



Final Drainage Report Amendment

***Compark Village South, Filing No. 1
Parker, Colorado***

P.N. CLCPKC3

Prepared for:
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Prepared by:
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Initially Submitted September 30, 2019

October 1, 2019

This final drainage report amendment for the Compark Village South project was prepared by me or under my direct supervision in accordance with the provisions of the *Town of Parker Storm Drainage and Environmental Criteria Manual*. I understand that the Town of Parker and its designated town authority do not and will not assume liability for drainage facilities designed by others.

Prepared by:

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October 1, 2019

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Drainage Amendment Exhibit

APPENDIX B

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UD Detention – CVS Filing No. 2 + Belford Ave
UD Detention – Grand View Estates (H180)
UD Detention – CVS Filing No. 2 + Belford Ave + Grand View Estates

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I. GENERAL LOCATION AND DESCRIPTION

A. Scope

The original scope of this project included realignment of the Green Acres Tributary and construction of an on-line regional detention pond. Since preparation of the previous design, it has been determined by a consultant for Mile High Flood Control District that the on-line regional detention basin is not required for this area. The realignment and improvements to the Green Acres Tributary will now be designed and permitted by RESPEC, the MHFD's consultant.

This amendment is to design an off-line detention basin to control the runoff and provide water quality treatment for the proposed stormwater runoff from Compark Village Filing No. 1 Belford Avenue improvements and the Compark Village Filing No. 2 residential subdivision. Drainage criteria utilized for the design are in accordance with the *Town of Parker Storm Drainage and Environmental Criteria Manual and Urban Drainage and Flood Control District*.

II. DRAINAGE BASINS AND SUB-BASINS

A. Basin Description

The basins and sub-basins utilized to size the proposed detention basin were taken from the "Final Drainage Report, Compark Village South Filing No. 2", prepared by Manhard Consulting, dated November 2016, revised December 2016. The areas include Belford Avenue from a high point at station 35+15 to the next high point at station 77+41, the 47 acres that comprise the CVS F2 project and 20 acres of off-site Grand View Estates property that currently drains through this property (H180).

In the original design, there were three direct discharges to the Green Acres Tributary and one discharge to the regional detention pond. The three direct discharges will remain unchanged with this amendment and the previous discharge to the regional detention pond will be re-routed from STMH 1-5 along Belford Avenue to station 77+50 then to the proposed detention basin. Although portions of Belford Avenue and CVS F2 will be directly discharged to the GAT with water quality structures for each pipe upstream of the channel, storage and water quality for these areas will be provided in the proposed

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detention basin. That is compensatory storage and treatment will be provided in the proposed detention basin.

III. DRAINAGE DESIGN CRITERIA

A. Regulations

The regulations, guidelines, and drainage design criteria to be used are those contained within the *Town of Parker Storm Drainage Design and Environmental Criteria* and the *Urban Storm Drainage Criteria Manual*. The general drainage concept is to construct a full spectrum extended detention basin to provide detention and water quality treatment for the proposed stormwater runoff from a portion of Belford Avenue and the entire Compark Village South Filing No. 2 subdivision. Hydrodynamic separator water quality structures will be installed to treat runoff from developed areas not routed through the detention basin prior to the runoff entering the Green Acres Tributary.

B. Hydrologic Criteria

The UDFCD UD Detention worksheet was utilized to size the proposed extended detention basin, the proposed outlet structure, emergency overflow weir, as well as, to calculate the direct runoff from the Grand View Estates property that currently drains across this property.

The UD Detention workbook was completed for the portions of Belford Avenue and all of Compark Village South Filing No. 2 to calculate the allowable release rates for the proposed development without the Grand View Estates area. Then the workbook was utilized to calculate the runoff from the Grand View Estates drainage basin. The 100-year runoff from Grand View Estates will be “passed through” the detention basin, i.e. the allowable 90% of the 100-year discharge from the CVS F2 basin, 42.7 cfs, was increased to include the runoff of 26.8 cfs as calculated by the UD Worksheet for the 20 acre drainage basin.

C. Variance from Criteria

No variance is required.

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D. CONCLUSION

This final drainage report amendment complies with all major standards of the Town of Parker and the Urban Drainage Flood Control District. This overall plan for the site's drainage design is effective and economical for controlling damage due to excess storm runoff and minimizing erosive discharges.

