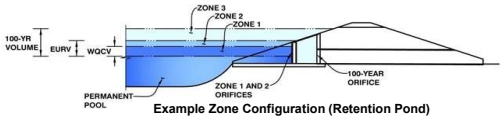
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Church at Bent Grass Meadows - FULL SPECTRUM DETENTION**

Basin ID: **Pond A**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	7.19	acres
Watershed Length =	1,186	ft
Watershed Length to Centroid =	260	ft
Watershed Slope =	0.023	ft/ft
Watershed Imperviousness =	78.60%	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) =	0.193	acre-feet	0.193	acre-feet
Excess Urban Runoff Volume (EURV) =	0.742	acre-feet	0.742	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.509	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.661	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.783	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.926	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.067	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.230	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.592	acre-feet		inches
Approximate 2-yr Detention Volume =	0.485	acre-feet		
Approximate 5-yr Detention Volume =	0.631	acre-feet		
Approximate 10-yr Detention Volume =	0.754	acre-feet		
Approximate 25-yr Detention Volume =	0.897	acre-feet		
Approximate 50-yr Detention Volume =	0.980	acre-feet		
Approximate 100-yr Detention Volume =	1.058	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.193	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.549	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.316	acre-feet
Total Detention Basin Volume =	1.058	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

6934.5

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)
Top of Micropool	--	0.00	--	--	--	11	0.000		
6935	--	0.50	--	--	--	11	0.000	6	0.000
6935.5	--	1.00	--	--	--	231	0.005	66	0.002
6936	--	1.50	--	--	--	1,150	0.026	411	0.009
6936.5	--	2.00	--	--	--	3,571	0.082	1,591	0.037
6937	--	2.50	--	--	--	6,687	0.154	4,156	0.095
6937.5	--	3.00	--	--	--	9,361	0.215	8,168	0.188
6938	--	3.50	--	--	--	11,792	0.271	13,456	0.309
6938.5	--	4.00	--	--	--	13,441	0.309	19,764	0.454
6939	--	4.50	--	--	--	14,415	0.331	26,728	0.614
6939.5	--	5.00	--	--	--	15,676	0.360	34,251	0.786
6940	--	5.50	--	--	--	16,745	0.384	42,356	0.972
6940.5	--	6.00	--	--	--	17,809	0.409	50,995	1.171
6941	--	6.50	--	--	--	18,869	0.433	60,164	1.381
6941.5	--	7.00	--	--	--	20,052	0.460	69,895	1.605

