CROCKETT
ENGINEERING CONSULTANTS

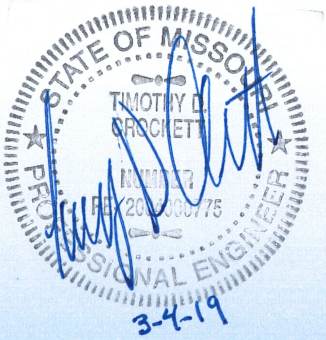
DETENTION & WATER QUALITY CALCULATIONS

FOR

STORAGE MART—156
LEE'S SUMMIT , MO

PROJECT NO.
170504

MARCH 4, 2019



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Stormwater Narrative

Storage Mart is expanding the facility located at 3920 South State Route 291 in Lee´s Summit, Missouri. The expansion will take place on Lots 2a and 3a of South M-291 Safety Mini Storage Lots 1A, 2A & 3A a subdivision in Lee´s Summit, Jackson County, Missouri and recorded as Instrument No. 2006D0058581. Lots 2a and 3a will be replatted to a single tract which will consist of 1.27 acres. The existing site consists of well-established grasses with an existing drainage ditch adjacent to the south property line. The following information will detail the pre-developed and post-developed conditions along with a summary on how detention and water quality is achieved for this development.

Pre-developed:

- Soil Types
  - Udarents- Urban Land Complex: Hydrologic soil group C.
  - Arisburg-Urban Land Complex: Hydrologic soil group C.
- Existing site is vacant and mainly consist of well-established grasses (1.24 acres) with an existing concrete access drive adjacent to the north property line (0.03 acres). Existing site grades range from 2% to 5% with the exception of the grades of the embankment at the existing drainage ditch adjacent to the south property line.
- Existing off-site stormwater discharge and overland flow is currently being conveyed through the existing ditch adjacent to the south property line of this development.
- Using NRCS Type II distribution the CN used for pervious areas is 74 and for impervious areas is 98. 74 is consistent with soils in the hydrologic soil group C for ˝open spaces in good condition˝. The overall pre-developed curve number is 75.
- Pre-developed runoff:
  - 2 yr – 2.03
  - 10 yr – 4.19
  - 100 yr – 7.06

Post-developed:

- Site development will consist of a 3-story building consisting of mini self-storage units and associated pavement.

- Site will consist of approximately 60% impervious area of the total site.
- Detention will be utilized to mitigate stormwater runoff.
- Extended detention with a water quality storage detainment time of 40 hours will be utilized to meet water quality requirements.
- Offsite stormwater runoff from the existing facility and areas draining to the existing ditch will be collected with storm sewer piping and routed through the site and be discharged into the existing drainage ditch along the west right-of-way of SW Raintree Tree. During the Pre-Application meeting this area was discussed and the City will allow the existing stormwater that is currently being discharged at the exiting ditch to not be detained and shall be conveyed with stormsewer to allow for this area to be "cleaned up".
- Total proposed stormwater conveyance to the detention facility is 1.17 acres (0.88 acres on-site and 0.29 acres off-site).
- Per the APWA 5600 Manual the CN for impervious area shall be 98 and pervious shall be 80.
- Post-developed runoff to the detention facility:
    - 2 yr – 5.06 cfs
    - 10 yr – 7.89 cfs
    - 100 yr – 11.33 cfs
- Post-developed runoff to off site:
    - 2 yr – 1.27 cfs
    - 10 yr – 2.22 cfs
    - 100 yr – 3.40 cfs

<u>Detention & Water Quality:</u>

- With the use of a dry extended detention basin and outlet structure the post-developed release rate of the detention facility:
    - 2 yr – 0.56 cfs
    - 10 yr – 2.49 cfs
    - 100 yr – 4.78 cfs
- The combined (post developed from detention plus post developed to off-site):
    - 2 yr – 1.34 cfs
    - 10 yr – 4.09 cfs
    - 100 yr – 6.99 cfs
- Per the APWA 5600 manual the allowable post developed release rate:
    - 2 yr – (0.5 x 1.27) = 0.64 cfs
    - 10 yr – (2.0 x 1.27) = 2.54 cfs
    - 100 yr – (3.0 x 1.27) = 3.81 cfs
- Pre vs Combined Post Developed Comparison:
    - 2 yr – (2.03 pre – 1.34 combined post) = 0.69 cfs reduction from pre
    - 10 yr – (4.19 pre – 4.09 combined post) = 0.10 cfs reduction from pre

    - 100 yr – (7.06 pre – 6.99 combined post) = 0.07 cfs reduction from pre
- My understanding is that the intent of the APWA max allowable release rates per acre is to protect downstream properties from flooding by over detaining the post developed runoff for larger developments. This is easier to be achieved on larger developments but can be difficult for small site such as the proposed development. The combined stormwater runoff as indicated in the calculations does not meet the APWA 5600 max allowable release rates. The detention facility is designed to meet the APWA 5600 stormwater runoff release rates. The offsite runoff is minimal and consists mainly of grassy areas. The offsite runoff will be conveyed through an existing drainage ditch along the west side of SW Raintree and will have little to no impact on any adjacent property. Due to site constraints and with the detention facility release rates meeting the APWA Manual for allowable release rates we are requesting that the City of Lee's Summit allow the combined release rate to exceed the allowable release rate. As shown above the combined post development condition is still lower than the predeveloped condition so there will be no impact on properties downstream of this development.
- The water quality level will be at 984.50. Required WQ storage volume is 3,720 cu.ft. Provided WQ storage volume is 3,944 cu.ft.
- Water quality is achieved with the use of extended detention by holding the water quality storm event (1.37 in.) in the detention facility for 40 hours. With the use of 4 – ½" diameter holes in the outlet structure the water quality storage volume will drain in 42.7 hours. Refer to calculations in this report.
- Proposed detention facility top of berm = 986.88
- The emergency spillway will consist of a 30' wide spillway in the detention berm at an elevation of 985.60 which will carry the 100 year post developed flow of 11.33 cfs at a depth of 0.28' in the event the primary emergency spillway is clogged.
- North American Green S150 erosion control mat shall be placed at spillway to protect basin during overtopping flow.
- Refer to attached calculations for additional information.

Water Quality Volume Calculation Worksheet

STORAGE MART - 156
170504

EXTENDED DRY DETENTION

Calculate WQv

(WQv) = P*Rv

P = Rainfall event in inches = 1.37 inches

Rv = Volumetric runoff coefficient

0.05 + 0.009(I)

I = Percent site imperviousness (%)

Size of Area	=	55449 sf
Size of Impervious Area	=	33122 sf

I = 60%

(WQv) = 0.81 watershed inches

(WQv) = 3719.8 ft3

Calculate peak discharge for the Water Quality Storm:

CN = $1000/[10 + 5P + 10Q – 10(Q^2 + 1.25QP)^{1/2}]$

P = Water Quality Storm rainfall (inches)

Q = Runoff volume (inches)—equal to WQv (watershed inches)

= 94.7

Tc = $(L^{0.8}[(1000/CN)-9]^{0.7})/(1140 * Y^{0.5})$

Tc = Time of concentration (hours)

L = Flow length (feet)	=	345 ft
CN = Runoff Curve Number		
Y = Average watershed slope (percent)	=	1.5 %

Tc = 0.09 hours (Note: If less than 0.1 hours, use 0.1 hours)

Ia = 0.113

Ia/P = 0.08 (The limiting value for Ia/P .1)

From Figure 2.3.1 in Appendix F

qu = 1000 cfs/sm/in

1.5625 cfs/ac/in

Qp = 1.60 CFS

OUTLET STRUCTURE DISCHARGE COMPUTATIONS
FOR EXTENDED DETENTION BASINS

****ENTER THE FOLLOWING INFORMATION*****

PROJECT: Storage Mart 156, Lee's Summit, MO
DATE: 27-Nov-18

RISER PIPE DIAMETER: 0 INCHES
OUTLET PIPE DIA.: 0 INCHES

PERFORATION DIA: 0.5 INCHES
HOLES PER ROW: 2
ORIFICE AREA: 0.39 SQ. IN.
(TOTAL FOR ROW)
ROW SPACING: 12 INCHES
NUMBER OF ROWS: 2

FLOWLINE ELEVATION
AT BOTTOM OF BASIN: 982.0

MAXIMUM PONDING
ELEV. FOR
EXTENDED DETENTION: 984.5

****

IN COLUMN A, ENTER WATER ELEVATIONS AT 3" INCREMENTS BEGINNING WITH THE ELEVATION
ENTERED ABOVE FOR MAXIMUM PONDING ELEVATION FOR EXTENDED DETENTION
AND PROCEEDING DOWNWARD TO THE FLOWLINE ELEVATION AT THE BOTTOM OF THE BASIN

IN COLUMN B ENTER THE AREA CORRESPONDING TO THE ELEVATION IN COLUMN A

ENTER THE ELEVATION OF EACH ROW OF HOLES BELOW THE ROW NUMBER
ENTER ELEVATION 9999.0 FOR ROWS NOT USED

RESULT IS DISPLAYED AT THE BOTTOM OF COLUMN K

WATER ELEVATION	AVERAGE AREA (SF)	AVERAGE VOL (CF)	OUTFLOW RATE (CFS) ROW 1	ROW 2	ROW 3	ROW 4	ROW 5	ROW 6	COMBINED OUTFLOW	DRAIN TIME (HOURS)
			982.00	983.00	9999.00	9999.00	9999.00	9999.00		
984.50	5239	1928	0.021	0.016	0.000	0.000	0.000	0.000	0.037	14.54
984.00	2474	1041	0.019	0.013	0.000	0.000	0.000	0.000	0.032	9.12
983.50	1689	648	0.016	0.009	0.000	0.000	0.000	0.000	0.025	7.10
983.00	903	351	0.013	0.000	0.000	0.000	0.000	0.000	0.013	7.43
982.50	502	151	0.009	0.000	0.000	0.000	0.000	0.000	0.009	4.50
982.00	100	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00
		4119						TOTAL DRAIN TIME		42.7 hours
								MAX. OUTFLOW RATE =		0.12 cfs

Weir Report

Emergency Spillway

Rectangular Weir

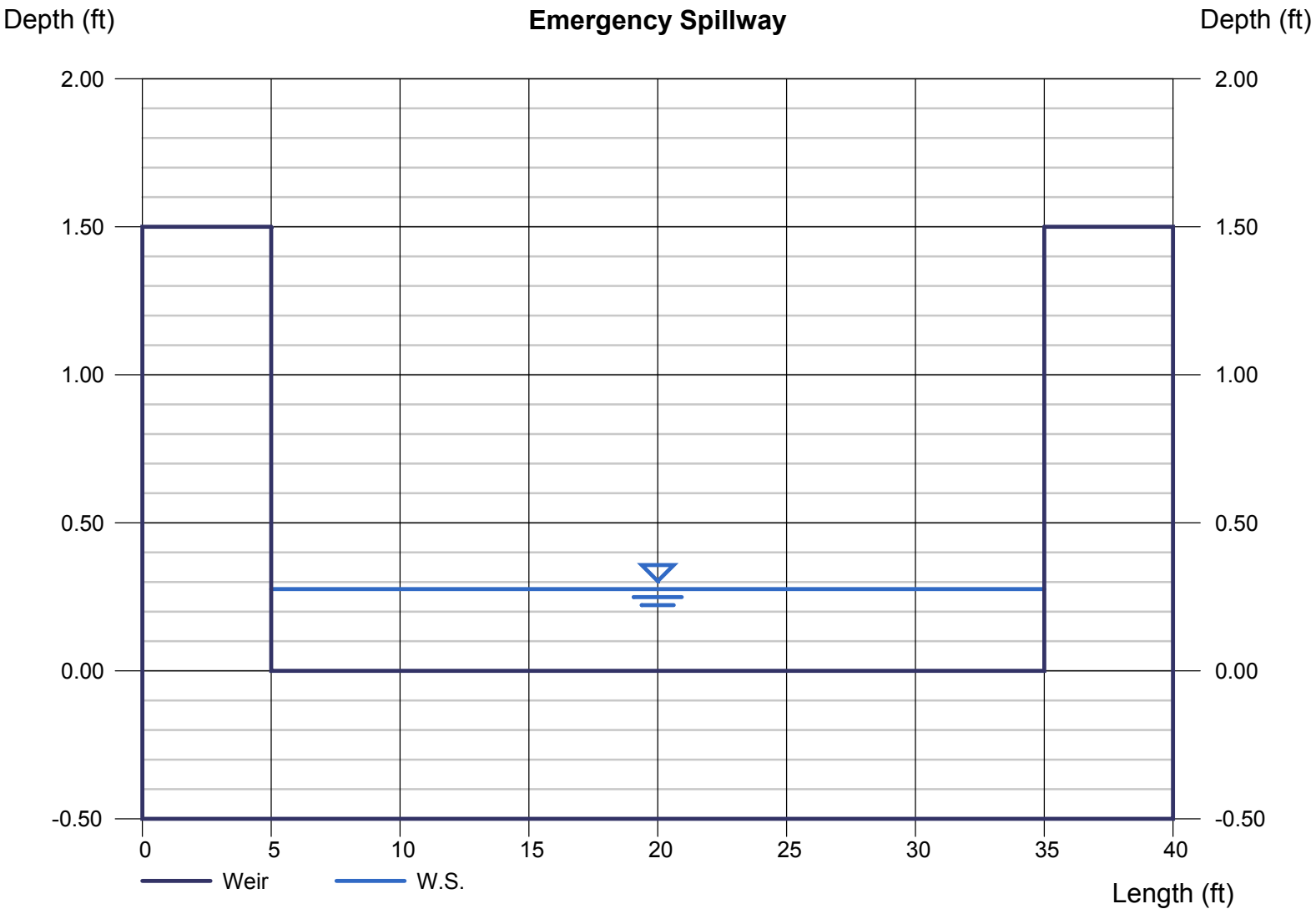
Crest	= Broad
Bottom Length (ft)	= 30.00
Total Depth (ft)	= 1.50