Appendix A

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Appendix B

Compark Villge South Filing No. 2
Proposed Sub-Basins to Detention Basin
9-27-19

	Design Pt	DA (ac)	% Imp	DA x % Imp
CVS-4A (Inlet 3-4)	4A	2.2	0.55	1.21
CVS-5 (Inlet 5-4)	5	2.19	0.45	0.9855
CVS-6 (Inlet 6-4)	6	0.58	0.45	0.261
CVS-6A (FES 2-4)	6A	0.78	0.02	0.0156
CVS-9 (Inlet 4-5A)	9	2.41	0.55	1.3255
CVS-9A (Inlet 4-4)	9A	0.37	0.55	0.2035
CVS-10 (Inlet 5-5A)	10	2.78	0.51	1.4178
CVS-10A (Inlet 5-4A)	10A	0.4	0.63	0.252
CVS-12 (Inlet 2-5)	12	4.58	0.55	2.519
CVS-12A (Inlet 3-5)	12	0.81	0.55	0.4455
CVS-12B (Inlet 3-5)	12A	1.31	0.55	0.7205
CVS-13 (Inlet 4-5)	13	1.16	0.55	0.638
CVS 13A (Inlet 6-5A)	13A	1.2	0.62	0.744
CVS 13B (Inlet 4-5B)	13B	1.53	0.63	0.9639
CVS 13C (Inlet 4-5C)	13C	1.26	0.55	0.693
CVS-14 (Inlet 6-5)	14	1.89	0.55	1.0395
CVS-14A (Inlet 7-5)	14A	4.01	0.02	0.0802
CVS-14B (Inlet 6-5)	14	2.73	0.08	0.2184
CVS-14C (Inlet 5-5B)	14C	1.93	0.55	1.0615
CVS-15 (Inlet 5-5)	15	2.05	0.55	1.1275
CVS-15A (Inlet 6-5B)	15A	0.95	0.59	0.5605
CVS-16	16	2.58	0.55	1.419
CVS-17	17	4.1	0.55	2.255
CVS-18	18	3.06	0.5	1.53
		46.86		21.6864

Overall % Imp = 21.69/46.86= 46.27913

Compark Village South
 Belford Ave Proposed Sub-Basins to Det Basin
 9-28-19

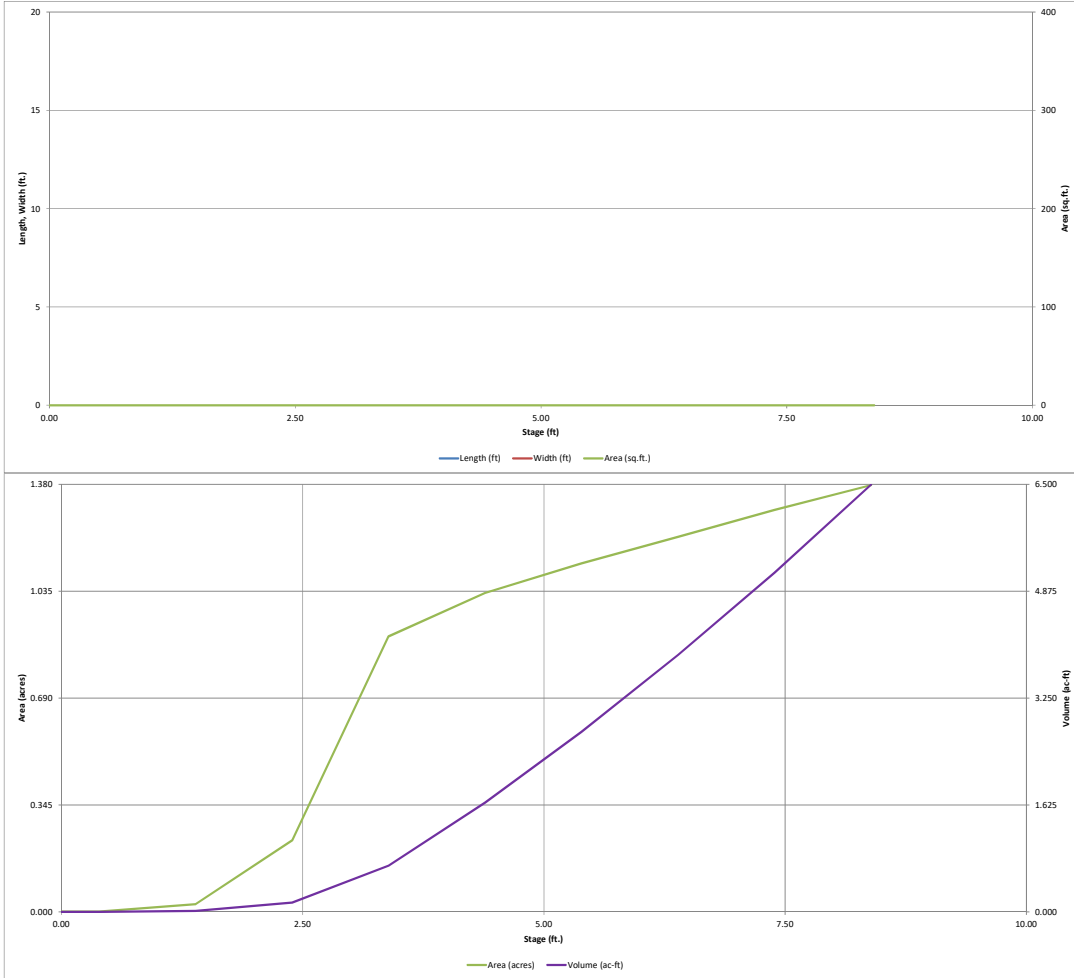
	Design Pt	DA	% Imp	DA x % Imp	
CVS-1 (Inlet 1-3)	1	3.85	0.32	1.232	
CVS-2 (Inlet 2-3)	2	1.42	0.77	1.0934	
CVS-3 (Inlet 1-4)	3	0.94	0.62	0.5828	
CVS-4 (Inlet 2-4)	4	1.17	0.49	0.5733	
CVS-7 (Inlet 1-6)	7	1.11	0.78	0.8658	
CVS-8 (Inlet 2-6)	8	1.59	0.55	0.8745	
CVS-11 (Inlet 1-5)	11	<u>2.03</u>	0.78	<u>1.5834</u>	
		12.11		6.8052	
			Total % Imp=		0.561949

