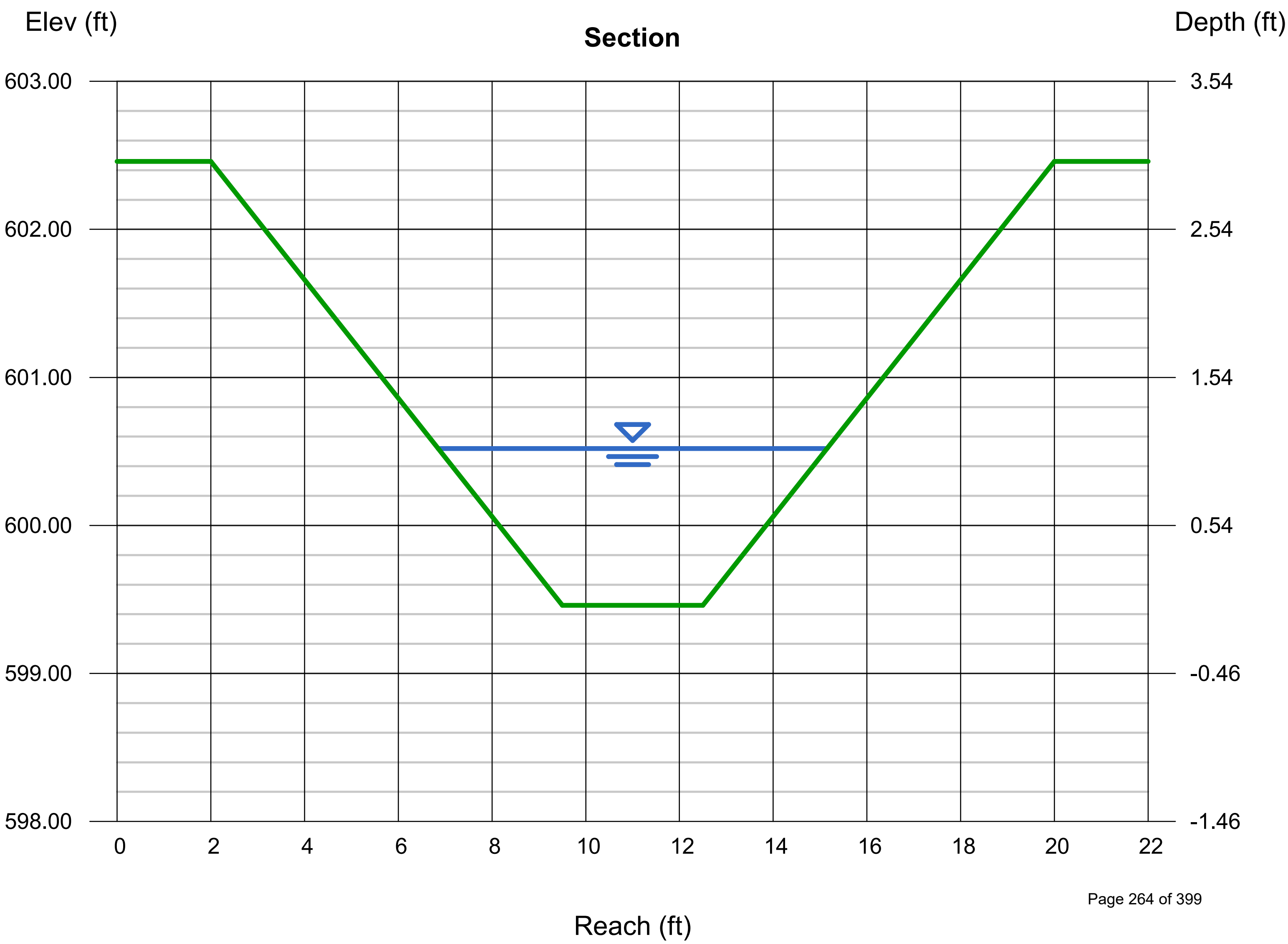


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH G-1 @ N 1551502, E 1942496 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.06
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 9.210
Total Depth (ft)	= 3.00	Area (sqft)	= 5.99
Invert Elev (ft)	= 599.46	Velocity (ft/s)	= 1.54
Slope (%)	= 1.00	Wetted Perim (ft)	= 8.71
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.57
		Top Width (ft)	= 8.30
Calculations		EGL (ft)	= 1.10
Compute by:	Known Q		
Known Q (cfs)	= 9.21		

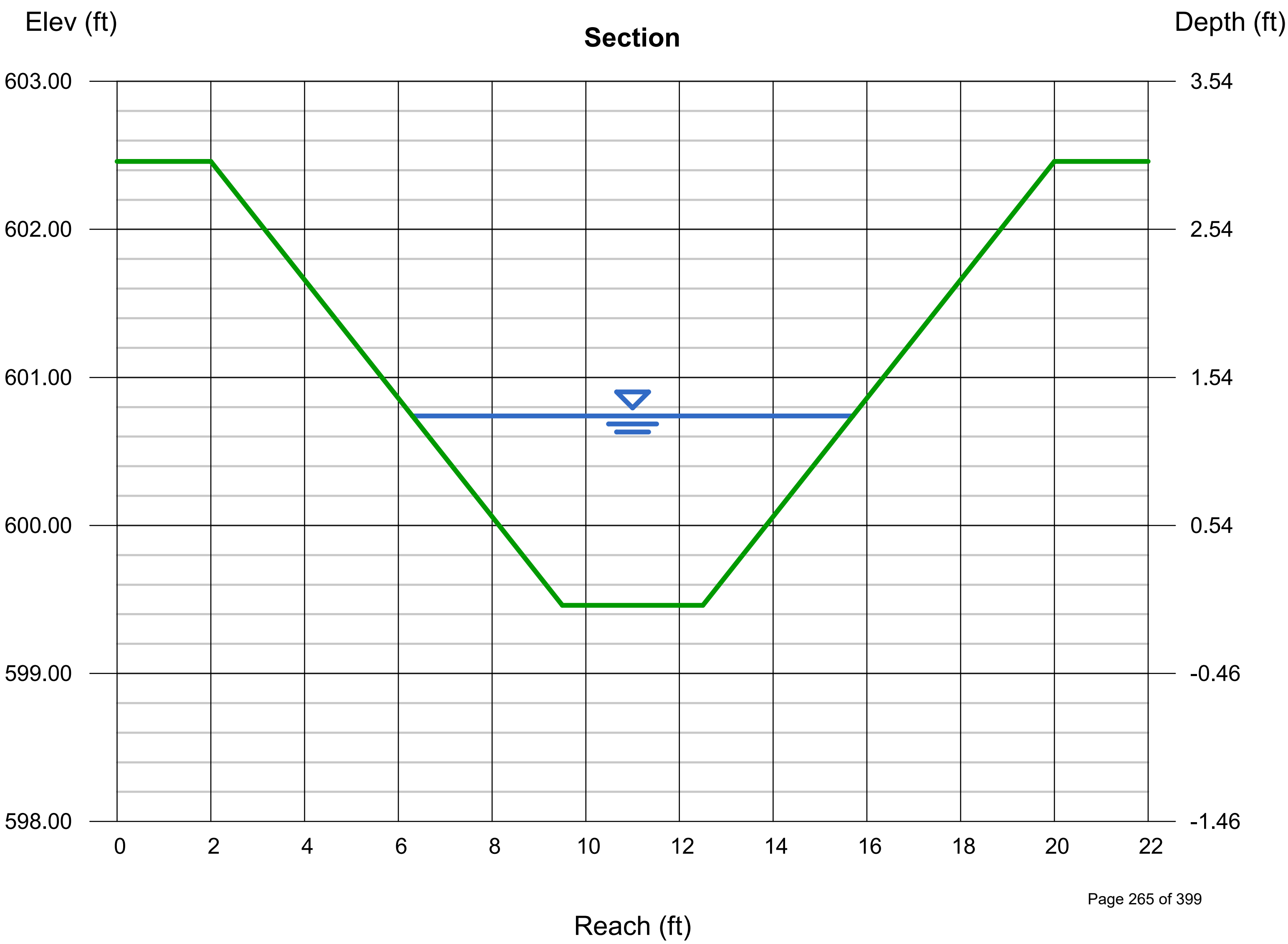


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH G-2 @ N 1550820, E 1942070 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.28
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 14.22
Total Depth (ft)	= 3.00	Area (sqft)	= 7.94
Invert Elev (ft)	= 599.46	Velocity (ft/s)	= 1.79
Slope (%)	= 1.09	Wetted Perim (ft)	= 9.89
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.73
		Top Width (ft)	= 9.40
Calculations		EGL (ft)	= 1.33
Compute by:	Known Q		
Known Q (cfs)	= 14.22		



Channel Report

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

Saturday, Nov 10 2018

DITCH G-2 @ N 1550820, E 1942070 (100 YR.)

Trapezoidal

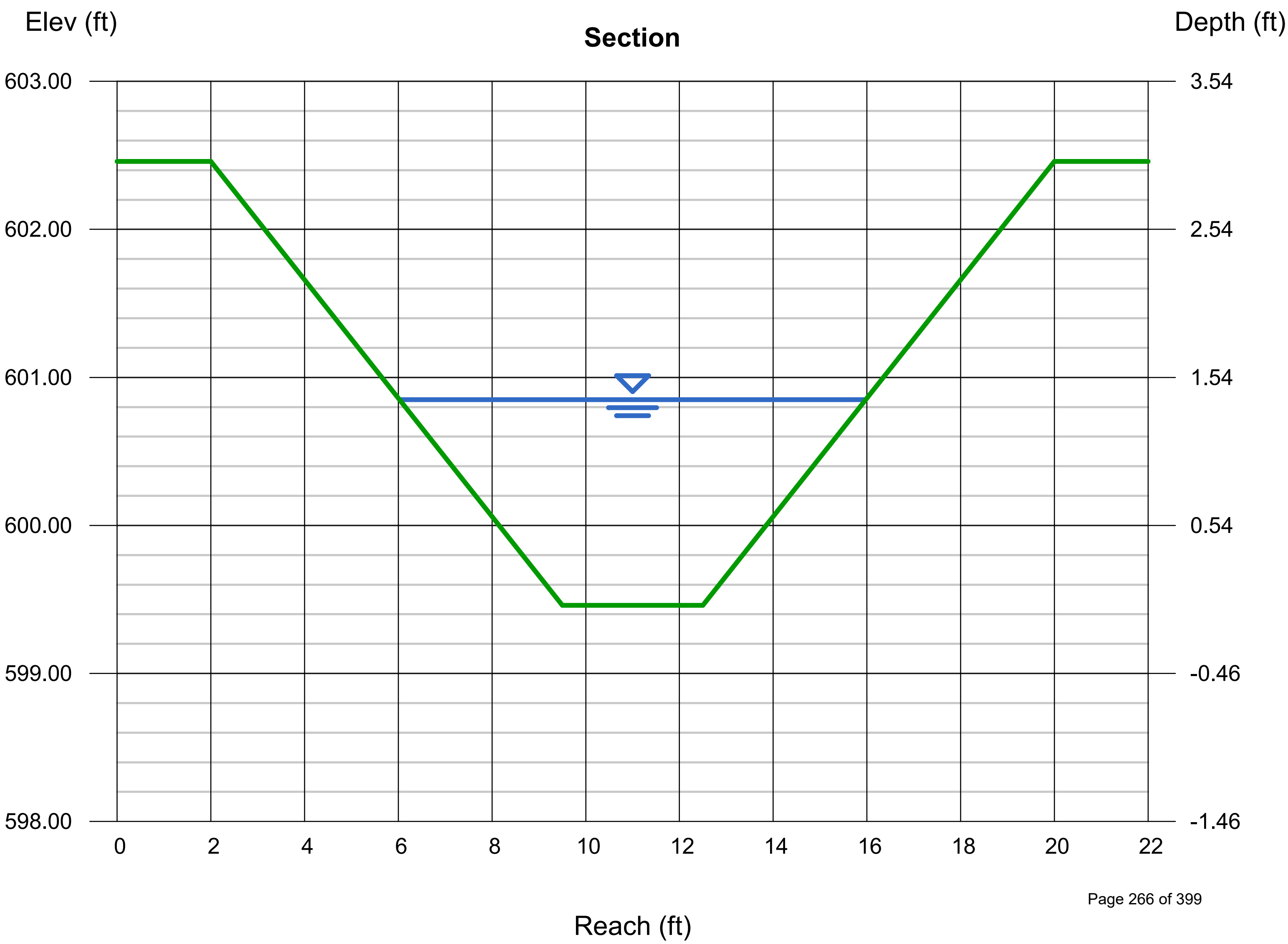
Bottom Width (ft)	= 3.00
Side Slopes (z:1)	= 2.50, 2.50
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 599.46
Slope (%)	= 1.09
N-Value	= 0.074

Calculations

Compute by:	Known Q
Known Q (cfs)	= 16.98

Highlighted

Depth (ft)	= 1.39
Q (cfs)	= 16.98
Area (sqft)	= 9.00
Velocity (ft/s)	= 1.89
Wetted Perim (ft)	= 10.49
Crit Depth, Yc (ft)	= 0.80
Top Width (ft)	= 9.95
EGL (ft)	= 1.45

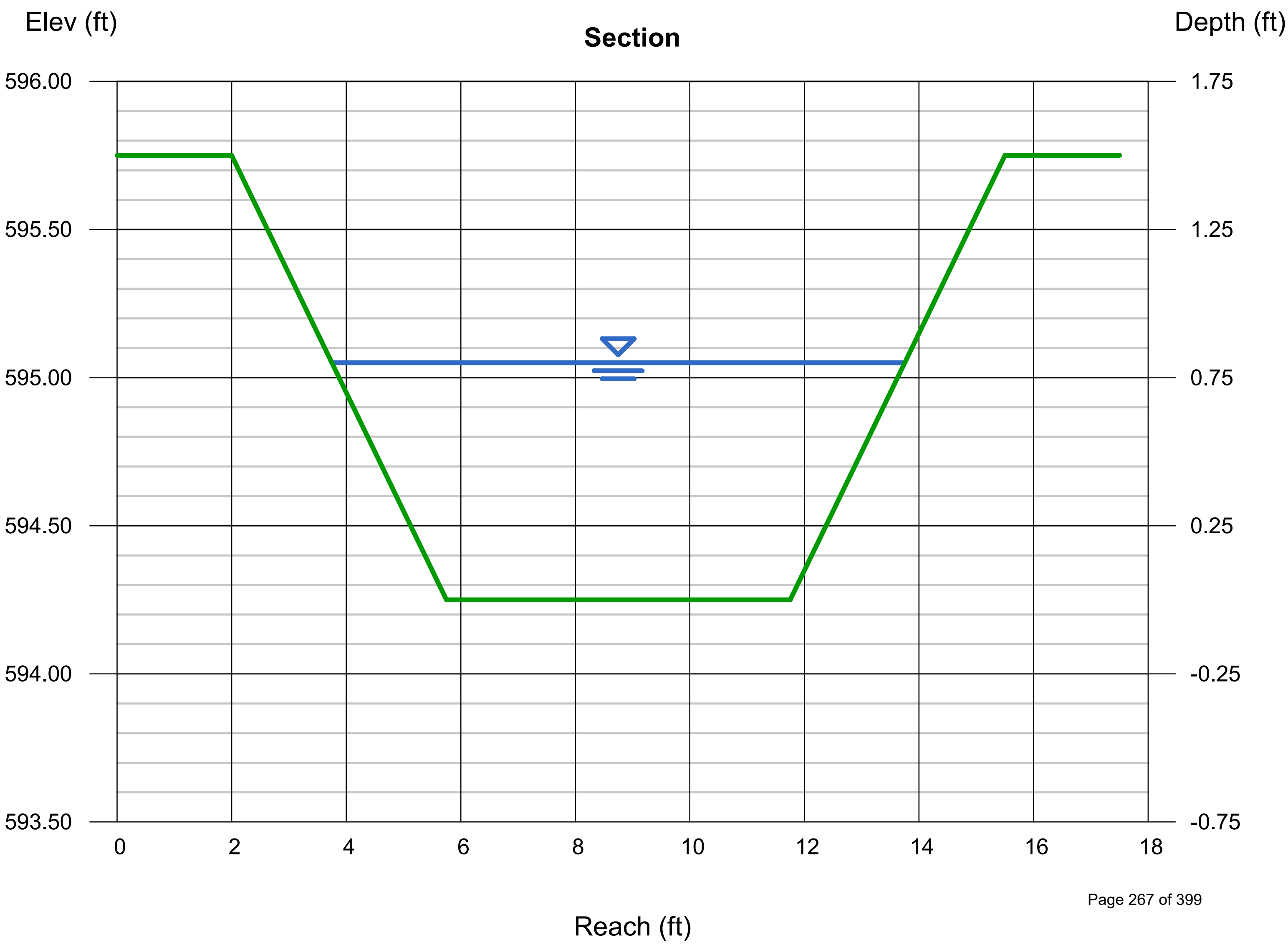


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH G-3 @ N 1551303, E 1942111 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.80
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 21.93
Total Depth (ft)	= 1.50	Area (sqft)	= 6.40
Invert Elev (ft)	= 594.25	Velocity (ft/s)	= 3.43
Slope (%)	= 5.50	Wetted Perim (ft)	= 10.31
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.68
		Top Width (ft)	= 10.00
Calculations		EGL (ft)	= 0.98
Compute by:	Known Q		
Known Q (cfs)	= 21.93		



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Saturday, Nov 10 2018

DITCH G-3 @ N 1551303, E 1942111 (100 YR.)

Trapezoidal

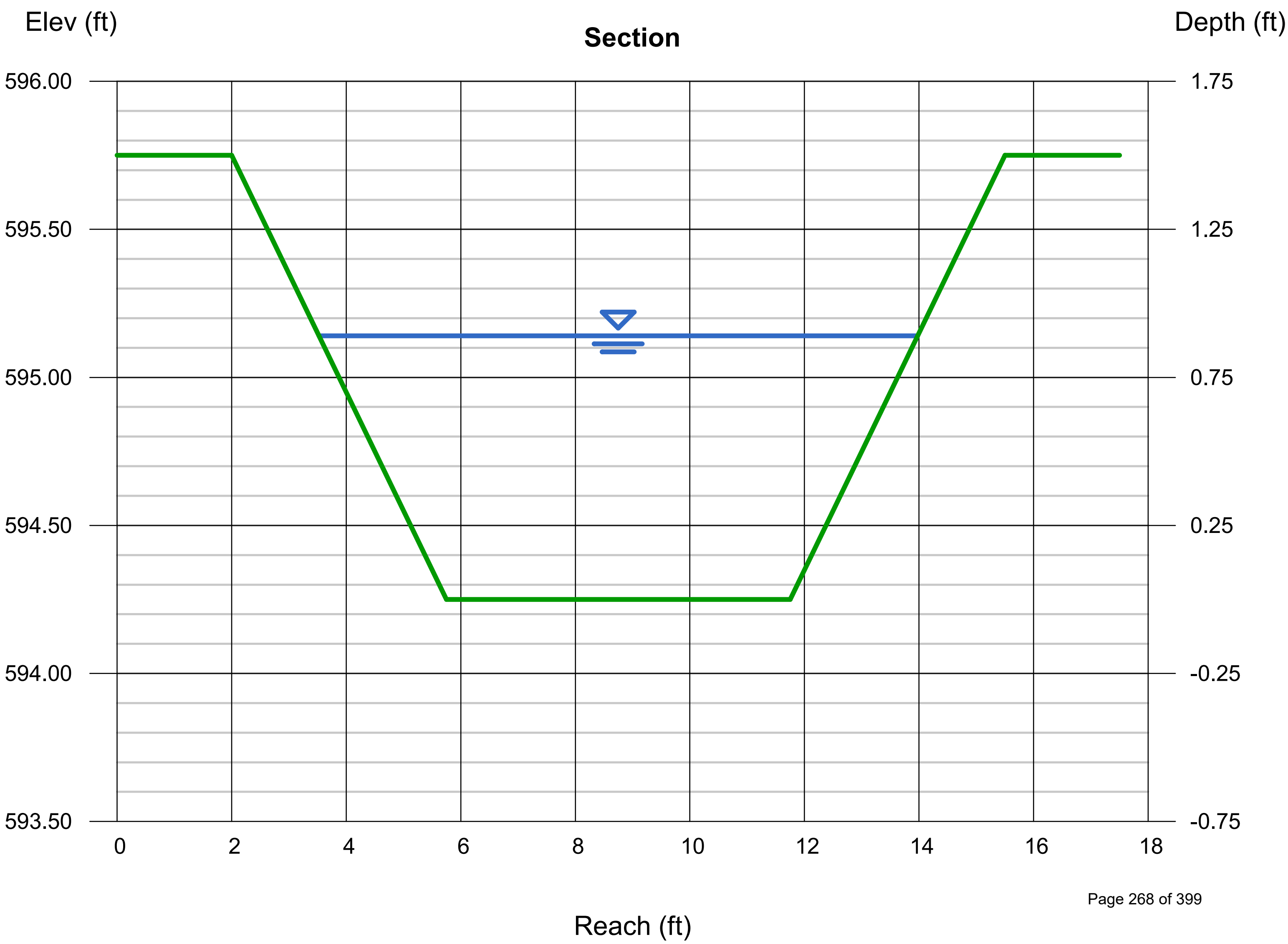
Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 2.50, 2.50
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 594.25
Slope (%)	= 5.50
N-Value	= 0.074

Calculations

Compute by:	Known Q
Known Q (cfs)	= 26.19

Highlighted

Depth (ft)	= 0.89
Q (cfs)	= 26.19
Area (sqft)	= 7.32
Velocity (ft/s)	= 3.58
Wetted Perim (ft)	= 10.79
Crit Depth, Yc (ft)	= 0.76
Top Width (ft)	= 10.45
EGL (ft)	= 1.09

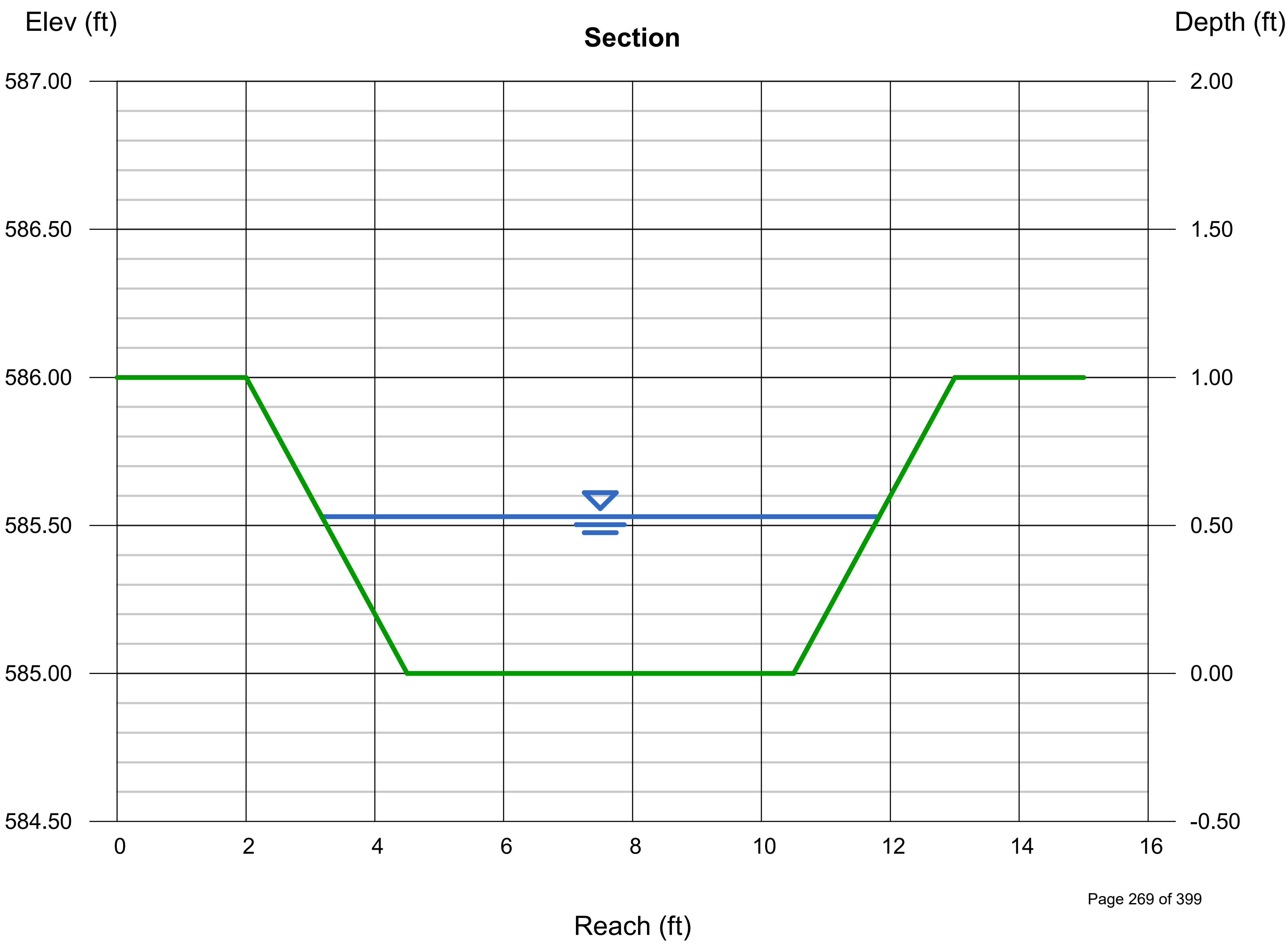


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH G-4 @ N 1551366, E 1942040 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.53
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 21.93
Total Depth (ft)	= 1.00	Area (sqft)	= 3.88
Invert Elev (ft)	= 585.00	Velocity (ft/s)	= 5.65
Slope (%)	= 25.00	Wetted Perim (ft)	= 8.85
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.68
		Top Width (ft)	= 8.65
Calculations		EGL (ft)	= 1.03
Compute by:	Known Q		
Known Q (cfs)	= 21.93		

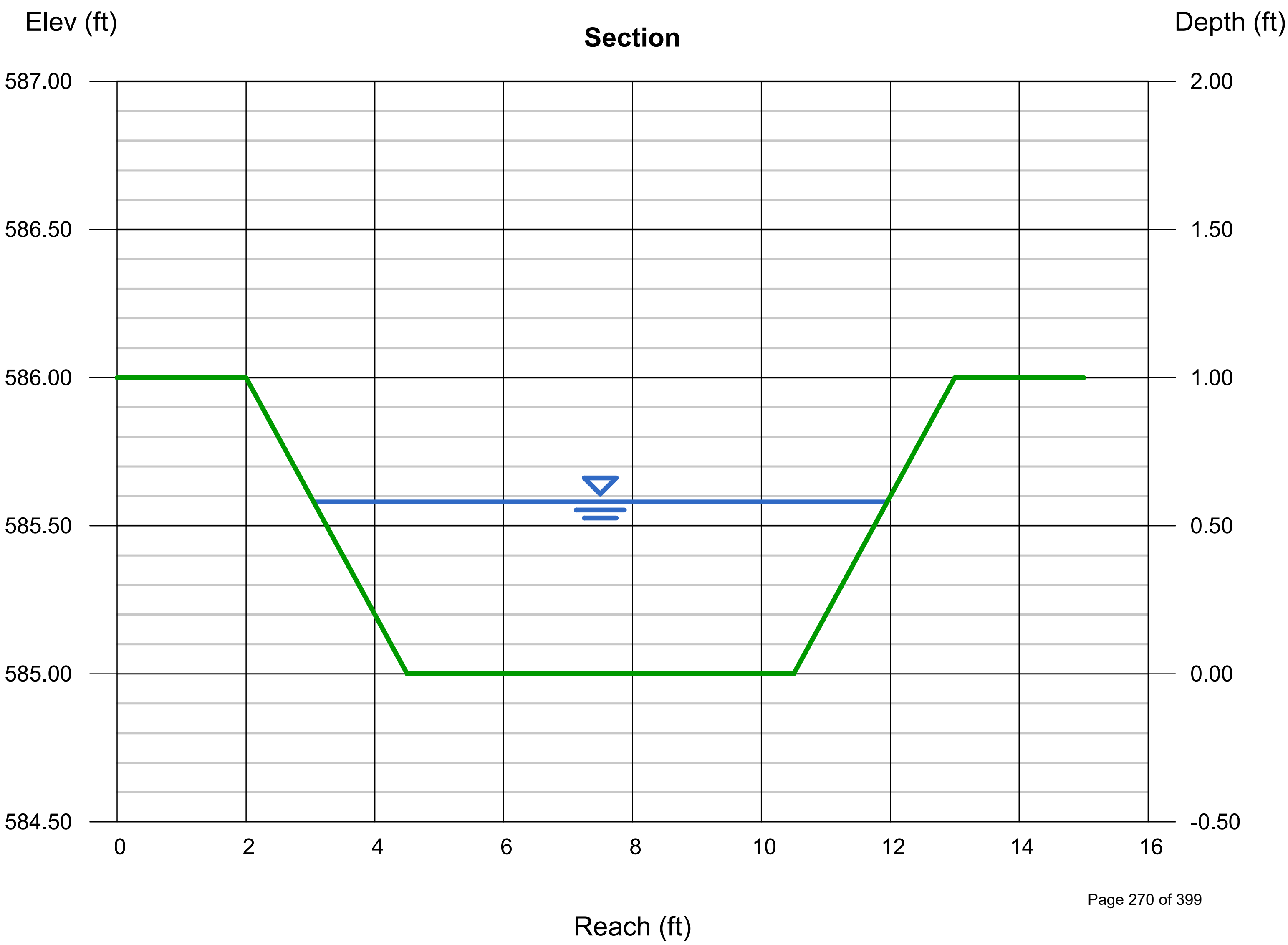


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH G-4 @ N 1551366, E 1942040 (100 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.58
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 26.19
Total Depth (ft)	= 1.00	Area (sqft)	= 4.32
Invert Elev (ft)	= 585.00	Velocity (ft/s)	= 6.06
Slope (%)	= 25.00	Wetted Perim (ft)	= 9.12
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.76
		Top Width (ft)	= 8.90
Calculations		EGL (ft)	= 1.15
Compute by:	Known Q		
Known Q (cfs)	= 26.19		

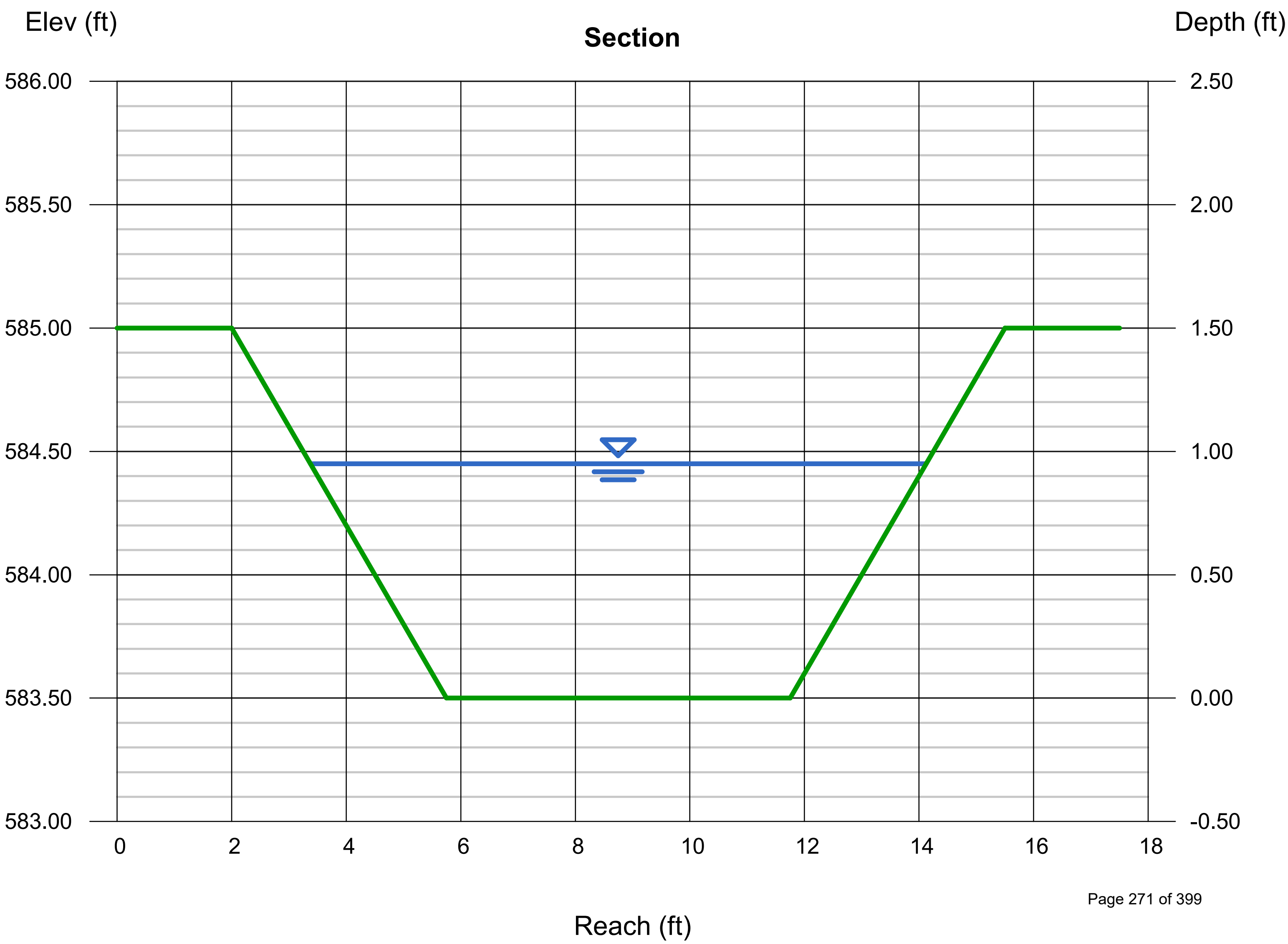


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH G-5 @ N 1551391, E 1942013 (25 YR.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.95
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 21.93
Total Depth (ft)	= 1.50	Area (sqft)	= 7.96
Invert Elev (ft)	= 583.50	Velocity (ft/s)	= 2.76
Slope (%)	= 3.00	Wetted Perim (ft)	= 11.12
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.68
		Top Width (ft)	= 10.75
Calculations		EGL (ft)	= 1.07
Compute by:	Known Q		
Known Q (cfs)	= 21.93		



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

DITCH G-5 @ N 1551391, E 1942013 (100 YR.)

Trapezoidal

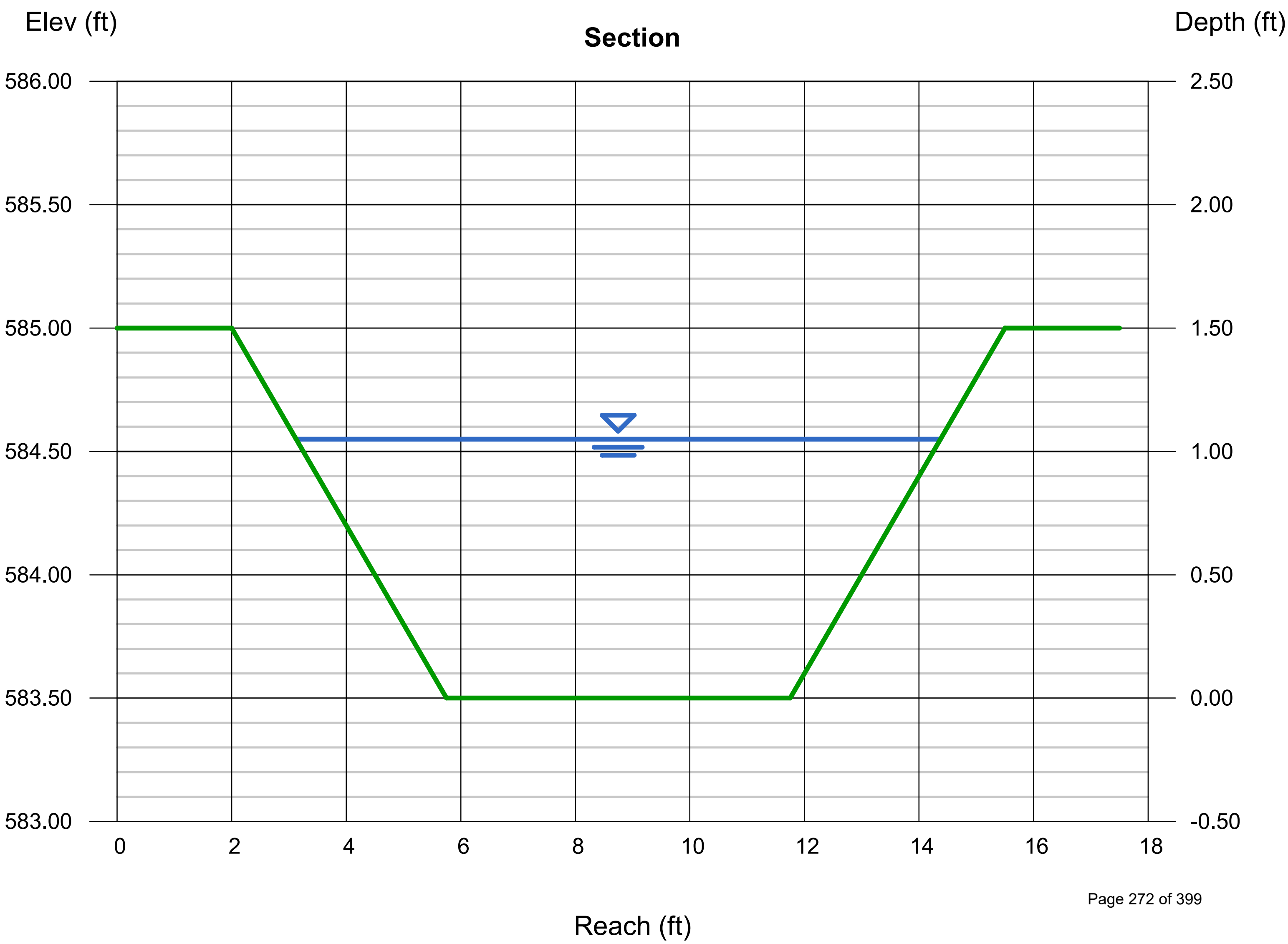
Bottom Width (ft)	= 6.00
Side Slopes (z:1)	= 2.50, 2.50
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 583.50
Slope (%)	= 3.00
N-Value	= 0.074

Calculations

Compute by:	Known Q
Known Q (cfs)	= 26.19

Highlighted

Depth (ft)	= 1.05
Q (cfs)	= 26.19
Area (sqft)	= 9.06
Velocity (ft/s)	= 2.89
Wetted Perim (ft)	= 11.65
Crit Depth, Yc (ft)	= 0.76
Top Width (ft)	= 11.25
EGL (ft)	= 1.18

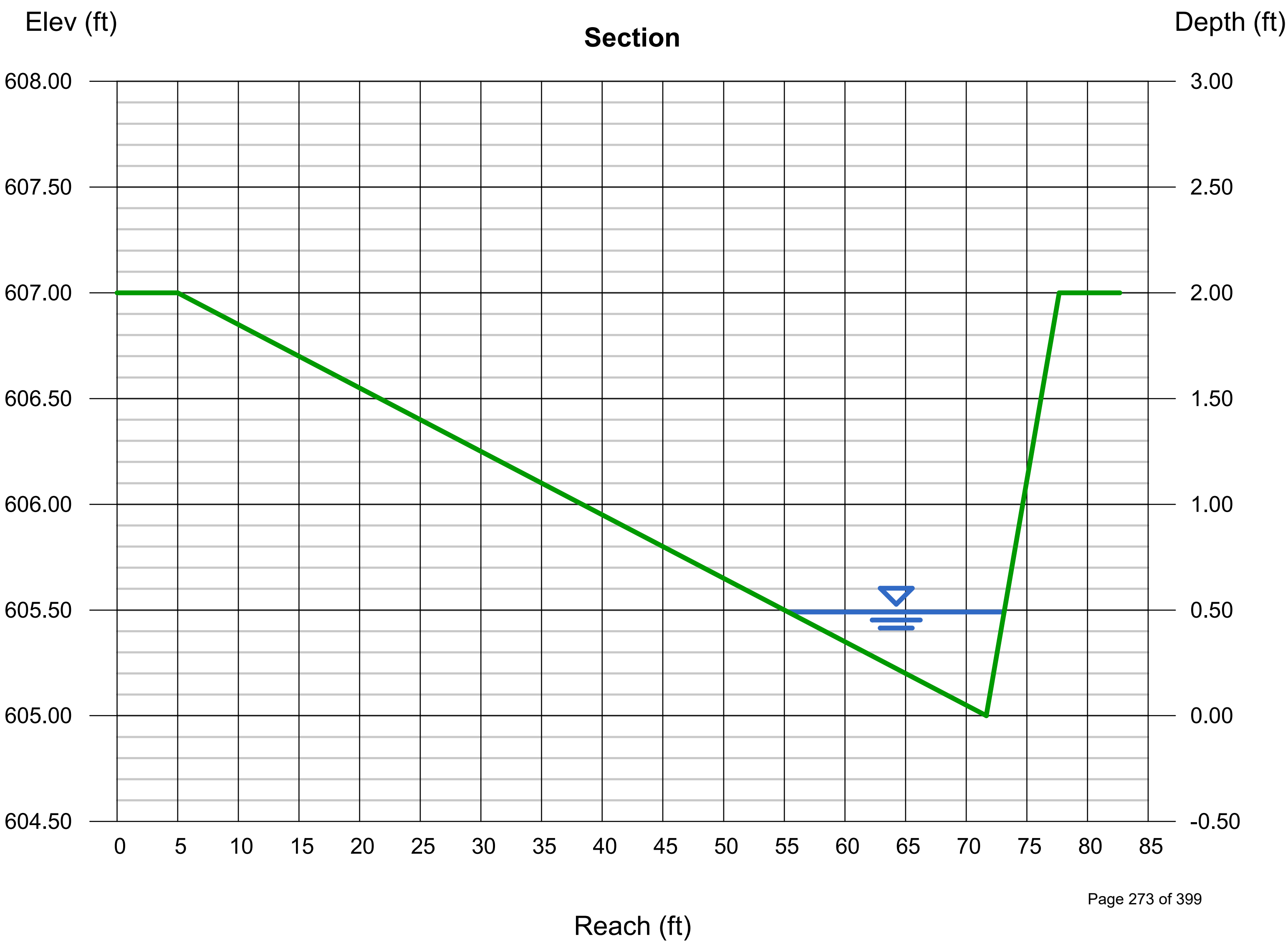


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

Typical Diversion Berm Ditch on Cap (25 YR.)

Triangular		**Highlighted**	
Side Slopes (z:1)	= 33.33, 3.00	Depth (ft)	= 0.49
Total Depth (ft)	= 2.00	Q (cfs)	= 8.290
		Area (sqft)	= 4.36
Invert Elev (ft)	= 605.00	Velocity (ft/s)	= 1.90
Slope (%)	= 1.00	Wetted Perim (ft)	= 17.89
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.42
		Top Width (ft)	= 17.80
Calculations		EGL (ft)	= 0.55
Compute by:	Known Q		
Known Q (cfs)	= 8.29		



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Nov 10 2018

Typical Diversion Berm Ditch on Cap (100 YR.)

Triangular

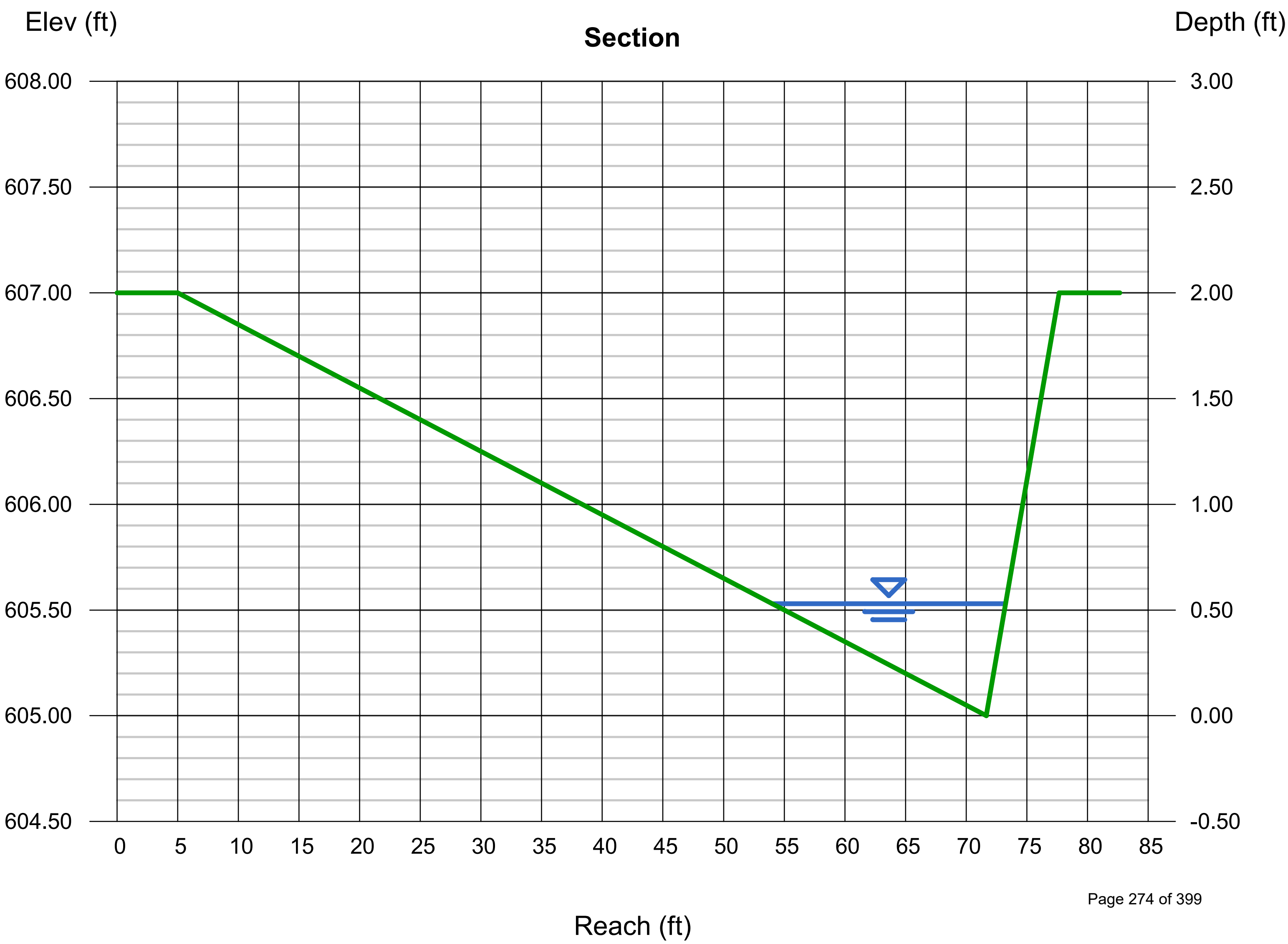
Side Slopes (z:1)	= 33.33, 3.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 605.00
Slope (%)	= 1.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 9.90

Highlighted

Depth (ft)	= 0.53
Q (cfs)	= 9.900
Area (sqft)	= 5.10
Velocity (ft/s)	= 1.94
Wetted Perim (ft)	= 19.35
Crit Depth, Yc (ft)	= 0.46
Top Width (ft)	= 19.25
EGL (ft)	= 0.59



Pre- and Post-Development Pipe Calculations (HydraFlow Express)

Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Wednesday, 11 / 14 / 2018

Pond No. 2 - F,G,H,J & J' DETENTION

Pond Data

Pond storage is based on user-defined values.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	575.00	n/a	0	0
1.00	576.00	n/a	66	66
2.00	577.00	n/a	197	263
3.00	578.00	n/a	805	1,068
4.00	579.00	n/a	3,266	4,334
5.00	580.00	n/a	11,856	16,190
6.00	581.00	n/a	26,087	42,277
7.00	582.00	n/a	34,733	77,010
8.00	583.00	n/a	53,090	130,100
9.00	584.00	n/a	63,299	193,399

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	18.00	18.00	Inactive
Span (in)	= 24.00	18.00	18.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 575.02	575.55	575.00	0.00
Length (ft)	= 77.00	55.00	60.00	0.00
Slope (%)	= 1.10	1.50	1.00	n/a
N-Value	= .012	.012	.012	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

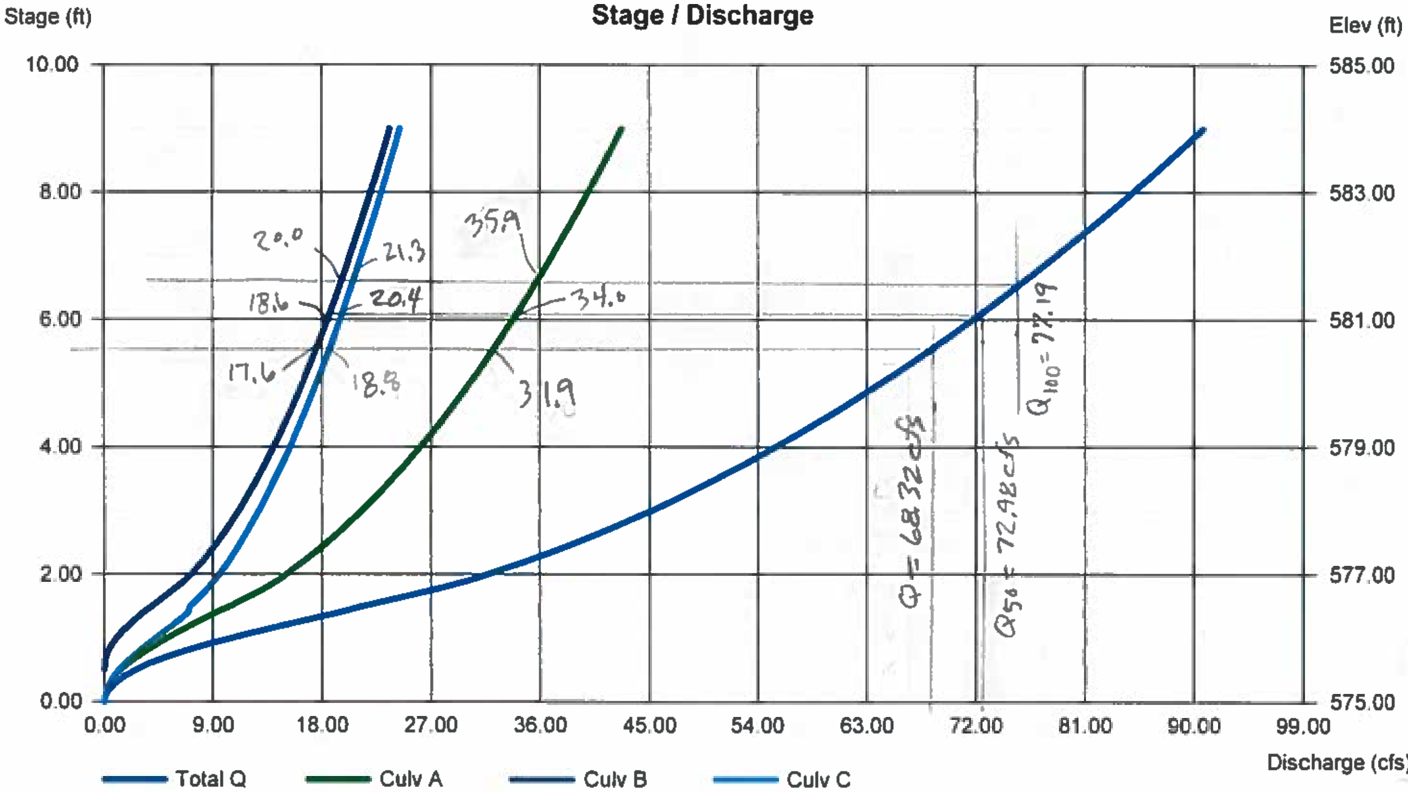
	[A]	[B]	[C]	[D]
Crest Len (ft)	Inactive	Inactive	Inactive	Inactive
Crest El. (ft)	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

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

Stage / Discharge



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Nov 14 2018

24 RCP @ N 1551813, E 1942775 - HWY 20 (Post-Solar)

Invert Elev Dn (ft)	=	574.20
Pipe Length (ft)	=	77.30
Slope (%)	=	1.06
Invert Elev Up (ft)	=	575.02
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

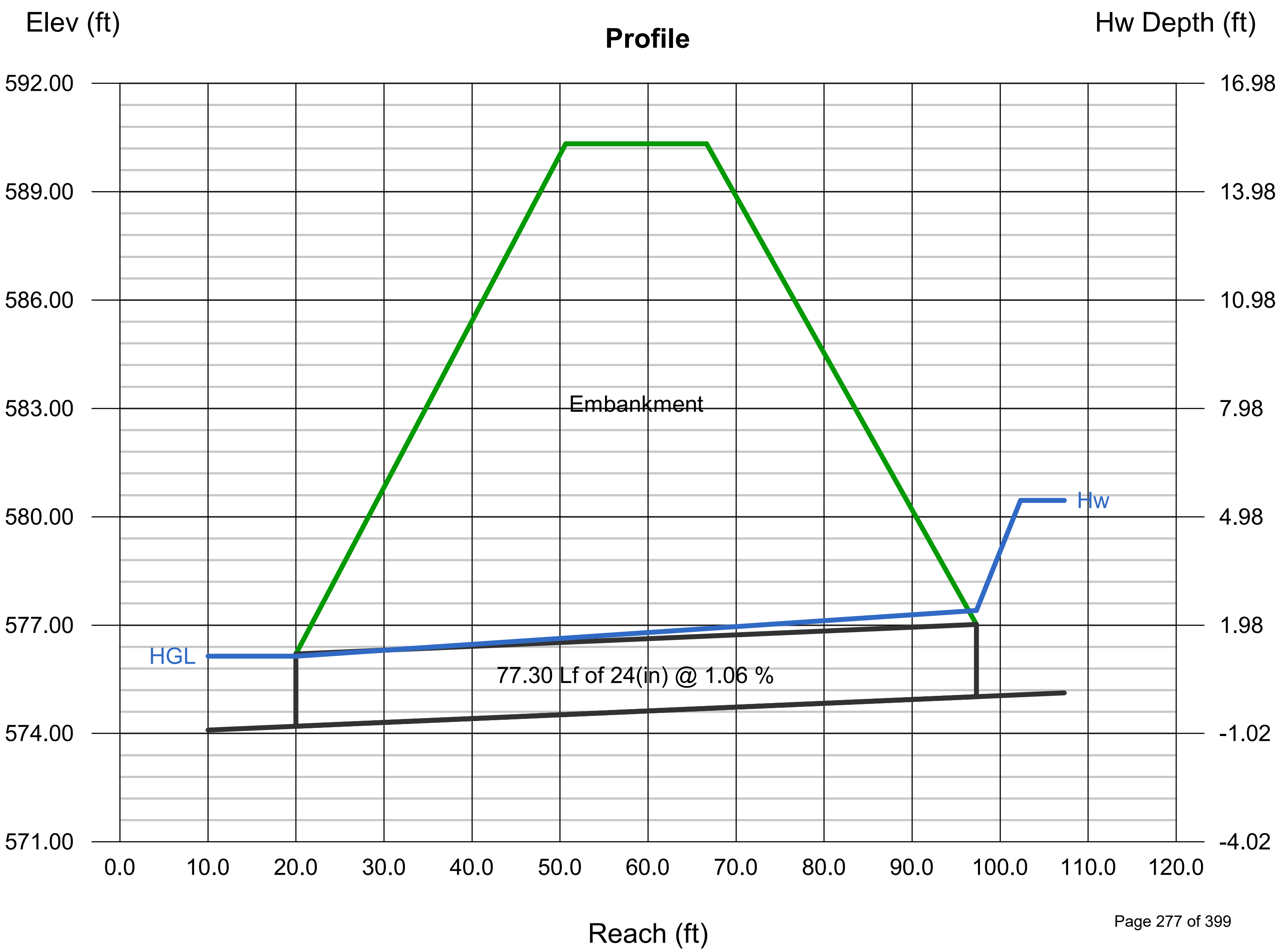
Top Elevation (ft)	=	590.33
Top Width (ft)	=	16.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	31.90
Qmax (cfs)	=	35.90
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	31.90
Qpipe (cfs)	=	31.90
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.24
Veloc Up (ft/s)	=	10.15
HGL Dn (ft)	=	576.14
HGL Up (ft)	=	577.40
Hw Elev (ft)	=	580.45
Hw/D (ft)	=	2.72
Flow Regime	=	Inlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
31.90	31.90	0.00	10.24	10.15	23.33	24.00
32.40	32.40	0.00	10.39	10.31	23.36	24.00
32.90	32.90	0.00	10.54	10.47	23.40	24.00
33.40	33.40	0.00	10.70	10.63	23.43	24.00
33.90	33.90	0.00	10.85	10.79	23.46	24.00
34.40	34.40	0.00	11.01	10.95	23.49	24.00
34.90	34.90	0.00	11.16	11.11	23.51	24.00
35.40	35.40	0.00	11.32	11.27	23.54	24.00
35.90	35.90	0.00	11.47	11.43	23.56	24.00

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
576.14	577.40	580.45	2.72
576.15	577.45	580.58	2.78
576.15	577.49	580.71	2.85
576.15	577.53	580.85	2.91
576.15	577.57	580.98	2.98
576.16	577.62	581.12	3.05
576.16	577.66	581.26	3.12
576.16	577.71	581.40	3.19
576.16	577.76	581.55	3.26

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Wednesday, Nov 14 2018

24 RCP @ N 1551813, E 1942775 - HWY 20 (Pre-Solar)

Invert Elev Dn (ft)	=	574.20
Pipe Length (ft)	=	77.30
Slope (%)	=	1.06
Invert Elev Up (ft)	=	575.02
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

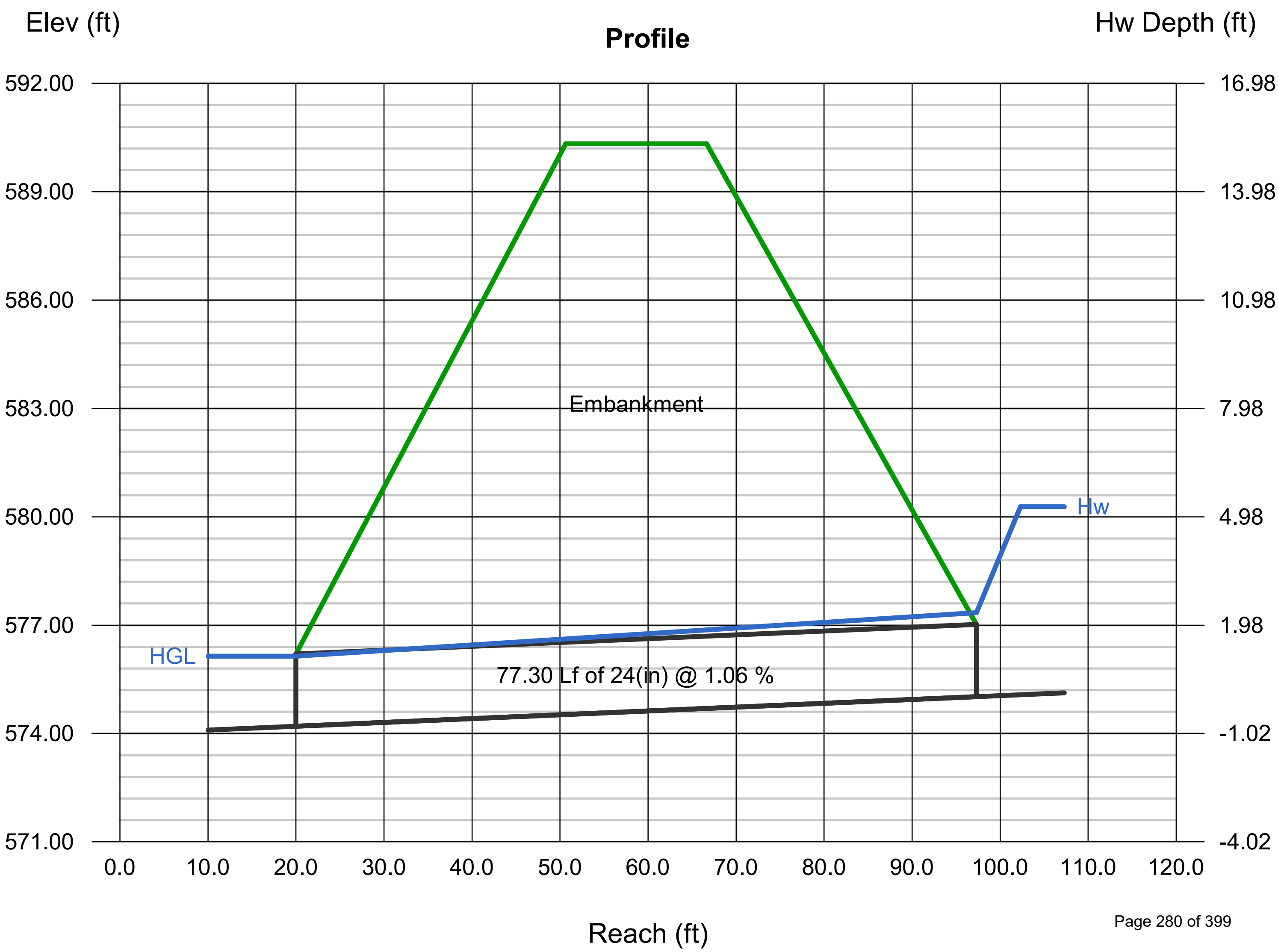
Top Elevation (ft)	=	590.33
Top Width (ft)	=	16.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	31.20
Qmax (cfs)	=	35.20
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	31.20
Qpipe (cfs)	=	31.20
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.02
Veloc Up (ft/s)	=	9.93
HGL Dn (ft)	=	576.14
HGL Up (ft)	=	577.35
Hw Elev (ft)	=	580.27
Hw/D (ft)	=	2.63
Flow Regime	=	Inlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
31.20	31.20	0.00	10.02	9.93	23.27	24.00
31.70	31.70	0.00	10.17	10.09	23.31	24.00
32.20	32.20	0.00	10.33	10.25	23.35	24.00
32.70	32.70	0.00	10.48	10.41	23.38	24.00
33.20	33.20	0.00	10.64	10.57	23.42	24.00
33.70	33.70	0.00	10.79	10.73	23.45	24.00
34.20	34.20	0.00	10.95	10.89	23.48	24.00
34.70	34.70	0.00	11.10	11.05	23.50	24.00
35.20	35.20	0.00	11.26	11.20	23.53	24.00

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
576.14	577.35	580.27	2.63
576.14	577.39	580.40	2.69
576.15	577.43	580.53	2.76
576.15	577.47	580.66	2.82
576.15	577.51	580.79	2.89
576.15	577.56	580.93	2.95
576.16	577.60	581.07	3.02
576.16	577.65	581.21	3.09
576.16	577.69	581.35	3.16

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Nov 14 2018

Exist. 18 RCP Northeast of AP#3 @ N 1,551,703; E 1,942,802 Under Railroad (Post-Solar)

Invert Elev Dn (ft)	=	574.72
Pipe Length (ft)	=	55.00
Slope (%)	=	1.51
Invert Elev Up (ft)	=	575.55
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0018, 2, 0.0292, 0.74, 0.2

Embankment

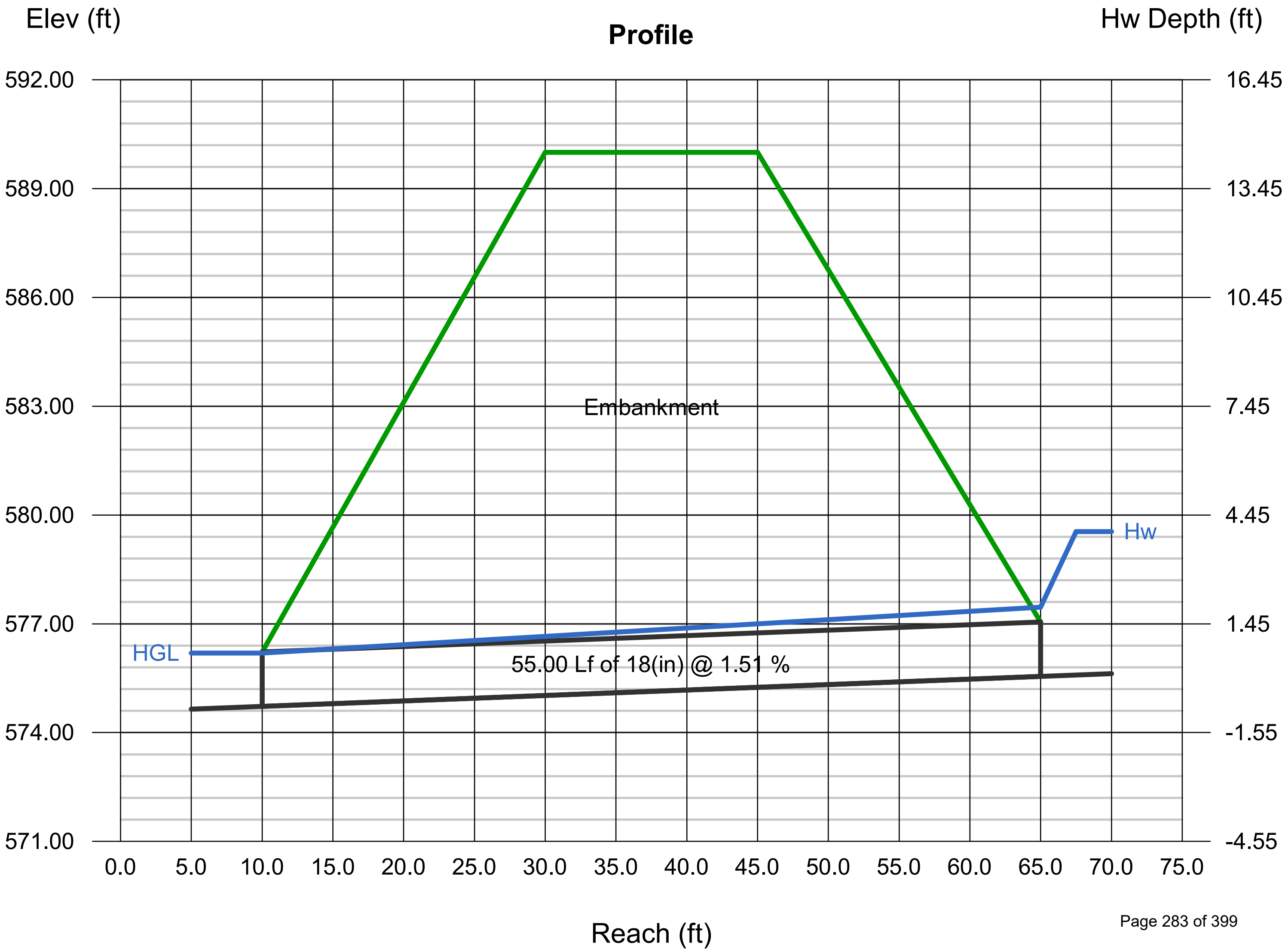
Top Elevation (ft)	=	590.00
Top Width (ft)	=	15.00
Crest Width (ft)	=	0.00

Calculations

Qmin (cfs)	=	17.60
Qmax (cfs)	=	20.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	17.60
Qpipe (cfs)	=	17.60
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.00
Veloc Up (ft/s)	=	9.96
HGL Dn (ft)	=	576.19
HGL Up (ft)	=	577.46
Hw Elev (ft)	=	579.55
Hw/D (ft)	=	2.66
Flow Regime	=	Inlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
17.60	17.60	0.00	10.00	9.96	17.68	18.00
18.00	18.00	0.00	10.22	10.19	17.71	18.00
18.40	18.40	0.00	10.44	10.41	17.73	18.00
18.80	18.80	0.00	10.67	10.64	17.75	18.00
19.20	19.20	0.00	10.89	10.86	17.77	18.00
19.60	19.60	0.00	11.12	11.09	17.79	18.00
20.00	20.00	0.00	11.34	11.32	17.80	18.00

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
576.19	577.46	579.55	2.66
576.20	577.52	579.68	2.75
576.20	577.58	579.81	2.84
576.20	577.64	579.95	2.94
576.20	577.71	580.10	3.03
576.20	577.77	580.24	3.13
576.20	577.84	580.39	3.23

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Nov 14 2018

18 RCP Northeast of AP#3 @ N 1,551,703; E 1,942,802 Under Railroad (Pre-Solar)

Invert Elev Dn (ft)	=	574.72
Pipe Length (ft)	=	55.00
Slope (%)	=	1.51
Invert Elev Up (ft)	=	575.55
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0018, 2, 0.0292, 0.74, 0.2

Embankment

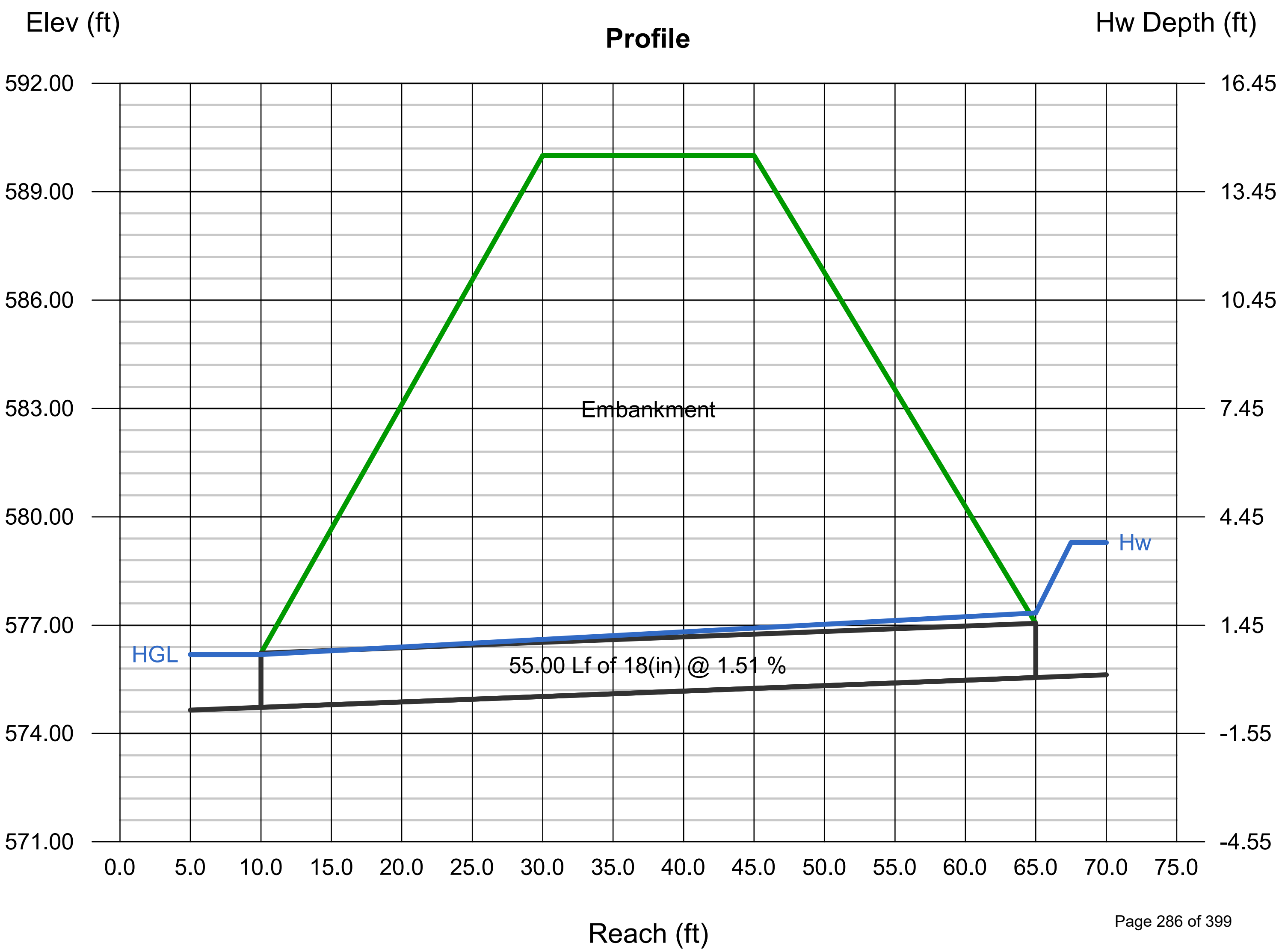
Top Elevation (ft)	=	590.00
Top Width (ft)	=	15.00
Crest Width (ft)	=	0.00

Calculations

Qmin (cfs)	=	16.80
Qmax (cfs)	=	19.60
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	16.80
Qpipe (cfs)	=	16.80
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.56
Veloc Up (ft/s)	=	9.51
HGL Dn (ft)	=	576.19
HGL Up (ft)	=	577.34
Hw Elev (ft)	=	579.29
Hw/D (ft)	=	2.49
Flow Regime	=	Inlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
16.80	16.80	0.00	9.56	9.51	17.62	18.00
17.20	17.20	0.00	9.78	9.73	17.65	18.00
17.60	17.60	0.00	10.00	9.96	17.68	18.00
18.00	18.00	0.00	10.22	10.19	17.71	18.00
18.40	18.40	0.00	10.44	10.41	17.73	18.00
18.80	18.80	0.00	10.67	10.64	17.75	18.00
19.20	19.20	0.00	10.89	10.86	17.77	18.00
19.60	19.60	0.00	11.12	11.09	17.79	18.00

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
576.19	577.34	579.29	2.49
576.19	577.40	579.41	2.58
576.19	577.46	579.55	2.66
576.20	577.52	579.68	2.75
576.20	577.58	579.81	2.84
576.20	577.64	579.95	2.94
576.20	577.71	580.10	3.03
576.20	577.77	580.24	3.13

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Nov 14 2018

New 18 Inch CPP NE of AP#3 @ N 1,551,728; E 1,942,802 Under Railroad (Post-Solar)

Invert Elev Dn (ft)	=	574.42
Pipe Length (ft)	=	60.00
Slope (%)	=	0.97
Invert Elev Up (ft)	=	575.00
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

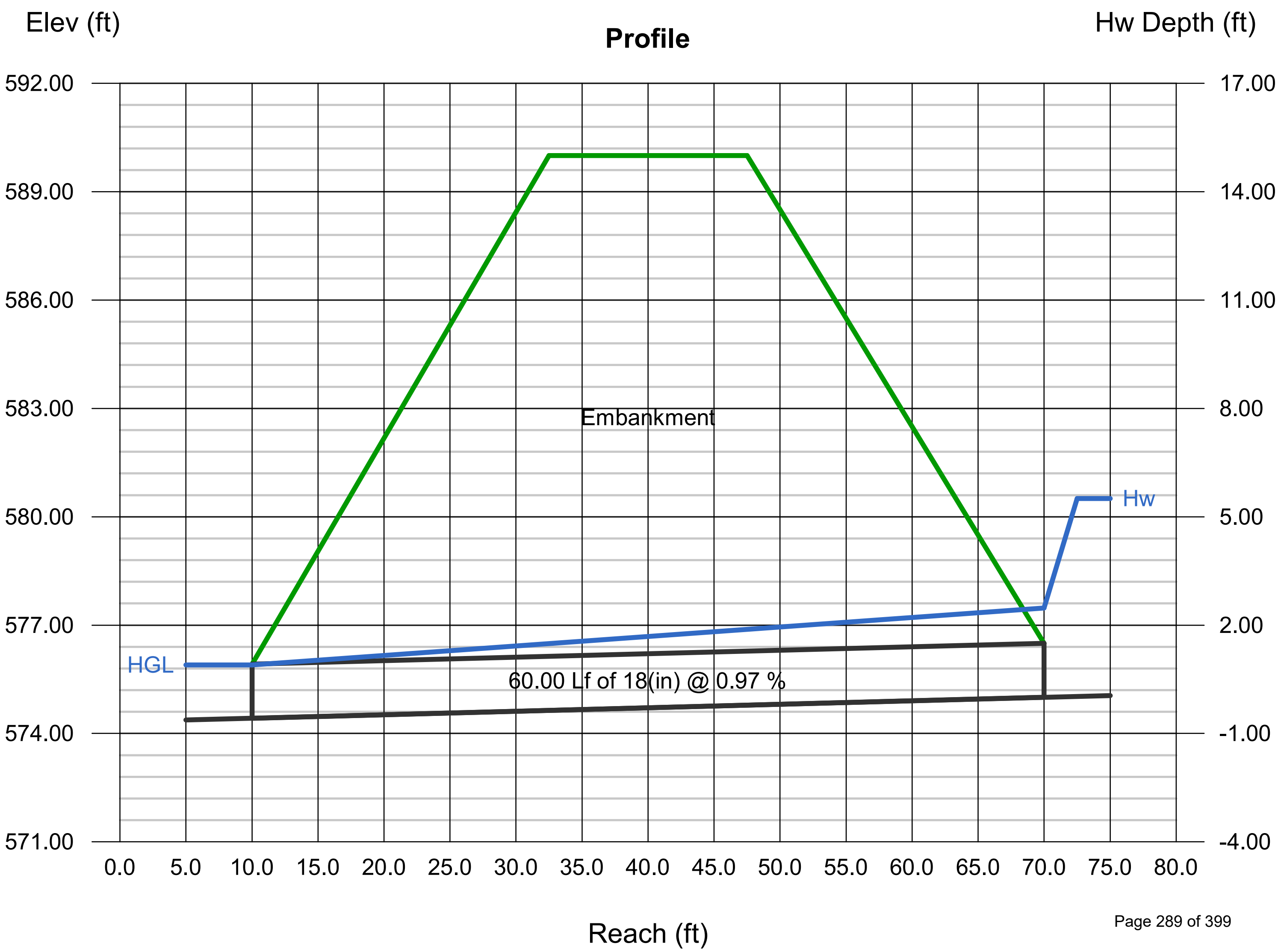
Top Elevation (ft)	=	590.00
Top Width (ft)	=	15.00
Crest Width (ft)	=	0.00

Calculations

Qmin (cfs)	=	18.80
Qmax (cfs)	=	21.30
Tailwater Elev (ft)	=	(dc+D)/2

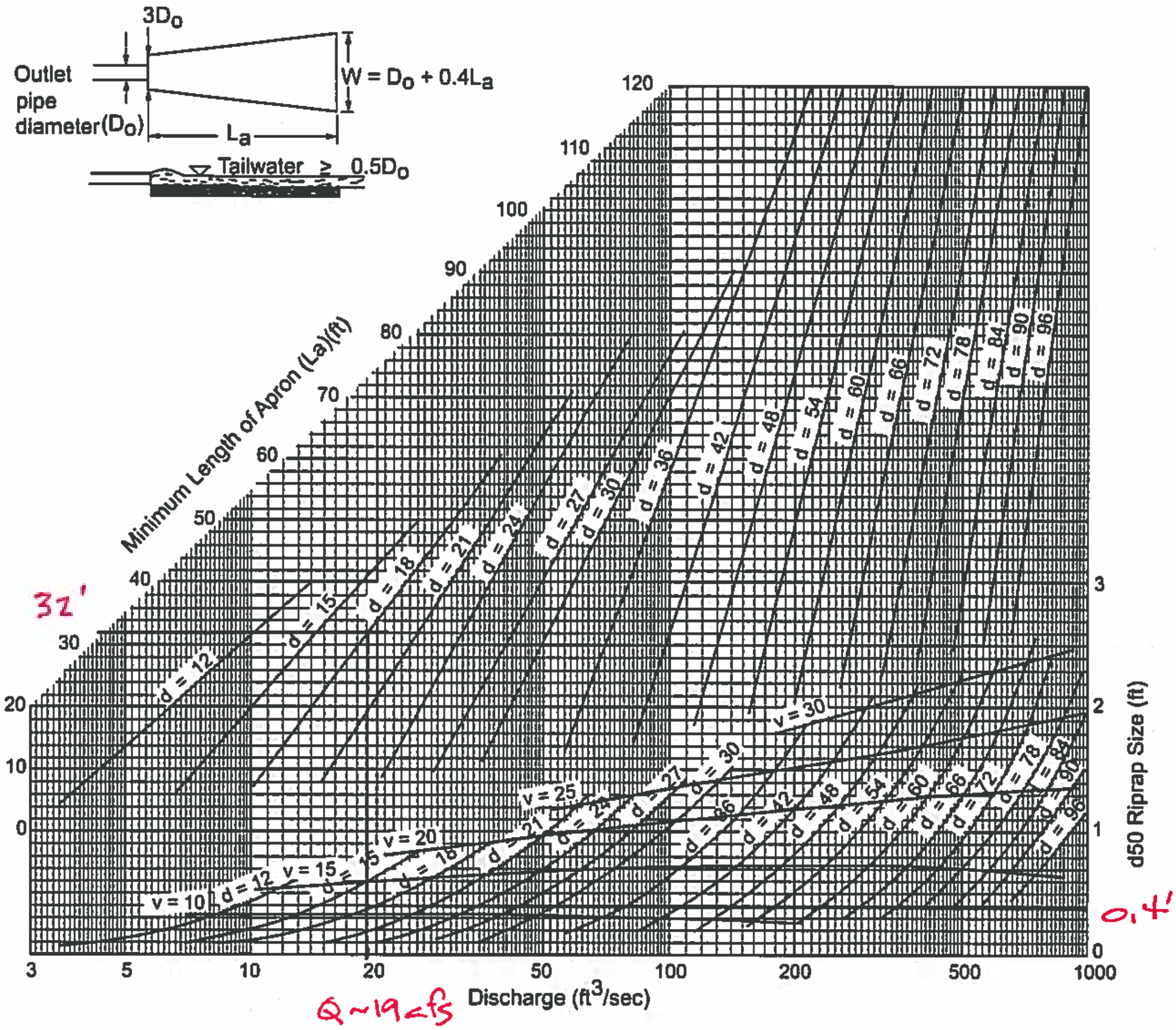
Highlighted

Qtotal (cfs)	=	18.80
Qpipe (cfs)	=	18.80
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.67
Veloc Up (ft/s)	=	10.64
HGL Dn (ft)	=	575.90
HGL Up (ft)	=	577.47
Hw Elev (ft)	=	580.50
Hw/D (ft)	=	3.67
Flow Regime	=	Inlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
18.80	18.80	0.00	10.67	10.64	17.75	18.00
19.05	19.05	0.00	10.81	10.78	17.76	18.00
19.30	19.30	0.00	10.95	10.92	17.78	18.00
19.55	19.55	0.00	11.09	11.06	17.79	18.00
19.80	19.80	0.00	11.23	11.20	17.80	18.00
20.05	20.05	0.00	11.37	11.35	17.81	18.00
20.30	20.30	0.00	11.51	11.49	17.81	18.00
20.55	20.55	0.00	11.65	11.63	17.82	18.00
20.80	20.80	0.00	11.79	11.77	17.83	18.00
21.05	21.05	0.00	11.93	11.91	17.84	18.00
21.30	21.30	0.00	12.07	12.05	17.85	18.00

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
575.90	577.47	580.50	3.67
575.90	577.52	580.62	3.75
575.90	577.56	580.75	3.83
575.90	577.61	580.87	3.91
575.90	577.65	580.99	4.00
575.90	577.70	581.12	4.08
575.90	577.75	581.25	4.17
575.91	577.79	581.38	4.25
575.91	577.84	581.51	4.34
575.91	577.89	581.65	4.43
575.91	577.94	581.78	4.52



Curves may not be extrapolated.

