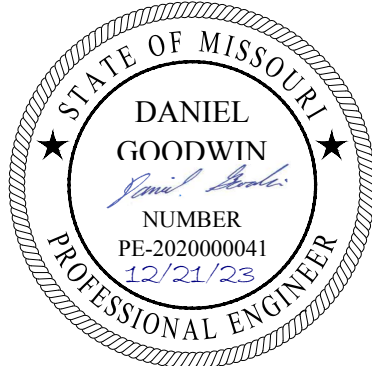


# LEE'S SUMMIT DOWNTOWN MARKET FINAL DEVELOPMENT PLAN DRAINAGE STUDY

Lee's Summit, Missouri

## Prepared for:

GLMV Architecture, Inc  
1525 E Douglas  
Wichita, KS 37211



## Prepared by: Olsson

1301 Burlington Street, North Kansas City, MO 64116  
Ph. 816-791-7530  
Email: dgoodwin@olsson.com  
Olsson Project No. 022-00393

Submitted December 2023



# TABLE OF CONTENTS

1. General Information	
1.1 Project Location.....	1
1.2 Federal Emergency Management Agency Floodplain Classification.....	2
1.3 Soil Classifications.....	2
2. Methodology.....	3-4
3. Existing Conditions.....	5-6
4. Proposed Conditions.....	7-9
5. Results.....	10
6. Conclusion.....	11

## LIST OF FIGURES

Figure 1. Lee's Summit Downtown Market Location Map.....	1
--	---

## LIST OF TABLES

Table 1. Soil Classifications .....	2
Table 2. Precipitation Depths. ....	4
Table 3-1. Lee's Summit Downtown Market – Existing Conditions Subarea.....	5
Table 3-2. Lee's Summit Downtown Market – Existing Conditions Subarea.....	6
Table 3-3 Lee's Summit Downtown Market – Existing Conditions Subarea Results .....	6
Table 4-1. Lee's Summit Downtown Market –Proposed Conditions Subarea Data.....	7
Table 4-2 Lee's Summit Downtown Market –Proposed (No Detention) Conditions Subarea Results.....	8
Table 4-3 Lee's Summit Downtown Market –Proposed (No Detention) Conditions Outfall Results .....	8
Table 4-4. Lee's Summit Downtown Market –Proposed (No Detention) vs. Existing Conditions Point of Interest Comparison.....	8
Table 4-5. Lee's Summit Downtown Market – Proposed Conditions Detention Flow and Volume Results.....	9
Table 4-6. Lee's Summit Downtown Market –Proposed (With Detention) Conditions Point of Interest Results .....	9
Table 4-7. Lee's Summit Downtown Market –Proposed (With Detention) vs. Existing Conditions Point Data .....	9
Table 5-1 Lee's Summit Downtown Market –Points of Interest Discharge Comparison.....	10

## APPENDICES

Appendix A: Exhibits
Appendix B: Hydrographs
Appendix C: Model Results
Appendix D: Soil Maps
Appendix E: FEMA



## 1.2. Federal Emergency Management Agency Floodplain Classification

FEMA Flood Boundary and Floodway Map Community Panel Number 29095C0436G classifies the Lee's Summit Downtown Market property as a "Zone X Unshaded" Area. This is the FEMA flood insurance rate zone that corresponds to areas outside the 0.2% annual chance floodplain. No Base Flood Elevations or depths are shown within this zone. Refer to Appendix E for the FIRM Map.

## 1.3. Soil Classifications

Soil maps published on the Natural Resources Conservation Service (NRCS) Web Soil Survey categorize soils on the Lee's Summit Downtown Market as shown in Table 1. Refer to Appendix D for a map of soils on the property.

**Table 1. Soil Classifications**

HSG	Symbol	Name	Slope
D	99012	Urban land	5-9%

## 2. METHODOLOGY

The storm drainage study will be analyzed in accordance with the February 15, 2006 edition of the Kansas City Metropolitan Chapter, American Public Works Association, (KCAPWA) Construction and Material Specifications, Section 5601.5.A.4.

The Existing Conditions hydrology will be evaluated in Section 3, and Proposed Conditions hydrology will be computed in Section 4. The Proposed Conditions discharge data for each stage of development will be compared to the Existing Conditions results; variations in quantity and rate of stormwater discharge between these models will represent the hydrologic impact generated by the proposed development. The overall stormwater management plan will be designed utilizing this information. Section 3 assumes current land use within the tributary sub-watersheds, and pre-development conditions within the project boundary. Section 4 assumes completion of the entire development. The program used is Autodesk Storm & Sanitary Analysis 2022 (SSA).

The following methods were used in this study to model Existing, Proposed (Micro) and Future (Macro) Conditions in for stormwater runoff:

- NRCS TR-55 Unit Hydrograph Method
- 1-, 10-, and 100-year Return Frequency, 24-hr. Storm Precip. Depths NOAA Atlas 14
- ARC Type II Soil Moisture Conditions
- 24-Hour NRCS Type II Rainfall Distribution
- Runoff Curve Numbers per NRCS TR-55 (Tables 2-2a - 2-2c) and KCAPWA Section 5602.3
- NRCS TR-55 Methods for determination of Time of Concentration and Travel Time.

*NOTE: SSA models use "Time of Concentration" rather than "Lag Time" for computing subarea hydrology.*

City code follows the February 16, 2011 version of APWA 5600, requiring comprehensive control to reduce flows to maximum allowable release rates. However, after conversations with the city, reaching maximum allowable release rates will cause an undue burden on the project, and a goal has been set of reducing post-development flows to pre-development rates.

Stormwater runoff models were created for the 1%, 10%, and 100% design storm events. The precipitation depths used in the analyses have been interpolated from the NOAA Atlas 14, Volume 8, Version 2. The following Table 2 summarizes the rainfall depths used in this analysis:

**Table 2. Precipitation Depths.**

Return Period	24-Hour Precipitation Depth (in.)
Water Quality Volume	1.37
1-Year (100% Storm)	3.10
2-Year (50% Storm)	3.71
10-Year (10% Storm)	5.67
100-Year (1% Storm)	9.25

### 3. EXISTING CONDITIONS

To quantify the effects of development of this project, the following area and point of interest has been used for Existing and Proposed Conditions analyses. See Exhibit 301 in Appendix A, Existing Conditions Drainage Area Map.

**Watershed A** is the watershed from the entire site. The Downtown Market site has an existing box culvert travelling through the site that receives water from the entire watershed area, approximately 133 acres. 100% of the site discharges into the box culvert. The entirety of the watershed was analyzed in a previous storm study. For the purpose of this study, only the on-site area will be analyzed for impacts from proposed developments. The entire site flows into multiple inlets, which ultimately discharge into the storm box culvert. Thus, a single point is chosen as the outfall, which is location where all flows from the site have discharged into the box.

The following table summarizes the results of the Existing Conditions analysis. The Proposed Conditions data will be compared to these results in Section 4 of this report. Refer to Appendix C for output from and a schematic of the Existing Conditions model.

Curve Numbers (CN) were assumed as follows:

**Table 3-1. Lee's Summit Downtown Market – Existing Conditions Subarea**

Cover Type	Soil Type	CN Value
Impervious Pavement	Any	98
Turf	D	84

The following tables summarize the results of the Existing Conditions analysis. With the prevalence of public storm sewer inlets around the site along with the majority of the site being impervious, a time of concentration (T<sub>c</sub>) of 5 minutes is chosen.

**Table 3-2. Lee's Summit Downtown Market – Existing Conditions Subarea**

Subarea	Area (acres)	T <sub>c</sub> (minutes)	Weighted Curve Number
A	6.43	5	93.49

**Table 3-3 Lee's Summit Downtown Market – Existing Conditions Subarea Results**

Subarea	Q <sub>1</sub> (cfs)	V <sub>R-1</sub> (ac-ft)	Q <sub>2</sub> (cfs)	V <sub>R-2</sub> (ac-ft)	Q <sub>10</sub> (cfs)	V <sub>R-10</sub> (ac-ft)	Q <sub>100</sub> (cfs)	V <sub>R-100</sub> (ac-ft)
A-1	23.44	1.285	28.86	1.602	46.07	2.633	77.03	4.537

\* cfs – cubic feet per second

## 4. PROPOSED CONDITIONS

This section of analysis assumes completion of the Lee's Summit Downtown Market site. In construction of these plans, several lots are undeveloped and their exact usage is to be determined. To ensure the detention meets all requirements, all undeveloped lots are assumed to have a CN of 98 (assuming 100% impervious surface) for this model, ensuring the future lots will not exceed the CN value given in this report. The mixed-use site includes construction of a multi-story apartment complex, open-air market area, commercial buildings, and associated parking and utilities.

The proposed development will result in no changes in overall tributary areas on the site. The development to occur on the site will increase the amount of impervious surface on the site. As a result of the increase in impervious surfaces, the CN value is increased, and thus the peak flows onsite are increased. To mitigate the increase in flows, detention must be installed on site. Due to the small site area and the lack of open space, an above ground detention basin will be infeasible, and underground detention in the form of isolator rows are proposed. To accurately model this, the area has been divided into three subareas, labeled **Pad Site 2**, **Farmers Market Roof**, and **A\_Undetained** in Proposed Drainage Area Map EX-302 (See Appendix A.)

**A\_Undetained** represents the area that will not enter the isolator row system, while **Pad Site 2** represents the area flowing into the isolator row system from Pad Site 2, while **Farmer's Market** represents the area that will be picked up by roof drains on the Farmer's Market building and the canopy. **Canopy and Pad Site 2** and **Farmer's Market** areas will both be treated by Isolator Rows.

The following tables summarize the results of the Proposed Conditions analysis for the revised subareas within Watershed A. Tables 4-2 and 4-3 assume no detention is provided, to demonstrate the effects of development in this watershed. Refer to Appendix C for outputs from the Proposed Conditions SSA model.

**Table 4-1. Lee's Summit Downtown Market –Proposed Conditions Subarea Data**

Subarea	Area (acres)	T <sub>c</sub> (minutes)	Weighted Curve Number
A_Undetained	5.52	5	95.85
Farmers Market Roof	0.71	5	98
Pad Site 2	0.20	5	98

**Table 4-2 Lee's Summit Downtown Market –Proposed (No Detention) Conditions Subarea**

Subarea	Q <sub>1</sub> (cfs)	V <sub>R-1</sub> (ac-ft)	Q <sub>2</sub> (cfs)	V <sub>R-2</sub> (ac-ft)	Q <sub>10</sub> (cfs)	V <sub>R-10</sub> (ac-ft)	Q <sub>100</sub> (cfs)	V <sub>R-100</sub> (ac-ft)
A_Undetained	21.80	1.235	26.44	1.517	41.25	2.428	68.04	4.098
Farmer's Market Roof	2.45	0.145	2.94	0.176	4.52	0.275	7.40	0.456
Pad Site 2	0.80	0.047	0.96	0.057	1.48	0.090	2.42	0.149

**Results****Table 4-3 Lee's Summit Downtown Market –Proposed (No Detention) Conditions Outfall Results**

Outfall	Q <sub>1</sub> (cfs)	V <sub>R-1</sub> (ac-ft)	Q <sub>2</sub> (cfs)	V <sub>R-2</sub> (ac-ft)	Q <sub>10</sub> (cfs)	V <sub>R-10</sub> (ac-ft)	Q <sub>100</sub> (cfs)	V <sub>R-100</sub> (ac-ft)
A	25.04	1.428	30.33	1.751	47.22	2.79	77.82	4.704

The following table compares the results of the Proposed Conditions analysis to the Existing Conditions from Section 3 at Outfall A. Positive values indicate an increase from Existing to Proposed conditions, while negative values indicate a decrease.

**Table 4-4. Lee's Summit Downtown Market –Proposed (No Detention) vs. Existing Conditions Point of Interest Comparison**

Point of Interest	Q <sub>1</sub> (cfs)	V <sub>R-1</sub> (ac-ft)	Q <sub>2</sub> (cfs)	V <sub>R-2</sub> (ac-ft)	Q <sub>10</sub> (cfs)	V <sub>R-10</sub> (ac-ft)	Q <sub>100</sub> (cfs)	V <sub>R-100</sub> (ac-ft)
<b>Outfall A</b>	+1.60	+1.143	+1.47	+0.149	+1.15	+0.157	+0.79	+0.167

As can be seen in the previous table, the flows increase with no detention. To mitigate the increases shown in the previous table, detention will be provided within the previously undeveloped area, to be constructed as part of the private development. Detention is intended to be constructed via underground isolator rows that will treat flows from the proposed developed site. Drainage areas for the proposed isolator rows can be found in Exhibit EX-302. To account for the increased flows on site, two systems of ADS MC3500 chambers are proposed to reduce the increase of stormwater flow to pre-development levels. The chambers will be restricted by a weir plate set in a junction box to restrict flows into the chamber system.

The table below shows results for the proposed isolator rows.

**Table 4-5. Lee's Summit Downtown Market – Proposed Conditions Detention Flow and Volume Results**

Storm Event	Peak Q In (cfs)	TP In (hr)	Peak Q Out (cfs)	TP Out (hr)	Peak W.S.E. (ft)	Stored Volume (ac-ft)
Pad Site 2 (10 Chambers)						
1-Year	0.80	11.93	0.39	12.07	1006.08	0.016
2-Year	0.96	11.93	0.44	12.07	1006.34	0.019
10-Year	1.48	11.93	0.60	12.08	1007.27	0.028
100-Year	2.41	11.93	1.92	12.05	1008.70	0.038
Farmers Market Roof (14 Chambers)						
1-Year	2.86	11.93	1.76	12.06	1008.08	0.036
2-Year	3.44	11.93	2.03	12.06	1008.67	0.043
10-Year	5.28	11.93	4.61	12.04	1010.28	0.058
100-Year	8.64	11.93	8.62	11.94	1010.59	0.059

The following table shows the results of the points of interest that are impacted by the constructed detention chambers.

**Table 4-6. Lee's Summit Downtown Market –Proposed (With Detention) Conditions Point of Interest Results**

Outfall	Q <sub>1</sub> (cfs)	V <sub>R-1</sub> (ac-ft)	Q <sub>2</sub> (cfs)	V <sub>R-2</sub> (ac-ft)	Q <sub>10</sub> (cfs)	V <sub>R-10</sub> (ac-ft)	Q <sub>100</sub> (cfs)	V <sub>R-100</sub> (ac-ft)
A	23.14	1.417	27.95	1.740	43.23	2.782	75.96	4.692

The following table compares the results of the Proposed Conditions analysis with the detention described above to the Existing Conditions from Section 3.

**Table 4-7. Lee's Summit Downtown Market –Proposed (With Detention) vs. Existing Conditions Point Data**

Subarea	Q <sub>1</sub> (cfs)	V <sub>R-1</sub> (ac-ft)	Q <sub>2</sub> (cfs)	V <sub>R-10</sub> (ac-ft)	Q <sub>10</sub> (cfs)	V <sub>R-10</sub> (ac-ft)	Q <sub>100</sub> (cfs)	V <sub>R-100</sub> (ac-ft)
Existing	23.44	1.285	28.86	1.602	46.07	2.633	77.03	4.537
Proposed	23.14	1.417	27.95	1.740	43.23	2.782	75.96	4.692
Difference	-0.30	+0.132	-0.91	+0.138	-2.84	+0.149	-1.07	+0.155

As shown in the table above, the proposed underground isolator systems reduce flows in the 1-, 2-, 10- and 100-year storms to below pre-development conditions at Outfall A.

## 5. RESULTS

As shown in the discussion and tables in the previous sections, the proposed underground detention system adequately reduces the peak stormwater rates and do not negatively impact downstream areas. Table 6-1 below, summarizes the Proposed Conditions results and compares them with Existing conditions.

**Table 5-1 Lee's Summit Downtown Market –Points of Interest Discharge Comparison**

Outfall	Condition	Q <sub>1</sub> (cfs)	Q <sub>2</sub> (cfs)	Q <sub>10</sub> (cfs)	Q <sub>100</sub> (cfs)
Outfall A	Existing	23.44	28.86	46.07	77.03
	Proposed	23.14	27.95	43.23	75.96
	Difference	-0.30	-0.91	-2.84	-1.07

## **6. CONCLUSION**

This Preliminary Development Plan Stormwater Drainage Study has been prepared for the proposed project to establish a comprehensive stormwater management plan for the site. The results of this analysis demonstrate that the proposed stormwater management plan for the project achieves compliance the stated goal of reducing peak flows for the 1-year, 2-year, 10-year and 100 year storm events to below the existing peak flow rates. As mentioned in Section 2, a waiver is requested to achieve pre-vs-post reduction, without achieving allowable rates, per APWA 2011. Based on information received, Olsson requests that this stormwater drainage report be approved.

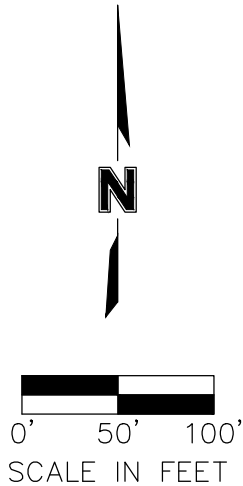
# **APPENDIX A**

## Exhibits

DWG: F:\2022\00001-00500\022-00393\40-Design\Reports\GNCV\PDP Storm Study\Appendix A - Exhibit\Micro Existing Drainage Areas.dwg  
DATE: Aug 28, 2023 9:55am XREFS: V\_XTOP0\_02200393 STORM\_LINES\_ExportCAD C\_PSTRM\_02200393 L\_PBASE\_02200393



LAND COVER LEGEND		
	TREATMENT	AREA (AC.)
	OPEN TURF	1.61
	IMPERVIOUS	4.82



PROJECT NO: 022-03930  
DRAWN BY: DFG  
DATE: 08/23/2023

EXISTING CONDITIONS DRAINAGE AREA MAP

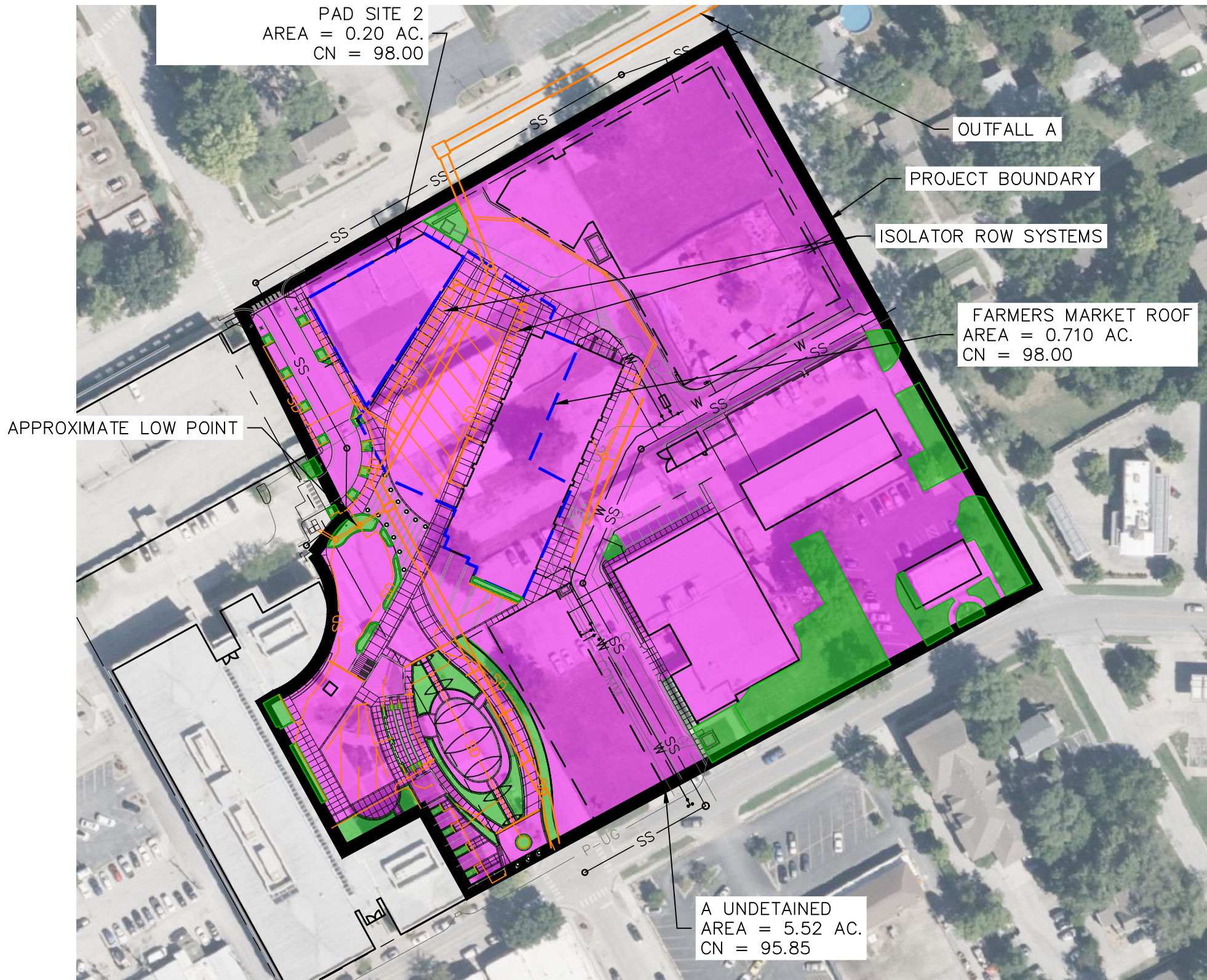
**olsson**

OLSSON - CIVIL ENGINEERING  
MISSOURI CERTIFICATE OF AUTHORITY #  
1301 Burlington Street  
North Kansas City, MO 64116  
TEL 816.361.1177

EXHIBIT

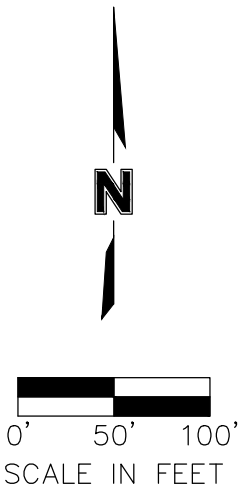
EX-301

DWG: F:\2022\00001-00500\022-00393\40-Design\Reports\GNCV\Storm Study\FDP Storm Study\Revision 1\Appendix A - Exhibit\Micro Pro  
DATE: Dec 20, 2023 2:23pm XREFS: L\_PBASE\_02200393 C\_PUTIL\_02200393



LAND COVER LEGEND		
	TREATMENT	AREA (AC.)
	OPEN TURF	0.66
	IMPERVIOUS	5.77

--- DENOTES BOUNDARY OF FLOWS TO ISOLATOR ROWS



PROJECT NO:	022-03930
DRAWN BY:	DFG
DATE:	12/13/2023

PROPOSED CONDITIONS DRAINAGE AREA MAP

**olsson**

OLSSON - CIVIL ENGINEERING  
MISSOURI CERTIFICATE OF AUTHORITY #  
1301 Burlington Street  
North Kansas City, MO 64116  
TEL 816.361.1177