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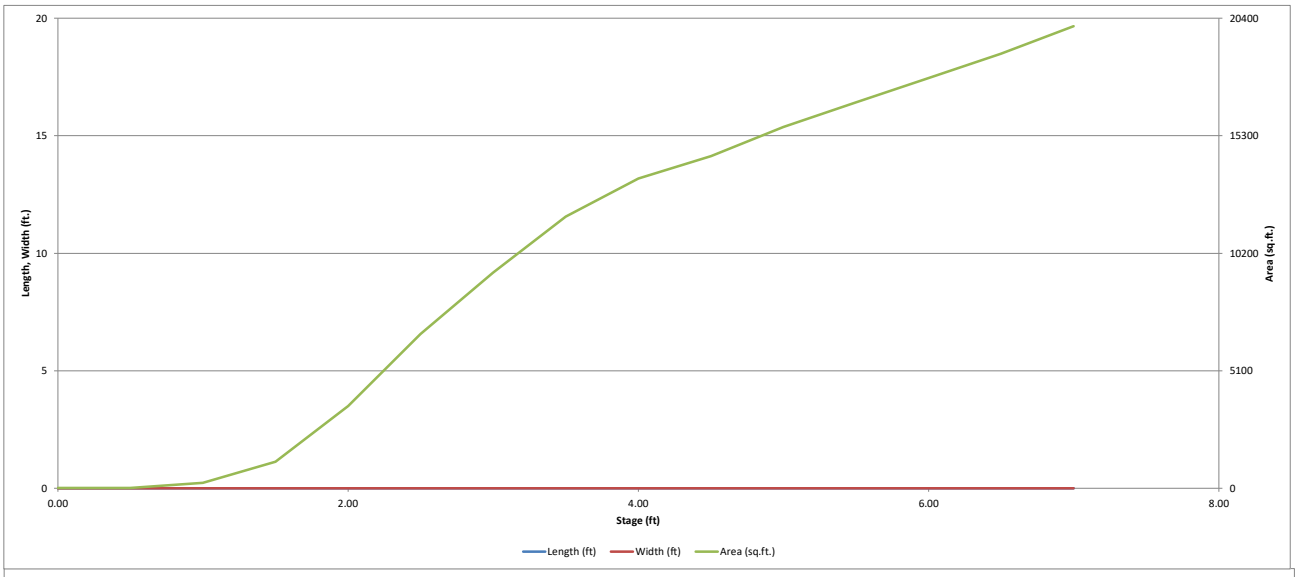
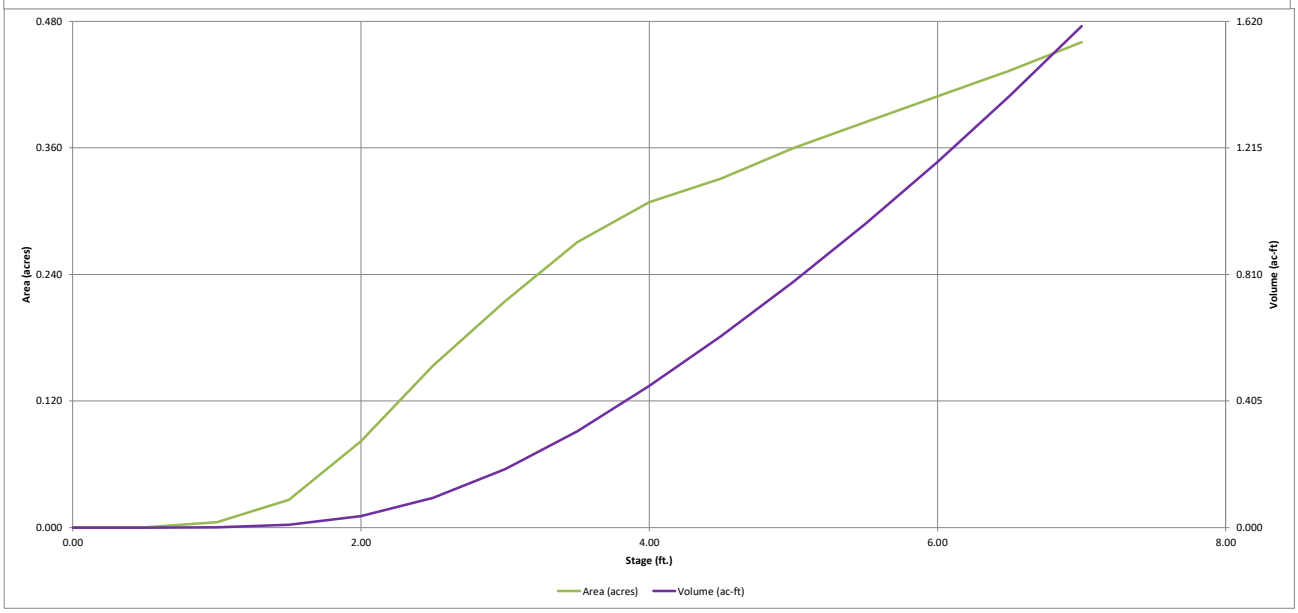
MHFD-Detention, Version 4.06 (July 2022)



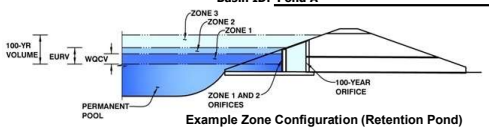


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Church at Bent Grass Meadows - FULL SPECTRUM DETENTION**

Basin ID: **Pond A**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.03	0.193	Orifice Plate
Zone 2 (EURV)	4.88	0.549	Rectangular Orifice
Zone 3 (100-year)	5.73	0.316	Weir&Pipe (Restrict)
Total (all zones)		1.058	

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

Underdrain Orifice Invert Depth =		ft (distance below the filtration media surface)	Underdrain Orifice Area =		ft^2
Underdrain Orifice Diameter =		inches	Underdrain Orifice Centroid =		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 =	2.75	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	16.00	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	1.30	2.60					
Orifice Area (sq. inches)	0.69	0.69	0.15					

