

El Paso County  
Engineering Development Review Team  
2880 International Circle  
Colorado Springs, CO 80910

June 2025

RE: MDG Project No. 20.1105.004 – Grandwood Ranch: PCM Certification Letter

Dear Sir or Madam,

Based on visual observation, 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 and other ground cover. The improvements (public improvements, common development improvements, site grading and paving) meet or exceed the minimum design requirements.

This letter certifies substantial compliance for dimensions, elevations and volumes of the Grandwood Ranch Pond 1 and Pond 2 within the west side of the development and Pond 3 and Pond 4 within the east side of the development. This certification letter is to confirm the full spectrum detention basins substantially comply with the approved plan documents and Final Drainage Report (FDR: Approved April 16, 2021).

Pond 5 is a minor embankment/impoundment providing a slight reduction in stormwater discharge from the site. It is not an official full spectrum detention or water quality facility.

This letter also certifies the RPA receiving and treating runoff from Grandwood Drive within Sub-basins E2 and E3 have been built in substantial compliance with the construction plans for the development.

As-built survey of the four ponds by a third-party Professional Land Surveyor and a detention pond site walkthrough indicate that the pond volume, trickle channels, two forebays, emergency spillway and outlet structure, as constructed and surveyed, are in substantial conformance with the construction plans.

Caveats: Because the certifier was not involved with construction administration of the pond, the compaction of earthwork in the pond embankment, placement of buried rip rap in the emergency spillway, and/or any other items not specifically mentioned are not certified in this letter. Submittal reviews during the construction phase of the project indicate that the appropriate material submittals were made, but do not certify that these actual materials were placed or whether appropriate means of storage were utilized prior to installation.

From the Colorado Springs Pond certification checklist (“Yes” indicates substantial compliance):

**Grading**

Pond 1, 2, 3, & 4 & RPA E2/E3

- Grading and Slopes Completed per approved plans Yes

**Soil Mixes**

- Proper storage of soil mix prior to placement (*see above*) N/A
- Soil Mix Correct per approved plans (*See above*) N/A

**Forebay**

- Built per approved plans Yes
- Forebay Volume per approved plans Yes

**Outlet Works**

- Built per approved plans Yes

**Spillway structure**

- Built per approved plans Yes

**WQCV and Elevations**

- WQCV per approved plans Yes
- All elevations per approved plans Yes

**As built Plans for Permanent BMP**

- Built per approved plans Yes

Per coordination with El Paso County and to reduce the maintenance burden for both the county and local HOA, we have revised the official receiving pervious areas (RPAs) and Unconnected Impervious Areas to leave approximately 1 Acre not officially treated as allowed for in the El Paso County MS4 permit (Section: E.4.a.iv.(A).1)). This section of the MS4 allows for up to 20% of the total site area (not to exceed 1 acre) which is impracticable to detain to be excluded from water quality treatment. Please note that the residential lots within the Grandwood Ranch subdivision are covered by the large lot (2.5-acre or greater) development exclusion and are not included in the areas below. None of these exclusions will increase runoff from the site or alter the design discussed in the approved PDR and FDR. The table below summarizes the excluded areas:

Excluded Areas		
Sq. Ft.	Acres	Descriptor
2871	0.066	Furrow Rd at Higby Intersection
3682	0.085	North Side of Higby Road
3919	0.090	South Side of Higby Road
12372	0.284	Sub-basin W1 Cul-de-Sac Sunnyvale Court
12254	0.281	Sub-basin W7 Cul-de-Sac Pasture Trail Court
7899	0.181	Secondary Fire Access road
<b>42997</b>	<b>0.987</b>	<b>Total</b>

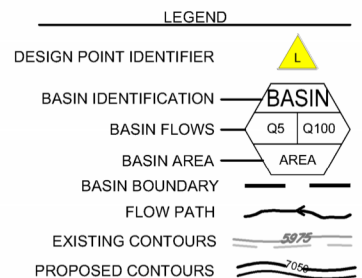
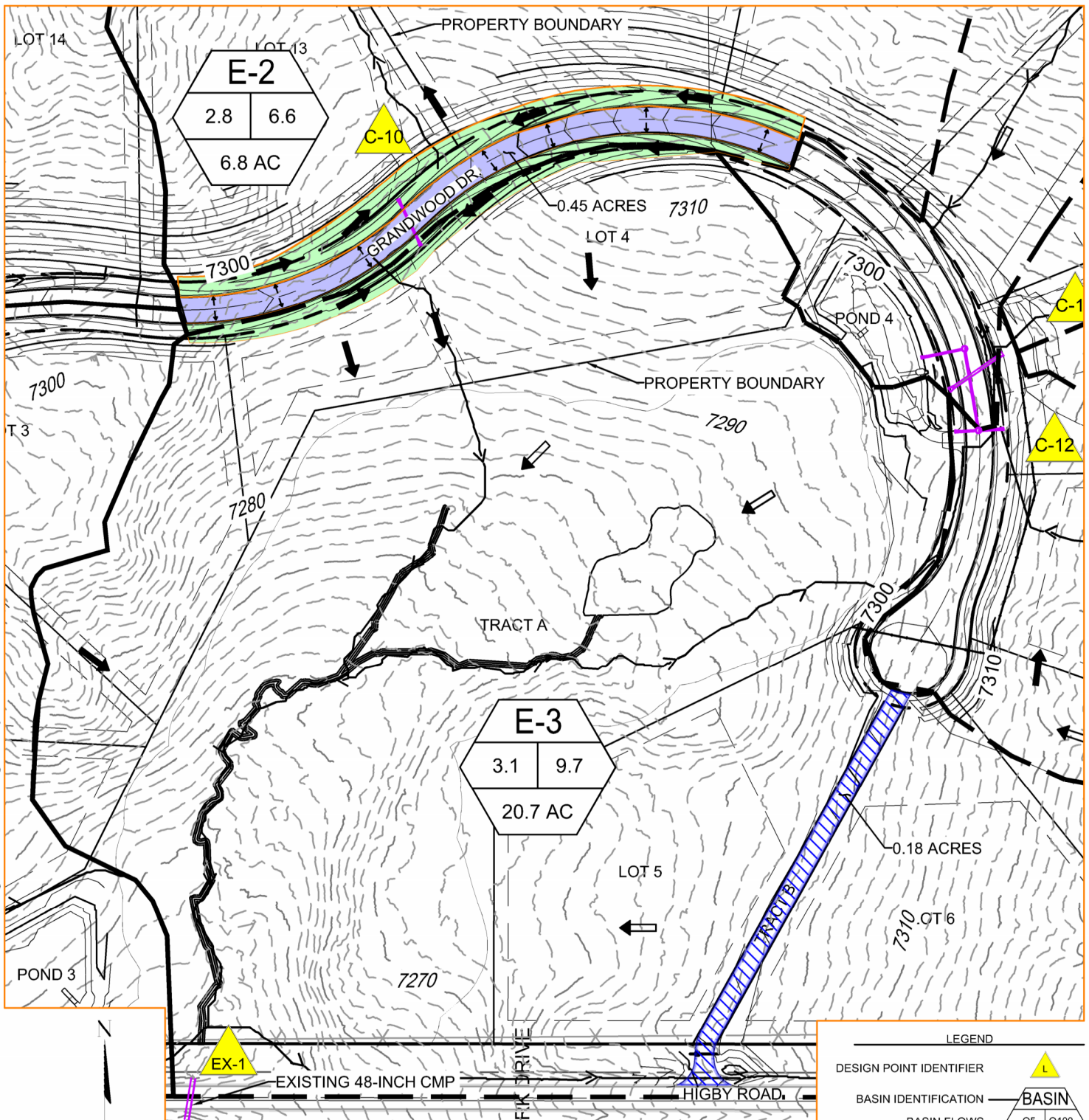
Revised illustrations of the UIA/SPA areas from the original PDR and FDR are attached which demonstrate the above discussion.

If there are any questions regarding this certification, please feel free to contact me by phone: 719-575-0100 or email: [corey.petersen@matrixdesigngroup.com](mailto:corey.petersen@matrixdesigngroup.com).

Thank you,



Corey Petersen, P.E. 56571



SURFACE TYPES	
UNCONNECTED IMPERVIOUS AREA (UIA)	
RECEIVING PERVIOUS AREA (RPA)	
DIRECTLY CONNECTED IMPERVIOUS AREA (DCIA)	
SEPARATE PERVIOUS AREA (SPA)	
EXCLUDED UIA	

