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Scott Meredith
Tri-State Generation and Transmission Association
1100 W. 116th Ave.
Denver, CO 80233

June 19, 2024

Scott,

This memo is to serve as an addendum to the original Vollmer Substation drainage report prepared by Terra Nova, dated January 31, 2022. This memo summarizes the design of a new extended detention basin to replace the existing sand filter and demonstrate compliance with El Paso County design requirements.

Watershed characteristics and rainfall depths, from the original drainage report were utilized and imported into The Mile High Flood District *Detention Basin Design Workbook* to calculate the water quality capture volume (WQCV) and required detention volumes for the proposed extended detention basin. The original spreadsheet utilized for the design of the sand filter is included as Exhibit 1 and the updated spreadsheet for the detention basin is included as Exhibit 2. The spreadsheet was also utilized to design the outlet structure and corresponding orifice plate. It should be noted that the basin geometry does not meet the length to width recommended ratio as the existing driveway geometry prevents the basin from obtaining the desired length.

The detention basin and outlet structure have been sized to discharge at lower rates than the originally approved sand filter, while fully detaining the 100-year storm event. The attached MHFD workbook shows a 5-year discharge rate of 0 cfs., but this is only due to a rounding issue in the spreadsheet as the calculated value is 0.02 cfs. Detailed design of the pond modifications and new outlet structure are attached. The table below summarizes the originally approved discharge values along with the reduced discharge values that can be expected with the installation of the orifice plate.

Sand Filter Discharge		**Proposed EDB Discharge**	
5 Year	**100 Year**	**5 Year**	**100 Year**
1.5 cfs	4.2 cfs	0.02 cfs	0.8 cfs

Please don't hesitate to contact me if you have any questions.

Sincerely,

David W. Schieldt, P.E., CFM
President
Del-Mont Consultants, Inc.

Attachments:

Exhibit 1 – Terra Nova MHFD Detention Workbook (1-31-2022)

Exhibit 2 – Del-Mont Consultant MHFD Detention Workbook

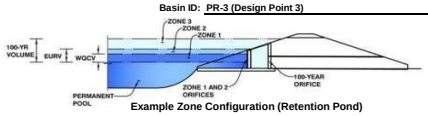
Exhibit 3 – Detention Basin Design Drawings

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Vollmer Substation

Basin ID: PR-3 (Design Point 3)



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	SF		
Watershed Area =	1.70	acres	Note: L / W Ratio < 1
Watershed Length =	180	ft	L / W Ratio = 0.4
Watershed Slope =	0.010	ft/ft	
Watershed Imperviousness =	40.00%	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	
Desired WQCV Drain Time =	40.0	hours	Drain Time Too Long
Location for 1-hr Rainfall Depths =	Denver - Capitol Building		
Water Quality Capture Volume (WQCV) =	0.020	acre-feet	Optional User Override 1-hr Precipitation
Excess Urban Runoff Volume (EURV) =	0.074	acre-feet	
2-yr Runoff Volume (P1 = 1.19 in.) =	0.050	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.066	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.082	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	0.105	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.136	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.175	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.265	acre-feet	inches
Approximate 2-yr Detention Volume =	0.047	acre-feet	
Approximate 5-yr Detention Volume =	0.062	acre-feet	
Approximate 10-yr Detention Volume =	0.077	acre-feet	
Approximate 25-yr Detention Volume =	0.095	acre-feet	
Approximate 50-yr Detention Volume =	0.107	acre-feet	
Approximate 100-yr Detention Volume =	0.125	acre-feet	

Stage-Storage Calculation

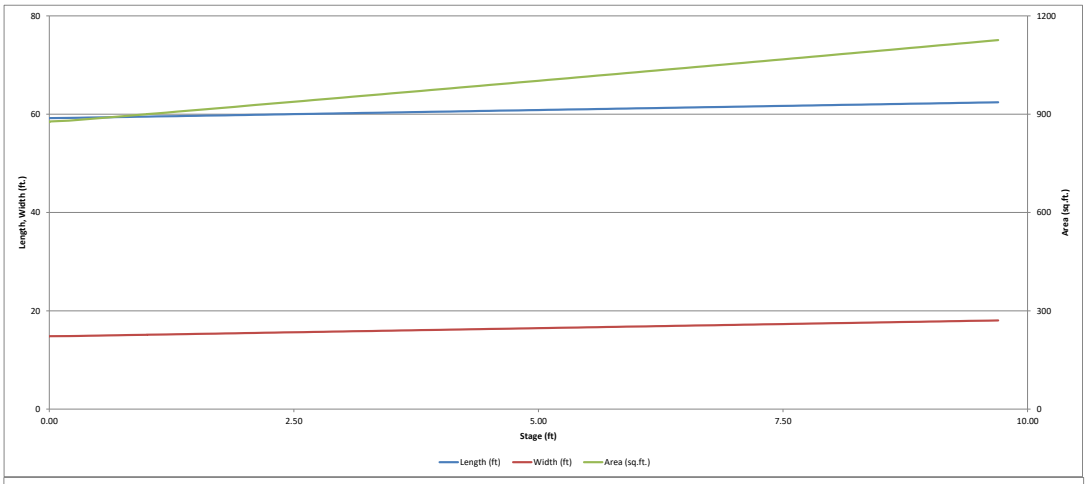
Zone 1 Volume (WQCV) =	0.020	acre-feet	
Select Zone 2 Storage Volume (Optional) =		acre-feet	Total detention volume is less than 100-year volume.
Select Zone 3 Storage Volume (Optional) =		acre-feet	
Total Detention Basin Volume =	0.020	acre-feet	
Initial Surcharge Volume (ISV) =	N/A	ft^3	
Initial Surcharge Depth (ISD) =	N/A	ft	
Total Available Detention Depth (H_{total}) =	1.00	ft	
Depth of Trickle Channel (H_{TC}) =	N/A	ft	
Slope of Trickle Channel (S_{TC}) =	N/A	ft/ft	
Slopes of Main Basin Sides (S_{main}) =	4:01	H:V	Smain not typical.
Basin Length-to-Width Ratio ($R_{L/W}$) =	4		
Initial Surcharge Area (A_{ISV}) =	0	ft^2	
Surcharge Volume Length (L_{ISV}) =	0.0	ft	
Surcharge Volume Width (W_{ISV}) =	0.0	ft	
Depth of Basin Floor (H_{FLOOR}) =	0.00	ft	
Length of Basin Floor (L_{FLOOR}) =	59.2	ft	
Width of Basin Floor (W_{FLOOR}) =	14.8	ft	
Area of Basin Floor (A_{FLOOR}) =	875	ft^2	
Volume of Basin Floor (V_{FLOOR}) =	0	ft^3	
Depth of Main Basin (H_{MAIN}) =	1.00	ft	
Length of Main Basin (L_{MAIN}) =	59.5	ft	
Width of Main Basin (W_{MAIN}) =	15.1	ft	
Area of Main Basin (A_{MAIN}) =	900	ft^2	
Volume of Main Basin (V_{MAIN}) =	888	ft^3	
Calculated Total Basin Volume (V_{total}) =	**0.020**	acre-feet	

