RAINTREE VILLAGE PRELIMINAY DEVELOPMENT PLAN MICRO STORMWATER DRAINAGE STUDY

Prepared for:

Scenic Development

Lee Summit, Missouri

March 2022

Olsson Project No. 021-04054-A

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1. GENERAL INFORMATION

The Raintree Village development is a proposed senior living facility located on 11.86-acres in Lee Summit, Jackson County, Missouri., The development will include three phases for the complete development of the lot. Phase 1 will include one 91,380 S.F. building and associated drives, parking, and utilities. Phase 2 will include five 6,987 S.F. buildings and associated sidewalk, and utilities. Phase 3 is a building addition to the phase 1 building that will be 9,045 S.F.

This report will analyze and establish detention and BMP requirements for the development.

1.1. Project Location

Raintree Villaget is located entirely in the City of Lee Summit, Missouri. The property is bounded by SW Arborwalk Blvd. on the north, Arboridge Drive on the west, MO State HW 150 on the south, and existing commercial properties to the east. Development areas, as described above and the project location are shown in Figure 1.

Figure 1. Site Location.

1.2. FEMA Floodplain Information

The site lies entirely within areas determined to be of minimal flood hazard (unshaded Zone X) as depicted on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Community Panel No. 29095 C 0531 G, effective date: 01/20/2017. A copy of the firmette is included in Appendix C.

1.3. Soils Information

Information obtained from the United States Department of Agriculture (USDA) Web Soil Survey website indicates site soils as:

Table 1. Soil Classifications

HSG	Map Symbol	Type	Slopes
D	10082	Arisburg-Urban Land Complet	1-5%
D	10181	Udarents-Urban Land-Sampsel Complex	5-9%

Natural Resources Conservation Services (NRCS) Runoff Curve Numbers (CN's) in this study have been assigned to tributary areas based upon these Hydrologic Soil Groups and associated existing and proposed land use. A copy of the NRCS printout is included in Appendix D.

1.4. Existing Stormwater Systems

No existing storm sewer systems exist on the property. Public storm sewers exist along SW Arborwalk Blvd and Arboridge Drive and south along State HW 150. This storm sewer then travels west/south to Tract 4, just west of our site before continuing south across State HW 150. Proposed storm sewers will be conveyed via the existing culvert pipes along the SW section of our site to Tract 4 before continuing south.

The existing storm sewer inlets and piping along SW Arborwalk Dr. were installed with previous phases of the Arborwalk development. This land area was shown as commercial development in the previously prepared and approved Arborwalk Preliminary Development Plan (PDP) prepared for Gale Communities dated June 19, 2003. During the previous PDP phases, stormwater management approaches where analysis for the land and uses shown. There are currently two large areas set aside for stormwater management, in a tract located north of SW Arborwalk Blvd and south of SW Arbor Park Drive and a tract located west of Arborridge and south of SW Arborwalk Blvd. There is also a basin currently installed on the unplatted land to the west of Arborridge just north of Highway 150. This basin is assumed to be temporary since located in unplatted land.

2. METHODOLOGY

This drainage study has been prepared to evaluate the hydrologic impact generated by development of Woodside Ridge Second Plat. The base data for the models prepared for this report has been obtained from available online maps and aerial imagery. Stormwater quantity management is based upon methods and objectives defined in the Kansas City Metropolitan Chapter of the American Public Works Association (KC-APWA) “Section 5600 Storm Drainage Systems & Facilities” (2011).

The following methods were used in this study to model existing and proposed (micro) conditions for stormwater runoff:

Runoff rates and conveyance systems were analyzed using Autodesk Storm and Sanitary Analysis 2020 (SSA). SSA utilizes the following approved methods:

- NRCS TR-55 Unit Hydrograph Method
- 2-year, 10-year, and 100-year, 24-hour Storm Precipitation Depths
    - 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)
    - NRCS TR-55 Methods for Time of Concentration and Travel Time.
- Hydrodynamic routing of storm sewer systems
    - Manning’s ‘n’ and Junction Loss (k) values within KCAPWA Section 5600

Stormwater runoff models were created for the 100-Year (1 percent), 10_Year (10 percent), and 2-Year (50 percent) design storm events. The precipitation depths used in the analyses have been obtained from the National Oceanic and Atmospheric Administration (NOAA), Point Precipitation Frequency Estimates based on NOAA’s Atlas 14, Volume 8, Version 2 publication. Table 2 summarizes the rainfall depths used in this analysis:

Table 2. Precipitation Depths

Return Period	24-hour Precipitation Depth (in)
2-Year (50% Storm)	3.69
10-Year (10% Storm)	5.62
100-Year (1% Storm)	9.17

3. EXISTING CONDITIONS

The Raintree Village property is an undeveloped lot just north of State HW 150 and east of Arboridge Drive. This section will analyze the project areas described above to provide the baseline runoff results required for comparison to the developed conditions that will be presented in Section 4.

The existing study area is split between areas that drain to culvert pipes along the west and southwest of the site as shown on the exhibits in Appendix A. Existing land cover is undeveloped area with native grasses. Runoff in Basin E1 is conveyed overland to an existing 24'' CMP that travels west across Arboridge Drive. Runoff in Basin E2 is conveyed overland to an existing 36'' CMP that travels west across Arboridge Drive. The remainder OS1 and OS2 are conveyed overland to the road before entering an existing inlet and traveling via the existing storm network. The entire area E1, E2, OS1, and OS2 ultimately outlet to the Tract 4 just west of our site across Arboridge Drive before ultimately traveling south via existing infrastructure ending at Winnebago Lake.

Runoff Curve Numbers have been developed for each subbasin based on the existing land cover/use obtained from survey data and aerial photography and using TR-55 values for the corresponding land cover/use, as stated in Section 2. Table 3 summarizes the subbasin input data used for the analysis. Refer to the exhibit within Appendix A for a visual representation of the tributary areas and CN values.

Table 3. Existing Conditions Hydrologic Input

Subbasin	Drainage Area (ac)	CN	Tc (min)
E1	3.17	74.00	7.36
E2	7.82	74.00	19.04
OS1	0.43	74.00	6.20
OS2	0.44	74.00	7.09
Total	**11.86**		

Existing peak runoff rates and times are summarized in Table 4 and can be found in their entirety in **Error! Reference source not found.**.

Table 4. Existing Conditions Runoff Results

Subbasin	2-Year		10-YeaR		100-Year	
	Peak Q (cfs)	Peak Time (hr)	Peak Q (cfs)	Peak Time (hr)	Peak Q (cfs)	Peak Time (hr)
E1	6.30	12.00	13.47	12.00	27.83	12.00
E2	11.79	12.00	25.06	12.00	51.66	12.00
OS1	0.88	12.00	1.87	12.00	3.82	12.00
OS2	0.89	12.00	1.89	12.00	3.88	12.00
Total	18.00		38.15		78.62	

4. PROPOSED CONDITIONS

Improvements to the site will include the construction of one 91,380 S.F. building and associated drives, parking, and utilities, phase 1. Plus, the construction of five 6,987 S.F. buildings and associated sidewalk, and utilities, phase 2. Finally, the construction of one 9.045 S.F. building, phase 3, attached to the phase 1 building. Phase 1 is to be constructed now while Phase 2/3 is to be constructed at a future date, at which point the site will be verified to conform to the assumptions made within this study. Watershed areas will be generally maintained with the site releasing at the SW of the lot similar to the existing conditions. Paved surfaces and building roofs will be graded to direct runoff into the existing private storm system, minus a section of the site that will exit the site via overland flow to the existing storm sewer network along SW Arborwalk Blvd and Arboridge Drive.

The difference between the existing conditions model and the proposed conditions model is a direct result of the construction of Tract 1.

Since this land area is apart of an existing approved development plan where stormwater management was required to be reviewed, we are still working with the city to determine the best path forward on this land and requirements based on the previously approved studies. For the purpose of the Preliminary Development Plan Submittal, we have laid out potential scenarios and paths forward to allow all parties time to resolve the on-going discussions regarding previously approved studies and intent for this area. The paths forward have been listed below and when each phase submits for construction documents an updated Stormwater Study shall be provided to evaluate the current conditions and discussions with City of Lee's Summit.

Phase 1

As noted, Phase 1 will consist of one 91,380 S.F. building and associated, drives, parking, and utilities. Since this phase is intended to be constructed before the west property and may occur prior to having full resolution on stormwater management for the area, a temporary detention pond will be construction in the SW corner of the site, to control stormwater in an interm condition. The pond will be designed to allow the full Phase 1/2 runoff to be held without any future dentition when phase 2 is constructed, case it is ultimately required. As the pond is located at the site of two of the future building the future layout may be modified to a three-building configuration if necessary. For permeant detention there are a few options available that are being considered.

- **Option 1:** Maintain interim condition detention pond and reconfigure phase 2 layout to eliminate two of the proposed memory care buildings.
- **Option 2:** This option involves coordinating with the adjacent lot to the west, Tract 1 for a combined detention system for both lots. We are currently coordinating between owners to determine if a combined storm system can be installed with the proposed layout for this lot. Once it is determined if combined stormwater can be installed a determination will be made on where the permanent detention pond will be located.
- **Option 3:** There are on-going conversations with the city regarding the previously approved study and what the stormwater management approach for this area was. Pending what these discussions lead to, stormwater management approaches may be revisited to determine if there is a need for this area to have a basin installed based on upstream controls measures and compliance with the previously approved Preliminary Development Plan.

Phase 2

Phase 2 will consist of five 6,987 S.F. buildings and associated sidewalk, and utilities. Detention was constructed during the phase 1 plans for the ultimate build out condition, however it should be revisited at time of Phase 2 to determine if the basin from Phase 1 is still needed or if other stormwater control measures have been installed. If the basin is still needed this phase will consist of less buildings, then shown, however ideally all five will be constructed, thus shown on the Preliminary Development Plan.

Phase 2

Phase 3 will consist of one 9,045 S.F. buildings and associated sidewalk, and utilities. Detention was constructed during the phase 1 plans for the ultimate build out condition, however it should be revisited at time of Phase 3 to determine if the basin from Phase 1 is still needed or if other stormwater control measures have been installed.

Runoff Curve Numbers have been updated for each subbasin based on the existing and proposed land cover/uses obtained from survey data, aerial photography, and proposed design, using TR-

55 values for the corresponding land cover/use, as stated in Section 2. Table 5 summarizes the subbasin input data used for the analysis. Refer to the exhibit within Appendix A for a visual representation of the tributary areas and CN values.

Table 5. Proposed Conditions Hydrologic Input

Subbasin	Drainage Area (ac)	CN	Tc (min)
P1	9.50	83.98	5.00
OS1	1.25	74.00	5.00
OS2	1.11	74.00	8.46
Total	**11.86**		

Proposed peak runoff rates, and detention basin results are summarized in the tables below

Table 6. Proposed Conditions Runoff Results

Subbasin	2-Year		10-YeaR		100-Year	
	Peak Q (cfs)	Peak Time (hr)	Peak Q (cfs)	Peak Time (hr)	Peak Q (cfs)	Peak Time (hr)
P1	30.37	12.00	55.32	12.00	101.50	12.00
OS1	2.72	12.00	5.66	12.00	11.62	12.00
OS2	2.13	12.00	4.52	12.00	9.39	12.00

Table 7. Allowable Peak Flowrate Comparison

Subbasin	Storm Event	Existing (cfs)	Allowable (cfs)
Tract 1 (Overall)	2-Year	18.00	18.00
	10-Year	38.15	38.15
	100-Year	78.62	78.62

Above tables show the peak allowable release rate for the proposed conditions site when fully developed.

5. CONCLUSION

The Raintree Village development is a proposed senior living facility development in Lee Summit, Jackson County, Missouri. This study has been prepared for the proposed project to review the site design in conformance with the city's proposed runoff and water quality criteria.

At the time this study was prepared there still is on-going overall discussions with the city regarding stormwater management for the land area. Along with discussions with the city, there are also discussions between the property owner to the west and this property owner and what can be done jointly to address stormwater. As these discussions are activily occurring, we have laid out a few paths forward to detail options. With each phase of construction an updated stormwater study shall be submitted to outline site conditions and serve as an update to the currently on-going discussions.

APPENDIX A

Exhibits

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PROJECT NO: A21-04054	RAINTREE VILLAGE - EXISTING CONDITIONS	EXHIBIT
DRAWN BY: CSM		1
DATE: 03/25/2022		

olsson
1301 Burlington Street
North Kansas City, MO 64116
TEL 816.361.1177

N

0’ 75’ 150’
SCALE IN FEET

LAND COVER LEGEND

TURF GRASS (GOOD)
(6.38 ACRES)

IMPERVIOUS
(5.48 ACRES)

DWG: Z:\2021\04001-04500\021-04054-A\40-Design\Reports\GNCV\Storm Sewer\Exhibits\OWBP - Proposed Land Cover.dwg USER: cmoyo
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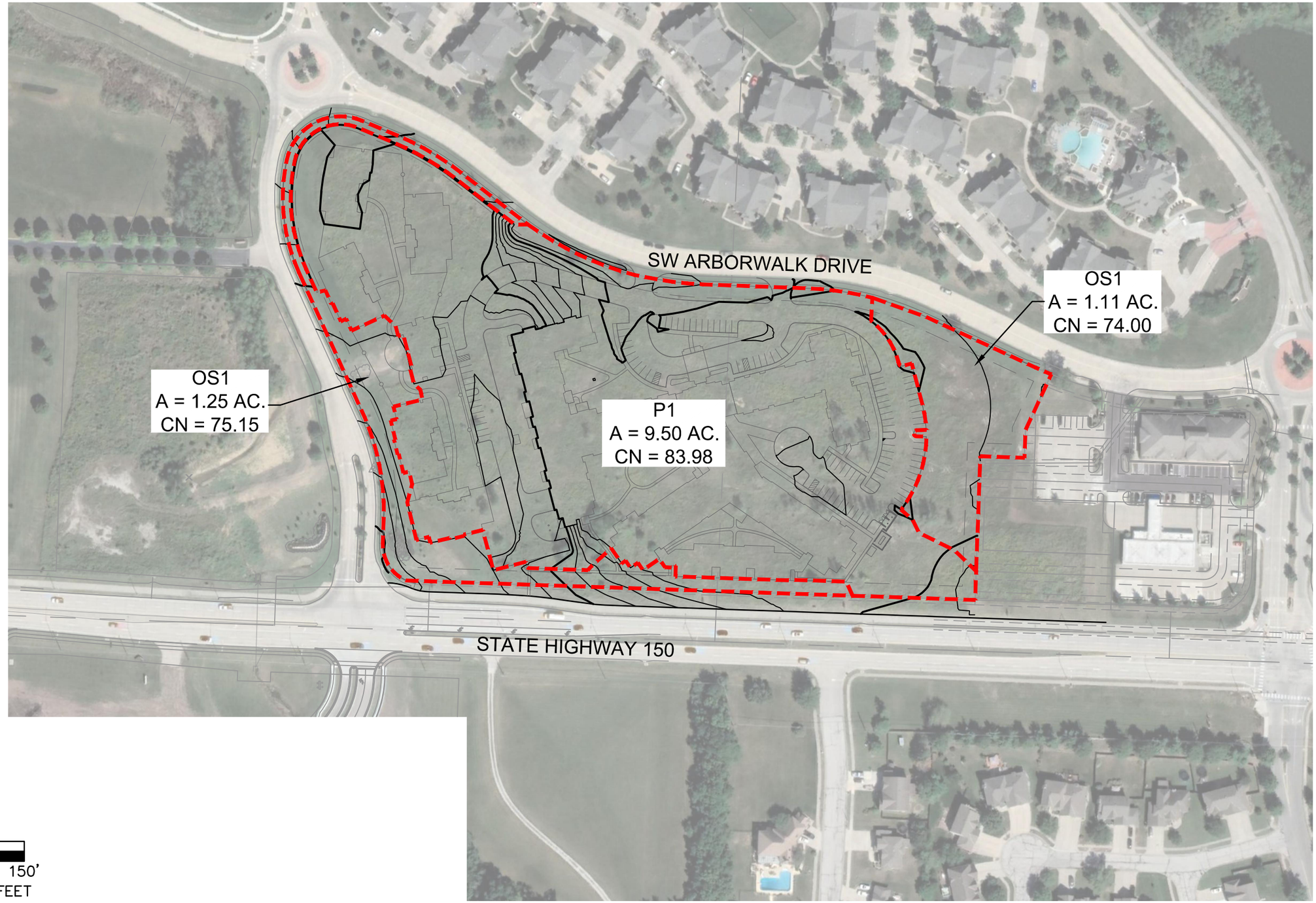
DRAWN BY: CSM			
DATE: 03/25/2022			



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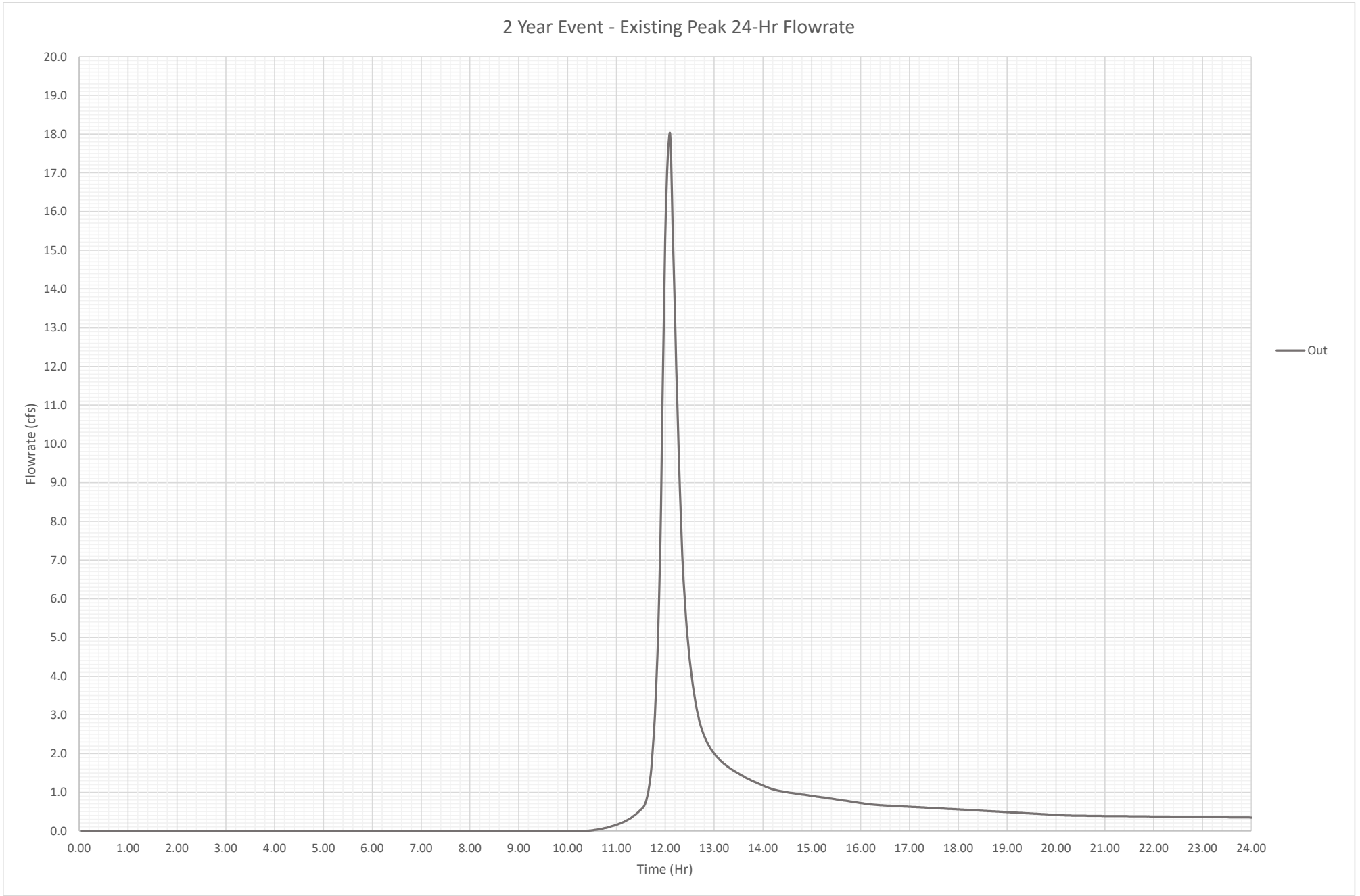
APPENDIX B

