

TRI-STATE GENERATION & TRANSMISSION, INC.

ROLLING MEADOWS SUBSTATION FINAL DRAINAGE REPORT

PCD FILE #

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Prepared by:



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TRI-STATE GENERATION & TRANSMISSION, INC.

ROLLING MEADOWS SUBSTATION FINAL DRAINAGE REPORT

Design Engineer's Statement:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

David Schieldt
Registered Professional Engineer
State of Colorado No. 47195

Date

Owner/Developer's Statement:

I, the owner/developer have read and will comply with all of the requirements specified in this drainage report and plan.

H. Steven Gray
Vice President, Land, Water, and Environmental Resources
Tri-State Generation and Transmission Association
1100 W. 116th Ave
Westminster, CO 80234

Date

El Paso County:

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code as amended.

Joushua J. Palmer, P.E.
County Engineer / ECM Administrator

Date



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1.0 General Location and Description

Tri-State Generation and Transmission (TSGT) in coordination with Del-Mont Consultants, Inc. (DMC) is in the process of designing a new substation yard. The scope of work includes the construction of the substation yard, driveway, detention pond and swales, installation of new perimeter fence, and the addition of high voltage electrical equipment and facilities. The purpose of this report is to present the findings from the hydrologic and hydraulic analyses that were performed on the existing property as well as present the results from a detailed analysis performed on the proposed improvements to the property.

1.1 Site Location

The proposed substation yard is located on a 5.95-acre parcel owned by TSGT, situated in the N ½ of Section 12, Township 15 South, Range 61 West, 6th Principal Meridian in El Paso County, Colorado. The substation site is accessed from Bradley Road. The site is in the Jimmy Camp Creek Drainage Basin.

1.2 Site Description

The site naturally drains to the south and is currently covered in various grasses. There are currently no features on the site to provide water quality or quantity treatment for discharge from the site. Site layout details will be discussed in more detail in **Section 2**.

There are currently no developments on the properties neighboring the site. No wetlands are present on the site and the site is located within the Zone AE 100 year floodplain per FIRM Map Number 08041C0790G.

2.0 Drainage Basins and Sub-Basins

The property functions as one drainage basin, flowing to the south, ultimately flowing into the Jimmy Camp Creek. Proposed conditions produce several smaller sub-basins and will be discussed in detail in the following sections.

2.1 Existing Drainage Sub-Basins

The existing site was analyzed as one basin. A map illustrating the delineation of the existing property can be found in **Appendix C**. There are no developments on the neighboring properties. **Table 2-1** presents the existing basin and its corresponding acreage.

Table 2-1: Existing Basin Acreages

Sub-Basin	Total Area (Acres)
Existing	4.76

Currently, the existing subbasin experiences unrestricted overland flow with no drainage detention measures in place. The existing site has experienced preliminary rough grading and all water remains within the existing basin.

2.2 Proposed Drainage Sub-Basins

The proposed conditions will produce several different sub-basins. The proposed site is divided into 9 different sub-basins. The substation yard accounts for 3 of the basins (Y 1-3), which were broken out separately to size the subdrain pipes. Areas outside of the substation make up 4 basins (P 1-4).

The access driveway and surrounding area on the west side of the site will be excluded (EXCL-1) per ECM Appendix I.7.1.C.1.a, as this area is less than totals less than 1 acre and is not practical to capture. The area west and south of the EDB embankment (EXCL-2) will be excluded per EPC ECM Appendix I.7.1.B.7 as this area is undeveloped land that will remain undeveloped.

A map illustrating the delineation of the sub-basins can be found in **Appendix C**.

Storm water will be routed through the detention basins via buried subdrains and overland flow. The disturbed areas of the proposed basins will be reseeded. **Table 2-2** presents the proposed sub-basins and their corresponding acreages.

Table 2-2: Proposed Sub-Basin Acreages

Sub-Basin	Total Area (Acres)
Y1	0.43
Y2	0.61
Y3	0.72
P1	0.63
P2	0.97
P3	0.72
P4	0.68

3.0 Drainage Design Criteria

3.1 Methodology

The hydrologic/hydraulic analysis of the site was performed using the Autodesk Storm and Sanitary analysis utilizing the Rational Method model for a 5-year and a 100-year rainfall event. Runoff Coefficients were obtained from El Paso County Drainage Criteria Manual Volume 1 Update, Chapter 6, Section 3.1, Table 6-6. Rainfall Intensity was obtained from EPC DCM Volume 1 Update, Figure 6-5. Modeling results are presented in **Appendix B**.

The Mile High Flood District *Detention Basin Design Workbook* was utilized to determine the required water quality capture volume (WQCV) and detention and to aid in the design the outlet structure. The spreadsheets/worksheets can be found in **Appendix A** and are discussed in more detail in **Section 4.0**.

Soil data was obtained from the SCS soils survey for El Paso County and identifies hydrologic soil group B for the site.

The described methods/tools used in the analysis, are in accordance with common engineering practices and guidelines.

3.2 Land Cover Hydrologic Properties

Runoff Coefficients and Percent Impervious numbers, for hydrologic soil group B, were assigned to the various land cover types found on the project, both existing and proposed, and are presented in **Table 3-1**. Runoff coefficients were obtained from Table 6-6, Section 3-1, EPC DCM Volume 1 Update.

Table 3-1: Land Cover Hydrologic Properties

Land Cover Type	Percent Impervious	Runoff Coefficient 5 Year	Runoff Coefficient 100 Year
Gravel	80	0.59	0.70
Historical Flow Analysis	2	0.09	0.36
Pond	100	0.90	0.96

3.3 Weighted Design Values

Utilizing the land cover hydrologic properties presented above, a weighted Runoff Coefficient and Percent Impervious value was calculated for each of the sub-basins, presented in **Section 2.0** to be used for analysis. **Table 3-2** presents the weighted design values for existing conditions and **Table 3-3** presents the weighted design values for proposed conditions. Detailed calculations can be found in **Appendix A**.

Table 3-2: Existing Sub-Basin Weighted Design Values

Sub-Basin	Total Area (Acres)	Weighted Percent Impervious	Weighted Runoff Coefficient 5 year	Weighted Runoff Coefficient 100 year
Existing	4.81	2%	0.09	0.36

Table 3-3: Proposed Sub-Basin Weighted Design Values

Sub-Basin	Total Area (Acres)	Weighted Percent Impervious	Weighted Runoff Coefficient 5 year	Weighted Runoff Coefficient 100 year
Y1	0.43	80%	0.59	0.70
Y2	0.61	80%	0.59	0.70
Y3	0.72	80%	0.59	0.70
P1	0.63	14%	0.17	0.41
P2	0.97	2%	0.09	0.36
P3	0.72	13%	0.16	0.41
P4	0.73	100%	0.90	0.96
EXCL-1	0.80	2%	0.09	0.36
EXCL-2	0.52	2%	0.09	0.36

4.0 Drainage Facility Design

4.1 Historical Drainage

Per common practice, the 100-year historical discharge value for the site shall be used to determine the allowable discharge from the site for the proposed conditions. Values presented in **Table 3-2** were used in the model to calculate a historical discharge rate for the existing property. **Table 4-1** presents the discharge rate for the existing property for both the 5-year and 100-year 1-hour storm events although the design is based on the 100-year discharge values.

Table 4-1: Existing Property Discharge Values

Sub-Basin	5-Year Discharge (CFS)	100-Year Discharge (CFS)
Existing	2.63	10.25

4.2 Proposed Drainage

Values presented in **Table 3-3** were utilized in the model to calculate the runoff for the proposed conditions. The Mile High Flood District *Detention Basin Design Workbook* was utilized to determine the WQCV in conjunction with the model to size the detention pond (EDB-1). Once the pond was sized, the Mile High Flood District *Detention Basin Design Workbook* was utilized to estimate required orifice sizes in the outlet structure to provide water quality treatment. The model was then used to verify all design elements of the pond and the outlet structure to ensure the pond not only retained the correct WQCV but to also discharge at or less than the required 100-year historic discharge rate presented in **Table 4-1** as well as drain the pond in less than the allowable time per State Requirements. The spreadsheet showing the detailed calculations can be found in **Appendix A**. The design of the outlet structure is detailed in the grading drawings.

The two drainage swales that will route flows from basin P1 and P2 were not analyzed as the contributing areas are extremely small. These swales are designed as a flat-bottom swale with 4:1 side slopes, a minimum depth of 1 foot, and a flow line slope of 0.5%. The swale has a max flow capacity 20cfs, which will easily convey the negligible run-on flows.

The proposed detention pond (EDB-1) was designed to provide water quality treatment as well as detain the 100-year storm event while maintaining the required 1-foot of freeboard. The proposed detention pond stage-storage curve is presented in **Table 4-2**. The emergency spillway has been designed to convey the 100 year storm event.

Table 4-2: Detention Pond Stage-Storage Table

Elevation	Surface Area (Sq. Ft.)
5808.02 (Top of Micropool)	10
5808.35 (Trickle Channel Invert)	10
5809.35	4,853
5810.35 (Weir)	13,958
5810.85 (Emergency Spillway)	17,074
5811.35	19,848
5812.35 (Top of Bank)	24,447

The model of the proposed site conditions was utilized to calculate discharge flow rates from the outlet structure in order to size the pond discharge culvert. **Table 4-3** presents the hydraulic capacity of the culvert and the required capacity to discharge flow from the outlet structure for the 100-year event. Hydraulic calculations for the remainder of the piping systems and corresponding capacities are found in **Appendix B**.

Table 4-3: Outlet Pipe Hydraulic Capacity (100-year event)

Drainage Feature	Pipe Diameter (in)	Total Capacity (cfs)	Required Flow Capacity (cfs)	Remaining Capacity (cfs)
Pond Outlet	18	6.45	0.08	6.37

Table 4-4 presents the discharge rates for the proposed sub-basins for both the 5-year and 100-year 1-hour storm events prior to detention. This discharge value represents the flow rate that the pond is receiving. The discharge from the pond and other basins (total discharge from site) is summarized in **Table 5-1**.

Table 4-4: Proposed Sub-Basin Discharge Values (Pre-Detention)

Sub-Basin	5-Year Discharge (CFS)	100-Year Discharge (CFS)
Y1	1.05	1.76
Y2	1.49	2.49
Y3	1.75	2.94
P1	0.41	0.74
P2	0.36	0.61
P3	0.48	0.80
P4	2.71	4.55

*Values from SSA Model

Utilizing the flow rates presented above, the model was utilized to analyze the flow path of water through the piping and pond system. With the installation of the outlet structure, the pond was designed to pass both the 5-year and 100-year events, treat the required WQCV, and slowly release the water in the required length of time after the end of an event set forth by the State. The entire substation drains to the pond and the discharge rate leaving the pond is presented in **Table 5-1**.

Table 4-5 presents the hydraulic capacity of the subdrain pipes and the required capacity for the 100-year 1-hour storm event. These values were obtained from the SSA drainage model. A model schematic identifying each pipe can be found in **Appendix C**.

Table 4-5: Subdrain Pipe Hydraulic Capacity (100-year event)

Subdrain ID	Pipe Diameter (in)	Total Capacity (cfs)	Peak Flow Capacity (cfs)	Remaining Capacity (cfs)
01-12-NP	12	3.33	0.74	2.59
02-12-P	12	2.55	1.71	0.84
03-15-NP	15	4.81	2.42	2.39
04-15-P	15	4.11	3.48	0.63
05-15-NP	15	6.02	4.64	1.38
06-12-P	12	3.07	2.90	0.17
07-12-NP	12	5.13	2.89	2.24

5.0 Conclusions

5.1 Drainage Concept

The drainage design has been prepared using sound engineering judgement and practices and will provide an effective means of controlling runoff on the project site as well as protect the site from damage. The design has been completed according to common engineering practices and will result in no downstream impacts to any people or structures. Historic flow paths, discharge rates, and water quality have been maintained or improved.

5.2 Compliance with Common Practices

Per common practices, the historical discharge rate from the 100-year storm shall be utilized to determine the allowable discharge rate for the proposed improvements. To demonstrate compliance with this requirement, both the existing and proposed conditions were combined into one overall sub-basin. **Table 5-1** presents the overall discharge rates for the overall basin.

Table 5-1: Overall Basin Discharge Values (Post Detention)

Basin	5-Year Discharge (CFS)		100-Year Discharge (CFS)	
	Existing	Proposed	Existing	Proposed
Total	8.26	0.10	13.85	3.40

*Value from MHFD-Detention Spreadsheet (Appendix A)

The pond outlet structure was sized so the proposed flows of the 5-year and 100-year storm events are less than the existing flows of the same storm events.

The detention pond was also sized according to UDFCD requirements to treat the WQCV, detain the 100-year event, maintain 1 foot of freeboard, and maintain historical discharge patterns resulting in no downstream impacts.

Inspections of the pond and outlet structure will be conducted by the owner on an annual basis as well as after large storm events. If deficiencies are identified or if maintenance is required, maintenance of the outlet structure will be performed by the owner of the property in an effort to return the structure to its original level of functionality. Maintenance may involve cleaning of sediment and debris from the facility, maintaining vegetation growth around the structure, and performing any additional maintenance required.

It should be noted that the use of forebays was also analyzed. Because this site has 4 locations of inflow into the detention basin, multiple forebays would be required. WQCVs for the subbasins emptying into the detention basin were calculated along with weighted imperviousness and weighted runoff coefficients for these subbasins. This information was then inputted into the UDFCD's Extended Detention Basin (EDB) Design Procedure Form to size forebays. Due to the smaller size of these subbasins, the required minimum forebay volume was recommended as 0% of the WQCV. It was then decided that forebays would not be necessary for this project. Forebay calculations have been included for reference in Appendix D

5.3 Four Step Process

The “Four Step Process” as recommended by the Urban Drainage Flood Control District has been addressed as follows:

Step 1 - Runoff Reduction

Runoff Reduction will be achieved by maintaining all perviousness in all areas not routed through the EDB. Any disturbance in these areas, including the construction of the swales, shall be reseeded and stabilized.

Step 2 – Stabilized Drainageways

All swales proposed on the site will be stabilized with grass cover and the use of Rip-Rap armoring will be implemented in areas of higher concentration and/or velocity. Riprap sizing and pond outlet swale calculations can be found in **Appendix A**.

Step 3 – Provide Water Quality Capture Volume

The detention pond and outlet structure on site have been designed to achieve WQCV. The Mile High Flood District *Detention Basin Design Workbook* was utilized to determine the required water quality capture volume (WQCV) and to aid in the design of the outlet structure. The spreadsheets/worksheets can be found in **Appendix A** and are discussed in more detail in **Section 4.0**. The design was then analyzed with Autodesk Storm and Sanitary analysis utilizing the Rational Method model for a 5-year and a 100-year rainfall event. Modeling results are presented in **Appendix B**.

Step 4 – Consider Need for Industrial and Commercial BMPs

The site has low potential for industrial pollution upon the completion of construction. The improved areas of the site that could see vehicular traffic are all routed through the detention pond system where it receives water quality treatment. The electrical equipment found inside of the yard also utilizes local containment basins to prevent the spilling of contaminants within the yard.

5.4 Cost Estimate

Line Item Description	Quantity	U.O.M.	Labor	CFM	Labor & Materials
D50=6" Rip Rap	98	SY	\$ 61.56	\$ 40.29	\$ 9,981.30
18" RCP Concrete Pipe	46	LF	\$ 123.47	\$ 48.28	\$ 7,900.50
18" RCP Concrete Pipe w/ Flared End Section	1	EA	\$ 1,262.59	\$ 759.20	\$ 2,021.79
6' Concrete Trickle Channel	254	LF	\$ 20.80	\$ 5.20	\$ 6,604.00
Concrete Outlet Structure, 5' X 6'-6" X 6'-8"	1	EA	\$10,324.00	\$ 830.00	\$ 11,154.00
EDB Access Road	99	CY	\$ 50.34	\$ 21.88	\$ 7,149.78
				TOTAL:	\$ 44,811.37

6.0 References

United States Department of Agriculture Natural Resources Conservation Service. Web Soil Survey

Mile High Flood District and Flood Control District. *Detention Basin Design Workbook*, Version 4.04, February 2021.

Urban Drainage and Flood Control District. *Urban Storm Drainage Criteria Manual*, Volume 1-3, June 2001.

El Paso County, Colorado, *Drainage Criteria Manual*, Volume 1-2, October 31, 2018

El Paso County, Colorado, *Engineering Criteria Manual*, December 13, 2016

Yeh and Associates, Inc. *Geotechnical Engineering Study, Rolling Meadows Substation*. Yeh Project Number 221-290. November 11, 2021

Appendix A

Site Specific Physical Design Properties



Rolling Meadows Substation Drainage Design

Existing Conditions-100 Year

Area Name	Total Area		Flow Length	Slope (%)	TOC (min)
	(sf)	(acres)			
Ex	207320.088	4.76	300	2.0%	18.41

TOC Calculated using equation 5.5.1.2 from WCECC

Land Cover Type	Percent Impervious	Runoff Coefficient
Historical Flow Analysis	2%	0.36
Packed Gravel	40%	0.5
Pond	100%	0.96

Runoff Coefficient and Imperviousness Analysis

Ex						
	<u>Description</u>	<u>Total Area (ac)</u>	<u>Runoff Coefficient</u>	<u>A*C</u>	<u>Percent Impervious</u>	<u>A*%</u>
Native		4.76	0.36	1.71	2%	10%
			sum	1.71		10%
			Weighted	0.36		2%
Total Area (ac)		4.759				
Weighted Runoff Coefficient		0.36				
Weighted Percent Impervious		2%				

Rolling Meadows Substation Drainage Design

Existing Conditions-5 Year

Area Name	Total Area		Flow Length	Slope (%)	TOC (min)
	(sf)	(acres)			
Ex	207320.088	4.76	300	2.0%	25.38

TOC Calculated using equation 5.5.1.2 from WCECC

Land Cover Type	Percent Impervious	Runoff Coefficient
Historical Flow Analysis	2%	0.08
Gravel	40%	0.3
Pond	100%	0.9

Runoff Coefficient and Imperviousness Analysis

Ex-1						
	<u>Description</u>	<u>Total Area (ac)</u>	<u>Runoff Coefficient</u>	<u>A*C</u>	<u>Percent Impervious</u>	<u>A*%</u>
Existing Site		4.76	0.08	0.38	2%	10%
			sum	0.38		10%
Total Area (ac)		4.76	Weighted	0.08		2%
Weighted Runoff Coefficient		0.08				
Weighted Percent Impervious		2%				

Rolling Meadows Substation Drainage Design

Proposed Conditions-100 Year

Area Name	Total Area		Flow Length	Slope (%)	TOC (min)
	(sf)	(acres)			
Y1	18832.55	0.43	50	1.00%	5.11
Y2	26554.27	0.61	50	1.00%	5.11
Y3	31214.27	0.72	50	1.00%	5.11
P1	27283.48	0.63	50	1.00%	8.76
P2	42442.99	0.97	50	3.00%	8.53
P3	31278.32	0.72	50	3.00%	9.77
P4	31878.69	0.73	50	3.00%	6.57

TOC Calculated using equation 5.5.1.2 from WCECC

Land Cover Type	Percent Impervious	Runoff Coefficient
Historical Flow Analysis	2%	0.36
Packed Gravel	80%	0.7
Pond/Swale	100%	0.96

Runoff Coefficient and Imperviousness Analysis

Y1

Description	Total Area (ac)	Runoff Coefficient	A*C	Percent Impervious	A*%
Substation Yard (Gravel)	0.43	0.7	0.30	80%	34.6%
Native	0.00	0.36	0.00	2%	0.0%
Pond	0.00	0.96	0.00	100%	0.0%
		sum	0.30		34.6%
Total Area (ac)	0.43	Weighted	0.70		80%
Weighted Runoff Coefficient	0.70				
Weighted Percent Impervious	80%				

Y2

Description	Total Area (ac)	Runoff Coefficient	A*C	Percent Impervious	A*%
Substation Yard (Gravel)	0.61	0.7	0.43	80%	48.8%
Native	0.00	0.36	0.00	2%	0.0%
Pond	0.00	0.96	0.00	100%	0.0%
		sum	0.43		48.8%
Total Area (ac)	0.61	Weighted	0.70		80%
Weighted Runoff Coefficient	0.70				
Weighted Percent Impervious	80%				

Y3

Description	Total Area (ac)	Runoff Coefficient	A*C	Percent Impervious	A*%
Substation Yard (Gravel)	0.72	0.7	0.50	80%	57.3%
Native	0.00	0.36	0.00	2%	0.0%
Pond	0.00	0.96	0.00	100%	0.0%
		sum	0.50		57.3%
Total Area (ac)	0.72	Weighted	0.70		80%
Weighted Runoff Coefficient	0.70				
Weighted Percent Impervious	80%				

