HYDRAULIC REPORT

FOR

Public Improvements to Serve Wilshire Hills III

Lee's Summit, Missouri

PREPARED FOR:

WILSHIRE HILLS III L.P.

206 PEACH WAY

COLUMBIA, MO 54202

JUNE 22, 2023

PREPARED BY:

Engineering Surveys & Services

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JOB NUMBER: 15925

6/22/23

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1   INTRODUCTION

The project consists of the construction of a public road and associated utilities to connect existing Wilshire Drive to Strother Road in Lee's Summit, MO. The road and associated storm sewer and sanitary sewer extensions will provide service to the future Wilshire Hills Phase III development and additional future development. The project shall be built in two phases. The first phase will be the rough grading of Wilshire Hills Phase III, excavation of the detention basin, and the completion of the road work. Phase II will include the completion of Wilshire Hills Phase III and future projects. Soil disturbing activities will include clearing and grubbing, installing erosion and sediment controls, grading, installation of underground utilities, and preparation for final seeding, mulching, and landscaping. Every part of the stormwater design will be accounted for to follow Lee's Summits stormwater requirements.

2   DESIGN

2.1   Erosion & Sediment Control Design

Design Standard(s):
- *Missouri Department of Natural Resources (MDNR) Protecting Water Quality Field Guide, 2011*

The Civil Site Plans and project Storm Water Pollution and Prevention Plan (SWPPP) indicate erosion and sediment control Best Management Practices (BMPs) to be utilized throughout construction activities. The proposed regional detention basin shall be used as a temporary sediment trap throughout construction. It is important to note that the sediment in the basin must be pumped out to its designed depth to provide adequate fish habitat. Appendix A includes erosion and sediment control storage calculations.

2.2   Stormwater Detention Design

Design Standard(s):
- *Lee's Summit, Missouri Stormwater Discharge Control Regulations (Code of Ordinance Chapter 34 Article 3)*
- *APWA Section 5300*
- *LS Section 5600 – Storm Drainage Systems and Facilities (revised July 2020)*

The regional detention basin has been designed to serve all sites south of Meadowview Drive and west of the existing box culvert. This basin will provide detention and water quality with allocations for impervious areas for future development. Table 1 compares the area of each lot, the approximate impervious area, and the total impervious treated by the regional basin for the entire development. The first development will be Wilshire Hills Phase III. The impervious area from this site will be subtracted from the overall total for future development.

Impervious areas have been approximated based on future use of each lot. The time of concentrations and curve numbers reflect these assumptions for future site development. The box culvert is the dividing

line separating the wet regional detention basin. Due to the shallow nature of the culvert, separating the basins is more practical than piping across the culvert to serve the remaining parcels.

Table 1: Future Land Development

	Area (acres)	Impervious (acres)	Curve Number
Wilshire III (Northwest + Bypass)	2.54	1.25	87
Northeast (0.62 ac detention basin included)	5.21	2.66	89
Southeast	2.59	1.81	91
Southwest	1.60	1.12	91
West	3.20	1.65	86
Total	15.14	8.49	

The pre-developed conditions were calculated based on conditions prior to any development, or pre-2006. The site was originally pasture before being cleared and mass graded for future development. Post-developed conditions include future impervious areas for future site development. This 8.49 acres of additional impervious area has been included with the design of this detention basin.

The assumptions for max release rate required all new additional impervious areas to have detention that restricts runoff to the pre project rates for the 50%, 10%, and 1% design storms. These rates come from the APWA Section 5300 and are 0.5, 2.0, and 3.0 cfs per acre in relation to the design storm. The existing onsite sediment trap will be removed and replaced with the new larger basin designed to serve all onsite lots west of the box culvert. It is important to note the large difference between pre vs. post detention that these limits create.

Appendix B includes HydraFlow detention calculations and Appendix D includes the detention drainage area maps. Table 2 shows the required discharge rates based on the area draining to the detention basin. This is then compared to the Designed basin discharge. This calculated data is then added with the offsite pass through and bypass to ensure that all is accounted for within the basin.

Table 2: Basin Discharge Rates

Design Storm	Rate (cfs) Allowable per Acre per APWA	Area Served (acres)	Maximum Site Rate (cfs)	Designed Basin Discharge (cfs)	Offsite Pass Through (cfs)	Onsite Bypass (cfs)	Total Allowed (csf)	Provided (cfs)	Basin Elevation
50% (2-yr)	0.5	15.14	7.57	7.02	3.02	(-) 0.56	11.15	11.15	921.67
20% (10-yr)	2.0	15.14	30.28	16.68	14.88	(-) 1.45	46.61	33.01	923.28
1% (100-yr)	3.0	15.14	45.45	42.66	35.92	(-) 2.74	81.37	81.32	924.88

The 100-year level of rise in the basin is 924.88 and the top of the dam is 924.90, providing 1.10' of freeboard. 924.88 is the maximum water surface elevation. The emergency spillway for the basin is the grated top of the outfall structure in the basin with an elevation of 924.9. The 100-year design storm was routed through the basin, and the level of rise is 925.46, providing 0.54' of freeboard.

A spillway for the basin has been designed for the top of the earthen dam in the unlikely event the outfall structure should become completely blocked. Appendix B includes weir calculations that indicate the 100-year flow through the spillway is fully contained in the spillway and will not overtop the dam.

2.3   Water Quality

Design Standard(s):
- *APWA Section 5608.4*
- *MARC/APWA BMP Manual Chapter 6.*

The water quality required for this site is provided by a 40-hour extended detention of runoff of the 90% mean annual event. This tis a 1.37"/24-hour event. The designed detention basin takes 60 hours to completely release all of the water quality storm after peaking at the 12-hour mark. This meets the qualifications to meet water quality standards and requirements, according to APWA 5608.4 and Chapter 6 of the MARC/APWA BMP Manual.

2.4   Storm Sewer Design

Design Standard(s):
- *Lee's Summit, Missouri Stormwater Discharge Control Regulations (Code of Ordinance Chapter 34 Article 3)*
- *APWA Section 5300*
- *LS Section 5600 – Storm Drainage Systems and Facilities (revised July 2020)*

All storm sewers for the road public improvement project will be public storm sewers. They have been designed to the 25-year storm but can handle the 100-year storm without impeding traffic. Appendix C includes HydraFlow storm sewer calculations. The calculations are based on the Storm Sewer Drainage Area Map in Appendix D.

It is important to note that the future offsite industrial is currently passing through the storm sewers causing an increase in volume in the pipes. The Storm Drainage Area map shows the designed divide between the inlets TMI42 and SOI6A. Currently all of the water is directed towards SOI6A through a swale to reduce water passing over the road. This is causing a much larger volume of water to enter SOI6A than usual though the pipes are sized to handle this increase in flow.

3   CONCLUSION

Erosion and sediment control has been designed per requirements. The site meets storm water detention requirements for developments within the City of Lee's Summit and is designed for future development on the site. The storm sewers have been designed to convey the 25-year design storm. All of the City of Lee's Summit stormwater requirements have been met.

APPENDIX A:

EROSION AND SEDIMENT CONTROL CALCULATIONS

EROSION CONTROL CALCULATIONS

Temporary Sediment Trap

11.3 Acres disturbed area to sediment basin

11.3 * 3,600 CF/Ac = 40,680 CF sediment storage required

ELEVATION	CONTOUR AREA (SF)	TOTAL STORAGE (CF)
910	4,286	0
911	5,114	4693
912	6,006	10,217
913	6,970	16,728
914	12,152	26,169
915	13,638	39,056
916	15,211	53,472

53,472 CF of sediment storage is provided at an elevation of 916.' This is below the outfall structure so will not require filter fabric to be wrapped.

It is extremely important to note that the depth of this pond is a requirement for housing fish. Once construction has been completed, the sediment accumulation in the pond must be removed back to its original elevation levels.
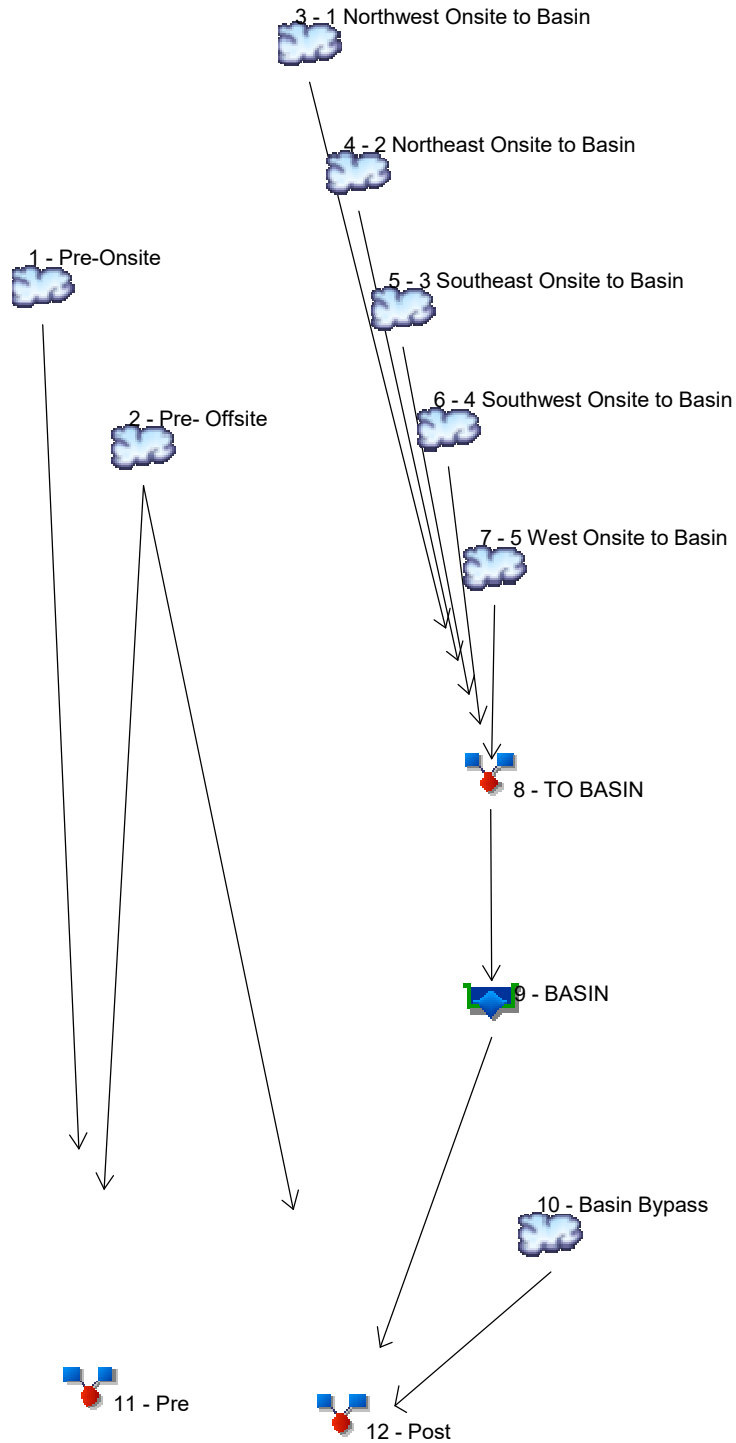
APPENDIX B:

STORMWATER DETENTION CALCULATIONS

Hydraflow Table of Contents

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Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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2 - Pre- Offsite

6 - 4 Southwest Onsite to Basin

7 - 5 West Onsite to Basin

8 - TO BASIN

9 - BASIN

10 - Basin Bypass

11 - Pre

12 - Post

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	------	0.795	18.14	-------	-------	56.95	-------	-------	117.54	Pre-Onsite
2	SCS Runoff	------	0.012	3.023	-------	-------	14.88	-------	-------	35.92	Pre- Offsite
3	SCS Runoff	------	1.239	5.273	-------	-------	11.81	-------	-------	20.88	1 Northwest Onsite to Basin
4	SCS Runoff	------	3.149	11.99	-------	-------	25.83	-------	-------	44.89	2 Northeast Onsite to Basin
5	SCS Runoff	------	1.897	6.426	-------	-------	13.29	-------	-------	22.69	3 Southeast Onsite to Basin
6	SCS Runoff	------	1.278	4.297	-------	-------	8.859	-------	-------	15.10	4 Southwest Onsite to Basin
7	SCS Runoff	------	1.558	7.062	-------	-------	16.17	-------	-------	28.87	5 West Onsite to Basin
8	Combine	3, 4, 5, 6, 7	9.103	34.66	-------	-------	75.08	-------	-------	131.12	TO BASIN
9	Reservoir	8	1.039	7.020	-------	-------	16.68	-------	-------	42.66	BASIN
10	SCS Runoff	------	0.085	0.562	-------	-------	1.449	-------	-------	2.740	Basin Bypass
11	Combine	1, 2,	0.715	19.14	-------	-------	65.94	-------	-------	141.26	Pre
12	Combine	2, 9, 10,	1.047	9.704	-------	-------	29.72	-------	-------	71.32	Post

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	18.14	2	724	53,373	------	------	------	Pre-Onsite
2	SCS Runoff	3.023	2	732	14,805	------	------	------	Pre- Offsite
3	SCS Runoff	5.273	2	722	14,805	------	------	------	1 Northwest Onsite to Basin
4	SCS Runoff	11.99	2	724	37,644	------	------	------	2 Northeast Onsite to Basin
5	SCS Runoff	6.426	2	724	20,351	------	------	------	3 Southeast Onsite to Basin
6	SCS Runoff	4.297	2	722	12,257	------	------	------	4 Southwest Onsite to Basin
7	SCS Runoff	7.062	2	722	19,803	------	------	------	5 West Onsite to Basin
8	Combine	34.66	2	724	104,860	3, 4, 5, 6, 7	------	------	TO BASIN
9	Reservoir	7.020	2	744	104,807	8	921.67	48,894	BASIN
10	SCS Runoff	0.562	2	718	1,128	------	------	------	Basin Bypass
11	Combine	19.14	2	726	69,546	1, 2,	------	------	Pre
12	Combine	9.704	2	736	120,739	2, 9, 10,	------	------	Post

Hydrograph Report

Hyd. No. 1

Pre-Onsite

Hydrograph type	= SCS Runoff		Peak discharge	= 18.14 cfs
Storm frequency	= 2 yrs		Time to peak	= 724 min
Time interval	= 2 min		Hyd. volume	= 53,373 cuft
Drainage area	= 15.510 ac		Curve number	= 74*
Basin Slope	= 0.0 %		Hydraulic length	= 0 ft
Tc method	= TR55		Time of conc. (Tc)	= 15.30 min
Total precip.	= 3.10 in		Distribution	= Type II
Storm duration	= 24 hrs		Shape factor	= 484

* Composite (Area/CN) = [(15.510 x 74)] / 15.510
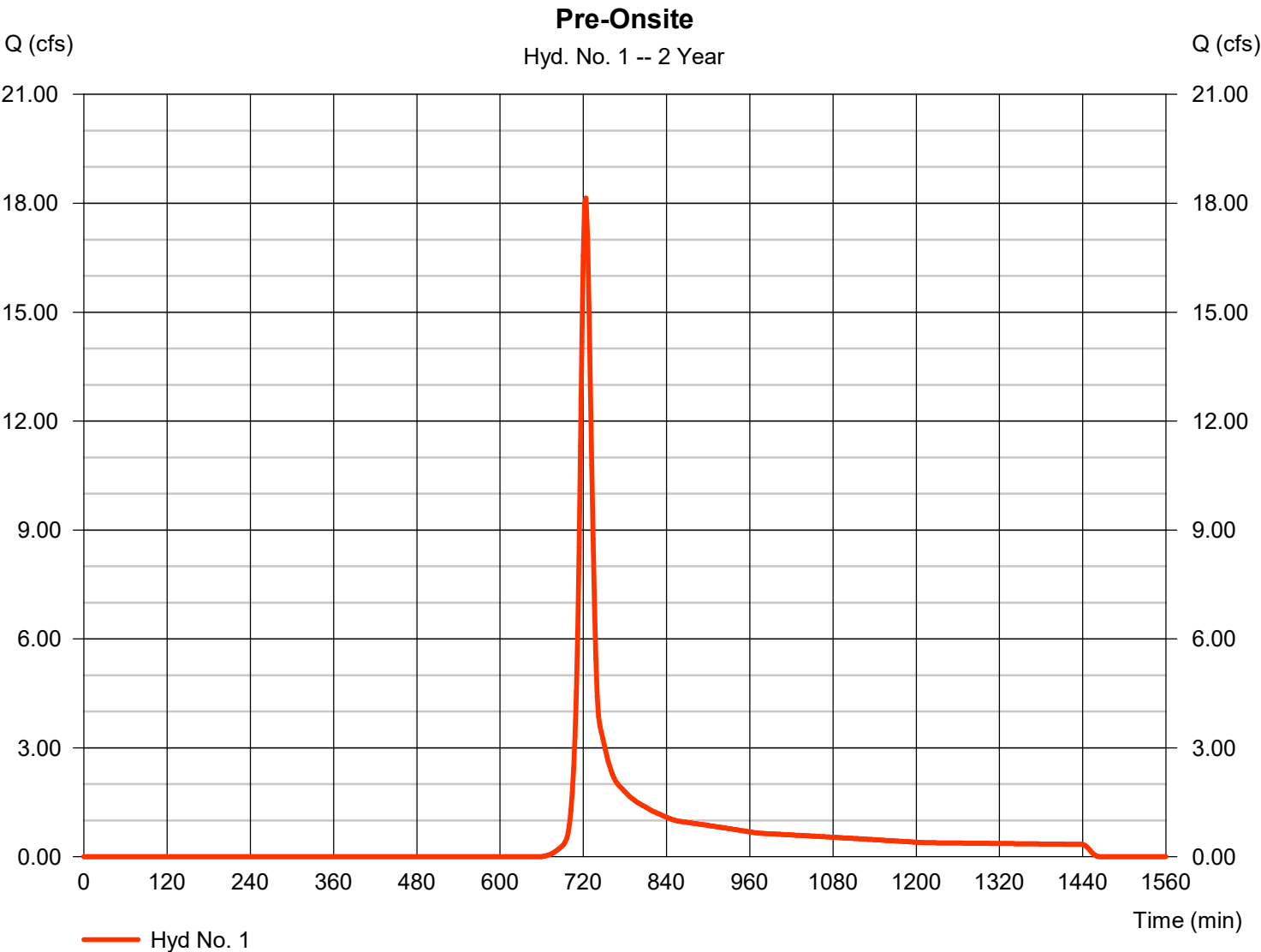
Pre-Onsite
Hyd. No. 1 -- 2 Year

TR55 Tc Worksheet

Hyd. No. 1

Pre-Onsite

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.170	0.011	0.011	
Flow length (ft)	= 100.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.10	0.00	0.00	
Land slope (%)	= 5.00	0.00	0.00	
Travel Time (min)	**= 7.63 +**	**0.00 +**	**0.00 =**	**7.63**
Shallow Concentrated Flow				
Flow length (ft)	= 1049.00	0.00	0.00	
Watercourse slope (%)	= 2.00	0.00	0.00	
Surface description	= Unpaved	Unpaved	Unpaved	
Average velocity (ft/s)	=2.28	0.00	0.00	
Travel Time (min)	**= 7.66 +**	**0.00 +**	**0.00 =**	**7.66**
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				**15.30 min**

Hydrograph Report

Hyd. No. 2

Pre- Offsite

Hydrograph type	= SCS Runoff	Peak discharge	= 3.023 cfs
Storm frequency	= 2 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 14,805 cuft
Drainage area	= 7.500 ac	Curve number	= 65*
Basin Slope	= 5.0 %	Hydraulic length	= 100 ft
Tc method	= TR55	Time of conc. (Tc)	= 25.20 min
Total precip.	= 3.10 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(7.500 x 65)] / 7.500
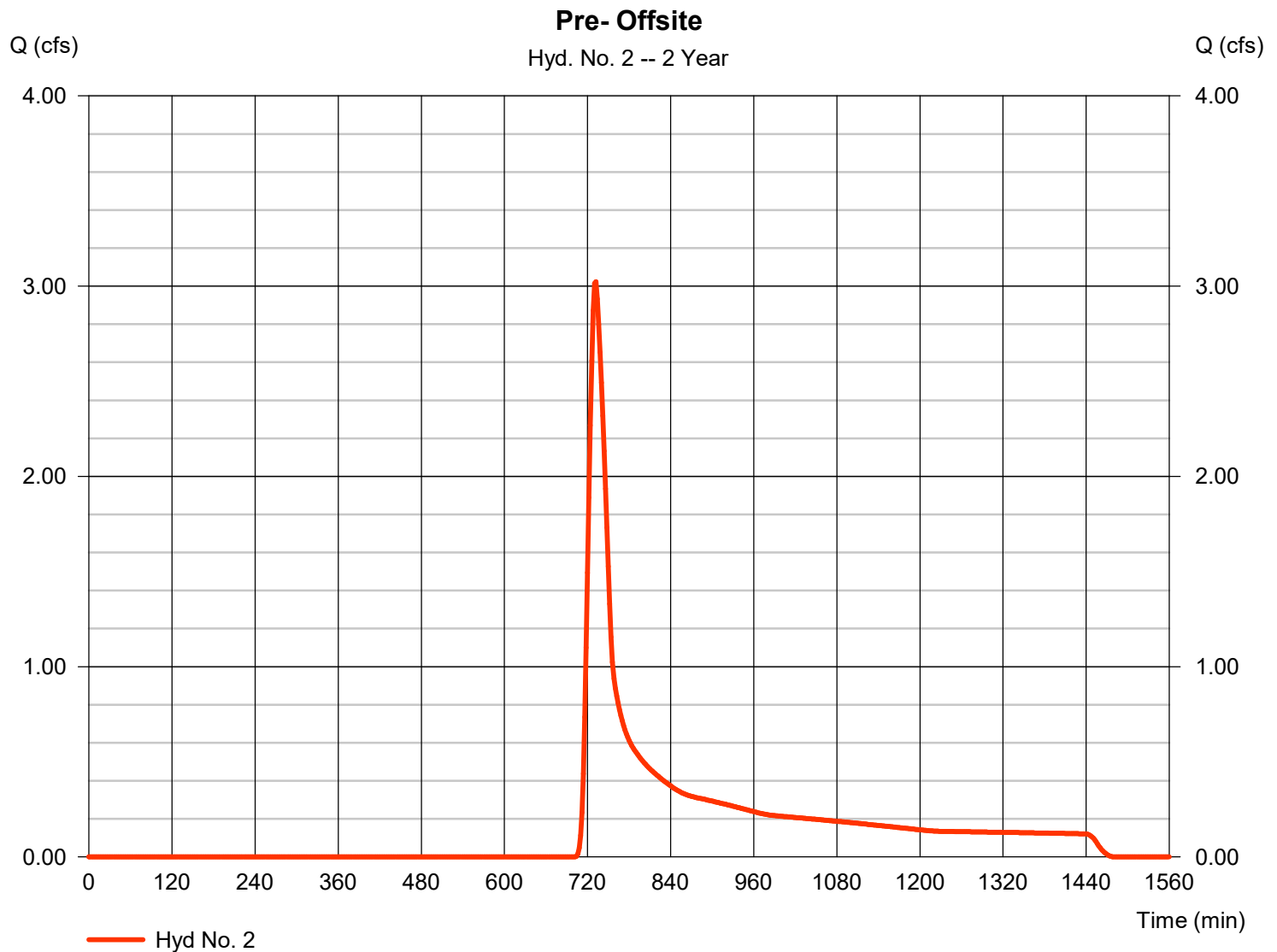
Pre- Offsite
Hyd. No. 2 -- 2 Year

