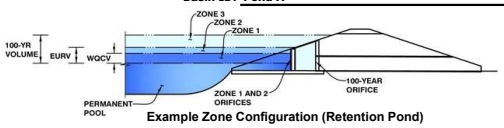
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Schmidt Phase 1 - District Infrastructure**

Basin ID: **Pond A**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	37.54	acres
Watershed Length =	2,710	ft
Watershed Length to Centroid =	1,260	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	73.00%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.905	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	3.513	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.95 in.) =	1.992	acre-feet	0.95	inches
5-yr Runoff Volume (P1 = 1.23 in.) =	2.661	acre-feet	1.23	inches
10-yr Runoff Volume (P1 = 1.48 in.) =	3.287	acre-feet	1.48	inches
25-yr Runoff Volume (P1 = 1.88 in.) =	4.380	acre-feet	1.88	inches
50-yr Runoff Volume (P1 = 2.24 in.) =	5.457	acre-feet	2.24	inches
100-yr Runoff Volume (P1 = 2.57 in.) =	6.531	acre-feet	2.57	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	8.333	acre-feet		inches
Approximate 2-yr Detention Volume =	1.830	acre-feet		
Approximate 5-yr Detention Volume =	2.455	acre-feet		
Approximate 10-yr Detention Volume =	3.036	acre-feet		
Approximate 25-yr Detention Volume =	4.030	acre-feet		
Approximate 50-yr Detention Volume =	4.680	acre-feet		
Approximate 100-yr Detention Volume =	5.205	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.905	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.608	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.692	acre-feet
Total Detention Basin Volume =	5.205	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 (S_{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 (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	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 (V_{total}) =	**user**	acre-feet

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
6996.53									
Top of Micropool	--	0.00	--	--	--	10	0.000		
6997	--	0.47	--	--	--	110	0.003	28	0.001
6998	--	1.47	--	--	--	6,291	0.144	3,229	0.074
6999	--	2.47	--	--	--	24,681	0.567	18,714	0.430
7000	--	3.47	--	--	--	42,835	0.983	52,472	1.205
7001	--	4.47	--	--	--	51,892	1.191	99,836	2.292
7002	--	5.47	--	--	--	58,705	1.348	155,134	3.561
7003	--	6.47	--	--	--	62,845	1.443	215,909	4.957
7004	--	7.47	--	--	--	67,648	1.553	281,156	6.454
7004.5	--	7.97	--	--	--	69,716	1.600	315,497	7.243
7005	--	8.47	--	--	--	72,420	1.663	351,031	8.059
7006-Top	--	9.47	--	--	--	77,197	1.772	425,839	9.776