	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 =	3.25	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.05	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	4.88	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.11	N/A	feet
Vertical Orifice Height =	2.75	N/A	inches				
Vertical Orifice Width =	2.75		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 =	4.90	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.90	N/A	feet
Overflow Weir Front Edge Length =	3.00	N/A	feet	Overflow Weir Slope Length =	3.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	11.49	N/A	
Horiz. Length of Weir Sides =	3.00	N/A	feet	Overflow Grate Open Area w/o Debris =	6.26	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	6.26	N/A	ft^2
Debris Clogging % =	0%	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 =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.55	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.30	N/A	feet
Restrictor Plate Height Above Pipe Invert =	6.25		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.26	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.30	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.59	feet
Spillway Crest Length =	15.00	feet	Stage at Top of Freeboard =	6.89	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.45	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.55	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	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.193	0.742	0.509	0.661	0.783	0.926	1.067	1.230	1.592
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.509	0.661	0.783	0.926	1.067	1.230	1.592
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.1	0.2	1.4	2.8	4.6	8.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.02	0.19	0.39	0.63	1.13
Peak Inflow Q (cfs) =	N/A	N/A	9.4	11.9	13.7	16.8	19.4	23.2	30.0
Peak Outflow Q (cfs) =	0.1	0.4	0.3	0.37	0.4	1.8	3.8	5.99	12.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	3.3	2.7	1.3	1.4	1.3	1.5
Structure Controlling Flow =	Plate	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	0.2	0.6	0.9	0.9
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	66	61	65	67	68	67	65	63
Time to Drain 99% of Inflow Volume (hours) =	**40**	70	64	69	72	73	72	72	71
Maximum Ponding Depth (ft) =	3.03	4.88	4.06	4.49	4.83	5.01	5.10	5.26	5.55
Area at Maximum Ponding Depth (acres) =	0.22	0.35	0.31	0.33	0.35	0.36	0.36	0.37	0.39
Maximum Volume Stored (acre-ft) =	0.194	0.744	0.469	0.610	0.726	0.786	0.819	0.882	0.988

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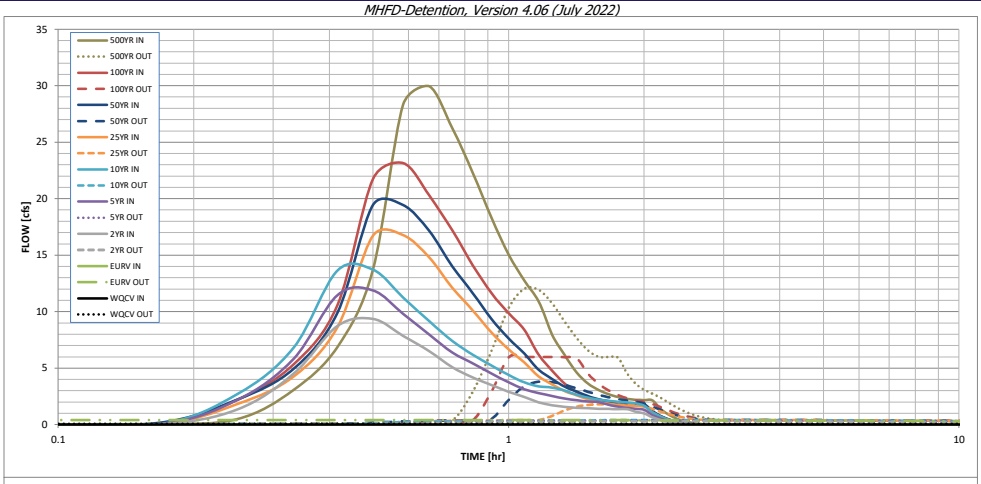

