Background
The owners of the single family residential lot at 102 SW 2nd Street are planning the addition of a new concrete driveway and the elimination of their existing gravel driveway that runs along the east side of the residence. The new driveway/parking will be ADA compliant. The house is located on a 6,050 sf lot or 0.139 acres. There are currently no ponds, waterways, BMPs nor drainage systems located on the property. See Exhibit A - Existing Drainage Map for a depiction of the existing lot land usage.

Purpose/Scope
The purpose of the memorandum is to determine if any negative impacts due to storm water runoff from the proposed improvements are anticipated downstream.

Methodology
The study conforms to the requirements of the City of Lee's Summit, Missouri "Design and Construction Manual" and all applicable codes and criteria referred to therein.

Proposed Improvements
The proposed improvements shall consist of a new concrete drive aisle, parking and sidewalk (1,018.20 sf) along with the elimination of the existing compacted gravel driveway which runs along the side of the house. See Exhibit B – Proposed Drainage Map for a depiction of the proposed improvements. The existing lot contained approx. 0.37 acres of impervious area. The proposed hard improvements as detailed in addition to the remaining infrastructure such as the house will makeup 0.45 acres of impervious area. The proposed increase in impervious area will be 18.4% which is greater than the 10% increase allowed for expansions and remodels per KC Metro APWA. Therefore the proposed project does not meet an exemption for stormwater improvements.

An analysis of existing peak discharge rates verse proposed peak discharge will be conducted to determine the increase in peak runoff. The difference or increase in peak runoff will be calculated and improvements designed to attenuate the net increase. The improvements will be detailed later in the memo. The improvements are designed to ensure no negative impacts from the proposed improvements are realized downstream.

Analysis
Due to the size of the lot 6,050 sf the Rational Method was utilized to determine the peak discharge rates for both pre and post development conditions. The runoff coefficients for both existing and proposed conditions may be found in Exhibit C – Composite Coefficients. The peak discharge rates were calculated with the use of Hydraflow along with determination of allowable detention. The 100-year peak discharge rate for the existing condition is 0.69 cfs. The 100-year peak discharge rate for the proposed condition is 0.76 cfs. A net increase of 0.07 cfs is anticipated for the proposed condition during the 100-year storm event. See Exhibit D for a complete Hydraflow Report. In order to reduce the proposed peak discharge rate below existing a detention pit will be designed to attenuate peak discharge rates.

Detention Pit

Runoff from a portion of the lot and new infrastructure will be routed via a swale to a detention pit located in the backyard. The pit will measure 15' x 15' x 3' deep and consist of 3' of clean 1.5 to 2.5 inch gravel to promote infiltration of runoff into the surrounding soil. In addition a 1 inch outlet pipe will be installed 2 feet above the bottom of the detention pit to allow excess water to drain. The detention pit shall be sized to store the runoff generated by the increase in impervious area for the 100-year storm event. In addition the detention pit shall be depressed providing capacity to store a consecutive 100-year storm event. The surface of the detention pit shall incorporate deep rooted plantings to help accelerate infiltration into the pit. See Exhibit E – Detention Pit Detail for a depiction of the proposed detention pit. The peak discharge from the proposed detention pit during the 100-year storm event as currently designed is 0.024 cfs well below both existing (0.69 cfs) and allowable discharge rates (0.42 cfs).

Conclusion

The renovation project does not meet the exception criteria as specifically outlined in APWA however it should be noted that both the existing and proposed runoff coefficients are below allowable regulatory requirements for single family residences. Please advise if stormwater attenuation is necessary for this project do to some other downstream issue. The proposed detention pit will significantly reduce proposed peak discharge rates well below both existing and allowable peak discharge rates for the 100-year storm event. The storm water memorandum is in conformance with applicable codes and design criteria therefore we recommend approval of this storm water memorandum and its findings.

Should you have any questions related to the storm water memorandum please contact Matt Schlicht with Engineering Solutions.

Sincerely,

Matt Schlicht

STATE OF MISSOURI
ANTHONY
PHILIPSHECK
NUMBER
10/5/21
PROFESSIONAL ENGINEER

50 SE 30th Street Lee's Summit, MO 64082
P: (816) 623-9888 F: (816) 623-9849 www.engineeringsolutionskc.com

Exhibit A
Existing Drainage Map

50 SE 30th Street Lee's Summit, MO 64082
P: (816) 623-9888 F: (816) 623-9849 www.engineeringsolutionskc.com

PALMER ADDITION

LEE'S SUMMIT

N61°23'09"E 50.00'(M)(D)

S28°54'28"E 121.00'(M)(D)

N28°54'28"W 121.00'(M)(D)

S61°23'09"W 50.00'(M)(D)

185.00'

N61°23'09"E 50.00'

S28°54'28"E 121.00'(M)(D)

N28°54'28"W

S61°23'09"W 50.00'(M)(D)

72'-00"(M)(D)

185.00'

185.00'

N

W E

S

0 20 40 60

5 6 11

ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 SE 30TH STREET
LEE'S SUMMIT, MO 64082
P:(816) 623-9888 F:(816)623-9849

Professional Registration
Missouri
Engineering 2005002186-D
Surveying 2005008319-D
Kansas
Engineering E-1695
Surveying LS-218
Oklahoma
Engineering 6254
Nebraska
Engineering CA2821

102 SW 2ND STREET
Lee's Summit, Jackson County, Missouri

Project: 102 SW 2ND STREET, LSMO
Issue Date: January 13, 2020

EXISTING DRAINAGE MAP
Preliminary Development Plans for:
102 SW 2ND STREET
Lee's Summit, Jackson County, Missouri

STATE OF MISSOURI
MATTHEW J. SCHLICHT
NUMBER
PE-2006019708
PROFESSIONAL ENGINEER

Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226
NE PE E-14335

REVISIONS

C.100

Exhibit B
Proposed Drainage Map

50 SE 30th Street Lee's Summit, MO 64082
P: (816) 623-9888 F: (816) 623-9849 www.engineeringsolutionskc.com

ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 SE 30TH STREET
LEE'S SUMMIT, MO 64082
P:(816) 623-9888 F:(816)623-9849

Professional Registration
Missouri
Engineering 2005002186-D
Surveying 2005008319-D
Kansas
Engineering E-1695
Surveying LS-218
Oklahoma
Engineering 6254
Nebraska
Engineering CA2821

102 SW 2ND STREET
Lee's Summit, Jackson County, Missouri

Project: 102 SW 2ND STREET, LSMO
Issue Date: January 13, 2020

PROPOSED DRAINAGE MAP
Preliminary Development Plans for:
102 SW 2ND STREET
Lee's Summit, Jackson County, Missouri