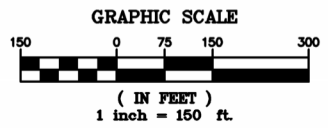
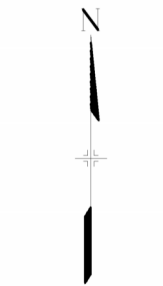
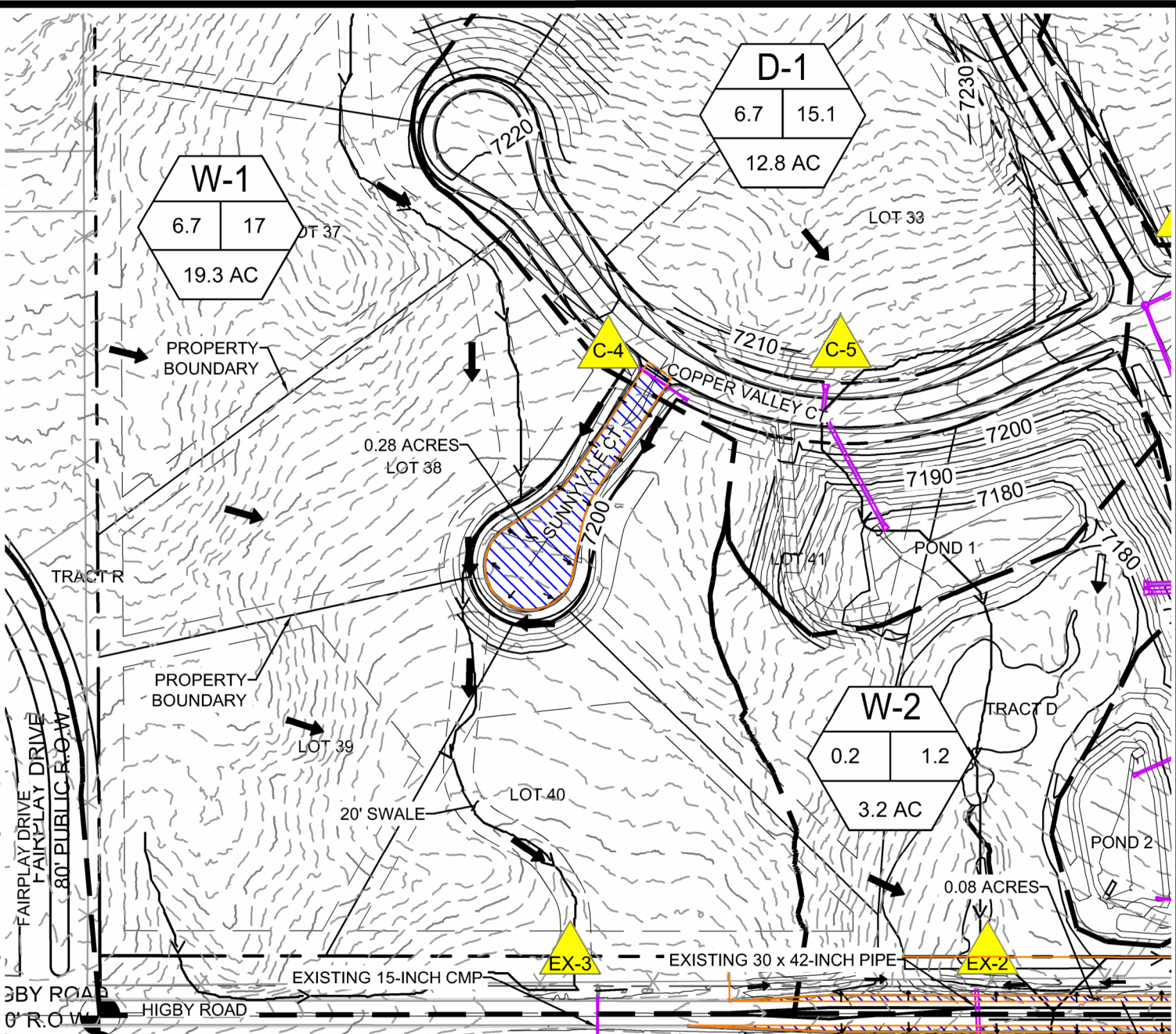
**Matrix**  
Excellence by Design

2435 Research Parkway, Suite 300  
Colorado Springs, CO 80920  
Phone 719-575-0100  
Fax 719-575-0208

## BASIN E-3 UIA RUNOFF CONFIGURATION



Apr 24, 2025 - 3:05pm S:\20.1105.004 Grandwood Ranch\200 Drainage\201 Drainage Reports\PRD\DWG\EXHIBITS\20.1105-PR-UIA DRAINAGE EXHIBITS-UPDATED FOR EXCLUS



SURFACE TYPES	
UNCONNECTED IMPERVIOUS AREA (UIA)	
RECEIVING PERVIOUS AREA (RPA)	
DIRECTLY CONNECTED IMPERVIOUS AREA (DCIA)	
SEPARATE PERVIOUS AREA (SPA)	
EXCLUDED UIA	

LEGEND

DESIGN POINT IDENTIFIER

BASIN IDENTIFICATION

BASIN FLOWS

BASIN AREA

BASIN BOUNDARY

FLOW PATH

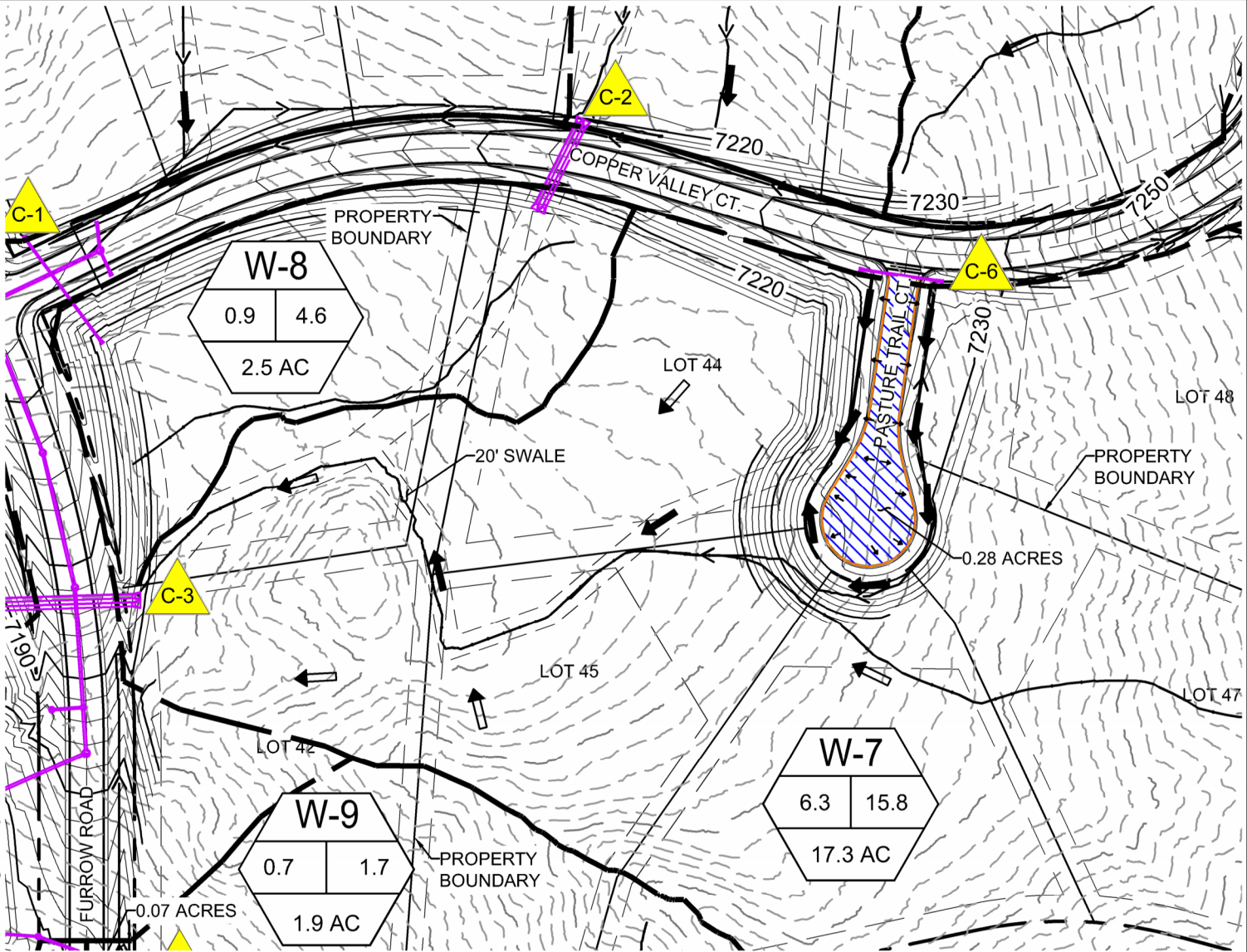
EXISTING CONTOURS

PROPOSED CONTOURS

# BASIN W-1 UIA RUNOFF CONFIGURATION

**Matrix**  
*Excellence by Design*  
2435 Research Parkway, Suite 300  
Colorado Springs, CO 80920  
Phone 719-575-0100  
Fax 719-575-0208

Apr 24, 2025 - 3:07pm S:\20.1105.004 Grandwood Ranch\200 Drainage\201 Drainage Reports\PDRI\DWG\EXHIBITS\20.1105-PR-UIA DRAINAGE EXHIBITS-UPDATED FOR EXCLUS



**SURFACE TYPES**

UNCONNECTED IMPERVIOUS AREA (UIA)	
RECEIVING PERVIOUS AREA (RPA)	
DIRECTLY CONNECTED IMPERVIOUS AREA (DCIA)	
SEPARATE PERVIOUS AREA (SPA)	
EXCLUDED UIA	

**LEGEND**

DESIGN POINT IDENTIFIER

BASIN IDENTIFICATION

BASIN FLOWS

BASIN AREA

BASIN BOUNDARY

FLOW PATH

EXISTING CONTOURS

PROPOSED CONTOURS

**GRAPHIC SCALE**

150 0 75 150 300

( IN FEET )

1 inch = 150 ft.

