MASTER DEVELOPMENT DRAINAGE PLAN

FOR

BULL HILL / ROLLING MEADOWS

SKP-23-003

SEPTEMBER, 2023
REV. JAN, 2024

Prepared for:

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Project No. 100.300

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STATEMENT

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

Richard L. Schindler, P.E. #33997 Date
For and on Behalf of Core Engineering Group, LLC

OWNER'S STATEMENT

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

The Landhuis Company Date

By Jeff Mark

Manager
Title

212 N. Wahsatch Avenue, Suite 301, Colorado Springs, CO 80903
Address

FLOODPLAIN STATEMENT

To the best of my knowledge and belief a portion of this development is located within a designated floodplain as shown on Flood Insurance Rate Map Panel No.'s 08041CO769G, 08041CO790G and 08041CO976G, dated December 7, 2018. (See Appendix A, FEMA FIRM Exhibit)

Richard L. Schindler, #33997 Date

EL PASO COUNTY

Filed in accordance with the requirements of the El Paso County Land Development Code, Drainage Criteria Manual, Volume 1 and 2, and Engineering Criteria Manual, As Amended.

County Engineer/ECM Administrator Date

Conditions:

1.0 INTRODUCTION

Purpose and Scope

The purpose of this Master Development Drainage Plan (MDDP) is to provide an overview of the overall drainage impacts/mitigation due to development in the proposed Bull Hill/Rolling Meadows development located along the East Tributary of Jimmy Camp Creek (hereafter referred to as the East Tributary). The project site area is approximately 499.109acres for Bull Hill and 637.806acres for Rolling Meadows for a total of 1,136.915 acres located within the Jimmy Camp Creek Drainage Basin. See ***Appendix A*** for vicinity map.

Analysis of the Jimmy Camp Creek Drainage Basin Planning Study (DBPS) is not included in this report due to the large size of the upstream area of the drainage basin and the relatively small study area of Bull Hill/Rolling Meadows. However, a Drainage Basin Planning Study (DBPS) was prepared in 2015 by Kiowa Engineering Corp. for the entire Jimmy Camp Creek Basin which will be referenced in this report. The Kiowa DBPS was not approved by El Paso County but the hydraulic analysis has been accepted by El Paso County. Channel improvements to the portion of the East Tributary of Jimmy Camp Creek that flows through the center portion of this development is being prepared by Matrix Design Group and will be submitted to El Paso County in the future for review and approval. The channel design is in general conformance with the Kiowa DBPS. El Paso County is currently preparing a new DBPS for the Jimmy Camp Drainage Basin but will not be used in this report since the study only has preliminary hydrology, no preferred alternates, and limited stakeholder input.

For the purposes of this report, the scope is limited to runoff directly tributary to Bull Hill/Rolling Meadows. Offsite runoff from the north and East will be routed to the East Tributary. On site runoff will be conveyed to the East Tributary through a system of swales, constructed streets, ponds, inlets, culverts, and storm sewers. A small portion of the site does flow west offsite to the main stem of Jimmy Camp Creek and the Francevile Tributary of JCC. Detention basins are strategically located to reduce developed runoff at a rate equal to or less than existing conditions.

The offsite basins flowing onto this site will be routed through proposed ponds or will be routed directly to the East Tributary to mimic historic conditions as much as possible.

Property Location and Description

The proposed 1,136.915-acre site is located South of Drennan Road and West of Meridian Road. The property in this report is bounded on the north by Drennan Road, on the west by the V. A. Cemetery and the Banning Lewis Ranch, on the south by Lorson Ranch and on the east by Meridian Road.

Within the entire project site, the East Tributary of Jimmy Camp Creek flows from north to south near the center of the site. The East Tributary of Jimmy Camp Creek enters the site at Drennan Road, near the easterly edge of the northern boundary and flows continue in a southerly direction and enters Lorson Ranch downstream of this site.

<u>The general description for the property is:</u>

The Bull Hill/Rolling Meadows project is located within the portions of Section 1, SE ¼ of Section 2, NE ¼ of Section 11, Section 12, the NE ¼ of Section 13, all in Township 15

South, Range 65 West of the 6th Principal Meridian. This site is more commonly located west of Meridian Road and south of Drennan Road, in El Paso County, State of Colorado. The total site consists of 1,136.915 acres.

2.0 DRAINAGE DESIGN CRITERIA

The supporting drainage design and calculations were performed in accordance with the City of Colorado Springs and El Paso County "Drainage Criteria Manual (DCM)", dated November, 1991, the El Paso County "Engineering Criteria Manual", Chapter 6 and Section 3.2.1 Chapter 13 of the City of Colorado Springs Drainage Criteria Manual dated May 2014, and the UDFCD "Urban Storm Drainage Criteria Manual" Volumes 1, 2 and 3 for inlet sizing and full spectrum ponds. No deviations from these published criteria are requested for this site.

The Rational Method as outlined in Section 6.3.0 of the May 2014 "Drainage Criteria Manual" and in Section 3.2.8.F of the El Paso County "Engineering Criteria Manual" was used for basins less than 130 acres to determine the rainfall and runoff conditions for the proposed development of the site. The runoff rates for the 5-year initial storm and 100-year major design storm were calculated.

Current updates to the Drainage Criteria manual for El Paso County states the if detention is necessary, Full Spectrum Detention will be included in the design, based on this criteria, Full Spectrum Detention will be required for this development. El Paso County is currently preparing a new DBPS for the Jimmy Camp Drainage Basin but will not be used in this report since the study only has preliminary hydrology but no preferred alternates or stakeholders input have been completed yet.

3.0 EXISTING HYDROLOGICAL CONDITIONS

The site is located within the Jimmy Camp Creek Drainage Basin. The roughly 43,000-acre (66.9 square miles) basin is located within unincorporated El Paso County, the City of Colorado Springs, and the City of Fountain, Colorado. The "2015 Jimmy Camp Creek Drainage Basin Planning Study" establishes drainage guidelines and mitigation for development within the Jimmy Camp Creek Drainage Basin. This report has not yet been adopted by El Paso County.

The area subject to this Master Development Drainage Plan covers approximately 1,137acres of undeveloped land that has been used for agriculture and grazing, and is currently zoned as PUD. The land east and west of the East Tributary consists of moderate to hilly terrain with slopes ranging from 1% to 15%.

The Soil Conservation Service (SCS) classifies the soils within the study area per Table 3.1.

Table 3.1: SCS Soils Survey for Entire Study Area

Soil No.	Soil	Hydro. Group	Shrink/Swell Potential	Permeability	Surface Runoff Potential	Erosion Hazard
2	Ascalon Sandy Loam (4.7%)	B	Low	Moderate	Low	Moderate
28	Ellicott Loamy	A	Low	Slow	Medium	Moderate

Soil No.	Soil	Hydro. Group	Shrink/Swell Potential	Permeability	Surface Runoff Potential	Erosion Hazard
	Coarse Sand (0.8%)					
43	Kim Loam (0.4%)	B	Low	Moderately Rapid	Medium	Moderate
52	Manzanst Clay Loam (2.2%)	C	High	Slow	Medium	Moderate
56	Nelson-Tassel Fine Sandy Loam (18%)	B	Low	Moderately Rapid	Medium	Moderate to High
75	Razor-Midway Complex (11%)	D	High	Slow	Medium	Moderate to High
78	Sampson Loam (12.7%)	B	Moderate	Slow	Low	Slight
86	Stoneham Sandy Loam (0.7%)	B	Low to Moderate	Moderately Rapid	Medium	Moderate
89	Tassel Fine Sandy Loam (20.9%)	D	Low	Moderately Rapid	Medium	Moderate to High
97	Truckton Sandy Loam (0.6%)	A	Low	Moderately Rapid	Low	Moderate
101	Ustic Torrifluvents Loamy (0.2%)	B	None	Moderately Rapid	Low	Moderate to High
104	Vona Sandy Loam (0.6%)	A	Low	Moderately Rapid	Low	Moderate
105	Vona Sandy Loam (8.6%)	A	Low	Moderately Rapid	Low	Moderate to High
108	Wiley Silt Loam (10.5%)	B	Low to Moderate	Moderate	Medium	Moderate
124	Olnest Sandy Loam (8.1%)	B	Low	Moderate	Low	Moderate to High

Excerpts from the SCS "Soil Survey of El Paso County Area, Colorado" are provided in ***Appendix A*** for further reference.

For the purpose of preparing hydrologic calculations for this report, the soils of each basin have been collected and weighted to determine the composite values for the soil hydrologic group.

An existing electrical easement, within existing transmission towers, runs along the easterly edge of this development south of Bradley Road, then runs diagonally northeasterly to the westerly edge of the site, then continues northerly across Drennan Road, and will be set aside as open space. It is the intent of this master development drainage plan to utilize some of the open space under the towers for detention of storm flows.

Portions of the site are located within the delineated 100-year floodplain of the East Tributary of Jimmy Camp Creek per the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map Panel No.'s 08041CO769G, 08041CO790G and 08041CO976G, dated December 7, 2018. Floodplain designations include Zone AE and

Zone X within the property boundary. A portion of this map is provided in ***Appendix A*** for reference.

As part of this development, the East Tributary channel is being designed and configured to contain the entire 100-year flood within the banks of the channel allowing for freeboard as well. The natural channel has been modified primarily to protect residences, roads, and other structures from the devastating impacts that can result from flooding. Upon completion of the channel redesign a Conditional Letter of Map Revision (CLOMR) will be submitted to FEMA. Channel improvement construction plans will be submitted to El Paso County upon completion.

This MDDP is divided into two (2) distinct locations divided through the center by Bradley Road. The first or north portion has been divided into several onsite basins, designated as EX-N_, the four (4) offsite basins were verified and compared to the previous (MDDP) report prepared by "Kiowa Engineering Corp." All these basins are located north of Bradley Road. The second or south portion of the onsite basins are designated as EX-S_, the eight (8) offsite basins were verified and compared to the (MDDP) report prepared by "Kiowa Engineering Corp." All these basins are located south of Bradley Road. The majority of the area drains naturally to the East Tributary, with some basins flowing offsite to the west to the main stem of JCC or the Franceville Tributary. See the pocket in the back of this report for the existing conditions map. The rational method was used to estimate the runoff from each basin for both 5-year and 100-year storm events except for the seven (7) basins which are larger than 130 acres where the SCS method was utilized (see ***Appendix B*** for calculation and break out of the basins). Following is a description of the Existing Basins and design points:

<u>Basin ET-48a</u>
This offsite basin is located east of Meridian Road and contains 27.54 acres; runoff is directed westerly and northwesterly to a low point in Meridian Road just south of Drennan Road. County records show that an existing 24" culvert crosses Meridian Road but multiple site visits have not confirmed there is an existing culvert to convey runoff west under Meridian Road. Therefore, we have assumed the runoff flows overland across Meridian Road through on-site basin EX-N1 and is routed to design point N1 on the East Tributary. The calculated historic flows are 7.4cfs and 47.7cfs for the 5-year and 100-year storm events respectively. This basin is only the southwesterly portion of Kiowa's MDDP for basin ET-48 (148.48ac.) because offsite areas to the north flow directly west to the East Tributary on the north side of Drennan and do not affect this site. In the future, runoff will be directed via storm sewer/swales westward to a future pond adjacent to the East Tributary (Des.Pt. N1) to mimic the existing basin discharge location and amounts.

<u>Basin EX-N1</u>
This on-site basin is located in the northeast corner of the site, south of Drennan Road and west of Meridian Road, contains 43.58 acres; runoff is directed westerly to the East Tributary of Jimmy Camp Creek. Existing condition flows from this basin are 9.0cfs and 53.4cfs for the 5-year and 100-year storm events respectively. These flows combined with the offsite basin ET-48a flows will be routed to design point N1 on the East Tributary.

<u>Design Point N1</u>
This existing flow design point is located in the northeast corner of the site, south of Drennan Road and west of Meridian Road adjacent to the East Tributary and contains

71.12 acres. The flow is from Basin ET-48a and EX-N1 and is calculated using the xcel spreadsheet rational method. The existing flows are 11.4cfs and 69.4cfs for the 5-year and 100-year storm events respectively. A future pond will be located near this design point.

Basin ET-46a

This offsite basin is located north of Drennan Road and west of Mockingbird Lane, contains 9.57 acres; runoff is directed southerly to an existing 24" CMP located at the low point in Drennan Road. These flows will continue through on-site basin EX-N2 and are routed to design point N2 at the East Tributary of Jimmy Camp Creek. The calculated historic flows are 5.0cfs and 28.2cfs for the 5-year and 100-year storm events respectively.

Basin EX-N2

This on-site basin is located in the north central portion of the site, south of Drennan Road and west of the East Tributary, contains 110.90 acres; runoff is directed easterly to the East Tributary of Jimmy Camp Creek. Existing condition flows from this basin are 21.2cfs and 138.9cfs for the 5-year and 100-year storm events respectively. These flows combined with the offsite basin ET-46a flows will be routed to design point N2 at the East Tributary.