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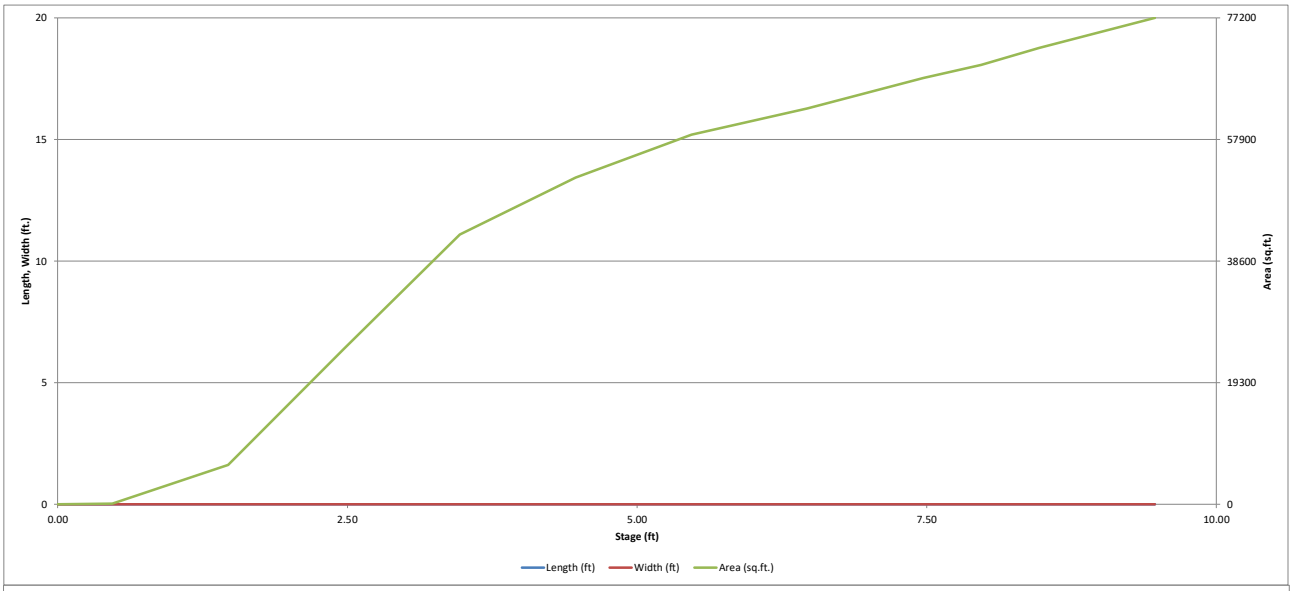
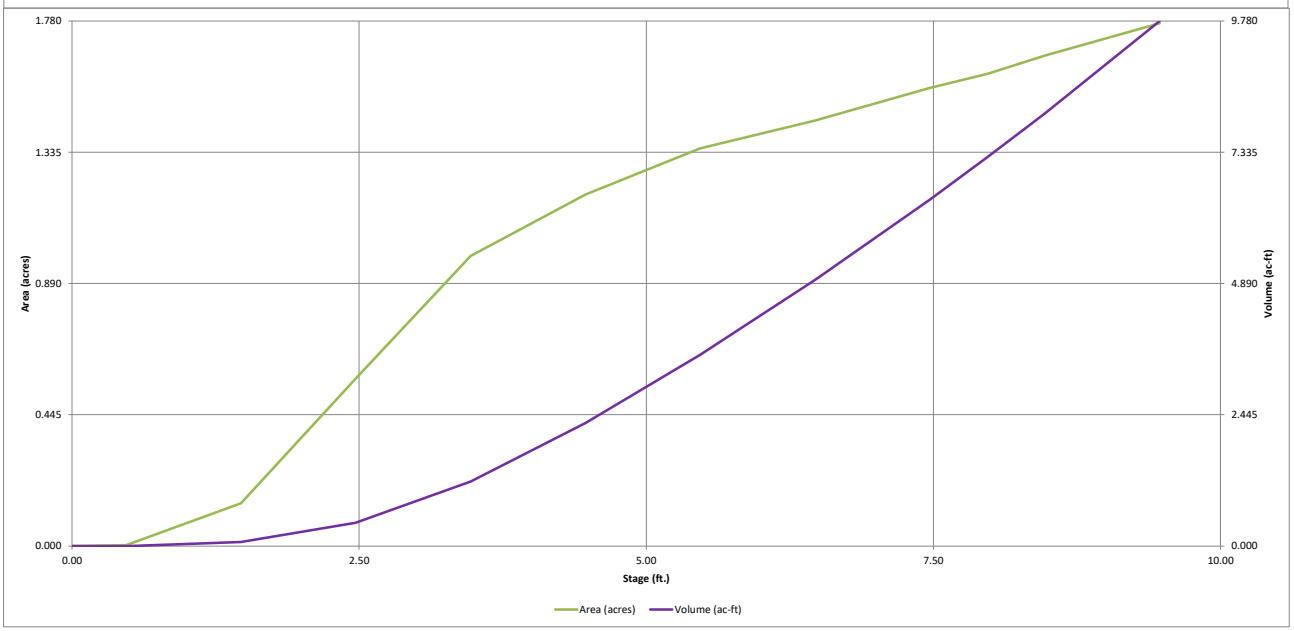


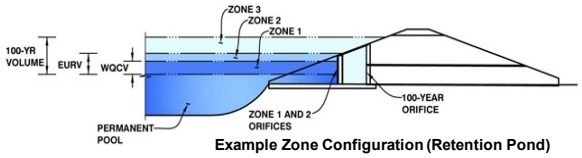


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Schmidt Phase 1 - District Infrastructure**

Basin ID: **Pond A**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.15	0.905	Orifice Plate
Zone 2 (EURV)	5.44	2.608	Rectangular Orifice
Zone 3 (100-year)	6.65	1.692	Weir&Pipe (Restrict)
Total (all zones)		5.205	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	3.09	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	sq. inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	1.10	2.10					
Orifice Area (sq. inches)	2.81	2.82	2.82					