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Appendix C

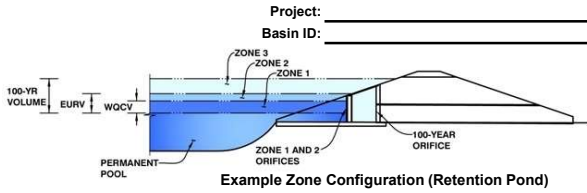
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)



	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.71	0.988	Orifice Plate
Zone 2 (EURV)	5.57	1.943	Weir&Pipe (Restrict)
Zone 3 (100-year)	7.14	1.900	Not Utilized
		4.831	Total

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice 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 =	5.59	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	22.00	inches
Orifice Plate: Orifice Area per Row =	3.36	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	2.333E-02	ft ²
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft ²

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.80	3.60	5.40				
Orifice Area (sq. inches)	3.36	3.36	3.36	3.36				
	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.59	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	5.66	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	3.42	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 2 Weir	Not Selected	
Height of Grate Upper Edge, H _c =	5.59	N/A	feet
Over Flow Weir Slope Length =	3.42	N/A	feet
Grate Open Area / 100-yr Orifice Area =	4.38	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	13.55	N/A	ft ²
Overflow Grate Open Area w/ Debris =	6.78	N/A	ft ²

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

	Zone 2 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	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 =	23.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 2 Restrictor	Not Selected	
Outlet Orifice Area =	3.10	N/A	ft ²
Outlet Orifice Centroid =	0.99	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.73	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	7.14	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	40.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

