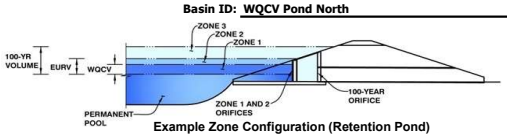
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.07 (June 2025)

Project: The Markets At Bent Grass

Basin ID: WQCV Pond North



Example Zone Configuration (Retention Pond)

Watershed Information

Selected SCM Type =	EDB	
Watershed Area =	13.39	acres
Watershed Length =	1,000	ft
Watershed Length to Centroid =	500	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	87.40%	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) =	0.424	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.578	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.95 in.) =	0.832	acre-feet	0.95	inches
5-yr Runoff Volume (P1 = 1.22 in.) =	1.101	acre-feet	1.22	inches
10-yr Runoff Volume (P1 = 1.48 in.) =	1.362	acre-feet	1.48	inches
25-yr Runoff Volume (P1 = 1.87 in.) =	1.773	acre-feet	1.87	inches
50-yr Runoff Volume (P1 = 2.19 in.) =	2.120	acre-feet	2.19	inches
100-yr Runoff Volume (P1 = 2.55 in.) =	2.527	acre-feet	2.55	inches
500-yr Runoff Volume (P1 = 3.47 in.) =	3.554	acre-feet	3.47	inches
Approximate 2-yr Detention Volume =	0.830	acre-feet		
Approximate 5-yr Detention Volume =	1.097	acre-feet		
Approximate 10-yr Detention Volume =	1.356	acre-feet		
Approximate 25-yr Detention Volume =	1.771	acre-feet		
Approximate 50-yr Detention Volume =	2.008	acre-feet		
Approximate 100-yr Detention Volume =	2.238	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.424	acre-feet
Zone 2 Volume (User Defined - Zone 1) =	0.691	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	1.115	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	

Total detention volume is less than 100-year volume.

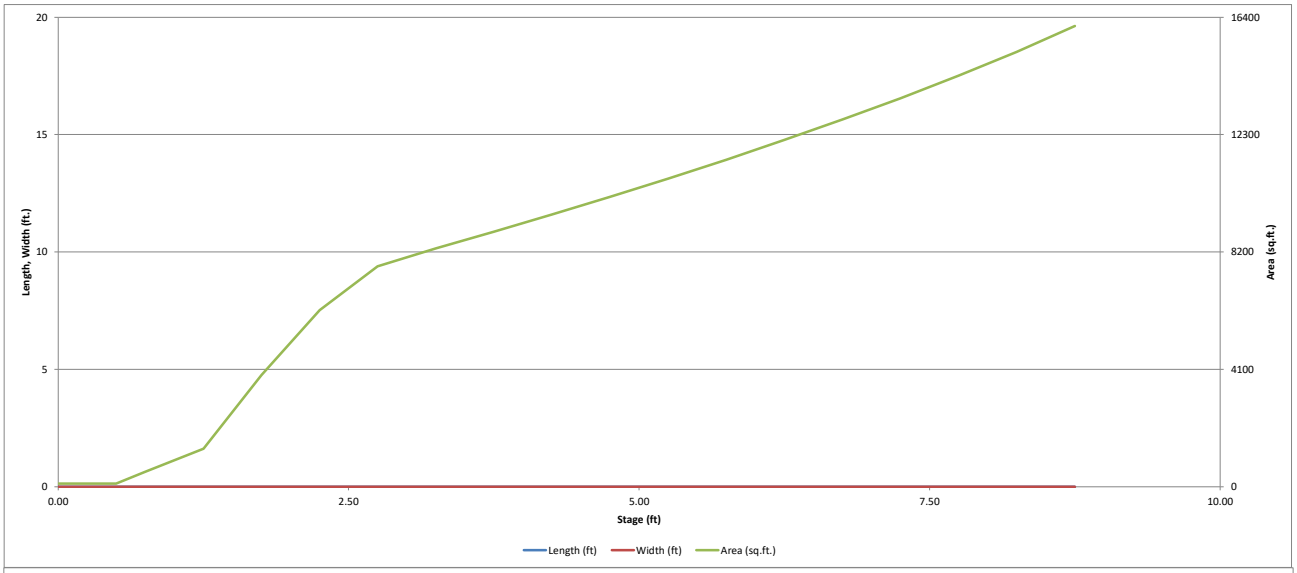
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