Calculations

Weir Coeff. Cw	= 2.60
Compute by:	Known Q
Known Q (cfs)	= 11.33

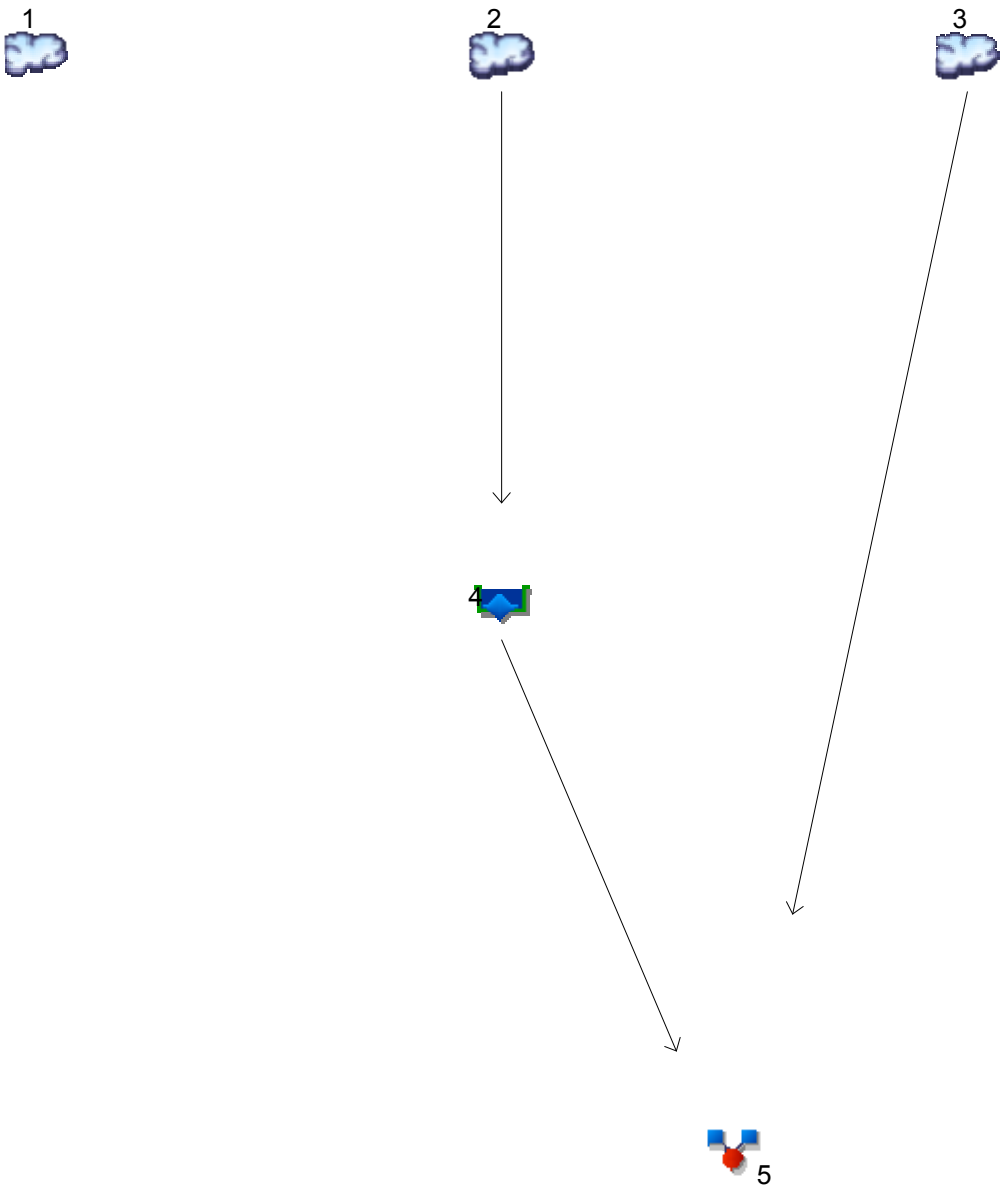
Highlighted

Depth (ft)	= 0.28
Q (cfs)	= 11.33
Area (sqft)	= 8.28
Velocity (ft/s)	= 1.37
Top Width (ft)	= 30.00



Watershed Model Schematic

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



Legend

Hyd.	Origin	Description
1	SCS Runoff	Pre Development
2	SCS Runoff	Post Developed to Detention
3	SCS Runoff	Post Developed Not to Detention
4	Reservoir	Route Thru Pond
5	Combine	Total Post Developed

Hydrograph Return Period Recap

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	------	-------	2.032	-------	-------	4.185	-------	-------	7.059	Pre Development
2	SCS Runoff	------	-------	5.062	-------	-------	7.888	-------	-------	11.33	Post Developed to Detention
3	SCS Runoff	------	-------	1.268	-------	-------	2.216	-------	-------	3.398	Post Developed Not to Detention
4	Reservoir	2	-------	0.558	-------	-------	2.492	-------	-------	4.782	Route Thru Pond
5	Combine	3, 4	-------	1.339	-------	-------	4.086	-------	-------	6.991	Total Post Developed

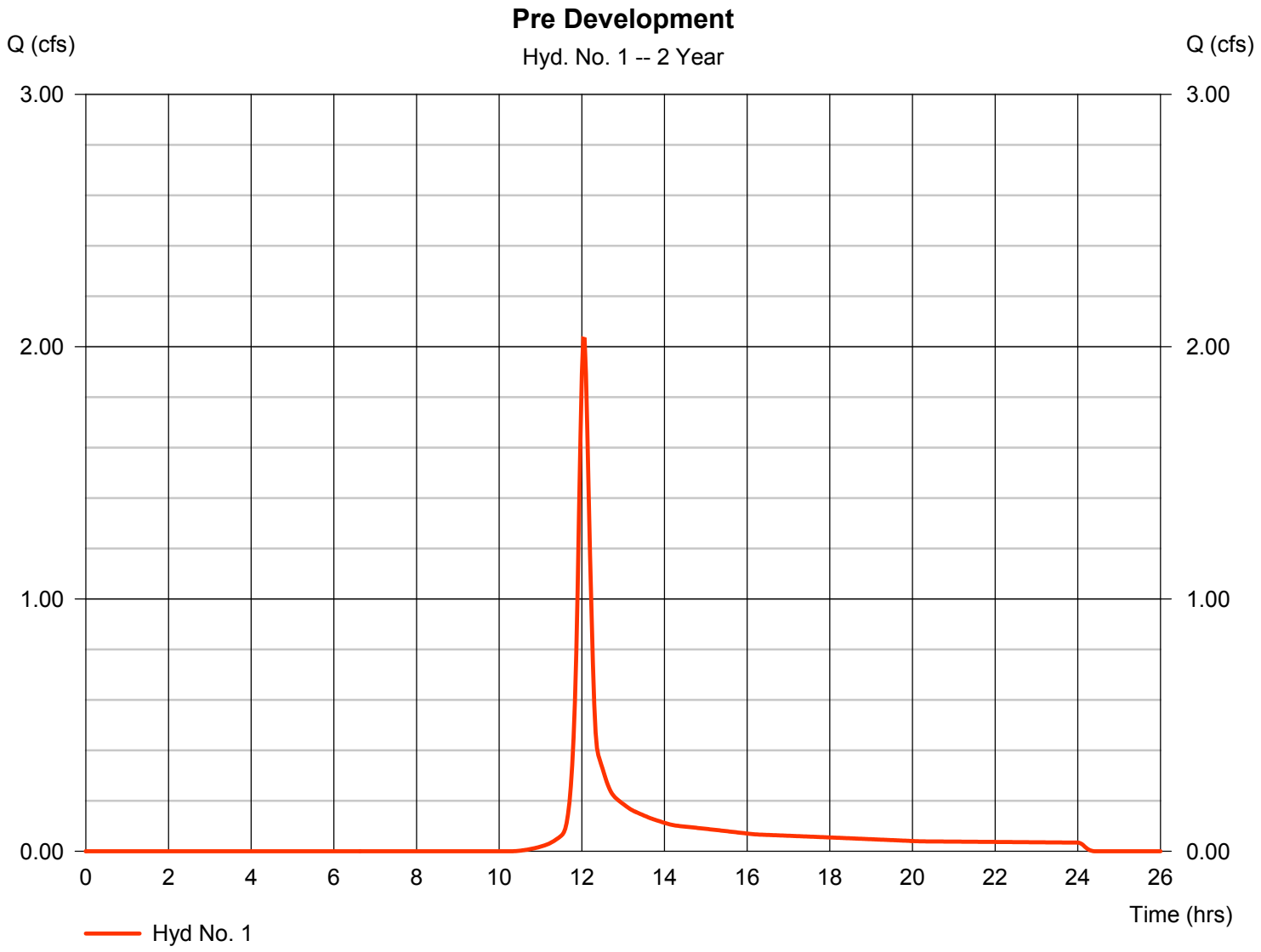
Hydrograph Report

Hyd. No. 1

Pre Development

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.032 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.03 hrs
Time interval	=	2 min	Hyd. volume	=	5,851 cuft
Drainage area	=	1.270 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	14.90 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.240 x 74) + (0.030 x 98)] / 1.270



TR55 Tc Worksheet

Hyd. No. 1

Pre Development

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.240		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.50		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 13.64**	**+**	**0.00**	**+**	**0.00**	**=**	**13.64**
Shallow Concentrated Flow							
Flow length (ft)	= 230.00		0.00		0.00		
Watercourse slope (%)	= 3.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=3.02		0.00		0.00		
Travel Time (min)	**= 1.27**	**+**	**0.00**	**+**	**0.00**	**=**	**1.27**
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 ..... 14.90 min