Figure 6-34.2 - Design of Outlet Protection From a Round Pipe Flowing Full, Maximum Tailwater Condition (Tw > 0.5 Diameter)

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Nov 14 2018

BOX CULVERT 4'X2' (Post-Solar)

Invert Elev Dn (ft)	=	593.14
Pipe Length (ft)	=	30.00
Slope (%)	=	0.50
Invert Elev Up (ft)	=	593.29
Rise (in)	=	24.0
Shape	=	Box
Span (in)	=	48.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

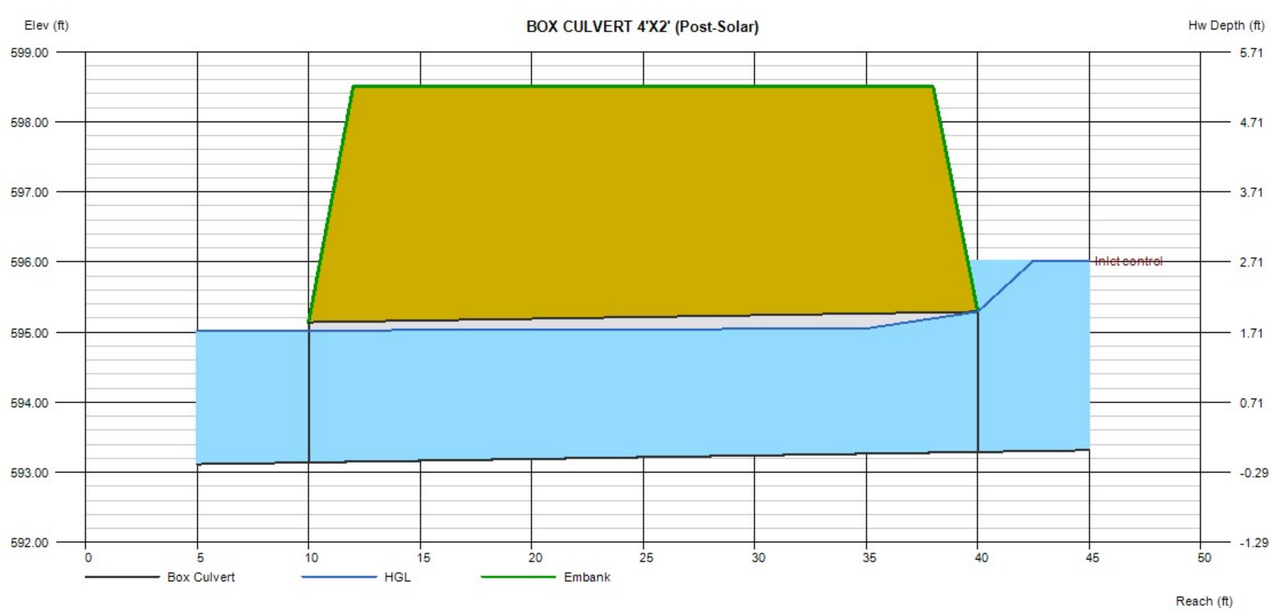
Top Elevation (ft)	=	598.50
Top Width (ft)	=	26.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	40.00
Qmax (cfs)	=	54.30
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	53.25
Qpipe (cfs)	=	53.25
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.07
Veloc Up (ft/s)	=	7.54
HGL Dn (ft)	=	595.02
HGL Up (ft)	=	595.06
Hw Elev (ft)	=	596.02
Hw/D (ft)	=	1.36
Flow Regime	=	Inlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
40.00	40.00	0.00	5.78	6.33	20.75	18.97
40.25	40.25	0.00	5.81	6.35	20.79	19.00
40.50	40.50	0.00	5.83	6.38	20.83	19.04
40.75	40.75	0.00	5.86	6.41	20.86	19.08
41.00	41.00	0.00	5.89	6.44	20.90	19.11
41.25	41.25	0.00	5.91	6.46	20.94	19.15
41.50	41.50	0.00	5.94	6.49	20.97	19.18
41.75	41.75	0.00	5.96	6.52	21.01	19.22
42.00	42.00	0.00	5.99	6.54	21.04	19.26
42.25	42.25	0.00	6.01	6.57	21.08	19.29
42.50	42.50	0.00	6.04	6.60	21.11	19.33
42.75	42.75	0.00	6.06	6.62	21.15	19.36
43.00	43.00	0.00	6.09	6.65	21.19	19.40
43.25	43.25	0.00	6.11	6.68	21.22	19.43
43.50	43.50	0.00	6.14	6.70	21.26	19.47
43.75	43.75	0.00	6.16	6.73	21.29	19.50
44.00	44.00	0.00	6.19	6.76	21.33	19.54
44.25	44.25	0.00	6.21	6.78	21.36	19.58
44.50	44.50	0.00	6.24	6.81	21.40	19.61
44.75	44.75	0.00	6.26	6.83	21.43	19.65
45.00	45.00	0.00	6.29	6.86	21.47	19.68
45.25	45.25	0.00	6.31	6.89	21.50	19.72
45.50	45.50	0.00	6.34	6.91	21.54	19.75

Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
45.75	45.75	0.00	6.36	6.94	21.57	19.79
46.00	46.00	0.00	6.39	6.96	21.61	19.82
46.25	46.25	0.00	6.41	6.99	21.64	19.86
46.50	46.50	0.00	6.44	7.01	21.68	19.89
46.75	46.75	0.00	6.46	7.04	21.71	19.92
47.00	47.00	0.00	6.48	7.06	21.75	19.96
47.25	47.25	0.00	6.51	7.09	21.78	19.99
47.50	47.50	0.00	6.53	7.12	21.82	20.03
47.75	47.75	0.00	6.56	7.14	21.85	20.06
48.00	48.00	0.00	6.58	7.17	21.88	20.10
48.25	48.25	0.00	6.60	7.19	21.92	20.13
48.50	48.50	0.00	6.63	7.22	21.95	20.17
48.75	48.75	0.00	6.65	7.24	21.99	20.20
49.00	49.00	0.00	6.68	7.27	22.02	20.23
49.25	49.25	0.00	6.70	7.29	22.06	20.27
49.50	49.50	0.00	6.72	7.31	22.09	20.30
49.75	49.75	0.00	6.75	7.34	22.12	20.33
50.00	50.00	0.00	6.77	7.36	22.16	20.37
50.25	50.25	0.00	6.79	7.39	22.19	20.40
50.50	50.50	0.00	6.82	7.40	22.22	20.46
50.75	50.75	0.00	6.84	7.42	22.26	20.53
51.00	51.00	0.00	6.86	7.43	22.29	20.59
51.25	51.25	0.00	6.89	7.44	22.32	20.66

Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
51.50	51.50	0.00	6.91	7.45	22.36	20.73
51.75	51.75	0.00	6.93	7.47	22.39	20.80
52.00	52.00	0.00	6.96	7.48	22.43	20.86
52.25	52.25	0.00	6.98	7.49	22.46	20.93
52.50	52.50	0.00	7.00	7.50	22.49	21.00
52.75	52.75	0.00	7.03	7.51	22.53	21.06
53.00	53.00	0.00	7.05	7.52	22.56	21.13
53.25	53.25	0.00	7.07	7.54	22.59	21.20
53.50	53.50	0.00	7.09	7.55	22.63	21.26
53.75	53.75	0.00	7.12	7.56	22.66	21.33
54.00	54.00	0.00	7.14	7.57	22.69	21.39
54.25	54.25	0.00	7.16	7.58	22.72	21.46

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
594.87	594.87	595.67	1.19
594.87	594.87	595.68	1.19
594.88	594.88	595.68	1.20
594.88	594.88	595.69	1.20
594.88	594.88	595.70	1.20
594.88	594.89	595.70	1.21
594.89	594.89	595.71	1.21
594.89	594.89	595.71	1.21
594.89	594.89	595.72	1.21
594.90	594.90	595.72	1.22
594.90	594.90	595.73	1.22
594.90	594.90	595.74	1.22
594.91	594.91	595.74	1.23
594.91	594.91	595.75	1.23
594.91	594.91	595.75	1.23
594.91	594.92	595.76	1.24
594.92	594.92	595.77	1.24
594.92	594.92	595.77	1.24
594.92	594.92	595.78	1.24
594.93	594.93	595.79	1.25
594.93	594.93	595.79	1.25
594.93	594.93	595.80	1.25
594.93	594.94	595.80	1.26

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
594.94	594.94	595.81	1.26
594.94	594.94	595.82	1.26
594.94	594.94	595.82	1.27
594.95	594.95	595.83	1.27
594.95	594.95	595.84	1.27
594.95	594.95	595.84	1.28
594.96	594.96	595.85	1.28
594.96	594.96	595.86	1.28
594.96	594.96	595.86	1.29
594.96	594.96	595.87	1.29
594.97	594.97	595.88	1.29
594.97	594.97	595.88	1.30
594.97	594.97	595.89	1.30
594.98	594.98	595.90	1.30
594.98	594.98	595.90	1.31
594.98	594.98	595.91	1.31
594.98	594.98	595.92	1.31
594.99	594.99	595.92	1.32
594.99	594.99	595.93	1.32
594.99	595.00	595.94	1.32
594.99	595.00	595.95	1.33
595.00	595.01	595.95	1.33
595.00	595.01	595.96	1.33

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
595.00	595.02	595.97	1.34
595.01	595.02	595.97	1.34
595.01	595.03	595.98	1.35
595.01	595.03	595.99	1.35
595.01	595.04	596.00	1.35
595.02	595.05	596.00	1.36
595.02	595.05	596.01	1.36
595.02	595.06	596.02	1.36
595.03	595.06	596.03	1.37
595.03	595.07	596.03	1.37
595.03	595.07	596.04	1.38
595.03	595.08	596.05	1.38

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Nov 14 2018

BOX CULVERT 4'X2' (Pre-Solar)

Invert Elev Dn (ft)	=	593.14
Pipe Length (ft)	=	30.00
Slope (%)	=	0.50
Invert Elev Up (ft)	=	593.29
Rise (in)	=	24.0
Shape	=	Box
Span (in)	=	48.0
No. Barrels	=	1
n-Value	=	0.012
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

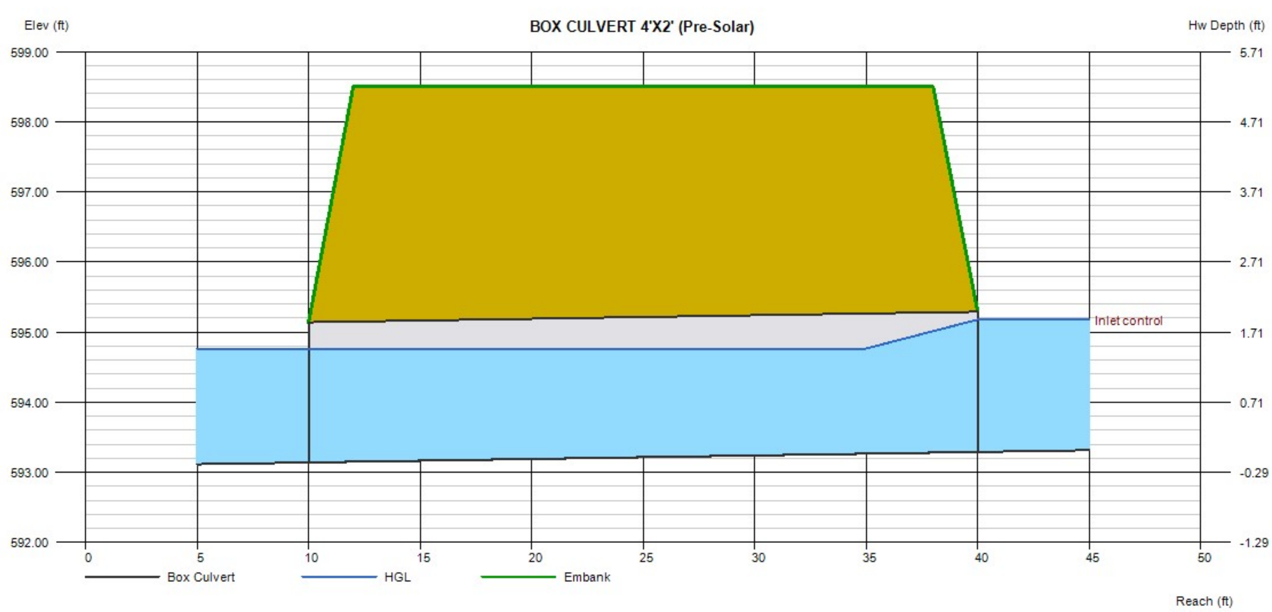
Top Elevation (ft)	=	598.50
Top Width (ft)	=	26.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	31.70
Qmax (cfs)	=	42.70
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	31.70
Qpipe (cfs)	=	31.70
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.88
Veloc Up (ft/s)	=	5.37
HGL Dn (ft)	=	594.76
HGL Up (ft)	=	594.77
Hw Elev (ft)	=	595.18
Hw/D (ft)	=	0.94
Flow Regime	=	Inlet Control



Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
31.70	31.70	0.00	4.88	5.37	19.50	17.71
32.70	32.70	0.00	4.99	5.49	19.65	17.87
33.70	33.70	0.00	5.10	5.61	19.81	18.02
34.70	34.70	0.00	5.21	5.73	19.96	18.18
35.70	35.70	0.00	5.32	5.84	20.12	18.33
36.70	36.70	0.00	5.43	5.96	20.27	18.48
37.70	37.70	0.00	5.54	6.07	20.42	18.63
38.70	38.70	0.00	5.65	6.18	20.56	18.78
39.70	39.70	0.00	5.75	6.29	20.71	18.92
40.70	40.70	0.00	5.85	6.40	20.86	19.07
41.70	41.70	0.00	5.96	6.51	21.00	19.21
42.70	42.70	0.00	6.06	6.62	21.14	19.36

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
594.76	594.77	595.18	0.94
594.78	594.78	595.22	0.96
594.79	594.79	595.26	0.98
594.80	594.80	595.56	1.14
594.82	594.82	595.58	1.15
594.83	594.83	595.60	1.16
594.84	594.84	595.62	1.17
594.85	594.85	595.64	1.18
594.87	594.87	595.67	1.19
594.88	594.88	595.69	1.20
594.89	594.89	595.71	1.21
594.90	594.90	595.73	1.22

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Nov 14 2018

EXISTING 24 CMP @ N 1550135, E 1941896 PLANT ROAD (Post-Solar)

Invert Elev Dn (ft)	= 577.56
Pipe Length (ft)	= 141.42
Slope (%)	= 0.97
Invert Elev Up (ft)	= 578.93
Rise (in)	= 24.0
Shape	= Circular
Span (in)	= 24.0
No. Barrels	= 1
n-Value	= 0.023
Culvert Type	= Circular Corrugate Metal Pipe
Culvert Entrance	= Headwall
Coeff. K,M,c,Y,k	= 0.0078, 2, 0.0379, 0.69, 0.5

Embankment

Top Elevation (ft)	= 599.50
Top Width (ft)	= 24.00
Crest Width (ft)	= 20.00

Calculations

Qmin (cfs)	= 15.16
Qmax (cfs)	= 16.70
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 15.16
Qpipe (cfs)	= 15.16
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 5.32
Veloc Up (ft/s)	= 4.83
HGL Dn (ft)	= 579.26
HGL Up (ft)	= 581.27
Hw Elev (ft)	= 581.81
Hw/D (ft)	= 1.44
Flow Regime	= Outlet Control

Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
15.16	15.16	0.00	5.32	4.83	20.41	24.00
15.26	15.26	0.00	5.35	4.86	20.44	24.00
15.36	15.36	0.00	5.38	4.89	20.47	24.00
15.46	15.46	0.00	5.41	4.92	20.50	24.00
15.56	15.56	0.00	5.44	4.95	20.52	24.00
15.66	15.66	0.00	5.47	4.98	20.55	24.00
15.76	15.76	0.00	5.50	5.02	20.58	24.00
15.86	15.86	0.00	5.53	5.05	20.61	24.00
15.96	15.96	0.00	5.55	5.08	20.63	24.00
16.06	16.06	0.00	5.58	5.11	20.66	24.00
16.16	16.16	0.00	5.61	5.14	20.69	24.00
16.26	16.26	0.00	5.64	5.18	20.72	24.00
16.36	16.36	0.00	5.67	5.21	20.74	24.00
16.46	16.46	0.00	5.70	5.24	20.77	24.00
16.56	16.56	0.00	5.73	5.27	20.80	24.00
16.66	16.66	0.00	5.75	5.30	20.82	24.00

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
579.26	581.27	581.81	1.44
579.26	581.30	581.85	1.46
579.27	581.32	581.88	1.47
579.27	581.35	581.91	1.49
579.27	581.37	581.95	1.51
579.27	581.40	581.98	1.53
579.28	581.43	582.01	1.54
579.28	581.45	582.05	1.56
579.28	581.48	582.08	1.58
579.28	581.51	582.12	1.59
579.28	581.54	582.15	1.61
579.29	581.56	582.19	1.63
579.29	581.59	582.22	1.65
579.29	581.62	582.26	1.66
579.29	581.65	582.29	1.68
579.30	581.67	582.33	1.70

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Wednesday, Nov 14 2018

EXISTING 24 CMP @ N 1550135, E 1941896 PLANT ROAD (Pre-Solar)

Invert Elev Dn (ft)	=	577.56
Pipe Length (ft)	=	141.42
Slope (%)	=	0.97
Invert Elev Up (ft)	=	578.93
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.023
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

Top Elevation (ft)	=	599.50
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	15.16
Qmax (cfs)	=	16.71
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	15.16
Qpipe (cfs)	=	15.16
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.32
Veloc Up (ft/s)	=	4.83
HGL Dn (ft)	=	579.26
HGL Up (ft)	=	581.27
Hw Elev (ft)	=	581.81
Hw/D (ft)	=	1.44
Flow Regime	=	Outlet Control

Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
15.16	15.16	0.00	5.32	4.83	20.41	24.00
15.31	15.31	0.00	5.37	4.87	20.46	24.00
15.46	15.46	0.00	5.41	4.92	20.50	24.00
15.61	15.61	0.00	5.45	4.97	20.54	24.00
15.76	15.76	0.00	5.50	5.02	20.58	24.00
15.91	15.91	0.00	5.54	5.06	20.62	24.00
16.06	16.06	0.00	5.58	5.11	20.66	24.00
16.21	16.21	0.00	5.63	5.16	20.70	24.00
16.36	16.36	0.00	5.67	5.21	20.74	24.00
16.51	16.51	0.00	5.71	5.26	20.78	24.00
16.66	16.66	0.00	5.75	5.30	20.82	24.00

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
579.26	581.27	581.81	1.44
579.26	581.31	581.86	1.47
579.27	581.35	581.91	1.49
579.27	581.39	581.96	1.52
579.28	581.43	582.01	1.54
579.28	581.47	582.07	1.57
579.28	581.51	582.12	1.59
579.29	581.55	582.17	1.62
579.29	581.59	582.22	1.65
579.29	581.63	582.28	1.67
579.30	581.67	582.33	1.70

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Nov 14 2018

Exist 36 CMP @ N 1,549,942, E 1,941,933 Under Bridge, RR (Post-Solar)

Invert Elev Dn (ft)	=	573.21
Pipe Length (ft)	=	311.72
Slope (%)	=	1.42
Invert Elev Up (ft)	=	577.64
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

Top Elevation (ft)	=	618.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	24.00

Calculations

Qmin (cfs)	=	21.57
Qmax (cfs)	=	39.14
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	21.57
Qpipe (cfs)	=	21.57
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	3.80
Veloc Up (ft/s)	=	6.14
HGL Dn (ft)	=	575.46
HGL Up (ft)	=	579.13
Hw Elev (ft)	=	579.77
Hw/D (ft)	=	0.71
Flow Regime	=	Inlet Control

Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
21.57	21.57	0.00	3.80	6.14	26.95	17.90
21.82	21.82	0.00	3.84	6.17	27.01	18.01
22.07	22.07	0.00	3.87	6.19	27.06	18.12
22.32	22.32	0.00	3.91	6.21	27.11	18.23
22.57	22.57	0.00	3.94	6.24	27.16	18.33
22.82	22.82	0.00	3.98	6.26	27.22	18.44
23.07	23.07	0.00	4.02	6.29	27.27	18.54
23.32	23.32	0.00	4.05	6.31	27.33	18.65
23.57	23.57	0.00	4.09	6.33	27.38	18.75
23.82	23.82	0.00	4.12	6.35	27.43	18.86
24.07	24.07	0.00	4.16	6.38	27.48	18.96
24.32	24.32	0.00	4.19	6.40	27.53	19.06
24.57	24.57	0.00	4.23	6.42	27.58	19.16
24.82	24.82	0.00	4.26	6.45	27.63	19.26
25.07	25.07	0.00	4.30	6.47	27.68	19.37
25.32	25.32	0.00	4.33	6.49	27.73	19.47
25.57	25.57	0.00	4.37	6.51	27.78	19.57
25.82	25.82	0.00	4.40	6.54	27.83	19.67
26.07	26.07	0.00	4.44	6.56	27.88	19.76
26.32	26.32	0.00	4.47	6.58	27.93	19.86
26.57	26.57	0.00	4.51	6.60	27.98	19.96
26.82	26.82	0.00	4.54	6.63	28.03	20.06
27.07	27.07	0.00	4.58	6.65	28.08	20.16

Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
27.32	27.32	0.00	4.61	6.67	28.13	20.26
27.57	27.57	0.00	4.64	6.69	28.18	20.35
27.82	27.82	0.00	4.68	6.71	28.23	20.45
28.07	28.07	0.00	4.71	6.73	28.28	20.55
28.32	28.32	0.00	4.75	6.76	28.32	20.64
28.57	28.57	0.00	4.78	6.78	28.37	20.74
28.82	28.82	0.00	4.82	6.80	28.42	20.84
29.07	29.07	0.00	4.85	6.82	28.46	20.92
29.32	29.32	0.00	4.88	6.84	28.51	21.02
29.57	29.57	0.00	4.92	6.86	28.55	21.11
29.82	29.82	0.00	4.95	6.88	28.60	21.21
30.07	30.07	0.00	4.99	6.91	28.65	21.30
30.32	30.32	0.00	5.02	6.93	28.70	21.39
30.57	30.57	0.00	5.05	6.95	28.74	21.48
30.82	30.82	0.00	5.09	6.97	28.79	21.58
31.07	31.07	0.00	5.12	6.99	28.83	21.67
31.32	31.32	0.00	5.15	7.01	28.88	21.76
31.57	31.57	0.00	5.19	7.03	28.92	21.84
31.82	31.82	0.00	5.22	7.05	28.97	21.94
32.07	32.07	0.00	5.25	7.08	29.01	22.03
32.32	32.32	0.00	5.29	7.10	29.06	22.12
32.57	32.57	0.00	5.32	7.12	29.10	22.20
32.82	32.82	0.00	5.35	7.14	29.15	22.29

Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
33.07	33.07	0.00	5.39	7.16	29.19	22.38
33.32	33.32	0.00	5.42	7.18	29.24	22.47
33.57	33.57	0.00	5.45	7.20	29.28	22.56
33.82	33.82	0.00	5.49	7.22	29.32	22.65
34.07	34.07	0.00	5.52	7.24	29.37	22.73
34.32	34.32	0.00	5.55	7.27	29.41	22.81
34.57	34.57	0.00	5.58	7.29	29.45	22.90
34.82	34.82	0.00	5.62	7.31	29.49	22.99
35.07	35.07	0.00	5.65	7.33	29.54	23.07
35.32	35.32	0.00	5.68	7.35	29.58	23.16
35.57	35.57	0.00	5.72	7.37	29.62	23.24
35.82	35.82	0.00	5.75	7.39	29.67	23.33
36.07	36.07	0.00	5.78	7.41	29.70	23.41
36.32	36.32	0.00	5.81	7.43	29.75	23.49
36.57	36.57	0.00	5.85	7.45	29.79	23.58
36.82	36.82	0.00	5.88	7.47	29.83	23.67
37.07	37.07	0.00	5.91	7.50	29.87	23.74
37.32	37.32	0.00	5.94	7.52	29.91	23.83
37.57	37.57	0.00	5.98	7.54	29.96	23.91
37.82	37.82	0.00	6.01	7.56	29.99	23.99
38.07	38.07	0.00	6.04	7.58	30.04	24.07
38.32	38.32	0.00	6.07	7.60	30.07	24.15
38.57	38.57	0.00	6.11	7.62	30.12	24.23

Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
38.82	38.82	0.00	6.14	7.64	30.16	24.31
39.07	39.07	0.00	6.17	7.66	30.20	24.39

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
575.46	579.13	579.77	0.71
575.46	579.14	579.79	0.72
575.47	579.15	579.80	0.72
575.47	579.16	579.82	0.73
575.47	579.17	579.83	0.73
575.48	579.18	579.85	0.74
575.48	579.19	579.86	0.74
575.49	579.19	579.88	0.75
575.49	579.20	579.89	0.75
575.50	579.21	579.91	0.76
575.50	579.22	579.92	0.76
575.50	579.23	579.94	0.77
575.51	579.24	579.95	0.77
575.51	579.25	579.97	0.78
575.52	579.25	579.98	0.78
575.52	579.26	580.00	0.79
575.53	579.27	580.01	0.79
575.53	579.28	580.03	0.80
575.53	579.29	580.04	0.80
575.54	579.30	580.06	0.81
575.54	579.30	580.07	0.81
575.55	579.31	580.09	0.82
575.55	579.32	580.10	0.82

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
575.55	579.33	580.11	0.82
575.56	579.34	580.13	0.83
575.56	579.34	580.14	0.83
575.57	579.35	580.16	0.84
575.57	579.36	580.17	0.84
575.57	579.37	580.19	0.85
575.58	579.38	580.20	0.85
575.58	579.38	580.22	0.86
575.59	579.39	580.23	0.86
575.59	579.40	580.25	0.87
575.59	579.41	580.26	0.87
575.60	579.41	580.28	0.88
575.60	579.42	580.29	0.88
575.61	579.43	580.31	0.89
575.61	579.44	580.32	0.89
575.61	579.45	580.33	0.90
575.62	579.45	580.35	0.90
575.62	579.46	580.36	0.91
575.62	579.47	580.38	0.91
575.63	579.48	580.39	0.92
575.63	579.48	580.41	0.92
575.64	579.49	580.42	0.93
575.64	579.50	580.44	0.93

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
575.64	579.50	580.45	0.94
575.65	579.51	580.47	0.94
575.65	579.52	580.48	0.95
575.65	579.53	580.50	0.95
575.66	579.53	580.51	0.96
575.66	579.54	580.52	0.96
575.66	579.55	580.54	0.97
575.67	579.56	580.55	0.97
575.67	579.56	580.57	0.98
575.68	579.57	580.58	0.98
575.68	579.58	580.60	0.99
575.68	579.58	580.61	0.99
575.69	579.59	580.63	1.00
575.69	579.60	580.64	1.00
575.69	579.61	580.66	1.01
575.70	579.61	580.67	1.01
575.70	579.62	580.69	1.02
575.70	579.63	580.70	1.02
575.71	579.63	580.71	1.02
575.71	579.64	580.73	1.03
575.71	579.65	580.74	1.03
575.72	579.65	580.76	1.04
575.72	579.66	580.77	1.04

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
575.72	579.67	580.79	1.05
575.73	579.67	580.80	1.05

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Nov 14 2018

Exist 36 CMP @ N 1,549,942, E 1,941,933 Under Bridge, RR (Pre-Solar)

Invert Elev Dn (ft)	= 573.21
Pipe Length (ft)	= 311.72
Slope (%)	= 1.42
Invert Elev Up (ft)	= 577.64
Rise (in)	= 36.0
Shape	= Circular
Span (in)	= 36.0
No. Barrels	= 1
n-Value	= 0.024
Culvert Type	= Circular Corrugate Metal Pipe
Culvert Entrance	= Headwall
Coeff. K,M,c,Y,k	= 0.0078, 2, 0.0379, 0.69, 0.5

Embankment

Top Elevation (ft)	= 618.00
Top Width (ft)	= 24.00
Crest Width (ft)	= 24.00

Calculations

Qmin (cfs)	= 21.57
Qmax (cfs)	= 39.14
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 21.57
Qpipe (cfs)	= 21.57
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 3.80
Veloc Up (ft/s)	= 6.14
HGL Dn (ft)	= 575.46
HGL Up (ft)	= 579.13
Hw Elev (ft)	= 579.77
Hw/D (ft)	= 0.71
Flow Regime	= Inlet Control

Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
21.57	21.57	0.00	3.80	6.14	26.95	17.90
21.82	21.82	0.00	3.84	6.17	27.01	18.01
22.07	22.07	0.00	3.87	6.19	27.06	18.12
22.32	22.32	0.00	3.91	6.21	27.11	18.23
22.57	22.57	0.00	3.94	6.24	27.16	18.33
22.82	22.82	0.00	3.98	6.26	27.22	18.44
23.07	23.07	0.00	4.02	6.29	27.27	18.54
23.32	23.32	0.00	4.05	6.31	27.33	18.65
23.57	23.57	0.00	4.09	6.33	27.38	18.75
23.82	23.82	0.00	4.12	6.35	27.43	18.86
24.07	24.07	0.00	4.16	6.38	27.48	18.96
24.32	24.32	0.00	4.19	6.40	27.53	19.06
24.57	24.57	0.00	4.23	6.42	27.58	19.16
24.82	24.82	0.00	4.26	6.45	27.63	19.26
25.07	25.07	0.00	4.30	6.47	27.68	19.37
25.32	25.32	0.00	4.33	6.49	27.73	19.47
25.57	25.57	0.00	4.37	6.51	27.78	19.57
25.82	25.82	0.00	4.40	6.54	27.83	19.67
26.07	26.07	0.00	4.44	6.56	27.88	19.76
26.32	26.32	0.00	4.47	6.58	27.93	19.86
26.57	26.57	0.00	4.51	6.60	27.98	19.96
26.82	26.82	0.00	4.54	6.63	28.03	20.06
27.07	27.07	0.00	4.58	6.65	28.08	20.16

Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
27.32	27.32	0.00	4.61	6.67	28.13	20.26
27.57	27.57	0.00	4.64	6.69	28.18	20.35
27.82	27.82	0.00	4.68	6.71	28.23	20.45
28.07	28.07	0.00	4.71	6.73	28.28	20.55
28.32	28.32	0.00	4.75	6.76	28.32	20.64
28.57	28.57	0.00	4.78	6.78	28.37	20.74
28.82	28.82	0.00	4.82	6.80	28.42	20.84
29.07	29.07	0.00	4.85	6.82	28.46	20.92
29.32	29.32	0.00	4.88	6.84	28.51	21.02
29.57	29.57	0.00	4.92	6.86	28.55	21.11
29.82	29.82	0.00	4.95	6.88	28.60	21.21
30.07	30.07	0.00	4.99	6.91	28.65	21.30
30.32	30.32	0.00	5.02	6.93	28.70	21.39
30.57	30.57	0.00	5.05	6.95	28.74	21.48
30.82	30.82	0.00	5.09	6.97	28.79	21.58
31.07	31.07	0.00	5.12	6.99	28.83	21.67
31.32	31.32	0.00	5.15	7.01	28.88	21.76
31.57	31.57	0.00	5.19	7.03	28.92	21.84
31.82	31.82	0.00	5.22	7.05	28.97	21.94
32.07	32.07	0.00	5.25	7.08	29.01	22.03
32.32	32.32	0.00	5.29	7.10	29.06	22.12
32.57	32.57	0.00	5.32	7.12	29.10	22.20
32.82	32.82	0.00	5.35	7.14	29.15	22.29

Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
33.07	33.07	0.00	5.39	7.16	29.19	22.38
33.32	33.32	0.00	5.42	7.18	29.24	22.47
33.57	33.57	0.00	5.45	7.20	29.28	22.56
33.82	33.82	0.00	5.49	7.22	29.32	22.65
34.07	34.07	0.00	5.52	7.24	29.37	22.73
34.32	34.32	0.00	5.55	7.27	29.41	22.81
34.57	34.57	0.00	5.58	7.29	29.45	22.90
34.82	34.82	0.00	5.62	7.31	29.49	22.99
35.07	35.07	0.00	5.65	7.33	29.54	23.07
35.32	35.32	0.00	5.68	7.35	29.58	23.16
35.57	35.57	0.00	5.72	7.37	29.62	23.24
35.82	35.82	0.00	5.75	7.39	29.67	23.33
36.07	36.07	0.00	5.78	7.41	29.70	23.41
36.32	36.32	0.00	5.81	7.43	29.75	23.49
36.57	36.57	0.00	5.85	7.45	29.79	23.58
36.82	36.82	0.00	5.88	7.47	29.83	23.67
37.07	37.07	0.00	5.91	7.50	29.87	23.74
37.32	37.32	0.00	5.94	7.52	29.91	23.83
37.57	37.57	0.00	5.98	7.54	29.96	23.91
37.82	37.82	0.00	6.01	7.56	29.99	23.99
38.07	38.07	0.00	6.04	7.58	30.04	24.07
38.32	38.32	0.00	6.07	7.60	30.07	24.15
38.57	38.57	0.00	6.11	7.62	30.12	24.23

Q			Veloc		Depth	
Total	Pipe	Over	Dn	Up	Dn	Up
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)
38.82	38.82	0.00	6.14	7.64	30.16	24.31
39.07	39.07	0.00	6.17	7.66	30.20	24.39

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
575.46	579.13	579.77	0.71
575.46	579.14	579.79	0.72
575.47	579.15	579.80	0.72
575.47	579.16	579.82	0.73
575.47	579.17	579.83	0.73
575.48	579.18	579.85	0.74
575.48	579.19	579.86	0.74
575.49	579.19	579.88	0.75
575.49	579.20	579.89	0.75
575.50	579.21	579.91	0.76
575.50	579.22	579.92	0.76
575.50	579.23	579.94	0.77
575.51	579.24	579.95	0.77
575.51	579.25	579.97	0.78
575.52	579.25	579.98	0.78
575.52	579.26	580.00	0.79
575.53	579.27	580.01	0.79
575.53	579.28	580.03	0.80
575.53	579.29	580.04	0.80
575.54	579.30	580.06	0.81
575.54	579.30	580.07	0.81
575.55	579.31	580.09	0.82
575.55	579.32	580.10	0.82

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
575.55	579.33	580.11	0.82
575.56	579.34	580.13	0.83
575.56	579.34	580.14	0.83
575.57	579.35	580.16	0.84
575.57	579.36	580.17	0.84
575.57	579.37	580.19	0.85
575.58	579.38	580.20	0.85
575.58	579.38	580.22	0.86
575.59	579.39	580.23	0.86
575.59	579.40	580.25	0.87
575.59	579.41	580.26	0.87
575.60	579.41	580.28	0.88
575.60	579.42	580.29	0.88
575.61	579.43	580.31	0.89
575.61	579.44	580.32	0.89
575.61	579.45	580.33	0.90
575.62	579.45	580.35	0.90
575.62	579.46	580.36	0.91
575.62	579.47	580.38	0.91
575.63	579.48	580.39	0.92
575.63	579.48	580.41	0.92
575.64	579.49	580.42	0.93
575.64	579.50	580.44	0.93

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
575.64	579.50	580.45	0.94
575.65	579.51	580.47	0.94
575.65	579.52	580.48	0.95
575.65	579.53	580.50	0.95
575.66	579.53	580.51	0.96
575.66	579.54	580.52	0.96
575.66	579.55	580.54	0.97
575.67	579.56	580.55	0.97
575.67	579.56	580.57	0.98
575.68	579.57	580.58	0.98
575.68	579.58	580.60	0.99
575.68	579.58	580.61	0.99
575.69	579.59	580.63	1.00
575.69	579.60	580.64	1.00
575.69	579.61	580.66	1.01
575.70	579.61	580.67	1.01
575.70	579.62	580.69	1.02
575.70	579.63	580.70	1.02
575.71	579.63	580.71	1.02
575.71	579.64	580.73	1.03
575.71	579.65	580.74	1.03
575.72	579.65	580.76	1.04
575.72	579.66	580.77	1.04

HGL			
Dn	Up	Hw	Hw/D
(ft)	(ft)	(ft)	
575.72	579.67	580.79	1.05
575.73	579.67	580.80	1.05

Curve Numbers (CN's) Adjustments for Solar

SOUTHERN COMPANY

Design Calculations

Project Hammond AP3	Prepared By CRM	Date 11/14/18
Subject/Title Solar Drainage Calc's	Reviewed By	Date
Modifications to CN's	Calculation Number	Sheet 1 of 6

- Calculate the impervious areas on AP3 due to the addition of solar panels with concrete ballasts.

- Area F @ NE corner:

  Total ballast blocks = 425

  $(425)(38\ ft^2/ea.) = 16{,}150\ ft^2 / 43560\ ft^2/Ac = \underline{0.37\ Ac}$

- Area G @ NW corner:

  Total ballast blocks = 249

  $(249)(38\ ft^2/ea.) = 9462\ ft^2 / 43560\ ft^2/Ac = \underline{0.22\ Ac}$

- Area D @ SW corner

  Total ballast blocks = 363

  $(363)(38\ ft^2/ea.) = 13{,}794\ ft^2 / 43560\ ft^2/Ac = \underline{0.32\ Ac}$

Form 9-0324B Rev. 10/98

SOUTHERN COMPANY

Design Calculations

Project Hammond AP3	Prepared By CRU	Date 11/14/18
Subject/Title Solar Drainage Calc's	Reviewed By	Date
	Calculation Number	Sheet 2 of 6

- Adjust the curve number (CN) runoff values for the addition of solar panels to the cap surface.

- Drainage Basin F:

$CN_{composite} = 80$ (Prior to Solar)

Previously grassed areas = 8.18 Ac, CN = 77

8.18 Ac
− 0.37 Ac (Area of Solar Panel Ballasts)

7.81 Ac grassed

- w/ 0.37 Ac Impervious, CN = 98
& 7.81 Ac grassed, CN = 77
& 0.44 Ac agg. road, CN = 85

$$CN = \frac{0.37(98) + 7.81(77) + 0.44(85)}{8.62}$$

$$CN = \frac{36.26 + 601.37 + 37.4}{8.62} = 78.3$$

CN = 78

SOUTHERN COMPANY

Design Calculations

Project Hammond AP3	Prepared By CRU	Date 11/14/18
Subject/Title Solar Drainage Calc's	Reviewed By	Date
	Calculation Number	Sheet 3 of 6

- Drainage Basin G:

CN composite = 78 (Prior to Solar)

Previously grassed areas = 4.96 Ac, CN = 77

$$\begin{array}{r} 4.96 \text{ Ac} \\ -0.22 \text{ Ac} \\ \hline 4.74 \text{ Ac} \end{array}$$

(Area of solar panel ballasts)

4.74 Ac grassed

- W/ 0.22 Ac Impervious, CN = 98
  4.74 Ac Grassed, CN = 77
  0.33 Ac Agg. Road, CN = 85

$$CN = \frac{0.22(98) + 4.74(77) + 0.33(85)}{5.29}$$

$$CN = \frac{21.56 + 364.98 + 28.05}{5.29} = \frac{414.59}{5.29}$$

$$CN = 78.37 = \underline{78}$$

SOUTHERN COMPANY

Design Calculations

Project Hammond AP3	Prepared By CRU	Date 11/14/18
Subject/Title Solar-Drainage Calc's	Reviewed By	Date
	Calculation Number	Sheet 4 of 6

– Drainage Basin D:

$CN_{composite} = 78$ (Prior to Solar)

Previously grassed areas = 8.61 Ac

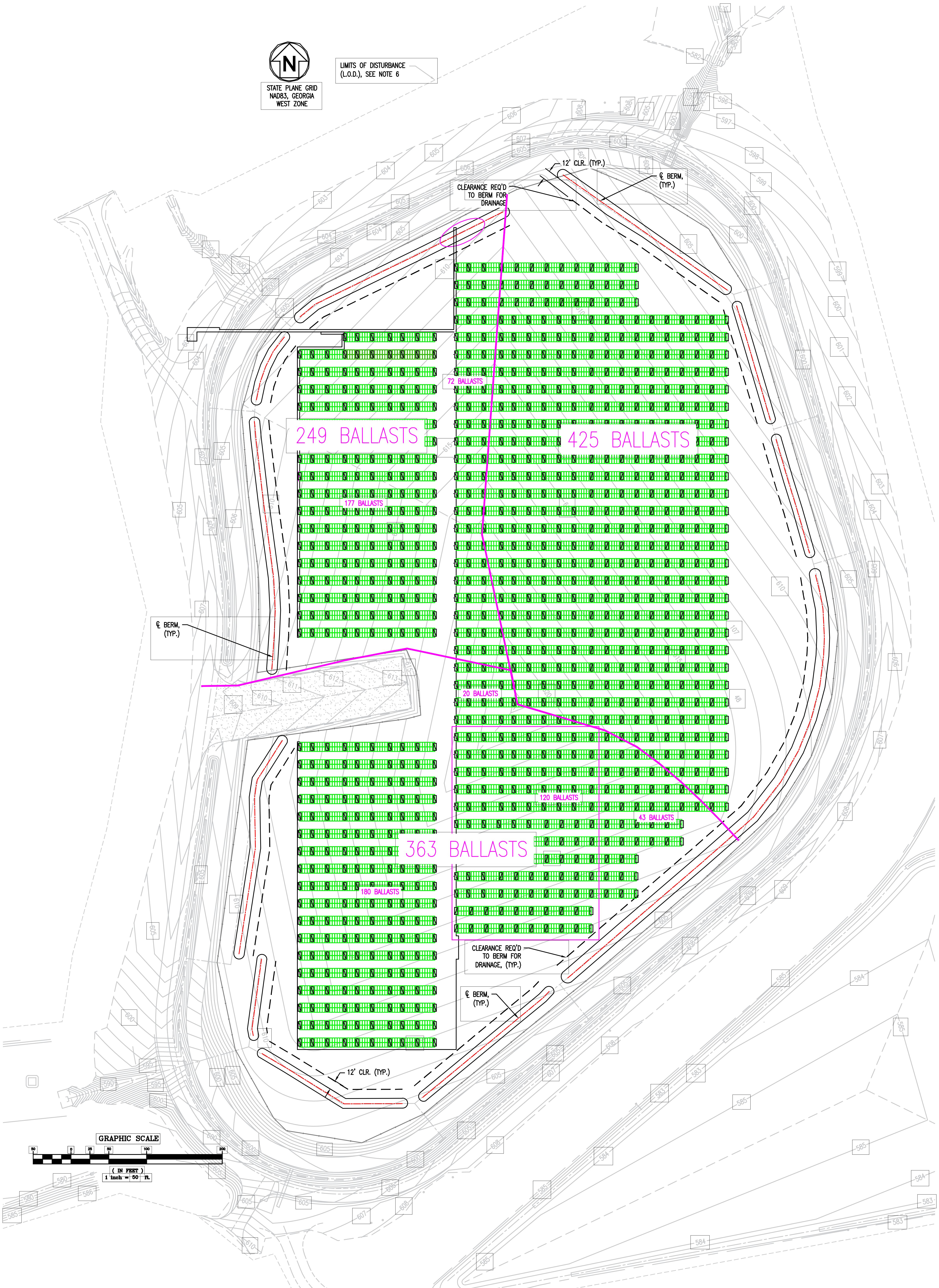
8.61 Ac
– 0.32 Ac (Area of solar panel ballasts)
8.29 Ac grassed

– w/ 0.32 Ac Impervious, CN=98
8.29 Ac Grassed, CN=77
0.91 Ac Agg. Road, CN=85

$$CN = \frac{0.32(98) + 8.29(77) + 0.91(85)}{9.52}$$

$$CN = \frac{31.36 + 638.33 + 77.35}{9.52} = \frac{747.04}{9.52}$$

CN = 78

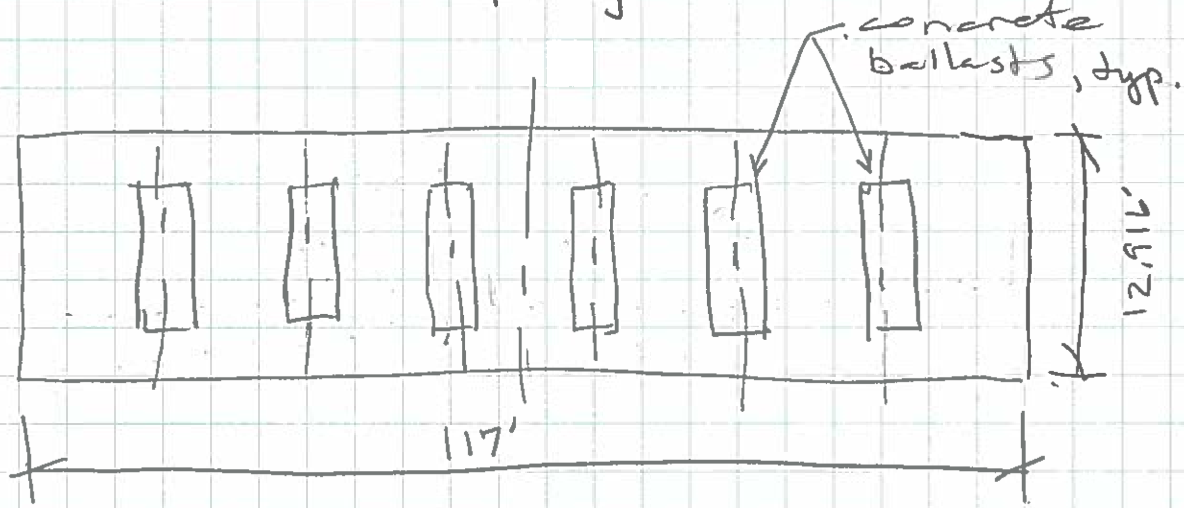

N
STATE PLANE GRID
NAD83, GEORGIA
WEST ZONE
LIMITS OF DISTURBANCE
(L.O.D.), SEE NOTE 6
12' CLR. (TYP.)
℄ BERM,
(TYP.)
CLEARANCE REQ'D
TO BERM FOR
DRAINAGE
72 BALLASTS
249 BALLASTS
425 BALLASTS
177 BALLASTS
20 BALLASTS
120 BALLASTS
43 BALLASTS
363 BALLASTS
180 BALLASTS
CLEARANCE REQ'D
TO BERM FOR
DRAINAGE, (TYP.)
GRAPHIC SCALE
(IN FEET)
1 inch = 50 ft.

SOUTHERN COMPANY

Design Calculations

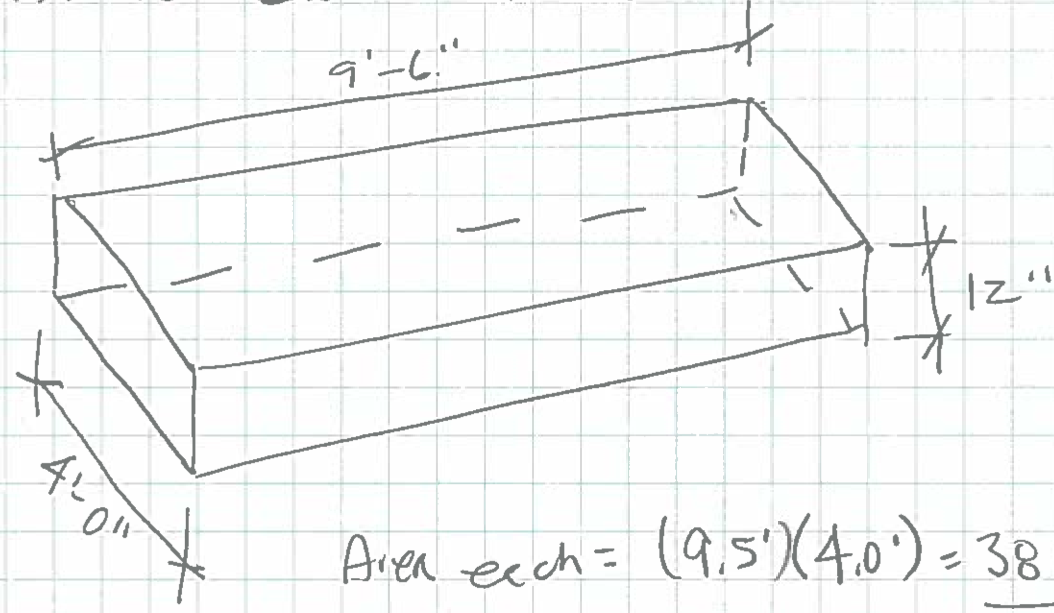
Project: Hammond AP 3	Prepared By: CRH	Date: 11/14/18
Subject/Title: Solar Drainage Calc's	Reviewed By:	Date:
	Calculation Number:	Sheet 6 of 6

- Ballast Locations & Spacing



6 each @ 20' c/c

Assume each ballast:



Area each = (9.5')(4.0') = 38 ft²

Rainfall Data
NOAA Atlas 14 Precipitation
SCS Rainfall Distribution

NOAA Atlas 14, Volume 9, Version 2
Location name: Rome, Georgia, USA*
Latitude: 34.2577°, Longitude: -85.3388°
Elevation: 578.84 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.407 (0.330‑0.504)	0.465 (0.377‑0.577)	0.570 (0.461‑0.709)	0.666 (0.534‑0.831)	0.811 (0.632‑1.05)	0.933 (0.705‑1.22)	1.07 (0.773‑1.42)	1.21 (0.834‑1.64)	1.41 (0.931‑1.96)	1.58 (1.00‑2.20)
10-min	0.596 (0.484‑0.738)	0.681 (0.552‑0.845)	0.834 (0.674‑1.04)	0.975 (0.783‑1.22)	1.19 (0.925‑1.54)	1.37 (1.03‑1.79)	1.56 (1.13‑2.08)	1.77 (1.22‑2.41)	2.07 (1.36‑2.87)	2.31 (1.47‑3.22)
15-min	0.726 (0.590‑0.901)	0.830 (0.674‑1.03)	1.02 (0.822‑1.26)	1.19 (0.954‑1.48)	1.45 (1.13‑1.88)	1.67 (1.26‑2.18)	1.90 (1.38‑2.54)	2.16 (1.49‑2.94)	2.52 (1.66‑3.50)	2.81 (1.79‑3.93)
30-min	1.03 (0.835‑1.27)	1.17 (0.951‑1.46)	1.44 (1.16‑1.79)	1.68 (1.35‑2.09)	2.05 (1.59‑2.66)	2.36 (1.78‑3.08)	2.69 (1.95‑3.59)	3.06 (2.11‑4.17)	3.58 (2.36‑4.98)	4.00 (2.55‑5.59)
60-min	1.34 (1.09‑1.66)	1.53 (1.24‑1.90)	1.87 (1.51‑2.32)	2.18 (1.75‑2.72)	2.65 (2.06‑3.43)	3.04 (2.30‑3.97)	3.46 (2.51‑4.61)	3.92 (2.71‑5.33)	4.57 (3.02‑6.35)	5.09 (3.25‑7.11)
2-hr	1.65 (1.35‑2.03)	1.89 (1.54‑2.32)	2.30 (1.88‑2.84)	2.68 (2.17‑3.31)	3.25 (2.55‑4.17)	3.72 (2.84‑4.82)	4.23 (3.10‑5.58)	4.78 (3.34‑6.44)	5.55 (3.71‑7.64)	6.18 (4.00‑8.56)
3-hr	1.86 (1.53‑2.28)	2.13 (1.75‑2.60)	2.60 (2.13‑3.18)	3.02 (2.45‑3.71)	3.64 (2.87‑4.63)	4.15 (3.18‑5.34)	4.70 (3.46‑6.16)	5.28 (3.72‑7.07)	6.11 (4.11‑8.35)	6.77 (4.41‑9.32)
6-hr	2.29 (1.90‑2.77)	2.61 (2.17‑3.17)	3.18 (2.62‑3.86)	3.68 (3.02‑4.48)	4.40 (3.49‑5.54)	4.99 (3.86‑6.34)	5.61 (4.17‑7.26)	6.26 (4.45‑8.28)	7.17 (4.89‑9.69)	7.89 (5.21‑10.8)
12-hr	2.79 (2.34‑3.35)	3.20 (2.67‑3.84)	3.88 (3.23‑4.67)	4.47 (3.69‑5.39)	5.31 (4.25‑6.60)	5.99 (4.67‑7.52)	6.69 (5.03‑8.56)	7.42 (5.34‑9.71)	8.43 (5.82‑11.3)	9.22 (6.18‑12.5)
24-hr	3.34 (2.82‑3.97)	3.82 (3.22‑4.55)	4.63 (3.89‑5.52)	5.32 (4.44‑6.36)	6.30 (5.08‑7.74)	7.07 (5.57‑8.78)	7.86 (5.97‑9.95)	8.68 (6.32‑11.2)	9.79 (6.84‑13.0)	10.7 (7.24‑14.3)
2-day	3.91 (3.32‑4.60)	4.46 (3.79‑5.26)	5.39 (4.56‑6.36)	6.17 (5.19‑7.31)	7.27 (5.92‑8.83)	8.13 (6.47‑9.99)	9.01 (6.92‑11.3)	9.91 (7.30‑12.7)	11.1 (7.89‑14.6)	12.1 (8.33‑16.0)
3-day	4.32 (3.69‑5.05)	4.89 (4.17‑5.73)	5.85 (4.97‑6.87)	6.67 (5.64‑7.85)	7.82 (6.40‑9.45)	8.72 (6.99‑10.7)	9.65 (7.47‑12.0)	10.6 (7.88‑13.5)	11.9 (8.52‑15.5)	12.9 (8.99‑17.0)
4-day	4.67 (4.00‑5.44)	5.25 (4.50‑6.13)	6.24 (5.32‑7.29)	7.08 (6.01‑8.30)	8.26 (6.80‑9.96)	9.21 (7.40‑11.2)	10.2 (7.91‑12.6)	11.2 (8.34‑14.2)	12.5 (9.01‑16.3)	13.6 (9.51‑17.8)
7-day	5.55 (4.79‑6.42)	6.19 (5.34‑7.17)	7.26 (6.24‑8.42)	8.17 (6.99‑9.51)	9.46 (7.85‑11.3)	10.5 (8.50‑12.6)	11.5 (9.04‑14.2)	12.6 (9.50‑15.8)	14.0 (10.2‑18.1)	15.2 (10.7‑19.8)
10-day	6.32 (5.48‑7.27)	7.01 (6.08‑8.08)	8.17 (7.05‑9.42)	9.14 (7.85‑10.6)	10.5 (8.76‑12.5)	11.6 (9.46‑13.9)	12.7 (10.0‑15.5)	13.8 (10.5‑17.3)	15.4 (11.2‑19.6)	16.5 (11.8‑21.4)
20-day	8.51 (7.44‑9.70)	9.35 (8.17‑10.7)	10.7 (9.36‑12.3)	11.9 (10.3‑13.7)	13.5 (11.4‑15.9)	14.8 (12.2‑17.6)	16.1 (12.8‑19.5)	17.4 (13.4‑21.5)	19.1 (14.2‑24.2)	20.4 (14.8‑26.2)
30-day	10.4 (9.15‑11.8)	11.4 (10.0‑12.9)	13.0 (11.4‑14.8)	14.4 (12.5‑16.4)	16.2 (13.7‑18.9)	17.6 (14.6‑20.8)	19.0 (15.3‑22.9)	20.5 (15.9‑25.1)	22.3 (16.7‑28.0)	23.7 (17.3‑30.2)
45-day	12.9 (11.4‑14.5)	14.1 (12.5‑15.9)	16.1 (14.2‑18.2)	17.7 (15.5‑20.1)	19.9 (16.9‑22.9)	21.5 (17.9‑25.1)	23.0 (18.6‑27.4)	24.6 (19.1‑29.9)	26.5 (20.0‑33.0)	27.9 (20.6‑35.4)
60-day	15.1 (13.4‑17.0)	16.6 (14.7‑18.6)	18.9 (16.7‑21.3)	20.7 (18.2‑23.4)	23.2 (19.7‑26.6)	24.9 (20.8‑28.9)	26.6 (21.6‑31.5)	28.2 (22.1‑34.1)	30.1 (22.8‑37.3)	31.5 (23.4‑39.8)

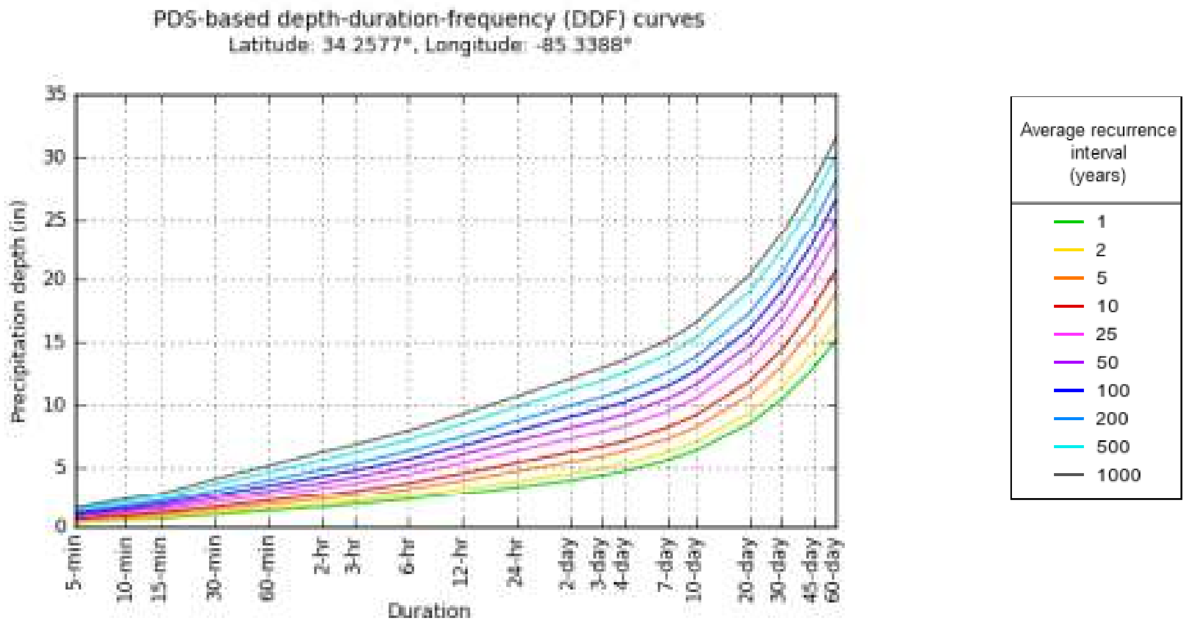
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

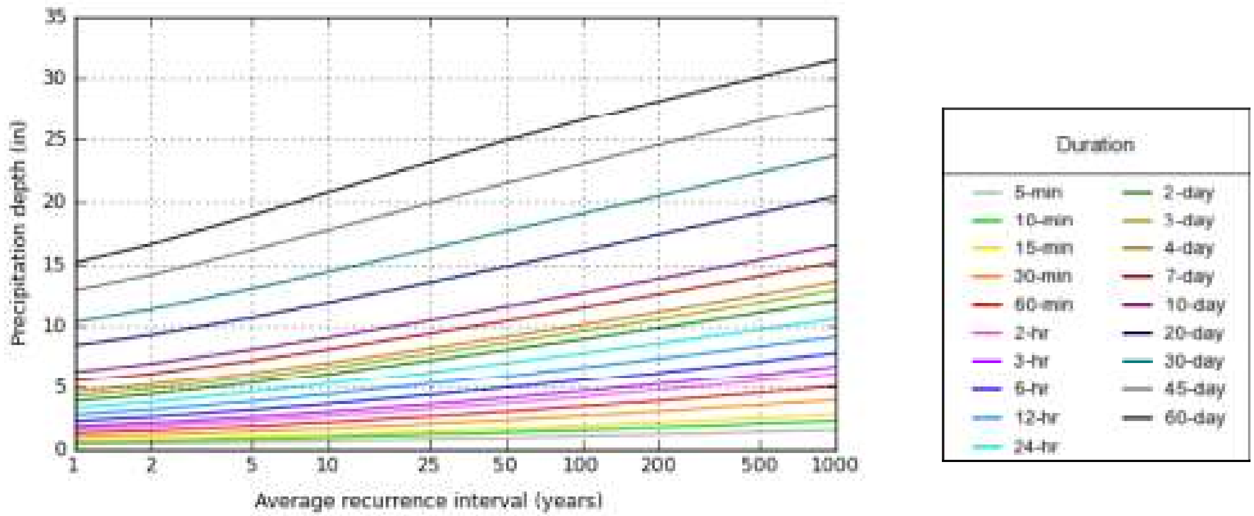
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper 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.

Back to Top

PF graphical





NOAA Atlas 14, Volume 9, Version 2

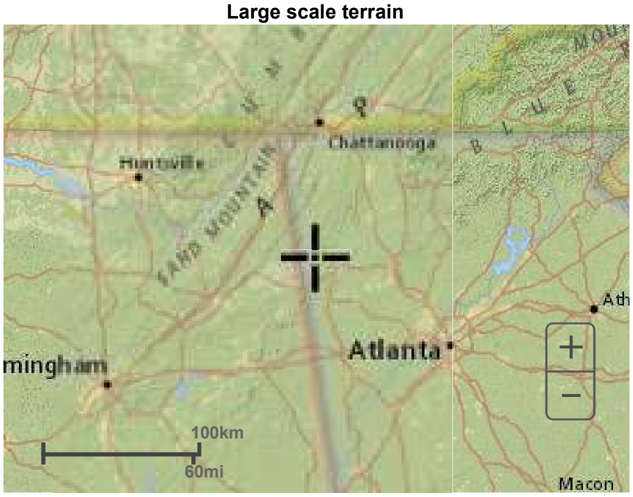
Created (GMT): Tue Jun 20 13:12:27 2017

Back to Top

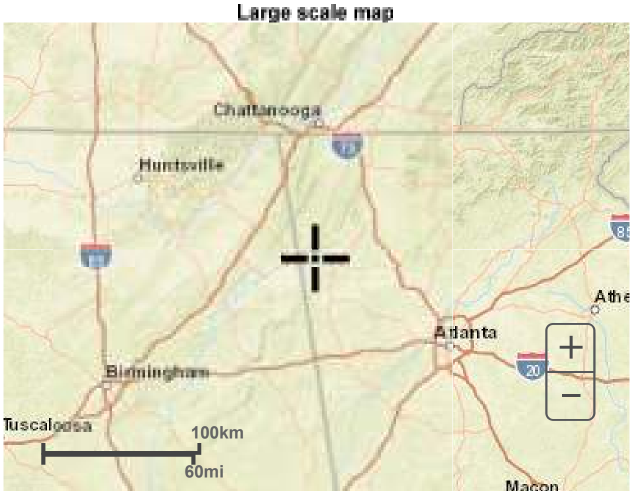
Maps & aerials

Small scale terrain

Large scale terrain



Large scale map



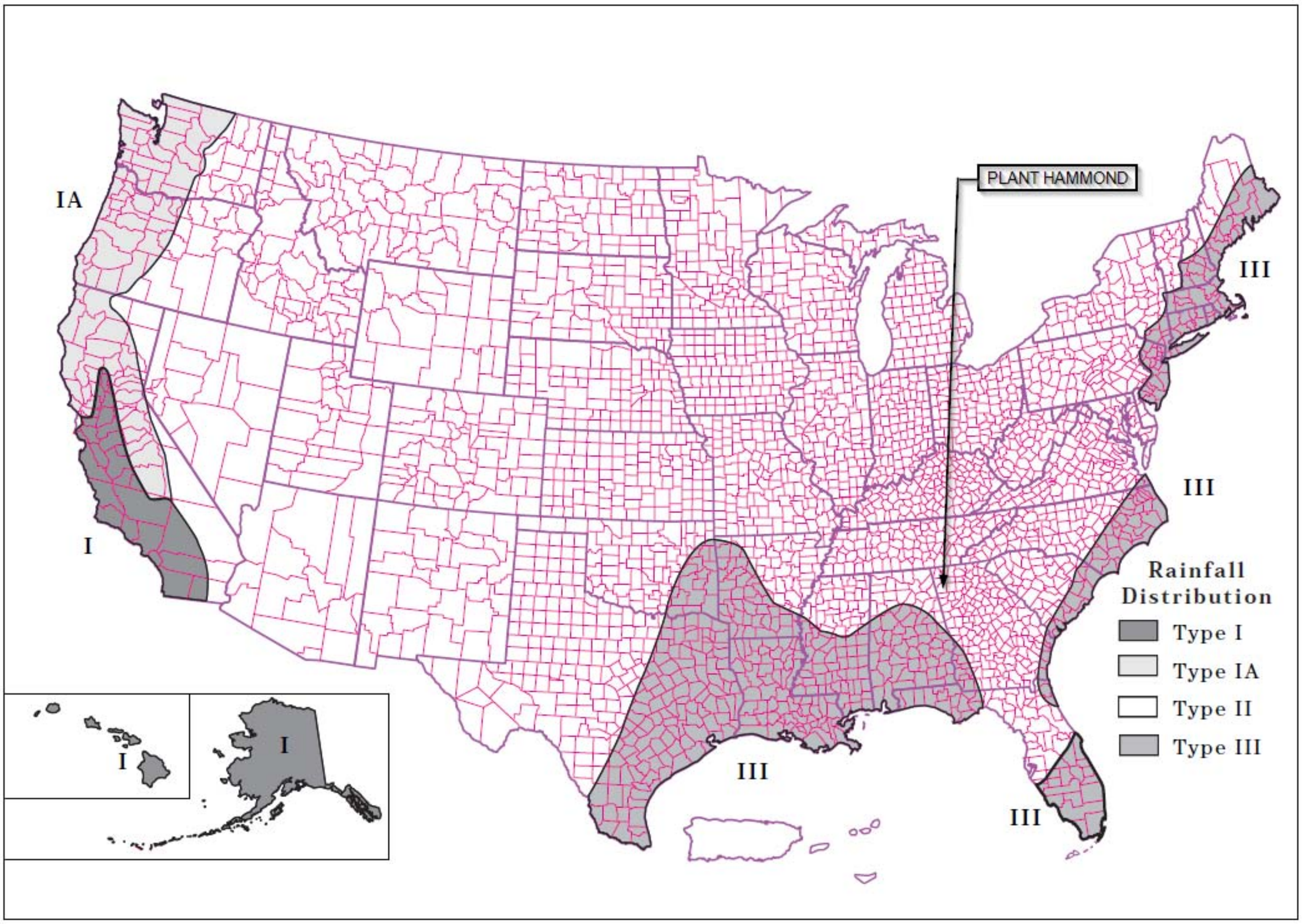
Large scale aerial

Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Figure B-2 Approximate geographic boundaries for NRCS (SCS) rainfall distributions



NRCS Soils Data

Soil Map—Chattooga, Floyd, and Polk Counties, Georgia

Map Scale: 1:8,600 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 100, 200, 400, 600

Feet: 0, 400, 800, 1600, 2400

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

Soil Map—Chattooga, Floyd, and Polk Counties, Georgia

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2011—Jan 4, 2012

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Chattooga, Floyd, and Polk Counties, Georgia (GA621)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AaE	Allen fine sandy loam, 15 to 25 percent slopes	9.1	2.6%
Ck	Chewacla silt loam, 0 to 2 percent slopes, frequently flooded	11.8	3.3%
CuE	Cunningham loam, 15 to 25 percent slopes	7.5	2.1%
DhB	Dewey silt loam, 2 to 6 percent slopes	25.0	7.1%
DhC	Dewey silt loam, 6 to 10 percent slopes	0.1	0.0%
EtA	Etowah loam, 0 to 2 percent slopes	40.3	11.4%
EtB	Etowah loam, 2 to 6 percent slopes	1.3	0.4%
HaE	Hartsells fine sandy loam, 15 to 25 percent slopes	7.4	2.1%
HoC	Holston fine sandy loam, 6 to 10 percent slopes	5.2	1.5%
Rn	Roanoke silt loam	16.7	4.7%
RoA	Rome fine sandy loam, 0 to 2 percent slopes	55.4	15.7%
RoB	Rome fine sandy loam, 2 to 6 percent slopes	49.8	14.1%
Tk	Toccoa fine sandy loam	6.2	1.8%
Tv	Tupelo clay loam, frequently flooded	36.6	10.4%
W	Water	27.2	7.7%
Wh	Whitwell silt loam	28.1	7.9%
WoA	Wolftever silt loam, 0 to 2 percent slopes	25.4	7.2%
Totals for Area of Interest		**352.9**	**100.0%**

Chattooga, Floyd, and Polk Counties, Georgia

Ck—Chewacla silt loam, 0 to 2 percent slopes, frequently flooded

Map Unit Setting

National map unit symbol: 2tg8j
Elevation: 510 to 1,750 feet
Mean annual precipitation: 51 to 63 inches
Mean annual air temperature: 48 to 71 degrees F
Frost-free period: 150 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Chewacla and similar soils: 89 percent
Minor components: 11 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chewacla

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium derived from interbedded sedimentary rock

Typical profile

Ap - 0 to 9 inches: silt loam
Bw - 9 to 50 inches: silt loam
C - 50 to 79 inches: sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: High (about 10.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Hydric soil rating: No

Minor Components

Roanoke

Percent of map unit: 5 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Wehadkee

Percent of map unit: 3 percent
Landform: Drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Guthrie

Percent of map unit: 3 percent
Landform: Drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

DhB—Dewey silt loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2v4ft
Elevation: 800 to 1,700 feet
Mean annual precipitation: 44 to 65 inches
Mean annual air temperature: 56 to 61 degrees F
Frost-free period: 171 to 209 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Dewey and similar soils: 86 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dewey

Setting

Landform: Stream terraces, ridges
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Clayey residuum weathered from limestone

Typical profile

Ap - 0 to 9 inches: silt loam
Bt - 9 to 72 inches: clay

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

EtA—Etowah loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2szhr
Elevation: 570 to 880 feet
Mean annual precipitation: 54 to 58 inches
Mean annual air temperature: 57 to 60 degrees F
Frost-free period: 155 to 218 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Etowah and similar soils: 94 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Etowah

Setting

Landform: Stream terraces
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Loamy alluvium derived from limestone, sandstone, and shale

Typical profile

Ap - 0 to 8 inches: loam
Bt1 - 8 to 13 inches: clay loam
Bt2 - 13 to 83 inches: clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

EtB—Etowah loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2szhs
Elevation: 690 to 1,190 feet
Mean annual precipitation: 45 to 59 inches
Mean annual air temperature: 57 to 60 degrees F
Frost-free period: 155 to 218 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Etowah and similar soils: 94 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Etowah

Setting

Landform: Stream terraces
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Loamy alluvium and/or colluvium derived from limestone, sandstone, and shale

Typical profile

A - 0 to 11 inches: loam
Bt1 - 11 to 36 inches: clay loam
Bt2 - 36 to 83 inches: silty clay loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

RoA—Rome fine sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: ktvd
Elevation: 500 to 1,200 feet
Mean annual precipitation: 48 to 55 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Rome and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rome

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 9 inches: fine sandy loam
H2 - 9 to 53 inches: sandy clay loam
H3 - 53 to 66 inches: sandy clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

RoB—Rome fine sandy loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: ktvf
Elevation: 500 to 1,200 feet
Mean annual precipitation: 48 to 55 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Rome and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rome

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 9 inches: fine sandy loam
H2 - 9 to 53 inches: sandy clay loam
H3 - 53 to 66 inches: sandy clay loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Soil Map—Chattooga, Floyd, and Polk Counties, Georgia

85° 25' 35" W
85° 24' 47" W

85° 25' 35" W
85° 24' 47" W

Map Scale: 1:5,590 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 50, 100, 200, 300

Feet: 0, 250, 500, 1000, 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

Soil Map—Chattooga, Floyd, and Polk Counties, Georgia

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 11, Oct 5, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2011—Jan 4, 2012

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AaB	Allen fine sandy loam, 2 to 6 percent slopes	1.4	1.2%
AaC	Allen fine sandy loam, 6 to 10 percent slopes	0.9	0.7%
AaD	Allen fine sandy loam, 10 to 15 percent slopes	1.6	1.4%
AaE	Allen fine sandy loam, 15 to 25 percent slopes	5.1	4.4%
Ck	Chewacla silt loam, 0 to 2 percent slopes, frequently flooded	4.3	3.8%
DcC	Decatur loam, 6 to 10 percent slopes	1.8	1.6%
Em	Emory silt loam, 0 to 4 percent slopes, rarely flooded	7.3	6.4%
EtB	Etowah loam, 2 to 6 percent slopes	0.7	0.6%
FuB	Fullerton gravelly silt loam, 2 to 6 percent slopes	0.6	0.5%
FuC	Fullerton cherty silt loam, 6 to 10 percent slopes	22.3	19.5%
FuD	Fullerton cherty silt loam, 10 to 15 percent slopes	8.1	7.1%
FuE	Fullerton cherty silt loam, 15 to 25 percent slopes	21.9	19.1%
FvE2	Fullerton gravelly silty clay loam, 10 to 25 percent slopes, eroded	15.2	13.2%
HoC	Holston fine sandy loam, 6 to 10 percent slopes	3.5	3.1%
Tk	Toccoa fine sandy loam	7.4	6.4%
WaB	Wax loam, 2 to 6 percent slopes	12.4	10.8%
Totals for Area of Interest		**114.5**	**100.0%**

Chattooga, Floyd, and Polk Counties, Georgia

Tv—Tupelo clay loam, frequently flooded

Map Unit Setting

National map unit symbol: ktw0
Elevation: 450 to 800 feet
Mean annual precipitation: 48 to 55 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Tupelo and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tupelo

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 12 inches: clay loam
H2 - 12 to 62 inches: silty clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Dowellton

Percent of map unit: 5 percent
Landform: Depressions on stream terraces

Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

WoA—Wolftever silt loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: ktw5
Elevation: 350 to 1,000 feet
Mean annual precipitation: 48 to 55 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Wolftever and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wolftever

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 6 inches: silt loam
H2 - 6 to 12 inches: silty clay loam
H3 - 12 to 58 inches: silty clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 30 to 42 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: High (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

FuC—Fullerton cherty silt loam, 6 to 10 percent slopes

Map Unit Setting

National map unit symbol: kttc
Mean annual precipitation: 48 to 55 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 200 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Fullerton and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fullerton

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Residuum

Typical profile

H1 - 0 to 17 inches: gravelly silt loam
H2 - 17 to 24 inches: gravelly silty clay loam
H3 - 24 to 88 inches: gravelly silty clay

Properties and qualities

Slope: 6 to 10 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Thermic Cherty Dolomite Upland Oak-Hickory Forest (F128XY001TN)

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 11, Oct 5, 2017

Chattooga, Floyd, and Polk Counties, Georgia

FuE—Fullerton cherty silt loam, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: kttf
Mean annual precipitation: 48 to 55 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Fullerton and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fullerton

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum

Typical profile

H1 - 0 to 17 inches: gravelly silt loam
H2 - 17 to 24 inches: gravelly silty clay loam
H3 - 24 to 88 inches: gravelly silty clay

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Thermic Cherty Dolomite Upland Oak-Hickory Forest (F128XY001TN)

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 11, Oct 5, 2017

Chattooga, Floyd, and Polk Counties, Georgia

FvE2—Fullerton gravelly silty clay loam, 10 to 25 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2szjc
Elevation: 670 to 1,100 feet
Mean annual precipitation: 52 to 56 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 219 days
Farmland classification: Not prime farmland

Map Unit Composition

Fullerton and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fullerton

Setting

Landform: Ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy creep deposits derived from cherty limestone over clayey residuum weathered from cherty limestone

Typical profile

A - 0 to 2 inches: gravelly silty clay loam
BE - 2 to 13 inches: gravelly silty clay loam
Bt1 - 13 to 21 inches: gravelly clay
Bt2 - 21 to 60 inches: gravelly clay
Bt3 - 60 to 90 inches: gravelly clay

Properties and qualities

Slope: 10 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: B
Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 11, Oct 5, 2017

Pre- and Post-Development Drainage Structure Summary

Hammond AP#3
Pre- and Post-Development Drainage Structure Summary

NW Corner of AP#3, Hwy 20 Side Drain/AP#3 Aggregate Drive (Pre & Post)
24" Dia. CMP, L= 68.42 LF
Inv. In. EL. 581.45
Inv. Out EL. 581.11
Slope = 0.50%
Manning's n = 0.023

NE Corner of AP#3, Hwy 20 Side Drain/NS RR X-Drain Aggregate Drive (Pre & Post)
24" Dia. RCP, L= 77.3 LF
Inv. In. EL. 575.02
Inv. Out EL. 574.20
Slope = 1.06%
Manning's n = 0.012

NE Corner of AP#3, NS RR X-Drain (Pre & Post)
18" Dia. RCP, L= 55 LF (Approx.)
Inv. In. ~~EL. 576.30~~ EL. 575.55 (Per Survey 11/17)
Inv. Out EL. 575.50
Slope = 1.5%
Manning's n = 0.012

SW Corner AP#3 (Pre & Post)
24" Dia. CMP, L= 143.0 LF
Inv. In. EL. 578.93
Inv. Out EL. 577.56
Slope = 1.5%
Manning's n = 0.023

SW Corner of AP#3, Plant Road/NS RR & Bridge X-Drain (Pre & Post)
36" Dia. CMP, L= 311.7 LF
Inv. In. EL. 577.64
Inv. Out EL. 573.21
Slope = 1.42%
Manning's n = 0.024

Boiler Waste Cleaning Basin Area (East RR X-Drains)
North Pipe
Pre-Development
12" Dia. CMP, L= 45.20 LF
Inv. In. EL. 580.46
Inv. Out EL. 578.32
Slope = 4.73%
Manning's n = 0.023
Post-Development (Inlet Extension)

12" Dia. CMP, L=49.70 LF
Inv. In. EL. 580.67
Inv. Out EL. 578.32
Slope = 4.73%
Manning's n = 0.023

South Pipe X-Drain
Pre-Development
12" Dia. CMP, L= 41.20 LF
Inv. In. EL. 580.16
Inv. Out EL. 579.83
Slope = 0.80%
Manning's n = 0.023
Post-Development (Inlet Extension)
12" Dia. CMP, L=48.30 LF
Inv. In. EL. 580.22
Inv. Out EL. 579.83
Slope = 0.80%
Manning's n = 0.023

Ash Pond Box Culvert (New)
CS 4'x2', L=30.00 LF
Inv. In. EL. 593.29
Inv. Out EL. 593.14
Slope = 0.50%
Manning's n = 0.012

NE Corner of AP#3,NS RR X-Drain Aggregate Drive (New)
18" Dia. RCP, L= 60.0 LF
Inv. In. EL. 575.00
Inv. Out EL. 574.40
Slope = 1.00%
Manning's n = 0.012

Reference Documents

November 5, 2018

Southern Company Services
42 Inverness Center Parkway
Birmingham, Alabama 35242

Attn: Mr. Stacy Sprayberry
E: sssprayb@southernco.com

Re: Double Ring Infiltrometer Testing
Plant Hammond, Rome, Georgia
Terracon Project No. E1185284

Dear Stacy:

Terracon has completed the double ring infiltrometer testing services for the above referenced project. These services were performed in general accordance with our proposal number PE1185284 dated October 23, 2018. This report presents the results of the testing.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Matthew S. McCullough, P.E.
Senior Engineer

Jerome A. Smith, P.E.
Geotechnical Department Manager
Georgia PE No. 22454

Attachments: Site Location Map (Exhibit A-1)
Test Location Plan (Exhibit A-2)
Graphs of Infiltration Velocity vs. Time (Exhibits A-3 through A-6)

1.0 PROJECT INFORMATION

Double ring infiltrometer tests were requested at 4 locations on an existing landfill cover at Plant Hammond in Rome, Georgia. The project vicinity is shown on the attached Exhibit A-1, Site Location Map. The approximate location of each test is shown on the attached Exhibit A-2, Infiltrometer Test Location Plan. The tests were conducted at the existing surface grade.

2.0 TESTING PROCEDURES

The tests were performed in general accordance with ASTM D 3385. To conduct the tests, two open cylinders (12-inch and 24-inch I.D.) were driven into the ground, one inside the other. The inner and outer rings were driven to depths ranging from about 2 to 4 inches below the existing grade. Hard driving conditions were encountered due to the stiff consistency of the surface soils. Therefore, the depth of driving was less than the planned depth of 4 to 6 inches.

After driving, the cylinders were partially filled with water. A constant head of water (above the existing ground surface) was maintained in both rings during the test, and the volume of water required to maintain the level in the inner and outer rings was recorded periodically over a total time period ranging from 3 to 4 hours. The volume of water added to the inner ring to maintain the water level constant was recorded as the measure of the volume of water that infiltrated the soil at each test location. This value was then used to calculate the infiltration velocity in cm/sec.

3.0 DOUBLE RING INFILTROMETER TEST RESULTS

The test results are summarized in the tables below. No recordable infiltration could be noted within the inner ring at Test Location 1 and Test Location 2. Graphs of the infiltration velocity vs. time are included in the attached Exhibits A-3 through A-6.

Table 3.1: Infiltrometer Results for Test Location 1

Elapsed Time (minutes)	Inner Ring		Outer Ring	
	Volume of Water Added (cm^3)	Incremental Infiltration Rate (cm/sec)	Volume of Water Added (cm^3)	Incremental Infiltration Rate (cm/sec)
15	0	0	1,457	8.0×10^{-2}
30	0	0	1,249	6.9×10^{-2}
45	0	0	937	5.2×10^{-2}
60	0	0	625	3.5×10^{-2}
90	0	0	1,874	5.2×10^{-2}
120	0	0	1,353	3.7×10^{-2}
180	0	0	3,955	5.5×10^{-2}
240	0	0	3,227	4.5×10^{-2}

Double Ring Infiltrometer Testing
Plant Hammond ■ Rome, Georgia
November 5, 2018 ■ Terracon Project No. E1185284

Table 3.2: Infiltrometer Results for Test Location 2

Elapsed Time (minutes)	Inner Ring		Outer Ring	
	Volume of Water Added (cm^3)	Incremental Infiltration Rate (cm/sec)	Volume of Water Added (cm^3)	Incremental Infiltration Rate (cm/sec)
15	0	0	1,353	7.4×10^{-2}
30	0	0	1,457	8.0×10^{-2}
45	0	0	833	4.6×10^{-2}
60	0	0	1,249	6.9×10^{-2}
90	0	0	1,769	4.9×10^{-2}
120	0	0	1,353	3.7×10^{-2}
180	0	0	3,227	4.4×10^{-2}
240	0	0	1,561	2.1×10^{-2}
300	0	0	2,082	2.9×10^{-2}

Table 3.3: Infiltrometer Results for Test Location 3

Elapsed Time (minutes)	Inner Ring		Outer Ring	
	Volume of Water Added (cm^3)	Incremental Infiltration Rate (cm/sec)	Volume of Water Added (cm^3)	Incremental Infiltration Rate (cm/sec)
15	104	6.6×10^{-5}	520	2.9×10^{-2}
30	104	6.6×10^{-5}	625	3.4×10^{-2}
45	104	6.6×10^{-5}	729	4.0×10^{-2}
60	208	1.3×10^{-4}	625	3.4×10^{-2}
90	104	3.3×10^{-5}	937	2.6×10^{-2}
120	104	3.3×10^{-5}	729	2.0×10^{-2}
180	0	0	1,769	2.4×10^{-2}
240	0	0	1,769	2.4×10^{-2}

Table 3.4: Infiltrometer Results for Test Location 4

Elapsed Time (minutes)	Inner Ring		Outer Ring	
	Volume of Water Added (cm^3)	Incremental Infiltration Rate (cm/sec)	Volume of Water Added (cm^3)	Incremental Infiltration Rate (cm/sec)
15	729	4.6×10^{-4}	2,082	1.2×10^{-1}
30	0	0	1,145	6.3×10^{-2}
45	0	0	1,145	6.3×10^{-2}
60	0	0	1,665	9.2×10^{-2}
90	0	0	3,122	8.6×10^{-2}
120	0	0	3,018	8.3×10^{-2}
180	833	1.3×10^{-4}	4,163	5.7×10^{-2}
240	833	1.3×10^{-4}	4,476	6.2×10^{-2}

The incremental infiltration rates for the inner ring at each test location are represented on the Graphs of Infiltration Velocity vs. Time attached to this report as Exhibits A-3 through A-6.