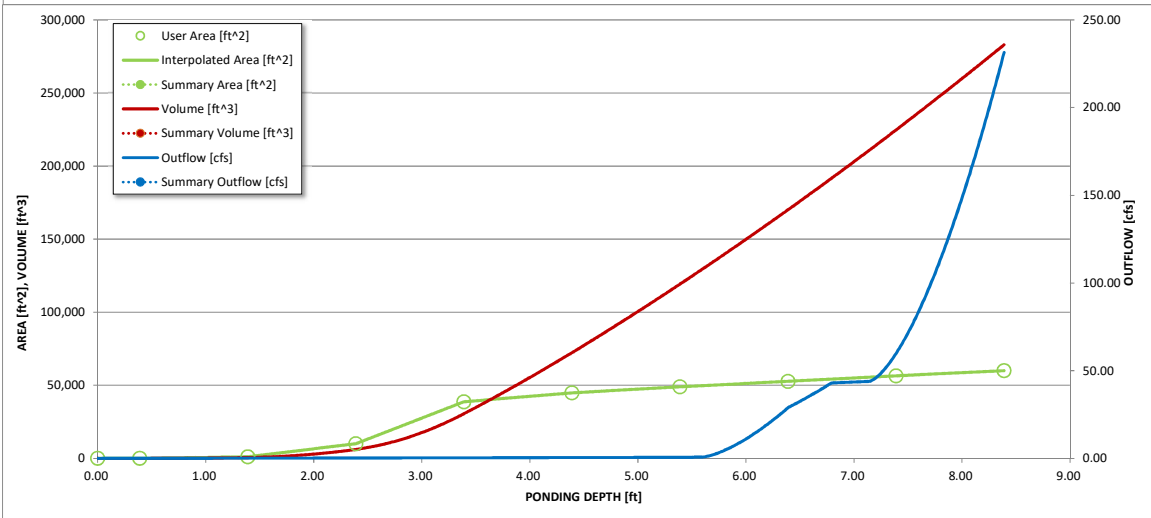
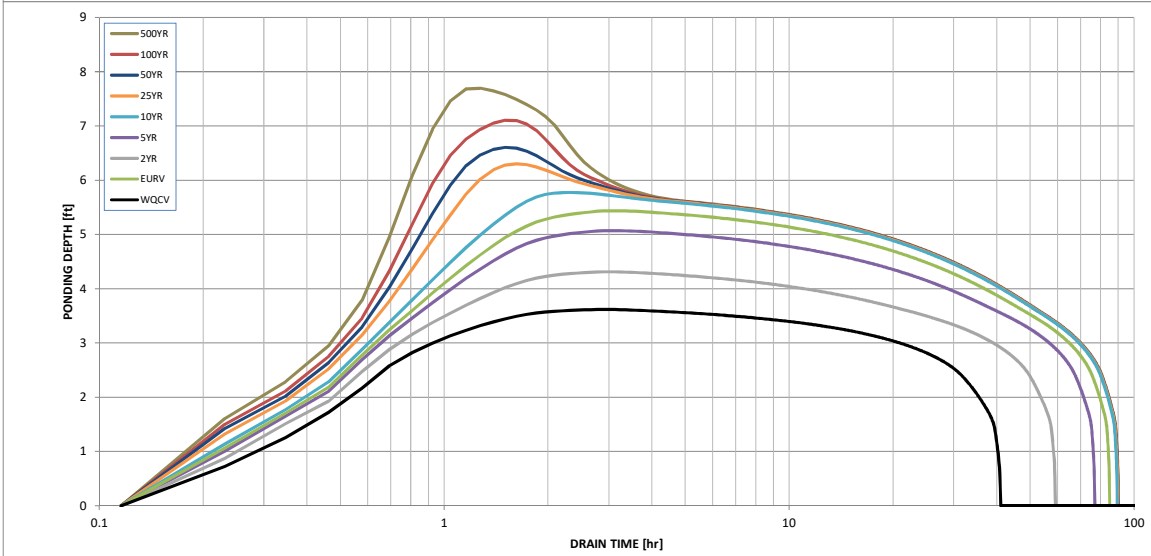
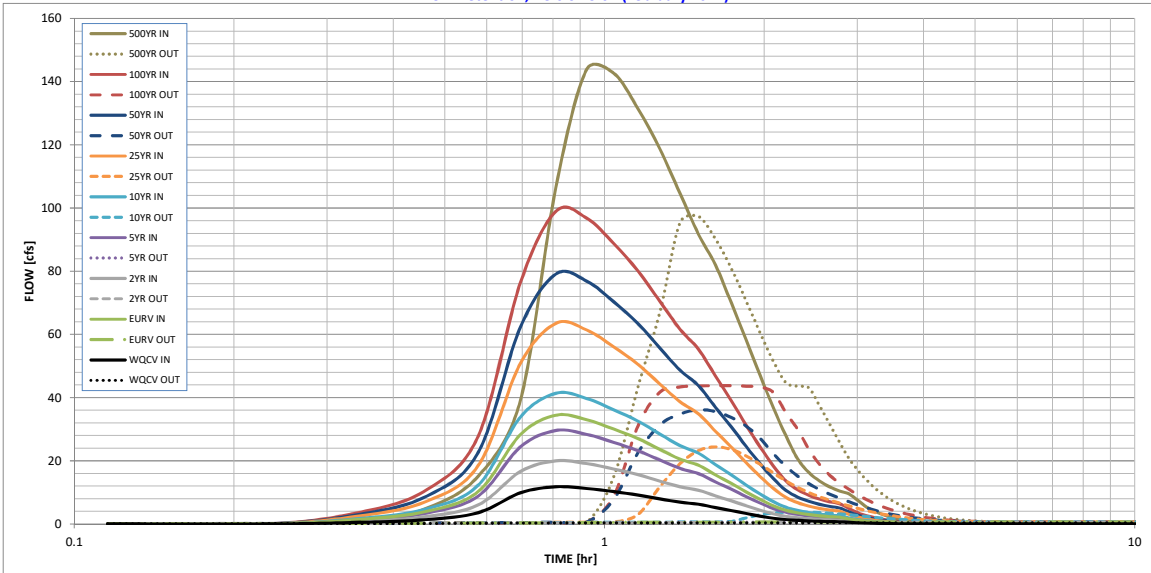
Spillway Design Flow Depth =	0.82	feet
Stage at Top of Freeboard =	8.96	feet
Basin Area at Top of Freeboard =	1.38	acres

Routed Hydrograph Results

	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) =	0.53	1.07	0.82	1.10	1.34	1.69	1.98	2.29	3.08
Calculated Runoff Volume (acre-ft) =	0.988	2.931	1.689	2.514	3.532	5.474	6.857	8.628	12.708
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.987	2.930	1.688	2.514	3.532	5.472	6.853	8.628	12.703
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.12	0.40	0.57	0.80	1.28
Predevelopment Peak Q (cfs) =	0.0	0.0	0.3	1.3	6.9	23.8	33.9	47.4	75.7
Peak Inflow Q (cfs) =	11.8	34.4	20.0	29.6	41.4	63.5	79.1	98.9	143.8
Peak Outflow Q (cfs) =	0.4	0.6	0.5	0.6	3.8	24.4	36.1	43.8	97.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.6	1.0	1.1	0.9	1.3
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Gate 1	Overflow Gate 1	Overflow Gate 1	Outlet Plate 1	Spillway
Max Velocity through Gate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	1.7	2.6	3.2	3.3
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	78	55	71	82	80	78	76	71
Time to Drain 99% of Inflow Volume (hours) =	40	82	57	75	86	85	84	83	82
Maximum Ponding Depth (ft) =	3.62	5.44	4.31	5.07	5.77	6.30	6.61	7.11	7.70
Area at Maximum Ponding Depth (acres) =	0.92	1.13	1.02	1.09	1.16	1.20	1.23	1.27	1.32
Maximum Volume Stored (acre-ft) =	0.900	2.782	1.578	2.382	3.171	3.796	4.161	4.786	5.551