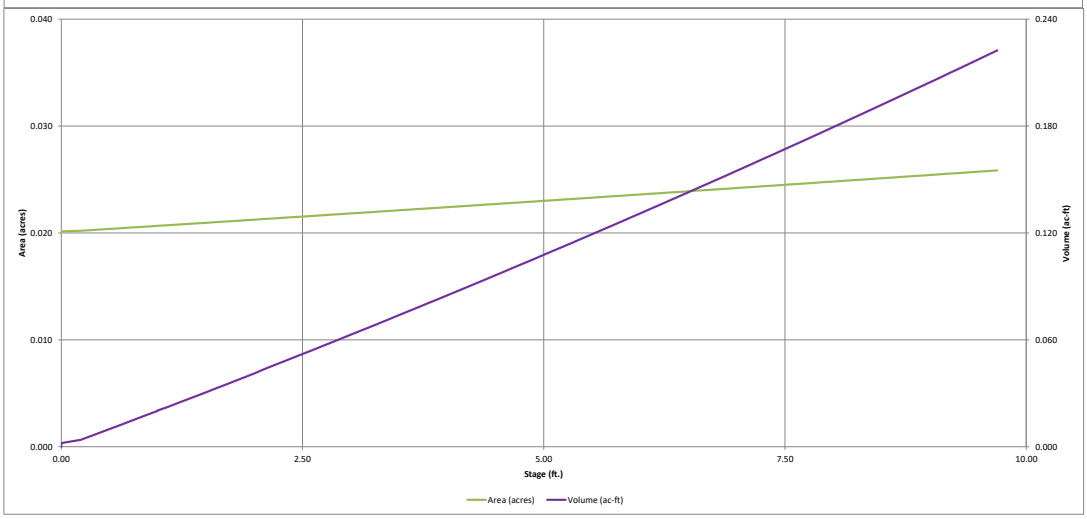
Depth Increment = 0.1 ft

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)
Media Surface	0.00		59.2	14.8	875		0.020		
	0.10		59.2	14.8	878		0.020	88	0.002
	0.20		59.2	14.9	880		0.020	167	0.004
	0.30		59.3	14.9	883		0.020	255	0.006
	0.40		59.3	14.9	885		0.020	343	0.008
	0.50		59.3	15.0	888		0.020	432	0.010
	0.60		59.4	15.0	890		0.020	521	0.012
	0.70		59.4	15.0	893		0.020	610	0.014
	0.80		59.4	15.1	895		0.021	699	0.016
	0.90		59.5	15.1	898		0.021	789	0.018
	1.00		59.5	15.1	900		0.021	879	0.020
Zone 1 (WQCV)	1.00		59.5	15.1	900		0.021	888	0.020
	1.10		59.5	15.2	903		0.021	969	0.022
	1.20		59.6	15.2	905		0.021	1,059	0.024
	1.30		59.6	15.2	908		0.021	1,150	0.026
	1.40		59.6	15.3	910		0.021	1,241	0.028
	1.50		59.7	15.3	913		0.021	1,332	0.031
	1.60		59.7	15.3	915		0.021	1,423	0.033
	1.70		59.7	15.4	918		0.021	1,515	0.035
	1.80		59.8	15.4	920		0.021	1,607	0.037
	1.90		59.8	15.4	923		0.021	1,699	0.039
	2.00		59.8	15.5	925		0.021	1,791	0.041
	2.10		59.9	15.5	928		0.021	1,893	0.043
	2.20		59.9	15.5	930		0.021	1,986	0.046
	2.30		59.9	15.6	933		0.021	2,079	0.048
	2.40		60.0	15.6	935		0.021	2,173	0.050
	2.50		60.0	15.6	938		0.022	2,267	0.052
	2.60		60.0	15.7	941		0.022	2,360	0.054
	2.70		60.1	15.7	943		0.022	2,455	0.056
	2.80		60.1	15.7	946		0.022	2,549	0.059
	2.90		60.1	15.8	948		0.022	2,644	0.061
	3.00		60.2	15.8	951		0.022	2,739	0.063
	3.10		60.2	15.8	953		0.022	2,834	0.065
	3.20		60.2	15.9	956		0.022	2,929	0.067
	3.30		60.3	15.9	958		0.022	3,025	0.069
	3.40		60.3	15.9	961		0.022	3,121	0.072
	3.50		60.3	16.0	963		0.022	3,217	0.074
	3.60		60.4	16.0	966		0.022	3,314	0.076
	3.70		60.4	16.0	969		0.022	3,410	0.078
	3.80		60.4	16.1	971		0.022	3,507	0.081
	3.90		60.5	16.1	974		0.022	3,605	0.083
	4.00		60.5	16.1	976		0.022	3,702	0.085
	4.10		60.5	16.2	979		0.022	3,800	0.087
	4.20		60.6	16.2	981		0.023	3,898	0.089
	4.30		60.6	16.2	984		0.023	3,996	0.092
	4.40		60.6	16.3	987		0.023	4,095	0.094
	4.50		60.7	16.3	989		0.023	4,194	0.096
	4.60		60.7	16.3	992		0.023	4,293	0.099
	4.70		60.7	16.4	994		0.023	4,392	0.101
	4.80		60.8	16.4	997		0.023	4,491	0.103
	4.90		60.8	16.4	999		0.023	4,591	0.105
	5.00		60.8	16.5	1,002		0.023	4,691	0.108
	5.10		60.9	16.5	1,005		0.023	4,792	0.110
	5.20		60.9	16.5	1,007		0.023	4,892	0.112
	5.30		60.9	16.6	1,010		0.023	4,993	0.115
	5.40		61.0	16.6	1,012		0.023	5,094	0.117
	5.50		61.0	16.6	1,015		0.023	5,196	0.119
	5.60		61.0	16.7	1,018		0.023	5,297	0.122
	5.70		61.1	16.7	1,020		0.023	5,399	0.124
	5.80		61.1	16.7	1,023		0.023	5,501	0.126
	5.90		61.2	16.8	1,025		0.024	5,604	0.129
	6.00		61.2	16.8	1,028		0.024	5,706	0.131
	6.10		61.2	16.8	1,031		0.024	5,809	0.133
	6.20		61.3	16.9	1,033		0.024	5,912	0.136
	6.30		61.3	16.9	1,036		0.024	6,016	0.138
	6.40		61.3	16.9	1,038		0.024	6,120	0.140
	6.50		61.4	17.0	1,041		0.024	6,224	0.143
	6.60		61.4	17.0	1,044		0.024	6,328	0.145
	6.70		61.4	17.0	1,046		0.024	6,432	0.148
	6.80		61.5	17.1	1,049		0.024	6,537	0.150
	6.90		61.5	17.1	1,052		0.024	6,642	0.152
	7.00		61.5	17.1	1,054		0.024	6,747	0.155
	7.10		61.6	17.2	1,057		0.024	6,853	0.157
	7.20		61.6	17.2	1,060		0.024	6,959	0.160
	7.30		61.6	17.2	1,062		0.024	7,065	0.162
	7.40		61.7	17.3	1,065		0.024	7,171	0.165
	7.50		61.7	17.3	1,067		0.025	7,278	0.167
	7.60		61.7	17.3	1,070		0.025	7,385	0.170
	7.70		61.8	17.4	1,073		0.025	7,492	0.172
	7.80		61.8	17.4	1,075		0.025	7,599	0.174
	7.90		61.8	17.4	1,078		0.025	7,707	0.177
	8.00		61.9	17.5	1,081		0.025	7,815	0.179
	8.10		61.9	17.5	1,083		0.025	7,923	0.182
	8.20		61.9	17.5	1,086		0.025	8,032	0.184
	8.30		62.0	17.6	1,089		0.025	8,140	0.187
	8.40		62.0	17.6	1,091		0.025	8,249	0.189
	8.50		62.0	17.6	1,094		0.025	8,359	0.192
	8.60		62.1	17.7	1,097		0.025	8,468	0.194
	8.70		62.1	17.7	1,099		0.025	8,578	0.197
	8.80		62.1	17.7	1,102		0.025	8,688	0.199
	8.90		62.2	17.8	1,105		0.025	8,798	0.202
	9.00		62.2	17.8	1,107		0.025	8,909	0.205
	9.10		62.2	17.8	1,110		0.025	9,020	0.207
	9.20		62.3	17.9	1,113		0.026	9,131	0.210
	9.30		62.3	17.9	1,115		0.026	9,242	0.212
	9.40		62.3	17.9	1,118		0.026	9,354	0.215
	9.50		62.4	18.0	1,121		0.026	9,466	0.217
	9.60		62.4	18.0	1,123		0.026	9,578	0.220
	9.70		62.4	18.0	1,126		0.026	9,691	0.222

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



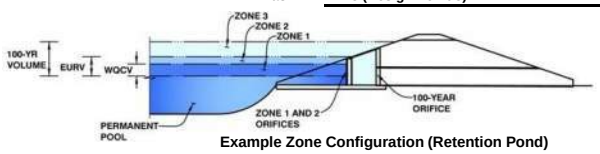


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Vollmer Substation

Basin ID: PR-3 (Design Point 3)