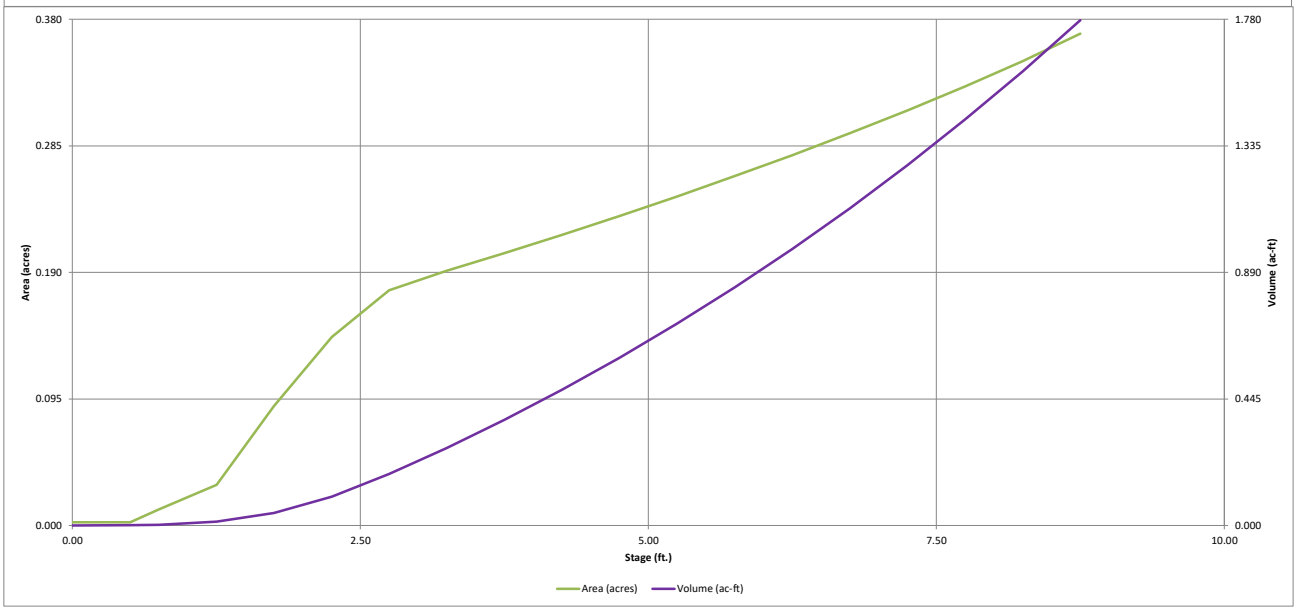
Depth Increment = 0.10 ft

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	--	--	--	111	0.003		
6908.75	--	0.50	--	--	--	111	0.003	56	0.001
6909	--	0.75	--	--	--	527	0.012	135	0.003
	--	1.25	--	--	--	1,332	0.031	600	0.014
6910	--	1.75	--	--	--	3,901	0.090	1,908	0.044
	--	2.25	--	--	--	6,167	0.142	4,425	0.102
6911	--	2.75	--	--	--	7,697	0.177	7,891	0.181
	--	3.25	--	--	--	8,328	0.191	11,897	0.273
6912	--	3.75	--	--	--	8,909	0.205	16,207	0.372
	--	4.25	--	--	--	9,508	0.218	20,811	0.478
6913	--	4.75	--	--	--	10,126	0.232	25,719	0.590
	--	5.25	--	--	--	10,764	0.247	30,942	0.710
6914	--	5.75	--	--	--	11,426	0.262	36,489	0.838
	--	6.25	--	--	--	12,113	0.278	42,374	0.973
6915	--	6.75	--	--	--	12,828	0.294	48,609	1.116
	--	7.25	--	--	--	13,574	0.312	55,210	1.267
6916	--	7.75	--	--	--	14,358	0.330	62,193	1.428
	--	8.25	--	--	--	15,188	0.349	69,579	1.597
6917	--	8.75	--	--	--	16,091	0.369	77,399	1.777

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.07 (June 2025)



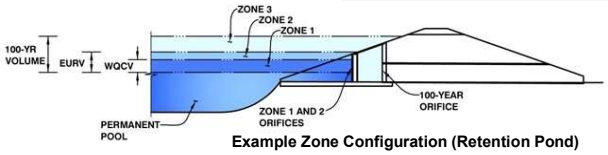


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)

Project: **The Markets At Bent Grass**

Basin ID: **WQCV Pond North**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.01	0.424	Orifice Plate
Zone 2 (User)	6.75	0.691	Weir&Pipe (Circular)
Zone 3			
Total (all zones)		1.115	

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

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 SCM)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.167E-02	ft^2
Depth at top of Zone using Orifice Plate =	4.01	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 =	1.68	sq. inches (diameter = 1-7/16 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	2.00						
Orifice Area (sq. inches)	1.68	1.68						

	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)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =			ft^2
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =			feet
Vertical Orifice Diameter =			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 2 Weir	Not Selected			Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.25		ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.25		feet
Overflow Weir Front Edge Length =	6.00		feet	Overflow Weir Slope Length =	4.12		feet
Overflow Weir Grate Slope =	4.00		H:V	Grate Open Area / 100-yr Orifice Area =	6.23		
Horiz. Length of Weir Sides =	4.00		feet	Overflow Grate Open Area w/o Debris =	19.57		ft^2
Overflow Grate Type =	Close Mesh Grate			Overflow Grate Open Area w/ Debris =	9.78		ft^2
Debris Clogging % =	50%		%				

Calculated Parameters for Overflow Weir

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

	Zone 2 Circular	Not Selected			Zone 2 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	0.33		ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	3.14		ft^2
Circular Orifice Diameter =	24.00		inches	Outlet Orifice Centroid =	1.00		feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.75	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.73	feet
Spillway Crest Length =	25.00	feet	Stage at Top of Freeboard =	8.48	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.36	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.68	acre-ft