P1

<u>Description</u>	<u>Total Area (ac)</u>	<u>Runoff Coefficient</u>	<u>A*C</u>	<u>Percent Impervious</u>	<u>A*%</u>
Driving Surface (Gravel)	0.10	0.7	0.07	80%	8.0%
Native	0.53	0.36	0.19	2%	1.1%
Pond	0.00	0.96	0.00	100%	0.0%
		sum	0.26		9.1%
Total Area (ac)	0.63	Weighted	0.41		14%
Weighted Runoff Coefficient	0.41				
Weighted Percent Impervious	14%				

P2

<u>Description</u>	<u>Total Area (ac)</u>	<u>Runoff Coefficient</u>	<u>A*C</u>	<u>Percent Impervious</u>	<u>A*%</u>
Driving Surface (Gravel)	0.00	0.7	0.00	80%	0.0%
Native	0.97	0.36	0.35	2%	1.9%
Pond	0.00	0.96	0.00	100%	0.0%
		sum	0.35		1.9%
Total Area (ac)	0.97	Weighted	0.36		2%
Weighted Runoff Coefficient	0.36				
Weighted Percent Impervious	2%				

P3

<u>Description</u>	<u>Total Area (ac)</u>	<u>Runoff Coefficient</u>	<u>A*C</u>	<u>Percent Impervious</u>	<u>A*%</u>
Driving Surface (Gravel)	0.10	0.7	0.07	80%	8.0%
Native	0.62	0.36	0.22	2%	1.2%
Pond	0.00	0.96	0.00	100%	0.0%
		sum	0.29		9.2%
Total Area (ac)	0.72	Weighted	0.41		13%
Weighted Runoff Coefficient	0.41				
Weighted Percent Impervious	13%				

P4

<u>Description</u>	<u>Total Area (ac)</u>	<u>Runoff Coefficient</u>	<u>A*C</u>	<u>Percent Impervious</u>	<u>A*%</u>
Driving Surface (Gravel)	0.00	0.7	0.00	80%	0.0%
Native	0.00	0.36	0.00	2%	0.0%
Pond	0.73	0.96	0.70	100%	73.2%
		sum	0.70		73.2%
Total Area (ac)	0.73	Weighted	0.96		100%
Weighted Runoff Coefficient	0.96				
Weighted Percent Impervious	100%				

Composite

<u>Description</u>	<u>Total Area (ac)</u>	<u>Runoff Coefficient</u>	<u>A*C</u>	<u>Percent Impervious</u>	<u>A*%</u>
Driving Surface (Gravel)	1.96	0.7	1.37	80%	156.7%
Native	2.12	0.36	0.76	2%	4.2%
Pond	0.73	0.96	0.70	100%	73.2%
		sum	2.84		234.1%
Total Area (ac)	4.81	Weighted	0.59		49%
Weighted Runoff Coefficient	0.59				
Weighted Percent Impervious	49%				

Rolling Meadows Substation Drainage Design

Proposed Conditions-5 Year

Area Name	Total Area		Flow Length	Slope (%)	TOC (min)
	(sf)	(acres)			
Y1	18832.55	0.43	50	1.0%	6.51
Y2	26554.27	0.61	50	1.0%	6.51
Y3	31214.27	0.72	50	1.0%	6.51
P1	27283.48	0.63	50	1.0%	11.87
P2	42442.99	0.97	50	3.0%	9.77
P3	31278.32	0.72	50	3.0%	9.77
P4	31878.69	0.73	50	3.0%	8.97

TOC Calculated using equation 5.5.1.2 from WCECC

Land Cover Type	Percent Impervious	Runoff Coefficient
Historical Flow Analysis	2%	0.09
Gravel	80%	0.59
Pond	100%	0.9

Runoff Coefficient and Imperviousness Analysis

Y1					
Description	Total Area (ac)	Runoff Coefficient	A*C	Percent Impervious	A*%
Substation Yard (Gravel)	0.43	0.59	0.26	80%	34.6%
Native	0.00	0.09	0.00	2%	0.0%
Pond	0.00	0.9	0.00	100%	0.0%
		sum	0.26		34.6%
Total Area (ac)	0.43	Weighted	0.59		80%
Weighted Runoff Coefficient	0.59				
Weighted Percent Impervious	80%				

Y2					
Description	Total Area (ac)	Runoff Coefficient	A*C	Percent Impervious	A*%
Substation Yard (Gravel)	0.61	0.59	0.36	80%	48.8%
Native	0.00	0.09	0.00	2%	0.0%
Pond	0.00	0.9	0.00	100%	0.0%
		sum	0.36		48.8%
Total Area (ac)	0.61	Weighted	0.59		80%
Weighted Runoff Coefficient	0.59				
Weighted Percent Impervious	80%				

Y3					
Description	Total Area (ac)	Runoff Coefficient	A*C	Percent Impervious	A*%
Substation Yard (Gravel)	0.72	0.59	0.42	80%	57.3%
Native	0.00	0.09	0.00	2%	0.0%
Pond	0.00	0.9	0.00	100%	0.0%
		sum	0.42		57.3%
Total Area (ac)	0.72	Weighted	0.59		80%
Weighted Runoff Coefficient	0.59				
Weighted Percent Impervious	80%				

P1

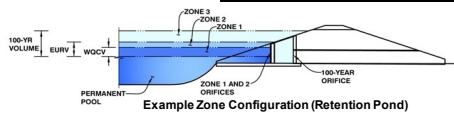
<u>Description</u>	<u>Total Area (ac)</u>	<u>Runoff Coefficient</u>	<u>A*C</u>	<u>Percent Impervious</u>	<u>A*%</u>
Driving Surface (Gravel)	0.10	0.59	0.06	80%	8.0%
Native	0.53	0.09	0.05	2%	1.1%
Pond	0.00	0.9	0.00	100%	0.0%
		sum	0.11		9.1%
Total Area (ac)	0.63	Weighted	0.17		14%
Weighted Runoff Coefficient	0.17				
Weighted Percent Impervious	14%				

P2

<u>Description</u>	<u>Total Area (ac)</u>	<u>Runoff Coefficient</u>	<u>A*C</u>	<u>Percent Impervious</u>	<u>A*%</u>
Driving Surface (Gravel)	0.00	0.59	0.00	80%	0.0%
Native	0.97	0.09	0.09	2%	1.9%
Pond	0.00	0.9	0.00	100%	0.0%
		sum	0.09		1.9%
Total Area (ac)	0.97	Weighted	0.09		2%
Weighted Runoff Coefficient	0.09				
Weighted Percent Impervious	2%				

MHFD-Detention, Version 4.07 (June 2025)

Basin ID: EDB-1



Selected SCM Type =	EDB	
Watershed Area =	4.81	acres
Watershed Length =	625	ft
Watershed Length to Centroid =	75	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	49.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depth = User Input		

Optional User Overrides

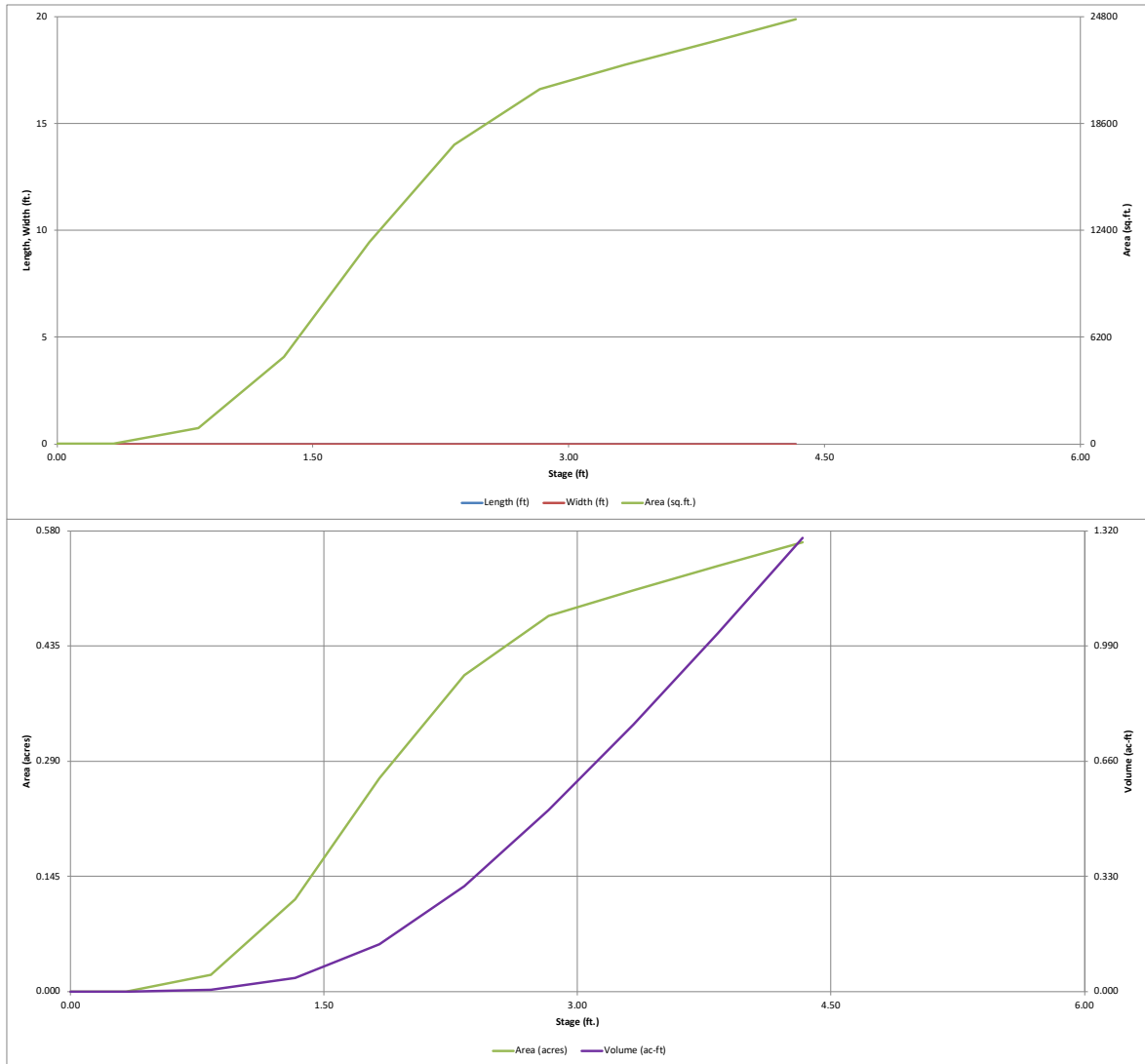
Water Quality Capture Volume (WQCV) =	0.082	acre-feet
Excess Urban Runoff Volume (EURV) =	0.252	acre-feet
2-yr Runoff Volume ($P1 = 1.19$ in.) =	0.218	acre-feet
5-yr Runoff Volume ($P1 = 1.5$ in.) =	0.312	acre-feet
10-yr Runoff Volume ($P1 = 1.75$ in.) =	0.395	acre-feet
25-yr Runoff Volume ($P1 = 2$ in.) =	0.508	acre-feet
50-yr Runoff Volume ($P1 = 2.25$ in.) =	0.598	acre-feet
100-yr Runoff Volume ($P1 = 2.52$ in.) =	0.714	acre-feet
500-yr Runoff Volume ($P1 = 3.14$ in.) =	0.947	acre-feet
Approximate 2-yr Detention Volume =	0.189	acre-feet
Approximate 5-yr Detention Volume =	0.260	acre-feet
Approximate 10-yr Detention Volume =	0.346	acre-feet
Approximate 25-yr Detention Volume =	0.379	acre-feet
Approximate 50-yr Detention Volume =	0.396	acre-feet
Approximate 100-yr Detention Volume =	0.443	acre-feet

Zone 1 Volume (WQV_1)	=	0.082	acre-feet
Zone 2 Volume ($EVRV$, Zone 1 -)	=	0.170	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2)	=	0.192	acre-feet
Total Detention Basin Volume	=	0.443	acre-feet
Initial Surcharge Volume (ISV)	=	user	ft ³
Initial Surcharge Depth (ISD)	=	user	ft
Total Available Detention Depth (H_{Total})	=	user	ft
Depth of Trickle Channel (H_{TC})	=	user	ft
Slope of Trickle Channel (ST_{TC})	=	user	ft/ft
Slopes of Main Basin Sides (S_{Main})	=	user	H/V
Basin Length-to-Width Ratio ($R_{L/W}$)	=	user	
Initial Surcharge Area (ASV)	=	user	ft ²
Surcharge Volume Length (LSV)	=	user	ft
Surcharge Volume Width (WSV)	=	user	ft
Depth of Basin Floor (H_{Floor})	=	user	ft
Length of Basin Floor (L_{Floor})	=	user	ft
Width of Basin Floor (W_{Floor})	=	user	ft
Area of Basin Floor (A_{Floor})	=	user	ft ²
Volume of Basin Floor (V_{Floor})	=	user	ft ³
Depth of Main Basin (H_{Main})	=	user	ft
Length of Main Basin (L_{Main})	=	user	ft
Width of Main Basin (W_{Main})	=	user	ft
Area of Main Basin (A_{Main})	=	user	ft ²
Volume of Main Basin (V_{Main})	=	user	ft ³
Calculated Total Basin Volume	=	user	acre-feet

[illegible]

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.07 (June 2025)

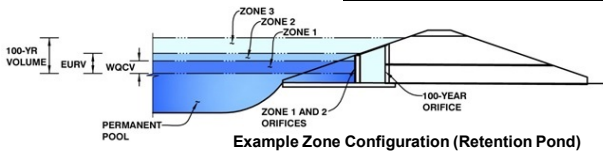


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)

Project: ROLLING MEADOWS SUBSTATION

Basin ID: EDB-1



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.60	0.082	Orifice Plate
Zone 2 (EURV)	2.20	0.170	Orifice Plate
Zone 3 (100-year)	2.67	0.192	Weir&Pipe (Restrict)
Total (all zones)		0.443	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration SCM)

Underdrain Orifice Invert Depth = ft (distance below the filtration media surface)
Underdrain Orifice Diameter = inches

Calculated Parameters for Underdrain
Underdrain Orifice Area = ft²
Underdrain Orifice Centroid = feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation SCM)

Centroid of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = inches
Orifice Plate: Orifice Area per Row = sq. inches

Calculated Parameters for Plate
WQ Orifice Area per Row = ft²
Elliptical Half-Width = feet
Elliptical Slot Centroid = feet
Elliptical Slot Area = ft²

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.75	1.25	1.50	1.75			
Orifice Area (sq. inches)	0.31	0.31	0.79	0.79	0.79			

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

Invert of Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter = inches

Calculated Parameters for Vertical Orifice
Vertical Orifice Area = ft²
Vertical Orifice Centroid = feet

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

Overflow Weir Front Edge Height, H_o = ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = feet
Overflow Weir Grate Slope = H:V
Horiz. Length of Weir Sides = feet
Overflow Grate Type =
Debris Clogging % = %

Calculated Parameters for Overflow Weir
Height of Grate Upper Edge, H_u = feet
Overflow Weir Slope Length = feet
Grate Open Area / 100-yr Orifice Area =
Overflow Grate Open Area w/o Debris = ft²
Overflow Grate Open Area w/ Debris = ft²

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Depth to Invert of Outlet Pipe = ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter = inches
Restrictor Plate Height Above Pipe Invert = inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate
Outlet Orifice Area = ft²
Outlet Orifice Centroid = feet
Half-Central Angle of Restrictor Plate on Pipe = radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage = ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length = feet
Spillway End Slopes = H:V
Freeboard above Max Water Surface = feet

Calculated Parameters for Spillway
Spillway Design Flow Depth = feet
Stage at Top of Freeboard = feet
Basin Area at Top of Freeboard = acres
Basin Volume at Top of Freeboard = acre-ft

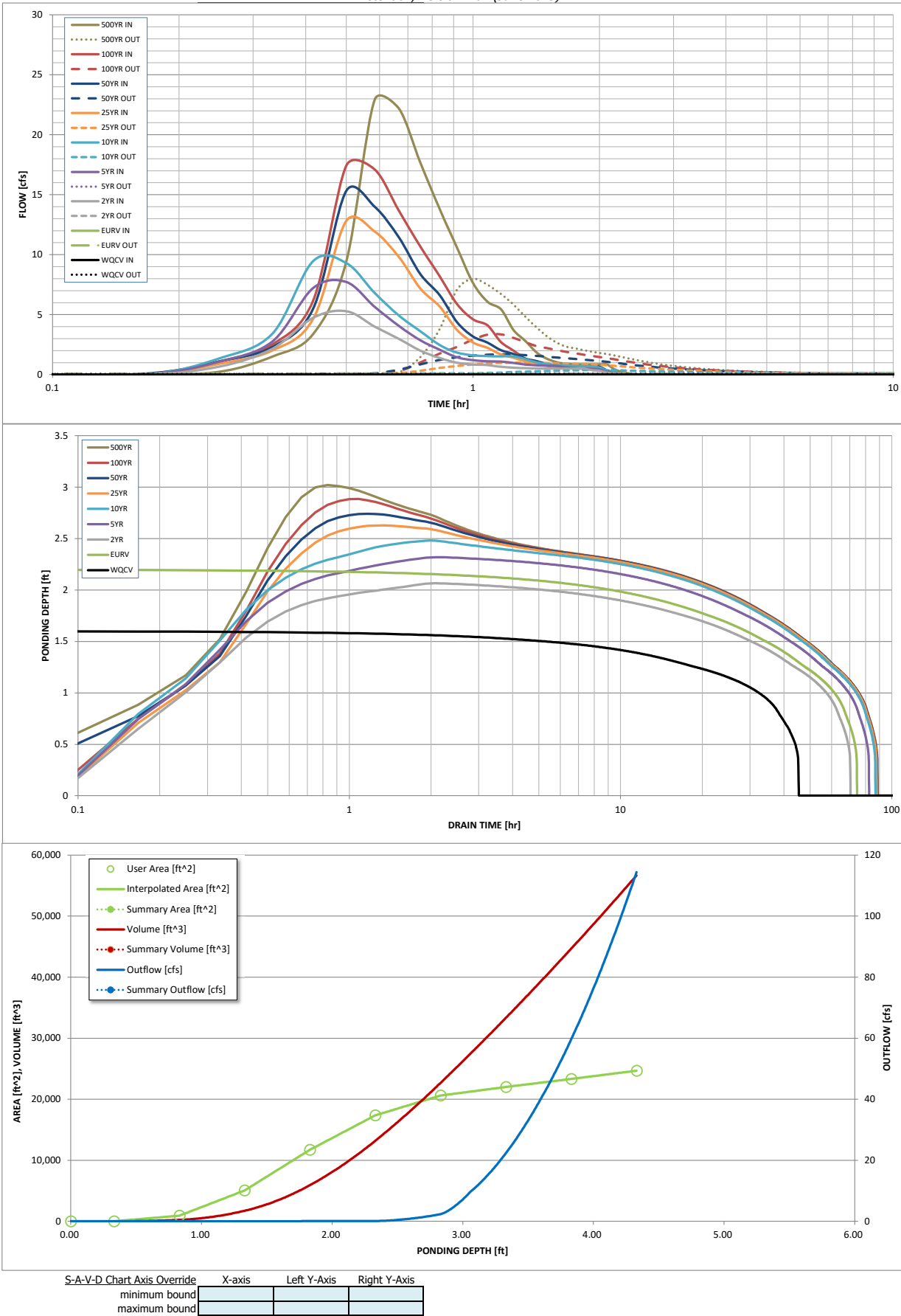
Routed Hydrograph Results

The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.082	0.252	0.218	0.312	0.395	0.508	0.598	0.714	0.947
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.218	0.312	0.395	0.508	0.598	0.714	0.947
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.1	2.8	4.1	6.6	8.3	10.4	14.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.23	0.59	0.86	1.37	1.72	2.17	3.00
Peak Inflow Q (cfs) =	N/A	N/A	5.3	7.7	9.5	12.8	15.3	17.4	22.9
Peak Outflow Q (cfs) =	0.0	0.1	0.1	0.1	0.4	1.0	1.7	3.4	8.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.0	0.1	0.2	0.2	0.3	0.6
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.1	0.2	0.4	0.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	41	65	62	71	74	72	71	69	64
Time to Drain 99% of Inflow Volume (hours) =	44	70	67	78	81	81	80	79	78
Maximum Ponding Depth (ft) =	1.60	2.20	2.06	2.32	2.48	2.63	2.74	2.88	3.02
Area at Maximum Ponding Depth (acres) =	0.20	0.36	0.33	0.39	0.42	0.44	0.46	0.48	0.48
Maximum Volume Stored (acre-ft) =	0.082	0.253	0.205	0.295	0.360	0.425	0.479	0.544	0.607

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)



DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0	0.00	0.00	0.00	0.00	0.00	0.08	0.01	0.24
	0:15:00	0	0.00	0.67	1.10	1.36	0.91	1.11	1.11	1.51
	0:20:00	0	0.00	2.16	2.76	3.42	2.01	2.31	2.52	3.37
	0:25:00	0	0.00	4.73	7.21	9.46	4.63	5.48	6.15	9.43
	0:30:00	0	0.00	5.29	7.71	9.30	12.82	15.32	17.42	22.90
	0:35:00	0	0.00	4.01	5.66	6.82	11.94	14.01	17.11	22.18
	0:40:00	0	0.00	2.99	4.06	4.93	9.81	11.44	13.67	17.66
	0:45:00	0	0.00	2.00	2.85	3.62	7.17	8.38	10.67	13.79
	0:50:00	0	0.00	1.38	2.07	2.47	5.68	6.63	8.20	10.59
	0:55:00	0	0.00	1.00	1.45	1.84	3.73	4.38	5.89	7.65
	1:00:00	0	0.00	0.84	1.20	1.61	2.68	3.18	4.62	6.08
	1:05:00	0	0.00	0.79	1.12	1.54	2.22	2.67	4.10	5.44
	1:10:00	0	0.00	0.65	1.09	1.52	1.68	2.03	2.71	3.70
	1:15:00	0	0.00	0.58	0.97	1.52	1.41	1.71	2.00	2.81
	1:20:00	0	0.00	0.53	0.84	1.30	1.10	1.33	1.32	1.85
	1:25:00	0	0.00	0.51	0.78	1.03	0.95	1.13	0.96	1.33
	1:30:00	0	0.00	0.50	0.74	0.88	0.76	0.89	0.75	1.03
	1:35:00	0	0.00	0.49	0.72	0.79	0.66	0.77	0.66	0.91
	1:40:00	0	0.00	0.49	0.60	0.74	0.61	0.70	0.63	0.86
	1:45:00	0	0.00	0.49	0.53	0.71	0.59	0.67	0.62	0.84
	1:50:00	0	0.00	0.49	0.50	0.71	0.58	0.66	0.62	0.84
	1:55:00	0	0.00	0.38	0.48	0.67	0.58	0.66	0.62	0.84
	2:00:00	0	0.00	0.32	0.44	0.58	0.58	0.66	0.62	0.84
	2:05:00	0	0.00	0.17	0.24	0.31	0.31	0.35	0.34	0.45
	2:10:00	0	0.00	0.09	0.13	0.16	0.17	0.19	0.18	0.24
	2:15:00	0	0.00	0.04	0.06	0.08	0.08	0.09	0.09	0.12
	2:20:00	0	0.00	0.02	0.03	0.03	0.04	0.04	0.04	0.05
	2:25:00	0	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	2:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

[illegible]

Detention Pond				Outlet Pipe Inv. Elev	Orifices				
Elevation	Depth	Area (FT^2)	Volume (FT^3)		Bottom Orifice CL	# Req'd	Sq. Inches Each	Dia. (In.)	Spacing (in)
5808.023	0	10	0	5807.77	5808.02	5	0.196	5/8	Varies
5808.853	0.83	910	382		5808.77		0.196	5/8	
5809.353	1.33	4853	1823		5809.27		0.785	1	
5809.853	1.83	10130	5568		5809.52		0.785	1	
5810.353	2.33	13958	11590		5809.77		0.785	1	
5810.853	2.83	17074	19348						
5811.353	3.33	19848	28579						
5811.853	3.83	22242	39101						
5812.353	4.33	24447	50774						

Basin Area (AC)		4.81	$WQCV=a(0.91i^3-1.19i^2+0.78i)$					
Imperviousness		49%						
WQCV (Basin-IN)	WQCV (FT^3)	WQCV (AC-FT)	WQCV Depth	WQCV WSEL	5 Year Depth	5 Year WSEL	100 Year Depth	100 Year WSEL
0.20	3553.90	0.082	1.63	5809.65	2.32	5810.34	2.88	5810.90

Storm Duration	5 Year Intensity	10 Year Intensity	100 Year Intensity	5 Year 1 Hour Depth	10 Year 1 Hour Depth	100 Year 1 Hour Depth
5	5.17	6.03	8.68	1.5	1.75	2.52
10	4.13	4.82	6.93			
15	3.52	4.11	5.91			
30	2.48	2.89	4.16			
60	1.44	1.68	2.42			

Rolling Meadows Spillway Calculations

3-14-2024

Calculated by: Thayne Clement

Broad-Crested Weir Sizing		
Equation 5.10.2.3 WCECC: $Q=C*L*H^{(1.5)}$		
Solve For L: $L=Q/(C*H^{(1.5)})$		
Variable	Input	Units
Discharge Rate (Q)	3.66	cfs
Discharge Coefficient (C)	2.6	
Weir Height (H)	1.25	ft
Required Freeboard	1	ft
Width of Weir (L) - Required	11.26	ft
Width of Weir (L) - Provided	12	ft
100 Year Flow Depth	0.24	ft

Swale Discharge Flow Spread

	5 Year Storm		100 Year Storm		Required D50 @ Specific Gravity 2.55
	Flow (cfs)	Velocity (ft/s)	Flow (cfs)	Velocity (ft/s)	
Pond Outlet	0.09	1.08	3.36	1.90	0.6

100 YR FLOW (CFS)	3.36
100 YR VELOCITY (FPS)	0.4
DIAMETER (FT)	1.8
TAILWATER DEPTH (FT)	0.49
FROUDE PARAMETER	0.77
EXPANSION FACTOR	4.50
EXPANSION ANGLE	0.11
 RIPRAP D50 (IN)	 1.829917

Emergency Spillway RipRap Sizing		
Assume RipRap Specific Gravity 2.55		
Variable	Input	Units
100 year Discharge Rate (Q)	3.36	cfs
Discharge Velocity (V)	#REF!	ft/s
Required D50 Value	#REF!	in
Provided D50 Value	6.00	in
Spillway Side Slope (X:1)	4	ft
100yr Flow Depth	0.49	ft
Spillway XS Area	#REF!	sqft

Det. Struct. Outlet RipRap Sizing		
Izbash Formula: $D50 = (V^2) / (2 * 32.2 * (0.86^2) * (2.55 - 1)) * 12$		
Assume RipRap Specific Gravity 2.55		
Variable	Input	Units
100 year Discharge Rate (Q)	0.08	cfs
Discharge Velocity (V)	0.05	ft/s
Required D50 Value	0.00	in
Provided D50 Value	6.00	in
Spillway Geometry		
Pipe Diameter	18	in
Pipe XS Area	1.77	sqft

Appendix B

Rational Method Modeling Results



Project Description

File Name 24028-5Y.SPF

Project Options

Flow Units CFS
Elevation Type Elevation
Hydrology Method Rational
Time of Concentration (TOC) Method User-Defined
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 0:00:00
Start Reporting On 00:00:00 0:00:00
Antecedent Dry Days 0 days
Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
Reporting Time Step 0 00:05:00 days hh:mm:ss
Routing Time Step 30 seconds

Number of Elements

	Qty
Rain Gages	0
Subbasins.....	8
Nodes.....	16
<i>Junctions</i>	13
<i>Outfalls</i>	2
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	1
Links.....	20
<i>Channels</i>	0
<i>Pipes</i>	13
<i>Pumps</i>	0
<i>Orifices</i>	5
<i>Weirs</i>	2
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period..... 5 year(s)

Subbasin Summary

SN	Subbasin ID	Area	Weighted Runoff Coefficient	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)		(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	Ex	4.76	0.4200	0.69	0.29	1.38	8.26	0 00:10:00
2	P1	0.63	0.1700	0.69	0.12	0.07	0.44	0 00:10:00
3	P2	0.97	0.0900	0.69	0.06	0.06	0.36	0 00:10:00
4	P3	0.72	0.1600	0.69	0.11	0.08	0.48	0 00:10:00
5	P4	0.73	0.9000	0.69	0.62	0.45	2.71	0 00:10:00
6	Y1	0.43	0.5900	0.69	0.41	0.17	1.05	0 00:10:00
7	Y2	0.61	0.5900	0.69	0.41	0.25	1.49	0 00:10:00
8	Y3	0.72	0.5900	0.69	0.41	0.29	1.75	0 00:10:00

Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	1-Jun	Junction	5812.59	5815.82	0.00	6.00	0.00	1.45	5813.06	0.00	2.76	0 00:00	0.00	0.00
2	2-Jun	Junction	5811.19	5814.56	0.00	6.00	0.00	2.77	5811.79	0.00	2.77	0 00:00	0.00	0.00
3	3-Jun	Junction	5810.49	5810.38	0.00	6.00	0.00	2.76	5811.09	0.00	0.65	0 00:00	0.00	0.00
4	5-Jun	Junction	5811.49	5814.60	5811.49	6.00	0.00	1.73	5812.03	0.00	2.57	0 00:00	0.00	0.00
5	6-Jun	Junction	5813.17	5813.95	0.00	6.00	0.00	0.44	5813.42	0.00	0.75	0 00:00	0.00	0.00
6	7-Jun	Junction	5811.35	5812.35	0.00	6.00	0.00	0.36	5811.35	0.00	1.00	0 00:00	0.00	0.00
7	8-Jun	Junction	5808.00	5809.00	0.00	6.00	0.00	0.48	5808.00	0.00	1.00	0 00:00	0.00	0.00
8	9-Jun	Junction	5804.42	5809.00	0.00	6.00	0.00	0.05	5807.87	0.00	1.40	0 00:00	0.00	0.00
9	10-Jun	Junction	5804.00	5806.00	0.00	6.00	0.00	0.05	5807.64	0.00	1.40	0 00:00	0.00	0.00
10	11-Jun	Junction	5812.00	5818.00	5812.00	0.00	0.00	1.44	5812.51	0.00	5.49	0 00:00	0.00	0.00
11	12-Jun	Junction	5812.97	5815.57	0.00	0.00	0.00	1.75	5813.51	0.00	2.06	0 00:00	0.00	0.00
12	13-Jun	Junction	5813.82	5815.99	5813.82	0.00	0.00	1.05	5814.27	0.00	1.72	0 00:00	0.00	0.00
13	SD-N-Out	Junction	5809.62	5809.62	0.00	6.00	0.00	1.72	5810.11	0.00	0.60	0 00:00	0.00	0.00
14	Out-01	Outfall	5807.54					0.05	5807.54					
15	Out-02	Outfall	0.00					8.26	0.00					
16	EDB	Storage Node	5808.35	5812.35	0.00		0.00	7.92	5809.76				0.00	0.00

Rolling Meadows Substation
5-Year Storm Event

Link Summary

SN	Element	From	To (Outlet)	Length	Inlet	Outlet	Average	Diameter or	Manning's	Peak	Design Flow	Peak Flow/	Peak Flow	Peak Flow	Peak Flow	Total Time Reported	
ID	Type	(Inlet)	Node		Invert	Invert	Slope	Height	Roughness	Flow	Capacity	Design Flow	Velocity	Depth	Depth/	Surcharged Condition	
		Node			Elevation	Elevation						Ratio			Total Depth		
				(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)	Ratio	(min)	
1	01-12-NP	Pipe	6-Jun	1-Jun	50.00	5813.17	5812.59	1.1600	12.000	0.0150	0.44	3.33	0.13	3.48	0.24	0.25	0.00 Calculated
2	02-12-P	Pipe	13-Jun	1-Jun	180.00	5813.49	5812.59	0.5000	12.000	0.0150	1.02	2.55	0.40	4.90	0.44	0.44	0.00 Calculated
3	03-15-NP	Pipe	1-Jun	11-Jun	80.00	5812.34	5811.94	0.5000	15.000	0.0150	1.44	4.81	0.30	3.44	0.47	0.38	0.00 Calculated
4	04-15-P	Pipe	11-Jun	2-Jun	150.00	5811.94	5811.19	0.5000	15.000	0.0150	1.43	4.11	0.35	3.09	0.51	0.41	0.00 Calculated
5	05-15-NP	Pipe	2-Jun	3-Jun	60.61	5811.19	5810.38	1.3400	15.000	0.0150	2.76	6.02	0.46	4.80	0.60	0.48	0.00 Calculated
6	06-12-P	Pipe	12-Jun	5-Jun	150.00	5812.97	5811.49	0.9900	12.000	0.0150	1.73	3.07	0.56	5.86	0.54	0.54	0.00 Calculated
7	07-12-NP	Pipe	5-Jun	SD-N-Out	64.51	5811.49	5809.71	2.7600	12.000	0.0150	1.72	5.13	0.34	5.89	0.40	0.40	0.00 Calculated
8	08-18-NP	Pipe	9-Jun	10-Jun	45.77	5807.77	5807.54	0.5000	18.000	0.0150	0.05	6.45	0.01	1.10	0.10	0.06	0.00 Calculated
9	Link-04	Pipe	7-Jun	EDB	130.91	0.00	0.00	0.0000	0.000	0.0150	0.36	0.00	0.01	0.00	0.10	0.06	0.00 Calculated
10	Link-05	Pipe	SD-N-Out	EDB	112.84	0.00	0.00	0.0000	0.000	0.0150	1.72	0.00	0.01	0.00	0.10	0.06	0.00 Calculated
11	Link-06	Pipe	3-Jun	EDB	93.80	0.00	0.00	0.0000	0.000	0.0150	2.76	0.00	0.01	0.00	0.10	0.06	0.00 Calculated
12	Link-07	Pipe	8-Jun	EDB	144.91	0.00	0.00	0.0000	0.000	0.0150	0.48	0.00	0.01	0.00	0.10	0.06	0.00 Calculated
13	Link-10	Pipe	10-Jun	Out-01	53.10	5804.00	5803.73	0.5100	0.000	0.0150	0.05	0.00	0.01	0.00	0.10	0.06	0.00 Calculated
14	Orifice-01	Orifice	EDB	9-Jun		5808.35	5804.42		0.625		0.01						
15	Orifice-02	Orifice	EDB	9-Jun		5808.35	5804.42		0.625		0.01						
16	Orifice-03	Orifice	EDB	9-Jun		5808.35	5804.42		1.000		0.02						
17	Orifice-04	Orifice	EDB	9-Jun		5808.35	5804.42		1.000		0.01						
18	Orifice-05	Orifice	EDB	9-Jun		5808.35	5804.42		1.000		0.00						
19	Spillway	Weir	EDB	10-Jun		5808.35	5804.00				0.00						
20	Weir-01	Weir	EDB	9-Jun		5808.35	5804.42				0.00						

Subbasin Hydrology

Subbasin : Ex

Input Data

Area (ac) 4.76
Weighted Runoff Coefficient 0.42

Runoff Coefficient

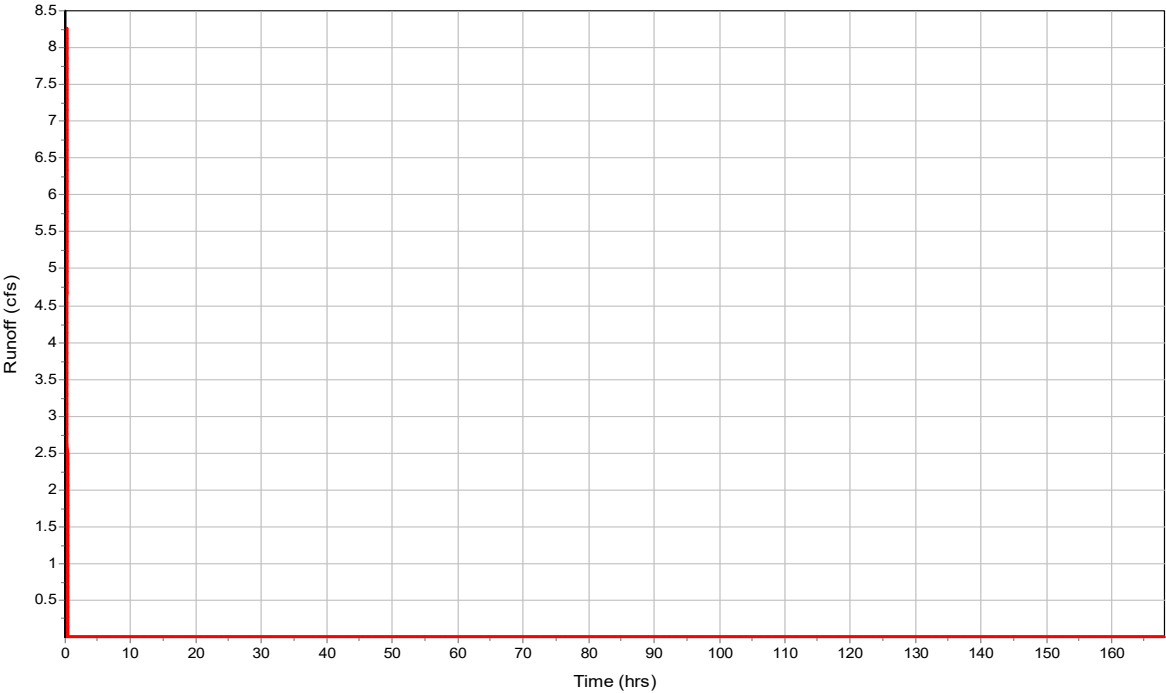
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	4.81	-	0.42
Composite Area & Weighted Runoff Coeff.	4.81		0.42

Subbasin Runoff Results

Total Rainfall (in) 0.69
Total Runoff (in) 0.29
Peak Runoff (cfs) 8.26
Rainfall Intensity 4.13
Weighted Runoff Coefficient 0.42
Time of Concentration (days hh:mm:ss) 0 00:10:00

Subbasin : Ex

Runoff Hydrograph



Subbasin : P1

Input Data

Area (ac) 0.63
Weighted Runoff Coefficient 0.17

Runoff Coefficient

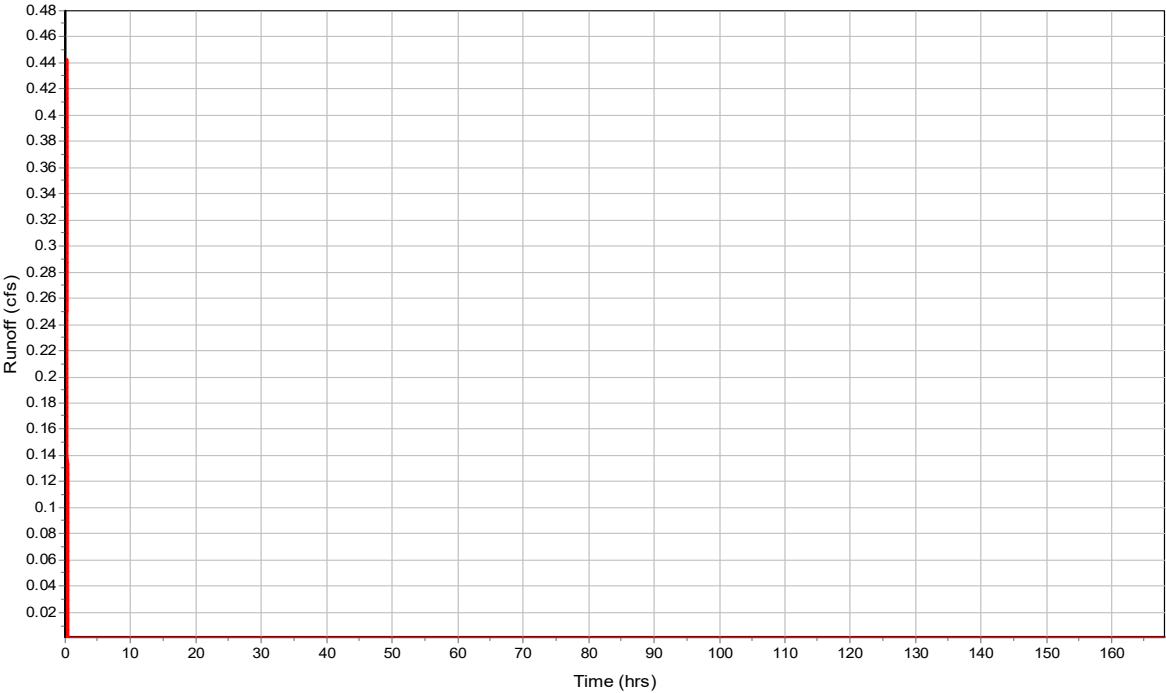
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.63	-	0.17
Composite Area & Weighted Runoff Coeff.	0.63		0.17

Subbasin Runoff Results

Total Rainfall (in) 0.69
Total Runoff (in) 0.12
Peak Runoff (cfs) 0.44
Rainfall Intensity 4.13
Weighted Runoff Coefficient 0.17
Time of Concentration (days hh:mm:ss) 0 00:10:00