## BASIN W-7 UIA RUNOFF CONFIGURATION



**Matrix**

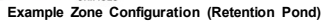
*Excellence by Design*

2435 Research Parkway, Suite 300  
Colorado Springs, CO 80920  
Phone 719-575-0100  
Fax 719-575-0208



*MHFD-Detention, Version 4.02 (February 2020)*

**Basin ID: Pond 1 (Lot 41) - As Built**



**Steep Slope > 0.06 ft/ft**

## Optional User Overrides

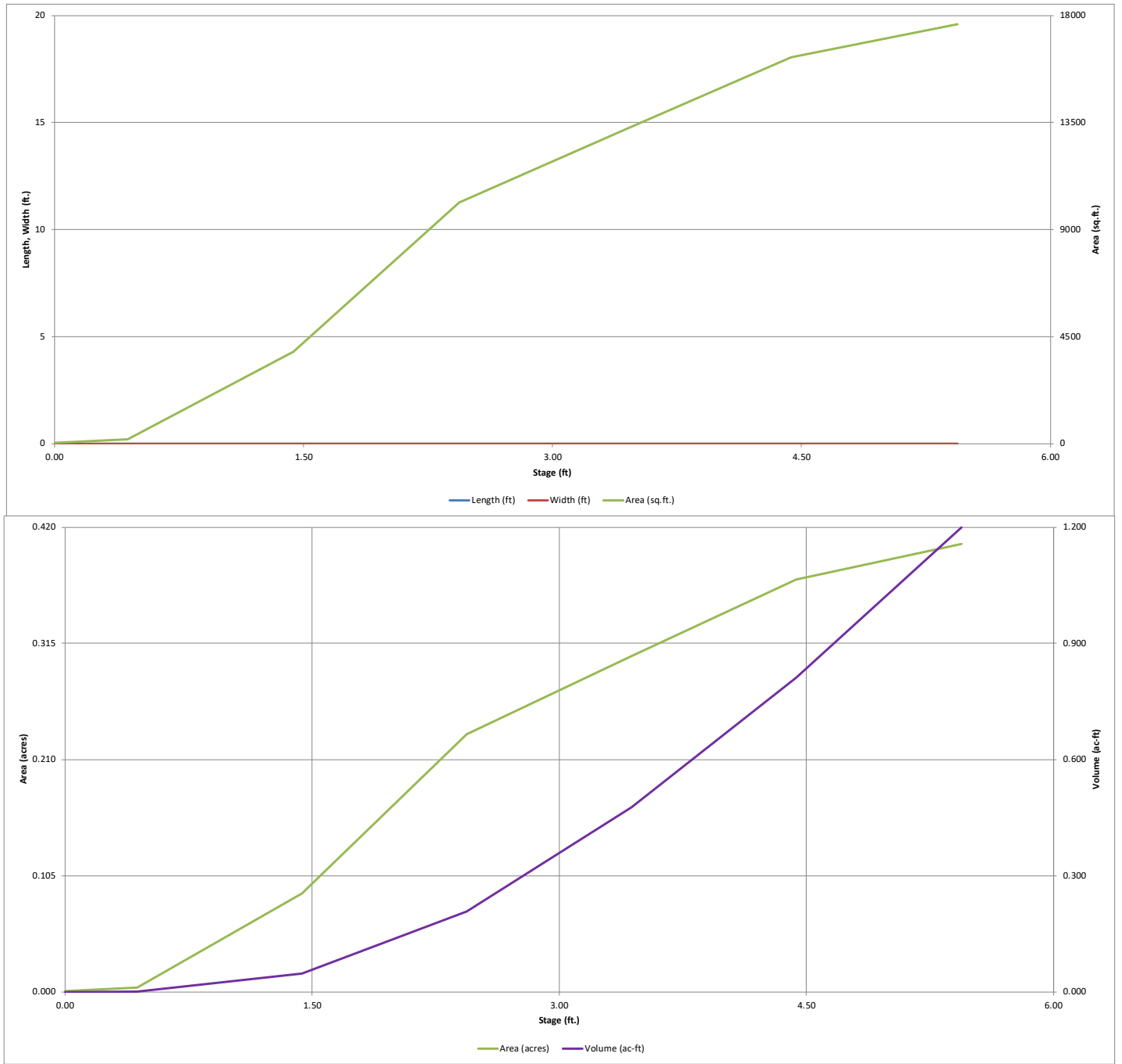
	acre-feet
	acre-feet
1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches

Initial Surcharge Area ( $A_{ISV}$ ) =	user	ft <sup>2</sup>
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 <sup>2</sup>
Volume of Basin Floor ( $V_{FLOOR}$ ) =	user	ft <sup>3</sup>
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 <sup>2</sup>
Volume of Main Basin ( $V_{MAIN}$ ) =	user	ft <sup>3</sup>
Calculated Total Basin Volume ( $V_{total}$ ) =	user	acre-feet

[illegible]

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)







= calcs match details in plans



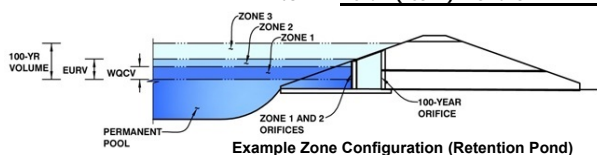
= calcs do not match details in plans

## DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: **Grandwood Ranch**

Basin ID: **Pond 1 (Lot 41) - As Built**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.75	0.082	Orifice Plate
Zone 2 (EURV)	2.26	0.087	Circular Orifice
Zone 3 (100-year)	3.34	0.276	Weir&Pipe (Restrict)
Total (all zones)		0.445	

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<sup>2</sup>  
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 = 1.72 ft (relative to basin bottom at Stage = 0 ft)  
Orifice Plate: Orifice Vertical Spacing = N/A inches  
Orifice Plate: Orifice Area per Row = 0.40 sq. inches (diameter = 11/16 inch)

Calculated Parameters for Plate  
WQ Orifice Area per Row = 2.778E-03 ft<sup>2</sup>  
Elliptical Half-Width = N/A feet  
Elliptical Slot Centroid = N/A feet  
Elliptical Slot Area = N/A ft<sup>2</sup>

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	0.70	1.40					
Orifice Area (sq. inches)	0.40	0.40	0.40					
	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 = 1.72 ft (relative to basin bottom at Stage = 0 ft)  
Depth at top of Zone using Vertical Orifice = 2.26 ft (relative to basin bottom at Stage = 0 ft)  
Vertical Orifice Diameter = 4.00 inches

Calculated Parameters for Vertical Orifice  
Zone 2 Circular = 0.09 ft<sup>2</sup>  
Not Selected = N/A ft<sup>2</sup>  
Vertical Orifice Centroid = 0.17 feet  
Not Selected = N/A 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<sub>1</sub> = 2.84 ft (relative to basin bottom at Stage = 0 ft)  
Overflow Weir Front Edge Length = 4.00 feet  
Overflow Weir Grate Slope = 0.00 H:V  
Horiz. Length of Weir Sides = 4.00 feet  
Overflow Grate Open Area % = 70% %  
Debris Clogging % = 50% %

Calculated Parameters for Overflow Weir  
Zone 3 Weir = 2.84 ft  
Not Selected = N/A ft  
Height of Grate Upper Edge, H<sub>2</sub> = 4.00 feet  
Overflow Weir Slope Length = 4.00 feet  
Grate Open Area / 100-yr Orifice Area = 21.72  
Overflow Grate Open Area w/o Debris = 11.20 ft<sup>2</sup>  
Overflow Grate Open Area w/ Debris = 5.60 ft<sup>2</sup>

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

Depth to Invert of Outlet Pipe = 0.00 ft (distance below basin bottom at Stage = 0 ft)  
Outlet Pipe Diameter = 18.00 inches  
Restrictor Plate Height Above Pipe Invert = 6.00 inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate  
Zone 3 Restrictor = 0.52 ft<sup>2</sup>  
Not Selected = N/A ft<sup>2</sup>  
Outlet Orifice Area = 0.29 ft<sup>2</sup>  
Outlet Orifice Centroid = 1.23 radians  
Half-Central Angle of Restrictor Plate on Pipe = N/A radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage = 4.14 ft (relative to basin bottom at Stage = 0 ft)  
Spillway Crest Length = 50.00 feet  
Spillway End Slopes = 4.00 H:V  
Freeboard above Max Water Surface = 1.00 feet

Calculated Parameters for Spillway  
Spillway Design Flow Depth = 0.22 feet  
Stage at Top of Freeboard = 5.36 feet  
Basin Area at Top of Freeboard = 0.40 acres  
Basin Volume at Top of Freeboard = 1.17 acre-ft