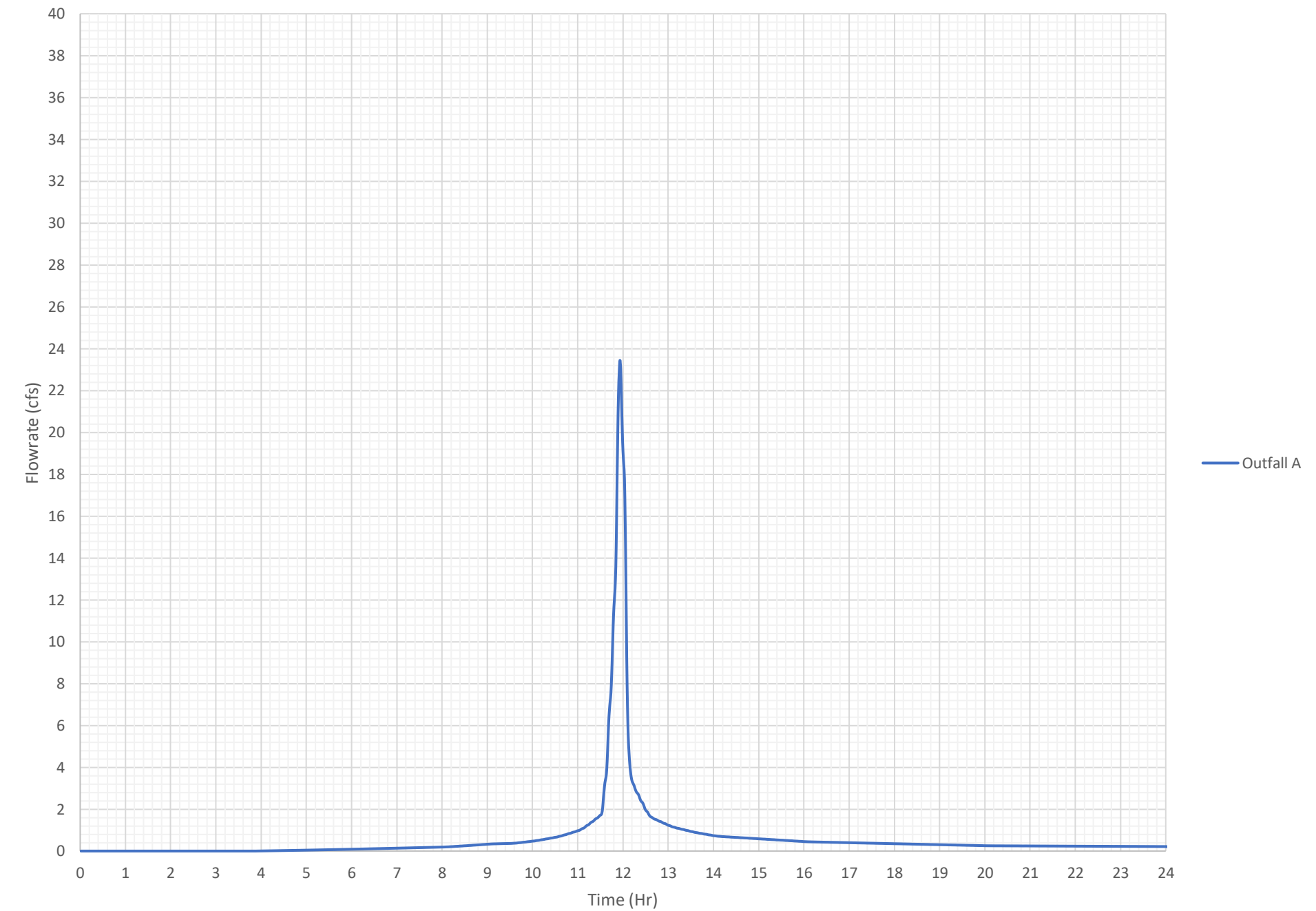
EXHIBIT

EX-302

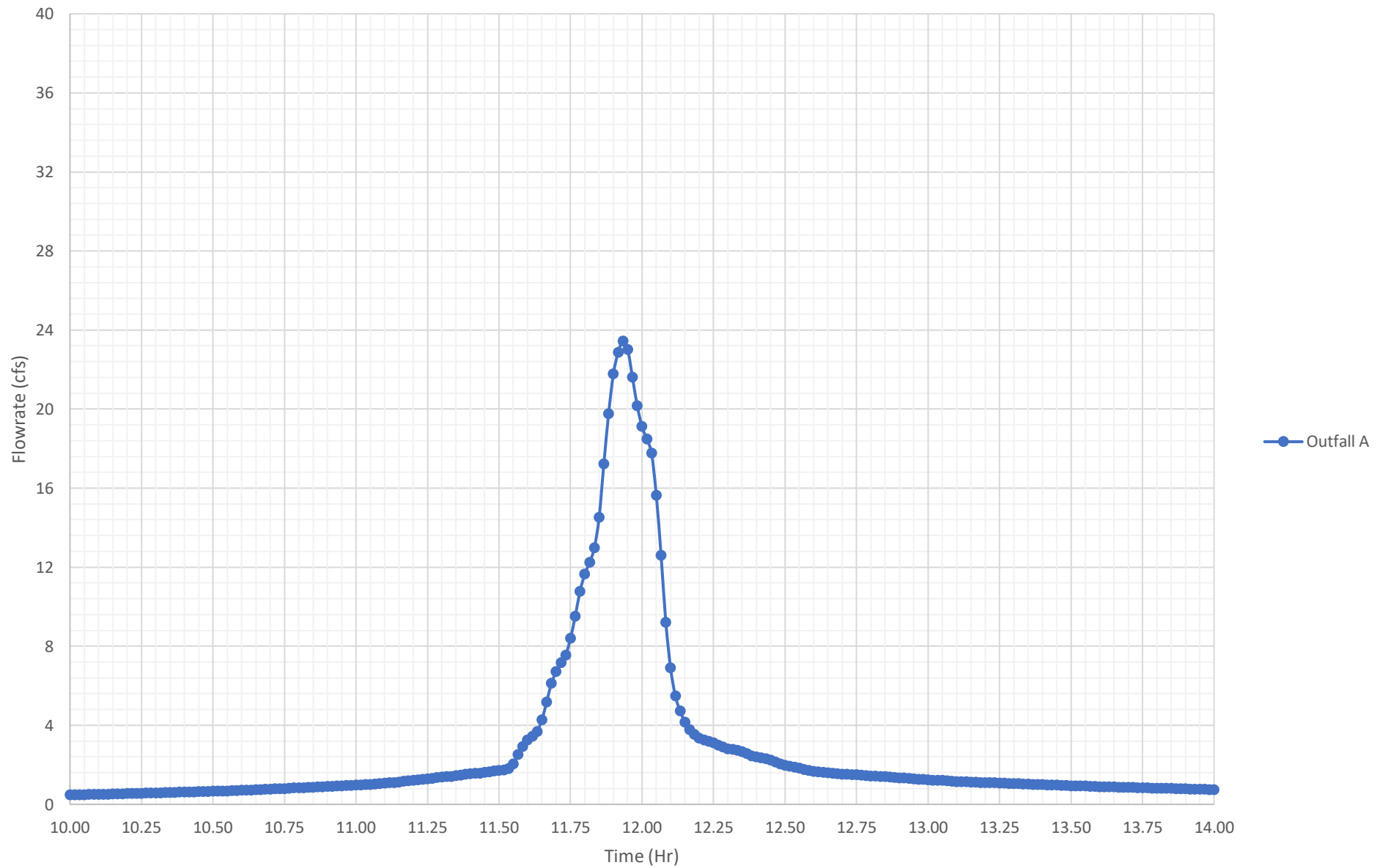
## **APPENDIX B**

### Hydrographs

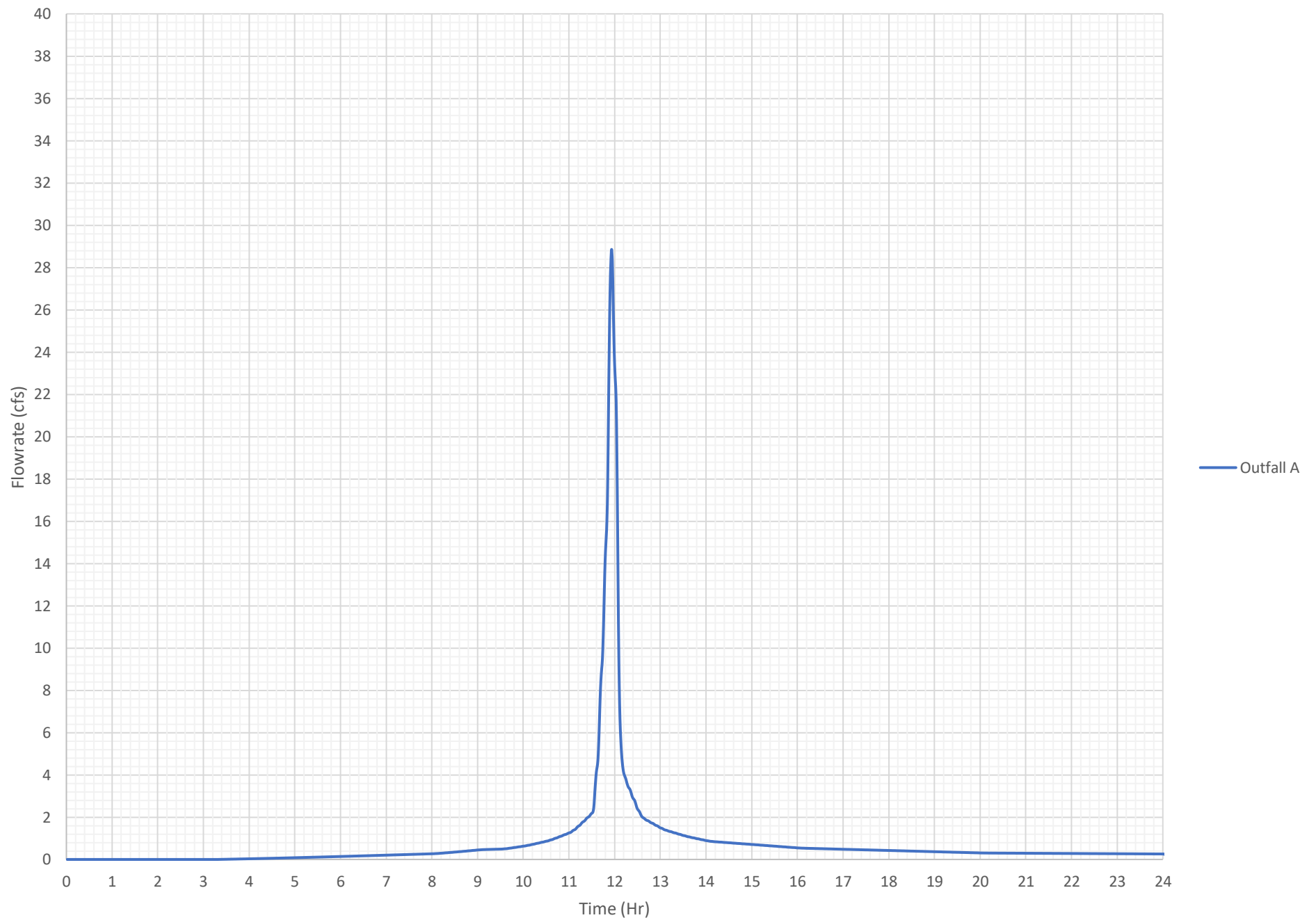
Existing Peak 24-Hr 100% Flowrates



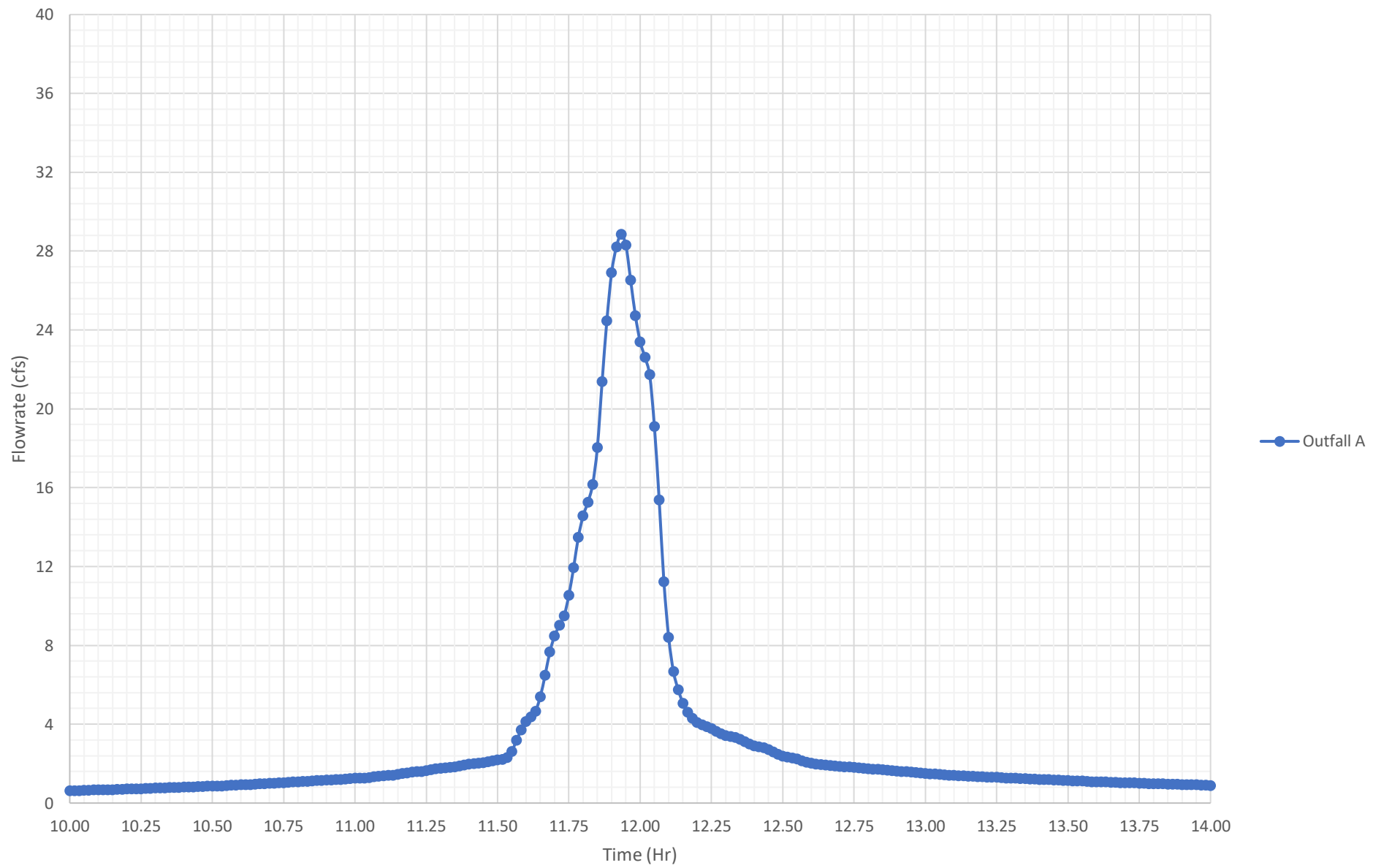
Existing Peak 4-Hr 100% Flowrates



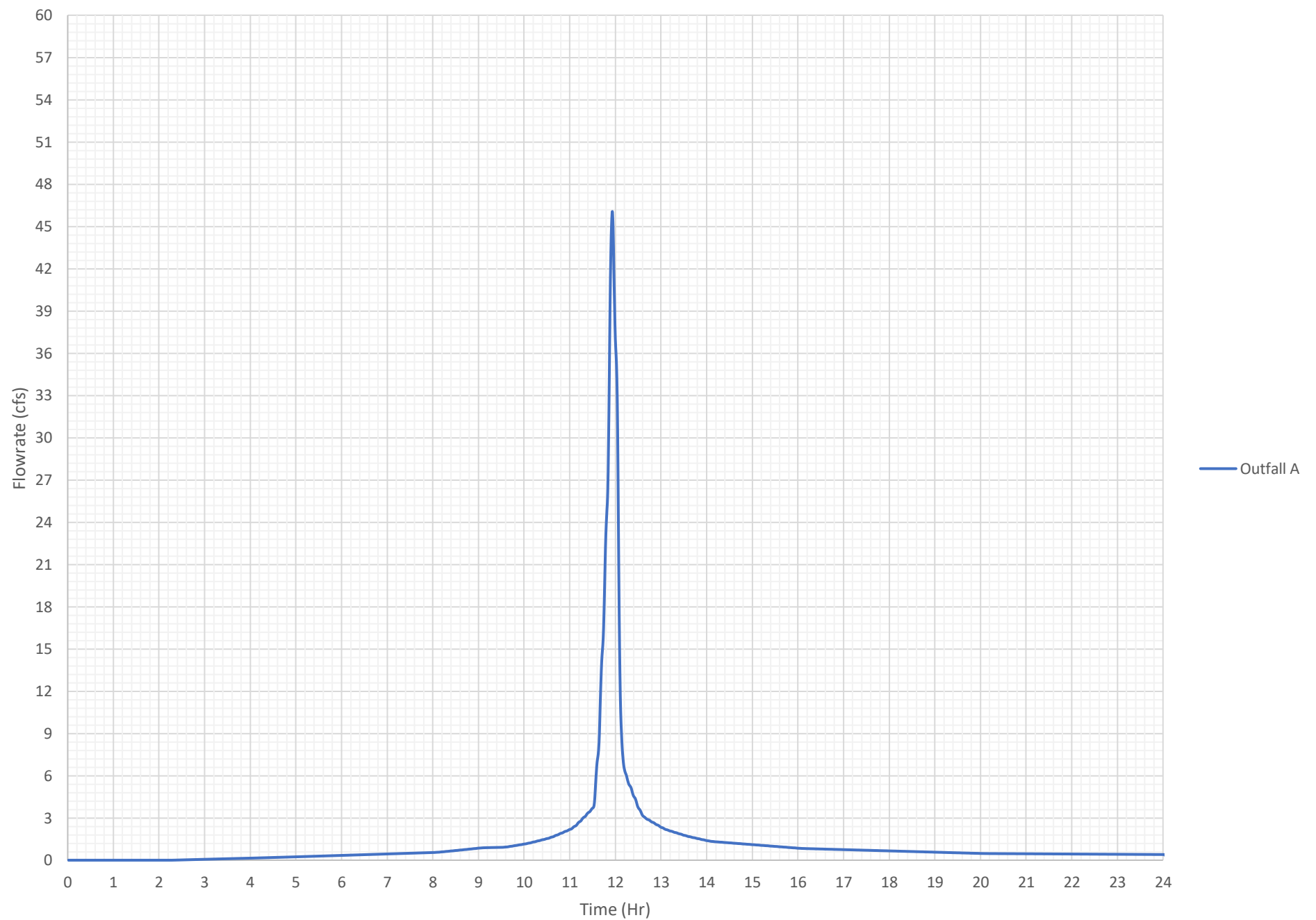
Existing Peak 24-Hr 50% Flowrates



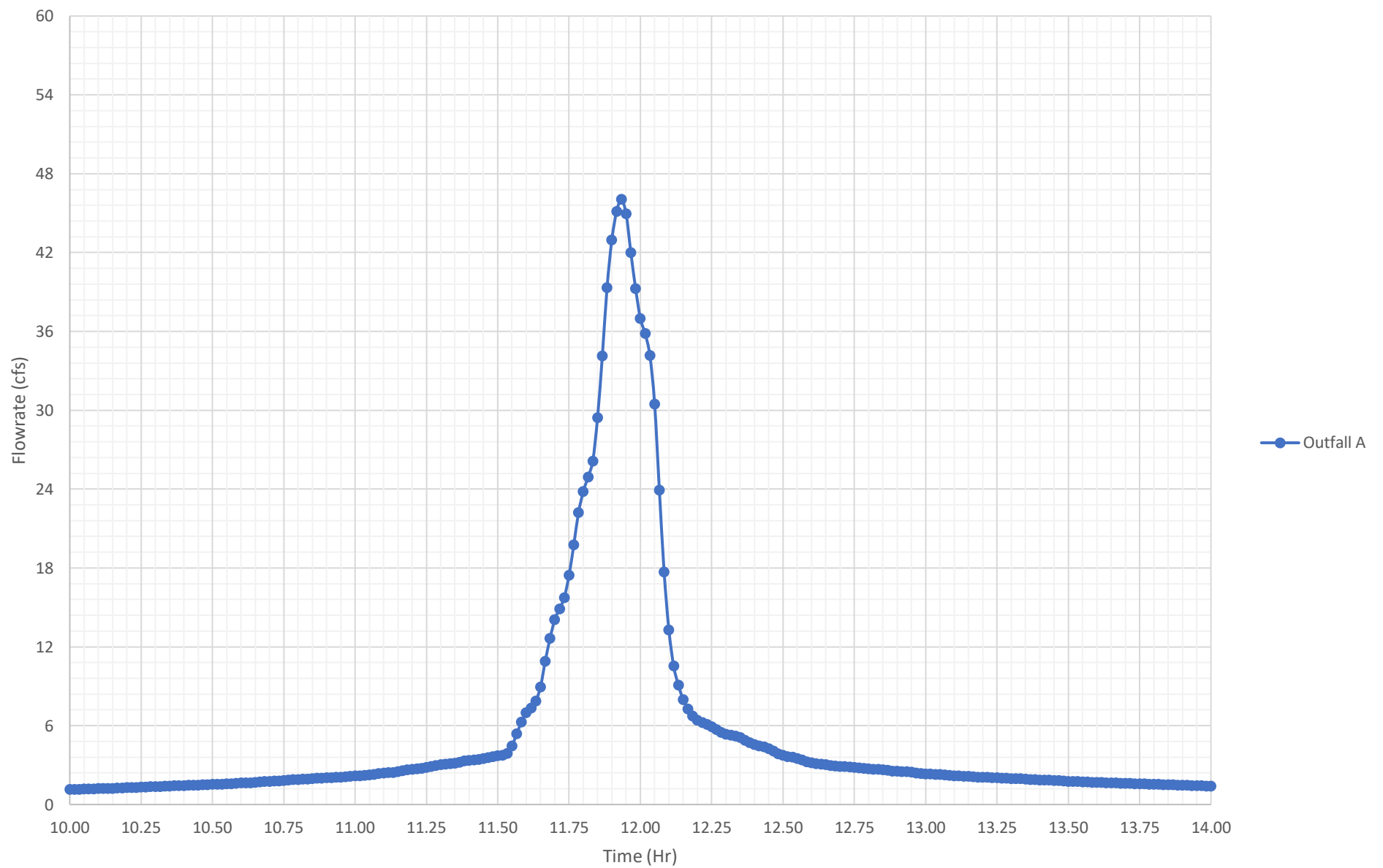
Existing Peak 4-Hr 50% Flowrates



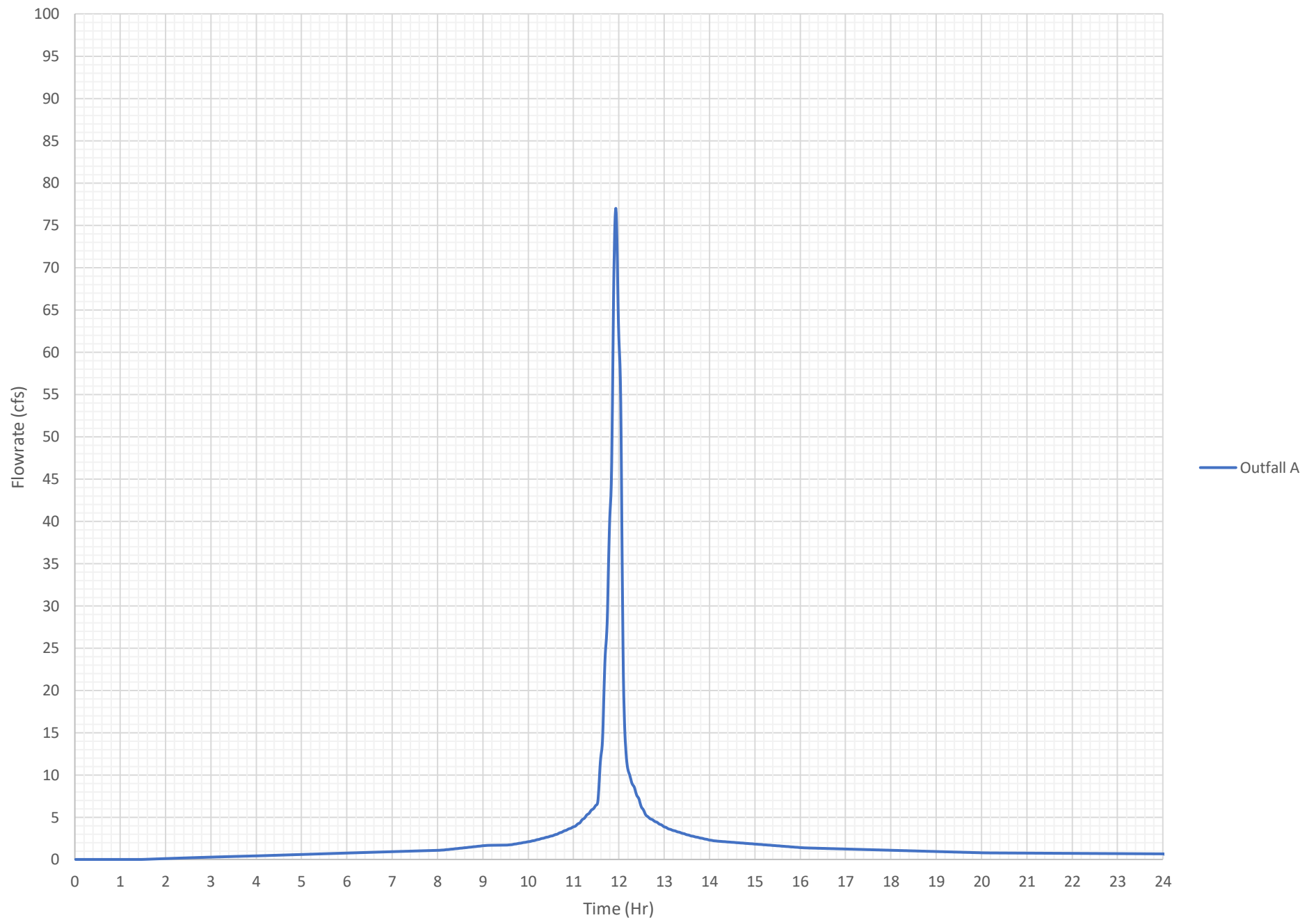
Existing Peak 24-Hr 10% Flowrates



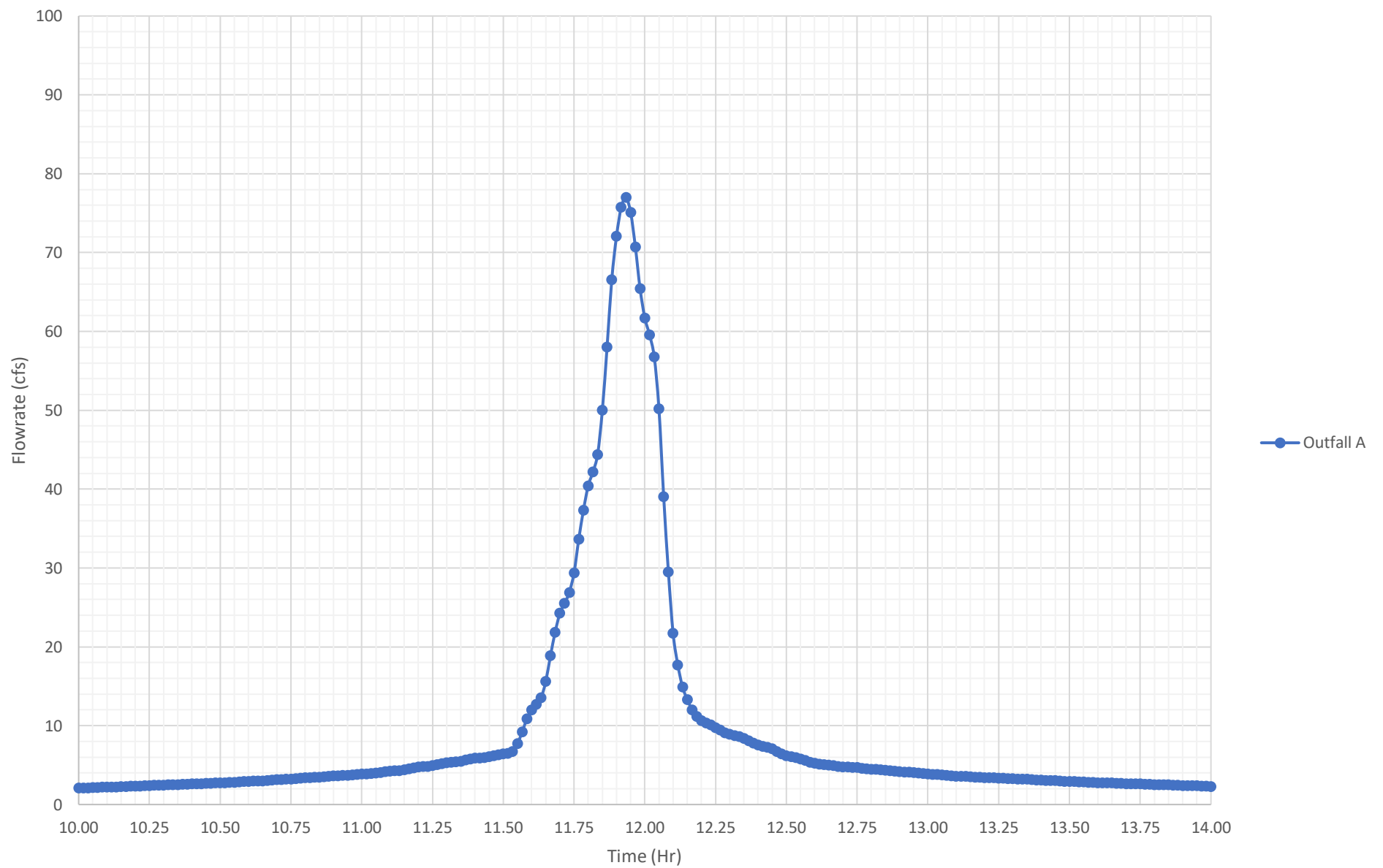
Existing Peak 4-Hr 10% Flowrates



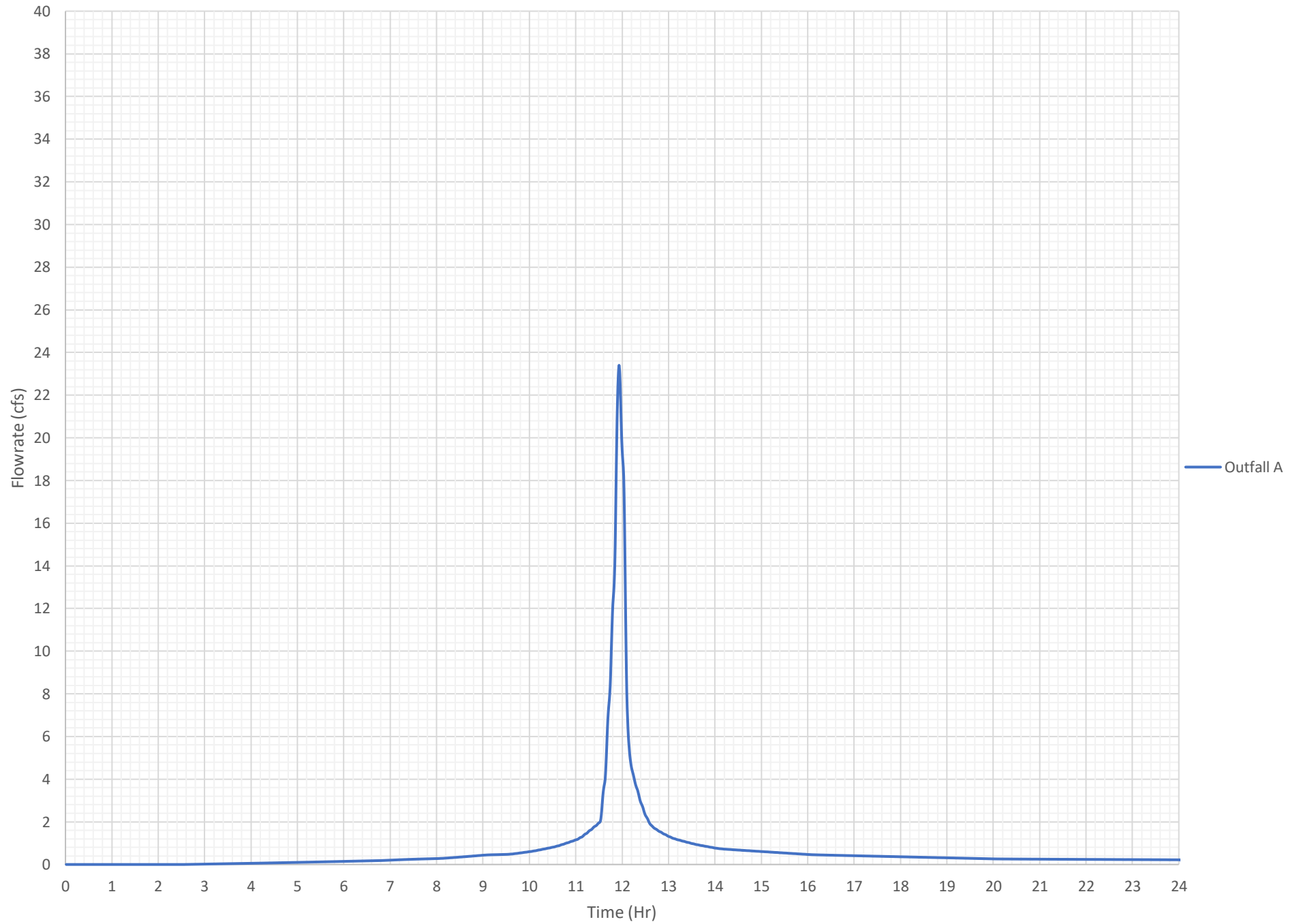
Existing Peak 24-Hr 1% Flowrates



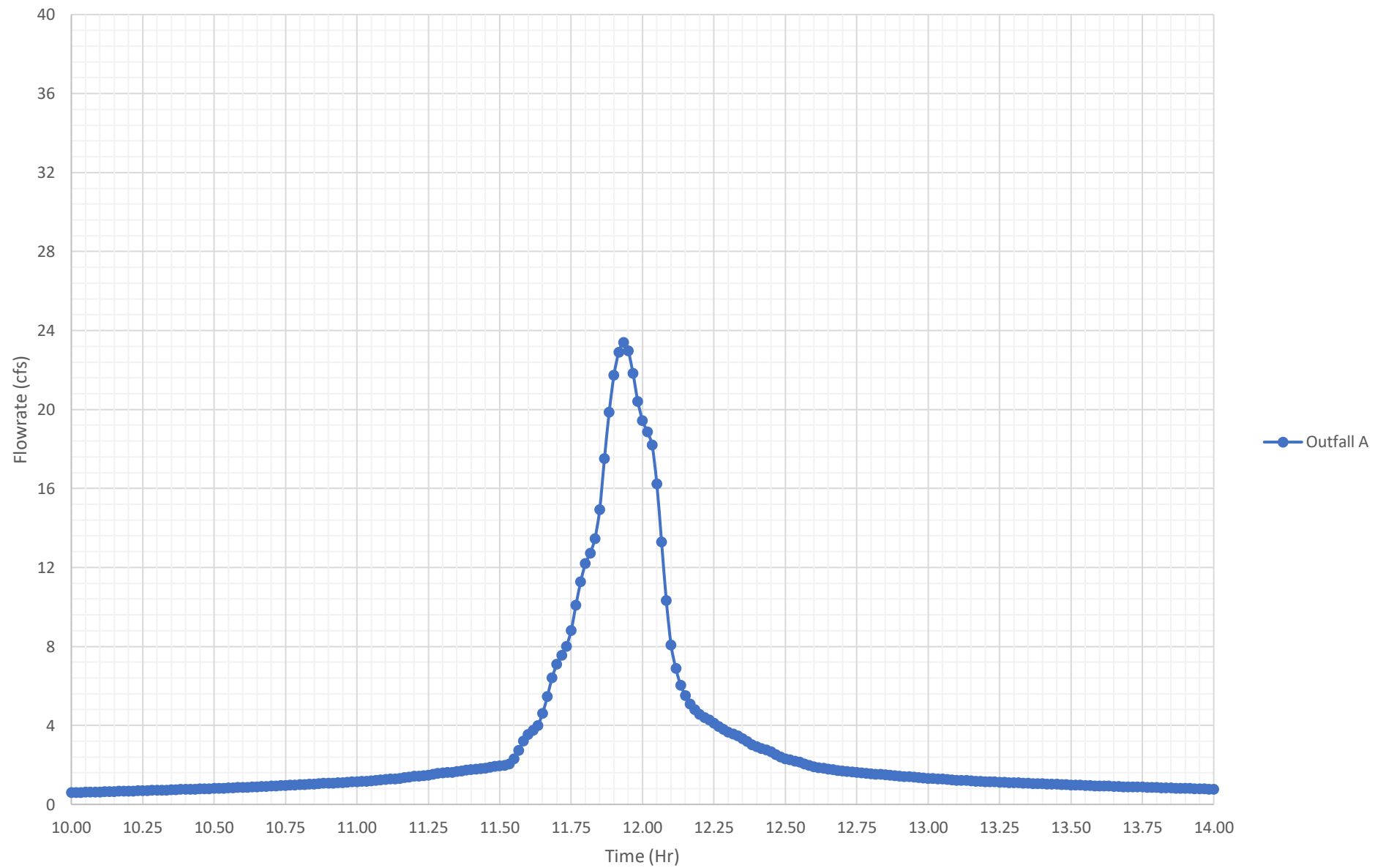
Existing Peak 4-Hr 1% Flowrates



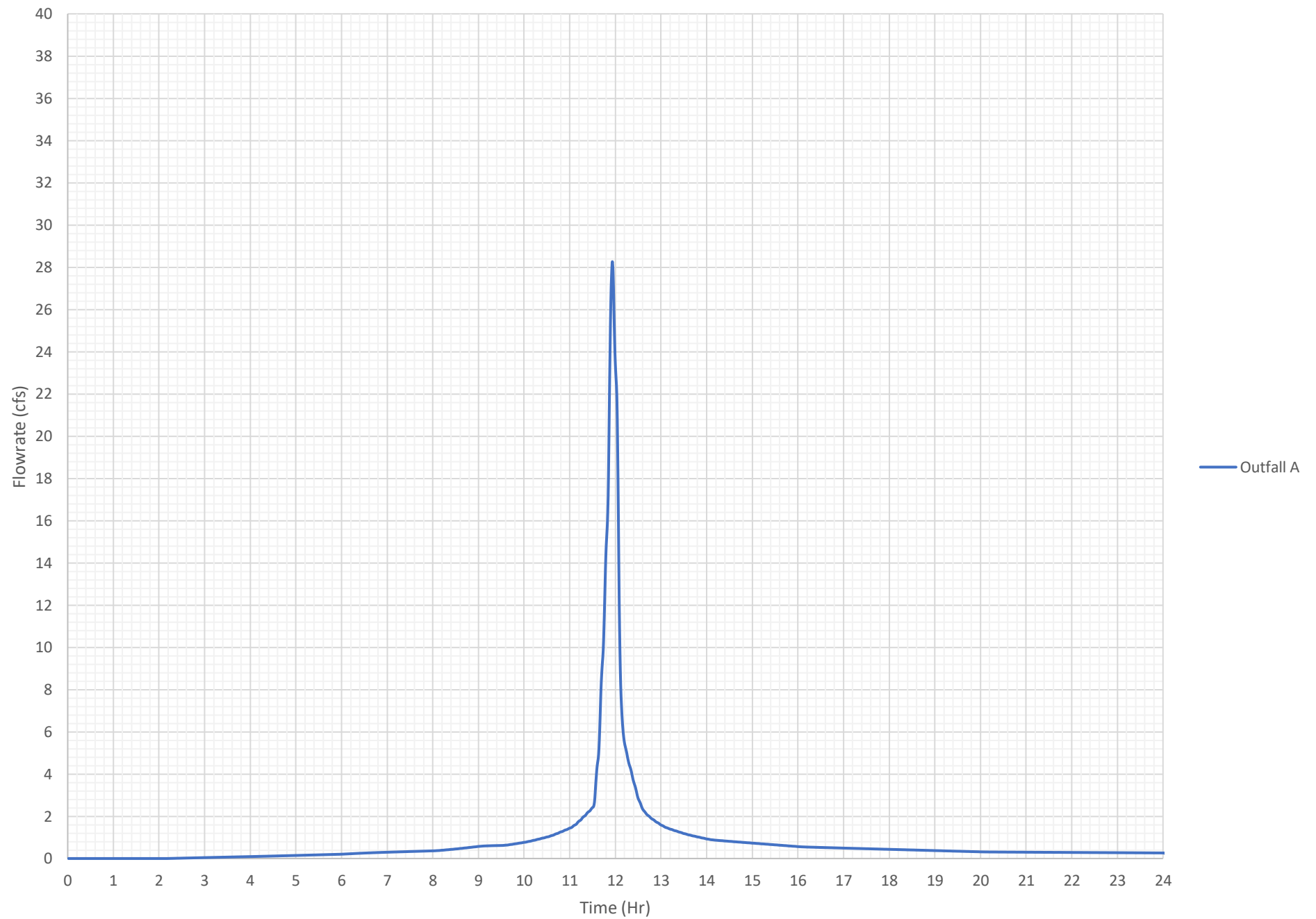
Proposed Peak 24-Hr 100% Flowrates



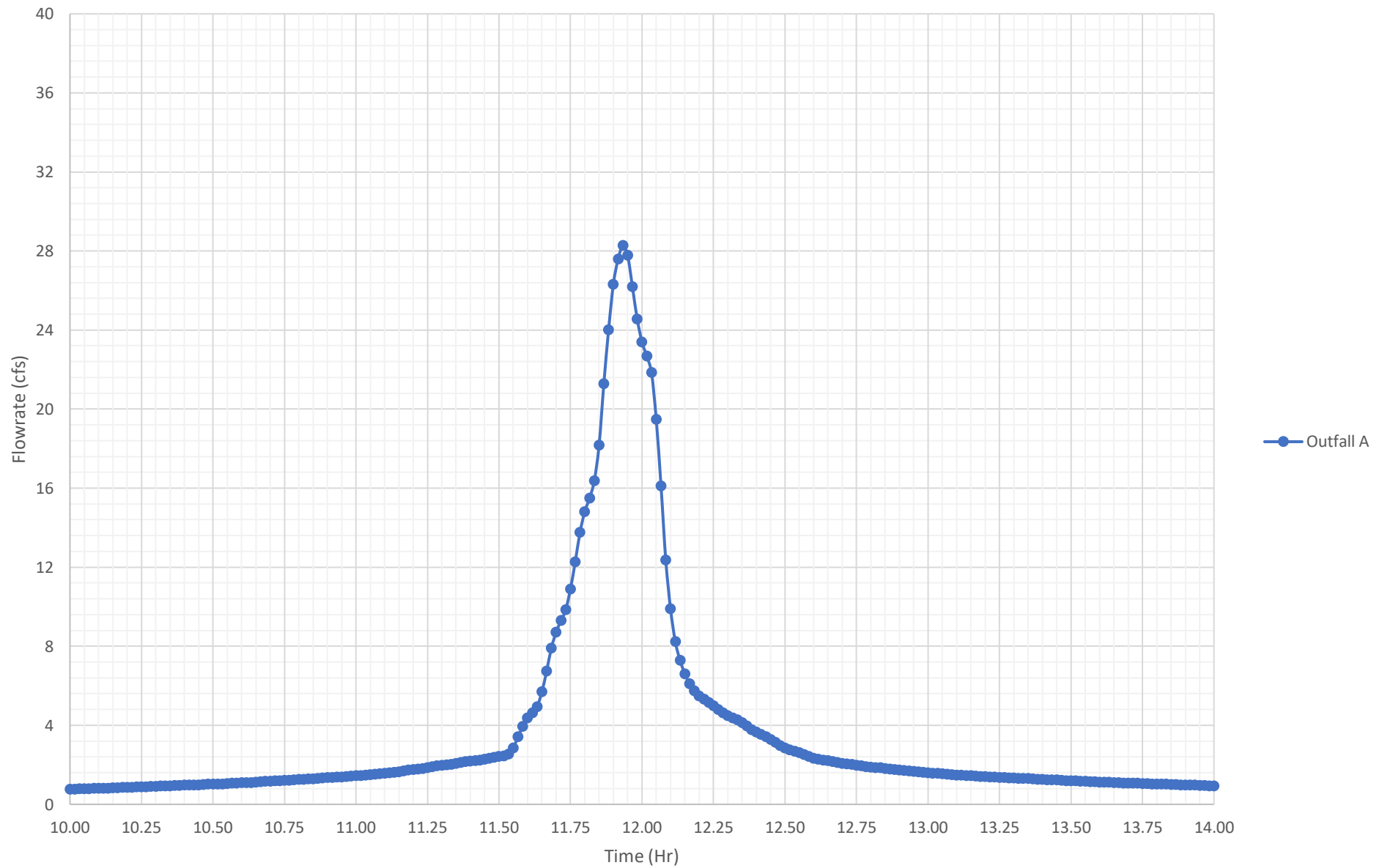
Proposed Peak 4-Hr 100% Flowrates



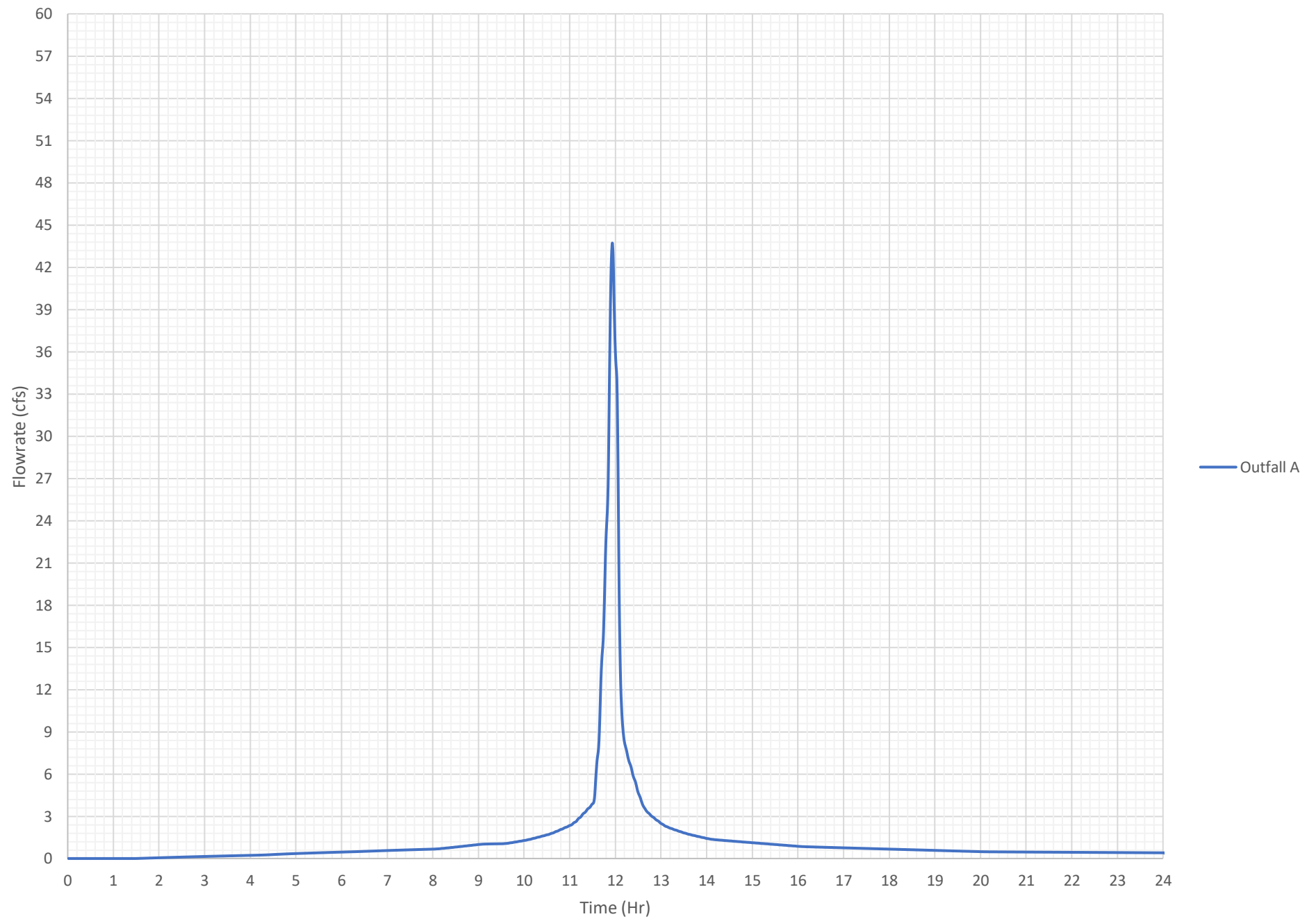
Proposed Peak 24-Hr 50% Flowrates



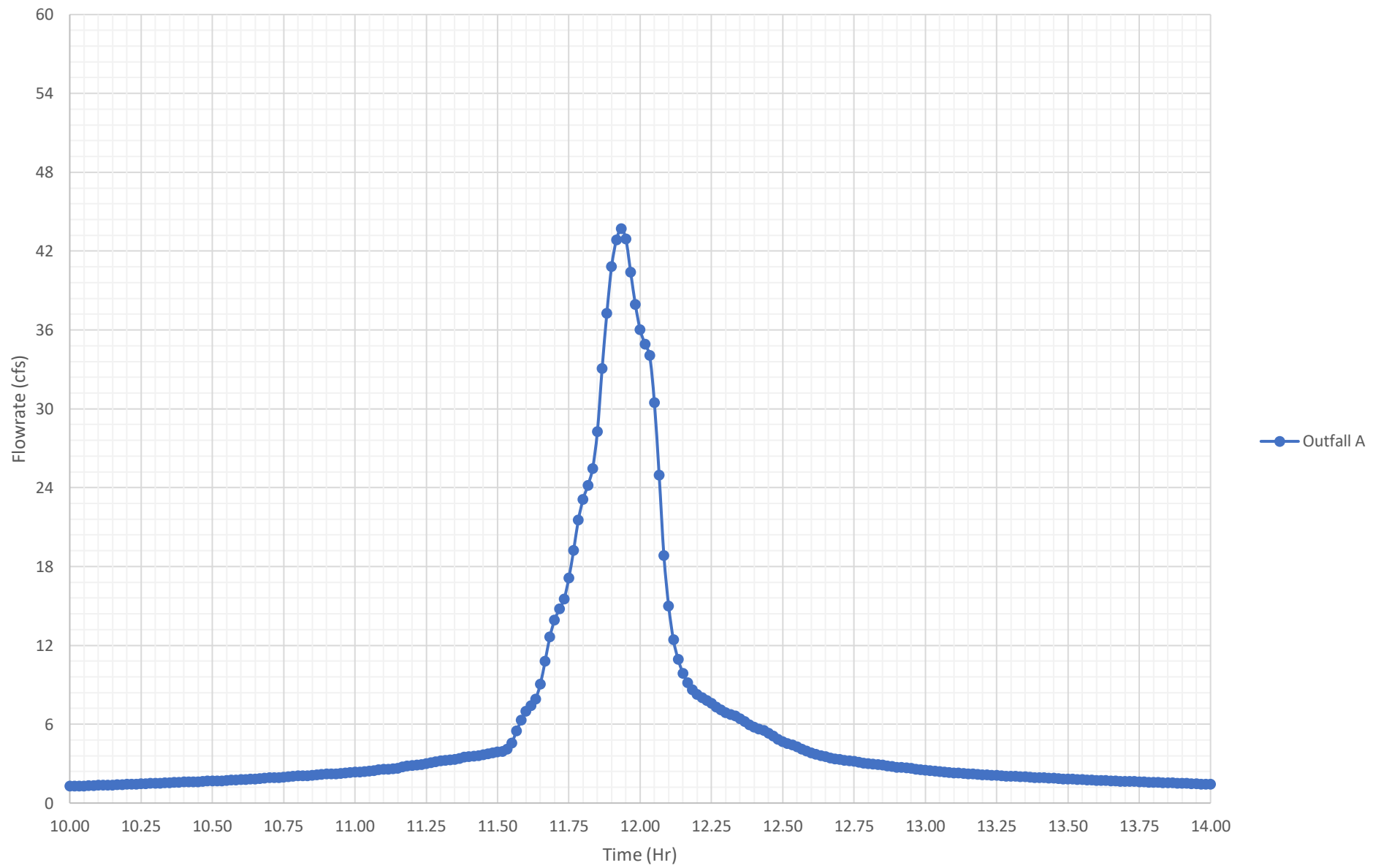
Proposed Peak 4-Hr 50% Flowrates



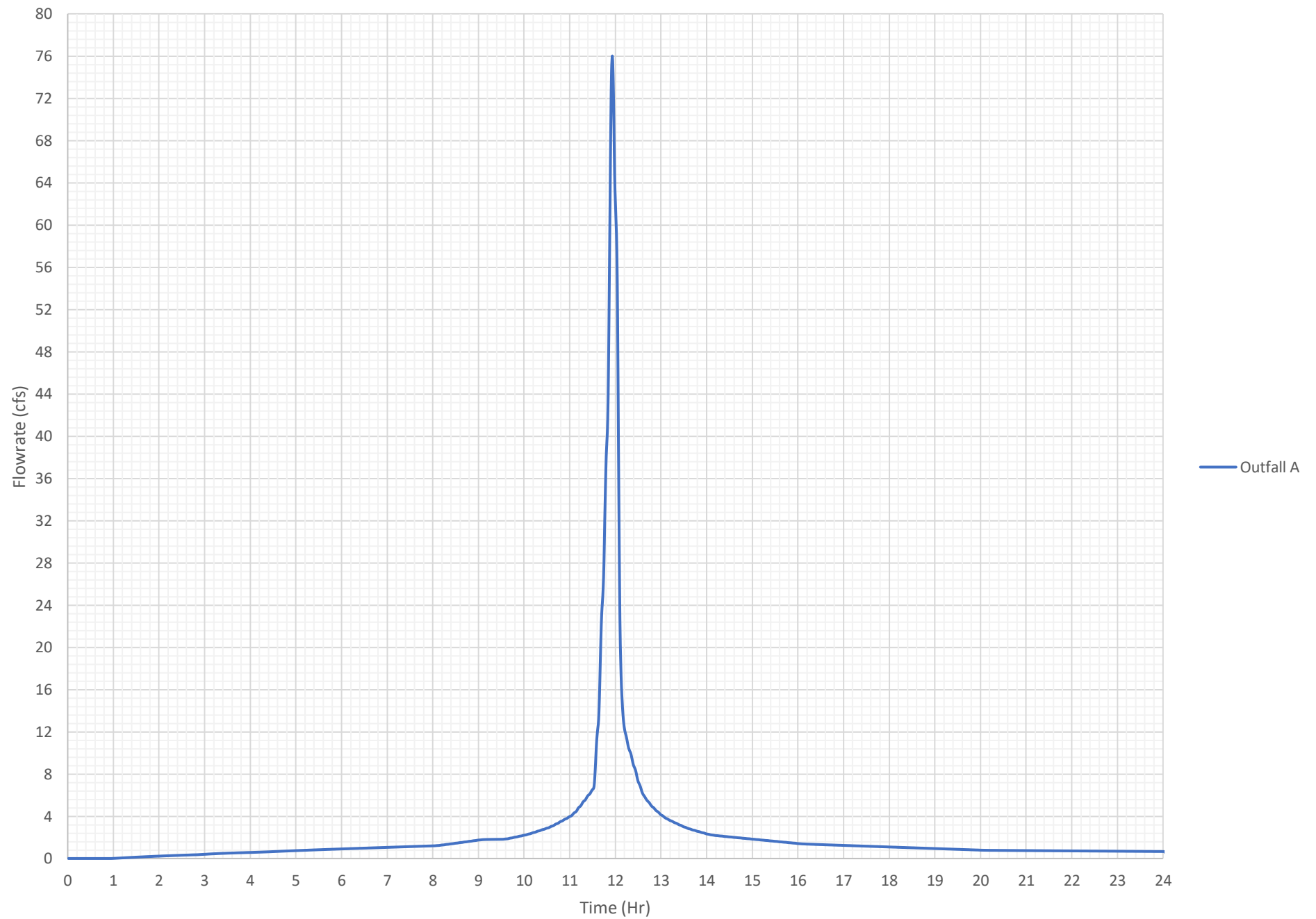
Proposed Peak 24-Hr 10% Flowrates



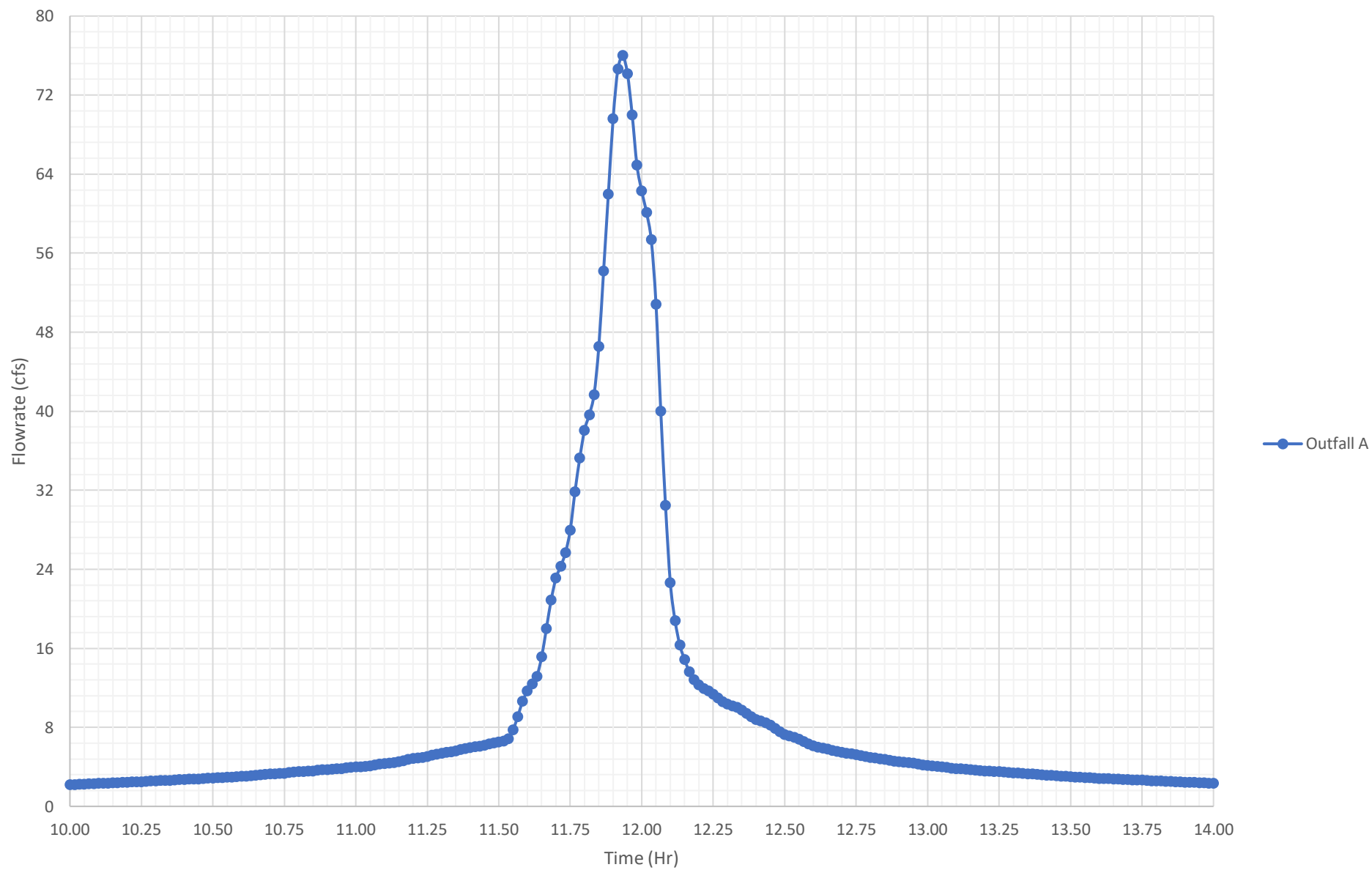
Proposed Peak 4-Hr 10% Flowrates



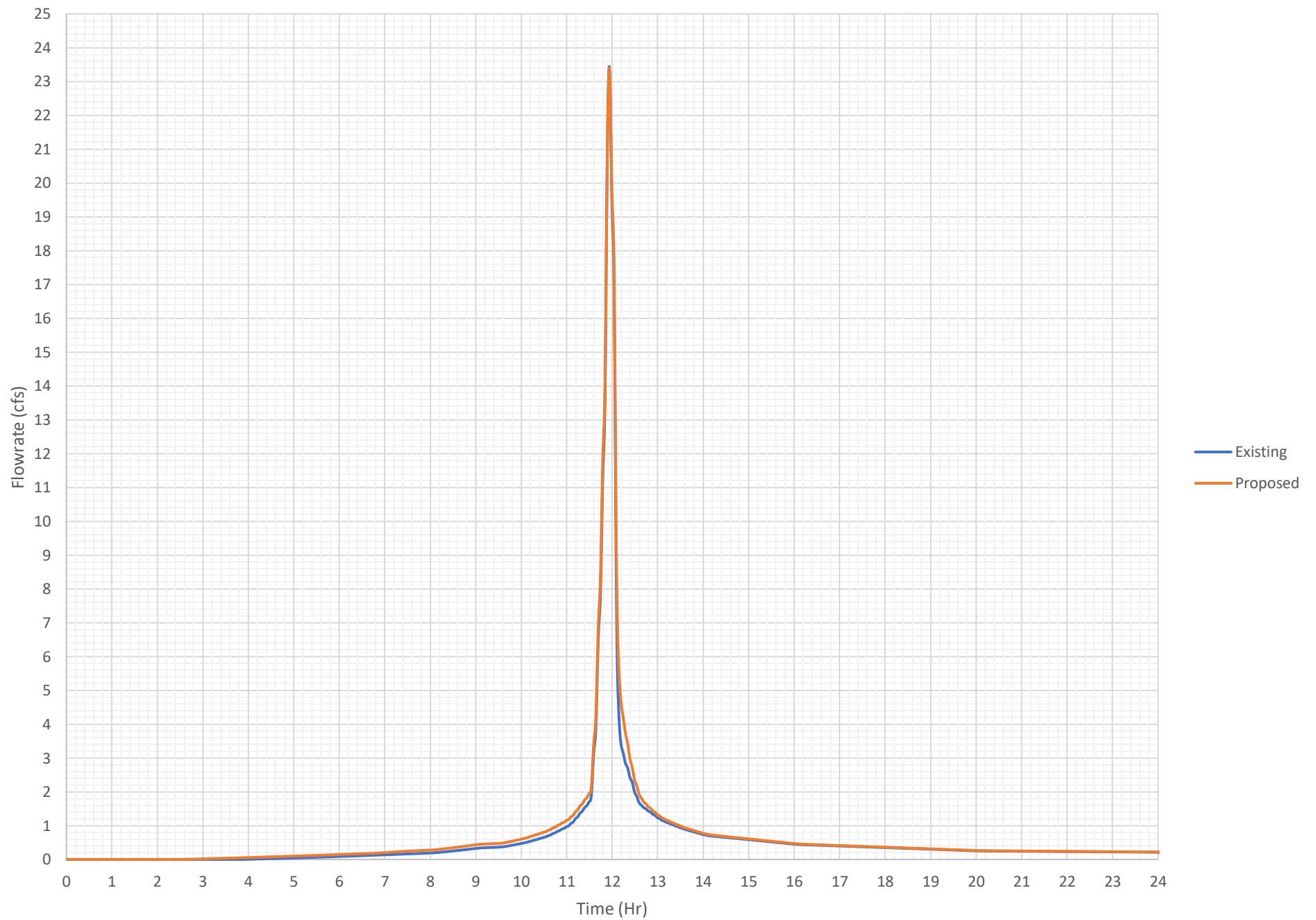
Proposed Peak 24-Hr 1% Flowrates



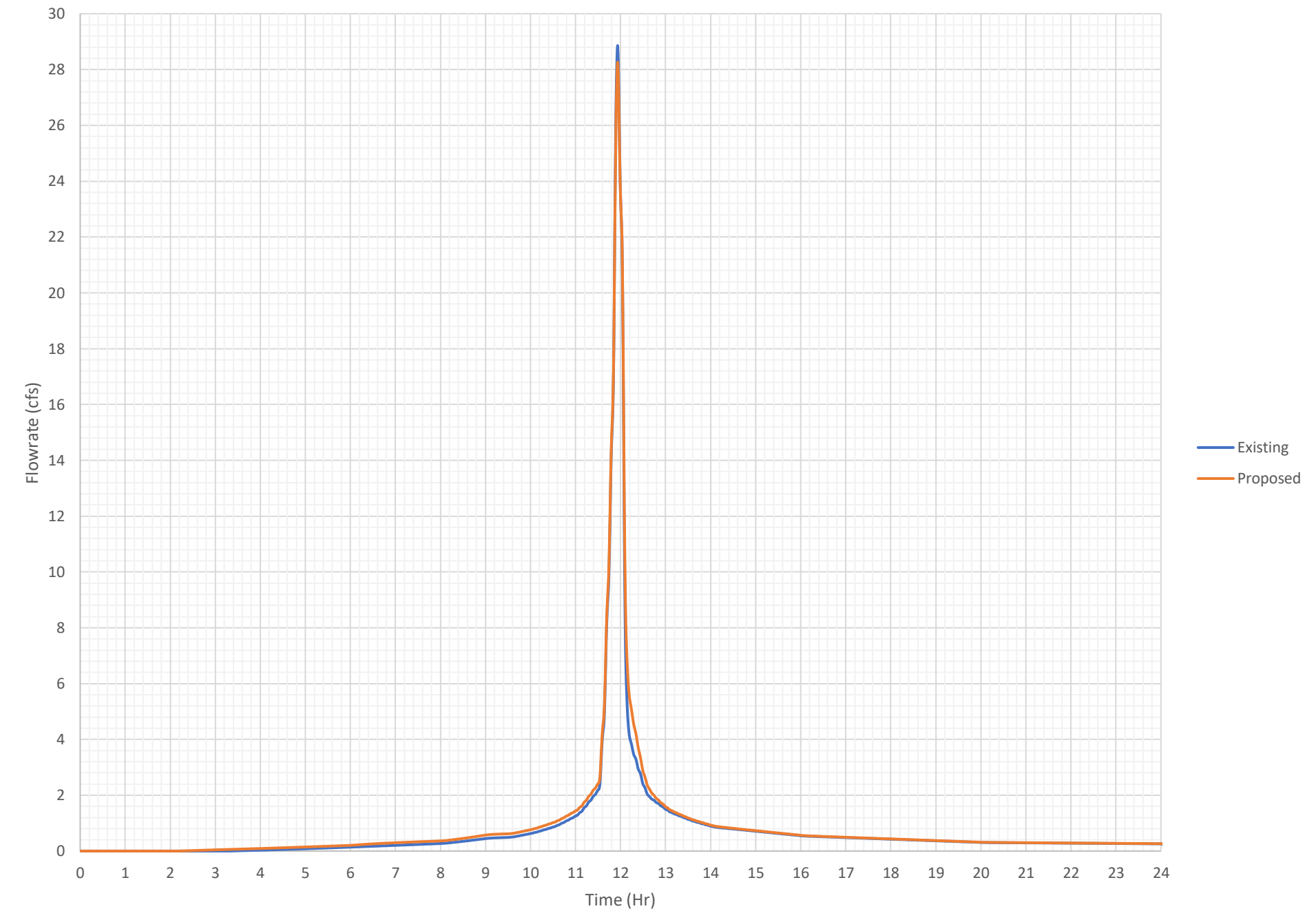
Proposed Peak 4-Hr 1% Flowrates



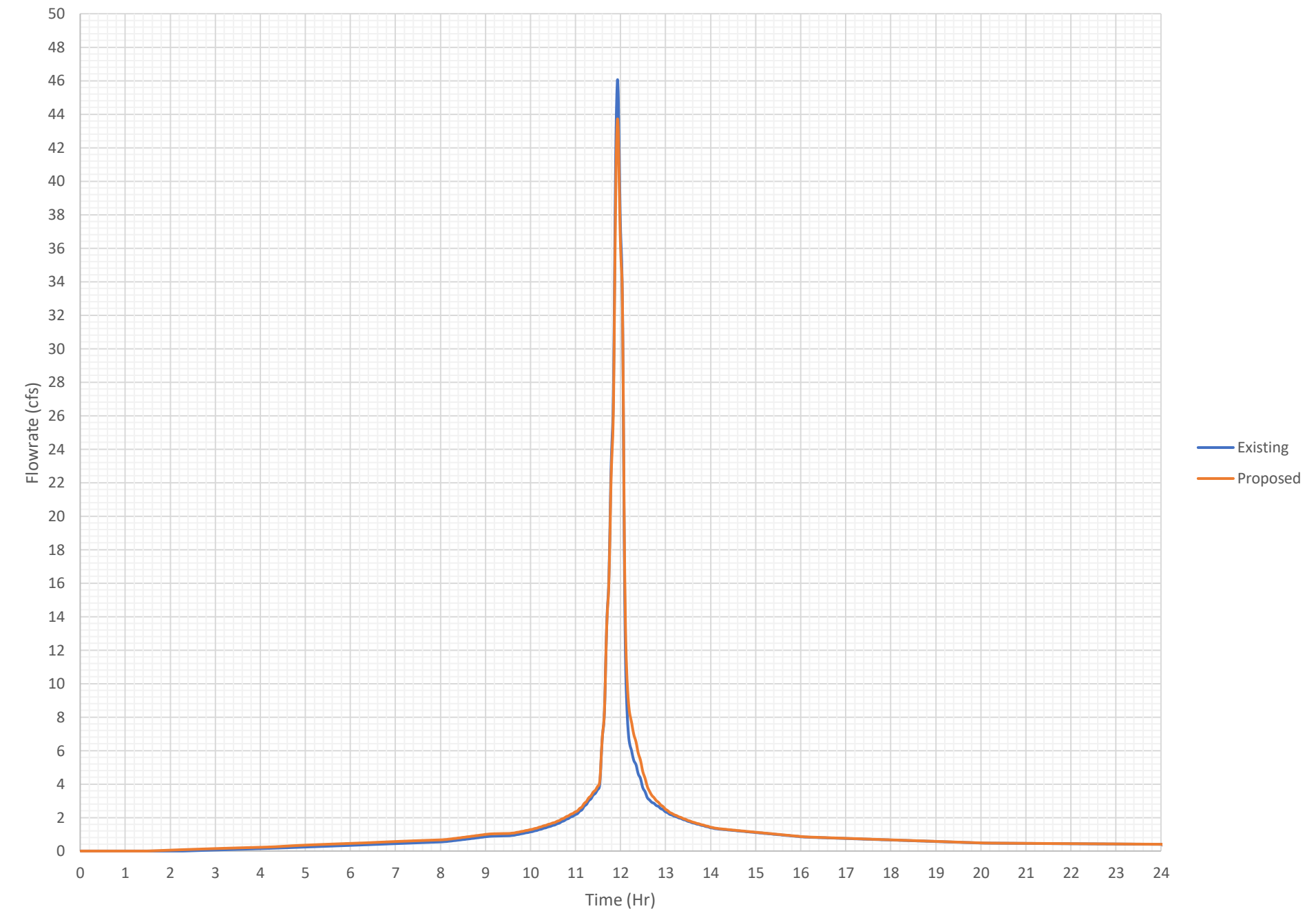
100% Event Flowrate Comparison



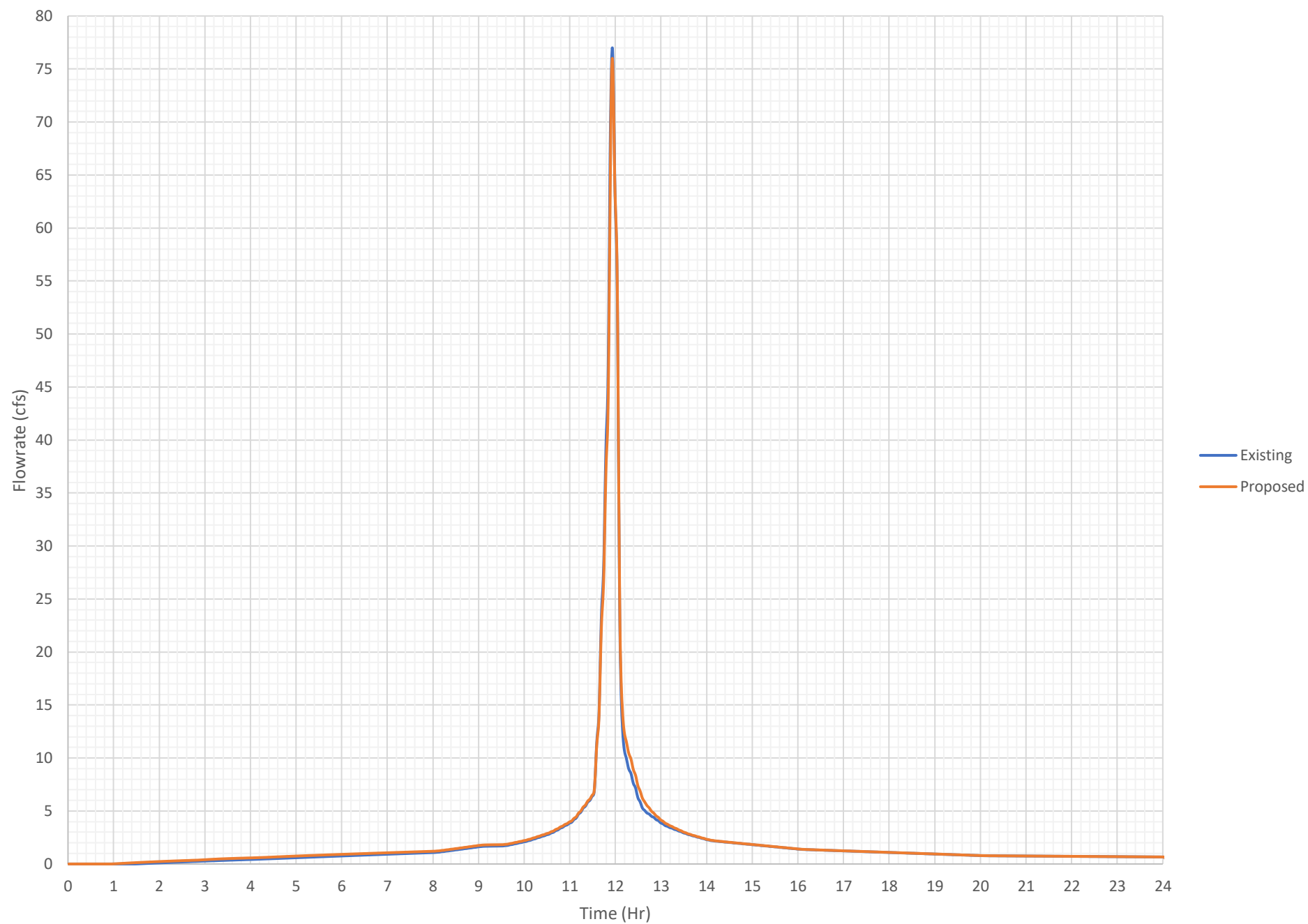
50% Event Flowrate Comparison



10% Event Flowrate Comparison



1% Event Flowrate Comparison



## **APPENDIX C**

### Model Results

## **Existing Conditions Results**

**100% Chance Event**

Project Description

File Name ..... Micro Existing Conditions.SPF