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: MSM	Project No. E1185294	Terracon 2147 Riverchase Office Road Birmingham, AL 35244	SITE LOCATION MAP	EXHIBIT
Drawn by: MSM	Scale: NTS		Double Ring Infiltrometer Testing Plant Hammond Rome, Georgia	A-1
Checked by: JAS	File Name:			
Approved by: JAS	Date: 11/5/2018			

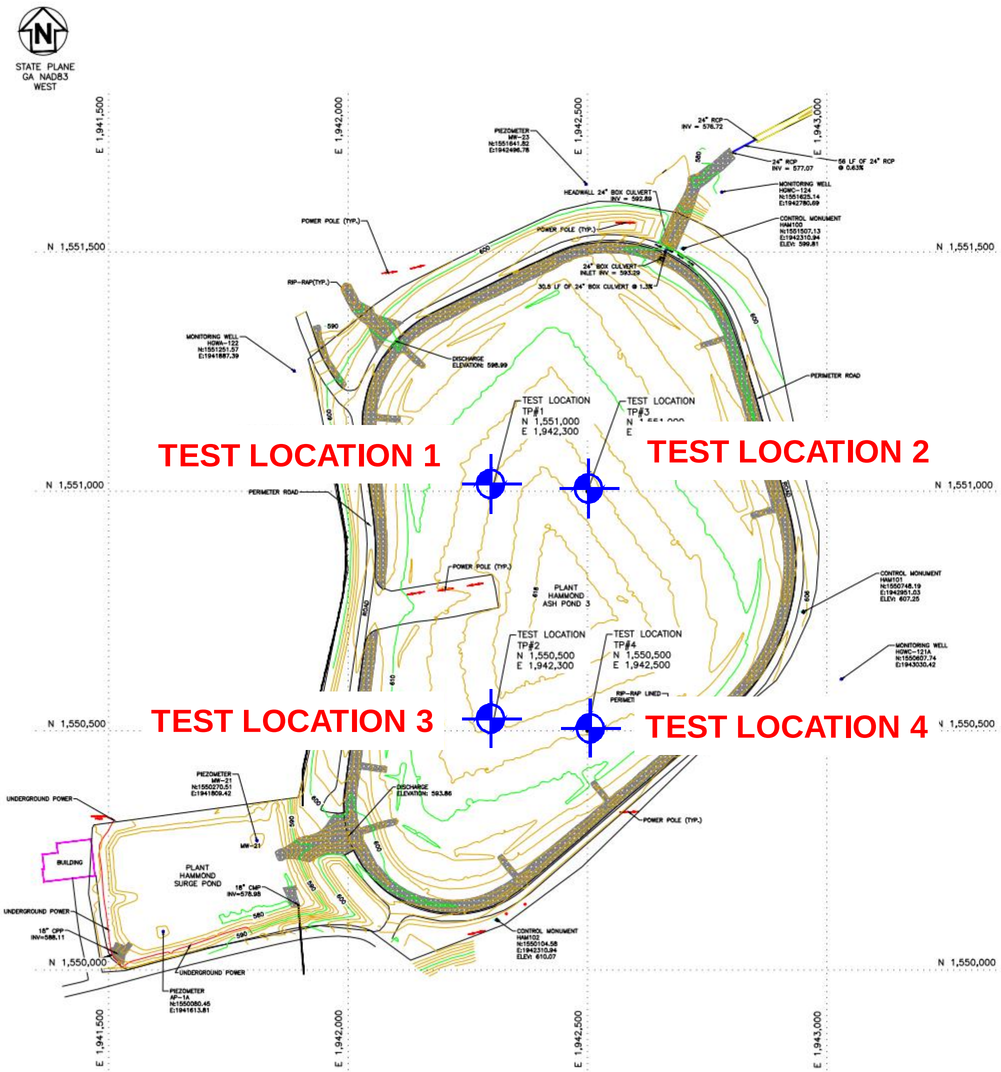


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: MSM	Project No. E1185294	Terracon 2147 Riverchase Office Road Birmingham, AL 35244	TEST LOCATION PLAN	EXHIBIT
Drawn by: MSM	Scale: NTS		Double Ring Infiltrometer Testing Plant Hammond Rome, Georgia	A-2
Checked by: JAS	File Name:			
Approved by: JAS	Date: 11/5/2018			

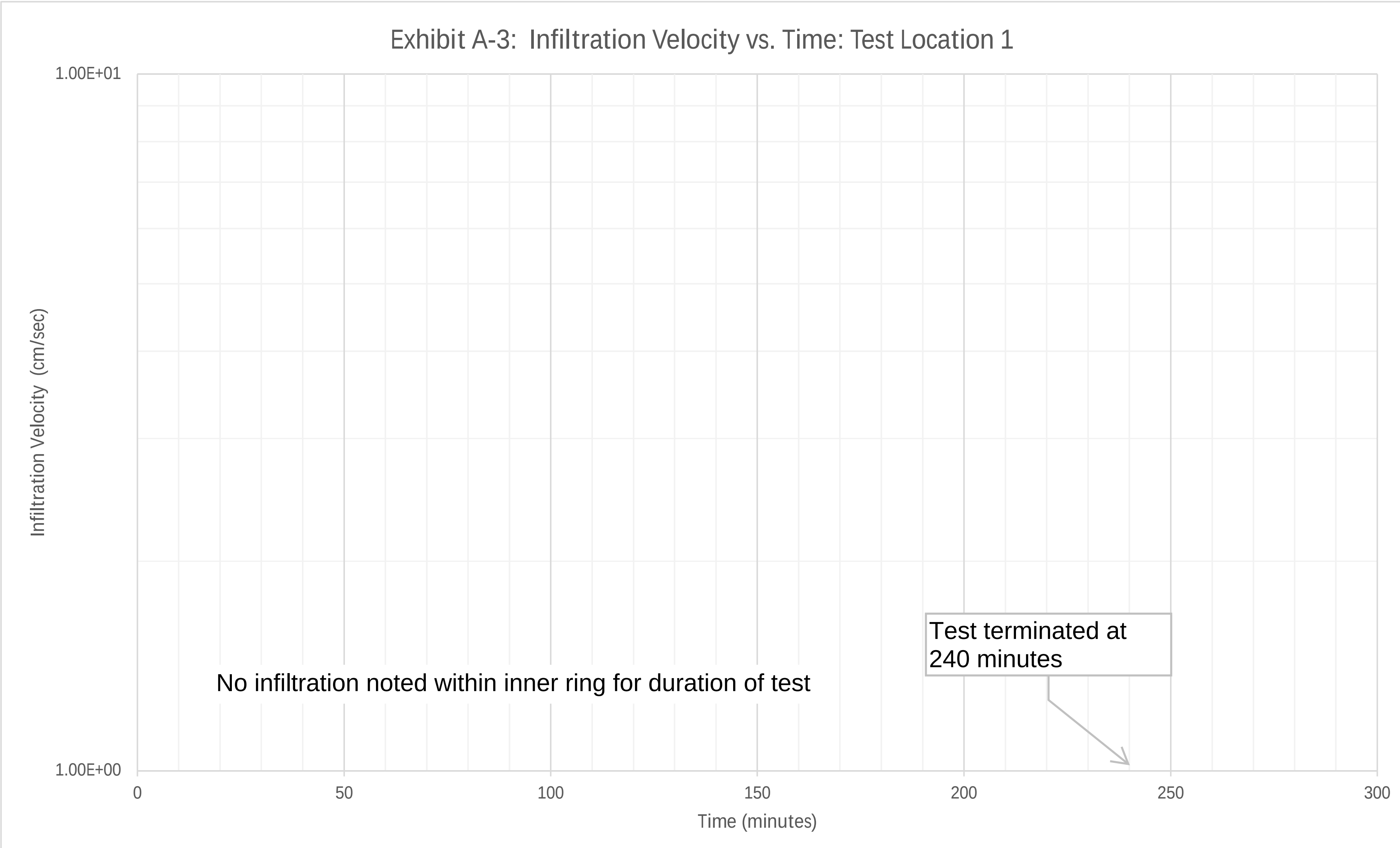


Exhibit A-3: Infiltration Velocity vs. Time: Test Location 1
1.00E+01
1.00E+00
Infiltration Velocity (cm/sec)
0
50
100
150
200
250
300
Time (minutes)
No infiltration noted within inner ring for duration of test
Test terminated at 240 minutes

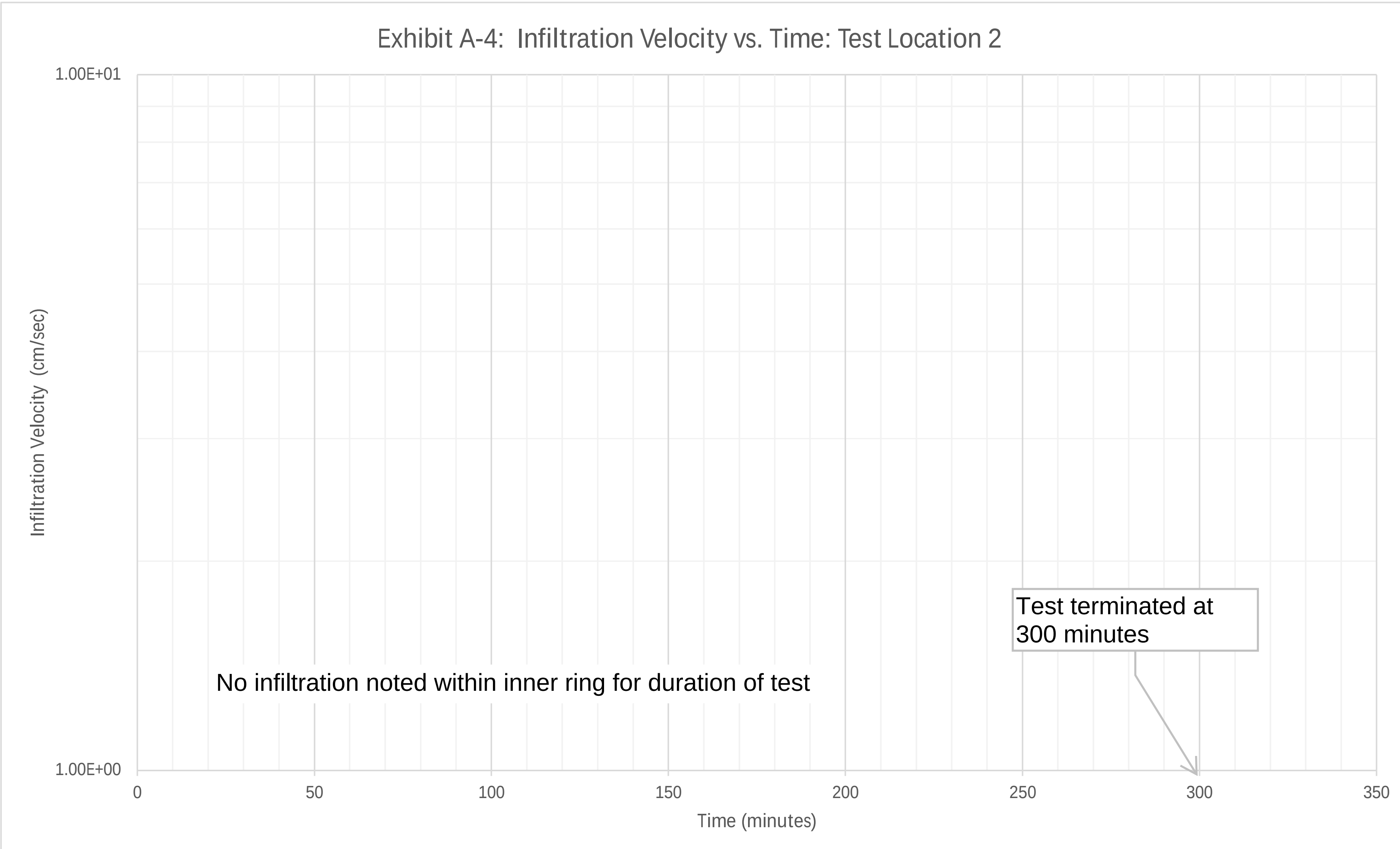


Exhibit A-4: Infiltration Velocity vs. Time: Test Location 2
1.00E+01
1.00E+00
Infiltration Velocity (cm/sec)
Test terminated at 300 minutes
No infiltration noted within inner ring for duration of test
0
50
100
150
200
250
300
350
Time (minutes)

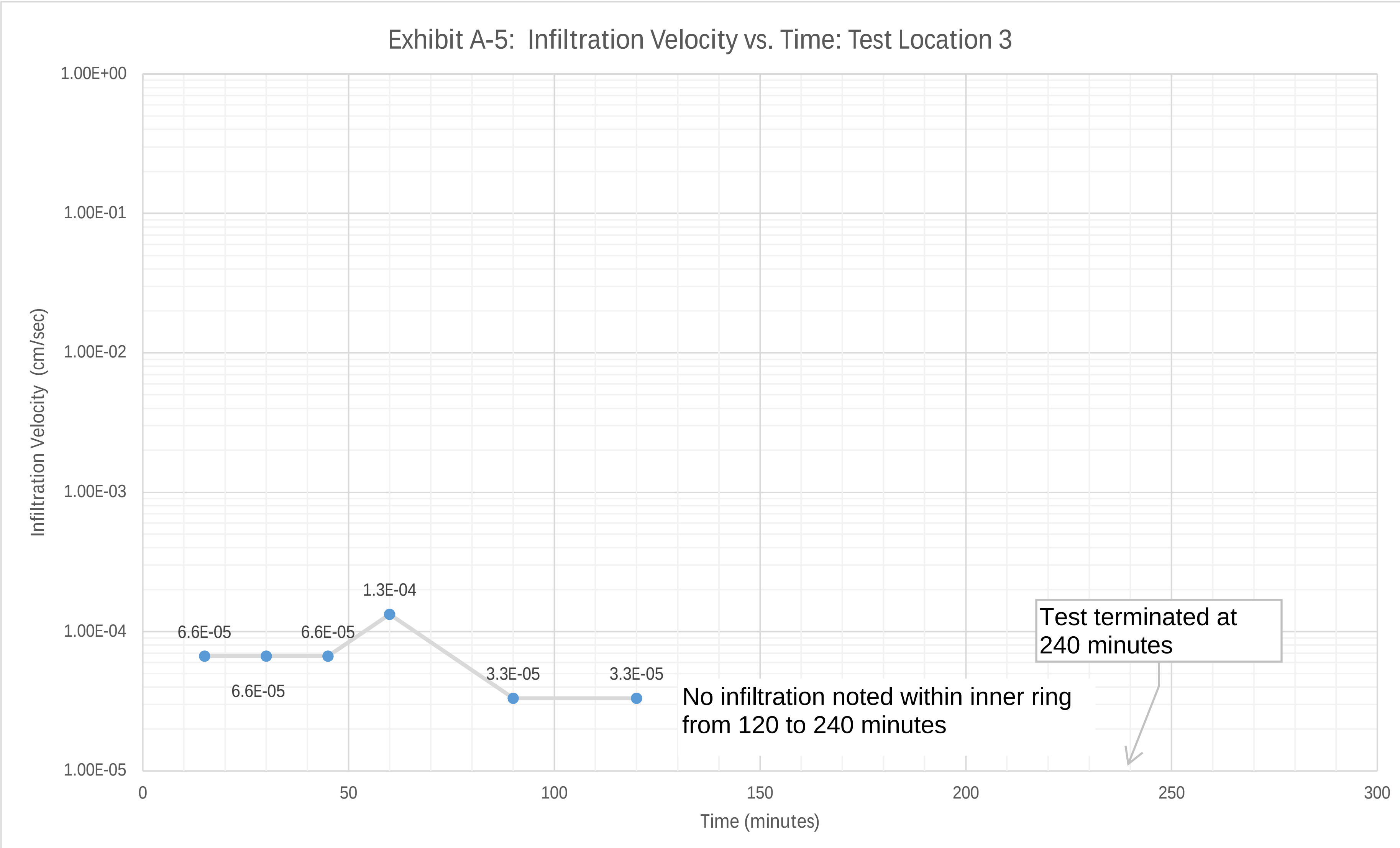


Exhibit A-5: Infiltration Velocity vs. Time: Test Location 3
Infiltration Velocity (cm/sec)
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
0
50
100
150
200
250
300
Time (minutes)
6.6E-05
6.6E-05
6.6E-05
1.3E-04
3.3E-05
3.3E-05
Test terminated at 240 minutes
No infiltration noted within inner ring from 120 to 240 minutes

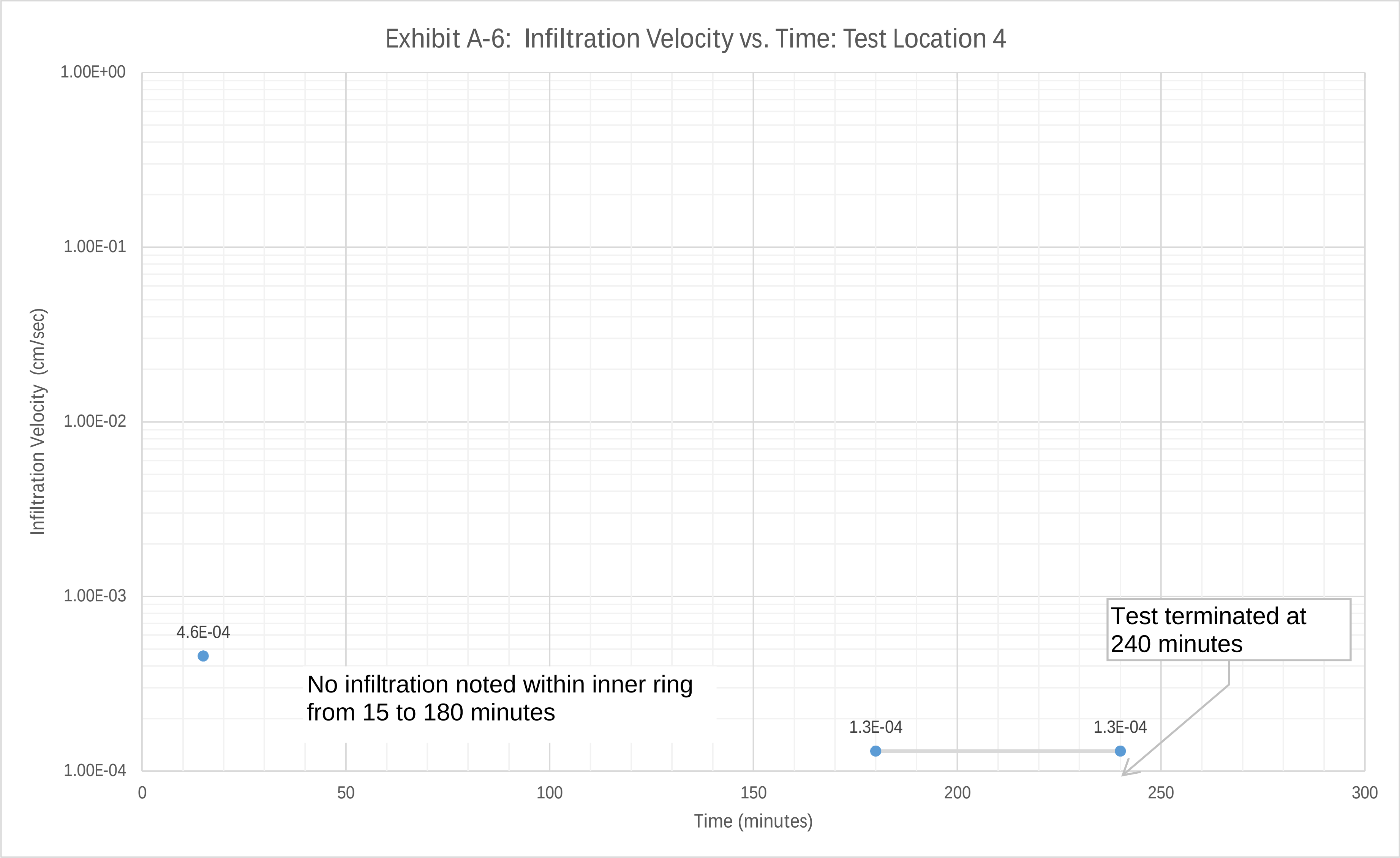


Exhibit A-6: Infiltration Velocity vs. Time: Test Location 4
Infiltration Velocity (cm/sec)
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
Time (minutes)
0
50
100
150
200
250
300
4.6E-04
1.3E-04
1.3E-04
No infiltration noted within inner ring from 15 to 180 minutes
Test terminated at 240 minutes

				Orig issue:
				Rev date: 8/15/07
	REV 0	**REV 1**	**REV 2**	**REV 3**
Prep By:	Frank D. Brizendine	J. David Merritt		
Rev'd By:	Frank Crisp	Ronald c. Bryan		
RAT App'd:	James A. Hartin			
App'd By:	Ozen Batum	Carl K. Toner		

STORM DRAINAGE DESIGN

1.0 GENERAL

1.1 Scope

This guideline presents design information for storm sewer systems and roadside culverts. The guideline is primarily intended to cover sites located in Southern Company's four-state area — Alabama, Florida, Georgia, and Mississippi. This guideline presents one method of hydrology (the rational method) for determining design flows and various concepts used for hydraulic analysis of pipe flow commonly accepted in design of storm sewer systems and culverts.

1.2 Objective

Storm water drainage structures are necessary to conduct runoff from places where it is not wanted to the nearest acceptable discharge point, all in sufficient time to avoid unacceptable amounts of damage and inconvenience. The design of storm drainage facilities involves many factors, interpretation of field data, and engineering judgement.

1.3 Specifications and Standards

For materials and construction requirements, the designs shall be prepared in accordance with the standards and specifications of the four states mentioned in section 1.1. These are as follows:

Alabama - Alabama Highway Department Standard Specifications for Highway Construction, latest edition.

Florida - Florida Department of Transportation Standard Specifications for Road and Bridge Construction, Latest Edition.

Georgia - Georgia Department of Transportation Standard Specifications-Construction of Transportation Systems, Latest Edition.

Mississippi - Mississippi Highway Department Standard Specification for Road and Bridge Construction, Latest Edition.

There are also many Southern Company Services (SCS) project specifications that describe materials and construction requirements recommended for storm sewer systems and culverts.

2.0 DEFINITIONS

storm sewer system — A series or group of inlets, catch basins, junction boxes, and pipes designed to carry precipitation runoff, surface waters, and, in some instances, groundwater. Storm water flow is analyzed on the basis of having flow characteristics of water.

culvert — A pipe or box structure used to carry water flow by gravity under a road, railroad, or other structure. Culverts normally have concrete headwalls at each end with either paved or unpaved ditches at the entrance and exit headwall locations.

storm pipe materials commonly used — CMP: corrugated metal pipe (steel or aluminum). BCCMP: Bituminous-coated corrugated-metal pipe (steel). RCP CLIII: reinforced concrete pipe (roadways). RCP CLV: reinforced concrete pipe (railroads).

storm runoff — Almost wholly that part of rainfall which is not lost by infiltration into the soil or left in surface depressions and on plant surfaces to evaporate.

3.0 DESIGN CRITERIA

For each plant site, during the early stages of preliminary design, the following design criteria items shall be established and concurred with by the associated operating company and/or the specific plant operations personnel.

- Storm frequency.
- Allowable pending for various areas (such as parking lots, switchyard, powerhouse, and so forth).
- Rate of discharge before development vs. rate of discharge after development (for outfall

systems discharging offsite).

- The possibility of any pollutants collecting in the storm runoff (ash, coal, chemicals, and so forth). This is further addressed in section 7.0, Environmental Considerations.

- Maximum discharge velocity - usually between 15 and 20 ft/s. For high outfall velocities, various types of energy dissipators may be required. This may vary from using riprap, to rock gabions, to concrete structures with baffles.

- Minimum discharge velocity - usually 2 to 5 ft/s. For low outfall velocities, sediment may build up in the storm pipe invert. The storm drain slope and selection of pipe materials can be effective when low velocities are encountered.

4.0 HYDROLOGY

Many facets are involved in the hydrologic cycle and the science of hydrology. These are addressed in the Hydrology section of the SCS Design Guide.

For the storm sewer design presented in this guideline, hydrology shall include determining the peak storm runoff for a chosen frequency at any point in a waterway channel in order to select the proper size and shape of structure and appurtenances to best handle that amount of runoff.

In using the peak discharge for sizing storm drain systems and culverts, an economic balance is necessary between the cost of the drain structures and the various costs of potential damage to property or inconvenience during storms.

The method presented in this guideline is commonly referred to as the rational method.

4.1 Other Methods

Other methods may be used for determining peak discharge. Hydrographs shall be produced which give the peak discharge, along with volume at runoff and the relationship of time to the rate and volume of runoff.

Commonly used methods are:

- SCS (Soil Conservation Service) TR-20 and TR-55 computer analysis programs.

- U.S. Corps of Engineers HEC-1 computer analysis program.

- Rational-method hydrographs.

There are several engineering texts that address the use of these methods and SCS has various computer software programs that use these methods.

4.2 Rational Method

The rational method is a common and accepted method of determining design flows for storm sewer systems and culverts. Good results can be expected from this method if it is used properly.

This method is recommended by the Federal Highway Administration for roadside culverts draining less than 200 acres. This method uses an empirical equation that relates the quantity of runoff from a given area to the total rainfall falling at a uniform rate on the same area and is expressed as:

$$Q = C\, i\, A$$

where:

Q = peak rate of runoff, in cfs (cubic feet per second)

C = runoff coefficient, weighted

i = average intensity of rainfall (in/hr)

A = drainage area (acres)

4.2.1 Assumptions for the Rational Method

- The maximum rate of runoff for a particular rainfall intensity occurs if the duration of rainfall is equal to or greater than the time of concentration. (The duration is the time of concentration.)

- The maximum rate of runoff from a specific rainfall intensity whose duration is equal to or greater than the time of concentration is directly proportional to the rainfall intensity.

- The frequency of occurrence of the peak discharge is the same as that of the rainfall intensity from which it was calculated.

- The peak discharge per unit area decreases as the drainage area increases, and the intensity of rainfall decreases as its duration increases.

- The coefficient of runoff remains constant for all storms on a given watershed.

The runoff coefficient C and the drainage area A are both constant for a given area at a given time. Rainfall intensity, *i*, however, is determined by using an appropriate storm frequency and duration which are selected on the basis of economics and engineering judgment. Storm sewers are designed on the basis they will flow full during storms occurring at certain intervals. Between those intervals, the flow in the storm drains will be partial flows.

4.2.2 Watershed Characteristics

Some of the primary watershed characteristics that influence the amount and rate of runoff for a particular drainage area are as follows:

- Area and shape.
- Steepness and length of slopes.
- Kind and extend of vegetation or cultivation.
- Condition of the surface—dry, saturated, frozen—pervious or impervious soil.
- Number, arrangement, and condition of drainage channels on the drainage area.

4.2.3 Time of Concentration

The time of concentration, *Tc*, is the time required for runoff from the most remote part of a drainage area to reach the collection point under design. The most remote portion of the drainage area means that which provides the longest time for overland flow to the design point, but the longest time for overland flow to the design point, is not necessarily the most distant point in the drainage area. For storm sewer systems, the time of concentration consists of the first inlet time plus the time of flow in the remaining sewers (*Tp*) from the first inlet to the point under design consideration. The minimum time of concentration recommended is 5 minutes, and the time of concentration is used as the storm duration in calculating the rainfall intensity values.
For most projects, a table with values of *Tc* up to 30 minutes and corresponding storm intensities should be adequate. Several methods or charts have been established for determining the time of concentration for a given drainage area, such as the SCS (Soil Conservation Service) overland method. Figure 1 shows a commonly used chart, the Kirpich nomograph, for determining time of concentration (reference 1).

4.2.4 Drainage Area

The drainage area, *A*, is the runoff area in acres served by the storm sewer system or culvert. This area can be accurately determined from topographic maps, aerial photos, or field surveys. It is the only element of the rational method subject to precise determination. For storm sewer systems, the complete drainage area is subdivided into component parts, each tributary to be a point of inlet.

Drainage area information shall include the following:

- Land use considering its degree of protection to be provided and percentage of imperviousness.

- The character of the soil and cover and how it affects the runoff coefficient.

- The magnitude of ground slopes and the shape of the area that will affect the time of concentration.

4.2.5 Runoff Coefficient

The runoff coefficient, *C*, is the least susceptible to precise determination. It implies it is a fixed ratio for any given drainage area, when actually the coefficient accounts for losses between rainfall and runoff, which may vary for different drainage subareas. These losses are influenced by soil characteristics, such as porosity and permeability. Other factors to consider in the coefficient are ground cover, such as paved, grassy, or wooded, and retention in depressed areas with accounting for evaporation. The values for the coefficient normally range from zero to unity. A list of commonly used values for *C* is shown in table 1, Runoff Coefficients (reference 2). Several other engineering texts address this subject. It is often desirable to develop a composite or weighted runoff coefficient based on the percentage of different types of surfaces encountered in the drainage area. Table 1 gives values for both description of areas and the character of surface. The coefficients presented in table 1 are good to use for storms of 2-, 5-, and 10-year frequencies. For less frequent, higher intensity storms, the higher side of the coefficients shall be used.

4.2.6 Rainfall Intensity

Rainfall intensity, *i*, is defined as the amount of rainfall measured in inches per hour that would be expected to occur during a storm of a certain duration. The storm frequency is the time in years in which a certain storm would be expected to occur again, determined from available rainfall statistics. U.S. Weather Bureau technical paper maps TP-40 and TP-25 show expected maximum rainfall intensities, *A*, for various frequency storms for the United States. Figure 2 shows the rainfall intensity map for the 2-year frequency, 30-minute duration storm (reference 3). For use with the rational methods the values from the TP-40 rainfall maps may be converted to storms of other durations and frequencies. There are methods, not addressed in this guideline, but presented in engineering texts on this subject, that explain how to develop a table of intensity vs. time of concentration for use in the rational method formula. Table 2 shows an example of the required table.

5.0 APPURTENANCES

Appurtenances are commonly referred to when designing structures which are necessary for proper functioning of storm sewer systems and culverts. These may include headwalls, inlets, junction boxes, catch basins, tide gates, and other devices of special design. The design of these structures is not presented in detail in this guideline. Several engineering texts discuss the hydraulics of gutters; various inlet type friction losses encountered; and the sizes, types, and construction requirements for appurtenances. The design standards for the four states listed in section 1.3 explain established criteria which govern the design and construction of these appurtenances. Commonly used inlets for storm sewer systems are (a) curb and gutter inlets with openings in the curb, (b) valley gutter inlets with grates, and (c) yard inlets with grates. Concrete headwalls are normally used at the entrance and exit locations of culverts to direct the flow of effluent and to stabilize embankments and reduce erosion around the culvert. Reinforced concrete function boxes are used for connecting two or more pipes and may be poured-in-place construction or precast concrete construction.

6.0 HYDRAULICS

A common and widely accepted method for determining flow characteristics in pipes, conduits, and channels is Manning's equation for open channels. This expresses the average velocity and discharge in pipes or culverts, as follows:

Velocity V = $(1.486/n)(R^{2/3})(S^{1/2})$
in feet per second (average or mean velocity)

and R = Hydraulic radius, ft
S = Hydraulic gradient, ft per ft
n = Manning's coefficient of surface roughness for various pipe materials or channels

Discharge Q = VA
in cubic feet per second

and A = Cross sectional area of flow, ft^2

This formula for discharge capacity of pipes, culverts, and open ditches can be used to size each, along with considerations of two very important items, inlet control and outlet control. Considering the many factors involved in field data and hydrology, the engineer shall use judgement and experience in the design of storm sewer systems and culverts. One cannot just use Manning's equation for sizing alone. A good rule of thumb for sizing pipes is to allow the design flow as determined from the rational method to be approximately 2/3 of the flowing-full pipe capacity determined from Manning's formula, and then to check the inlet and outlet conditions and pipe sizes by trial and error. Conventional storm sewers and culverts are circular pipes, arch-pipes, and box culverts, all with uniform cross-sectional areas throughout. The portion of design of these sections using Manning's formula is commonly referred to as barrel flow.

6.1 Open-Channel Flow Analysis

Many texts and computer programs are available on open-channel flow characteristics, factors, and analysis to consider, which will not be addressed in detail in this guideline. Some of the characteristics and factors covered elsewhere are as follows; uniform flow, nonuniform flow, and the effect on hydraulic gradient; critical flow, depth, slope, and Fraude number; energy grade line, friction losses, and head losses (velocity and static); and normal depth (d_n), supercritical, and subcritical flows. Figure 3 shows sketches of uniform and nonuniform open-channel flow sections (reference 2).

6.2 Inlet and Outlet Control Factors

D = Inside diameter of circular pipe or height of arch pipe or box culvert, in.

H = Head, ft

L = Length of culvert, ft

n = Manning's definition for roughness coefficient

S_o = Slope of culvert or pipe, ft per ft

Hw = Headwater depth at culvert entrance, ft

Tw = Tailwater depth at culvert outlet, ft

The headwater depth, *Hw*, shall be computed or determined using textbook charts or computer programs for both inlet and outlet control conditions. Partial flows, as well as full flow conditions, may be desired depending on storm frequency being analyzed. For various sketches of inlet and outlet control conditions, see figures 4 and 5 (reference 1).

The headwater depth is the vertical distance from the culvert invert at the entrance to the energy line of the headwater pool (depth + velocity head). The water surface and energy line at the entrance are assumed to coincide. It most cases, the Hw depth either for inlet control or outlet control will govern over barrel flow in selection of sizes and materials for storm drains and culverts.

6.3 Inlet Control

The inlet control condition occurs when the control section is located at or near the culvert entrance, affected by the size and given shape, and the pipe discharge is dependent on the inlet geometry and headwater depth. It will determine flow values in the culvert and usually govern size selection over barrel-flow capacities determined from Manning's equation. The inlet control condition will exist when water can flow through the barrel of the culvert at a rate greater than water can enter the inlet. Since the control section is at the inlet, the flow capacity is not affected by any hydraulic factors beyond the culvert entrance such as slope, length, or surface roughness. Culverts and pipes operating under inlet control will always flow partially full. The *Hw* depth and amount of ponding allowed for the storm sewer system or culvert are of primary importance.

6.4 Outlet Control

The outlet control condition occurs when the control section is located at or near the culvert outlet, and for any given shape and size of culvert, the discharge is dependent on all of the hydraulic factors upstream from the outlet such as shape, slope, surface roughness, tailwater depth, headwater depth, and inlet geometry. Basically, the outlet control condition will exist as long as water can enter the culvert at a greater rate than it can flow through it. Culverts and pipes operating under outlet control can flow either full or partially full.

7.0 STRUCTURAL REQUIREMENTS

7.1 Construction Installation

Storm drain system pipes and culverts are normally installed in relatively narrow trenches on uniform granular beds. Care in installation for proper horizontal and vertical alignment shall be observed to avoid joint displacements. The pipe trenches then shall be backfilled with compacted earth or crushed stone, with compaction requirements under roadways and railroads specified to reduce undesired settlement. Care must be taken in backfilling over pipes, especially corrugated metal pipes, to avoid unnecessary damage to the pipe walls.

7.2 Loads and Supporting Strengths

Storm drain system pipes and culverts are subjected to a variety of loading conditions, including highway, railroad, and airport live loads and earth and backfill loads. The design handbook for concrete pipe and steel pipe has several allowable loading tables and charts for different pipe installation depths. This guideline describes the procedures for selection of pipe strength for design, factors of safety to be applied, jacked or tunneled procedures, and live load distribution through the backfill induced on the pipe. For reinforced box culverts, an individual design for the top slab, walls, and footings shall be required for each independent project.

8.0 ENVIRONMENTAL CONSIDERATION

In design of storm sewer system and culverts, the engineer shall give consideration to federal, state, and local regulations, which address both the quality and quantity of water discharged from a system. The primary concern is for the outfall points that discharge offsite into classified U.S. navigable streams, rivers, and lakes. Most counties and cities have regulations governing increases in rate of flow, usually from an undeveloped portion of a plant site that is being developed. They also have regulations governing sedimentation and erosion.

The Environmental Protection Agency (EPA) has set federal regulations that address the discharge of pollutants into the waters offsite at a given power plant location. The EPA and the four system states have regulatory agencies that monitor storm water pollutants and discharges under the NPDES (National Pollutant Discharge Elimination System) permitting program. Each power company headquarters and plant site has environmental personnel familiar with these regulations and each site's existing permit situation. The engineer shall coordinate storm drain design with these personnel.

In the Southern Company territories, the following are the state regulatory agencies that enforce the EPA (or more stringent of their own) regulations concerning storm water pollution, discharge, and the NPDES permitting program:

Alabama - ADEM	Alabama Department of Environmental Management, Montgomery, AL
Georgia - GEPD	Georgia Environmental Protection Division, Atlanta, GA
Gulf - FDER	Florida Department of Environmental Regulations, Tallahassee, FL
Mississippi - MEQD	Mississippi Environmental Quality Department, Jackson, MS

8.0 REFERENCES

1. SG-861, Handbook of Steel Drainage and Highway Construction Products. American Iron and Steel Institute, Washington, D.C., 1983.

2. Design and Construction of Sanitary and Storm Sewers. M&R No. 37 NPCF MOP 9, American Society of Civil Engineers, New York, 1986.

3. Concrete Pipe Design Manual. American Concrete Pipe Association, [City and State] 1980.

TABLE 1
RUNOFF COEFFICIENTS, C

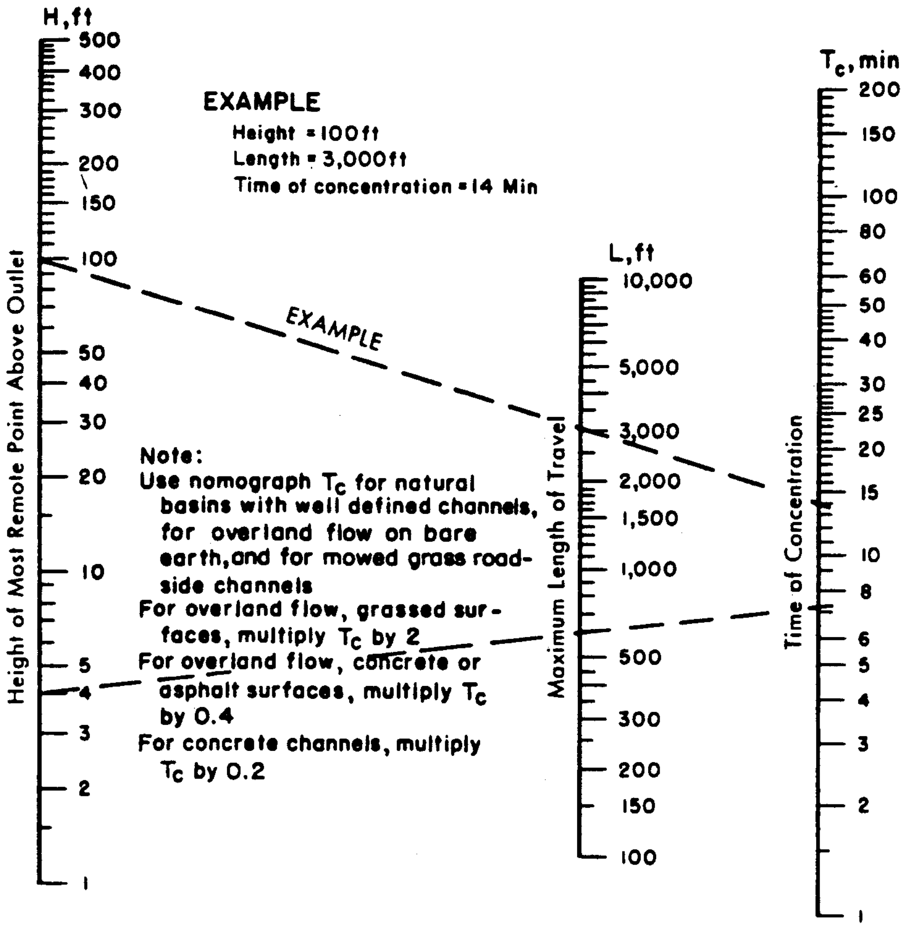
Description of Area	Runoff Coefficients
Business	
Downtown	0.70 to 0.95
Neighborhood	0.50 to 0.70
Residential	
Single-family	0.30 to 0.50
Multi-units, detached	0.40 to 0.60
Multi-units, attached	0.60 to 0.75
Residential (suburban)	0.25 to 0.40
Apartment	0.50 to 0.70
Industrial	
Light	0.50 to 0.80
Heavy	0.60 to 0.90
Parks, cemeteries	0.10 to 0.25
Playgrounds	0.20 to 0.35
Railroad yard	0.20 to 0.35
Unimproved	0.10 to 0.30

Character of Surface	Runoff Coefficients
Pavement	
Asphaltic and Concrete	0.70 to 0.95
Brick	0.70 to 0.85
Roofs	0.75 to 0.95
Lawns, sandy soil	
Flat, 2 percent	0.05 to 0.10
Average, 2 to 7 percent	0.10 to 0.15
Steep, 7 percent	0.15 to 0.20
Lawns, heavy soil	
Flat, 2 percent	0.13 to 0.17
Average, 2 to 7 percent	0.18 to 0.22
Steep, 7 percent	0.25 to 0.35

TABLE 2

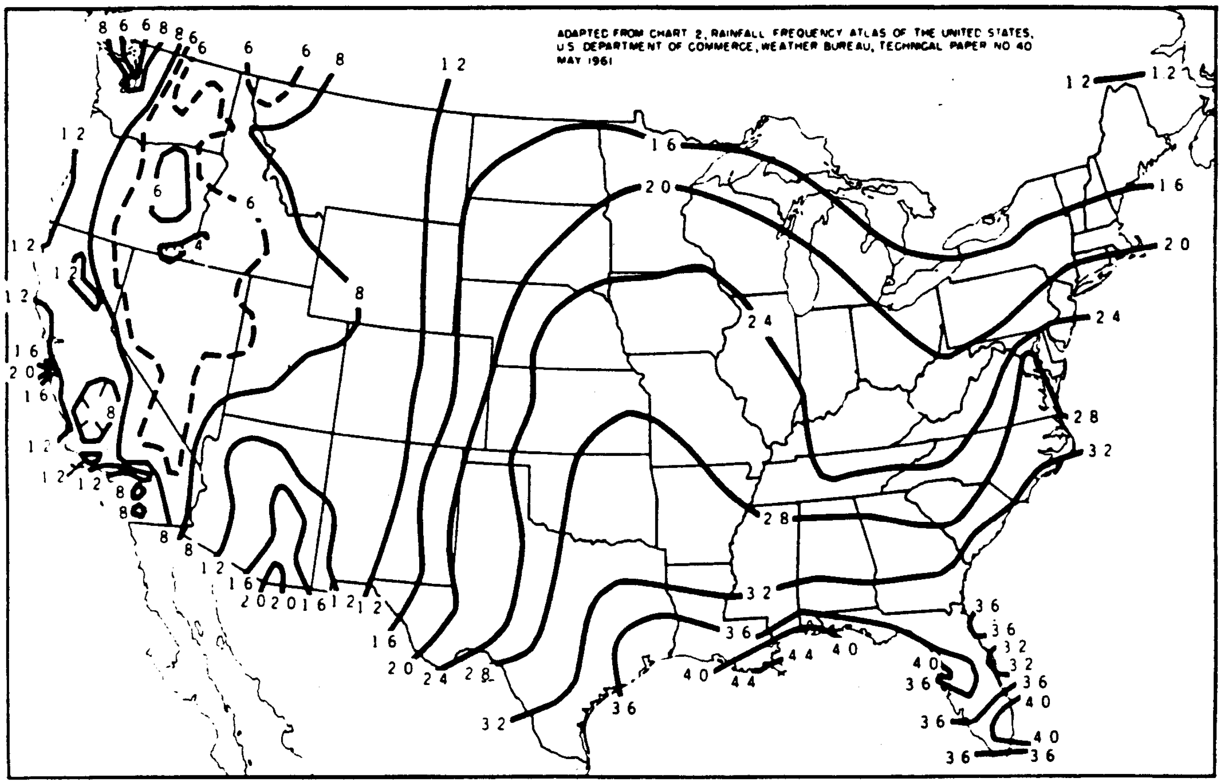
100 YEAR RAINFALL (YARD)

Time (min)	Maximum Rainfall (in.)	Corresponding Intensity (in./hr)
5	1.1	12.8
6	1.2	12.2
8	1.5	11.1
10	1.7	10.1
12	1.9	9.4
14	2.1	8.8
15	2.2	8.6
16	2.3	8.4
18	2.4	7.9
20	2.5	7.6
22	2.6	7.2
24	2.8	6.9
26	2.9	6.6
28	3.0	6.4
30	3.1	6.1
35	3.3	5.6
40	3.5	5.2
60	4.0	4.0
120	4.8	2.4
180	5.1	1.7
360	6.0	1.0



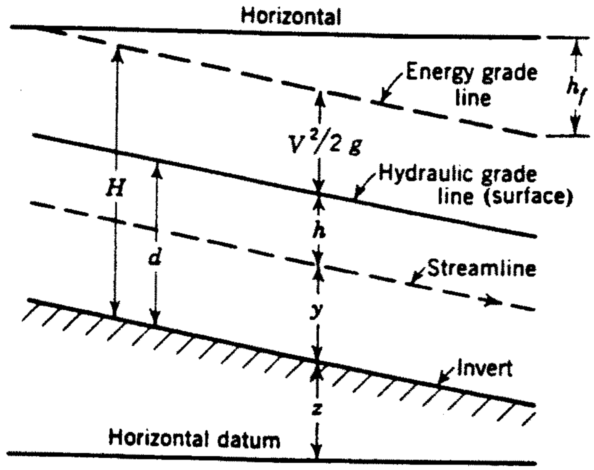
From *Handbook of Steel Drainage and Highway Construction Products, 1983*
Used by permission of American Iron and Steel Institute.

Figure 1
Kirpich Nomograph for
Time of Concentration of Rainfall on Small Drainage Basins



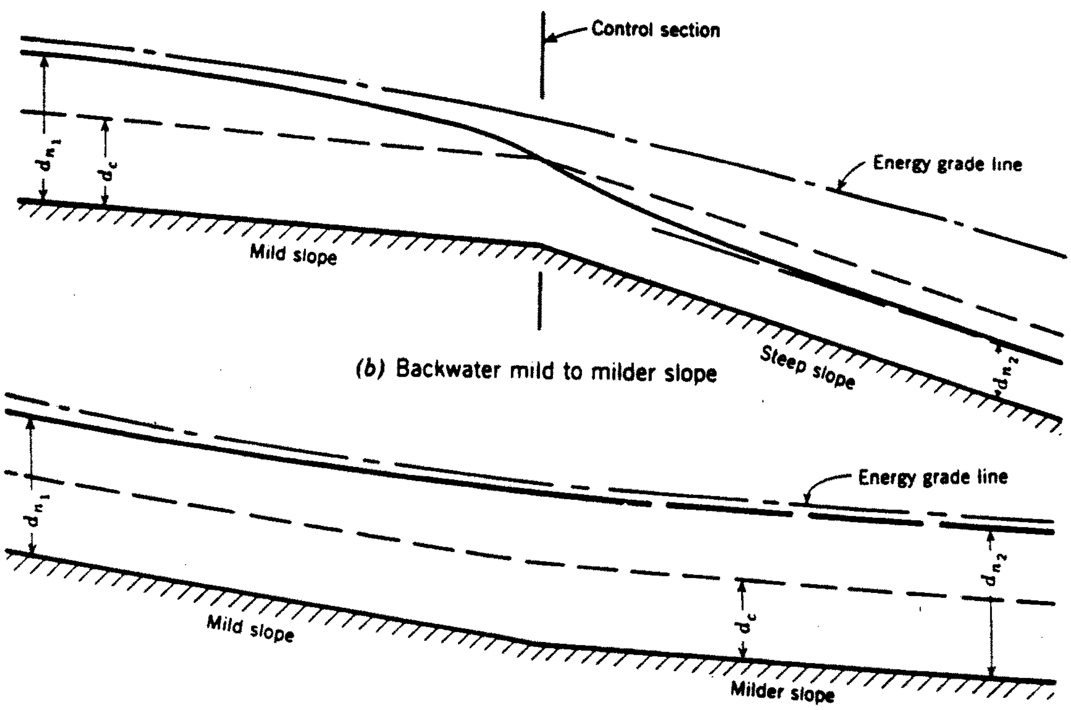
From *Concrete Pipe Design Manual*
Used by permission of American Concrete Pipe Association

Figure 2
Map of the United States
2-Year, 30-Minute Rainfall Intensity



Non-Uniform Flow - Open Channel

(a) Drawdown mild to steep slope



From *Design and Construction of Sanitary and Storm Sewers, 1986.*
Used by permission of the American Society of Civil Engineers
and the Water Environment Federation

Figure 3
Uniform and Nonuniform
Open-Channel Flow

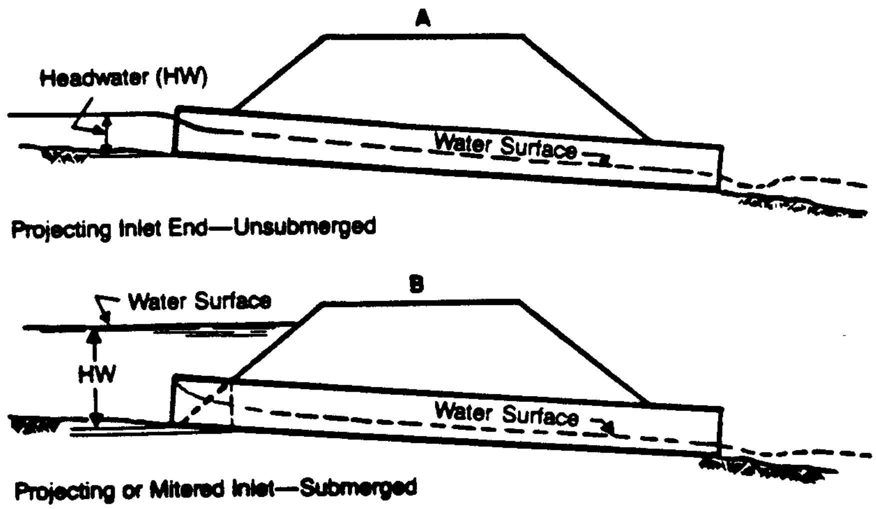
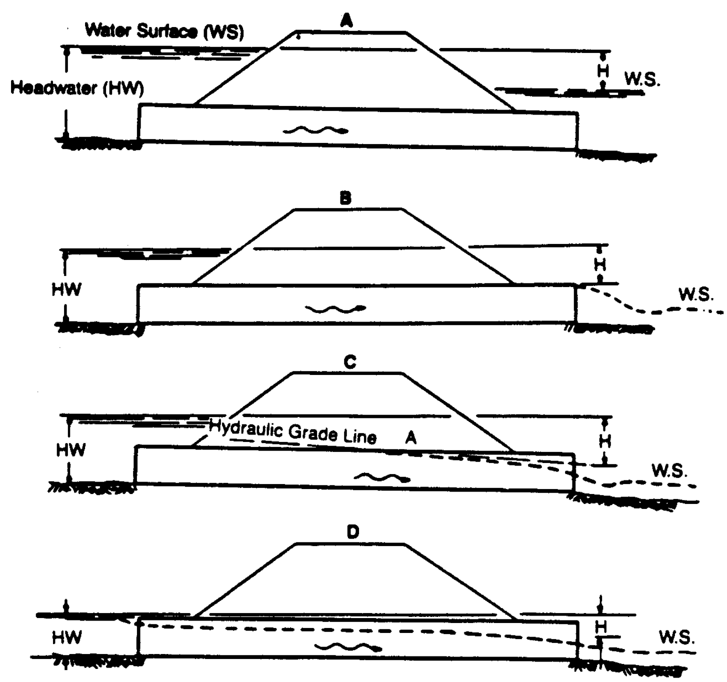


Figure 4
Inlet Control Conditions



From *Handbook of Steel Drainage and Highway Construction Products, 1983*
Used by permission of American Iron and Steel Institute.

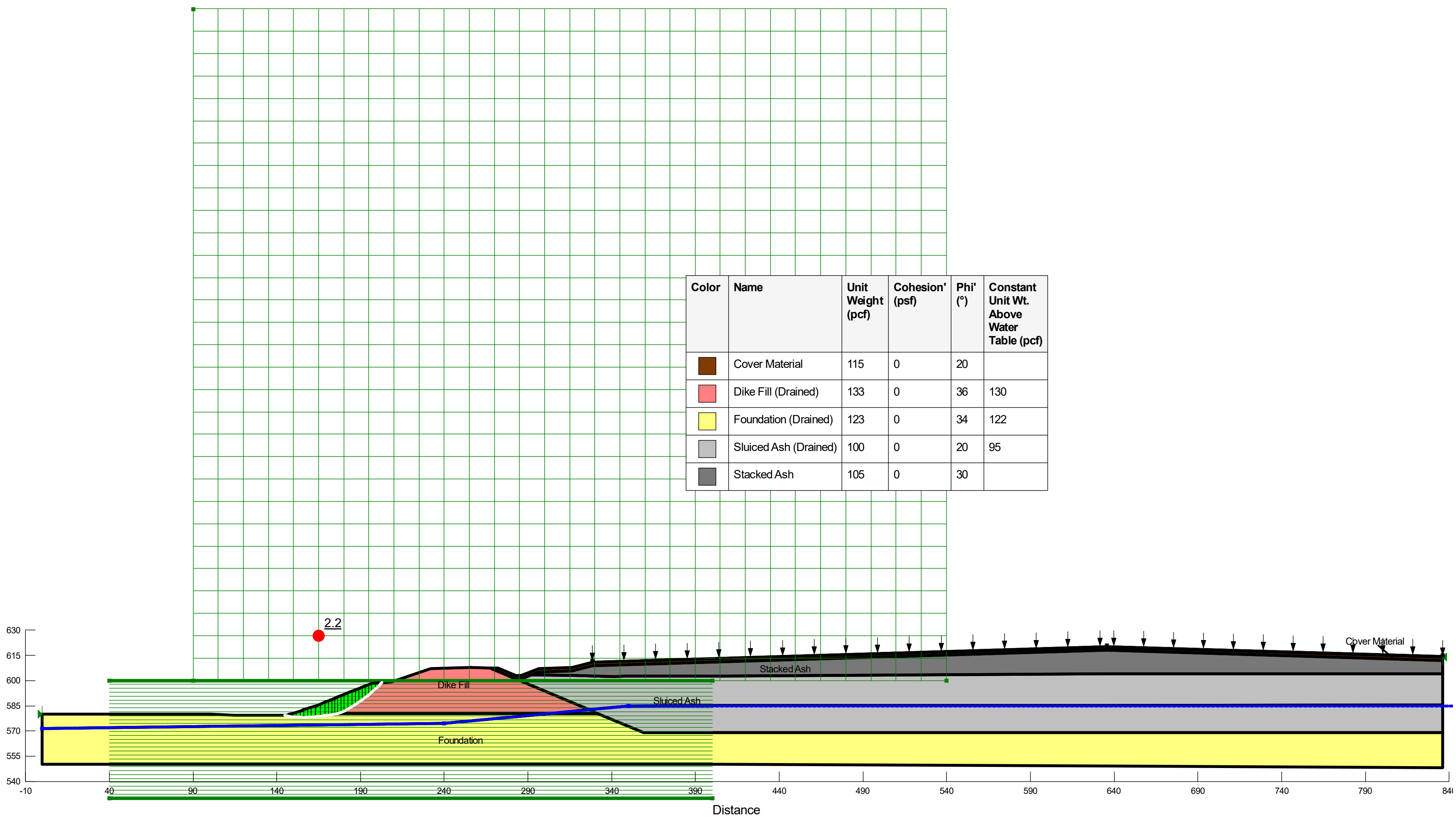
Figure 5
Outlet Control Conditions

ATTACHMENT D

GLOBAL STABILITY CALCULATION

Georgia Power - Plant Hammond
Ash Pond 3
Rome, Floyd County, Georgia
Drained Analysis
Section C-C'
Spencer

Color	Name	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Constant Unit Wt. Above Water Table (pcf)
	Cover Material	115	0	20	
	Dike Fill (Drained)	133	0	36	130
	Foundation (Drained)	123	0	34	122
	Sluiced Ash (Drained)	100	0	20	95
	Stacked Ash	105	0	30	



Drained

File Information

File Version: 9.00
Created By: Hartsfield, Terri H.
Last Edited By: Gondhalekar, Rajendra S.
Revision Number: 82
Date: 10/30/2018
Time: 01:54:17 PM
Tool Version: 9.0.4.15639
File Name: Hammond Ash Pond 3-with solar.gsz
Directory: T:\ESEE MAJOR PROJECTS\PROJECTS\Solar Development on RCRA Covers\Hammond AP3\Hammond AP-3 Solar Geotechnical Calculations\Revised\Global Stability\
Last Solved Date: 10/30/2018
Last Solved Time: 01:56:40 PM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Drained

- Kind: SLOPE/W
- Method: Spencer
- Settings
  - PWP Conditions from: Piezometric Line
    - Apply Phreatic Correction: No
    - Use Staged Rapid Drawdown: No
  - Unit Weight of Water: 62.4 pcf
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Grid and Radius
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: Yes
  - Optimizations Settings
    - Maximum Iterations: 2,000
    - Convergence Tolerance: 1e-07
    - Starting Points: 8
    - Ending Points: 16
    - Complete Passes per Insertion: 1
    - Driving Side Maximum Convex Angle: 5 °
    - Resisting Side Maximum Convex Angle: 1 °

Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 10 ft
Number of Slices: 30
Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.01
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Sluiced Ash (Drained)

Model: Mohr-Coulomb
Unit Weight: 100 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 95 pcf
Pore Water Pressure
Piezometric Line: 1

Dike Fill (Drained)

Model: Mohr-Coulomb
Unit Weight: 133 pcf
Cohesion': 0 psf
Phi': 36 °
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 130 pcf
Pore Water Pressure
Piezometric Line: 1

Foundation (Drained)

Model: Mohr-Coulomb
Unit Weight: 123 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 122 pcf
Pore Water Pressure
Piezometric Line: 1

Stacked Ash

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Cover Material

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (90, 1,000) ft
Lower Left: (90, 600) ft
Lower Right: (540, 600) ft
Grid Horizontal Increment: 30
Grid Vertical Increment: 30

Slip Surface Radius

Upper Left Coordinate: (40, 600) ft
Upper Right Coordinate: (400, 600) ft
Lower Left Coordinate: (40, 530) ft
Lower Right Coordinate: (400, 530) ft
Number of Increments: 30
Use Left Projection: No
Left Projection Angle: 135 °
Use Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (0, 580) ft
Right Coordinate: (836, 614) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X	Y
Coordinate 1	0 ft	571.5 ft
Coordinate 2	240 ft	574.5 ft
Coordinate 3	350 ft	585 ft
Coordinate 4	1,500 ft	585 ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 13.69 pcf
Direction: Vertical

Coordinates

	X	Y
	328.44 ft	611.78 ft
	635.77 ft	621 ft
	836 ft	615 ft

Points

	X	Y
Point 1	100 ft	580.172 ft
Point 2	115.033 ft	579.268 ft
Point 3	134.498 ft	579.482 ft
Point 4	149.566 ft	580.486 ft
Point 5	165.618 ft	585.613 ft
Point 6	182.444 ft	592.61 ft
Point 7	196.601 ft	598.279 ft
Point 8	208.647 ft	599.248 ft
Point 9	317.959 ft	602.91 ft
Point 10	341.424 ft	602.372 ft
Point 11	348.5 ft	602.67 ft
Point 12	360.019 ft	602.583 ft
Point 13	382.371 ft	602.601 ft
Point 14	405 ft	602.722 ft
Point 15	215 ft	580.5 ft
Point 16	146 ft	579.486 ft
Point 17	359.091 ft	569 ft

Point 18	163.2034 ft	584.8848 ft
Point 19	405 ft	569 ft
Point 20	0 ft	580 ft
Point 21	0 ft	550 ft
Point 22	405 ft	550 ft
Point 23	331.5 ft	580.5 ft
Point 24	350 ft	585 ft
Point 25	405 ft	585 ft
Point 26	836 ft	604.2 ft
Point 27	836 ft	569.0371 ft
Point 28	836 ft	548.2497 ft
Point 29	836 ft	585.4791 ft
Point 30	405 ft	585.0555 ft
Point 31	326.3031 ft	582.6935 ft
Point 32	256 ft	608 ft
Point 33	282.931 ft	601 ft
Point 34	286 ft	601 ft
Point 35	282.931 ft	603 ft
Point 36	231.7814 ft	607.295 ft
Point 37	286 ft	603 ft
Point 38	292.1199 ft	603.3885 ft
Point 39	267.1944 ft	607.5653 ft
Point 40	271.981 ft	607.3794 ft
Point 41	296.4645 ft	607.1787 ft

Point 42	296.4645 ft	605.179 ft
Point 43	316.4468 ft	607.7843 ft
Point 44	316.4504 ft	605.78 ft
Point 45	328.44 ft	610.78 ft
Point 46	328.44 ft	608.78 ft
Point 47	635.77 ft	620 ft
Point 48	635.7687 ft	618 ft
Point 49	635.8372 ft	604.1997 ft
Point 50	635.9176 ft	585.2884 ft
Point 51	635.9868 ft	569.0204 ft
Point 52	636.0718 ft	549.037 ft
Point 53	836 ft	614 ft
Point 54	836 ft	612 ft
Point 55	303.1987 ft	580.5 ft
Point 56	0 ft	571.5623 ft
Point 57	239.9317 ft	574.4814 ft

Regions

	Material	Points	Area
Region 1	Foundation (Drained)	19,17,23,55,57,56,21,22,52,28,27,51	18,261 ft^2
Region 2	Sluiced Ash (Drained)	14,13,12,11,10,9,38,34,33,31,24,30,50,29,26,49	9,874 ft^2
Region 3	Dike Fill (Drained)	32,36,8,7,6,18,4,15,55,31,33,39	2,951.3 ft^2
Region 4	Cover Material	45,43,41,37,35,40,39,33,34,38,42,44,46,48,54,53,47	1,131.7 ft^2
Region 5	Stacked Ash	26,54,48,46,44,42,38,9,10,11,12,13,14,49	5,384.9 ft^2
Region 6	Sluiced Ash (Drained)	51,27,29,50,30,24,31,23,17,19	8,013.6 ft^2
Region 7	Dike Fill (Drained)	23,31,55	31.039 ft^2
Region 8	Foundation (Drained)	15,4,16,3,2,1,20,56,57,55	1,895.6 ft^2

Current Slip Surface

Slip Surface: 29,792
Factor of Safety: 2.2
Volume: 358.79706 ft³
Weight: 46,245.633 lbf
Resisting Moment: 1,497,403.6 lbf·ft
Activating Moment: 693,496.82 lbf·ft
Resisting Force: 29,150.785 lbf
Activating Force: 13,482.713 lbf
Slip Rank: 1 of 29,792 slip surfaces
Exit: (144.75823, 579.48557) ft
Entry: (202.81446, 598.77882) ft
Radius: 30.808896 ft
Center: (165, 626.66667) ft

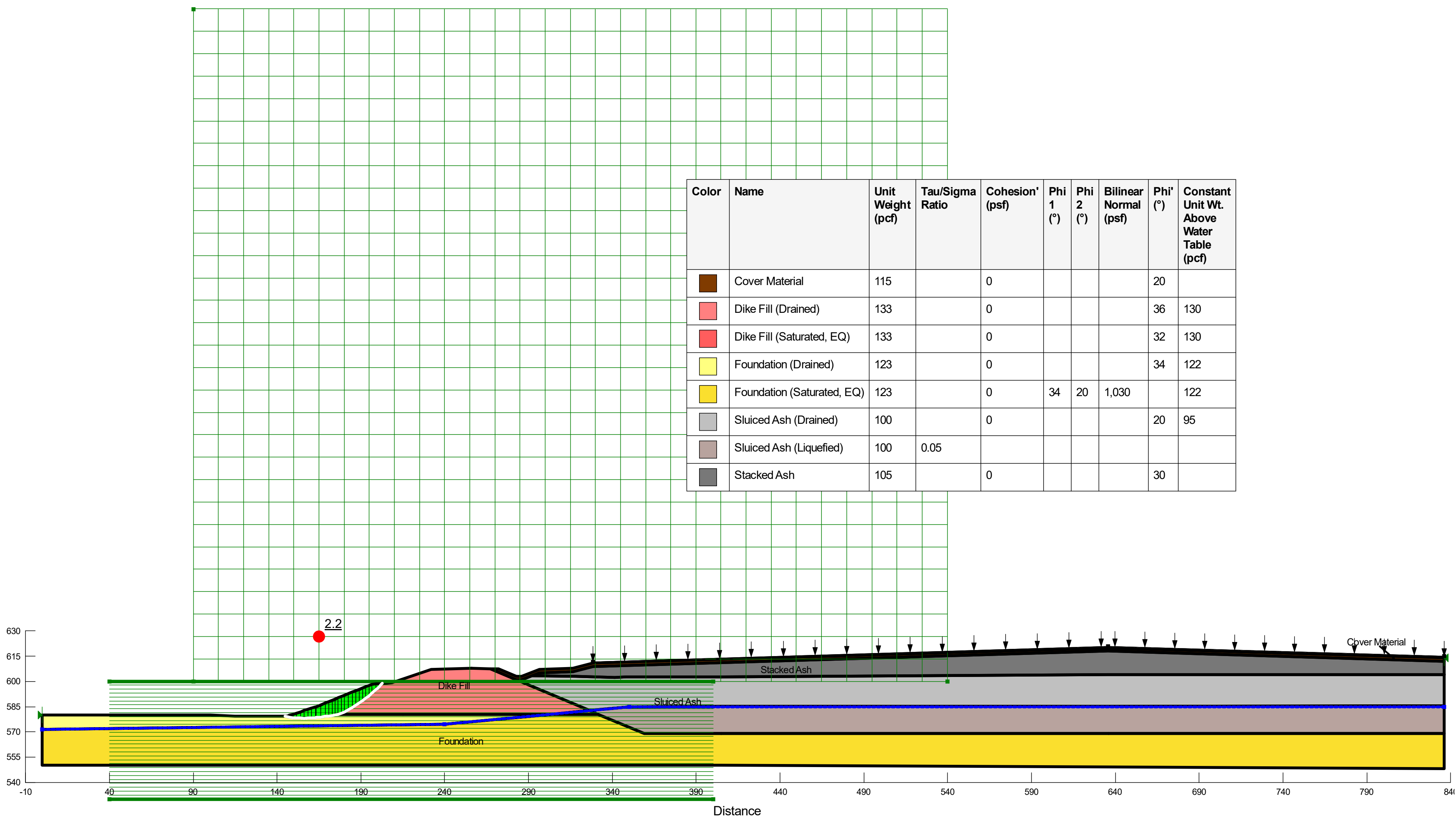
Slip Slices

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength
Slice 1	145.37911 ft	579.30068 ft	-373.36654 psf	32.25374 psf	21.755422 psf	0 psf
Slice 2	146.76865 ft	578.88689 ft	-346.46257 psf	141.94878 psf	95.74566 psf	0 psf
Slice 3	148.55165 ft	578.54009 ft	-323.43148 psf	248.16974 psf	167.3926 psf	0 psf
Slice 4	150.61205 ft	578.30059 ft	-306.87957 psf	380.1323 psf	256.40248 psf	0 psf
Slice 5	152.80292 ft	578.16665 ft	-296.81268 psf	472.76363 psf	318.88309 psf	0 psf
Slice 6	155.09258 ft	578.14195 ft	-293.48547 psf	584.57214 psf	394.29889 psf	0 psf
Slice 7	157.33363 ft	578.18842 ft	-294.63697 psf	653.11707 psf	440.53302 psf	0 psf
Slice 8	159.5261 ft	578.30605 ft	-300.26716 psf	736.7279 psf	496.92924 psf	0 psf
Slice 9	161.71857 ft	578.42368 ft	-305.89736 psf	820.33873 psf	553.32546 psf	0 psf
Slice 10	163.0091 ft	578.50182 ft	-309.76627 psf	841.14542 psf	567.35975 psf	0 psf
Slice 11	164.623 ft	578.66227 ft	-318.51951 psf	906.56547 psf	611.48613 psf	0 psf
Slice 12	167.4779 ft	578.99595 ft	-337.11452 psf	995.89881 psf	671.74223 psf	0 psf
Slice 13	169.93245 ft	579.34 ft	-356.66869 psf	1,073.3131 psf	723.95882 psf	0 psf
Slice 14	171.84869 ft	579.6582 ft	-375.02999 psf	1,107.7559 psf	747.19081 psf	0 psf
Slice 15	173.64266 ft	579.99161 ft	-394.43541 psf	1,159.9473 psf	782.39432 psf	0 psf

Slice 16	175.45862 ft	580.32911 ft	-414.07868 psf	1,212.7461 psf	818.00761 psf	0 psf
Slice 17	177.34137 ft	580.8041 ft	-442.24957 psf	1,153.8458 psf	838.31807 psf	0 psf
Slice 18	179.26892 ft	581.4125 ft	-478.71024 psf	1,173.4197 psf	852.53935 psf	0 psf
Slice 19	181.33835 ft	582.37956 ft	-537.44047 psf	984.33971 psf	715.16466 psf	0 psf
Slice 20	183.7256 ft	583.81076 ft	-624.88529 psf	936.65673 psf	680.52095 psf	0 psf
Slice 21	186.009 ft	585.23407 ft	-711.91874 psf	860.92363 psf	625.49763 psf	0 psf
Slice 22	188.0126 ft	586.544 ft	-792.09577 psf	811.28215 psf	589.43099 psf	0 psf
Slice 23	190.0162 ft	587.85393 ft	-872.2728 psf	761.64067 psf	553.36434 psf	0 psf
Slice 24	191.99863 ft	589.23563 ft	-956.94407 psf	674.15862 psf	489.80491 psf	0 psf
Slice 25	193.95988 ft	590.68908 ft	-1,046.1096 psf	611.60671 psf	444.35829 psf	0 psf
Slice 26	195.77075 ft	592.19292 ft	-1,138.5373 psf	492.1905 psf	357.59733 psf	0 psf
Slice 27	197.79925 ft	594.09162 ft	-1,255.4339 psf	366.453 psf	266.24369 psf	0 psf
Slice 28	199.78098 ft	595.93663 ft	-1,369.0162 psf	223.50588 psf	162.38653 psf	0 psf
Slice 29	201.34793 ft	597.38348 ft	-1,458.0775 psf	109.88508 psf	79.836182 psf	0 psf
Slice 30	202.47293 ft	598.44286 ft	-1,523.3056 psf	25.848 psf	18.779671 psf	0 psf

Georgia Power - Plant Hammond
Ash Pond 3
Rome, Floyd County, Georgia
Post-EQ Analysis
Section C-C'
Spencer

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion' (psf)	Phi 1 (°)	Phi 2 (°)	Bilinear Normal (psf)	Phi' (°)	Constant Unit Wt. Above Water Table (pcf)
	Cover Material	115		0				20	
	Dike Fill (Drained)	133		0				36	130
	Dike Fill (Saturated, EQ)	133		0				32	130
	Foundation (Drained)	123		0				34	122
	Foundation (Saturated, EQ)	123		0	34	20	1,030		122
	Sluiced Ash (Drained)	100		0				20	95
	Sluiced Ash (Liquefied)	100	0.05						
	Stacked Ash	105		0				30	



Post-EQ

File Information

File Version: 9.00
Created By: Hartsfield, Terri H.
Last Edited By: Gondhalekar, Rajendra S.
Revision Number: 82
Date: 10/30/2018
Time: 01:54:17 PM
Tool Version: 9.0.4.15639
File Name: Hammond Ash Pond 3-with solar.gsz
Directory: T:\ESEE MAJOR PROJECTS\PROJECTS\Solar Development on RCRA Covers\Hammond AP3 \Hammond AP-3 Solar Geotechnical Calculations\Revised\Global Stability\
Last Solved Date: 10/30/2018
Last Solved Time: 01:57:26 PM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Post-EQ

- Kind: SLOPE/W
- Method: Spencer
- Settings
  - PWP Conditions from: Piezometric Line
    - Apply Phreatic Correction: No
    - Use Staged Rapid Drawdown: No
  - Unit Weight of Water: 62.4 pcf
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Grid and Radius
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: Yes
  - Optimizations Settings
    - Maximum Iterations: 2,000
    - Convergence Tolerance: 1e-07
    - Starting Points: 8
    - Ending Points: 16
    - Complete Passes per Insertion: 1
    - Driving Side Maximum Convex Angle: 5 °
    - Resisting Side Maximum Convex Angle: 1 °

Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 10 ft
Number of Slices: 30
Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.01
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Sluiced Ash (Drained)

Model: Mohr-Coulomb
Unit Weight: 100 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 95 pcf
Pore Water Pressure
Piezometric Line: 1

Dike Fill (Drained)

Model: Mohr-Coulomb
Unit Weight: 133 pcf
Cohesion': 0 psf
Phi': 36 °
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 130 pcf
Pore Water Pressure
Piezometric Line: 1

Foundation (Drained)

Model: Mohr-Coulomb
Unit Weight: 123 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 122 pcf
Pore Water Pressure
Piezometric Line: 1

Sluiced Ash (Liquefied)

Model: SHANSEP
Unit Weight: 100 pcf
Minimum Strength: 0 psf
Tau/Sigma Ratio: 0.05
Pore Water Pressure
Piezometric Line: 1

Stacked Ash

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Cover Material

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Foundation (Saturated, EQ)

Model: Bilinear
Unit Weight: 123 pcf
Cohesion': 0 psf
Phi 1: 34 °
Phi 2: 20 °
Bilinear Normal: 1,030 psf
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 122 pcf
Pore Water Pressure
Piezometric Line: 1

Dike Fill (Saturated, EQ)

Model: Mohr-Coulomb
Unit Weight: 133 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 130 pcf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (90, 1,000) ft
Lower Left: (90, 600) ft
Lower Right: (540, 600) ft
Grid Horizontal Increment: 30
Grid Vertical Increment: 30

Slip Surface Radius

Upper Left Coordinate: (40, 600) ft
Upper Right Coordinate: (400, 600) ft
Lower Left Coordinate: (40, 530) ft
Lower Right Coordinate: (400, 530) ft
Number of Increments: 30
Use Left Projection: No
Left Projection Angle: 135 °
Use Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (0, 580) ft
Right Coordinate: (836, 614) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X	Y
Coordinate 1	0 ft	571.5 ft
Coordinate 2	240 ft	574.5 ft
Coordinate 3	350 ft	585 ft
Coordinate 4	836 ft	585 ft

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 13.69 pcf
Direction: Vertical

Coordinates

	X	Y
	328.44 ft	611.78 ft

	635.77 ft	621 ft
	836 ft	615 ft

Points

	X	Y
Point 1	100 ft	580.172 ft
Point 2	115.033 ft	579.268 ft
Point 3	134.498 ft	579.482 ft
Point 4	149.566 ft	580.486 ft
Point 5	165.618 ft	585.613 ft
Point 6	182.444 ft	592.61 ft
Point 7	196.601 ft	598.279 ft
Point 8	208.647 ft	599.248 ft
Point 9	317.959 ft	602.91 ft
Point 10	341.424 ft	602.372 ft
Point 11	348.5 ft	602.67 ft
Point 12	360.019 ft	602.583 ft
Point 13	382.371 ft	602.601 ft
Point 14	405 ft	602.722 ft
Point 15	215 ft	580.5 ft
Point 16	146 ft	579.486 ft
Point 17	359.091 ft	569 ft
Point 18	163.2034 ft	584.8848 ft
Point 19	405 ft	569 ft
Point 20	0 ft	580 ft
Point 21	0 ft	550 ft
Point 22	405 ft	550 ft
Point 23	331.5 ft	580.5 ft
Point 24	350 ft	585 ft
Point 25	405 ft	585 ft
Point 26	836 ft	604.2 ft
Point 27	836 ft	569.0371 ft
Point 28	836 ft	548.2497 ft
Point 29	836 ft	585.4791 ft
Point 30	405 ft	585.0555 ft
Point 31	326.3031 ft	582.6935 ft
Point 32	256 ft	608 ft
Point 33	282.931 ft	601 ft
Point 34	286 ft	601 ft
Point 35	282.931 ft	603 ft
Point 36	231.7814 ft	607.295 ft
Point 37	286 ft	603 ft

Point 38	292.1199 ft	603.3885 ft
Point 39	267.1944 ft	607.5653 ft
Point 40	271.981 ft	607.3794 ft
Point 41	296.4645 ft	607.1787 ft
Point 42	296.4645 ft	605.179 ft
Point 43	316.4468 ft	607.7843 ft
Point 44	316.4504 ft	605.78 ft
Point 45	328.44 ft	610.78 ft
Point 46	328.44 ft	608.78 ft
Point 47	635.77 ft	620 ft
Point 48	635.7687 ft	618 ft
Point 49	635.8372 ft	604.1997 ft
Point 50	635.9176 ft	585.2884 ft
Point 51	635.9868 ft	569.0204 ft
Point 52	636.0718 ft	549.037 ft
Point 53	836 ft	614 ft
Point 54	836 ft	612 ft
Point 55	303.1987 ft	580.5 ft
Point 56	0 ft	571.5623 ft
Point 57	239.9317 ft	574.4814 ft

Regions

	Material	Points	Area
Region 1	Foundation (Saturated, EQ)	19,17,23,55,57,56,21,22,52,28,27,51	18,261 ft^2
	Sluiced Ash (Drained)	14,13,12,11,10,9,38,34,33,31,24,30,50,29,26,49	9,874 ft^2

Region 2			
Region 3	Dike Fill (Drained)	32,36,8,7,6,18,4,15,55,31,33,39	2,951.3 ft^2
Region 4	Cover Material	45,43,41,37,35,40,39,33,34,38,42,44,46,48,54,53,47	1,131.7 ft^2
Region 5	Stacked Ash	26,54,48,46,44,42,38,9,10,11,12,13,14,49	5,384.9 ft^2
Region 6	Sluiced Ash (Liquefied)	51,27,29,50,30,24,31,23,17,19	8,013.6 ft^2
Region 7	Dike Fill (Saturated, EQ)	23,31,55	31.039 ft^2
Region 8	Foundation (Drained)	15,4,16,3,2,1,20,56,57,55	1,895.6 ft^2

Current Slip Surface

Slip Surface: 29,792
Factor of Safety: 2.2
Volume: 358.79706 ft^3
Weight: 46,245.633 lbf
Resisting Moment: 1,497,403.6 lbf·ft
Activating Moment: 693,496.82 lbf·ft
Resisting Force: 29,150.785 lbf
Activating Force: 13,482.713 lbf
Slip Rank: 1 of 29,792 slip surfaces
Exit: (144.75823, 579.48557) ft
Entry: (202.81446, 598.77882) ft
Radius: 30.808896 ft
Center: (165, 626.66667) ft

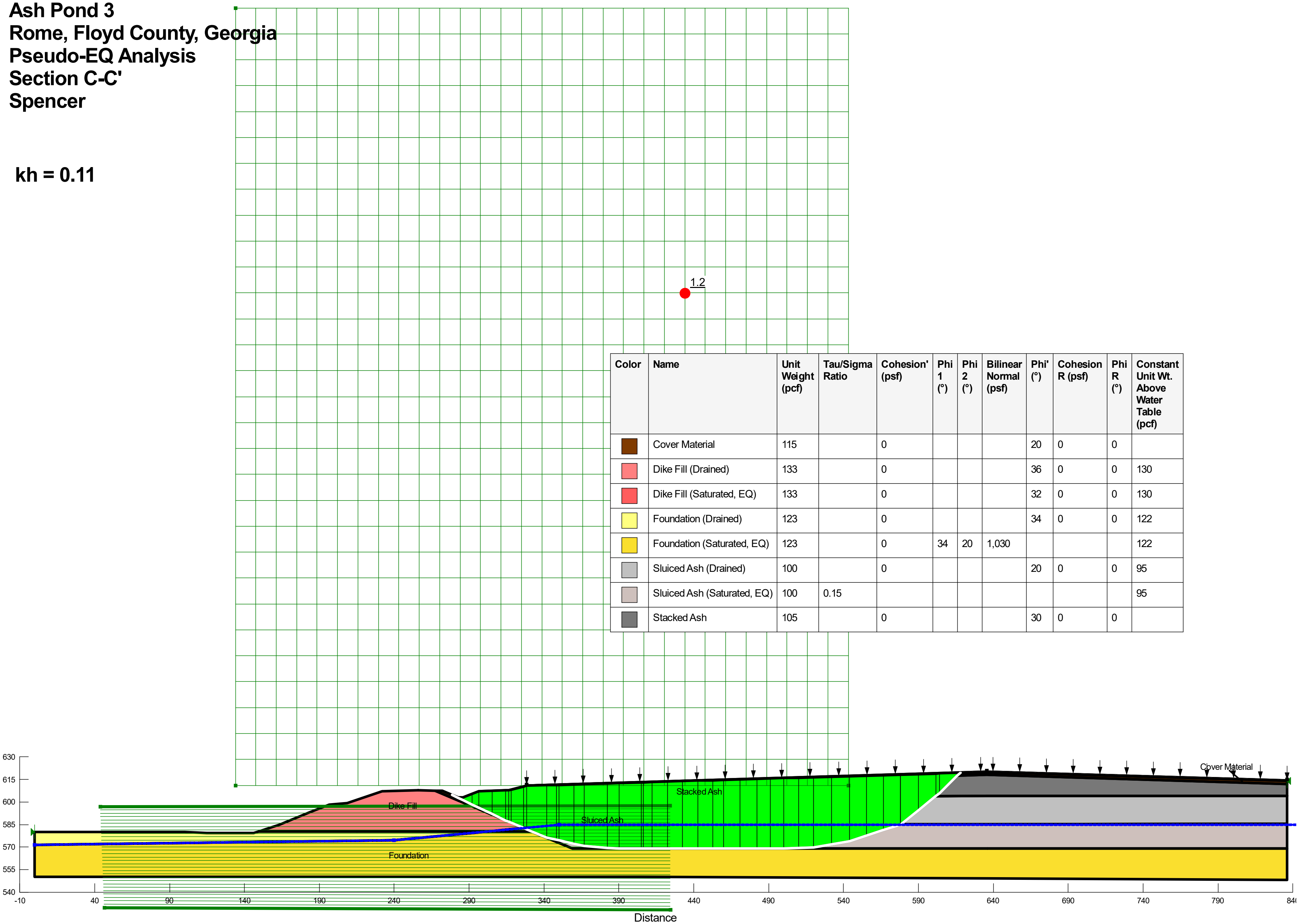
Slip Slices

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength
Slice 1	145.37911 ft	579.30068 ft	-373.36654 psf	32.25374 psf	21.755422 psf	0 psf
Slice 2	146.76865 ft	578.88689 ft	-346.46257 psf	141.94878 psf	95.74566 psf	0 psf
Slice 3	148.55165 ft	578.54009 ft	-323.43148 psf	248.16974 psf	167.3926 psf	0 psf
Slice 4	150.61205 ft	578.30059 ft	-306.87957 psf	380.1323 psf	256.40248 psf	0 psf
Slice 5	152.80292 ft	578.16665 ft	-296.81268 psf	472.76363 psf	318.88309 psf	0 psf
Slice 6	155.09258 ft	578.14195 ft	-293.48547 psf	584.57214 psf	394.29889 psf	0 psf
Slice 7	157.33363 ft	578.18842 ft	-294.63697 psf	653.11707 psf	440.53302 psf	0 psf

Slice 8	159.5261 ft	578.30605 ft	-300.26716 psf	736.7279 psf	496.92924 psf	0 psf
Slice 9	161.71857 ft	578.42368 ft	-305.89736 psf	820.33873 psf	553.32546 psf	0 psf
Slice 10	163.0091 ft	578.50182 ft	-309.76627 psf	841.14542 psf	567.35975 psf	0 psf
Slice 11	164.623 ft	578.66227 ft	-318.51951 psf	906.56547 psf	611.48613 psf	0 psf
Slice 12	167.4779 ft	578.99595 ft	-337.11452 psf	995.89881 psf	671.74223 psf	0 psf
Slice 13	169.93245 ft	579.34 ft	-356.66869 psf	1,073.3131 psf	723.95882 psf	0 psf
Slice 14	171.84869 ft	579.6582 ft	-375.02999 psf	1,107.7559 psf	747.19081 psf	0 psf
Slice 15	173.64266 ft	579.99161 ft	-394.43541 psf	1,159.9473 psf	782.39432 psf	0 psf
Slice 16	175.45862 ft	580.32911 ft	-414.07868 psf	1,212.7461 psf	818.00761 psf	0 psf
Slice 17	177.34137 ft	580.8041 ft	-442.24957 psf	1,153.8458 psf	838.31807 psf	0 psf
Slice 18	179.26892 ft	581.4125 ft	-478.71024 psf	1,173.4197 psf	852.53935 psf	0 psf
Slice 19	181.33835 ft	582.37956 ft	-537.44047 psf	984.33971 psf	715.16466 psf	0 psf
Slice 20	183.7256 ft	583.81076 ft	-624.88529 psf	936.65673 psf	680.52095 psf	0 psf
Slice 21	186.009 ft	585.23407 ft	-711.91874 psf	860.92363 psf	625.49763 psf	0 psf
Slice 22	188.0126 ft	586.544 ft	-792.09577 psf	811.28215 psf	589.43099 psf	0 psf
Slice 23	190.0162 ft	587.85393 ft	-872.2728 psf	761.64067 psf	553.36434 psf	0 psf
Slice 24	191.99863 ft	589.23563 ft	-956.94407 psf	674.15862 psf	489.80491 psf	0 psf
Slice 25	193.95988 ft	590.68908 ft	-1,046.1096 psf	611.60671 psf	444.35829 psf	0 psf
Slice 26	195.77075 ft	592.19292 ft	-1,138.5373 psf	492.1905 psf	357.59733 psf	0 psf
Slice 27	197.79925 ft	594.09162 ft	-1,255.4339 psf	366.453 psf	266.24369 psf	0 psf
Slice 28	199.78098 ft	595.93663 ft	-1,369.0162 psf	223.50588 psf	162.38653 psf	0 psf
Slice 29	201.34793 ft	597.38348 ft	-1,458.0775 psf	109.88508 psf	79.836182 psf	0 psf
Slice 30	202.47293 ft	598.44286 ft	-1,523.3056 psf	25.848 psf	18.779671 psf	0 psf