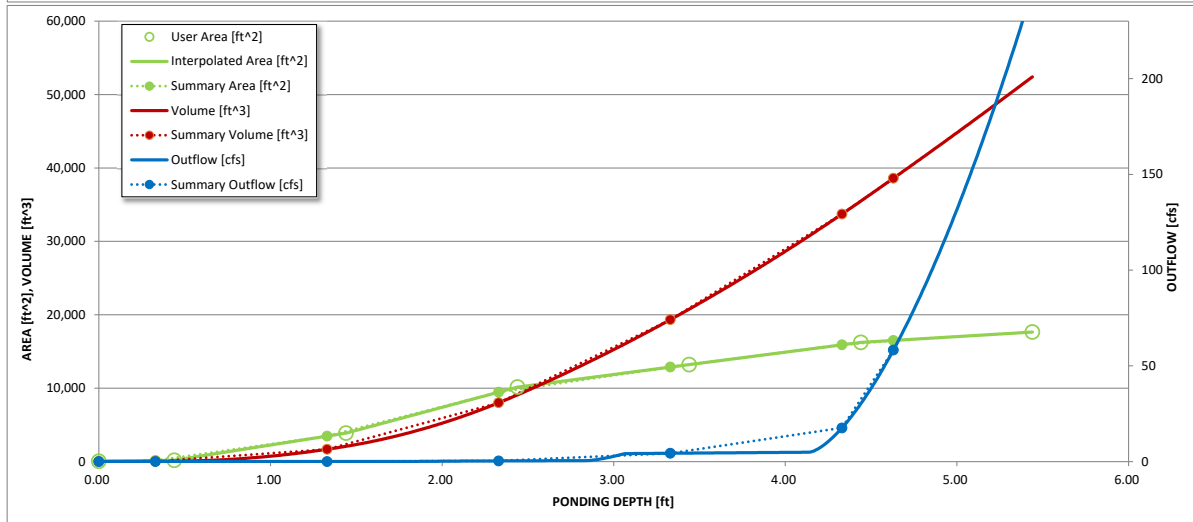
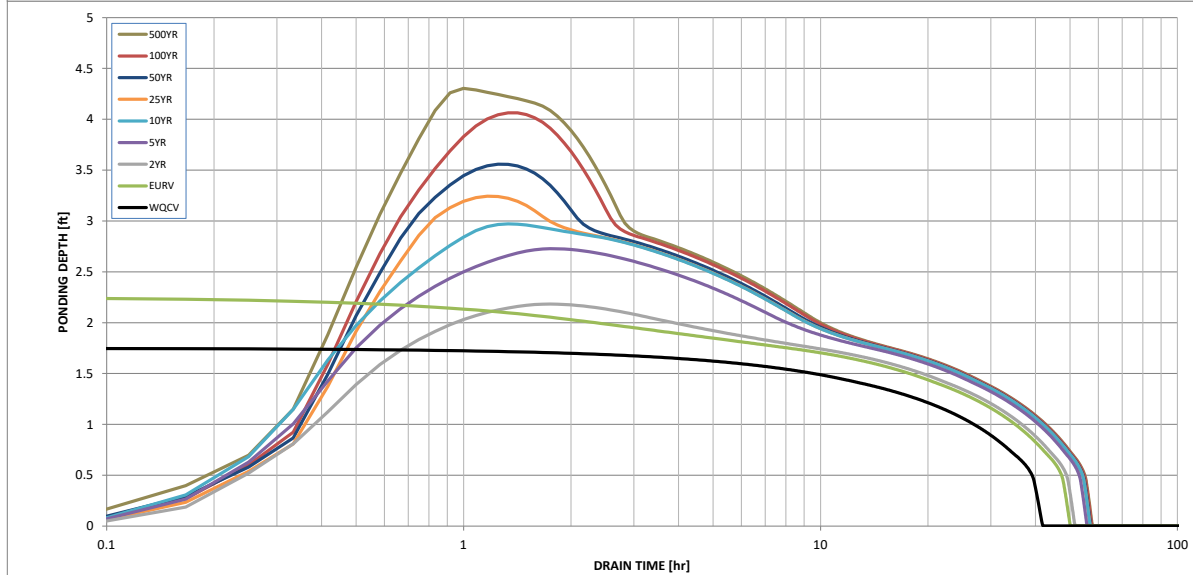
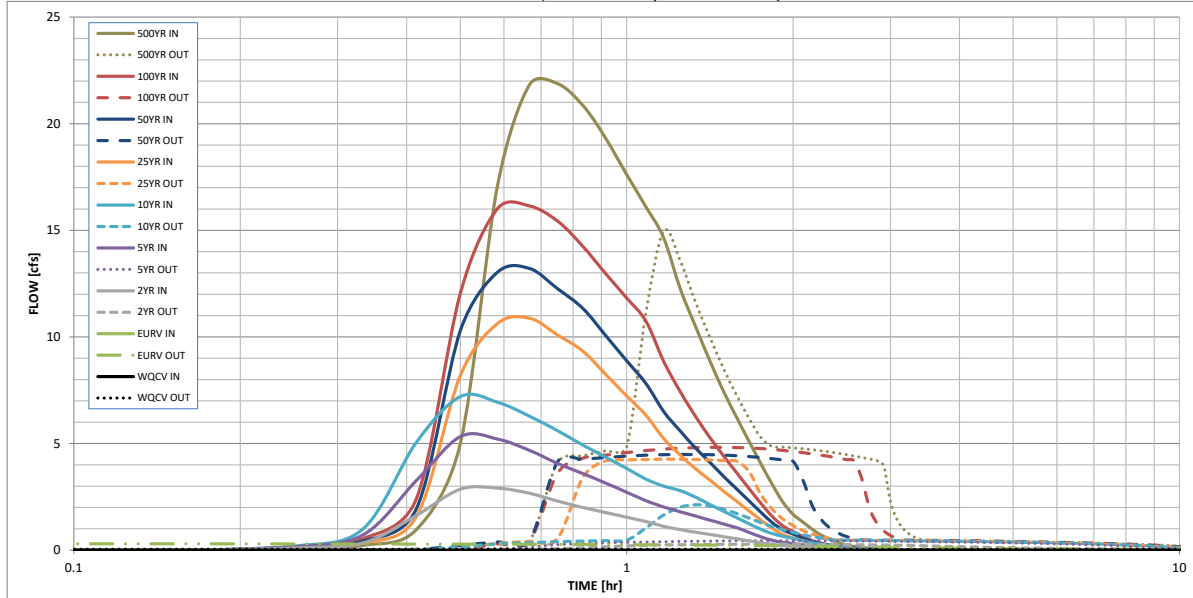
### Routed Hydrograph Results

The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through A5).

	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) =	0.082	0.168	0.181	0.330	0.471	0.702	0.867	1.096	1.525
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.181	0.330	0.471	0.702	0.867	1.096	1.525
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.3	3.4	5.1	9.0	11.3	14.1	19.6
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.15	0.41	0.60	1.06	1.33	1.66	2.31
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A	2.9	5.3	7.2	10.9	13.2	16.1	21.9
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.0	0.3	0.3	0.4	2.1	4.3	4.5	4.8	15.0
Peak Inflow Q (cfs) =	N/A	N/A	N/A	0.1	0.4	0.5	0.4	0.3	0.8
Peak Outflow Q (cfs) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.3	0.3	0.4	0.4
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	43	45	45	44	40	37	34	28
Time to Drain 99% of Inflow Volume (hours) =	40	47	49	51	51	48	47	46	44
Maximum Ponding Depth (ft) =	1.75	2.26	2.18	2.73	2.97	3.24	3.56	4.06	4.30
Area at Maximum Ponding Depth (acres) =	0.13	0.21	0.20	0.25	0.27	0.29	0.31	0.35	0.36
Maximum Volume Stored (acre-ft) =	0.082	0.169	0.153	0.277	0.342	0.417	0.511	0.678	0.763

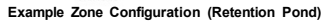
# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)



*MHFD-Detention, Version 4.02 (February 2020)*

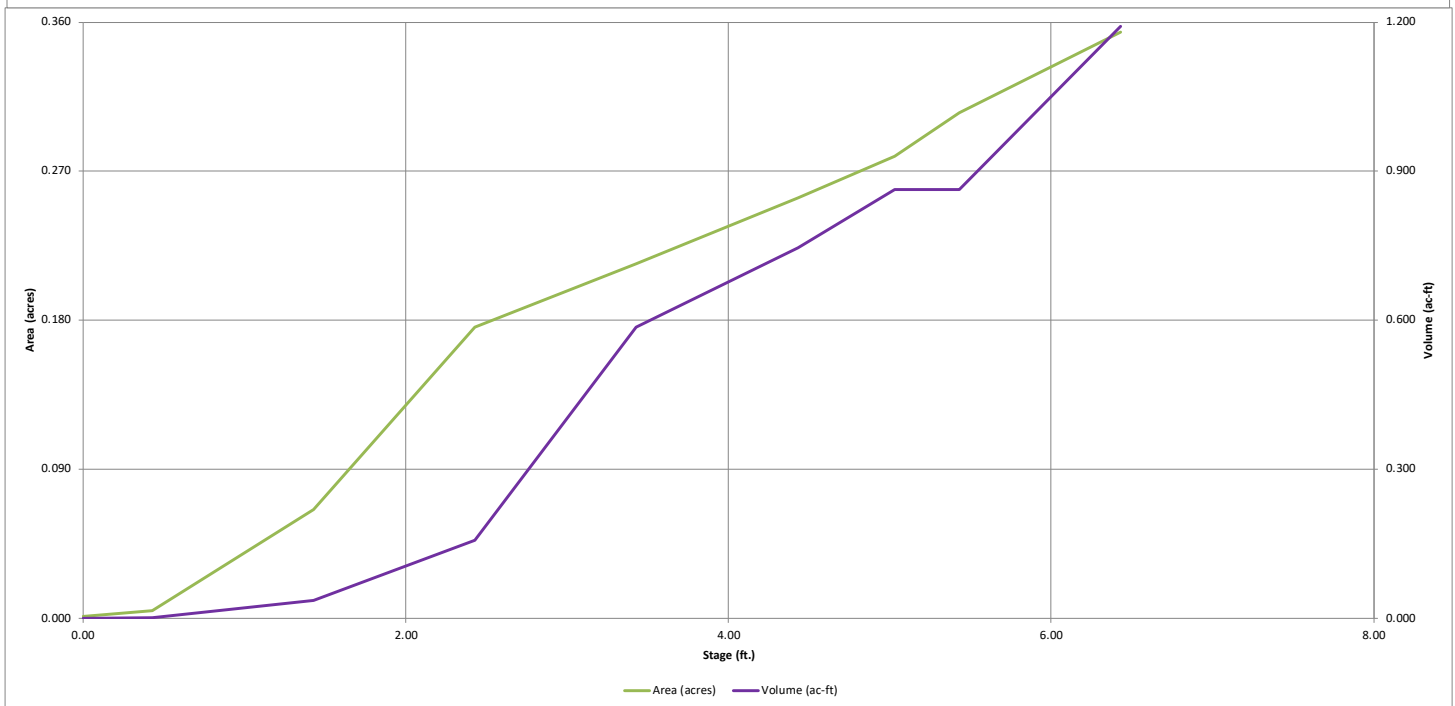
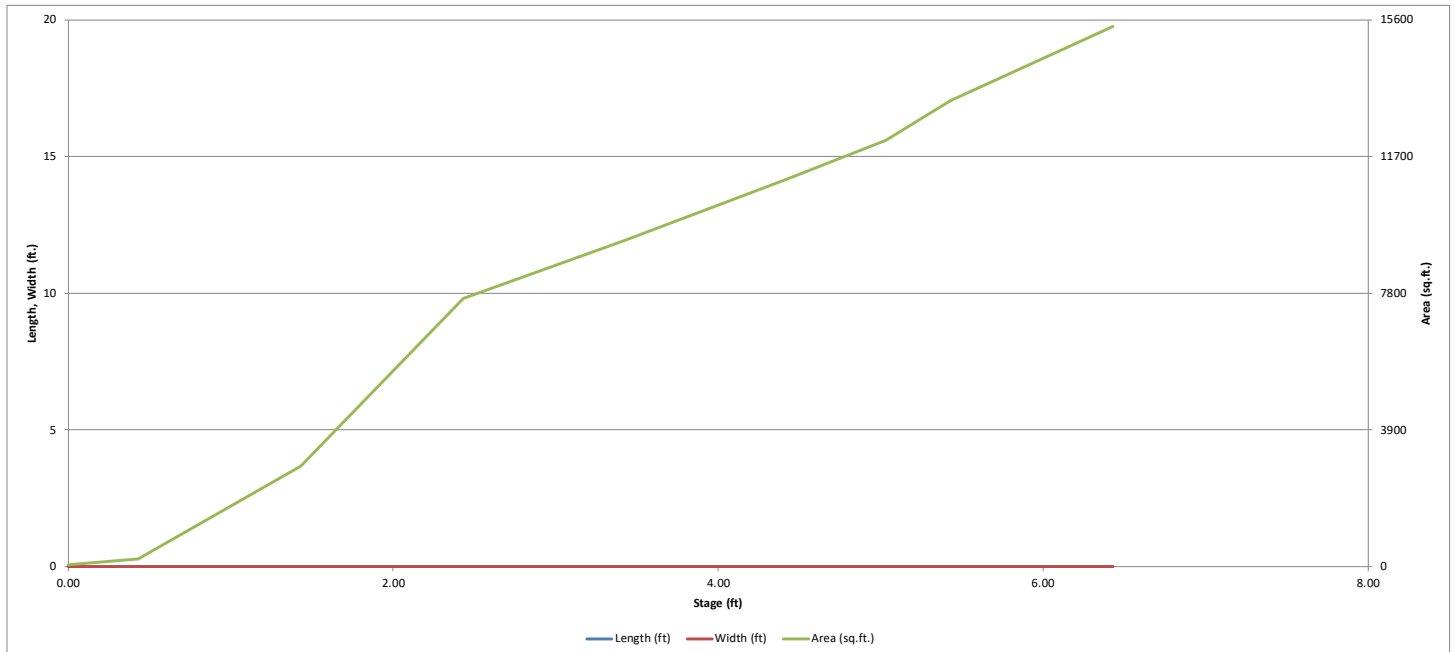
**Basin ID: Pond 2 (West) - As Built**



