CIVIL CONSULTANTS, INC.

March 28, 2024

El Paso County
Planning & Community Development
2880 International Circle, Suite 110
Colorado Springs, CO 80910

Attn.: Project Manager

RE: Paint Brush Hills Filing No. 13E
Private Detention/Stormwater Quality Pond 'D'

Dear Project Manager:

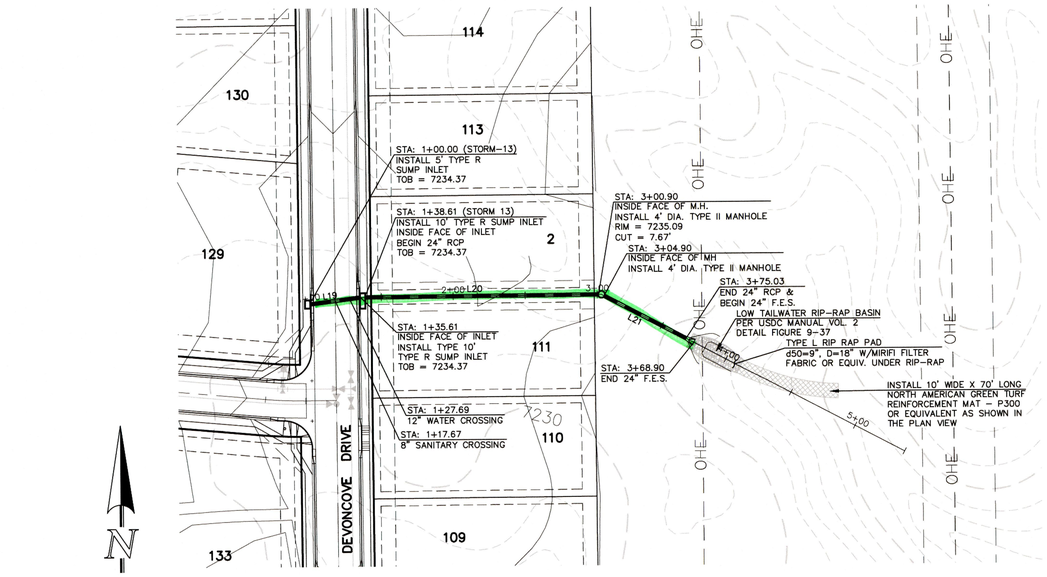
Per the approved construction drawings for "Paint Brush Hills Filing 13E" improvements were made to construct a water quality facility in compliance with the current El Paso County Drainage Criteria and with the approved Final Drainage Report for this project.

Based upon this information and periodic site visits to the project during significant/key phases of the stormwater BMP installation, M&S Civil Consultants, Inc. is of the opinion that the stormwater BMPs have been constructed in general compliance with the approved design plans, and specifications as filed with El Paso County.

Statement Of Engineer In Responsible Charge
To the best of my knowledge, information and belief, for the referenced project above, the improvements have been constructed in general compliance with the approved design plans and specifications as filed with El Paso County to provide the required storage volume and meet the required release rates documented by the SDI design form, the stage areas, elevations and outlet dimensions. In addition, to the best of my knowledge, information and belief, for the referenced project above, the site and adjacent properties (as affected by work performed under the County permit) are stable with respect to settlement and subsidence, sloughing of cut and fill slopes, revegetation or other ground cover, and that the improvements (public improvements, common development improvements, site grading and paving) meet or exceed the minimum design requirements.


Virgil A. Sanchez
Colorado P.E. No.37160
For and on behalf of M&S Civil
Consultants, Inc.

| STORM LINE TABLE | | |
|---|---|---|
| LINE | LENGTH | BEARING |
| L19 | 35.61' | N82°36'44"E |
| L20 | 162.27' | N89°37'00"E |
| L21 | 64.00' | S62°10'18"E |
| L22 | 26.67' | N18°52'36"E |

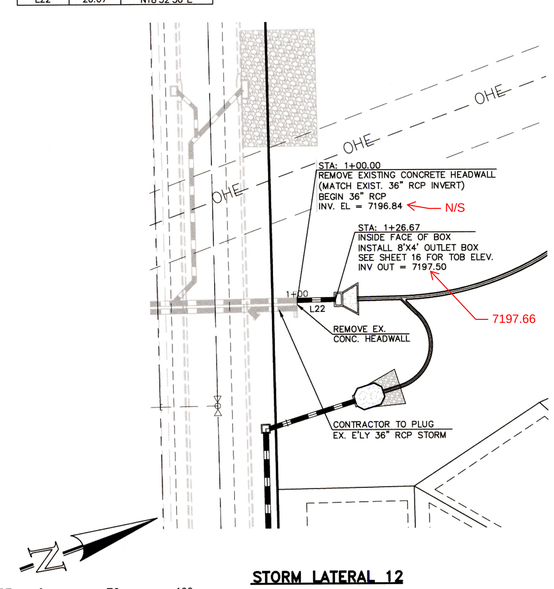



50 25 0 50 100

SCALE: 1" = 50'

## STORM-13 & STORM LATERAL 13 (PUBLIC)

24" - 162' + 64 + 35'

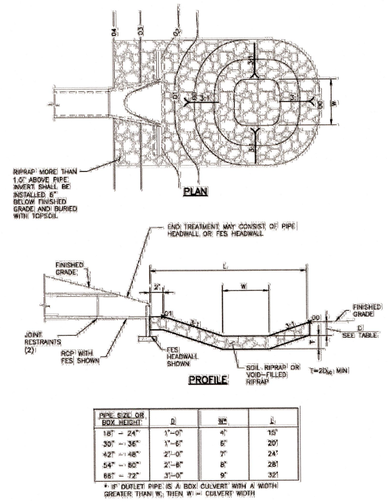



50 25 0 50 100

SCALE: 1" = 50'

## STORM LATERAL 12

Hydraulic Structures — Chapter 9

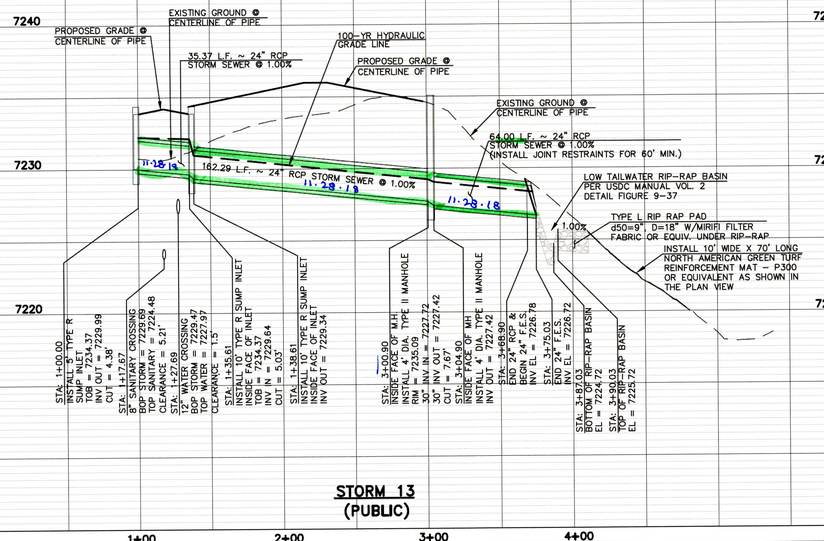



| PIPE SIZE OR BOX HEIGHT | R | W* | L |
|---|---|---|---|
| 18" – 24" | 1'-0" | 4" | 16' |
| 30" – 36" | 1'-6" | 6" | 20' |
| 42" – 48" | 2'-0" | 7" | 24' |
| 54" – 60" | 2'-6" | 8" | 28' |
| 66" – 72" | 3'-0" | 9" | 32' |

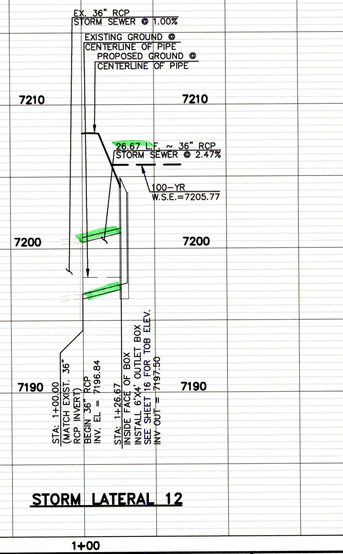
* IF OUTLET PIPE IS A BOX CULVERT WITH A WIDTH GREATER THAN W, THEN W = CULVERT WIDTH

**Figure 9-37. Low tailwater riprap basin**

9-72 — Urban Drainage and Flood Control District, Urban Storm Drainage Criteria Manual Volume 2 — September 2017




## STORM 13 (PUBLIC)




## STORM LATERAL 12



48 HOURS BEFORE YOU DIG, CALL UTILITY LOCATORS
**811**
UTILITY NOTIFICATION CENTER OF COLORADO
IT'S THE LAW

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| NO. | REVISION | DATE |
|---|---|---|
| 1 | REVISED PER COUNTY COMMENTS | 9-26-18 |
| 2 | REVISED PER COUNTY COMMENTS | 10-18-18 |