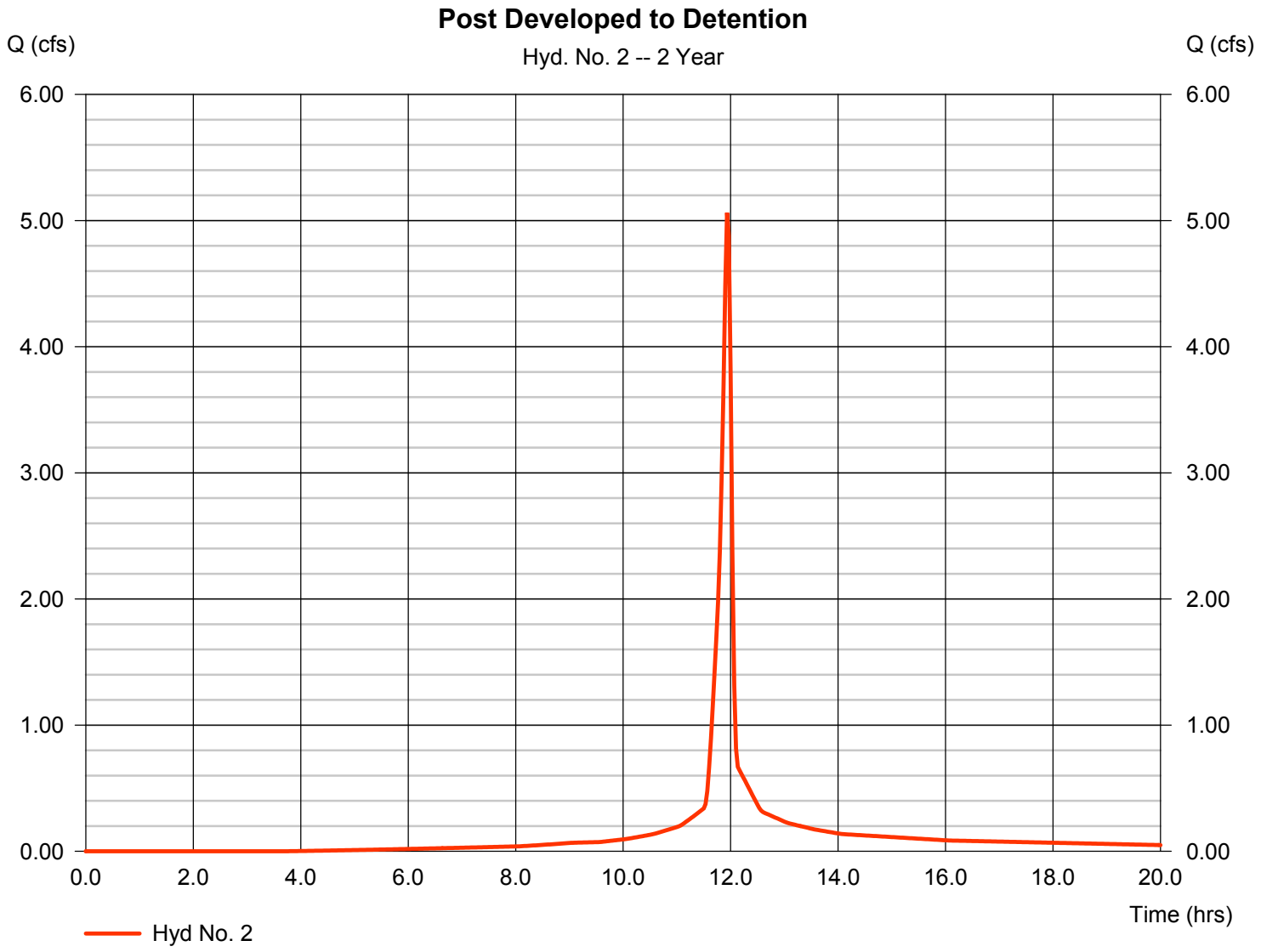
Hydrograph Report

Hyd. No. 2

Post Developed to Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 5.062 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 10,889 cuft
Drainage area	= 1.170 ac	Curve number	= 93*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 3.10 min
Total precip.	= 3.50 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.760 x 98) + (0.120 x 80) + (0.090 x 98) + (0.200 x 80)] / 1.170



TR55 Tc Worksheet

Hyd. No. 2

Post Developed to Detention

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.011		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.50		0.00		0.00		
Land slope (%)	= 1.00		0.00		0.00		
Travel Time (min)	**= 1.53**	**+**	**0.00**	**+**	**0.00**	**=**	**1.53**
Shallow Concentrated Flow							
Flow length (ft)	= 190.00		0.00		0.00		
Watercourse slope (%)	= 1.00		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=2.03		0.00		0.00		
Travel Time (min)	**= 1.56**	**+**	**0.00**	**+**	**0.00**	**=**	**1.56**
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 ..... 3.10 min

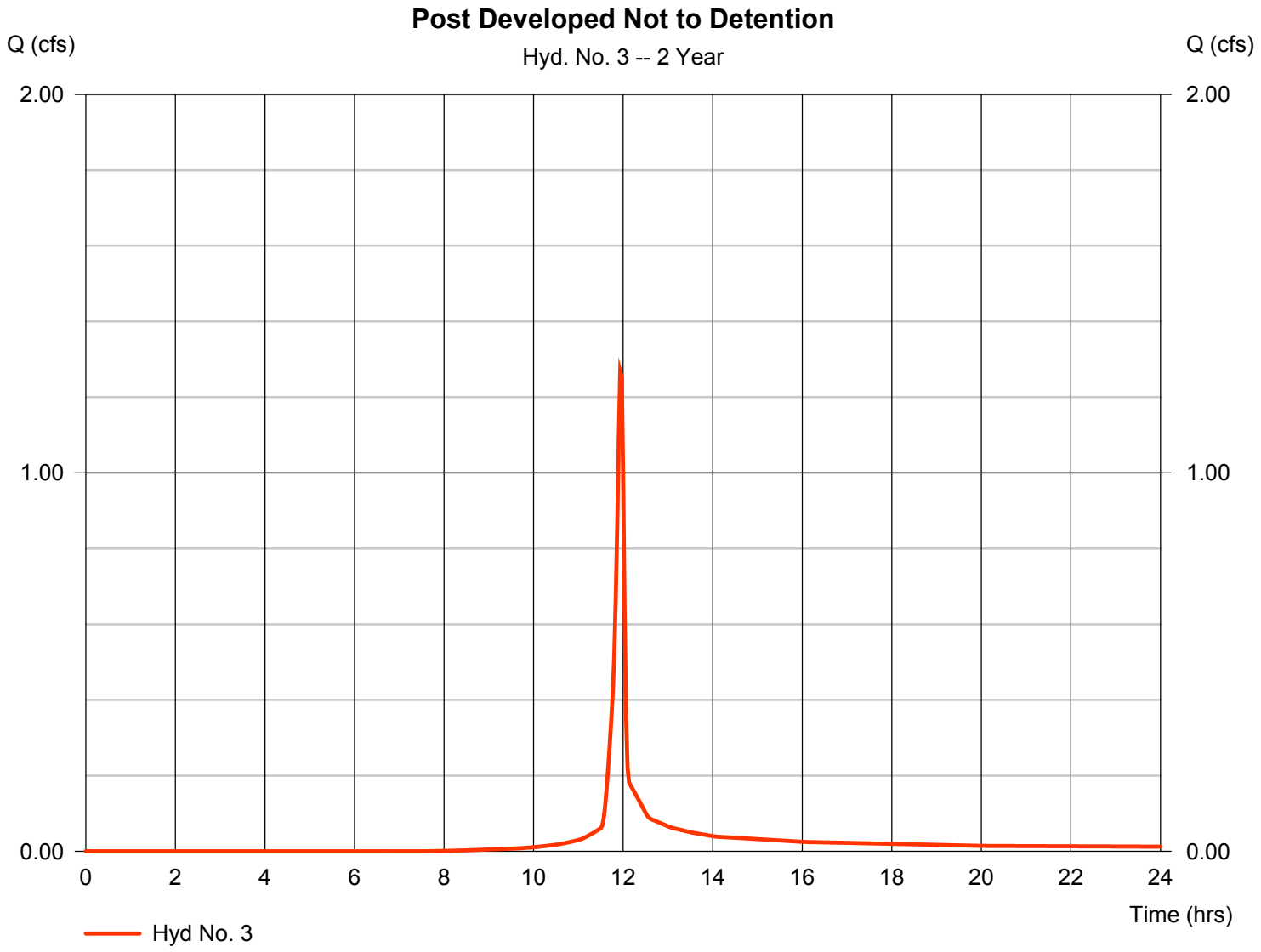
Hydrograph Report

Hyd. No. 3

Post Developed Not to Detention

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.268 cfs
Storm frequency	=	2 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	2,570 cuft
Drainage area	=	0.390 ac	Curve number	=	84*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	6.50 min
Total precip.	=	3.50 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.090 x 98) + (0.300 x 80)] / 0.390



TR55 Tc Worksheet

Hyd. No. 3

Post Developed Not to Detention

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 100.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.50		0.00		0.00		
Land slope (%)	= 5.00		0.00		0.00		
Travel Time (min)	**= 6.49**	**+**	**0.00**	**+**	**0.00**	**=**	**6.49**
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)	= 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 ..... 6.50 min

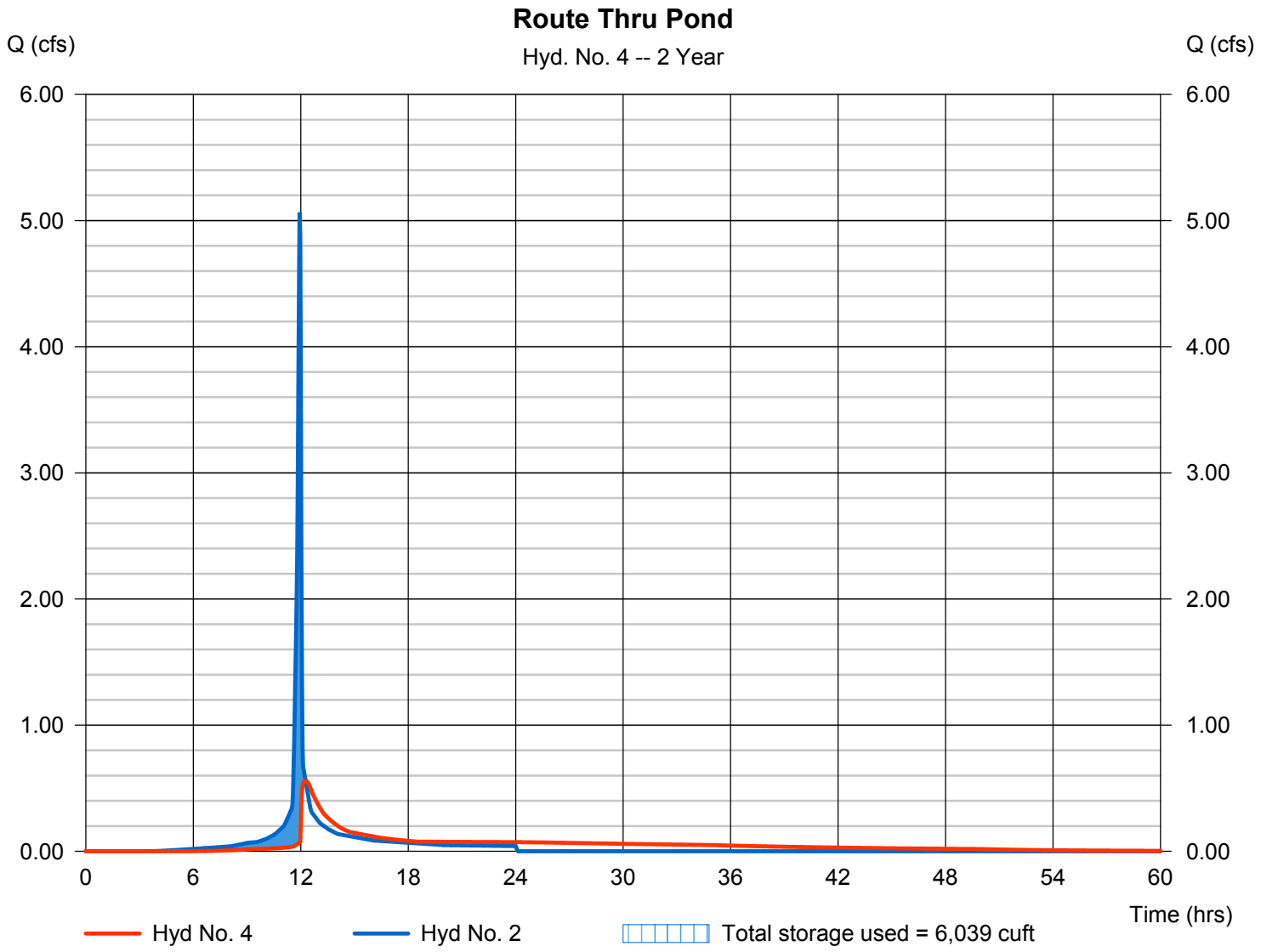
Hydrograph Report

Hyd. No. 4

Route Thru Pond

Hydrograph type	=	Reservoir	Peak discharge	=	0.558 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.27 hrs
Time interval	=	2 min	Hyd. volume	=	10,827 cuft
Inflow hyd. No.	=	2 - Post Developed to Detention	Max. Elevation	=	984.82 ft
Reservoir name	=	DETENTION POND	Max. Storage	=	6,039 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - DETENTION POND