Project Options

Flow Units ..... CFS  
Elevation Type ..... Elevation  
Hydrology Method ..... SCS TR-55  
Time of Concentration (TOC) Method ..... SCS TR-55  
Link Routing Method ..... Hydrodynamic  
Enable Overflow Ponding at Nodes ..... YES  
Skip Steady State Analysis Time Periods ... NO

Analysis Options

Start Analysis On ..... Feb 15, 2023 00:00:00  
End Analysis On ..... Feb 18, 2023 00:00:00  
Start Reporting On ..... Feb 15, 2023 00:00:00  
Antecedent Dry Days ..... 0 days  
Runoff (Dry Weather) Time Step ..... 0 01:00:00 days hh:mm:ss  
Runoff (Wet Weather) Time Step ..... 0 00:05:00 days hh:mm:ss  
Reporting Time Step ..... 0 00:01:00 days hh:mm:ss  
Routing Time Step ..... 5 seconds

Number of Elements

	Qty
Rain Gages .....	1
Subbasins.....	1
Nodes.....	1
<i>Junctions</i> .....	0
<i>Outfalls</i> .....	1
<i>Flow Diversions</i> .....	0
<i>Inlets</i> .....	0
<i>Storage Nodes</i> .....	0
Links.....	0
<i>Channels</i> .....	0
<i>Pipes</i> .....	0
<i>Pumps</i> .....	0
<i>Orifices</i> .....	0
<i>Weirs</i> .....	0
<i>Outlets</i> .....	0
Pollutants .....	0
Land Uses .....	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	1 Year	Cumulative	inches	Missouri	Jackson	1	3.10	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Peak Rate Factor	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)			(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	A-1	6.43	484.00	93.49	3.10	2.40	15.41	23.44	0 00:05:00

Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	Out-01	Outfall	0.00					0.00	0.00					

# Subbasin Hydrology

## Subbasin : A-1

### Input Data

Area (ac) ..... 6.43  
Peak Rate Factor ..... 484.00  
Weighted Curve Number ..... 93.49  
Rain Gage ID ..... Rain Gage-01

### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved roads with curbs & sewers	4.82	D	98.00
> 75% grass cover, Good	1.61	D	80.00
Composite Area & Weighted CN	6.43		93.49

### Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

T<sub>c</sub> = Time of Concentration (hr)  
n = Manning's roughness  
L<sub>f</sub> = Flow Length (ft)  
P = 2 yr, 24 hr Rainfall (inches)  
S<sub>f</sub> = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 \* (S<sub>f</sub><sup>0.5</sup>) (unpaved surface)  
V = 20.3282 \* (S<sub>f</sub><sup>0.5</sup>) (paved surface)  
V = 15.0 \* (S<sub>f</sub><sup>0.5</sup>) (grassed waterway surface)  
V = 10.0 \* (S<sub>f</sub><sup>0.5</sup>) (nearly bare & untilled surface)  
V = 9.0 \* (S<sub>f</sub><sup>0.5</sup>) (cultivated straight rows surface)  
V = 7.0 \* (S<sub>f</sub><sup>0.5</sup>) (short grass pasture surface)  
V = 5.0 \* (S<sub>f</sub><sup>0.5</sup>) (woodland surface)  
V = 2.5 \* (S<sub>f</sub><sup>0.5</sup>) (forest w/heavy litter surface)  
T<sub>c</sub> = (L<sub>f</sub> / V) / (3600 sec/hr)

Where:

T<sub>c</sub> = Time of Concentration (hr)  
L<sub>f</sub> = Flow Length (ft)  
V = Velocity (ft/sec)  
S<sub>f</sub> = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 \* (R<sup>2/3</sup>) \* (S<sub>f</sub><sup>0.5</sup>)) / n  
R = A<sub>q</sub> / W<sub>p</sub>  
T<sub>c</sub> = (L<sub>f</sub> / V) / (3600 sec/hr)

Where :

T<sub>c</sub> = Time of Concentration (hr)  
L<sub>f</sub> = Flow Length (ft)  
R = Hydraulic Radius (ft)  
A<sub>q</sub> = Flow Area (ft<sup>2</sup>)  
W<sub>p</sub> = Wetted Perimeter (ft)  
V = Velocity (ft/sec)  
S<sub>f</sub> = Slope (ft/ft)  
n = Manning's roughness

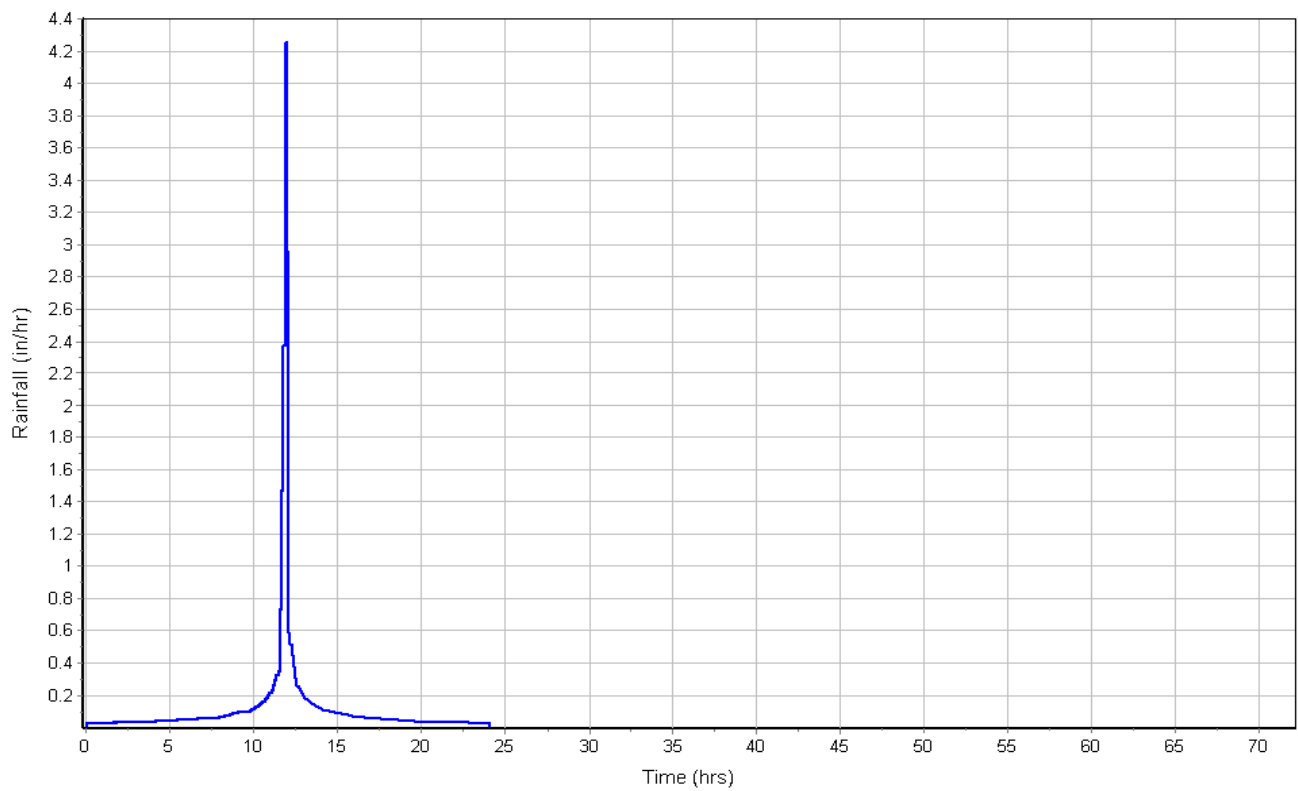
User-Defined TOC override (minutes): 5.00