Hyd No. 2

TR55 Tc Worksheet

Hyd. No. 2

Pre- Offsite

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.170	0.011	0.011	
Flow length (ft)	= 100.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.10	0.00	0.00	
Land slope (%)	= 2.00	0.00	0.00	
Travel Time (min)	= **11.00** +	**0.00** +	**0.00** =	**11.00**
Shallow Concentrated Flow				
Flow length (ft)	= 500.00	120.00	774.00	
Watercourse slope (%)	= 2.00	5.00	1.00	
Surface description	= Unpaved	Unpaved	Unpaved	
Average velocity (ft/s)	=2.28	3.61	1.61	
Travel Time (min)	= **3.65** +	**0.55** +	**8.00** =	**12.20**
Channel Flow				
X sectional flow area (sqft)	= 2.00	5.00	0.00	
Wetted perimeter (ft)	= 12.00	31.00	0.00	
Channel slope (%)	= 0.50	2.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=2.11			
		4.14		
			0.00	
Flow length (ft)	({0})200.0	96.0	0.0	
Travel Time (min)	= **1.58** +	**0.39** +	**0.00** =	**1.96**
Total Travel Time, Tc				**25.20 min**

Hydrograph Report

Hyd. No. 3

1 Northwest Onsite to Basin

Hydrograph type	= SCS Runoff	Peak discharge	= 5.273 cfs
Storm frequency	= 2 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 14,805 cuft
Drainage area	= 2.290 ac	Curve number	= 87*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.90 min
Total precip.	= 3.10 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.180 x 98) + (1.110 x 74)] / 2.290

1 Northwest Onsite to Basin

Hyd. No. 3 -- 2 Year

Q (cfs)

Time (min)

Hyd No. 3

TR55 Tc Worksheet

Hyd. No. 3

1 Northwest Onsite to Basin

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)	= 3.10	0.00	0.00	
Land slope (%)	= 5.00	0.00	0.00	
Travel Time (min)	**= 10.05 +**	**0.00 +**	**0.00 =**	**10.05**
Shallow Concentrated Flow				
Flow length (ft)	= 131.00	178.00	0.00	
Watercourse slope (%)	= 3.00	1.00	0.00	
Surface description	= Unpaved	Unpaved	Paved	
Average velocity (ft/s)	=2.79	1.61	0.00	
Travel Time (min)	**= 0.78 +**	**1.84 +**	**0.00 =**	**2.62**
Channel Flow				
X sectional flow area (sqft)	= 2.00	5.00	0.00	
Wetted perimeter (ft)	= 2.00	31.00	0.00	
Channel slope (%)	= 1.00	2.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=9.93			
		4.14		
			0.00	
Flow length (ft)	({0})516.0	96.0	0.0	
Travel Time (min)	**= 0.87 +**	**0.39 +**	**0.00 =**	**1.25**
Total Travel Time, Tc				**13.90 min**

Hydrograph Report

Thursday, 06 / 22 / 2023

Hyd. No. 4

2 Northeast Onsite to Basin

Hydrograph type	= SCS Runoff		Peak discharge	= 11.99 cfs
Storm frequency	= 2 yrs		Time to peak	= 724 min
Time interval	= 2 min		Hyd. volume	= 37,644 cuft
Drainage area	= 5.210 ac		Curve number	= 89*
Basin Slope	= 0.0 %		Hydraulic length	= 0 ft
Tc method	= TR55		Time of conc. (Tc)	= 19.90 min
Total precip.	= 3.10 in		Distribution	= Type II
Storm duration	= 24 hrs		Shape factor	= 484

* Composite (Area/CN) = [(2.660 x 98) + (1.930 x 74) + (0.620 x 98)] / 5.210

2 Northeast Onsite to Basin

Hyd. No. 4 -- 2 Year

TR55 Tc Worksheet

Hyd. No. 4

2 Northeast Onsite to Basin

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)	= 3.10	0.00	0.00	
Land slope (%)	= 1.00	0.00	0.00	
Travel Time (min)	= **19.13** +	**0.00** +	**0.00** =	**19.13**
Shallow Concentrated Flow				
Flow length (ft)	= 0.00	84.00	0.00	
Watercourse slope (%)	= 2.00	6.00	0.00	
Surface description	= Unpaved	Unpaved	Paved	
Average velocity (ft/s)	=2.28	3.95	0.00	
Travel Time (min)	= **0.00** +	**0.35** +	**0.00** =	**0.35**
Channel Flow				
X sectional flow area (sqft)	= 5.00	0.00	0.00	
Wetted perimeter (ft)	= 31.00	0.00	0.00	
Channel slope (%)	= 2.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=4.14			
		0.00		
			0.00	
Flow length (ft)	({0})96.0	0.0	0.0	
Travel Time (min)	= **0.39** +	**0.00** +	**0.00** =	**0.39**
Total Travel Time, Tc				**19.90 min**

Hydrograph Report

Hyd. No. 5

3 Southeast Onsite to Basin

Hydrograph type	= SCS Runoff		Peak discharge	= 6.426 cfs
Storm frequency	= 2 yrs		Time to peak	= 724 min
Time interval	= 2 min		Hyd. volume	= 20,351 cuft
Drainage area	= 2.590 ac		Curve number	= 91*
Basin Slope	= 5.0 %		Hydraulic length	= 200 ft
Tc method	= TR55		Time of conc. (Tc)	= 18.70 min
Total precip.	= 3.10 in		Distribution	= Type II
Storm duration	= 24 hrs		Shape factor	= 484

* Composite (Area/CN) = [(1.810 x 98) + (0.780 x 74)] / 2.590

3 Southeast Onsite to Basin
Hyd. No. 5 -- 2 Year

TR55 Tc Worksheet

Hyd. No. 5

3 Southeast Onsite to Basin

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)	= 3.10	0.00	0.00	
Land slope (%)	= 2.00	0.00	0.00	
Travel Time (min)	**= 14.50 +**	**0.00 +**	**0.00 =**	**14.50**
Shallow Concentrated Flow				
Flow length (ft)	= 639.00	0.00	0.00	
Watercourse slope (%)	= 3.00	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=2.79	0.00	0.00	
Travel Time (min)	**= 3.81 +**	**0.00 +**	**0.00 =**	**3.81**
Channel Flow				
X sectional flow area (sqft)	= 2.00	5.00	0.00	
Wetted perimeter (ft)	= 2.00	31.00	0.00	
Channel slope (%)	= 1.00	2.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=9.93			
		4.14		
			0.00	
Flow length (ft)	({0})0.0	96.0	0.0	
Travel Time (min)	**= 0.00 +**	**0.39 +**	**0.00 =**	**0.39**
Total Travel Time, Tc				**18.70 min**

Hydrograph Report

Hyd. No. 6

4 Southwest Onsite to Basin

Hydrograph type	= SCS Runoff		Peak discharge	= 4.297 cfs
Storm frequency	= 2 yrs		Time to peak	= 722 min
Time interval	= 2 min		Hyd. volume	= 12,257 cuft
Drainage area	= 1.600 ac		Curve number	= 91*
Basin Slope	= 5.0 %		Hydraulic length	= 126 ft
Tc method	= TR55		Time of conc. (Tc)	= 14.40 min
Total precip.	= 3.10 in		Distribution	= Type II
Storm duration	= 24 hrs		Shape factor	= 484

* Composite (Area/CN) = [(1.120 x 98) + (0.480 x 74)] / 1.600

4 Southwest Onsite to Basin

Hyd. No. 6 -- 2 Year

TR55 Tc Worksheet

Hyd. No. 6

4 Southwest Onsite to Basin

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)	= 3.10	0.00	0.00	
Land slope (%)	= 9.00	0.00	0.00	
Travel Time (min)	**= 7.94 +**	**0.00 +**	**0.00 =**	**7.94**
Shallow Concentrated Flow				
Flow length (ft)	= 676.00	0.00	0.00	
Watercourse slope (%)	= 2.00	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=2.28	0.00	0.00	
Travel Time (min)	**= 4.94 +**	**0.00 +**	**0.00 =**	**4.94**
Channel Flow				
X sectional flow area (sqft)	= 2.00	5.00	0.00	
Wetted perimeter (ft)	= 2.00	31.00	0.00	
Channel slope (%)	= 1.00	2.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=9.93			
		4.14		
			0.00	
Flow length (ft)	({0})700.0	96.0	0.0	
Travel Time (min)	**= 1.17 +**	**0.39 +**	**0.00 =**	**1.56**
Total Travel Time, Tc				**14.40 min**

Hydrograph Report

Hyd. No. 7

5 West Onsite to Basin

Hydrograph type	= SCS Runoff		Peak discharge	= 7.062 cfs
Storm frequency	= 2 yrs		Time to peak	= 722 min
Time interval	= 2 min		Hyd. volume	= 19,803 cuft
Drainage area	= 3.200 ac		Curve number	= 86*
Basin Slope	= 5.0 %		Hydraulic length	= 100 ft
Tc method	= TR55		Time of conc. (Tc)	= 14.20 min
Total precip.	= 3.10 in		Distribution	= Type II
Storm duration	= 24 hrs		Shape factor	= 484

* Composite (Area/CN) = [(1.650 x 98) + (1.550 x 74)] / 3.200

5 West Onsite to Basin

Hyd. No. 7 -- 2 Year

TR55 Tc Worksheet

Hyd. No. 7

5 West Onsite to Basin

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)	= 3.10	0.00	0.00	
Land slope (%)	= 6.00	0.00	0.00	
Travel Time (min)	**= 9.34** +	**0.00** +	**0.00** =	**9.34**
Shallow Concentrated Flow				
Flow length (ft)	= 398.00	0.00	0.00	
Watercourse slope (%)	= 1.00	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=1.61	0.00	0.00	
Travel Time (min)	**= 4.11** +	**0.00** +	**0.00** =	**4.11**
Channel Flow				
X sectional flow area (sqft)	= 2.00	5.00	0.00	
Wetted perimeter (ft)	= 2.00	31.00	0.00	
Channel slope (%)	= 1.00	2.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=9.93			
		4.14		
			0.00	
Flow length (ft)	({0})200.0	96.0	0.0	
Travel Time (min)	**= 0.34** +	**0.39** +	**0.00** =	**0.72**
Total Travel Time, Tc				**14.20 min**

Hydrograph Report

Thursday, 06 / 22 / 2023

Hyd. No. 8

TO BASIN

Hydrograph type	= Combine		Peak discharge	= 34.66 cfs
Storm frequency	= 2 yrs		Time to peak	= 724 min
Time interval	= 2 min		Hyd. volume	= 104,860 cuft
Inflow hyds.	= 3, 4, 5, 6, 7		Contrib. drain. area	= 14.890 ac
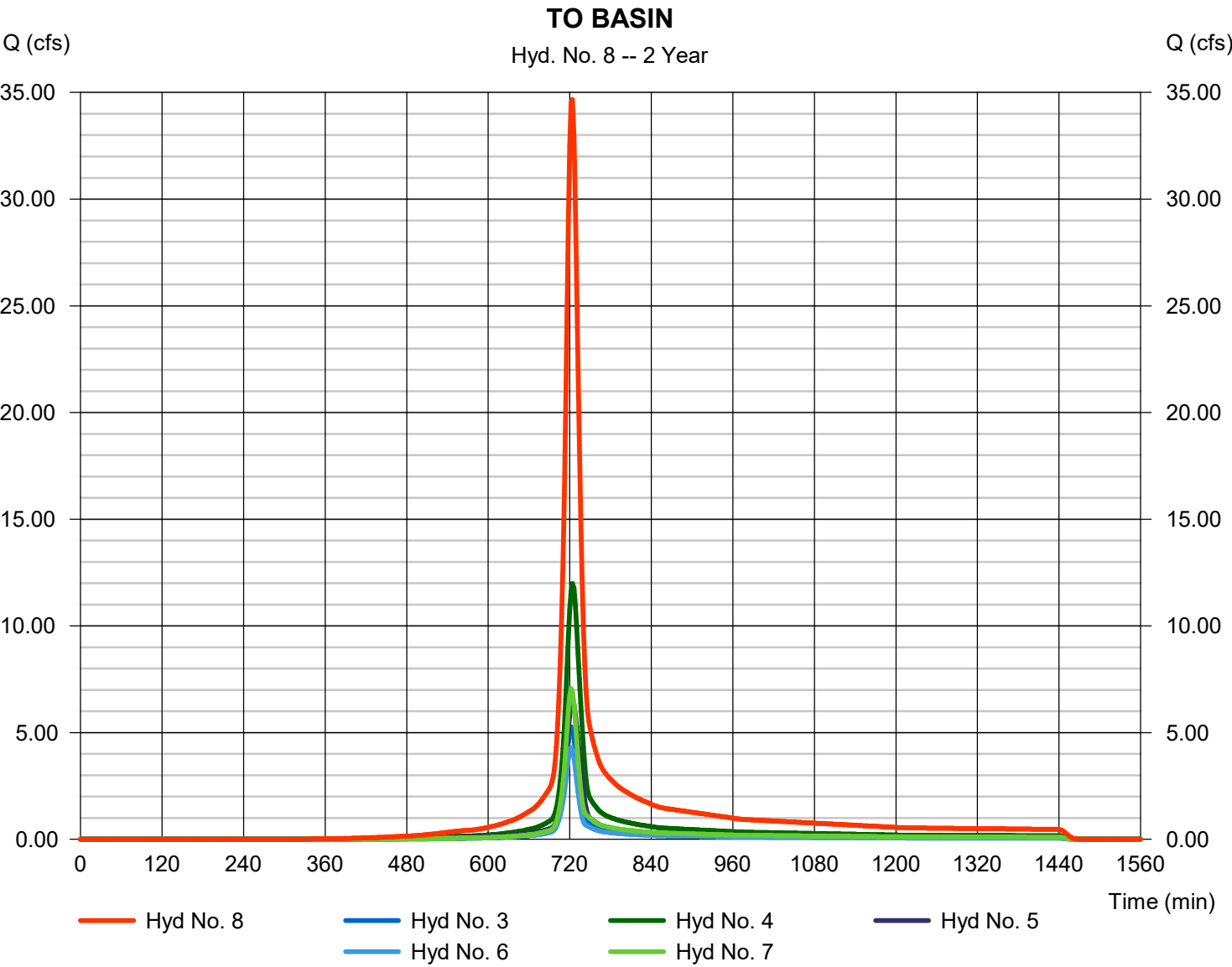
TO BASIN

Hyd. No. 8 -- 2 Year

Q (cfs)

Q (cfs)

Time (min)

Hyd No. 8   Hyd No. 3   Hyd No. 4   Hyd No. 5

Hyd No. 6   Hyd No. 7

Hydrograph Report

Thursday, 06 / 22 / 2023

Hyd. No. 9

BASIN

Hydrograph type	= Reservoir		Peak discharge	= 7.020 cfs
Storm frequency	= 2 yrs		Time to peak	= 744 min
Time interval	= 2 min		Hyd. volume	= 104,807 cuft
Inflow hyd. No.	= 8 - TO BASIN		Max. Elevation	= 921.67 ft
Reservoir name	= Regional Detention		Max. Storage	= 48,894 cuft

Storage Indication method used.
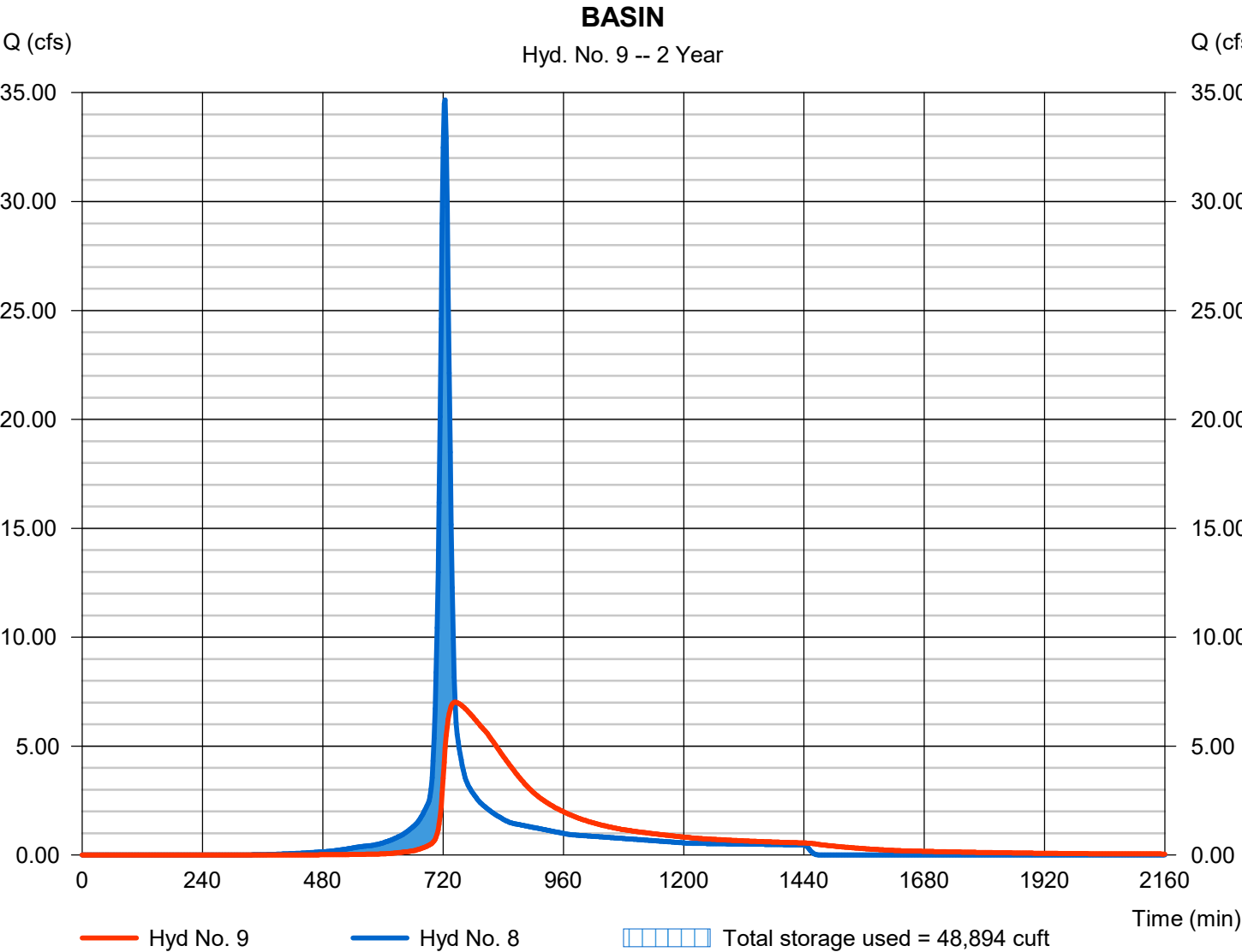
Hydrograph Report

Hyd. No. 10

Basin Bypass

Hydrograph type	= SCS Runoff	Peak discharge	= 0.562 cfs
Storm frequency	= 2 yrs	Time to peak	= 718 min
Time interval	= 2 min	Hyd. volume	= 1,128 cuft
Drainage area	= 0.250 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.10 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.070 x 98) + (0.180 x 74)] / 0.250

Basin Bypass

Hyd. No. 10 -- 2 Year

Q (cfs)

Q (cfs)

Time (min)