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 982.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	982.00	100	0	0
1.00	983.00	903	434	434
2.00	984.00	2,474	1,624	2,058
2.50	984.50	5,239	1,885	3,944
3.00	985.00	8,003	3,286	7,229
4.00	986.00	11,289	9,598	16,827

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 15.00	6.00	0.00	0.50
Span (in)	= 15.00	24.00	0.00	0.50
No. Barrels	= 1	1	0	4
Invert El. (ft)	= 975.32	984.65	0.00	982.00
Length (ft)	= 60.85	0.00	0.00	1.00
Slope (%)	= 2.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	Yes

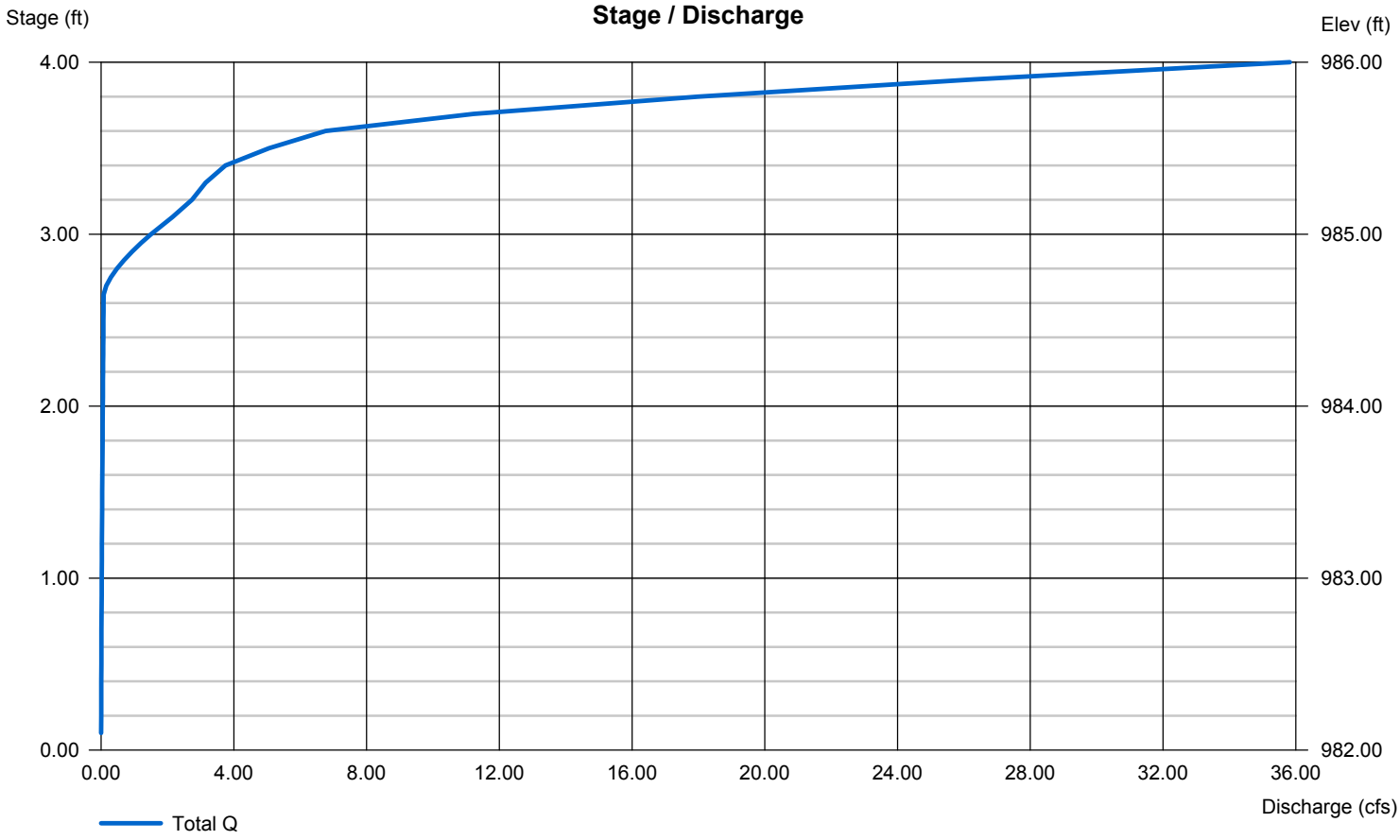
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.28	30.00	0.00	0.00
Crest El. (ft)	= 985.35	985.60	0.00	0.00
Weir Coeff.	= 3.33	2.60	3.33	3.33
Weir Type	= 1	Broad	---	---
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).

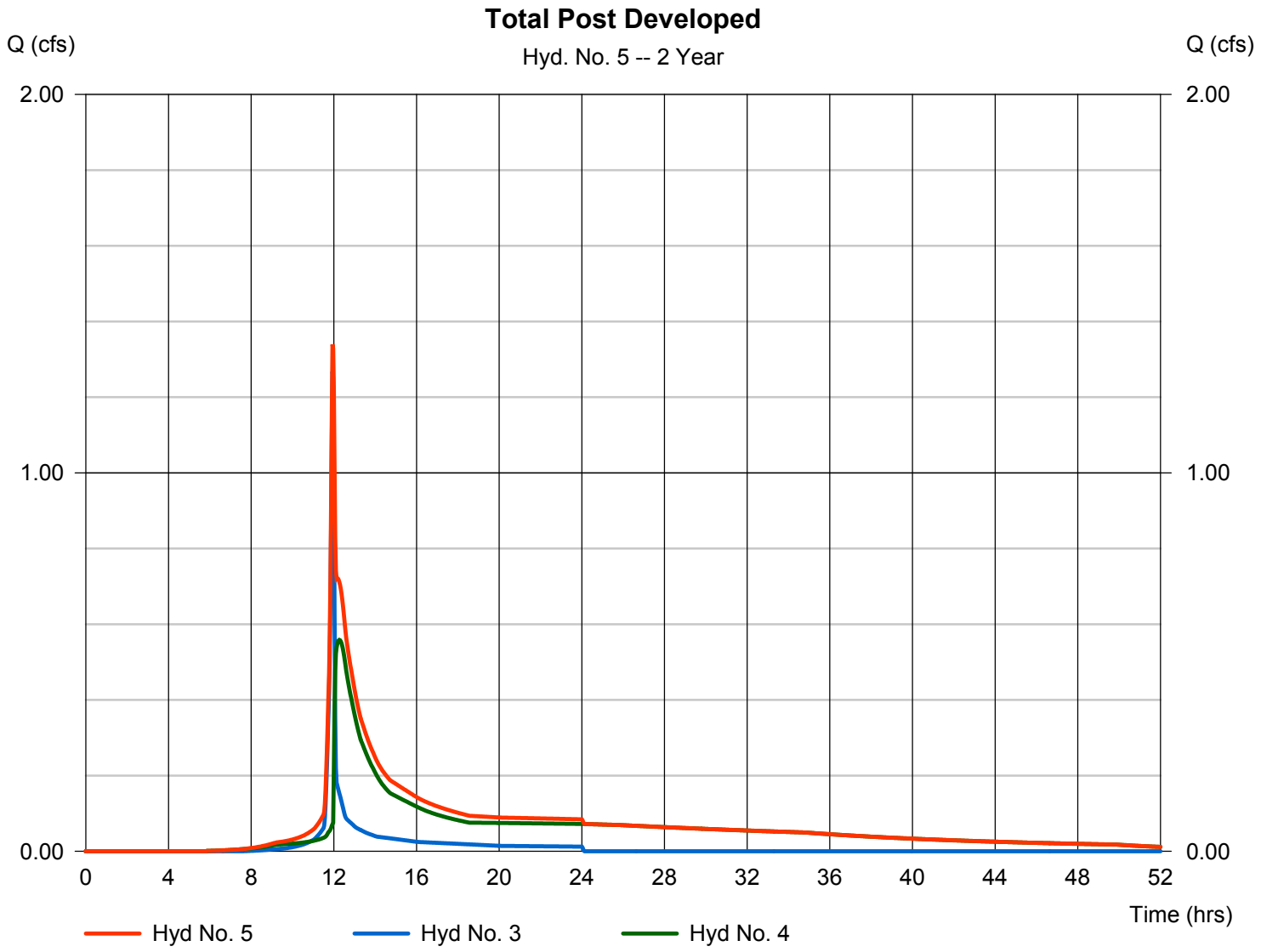


Hydrograph Report

Hyd. No. 5

Total Post Developed

Hydrograph type	= Combine	Peak discharge	= 1.339 cfs
Storm frequency	= 2 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 13,397 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 0.390 ac



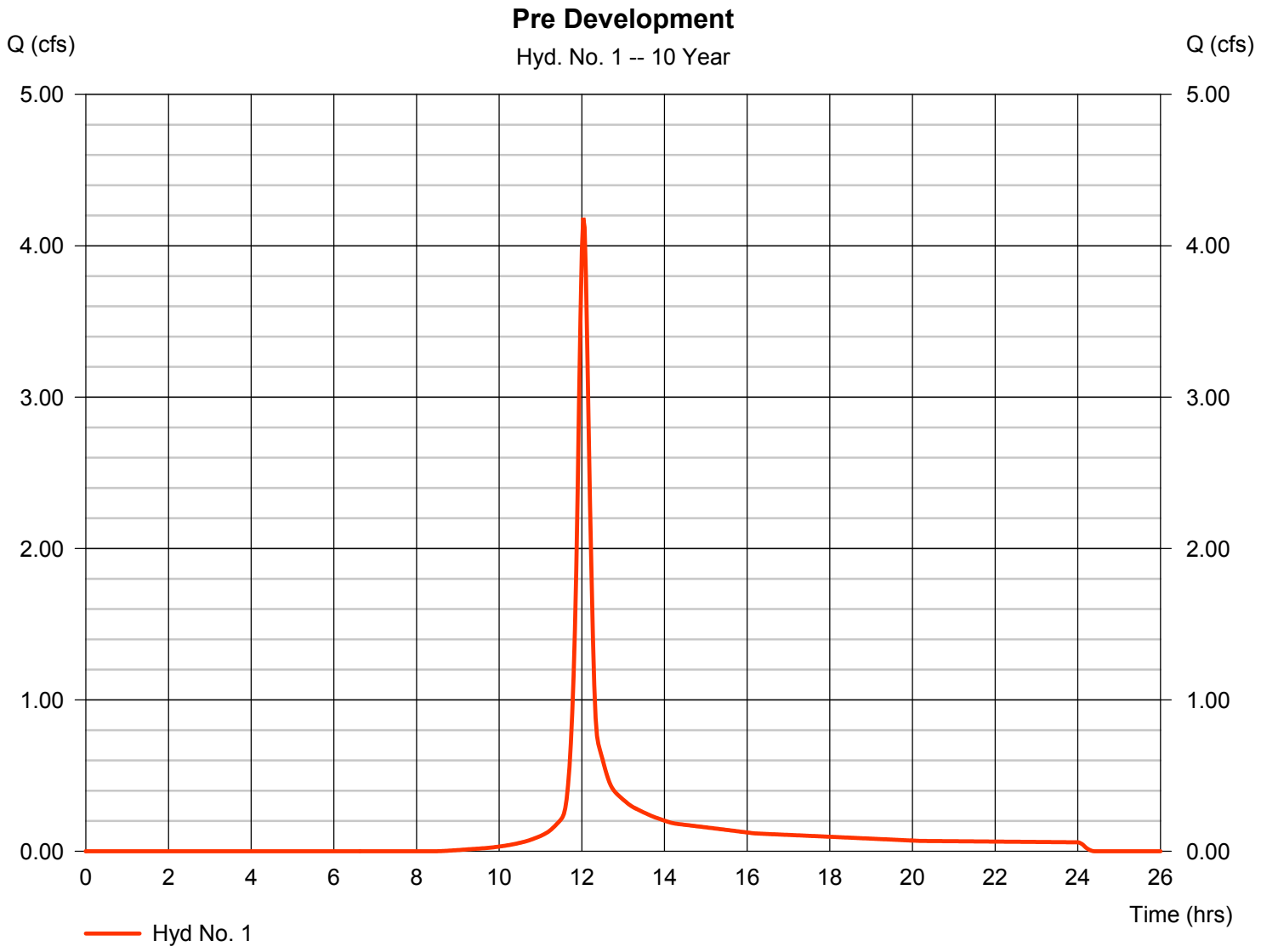
Hydrograph Report

Hyd. No. 1

Pre Development

Hydrograph type	= SCS Runoff	Peak discharge	= 4.185 cfs
Storm frequency	= 10 yrs	Time to peak	= 12.03 hrs
Time interval	= 2 min	Hyd. volume	= 11,742 cuft
Drainage area	= 1.270 ac	Curve number	= 75*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 14.90 min
Total precip.	= 5.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.240 x 74) + (0.030 x 98)] / 1.270



