

May 26th, 2026

Attn: Gleen Reese

Stormwater Engineer

El Paso County - Department of Public Works

3275 Akers Drive

Colorado Springs, CO 80922



**RE: STERLING RANCH FILING NO. 2 (SF20-15) – VOLUME CERTIFICATION LETTER FOR FULL SPECTRUM
DETENTION PONDS W4 & W5**

Dear Mr. Reese,

Based upon survey of the as-built condition of Sterling Ranch Filing No. 2 Ponds W4 & W5, the required storage volume for WQCV, EURV and 100-year is provided. Additionally, the release rate for Ponds W4 & W5 is at or below the historic 100-yr design storm level. It is our opinion that the site and adjacent properties (as affected by work performed under the County permit) are stable with respect to settlement and subsidence, sloughing of cut and fill slopes, revegetation or other ground cover, and that the improvements (public improvements, common development improvements, site grading and paving) meet or exceed the minimum design requirements. The PCM(s) provide the required storage volume and meet the required release rates, stage areas, elevations, and outlet dimensions, as documented by the attached revised MHFD-Detention spreadsheet that shows the as-built conditions.

I hereby certify that Pond W4 & Pond W5 have been reasonably constructed, to the best of my knowledge and belief, per the approved design.

Respectfully submitted,

A handwritten signature in blue ink, appearing to read "Ryan Burns".

RYAN BURNS, PE

All Terrain Engineering LLC

rburns@allterraineng.com

203.577.8656

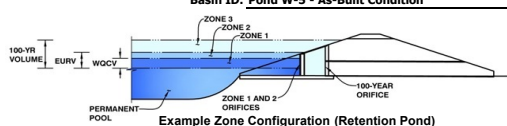
Additional discussion(s) may need to be added to this letter per my comments in the as-built CDs.

Additional calcs may need to be attached to this letter per my comments in the as-built CDs.

MHFD-Detention, Version 4.04 (February 2021)

Project: Sterling Ranch Filing No. 2 (As-Built)

Basin ID: Pond W-5 - As-Built Condition



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	173.97	acres
Watershed Length =	3,888	ft
Watershed Length to Centroid =	1,814	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	57.10%	percent
Percentage Hydrologic Soil Group A =	85.0%	percent
Percentage Hydrologic Soil Group B =	15.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQVC Drain Time =	40.0	hours
Location for 1-hr Rainfall Depth =	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.

Water Quality Capture Volume (WQCV) =	3.288	acre-feet
Excess Urban Runoff Volume (EURV) =	11.714	acre-feet
2-yr Runoff Volume ($P1 = 1.19$ in.) =	9.031	acre-feet
5-yr Runoff Volume ($P1 = 1.5$ in.) =	11.873	acre-feet
10-yr Runoff Volume ($P1 = 1.75$ in.) =	14.194	acre-feet
25-yr Runoff Volume ($P1 = 2$ in.) =	18.106	acre-feet
50-yr Runoff Volume ($P1 = 2.25$ in.) =	21.364	acre-feet
100-yr Runoff Volume ($P1 = 2.52$ in.) =	25.580	acre-feet
500-yr Runoff Volume ($P1 = 3.14$ in.) =	34.562	acre-feet
Approximate 2-yr Detention Volume =	7.768	acre-feet
Approximate 5-yr Detention Volume =	10.244	acre-feet
Approximate 10-yr Detention Volume =	12.566	acre-feet
Approximate 25-yr Detention Volume =	14.965	acre-feet
Approximate 50-yr Detention Volume =	16.434	acre-feet
Approximate 100-yr Detention Volume =	18.217	acre-feet