6/6/2025, 12:42 PM

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)



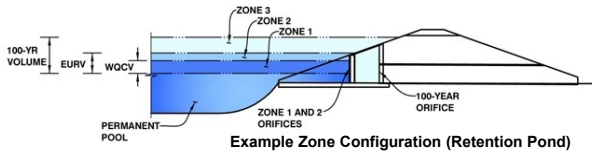


# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: **Grandwood Ranch**

Basin ID: **Pond 2 (West) - As Built**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.32	0.138	Orifice Plate
Zone 2 (EURV)	3.79	0.292	Circular Orifice
Zone 3 (100-year)	5.06	0.322	Weir&Pipe (Restrict)
Total (all zones)		0.752	

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 =  ft<sup>2</sup>  
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 (diameter = 7/8 inch)

Calculated Parameters for Plate  
WQ Orifice Area per Row =  ft<sup>2</sup>  
Elliptical Half-Width =  feet  
Elliptical Slot Centroid =  feet  
Elliptical Slot Area =  ft<sup>2</sup>

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	0.99	1.85					
Orifice Area (sq. inches)	0.60	0.60	0.60					

	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  
Zone 2 Circular ☒ Not Selected ☐  
Vertical Orifice Area =  ft<sup>2</sup>  
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<sub>1</sub> =  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 % =  %  
Debris Clogging % =  %

Calculated Parameters for Overflow Weir  
Zone 3 Weir ☒ Not Selected ☐  
Height of Grate Upper Edge, H<sub>1</sub> =  feet  
Overflow Weir Slope Length =  feet  
Grate Open Area / 100-yr Orifice Area =   
Overflow Grate Open Area w/o Debris =  ft<sup>2</sup>  
Overflow Grate Open Area w/ Debris =  ft<sup>2</sup>

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  
Zone 3 Restrictor ☒ Not Selected ☐  
Outlet Orifice Area =  ft<sup>2</sup>  
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

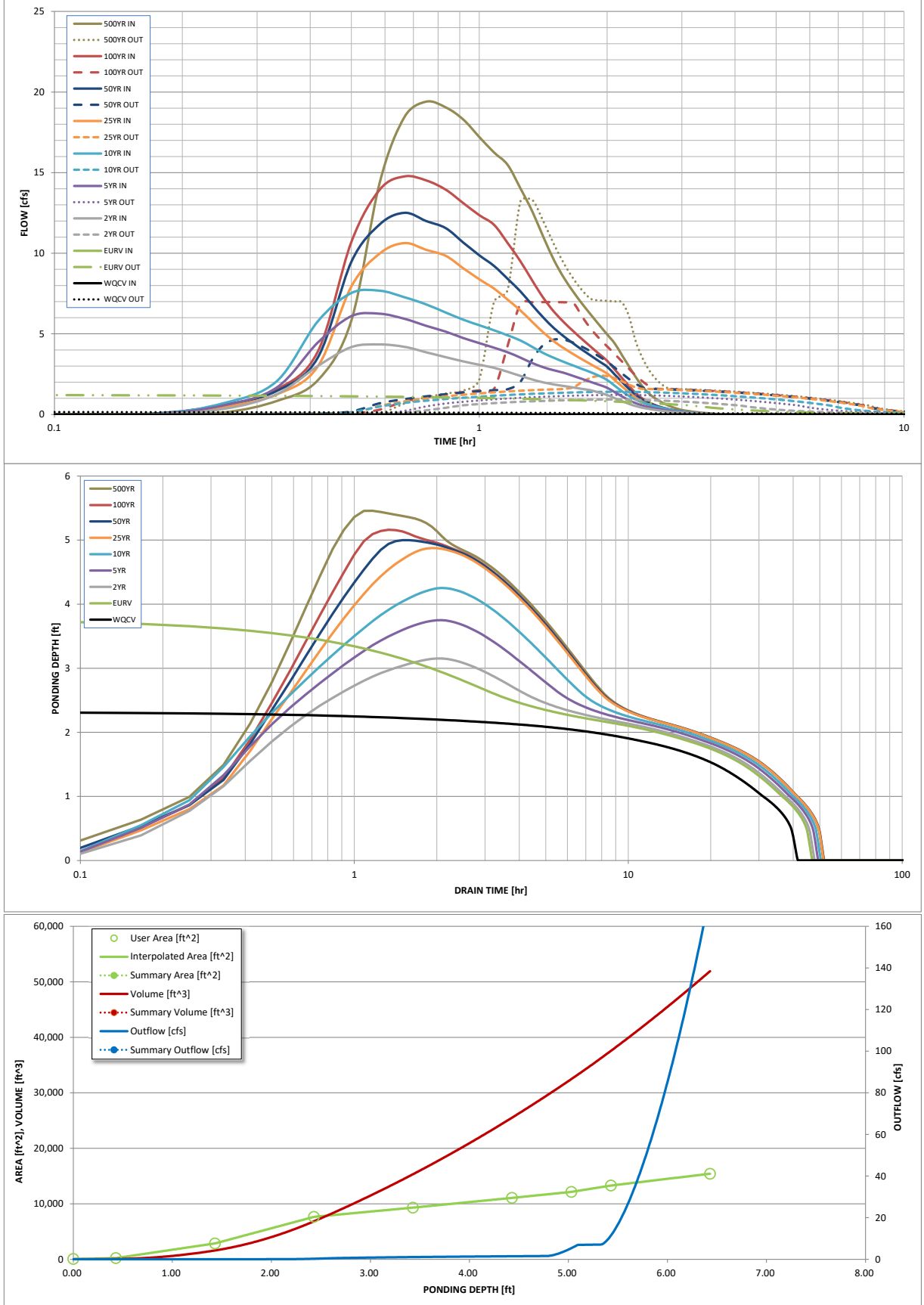
## Routed Hydrograph Results

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

	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)	0.138	0.430	0.409	0.584	0.738	0.945	1.113	1.325	1.758
CUHP Runoff Volume (acre-ft)	N/A	N/A	0.409	0.584	0.738	0.945	1.113	1.325	1.758
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	0.5	1.5	2.3	4.3	5.3	6.9	9.6
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.07	0.18	0.28	0.53	0.66	0.85	1.20
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A	4.3	6.2	7.7	10.6	12.5	14.8	19.4
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.9	1.2	1.4	2.4	4.6	7.0	13.3
Peak Inflow Q (cfs)	N/A	N/A	0.8	0.8	0.6	0.6	0.9	1.0	1.4
Peak Outflow Q (cfs)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Structure Controlling Flow	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps)	N/A	N/A	N/A	N/A	N/A	0.1	0.3	0.5	0.5
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	37	39	37	36	35	34	32	28
Time to Drain 99% of Inflow Volume (hours)	40	43	44	44	44	44	43	42	40
Maximum Ponding Depth (ft)	2.32	3.79	3.15	3.75	4.25	4.88	5.00	5.16	5.46
Area at Maximum Ponding Depth (acres)	0.16	0.23	0.20	0.23	0.25	0.27	0.28	0.29	0.31
Maximum Volume Stored (acre-ft)	0.139	0.432	0.294	0.422	0.541	0.702	0.735	0.780	0.869

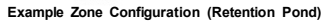
# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)