Model Results

EXISTING CONDITIONS HYDROGRAPHS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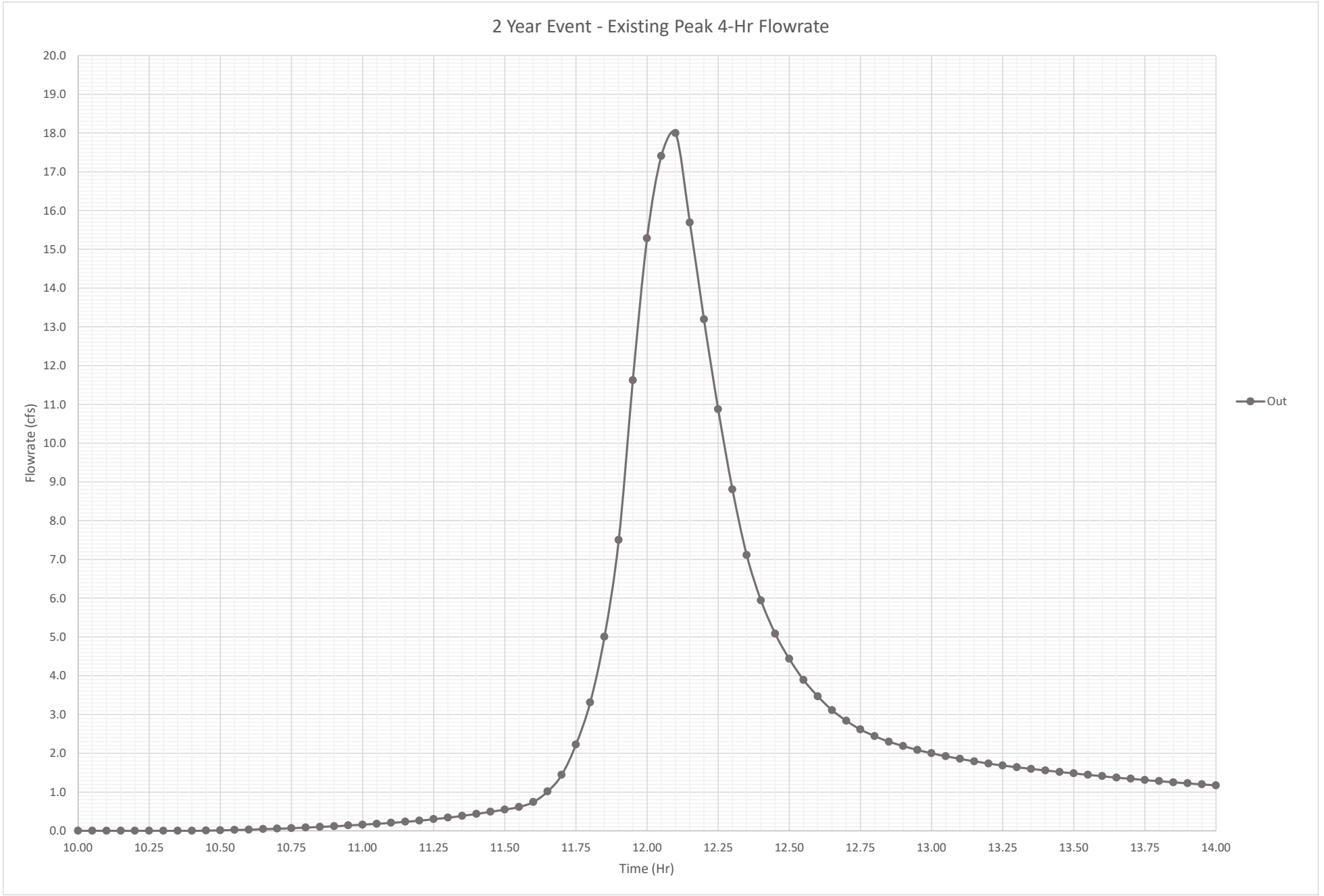
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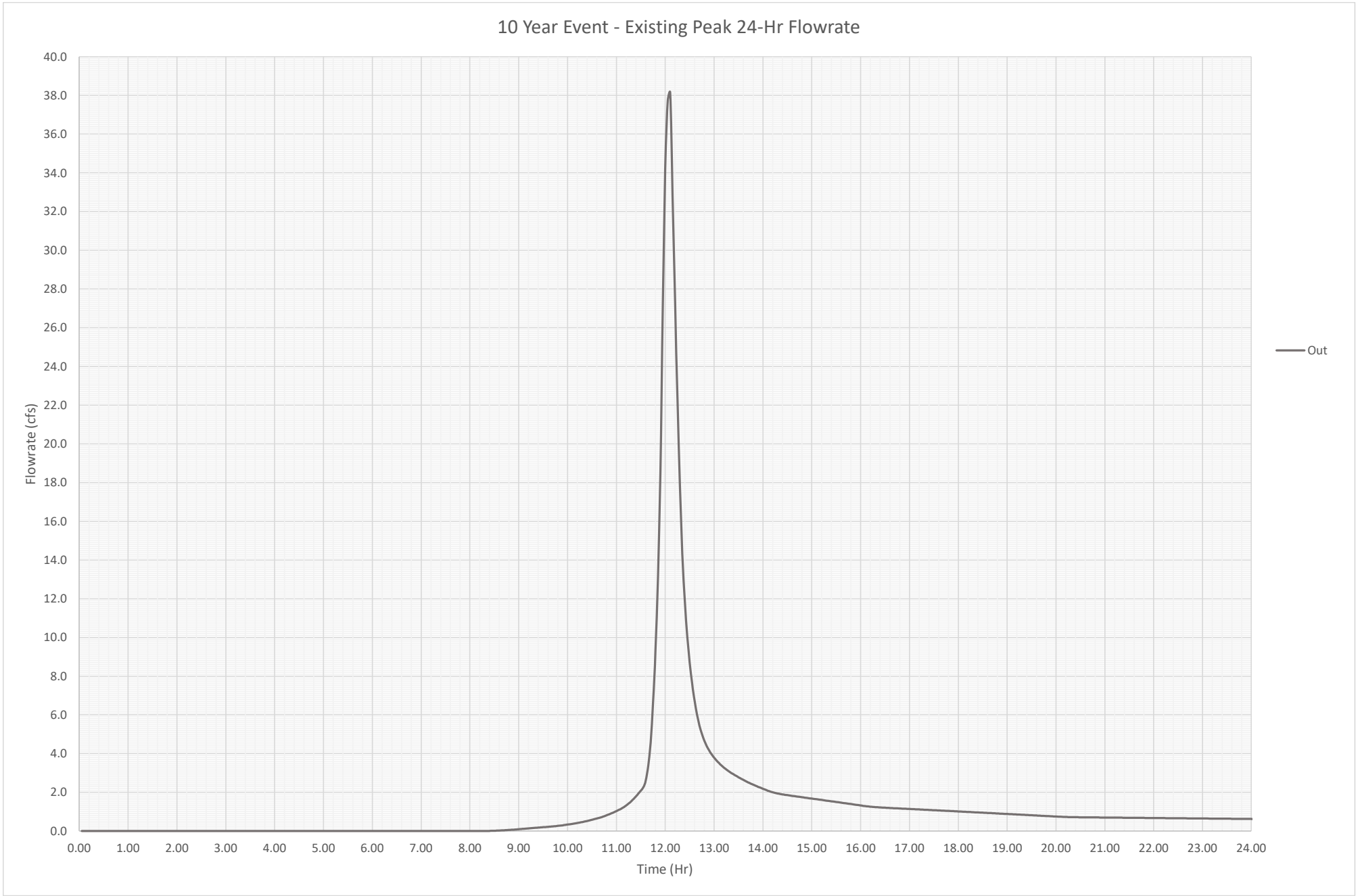
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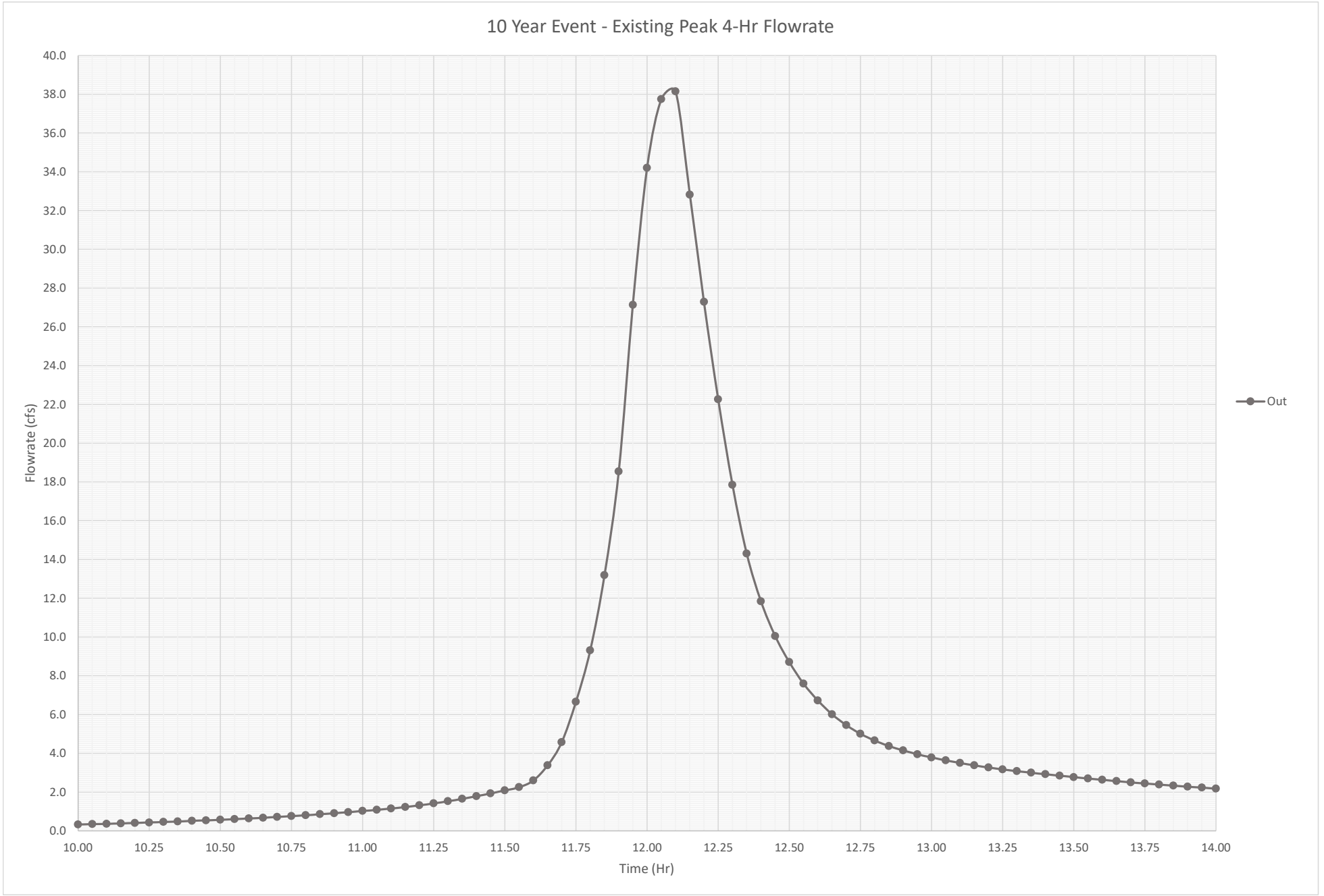
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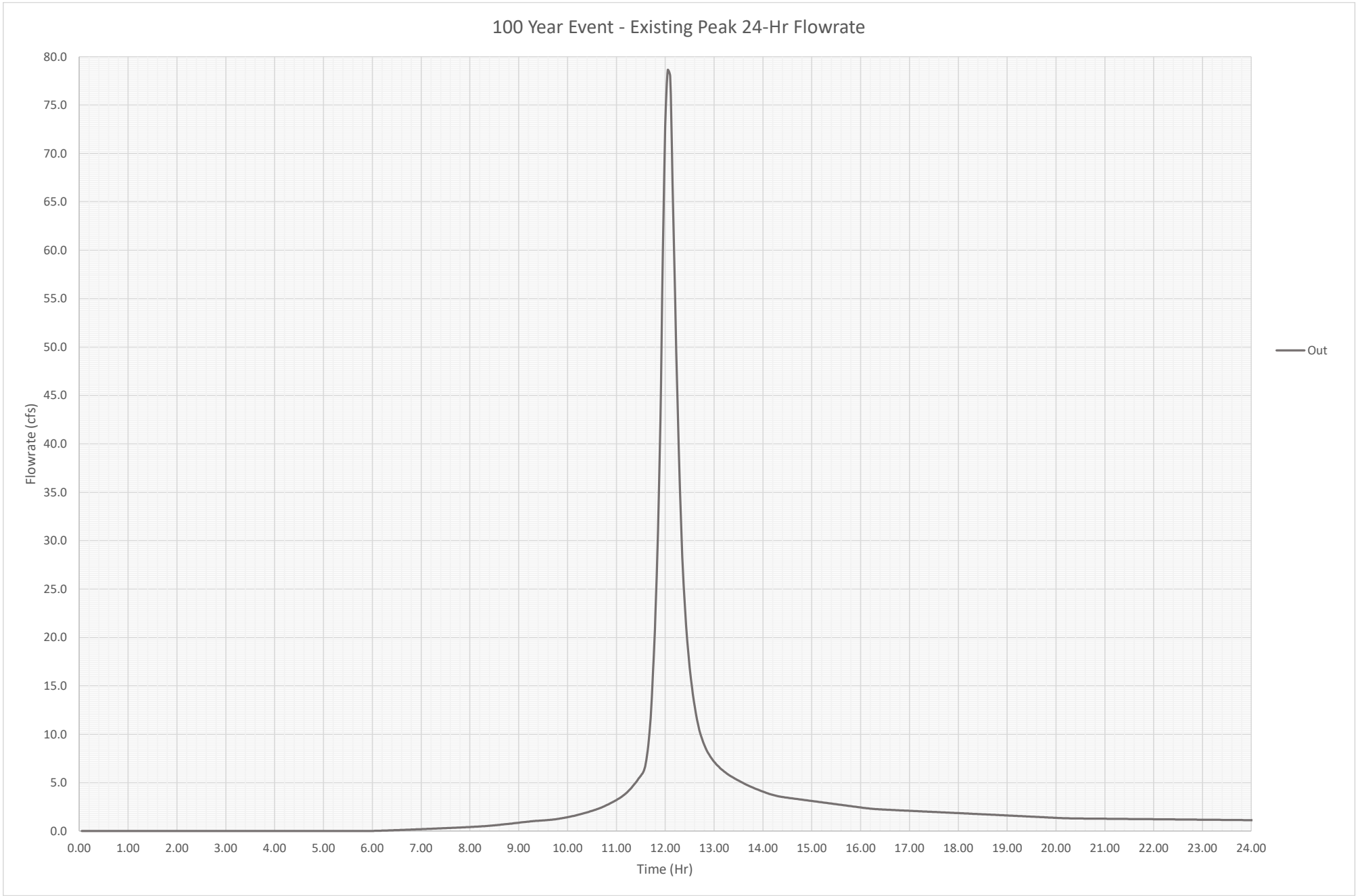
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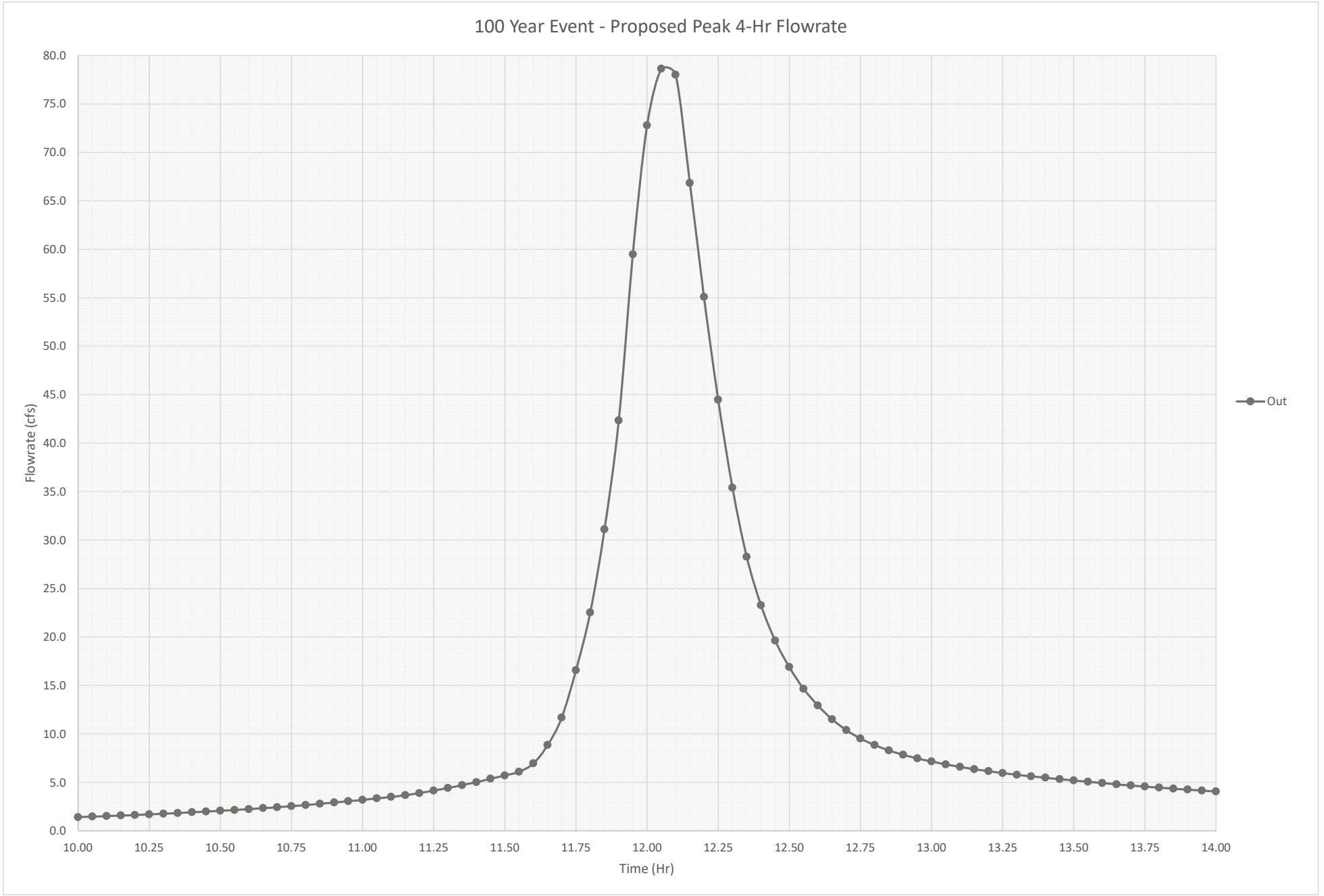
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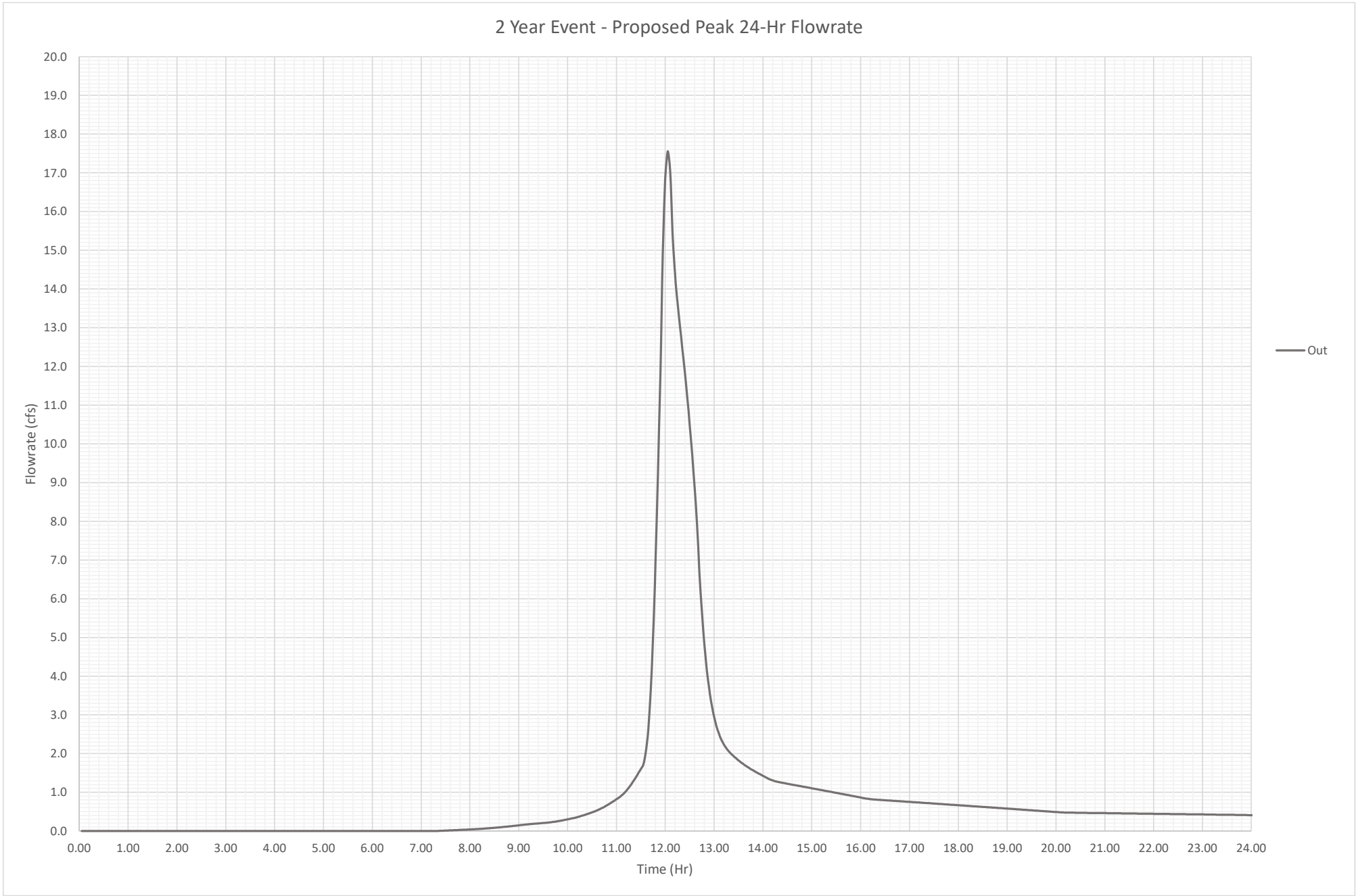
PROPOSED CONDITIONS
HYDROGRAPHS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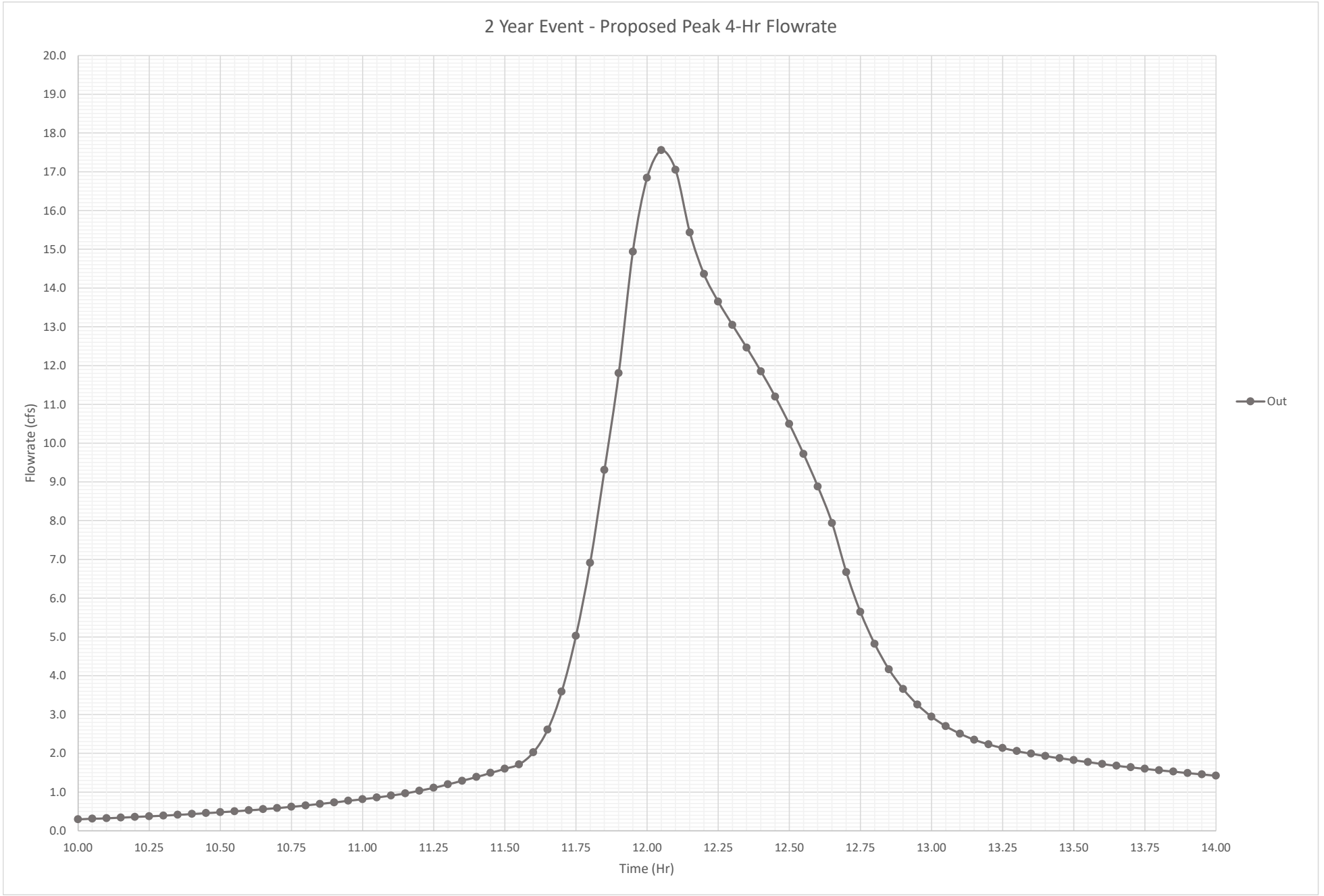
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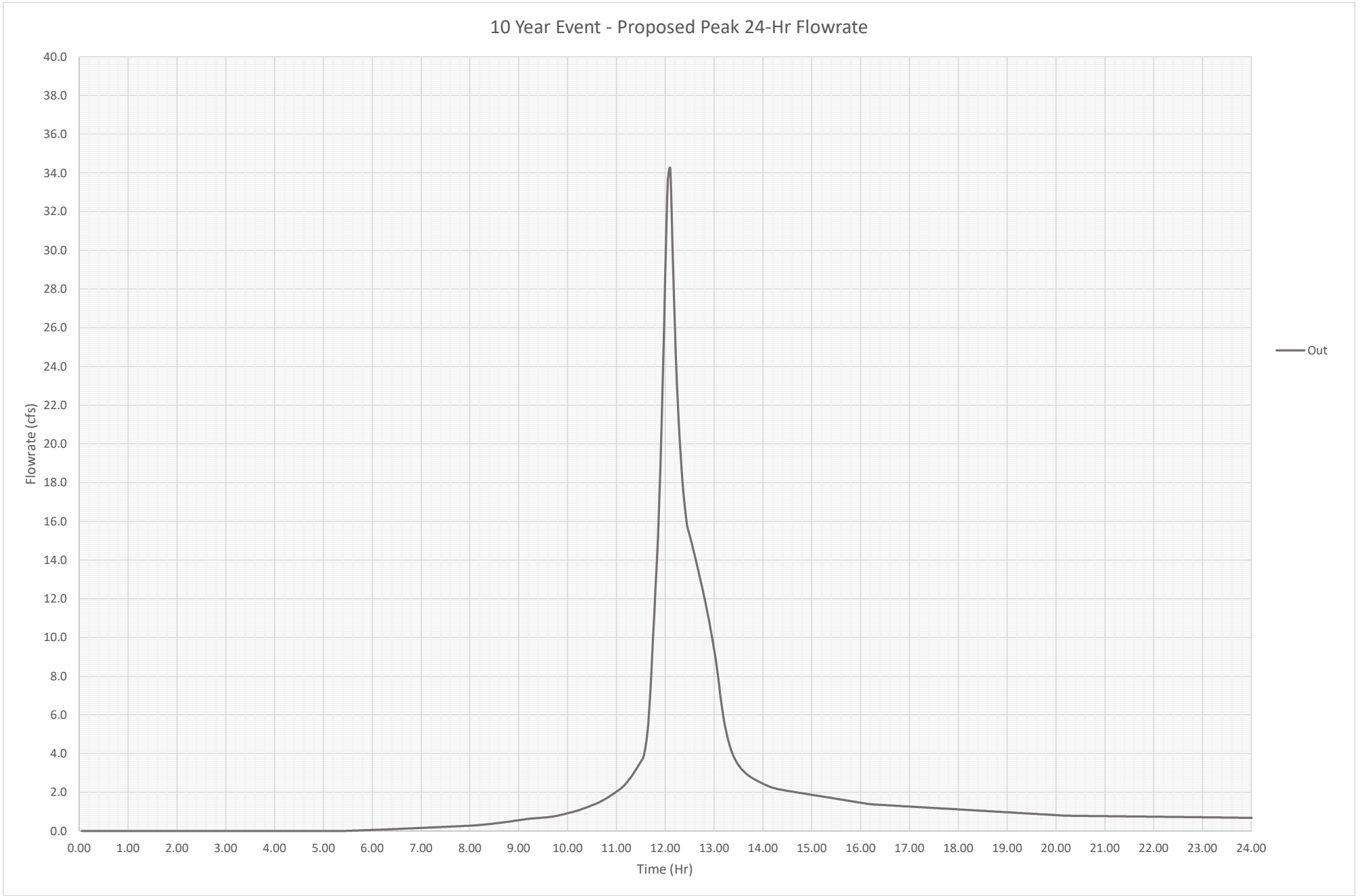
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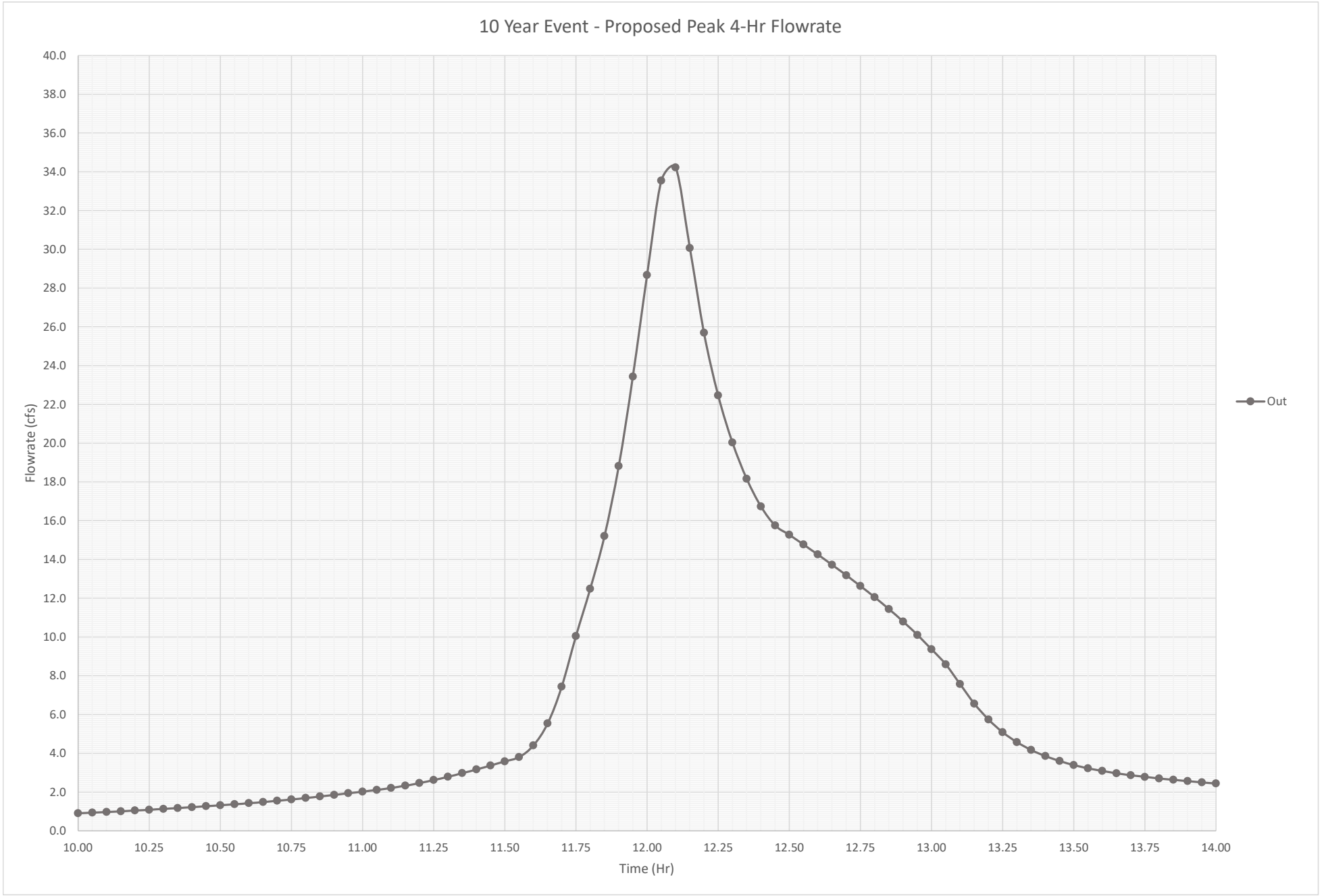
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Flowrate (cfs)
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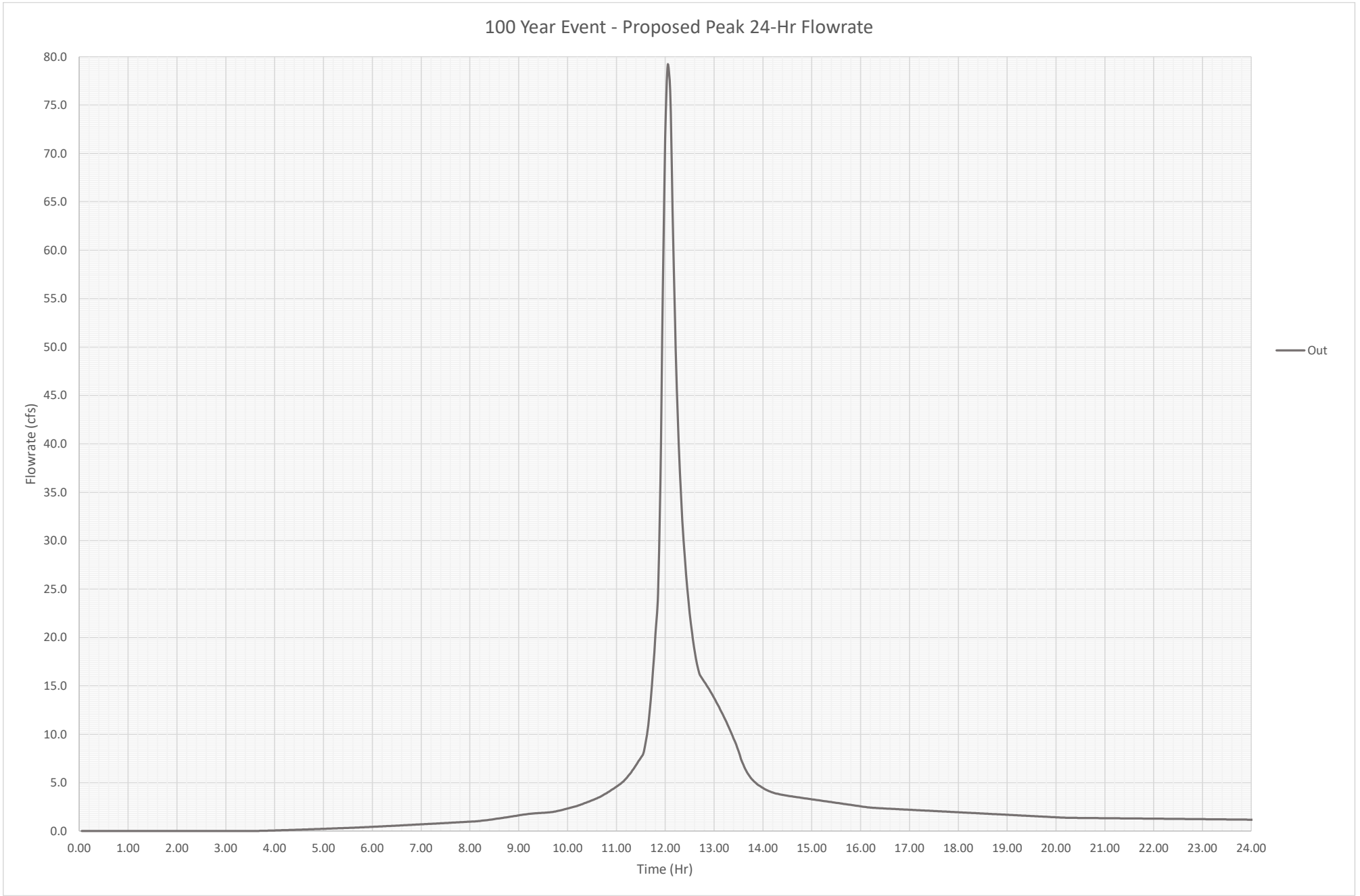
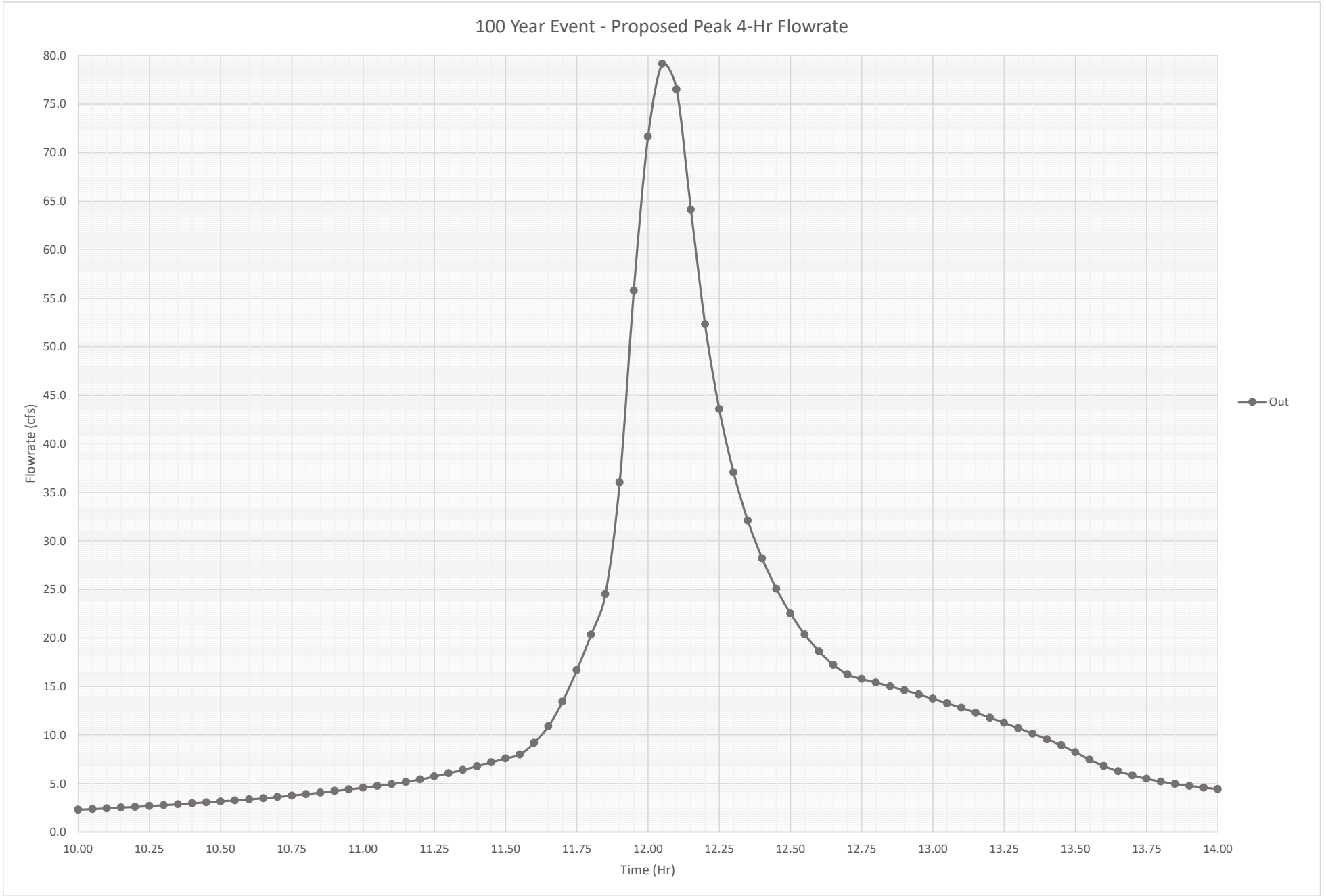