REVIEW:

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF CLASSIC CONSULTING ENGINEERS AND SURVEYORS, LLC

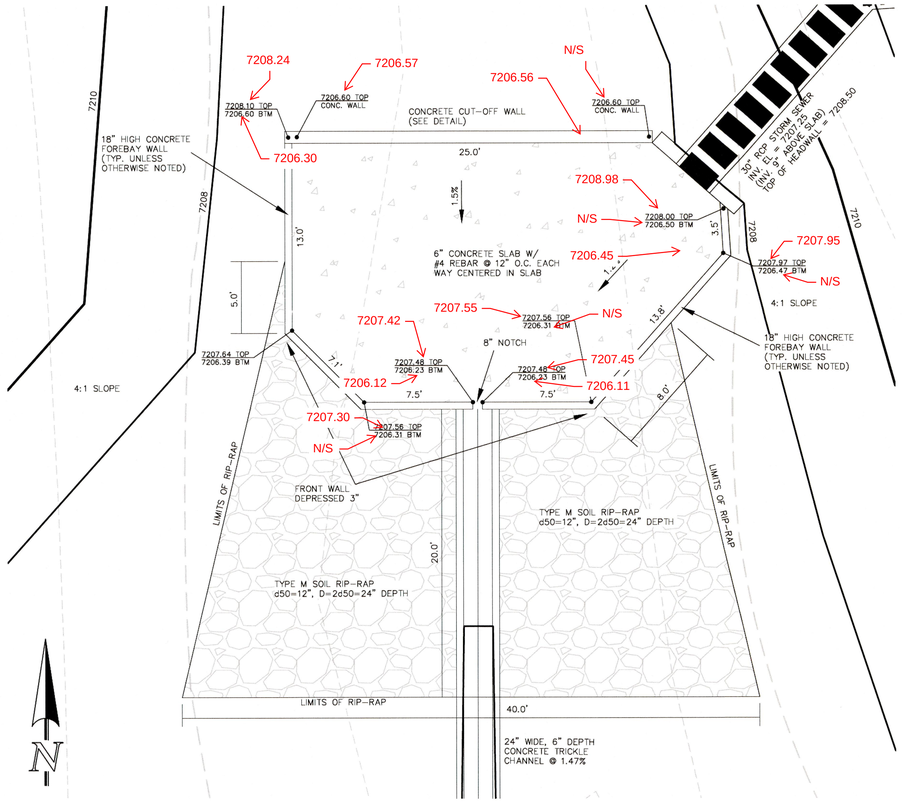
MARC A. WHORTON, COLORADO P.E. #37155 — 10/19/18 DATE


CLASSIC CONSULTING SM
619 N. Cascade Avenue, Suite 200 (719)785-0790
Colorado Springs, Colorado 80903 (719)785-0799(Fax)


**PAINT BRUSH HILLS FILING NO. 13E CONSTRUCTION PLANS**
STORM SEWER PLAN

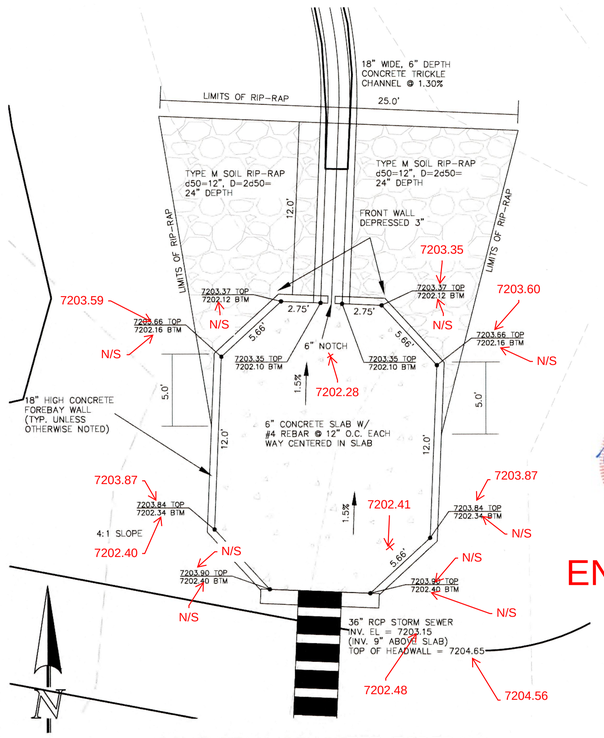
CLASSIC CONSULTING

| | | | | | |
|---|---|---|---|---|---|
| DESIGNED BY | ESO | SCALE | | DATE | 8-10-12 |
| DRAWN BY | ESO | (H) 1"= | 50' | SHEET | 14 OF ~~17~~ 18 |
| CHECKED BY | | (V) 1"= | 5' | JOB NO. | 2053.50 |



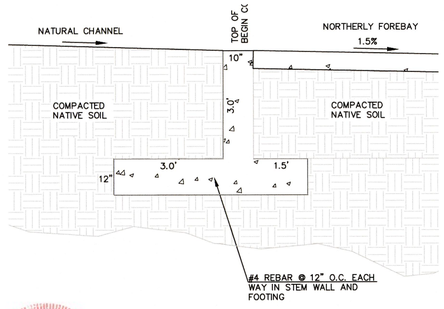

## NORTHERLY CONCRETE FOREBAY

SCALE: 1 "= 5'



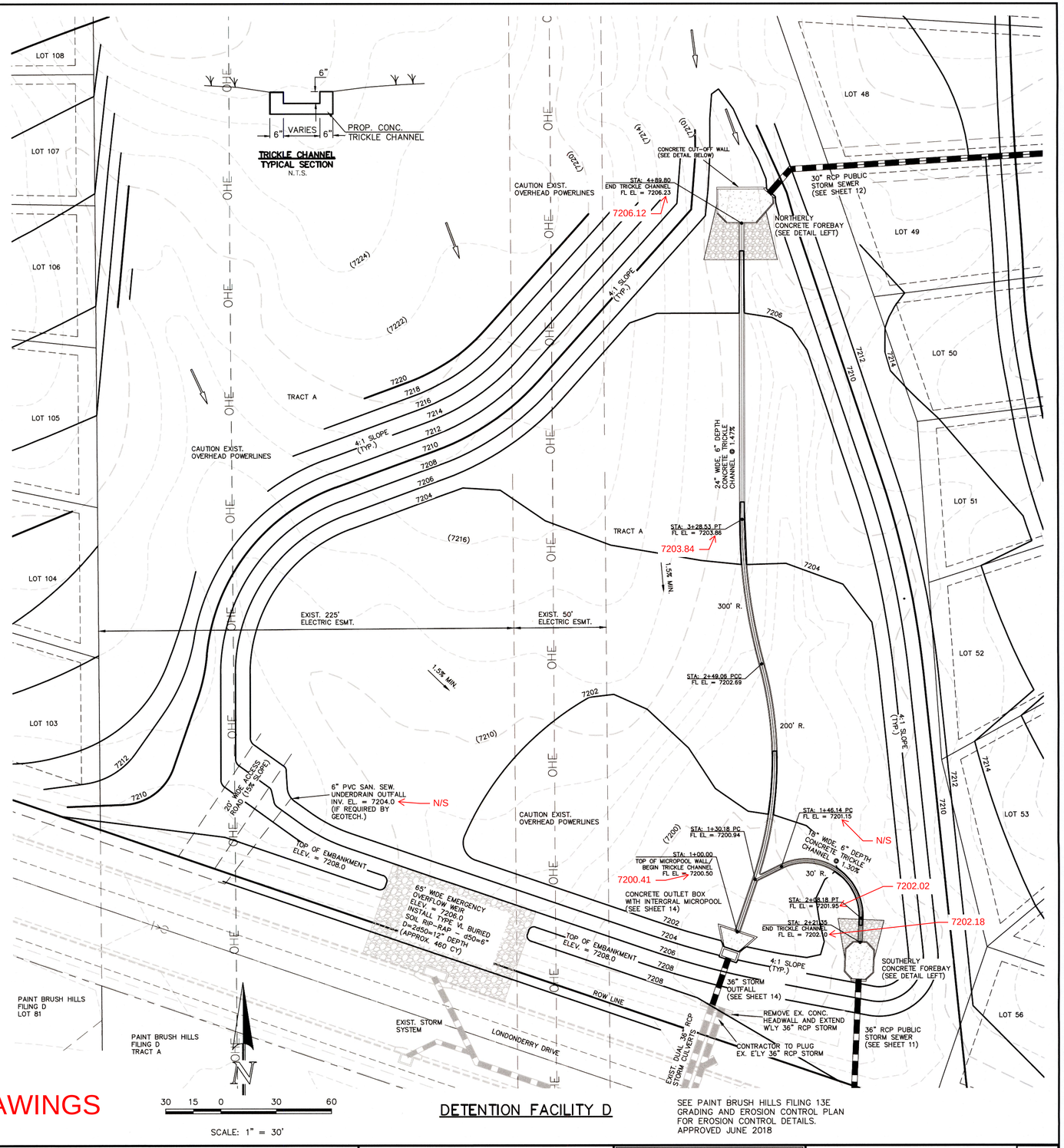

## SOUTHERLY CONCRETE FOREBAY

SCALE: 1 "= 5'




