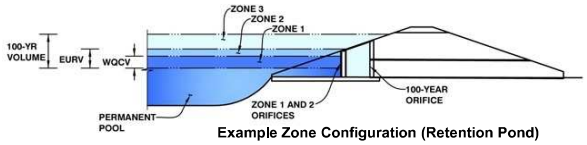
Accepted for File
By: Christina Prete, PE
Stormwater Manager
Date: 10/26/2026 10:28:16 AM
El Paso County Department of Public Works

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: RIVERBEND CROSSING

Basin ID: EXTENDED DETENTION BASIN



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.56	1.170	Orifice Plate
Zone 2 (EURV)	6.57	2.542	Orifice Plate
Zone 3 (100-year)	8.65	2.458	Weir&Pipe (Restrict)
		6.169	Total

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)

Invert 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 =	6.57	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	26.30	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	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	2.19	4.38					
Orifice Area (sq. inches)	5.51	5.51	12.00					

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

Calculated Parameters for Vertical Orifice

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

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	7.25	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	8.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	7.25	N/A	feet
Over Flow Weir Slope Length =	4.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	4.47	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	22.40	N/A	ft^2
Overflow Grate Open Area w/ Debris =	11.20	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	36.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	24.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	5.01	N/A	ft^2
Outlet Orifice Centroid =	1.12	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.91	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	9.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.94	feet
Spillway Crest Length =	60.00	feet	Stage at Top of Freeboard =	12.00	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.74	acres
Freeboard above Max Water Surface =	2.06	feet			