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.00	0.020	Filtration Media
Zone 2			Weir&Pipe (Circular)
Zone 3			
		0.020	Total

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

			Calculated Parameters for Underdrain		
Underdrain Orifice Invert Depth =	2.17	ft (distance below the filtration media surface)	Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Diameter =	0.37	inches	Underdrain Orifice Centroid =	0.02	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 BMP)

			Calculated Parameters for Plate		
Invert of Lowest Orifice =	N/A	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 =	N/A	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	inches	Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected		**Calculated Parameters for Vertical Orifice**	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				

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

	Zone 2 Weir	Not Selected		**Calculated Parameters for Overflow Weir**	Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	1.00		ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	1.00		feet
Overflow Weir Front Edge Length =	2.00		feet	Over Flow Weir Slope Length =	2.00		feet
Overflow Weir Slope =	0.00		H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	1.58		should be ≥ 4
Horiz. Length of Weir Sides =	2.00		feet	Overflow Grate Open Area w/o Debris =	2.80		ft^2
Overflow Grate Open Area % =	70%		%, grate open area/total area	Overflow Grate Open Area w/ Debris =	1.40		ft^2
Debris Clogging % =	50%		%				

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

	Zone 2 Circular	Not Selected		**Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate**	Zone 2 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	2.50		ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.77		ft^2
Circular Orifice Diameter =	18.00		inches	Outlet Orifice Centroid =	0.75		feet
				Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

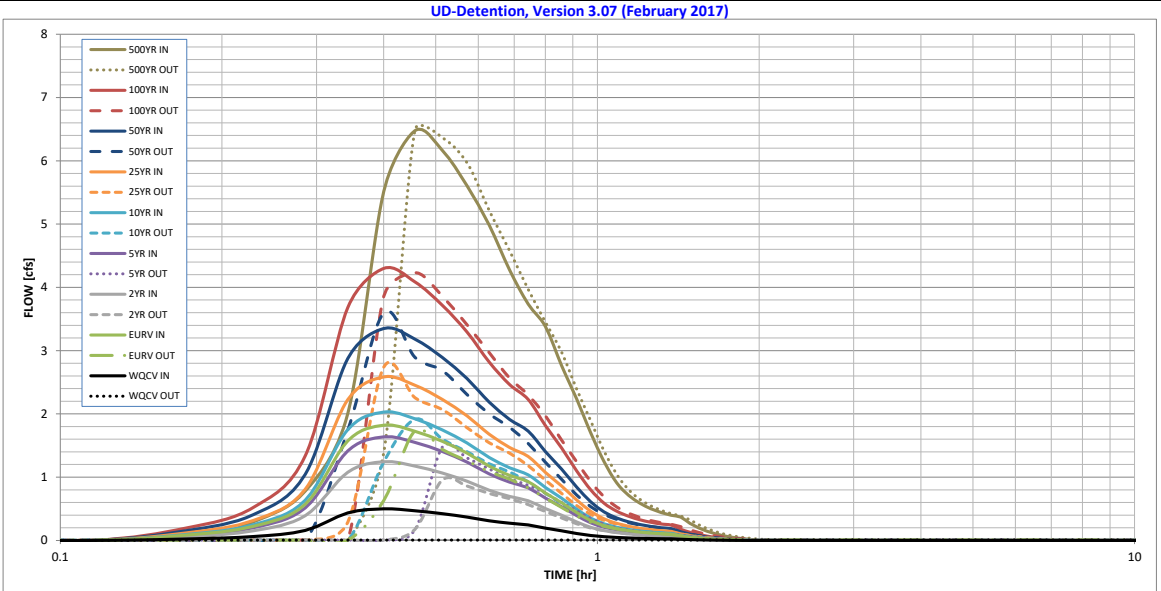
			Calculated Parameters for Spillway		
Spillway Invert Stage=		ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=		feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =		feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =		acres
Freeboard above Max Water Surface =		feet			

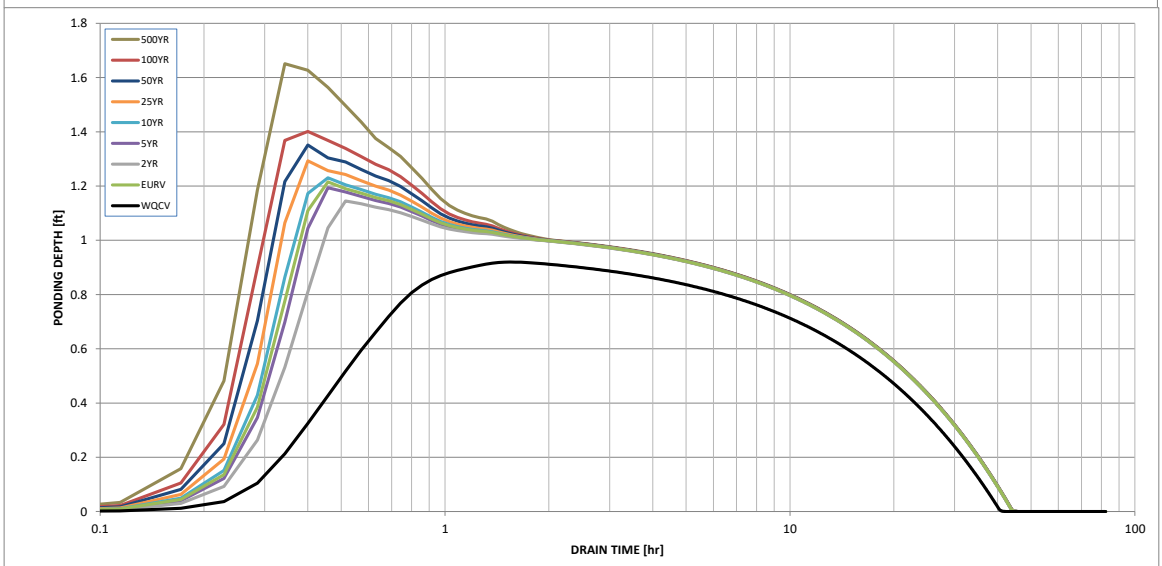
Routed Hydrograph Results

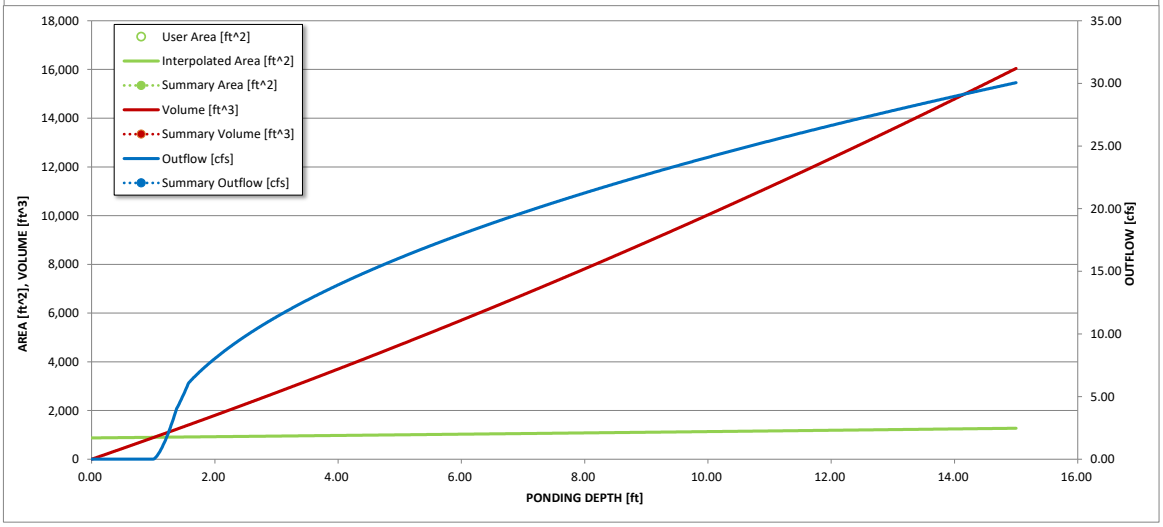
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.14
Calculated Runoff Volume (acre-ft) =	0.020	0.074	0.050	0.066	0.082	0.105	0.136	0.175	0.265
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.020	0.073	0.049	0.065	0.081	0.104	0.136	0.175	0.265
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.01	0.01	0.03	0.23	0.56	1.25
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.1	0.4	0.9	2.1
Peak Inflow Q (cfs) =	0.5	1.8	1.2	1.6	2.0	2.6	3.3	4.3	6.5
Peak Outflow Q (cfs) =	0.0	1.7	1.0	1.5	1.9	2.7	3.6	4.2	6.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	144.1	80.3	53.1	9.1	4.5	3.1
Structure Controlling Flow =	Filtration Media	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1
Max Velocity through Grate 1 (fps) =	N/A	0.59	0.29	0.5	0.6	0.9	1.2	1.5	2.3
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) =	40	39	41	40	39	37	35	33	27
Time to Drain 99% of Inflow Volume (hours) =	**40**	43	43	43	42	42	41	40	38
Maximum Ponding Depth (ft) =	0.92	1.22	1.14	1.19	1.23	1.29	1.35	1.40	1.65
Area at Maximum Ponding Depth (acres) =	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Maximum Volume Stored (acre-ft) =	0.019	0.025	0.023	0.024	0.025	0.026	0.028	0.029	0.034