Design Point N2

This existing flow design point is located in the north central portion the site, south of Drennan Road and west of Meridian Road adjacent to the East Tributary and contains 120.47acres. The flow is from Basin ET-46a and EX-N2 and is calculated using the xcel spreadsheet rational method. The existing flows are 24.0cfs and 154.2cfs for the 5-year and 100-year storm events respectively.

Basin ET-38

This offsite basin is located east of Meridian Road and contains 602.40 acres; runoff is directed westerly to two (2) existing 48" CMP's located at a low point in Meridian Road. These flows continue through on-site basin EX-N3 and are routed to design point N3 on the East Tributary of Jimmy Camp Creek. Existing condition flows from this basin are 306.4cfs and 747.7cfs for the 5-year and 100-year storm events respectively using the SCS method. (Kiowa's report for basin ET-38 shows an area of 602.50ac. and a flow of 225.3cfs and 748.7cfs for the 5/100-year storm event.) Flow from Basin ET-38 will be routed directly to the East Tributary via swales/storm sewer.

Basin EX-N3

This on-site basin is located in the center of the site, adjacent to and west of Meridian Road, contains 64.59 acres; runoff is directed westerly to the East Tributary of Jimmy Camp Creek. Existing condition flows from this basin are 17.6cfs and 112.5cfs for the 5-year and 100-year storm events respectively. These flows combined with the offsite basin ET-38 flows will be routed to design point N3 on the East Tributary.

Design Point N3

This existing flow design point is located in the north central portion the site, south of Drennan Road and west of Meridian Road adjacent to the East Tributary and contains 666.99acres. The flow is from Basin ET-38 and EX-N3 and is calculated using the SCS Method. The existing flows are 344.0cfs and 835.7cfs for the 5-year and 100-year storm events respectively.

Basin EX-N4

This basin is located in the south-center of the site, west of the East Tributary of Jimmy Camp Creek and north of Bradley Road, contains 169.59 acres; runoff is directed easterly to the East Tributary, then southerly in the East Tributary of Jimmy Camp Creek to an existing twin 8'x12' CBC at Bradley Road. Existing condition flows from this basin are 25.0cfs and 167.5cfs for the 5-year and 100-year storm events respectively.

Basin ET-32

This offsite basin is located east of Meridian Road, north/south of Bradley Road, and contains 111.97 acres; runoff is directed northwesterly to an existing 30" CMP located at a low point in Meridian Road. These flows continue through on-site basin EX-N5 and are routed to design point N4 on the East Tributary of Jimmy Camp Creek. The calculated historic flows are 33.3cfs and 191.6cfs for the 5-year and 100-year storm events respectively. (Kiowa's report for basin ET-32 shows an area of 112.70ac. and a flow of 88.2cfs and 223.5cfs for the 5/100-year storm event.) In the future, runoff will be directed via storm sewer/swales westward from Meridian Road to the East Tributary to mimic the existing basin discharge location and amounts.

Basin EX-N5

This on-site basin is located north of Bradley Road and east of Meridian Road, contains 81.59 acres; runoff is directed southwesterly to the East Tributary of Jimmy Camp Creek. Existing condition flows from this basin are 19.4cfs and 122.0cfs for the 5-year and 100-year storm events respectively. These flows combine with the offsite basin ET-32 flows and flow south to design point N4 at Bradley Road.

Design Point N4 (existing flows)

This existing flow design point is located on the north side of Bradley Road west of Meridian Road. The flow is from Basin ET-32 and EX-N5, contains 193.56 acres, and is calculated using the SCS Method. The existing flows are 130.1cfs and 301.5cfs for the 5-year and 100-year storm events respectively. The existing flows appear to cross south under Bradley Road in twin 66" RCP culverts and continue flowing southwest to the East Tributary. A future pond will be located near this design point and the discharge will be routed directly west to the East Tributary at which point the two existing 66" RCP's would be abandoned in place. The CLOMR and creek reconstruction by Matrix will include elimination of the existing 66" culverts.

Basin EX-N6

This off-site basin is located in the VA Cemetery north of the site (vacant land) and contains 8.42 acres; runoff is directed overland southerly and continues through on-site basin EX-N7 and is routed to design point N5 at the East Tributary of Jimmy Camp Creek. Existing condition flows from this basin are 2.3cfs and 17.0cfs for the 5-year and 100-year storm events respectively.

Basin EX-N7

This basin is located along the westerly edge of the site and adjacent to the north side Bradley Road, contains 100.60 acres; runoff is directed southeasterly, then easterly to the East Tributary of Jimmy Camp Creek to an existing twin 8'x12' CBC at Des. Pt. ET13. Existing condition flows from this basin are 16.7cfs and 122.8cfs for the 5-year and 100-year storm events respectively. These flows combined with basins EX-N4, EX-N6 and EX-N8 flows at design point ET13 at the East Tributary.

Design Point N5

This existing flow design point is located on the north side of Bradley Road and is the existing flow entering from this site entering the East Tributary from Basin EX-N6 and EX-N7, contains 109.02 acres, and is calculated using the Rational Method. The existing flows are 18.1cfs and 133.2cfs for the 5-year and 100-year storm events respectively. The existing flows enter the East Tributary and flow south under Bradley Road in existing box culverts at Design Point ET-13. A future pond will be located near this design point and will discharge into the East Tributary.

Basin EX-N8

This basin is located in the south-center of the site, west of the East Tributary of Jimmy Camp Creek and north of Bradley Road including a portion of the VA cemetery (vacant land) and the vacant land under the existing electric transmission line, contains 112.67 acres; runoff is directed southerly to an existing twin 8'x12' CBC at Design Point ET13 located in the East Tributary of Jimmy Camp Creek. Existing condition flows from this basin are 20.1cfs and 131.5cfs for the 5-year and 100-year storm events respectively. These flows combined with basins EX-N4, EX-N6 and EX-N7 flows at design point ET13 at the East Tributary.

Basin EX-N9

This basin is located in the northwest corner of the site, south and adjacent to Drennan Road, west of the VA Cemetery, and contains 96.77 acres. Runoff is directed overland westerly and northwesterly to the VA Cemetery property and into the Franceville Tributary which was reconstructed as part of the VA Cemetery improvements. Basin EX-N9 generates a peak flow of 17.6cfs and 109.8cfs for the 5-year and 100-year storm events respectively.

Basin EX-N10

This off-site basin is located in the VA Cemetery north of the site and contains 13.64 acres of vacant land; runoff is directed southwesterly to on-site basin EX-N11. Existing condition flows from this basin are 2.8cfs and 20.2cfs for the 5-year and 100-year storm events respectively.

Basin EX-N11

This basin is located along the west central portion of the site, north and adjacent to Bradley Road, contains 81.68 acres; runoff is directed westerly to the unplatted portion of the Banning-Lewis Ranch development. Existing condition flows from this basin are 18.4cfs and 120.7cfs for the 5-year and 100-year storm events respectively. These flows combined with basin EX-N10 flows will be routed overland westerly to the unplatted vacant portion of the Banning-Lewis Ranch development. Peak runoff from this location should not exceed historic rates.

Design Point N6

This existing flow design point is located in the west portion the site, north of Bradley Road and contains 95.32acres. The flow is from Basin EX-N10 and EX-N11 and is calculated using the rational method. The existing flows are 20.9cfs and 138.8cfs for the 5-year and 100-year storm events respectively. A future pond will be located near this design point and an offsite drainage easement will need to be secured from Banning Lewis Ranch for the pond discharge overland to the west.

Basin EX-S1

This basin is located on the west central portion of the site and is inclusive of Bradley Road, contains 2.05 acres; runoff is directed southwesterly in the roadside ditch within the right of way of Bradley Road. Existing condition flows from this basin are 8.5cfs and 15.3cfs for the 5-year and 100-year storm events respectively. These flows will continue southwesterly within the Bradley Road right of way roadside ditch.

Basin EX-S2

This basin is located at the west-southwest corner of the site, south and adjacent to Bradley Road, contains 11.00 acres. Existing condition flows from this basin are 2.2cfs and 16.3cfs for the 5-year and 100-year storm events respectively. These flows will be routed overland westerly to the unplatted vacant portion of the Banning-Lewis Ranch development. Peak runoff from this location should not exceed historic rates.

Basin EX-S3

This basin is located at the south-southwest portion of the site, south and adjacent to Bradley Road, contains 62.45 acres. Existing condition flows from this basin are 13.4cfs and 88.0cfs for the 5-year and 100-year storm events respectively. These flows will be routed southeasterly to the unplatted vacant portion of the Banning-Lewis Ranch development. Peak runoff from this location should not exceed historic rates.

Basin ET-31

This offsite-basin is located east of Meridian Road extended, adjacent and south of Bradley Road, and contains 28.35 acres; runoff is directed westerly to existing basin EX-S4 and is routed to design point S1. The calculated historic flows are 12.2cfs and 68.1cfs for the 5-year and 100-year storm events respectively. The eastern boundary of this basin is similar to the Kiowa MDDP basin limits. In the future, runoff will be directed via storm sewer/swales westward from Meridian Road to mimic the existing basin discharge location and amounts.

Basin EX-S4

This basin is located in the east-central portion of the site, adjacent and south of Bradley Road and east of Meridian Road extended, contains 84.39 acres; runoff is routed westerly to design point S1 near Bradley Road. Existing condition flows from this basin are 19.4cfs and 116.6cfs for the 5-year and 100-year storm events respectively. These flows combined with the offsite basin ET-31 flows will be routed to design point S1.

Design Point S1

This existing flow design point is located south of Bradley Road and west of Meridian Road under the electric transmission lines and contains 112.74 acres. The flow is from Basin ET-31 and EX-S4 and is calculated using the Rational Method. The existing flows are 23.8cfs and 140.3cfs for the 5-year and 100-year storm events respectively and flows to design point S2.

Design Point S2

This existing flow design point is located south of Bradley Road and west of Meridian Road downstream from design point S1 and contains 306.30 acres. The flow is from Design Points N4 and S1 and is calculated using the SCS Method. The existing flows are 175.7cfs and 413.0cfs for the 5-year and 100-year storm events respectively and flow southwesterly to the East Tributary. In the future runoff from Design Point N4 will be re-routed west directly to the East Tributary which will lower the flow at this design point.

Basin EX-S5
This basin is located in the east-center portion of the site, south of Bradley Road, contains 94.81 acres; runoff is routed westerly and southerly to design point S3 at the East Tributary of Jimmy Camp Creek. Existing condition flows from this basin are 18.0cfs and 112.5cfs for the 5-year and 100-year storm events respectively.

Design Point S3
This existing flow design point is located south of Bradley Road and west of Meridian Road downstream from design point S2 and contains 401.11 acres. The flow is from Design Points N4, S1, S2, Basin EX-S5, and is calculated using the SCS Method. The existing flows are 189.8cfs and 457.2cfs for the 5-year and 100-year storm events respectively and flow southwesterly to the East Tributary at Design Point ET-11. Future ponds will be located near this design point and will discharge into the East Tributary.

Basin EX-S6
This basin is located in the south-central portion of the site, located south of and adjacent to Bradley Road, contains 207.92 acres; runoff is routed southeasterly to Design Point ET-11 on the East Tributary of Jimmy Camp Creek. Existing condition flows from this basin are 21.7cfs and 153.6cfs for the 5-year and 100-year storm events respectively.

Basin ET-28
This offsite-basin is located east of Meridian Road extended, approximately 1700' south of Bradley Road. The existing electrical easement, within existing transmission towers is located on the west side. This basin contains 69.31 acres; runoff is directed westerly and southerly to design point S4a at Meridian Road. The calculated historic flows are 21.2cfs and 125.7cfs for the 5-year and 100-year storm events respectively. (Kiowa's report for basin ET-28 shows an area of 66.30ac. and a flow of 48.2cfs and 129.0cfs for the 5/100-year storm event.) In the future, runoff will be directed via storm sewer/swales westward from Meridian Road to the East Tributary to mimic the existing basin discharge location and amounts.

Basin ET-27
This offsite-basin is located east of Meridian Road extended, approximately 3080' south of Bradley Road. This basin contains 181.14 acres; runoff is directed southerly and westerly to existing basin EX-S7 and is routed to design point S4a at Meridian Road. The calculated historic flows are 32.7cfs and 231.6cfs for the 5-year and 100-year storm events respectively. (Kiowa's report for basin ET-27 shows an area of 145.22ac. and a flow of 52.3cfs and 185.9cfs for the 5/100-year storm event.) In the future, runoff will be directed via storm sewer/swales westward from Meridian Road to the East Tributary to mimic the existing basin discharge location and amounts.

Basin ET-25
This offsite-basin is located east of Meridian Road extended, approximately 4400' south of Bradley Road. This basin contains 127.20 acres; runoff is directed northerly and westerly to existing basin EX-S7 and is routed to design point S4 at the East Tributary of Jimmy Camp Creek. The calculated historic flows are 33.1cfs and 196.5cfs for the 5-year and 100-year storm events respectively. (Kiowa's report for basin ET-25 shows an area of 162.11ac. and a flow of 69.6cfs and 222.0cfs for the 5/100-year storm event.) In the future, runoff will be directed via storm sewer/swales westward from Meridian Road to the East Tributary to mimic the existing basin discharge location and amounts.