Define Zones and Basin Geometry

Zone 1 Volume ($WQCV_1$)	=	3.288	acre-feet
Zone 2 Volume ($EURV - Zone\ 1$)	=	8.426	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2)	=	6.502	acre-feet
Total Detention Basin Volume	=	18.217	acre-feet
Initial Surge Volume (ISV)	=	user	ft ³
Initial Surge Depth (ISD)	=	user	ft
Total Available Detention Depth (H_{total})	=	user	ft
Depth of Trickle Channel (H_{TC})	=	user	ft
Slope of Trickle Channel (STC)	=	user	ft/ft
Slopes of Main Basin Sides (S_{main})	=	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$)	=	user	
Initial Surge Area (ASV)	=	user	ft ²
Surcharge Volume Length (L_{SV})	=	user	ft
Surcharge Volume Width (W_{SV})	=	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

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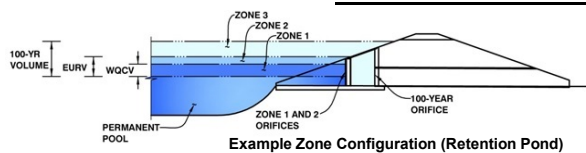
- ✓ = calcs match details in plans
✗ = calcs do not match details in plans

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Sterling Ranch Filing No. 2 (As-Built)

Basin ID: Pond W-5 - As-Built Condition



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.78	3.288	Orifice Plate
Zone 2 (EURV)	7.34	8.426	Rectangular Orifice
Zone 3 (100-year)	8.87	6.502	Weir&Pipe (Restrict)
Total (all zones)		18.217	

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 Diameter =	N/A	inches

Calculated Parameters for Underdrain	
Underdrain Orifice Area =	N/A ft ²
Underdrain Orifice Centroid =	N/A 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)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	7.34	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate	
WQ Orifice Area per Row =	N/A 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)	✓ 0.10	✓ 2.25	✗ 4.20					
Orifice Area (sq. inches)	✓ 8.13	✓ 12.50	✓ 25.00					

	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)

	Zone 2 Rectangular	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 Height =		N/A	inches
Vertical Orifice Width =			inches

Calculated Parameters for Vertical Orifice	
Zone 2 Rectangular	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 3 Weir	Not Selected	
Overflow Weir Front Edge Height, H _o =	✓ 7.90	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	✗ 20.00	N/A	feet
Overflow Weir Grate Slope =	✓ 0.00	N/A	H:V
Horiz. Length of Weir Sides =	✗ 6.50	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

		Calculated Parameters for Overflow Weir		
		Zone 3 Weir	Not Selected	
Outlet Pipe)	Height of Grate Upper Edge, H_u =	7.90	N/A	feet
	Overflow Weir Slope Length =	6.50	N/A	feet
	Grate Open Area / 100-yr Orifice Area =	7.20	N/A	
	Overflow Grate Open Area w/o Debris =	90.48	N/A	ft ²
	Overflow Grate Open Area w/ Debris =	45.24	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 =	✓ 0.61	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	✓ 48.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	✓ 48.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate				
		Zone 3 Restrictor	Not Selected	
n at Stage = 0 ft)	Outlet Orifice Area =	12.57	N/A	ft ²
	Outlet Orifice Centroid =	2.00	N/A	feet
	Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	✓ 9.10	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	✓ 50.00	feet
Spillway End Slopes =	✓ 10.00	H:V
Freeboard above Max Water Surface =	0.83	feet

Calculated Parameters for Spillway		
Spillway Design Flow Depth=	1.70	feet
Stage at Top of Freeboard =	11.63	feet
Basin Area at Top of Freeboard =	4.84	acres
Basin Volume at Top of Freeboard =	28.03	acre-ft

Routed Hydrograph Results

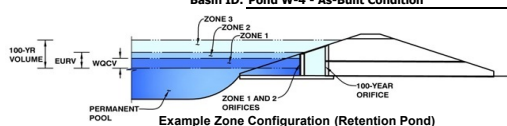
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	3.288	11.714	9.031	11.873	14.194	18.106	21.364	25.580	34.562
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	9.031	11.873	14.194	18.106	21.364	25.580	34.562
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.6	2.9	5.1	54.6	85.6	128.5	217.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.03	0.31	0.49	0.74	1.25
Peak Inflow Q (cfs) =	N/A	N/A	138.3	183.8	219.1	298.2	357.8	427.1	581.1
Peak Outflow Q (cfs) =	1.9	3.2	2.8	3.1	3.3	28.3	58.1	111.6	240.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.1	0.7	0.5	0.7	0.9	1.1
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Gate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.3	0.6	1.2	1.9
Max Velocity through Gate 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	71	62	72	79	81	80	78	74
Time to Drain 99% of Inflow Volume (hours) =	40	77	68	78	86	88	87	86	85
Maximum Ponding Depth (ft) =	4.78	7.34	6.50	7.24	7.80	8.34	8.64	9.07	9.65
Area at Maximum Ponding Depth (acres) =	2.37	3.98	3.60	3.94	4.17	4.33	4.41	4.50	4.60
Maximum Volume Stored (acre-ft) =	3.295	11.740	8.551	11.305	13.574	15.876	17.231	19.103	21.744

MHFD-Detention, Version 4.04 (February 2021)

Project: Sterling Ranch Filing No. 2 (AS-Built)

Basin ID: Pond W-4 - As-Built Condition



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	349.78	acres
Watershed Length =	9,241	ft
Watershed Length to Centroid =	4,488	ft
Watershed Slope =	0.060	ft/ft
Watershed Imperviousness =	9.40%	percent
Percentage Hydrologic Soil Group A =	40.0%	percent
Percentage Hydrologic Soil Group B =	60.0%	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.

Water Quality Capture Volume (WQCV) =	1.853	acre-feet
Excess Urban Runoff Volume (EURV) =	2.795	acre-feet
2-yr Runoff Volume ($P1 = 1.19$ in.) =	2.080	acre-feet
5-yr Runoff Volume ($P1 = 1.5$ in.) =	5.597	acre-feet
10-yr Runoff Volume ($P1 = 1.75$ in.) =	9.733	acre-feet
25-yr Runoff Volume ($P1 = 2$ in.) =	19.177	acre-feet
50-yr Runoff Volume ($P1 = 2.25$ in.) =	25.536	acre-feet
100-yr Runoff Volume ($P1 = 2.52$ in.) =	35.668	acre-feet
500-yr Runoff Volume ($P1 = 3.14$ in.) =	52.705	acre-feet
Approximate 2-yr Detention Volume =	1.737	acre-feet
Approximate 5-yr Detention Volume =	2.626	acre-feet
Approximate 10-yr Detention Volume =	4.967	acre-feet
Approximate 25-yr Detention Volume =	6.953	acre-feet
Approximate 50-yr Detention Volume =	7.709	acre-feet
Approximate 100-yr Detention Volume =	10.691	acre-feet

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.853	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.942	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	7.896	acre-feet
Total Detention Basin Volume =	10.691	acre-feet
Initial Surge Volume (ISV) =	user	ft ³
Initial Surge 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 Surge 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

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Depth Increment = f

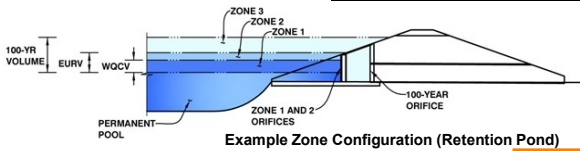
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DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Sterling Ranch Filing No. 2 (AS-Built)

Basin ID: Pond W-4 - As-Built Condition



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.89	1.853	Orifice Plate
Zone 2 (EURV)	5.89	0.942	Orifice Plate
Zone 3 (100-year)	#VALUE!	7.896	Weir&Pipe (Restrict)
Total (all zones)		10.691	

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

Underdrain Orifice Invert Depth = N/A ft (dist)

Underdrain Orifice Diameter = N/A inches

Calculated Parameters for Underdrain

Underdrain Orifice Area = N/A ft²

Underdrain Orifice Centroid = N/A feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typ

Invert of Lowest Orifice = 0.00 ft (relat

Depth at top of Zone using Orifice Plate = 5.89 ft (relat

Orifice Plate: Orifice Vertical Spacing = N/A inches

Orifice Plate: Orifice Area per Row = N/A inches

mentation BMP)

Calculated Parameters for Plate

WQ Orifice Area per Row = N/A ft²

Elliptical Half-Width = N/A feet

Elliptical Slot Centroid = N/A feet

Elliptical Slot Area = N/A ft²

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)	X 0.09	X 1.29	X 2.45					
Orifice Area (sq. inches)	X 1.83	5.63	5.63					

	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
Depth at top of Zone using Vertical Orifice =	N/A	N/A
Vertical Orifice Diameter =	N/A	N/A

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

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

inches

Vertical Orifice Area =

Vertical Orifice Centroid =

Not Selected	Not Selected
N/A	N/A
N/A	N/A

ft²

feet

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
Overflow Weir Front Edge Height, H _o =	X 5.03	N/A
Overflow Weir Front Edge Length =	X 19.50	N/A
Overflow Weir Grate Slope =	X 4.70	N/A
Horiz. Length of Weir Sides =	10.00	N/A
Overflow Grate Type =	Type C Grate	N/A
Debris Clogging % =	50%	N/A

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

feet

H:V

feet

%

Height of Grate Upper Edge, H_u =

Overflow Weir Slope Length =

Grate Open Area / 100-yr Orifice Area =

Overflow Grate Open Area w/o Debris =

Overflow Grate Open Area w/ Debris =

Calculated Parameters for Overflow Weir

Zone 3 Weir	Not Selected
7.16	N/A
10.22	N/A
8.72	N/A
138.76	N/A
69.38	N/A

feet

feet

ft²

ft²

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 =	X 2.52	N/A
Outlet Pipe Diameter =	X 54.00	N/A
Restrictor Plate Height Above Pipe Invert =	X 54.00	N/A

ft (distance below basin bottom at Stage = 0 ft)

inches

inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

Zone 3 Restrictor	Not Selected
15.90	N/A
2.25	N/A
3.14	N/A

Outlet Orifice Area =

Outlet Orifice Centroid =

Half-Central Angle of Restrictor Plate on Pipe =

ft²

feet

radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	X 10.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	X 75.00	feet
Spillway End Slopes =	X 5.00	H:V
Freeboard above Max Water Surface =	X 0.67	feet

as-built this on the plans

Calculated Parameters for Spillway

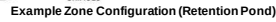
Spillway Design Flow Depth =	1.16	feet
Stage at Top of Freeboard =	11.83	feet
Basin Area at Top of Freeboard =	1.56	acres
Basin Volume at Top of Freeboard =	10.32	acre-ft

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).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
One-Hour Rainfall Depth (in) =	N/A	N/A	1.853	2.795	2.080	5.597	9.733	19.177	25.536
CUHP Runoff Volume (acre-ft) =	N/A	N/A	2.080	5.597	9.733	19.177	25.536	35.668	52.705
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.080	5.597	9.733	19.177	25.536	35.668	52.705
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	3.7	30.3	64.3	150.1	202.8	279.5	414.6
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.09	0.18	0.43	0.58	0.80	1.19
Peak Inflow Q (cfs) =	N/A	N/A	17.8	48.6	83.8	170.9	224.0	298.7	434.1
Peak Outflow Q (cfs) =	0.8	16.8	0.8	23.8	55.1	138.6	191.8	240.9	413.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	0.9	0.9	0.9	0.9	1.0
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.13	N/A	0.2	0.4	1.0	1.4	1.7	1.8
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	43	43	42	39	32	28	22	13
Time to Drain 99% of Inflow Volume (hours) =	42	46	46	47	46	42	40	37	33
Maximum Ponding Depth (ft) =	4.89	5.89	4.91	6.02	6.67	7.82	8.39	9.63	10.77
Area at Maximum Ponding Depth (acres) =	0.90	0.99	0.90	1.00	1.06	1.16	1.21	1.33	1.46
Maximum Volume Stored (acre-ft) =	1.861	2.803	1.870	2.923	3.603	4.870	5.547	7.121	8.720

MHFD-Detention, Version 4.03 (May 2020)

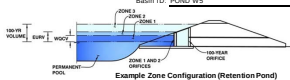
Basin ID: POND W5[illegible]

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD- Detention, Version 4.03 (May 2020)

Project: STERLING RANCH FILING NO. 2

Basin ID: POND W5



	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.13	Orifice Plate
Zone 2 (EURV)	6.88	Rectangular Orifice
Zone 3 (100-year)	8.49	Weir&Pipe (Restrict)
Total (all zones)	18.376	

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

Underdrain Orifice Invert Depth =	N/A	ft (relative to the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft ²
Underdrain Orifice Centroid =	N/A	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)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	6.88	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft ²
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	ft ²
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	2.35	4.00				
Orifice Area (sq. inches)	12.55	12.55	25.00				
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)

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 Width =	N/A	N/A	inches
Vertical Orifice Height =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

Zone 2 Rectangular	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, NB Rectangular/Trapezoidal Weir (and No Outlet Pipe))

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho	7.30	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length	20.00	N/A	feet
Overflow Weir Grate Slope	0.00	N/A	H-V
Horiz. Length of Weir Sides	6.00	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 ₁ =	7.30	N/A	feet
Overflow Weir Slope Length =	6.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	7.35	N/A	
Overflow Grate Open Area w/o Debris =	84.00	N/A	ft ²
Overflow Grate Open Area w/ Debris =	42.00	N/A	ft ²

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

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

Zone 3 Restrictor			Not Selected				
Depth to Invert of Outlet Pipe =	0.83	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	11.43	N/A	ft ²
Outlet Pipe Diameter =	48.00	N/A	inches	Outlet Orifice Centroid =	1.84	N/A	feet
Restrictor Plate Height Above Pipe Invert =	41.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.36	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Calculated Parameters for Spillway

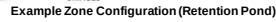
Spillway Invert Stage =	8.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	48.00	feet
Spillway End Slopes =	10.00	H-V
Freeboard above Max Water Surface =	2.00	feet
Spillway Design Flow Depth =	1.74	feet
Stage at Top of Freeboard =	12.24	feet
Basin Area at Top of Freeboard =	4.83	acres
Basin Volume at Top of Freeboard =	27.61	acre-ft

ROUTED HYDROGRAPH RESULTS

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
One-Hour Rainfall Depth (in) =	N/A	N/A	9.121	11.991	14.334	18.244	21.510	25.732	34.734
CUPP Runoff Volume (acre-ft) =	N/A	N/A	9.121	11.991	14.334	18.244	21.510	25.732	34.734
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.6	2.9	5.1	54.6	85.6	128.5	217.8
CUPP Preadevelopment Peak Q (cfs) =	N/A	N/A	0.01	0.02	0.03	0.31	0.49	0.74	1.25
OPTIONAL: Override Preadevelopment Peak Q (cfs) =	N/A	N/A	140.5	186.5	222.1	301.6	361.5	431.2	586.0
Preadevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	3.0	3.4	5.1	38.8	77.3	139.3	241.3
Ratio Peak Outflow to Preadevelopment Q =	N/A	N/A	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate	Plate
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
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	70	63	71	78	76	75	73	70
Time to Drain 99% of Inflow Volume (hours) =	40	78	67	77	84	84	83	82	81
Maximum Ponding Depth (ft) =	4.13	6.88	5.98	6.77	7.35	7.76	8.05	8.43	9.15
Area at Maximum Ponding Depth (acres) =	2.23	3.78	3.37	3.73	3.96	4.10	4.19	4.31	4.50
Maximum Volume Stored (acre-ft) =	3.320	11.847	8.616	11.396	13.666	15.319	16.522	18.138	21.311

MHFD-Detention, Version 4.03 (May 2020)

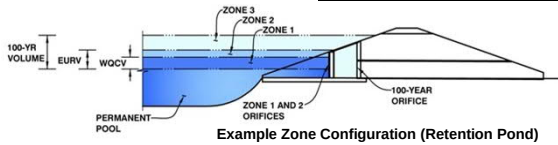
Basin ID: POND W4 Interim[illegible]

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: STERLING RANCH FILING NO. 2

Basin ID: POND W4 Interim



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.12	1.853	Orifice Plate
Zone 2 (EURV)	5.15	0.942	Orifice Plate
Zone 3 (100-year)	11.49	7.896	Weir&Pipe (Restrict)
Total (all zones)		10.691	

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

Underdrain Orifice Invert Depth = ft (distance below the filtration media surface)
Underdrain Orifice Diameter = inches

Calculated Parameters for Underdrain
Underdrain Orifice Area = ft²
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 BMP)

Invert of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = inches
Orifice Plate: Orifice Area per Row = sq. inches (use rectangular openings)

Calculated Parameters for Plate
WQ Orifice Area per Row = ft²
Elliptical Half-Width = feet
Elliptical Slot Centroid = feet
Elliptical Slot Area = ft²

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.15	2.31					
Orifice Area (sq. inches)	5.54	5.54	5.54					

	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)

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

Calculated Parameters for Vertical Orifice
Vertical Orifice Area = ft²
Vertical Orifice Centroid = feet

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

Overflow Weir Front Edge Height, H_o = ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = feet
Overflow Weir Grate Slope = H:V
Horiz. Length of Weir Sides = feet
Overflow Grate Open Area % = %, grate open area/total area
Debris Clogging % = %

Calculated Parameters for Overflow Weir
Height of Grate Upper Edge, H_u = feet
Overflow Weir Slope Length = feet
Grate Open Area / 100-yr Orifice Area =
Overflow Grate Open Area w/o Debris = ft²
Overflow Grate Open Area w/ Debris = ft²

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

Depth to Invert of Outlet Pipe = ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter = inches
Restrictor Plate Height Above Pipe Invert = inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate
Outlet Orifice Area = ft²
Outlet Orifice Centroid = feet
Half-Central Angle of Restrictor Plate on Pipe = radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage = ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length = feet
Spillway End Slopes = H:V
Freeboard above Max Water Surface = feet

Calculated Parameters for Spillway
Spillway Design Flow Depth = feet
Stage at Top of Freeboard = feet
Basin Area at Top of Freeboard = acres
Basin Volume at Top of Freeboard = 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).

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
One-Hour Rainfall Depth (in) =	1.853	2.795	2.080	5.597	9.733	19.177	25.536	35.668	52.705
CUHP Runoff Volume (acre-ft) =	N/A	N/A	2.080	5.597	9.733	19.177	25.536	35.668	52.705
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	3.7	30.3	64.3	150.1	202.8	279.5	414.6
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A							
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.09	0.18	0.43	0.58	0.80	1.19
Peak Inflow Q (cfs) =	N/A	N/A	17.8	48.6	83.8	170.9	224.0	298.7	434.1
Peak Outflow Q (cfs) =	0.9	30.1	0.9	27.4	61.4	151.2	197.1	221.6	416.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.9	1.0	1.0	1.0	0.8	1.0
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.25	N/A	0.2	0.4	1.0	1.4	1.5	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) =	37	38	41	38	34	26	23	18	10
Time to Drain 99% of Inflow Volume (hours) =	40	42	44	43	41	37	35	32	28
Maximum Ponding Depth (ft) =	4.13	5.15	4.11	4.99	5.51	6.43	6.94	9.14	10.02
Area at Maximum Ponding Depth (acres) =	0.87	0.96	0.87	0.94	0.99	1.07	1.12	1.32	1.40
Maximum Volume Stored (acre-ft) =	1.862	2.795	1.844	2.643	3.146	4.094	4.642	7.320	8.519