POST-CONSTRUCTION
STORMWATER MANAGEMENT PLAN

Firestone Complete Auto Care

3501 SW Market Street
Lee's Summit, MO 64082

Jackson County

Gresham Smith Project # 40831.45

January 8, 2020

STATE OF MISSOURI
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GENERAL INFORMATION

The proposed Firestone Auto Care store is located on approximately 1.24 acres at 3501 SW Market Street in Lee's Summit, Jackson County, Missouri. The site is currently undeveloped. Existing slopes range from 1 to 5 percent, draining to the northeast (see Appendix A). The proposed development is a one story, 6,262 square foot commercial auto maintenance store with associated parking and utilities. Existing drainage patterns will be preserved in the proposed design, with the addition of a detention pond for stormwater discharge management and quality.

Approximately 49.6% of the proposed site will consist of the building footprint and pavement, and the remaining 50.4% will be grass and landscaped areas. See Figure 1 for a further pre and post development breakdown. The soils onsite consist of 16.6% Arisburg-Urban land complex loam, classified as Hydrologic soil group C and 83.4% Udarents-Urban land-Sampsel complex, classified as Hydrologic soil group C according to the NRCS Web Soil Survey. Runoff coefficients for soil group C were used in the following analysis. None of the project site is located within a Flood Zone according to FEMA map number 29095C0532G, revised January 20, 2017. The proposed area of disturbance is 1.60 acres.

STORMWATER QUANTITY:

The proposed site grading reduces the storm peak discharge and volume of runoff from the site through the use of a detention pond and outlet control structure. The pond is located to the east of the proposed building. The pond's exact location and outfall may be seen on Drawing C3.1. The detention pond is 3.75 feet from the lowest pond bottom elevation to the top of berm.

The Critical Storm was found using the method presented in Section 5602.6 of the APWA 5600 Manual. Post-developed conditions are not to exceed pre-developed conditions. Post-developed conditions do not exceed 3 cfs per acre for the 100 year storm event, 2 cfs per acre for the 10 year storm event or 0.5 cfs per acre for the 2 year storm event. The comprehensive control strategy also includes a water quality element which specifies that a 40 hour extended detention be provided for the 1.37 inch 90% mean annual storm event. For this project, a detention basin is incorporated to achieve the water quality and storm water management requirements. Refer to the Hydraflow calculations provided in Appendix B for detailed stage-storage volumes for the pond.

The water surface elevation needed to achieve the required Water Quality Volume was calculated as 1012.18 from the Hydraflow pond stage-storage graph provided in Appendix D. This elevation was taken as the bottom of the pond in the Hydraflow model used for detention calculations to ensure that the detention volume would be provided in addition to the water quality volume.

The outlet of the detention pond will be a precast concrete outlet control structure with flow control orifices. See sheet C903 for details of the outlet structure and underdrain connection. A 10' wide emergency overflow spillway will also be provided, refer to the schematic below.

Figure 1 shows the detailed breakdown of land use types used in calculating the runoff coefficient. Runoff coefficients used below are for Hydrologic Soil Group C.

Figure 1: Runoff Coefficient Summary Table

Land Use Runoff Coefficients					
Land Use	Runoff Coefficient	Predeveloped Acres	Post Developed Acres	Bypass Acres	To Pond Acres
Impervious	0.90	0.000	0.613	0.040	0.573
Pervious (Open Space)	0.30	1.237	0.624	0.163	0.461
	Total Area	1.237	1.237	0.203	1.034
	Runoff Coefficient	0.30	0.60	0.42	0.63

Figure 2: Stormwater Discharge Summary Table

Storm event (Year)	Pre-Developed (cfs)	Post-Developed (cfs) (with Detention)	Runoff Difference (cfs)
2	1.70	0.51	-1.19
10	2.34	0.73	-1.60
100	3.30	1.10	-2.20

Figure 3: Detention Pond Summary Table

Storm event (Year)	Post-Developed (cfs) (with Detention)	Peak storage (cu.ft.)	Outlet Peak Discharge (cfs)	Freeboard (ft) Top of Berm = 1014.5
2	0.51	1011.55	0.02	2.95
10	0.73	1613.00	0.03	2.59
100	1.10	2404.00	0.24	2.40
*For detailed calculations, see Appendix B in the Stormwater Report.				

STORMWATER QUALITY:

The proposed site grading treats the stormwater runoff quality through the use of an extended dry detention pond. The detention pond will provide temporary storage of stormwater runoff allowing settlement of suspended solids over a period of 40 hours. The significant reduction in volume from the pre-developed to post-developed conditions will correlate to a significant water quality improvement for the site. Water Quality Volume required by the city of Lee's Summit is found by the equation below, given in Section 5600 of the Comprehensive Control Strategy Design and Construction Manual.

$$WQv = 1.37 * 0.05 + 0.009(Percent\ site\ imperviousness)$$

The percent site imperviousness will be 55.5%, yielding a required Water Quality Volume of 2,826 cubic feet. Adding in an additional 20%, a water quality volume of 3390.76 cubic feet was used for design of this site.

An Extended Dry Detention Basin will be used to achieve the water quality requirement. A 4" perforated PVC riser will connect to the structure. The end of the PVC riser will be capped and a 1" water quality orifice drilled in the end cap and will dewater the pond in approximately 40 hours. The depth of water quality volume was found to be 1.43' (elevation = 1010.75) using the stage-storage table from Hydraflow as shown in Appendix D.

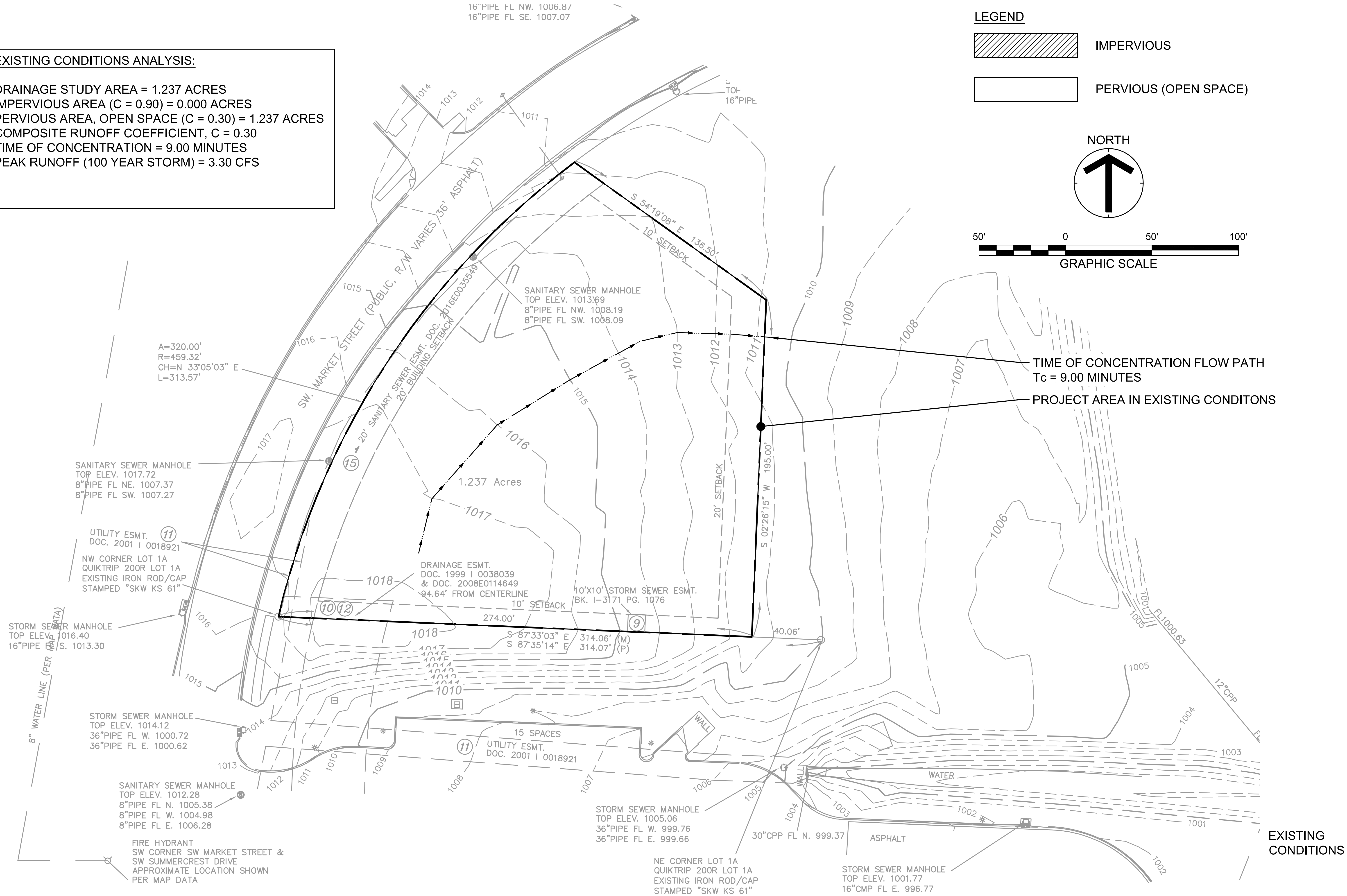
The 1" diameter Extended Detention drawdown orifice in the outlet structure was sized using the method outlined in Appendix D so that the water quality volume will be released over a period of 40 hours, allowing stormwater to infiltrate and suspended solids to settle out.

APPENDIX A

Drainage Area Maps

EXISTING CONDITIONS ANALYSIS:

DRAINAGE STUDY AREA = 1.237 ACRES
IMPERVIOUS AREA (C = 0.90) = 0.000 ACRES
PERVIOUS AREA, OPEN SPACE (C = 0.30) = 1.237 ACRES
COMPOSITE RUNOFF COEFFICIENT, C = 0.30
TIME OF CONCENTRATION = 9.00 MINUTES
PEAK RUNOFF (100 YEAR STORM) = 3.30 CFS



PROPOSED CONDITIONS ANALYSIS:

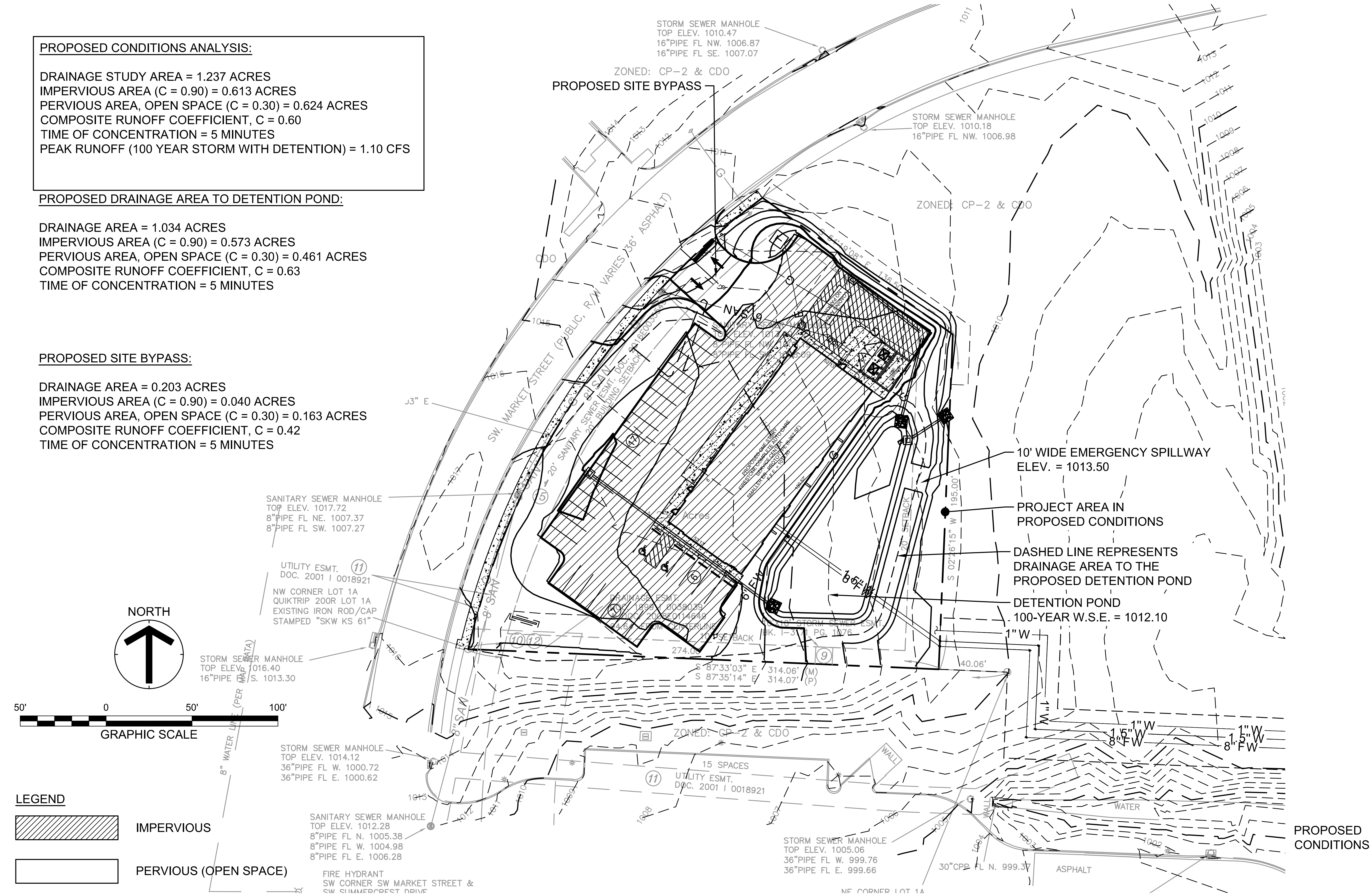
DRAINAGE STUDY AREA = 1.237 ACRES
IMPERVIOUS AREA (C = 0.90) = 0.613 ACRES
PERVIOUS AREA, OPEN SPACE (C = 0.30) = 0.624 ACRES
COMPOSITE RUNOFF COEFFICIENT, C = 0.60
TIME OF CONCENTRATION = 5 MINUTES
PEAK RUNOFF (100 YEAR STORM WITH DETENTION) = 1.10 CFS