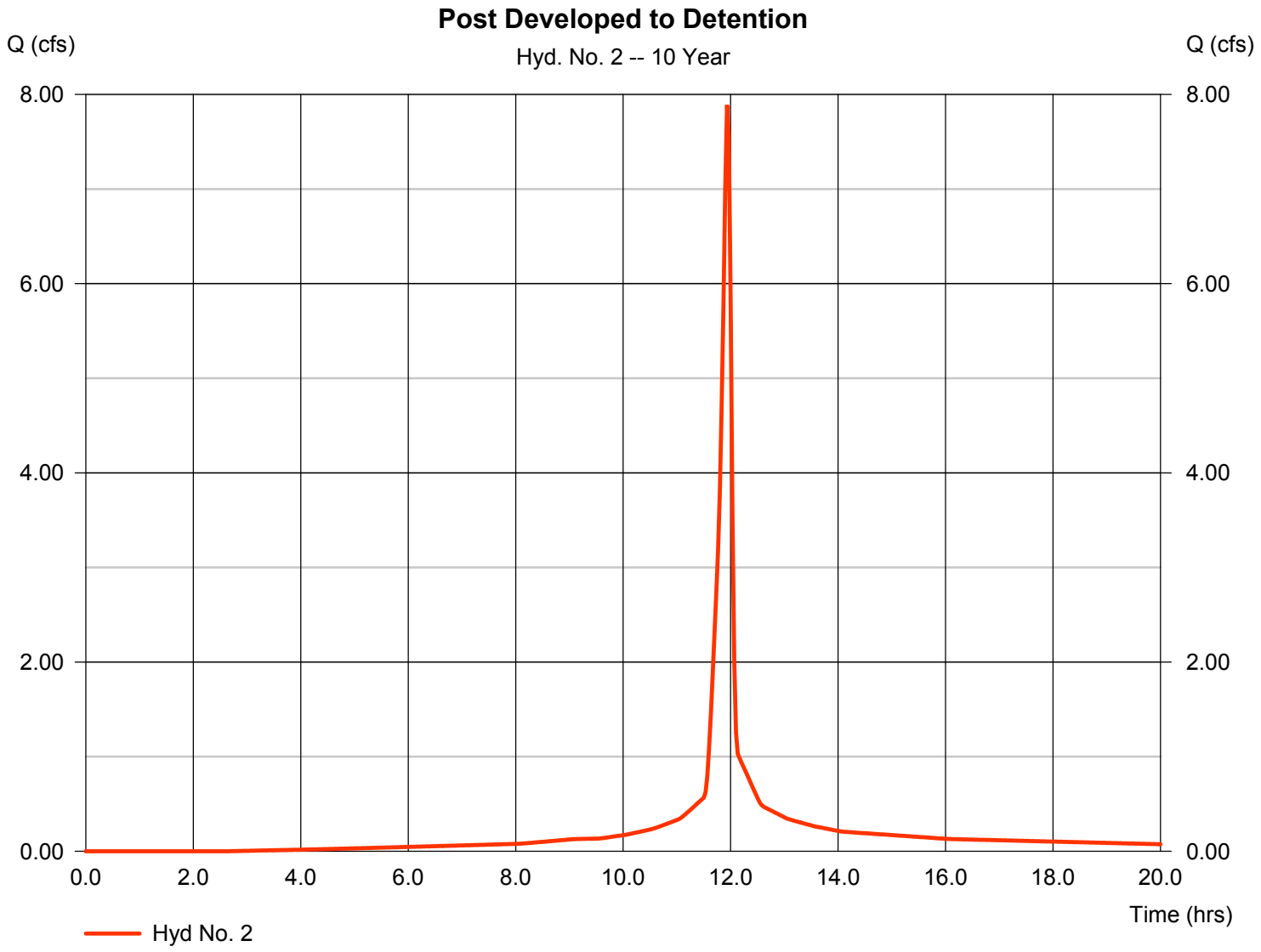
Hydrograph Report

Hyd. No. 2

Post Developed to Detention

Hydrograph type	=	SCS Runoff	Peak discharge	=	7.888 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	17,497 cuft
Drainage area	=	1.170 ac	Curve number	=	93*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	3.10 min
Total precip.	=	5.20 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.760 x 98) + (0.120 x 80) + (0.090 x 98) + (0.200 x 80)] / 1.170



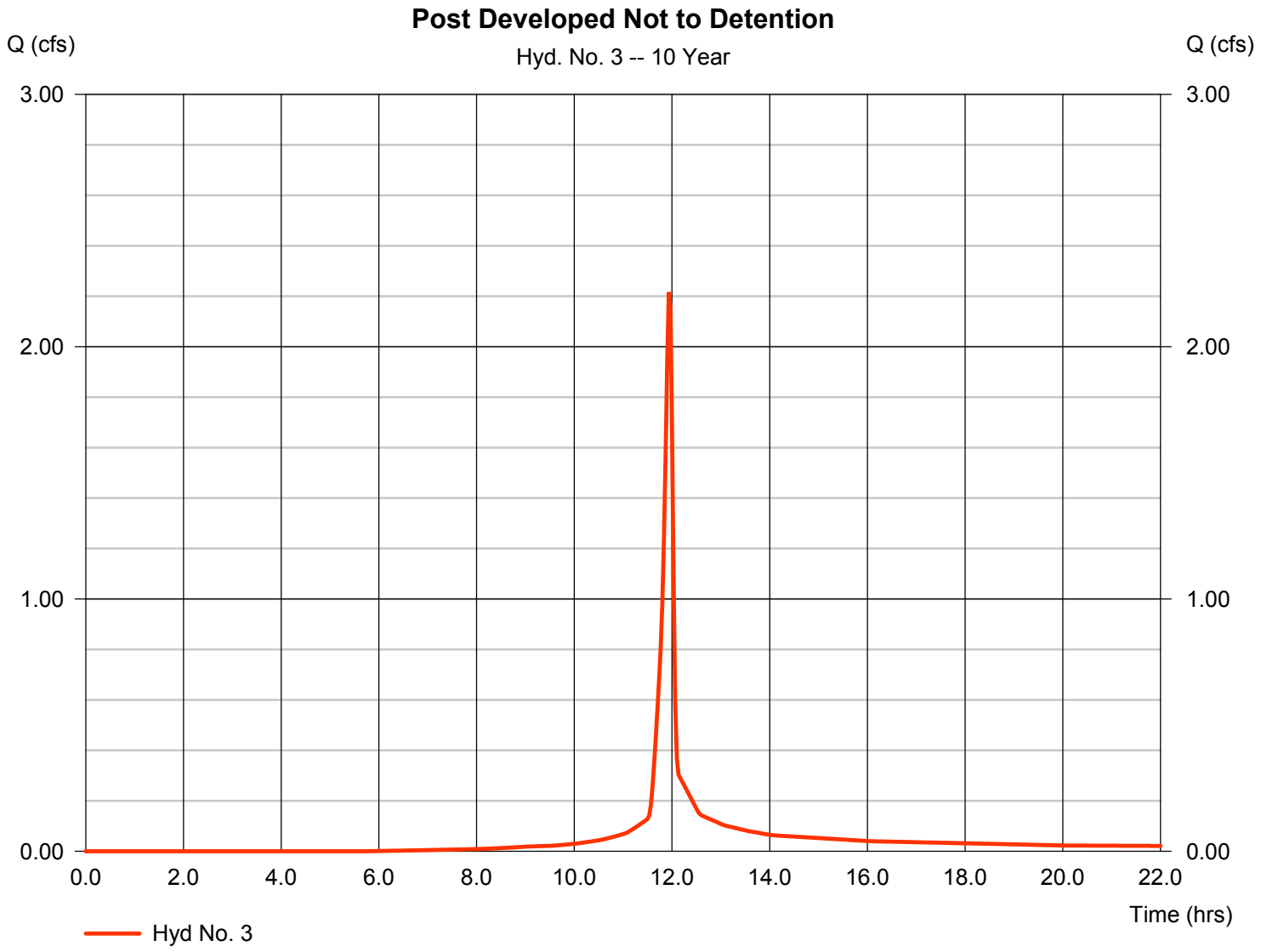
Hydrograph Report

Hyd. No. 3

Post Developed Not to Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 2.216 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 4,584 cuft
Drainage area	= 0.390 ac	Curve number	= 84*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.50 min
Total precip.	= 5.20 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 98) + (0.300 x 80)] / 0.390



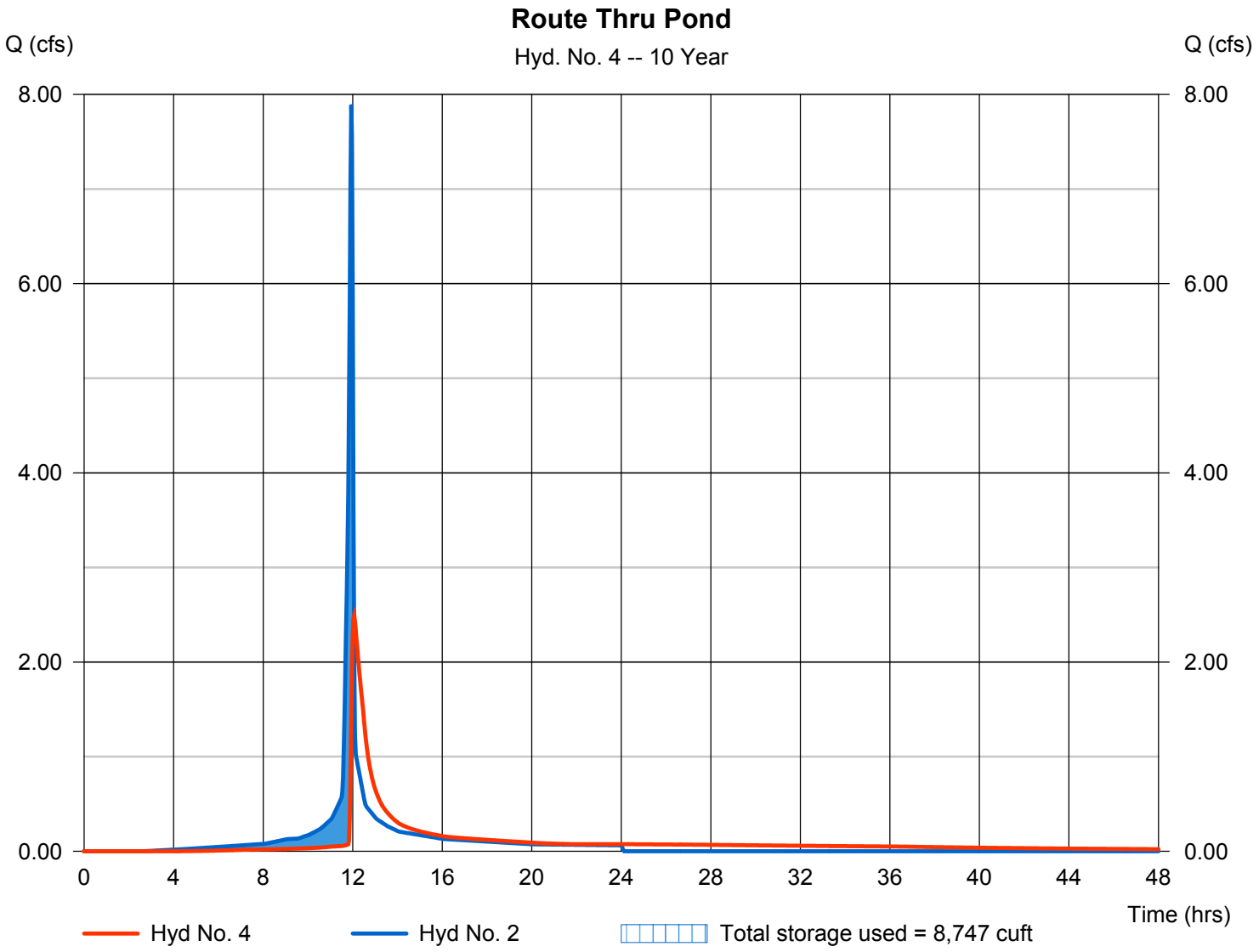
Hydrograph Report

Hyd. No. 4

Route Thru Pond

Hydrograph type	=	Reservoir	Peak discharge	=	2.492 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.07 hrs
Time interval	=	2 min	Hyd. volume	=	17,434 cuft
Inflow hyd. No.	=	2 - Post Developed to Detention	Max. Elevation	=	985.16 ft
Reservoir name	=	DETENTION POND	Max. Storage	=	8,747 cuft

Storage Indication method used.