Subbasin : P1

Runoff Hydrograph



Subbasin : P2

Input Data

Area (ac) 0.97
Weighted Runoff Coefficient 0.09

Runoff Coefficient

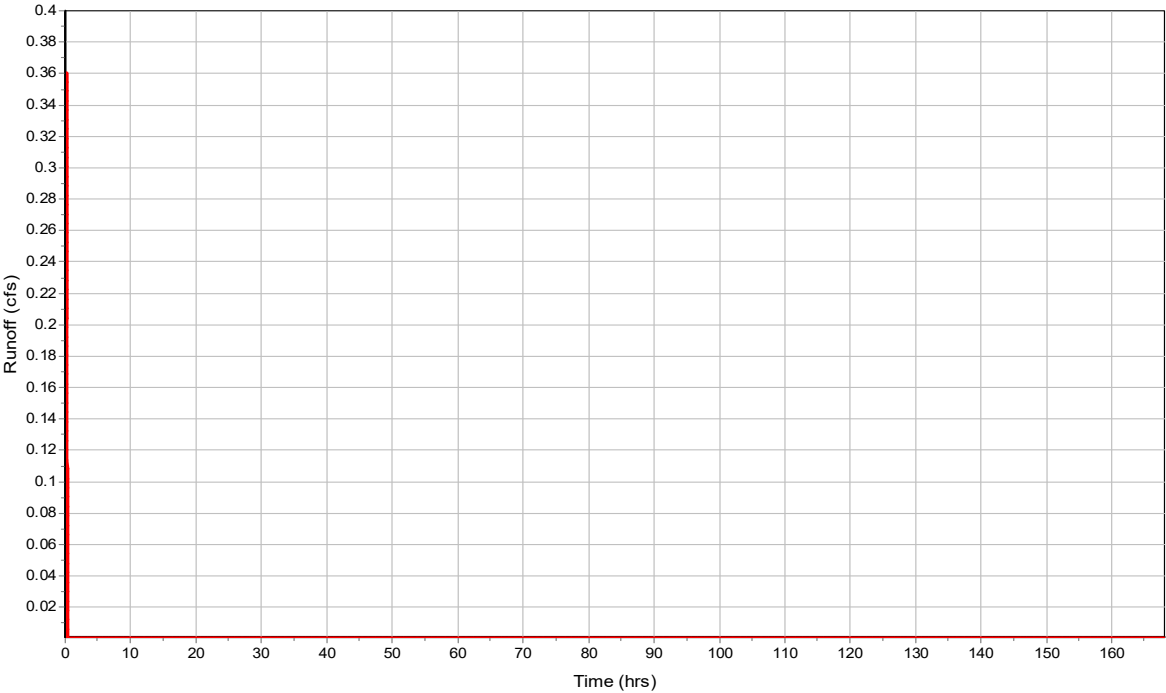
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-	0.97	-	0.09
Composite Area & Weighted Runoff Coeff.	0.97		0.09

Subbasin Runoff Results

Total Rainfall (in) 0.69
Total Runoff (in) 0.06
Peak Runoff (cfs) 0.36
Rainfall Intensity 4.13
Weighted Runoff Coefficient 0.09
Time of Concentration (days hh:mm:ss) 0 00:10:00

Subbasin : P2

Runoff Hydrograph



Subbasin : P3

Input Data

Area (ac) 0.72
Weighted Runoff Coefficient 0.16

Runoff Coefficient

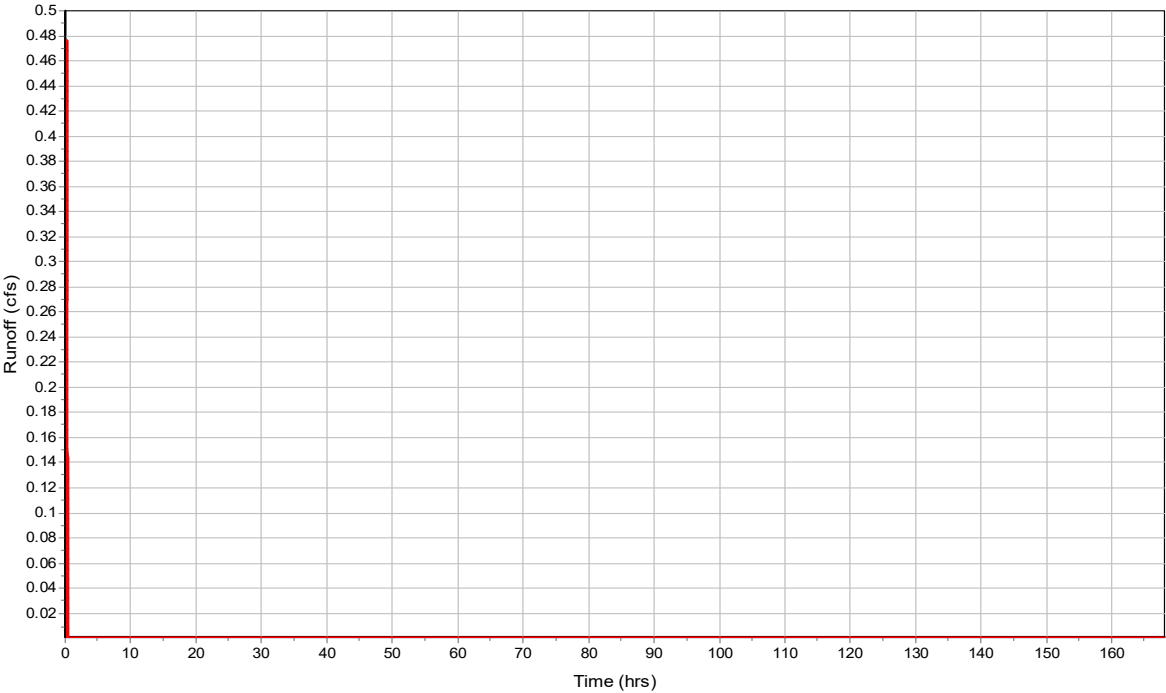
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.72	-	0.16
Composite Area & Weighted Runoff Coeff.	0.72		0.16

Subbasin Runoff Results

Total Rainfall (in) 0.69
Total Runoff (in) 0.11
Peak Runoff (cfs) 0.48
Rainfall Intensity 4.13
Weighted Runoff Coefficient 0.16
Time of Concentration (days hh:mm:ss) 0 00:10:00

Subbasin : P3

Runoff Hydrograph



Subbasin : P4

Input Data

Area (ac) 0.73
Weighted Runoff Coefficient 0.9

Runoff Coefficient

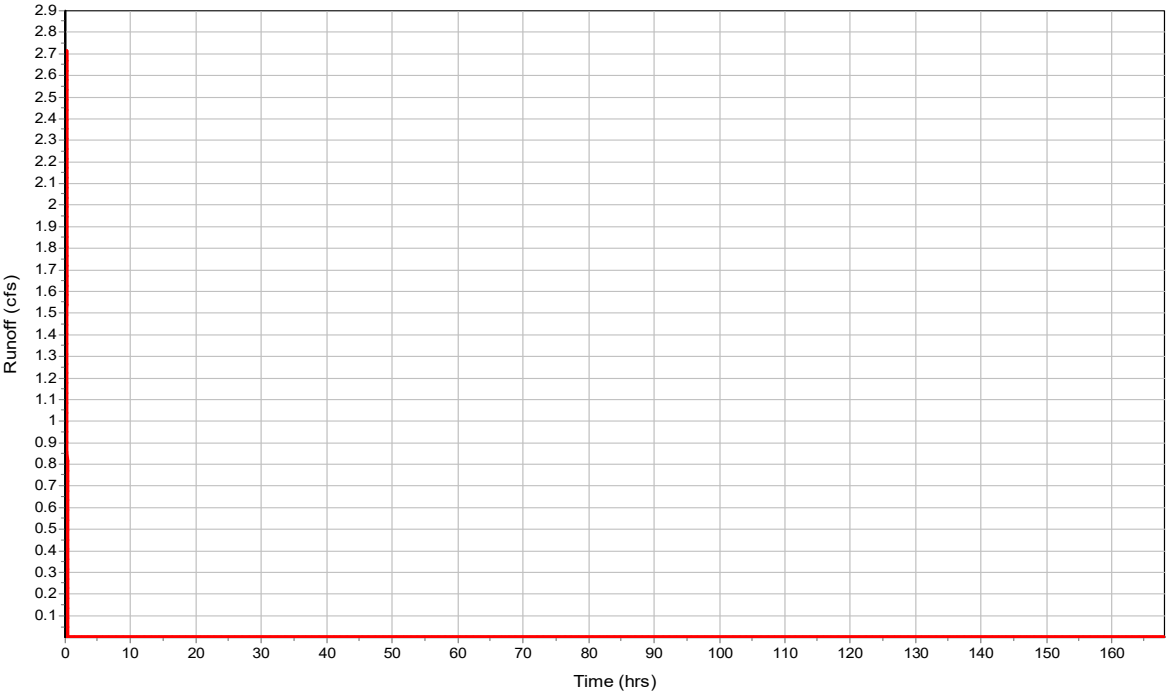
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.73	-	0.9
Composite Area & Weighted Runoff Coeff.	0.73		0.9

Subbasin Runoff Results

Total Rainfall (in) 0.69
Total Runoff (in) 0.62
Peak Runoff (cfs) 2.71
Rainfall Intensity 4.13
Weighted Runoff Coefficient 0.9
Time of Concentration (days hh:mm:ss) 0 00:10:00

Subbasin : P4

Runoff Hydrograph



Subbasin : Y1

Input Data

Area (ac) 0.43
Weighted Runoff Coefficient 0.59

Runoff Coefficient

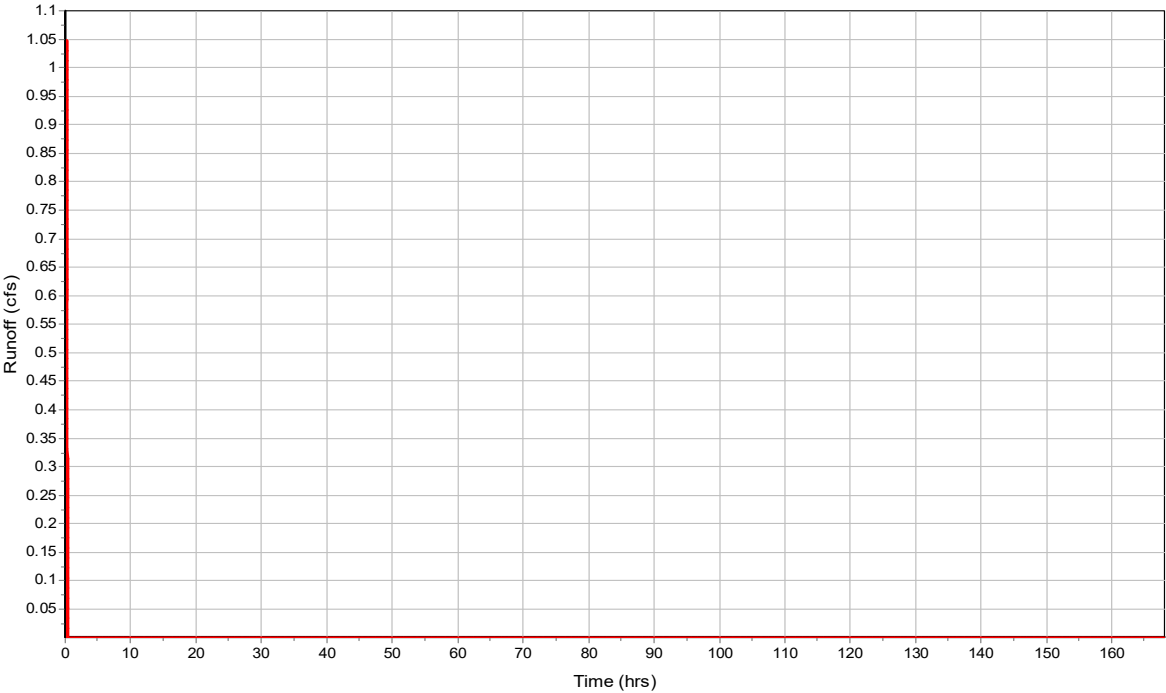
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.43	-	0.59
Composite Area & Weighted Runoff Coeff.	0.43		0.59

Subbasin Runoff Results

Total Rainfall (in) 0.69
Total Runoff (in) 0.41
Peak Runoff (cfs) 1.05
Rainfall Intensity 4.13
Weighted Runoff Coefficient 0.59
Time of Concentration (days hh:mm:ss) 0 00:10:00

Subbasin : Y1

Runoff Hydrograph



Subbasin : Y2

Input Data

Area (ac) 0.61
Weighted Runoff Coefficient 0.59

Runoff Coefficient

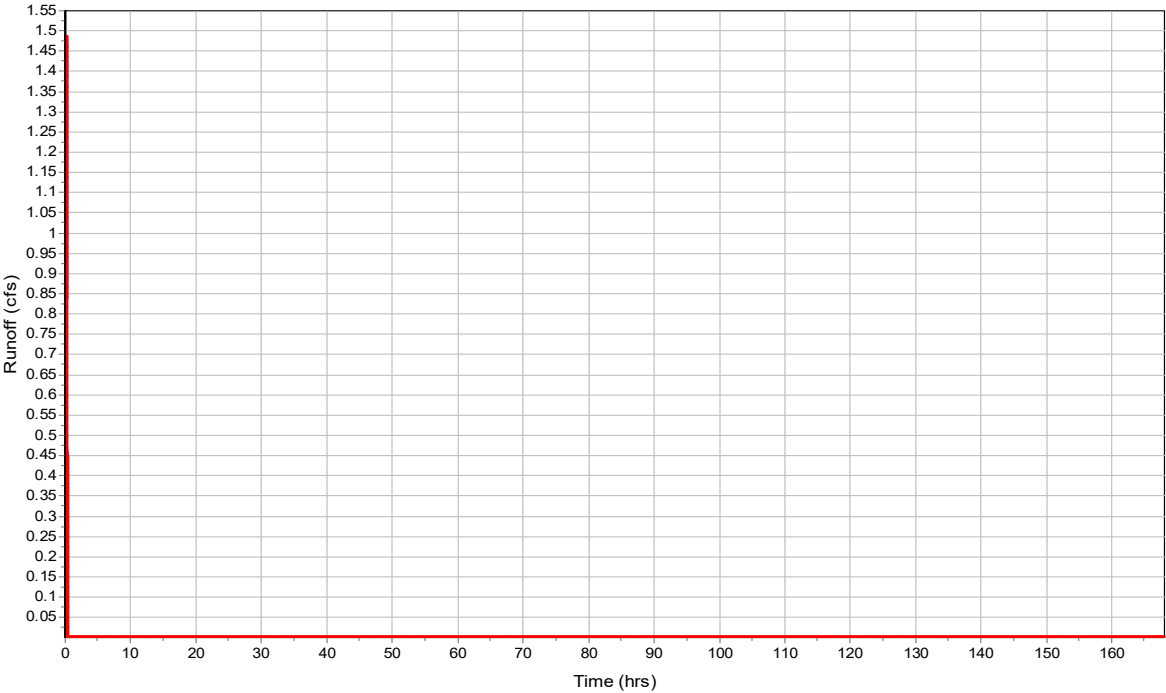
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.61	-	0.59
Composite Area & Weighted Runoff Coeff.	0.61		0.59

Subbasin Runoff Results

Total Rainfall (in) 0.69
Total Runoff (in) 0.41
Peak Runoff (cfs) 1.49
Rainfall Intensity 4.13
Weighted Runoff Coefficient 0.59
Time of Concentration (days hh:mm:ss) 0 00:10:00

Subbasin : Y2

Runoff Hydrograph



Subbasin : Y3

Input Data

Area (ac) 0.72
Weighted Runoff Coefficient 0.59

Runoff Coefficient

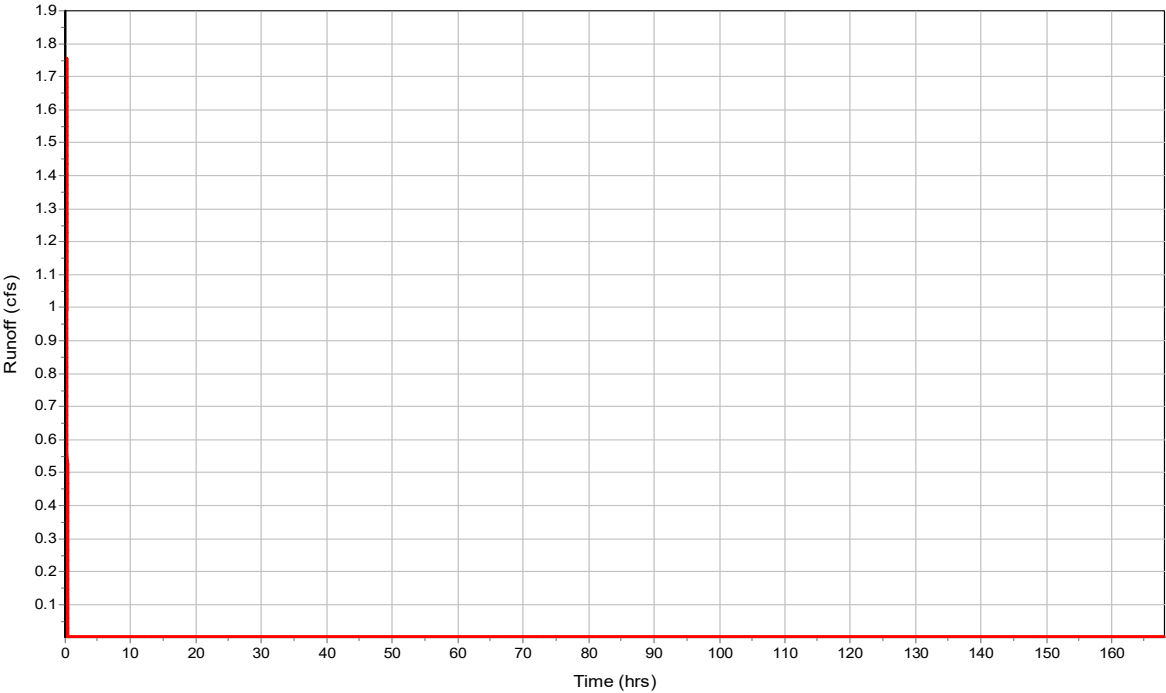
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	5	-	0.59
Composite Area & Weighted Runoff Coeff.	5		0.59

Subbasin Runoff Results

Total Rainfall (in) 0.69
Total Runoff (in) 0.41
Peak Runoff (cfs) 1.75
Rainfall Intensity 4.13
Weighted Runoff Coefficient 0.59
Time of Concentration (days hh:mm:ss) 0 00:10:00

Subbasin : Y3

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 (ft²)	Minimum Pipe Cover (in)
1	1-Jun	5812.59	5815.82	3.23	0.00	-5812.59	6.00	-5809.82	0.00	0.00
2	2-Jun	5811.19	5814.56	3.37	0.00	-5811.19	6.00	-5808.56	0.00	0.00
3	3-Jun	5810.49	5810.38	-0.11	0.00	-5810.49	6.00	-5804.38	0.00	0.00
4	5-Jun	5811.49	5814.60	3.11	5811.49	0.00	6.00	-5808.60	0.00	0.00
5	6-Jun	5813.17	5813.95	0.78	0.00	-5813.17	6.00	-5807.95	0.00	0.00
6	7-Jun	5811.35	5812.35	1.00	0.00	-5811.35	6.00	-5806.35	0.00	0.00
7	8-Jun	5808.00	5809.00	1.00	0.00	-5808.00	6.00	-5803.00	0.00	0.00
8	9-Jun	5804.42	5809.00	4.58	0.00	-5804.42	6.00	-5803.00	0.00	0.00
9	10-Jun	5804.00	5806.00	2.00	0.00	-5804.00	6.00	-5800.00	0.00	0.00
10	11-Jun	5812.00	5818.00	6.00	5812.00	0.00	0.00	-5818.00	0.00	0.00
11	12-Jun	5812.97	5815.57	2.60	0.00	-5812.97	0.00	-5815.57	0.00	0.00
12	13-Jun	5813.82	5815.99	2.17	5813.82	0.00	0.00	-5815.99	0.00	0.00
13	SD-N-Out	5809.62	5809.62	0.00	0.00	-5809.62	6.00	-5803.62	0.00	0.00