PROPOSED DRAINAGE AREA TO DETENTION POND:

DRAINAGE AREA = 1.034 ACRES
IMPERVIOUS AREA (C = 0.90) = 0.573 ACRES
PERVIOUS AREA, OPEN SPACE (C = 0.30) = 0.461 ACRES
COMPOSITE RUNOFF COEFFICIENT, C = 0.63
TIME OF CONCENTRATION = 5 MINUTES

PROPOSED SITE BYPASS:

DRAINAGE AREA = 0.203 ACRES
IMPERVIOUS AREA (C = 0.90) = 0.040 ACRES
PERVIOUS AREA, OPEN SPACE (C = 0.30) = 0.163 ACRES
COMPOSITE RUNOFF COEFFICIENT, C = 0.42
TIME OF CONCENTRATION = 5 MINUTES



PROPOSED CONDITIONS

LEGEND

IMPERVIOUS

PERVIOUS (OPEN SPACE)

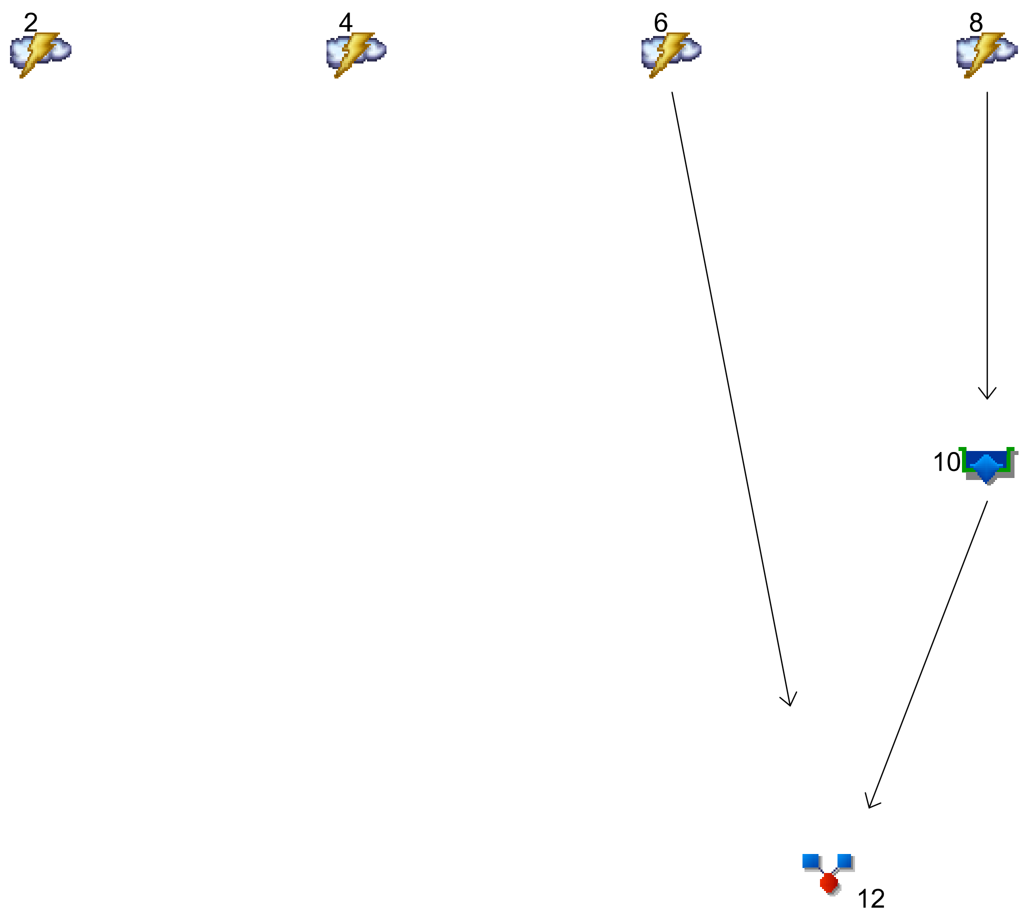
APPENDIX B

Onsite Drainage Calculations

Hydraflow Table of Contents

Watershed Model Schematic

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



Legend

Hyd.	Origin	Description
2	Rational	Existing
4	Rational	Proposed
6	Rational	Bypass
8	Rational	To Pond
10	Reservoir	Pond
12	Combine	Total Post Construction

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	
2	Rational	------	1.434	1.689	-------	2.104	2.450	2.924	3.292	3.665	Existing
4	Rational	------	3.662	4.301	-------	5.336	6.207	7.408	8.359	9.331	Proposed
6	Rational	------	0.421	0.494	-------	0.613	0.713	0.851	0.960	1.072	Bypass
8	Rational	------	3.214	3.775	-------	4.684	5.448	6.502	7.336	8.190	To Pond
10	Reservoir	8	0.022	0.023	-------	0.025	0.026	0.028	0.119	0.238	Pond
12	Combine	6, 10,	0.438	0.512	-------	0.632	0.733	0.873	0.983	1.096	Total Post Construction

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
2	Rational	1.689	1	9	912	------	------	------	Existing
4	Rational	4.301	1	5	1,290	------	------	------	Proposed
6	Rational	0.494	1	5	148	------	------	------	Bypass
8	Rational	3.775	1	5	1,132	------	------	------	To Pond
10	Reservoir	0.023	1	10	652	8	1011.55	1,115	Pond
12	Combine	0.512	1	5	800	6, 10,	------	------	Total Post Construction

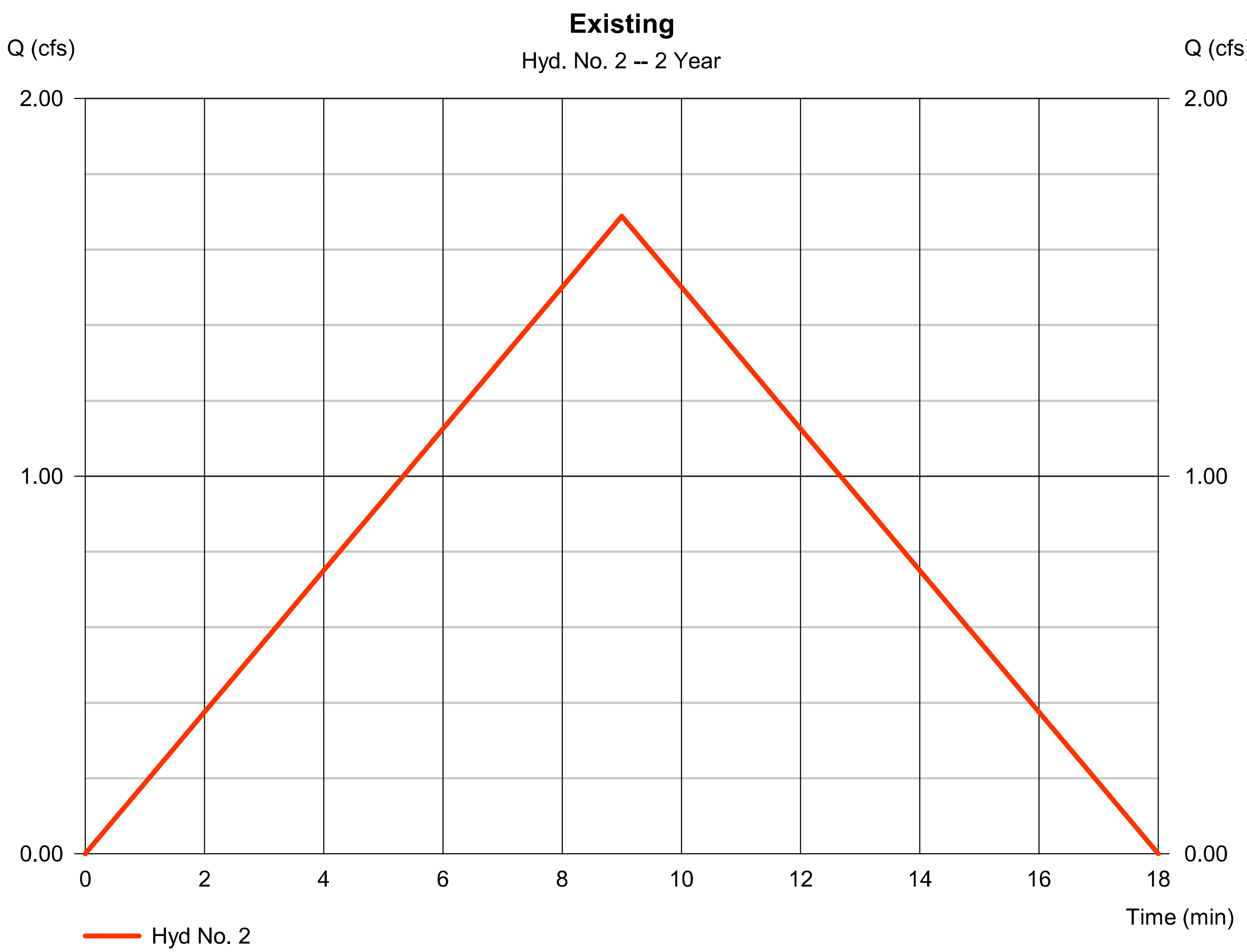
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 01 / 2 / 2020

Hyd. No. 2

Existing

Hydrograph type	= Rational	Peak discharge	= 1.689 cfs
Storm frequency	= 2 yrs	Time to peak	= 9 min
Time interval	= 1 min	Hyd. volume	= 912 cuft
Drainage area	= 1.237 ac	Runoff coeff.	= 0.3
Intensity	= 4.551 in/hr	Tc by User	= 9.00 min
IDF Curve	= Lees Summit.IDF	Asc/Rec limb fact	= 1/1



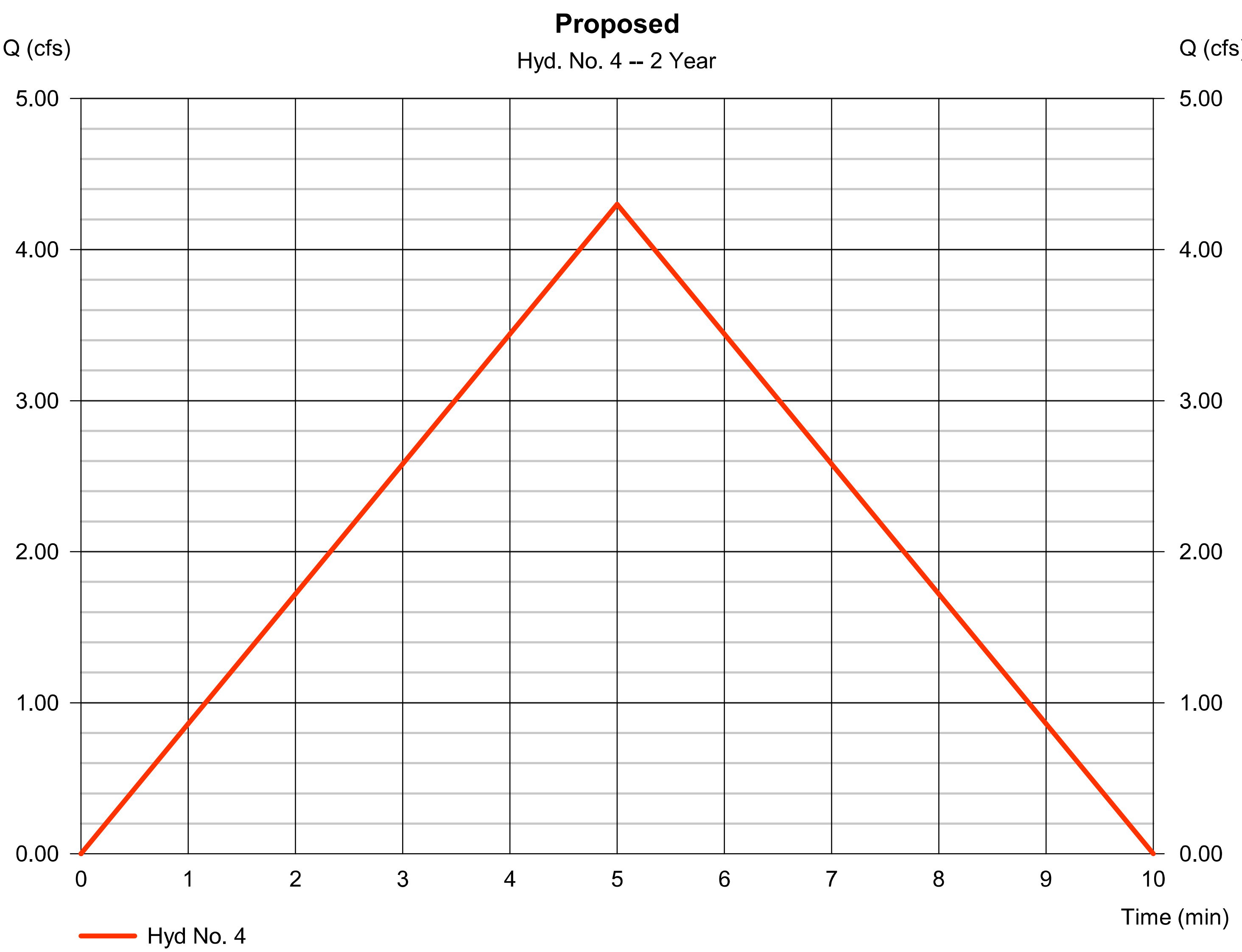
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 01 / 2 / 2020