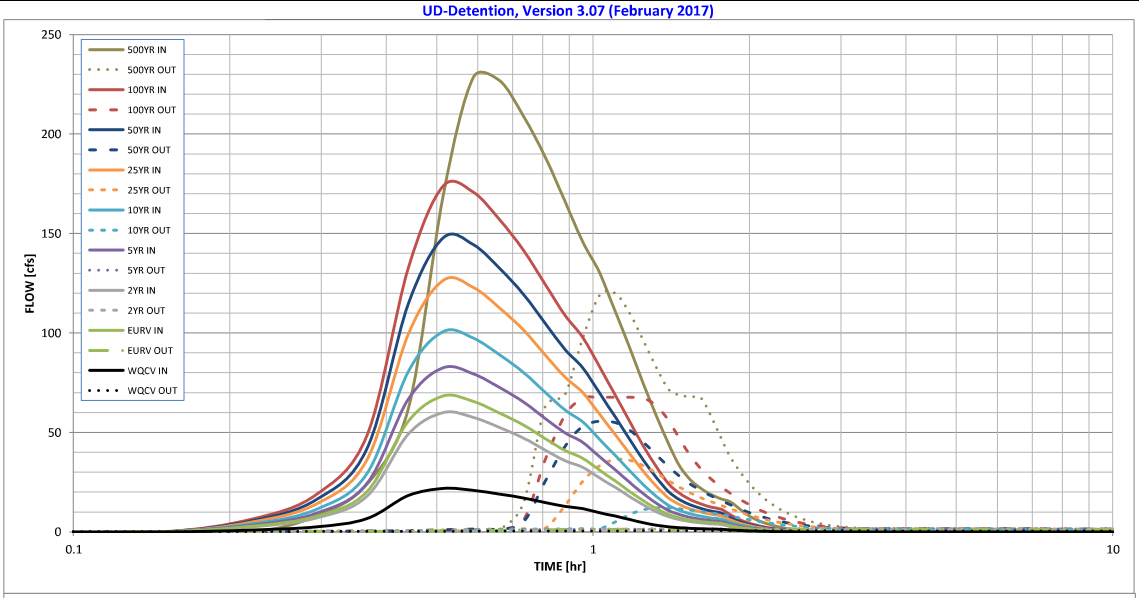
Calculated Parameters for Spillway

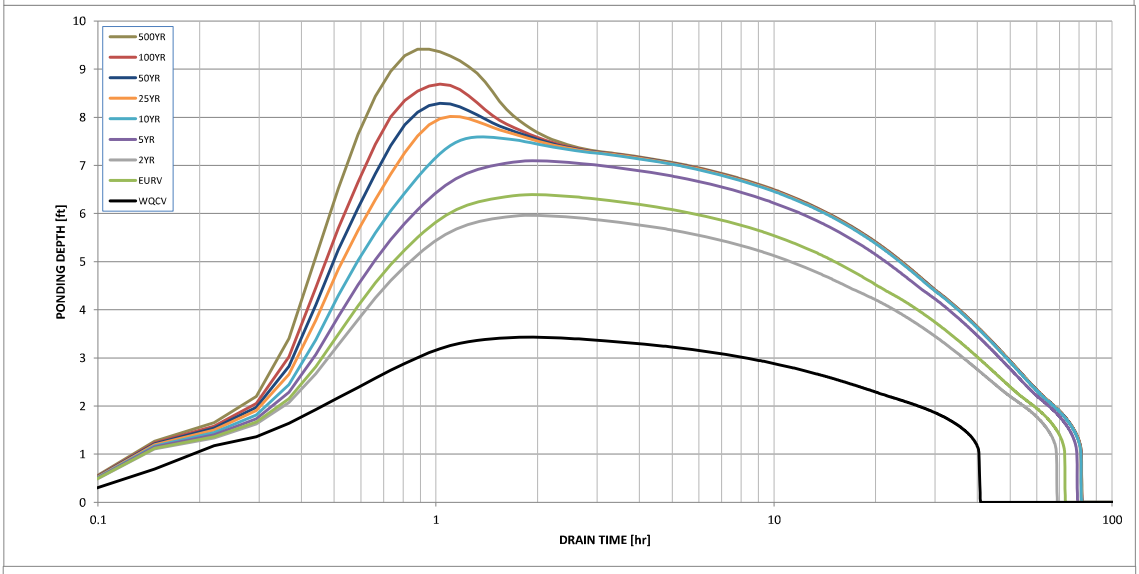
Routed Hydrograph Results

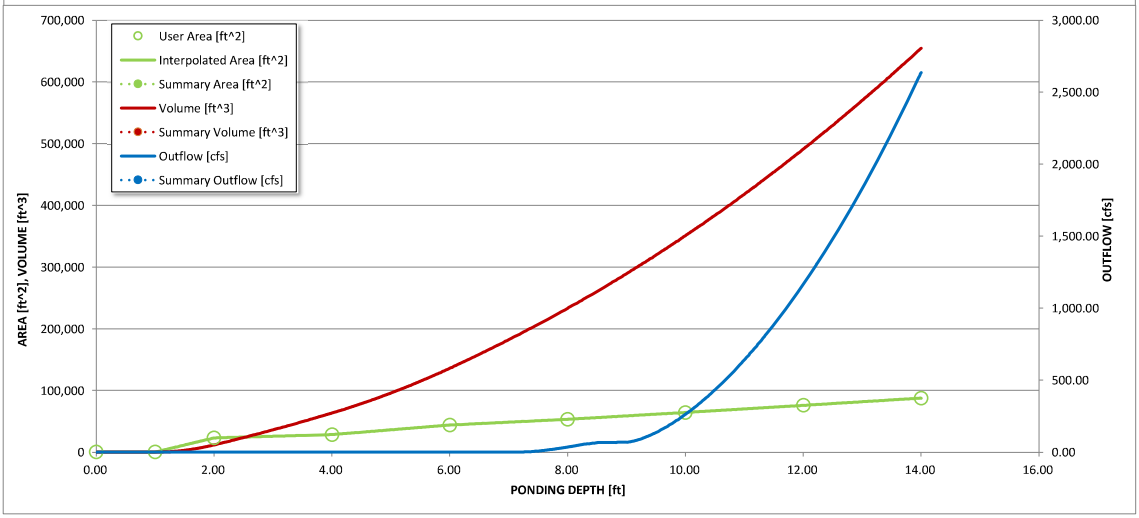
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.14
Calculated Runoff Volume (acre-ft) =	1.170	3.712	3.254	4.504	5.530	6.972	8.198	9.691	12.843
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	1.169	3.707	3.250	4.499	5.516	6.964	8.180	9.671	12.826
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.11	0.30	0.70	0.97	1.32	2.01
Predevelopment Peak Q (cfs) =	0.0	0.0	0.7	6.1	16.7	38.3	53.1	72.3	110.4
Peak Inflow Q (cfs) =	21.8	68.2	60.0	82.5	100.7	126.4	147.8	173.9	228.4
Peak Outflow Q (cfs) =	0.5	1.4	1.3	1.6	12.1	36.4	55.6	67.7	120.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.7	1.0	1.0	0.9	1.1
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.5	1.5	2.4	2.9	3.1
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	67	63	72	72	70	69	67	63
Time to Drain 99% of Inflow Volume (hours) =	40	71	67	76	78	77	77	76	75
Maximum Ponding Depth (ft) =	3.43	6.39	5.96	7.10	7.59	8.01	8.29	8.69	9.42
Area at Maximum Ponding Depth (acres) =	0.62	1.05	1.00	1.13	1.18	1.22	1.26	1.31	1.40
Maximum Volume Stored (acre-ft) =	1.093	3.522	3.080	4.284	4.861	5.365	5.701	6.214	7.204