Georgia Power - Plant Hammond
Ash Pond 3
Rome, Floyd County, Georgia
Pseudo-EQ Analysis
Section C-C'
Spencer

kh = 0.11



Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion' (psf)	Phi 1 (°)	Phi 2 (°)	Bilinear Normal (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Constant Unit Wt. Above Water Table (pcf)
	Cover Material	115		0				20	0	0	
	Dike Fill (Drained)	133		0				36	0	0	130
	Dike Fill (Saturated, EQ)	133		0				32	0	0	130
	Foundation (Drained)	123		0				34	0	0	122
	Foundation (Saturated, EQ)	123		0	34	20	1,030				122
	Sluiced Ash (Drained)	100		0				20	0	0	95
	Sluiced Ash (Saturated, EQ)	100	0.15								95
	Stacked Ash	105		0				30	0	0	

Pseudo-EQ

File Information

File Version: 9.00
Created By: Hartsfield, Terri H.
Last Edited By: Gondhalekar, Rajendra S.
Revision Number: 82
Date: 10/30/2018
Time: 01:54:17 PM
Tool Version: 9.0.4.15639
File Name: Hammond Ash Pond 3-with solar.gsz
Directory: T:\ESEE MAJOR PROJECTS\PROJECTS\Solar Development on RCRA Covers\Hammond AP3 \Hammond AP-3 Solar Geotechnical Calculations\Revised\Global Stability\
Last Solved Date: 10/30/2018
Last Solved Time: 01:56:06 PM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Pseudo-EQ

- Kind: SLOPE/W
- Method: Spencer
- Settings
  - PWP Conditions from: Piezometric Line
    - Apply Phreatic Correction: No
    - Use Staged Rapid Drawdown: No
  - Staged Pseudo Static Analysis Option: Effective Stress Strengths
  - Unit Weight of Water: 62.4 pcf
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Grid and Radius
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: Yes
  - Optimizations Settings
    - Maximum Iterations: 2,000
    - Convergence Tolerance: 1e-07
    - Starting Points: 8
    - Ending Points: 16
    - Complete Passes per Insertion: 1
    - Driving Side Maximum Convex Angle: 5 °

Resisting Side Maximum Convex Angle: 1 °
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 10 ft
Number of Slices: 30
Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.01
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Sluiced Ash (Drained)

Model: Mohr-Coulomb
Unit Weight: 100 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Cohesion R: 0 psf
Phi R: 0 °
Constant Unit Wt. Above Water Table: 95 pcf
Pore Water Pressure
Piezometric Line: 1

Dike Fill (Drained)

Model: Mohr-Coulomb
Unit Weight: 133 pcf
Cohesion': 0 psf
Phi': 36 °
Phi-B: 0 °
Cohesion R: 0 psf
Phi R: 0 °
Constant Unit Wt. Above Water Table: 130 pcf
Pore Water Pressure
Piezometric Line: 1

Foundation (Drained)

Model: Mohr-Coulomb
Unit Weight: 123 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Cohesion R: 0 psf
Phi R: 0 °
Constant Unit Wt. Above Water Table: 122 pcf
Pore Water Pressure
Piezometric Line: 1

Stacked Ash

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °
Cohesion R: 0 psf
Phi R: 0 °
Pore Water Pressure
Piezometric Line: 1

Cover Material

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Cohesion R: 0 psf
Phi R: 0 °
Pore Water Pressure
Piezometric Line: 1

Foundation (Saturated, EQ)

Model: Bilinear
Unit Weight: 123 pcf
Cohesion': 0 psf
Phi 1: 34 °
Phi 2: 20 °
Bilinear Normal: 1,030 psf
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 122 pcf
Pore Water Pressure
Piezometric Line: 1

Sluiced Ash (Saturated, EQ)

Model: SHANSEP
Unit Weight: 100 pcf
Minimum Strength: 0 psf
Tau/Sigma Ratio: 0.15
Constant Unit Wt. Above Water Table: 95 pcf
Pore Water Pressure
Piezometric Line: 1

Dike Fill (Saturated, EQ)

Model: Mohr-Coulomb
Unit Weight: 133 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °
Cohesion R: 0 psf
Phi R: 0 °
Constant Unit Wt. Above Water Table: 130 pcf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Grid

Upper Left: (134.1556, 1,128.7609) ft
Lower Left: (134.1556, 610.9186) ft
Lower Right: (543.4415, 610.9186) ft
Grid Horizontal Increment: 30
Grid Vertical Increment: 30

Slip Surface Radius

Upper Left Coordinate: (43.7356, 596.9564) ft
Upper Right Coordinate: (424.0506, 597.4951) ft
Lower Left Coordinate: (46.6884, 529.6262) ft
Lower Right Coordinate: (424.6411, 528.2796) ft
Number of Increments: 30
Use Left Projection: No
Left Projection Angle: 135 °
Use Right Projection: No
Right Projection Angle: 45 °

Slip Surface Limits

Left Coordinate: (0, 580) ft
Right Coordinate: (836, 614) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X	Y
Coordinate 1	0 ft	571.5 ft
Coordinate 2	240 ft	574.5 ft
Coordinate 3	350 ft	585 ft

Coordinate 4	1,500 ft	585 ft

Seismic Coefficients

Horz Seismic Coef.: 0.11

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 0 pcf
Direction: Vertical

Coordinates

	X	Y
	328.44 ft	611.78 ft
	635.77 ft	621 ft
	836 ft	615 ft

Points

	X	Y
Point 1	100 ft	580.172 ft
Point 2	115.033 ft	579.268 ft
Point 3	134.498 ft	579.482 ft
Point 4	149.566 ft	580.486 ft
Point 5	165.618 ft	585.613 ft
Point 6	182.444 ft	592.61 ft
Point 7	196.601 ft	598.279 ft
Point 8	208.647 ft	599.248 ft
Point 9	317.959 ft	602.91 ft
Point 10	341.424 ft	602.372 ft
Point 11	348.5 ft	602.67 ft
Point 12	360.019 ft	602.583 ft
Point 13	382.371 ft	602.601 ft
Point 14	405 ft	602.722 ft
Point 15	215 ft	580.5 ft
Point 16	146 ft	579.486 ft
Point 17	359.091 ft	569 ft
Point 18	163.2034 ft	584.8848 ft
Point 19	405 ft	569 ft
Point 20	0 ft	580 ft
Point 21	0 ft	550 ft

Point 22	405 ft	550 ft
Point 23	331.5 ft	580.5 ft
Point 24	350 ft	585 ft
Point 25	405 ft	585 ft
Point 26	836 ft	604.2 ft
Point 27	836 ft	569.0371 ft
Point 28	836 ft	548.2497 ft
Point 29	836 ft	585.4791 ft
Point 30	405 ft	585.0555 ft
Point 31	326.3031 ft	582.6935 ft
Point 32	256 ft	608 ft
Point 33	282.931 ft	601 ft
Point 34	286 ft	601 ft
Point 35	282.931 ft	603 ft
Point 36	231.7814 ft	607.295 ft
Point 37	286 ft	603 ft
Point 38	292.1199 ft	603.3885 ft
Point 39	267.1944 ft	607.5653 ft
Point 40	271.981 ft	607.3794 ft
Point 41	296.4645 ft	607.1787 ft
Point 42	296.4645 ft	605.179 ft
Point 43	316.4468 ft	607.7843 ft
Point 44	316.4504 ft	605.78 ft
Point 45	328.44 ft	610.78 ft

Point 46	328.44 ft	608.78 ft
Point 47	635.77 ft	620 ft
Point 48	635.7687 ft	618 ft
Point 49	635.8372 ft	604.1997 ft
Point 50	635.9176 ft	585.2884 ft
Point 51	635.9868 ft	569.0204 ft
Point 52	636.0718 ft	549.037 ft
Point 53	836 ft	614 ft
Point 54	836 ft	612 ft
Point 55	303.1987 ft	580.5 ft
Point 56	0 ft	571.5623 ft
Point 57	239.9317 ft	574.4814 ft

Regions

	Material	Points	Area
Region 1	Foundation (Saturated, EQ)	19,17,23,55,57,56,21,22,52,28,27,51	18,261 ft²
Region 2	Sluiced Ash (Drained)	14,13,12,11,10,9,38,34,33,31,24,30,50,29,26,49	9,874 ft²
Region 3	Dike Fill (Drained)	32,36,8,7,6,18,4,15,55,31,33,39	2,951.3 ft²
Region 4	Cover Material	45,43,41,37,35,40,39,33,34,38,42,44,46,48,54,53,47	1,131.7 ft²
Region 5	Stacked Ash	26,54,48,46,44,42,38,9,10,11,12,13,14,49	5,384.9 ft²
Region 6	Sluiced Ash (Saturated, EQ)	51,27,29,50,30,24,31,23,17,19	8,013.6 ft²
Region 7	Dike Fill (Saturated, EQ)	23,31,55	31.039 ft²
Region 8	Foundation (Drained)	15,4,16,3,2,1,20,56,57,55	1,895.6 ft²

Current Slip Surface

Slip Surface: 29,792
Factor of Safety: 1.2
Volume: 12,047.303 ft³
Weight: 1,202,795.4 lbf
Resisting Moment: 71,292,039 lbf·ft
Activating Moment: 58,878,120 lbf·ft
Resisting Force: 179,883.15 lbf
Activating Force: 149,696.35 lbf
Slip Rank: 1 of 29,792 slip surfaces
Exit: (278.79682, 604.65345) ft
Entry: (618.06644, 619.46889) ft
Radius: 131.49725 ft
Center: (434.29859, 938.88539) ft

Slip Slices

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength
Slice 1	280.86391 ft	603.67087 ft	-1,576.8622 psf	22.072623 psf	0 psf	6.8987072 psf
Slice 2	284.4655 ft	601.95889 ft	-1,448.5822 psf	147.45038 psf	0 psf	46.085008 psf
Slice 3	289.05995 ft	599.77496 ft	-1,284.9388 psf	567.39705 psf	0 psf	177.33761 psf
Slice 4	294.2922 ft	597.28786 ft	-1,098.5786 psf	1,117.1729 psf	0 psf	349.16778 psf
Slice 5	300.95232 ft	594.12204 ft	-861.36081 psf	1,618.5157 psf	0 psf	505.86041 psf
Slice 6	309.92798 ft	589.85555 ft	-541.66957 psf	2,154.9328 psf	0 psf	673.51537 psf
Slice 7	315.4313 ft	587.29816 ft	-349.3089 psf	2,421.0105 psf	0 psf	769.03924 psf
Slice 8	317.2029 ft	586.55822 ft	-292.58447 psf	2,533.7837 psf	0 psf	804.8619 psf
Slice 9	322.1499 ft	584.49202 ft	-134.18754 psf	2,927.5441 psf	0 psf	929.94074 psf
Slice 10	327.3904 ft	582.30324 ft	33.606772 psf	3,056.6245 psf	0 psf	412.29794 psf
Slice 11	335.09945 ft	579.08343 ft	280.44088 psf	3,453.383 psf	0 psf	431.67156 psf
Slice 12	345.12945 ft	575.55006 ft	560.66519 psf	3,711.7455 psf	0 psf	448.0699 psf
Slice 13	349.25 ft	574.63081 ft	642.57004 psf	3,819.4319 psf	0 psf	451.6085 psf
Slice 14	355.0095 ft	573.34593 ft	727.21416 psf	3,970.172 psf	0 psf	460.88694 psf
Slice 15	363.511 ft	571.44933 ft	845.56184 psf	4,193.5202 psf	0 psf	475.65328 psf

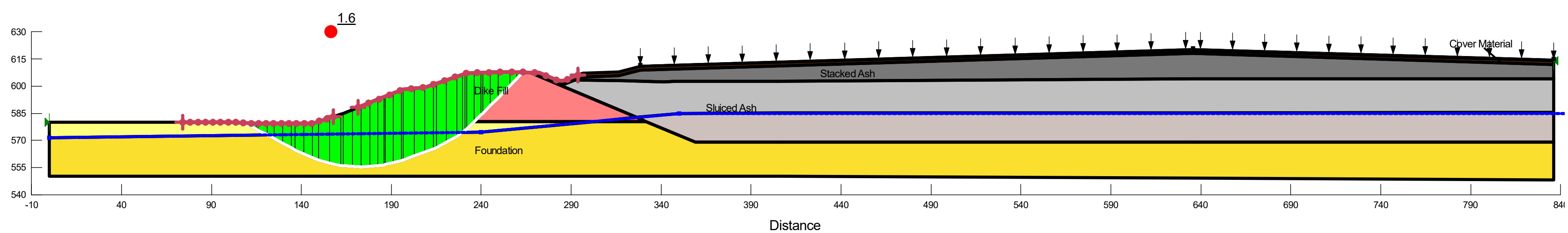
Slice 16	374.6708 ft	569.98355 ft	937.02648 psf	4,267.1265 psf	0 psf	489.17986 psf
Slice 17	386.31685 ft	569.14855 ft	989.13048 psf	4,343.568 psf	0 psf	499.35027 psf
Slice 18	397.64755 ft	569.00144 ft	998.31017 psf	4,361.5398 psf	0 psf	505.44376 psf
Slice 19	405.71205 ft	569.00269 ft	998.23217 psf	4,386.4144 psf	0 psf	509.18142 psf
Slice 20	409.35395 ft	569.00185 ft	998.28456 psf	4,398.1664 psf	0 psf	510.872 psf
Slice 21	417.35573 ft	569.00132 ft	998.31789 psf	4,422.5961 psf	0 psf	514.57906 psf
Slice 22	427.49958 ft	569.00215 ft	998.26599 psf	4,453.8608 psf	0 psf	519.26998 psf
Slice 23	437.64344 ft	569.00298 ft	998.2141 psf	4,485.1256 psf	0 psf	523.96091 psf
Slice 24	447.78729 ft	569.00381 ft	998.1622 psf	4,516.3903 psf	0 psf	528.65184 psf
Slice 25	456.35496 ft	569.00451 ft	998.11836 psf	4,542.797 psf	0 psf	532.61387 psf
Slice 26	465.42953 ft	569.0053 ft	998.06928 psf	4,570.7549 psf	0 psf	536.81008 psf
Slice 27	476.58718 ft	569.0063 ft	998.00688 psf	4,605.1358 psf	0 psf	541.96934 psf
Slice 28	486.60557 ft	569.0072 ft	997.95072 psf	4,636.0056 psf	0 psf	546.60181 psf
Slice 29	495.48473 ft	569.008 ft	997.9008 psf	4,663.3651 psf	0 psf	550.70748 psf
Slice 30	504.91823 ft	569.22772 ft	984.18996 psf	4,630.2187 psf	0 psf	553.83503 psf
Slice 31	514.90607 ft	569.66638 ft	956.8182 psf	4,617.4751 psf	0 psf	555.98444 psf
Slice 32	525.93975 ft	570.89435 ft	880.19256 psf	4,419.4402 psf	0 psf	554.16618 psf
Slice 33	538.01925 ft	572.91165 ft	754.31304 psf	4,259.7874 psf	0 psf	548.38024 psf
Slice 34	549.72153 ft	575.76623 ft	576.18704 psf	3,887.2805 psf	0 psf	537.69741 psf
Slice 35	561.0466 ft	579.4581 ft	345.81456 psf	3,569.9916 psf	0 psf	522.11769 psf
Slice 36	572.37167 ft	583.14997 ft	115.44208 psf	3,252.7026 psf	0 psf	506.53796 psf
Slice 37	578.03675 ft	584.99795 ft	0.12792 psf	2,774.6056 psf	0 psf	498.73772 psf
Slice 38	584.00825 ft	589.80276 ft	-299.69206 psf	2,119.8974 psf	0 psf	967.91527 psf
Slice 39	595.80303 ft	599.29312 ft	-891.8904 psf	1,484.6284 psf	0 psf	677.86039 psf

Slice 40	602.78163 ft	604.90826 ft	-1,242.2753 psf	956.24508 psf	0 psf	772.74855 psf
Slice 41	609.93057 ft	611.62027 ft	-1,661.1046 psf	469.27882 psf	0 psf	412.29741 psf
Slice 42	616.99659 ft	618.43681 ft	-2,086.4569 psf	78.988482 psf	0 psf	37.94346 psf

Georgia Power - Plant Hammond
Ash Pond 3
Rome, Floyd County, Georgia
Pseudo-EQ (Dike) Analysis
Section C-C'
Spencer

kh = 0.11

Color	Name	Unit Weight (pcf)	Tau/Sigma Ratio	Cohesion' (psf)	Phi 1 (°)	Phi 2 (°)	Bilinear Normal (psf)	Phi' (°)	Cohesion R (psf)	Phi R (°)	Constant Unit Wt. Above Water Table (pcf)
	Cover Material	115		0				20	0	0	
	Dike Fill (Drained)	133		0				36	0	0	130
	Dike Fill (Saturated, EQ)	133		0				32	0	0	130
	Foundation (Drained)	123		0				34	0	0	122
	Foundation (Saturated, EQ)	123		0	34	20	1,030				122
	Sluiced Ash (Drained)	100		0				20	0	0	95
	Sluiced Ash (Saturated, EQ)	100	0.15								95
	Stacked Ash	105		0				30	0	0	



Pseudo-EQ (Dike)

File Information

File Version: 9.00
Created By: Hartsfield, Terri H.
Last Edited By: Gondhalekar, Rajendra S.
Revision Number: 82
Date: 10/30/2018
Time: 01:54:17 PM
Tool Version: 9.0.4.15639
File Name: Hammond Ash Pond 3-with solar.gsz
Directory: T:\ESEE MAJOR PROJECTS\PROJECTS\Solar Development on RCRA Covers\Hammond AP3 \Hammond AP-3 Solar Geotechnical Calculations\Revised\Global Stability\
Last Solved Date: 10/30/2018
Last Solved Time: 01:58:00 PM

Project Settings

Unit System: U.S. Customary Units

Analysis Settings

Pseudo-EQ (Dike)

Kind: SLOPE/W
Method: Spencer
Settings
- PWP Conditions from: Piezometric Line
  - Apply Phreatic Correction: No
  - Use Staged Rapid Drawdown: No
- Staged Pseudo Static Analysis Option: Effective Stress Strengths
- Unit Weight of Water: 62.4 pcf

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: Yes
- Optimizations Settings
  - Maximum Iterations: 2,000
  - Convergence Tolerance: 1e-07
  - Starting Points: 8
  - Ending Points: 16
  - Complete Passes per Insertion: 1
  - Driving Side Maximum Convex Angle: 5 °

Resisting Side Maximum Convex Angle: 1 °
Tension Crack Option: (none)
Distribution
F of S Calculation Option: Constant
Advanced
Geometry Settings
Minimum Slip Surface Depth: 10 ft
Number of Slices: 30
Factor of Safety Convergence Settings
Maximum Number of Iterations: 100
Tolerable difference in F of S: 0.01
Solution Settings
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Sluiced Ash (Drained)

Model: Mohr-Coulomb
Unit Weight: 100 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Cohesion R: 0 psf
Phi R: 0 °
Constant Unit Wt. Above Water Table: 95 pcf
Pore Water Pressure
Piezometric Line: 1

Dike Fill (Drained)

Model: Mohr-Coulomb
Unit Weight: 133 pcf
Cohesion': 0 psf
Phi': 36 °
Phi-B: 0 °
Cohesion R: 0 psf
Phi R: 0 °
Constant Unit Wt. Above Water Table: 130 pcf
Pore Water Pressure
Piezometric Line: 1

Foundation (Drained)

Model: Mohr-Coulomb
Unit Weight: 123 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °

Cohesion R: 0 psf
Phi R: 0 °
Constant Unit Wt. Above Water Table: 122 pcf
Pore Water Pressure
Piezometric Line: 1

Stacked Ash

Model: Mohr-Coulomb
Unit Weight: 105 pcf
Cohesion': 0 psf
Phi': 30 °
Phi-B: 0 °
Cohesion R: 0 psf
Phi R: 0 °
Pore Water Pressure
Piezometric Line: 1

Cover Material

Model: Mohr-Coulomb
Unit Weight: 115 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Cohesion R: 0 psf
Phi R: 0 °
Pore Water Pressure
Piezometric Line: 1

Foundation (Saturated, EQ)

Model: Bilinear
Unit Weight: 123 pcf
Cohesion': 0 psf
Phi 1: 34 °
Phi 2: 20 °
Bilinear Normal: 1,030 psf
Phi-B: 0 °
Constant Unit Wt. Above Water Table: 122 pcf
Pore Water Pressure
Piezometric Line: 1

Sluiced Ash (Saturated, EQ)

Model: SHANSEP
Unit Weight: 100 pcf
Minimum Strength: 0 psf
Tau/Sigma Ratio: 0.15
Constant Unit Wt. Above Water Table: 95 pcf
Pore Water Pressure
Piezometric Line: 1

Dike Fill (Saturated, EQ)

Model: Mohr-Coulomb
Unit Weight: 133 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °
Cohesion R: 0 psf
Phi R: 0 °
Constant Unit Wt. Above Water Table: 130 pcf
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Type: Range
Left-Zone Left Coordinate: (74.0087, 580.1273) ft
Left-Zone Right Coordinate: (157.8916, 583.1715) ft
Left-Zone Increment: 20
Right Type: Range
Right-Zone Left Coordinate: (171.3631, 588.161) ft
Right-Zone Right Coordinate: (293.6774, 606.0658) ft
Right-Zone Increment: 20
Radius Increments: 30

Slip Surface Limits

Left Coordinate: (0, 580) ft
Right Coordinate: (836, 614) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X	Y
Coordinate 1	0 ft	571.5 ft
Coordinate 2	240 ft	574.5 ft
Coordinate 3	350 ft	585 ft
Coordinate 4	1,500 ft	585 ft

Seismic Coefficients

Horz Seismic Coef.: 0.11

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 0 pcf
Direction: Vertical

Coordinates

	X	Y
	328.44 ft	611.78 ft
	635.77 ft	621 ft
	836 ft	615 ft

Points

	X	Y
Point 1	100 ft	580.172 ft
Point 2	115.033 ft	579.268 ft
Point 3	134.498 ft	579.482 ft
Point 4	149.566 ft	580.486 ft
Point 5	165.618 ft	585.613 ft
Point 6	182.444 ft	592.61 ft
Point 7	196.601 ft	598.279 ft
Point 8	208.647 ft	599.248 ft
Point 9	317.959 ft	602.91 ft
Point 10	341.424 ft	602.372 ft
Point 11	348.5 ft	602.67 ft
Point 12	360.019 ft	602.583 ft
Point 13	382.371 ft	602.601 ft
Point 14	405 ft	602.722 ft
Point 15	215 ft	580.5 ft
Point 16	146 ft	579.486 ft
Point 17	359.091 ft	569 ft
Point 18	163.2034 ft	584.8848 ft
Point 19	405 ft	569 ft
Point 20	0 ft	580 ft
Point 21	0 ft	550 ft
Point 22	405 ft	550 ft
Point 23	331.5 ft	580.5 ft
Point 24	350 ft	585 ft
Point 25	405 ft	585 ft
Point 26	836 ft	604.2 ft
Point 27	836 ft	569.0371 ft
Point 28	836 ft	548.2497 ft
Point 29	836 ft	585.4791 ft

Point 30	405 ft	585.0555 ft
Point 31	326.3031 ft	582.6935 ft
Point 32	256 ft	608 ft
Point 33	282.931 ft	601 ft
Point 34	286 ft	601 ft
Point 35	282.931 ft	603 ft
Point 36	231.7814 ft	607.295 ft
Point 37	286 ft	603 ft
Point 38	292.1199 ft	603.3885 ft
Point 39	267.1944 ft	607.5653 ft
Point 40	271.981 ft	607.3794 ft
Point 41	296.4645 ft	607.1787 ft
Point 42	296.4645 ft	605.179 ft
Point 43	316.4468 ft	607.7843 ft
Point 44	316.4504 ft	605.78 ft
Point 45	328.44 ft	610.78 ft
Point 46	328.44 ft	608.78 ft
Point 47	635.77 ft	620 ft
Point 48	635.7687 ft	618 ft
Point 49	635.8372 ft	604.1997 ft
Point 50	635.9176 ft	585.2884 ft
Point 51	635.9868 ft	569.0204 ft
Point 52	636.0718 ft	549.037 ft
Point 53	836 ft	614 ft

Point 54	836 ft	612 ft
Point 55	303.1987 ft	580.5 ft
Point 56	0 ft	571.5623 ft
Point 57	239.9317 ft	574.4814 ft

Regions

	Material	Points	Area
Region 1	Foundation (Saturated, EQ)	19,17,23,55,57,56,21,22,52,28,27,51	18,261 ft²
Region 2	Sluiced Ash (Drained)	14,13,12,11,10,9,38,34,33,31,24,30,50,29,26,49	9,874 ft²
Region 3	Dike Fill (Drained)	32,36,8,7,6,18,4,15,55,31,33,39	2,951.3 ft²
Region 4	Cover Material	45,43,41,37,35,40,39,33,34,38,42,44,46,48,54,53,47	1,131.7 ft²
Region 5	Stacked Ash	26,54,48,46,44,42,38,9,10,11,12,13,14,49	5,384.9 ft²
Region 6	Sluiced Ash (Saturated, EQ)	51,27,29,50,30,24,31,23,17,19	8,013.6 ft²
Region 7	Dike Fill (Saturated, EQ)	23,31,55	31.039 ft²
Region 8	Foundation (Drained)	15,4,16,3,2,1,20,56,57,55	1,895.6 ft²

Current Slip Surface

Slip Surface: 13,672
Factor of Safety: 1.6
Volume: 3,699.3995 ft³
Weight: 465,750.78 lbf
Resisting Moment: 21,491,571 lbf·ft
Activating Moment: 13,425,619 lbf·ft
Resisting Force: 187,685.32 lbf
Activating Force: 117,733.41 lbf
Slip Rank: 1 of 13,672 slip surfaces
Exit: (108.48255, 579.66191) ft
Entry: (263.14812, 607.72242) ft
Radius: 73.774427 ft
Center: (173.88037, 658.56876) ft

Slip Slices

	X	Y	PWP	Base Normal Stress	Frictional Strength	Cohesive Strength

Slice 1	111.75778 ft	577.95519 ft	-315.63304 psf	301.05636 psf	0 psf	174.09483 psf
Slice 2	115.5397 ft	575.98444 ft	-189.70812 psf	655.87504 psf	0 psf	379.27933 psf
Slice 3	118.569 ft	574.36702 ft	-86.418384 psf	998.84134 psf	0 psf	575.30635 psf
Slice 4	122.92445 ft	572.03032 ft	62.788947 psf	1,421.026 psf	0 psf	744.43692 psf
Slice 5	127.19248 ft	569.74826 ft	208.51859 psf	1,777.1047 psf	0 psf	813.09345 psf
Slice 6	132.06283 ft	567.15079 ft	374.39997 psf	2,186.2879 psf	0 psf	892.10381 psf
Slice 7	135.5505 ft	565.29072 ft	493.18822 psf	2,477.4286 psf	0 psf	948.06382 psf
Slice 8	138.95225 ft	563.70471 ft	594.80856 psf	2,564.8557 psf	0 psf	959.17829 psf
Slice 9	143.65075 ft	561.65534 ft	726.35411 psf	2,866.7708 psf	0 psf	1,015.8654 psf
Slice 10	147.783 ft	559.85296 ft	842.04617 psf	3,211.3434 psf	0 psf	1,092.298 psf
Slice 11	149.62235 ft	559.05068 ft	893.5431 psf	3,411.4481 psf	0 psf	1,142.0316 psf
Slice 12	152.77555 ft	558.25387 ft	945.72313 psf	3,340.3611 psf	0 psf	1,138.6213 psf
Slice 13	158.96925 ft	556.70943 ft	1,046.9279 psf	3,853.8294 psf	0 psf	1,282.1812 psf
Slice 14	162.63475 ft	555.89928 ft	1,100.3403 psf	3,779.2868 psf	0 psf	1,278.01 psf
Slice 15	165.74588 ft	555.69179 ft	1,115.7142 psf	3,972.0249 psf	0 psf	1,341.7558 psf
Slice 16	170.83083 ft	555.35266 ft	1,140.8419 psf	4,297.2004 psf	0 psf	1,449.5882 psf
Slice 17	175.64097 ft	555.41336 ft	1,140.8064 psf	4,207.356 psf	0 psf	1,457.3005 psf
Slice 18	180.17632 ft	555.87387 ft	1,115.6078 psf	4,385.0315 psf	0 psf	1,531.736 psf
Slice 19	184.28205 ft	556.29077 ft	1,092.7962 psf	4,545.4568 psf	0 psf	1,598.9659 psf
Slice 20	186.42948 ft	556.55426 ft	1,078.0294 psf	4,325.8205 psf	0 psf	1,558.3992 psf
Slice 21	188.94326 ft	557.17873 ft	1,041.0228 psf	4,375.5904 psf	0 psf	1,590.4514 psf
Slice 22	193.35209 ft	558.27398 ft	976.11841 psf	4,462.4333 psf	0 psf	1,646.4981 psf
Slice 23	196.07875 ft	559.00722 ft	932.49084 psf	4,301.2199 psf	0 psf	1,626.6828 psf
Slice 24	199.6125 ft	560.26321 ft	856.87371 psf	4,215.8267 psf	0 psf	1,621.3789 psf

Slice 25	205.6355 ft	562.40393 ft	727.99023 psf	4,037.9274 psf	0 psf	1,599.9568 psf
Slice 26	211.0212 ft	564.31815 ft	612.74405 psf	3,950.9608 psf	0 psf	1,608.3983 psf
Slice 27	214.1977 ft	565.58794 ft	535.98674 psf	3,642.7499 psf	0 psf	1,554.0583 psf
Slice 28	217.89388 ft	567.55024 ft	416.42254 psf	3,576.0651 psf	0 psf	1,571.7083 psf
Slice 29	223.68162 ft	570.62295 ft	229.19989 psf	3,471.6468 psf	0 psf	1,599.3468 psf
Slice 30	227.99903 ft	573.26354 ft	67.794285 psf	3,008.4911 psf	0 psf	1,519.3968 psf
Slice 31	230.19458 ft	574.96664 ft	-36.766626 psf	2,755.2098 psf	0 psf	2,106.5942 psf
Slice 32	231.374 ft	575.95514 ft	-97.528906 psf	2,469.9269 psf	0 psf	1,948.2947 psf
Slice 33	233.95372 ft	578.42239 ft	-249.47312 psf	2,301.3313 psf	0 psf	1,815.3054 psf
Slice 34	238.06302 ft	582.35253 ft	-491.50881 psf	1,971.2414 psf	0 psf	1,683.1244 psf
Slice 35	240.409 ft	584.59623 ft	-627.56869 psf	1,800.5668 psf	0 psf	1,537.3956 psf
Slice 36	242.97885 ft	587.0934 ft	-768.08505 psf	1,595.4269 psf	0 psf	1,366.6018 psf
Slice 37	247.30055 ft	591.3054 ft	-1,005.1722 psf	1,277.8427 psf	0 psf	1,094.5673 psf
Slice 38	252.7307 ft	596.80179 ft	-1,315.8029 psf	835.92539 psf	0 psf	723.79997 psf
Slice 39	257.90105 ft	602.16364 ft	-1,619.5859 psf	433.84986 psf	0 psf	375.65615 psf
Slice 40	261.47511 ft	605.92876 ft	-1,833.2412 psf	137.49547 psf	0 psf	119.76268 psf

ATTACHMENT E

VENEER STABILITY CALCULATION

Final Cover System Stability
Veneer Mode
Case I - Drained

Units

(●) Customary ( ) SI

a	Apparent Interface Adhesion	=	78	psf
δ	Interface Friction Angle	=	16.8	degrees
c	Apparent Soil Cohesion	=	0	psf
ϕ	Soil Internal Friction Angle	=	20	degrees
γ	Moist Soil Unit Weight	=	115	pcf
γ_{sat}	Saturated Soil Unit Weight	=	120	pcf
γ_w	Water Unit Weight	=	62.4	pcf
h	Depth of Cover Soil Above Critical Interface	=	2	ft
h_w	Water Depth Above Critical Interface	=	0.00E+00	ft
β	Slope Inclination	=	1.72	degrees
H	Vertical Height of Slope	=	16.5	ft
S	Additional Vertical Surcharge Load	=	13.69	psf
L	Additional Lateral Surcharge Load	=	1.3	psf
u_g	Landfill Gas Pressure	=	0	psf
T	Allowable Tesion in Geosynthetics	=	0	lb/ft
k_s	Peak Seismic Horizontal Acceleration	=	0.000	gravity

☑ Critical Interface Above Geomembrane

W_A	Weight of Active Wedge	=	118883.35	lb/ft
W_P	Weight of Passive Wedge	=	7673.57	lb/ft
U_H	Horizontal Hydrostatic Force at Toe	=	0.00	lb/ft
U_{AN}	Pore Water Pressure Resultant on Active Wedge	=	0.00	lb/ft
U_{PN}	Pore Water Pressure Resultant on Passive Wedge	=	0.00	lb/ft
U_{GN}	Gas Water Pressure Resultant on Active Wedge	=	0.00	lb/ft
A		=	4503.76	
B		=	-83867.31	
C		=	416.38	
FS		=	18.62	

Final Cover System Stability
Veneer Mode
Case II - Saturated

Units

(●) Customary ( ) SI

a	Apparent Interface Adhesion	=	78	psf
δ	Interface Friction Angle	=	16.8	degrees
c	Apparent Soil Cohesion	=	0	psf
ϕ	Soil Internal Friction Angle	=	20	degrees
γ	Moist Soil Unit Weight	=	115	pcf
γ_{sat}	Saturated Soil Unit Weight	=	120	pcf
γ_w	Water Unit Weight	=	62.4	pcf
h	Depth of Cover Soil Above Critical Interface	=	2	ft
h_w	Water Depth Above Critical Interface	=	2.50E-02	ft
β	Slope Inclination	=	1.72	degrees
H	Vertical Height of Slope	=	16.5	ft
S	Additional Vertical Surcharge Load	=	13.69	psf
L	Additional Lateral Surcharge Load	=	1.3	psf
u_g	Landfill Gas Pressure	=	0	psf
T	Allowable Tesion in Geosynthetics	=	0	lb/ft
k_s	Peak Seismic Horizontal Acceleration	=	0.000	gravity

☑ Critical Interface Above Geomembrane

W_A	Weight of Active Wedge	=	118952.07	lb/ft
W_P	Weight of Passive Wedge	=	7673.62	lb/ft
U_H	Horizontal Hydrostatic Force at Toe	=	0.02	lb/ft
U_{AN}	Pore Water Pressure Resultant on Active Wedge	=	857.73	lb/ft
U_{PN}	Pore Water Pressure Resultant on Passive Wedge	=	0.65	lb/ft
U_{GN}	Gas Water Pressure Resultant on Active Wedge	=	0.00	lb/ft
A		=	4505.82	
B		=	-83629.00	
C		=	413.78	
FS		=	18.56	

Final Cover System Stability
Veneer Mode
Case III - Seismic

Units

(●) Customary   ( ) SI

a	Apparent Interface Adhesion	=	78	psf
δ	Interface Friction Angle	=	16.8	degrees
c	Apparent Soil Cohesion	=	0	psf
ϕ	Soil Internal Friction Angle	=	20	degrees
γ	Moist Soil Unit Weight	=	115	pcf
γ_{sat}	Saturated Soil Unit Weight	=	120	pcf
γ_w	Water Unit Weight	=	62.4	pcf
h	Depth of Cover Soil Above Critical Interface	=	2	ft
h_w	Water Depth Above Critical Interface	=	0.00E+00	ft
β	Slope Inclination	=	1.72	degrees
H	Vertical Height of Slope	=	16.5	ft
S	Additional Vertical Surcharge Load	=	13.69	psf
L	Additional Lateral Surcharge Load	=	1.3	psf
u_g	Landfill Gas Pressure	=	0	psf
T	Allowable Tesion in Geosynthetics	=	0	lb/ft
k_s	Peak Seismic Horizontal Acceleration	=	0.220	gravity

☑ Critical Interface Above Geomembrane

W_A	Weight of Active Wedge	=	118883.35	lb/ft
W_P	Weight of Passive Wedge	=	7673.57	lb/ft
U_H	Horizontal Hydrostatic Force at Toe	=	0.00	lb/ft
U_{AN}	Pore Water Pressure Resultant on Active Wedge	=	0.00	lb/ft
U_{PN}	Pore Water Pressure Resultant on Passive Wedge	=	0.00	lb/ft
U_{GN}	Gas Water Pressure Resultant on Active Wedge	=	0.00	lb/ft
A		=	33978.50	
B		=	-83919.04	
C		=	413.63	
FS		=	2.46	

Final Cover System Stability
Veneer Mode
Case IV - Static Residual

Units

(●) Customary (○) SI

a	Apparent Interface Adhesion	=	78	psf
δ	Interface Friction Angle	=	16.8	degrees
c	Apparent Soil Cohesion	=	0	psf
ϕ	Soil Internal Friction Angle	=	20	degrees
γ	Moist Soil Unit Weight	=	115	pcf
γ_{sat}	Saturated Soil Unit Weight	=	120	pcf
γ_w	Water Unit Weight	=	62.4	pcf
h	Depth of Cover Soil Above Critical Interface	=	2	ft
h_w	Water Depth Above Critical Interface	=	0.00E+00	ft
β	Slope Inclination	=	1.72	degrees
H	Vertical Height of Slope	=	16.5	ft
S	Additional Vertical Surcharge Load	=	13.69	psf
L	Additional Lateral Surcharge Load	=	1.3	psf
u_g	Landfill Gas Pressure	=	0	psf
T	Allowable Tesion in Geosynthetics	=	0	lb/ft
k_s	Peak Seismic Horizontal Acceleration	=	0.000	gravity

☑ Critical Interface Above Geomembrane

W_A	Weight of Active Wedge	=	118883.35	lb/ft
W_P	Weight of Passive Wedge	=	7673.57	lb/ft
U_H	Horizontal Hydrostatic Force at Toe	=	0.00	lb/ft
U_{AN}	Pore Water Pressure Resultant on Active Wedge	=	0.00	lb/ft
U_{PN}	Pore Water Pressure Resultant on Passive Wedge	=	0.00	lb/ft
U_{GN}	Gas Water Pressure Resultant on Active Wedge	=	0.00	lb/ft
A		=	4503.76	
B		=	-83867.31	
C		=	416.38	
FS		=	18.62	

ATTACHMENT F

SETTLEMENT CALCULATION

Project	Prepared By	Date
Plant Hammond AP-3 Solar Demonstration	Rajendra S. Gondhalekar	09/11/2018
Subject/Title	Reviewed By	Date
AP-3 Settlement with Solar Development	Joshua A. Lippert	09/11/2018
	Calculation Number	Sheet
		1 of 4

Foundation Settlement

Modification of settlement in foundation clay layer after addition of solar development

Geometry

Same as Stantec permit calculations dated May 30, 2018

Parameters Used:

Unit Weights

Same as Stantec permit calculations dated May 30, 2018

Layer Heights

Same as Stantec permit calculations dated May 30, 2018

Void Ratio

Same as Stantec permit calculations dated May 30, 2018

Compression Indices

Same as Stantec permit calculations dated May 30, 2018

Additional Average Surcharge Load

Additional load due to solar development over final cover

S = 13.69 psf

Overburden Pressure in Clay Layer (full layer thickness)

$$\sigma_0 = \gamma_{ashs} \cdot H_{ashs} + \gamma_c \cdot \frac{H_c}{2} - \gamma_w \cdot \left(\frac{H_c}{2} + 4\text{ft}\right) = 2763.9 \text{ psf}$$

$$\sigma_1 = \sigma_0 + \gamma_{ash} \cdot H_{ash} + \gamma_{cs} \cdot H_{cs} + S = 4747.6 \text{ psf}$$

Consolidation Settlement in Clay Layer (full layer thickness method)

$$S_c = \frac{H_c \cdot C_c}{1 + e_{0c}} \cdot \log\left(\frac{\sigma_1}{\sigma_0}\right) = 6.471 \text{ in}$$

Project Plant Hammond AP-3 Solar Demonstration	Prepared By Rajendra S. Gondhalekar	Date 09/11/2018
Subject/Title AP-3 Settlement with Solar Development	Reviewed By Joshua A. Lippert	Date 09/11/2018
	Calculation Number	Sheet 2 of 4

Overburden Pressure in Clay Layer (analyzing top, mid, and bottom 1/3 intervals)

$$\sigma_{0T} = \gamma_{ashs} \cdot H_{ashs} + \gamma_c \cdot \frac{H_c}{6} - \gamma_w \cdot \left(\frac{H_c}{6} + 4\text{ft}\right) = 2450.9 \text{ psf}$$

$$\sigma_{1T} = \sigma_{0T} + \gamma_{ash} \cdot H_{ash} + \gamma_{cs} \cdot H_{cs} + S = 4434.6 \text{ psf}$$

$$\sigma_{0M} = \gamma_{ashs} \cdot H_{ashs} + \gamma_c \cdot \frac{H_c}{2} - \gamma_w \cdot \left(\frac{H_c}{2} + 4\text{ft}\right) = 2463.9 \text{ psf}$$

$$\sigma_{1M} = \sigma_{0M} + \gamma_{ash} \cdot H_{ash} + \gamma_{cs} \cdot H_{cs} + S = 4747.6 \text{ psf}$$

$$\sigma_{0B} = \gamma_{ashs} \cdot H_{ashs} + \gamma_c \cdot \frac{H_c}{1.2} - \gamma_w \cdot \left(\frac{H_c}{1.2} + 4\text{ft}\right) = 3076.9 \text{ psf}$$

$$\sigma_{1B} = \sigma_{0B} + \gamma_{ash} \cdot H_{ash} + \gamma_{cs} \cdot H_{cs} + S = 5060.9 \text{ psf}$$

Consolidation Settlement in Clay Layer (full layer thickness method)

$$S_{cT} = \frac{\left(\frac{1}{3} \cdot H_c\right) \cdot C_c}{1 + e_{0c}} \cdot \log\left(\frac{\sigma_{1T}}{\sigma_{0T}}\right) = 2.364 \text{ in}$$

$$S_{cM} = \frac{\left(\frac{1}{3} \cdot H_c\right) \cdot C_c}{1 + e_{0c}} \cdot \log\left(\frac{\sigma_{1M}}{\sigma_{0M}}\right) = 2.157 \text{ in}$$

$$S_{cB} = \frac{\left(\frac{1}{3} \cdot H_c\right) \cdot C_c}{1 + e_{0c}} \cdot \log\left(\frac{\sigma_{1T}}{\sigma_{0T}}\right) = 1.984 \text{ in}$$

$$S_c = S_{cT} + S_{cB} + S_{cM} = 6.505 \text{ in}$$

Maximum Anticipated Differential Settlement

$$\Delta S_c = \frac{S_c}{350 \text{ ft}} = 0.0015 \frac{\text{in}}{\text{in}}$$

The differential settlement is essentially unchanged due to addition of solar development over AP-3

Project Plant Hammond AP-3 Solar Demonstration	Prepared By Rajendra S. Gondhalekar	Date 09/11/2018
Subject/Title AP-3 Settlement with Solar Development	Reviewed By Joshua A. Lippert	Date 09/11/2018
	Calculation Number	Sheet 3 of 4

Local Settlement

Computation of settlement in near surface final cover and ash layers due to addition of solar development.

Geometry

Settlement is computed using elastic method in upper 10 ft of subgrade (subdivided in 5 equal thickness layers) due to the addition of solar development. Settlement of subgrade below a depth of 10 ft is estimated to be negligible.

Round Tub Diameter = 3.87 ft (Radius = 1.935 ft)

Vertical Bearing Pressure = 400 psf

Minimum Spacing between Tubs = 10 ft Center to Center

Layer Properties

Layer 1 – Final Cover Soil (Cohesive)

Thickness = 2 ft

From Kulhawy and Mayne, 1990 – Normalized Undrained Modulus for Medium Stiff Clay

$E/p_a = 40 \text{ to } 80$

$E \approx 60 \cdot p_a = 126973 \text{ psf}$

Layers 2 through 5 – Stacked Ash (Cohesionless)

Thickness = 2 ft

From Kulhawy and Mayne, 1990 – Young's Modulus for Cohesionless Soils

$E/p_a = 9.08 \cdot N^{0.66}$

For SPT N = 10

$$\frac{E}{p_a} = 9.08 \cdot 10^{0.66} = 41.5$$

$E \approx 41.5 \cdot p_a = 87823 \text{ psf}$

Stress Distribution

At depth z below the center of a circular footing of radius r and pressure p:

$$\sigma_z = p \cdot \left\{1 - \frac{1}{\left[1 + \left({}^{r}/_{z}\right)^2\right]^{3/2}}\right\}$$

Computation of Elastic Settlement

The settlement as calculated is indicated in the following table:

Layer	Mid Layer Depth (ft)	Change in Stress (psf)	Youngs Modulus E (psf)	Layer Compressive Strain	Settlement (in)
1	1	361	126973	0.28%	0.07
2	3	163	87823	0.19%	0.04
3	5	76	87823	0.09%	0.02
4	7	42	87823	0.05%	0.01
5	9	26	87823	0.03%	0.01
6	11	18	87823	0.02%	0.00

Total elastic settlement = 0.16 in

Computation of Geosynthetic Strain

For a minimum distance of 10 ft between tubs and a Settlement of 0.16 in of the tub.

Initial Geosynthetic Length = 60 in

Final Geosythetic Length $= \sqrt{60^2 + 0.16^2} = 60.0002$ in

Geosynthetic Tensile Strain = 0.0003% < 5% (Acceptable)

3. DC-HM-HAM20002-001 (REVISION B)

SOUTHERN COMPANY

Technical and Project Solutions Calculation

Calculation Number: DC-HM-HAM20002-001

Project/Plant: Hammond	Unit(s): N/A	Discipline/Area: Civil
Title/Subject: AP3 Solar – Proposed Pipe Outfall at Norfolk Southern Track		
Purpose/Objective: Provide hydraulic design for additional outfall pipe under Norfolk Southern track to Cabin Creek.		
System or Equipment Tag Numbers: N/A	**Originator:** Curtis Upchurch	

Contents

Topic	Page	Attachments (Computer Printouts, Tech. Papers, Sketches, Correspondence)	# of Pages
Purpose of Calculation/ Conclusions	2,3	Drainage Maps – Pre-Dev and Post- Dev. (MAP1 & MAP2)	2
		Jack and Bore Pipe Plan and Profile (C-SK-08282020 Sheets 1 & 2)	2
Project Narrative	3	HY8 Pipe Calcs	7
Summary of Calculations	3,4,5	Rainfall Distribution Map	1
Methodology	5 -13	Curve Number (CN) Adjustments for Solar	6
Assumptions/Criteria	14 - 15	NRCS Soils Data	28
Design Inputs/References	16	Ditch Calcs - Hydraflow Express	2
Drawing References	16	Tc Calcs - Hydraflow Hydrographs and Express	30
Body of Calculation	16	Hydraflow Hydrographs Calcs	42
Total # of pages including cover sheet & attachments:	139	Plant Hammond Solar Facility Drawings, SK-0001, SK-0002 & SK-0003	3
			123

Revision Record

Rev. No.	Description	Originator Initial / Date	Reviewer Initial / Date	Approver Initial / Date
A	Issued for Permit	CRU 1/8/2021	JWM 1/15/2021	SSS 1/20/2021
B	Revised for Permit	CRU 5/18/2021	JWM 5/18/2021	SSS 5/18/2021

Notes:

GEORGIA REGISTERED No. 031968 PROFESSIONAL ENGINEER JIM W. MINOR

5/18/21

1. Purpose of Calculation

The purpose of this calculation is to provide design for the outfall pipe from Plant Hammond at NE corner of AP3 under a Norfolk Southern (NS) railroad track to discharge into Cabin Creek. The pipe is to be jack and bored under the NS track. The peak discharges from the 25-year and 100-year 24-hour storm events are used for analysis and design. Norfolk Southern criteria is being followed for this design, however these calculations are not subject to permit approval by NS due to the track/ easement property contract as determined by Georgia Land Dept. of Georgia Power Company. Per the NS guidelines, storm pipes must convey discharge from 100-year 24-hour storm event with $HW/d \leq 1.5$. Minimum stormwater pipe diameter is 36 inches. Note that these calculations are to be an addendum to the prior submitted set of calculations for the AP3 north drainage basin.

2. Conclusions

2.1 Channels

A short section of ditch will be excavated at the outfall to tie the new pipe outfall to an existing ditch flowing into Cabin Creek. This ditch will be grassed lined. A ditch will also be excavated matching inverts of the inlets of the new jack and bored pipe and the adjacent existing 18-inch RCP.

2.2 Pipes/Culverts

An additional pipe is needed to convey the storm flows from the basin to Cabin Creek. This pipe is designed as a 36-inch corrugated metal pipe which would be placed under the existing NS railbed inside a steel casing pipe installed via jack and boring.

2.3 Energy Dissipation

Due to low out velocities of the new 36-inch cmp, an energy dissipator is not required. There will be GDOT class 3 rip rap with filter fabric placed at the outfall in the area of the receiving pit for the jack and bore.

2.4 Stormwater Hydrologic Analysis

The pre- and post-development storm flows for the basin have been calculated and can be seen below in Table 1.

Pre- & Post-Development 25-Year & 100-Year 24-Hour Peak Discharge Results Summary				
Basin Area	Pre-Dev. Q, cfs		Post-Dev. Q, cfs	
	25yr.	100 yr.	25yr.	100 yr.
F G H J & J'	32.2	46.6	71.4	101.5

Table 1: Pre- & Post-Development Discharge Summary

As shown in table 1 above, the post-development peak discharge has increased from the pre-closed ash pond condition to the final closed with solar array condition. Note that the discharge is from Georgia Power property to Cabin Creek just prior to discharge to the Coosa River. There is no property available for detention at this discharge location or upstream in the drainage basin. Additional detention storage is planned for the AP3 south drainage basin. See Pre- and Post-Development Map attachments.

3. Project Narrative

This project consists of adding an additional outfall pipe from the Plant Hammond property at the northeast corner to provide additional flow capacity from the closure of Ash Pond 3 and the addition of solar panels to the final cap surface. Currently water is conveyed under the Norfolk Southern track by a Georgia State Highway 20 side-drain pipe (24" diameter RCP) and a culvert (18" RCP) under the NS track approximately 155' south of the highway. Note that the area to the west of Ash Pond 3 (Pisgah Church property) which contributes flow to this basin has undergone improvements in the past 10 years increasing runoff from additional impervious surface cover (buildings, paving, etc.).

4. Summary of Calculations

4.1 Channel Analysis

The outfall channel for this new pipe will be grassed lined. Peak flows, velocities, maximum flow depth and lining information are provided in Table 2 below.

Ditch Location	Description	Slope, %	Manning's n	25-year 24-hour Storm				
				Flow, cfs	Velocity, fps	Depth of Flow,	Freeboard, ft.	Required Ditch Lining
36" CMP outfall channel	3' F.B. Ditch with 3:1 S.S.	0.50	0.03	37.7	3.3	1.5	1.0	Grassed to Cabin Creek w/ 25 LF Rip rap GDOT CL3 @ pipe outlet
RR Side ditch Inlet of new 36"CMP to Exist. 18"RCP	2'F.B. ditch tie at inlets with 2:1 S.S.	1.50	0.069	N/A	N/A	N/A	N/A	RR ballast stone – match exist.

Table 2: Channel Analysis

4.2 Storm Sewer and Pipe Culvert Analysis

The existing pipes for the outfall of the drainage basin (24" rcp and 18" rcp) along with the new 36" cmp were analysed/designed using Hydraflow Hydrographs and FHWA HY8 software. Peak flow rates were calculated using Hydraflow Hydrographs and the flows then input into HY8 to calculate pipe flow rates, headwater depths (HW/d) and pipe discharge velocities. The results are listed in table 3 below.

Basin Discharge Pipes		25-year 24-hour Storm				100-year 24-hour Storm			
		Flow, cfs	Velocity, fps	HW EL.	HW/d	Flow, cfs	Velocity, fps	HW EL.	HW/d
New 36" CMP	Post-Dev.	37.7	7.5	579.1	1.0	54.7	9.0	580.7	1.5
Exist. 18" RCP	Pre-Dev.	8.2	5.9	579.0	1.3	14.7	8.6	580.7	2.4
	Post-Dev.	8.9	6.1*	579.1	1.3	14.8	8.6*	580.7	2.4
Exist. 24" RCP	Pre-Dev.	24.0	8.3	579.0	1.9	31.9	10.4	580.7	2.7
	Post-Dev.	24.8	8.5*	579.1	1.9	32.0	10.4*	580.7	2.7

*Existing rip rap lined ditch oufall.

Table 3: Pipe Culvert Analysis

4.3 Energy Dissipation Analysis

Energy dissipation will not be required for this installation as the existing pipes listed in Table 3 have rip rap lined discharge channels and the proposed pipe will discharge into a rip rap lined section of ditch below the outlet at V25= 7.5 ft/s and then into a grassed lined ditch with low velocities. GDOT class 3 rip rap underlain with a geotextile filter fabric will be placed at the pipe outlet to stabilize the area where the receiving pit is filled and compacted with soil.

5. Methodology

The storm water flows have been calculated using the National Resources Conservation Service Method (also known as the Soil Conservation Service method-SCS Method, ref. 1) using 24-hour storm events. Storm basin calculation data was gathered from a number of sources including the Georgia Stormwater Manual, TR-55 Urban Hydrology for Small Watersheds,

NOAA Atlas 14 Precipitation Server and the USDA's NRCS Soil Survey. This method has been selected in lieu of simple culvert analysis as prior modelling of the upstream improvements is available. Drainage basin delineation was made using topographic survey data for the Plant Hammond Ash Pond 3 closure project provided by several sources and are noted in the reference section of this calculation. Refer to Pre-Dev Map and Post-Dev Map attachments for the delineation of the drainage basins.

6. Curve number data

Curve numbers for these calculations have been selected using the NRCS TR-55 curve number values for select hydrologic soil groups along with a weighted computation for proposed solar using the concrete ballast areas and grassed surface. The pre- and post-development drainage sub-basin curve numbers are listed in the tables below along with the TR-55 tables. See attached Pre- and Post-Development Maps for further information.

Pre-Development Sub-basin CN's								
	Acres (CN)							
Drainage Sub-basin	Area (Ac)	Grassed CN=60	Imperv.[1,2] CN=98	Railroad CN=65	Wooded[1] CN=55	Dirt ROW[1] CN=82	Aggregate[1] CN=85	Weighted CN
H	9.11	6.67	1.71		0.43		0.30	68
J	4.32	3.06	0.69	0.02			0.55	69
J'	1.69	1.04		0.22		0.23	0.20	67

Post-Development Sub-basin CN's								
	Acres (CN)							
Drainage Sub-basin	Area (Ac)	Grassed CN=60	Grassed Solar[3] CN=77	Imperv.[1,2] CN=98	Railroad CN=65	Wooded[1] CN=55	Aggregate[1] CN=85	Weighted CN
F	8.62		7.81	0.37			0.44	78
G	5.29		4.74	0.22			0.33	78
H	9.11	6.67		1.71		0.43	0.30	68
J	4.82	4.03		0.68	0.02		0.09	66
J'	1.44	1.22			0.22			61

1. Curve number referenced from TR-55 curve number values, Table 5 below.
2. Impervious curve number includes concrete and asphalt paving along with buildings and other structures including concrete ballast for solar panels. See Hammond Solar Facility drawings attachments SK-0001, SK-0002 and SK-0003.
3. Curve number of 77 was derived for the grassed solar area of Ash Pond 3 in previous set of calculations.

Table 4: Runoff Curve Numbers (CN's)

Table 2-2a Runoff curve numbers for urban areas [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	$\boxed{98}$	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	$\boxed{85}$	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

1 Average runoff condition, and $I_a = 0.2S$.
2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Chapter 2 | Estimating Runoff | Technical Release 55 Urban Hydrology for Small Watersheds

Table 2-2c Runoff curve numbers for other agricultural lands [1]

Cover description: Cover type	Hydrologic condition	Curve numbers for hydrologic soil group: A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4]	48	65	73
Woods—grass combination (orchard or tree farm). [5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4]	$\boxed{55}$	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

1 Average runoff condition, and $I_a = 0.2S$.
2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.
3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.
4 Actual curve number is less than 30; use CN = 30 for runoff computations.
5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.
6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Table 5: Curve Number Values, (Ref. 3)

7. Time of concentration

Tc data for drainage basins was calculated using the topographic data and SCS TR-55 method. Trial Tc values were typically derived using the Kirpich method and then input into Hydraflow Hydrographs to calculate a storm flow for the Q2-year, 24-hour storm (bank-full condition).

Using this flow, the channel geometries derived from Hydraflow Express were then input into Hydraflow Hydrograph's TR-55 Tc channel geometry for final Tc and flow calculation.

Pre-Development Tc's:

Drainage Basin H								
Sheet Flow		Shallow Concentrated Flow			Open Channel Flow			
Segment	A	Segment	A	B	Segment	A	B	C
Manning's n	0.41	Flow length, ft.	324		X-Sectional Area, ft.^{2}	4.878	5.09	5.87
Flow length(ft)	94	Slope, %	2.0		Wetted Perimeter, ft.	24.89	30.79	21.11
2 hr 24 hr rain	3.82	Paved/Unpaved	Unpv'd		Slope, %	0.55	0.65	0.32
Land slope, %	2.5	Tc, min.	2.37		Manning's n	0.03	0.03	0.035
					Flow Length, ft.	238	152	315
Tc, min.	17.45				Tc, min.	3.21	2.11	5.14
Total Tc, min.	17.45	2.37			10.46			
Basin Tc, min.	30.3							

Drainage Basin J								
Sheet Flow			Shallow Concentrated Flow			Open Channel Flow		
Segment	A	B	Segment	A	B	Segment	A	B
Manning's n	0.011	0.24	Flow length, ft.	57	198	X-Sectional Area, ft.^{2}		
Flow length (ft)	8	16	Slope, %	11.0	6.1	Wetted Perimeter, ft.		
2 hr 24 hr rain	3.82	3.82	Paved/Unpaved	Unpv'd	Unpv'd	Slope, %		
Land slope, %	4.2	12.5	Tc, min.	0.18	0.83	Manning's n		
						Flow Length, ft.		
Tc, min.	0.11	1.45				Tc, min.		
Total Tc, min.	1.56		1.01					
Basin Tc, min.	2.6 - Use 5.0 min							

Drainage Basin J'								
Sheet Flow			Shallow Concentrated Flow			Open Channel Flow		
Segment	A	B	Segment	A	B	Segment	A	B
Manning's n	0.011		Flow length, ft.	45		X-Sectional Area, ft.^{2}	1.439	2.025
Flow length (ft)	15		Slope, %	45		Wetted Perimeter, ft.	10.63	20.54
2 hr 24 hr rain	3.82		Paved/Unpaved	Unpv'd		Slope, %	3.0	2.60
Land slope, %	4.2		Tc, min.	0.07		Manning's n	0.03	0.03
						Flow Length, ft.	210	170
Tc, min.	0.18					Tc, min.	1.55	1.67
Total Tc, min.	0.18		0.07			3.22		
Basin Tc, min.	3.5 - Use 5.0 min.							

Ditch Channels (Reach Flow)

Reach Channel Flow (Grassed Ditch)	
Type	Trapezoidal
Flow Length, (ft)	522
Slope, %	0.5
Manning's n	0.045[3]
Bot. Width, ft	2
Side Slopes	2
Ditch Depth, ft	5

[3]Tall grass with weeds.

Reach Channel Flow (Wooded Ditch)	
Type	Trapezoidal
Flow Length, (ft)	415
Slope, %	0.19
Manning's n	0.15[4]
Bot. Width, ft	2
Side Slopes[5]	10
Ditch Depth, ft	3

[4]Heavily wooded ditch section.

[5]Exist. Channel 2' F.B. w/2:1 & 20:1 s.s is approximated by 2' FB w 10:1 s.s. due to limits of program.

Figure 1: Pre-Development Tc's

Post-Development Tc's:

Drainage Basin H

Sheet Flow		Shallow Concentrated Flow			Open Channel Flow			
Segment	A	Segment	A	B	Segment	A	B	C
Manning's n	0.41	Flow length, ft.	324		X-Sectional Area, ft.^{2}	4.878	5.09	5.87
Flow length(ft)	94	Slope, %	2.0		Wetted Perimeter, ft.	24.89	30.79	21.11
2 hr 24 hr rain	3.82	Paved/Unpaved	Unpv'd		Slope, %	0.55	0.65	0.32
Land slope, %	2.5	Tc, min.	2.37		Manning's n	0.03	0.03	0.035
					Flow Length, ft.	238	152	315
Tc, min.	17.45				Tc, min.	3.21	2.11	5.14
Total Tc, min.	17.45	2.37			10.46			
Basin Tc, min.	30.3							

Drainage Basin J

Sheet Flow			Shallow Concentrated Flow			Open Channel Flow		
Segment	A	B	Segment	A	B	Segment	A	B
Manning's n	0.011	0.24	Flow length, ft.	21	155	X-Sectional Area, ft.^{2}		
Flow length(ft)	8	30	Slope, %	7.75	6.6	Wetted Perimeter, ft.		
2 hr 24 hr rain	3.82	3.82	Paved/Unpaved	Unpv'd	Unpv'd	Slope, %		
Land slope, %	4.2	4.2	Tc, min.	0.08	0.62	Manning's n		
						Flow Length, ft.		
Tc, min.	0.11	3.70				Tc, min.		
Total Tc, min.	3.81		0.70					
Basin Tc, min.	4.5 - Use 5.0 min.							

Drainage Basin J'								
Sheet Flow			Shallow Concentrated Flow			Open Channel Flow		
Segment	A	B	Segment	A	B	Segment	A	B
Manning's n	0.15		Flow length, ft.	55	28	X-Sectional Area, ft.^{2}	1.439	2.025
Flow length (ft)	25		Slope, %	4.2	45.0	Wetted Perimeter, ft.	10.63	20.54
2 hr 24 hr rain	3.82		Paved/Unpaved	Unpv'd	Unpv'd	Slope, %	3.0	2.60
Land slope, %	4.2		Tc, min.	0.28	0.04	Manning's n	0.03	0.03
						Flow Length, ft.	205	170
Tc, min.	2.20					Tc, min.	1.52	1.67
Total Tc, min.	2.20		0.32			3.19		
Basin Tc, min.	5.7							

Ditch Channels (Reach Flow)

Reach Channel Flow (Grassed Ditch)	
Type	Trapezoidal
Flow Length, (ft)	522
Slope, %	0.5
Manning's n	0.045[3]
Bot. Width, ft	2
Side Slopes	2
Ditch Depth, ft	5

[3]Tall grass with weeds.

Reach Channel Flow (Wooded Ditch)	
Type	Trapezoidal
Flow Length, (ft)	415
Slope, %	0.19
Manning's n	0.15[4]
Bot. Width, ft	2
Side Slopes	10
Ditch Depth, ft	3

[4]Heavily wooded ditch section.

AP3 Cap with solar arrays (taken from prior hydraulic submittal).

.

Drainage Basin F	
Sheet Flow 50’ @ 3.0%, Grass	8.23 min.*
Shallow Conc. Flow 405’ @ 3.0%, Grass	2.42 min.*
Ditch Flow	
Cap Swale, 100’ @ 1.0%, Grass	0.76 min.
Cap Flume, 5’ F.B., 50’ @ 2.83%, Rip Rap	0.33 min.
Perimeter Ditch 3’ F.B., 407’ @ 1.0%, Rip Rap	3.90 min.
CS4’x2’, 30’ @ 0.5%, Concrete	0.09 min.
Outfall Ditch 108’ @ 1.0%, Rip Rap	1.05 min.
Outfall Ditch, 4’ F.B. 50’ @ 32.5%, Rip Rap	0.14 min.
Outfall Ditch 4’ F.B., 115’ @ 4.0%, Rip Rap	1.05 min.
Total Tc =	18.0 min
Drainage Basin G	
Sheet Flow 50’ @ 3.0%, Grass	8.23 min.*
Shallow Conc. Flow 269’ @ 3.0%, Grass	1.60 min.*
Ditch Flow	
Cap Swale, 281’ @ 1.0%, Grass	2.45 min.
Cap Flume, 5’ F.B., 50’ @ 2.83%, Rip Rap	0.40 min.
Perimeter Ditch 3’ F.B., 163’ @ 1.0%, Rip Rap	1.80 min.
Outfall Ditch, 6’ F.B., 50’ @ 3.0%, Rip Rap	0.41 min.
Outfall Ditch, 6’ F.B. 42’ @ 25.0%, Rip Rap	0.17 min.
Outfall Ditch 6’ F.B., 99’ @ 5.5%, Rip Rap	0.70 min.
Total Tc =	15.8 min.
Drainage Basin D	
Sheet Flow 50’ @ 3.0%, Grass	8.23 min.*
Shallow Conc. Flow 337’ @ 3.0%, Grass	1.71 min.*
Ditch Flow	
Cap Swale, 88’ @ 1.0%, Grass	0.65 min.
Cap Flume, 5’ F.B., 50’ @ 2.83%, Rip Rap	0.33 min.
Perimeter Ditch 3’ F.B., 670’ @ 1.0%, Rip Rap	6.27 min.
Outfall Ditch, 6’ F.B. 120’ @ 5.0%, Rip Rap	0.72 min.
Outfall Ditch 6’ F.B., 45’ @ 25.0%, Rip Rap	0.15 min.
Total Tc =	18.1 min.

*Sheet flow has been reduced in the Tc calculations due to the addition of the concrete ballast blocks. It is assumed that most of the flow from the cap to the perimeter swales will occur as shallow concentrate flow. See attached HydraFlow Hydrograph Pre- and Post-Development reports for Tc values of other basins.

Figure 2: Post-Development Tc’s

8. Assumptions and Criteria

9.1 Design Storm and Precipitation

1. Design storms evaluated are the 25-year and 100-year 24-hour events.
2. Precipitation Values (SCS 24-hour precipitation, obtained from NOAA Atlas 14. Ref. 2)
   2 yr-24 hr = 3.82in
   25 yr-24 hr = 6.30 in
   100 yr-24 hr = 7.86 in

9.2 Hydrologic Soil Groups

Hydrologic Soil Groups were determined using USDA's NRCS Soil Survey data (Ref. 6) shown below.

NRCS soils data and field testing were used to determine the soil characteristics and hydrological soil groups. Ash Pond 3 is covered with an HDPE liner overlain with a geo-composite drainage layer, an 18-inch protective soil layer and 6 inches of topsoil. SCS curve numbers were assigned to these areas as well as the other cover conditions for the basins. Soils for this site are listed as silty to sandy loams with a hydrologic soil group of B. Cover soil was hauled from an off-site borrow pit approximately 1 mile west of the site, just north of Georgia State Highway 20. Soils from this area are listed as type B soils as well. In addition, the existing dikes on the north half of the ash pond were reduced in height and the material removed and used on site. See attached NRCS soil maps and soil unit data of the project site and borrow pit. The following curve numbers were used in the calculations:

Surface Condition	CN
Grassed	60
Wooded	55
Aggregate Surfaced	85
Concrete Solar Panel Ballasts	98
Paved	98
Buildings/Roof	98
Railroad	65
Grassed (Cap Ash Pond-PreDev.)	77*
Grassed (Cap with Solar-PostDev)	78**

*Clayey material was used for cover of the cap surface. This was confirmed by infiltrometer testing of the Ash Pond cap surface (Ref. 10). Infiltration of cap cover approaches type D soil.

**With the addition of solar panels, the curve number for grass cover has been increased for the post-development calculations as coverage may be affected due to shading. The impervious concrete ballast area was totaled and weighted along with the grass cover resulting in a higher curve number CN ~ 78 for the cap.

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms. The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

9. Design Inputs/References

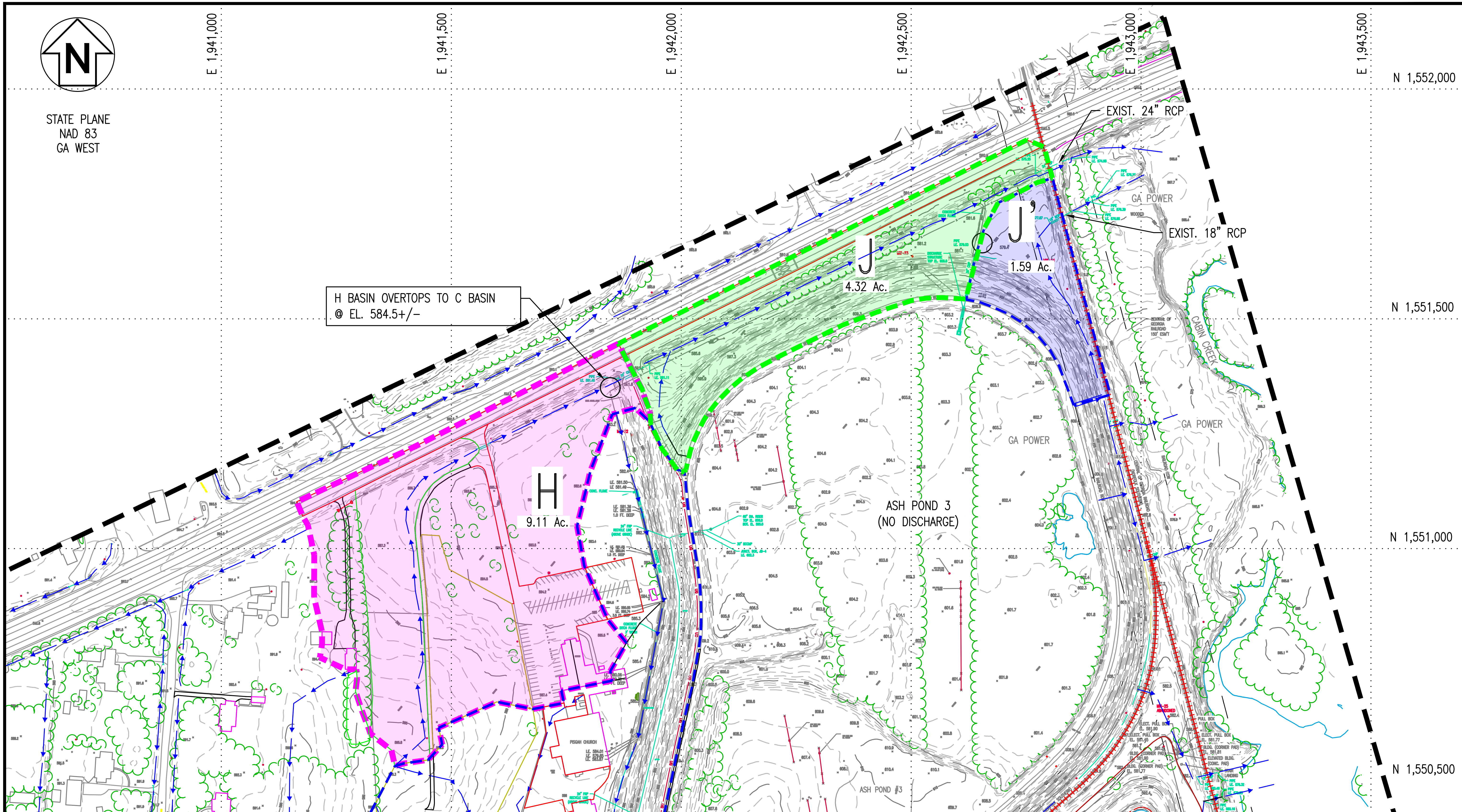
1. AutoCAD Civil 3D, 2019 Autodesk, Inc.
2. NOAA Atlas 14, Volume 9, Version 2 for Rome, Georgia.
3. TR-55 – Urban Hydrology for Small Watersheds, Appendix B, National Resources Conservation Service, Conservation Engineering Division, 1986.
4. Hydraflow Hydrographs Extension for AutoCAD Civil 3D, 2019, V12 Autodesk, Inc.
5. Hydraflow Express Extension for AutoCAD Civil 3D, 2019, V12Autodesk, Inc.
6. HY8, Federal Highway Administration (FHWA), V7.60, Build Date 7/30/19.
7. Natural Resource Conservation Service (NRCS) Web Soil Survey, Site Soil and Hydrologic Information
8. Plant Hammond Ash Pond 3 Closure Project Construction Plans, 2016-Present.
9. Plant Hammond Topographic Survey Lidar by Metro Engineering and Survey Co. 2012.
10. Plant Hammond Surveys by Georgia Land Department and SCS Civil Field Services, 2015
11. Plant Hammond Ash Pond 3 As-Built Survey by SCS Civil Field Services, Dwg. No. ACAD10-4278HAM_BOILER-POND ASBUILT, 7-12-16.
12. Double Ring Infiltrometer Testing, Terracon Consultants, Inc., November 5, 2018
13. Storm Drainage Design C-7-2, Southern Company Services Engineering Standards and Guidelines Civil, Current Revision.

10. Drawing References

1. Sitework Ash Pond 3 solar Jack and Bore Pipe and Norfolk Southern Track Pre-Development Drainage Map (Drawing No. MAP1)
2. Sitework Ash Pond 3 solar Jack and Bore Pipe and Norfolk Southern Track Post-Development Drainage Map (Drawing No. MAP2)
3. Jack and Bore Pipe Plan and Profile (Drawing No. C-SK-08282020 Sheets 1 and 2)
4. Plant Hammond Solar Facility drawings, Preliminary Rev. A, SK-0001, SK-0002 and SK-0003.

11. Body of Calculation

See detailed calculations and software output attached.



GRAPHIC SCALE

200 0 100 200 400

(IN FEET)
1 inch = 100 ft.

PROJECT ID	DATE	BY	CHK	APPR
HAM2002	12-30-2020	CRU	JWM	SSS

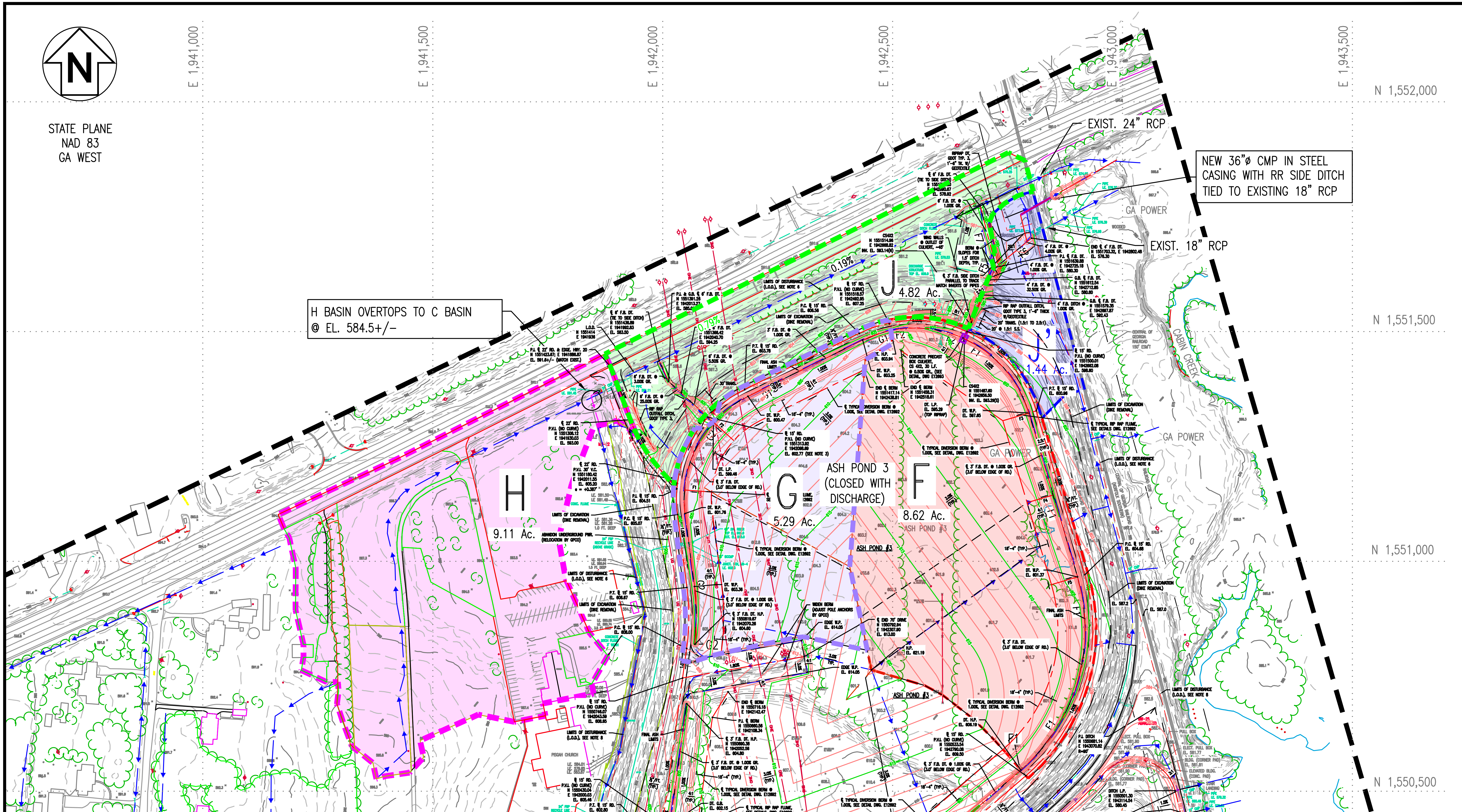
Southern Company
Technical and Project Solutions
FOR
Georgia Power Company

PLANT HAMMOND **UNIT N/A**

SITEWORK
ASH POND 3 SOLAR
JACK AND BORE PIPE AT NORFOLK SOUTHERN TRACK
PRE-DEVELOPMENT DRAINAGE MAP

ISSUE DATE	DRAWING NUMBER	SHEET	CONT'D	REV
12-30-2020	MAP1	1	FINAL	A

ANSI B 17x11



GRAPHIC SCALE

200 0 100 200 400

(IN FEET)
1 inch = 100 ft.

PROJECT ID	DATE	BY	CHK	APPR
HAM20002	12-30-2020	CRU	JWM	SSS

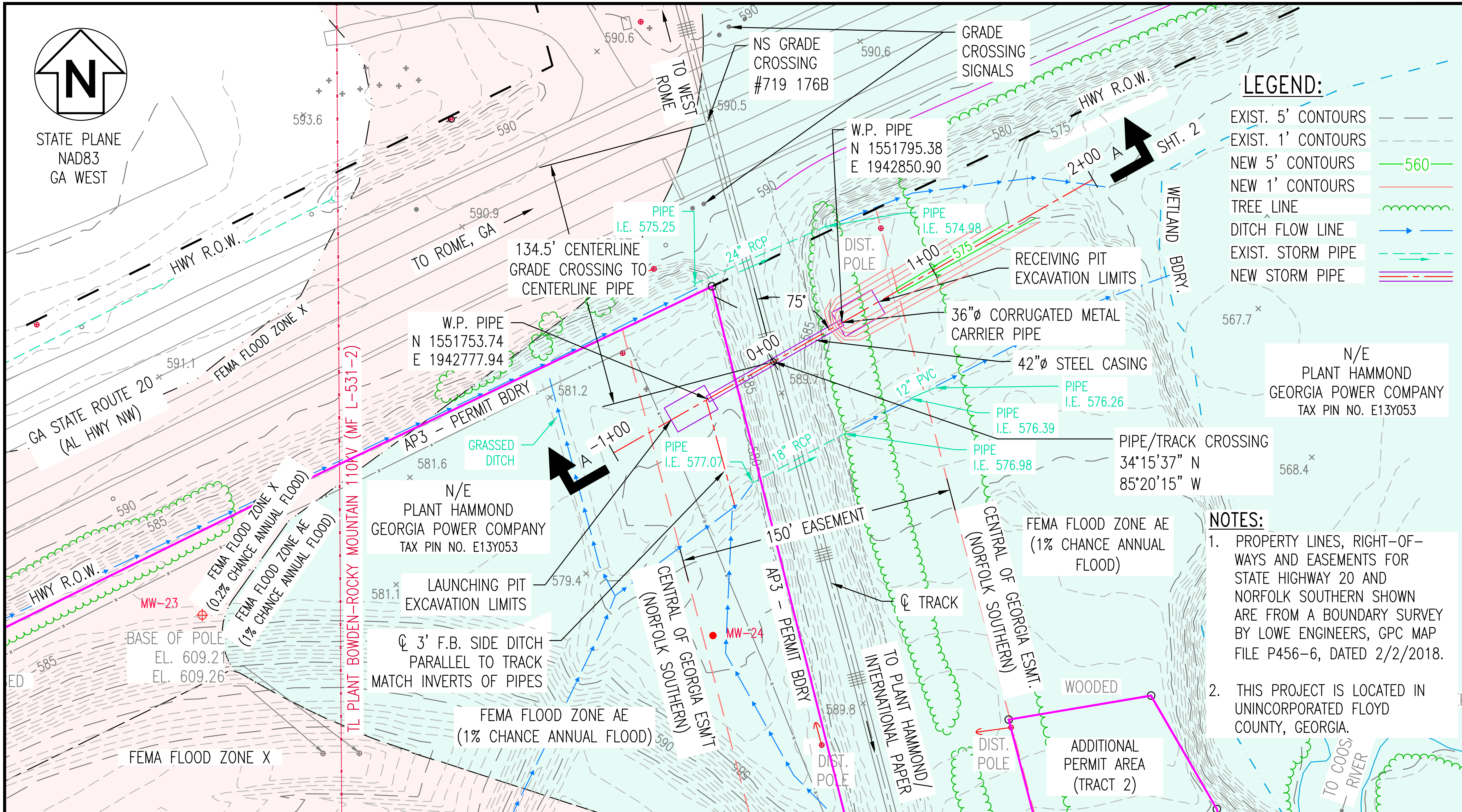
Southern Company
Technical and Project Solutions
FOR
Georgia Power Company

PLANT HAMMOND **UNIT N/A**

SITEWORK
ASH POND 3 SOLAR
JACK AND BORE PIPE AT NORFOLK SOUTHERN TRACK
POST-DEVELOPMENT DRAINAGE MAP

ISSUE DATE	DRAWING NUMBER	SHEET	CONT'D	REV
12-30-2020	MAP2	1	FINAL	A

ANSI B 17x11



GRAPHIC SCALE

50 0 25 50 100

(IN FEET)
1 inch = 50 ft.