Calculated Parameters for Spillway

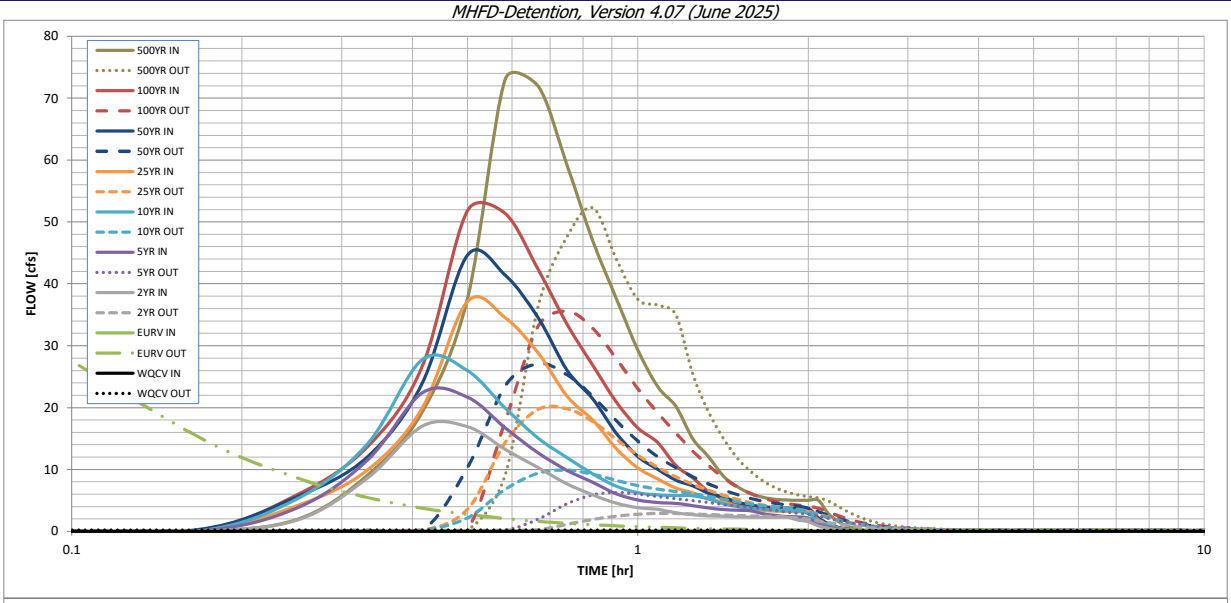
Routed Hydrograph Results

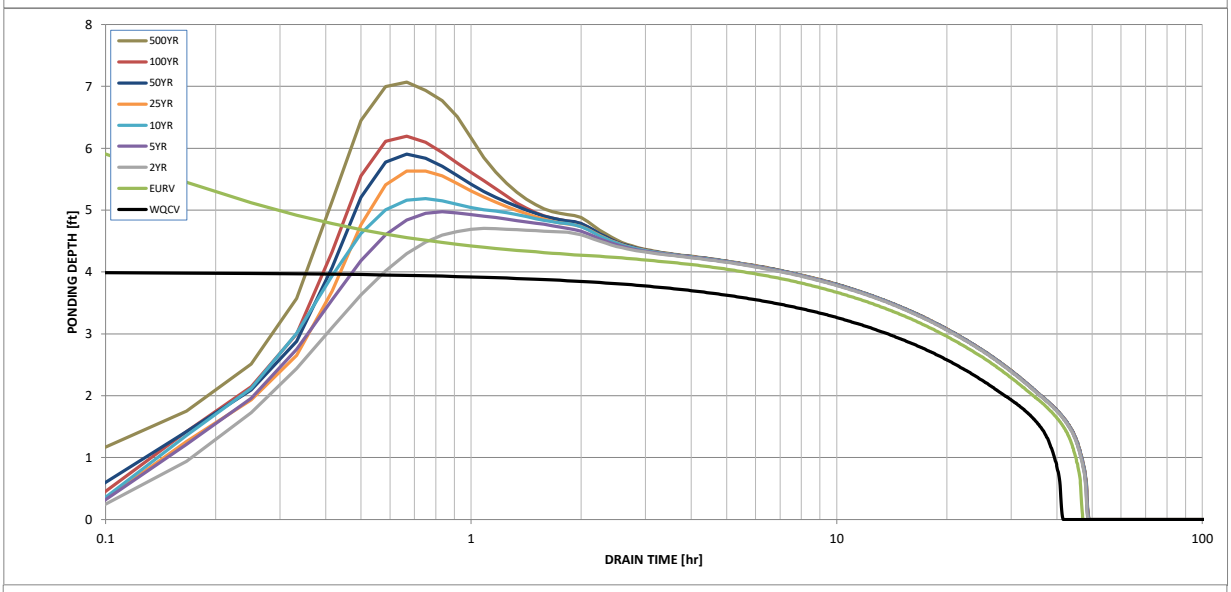
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

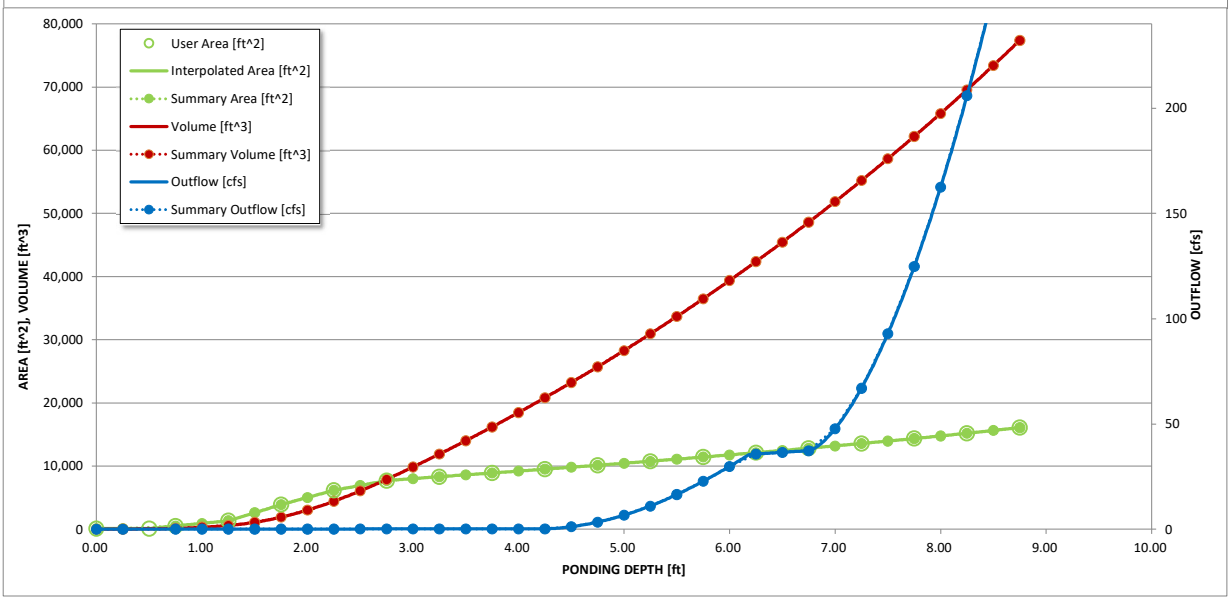
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.95	1.22	1.48	1.87	2.19	2.55	3.47
CUHP Runoff Volume (acre-ft) =	0.424	1.578	0.832	1.101	1.362	1.773	2.120	2.527	3.554
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.832	1.101	1.362	1.773	2.120	2.527	3.554
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.3	0.6	2.2	5.9	10.9	22.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.02	0.04	0.16	0.44	0.81	1.70
Peak Inflow Q (cfs) =	N/A	N/A	17.0	22.4	27.8	37.1	44.6	51.8	73.1
Peak Outflow Q (cfs) =	0.2	79.0	2.9	6.3	9.9	19.8	27.1	35.6	52.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	19.7	17.4	9.2	4.6	3.3	2.3
Structure Controlling Flow =	Plate	Spillway	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	2.11	0.14	0.3	0.5	1.0	1.4	1.8	1.9
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	39	43	42	41	39	37	35	32
Time to Drain 99% of Inflow Volume (hours) =	**40**	44	46	46	46	45	44	43	42
Maximum Ponding Depth (ft) =	4.00	8.20	4.70	4.97	5.19	5.63	5.91	6.20	7.07
Area at Maximum Ponding Depth (acres) =	0.21	0.35	0.23	0.24	0.25	0.26	0.27	0.28	0.31
Maximum Volume Stored (acre-ft) =	0.424	1.580	0.579	0.642	0.693	0.806	0.877	0.956	1.209