— Hyd No. 10

Hydrograph Report

Hyd. No. 11

Pre
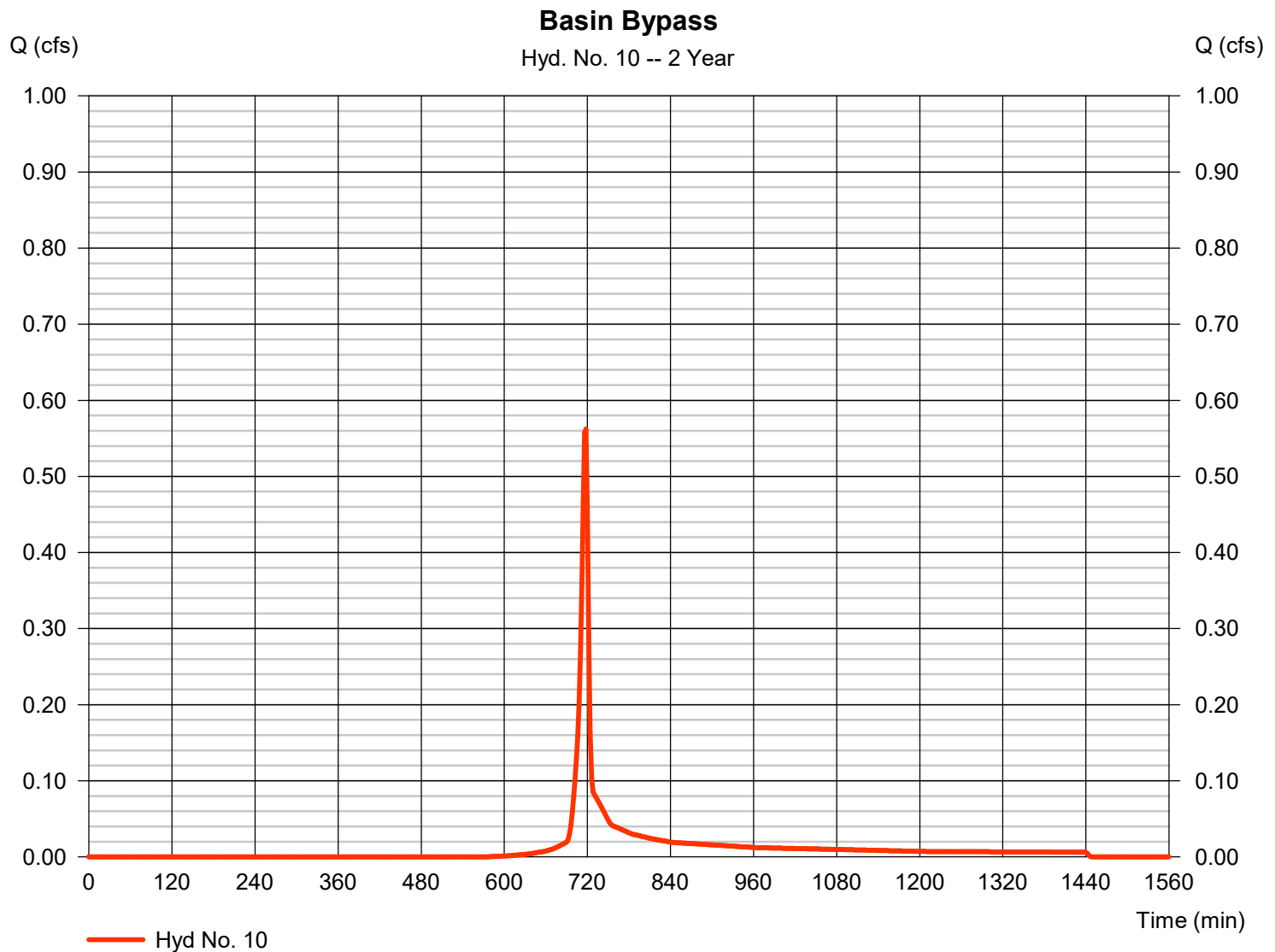
Hydrograph type	= Combine	Peak discharge	= 19.14 cfs
Storm frequency	= 2 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 69,546 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 23.010 ac
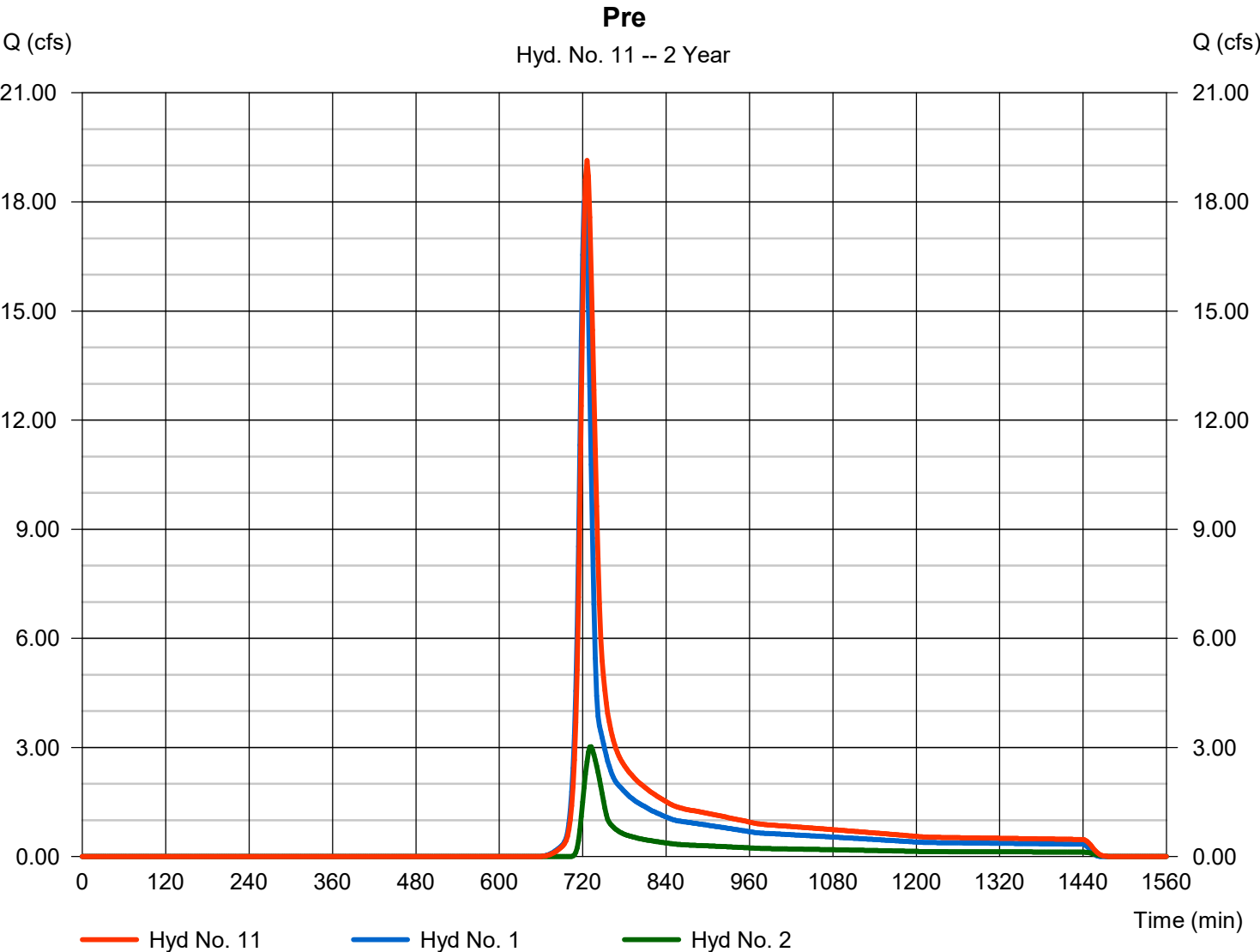
Pre

Hyd. No. 11 -- 2 Year

Legend: Hyd No. 11 (red), Hyd No. 1 (blue), Hyd No. 2 (green)

Hydrograph Report

Hyd. No. 12

Post

Hydrograph type	= Combine	Peak discharge	= 9.704 cfs
Storm frequency	= 2 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 120,739 cuft
Inflow hyds.	= 2, 9, 10	Contrib. drain. area	= 7.750 ac

Post

Hyd. No. 12 -- 2 Year

Hydrograph Summary Report

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	56.95	2	722	159,708	------	------	------	Pre-Onsite
2	SCS Runoff	14.88	2	730	56,664	------	------	------	Pre- Offsite
3	SCS Runoff	11.81	2	722	34,058	------	------	------	1 Northwest Onsite to Basin
4	SCS Runoff	25.83	2	724	83,522	------	------	------	2 Northeast Onsite to Basin
5	SCS Runoff	13.29	2	724	43,573	------	------	------	3 Southeast Onsite to Basin
6	SCS Runoff	8.859	2	722	26,245	------	------	------	4 Southwest Onsite to Basin
7	SCS Runoff	16.17	2	722	46,396	------	------	------	5 West Onsite to Basin
8	Combine	75.08	2	722	233,793	3, 4, 5, 6, 7	------	------	TO BASIN
9	Reservoir	16.68	2	742	233,740	8	923.28	107,383	BASIN
10	SCS Runoff	1.449	2	716	2,965	------	------	------	Basin Bypass
11	Combine	65.94	2	726	220,467	1, 2,	------	------	Pre
12	Combine	29.72	2	732	293,369	2, 9, 10,	------	------	Post

15925 Regional Detention Basin (6-21-2023).gpw Return Period: 10 Year | Thursday, 06 / 22 / 2023

Hydrograph Report

Thursday, 06 / 22 / 2023

Hyd. No. 1

Pre-Onsite

Hydrograph type	= SCS Runoff	Peak discharge	= 56.95 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 159,708 cuft
Drainage area	= 15.510 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 15.30 min
Total precip.	= 5.67 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(15.510 x 74)] / 15.510

Pre-Onsite
Hyd. No. 1 -- 10 Year
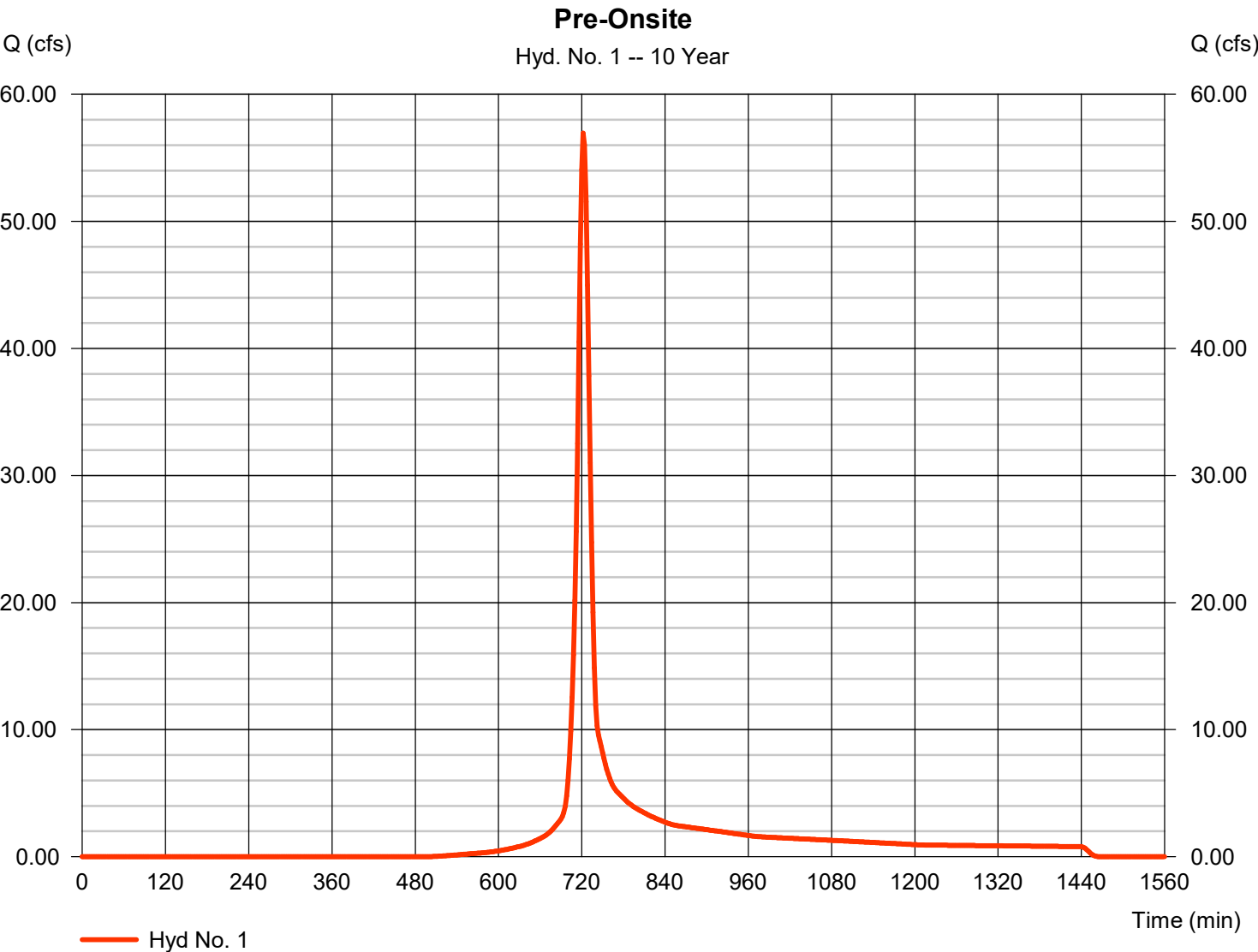
Hyd No. 1

Hydrograph Report

Hyd. No. 2

Pre- Offsite

Hydrograph type	= SCS Runoff		Peak discharge	= 14.88 cfs
Storm frequency	= 10 yrs		Time to peak	= 730 min
Time interval	= 2 min		Hyd. volume	= 56,664 cuft
Drainage area	= 7.500 ac		Curve number	= 65*
Basin Slope	= 5.0 %		Hydraulic length	= 100 ft
Tc method	= TR55		Time of conc. (Tc)	= 25.20 min
Total precip.	= 5.67 in		Distribution	= Type II
Storm duration	= 24 hrs		Shape factor	= 484

* Composite (Area/CN) = [(7.500 x 65)] / 7.500

Pre- Offsite

Hyd. No. 2 -- 10 Year
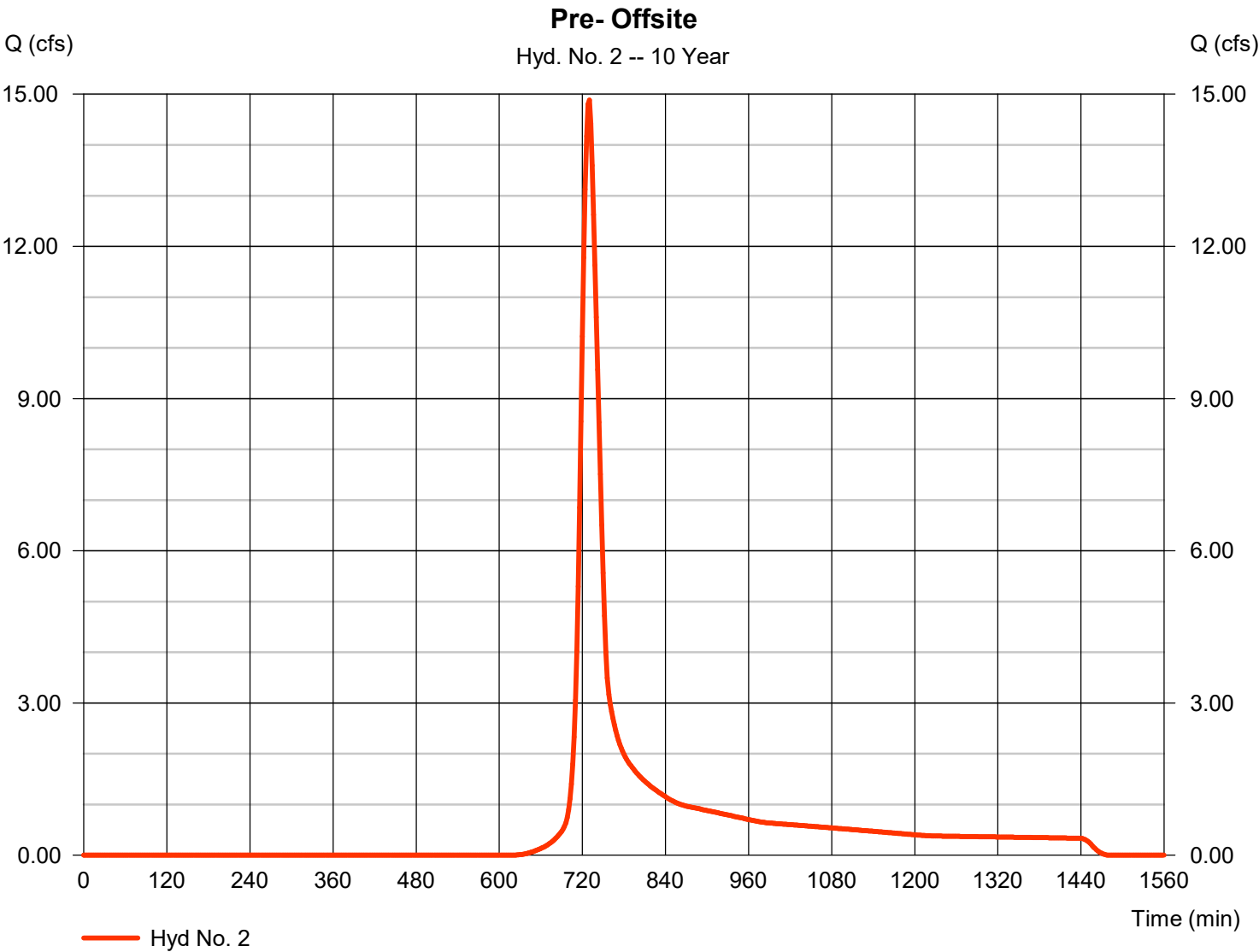
Hyd No. 2

Hydrograph Report

Hyd. No. 3

1 Northwest Onsite to Basin

Hydrograph type	= SCS Runoff	Peak discharge	= 11.81 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 34,058 cuft
Drainage area	= 2.290 ac	Curve number	= 87*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 13.90 min
Total precip.	= 5.67 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.180 x 98) + (1.110 x 74)] / 2.290
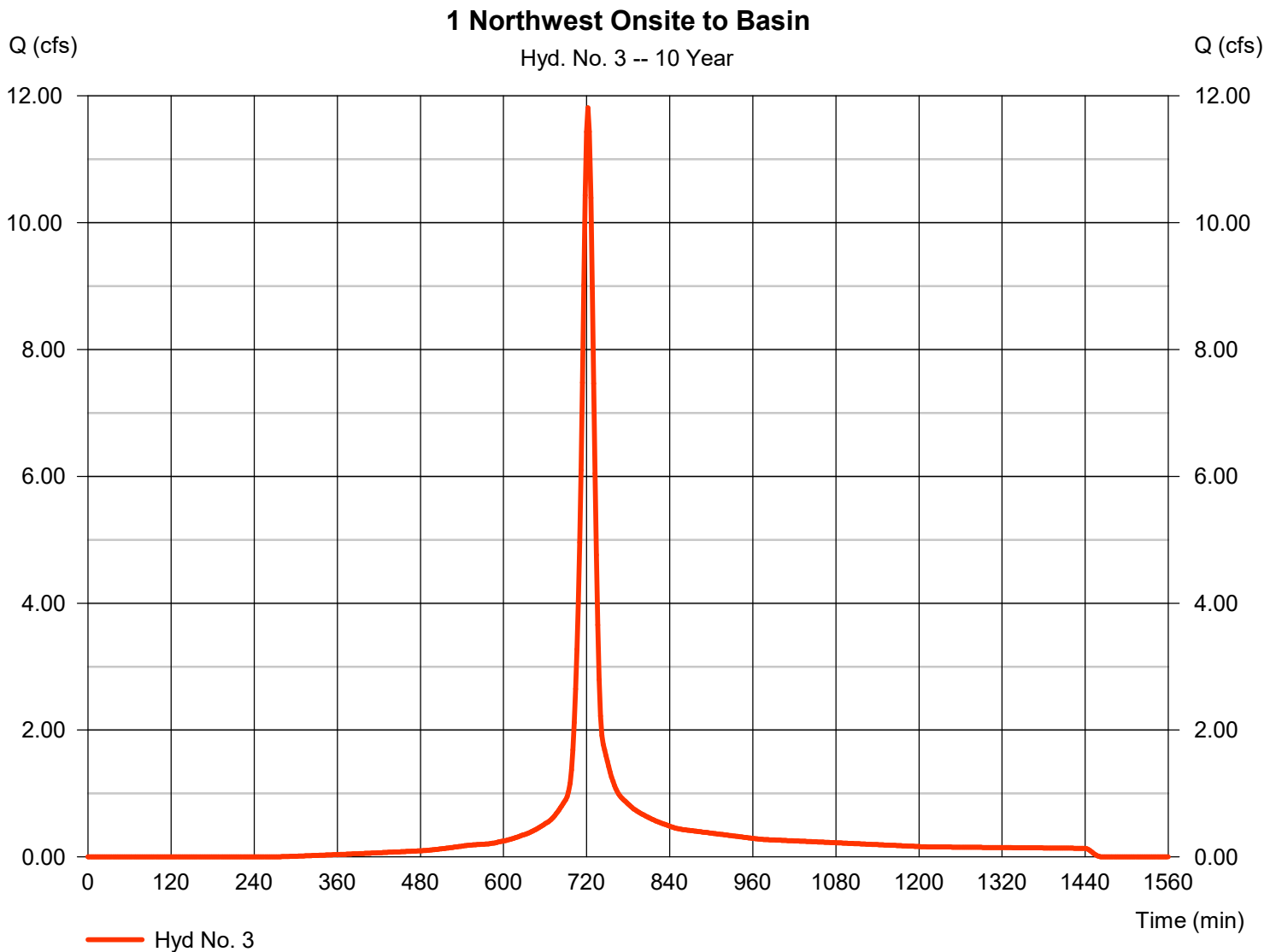
1 Northwest Onsite to Basin
Hyd. No. 3 -- 10 Year

Hydrograph Report

Hyd. No. 4

2 Northeast Onsite to Basin

Hydrograph type	= SCS Runoff	Peak discharge	= 25.83 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 83,522 cuft
Drainage area	= 5.210 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 19.90 min
Total precip.	= 5.67 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.660 x 98) + (1.930 x 74) + (0.620 x 98)] / 5.210