STATE OF MISSOURI
MATTHEW J. SCHLICHT
NUMBER
PE-2006019708
PROFESSIONAL ENGINEER

Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226
NE PE E-14335

REVISIONS

C.100

Exhibit C
Composite Coefficients

50 SE 30th Street Lee's Summit, MO 64082
P: (816) 623-9888 F: (816) 623-9849 www.engineeringsolutionskc.com

102 SW 2nd Street

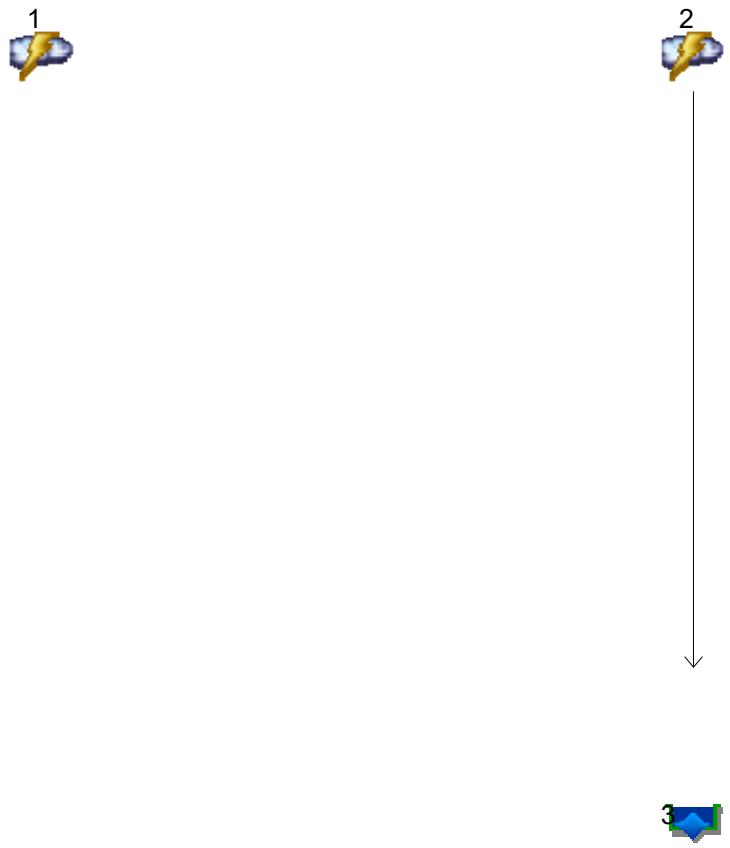
Existing Land Usage	Area (ac.)	CN	Area x CN
Gravel Area	0.014	89	1.266023
Impervious Area	0.024	98	2.352
Pervious Area	0.101	74	7.449129
Total Area	0.139		11.07
Composite CN	80		

Proposed Land Usage	Area (ac.)	CN	Area x CN
Gravel Area	0.000	89	0
Impervious Area	0.045	98	4.378256
Pervious Area	0.094	74	6.971748
Total Area	0.139		11.35
Composite CN	82		

Exhibit D
Hydraflow Report

50 SE 30th Street Lee's Summit, MO 64082
P: (816) 623-9888 F: (816) 623-9849 www.engineeringsolutionskc.com

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	Rational	EXISTING
2	Rational	PROPOSED
3	Reservoir	DETENTION PIT

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	Rational	------	-------	0.308	-------	-------	0.455	-------	-------	0.688	EXISTING
2	Rational	------	-------	0.342	-------	-------	0.505	-------	-------	0.764	PROPOSED
3	Reservoir	2	-------	0.019	-------	-------	0.022	-------	-------	0.024	DETENTION PIT

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

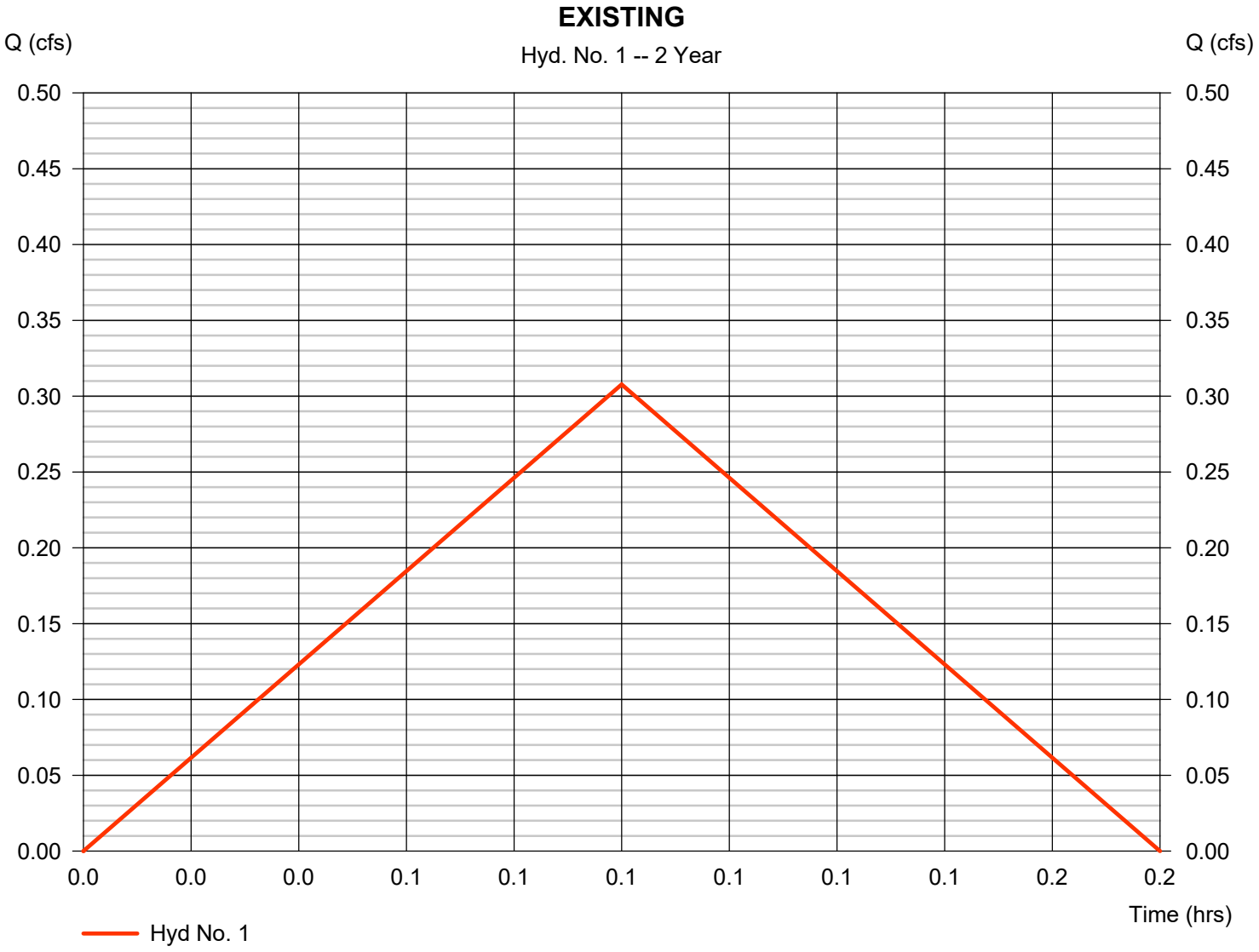
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	0.308	1	5	92	------	------	------	EXISTING
2	Rational	0.342	1	5	103	------	------	------	PROPOSED
3	Reservoir	0.019	1	10	100	2	1043.61	95.5	DETENTION PIT