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)







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	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	0.26	0.10	1.94
	0:15:00	0	0.00	1.83	3.76	5.25	4.14	5.61	5.91	9.12
	0:20:00	0	0.00	8.65	11.53	14.18	9.92	12.08	13.69	19.33
	0:25:00	0	0.00	17.02	22.40	27.77	19.98	24.02	26.72	37.61
	0:30:00	0	0.00	16.92	21.69	25.95	37.11	44.63	51.83	73.09
	0:35:00	0	0.00	13.22	16.70	19.93	34.52	41.39	51.37	71.92
	0:40:00	0	0.00	10.30	12.66	15.06	28.81	34.50	42.30	59.17
	0:45:00	0	0.00	7.67	9.85	11.92	21.81	26.03	33.48	46.87
	0:50:00	0	0.00	5.88	7.90	9.25	17.95	21.37	26.78	37.61
	0:55:00	0	0.00	4.54	6.05	7.28	13.35	15.85	20.89	29.30
	1:00:00	0	0.00	3.83	5.05	6.24	10.22	12.12	16.69	23.41
	1:05:00	0	0.00	3.56	4.66	5.90	8.46	10.04	14.37	20.21
	1:10:00	0	0.00	3.00	4.53	5.78	7.01	8.27	10.67	14.97
	1:15:00	0	0.00	2.69	4.16	5.74	6.24	7.34	8.63	12.08
	1:20:00	0	0.00	2.51	3.77	5.21	5.25	6.16	6.42	8.92
	1:25:00	0	0.00	2.42	3.53	4.46	4.72	5.54	5.22	7.21
	1:30:00	0	0.00	2.35	3.40	4.00	4.03	4.72	4.45	6.10
	1:35:00	0	0.00	2.31	3.32	3.73	3.63	4.25	4.01	5.48
	1:40:00	0	0.00	2.30	2.85	3.57	3.39	3.97	3.81	5.19
	1:45:00	0	0.00	2.30	2.57	3.46	3.27	3.83	3.72	5.07
	1:50:00	0	0.00	2.30	2.41	3.41	3.20	3.75	3.70	5.03
	1:55:00	0	0.00	1.83	2.32	3.25	3.17	3.72	3.70	5.03
	2:00:00	0	0.00	1.54	2.14	2.87	3.17	3.71	3.70	5.03
	2:05:00	0	0.00	0.89	1.24	1.68	1.86	2.18	2.17	2.96
	2:10:00	0	0.00	0.51	0.71	0.97	1.08	1.27	1.26	1.72
	2:15:00	0	0.00	0.26	0.39	0.52	0.59	0.69	0.69	0.93
	2:20:00	0	0.00	0.13	0.21	0.27	0.32	0.38	0.38	0.51
	2:25:00	0	0.00	0.05	0.09	0.11	0.14	0.16	0.16	0.21
	2:30:00	0	0.00	0.01	0.02	0.02	0.03	0.03	0.03	0.04
	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.

Stage - Storage Description	Stage [ft]	Elevation [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
Top of Micropool	0.00	6908.25	111	0.003	0	0.000	0.00
	0.25	6908.50	111	0.003	28	0.001	0.03
	0.75	6909.00	527	0.012	135	0.003	0.05
	1.00	6909.25	930	0.021	317	0.007	0.06
	1.25	6909.50	1332	0.031	600	0.014	0.06
	1.50	6909.75	2617	0.060	1094	0.025	0.07
	1.75	6910.00	3901	0.090	1908	0.044	0.07
	2.00	6910.25	5034	0.116	3025	0.069	0.08
	2.25	6910.50	6167	0.142	4425	0.102	0.11
	2.50	6910.75	6932	0.159	6063	0.139	0.13
	2.75	6911.00	7697	0.177	7891	0.181	0.14
	3.00	6911.25	8012	0.184	9855	0.226	0.15
	3.25	6911.50	8328	0.191	11897	0.273	0.16
	3.50	6911.75	8618	0.198	14016	0.322	0.17
	3.75	6912.00	8909	0.205	16207	0.372	0.18
	4.00	6912.25	9208	0.211	18471	0.424	0.19
Top of WQ Zone	4.25	6912.50	9508	0.218	20811	0.478	0.20
	4.50	6912.75	9817	0.225	23227	0.533	1.22
	4.75	6913.00	10126	0.232	25719	0.590	3.40
	5.00	6913.25	10445	0.240	28291	0.649	6.69
	5.25	6913.50	10764	0.247	30942	0.710	11.02
	5.50	6913.75	11095	0.255	33674	0.773	16.49
	5.75	6914.00	11426	0.262	36489	0.838	22.80
	6.00	6914.25	11769	0.270	39389	0.904	29.84
	6.25	6914.50	12113	0.278	42374	0.973	35.73
	6.50	6914.75	12470	0.286	45447	1.043	36.52
Spillway Crest	6.75	6915.00	12828	0.294	48609	1.116	37.30
	7.00	6915.25	13201	0.303	51863	1.191	47.73
	7.25	6915.50	13574	0.312	55210	1.267	67.02
	7.50	6915.75	13966	0.321	58652	1.346	92.92
	7.75	6916.00	14358	0.330	62193	1.428	124.85
	8.00	6916.25	14773	0.339	65834	1.511	162.54
	8.25	6916.50	15188	0.349	69579	1.597	205.88
	8.50	6916.75	15639	0.359	73433	1.686	254.85
	8.75	6917.00	16091	0.369	77399	1.777	309.44

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'.