Design Point S4a

This existing flow design point is located 3080' south of Bradley Road and west of Meridian Road at the electric transmission lines and contains 377.65acres. The flow is from Basin ET-25, ET-27, and ET-28 and is calculated using the Rational Method. The existing flows are 83.8cfs and 534.8cfs for the 5-year and 100-year storm events respectively and flows to design point S4. The rational method was used for this basin because it matched the offsite flows from the Kiowa MDDP entering Bull Hill better than using the SCS Method which appears to calculate unreasonably high flow rates (See SCS printouts). In the future, runoff will be directed via storm sewer/swales westward from Meridian Road to the East Tributary to mimic the existing basin discharge location and amounts.

Basin ET-24

This offsite-basin is located east of Meridian Road extended, approximately 5365' south of Bradley Road. This basin contains 23.89 acres; runoff is directed southerly and westerly to existing basin EX-S7 and is routed to design point S4 at the East Tributary of Jimmy Camp Creek. The calculated historic flows are 9.1cfs and 52.1cfs for the 5-year and 100-year storm events respectively. In the future, runoff will be directed via storm sewer/swales westward from Meridian Road to the East Tributary to mimic the existing basin discharge location and amounts.

Basin EX-S7

This basin is located along the easterly portion of the site and west of Meridian Road extended, approximately 1700' south of Bradley Road, contains 213.32 acres; this basin accepts flows from offsite basins ET-24, ET-25, ET-27 and ET-28, these flows are then routed southwesterly, then southerly to design point S4 at the East Tributary of Jimmy Camp Creek. Existing condition flows from basin EX-S7 are 22.3cfs and 142.6cfs for the 5-year and 100-year storm events respectively.

Design Point S4

This existing flow design point is located south of Bradley Road at the East Tributary where the East Tributary flows onto Banning Lewis Ranch property and contains 614.86acres. The flow is from Basin ET-24, ET-25, ET-27, ET-28, and EX-S7 and is calculated using the SCS Method. The existing flows are 337.5cfs and 777.1cfs for the 5-year and 100-year storm events respectively entering the East Tributary. Future ponds in this area will discharge into the East Tributary.

Basin ET-19

This offsite-basin is located east of Meridian Road extended, approximately 6225' south of Bradley Road and is immediately east of the southeast portion of this project. This off-basin contains 24.44 acres; runoff is directed westerly to existing basin EX-S8 and is routed to design point S5 on the west boundary of this site. The calculated historic flows are 10.3cfs and 41.7cfs for the 5-year and 100-year storm events respectively. In the future, runoff will be directed via storm sewer/swales westward from Meridian Road to the west to mimic the existing basin discharge location and amounts.

Basin ET-18b

This offsite-basin is located east of Meridian Road extended, approximately 7260' south of Bradley Road and is immediately east of the southeast portion of this project. This off-basin contains 27.69 acres; runoff is directed westerly to existing basin EX-S8 and is routed to design point S5 on the west boundary of this site. The calculated historic flows

are 13.6cfs and 57.2cfs for the 5-year and 100-year storm events respectively. In the future, runoff will be directed via storm sewer/swales westward from Meridian Road to the west to mimic the existing basin discharge location and amounts.

Basin ET-18a

This offsite-basin is located east of Meridian Road extended and east of Lorson Ranch approximately 7930' south of Bradley Road and is the southeast corner of this project. This off-basin contains 16.28 acres; runoff is directed westerly to a swale constructed in Lorson Ranch and then flows northerly to existing basin EX-S8 and is routed to design point S5 on the west boundary of this site. The calculated historic flows are 5.3cfs and 23.8cfs for the 5-year and 100-year storm events respectively. In the future, runoff will be directed via storm sewer/swales westward from Meridian Road to mimic the existing basin discharge location and amounts.

Design Point S5a

This existing flow design point is located 7000' south of Bradley Road at Meridian Road and the electric transmission lines and contains 68.41acres. The flow is from Basin ET-18a, ET-18b, and ET-19 and is calculated using the Rational Method. The existing flows are 22.9cfs and 96.5cfs for the 5-year and 100-year storm events respectively and flows west to design point S5. In the future, runoff will be directed via storm sewer/swales westward from Meridian Road to Design Point 5 to mimic the existing basin discharge location and amounts.

Basin EX-S8

This basin is located in the southeast corner of the site and west of Meridian Road extended, approximately 6225' south of Bradley Road and north of the "Lorson Ranch" development, contains 136.49 acres; this basin accepts flows from offsite basins ET-18a, ET-18b and ET-19, these flows are then routed northwesterly to design point S5 at the west boundary of this site and continues overland across Banning Lewis Ranch to the East Tributary of Jimmy Camp Creek. Existing condition flows from basin EX-S8 are 53.0cfs and 278.5cfs for the 5-year and 100-year storm events respectively.

Design Point S5

This existing flow design point is located in the southwest portion the site where runoff from on-site basins flow overland onto Banning Lewis Ranch property and contains 204.90 acres. The flow is from Basin ET-18a, ET-18b, ET-19, and EX-S8 and is calculated using the rational method. The existing flows are 61.3cfs and 298.0cfs for the 5-year and 100-year storm events respectively. A future pond will be located near this design point and an offsite drainage easement will need to be secured from Banning Lewis Ranch for the pond discharge overland west to the East Tributary. The rational method was used for this basin because it matched the offsite flows from the Kiowa MDDP entering Bull Hill better than using the SCS Method which appears to calculate unreasonably high flow rates (See SCS printouts).

Basin EX-S9

This basin is located in the south section of this project, just north of "Skyline at Lorson Ranch Fil. #1," contains 10.27 acres; runoff is directed southwesterly to the unplatted portion of the Banning-Lewis Ranch development and to the "Lorson Ranch" development. Existing condition flows from basin EX-S9 are 2.1cfs for the 5-year storm event and 13.1cfs for the 100-year storm event. Peak runoff from this location should not exceed historic rates.

Design Point ET9
Design Point ET9 is an existing flow design point located in Banning Lewis Ranch on the East Tributary downstream of Bull Hill/Rolling Meadows located downstream of Design Point S5. The flow at this design point was taken from the Kiowa Engineering DBPS for Jimmy Camp Creek. The existing creek flows are 100cfs and 4220cfs for the 5-year and 100-year storm events respectively.

Design Point ET10
Design Point ET10 is an existing flow design point located in Banning Lewis Ranch on the East Tributary downstream of Bull Hill/Rolling Meadows located downstream of Design Point S4. The flow at this design point was taken from the Kiowa Engineering DBPS for Jimmy Camp Creek. The existing creek flows are 100cfs and 3990cfs for the 5-year and 100-year storm events respectively.

Design Point ET11
Design Point ET11 is an existing flow design point located in Banning Lewis Ranch on the East Tributary downstream of Bull Hill/Rolling Meadows located upstream of Design Point S4. The flow at this design point was taken from the Kiowa Engineering DBPS for Jimmy Camp Creek. The existing creek flows are 90cfs and 2990cfs for the 5-year and 100-year storm events respectively.

Design Point ET12
Design Point ET12 is an existing flow design point located in Bull Hill/Rolling Meadows where the East Tributary flows onto Banning Lewis Ranch. The flow at this design point was taken from the Kiowa Engineering DBPS for Jimmy Camp Creek. The existing creek flows are 90cfs and 2960cfs for the 5-year and 100-year storm events respectively.

Design Point ET13
Design Point ET13 is an existing flow design point at existing twin 8'x12' CBC where the East Tributary flows under Bradley Road. The flow at this design point was taken from the Kiowa Engineering DBPS for Jimmy Camp Creek. The existing creek flows are 80cfs and 2860cfs for the 5-year and 100-year storm events respectively in the box culverts.

Design Point ET14
Design Point ET14 is an existing flow design point north of Bradley Road downstream of Design Point N3 on the East Tributary. The flow at this design point was taken from the Kiowa Engineering DBPS for Jimmy Camp Creek. The existing creek flows are 80cfs and 2640cfs for the 5-year and 100-year storm events respectively in the box culverts.

Design Point ET15
Design Point ET15 is an existing flow design point located on the south side of Drennan Road on the East Tributary. The flow at this design point was taken from the Kiowa Engineering DBPS for Jimmy Camp Creek. The existing creek flows are 50cfs and 1720cfs for the 5-year and 100-year storm events respectively in the box culverts.

4.0 DEVELOPED HYDROLOGICAL CONDITIONS

Under the developed conditions, there will be ten (10) major drainage basins that will drain into the East Tributary and one (1) basin that will drain offsite. Basins A through D

are located south of Bradley Road and basins E, F, G and J through L are located between Drennan Road and Bradley Road. These basins closely mimic the historic drainage patterns and locations and flow rates.

The site will be divided into multiple phases with total build out in the year 2033. The proposed total build-out of this portion of the development will include single-family homes, town homes and apartments; elementary schools and a junior high school.
The runoff coefficient of 0.45 (5-year) and 0.59 (100-year for A & B soils and 0.49 (5-year) and 0.65 (100-year) for the C & D soils were utilized which correspond to 1/8 acres residential lots.

Bradley Road will extend through the center of the development from the west, Drennan Road is located along the north edge of the property and Meridian Road is along the east boundary of this site, all three are considered arterial/collector roadways. There will also be several local and collector roads that will be constructed for access throughout the site. The proposed detention ponds, storm sewer, drainage channels, and diversion swales shown on the plan are schematic in nature and shown for information only. As more of the development is designed in greater detail, localized, detailed drainage plans will need to be created that follow the general plan set forth in this document.

A summary table with the design point developed flows can be found on the Developed Conditions MDDP (master development drainage plan) map in the back pocket of this report. Following is a description of the adjacent offsite drainage conditions that contribute flow to this site and a brief description of the onsite developed basins along with the Design Points:

Some of these offsite basins along Meridian Road have been modified and adjusted to account for flows that overtopped Meridian Road, these flows have been directed within roadside swales to storm drains that carry flow under Meridian Road. Adjusted basin area and peak runoff will be discussed in greater detail in the following paragraphs. These basins will start from the south and continue north.

<u>Basin ET-18a</u>
Offsite Basin ET-18a is an undeveloped offsite basin consisting of 16.28 acres, runoff is directed northerly in a roadside swale or curb in the future Meridian Road to a low point in offsite basin ET-18b (Design Point A1a), located on the east side of Meridian Road. Current flows will be collected and routed via future storm drain in Meridian Road, then westerly and northerly to future proposed Pond A in basin A1. This offsite basin generates a peak 5-yr flow of 5.3cfs and a peak 100-yr flow of 23.8cfs and may be altered by the final design of this area and Meridian Road. Runoff from offsite basin ET-18a will flow through Pond A to the East Tributary.

<u>Basin ET-18b</u>
Offsite Basin ET-18b is an undeveloped offsite basin consisting of 27.69 acres, runoff is directed southerly in a roadside swale or future curb/gutter to a low point in this offsite basin (Design Point A1a), located on the east side of Meridian Road. Current flows will be collected and routed via future storm drain in Meridian Road, then westerly and northerly to future proposed Pond A in basin A1. This offsite basin generates a peak 5-yr flow of 13.6cfs and a peak 100-yr flow of 57.2cfs and may be altered by the final design of this area and Meridian Road. Runoff from offsite basin ET-18b will flow through Pond A to the East Tributary.

Basin ET-19

Offsite Basin ET-19 is an undeveloped offsite basin consisting of 24.44 acres, runoff is directed southerly in a roadside swale or future curb/gutter to a low point in offsite basin ET-18b (Design Point A1a), located on the east side of Meridian Road. Current flows will be collected and routed via future storm drain in Meridian Road, then westerly and northerly to future proposed Pond A in basin A1. This offsite basin generates a peak 5-yr flow of 10.3cfs and a peak 100-yr flow of 41.7cfs and may be altered by the final design of this area and Meridian Road. Runoff from offsite basin ET-18a will flow through Pond A to the East Tributary.

Basin A1

Basin A1 is located at the southeast portion of this development, contains 83.55 acres, and consists of residential development. Runoff from this basin will be directed to the street system, when the flows reach street capacity, they will be intercepted by inlets and collected a storm sewer system and transported downstream to proposed pond A. The proposed storm drain system also contains runoff from Design Point A1a. Basin A1 generates a peak 5-yr flow of 112.7cfs and a peak 100-yr flow of 250.9cfs and may be altered by the final design of this area. Runoff from basin A1 will be routed to Pond A and outlets into the East Tributary by use of the full Spectrum Detention criteria.

Basin A2

Basin A2 is located at the southerly portion of this development, contains 36.38 acres, and consists of residential development. Runoff from this basin will be directed to the street system, when the flows reach street capacity, they will be intercepted by inlets and collected a storm sewer system and transported downstream to proposed pond A. The proposed storm drain system also contains runoff from Design Point A1a. Basin A2 generates a peak 5-yr flow of 56.8cfs and a peak 100-yr flow of 126.4cfs and may be altered by the final design of this area. Runoff from basin A2 will be routed to Pond A and outlets into the East Tributary by use of the full Spectrum Detention criteria.