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.

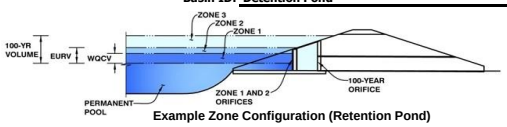
Time Interval	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
3.43 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:03:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph Constant	0:06:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:17	0.02	0.08	0.06	0.08	0.09	0.12	0.15	0.20	0.29
1.457	0:13:43	0.06	0.22	0.15	0.20	0.25	0.31	0.41	0.52	0.78
	0:17:09	0.16	0.57	0.39	0.51	0.64	0.81	1.05	1.34	2.01
	0:20:35	0.44	1.57	1.08	1.42	1.75	2.23	2.88	3.68	5.52
	0:24:01	0.50	1.82	1.24	1.64	2.03	2.59	3.35	4.30	6.48
	0:27:26	0.47	1.73	1.18	1.55	1.92	2.45	3.18	4.09	6.16
	0:30:52	0.42	1.57	1.07	1.41	1.75	2.23	2.89	3.72	5.61
	0:34:18	0.37	1.38	0.94	1.24	1.54	1.97	2.56	3.29	4.98
	0:37:44	0.31	1.17	0.79	1.05	1.31	1.68	2.19	2.82	4.28
	0:41:10	0.27	1.03	0.70	0.92	1.15	1.47	1.91	2.46	3.74
	0:44:35	0.25	0.93	0.63	0.83	1.04	1.33	1.73	2.23	3.38
	0:48:01	0.19	0.75	0.50	0.67	0.84	1.07	1.40	1.81	2.76
	0:51:27	0.15	0.60	0.40	0.53	0.67	0.86	1.13	1.46	2.24
	0:54:53	0.11	0.44	0.29	0.39	0.49	0.64	0.84	1.10	1.70
	0:58:19	0.08	0.31	0.21	0.28	0.35	0.46	0.61	0.80	1.24
	1:01:44	0.06	0.23	0.16	0.21	0.26	0.34	0.45	0.59	0.91
	1:05:10	0.05	0.19	0.12	0.17	0.21	0.27	0.36	0.46	0.71
	1:08:36	0.04	0.15	0.10	0.14	0.17	0.22	0.29	0.38	0.59
	1:12:02	0.03	0.13	0.09	0.12	0.15	0.19	0.25	0.33	0.50
	1:15:28	0.03	0.12	0.08	0.10	0.13	0.17	0.22	0.29	0.44
	1:18:53	0.03	0.11	0.07	0.09	0.12	0.15	0.20	0.26	0.40
	1:22:19	0.03	0.10	0.07	0.09	0.11	0.14	0.19	0.24	0.37
	1:25:45	0.02	0.07	0.05	0.07	0.08	0.10	0.14	0.18	0.27
	1:29:11	0.01	0.05	0.04	0.05	0.06	0.08	0.10	0.13	0.20
	1:32:37	0.01	0.04	0.03	0.03	0.04	0.06	0.07	0.09	0.14
	1:36:02	0.01	0.03	0.02	0.02	0.03	0.04	0.05	0.07	0.11
	1:39:28	0.00	0.02	0.01	0.02	0.02	0.03	0.04	0.05	0.07
	1:42:54	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.05
	1:46:20	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.04
	1:49:46	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.02
	1:53:11	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
	1:56:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	2:00:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:03:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:06:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:10:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:13:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:17:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:20:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:24:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:27:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:30:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:34:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:37:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:41:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:44:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:48:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:51:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:54:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:58:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:01:47	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
	3:08:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:12:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:18:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:22:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:29:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:32:40	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
	3:39:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:42:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:46:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:49:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:53:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:56:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:03:32	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

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: Vollmer Substation

Basin ID: Detention Pond



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**		**Note: L / W Ratio < 1**
Watershed Area =	1.70	acres	**L / W Ratio = 0.44**
Watershed Length =	180	ft	
Watershed Length to Centroid =	40	ft	
Watershed Slope =	0.010	ft/ft	
Watershed Imperviousness =	40.00%	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) =	0.025	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.074	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.049	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.066	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.080	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	0.105	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.129	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.5 in.) =	0.159	acre-feet	2.50 inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.230	acre-feet	inches
Approximate 2-yr Detention Volume =	0.047	acre-feet	
Approximate 5-yr Detention Volume =	0.062	acre-feet	
Approximate 10-yr Detention Volume =	0.077	acre-feet	
Approximate 25-yr Detention Volume =	0.095	acre-feet	
Approximate 50-yr Detention Volume =	0.107	acre-feet	
Approximate 100-yr Detention Volume =	0.124	acre-feet	

Define Zones and Basin Geometry

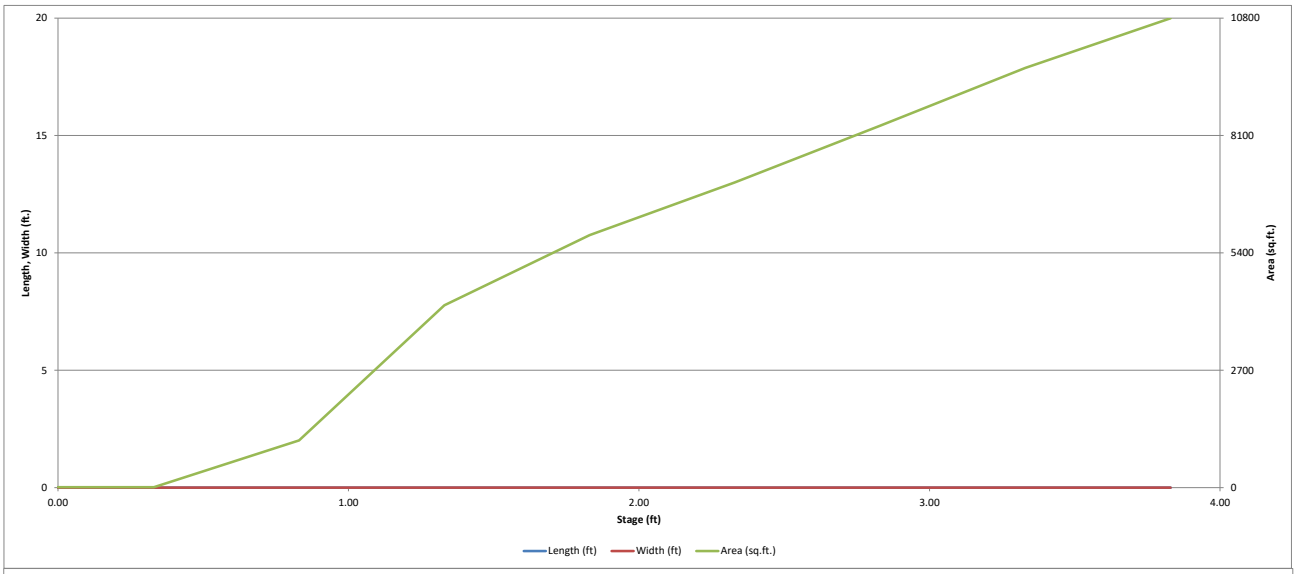
Zone 1 Volume (WQCV) =	0.025	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.048	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.050	acre-feet
Total Detention Basin Volume =	0.124	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (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