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

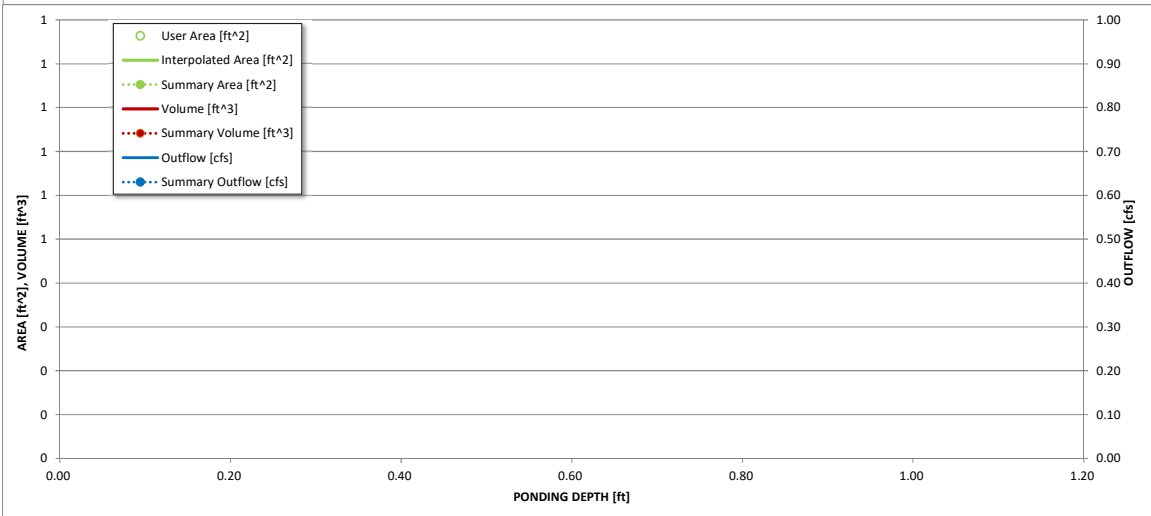
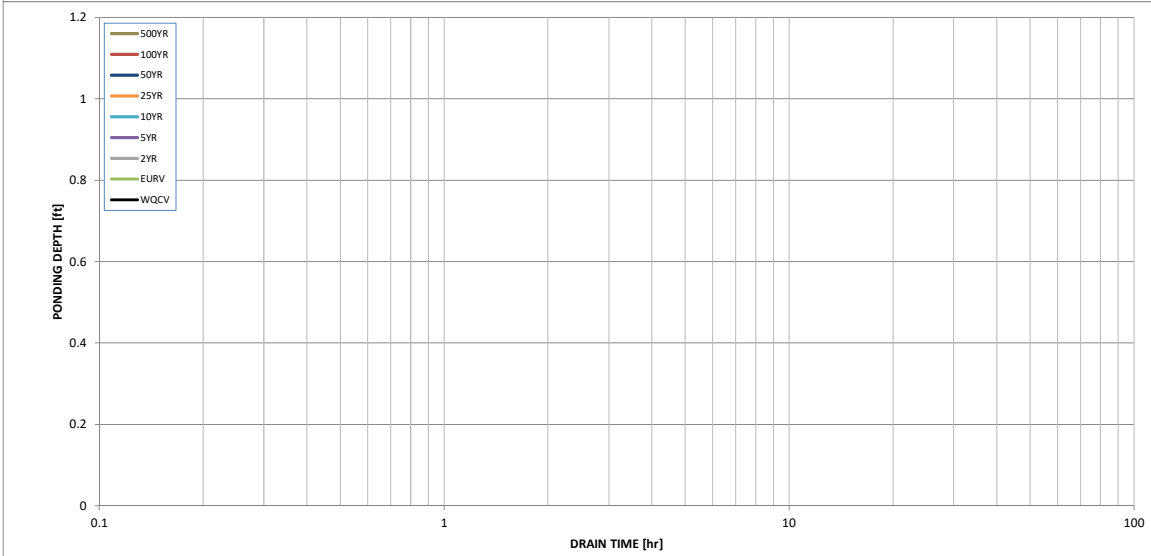
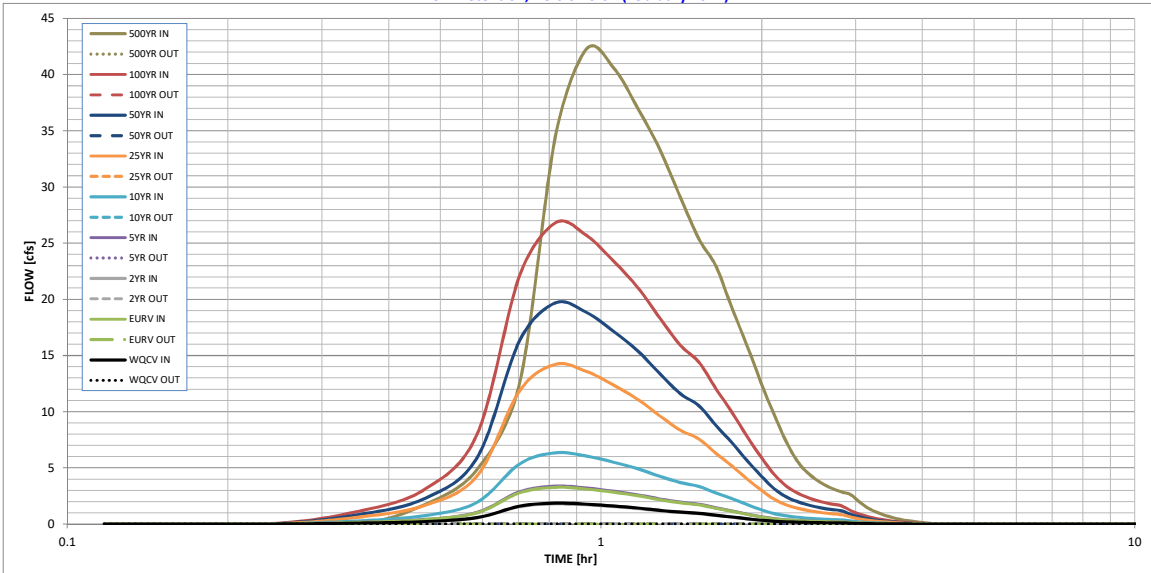