Basin A3

Basin A3 is located in the southerly portion of this development, contains 12.70 acres, and consists of residential development. Runoff from this basin will be directed to the street system, when the flows reach street capacity, they will be intercepted by inlets and collected a storm sewer system and transported downstream to proposed pond A. Basin A3 generates a peak 5-yr flow of 19.5cfs and a peak 100-yr flow of 43.4cfs and may be altered by the final design of this area. Runoff from basin A3 will be routed to Pond A and outlets into the East Tributary by use of the full Spectrum Detention criteria.

Basin A4

Basin A4 is located in the south and west portion of this development, contains 21.76 acres, and consists of an elementary school and pond. Runoff from this basin will be directed to pond A. Basin A4 generates a peak 5-yr flow of 29.0cfs and a peak 100-yr flow of 78.8cfs and may be altered by the final design of this area. Runoff from basin A4 will be routed to Pond A and outlets into the East Tributary by use of the full Spectrum Detention criteria.

Basin AB

Basin AB is located in the south and west portion of this development, contains 4.81 acres, and consists of open space and the extension of Grayling Drive. Runoff from this basin will be directed overland to Grayling Drive and to Garganey Drive in “Skyline at Lorson Ranch Filing No. 1”. Basin AB generates a peak 5-yr flow of 2.3cfs and a peak

100-yr flow of 10.2cfs and may be altered by the final design of this area. Flows from this basin were included in "Skyline at Lorson Ranch Filing No. 1 (SF 221)" development and include detention and treatment for water quality. The WQ and detention is provided downstream in Pond C3 constructed as part of The Hills at Lorson Ranch (SF211). No modifications of Pond C3 are anticipated for this basin.

Basin ET-24

Offsite Basin ET-24 contains 20.13 acres of offsite undeveloped land, runoff is directed northerly in a roadside swale or future curb/gutter in Meridian Road to a low point in offsite basin ET-25 (Design Point B1), located on the east side of Meridian Road. Current flows will be collected and routed via future storm drain under Meridian Road, then westerly to future proposed Pond B in basin B9. This offsite basin generates a peak 5-yr flow of 10.9cfs and a peak 100-yr flow of 43.1cfs and may be altered by the final design of this area. Runoff from offsite basin ET-24 will flow through Pond B to the East Tributary.

Basin ET-25

Offsite Basin ET-25 contains 123.63 acres of offsite undeveloped land, runoff is directed northerly in a roadside swale to a low point in this offsite basin (Design Point B1), located on the east side of Meridian Road. Current flows will be collected and routed via future storm drain under Meridian Road, then westerly to future proposed Pond B in basin B9. This offsite basin generates a peak 5-yr flow of 33.3cfs and a peak 100-yr flow of 197.7cfs and may be altered by the final design of this area. Runoff from offsite basin ET-25 will flow through Pond B to the East Tributary.

Basin ET-27

Offsite Basin ET-27 contains 176.51 acres of offsite undeveloped land, runoff is directed southerly in a roadside swale to a low point in offsite basin ET-25 (Design Point B1), located on the east side of Meridian Road. Current flows will be collected and routed via future storm drain under Meridian Road, then westerly to future proposed Pond B in basin B9. This offsite basin generates a peak 5-yr flow of 32.3cfs and a peak 100-yr flow of 228.9cfs and may be altered by the final design of this area. Runoff from offsite basin ET-27 will flow through Pond B to the East Tributary.

Basin ET-28

Offsite Basin ET-28 contains 66.06 acres of offsite undeveloped land, runoff is directed southerly in a roadside swale to a low point in this offsite basin, located on the east side of Meridian Road. Current flows will be collected and routed via future storm drain in Meridian Road, to Design Point B1, then westerly to future proposed Pond B in basin B9. This offsite basin generates a peak 5-yr flow of 20.6cfs and a peak 100-yr flow of 122.0cfs and may be altered by the final design of this area. Runoff from offsite basin ET-28 will flow through Pond B to the East Tributary.

Basin B1

Basin B1 is located at the east-center portion of this development, adjacent to Meridian Road and contains 9.10 acres of residential development. Runoff from this basin will be directed to the street system, when the flows reach street capacity, they will be intercepted by inlets and collected a storm sewer system and transported downstream via the storm system and a proposed channel to proposed pond B. Basin B1 generates a peak 5-yr flow of 17.4cfs and a peak 100-yr flow of 38.7cfs and may be altered by the final design of this area. Runoff from basin B1 will be routed to Pond B and outlets into the East Tributary by use of the full Spectrum Detention criteria.

Basin B2
Basin B2 is located at the east-center portion of this development, adjacent to Meridian Road and contains 52.04 acres of residential land and open space. Runoff from this basin will be directed to the street system, when the flows reach street capacity, they will be intercepted by inlets and collected a storm sewer system and transported downstream via the storm system and a proposed channel to proposed pond B. Basin B2 generates a peak 5-yr flow of 61.9cfs and a peak 100-yr flow of 137.7cfs and may be altered by the final design of this area. Runoff from basin B2 will be routed to Pond B and outlets into the East Tributary by use of the full Spectrum Detention criteria.

Basin B3
Basin B3 is located at the east-center portion of this development and contains 5.02 acres of residential land. Runoff from this basin will be directed to the street system, when the flows reach street capacity, they will be intercepted by inlets and collected a storm sewer system and transported downstream via the storm system and a proposed channel to proposed pond B. Basin B3 generates a peak 5-yr flow of 8.6cfs and a peak 100-yr flow of 19.0cfs and may be altered by the final design of this area. Runoff from basin B3 will be routed to Pond B and outlets into the East Tributary by use of the full Spectrum Detention criteria.

Basin B4
Basin B4 is located at the east-center portion of this development, and a portion is adjacent to Meridian Road and contains 38.33 acres of residential land and open space. Runoff from this basin will be directed to the street system, when the flows reach street capacity, they will be intercepted by inlets and collected a storm sewer system and transported downstream via the storm system and a proposed channel to proposed pond B. Basin B4 generates a peak 5-yr flow of 48.4cfs and a peak 100-yr flow of 107.8cfs and may be altered by the final design of this area. Runoff from basin B4 will be routed to Pond B and outlets into the East Tributary by use of the full Spectrum Detention criteria.

Basin B5
Basin B5 is located at the east-center portion of this development, adjacent to Meridian Road and contains 24.58 acres of open space and Meridian Road. Runoff from this basin will be directed to the street system, when the flows reach street capacity, they will be intercepted by inlets and collected a storm sewer system and transported downstream via the storm system and a proposed channel to proposed pond B. Basin B5 generates a peak 5-yr flow of 31.8cfs and a peak 100-yr flow of 70.8cfs and may be altered by the final design of this area. Runoff from basin B5 will be routed to Pond B and outlets into the East Tributary by use of the full Spectrum Detention criteria.

Basin B6
Basin B6 is located at the west-center portion of this development and contains 21.06 acres of residential land. Runoff from this basin will be directed to the street system. When the flows reach street capacity, 1they will be intercepted by inlets and collected a storm sewer drain system and transported downstream via the storm system to proposed pond B. Basin B6 generates a peak 5-yr flow of 31.8cfs and a peak 100-yr flow of 70.4cfs and may be altered by the final design of this area. Runoff from basin B6 will

be routed to Pond B and outlets into the East Tributary by use of the full Spectrum Detention criteria.

Basin B7

Basin B7 is located at the west-center portion of this development and contains 41.68 acres of residential land. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected a storm drain sewer system and transported downstream via the storm system to proposed pond B. Basin B7 generates a peak 5-yr flow of 53.4cfs and a peak 100-yr flow of 119.6fs and may be altered by the final design of this area. Runoff from basin B7 will be routed to Pond B and outlets into the East Tributary by use of the full Spectrum Detention criteria.

Basin B8

Basin B8 is located at the west-center portion of this development adjacent to the east tributary and contains 15.94 acres. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected a storm drain sewer system and transported downstream via the storm system to proposed pond B. Basin B8 generates a peak 5-yr flow of 21.8cfs and a peak 100-yr flow of 47.9cfs and may be altered by the final design of this area. Runoff from basin B8 will be routed to Pond B and outlets into the East Tributary by use of the full Spectrum Detention criteria.

Basin B9

Basin B9 is located at the west-center portion of this development adjacent to the east tributary and contains 21.25 acres of residential land and Pond B. This basin encompasses Proposed Pond B and runoff from this basin will be directed to this proposed pond. Basin B9 generates a peak 5-yr flow of 9.0cfs and a peak 100-yr flow of 47.8cfs and may be altered by the final design of this area. Runoff from basin B9 will be routed to Pond B and outlets into the East Tributary by use of the full Spectrum Detention criteria.

Basin C1

Basin C1 is located south of Bradley Road and consists of nearly 12 acres within a school site. The school site will provide a full spectrum detention/water quality pond within this basin prior to discharge into a storm sewer system draining to Pond C. Runoff from this basin will be directed to Pond C1 which the school will build and is a full spectrum WQ/Detention pond. Basin C1 generates a peak 5-yr flow of 29.1cfs and a peak 100-yr flow of 57.8cfs and may be altered by the final design of this area. Runoff from Basin C1 will be routed to Pond C1 and outlets westward into Pond C which drains into the East Tributary.

Basin C2

Basin C2 is located at the north-center portion of this development, south of Bradley Road and contains 118.78acres of residential land and open space. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected a storm sewer system and transported downstream to proposed pond C. Basin C2 generates a peak 5-yr flow of 187.2cfs and a peak 100-yr flow of 404.0cfs and may be altered by the final design of this area. Runoff

from basin C2 will be routed to Pond C and outlets into the East Tributary by use of the full Spectrum Detention criteria.

Basin C3

Basin C3 is located at the west-center portion of this development, adjacent to the east tributary, south of Bradley Road and contains 32.38 acres of commercial, residential land, and Pond C. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected a storm sewer system and transported downstream to proposed pond C and outlets into the East Tributary by use of the full Spectrum Detention criteria. Basin C3 generates a peak 5-yr flow of 42.5cfs and a peak 100-yr flow of 89.5cfs and may be altered by the final design of this area.

Basin ET-31

Offsite Basin ET-28 contains 28.35 acres of offsite undeveloped land, runoff is directed to a low point in this offsite basin, located on the east side of Meridian Road. Current flows will be collected and routed via future storm drain under Meridian Road, and with runoff from Basin D2 they will be directed westerly in a storm drain system to the East Tributary of Jimmy Camp Creek. This offsite basin generates a peak 5-yr flow of 12.2cfs and a peak 100-yr flow of 68.1cfs and may be altered by the final design of this area.

Basin D1

Basin D1 is located at the northerly portion, adjacent to and south of Bradley Road, contains 69.37 acres of residential land. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected by a storm sewer system and transported downstream to proposed pond D1. Basin D1 generates a peak 5-yr flow of 111.7cfs and a peak 100-yr flow of 246.1cfs and may be altered by the final design of this area. Runoff from basin D1 will be routed through Pond D1 by use of the full Spectrum Detention criteria and outlets into a proposed drainage channel then continues to the East Tributary.

Basin D2

Basin D2 is located at the northerly portion, adjacent to and south of Bradley Road, contains 11.73 acres of open space and a proposed electric substation. Runoff from this basin will be directed to a storm sewer system along with Pond D outflow. Basin D2 generates a peak 5-yr flow of 12.7cfs and a peak 100-yr flow of 36.7cfs and may be altered by the final design of this area. The electric substation will provide an on-site full spectrum detention/water quality pond prior to discharge into the downstream storm sewer system.

Basin D3

Basin D3 is located at the northerly portion, adjacent to and south of Bradley Road, contains 4.09 acres of swale/road. Flows from Basin D3 will be routed to the East Tributary of Jimmy Camp Creek via proposed drainage Swale D. Basin D3 generates a peak 5-yr flow of 13.7cfs and a peak 100-yr flow of 24.6cfs and may be altered by the final design of this area. Water quality will need to be provided for this basin within the swale or other water quality structures prior to discharge into the East Tributary.

Basin D4

Not used at this time

Basin D5
Basin D5 is located at the westerly portion south of Bradley Road, contains 43.05 acres of open space and the East Tributary. Runoff from this basin is directly into the East Tributary. Basin D5 generates a peak 5-yr flow of 8.2cfs and a peak 100-yr flow of 55.1cfs and may be altered by the final design of this area.

Basin ET-32
Offsite Basin ET-32 contains 111.97 acres of offsite undeveloped land south of Bradley Road and rural lots (RR5) north of Bradley Road. Runoff is directed to a low point in this offsite basin located on the east side of Meridian Road north of Bradley Road at Design Point E1a. Current flows will be collected and routed via an existing pipe and/or a future storm drain under Meridian Road, and with runoff from Basin E3 flows will be directed to a storm drain system to Pond E1. This offsite basin generates a peak 5-yr flow of 33.3cfs and a peak 100-yr flow of 191.6cfs and may be altered by the final design of this area.