2 Northeast Onsite to Basin

Hyd. No. 4 -- 10 Year
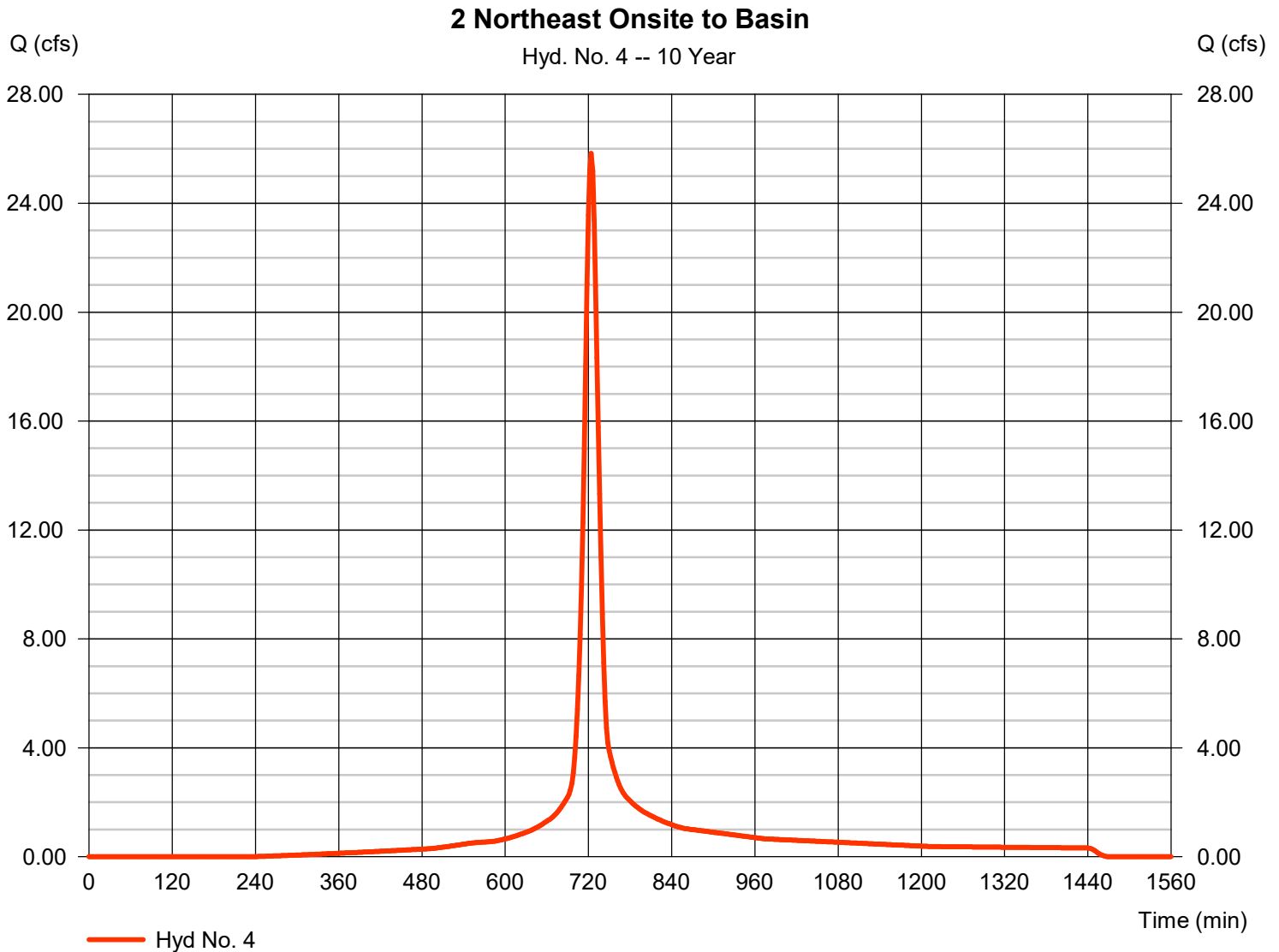
Hyd No. 4

Hydrograph Report

Hyd. No. 5

3 Southeast Onsite to Basin

Hydrograph type	= SCS Runoff		Peak discharge	= 13.29 cfs
Storm frequency	= 10 yrs		Time to peak	= 724 min
Time interval	= 2 min		Hyd. volume	= 43,573 cuft
Drainage area	= 2.590 ac		Curve number	= 91*
Basin Slope	= 5.0 %		Hydraulic length	= 200 ft
Tc method	= TR55		Time of conc. (Tc)	= 18.70 min
Total precip.	= 5.67 in		Distribution	= Type II
Storm duration	= 24 hrs		Shape factor	= 484

* Composite (Area/CN) = [(1.810 x 98) + (0.780 x 74)] / 2.590

3 Southeast Onsite to Basin

Hyd. No. 5 -- 10 Year

Q (cfs)

Time (min)
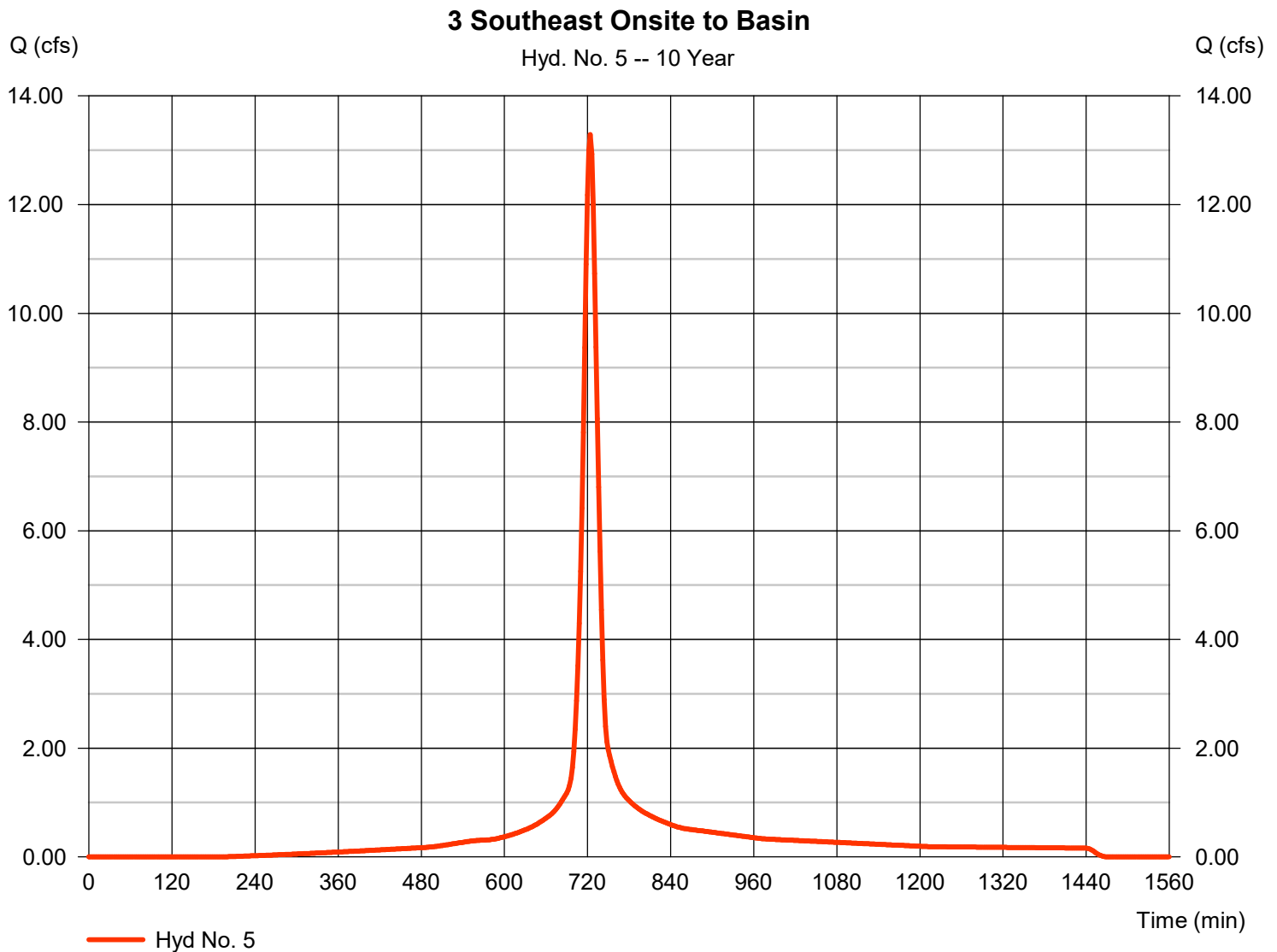
— Hyd No. 5

Hydrograph Report

Hyd. No. 6

4 Southwest Onsite to Basin

Hydrograph type	= SCS Runoff	Peak discharge	= 8.859 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 26,245 cuft
Drainage area	= 1.600 ac	Curve number	= 91*
Basin Slope	= 5.0 %	Hydraulic length	= 126 ft
Tc method	= TR55	Time of conc. (Tc)	= 14.40 min
Total precip.	= 5.67 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.120 x 98) + (0.480 x 74)] / 1.600

4 Southwest Onsite to Basin

Hyd. No. 6 -- 10 Year
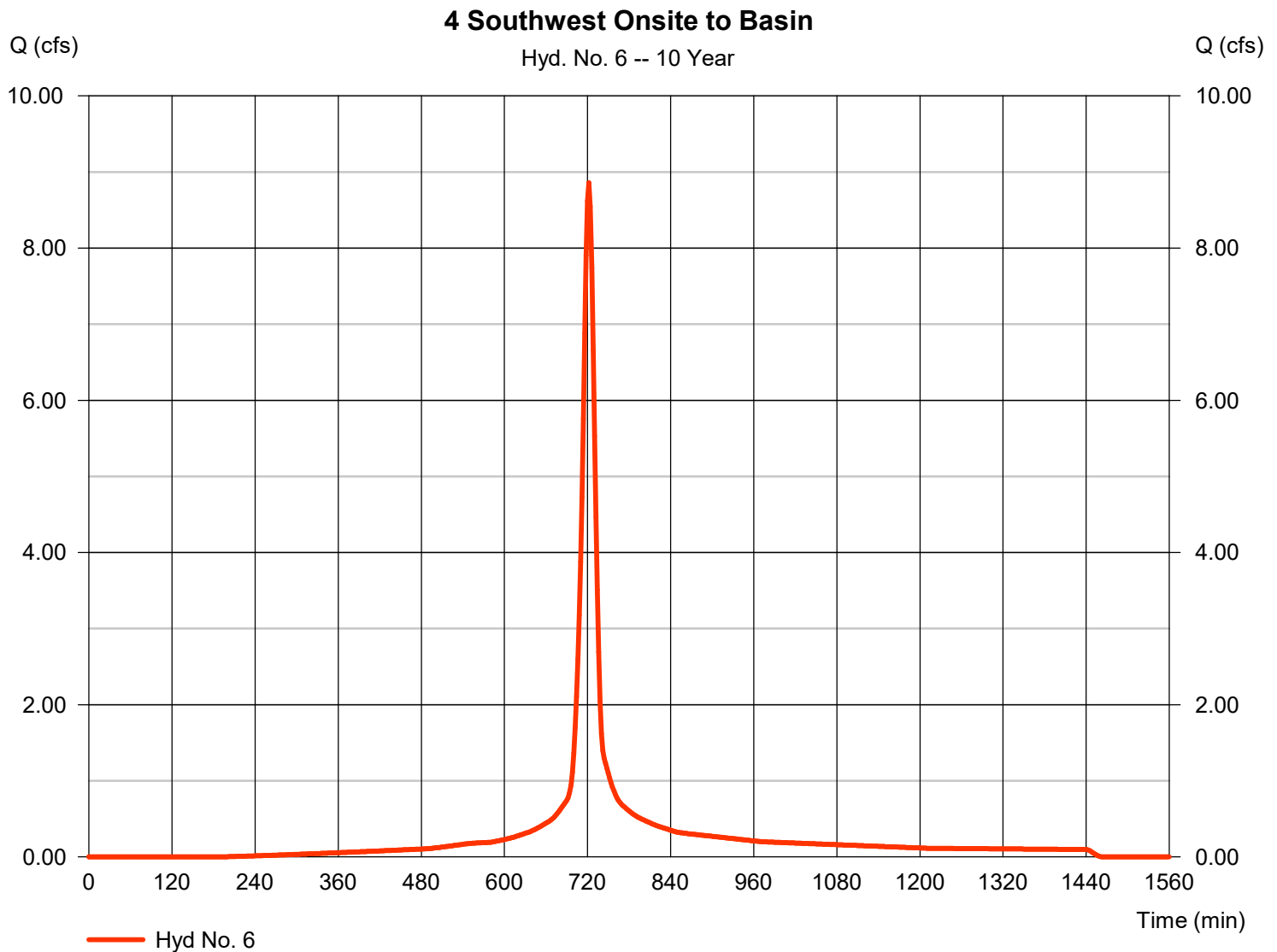
Hydrograph Report

Hyd. No. 7

5 West Onsite to Basin

Hydrograph type	= SCS Runoff		Peak discharge	= 16.17 cfs
Storm frequency	= 10 yrs		Time to peak	= 722 min
Time interval	= 2 min		Hyd. volume	= 46,396 cuft
Drainage area	= 3.200 ac		Curve number	= 86*
Basin Slope	= 5.0 %		Hydraulic length	= 100 ft
Tc method	= TR55		Time of conc. (Tc)	= 14.20 min
Total precip.	= 5.67 in		Distribution	= Type II
Storm duration	= 24 hrs		Shape factor	= 484

* Composite (Area/CN) = [(1.650 x 98) + (1.550 x 74)] / 3.200

5 West Onsite to Basin

Hyd. No. 7 -- 10 Year
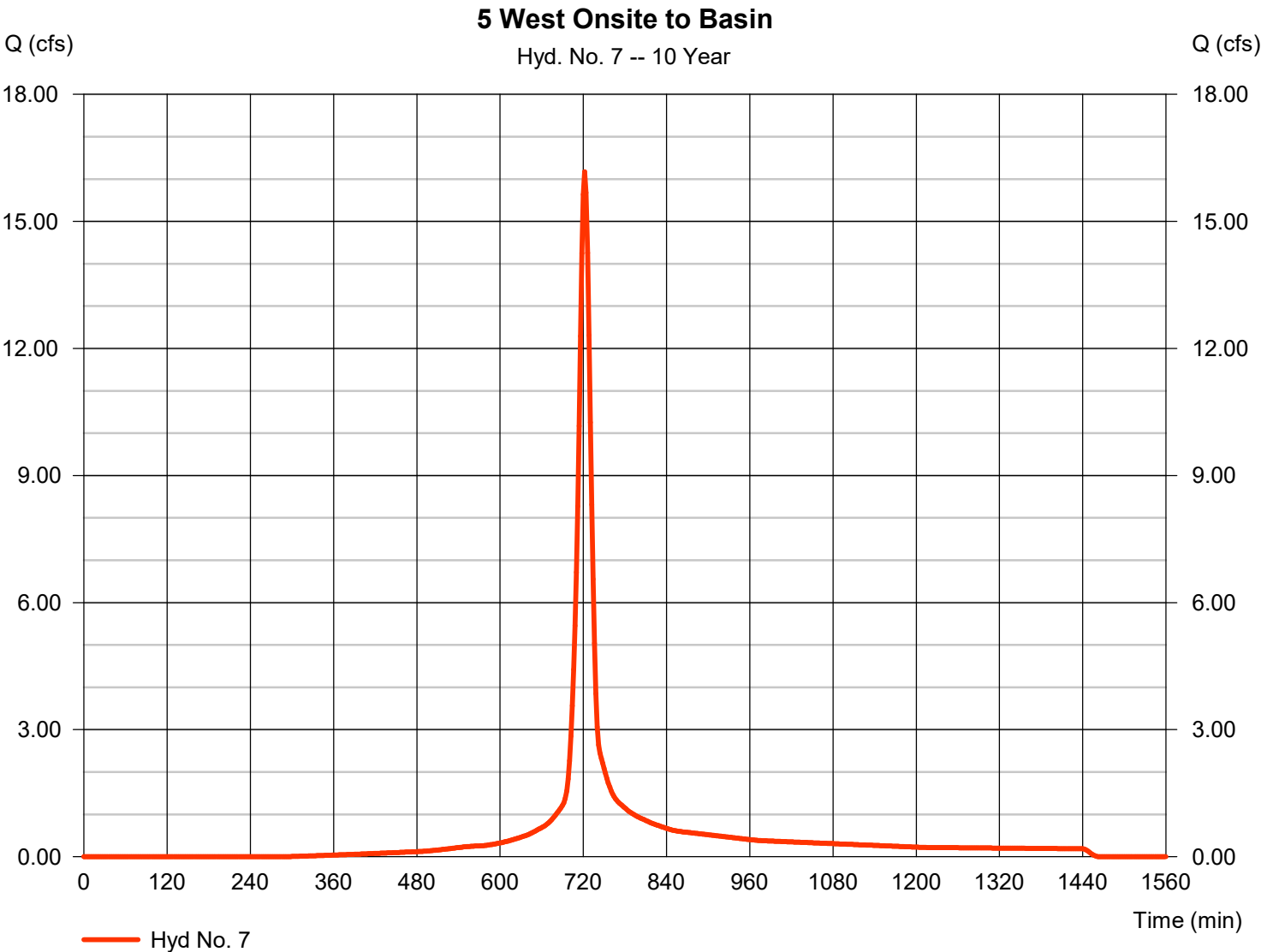
Hyd No. 7

Hydrograph Report

Hyd. No. 8

TO BASIN

Hydrograph type	= Combine	Peak discharge	= 75.08 cfs
Storm frequency	= 10 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 233,793 cuft
Inflow hyds.	= 3, 4, 5, 6, 7	Contrib. drain. area	= 14.890 ac

TO BASIN

Hyd. No. 8 -- 10 Year

Hydrograph Report

Hyd. No. 9

BASIN

Hydrograph type	= Reservoir	Peak discharge	= 16.68 cfs
Storm frequency	= 10 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 233,740 cuft
Inflow hyd. No.	= 8 - TO BASIN	Max. Elevation	= 923.28 ft
Reservoir name	= Regional Detention	Max. Storage	= 107,383 cuft

Storage Indication method used.

BASIN

Hyd. No. 9 -- 10 Year

Hyd No. 9   Hyd No. 8   Total storage used = 107,383 cuft
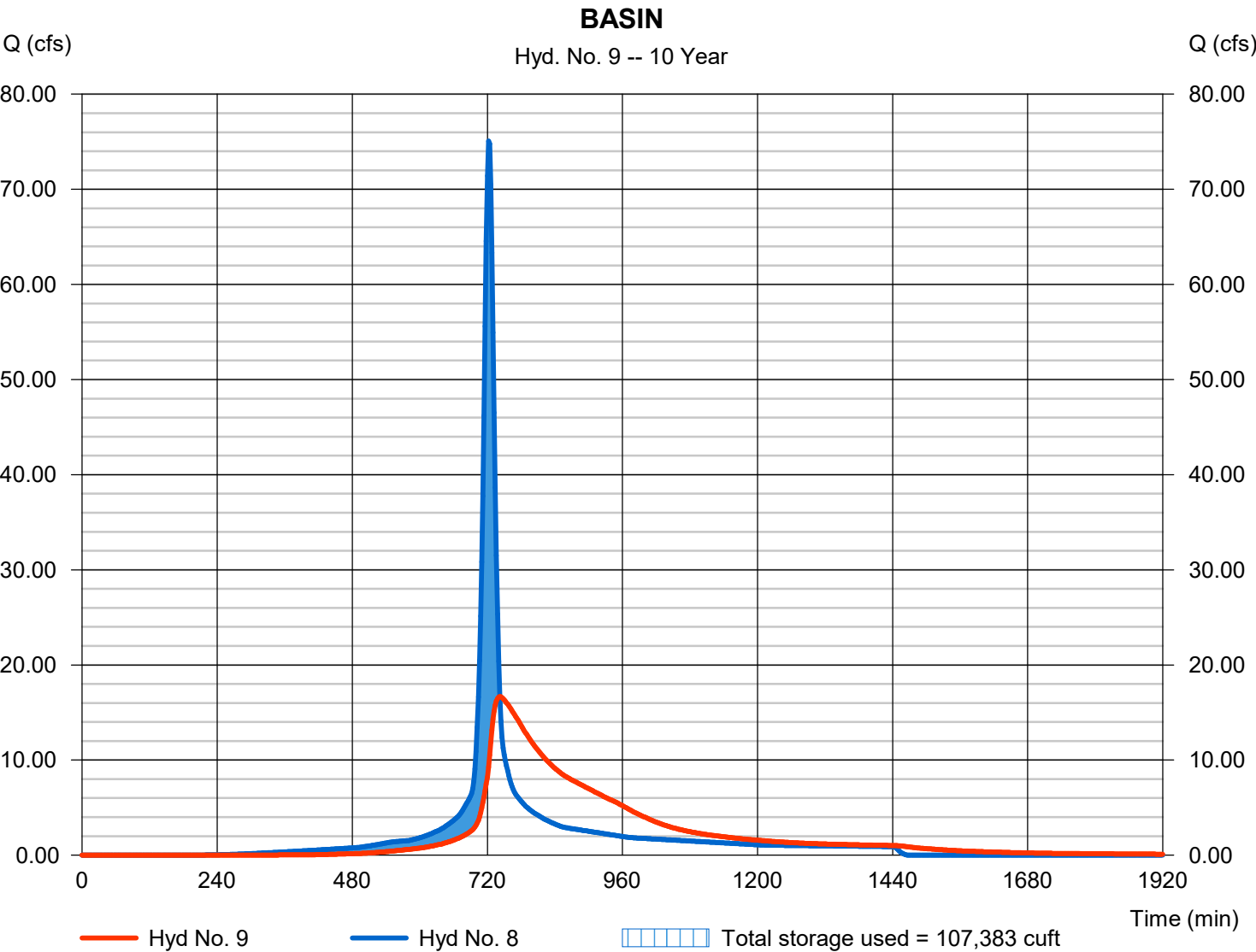
Hydrograph Report

Hyd. No. 10

Basin Bypass

Hydrograph type	= SCS Runoff	Peak discharge	= 1.449 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 2,965 cuft
Drainage area	= 0.250 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.67 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.070 x 98) + (0.180 x 74)] / 0.250