Hyd. No. 4

Proposed

Hydrograph type	= Rational	Peak discharge	= 4.301 cfs
Storm frequency	= 2 yrs	Time to peak	= 5 min
Time interval	= 1 min	Hyd. volume	= 1,290 cuft
Drainage area	= 1.237 ac	Runoff coeff.	= 0.6
Intensity	= 5.794 in/hr	Tc by User	= 5.00 min
IDF Curve	= Lees Summit.IDF	Asc/Rec limb fact	= 1/1



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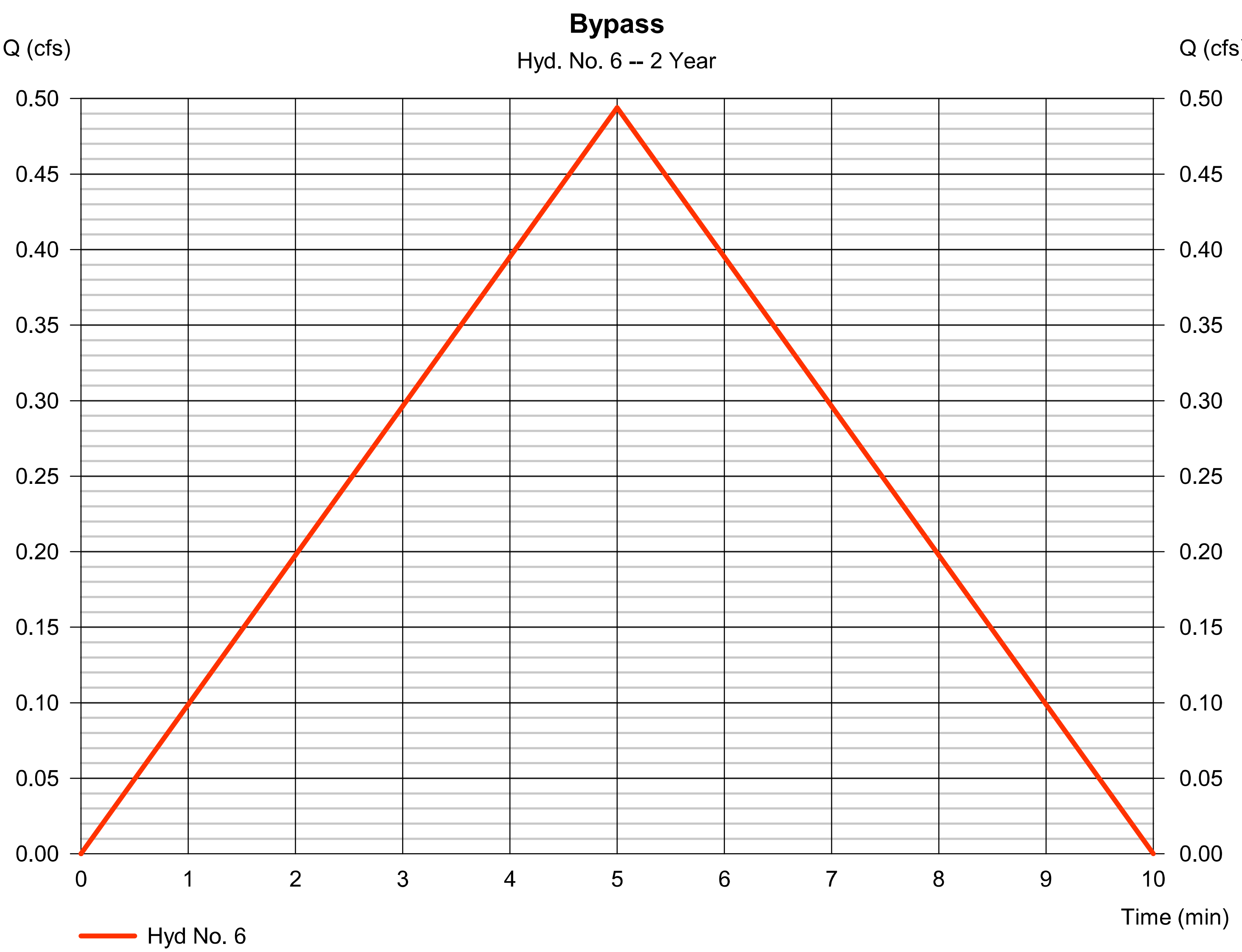
Hyd. No. 6

Bypass

Hydrograph type	= Rational	Peak discharge	= 0.494 cfs
Storm frequency	= 2 yrs	Time to peak	= 5 min
Time interval	= 1 min	Hyd. volume	= 148 cuft
Drainage area	= 0.203 ac	Runoff coeff.	= 0.42
Intensity	= 5.794 in/hr	Tc by User	= 5.00 min
IDF Curve	= Lees Summit.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

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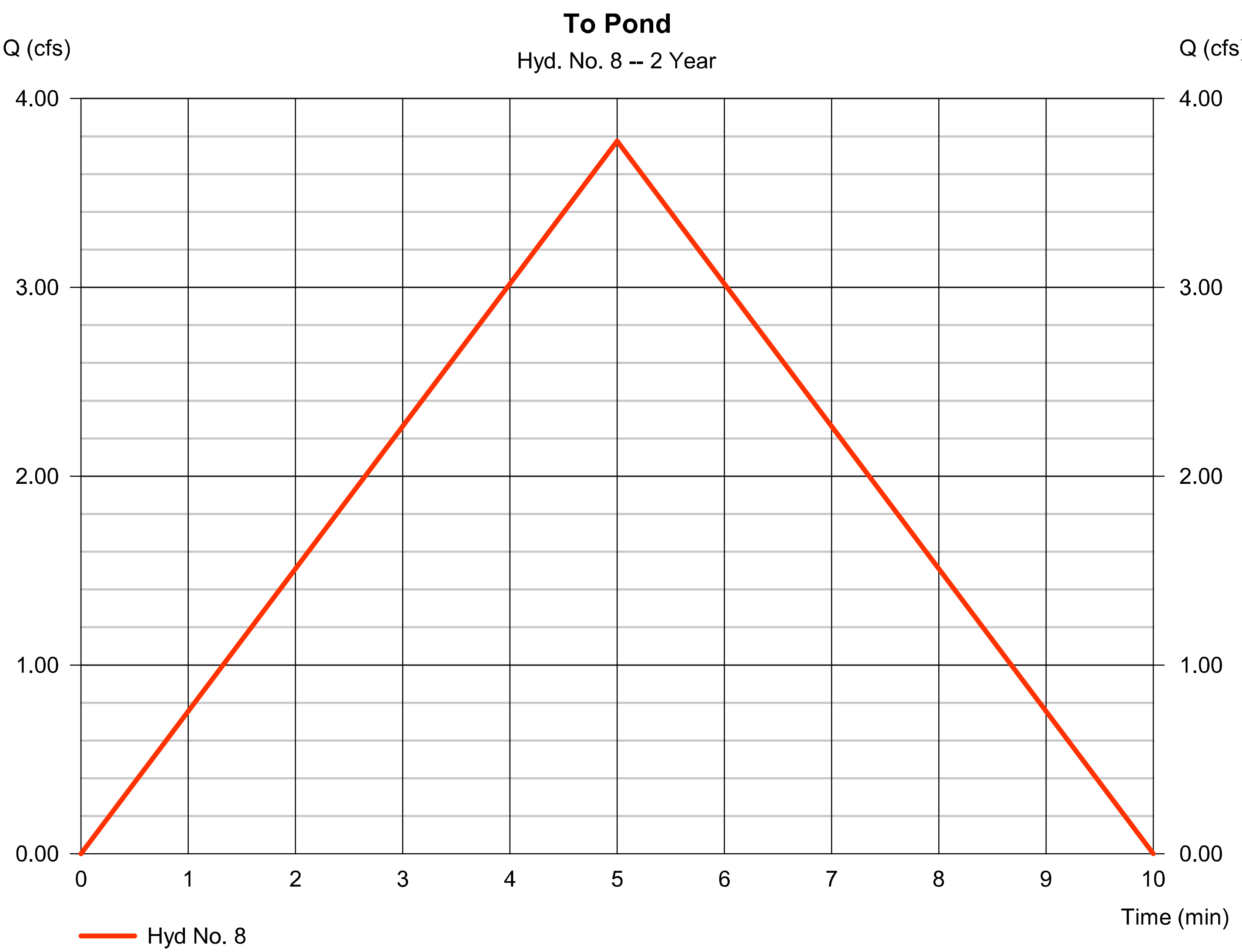
Hyd. No. 8

To Pond

Hydrograph type	= Rational	Peak discharge	= 3.775 cfs
Storm frequency	= 2 yrs	Time to peak	= 5 min
Time interval	= 1 min	Hyd. volume	= 1,132 cuft
Drainage area	= 1.034 ac	Runoff coeff.	= 0.63
Intensity	= 5.794 in/hr	Tc by User	= 5.00 min
IDF Curve	= Lees Summit.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

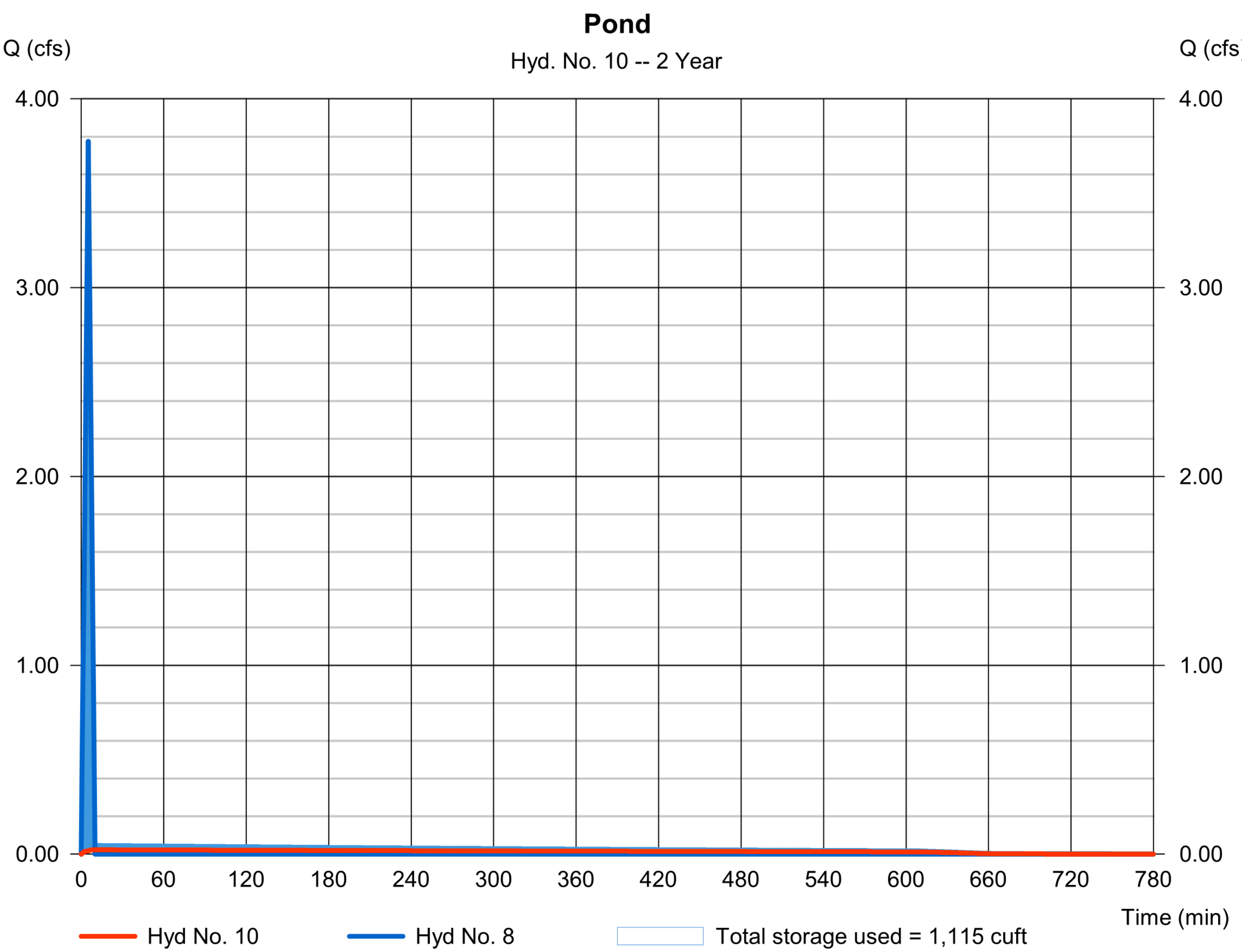
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 01 / 2 / 2020