## CONCRETE CUT-OFF WALL

SCALE: 1"=2'




## DETENTION FACILITY D

SEE PAINT BRUSH HILLS FILING 13E GRADING AND EROSION CONTROL PLAN FOR EROSION CONTROL DETAILS. APPROVED JUNE 2018

COLORADO REGISTERED 37160 PROFESSIONAL ENGINEER 03/28/2024

# AS-BUILT
## ENGINEERING RECORD DRAWINGS

48 HOURS BEFORE YOU DIG, CALL UTILITY LOCATORS **811**
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| 1 | REVISED PER COUNTY COMMENTS | 9-20-18 |

REVIEW:

PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF CLASSIC CONSULTING ENGINEERS AND SURVEYORS, LLC

STATE OF COLORADO MARC A. WHORTON 37155 REGISTERED PROFESSIONAL ENGINEER

MARC A. WHORTON, COLORADO P.E. #37155 — 10/19/18 DATE

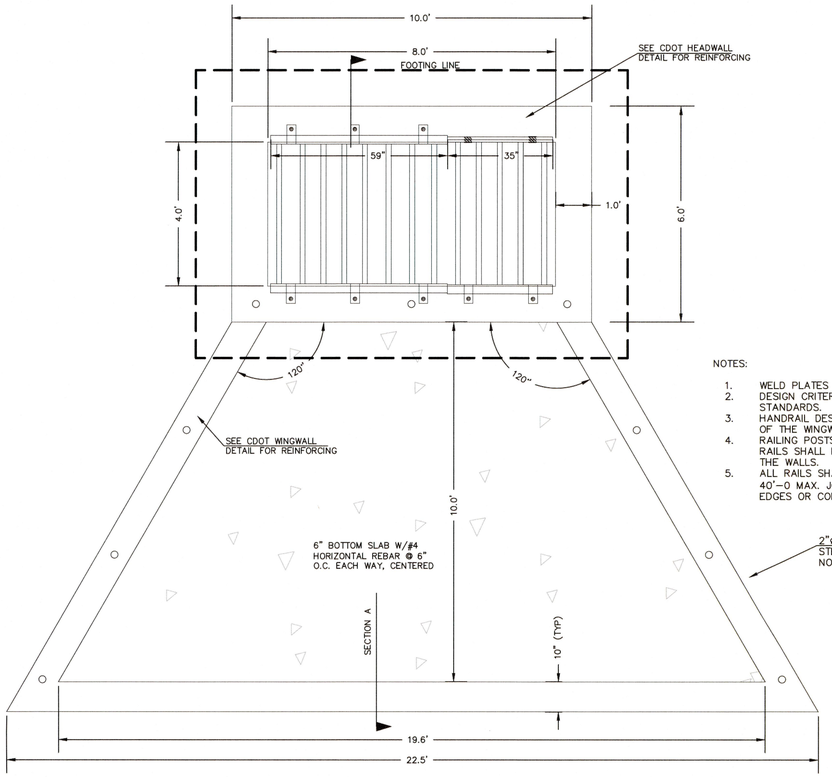
CLASSIC CONSULTING SM
619 N. Cascade Avenue, Suite 200 (719)785-0790
Colorado Springs, Colorado 80903 (719)785-0799(Fax)

**PAINT BRUSH HILLS FILING 13A**
**CONSTRUCTION PLANS**
DETENTION FACILITY D
POND PLAN

CLASSIC CONSULTING

| | | | | | |
|---|---|---|---|---|---|
| DESIGNED BY | MAW | SCALE | | DATE | 7-12-18 |
| DRAWN BY | MAW | (H) 1"= | 30' | SHEET | 15 OF ~~17~~ 18 |
| CHECKED BY | | (V) 1"= | N/A | JOB NO. | 2053.50 |

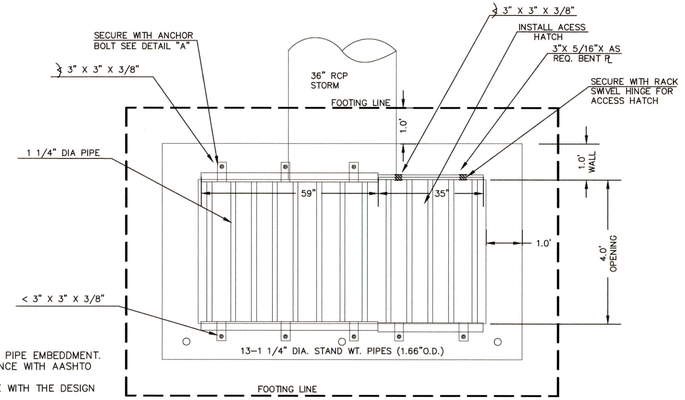
N:\2053\50\DRAWINGS\CONSTRUCTION\Constructions Plans\STREET AND STORM CDS\2053S0- POND PLAN-SHEET 15.dwg, 9/27/2018 3:03:42 PM, 1:1




**CONCRETE MICROPOOL**
SCALE 1" = 2'

# AS-BUILT

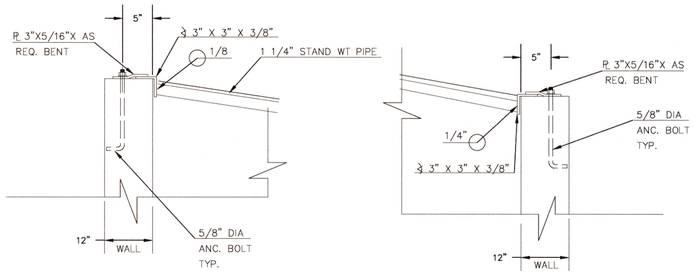
## ENGINEERING RECORD DRAWINGS

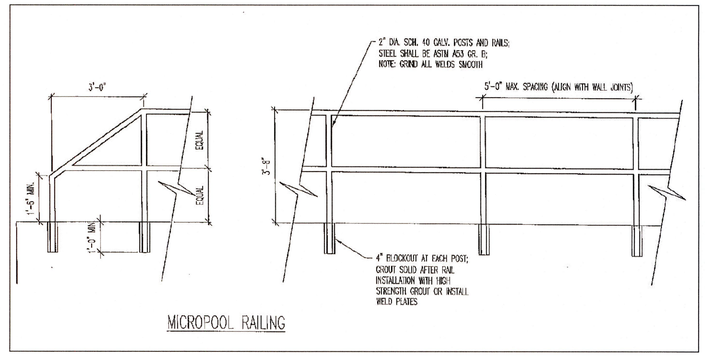



**8'X4' OUTLET BOX OVERFLOW TRASH RACK**
SCALE 1" = 2'

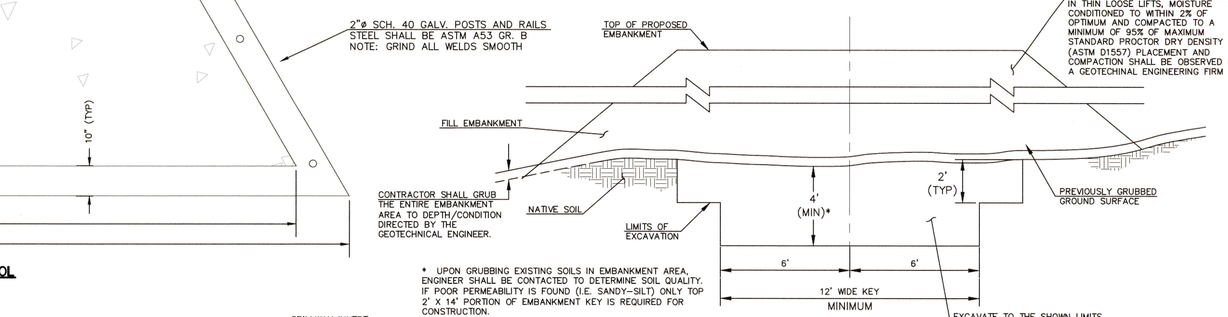
NOTES:

1. WELD PLATES MAY BE SUBSTITUTED FOR PIPE EMBEDDMENT.
2. DESIGN CRITERIA SHALL BE IN ACCORDANCE WITH AASHTO STANDARDS.
3. HANDRAIL DESIGN SHALL BE COMPATIBLE WITH THE DESIGN OF THE WINGWALLS AND HEADWALLS.
4. RAILING POSTS SHALL BE SET TO NORMAL TO GRADE. RAILS SHALL RUN PARALLEL TO THE SLOPES OF TOPS OF THE WALLS.
5. ALL RAILS SHALL HAVE EXPANSION JOINTS SPACED AT 40'-0 MAX. JOINT ENDS SHALL BE FREE OF ANY SHARP EDGES OR CORNERS.



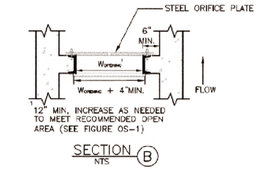




**OUTLET BOX RAILING**
N.T.S.

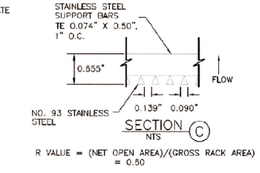



* UPON GRUBBING EXISTING SOILS IN EMBANKMENT AREA, ENGINEER SHALL BE CONTACTED TO DETERMINE SOIL QUALITY. IF POOR PERMEABILITY IS FOUND (I.E. SANDY-SILT) ONLY TOP 2' X 14' PORTION OF EMBANKMENT KEY IS REQUIRED FOR CONSTRUCTION.