ISSUED FOR INFORMATION

PROJECT ID	DATE	BY	CHK	APPR
PROJ ID:	1-19-21	CRU		

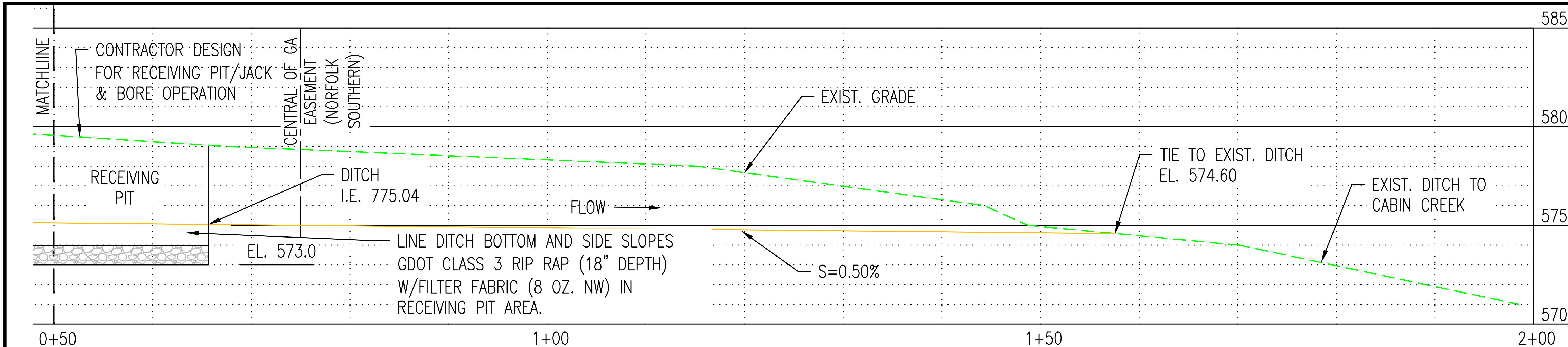
Southern Company
Technical and Project Solutions
FOR
Georgia Power Company

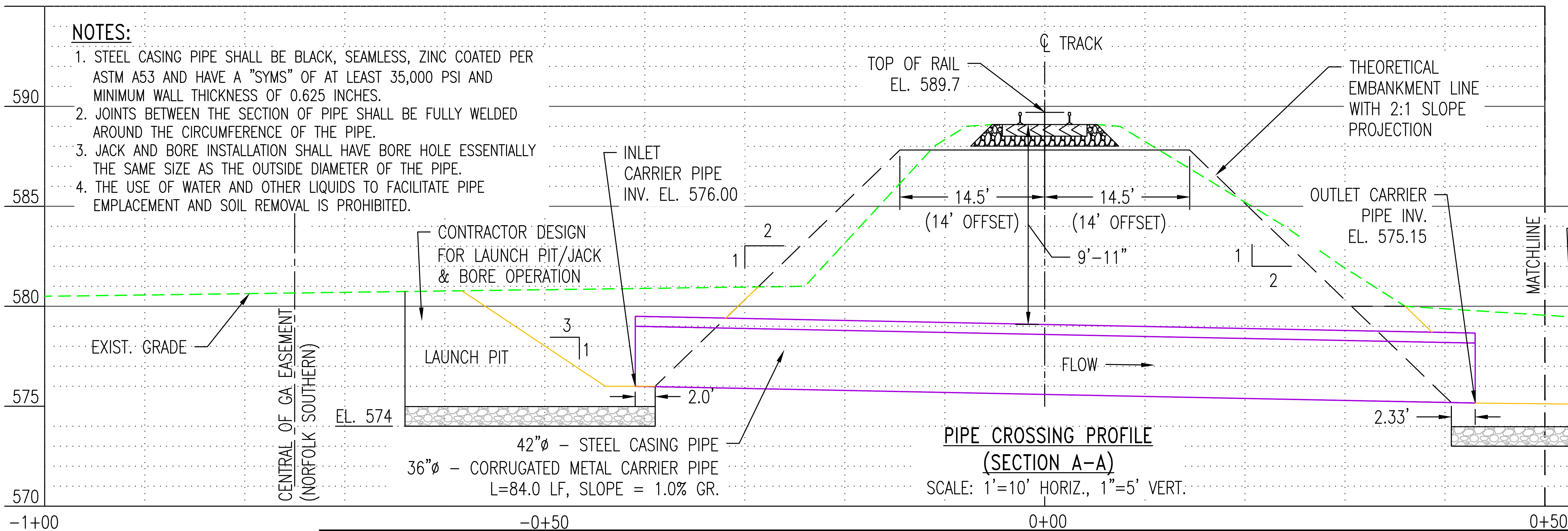
PLANT HAMMOND **UNIT N/A**

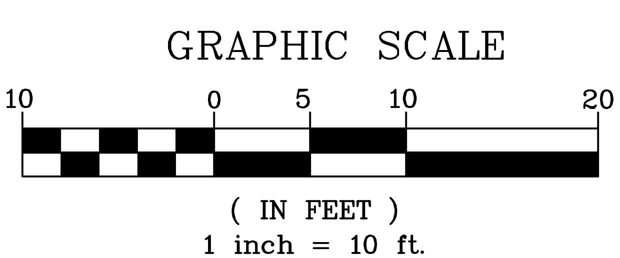
SITEWORK
PIPE CROSSING
PLAN VIEW

ISSUE DATE	DRAWING NUMBER	SHEET	CONT'D	REV
1-19-21	C-SK-08282020	1	2	E

ANSI B 17x11







ISSUED FOR INFORMATION

PROJECT ID	DATE	BY	CHK	APPR
PROJ ID:	1-19-21	CRU		

Southern Company
Technical and Project Solutions
FOR
Georgia Power Company

PLANT HAMMOND **UNIT N/A**

SITEWORK
STORM WATER PIPE CROSSING
SECTION A-A
(PROFILE VIEW)

ISSUE DATE	DRAWING NUMBER	SHEET	CONT'D	REV
1-19-21	C-SK-08282020	2	FINAL	C

ANSI B 17x11

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: Pre-Development

Headwater Elevation (ft)	Total Discharge (cfs)	24 Discharge (cf	18 Discharge (cf	Roadway Discharge (cfs)	Iterations
575.25	0.00	0.00	0.00	0.00	0
576.42	4.66	4.65	0.00	0.00	5
576.97	9.32	9.31	0.00	0.00	4
577.42	13.98	13.56	0.42	0.00	4
577.79	18.64	16.94	1.69	0.00	3
578.17	23.30	19.70	3.61	0.00	3
578.57	27.96	21.96	6.01	0.00	3
578.96	32.20	24.00	8.20	0.00	4
579.50	37.28	26.74	10.54	0.00	5
580.05	41.94	29.32	12.63	0.00	3
580.67	46.60	31.88	14.72	0.00	3
584.00	65.53	42.38	23.15	0.00	Overtopping

HY-8 Analysis Results

Culvert Summary Table - 18

Culvert Crossing: Pre-Development

Total Dischar e (cfs)	Culvert Dischar e (cfs)	Headwa er Elevatio (ft)	Inlet Control Depth(ft	Outlet Control Depth(ft	Flow Type	Normal Depth (f	Critical Depth (f	Outlet Depth (f	Tailwate Depth (f	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	575.25	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
4.66	0.00	576.42	0.00	0.0	0-NF	0.00	0.00	0.00	0.28	0.00	6.43
9.32	0.00	576.97	0.00	0.0	0-NF	0.00	0.00	0.00	0.42	0.00	7.93
13.98	0.42	577.42	0.32	0.35	2-M2c	0.31	0.24	0.24	0.52	2.30	8.92
18.64	1.69	577.79	0.67	0.73	2-M2c	0.63	0.49	0.49	0.60	3.38	9.68
23.30	3.61	578.17	1.03	1.10	2-M2c	1.01	0.73	0.73	0.68	4.26	10.30
27.96	6.01	578.57	1.39	1.50	7-M2c	1.50	0.95	0.95	0.74	5.11	10.82
32.20	8.20	578.96	1.72	1.89	7-M2c	1.50	1.11	1.11	0.80	5.85	11.25
37.28	10.54	579.50	2.16	2.43	7-M2c	1.50	1.25	1.25	0.86	6.71	11.70
41.94	12.63	580.05	2.65	2.98	7-M2c	1.50	1.34	1.34	0.91	7.59	12.07
46.60	14.72	580.67	3.24	3.61	7-M2c	1.50	1.40	1.40	0.96	8.58	12.42

HY-8 Analysis Results

Culvert Summary Table - 24

Culvert Crossing: Pre-Development

Total Dischar e (cfs)	Culvert Dischar e (cfs)	Headwater Elevatio (ft)	Inlet Control Depth(ft	Outlet Control Depth(ft	Flow Type	Normal Depth (f	Critical Depth (f	Outlet Depth (f	Tailwate Depth (f	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	575.25	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
4.66	4.65	576.42	1.06	1.17	2-M2c	0.78	0.76	0.76	0.28	4.26	6.43
9.32	9.31	576.97	1.63	1.73	2-M2c	1.17	1.09	1.09	0.42	5.32	7.93
13.98	13.56	577.42	2.09	2.17	7-M2c	1.53	1.33	1.33	0.52	6.14	8.92
18.64	16.94	577.79	2.50	2.54	7-M2c	2.00	1.48	1.48	0.60	6.78	9.68
23.30	19.70	578.17	2.89	2.92	7-M2c	2.00	1.59	1.59	0.68	7.33	10.30
27.96	21.96	578.57	3.26	3.32	7-M2c	2.00	1.67	1.67	0.74	7.82	10.82
32.20	24.00	578.96	3.64	3.71	7-M2c	2.00	1.74	1.74	0.80	8.29	11.25
37.28	26.74	579.50	4.20	4.25	7-M2c	2.00	1.80	1.80	0.86	8.97	11.70
41.94	29.32	580.05	4.79	4.80	7-M2c	2.00	1.85	1.85	0.91	9.66	12.07
46.60	31.88	580.67	5.42~	5.39	7-M2c	2.00	1.89	1.89	0.96	10.38	12.42

HY-8 Analysis Results

Crossing Summary Table

Culvert Crossing: Post-Development

Headwater Elevation (ft)	Total Discharg (cfs)	24 Discharge (cfs)	18 Discharge (cfs)	36 Discharge (cfs)	Roadway Discharge (cfs	Iterations
575.25	0.00	0.00	0.00	0.00	0.00	0
576.75	10.15	7.26	0.00	2.89	0.00	6
577.27	20.30	12.13	0.14	8.01	0.00	4
577.67	30.45	15.91	1.20	13.34	0.00	4
578.03	40.60	18.83	2.86	18.91	0.00	3
578.39	50.75	20.91	4.90	24.96	0.00	2
578.74	60.90	22.85	7.00	31.09	0.00	4
579.12	71.40	24.82	8.90	37.66	0.00	4
579.52	81.20	26.82	10.59	43.78	0.00	4
580.07	91.35	29.41	12.69	49.27	0.00	3
580.71	101.50	32.00	14.82	54.68	0.00	4
584.00	144.16	42.38	23.15	78.63	0.00	Overtopping

HY-8 Analysis Results

Culvert Summary Table - 18

Culvert Crossing: Post-Development

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	575.25	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
10.15	0.00	576.75	0.00	0.0	0-NF	0.00	0.00	0.00	0.43	0.00	8.13
20.30	0.14	577.27	0.18	0.20	2-M2c	0.18	0.14	0.14	0.63	1.73	9.91
30.45	1.20	577.67	0.55	0.61	2-M2c	0.53	0.41	0.41	0.77	3.07	11.08
40.60	2.86	578.03	0.90	0.96	2-M2c	0.86	0.64	0.64	0.89	3.96	11.97
50.75	4.90	578.39	1.23	1.32	2-M2c	1.50	0.85	0.85	1.00	4.74	12.70
60.90	7.00	578.74	1.53	1.67	7-M2c	1.50	1.02	1.02	1.09	5.45	13.33
71.40	8.90	579.12	1.82	2.05	7-M2c	1.50	1.15	1.15	1.18	6.10	13.89
81.20	10.59	579.52	2.11	2.45	7-M2c	1.50	1.25	1.25	1.25	6.73	14.37
91.35	12.69	580.07	2.53	3.00	7-M2c	1.50	1.34	1.34	1.33	7.61	14.81
101.50	14.82	580.71	3.02	3.63	7-M2c	1.50	1.40	1.40	1.39	8.63	15.22

HY-8 Analysis Results

Culvert Summary Table - 24

Culvert Crossing: Post-Development

Total Dischar e (cfs)	Culvert Dischar e (cfs)	Headwa er Elevatio (ft)	Inlet Control Depth(ft	Outlet Control Depth(ft	Flow Type	Normal Depth (f	Critical Depth (f	Outlet Depth (f	Tailwate Depth (f	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	575.25	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
10.15	7.26	576.75	1.40	1.50	2-M2c	1.00	0.96	0.96	0.43	4.89	8.13
20.30	12.13	577.27	1.93	2.02	7-M2c	1.40	1.25	1.25	0.63	5.87	9.91
30.45	15.91	577.67	2.37	2.42	7-M2c	2.00	1.44	1.44	0.77	6.58	11.08
40.60	18.83	578.03	2.76	2.78	7-M2c	2.00	1.56	1.56	0.89	7.16	11.97
50.75	20.91	578.39	3.09	3.14	7-M2c	2.00	1.64	1.64	1.00	7.59	12.70
60.90	22.85	578.74	3.42	3.49	7-M2c	2.00	1.70	1.70	1.09	8.02	13.33
71.40	24.82	579.12	3.80	3.87	7-M2c	2.00	1.76	1.76	1.18	8.49	13.89
81.20	26.82	579.52	4.22	4.27	7-M2c	2.00	1.80	1.80	1.25	8.99	14.37
91.35	29.41	580.07	4.81	4.82	7-M2c	2.00	1.85	1.85	1.33	9.68	14.81
101.50	32.00	580.71	5.46~	5.42	7-M2c	2.00	1.89	1.89	1.39	10.41	15.22

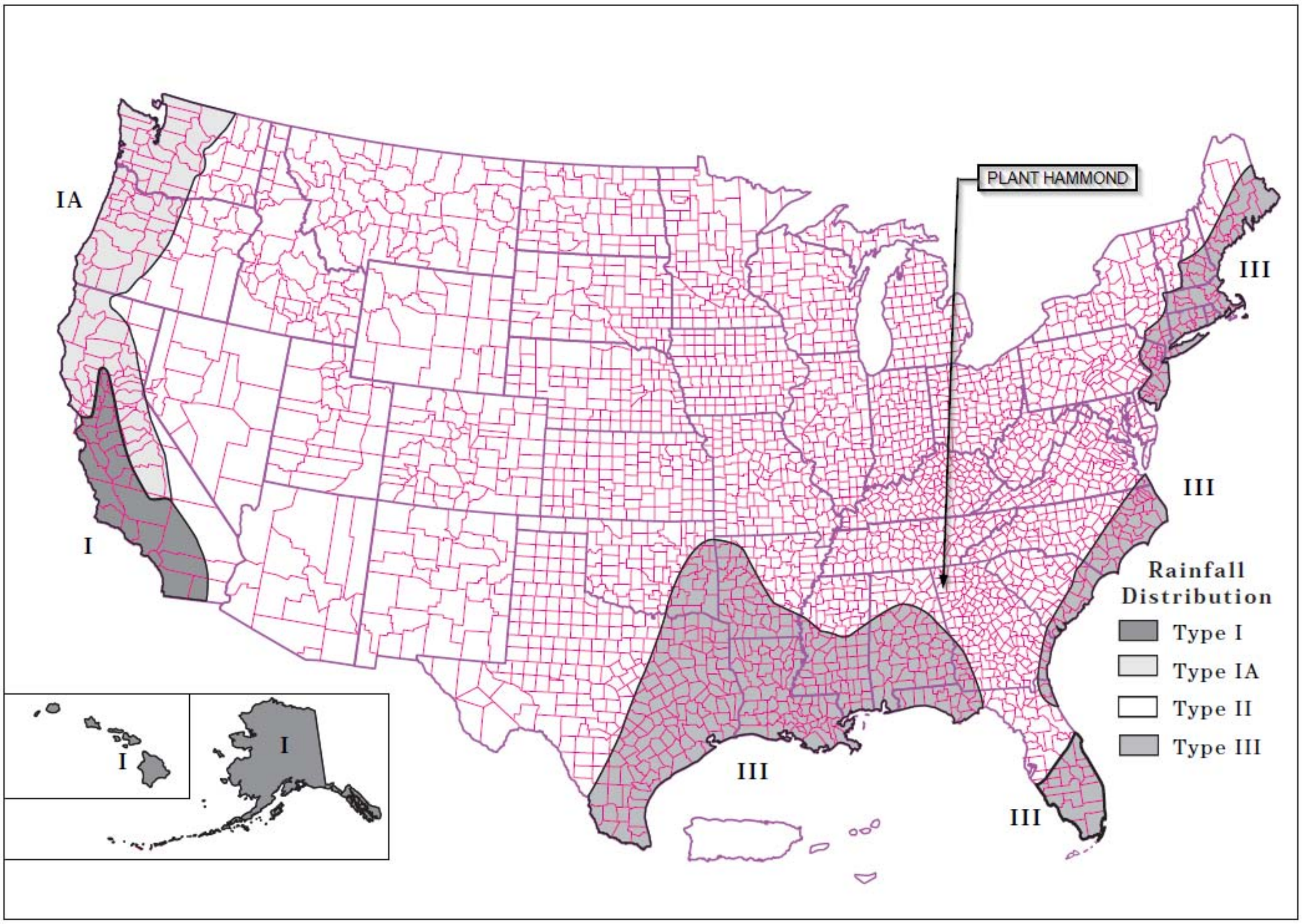
HY-8 Analysis Results

Culvert Summary Table - 36

Culvert Crossing: Post-Development

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	575.25	0.00	0.0	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
10.15	2.89	576.75	0.71	0.75	2-M2c	0.56	0.53	0.53	0.43	3.44	8.13
20.30	8.01	577.27	1.20	1.27	2-M2c	0.94	0.89	0.89	0.63	4.55	9.91
30.45	13.34	577.67	1.60	1.68	2-M2c	1.23	1.16	1.16	0.77	5.28	11.08
40.60	18.91	578.03	1.98	2.03	2-M2c	1.50	1.39	1.39	0.89	5.88	11.97
50.75	24.96	578.39	2.32	2.39	2-M2c	1.78	1.61	1.61	1.00	6.45	12.70
60.90	31.09	578.74	2.65	2.74	2-M2c	2.07	1.81	1.81	1.09	6.99	13.33
71.40	37.66	579.12	3.00	3.12	7-M2c	2.45	2.00	2.00	1.18	7.54	13.89
81.20	43.78	579.52	3.36	3.52	7-M2c	3.00	2.16	2.16	1.25	8.05	14.37
91.35	49.27	580.07	3.72	4.07	7-M2c	3.00	2.28	2.28	1.33	8.53	14.81
101.50	54.68	580.71	4.12	4.71	7-M2c	3.00	2.40	2.40	1.39	9.02	15.22

Figure B-2 Approximate geographic boundaries for NRCS (SCS) rainfall distributions



SOUTHERN COMPANY

Design Calculations

Project Hammond AP3	Prepared By CRU	Date 11/14/18
Subject/Title Solar Drainage Calc's	Reviewed By	Date
Modifications to CN's	Calculation Number	Sheet 1 of 6

- Calculate the impervious areas on AP3 due to the addition of solar panels with concrete ballasts.

- Area F @ NE corner:

  Total ballast blocks = 425

  $(425)(38\ ft^2/ea.) = 16{,}150\ ft^2 / 43560\ ft^2/Ac = \underline{0.37\ Ac}$

- Area G @ NW corner:

  Total ballast blocks = 249

  $(249)(38\ ft^2/ea.) = 9462\ ft^2 / 43560\ ft^2/Ac = \underline{0.22\ Ac}$

- Area D @ SW corner

  Total ballast blocks = 363

  $(363)(38\ ft^2/ea.) = 13{,}794\ ft^2 / 43560\ ft^2/Ac = \underline{0.32\ Ac}$

Design Calculations

SOUTHERN COMPANY

Project Hammond AP3	Prepared By CRM	Date 11/14/18
Subject/Title Solar Drainage Calc's	Reviewed By	Date
	Calculation Number	Sheet 2 of 6

- Adjust the curve number (CN) runoff values for the addition of solar panels to the cap surface.

  - Drainage Basin F:

    $CN_{composite} = 80$ (Prior to Solar)

    Previously grassed areas = 8.18 Ac, CN = 77

    $$\begin{array}{r} 8.18 \text{ Ac} \\ - 0.37 \text{ Ac} \\ \hline 7.81 \text{ Ac grassed} \end{array}$$
    (Area of Solar Panel Ballasts)

  - W/ 0.37 Ac Impervious, CN = 98

    & 7.81 Ac grassed, CN = 77

    & 0.44 Ac agg. road, CN = 85

$$CN = \frac{0.37(98) + 7.81(77) + 0.44(85)}{8.62}$$

$$CN = \frac{36.26 + 601.37 + 37.4}{8.62} = 78.3$$

$$\underline{CN = 78}$$

Design Calculations

SOUTHERN COMPANY

Project: Hammond AP3	Prepared By: CRU	Date: 11/14/18
Subject/Title: Solar Drainage Calc's	Reviewed By:	Date:
	Calculation Number:	Sheet 3 of 6

- Drainage Basin G:

$CN_{composite} = 78$ (Prior to Solar)

Previously grassed areas = 4.96 Ac, CN = 77

4.96 Ac
−0.22 Ac (Area of solar panel ballasts)

4.74 Ac grassed

- W/ 0.22 Ac Impervious, CN = 98
  4.74 Ac Grassed, CN = 77
  0.33 Ac Agg. Road, CN = 85

$$CN = \frac{0.22(98) + 4.74(77) + 0.33(85)}{5.29}$$

$$CN = \frac{21.56 + 364.98 + 28.05}{5.29} = \frac{414.59}{5.29}$$

$$CN = 78.37 = \underline{78}$$

SOUTHERN COMPANY

Design Calculations

Project Hammond AP3	Prepared By CRU	Date 11/14/18
Subject/Title Sola-Drainage Calc's	Reviewed By	Date
	Calculation Number	Sheet 4 of 6

– Drainage Basin D:

$CN_{composite} = 78$ (Prior to Solar)

Previously grassed areas = 8.61 Ac

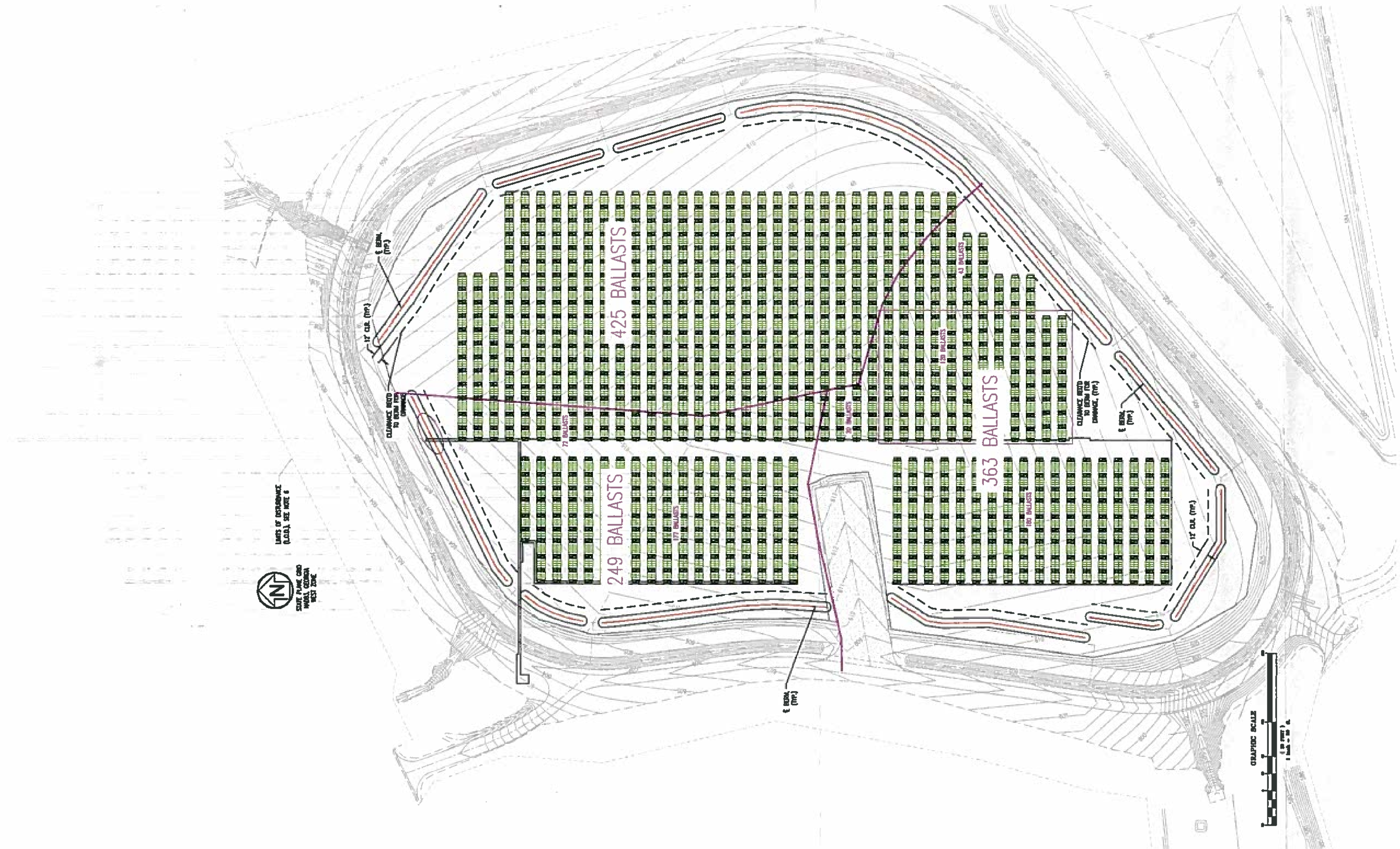
  8.61 Ac
– 0.32 Ac (Area of solar panel ballasts)
  8.29 Ac grassed

– w/ 0.32 Ac Impervious, CN=98
8.29 Ac Grassed, CN=77
0.91 Ac Agg. Road, CN=85

$$CN = \frac{0.32(98) + 8.29(77) + 0.91(85)}{9.52}$$

$$CN = \frac{31.36 + 638.33 + 77.35}{9.52} = \frac{747.04}{9.52}$$

CN = 78

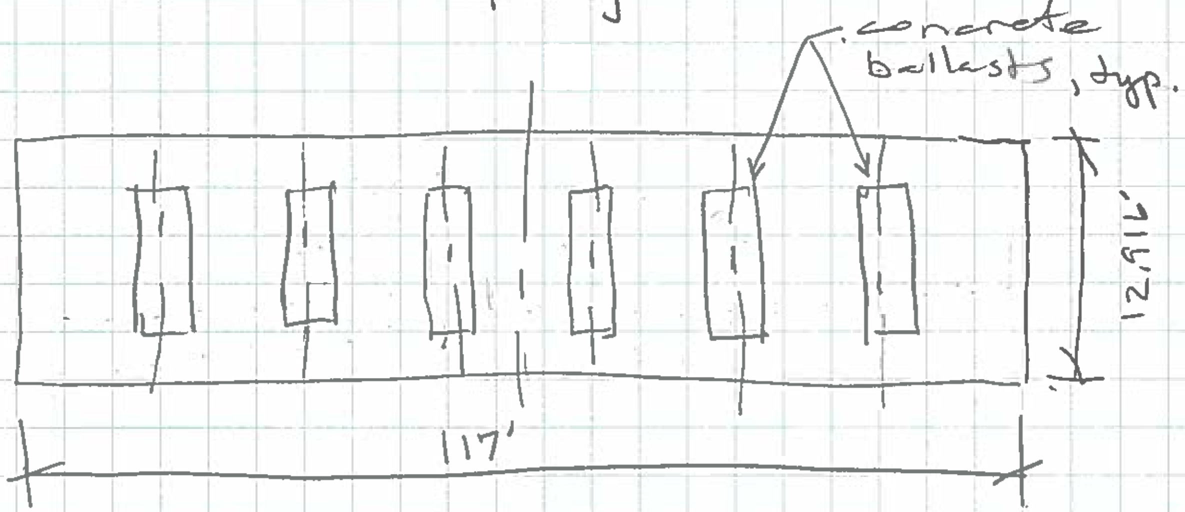

425 BALLASTS
249 BALLASTS
363 BALLASTS

Design Calculations

SOUTHERN COMPANY

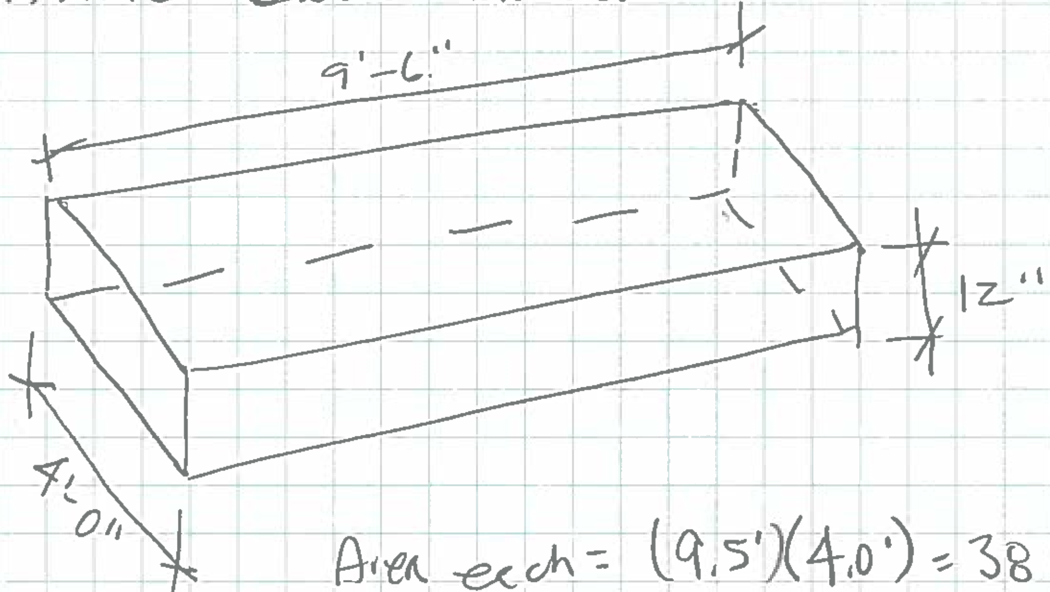
Project Hammond AP 3	Prepared By cRh		Date 11/14/18
Subject/Title Solar Drainage Calc's	Reviewed By		Date
	Calculation Number		Sheet 6 of 6

- Ballast Locations & Spacing

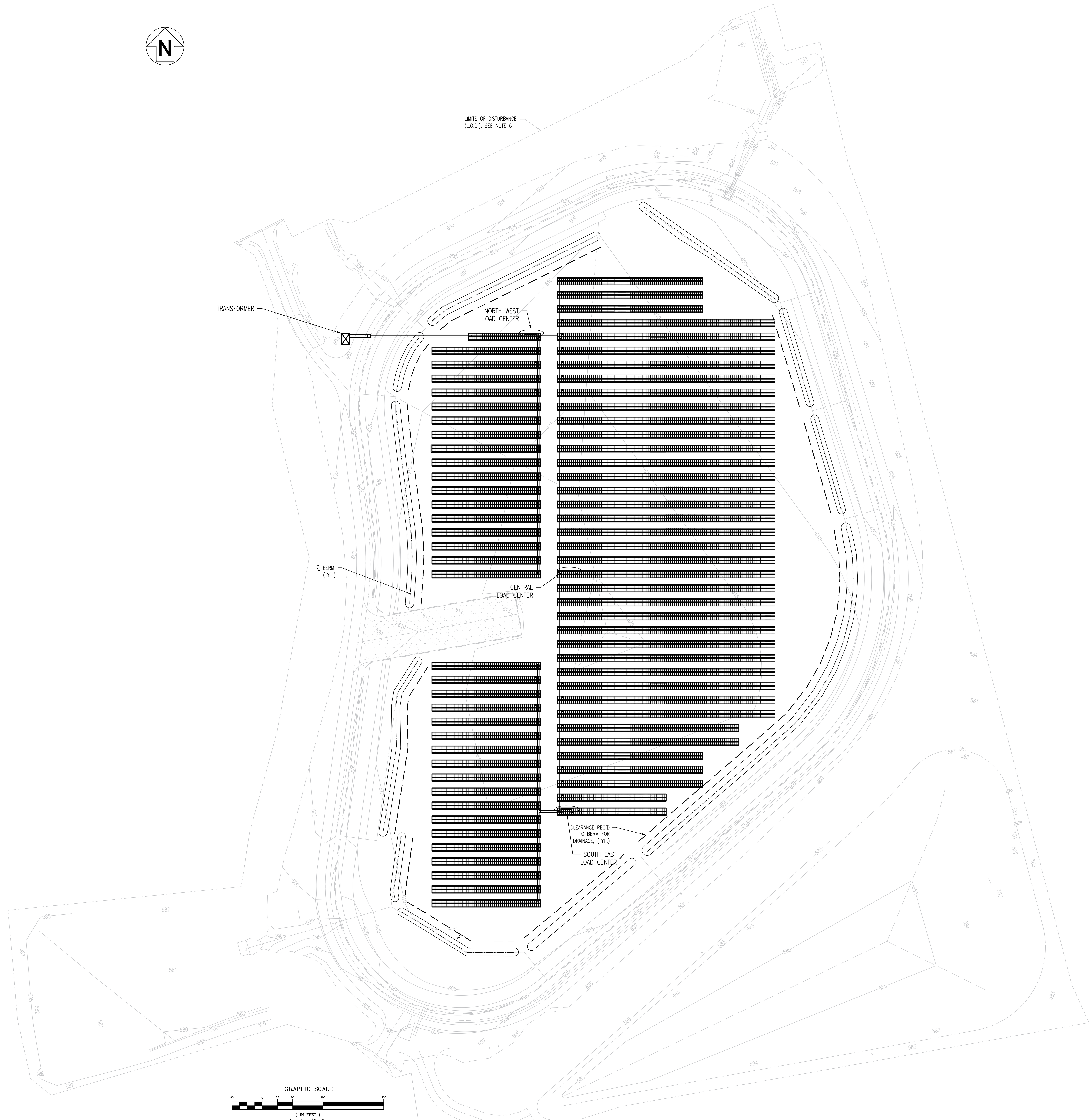


6 each @ 20' c/c

Assume each ballast:



Area each = $(9.5')(4.0') = \underline{38\ ft^2}$



SYSTEM SUMMARY	
PROJECT LOCATION	ROME, GA
LATITUDE, LONGITUDE	32.45, -85.36
GRID VOLTAGE	XX KV
DC VOLTAGE	1000VDC
MODULE TYPE/WATTAGE	REC 315W
MODULE QTY.	11,556
MODULES PER STRING	18
STRING QTY.	642
INVERTER QTY.	56
MINIMUM DESIGN TEMP.	-10°C
INVERTER	SMA CORE1 50KW
AC CAPACITY	2.8 MW (40°C, 1 PF)
DC CAPACITY	3.867
DC/AC RATIO	1.3568
ARRAY ORIENTATION - FIXED TILT	
PITCH (ROW SPACING)	23 FT
TILT	20°
AZIMUTH	0°

PRELIMINARY

Southern Company Generation Engineering and Construction Services
FOR
Georgia Power Company

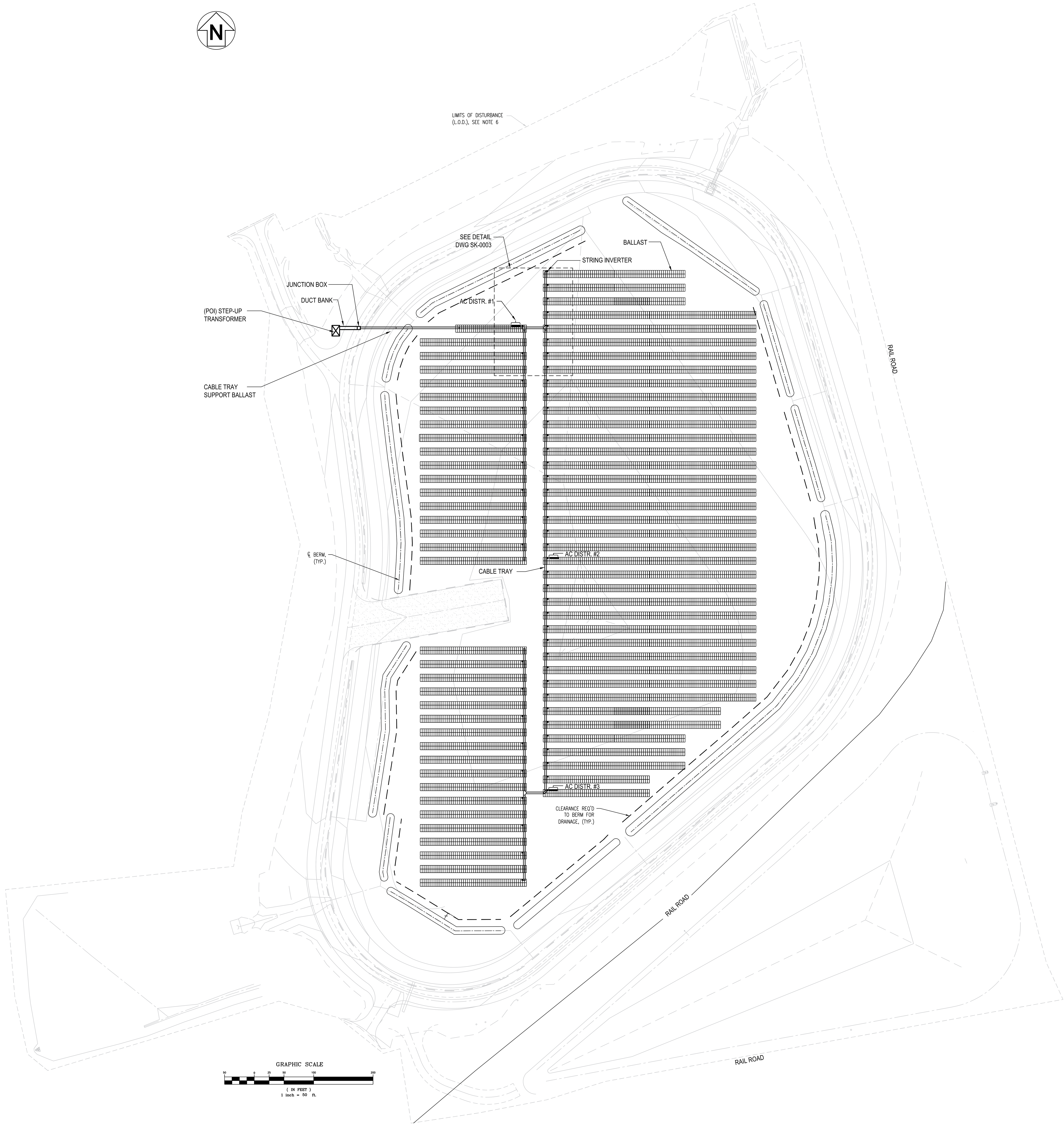
PLANT HAMMOND SOLAR FACILITY
BLOCK LAYOUT

REVISION	DATE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
1/64"=1'-0"	**SK-0001**	1	FINAL	A

ANSI E: 44x34



CONTRACTOR TRAY NOTES:

1. ALL TRAY SHOWN TO BE 36" WIDE, LADDER TYPE, WITH TRAY COVERS.
2. AS SHOWN, APPROXIMATELY 2015 FEET OF STRAIGHT TRAY, WITH TRAY COVERS.
3. (1) 90 DEG. HORIZONTAL TURN (24" RADIUS).
4. (3) HORIZONTAL TEE'S (24" RADIUS).

PRELIMINARY

Southern Company Generation Engineering and Construction Services FOR

Georgia Power Company

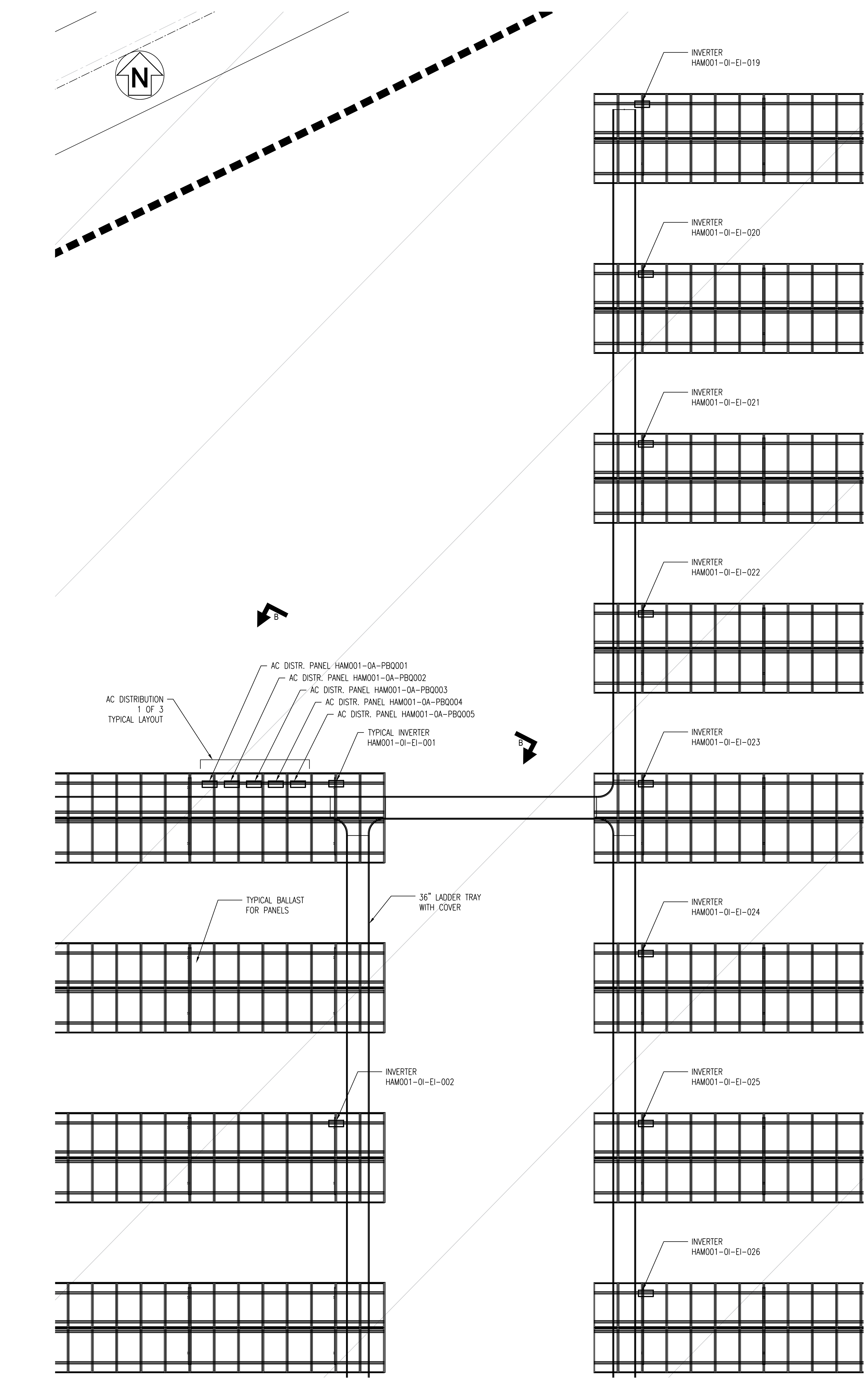
PLANT HAMMOND SOLAR FACILITY
CABLE TRAY LAYOUT

REVISION	DATE

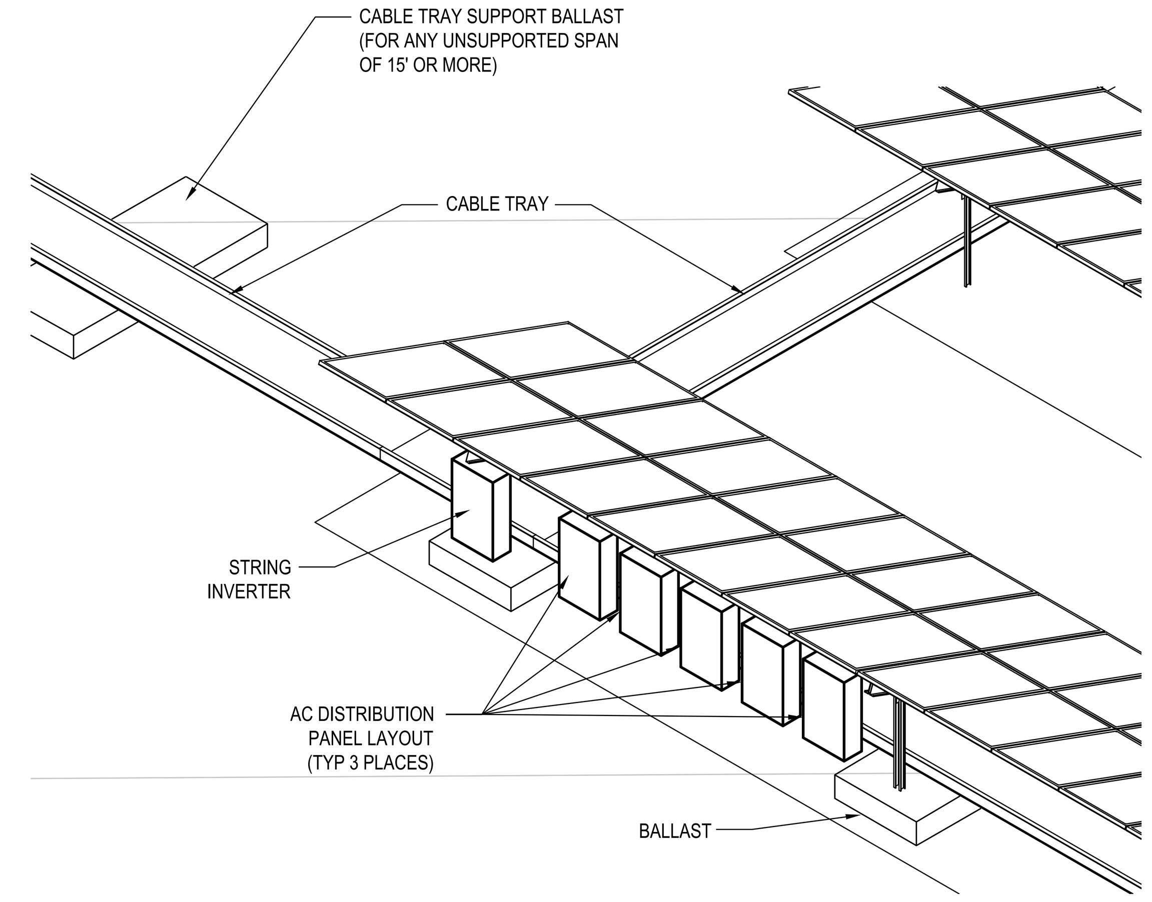
BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
1/64"=1'-0"	**SK-0002**	1	FINAL	A

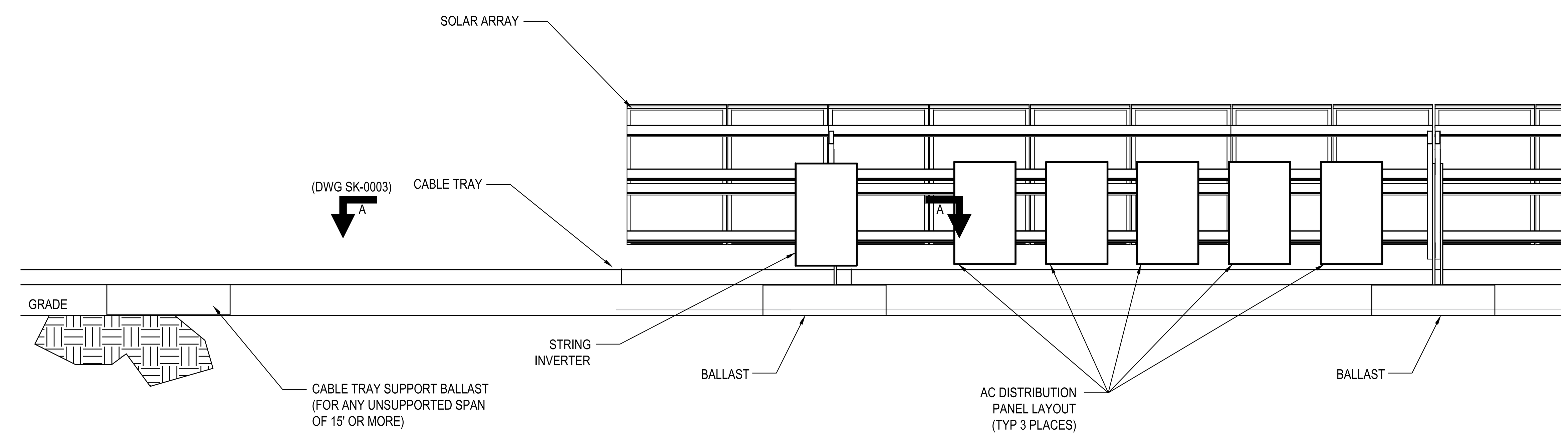
ANSI E: 44x34



ENLARGED VIEW
FROM DWG SK-0002



ISO OF TYPICAL
AC DISTRIBUTION LAYOUT
(TYPICAL 3 PLACES ON SITE)



SECTION A:
FROM DWG SK-0002

PRELIMINARY

Southern Company Generation
Engineering and Construction Services
FOR
Georgia Power Company

PLANT HAMMOND SOLAR FACILITY
CABLE TRAY
SECTIONS AND DETAILS

REVISION	DATE

BY	CHK'D	CIVIL APPR	ELECT APPR	I/C APPR	MECH APPR	DISC MGR

SCALE	DRAWING NUMBER	SHEET	CONT'D	REV
AS SHOWN	**SK-0003**	1	FINAL	A

ANSI E: 44x34


85° 21' 15" W
85° 20' 2" W
34° 15' 43" N
34° 15' 3" N
651600
651800
652000
652200
652400
652600
652800
653000
653200
653400
3792300
3792100
3791900
3791700
3791500
3791300
Huffaker Rd Nw
20
Tk
AaE
HaE
CuE
Tv
DhC
RoB
EtA
EtB
Ck
W
RoA
DhB
Wh
HoC
WoA
Rn
Soil Map may not be valid at this scale.
Map Scale: 1:8,600 if printed on A landscape (11" x 8.5") sheet.
Meters
0 100 200 400 600
Feet
0 400 800 1600 2400
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2011—Jan 4, 2012

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Chattooga, Floyd, and Polk Counties, Georgia (GA621)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AaE	Allen fine sandy loam, 15 to 25 percent slopes	9.1	2.6%
Ck	Chewacla silt loam, 0 to 2 percent slopes, frequently flooded	11.8	3.3%
CuE	Cunningham loam, 15 to 25 percent slopes	7.5	2.1%
DhB	Dewey silt loam, 2 to 6 percent slopes	25.0	7.1%
DhC	Dewey silt loam, 6 to 10 percent slopes	0.1	0.0%
EtA	Etowah loam, 0 to 2 percent slopes	40.3	11.4%
EtB	Etowah loam, 2 to 6 percent slopes	1.3	0.4%
HaE	Hartsells fine sandy loam, 15 to 25 percent slopes	7.4	2.1%
HoC	Holston fine sandy loam, 6 to 10 percent slopes	5.2	1.5%
Rn	Roanoke silt loam	16.7	4.7%
RoA	Rome fine sandy loam, 0 to 2 percent slopes	55.4	15.7%
RoB	Rome fine sandy loam, 2 to 6 percent slopes	49.8	14.1%
Tk	Toccoa fine sandy loam	6.2	1.8%
Tv	Tupelo clay loam, frequently flooded	36.6	10.4%
W	Water	27.2	7.7%
Wh	Whitwell silt loam	28.1	7.9%
WoA	Wolftever silt loam, 0 to 2 percent slopes	25.4	7.2%
Totals for Area of Interest		**352.9**	**100.0%**

Chattooga, Floyd, and Polk Counties, Georgia

Ck—Chewacla silt loam, 0 to 2 percent slopes, frequently flooded

Map Unit Setting

National map unit symbol: 2tg8j
Elevation: 510 to 1,750 feet
Mean annual precipitation: 51 to 63 inches
Mean annual air temperature: 48 to 71 degrees F
Frost-free period: 150 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Chewacla and similar soils: 89 percent
Minor components: 11 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chewacla

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium derived from interbedded sedimentary rock

Typical profile

Ap - 0 to 9 inches: silt loam
Bw - 9 to 50 inches: silt loam
C - 50 to 79 inches: sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: High (about 10.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Hydric soil rating: No

Minor Components

Roanoke

Percent of map unit: 5 percent
Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Wehadkee

Percent of map unit: 3 percent
Landform: Drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Guthrie

Percent of map unit: 3 percent
Landform: Drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

DhB—Dewey silt loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2v4ft
Elevation: 800 to 1,700 feet
Mean annual precipitation: 44 to 65 inches
Mean annual air temperature: 56 to 61 degrees F
Frost-free period: 171 to 209 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Dewey and similar soils: 86 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Dewey

Setting

Landform: Stream terraces, ridges
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Clayey residuum weathered from limestone

Typical profile

Ap - 0 to 9 inches: silt loam
Bt - 9 to 72 inches: clay

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

EtA—Etowah loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2szhr
Elevation: 570 to 880 feet
Mean annual precipitation: 54 to 58 inches
Mean annual air temperature: 57 to 60 degrees F
Frost-free period: 155 to 218 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Etowah and similar soils: 94 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Etowah

Setting

Landform: Stream terraces
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Loamy alluvium derived from limestone, sandstone, and shale

Typical profile

Ap - 0 to 8 inches: loam
Bt1 - 8 to 13 inches: clay loam
Bt2 - 13 to 83 inches: clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

EtB—Etowah loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2szhs
Elevation: 690 to 1,190 feet
Mean annual precipitation: 45 to 59 inches
Mean annual air temperature: 57 to 60 degrees F
Frost-free period: 155 to 218 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Etowah and similar soils: 94 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Etowah

Setting

Landform: Stream terraces
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Loamy alluvium and/or colluvium derived from limestone, sandstone, and shale

Typical profile

A - 0 to 11 inches: loam
Bt1 - 11 to 36 inches: clay loam
Bt2 - 36 to 83 inches: silty clay loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

RoA—Rome fine sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: ktvd
Elevation: 500 to 1,200 feet
Mean annual precipitation: 48 to 55 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Rome and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rome

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 9 inches: fine sandy loam
H2 - 9 to 53 inches: sandy clay loam
H3 - 53 to 66 inches: sandy clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 1
Hydrologic Soil Group: B

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

RoB—Rome fine sandy loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: ktvf
Elevation: 500 to 1,200 feet
Mean annual precipitation: 48 to 55 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Rome and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rome

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 9 inches: fine sandy loam
H2 - 9 to 53 inches: sandy clay loam
H3 - 53 to 66 inches: sandy clay loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: High (about 9.9 inches)

Interpretive groups

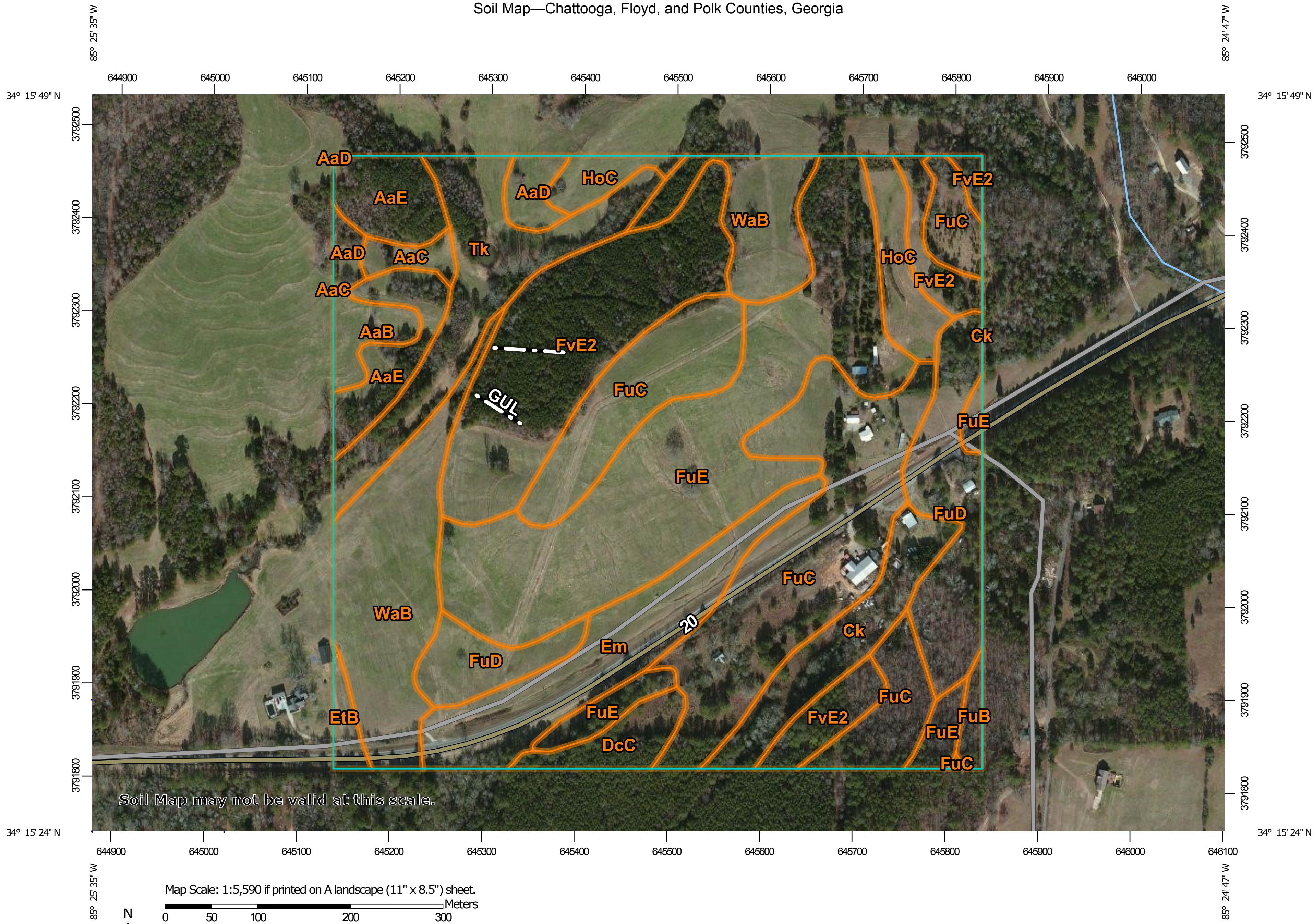
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Soil Map—Chattooga, Floyd, and Polk Counties, Georgia



Map Scale: 1:5,590 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 11, Oct 5, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2011—Jan 4, 2012

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AaB	Allen fine sandy loam, 2 to 6 percent slopes	1.4	1.2%
AaC	Allen fine sandy loam, 6 to 10 percent slopes	0.9	0.7%
AaD	Allen fine sandy loam, 10 to 15 percent slopes	1.6	1.4%
AaE	Allen fine sandy loam, 15 to 25 percent slopes	5.1	4.4%
Ck	Chewacla silt loam, 0 to 2 percent slopes, frequently flooded	4.3	3.8%
DcC	Decatur loam, 6 to 10 percent slopes	1.8	1.6%
Em	Emory silt loam, 0 to 4 percent slopes, rarely flooded	7.3	6.4%
EtB	Etowah loam, 2 to 6 percent slopes	0.7	0.6%
FuB	Fullerton gravelly silt loam, 2 to 6 percent slopes	0.6	0.5%
FuC	Fullerton cherty silt loam, 6 to 10 percent slopes	22.3	19.5%
FuD	Fullerton cherty silt loam, 10 to 15 percent slopes	8.1	7.1%
FuE	Fullerton cherty silt loam, 15 to 25 percent slopes	21.9	19.1%
FvE2	Fullerton gravelly silty clay loam, 10 to 25 percent slopes, eroded	15.2	13.2%
HoC	Holston fine sandy loam, 6 to 10 percent slopes	3.5	3.1%
Tk	Toccoa fine sandy loam	7.4	6.4%
WaB	Wax loam, 2 to 6 percent slopes	12.4	10.8%
Totals for Area of Interest		**114.5**	**100.0%**

Chattooga, Floyd, and Polk Counties, Georgia

Tv—Tupelo clay loam, frequently flooded

Map Unit Setting

National map unit symbol: ktw0
Elevation: 450 to 800 feet
Mean annual precipitation: 48 to 55 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Tupelo and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tupelo

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 12 inches: clay loam
H2 - 12 to 62 inches: silty clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Dowellton

Percent of map unit: 5 percent
Landform: Depressions on stream terraces

Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

WoA—Wolftever silt loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: ktw5
Elevation: 350 to 1,000 feet
Mean annual precipitation: 48 to 55 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 200 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Wolftever and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wolftever

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 6 inches: silt loam
H2 - 6 to 12 inches: silty clay loam
H3 - 12 to 58 inches: silty clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 30 to 42 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: High (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 10, Sep 9, 2016

Chattooga, Floyd, and Polk Counties, Georgia

FuC—Fullerton cherty silt loam, 6 to 10 percent slopes

Map Unit Setting

National map unit symbol: kttc
Mean annual precipitation: 48 to 55 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 200 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Fullerton and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fullerton

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Side slope, interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Residuum

Typical profile

H1 - 0 to 17 inches: gravelly silt loam
H2 - 17 to 24 inches: gravelly silty clay loam
H3 - 24 to 88 inches: gravelly silty clay

Properties and qualities

Slope: 6 to 10 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Thermic Cherty Dolomite Upland Oak-Hickory Forest (F128XY001TN)

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 11, Oct 5, 2017

Chattooga, Floyd, and Polk Counties, Georgia

FuE—Fullerton cherty silt loam, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: kttf
Mean annual precipitation: 48 to 55 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Fullerton and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fullerton

Setting

Landform: Ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum

Typical profile

H1 - 0 to 17 inches: gravelly silt loam
H2 - 17 to 24 inches: gravelly silty clay loam
H3 - 24 to 88 inches: gravelly silty clay

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Thermic Cherty Dolomite Upland Oak-Hickory Forest (F128XY001TN)

Hydric soil rating: No

Data Source Information

Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 11, Oct 5, 2017

Chattooga, Floyd, and Polk Counties, Georgia

FvE2—Fullerton gravelly silty clay loam, 10 to 25 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2szjc
Elevation: 670 to 1,100 feet
Mean annual precipitation: 52 to 56 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 180 to 219 days
Farmland classification: Not prime farmland

Map Unit Composition

Fullerton and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fullerton

Setting

Landform: Ridges
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy creep deposits derived from cherty limestone over clayey residuum weathered from cherty limestone

Typical profile

A - 0 to 2 inches: gravelly silty clay loam
BE - 2 to 13 inches: gravelly silty clay loam
Bt1 - 13 to 21 inches: gravelly clay
Bt2 - 21 to 60 inches: gravelly clay
Bt3 - 60 to 90 inches: gravelly clay

Properties and qualities

Slope: 10 to 25 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: B
Hydric soil rating: No

Data Source Information

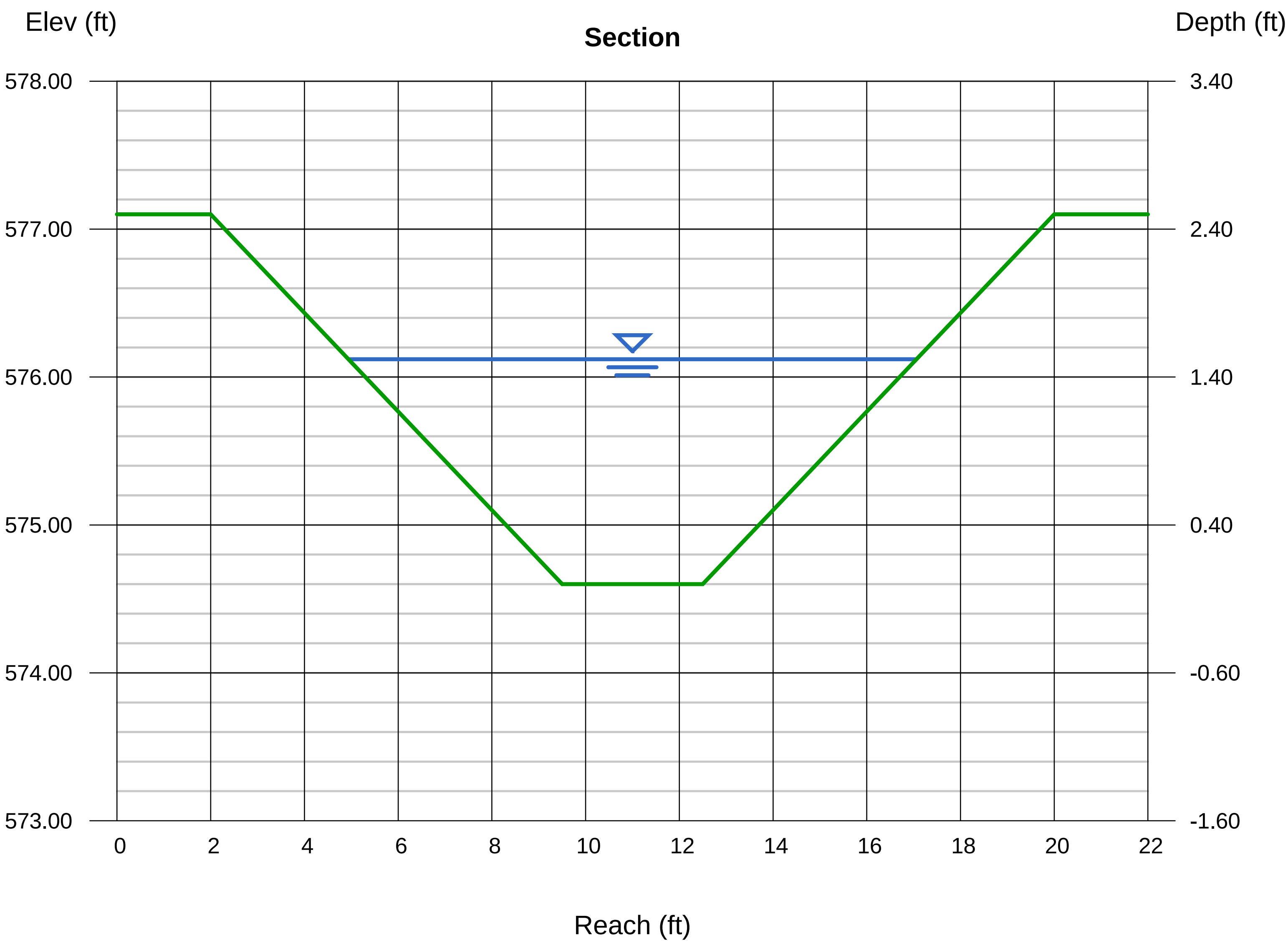
Soil Survey Area: Chattooga, Floyd, and Polk Counties, Georgia
Survey Area Data: Version 11, Oct 5, 2017

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Saturday, Jan 9 2021

36 INCH CMP DISCHARGE DITCH - GRASSED

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 1.52
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 37.66
Total Depth (ft)	= 2.50	Area (sqft)	= 11.49
Invert Elev (ft)	= 574.60	Velocity (ft/s)	= 3.28
Slope (%)	= 0.50	Wetted Perim (ft)	= 12.61
N-Value	= 0.030	Crit Depth, Yc (ft)	= 1.18
		Top Width (ft)	= 12.12
Calculations		EGL (ft)	= 1.69
Compute by:	Known Q		
Known Q (cfs)	= 37.66		

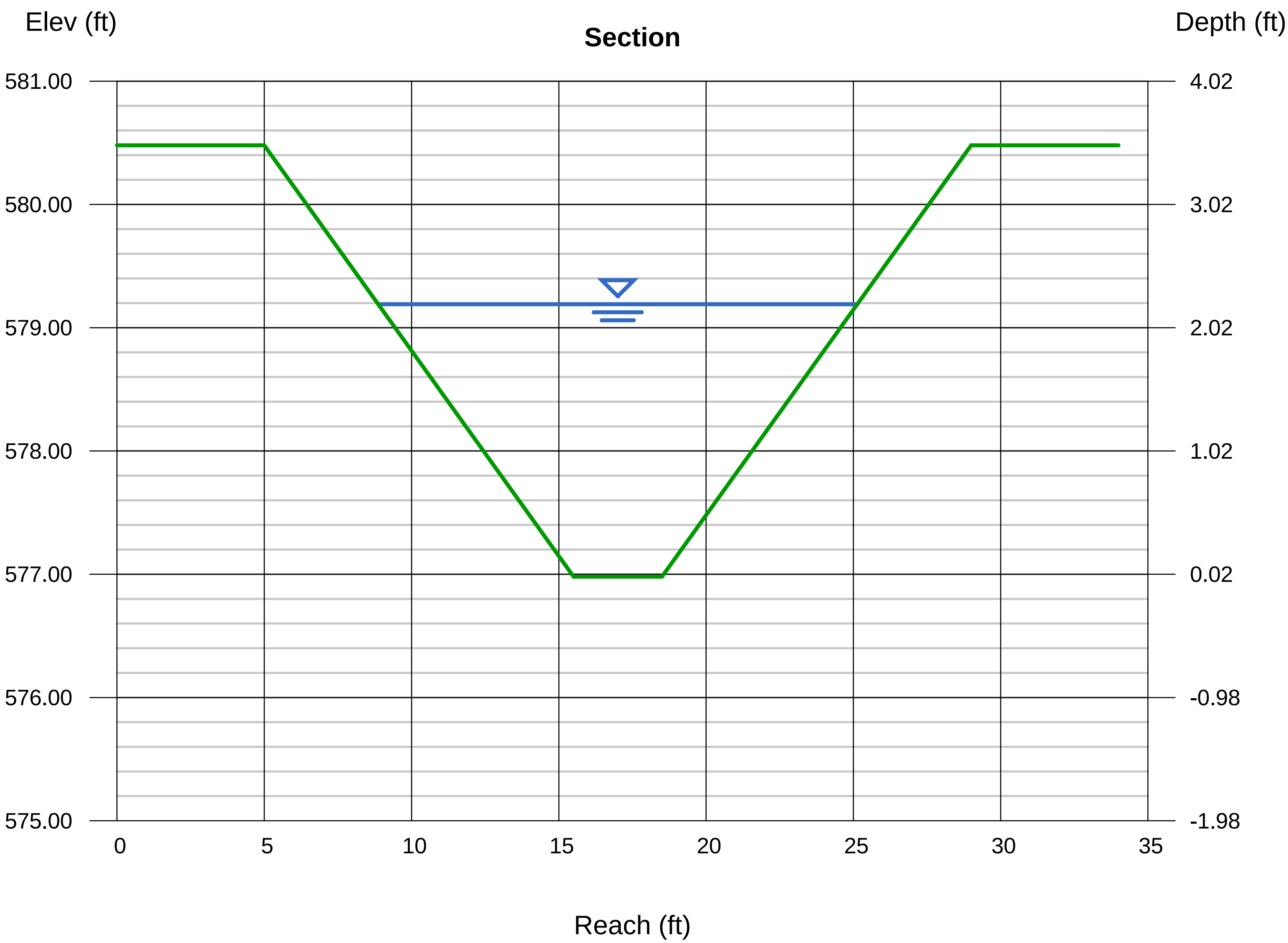


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. | Sunday, Jan 10 2021

36 INCH CMP DISCHARGE DITCH - RIP RAP

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 2.21
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 37.66
Total Depth (ft)	= 3.50	Area (sqft)	= 21.28
Invert Elev (ft)	= 576.98	Velocity (ft/s)	= 1.77
Slope (%)	= 0.50	Wetted Perim (ft)	= 16.98
N-Value	= 0.069	Crit Depth, Yc (ft)	= 1.18
		Top Width (ft)	= 16.26
Calculations		EGL (ft)	= 2.26
Compute by:	Known Q		
Known Q (cfs)	= 37.66		



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Jan 8 2021

Area H DITCH- TcTrial

Trapezoidal

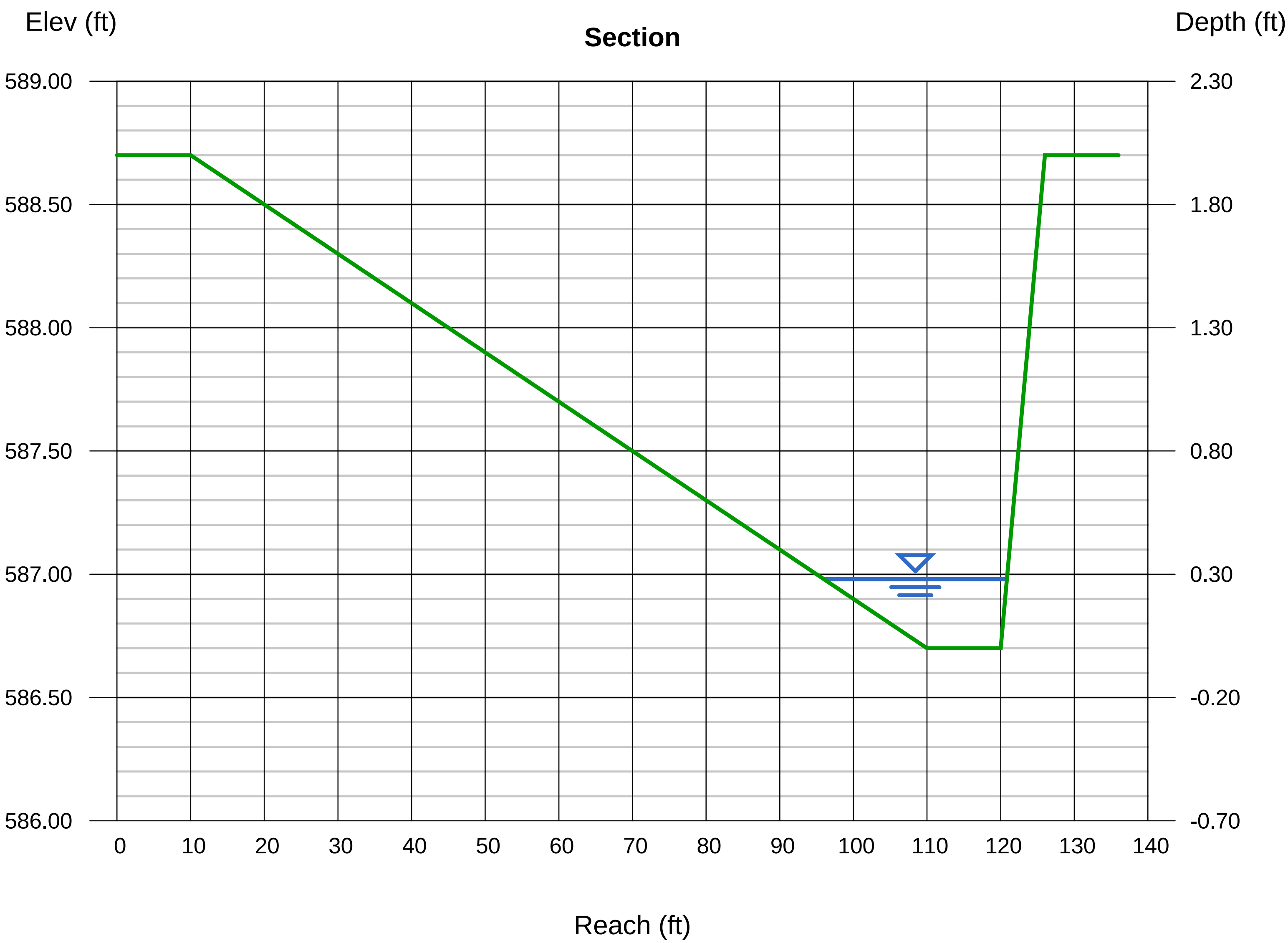
Bottom Width (ft)	=	10.00
Side Slopes (z:1)	=	50.00, 3.00
Total Depth (ft)	=	2.00
Invert Elev (ft)	=	586.70
Slope (%)	=	0.55
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cfs)	=	6.00

Highlighted

Depth (ft)	=	0.28
Q (cfs)	=	6.000
Area (sqft)	=	4.88
Velocity (ft/s)	=	1.23
Wetted Perim (ft)	=	24.89
Crit Depth, Yc (ft)	=	0.19
Top Width (ft)	=	24.84
EGL (ft)	=	0.30

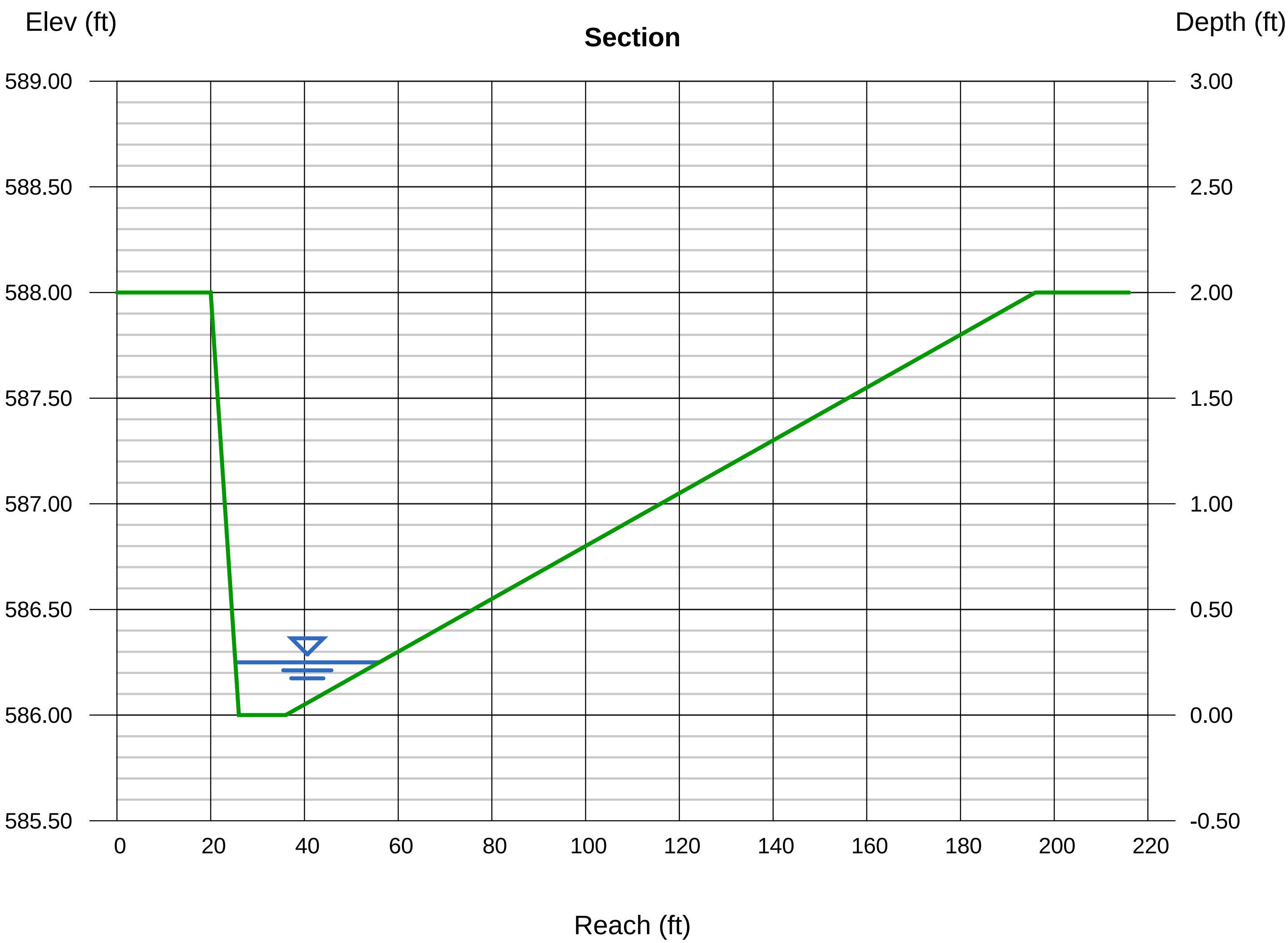


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Jan 8 2021

Area H DITCH- TcTrial

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 0.25
Side Slopes (z:1)	= 3.00, 80.00	Q (cfs)	= 6.000
Total Depth (ft)	= 2.00	Area (sqft)	= 5.09
Invert Elev (ft)	= 586.00	Velocity (ft/s)	= 1.18
Slope (%)	= 0.65	Wetted Perim (ft)	= 30.79
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.18
		Top Width (ft)	= 30.75
Calculations		EGL (ft)	= 0.27
Compute by:	Known Q		
Known Q (cfs)	= 6.00		

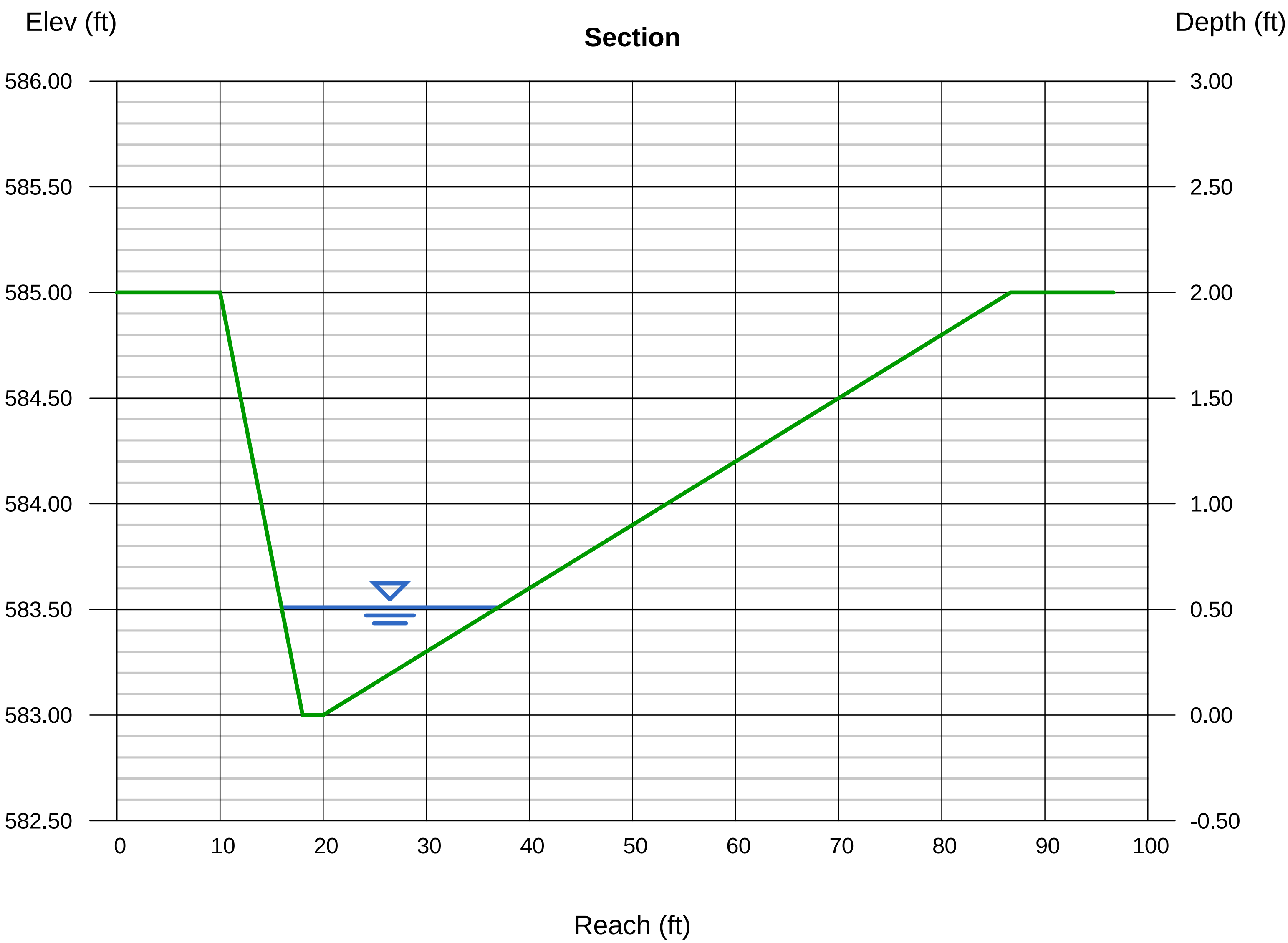


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. | Friday, Jan 8 2021

Area H DITCH- TcTrial

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 2.00	Depth (ft)	= 0.51
Side Slopes (z:1)	= 4.00, 33.33	Q (cfs)	= 6.000
Total Depth (ft)	= 2.00	Area (sqft)	= 5.87
Invert Elev (ft)	= 583.00	Velocity (ft/s)	= 1.02
Slope (%)	= 0.32	Wetted Perim (ft)	= 21.11
N-Value	= 0.035	Crit Depth, Yc (ft)	= 0.32
		Top Width (ft)	= 21.04
Calculations		EGL (ft)	= 0.53
Compute by:	Known Q		
Known Q (cfs)	= 6.00		