Hyd. No. 10

Pond

Hydrograph type	= Reservoir	Peak discharge	= 0.023 cfs
Storm frequency	= 2 yrs	Time to peak	= 10 min
Time interval	= 1 min	Hyd. volume	= 652 cuft
Inflow hyd. No.	= 8 - To Pond	Max. Elevation	= 1011.55 ft
Reservoir name	= Pond	Max. Storage	= 1,115 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Pond No. 1 - Pond

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1010.75 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1010.75	05	0	0
0.25	1011.00	520	48	48
1.25	1012.00	3,884	1,941	1,989
2.25	1013.00	4,712	4,290	6,279
3.25	1014.00	5,608	5,153	11,432

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	1.00	6.00	0.00
Span (in)	= 12.00	1.00	24.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 1010.65	1010.75	1012.00	0.00
Length (ft)	= 17.00	0.50	0.50	0.00
Slope (%)	= 0.50	0.50	0.50	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 12.00	10.00	0.00	0.00
Crest El. (ft)	= 1012.50	1013.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Ciplti	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.420 (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	1010.75	0.00	0.00	0.00	---	0.00	0.00	---	---	0.000	---	0.000
0.25	48	1011.00	0.04 oc	0.01 ic	0.00	---	0.00	0.00	---	---	0.005	---	0.017
1.25	1,989	1012.00	0.04 oc	0.03 ic	0.00	---	0.00	0.00	---	---	0.038	---	0.067
2.25	6,279	1013.00	5.12 ic	0.04 ic	0.63 ic	---	4.49 s	0.00	---	---	0.046	---	5.200
3.25	11,432	1014.00	6.38 ic	0.05 ic	0.19 ic	---	6.15 s	33.30	---	---	0.055	---	39.75

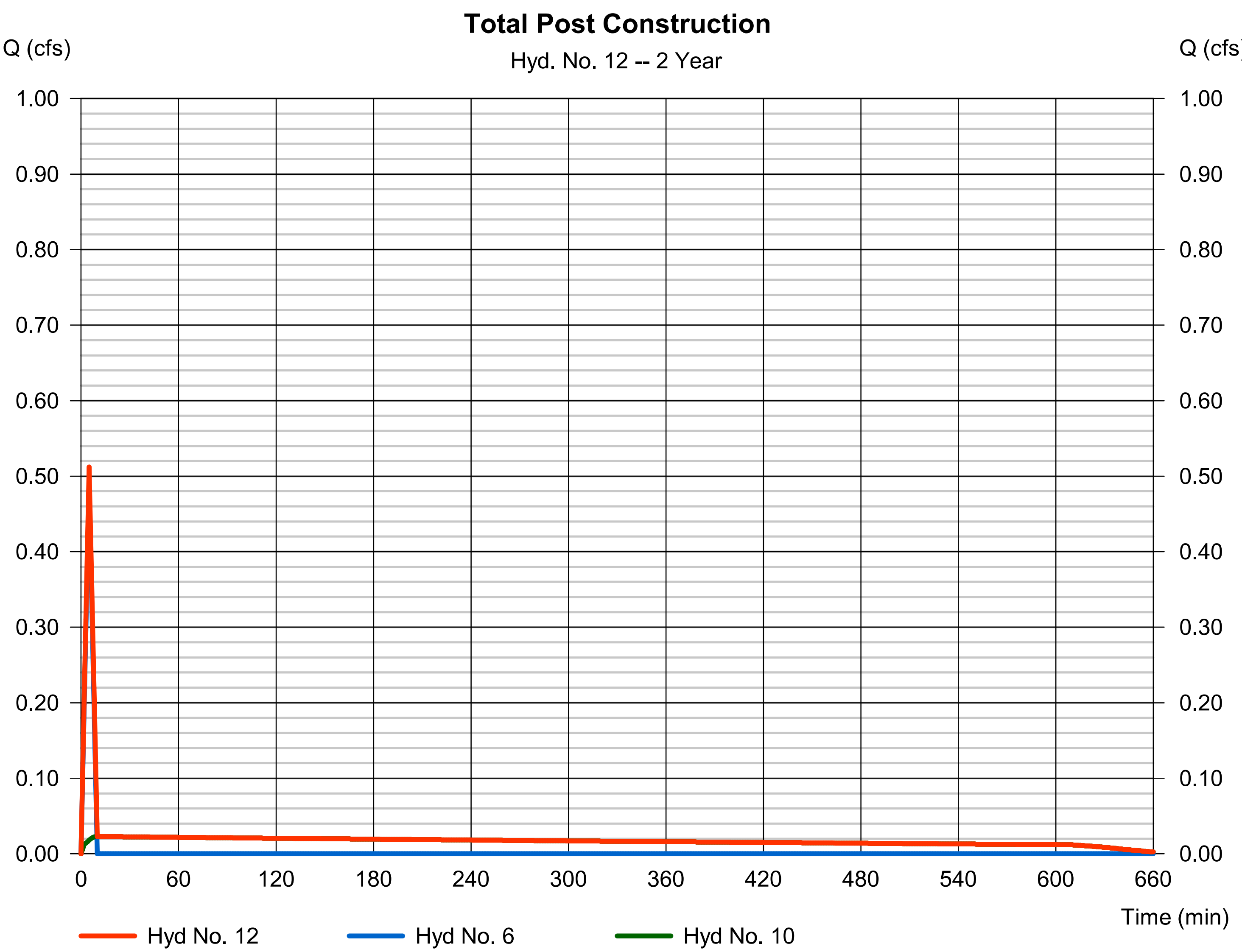
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 01 / 2 / 2020

Hyd. No. 12

Total Post Construction

Hydrograph type	= Combine	Peak discharge	= 0.512 cfs
Storm frequency	= 2 yrs	Time to peak	= 5 min
Time interval	= 1 min	Hyd. volume	= 800 cuft
Inflow hyds.	= 6, 10	Contrib. drain. area	= 0.203 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
2	Rational	2.450	1	9	1,323	------	------	------	Existing
4	Rational	6.207	1	5	1,862	------	------	------	Proposed
6	Rational	0.713	1	5	214	------	------	------	Bypass
8	Rational	5.448	1	5	1,634	------	------	------	To Pond
10	Reservoir	0.026	1	10	891	8	1011.81	1,613	Pond
12	Combine	0.733	1	5	1,105	6, 10,	------	------	Total Post Construction

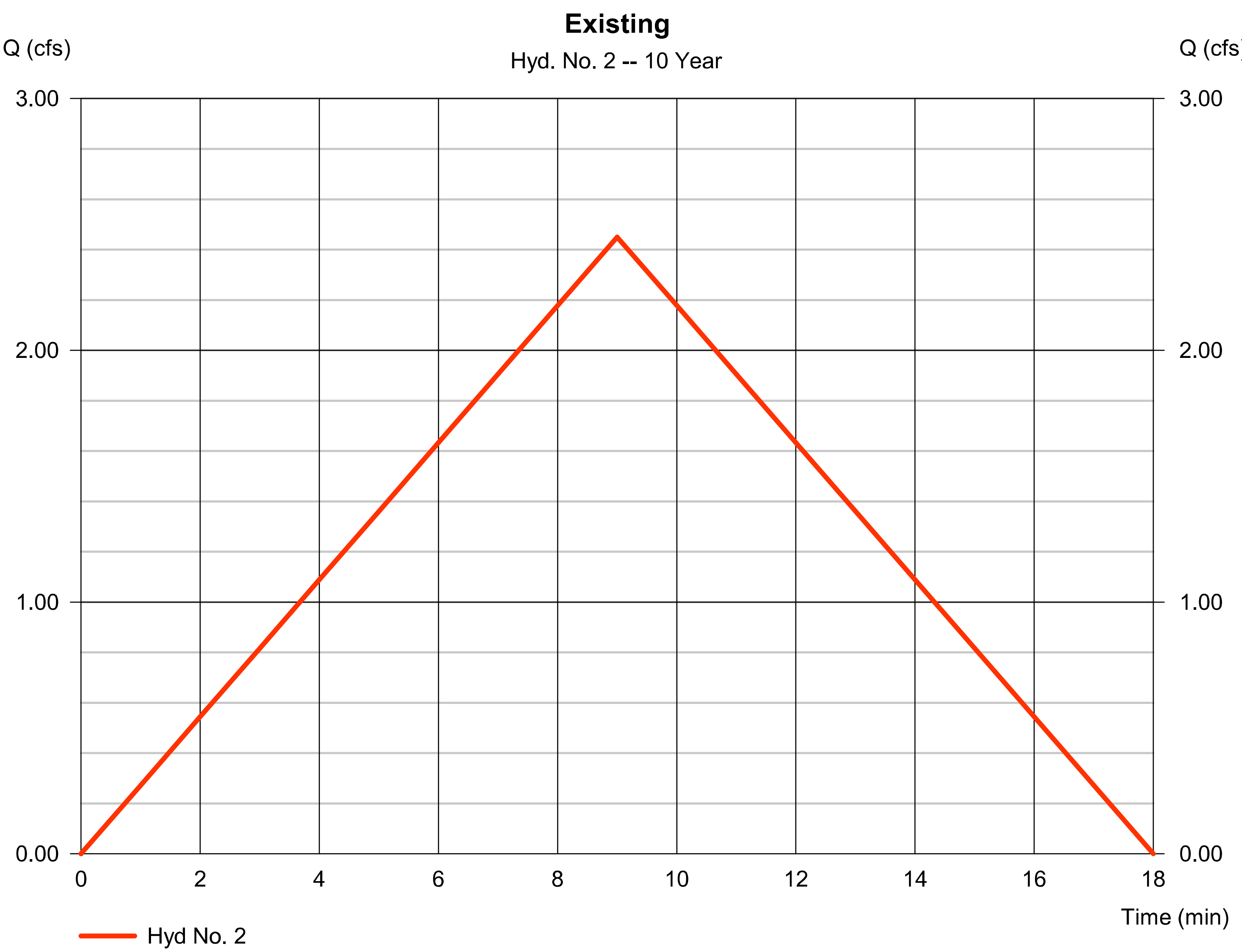
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 01 / 2 / 2020

Hyd. No. 2

Existing

Hydrograph type	= Rational	Peak discharge	= 2.450 cfs
Storm frequency	= 10 yrs	Time to peak	= 9 min
Time interval	= 1 min	Hyd. volume	= 1,323 cuft
Drainage area	= 1.237 ac	Runoff coeff.	= 0.3
Intensity	= 6.601 in/hr	Tc by User	= 9.00 min
IDF Curve	= Lees Summit.IDF	Asc/Rec limb fact	= 1/1



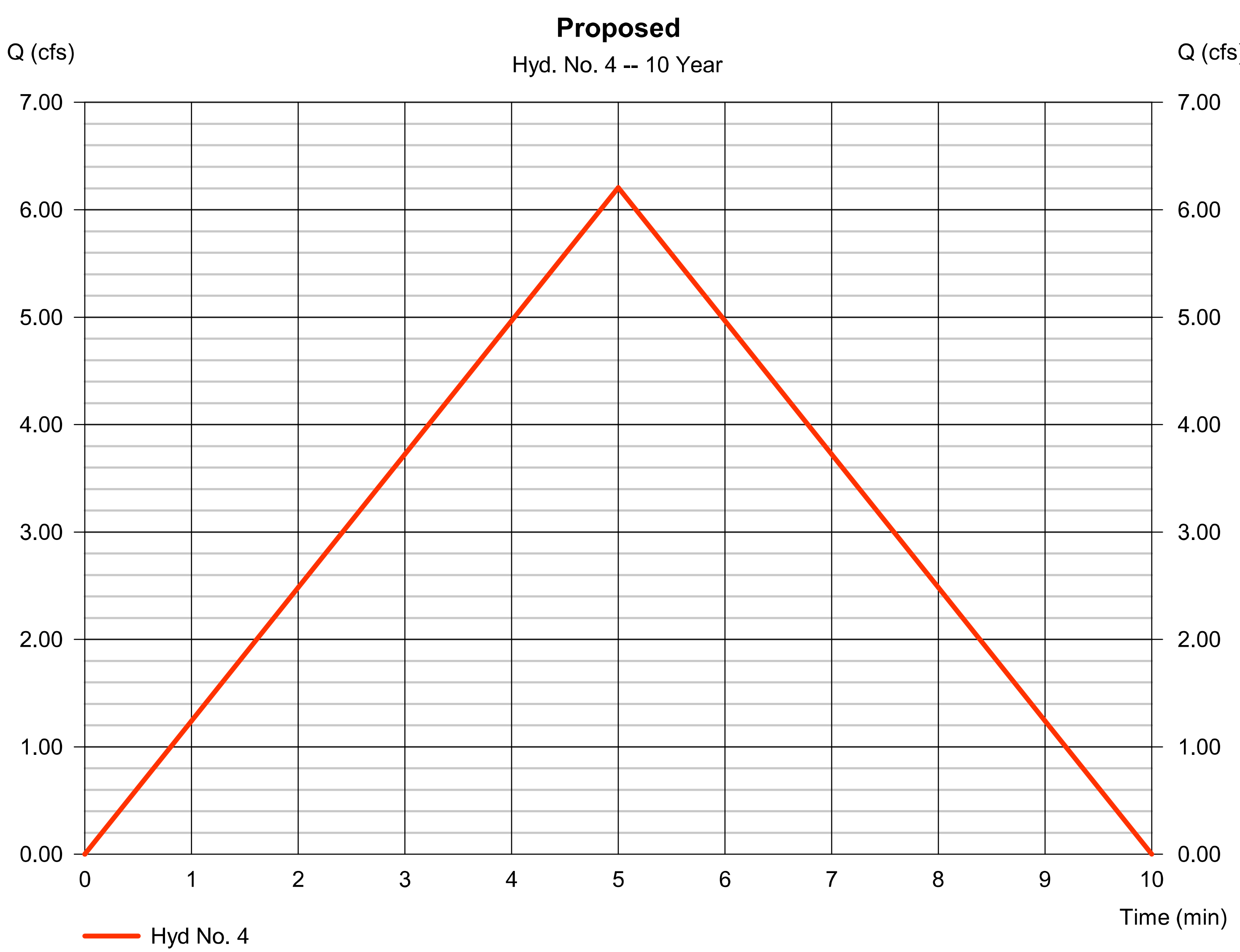
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 01 / 2 / 2020

Hyd. No. 4

Proposed

Hydrograph type	= Rational	Peak discharge	= 6.207 cfs
Storm frequency	= 10 yrs	Time to peak	= 5 min
Time interval	= 1 min	Hyd. volume	= 1,862 cuft
Drainage area	= 1.237 ac	Runoff coeff.	= 0.6
Intensity	= 8.363 in/hr	Tc by User	= 5.00 min
IDF Curve	= Lees Summit.IDF	Asc/Rec limb fact	= 1/1



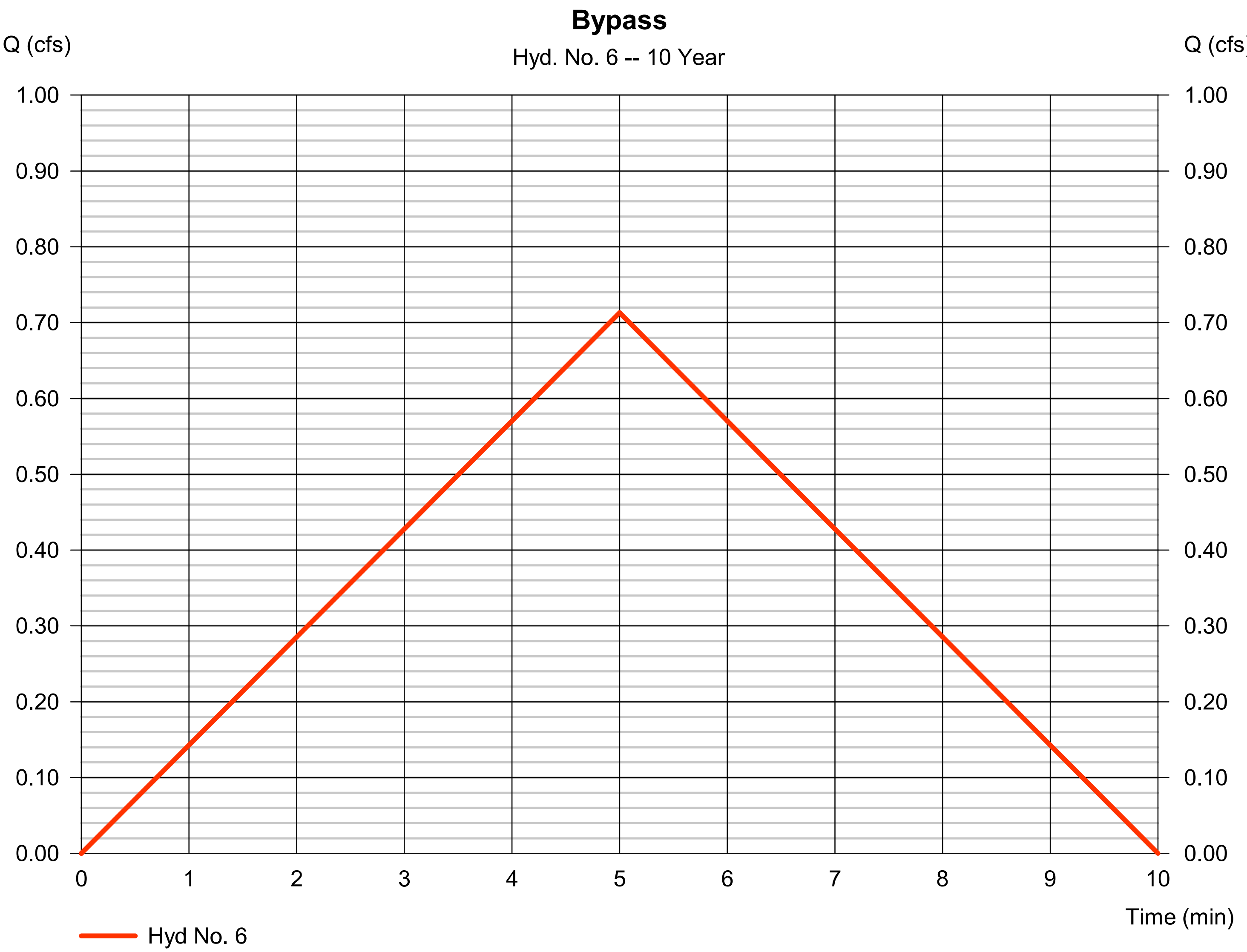
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 01 / 2 / 2020

Hyd. No. 6

Bypass

Hydrograph type	= Rational	Peak discharge	= 0.713 cfs
Storm frequency	= 10 yrs	Time to peak	= 5 min
Time interval	= 1 min	Hyd. volume	= 214 cuft
Drainage area	= 0.203 ac	Runoff coeff.	= 0.42
Intensity	= 8.363 in/hr	Tc by User	= 5.00 min
IDF Curve	= Lees Summit.IDF	Asc/Rec limb fact	= 1/1



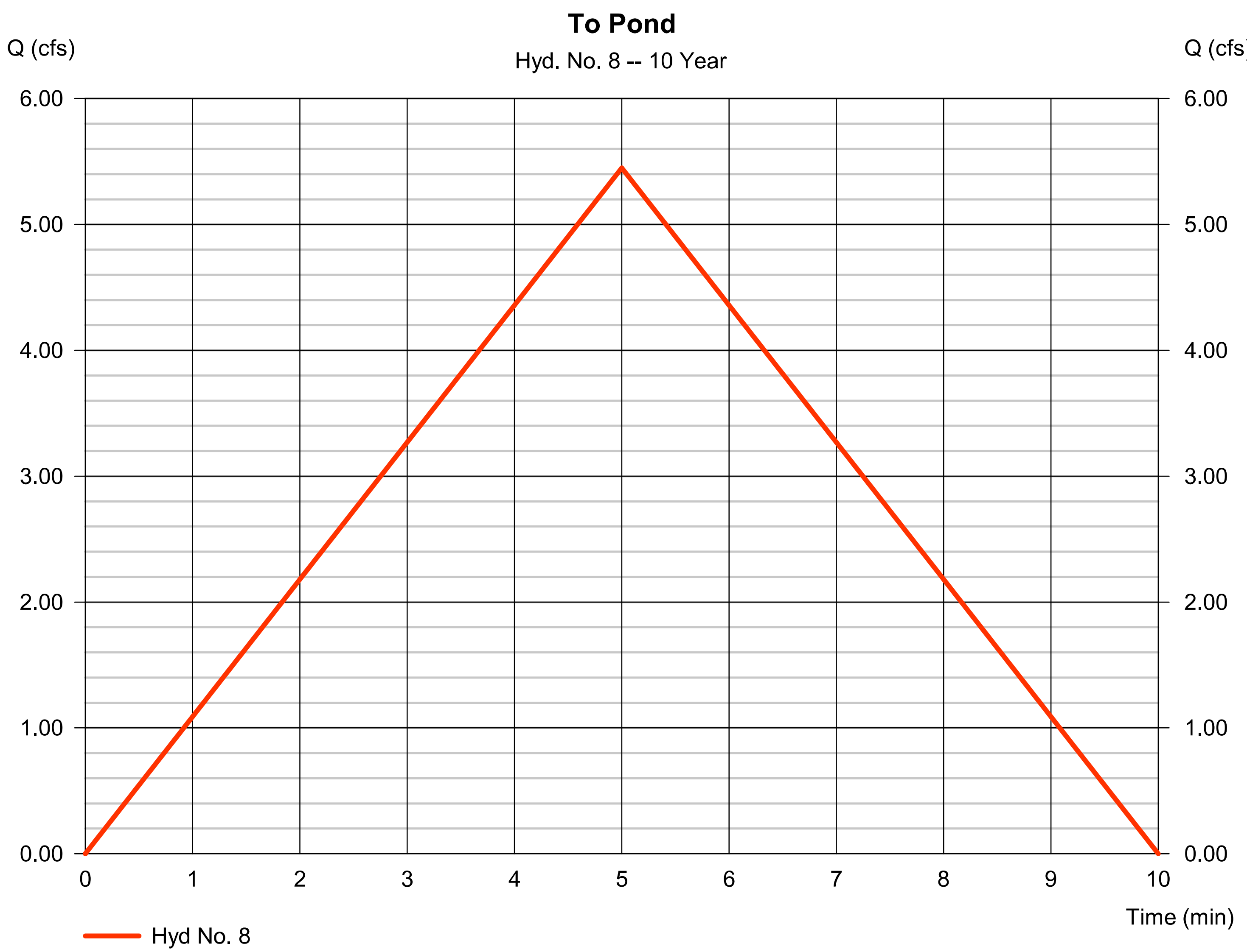
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 01 / 2 / 2020

Hyd. No. 8

To Pond

Hydrograph type	= Rational	Peak discharge	= 5.448 cfs
Storm frequency	= 10 yrs	Time to peak	= 5 min
Time interval	= 1 min	Hyd. volume	= 1,634 cuft
Drainage area	= 1.034 ac	Runoff coeff.	= 0.63
Intensity	= 8.363 in/hr	Tc by User	= 5.00 min
IDF Curve	= Lees Summit.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

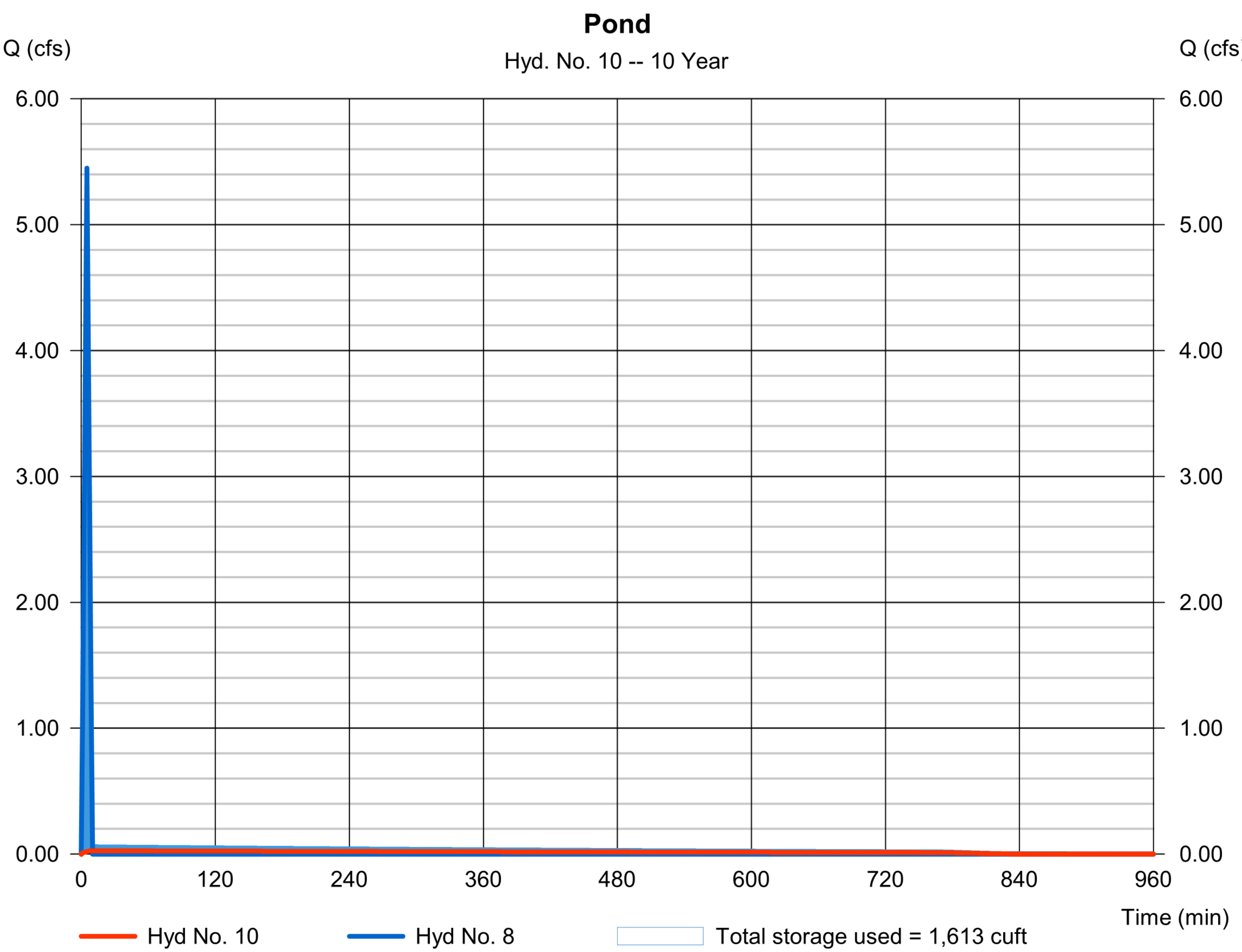
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 01 / 2 / 2020

Hyd. No. 10

Pond

Hydrograph type	= Reservoir	Peak discharge	= 0.026 cfs
Storm frequency	= 10 yrs	Time to peak	= 10 min
Time interval	= 1 min	Hyd. volume	= 891 cuft
Inflow hyd. No.	= 8 - To Pond	Max. Elevation	= 1011.81 ft
Reservoir name	= Pond	Max. Storage	= 1,613 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



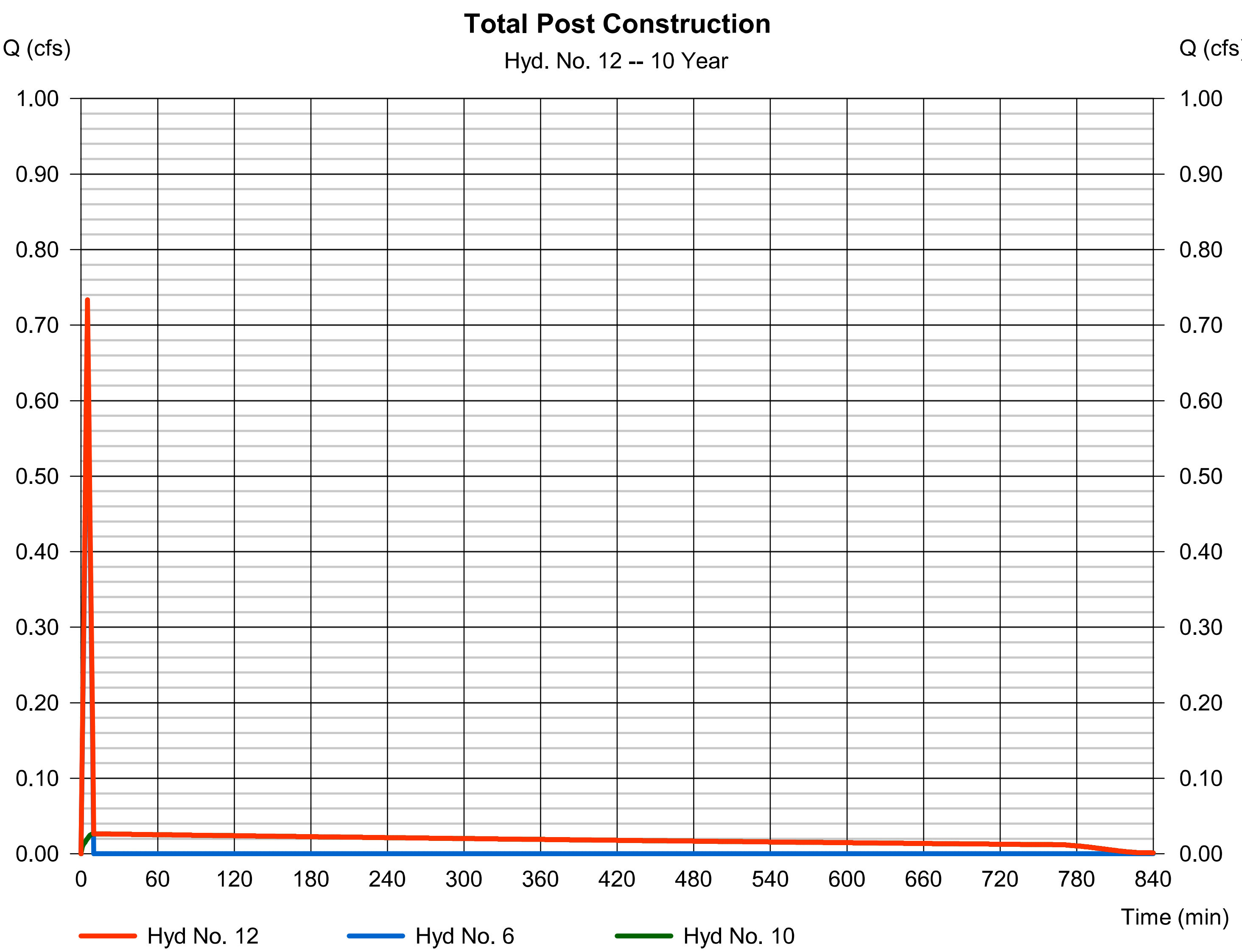
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 01 / 2 / 2020

Hyd. No. 12

Total Post Construction

Hydrograph type	= Combine	Peak discharge	= 0.733 cfs
Storm frequency	= 10 yrs	Time to peak	= 5 min
Time interval	= 1 min	Hyd. volume	= 1,105 cuft
Inflow hyds.	= 6, 10	Contrib. drain. area	= 0.203 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
2	Rational	3.665	1	9	1,979	------	------	------	Existing
4	Rational	9.331	1	5	2,799	------	------	------	Proposed
6	Rational	1.072	1	5	322	------	------	------	Bypass
8	Rational	8.190	1	5	2,457	------	------	------	To Pond
10	Reservoir	0.238	1	10	1,394	8	1012.10	2,404	Pond
12	Combine	1.096	1	5	1,715	6, 10,	------	------	Total Post Construction

Lee's Summit.gpw	Return Period: 100 Year	Thursday, 01 / 2 / 2020

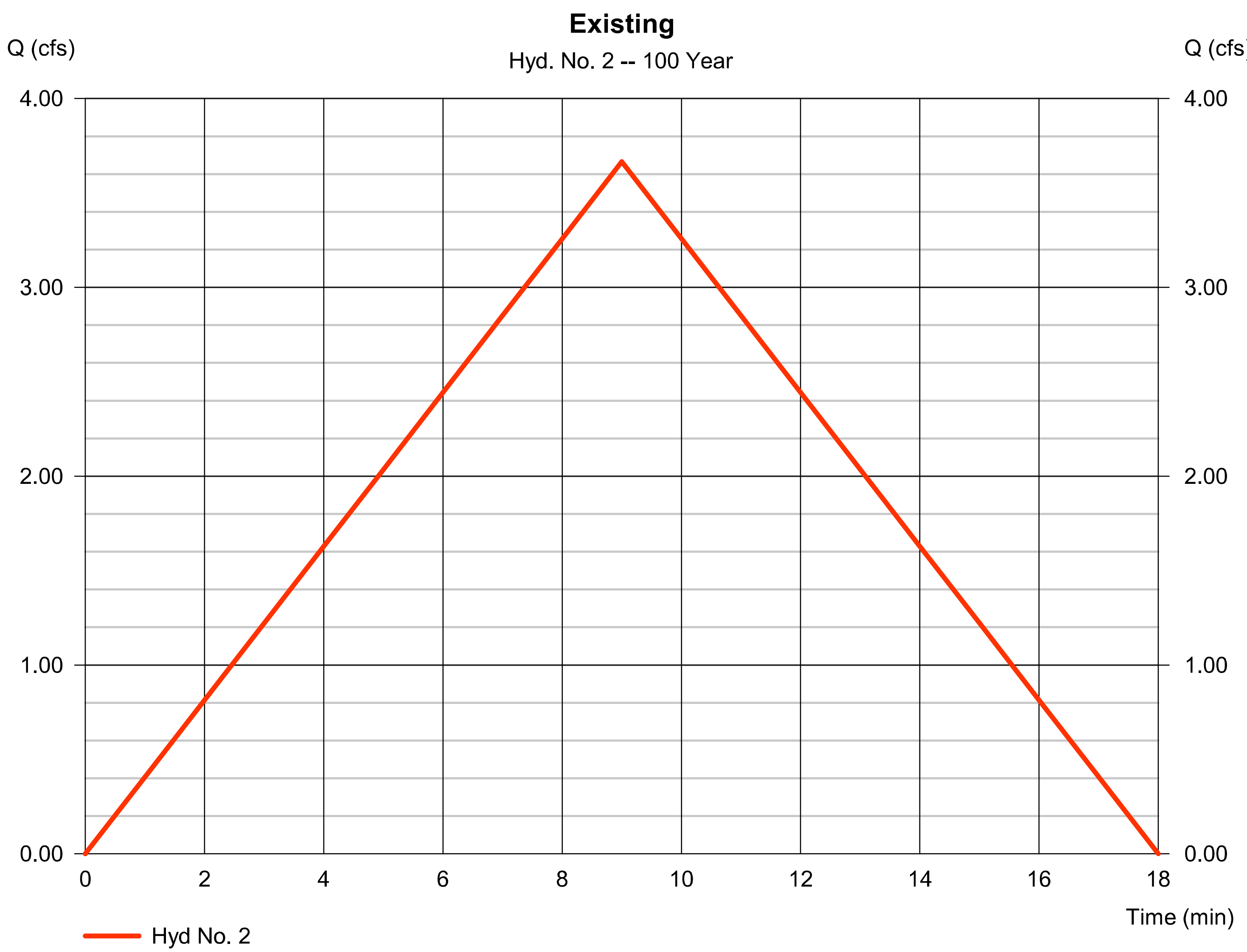
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 01 / 2 / 2020

Hyd. No. 2

Existing

Hydrograph type	= Rational	Peak discharge	= 3.665 cfs
Storm frequency	= 100 yrs	Time to peak	= 9 min
Time interval	= 1 min	Hyd. volume	= 1,979 cuft
Drainage area	= 1.237 ac	Runoff coeff.	= 0.3
Intensity	= 9.877 in/hr	Tc by User	= 9.00 min
IDF Curve	= Lees Summit.IDF	Asc/Rec limb fact	= 1/1



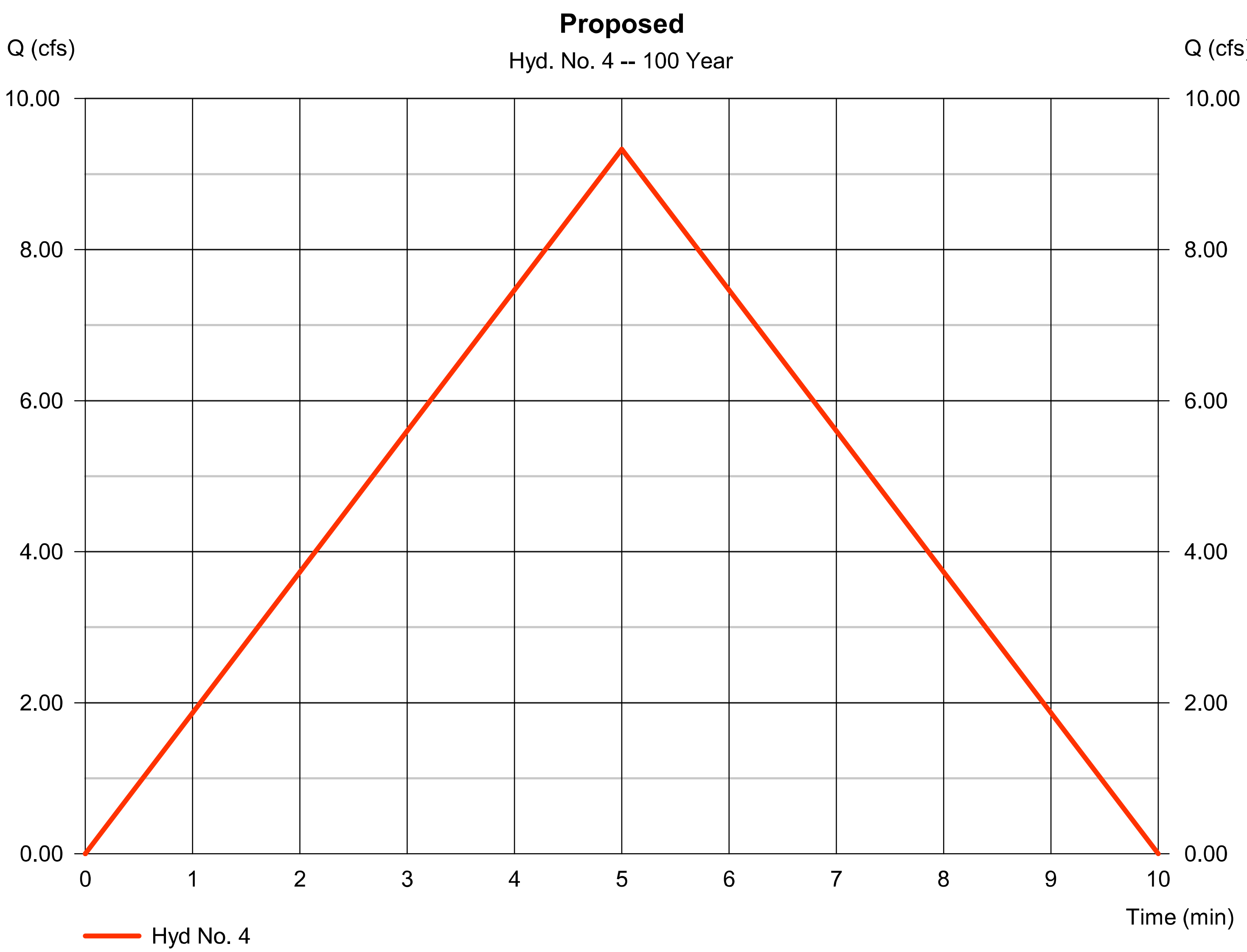
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 — Thursday, 01 / 2 / 2020

Hyd. No. 4

Proposed

Hydrograph type	= Rational	Peak discharge	= 9.331 cfs
Storm frequency	= 100 yrs	Time to peak	= 5 min
Time interval	= 1 min	Hyd. volume	= 2,799 cuft
Drainage area	= 1.237 ac	Runoff coeff.	= 0.6
Intensity	= 12.572 in/hr	Tc by User	= 5.00 min
IDF Curve	= Lees Summit.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 01 / 2 / 2020

Hyd. No. 6

Bypass

Hydrograph type	= Rational	Peak discharge	= 1.072 cfs
Storm frequency	= 100 yrs	Time to peak	= 5 min
Time interval	= 1 min	Hyd. volume	= 322 cuft
Drainage area	= 0.203 ac	Runoff coeff.	= 0.42
Intensity	= 12.572 in/hr	Tc by User	= 5.00 min
IDF Curve	= Lees Summit.IDF	Asc/Rec limb fact	= 1/1

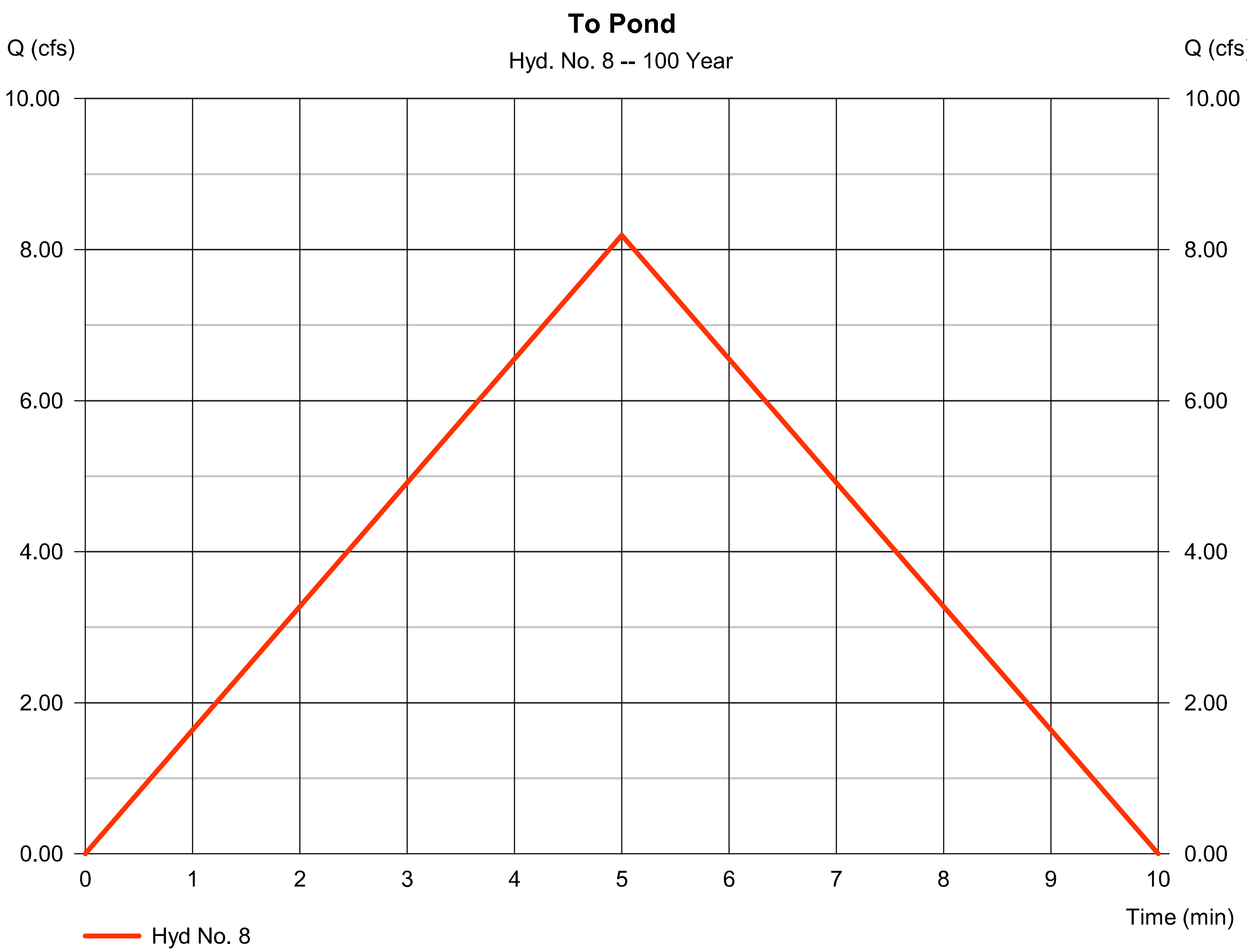
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 01 / 2 / 2020

Hyd. No. 8

To Pond

Hydrograph type	= Rational	Peak discharge	= 8.190 cfs
Storm frequency	= 100 yrs	Time to peak	= 5 min
Time interval	= 1 min	Hyd. volume	= 2,457 cuft
Drainage area	= 1.034 ac	Runoff coeff.	= 0.63
Intensity	= 12.572 in/hr	Tc by User	= 5.00 min
IDF Curve	= Lees Summit.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

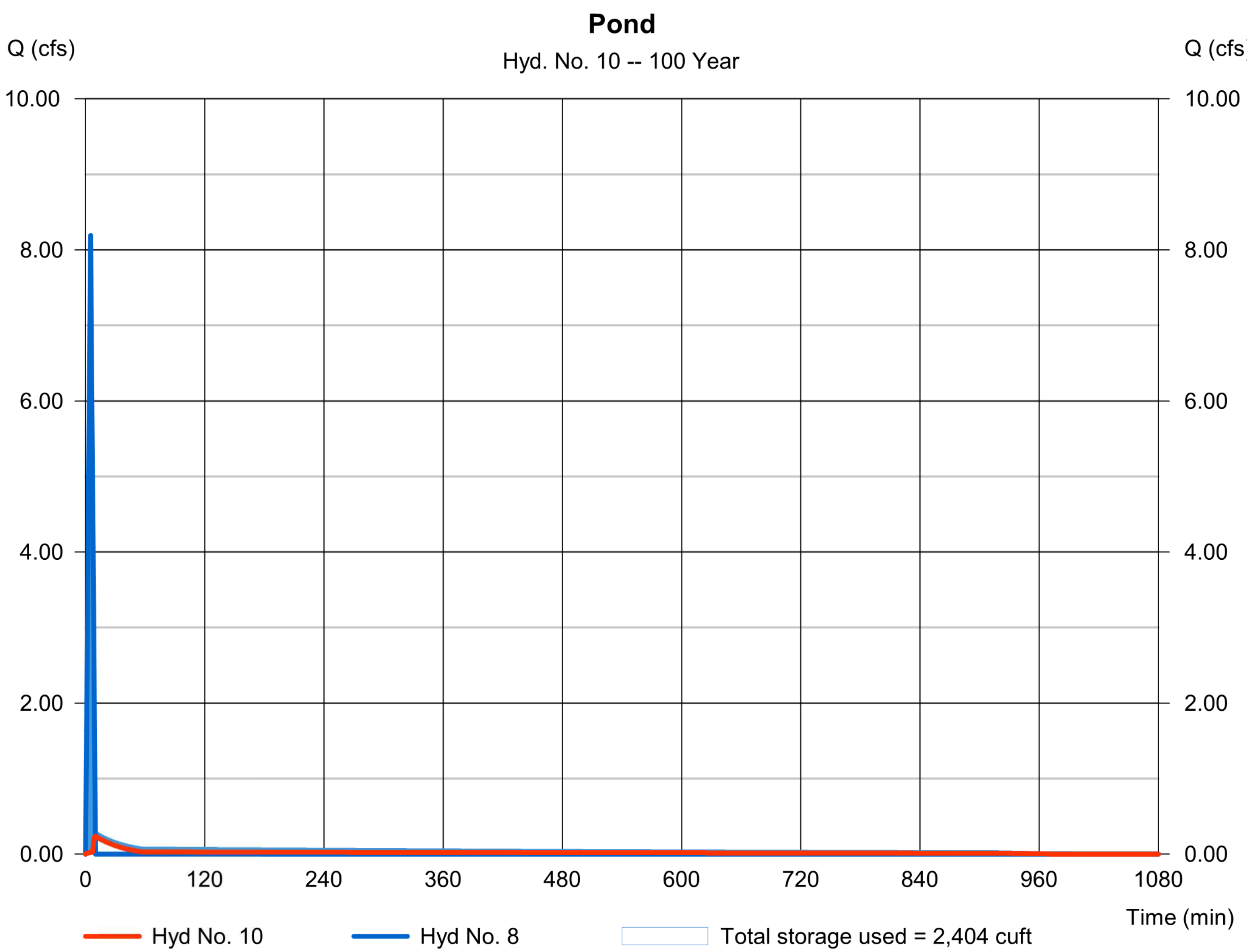
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 01 / 2 / 2020

Hyd. No. 10

Pond

Hydrograph type	= Reservoir	Peak discharge	= 0.238 cfs
Storm frequency	= 100 yrs	Time to peak	= 10 min
Time interval	= 1 min	Hyd. volume	= 1,394 cuft
Inflow hyd. No.	= 8 - To Pond	Max. Elevation	= 1012.10 ft
Reservoir name	= Pond	Max. Storage	= 2,404 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



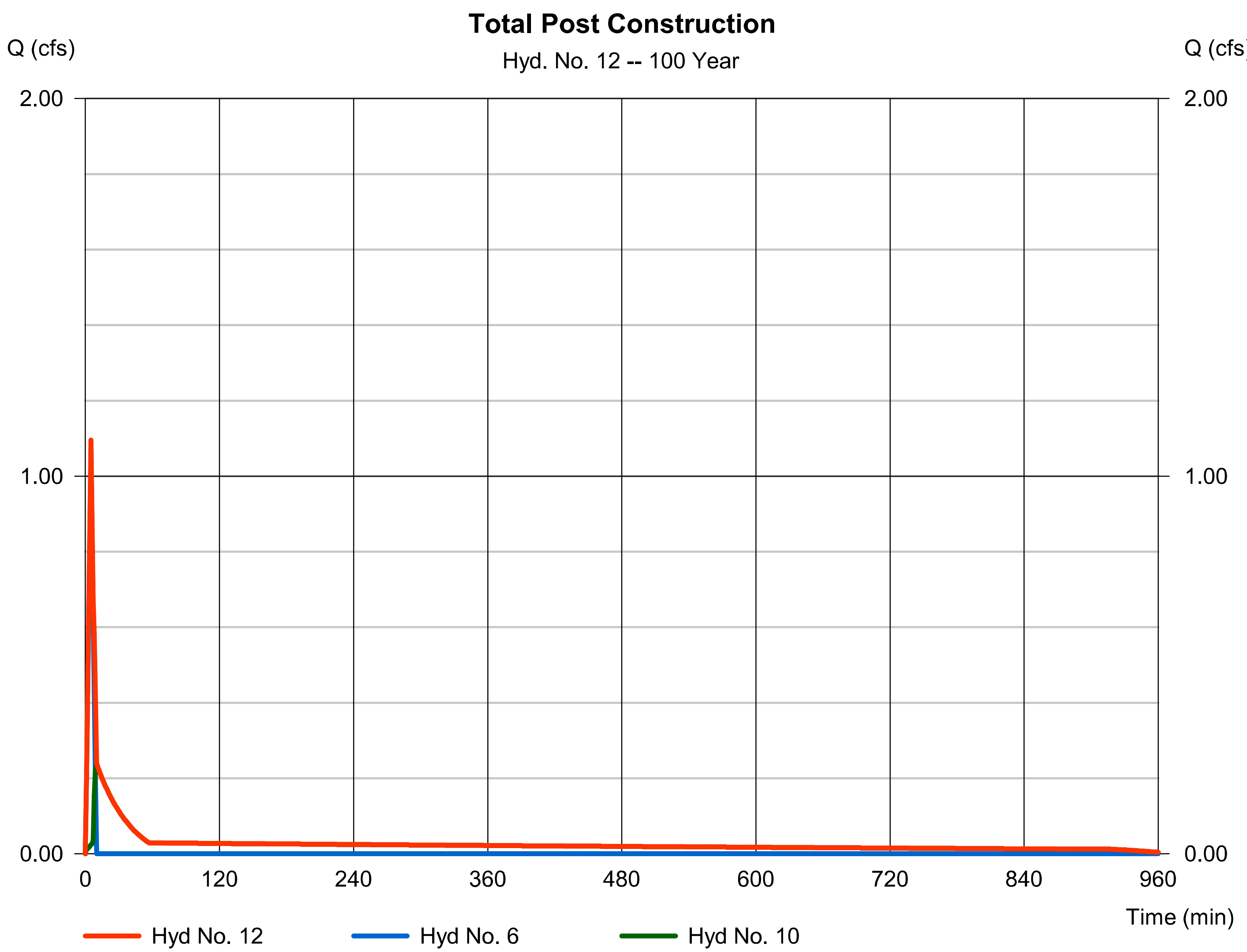
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 01 / 2 / 2020

Hyd. No. 12

Total Post Construction

Hydrograph type	= Combine	Peak discharge	= 1.096 cfs
Storm frequency	= 100 yrs	Time to peak	= 5 min
Time interval	= 1 min	Hyd. volume	= 1,715 cuft
Inflow hyds.	= 6, 10	Contrib. drain. area	= 0.203 ac



Hydraflow Rainfall Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2020 Thursday, 01 / 2 / 2020

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	21.2433	4.0000	0.6645	--------
2	26.1250	4.3000	0.6753	--------
3	0.0000	0.0000	0.0000	--------
5	33.6055	4.6000	0.6818	--------
10	38.8836	4.6000	0.6794	--------
25	45.4115	4.5000	0.6730	--------
50	48.7964	4.2000	0.6607	--------
100	52.0785	3.9000	0.6501	--------

File name: Lees Summit.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	4.93	3.68	3.00	2.57	2.27	2.04	1.86	1.72	1.60	1.50	1.41	1.34
2	5.79	4.33	3.54	3.03	2.67	2.40	2.19	2.02	1.88	1.76	1.66	1.57
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	7.19	5.40	4.42	3.79	3.34	3.00	2.74	2.52	2.35	2.20	2.07	1.96
10	8.36	6.29	5.15	4.41	3.89	3.50	3.19	2.95	2.74	2.57	2.42	2.29
25	9.98	7.51	6.15	5.28	4.66	4.19	3.83	3.53	3.29	3.08	2.90	2.75
50	11.26	8.45	6.93	5.94	5.25	4.73	4.32	3.99	3.72	3.49	3.29	3.12
100	12.57	9.41	7.71	6.61	5.85	5.27	4.82	4.45	4.15	3.90	3.68	3.49

Tc = time in minutes. Values may exceed 60.

Precip. file name: \\global.gsp\data\nf\na_nf05\4243497\01Work\03Tech\LP\00DesignBasis\Somerville.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	3.23	4.20	0.00	5.53	6.86	8.93	10.80	12.90
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

APPENDIX C

Water Quality Calculations

WATER QUALITY POND CALCULATIONS-PERFORATED PIPE

Project: Firestone Complete Auto Care, Lee's Summit, MO ***Date: 11/18/19***
GSP# 40831.45 ***Revised Date: XXX***

Calculate Water Quality Volume

P (in.), rainfall for 90% storm event	1.37
I, impervious cover by %	55.5
R_v, runoff coeffcient = 0.05 + 0.009 x I	0.55
A (ac), drainage area	1.03
WQ_v (ac-ft), water quality volume = P x R_v x A/12	0.06
WQ_v (ft^3), water quality volume converted units	2826
Add 20% WQv (ft3), water quality volume converted units	**3390.76**

Pond Areas

Elevation (ft)	Area (ft^2)	Elev. Difference (ft)	Increment Volume (ft^3)	Total Volume (ft^3)
1010.75	5			0
1011	577	0.25	73	73
1012	4315	1	2446	2519
1013	5235	1	4775	7294
1014	6231	1	5733	13027
1014.5	6930	1	6581	19607

.

Required WQ_v elevation (ft)	1012.18
Spillway elevation (ft)	1013.50

Size Low Flow Orifice

C, orifice coefficient	0.66
T (hrs), drawdown time (should be between 24 and 48 hrs)	40
g (ft/s^2), gravity	32.20
$Q_{wq, avg}$ (cfs), average release rate of WQ_v	0.024
$H_{wq, avg}$ (ft), average head on the water quality outlet	0.72
A_{wq} (ft^2), the orifice area	0.005
D_{wq} (ft), the orifice area	0.08
D_{wq} (in), the orifice area	0.98
Use D=	**1.00**

APPENDIX D

NRCS Soil Map

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

October 22, 2019

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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Contents

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.

Soil Map

Map Scale: 1:1,200 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 15, 30, 60, 90

Feet: 0, 50, 100, 200, 300

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 20, Sep 16, 2019

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	0.6	16.6%
10180	Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes	3.0	83.4%
Totals for Area of Interest		**3.6**	**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

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

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

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 Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Physical Properties

Soil Physical Properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

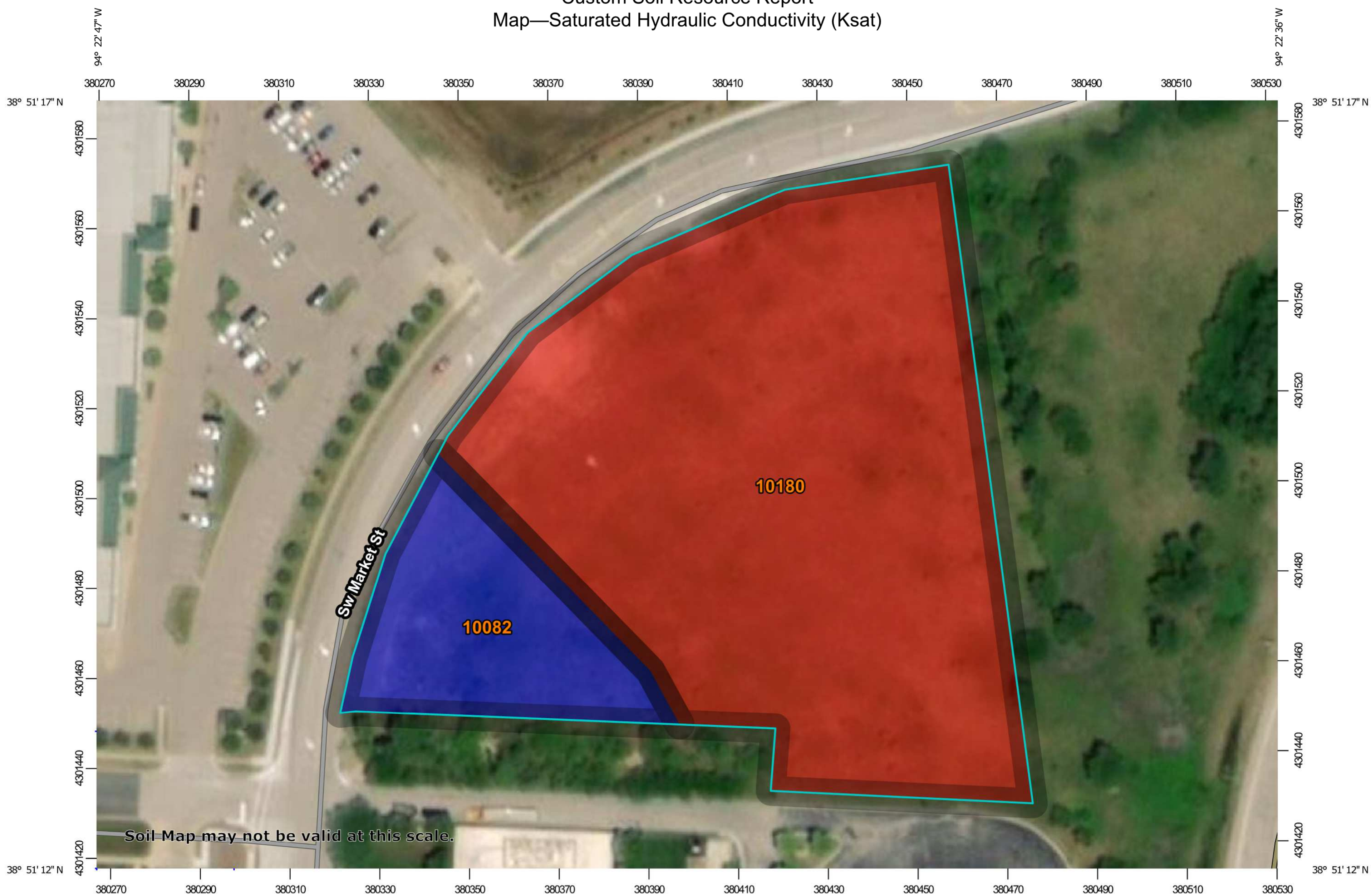
Saturated Hydraulic Conductivity (Ksat)

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

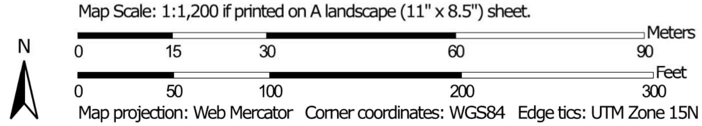
For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits.

Custom Soil Resource Report
Map—Saturated Hydraulic Conductivity (Ksat)



Map Scale: 1:1,200 if printed on A landscape (11" x 8.5") sheet.



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 Rating Polygons

- <= 2.9163
- > 2.9163 and <= 3.8300
- Not rated or not available

Soil Rating Lines

- <= 2.9163
- > 2.9163 and <= 3.8300
- Not rated or not available

Soil Rating Points

- <= 2.9163
- > 2.9163 and <= 3.8300
- Not rated or not available

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 20, Sep 16, 2019

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.

Table—Saturated Hydraulic Conductivity (Ksat)

Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	3.8300	0.6	16.6%
10180	Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes	2.9163	3.0	83.4%
Totals for Area of Interest			**3.6**	**100.0%**

Rating Options—Saturated Hydraulic Conductivity (Ksat)

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Fastest

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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.

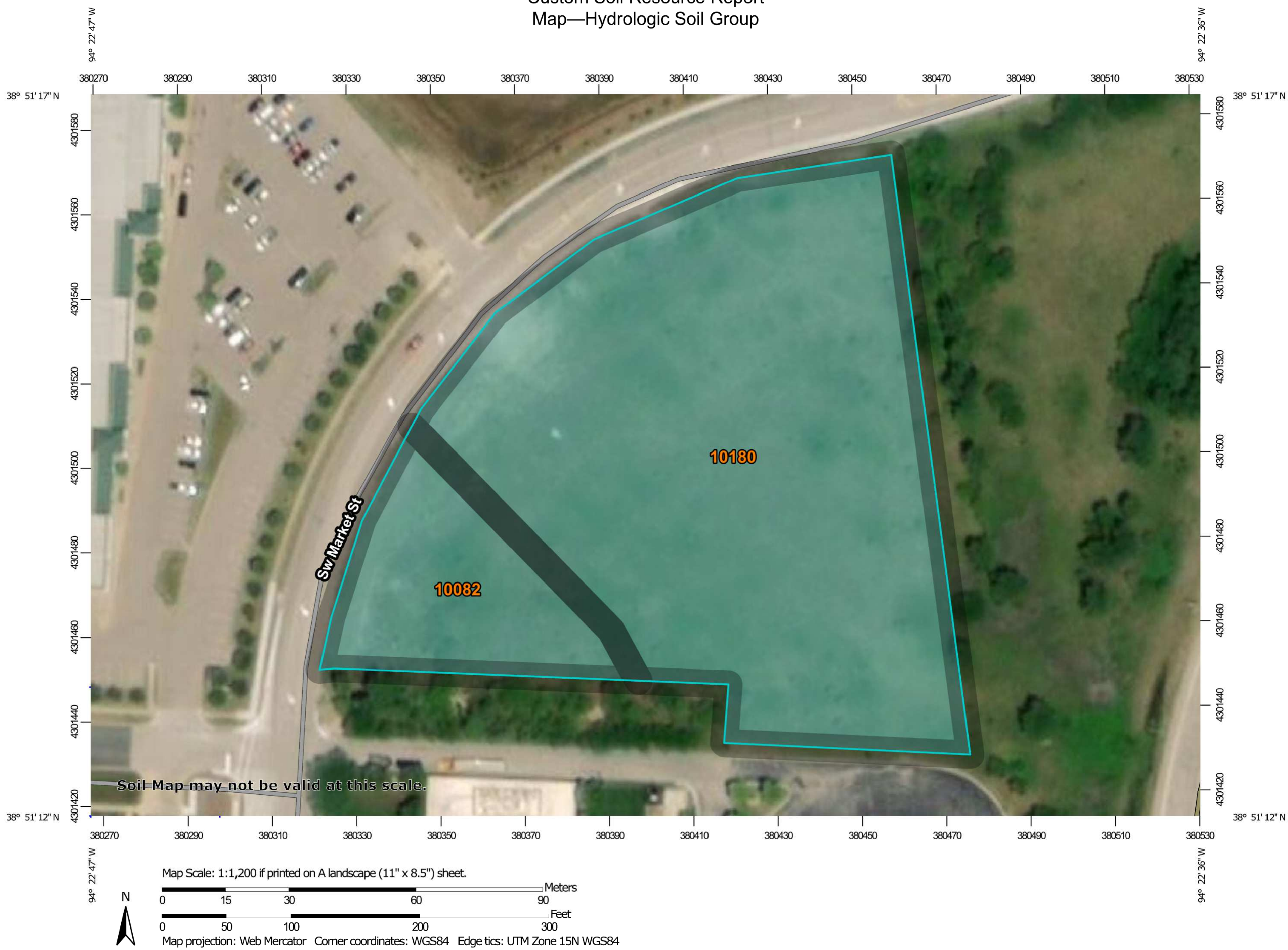
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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.

Map—Hydrologic Soil Group



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

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Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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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 20, Sep 16, 2019

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.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	C	0.6	16.6%
10180	Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes	C	3.0	83.4%
Totals for Area of Interest			**3.6**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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