S-A-V-D Chart Axis Override

	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

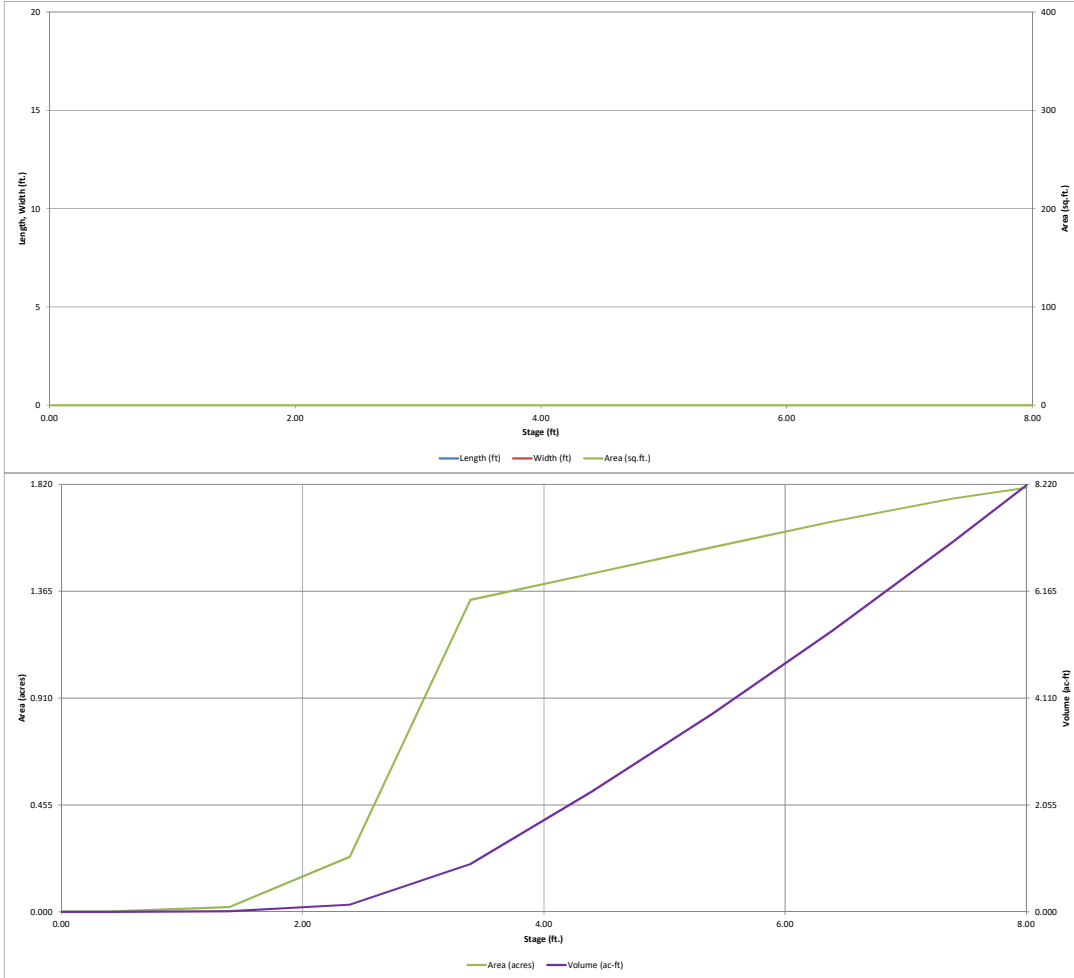


S-A-V-D Chart Axis Override

	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

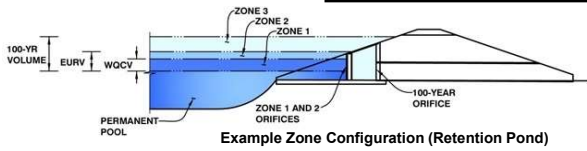


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: **Compark South**

Basin ID: _____



	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.59	1.184	Orifice Plate
Zone 2 (EURV)	5.02	2.039	Weir&Pipe (Restrict)
Zone 3 (100-year)	6.58	2.484	Weir&Pipe (Restrict)
		5.707	Total