Hydrograph Report

Hyd. No. 1

EXISTING

Hydrograph type	=	Rational	Peak discharge	=	0.308 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.08 hrs
Time interval	=	1 min	Hyd. volume	=	92 cuft
Drainage area	=	0.139 ac	Runoff coeff.	=	0.45
Intensity	=	4.920 in/hr	Tc by User	=	5.00 min
IDF Curve	=	KCMO.IDF	Asc/Rec limb fact	=	1/1

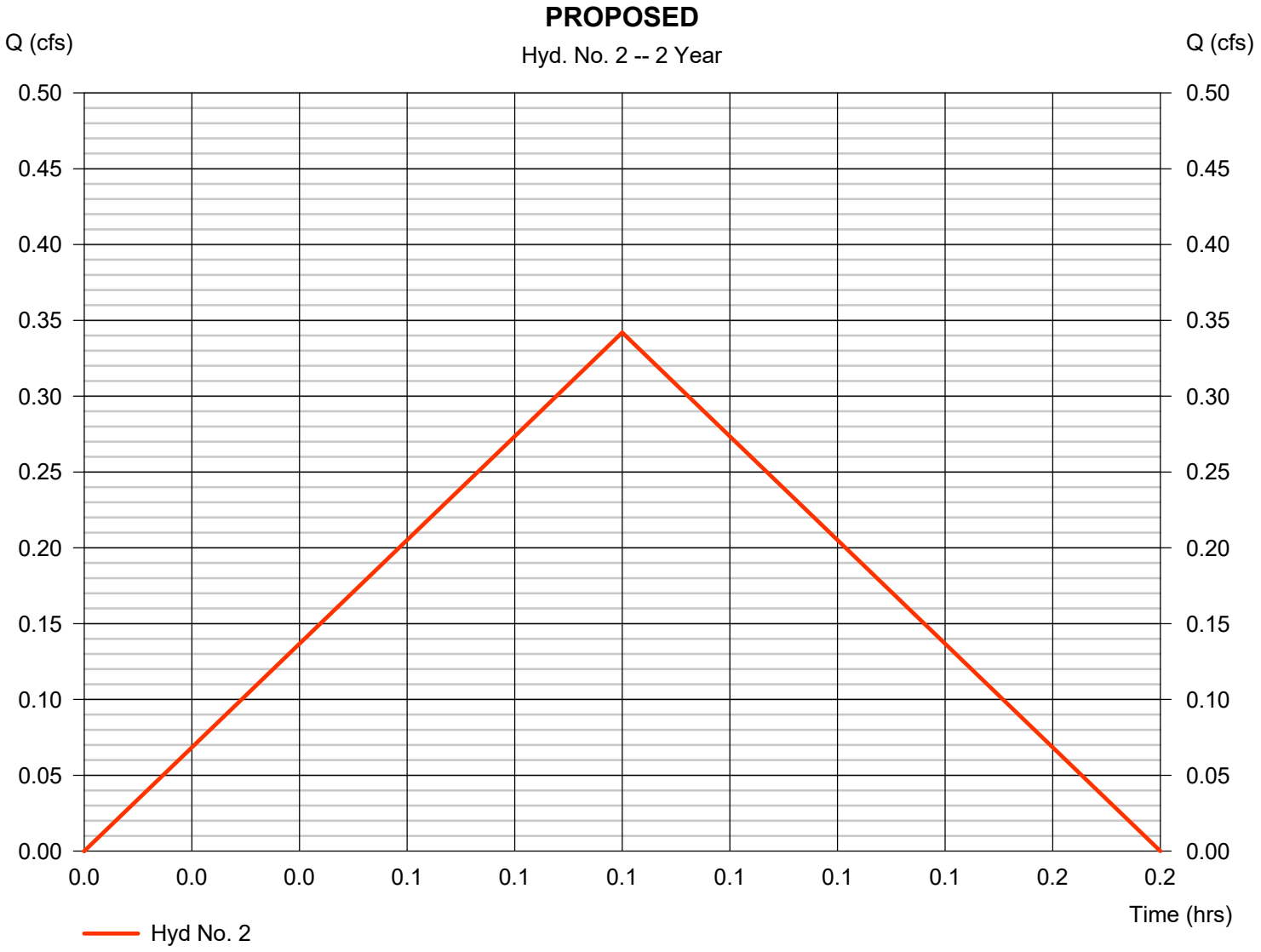


Hydrograph Report

Hyd. No. 2

PROPOSED

Hydrograph type	=	Rational	Peak discharge	=	0.342 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.08 hrs
Time interval	=	1 min	Hyd. volume	=	103 cuft
Drainage area	=	0.139 ac	Runoff coeff.	=	0.5
Intensity	=	4.920 in/hr	Tc by User	=	5.00 min
IDF Curve	=	KCMO.IDF	Asc/Rec limb fact	=	1/1