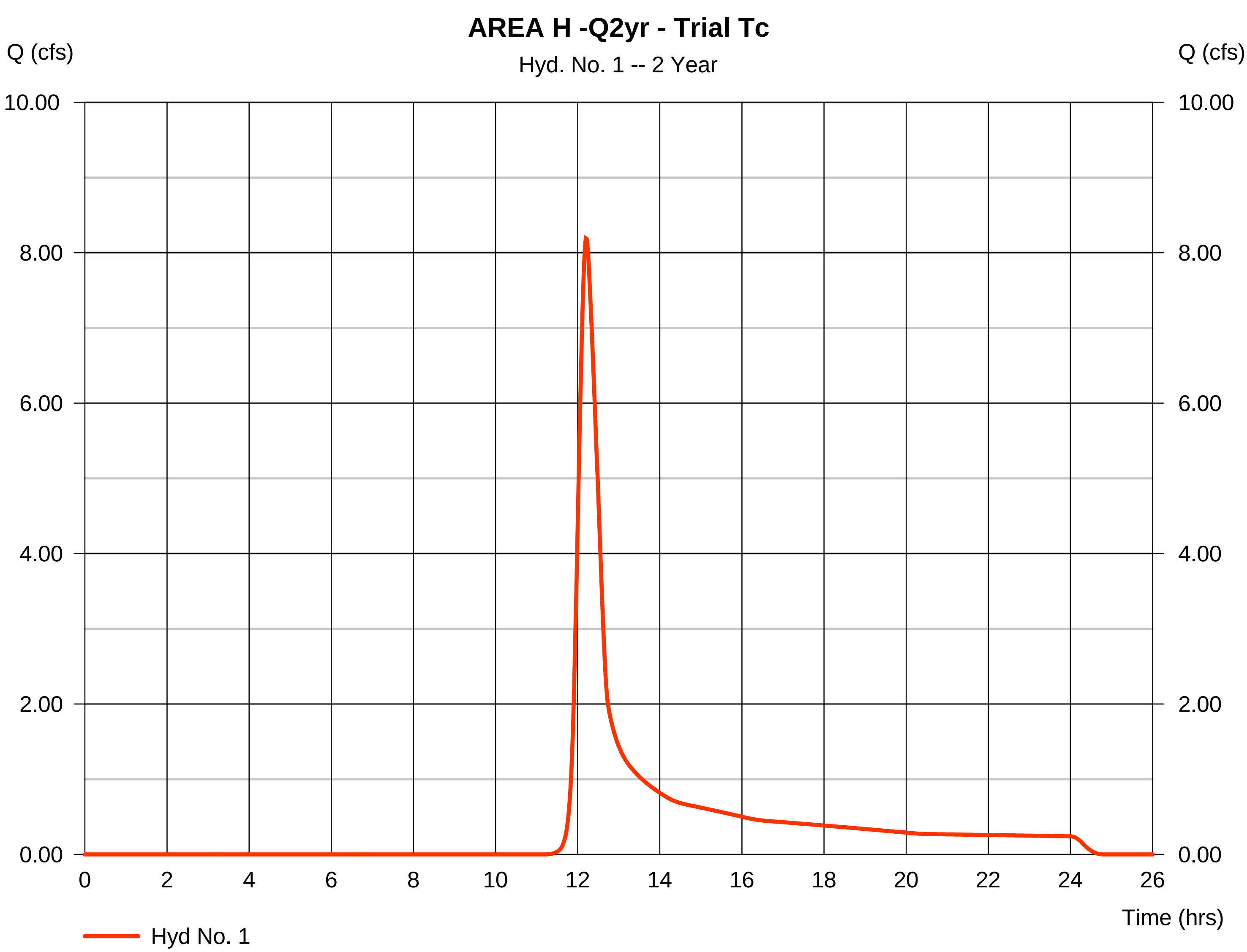
Hydrograph Report

Hyd. No. 1

AREA H -Q2yr - Trial Tc

Hydrograph type	= SCS Runoff	Peak discharge	= 8.190 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 1 min	Hyd. volume	= 36,134 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 30.00 min
Total precip.	= 3.82 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110

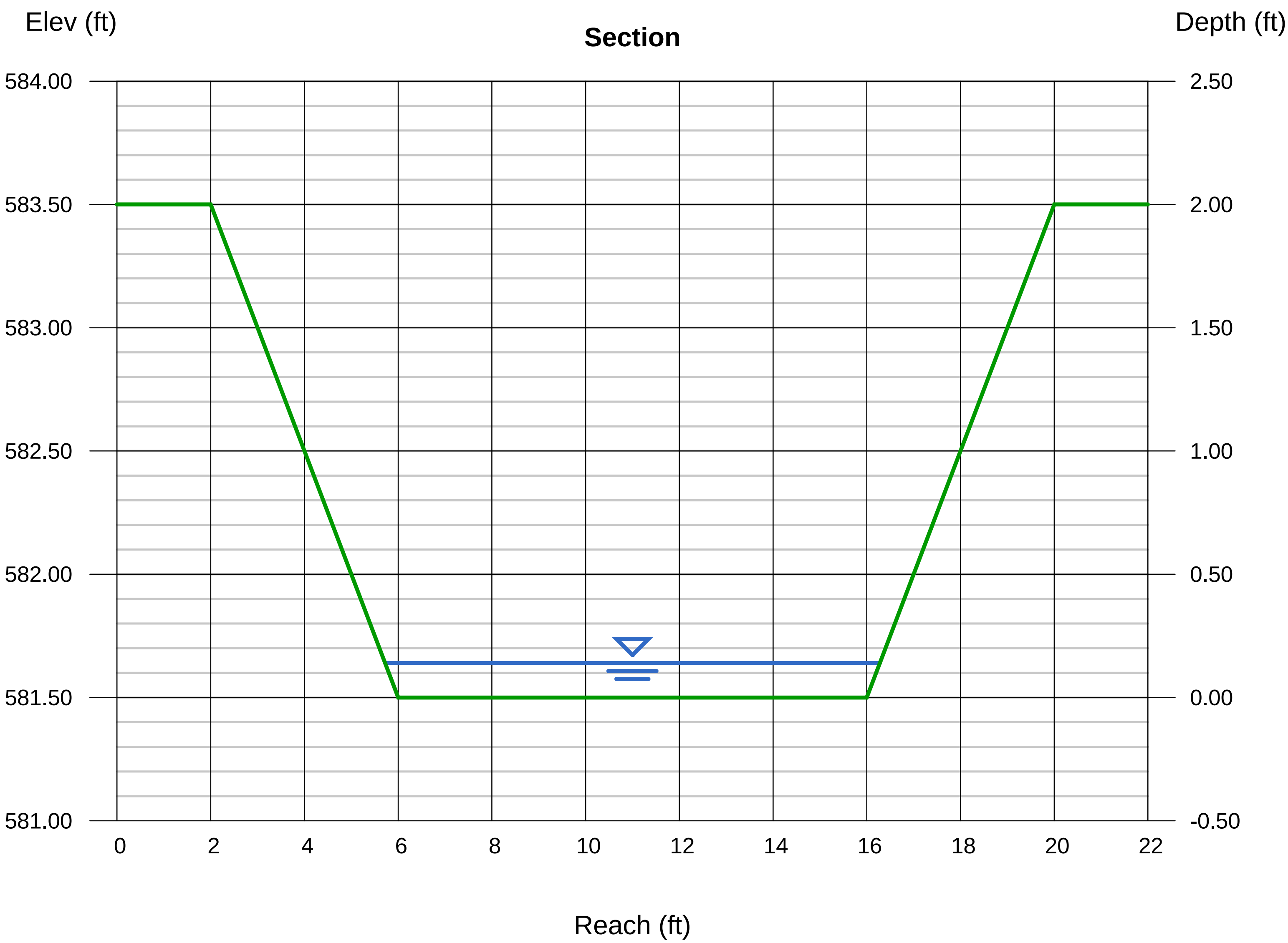


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Jan 9 2021

Area J' Ditch_1Trial Tc

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 0.14
Side Slopes (z:1)	= 2.00, 2.00	Q (cfs)	= 3.000
Total Depth (ft)	= 2.00	Area (sqft)	= 1.44
Invert Elev (ft)	= 581.50	Velocity (ft/s)	= 2.08
Slope (%)	= 3.00	Wetted Perim (ft)	= 10.63
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.14
		Top Width (ft)	= 10.56
Calculations		EGL (ft)	= 0.21
Compute by:	Known Q		
Known Q (cfs)	= 3.00		

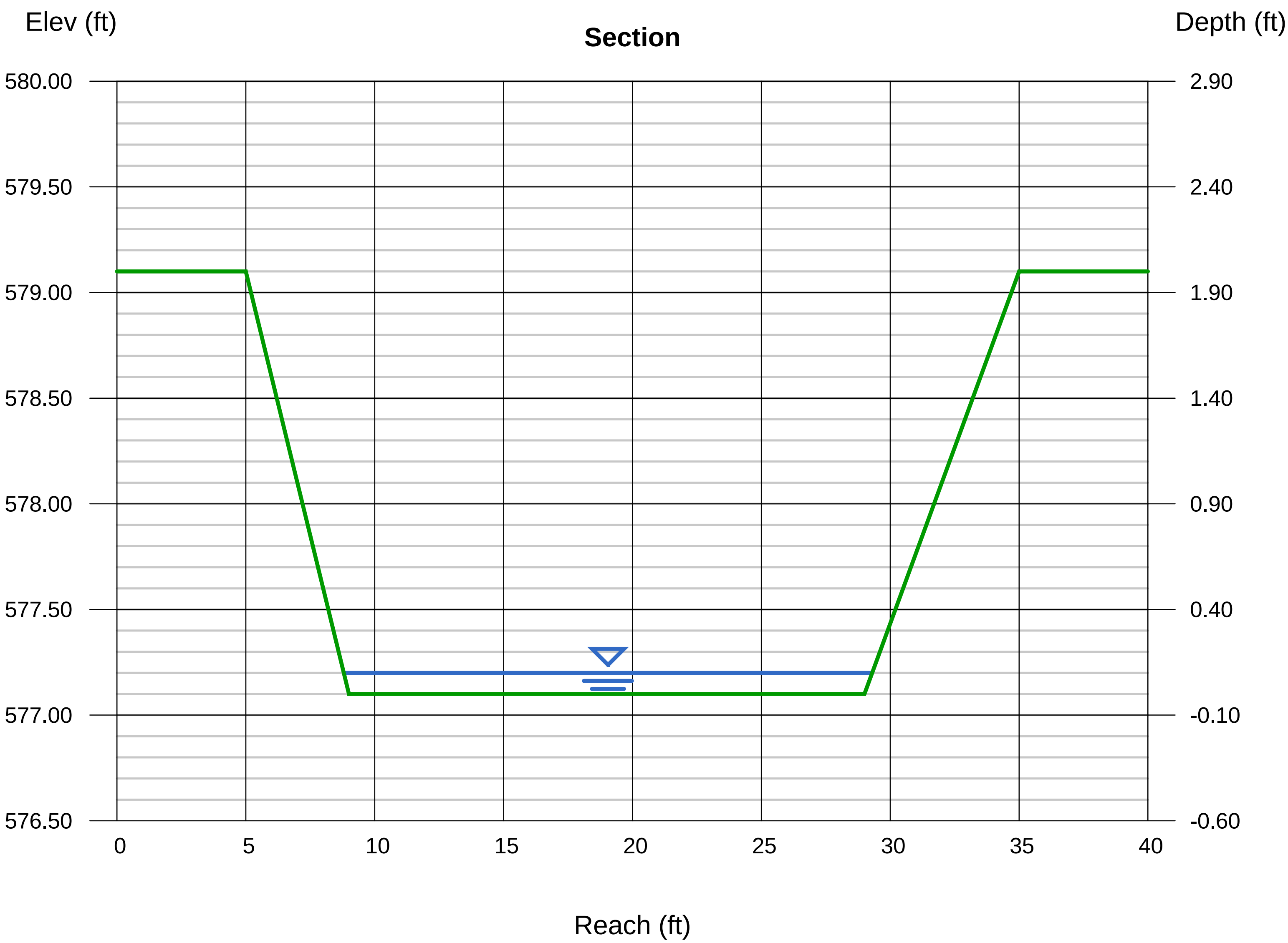


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Jan 9 2021

Area J' Ditch_2 Trial Tc

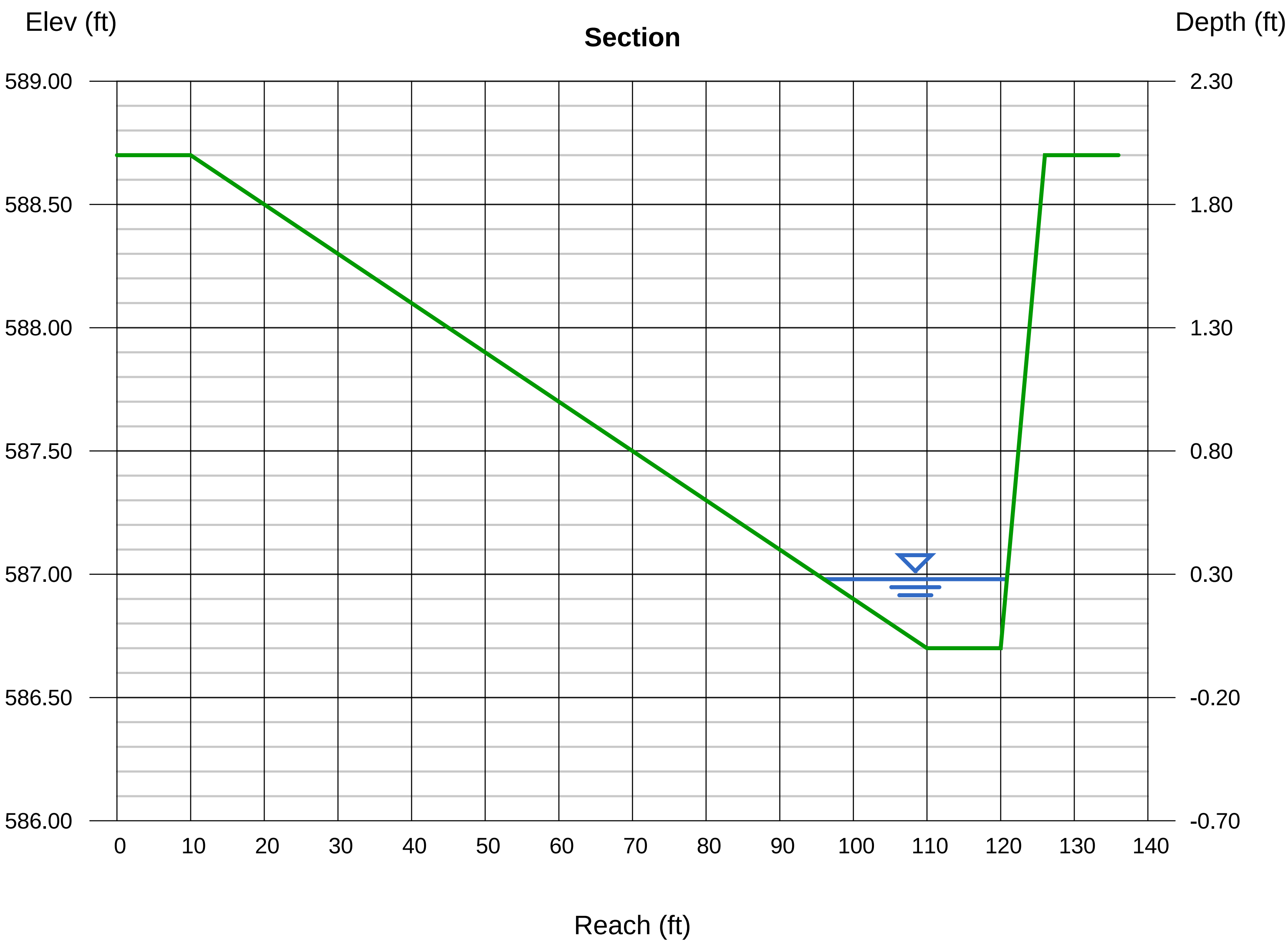
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 20.00	Depth (ft)	= 0.10
Side Slopes (z:1)	= 2.00, 3.00	Q (cfs)	= 3.000
Total Depth (ft)	= 2.00	Area (sqft)	= 2.03
Invert Elev (ft)	= 577.10	Velocity (ft/s)	= 1.48
Slope (%)	= 2.60	Wetted Perim (ft)	= 20.54
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.09
		Top Width (ft)	= 20.50
Calculations		EGL (ft)	= 0.13
Compute by:	Known Q		
Known Q (cfs)	= 3.00		



Channel Report

Area H DITCH- TcTrial

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 10.00	Depth (ft)	= 0.28
Side Slopes (z:1)	= 50.00, 3.00	Q (cfs)	= 6.000
Total Depth (ft)	= 2.00	Area (sqft)	= 4.88
Invert Elev (ft)	= 586.70	Velocity (ft/s)	= 1.23
Slope (%)	= 0.55	Wetted Perim (ft)	= 24.89
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.19
		Top Width (ft)	= 24.84
Calculations		EGL (ft)	= 0.30
Compute by:	Known Q		
Known Q (cfs)	= 6.00		

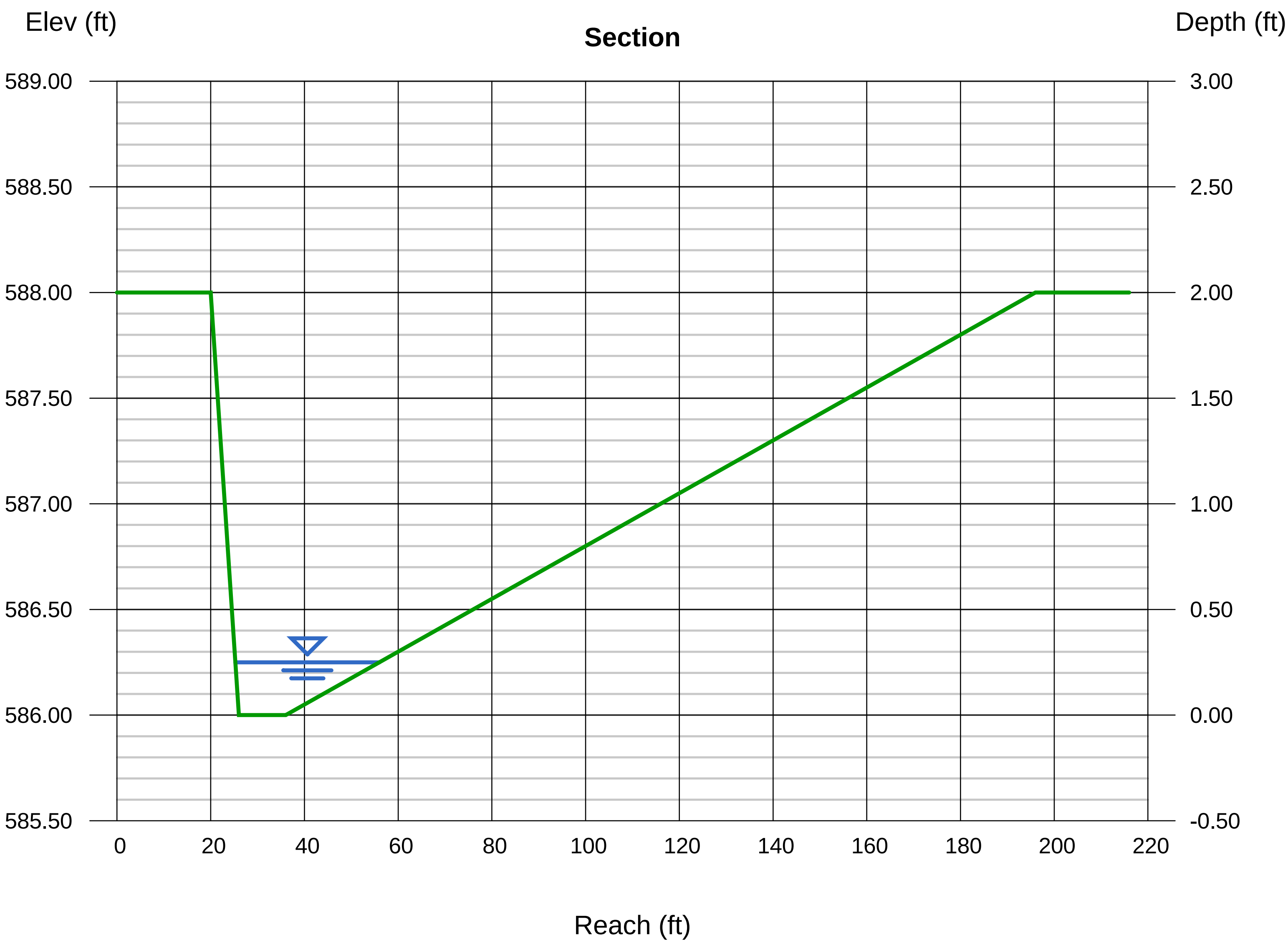


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Jan 8 2021

Area H DITCH- TcTrial

Trapezoidal			**Highlighted**	
Bottom Width (ft)	= 10.00		Depth (ft)	= 0.25
Side Slopes (z:1)	= 3.00, 80.00		Q (cfs)	= 6.000
Total Depth (ft)	= 2.00		Area (sqft)	= 5.09
Invert Elev (ft)	= 586.00		Velocity (ft/s)	= 1.18
Slope (%)	= 0.65		Wetted Perim (ft)	= 30.79
N-Value	= 0.030		Crit Depth, Yc (ft)	= 0.18
			Top Width (ft)	= 30.75
Calculations			EGL (ft)	= 0.27
Compute by:	Known Q			
Known Q (cfs)	= 6.00			



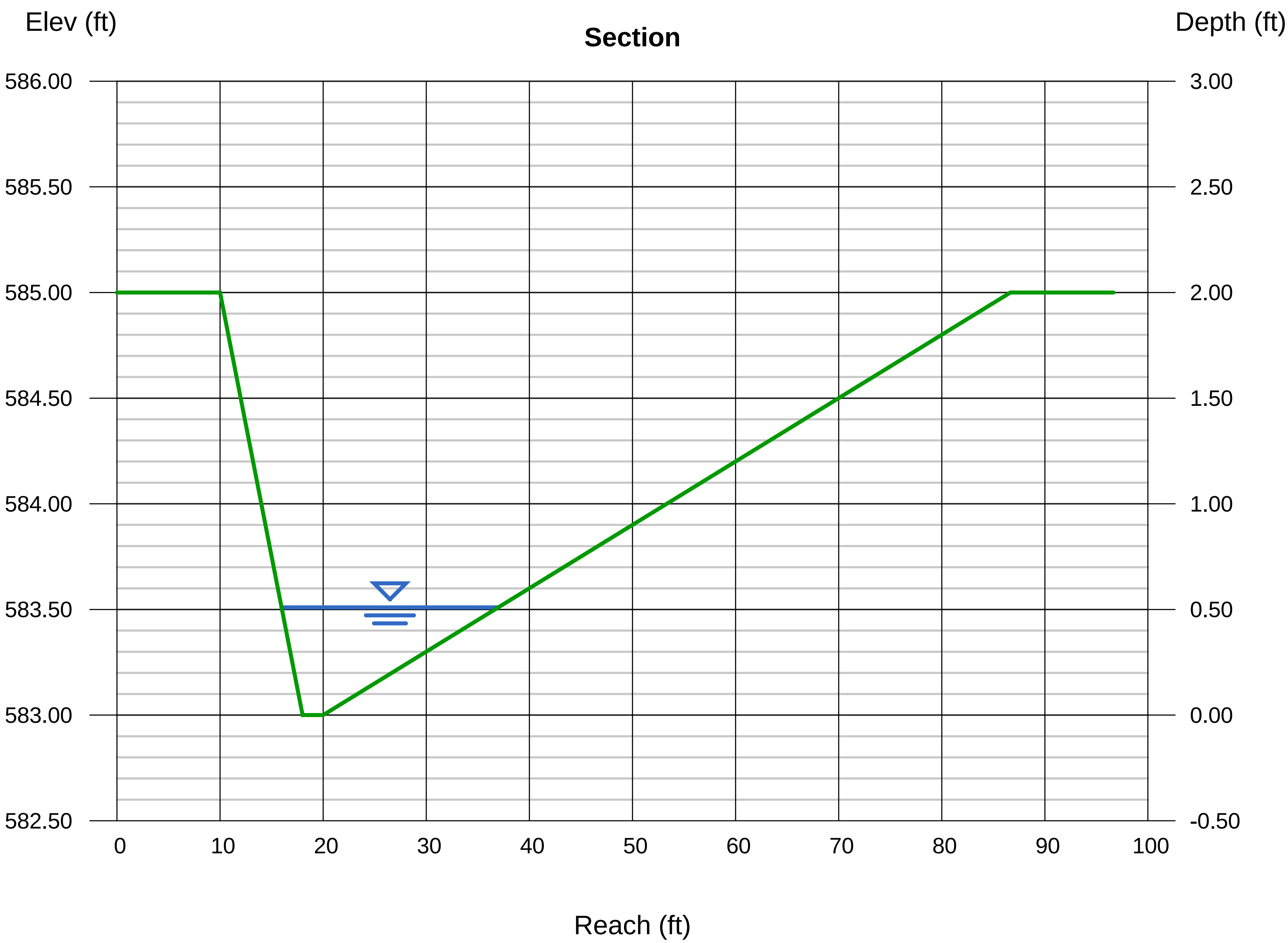
Channel Report

Area H DITCH- TcTrial

Trapezoidal
Bottom Width (ft) = 2.00
Side Slopes (z:1) = 4.00, 33.33
Total Depth (ft) = 2.00
Invert Elev (ft) = 583.00
Slope (%) = 0.32
N-Value = 0.035

Calculations
Compute by: Known Q
Known Q (cfs) = 6.00

Highlighted
Depth (ft) = 0.51
Q (cfs) = 6.000
Area (sqft) = 5.87
Velocity (ft/s) = 1.02
Wetted Perim (ft) = 21.11
Crit Depth, Yc (ft) = 0.32
Top Width (ft) = 21.04
EGL (ft) = 0.53



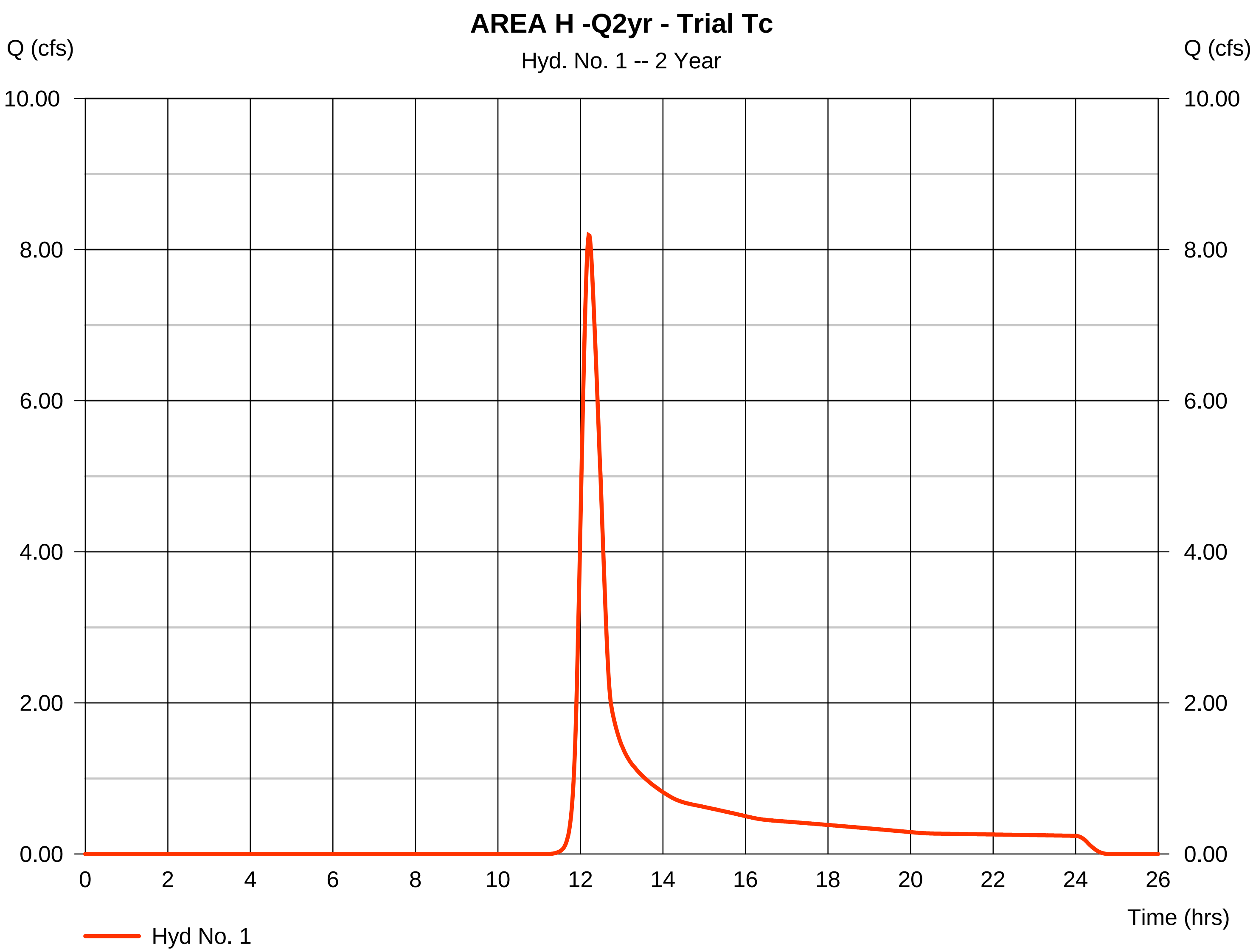
Hydrograph Report

Hyd. No. 1

AREA H -Q2yr - Trial Tc

Hydrograph type	= SCS Runoff	Peak discharge	= 8.190 cfs
Storm frequency	= 2 yrs	Time to peak	= 12.20 hrs
Time interval	= 1 min	Hyd. volume	= 36,134 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 30.00 min
Total precip.	= 3.82 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110

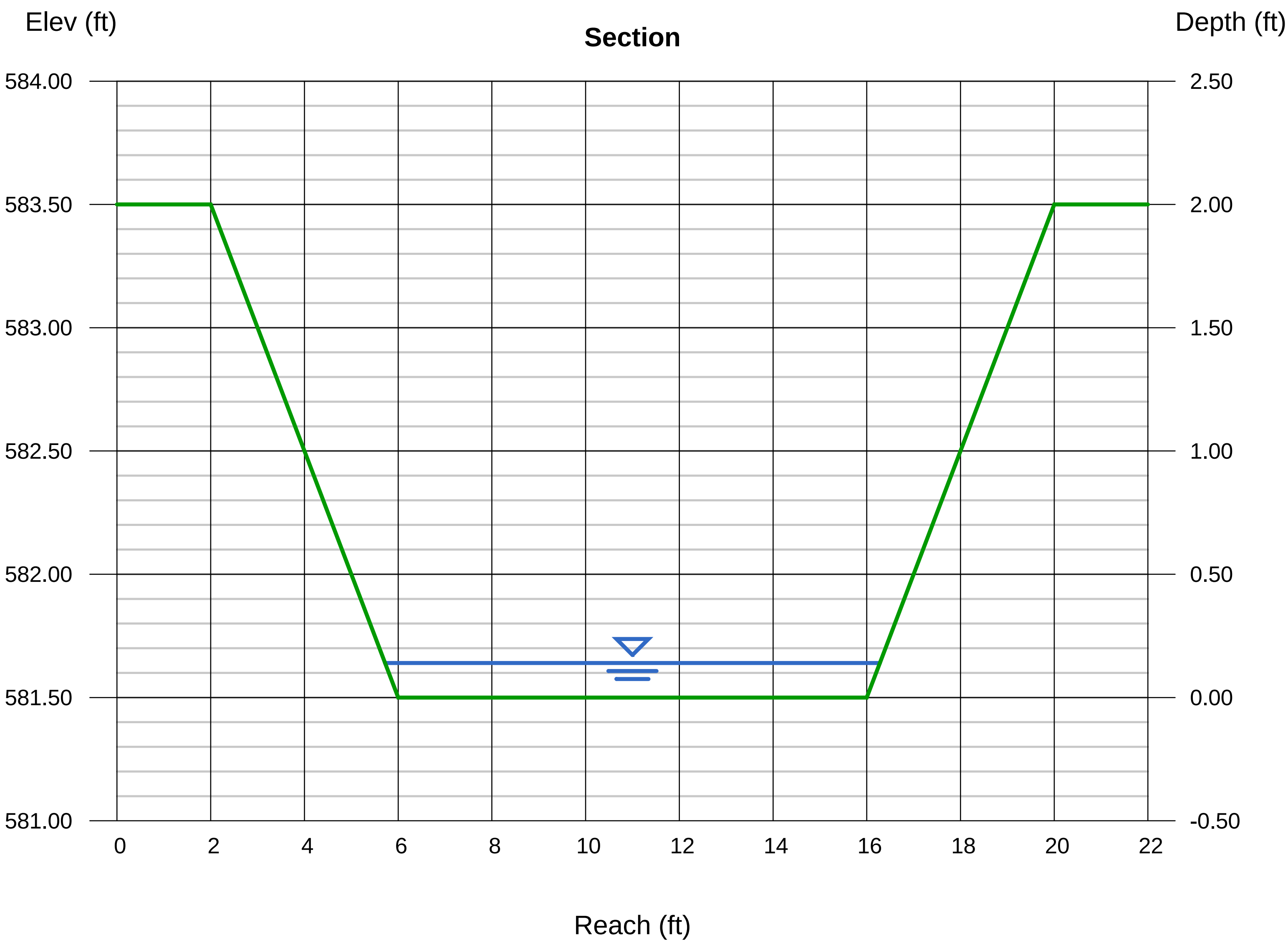


Channel Report

Area J' Ditch_1Trial Tc

Trapezoidal	
Bottom Width (ft)	= 10.00
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 581.50
Slope (%)	= 3.00
N-Value	= 0.030
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 3.00

Highlighted	
Depth (ft)	= 0.14
Q (cfs)	= 3.000
Area (sqft)	= 1.44
Velocity (ft/s)	= 2.08
Wetted Perim (ft)	= 10.63
Crit Depth, Yc (ft)	= 0.14
Top Width (ft)	= 10.56
EGL (ft)	= 0.21

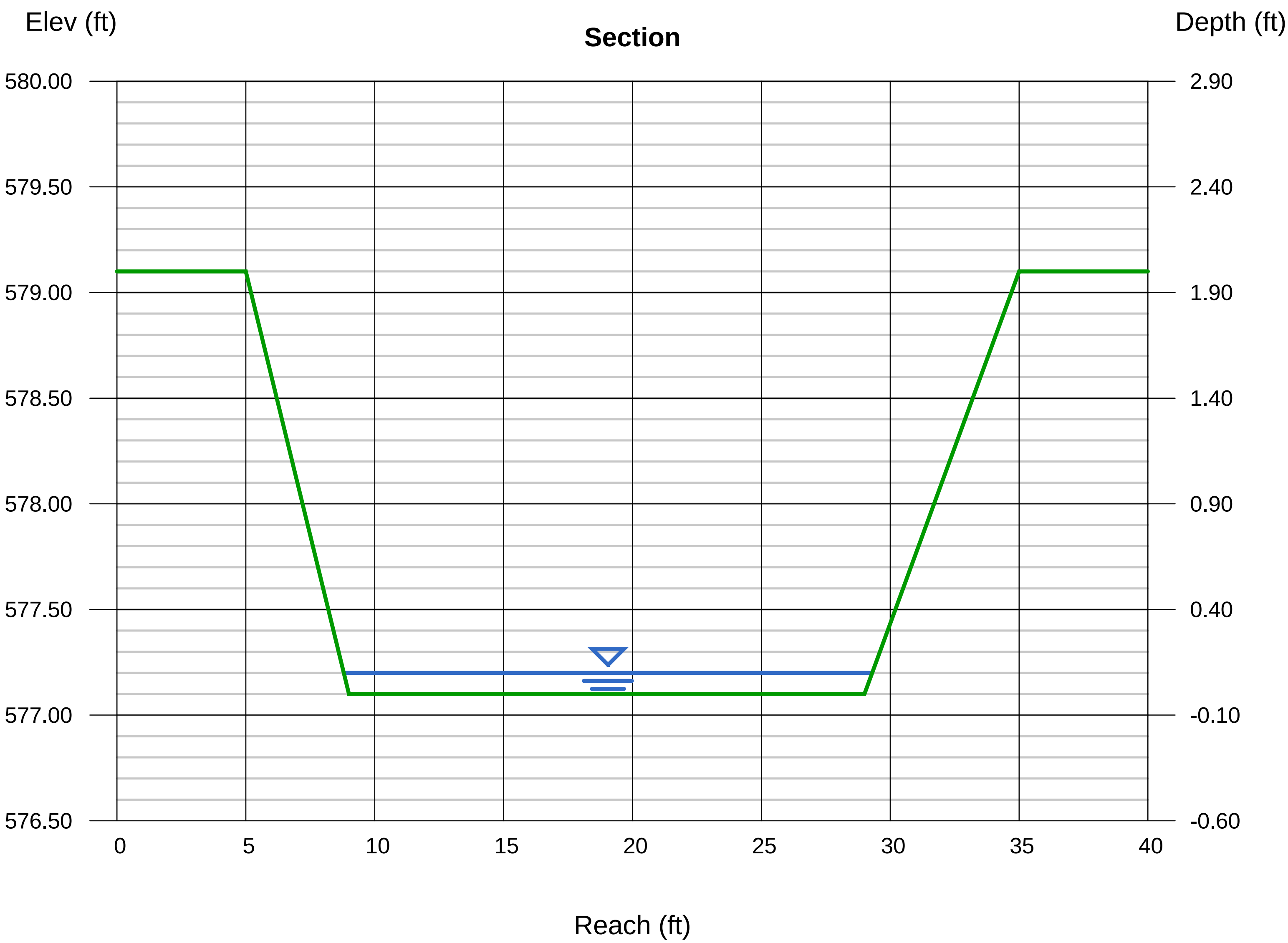


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Saturday, Jan 9 2021

Area J' Ditch_2 Trial Tc

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 20.00	Depth (ft)	= 0.10
Side Slopes (z:1)	= 2.00, 3.00	Q (cfs)	= 3.000
Total Depth (ft)	= 2.00	Area (sqft)	= 2.03
Invert Elev (ft)	= 577.10	Velocity (ft/s)	= 1.48
Slope (%)	= 2.60	Wetted Perim (ft)	= 20.54
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.09
		Top Width (ft)	= 20.50
Calculations		EGL (ft)	= 0.13
Compute by:	Known Q		
Known Q (cfs)	= 3.00		



Channel Report

FBASIN_3'FB@1.0%-Tc2YR

Trapezoidal

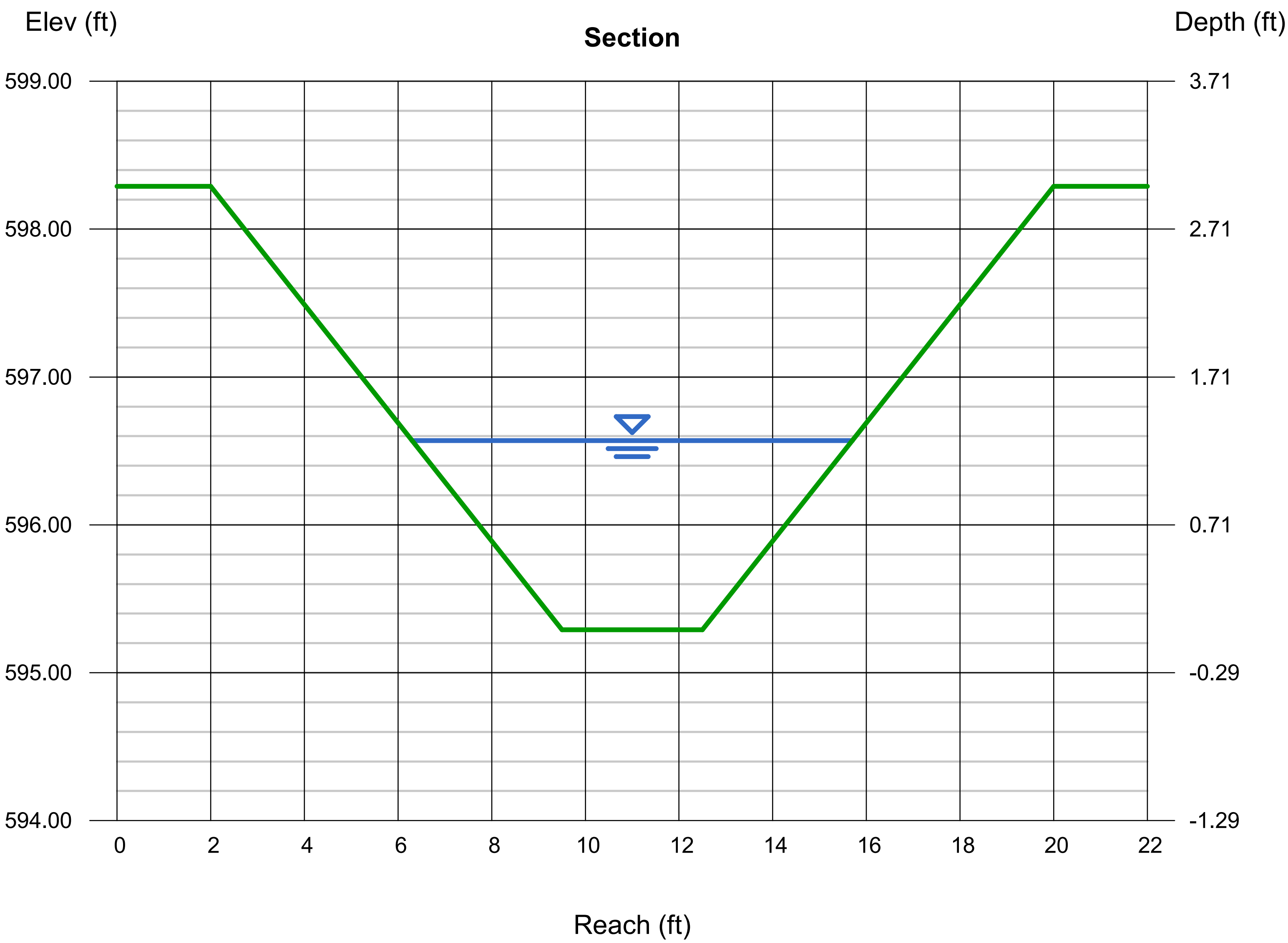
Bottom Width (ft)	= 3.00
Side Slopes (z:1)	= 2.50, 2.50
Total Depth (ft)	= 3.00
Invert Elev (ft)	= 595.29
Slope (%)	= 1.00
N-Value	= 0.074

Calculations

Compute by:	Known Q
Known Q (cfs)	= 13.73

Highlighted

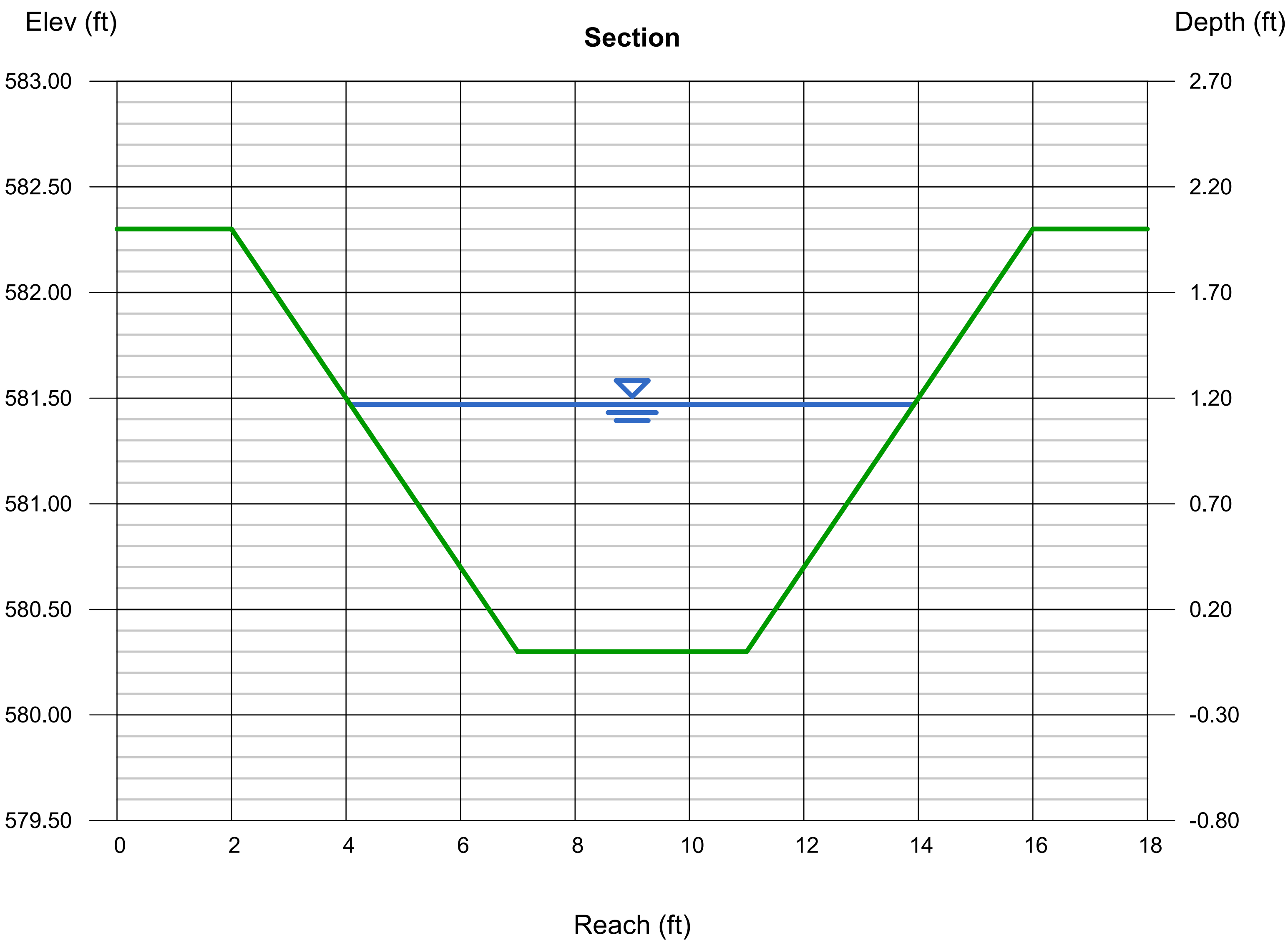
Depth (ft)	= 1.28
Q (cfs)	= 13.73
Area (sqft)	= 7.94
Velocity (ft/s)	= 1.73
Wetted Perim (ft)	= 9.89
Crit Depth, Yc (ft)	= 0.71
Top Width (ft)	= 9.40
EGL (ft)	= 1.33



Channel Report

FBASIN_4'FB@1.00%-Tc2YR

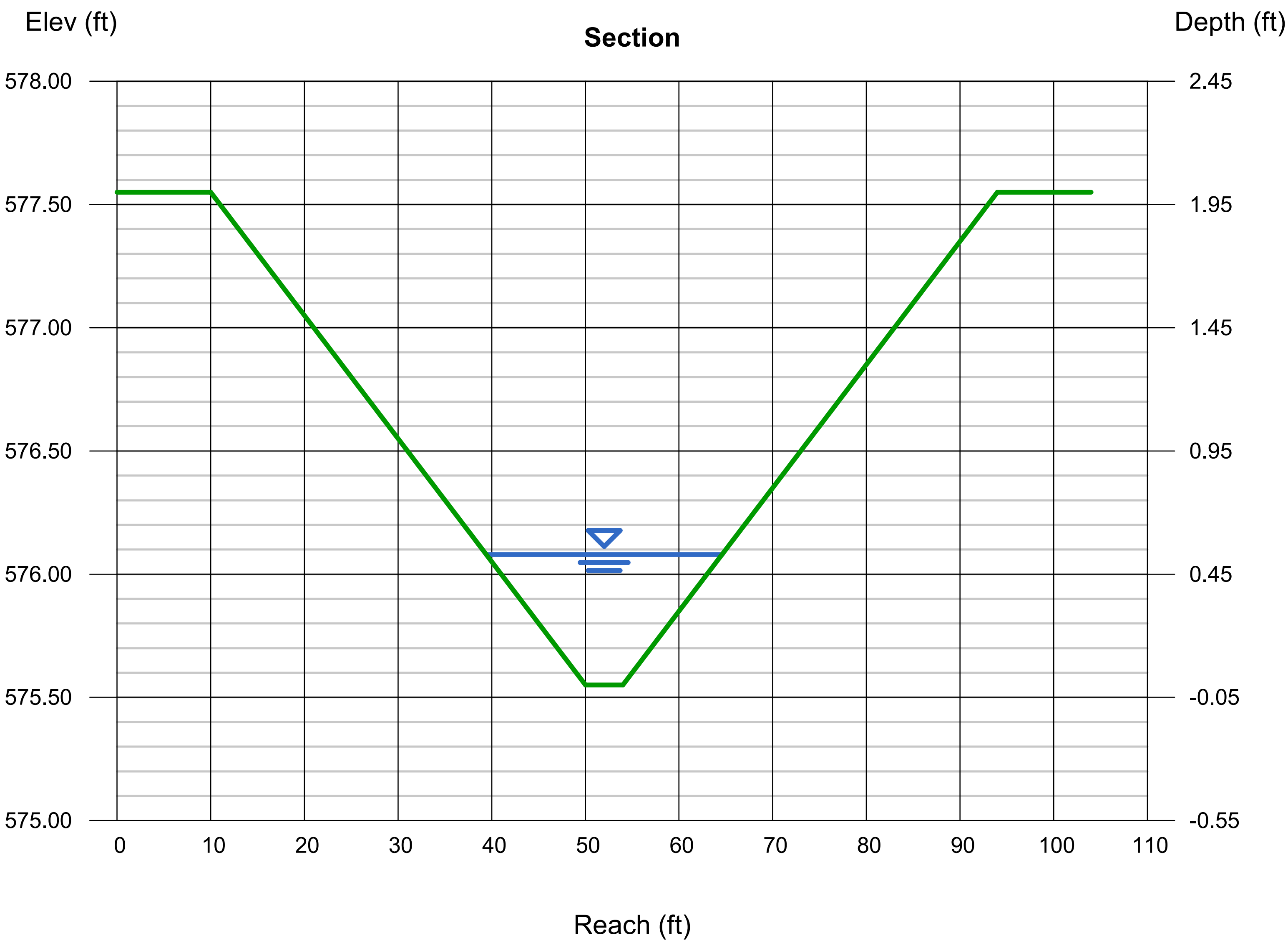
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 1.17
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 13.73
Total Depth (ft)	= 2.00	Area (sqft)	= 8.10
Invert Elev (ft)	= 580.30	Velocity (ft/s)	= 1.69
Slope (%)	= 1.00	Wetted Perim (ft)	= 10.30
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.63
		Top Width (ft)	= 9.85
Calculations		EGL (ft)	= 1.21
Compute by:	Known Q		
Known Q (cfs)	= 13.73		



Channel Report

FBASIN_4'FB@4.0%-Tc2YR

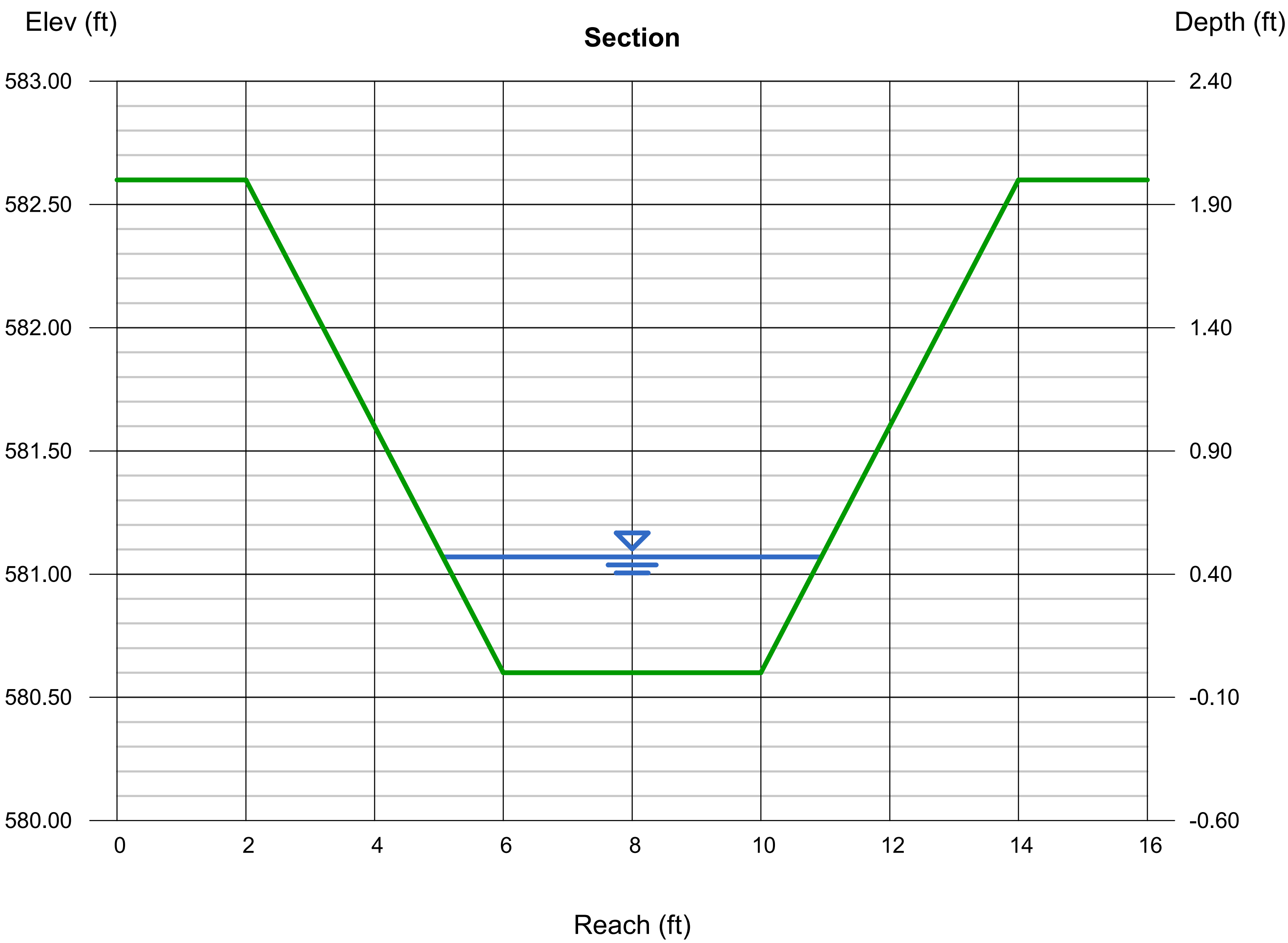
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 0.53
Side Slopes (z:1)	= 20.00, 20.00	Q (cfs)	= 13.73
Total Depth (ft)	= 2.00	Area (sqft)	= 7.74
Invert Elev (ft)	= 575.55	Velocity (ft/s)	= 1.77
Slope (%)	= 4.00	Wetted Perim (ft)	= 25.23
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.41
		Top Width (ft)	= 25.20
Calculations		EGL (ft)	= 0.58
Compute by:	Known Q		
Known Q (cfs)	= 13.73		



Channel Report

FBASIN_4'FB@32.5%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 0.47
Side Slopes (z:1)	= 2.00, 2.00	Q (cfs)	= 13.73
Total Depth (ft)	= 2.00	Area (sqft)	= 2.32
Invert Elev (ft)	= 580.60	Velocity (ft/s)	= 5.91
Slope (%)	= 32.50	Wetted Perim (ft)	= 6.10
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.64
		Top Width (ft)	= 5.88
Calculations		EGL (ft)	= 1.01
Compute by:	Known Q		
Known Q (cfs)	= 13.73		

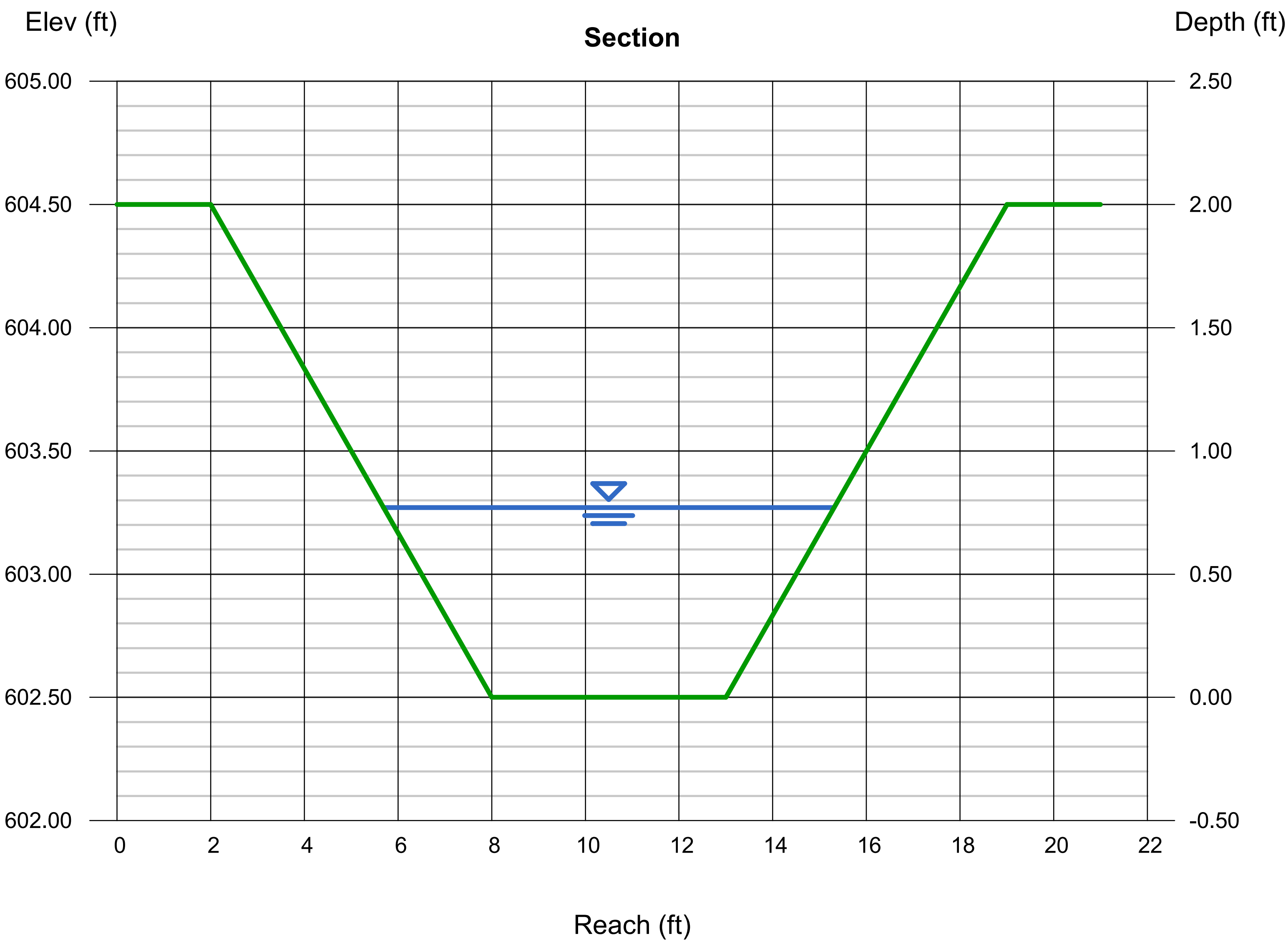


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. | Friday, Nov 9 2018

FBASIN_5'FB@2.83%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 5.00	Depth (ft)	= 0.77
Side Slopes (z:1)	= 3.00, 3.00	Q (cfs)	= 13.73
Total Depth (ft)	= 2.00	Area (sqft)	= 5.63
Invert Elev (ft)	= 602.50	Velocity (ft/s)	= 2.44
Slope (%)	= 2.83	Wetted Perim (ft)	= 9.87
N-Value	= 0.069	Crit Depth, Yc (ft)	= 0.55
		Top Width (ft)	= 9.62
Calculations		EGL (ft)	= 0.86
Compute by:	Known Q		
Known Q (cfs)	= 13.73		

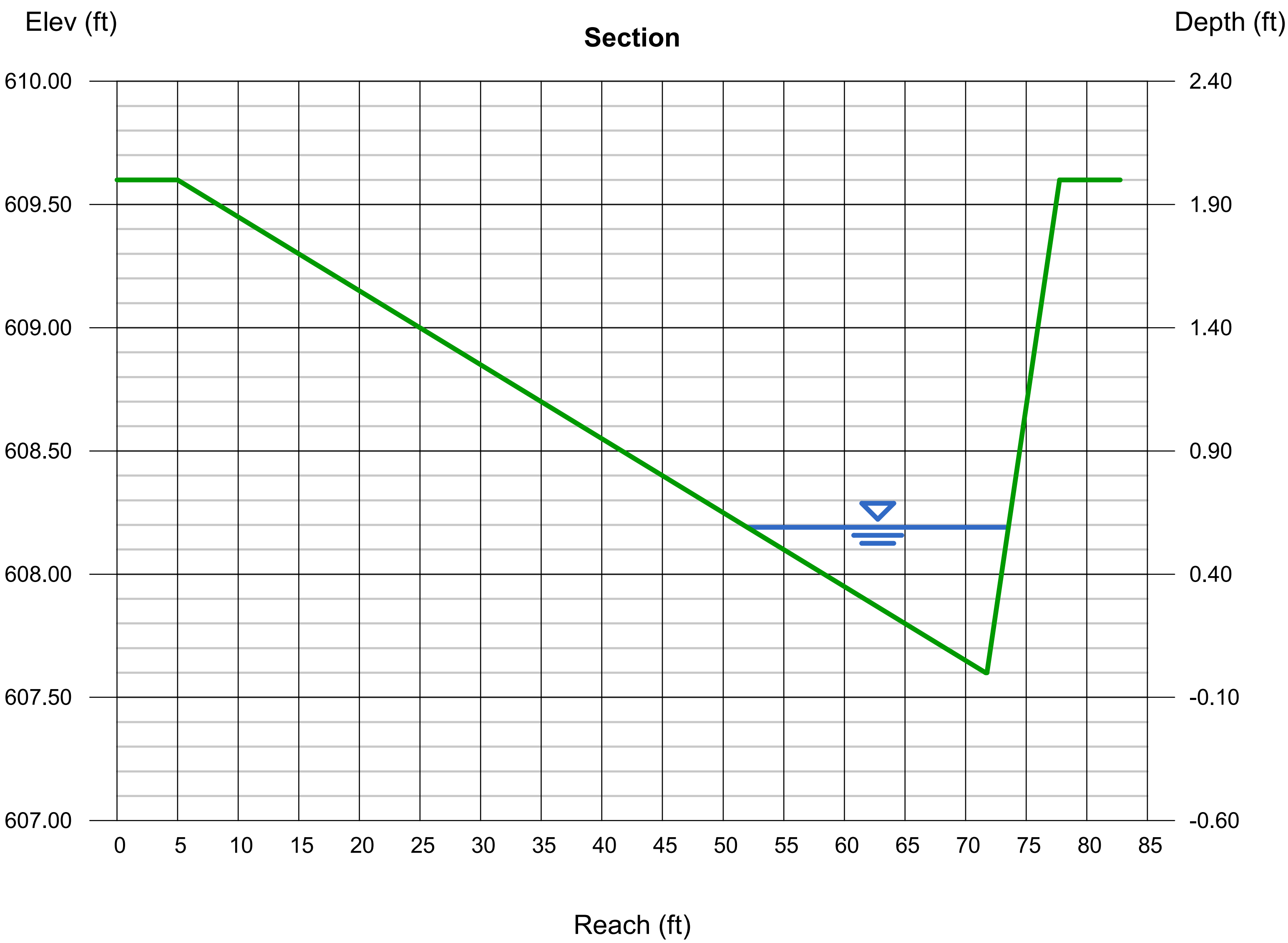


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

FBASIN_CapSwale@1.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 0.10	Depth (ft)	= 0.59
Side Slopes (z:1)	= 33.33, 3.00	Q (cfs)	= 13.73
Total Depth (ft)	= 2.00	Area (sqft)	= 6.38
Invert Elev (ft)	= 607.60	Velocity (ft/s)	= 2.15
Slope (%)	= 1.00	Wetted Perim (ft)	= 21.64
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.52
		Top Width (ft)	= 21.53
Calculations		EGL (ft)	= 0.66
Compute by:	Known Q		
Known Q (cfs)	= 13.73		

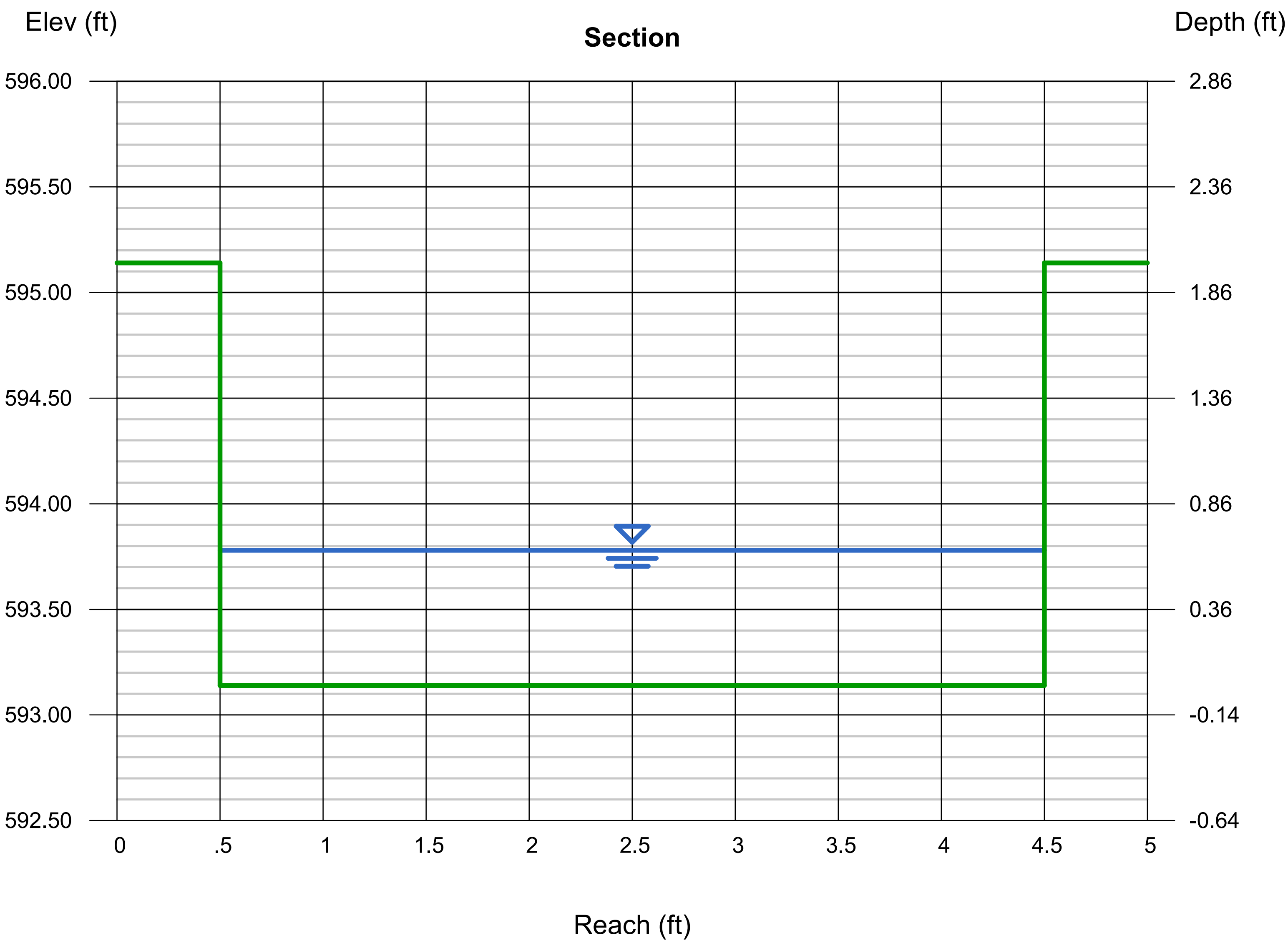


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

FBASIN_CS4X2@0.50%-Tc2YR

Rectangular		**Highlighted**	
Bottom Width (ft)	= 4.00	Depth (ft)	= 0.64
Total Depth (ft)	= 2.00	Q (cfs)	= 13.73
		Area (sqft)	= 2.56
Invert Elev (ft)	= 593.14	Velocity (ft/s)	= 5.36
Slope (%)	= 0.50	Wetted Perim (ft)	= 5.28
N-Value	= 0.012	Crit Depth, Yc (ft)	= 0.72
		Top Width (ft)	= 4.00
Calculations		EGL (ft)	= 1.09
Compute by:	Known Q		
Known Q (cfs)	= 13.73		



TR-55 Tc Worksheet

Sheet Flow

	A	B	C
Manning's n-value .... =	0.33	0.011	0.011
Flow length (ft, 300 max.) =	50		
Two-yr 24-hr rain (in) .... =	3.82	3.82	
Land slope (%) .... =	3.0		
Sheet flow time .... =	8.23	0.00	0.00

Shallow Concentrated Flow

	A	B	C
Flow length (ft) .... =	405		
Watercourse slope (%) .... =	3		
Surface description .... =	Unpaved	Paved	Paved
Shallow conc. flow time .. =	2.42	0.00	0.00

Channel Flow

	A	B	C
X-sectional area (sqft) =	6.38	5.63	7.94
Wetted perimeter (ft) =	21.64	9.87	9.89
Channel slope (%) .... =	1	2.83	1
Manning's n-value ... =	0.030	0.069	0.074
Flow length (ft) .... =	100	50	407
Channel flow time .... =	0.76	0.33	3.90

Sheet flow time = 8.23 min

Shallow conc. flow time = 2.42 min

Channel flow time = 5.00 min

Time of conc., Tc = 15.6 min

Compute | Print... | Help | Exit

TR-55 Tc Worksheet

Sheet Flow

	A	B	C
Manning's n-value .... =			
Flow length (ft, 300 max.) =			
Two-yr 24-hr rain (in) .... =			
Land slope (%) .... =			
Sheet flow time .... =	0.00	0.00	0.00

Shallow Concentrated Flow

	A	B	C
Flow length (ft) .... =			
Watercourse slope (%) .... =			
Surface description .... =	Unpaved	Paved	Paved
Shallow conc. flow time .. =	0.00	0.00	0.00

Channel Flow

	A	B	C
X-sectional area (sqft) =	2.56	8.10	2.32
Wetted perimeter (ft) =	5.28	10.3	6.10
Channel slope (%) .... =	0.50	1.0	32.5
Manning's n-value ... =	0.012	0.074	0.074
Flow length (ft) .... =	30	108	50
Channel flow time .... =	0.09	1.05	0.14

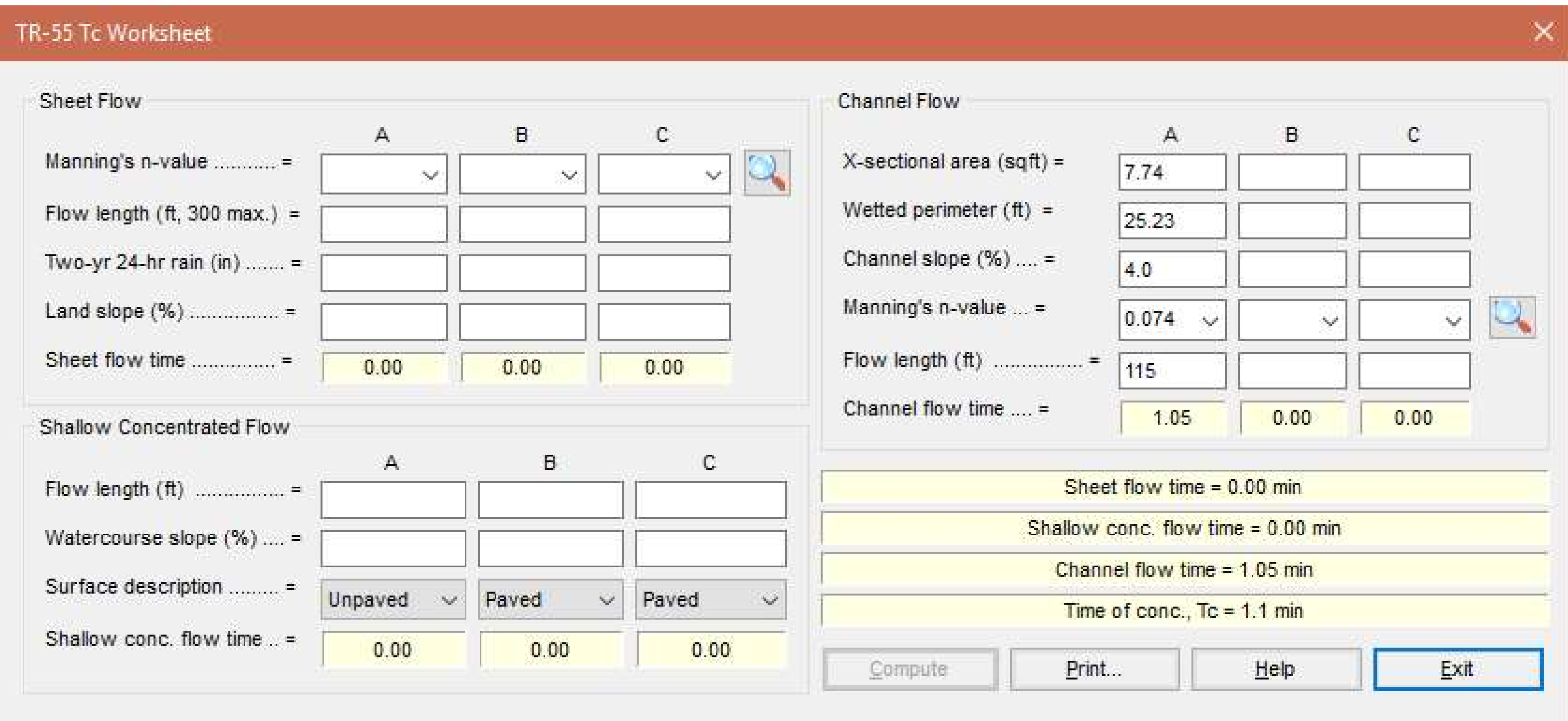
Sheet flow time = 0.00 min

Shallow conc. flow time = 0.00 min

Channel flow time = 1.28 min

Time of conc., Tc = 1.3 min

Compute | Print... | Help | Exit



TR-55 Tc Worksheet

Sheet Flow

	A	B	C
Manning's n-value .... =			
Flow length (ft, 300 max.) =			
Two-yr 24-hr rain (in) .... =			
Land slope (%) .... =			
Sheet flow time .... =	0.00	0.00	0.00

Shallow Concentrated Flow

	A	B	C
Flow length (ft) .... =			
Watercourse slope (%) .... =			
Surface description .... =	Unpaved	Paved	Paved
Shallow conc. flow time .. =	0.00	0.00	0.00

Channel Flow

	A	B	C
X-sectional area (sqft) =	7.74		
Wetted perimeter (ft) =	25.23		
Channel slope (%) .... =	4.0		
Manning's n-value ... =	0.074		
Flow length (ft) .... =	115		
Channel flow time .... =	1.05	0.00	0.00

Sheet flow time = 0.00 min

Shallow conc. flow time = 0.00 min

Channel flow time = 1.05 min

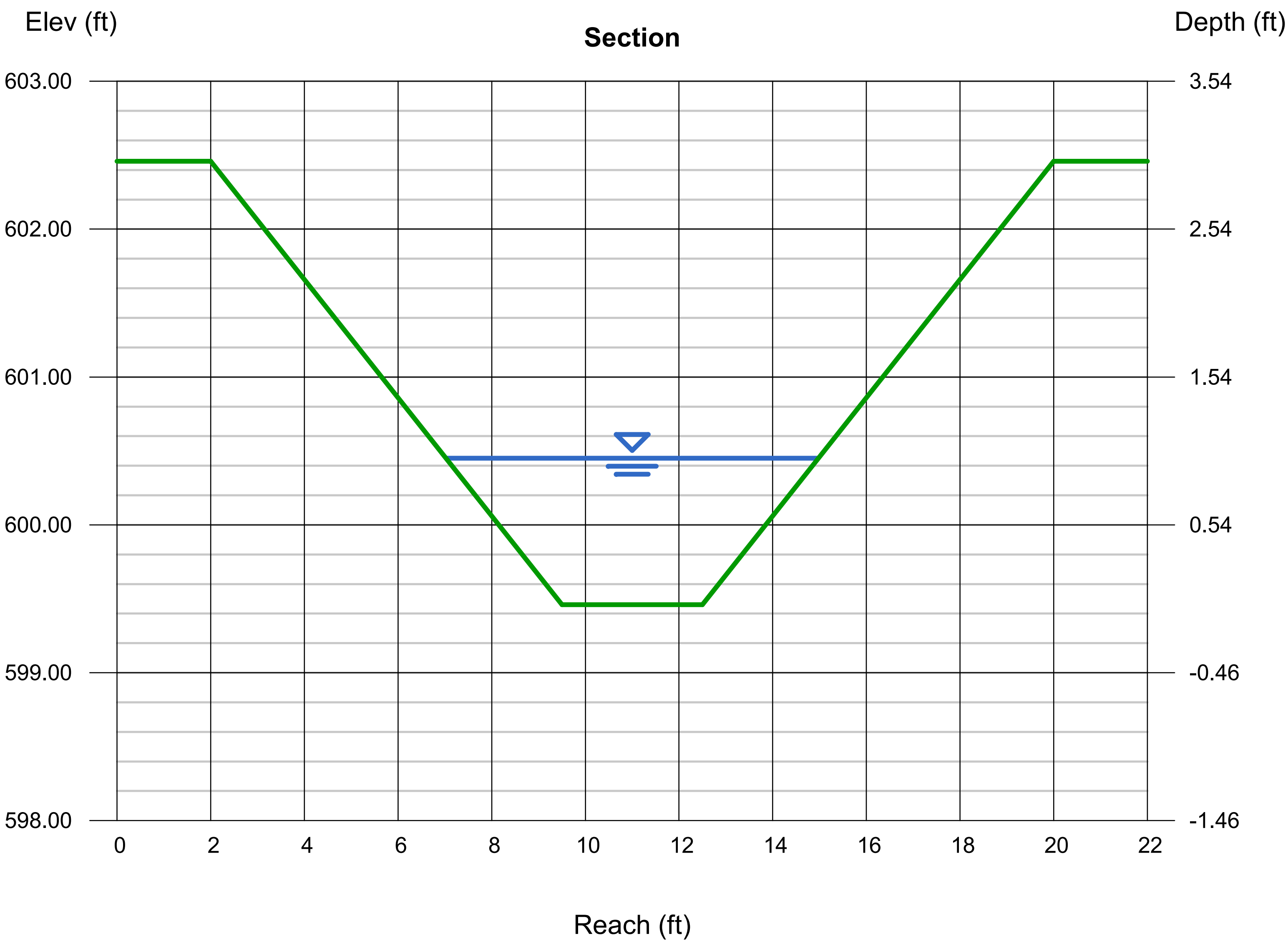
Time of conc., Tc = 1.1 min

Compute | Print... | Help | Exit

Channel Report

GBASIN_3'FB@1.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 3.00	Depth (ft)	= 0.99
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 8.010
Total Depth (ft)	= 3.00	Area (sqft)	= 5.42
Invert Elev (ft)	= 599.46	Velocity (ft/s)	= 1.48
Slope (%)	= 1.00	Wetted Perim (ft)	= 8.33
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.52
		Top Width (ft)	= 7.95
Calculations		EGL (ft)	= 1.02
Compute by:	Known Q		
Known Q (cfs)	= 8.01		



Channel Report

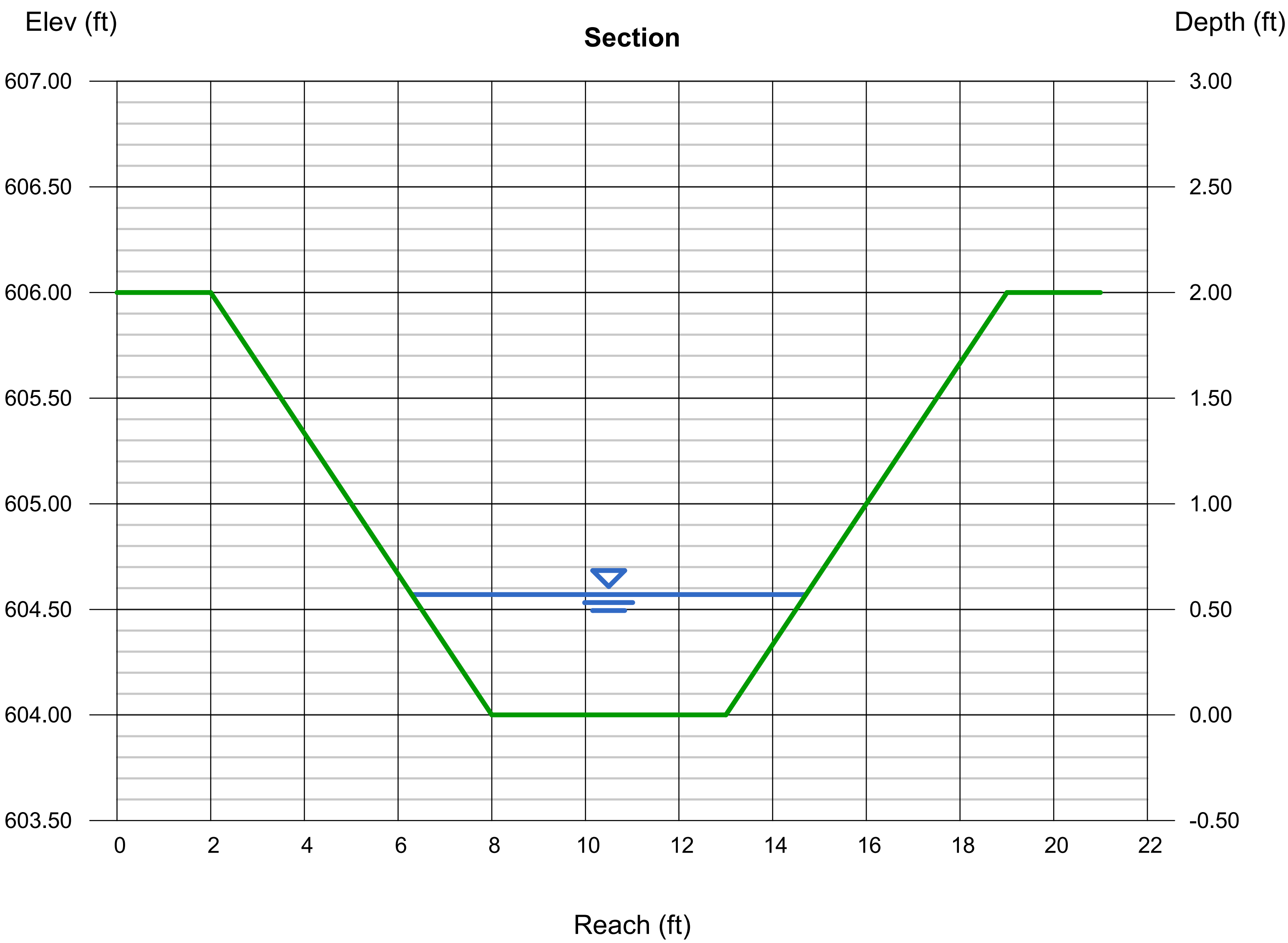
Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Friday, Nov 9 2018

GBASIN_5'FB@2.83%-Tc2YR

Trapezoidal	
Bottom Width (ft)	= 5.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 604.00
Slope (%)	= 2.83
N-Value	= 0.069

Calculations	
Compute by:	Known Q
Known Q (cfs)	= 8.01

Highlighted	
Depth (ft)	= 0.57
Q (cfs)	= 8.010
Area (sqft)	= 3.82
Velocity (ft/s)	= 2.09
Wetted Perim (ft)	= 8.60
Crit Depth, Yc (ft)	= 0.40
Top Width (ft)	= 8.42
EGL (ft)	= 0.64