Basin Bypass

Hyd. No. 10 -- 10 Year

Hyd No. 10

Hydrograph Report

Hyd. No. 11

Pre
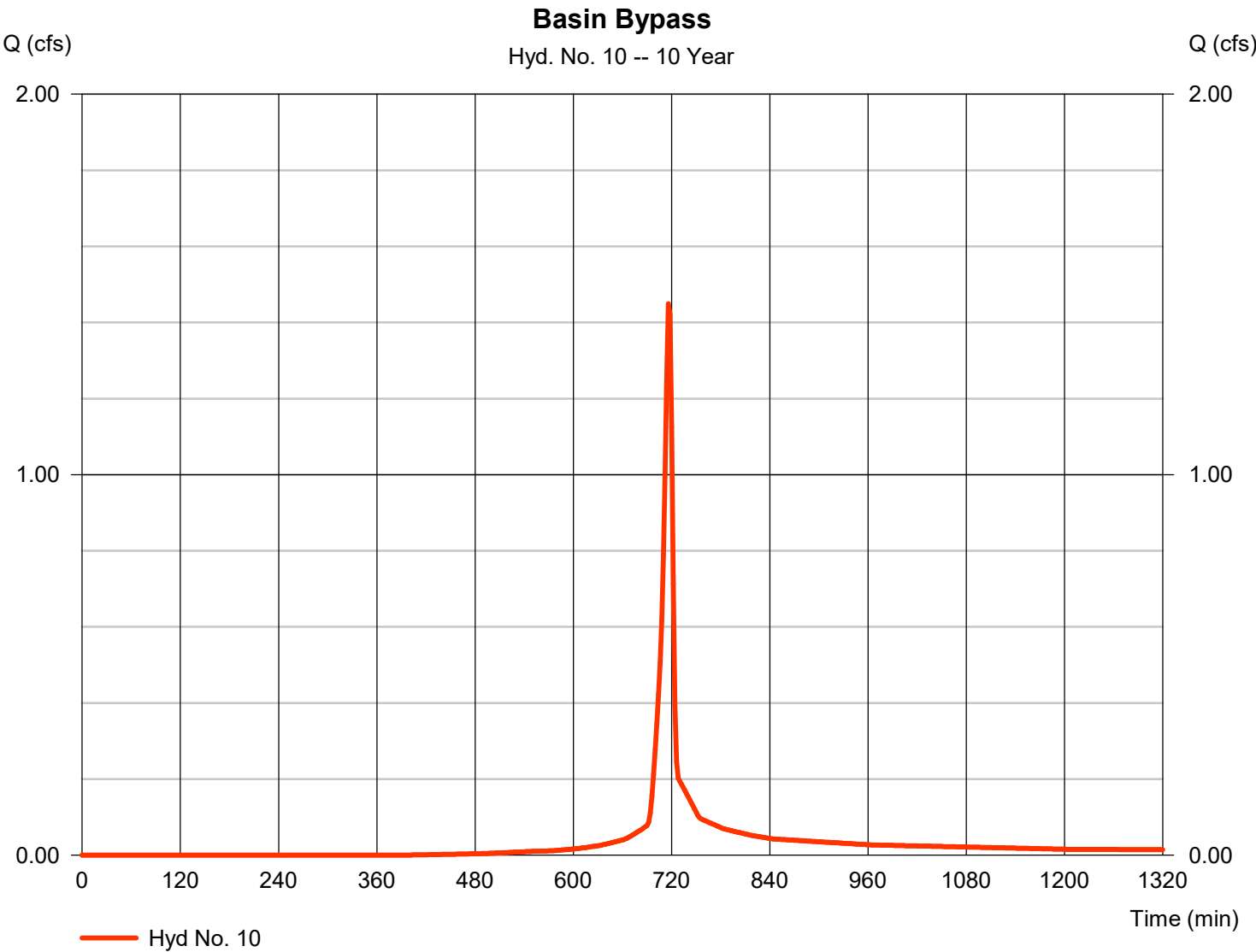
Hydrograph type	= Combine	Peak discharge	= 65.94 cfs
Storm frequency	= 10 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 220,467 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 23.010 ac

Pre

Hyd. No. 11 -- 10 Year

Legend: Hyd No. 11, Hyd No. 1, Hyd No. 2
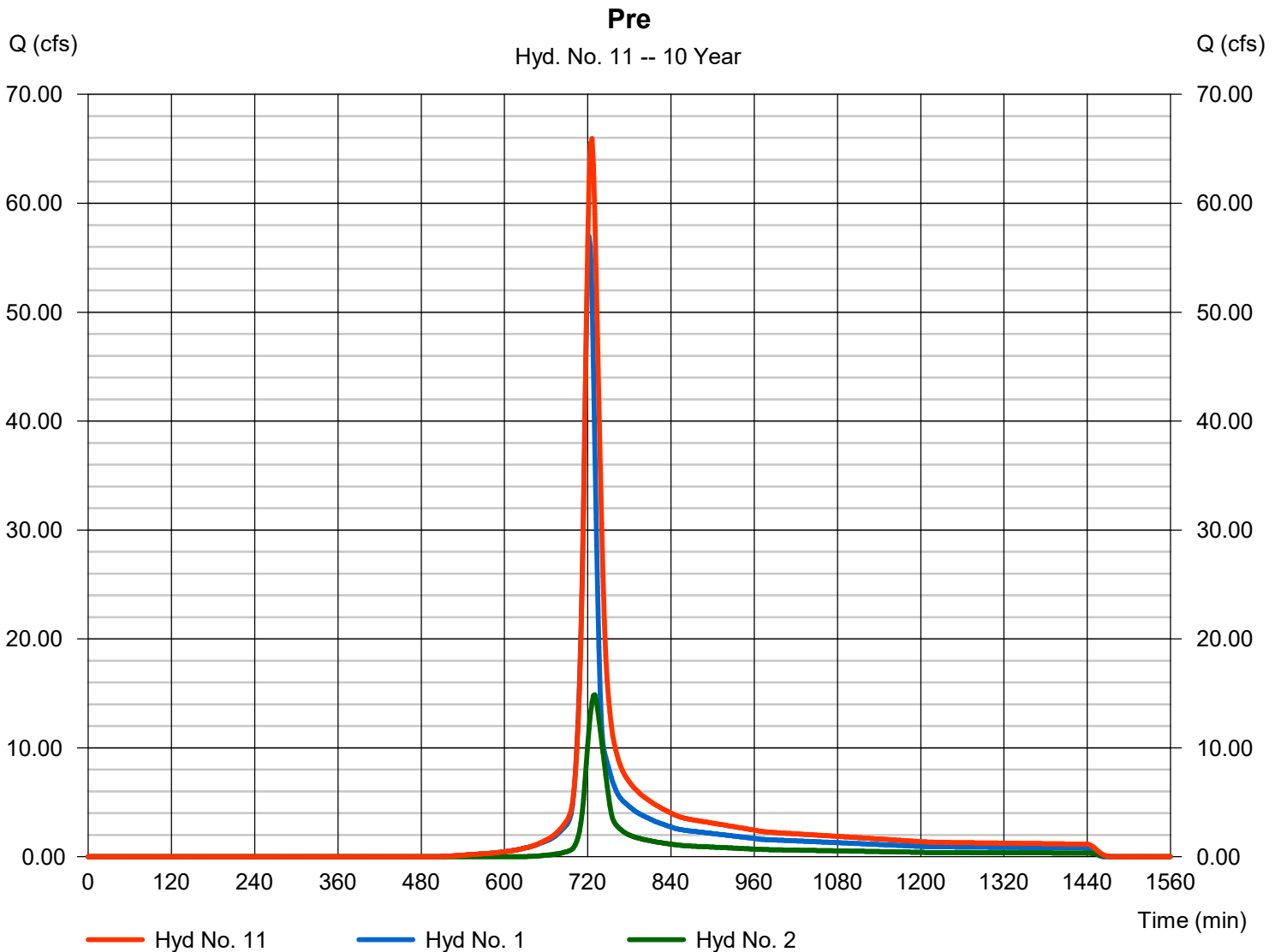
Hydrograph Report

Hyd. No. 12

Post

Hydrograph type	= Combine		Peak discharge	= 29.72 cfs
Storm frequency	= 10 yrs		Time to peak	= 732 min
Time interval	= 2 min		Hyd. volume	= 293,369 cuft
Inflow hyds.	= 2, 9, 10		Contrib. drain. area	= 7.750 ac

Post

Hyd. No. 12 -- 10 Year

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	117.54	2	722	332,510	------	------	------	Pre-Onsite
2	SCS Runoff	35.92	2	728	132,043	------	------	------	Pre- Offsite
3	SCS Runoff	20.88	2	722	62,170	------	------	------	1 Northwest Onsite to Basin
4	SCS Runoff	44.89	2	724	149,711	------	------	------	2 Northeast Onsite to Basin
5	SCS Runoff	22.69	2	724	76,724	------	------	------	3 Southeast Onsite to Basin
6	SCS Runoff	15.10	2	722	46,212	------	------	------	4 Southwest Onsite to Basin
7	SCS Runoff	28.87	2	722	85,482	------	------	------	5 West Onsite to Basin
8	Combine	131.12	2	722	420,298	3, 4, 5, 6, 7	------	------	TO BASIN
9	Reservoir	42.66	2	738	420,244	8	924.88	179,502	BASIN
10	SCS Runoff	2.740	2	716	5,790	------	------	------	Basin Bypass
11	Combine	141.26	2	724	473,078	1, 2,	------	------	Pre
12	Combine	71.32	2	736	558,077	2, 9, 10,	------	------	Post

15925 Regional Detention Basin (6-21-2023).gpw   Return Period: 100 Year   Thursday, 06 / 22 / 2023

Hydrograph Report

Thursday, 06 / 22 / 2023

Hyd. No. 1

Pre-Onsite

Hydrograph type	= SCS Runoff	Peak discharge	= 117.54 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 332,510 cuft
Drainage area	= 15.510 ac	Curve number	= 74*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 15.30 min
Total precip.	= 9.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(15.510 x 74)] / 15.510

Pre-Onsite

Hyd. No. 1 -- 100 Year
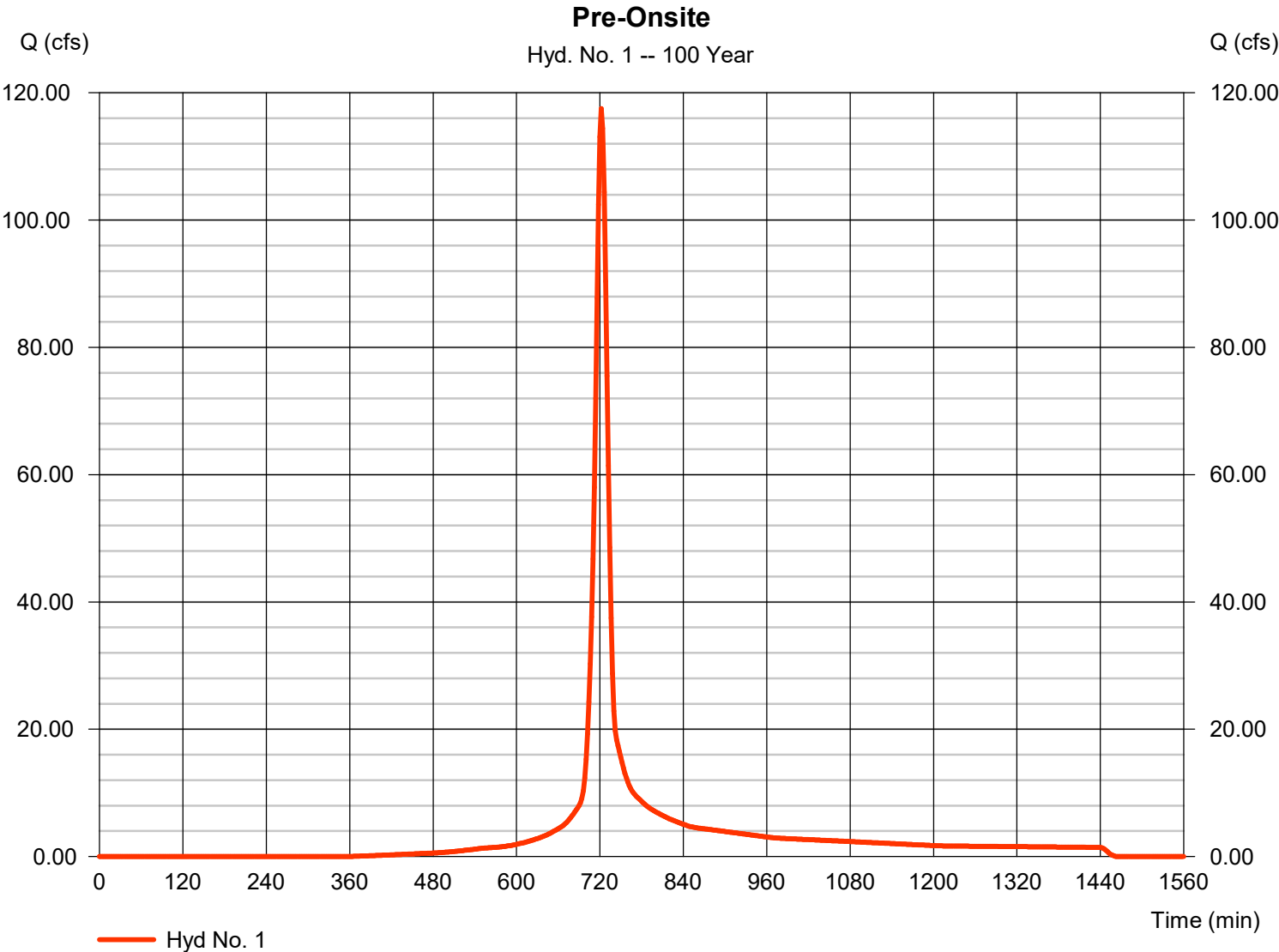
Hydrograph Report

Hyd. No. 2

Pre- Offsite

Hydrograph type	= SCS Runoff		Peak discharge	= 35.92 cfs
Storm frequency	= 100 yrs		Time to peak	= 728 min
Time interval	= 2 min		Hyd. volume	= 132,043 cuft
Drainage area	= 7.500 ac		Curve number	= 65*
Basin Slope	= 5.0 %		Hydraulic length	= 100 ft
Tc method	= TR55		Time of conc. (Tc)	= 25.20 min
Total precip.	= 9.25 in		Distribution	= Type II
Storm duration	= 24 hrs		Shape factor	= 484

* Composite (Area/CN) = [(7.500 x 65)] / 7.500

Pre- Offsite

Hyd. No. 2 -- 100 Year
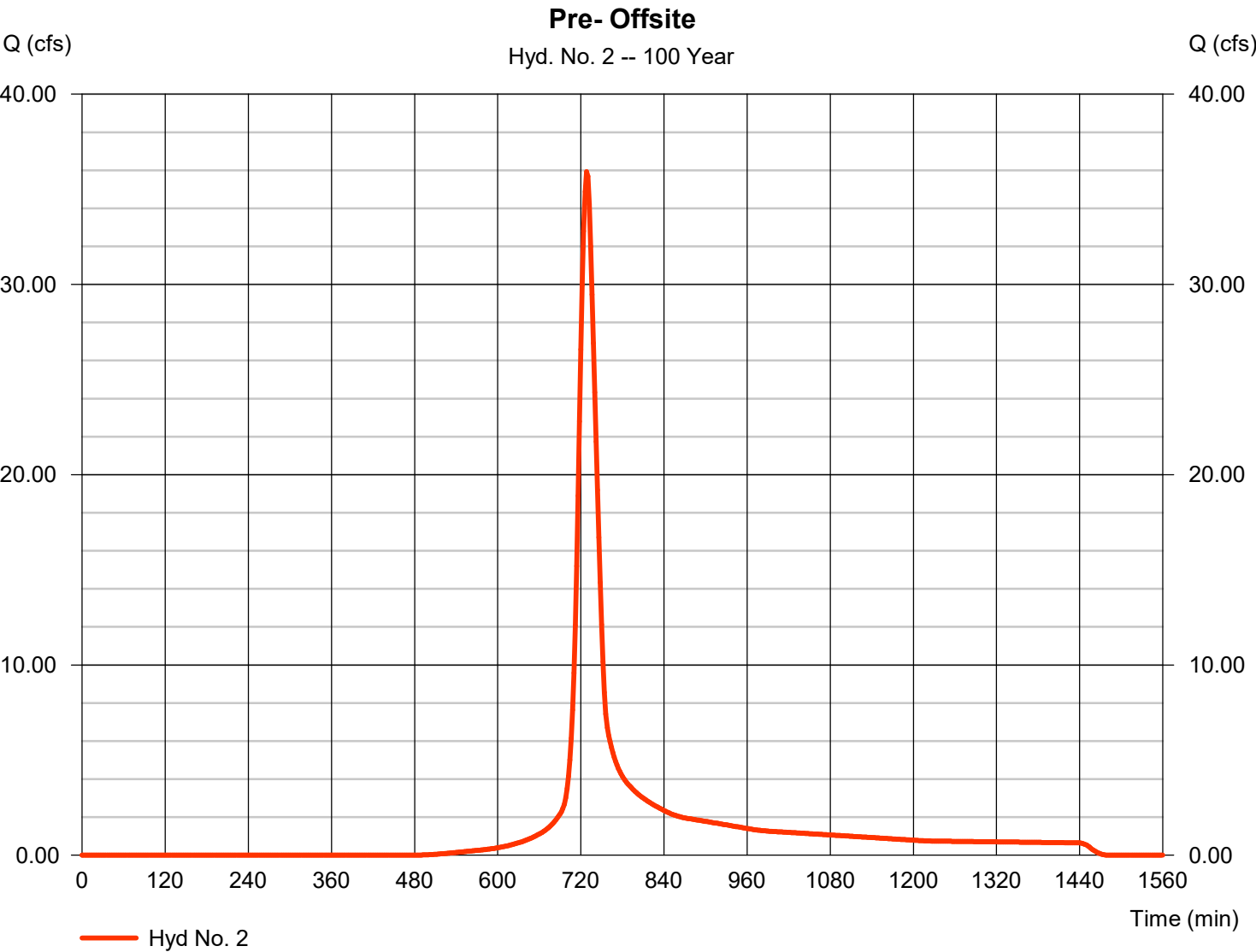
Hyd No. 2

Hydrograph Report

Hyd. No. 3

1 Northwest Onsite to Basin

Hydrograph type	= SCS Runoff		Peak discharge	= 20.88 cfs
Storm frequency	= 100 yrs		Time to peak	= 722 min
Time interval	= 2 min		Hyd. volume	= 62,170 cuft
Drainage area	= 2.290 ac		Curve number	= 87*
Basin Slope	= 0.0 %		Hydraulic length	= 0 ft
Tc method	= TR55		Time of conc. (Tc)	= 13.90 min
Total precip.	= 9.25 in		Distribution	= Type II
Storm duration	= 24 hrs		Shape factor	= 484

* Composite (Area/CN) = [(1.180 x 98) + (1.110 x 74)] / 2.290

1 Northwest Onsite to Basin

Hyd. No. 3 -- 100 Year

— Hyd No. 3

Hydrograph Report

Hyd. No. 4

2 Northeast Onsite to Basin

Hydrograph type	= SCS Runoff	Peak discharge	= 44.89 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 149,711 cuft
Drainage area	= 5.210 ac	Curve number	= 89*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 19.90 min
Total precip.	= 9.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.660 x 98) + (1.930 x 74) + (0.620 x 98)] / 5.210

2 Northeast Onsite to Basin

Hyd. No. 4 -- 100 Year

Hydrograph Report

Hyd. No. 5

3 Southeast Onsite to Basin

Hydrograph type	= SCS Runoff		Peak discharge	= 22.69 cfs
Storm frequency	= 100 yrs		Time to peak	= 724 min
Time interval	= 2 min		Hyd. volume	= 76,724 cuft
Drainage area	= 2.590 ac		Curve number	= 91*
Basin Slope	= 5.0 %		Hydraulic length	= 200 ft
Tc method	= TR55		Time of conc. (Tc)	= 18.70 min
Total precip.	= 9.25 in		Distribution	= Type II
Storm duration	= 24 hrs		Shape factor	= 484