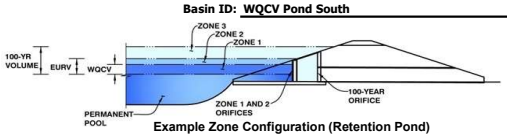
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.07 (June 2025)

Project: The Markets at Bent Grass

Basin ID: WQCV Pond South



Example Zone Configuration (Retention Pond)

Watershed Information

Selected SCM Type =	**EDB**	
Watershed Area =	28.94	acres
Watershed Length =	1,285	ft
Watershed Length to Centroid =	645	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	83.70%	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) =	0.851	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	3.226	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.95 in.) =	1.741	acre-feet	0.95	inches
5-yr Runoff Volume (P1 = 1.22 in.) =	2.303	acre-feet	1.22	inches
10-yr Runoff Volume (P1 = 1.48 in.) =	2.854	acre-feet	1.48	inches
25-yr Runoff Volume (P1 = 1.87 in.) =	3.729	acre-feet	1.87	inches
50-yr Runoff Volume (P1 = 2.19 in.) =	4.480	acre-feet	2.19	inches
100-yr Runoff Volume (P1 = 2.55 in.) =	5.368	acre-feet	2.55	inches
500-yr Runoff Volume (P1 = 3.47 in.) =	7.608	acre-feet	3.47	inches
Approximate 2-yr Detention Volume =	1.694	acre-feet		
Approximate 5-yr Detention Volume =	2.242	acre-feet		
Approximate 10-yr Detention Volume =	2.777	acre-feet		
Approximate 25-yr Detention Volume =	3.636	acre-feet		
Approximate 50-yr Detention Volume =	4.129	acre-feet		
Approximate 100-yr Detention Volume =	4.614	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.851	acre-feet
Zone 2 Volume (User Defined - Zone 1) =	1.009	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	1.860	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	

Total detention volume is less than 100-year volume.

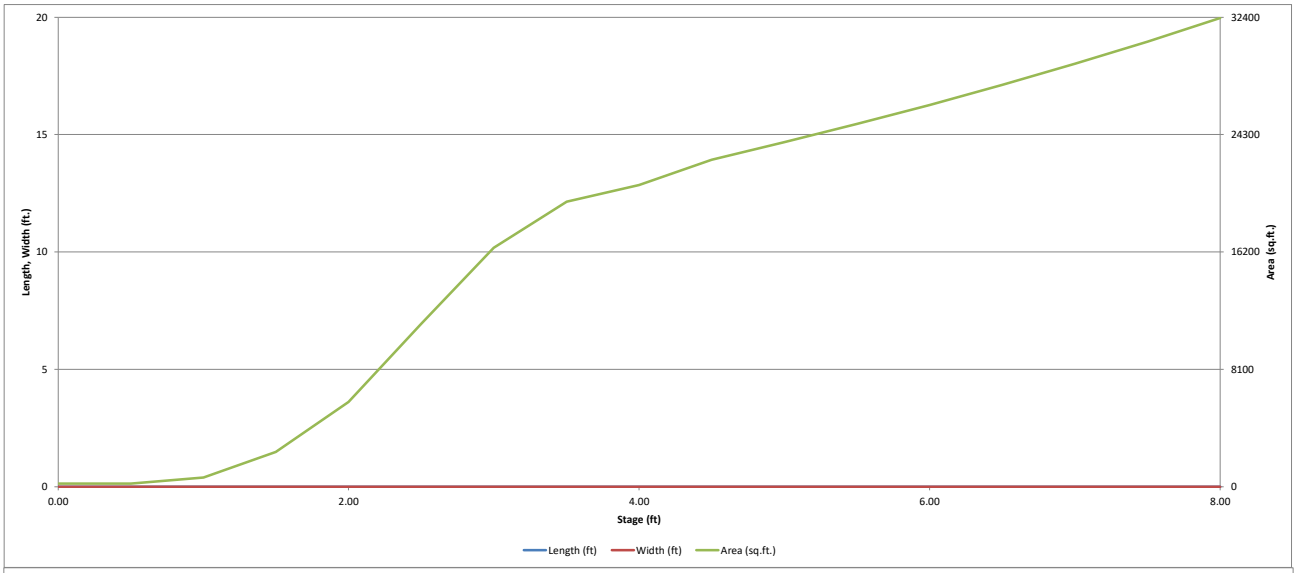
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	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