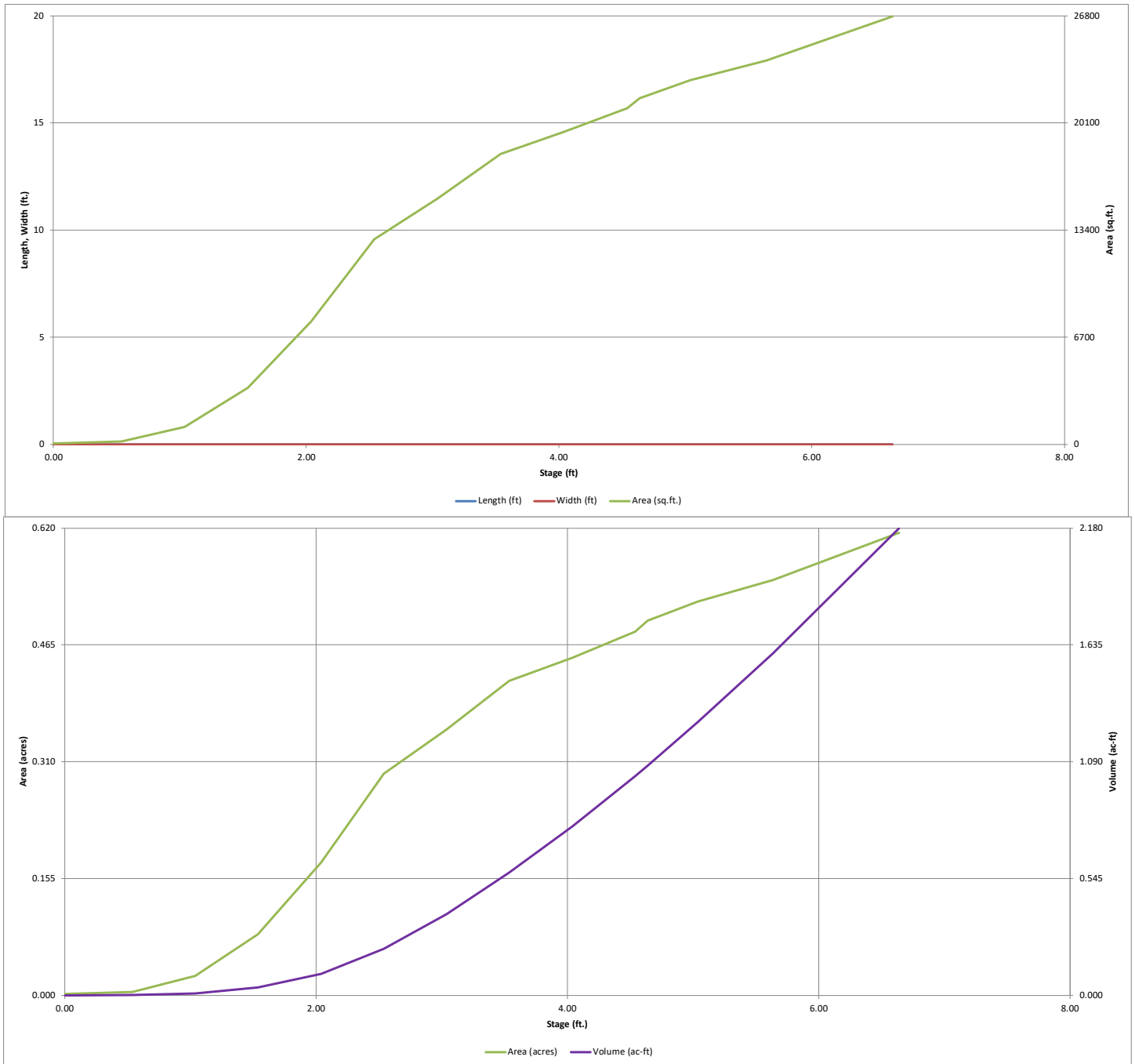
*MHFD-Detention, Version 4.02 (February 2020)*

**Basin ID: Pond 3 (Adjacent to Lot 1) (Includes Sub-basins E-1 and D-3) - As Built**



# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)



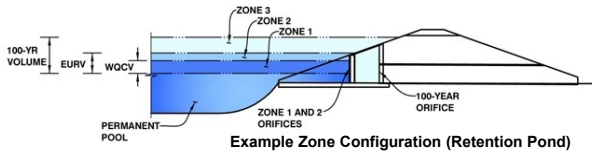


# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-DETENTION, Version 4.02 (February 2020)

Project: Grandwood Ranch

Basin ID: Pond 3 (Adjacent to Lot 1) (Includes Sub-basins E-1 and D-3) - As Built



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.46	0.195	Orifice Plate
Zone 2 (EURV)	3.00	0.170	Rectangular Orifice
Zone 3 (100-year)	4.76	0.764	Weir&Pipe (Restrict)
Total (all zones)		1.130	

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 <sup>2</sup>
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 =	2.35	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	0.75	sq. inches (diameter = 15/16 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	5.208E-03	ft <sup>2</sup>
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft <sup>2</sup>

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	0.99	1.99					
Orifice Area (sq. inches)	0.75	0.75	0.75					

	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 =	2.50	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	3.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	5.50	N/A	inches
Vertical Orifice Width =	12.00	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Not Selected	
Vertical Orifice Area =	0.46	N/A	ft <sup>2</sup>
Vertical Orifice Centroid =	0.23	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, Ho =	3.87	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	80%	N/A	%
Debris Clogging % =	40%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H <sub>u</sub> =	3.87	N/A	feet
Overflow Weir Slope Length =	4.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	4.07	N/A	
Overflow Grate Open Area w/o Debris =	12.80	N/A	ft <sup>2</sup>
Overflow Grate Open Area w/ Debris =	7.68	N/A	ft <sup>2</sup>

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 =	0.06	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	24.00	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	3.14	N/A	ft <sup>2</sup>
Outlet Orifice Centroid =	1.00	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 =	4.64	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	60.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth =	0.35	feet
Stage at Top of Freeboard =	5.99	feet
Basin Area at Top of Freeboard =	0.57	acres
Basin Volume at Top of Freeboard =	1.79	acre-ft

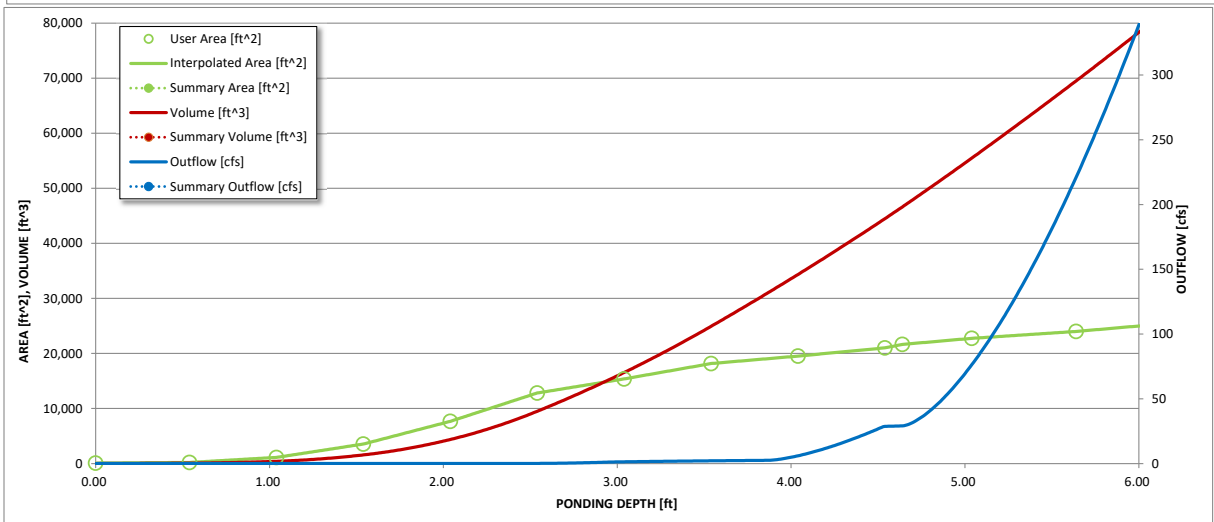
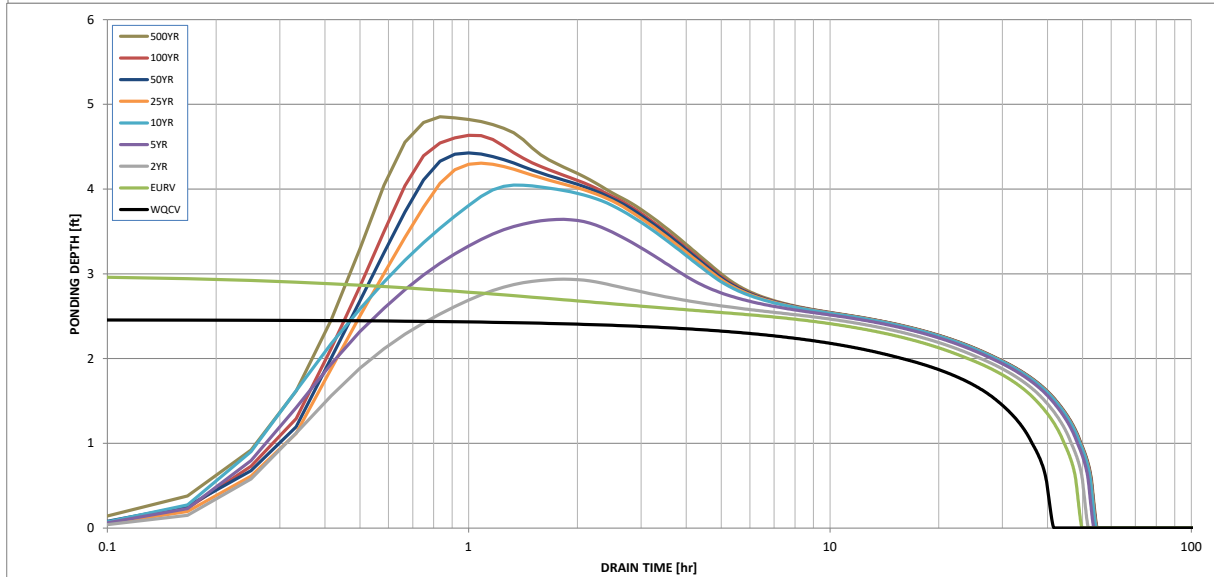
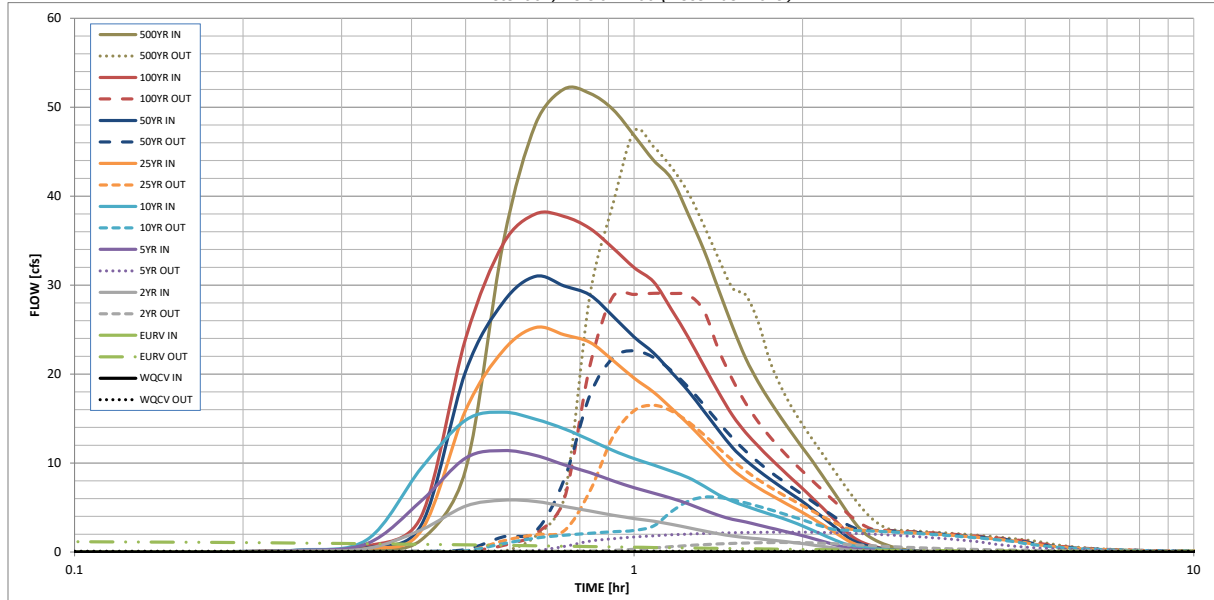
## Routed Hydrograph Results

