

**ADDENDUM 2 TO THE  
FINAL DRAINAGE REPORT  
FOR  
HOMESTEAD AT STERLING RANCH FILING NO. 2**

**EPCD File No. SF-19-004/CDR-20-012**

**Add "PCD File No. VR234"**

**Prepared For:**

**SR Land, LLC  
20 Boulder Crescent, Suite 210  
Colorado Springs, CO 80903**

**December 27, 2022  
Project No. 25188.29**

**Prepared By:  
JR Engineering, LLC  
5475 Tech Center Drive, Suite 235  
Colorado Springs, CO 80919  
719-593-2593**

**ADDENDUM 2 TO THE FINAL DRAINAGE REPORT FOR HOMESTEAD AT  
STERLING RANCH FILING NO. 2**

**ENGINEER'S STATEMENT:**

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by El Paso County for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

---

Mike Bramlett, Colorado P.E. # 32314  
For and On Behalf of JR Engineering, LLC

**DEVELOPER'S STATEMENT:**

I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name: SR Land, LLC

By: \_\_\_\_\_

Title: \_\_\_\_\_

Address: 20 Boulder Crescent, Suite 210  
Colorado Springs, CO 80903

**El Paso County:**

Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual, Volumes 1 and 2 and Engineering Criteria Manual, as amended.

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Joshua Palmer, P.E.  
County Engineer/ ECM Administrator

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Date

Conditions:

**ADDENDUM 2 TO THE FINAL DRAINAGE REPORT FOR HOMESTEAD AT  
STERLING RANCH FILING NO. 2**

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**REVISED APPENDIX MATERIALS**

- Composite Percent Impervious & Composite Runoff Coefficient Calculations
- SF-2 Minor Basins X1, X2, W1, & Y1
- SF-3 Minor Basins X1, X2, W1, & Y1
- SF-3 Major Basins X1, X2, W1, & Y1
- MHFD Detention workbook Sand Filter 1
- MHFD Detention workbook Sand Filter 2
- Emergency Spillway Protection Sizing
- Proposed basin map (limited to Basins X1, X2, W1, & Y1)

# ADDENDUM 2 TO THE FINAL DRAINAGE REPORT FOR HOMESTEAD AT STERLING RANCH FILING NO. 2

## PURPOSE

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This document is an Addendum 2 to the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2. The purpose of this report is to update the approved “Addendum to the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2”. The scope of the updates included in this addendum are limited to proposed Basins W1 & X1 due to the addition of a new lot (Basin X1) and the modification to lot 24 (Basin W1), making it smaller. More specifically, this Addendum 2 proposes updated design information for two common Sand Filters, one to serve basin X1: lots 36-41 & new lot, and one to serve basins W1, X2, & Y1, lots 13-24 & 28-35.

The text below replaces the original corresponding text from the Addendum to the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2.

Identify as existing or proposed

## PROPOSED DRAINAGE CHARACTERISTICS

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### DETAILED DRAINAGE DISCUSSION (DESIGN POINTS)

**BASIN X1** (0.91 acres), consists of existing residential backyards of lots 36-41 and proposed new lot along the eastern boundary of the site. Italicized text within this section is original and unchanged. Basin X1 increased in size due to the additional lot that will be treated within Sand Filter 1. Previously the area for the new lot was located within a tract and was assumed to drain freely to the existing Sand Creek. In accordance with the previous design, a swale/berm and area drain will be used for the new lot to collect the runoff and pipe it directly to Sand Filter 1. *Runoff in this basin will be directed via backyard swales/berms towards the rear of the lots where it will be collected in a 12” Nyoplast Drain Basin w/ a 12” dome grate placed in the rear southwest corner of each lot. Each lot will have a half foot berm/swale along the rear and low side of lot that directs water to each inlet, see the detail included on the drainage map, GESD, and Storm plans. Should the inlet in any lot become clogged, the berm will overtop, and flow will continue to Sand Creek. Per the original drainage report by MandS, the estimated flows per each lot in basin X1 = 0.2 cfs for the 100 year storm. The 12” Nyoplast Drain Basins are sized to collect all flows (Q5 = 0.7 cfs, Q100 = 2.6 cfs) in both the 5 and 100 year storms. Collected flows will then be piped to a proposed full-spectrum sand filter, with a 12-hour drain time and a 4” perforated underdrain. The treated flows from the sand filter will be discharged via an outlet structure to the adjacent Sand Creek. See the comparison table at the end of the Detailed Drainage Discussion section to see the changes to Basin X1.*

**BASIN X2** has no proposed changes from the “Addendum to the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2”.



**ADDENDUM 2 TO THE FINAL DRAINAGE REPORT FOR HOMESTEAD AT STERLING RANCH FILING NO. 2**

**BASIN W1** (0.84 acres), consists of existing residential backyards of lots 19-23 and a proposed adjustment to lot 24 along the southeastern boundary of the site. Italicized text within this section is original and unchanged. Basin W1 decreased in size due to the adjustment to lot 24 decreasing the lot area. Only the runoff from lot areas are collected and treated in Sand Filter 2 and since the lot size is decreasing, the swale/berm configuration along the back of the lot is also decreasing in length. *Runoff in this basin will be directed via backyard swales towards the rear of the lots where it will be collected in a 12" Nyoplast Drain Basin w/ a 12" dome grate placed in the rear corner of each lot (DP3). Each lot will have a half foot berm/swale along the rear and low side of lot that directs water to each inlet, see the detail included on the drainage map, GESC, and Storm plans. Should the inlet in any lot become clogged, the berm will overtop, and flow will continue to Sand Creek per existing drainage patterns. The 12" Nyoplast Drain Basins are sized to collect all flows (Q5 = 0.6 cfs, Q100 = 2.2 cfs) in both the 5 and 100 year storms. Collected flows will then be piped southwest via 12" HDPE pipe following the rear lot lines towards DP3.1, where flows in the pipe combine with collected flows from Basin X2 (Q5 = 1.3 cfs, Q100 = 4.6 cfs). See the comparison table at the end of the Detailed Drainage Discussion section to see the changes to Basin W1.*

**BASIN Y1** has no proposed changes from the “Addendum to the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2”.

The basin characteristics, hydrologic parameters, runoff and rational calcs for Basins X1, X2, W1, and Y1 have remained consistent with the approved Addendum to the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2. However, the size of the basins X1 and W1 has changed and therefore revised composite percent impervious, SF-2, & SF-3 forms are included in the appendix section of this report. A revised basin map, showing the changes within the above described basins is also attached to this report. See the table below for a comparison of the changed basins in the previously approved Addendum to the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2 as well as the changes proposed in this Addendum 2.

Addendum to the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2					
Basin	Area	C <sub>5</sub>	C <sub>100</sub>	Q <sub>5</sub> (cfs)	Q <sub>100</sub> (cfs)
X1	0.78	0.22	0.46	0.6	2.3
W1	0.86	0.22	0.46	0.6	2.2
Addendum 2 to the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2					
Basin	Area	C <sub>5</sub>	C <sub>100</sub>	Q <sub>5</sub> (cfs)	Q <sub>100</sub> (cfs)
X1	0.91	0.22	0.46	0.7	2.6
W1	0.84	0.22	0.46	0.6	2.2

## ADDENDUM 2 TO THE FINAL DRAINAGE REPORT FOR HOMESTEAD AT STERLING RANCH FILING NO. 2

### WATER QUALITY PROVISIONS

Put "North Sand Filter" in parenthesis here since that's also what it is called on Sht 8 of GEC Plans

The design of the full-spectrum Sand Filter 1 outlet structure changed to accept the additional area of the new proposed lot within Basin X1. Italicized text within this section is original and unchanged. Runoff from this additional lot will be collected in a drain basin and piped via a private storm sewer into the Sand Filter 1. The new proposed flared end section (FES) in the sand filter will be protected by Type L riprap per the previously approved design. The runoff will be treated in the full-spectrum sand filter, and discharged into Sand Creek via an existing private storm sewer system. The increased Basin X1 area from 0.78 acres to 0.91 acres (as shown in the Detailed Drainage Discussion section) caused changes to the outlet structure in order to meet the required drain times. Specifically, the underdrain orifice diameter increased from 0.42 inches to 0.46 inches and the height of the restrictor plate above the outlet pipe invert increased from 1.90 feet to 2.10 feet. *Sand Filter 1 was designed to have a 12 hour WQCV drain time and a peak outflow for the 100 year design storm of 0.9 cfs which is less than or equal to pre-development peak flows. The peak discharge rate of the proposed sand filter is at or below the historic flows for the basin which it serves.* See the comparison table at the end of the Water Quality Provisions section to see the changes to Sand Filter 1.

shown as 2.5ft on Sht 8 of GEC Plans and in calcs on pdf pg 15 below. Revise to remove discrepancy.

add: "(South Sand Filter)"

The design of the full-spectrum Sand Filter 2 remained unchanged with the decrease of lot 24 within Basin W1. Italicized text within this section is original and unchanged. Runoff from the decreased lot 24 area will still be collected in a drain basin, treated in the full-spectrum sand filter, and discharged into Sand Creek via a private storm sewer system. The decreased Basin W1 area from 0.86 acres to 0.84 acres (as shown in the Detailed Drainage Discussion section) was a small enough change overall for the Sand Filter 2 basin that no changes to the outlet structure design are required order to satisfy drain times. *Sand Filter 2 was designed to have a 12 hour WQCV drain time and a peak outflow for the 100 year design storm of 2.7 cfs which is less than or equal to pre-development peak flow rates. The peak discharge rate of the proposed sand filter is at or below the historic flows for the basins which it serves.* See the comparison table at the end of the Water Quality Provisions section to see the changes to Sand Filter 2.

The proposed sand filters calculations were updated using the MHFD Detention workbook and printouts are included in the Hydraulic Calculations section of this report.