100 Year Event - Proposed Peak 24-Hr Flowrate
Flowrate (cfs)
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00
11.00
12.00
13.00
14.00
15.00
16.00
17.00
18.00
19.00
20.00
21.00
22.00
23.00
24.00
Time (Hr)
Out


100 Year Event - Proposed Peak 4-Hr Flowrate
Flowrate (cfs)
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
10.00
10.25
10.50
10.75
11.00
11.25
11.50
11.75
12.00
12.25
12.50
12.75
13.00
13.25
13.50
13.75
14.00
Time (Hr)
Out

EXISTING CONDITIONS
MODEL RESULTS

2 Year Event

Project Description

File Name	Existing_Model_A2104054.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	0:03:00
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 00:03:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	4
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
49		Time Series	2-Year	Cumulative	inches	Missouri	Jackson	2.00	3.69	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	E1	3.17	484.00	74.00	3.69	1.37	4.36	6.32	0 00:07:21
2	E2	7.82	484.00	74.00	3.69	1.37	10.73	11.80	0 00:19:02
3	OS1	0.43	484.00	74.00	3.69	1.37	0.59	0.88	0 00:06:12
4	OS2	0.44	484.00	74.00	3.69	1.37	0.61	0.89	0 00:07:05

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Tract-4_OUT	Outfall	0.00					0.00	0.00					

Subbasin Hydrology

Subbasin : E1

Input Data

Area (ac) 3.17
Peak Rate Factor 484
Weighted Curve Number 74
Rain Gage ID ..... Rain Gage

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	3.43	-	74
Composite Area & Weighted CN	3.43		74

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^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 (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.1	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	8.67	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.44	0	0
Computed Flow Time (min) :	3.77	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	289	0	0
Slope (%) :	3.65	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.34	0	0
Computed Flow Time (min) :	3.59	0	0

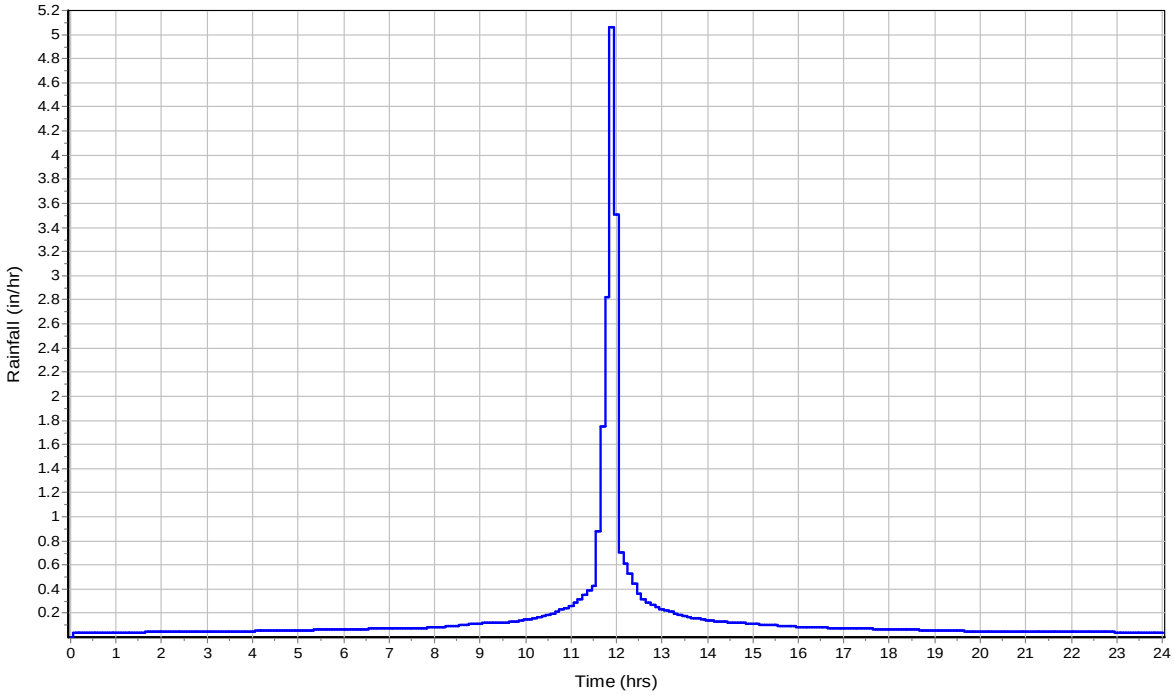
Total TOC (min) 7.36

Subbasin Runoff Results

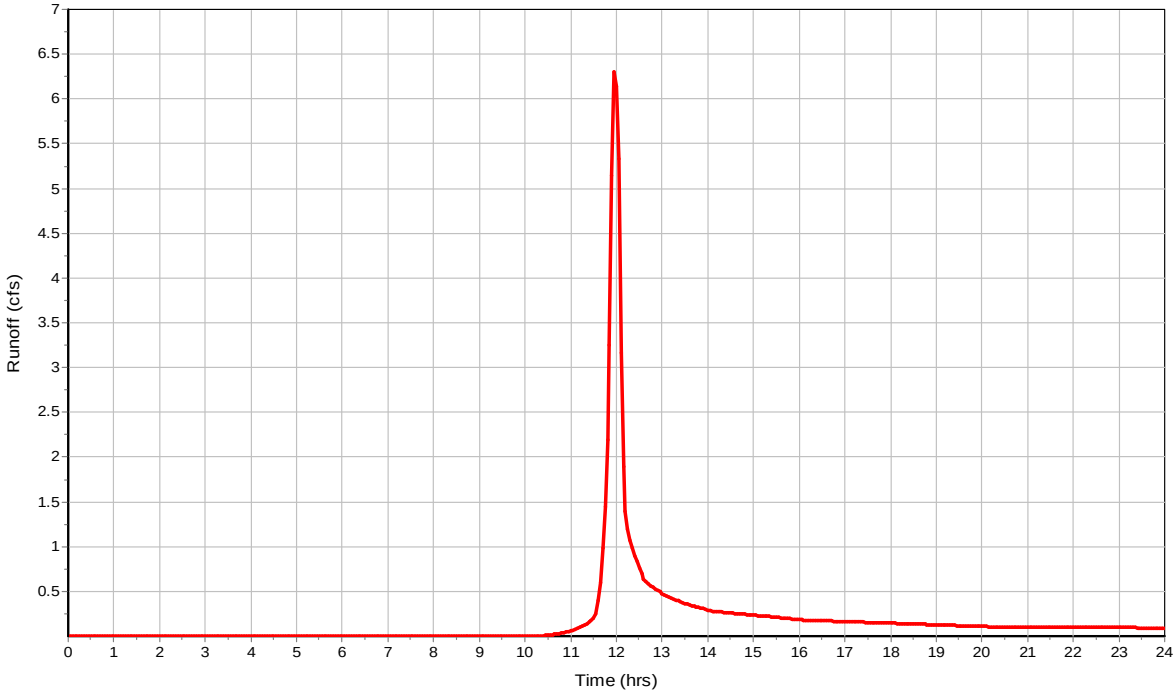
Total Rainfall (in)	3.69
Total Runoff (in)	1.37
Peak Runoff (cfs)	6.32
Weighted Curve Number	74
Time of Concentration (days hh:mm:ss)	0 00:07:22

Subbasin : E1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : E2

Input Data

Area (ac)	7.82
Peak Rate Factor	484
Weighted Curve Number	74
Rain Gage ID	*

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	8.43	-	74
Composite Area & Weighted CN	8.43		74

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.1	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	1.2	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.2	0	0
Computed Flow Time (min) :	8.31	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	766	0	0
Slope (%) :	2.88	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.19	0	0
Computed Flow Time (min) :	10.73	0	0

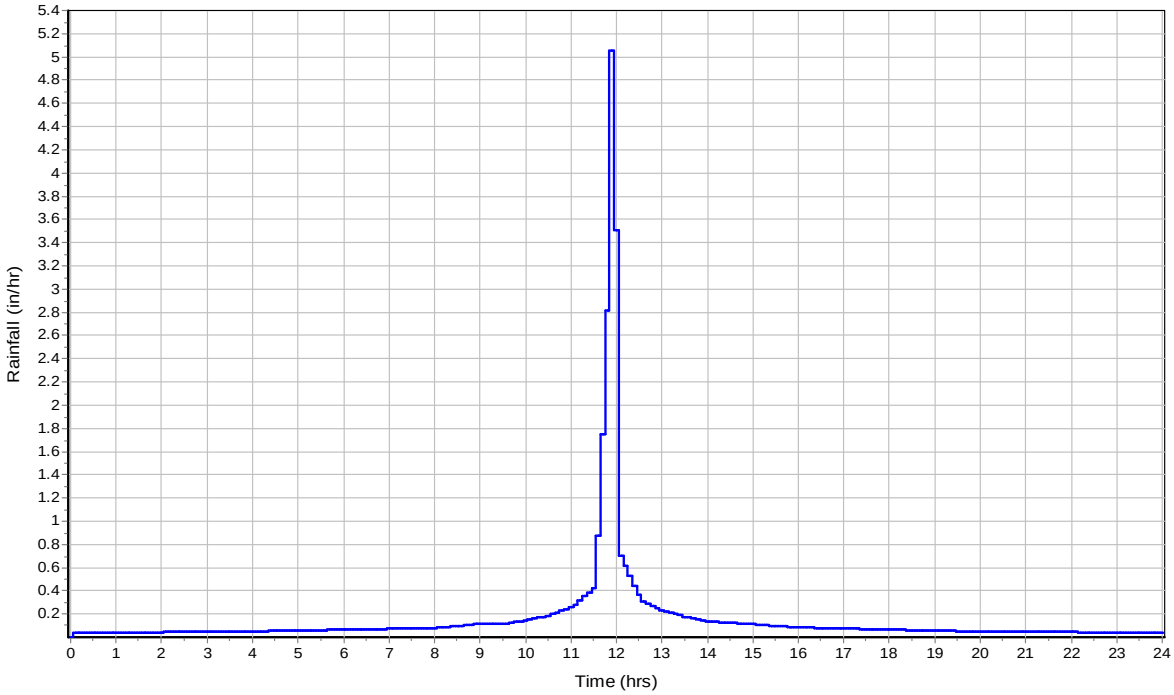
Total TOC (min) 19.04

Subbasin Runoff Results

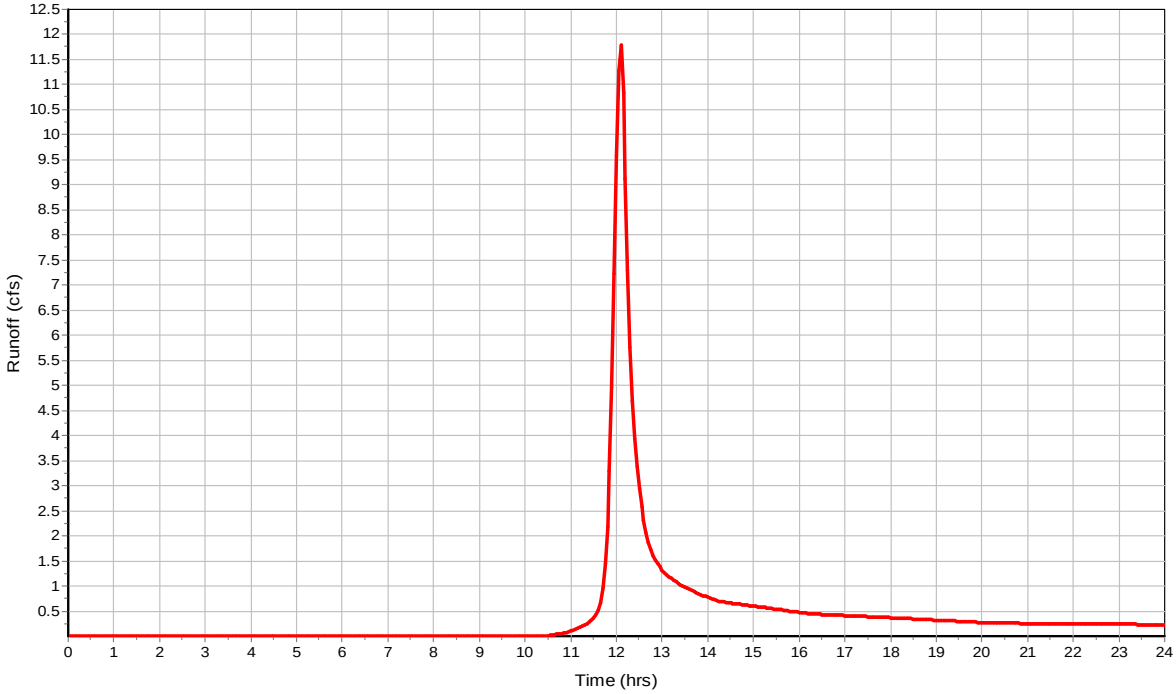
Total Rainfall (in)	3.69
Total Runoff (in)	1.37
Peak Runoff (cfs)	11.8
Weighted Curve Number	74
Time of Concentration (days hh:mm:ss)	0 00:19:02

Subbasin : E2

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : OS1

Input Data

Area (ac)	0.43
Peak Rate Factor	484
Weighted Curve Number	74
Rain Gage ID	*

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	0.46	-	74
Composite Area & Weighted CN	0.46		74

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.1	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	4.19	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.33	0	0
Computed Flow Time (min) :	5.04	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	100	0	0
Slope (%) :	4.19	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.43	0	0
Computed Flow Time (min) :	1.17	0	0

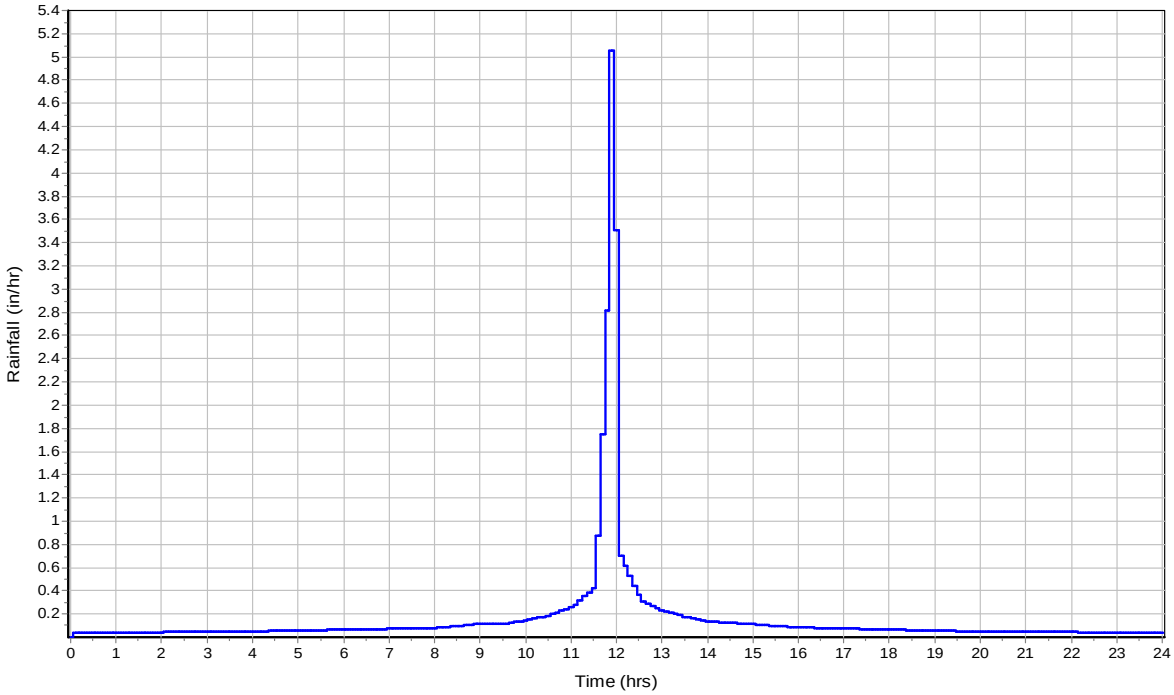
Total TOC (min) 6.20

Subbasin Runoff Results

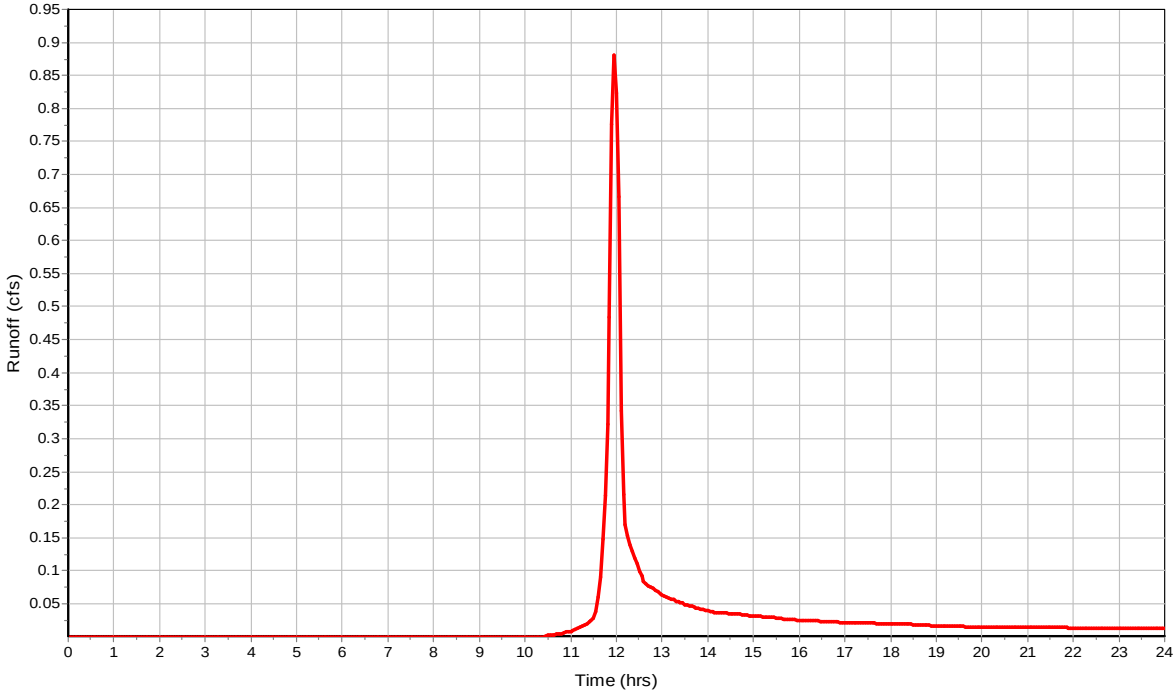
Total Rainfall (in)	3.69
Total Runoff (in)	1.37
Peak Runoff (cfs)	0.88
Weighted Curve Number	74
Time of Concentration (days hh:mm:ss)	0 00:06:12