Junction Results

SN	Element	Peak	Peak	Max HGL	Max HGL	Max	Min	Average HGL	Average HGL	Time of	Time of	Total	Total Time
ID		Inflow	Lateral	Elevation	Depth	Surcharge	Freeboard	Elevation	Depth	Max HGL	Peak	Flooded	Flooded
			Inflow	Attained	Attained	Depth	Attained	Attained	Attained	Occurrence	Flooding	Volume	
		(cfs)	(cfs)	(ft)	(ft)	Attained	(ft)	(ft)	(ft)	(days hh:mm)	Occurrence	(ac-in)	(min)
1	1-Jun	1.45	0.00	5813.06	0.47	0.00	2.76	5812.59	0.00	0 00:10	0 00:00	0.00	0.00
2	2-Jun	2.77	1.49	5811.79	0.60	0.00	2.77	5811.19	0.00	0 00:10	0 00:00	0.00	0.00
3	3-Jun	2.76	0.00	5811.09	0.60	0.00	0.65	5810.49	0.00	0 00:11	0 00:00	0.00	0.00
4	5-Jun	1.73	0.00	5812.03	0.54	0.00	2.57	5811.49	0.00	0 00:10	0 00:00	0.00	0.00
5	6-Jun	0.44	0.44	5813.42	0.25	0.00	0.75	5813.17	0.00	0 00:10	0 00:00	0.00	0.00
6	7-Jun	0.36	0.36	5811.35	0.00	0.00	1.00	5811.35	0.00	0 00:00	0 00:00	0.00	0.00
7	8-Jun	0.48	0.48	5808.00	0.00	0.00	1.00	5808.00	0.00	0 00:00	0 00:00	0.00	0.00
8	9-Jun	0.05	0.00	5807.87	3.45	0.00	1.40	5807.79	3.37	0 00:24	0 00:00	0.00	0.00
9	10-Jun	0.05	0.00	5807.64	3.64	0.00	1.40	5807.56	3.56	0 00:24	0 00:00	0.00	0.00
10	11-Jun	1.44	0.00	5812.51	0.51	0.00	5.49	5812.00	0.00	0 00:10	0 00:00	0.00	0.00
11	12-Jun	1.75	1.75	5813.51	0.54	0.00	2.06	5812.97	0.00	0 00:10	0 00:00	0.00	0.00
12	13-Jun	1.05	1.05	5814.27	0.45	0.00	1.72	5813.82	0.00	0 00:10	0 00:00	0.00	0.00
13	SD-N-Out	1.72	0.00	5810.11	0.49	0.00	0.60	5809.71	0.09	0 00:10	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Pipe 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	01-12-NP	50.00	5813.17	0.00	5812.59	0.00	0.58	1.1600	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
2	02-12-P	180.00	5813.49	-0.33	5812.59	0.00	0.90	0.5000	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
3	03-15-NP	80.00	5812.34	-0.25	5811.94	-0.06	0.40	0.5000	CIRCULAR	15.000	15.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
4	04-15-P	150.00	5811.94	-0.06	5811.19	0.00	0.75	0.5000	CIRCULAR	15.000	15.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
5	05-15-NP	60.61	5811.19	0.00	5810.38	-0.11	0.81	1.3400	CIRCULAR	15.000	15.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
6	06-12-P	150.00	5812.97	0.00	5811.49	0.00	1.48	0.9900	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
7	07-12-NP	64.51	5811.49	0.00	5809.71	0.09	1.78	2.7600	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
8	08-18-NP	45.77	5807.77	3.35	5807.54	3.54	0.23	0.5000	CIRCULAR	18.000	18.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
9	Link-04	130.91	0.00	-5811.35	0.00	-5808.35	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
10	Link-05	112.84	0.00	-5809.62	0.00	-5808.35	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
11	Link-06	93.80	0.00	-5810.49	0.00	-5808.35	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
12	Link-07	144.91	0.00	-5808.00	0.00	-5808.35	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
13	Link-10	53.10	5804.00	0.00	5803.73	-3.81	0.27	0.5100	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
		(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1	01-12-NP	0.44	0 00:10	3.33	0.13	3.48	0.24	0.24	0.25	0.00		Calculated
2	02-12-P	1.02	0 00:10	2.55	0.40	4.90	0.61	0.44	0.44	0.00		Calculated
3	03-15-NP	1.44	0 00:10	4.81	0.30	3.44	0.39	0.47	0.38	0.00		Calculated
4	04-15-P	1.43	0 00:11	4.11	0.35	3.09	0.81	0.51	0.41	0.00		Calculated
5	05-15-NP	2.76	0 00:11	6.02	0.46	4.80	0.21	0.60	0.48	0.00		Calculated
6	06-12-P	1.73	0 00:10	3.07	0.56	5.86	0.43	0.54	0.54	0.00		Calculated
7	07-12-NP	1.72	0 00:10	5.13	0.34	5.89	0.18	0.40	0.40	0.00		Calculated
8	08-18-NP	0.05	0 00:24	6.45	0.01	1.10	0.69	0.10	0.06	0.00		Calculated
9	Link-04	0.36	0 00:10	0.00	0.01	0.00		0.10	0.06	0.00		Calculated
10	Link-05	1.72	0 00:10	0.00	0.01	0.00		0.10	0.06	0.00		Calculated
11	Link-06	2.76	0 00:11	0.00	0.01	0.00		0.10	0.06	0.00		Calculated
12	Link-07	0.48	0 00:10	0.00	0.01	0.00		0.10	0.06	0.00		Calculated
13	Link-10	0.05	0 00:24	0.00	0.01	0.00		0.10	0.06	0.00		Calculated

Storage Nodes

Storage Node : EDB

Input Data

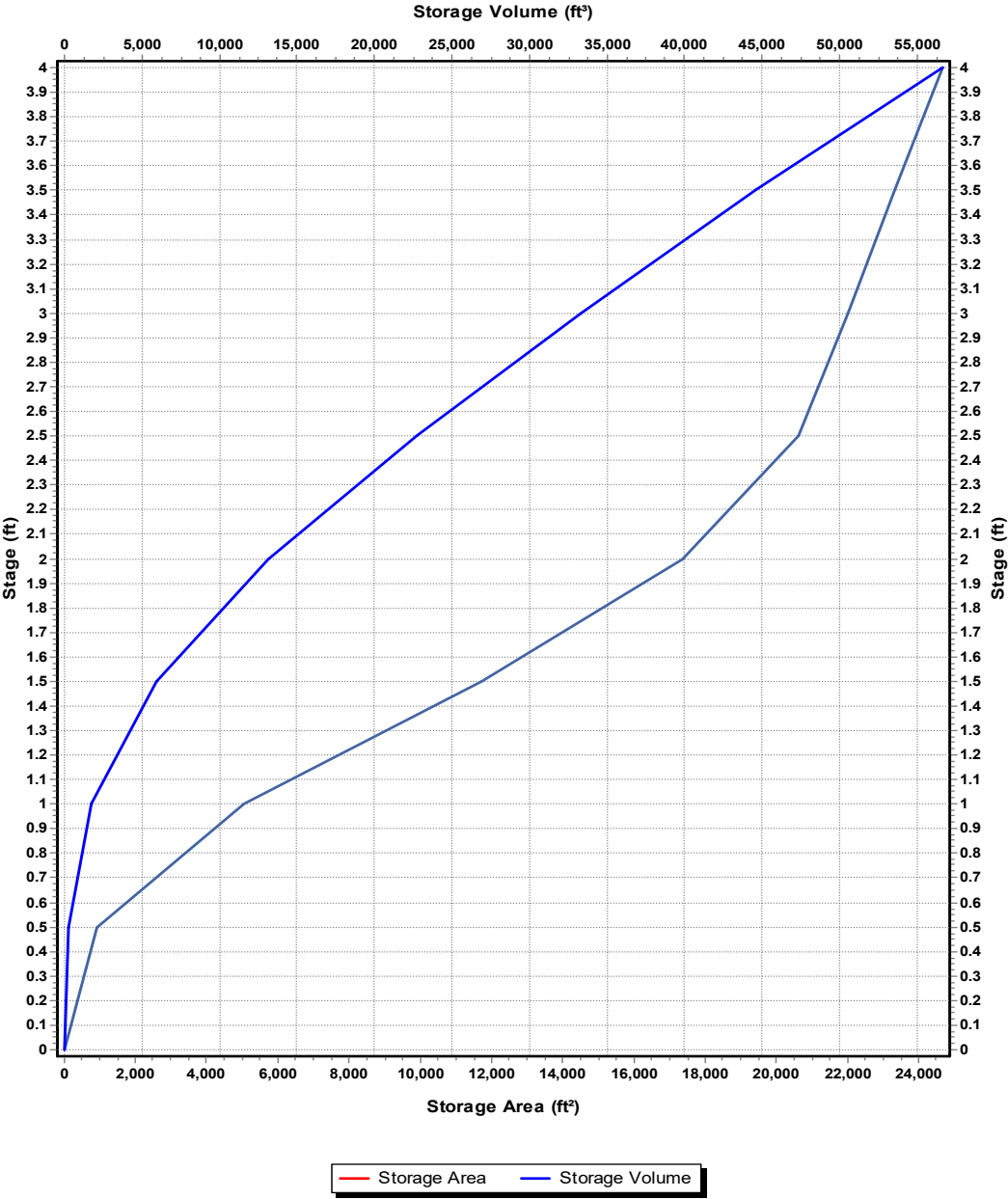
Invert Elevation (ft)	5808.35
Max (Rim) Elevation (ft)	5812.35
Max (Rim) Offset (ft)	4.00
Initial Water Elevation (ft)	0.00
Initial Water Depth (ft)	-5808.35
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : Storage-01

Stage	Storage Area	Storage Volume
(ft)	(ft²)	(ft³)
0	10	0
0.5	917	231.75
1	5052	1724
1.5	11717	5916.25
2	17359	13185.25
2.5	20610	22677.5
3	22010	33332.5
3.5	23327	44666.75
4	24671	56666.25

Storage Area Volume Curves



Storage Node : EDB (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Spillway	Trapezoidal	No	5811.10	2.75	50.00	1.25	3.33
2	Weir-01	Rectangular	No	5810.35	2.00	4.00	0.75	3.33

Outflow Orifices

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	Orifice-01	Side	CIRCULAR	No	0.63			5808.02	0.61
2	Orifice-02	Side	CIRCULAR	No	0.63			5808.77	0.61
3	Orifice-03	Side	CIRCULAR	No	1.00			5809.27	0.61
4	Orifice-04	Side	CIRCULAR	No	1.00			5809.52	0.61
5	Orifice-05	Side	CIRCULAR	No	1.00			5809.77	0.61

Output Summary Results

Peak Inflow (cfs)	7.92
Peak Lateral Inflow (cfs)	2.71
Peak Outflow (cfs)	0.05
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	5809.76
Max HGL Depth Attained (ft)	1.41
Average HGL Elevation Attained (ft)	5808.67
Average HGL Depth Attained (ft)	0.32
Time of Max HGL Occurrence (days hh:mm)	0 00:24
Total Exfiltration Volume (1000-ft³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Project Description

File Name 24028-100Y.SPF

Project Options

Flow Units CFS
Elevation Type Elevation
Hydrology Method Rational
Time of Concentration (TOC) Method User-Defined
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 0:00:00
Start Reporting On 00:00:00 0:00:00
Antecedent Dry Days 0 days
Runoff (Dry Weather) Time Step 0 01:00:00 days hh:mm:ss
Runoff (Wet Weather) Time Step 0 00:05:00 days hh:mm:ss
Reporting Time Step 0 00:05:00 days hh:mm:ss
Routing Time Step 30 seconds

Number of Elements

	Qty
Rain Gages	0
Subbasins.....	8
Nodes.....	16
<i>Junctions</i>	13
<i>Outfalls</i>	2
<i>Flow Diversions</i>	0
<i>Inlets</i>	0
<i>Storage Nodes</i>	1
Links.....	20
<i>Channels</i>	0
<i>Pipes</i>	13
<i>Pumps</i>	0
<i>Orifices</i>	5
<i>Weirs</i>	2
<i>Outlets</i>	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period..... 100 year(s)

Subbasin Summary

SN	Subbasin ID	Area	Weighted Runoff Coefficient	Total Rainfall	Total Runoff	Total Runoff Volume	Peak Runoff	Time of Concentration
		(ac)		(in)	(in)	(ac-in)	(cfs)	(days hh:mm:ss)
1	Ex	4.76	0.4200	1.16	0.49	2.31	13.85	0 00:10:00
2	P1	0.63	0.1700	1.16	0.20	0.12	0.74	0 00:10:00
3	P2	0.97	0.0900	1.16	0.10	0.10	0.61	0 00:10:00
4	P3	0.72	0.1600	1.16	0.19	0.13	0.80	0 00:10:00
5	P4	0.73	0.9000	1.16	1.04	0.76	4.55	0 00:10:00
6	Y1	0.43	0.5900	1.16	0.68	0.29	1.76	0 00:10:00
7	Y2	0.61	0.5900	1.16	0.68	0.42	2.49	0 00:10:00
8	Y3	0.72	0.5900	1.16	0.68	0.49	2.94	0 00:10:00

Node Summary

SN	Element ID	Element Type	Invert Elevation	Ground/Rim (Max) Elevation	Initial Water Elevation	Surcharge Elevation	Ponded Area	Peak Inflow	Max HGL Elevation Attained	Max Surcharge Depth Attained	Min Freeboard Attained	Time of Peak Flooding Occurrence	Total Flooded Volume	Total Time Flooded
			(ft)	(ft)	(ft)	(ft)	(ft²)	(cfs)	(ft)	(ft)	(ft)	(days hh:mm)	(ac-in)	(min)
1	1-Jun	Junction	5812.59	5815.82	0.00	6.00	0.00	2.43	5813.22	0.00	2.60	0 00:00	0.00	0.00
2	2-Jun	Junction	5811.19	5814.56	0.00	6.00	0.00	4.65	5812.01	0.00	2.55	0 00:00	0.00	0.00
3	3-Jun	Junction	5810.49	5810.38	0.00	6.00	0.00	4.64	5811.31	0.00	0.43	0 00:00	0.00	0.00
4	5-Jun	Junction	5811.49	5814.60	5811.49	6.00	0.00	2.90	5812.26	0.00	2.34	0 00:00	0.00	0.00
5	6-Jun	Junction	5813.17	5813.95	0.00	6.00	0.00	0.74	5813.49	0.00	0.68	0 00:00	0.00	0.00
6	7-Jun	Junction	5811.35	5812.35	0.00	6.00	0.00	0.60	5811.35	0.00	1.00	0 00:00	0.00	0.00
7	8-Jun	Junction	5808.00	5809.00	0.00	6.00	0.00	0.80	5808.00	0.00	1.00	0 00:00	0.00	0.00
8	9-Jun	Junction	5804.42	5809.00	0.00	6.00	0.00	0.08	5807.89	0.00	1.38	0 00:00	0.00	0.00
9	10-Jun	Junction	5804.00	5806.00	0.00	6.00	0.00	0.08	5807.66	0.00	1.38	0 00:00	0.00	0.00
10	11-Jun	Junction	5812.00	5818.00	5812.00	0.00	0.00	2.42	5812.69	0.00	5.31	0 00:00	0.00	0.00
11	12-Jun	Junction	5812.97	5815.57	0.00	0.00	0.00	2.94	5813.76	0.00	1.81	0 00:00	0.00	0.00
12	13-Jun	Junction	5813.82	5815.99	5813.82	0.00	0.00	1.76	5814.43	0.00	1.56	0 00:00	0.00	0.00
13	SD-N-Out	Junction	5809.62	5809.62	0.00	6.00	0.00	2.89	5810.25	0.00	0.46	0 00:00	0.00	0.00
14	Out-01	Outfall	5807.54					0.08	5807.54					
15	Out-02	Outfall	0.00					13.85	0.00					
16	EDB	Storage Node	5808.35	5812.35	0.00		0.00	13.30	5810.03				0.00	0.00

Rolling Meadows Substation
100-Year Storm Event

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Diameter or Height (in)	Manning's Roughness	Peak Flow (cfs)	Design Flow Capacity (cfs)	Peak Flow/Design Flow Ratio	Peak Flow Velocity (ft/sec)	Peak Flow Depth (ft)	Peak Flow Depth/Total Depth Ratio	Total Time Reported (min)	Surcharged Condition
1	01-12-NP	Pipe	6-Jun	1-Jun	50.00	5813.17	5812.59	1.1600	12.000	0.0150	0.74	3.33	0.22	3.93	0.32	0.32	0.00	Calculated
2	02-12-P	Pipe	13-Jun	1-Jun	180.00	5813.49	5812.59	0.5000	12.000	0.0150	1.71	2.55	0.67	5.46	0.60	0.60	0.00	Calculated
3	03-15-NP	Pipe	1-Jun	11-Jun	80.00	5812.34	5811.94	0.5000	15.000	0.0150	2.42	4.81	0.50	3.94	0.63	0.50	0.00	Calculated
4	04-15-P	Pipe	11-Jun	2-Jun	150.00	5811.94	5811.19	0.5000	15.000	0.0150	2.40	4.11	0.58	3.52	0.68	0.55	0.00	Calculated
5	05-15-NP	Pipe	2-Jun	3-Jun	60.61	5811.19	5810.38	1.3400	15.000	0.0150	4.64	6.02	0.77	5.42	0.82	0.66	0.00	Calculated
6	06-12-P	Pipe	12-Jun	5-Jun	150.00	5812.97	5811.49	0.9900	12.000	0.0150	2.90	3.07	0.94	6.46	0.77	0.77	0.00	Calculated
7	07-12-NP	Pipe	5-Jun	SD-N-Out	64.51	5811.49	5809.71	2.7600	12.000	0.0150	2.89	5.13	0.56	6.73	0.54	0.54	0.00	Calculated
8	08-18-NP	Pipe	9-Jun	10-Jun	45.77	5807.77	5807.54	0.5000	18.000	0.0150	0.08	6.45	0.01	1.25	0.12	0.08	0.00	Calculated
9	Link-04	Pipe	7-Jun	EDB	130.91	0.00	0.00	0.0000	0.000	0.0150	0.60	0.00	0.01	0.00	0.12	0.08	0.00	Calculated
10	Link-05	Pipe	SD-N-Out	EDB	112.84	0.00	0.00	0.0000	0.000	0.0150	2.89	0.00	0.01	0.00	0.12	0.08	0.00	Calculated
11	Link-06	Pipe	3-Jun	EDB	93.80	0.00	0.00	0.0000	0.000	0.0150	4.64	0.00	0.01	0.00	0.12	0.08	0.00	Calculated
12	Link-07	Pipe	8-Jun	EDB	144.91	0.00	0.00	0.0000	0.000	0.0150	0.80	0.00	0.01	0.00	0.12	0.08	0.00	Calculated
13	Link-10	Pipe	10-Jun	Out-01	53.10	5804.00	5803.73	0.5100	0.000	0.0150	0.08	0.00	0.01	0.00	0.12	0.08	0.00	Calculated
14	Orifice-01	Orifice	EDB	9-Jun		5808.35	5804.42		0.625		0.01							
15	Orifice-02	Orifice	EDB	9-Jun		5808.35	5804.42		0.625		0.01							
16	Orifice-03	Orifice	EDB	9-Jun		5808.35	5804.42		1.000		0.02							
17	Orifice-04	Orifice	EDB	9-Jun		5808.35	5804.42		1.000		0.02							
18	Orifice-05	Orifice	EDB	9-Jun		5808.35	5804.42		1.000		0.01							
19	Spillway	Weir	EDB	10-Jun		5808.35	5804.00				0.00							
20	Weir-01	Weir	EDB	9-Jun		5808.35	5804.42				0.00							

Subbasin Hydrology

Subbasin : Ex

Input Data

Area (ac) 4.76
Weighted Runoff Coefficient 0.42

Runoff Coefficient

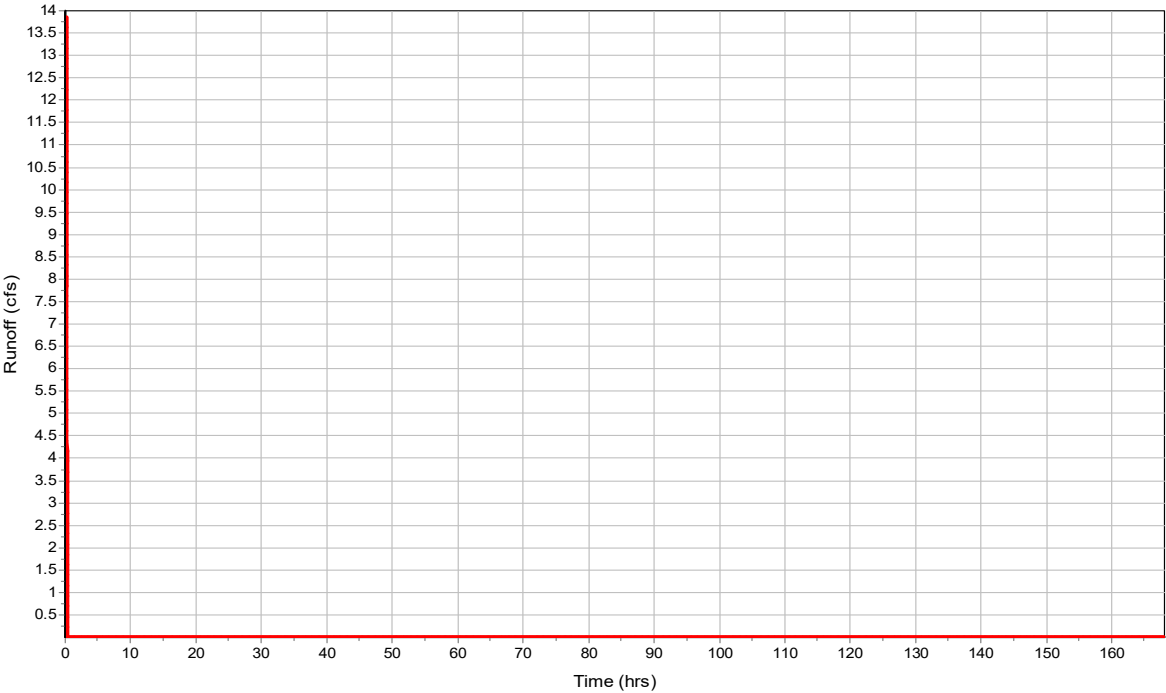
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	4.81	-	0.42
Composite Area & Weighted Runoff Coeff.	4.81		0.42