### Subbasin Runoff Results

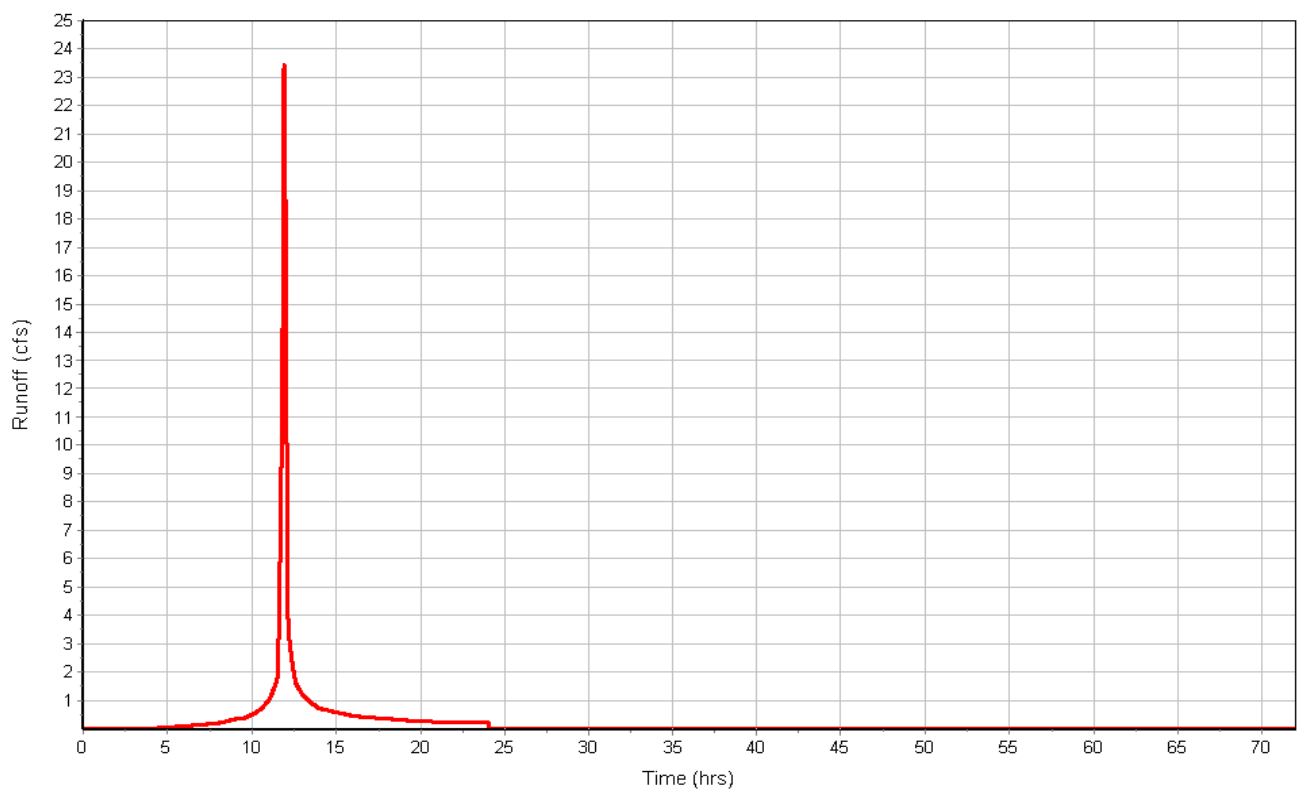
Total Rainfall (in) ..... 3.10  
Total Runoff (in) ..... 2.40  
Peak Runoff (cfs) ..... 23.44  
Weighted Curve Number ..... 93.49  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

Subbasin : A-1

Rainfall Intensity Graph



Runoff Hydrograph



**50% Chance Event**

Project Description

File Name ..... Micro Existing Conditions.SPF

Project Options

Flow Units ..... CFS  
Elevation Type ..... Elevation  
Hydrology Method ..... SCS TR-55  
Time of Concentration (TOC) Method ..... SCS TR-55  
Link Routing Method ..... Hydrodynamic  
Enable Overflow Ponding at Nodes ..... YES  
Skip Steady State Analysis Time Periods ... NO

Analysis Options

Start Analysis On ..... Feb 15, 2023 00:00:00  
End Analysis On ..... Feb 18, 2023 00:00:00  
Start Reporting On ..... Feb 15, 2023 00:00:00  
Antecedent Dry Days ..... 0 days  
Runoff (Dry Weather) Time Step ..... 0 01:00:00 days hh:mm:ss  
Runoff (Wet Weather) Time Step ..... 0 00:05:00 days hh:mm:ss  
Reporting Time Step ..... 0 00:01:00 days hh:mm:ss  
Routing Time Step ..... 5 seconds

Number of Elements

Qty  
Rain Gages ..... 1  
Subbasins..... 1  
Nodes..... 1  
    *Junctions* ..... 0  
    *Outfalls* ..... 1  
    *Flow Diversions* ..... 0  
    *Inlets* ..... 0  
    *Storage Nodes* ..... 0  
Links..... 0  
    *Channels* ..... 0  
    *Pipes* ..... 0  
    *Pumps* ..... 0  
    *Orifices* ..... 0  
    *Weirs* ..... 0  
    *Outlets* ..... 0  
Pollutants ..... 0  
Land Uses ..... 0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	2-Year	Cumulative	inches	Missouri	Jackson	2	3.71	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Peak Rate Factor	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)			(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	A-1	6.43	484.00	93.49	3.71	2.99	19.21	28.86	0 00:05:00

Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	Out-01	Outfall	0.00					0.00	0.00					

Subbasin Hydrology

Subbasin : A-1

Input Data

Area (ac) ..... 6.43  
Peak Rate Factor ..... 484.00  
Weighted Curve Number ..... 93.49  
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved roads with curbs & sewers	4.82	D	98.00
> 75% grass cover, Good	1.61	D	80.00
Composite Area & Weighted CN	6.43		93.49

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$

Where :

Tc = Time of Concentration (hr)  
n = Manning's roughness  
Lf = Flow Length (ft)  
P = 2 yr, 24 hr Rainfall (inches)  
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 \* (Sf^0.5) (unpaved surface)  
V = 20.3282 \* (Sf^0.5) (paved surface)  
V = 15.0 \* (Sf^0.5) (grassed waterway surface)  
V = 10.0 \* (Sf^0.5) (nearly bare & untilled surface)  
V = 9.0 \* (Sf^0.5) (cultivated straight rows surface)  
V = 7.0 \* (Sf^0.5) (short grass pasture surface)  
V = 5.0 \* (Sf^0.5) (woodland surface)  
V = 2.5 \* (Sf^0.5) (forest w/heavy litter surface)  
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)  
Lf = Flow Length (ft)  
V = Velocity (ft/sec)  
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 \* (R^(2/3)) \* (Sf^0.5)) / n  
R = Aq / Wp  
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)  
Lf = Flow Length (ft)  
R = Hydraulic Radius (ft)  
Aq = Flow Area (ft²)  
Wp = Wetted Perimeter (ft)  
V = Velocity (ft/sec)  
Sf = Slope (ft/ft)  
n = Manning's roughness

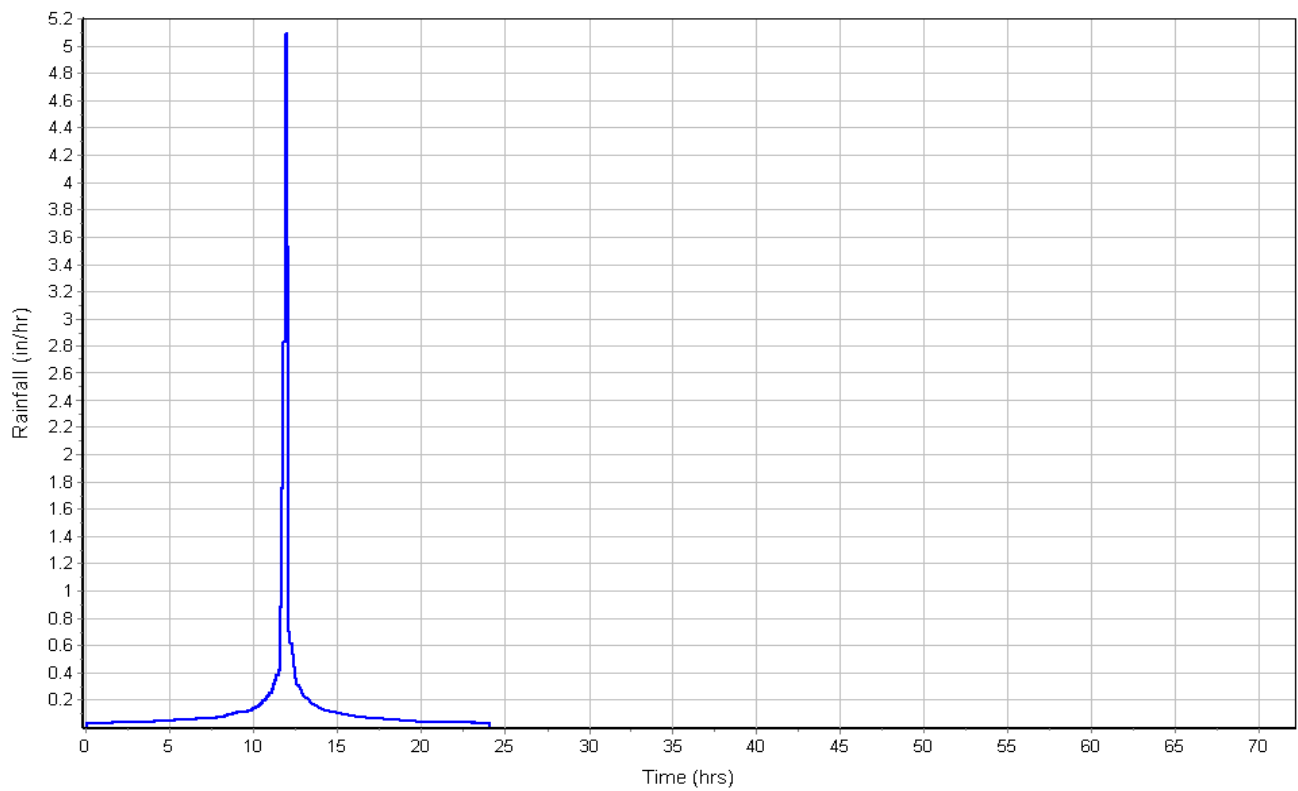
User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

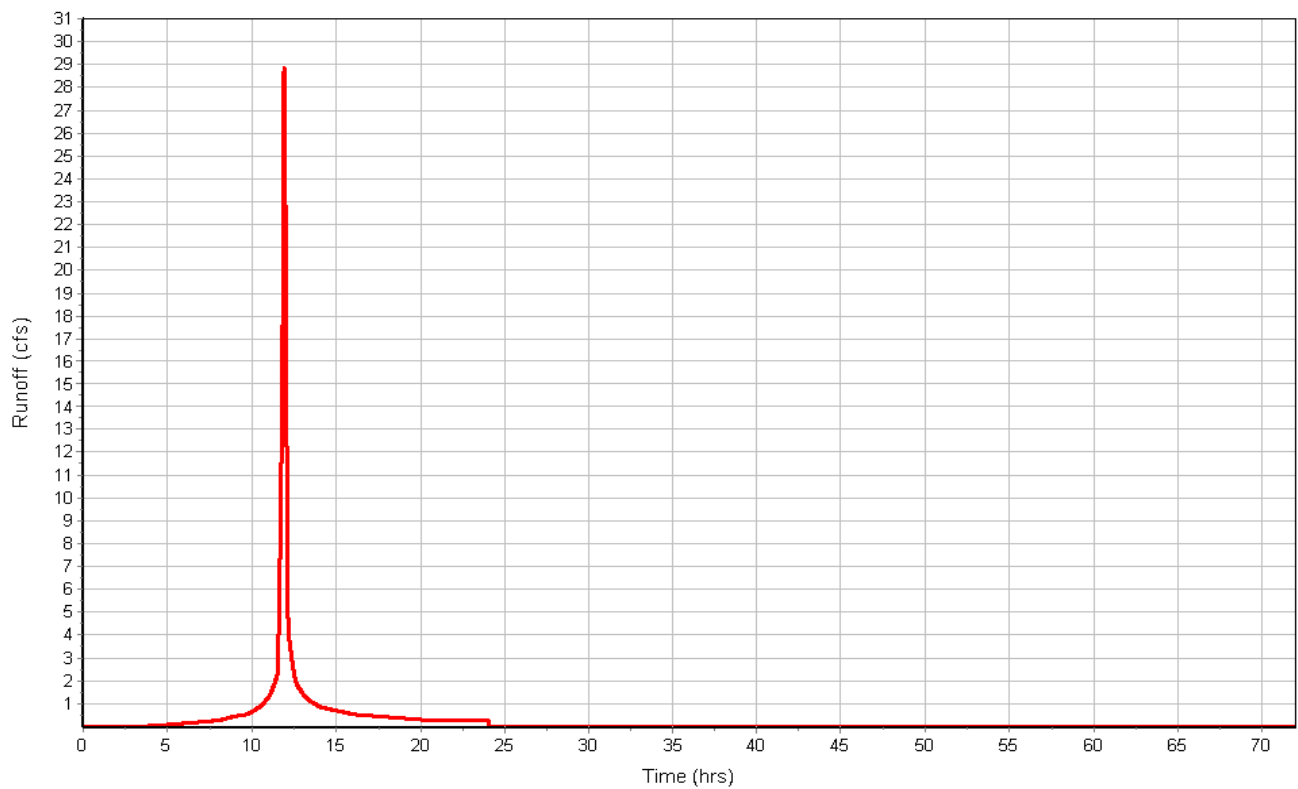
Total Rainfall (in) ..... 3.71  
Total Runoff (in) ..... 2.99  
Peak Runoff (cfs) ..... 28.86  
Weighted Curve Number ..... 93.49  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

Subbasin : A-1

Rainfall Intensity Graph



Runoff Hydrograph



**10% Chance Event**

Project Description

File Name ..... Micro Existing Conditions.SPF

Project Options

Flow Units ..... CFS  
Elevation Type ..... Elevation  
Hydrology Method ..... SCS TR-55  
Time of Concentration (TOC) Method ..... SCS TR-55  
Link Routing Method ..... Hydrodynamic  
Enable Overflow Ponding at Nodes ..... YES  
Skip Steady State Analysis Time Periods ... NO

Analysis Options

Start Analysis On ..... Feb 15, 2023 00:00:00  
End Analysis On ..... Feb 18, 2023 00:00:00  
Start Reporting On ..... Feb 15, 2023 00:00:00  
Antecedent Dry Days ..... 0 days  
Runoff (Dry Weather) Time Step ..... 0 01:00:00 days hh:mm:ss  
Runoff (Wet Weather) Time Step ..... 0 00:05:00 days hh:mm:ss  
Reporting Time Step ..... 0 00:01:00 days hh:mm:ss  
Routing Time Step ..... 5 seconds

Number of Elements

	Qty
Rain Gages .....	1
Subbasins.....	1
Nodes.....	1
<i>Junctions</i> .....	0
<i>Outfalls</i> .....	1
<i>Flow Diversions</i> .....	0
<i>Inlets</i> .....	0
<i>Storage Nodes</i> .....	0
Links.....	0
<i>Channels</i> .....	0
<i>Pipes</i> .....	0
<i>Pumps</i> .....	0
<i>Orifices</i> .....	0
<i>Weirs</i> .....	0
<i>Outlets</i> .....	0
Pollutants .....	0
Land Uses .....	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	10 Year	Cumulative	inches	Missouri	Jackson	10	5.67	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Peak Rate Factor	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)			(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	A-1	6.43	484.00	93.49	5.67	4.91	31.58	46.07	0 00:05:00

Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	Out-01	Outfall	0.00					0.00	0.00					

## Subbasin Hydrology

### Subbasin : A-1

#### Input Data

Area (ac) ..... 6.43  
Peak Rate Factor ..... 484.00  
Weighted Curve Number ..... 93.49  
Rain Gage ID ..... Rain Gage-01

#### Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved roads with curbs & sewers	4.82	D	98.00
> 75% grass cover, Good	1.61	D	80.00
Composite Area & Weighted CN	6.43		93.49

#### Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$$

Where :

T<sub>c</sub> = Time of Concentration (hr)  
n = Manning's roughness  
L<sub>f</sub> = Flow Length (ft)  
P = 2 yr, 24 hr Rainfall (inches)  
S<sub>f</sub> = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 \* (S<sub>f</sub><sup>0.5</sup>) (unpaved surface)  
V = 20.3282 \* (S<sub>f</sub><sup>0.5</sup>) (paved surface)  
V = 15.0 \* (S<sub>f</sub><sup>0.5</sup>) (grassed waterway surface)  
V = 10.0 \* (S<sub>f</sub><sup>0.5</sup>) (nearly bare & untilled surface)  
V = 9.0 \* (S<sub>f</sub><sup>0.5</sup>) (cultivated straight rows surface)  
V = 7.0 \* (S<sub>f</sub><sup>0.5</sup>) (short grass pasture surface)  
V = 5.0 \* (S<sub>f</sub><sup>0.5</sup>) (woodland surface)  
V = 2.5 \* (S<sub>f</sub><sup>0.5</sup>) (forest w/heavy litter surface)  
T<sub>c</sub> = (L<sub>f</sub> / V) / (3600 sec/hr)

Where:

T<sub>c</sub> = Time of Concentration (hr)  
L<sub>f</sub> = Flow Length (ft)  
V = Velocity (ft/sec)  
S<sub>f</sub> = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 \* (R<sup>2/3</sup>) \* (S<sub>f</sub><sup>0.5</sup>)) / n  
R = A<sub>q</sub> / W<sub>p</sub>  
T<sub>c</sub> = (L<sub>f</sub> / V) / (3600 sec/hr)

Where :

T<sub>c</sub> = Time of Concentration (hr)  
L<sub>f</sub> = Flow Length (ft)  
R = Hydraulic Radius (ft)  
A<sub>q</sub> = Flow Area (ft<sup>2</sup>)  
W<sub>p</sub> = Wetted Perimeter (ft)  
V = Velocity (ft/sec)  
S<sub>f</sub> = Slope (ft/ft)  
n = Manning's roughness

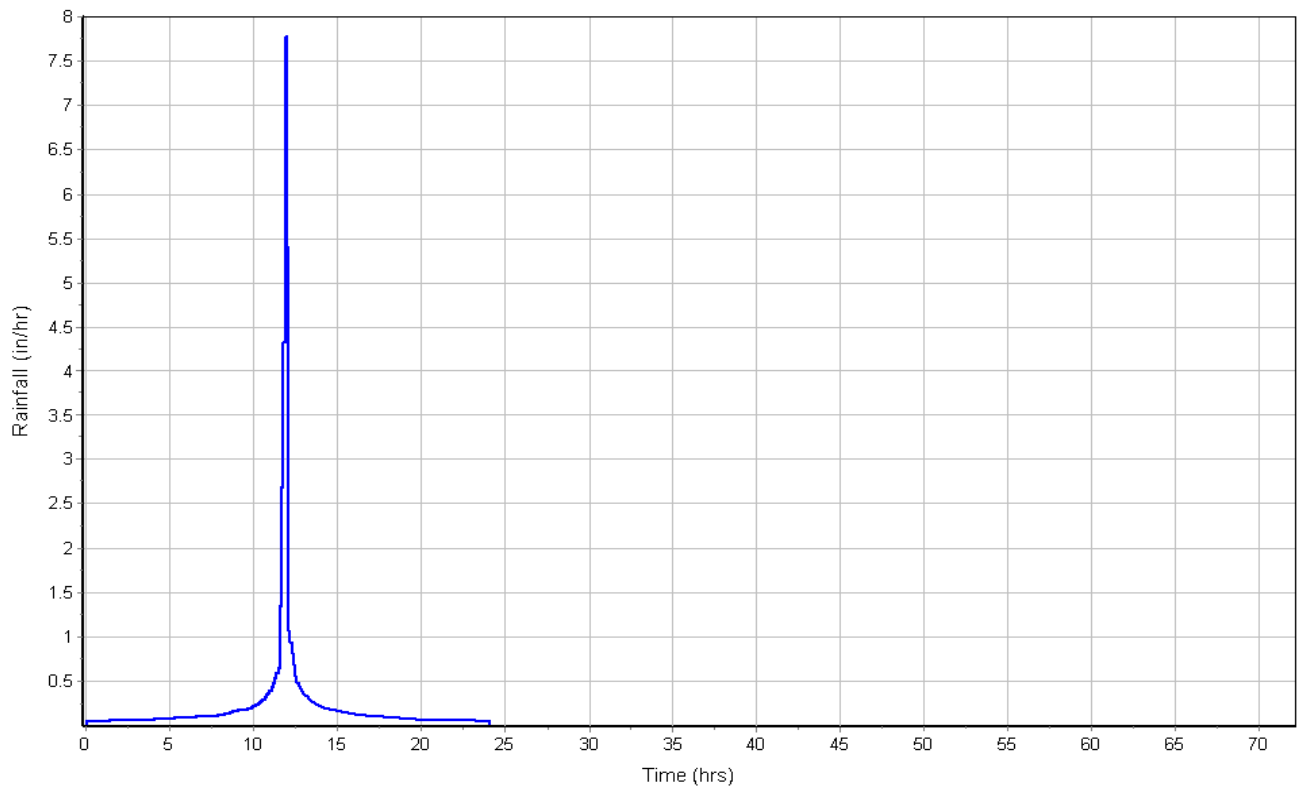
User-Defined TOC override (minutes): 5.00

#### Subbasin Runoff Results

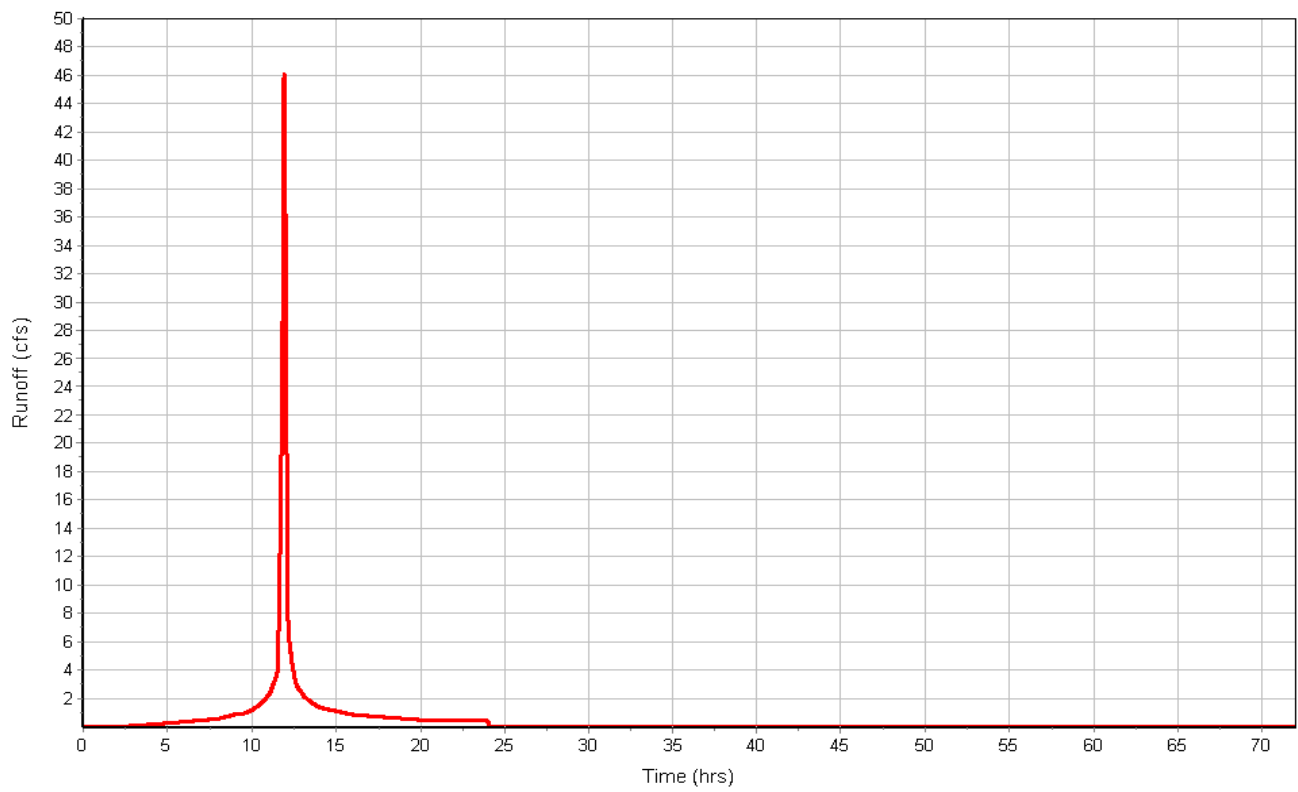
Total Rainfall (in) ..... 5.67  
Total Runoff (in) ..... 4.91  
Peak Runoff (cfs) ..... 46.07  
Weighted Curve Number ..... 93.49  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

Subbasin : A-1

Rainfall Intensity Graph



Runoff Hydrograph



**1% Chance Event**

Project Description

File Name ..... Micro Existing Conditions.SPF

Project Options

Flow Units ..... CFS  
Elevation Type ..... Elevation  
Hydrology Method ..... SCS TR-55  
Time of Concentration (TOC) Method ..... SCS TR-55  
Link Routing Method ..... Hydrodynamic  
Enable Overflow Ponding at Nodes ..... YES  
Skip Steady State Analysis Time Periods ... NO

Analysis Options

Start Analysis On ..... Feb 15, 2023 00:00:00  
End Analysis On ..... Feb 18, 2023 00:00:00  
Start Reporting On ..... Feb 15, 2023 00:00:00  
Antecedent Dry Days ..... 0 days  
Runoff (Dry Weather) Time Step ..... 0 01:00:00 days hh:mm:ss  
Runoff (Wet Weather) Time Step ..... 0 00:05:00 days hh:mm:ss  
Reporting Time Step ..... 0 00:01:00 days hh:mm:ss  
Routing Time Step ..... 5 seconds