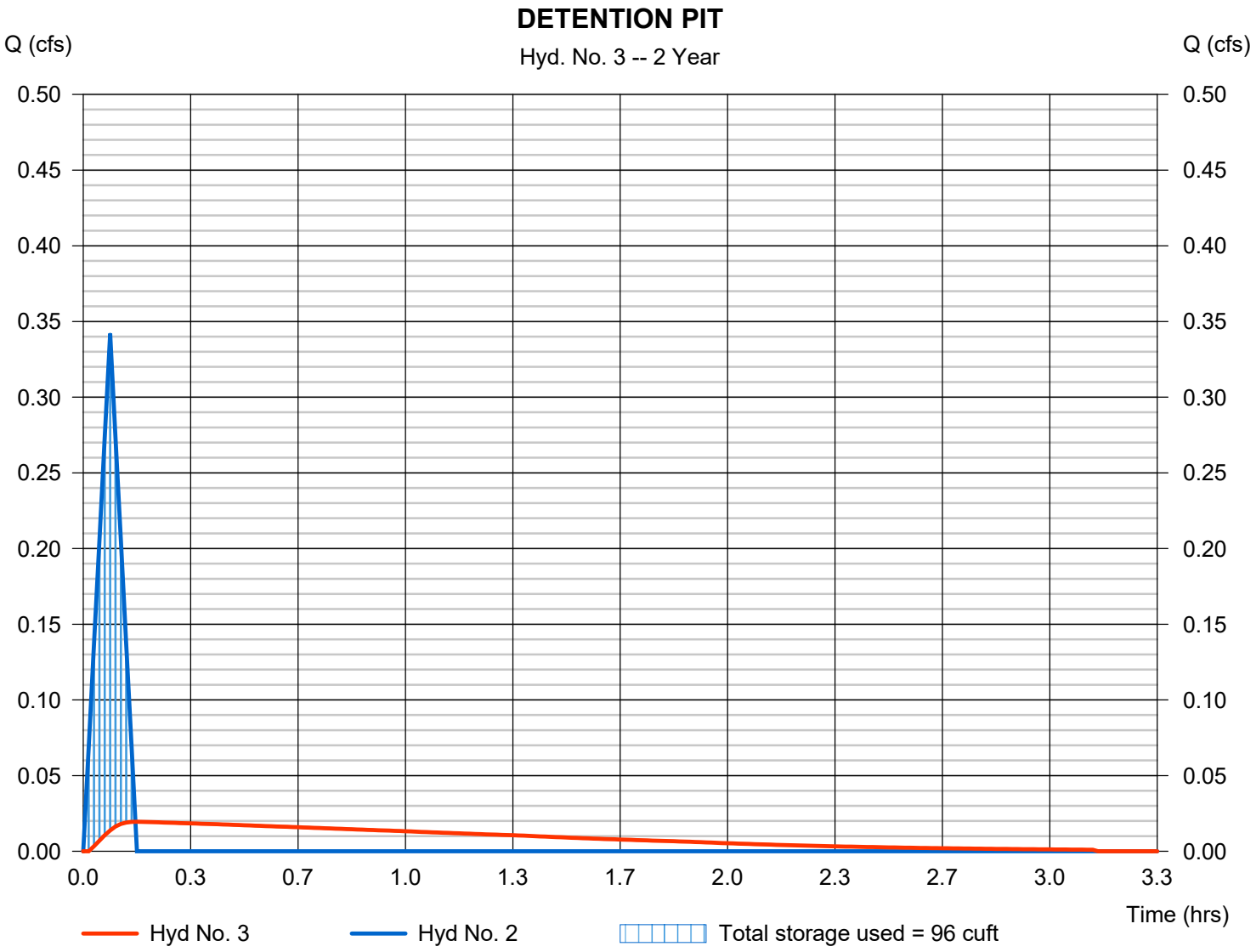
Hydrograph Report

Hyd. No. 3

DETENTION PIT

Hydrograph type	= Reservoir	Peak discharge	= 0.019 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 100 cuft
Inflow hyd. No.	= 2 - PROPOSED	Max. Elevation	= 1043.61 ft
Reservoir name	= DETENTION PIT	Max. Storage	= 96 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - DETENTION PIT

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1043.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1043.00	56	0	0
1.00	1044.00	285	156	156
1.42	1044.42	285	120	275

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 1.00	0.00	0.00	0.00
Span (in)	= 1.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 1043.00	0.00	0.00	0.00
Length (ft)	= 10.00	0.00	0.00	0.00
Slope (%)	= 7.54	0.00	0.00	n/a
N-Value	= .010	.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)	= 0.00	0.00	0.00	0.00
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 Contour)

TW Elev. (ft) = 0.00

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

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	1043.00	0.00	---	---	---	---	---	---	---	---	---	0.000
1.00	156	1044.00	0.02 oc	---	---	---	---	---	---	---	---	---	0.022
1.42	275	1044.42	0.02 oc	---	---	---	---	---	---	---	---	---	0.025

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

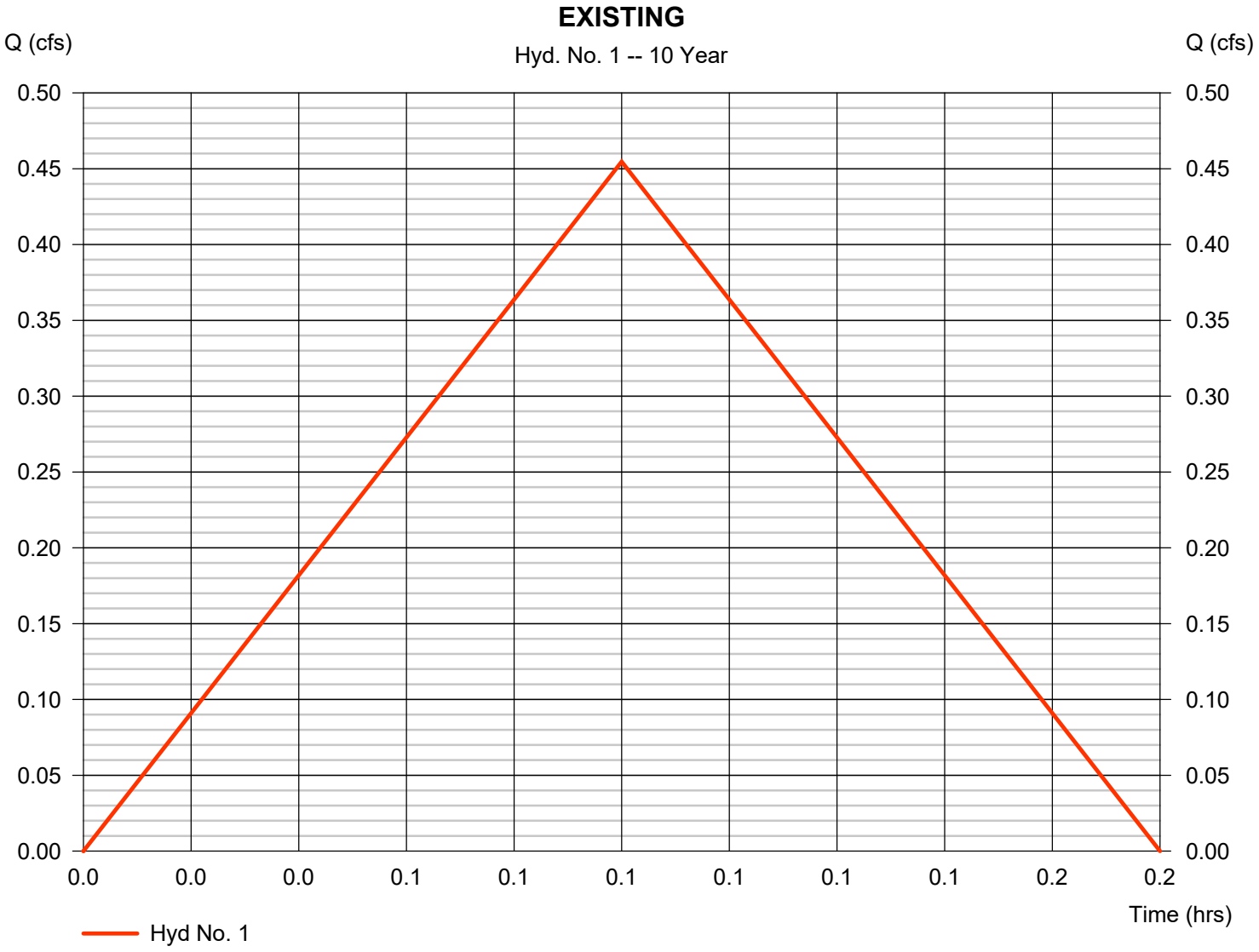
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	0.455	1	5	136	------	------	------	EXISTING
2	Rational	0.505	1	5	152	------	------	------	PROPOSED
3	Reservoir	0.022	1	10	149	2	1043.92	143	DETENTION PIT