* Composite (Area/CN) = [(1.810 x 98) + (0.780 x 74)] / 2.590

3 Southeast Onsite to Basin

Hyd. No. 5 -- 100 Year
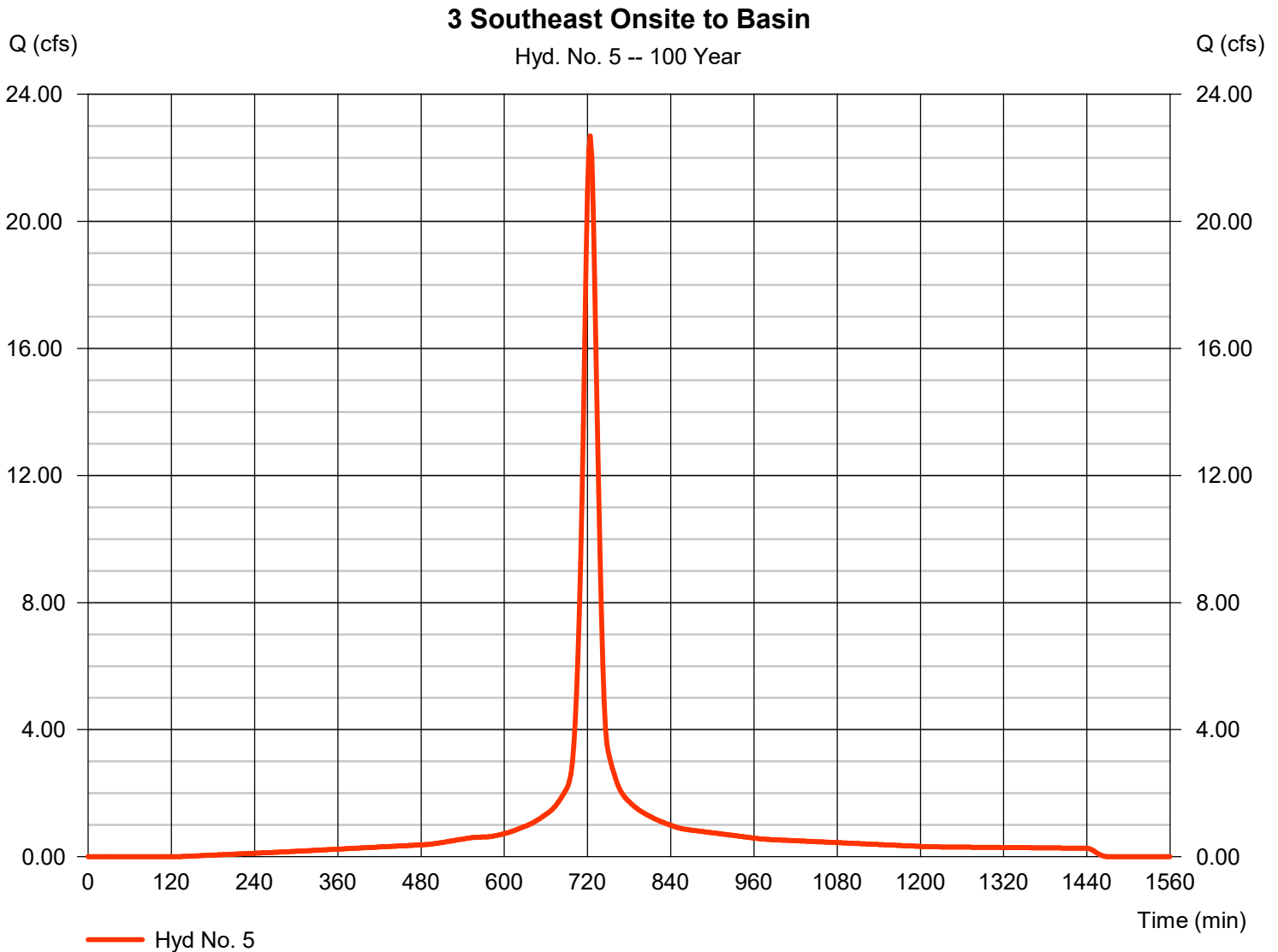
Hydrograph Report

Hyd. No. 6

4 Southwest Onsite to Basin

Hydrograph type	= SCS Runoff	Peak discharge	= 15.10 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 46,212 cuft
Drainage area	= 1.600 ac	Curve number	= 91*
Basin Slope	= 5.0 %	Hydraulic length	= 126 ft
Tc method	= TR55	Time of conc. (Tc)	= 14.40 min
Total precip.	= 9.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.120 x 98) + (0.480 x 74)] / 1.600
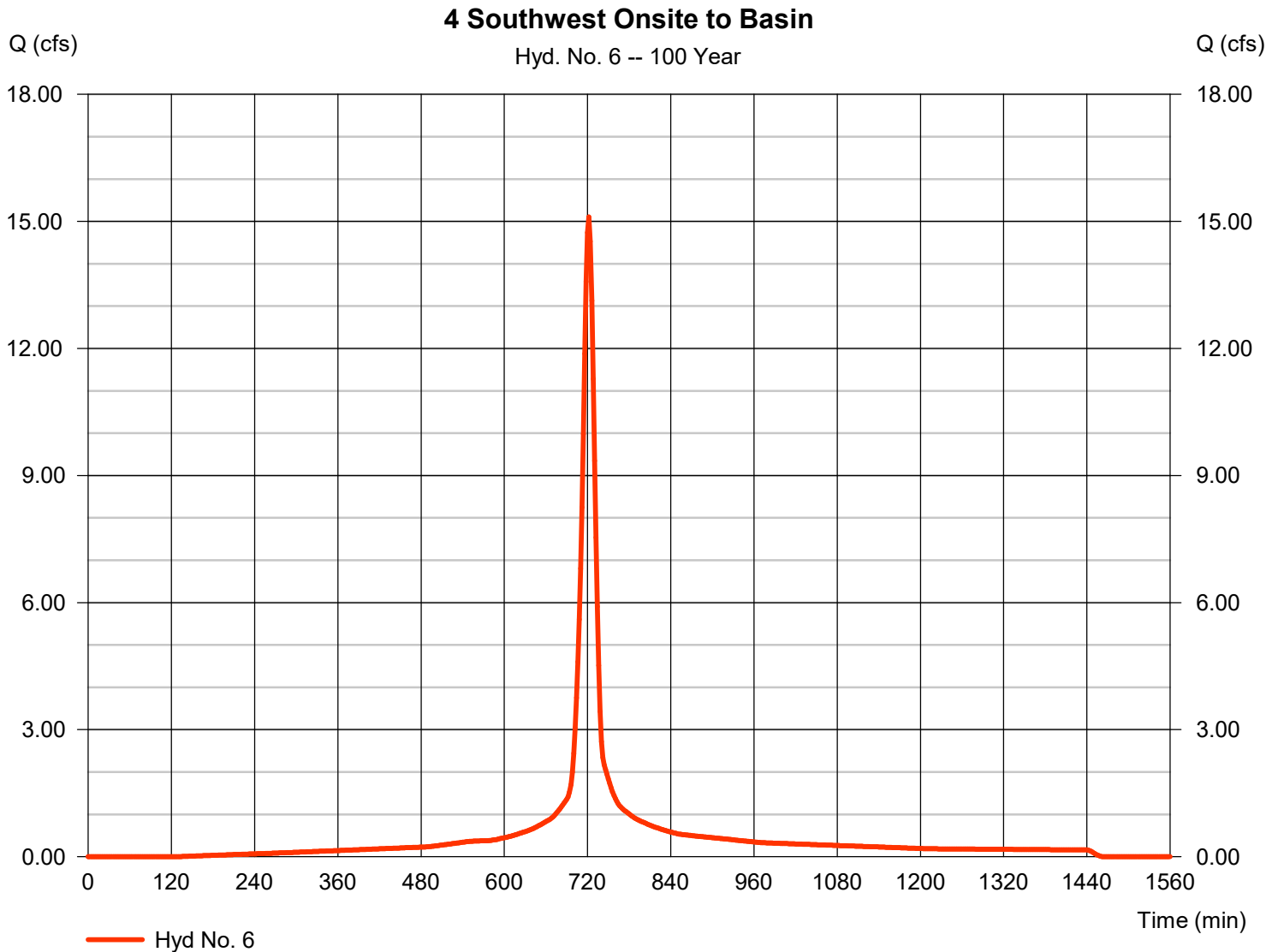
4 Southwest Onsite to Basin
Hyd. No. 6 -- 100 Year

Hyd No. 6

Hydrograph Report

Thursday, 06 / 22 / 2023

Hyd. No. 7

5 West Onsite to Basin

Hydrograph type	= SCS Runoff	Peak discharge	= 28.87 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 85,482 cuft
Drainage area	= 3.200 ac	Curve number	= 86*
Basin Slope	= 5.0 %	Hydraulic length	= 100 ft
Tc method	= TR55	Time of conc. (Tc)	= 14.20 min
Total precip.	= 9.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(1.650 x 98) + (1.550 x 74)] / 3.200

5 West Onsite to Basin

Hyd. No. 7 -- 100 Year
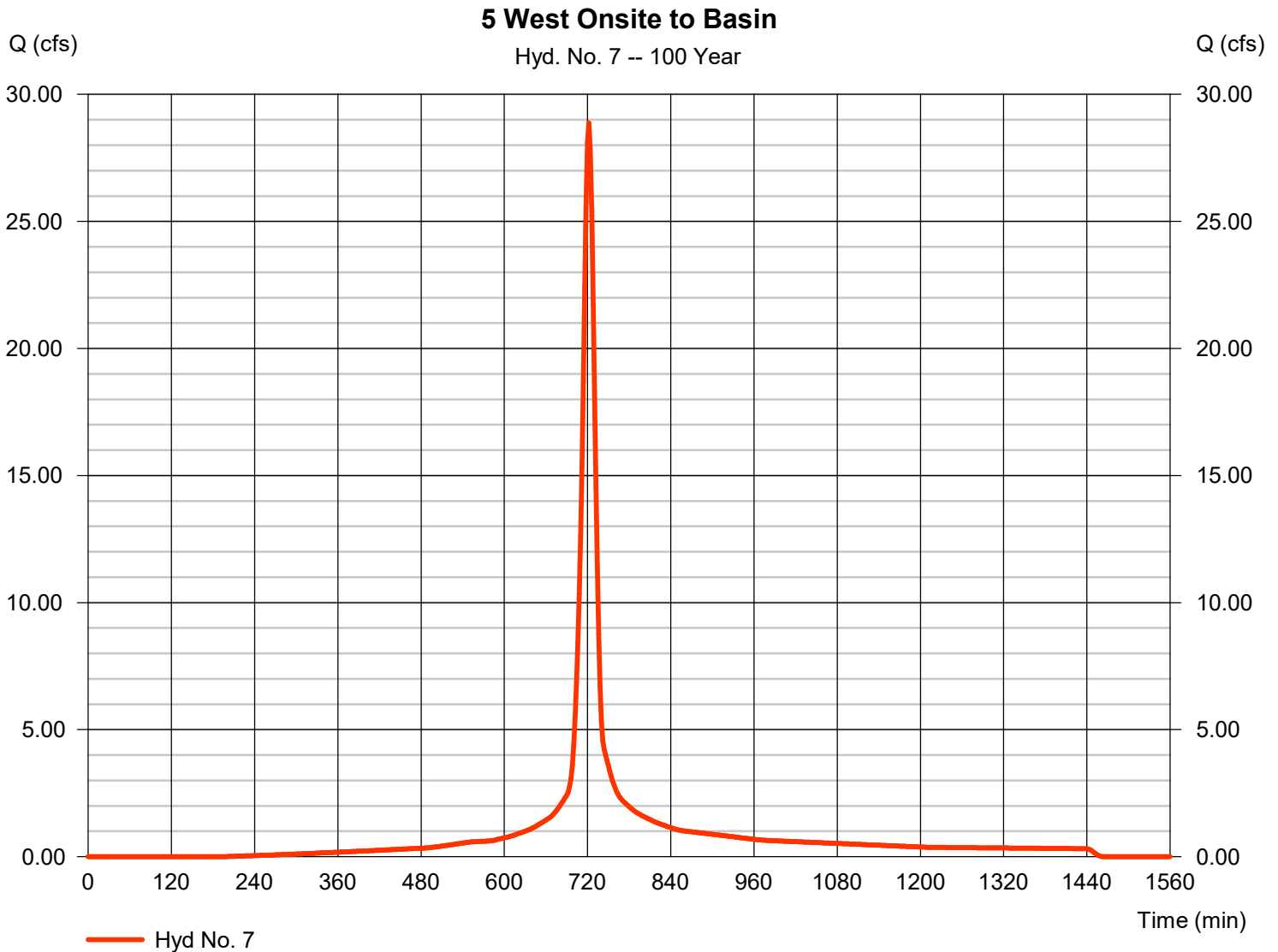
——— Hyd No. 7

Hydrograph Report

Hyd. No. 8

TO BASIN

Hydrograph type	= Combine	Peak discharge	= 131.12 cfs
Storm frequency	= 100 yrs	Time to peak	= 722 min
Time interval	= 2 min	Hyd. volume	= 420,298 cuft
Inflow hyds.	= 3, 4, 5, 6, 7	Contrib. drain. area	= 14.890 ac

TO BASIN

Hyd. No. 8 -- 100 Year

Q (cfs) vs Time (min)

Legend: Hyd No. 8, Hyd No. 3, Hyd No. 4, Hyd No. 5, Hyd No. 6, Hyd No. 7
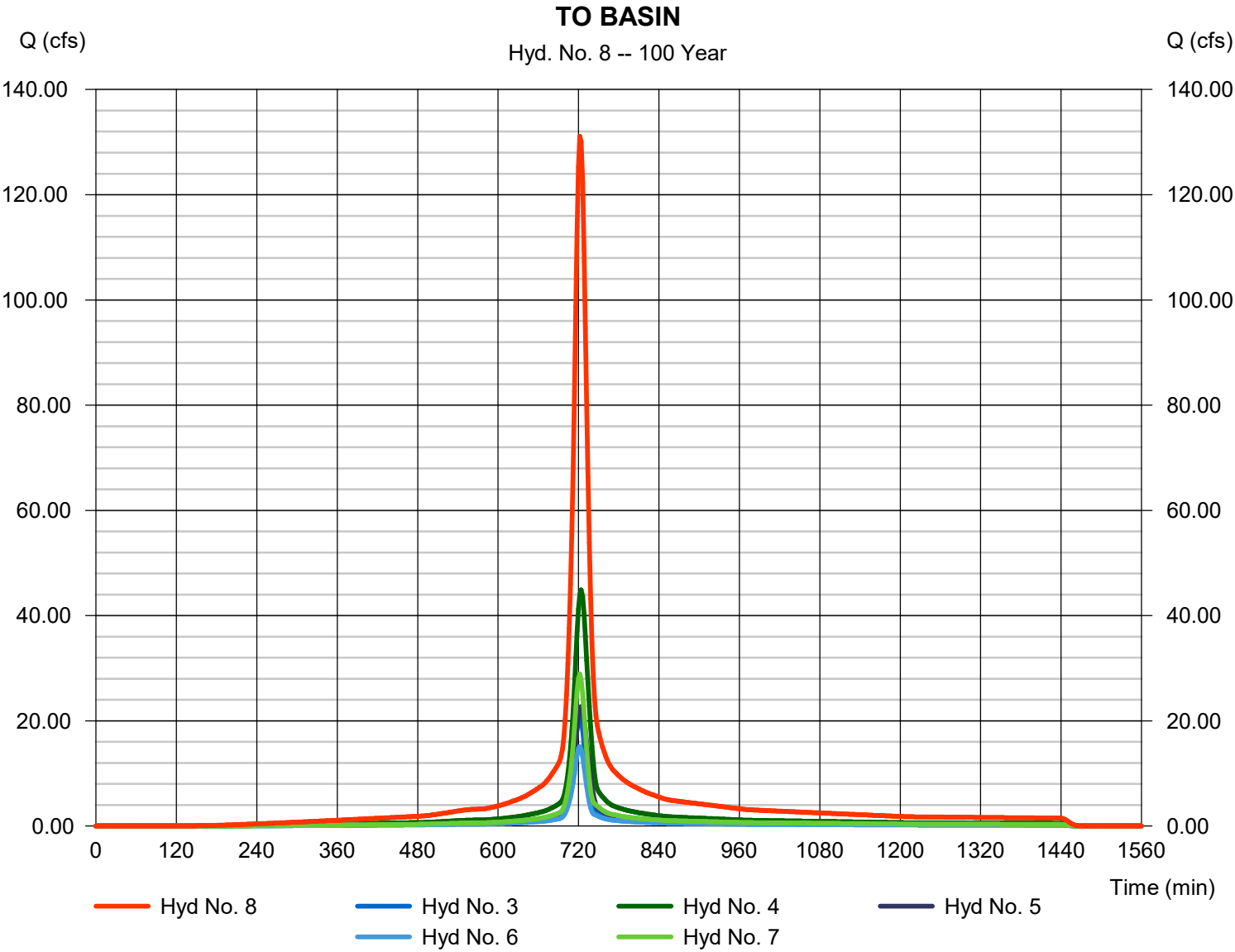
Hydrograph Report

Hyd. No. 9

BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	42.66 cfs
Storm frequency	=	100 yrs	Time to peak	=	738 min
Time interval	=	2 min	Hyd. volume	=	420,244 cuft
Inflow hyd. No.	=	8 - TO BASIN	Max. Elevation	=	924.88 ft
Reservoir name	=	Regional Detention	Max. Storage	=	179,502 cuft

Storage Indication method used.
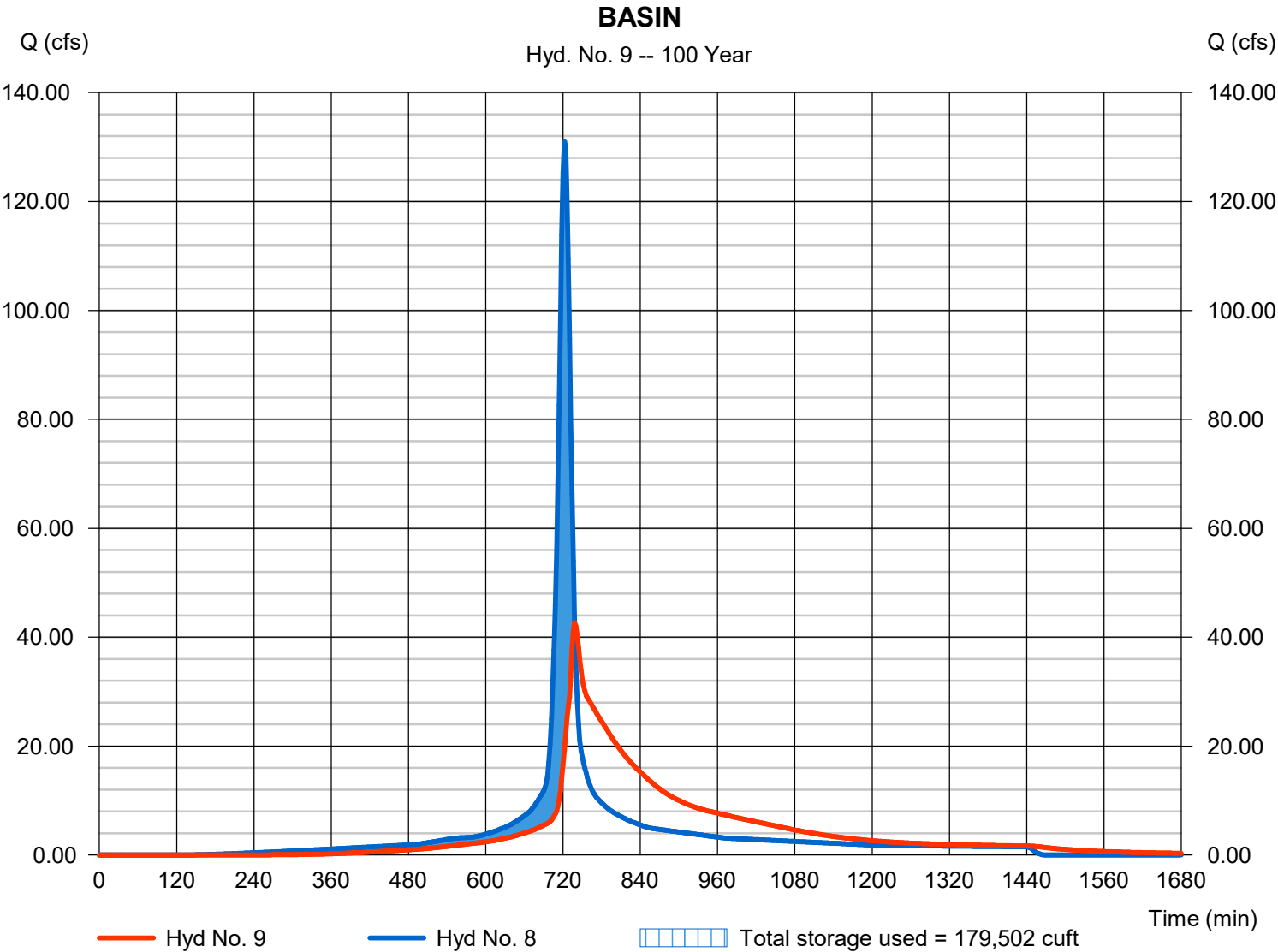
BASIN

Hyd. No. 9 -- 100 Year

Hyd No. 9   Hyd No. 8   Total storage used = 179,502 cuft

Hydrograph Report

Thursday, 06 / 22 / 2023

Hyd. No. 10

Basin Bypass

Hydrograph type	= SCS Runoff	Peak discharge	= 2.740 cfs
Storm frequency	= 100 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 5,790 cuft
Drainage area	= 0.250 ac	Curve number	= 80*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 9.25 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.070 x 98) + (0.180 x 74)] / 0.250