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice 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 =	5.02	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	20.00	inches
Orifice Plate: Orifice Area per Row =	3.84	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	2.667E-02	ft ²
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft ²

2"x2" Rectangular Openings shown on Construction Plans for ease of Constructability

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	1.70	3.40					
Orifice Area (sq. inches)	3.84	3.84	3.84					
	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 2 Weir	Zone 3 Weir	
Overflow Weir Front Edge Height, Ho =	5.02		ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	11.33		feet
Overflow Weir Slope =	0.00		H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	3.42		feet
Overflow Grate Open Area % =	70%		% grate open area/total area
Debris Clogging % =	50%		%

Calculated Parameters for Overflow Weir

	Zone 2 Weir	Zone 3 Weir	
Height of Grate Upper Edge, H _g =	5.02		feet
Over Flow Weir Slope Length =	3.42		feet
Grate Open Area / 100-yr Orifice Area =	5.26		should be ≥ 4
Overflow Grate Open Area w/o Debris =	27.12		ft ²
Overflow Grate Open Area w/ Debris =	13.56		ft ²

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

	Zone 2 Restrictor	Zone 3 Restrictor	
Depth to Invert of Outlet Pipe =	2.50		ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	36.00		inches
Restrictor Plate Height Above Pipe Invert =	24.65		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 2 Restrictor	Zone 3 Restrictor	
Outlet Orifice Area =	5.16		ft ²
Outlet Orifice Centroid =	1.15		feet
Half-Central Angle of Restrictor Plate on Pipe =	1.95		radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	6.58	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	150.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