**SECTION A**
**TYPICAL EMBANKMENT**
**WITH SOIL KEYWAY**
SCALE: N.T.S.

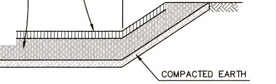



SECTION (B)
NTS

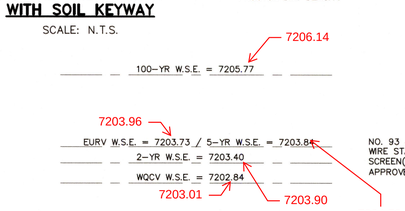


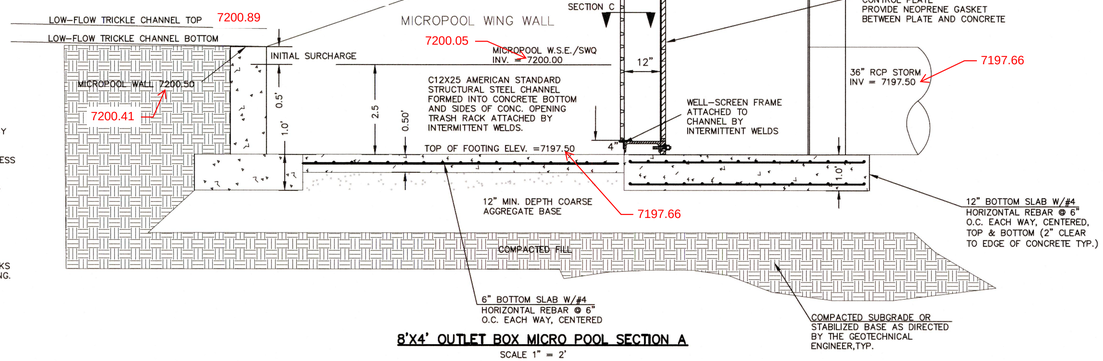

SECTION (C)
NTS

R VALUE = (NET OPEN AREA)/(GROSS RACK AREA) = 0.50

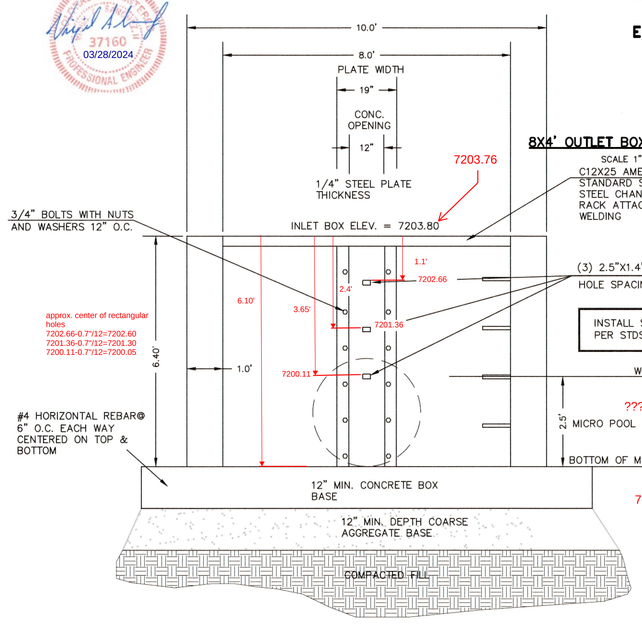



**EMERGENCY SPILLWAY**
**CROSS SECTION**
SCALE: N.T.S.




**8'X4' OUTLET BOX MICRO POOL SECTION A**
SCALE 1" = 2'




**8'X4' OUTLET BOX ORIFICE PLATE**
SCALE 1" = 2'
C12X25 AMERICAN STANDARD STRUCTURAL STEEL CHANNEL. TRASH RACK ATTACHED BY WELDING

(ALL MATERIALS PER EL PASO COUNTY SPECIFICATIONS)

ORIFICE PLATE NOTES:

1. INSTALL HOLES AS SHOWN ON DETAIL TO RIGHT.
2. PROVIDE GASKET MATERIAL BETWEEN THE ORIFICE PLATE AND CONCRETE

EURV AND WQCV TRASH RACKS:

3. WELL-SCREEN TRASH RACKS SHALL BE STAINLESS STEEL AND SHALL BE ATTACHED BY INTERMITTENT WELDS ALONG THE EDGE OF THE MOUNTING FRAME.
4. BAR GRATE TRASH RACKS SHALL BE ALUMINUM AND SHALL BE BOLTED USING STAINLESS STEEL HARDWARE.
5. STRUCTURAL DESIGN OF TRASH RACKS SHALL BE BASED ON FULL HYDROSTATIC HEAD WITH ZERO HEAD DOWNSTREAM OF RACK

OVERFLOW TRASH RACKS:

1. ALL TRASH RACKS SHALL BE MOUNTED USING STAINLESS STEEL HARDWARE AND PROVIDED WITH HINGED AND LOCKABLE OR BOLTABLE ACCESS PANELS
2. TRASH RACKS SHALL BE STAINLESS STEEL, ALUMINUM, OR STEEL. STEEL TRASH RACKS SHALL BE HOT DIP GALVANIZED AND MAY BE HOT POWDER COATED AFTER GALVANIZING.
3. TRASH RACKS SHALL BE DESIGNED SUCH THAT THE DIAGONAL DIMENSION OF EACH OPENING IS SMALLER THAN THE DIAMETER OF THE OUTLET PIPE.
4. STRUCTURAL DESIGN OF THE TRASH RACKS SHALL BE BASED ON FULL HYDROSTATIC HEAD WITH ZERO HEAD DOWNSTREAM OF THE RACK.



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| NO. | REVISION | DATE |
|---|---|---|
| 1 | REVISED PER COUNTY COMMENTS | 9-21-18 |
| 2 | REVISED PER COUNTY COMMENTS | 10-18-18 |

REVIEW:

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MARC A. WHORTON, COLORADO P.E. #37155 — 10/19/18 DATE

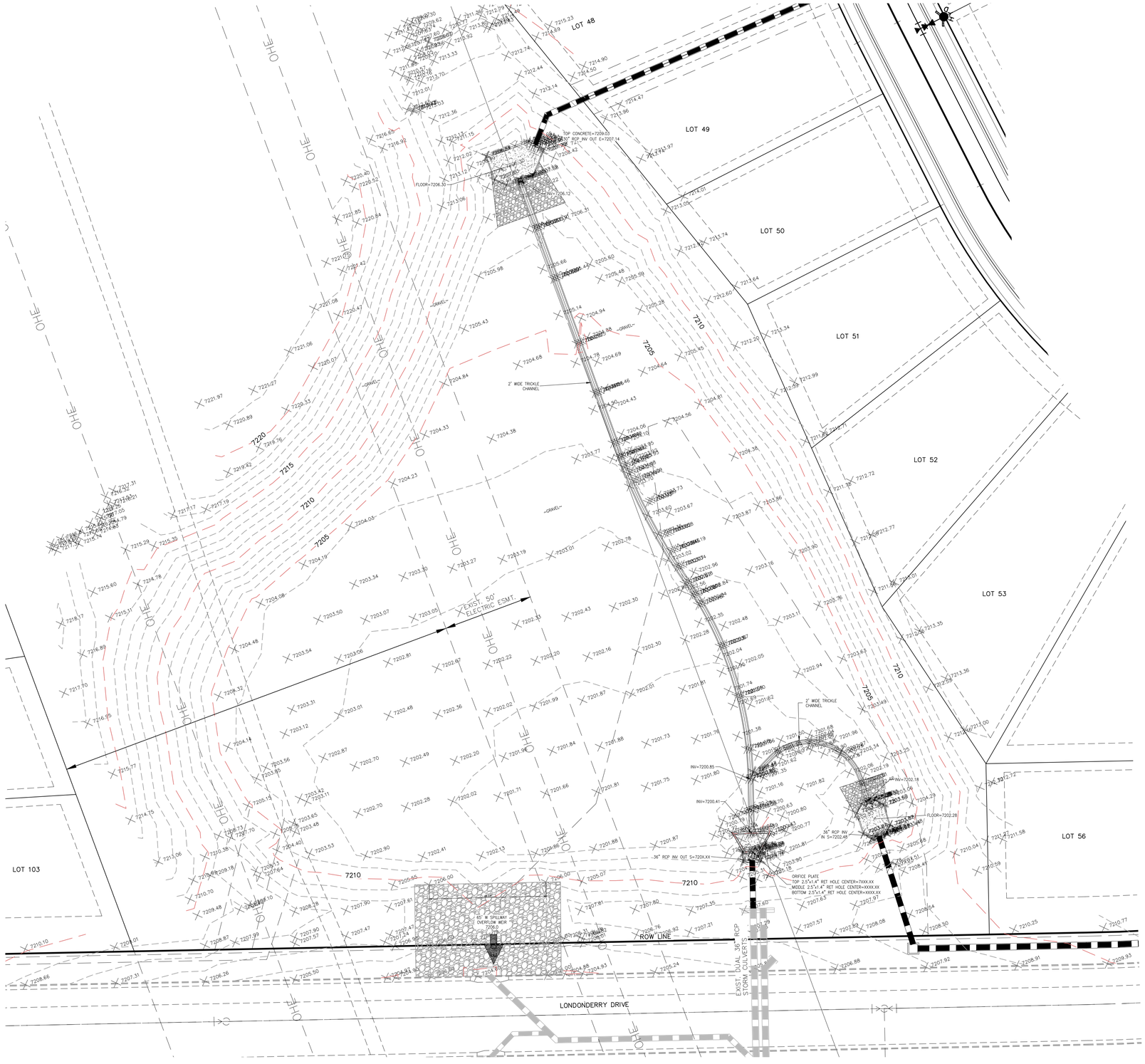

CLASSIC CONSULTING
619 N. Cascade Avenue, Suite 200 (719)785-0790
Colorado Springs, Colorado 80903 (719)785-0799(Fax)