Subbasin : OS1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : OS2

Input Data

Area (ac)	0.44
Peak Rate Factor	484
Weighted Curve Number	74
Rain Gage ID	*

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	0.44	-	74
Composite Area & Weighted CN	0.44		74

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.1	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.25	0	0
Computed Flow Time (min) :	6.77	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	19	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	0.32	0	0

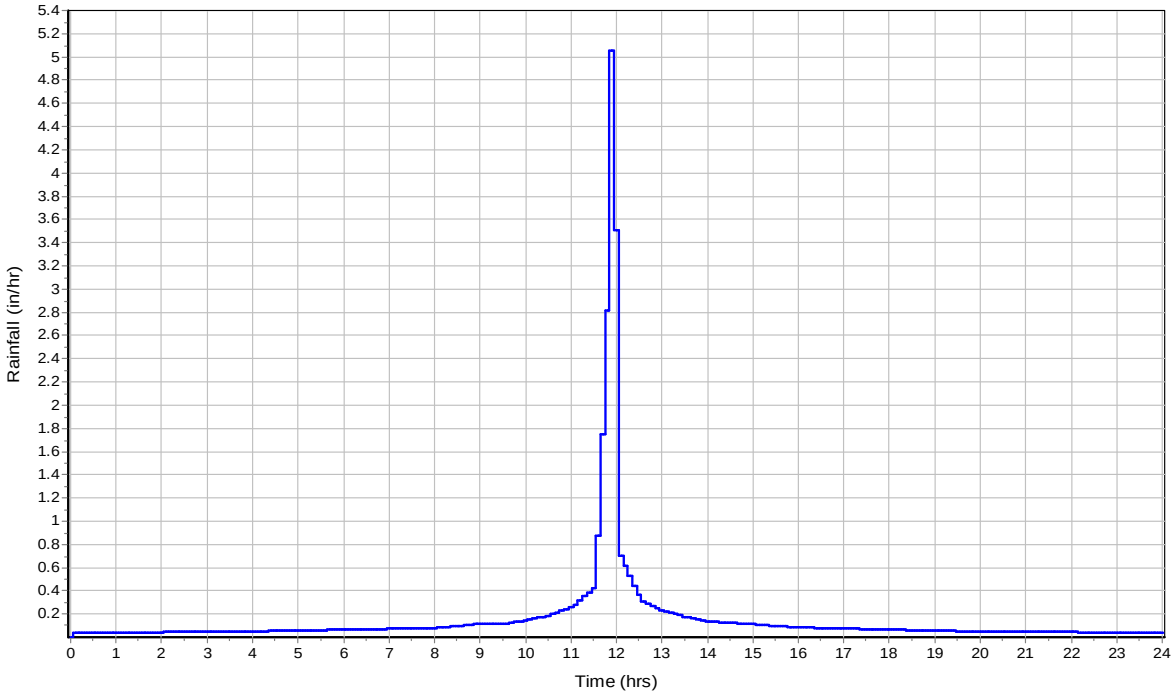
Total TOC (min) 7.09

Subbasin Runoff Results

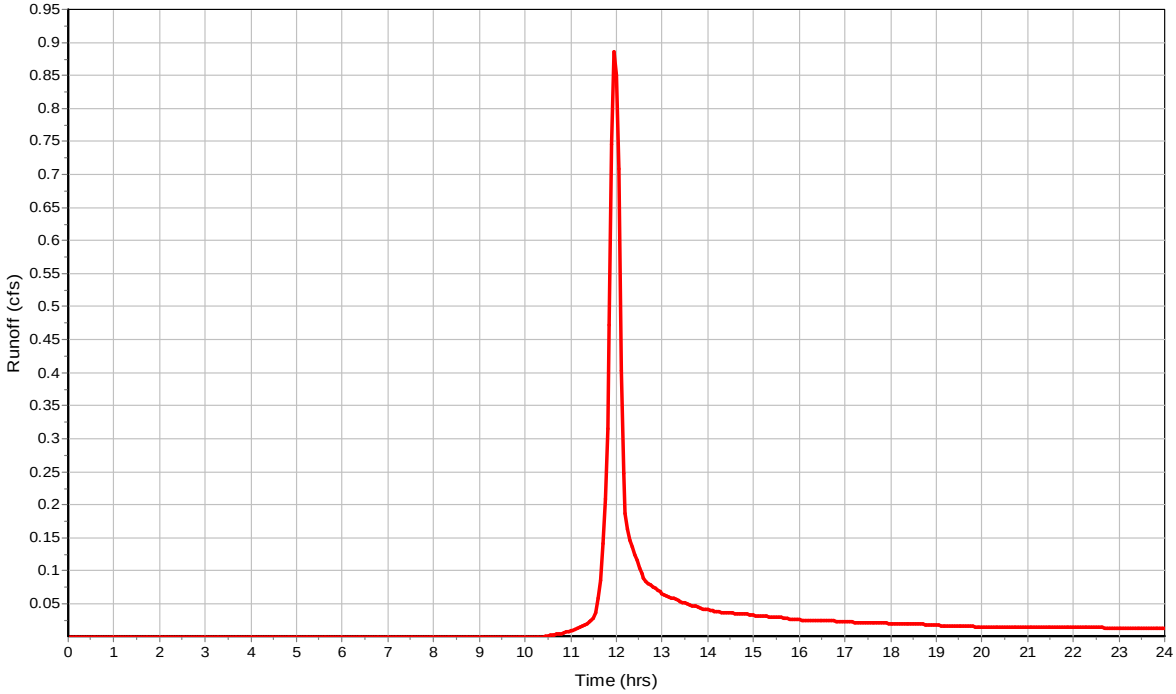
Total Rainfall (in)	3.69
Total Runoff (in)	1.37
Peak Runoff (cfs)	0.89
Weighted Curve Number	74
Time of Concentration (days hh:mm:ss)	0 00:07:05

Subbasin : OS2

Rainfall Intensity Graph



Runoff Hydrograph



10 Year Event

Project Description

File Name	Existing_Model_A2104054.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	0:03:00
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 00:03:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	4
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
49		Time Series	10-Year	Cumulative	inches	Missouri	Jackson	10.00	5.62	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	E1	3.17	484.00	74.00	5.62	2.87	9.10	13.47	0 00:07:21
2	E2	7.82	484.00	74.00	5.62	2.87	22.42	25.27	0 00:19:02
3	OS1	0.43	484.00	74.00	5.62	2.87	1.23	1.88	0 00:06:12
4	OS2	0.44	484.00	74.00	5.62	2.87	1.27	1.89	0 00:07:05

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Tract-4_OUT	Outfall	0.00					0.00	0.00					

Subbasin Hydrology

Subbasin : E1

Input Data

Area (ac) 3.17
Peak Rate Factor 484
Weighted Curve Number 74
Rain Gage ID ..... Rain Gage

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	3.43	-	74
Composite Area & Weighted CN	3.43		74

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^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 (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.1	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	8.67	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.44	0	0
Computed Flow Time (min) :	3.77	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	289	0	0
Slope (%) :	3.65	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.34	0	0
Computed Flow Time (min) :	3.59	0	0

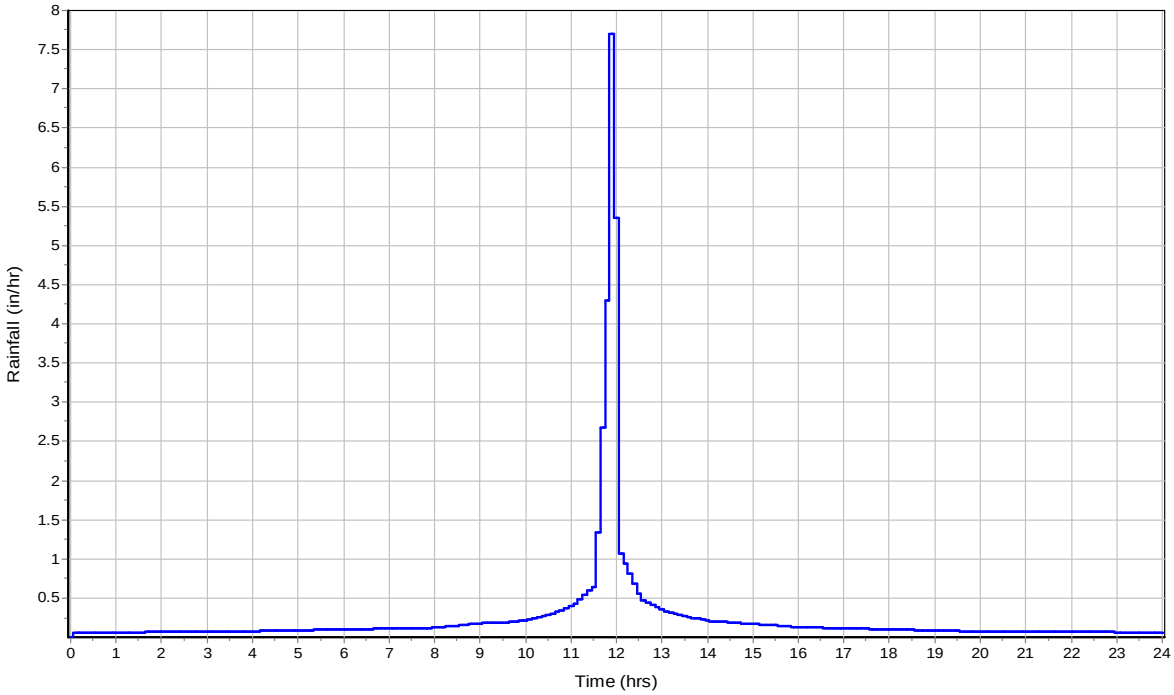
Total TOC (min) 7.36

Subbasin Runoff Results

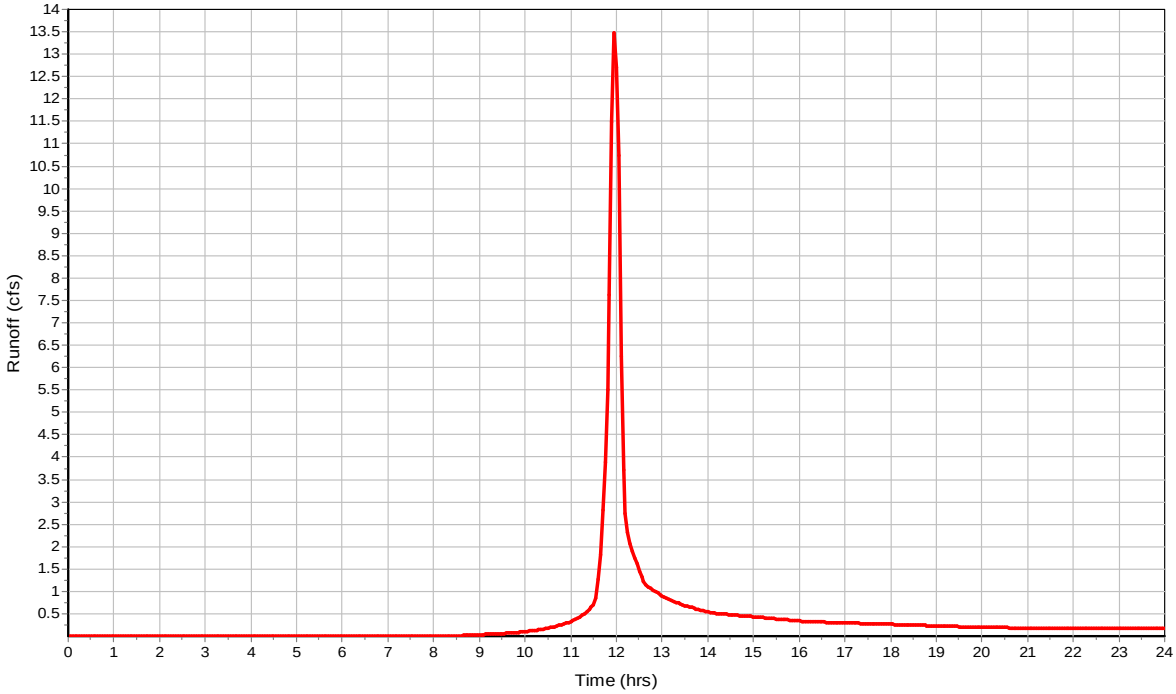
Total Rainfall (in)	5.62
Total Runoff (in)	2.87
Peak Runoff (cfs)	13.47
Weighted Curve Number	74
Time of Concentration (days hh:mm:ss)	0 00:07:22

Subbasin : E1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : E2

Input Data

Area (ac)	7.82
Peak Rate Factor	484
Weighted Curve Number	74
Rain Gage ID	*

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	8.43	-	74
Composite Area & Weighted CN	8.43		74

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.1	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	1.2	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.2	0	0
Computed Flow Time (min) :	8.31	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	766	0	0
Slope (%) :	2.88	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.19	0	0
Computed Flow Time (min) :	10.73	0	0

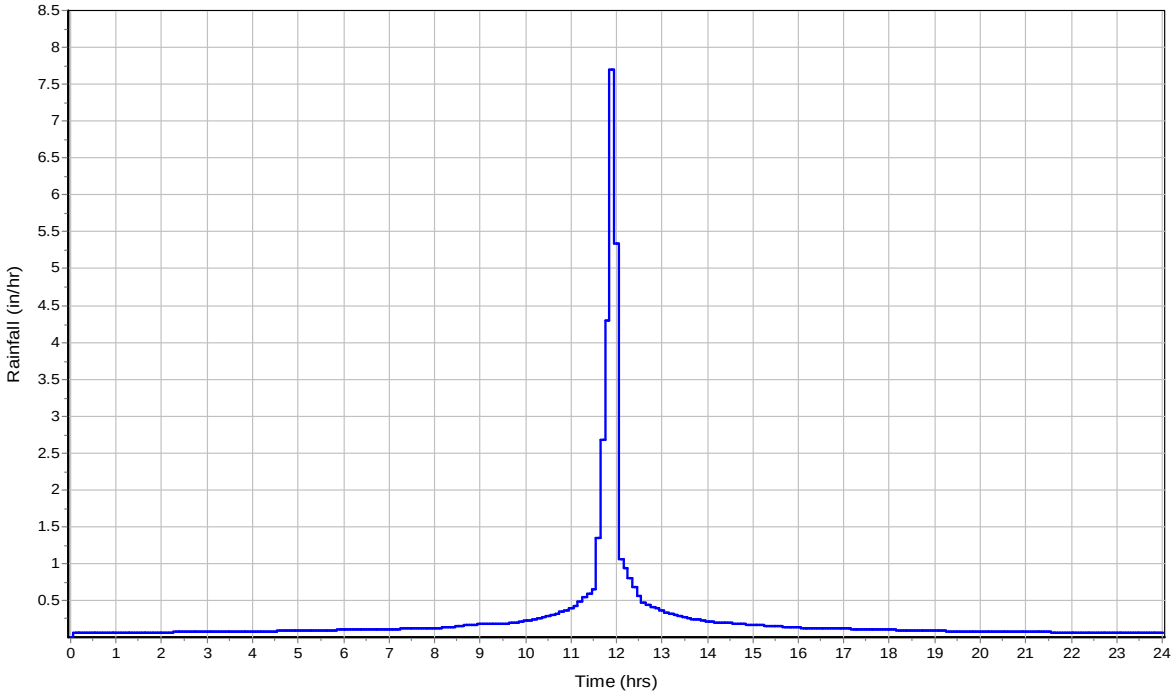
Total TOC (min) 19.04

Subbasin Runoff Results

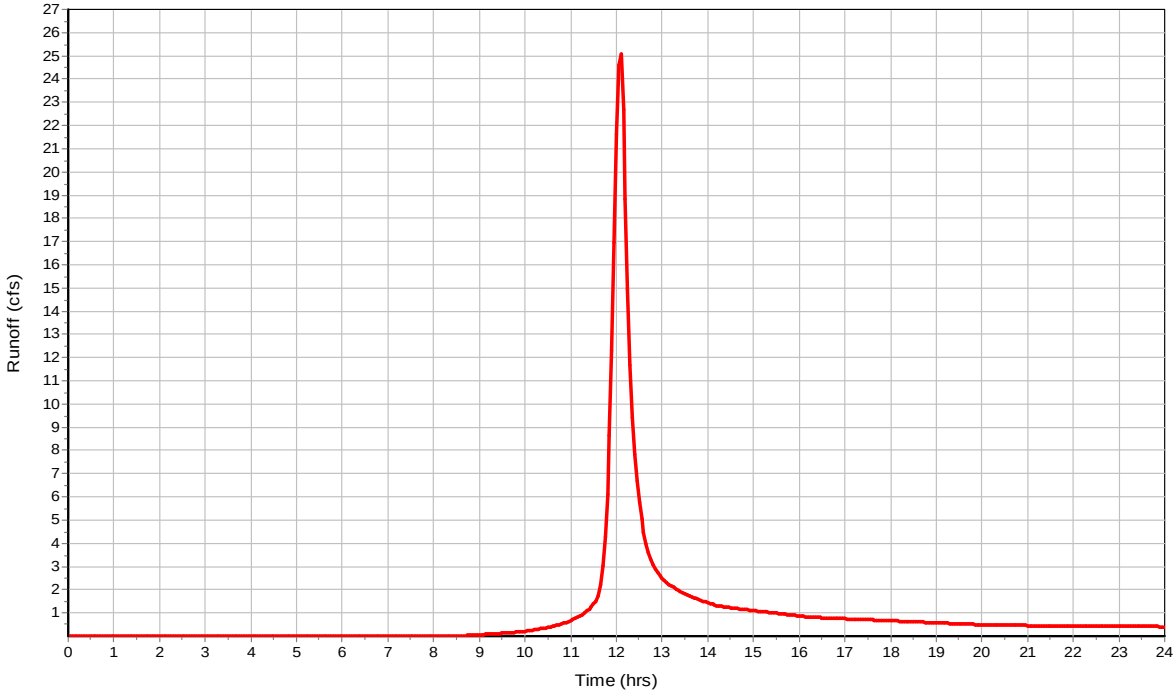
Total Rainfall (in)	5.62
Total Runoff (in)	2.87
Peak Runoff (cfs)	25.27
Weighted Curve Number	74
Time of Concentration (days hh:mm:ss)	0 00:19:02

Subbasin : E2

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : OS1

Input Data

Area (ac)	0.43
Peak Rate Factor	484
Weighted Curve Number	74
Rain Gage ID	*

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	0.46	-	74
Composite Area & Weighted CN	0.46		74

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.1	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	4.19	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.33	0	0
Computed Flow Time (min) :	5.04	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	100	0	0
Slope (%) :	4.19	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.43	0	0
Computed Flow Time (min) :	1.17	0	0

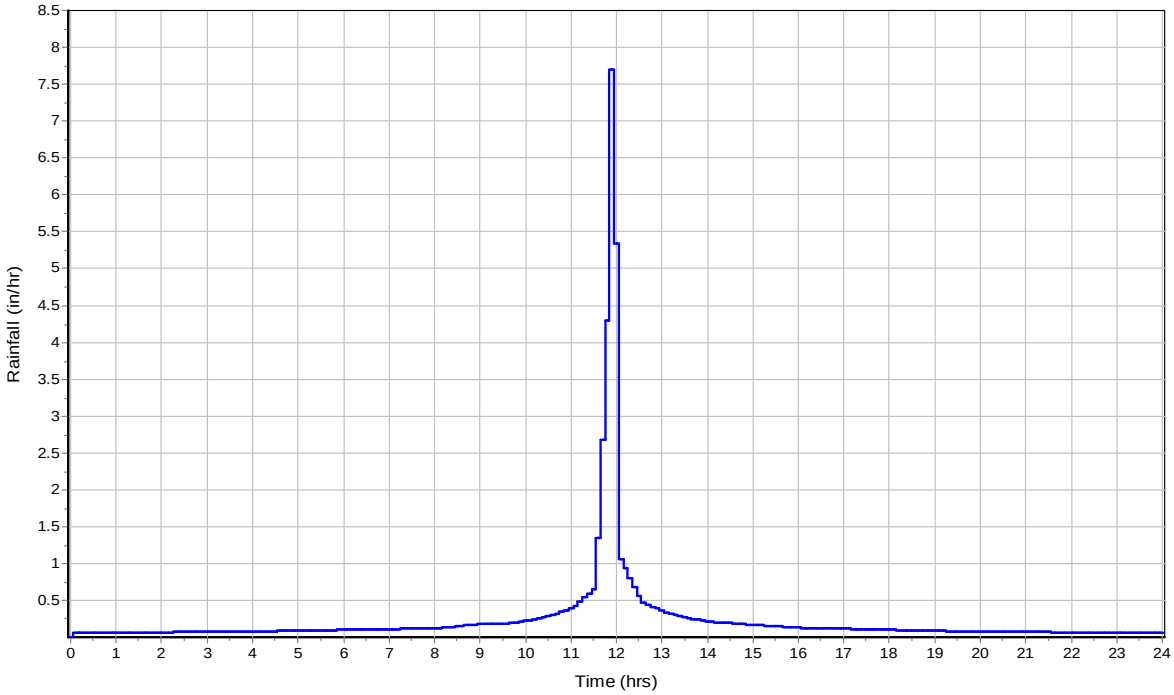
Total TOC (min) 6.20

Subbasin Runoff Results

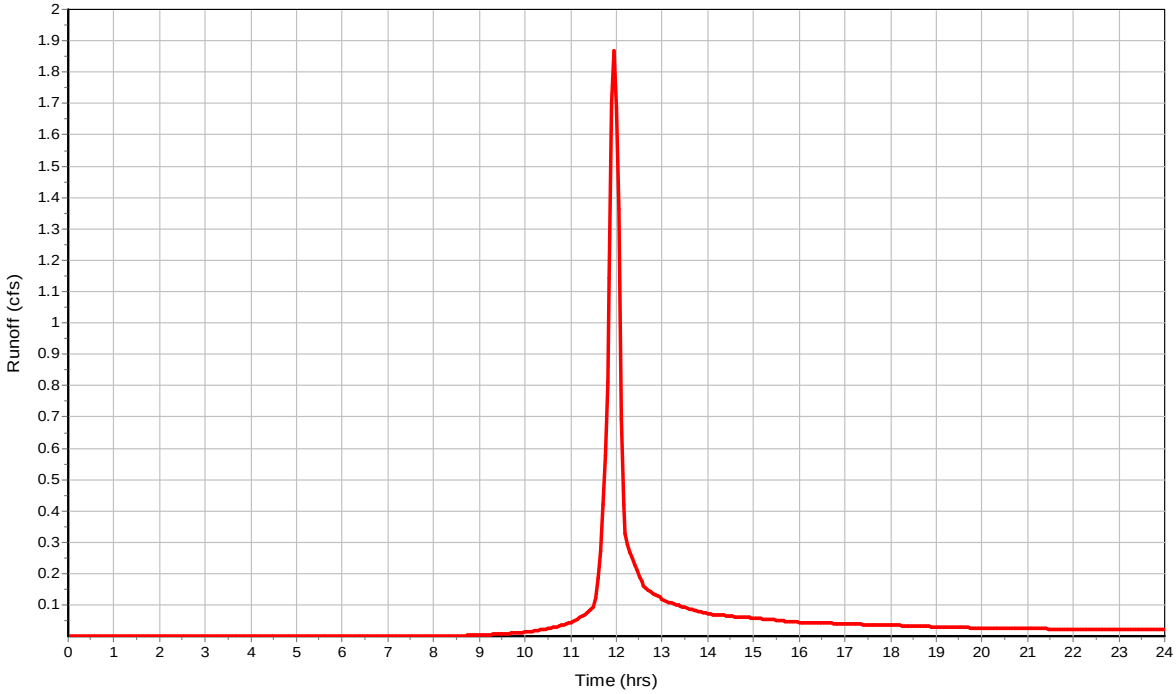
Total Rainfall (in)	5.62
Total Runoff (in)	2.87
Peak Runoff (cfs)	1.88
Weighted Curve Number	74
Time of Concentration (days hh:mm:ss)	0 00:06:12

Subbasin : OS1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : OS2

Input Data

Area (ac)	0.44
Peak Rate Factor	484
Weighted Curve Number	74
Rain Gage ID	*

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	0.44	-	74
Composite Area & Weighted CN	0.44		74

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.1	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.25	0	0
Computed Flow Time (min) :	6.77	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	19	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	0.32	0	0