Subbasin Runoff Results

Total Rainfall (in) 1.16
Total Runoff (in) 0.49
Peak Runoff (cfs) 13.85
Rainfall Intensity 6.93
Weighted Runoff Coefficient 0.42
Time of Concentration (days hh:mm:ss) 0 00:10:00

Subbasin : Ex

Runoff Hydrograph



Subbasin : P1

Input Data

Area (ac) 0.63
Weighted Runoff Coefficient 0.17

Runoff Coefficient

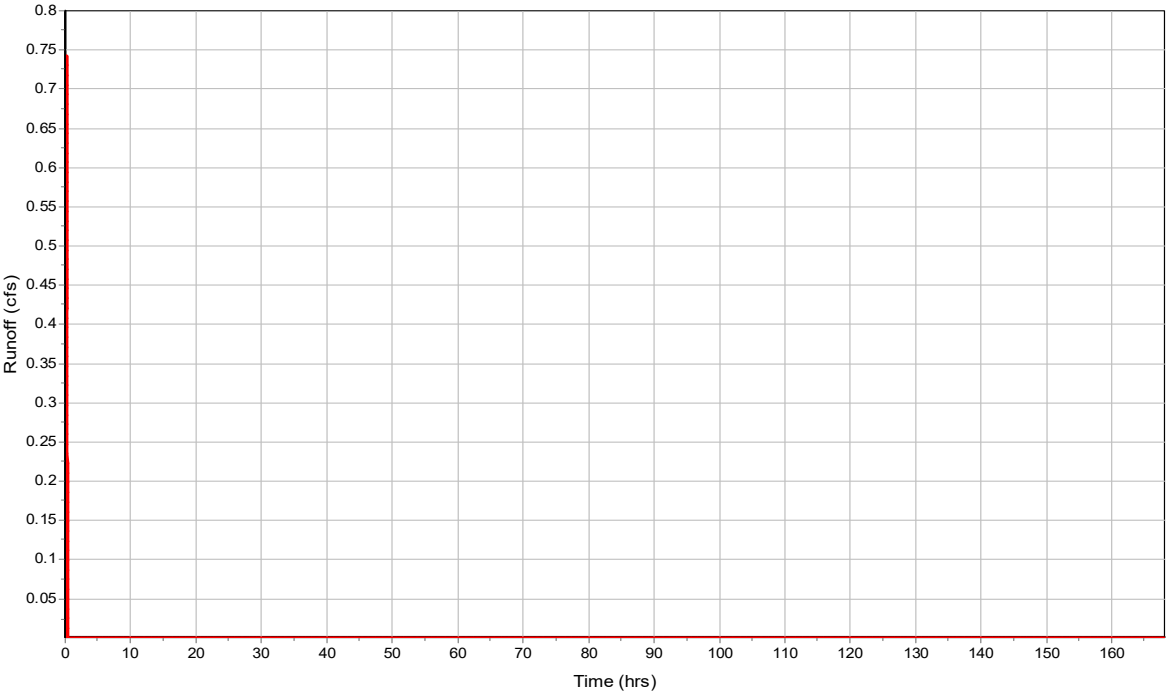
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.63	-	0.17
Composite Area & Weighted Runoff Coeff.	0.63		0.17

Subbasin Runoff Results

Total Rainfall (in) 1.16
Total Runoff (in) 0.2
Peak Runoff (cfs) 0.74
Rainfall Intensity 6.93
Weighted Runoff Coefficient 0.17
Time of Concentration (days hh:mm:ss) 0 00:10:00

Subbasin : P1

Runoff Hydrograph



Subbasin : P2

Input Data

Area (ac) 0.97
Weighted Runoff Coefficient 0.09

Runoff Coefficient

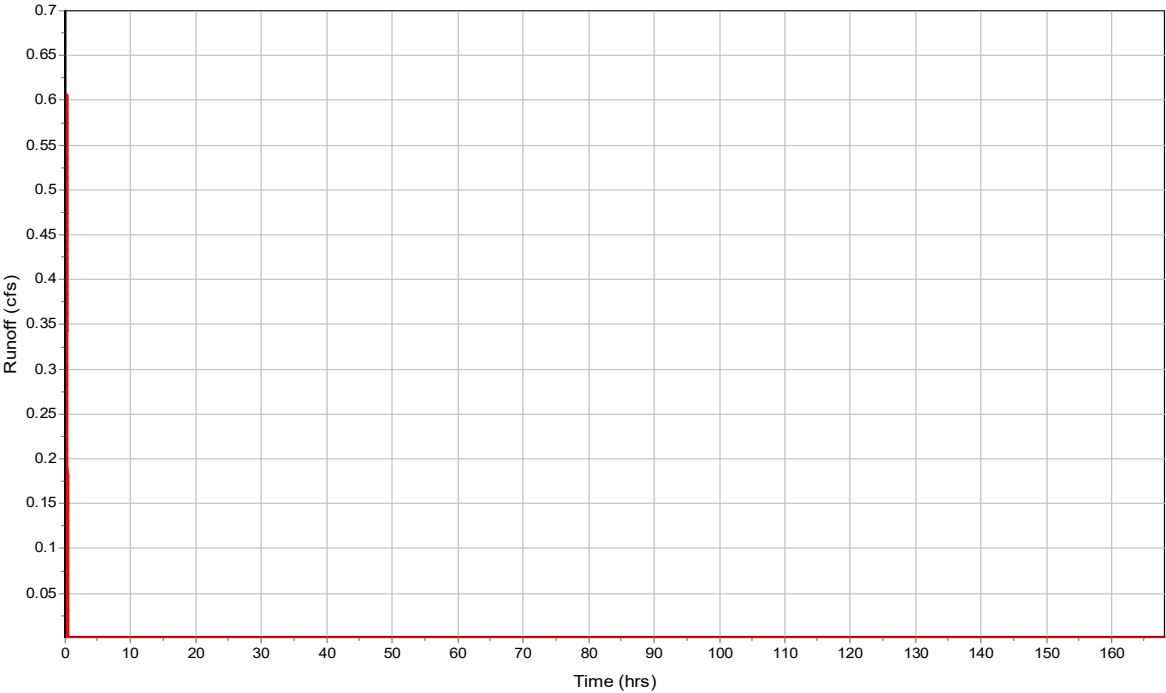
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-	0.97	-	0.09
Composite Area & Weighted Runoff Coeff.	0.97		0.09

Subbasin Runoff Results

Total Rainfall (in) 1.16
Total Runoff (in) 0.1
Peak Runoff (cfs) 0.61
Rainfall Intensity 6.93
Weighted Runoff Coefficient 0.09
Time of Concentration (days hh:mm:ss) 0 00:10:00

Subbasin : P2

Runoff Hydrograph



Subbasin : P3

Input Data

Area (ac) 0.72
Weighted Runoff Coefficient 0.16

Runoff Coefficient

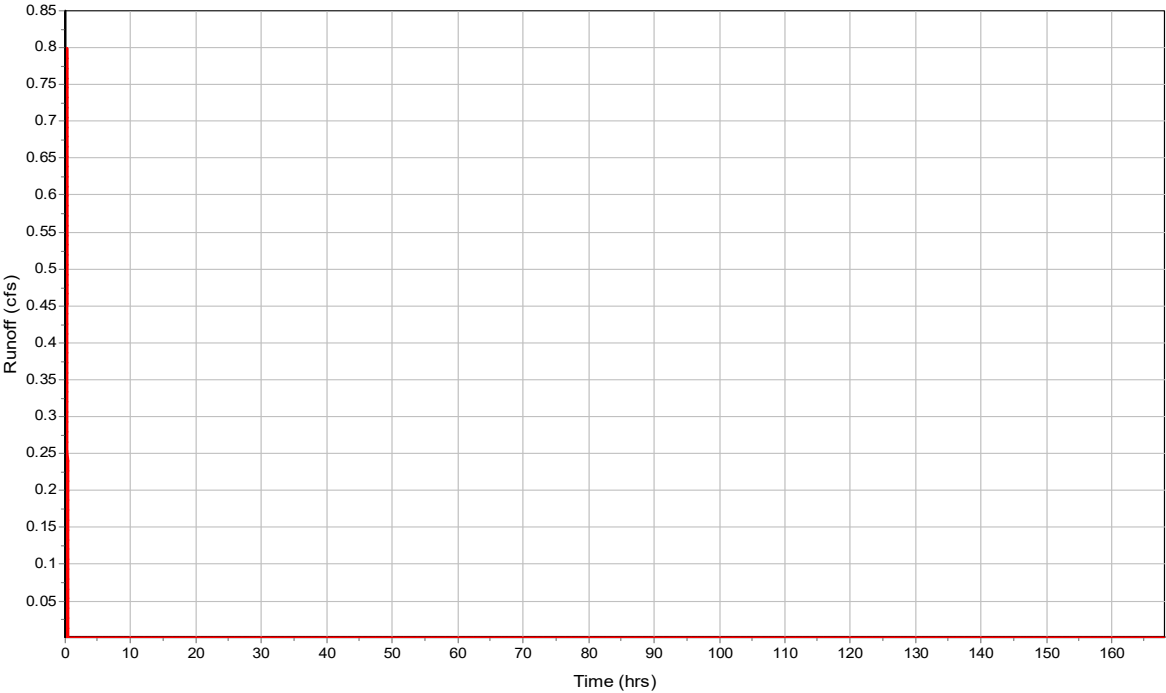
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.72	-	0.16
Composite Area & Weighted Runoff Coeff.	0.72		0.16

Subbasin Runoff Results

Total Rainfall (in) 1.16
Total Runoff (in) 0.19
Peak Runoff (cfs) 0.8
Rainfall Intensity 6.93
Weighted Runoff Coefficient 0.16
Time of Concentration (days hh:mm:ss) 0 00:10:00

Subbasin : P3

Runoff Hydrograph



Subbasin : P4

Input Data

Area (ac) 0.73
Weighted Runoff Coefficient 0.9

Runoff Coefficient

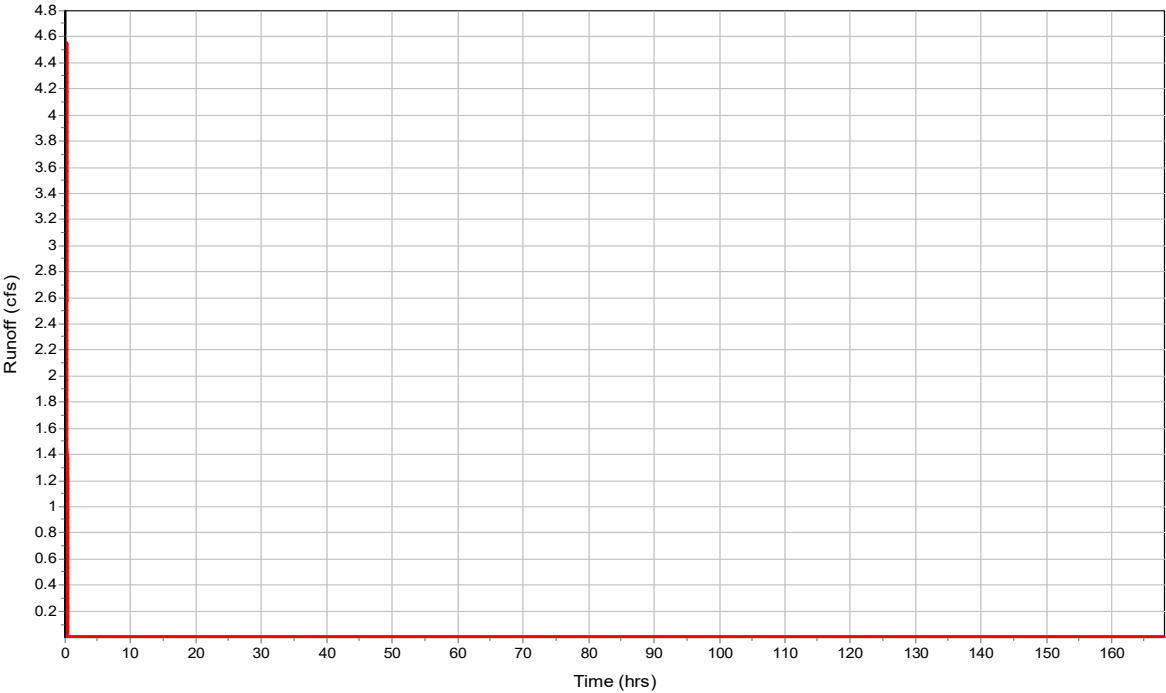
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.73	-	0.9
Composite Area & Weighted Runoff Coeff.	0.73		0.9

Subbasin Runoff Results

Total Rainfall (in) 1.16
Total Runoff (in) 1.04
Peak Runoff (cfs) 4.55
Rainfall Intensity 6.93
Weighted Runoff Coefficient 0.9
Time of Concentration (days hh:mm:ss) 0 00:10:00

Subbasin : P4

Runoff Hydrograph



Subbasin : Y1

Input Data

Area (ac) 0.43
Weighted Runoff Coefficient 0.59

Runoff Coefficient

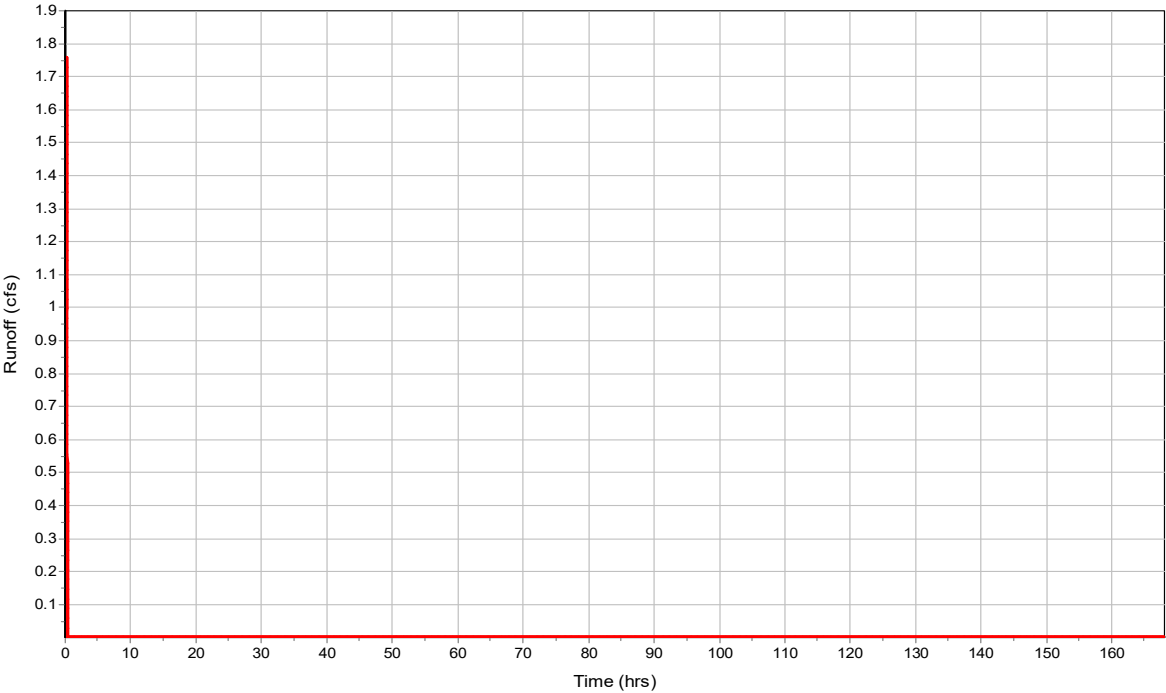
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.43	-	0.59
Composite Area & Weighted Runoff Coeff.	0.43		0.59

Subbasin Runoff Results

Total Rainfall (in) 1.16
Total Runoff (in) 0.68
Peak Runoff (cfs) 1.76
Rainfall Intensity 6.93
Weighted Runoff Coefficient 0.59
Time of Concentration (days hh:mm:ss) 0 00:10:00

Subbasin : Y1

Runoff Hydrograph



Subbasin : Y2

Input Data

Area (ac) 0.61
Weighted Runoff Coefficient 0.59

Runoff Coefficient

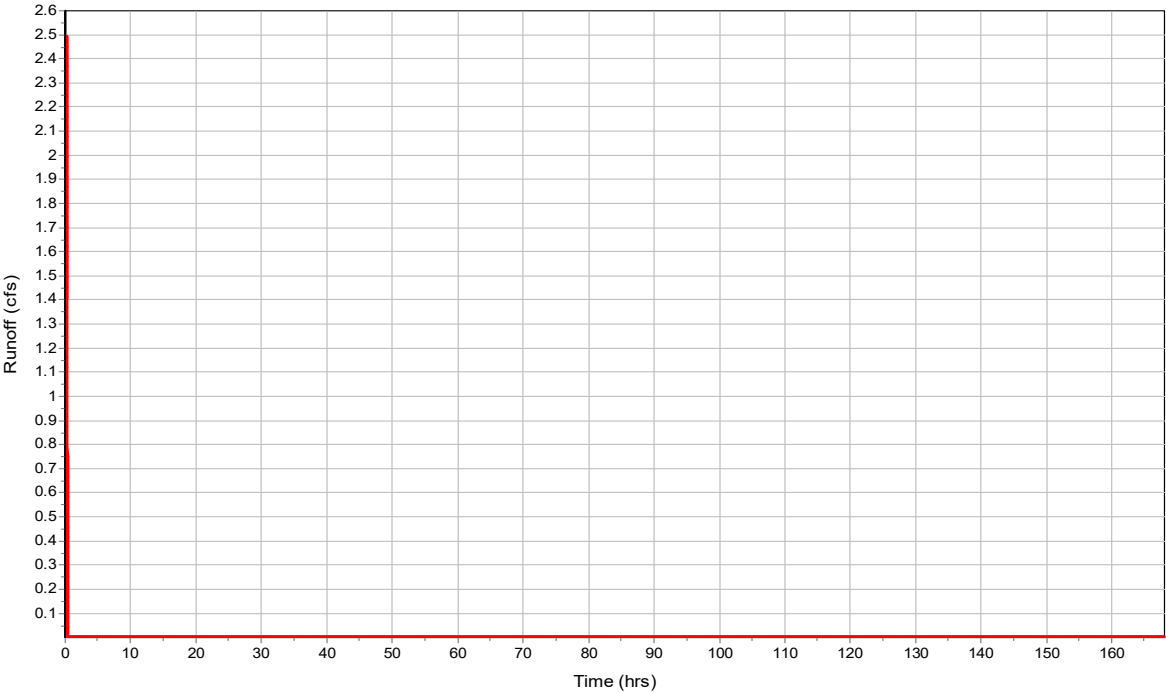
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.61	-	0.59
Composite Area & Weighted Runoff Coeff.	0.61		0.59

Subbasin Runoff Results

Total Rainfall (in) 1.16
Total Runoff (in) 0.68
Peak Runoff (cfs) 2.49
Rainfall Intensity 6.93
Weighted Runoff Coefficient 0.59
Time of Concentration (days hh:mm:ss) 0 00:10:00

Subbasin : Y2

Runoff Hydrograph



Subbasin : Y3

Input Data

Area (ac) 0.72
Weighted Runoff Coefficient 0.59

Runoff Coefficient

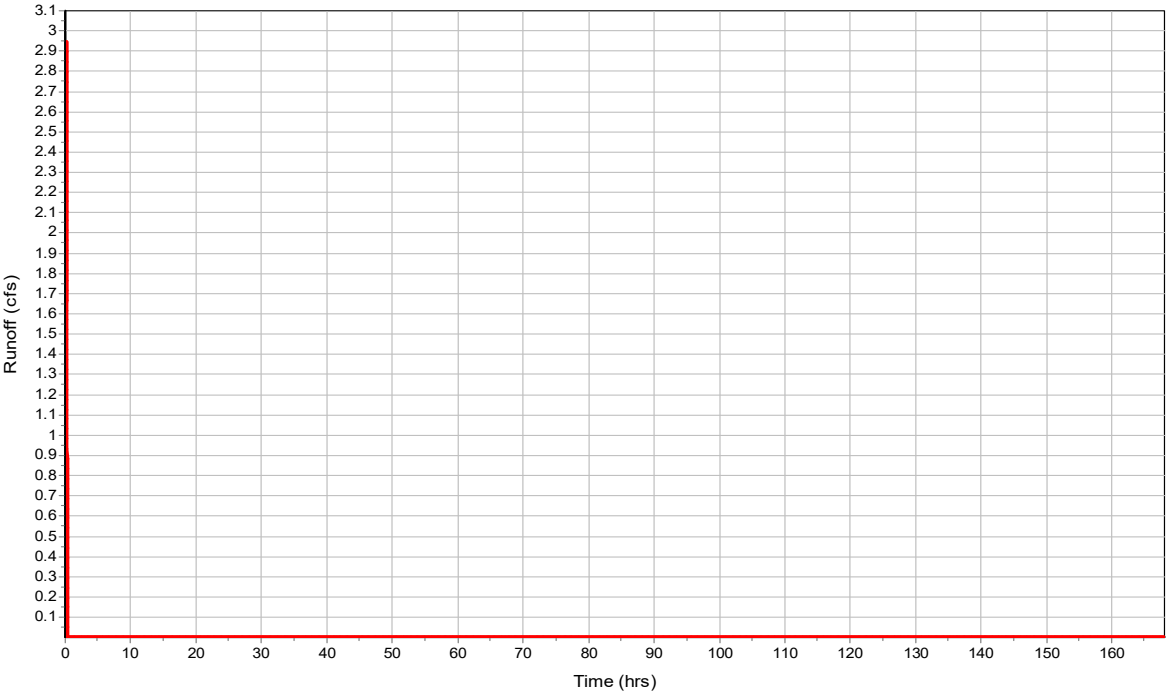
Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	5	-	0.59
Composite Area & Weighted Runoff Coeff.	5		0.59