	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)

	Zone 2 Rectangular	Not Selected			Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	3.09	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.09	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	5.28	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.08	N/A	feet
Vertical Orifice Height =	2.00	N/A	inches				
Vertical Orifice Width =	6.50		inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.58	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.58	N/A	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	Overflow Weir Slope Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	8.43	N/A	
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	11.14	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	5.57	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.83	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.32	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.59	N/A	feet
Restrictor Plate Height Above Pipe Invert =	12.60		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.98	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.93	feet
Spillway Crest Length =	31.00	feet	Stage at Top of Freeboard =	8.93	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.71	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	8.83	acre-ft

Calculated Parameters for Spillway

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).

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.95	1.23	1.48	1.88	2.24	2.57	3.14
CUHP Runoff Volume (acre-ft) =	0.905	3.513	1.992	2.661	3.287	4.380	5.457	6.531	8.333
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.992	2.661	3.287	4.380	5.457	6.531	8.333
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.2	0.4	2.7	10.1	18.2	31.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.01	0.01	0.07	0.27	0.49	0.83
Peak Inflow Q (cfs) =	N/A	N/A	28.0	36.7	44.8	63.2	80.3	97.6	124.8
Peak Outflow Q (cfs) =	0.4	1.2	0.9	1.1	1.2	4.3	12.2	16.6	32.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	5.1	3.2	1.6	1.2	0.9	1.0
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.3	1.0	1.4	1.4
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) =	38	67	54	61	66	72	70	69	66
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	58	65	71	78	77	77	76
Maximum Ponding Depth (ft) =	3.15	5.44	4.09	4.64	5.11	5.81	6.14	6.58	7.28
Area at Maximum Ponding Depth (acres) =	0.85	1.34	1.11	1.22	1.29	1.38	1.41	1.45	1.53
Maximum Volume Stored (acre-ft) =	0.911	3.521	1.843	2.485	3.086	4.025	4.486	5.116	6.161

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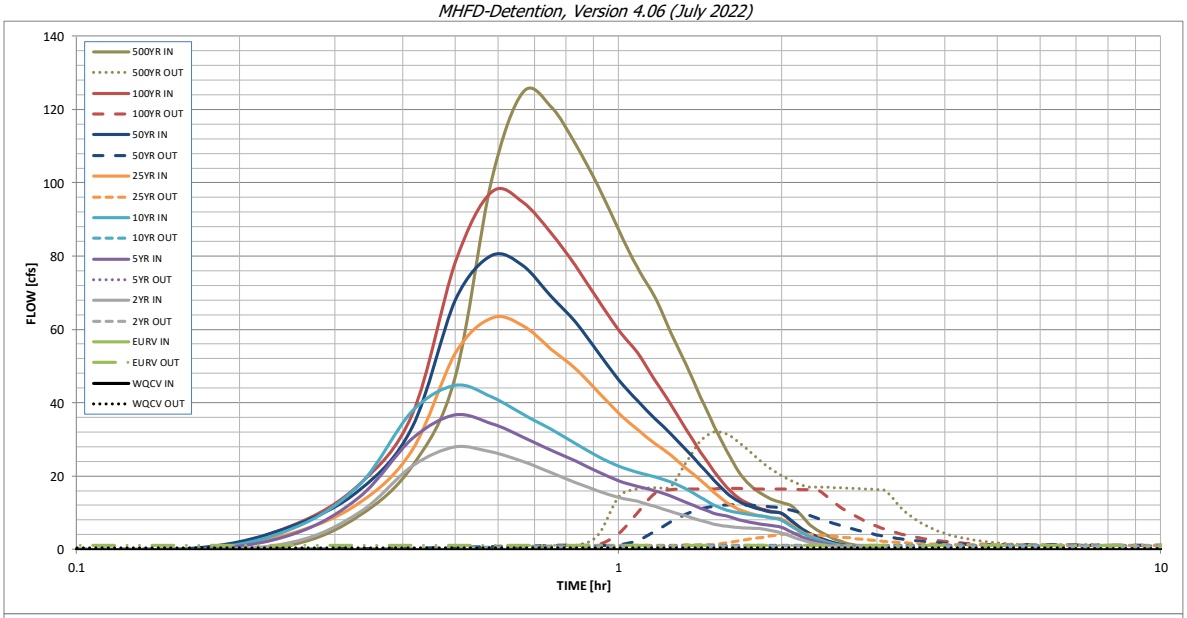