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

	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) =	0.195	0.366	0.439	0.867	1.284	1.992	2.487	3.187	4.480
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.439	0.867	1.284	1.992	2.487	3.187	4.480
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.9	8.1	12.3	21.6	27.2	34.5	48.1
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	0.12	0.32	0.49	0.86	1.08	1.38	1.92
Peak Inflow Q (cfs) =	N/A	N/A	5.8	11.4	15.7	25.2	31.0	38.0	52.0
Peak Outflow Q (cfs) =	0.1	1.2	1.1	2.2	6.2	16.5	22.6	29.1	47.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.5	0.8	0.8	0.8	1.0
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.3	1.1	1.5	2.0	2.1
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) =	38	44	45	43	41	36	33	29	22
Time to Drain 99% of Inflow Volume (hours) =	40	47	49	48	48	46	44	43	40
Maximum Ponding Depth (ft) =	2.46	3.01	2.94	3.64	4.05	4.31	4.43	4.63	4.85
Area at Maximum Ponding Depth (acres) =	0.28	0.35	0.34	0.42	0.45	0.47	0.47	0.50	0.51
Maximum Volume Stored (acre-ft) =	0.195	0.369	0.342	0.614	0.789	0.908	0.964	1.065	1.176

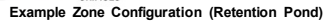
# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)



*MHFD-Detention, Version 4.02 (February 2020)*

**Basin ID: Pond 4 (East) - As Built**



**Steep Slope > 0.06 ft/ft**

## Optional User Overrides

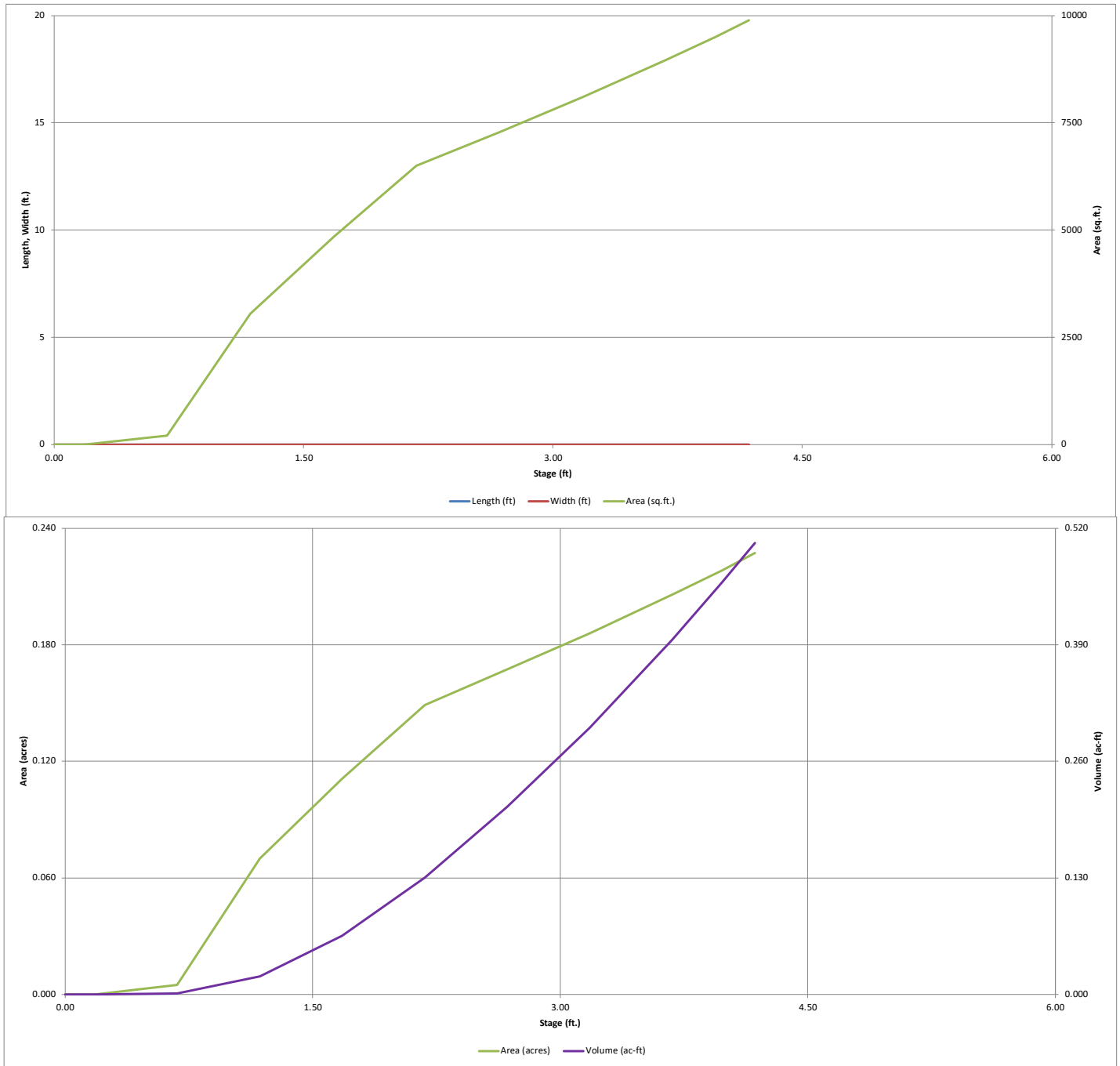
	acre-feet
	acre-feet
1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
	inches

Initial Surcharge Area ( $A_{ISV}$ ) =	user	ft <sup>2</sup>
Surcharge Volume Length ( $L_{ISV}$ ) =	user	ft
Surcharge Volume Width ( $W_{ISV}$ ) =	user	ft
Depth of Basin Floor ( $H_{LFLOOR}$ ) =	user	ft
Length of Basin Floor ( $L_{LFLOOR}$ ) =	user	ft
Width of Basin Floor ( $W_{LFLOOR}$ ) =	user	ft
Area of Basin Floor ( $A_{LFLOOR}$ ) =	user	ft <sup>2</sup>
Volume of Basin Floor ( $V_{LFLOOR}$ ) =	user	ft <sup>3</sup>
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 <sup>2</sup>
Volume of Main Basin ( $V_{MAIN}$ ) =	user	ft <sup>3</sup>
Calculated Total Basin Volume ( $V_{total}$ ) =	user	acre-feet

[illegible]

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

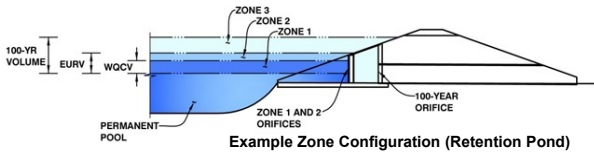
MHFD-Detention, Version 4.02 (February 2020)



# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: **Grandwood Ranch**  
Basin ID: **Pond 4 (East) - As Built**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.63	0.059	Orifice Plate
Zone 2 (EURV)	2.02	0.047	Circular Orifice
Zone 3 (100-year)	3.50	0.251	Weir&Pipe (Restrict)
Total (all zones)		0.357	

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 =  ft<sup>2</sup>  
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 (diameter = 5/8 inch)

Calculated Parameters for Plate  
WQ Orifice Area per Row =  ft<sup>2</sup>  
Elliptical Half-Width =  feet  
Elliptical Slot Centroid =  feet  
Elliptical Slot Area =  ft<sup>2</sup>

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	0.80	1.61					
Orifice Area (sq. inches)	0.30	0.30	0.30					

	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 =  ft<sup>2</sup>  
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<sub>o</sub> =  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 % =  %  
Debris Clogging % =  %

Calculated Parameters for Overflow Weir  
Height of Grate Upper Edge, H<sub>u</sub> =  feet  
Overflow Weir Slope Length =  feet  
Grate Open Area / 100-yr Orifice Area =  ft<sup>2</sup>  
Overflow Grate Open Area w/o Debris =  ft<sup>2</sup>  
Overflow Grate Open Area w/ Debris =  ft<sup>2</sup>

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 =  ft<sup>2</sup>  
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