Subbasin Runoff Results

Total Rainfall (in) 1.16
Total Runoff (in) 0.68
Peak Runoff (cfs) 2.94
Rainfall Intensity 6.93
Weighted Runoff Coefficient 0.59
Time of Concentration (days hh:mm:ss) 0 00:10:00

Subbasin : Y3

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 (ft²)	Minimum Pipe Cover (in)
1	1-Jun	5812.59	5815.82	3.23	0.00	-5812.59	6.00	-5809.82	0.00	0.00
2	2-Jun	5811.19	5814.56	3.37	0.00	-5811.19	6.00	-5808.56	0.00	0.00
3	3-Jun	5810.49	5810.38	-0.11	0.00	-5810.49	6.00	-5804.38	0.00	0.00
4	5-Jun	5811.49	5814.60	3.11	5811.49	0.00	6.00	-5808.60	0.00	0.00
5	6-Jun	5813.17	5813.95	0.78	0.00	-5813.17	6.00	-5807.95	0.00	0.00
6	7-Jun	5811.35	5812.35	1.00	0.00	-5811.35	6.00	-5806.35	0.00	0.00
7	8-Jun	5808.00	5809.00	1.00	0.00	-5808.00	6.00	-5803.00	0.00	0.00
8	9-Jun	5804.42	5809.00	4.58	0.00	-5804.42	6.00	-5803.00	0.00	0.00
9	10-Jun	5804.00	5806.00	2.00	0.00	-5804.00	6.00	-5800.00	0.00	0.00
10	11-Jun	5812.00	5818.00	6.00	5812.00	0.00	0.00	-5818.00	0.00	0.00
11	12-Jun	5812.97	5815.57	2.60	0.00	-5812.97	0.00	-5815.57	0.00	0.00
12	13-Jun	5813.82	5815.99	2.17	5813.82	0.00	0.00	-5815.99	0.00	0.00
13	SD-N-Out	5809.62	5809.62	0.00	0.00	-5809.62	6.00	-5803.62	0.00	0.00

Junction Results

SN	Element	Peak	Peak	Max HGL	Max HGL	Max	Min	Average HGL	Average HGL	Time of	Time of	Total	Total Time
ID		Inflow	Lateral	Elevation	Depth	Surcharge	Freeboard	Elevation	Depth	Max HGL	Peak	Flooded	Flooded
			Inflow	Attained	Attained	Depth	Attained	Attained	Attained	Occurrence	Flooding	Volume	
		(cfs)	(cfs)	(ft)	(ft)	Attained	(ft)	(ft)	(ft)	(days hh:mm)	Occurrence	(ac-in)	(min)
1	1-Jun	2.43	0.00	5813.22	0.63	0.00	2.60	5812.59	0.00	0 00:10	0 00:00	0.00	0.00
2	2-Jun	4.65	2.49	5812.01	0.82	0.00	2.55	5811.19	0.00	0 00:10	0 00:00	0.00	0.00
3	3-Jun	4.64	0.00	5811.31	0.82	0.00	0.43	5810.49	0.00	0 00:11	0 00:00	0.00	0.00
4	5-Jun	2.90	0.00	5812.26	0.77	0.00	2.34	5811.49	0.00	0 00:10	0 00:00	0.00	0.00
5	6-Jun	0.74	0.74	5813.49	0.32	0.00	0.68	5813.17	0.00	0 00:10	0 00:00	0.00	0.00
6	7-Jun	0.60	0.60	5811.35	0.00	0.00	1.00	5811.35	0.00	0 00:00	0 00:00	0.00	0.00
7	8-Jun	0.80	0.80	5808.00	0.00	0.00	1.00	5808.00	0.00	0 00:00	0 00:00	0.00	0.00
8	9-Jun	0.08	0.00	5807.89	3.47	0.00	1.38	5807.80	3.38	0 00:23	0 00:00	0.00	0.00
9	10-Jun	0.08	0.00	5807.66	3.66	0.00	1.38	5807.57	3.57	0 00:24	0 00:00	0.00	0.00
10	11-Jun	2.42	0.00	5812.69	0.69	0.00	5.31	5812.00	0.00	0 00:10	0 00:00	0.00	0.00
11	12-Jun	2.94	2.94	5813.76	0.79	0.00	1.81	5812.97	0.00	0 00:10	0 00:00	0.00	0.00
12	13-Jun	1.76	1.76	5814.43	0.61	0.00	1.56	5813.82	0.00	0 00:10	0 00:00	0.00	0.00
13	SD-N-Out	2.89	0.00	5810.25	0.63	0.00	0.46	5809.71	0.09	0 00:10	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Pipe Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow	Flap Gate	No. of Barrels
																		(cfs)
1	01-12-NP	50.00	5813.17	0.00	5812.59	0.00	0.58	1.1600	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
2	02-12-P	180.00	5813.49	-0.33	5812.59	0.00	0.90	0.5000	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
3	03-15-NP	80.00	5812.34	-0.25	5811.94	-0.06	0.40	0.5000	CIRCULAR	15.000	15.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
4	04-15-P	150.00	5811.94	-0.06	5811.19	0.00	0.75	0.5000	CIRCULAR	15.000	15.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
5	05-15-NP	60.61	5811.19	0.00	5810.38	-0.11	0.81	1.3400	CIRCULAR	15.000	15.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
6	06-12-P	150.00	5812.97	0.00	5811.49	0.00	1.48	0.9900	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
7	07-12-NP	64.51	5811.49	0.00	5809.71	0.09	1.78	2.7600	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
8	08-18-NP	45.77	5807.77	3.35	5807.54	3.54	0.23	0.5000	CIRCULAR	18.000	18.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
9	Link-04	130.91	0.00	-5811.35	0.00	-5808.35	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
10	Link-05	112.84	0.00	-5809.62	0.00	-5808.35	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
11	Link-06	93.80	0.00	-5810.49	0.00	-5808.35	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
12	Link-07	144.91	0.00	-5808.00	0.00	-5808.35	0.00	0.0000	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1
13	Link-10	53.10	5804.00	0.00	5803.73	-3.81	0.27	0.5100	Dummy	0.000	0.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow	Time of Peak Flow Occurrence	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Travel Time	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Froude Number	Reported Condition
		(cfs)	(days hh:mm)	(cfs)		(ft/sec)	(min)	(ft)		(min)		
1	01-12-NP	0.74	0 00:10	3.33	0.22	3.93	0.21	0.32	0.32	0.00		Calculated
2	02-12-P	1.71	0 00:10	2.55	0.67	5.46	0.55	0.60	0.60	0.00		Calculated
3	03-15-NP	2.42	0 00:10	4.81	0.50	3.94	0.34	0.63	0.50	0.00		Calculated
4	04-15-P	2.40	0 00:11	4.11	0.58	3.52	0.71	0.68	0.55	0.00		Calculated
5	05-15-NP	4.64	0 00:11	6.02	0.77	5.42	0.19	0.82	0.66	0.00		Calculated
6	06-12-P	2.90	0 00:10	3.07	0.94	6.46	0.39	0.77	0.77	0.00		Calculated
7	07-12-NP	2.89	0 00:10	5.13	0.56	6.73	0.16	0.54	0.54	0.00		Calculated
8	08-18-NP	0.08	0 00:24	6.45	0.01	1.25	0.61	0.12	0.08	0.00		Calculated
9	Link-04	0.60	0 00:10	0.00	0.01	0.00		0.12	0.08	0.00		Calculated
10	Link-05	2.89	0 00:10	0.00	0.01	0.00		0.12	0.08	0.00		Calculated
11	Link-06	4.64	0 00:11	0.00	0.01	0.00		0.12	0.08	0.00		Calculated
12	Link-07	0.80	0 00:10	0.00	0.01	0.00		0.12	0.08	0.00		Calculated
13	Link-10	0.08	0 00:24	0.00	0.01	0.00		0.12	0.08	0.00		Calculated

Storage Nodes

Storage Node : EDB

Input Data

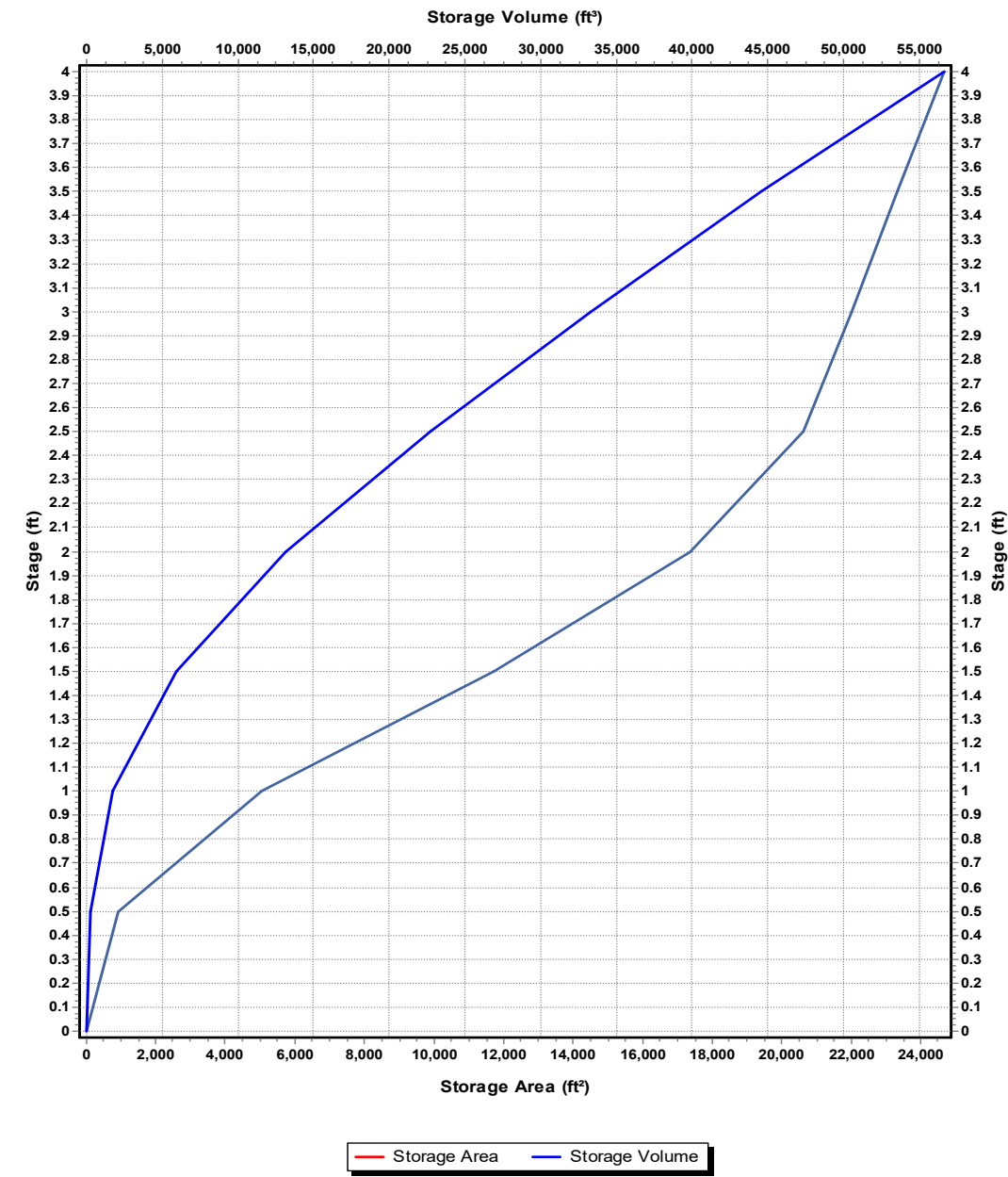
Invert Elevation (ft)	5808.35
Max (Rim) Elevation (ft)	5812.35
Max (Rim) Offset (ft)	4.00
Initial Water Elevation (ft)	0.00
Initial Water Depth (ft)	-5808.35
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

Storage Area Volume Curves

Storage Curve : Storage-01

Stage	Storage Area	Storage Volume
(ft)	(ft²)	(ft³)
0	10	0
0.5	917	231.75
1	5052	1724
1.5	11717	5916.25
2	17359	13185.25
2.5	20610	22677.5
3	22010	33332.5
3.5	23327	44666.75
4	24671	56666.25

Storage Area Volume Curves



Storage Node : EDB (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Spillway	Trapezoidal	No	5811.10	2.75	50.00	1.25	3.33
2	Weir-01	Rectangular	No	5810.35	2.00	4.00	0.75	3.33

Outflow Orifices

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	Orifice-01	Side	CIRCULAR	No	0.63			5808.02	0.61
2	Orifice-02	Side	CIRCULAR	No	0.63			5808.77	0.61
3	Orifice-03	Side	CIRCULAR	No	1.00			5809.27	0.61
4	Orifice-04	Side	CIRCULAR	No	1.00			5809.52	0.61
5	Orifice-05	Side	CIRCULAR	No	1.00			5809.77	0.61

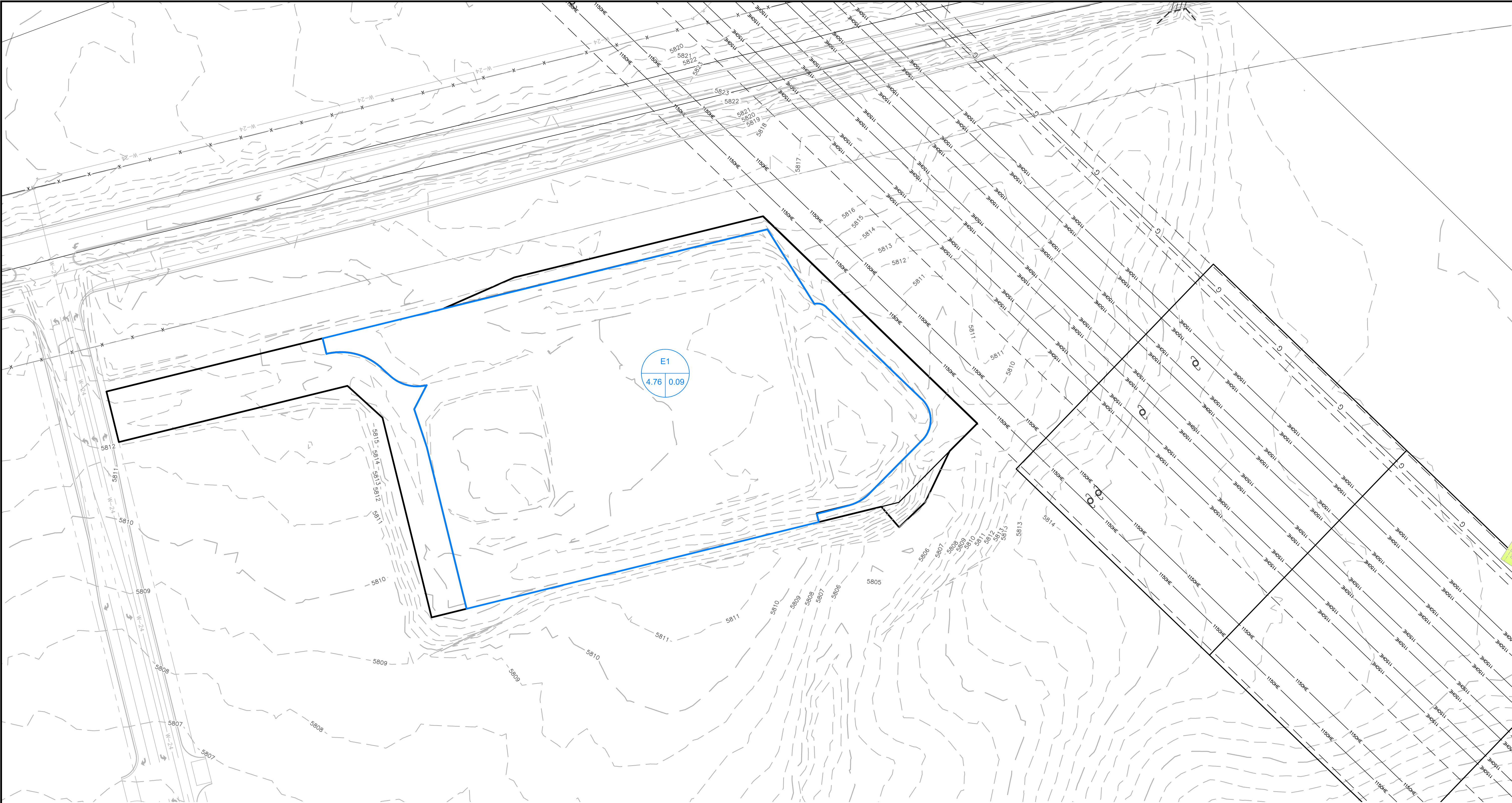
Output Summary Results

Peak Inflow (cfs)	13.3
Peak Lateral Inflow (cfs)	4.55
Peak Outflow (cfs)	0.08
Peak Exfiltration Flow Rate (cfm)	0
Max HGL Elevation Attained (ft)	5810.03
Max HGL Depth Attained (ft)	1.68
Average HGL Elevation Attained (ft)	5808.8
Average HGL Depth Attained (ft)	0.45
Time of Max HGL Occurrence (days hh:mm)	0 00:23
Total Exfiltration Volume (1000-ft³)	0
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0

Appendix C

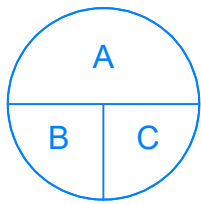
Site Maps & Design Drawings





LEGEND

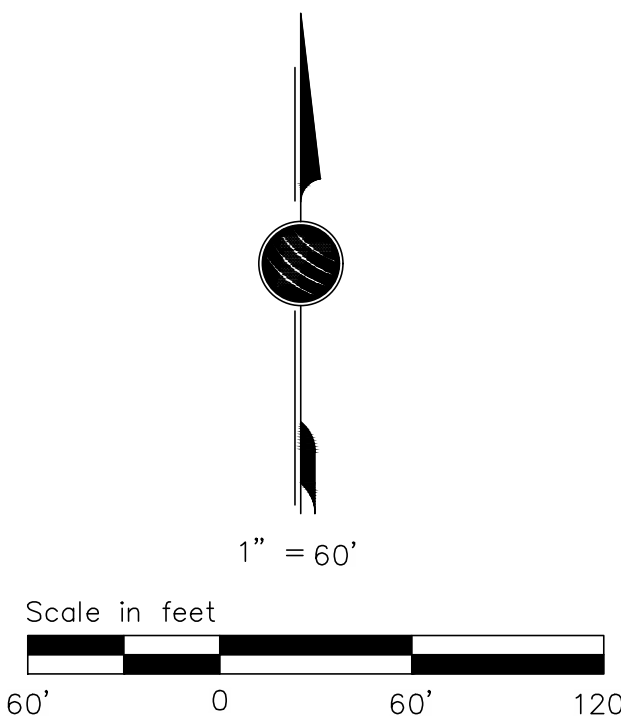
- 5800- EXISTING INDEX CONTOUR
- 5796- EXISTING INTERMEDIATE CONTOUR
- EXISTING DRAINAGE FLOWLINE
- ← FLOW ARROW
- DRAINAGE BASIN
- UNANALYZED DRAINAGE AREA = 1.32 ACRES



- A = BASIN
- B = AREA IN ACRES
- C = WEIGHTED RUNOFF COEFFICIENT

Sumarry Runoff Tables

Existing			
Design Point	Contributing Area (acres)	Runoff Peak 5-year Event (cfs)	Runoff Peak 100-year Event (cfs)
1	4.76	2.63	10.25



ROLLING MEADOWS SUBSTATION
115/12.47KV
EXISTING BASINS

TRI-STATE
Generation and Transmission
Association, Inc.
A Touchstone Energy Cooperative