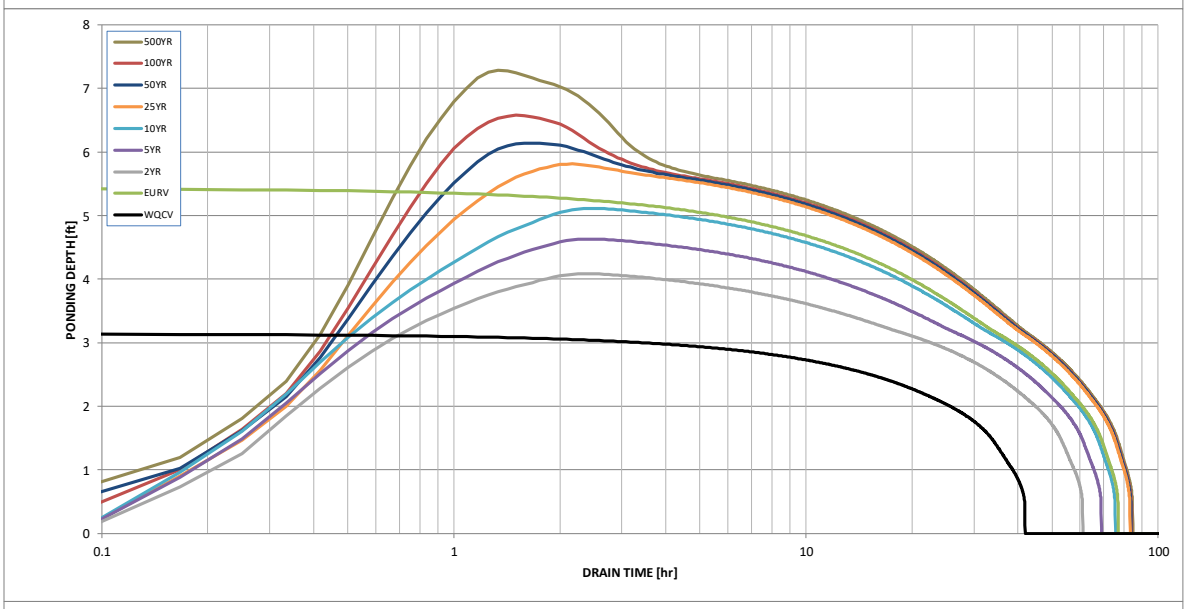

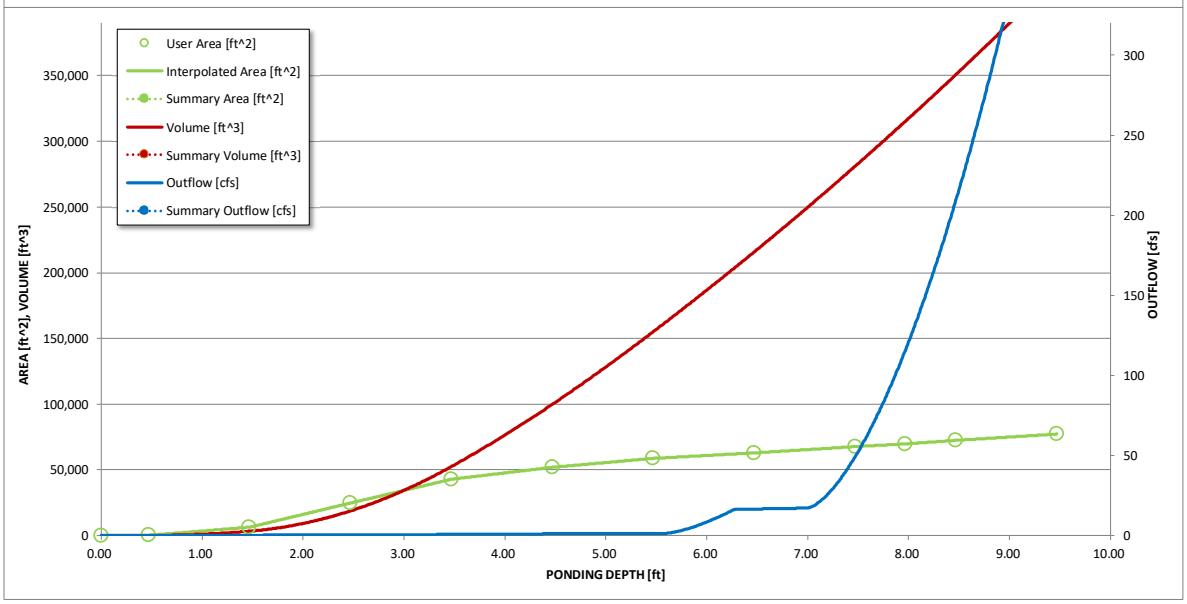

S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.15	1.39
	0:15:00	0.00	0.00	1.96	4.13	5.67	4.54	6.47	6.55	9.28
	0:20:00	0.00	0.00	10.17	14.41	17.82	12.83	16.29	17.90	22.85
	0:25:00	0.00	0.00	22.73	30.27	37.75	27.19	33.38	36.88	47.13
	0:30:00	0.00	0.00	27.98	36.69	44.83	53.49	68.05	78.35	100.82
	0:35:00	0.00	0.00	26.57	34.40	41.58	63.21	80.34	97.56	124.83
	0:40:00	0.00	0.00	24.02	30.64	36.92	61.10	77.42	94.72	120.98
	0:45:00	0.00	0.00	21.02	27.15	32.85	54.83	69.22	86.46	110.57
	0:50:00	0.00	0.00	18.32	24.16	28.92	49.33	62.03	77.42	99.29
	0:55:00	0.00	0.00	16.01	21.20	25.46	43.07	53.91	68.17	87.37
	1:00:00	0.00	0.00	14.26	18.82	22.81	37.28	46.41	60.01	76.85
	1:05:00	0.00	0.00	13.13	17.28	21.14	32.83	40.67	53.68	68.84
	1:10:00	0.00	0.00	11.73	16.08	19.81	28.99	35.78	46.27	59.18
	1:15:00	0.00	0.00	10.36	14.59	18.49	25.69	31.56	39.58	50.38
	1:20:00	0.00	0.00	9.12	12.88	16.59	22.18	27.13	32.81	41.62
	1:25:00	0.00	0.00	7.94	11.28	14.22	18.89	23.00	26.69	33.73
	1:30:00	0.00	0.00	6.96	9.97	12.19	15.65	18.95	21.43	26.95