**PAINT BRUSH HILLS FILING 13A**
**CONSTRUCTION PLANS**
DETENTION FACILITY D
OUTLET BOX DETAILS

CLASSIC CONSULTING

| | | | | |
|---|---|---|---|---|
| DESIGNED BY | MAW | SCALE | DATE | 7-12-18 |
| DRAWN BY | MAW | (H) 1"= N/A | SHEET | 16 OF ~~17~~ 18 |
| CHECKED BY | | (V) 1"= N/A | JOB NO. | 2053.50 |

N:\2053\0\DRAWINGS\CONSTRUCTION\Construction Plans\STREET AND STORM CDS\2053SO-POND DETAIL-SHEET 16.dwg, 10/18/2018 11:39:02 AM, 1:1




## LEGEND

- EXIST MAJ CONT
- EXIST MIN CONT
- UNDERGROUND STORM SEWER LINE(S)
- EMERGENCY OVERFLOW/SPILLWAY
- RIPRAP

## POND CERTIFICATION

**FOREBAY INLETS**

DESIGNED INVERT 30" IN (NE) = 7207.25', SURVEY INVERT 30" IN (NE) = 7207.14'
DESIGNED INVERT 36" IN (S) = 7202.80', SURVEY INVERT 36" IN (S) = 7202.48'

**OUTLET STRUCTURE**

DESIGNED LF CHANNEL INVERT IN = 7200.50', SURVEY INVERT IN = 7200.41'
DESIGNED 36" INVERT OUT (S) = 7197.50', SURVEY 36" INVERT OUT (S)= 7197.66'
DESIGNED TOP CONC. BOX/GRATE (FRONT) = 7203.80', SURVEY TOP CONC. GRATE = 7203.76'
DESIGNED TOP CONC. BOX/GRATE (BACK) = 7204.80', SURVEY TOP CONC. GRATE = 7204.79'

**SPILLWAY (EDB)**

DESIGNED SPILLWAY ELEVATION = 7206.00', SURVEY SPILLWAY ELEVATION = 7206.00'

**VOLUME**

DESIGNED VOLUME = 5.941 ACRE FEET @ 7205.77' (100 YR SURFACE)
PROVIDED VOLUME = 6.211 ACRE FEET @ 7206.09' (100 YR SURFACE)

FOR LOCATING & MARKING GAS, ELECTRIC, WATER & TELEPHONE LINES
FOR BURIED UTILITY INFORMATION
48 HRS BEFORE YOU DIG
CALL 1-800-922-1987

PAINT BRUSH HILLS FILING 13A
PERMANENT BMP PLAN

PROJECT NO. 43-124
DESIGNED BY: DLM
DRAWN BY: DLM
CHECKED BY:
SCALE: HORIZONTAL: 1"=20' VERTICAL: N/A
DATE: 03/28/2024
SHEET 18 OF 18
BMPAB

212 N. WAHSATCH AVE. STE 305
COLORADO SPRINGS, CO 80903
PHONE: 719.955.5485
CIVIL CONSULTANTS, INC.

FOR AND ON BEHALF OF M&S CIVIL CONSULTANTS, INC.
VIRGIL A. SANCHEZ, COLORADO P.E. NO. 37160

REVISIONS:

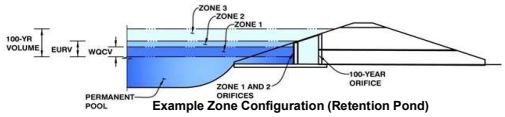
| NO. | DATE: | BY: | DESCRIPTION: | APP'D BY: | DATE: |
|---|---|---|---|---|---|

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

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

**Project:** **PAINT BRUSH HILLS FILING 13E**

**Basin ID:** **POND D (AS-BUILT)**




**Example Zone Configuration (Retention Pond)**

## Watershed Information

| | | |
|---|---|---|
| Selected BMP Type = | **EDB** | |
| Watershed Area = | 75.03 | acres |
| Watershed Length = | 2,280 | ft |
| Watershed Length to Centroid = | 1,140 | ft |
| Watershed Slope = | 0.010 | ft/ft |
| Watershed Imperviousness = | 27.00% | 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 = | 40.0 | hours |
| Location for 1-hr Rainfall Depths = | User Input | |

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

| | | | Optional User Overrides | |
|---|---|---|---|---|
| Water Quality Capture Volume (WQCV) = | 0.886 | acre-feet | | acre-feet |
| Excess Urban Runoff Volume (EURV) = | 2.062 | acre-feet | | acre-feet |
| 2-yr Runoff Volume (P1 = 1.19 in.) = | 2.127 | acre-feet | 1.19 | inches |
| 5-yr Runoff Volume (P1 = 1.5 in.) = | 3.558 | acre-feet | 1.50 | inches |
| 10-yr Runoff Volume (P1 = 1.75 in.) = | 4.887 | acre-feet | 1.75 | inches |
| 25-yr Runoff Volume (P1 = 2 in.) = | 6.936 | acre-feet | 2.00 | inches |
| 50-yr Runoff Volume (P1 = 2.25 in.) = | 8.464 | acre-feet | 2.25 | inches |
| 100-yr Runoff Volume (P1 = 2.52 in.) = | 10.524 | acre-feet | 2.52 | inches |
| 500-yr Runoff Volume (P1 = 3.85 in.) = | 19.067 | acre-feet | 3.85 | inches |
| Approximate 2-yr Detention Volume = | 1.459 | acre-feet | | |
| Approximate 5-yr Detention Volume = | 2.106 | acre-feet | | |
| Approximate 10-yr Detention Volume = | 3.147 | acre-feet | | |
| Approximate 25-yr Detention Volume = | 3.708 | acre-feet | | |
| Approximate 50-yr Detention Volume = | 3.911 | acre-feet | | |
| Approximate 100-yr Detention Volume = | 4.674 | acre-feet | | |

## Define Zones and Basin Geometry

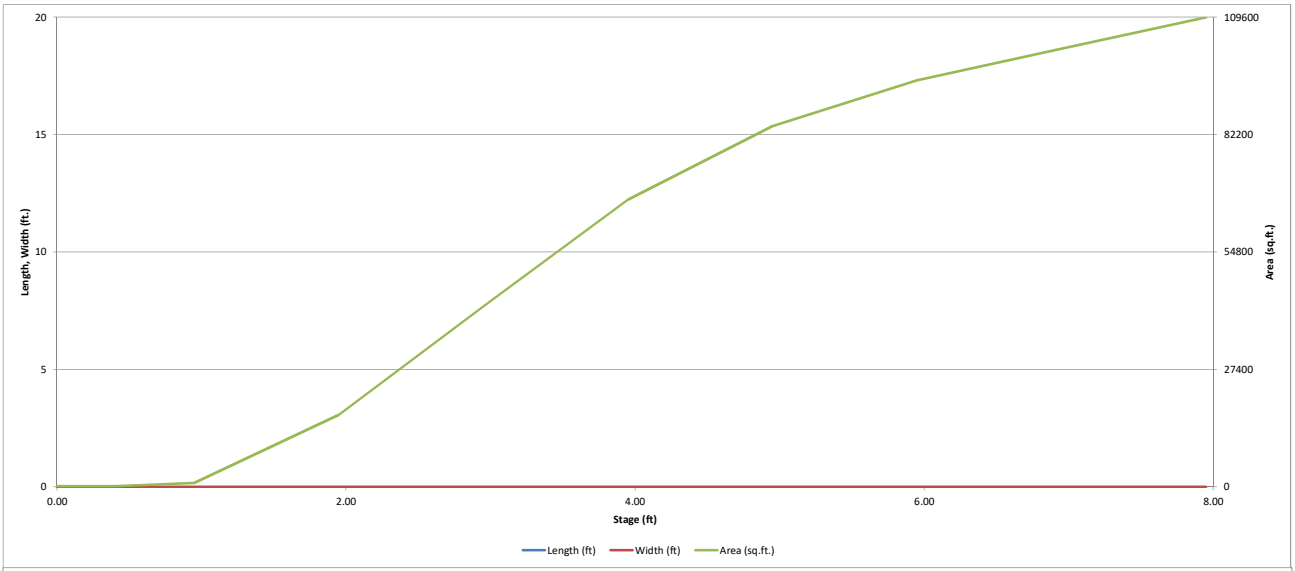
| | | |
|---|---|---|
| Zone 1 Volume (WQCV) = | 0.886 | acre-feet |
| Zone 2 Volume (EURV - Zone 1) = | 1.175 | acre-feet |
| Zone 3 Volume (100-year - Zones 1 & 2) = | 2.612 | acre-feet |
| Total Detention Basin Volume = | 4.674 | acre-feet |
| Initial Surcharge Volume (ISV) = | user | $ft^3$ |
| Initial Surcharge Depth (ISD) = | user | ft |
| Total Available Detention Depth ($H_{total}$) = | user | ft |
| Depth of Trickle Channel ($H_{TC}$) = | user | ft |
| Slope of Trickle Channel ($S_{TC}$) = | user | ft/ft |
| Slopes of Main Basin Sides ($S_{main}$) = | user | H:V |
| Basin Length-to-Width Ratio ($R_{L/W}$) = | user | |
| Initial 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 |