Hydrograph Report

Hyd. No. 1

EXISTING

Hydrograph type	=	Rational	Peak discharge	=	0.455 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.08 hrs
Time interval	=	1 min	Hyd. volume	=	136 cuft
Drainage area	=	0.139 ac	Runoff coeff.	=	0.45
Intensity	=	7.269 in/hr	Tc by User	=	5.00 min
IDF Curve	=	KCMO.IDF	Asc/Rec limb fact	=	1/1

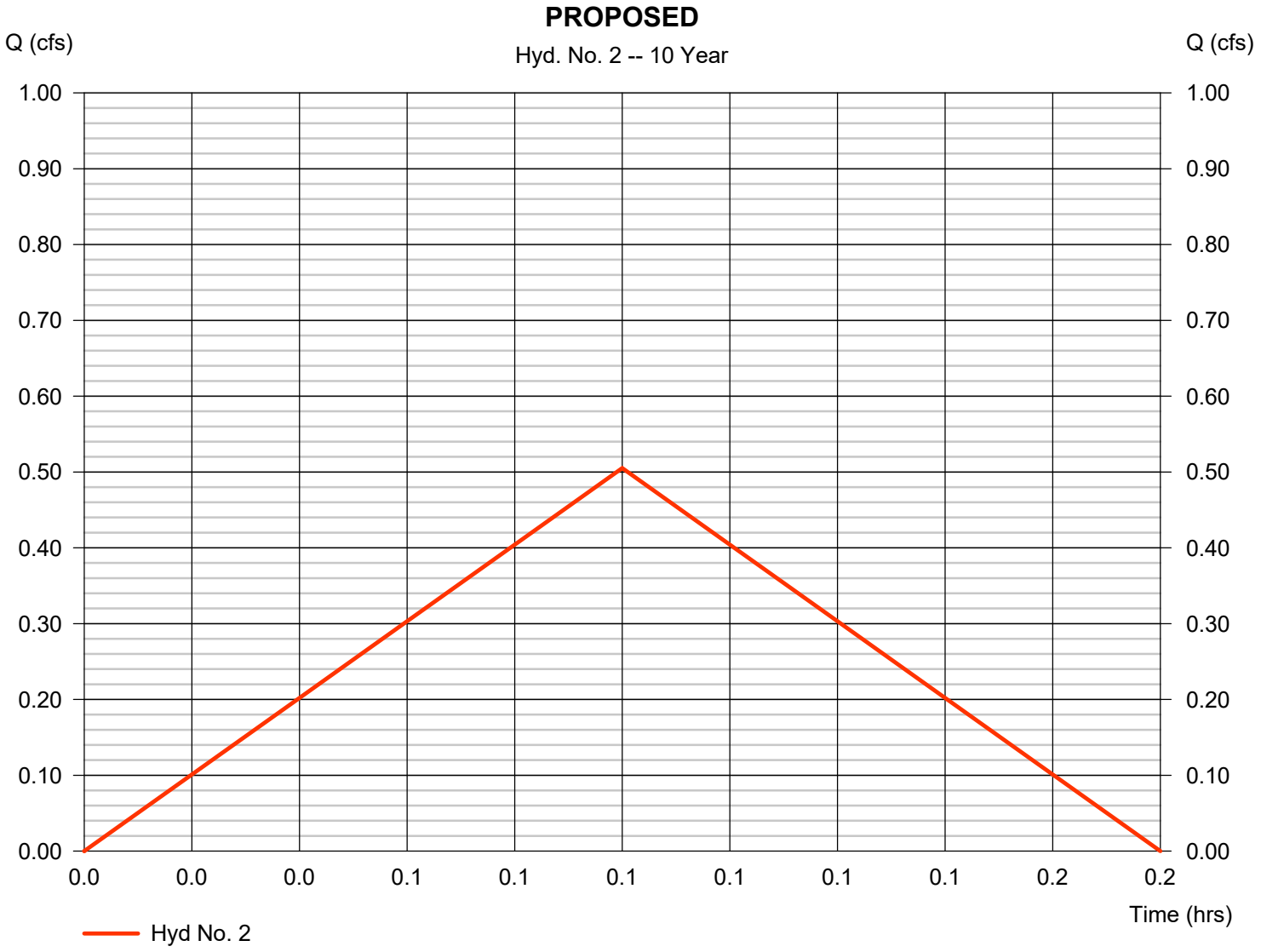


Hydrograph Report

Hyd. No. 2

PROPOSED

Hydrograph type	= Rational	Peak discharge	= 0.505 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 152 cuft
Drainage area	= 0.139 ac	Runoff coeff.	= 0.5
Intensity	= 7.269 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCMO.IDF	Asc/Rec limb fact	= 1/1