Number of Elements

	Qty
Rain Gages .....	1
Subbasins.....	1
Nodes.....	1
<i>Junctions</i> .....	0
<i>Outfalls</i> .....	1
<i>Flow Diversions</i> .....	0
<i>Inlets</i> .....	0
<i>Storage Nodes</i> .....	0
Links.....	0
<i>Channels</i> .....	0
<i>Pipes</i> .....	0
<i>Pumps</i> .....	0
<i>Orifices</i> .....	0
<i>Weirs</i> .....	0
<i>Outlets</i> .....	0
Pollutants .....	0
Land Uses .....	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
1		Time Series	100 Year	Cumulative	inches	Missouri	Jackson	100	9.25	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Peak Rate Factor	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)			(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	A-1	6.43	484.00	93.49	9.25	8.46	54.42	77.03	0 00:05:00

Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	Out-01	Outfall	0.00					0.00	0.00					

Subbasin Hydrology

Subbasin : A-1

Input Data

Area (ac) ..... 6.43  
Peak Rate Factor ..... 484.00  
Weighted Curve Number ..... 93.49  
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Paved roads with curbs & sewers	4.82	D	98.00
> 75% grass cover, Good	1.61	D	80.00
Composite Area & Weighted CN	6.43		93.49

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$

Where :

Tc = Time of Concentration (hr)  
n = Manning's roughness  
Lf = Flow Length (ft)  
P = 2 yr, 24 hr Rainfall (inches)  
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 \* (Sf^0.5) (unpaved surface)  
V = 20.3282 \* (Sf^0.5) (paved surface)  
V = 15.0 \* (Sf^0.5) (grassed waterway surface)  
V = 10.0 \* (Sf^0.5) (nearly bare & untilled surface)  
V = 9.0 \* (Sf^0.5) (cultivated straight rows surface)  
V = 7.0 \* (Sf^0.5) (short grass pasture surface)  
V = 5.0 \* (Sf^0.5) (woodland surface)  
V = 2.5 \* (Sf^0.5) (forest w/heavy litter surface)  
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)  
Lf = Flow Length (ft)  
V = Velocity (ft/sec)  
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 \* (R^(2/3)) \* (Sf^0.5)) / n  
R = Aq / Wp  
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)  
Lf = Flow Length (ft)  
R = Hydraulic Radius (ft)  
Aq = Flow Area (ft²)  
Wp = Wetted Perimeter (ft)  
V = Velocity (ft/sec)  
Sf = Slope (ft/ft)  
n = Manning's roughness

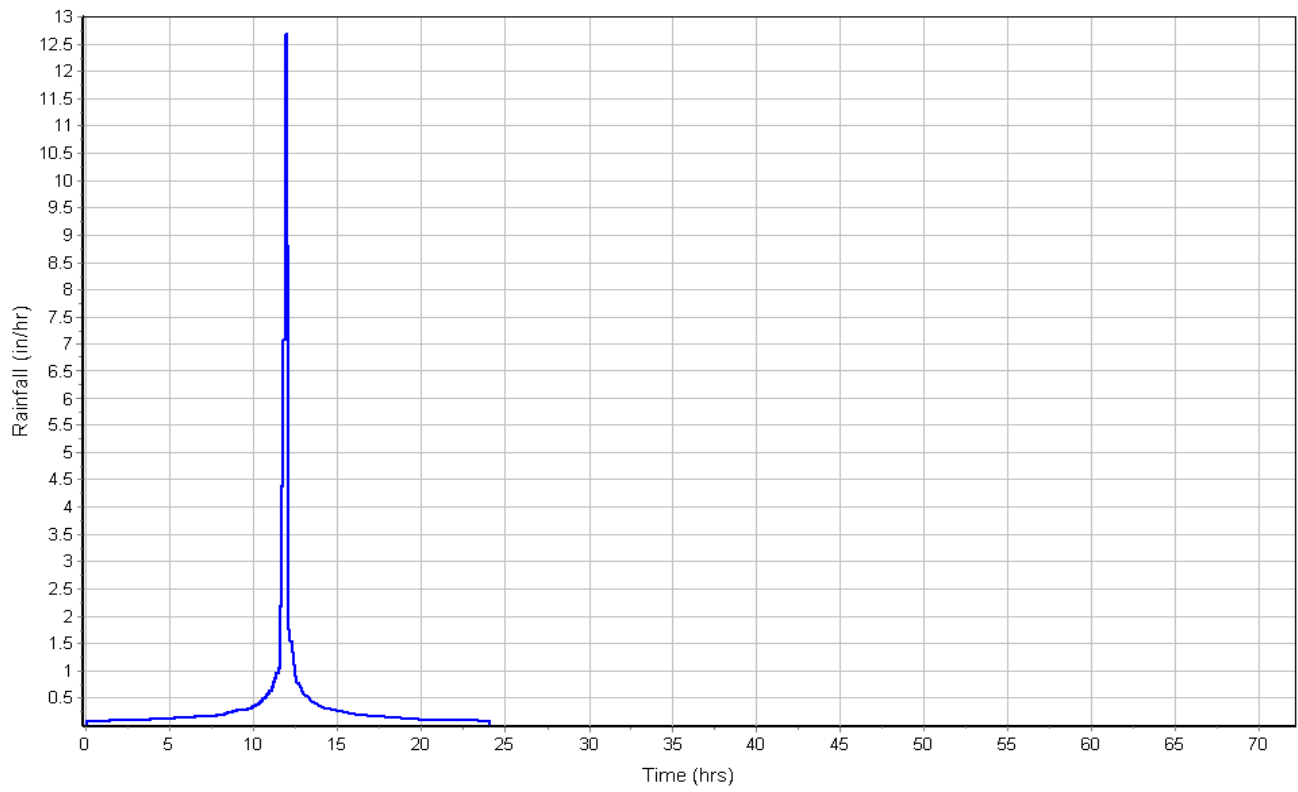
User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

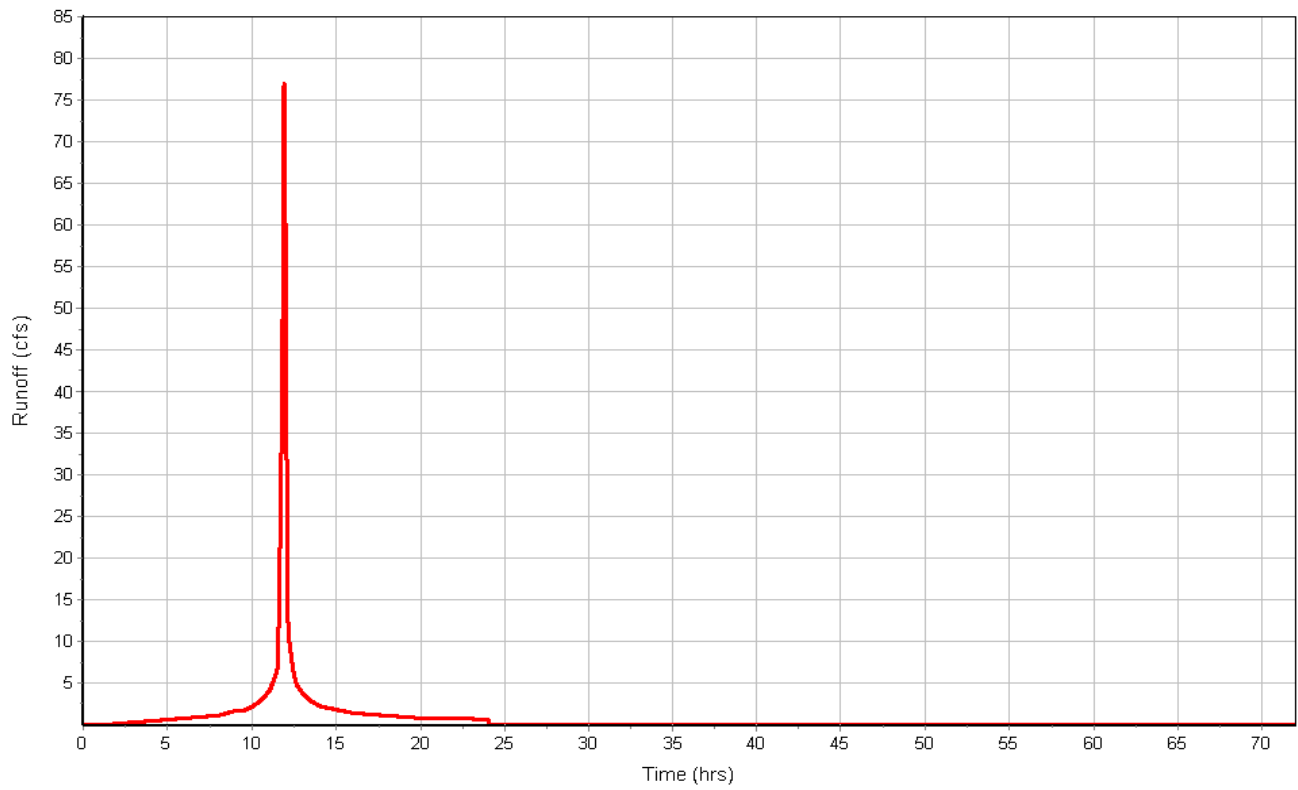
Total Rainfall (in) ..... 9.25  
Total Runoff (in) ..... 8.46  
Peak Runoff (cfs) ..... 77.03  
Weighted Curve Number ..... 93.49  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

Subbasin : A-1

Rainfall Intensity Graph



Runoff Hydrograph



## **Proposed Conditions Results**

**100% Chance Event**

Project Description

File Name ..... Revisions.SPF

Project Options

Flow Units ..... CFS  
Elevation Type ..... Elevation  
Hydrology Method ..... SCS TR-55  
Time of Concentration (TOC) Method ..... SCS TR-55  
Link Routing Method ..... Hydrodynamic  
Enable Overflow Ponding at Nodes ..... YES  
Skip Steady State Analysis Time Periods ... NO

Analysis Options

Start Analysis On ..... 00:00:00      0:00:00  
End Analysis On ..... 00:00:00      0:00:00  
Start Reporting On ..... 00:00:00      0:00:00  
Antecedent Dry Days ..... 0      days  
Runoff (Dry Weather) Time Step ..... 0 01:00:00      days hh:mm:ss  
Runoff (Wet Weather) Time Step ..... 0 00:05:00      days hh:mm:ss  
Reporting Time Step ..... 0 00:01:00      days hh:mm:ss  
Routing Time Step ..... 5      seconds

Number of Elements

Qty  
Rain Gages ..... 1  
Subbasins..... 3  
Nodes..... 4  
    *Junctions* ..... 1  
    *Outfalls* ..... 1  
    *Flow Diversions* ..... 0  
    *Inlets* ..... 0  
    *Storage Nodes* ..... 2  
Links..... 5  
    *Channels* ..... 0  
    *Pipes* ..... 1  
    *Pumps* ..... 0  
    *Orifices* ..... 2  
    *Weirs* ..... 2  
    *Outlets* ..... 0  
Pollutants ..... 0  
Land Uses ..... 0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	1 Year	Cumulative	inches	Missouri	Jackson	1.00	3.10	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Peak Rate Factor	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)			(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	A_Undetained	5.52	484.00	95.85	3.10	2.64	14.53	21.38	0 00:05:00
2	Farmers Market Roof	0.71	484.00	98.00	3.10	2.87	2.04	2.86	0 00:05:00
3	Pad Site 2	0.20	484.00	98.00	3.10	2.87	0.57	0.80	0 00:05:00

Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	1-Jun	Junction	1002.00	1007.00	0.00	0.00	0.00	2.15	1002.27	0.00	7.73	0 00:00	0.00	0.00
2	Out-01	Outfall	995.00					23.14	995.26					
3	Farmers Market Storage	Storage Node	1001.00	1007.00	0.00		0.00	2.86	1004.08				0.00	0.00
4	Pad Site 2 Storage	Storage Node	1001.00	1007.00	0.00		0.00	0.80	1003.09				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length  (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Link-01	Pipe	1-Jun	Out-01	200.00	1002.00	995.00	3.5000	36.000	0.0120	2.15	135.18	0.02	6.87	0.27	0.09	0.00	Calculated
2	Farmers Market Orifice	Orifice	Farmers Market Storage	1-Jun		1001.00	1002.00		7.000		1.76							
3	Pad Site 2 Orifice	Orifice	Pad Site 2 Storage	1-Jun		1001.00	1002.00		4.000		0.39							
4	Farmers Market Weir	Weir	Farmers Market Storage	1-Jun		1001.00	1002.00				0.00							
5	Pad Site 2 Weir	Weir	Pad Site 2 Storage	1-Jun		1001.00	1002.00				0.00							

Subbasin Hydrology

Subbasin : A\_Undetained

Input Data

Area (ac)	5.52
Peak Rate Factor	484
Weighted Curve Number	95.85
Rain Gage ID	Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Paved roads with curbs & sewers	4.86	D	98
> 75% grass cover, Good	0.66	D	80
Composite Area & Weighted CN	5.52		95.85

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$

Where :

- Tc = Time of Concentration (hr)
- n = Manning's roughness
- Lf = Flow Length (ft)
- P = 2 yr, 24 hr Rainfall (inches)
- Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

- V = 16.1345 \* (Sf^0.5) (unpaved surface)
- V = 20.3282 \* (Sf^0.5) (paved surface)
- V = 15.0 \* (Sf^0.5) (grassed waterway surface)
- V = 10.0 \* (Sf^0.5) (nearly bare & untilled surface)
- V = 9.0 \* (Sf^0.5) (cultivated straight rows surface)
- V = 7.0 \* (Sf^0.5) (short grass pasture surface)
- V = 5.0 \* (Sf^0.5) (woodland surface)
- V = 2.5 \* (Sf^0.5) (forest w/heavy litter surface)
- Tc = (Lf / V) / (3600 sec/hr)

Where:

- Tc = Time of Concentration (hr)
- Lf = Flow Length (ft)
- V = Velocity (ft/sec)
- Sf = Slope (ft/ft)

Channel Flow Equation :

- $V = (1.49 * (R^{(2/3)}) * (S_f^{0.5})) / n$
- R = Aq / Wp
- Tc = (Lf / V) / (3600 sec/hr)

Where :

- Tc = Time of Concentration (hr)
- Lf = Flow Length (ft)
- R = Hydraulic Radius (ft)
- Aq = Flow Area (ft²)
- Wp = Wetted Perimeter (ft)
- V = Velocity (ft/sec)
- Sf = Slope (ft/ft)
- n = Manning's roughness

User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

Total Rainfall (in)	3.1
Total Runoff (in)	2.64
Peak Runoff (cfs)	21.38

Weighted Curve Number ..... 95.85  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

Subbasin : Farmers Market Roof

Input Data

Area (ac) ..... 0.71  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Paved parking & roofs	0.31	D	98
Composite Area & Weighted CN	0.31		98

Time of Concentration

User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

Total Rainfall (in) ..... 3.1  
Total Runoff (in) ..... 2.87  
Peak Runoff (cfs) ..... 2.86  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

Subbasin : Pad Site 2

Input Data

Area (ac) ..... 0.2  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Paved parking & roofs	0.52	D	98
Composite Area & Weighted CN	0.52		98

Time of Concentration

User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

Total Rainfall (in) ..... 3.1  
Total Runoff (in) ..... 2.87  
Peak Runoff (cfs) ..... 0.8  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

Storage Nodes

Storage Node : Farmers Market Storage

Input Data

Invert Elevation (ft)	1001
Max (Rim) Elevation (ft)	1007
Max (Rim) Offset (ft)	6
Initial Water Elevation (ft)	0
Initial Water Depth (ft)	-1001
Ponded Area (ft²)	0
Evaporation Loss	0

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 Farmers Market Weir	Rectangular	No	1006.00	5.00	4.00	3.00	3.33

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 Farmers Market Orifice	Side	CIRCULAR	No	7.00			1002.00	0.61

Output Summary Results

Peak Inflow (cfs)	2.86
Peak Lateral Inflow (cfs)	2.86
Peak Outflow (cfs)	1.76
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	1004.08
Max HGL Depth Attained (ft)	3.08
Average HGL Elevation Attained (ft)	1001.98
Average HGL Depth Attained (ft)	0.98
Time of Max HGL Occurrence (days hh:mm)	0 12:03
Total Exfiltration Volume (1000-ft³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : Pad Site 2 Storage

Input Data

Invert Elevation (ft)	1001
Max (Rim) Elevation (ft)	1007
Max (Rim) Offset (ft)	6
Initial Water Elevation (ft)	0
Initial Water Depth (ft)	-1001
Ponded Area (ft²)	0
Evaporation Loss	0

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 Pad Site 2 Weir	Rectangular	No	1005.50	4.50	4.00	1.00	3.33

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 Pad Site 2 Orifice	Side	CIRCULAR	No	4.00			1002.00	0.61

Output Summary Results

Peak Inflow (cfs)	0.8
Peak Lateral Inflow (cfs)	0.8
Peak Outflow (cfs)	0.39
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	1003.09
Max HGL Depth Attained (ft)	2.09
Average HGL Elevation Attained (ft)	1001.94
Average HGL Depth Attained (ft)	0.94
Time of Max HGL Occurrence (days hh:mm)	0 12:04
Total Exfiltration Volume (1000-ft³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

**50% Chance Event**

Project Description

File Name ..... Revisions.SPF

Project Options

Flow Units ..... CFS  
Elevation Type ..... Elevation  
Hydrology Method ..... SCS TR-55  
Time of Concentration (TOC) Method ..... SCS TR-55  
Link Routing Method ..... Hydrodynamic  
Enable Overflow Ponding at Nodes ..... YES  
Skip Steady State Analysis Time Periods ... NO

Analysis Options

Start Analysis On ..... 00:00:00 0:00:00  
End Analysis On ..... 00:00:00 0:00:00  
Start Reporting On ..... 00:00:00 0:00:00  
Antecedent Dry Days ..... 0 days  
Runoff (Dry Weather) Time Step ..... 0 01:00:00 days hh:mm:ss  
Runoff (Wet Weather) Time Step ..... 0 00:05:00 days hh:mm:ss  
Reporting Time Step ..... 0 00:01:00 days hh:mm:ss  
Routing Time Step ..... 5 seconds

Number of Elements

Qty  
Rain Gages ..... 1  
Subbasins..... 3  
Nodes..... 5  
    *Junctions* ..... 2  
    *Outfalls* ..... 1  
    *Flow Diversions* ..... 0  
    *Inlets* ..... 0  
    *Storage Nodes* ..... 2  
Links..... 6  
    *Channels* ..... 0  
    *Pipes* ..... 2  
    *Pumps* ..... 0  
    *Orifices* ..... 2  
    *Weirs* ..... 2  
    *Outlets* ..... 0  
Pollutants ..... 0  
Land Uses ..... 0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	2-Year	Cumulative	inches	Missouri	Jackson	2.00	3.71	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Peak Rate Factor	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)			(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	A_Undetained	5.72	484.00	95.26	3.71	3.17	18.16	26.63	0 00:05:00
2	Canopy and Pad Site 2	0.40	484.00	98.00	3.71	3.48	1.39	1.95	0 00:05:00
3	Farmers Market	0.31	484.00	98.00	3.71	3.48	1.06	1.49	0 00:05:00

Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	1-Jun	Junction	1001.90	1007.00	0.00	0.00	0.00	2.73	1002.30	0.00	7.35	0 00:00	0.00	0.00
2	2-Jun	Junction	1002.00	1007.00	0.00	0.00	0.00	1.78	1002.44	0.00	5.06	0 00:00	0.00	0.00
3	Out-01	Outfall	995.00					28.17	995.30					
4	Stor-01	Storage Node	1001.00	1007.00	0.00		0.00	1.49	1003.32				0.00	0.00
5	Stor-02	Storage Node	1001.00	1007.00	0.00		0.00	1.95	1005.68				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Link-01	Pipe	1-Jun	Out-01	200.00	1002.00	995.00	3.5000	36.000	0.0120	2.70	135.18	0.02	7.26	0.30	0.10	0.00	Calculated
2	Link-02	Pipe	2-Jun	1-Jun	1.00	1002.00	1001.90	10.0000	36.000	0.0150	1.82	182.80	0.01	3.00	0.42	0.14	0.00	Calculated
3	Orifice-01	Orifice	Stor-01	1-Jun		1001.00	1001.90		6.000		0.99							
4	Orifice-02	Orifice	Stor-02	2-Jun		1001.00	1002.00		4.000		0.78							
5	Weir-01	Weir	Stor-01	1-Jun		1001.00	1001.90				0.00							
6	Weir-02	Weir	Stor-02	2-Jun		1001.00	1002.00				1.01							

Subbasin Hydrology

Subbasin : A\_Undetained

Input Data

Area (ac)	5.72
Peak Rate Factor	484
Weighted Curve Number	95.26
Rain Gage ID	Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Paved roads with curbs & sewers	4.85	D	98
> 75% grass cover, Good	0.87	D	80
Composite Area & Weighted CN	5.72		95.26

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$

Where :

- Tc = Time of Concentration (hr)
- n = Manning's roughness
- Lf = Flow Length (ft)
- P = 2 yr, 24 hr Rainfall (inches)
- Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

- V = 16.1345 \* (Sf^0.5) (unpaved surface)
- V = 20.3282 \* (Sf^0.5) (paved surface)
- V = 15.0 \* (Sf^0.5) (grassed waterway surface)
- V = 10.0 \* (Sf^0.5) (nearly bare & untilled surface)
- V = 9.0 \* (Sf^0.5) (cultivated straight rows surface)
- V = 7.0 \* (Sf^0.5) (short grass pasture surface)
- V = 5.0 \* (Sf^0.5) (woodland surface)
- V = 2.5 \* (Sf^0.5) (forest w/heavy litter surface)
- Tc = (Lf / V) / (3600 sec/hr)

Where:

- Tc = Time of Concentration (hr)
- Lf = Flow Length (ft)
- V = Velocity (ft/sec)
- Sf = Slope (ft/ft)

Channel Flow Equation :

- $V = (1.49 * (R^{(2/3)}) * (S_f^{0.5})) / n$
- R = Aq / Wp
- Tc = (Lf / V) / (3600 sec/hr)

Where :

- Tc = Time of Concentration (hr)
- Lf = Flow Length (ft)
- R = Hydraulic Radius (ft)
- Aq = Flow Area (ft²)
- Wp = Wetted Perimeter (ft)
- V = Velocity (ft/sec)
- Sf = Slope (ft/ft)
- n = Manning's roughness

User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

Total Rainfall (in)	3.71
Total Runoff (in)	3.17
Peak Runoff (cfs)	26.63

Weighted Curve Number ..... 95.26  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

Subbasin : Canopy and Pad Site 2

Input Data

Area (ac) ..... 0.4  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Paved parking & roofs	0.52	D	98
Composite Area & Weighted CN	0.52		98

Time of Concentration

User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

Total Rainfall (in) ..... 3.71  
Total Runoff (in) ..... 3.48  
Peak Runoff (cfs) ..... 1.95  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

Subbasin : Farmers Market

Input Data

Area (ac) ..... 0.31  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Paved parking & roofs	0.31	D	98
Composite Area & Weighted CN	0.31		98

Time of Concentration

User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

Total Rainfall (in) ..... 3.71  
Total Runoff (in) ..... 3.48  
Peak Runoff (cfs) ..... 1.49  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

Storage Nodes

Storage Node : Stor-01

Input Data

Invert Elevation (ft)	1001
Max (Rim) Elevation (ft)	1007
Max (Rim) Offset (ft)	6
Initial Water Elevation (ft)	0
Initial Water Depth (ft)	-1001
Ponded Area (ft²)	0
Evaporation Loss	0

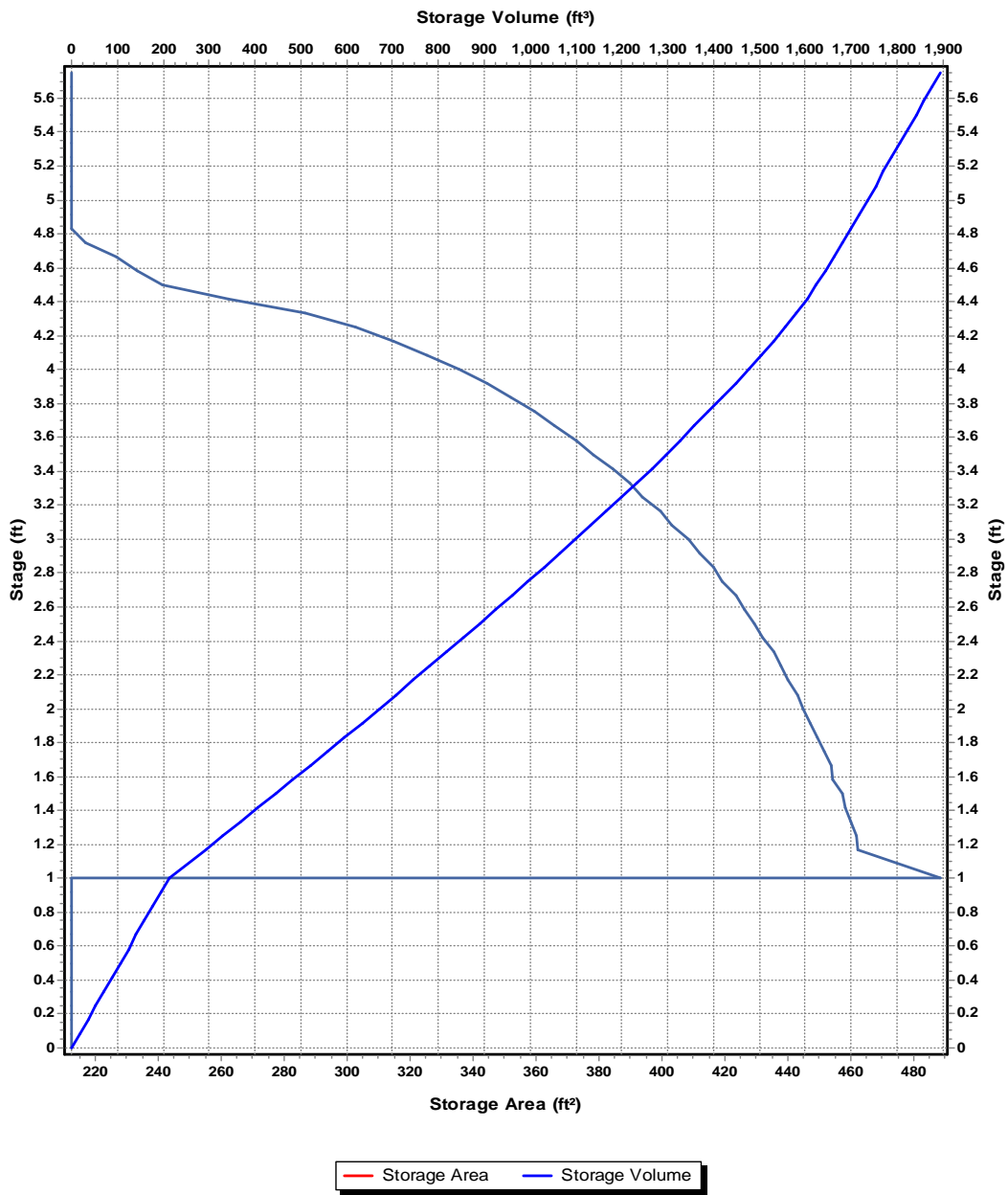
Storage Area Volume Curves

Storage Curve : Underground Storage

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	212.6667	0
0.083	212.6667	17.65
0.167	212.6667	35.51
0.25	212.6667	53.16
0.333	212.6667	70.81
0.417	212.6667	88.67
0.5	212.6667	106.32
0.583	212.6667	123.97
0.667	212.6667	141.83
0.75	212.6667	159.48
0.833	212.6667	177.13
0.917	212.6667	194.99
1	212.667	212.64
1.001	488.6067	212.99
1.167	462.5067	291.93
1.25	461.7867	330.29
1.333	460.3467	368.56
1.417	458.1867	407.14
1.5	457.4667	445.14
1.583	454.5867	482.99
1.667	453.8667	521.15
1.75	451.7067	558.73
1.833	449.5467	596.13
1.917	447.3867	633.8
2	445.2267	670.84
2.083	443.0667	707.7
2.167	440.1867	744.8
2.25	438.0267	781.25
2.333	435.8667	817.52
2.417	432.2667	853.98
2.5	429.3867	889.74
2.583	426.5067	925.26
2.667	423.6267	960.97
2.75	419.3067	995.95
2.833	416.4267	1030.63
2.917	412.1067	1065.43
3	408.5067	1099.49
3.083	403.4667	1133.19
3.167	399.8667	1166.93
3.25	394.1067	1199.88
3.333	389.7867	1232.41
3.417	384.7467	1264.94
3.5	378.2667	1296.61
3.583	373.2267	1327.8
3.667	366.0267	1358.85
3.75	359.5467	1388.96
3.833	352.3467	1418.5
3.917	344.4267	1447.76
4	335.7867	1475.99
4.083	325.7067	1503.44
4.167	314.9067	1530.35
4.25	302.6667	1555.98
4.333	286.8267	1580.44
4.417	262.3467	1603.51
4.5	241.4667	1624.42
4.583	233.5467	1644.13
4.667	227.0667	1663.48
4.75	216.9867	1681.91