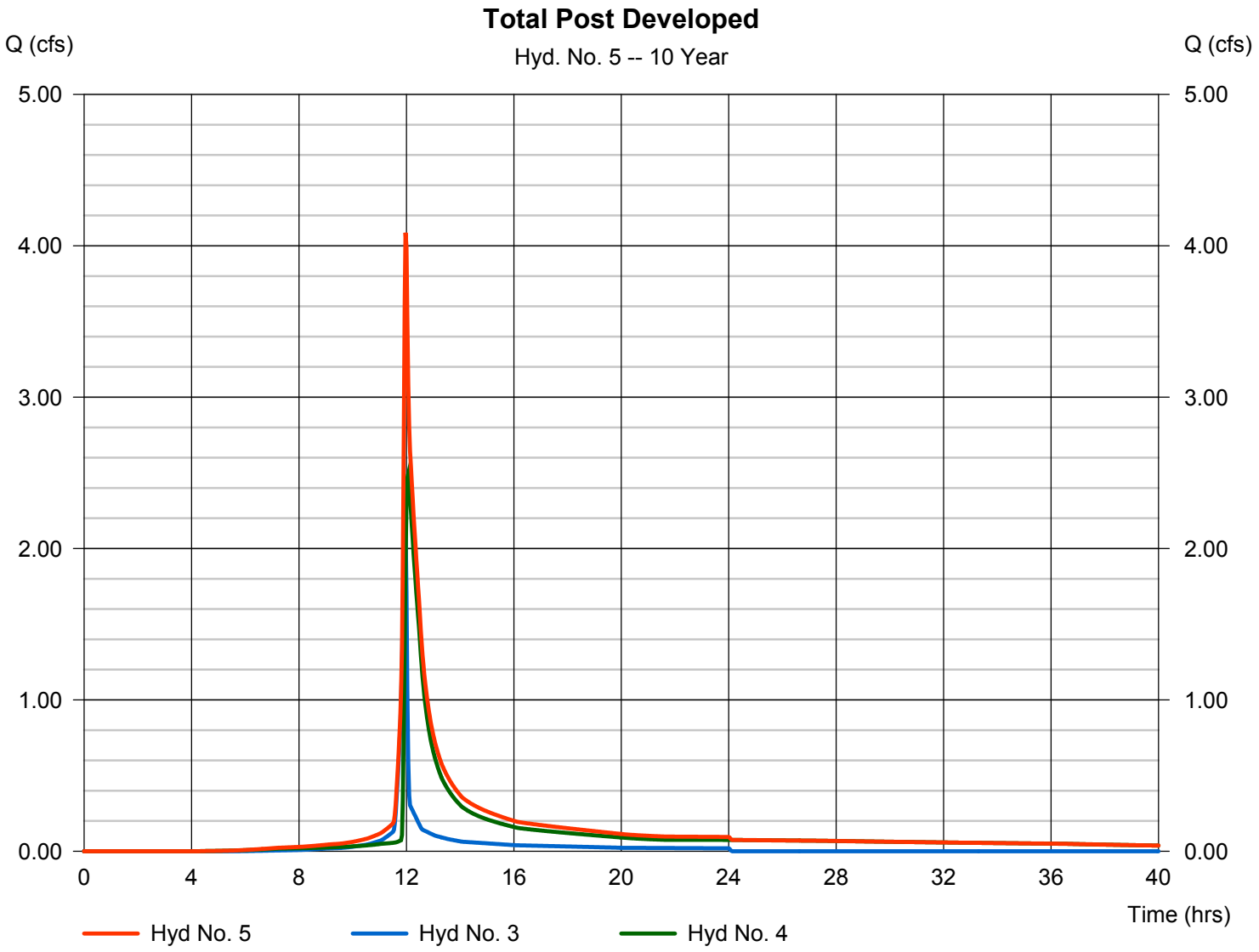


Hydrograph Report

Hyd. No. 5

Total Post Developed

Hydrograph type	= Combine	Peak discharge	= 4.086 cfs
Storm frequency	= 10 yrs	Time to peak	= 11.97 hrs
Time interval	= 2 min	Hyd. volume	= 22,018 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 0.390 ac



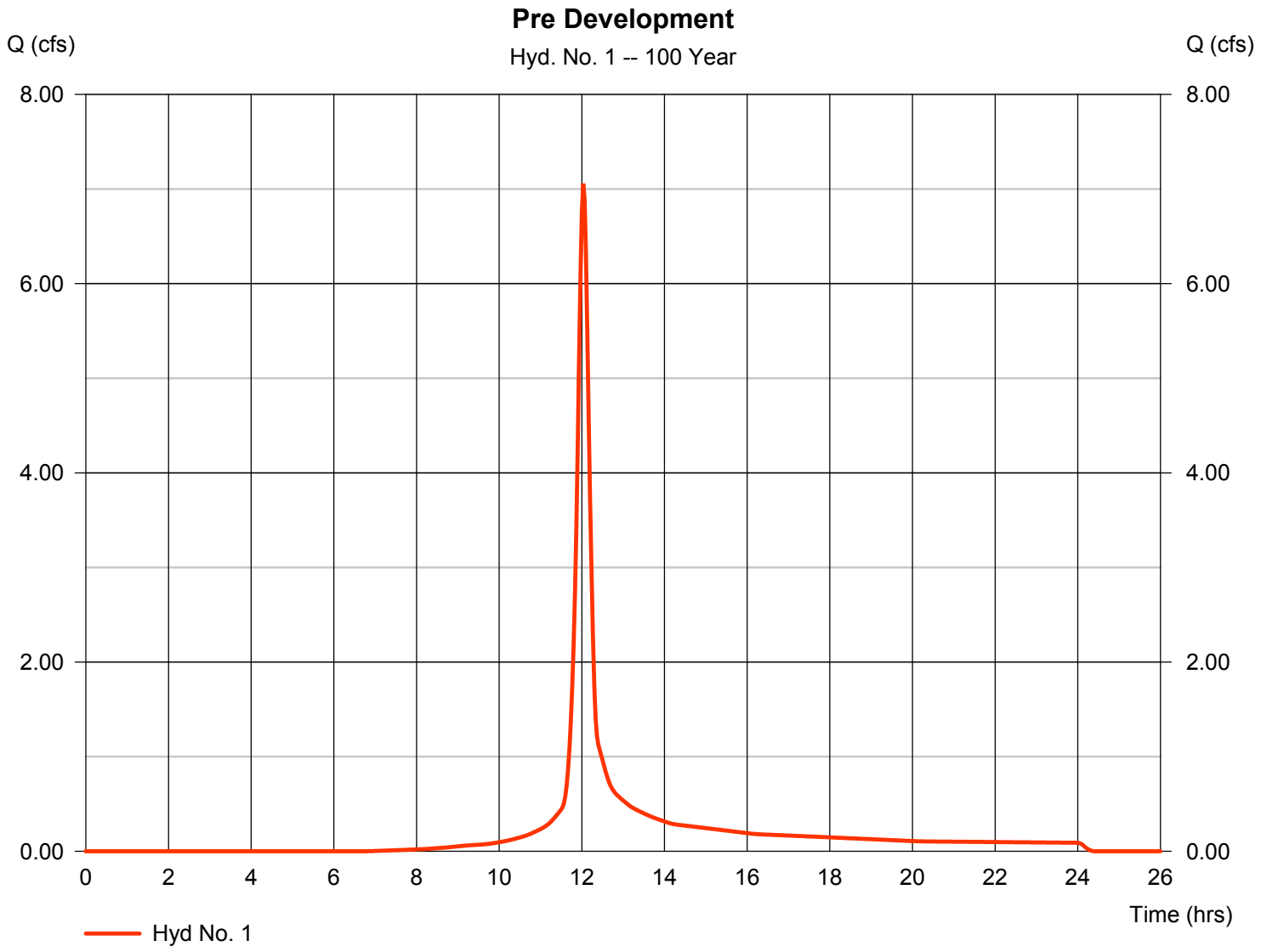
Hydrograph Report

Hyd. No. 1

Pre Development

Hydrograph type	=	SCS Runoff	Peak discharge	=	7.059 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.03 hrs
Time interval	=	2 min	Hyd. volume	=	19,844 cuft
Drainage area	=	1.270 ac	Curve number	=	75*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	14.90 min
Total precip.	=	7.30 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(1.240 x 74) + (0.030 x 98)] / 1.270



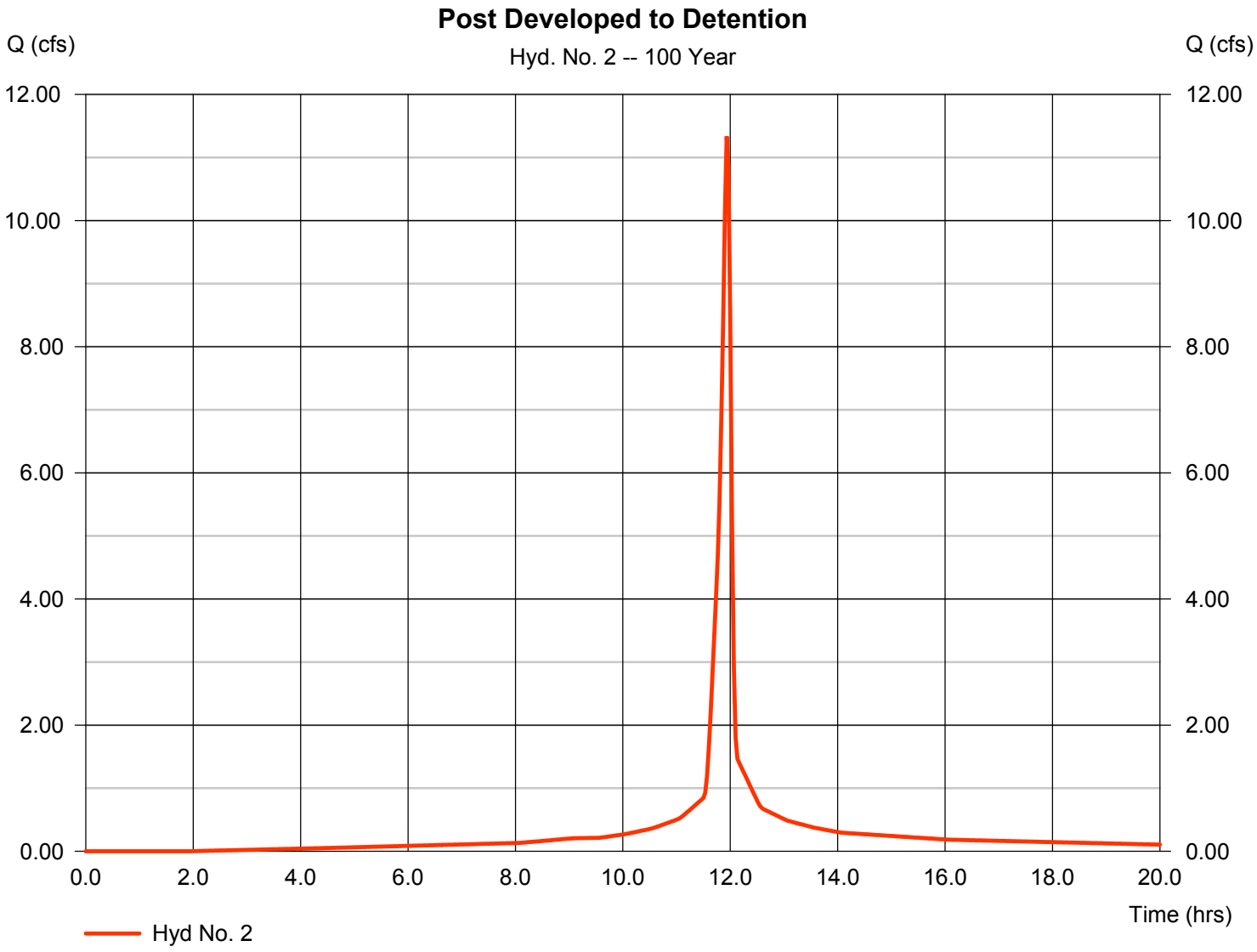
Hydrograph Report

Hyd. No. 2

Post Developed to Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 11.33 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 25,755 cuft
Drainage area	= 1.170 ac	Curve number	= 93*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 3.10 min
Total precip.	= 7.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.760 x 98) + (0.120 x 80) + (0.090 x 98) + (0.200 x 80)] / 1.170