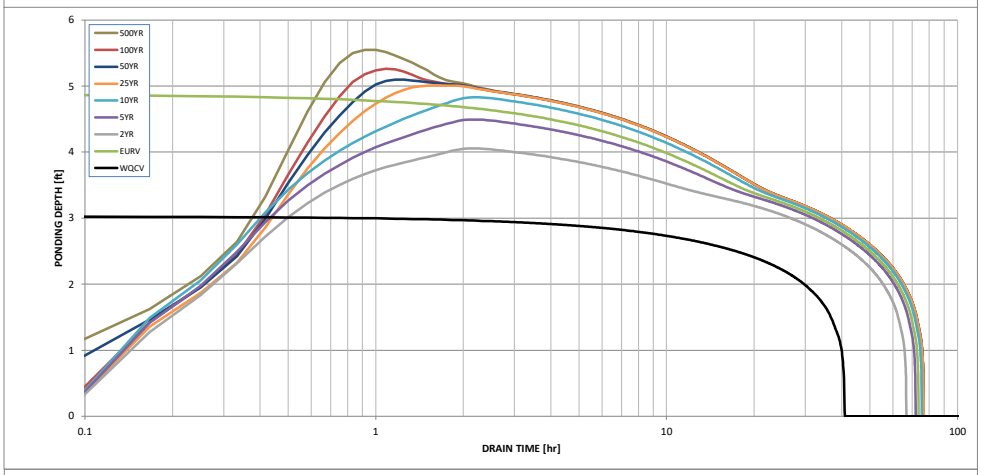

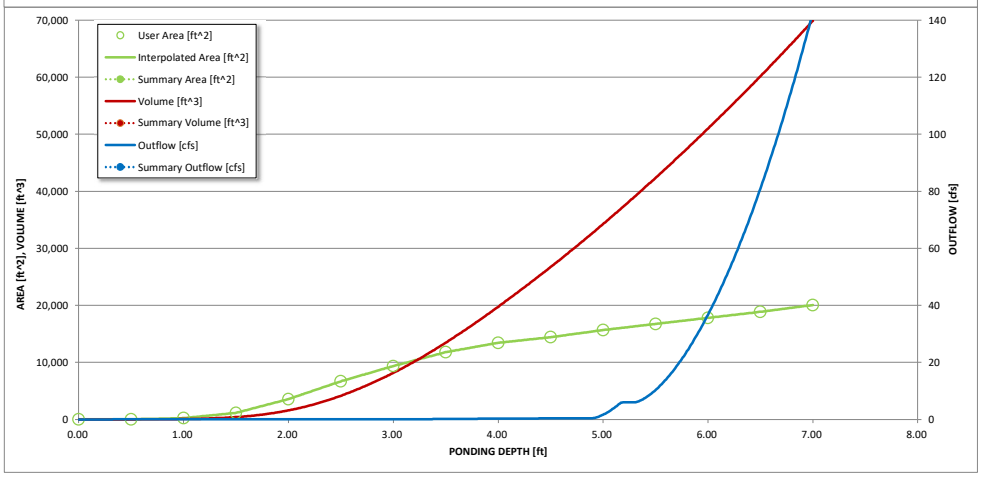

S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

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	0.15	0.02	0.48
	0:15:00	0.00	0.00	1.34	2.18	2.69	1.81	2.23	2.20	3.07
	0:20:00	0.00	0.00	4.51	5.83	6.81	4.27	4.94	5.33	6.87
	0:25:00	0.00	0.00	8.73	11.46	13.63	8.61	9.89	10.57	13.72
	0:30:00	0.00	0.00	9.35	11.88	13.71	16.72	19.45	21.74	28.31
	0:35:00	0.00	0.00	7.86	9.80	11.26	16.77	19.43	23.16	29.95
	0:40:00	0.00	0.00	6.50	7.97	9.15	14.80	17.15	20.28	26.24
	0:45:00	0.00	0.00	5.07	6.40	7.41	12.12	14.00	17.19	22.27
	0:50:00	0.00	0.00	4.17	5.43	6.17	10.10	11.63	14.10	18.29
	0:55:00	0.00	0.00	3.50	4.52	5.22	8.14	9.34	11.63	15.06
	1:00:00	0.00	0.00	2.91	3.74	4.39	6.66	7.63	9.86	12.77
	1:05:00	0.00	0.00	2.46	3.14	3.73	5.50	6.30	8.41	10.90
	1:10:00	0.00	0.00	1.97	2.79	3.39	4.27	4.86	6.18	7.95
	1:15:00	0.00	0.00	1.71	2.53	3.28	3.56	4.03	4.78	6.13
	1:20:00	0.00	0.00	1.57	2.30	3.01	2.96	3.34	3.61	4.61
	1:25:00	0.00	0.00	1.49	2.15	2.63	2.60	2.93	2.88	3.65
	1:30:00	0.00	0.00	1.45	2.05	2.38	2.23	2.52	2.44	3.08
	1:35:00	0.00	0.00	1.41	1.99	2.21	1.99	2.25	2.14	2.69
	1:40:00	0.00	0.00	1.39	1.76	2.10	1.84	2.07	1.95	2.44
	1:45:00	0.00	0.00	1.37	1.59	2.02	1.74	1.96	1.83	2.28
	1:50:00	0.00	0.00	1.37	1.48	1.97	1.68	1.89	1.77	2.20
	1:55:00	0.00	0.00	1.14	1.40	1.87	1.64	1.85	1.74	2.17
	2:00:00	0.00	0.00	0.99	1.31	1.67	1.62	1.82	1.74	2.17
	2:05:00	0.00	0.00	0.66	0.87	1.12	1.08	1.22	1.17	1.45
	2:10:00	0.00	0.00	0.43	0.57	0.73	0.72	0.80	0.77	0.96
	2:15:00	0.00	0.00	0.28	0.36	0.47	0.46	0.52	0.50	0.62
	2:20:00	0.00	0.00	0.17	0.22	0.29	0.29	0.32	0.31	0.38
	2:25:00	0.00	0.00	0.10	0.14	0.18	0.18	0.20	0.19	0.24
	2:30:00	0.00	0.00	0.05	0.07	0.09	0.10	0.11	0.11	0.13
	2:35:00	0.00	0.00	0.02	0.03	0.04	0.04	0.05	0.04	0.05
	2:40:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	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]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).