4.833	212.6667	1699.74
4.917	212.6667	1717.6
5	212.6667	1735.25
5.083	212.6667	1752.9
5.167	212.6667	1770.76
5.25	212.6667	1788.41
5.333	212.6667	1806.06
5.417	212.6667	1823.92
5.5	212.6667	1841.57
5.583	212.6667	1859.22
5.667	212.6667	1877.08
5.75	212.6667	1894.73

### Storage Area Volume Curves



Storage Node : Stor-01 (continued)

Outflow Weirs

SN	Element	Weir	Flap	Crest	Crest	Length	Weir Total	Discharge
	ID	Type	Gate	Elevation	Offset		Height	Coefficient
				(ft)	(ft)	(ft)	(ft)	
1	Weir-01	Rectangular	No	1005.75	4.75	4.00	3.00	3.33

Outflow Orifices

SN	Element	Orifice	Orifice	Flap	Circular	Rectangular	Rectangular	Orifice	Orifice
	ID	Type	Shape	Gate	Orifice	Orifice	Orifice	Invert	Coefficient
					Diameter	Height	Width	Elevation	
					(in)	(in)	(in)	(ft)	
1	Orifice-01	Side	CIRCULAR	No	6.00			1002.00	0.61

Output Summary Results

Peak Inflow (cfs)	1.49
Peak Lateral Inflow (cfs)	1.49
Peak Outflow (cfs)	0.99
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	1003.32
Max HGL Depth Attained (ft)	2.32
Average HGL Elevation Attained (ft)	1001.96
Average HGL Depth Attained (ft)	0.96
Time of Max HGL Occurrence (days hh:mm)	0 12:02
Total Exfiltration Volume (1000-ft³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : Stor-02

Input Data

Invert Elevation (ft) .....	1001
Max (Rim) Elevation (ft) .....	1007
Max (Rim) Offset (ft) .....	6
Initial Water Elevation (ft) .....	0
Initial Water Depth (ft) .....	-1001
Ponded Area (ft²) .....	0
Evaporation Loss .....	0

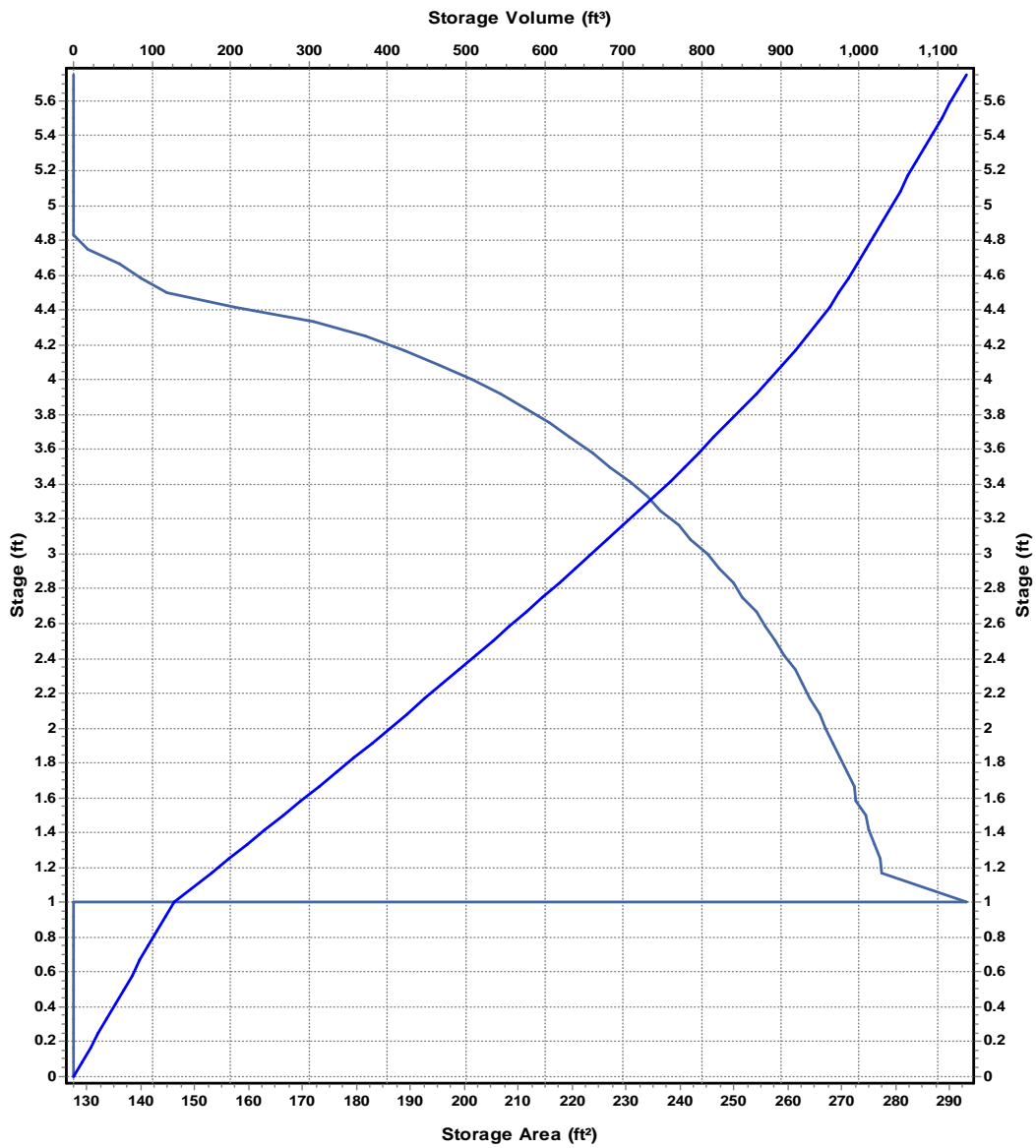
Storage Area Volume Curves

Storage Curve : 2 Underground Storage

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	127.6	0
0.083	127.6	10.59
0.167	127.6	21.31
0.25	127.6	31.9
0.333	127.6	42.49
0.417	127.6	53.21
0.5	127.6	63.8
0.583	127.6	74.39
0.667	127.6	85.11
0.75	127.6	95.7
0.833	127.6	106.29
0.917	127.6	117.01
1	127.6	127.6
1.001	293.164	127.81
1.167	277.504	175.18
1.25	277.072	198.19
1.333	276.208	221.15
1.417	274.912	244.3
1.5	274.48	267.1
1.583	272.752	289.81
1.667	272.32	312.7
1.75	271.024	335.25
1.833	269.728	357.69
1.917	268.432	380.29
2	267.136	402.52
2.083	265.84	424.64
2.167	264.112	446.9
2.25	262.816	468.77
2.333	261.52	490.53
2.417	259.36	512.41
2.5	257.632	533.87
2.583	255.904	555.18
2.667	254.176	576.6
2.75	251.584	597.59
2.833	249.856	618.4
2.917	247.264	639.28
3	245.104	659.71
3.083	242.08	679.93
3.167	239.92	700.17
3.25	236.464	719.94
3.333	233.872	739.46
3.417	230.848	758.98
3.5	226.96	777.98
3.583	223.936	796.69
3.667	219.616	815.32
3.75	215.728	833.39
3.833	211.408	851.12
3.917	206.656	868.68
4	201.472	885.62
4.083	195.424	902.09
4.167	188.944	918.23
4.25	181.6	933.61
4.333	172.096	948.29
4.417	157.408	962.13
4.5	144.88	974.67
4.583	140.128	986.5
4.667	136.24	998.11
4.75	130.192	1009.17
4.833	127.6	1019.87
4.917	127.6	1030.59
5	127.6	1041.18
5.083	127.6	1051.77

5.167	127.6	1062.49
5.25	127.6	1073.08
5.333	127.6	1083.67
5.417	127.6	1094.39
5.5	127.6	1104.98
5.583	127.6	1115.57
5.667	127.6	1126.29
5.75	127.6	1136.88

### Storage Area Volume Curves



Storage Area      Storage Volume

Storage Node : Stor-02 (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-02	Rectangular	No	1005.50	4.50	4.00	1.00	3.33

Outflow Orifices

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	Orifice-02	Side	CIRCULAR	No	4.00			1002.00	0.61

Output Summary Results

Peak Inflow (cfs)	1.95
Peak Lateral Inflow (cfs)	1.95
Peak Outflow (cfs)	1.78
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	1005.68
Max HGL Depth Attained (ft)	4.68
Average HGL Elevation Attained (ft)	1002.01
Average HGL Depth Attained (ft)	1.01
Time of Max HGL Occurrence (days hh:mm)	0 11:58
Total Exfiltration Volume (1000-ft³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

**10% Chance Event**

Project Description

File Name ..... Revisions.SPF

Project Options

Flow Units ..... CFS  
Elevation Type ..... Elevation  
Hydrology Method ..... SCS TR-55  
Time of Concentration (TOC) Method ..... SCS TR-55  
Link Routing Method ..... Hydrodynamic  
Enable Overflow Ponding at Nodes ..... YES  
Skip Steady State Analysis Time Periods ... NO

Analysis Options

Start Analysis On ..... 00:00:00      0:00:00  
End Analysis On ..... 00:00:00      0:00:00  
Start Reporting On ..... 00:00:00      0:00:00  
Antecedent Dry Days ..... 0      days  
Runoff (Dry Weather) Time Step ..... 0 01:00:00      days hh:mm:ss  
Runoff (Wet Weather) Time Step ..... 0 00:05:00      days hh:mm:ss  
Reporting Time Step ..... 0 00:01:00      days hh:mm:ss  
Routing Time Step ..... 5      seconds

Number of Elements

Qty  
Rain Gages ..... 1  
Subbasins..... 3  
Nodes..... 4  
    *Junctions* ..... 1  
    *Outfalls* ..... 1  
    *Flow Diversions* ..... 0  
    *Inlets* ..... 0  
    *Storage Nodes* ..... 2  
Links..... 5  
    *Channels* ..... 0  
    *Pipes* ..... 1  
    *Pumps* ..... 0  
    *Orifices* ..... 2  
    *Weirs* ..... 2  
    *Outlets* ..... 0  
Pollutants ..... 0  
Land Uses ..... 0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	10 Year	Cumulative	inches	Missouri	Jackson	10.00	5.67	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Peak Rate Factor	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)			(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	A_Undetained	5.52	484.00	95.85	5.67	5.18	28.58	40.49	0 00:05:00
2	Farmers Market Roof	0.71	484.00	98.00	5.67	5.43	3.86	5.29	0 00:05:00
3	Pad Site 2	0.20	484.00	98.00	5.67	5.43	1.09	1.48	0 00:05:00

Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	1-Jun	Junction	1002.00	1007.00	0.00	0.00	0.00	5.13	1002.42	0.00	7.58	0 00:00	0.00	0.00
2	Out-01	Outfall	995.00					43.23	995.40					
3	Farmers Market Storage	Storage Node	1001.00	1007.00	0.00		0.00	5.28	1006.28				0.00	0.00
4	Pad Site 2 Storage	Storage Node	1001.00	1007.00	0.00		0.00	1.48	1004.28				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length  (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Link-01	Pipe	1-Jun	Out-01	200.00	1002.00	995.00	3.5000	36.000	0.0120	5.13	135.18	0.04	8.83	0.41	0.14	0.00	Calculated
2	Farmers Market Orifice	Orifice	Farmers Market Storage	1-Jun		1001.00	1002.00		7.000		2.59							
3	Pad Site 2 Orifice	Orifice	Pad Site 2 Storage	1-Jun		1001.00	1002.00		4.000		0.60							
4	Farmers Market Weir	Weir	Farmers Market Storage	1-Jun		1001.00	1002.00				2.02							
5	Pad Site 2 Weir	Weir	Pad Site 2 Storage	1-Jun		1001.00	1002.00				0.00							

Subbasin Hydrology

Subbasin : A\_Undetained

Input Data

Area (ac)	5.52
Peak Rate Factor	484
Weighted Curve Number	95.85
Rain Gage ID	Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Paved roads with curbs & sewers	4.86	D	98
> 75% grass cover, Good	0.66	D	80
Composite Area & Weighted CN	5.52		95.85

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$

Where :

- Tc = Time of Concentration (hr)
- n = Manning's roughness
- Lf = Flow Length (ft)
- P = 2 yr, 24 hr Rainfall (inches)
- Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

- V = 16.1345 \* (Sf^0.5) (unpaved surface)
- V = 20.3282 \* (Sf^0.5) (paved surface)
- V = 15.0 \* (Sf^0.5) (grassed waterway surface)
- V = 10.0 \* (Sf^0.5) (nearly bare & untilled surface)
- V = 9.0 \* (Sf^0.5) (cultivated straight rows surface)
- V = 7.0 \* (Sf^0.5) (short grass pasture surface)
- V = 5.0 \* (Sf^0.5) (woodland surface)
- V = 2.5 \* (Sf^0.5) (forest w/heavy litter surface)
- Tc = (Lf / V) / (3600 sec/hr)

Where:

- Tc = Time of Concentration (hr)
- Lf = Flow Length (ft)
- V = Velocity (ft/sec)
- Sf = Slope (ft/ft)

Channel Flow Equation :

- $V = (1.49 * (R^{(2/3)}) * (S_f^{0.5})) / n$
- R = Aq / Wp
- Tc = (Lf / V) / (3600 sec/hr)

Where :

- Tc = Time of Concentration (hr)
- Lf = Flow Length (ft)
- R = Hydraulic Radius (ft)
- Aq = Flow Area (ft²)
- Wp = Wetted Perimeter (ft)
- V = Velocity (ft/sec)
- Sf = Slope (ft/ft)
- n = Manning's roughness

User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

Total Rainfall (in)	5.67
Total Runoff (in)	5.18
Peak Runoff (cfs)	40.49

Weighted Curve Number ..... 95.85  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

Subbasin : Farmers Market Roof

Input Data

Area (ac) ..... 0.71  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Paved parking & roofs	0.31	D	98
Composite Area & Weighted CN	0.31		98

Time of Concentration

User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

Total Rainfall (in) ..... 5.67  
Total Runoff (in) ..... 5.43  
Peak Runoff (cfs) ..... 5.29  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

Subbasin : Pad Site 2

Input Data

Area (ac) ..... 0.2  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Paved parking & roofs	0.52	D	98
Composite Area & Weighted CN	0.52		98

Time of Concentration

User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

Total Rainfall (in) ..... 5.67  
Total Runoff (in) ..... 5.43  
Peak Runoff (cfs) ..... 1.48  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

Storage Nodes

Storage Node : Farmers Market Storage

Input Data

Invert Elevation (ft)	1001
Max (Rim) Elevation (ft)	1007
Max (Rim) Offset (ft)	6
Initial Water Elevation (ft)	0
Initial Water Depth (ft)	-1001
Ponded Area (ft²)	0
Evaporation Loss	0

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 Farmers Market Weir	Rectangular	No	1006.00	5.00	4.00	3.00	3.33

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 Farmers Market Orifice	Side	CIRCULAR	No	7.00			1002.00	0.61

Output Summary Results

Peak Inflow (cfs)	5.28
Peak Lateral Inflow (cfs)	5.28
Peak Outflow (cfs)	4.61
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	1006.28
Max HGL Depth Attained (ft)	5.28
Average HGL Elevation Attained (ft)	1002.04
Average HGL Depth Attained (ft)	1.04
Time of Max HGL Occurrence (days hh:mm)	0 11:58
Total Exfiltration Volume (1000-ft³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Storage Node : Pad Site 2 Storage

Input Data

Invert Elevation (ft)	1001
Max (Rim) Elevation (ft)	1007
Max (Rim) Offset (ft)	6
Initial Water Elevation (ft)	0
Initial Water Depth (ft)	-1001
Ponded Area (ft²)	0
Evaporation Loss	0

Outflow Weirs

SN Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1 Pad Site 2 Weir	Rectangular	No	1005.50	4.50	4.00	1.00	3.33

Outflow Orifices

SN Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1 Pad Site 2 Orifice	Side	CIRCULAR	No	4.00			1002.00	0.61

Output Summary Results

Peak Inflow (cfs)	1.48
Peak Lateral Inflow (cfs)	1.48
Peak Outflow (cfs)	0.6
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	1004.28
Max HGL Depth Attained (ft)	3.28
Average HGL Elevation Attained (ft)	1001.99
Average HGL Depth Attained (ft)	0.99
Time of Max HGL Occurrence (days hh:mm)	0 12:04
Total Exfiltration Volume (1000-ft³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

**1% Chance Event**

Project Description

File Name ..... Revisions.SPF

Project Options

Flow Units ..... CFS  
Elevation Type ..... Elevation  
Hydrology Method ..... SCS TR-55  
Time of Concentration (TOC) Method ..... SCS TR-55  
Link Routing Method ..... Hydrodynamic  
Enable Overflow Ponding at Nodes ..... YES  
Skip Steady State Analysis Time Periods ... NO

Analysis Options

Start Analysis On ..... 00:00:00 0:00:00  
End Analysis On ..... 00:00:00 0:00:00  
Start Reporting On ..... 00:00:00 0:00:00  
Antecedent Dry Days ..... 0 days  
Runoff (Dry Weather) Time Step ..... 0 01:00:00 days hh:mm:ss  
Runoff (Wet Weather) Time Step ..... 0 00:05:00 days hh:mm:ss  
Reporting Time Step ..... 0 00:01:00 days hh:mm:ss  
Routing Time Step ..... 5 seconds

Number of Elements

Qty  
Rain Gages ..... 1  
Subbasins..... 3  
Nodes..... 5  
    *Junctions* ..... 2  
    *Outfalls* ..... 1  
    *Flow Diversions* ..... 0  
    *Inlets* ..... 0  
    *Storage Nodes* ..... 2  
Links..... 6  
    *Channels* ..... 0  
    *Pipes* ..... 2  
    *Pumps* ..... 0  
    *Orifices* ..... 2  
    *Weirs* ..... 2  
    *Outlets* ..... 0  
Pollutants ..... 0  
Land Uses ..... 0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	100 Year	Cumulative	inches	Missouri	Jackson	100.00	9.25	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area	Peak Rate	Weighted Curve Number	Total Rainfall	Total Runoff	Total Runoff	Peak Runoff	Time of Concentration
		(ac)	Factor	Number	(in)	(in)	Volume (ac-in)	(cfs)	(days hh:mm:ss)
1	A_Undetained	5.72	484.00	95.26	9.25	8.68	49.66	69.08	0 00:05:00
2	Canopy and Pad Site 2	0.40	484.00	98.00	9.25	9.01	3.60	4.91	0 00:05:00
3	Farmers Market	0.31	484.00	98.00	9.25	9.01	2.76	3.74	0 00:05:00

Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	1-Jun	Junction	1001.90	1007.00	0.00	0.00	0.00	7.92	1002.53	0.00	7.12	0 00:00	0.00	0.00
2	2-Jun	Junction	1002.00	1007.00	0.00	0.00	0.00	4.90	1002.74	0.00	4.76	0 00:00	0.00	0.00
3	Out-01	Outfall	995.00					75.54	995.49					
4	Stor-01	Storage Node	1001.00	1007.00	0.00		0.00	3.74	1005.99				0.00	0.00
5	Stor-02	Storage Node	1001.00	1007.00	0.00		0.00	4.91	1005.96				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Reported Condition
1	Link-01	Pipe	1-Jun	Out-01	200.00	1002.00	995.00	3.5000	36.000	0.0120	7.94	135.18	0.06	9.93	0.51	0.17	0.00	Calculated
2	Link-02	Pipe	2-Jun	1-Jun	1.00	1002.00	1001.90	10.0000	36.000	0.0150	4.93	182.80	0.03	4.32	0.68	0.23	0.00	Calculated
3	Orifice-01	Orifice	Stor-01	1-Jun		1001.00	1001.90		6.000		1.80							
4	Orifice-02	Orifice	Stor-02	2-Jun		1001.00	1002.00		4.000		0.78							
5	Weir-01	Weir	Stor-01	1-Jun		1001.00	1001.90				1.59							
6	Weir-02	Weir	Stor-02	2-Jun		1001.00	1002.00				4.12							

Subbasin Hydrology

Subbasin : A\_Undetained

Input Data

Area (ac)	5.72
Peak Rate Factor	484
Weighted Curve Number	95.26
Rain Gage ID	Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Paved roads with curbs & sewers	4.85	D	98
> 75% grass cover, Good	0.87	D	80
Composite Area & Weighted CN	5.72		95.26

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

$T_c = (0.007 * ((n * L_f)^{0.8})) / ((P^{0.5}) * (S_f^{0.4}))$

Where :

- Tc = Time of Concentration (hr)
- n = Manning's roughness
- Lf = Flow Length (ft)
- P = 2 yr, 24 hr Rainfall (inches)
- Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

- V = 16.1345 \* (Sf^0.5) (unpaved surface)
- V = 20.3282 \* (Sf^0.5) (paved surface)
- V = 15.0 \* (Sf^0.5) (grassed waterway surface)
- V = 10.0 \* (Sf^0.5) (nearly bare & untilled surface)
- V = 9.0 \* (Sf^0.5) (cultivated straight rows surface)
- V = 7.0 \* (Sf^0.5) (short grass pasture surface)
- V = 5.0 \* (Sf^0.5) (woodland surface)
- V = 2.5 \* (Sf^0.5) (forest w/heavy litter surface)
- Tc = (Lf / V) / (3600 sec/hr)

Where:

- Tc = Time of Concentration (hr)
- Lf = Flow Length (ft)
- V = Velocity (ft/sec)
- Sf = Slope (ft/ft)

Channel Flow Equation :

$V = (1.49 * (R^{(2/3)}) * (S_f^{0.5})) / n$   
 $R = A_q / W_p$   
 $T_c = (L_f / V) / (3600 \text{ sec/hr})$

Where :

- Tc = Time of Concentration (hr)
- Lf = Flow Length (ft)
- R = Hydraulic Radius (ft)
- Aq = Flow Area (ft²)
- Wp = Wetted Perimeter (ft)
- V = Velocity (ft/sec)
- Sf = Slope (ft/ft)
- n = Manning's roughness

User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

Total Rainfall (in)	9.25
Total Runoff (in)	8.68
Peak Runoff (cfs)	69.08

Weighted Curve Number ..... 95.26  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

Subbasin : Canopy and Pad Site 2

Input Data

Area (ac) ..... 0.4  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Paved parking & roofs	0.52	D	98
Composite Area & Weighted CN	0.52		98

Time of Concentration

User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

Total Rainfall (in) ..... 9.25  
Total Runoff (in) ..... 9.01  
Peak Runoff (cfs) ..... 4.91  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

Subbasin : Farmers Market

Input Data

Area (ac) ..... 0.31  
Peak Rate Factor ..... 484  
Weighted Curve Number ..... 98  
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

32	Area	Soil	Curve
Soil/Surface Description	(acres)	Group	Number
Paved parking & roofs	0.31	D	98
Composite Area & Weighted CN	0.31		98

Time of Concentration

User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

Total Rainfall (in) ..... 9.25  
Total Runoff (in) ..... 9.01  
Peak Runoff (cfs) ..... 3.74  
Weighted Curve Number ..... 98  
Time of Concentration (days hh:mm:ss) ..... 0 00:05:00

Storage Nodes

Storage Node : Stor-01

Input Data

Invert Elevation (ft)	1001
Max (Rim) Elevation (ft)	1007
Max (Rim) Offset (ft)	6
Initial Water Elevation (ft)	0
Initial Water Depth (ft)	-1001
Ponded Area (ft²)	0
Evaporation Loss	0