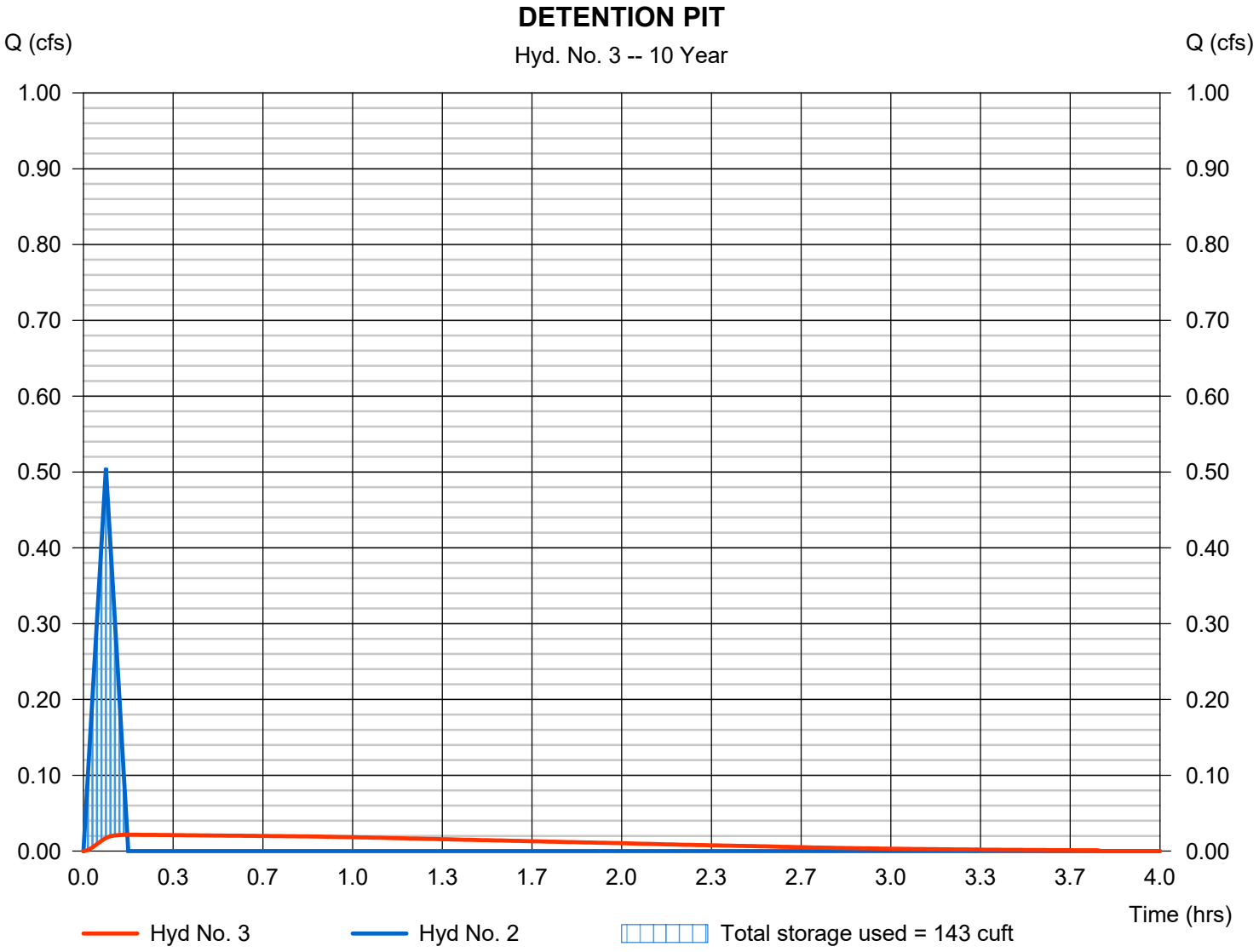
Hydrograph Report

Hyd. No. 3

DETENTION PIT

Hydrograph type	=	Reservoir	Peak discharge	=	0.022 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.17 hrs
Time interval	=	1 min	Hyd. volume	=	149 cuft
Inflow hyd. No.	=	2 - PROPOSED	Max. Elevation	=	1043.92 ft
Reservoir name	=	DETENTION PIT	Max. Storage	=	143 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

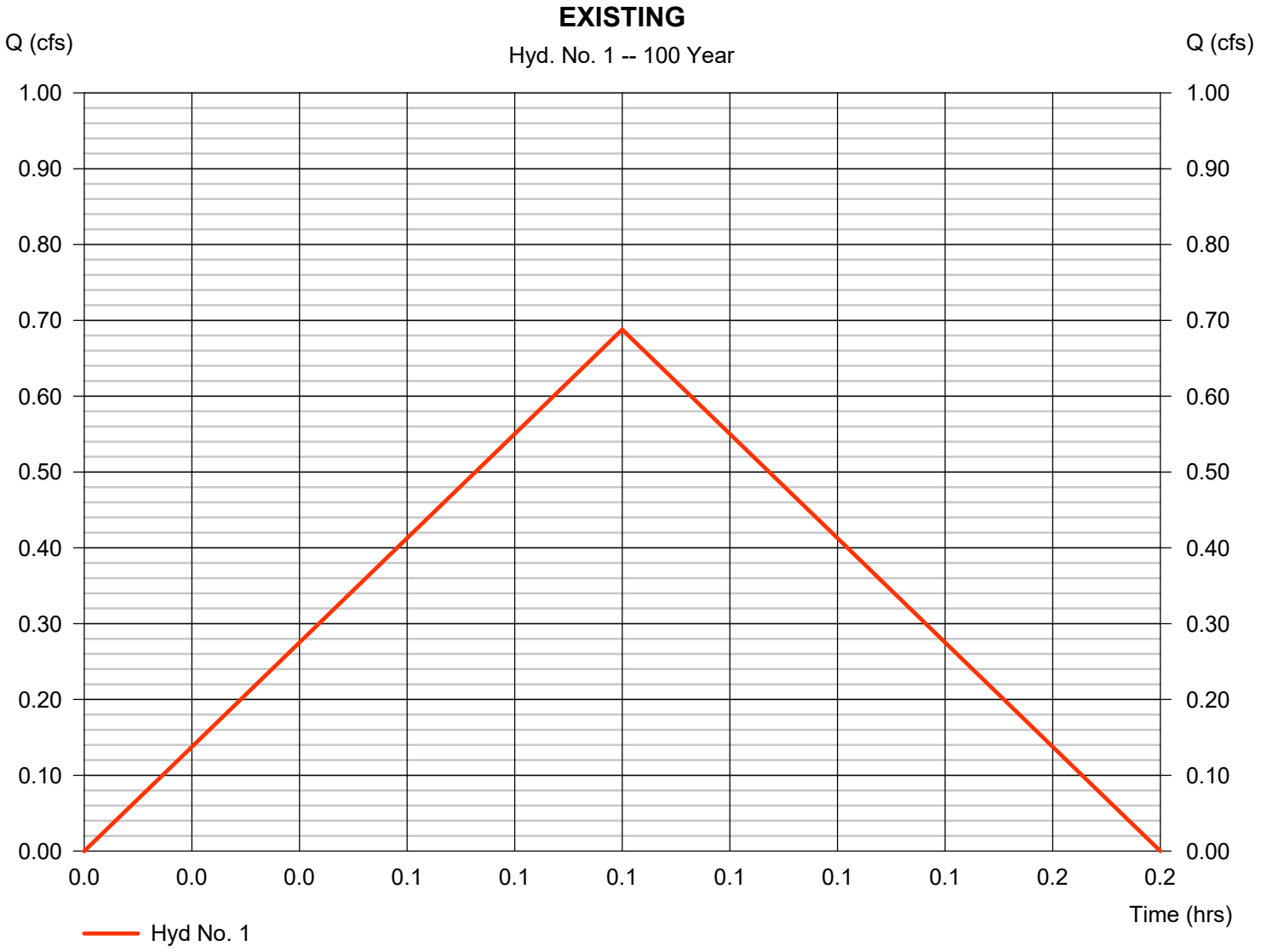
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	0.688	1	5	206	------	------	------	EXISTING
2	Rational	0.764	1	5	229	------	------	------	PROPOSED
3	Reservoir	0.024	1	10	227	2	1044.22	220	DETENTION PIT

Hydrograph Report

Hyd. No. 1

EXISTING

Hydrograph type	=	Rational	Peak discharge	=	0.688 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.08 hrs
Time interval	=	1 min	Hyd. volume	=	206 cuft
Drainage area	=	0.139 ac	Runoff coeff.	=	0.45
Intensity	=	10.996 in/hr	Tc by User	=	5.00 min
IDF Curve	=	KCMO.IDF	Asc/Rec limb fact	=	1/1