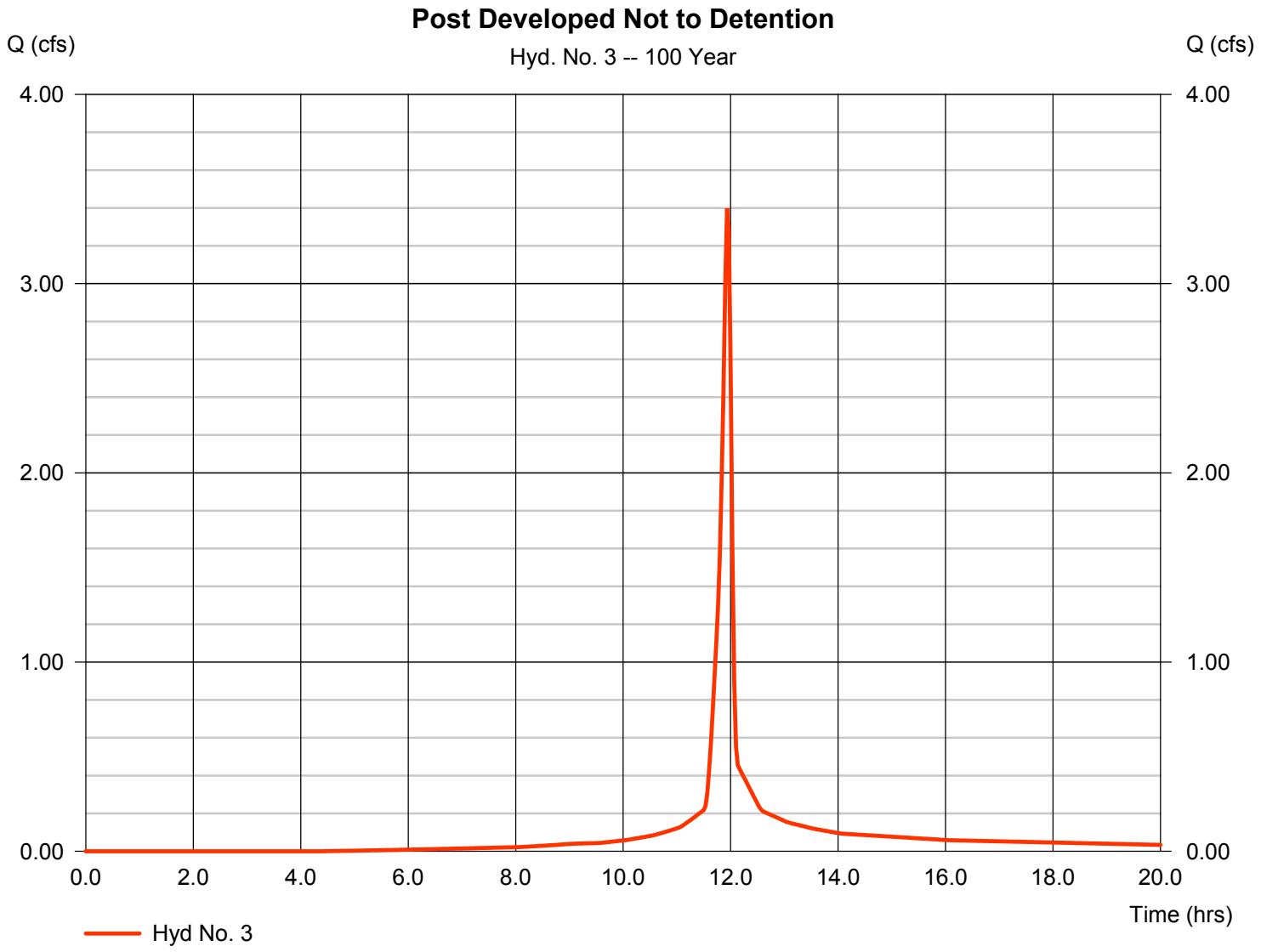
Hydrograph Report

Hyd. No. 3

Post Developed Not to Detention

Hydrograph type	= SCS Runoff	Peak discharge	= 3.398 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.93 hrs
Time interval	= 2 min	Hyd. volume	= 7,201 cuft
Drainage area	= 0.390 ac	Curve number	= 84*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 6.50 min
Total precip.	= 7.30 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.090 x 98) + (0.300 x 80)] / 0.390



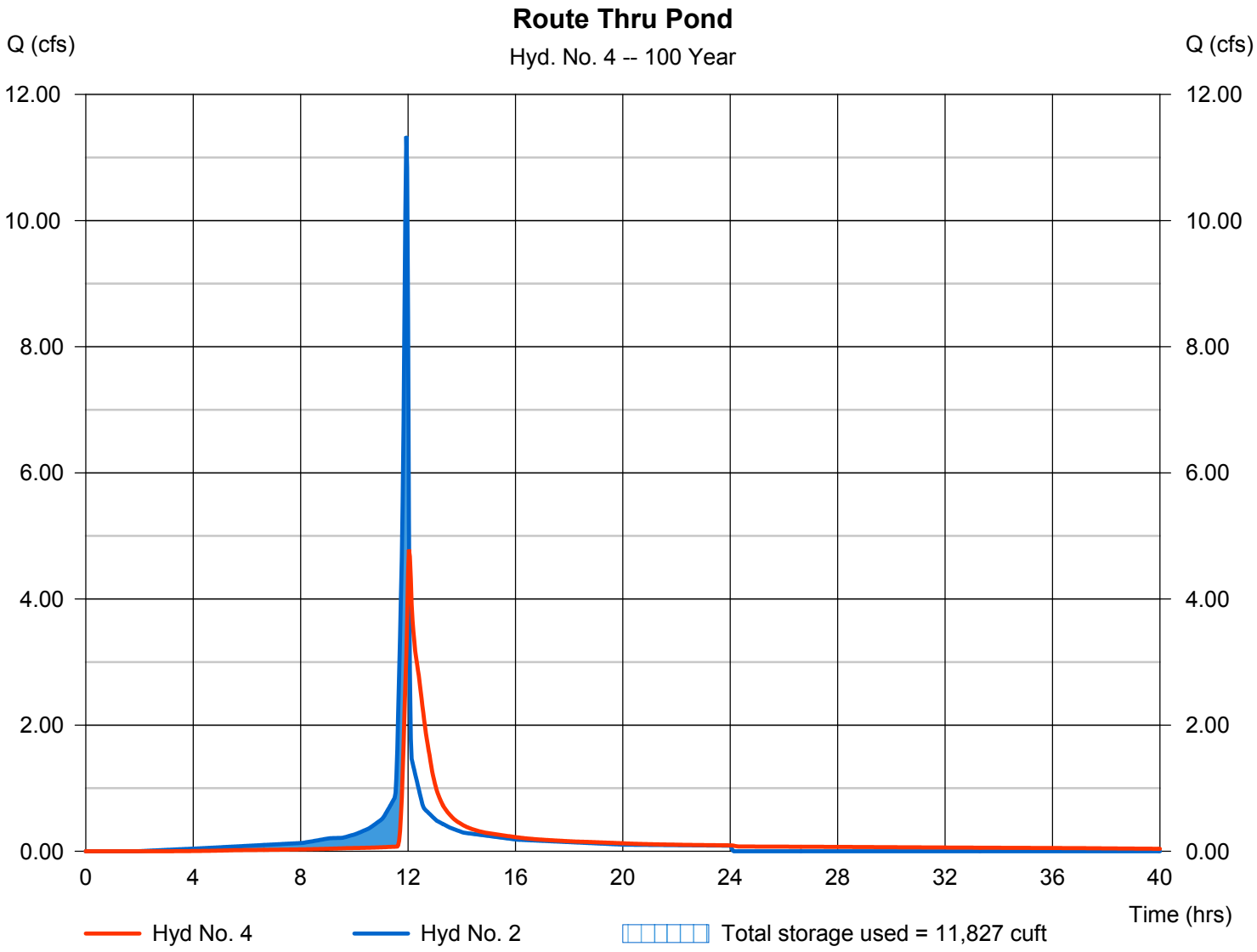
Hydrograph Report

Hyd. No. 4

Route Thru Pond

Hydrograph type	=	Reservoir	Peak discharge	=	4.782 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.03 hrs
Time interval	=	2 min	Hyd. volume	=	25,693 cuft
Inflow hyd. No.	=	2 - Post Developed to Detention	Max. Elevation	=	985.48 ft
Reservoir name	=	DETENTION POND	Max. Storage	=	11,827 cuft

Storage Indication method used.