Basin E1
Basin E1 is located at the east-center portion, adjacent to and north of Bradley Road, west of Meridian Road and contains 75.97 acres of residential land. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected by a storm sewer system and transported south to proposed pond E1 located in this basin. Basin E1 generates a peak 5-yr flow of 90.9cfs and a peak 100-yr flow of 202.4cfs and may be altered by the final design of this area. Runoff from basin E1 will be routed through Pond E1 by use of the full Spectrum Detention criteria and outlets from this pond into the East Tributary.

Basin E2
Basin E2 is located at the east-center portion, north of Bradley Road, adjacent to and west of Meridian Road, and contains 21.94 acres of residential land. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected by a storm sewer system and transported downstream to proposed pond E1 located in basin E1. Basin E2 generates a peak 5-yr flow of 39.7cfs and a peak 100-yr flow of 88.9cfs and may be altered by the final design of this area. Runoff from basin E2 will be routed through Pond E1 by use of the full Spectrum Detention criteria and outlets from this pond into the East Tributary.

Basin E3
Basin E3 is located at the east-center portion, adjacent to and north of Bradley Road, adjacent to and west of Meridian Road, and contains 34.58 acres. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected by a storm sewer system and transported downstream to proposed Pond E1 located in basin E1. Basin E3 generates a peak 5-yr flow of 43.7cfs and a peak 100-yr flow of 97.8cfs and may be altered by the final design of this area. Runoff from basin E3 will be routed through Pond E1 by use of the full Spectrum Detention criteria and outlets from this pond into the East Tributary.

Basin ET-38
Offsite Basin ET-38 contains 602.40 acres of rural residential (RR5) land. Runoff is directed in a roadside swale to a low point in offsite basin ET-38, located on the east side of Meridian Road at Design Point E3a. Current flows will be collected and routed via future storm drain under Meridian Road, then westerly to the East Tributary. This offsite basin generates a peak 5-yr flow of 306.4cfs and a peak 100-yr flow of 747.7cfs

and may be altered by the final design of this area. Runoff from offsite basin ET-38 will flow by drainage channel and storm drain system directly to the East Tributary.

Basin F1

Basin F1 is located at the east-center portion, south of Drennan Road, and west of Meridian Road, contains 20.84 acres of residential land. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected by a storm sewer system and transported downstream to proposed pond F1 located in basin F1. Basin F1 generates a peak 5-yr flow of 34.5cfs and a peak 100-yr flow of 76.9cfs and may be altered by the final design of this area. Runoff from basin F1 will be routed through Pond F1 by use of the full Spectrum Detention criteria and outlets from this pond into the East Tributary.

Basin ET-48a

Offsite Basin ET-38 contains 27.54 acres of rural residential (RR5) land. Runoff is directed in a roadside swale to a low point in offsite basin ET-48a, located on the east side of Meridian Road. Current flows will be collected and routed via future storm drain under Meridian Road to the East Tributary. This offsite basin generates a peak 5-yr flow of 7.4cfs and a peak 100-yr flow of 47.7cfs and may be altered by the final design of this area. Runoff from offsite basin ET-48a can be allowed to flow through Pond F2 to the East Tributary if necessary.

Basin F2

Basin F2 is located at the north-east portion of the site, corner of Drennan Road, and Meridian Road, contains 6.25 acres. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected by a storm sewer system and transported downstream to proposed pond F1 located in basin F1. Basin F1 generates a peak 5-yr flow of 12.0cfs and a peak 100-yr flow of 26.5cfs and may be altered by the final design of this area. Runoff from basin F2 will be routed through Pond F2 by use of the full Spectrum Detention criteria and outlets from this pond into the East Tributary.

Basin F3

Basin F3 is located at the north-east portion of the site, south of Drennan Road, west and adjacent to Meridian Road, contains 19.80 acres of residential land. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected by a storm sewer system and transported downstream to proposed Pond F1 located in Basin F1. Basin F3 generates a peak 5-yr flow of 33.0cfs and a peak 100-yr flow of 73.4cfs and may be altered by the final design of this area. Runoff from basin F3 will be routed through Pond F1 by use of the full Spectrum Detention criteria and outlets from this pond into the East Tributary.

Basin F4

Basin F4 is located at the east, north-east portion of the site, south of Drennan Road, west and adjacent to Meridian Road, contains 8.84 acres. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected by a storm sewer system and transported downstream to proposed Pond F1 located in Basin F1. Basin F4 generates a peak 5-yr flow of 16.9cfs and a peak 100-yr flow of 37.7cfs and may be altered by the final design of this area. Runoff from basin F4 will be routed through Pond F1 by use of the full Spectrum Detention criteria and outlets from this pond into the East Tributary.

Basin F5

Basin F5 is located at the east, north-east portion of the site, south of Drennan Road, west and adjacent to Meridian Road, contains 13.51 acres of residential land. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected by a storm sewer system and transported downstream to proposed Pond F1 located in Basin F1. Basin F5 generates a peak 5-yr flow of 21.6cfs and a peak 100-yr flow of 48.5cfs and may be altered by the final design of this area. Runoff from basin F4 will be routed through Pond F1 by use of the full Spectrum Detention criteria and outlets from this pond into the East Tributary.

Basin G

Basin G is located at the east-center portion, north of Bradley Road, adjacent to and west of Meridian Road, and contains 5.23 acres from the proposed swale. No backyard runoff will enter the swale. Runoff from this basin will be directed to the East Tributary by a drainage channel and storm drain system. Basin G generates a peak 5-yr flow of 7.1cfs and a peak 100-yr flow of 15.6cfs and may be altered by the final design of this area.

Basin J1

Basin J1 is located at the west-center portion, adjacent to and north of Bradley Road, and contains 15.00 acres of residential land. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected by a storm sewer system and transported downstream to proposed Pond J located in basin J2. Basin J1 generates a peak 5-yr flow of 19.2cfs and a peak 100-yr flow of 54.0cfs and may be altered by the final design of this area. Runoff from basin J2 will be routed through Pond J by use of the full Spectrum Detention criteria and outlets from this pond via historic flow patterns.

Basin J2

Basin J2 is located at the west-center portion, adjacent to and north of Bradley Road, and contains 61.86 acres of residential land. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected by a storm sewer system and transported downstream to proposed Pond J located in this basin. Basin J2 generates a peak 5-yr flow of 79.3cfs and a peak 100-yr flow of 173.5cfs and may be altered by the final design of this area. Runoff from basin J2 will be routed through Pond J by use of the full Spectrum Detention criteria and outlets from this pond via historic flow patterns.

Basin K

Basin K is located at the center portion, adjacent to and north of Bradley Road, and contains 75.88 acres of residential land and a middle school. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected by a storm sewer system and transported downstream to proposed Pond K. Basin K generates a peak 5-yr flow of 92.5cfs and a peak 100-yr flow of 203.6cfs and may be altered by the final design of this area. Runoff from basin K will be routed through Pond K by use of the full Spectrum Detention criteria and outlets from this pond into the East Tributary.

Basin L1

Basin L1 is located at the center portion, north of Bradley Road, and contains 36.95 acres of residential land. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected by

a storm sewer system and transported downstream to proposed Pond L, located in Basin L2. Basin L1 generates a peak 5-yr flow of 53.4cfs and a peak 100-yr flow of 117.6cfs and may be altered by the final design of this area. Runoff from Basin L1 will be routed through Pond L by use of the full Spectrum Detention criteria and outlets from this pond into the East Tributary.

Basin L2

Basin L2 is located at the center portion, and north of Bradley Road, and contains 48.87 acres of residential land, open space under powerlines, and future residential development. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected by a storm sewer system and transported downstream to proposed Pond L, located in this basin. Basin L2 generates a peak 5-yr flow of 65.8cfs and a peak 100-yr flow of 145.6cfs and may be altered by the final design of this area. Runoff from basin L2 will be routed through Pond L by use of the full Spectrum Detention criteria and outlets from this pond into the East Tributary.

Basin L3

Basin L3 is located at the center portion, and north of Bradley Road, and contains 50.27 acres of residential land, open space under powerlines, and future residential development. Runoff from this basin will be directed to the street system. When the flows reach street capacity, they will be intercepted by inlets and collected by a storm sewer system and transported downstream to proposed Pond L, located in Basin L2. Basin L3 generates a peak 5-yr flow of 38.9cfs and a peak 100-yr flow of 120.5cfs and may be altered by the final design of this area. Runoff from basin L3 will be routed through Pond L by use of the full Spectrum Detention criteria and outlets from this pond into the East Tributary.

Basin M

Basin M is located at the center portion, and south of Drennan Road, and contains 95.89 acres of open space which includes the East Tributary. Runoff from this basin is directly tributary to the East Tributary. Basin M generates a peak 5-yr flow of 16.2cfs and a peak 100-yr flow of 103.0cfs and may be altered by the final design of this area.

4.1 DEVELOPED CONDITIONS DESIGN POINTS

Design Point A1a

Design Point A1a is located on Meridian Road at a low point north of Lorson Ranch. Flow at this design point is from offsite areas to the east and south and will be collected by the future Meridian Road and storm sewer system. The total flow at this design point is 22.9cfs/96.5cfs in the 5-year/100-year storm event. A 42-inch storm sewer will be constructed in Meridian Road and BH Collector 1 to convey the runoff west to Pond A for detention/WQ treatment.

Design Point A2a

Design Point A2a is located on BH Collector 1 at a low point east of Pond A. Flow at this design point is from Des. Pt. A1a and Basin A1. The total flow at this design point is 135.6cfs/347.4cfs in the 5-year/100-year storm event by adding the two flows together. A 66-inch storm sewer will convey runoff from Bull Hill Road west to Pond A for detention/WQ treatment.

Design Point A3a
Design Point A3a is located on the south side of Pond A. Flow at this design point is from Des. Pt. A2a and Basin A2. The total flow at this design point is 192.4cfs/473.8cfs in the 5-year/100-year storm event by adding the two flows together. A 72-inch storm sewer will convey runoff west to Pond A for detention/WQ treatment.

Design Point A4a
Design Point A4a is located on the west side of Pond A and is the outflow from Pond A. The total flow at this design point is 86.1cfs/285.6cfs in the 5-year/100-year storm event. The pond outflow from the design spreadsheets is similar to the existing runoff at this point (Des.Pt. S5) of 61.3cfs/298.00cfs in the 5-year/100-year storm event. Swale 'A' will convey the flow west to the East Tributary. The design event for Swale 'A' is set at the un-detained inflow to Pond A which is 520cfs in the 100-year storm event. Swale 'A' is located on adjacent Banning Lewis Ranch land and an easement will be secured for construction and maintenance of the swale. Swale 'A' is a trapezoid swale with a 10' bottom, 4:1 sides, 0.2% slope, and a minimum depth of 5.5' to keep velocities under 6fps.

Design Point B1a
Design Point B1a is located on Meridian Road at a low point halfway from Lorson Ranch to Bradley Road. Flow at this design point is from offsite areas to the east and south and will be collected by the future Meridian Road and storm sewer system. The total flow at this design point is 79.9cfs/492.3cfs in the 5-year/100-year storm event. A twin 5'x7' RC box culvert will be constructed under Meridian Road to convey the runoff west in Swale B1/B2 to Pond B for detention/WQ treatment.

Design Point B2a
Design Point B2a is located north of a low point in BH Collector 1 east of Pond B. Flow at this design point is from Basin B1 and B2. The total flow at this design point is 73.4cfs/163.3cfs in the 5-year/100-year storm event. A storm sewer will convey runoff downstream to Design Pont B3a.

Design Point B3a
Design Point B3a is located at a low point in BH Collector 1 east of Pond B. Flow at this design point is from Basin B1, B2, and B3. The total flow at this design point is 79.2cfs/176.2cfs in the 5-year/100-year storm event. A storm sewer will convey runoff into the downstream wingwall of the box culvert under BH Collector 1 and into Swale B2 then downstream to Pond B for detention /WQ treatment.

Design Point B4a
Design Point B4a is located in Swale B1 east of a low point in BH Collector 1 east of Pond B and will be used to design Swale B1 and the box culvert under BH Collector 1. Flow at this design point is from Des. Pt B1a and Basin B5. The total flow at this design point is 98.2cfs/527.1cfs in the 5-year/100-year storm event. A twin 5'x7' RC box culvert will be constructed under BH Collector 1 to convey the runoff west into Swale B2 to Pond B for detention/WQ treatment. Swale 'B1' is a trapezoid swale with an 8' bottom, 4:1 sides, 0.4% slope, and a minimum depth of 5'. Drop structures will be required in the swale due to maintain the design slope.