	1:35:00	0.00	0.00	6.31	9.11	10.82	12.87	15.47	17.03	21.29
	1:40:00	0.00	0.00	5.98	8.20	10.03	11.00	13.15	14.05	17.50
	1:45:00	0.00	0.00	5.82	7.45	9.51	9.88	11.79	12.31	15.27
	1:50:00	0.00	0.00	5.71	6.92	9.13	9.15	10.91	11.17	13.79
	1:55:00	0.00	0.00	5.13	6.52	8.71	8.66	10.32	10.38	12.77
	2:00:00	0.00	0.00	4.54	6.07	8.02	8.31	9.90	9.82	12.04
	2:05:00	0.00	0.00	3.59	4.83	6.37	6.66	7.93	7.74	9.47
	2:10:00	0.00	0.00	2.72	3.65	4.81	5.00	5.95	5.74	7.00
	2:15:00	0.00	0.00	2.07	2.76	3.63	3.77	4.48	4.31	5.25
	2:20:00	0.00	0.00	1.55	2.07	2.71	2.83	3.36	3.24	3.95
	2:25:00	0.00	0.00	1.16	1.53	2.01	2.10	2.49	2.42	2.95
	2:30:00	0.00	0.00	0.85	1.11	1.47	1.53	1.82	1.78	2.16
	2:35:00	0.00	0.00	0.61	0.79	1.07	1.12	1.32	1.30	1.58
	2:40:00	0.00	0.00	0.43	0.56	0.77	0.82	0.97	0.95	1.15
	2:45:00	0.00	0.00	0.28	0.38	0.52	0.56	0.67	0.65	0.79
	2:50:00	0.00	0.00	0.16	0.24	0.32	0.36	0.42	0.41	0.50
	2:55:00	0.00	0.00	0.08	0.13	0.17	0.20	0.23	0.23	0.27
	3:00:00	0.00	0.00	0.03	0.06	0.07	0.09	0.10	0.10	0.11
	3:05:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

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.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]