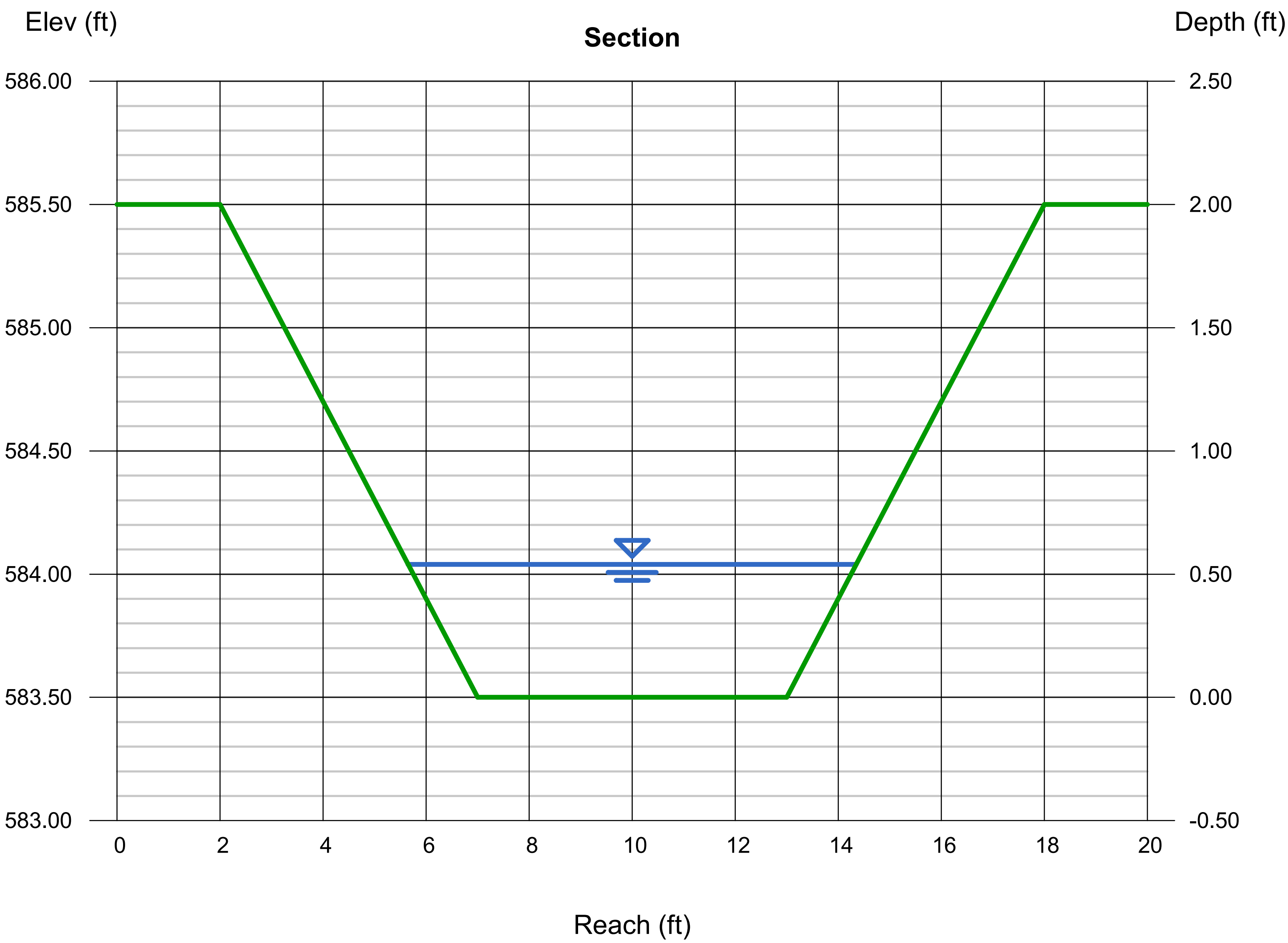


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. | Friday, Nov 9 2018

GBASIN_6'FB@3.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.54
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 8.010
Total Depth (ft)	= 2.00	Area (sqft)	= 3.97
Invert Elev (ft)	= 583.50	Velocity (ft/s)	= 2.02
Slope (%)	= 3.00	Wetted Perim (ft)	= 8.91
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.37
		Top Width (ft)	= 8.70
Calculations		EGL (ft)	= 0.60
Compute by:	Known Q		
Known Q (cfs)	= 8.01		



Channel Report

GBASIN_6'FB@5.5%-Tc2YR

Trapezoidal

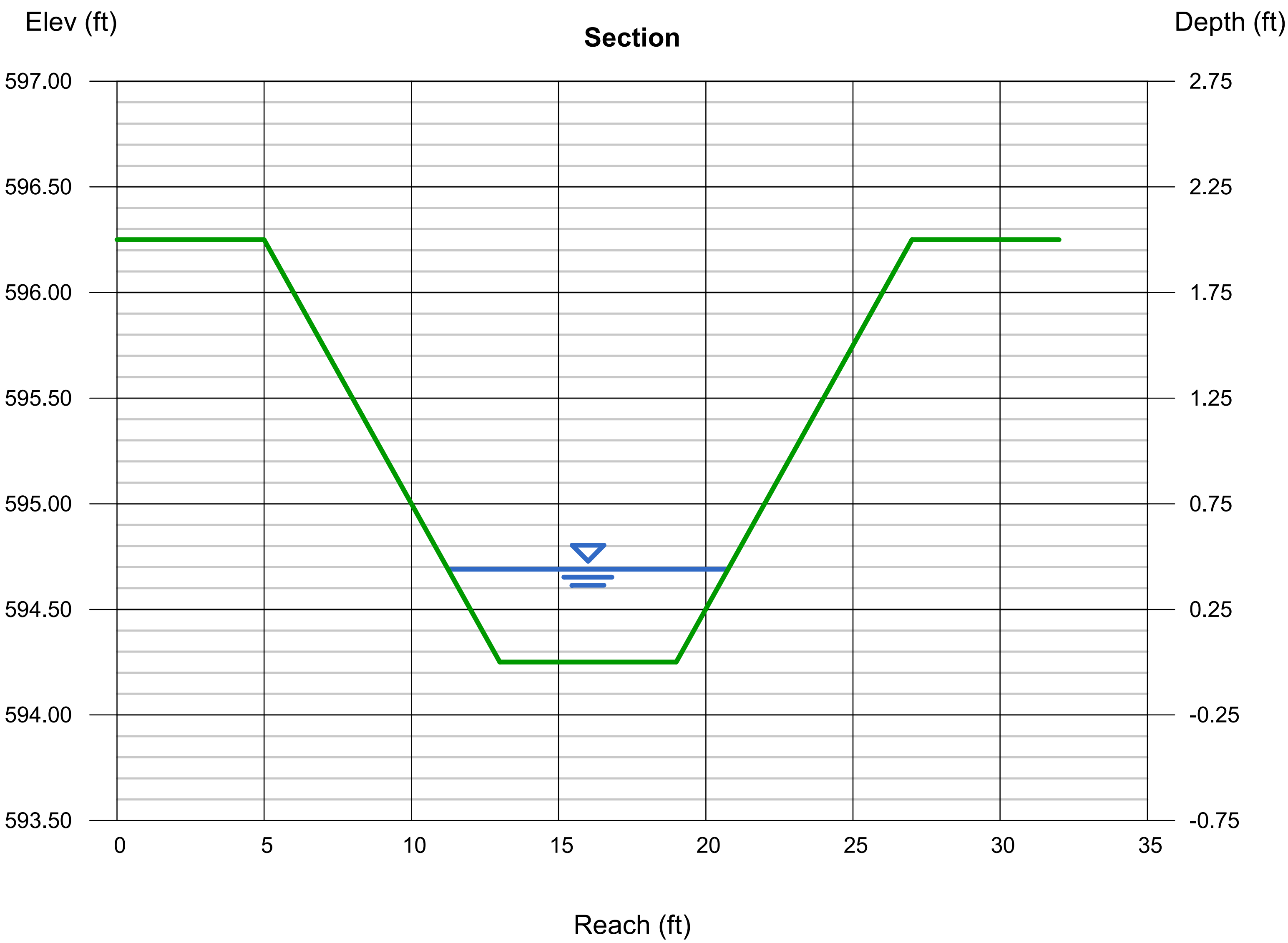
Bottom Width (ft)	=	6.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	2.00
Invert Elev (ft)	=	594.25
Slope (%)	=	5.50
N-Value	=	0.074

Calculations

Compute by:		Known Q
Known Q (cfs)	=	8.01

Highlighted

Depth (ft)	=	0.44
Q (cfs)	=	8.010
Area (sqft)	=	3.41
Velocity (ft/s)	=	2.35
Wetted Perim (ft)	=	9.63
Crit Depth, Yc (ft)	=	0.36
Top Width (ft)	=	9.52
EGL (ft)	=	0.53

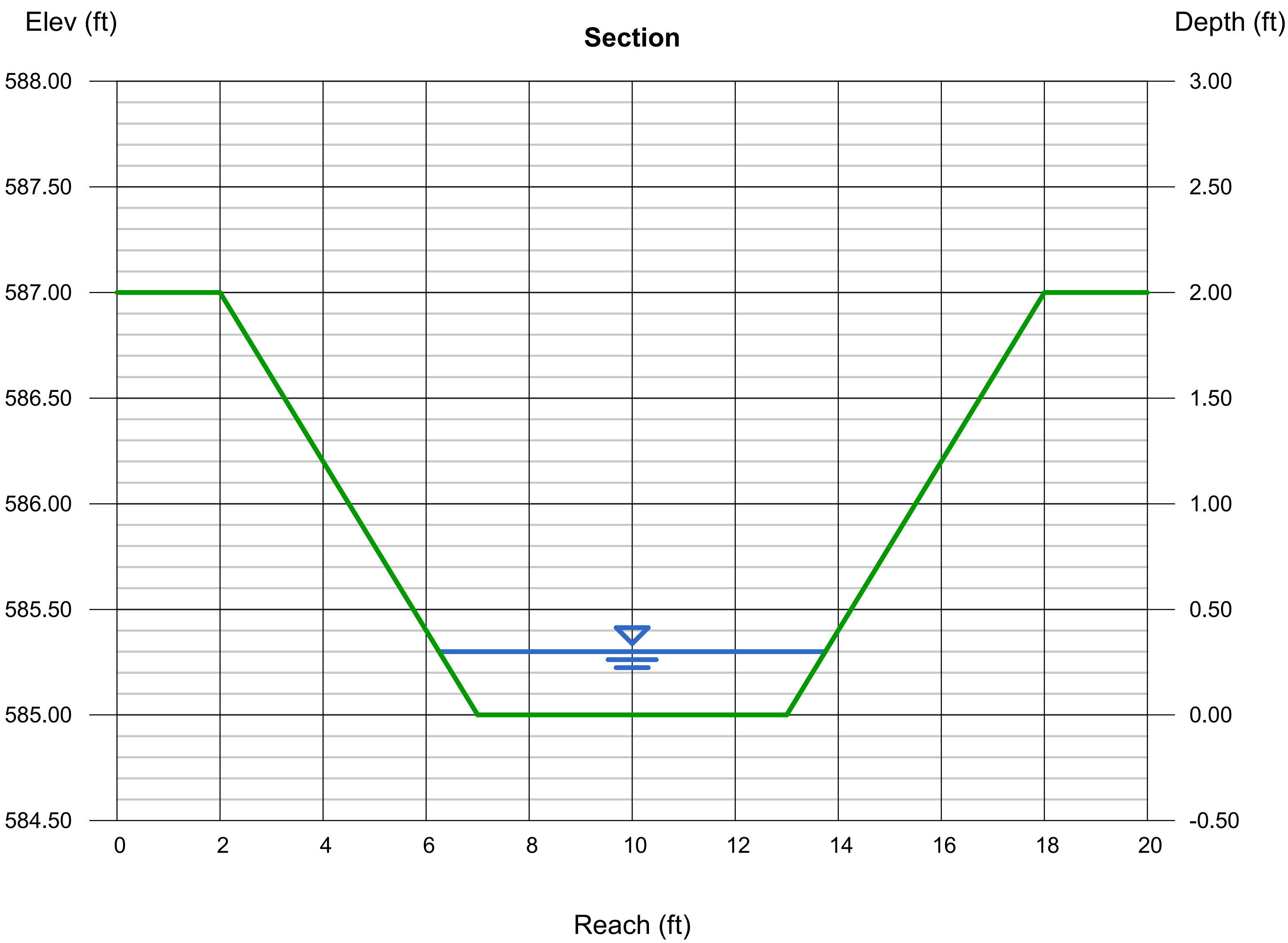


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Nov 9 2018

GBASIN_6'FB@25.0%-Tc2YR

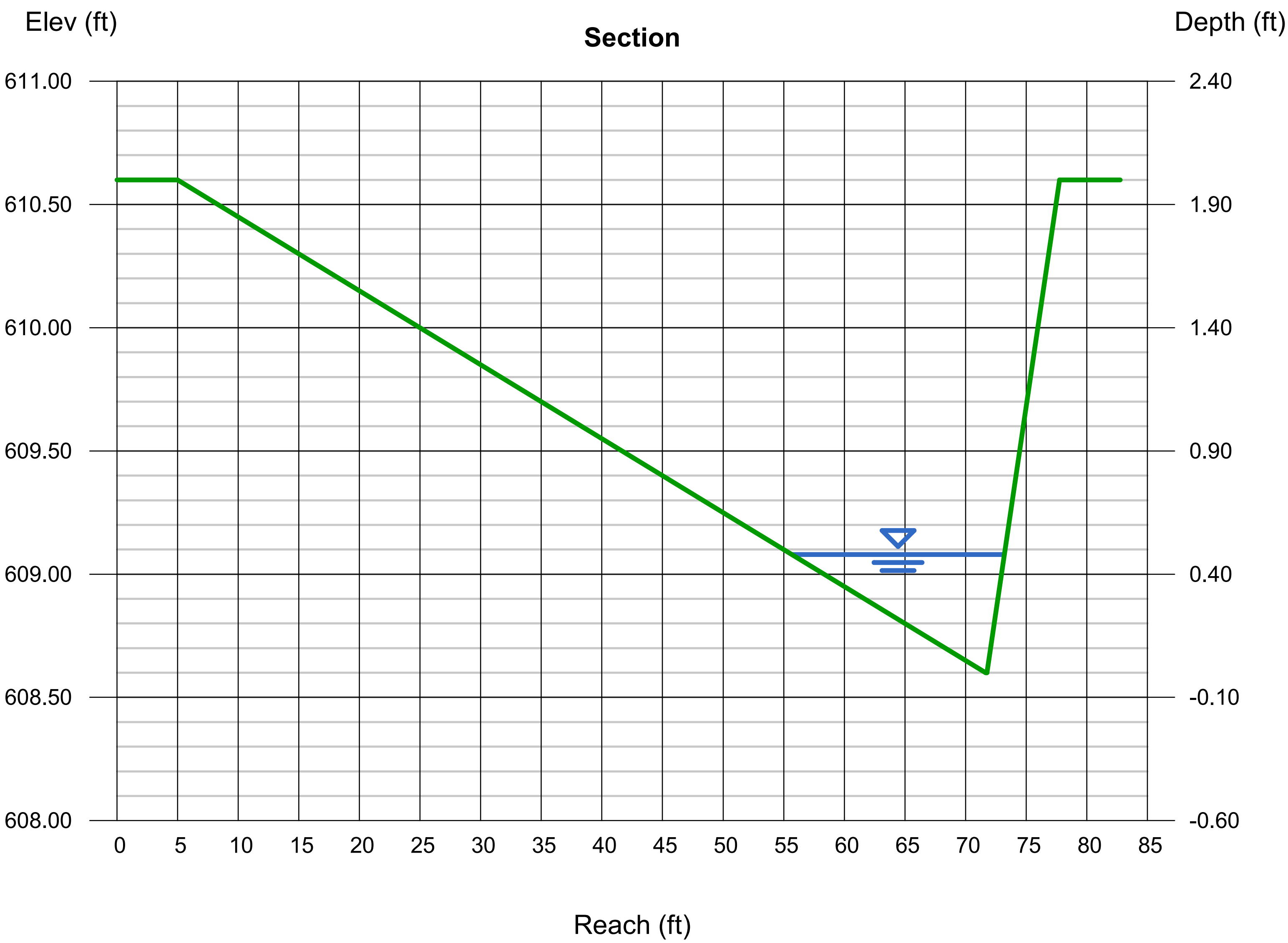
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 6.00	Depth (ft)	= 0.30
Side Slopes (z:1)	= 2.50, 2.50	Q (cfs)	= 8.010
Total Depth (ft)	= 2.00	Area (sqft)	= 2.03
Invert Elev (ft)	= 585.00	Velocity (ft/s)	= 3.96
Slope (%)	= 25.00	Wetted Perim (ft)	= 7.62
N-Value	= 0.074	Crit Depth, Yc (ft)	= 0.37
		Top Width (ft)	= 7.50
Calculations		EGL (ft)	= 0.54
Compute by:	Known Q		
Known Q (cfs)	= 8.01		



Channel Report

GBASIN_CapSwale@1.0%-Tc2YR

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 0.10	Depth (ft)	= 0.48
Side Slopes (z:1)	= 33.33, 3.00	Q (cfs)	= 8.010
Total Depth (ft)	= 2.00	Area (sqft)	= 4.23
Invert Elev (ft)	= 608.60	Velocity (ft/s)	= 1.89
Slope (%)	= 1.00	Wetted Perim (ft)	= 17.62
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.42
		Top Width (ft)	= 17.54
Calculations		EGL (ft)	= 0.54
Compute by:	Known Q		
Known Q (cfs)	= 8.01		



TR-55 Tc Worksheet

Sheet Flow

	A	B	C
Manning's n-value .... =	0.33		
Flow length (ft, 300 max.) =	50		
Two-yr 24-hr rain (in) .... =	3.82		
Land slope (%) .... =	3		
Sheet flow time .... =	8.23	0.00	0.00

Shallow Concentrated Flow

	A	B	C
Flow length (ft) .... =	269		
Watercourse slope (%) .... =	3		
Surface description .... =	Unpaved	Paved	Paved
Shallow conc. flow time .. =	1.60	0.00	0.00

Channel Flow

	A	B	C
X-sectional area (sqft) =	4.23	3.82	5.42
Wetted perimeter (ft) =	17.62	8.6	8.33
Channel slope (%) .... =	1	2.83	1.0
Manning's n-value ... =	0.03	0.069	0.074
Flow length (ft) .... =	281	50	163
Channel flow time .... =	2.45	0.40	1.80

Sheet flow time = 8.23 min

Shallow conc. flow time = 1.60 min

Channel flow time = 4.65 min

Time of conc., Tc = 14.5 min

Compute | Print... | Help | Exit

TR-55 Tc Worksheet

Sheet Flow

	A	B	C
Manning's n-value .... =			
Flow length (ft, 300 max.) =			
Two-yr 24-hr rain (in) .... =			
Land slope (%) .... =			
Sheet flow time .... =	0.00	0.00	0.00

Shallow Concentrated Flow

	A	B	C
Flow length (ft) .... =			
Watercourse slope (%) .... =			
Surface description .... =	Unpaved	Paved	Paved
Shallow conc. flow time .. =	0.00	0.00	0.00

Channel Flow

	A	B	C
X-sectional area (sqft) =	3.97	2.03	3.41
Wetted perimeter (ft) =	8.91	7.62	9.63
Channel slope (%) .... =	3	25	5.5
Manning's n-value ... =	0.074	0.074	0.074
Flow length (ft) .... =	50	42	99
Channel flow time .... =	0.41	0.17	0.70

Sheet flow time = 0.00 min

Shallow conc. flow time = 0.00 min

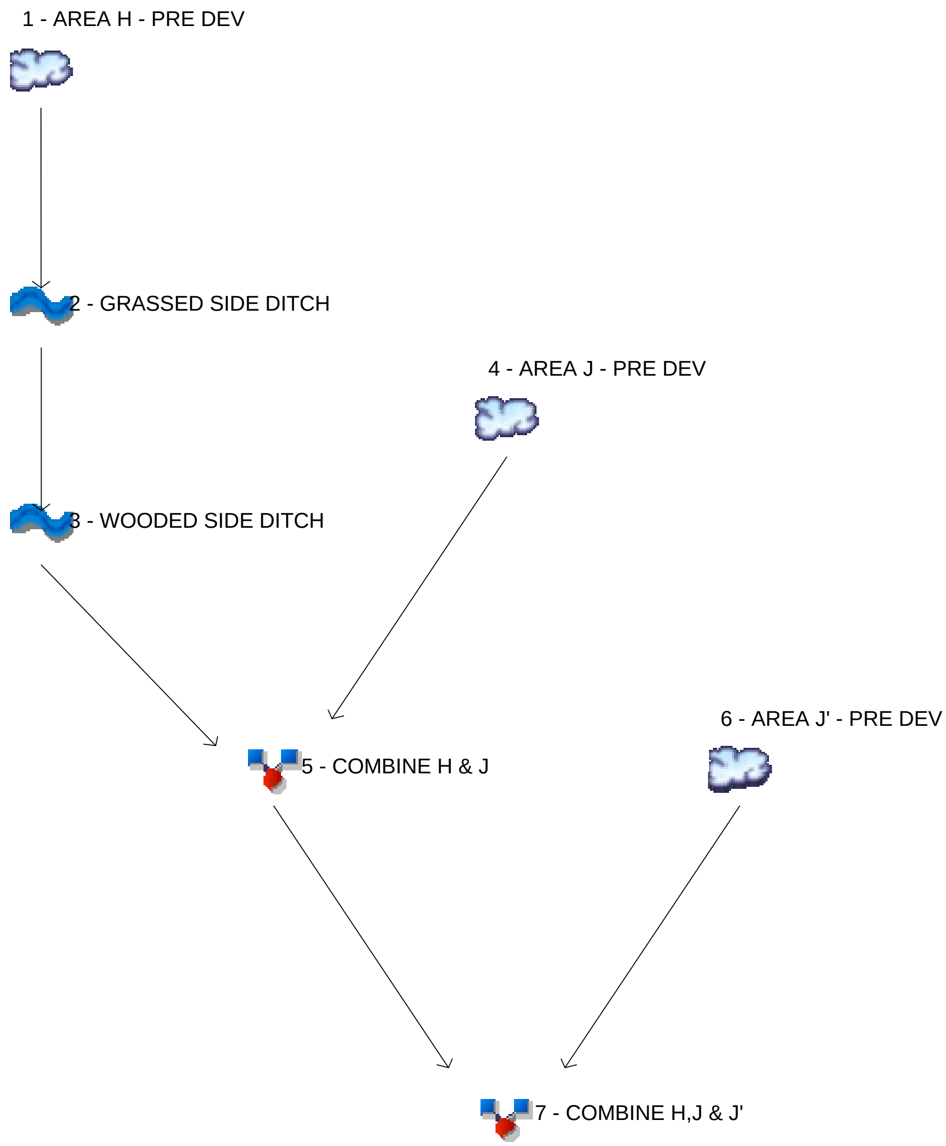
Channel flow time = 1.28 min

Time of conc., Tc = 1.3 min

Compute | Print... | Help | Exit

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12



Project: PREDEV_SOLAR.gpw	Sunday, 01 / 10 / 2021

Hydrograph Report

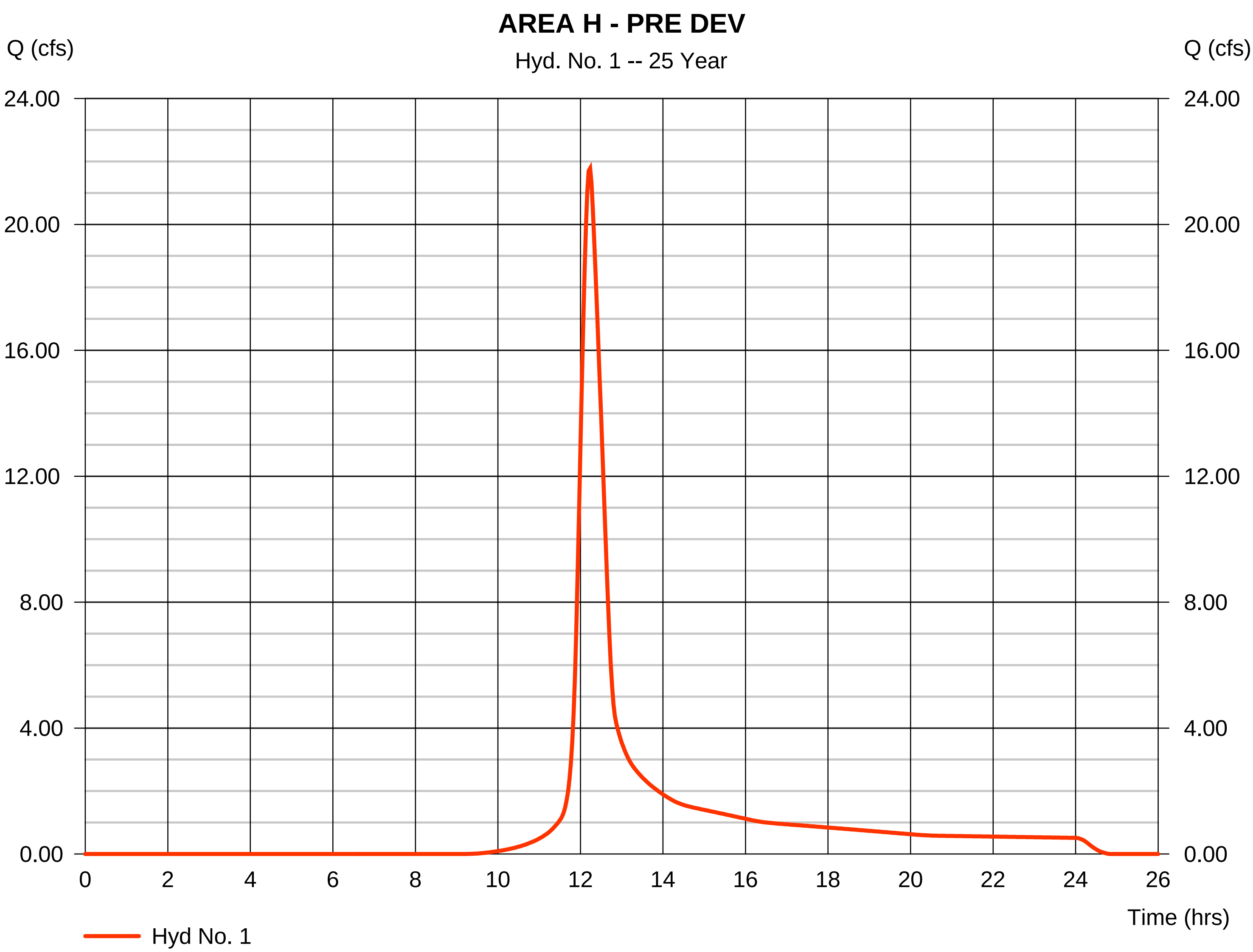
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 1

AREA H - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 21.78 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 95,534 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 30.30 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



TR55 Tc Worksheet

Hyd. No. 1

AREA H - PRE DEV

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.410		0.011		0.011		
Flow length (ft)	=	94.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.82		3.82		0.00		
Land slope (%)	=	2.50		0.00		0.00		
Travel Time (min)	**=**	**17.45**	**+**	**0.00**	**+**	**0.00**	**=**	**17.45**
Shallow Concentrated Flow								
Flow length (ft)	=	324.00		0.00		0.00		
Watercourse slope (%)	=	2.00		0.00		0.00		
Surface description	=	Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=2.28			0.00		0.00		
Travel Time (min)	**=**	**2.37**	**+**	**0.00**	**+**	**0.00**	**=**	**2.37**
Channel Flow								
X sectional flow area (sqft)	=	4.88		5.09		5.87		
Wetted perimeter (ft)	=	24.89		30.79		21.11		
Channel slope (%)	=	0.55		0.65		0.32		
Manning's n-value	=	0.030		0.030		0.035		
Velocity (ft/s)	=1.24							
				1.20				
						1.02		
Flow length (ft)	({0})238.0			152.0		315.0		
Travel Time (min)	**=**	**3.21**	**+**	**2.11**	**+**	**5.14**	**=**	**10.46**

Total Travel Time, Tc .... **30.30 min**

Hydrograph Report

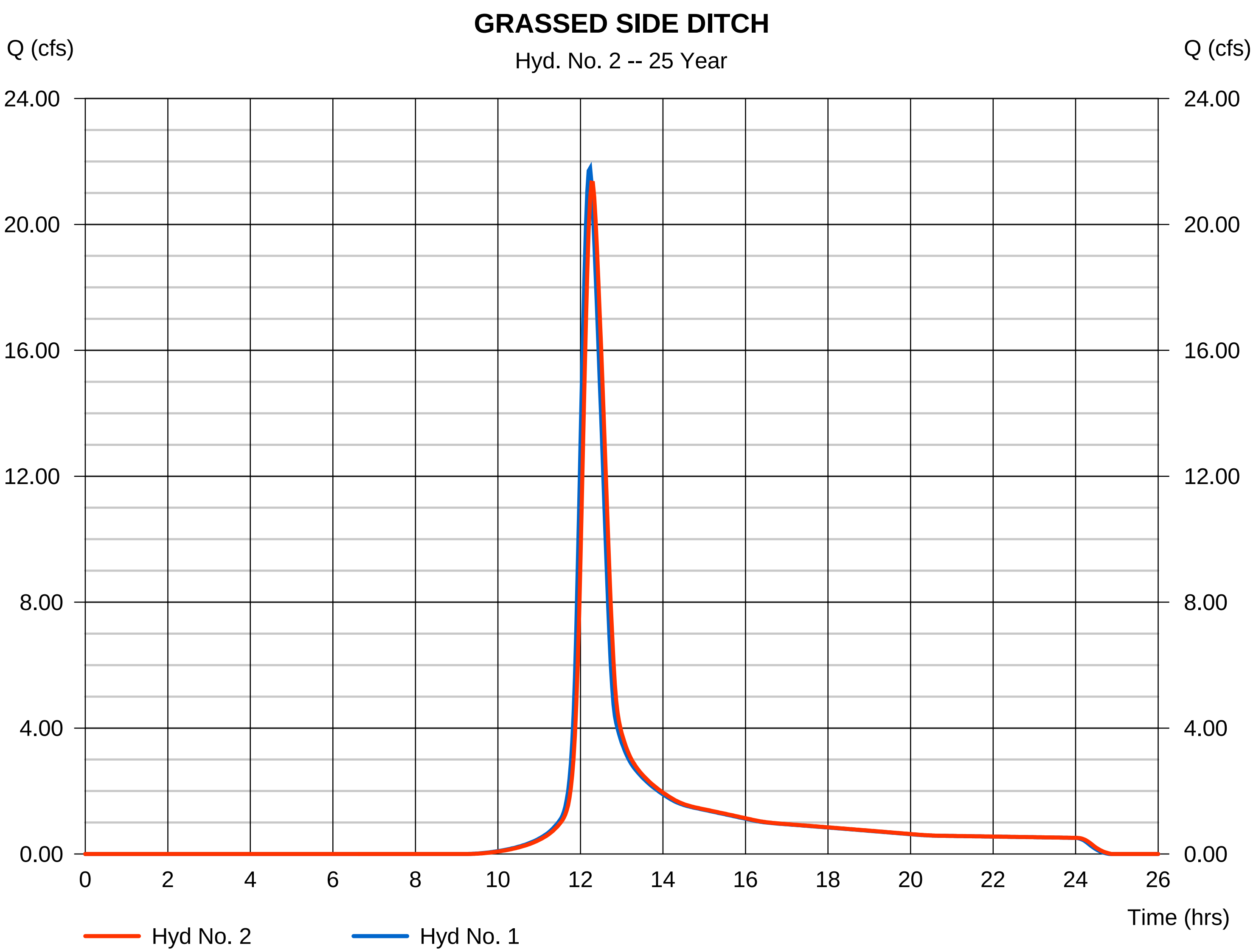
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 | Sunday, 01 / 10 / 2021

Hyd. No. 2

GRASSED SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 21.33 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.27 hrs
Time interval	= 2 min	Hyd. volume	= 95,532 cuft
Inflow hyd. No.	= 1 - AREA H - PRE DEV	Section type	= Trapezoidal
Reach length	= 522.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.045	Bottom width	= 2.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 1.475	Rating curve m	= 1.244
Ave. velocity	= 2.50 ft/s	Routing coeff.	= 0.5268

Modified Att-Kin routing method used.



Hydrograph Report

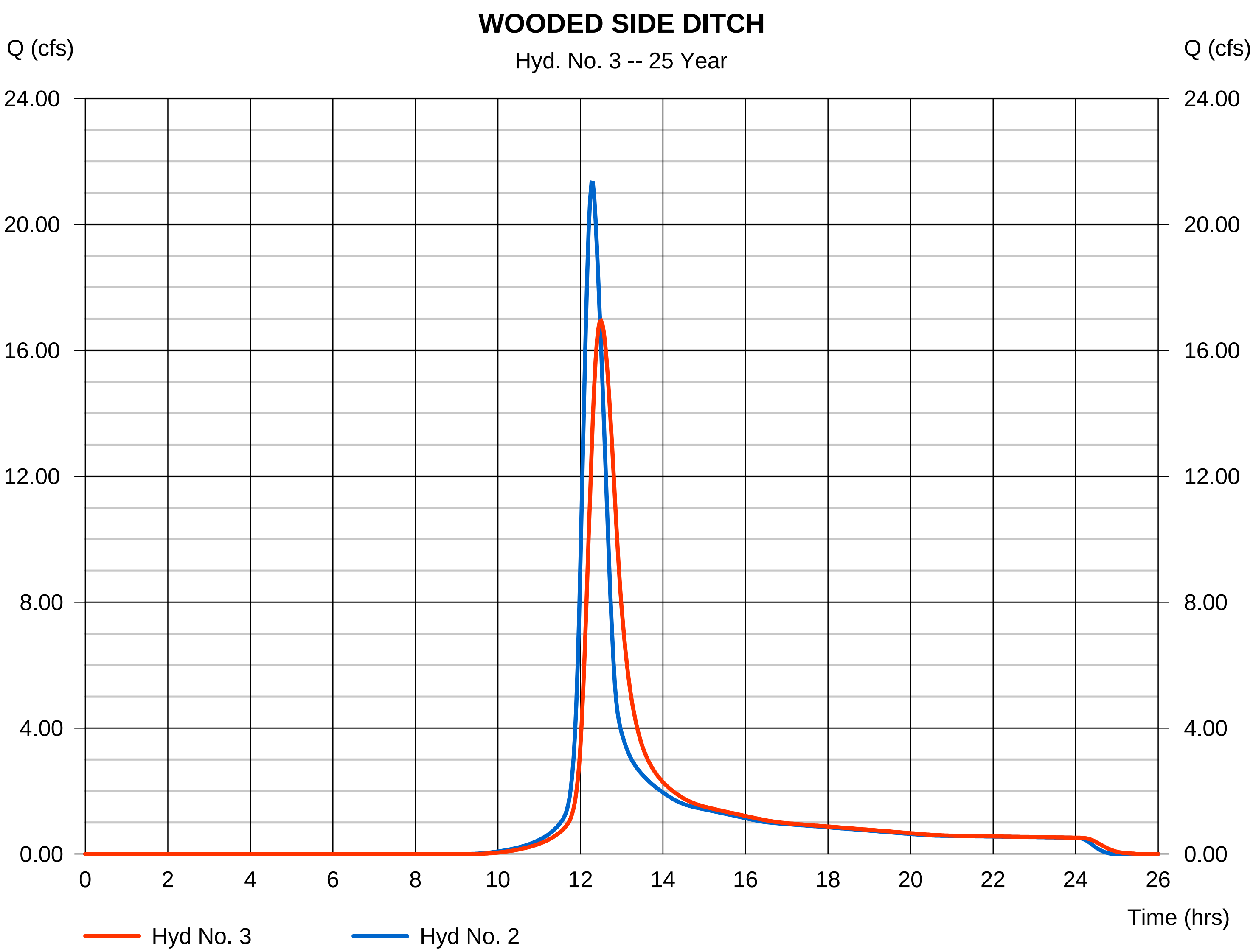
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 3

WOODED SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 16.94 cfs
Storm frequency	= 25 yrs	Time to peak	= 12.50 hrs
Time interval	= 2 min	Hyd. volume	= 95,524 cuft
Inflow hyd. No.	= 2 - GRASSED SIDE DITCH	Section type	= Trapezoidal
Reach length	= 415.0 ft	Channel slope	= 0.2 %
Manning's n	= 0.150	Bottom width	= 2.0 ft
Side slope	= 10.0:1	Max. depth	= 3.0 ft
Rating curve x	= 0.273	Rating curve m	= 1.127
Ave. velocity	= 0.45 ft/s	Routing coeff.	= 0.1355

Modified Att-Kin routing method used.



Hydrograph Report

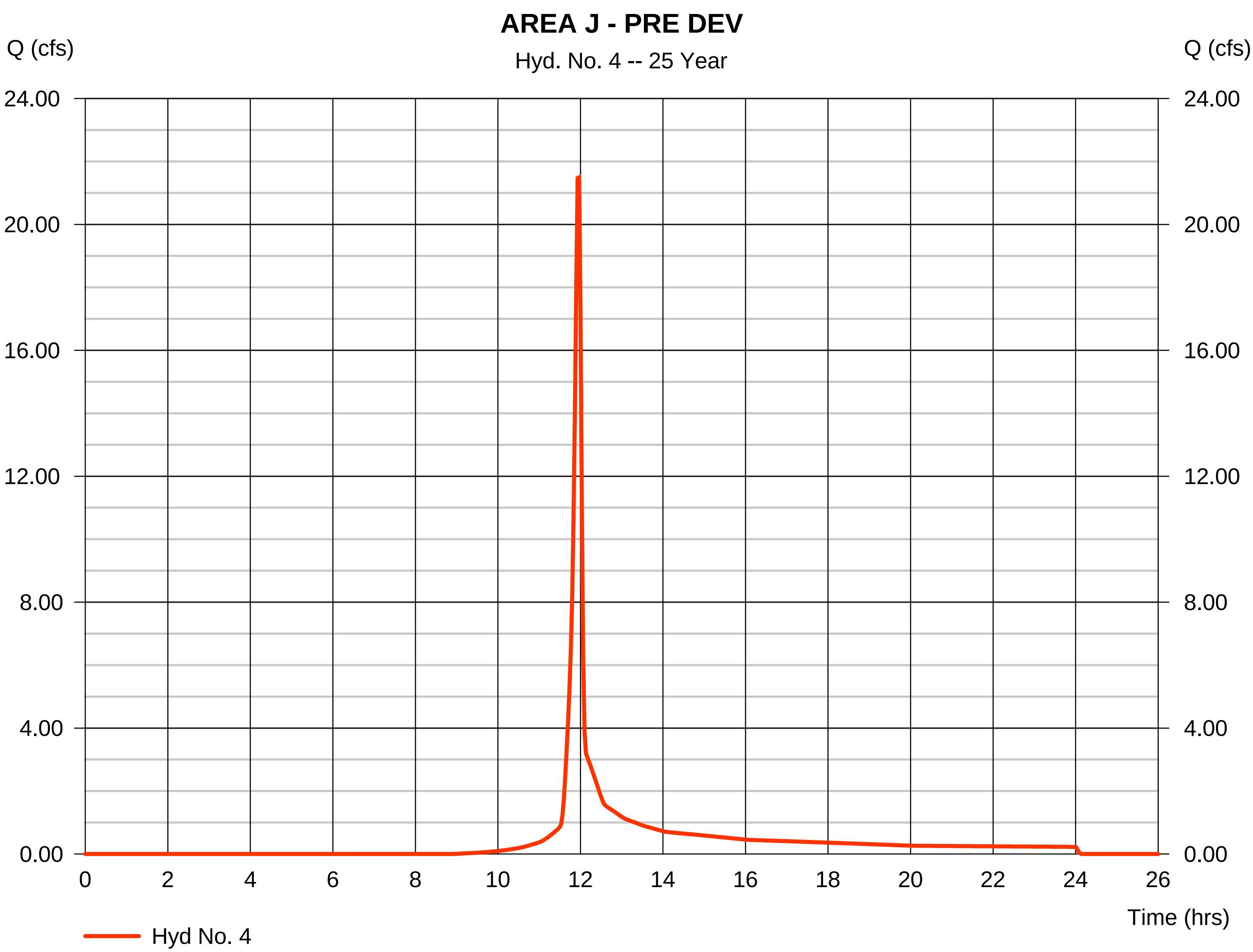
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 | Sunday, 01 / 10 / 2021

Hyd. No. 4

AREA J - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 21.49 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 43,351 cuft
Drainage area	= 4.320 ac	Curve number	= 69*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.550 x 85) + (0.020 x 65) + (0.690 x 98) + (3.060 x 60)] / 4.320



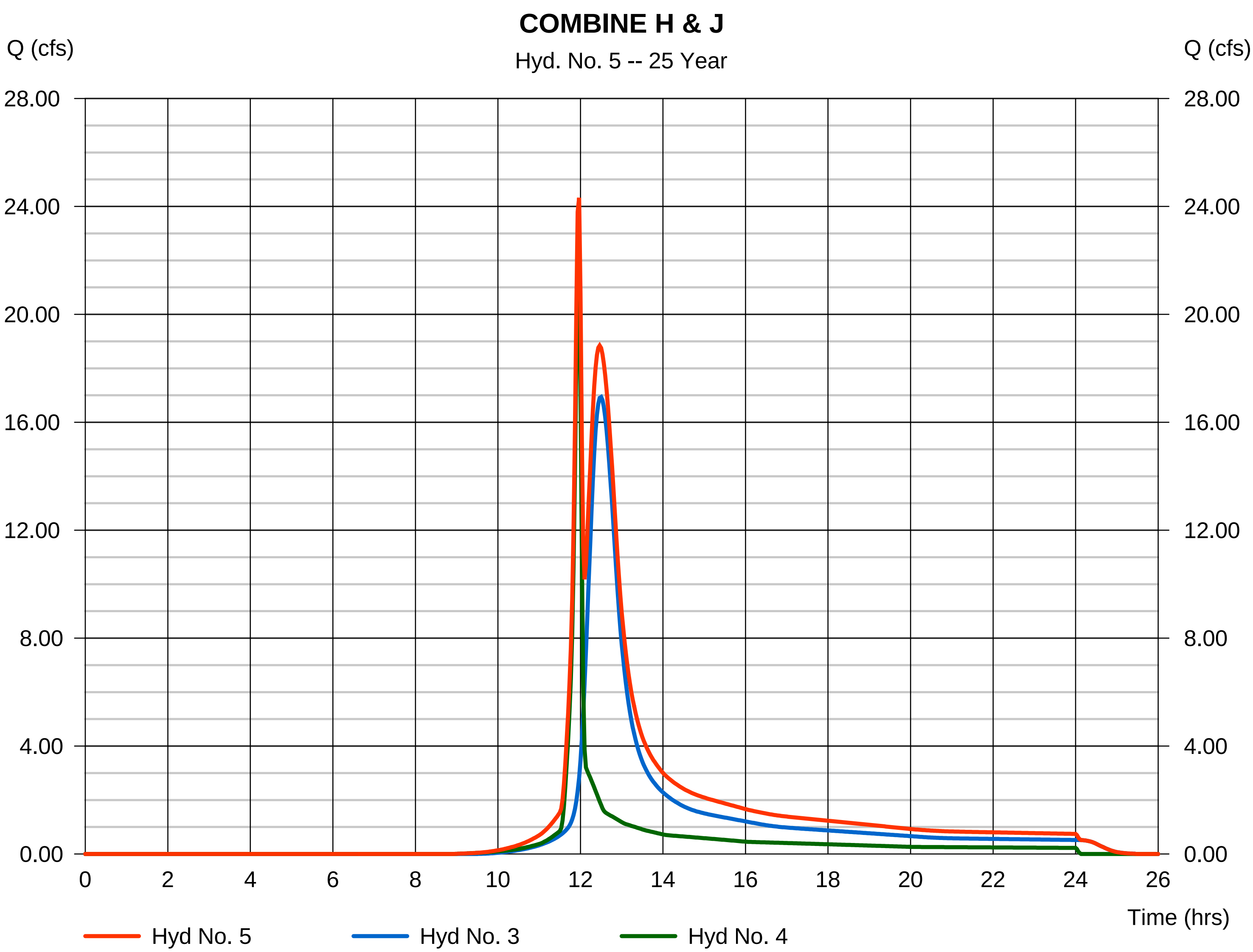
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 5

COMBINE H & J

Hydrograph type	= Combine	Peak discharge	= 24.32 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 138,875 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 4.320 ac



Hydrograph Report

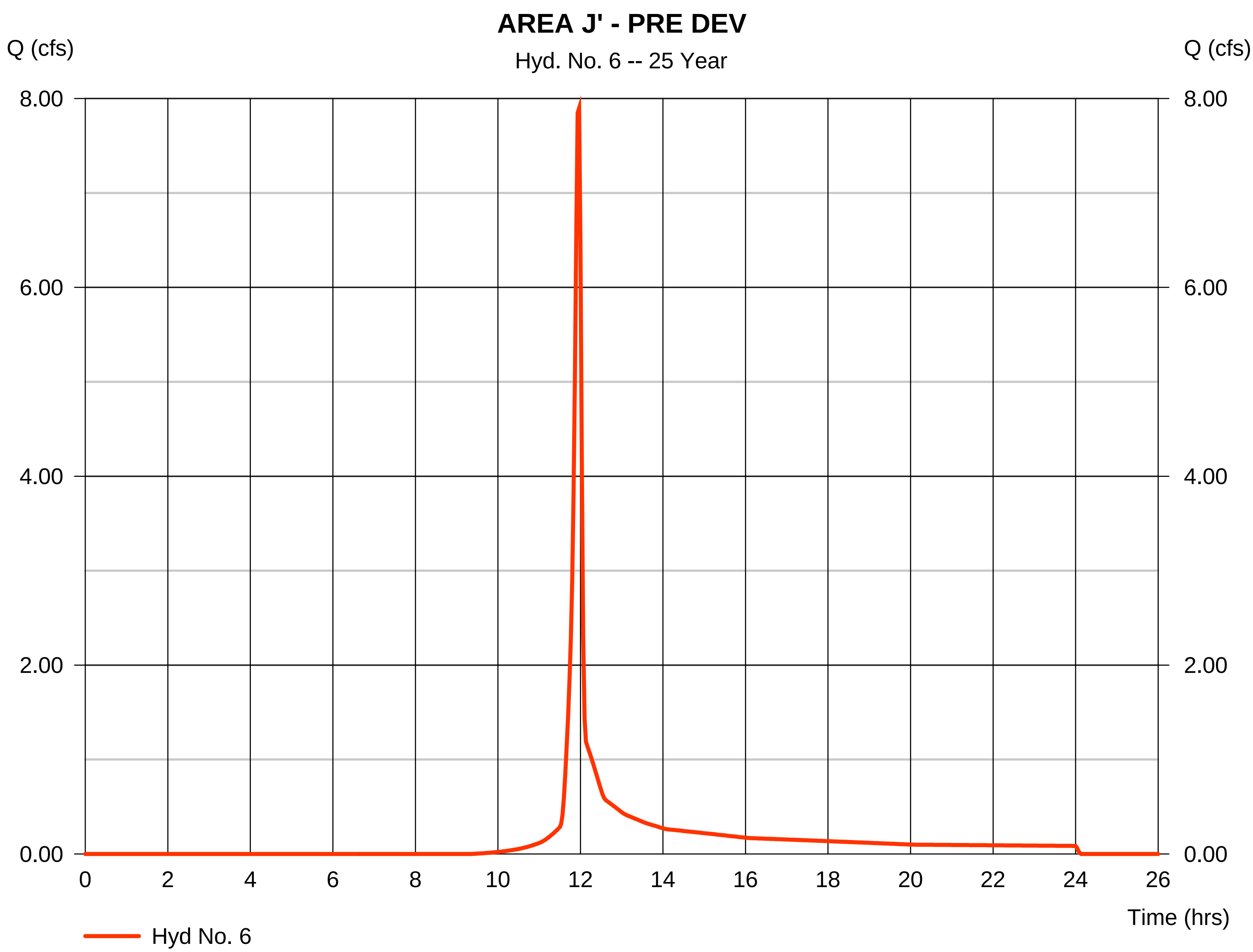
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 | Sunday, 01 / 10 / 2021

Hyd. No. 6

AREA J' - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 7.899 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 15,865 cuft
Drainage area	= 1.690 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.200 x 85) + (0.220 x 65) + (1.040 x 60) + (0.230 x 82)] / 1.690



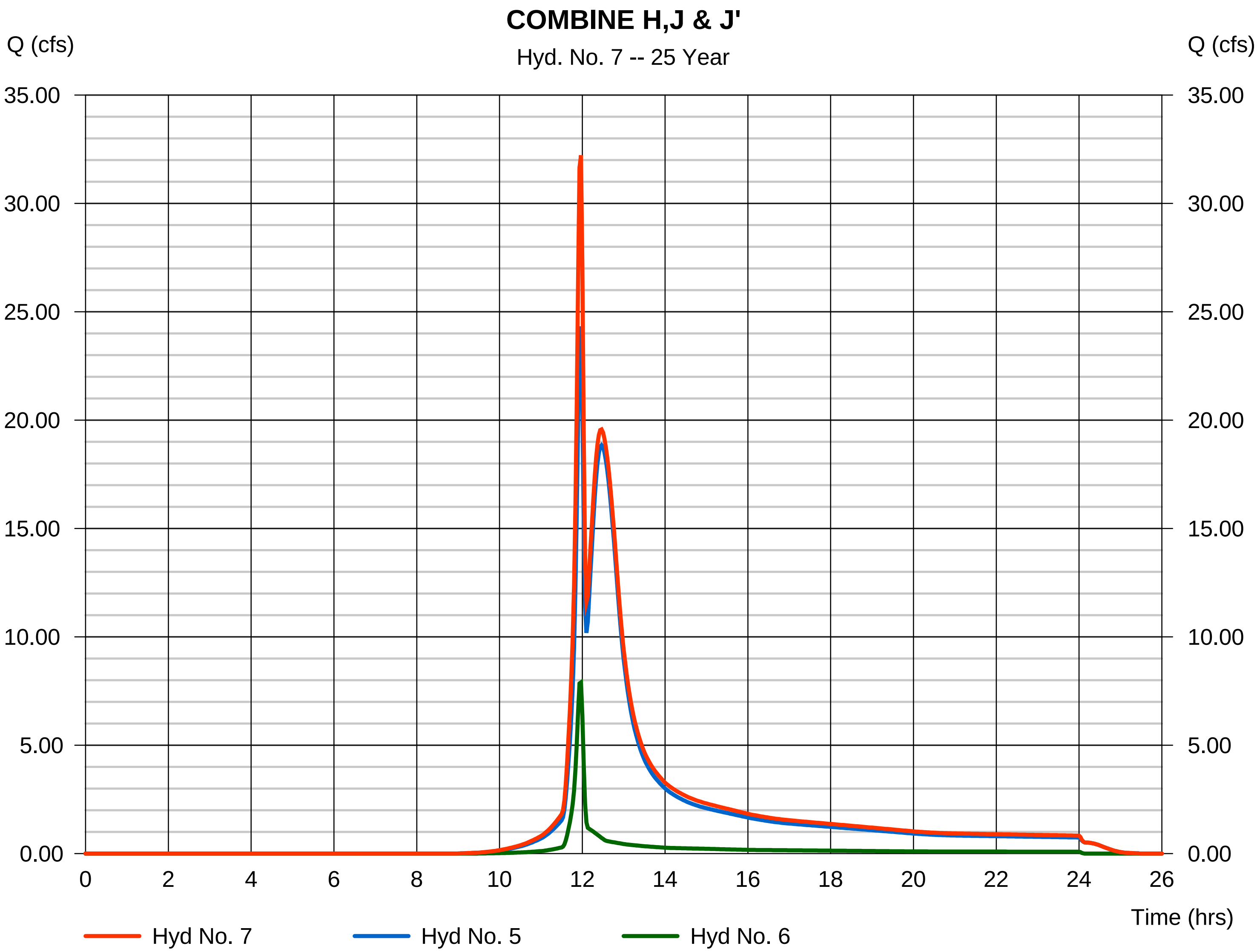
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 | Sunday, 01 / 10 / 2021

Hyd. No. 7

COMBINE H,J & J'

Hydrograph type	= Combine	Peak discharge	= 32.22 cfs
Storm frequency	= 25 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 154,740 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 1.690 ac



Hydrograph Report

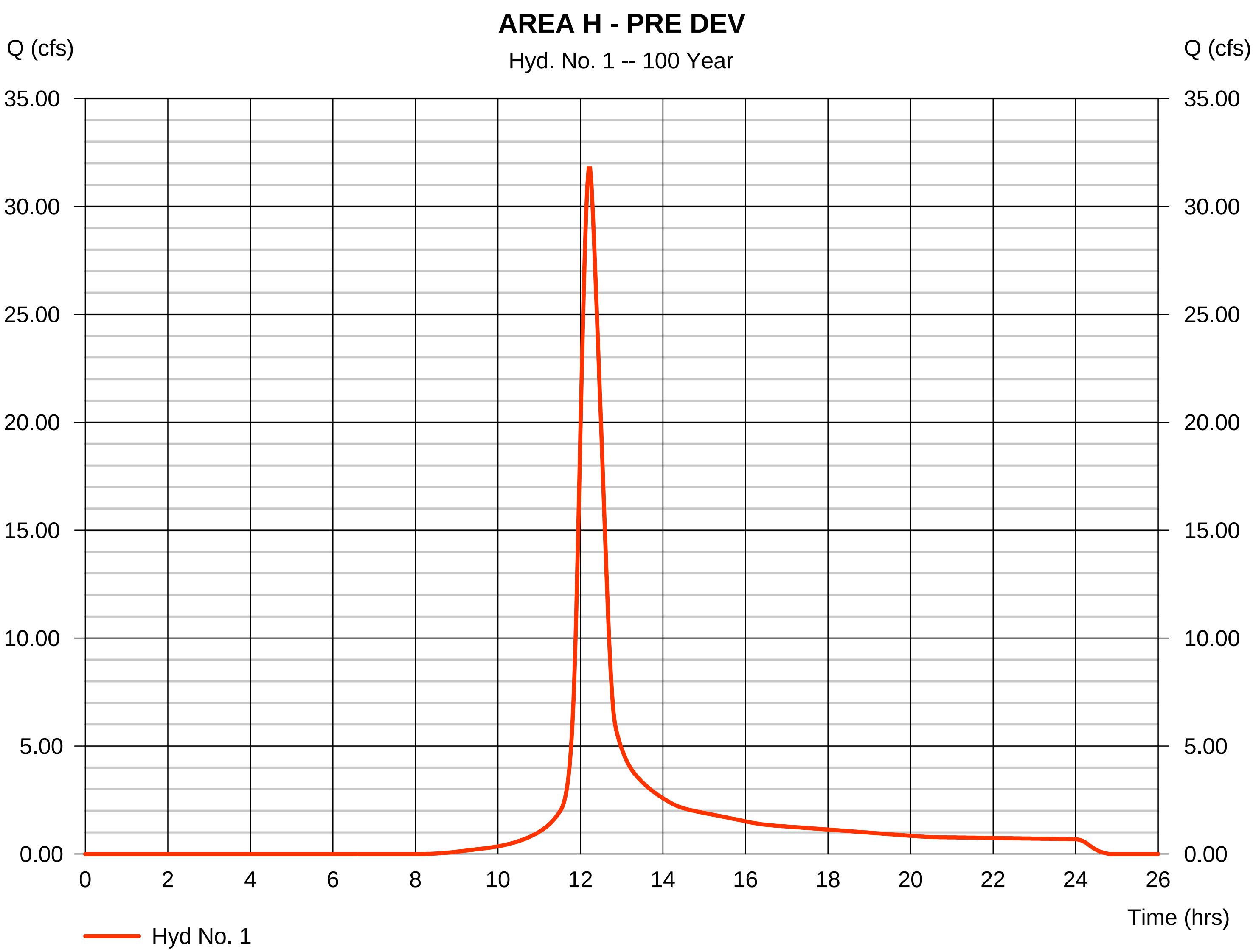
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 | Sunday, 01 / 10 / 2021

Hyd. No. 1

AREA H - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 31.76 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.23 hrs
Time interval	= 2 min	Hyd. volume	= 137,880 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 30.30 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



Hydrograph Report

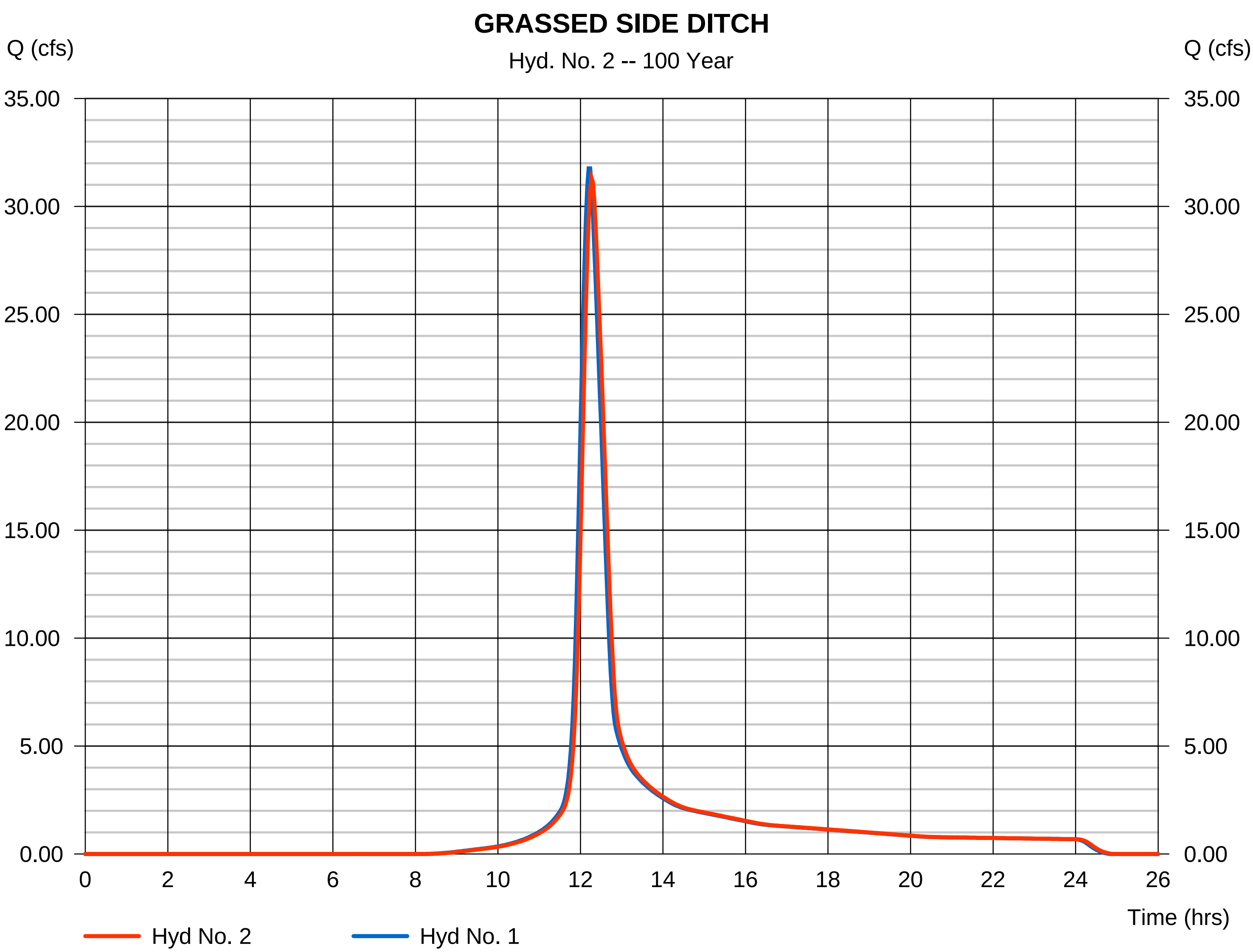
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 2

GRASSED SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 31.31 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.27 hrs
Time interval	= 2 min	Hyd. volume	= 137,878 cuft
Inflow hyd. No.	= 1 - AREA H - PRE DEV	Section type	= Trapezoidal
Reach length	= 522.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.045	Bottom width	= 2.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 1.475	Rating curve m	= 1.244
Ave. velocity	= 2.69 ft/s	Routing coeff.	= 0.5560

Modified Att-Kin routing method used.



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 | Sunday, 01 / 10 / 2021

Hyd. No. 3

WOODED SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 25.13 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.47 hrs
Time interval	= 2 min	Hyd. volume	= 137,871 cuft
Inflow hyd. No.	= 2 - GRASSED SIDE DITCH	Section type	= Trapezoidal
Reach length	= 415.0 ft	Channel slope	= 0.2 %
Manning's n	= 0.150	Bottom width	= 2.0 ft
Side slope	= 10.0:1	Max. depth	= 3.0 ft
Rating curve x	= 0.273	Rating curve m	= 1.127
Ave. velocity	= 0.47 ft/s	Routing coeff.	= 0.1411

Modified Att-Kin routing method used.

Hydrograph Report

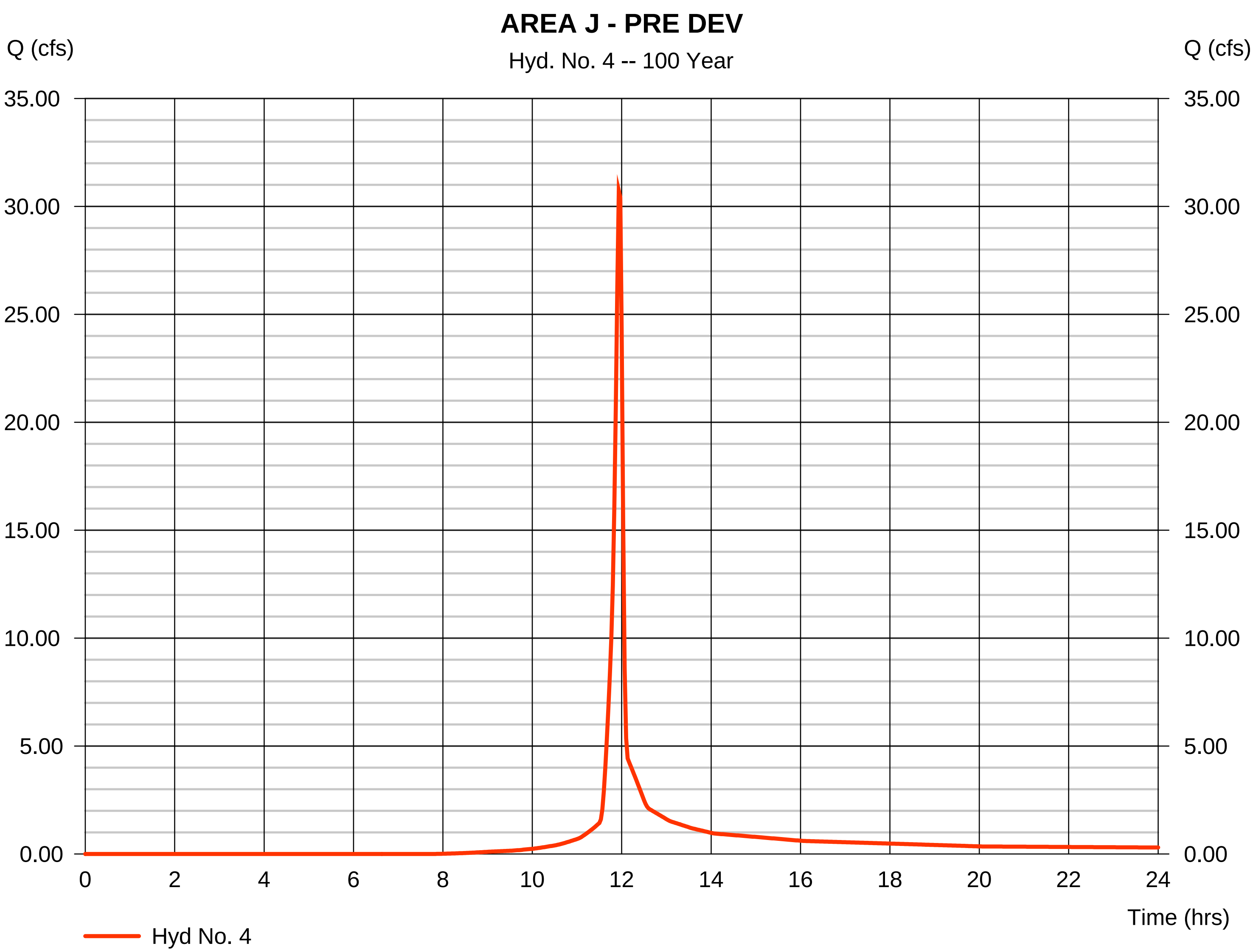
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 4

AREA J - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 30.72 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 62,201 cuft
Drainage area	= 4.320 ac	Curve number	= 69*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.550 x 85) + (0.020 x 65) + (0.690 x 98) + (3.060 x 60)] / 4.320



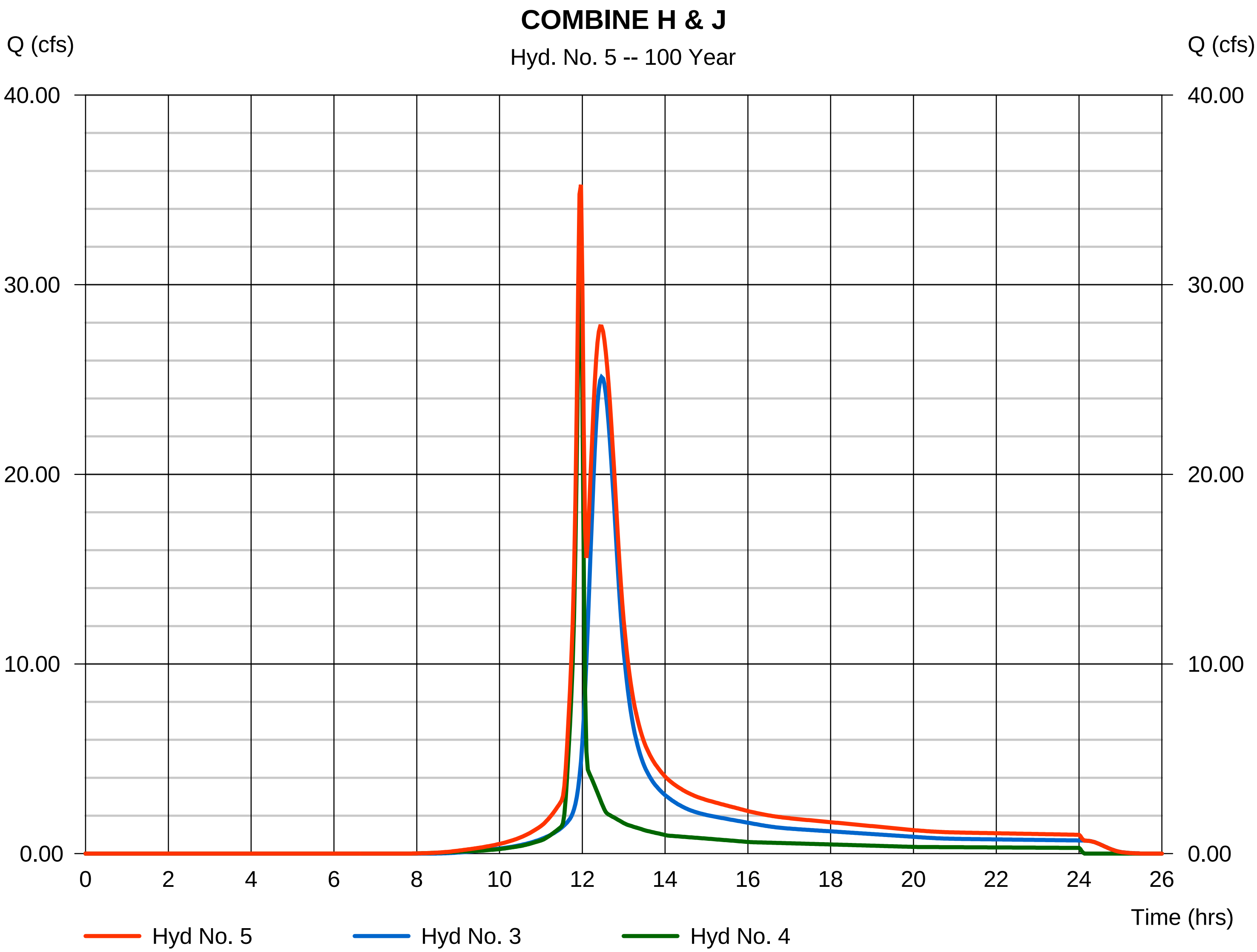
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Sunday, 01 / 10 / 2021

Hyd. No. 5

COMBINE H & J

Hydrograph type	= Combine	Peak discharge	= 35.27 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 200,072 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 4.320 ac



Hydrograph Report

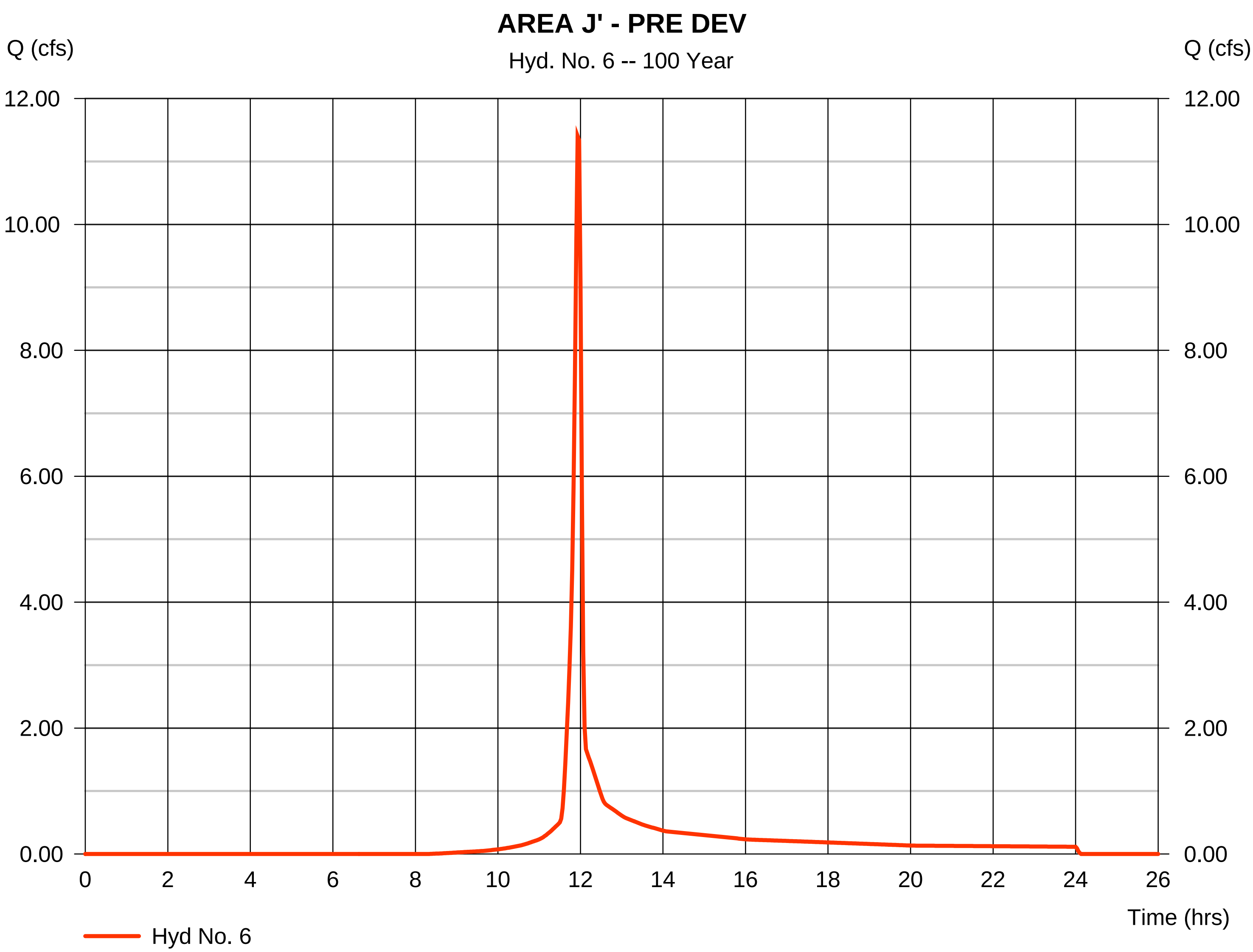
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 6

AREA J' - PRE DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 11.40 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 23,036 cuft
Drainage area	= 1.690 ac	Curve number	= 67*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.200 x 85) + (0.220 x 65) + (1.040 x 60) + (0.230 x 82)] / 1.690



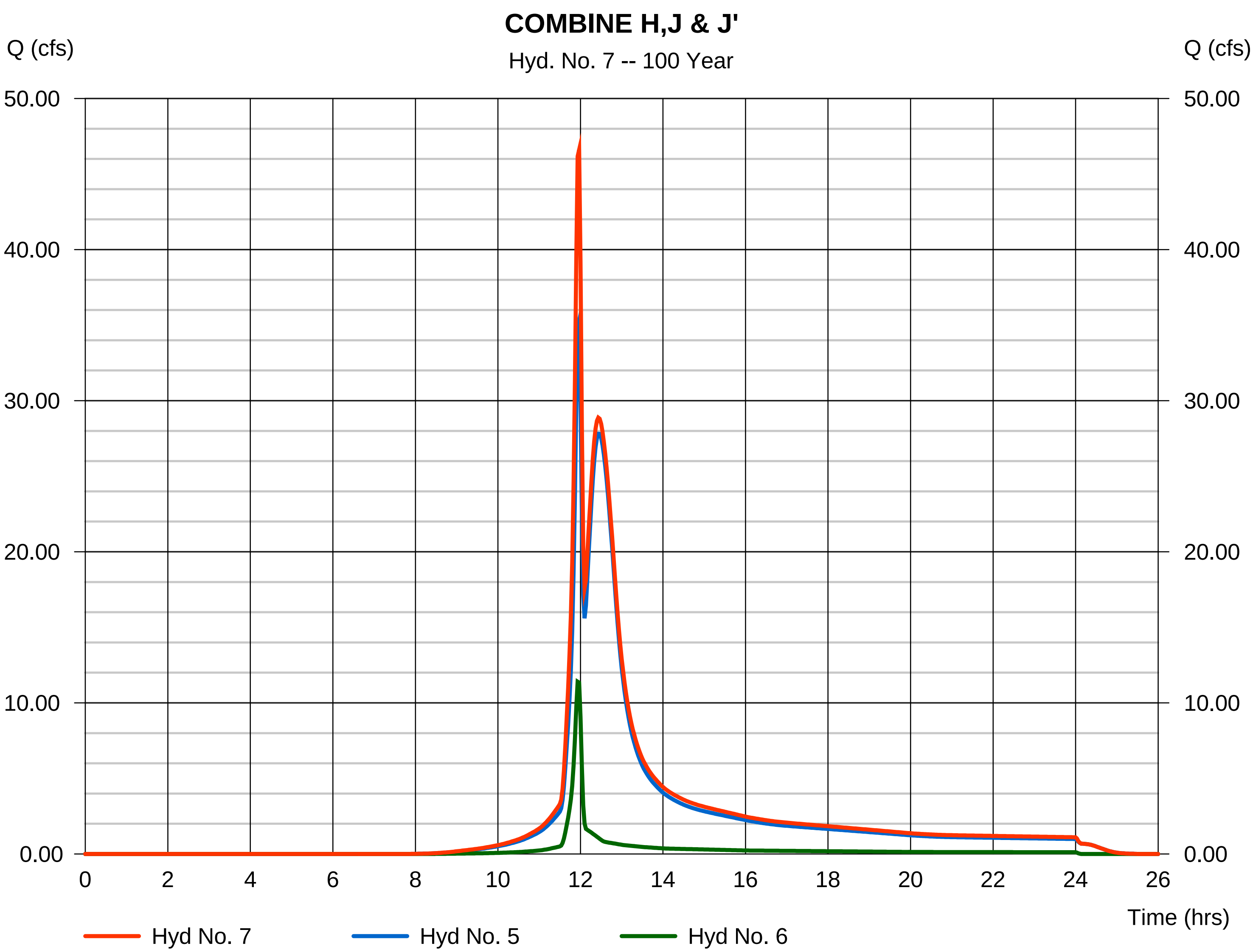
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Sunday, 01 / 10 / 2021

Hyd. No. 7

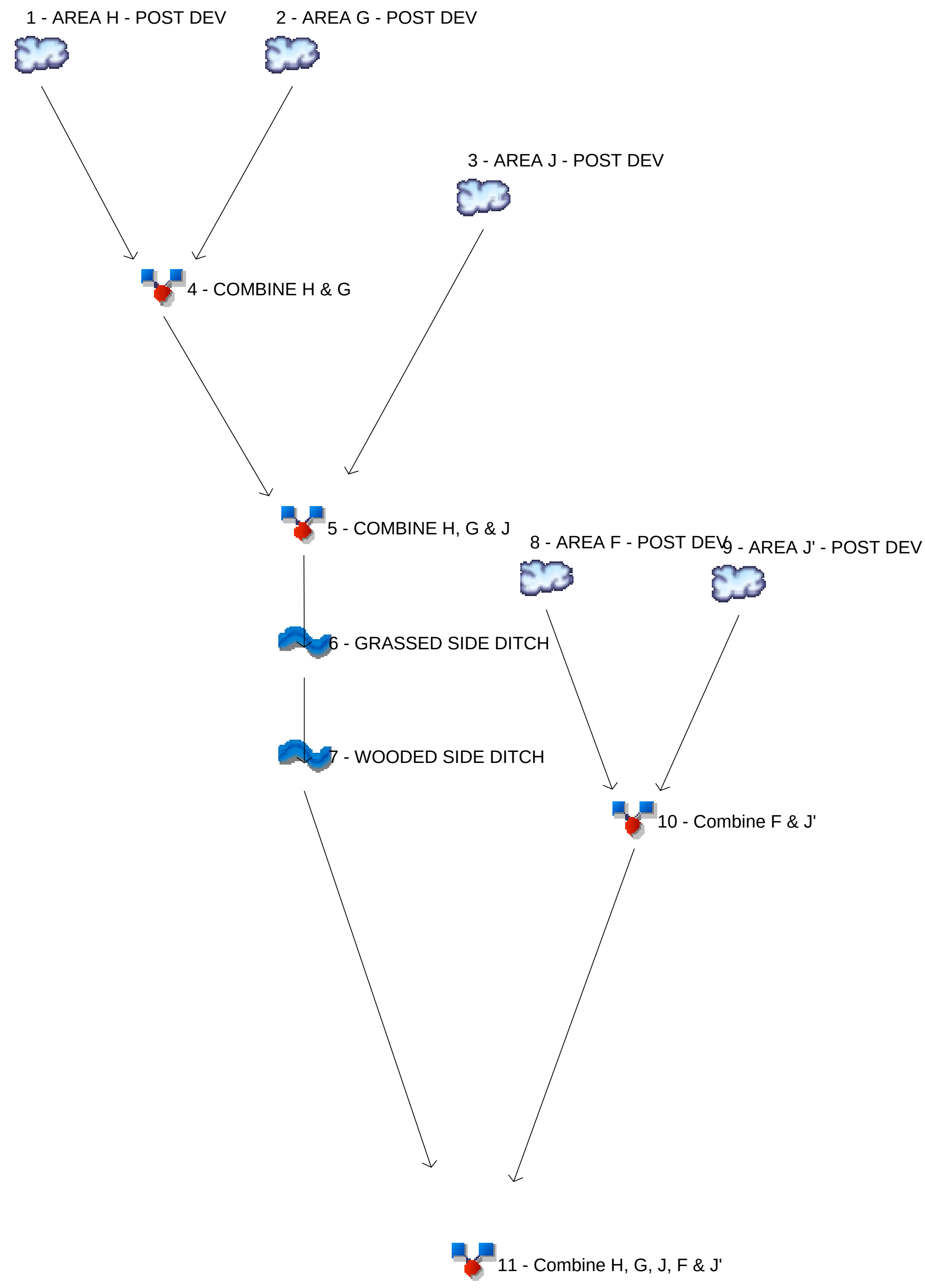
COMBINE H,J & J'

Hydrograph type	= Combine	Peak discharge	= 46.61 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 223,108 cuft
Inflow hyds.	= 5, 6	Contrib. drain. area	= 1.690 ac



Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12



Project: POSTDEV_SOLAR.gpw	Sunday, 01 / 10 / 2021

Hydrograph Report

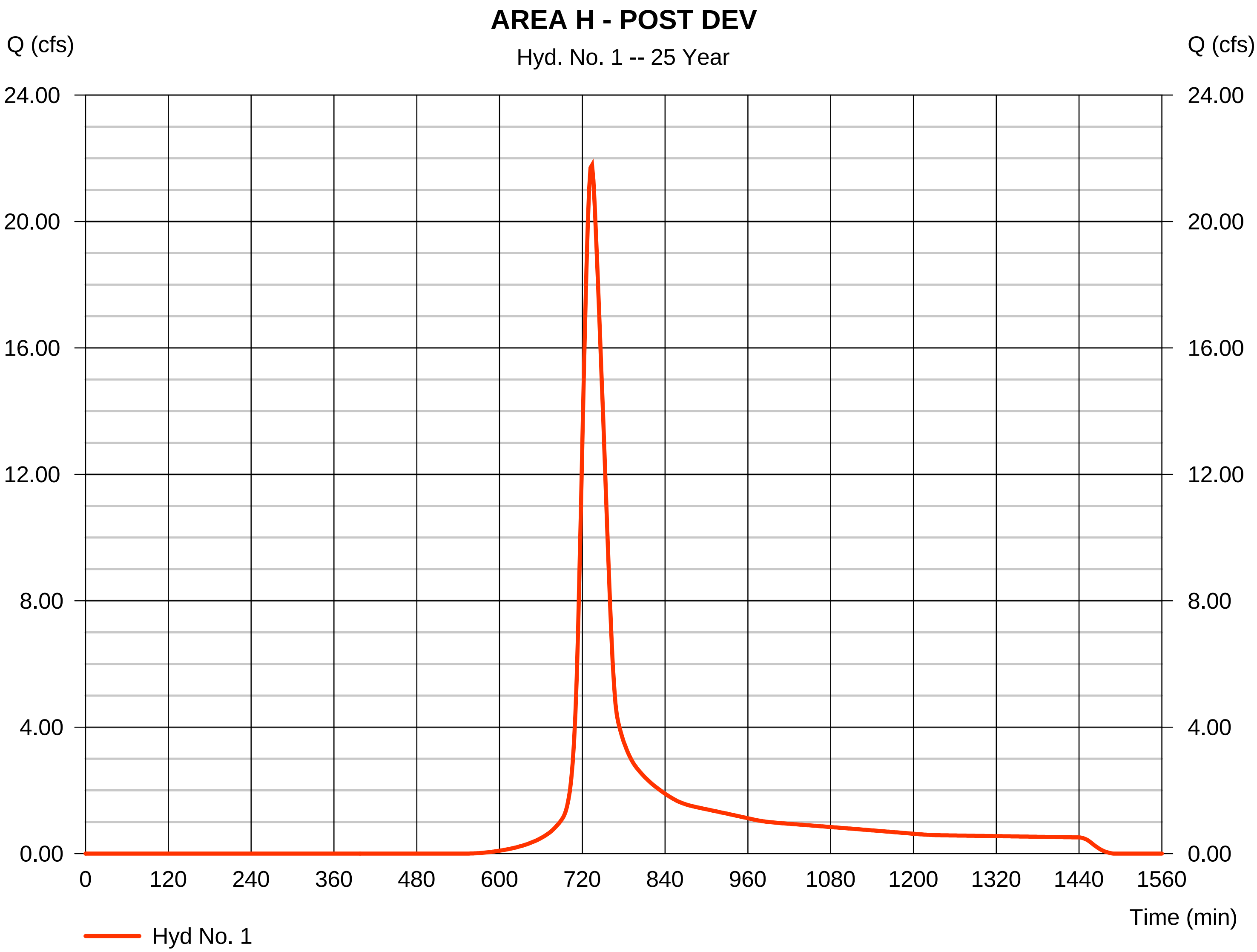
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Sunday, 01 / 10 / 2021