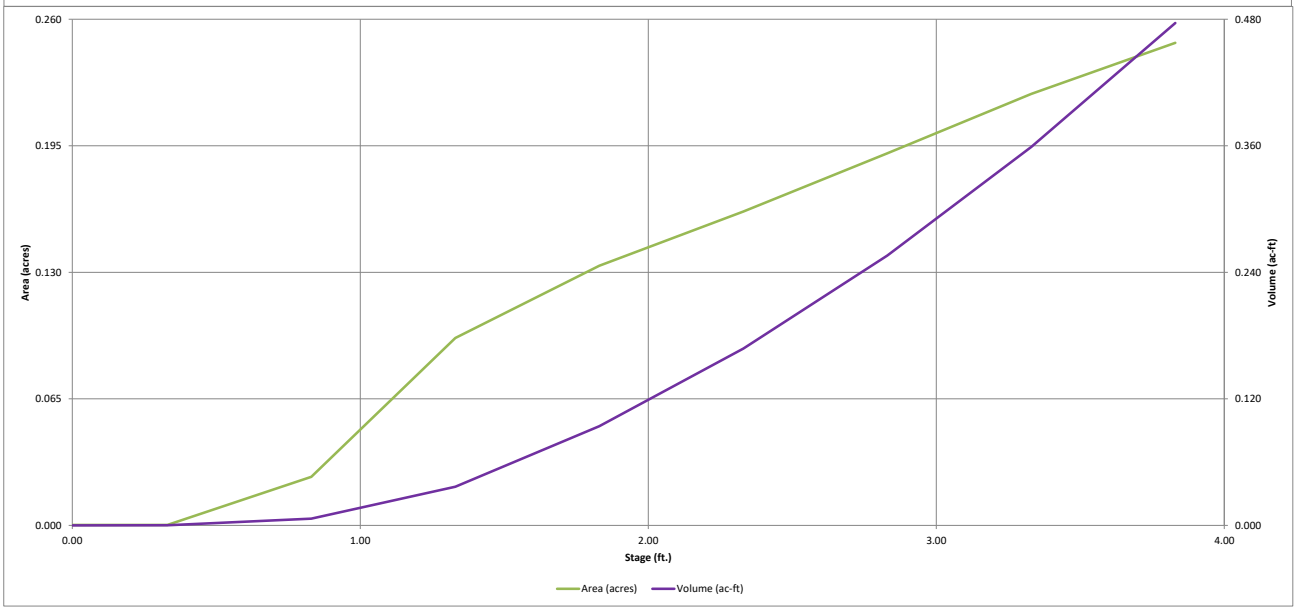
Depth Increment = ft

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)
Top of Micropool	--	0.00	--	--	--	10	0.000		
7022.5	--	0.33	--	--	--	10	0.000	3	0.000
7023	--	0.83	--	--	--	1,087	0.025	278	0.006
7023.5	--	1.33	--	--	--	4,194	0.096	1,598	0.037
7024	--	1.83	--	--	--	5,810	0.133	4,099	0.094
7024.5	--	2.33	--	--	--	7,022	0.161	7,307	0.168
7025	--	2.83	--	--	--	8,325	0.191	11,144	0.256
7025.5	--	3.33	--	--	--	9,655	0.222	15,639	0.359
7026	--	3.83	--	--	--	10,797	0.248	20,752	0.476

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)



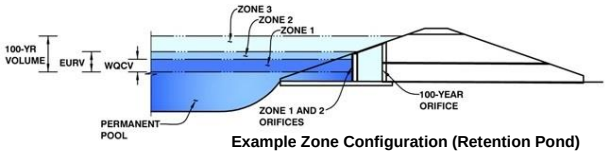


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Vollmer Substation**

Basin ID: **Detention Pond**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.21	0.025	Orifice Plate
Zone 2 (EURV)	1.67	0.048	Orifice Plate
Zone 3 (100-year)	2.05	0.050	Weir&Pipe (Restrict)
Total (all zones)		0.124	

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 =	1.389E-03	ft^2
Depth at top of Zone using Orifice Plate =	1.83	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	6.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.20	sq. inches (diameter = 1/2 inch)	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	0.50	1.00	1.50				
Orifice Area (sq. inches)	0.20	0.20	0.20	0.20				

	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 =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	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 =	1.83	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.00	N/A	feet
Overflow Weir Front Edge Length =	4.00	N/A	feet	Overflow Weir Slope Length =	2.51	N/A	feet
Overflow Weir Grate Slope =	15.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	3.95	N/A	
Horiz. Length of Weir Sides =	2.50	N/A	feet	Overflow Grate Open Area w/o Debris =	6.98	N/A	ft^2
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	3.49	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 =	1.21	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.77	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.75	N/A	feet
Restrictor Plate Height Above Pipe Invert =	18.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway

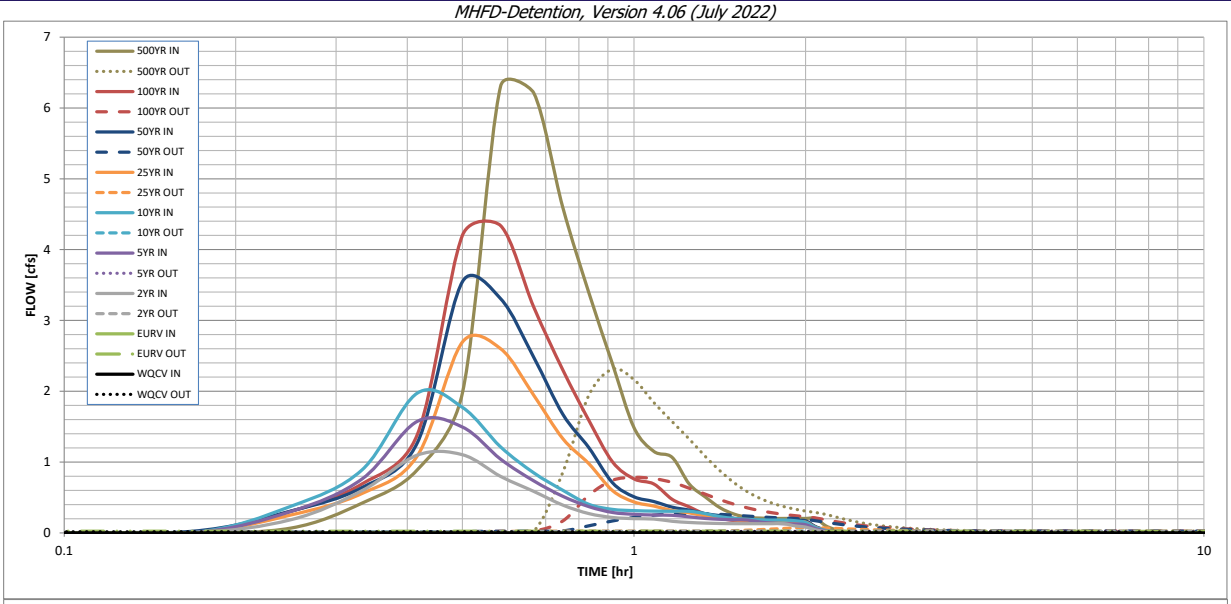
Routed Hydrograph Results

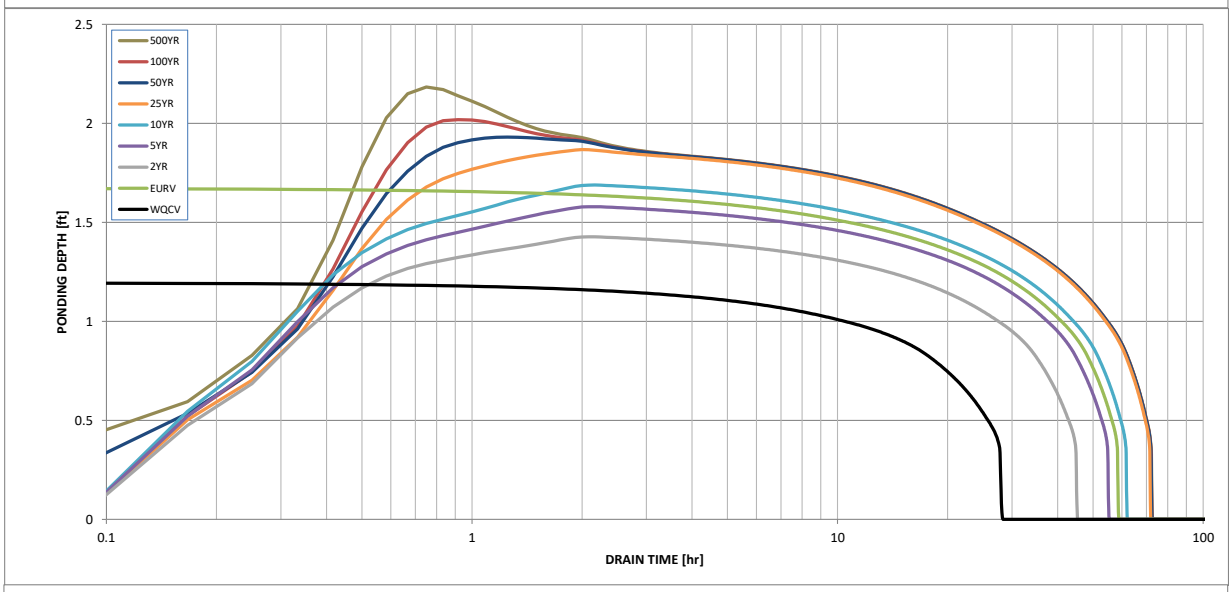
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

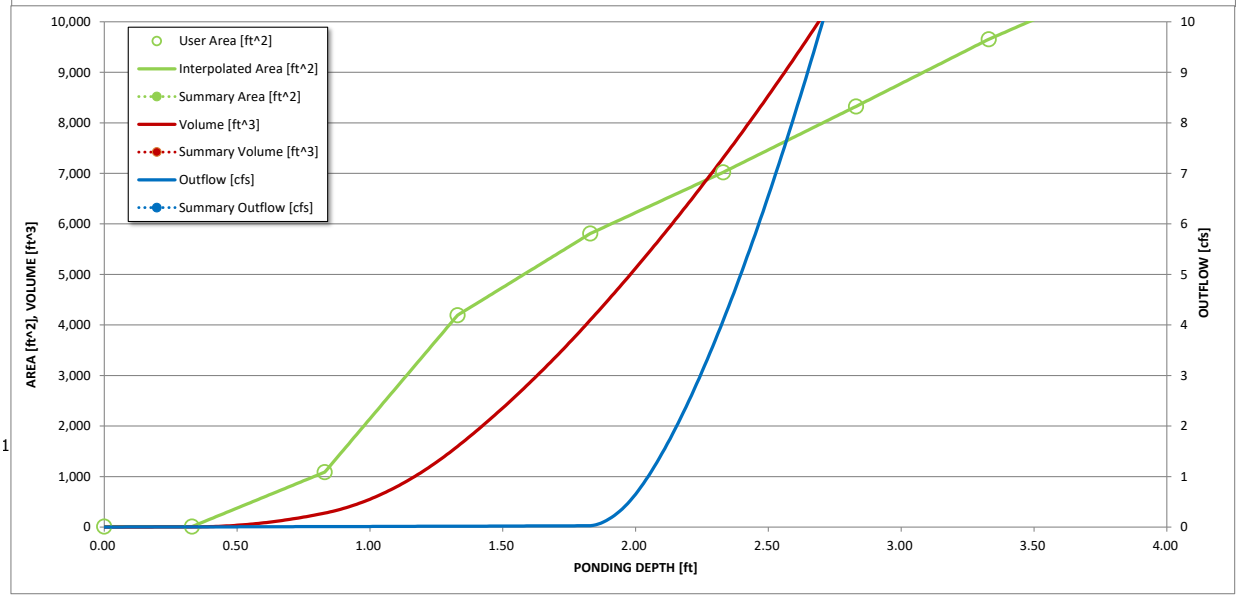
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.50	3.14
CUHP Runoff Volume (acre-ft) =	0.025	0.074	0.049	0.066	0.080	0.105	0.129	0.159	0.230
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.049	0.066	0.080	0.105	0.129	0.159	0.230
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.1	0.1	0.7	1.3	2.1	3.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.02	0.03	0.04	0.41	0.77	1.23	2.18
Peak Inflow Q (cfs) =	N/A	N/A	1.1	1.6	2.0	2.7	3.5	4.3	6.3
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.8	2.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.3	0.1	0.2	0.4	0.6
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.0	0.1	0.3
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) =	26	54	42	51	57	66	65	64	61
Time to Drain 99% of Inflow Volume (hours) =	**27**	57	44	53	60	69	69	69	68
Maximum Ponding Depth (ft) =	1.20	1.68	1.43	1.58	1.69	1.87	1.93	2.02	2.18
Area at Maximum Ponding Depth (acres) =	0.08	0.12	0.10	0.11	0.12	0.14	0.14	0.14	0.15
Maximum Volume Stored (acre-ft) =	0.025	0.075	0.046	0.062	0.075	0.098	0.108	0.119	0.144

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)







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.

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	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	0.02	0.00	0.07
	0:15:00	0.00	0.00	0.19	0.30	0.38	0.25	0.31	0.31	0.42
	0:20:00	0.00	0.00	0.60	0.76	0.89	0.56	0.64	0.69	0.89
	0:25:00	0.00	0.00	1.10	1.58	1.97	1.09	1.27	1.39	1.98
	0:30:00	0.00	0.00	1.10	1.49	1.77	2.70	3.55	4.20	6.31
	0:35:00	0.00	0.00	0.80	1.04	1.21	2.60	3.31	4.34	6.21
	0:40:00	0.00	0.00	0.59	0.74	0.85	1.94	2.48	3.19	4.59
	0:45:00	0.00	0.00	0.39	0.52	0.60	1.33	1.68	2.30	3.39
	0:50:00	0.00	0.00	0.27	0.37	0.40	0.98	1.20	1.59	2.39
	0:55:00	0.00	0.00	0.22	0.29	0.33	0.60	0.71	1.00	1.49
	1:00:00	0.00	0.00	0.20	0.26	0.31	0.44	0.51	0.76	1.15
	1:05:00	0.00	0.00	0.20	0.25	0.31	0.38	0.44	0.69	1.07
	1:10:00	0.00	0.00	0.16	0.25	0.31	0.32	0.36	0.47	0.69
	1:15:00	0.00	0.00	0.15	0.23	0.31	0.28	0.32	0.37	0.51
	1:20:00	0.00	0.00	0.14	0.20	0.27	0.24	0.27	0.26	0.35
	1:25:00	0.00	0.00	0.13	0.19	0.23	0.22	0.24	0.21	0.26
	1:30:00	0.00	0.00	0.13	0.19	0.20	0.18	0.20	0.18	0.22
	1:35:00	0.00	0.00	0.13	0.18	0.19	0.17	0.19	0.17	0.21
	1:40:00	0.00	0.00	0.13	0.15	0.18	0.16	0.18	0.16	0.20
	1:45:00	0.00	0.00	0.13	0.14	0.18	0.15	0.17	0.16	0.20
	1:50:00	0.00	0.00	0.13	0.13	0.18	0.15	0.17	0.16	0.20
	1:55:00	0.00	0.00	0.10	0.13	0.17	0.15	0.17	0.16	0.20
	2:00:00	0.00	0.00	0.08	0.12	0.15	0.15	0.17	0.16	0.20
	2:05:00	0.00	0.00	0.04	0.06	0.08	0.08	0.09	0.08	0.10
	2:10:00	0.00	0.00	0.02	0.03	0.04	0.04	0.04	0.04	0.05
	2:15:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.02
	2:20:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
	2:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	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)