Addendum to the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2							
Name	Watershed Area (acres)	Req. WQCV (acre-feet)	Req. EURV (acre-feet)	Req. 100-year Volume (acre-feet)	Provided WQCV (acre-feet)	Provided EURV (acre-feet)	Provided 100-year Volume (acre-feet)
Sand Filter 1	0.78	0.007	0.013	0.027	0.007	0.020	0.042
Sand Filter 2	2.74	0.025	0.045	0.094	0.026	0.070	0.123
Addendum 2 to the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2							
Name	Watershed Area (acres)	Req. WQCV (acre-feet)	Req. EURV (acre-feet)	Req. 100-year Volume (acre-feet)	Provided WQCV (acre-feet)	Provided EURV (acre-feet)	Provided 100-year Volume (acre-feet)
Sand Filter 1	0.91	0.008	0.015	0.031	0.008	0.023	0.043
Sand Filter 2	2.72	0.024	0.044	0.093	0.024	0.070	0.122



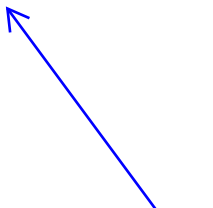
**ADDENDUM 2 TO THE FINAL DRAINAGE REPORT FOR HOMESTEAD AT STERLING RANCH FILING NO. 2**

**CONSTRUCTION COST OPINION – HOMESTEAD AT STERLING RANCH FIL. NO. 2**

Drainage improvements are planned with the development of Homestead at Sterling Ranch Filing No. 2. A majority of the construction costs have been accounted for in the “Master Development Drainage Report for Sterling Ranch Filing Nos. 1&2, and Final Drainage Report for Sterling Ranch Filing No.1” prepared by MS Civil Consultants, dated April 2017. Further cost updates were included in “Addendum to the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2” by JR Engineering, dated June 2021. Any additional improvements and costs are listed below.

The following list of drainage improvements is Non-Reimbursable.

Item	Description	Additional Quantity	Unit	Unit Cost	Cost
1	12" Storm Pipe	108	LF	\$ 26.00	\$ 2,808.00
2	12" Nyloplast Drain Basin w/ 12" Dome Grate	1	EA	\$1,000.00	\$ 1,000.00
3	12"-15" FES	1	EA	\$ 350.00	\$ 350.00

 If riprap outlet protection was not included in the previous report estimates, please add to this estimate.

**ADDENDUM 2 TO THE FINAL DRAINAGE REPORT FOR HOMESTEAD AT  
STERLING RANCH FILING NO. 2**

**REVISED APPENDIX MATERIAL**



## COMPOSITE % IMPERVIOUS & COMPOSITE RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Homestead at Sterling Ranch Filing No. 2  
 Location: Colorado Springs

Project Name: Homestead at Sterling Ranch Filing No. 2  
 Project No.: 2000-5188.29  
 Calculated By: GAG  
 Checked By: \_\_\_\_\_  
 Date: 12/20/22

Basin ID	Total Area (ac)	M & S Report (1/2 ac lots)				Roofs (90% Impervious)				Gravel (80% Impervious)				Lawns (0% Impervious)				Basins Total Weighted C		Basins Total Weighted % Imp.
		C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	Area (ac)	Weighted % Imp.	C <sub>5</sub>	C <sub>100</sub>	Imp.
W1	0.84	0.22	0.46	0.84	25.0%	0.73	0.81		0.0%	0.59	0.70		0.0%	0.08	0.35		0.0%	0.22	0.46	25.0%
X1	0.91	0.22	0.46	0.91	25.0%	0.73	0.81		0.0%	0.59	0.70		0.0%	0.08	0.35		0.0%	0.22	0.46	25.0%
X2	1.04	0.22	0.46	1.04	25.0%	0.73	0.81		0.0%	0.59	0.70		0.0%	0.08	0.35		0.0%	0.22	0.46	25.0%
Y1	0.84	0.22	0.46	0.84	25.0%	0.73	0.81		0.0%	0.59	0.70		0.0%	0.08	0.35		0.0%	0.22	0.46	25.0%
TOTAL	3.63																			25.0%

Grey-boxes indicate no change from the approved "Addendum to the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2" by JR Engineering dated 6/16/21.

## STANDARD FORM SF-2 TIME OF CONCENTRATION

Subdivision: Homestead at Sterling Ranch Filing No. 2  
Location: Colorado Springs

Project Name: Homestead at Sterling Ranch Filing No. 2  
Project No.: 2000-5188.29  
Calculated By: GAG  
Checked By: \_\_\_\_\_  
Date: 12/20/22

SUB-BASIN						INITIAL/OVERLAND			TRAVEL TIME					t <sub>c</sub> CHECK			FINAL
DATA						(T <sub>i</sub> )			(T <sub>t</sub> )					(URBANIZED BASINS)			
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C <sub>5</sub>	C <sub>100</sub>	L (ft)	S <sub>o</sub> (%)	t <sub>i</sub> (min)	L <sub>t</sub> (ft)	S <sub>t</sub> (%)	K	VEL. (ft/s)	t <sub>t</sub> (min)	COMP. t <sub>c</sub> (min)	TOTAL LENGTH (ft)	Urbanized t <sub>c</sub> (min)	t <sub>c</sub> (min)
W1	0.84	B	25%	0.22	0.46	100	2.0%	12.6	50	0.0%	20.0	0.2	4.2	16.8	150.0	28.4	16.8
X1	0.91	B	25%	0.22	0.46	100	2.0%	12.6	50	2.5%	20.0	3.2	0.3	12.9	150.0	22.2	12.9
X2	1.04	B	25%	0.22	0.46	100	2.0%	12.6	50	2.5%	20.0	3.2	0.3	12.9	150.0	22.2	12.9
Y1	0.84	B	25%	0.22	0.46	100	2.0%	12.6	50	2.5%	20.0	3.2	0.3	12.9	150.0	22.2	12.9

Grey-boxes indicate no change from the approved "Addendum to the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2" by JR Engineering dated 6/16/21.

**NOTES:**

$$t_c = t_i + t_t$$

Where:

t<sub>c</sub> = computed time of concentration (minutes)

t<sub>i</sub> = overland (initial) flow time (minutes)

t<sub>t</sub> = channelized flow time (minutes).

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t}$$

Where:

t<sub>t</sub> = channelized flow time (travel time, min)  
L<sub>t</sub> = waterway length (ft)  
S<sub>o</sub> = waterway slope (ft/ft)  
V<sub>t</sub> = travel time velocity (ft/sec) = K√S<sub>o</sub>  
K = NRCS conveyance factor (see Table 6-2).

Equation 6-2

$$t_i = \frac{0.395(1.1 - C_3)\sqrt{L_i}}{S_o^{0.33}}$$

Where:

t<sub>i</sub> = overland (initial) flow time (minutes)  
C<sub>3</sub> = runoff coefficient for 5-year frequency (from Table 6-4)  
L<sub>i</sub> = length of overland flow (ft)  
S<sub>o</sub> = average slope along the overland flow path (ft/ft).

Equation 6-4

$$t_t = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

Where:

t<sub>c</sub> = minimum time of concentration for first design point when less than t<sub>c</sub> from Equation 6-1.  
L<sub>t</sub> = length of channelized flow path (ft)  
i = imperviousness (expressed as a decimal)  
S<sub>t</sub> = slope of the channelized flow path (ft/ft).

Equation 6-3

**Table 6-2. NRCS Conveyance factors, K**

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

Use a minimum t<sub>c</sub> value of 5 minutes for urbanized areas and a minimum t<sub>c</sub> value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

STANDARD FORM SF-3  
STORM DRAINAGE SYSTEM DESIGN  
(RATIONAL METHOD PROCEDURE)

Project Name: Homestead at Sterling Ranch Filing No. 2  
 Project No.: 2000-5188  
 Calculated By: GAG  
 Checked By: \_\_\_\_\_  
 Date: 12/20/22

Subdivision: Homestead at Sterling Ranch Filing No. 2  
 Location: Colorado Springs  
 Design Storm: 5-Year

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				PIPE			TRAVEL TIME			REMARKS	
		Basin ID	Area (Ac)	Runoff Coeff.	$t_c$ (min)	C*A (Ac)	I (in/hr)	Q (cfs)	$t_c$ (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{pipe}$ (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)		$t_t$ (min)
	1	X1	0.91	0.22	12.9	0.20	3.75	0.7					0.7	0.20	0.5	18	250	1.8	2.3	Runoff from Basin X1, collected by private 12" Nyoplast Drain Basins, Piped via 12" HDPE to pvt. sand filter @ DP1.1
	2	X2	1.04	0.22	12.9	0.23	3.75	0.9					0.9	0.23	1.5	12	950	2.8	5.6	Runoff from Basin X2, collected by private 12" Nyoplast Drain Basins, Piped via 12" HDPE to DP3.1
	3	W1	0.84	0.22	16.8	0.18	3.35	0.6					0.6	0.18	1.5	12	250	2.7	1.5	Runoff from Basin W1, collected by private 12" Nyoplast Drain Basins, Piped via 12" HDPE to DP3.1
	3.1								20.0	0.41	3.09	1.3								Combined flow in private 12" HDPE pipe @ DP3.1, piped to private sand filter @ DP-4.1
	4	Y1	0.84	0.22	12.9	0.18	3.75	0.7					0.7	0.18	1.5	15	350	2.4	2.4	Runoff from Basin Y1, collected by private 12" Nyoplast Drain Basins, Piped via 15" HDPE to DP4.1
	4.1								22.5	0.59	2.91	1.7								Combined flow in private 15" HDPE pipe @ DP4.1, inflow to proposed private sand filter

Notes:  
 Street and Pipe C\*A values are determined by  $Q/i$  using the catchment's intensity value.  
 All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.  
 Grey-boxes indicate no change from the approved "Addendum to the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2" by JR Engineering dated 6/16/21.

STANDARD FORM SF-3  
STORM DRAINAGE SYSTEM DESIGN  
(RATIONAL METHOD PROCEDURE)

Subdivision: Homestead at Sterling Ranch Filing No. 2  
Location: Colorado Springs  
Design Storm: 100-Year

Project Name: Homestead at Sterling Ranch Filing No. 2  
Project No.: 2000-5188.  
Calculated By: GAG  
Checked By:  
Date: 12/20/22

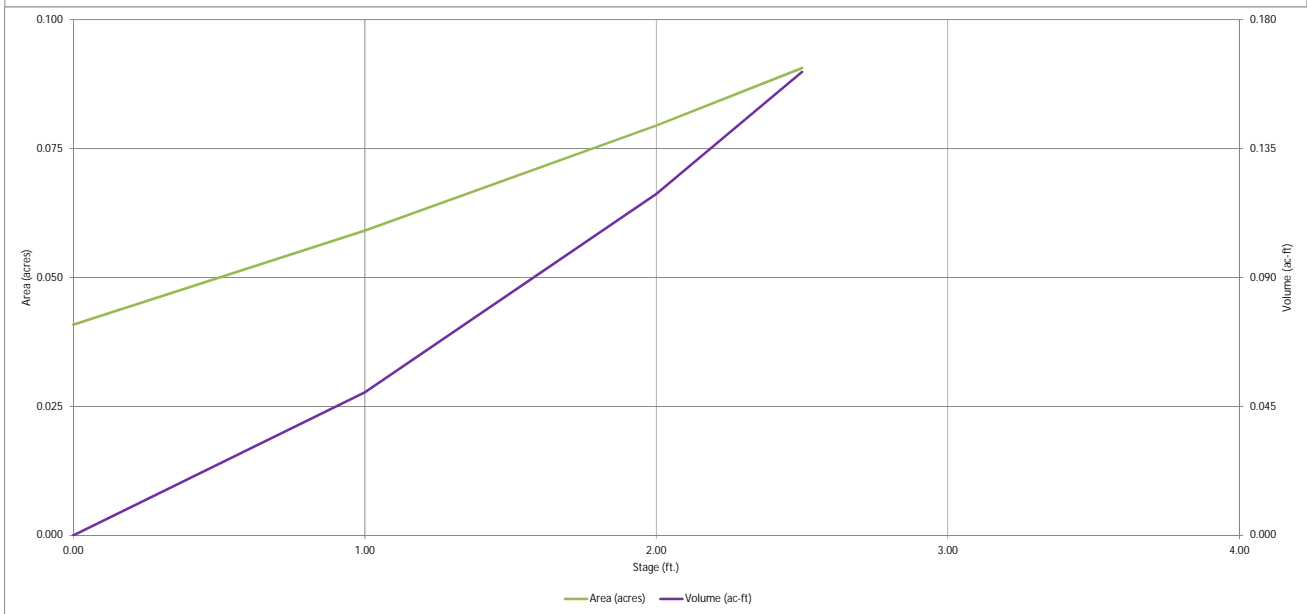
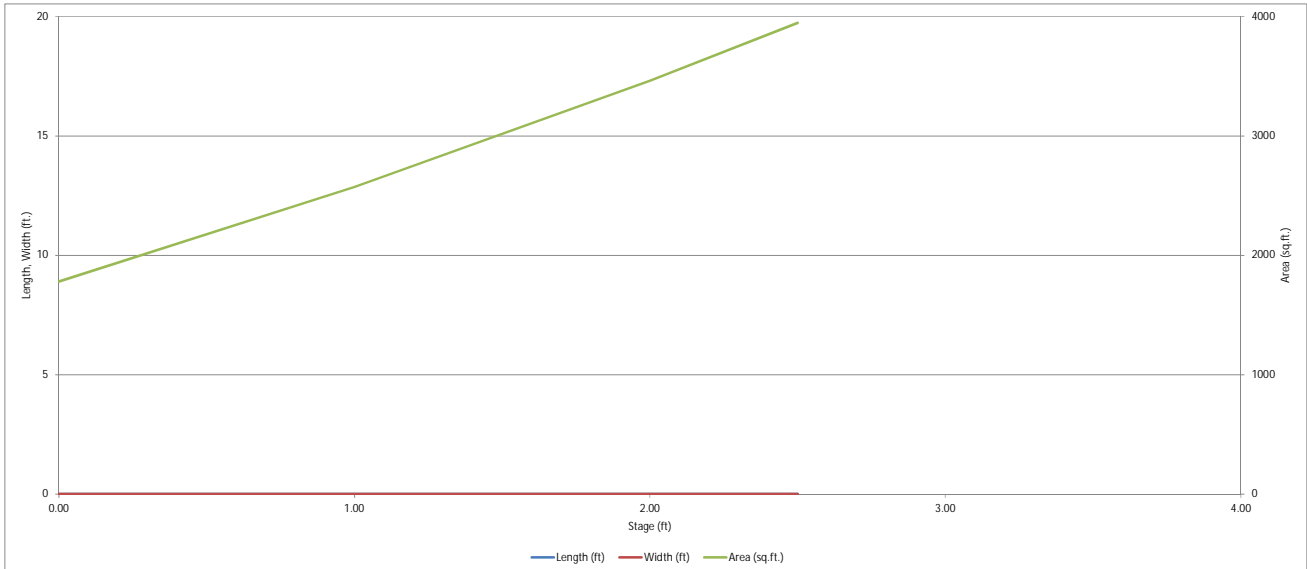
Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				PIPE			TRAVEL TIME			REMARKS	
		Basin ID	Area (ac)	Runoff Coeff.	$t_c$ (min)	C*A (ac)	(in/hr)	Q (cfs)	$t_c$ (min)	C*A (ac)	(in/hr)	Q (cfs)	$Q_{pipe}$ (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)		$t_t$ (min)
	1	X1	0.91	0.46	12.9	0.42	6.29	2.6					2.6	0.42	0.5	12	250	2.3	1.8	Runoff from Basin X1, collected by private 12" Nyoplast Drain Basins, Piped via 12" HDPE to pvt. sand filter @ DP1.1
	2	X2	1.04	0.46	12.9	0.48	6.29	3.0					3.0	0.48	1.0	12	950	3.1	5.1	Runoff from Basin X2, collected by private 12" Nyoplast Drain Basins, Piped via 12" HDPE to DP3.1
	3	W1	0.84	0.46	16.8	0.39	5.62	2.2					2.2	0.39	1.0	12	250	2.9	1.5	Runoff from Basin W1, collected by private 12" Nyoplast Drain Basins, Piped via 12" HDPE to DP3.1
	3.1								19.4	0.87	5.26	4.6								Combined flow in private 12" HDPE pipe @ DP3.1, piped to private sand filter @ DP-4.1
	4	Y1	0.84	0.46	12.9	0.39	6.29	2.5					2.5	0.39	1.5	15	350	3.3	1.8	Runoff from Basin Y1, collected by private 15" Nyoplast Drain Basins, Piped via 12" HDPE to DP4.1
	4.1								21.2	1.26	5.04	6.4								Combined flow in private 15" HDPE pipe @ DP4.1, inflow to proposed private sand filter

Notes:  
Street and Pipe C\*A values are determined by Q/i using the catchment's intensity value.  
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.  
Grey-boxes indicate no change from the approved "Addendum to the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2" by JR Engineering dated 6/16/21.



# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.04 (February 2021)*

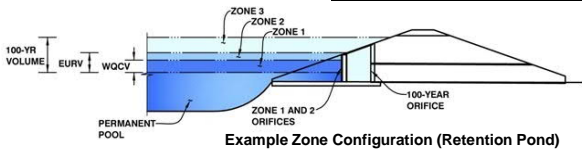


# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.04 (February 2021)*

Project: Homestead at Sterling Ranch Filing No. 2

Basin ID: Sand Filter - Basin X1



**Example Zone Configuration (Retention Pond)**

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.20	0.008	Filtration Media
Zone 2 (EURV)	0.51	0.015	Rectangular Orifice
Zone 3 (100-year)	1.08	0.031	Weir&Pipe (Restrict)
<b>Total (all zones)</b>		<b>0.054</b>	

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

Underdrain Orifice Invert Depth =	2.10	ft (distance below the filtration media surface)
<b>Underdrain Orifice Diameter =</b>	<b>0.46</b>	<b>inches</b>

Calculated Parameters for Underdrain	
Underdrain Orifice Area =	0.0 ft <sup>2</sup>
Underdrain Orifice Centroid =	0.02 feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	N/A	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 <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 (optional)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	0.35	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	0.51	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	2.00	N/A	inches
Vertical Orifice Width =	4.00		inches

Calculated Parameters for Vertical Orifice	
Zone 2 Rectangular	Not Selected
Vertical Orifice Area =	0.06 N/A ft <sup>2</sup>
Vertical Orifice Centroid =	0.08 N/A feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	0.75	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.21	N/A	feet
Overflow Weir Gate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	2.21	N/A	feet
Overflow Gate Type =	Type C Gate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir	
Zone 3 Weir	Not Selected
Height of Gate Upper Edge, H <sub>i</sub> =	0.75 N/A feet
Overflow Weir Slope Length =	2.21 N/A feet
Gate Open Area / 100-yr Orifice Area =	28.68 N/A
Overflow Gate Open Area w/o Debris =	3.40 N/A ft <sup>2</sup>
Overflow Gate Open Area w/ Debris =	1.70 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 =	2.10	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	12.00	N/A	inches
<b>Restrictor Plate Height Above Pipe Invert =</b>	<b>2.50</b>		<b>inches</b>

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate	
Zone 3 Restrictor	Not Selected
Outlet Orifice Area =	0.12 N/A ft <sup>2</sup>
Outlet Orifice Centroid =	0.12 N/A feet
Half-Central Angle of Restrictor Plate on Pipe =	0.95 N/A radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	2.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	5.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.50	feet

Calculated Parameters for Spillway	
Spillway Design Flow Depth =	0.14 feet
Stage at Top of Freeboard =	4.14 feet
Basin Area at Top of Freeboard =	0.09 acres
Basin Volume at Top of Freeboard =	0.16 acre-ft

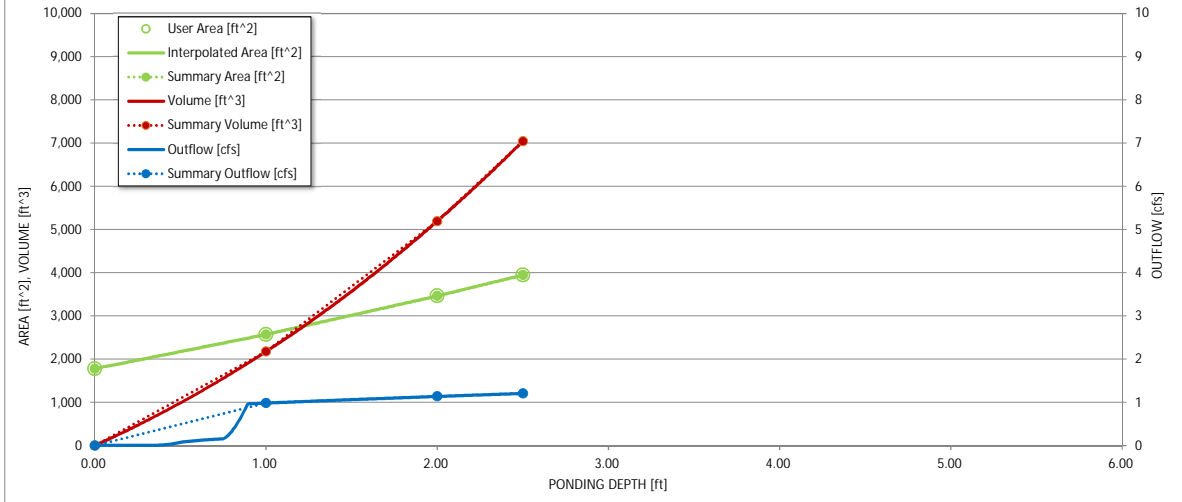
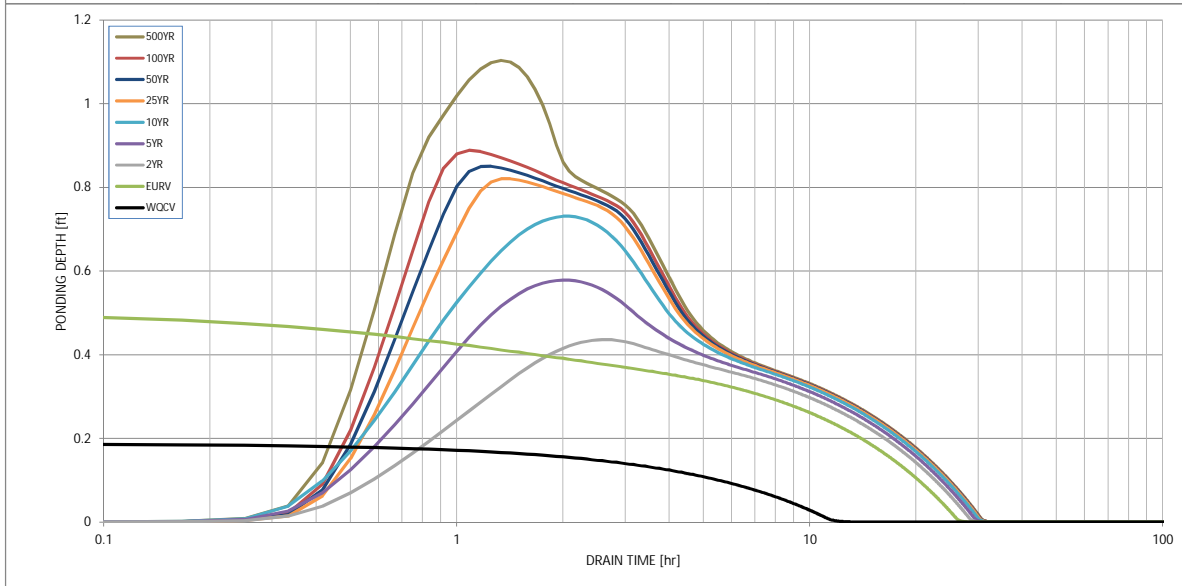
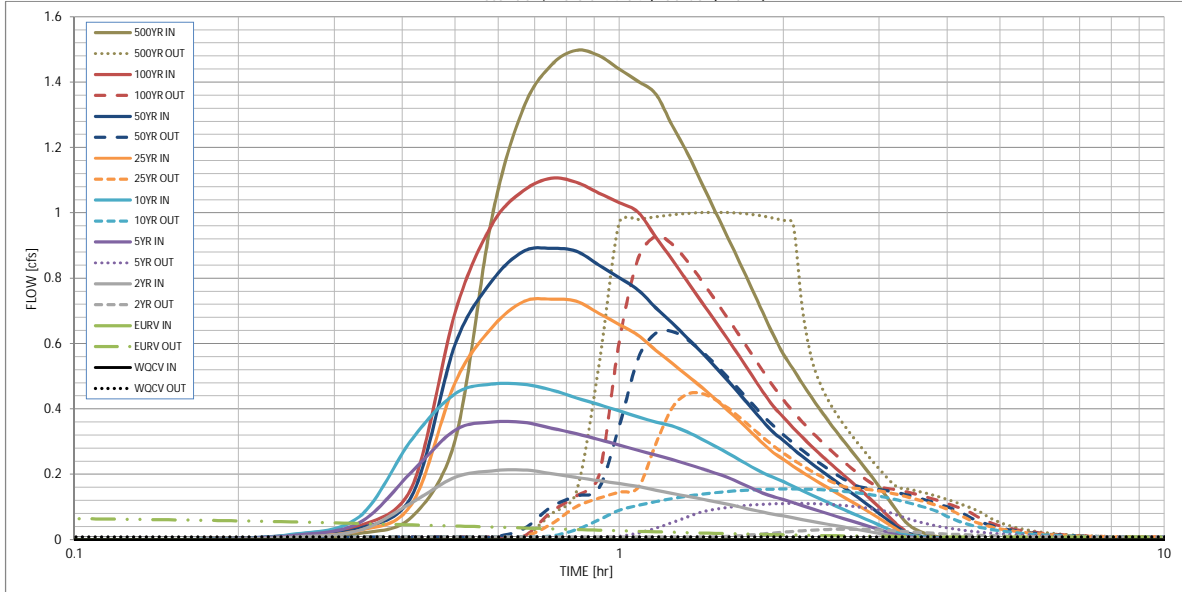
## Routed Hydrograph Results

*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)	0.008	0.023	0.024	0.041	0.056	0.081	0.099	0.124	0.171
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	0.024	0.041	0.056	0.081	0.099	0.124	0.171
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.1	0.2	0.3	0.6	0.7	0.9	1.2
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.08	0.22	0.33	0.61	0.76	0.97	1.36
Peak Inflow Q (cfs)	N/A	N/A	0.2	0.4	0.5	0.7	0.9	1.1	1.5
Peak Outflow Q (cfs)	0.0	0.1	0.0	0.1	0.2	0.4	0.6	0.9	1.0
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	0.6	0.5	0.8	0.9	1.0	0.8
Structure Controlling Flow	Filtration Media	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Gate 1 (fps)	N/A	N/A	N/A	N/A	N/A	N/A	0.1	0.1	0.2
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)	12	26	28	28	28	27	27	26	24
Time to Drain 99% of Inflow Volume (hours)	12	26	29	29	30	30	30	29	29
Maximum Ponding Depth (ft)	0.19	0.51	0.44	0.58	0.73	0.82	0.85	0.89	1.10
Area at Maximum Ponding Depth (acres)	0.04	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06
Maximum Volume Stored (acre-ft)	0.008	0.023	0.019	0.026	0.035	0.040	0.041	0.043	0.056

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.04 (February 2021)*



S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			



# DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: \_\_\_\_\_

**Inflow Hydrographs**

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

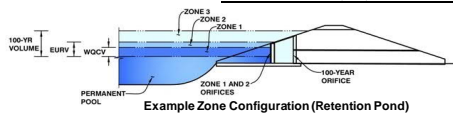
Time Interval	SOURCE	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:15:00	0.00	0.00	0.01	0.01	0.02	0.01	0.01	0.01	0.02
	0:20:00	0.00	0.00	0.03	0.05	0.07	0.03	0.03	0.04	0.07
	0:25:00	0.00	0.00	0.11	0.21	0.31	0.11	0.14	0.16	0.31
	0:30:00	0.00	0.00	0.19	0.34	0.45	0.48	0.60	0.70	0.98
	0:35:00	0.00	0.00	0.21	0.36	0.48	0.65	0.79	0.96	1.32
	0:40:00	0.00	0.00	0.21	0.36	0.48	0.73	0.88	1.07	1.45
	0:45:00	0.00	0.00	0.20	0.34	0.46	0.74	0.89	1.11	1.50
	0:50:00	0.00	0.00	0.19	0.32	0.43	0.73	0.88	1.09	1.48
	0:55:00	0.00	0.00	0.18	0.31	0.41	0.69	0.84	1.06	1.44
	1:00:00	0.00	0.00	0.17	0.29	0.39	0.66	0.80	1.03	1.40
	1:05:00	0.00	0.00	0.16	0.27	0.38	0.63	0.76	1.00	1.36
	1:10:00	0.00	0.00	0.15	0.26	0.36	0.58	0.71	0.93	1.27
	1:15:00	0.00	0.00	0.14	0.25	0.35	0.54	0.66	0.86	1.18
	1:20:00	0.00	0.00	0.13	0.23	0.33	0.50	0.62	0.79	1.09
	1:25:00	0.00	0.00	0.12	0.22	0.31	0.47	0.57	0.73	1.00
	1:30:00	0.00	0.00	0.12	0.20	0.29	0.43	0.53	0.67	0.92
	1:35:00	0.00	0.00	0.11	0.19	0.26	0.40	0.49	0.61	0.85
	1:40:00	0.00	0.00	0.10	0.17	0.24	0.36	0.44	0.56	0.77
	1:45:00	0.00	0.00	0.09	0.16	0.22	0.33	0.40	0.50	0.70
	1:50:00	0.00	0.00	0.08	0.14	0.20	0.30	0.36	0.45	0.63
	1:55:00	0.00	0.00	0.08	0.13	0.19	0.27	0.33	0.41	0.57
	2:00:00	0.00	0.00	0.07	0.12	0.18	0.25	0.30	0.38	0.52
	2:05:00	0.00	0.00	0.07	0.11	0.16	0.23	0.28	0.34	0.48
	2:10:00	0.00	0.00	0.06	0.10	0.15	0.21	0.26	0.31	0.44
	2:15:00	0.00	0.00	0.06	0.10	0.14	0.19	0.23	0.29	0.40
	2:20:00	0.00	0.00	0.05	0.09	0.13	0.17	0.21	0.26	0.36
	2:25:00	0.00	0.00	0.05	0.08	0.11	0.16	0.20	0.24	0.33
	2:30:00	0.00	0.00	0.04	0.07	0.10	0.14	0.18	0.22	0.30
	2:35:00	0.00	0.00	0.04	0.06	0.09	0.13	0.16	0.20	0.27
	2:40:00	0.00	0.00	0.03	0.06	0.08	0.12	0.14	0.18	0.24
	2:45:00	0.00	0.00	0.03	0.05	0.07	0.10	0.13	0.16	0.22
	2:50:00	0.00	0.00	0.03	0.04	0.06	0.09	0.11	0.14	0.19
	2:55:00	0.00	0.00	0.02	0.04	0.05	0.08	0.10	0.12	0.16
	3:00:00	0.00	0.00	0.02	0.03	0.04	0.07	0.08	0.10	0.14
	3:05:00	0.00	0.00	0.02	0.02	0.04	0.05	0.06	0.08	0.11
	3:10:00	0.00	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.08
	3:15:00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.04	0.06
	3:20:00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.04
	3:25:00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.03
	3:30:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02
	3:35:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02
	3:40:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
	3:45:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
	3:50:00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.01
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Homestead at Sterling Ranch Filling No. 2

Basin ID: Sand Filter - Basin Y1, W1, X2



Example Zone Configuration (Retention Pond)

Watershed Information

Table with watershed parameters: Selected BMP Type (SF), Watershed Area (2.72 acres), Watershed Length (900 ft), Watershed Length to Centroid (300 ft), Watershed Slope (0.020 ft/ft), Watershed Imperviousness (25.00% percent), Percentage Hydrologic Soil Group A (0.0% percent), Percentage Hydrologic Soil Group B (100.0% percent), Percentage Hydrologic Soil Groups C/D (0.0% percent), Target WQC Drain Time (12.0 hours), Location for 1-hr Rainfall Depths (User Input).

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

Optional User Overrides

Table for optional user overrides for runoff volumes: Water Quality Capture Volume (WOCV), Excess Urban Runoff Volume (EURV), 2-yr Runoff Volume (P1 = 1.19 in.), 5-yr Runoff Volume (P1 = 1.5 in.), 10-yr Runoff Volume (P1 = 1.75 in.), 25-yr Runoff Volume (P1 = 2 in.), 50-yr Runoff Volume (P1 = 2.25 in.), 100-yr Runoff Volume (P1 = 2.52 in.), 500-yr Runoff Volume (P1 = 3.14 in.), and approximate detention volumes for 2, 5, 25, 50, and 100 years.

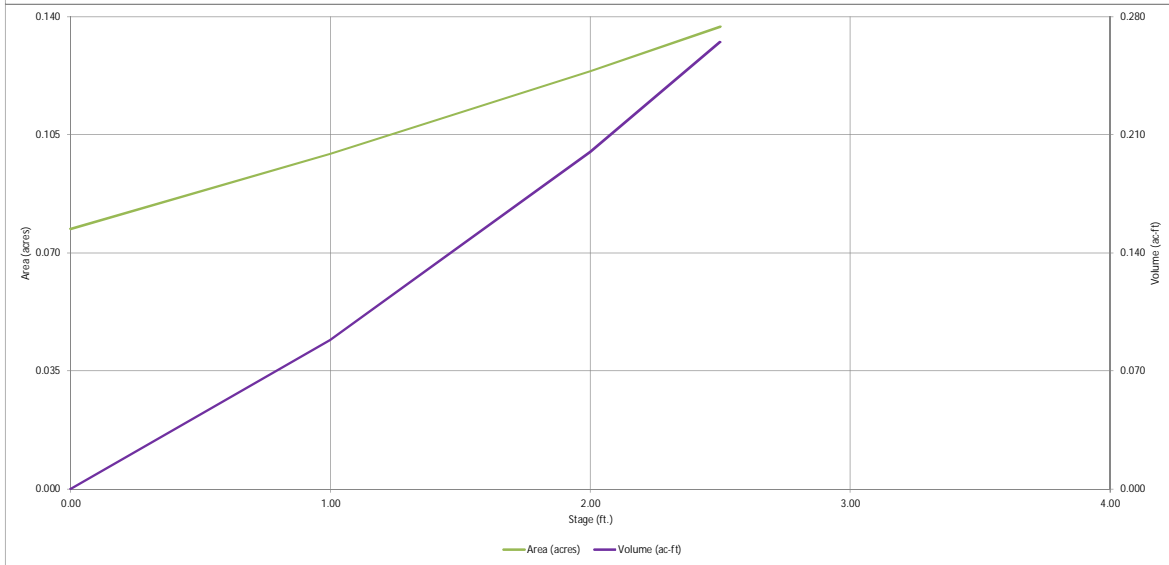
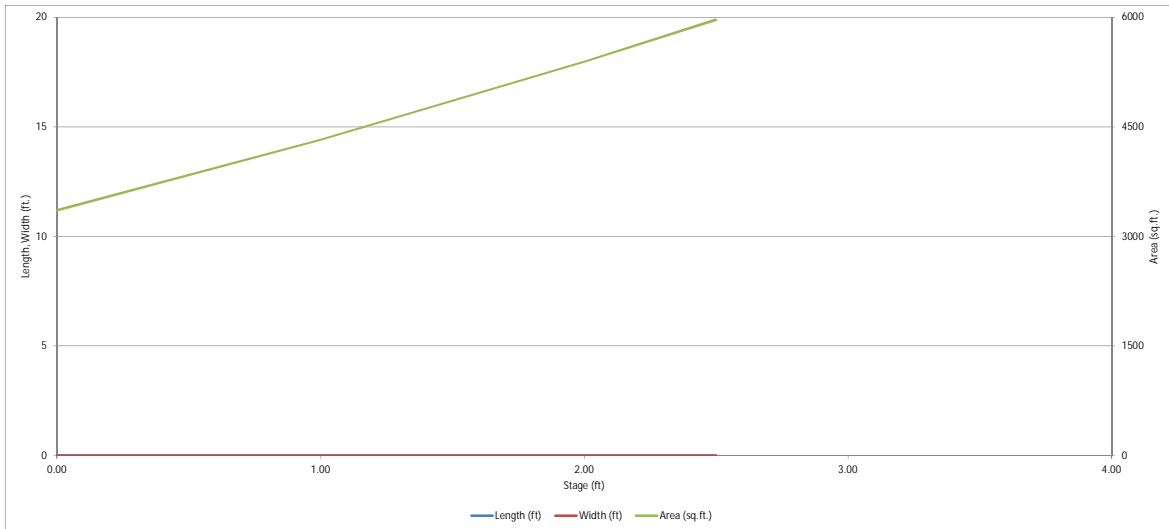
Define Zones and Basin Geometry

Table for basin geometry: Zone 1 Volume (WOCV), Zone 2 Volume (EURV - Zone 1), Zone 3 Volume (100-year - Zones 1 & 2), Total Detention Basin Volume, Initial Surcharge Volume (ISV), Initial Surcharge Depth (ISD), Total Available Detention Depth (Htotal), Depth of Trickle Channel (Htc), Slope of Trickle Channel (Stc), Slopes of Main Basin Sides (Smain), Basin Length-to-Width Ratio (RLW), Initial Surcharge Area (AISV), Surcharge Volume Length (LSV), Surcharge Volume Width (WSV), Depth of Basin Floor (HfL00R), Length of Basin Floor (LfL00R), Width of Basin Floor (WfL00R), Area of Basin Floor (AfL00R), Volume of Basin Floor (VfL00R), Depth of Main Basin (HMAIN), Length of Main Basin (LMAIN), Width of Main Basin (WMAIN), Area of Main Basin (AMAIN), Volume of Main Basin (VMAIN), Calculated Total Basin Volume (Vtotal).

Main table for Stage-Storage with columns: Stage - Storage Description, Stage (ft), Optional Override Stage (ft), Length (ft), Width (ft), Area (ft^2), Optional Override Area (ft^2), Area (acre), Volume (ft^3), Volume (ac-ft). The table contains 10 rows of data, starting with Media Surface and various 7062, 7063, and 7063.5 stage entries.

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.04 (February 2021)*

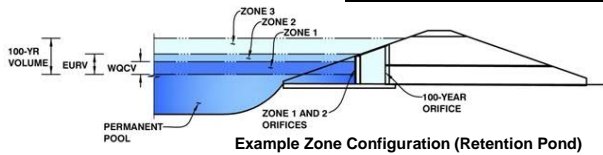


# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.04 (February 2021)*

Project: **Homestead at Sterling Ranch Filing No. 2**

Basin ID: **Sand Filter - Basin Y1, W1, X2**



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.31	0.024	Filtration Media
Zone 2 (EURV)	0.80	0.044	Rectangular Orifice
Zone 3 (100-year)	1.69	0.093	Weir&Pipe (Restrict)
<b>Total (all zones)</b>		<b>0.162</b>	

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

Underdrain Orifice Invert Depth =	2.10	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	0.80	inches

Underdrain Orifice Area =	0.0	ft <sup>2</sup>
Underdrain Orifice Centroid =	0.03	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 =	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	N/A	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

WQ Orifice Area per Row =	N/A	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 (optional)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	0.33	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	0.80	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	2.00	N/A	inches
Vertical Orifice Width =	4.00		inches

Vertical Orifice Area =	0.06	ft <sup>2</sup>
Vertical Orifice Centroid =	0.08	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 =	1.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.21	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	2.21	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Height of Grate Upper Edge, H <sub>u</sub> =	1.00	feet
Overflow Weir Slope Length =	2.21	feet
Grate Open Area / 100-yr Orifice Area =	10.98	
Overflow Grate Open Area w/o Debris =	3.40	ft <sup>2</sup>
Overflow Grate Open Area w/ Debris =	1.70	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 =	2.10	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	15.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	4.50		inches

Outlet Orifice Area =	0.31	ft <sup>2</sup>
Outlet Orifice Centroid =	0.22	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.16	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	2.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	10.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.50	feet

Spillway Design Flow Depth =	0.22	feet
Stage at Top of Freeboard =	3.72	feet
Basin Area at Top of Freeboard =	0.14	acres
Basin Volume at Top of Freeboard =	0.26	acre-ft

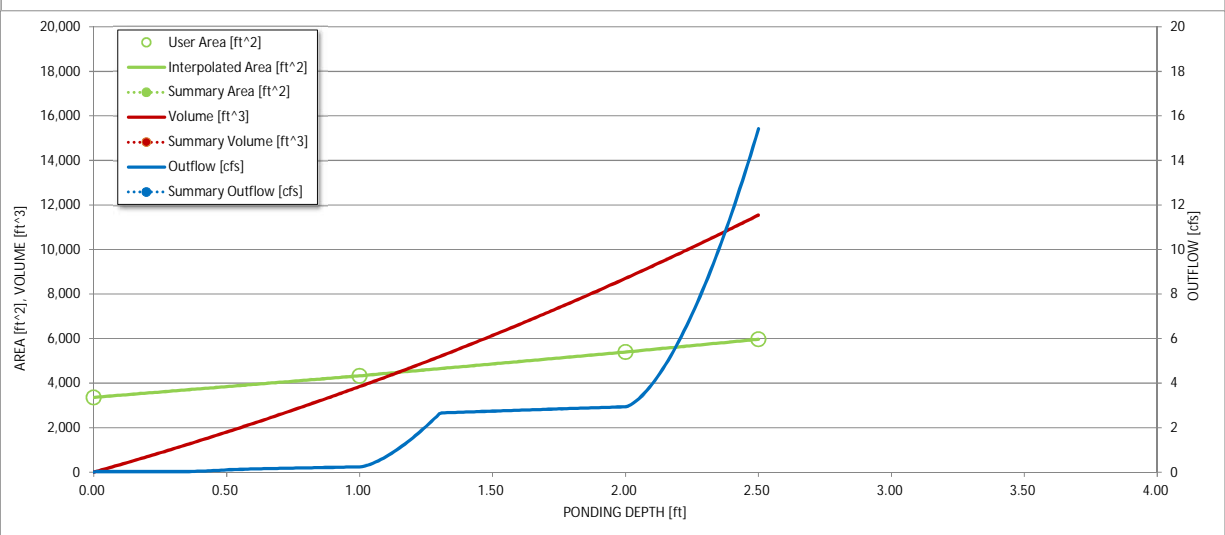
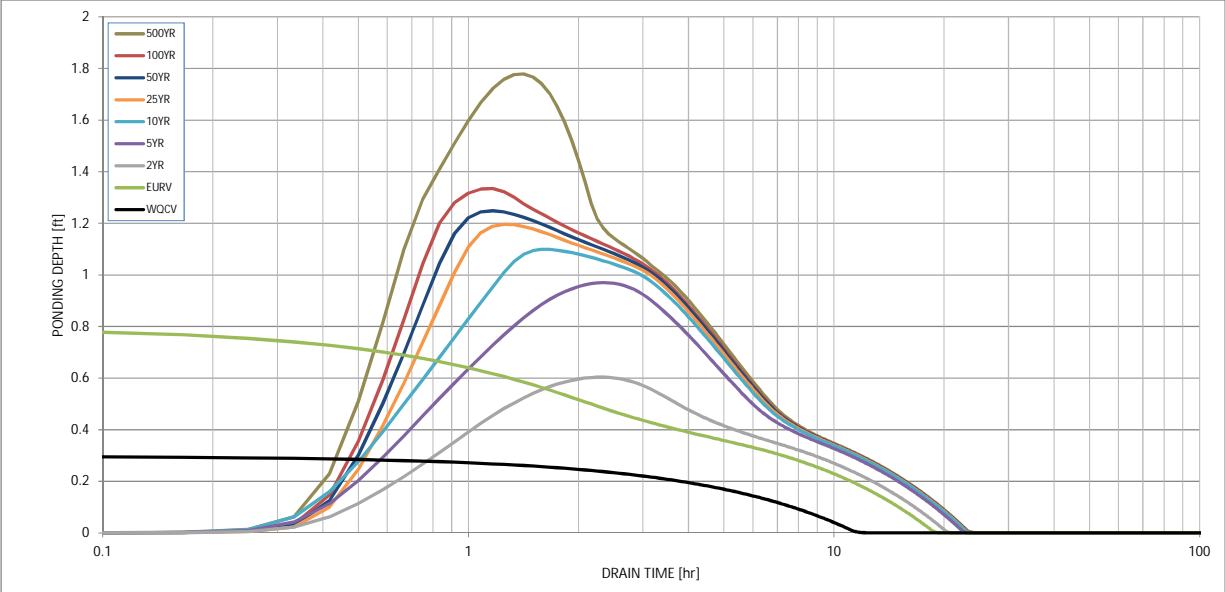
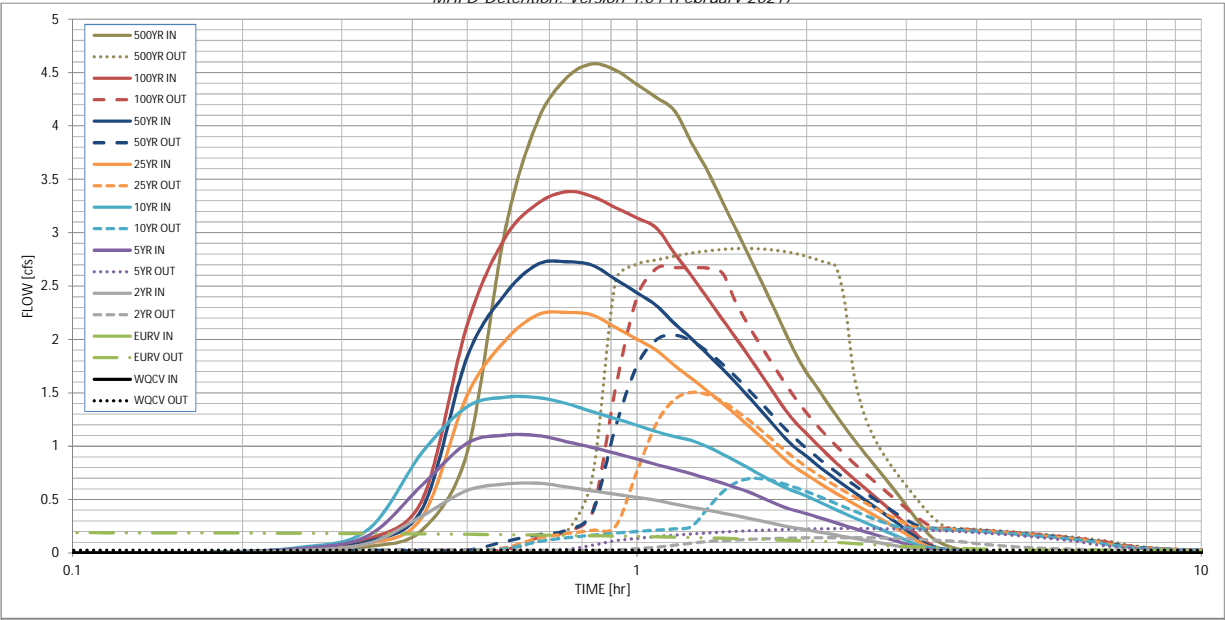
## Routed Hydrograph Results

*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	0.071	0.122	0.169	0.243	0.297	0.372	0.512
CUHP Runoff Volume (acre-ft)	0.024	0.069	0.071	0.122	0.169	0.243	0.297	0.372	0.512
Inflow Hydrograph Volume (acre-ft)	N/A	N/A	0.071	0.122	0.169	0.243	0.297	0.372	0.512
CUHP Predevelopment Peak Q (cfs)	N/A	N/A	0.2	0.6	0.9	1.7	2.1	2.7	3.8
OPTIONAL Override Predevelopment Peak Q (cfs)	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre)	N/A	N/A	0.08	0.22	0.34	0.62	0.78	1.00	1.40
Peak Inflow Q (cfs)	N/A	N/A	0.7	1.1	1.5	2.3	2.7	3.4	4.6
Peak Outflow Q (cfs)	0.0	0.2	0.1	0.2	0.7	1.5	2.0	2.7	2.9
Ratio Peak Outflow to Predevelopment Q	N/A	N/A	N/A	0.4	0.8	0.9	1.0	1.0	0.7
Structure Controlling Flow	Filtration Media	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps)	N/A	N/A	N/A	N/A	0.1	0.4	0.5	0.7	0.7
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)	11	18	20	21	21	20	19	18	16
Time to Drain 99% of Inflow Volume (hours)	12	19	20	22	22	22	22	22	21
Maximum Ponding Depth (ft)	0.30	0.81	0.60	0.97	1.10	1.20	1.25	1.33	1.78
Area at Maximum Ponding Depth (acres)	0.08	0.10	0.09	0.10	0.10	0.10	0.11	0.11	0.12
Maximum Volume Stored (acre-ft)	0.024	0.070	0.050	0.085	0.097	0.108	0.113	0.122	0.172

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.04 (February 2021)*



S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

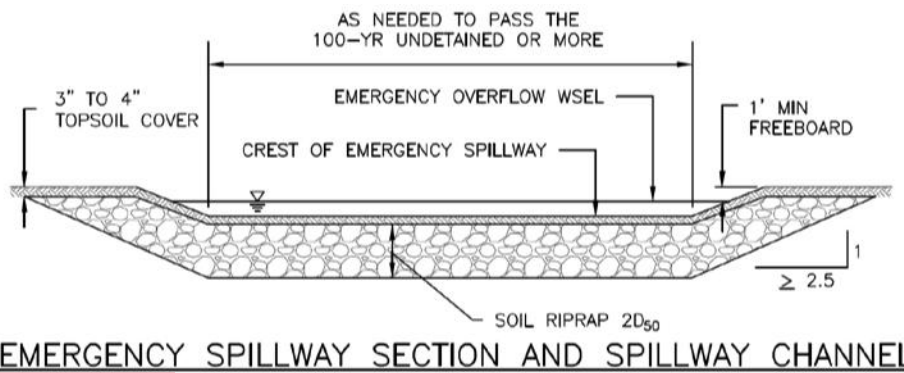
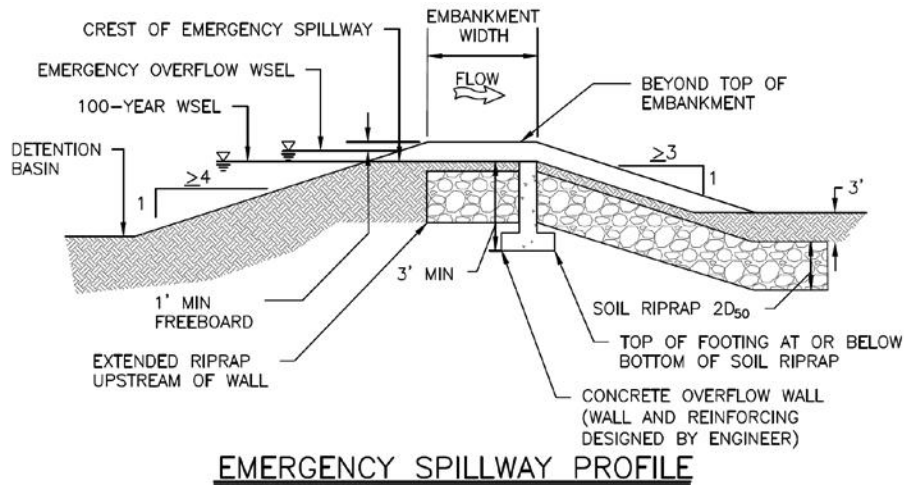
# DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: \_\_\_\_\_