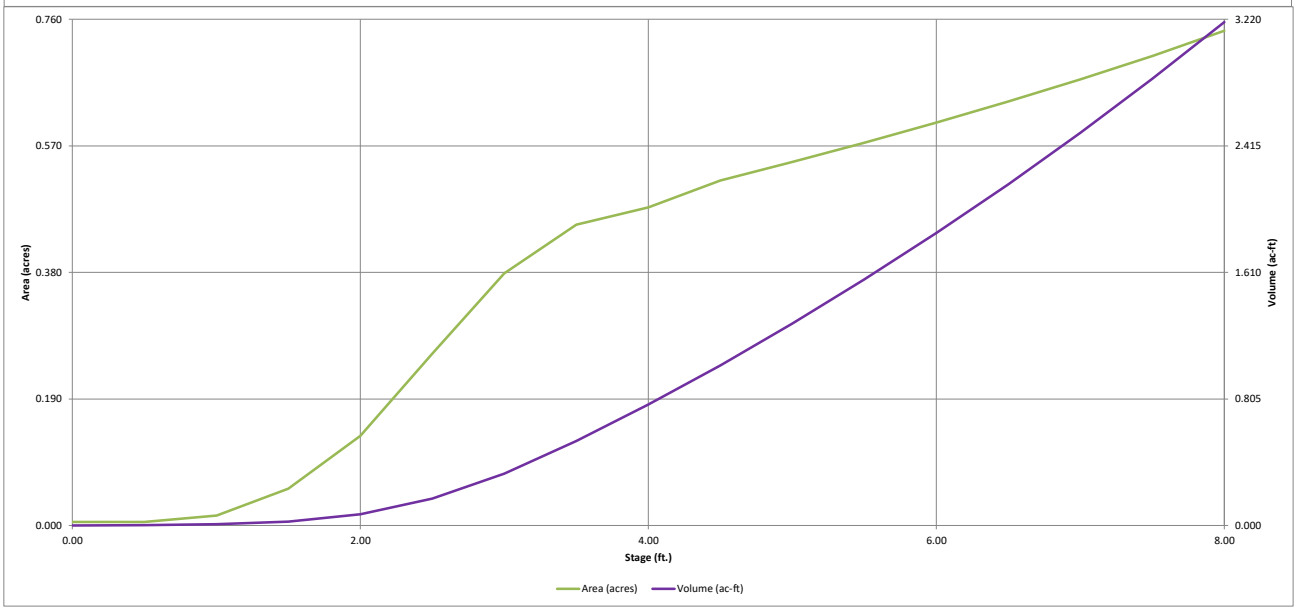
Depth Increment = 0.50 ft

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	--	--	--	231	0.005		
6893	--	0.50	--	--	--	231	0.005	116	0.003
	--	1.00	--	--	--	651	0.015	336	0.008
6894	--	1.50	--	--	--	2,399	0.055	1,098	0.025
	--	2.00	--	--	--	5,861	0.135	3,163	0.073
6895	--	2.50	--	--	--	11,249	0.258	7,441	0.171
	--	3.00	--	--	--	16,498	0.379	14,378	0.330
6896	--	3.50	--	--	--	19,676	0.452	23,421	0.538
	--	4.00	--	--	--	20,816	0.478	33,544	0.770
6897	--	4.50	--	--	--	22,562	0.518	44,389	1.019
	--	5.00	--	--	--	23,784	0.546	55,975	1.285
6898	--	5.50	--	--	--	25,050	0.575	68,184	1.565
	--	6.00	--	--	--	26,355	0.605	81,035	1.860
6899	--	6.50	--	--	--	27,737	0.637	94,558	2.171
	--	7.00	--	--	--	29,187	0.670	108,789	2.497
6900	--	7.50	--	--	--	30,713	0.705	123,764	2.841
	--	8.00	--	--	--	32,356	0.743	139,531	3.203

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.07 (June 2025)



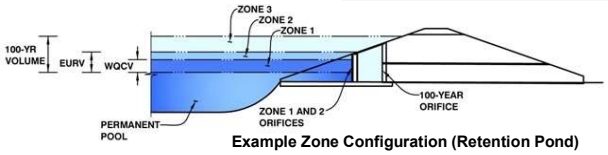


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)

Project: **The Markets at Bent Grass**

Basin ID: **WQCV Pond South**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.17	0.851	Orifice Plate
Zone 2 (User)	6.00	1.009	Weir&Pipe (Circular)
Zone 3			
Total (all zones)		1.860	

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 = ft^2

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 = 0.00 ft (relative to basin bottom at Stage = 0 ft)

Depth at top of Zone using Orifice Plate = 4.17 ft (relative to basin bottom at Stage = 0 ft)

Orifice Plate: Orifice Vertical Spacing = N/A inches

Orifice Plate: Orifice Area per Row = 2.95 sq. inches (diameter = 1-15/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row = 2.049E-02 ft^2

Elliptical Half-Width = N/A feet

Elliptical Slot Centroid = N/A feet

Elliptical Slot Area = N/A ft^2

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	2.00						
Orifice Area (sq. inches)	2.95	2.95						

	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)

	Not Selected	Not Selected	
Invert of Vertical Orifice =		N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =		N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =		N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =		N/A	ft^2
Vertical Orifice Centroid =		N/A	feet

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

	Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.25		ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	20.00		feet
Overflow Weir Grate Slope =	4.00		H:V
Horiz. Length of Weir Sides =	4.00		feet
Overflow Grate Type =	Close Mesh Grate		
Debris Clogging % =	50%		%

Calculated Parameters for Overflow Weir

	Zone 2 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	5.25		feet
Overflow Weir Slope Length =	4.12		feet
Grate Open Area / 100-yr Orifice Area =	6.94		
Overflow Grate Open Area w/o Debris =	65.23		ft^2
Overflow Grate Open Area w/ Debris =	32.61		ft^2

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

	Zone 2 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	2.50		ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	41.50		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 2 Circular	Not Selected	
Outlet Orifice Area =	9.39		ft^2
Outlet Orifice Centroid =	1.73		feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage= 6.25 ft (relative to basin bottom at Stage = 0 ft)