Design Point B5a

Design Point B5a is located in Swale B2 west of a low point in BH Collector 1 east of Pond B. Flow at this design point is from Des. Pt B1a and Basins B1-B5. The total flow at this design point is 184.7cfs/718.9cfs in the 5-year/100-year storm event. Swale 'B2' is a trapezoid swale with an 8' bottom, 4:1 sides, 0.4% slope, and a minimum depth of 5'. Swale 'B1' is a trapezoid swale with an 8' bottom, 4:1 sides, 0.4% slope, and a minimum depth of 5' draining west to Pond B. Drop structures will be required in the swale due to maintain the design slope.

Design Point B6a

Design Point B6a is located on the south side of Pond B and is the outflow from Pond B. The total pond outflow at this design point is 129.1cfs/419.1cfs in the 5-year/100-year storm event which outlets into Swale 'A' to convey flow west to the East Tributary.

Design Point B7a

Design Point B7a is located on the south side of Pond B in Swale A and is the outflow from Pond B and Pond A. Swale 'A' will convey the flow west to the East Tributary. The design event for Swale 'A' is set at the un-detained inflow to Pond A and Pond B which is (520.2+769.4cfs) 1,289.6 in the 100-year storm event. Swale 'A' is located on adjacent Banning Lewis Ranch land and an easement will be secured for construction and maintenance of the swale. Swale 'A' is a trapezoid swale with a 10' bottom, 4:1 sides, 0.1% slope, and a minimum depth of 7' to keep velocities under 6fps.

Design Point C1a

Design Point C1a is located on the south side of Pond C and is the outflow from Pond C. The total pond outflow at this design point is 21.6cfs/172.8cfs in the 5-year/100-year storm event which outlets west directly to the East Tributary.

Design Point D1a

Design Point D1a is located on the west side of Pond D and is the outflow from Pond D. The total pond outflow at this design point is 15.5cfs/109.9cfs in the 5-year/100-year storm event. The pond outflow has split flows that drain west. The WQ/EURV flows are directed overland to Design Point D2a to a storm sewer system which collects the outflow. Flows above the EURV will be directed NW via a weir into Swale D which flows west to the East Tributary. The emergency overflow for Pond D will be directed northwest to Swale 'D' to convey the overflow west directly to the East Tributary. The emergency overflow to Swale 'D' is designed for the un-detained inflow to Pond D which is 260.5cfs.

Design Point D2a

Design Point D2a is located on the southwest side of Pond D in Basin D2 and is the EURV outflow (6.9cfs) from Pond D and runoff from Basin D2. A storm sewer will convey the flow southwest to Pond C. The total undetained flow at this design point is 19.6cfs/43.6cfs in the 5-year/100-year storm event. The electric substation within this basin will be required to provide an on-site full spectrum WQ/Detention pond for their site.

Design Point D3a

Not used

Design Point D4a

Design Point D4a is located at BH Collector 1 and Bradley Road and will be used to design Swale 'D' and the storm sewer under BH Collector 1. Flow at this design point is from Pond D emergency overflow (260.5cfs). Twin 48" RCP culverts will be constructed under BH Collector 1 to convey the runoff west in Swale 'D' directly to the East Tributary. Swale 'D' is a trapezoid swale with a 5' bottom, 4:1 sides, 0.3% slope, and a minimum depth of 4'.

Design Point E1a

Design Point E1a is located on Meridian Road at a low point north of Bradley Road. Flow at this design point is from offsite Basin ET-32. The existing culvert is undersized and will need to be replaced. The total flow at this design point is 33.3cfs/191.6cfs in the 5-year/100-year storm event. A 54-inch storm sewer will be constructed under Meridian Road to convey the runoff west. Runoff has been routed to Pond E1 similar to existing conditions but could be routed directly to the East Tributary in the future.

Design Point E2a

Design Point E2a is located on the south side of Pond E1 and is the outflow from Pond E1. The total pond outflow at this design point is 44.7cfs/235.1cfs in the 5-year/100-year storm event which will flow west directly to the East Tributary on the north side of Bradley Road. The twin 66" culverts at this design point under Bradley Road will be abandoned and all pond outflow will be routed west to the East Tributary. The CLOMR and Creek construction prepared by Matrix can be referenced for further information on the hydraulic design of the creek and tributary areas and for the culvert abandonment.

Design Point E3a

Design Point E3a is located on Meridian Road at a low point 2,600 feet north of Bradley Road. Flow at this design point is from offsite Basin ET-38. The existing twin 48" CMP culverts are undersized and will need to be replaced. The total flow at this design point is 306.4cfs/747.7cfs in the 5-year/100-year storm event. Twin 5'x7' RC box culverts will be constructed under Meridian Road to convey the offsite runoff west in Swale 'E' directly to the East Tributary.

Design Point E4a

Design Point E4a is located on RM Collector 3 at a low point 2,600 feet north of Bradley Road. Flow at this design point is from offsite Basin ET-38 in Swale 'E'. The total flow at this design point is 306.4cfs/747.7cfs in the 5-year/100-year storm event. Twin 5'x7' RC box culverts will be constructed under RM Collector 3 to convey the offsite runoff west in Swale 'E' directly to the East Tributary. Swale 'E' is a trapezoid swale with an 8' bottom, 4:1 sides, 0.4% slope, and a minimum depth of 5'. Drop structures will be required in the swale due to maintain the design slope.

Design Point F1a

Design Point F1a is located on the south side of Pond F1 and is the outflow from Pond F1. The total pond outflow at this design point is 8.7cfs/77.7cfs in the 5-year/100-year storm event which outlets west directly to the East Tributary.

Design Point F2a

Design Point F2a is located on Meridian Road at the south side of Drennan Road. Flow at this design point is from offsite Basin ET-48a. The existing culvert could not be found at this location but a new 30" culvert is required to convey flow west under Meridian. The total flow at this design point is 7.4cfs/47.7cfs in the 5-year/100-year storm event.

The flow is proposed to be direct west directly to the East Tributary via a swale but could be routed into Pond F2.

Design Point F3a

Design Point F3a is located on the west side of Pond F2 and is the outflow from Pond F2. The total pond outflow at this design point is 1.1cfs/13.2cfs in the 5-year/100-year storm event which outlets west directly to the East Tributary.

Design Point J1a

Design Point J1a is located on the west side of Pond J and is the outflow from Pond J. The total flow at this design point is 12.8cfs/116.3cfs in the 5-year/100-year storm event. The pond outflow from the design spreadsheets is less than the existing runoff at this point (Des.Pt. N6) of 20.9cfs/138.8cfs in the 5-year/100-year storm event. The existing and proposed flows from this pond are directed west to Banning Lewis Ranch land which will require a spreader to diffuse point discharge from the pond outlet. A easement will be secured for drainage flowing offsite to the west.

Design Point K1a

Design Point K1a is located on the east side of Pond K and is the outflow from Pond K. The total pond outflow at this design point is 10.2cfs/116.0cfs in the 5-year/100-year storm event which outlets east directly to the East Tributary.

Design Point L1a

Design Point L1a is located on the east side of Pond L and is the outflow from Pond L. The total pond outflow at this design point is 25.8cfs/202.9cfs in the 5-year/100-year storm event which outlets east directly to the East Tributary.

Design Point ET13

Design Point ET13 is located on the East Tributary of Jimmy Camp Creek and comprises of an existing twin 8'x12' RC Box Culvert. Based on information in the Kiowa 2014 DBPS the existing culverts are undersized. As part of the East Tributary CLOMR improvements the capacity of the culverts will need to be increased as well. The capacity improvements are unknown at this time of this report but Matrix Design Group is currently designing the CLOMR improvements.

5.0 DRAINAGE AND BRIDGE FEES

Bull Hill / Rolling Meadows is located within the Jimmy Camp Creek drainage basin which is currently a fee basin in El Paso County. Current El Paso County regulations require drainage and bridge fees to be paid for platting of land. However, The Landhuis Company is currently submitting a request to close the Jimmy Camp Basin in El Paso County. Therefore, drainage/bridge fees may not be necessary and construction of the major drainage infrastructure on the East Tributary will be completed with this subdivision.

6.0 DETENTION AND WATER QUALITY POND

The purpose of this MDDP is to provide an overview of the overall drainage impacts/mitigation due to development in the proposed Bull Hill / Rolling Meadows Development along the East Tributary. It is recommended to construct larger local detention ponds to reduce the developed runoff at or below historic runoff rates. Also included within the detention ponds are provisions for storm water quality as required by El Paso County DCM, Volume 2 [4].

There is existing 325 foot electrical transmission line easement that meanders through the site in a north-south direction. Grading and improvements within the easement shall not adversely affect the existing power poles and should be at existing grade or lower as to not raise the grade under the power lines.

The detention ponds are full spectrum ponds including water quality provisions and have been designed per the Xcel spreadsheet MHFD-Detention, Version 4.06 from the MHFD. See Table 6.1 and 6.2 below for the required volumes of the 5-year, 100-year, and Water Quality Captured Volume (WQCV) and the allowable release rates of each pond. Please see the plan in the back pocket of this report for the location. The detention ponds shown are schematic and will need to be designed with greater detail when the localized plans are designed.

Table 6.1: Detention Pond Areas and Imperviousness

Pond	Offsite Area at 2% Impervious (Ac)	Elec. Esmt open space at 2% Impervious (Ac)	Ponds/parks at 2% Impervious (Ac)	Residential at 65% Impervious (Ac)	Comm at 90% Impervious (Ac)	Total Pond Tributary Area (Ac)	Percent Impervious
Pond A	68.4		24.4	130		222.8	39%
Pond B	386.3	35.8	17.8	175.4		615.3	20%
Pond C		21.0		129.2	7.8	158.0	58%
Pond C1				12.0	(school)	12.0	80%
Pond D	28.4			68.9		97.3	47%
Pond E1	112.0			132.5		244.5	36%
Pond F1				63.0		63.0	65%
Pond F2				7.0		7.0	65%
Pond J	13.6			76.9		90.5	56%
Pond K				76.0		76.0	65%
Pond L	8.4	42.8		93.5		144.7	43%

Table 6.2: Detention Pond Data

Pond	WQCV (Ac-ft)	5-year Volume (Ac-ft)	100-year Volume (Ac-ft)	Release Rate 5-year (cfs)	Release Rate 100-year (cfs)
Pond A	3.323	8.119	17.343	86.1	285.6
Pond B	5.965	12.837	36.044	129.1	419.1
Pond C	3.043	10.327	18.255	21.6	172.8
Pond C1	0.329	1.069	1.360	1.2	18.2
Pond D1	1.611	5.708	9.840	15.5	109.8
Pond E1	3.454	10.794	17.411	44.7	235.1
Pond F1	1.334	4.724	7.240	8.7	77.7
Pond F2	0.149	0.49	0.621	1.1	13.2
Pond J	1.700	5.956	9.587	12.8	116.3
Pond K	1.619	5.557	7.777	10.2	116.0
Pond L	2.265	7.339	12.243	25.8	202.9

7.0 CONCLUSIONS

This drainage report has been prepared in accordance with the City of Colorado Springs/El Paso County Drainage Criteria Manual. The proposed development and drainage infrastructure will not cause adverse impacts to adjacent properties or properties located downstream. Several key aspects of the development discussed above are summarized as follows:

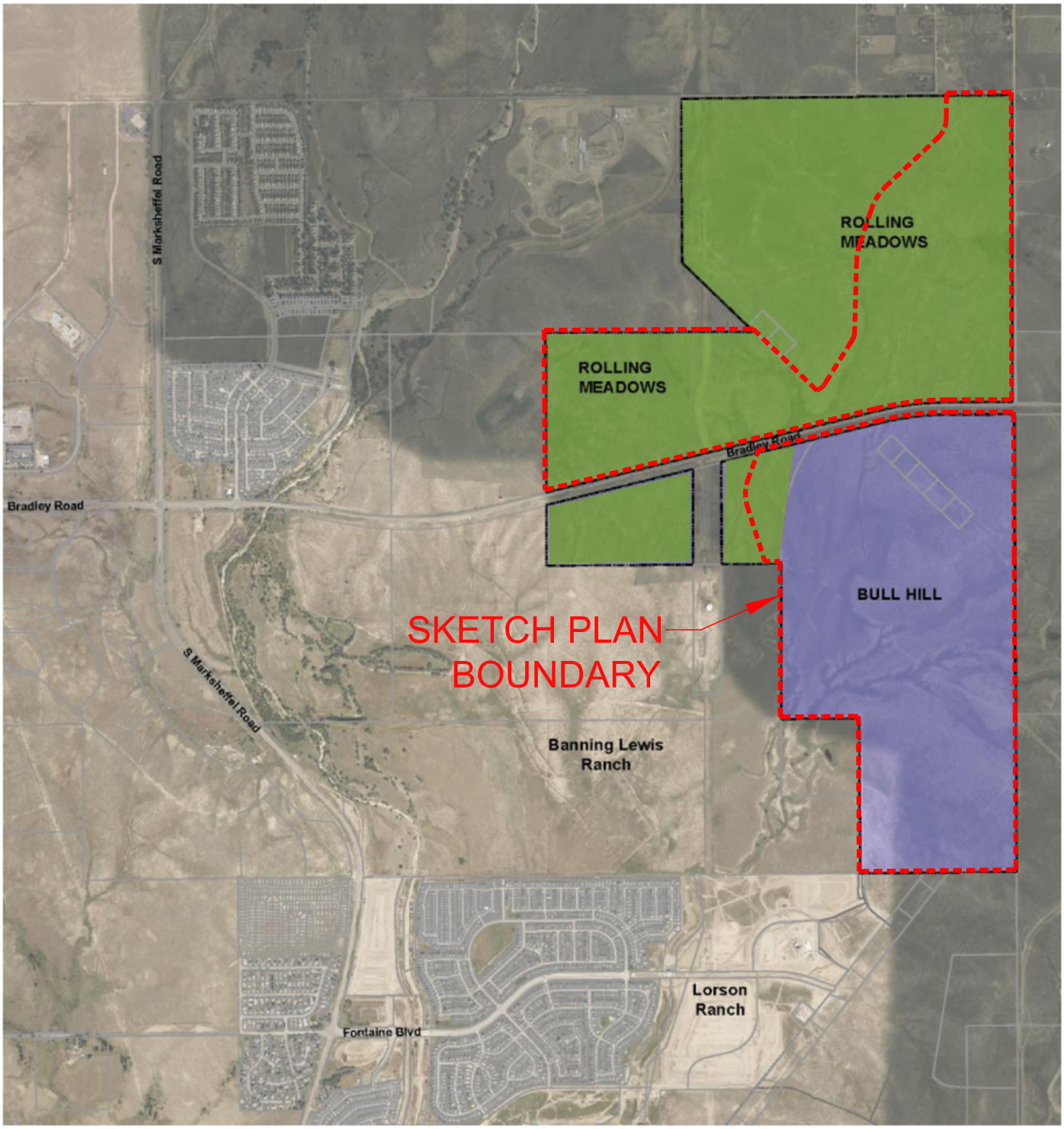
- Developed runoff will be conveyed via curb/gutter and storm sewer facilities
- Detention for this development is provided in the ponds.
- Water Quality for this development is provided in the Ponds.

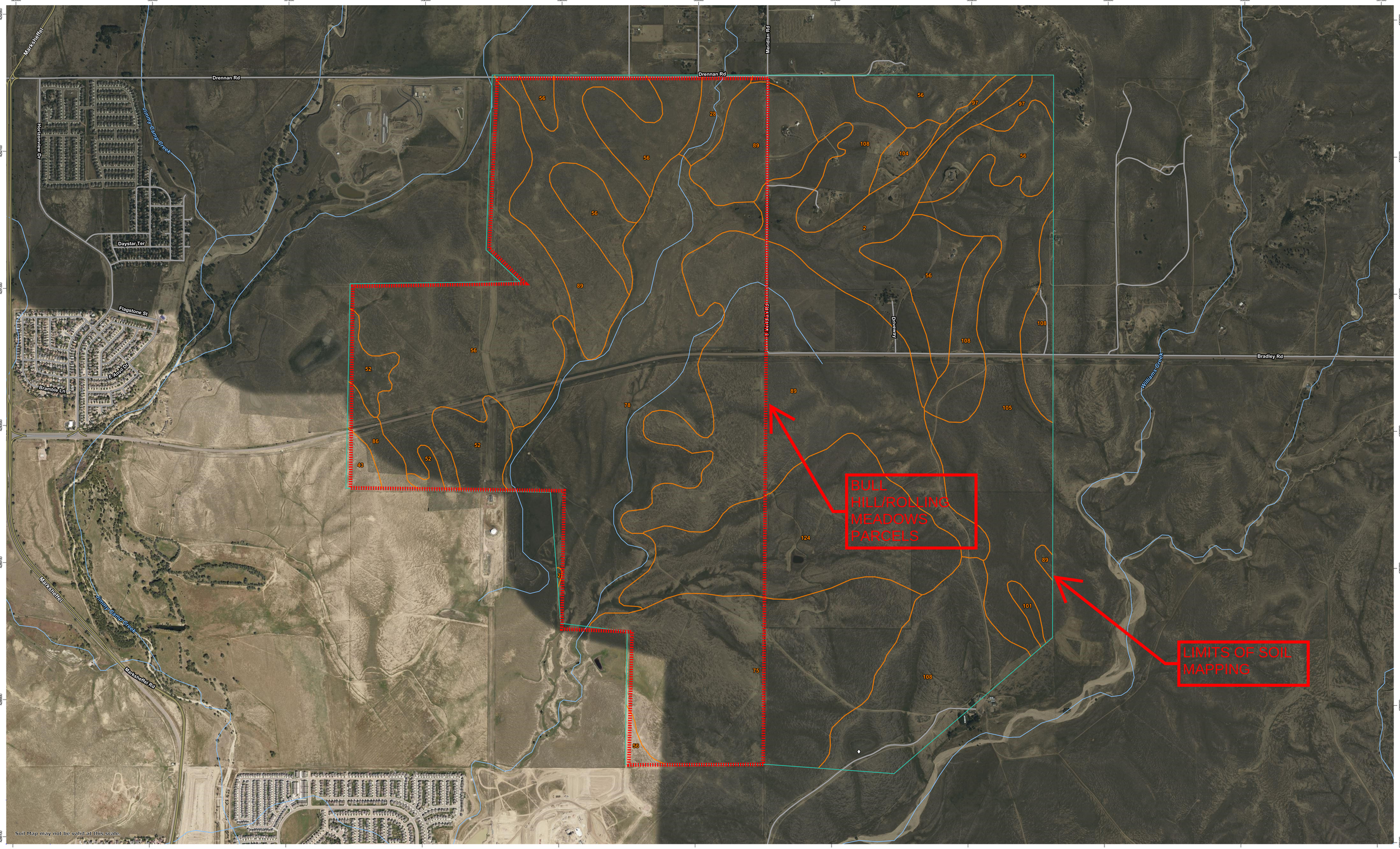
8.0 REFERENCES

1. City of Colorado Springs/El Paso County Drainage Criteria Manual DCM
2. Soil Survey of El Paso County Area, Colorado by USDA, SCS
3. Jimmy Camp Creek Drainage Basin Planning Study, 1987, Wilson & Co.
4. Jimmy Camp Creek Drainage Basin Planning Study, 2015, Kiowa Engineering
5. City of Colorado Springs “Drainage Criteria Manual, Volume 2
6. El Paso County “Engineering Criteria Manual”
7. Final Drainage Report for Skyline at Lorson Ranch, approved July 28, 2022
8. Final Drainage Report for Ridge at Lorson Ranch Fil. 1-3, approved August 16, 2022
9. Draft MDDP for Rolling Hills Ranch, revised October 9, 2006, Kiowa Engineering Corporation

APPENDIX A – VICINTIY MAP, SOILS MAP, FEMA MAP, LEGAL DESCRIPTION

Rolling Meadows/ Bull Hill
Vicinity Map





Map Scale: 1:10,100 if printed on D landscape (34" x 22") sheet.

Meters: 0 100 200 400 600

Feet: 0 450 900 1800 2700

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 19, Aug 31, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 14, 2018—May 26, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
2	Ascalon sandy loam, 1 to 3 percent slopes	150.2	4.7%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	24.3	0.8%
43	Kim loam, 1 to 8 percent slopes	12.4	0.4%
52	Manzanst clay loam, 0 to 3 percent slopes	70.5	2.2%
56	Nelson-Tassel fine sandy loams, 3 to 18 percent slopes	580.9	18.0%
75	Razor-Midway complex	354.6	11.0%
78	Sampson loam, 0 to 3 percent slopes	409.4	12.7%
86	Stoneham sandy loam, 3 to 8 percent slopes	22.2	0.7%
89	Tassel fine sandy loam, 3 to 18 percent slopes	675.2	20.9%
97	Truckton sandy loam, 3 to 9 percent slopes	20.5	0.6%
101	Ustic Torrifluvents, loamy	7.4	0.2%
104	Vona sandy loam, warm, 0 to 3 percent slopes	17.8	0.6%
105	Vona sandy loam, warm, 3 to 6 percent slopes	277.9	8.6%
108	Wiley silt loam, 3 to 9 percent slopes	340.1	10.5%
124	Olnest sandy loam, 0 to 3 percent slopes	261.7	8.1%
Totals for Area of Interest		**3,225.3**	**100.0%**

El Paso County Area, Colorado

2—Ascalon sandy loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 367q
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Ascalon and similar soils: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ascalon

Setting

Landform: Flats
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium and/or eolian deposits

Typical profile

A - 0 to 8 inches: sandy loam
Bt - 8 to 21 inches: sandy clay loam
BC - 21 to 27 inches: sandy loam
Ck1 - 27 to 48 inches: sandy loam
Ck2 - 48 to 60 inches: loamy sand

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e

Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R069XY026CO - Sandy Plains
Other vegetative classification: SANDY PLAINS (069BY026CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 1 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

El Paso County Area, Colorado

28—Ellicott loamy coarse sand, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 3680
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Ellicott and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ellicott

Setting

Landform: Stream terraces, flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium

Typical profile

A - 0 to 4 inches: loamy coarse sand
C - 4 to 60 inches: stratified coarse sand to sandy loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: NoneFrequent
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A
Ecological site: R069XY031CO - Sandy Bottomland
Other vegetative classification: SANDY BOTTOMLAND (069AY031CO)
Hydric soil rating: No

Minor Components

Fluvaquentic haplaquoll
Percent of map unit: 1 percent
Landform: Swales
Hydric soil rating: Yes

Other soils
Percent of map unit: 1 percent
Hydric soil rating: No

Pleasant
Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

El Paso County Area, Colorado

43—Kim loam, 1 to 8 percent slopes

Map Unit Setting

National map unit symbol: 368k
Elevation: 5,300 to 5,600 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Kim and similar soils: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kim

Setting

Landform: Hills, fans
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous loamy alluvium

Typical profile

A - 0 to 6 inches: loam
C - 6 to 60 inches: loam

Properties and qualities

Slope: 1 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 20 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R069XY006CO - Loamy Plains
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 1 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

El Paso County Area, Colorado

52—Manzanst clay loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2w4nr
Elevation: 4,060 to 6,660 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Manzanst and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Manzanst

Setting

Landform: Drainageways, terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Concave, linear
Parent material: Clayey alluvium derived from shale

Typical profile

A - 0 to 3 inches: clay loam
Bt - 3 to 12 inches: clay
Btk - 12 to 37 inches: clay
Bk1 - 37 to 52 inches: clay
Bk2 - 52 to 79 inches: clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 3 percent
Maximum salinity: Slightly saline (4.0 to 7.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water supply, 0 to 60 inches: High (about 9.0 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c

Hydrologic Soil Group: C
Ecological site: R067BY037CO - Saline Overflow
Hydric soil rating: No

Minor Components

Ritoazul
Percent of map unit: 7 percent
Landform: Interfluves, drainageways
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY042CO - Clayey Plains
Hydric soil rating: No

Arvada
Percent of map unit: 6 percent
Landform: Interfluves, drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY033CO - Salt Flat
Hydric soil rating: No

Wiley
Percent of map unit: 2 percent
Landform: Interfluves
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY002CO - Loamy Plains
Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

El Paso County Area, Colorado

56—Nelson-Tassel fine sandy loams, 3 to 18 percent slopes

Map Unit Setting

National map unit symbol: 3690
Elevation: 5,600 to 6,400 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Nelson and similar soils: 55 percent
Tassel and similar soils: 40 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nelson

Setting

Landform: Hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous residuum weathered from interbedded sedimentary rock

Typical profile

A - 0 to 5 inches: fine sandy loam
Ck - 5 to 23 inches: fine sandy loam
Cr - 23 to 27 inches: weathered bedrock

Properties and qualities

Slope: 3 to 12 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: B
Ecological site: R067BY045CO - Shaly Plains
Other vegetative classification: SHALY PLAINS (069AY046CO)
Hydric soil rating: No

Description of Tassel

Setting

Landform: Hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous slope alluvium over residuum weathered from sandstone

Typical profile

A - 0 to 4 inches: fine sandy loam
C - 4 to 10 inches: fine sandy loam
Cr - 10 to 14 inches: weathered bedrock

Properties and qualities

Slope: 3 to 18 percent
Depth to restrictive feature: 6 to 20 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Available water supply, 0 to 60 inches: Very low (about 1.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: R067BY045CO - Shaly Plains
Other vegetative classification: SHALY PLAINS (069AY046CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions

Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

El Paso County Area, Colorado

75—Razor-Midway complex

Map Unit Setting

National map unit symbol: 369p
Elevation: 5,300 to 6,100 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Razor and similar soils: 60 percent
Midway and similar soils: 35 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Razor

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Concave, linear
Across-slope shape: Linear
Parent material: Clayey slope alluvium over residuum weathered from shale

Typical profile

A - 0 to 4 inches: stony clay loam
Bw - 4 to 22 inches: cobbly clay loam
Bk - 22 to 29 inches: cobbly clay
Cr - 29 to 33 inches: weathered bedrock