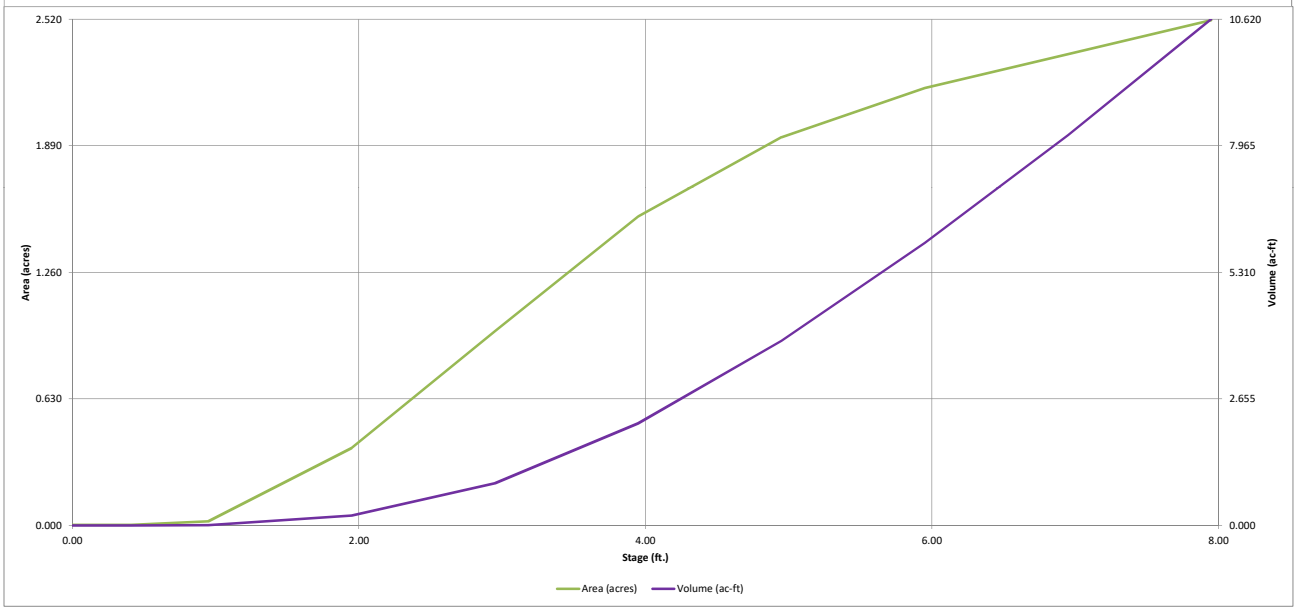
Depth Increment = ft

| 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) |
|---|---|---|---|---|---|---|---|---|---|
| **Top of Micropool** | -- | 0.00 | -- | -- | -- | 137 | 0.003 | | |
| **ISV=7200.50** | -- | 0.41 | -- | -- | -- | 137 | 0.003 | 56 | 0.001 |
| **ISV=7200.41** | -- | 0.95 | -- | -- | -- | 863 | 0.020 | 326 | 0.007 |
| **WQ=7200.05** | -- | 1.95 | -- | -- | -- | 16,768 | 0.385 | 9,141 | 0.210 |
| | -- | 2.95 | -- | -- | -- | 42,094 | 0.966 | 38,572 | 0.885 |
| | -- | 3.95 | -- | -- | -- | 66,942 | 1.537 | 93,090 | 2.137 |
| | -- | 4.95 | -- | -- | -- | 84,160 | 1.932 | 168,641 | 3.871 |
| | -- | 5.95 | -- | -- | -- | 94,836 | 2.177 | 258,139 | 5.926 |
| | -- | 6.95 | -- | -- | -- | 102,203 | 2.346 | 356,659 | 8.188 |
| | -- | 7.95 | -- | -- | -- | 109,552 | 2.515 | 462,536 | 10.618 |

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

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



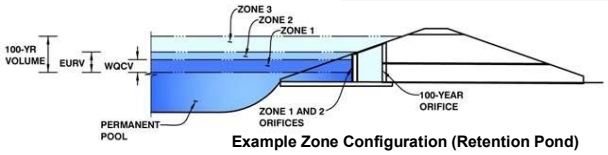



# DETENTION BASIN OUTLET STRUCTURE DESIGN

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

**Project:** **PAINT BRUSH HILLS FILING 13E**

**Basin ID:** **POND D (AS-BUILT)**




**Example Zone Configuration (Retention Pond)**

| | Estimated Stage (ft) | Estimated Volume (ac-ft) | Outlet Type |
|---|---|---|---|
| Zone 1 (WQCV) | 2.96 | 0.886 | Orifice Plate |
| Zone 2 (EURV) | 3.91 | 1.175 | Orifice Plate |
| Zone 3 (100-year) | 5.36 | 2.612 | Weir&Pipe (Restrict) |
| Total (all zones) | | 4.674 | |

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

| | | | | | |
|---|---|---|---|---|---|
| Underdrain Orifice Invert Depth = | N/A | ft (distance below the filtration media surface) | Underdrain Orifice Area = | N/A | $ft^2$ |
| Underdrain Orifice Diameter = | N/A | inches | Underdrain Orifice Centroid = | N/A | 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 = | 0.00 | ft (relative to basin bottom at Stage = 0 ft) | WQ Orifice Area per Row = | N/A | $ft^2$ |
| Depth at top of Zone using Orifice Plate = | 3.96 | 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 | $ft^2$ |

Calculated Parameters for Plate

2.55 per plans

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

| | Row 1 (required) | Row 2 (optional) | Row 3 (optional) | Row 4 (optional) | Row 5 (optional) | Row 6 (optional) | Row 7 (optional) | Row 8 (optional) |
|---|---|---|---|---|---|---|---|---|
| Stage of Orifice Centroid (ft) | 0.00 | 1.25 | 2.61 | | | | | |
| Orifice Area (sq. inches) | 3.51 | 3.51 | 3.51 | | | | | |

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

User Input: Vertical Orifice (Circular or Rectangular)

| | Not Selected | Not Selected | | | | |
|---|---|---|---|---|---|---|
| Invert of Vertical Orifice = | N/A | N/A | ft (relative to basin bottom at Stage = 0 ft) | Vertical Orifice Area = | N/A | N/A | $ft^2$ |
| 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 | feet |
| Vertical Orifice Diameter = | N/A | N/A | inches | | | | |

Calculated Parameters for Vertical Orifice

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 | | | Zone 3 Weir | Not Selected | |
|---|---|---|---|---|---|---|---|
| Overflow Weir Front Edge Height, Ho = | 3.71 | N/A | ft (relative to basin bottom at Stage = 0 ft) | Height of Grate Upper Edge, $H_t$ = | 4.71 | N/A | feet |
| Overflow Weir Front Edge Length = | 8.00 | N/A | feet | Overflow Weir Slope Length = | 4.12 | N/A | feet |
| Overflow Weir Grate Slope = | 4.00 | N/A | H:V | Grate Open Area / 100-yr Orifice Area = | 3.25 | N/A | |
| Horiz. Length of Weir Sides = | 4.00 | N/A | feet | Overflow Grate Open Area w/o Debris = | 22.96 | N/A | $ft^2$ |
| Overflow Grate Type = | Type C Grate | N/A | | Overflow Grate Open Area w/ Debris = | 11.48 | N/A | $ft^2$ |
| Debris Clogging % = | 50% | N/A | % | | | | |

Calculated Parameters for Overflow Weir

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

| | Zone 3 Restrictor | Not Selected | | | Zone 3 Restrictor | Not Selected | |
|---|---|---|---|---|---|---|---|
| Depth to Invert of Outlet Pipe = | 2.39 | N/A | ft (distance below basin bottom at Stage = 0 ft) | Outlet Orifice Area = | 7.07 | N/A | $ft^2$ |
| Outlet Pipe Diameter = | 36.00 | N/A | inches | Outlet Orifice Centroid = | 1.50 | N/A | feet |
| Restrictor Plate Height Above Pipe Invert = | 36.00 | | inches | Half-Central Angle of Restrictor Plate on Pipe = | 3.14 | N/A | radians |