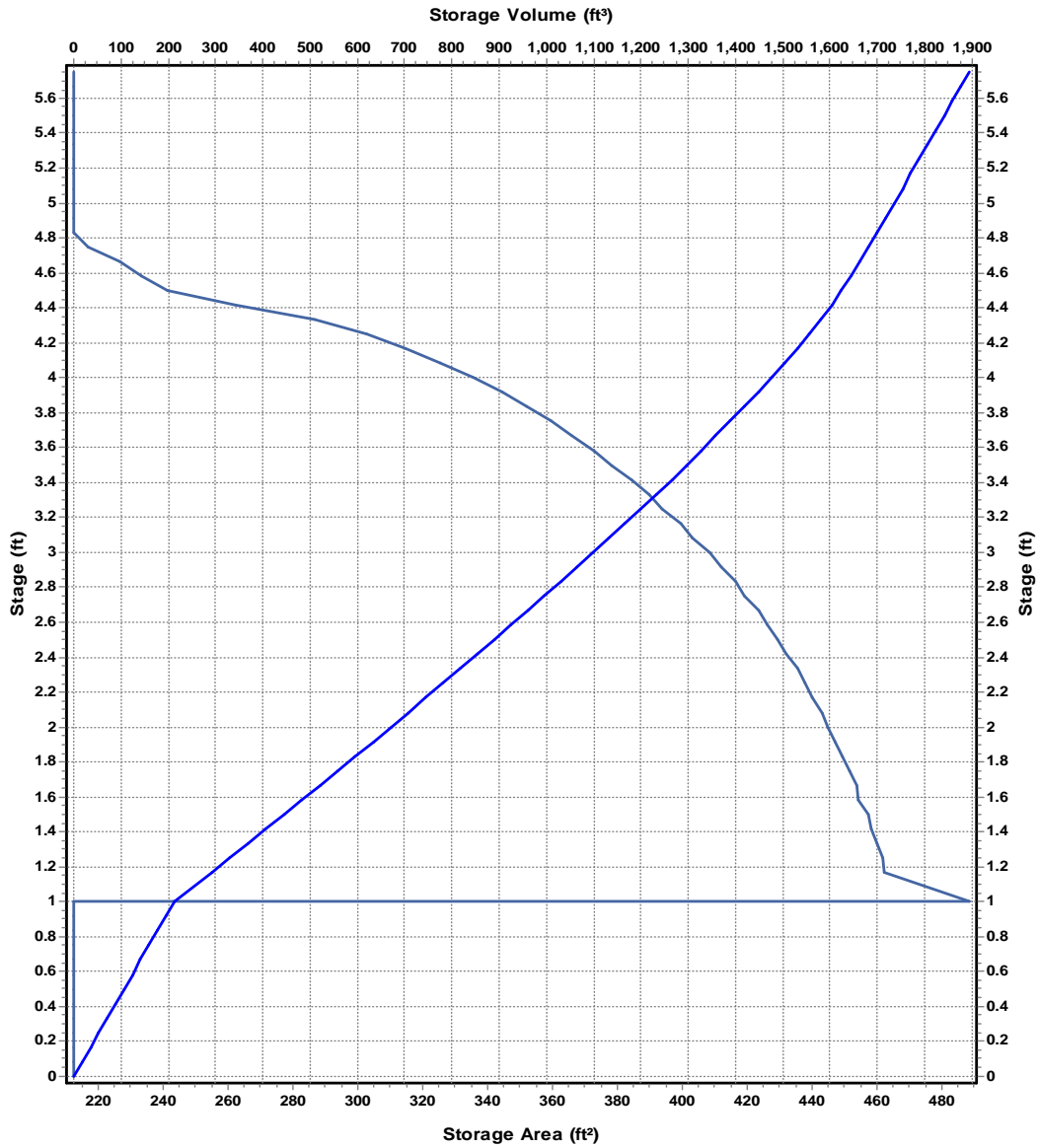
Storage Area Volume Curves

Storage Curve : Underground Storage

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	212.6667	0
0.083	212.6667	17.65
0.167	212.6667	35.51
0.25	212.6667	53.16
0.333	212.6667	70.81
0.417	212.6667	88.67
0.5	212.6667	106.32
0.583	212.6667	123.97
0.667	212.6667	141.83
0.75	212.6667	159.48
0.833	212.6667	177.13
0.917	212.6667	194.99
1	212.667	212.64
1.001	488.6067	212.99
1.167	462.5067	291.93
1.25	461.7867	330.29
1.333	460.3467	368.56
1.417	458.1867	407.14
1.5	457.4667	445.14
1.583	454.5867	482.99
1.667	453.8667	521.15
1.75	451.7067	558.73
1.833	449.5467	596.13
1.917	447.3867	633.8
2	445.2267	670.84
2.083	443.0667	707.7
2.167	440.1867	744.8
2.25	438.0267	781.25
2.333	435.8667	817.52
2.417	432.2667	853.98
2.5	429.3867	889.74
2.583	426.5067	925.26
2.667	423.6267	960.97
2.75	419.3067	995.95
2.833	416.4267	1030.63
2.917	412.1067	1065.43
3	408.5067	1099.49
3.083	403.4667	1133.19
3.167	399.8667	1166.93
3.25	394.1067	1199.88
3.333	389.7867	1232.41
3.417	384.7467	1264.94
3.5	378.2667	1296.61
3.583	373.2267	1327.8
3.667	366.0267	1358.85
3.75	359.5467	1388.96
3.833	352.3467	1418.5
3.917	344.4267	1447.76
4	335.7867	1475.99
4.083	325.7067	1503.44
4.167	314.9067	1530.35
4.25	302.6667	1555.98
4.333	286.8267	1580.44
4.417	262.3467	1603.51
4.5	241.4667	1624.42
4.583	233.5467	1644.13
4.667	227.0667	1663.48
4.75	216.9867	1681.91

4.833	212.6667	1699.74
4.917	212.6667	1717.6
5	212.6667	1735.25
5.083	212.6667	1752.9
5.167	212.6667	1770.76
5.25	212.6667	1788.41
5.333	212.6667	1806.06
5.417	212.6667	1823.92
5.5	212.6667	1841.57
5.583	212.6667	1859.22
5.667	212.6667	1877.08
5.75	212.6667	1894.73

## Storage Area Volume Curves



Storage Area      Storage Volume

Storage Node : Stor-01 (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-01	Rectangular	No	1005.75	4.75	4.00	3.00	3.33

Outflow Orifices

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	Orifice-01	Side	CIRCULAR	No	6.00			1002.00	0.61

Output Summary Results

Peak Inflow (cfs) .....	3.74
Peak Lateral Inflow (cfs) .....	3.74
Peak Outflow (cfs) .....	3.39
Peak Exfiltration Flow Rate (cfm) .....	0
Max HGL Elevation Attained (ft) .....	1005.99
Max HGL Depth Attained (ft) .....	4.99
Average HGL Elevation Attained (ft) .....	1002.04
Average HGL Depth Attained (ft) .....	1.04
Time of Max HGL Occurrence (days hh:mm) .....	0 11:58
Total Exfiltration Volume (1000-ft³) .....	0
Total Flooded Volume (ac-in) .....	0
Total Time Flooded (min) .....	0
Total Retention Time (sec) .....	0

Storage Node : Stor-02

Input Data

Invert Elevation (ft) .....	1001
Max (Rim) Elevation (ft) .....	1007
Max (Rim) Offset (ft) .....	6
Initial Water Elevation (ft) .....	0
Initial Water Depth (ft) .....	-1001
Ponded Area (ft²) .....	0
Evaporation Loss .....	0

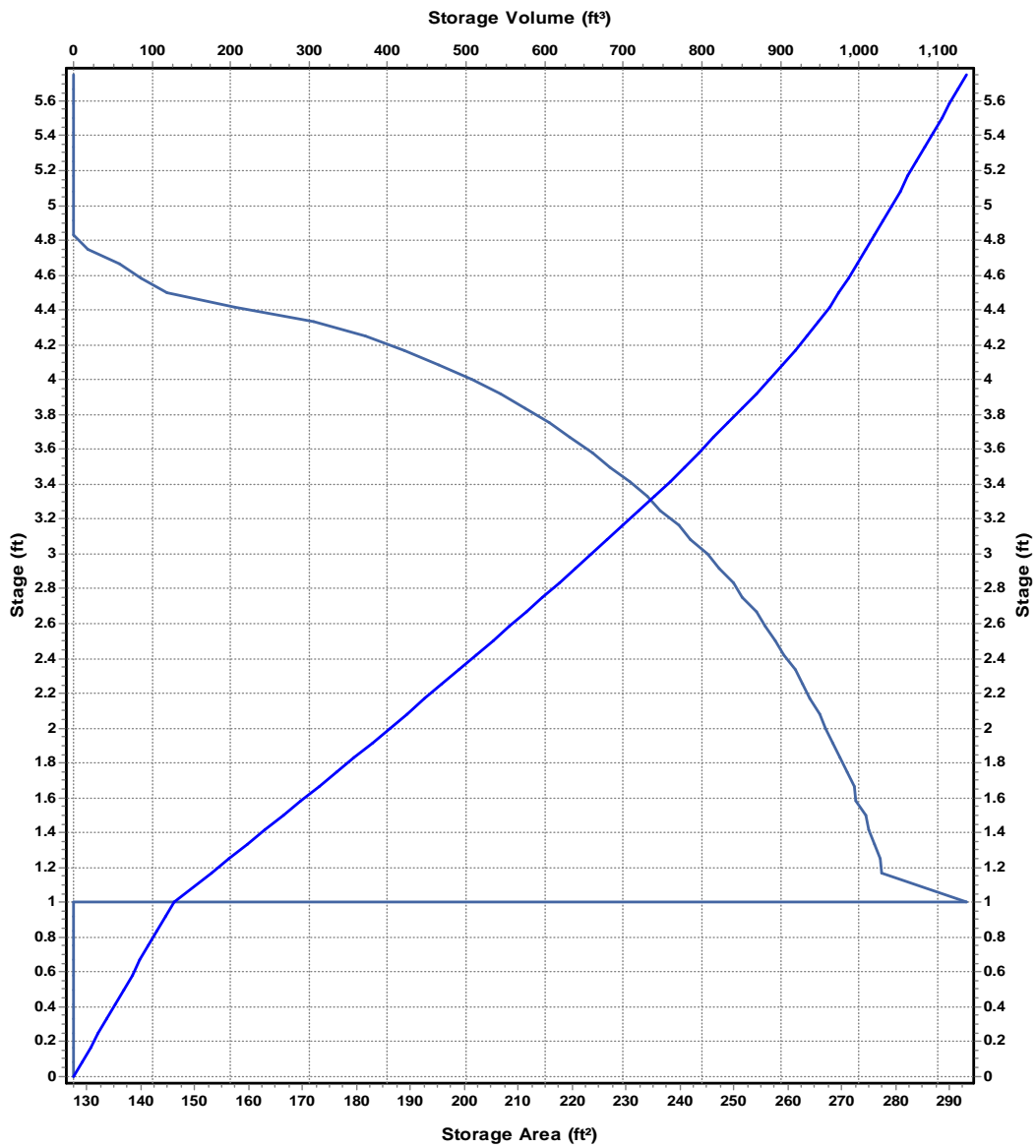
Storage Area Volume Curves

Storage Curve : 2 Underground Storage

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	127.6	0
0.083	127.6	10.59
0.167	127.6	21.31
0.25	127.6	31.9
0.333	127.6	42.49
0.417	127.6	53.21
0.5	127.6	63.8
0.583	127.6	74.39
0.667	127.6	85.11
0.75	127.6	95.7
0.833	127.6	106.29
0.917	127.6	117.01
1	127.6	127.6
1.001	293.164	127.81
1.167	277.504	175.18
1.25	277.072	198.19
1.333	276.208	221.15
1.417	274.912	244.3
1.5	274.48	267.1
1.583	272.752	289.81
1.667	272.32	312.7
1.75	271.024	335.25
1.833	269.728	357.69
1.917	268.432	380.29
2	267.136	402.52
2.083	265.84	424.64
2.167	264.112	446.9
2.25	262.816	468.77
2.333	261.52	490.53
2.417	259.36	512.41
2.5	257.632	533.87
2.583	255.904	555.18
2.667	254.176	576.6
2.75	251.584	597.59
2.833	249.856	618.4
2.917	247.264	639.28
3	245.104	659.71
3.083	242.08	679.93
3.167	239.92	700.17
3.25	236.464	719.94
3.333	233.872	739.46
3.417	230.848	758.98
3.5	226.96	777.98
3.583	223.936	796.69
3.667	219.616	815.32
3.75	215.728	833.39
3.833	211.408	851.12
3.917	206.656	868.68
4	201.472	885.62
4.083	195.424	902.09
4.167	188.944	918.23
4.25	181.6	933.61
4.333	172.096	948.29
4.417	157.408	962.13
4.5	144.88	974.67
4.583	140.128	986.5
4.667	136.24	998.11
4.75	130.192	1009.17
4.833	127.6	1019.87
4.917	127.6	1030.59
5	127.6	1041.18
5.083	127.6	1051.77

5.167	127.6	1062.49
5.25	127.6	1073.08
5.333	127.6	1083.67
5.417	127.6	1094.39
5.5	127.6	1104.98
5.583	127.6	1115.57
5.667	127.6	1126.29
5.75	127.6	1136.88

### Storage Area Volume Curves



— Storage Area — Storage Volume

Storage Node : Stor-02 (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-02	Rectangular	No	1005.50	4.50	4.00	1.00	3.33

Outflow Orifices

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	Orifice-02	Side	CIRCULAR	No	4.00			1002.00	0.61

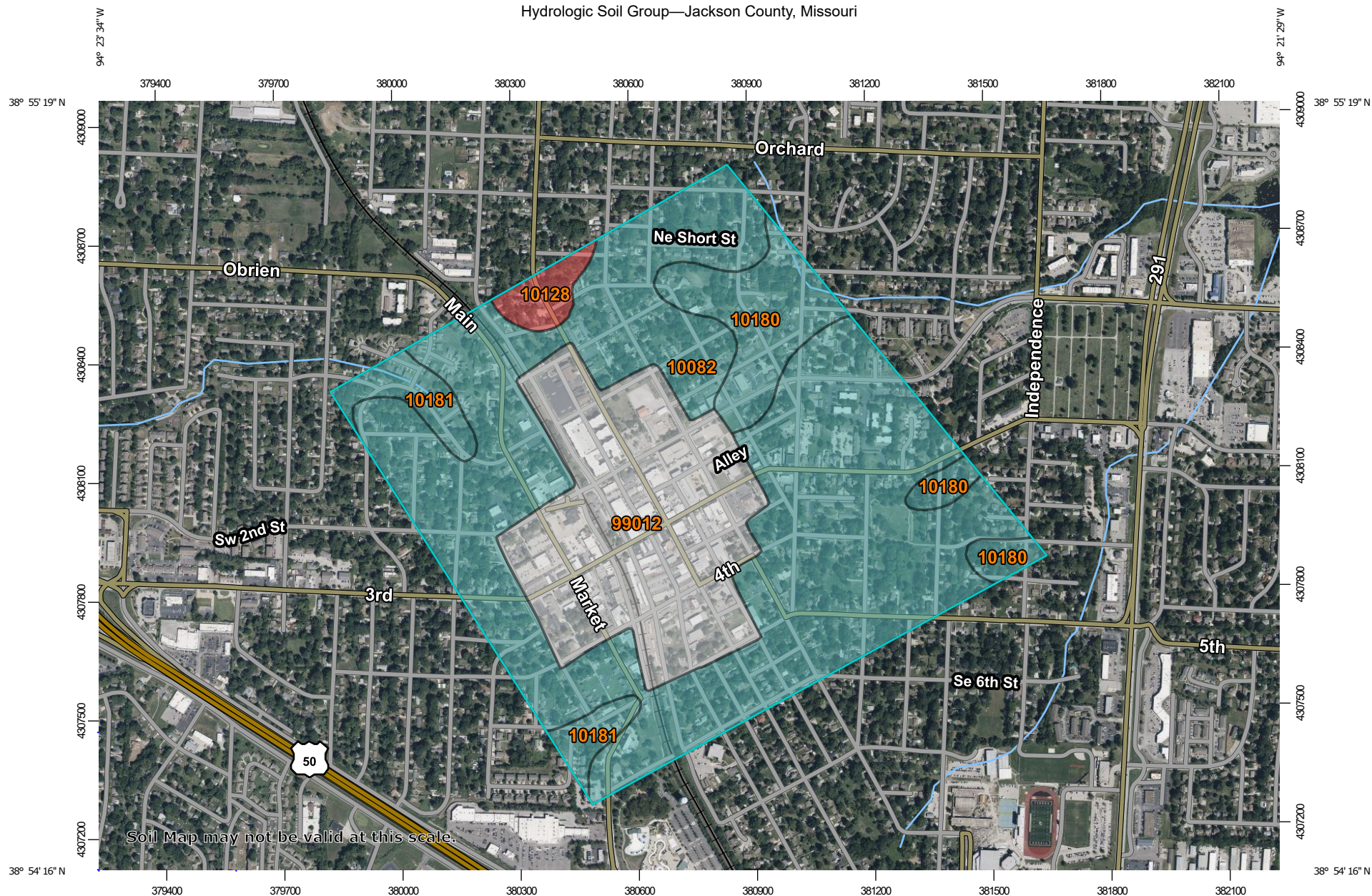
Output Summary Results

Peak Inflow (cfs)	4.91
Peak Lateral Inflow (cfs)	4.91
Peak Outflow (cfs)	4.9
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	1005.96
Max HGL Depth Attained (ft)	4.96
Average HGL Elevation Attained (ft)	1002.09
Average HGL Depth Attained (ft)	1.09
Time of Max HGL Occurrence (days hh:mm)	0 11:56
Total Exfiltration Volume (1000-ft³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

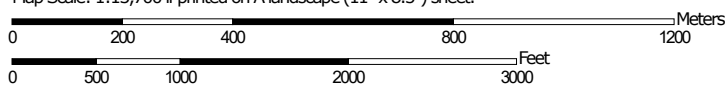
## **APPENDIX D**

### Soil Maps

# Hydrologic Soil Group—Jackson County, Missouri



Map Scale: 1:13,700 if printed on A landscape (11" x 8.5") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84




**Natural Resources  
Conservation Service**

Web Soil Survey  
National Cooperative Soil Survey

2/14/2023  
Page 1 of 4

## 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

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 24, Aug 31, 2022

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

Date(s) aerial images were photographed: Aug 30, 2022—Sep 8, 2022

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.

## 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	232.8	60.9%
10128	Sharpsburg-Urban land complex, 2 to 5 percent slopes	D	6.9	1.8%
10180	Udarents-Urban land-Sampsel complex, 2 to 5 percent slopes	C	33.7	8.8%
10181	Udarents-Urban land-Sampsel complex, 5 to 9 percent slopes	C	15.5	4.0%
99012	Urban land, upland, 5 to 9 percent slopes		93.4	24.4%
<b>Totals for Area of Interest</b>			<b>382.3</b>	<b>100.0%</b>

## Description

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.

## Rating Options

*Aggregation Method:* Dominant Condition

*Component Percent Cutoff:* None Specified

*Tie-break Rule:* Higher

## **APPENDIX E**

FEMA

## NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Missouri State Plane West Zone (FIPS zone 2403). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services  
NOAA, NIMS 12  
National Geodetic Survey  
SSM-C-3, 9202  
1316 East West Highway  
Silver Spring, Maryland 20910-3282  
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov>.

**Base map** information shown on this FIRM was derived from the U.S.D.A. Farm Service National Agriculture Imagery Program (NAIP) dated 2014. Produced at scale of 1:24,000.

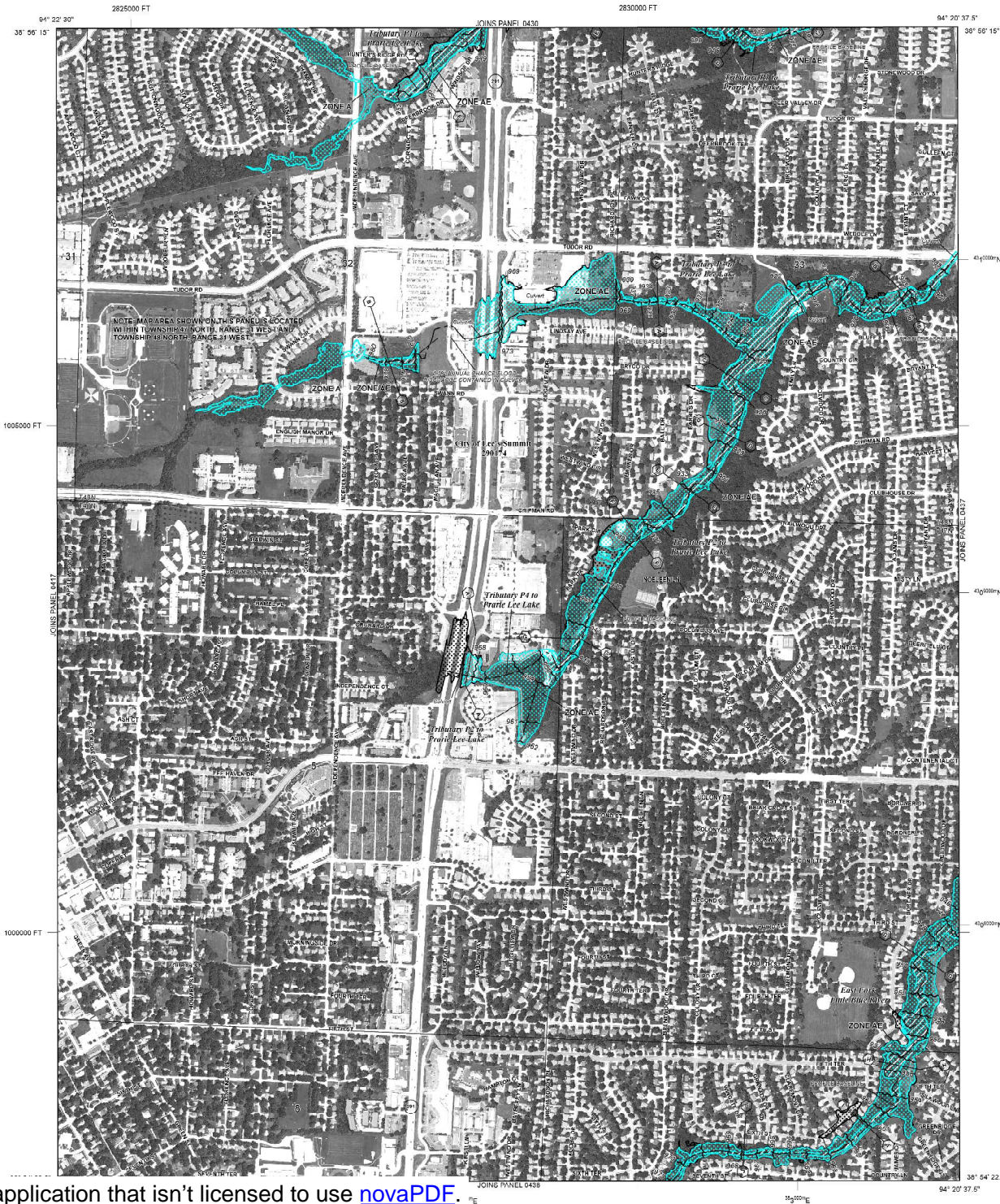
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Based on updated topographic information, this map reflects more detailed and up to date **stream channel configurations** and **floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the flood profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unimproved streams may differ from what is shown on previous maps.

**Corporate limits** shown on this map are based on the best data available at the time of publication. Because changes due to annexations or disannexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.



### LEGEND

**SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Areas are the areas subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include zones A, AE, AH, AO, AR, V, and X. The base flood elevation is the water surface elevation of the 1% annual chance flood.

**ZONE A** No Base Flood Elevations determined.

**ZONE AE** Base Flood Elevations determined.

**ZONE AH** Flood depths of 1 to 3 feet (nearly all areas of ponding); Base Flood Elevations determined.

**ZONE AO** Flood depths of 1 to 3 feet (nearly all areas of ponding); Base Flood Elevations determined.

**ZONE AR** Special Flood Hazard Areas formerly included in the 1% annual chance flood by a flood control system that has subsequently been identified. Zone AR indicates that the former flood control system is being removed to provide protection from the 1% annual chance or greater flood.

**ZONE ARS** Area to be protected from 1% annual chance flood by a federal flood protection system under construction; no base flood elevations determined.

**ZONE V** Coastal flood zone with velocity hazard (wave action); no base flood elevations determined.

**ZONE VV** Coastal flood zone with velocity hazard (wave action); base flood elevations determined.

**FLOODWAY AREAS IN ZONE AE**

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of flood heights.

**OTHER FLOOD AREAS**

**ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with depths more than 1 foot; 1% and 0.2% annual chance flood.

**OTHER AREAS**

**ZONE D** Areas determined to be outside the 0.2% annual chance floodplain.

**COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**

**OTHERWISE PROTECTED AREAS (OPAs)**

OPAs are normally located within or adjacent to Special Flood Hazard Areas.

**1% Annual Chance Floodplain Boundary**

**Floodway boundary**

**Zone D boundary**

**CBRS and OPA boundary**

**Boundary dividing Special Flood Hazard Areas and boundary between Special Flood Hazard Areas of different base flood elevations, flood depths, or flood velocities.**

**Base Flood Elevation line and value; elevation in feet\***

**Base Flood Elevation value where uniform within zone; elevation in feet\***

**\*Referenced to the North American Vertical Datum of 1988**

**Cross section line**

**Transect line**

**Bridge**

**Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere**

**Community Name: Missouri State Plane West Zone (FIPS Zone 2403); Township: Missouri projection**

**North arrow (see explanation in Notes to Users section of this FIRM panel)**

**River Mile**

**MAP REVISIONS**

Refer to Map Repository for Map Index

**EFFECTIVE DATE OF COUNTRYWIDE FLOOD INSURANCE RATE MAP**

September 26, 2008

**EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL**

January 20, 2017 - to change Special Flood Hazard Areas

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine a flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6820.

**MAP SCALE 1" = 500'**

**250 0 250 500 FEET**

**250 0 250 500 METERS**

**NATIONAL FLOOD INSURANCE PROGRAM**

**PANEL 0436G**

**FIRM**

**FLOOD INSURANCE RATE MAP**

**JACKSON COUNTY, MISSOURI AND INCORPORATED AREAS**

**PANEL 436 OF 625**

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

**CONTAINS:**

COMMUNITY	NUMBERS	PANEL	SUFFIX
LEE'S GUMMUT, CITY OF	200/71	0436	0

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

**MAP NUMBER**  
2909SC0436G

**MAP REVISED**  
JANUARY 20, 2017

**Federal Emergency Management Agency**

This document was created by an application that isn't licensed to use novaPDF.

Purchase a license to generate PDF files without this notice.



**LEE'S SUMMIT DOWNTOWN MARKET  
FINAL DEVELOPMENT PLAN  
DRAINAGE STUDY**

Lee's Summit, MO

December 2023

Olsson Project No. 022-00393