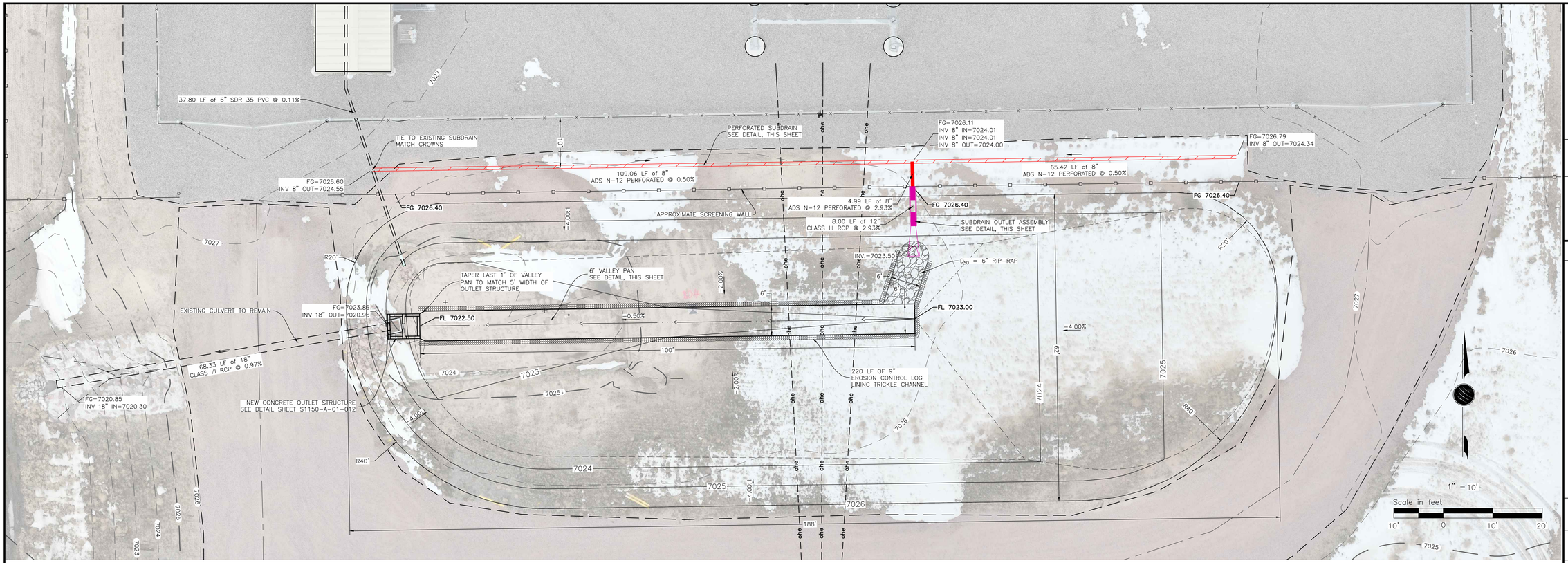
Summary Stage-Area-Volume-Discharge Relationships

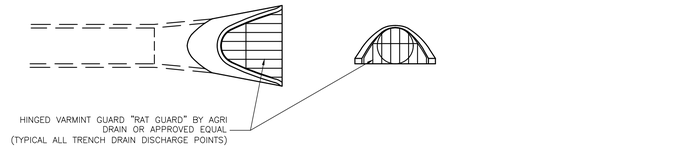
The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.
The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

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

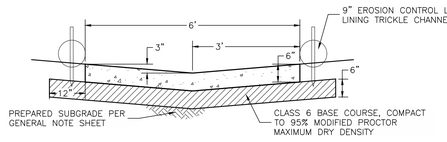
For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

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



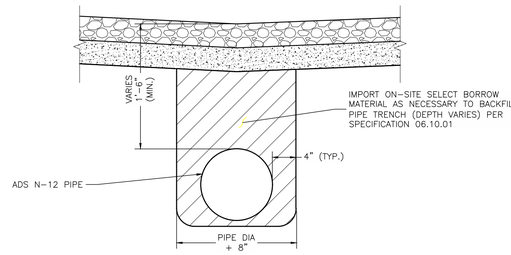


ADS SUBDRAIN OUTLET ASSEMBLY
N.T.S.

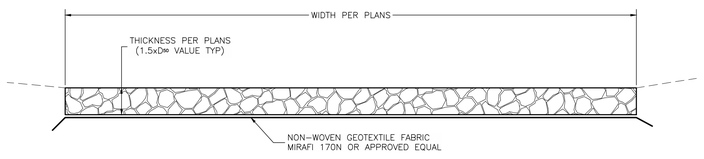


NOTE: TRICKLE CHANNEL TO BE INSTALLED WITH CONTROL JOINTS AT 10 FOOT INCREMENTS

6' TRICKLE CHANNEL
N.T.S.

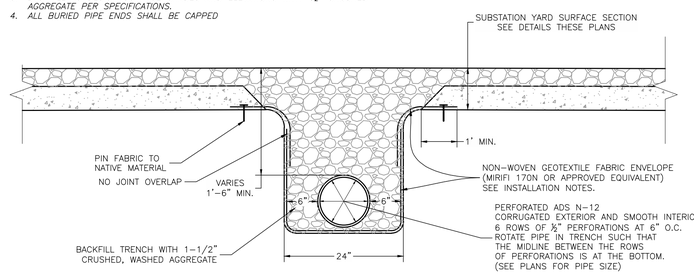


TYPICAL SOLID SUBDRAIN DRAIN DETAIL
N.T.S.



TYPICAL RIP RAP INSTALLATION
N.T.S.

PIPE, AGGREGATE, & FABRIC INSTALLATION NOTES:
1. *LAY FABRIC IN TRENCH PRIOR TO PLACEMENT OF AGGREGATE.*
2. *INSTALL PERFORATED PIPE TO DESIGN GRADES WITH PERFORATIONS PER DETAIL.*
3. *BACKFILL TO DESIGN SURFACE GRADES AND ELEVATIONS WITH 1½" CRUSHED AGGREGATE PER SPECIFICATIONS.*
4. *ALL BURIED PIPE ENDS SHALL BE CAPPED*



TYPICAL PERFORATED SUBDRAIN DETAIL
N.T.S.

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

Drawing Title
Mfgr. Reference Drawings
Dwg. No.
M.E.

VOLLMER DRAINAGE IMPROVEMENTS
115 KV

LAYOUT, GRADING, & DRAINAGE DETAILS
TRI-STATE GENERATION & TRANSMISSION ASSOCIATION, INCORPORATED

UPDATED BY: TCLEMENT 6/19/2024 6:57 AM | Contract: .

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	06/19/24
Appd:	Date:
.	.

S1150-A-01-011

PATH: \\DMS1\Projects\Active Projects\2023\23203-Vollmer Sub Drainage Fix\Facility Civil\Model\23203c_BASE.dwg

REMOVE EXISTING DRAIN PIPE TO TIE-IN POINT

SD

EXISTING SAND FILTER MEDIA, DRAINAGE PIPE, AND OUTLET BOX TO BE REMOVED. APPROXIMATELY 60 CU. YD. OF SAND AND 30 CU. YD. OF BEDDING GRAVEL

TOTAL DETENTION POND EXCAVATION OF APPROXIMATELY 600 CU. YDS. OF NATIVE MATERIAL. USE APPROXIMATELY 30 CU. YDS. TO TO FILL IN SAND FILTER AREA AFTER MEDIA REMOVAL.

7027 7026 7025 7024 7023

1" = 10'

Scale in feet

10' 0 10' 20'

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

Drawing Title

Mfgr. Reference Drawings

Dwg. No.

VOLLMER DRAINAGE IMPROVEMENTS

115 KV

LAYOUT & GRADING

TRI-STATE GENERATION & TRANSMISSION ASSOCIATION, INCORPORATED

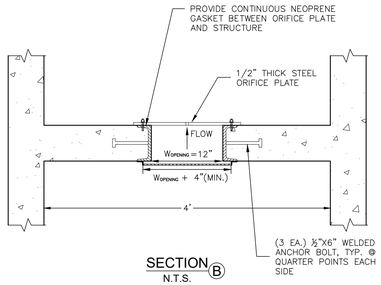
UPDATED By: TCLEMENT 6/19/2024 6:57 AM Contract:

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

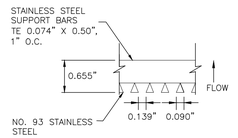
Dwn: TMC	Date: 06/19/24
Appd: .	Date: .

S1150-A-01-011R

PATH: \\DMS1A\Projects\Active Projects\2023\23203-Vollmer Sub Drainage Fix\Facility Civil\Model\23203c_BASE.dwg

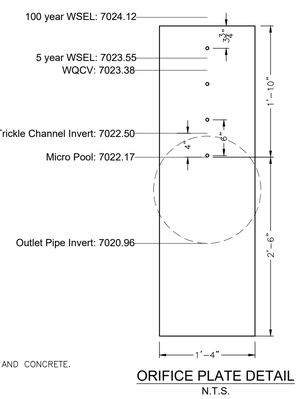


SECTION (B)
N.T.S.

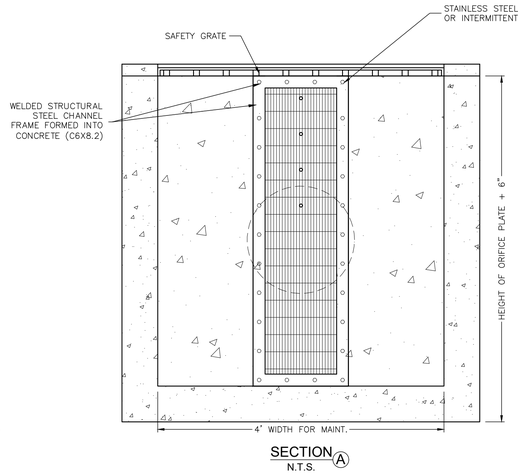


R VALUE = (NET OPEN AREA)/(GROSS RACK AREA)
= 0.60

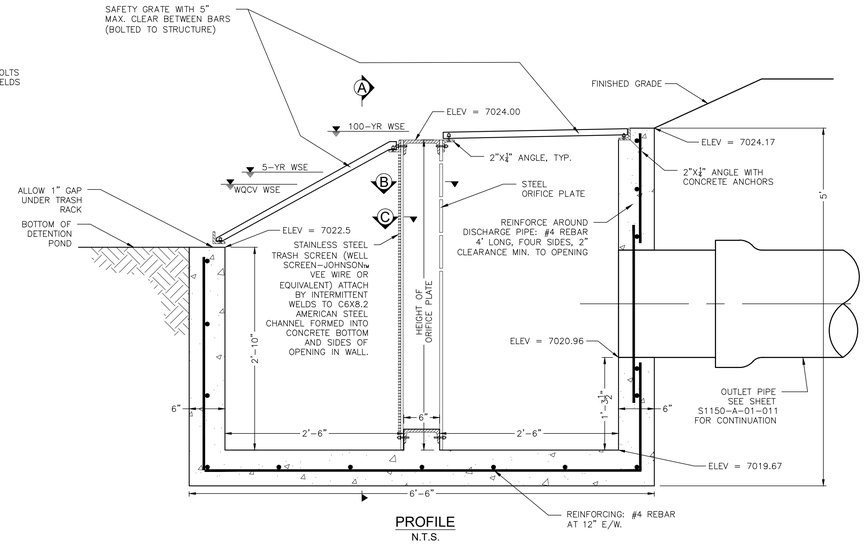
SECTION (C)
N.T.S.



ORIFICE PLATE DETAIL
N.T.S.



SECTION (A)
N.T.S.



PROFILE
N.T.S.

ORIFICE PLATE NOTES:

1. PROVIDE CONTINUOUS NEOPRENE GASKET MATERIAL BETWEEN THE ORIFICE PLATE AND CONCRETE.
2. BOLT PLATE TO CONCRETE 12" MAX. ON CENTER.

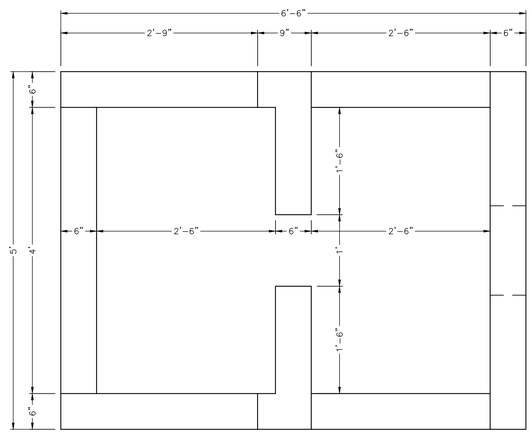
WQCV TRASH RACKS:

1. WELL-SCREEN TRASH RACKS SHALL BE STAINLESS STEEL AND SHALL BE ATTACHED BY INTERMITTENT WELDS ALONG THE EDGE OF THE MOUNTING FRAME.

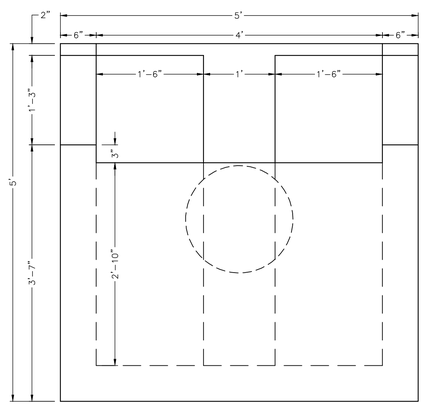
OVERFLOW SAFETY GRATES:

1. ALL SAFETY GRATES SHALL BE MOUNTED USING STAINLESS STEEL HARDWARE AND PROVIDED WITH HINGED AND LOCKABLE OR BOLTABLE ACCESS PANELS.
2. SAFETY GRATES SHALL BE STAINLESS STEEL, ALUMINUM, OR STEEL. STEEL GRATES SHALL BE HOT DIP GALVANIZED AND MAY BE HOT POWDER COATED AFTER GALVANIZING.

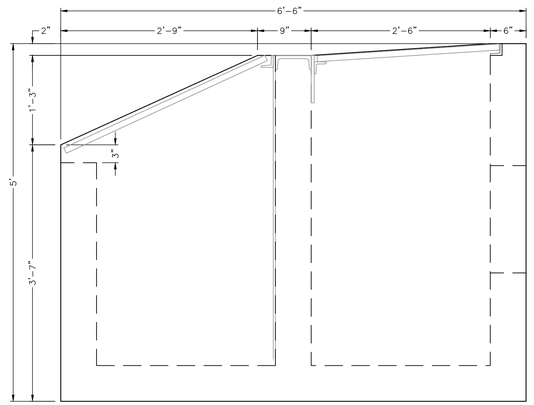
ORIFICE PLATE AND TRASH RACK DETAILS AND NOTES



CONCRETE OUTLET STRUCTURE
TOP VIEW
N.T.S.



CONCRETE OUTLET STRUCTURE
FRONT VIEW
N.T.S.



CONCRETE OUTLET STRUCTURE
SIDE VIEW
N.T.S.

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

Drawing Title
Mfgr. Reference Drawings
Dwg. No.
M.F.

VOLLMER DRAINAGE IMPROVEMENTS
115 KV
OUTLET STRUCTURE DETAILS
TRI-STATE GENERATION & TRANSMISSION ASSOCIATION, INCORPORATED
UPDATED BY: TCLEMENT 6/19/2024 6:57 AM Contract:

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: TMC Date: 06/19/24
Appd: Date:

S1150-A-01-012

PATH: \\DMS14\Projects\Active Projects\2023\23203-Vollmer Sub Drainage Fix\Facility\Civil\Model\23203S_BASE.dwg