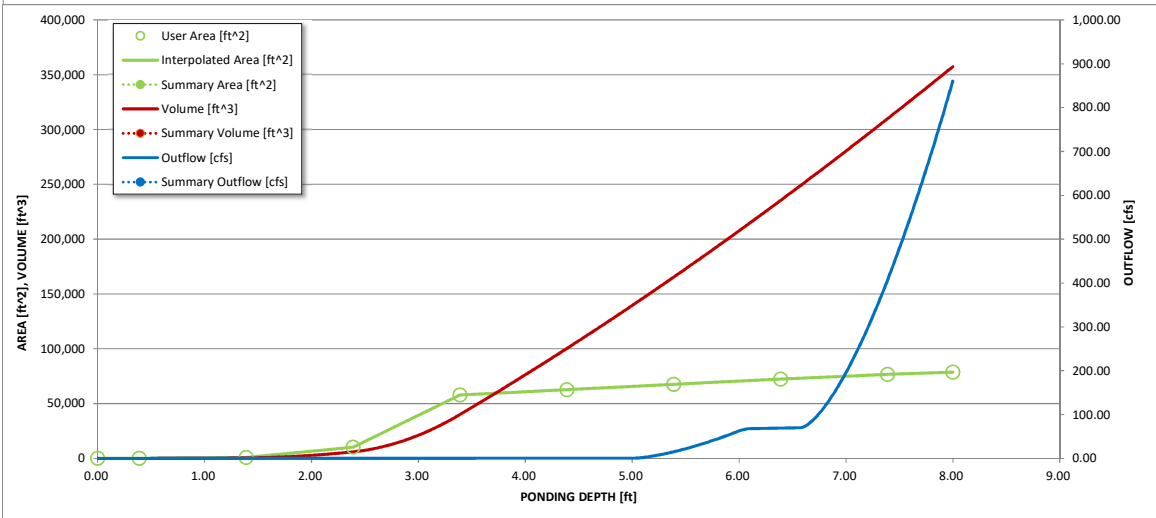
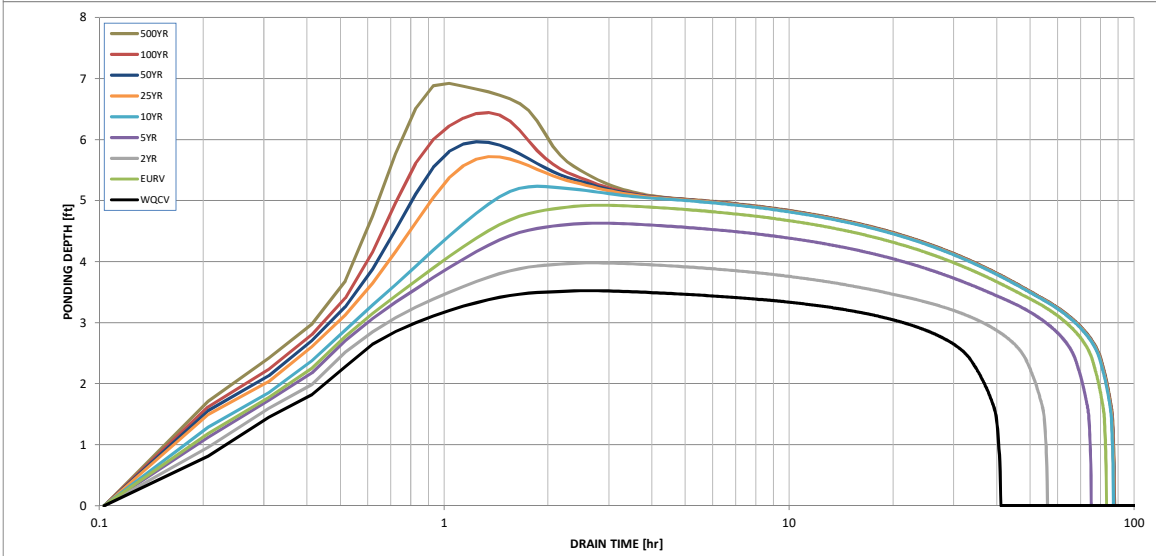
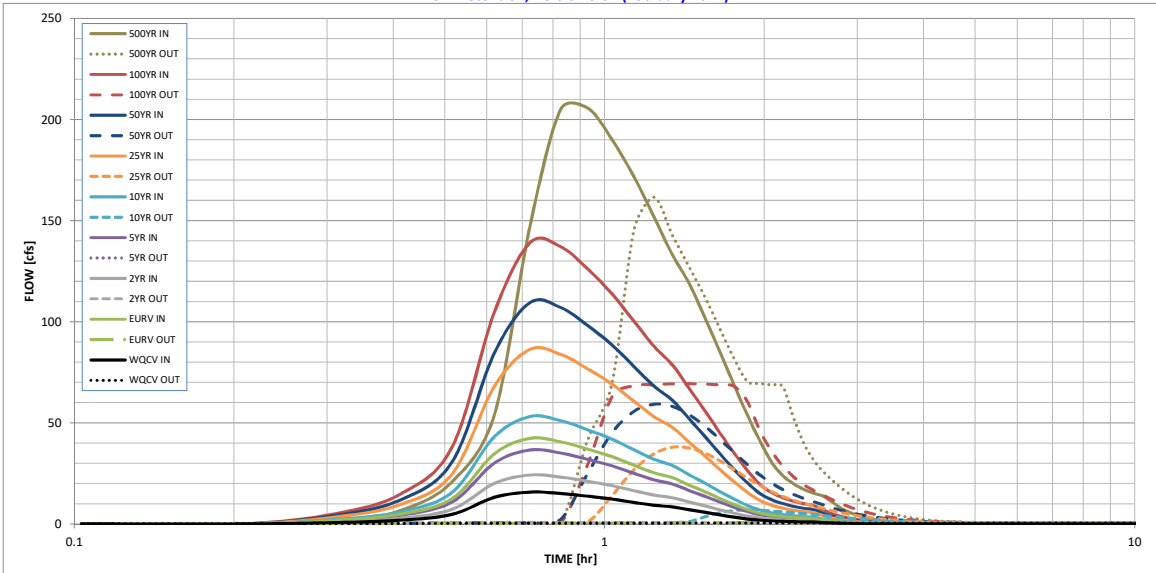
Spillway Design Flow Depth =	0.45	feet
Stage at Top of Freeboard =	8.03	feet
Basin Area at Top of Freeboard =	1.81	acres

Routed Hydrograph Results

	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) =	0.53	1.07	0.82	1.10	1.34	1.69	1.98	2.29	3.08
Calculated Runoff Volume (acre-ft) =	1.184	3.223	1.828	2.780	4.060	6.676	8.525	10.909	16.339
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	1.184	3.225	1.829	2.781	4.062	6.677	8.523	10.911	16.344
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.03	0.14	0.46	0.65	0.91	1.45
Predevelopment Peak Q (cfs) =	0.0	0.0	0.5	2.0	10.7	36.3	51.7	71.9	114.7
Peak Inflow Q (cfs) =	15.7	42.3	24.2	36.6	53.1	86.3	109.4	139.0	205.6
Peak Outflow Q (cfs) =	0.5	0.7	0.5	0.6	6.9	37.9	59.2	69.3	161.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.6	1.0	1.1	1.0	1.4
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	1.4	2.1	2.5	2.6
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) =	38	78	52	70	80	78	76	73	68
Time to Drain 99% of Inflow Volume (hours) =	40	81	55	73	84	83	82	81	79
Maximum Ponding Depth (ft) =	3.52	4.92	3.98	4.63	5.23	5.72	5.96	6.44	6.92
Area at Maximum Ponding Depth (acres) =	1.34	1.50	1.39	1.46	1.53	1.59	1.61	1.67	1.71
Maximum Volume Stored (acre-ft) =	1.093	3.081	1.708	2.637	3.551	4.300	4.700	5.487	6.298

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			