Hyd. No. 1

AREA H - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 21.78 cfs
Storm frequency	= 25 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 95,534 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 30.30 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



TR55 Tc Worksheet

Hyd. No. 1

AREA H - POST DEV

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.410		0.011		0.011		
Flow length (ft)	= 94.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.82		0.00		0.00		
Land slope (%)	= 2.50		0.00		0.00		
Travel Time (min)	**= 17.45**	**+**	**0.00**	**+**	**0.00**	**=**	**17.45**
Shallow Concentrated Flow							
Flow length (ft)	= 324.00		0.00		0.00		
Watercourse slope (%)	= 2.00		0.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=2.28		0.00		0.00		
Travel Time (min)	**= 2.37**	**+**	**0.00**	**+**	**0.00**	**=**	**2.37**
Channel Flow							
X sectional flow area (sqft)	= 4.88		5.09		5.87		
Wetted perimeter (ft)	= 24.89		30.79		21.11		
Channel slope (%)	= 0.55		0.65		0.32		
Manning's n-value	= 0.030		0.030		0.035		
Velocity (ft/s)	=1.24		1.20		1.02		
Flow length (ft)	({0})238.0		152.0		315.0		
Travel Time (min)	**= 3.21**	**+**	**2.11**	**+**	**5.14**	**=**	**10.46**

Total Travel Time, Tc .... 30.30 min

Hydrograph Report

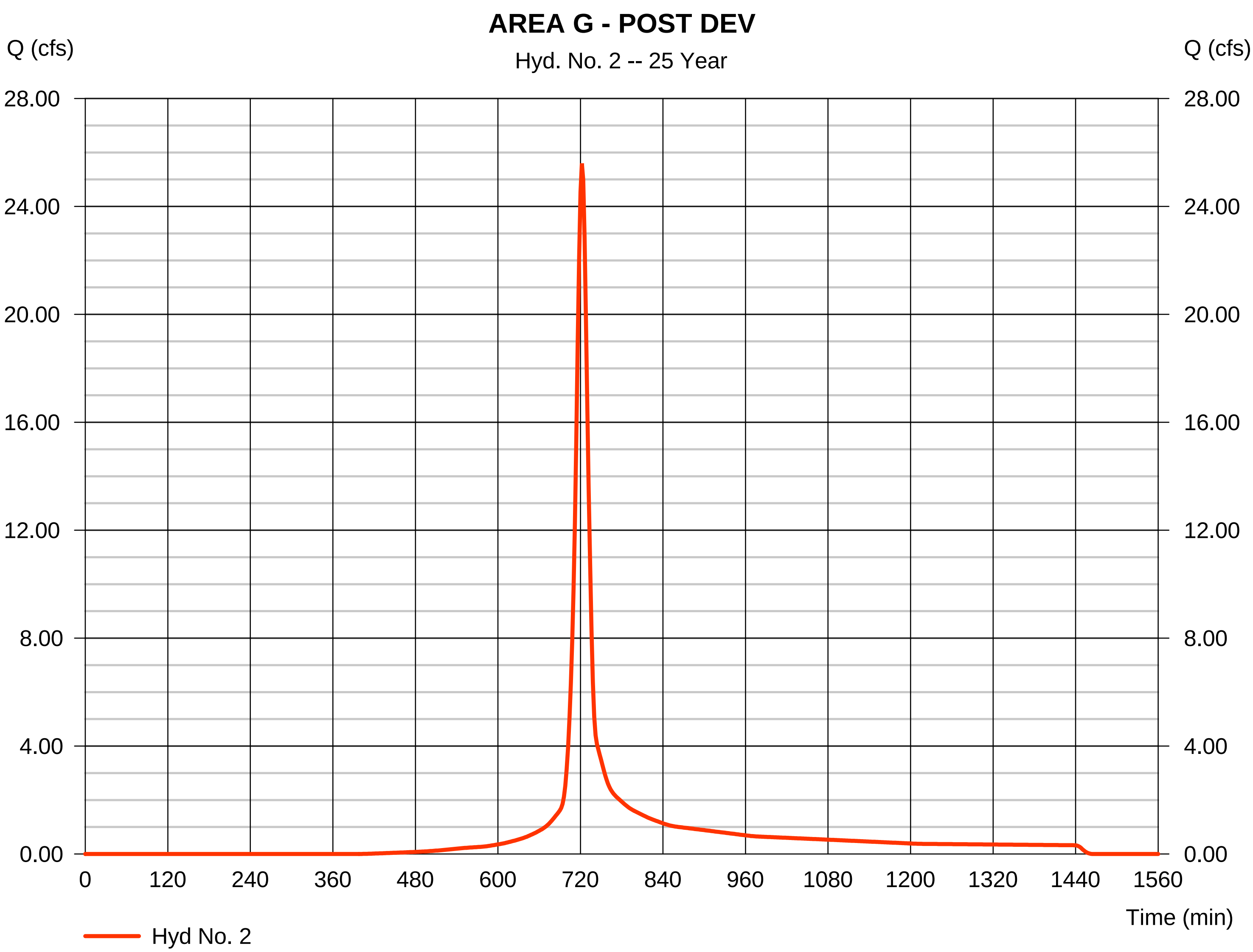
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 2

AREA G - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 25.59 cfs
Storm frequency	= 25 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 71,991 cuft
Drainage area	= 5.290 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.80 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.330 x 85) + (4.740 x 77) + (0.220 x 98)] / 5.290



Hydrograph Report

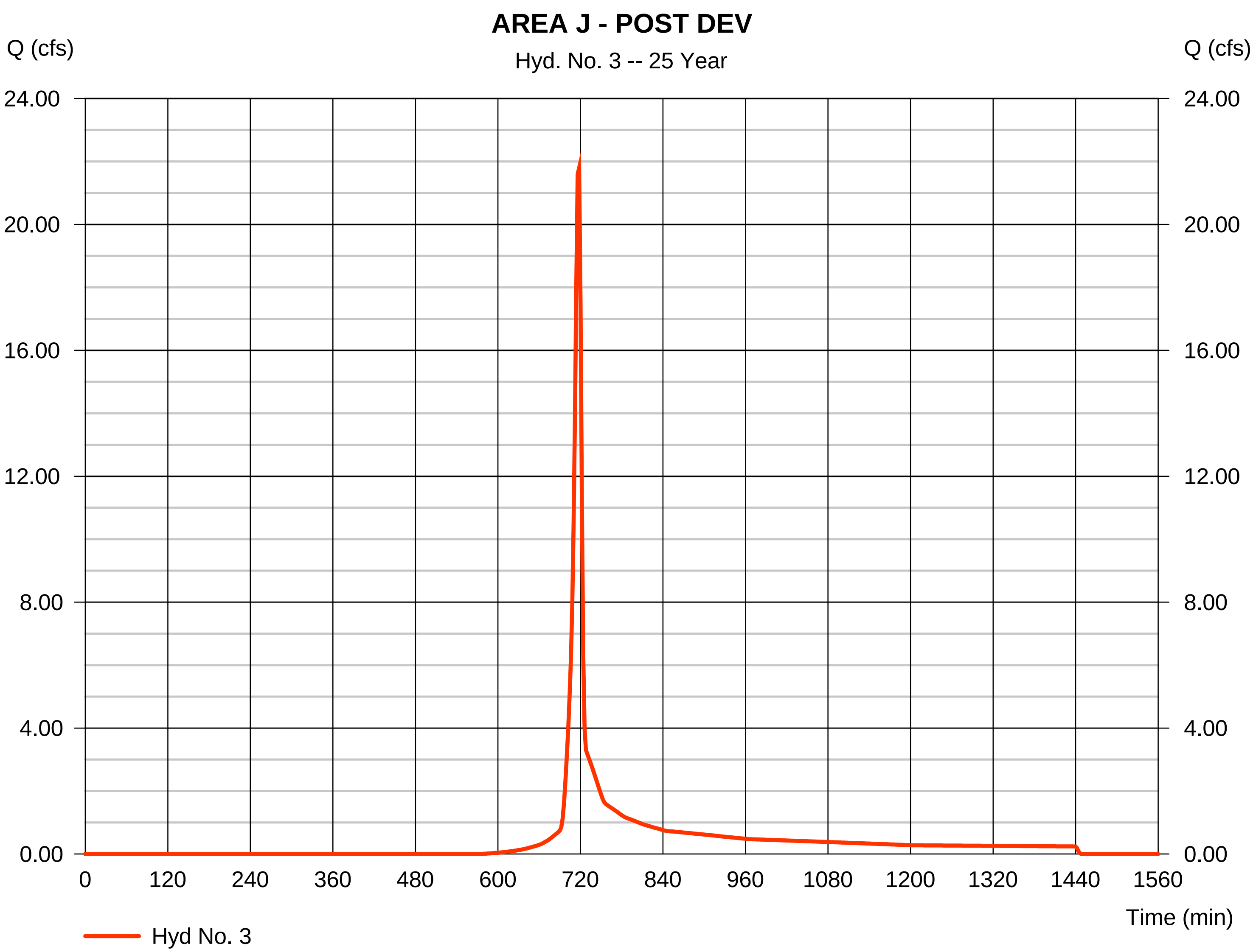
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 3

AREA J - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 21.80 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 43,710 cuft
Drainage area	= 4.820 ac	Curve number	= 66*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 4.50 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 85) + (0.020 x 65) + (0.680 x 98) + (4.030 x 60)] / 4.820



TR55 Tc Worksheet

Hyd. No. 3

AREA J - POST DEV

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.011		0.240		0.011		
Flow length (ft)	=	8.0		30.0		0.0		
Two-year 24-hr precip. (in)	=	3.82		3.82		0.00		
Land slope (%)	=	4.20		4.20		0.00		
Travel Time (min)	**=**	**0.11**	**+**	**3.70**	**+**	**0.00**	**=**	**3.81**
Shallow Concentrated Flow								
Flow length (ft)	=	21.00		155.00		0.00		
Watercourse slope (%)	=	7.75		6.60		0.00		
Surface description	=	Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=4.49			4.15		0.00		
Travel Time (min)	**=**	**0.08**	**+**	**0.62**	**+**	**0.00**	**=**	**0.70**
Channel Flow								
X sectional flow area (sqft)	=	0.00		0.00		0.00		
Wetted perimeter (ft)	=	0.00		0.00		0.00		
Channel slope (%)	=	0.00		0.00		0.00		
Manning's n-value	=	0.015		0.015		0.015		
Velocity (ft/s)	=0.00							
				0.00				
						0.00		
Flow length (ft)	({0})0.0			0.0		0.0		
Travel Time (min)	**=**	**0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc .... **4.50 min**

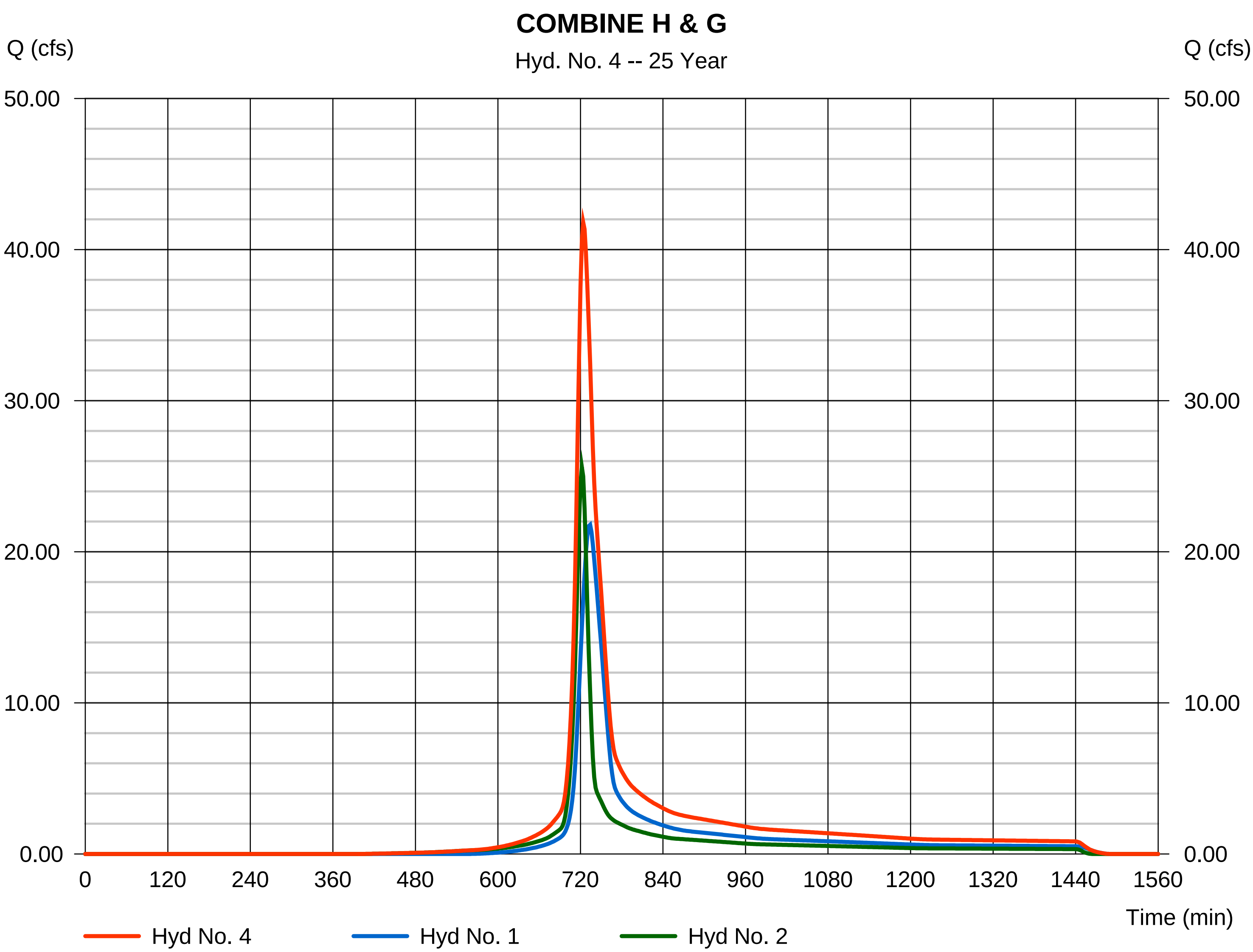
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 4

COMBINE H & G

Hydrograph type	= Combine	Peak discharge	= 41.80 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 167,525 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 14.400 ac

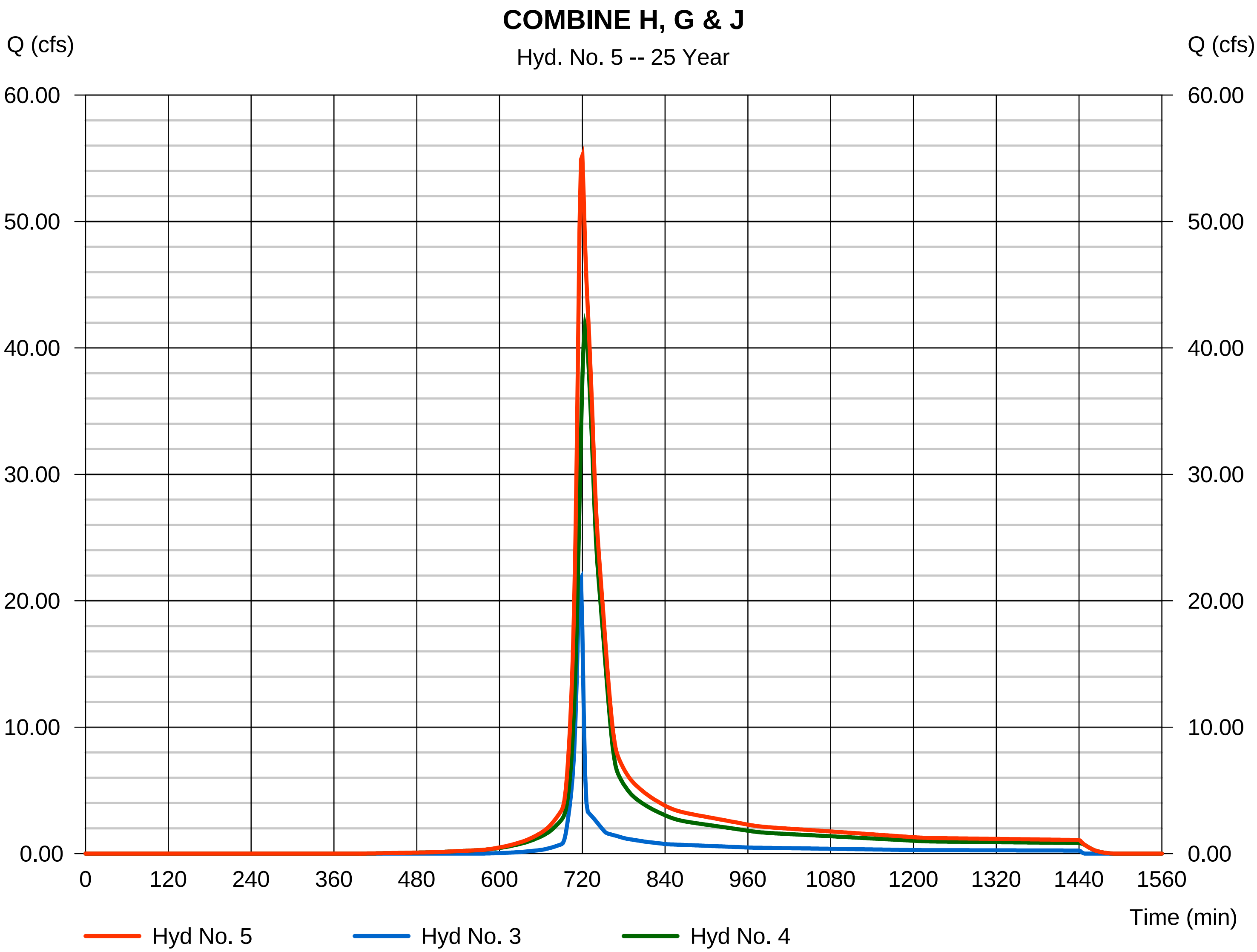


Hydrograph Report

Hyd. No. 5

COMBINE H, G & J

Hydrograph type	= Combine	Peak discharge	= 55.20 cfs
Storm frequency	= 25 yrs	Time to peak	= 720 min
Time interval	= 2 min	Hyd. volume	= 211,235 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 4.820 ac



Hydrograph Report

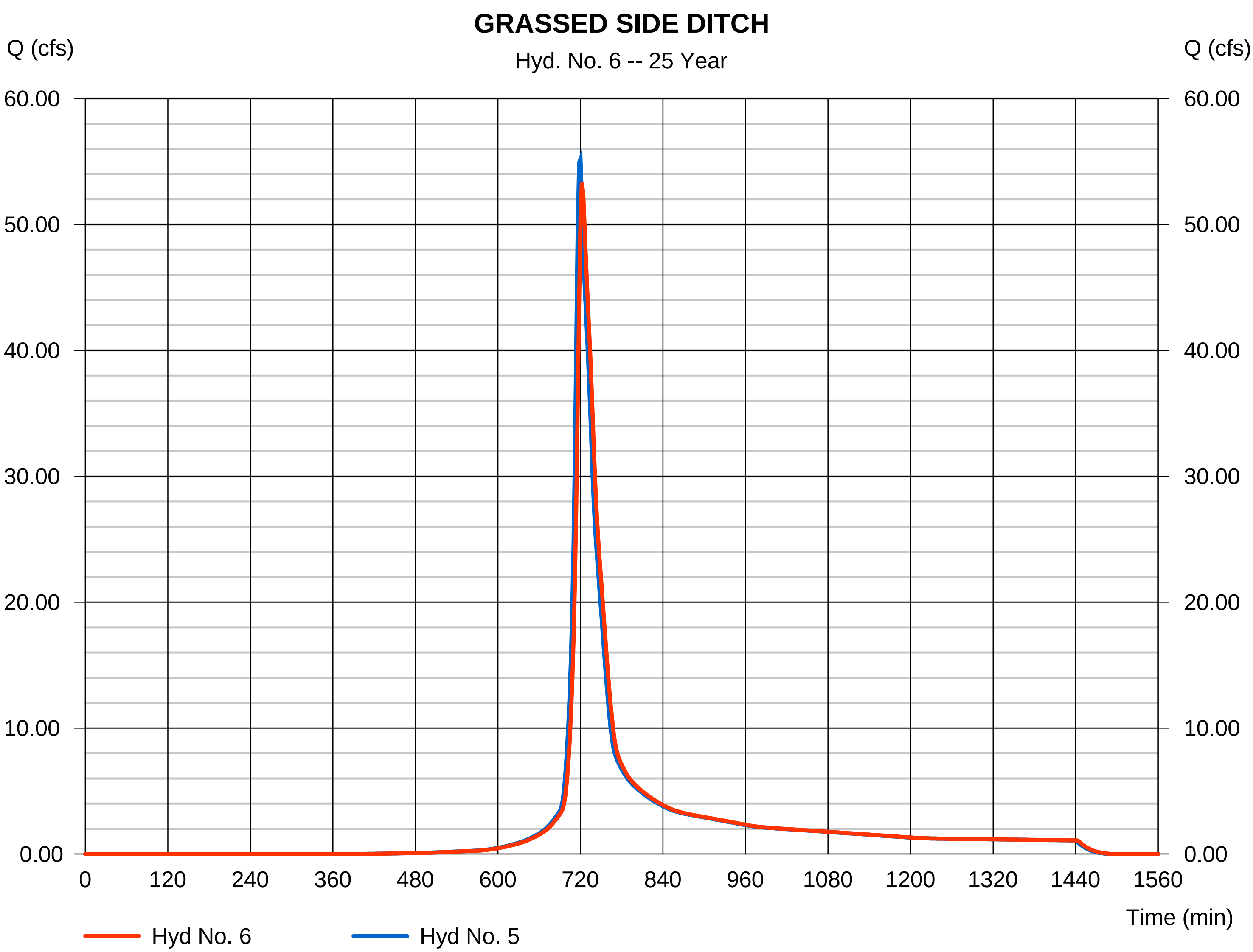
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 6

GRASSED SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 53.32 cfs
Storm frequency	= 25 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 211,234 cuft
Inflow hyd. No.	= 5 - COMBINE H, G & J	Section type	= Trapezoidal
Reach length	= 522.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.045	Bottom width	= 2.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 1.475	Rating curve m	= 1.244
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.6005

Modified Att-Kin routing method used.



Hydrograph Report

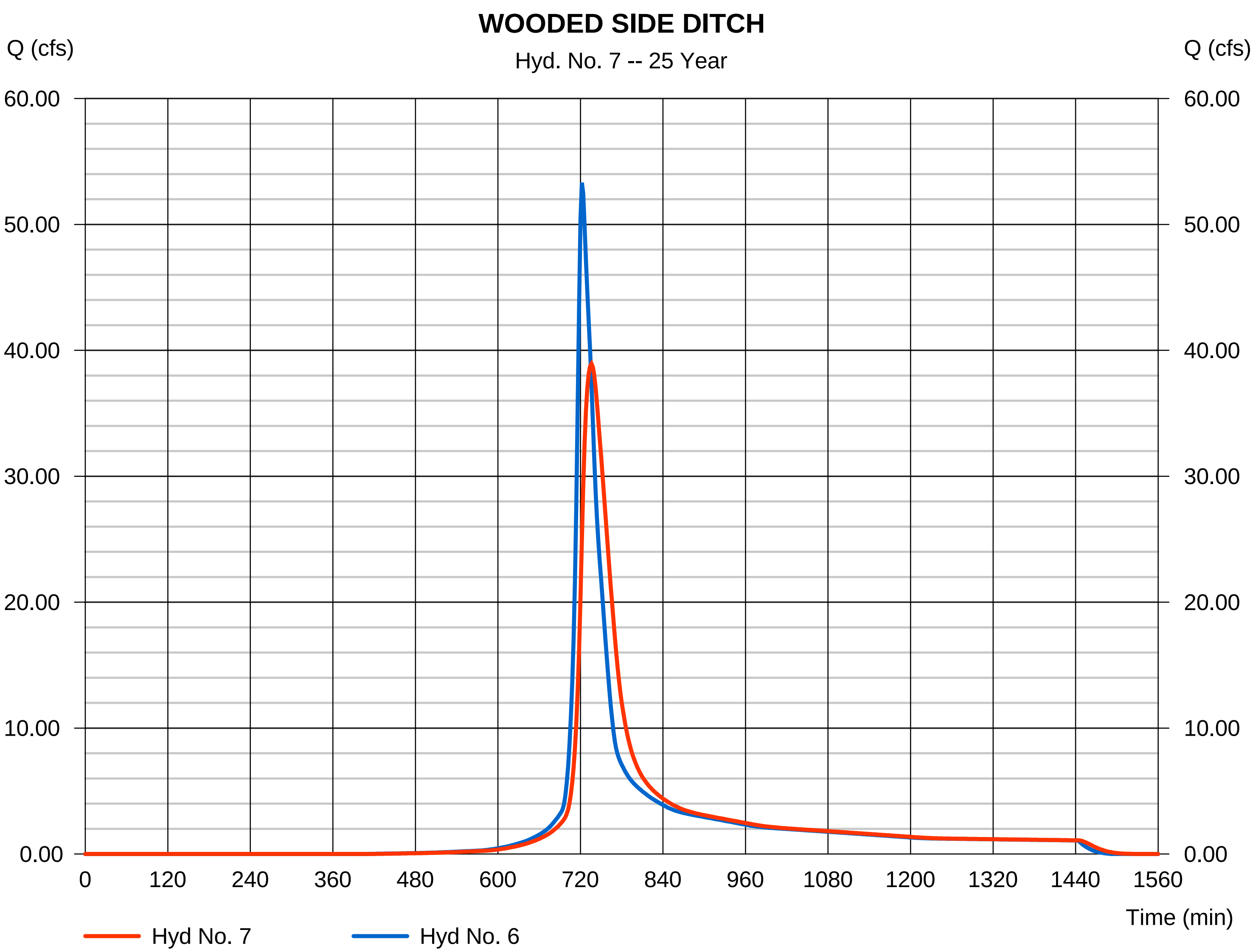
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 7

WOODED SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 38.93 cfs
Storm frequency	= 25 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 211,226 cuft
Inflow hyd. No.	= 6 - GRASSED SIDE DITCH	Section type	= Trapezoidal
Reach length	= 415.0 ft	Channel slope	= 0.2 %
Manning's n	= 0.150	Bottom width	= 2.0 ft
Side slope	= 10.0:1	Max. depth	= 3.0 ft
Rating curve x	= 0.273	Rating curve m	= 1.127
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.1492

Modified Att-Kin routing method used.



Hydrograph Report

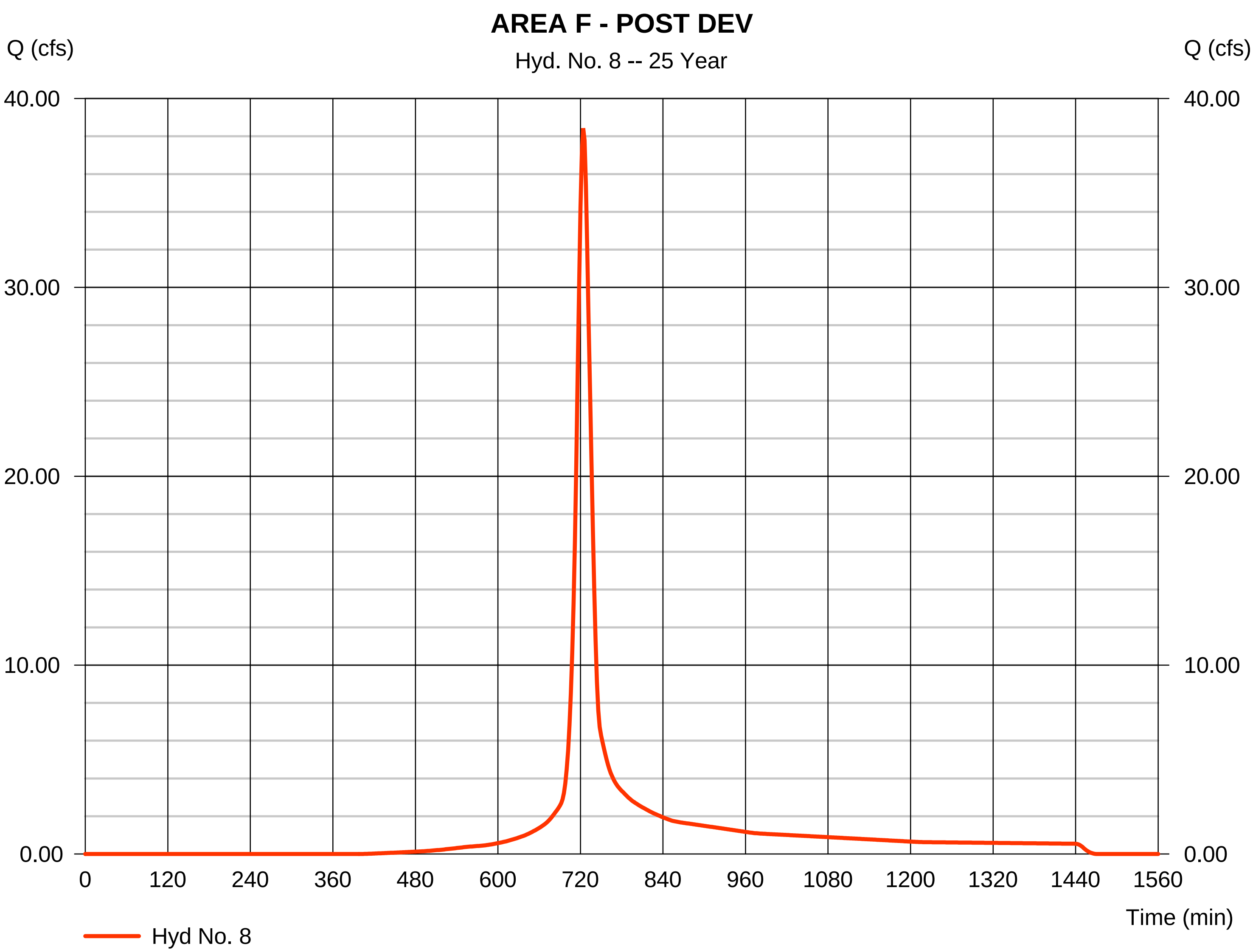
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 8

AREA F - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 38.43 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 120,317 cuft
Drainage area	= 8.620 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.00 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.440 x 85) + (7.810 x 77) + (0.370 x 98)] / 8.620



Hydrograph Report

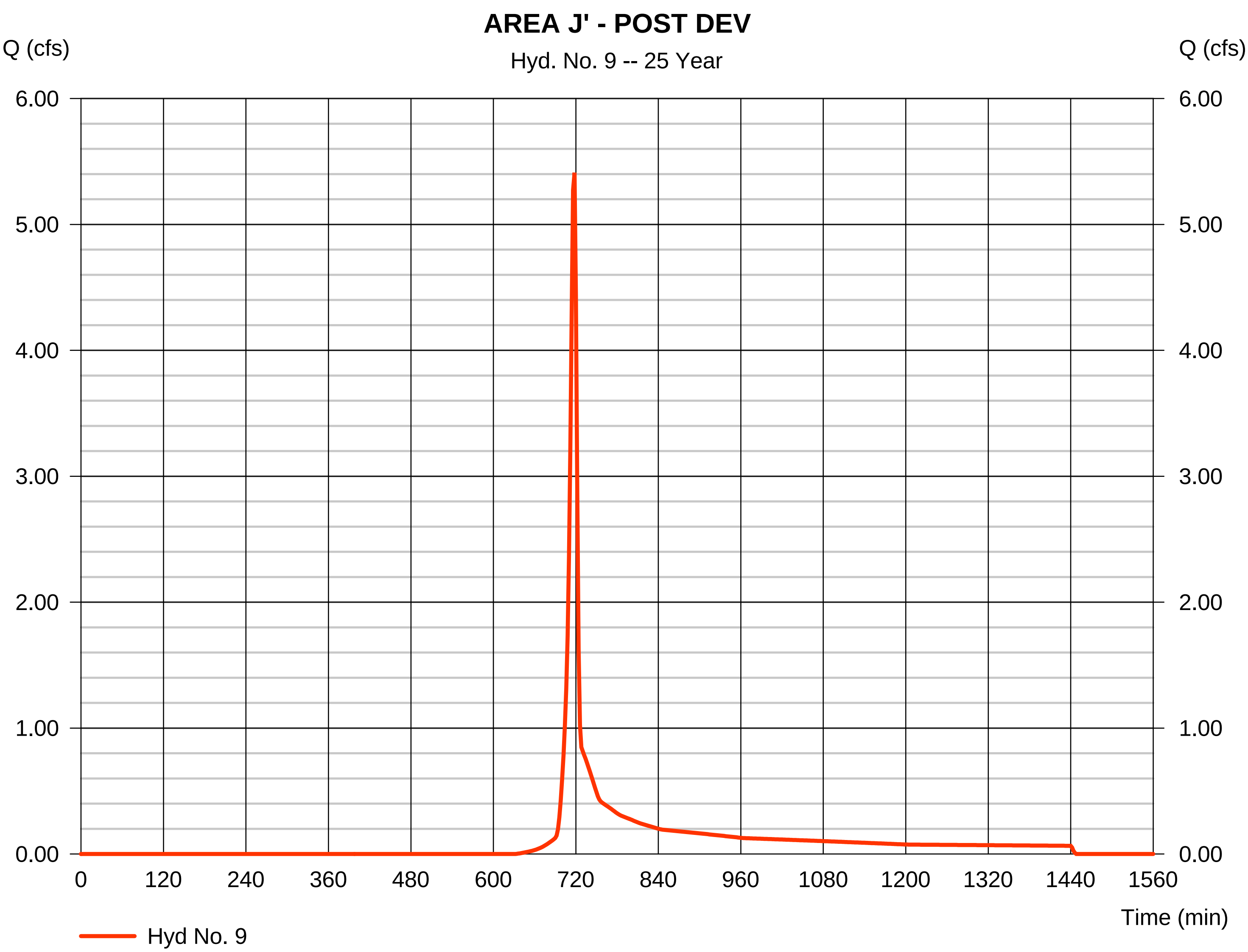
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 | Sunday, 01 / 10 / 2021

Hyd. No. 9

AREA J' - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 5.411 cfs
Storm frequency	= 25 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 10,825 cuft
Drainage area	= 1.440 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 5.70 min
Total precip.	= 6.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.220 x 65) + (1.220 x 60)] / 1.440



TR55 Tc Worksheet

Hyd. No. 9

AREA J' - POST DEV

Description		A		B		C		Totals
Sheet Flow								
Manning's n-value	=	0.150		0.011		0.011		
Flow length (ft)	=	25.0		0.0		0.0		
Two-year 24-hr precip. (in)	=	3.82		0.00		0.00		
Land slope (%)	=	4.20		0.00		0.00		
Travel Time (min)	**=**	**2.20**	**+**	**0.00**	**+**	**0.00**	**=**	**2.20**
Shallow Concentrated Flow								
Flow length (ft)	=	55.00		28.00		0.00		
Watercourse slope (%)	=	4.20		45.00		0.00		
Surface description	=	Unpaved		Unpaved		Paved		
Average velocity (ft/s)		=3.31		10.82		0.00		
Travel Time (min)	**=**	**0.28**	**+**	**0.04**	**+**	**0.00**	**=**	**0.32**
Channel Flow								
X sectional flow area (sqft)	=	1.44		2.03		0.00		
Wetted perimeter (ft)	=	10.63		20.54		0.00		
Channel slope (%)	=	3.00		2.60		0.00		
Manning's n-value	=	0.030		0.030		0.015		
Velocity (ft/s)		=2.25						
				1.70				
						0.00		
Flow length (ft)		({0})205.0		170.0		0.0		
Travel Time (min)	**=**	**1.52**	**+**	**1.67**	**+**	**0.00**	**=**	**3.19**

Total Travel Time, Tc .... 5.70 min

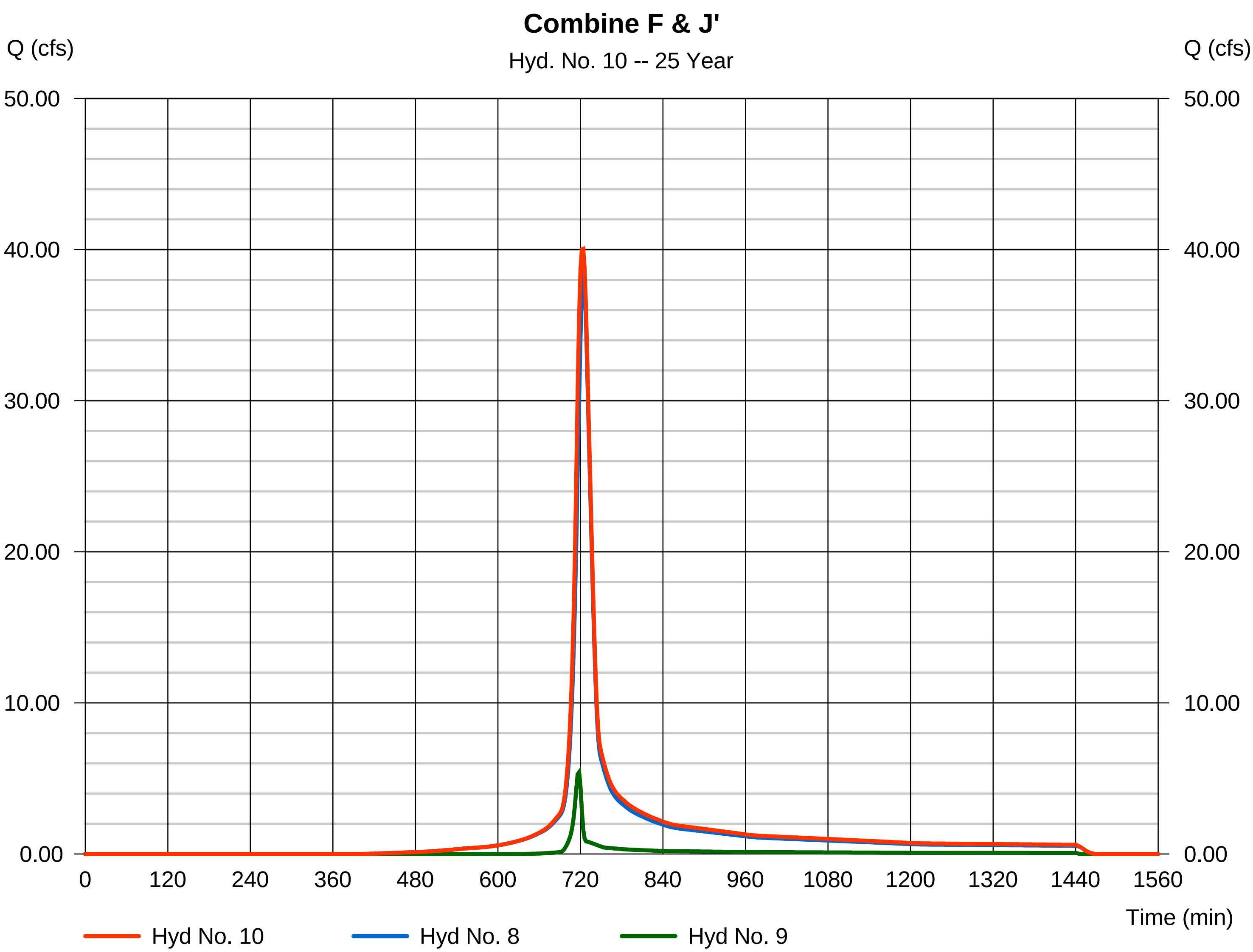
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 10

Combine F & J'

Hydrograph type	= Combine	Peak discharge	= 40.05 cfs
Storm frequency	= 25 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 131,141 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 10.060 ac



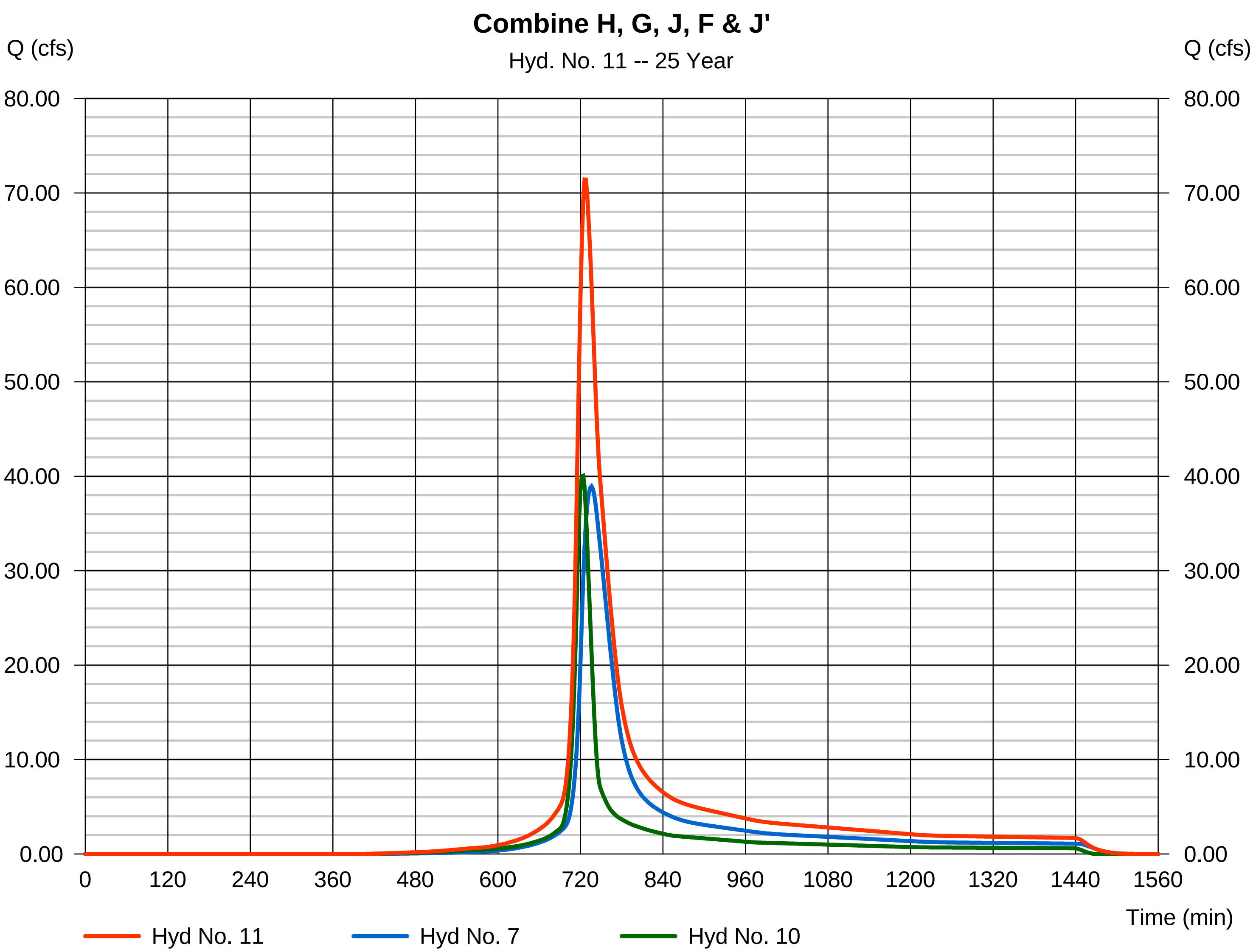
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 11

Combine H, G, J, F & J'

Hydrograph type	= Combine	Peak discharge	= 71.42 cfs
Storm frequency	= 25 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 342,367 cuft
Inflow hyds.	= 7, 10	Contrib. drain. area	= 0.000 ac



Hydrograph Report

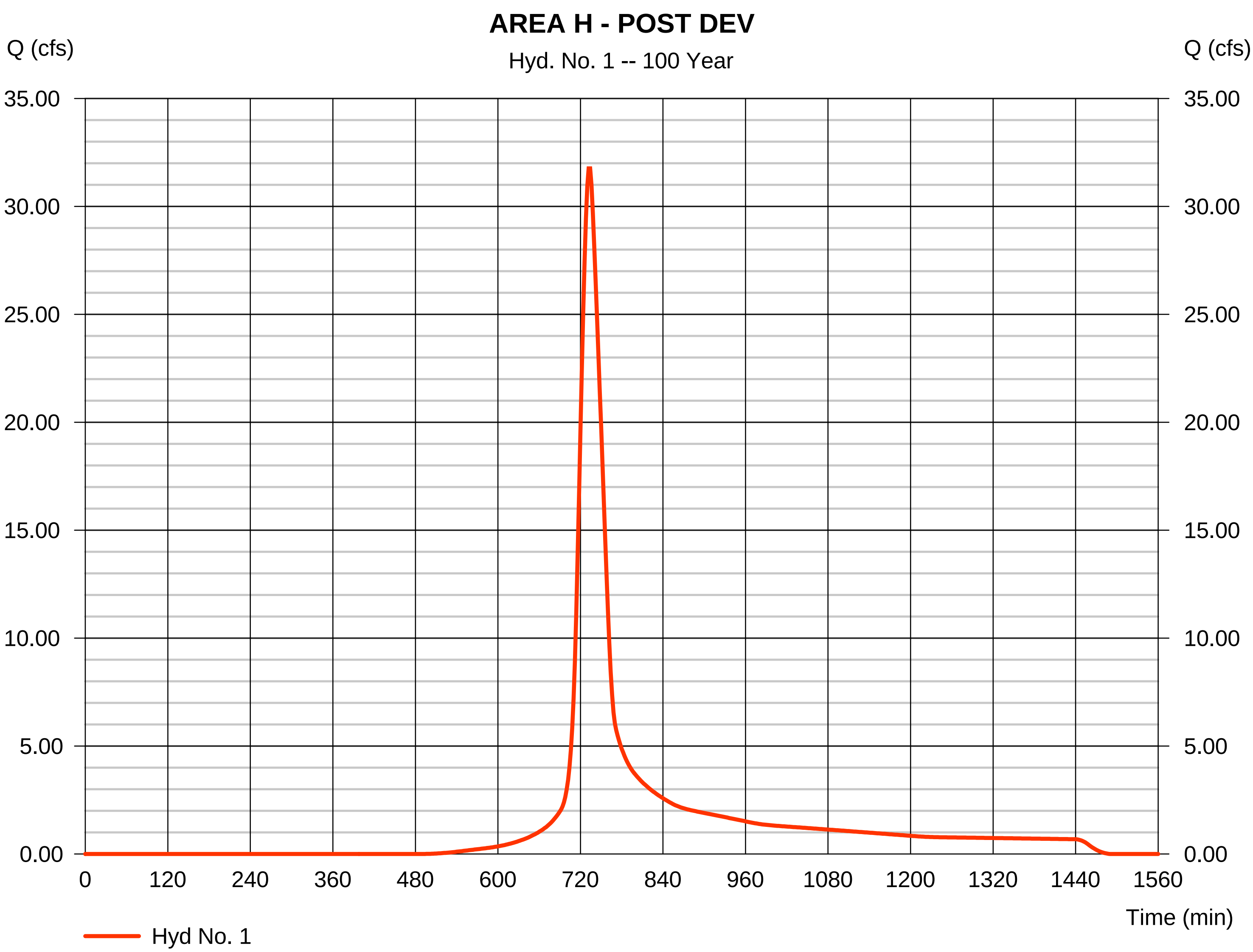
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 1

AREA H - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 31.76 cfs
Storm frequency	= 100 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 137,880 cuft
Drainage area	= 9.110 ac	Curve number	= 68*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 30.30 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.300 x 85) + (1.710 x 98) + (6.670 x 60) + (0.430 x 55)] / 9.110



Hydrograph Report

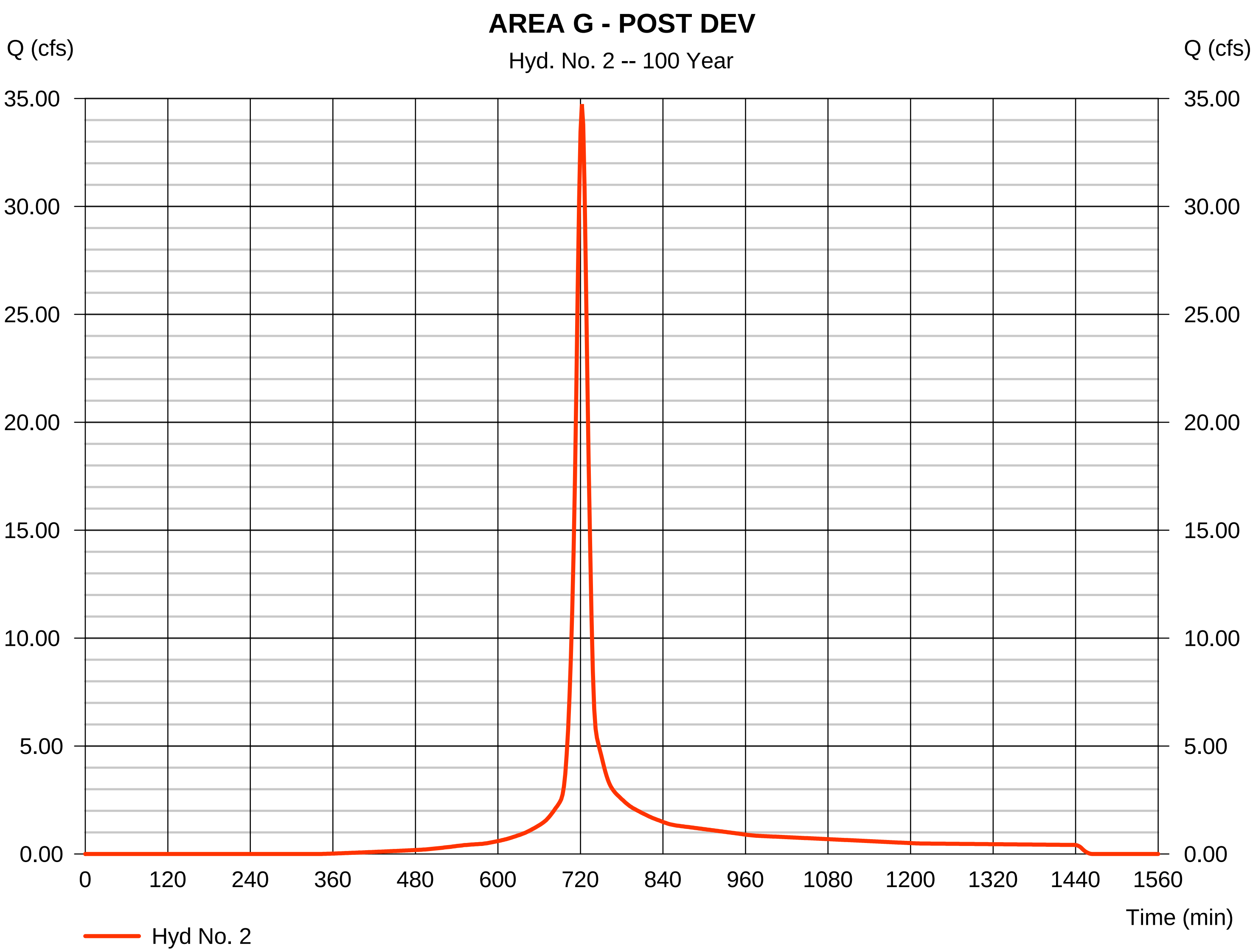
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 2

AREA G - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 34.74 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 98,514 cuft
Drainage area	= 5.290 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 15.80 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.330 x 85) + (4.740 x 77) + (0.220 x 98)] / 5.290



Hydrograph Report

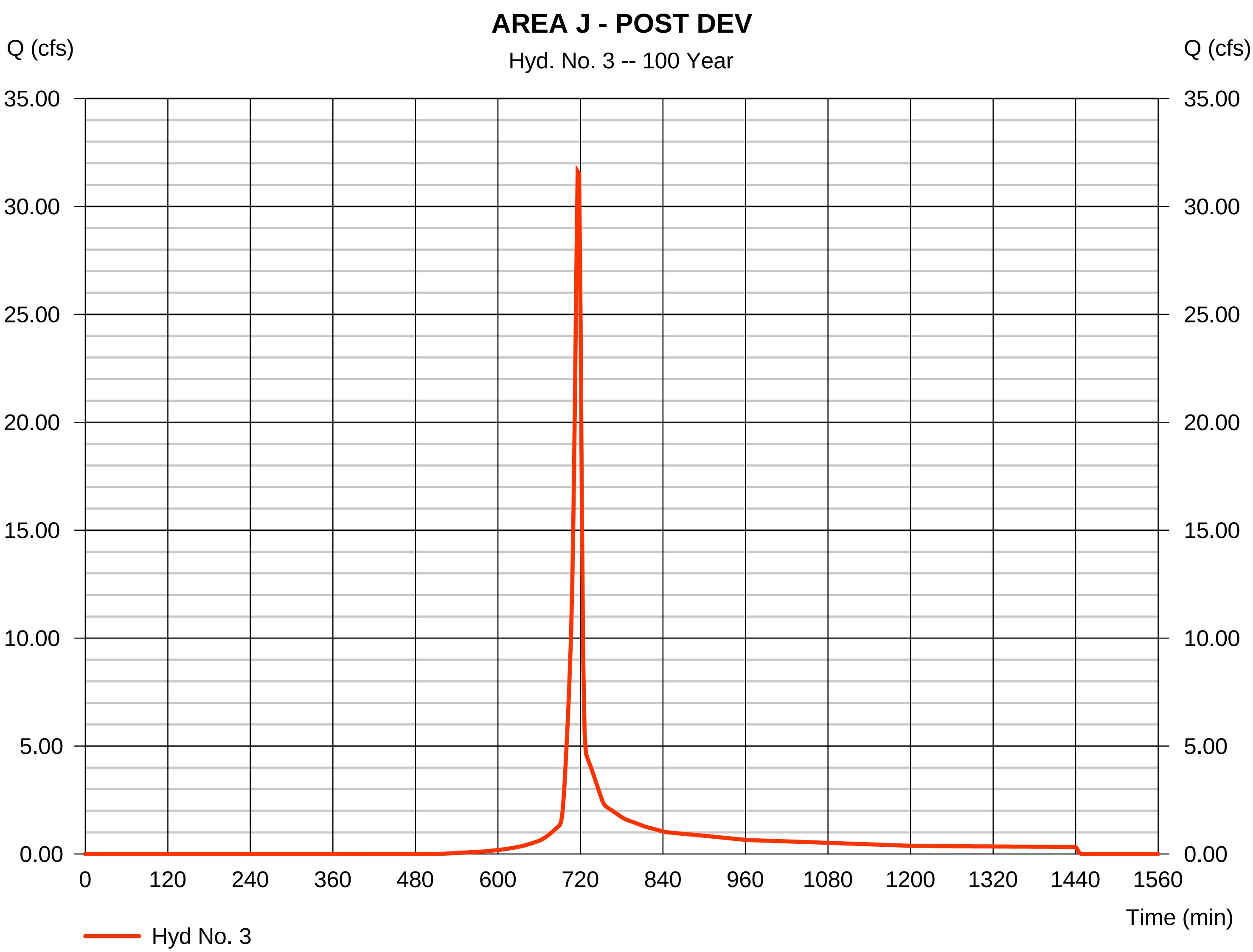
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 3

AREA J - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 31.62 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 63,860 cuft
Drainage area	= 4.820 ac	Curve number	= 66*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 4.50 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 85) + (0.020 x 65) + (0.680 x 98) + (4.030 x 60)] / 4.820



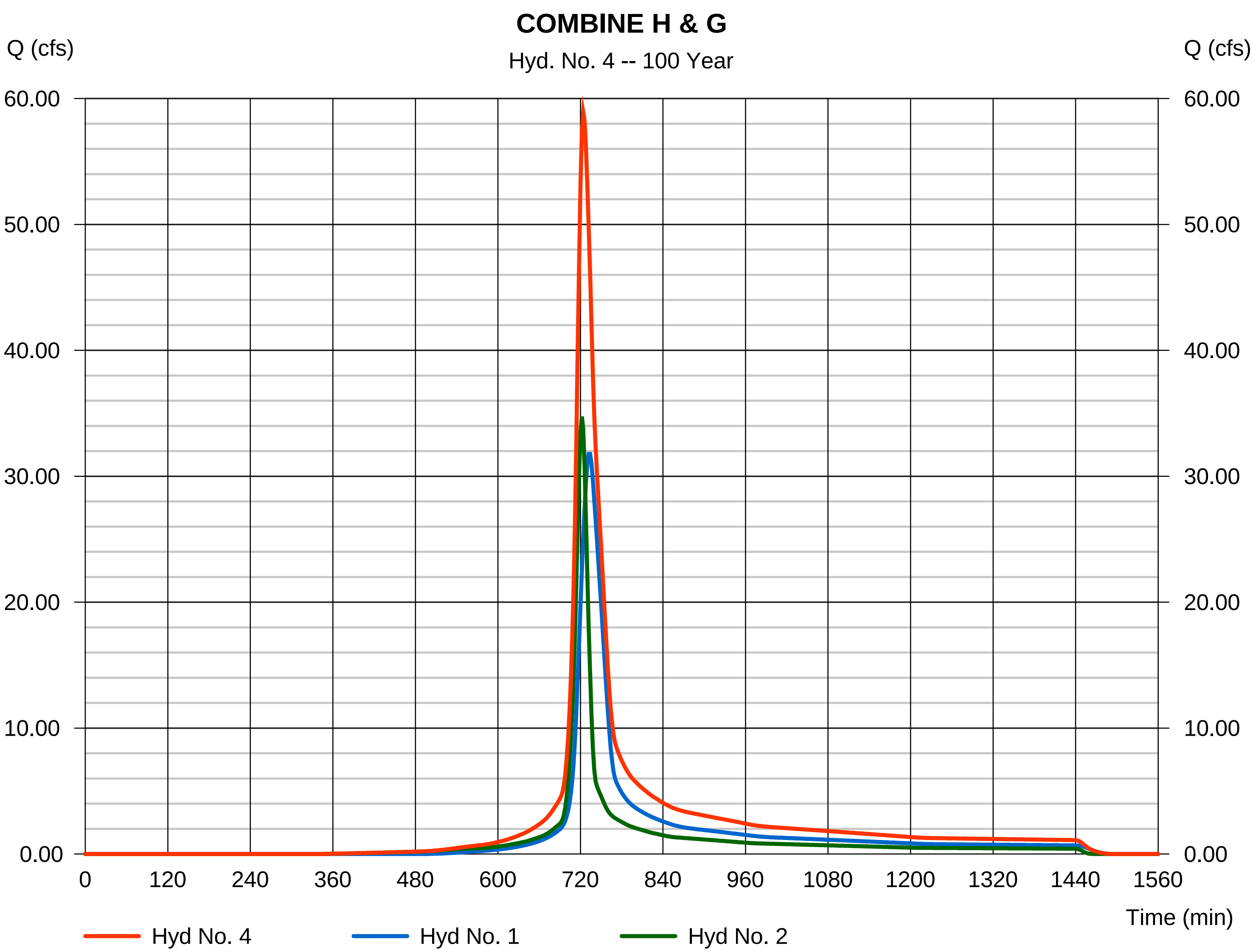
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Sunday, 01 / 10 / 2021

Hyd. No. 4

COMBINE H & G

Hydrograph type	= Combine	Peak discharge	= 58.90 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 236,395 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 14.400 ac

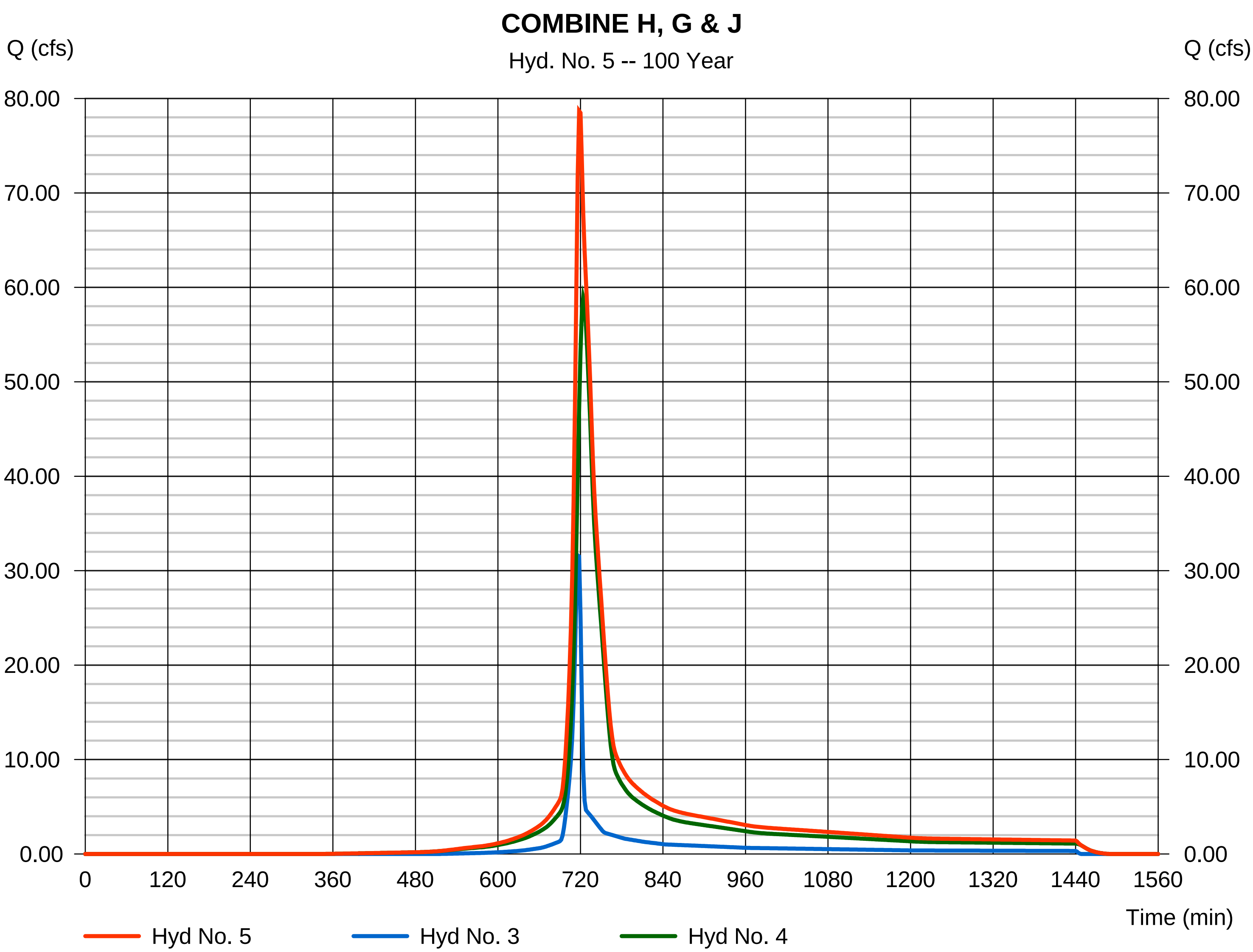


Hydrograph Report

Hyd. No. 5

COMBINE H, G & J

Hydrograph type	= Combine	Peak discharge	= 78.68 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 300,254 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 4.820 ac



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 6

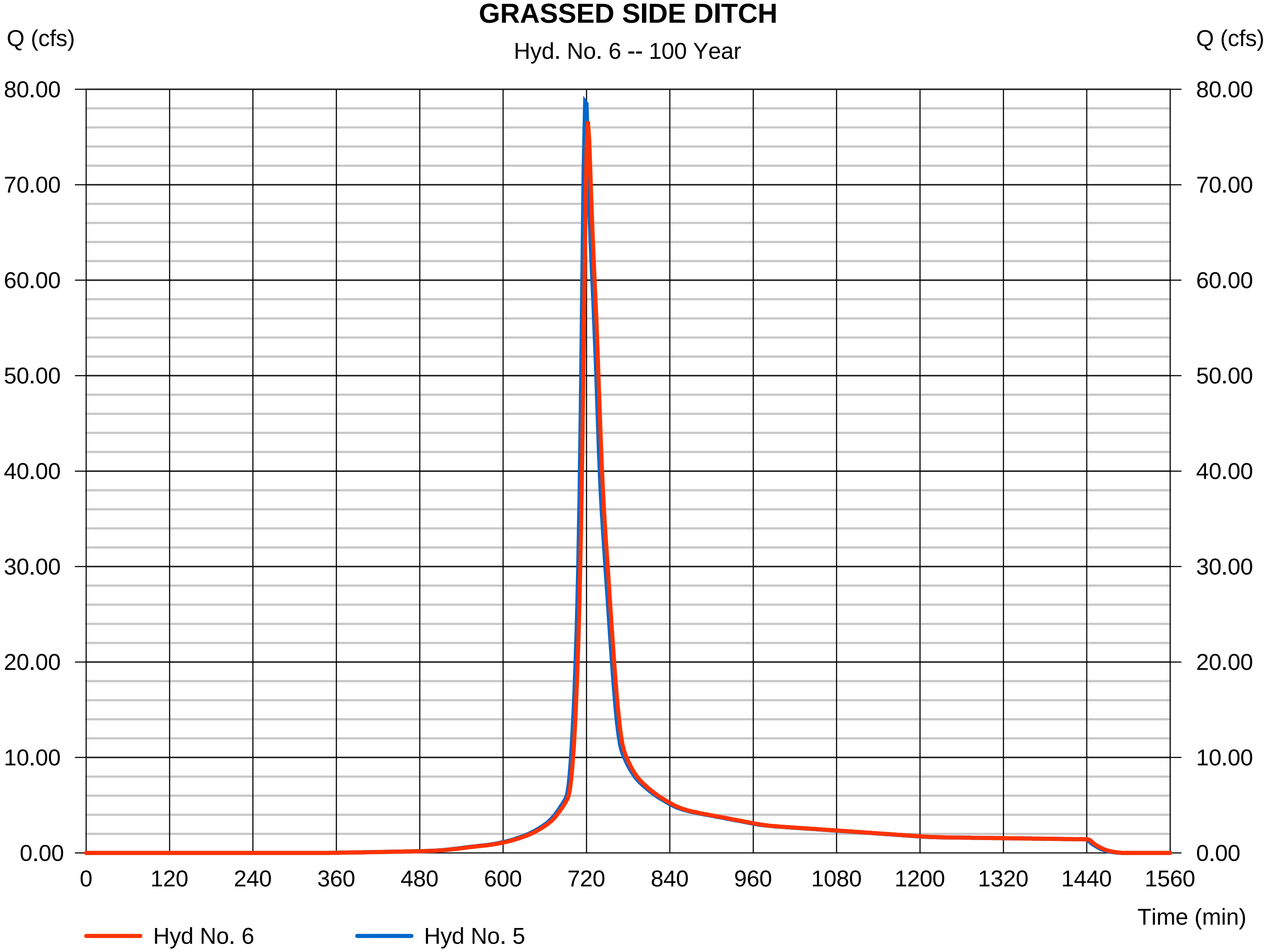
GRASSED SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 76.64 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 300,253 cuft
Inflow hyd. No.	= 5 - COMBINE H, G & J	Section type	= Trapezoidal
Reach length	= 522.0 ft	Channel slope	= 0.5 %
Manning's n	= 0.045	Bottom width	= 2.0 ft
Side slope	= 2.0:1	Max. depth	= 5.0 ft
Rating curve x	= 1.475	Rating curve m	= 1.244
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.6301

Modified Att-Kin routing method used.

GRASSED SIDE DITCH

Hyd. No. 6 -- 100 Year



Hydrograph Report

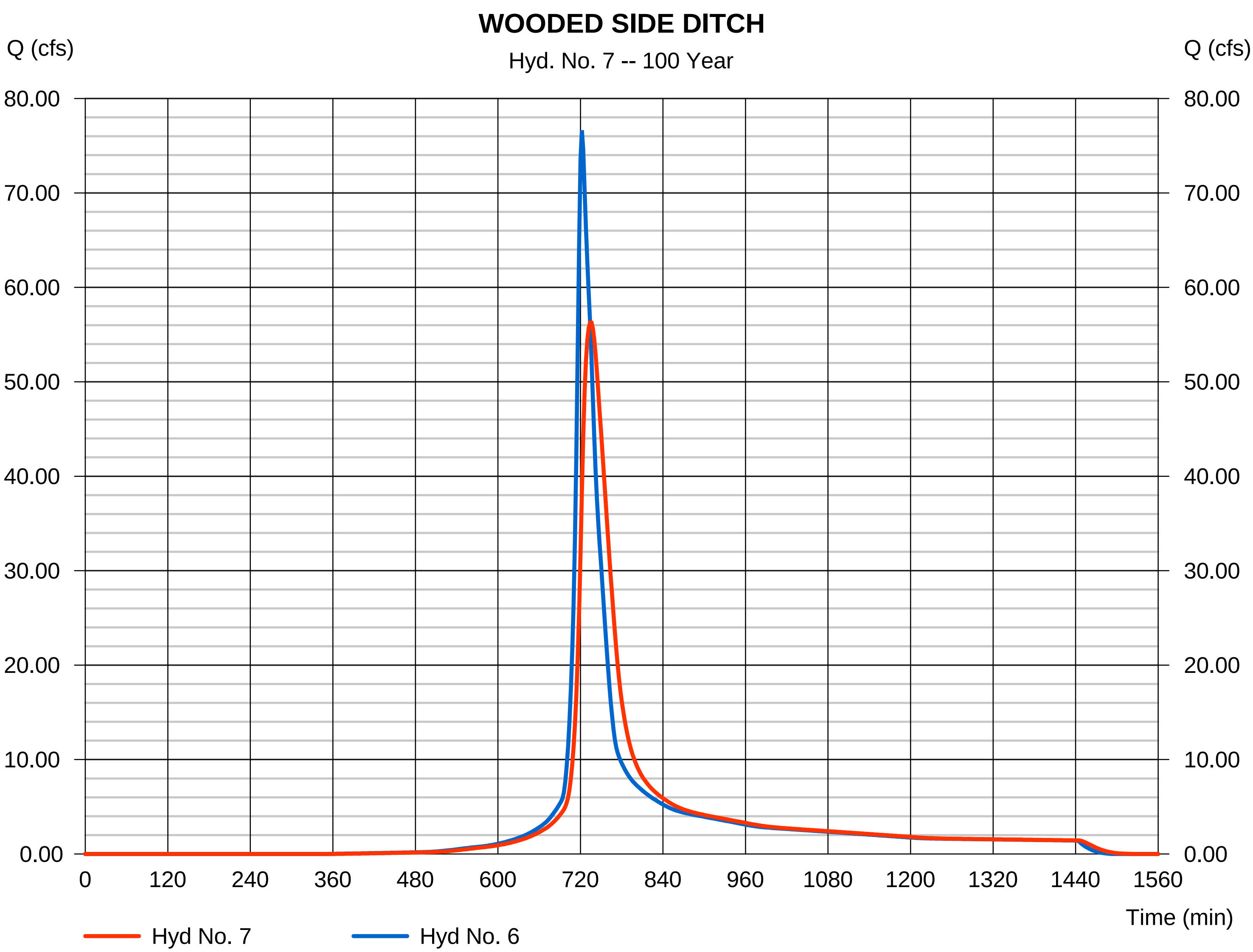
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 — Sunday, 01 / 10 / 2021

Hyd. No. 7

WOODED SIDE DITCH

Hydrograph type	= Reach	Peak discharge	= 56.28 cfs
Storm frequency	= 100 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 300,246 cuft
Inflow hyd. No.	= 6 - GRASSED SIDE DITCH	Section type	= Trapezoidal
Reach length	= 415.0 ft	Channel slope	= 0.2 %
Manning's n	= 0.150	Bottom width	= 2.0 ft
Side slope	= 10.0:1	Max. depth	= 3.0 ft
Rating curve x	= 0.273	Rating curve m	= 1.127
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 0.1549

Modified Att-Kin routing method used.



Hydrograph Report

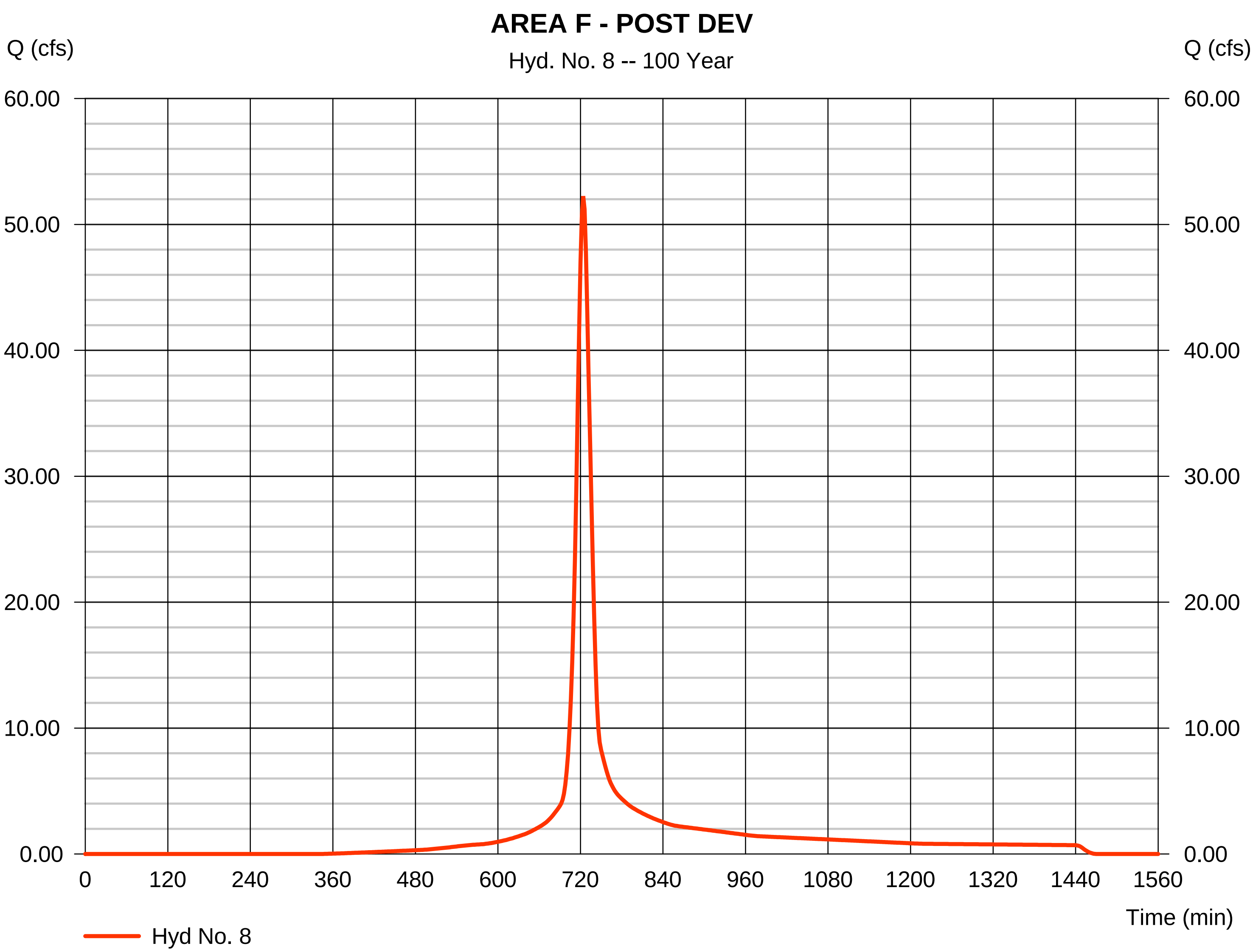
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 | Sunday, 01 / 10 / 2021

Hyd. No. 8

AREA F - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 52.25 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 164,644 cuft
Drainage area	= 8.620 ac	Curve number	= 78*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.00 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.440 x 85) + (7.810 x 77) + (0.370 x 98)] / 8.620



Hydrograph Report

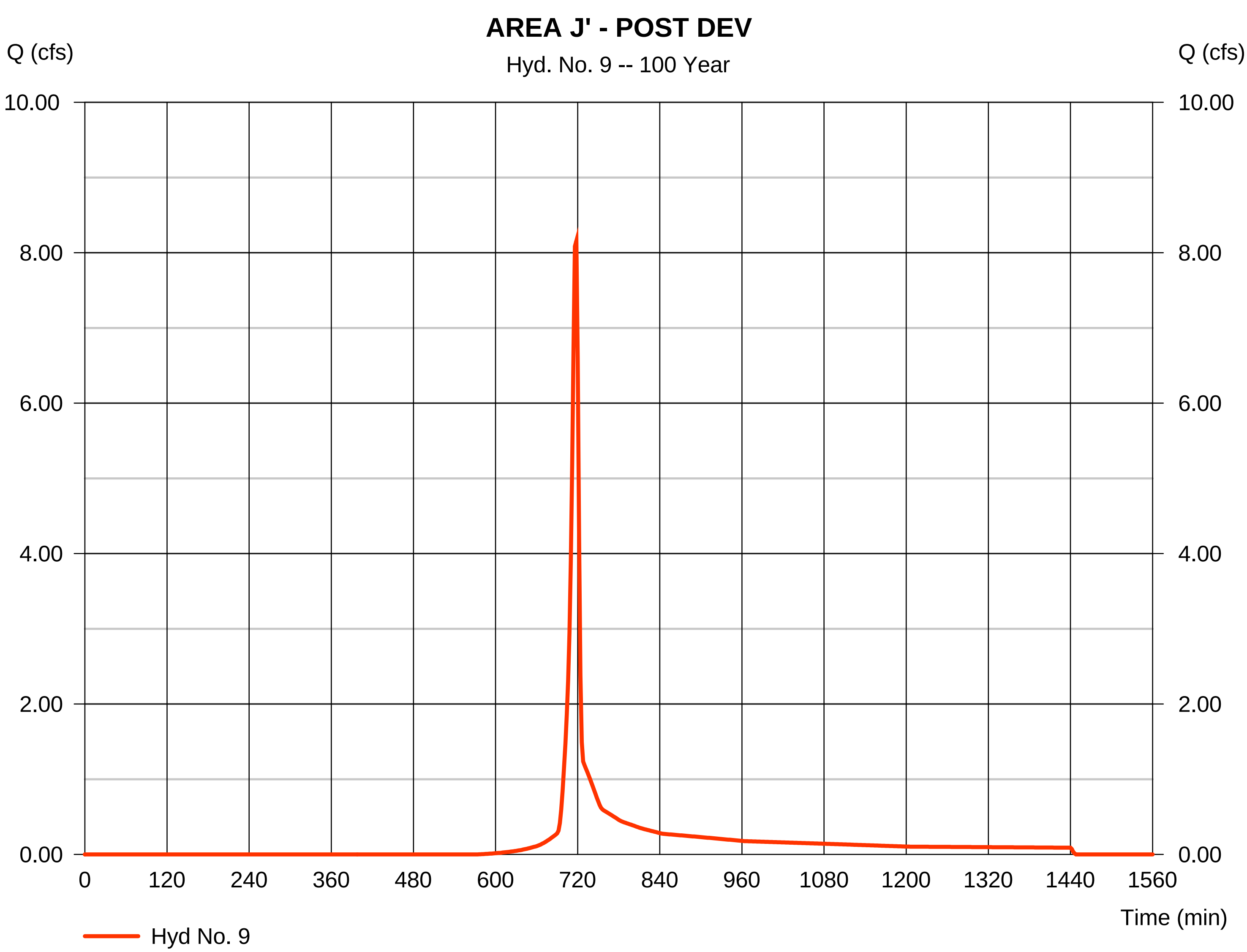
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 Sunday, 01 / 10 / 2021

Hyd. No. 9

AREA J' - POST DEV

Hydrograph type	= SCS Runoff	Peak discharge	= 8.156 cfs
Storm frequency	= 100 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 16,359 cuft
Drainage area	= 1.440 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 5.70 min
Total precip.	= 7.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.220 x 65) + (1.220 x 60)] / 1.440



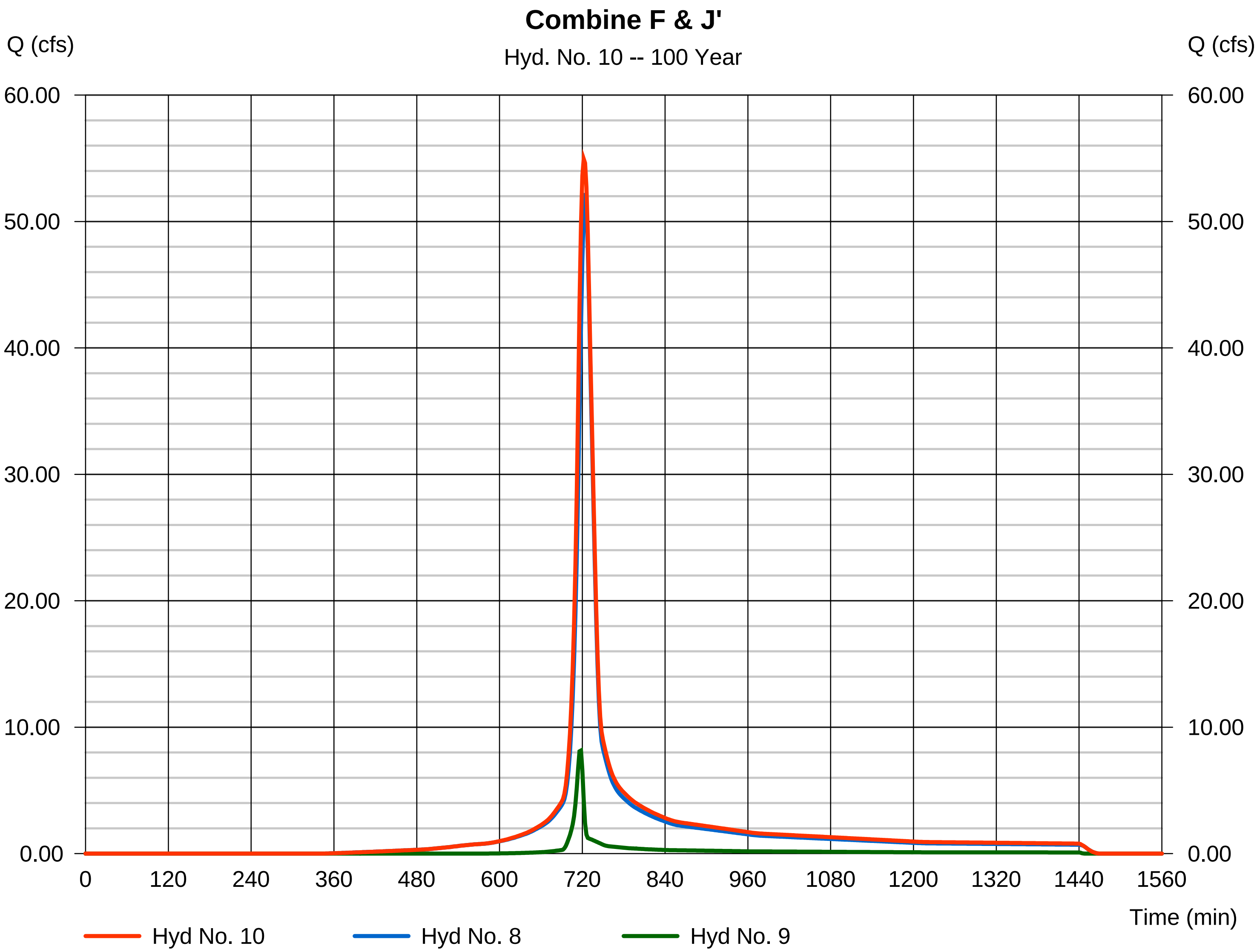
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 | Sunday, 01 / 10 / 2021

Hyd. No. 10

Combine F & J'

Hydrograph type	= Combine	Peak discharge	= 54.95 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 181,003 cuft
Inflow hyds.	= 8, 9	Contrib. drain. area	= 10.060 ac



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v12 | Sunday, 01 / 10 / 2021

Hyd. No. 11

Combine H, G, J, F & J'

Hydrograph type	= Combine	Peak discharge	= 101.55 cfs
Storm frequency	= 100 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 481,248 cuft
Inflow hyds.	= 7, 10	Contrib. drain. area	= 0.000 ac