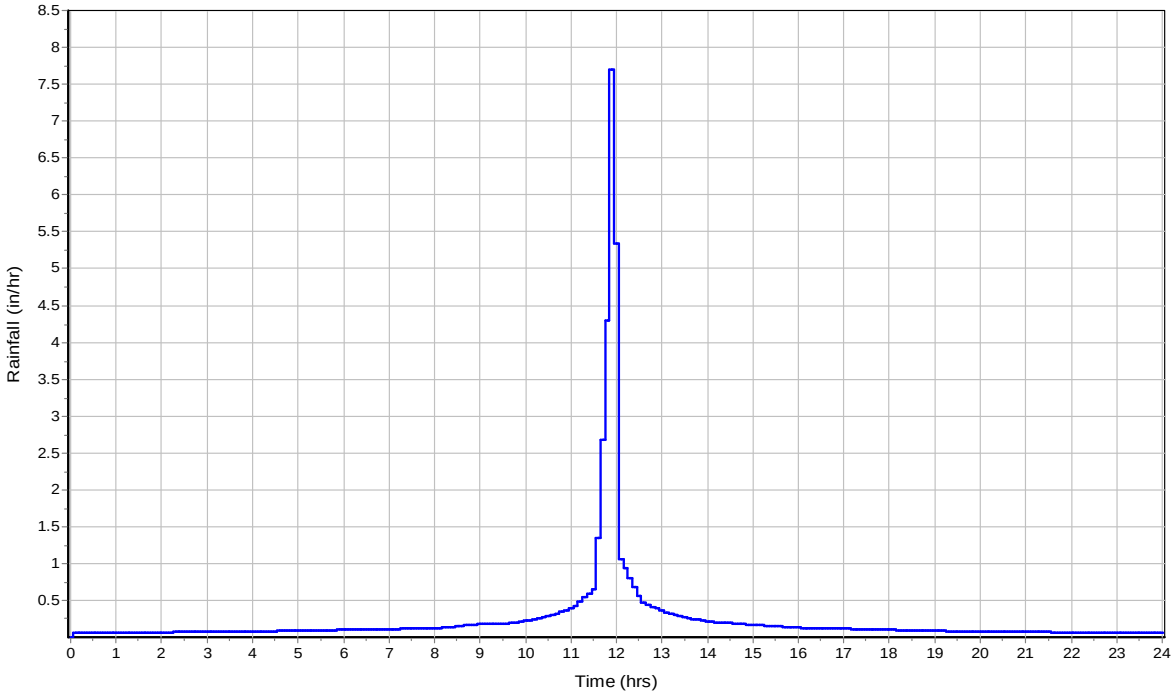
Total TOC (min) 7.09

Subbasin Runoff Results

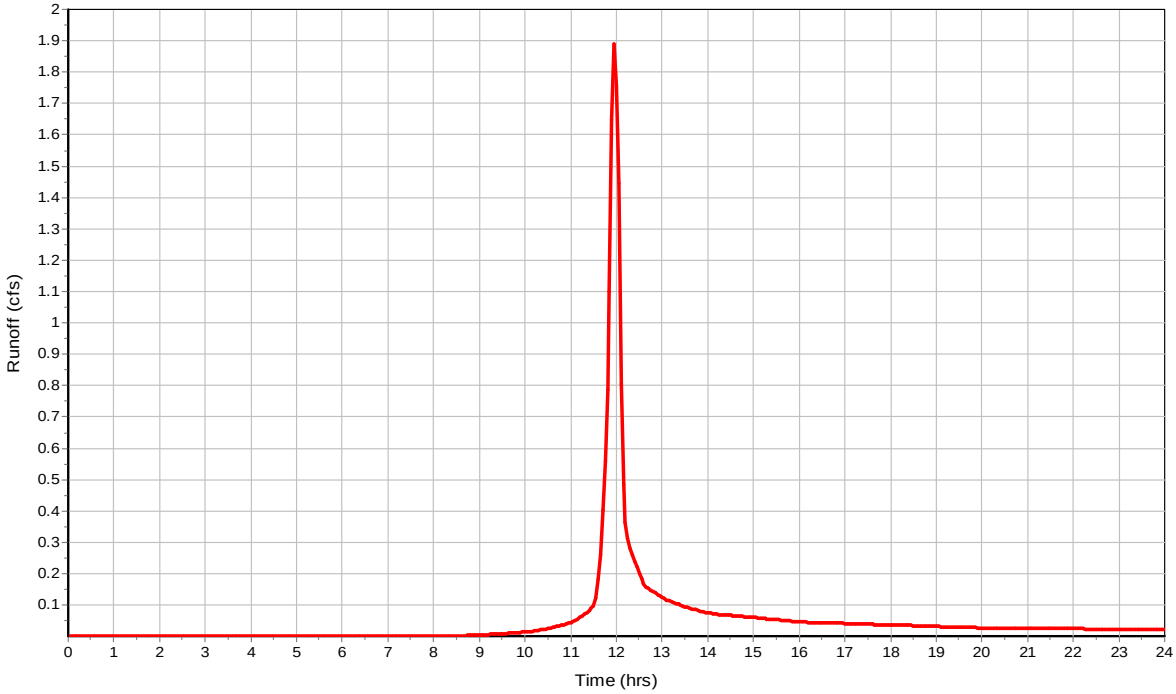
Total Rainfall (in)	5.62
Total Runoff (in)	2.87
Peak Runoff (cfs)	1.89
Weighted Curve Number	74
Time of Concentration (days hh:mm:ss)	0 00:07:05

Subbasin : OS2

Rainfall Intensity Graph



Runoff Hydrograph



100 Year Event

Project Description

File Name ..... Existing_Model_A2104054.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	0:03:00
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 00:03:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	4
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
49		Time Series	100-Year	Cumulative	inches	Missouri	Jackson	100.00	9.17	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	E1	3.17	484.00	74.00	9.17	5.98	18.98	27.84	0 00:07:21
2	E2	7.82	484.00	74.00	9.17	5.98	46.78	52.31	0 00:19:02
3	OS1	0.43	484.00	74.00	9.17	5.98	2.56	3.89	0 00:06:12
4	OS2	0.44	484.00	74.00	9.17	5.98	2.65	3.90	0 00:07:05

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Tract-4_OUT	Outfall	0.00					0.00	0.00					

Subbasin Hydrology

Subbasin : E1

Input Data

Area (ac) 3.17
Peak Rate Factor 484
Weighted Curve Number 74
Rain Gage ID ..... Rain Gage

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	3.43	-	74
Composite Area & Weighted CN	3.43		74

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^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 (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.1	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	8.67	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.44	0	0
Computed Flow Time (min) :	3.77	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	289	0	0
Slope (%) :	3.65	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.34	0	0
Computed Flow Time (min) :	3.59	0	0

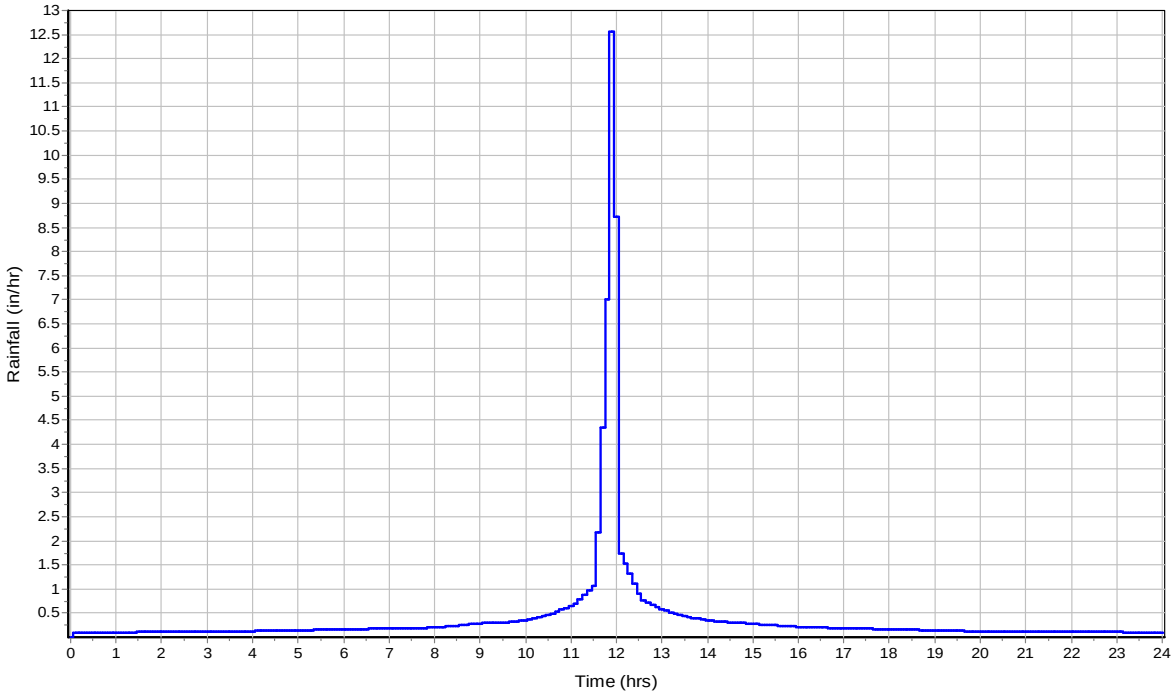
Total TOC (min) 7.36

Subbasin Runoff Results

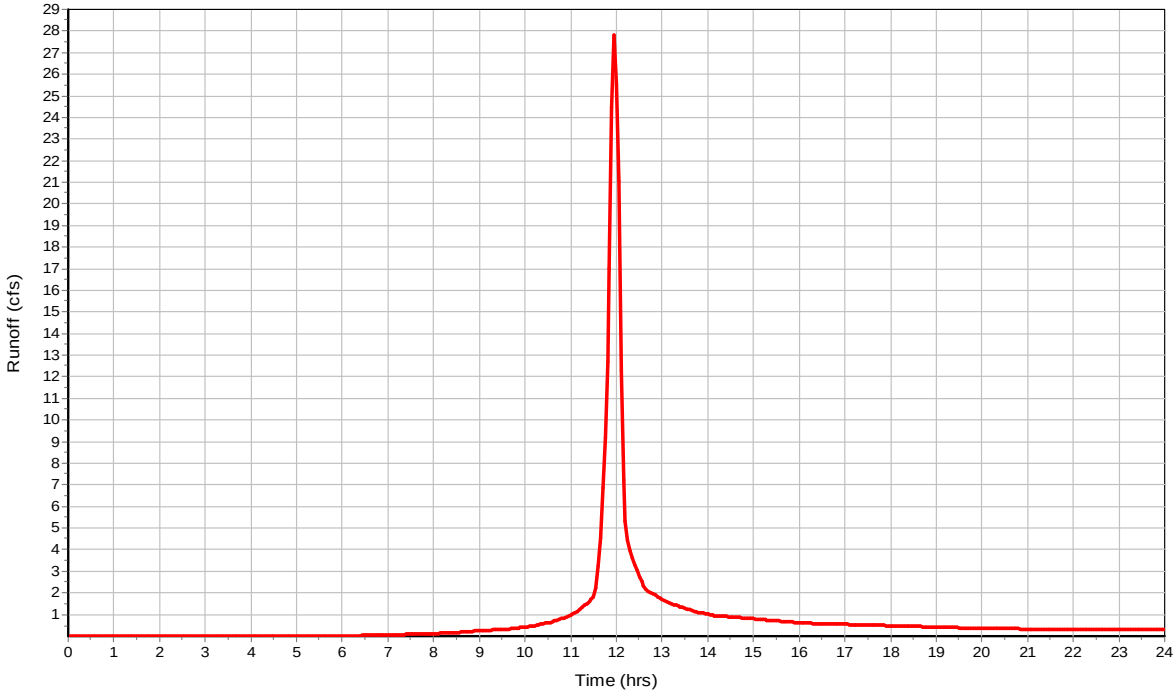
Total Rainfall (in)	9.17
Total Runoff (in)	5.98
Peak Runoff (cfs)	27.84
Weighted Curve Number	74
Time of Concentration (days hh:mm:ss)	0 00:07:22

Subbasin : E1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : E2

Input Data

Area (ac)	7.82
Peak Rate Factor	484
Weighted Curve Number	74
Rain Gage ID	*

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	8.43	-	74
Composite Area & Weighted CN	8.43		74

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.1	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	1.2	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.2	0	0
Computed Flow Time (min) :	8.31	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	766	0	0
Slope (%) :	2.88	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.19	0	0
Computed Flow Time (min) :	10.73	0	0

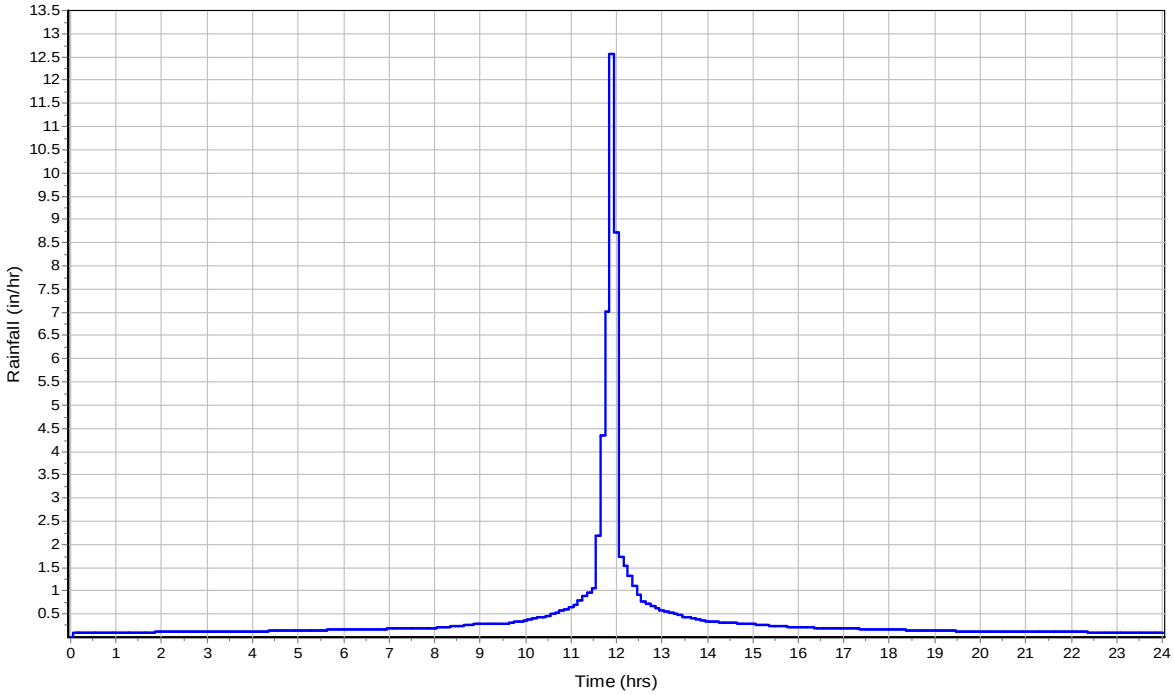
Total TOC (min) 19.04

Subbasin Runoff Results

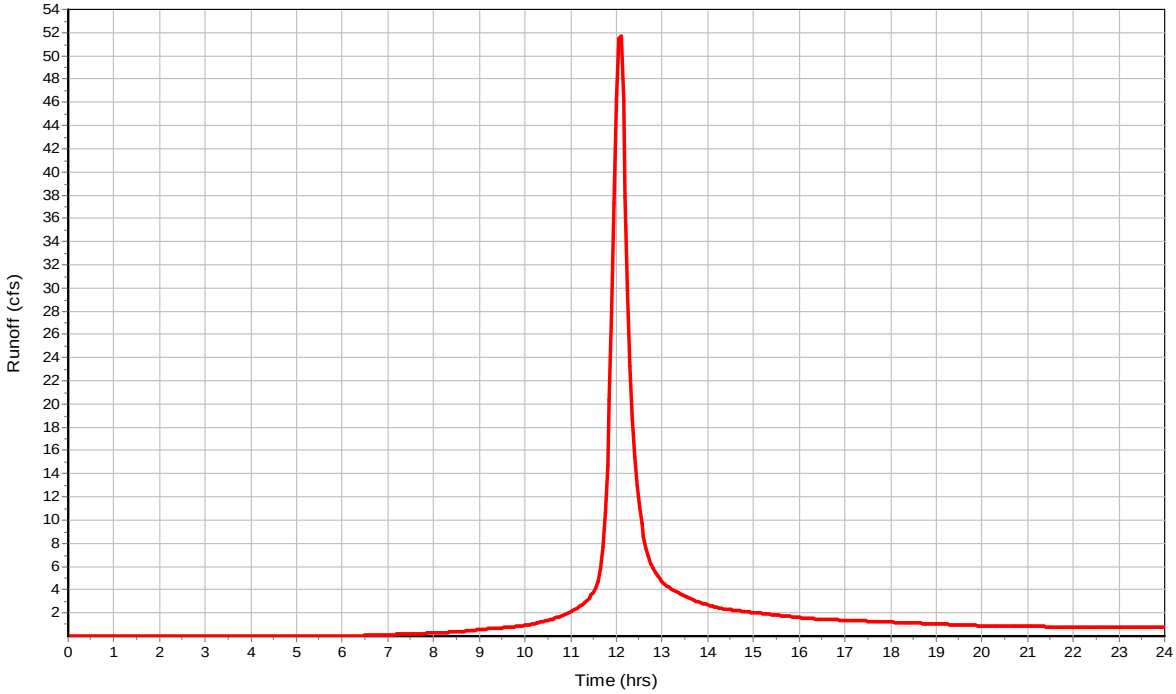
Total Rainfall (in)	9.17
Total Runoff (in)	5.98
Peak Runoff (cfs)	52.31
Weighted Curve Number	74
Time of Concentration (days hh:mm:ss)	0 00:19:02

Subbasin : E2

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : OS1

Input Data

Area (ac)	0.43
Peak Rate Factor	484
Weighted Curve Number	74
Rain Gage ID	*

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	0.46	-	74
Composite Area & Weighted CN	0.46		74

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.1	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	4.19	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.33	0	0
Computed Flow Time (min) :	5.04	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	100	0	0
Slope (%) :	4.19	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	1.43	0	0
Computed Flow Time (min) :	1.17	0	0

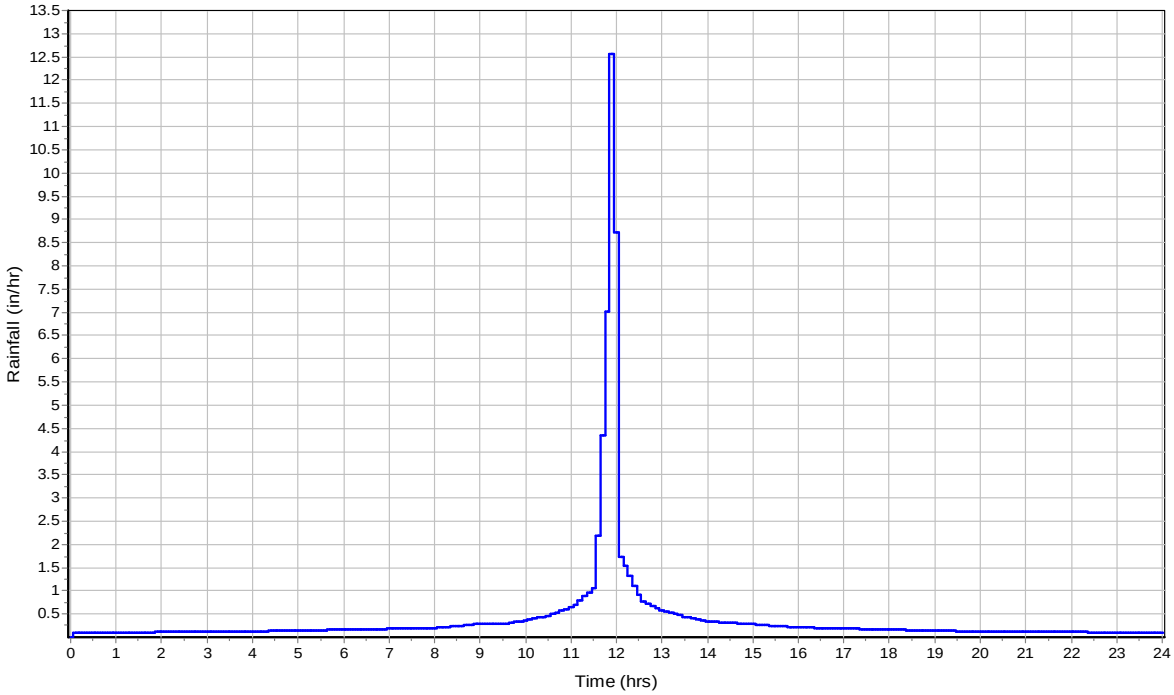
Total TOC (min) 6.20

Subbasin Runoff Results

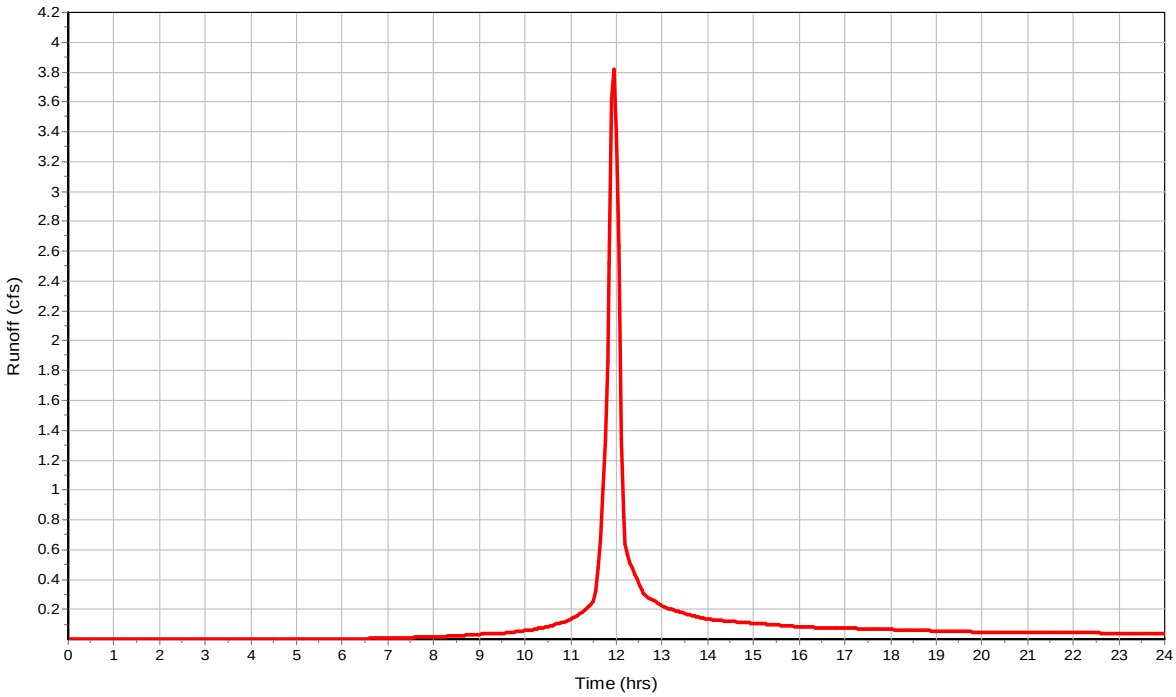
Total Rainfall (in)	9.17
Total Runoff (in)	5.98
Peak Runoff (cfs)	3.89
Weighted Curve Number	74
Time of Concentration (days hh:mm:ss)	0 00:06:12

Subbasin : OS1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : OS2

Input Data

Area (ac)	0.44
Peak Rate Factor	484
Weighted Curve Number	74
Rain Gage ID	*

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	0.44	-	74
Composite Area & Weighted CN	0.44		74

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.1	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.25	0	0
Computed Flow Time (min) :	6.77	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	19	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	0.32	0	0

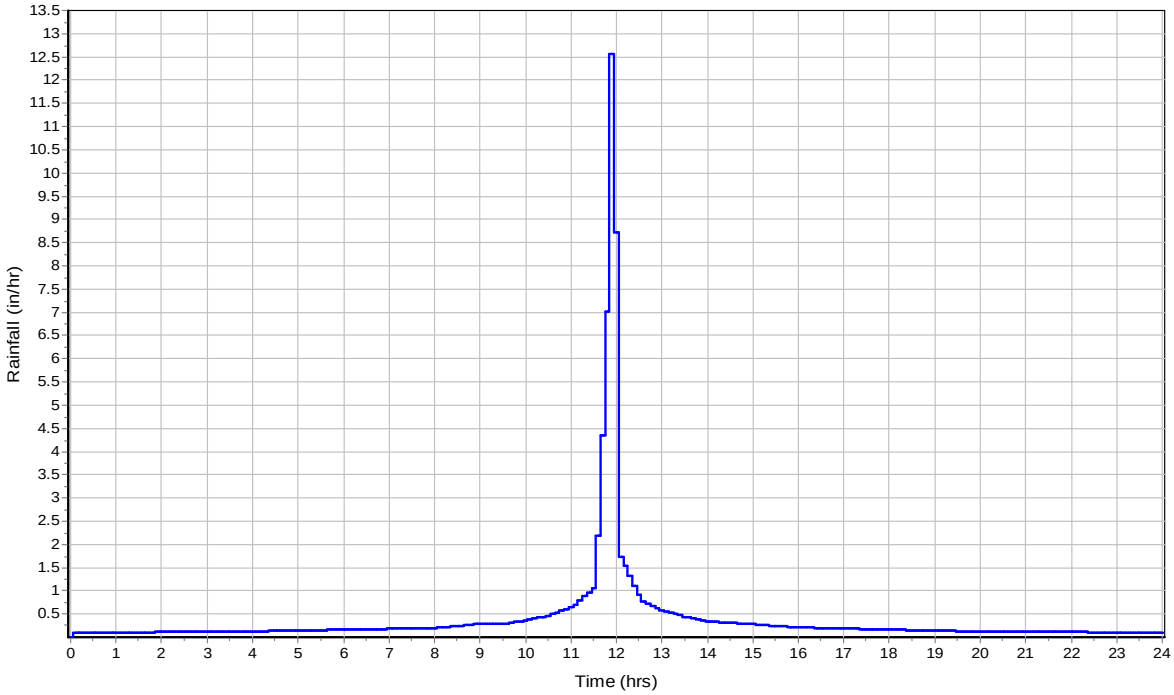
Total TOC (min) 7.09

Subbasin Runoff Results

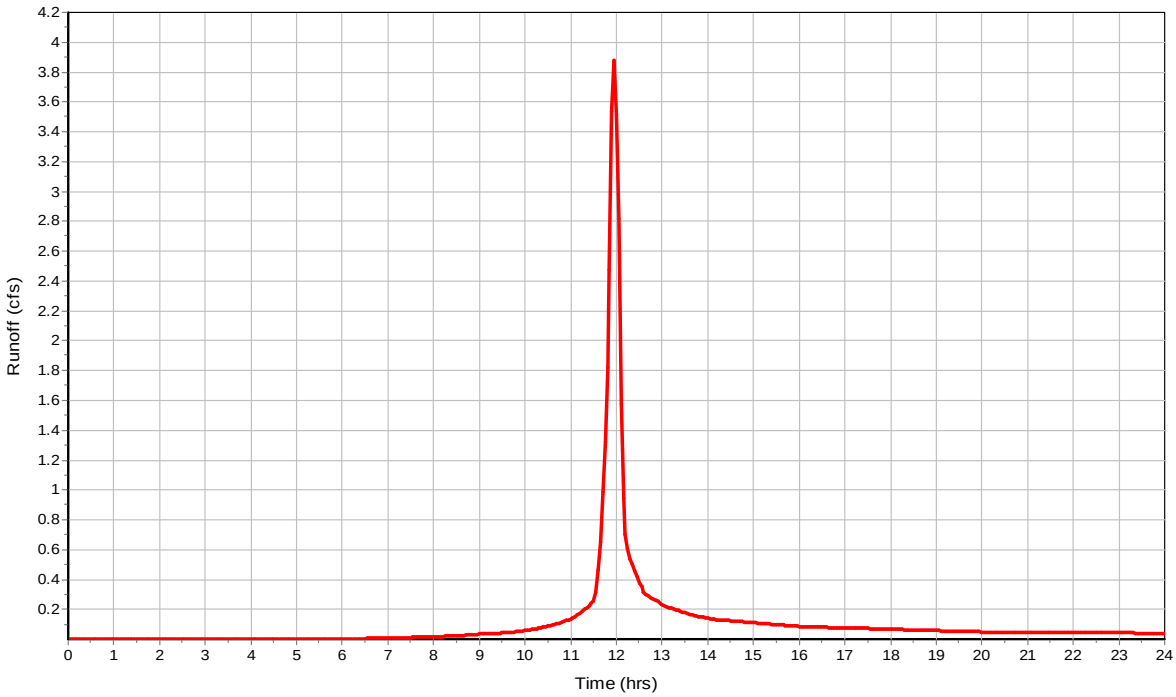
Total Rainfall (in)	9.17
Total Runoff (in)	5.98
Peak Runoff (cfs)	3.9
Weighted Curve Number	74
Time of Concentration (days hh:mm:ss)	0 00:07:05