Basin Bypass

Hyd. No. 10 -- 100 Year

Hyd No. 10

Hydrograph Report

Hyd. No. 11

Pre
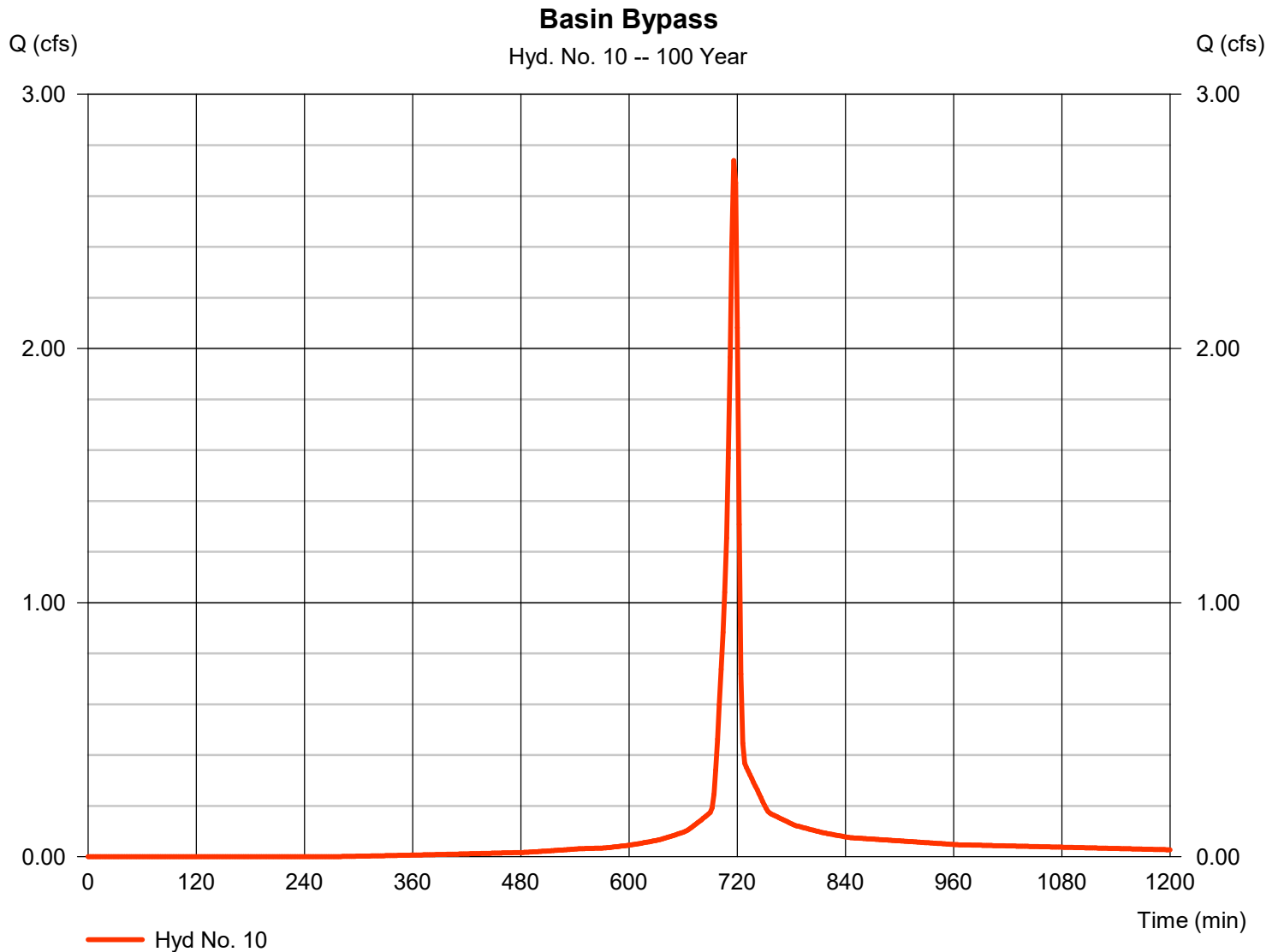
Hydrograph type	= Combine	Peak discharge	= 141.26 cfs
Storm frequency	= 100 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 473,078 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 23.010 ac

Pre
Hyd. No. 11 -- 100 Year
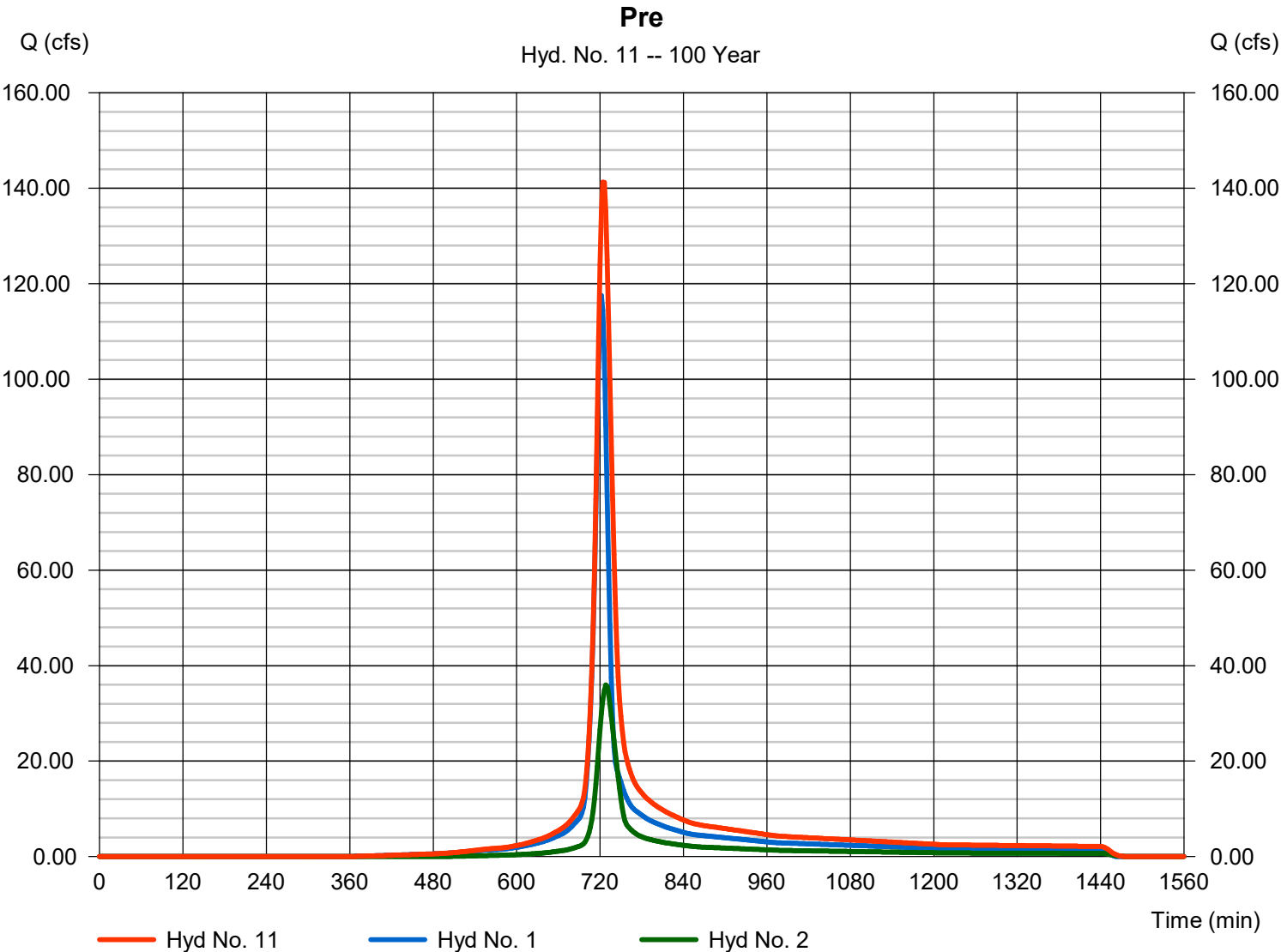
Hydrograph Report

Hyd. No. 12

Post

Hydrograph type	= Combine		Peak discharge	= 71.32 cfs
Storm frequency	= 100 yrs		Time to peak	= 736 min
Time interval	= 2 min		Hyd. volume	= 558,077 cuft
Inflow hyds.	= 2, 9, 10		Contrib. drain. area	= 7.750 ac

Post

Hyd. No. 12 -- 100 Year
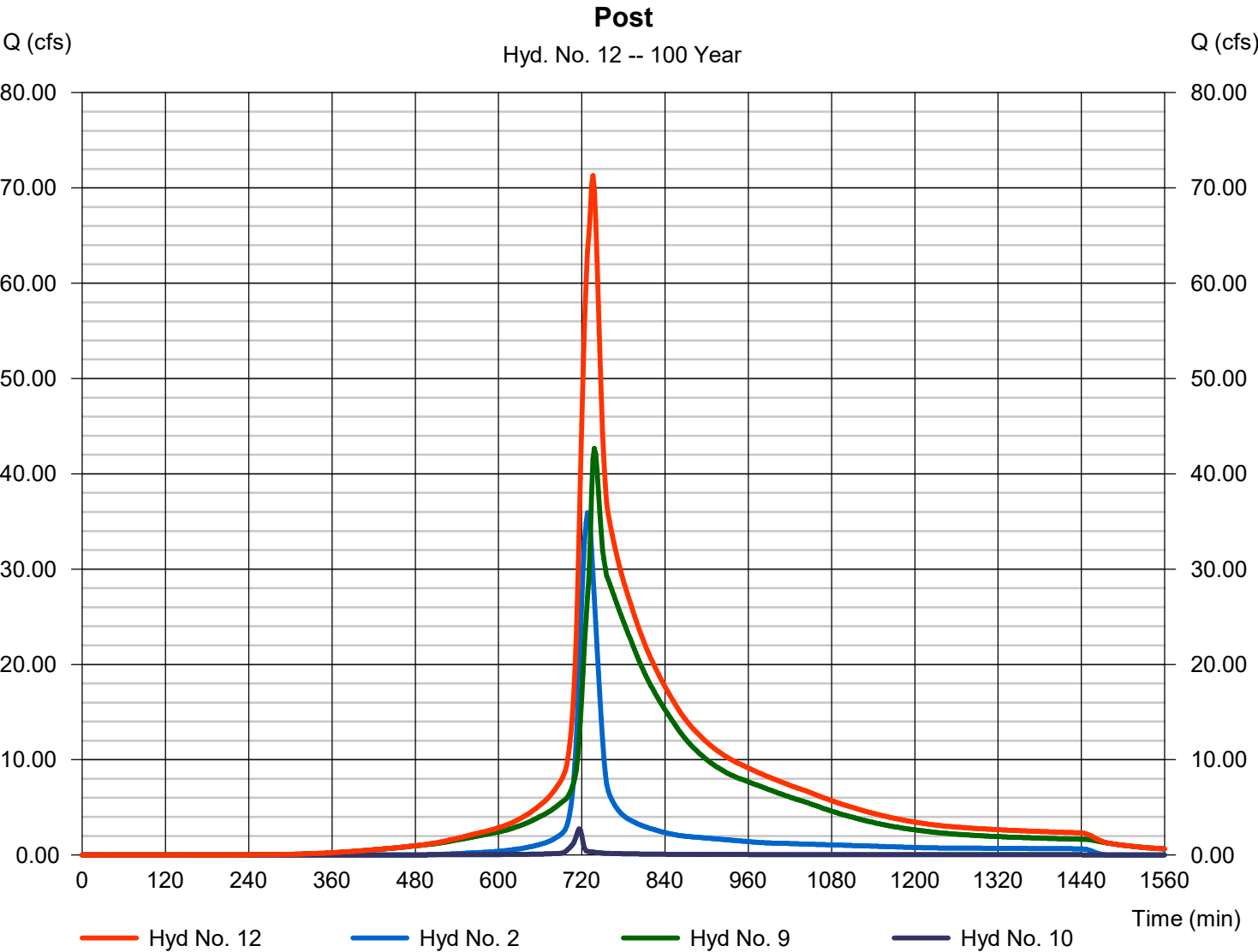
APPENDIX C:
STORM SEWER CALCULATIONS

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan
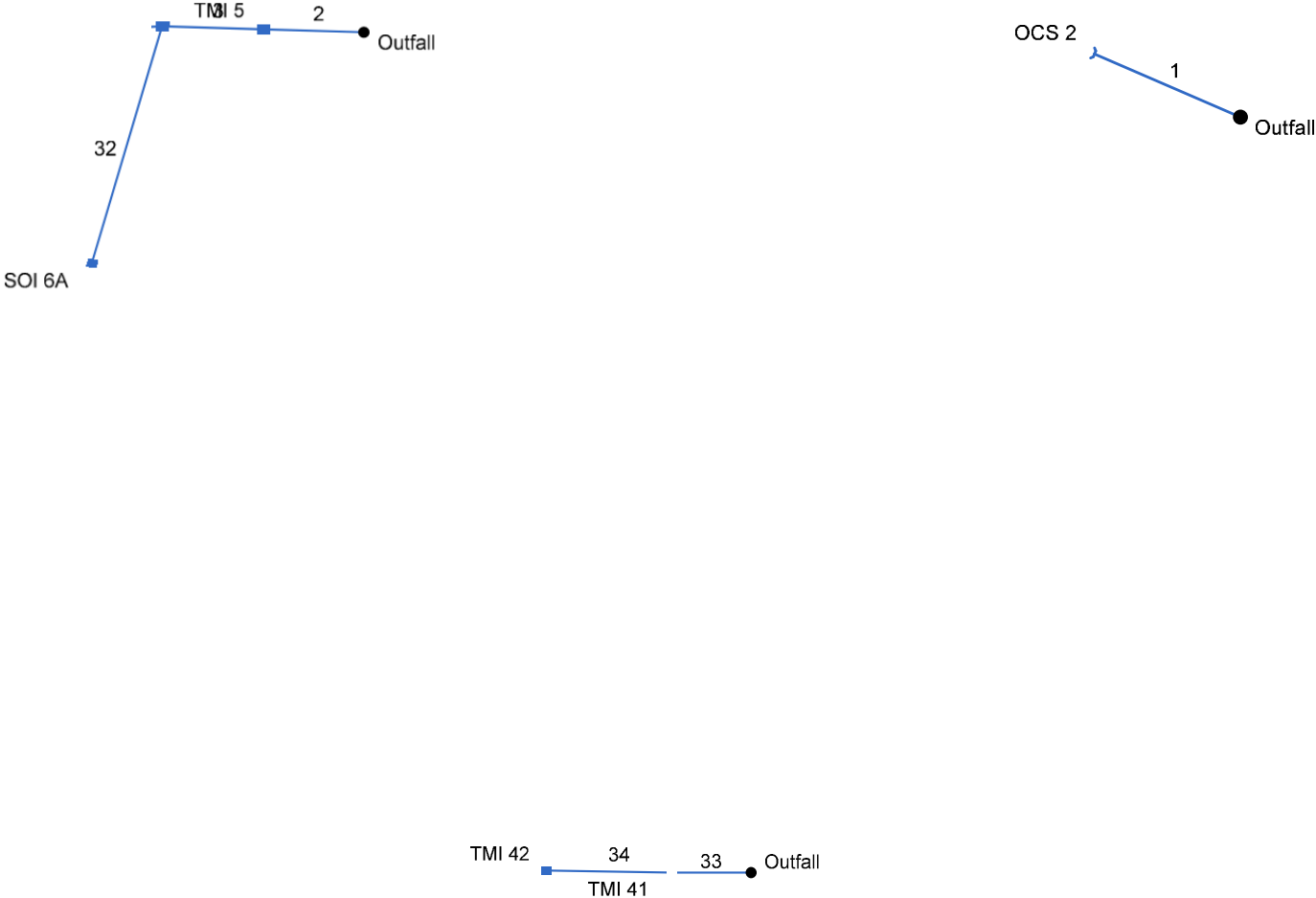
Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	EX WALL	22.82	60	Cir	98.333	911.00	920.00	9.153	912.32	921.32	0.47	921.32	End	OpenHeadwall
2	FES 4	41.63	36	Cir	33.145	922.47	922.64	0.513	924.51	924.74	n/a	924.74	End	Curb-Horiz
3	6	40.17	36	Cir	33.000	922.83	923.00	0.515	924.81	925.06	n/a	925.06	2	Curb-Horiz
32	6A	34.04	24	Cir	98.565	923.20	923.69	0.497	925.20*	927.10*	1.83	928.93	3	
33	FES 40	1.60	24	Cir	26.463	928.76	929.03	1.020	929.12	929.47	0.08	929.47	End	Curb-Horiz
34	42	0.88	24	Cir	42.000	929.23	929.65	1.000	929.49	929.97	0.11	929.97	33	Curb-Horiz

Project File: STORM SEWERS 6-20-23.stm   Number of lines: 1   Run Date: 6/21/2023

NOTES: Return period = 25 Yrs.

Storm Sewer Tabulation

page 1

Station Line	To Line	Len (ft)	Drng Area Incr (ac)	Drng Area Total (ac)	Rnoff coeff (C)	Area x C Incr	Area x C Total	Tc Inlet (min)	Tc Syst (min)	Rain (I) (in/hr)	Total flow (cfs)	Cap full (cfs)	Vel (ft/s)	Pipe Size (in)	Pipe Slope (%)	Invert Elev Dn (ft)	Invert Elev Up (ft)	HGL Elev Dn (ft)	HGL Elev Up (ft)	Grnd / Rim Elev Dn (ft)	Grnd / Rim Elev Up (ft)	Line ID
1	End	98.333	0.00	0.00	0.00	0.00	0.00	5.0	5.0	0.0	22.82	853.7	5.51	60	9.15	911.00	920.00	912.32	921.32	0.00	920.00	EX WALL
2	End	33.145	0.40	13.35	0.76	0.30	8.24	5.0	22.5	5.1	41.63	51.75	8.01	36	0.51	922.47	922.64	924.51	924.74	0.00	928.10	FES 4
3	2	33.000	0.91	12.95	0.58	0.53	7.94	5.0	22.4	5.1	40.17	51.86	7.93	36	0.52	922.83	923.00	924.81	925.06	928.10	929.66	6
32	3	98.565	8.38	8.38	0.66	5.53	5.53	14.2	14.2	6.2	34.04	17.28	10.84	24	0.50	923.20	923.69	925.20	927.10	929.66	929.00	6A
33	End	26.463	0.18	0.36	0.59	0.11	0.21	5.0	7.5	7.5	1.60	24.75	3.66	24	1.02	928.76	929.03	929.12	929.47	0.00	934.65	FES 40
34	33	42.000	0.18	0.18	0.59	0.11	0.11	5.0	5.0	8.2	0.88	24.50	3.18	24	1.00	929.23	929.65	929.49	929.97	934.65	934.65	42

Project File: STORM SEWERS 6-20-23.stm

Number of lines: 1

Run Date: 6/21/2023

NOTES:Intensity = 102.61 / (Inlet time + 16.50) ^ 0.82; Return period =Yrs. 25 ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet Ht (in)	L (ft)	Grate Inlet Area (sqft)	L (ft)	W (ft)	Gutter So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Inlet Depth (ft)	Spread (ft)	Depr (in)	Byp Line No
1	OCS 2	22.82*	0.00	22.82	0.00	Hdwl	0.0	0.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	0.00	0.00	0.00	0.00	0.0	Off
2	TMI 5	2.51	0.00	2.51	0.00	Curb	6.0	2.93	0.00	0.00	0.00	Sag	1.50	0.020	0.020	0.013	0.43	21.66	0.43	21.66	0.0	Off
3	TMI 6	4.35	0.00	4.35	0.00	Curb	6.0	2.93	0.00	0.00	0.00	Sag	1.50	0.020	0.020	0.013	0.63	31.29	0.63	31.29	0.0	Off
32	SOI 6A	34.04	0.00	34.04	0.00	DrCrb	4.0	1.00	0.00	0.00	0.00	Sag	0.00	0.000	0.000	0.013	361.34	inf.00	361.34	inf.00	0.0	Off
33	TMI 41	0.88	0.00	0.88	0.00	Curb	4.0	1.00	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.25	9.49	0.25	9.49	0.0	Off
34	TMI 42	0.88	0.00	0.88	0.00	Curb	6.0	4.00	0.00	0.00	0.00	Sag	2.00	0.050	0.020	0.013	0.20	6.79	0.20	6.79	0.0	Off

Project File: STORM SEWERS 6-20-23.stm   Number of lines: 1   Run Date: 6/21/2023

NOTES: Inlet N-Values = 0.016; Intensity = 102.61 / (Inlet time + 16.50) ^ 0.82;   Return period = 25 Yrs. ;   * Indicates Known Q added. All curb inlets are Horiz throat.