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

| | | | | | |
|---|---|---|---|---|---|
| Spillway Invert Stage= | 5.95 | ft (relative to basin bottom at Stage = 0 ft) | Spillway Design Flow Depth= | 0.70 | feet |
| Spillway Crest Length = | 65.00 | feet | Stage at Top of Freeboard = | 7.65 | feet |
| Spillway End Slopes = | 4.00 | H:V | Basin Area at Top of Freeboard = | 2.46 | acres |
| Freeboard above Max Water Surface = | 1.00 | feet | Basin Volume at Top of Freeboard = | 9.87 | acre-ft |

Calculated Parameters for Spillway

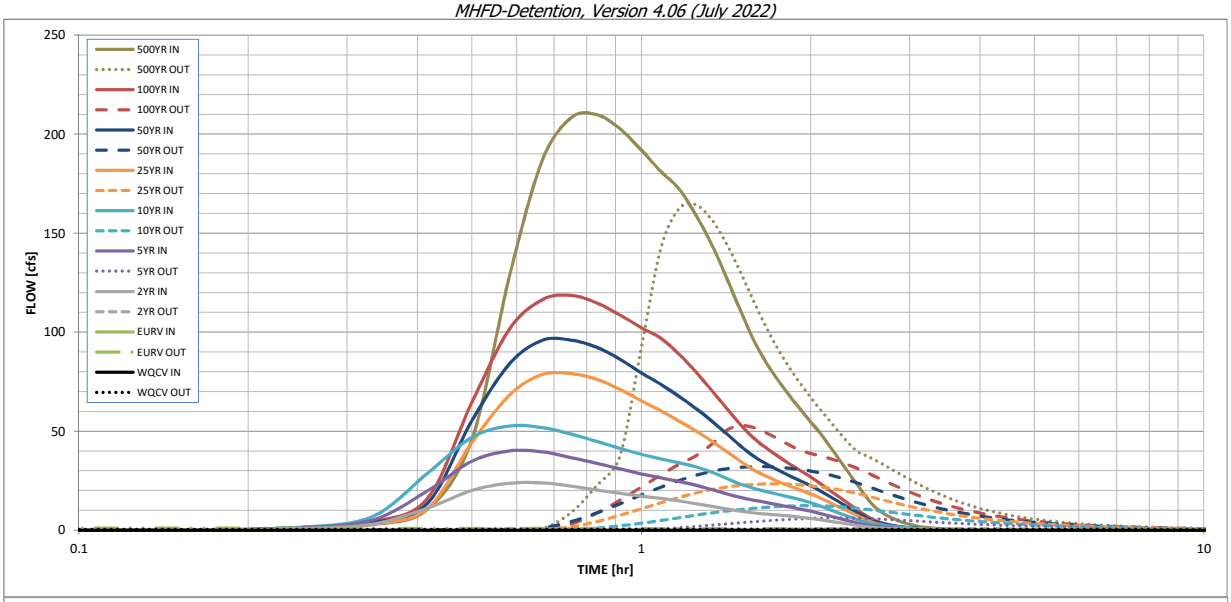
Routed Hydrograph Results

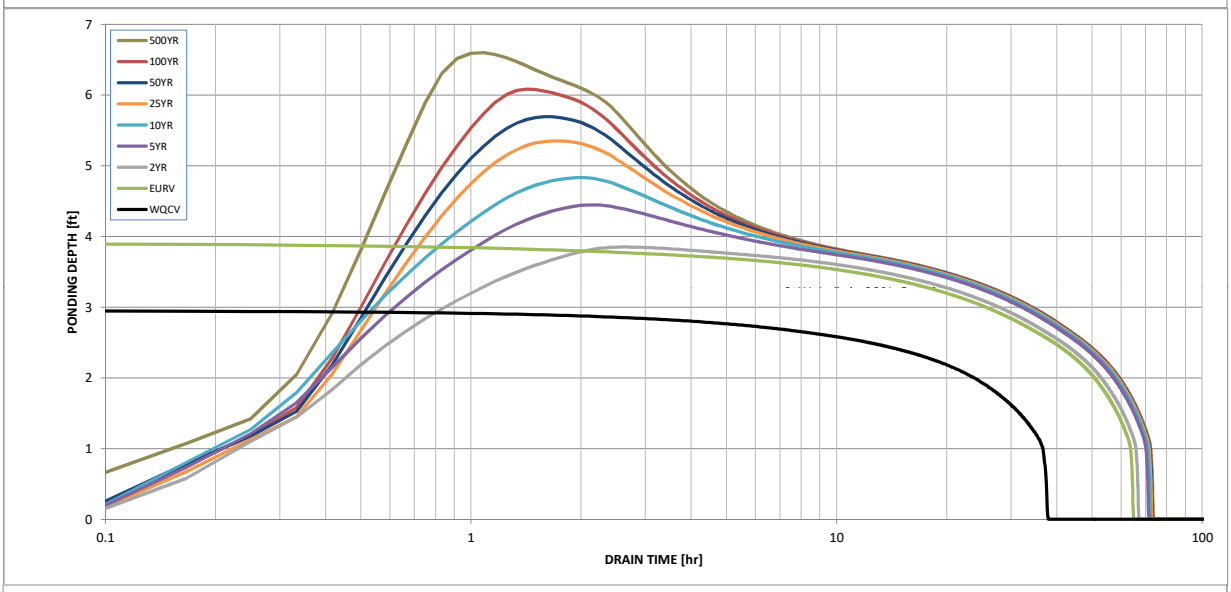
*The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

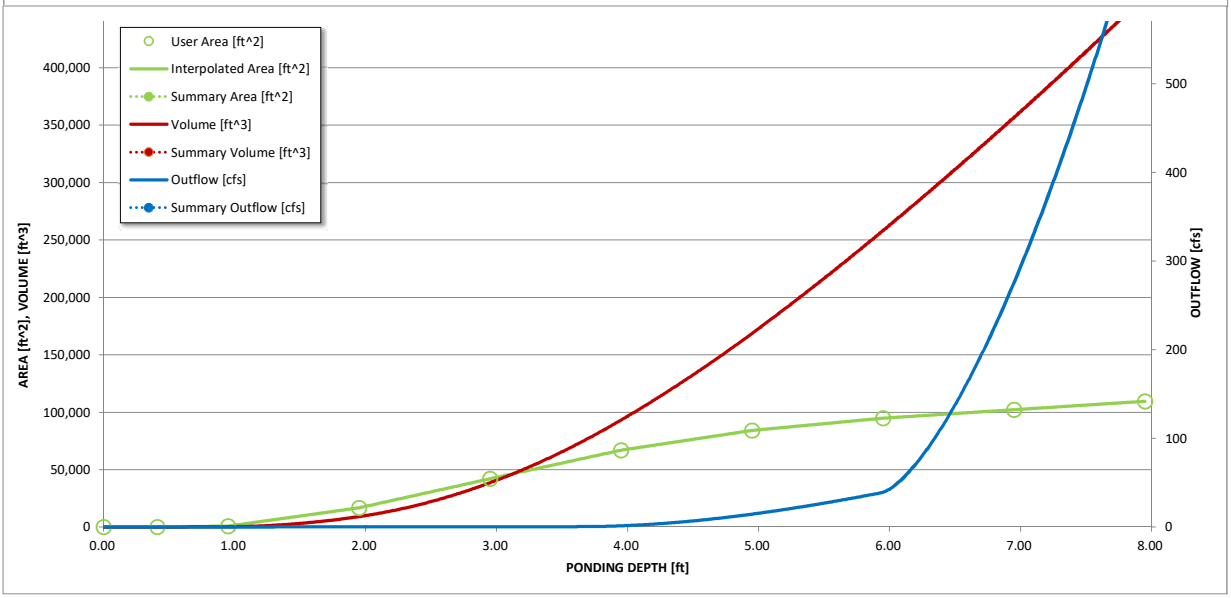
| Design Storm Return Period = | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year | 500 Year |
|---|---|---|---|---|---|---|---|---|---|
| One-Hour Rainfall Depth (in) = | N/A | N/A | 1.19 | 1.50 | 1.75 | 2.00 | 2.25 | 2.52 | 3.85 |
| CUHP Runoff Volume (acre-ft) = | 0.886 | 2.062 | 2.127 | 3.558 | 4.887 | 6.936 | 8.464 | 10.524 | 19.067 |
| Inflow Hydrograph Volume (acre-ft) = | N/A | N/A | 2.127 | 3.558 | 4.887 | 6.936 | 8.464 | 10.524 | 19.067 |
| CUHP Predevelopment Peak Q (cfs) = | N/A | N/A | 7.6 | 21.3 | 32.4 | 57.9 | 72.7 | 92.6 | 173.1 |
| OPTIONAL Override Predevelopment Peak Q (cfs) = | N/A | N/A | | | | | | | |
| Predevelopment Unit Peak Flow, q (cfs/acre) = | N/A | N/A | 0.10 | 0.28 | 0.43 | 0.77 | 0.97 | 1.23 | 2.31 |
| Peak Inflow Q (cfs) = | N/A | N/A | 23.9 | 40.0 | 52.6 | 79.0 | 95.9 | 118.6 | 209.7 |
| Peak Outflow Q (cfs) = | 0.4 | 1.2 | 0.9 | 6.2 | 12.4 | 23.4 | 32.0 | 52.9 | 164.4 |
| Ratio Peak Outflow to Predevelopment Q = | N/A | N/A | N/A | 0.3 | 0.4 | 0.4 | 0.4 | 0.6 | 0.9 |
| Structure Controlling Flow = | Plate | Overflow Weir 1 | Overflow Weir 1 | Overflow Weir 1 | Overflow Weir 1 | Overflow Weir 1 | Overflow Weir 1 | Spillway | Spillway |
| Max Velocity through Grate 1 (fps) = | N/A | 0.03 | 0.02 | 0.2 | 0.5 | 1.0 | 1.4 | 1.8 | 2.5 |
| Max Velocity through Grate 2 (fps) = | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Time to Drain 97% of Inflow Volume (hours) = | 35 | 59 | 62 | 63 | 62 | 60 | 58 | 56 | 46 |
| Time to Drain 99% of Inflow Volume (hours) = | **37** | 63 | 65 | 68 | 68 | 67 | 66 | 65 | 61 |
| Maximum Ponding Depth (ft) = | 2.96 | 3.91 | 3.85 | 4.45 | 4.83 | 5.35 | 5.69 | 6.09 | 6.60 |
| Area at Maximum Ponding Depth (acres) = | 0.97 | 1.51 | 1.48 | 1.73 | 1.88 | 2.03 | 2.11 | 2.20 | 2.29 |
| Maximum Volume Stored (acre-ft) = | 0.895 | 2.076 | 1.986 | 2.938 | 3.642 | 4.664 | 5.368 | 6.211 | 7.354 |

# 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 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.

| | SOURCE | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP | CUHP |
|---|---|---|---|---|---|---|---|---|---|---|
| Time Interval | 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 | 0.09 | 0.01 | 0.61 |
| | 0:15:00 | 0.00 | 0.00 | 0.76 | 1.24 | 1.54 | 1.04 | 1.35 | 1.29 | 2.79 |
| | 0:20:00 | 0.00 | 0.00 | 3.02 | 5.21 | 6.94 | 3.09 | 3.72 | 4.40 | 10.53 |
| | 0:25:00 | 0.00 | 0.00 | 11.11 | 19.84 | 28.71 | 10.96 | 13.44 | 16.04 | 45.90 |
| | 0:30:00 | 0.00 | 0.00 | 20.11 | 34.83 | 46.86 | 44.30 | 55.30 | 64.59 | 128.51 |
| | 0:35:00 | 0.00 | 0.00 | 23.74 | 40.01 | 52.57 | 68.25 | 83.99 | 101.56 | 186.69 |
| | 0:40:00 | 0.00 | 0.00 | 23.94 | 39.53 | 51.73 | 78.60 | 95.80 | 116.31 | 208.20 |
| | 0:45:00 | 0.00 | 0.00 | 22.26 | 36.64 | 48.49 | 79.03 | 95.89 | 118.55 | 209.73 |
| | 0:50:00 | 0.00 | 0.00 | 20.32 | 33.74 | 44.78 | 76.18 | 92.29 | 114.69 | 202.60 |
| | 0:55:00 | 0.00 | 0.00 | 18.64 | 30.96 | 41.27 | 71.07 | 86.21 | 108.64 | 191.89 |
| | 1:00:00 | 0.00 | 0.00 | 17.18 | 28.41 | 38.27 | 65.30 | 79.37 | 102.23 | 181.03 |
| | 1:05:00 | 0.00 | 0.00 | 16.04 | 26.37 | 35.97 | 60.31 | 73.58 | 96.94 | 172.38 |
| | 1:10:00 | 0.00 | 0.00 | 14.76 | 24.60 | 33.96 | 55.17 | 67.50 | 88.89 | 159.14 |
| | 1:15:00 | 0.00 | 0.00 | 13.39 | 22.67 | 31.96 | 50.16 | 61.49 | 79.97 | 144.37 |
| | 1:20:00 | 0.00 | 0.00 | 12.04 | 20.53 | 29.29 | 44.99 | 55.09 | 70.67 | 127.60 |
| | 1:25:00 | 0.00 | 0.00 | 10.73 | 18.40 | 26.15 | 39.92 | 48.76 | 61.68 | 110.98 |
| | 1:30:00 | 0.00 | 0.00 | 9.57 | 16.52 | 23.25 | 34.90 | 42.54 | 53.40 | 96.16 |
| | 1:35:00 | 0.00 | 0.00 | 8.71 | 15.19 | 21.14 | 30.51 | 37.32 | 46.64 | 84.71 |
| | 1:40:00 | 0.00 | 0.00 | 8.12 | 13.99 | 19.51 | 27.29 | 33.45 | 41.56 | 75.73 |
| | 1:45:00 | 0.00 | 0.00 | 7.61 | 12.81 | 18.06 | 24.67 | 30.25 | 37.33 | 67.99 |
| | 1:50:00 | 0.00 | 0.00 | 7.14 | 11.70 | 16.73 | 22.40 | 27.44 | 33.57 | 61.06 |
| | 1:55:00 | 0.00 | 0.00 | 6.54 | 10.64 | 15.37 | 20.32 | 24.87 | 30.13 | 54.67 |
| | 2:00:00 | 0.00 | 0.00 | 5.92 | 9.62 | 13.85 | 18.39 | 22.47 | 26.92 | 48.65 |
| | 2:05:00 | 0.00 | 0.00 | 5.18 | 8.40 | 12.07 | 16.18 | 19.69 | 23.45 | 42.06 |
| | 2:10:00 | 0.00 | 0.00 | 4.43 | 7.15 | 10.26 | 13.91 | 16.85 | 20.05 | 35.54 |
| | 2:15:00 | 0.00 | 0.00 | 3.72 | 5.95 | 8.53 | 11.71 | 14.10 | 16.76 | 29.23 |
| | 2:20:00 | 0.00 | 0.00 | 3.03 | 4.80 | 6.91 | 9.59 | 11.45 | 13.57 | 23.19 |
| | 2:25:00 | 0.00 | 0.00 | 2.38 | 3.73 | 5.41 | 7.56 | 8.93 | 10.50 | 17.46 |
| | 2:30:00 | 0.00 | 0.00 | 1.79 | 2.76 | 4.07 | 5.62 | 6.56 | 7.61 | 12.54 |
| | 2:35:00 | 0.00 | 0.00 | 1.34 | 2.08 | 3.19 | 3.89 | 4.64 | 5.36 | 9.31 |
| | 2:40:00 | 0.00 | 0.00 | 1.05 | 1.67 | 2.60 | 2.84 | 3.45 | 3.91 | 7.03 |
| | 2:45:00 | 0.00 | 0.00 | 0.85 | 1.37 | 2.13 | 2.13 | 2.62 | 2.88 | 5.27 |
| | 2:50:00 | 0.00 | 0.00 | 0.70 | 1.12 | 1.74 | 1.62 | 2.00 | 2.10 | 3.91 |
| | 2:55:00 | 0.00 | 0.00 | 0.58 | 0.92 | 1.42 | 1.23 | 1.53 | 1.52 | 2.86 |
| | 3:00:00 | 0.00 | 0.00 | 0.47 | 0.74 | 1.14 | 0.96 | 1.18 | 1.09 | 2.07 |
| | 3:05:00 | 0.00 | 0.00 | 0.39 | 0.60 | 0.92 | 0.74 | 0.92 | 0.79 | 1.52 |
| | 3:10:00 | 0.00 | 0.00 | 0.32 | 0.48 | 0.73 | 0.58 | 0.72 | 0.60 | 1.19 |
| | 3:15:00 | 0.00 | 0.00 | 0.26 | 0.38 | 0.56 | 0.46 | 0.56 | 0.48 | 0.93 |
| | 3:20:00 | 0.00 | 0.00 | 0.21 | 0.29 | 0.44 | 0.36 | 0.44 | 0.39 | 0.74 |
| | 3:25:00 | 0.00 | 0.00 | 0.17 | 0.22 | 0.34 | 0.28 | 0.34 | 0.30 | 0.58 |
| | 3:30:00 | 0.00 | 0.00 | 0.13 | 0.16 | 0.26 | 0.22 | 0.26 | 0.23 | 0.44 |
| | 3:35:00 | 0.00 | 0.00 | 0.09 | 0.12 | 0.19 | 0.16 | 0.19 | 0.17 | 0.31 |
| | 3:40:00 | 0.00 | 0.00 | 0.06 | 0.08 | 0.13 | 0.11 | 0.14 | 0.12 | 0.21 |
| | 3:45:00 | 0.00 | 0.00 | 0.04 | 0.05 | 0.08 | 0.08 | 0.09 | 0.08 | 0.13 |
| | 3:50:00 | 0.00 | 0.00 | 0.02 | 0.03 | 0.05 | 0.05 | 0.05 | 0.04 | 0.06 |
| | 3:55:00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| | 4:00:00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 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 |