Subbasin : OS2

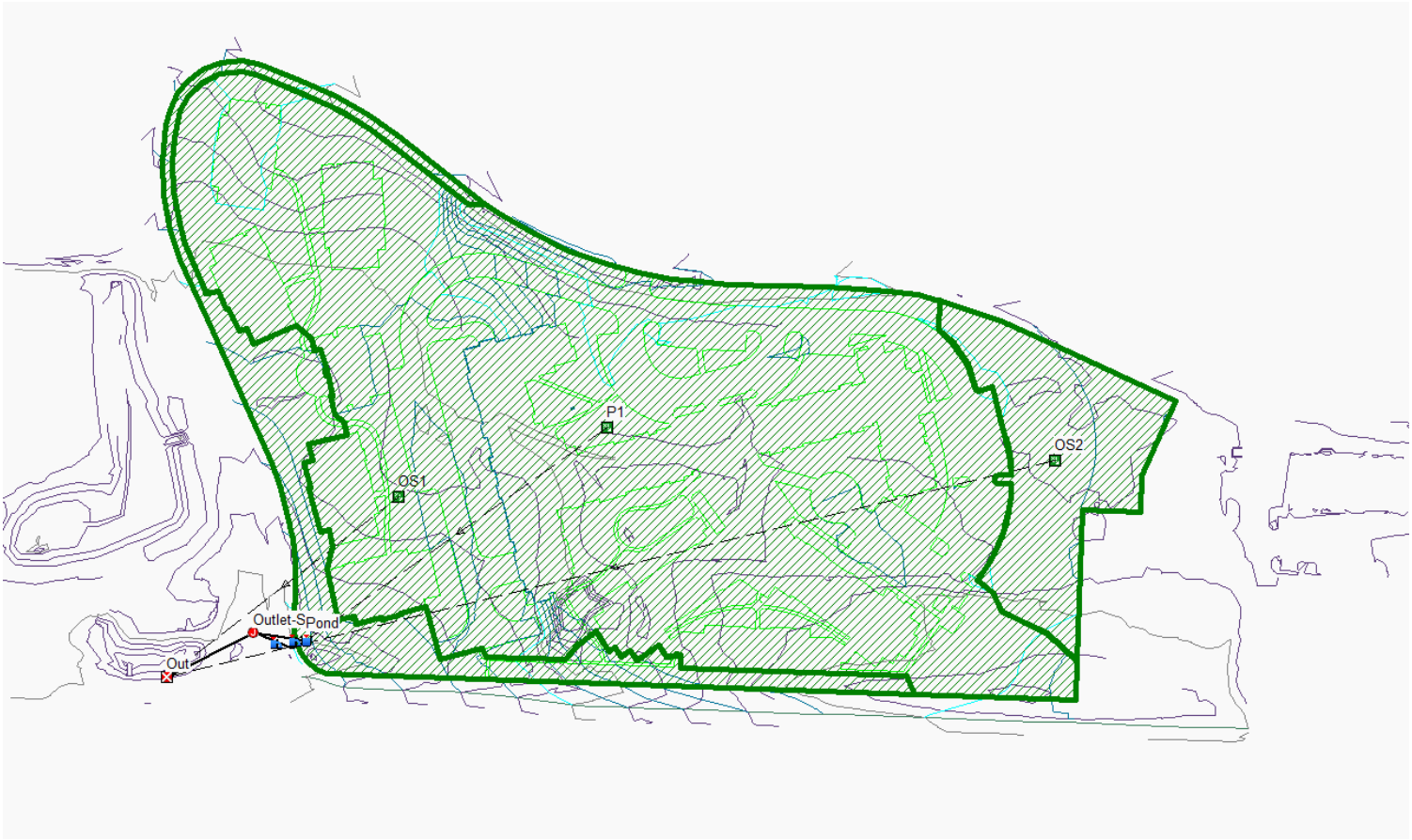
Rainfall Intensity Graph



Runoff Hydrograph



PROPOSED CONDITIONS
MODEL RESULTS



2 Year Event

Project Description

File Name	Proposed_Model_A2104054.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	Kinematic Wave
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	0:03:00
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 00:03:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	3
Nodes	3
Junctions	1
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links	3
Channels	0
Pipes	1
Pumps	0
Orifices	2
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
49		Time Series	2-Year	Cumulative	inches	Missouri	Jackson	2.00	3.69	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	OS1	1.25	484.00	75.15	3.69	1.45	1.81	2.84	0 00:05:00
2	OS2	1.11	484.00	74.00	3.69	1.37	1.52	2.14	0 00:08:27
3	P1	9.50	484.00	83.98	3.69	2.10	19.94	31.63	0 00:05:00

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Outlet-Struc	Junction	993.50	1004.00	993.50	0.00	0.00	13.44	993.50	0.00	10.50	0 00:00	0.00	0.00
2	Out	Outfall	993.50					17.55	993.50					
3	Pond	Storage Node	993.50	1004.00	993.50		147000.00	30.37	996.63				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Reported Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	Link-01	Pipe	Outlet-Struc	Out	181.72	0.00	0.00	0.0000	0.000	0.0150	13.44	0.00	0.00	0.00	0.00	0.00	0.00	
2	10-Year	Orifice	Pond	Outlet-Struc		993.50	993.50		36.000		0.00							
3	2-Year	Orifice	Pond	Outlet-Struc		993.50	993.50		18.000		13.44							

Subbasin Hydrology

Subbasin : OS1

Input Data

Area (ac) 1.25
Peak Rate Factor 484
Weighted Curve Number 75.15
Rain Gage ID ..... *

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	0.06	-	98
-	1.19	-	74
Composite Area & Weighted CN	1.25		75.15

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^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 (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

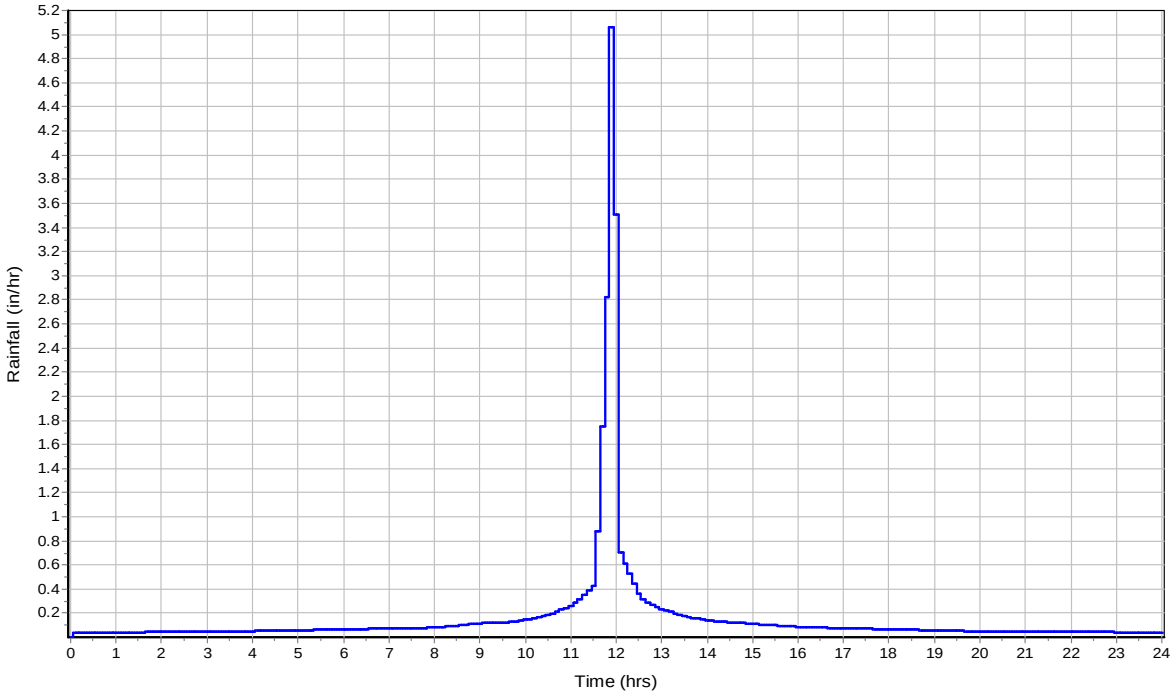
User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

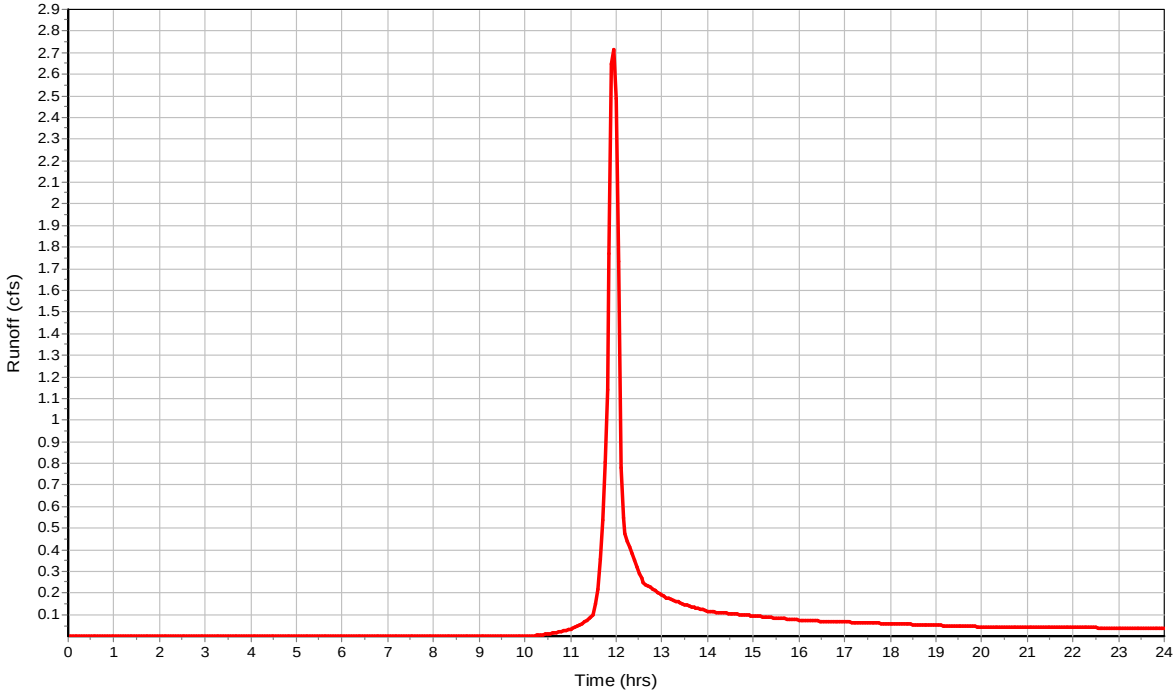
Total Rainfall (in) 3.69
Total Runoff (in) 1.45
Peak Runoff (cfs) 2.84
Weighted Curve Number 75.15
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : OS1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : OS2

Input Data

Area (ac)	1.11
Peak Rate Factor	484
Weighted Curve Number	74
Rain Gage ID	*

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.11	-	74
Composite Area & Weighted CN	1.11		74

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.1	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.25	0	0
Computed Flow Time (min) :	6.77	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	100	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	1.68	0	0

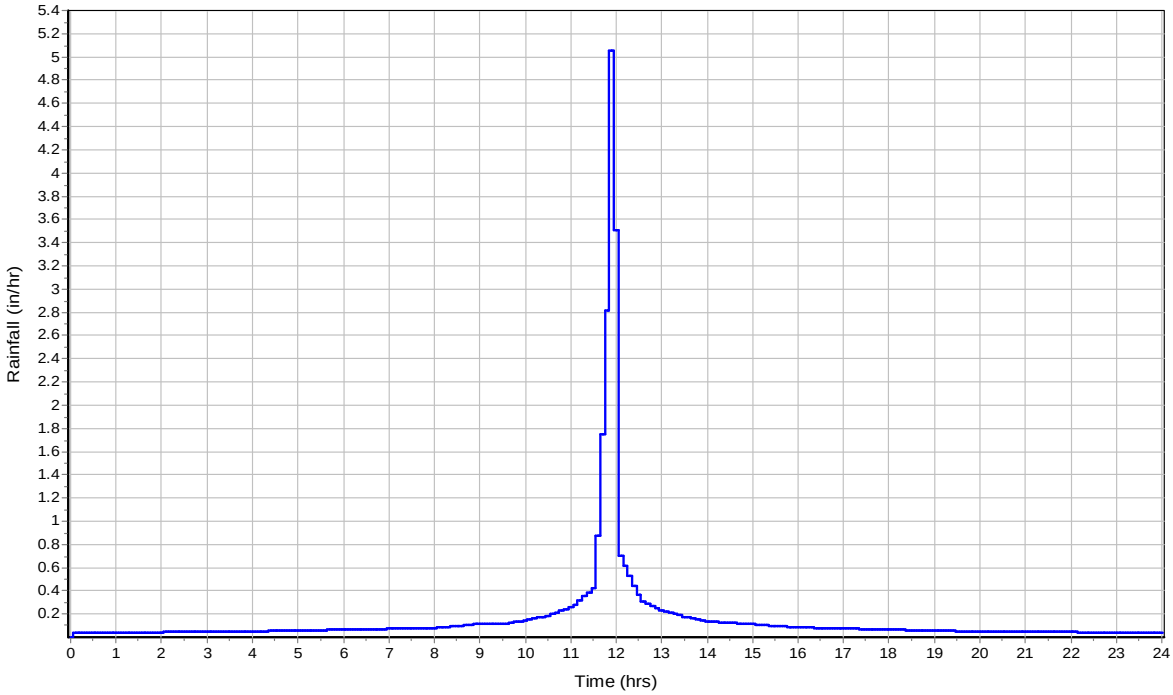
Total TOC (min) 8.46

Subbasin Runoff Results

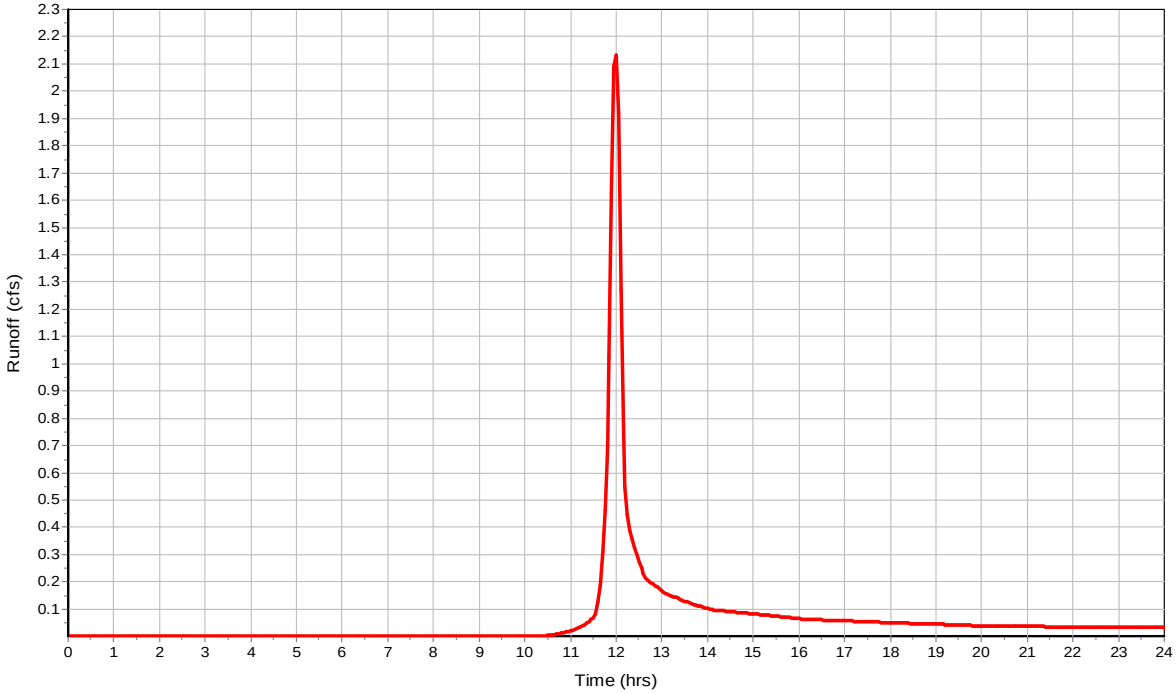
Total Rainfall (in)	3.69
Total Runoff (in)	1.37
Peak Runoff (cfs)	2.14
Weighted Curve Number	74
Time of Concentration (days hh:mm:ss)	0 00:08:28

Subbasin : OS2

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : P1

Input Data

Area (ac)	9.5
Peak Rate Factor	484
Weighted Curve Number	83.98
Rain Gage ID	*

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	5.55	-	74
-	3.95	-	98
Composite Area & Weighted CN	9.5		83.98

Time of Concentration

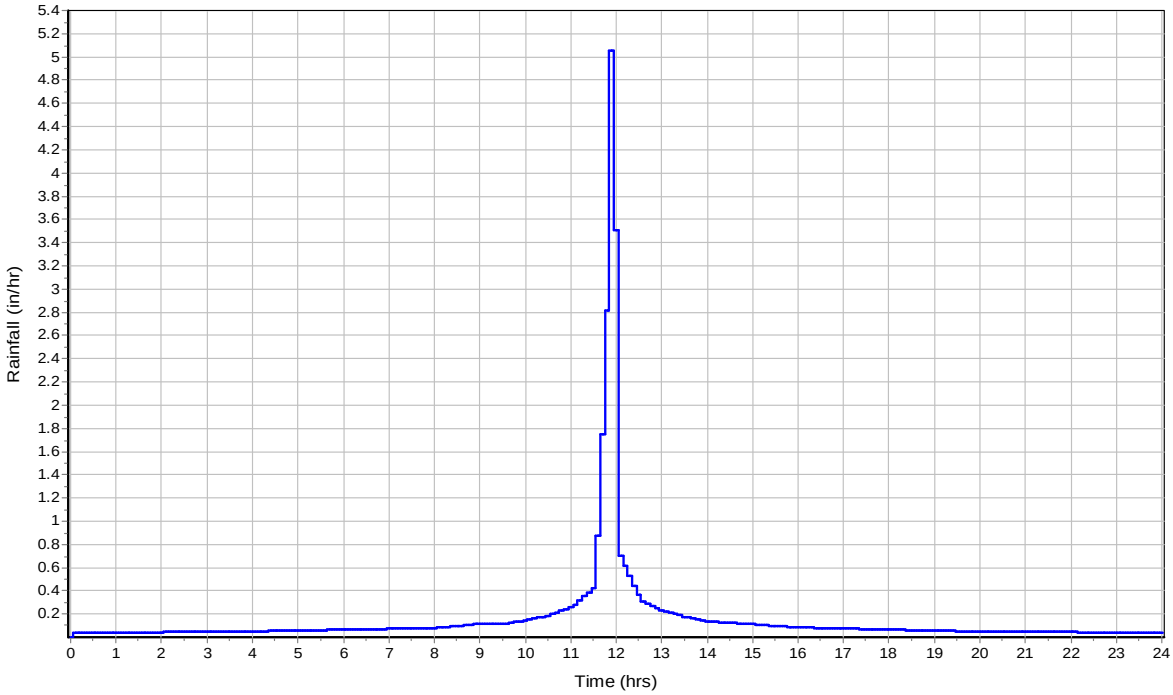
User-Defined TOC override (minutes): 5

Subbasin Runoff Results

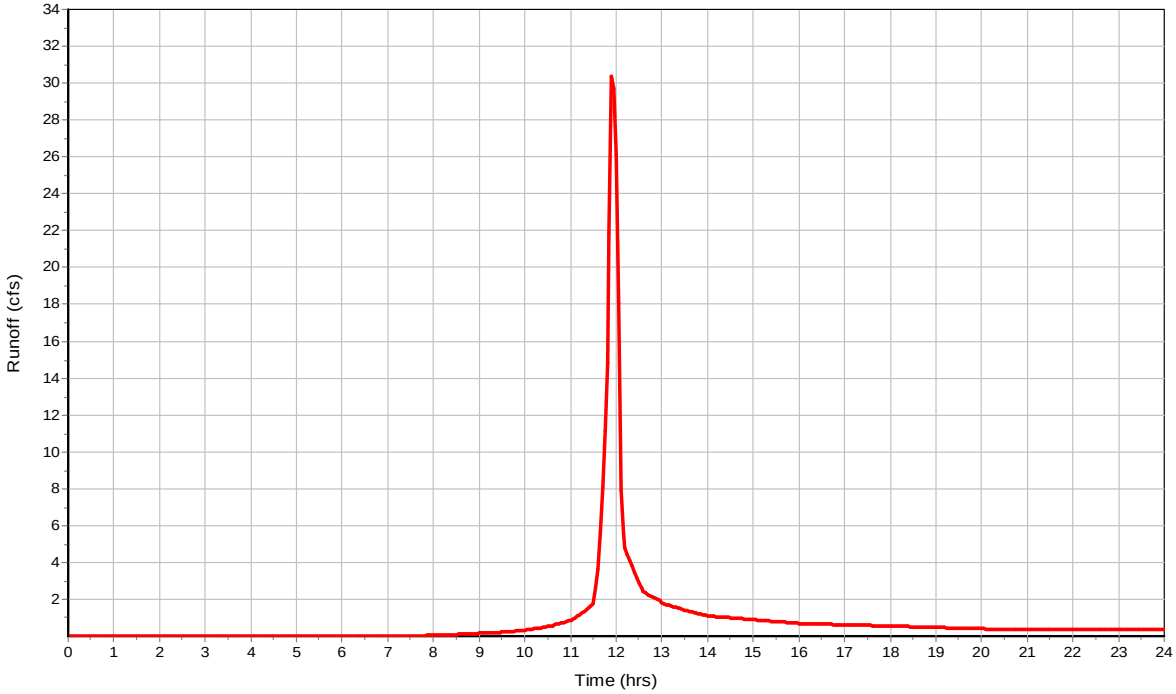
Total Rainfall (in)	3.69
Total Runoff (in)	2.1
Peak Runoff (cfs)	31.63
Weighted Curve Number	83.98
Time of Concentration (days hh:mm:ss)	0 00:05:00

Subbasin : P1

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft^2)	Minimum Pipe Cover (in)
1	Outlet-Struc	993.50	1004.00	10.50	993.50	0.00	0.00	-1004.00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Outlet-Struc	13.44	0.00	993.50	0.00	0.00	10.50	993.50	0.00	0 00:00	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	Link-01	181.72	0.00	-993.50	0.00	-993.50	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	Link-01	13.44	0 12:07	0.00	0.00	0.00		0.00	0.00	0.00		

Storage Nodes

Storage Node : Pond

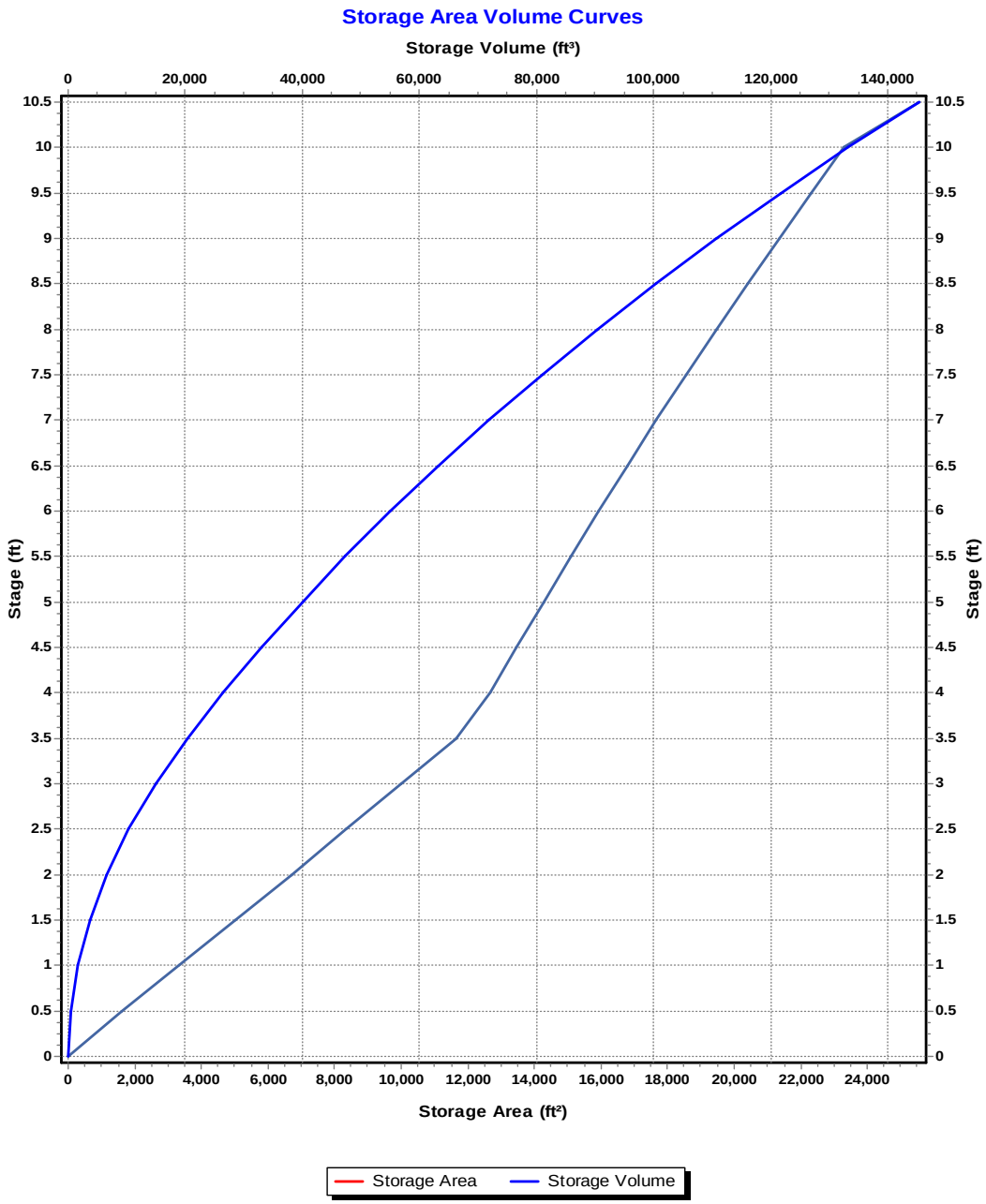
Input Data

Invert Elevation (ft)	993.5
Max (Rim) Elevation (ft)	1004
Max (Rim) Offset (ft)	10.5
Initial Water Elevation (ft)	993.5
Initial Water Depth (ft)	0
Ponded Area (ft²)	147000
Evaporation Loss	0

Storage Area Volume Curves

Storage Curve : Pond-Two Buildings

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	0.5	0
0.5	1620.6	405.28
1	3317.15	1639.72
1.5	5022.08	3724.53
2	6695.11	6653.83
2.5	8348.05	10414.62
3	9987.8	14998.58
3.5	11639.88	20405.5
4	12693.19	26488.77
4.5	13472.43	33030.18
5	14270.87	39966.01
5.5	15088.51	47305.86
6	15925.35	55059.33
6.5	16781.39	63236.02
7	17656.64	71845.53
7.5	18551.09	80897.46
8	19464.74	90401.42
8.5	20397.6	100367.01
9	21349.65	110803.82
9.5	22320.91	121721.46
10	23311.38	133129.53
10.5	25556.79	145346.57


Storage Area Volume Curves
Storage Volume (ft³)
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
Stage (ft)
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Storage Area (ft²)
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
20,000
22,000
24,000
Storage Area
Storage Volume

Storage Node : Pond (continued)

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	10-Year	Side	Rectangular	No		36.00	34.00	997.00	0.63
2	2-Year	Side	CIRCULAR	No	18.00			993.50	0.61

Output Summary Results

Peak Inflow (cfs)	30.37
Peak Lateral Inflow (cfs)	30.37
Peak Outflow (cfs)	13.44
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	996.63
Max HGL Depth Attained (ft)	3.13
Average HGL Elevation Attained (ft)	993.77
Average HGL Depth Attained (ft)	0.27
Time of Max HGL Occurrence (days hh:mm)	0 12:07
Total Exfiltration Volume (1000-ft³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

10 Year Event

Project Description

File Name ..... Proposed_Model_A2104054.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 ..... Kinematic Wave
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	0:03:00
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 00:03:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins.....	3
Nodes.....	3
Junctions	1
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links.....	3
Channels	0
Pipes	1
Pumps	0
Orifices	2
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
49		Time Series	10-Year	Cumulative	inches	Missouri	Jackson	10.00	5.62	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	OS1	1.25	484.00	75.15	5.62	2.98	3.72	5.90	0 00:05:00
2	OS2	1.11	484.00	74.00	5.62	2.87	3.18	4.56	0 00:08:27
3	P1	9.50	484.00	83.98	5.62	3.84	36.48	56.90	0 00:05:00

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Outlet-Struc	Junction	993.50	1004.00	993.50	0.00	0.00	27.07	993.50	0.00	10.50	0 00:00	0.00	0.00
2	Out	Outfall	993.50					34.43	993.50					
3	Pond	Storage Node	993.50	1004.00	993.50		147000.00	55.32	998.01				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Reported Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	Link-01	Pipe	Outlet-Struc	Out	181.72	0.00	0.00	0.0000	0.000	0.0150	27.07	0.00	0.00	0.00	0.00	0.00	0.00	
2	10-Year	Orifice	Pond	Outlet-Struc		993.50	993.50		36.000		10.19							
3	2-Year	Orifice	Pond	Outlet-Struc		993.50	993.50		18.000		16.88							

Subbasin Hydrology

Subbasin : OS1

Input Data

Area (ac) 1.25
Peak Rate Factor 484
Weighted Curve Number 75.15
Rain Gage ID ..... *

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	0.06	-	98
-	1.19	-	74
Composite Area & Weighted CN	1.25		75.15

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^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 (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

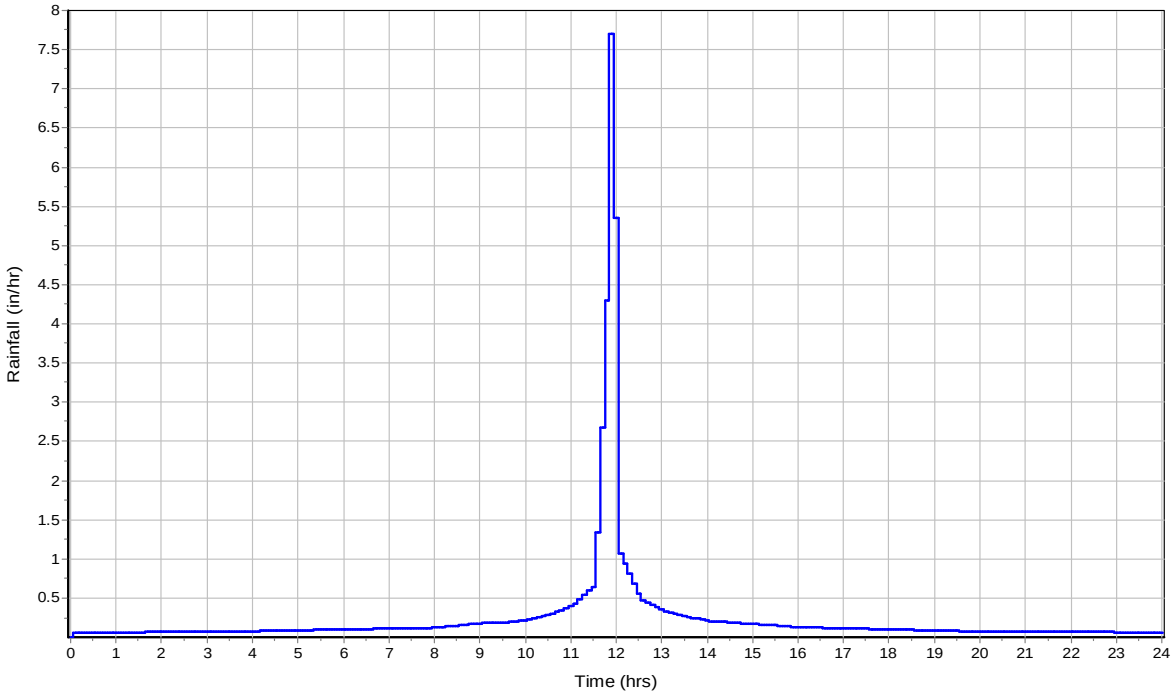
User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

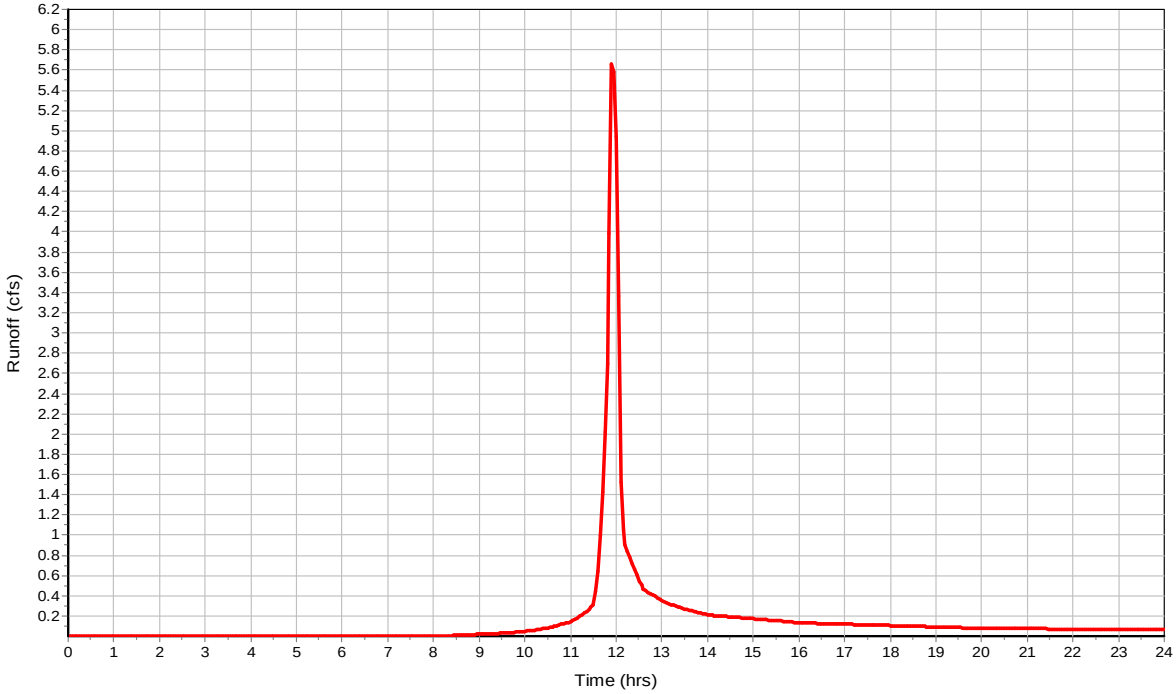
Total Rainfall (in) 5.62
Total Runoff (in) 2.98
Peak Runoff (cfs) 5.9
Weighted Curve Number 75.15
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : OS1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : OS2

Input Data

Area (ac)	1.11
Peak Rate Factor	484
Weighted Curve Number	74
Rain Gage ID	*

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.11	-	74
Composite Area & Weighted CN	1.11		74

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.1	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.25	0	0
Computed Flow Time (min) :	6.77	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	100	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	1.68	0	0

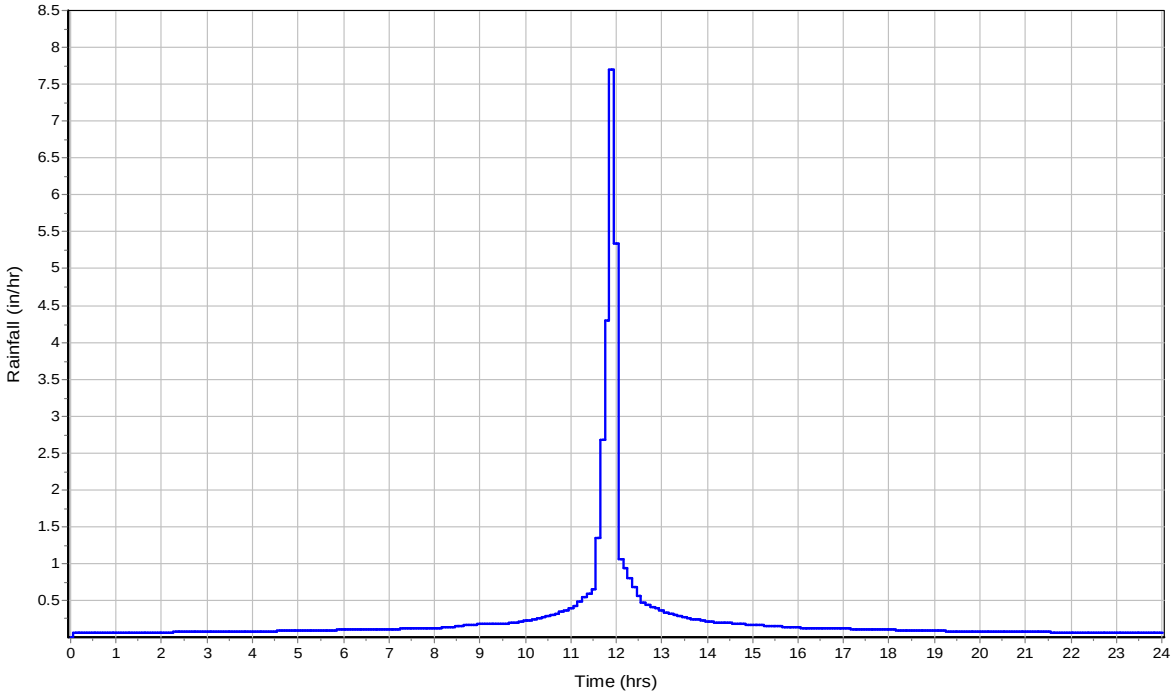
Total TOC (min) 8.46

Subbasin Runoff Results

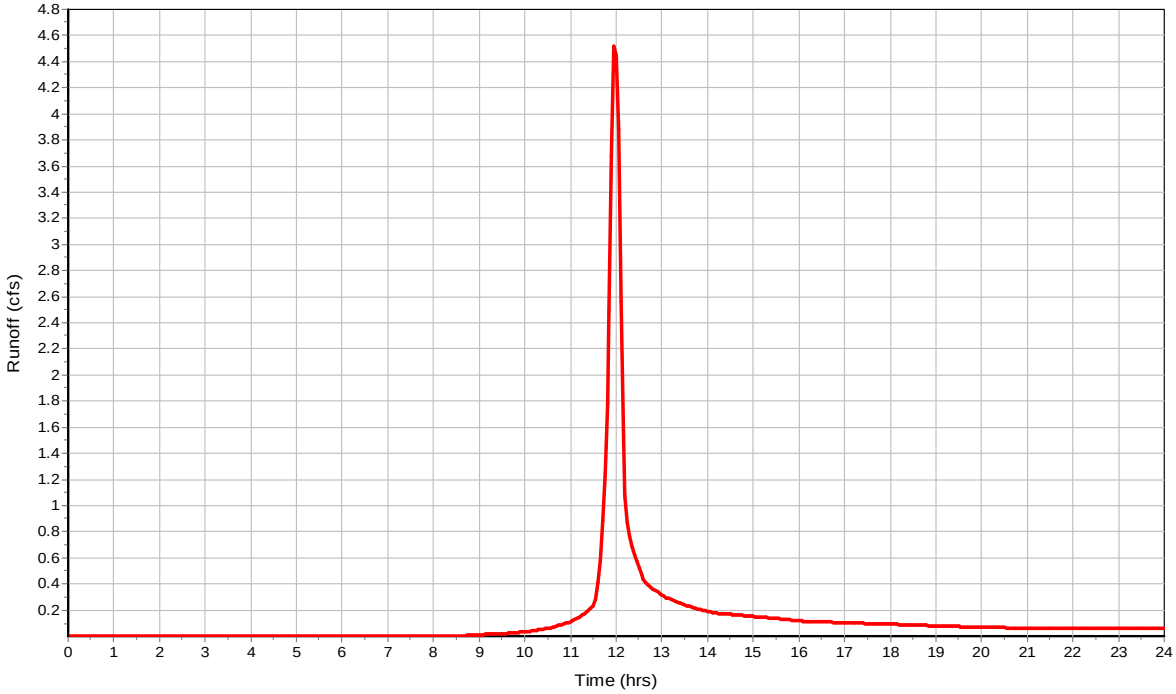
Total Rainfall (in)	5.62
Total Runoff (in)	2.87
Peak Runoff (cfs)	4.56
Weighted Curve Number	74
Time of Concentration (days hh:mm:ss)	0 00:08:28

Subbasin : OS2

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : P1

Input Data

Area (ac)	9.5
Peak Rate Factor	484
Weighted Curve Number	83.98
Rain Gage ID	*

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	5.55	-	74
-	3.95	-	98
Composite Area & Weighted CN	9.5		83.98

Time of Concentration

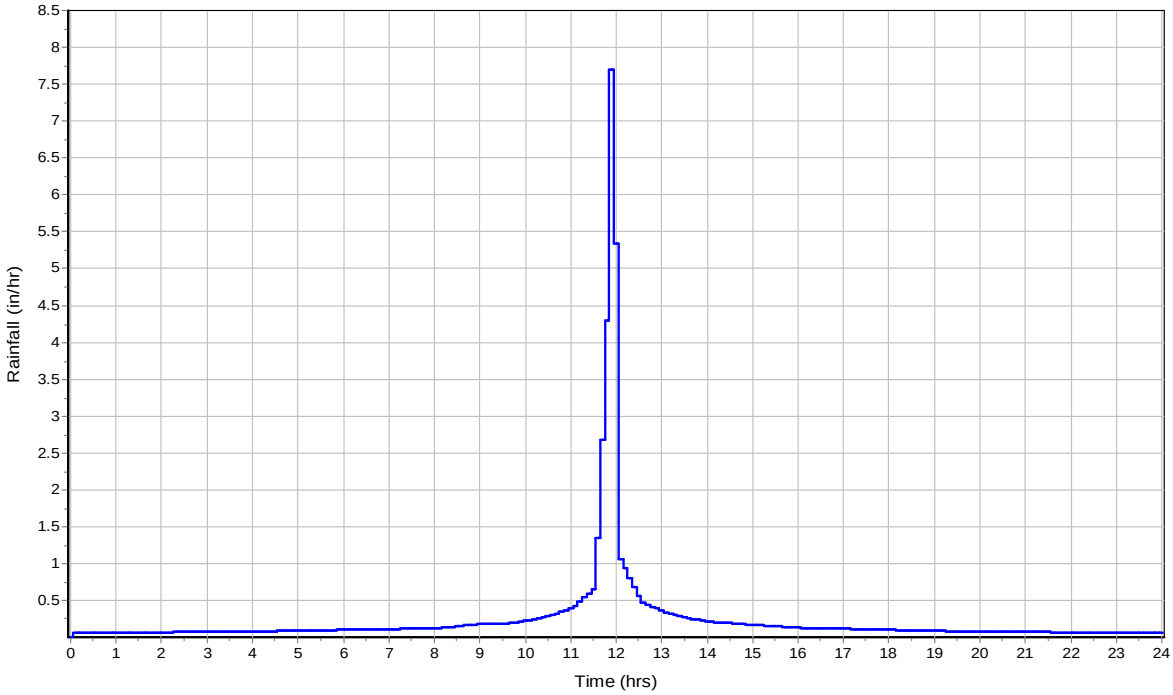
User-Defined TOC override (minutes): 5

Subbasin Runoff Results

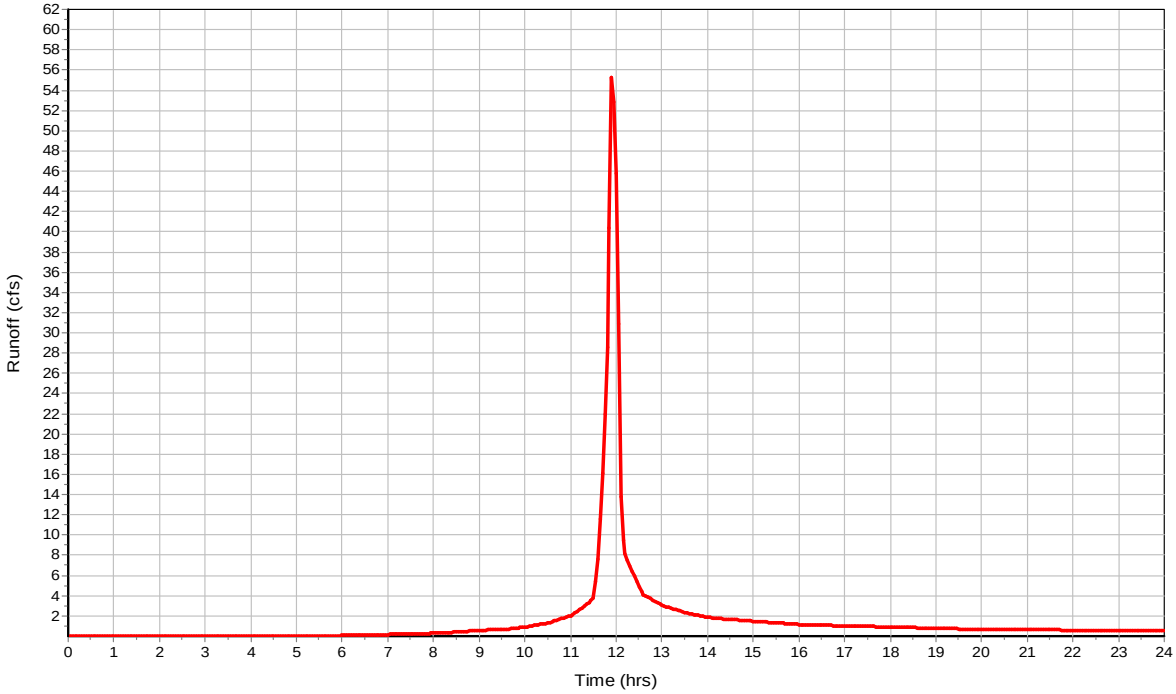
Total Rainfall (in)	5.62
Total Runoff (in)	3.84
Peak Runoff (cfs)	56.9
Weighted Curve Number	83.98
Time of Concentration (days hh:mm:ss)	0 00:05:00

Subbasin : P1

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft^2)	Minimum Pipe Cover (in)
1	Outlet-Struc	993.50	1004.00	10.50	993.50	0.00	0.00	-1004.00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Outlet-Struc	27.07	0.00	993.50	0.00	0.00	10.50	993.50	0.00	0 00:00	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	Link-01	181.72	0.00	-993.50	0.00	-993.50	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	Link-01	27.07	0 12:06	0.00	0.00	0.00		0.00	0.00	0.00		

Storage Nodes

Storage Node : Pond

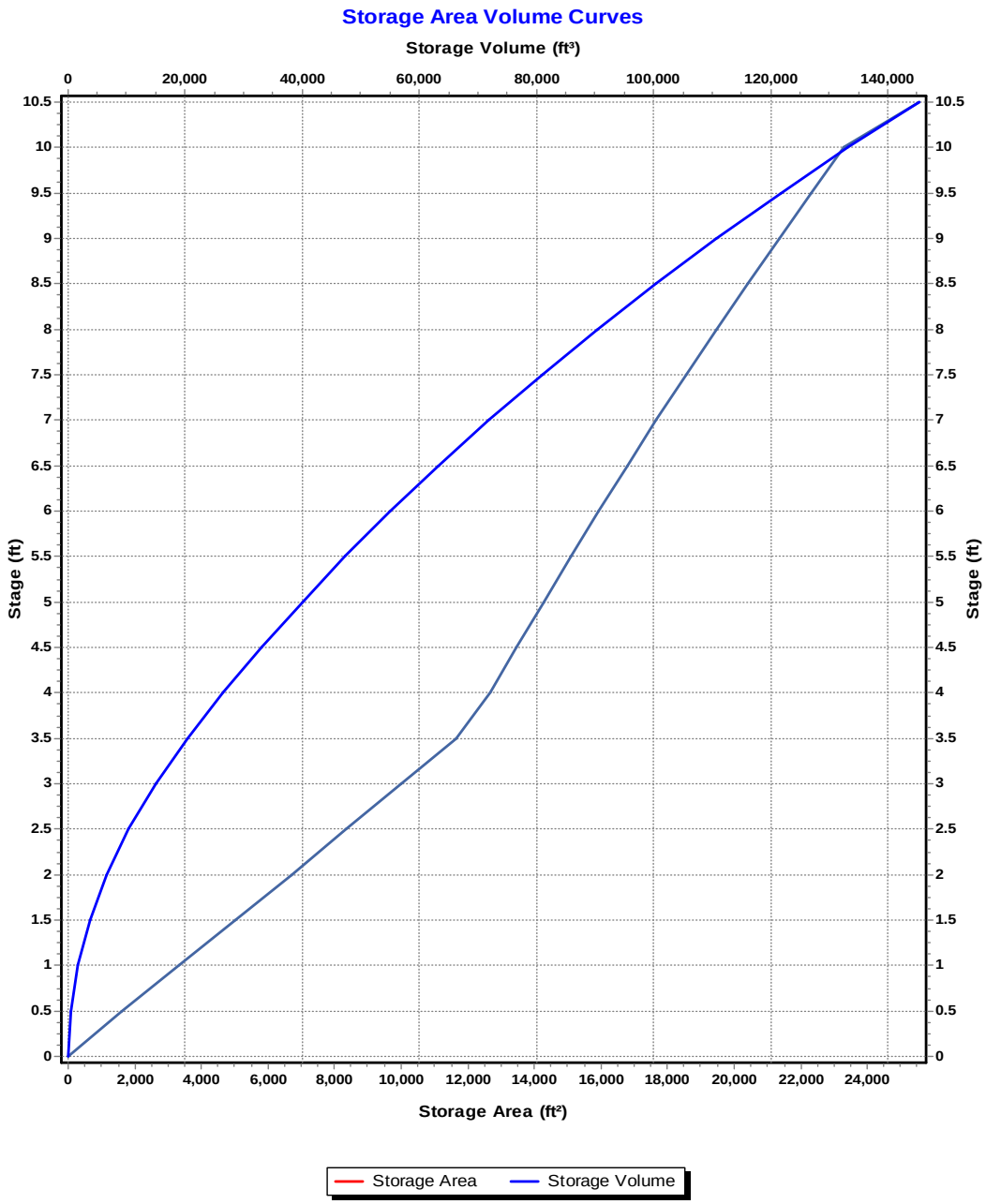
Input Data

Invert Elevation (ft)	993.5
Max (Rim) Elevation (ft)	1004
Max (Rim) Offset (ft)	10.5
Initial Water Elevation (ft)	993.5
Initial Water Depth (ft)	0
Ponded Area (ft²)	147000
Evaporation Loss	0

Storage Area Volume Curves

Storage Curve : Pond-Two Buildings

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	0.5	0
0.5	1620.6	405.28
1	3317.15	1639.72
1.5	5022.08	3724.53
2	6695.11	6653.83
2.5	8348.05	10414.62
3	9987.8	14998.58
3.5	11639.88	20405.5
4	12693.19	26488.77
4.5	13472.43	33030.18
5	14270.87	39966.01
5.5	15088.51	47305.86
6	15925.35	55059.33
6.5	16781.39	63236.02
7	17656.64	71845.53
7.5	18551.09	80897.46
8	19464.74	90401.42
8.5	20397.6	100367.01
9	21349.65	110803.82
9.5	22320.91	121721.46
10	23311.38	133129.53
10.5	25556.79	145346.57


Storage Area Volume Curves
Storage Volume (ft³)
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
Stage (ft)
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Storage Area (ft²)
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
20,000
22,000
24,000
Storage Area
Storage Volume

Storage Node : Pond (continued)

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	10-Year	Side	Rectangular	No		36.00	34.00	997.00	0.63
2	2-Year	Side	CIRCULAR	No	18.00			993.50	0.61

Output Summary Results

Peak Inflow (cfs)	55.32
Peak Lateral Inflow (cfs)	55.32
Peak Outflow (cfs)	27.07
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	998.01
Max HGL Depth Attained (ft)	4.51
Average HGL Elevation Attained (ft)	993.93
Average HGL Depth Attained (ft)	0.43
Time of Max HGL Occurrence (days hh:mm)	0 12:06
Total Exfiltration Volume (1000-ft³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