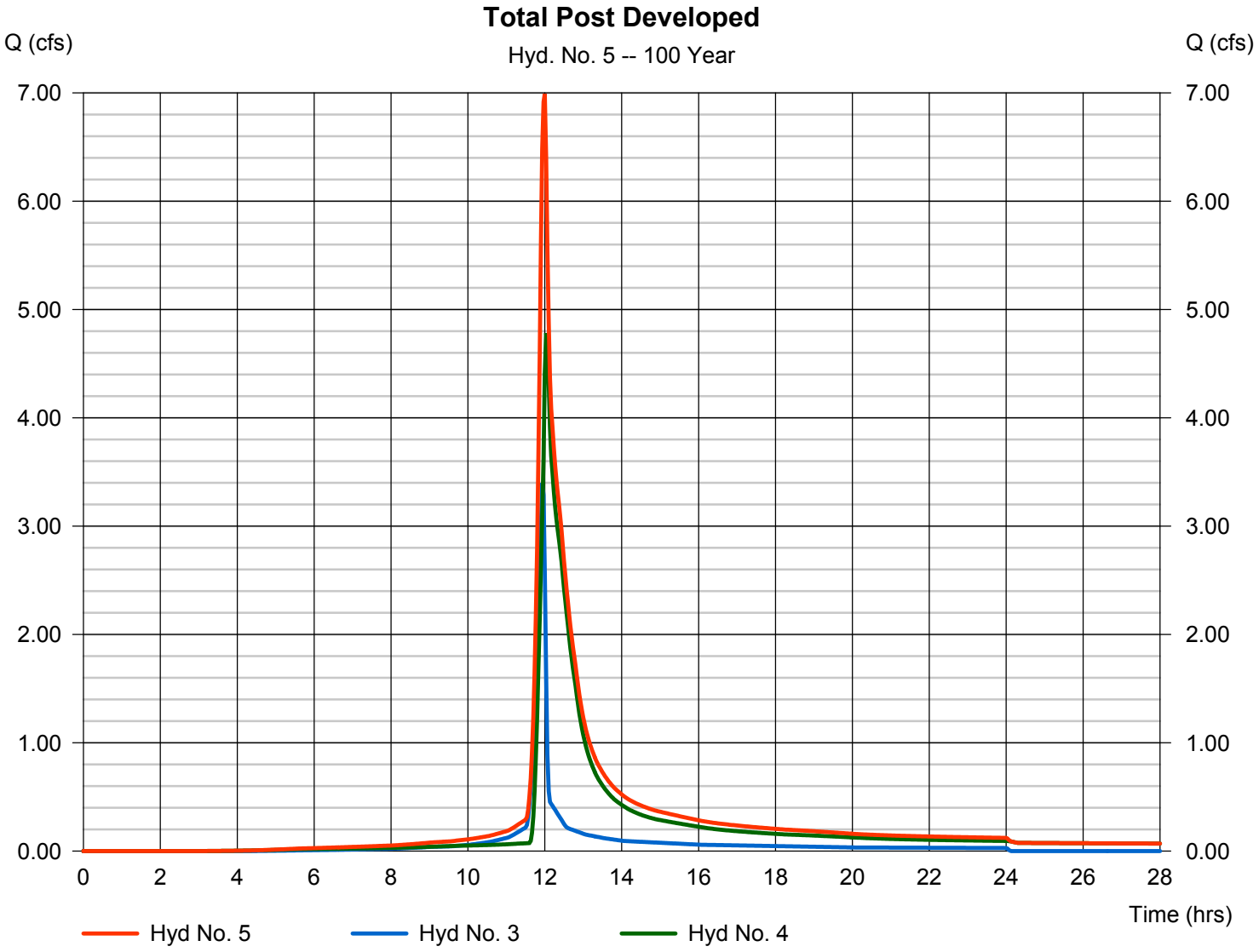


Hydrograph Report

Hyd. No. 5

Total Post Developed

Hydrograph type	= Combine	Peak discharge	= 6.991 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.00 hrs
Time interval	= 2 min	Hyd. volume	= 32,893 cuft
Inflow hyds.	= 3, 4	Contrib. drain. area	= 0.390 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	97.4891	21.4000	0.9996	--------
2	45.6810	10.9000	0.7723	--------
3	0.0000	0.0000	0.0000	--------
5	41.0993	9.2000	0.7134	--------
10	104.6537	15.4000	0.8832	--------
25	130.7578	16.9000	0.8935	--------
50	97.9050	14.1000	0.8019	--------
100	140.8789	15.4000	0.8548	--------

File name: Kansas City IDF.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	3.70	3.11	2.68	2.36	2.10	1.90	1.73	1.59	1.47	1.37	1.28	1.20
2	5.39	4.37	3.70	3.23	2.88	2.60	2.38	2.20	2.04	1.91	1.80	1.70
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.19	4.99	4.23	3.70	3.31	3.00	2.75	2.55	2.38	2.24	2.11	2.00
10	7.30	6.01	5.13	4.48	3.99	3.60	3.28	3.02	2.80	2.61	2.44	2.30
25	8.29	6.90	5.93	5.20	4.65	4.20	3.84	3.53	3.28	3.06	2.87	2.70
50	9.19	7.63	6.56	5.78	5.18	4.70	4.31	3.99	3.72	3.48	3.28	3.10
100	10.70	8.87	7.61	6.68	5.97	5.40	4.94	4.56	4.23	3.95	3.71	3.50

Tc = time in minutes. Values may exceed 60.

ame: Y:\2017\170504- Storage Mart- Hwy 291, Lee's Summit, MO\Civil\Engineering Calcs\Kansas City Storm Data.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	3.00	3.50	0.00	4.50	5.20	5.90	6.60	7.30
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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170504 Detention.gpw

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STORAGE MART
HWY 291, LEE'S SUMMIT, MO
PRE DEVELOPED DRAINAGE AREA MAP

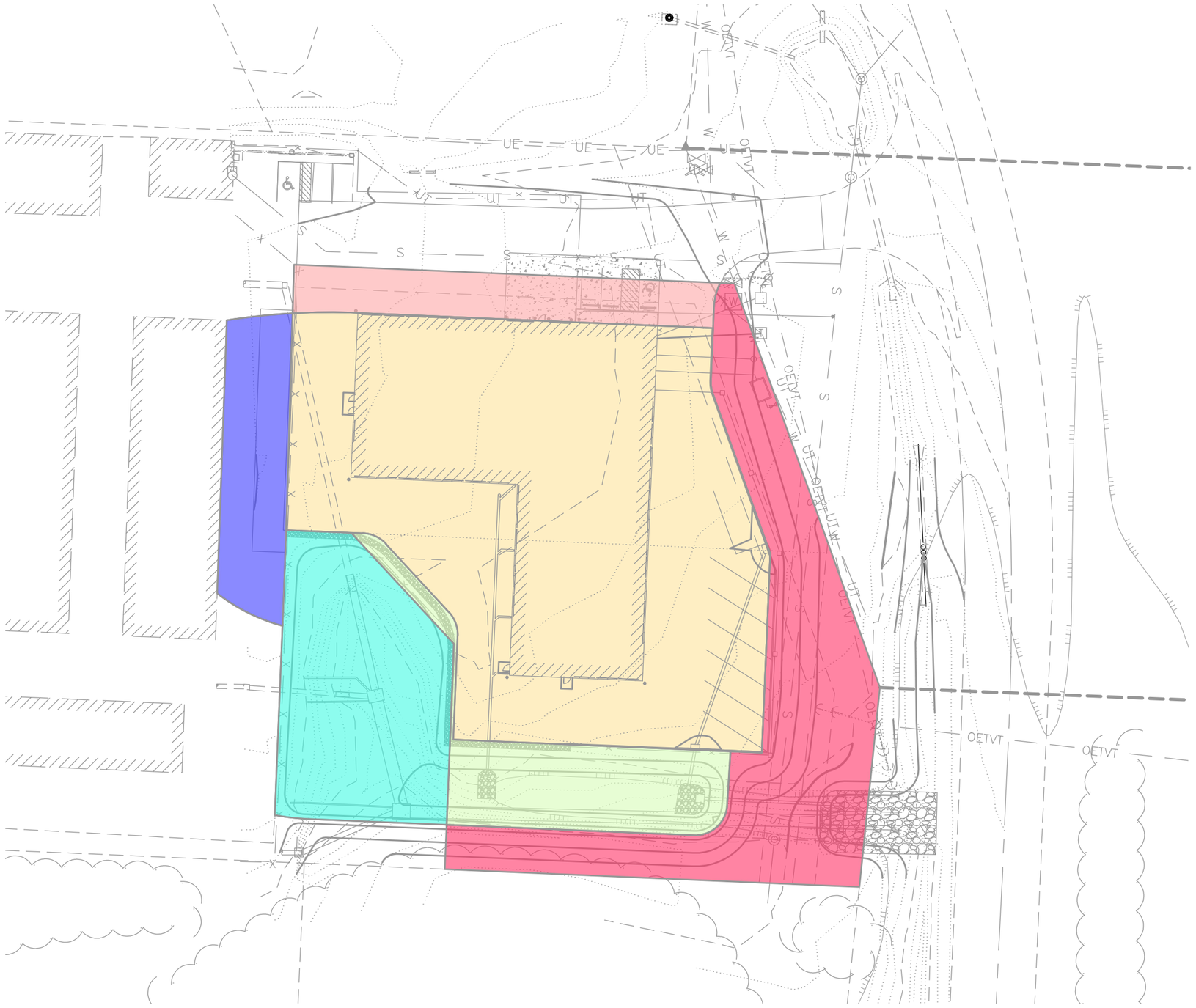
SCALE: 1"= 50'

SITE/CIVIL ENGINEER:
CROCKETT
ENGINEERING CONSULTANTS
1000 W. Nifong Blvd., Bldg. 1
Columbia, Missouri 65203
(573) 447-0292

www.crockettengineering.com

Crockett Engineering Consultants, LLC
Missouri Certificate of Authority
#2000151301

STORAGE MART
HWY 291, LEE'S SUMMIT, MO
POST DEVELOPED DRAINAGE AREA MAP



POST DEV ONSITE
TO DETENTION
CN = 80
0.12 ACRES

POST DEV ONSITE
TO DETENTION
CN = 98
0.76 ACRES

POST DEV OFFSITE
TO DETENTION
CN = 98
0.09 ACRES

POST DEV OFFSITE
TO DETENTION
CN = 80
0.20 ACRES

POST DEV TO OFFSITE
CN = 98
0.09 ACRES

POST DEV TO OFFSITE
CN = 80
0.30 ACRES

N

SCALE: 1"= 50'

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United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Jackson County, Missouri

August 30, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:675 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 30 60 120 180

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N 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 1:24,000.

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: Jackson County, Missouri
Survey Area Data: Version 18, Sep 16, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 11, 2017—Sep 22, 2017

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
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	0.0	0.9%
10180	Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes	2.0	99.1%
Totals for Area of Interest		**2.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the

development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Jackson County, Missouri

10082—Arisburg-Urban land complex, 1 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2w7ld
Elevation: 750 to 1,130 feet
Mean annual precipitation: 39 to 45 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Arisburg and similar soils: 61 percent
Urban land: 30 percent
Minor components: 9 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Arisburg

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess

Typical profile

Ap - 0 to 6 inches: silt loam
A - 6 to 13 inches: silt loam
Bt - 13 to 19 inches: silty clay loam
Btg - 19 to 56 inches: silty clay loam
BCg - 56 to 79 inches: silty clay loam

Properties and qualities

Slope: 1 to 5 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 high (0.20 to 0.60 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: Loess Upland Prairie (R107BY007MO)
Hydric soil rating: No

Description of Urban Land

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Sharpsburg

Percent of map unit: 3 percent
Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Loess Upland Prairie (R109XY002MO)
Hydric soil rating: No

Sampsel

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Concave
Ecological site: Interbedded Sedimentary Upland Savanna (R109XY010MO)
Hydric soil rating: Yes

Greenton

Percent of map unit: 3 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: Loess Upland Prairie (R109XY002MO)
Hydric soil rating: No

10180—Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 1n85h
Elevation: 600 to 900 feet
Mean annual precipitation: 33 to 43 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 175 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Udarents and similar soils: 41 percent
Urban land: 39 percent
Sampsel and similar soils: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udarents

Setting

Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Mine spoil or earthy fill

Typical profile

C1 - 0 to 5 inches: silt loam
C2 - 5 to 80 inches: silty clay loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: Deep Loess Upland Prairie (R107BY002MO)
Other vegetative classification: Mixed/Transitional (Mixed Native Vegetation)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Across-slope shape: Convex

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Description of Sampsel

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from shale

Typical profile

Ap - 0 to 13 inches: silty clay loam
Bt - 13 to 80 inches: silty clay

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Very high
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 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C/D
Ecological site: Wet Footslope Prairie (R112XY041MO)
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

Soil Information for All Uses

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Water Features

This folder contains tabular reports that present soil hydrology information. The reports (tables) include all selected map units and components for each map unit. Water Features include ponding frequency, flooding frequency, and depth to water table.

Hydrologic Soil Group and Surface Runoff

This table gives estimates of various soil water features. The estimates are used in land use planning that involves engineering considerations.

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 four hydrologic soil groups are:

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.

Surface runoff refers to the loss of water from an area by flow over the land surface. Surface runoff classes are based on slope, climate, and vegetative cover. The concept indicates relative runoff for very specific conditions. It is assumed that the surface of the soil is bare and that the retention of surface water resulting from irregularities in the ground surface is minimal. The classes are negligible, very low, low, medium, high, and very high.

Report—Hydrologic Soil Group and Surface Runoff

Absence of an entry indicates that the data were not estimated. The dash indicates no documented presence.

Hydrologic Soil Group and Surface Runoff–Jackson County, Missouri			
Map symbol and soil name	**Pct. of map unit**	**Surface Runoff**	**Hydrologic Soil Group**
10082—Arisburg-Urban land complex, 1 to 5 percent slopes			
Arisburg	61	—	C
Urban land	30	—	—
10180—Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes			
Udarents	41	Very high	C
Urban land	39	—	—
Sampsel	15	Very high	C/D

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf