MARTIN/MARTIN
CONSULTING ENGINEERS

October 14, 2024

City of Aurora
Aurora Water
15151 E Alameda Parkway
Aurora, CO 80012

Re:

Blackhawk, Solar Decathlon, Site Plan Amendment – Drainage Conformance Letter
Martin/Martin, Inc. Project No.: 19.0741

This Drainage Conformance letter accompanies the Site Plan Amendment of the project. The intent of this conformance letter is to confirm the grading changes due to modifications of the building footprint comply with the intent of the approved drainage design and remain in compliance with Aurora Water Storm Drainage Design and Technical Criteria, last revised August 2024.

The Solar Decathlon development is a 0.62 acre site located in Aurora, Colorado, and is located within the southwest quarter of Section 31, Township 3 South, Range 66 West of the Sixth Principal Meridian. The project is bound by single-family dwellings to the north, east and west, and by a multi-family dwelling to the south.

Pre-development conditions consist of being vacant land with sparse vegetation and trees. Proposed conditions from the approved Site Plan includes placement of four prefabricated single-family homes. Foundations will be installed on site for each home. Water and sewer mains will be extended from Blackhawk Street into the site, and each house will be provided with service taps. Additionally, the project will include a shared 9-stall asphalt parking lot and landscaping. Per the project's Final Drainage Report dated August 24, 2020, the proposed development results in composite imperviousness of 66.3%. This includes runoff from the property to the south. The 10-year is 4.12 cfs while the 100-year is 6.92 cfs.

A recent Site Plan Amendment in process reduces decks for Houses A and B along with limited sidewalk expansion, and a new floor plan for House D. While drainage routing will remain unchanged, the stated amendments result in a composite imperviousness of 68.2%. The 10-year is 4.13 cfs while the 100-year is 6.96 cfs. Specifically, Basins A1, A3, B1 and D1 have been affected by the Amendment changes.

The project's Amendment to grading and drainage design will match the outfall locations and general drainage patterns of the previously approved Site Plan. The Amendment imperviousness has increased 3% while the 10 and 100-year events increased by 1% each. The increases are limited in nature and are not anticipated to affect the previously approved stormwater infrastructure systems based on updated calculations, therefore, the project's Amendment to grading and drainage conforms to the design requirements set forth in the Final Drainage Report.

Sincerely,

Mark Thornbrough, PE
Principal

Attachments
Amendment Rational Calculations dated September 17, 2024
Amendment City of Aurora Detention Calculations dated September 17, 2024
Amendment MHFD Detention Calculations dated September 17, 2024

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## PROJECT INFORMATION

| | |
|---|---|
| **PROJECT NAME:** | Solar Decathlon-Amendment |
| **PROJECT NO:** | 19.0741 |
| **DESIGN BY:** | A. Kuhlman |
| **REVIEWED BY:** | J. Rausch |
| **JURISDICTION:** | City of Aurora |
| **REPORT TYPE:** | Drainage Report |
| **DATE:** | 09/17/24 |

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| JURISDICTIONAL STANDARD | C2 | C5 | C10 | C100 | % IMPERV |
|---|---|---|---|---|---|
| LAWNS (A AND B) | 0.10 | 0.11 | 0.13 | 0.15 | 2% |
| ROOF | 0.80 | 0.85 | 0.90 | 0.90 | 90% |
| PAVED STREETS | 0.87 | 0.88 | 0.90 | 0.93 | 100% |
| GRAVEL | 0.15 | 0.25 | 0.35 | 0.65 | 40% |

| TOTAL SITE COMPOSITE | 1.11 | 0.62 | 0.64 | 0.66 | 0.68 | 68.2% |
|---|---|---|---|---|---|---|

| SUB-BASIN | SURFACE CHARACTERISTICS | AREA (ACRES) | COMPOSITE RUNOFF COEFFICIENTS C2 | C5 | C10 | C100 | PERCENT IMPERVIOUSNESS |
|---|---|---|---|---|---|---|---|
| A1 | ROOF | 0.02 | 0.80 | 0.85 | 0.90 | 0.90 | 90% |
| | PAVED STREETS | 0.01 | 0.87 | 0.88 | 0.90 | 0.93 | 100% |
| | LAWNS (A AND B) | 0.07 | 0.10 | 0.11 | 0.13 | 0.15 | 2% |
| | | | | | | | |
| **SUB-BASIN COMPOSITE** | | **0.10** | **0.31** | **0.32** | **0.35** | **0.37** | **28.0%** |

| SUB-BASIN | SURFACE CHARACTERISTICS | AREA (ACRES) | COMPOSITE RUNOFF COEFFICIENTS C2 | C5 | C10 | C100 | PERCENT IMPERVIOUSNESS |
|---|---|---|---|---|---|---|---|
| A2 | ROOF | 0.03 | 0.80 | 0.85 | 0.90 | 0.90 | 90% |
| | LAWNS (A AND B) | 0.04 | 0.10 | 0.11 | 0.13 | 0.15 | 2% |
| | | | | | | | |
| | | | | | | | |
| **SUB-BASIN COMPOSITE** | | **0.07** | **0.42** | **0.45** | **0.49** | **0.50** | **42.7%** |

| SUB-BASIN | SURFACE CHARACTERISTICS | AREA (ACRES) | COMPOSITE RUNOFF COEFFICIENTS C2 | C5 | C10 | C100 | PERCENT IMPERVIOUSNESS |
|---|---|---|---|---|---|---|---|
| A3 | ROOF | 0.02 | 0.80 | 0.85 | 0.90 | 0.90 | 90% |
| | LAWNS (A AND B) | 0.02 | 0.10 | 0.11 | 0.13 | 0.15 | 2% |
| | | | | | | | |
| | | | | | | | |
| **SUB-BASIN COMPOSITE** | | **0.04** | **0.43** | **0.46** | **0.49** | **0.51** | **43.7%** |

| SUB-BASIN | SURFACE CHARACTERISTICS | AREA (ACRES) | COMPOSITE RUNOFF COEFFICIENTS C2 | C5 | C10 | C100 | PERCENT IMPERVIOUSNESS |
|---|---|---|---|---|---|---|---|
| A4 | PAVED STREETS | 0.02 | 0.87 | 0.88 | 0.90 | 0.93 | 100% |
| | LAWNS (A AND B) | 0.02 | 0.10 | 0.11 | 0.13 | 0.15 | 2% |
| | | | | | | | |
| | | | | | | | |
| **SUB-BASIN COMPOSITE** | | **0.04** | **0.45** | **0.46** | **0.48** | **0.50** | **46.1%** |

| SUB-BASIN | SURFACE CHARACTERISTICS | AREA (ACRES) | COMPOSITE RUNOFF COEFFICIENTS C2 | C5 | C10 | C100 | PERCENT IMPERVIOUSNESS |
|---|---|---|---|---|---|---|---|
| B1 | PAVED STREETS | 0.19 | 0.87 | 0.88 | 0.90 | 0.93 | 100% |
| | LAWNS (A AND B) | 0.05 | 0.10 | 0.11 | 0.13 | 0.15 | 2% |
| | ROOF | 0.01 | 0.80 | 0.85 | 0.90 | 0.90 | 90% |
| | | | | | | | |
| **SUB-BASIN COMPOSITE** | | **0.25** | **0.71** | **0.73** | **0.75** | **0.77** | **80.2%** |

| SUB-BASIN | SURFACE CHARACTERISTICS | AREA (ACRES) | COMPOSITE RUNOFF COEFFICIENTS C2 | C5 | C10 | C100 | PERCENT IMPERVIOUSNESS |
|---|---|---|---|---|---|---|---|
| C1 | LAWNS (A AND B) | 0.02 | 0.10 | 0.11 | 0.13 | 0.15 | 2% |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| **SUB-BASIN COMPOSITE** | | **0.02** | **0.10** | **0.11** | **0.13** | **0.15** | **2.0%** |

| SUB-BASIN | SURFACE CHARACTERISTICS | AREA (ACRES) | COMPOSITE RUNOFF COEFFICIENTS C2 | C5 | C10 | C100 | PERCENT IMPERVIOUSNESS |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **C2** | LAWNS (A AND B) | 0.03 | 0.10 | 0.11 | 0.13 | 0.15 | 2% |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| **SUB-BASIN COMPOSITE** | | **0.03** | **0.10** | **0.11** | **0.13** | **0.15** | **2.0%** |

| SUB-BASIN | SURFACE CHARACTERISTICS | AREA | COMPOSITE RUNOFF COEFFICIENTS | | | | PERCENT IMPERVIOUSNESS |
|---|---|---|---|---|---|---|---|
| | | (ACRES) | C2 | C5 | C10 | C100 | |
| **C3** | LAWNS (A AND B) | 0.01 | 0.10 | 0.11 | 0.13 | 0.15 | 2% |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| **SUB-BASIN COMPOSITE** | | **0.01** | **0.10** | **0.11** | **0.13** | **0.15** | **2.0%** |

| SUB-BASIN | SURFACE CHARACTERISTICS | AREA | COMPOSITE RUNOFF COEFFICIENTS | | | | PERCENT IMPERVIOUSNESS |
|---|---|---|---|---|---|---|---|
| | | (ACRES) | C2 | C5 | C10 | C100 | |
| **D1** | LAWNS (A AND B) | 0.05 | 0.10 | 0.11 | 0.13 | 0.15 | 2% |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| **SUB-BASIN COMPOSITE** | | **0.05** | **0.10** | **0.11** | **0.13** | **0.15** | **2.0%** |

| SUB-BASIN | SURFACE CHARACTERISTICS | AREA | COMPOSITE RUNOFF COEFFICIENTS | | | | PERCENT IMPERVIOUSNESS |
|---|---|---|---|---|---|---|---|
| | | (ACRES) | C2 | C5 | C10 | C100 | |
| **OS1** | PAVED STREETS | 0.46 | 0.87 | 0.88 | 0.90 | 0.93 | 100% |
| | LAWNS (A AND B) | 0.04 | 0.10 | 0.11 | 0.13 | 0.15 | 2% |
| | | | | | | | |
| | | | | | | | |
| **SUB-BASIN COMPOSITE** | | **0.50** | **0.81** | **0.82** | **0.84** | **0.87** | **92.2%** |

| SUB-BASIN | SURFACE CHARACTERISTICS | AREA | COMPOSITE RUNOFF COEFFICIENTS | | | | PERCENT IMPERVIOUSNESS |
|---|---|---|---|---|---|---|---|
| | | (ACRES) | C2 | C5 | C10 | C100 | |
| **OS2** | PAVED STREETS | 0.03 | 0.87 | 0.88 | 0.90 | 0.93 | 100% |
| | LAWNS (A AND B) | 0.01 | 0.10 | 0.11 | 0.13 | 0.15 | 2% |
| | | | | | | | |
| | | | | | | | |
| **SUB-BASIN COMPOSITE** | | **0.04** | **0.72** | **0.73** | **0.75** | **0.77** | **80.4%** |

| | | | | | | |
|---|---|---|---|---|---|---|
| **TOTAL BASIN-A COMPOSITE** | **0.25** | **0.38** | **0.40** | **0.43** | **0.45** | **37.6%** |
| **TOTAL BASIN-B COMPOSITE (includes OS2)** | **0.29** | **0.71** | **0.73** | **0.75** | **0.77** | **80.2%** |
| **TOTAL SITE COMPOSITE** | **1.11** | **0.62** | **0.64** | **0.66** | **0.68** | **68.2%** |

**PROJECT:** Solar Decathlon-Amendment
**JOB NO:** 19.0741
**DATE:** 09/17/24

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| RUNOFF SUMMARY | | | | | | | |
|---|---|---|---|---|---|---|---|
| BASIN | DESIGN POINT | AREA (ACRES) | % IMP. | $C_{10}$ | $C_{100}$ | $Q_{10}$ (CFS) | $Q_{100}$ (CFS) |
| A1 | A1 | 0.10 | 28.0% | 0.35 | 0.37 | 0.19 | 0.32 |
| A2 | A2 | 0.07 | 42.7% | 0.49 | 0.50 | 0.20 | 0.33 |
| A3 | A3 | 0.04 | 43.7% | 0.49 | 0.51 | 0.10 | 0.17 |
| A4 | A4 | 0.04 | 46.1% | 0.48 | 0.50 | 0.10 | 0.18 |
| B1 | B1 | 0.25 | 80.2% | 0.75 | 0.77 | 1.03 | 1.71 |
| C1 | C1 | 0.02 | 2.0% | 0.13 | 0.15 | 0.01 | 0.03 |
| C2 | C2 | 0.03 | 2.0% | 0.13 | 0.15 | 0.02 | 0.04 |
| C3 | C3 | 0.01 | 2.0% | 0.13 | 0.15 | 0.01 | 0.01 |
| D1 | D1 | 0.05 | 2.0% | 0.13 | 0.15 | 0.04 | 0.07 |
| OS1 | OS1 | 0.50 | 92.2% | 0.84 | 0.87 | 2.29 | 3.84 |
| OS2 | OS2 | 0.04 | 80.4% | 0.75 | 0.77 | 0.14 | 0.27 |
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| | | | | | | | |
| **SITE COMPOSITE** | | **1.11** | **68.2%** | **0.64** | **0.68** | **4.13** | **6.96** |

**Project:** SOLAR DECATHLON VILLAGE-Amendment
**Project Number:** 19.0741
**Date:** 9/17/2024
**Engineer:** A. KUHLMAN
**Project Manager:** J. RAUSCH

| CITY OF AURORA DETENTION CALCULATIONS-AMENDMENT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| DETENTION VOLUMES | | | | | | | | |
| | AREA (ACRE) | % IMP | K 10-YR | K 100-YR | 10-YR VOL (AC-FT) | 10-YR VOL (CF) | 100-YR VOL (AC-FT) | 100-YR VOL (CF) |
| **DETENTION A** | 0.25 | 37.60 | 0.034 | 0.067 | 0.0085 | 368 | 0.0168 | 733 |
| **DETENTION B** | 0.29 | 80.20 | 0.074 | 0.140 | 0.0215 | 938 | 0.0407 | 1773 |
| WATER QUALITY CAPTURE VOLUMES | | | | | | | | |
| | AREA (ACRE) | % IMP | a | WQCV (watershed-in) | | WQCV (CF) | 1.2*WQCV (CF) | 1.2*WQCV (AC-FT) |
| **RAIN GARDEN A1** | 0.1 | 28.00 | 0.8 | 0.116 | | 42 | 51 | 0.0012 |
| **RAIN GARDEN A2** | 0.07 | 42.70 | 0.8 | 0.150 | | 38 | 46 | 0.0010 |
| **RAIN GARDEN A3** | 0.04 | 43.70 | 0.8 | 0.152 | | 22 | 26 | 0.0006 |
| **RAIN GARDEN B1** | 0.29 | 80.20 | 0.8 | 0.264 | | 278 | 333 | 0.0076 |

*WQCV for Rain Garden B1 is calculated including off-site basin, OS2.

| RELEASE RATES ($Q_R$) | | | | | | |
|---|---|---|---|---|---|---|
| | SOIL GROUP | AREA (ACRE) | 10-YR $Q_R$ (CFS) | ACTUAL* 10-YR $Q_R$ (CFS) | 100-YR $Q_R$ (CFS) | ACTUAL* 100-YR $Q_R$ (CFS) |
| **DETENTION A** | B | 0.25 | 0.058 | 0.028 | 0.213 | 0.163 |
| **DETENTION B** | B | 0.29 | 0.067 | 0.057 | 0.247 | 0.237 |

* Actual release rates account for undetained basins: peak runoff from basins C1 & C2 are subtracted from Detention A release rate, and peak runoff from C3 is subtracted from Detention B release rate.

**6.33 Volume and Release Rates**

a) When the detention facility discharges into an existing storm sewer, street, or improved drainageway, the minimum detention volume shall be determined using the following equation (see Paragraph c) for additional limitations):

V = KA
For the 100-year, $K_{100}$ = (1.78I-0.002I$^2$-3.56)/900 (6.1)
For the 10-year, $K_{10}$ = (0.95I-1.90)/1000 (6.2)
Where V = required volume for the 100- or 10-year storm (acre-feet)

I = Developed basin imperviousness (%)
A = Tributary area (acres)

The maximum release rates at the ponding depths corresponding to the 10- and 100-year volumes are as follows:

Allowable release rates for detention ponds - CFS/ACRE

| | SCS Hydrologic Soil Group | | |
|---|---|---|---|
| Storm Frequency | A | B | C&D |
| 10-year | 0.13 | 0.23 | 0.30 |
| 100-year | 0.50 | 0.85 | 1.00 |

The predominant soil group for the total basin area tributary to the detention pond shall be used for determining the allowable release rate.

*City of Aurora Storm Drainage Design and Technical Criteria, October 2010*

**3.0 Calculation of the WQCV**

The WQCV is calculated as a function of imperviousness and BMP type using Equation 3-1 and Table 3-2, and as shown in Figure 3-1:

$$WQCV = a(0.91I^3 - 1.19I^2 + 0.78I) \quad \text{Equation 3-1}$$

Where:

WQCV = Water Quality Capture Volume (watershed-inches)

*a* = Coefficient corresponding to BMP type and based on WQCV design drain time (Table 3-2)

*I* = Imperviousness (percent expressed as a decimal) Note: At a planning level, the watershed imperviousness can be estimated based on the zoned density. When finalizing design, calculate imperviousness based on the site plan.

**Table 3-2. Drain Time Coefficients for WQCV Calculations**

| Drain Time (hours) | Coefficient, a |
|---|---|
| 12 hours (filtration BMPs and retention ponds) | 0.8 |
| 24 hours (constructed wetland ponds) | 0.9 |
| 40 hours (extended detention) | 1.0 |
| No attenuation (e.g., grass buffer or swale) | 1.0 |

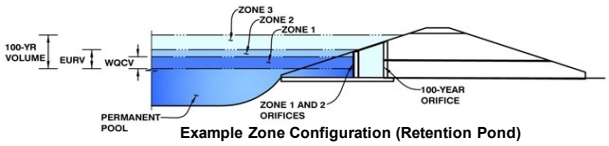
*Mile High Flood District, Urban Drainage Criteria Manual, Volume 3, October 2019*

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.06 (July 2022)*

**Project:** **Solar Decathlon Village-Amendment**

**Basin ID:** **Courtyard Detention**




**Example Zone Configuration (Retention Pond)**

## Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | **RG** | |
| Watershed Area = | 0.25 | acres |
| Watershed Length = | 160 | ft |
| Watershed Length to Centroid = | 80 | ft |
| Watershed Slope = | 0.010 | ft/ft |
| Watershed Imperviousness = | 37.60% | 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 WQCV 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 | |
|---|---|---|---|---|
| Water Quality Capture Volume (WQCV) = | 0.003 | acre-feet | | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 0.010 | acre-feet | | acre-feet |
| 2-yr Runoff Volume (P1 = 0.95 in.) = | 0.006 | acre-feet | 0.95 | inches |
| 5-yr Runoff Volume (P1 = 1.38 in.) = | 0.012 | acre-feet | 1.38 | inches |
| 10-yr Runoff Volume (P1 = 1.61 in.) = | 0.016 | acre-feet | 1.61 | inches |
| 25-yr Runoff Volume (P1 = [illegible] in.) = | [illegible] | acre-feet | [illegible] | inches |
| 50-yr Runoff V[illegible] = | [illegible] | acre-feet | [illegible] | inches |
| 100-yr Runoff[illegible] = | [illegible] | acre-feet | [illegible] | inches |
| 500-yr Runoff V[illegible] = | [illegible] | acre-feet | [illegible] | inches |
| Approximate [illegible] = | [illegible] | acre-feet | | |
| Approximate 5-yr Detention Volume = | 0.009 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 0.013 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 0.016 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 0.017 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 0.020 | acre-feet | | |

CUHP not used - Volumes calclated in accordance with Section 6.33 of COA SDDTCM.

## Define Zones and Basin Geometry

| | | |
|---|---|---|
| Zone 1 Volume (User Defined) = | 0.009 | acre-feet |
| Zone 2 Volume (User Defined - Zone 1) = | 0.008 | acre-feet |
| Select Zone 3 Storage Volume (Optional) = | | acre-feet |
| Total Detention Basin Volume = | 0.017 | acre-feet |
| Initial Surcharge Volume (ISV) = | N/A | $ft^3$ |
| Initial Surcharge Depth (ISD) = | N/A | ft |
| Total Available Detention Depth ($H_{total}$) = | user | ft |
| Depth of Trickle Channel ($H_{TC}$) = | N/A | ft |
| Slope of Trickle Channel ($S_{TC}$) = | N/A | ft/ft |
| Slopes of Main Basin Sides ($S_{main}$) = | user | H:V |
| Basin Length-to-Width Ratio ($R_{L/W}$) = | user | |

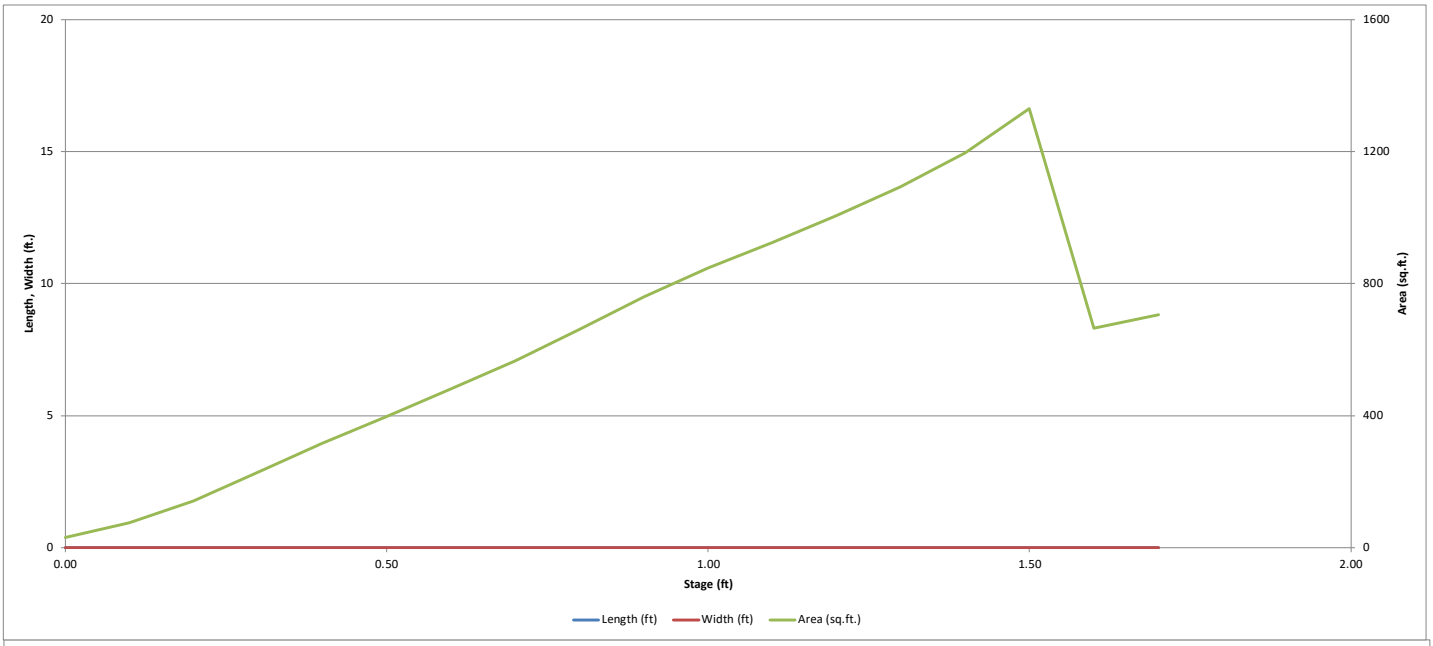
| | | |
|---|---|---|
| Initial Surcharge Area ($A_{ISV}$) = | user | $ft^2$ |
| Surcharge Volume Length ($L_{ISV}$) = | user | ft |
| Surcharge Volume Width ($W_{ISV}$) = | user | ft |
| Depth of Basin Floor ($H_{FLOOR}$) = | user | ft |
| Length of Basin Floor ($L_{FLOOR}$) = | user | ft |
| Width of Basin Floor ($W_{FLOOR}$) = | user | ft |
| Area of Basin Floor ($A_{FLOOR}$) = | user | $ft^2$ |
| Volume of Basin Floor ($V_{FLOOR}$) = | user | $ft^3$ |
| Depth of Main Basin ($H_{MAIN}$) = | user | ft |
| Length of Main Basin ($L_{MAIN}$) = | user | ft |
| Width of Main Basin ($W_{MAIN}$) = | user | ft |
| Area of Main Basin ($A_{MAIN}$) = | user | $ft^2$ |
| Volume of Main Basin ($V_{MAIN}$) = | user | $ft^3$ |
| Calculated Total Basin Volume ($V_{total}$) = | **user** | acre-feet |

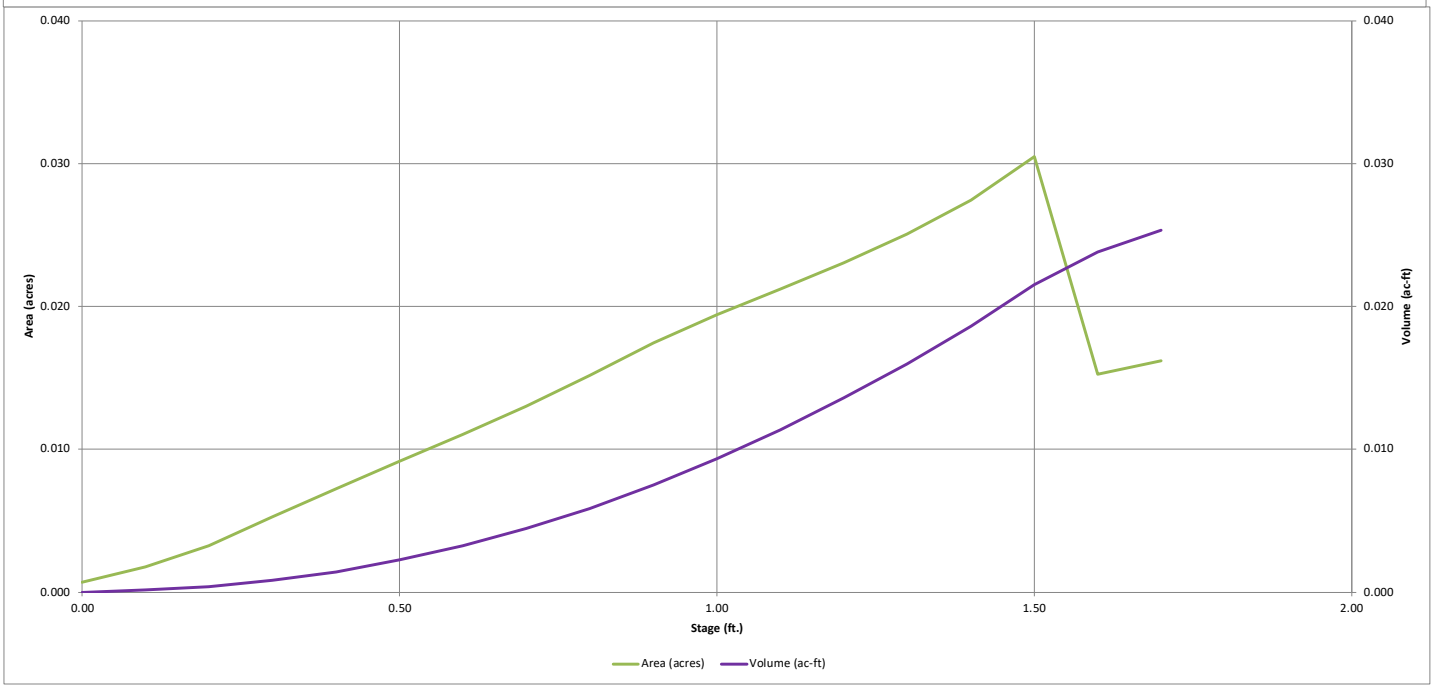
Depth Increment = ft

| Stage - Storage Description | Stage (ft) | Optional Override Stage (ft) | Length (ft) | Width (ft) | Area ($ft^2$) | Optional Override Area ($ft^2$) | Area (acre) | Volume ($ft^3$) | Volume (ac-ft) |
|---|---|---|---|---|---|---|---|---|---|
| **Media Surface** | -- | 0.00 | -- | -- | -- | 31 | 0.001 | | |
| | -- | 0.10 | -- | -- | -- | 76 | 0.002 | 5 | 0.000 |
| | -- | 0.20 | -- | -- | -- | 141 | 0.003 | 16 | 0.000 |
| | -- | 0.30 | -- | -- | -- | 228 | 0.005 | 35 | 0.001 |
| | -- | 0.40 | -- | -- | -- | 315 | 0.007 | 62 | 0.001 |
| | -- | 0.50 | -- | -- | -- | 398 | 0.009 | 97 | 0.002 |
| | -- | 0.60 | -- | -- | -- | 481 | 0.011 | 141 | 0.003 |
| | -- | 0.70 | -- | -- | -- | 566 | 0.013 | 194 | 0.004 |
| | -- | 0.80 | -- | -- | -- | 661 | 0.015 | 255 | 0.006 |
| | -- | 0.90 | -- | -- | -- | 760 | 0.017 | 326 | 0.007 |
| | -- | 1.00 | -- | -- | -- | 846 | 0.019 | 406 | 0.009 |
| | -- | 1.10 | -- | -- | -- | 925 | 0.021 | 495 | 0.011 |
| | -- | 1.20 | -- | -- | -- | 1,005 | 0.023 | 591 | 0.014 |
| | -- | 1.30 | -- | -- | -- | 1,093 | 0.025 | 696 | 0.016 |
| | -- | 1.40 | -- | -- | -- | 1,196 | 0.027 | 811 | 0.019 |
| | -- | 1.50 | -- | -- | -- | 1,330 | 0.031 | 937 | 0.022 |
| | -- | 1.60 | -- | -- | -- | 665 | 0.015 | 1,037 | 0.024 |
| | -- | 1.70 | -- | -- | -- | 705 | 0.016 | 1,105 | 0.025 |
| | -- | | -- | -- | -- | | | | |
| | -- | | -- | -- | -- | | | | |
| | -- | | -- | -- | -- | | | |

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.06 (July 2022)*



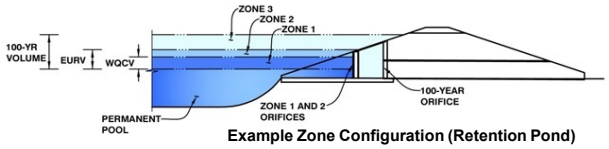



# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*

**Project: Solar Decathlon Village-Amendment**

**Basin ID: Courtyard Detention**




**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (User) | 0.96 | 0.009 | Filtration Media |
| Zone 2 (User) | 1.34 | 0.008 | Weir&Pipe (Circular) |
| Zone 3 | | | |
| Total (all zones) | | 0.017 | |

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 Area = | | ft² |
| Underdrain Orifice Diameter = | | inches | Underdrain Orifice Centroid = | | feet |

Calculated Parameters for Underdrain

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

| | | | | | |
|---|---|---|---|---|---|
| Centroid of Lowest Orifice = | N/A | ft (relative to basin bottom at Stage = 0 ft) | WQ Orifice Area per Row = | N/A | ft² |
| Depth at top of Zone using Orifice Plate = | N/A | ft (relative to basin bottom at Stage = 0 ft) | Elliptical Half-Width = | N/A | feet |
| Orifice Plate: Orifice Vertical Spacing = | N/A | inches | Elliptical Slot Centroid = | N/A | feet |
| Orifice Plate: Orifice Area per Row = | N/A | sq. inches | Elliptical Slot Area = | N/A | ft² |

Calculated Parameters for Plate

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

| | Row 1 (optional) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (optional) |
|---|---|---|---|---|---|---|---|---|
| Stage of Orifice Centroid (ft) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Orifice Area (sq. inches) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

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

User Input: Vertical Orifice (Circular or Rectangular)

| | Not Selected | Not Selected | | | Calculated Parameters for Vertical Orif | |
|---|---|---|---|---|---|---|
| | | | | | Not Selected | Not Selected |
| Invert of Vertical Orifice = | | N/A | ft (relative to basin bottom at Stage = 0 ft) | Vertical Orifice Area = | | N/A |
| Depth at top of Zone using Vertical Orifice = | | N/A | ft (relative to basin bottom at Stage = 0 ft) | Vertical Orifice Centroid = | | N/A |
| Vertical Orifice Diameter = | | N/A | inches | | | |

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

| | Zone 2 Weir | Not Selected | | | Calculated Parameters for Overflow W | |
|---|---|---|---|---|---|---|
| | | | | | Zone 2 Weir | Not Selected |
| Overflow Weir Front Edge Height, Ho = | 0.00 | 1.08 | ft (relative to basin bottom at Stage = 0 ft) | Height of Grate Upper Edge, $H_t$ = | 0.00 | 1.08 |
| Overflow Weir Front Edge Length = | 1.50 | 2.50 | feet | Overflow Weir Slope Length = | 1.50 | 0.50 |
| Overflow Weir Grate Slope = | 0.00 | 0.00 | H:V | Grate Open Area / 100-yr Orifice Area = | 416.78 | 49.23 |
| Horiz. Length of Weir Sides = | 1.50 | 0.50 | feet | Overflow Grate Open Area w/o Debris = | 1.57 | 0.87 |
| Overflow Grate Type = | Type C Grate | Type C Grate | | Overflow Grate Open Area w/ Debris = | 0.78 | 0.87 |
| Debris Clogging % = | 50% | 0% | % | | | |

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

| | Zone 2 Circular | Not Selected | | | Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla | |
|---|---|---|---|---|---|---|
| | | | | | Zone 2 Circular | Not Selected |
| Depth to Invert of Outlet Pipe = | 2.10 | 3.10 | ft (distance below basin bottom at Stage = 0 ft) | Outlet Orifice Area = | 0.00 | 0.02 |
| Circular Orifice Diameter = | 0.83 | 1.80 | inches | Outlet Orifice Centroid = | 0.03 | 0.08 |
| | | | | Half-Central Angle of Restrictor Plate on Pipe = | N/A | N/A |

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

| Design Storm Return Period = | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year |
|---|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth (in) = | N/A | N/A | 0.95 | 1.38 | 1.61 | 2.00 | 2.27 | 2.60 |
| CUHP Runoff Volume (acre-ft) = | 0.003 | 0.010 | 0.006 | 0.012 | 0.016 | 0.025 | 0.030 | 0.038 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 0.006 | 0.012 | 0.016 | 0.025 | 0.030 | 0.038 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.000 | 0.043 | 0.073 | 0.173 | 0.221 | 0.295 |
| OPTIONAL Override Predevelopment Peak Q (cfs) = | N/A | N/A | | | | | | |
| Predevelopment Unit Peak Flow, q (cfs/acre) = | N/A | N/A | 0.000 | 0.173 | 0.290 | 0.691 | 0.885 | 1.180 |
| Peak Inflow Q (cfs) = | N/A | N/A | 0.075 | 0.156 | 0.202 | 0.332 | 0.401 | 0.495 |
| Peak Outflow Q (cfs) = | 0.029 | 0.032 | 0.029 | 0.031 | 0.032 | 0.174 | 0.176 | 0.180 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 0.720 | 0.441 | 1.006 | 0.796 | 0.611 |
| Structure Controlling Flow = | Outlet Plate 1 | Outlet Plate 1 | Outlet Plate 1 | Outlet Plate 1 | Outlet Plate 1 | Outlet Plate 2 | Outlet Plate 2 | Outlet Plate 2 |
| Max Velocity through Grate 1 (fps) = | 0.02 | 0.02 | 0.02 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Max Velocity through Grate 2 (fps) = | N/A | N/A | N/A | N/A | N/A | 0.2 | 0.2 | 0.2 |
| Time to Drain 97% of Inflow Volume (hours) = | 1 | 4 | 3 | 5 | 6 | 6 | 6 | 7 |
| Time to Drain 99% of Inflow Volume (hours) = | 1 | 4 | 3 | 5 | 7 | 7 | 7 | 7 |
| Maximum Ponding Depth (ft) = | 0.58 | 1.04 | 0.49 | 0.89 | 1.06 | 1.15 | 1.27 | 1.47 |
| Area at Maximum Ponding Depth (acres) = | 0.01 | 0.02 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.03 |
| Maximum Volume Stored (acre-ft) = | 0.003 | 0.010 | 0.002 | 0.007 | 0.011 | 0.012 | 0.015 | 0.020 |

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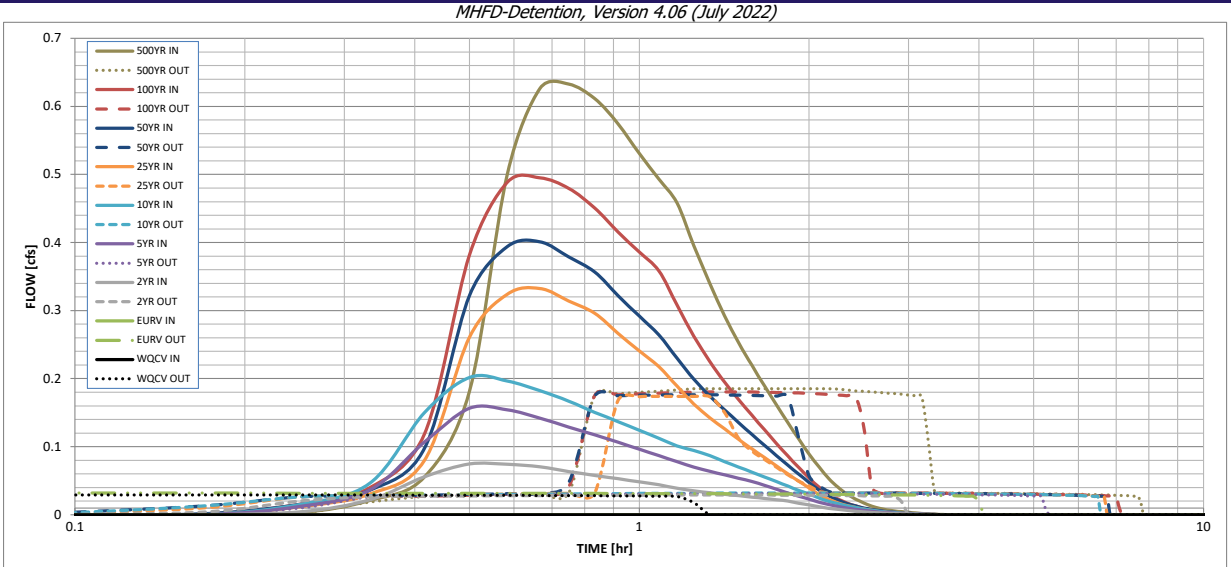
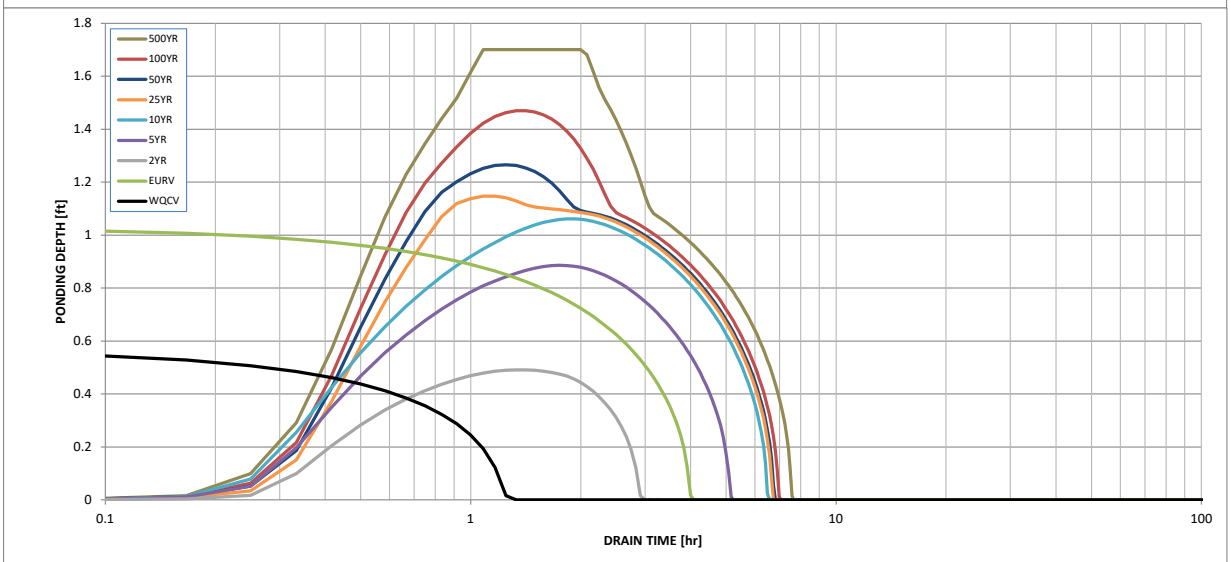
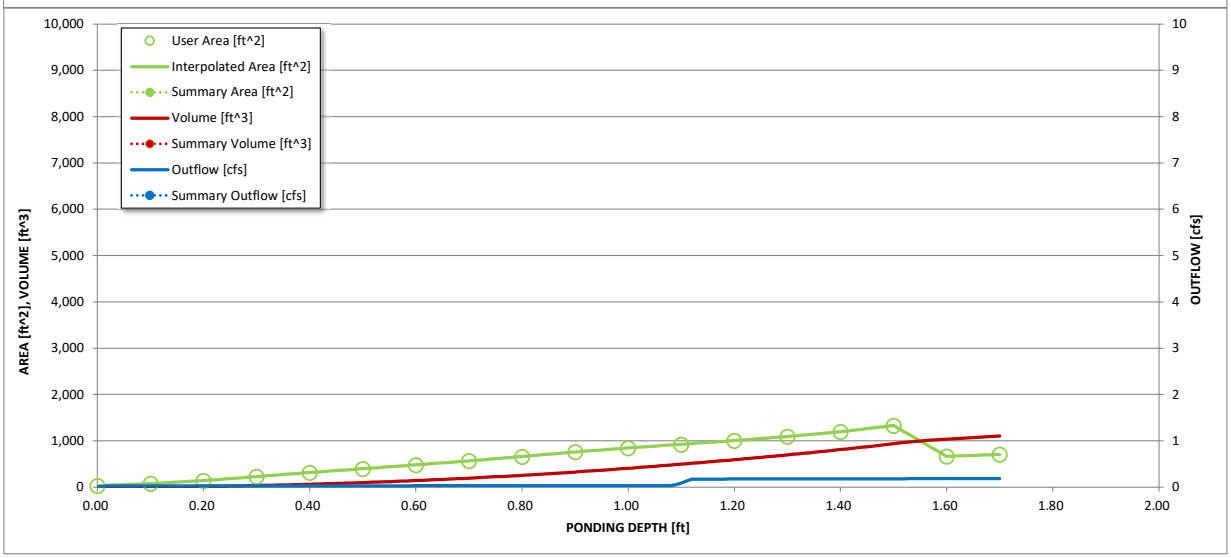


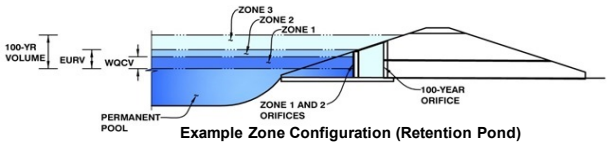

| S-A-V-D Chart Axis Override | X-axis | Left Y-Axis | Right Y-Axis |
|---|---|---|---|
| minimum bound | | | |
| maximum bound | | | |

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.06 (July 2022)*

**Project:** **Solar Decathlon Village-Amendment**

**Basin ID:** **Parking Lot Detention**




**Example Zone Configuration (Retention Pond)**

## Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | **RG** | |
| Watershed Area = | 0.29 | acres |
| Watershed Length = | 160 | ft |
| Watershed Length to Centroid = | 80 | ft |
| Watershed Slope = | 0.010 | ft/ft |
| Watershed Imperviousness = | 80.20% | 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 WQCV 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 | |
|---|---|---|---|---|
| Water Quality Capture Volume (WQCV) = | 0.006 | acre-feet | | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 0.026 | acre-feet | | acre-feet |
| 2-yr Runoff Volume (P1 = 0.95 in.) = | 0.017 | acre-feet | 0.95 | inches |
| 5-yr Runoff Volume (P1 = 1.38 in.) = | 0.026 | acre-feet | 1.38 | inches |
| 10-yr Runoff Volume (P1 = 1.61 in.) = | 0.031 | acre-feet | 1.61 | inches |
| 25-yr Runoff Volume (P1 = [illegible] in.) = | [illegible] | acre-feet | [illegible] | inches |
| 50-yr Runoff [illegible] = | [illegible] | acre-feet | [illegible] | inches |
| 100-yr Runoff [illegible] = | [illegible] | acre-feet | [illegible] | inches |
| 500-yr Runoff [illegible] = | [illegible] | acre-feet | [illegible] | inches |
| Approximate [illegible] = | [illegible] | acre-feet | | |
| Approximate 5-yr Detention Volume = | 0.025 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 0.031 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 0.036 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 0.038 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 0.040 | acre-feet | | |

CUHP not used - Volumes calclated in accordance with Section 6.33 of COA SDDTCM.

## Define Zones and Basin Geometry

| | | |
|---|---|---|
| Zone 1 Volume (User Defined) = | 0.008 | acre-feet |
| Zone 2 Volume (User Defined - Zone 1) = | 0.014 | acre-feet |
| Zone 3 Volume (User Defined - Zones 1 & 2) = | 0.019 | acre-feet |
| Total Detention Basin Volume = | 0.041 | acre-feet |
| Initial Surcharge Volume (ISV) = | N/A | $ft^3$ |
| Initial Surcharge Depth (ISD) = | N/A | ft |
| Total Available Detention Depth ($H_{total}$) = | user | ft |
| Depth of Trickle Channel ($H_{TC}$) = | N/A | ft |
| Slope of Trickle Channel ($S_{TC}$) = | N/A | ft/ft |
| Slopes of Main Basin Sides ($S_{main}$) = | user | H:V |
| Basin Length-to-Width Ratio ($R_{L/W}$) = | user | |

| | | |
|---|---|---|
| Initial Surcharge Area ($A_{ISV}$) = | user | $ft^2$ |
| Surcharge Volume Length ($L_{ISV}$) = | user | ft |
| Surcharge Volume Width ($W_{ISV}$) = | user | ft |
| Depth of Basin Floor ($H_{FLOOR}$) = | user | ft |
| Length of Basin Floor ($L_{FLOOR}$) = | user | ft |
| Width of Basin Floor ($W_{FLOOR}$) = | user | ft |
| Area of Basin Floor ($A_{FLOOR}$) = | user | $ft^2$ |
| Volume of Basin Floor ($V_{FLOOR}$) = | user | $ft^3$ |
| Depth of Main Basin ($H_{MAIN}$) = | user | ft |
| Length of Main Basin ($L_{MAIN}$) = | user | ft |
| Width of Main Basin ($W_{MAIN}$) = | user | ft |
| Area of Main Basin ($A_{MAIN}$) = | user | $ft^2$ |
| Volume of Main Basin ($V_{MAIN}$) = | user | $ft^3$ |
| Calculated Total Basin Volume ($V_{total}$) = | **user** | acre-feet |

Depth Increment = ft

| Stage - Storage Description | Stage (ft) | Optional Override Stage (ft) | Length (ft) | Width (ft) | Area ($ft^2$) | Optional Override Area ($ft^2$) | Area (acre) | Volume ($ft^3$) | Volume (ac-ft) |
|---|---|---|---|---|---|---|---|---|---|
| **Media Surface** | -- | 0.00 | -- | -- | -- | 0 | 0.000 | | |
| | -- | 0.10 | -- | -- | -- | 2 | 0.000 | 0 | 0.000 |
| | -- | 0.20 | -- | -- | -- | 8 | 0.000 | 1 | 0.000 |
| | -- | 0.30 | -- | -- | -- | 18 | 0.000 | 2 | 0.000 |
| | -- | 0.40 | -- | -- | -- | 32 | 0.001 | 4 | 0.000 |
| | -- | 0.50 | -- | -- | -- | 52 | 0.001 | 9 | 0.000 |
| | -- | 0.60 | -- | -- | -- | 75 | 0.002 | 15 | 0.000 |
| | -- | 0.70 | -- | -- | -- | 105 | 0.002 | 24 | 0.001 |
| | -- | 0.80 | -- | -- | -- | 147 | 0.003 | 37 | 0.001 |
| | -- | 0.90 | -- | -- | -- | 263 | 0.006 | 57 | 0.001 |
| | -- | 1.00 | -- | -- | -- | 538 | 0.012 | 97 | 0.002 |
| | -- | 1.10 | -- | -- | -- | 1,054 | 0.024 | 177 | 0.004 |
| | -- | 1.20 | -- | -- | -- | 1,725 | 0.040 | 316 | 0.007 |
| | -- | 1.30 | -- | -- | -- | 2,573 | 0.059 | 530 | 0.012 |
| | -- | 1.40 | -- | -- | -- | 3,667 | 0.084 | 842 | 0.019 |
| | -- | 1.50 | -- | -- | -- | 4,735 | 0.109 | 1,263 | 0.029 |
| | -- | 1.60 | -- | -- | -- | 5,402 | 0.124 | 1,769 | 0.041 |
| | -- | | -- | -- | -- | | | | |
| | -- | | -- | -- | -- | | | | |
| | -- | | -- | -- | -- | | | |

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

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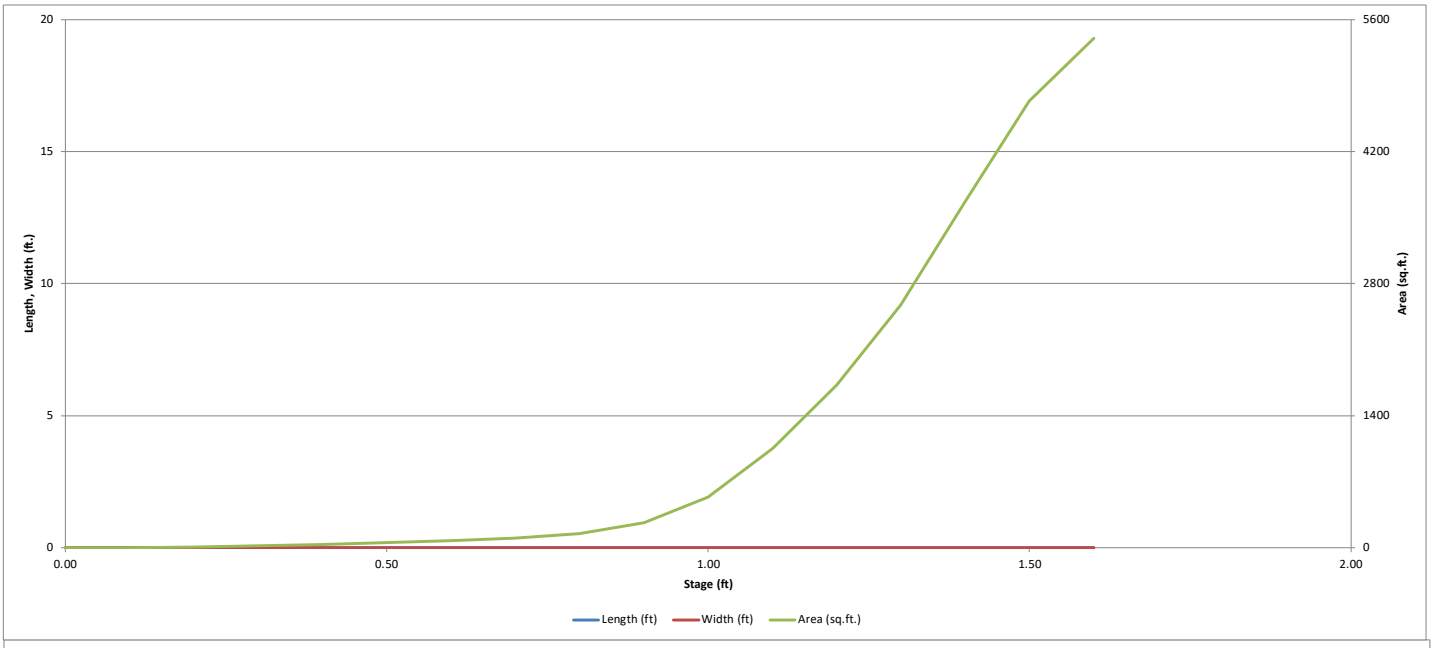


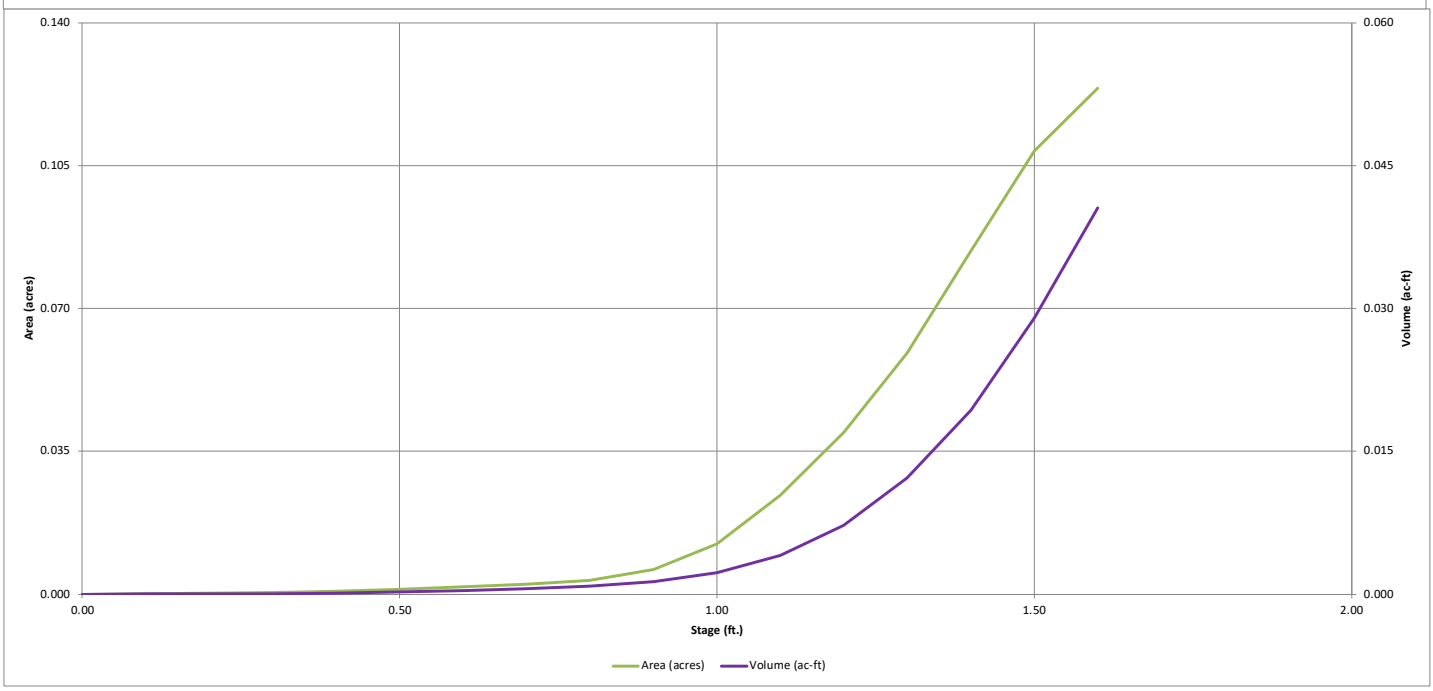

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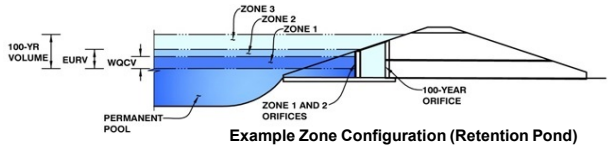
*MHFD-Detention, Version 4.06 (July 2022)*

**Project: Solar Decathlon Village-Amendment**

**Basin ID: Parking Lot Detention**




**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (User) | 1.21 | 0.008 | Filtration Media |
| Zone 2 (User) | 1.43 | 0.014 | Weir&Pipe (Circular) |
| Zone 3 (User) | 1.60 | 0.019 | Weir&Pipe (Circular) |
| Total (all zones) | | 0.041 | |

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

| | | | | | |
|---|---|---|---|---|---|
| Underdrain Orifice Invert Depth = | 1.50 | ft (distance below the filtration media surface) | Underdrain Orifice Area = | 0.0 | ft² |
| Underdrain Orifice Diameter = | 0.35 | inches | Underdrain Orifice Centroid = | 0.01 | feet |

Calculated Parameters for Underdrain

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

| | | | | | |
|---|---|---|---|---|---|
| Centroid of Lowest Orifice = | N/A | ft (relative to basin bottom at Stage = 0 ft) | WQ Orifice Area per Row = | N/A | ft² |
| Depth at top of Zone using Orifice Plate = | N/A | ft (relative to basin bottom at Stage = 0 ft) | Elliptical Half-Width = | N/A | feet |
| Orifice Plate: Orifice Vertical Spacing = | N/A | inches | Elliptical Slot Centroid = | N/A | feet |
| Orifice Plate: Orifice Area per Row = | N/A | sq. inches | Elliptical Slot Area = | N/A | ft² |

Calculated Parameters for Plate

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

| | Row 1 (optional) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (optional) |
|---|---|---|---|---|---|---|---|---|
| Stage of Orifice Centroid (ft) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Orifice Area (sq. inches) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orif

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

| | Zone 2 Weir | Zone 3 Weir | | | Zone 2 Weir | Zone 3 Weir |
|---|---|---|---|---|---|---|
| Overflow Weir Front Edge Height, Ho = | 1.25 | 1.45 | ft (relative to basin bottom at Stage = 0 ft) | Height of Grate Upper Edge, $H_t$ = | 1.25 | 1.45 |
| Overflow Weir Front Edge Length = | 1.50 | 1.50 | feet | Overflow Weir Slope Length = | 1.50 | 1.50 |
| Overflow Weir Grate Slope = | 0.00 | 0.00 | H:V | Grate Open Area / 100-yr Orifice Area = | 287.12 | 56.72 |
| Horiz. Length of Weir Sides = | 1.50 | 1.50 | feet | Overflow Grate Open Area w/o Debris = | 1.57 | 1.57 |
| Overflow Grate Type = | Type C Grate | Type C Grate | | Overflow Grate Open Area w/ Debris = | 0.78 | 0.78 |
| Debris Clogging % = | 50% | 50% | % | | | |

Calculated Parameters for Overflow W

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

| | Zone 2 Circular | Zone 3 Circular | | | Zone 2 Circular | Zone 3 Circular |
|---|---|---|---|---|---|---|
| Depth to Invert of Outlet Pipe = | 1.50 | 1.57 | ft (distance below basin bottom at Stage = 0 ft) | Outlet Orifice Area = | 0.01 | 0.03 |
| Circular Orifice Diameter = | 1.00 | 2.25 | inches | Outlet Orifice Centroid = | 0.04 | 0.09 |
| | | | | Half-Central Angle of Restrictor Plate on Pipe = | N/A | N/A |

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway

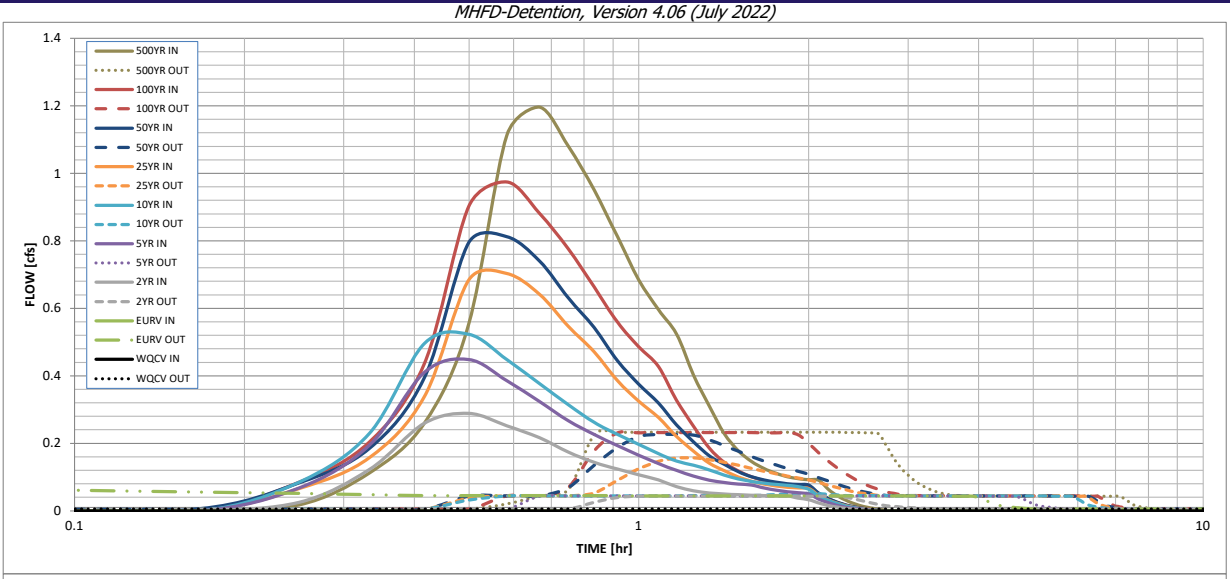
Routed Hydrograph Results

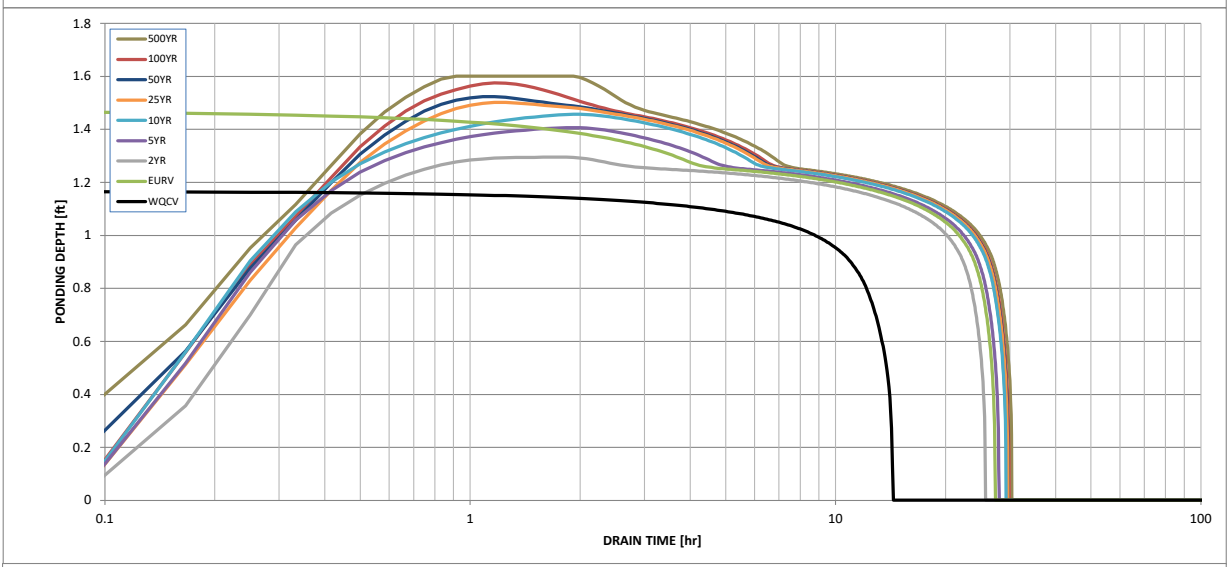
*The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI*

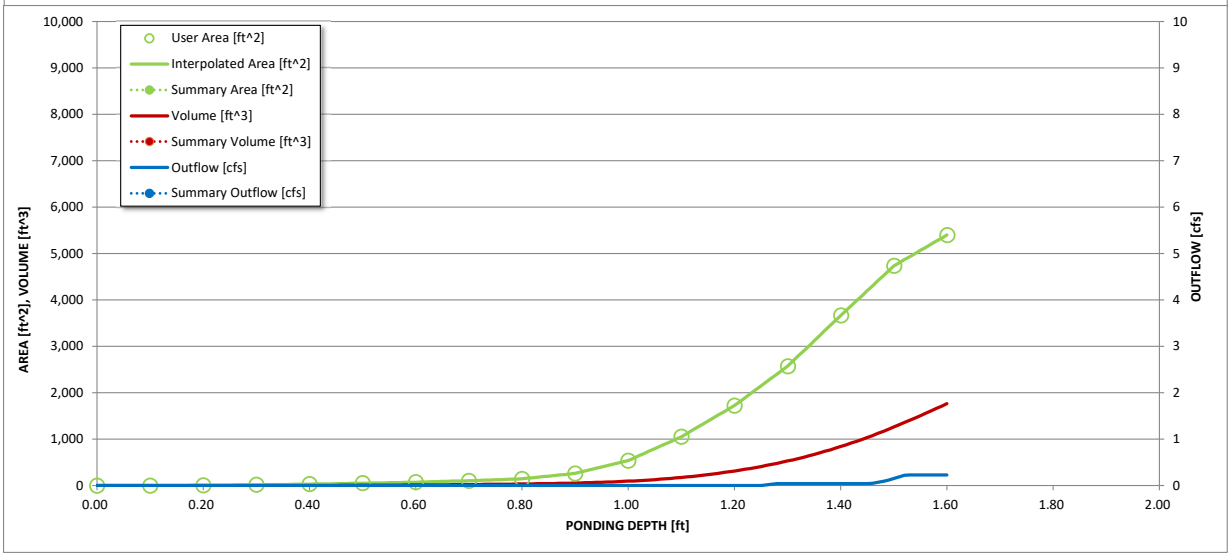
| Design Storm Return Period = | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year |
|---|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth (in) = | N/A | N/A | 0.95 | 1.38 | 1.61 | 2.00 | 2.27 | 2.60 |
| CUHP Runoff Volume (acre-ft) = | 0.006 | 0.026 | 0.017 | 0.026 | 0.031 | 0.041 | 0.047 | 0.056 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 0.017 | 0.026 | 0.031 | 0.041 | 0.047 | 0.056 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.000 | 0.053 | 0.089 | 0.212 | 0.272 | 0.358 |
| OPTIONAL Override Predevelopment Peak Q (cfs) = | N/A | N/A | | | | | | |
| Predevelopment Unit Peak Flow, q (cfs/acre) = | N/A | N/A | 0.000 | 0.184 | 0.308 | 0.732 | 0.937 | 1.235 |
| Peak Inflow Q (cfs) = | N/A | N/A | 0.288 | 0.448 | 0.523 | 0.703 | 0.812 | 0.975 |
| Peak Outflow Q (cfs) = | 0.005 | 0.071 | 0.044 | 0.044 | 0.051 | 0.157 | 0.226 | 0.232 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 0.835 | 0.576 | 0.738 | 0.832 | 0.649 |
| Structure Controlling Flow = | Filtration Media | Overflow Weir 2 | Outlet Plate 1 | Outlet Plate 1 | Overflow Weir 2 | Overflow Weir 2 | Outlet Plate 2 | Outlet Plate 2 |
| Max Velocity through Grate 1 (fps) = | N/A | 0.03 | 0.02 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Max Velocity through Grate 2 (fps) = | N/A | 0.03 | N/A | N/A | 0.0 | 0.1 | 0.1 | 0.1 |
| Time to Drain 97% of Inflow Volume (hours) = | 14 | 25 | 24 | 26 | 27 | 27 | 26 | 26 |
| Time to Drain 99% of Inflow Volume (hours) = | **14** | 27 | 25 | 27 | 29 | 29 | 29 | 28 |
| Maximum Ponding Depth (ft) = | 1.17 | 1.48 | 1.29 | 1.41 | 1.46 | 1.50 | 1.52 | 1.57 |
| Area at Maximum Ponding Depth (acres) = | 0.03 | 0.10 | 0.06 | 0.08 | 0.10 | 0.11 | 0.11 | 0.12 |
| Maximum Volume Stored (acre-ft) = | 0.006 | 0.027 | 0.012 | 0.019 | 0.024 | 0.029 | 0.031 | 0.037 |

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*



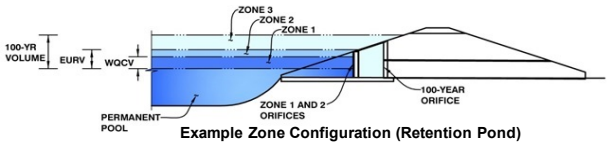

| S-A-V-D Chart Axis Override | X-axis | Left Y-Axis | Right Y-Axis |
|---|---|---|---|
| minimum bound | | | |
| maximum bound | | | |

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.06 (July 2022)*

**Project:** **Solar Decathlon Village-Amendment**

**Basin ID:** **Rain Garden - A1**




**Example Zone Configuration (Retention Pond)**

## Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | **RG** | |
| Watershed Area = | 0.10 | acres |
| Watershed Length = | 100 | ft |
| Watershed Length to Centroid = | 50 | ft |
| Watershed Slope = | 0.010 | ft/ft |
| Watershed Imperviousness = | 28.00% | 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 WQCV 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 | |
|---|---|---|---|---|
| Water Quality Capture Volume (WQCV) = | 0.001 | acre-feet | | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 0.003 | acre-feet | | acre-feet |
| 2-yr Runoff Volume (P1 = 0.95 in.) = | 0.002 | acre-feet | 0.95 | inches |
| 5-yr Runoff Volume (P1 = 1.38 in.) = | 0.004 | acre-feet | 1.38 | inches |
| 10-yr Runoff Volume (P1 = 1.61 in.) = | 0.005 | acre-feet | 1.61 | inches |
| 25-yr Runoff Volume (P1 = [illegible] in.) = | | | | inches |
| 50-yr Runoff V | | | | inches |
| 100-yr Runoff | | | | inches |
| 500-yr Runoff V | | | | inches |
| Approximate | | | | |
| Approximate 5-yr Detention Volume = | 0.003 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 0.004 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 0.005 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 0.005 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 0.007 | acre-feet | | |

CUHP not used - Volumes calclated in accordance with Section 6.33 of COA SDDTCM.

## Define Zones and Basin Geometry

| | | |
|---|---|---|
| Select Zone 1 Storage Volume (Required) = | 0.001 | acre-feet |
| Select Zone 2 Storage Volume (Optional) = | | acre-feet |
| Select Zone 3 Storage Volume (Optional) = | | acre-feet |
| Total Detention Basin Volume = | 0.001 | acre-feet |
| Initial Surcharge Volume (ISV) = | N/A | $ft^3$ |
| Initial Surcharge Depth (ISD) = | N/A | ft |
| Total Available Detention Depth ($H_{total}$) = | user | ft |
| Depth of Trickle Channel ($H_{TC}$) = | N/A | ft |
| Slope of Trickle Channel ($S_{TC}$) = | N/A | ft/ft |
| Slopes of Main Basin Sides ($S_{main}$) = | user | H:V |
| Basin Length-to-Width Ratio ($R_{L/W}$) = | user | |

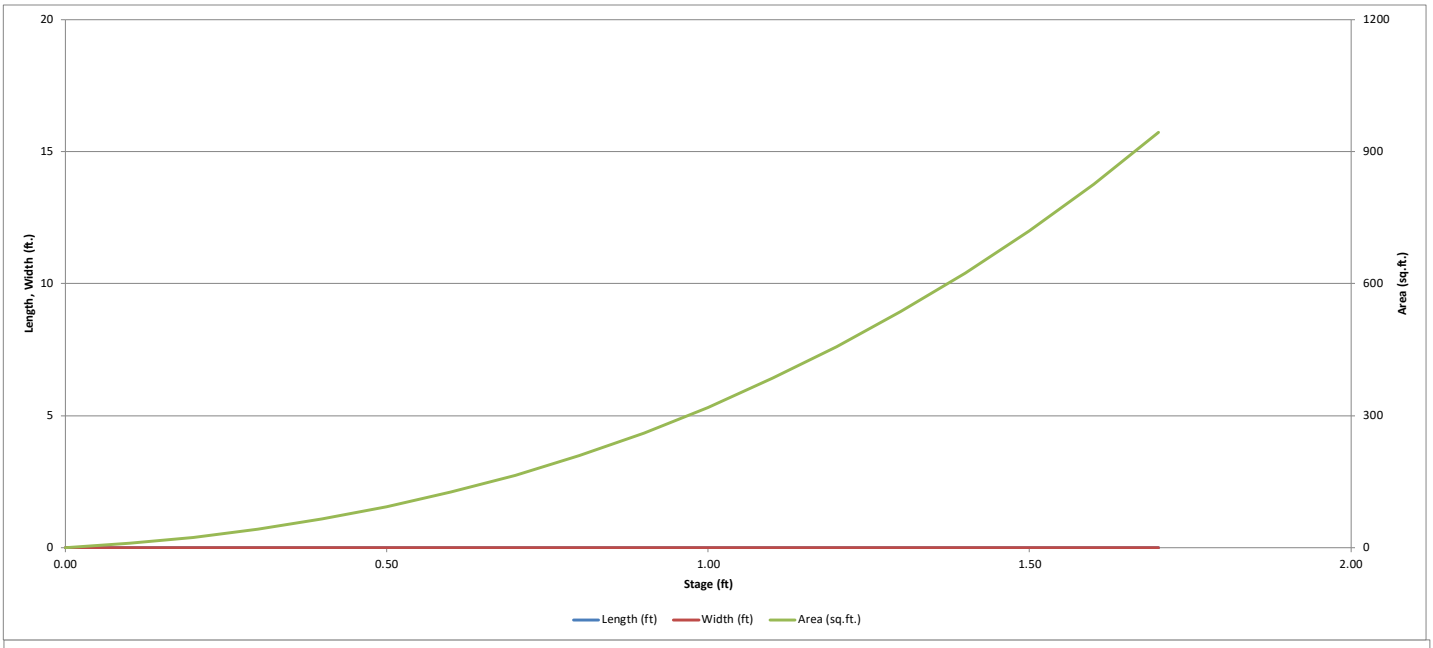
| | | |
|---|---|---|
| Initial Surcharge Area ($A_{ISV}$) = | user | $ft^2$ |
| Surcharge Volume Length ($L_{ISV}$) = | user | ft |
| Surcharge Volume Width ($W_{ISV}$) = | user | ft |
| Depth of Basin Floor ($H_{FLOOR}$) = | user | ft |
| Length of Basin Floor ($L_{FLOOR}$) = | user | ft |
| Width of Basin Floor ($W_{FLOOR}$) = | user | ft |
| Area of Basin Floor ($A_{FLOOR}$) = | user | $ft^2$ |
| Volume of Basin Floor ($V_{FLOOR}$) = | user | $ft^3$ |
| Depth of Main Basin ($H_{MAIN}$) = | user | ft |
| Length of Main Basin ($L_{MAIN}$) = | user | ft |
| Width of Main Basin ($W_{MAIN}$) = | user | ft |
| Area of Main Basin ($A_{MAIN}$) = | user | $ft^2$ |
| Volume of Main Basin ($V_{MAIN}$) = | user | $ft^3$ |
| Calculated Total Basin Volume ($V_{total}$) = | **user** | acre-feet |

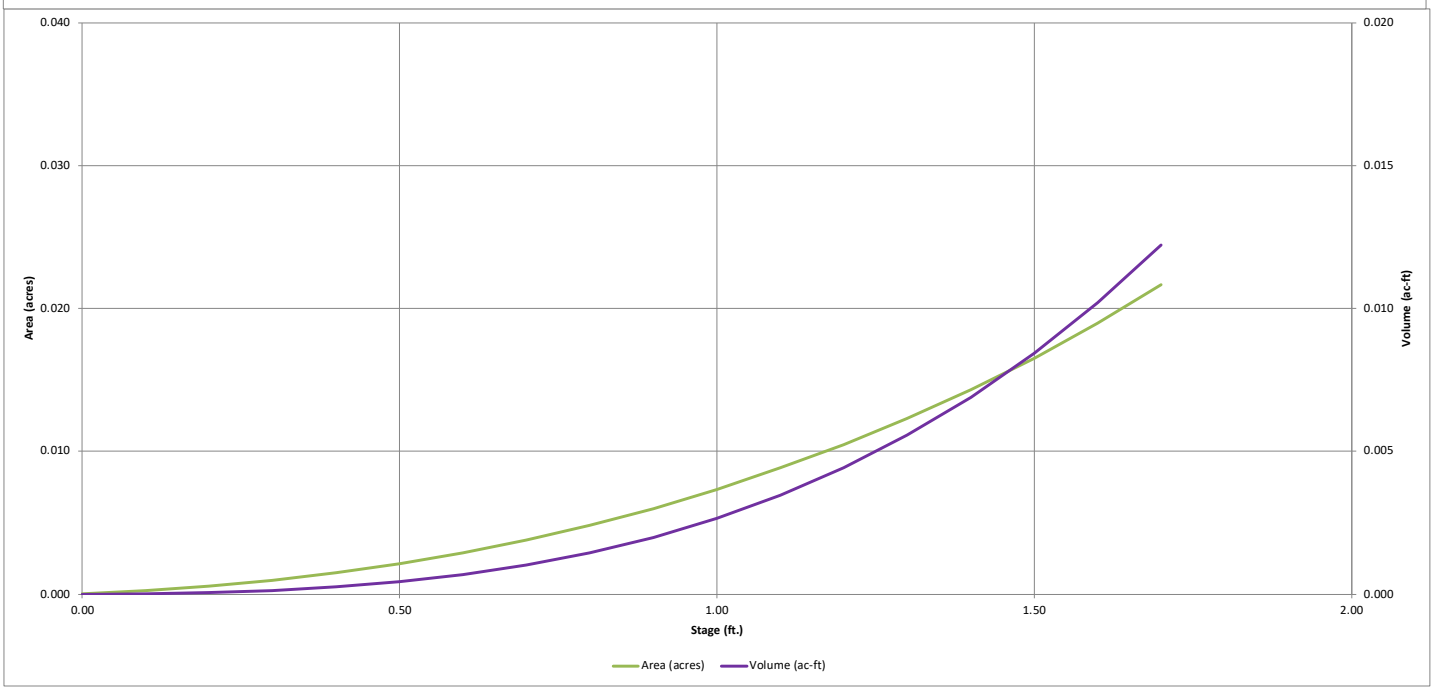
Depth Increment = ft

| Stage - Storage Description | Stage (ft) | Optional Override Stage (ft) | Length (ft) | Width (ft) | Area ($ft^2$) | Optional Override Area ($ft^2$) | Area (acre) | Volume ($ft^3$) | Volume (ac-ft) |
|---|---|---|---|---|---|---|---|---|---|
| **Media Surface** | -- | 0.00 | -- | -- | -- | 1 | 0.000 | | |
| | -- | 0.10 | -- | -- | -- | 10 | 0.000 | 1 | 0.000 |
| | -- | 0.20 | -- | -- | -- | 24 | 0.001 | 2 | 0.000 |
| | -- | 0.30 | -- | -- | -- | 42 | 0.001 | 6 | 0.000 |
| | -- | 0.40 | -- | -- | -- | 65 | 0.001 | 11 | 0.000 |
| | -- | 0.50 | -- | -- | -- | 93 | 0.002 | 19 | 0.000 |
| | -- | 0.60 | -- | -- | -- | 126 | 0.003 | 30 | 0.001 |
| | -- | 0.70 | -- | -- | -- | 165 | 0.004 | 44 | 0.001 |
| | -- | 0.80 | -- | -- | -- | 209 | 0.005 | 63 | 0.001 |
| | -- | 0.90 | -- | -- | -- | 260 | 0.006 | 86 | 0.002 |
| | -- | 1.00 | -- | -- | -- | 319 | 0.007 | 115 | 0.003 |
| | -- | 1.10 | -- | -- | -- | 385 | 0.009 | 151 | 0.003 |
| | -- | 1.20 | -- | -- | -- | 456 | 0.010 | 193 | 0.004 |
| | -- | 1.30 | -- | -- | -- | 536 | 0.012 | 242 | 0.006 |
| | -- | 1.40 | -- | -- | -- | 624 | 0.014 | 300 | 0.007 |
| | -- | 1.50 | -- | -- | -- | 720 | 0.017 | 367 | 0.008 |
| | -- | 1.60 | -- | -- | -- | 826 | 0.019 | 445 | 0.010 |
| | -- | 1.70 | -- | -- | -- | 944 | 0.022 | 533 | 0.012 |
| | -- | | -- | -- | -- | | | | |
| | -- | | -- | -- | -- | | | | |
| | -- | | -- | -- | -- | | | |

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.06 (July 2022)*



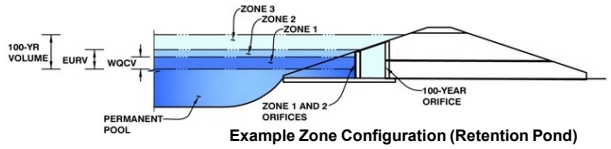



# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*

**Project: Solar Decathlon Village-Amendment**

**Basin ID: Rain Garden - A1**




**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 | 0.73 | 0.001 | Filtration Media |
| Zone 2 | | | |
| Zone 3 | | | |
| Total (all zones) | | 0.001 | |

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

| | | | | | |
|---|---|---|---|---|---|
| Underdrain Orifice Invert Depth = | 1.50 | ft (distance below the filtration media surface) | Underdrain Orifice Area = | 0.0 | ft² |
| Underdrain Orifice Diameter = | 0.20 | inches | Underdrain Orifice Centroid = | 0.01 | feet |

Calculated Parameters for Underdrain

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

| | | | | | |
|---|---|---|---|---|---|
| Centroid of Lowest Orifice = | | ft (relative to basin bottom at Stage = 0 ft) | WQ Orifice Area per Row = | N/A | ft² |
| Depth at top of Zone using Orifice Plate = | | ft (relative to basin bottom at Stage = 0 ft) | Elliptical Half-Width = | N/A | feet |
| Orifice Plate: Orifice Vertical Spacing = | | inches | Elliptical Slot Centroid = | N/A | feet |
| Orifice Plate: Orifice Area per Row = | | sq. inches | Elliptical Slot Area = | N/A | ft² |

Calculated Parameters for Plate

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) | | | | | | | | |
| Orifice Area (sq. inches) | | | | | | | | |

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

User Input: Vertical Orifice (Circular or Rectangular)

| | Not Selected | Not Selected | | | Not Selected | Not Selected |
|---|---|---|---|---|---|---|
| Invert of Vertical Orifice = | | | ft (relative to basin bottom at Stage = 0 ft) | Vertical Orifice Area = | | |
| Depth at top of Zone using Vertical Orifice = | | | ft (relative to basin bottom at Stage = 0 ft) | Vertical Orifice Centroid = | | |
| Vertical Orifice Diameter = | | | inches | | | |

Calculated Parameters for Vertical Orif

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

| | Not Selected | Not Selected | | | Not Selected | Not Selected |
|---|---|---|---|---|---|---|
| Overflow Weir Front Edge Height, Ho = | | | ft (relative to basin bottom at Stage = 0 ft) | Height of Grate Upper Edge, $H_t$ = | | |
| Overflow Weir Front Edge Length = | | | feet | Overflow Weir Slope Length = | | |
| Overflow Weir Grate Slope = | | | H:V | Grate Open Area / 100-yr Orifice Area = | | |
| Horiz. Length of Weir Sides = | | | feet | Overflow Grate Open Area w/o Debris = | | |
| Overflow Grate Type = | | | | Overflow Grate Open Area w/ Debris = | | |
| Debris Clogging % = | | | % | | | |

Calculated Parameters for Overflow W

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

| | Not Selected | Not Selected | | | Not Selected | Not Selected |
|---|---|---|---|---|---|---|
| Depth to Invert of Outlet Pipe = | | | ft (distance below basin bottom at Stage = 0 ft) | Outlet Orifice Area = | | |
| Circular Orifice Diameter = | | | inches | Outlet Orifice Centroid = | | |
| | | | | Half-Central Angle of Restrictor Plate on Pipe = | N/A | N/A |

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway

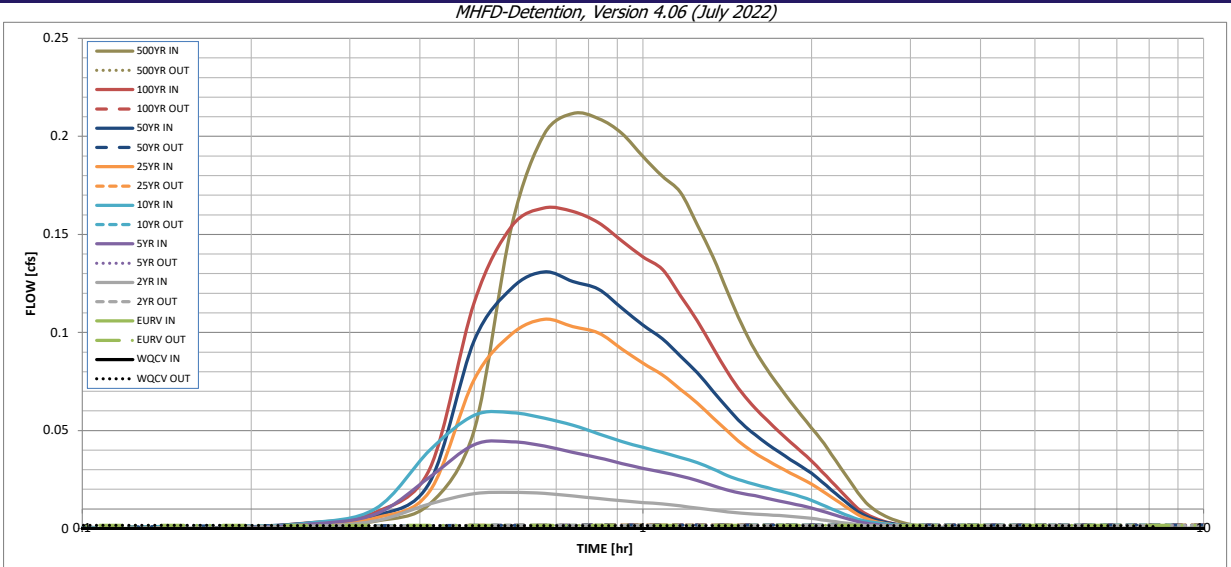
Routed Hydrograph Results

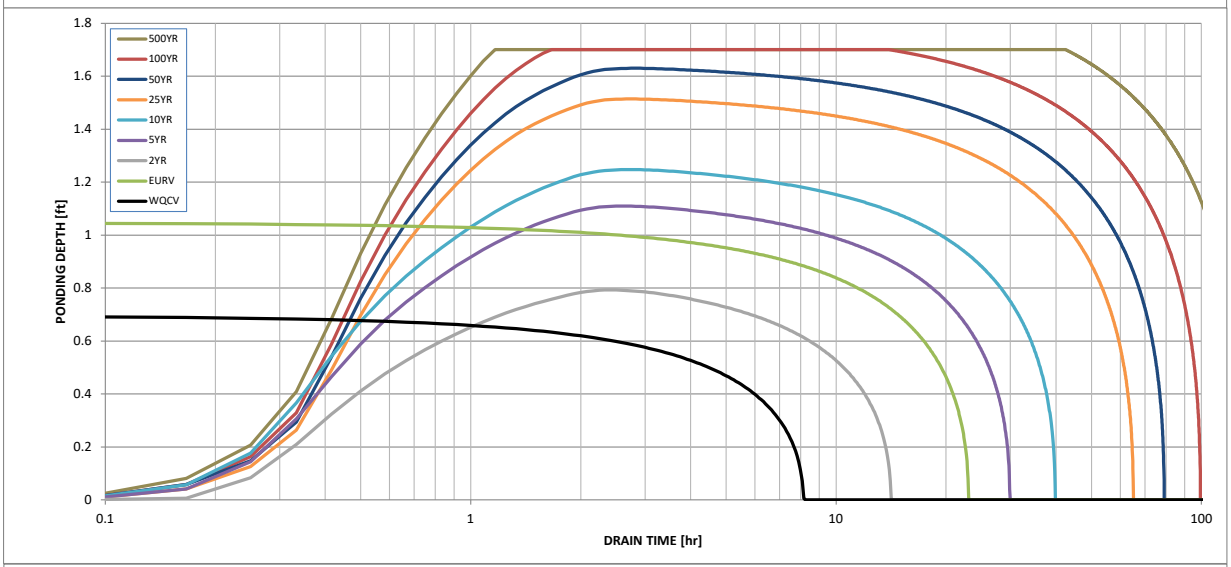
*The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AI*

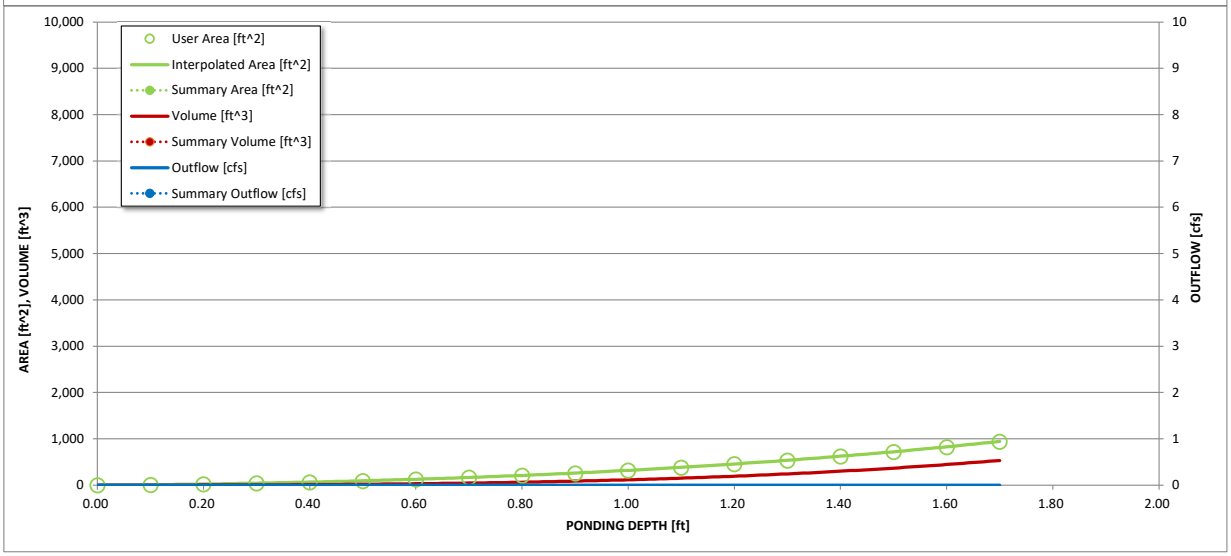
| Design Storm Return Period = | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year |
|---|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth (in) = | N/A | N/A | 0.95 | 1.38 | 1.61 | 2.00 | 2.27 | 2.60 |
| CUHP Runoff Volume (acre-ft) = | 0.001 | 0.003 | 0.002 | 0.004 | 0.005 | 0.009 | 0.011 | 0.014 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 0.002 | 0.004 | 0.005 | 0.009 | 0.011 | 0.014 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.000 | 0.018 | 0.030 | 0.071 | 0.091 | 0.121 |
| OPTIONAL Override Predevelopment Peak Q (cfs) = | N/A | N/A | | | | | | |
| Predevelopment Unit Peak Flow, q (cfs/acre) = | N/A | N/A | 0.000 | 0.179 | 0.300 | 0.713 | 0.913 | 1.208 |
| Peak Inflow Q (cfs) = | N/A | N/A | 0.018 | 0.044 | 0.059 | 0.107 | 0.131 | 0.163 |
| Peak Outflow Q (cfs) = | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 0.095 | 0.058 | 0.026 | 0.020 | 0.016 |
| Structure Controlling Flow = | Filtration Media | Filtration Media | Filtration Media | Filtration Media | Filtration Media | Filtration Media | Filtration Media | N/A |
| Max Velocity through Grate 1 (fps) = | 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 |
| Time to Drain 97% of Inflow Volume (hours) = | 8 | 22 | 14 | 29 | 39 | 63 | 76 | 96 |
| Time to Drain 99% of Inflow Volume (hours) = | 8 | 23 | 14 | 30 | 39 | 64 | 78 | 98 |
| Maximum Ponding Depth (ft) = | 0.70 | 1.05 | 0.79 | 1.11 | 1.25 | 1.51 | 1.63 | 1.70 |
| Area at Maximum Ponding Depth (acres) = | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.02 | 0.02 | 0.02 |
| Maximum Volume Stored (acre-ft) = | 0.001 | 0.003 | 0.001 | 0.003 | 0.005 | 0.009 | 0.011 | 0.012 |

# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*



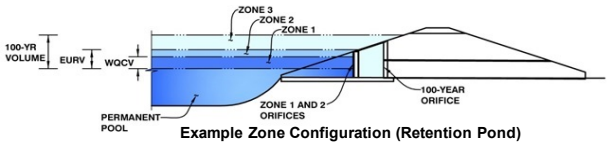

| S-A-V-D Chart Axis Override | X-axis | Left Y-Axis | Right Y-Axis |
|---|---|---|---|
| minimum bound | | | |
| maximum bound | | | |

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.06 (July 2022)*

**Project:** **Solar Decathlon Village-Amendment**

**Basin ID:** **Rain Garden - A3**




**Example Zone Configuration (Retention Pond)**

## Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | **RG** | |
| Watershed Area = | 0.04 | acres |
| Watershed Length = | 50 | ft |
| Watershed Length to Centroid = | 20 | ft |
| Watershed Slope = | 0.010 | ft/ft |
| Watershed Imperviousness = | 43.70% | 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 WQCV 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 |
|---|---|---|---|
| Water Quality Capture Volume (WQCV) = | 0.001 | acre-feet | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 0.002 | acre-feet | acre-feet |
| 2-yr Runoff Volume (P1 = 0.95 in.) = | 0.001 | acre-feet | 0.95 inches |
| 5-yr Runoff Volume (P1 = 1.38 in.) = | 0.002 | acre-feet | 1.38 inches |
| 10-yr Runoff Volume (P1 = 1.61 in.) = | 0.003 | acre-feet | 1.61 inches |
| 25-yr Runoff Volume (P1 = [illegible] in.) = | [illegible] | acre-feet | [illegible] inches |
| 50-yr Runoff V | | | inches |
| 100-yr Runoff | | | inches |
| 500-yr Runoff V | | | inches |
| Approximate | | | |
| Approximate 5-yr Detention Volume = | 0.002 | acre-feet | |
| Approximate 10-yr Detention Volume = | 0.002 | acre-feet | |
| Approximate 25-yr Detention Volume = | 0.003 | acre-feet | |
| Approximate 50-yr Detention Volume = | 0.003 | acre-feet | |
| Approximate 100-yr Detention Volume = | 0.004 | acre-feet | |

CUHP not used - Volumes calclated in accordance with Section 6.33 of COA SDDTCM.

## Define Zones and Basin Geometry

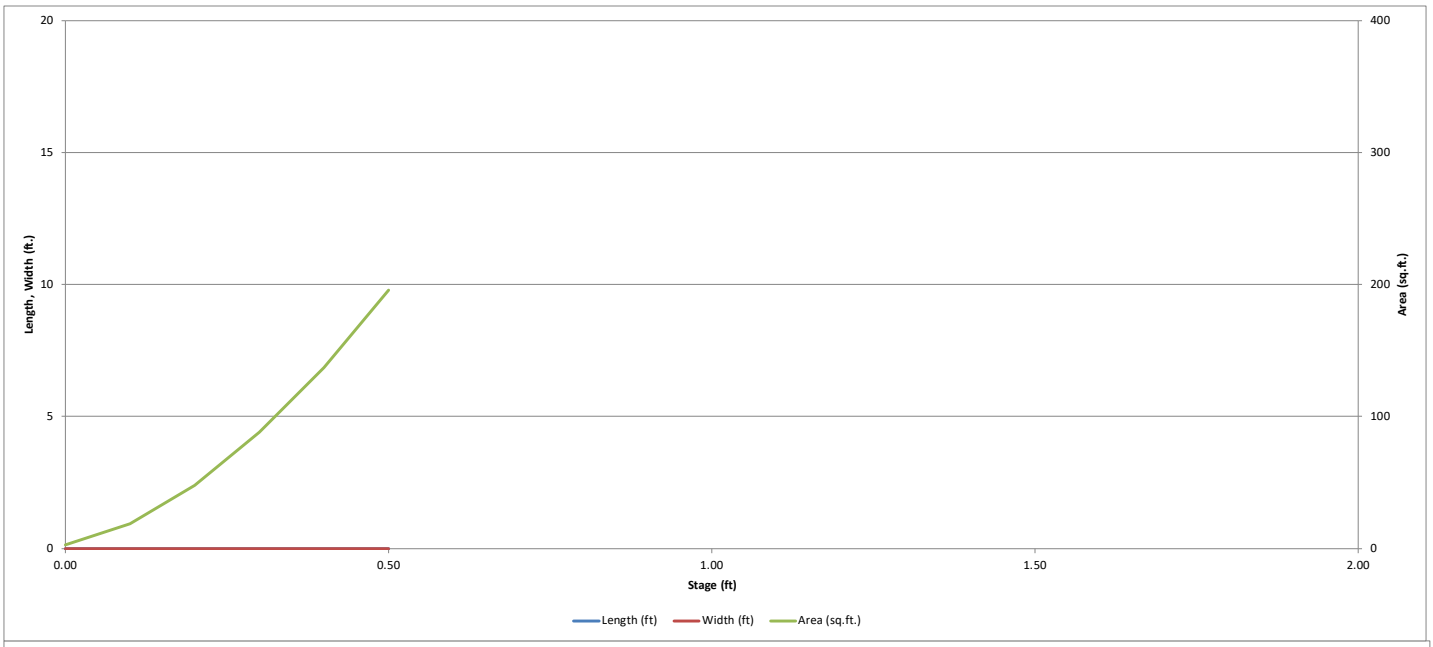
| | | |
|---|---|---|
| Select Zone 1 Storage Volume (Required) = | 0.001 | acre-feet |
| Select Zone 2 Storage Volume (Optional) = | | acre-feet |
| Select Zone 3 Storage Volume (Optional) = | | acre-feet |
| Total Detention Basin Volume = | 0.001 | acre-feet |
| Initial Surcharge Volume (ISV) = | N/A | $ft^3$ |
| Initial Surcharge Depth (ISD) = | N/A | ft |
| Total Available Detention Depth ($H_{total}$) = | user | ft |
| Depth of Trickle Channel ($H_{TC}$) = | N/A | ft |
| Slope of Trickle Channel ($S_{TC}$) = | N/A | ft/ft |
| Slopes of Main Basin Sides ($S_{main}$) = | user | H:V |
| Basin Length-to-Width Ratio ($R_{L/W}$) = | user | |
| Initial Surcharge Area ($A_{ISV}$) = | user | $ft^2$ |
| Surcharge Volume Length ($L_{ISV}$) = | user | ft |
| Surcharge Volume Width ($W_{ISV}$) = | user | ft |
| Depth of Basin Floor ($H_{FLOOR}$) = | user | ft |
| Length of Basin Floor ($L_{FLOOR}$) = | user | ft |
| Width of Basin Floor ($W_{FLOOR}$) = | user | ft |
| Area of Basin Floor ($A_{FLOOR}$) = | user | $ft^2$ |
| Volume of Basin Floor ($V_{FLOOR}$) = | user | $ft^3$ |
| Depth of Main Basin ($H_{MAIN}$) = | user | ft |
| Length of Main Basin ($L_{MAIN}$) = | user | ft |
| Width of Main Basin ($W_{MAIN}$) = | user | ft |
| Area of Main Basin ($A_{MAIN}$) = | user | $ft^2$ |
| Volume of Main Basin ($V_{MAIN}$) = | user | $ft^3$ |
| Calculated Total Basin Volume ($V_{total}$) = | **user** | acre-feet |

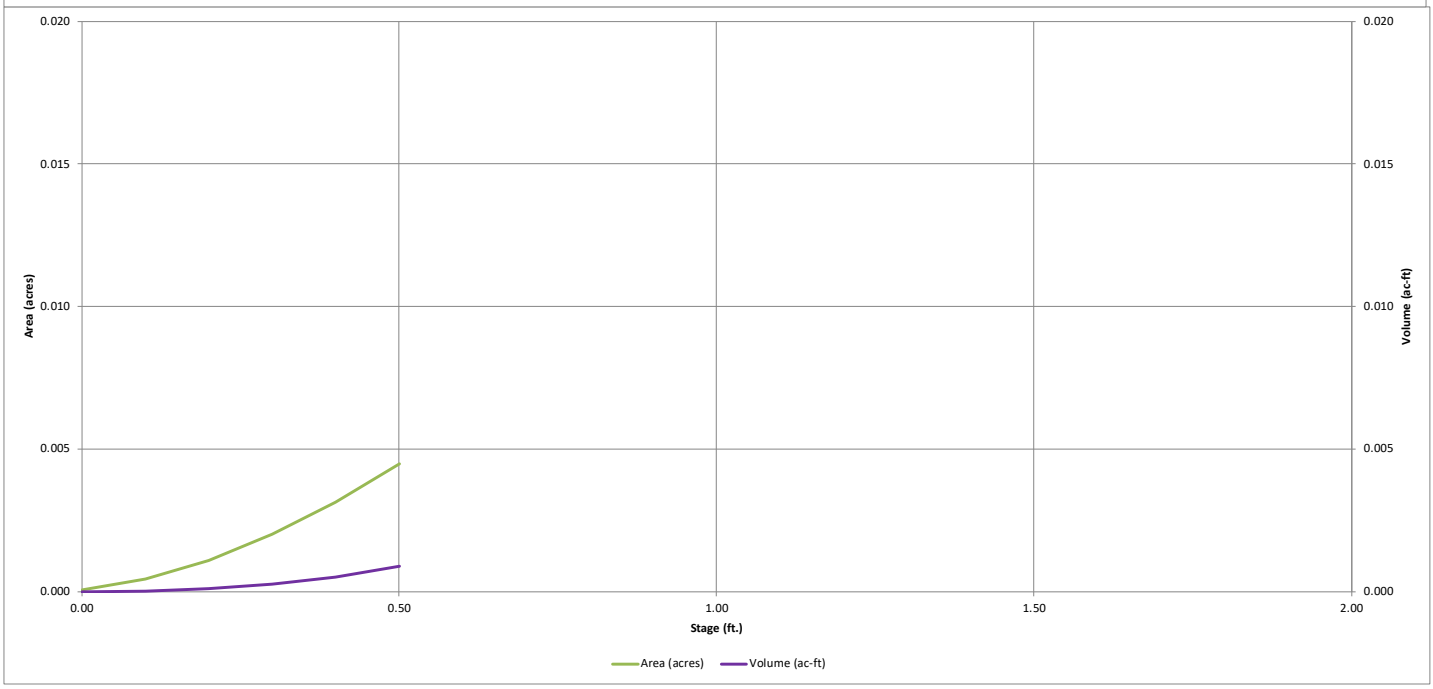
Depth Increment = ft

| Stage - Storage Description | Stage (ft) | Optional Override Stage (ft) | Length (ft) | Width (ft) | Area ($ft^2$) | Optional Override Area ($ft^2$) | Area (acre) | Volume ($ft^3$) | Volume (ac-ft) |
|---|---|---|---|---|---|---|---|---|---|
| **Media Surface** | -- | 0.00 | -- | -- | -- | 3 | 0.000 | | |
| | -- | 0.10 | -- | -- | -- | 19 | 0.000 | 1 | 0.000 |
| | -- | 0.20 | -- | -- | -- | 48 | 0.001 | 4 | 0.000 |
| | -- | 0.30 | -- | -- | -- | 88 | 0.002 | 11 | 0.000 |
| | -- | 0.40 | -- | -- | -- | 137 | 0.003 | 22 | 0.001 |
| | -- | 0.50 | -- | -- | -- | 196 | 0.004 | 39 | 0.001 |

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.06 (July 2022)*



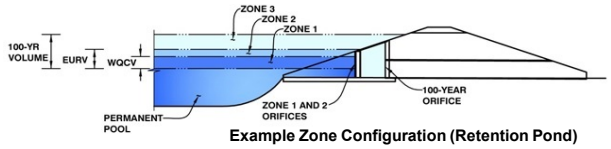



# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.06 (July 2022)*

**Project: Solar Decathlon Village-Amendment**

**Basin ID: Rain Garden - A3**




**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 | 0.46 | 0.001 | Filtration Media |
| Zone 2 | | | |
| Zone 3 | | | |
| Total (all zones) | | 0.001 | |

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

| | | | |
|---|---|---|---|
| Underdrain Orifice Invert Depth = | 1.50 | ft (distance below the filtration media surface) | |
| Underdrain Orifice Diameter = | 0.19 | inches | |

Calculated Parameters for Underdrain

| | | |
|---|---|---|
| Underdrain Orifice Area = | 0.0 | $ft^2$ |
| Underdrain Orifice Centroid = | 0.01 | 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)

| | | | |
|---|---|---|---|
| Centroid 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 | |

Calculated Parameters for Plate

| | | |
|---|---|---|
| WQ Orifice Area per Row = | N/A | $ft^2$ |
| Elliptical Half-Width = | N/A | feet |
| Elliptical Slot Centroid = | N/A | feet |
| Elliptical Slot Area = | N/A | $ft^2$ |

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

| | Row 1 (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) | | | | | | | | |
| Orifice Area (sq. inches) | | | | | | | | |

| | 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 = | | | 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 Orif

| | Not Selected | Not Selected |
|---|---|---|
| Vertical Orifice Area = | | |
| Vertical Orifice Centroid = | | |

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

| | Not Selected | Not Selected | |
|---|---|---|---|
| Overflow Weir Front Edge Height, Ho = | | | 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 Type = | | | |
| Debris Clogging % = | | | % |

Calculated Parameters for Overflow W

| | Not Selected | Not Selected |
|---|---|---|
| Height of Grate Upper Edge, $H_t$ = | | |
| Overflow Weir Slope Length = | | |
| Grate Open Area / 100-yr Orifice Area = | | |
| Overflow Grate Open Area w/o Debris = | | |
| Overflow Grate Open Area w/ Debris = | | |

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

| | Not Selected | Not Selected | |
|---|---|---|---|
| Depth to Invert of Outlet Pipe = | | | ft (distance below basin bottom at Stage = 0 ft) |
| Circular Orifice Diameter = | | | inches |

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

| | Not Selected | Not Selected |
|---|---|---|
| Outlet Orifice Area = | | |
| Outlet Orifice Centroid = | | |
| Half-Central Angle of Restrictor Plate on Pipe = | N/A | N/A |

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 Al*

| Design Storm Return Period = | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year |
|---|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth (in) = | N/A | N/A | 0.95 | 1.38 | 1.61 | 2.00 | 2.27 | 2.60 |
| CUHP Runoff Volume (acre-ft) = | 0.001 | 0.002 | 0.001 | 0.002 | 0.003 | 0.004 | 0.005 | 0.006 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 0.001 | 0.002 | 0.003 | 0.004 | 0.005 | 0.006 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 0.000 | 0.010 | 0.016 | 0.037 | 0.048 | 0.062 |
| OPTIONAL Override Predevelopment Peak Q (cfs) = | N/A | N/A | | | | | | |
| Predevelopment Unit Peak Flow, q (cfs/acre) = | N/A | N/A | 0.000 | 0.242 | 0.396 | 0.931 | 1.188 | 1.541 |
| Peak Inflow Q (cfs) = | N/A | N/A | 0.021 | 0.040 | 0.049 | 0.076 | 0.091 | 0.113 |
| Peak Outflow Q (cfs) = | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 0.138 | 0.085 | 0.036 | 0.028 | 0.022 |
| Structure Controlling Flow = | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Max Velocity through Grate 1 (fps) = | 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 |
| Time to Drain 97% of Inflow Volume (hours) = | 9 | 18 | 12 | 20 | 25 | 37 | 44 | 55 |
| Time to Drain 99% of Inflow Volume (hours) = | 9 | 18 | 12 | 20 | 25 | 38 | 45 | 56 |
| Maximum Ponding Depth (ft) = | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Area at Maximum Ponding Depth (acres) = | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Maximum Volume Stored (acre-ft) = | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |

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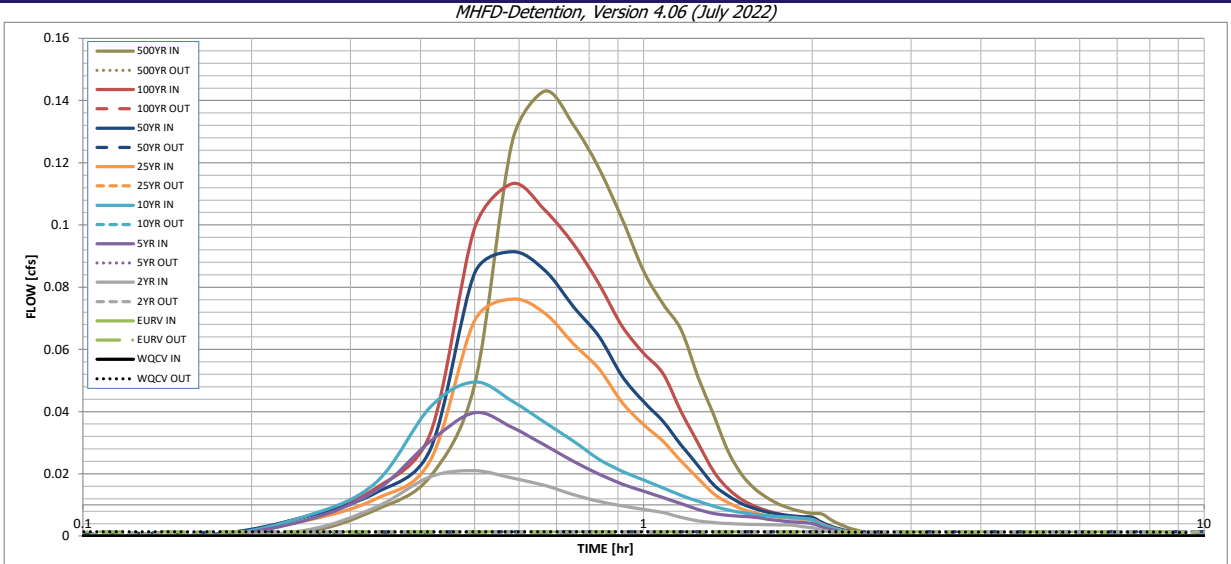


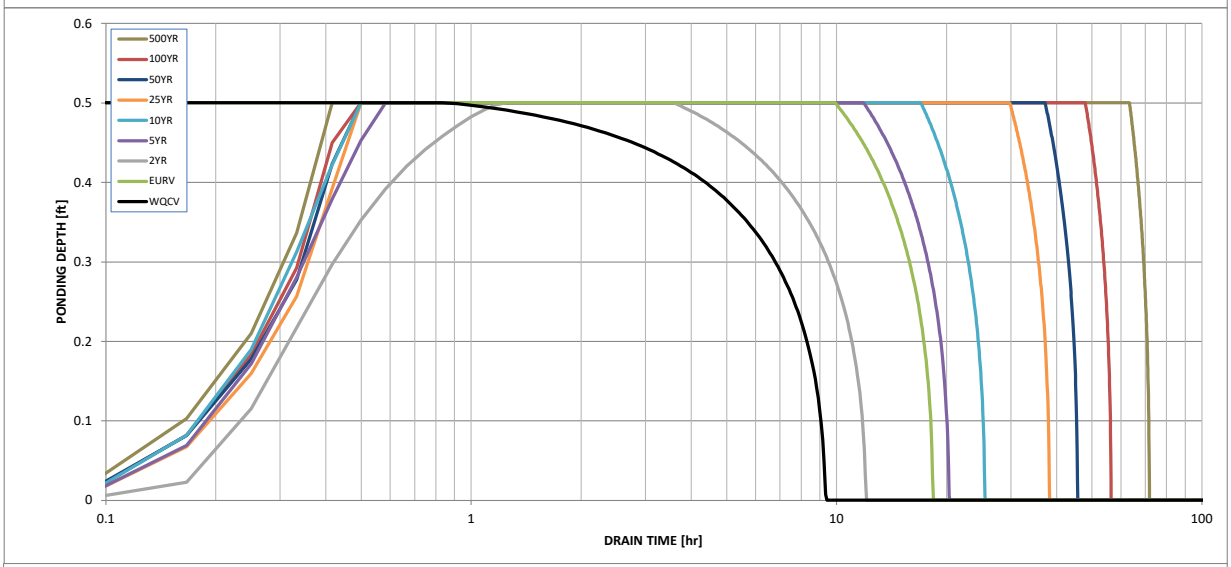


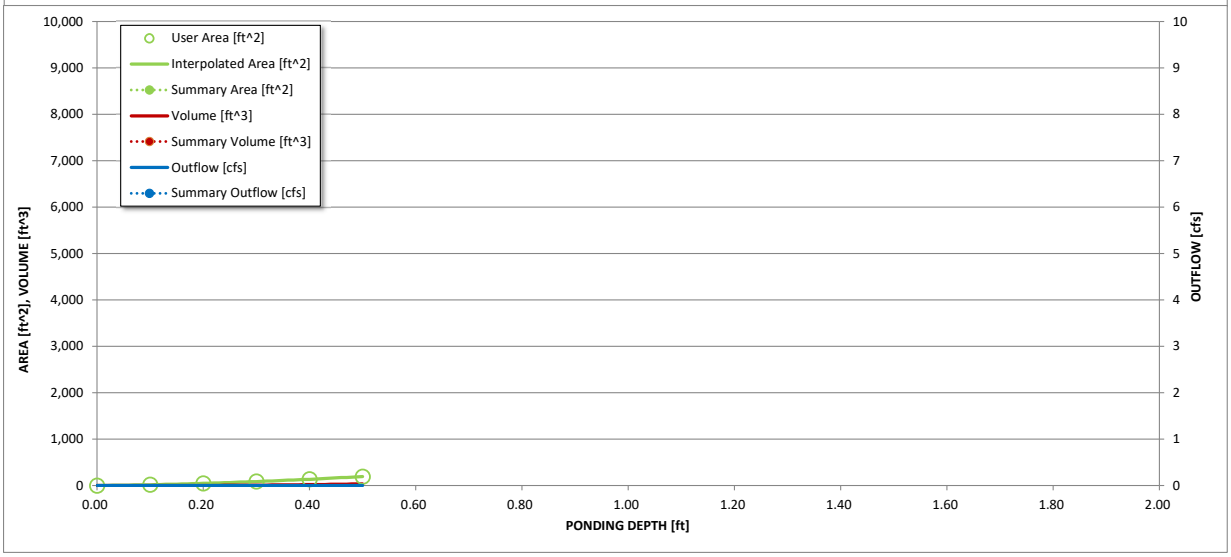


| S-A-V-D Chart Axis Override | X-axis | Left Y-Axis | Right Y-Axis |
|---|---|---|---|
| minimum bound | | | |
| maximum bound | | | |