100 Year Event

Project Description

File Name	Proposed_Model_A2104054.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	Kinematic Wave
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	0:03:00
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 00:03:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	3
Nodes	3
Junctions	1
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links	3
Channels	0
Pipes	1
Pumps	0
Orifices	2
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
49		Time Series	100-Year	Cumulative	inches	Missouri	Jackson	100.00	9.17	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	OS1	1.25	484.00	75.15	9.17	6.13	7.66	11.98	0 00:05:00
2	OS2	1.11	484.00	74.00	9.17	5.98	6.64	9.43	0 00:08:27
3	P1	9.50	484.00	83.98	9.17	7.22	68.60	103.76	0 00:05:00

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft^2)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Outlet-Struc	Junction	993.50	1004.00	993.50	0.00	0.00	62.54	993.50	0.00	10.50	0 00:00	0.00	0.00
2	Out	Outfall	993.50					79.35	993.50					
3	Pond	Storage Node	993.50	1004.00	993.50		147000.00	101.50	999.61				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Reported Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	Link-01	Pipe	Outlet-Struc	Out	181.72	0.00	0.00	0.0000	0.000	0.0150	62.54	0.00	0.00	0.00	0.00	0.00	0.00	
2	10-Year	Orifice	Pond	Outlet-Struc		993.50	993.50		36.000		42.38							
3	2-Year	Orifice	Pond	Outlet-Struc		993.50	993.50		18.000		20.15							

Subbasin Hydrology

Subbasin : OS1

Input Data

Area (ac) 1.25
Peak Rate Factor 484
Weighted Curve Number 75.15
Rain Gage ID ..... *

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	0.06	-	98
-	1.19	-	74
Composite Area & Weighted CN	1.25		75.15

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^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 (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

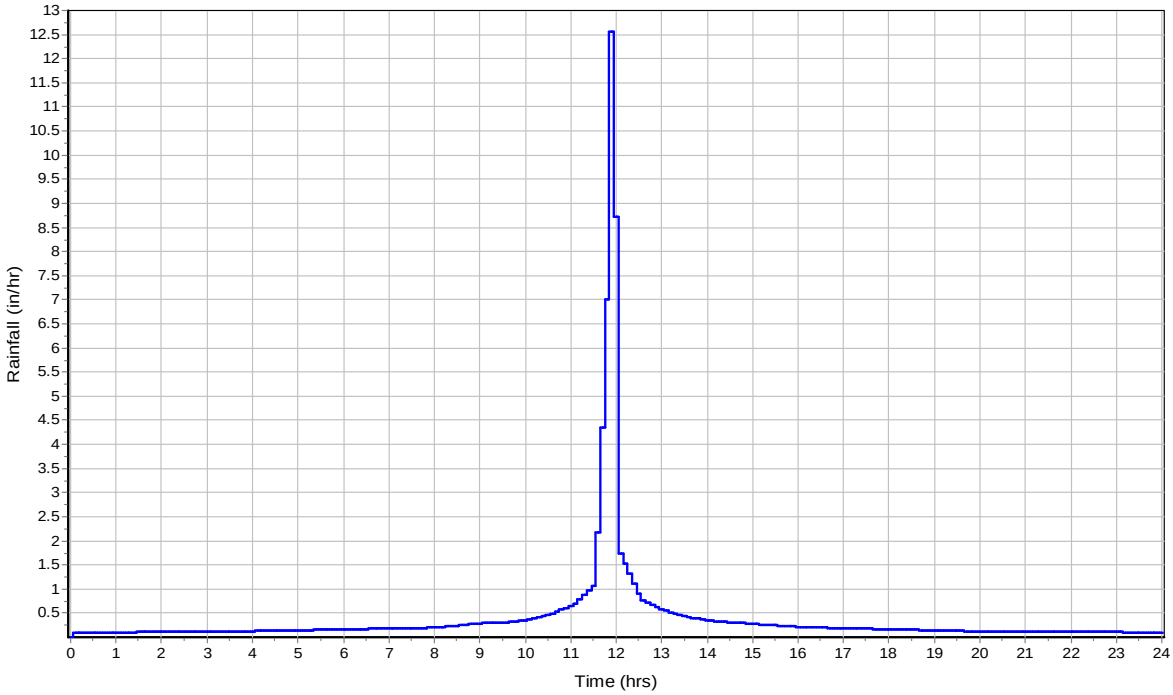
User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

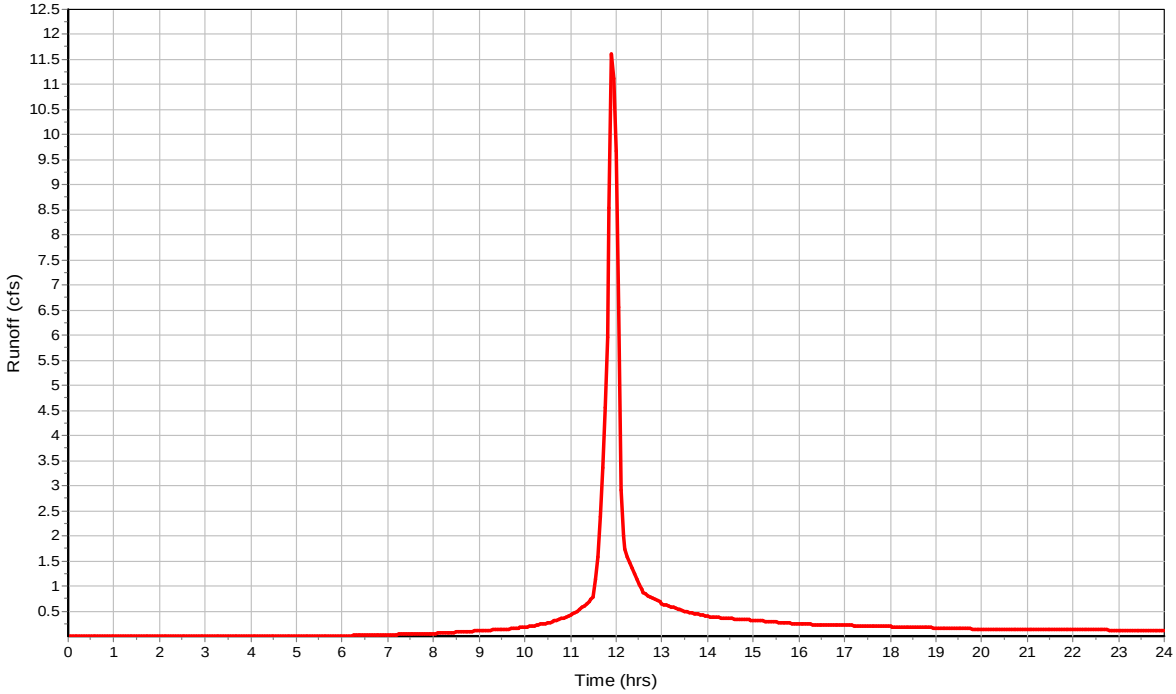
Total Rainfall (in) 9.17
Total Runoff (in) 6.13
Peak Runoff (cfs) 11.98
Weighted Curve Number 75.15
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : OS1

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : OS2

Input Data

Area (ac)	1.11
Peak Rate Factor	484
Weighted Curve Number	74
Rain Gage ID	*

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	1.11	-	74
Composite Area & Weighted CN	1.11		74

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.1	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	2	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.25	0	0
Computed Flow Time (min) :	6.77	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	100	0	0
Slope (%) :	2	0	0
Surface Type :	Grass pasture	Unpaved	Unpaved
Velocity (ft/sec) :	0.99	0	0
Computed Flow Time (min) :	1.68	0	0

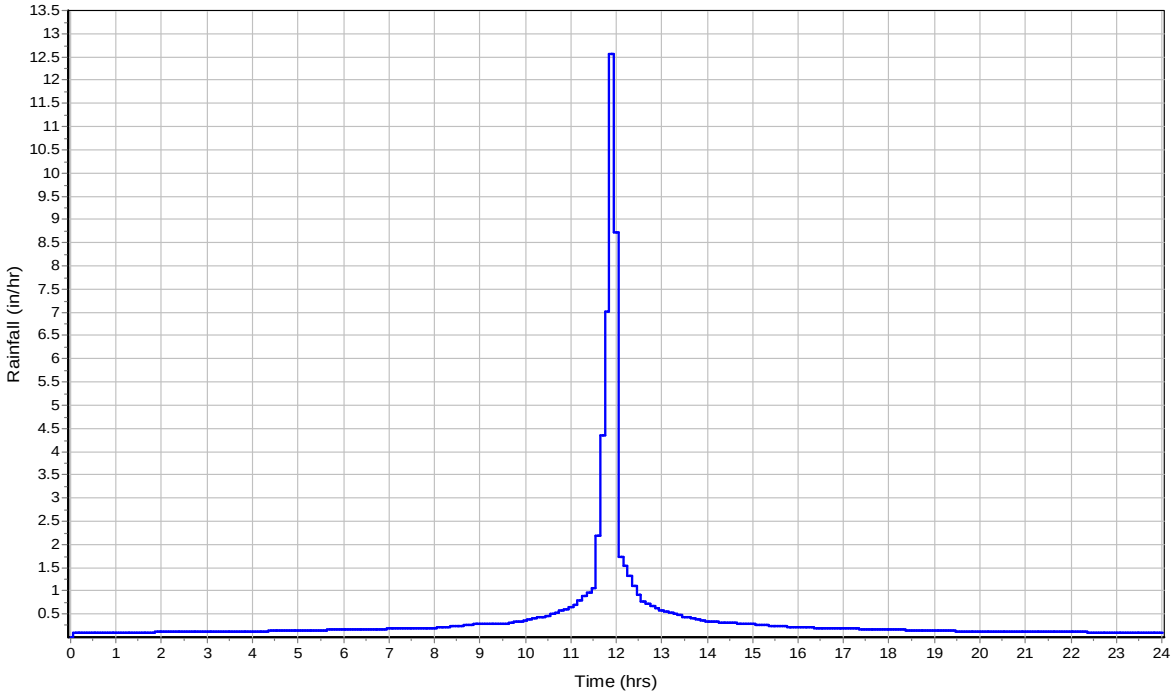
Total TOC (min) 8.46

Subbasin Runoff Results

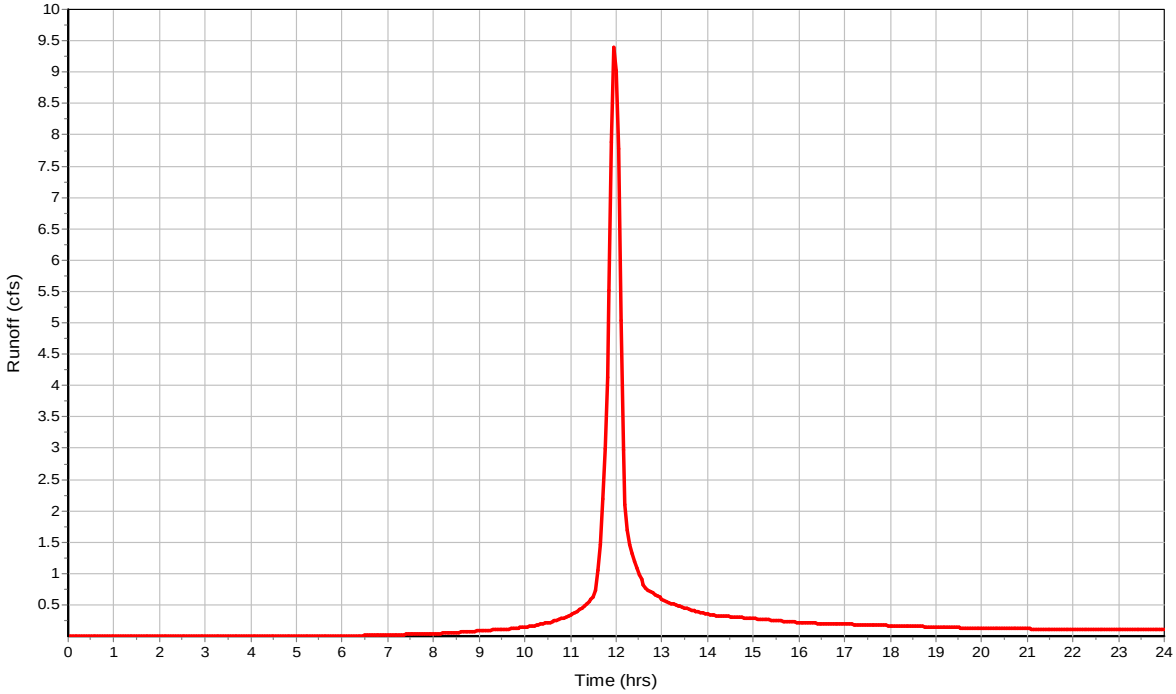
Total Rainfall (in)	9.17
Total Runoff (in)	5.98
Peak Runoff (cfs)	9.43
Weighted Curve Number	74
Time of Concentration (days hh:mm:ss)	0 00:08:28

Subbasin : OS2

Rainfall Intensity Graph



Runoff Hydrograph



Subbasin : P1

Input Data

Area (ac)	9.5
Peak Rate Factor	484
Weighted Curve Number	83.98
Rain Gage ID	*

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
-	5.55	-	74
-	3.95	-	98
Composite Area & Weighted CN	9.5		83.98

Time of Concentration

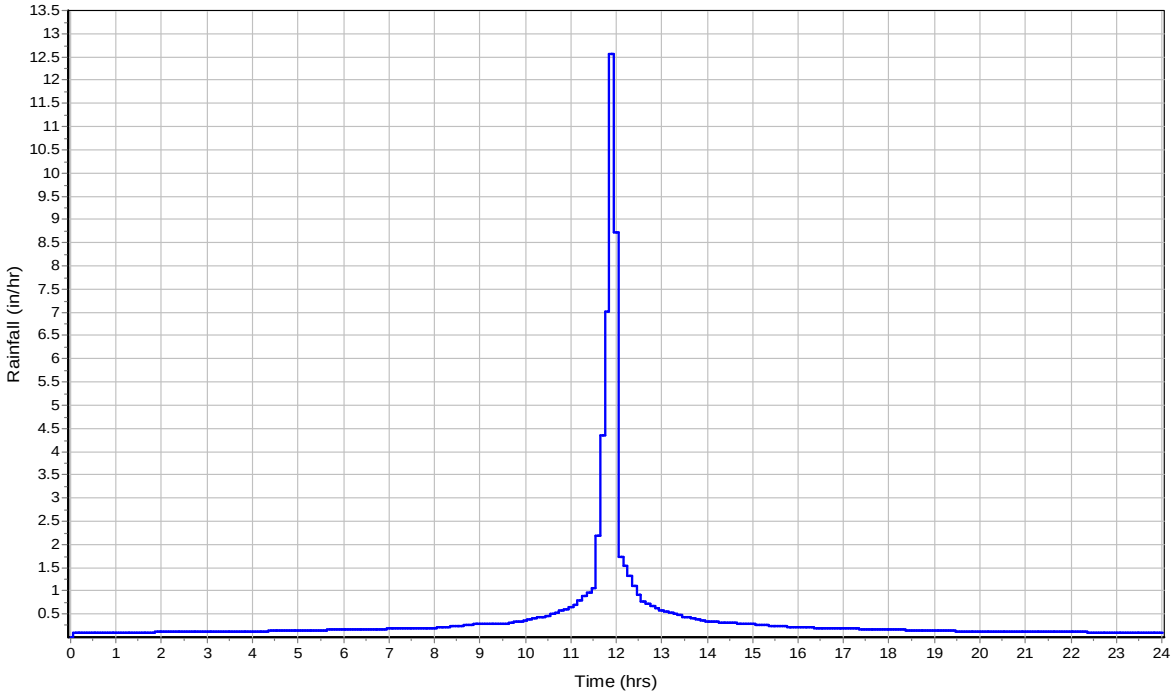
User-Defined TOC override (minutes): 5

Subbasin Runoff Results

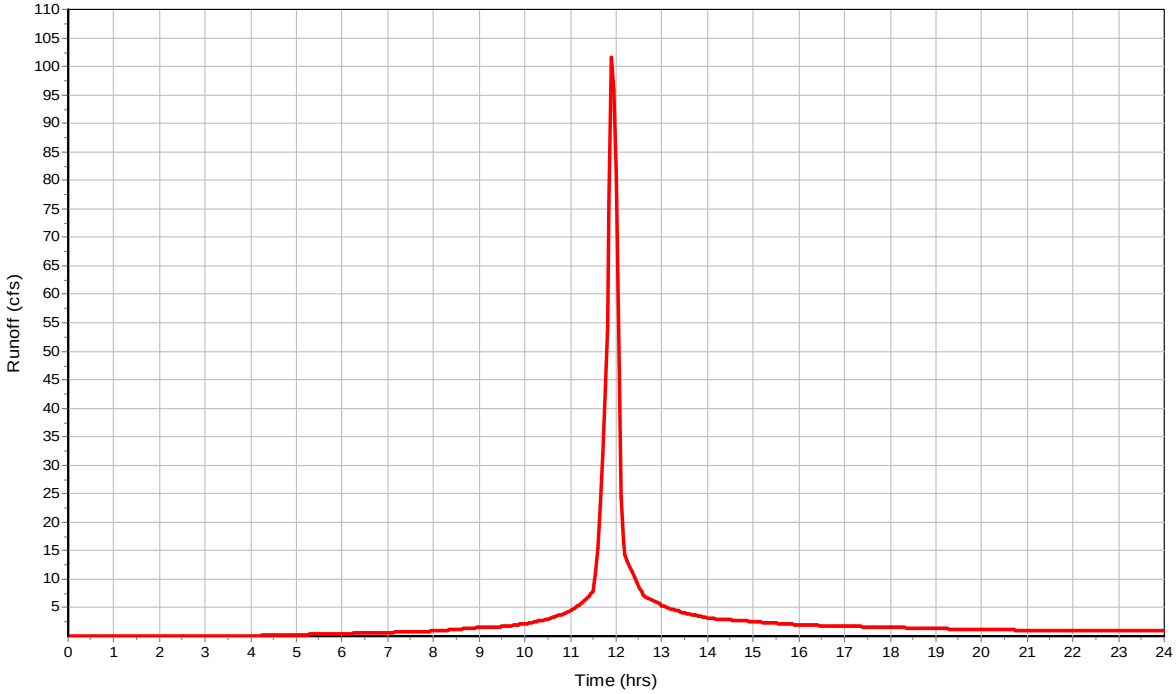
Total Rainfall (in)	9.17
Total Runoff (in)	7.22
Peak Runoff (cfs)	103.76
Weighted Curve Number	83.98
Time of Concentration (days hh:mm:ss)	0 00:05:00

Subbasin : P1

Rainfall Intensity Graph



Runoff Hydrograph



Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft^2)	Minimum Pipe Cover (in)
1	Outlet-Struc	993.50	1004.00	10.50	993.50	0.00	0.00	-1004.00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Outlet-Struc	62.54	0.00	993.50	0.00	0.00	10.50	993.50	0.00	0 00:00	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	Link-01	181.72	0.00	-993.50	0.00	-993.50	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	Link-01	62.54	0 12:05	0.00	0.00	0.00		0.00	0.00	0.00		

Storage Nodes

Storage Node : Pond

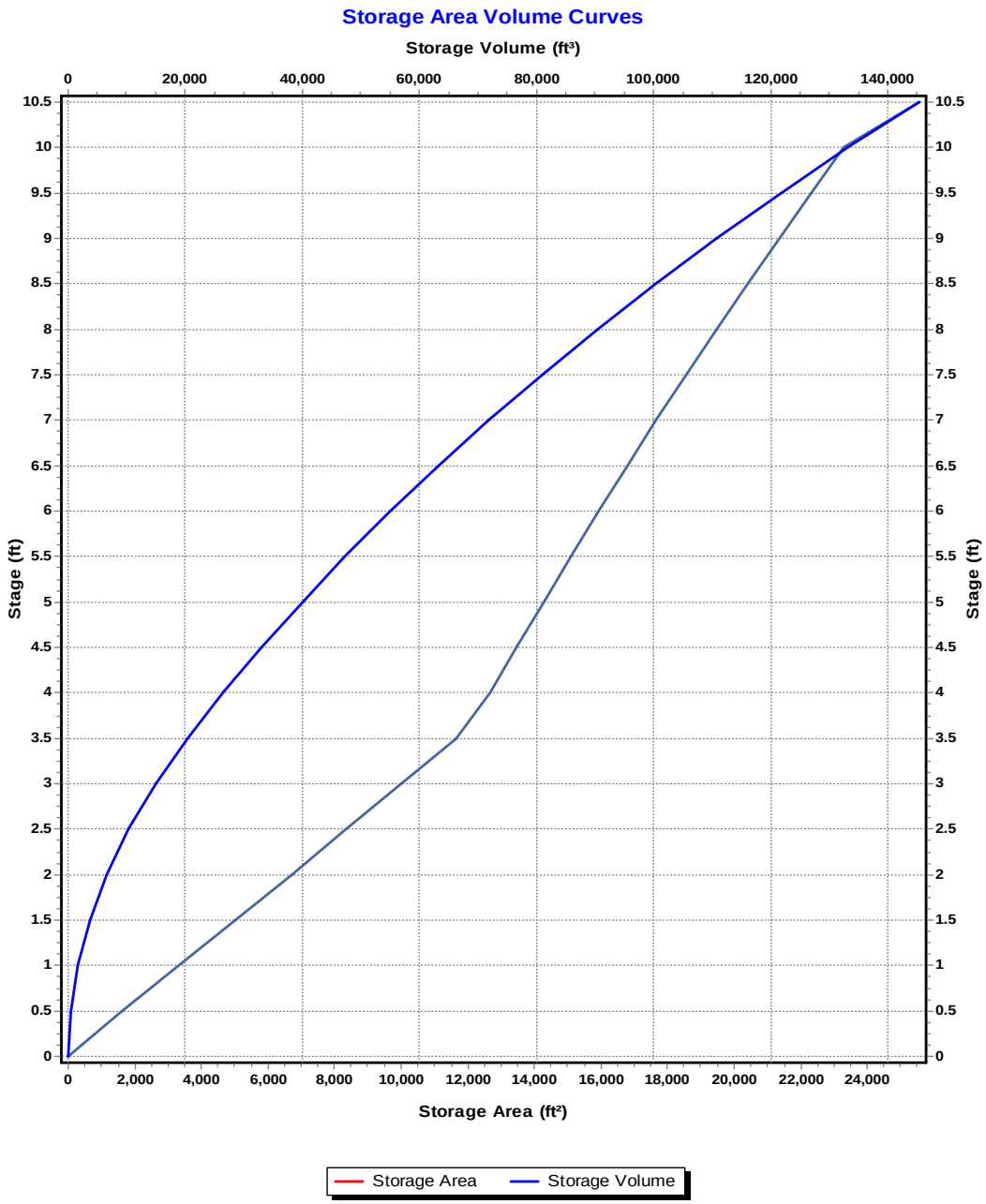
Input Data

Invert Elevation (ft)	993.5
Max (Rim) Elevation (ft)	1004
Max (Rim) Offset (ft)	10.5
Initial Water Elevation (ft)	993.5
Initial Water Depth (ft)	0
Ponded Area (ft²)	147000
Evaporation Loss	0

Storage Area Volume Curves

Storage Curve : Pond-Two Buildings

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	0.5	0
0.5	1620.6	405.28
1	3317.15	1639.72
1.5	5022.08	3724.53
2	6695.11	6653.83
2.5	8348.05	10414.62
3	9987.8	14998.58
3.5	11639.88	20405.5
4	12693.19	26488.77
4.5	13472.43	33030.18
5	14270.87	39966.01
5.5	15088.51	47305.86
6	15925.35	55059.33
6.5	16781.39	63236.02
7	17656.64	71845.53
7.5	18551.09	80897.46
8	19464.74	90401.42
8.5	20397.6	100367.01
9	21349.65	110803.82
9.5	22320.91	121721.46
10	23311.38	133129.53
10.5	25556.79	145346.57


Storage Area Volume Curves
Storage Volume (ft³)
0
20,000
40,000
60,000
80,000
100,000
120,000
140,000
Stage (ft)
10.5
10
9.5
9
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Storage Area (ft²)
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
20,000
22,000
24,000
Storage Area
Storage Volume

Storage Node : Pond (continued)

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	10-Year	Side	Rectangular	No		36.00	34.00	997.00	0.63
2	2-Year	Side	CIRCULAR	No	18.00			993.50	0.61

Output Summary Results

Peak Inflow (cfs)	101.5
Peak Lateral Inflow (cfs)	101.5
Peak Outflow (cfs)	62.54
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	999.61
Max HGL Depth Attained (ft)	6.11
Average HGL Elevation Attained (ft)	994.15
Average HGL Depth Attained (ft)	0.65
Time of Max HGL Occurrence (days hh:mm)	0 12:05
Total Exfiltration Volume (1000-ft³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

APPENDIX C

FEMA Map

National Flood Hazard Layer FIRMette

FEMA

94°24'48"W 38°51'30"N

94°24'10"W 38°51'2"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 — Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/17/2022 at 4:09 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX D

Soils

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Jackson County, Missouri

March 17, 2022

Preface

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

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

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

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

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

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

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Soil Map

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

Custom Soil Resource Report
Soil Map

MAP LEGEND

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

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

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

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 23, Sep 1, 2021

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

Date(s) aerial images were photographed: Sep 6, 2019—Nov 16, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10082	Arisburg-Urban land complex, 1 to 5 percent slopes	4.1	34.7%
10181	Udarents-Urban land-Sampsel complex, 5 to 9 percent slopes	7.7	65.3%
Totals for Area of Interest		**11.8**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

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

Jackson County, Missouri

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

Map Unit Setting

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

Map Unit Composition

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

Description of Arisburg

Setting

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

Typical profile

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

Properties and qualities

Slope: 1 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 11.5 inches)

Interpretive groups

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

Description of Urban Land

Interpretive groups

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

Minor Components

Sampsel

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

Greenton

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

Sharpsburg

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

10181—Udarents-Urban land-Sampsel complex, 5 to 9 percent slopes

Map Unit Setting

National map unit symbol: 1n85g
Elevation: 600 to 900 feet
Mean annual precipitation: 33 to 43 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 175 to 220 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Udarents

Setting

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

Typical profile

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

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.14 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 9.0 inches)

Interpretive groups

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

Description of Urban Land

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Across-slope shape: Convex

Interpretive groups

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

Description of Sampsel

Setting

Landform: Hillslopes

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

Typical profile

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

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Ecological site: R109XY010MO - Interbedded Sedimentary Upland Savanna
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

RAINTREE VILLAGE
PRELIMINARY DEVELOPMENT PLAN
MICRO STORMWATER DRAINAGE STUDY

Lee Summit, Missouri

December 2020

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