## Inflow Hydrographs

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

Time Interval	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	0:15:00	0.00	0.00	0.02	0.04	0.05	0.03	0.04	0.04	0.06
	0:20:00	0.00	0.00	0.09	0.16	0.22	0.09	0.11	0.13	0.22
	0:25:00	0.00	0.00	0.35	0.64	0.94	0.34	0.42	0.50	0.94
	0:30:00	0.00	0.00	0.59	1.03	1.37	1.47	1.83	2.13	3.01
	0:35:00	0.00	0.00	0.64	1.10	1.46	1.99	2.42	2.95	4.04
	0:40:00	0.00	0.00	0.65	1.10	1.46	2.23	2.70	3.27	4.45
	0:45:00	0.00	0.00	0.62	1.04	1.40	2.25	2.73	3.38	4.58
	0:50:00	0.00	0.00	0.58	0.99	1.32	2.23	2.70	3.34	4.52
	0:55:00	0.00	0.00	0.55	0.93	1.26	2.11	2.56	3.23	4.39
	1:00:00	0.00	0.00	0.52	0.88	1.20	2.00	2.44	3.14	4.27
	1:05:00	0.00	0.00	0.49	0.83	1.14	1.90	2.32	3.04	4.14
	1:10:00	0.00	0.00	0.46	0.78	1.09	1.75	2.15	2.80	3.84
	1:15:00	0.00	0.00	0.43	0.74	1.05	1.63	2.01	2.60	3.58
	1:20:00	0.00	0.00	0.40	0.70	0.99	1.52	1.86	2.39	3.30
	1:25:00	0.00	0.00	0.37	0.65	0.93	1.41	1.73	2.19	3.03
	1:30:00	0.00	0.00	0.35	0.61	0.86	1.29	1.59	2.01	2.77
	1:35:00	0.00	0.00	0.32	0.57	0.79	1.18	1.45	1.83	2.53
	1:40:00	0.00	0.00	0.30	0.52	0.72	1.08	1.32	1.66	2.29
	1:45:00	0.00	0.00	0.27	0.47	0.66	0.97	1.19	1.49	2.06
	1:50:00	0.00	0.00	0.25	0.42	0.61	0.87	1.07	1.34	1.85
	1:55:00	0.00	0.00	0.23	0.39	0.57	0.79	0.98	1.21	1.69
	2:00:00	0.00	0.00	0.22	0.37	0.53	0.73	0.90	1.12	1.56
	2:05:00	0.00	0.00	0.20	0.34	0.49	0.67	0.83	1.02	1.42
	2:10:00	0.00	0.00	0.18	0.31	0.45	0.61	0.76	0.93	1.30
	2:15:00	0.00	0.00	0.17	0.28	0.41	0.56	0.69	0.85	1.18
	2:20:00	0.00	0.00	0.15	0.26	0.37	0.51	0.63	0.77	1.07
	2:25:00	0.00	0.00	0.14	0.23	0.33	0.47	0.57	0.70	0.97
	2:30:00	0.00	0.00	0.12	0.21	0.30	0.42	0.52	0.64	0.88
	2:35:00	0.00	0.00	0.11	0.19	0.27	0.38	0.47	0.57	0.79
	2:40:00	0.00	0.00	0.10	0.16	0.24	0.34	0.41	0.51	0.70
	2:45:00	0.00	0.00	0.09	0.14	0.21	0.30	0.36	0.45	0.62
	2:50:00	0.00	0.00	0.07	0.12	0.18	0.26	0.31	0.39	0.53
	2:55:00	0.00	0.00	0.06	0.10	0.15	0.22	0.26	0.33	0.45
	3:00:00	0.00	0.00	0.05	0.08	0.12	0.18	0.22	0.26	0.36
	3:05:00	0.00	0.00	0.04	0.06	0.09	0.14	0.17	0.21	0.28
	3:10:00	0.00	0.00	0.03	0.05	0.07	0.10	0.12	0.15	0.20
	3:15:00	0.00	0.00	0.02	0.03	0.05	0.07	0.08	0.10	0.14
	3:20:00	0.00	0.00	0.02	0.03	0.04	0.05	0.06	0.07	0.11
	3:25:00	0.00	0.00	0.01	0.02	0.04	0.04	0.05	0.05	0.08
	3:30:00	0.00	0.00	0.01	0.02	0.03	0.03	0.04	0.04	0.06
	3:35:00	0.00	0.00	0.01	0.02	0.03	0.02	0.03	0.03	0.04
	3:40:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.03
	3:45:00	0.00	0.00	0.01	0.01	0.02	0.01	0.02	0.02	0.02
	3:50:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	3:55:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	4:00:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	4:05:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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**CHOOSE TYPE VL**

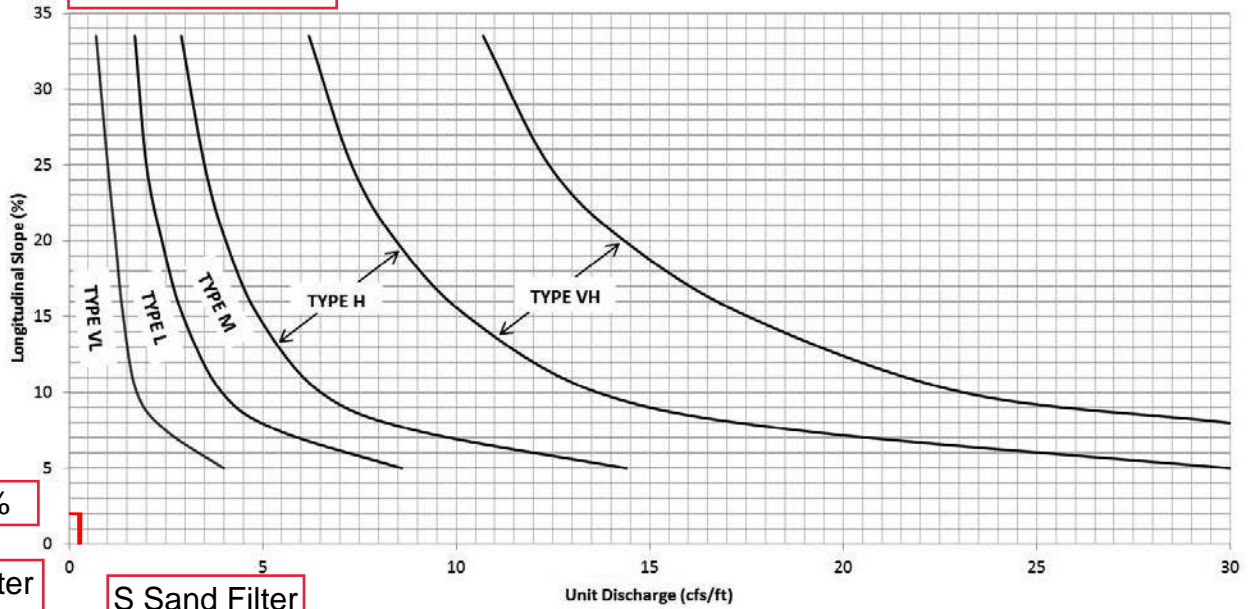


Figure 12-21. Embankment protection details and rock sizing chart (adapted from Arapahoe County)

# HOMESTEAD AT STERLING RANCH FILING NO. 2

COUNTY OF EL PASO, STATE OF COLORADO

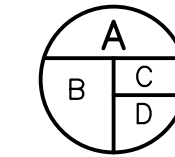
## PROPOSED DRAINAGE MAP (ADDENDUM)

Tributary Sub-basin	Area (acres)	Percent Impervious	C <sub>s</sub>	C <sub>100</sub>	t <sub>c</sub> (min)	Q <sub>s</sub> (cfs)	Q <sub>100</sub> (cfs)
X1	0.91	25%	0.22	0.46	12.9	0.7	2.6
X2	1.04	25%	0.22	0.46	12.9	0.9	3.0
W1	0.84	25%	0.22	0.46	16.8	0.6	2.2
Y1	0.84	25%	0.22	0.46	12.9	0.7	2.5

Grey-boxes indicate no change from the approved "Addendum to the Final Drainage Report for Homestead at Sterling Ranch Filing No. 2" by JR Engineering dated 6/16/21.

DP	Q <sub>5</sub>	Q <sub>100</sub>
	Total	Total
1	0.7	2.6
2	0.9	2.2
3	0.6	2.5
3.1	1.3	4.6
4	0.7	2.5
4.1	1.7	6.4

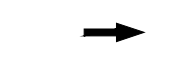
### LEGEND



BASIN ID  
 A: SUB-BASIN DESIGNATION  
 B: AREA (AC)  
 C: 5 YEAR STORM COEFFICIENT  
 D: 100 YEAR STORM COEFFICIENT



DRAINAGE DISCHARGE DESIGN POINT



PROPOSED FLOW DIRECTION



HISTORIC FLOW DIRECTION



EXISTING DRAINAGE BASIN



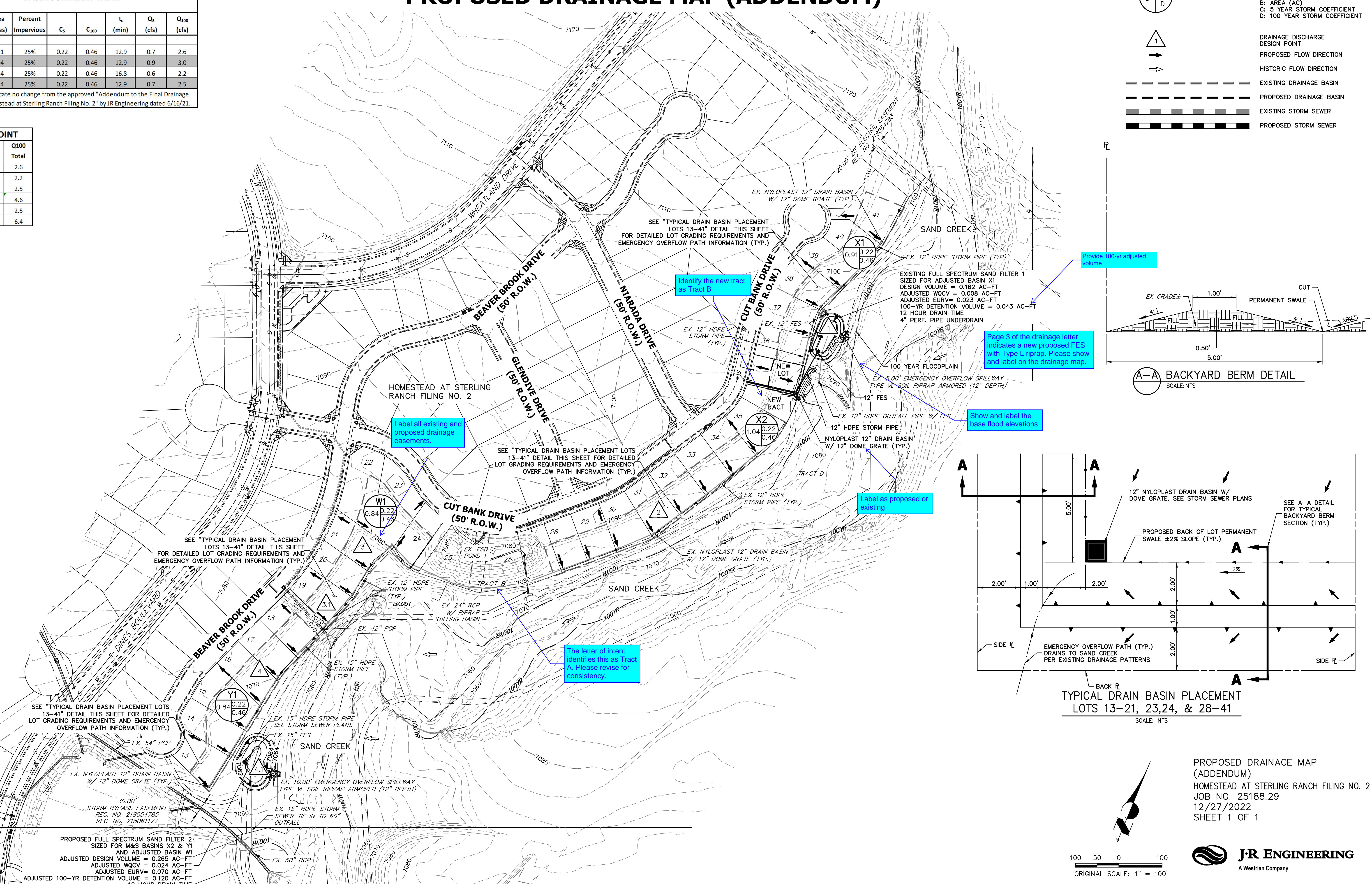
PROPOSED DRAINAGE BASIN



EXISTING STORM SEWER



PROPOSED STORM SEWER



Provide 100-yr adjusted volume

Identify the new tract as Tract B

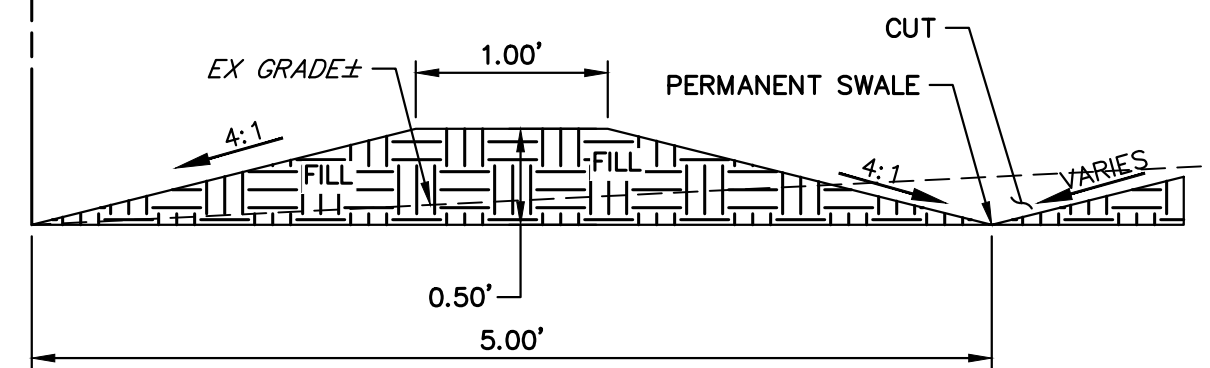
Page 3 of the drainage letter indicates a new proposed FES with Type L riprap. Please show and label on the drainage map.

Show and label the base flood elevations

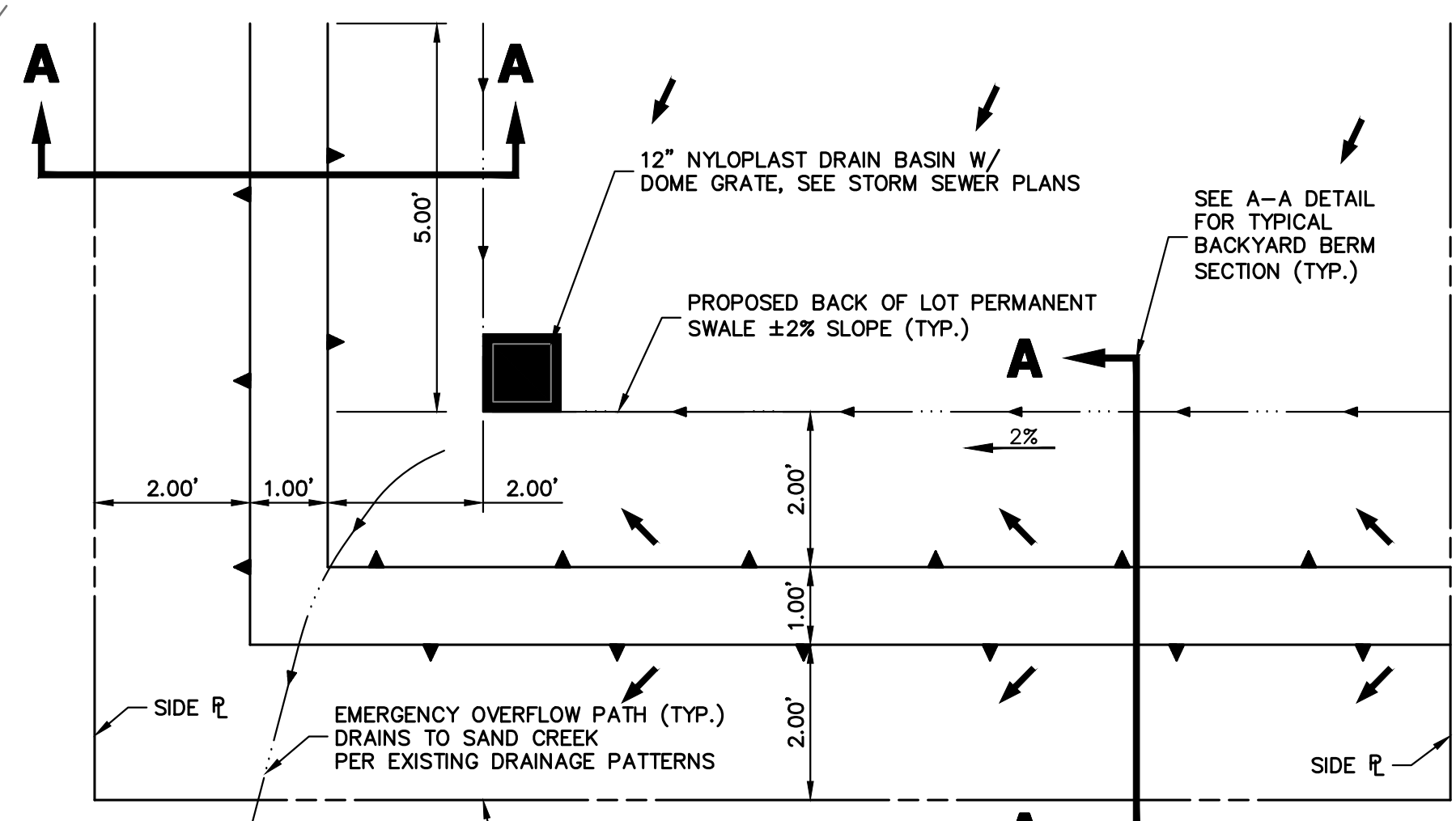
Label as proposed or existing

The letter of intent identifies this as Tract A. Please revise for consistency.

Label all existing and proposed drainage easements.



A-A BACKYARD BERM DETAIL  
SCALE: NTS



TYPICAL DRAIN BASIN PLACEMENT  
LOTS 13-21, 23,24, & 28-41  
SCALE: NTS

PROPOSED DRAINAGE MAP (ADDENDUM)  
 HOMESTEAD AT STERLING RANCH FILING NO. 2  
 JOB NO. 25188.29  
 12/27/2022  
 SHEET 1 OF 1



Centennial 303-740-9393 • Colorado Springs 719-593-2593  
 Fort Collins 970-491-9888 • www.jrengineering.com



X:\25188\Drawings\Sheet\Drawings\Drainage\Drainage Map.dwg, PROPOSED DRAINAGE, 12/27/2022 9:42:23 AM, CS