Spillway Crest Length = 100.00 feet

Spillway End Slopes = 6.67 H:V

Freeboard above Max Water Surface = 1.00 feet

Calculated Parameters for Spillway

Spillway Design Flow Depth= 0.49 feet

Stage at Top of Freeboard = 7.74 feet

Basin Area at Top of Freeboard = 0.72 acres

Basin Volume at Top of Freeboard = 3.01 acre-ft

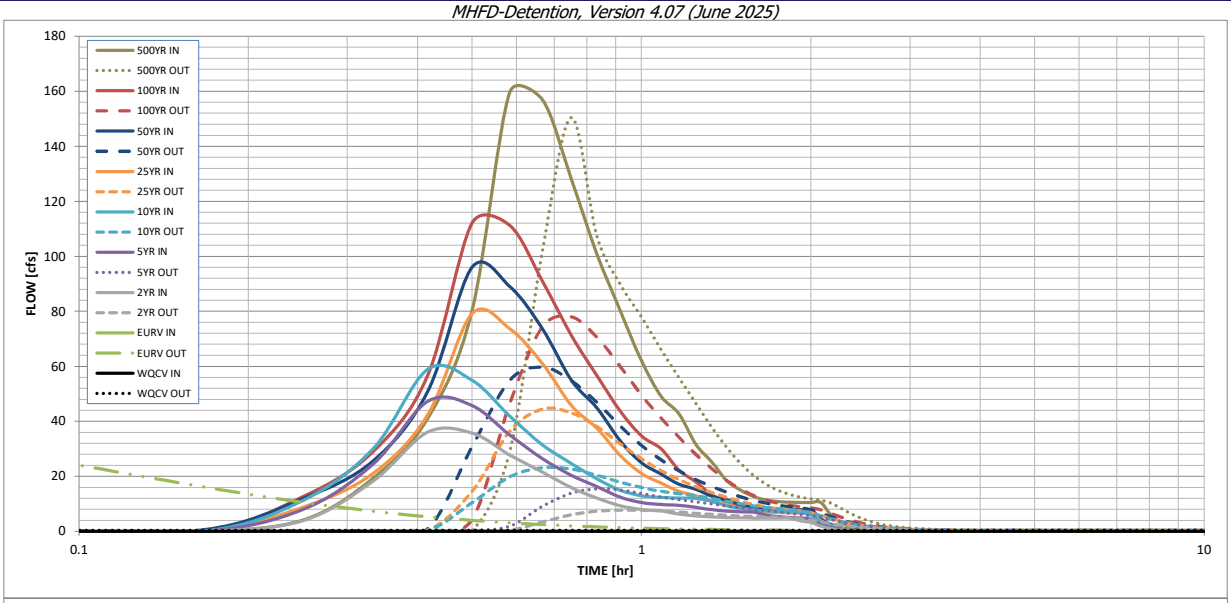
Routed Hydrograph Results

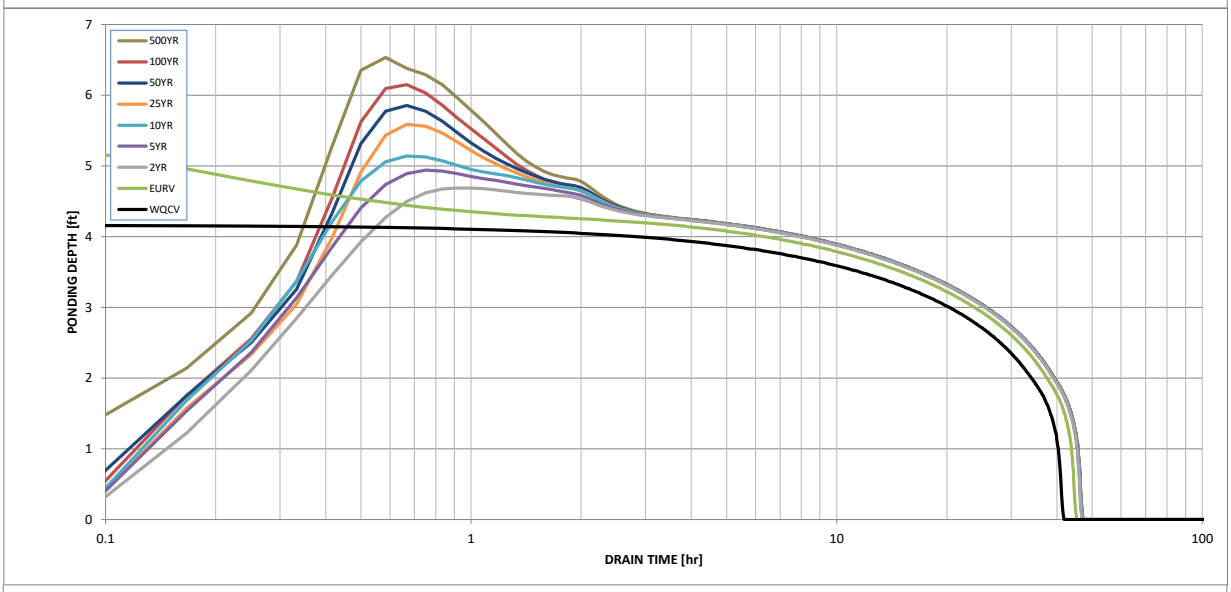
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

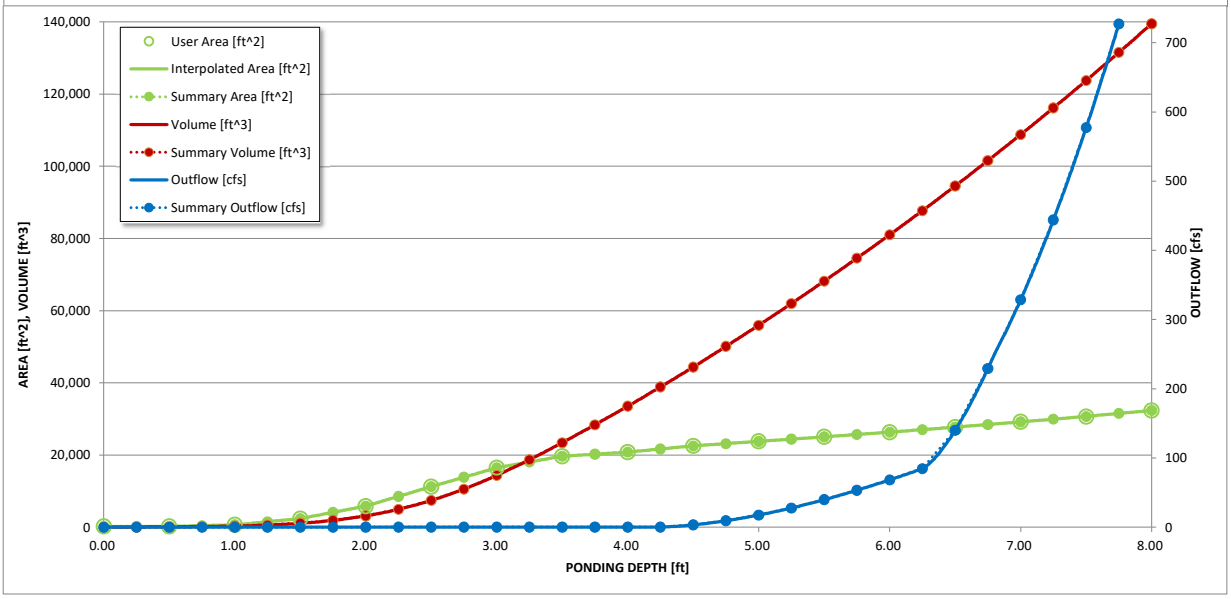
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.95	1.22	1.48	1.87	2.19	2.55	3.47
CUHP Runoff Volume (acre-ft) =	0.851	3.226	1.741	2.303	2.854	3.729	4.480	5.368	7.608
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.741	2.303	2.854	3.729	4.480	5.368	7.608
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.7	1.3	4.8	13.3	24.5	51.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.02	0.04	0.17	0.46	0.84	1.76
Peak Inflow Q (cfs) =	N/A	N/A	36.0	47.2	58.9	79.1	96.0	112.1	159.7
Peak Outflow Q (cfs) =	0.3	250.1	7.7	15.4	23.1	44.4	59.7	78.0	150.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	22.0	18.4	9.2	4.5	3.2	2.9
Structure Controlling Flow =	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.41	0.11	0.2	0.3	0.7	0.9	1.2	1.6
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) =	39	38	41	40	38	37	35	34	31
Time to Drain 99% of Inflow Volume (hours) =	**40**	42	44	44	43	43	42	41	39
Maximum Ponding Depth (ft) =	4.17	5.23	4.69	4.94	5.14	5.59	5.86	6.15	6.53
Area at Maximum Ponding Depth (acres) =	0.49	0.56	0.53	0.54	0.55	0.58	0.60	0.61	0.64
Maximum Volume Stored (acre-ft) =	0.852	1.407	1.113	1.247	1.362	1.611	1.770	1.946	2.190

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)







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	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	0.54	0.21	4.11
	0:15:00	0	0.00	3.88	7.97	11.13	8.79	11.89	12.53	19.34
	0:20:00	0	0.00	18.32	24.42	30.03	21.02	25.59	29.03	40.96
	0:25:00	0	0.00	36.02	47.23	58.86	42.28	50.69	56.58	80.12
	0:30:00	0	0.00	35.69	45.73	54.92	79.07	95.97	112.07	159.66
	0:35:00	0	0.00	27.73	34.99	41.87	73.63	88.99	111.24	157.03
	0:40:00	0	0.00	21.48	26.39	31.44	61.02	73.65	90.94	128.26
	0:45:00	0	0.00	15.89	20.39	24.72	45.82	55.05	71.38	100.86
	0:50:00	0	0.00	12.07	16.24	19.04	37.45	44.87	56.62	80.33
	0:55:00	0	0.00	9.30	12.40	14.94	27.62	32.92	43.75	61.98
	1:00:00	0	0.00	7.93	10.46	12.95	21.03	24.94	34.68	49.15
	1:05:00	0	0.00	7.42	9.72	12.31	17.53	20.79	30.02	42.72
	1:10:00	0	0.00	6.24	9.46	12.08	14.54	17.16	22.25	31.48
	1:15:00	0	0.00	5.61	8.69	12.00	12.97	15.26	17.95	25.26
	1:20:00	0	0.00	5.24	7.86	10.89	10.91	12.81	13.31	18.56
	1:25:00	0	0.00	5.04	7.38	9.30	9.83	11.53	10.82	14.96
	1:30:00	0	0.00	4.90	7.11	8.34	8.38	9.82	9.20	12.63
	1:35:00	0	0.00	4.82	6.94	7.77	7.55	8.85	8.33	11.37
	1:40:00	0	0.00	4.81	5.94	7.44	7.07	8.28	7.94	10.81
	1:45:00	0	0.00	4.81	5.36	7.22	6.82	7.99	7.77	10.58
	1:50:00	0	0.00	4.81	5.02	7.13	6.70	7.84	7.74	10.53
	1:55:00	0	0.00	3.81	4.84	6.80	6.64	7.77	7.74	10.53
	2:00:00	0	0.00	3.21	4.46	5.99	6.62	7.76	7.74	10.53
	2:05:00	0	0.00	1.83	2.56	3.48	3.86	4.52	4.51	6.12
	2:10:00	0	0.00	1.04	1.46	1.97	2.21	2.59	2.58	3.51
	2:15:00	0	0.00	0.53	0.78	1.05	1.18	1.38	1.38	1.87
	2:20:00	0	0.00	0.25	0.41	0.54	0.64	0.74	0.74	1.00
	2:25:00	0	0.00	0.09	0.16	0.20	0.26	0.30	0.30	0.40
	2:30:00	0	0.00	0.02	0.03	0.03	0.05	0.05	0.05	0.07
	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.

Stage - Storage Description	Stage [ft]	Elevation [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	6892.50	231	0.005	0	0.000	0.00
	0.25	6892.75	231	0.005	58	0.001	0.05
	0.50	6893.00	231	0.005	116	0.003	0.07
	0.75	6893.25	441	0.010	199	0.005	0.09
	1.00	6893.50	651	0.015	336	0.008	0.10
	1.25	6893.75	1525	0.035	608	0.014	0.11
	1.50	6894.00	2399	0.055	1098	0.025	0.12
	1.75	6894.25	4130	0.095	1915	0.044	0.13
	2.00	6894.50	5861	0.135	3163	0.073	0.14
	2.25	6894.75	8555	0.196	4965	0.114	0.20
	2.50	6895.00	11249	0.258	7441	0.171	0.23
	2.75	6895.25	13873	0.318	10581	0.243	0.25
	3.00	6895.50	16498	0.379	14378	0.330	0.27
	3.25	6895.75	18087	0.415	18701	0.429	0.29
	3.50	6896.00	19676	0.452	23421	0.538	0.31
	3.75	6896.25	20246	0.465	28411	0.652	0.32
	4.00	6896.50	20816	0.478	33544	0.770	0.34
	4.25	6896.75	21689	0.498	38857	0.892	0.35
	4.50	6897.00	22562	0.518	44389	1.019	3.45
	4.75	6897.25	23173	0.532	50106	1.150	9.43
	5.00	6897.50	23784	0.546	55975	1.285	17.64
	5.25	6897.75	24417	0.561	62000	1.423	27.80
	5.50	6898.00	25050	0.575	68184	1.565	39.87
	5.75	6898.25	25702	0.590	74528	1.711	53.48
	6.00	6898.50	26355	0.605	81035	1.860	68.45
	6.25	6898.75	27046	0.621	87710	2.014	84.65
	6.50	6899.00	27737	0.637	94558	2.171	140.01
	6.75	6899.25	28462	0.653	101583	2.332	229.32
	7.00	6899.50	29187	0.670	108789	2.497	328.74
	7.25	6899.75	29950	0.688	116181	2.667	444.10
	7.50	6900.00	30713	0.705	123764	2.841	577.30
	7.75	6900.25	31534	0.724	131545	3.020	727.27
	8.00	6900.50	32356	0.743	139531	3.203	893.31

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).