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

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

Time Interval	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
	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]
4.41 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:04:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:08:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:13:14	0.95	2.86	2.53	3.40	4.06	4.94	5.63	6.43	7.95
1.133	0:17:38	2.59	7.91	6.97	9.48	11.44	14.13	16.31	18.89	24.08
	0:22:03	6.64	20.30	17.91	24.34	29.38	36.29	41.89	48.54	61.91
	0:26:28	18.25	55.67	49.12	66.73	80.49	99.35	114.60	132.67	168.94
	0:30:52	21.85	68.25	59.96	82.51	100.71	126.42	147.83	173.91	228.41
	0:35:17	20.89	65.57	57.54	79.49	97.39	122.92	144.39	170.77	226.68
	0:39:41	19.02	59.67	52.36	72.44	88.90	112.45	132.31	156.78	208.86
	0:44:06	17.03	53.74	47.13	65.27	80.13	101.40	119.35	141.48	188.58
	0:48:31	14.76	46.98	41.15	57.13	70.24	89.04	104.94	124.55	166.39
	0:52:55	12.84	40.99	35.87	49.89	61.39	77.90	91.85	109.07	145.79
	0:57:20	11.64	37.03	32.43	45.01	55.30	70.03	82.45	97.75	130.28
	1:01:44	9.66	31.00	27.13	37.76	46.50	59.08	69.74	82.92	111.09
	1:06:09	7.93	25.67	22.44	31.30	38.59	49.09	57.98	68.98	92.52
	1:10:34	6.17	20.31	17.72	24.83	30.71	39.21	46.43	55.39	74.62
	1:14:58	4.65	15.66	13.63	19.20	23.82	30.49	36.18	43.24	58.43
	1:19:23	3.38	11.67	10.13	14.36	17.88	22.98	27.33	32.74	44.44
	1:23:47	2.59	8.77	7.63	10.76	13.34	17.08	20.26	24.21	32.80
	1:28:12	2.12	7.06	6.16	8.64	10.68	13.63	16.12	19.21	25.87
	1:32:37	1.80	5.95	5.19	7.27	8.98	11.44	13.52	16.09	21.61
	1:37:01	1.57	5.18	4.52	6.32	7.80	9.92	11.71	13.92	18.65
	1:41:26	1.41	4.63	4.05	5.65	6.96	8.85	10.44	12.40	16.58
	1:45:50	1.30	4.24	3.71	5.17	6.37	8.09	9.53	11.31	15.11
	1:50:15	0.96	3.16	2.75	3.86	4.79	6.12	7.26	8.68	11.75
	1:54:40	0.70	2.29	2.00	2.80	3.46	4.42	5.24	6.26	8.46
	1:59:04	0.51	1.69	1.47	2.07	2.56	3.28	3.89	4.64	6.28
	2:03:29	0.38	1.26	1.10	1.54	1.91	2.44	2.89	3.45	4.66
	2:07:53	0.27	0.92	0.80	1.13	1.40	1.79	2.13	2.55	3.45
	2:12:18	0.19	0.66	0.57	0.81	1.01	1.29	1.54	1.84	2.50
	2:16:43	0.14	0.48	0.42	0.59	0.73	0.94	1.11	1.33	1.81
	2:21:07	0.09	0.33	0.29	0.41	0.51	0.66	0.79	0.95	1.29
	2:25:32	0.06	0.21	0.18	0.27	0.33	0.44	0.52	0.63	0.87
	2:29:56	0.03	0.12	0.10	0.15	0.19	0.26	0.31	0.37	0.52
	2:34:21	0.01	0.05	0.05	0.07	0.09	0.12	0.15	0.18	0.26
	2:38:46	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.09
	2:43:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:47:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:51:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:56:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:09:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:14:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:18:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:22:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:27:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:31:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:36:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:44:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:49:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:53:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:58:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:02:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:06:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:11:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:24:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:29:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:33:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:37:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:42:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:46:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:51:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:59:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:04:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:08:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:13:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:17:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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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).