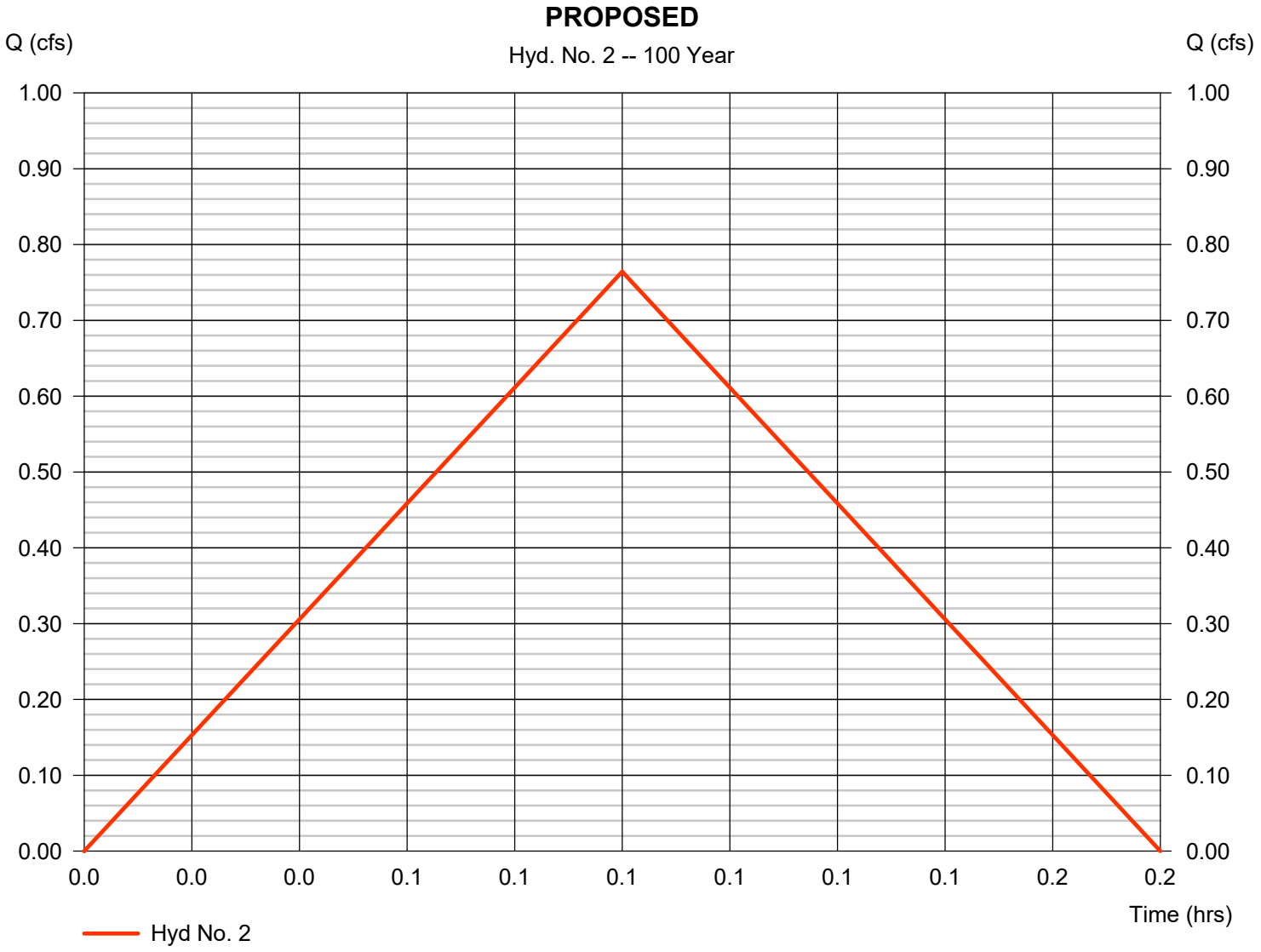


Hydrograph Report

Hyd. No. 2

PROPOSED

Hydrograph type	=	Rational	Peak discharge	=	0.764 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.08 hrs
Time interval	=	1 min	Hyd. volume	=	229 cuft
Drainage area	=	0.139 ac	Runoff coeff.	=	0.5
Intensity	=	10.996 in/hr	Tc by User	=	5.00 min
IDF Curve	=	KCMO.IDF	Asc/Rec limb fact	=	1/1