1100 W. 116th Ave.
P.O. Box 33695
Denver, Colorado 80233
303-452-6111

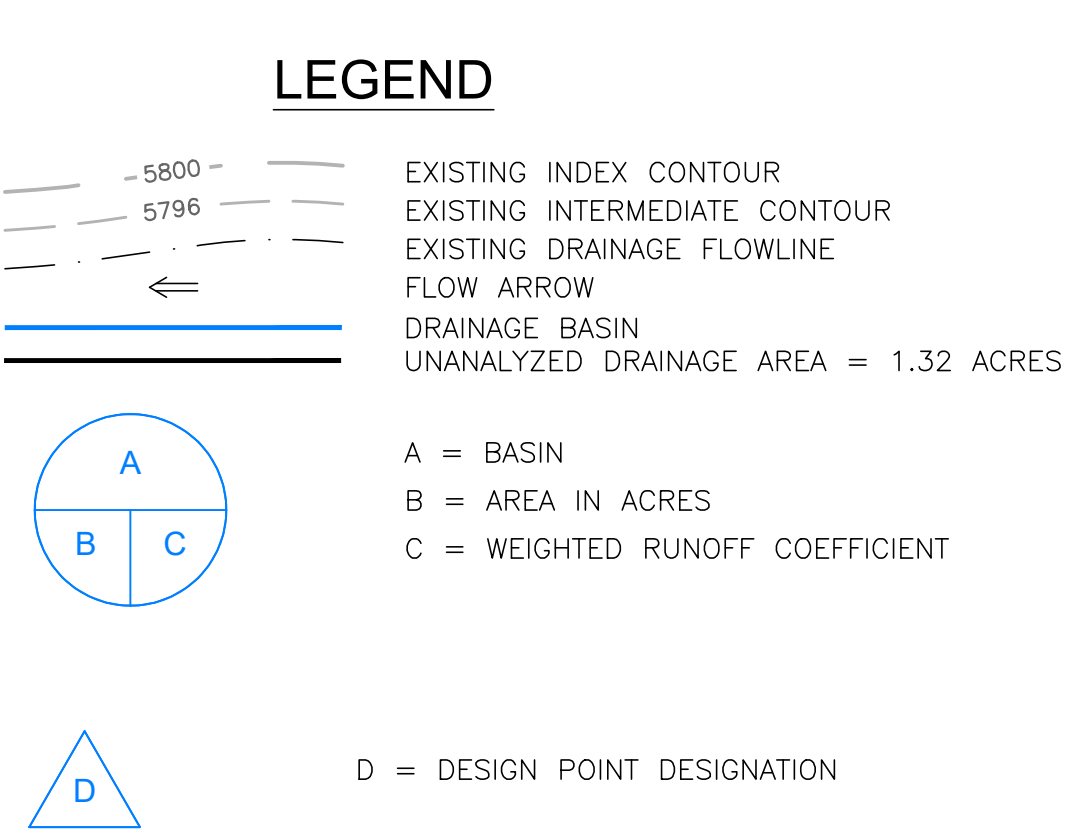
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Appd:	Date:

EXISTING BASINS

TRI-STATE GENERATION & TRANSMISSION
ASSOCIATION, INCORPORATED
UPDATED BY: WLUCCATE 6/18/2026 3:54 PM Contract: 4713
PATH: \\QMS1\Projects\Active Projects\2024\2026-TSE Rolling Meadows Substation\Facility Civil\Sheets\1183-A-01-SHEETS.dwg

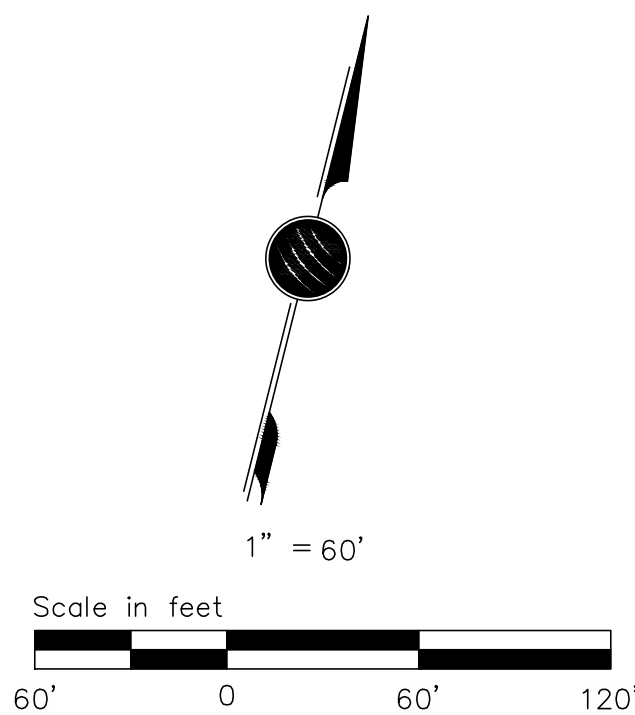
No.	Date	Dwn.	Appd.	Revision	M.F.
7					
6					
5					
4					
3					
2					
1					

Dwg. No.	Mfr.	Drawing Title
		Reference Drawings

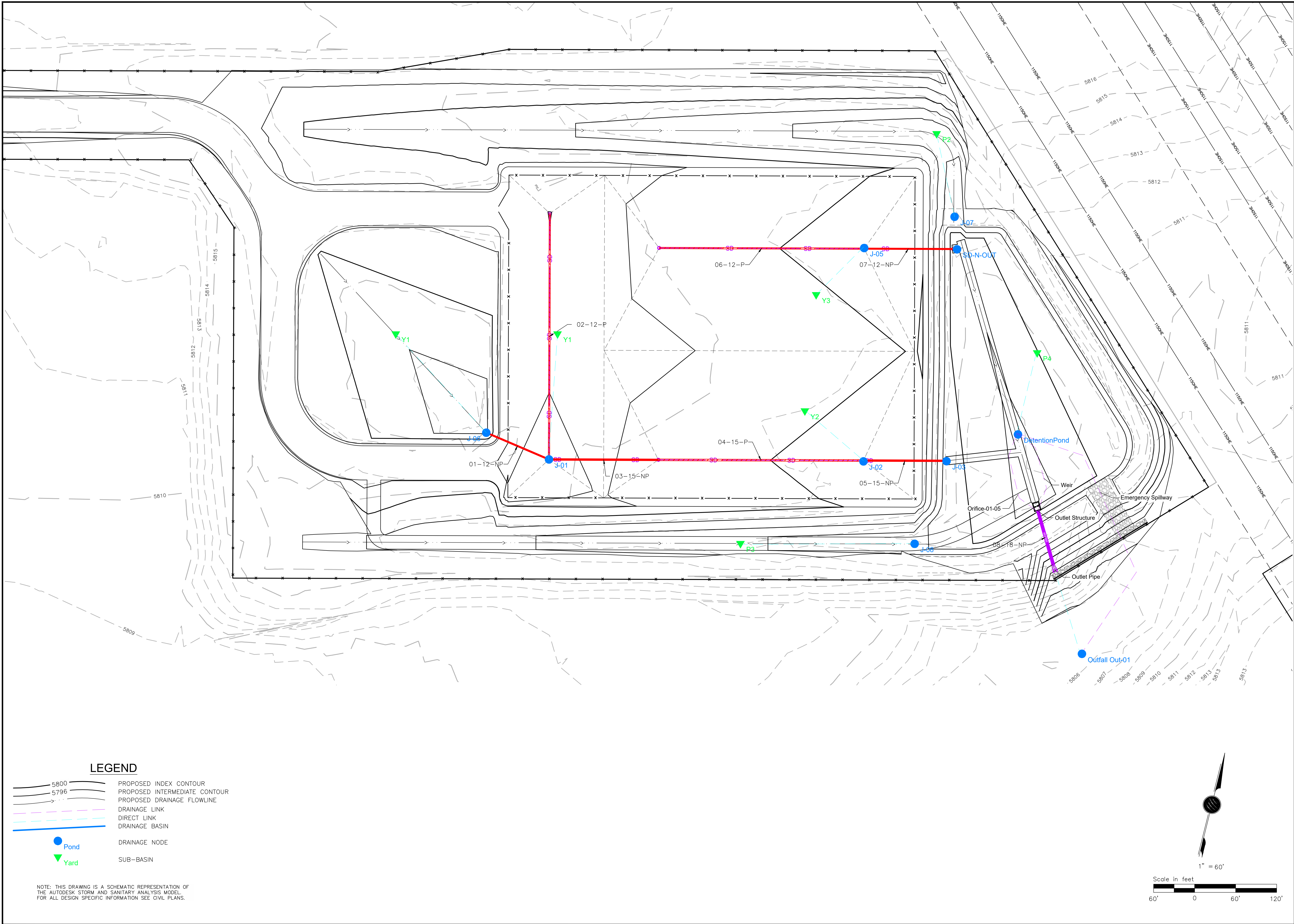


Summary Runoff Tables			
Proposed			
Design Point	Contributing Area	Runoff Peak 5-year Event	Runoff Peak 100-year Event
	(acres)	(cfs)	(cfs)
1	4.82	0.09	3.48
2	4.82	0.05	0.08

Water Quality Treatment Summary Table		
Basin ID(s)	PCM Tributary Area	PCM ID
Y1-Y3	1.76	EDB-1
P1-P4	3.00	Runoff Reduction
EXCL-1	0.80	EXCLUDED
EXCL-2	0.52	EXCLUDED



 TRI-STATE Generation and Transmission Association, Inc. A Touchstone Energy Cooperative		1100 W. 116th Ave. P.O. Box 33695 Denver, Colorado 80233 303-452-6111		Dwn: _____ Date: _____ TMC: _____ Date: _____ Appd: _____ Date: _____		PROPOSED BASINS	
ROLLING MEADOWS SUBSTATION 115/112.47kV PROPOSED BASINS				7 6 5 4 3 2 1			
TRI-STATE GENERATION & TRANSMISSION ASSOCIATION, INCORPORATED				No. Date Dwn. Appd. Revision			
UPDATED BY: WJLDGATE 6/18/2028 3:54 PM Contract: 4713				M.F. Mgr. Dwg. No. Reference Drawings			



LEGEND

- 5800 PROPOSED INDEX CONTOUR
- 5796 PROPOSED INTERMEDIATE CONTOUR
- PROPOSED DRAINAGE FLOWLINE
- DRAINAGE LINK
- DIRECT LINK
- DRAINAGE BASIN
- Pond DRAINAGE NODE
- Yard SUB-BASIN

NOTE: THIS DRAWING IS A SCHEMATIC REPRESENTATION OF THE AUTODESK STORM AND SANITARY ANALYSIS MODEL. FOR ALL DESIGN SPECIFIC INFORMATION SEE CIVIL PLANS.

ROLLING MEADOWS SUBSTATION
115/12.47KV
BASIN SCHEMATIC

TRI-STATE
Generation and Transmission
Association, Inc.

1100 W. 116th Ave.
P.O. Box 33695
Denver, Colorado 80233
303-452-6111

UPDATED BY: WLUCCATE

6/18/2026 3:54 PM

Contract: 4713

PATH: \\QMS1\Projects\Active Projects\2024\24028-TSG Rolling Meadows Substation\Facility Civil\Sheets\1183-A-01-SHEETS.dwg

Dwn: TMC

Date: 02/18/26

Appd:

Date:

7

6

5

4

3

2

1

No.

Date

Dwn.

Appd.

Revision

M.F.

Dwg. No.

Mfr.

Reference Drawings

Drawing Title

BASIN SCHEMATIC

Appendix D

Forebay Analysis



Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 3

Designer: Thayne Clement
 Company: Del-Mont Consultants
 Date: February 16, 2026
 Project: Crosspoint Substation - Forebay 1
 Location: El Paso County, CO

1. Basin Storage Volume

- A) Effective Imperviousness of Tributary Area, I_a
- B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)
- C) Contributing Watershed Area
- D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm
- E) Design Concept
(Select EURV when also designing for flood control)
- F) Design Volume (WQCV) Based on 40-hour Drain Time
($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$)
- G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN} / 0.43))$)
- H) User Input of Water Quality Capture Volume (WQCV) Design Volume
(Only if a different WQCV Design Volume is desired)
- I) NRCS Hydrologic Soil Groups of Tributary Watershed
 i) Percentage of Watershed consisting of Type A Soils
 ii) Percentage of Watershed consisting of Type B Soils
 iii) Percentage of Watershed consisting of Type C/D Soils
- J) Excess Urban Runoff Volume (EURV) Design Volume
 For HSG A: $EURV_A = 1.68 * i^{1.28}$
 For HSG B: $EURV_B = 1.36 * i^{1.08}$
 For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$
- K) User Input of Excess Urban Runoff Volume (EURV) Design Volume
(Only if a different EURV Design Volume is desired)

$I_a =$ %

$i =$

Area = ac

$d_6 =$ in

Choose One

☒ Water Quality Capture Volume (WQCV)

☐ Excess Urban Runoff Volume (EURV)

$V_{DESIGN} =$ ac-ft

$V_{DESIGN\ OTHER} =$ ac-ft

$V_{DESIGN\ USER} =$ ac-ft

HSG _A = %

HSG _B = %

HSG _{C/D} = %

$EURV_{DESIGN} =$ ac-ft

$EURV_{DESIGN\ USER} =$ ac-ft

2. Basin Shape: Length to Width Ratio

(A basin length to width ratio of at least 2:1 will improve TSS reduction.)

L : W = : 1

3. Basin Side Slopes

- A) Basin Maximum Side Slopes
(Horizontal distance per unit vertical, 4:1 or flatter preferred)

Z = ft / ft

4. Inlet

- A) Describe means of providing energy dissipation at concentrated inflow locations:

5. Forebay

- A) Minimum Forebay Volume
($V_{FMIN} =$ of the WQCV)
- B) Actual Forebay Volume
- C) Forebay Depth
($D_F =$ inch maximum)
- D) Forebay Discharge
 i) Undetained 100-year Peak Discharge
 ii) Forebay Discharge Design Flow
($Q_F = 0.02 * Q_{100}$)
- E) Forebay Discharge Design
- F) Discharge Pipe Size (minimum 8-inches)
- G) Rectangular Notch Width

$V_{FMIN} =$ ac-ft

A FOREBAY MAY NOT BE NECESSARY FOR THIS SIZE SITE

$V_F =$ ac-ft

$D_F =$ in

$Q_{100} =$ cfs

$Q_F =$ cfs

Choose One

☐ Berm With Pipe

☒ Wall with Rect. Notch

☐ Wall with V-Notch Weir

Flow too small for berm w/ pipe

Calculated $D_P =$ in

Calculated $W_N =$ in

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 3

Designer: Thayne Clement
 Company: Del-Mont Consultants
 Date: February 16, 2026
 Project: Crosspoint Substation - Forebay 2
 Location: Yoder, CO

1. Basin Storage Volume

- A) Effective Imperviousness of Tributary Area, I_a
- B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)
- C) Contributing Watershed Area
- D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm
- E) Design Concept
(Select EURV when also designing for flood control)
- F) Design Volume (WQCV) Based on 40-hour Drain Time
($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * \text{Area})$)
- G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
($V_{WQCV \text{ OTHER}} = (d_s * (V_{DESIGN} / 0.43))$)
- H) User Input of Water Quality Capture Volume (WQCV) Design Volume
(Only if a different WQCV Design Volume is desired)
- I) NRCS Hydrologic Soil Groups of Tributary Watershed
 i) Percentage of Watershed consisting of Type A Soils
 ii) Percentage of Watershed consisting of Type B Soils
 iii) Percentage of Watershed consisting of Type C/D Soils
- J) Excess Urban Runoff Volume (EURV) Design Volume
 For HSG A: $EURV_A = 1.68 * i^{1.28}$
 For HSG B: $EURV_B = 1.36 * i^{1.08}$
 For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$
- K) User Input of Excess Urban Runoff Volume (EURV) Design Volume
(Only if a different EURV Design Volume is desired)

$I_a =$ %

$i =$

Area = ac

$d_s =$ in

Choose One

☒ Water Quality Capture Volume (WQCV)

☐ Excess Urban Runoff Volume (EURV)

$V_{DESIGN} =$ ac-ft

$V_{DESIGN \text{ OTHER}} =$ ac-ft

$V_{DESIGN \text{ USER}} =$ ac-ft

HSG _A = %

HSG _B = %

HSG _{C/D} = %

$EURV_{DESIGN} =$ ac-ft

$EURV_{DESIGN \text{ USER}} =$ ac-ft

2. Basin Shape: Length to Width Ratio

(A basin length to width ratio of at least 2:1 will improve TSS reduction.)

L : W = : 1

3. Basin Side Slopes

- A) Basin Maximum Side Slopes
(Horizontal distance per unit vertical, 4:1 or flatter preferred)

Z = ft / ft

4. Inlet

- A) Describe means of providing energy dissipation at concentrated inflow locations:

5. Forebay

- A) Minimum Forebay Volume
($V_{FMIN} =$ of the WQCV)

- B) Actual Forebay Volume

- C) Forebay Depth
($D_F =$ inch maximum)

- D) Forebay Discharge

- i) Undetained 100-year Peak Discharge

- ii) Forebay Discharge Design Flow
($Q_F = 0.02 * Q_{100}$)

- E) Forebay Discharge Design

- F) Discharge Pipe Size (minimum 8-inches)

- G) Rectangular Notch Width

$V_{FMIN} =$ ac-ft

A FOREBAY MAY NOT BE NECESSARY FOR THIS SIZE SITE

$V_F =$ ac-ft

$D_F =$ in

$Q_{100} =$ cfs

$Q_F =$ cfs

Choose One

☐ Berm With Pipe

☒ Wall with Rect. Notch

☐ Wall with V-Notch Weir

Flow too small for berm w/ pipe

Calculated $D_P =$ in

Calculated $W_N =$ in

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 3

Designer: Thayne Clement
 Company: Del-Mont Consultants
 Date: February 16, 2026
 Project: Crosspoint Substation - Forebay 3
 Location: Yoder, CO

1. Basin Storage Volume

- A) Effective Imperviousness of Tributary Area, I_a
- B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)
- C) Contributing Watershed Area
- D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm
- E) Design Concept
(Select EURV when also designing for flood control)
- F) Design Volume (WQCV) Based on 40-hour Drain Time
($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * \text{Area})$)
- G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
($V_{WQCV \text{ OTHER}} = (d_6 * (V_{DESIGN} / 0.43))$)
- H) User Input of Water Quality Capture Volume (WQCV) Design Volume
(Only if a different WQCV Design Volume is desired)
- I) NRCS Hydrologic Soil Groups of Tributary Watershed
 i) Percentage of Watershed consisting of Type A Soils
 ii) Percentage of Watershed consisting of Type B Soils
 iii) Percentage of Watershed consisting of Type C/D Soils
- J) Excess Urban Runoff Volume (EURV) Design Volume
 For HSG A: $EURV_A = 1.68 * i^{1.28}$
 For HSG B: $EURV_B = 1.36 * i^{1.08}$
 For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$
- K) User Input of Excess Urban Runoff Volume (EURV) Design Volume
(Only if a different EURV Design Volume is desired)

$I_a =$ 13.0 %

$i =$ 0.130

Area = 0.720 ac

$d_6 =$ 1.19 in

Choose One

☒ Water Quality Capture Volume (WQCV)

☐ Excess Urban Runoff Volume (EURV)

$V_{DESIGN} =$ ac-ft

$V_{DESIGN \text{ OTHER}} =$ ac-ft

$V_{DESIGN \text{ USER}} =$ 0.005 ac-ft

HSG _A = %

HSG _B = %

HSG _{C/D} = %

$EURV_{DESIGN} =$ ac-ft

$EURV_{DESIGN \text{ USER}} =$ ac-ft

2. Basin Shape: Length to Width Ratio

(A basin length to width ratio of at least 2:1 will improve TSS reduction.)

L : W = 2.0 : 1

3. Basin Side Slopes

- A) Basin Maximum Side Slopes
(Horizontal distance per unit vertical, 4:1 or flatter preferred)

Z = 4.00 ft / ft

4. Inlet

- A) Describe means of providing energy dissipation at concentrated inflow locations:

5. Forebay

- A) Minimum Forebay Volume
($V_{FMIN} =$ 0% of the WQCV)
- B) Actual Forebay Volume
- C) Forebay Depth
($D_F =$ 12 inch maximum)
- D) Forebay Discharge
 i) Undetained 100-year Peak Discharge
 ii) Forebay Discharge Design Flow
($Q_F = 0.02 * Q_{100}$)
- E) Forebay Discharge Design
- F) Discharge Pipe Size (minimum 8-inches)
- G) Rectangular Notch Width

$V_{FMIN} =$ 0.000 ac-ft

A FOREBAY MAY NOT BE NECESSARY FOR THIS SIZE SITE

$V_F =$ 0.001 ac-ft

$D_F =$ 12.0 in

$Q_{100} =$ 0.74 cfs

$Q_F =$ 0.01 cfs

Choose One

☐ Berm With Pipe

☒ Wall with Rect. Notch

☐ Wall with V-Notch Weir

Flow too small for berm w/ pipe

Calculated $D_P =$ in

Calculated $W_N =$ 2.5 in