Storm Sewer Inlet Time Tabulation

Line No.	Line ID	Tc Method	Sheet Flow					Shallow Concentrated Flow					Channel Flow							Total
			n-Value	flow Length (ft)	2-yr 24h P (in)	Land Slope (%)	Travel Time (min)	flow Length (ft)	Water Slope (%)	Surf Descr	Ave Vel (ft/s)	Travel Time (min)	X-sec Area (sqft)	Wetted Perim (ft)	Chan Slope (%)	n-Value	Vel	flow Length (ft)	Travel Time (min)	Travel Time (min)
1	EX WALL	User																		5.00
2	FES 4	User																		5.00
3	6	User																		5.00
32	6A	User																		14.20
33	FES 40	User																		5.00
34	42	User																		5.00

Project File: STORM SEWERS 6-20-23.stm   Min. Tc used for intensity calculations = 5 min   Number of lines: 1   Date: 6/21/2023

Hydraulic Grade Line Computations

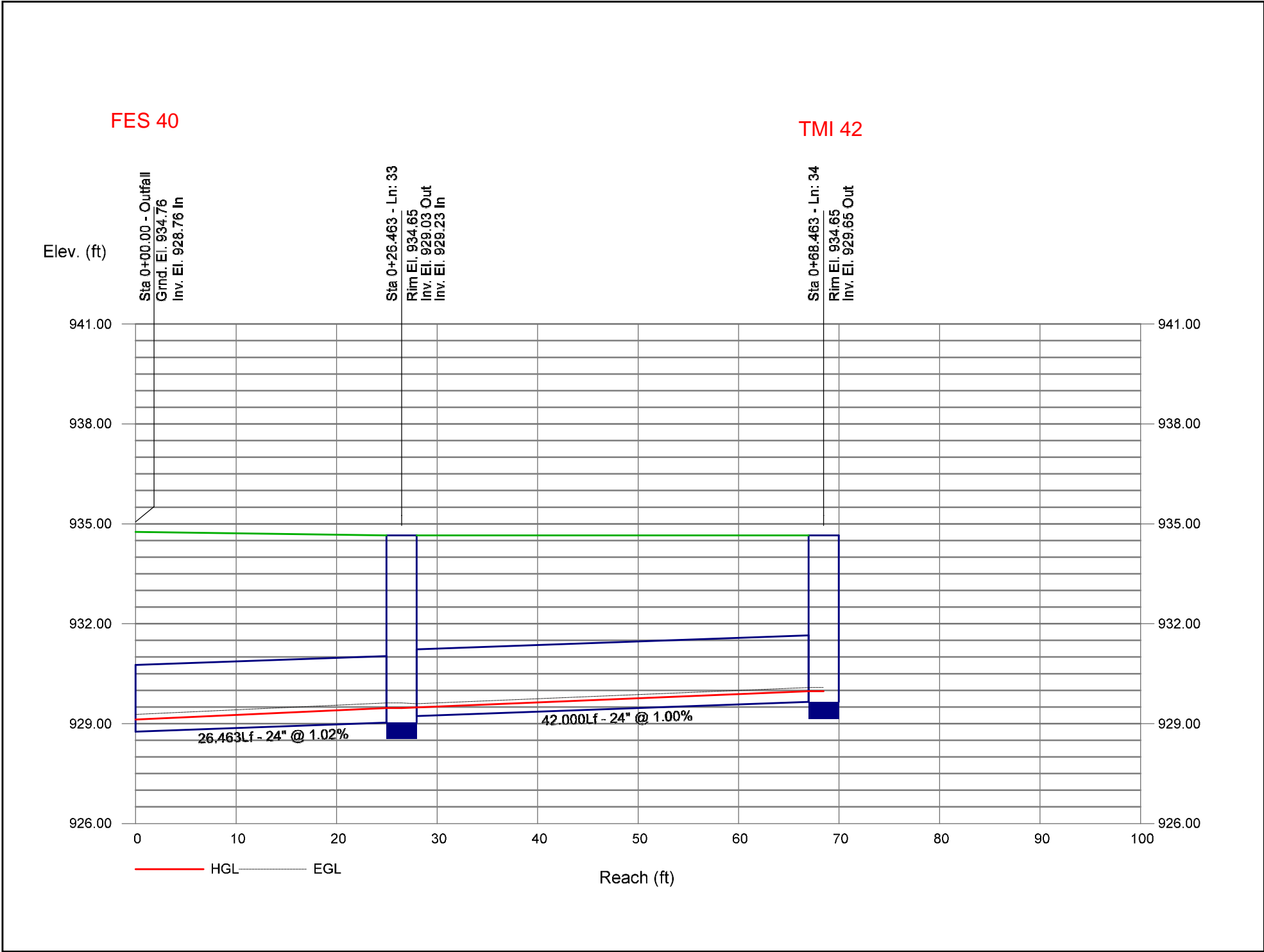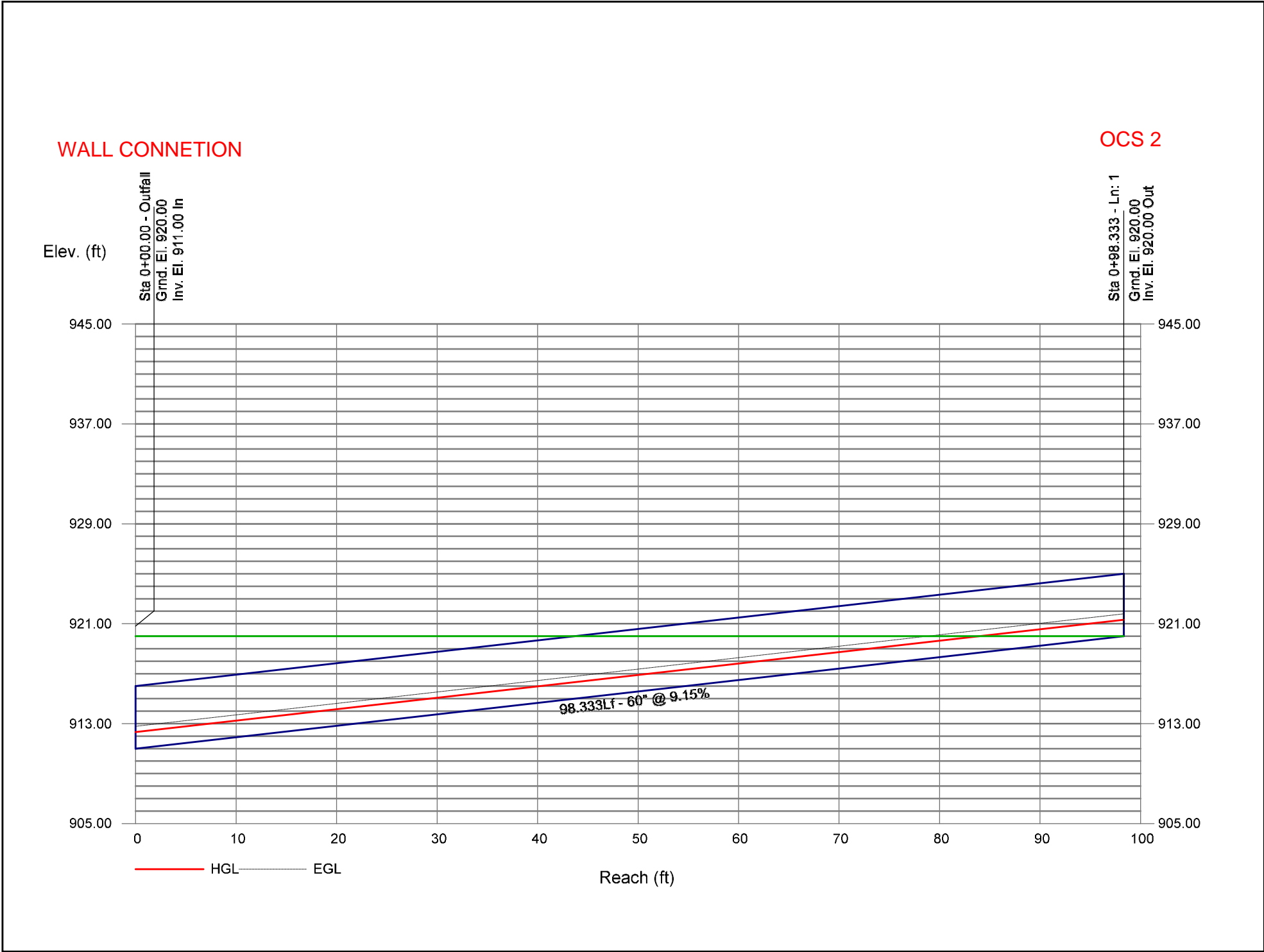| Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
1	60	22.82	911.00	912.32	1.32	4.14	5.51	0.47	912.79	0.000	98.333	920.00	921.32	1.32**	4.14	5.51	0.47	921.79	0.000	0.000	n/a	1.00	0.47
2	36	41.63	922.47	924.51	2.04*	5.11	8.14	0.97	925.47	0.000	33.145	922.64	924.74	2.10**	5.28	7.88	0.97	925.70	0.000	0.000	n/a	0.50	n/a
3	36	40.17	922.83	924.81	1.98*	4.96	8.10	0.93	925.75	0.000	33.000	923.00	925.06	2.06**	5.18	7.75	0.93	926.00	0.000	0.000	n/a	1.48	n/a
32	24	34.04	923.20	925.20	2.00*	3.14	10.84	1.83	927.03	1.931	98.565	923.69	927.10	2.00	3.14	10.84	1.83	928.93	1.930	1.930	1.903	1.00	1.83
33	24	1.60	928.76	929.12	0.36	0.38	4.16	0.15	929.27	0.000	26.463	929.03	929.47	0.44**	0.51	3.15	0.15	929.62	0.000	0.000	n/a	0.50	0.08
34	24	0.88	929.23	929.49	0.26*	0.24	3.67	0.11	929.60	0.000	42.000	929.65	929.97	0.32**	0.33	2.68	0.11	930.08	0.000	0.000	n/a	1.00	0.11

Notes: ; ** Critical depth. ; c = cir e = ellip b = box

Storm Sewer Profile

FES 4

SOI 6A

Elev. (ft)

Sta 0+00.00 - Outfall
Grnd. El. 929.47
Inv. El. 922.47 In

Sta 0+33.145 - Ln: 2
Rim El. 928.10
Inv. El. 922.64 Out
Inv. El. 922.83 In

Sta 0+66.145 - Ln: 3
Rim El. 929.66
Inv. El. 923.00 Out
Inv. El. 923.20 In

Sta 1+64.71 - Ln: 32
Rim El. 929.00
Inv. El. 923.69 Out

940.00 — 940.00

936.00 — 936.00

932.00 — 932.00

928.00 — 928.00

924.00 — 924.00

920.00 — 920.00

0   25   50   75   100   125   150   175

33.145Lf - 36" @ 0.51%

98.565Lf - 24" @ 0.50%

33.000Lf - 36" @ 0.52%

HGL ———— EGL

Reach (ft)

Storm Sewers

Storm Sewer Profile

FES 40

TMI 42

Elev. (ft)

Sta 0+00.00 - Outfall
Grnd. El. 934.76
Inv. El. 928.76 In

Sta 0+26.463 - Ln: 33
Rim El. 934.65
Inv. El. 929.03 Out
Inv. El. 929.23 In

Sta 0+68.463 - Ln: 34
Rim El. 934.65
Inv. El. 929.65 Out

941.00	941.00
938.00	938.00
935.00	935.00
932.00	932.00
929.00	929.00
926.00	926.00

26.463Lf - 24" @ 1.02%

42.000Lf - 24" @ 1.00%

0   10   20   30   40   50   60   70   80   90   100

——— HGL   ········· EGL

Reach (ft)

Storm Sewer Profile

WALL CONNETION

OCS 2

Elev. (ft)

Sta 0+00.00 - Outfall
Grnd. El. 920.00
Inv. El. 911.00 In

Sta 0+98.333 - Ln: 1
Grnd. El. 920.00
Inv. El. 920.00 Out

98.333Lf - 60" @ 9.15%

945.00	945.00
937.00	937.00
929.00	929.00
921.00	921.00
913.00	913.00
905.00	905.00

0   10   20   30   40   50   60   70   80   90   100

——— HGL ———— EGL

Reach (ft)

APPENDIX D:
DRAINAGE AREA MAP(S)

N

0 ——— 1"
SCALE: 1" = 60'

OFFSITE TO ONSITE
AREA: 7.50 AC
IMPV: 0.0 AC
CN: 65

TOC: 25.2

AREA: 15.21 AC
IMPV: 0.0 AC
CN: 65

TOC: 15.3

20' BUILDING LINE

20' BUILDING LINE

NE STROTHER ROAD
(40' CONCRETE W/ CURB — 100' R/W)

WILSHIRE HILLS PHASE III
STREET ADDRESS
LEE'S SUMMIT JACKSON COUNTY, MO

Date
JUNE 22, 2023

Revised

Design: ST   Drawn: ST

PRE-DRAINAGE AREA MAP

Sheet

C12.01

CONSTRUCTION DOCUMENTS

ES&S PROJECT NO. 15925

3.44 ACRES ±

ONSITE BASIN BYPASS
TOTAL: 0.25 AC
IMPV: 0.07
CN: 75

TOC:5.0

TOC: 13.9

NORTHWEST
ONSITE TO BASIN
TOTAL: 2.29 AC
IMPV:1.18 AC
CN: 87

OFFSITE TO BASIN
TOTAL: 7.50 AC
IMPV: 0 AC
CN: 65

NORTHEAST
ONSITE TO BASIN
TOTAL: 5.21 AC
IMPV: 2.66 AC
BASIN: 0.62
CN : 89

WEST
ONSITE TO BASIN
TOTAL: 3.2 AC
IMPV: 1.65 AC
CN: 86

TOC: 25.2

TOC:19.9

TOC:14.2

SOUTHWEST
ONSITE TO BASIN
TOTAL: 1.60 AC
IMPV: 1.12
CN: 91

SOUTHEAST
ONSITE TO BASIN
TOTAL: 2.59 AC
IMPV: 1.81 AC
CN: 91

TOC:14.4

TOC:18.7

N
SCALE: 1" = 60'
0   1"

WILSHIRE HILLS PHASE III
STREET ADDRESS
LEE'S SUMMIT JACKSON COUNTY, MO

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MATTHEW A. KRIETE
PROFESSIONAL ENGINEER
PE-2007002811

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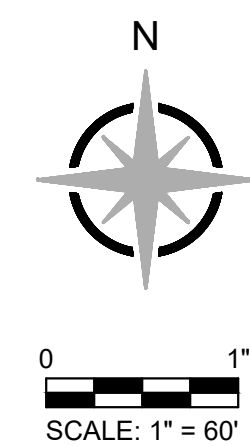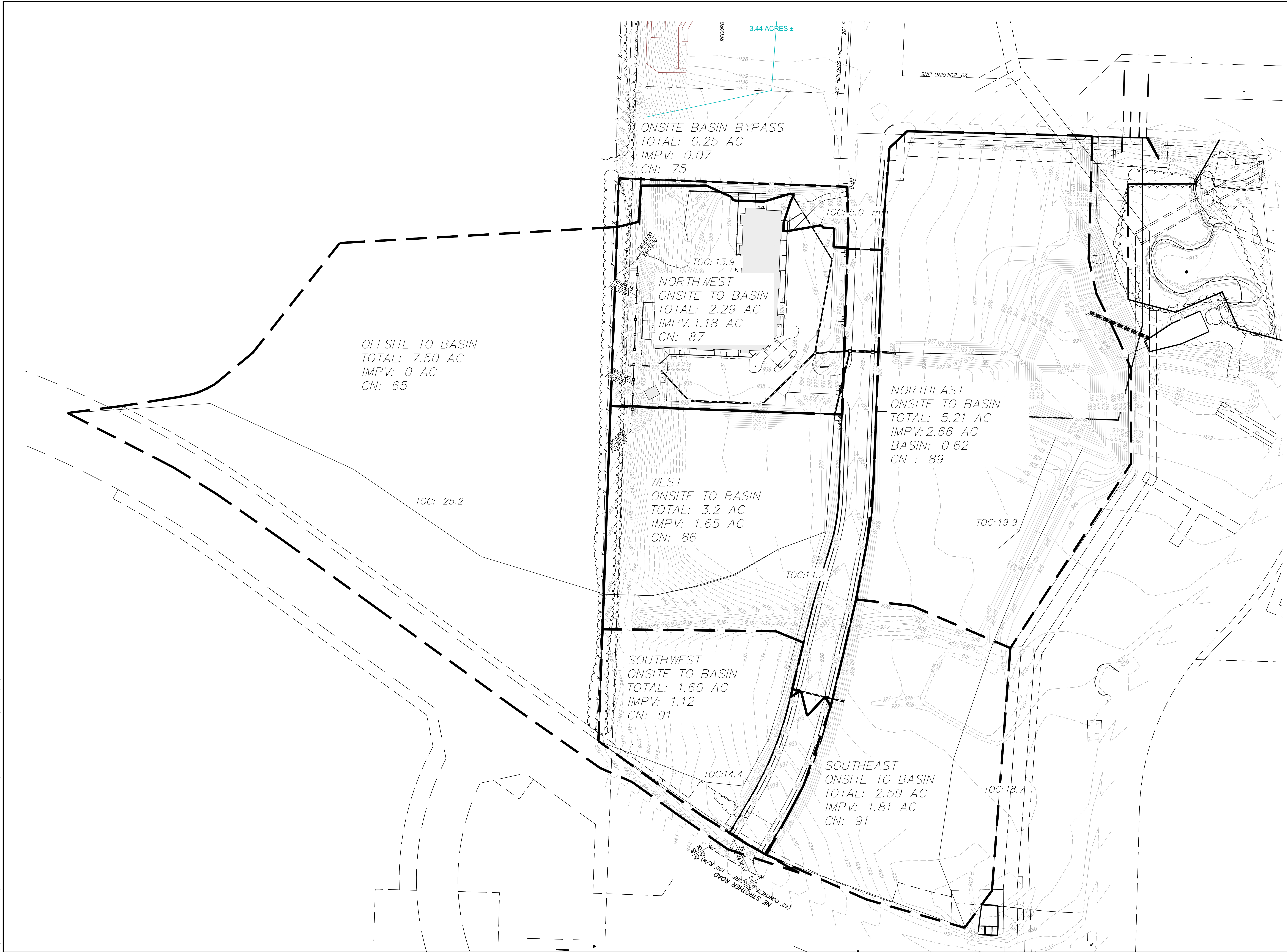CERTIFIED DOCUMENT.

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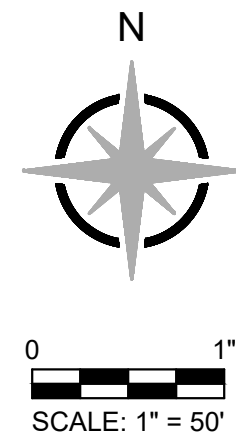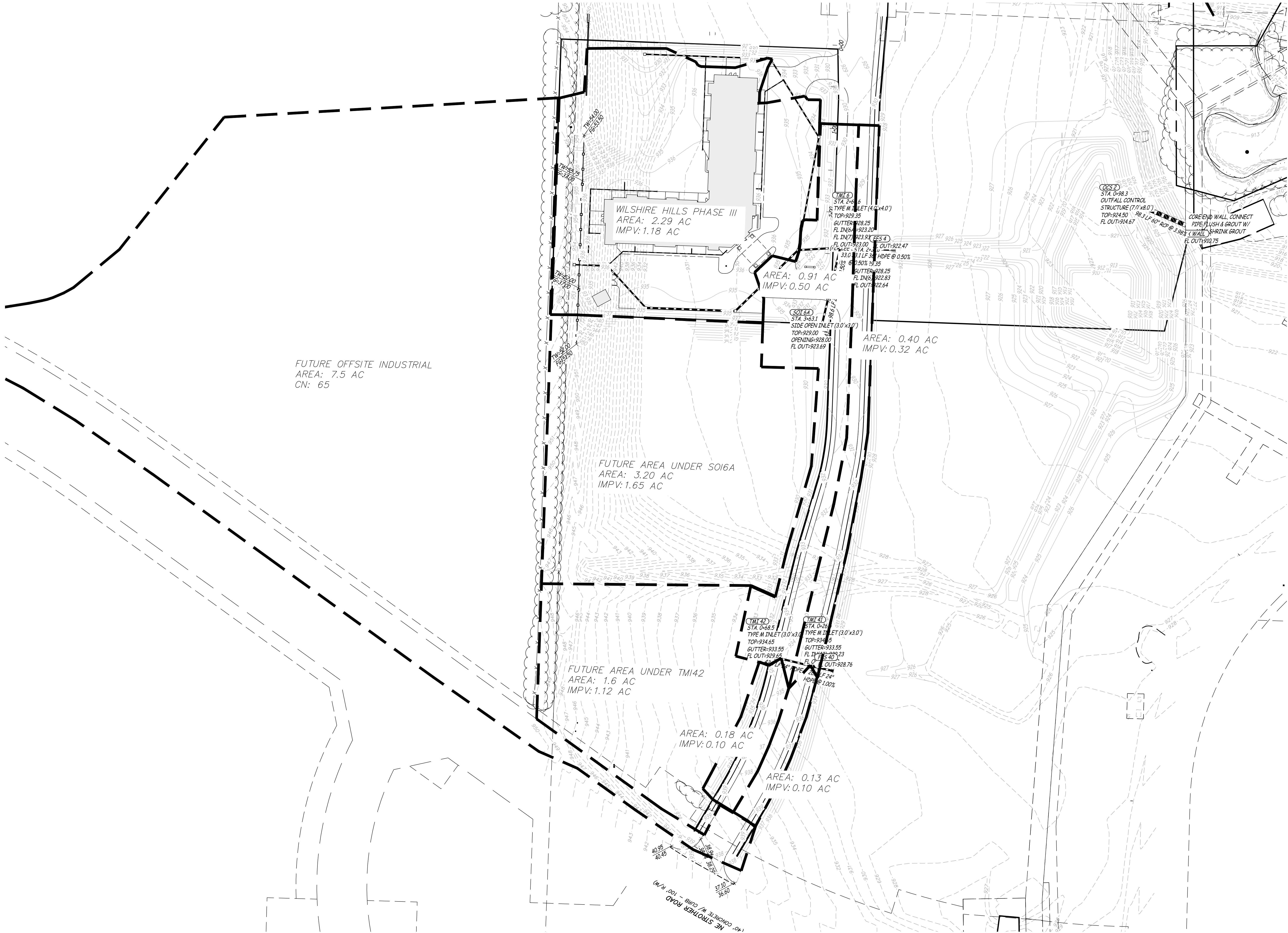
Revised

Design: ST   Drawn: ST

POST-DRAINAGE AREA MAP

Sheet
C12.02

CONSTRUCTION DOCUMENTS

ES&S PROJECT NO. 15925

N

0   1"

SCALE: 1" = 50'

WILSHIRE HILLS PHASE III
AREA: 2.29 AC
IMPV: 1.18 AC

FUTURE OFFSITE INDUSTRIAL
AREA: 7.5 AC
CN: 65

AREA: 0.91 AC
IMPV: 0.50 AC

AREA: 0.40 AC
IMPV: 0.32 AC

FUTURE AREA UNDER SOI6A
AREA: 3.20 AC
IMPV: 1.65 AC

FUTURE AREA UNDER TMI42
AREA: 1.6 AC
IMPV: 1.12 AC

AREA: 0.18 AC
IMPV: 0.10 AC

AREA: 0.13 AC
IMPV: 0.10 AC

TMI 6
STA. 2+24.6
TYPE M INLET (4.0'x4.0')
TOP:929.35
GUTTER:928.25
FL IN(6):923.20
FL OUT:923.00

OCS 2
STA. 0+98.3
OUTFALL CONTROL
STRUCTURE (7.0'x8.0')
TOP:924.50
FL OUT:914.67

CORE END WALL, CONNECT
PIPE FLUSH & GROUT W/
WALL SHRINK GROUT
FL OUT:910.75

SOI 6A
STA. 3+63.1
SIDE OPEN INLET (3.0'x3.0')
TOP:929.00
OPENING:928.00
FL OUT:923.69

TMI 42
STA. 0+68.5
TYPE M INLET (3.0'x3.0')
TOP:934.65
GUTTER:933.55
FL OUT:929.65

TMI 54
STA. 0+29
TYPE M INLET (3.0'x3.0')
TOP:934.65
GUTTER:933.55
FL IN:929.23
FL OUT:928.76

NE STROTHER ROAD

MATTHEW A. KRIETE
PROFESSIONAL ENGINEER
PE-2007002811

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Date
JUNE 22, 2023

Revised

WILSHIRE HILLS PHASE III
STREET ADDRESS
LEE'S SUMMIT JACKSON COUNTY, MO

CONSTRUCTION DOCUMENTS

Design: ST   Drawn: ST

PUBLIC STORM DRAINAGE

Sheet

C12.03

ES&S PROJECT NO. 15925