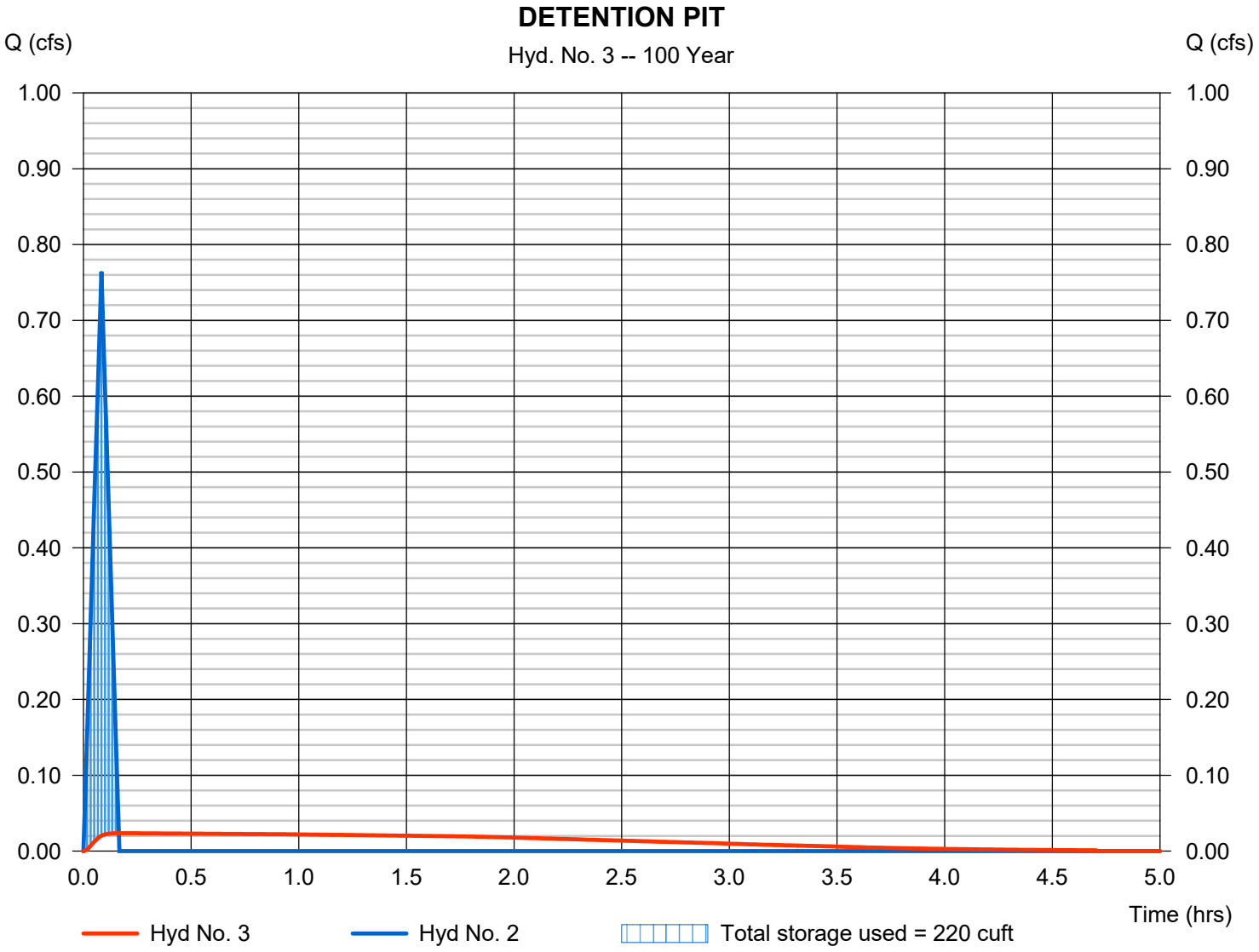
Hydrograph Report

Hyd. No. 3

DETENTION PIT

Hydrograph type	=	Reservoir	Peak discharge	=	0.024 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.17 hrs
Time interval	=	1 min	Hyd. volume	=	227 cuft
Inflow hyd. No.	=	2 - PROPOSED	Max. Elevation	=	1044.22 ft
Reservoir name	=	DETENTION PIT	Max. Storage	=	220 cuft

Storage Indication method used.



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	64.1474	17.7000	0.8922	--------
2	95.7859	19.2000	0.9317	--------
3	0.0000	0.0000	0.0000	--------
5	118.7799	19.1000	0.9266	--------
10	125.1300	18.2000	0.9051	--------
25	158.9867	18.7000	0.9180	--------
50	171.2459	18.3000	0.9078	--------
100	187.3624	18.1000	0.9031	--------

File name: KCMO.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	3.96	3.31	2.86	2.52	2.25	2.04	1.87	1.72	1.60	1.49	1.40	1.32
2	4.92	4.13	3.56	3.14	2.81	2.54	2.32	2.14	1.98	1.85	1.73	1.63
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	6.23	5.23	4.51	3.98	3.56	3.22	2.94	2.71	2.52	2.35	2.20	2.07
10	7.27	6.09	5.26	4.63	4.14	3.75	3.43	3.16	2.93	2.74	2.57	2.42
25	8.70	7.30	6.30	5.54	4.96	4.49	4.10	3.78	3.51	3.27	3.07	2.89
50	9.83	8.24	7.11	6.26	5.60	5.07	4.64	4.27	3.97	3.70	3.47	3.27
100	11.00	9.21	7.95	7.00	6.26	5.67	5.19	4.78	4.44	4.14	3.89	3.66

Tc = time in minutes. Values may exceed 60.

Precip. file name: Z:\acad\KCMO.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	2.93	3.50	0.00	3.30	5.20	6.00	6.80	7.70
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	0.00	0.00	4.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Huff-2nd	2.49	3.10	0.00	4.01	4.64	5.52	6.21	6.90
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	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	7.10

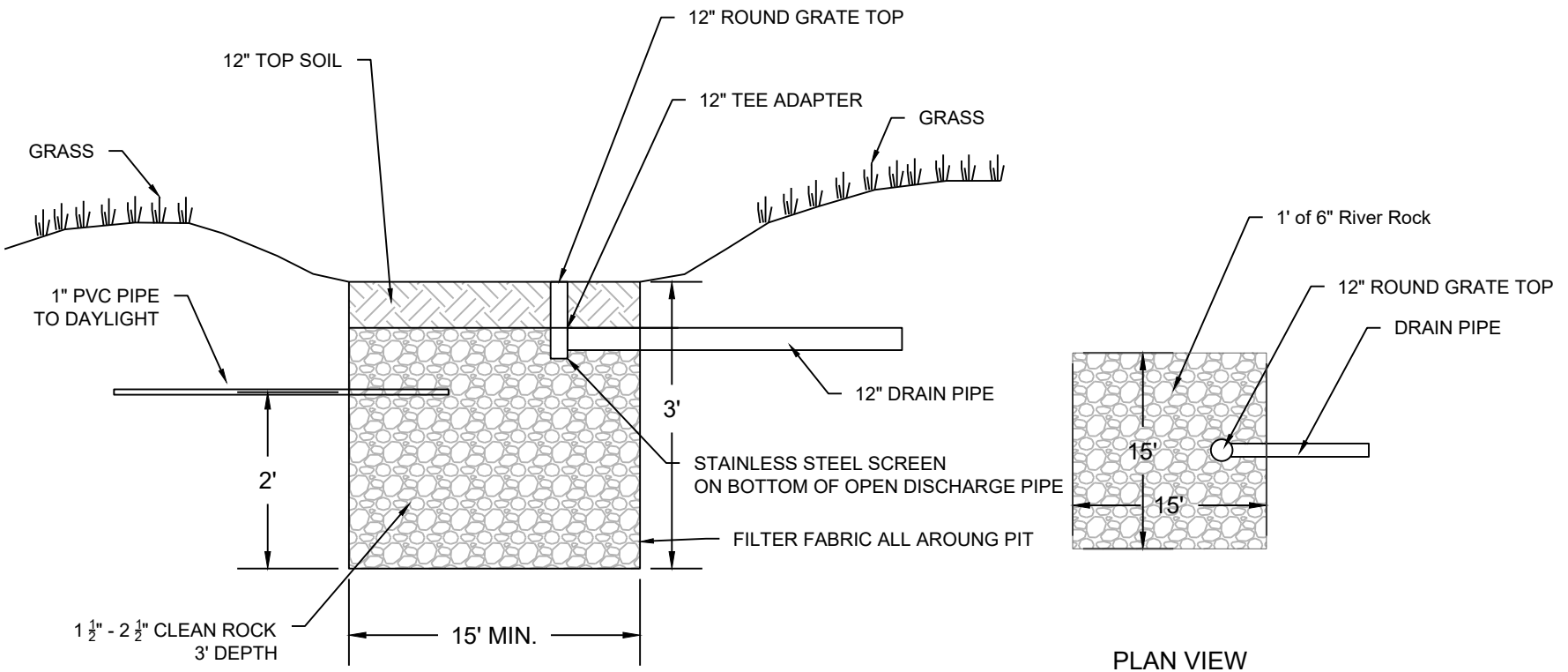
Hydraflow Table of Contents

Z:\acad\102 SW 2ND STREET, LSMO\STORM\102 SW 2ND STREET.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 10 / 5 / 2021

Exhibit E
Detention Pit Detail

50 SE 30th Street Lee's Summit, MO 64082
P: (816) 623-9888 F: (816) 623-9849 www.engineeringsolutionskc.com



DETENTION PIT DETAIL

NOT TO SCALE