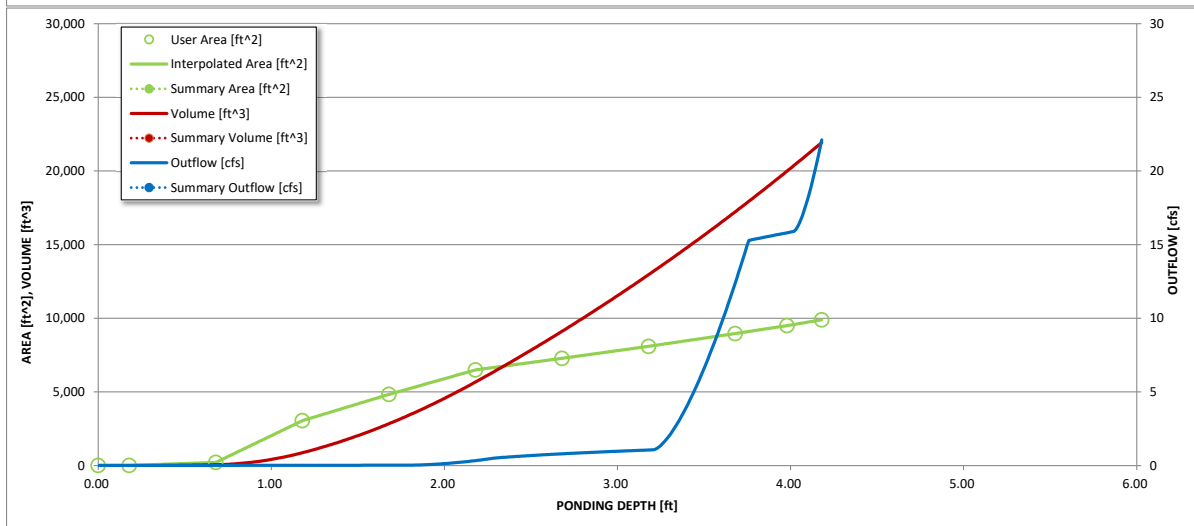
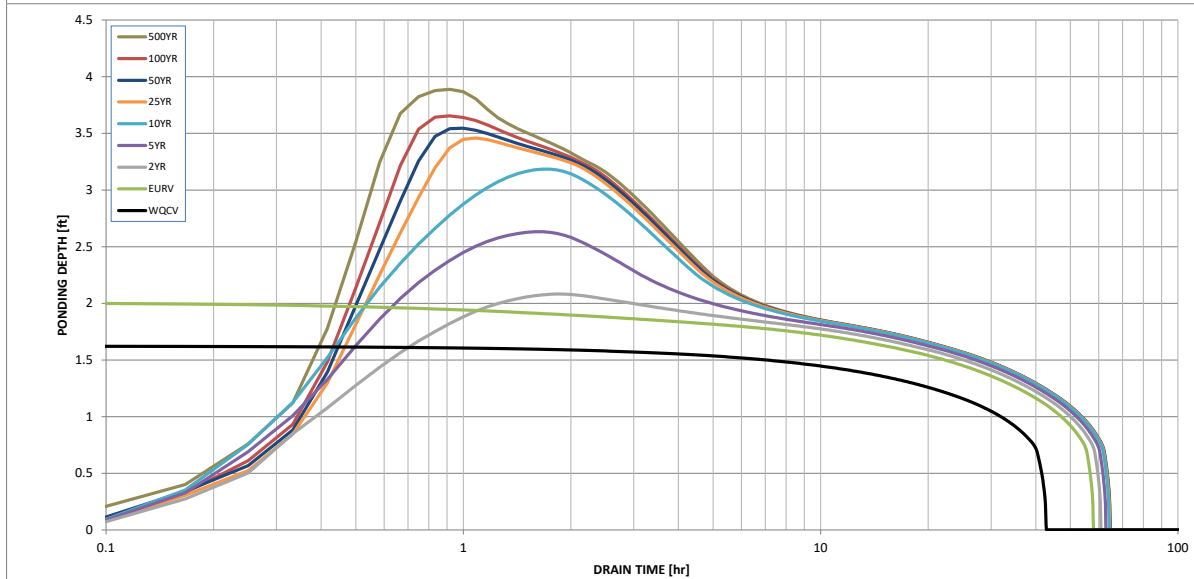
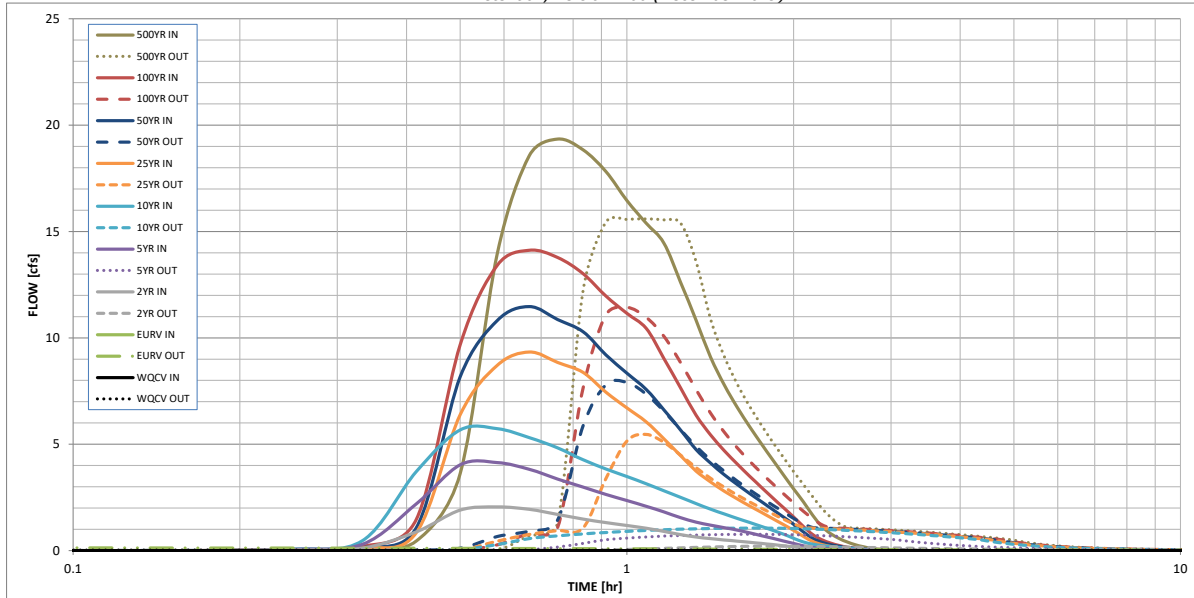
## Routed Hydrograph Results

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)	0.059	0.106	0.133	0.273	0.411	0.650	0.816	1.051	1.483
CUHP Runoff Volume (acre-ft)	N/A	N/A	0.133	0.273	0.411	0.650	0.816	1.051	1.483
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	1.1	3.2	4.7	8.4	10.5	13.1	18.2
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.13	0.37	0.55	0.98	1.23	1.54	2.14
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A	2.1	4.1	5.7	9.3	11.5	14.1	19.3
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.2	0.8	1.1	5.5	7.9	11.4	15.6
Peak Inflow Q (cfs)	0.0	0.1	0.2	0.8	1.1	5.5	7.9	11.4	15.6
Peak Outflow Q (cfs)	N/A	N/A	N/A	0.2	0.2	0.7	0.8	0.9	0.9
Ratio Peak Outflow to Predevelopment Q	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Structure Controlling Flow	N/A	N/A	N/A	N/A	N/A	0.4	0.6	0.9	1.3
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)	40	53	55	53	51	46	43	38	30
Time to Drain 99% of Inflow Volume (hours)	42	56	59	59	58	56	55	53	50
Maximum Ponding Depth (ft)	1.63	2.02	2.08	2.63	3.18	3.46	3.55	3.65	3.89
Area at Maximum Ponding Depth (acres)	0.11	0.14	0.14	0.17	0.19	0.20	0.20	0.20	0.21
Maximum Volume Stored (acre-ft)	0.060	0.107	0.116	0.201	0.298	0.349	0.367	0.389	0.437

# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)





# Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 1

**Designer:** Jesse Sullivan  
**Company:** Matrix Design Group  
**Date:** May 1, 2025  
**Project:** Grandwood Ranch  
**Location:** El Paso County

## SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth 0.60 inches  
Depth of Average Runoff Producing Storm,  $d_0$  = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	DCIA	SPA	UIA:RPA	DCIA	SPA							
Area ID	W1-Imp	W1-Perm	E2	W7-Imp	W7-Perm							
Downstream Design Point ID	EX-3	EX-3	EX-1	EX-4	EX-4							
Downstream BMP Type	None	None	None	None	None							
DCIA (ft <sup>2</sup> )	12,197	--	--	11,761	--							
UIA (ft <sup>2</sup> )	--	--	17,860	--	--							
RPA (ft <sup>2</sup> )	--	--	36,059	--	--							
SPA (ft <sup>2</sup> )	--	10,675	--	--	20,750							
HSG A (%)	--	0%	0%	--	0%							
HSG B (%)	--	100%	100%	--	100%							
HSG C/D (%)	--	0%	0%	--	0%							
Average Slope of RPA (ft/ft)	--	--	0.050	--	--							
UIA:RPA Interface Width (ft)	--	--	25.00	--	--							

## CALCULATED RUNOFF RESULTS

Area ID	W1-Imp	W1-Perm	E2	W7-Imp	W7-Perm							
UIA:RPA Area (ft <sup>2</sup> )	--	--	53,919	--	--							
L / W Ratio	--	--	16.00	--	--							
UIA / Area	--	--	0.3312	--	--							
Runoff (in)	0.50	0.00	0.00	0.50	0.00							
Runoff (ft <sup>3</sup> )	508	0	0	490	0							
Runoff Reduction (ft <sup>3</sup> )	0	534	744	0	1038							

## CALCULATED WQCV RESULTS

Area ID	W1-Imp	W1-Perm	E2	W7-Imp	W7-Perm							
WQCV (ft <sup>3</sup> )	508	0	744	490	0							
WQCV Reduction (ft <sup>3</sup> )	0	0	744	0	0							
WQCV Reduction (%)	0%	0%	100%	0%	0%							
Untreated WQCV (ft <sup>3</sup> )	508	0	0	490	0							

## CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	EX-3	EX-1	EX-4									
DCIA (ft <sup>2</sup> )	12,197	0	11,761									
UIA (ft <sup>2</sup> )	0	17,860	0									
RPA (ft <sup>2</sup> )	0	36,059	0									
SPA (ft <sup>2</sup> )	10,675	0	20,750									
Total Area (ft <sup>2</sup> )	22,872	53,919	32,511									
Total Impervious Area (ft <sup>2</sup> )	12,197	17,860	11,761									
WQCV (ft <sup>3</sup> )	508	744	490									
WQCV Reduction (ft <sup>3</sup> )	0	744	0									
WQCV Reduction (%)	0%	100%	0%									
Untreated WQCV (ft <sup>3</sup> )	508	0	490									

## CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft <sup>2</sup> )	109,302
Total Impervious Area (ft <sup>2</sup> )	41,818
WQCV (ft <sup>3</sup> )	1,742
WQCV Reduction (ft <sup>3</sup> )	744
WQCV Reduction (%)	43%
Untreated WQCV (ft <sup>3</sup> )	998