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 15.0
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R069XY047CO - Alkaline Plains
Other vegetative classification: ALKALINE PLAINS (069AY047CO)
Hydric soil rating: No

Description of Midway

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Slope alluvium over residuum weathered from shale

Typical profile

A - 0 to 4 inches: clay loam
C - 4 to 13 inches: clay
Cr - 13 to 17 inches: weathered bedrock

Properties and qualities

Slope: 3 to 25 percent
Depth to restrictive feature: 6 to 20 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 15 percent
Maximum salinity: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 15.0
Available water supply, 0 to 60 inches: Very low (about 2.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: R069XY046CO - Shaly Plains
Other vegetative classification: SHALY PLAINS (069AY045CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

El Paso County Area, Colorado

78—Sampson loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 369s
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Sampson and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sampson

Setting

Landform: Terraces, alluvial fans, depressions
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 15 inches: loam
Bt - 15 to 34 inches: clay loam
Bk - 34 to 60 inches: sandy clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: B
Ecological site: R049XB202CO - Loamy Foothill
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

El Paso County Area, Colorado

86—Stoneham sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 36b2
Elevation: 5,100 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Stoneham and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Stoneham

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous loamy alluvium

Typical profile

A - 0 to 4 inches: sandy loam
Bt - 4 to 8 inches: sandy clay loam
Btk - 8 to 11 inches: sandy clay loam
Ck - 11 to 60 inches: loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B

Ecological site: R067BY024CO - Sandy Plains
Other vegetative classification: SANDY PLAINS (069AY026CO)
Hydric soil rating: No

Minor Components

Other soils
Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant
Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

El Paso County Area, Colorado

89—Tassel fine sandy loam, 3 to 18 percent slopes

Map Unit Setting

National map unit symbol: 36b5
Elevation: 5,600 to 6,400 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 51 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Tassel and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tassel

Setting

Landform: Hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous slope alluvium over residuum weathered from sandstone

Typical profile

A - 0 to 4 inches: fine sandy loam
C - 4 to 10 inches: sandy loam
Cr - 10 to 14 inches: weathered bedrock

Properties and qualities

Slope: 3 to 18 percent
Depth to restrictive feature: 6 to 20 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Available water supply, 0 to 60 inches: Very low (about 1.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: R067BY024CO - Sandy Plains
Other vegetative classification: SANDY PLAINS (069AY026CO)

Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 5 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

El Paso County Area, Colorado

97—Truckton sandy loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2x0j2
Elevation: 5,300 to 6,850 feet
Mean annual precipitation: 14 to 19 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 85 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Truckton and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Truckton

Setting

Landform: Hillslopes, interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Re-worked alluvium derived from arkose

Typical profile

A - 0 to 4 inches: sandy loam
Bt1 - 4 to 12 inches: sandy loam
Bt2 - 12 to 19 inches: sandy loam
C - 19 to 80 inches: sandy loam

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Maximum salinity: Nonsaline (0.1 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.6 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Blakeland

Percent of map unit: 8 percent
Landform: Hillslopes, interfluves
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Bresser

Percent of map unit: 7 percent
Landform: Low hills, interfluves
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Linear, concave
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

El Paso County Area, Colorado

101—Ustic Torrifluvents, loamy

Map Unit Setting

National map unit symbol: 3673
Elevation: 5,500 to 7,000 feet
Mean annual precipitation: 13 to 16 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 125 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Ustic torrifluvents and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ustic Torrifluvents

Setting

Landform: Stream terraces, flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy, clayey, stratified loamy

Typical profile

A - 0 to 6 inches: variable
C - 6 to 60 inches: stratified loamy sand to clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R069XY037CO - Saline Overflow
Other vegetative classification: OVERFLOW (069BY036CO)

Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

El Paso County Area, Colorado

104—Vona sandy loam, warm, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2t516
Elevation: 3,590 to 6,000 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Vona, warm, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Vona, Warm

Setting

Landform: Sand sheets
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian sands

Typical profile

A - 0 to 5 inches: sandy loam
Bt1 - 5 to 12 inches: sandy loam
Bt2 - 12 to 17 inches: sandy loam
Bk - 17 to 41 inches: sandy loam
BCk - 41 to 79 inches: loamy sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Nonsaline to slightly saline (0.5 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water supply, 0 to 60 inches: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: R067BY024CO - Sandy Plains
Forage suitability group: Loamy, Dry (G067BW019CO)
Other vegetative classification: Sandy Plains #24 (067XY024CO_2), Loamy, Dry (G067BW019CO)
Hydric soil rating: No

Minor Components

Olnest, warm

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Other vegetative classification: Loamy, Dry (G067BW019CO)
Hydric soil rating: No

Otero

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope, head slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Other vegetative classification: SANDY PLAINS (067XY024CO_1), Loamy, Dry (G067BW019CO)
Hydric soil rating: No

Valent, warm

Percent of map unit: 5 percent
Landform: Sand sheets
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R067BY015CO - Deep Sand
Other vegetative classification: Deep Sands #15 (067XY015CO_3), Sandy, Dry (G067BW026CO)
Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

El Paso County Area, Colorado

105—Vona sandy loam, warm, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2t517
Elevation: 3,400 to 6,000 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Vona, warm, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Vona, Warm

Setting

Landform: Sand sheets
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope, head slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian sands

Typical profile

A - 0 to 5 inches: sandy loam
Bt1 - 5 to 12 inches: sandy loam
Bt2 - 12 to 17 inches: sandy loam
Bk - 17 to 41 inches: sandy loam
BCk - 41 to 79 inches: loamy sand

Properties and qualities

Slope: 3 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 3.9 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water supply, 0 to 60 inches: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: R067BY024CO - Sandy Plains
Forage suitability group: Loamy, Dry (G067BW019CO)
Other vegetative classification: Sandy Plains #24 (067XY024CO_2), Loamy, Dry (G067BW019CO)
Hydric soil rating: No

Minor Components

Valent, warm

Percent of map unit: 5 percent
Landform: Sand sheets
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R067BY015CO - Deep Sand
Other vegetative classification: Deep Sands #15 (067XY015CO_3), Sandy, Dry (G067BW026CO)
Hydric soil rating: No

Olnest, warm

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Other vegetative classification: Loamy, Dry (G067BW019CO)
Hydric soil rating: No

Otero, warm

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope, head slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Other vegetative classification: SANDY PLAINS (067XY024CO_1), Loamy, Dry (G067BW019CO)
Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

El Paso County Area, Colorado

108—Wiley silt loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: 367b
Elevation: 5,200 to 6,200 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Wiley and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wiley

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous silty eolian deposits

Typical profile

A - 0 to 4 inches: silt loam
Bt - 4 to 16 inches: silt loam
Bk - 16 to 60 inches: silt loam

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 11.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R067BY002CO - Loamy Plains

Other vegetative classification: LOAMY PLAINS (069AY006CO)
Hydric soil rating: No

Minor Components

Other soils
Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant
Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

El Paso County Area, Colorado

124—Olnest sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2t51j
Elevation: 4,500 to 6,100 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Olnest and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Olnest

Setting

Landform: Sand sheets
Parent material: Eolian sands

Typical profile

A - 0 to 4 inches: sandy loam
Bt - 4 to 20 inches: sandy clay loam
Bk1 - 20 to 48 inches: sandy loam
Bk2 - 48 to 79 inches: very fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 14 percent
Maximum salinity: Very slightly saline (2.0 to 3.9 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 7.4 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Minor Components

Udic haplusterts, ponded

Percent of map unit: 5 percent
Landform: Closed depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R067BY010CO - Closed Upland Depression
Hydric soil rating: No

Otero

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Vona

Percent of map unit: 5 percent
Landform: Sand sheets
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

212 N WAHSATCH AVE, STE 305
COLORADO SPRINGS, CO
80903
MAIL TO: PO BOX
1360
COLORADO SPRINGS, CO
80901
719.955.5485

DP LEGAL DESCRIPTIONS
43133 ROLLING HILLS

PARCEL A:

A TRACT OF LAND BEING A PORTION OF SECTIONS 1, 2, 11 AND 12, T15S, R65W OF THE 6TH P.M., EL PASO COUNTY, COLORADO, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT THE NORTHEAST CORNER OF SAID SECTION 1 SAID POINT BEING THE POINT OF BEGINNING;

THENCE S00°04'50"E AND ALONG THE EAST LINE OF THE NORTHEAST ONE-QUARTER OF SECTION 1 A DISTANCE OF 2643.48 FEET TO THE EAST ONE-QUARTER CORNER OF SECTION 1;

THENCE S00°04'54"E AND ALONG THE EAST LINE OF THE SOUTHEAST ONE-QUARTER OF SECTION 1 A DISTANCE OF 2609.71 FEET TO A POINT ON THE NORTH RIGHT-OF-WAY LINE OF BRADLEY ROAD AS RECORDED IN THE EL PASO COUNTY RECORDS UNDER RECEPTION NO. 098124132;

THENCE WESTERLY AND ALONG THE NORTH RIGHT-OF-WAY LINE OF BRADLEY ROAD THE FOLLOWING THREE (3) COURSES;

(1) THENCE S89°50'56"W A DISTANCE OF 1123.99 FEET TO A POINT OF CURVE;

(2) THENCE ALONG THE ARC OF CURVE TO THE LEFT, SAID CURVE HAVING A CENTRAL ANGLE OF 13°39'40", A RADIUS OF 5105.00 FEET, AND A LENGTH OF 1217.20 TO A POINT OF TANGENT;

(3) THENCE S76°10'56"W A DISTANCE OF 5797.68 FEET TO A POINT ON THE WEST LINE OF THE NORTHEAST QUARTER OF SECTION 11;

THENCE N00°09'56"W AND ALONG THE WEST LINE OF THE NORTHEAST ONE-QUARTER OF SECTION 11 A DISTANCE OF 1392.61 FEET TO THE NORTH QUARTER CORNER OF SECTION 11;

THENCE N00°23'35"W AND ALONG THE EAST LINE OF THE SOUTHWEST ONE-QUARTER OF SECTION 2 A DISTANCE OF 1319.07 FEET TO THE NORTHEAST CORNER OF THE SOUTH ONE-HALF OF SECTION 2, SAID POINT BEING ON THE SOUTH LINE OF THAT PARCEL DESCRIBED IN A SPECIAL WARRANTY DEED UNDER RECEPTION NO. 214004738;

THENCE N89°38'06"E ALONG THE SOUTH LINE THEREOF 2668.39 FEET;

THENCE N89°37'47"E ALONG SAID SOUTH LINE 880.43 FEET TO THE WEST LINE OF ROLLING HILLS RANCH DISTRICT 9 AS RECORDED UNDER RECEPTION NO. 207001688;

THENCE S46°04’43”E ALONG THE SOUTWESTERLY LINE OF ROLLING HILLS RANCH DISTRICTS 9 AND 10 AND THE SOUTHEASTERLY EXTENSION OF SAID LINE 1498.91 FEET;

THENCE 178.50 FEET ALONG THE ARC OF A CURVE TO THE LEFT, SAID CURVE HAVING A RADIUS OF 250.00 FEET, A CENTRAL ANGLE OF 40°54’37”, AND A CHORD OF 174.74 FEET WHICH BEARS N52°29’48”E TO A POINT OF TANGENT;

THENCE N32°02’30”E ALONG SAID TANGENT 885.42 FEET TO A POINT OF CURVE;

THENCE 132.95 FEET ALONG THE ARC OF A CURVE TO THE LEFT, SAID CURVE HAVING A RADIUS OF 250.00 FEET, A CENTRAL ANGLE OF 30°28’10” TO A POINT OF TANGENT;

THENCE N01°34’19”E ALONG SAID TANGENT 1187.48 FEET TO A POINT OF CURVE;

THENCE 311.09 FEET ALONG THE ARC OF A CURVE TO THE RIGHT, SAID CURVE HAVING A RADIUS OF 1067.32 FEET, A CENTRAL ANGLE OF 16°42’00” TO A POINT OF TANGENT;

THENCE N18°16’19”E ALONG SAID TANGENT 629.02 FEET TO A POINT OF CURVE;

THENCE 477.82 FEET ALONG THE ARC OF A CURVE TO THE RIGHT, SAID CURVE HAVING A RADIUS OF 953.04 FEET, A CENTRAL ANGLE OF 28°43’34” TO A POINT OF TANGENT;

THENCE N46°59’53”E ALONG SAID TANGENT 1196.80 FEET TO A POINT OF CURVE;

THENCE 364.22 FEET ALONG THE ARC OF A CURVE TO THE LEFT, SAID CURVE HAVING A RADIUS OF 450.00 FEET, A CENTRAL ANGLE OF 46°22’26” TO A POINT OF TANGENT;

THENCE N00°37’26”E ALONG SAID TANGENT 469.63 FEET TO THE NORTH LINE OF AFORESAID SECTION 1;

THENCE N89°19'27"E ALONG THE NORTH LINE OF THE NORTHEAST QUARTER OF SECTION 1 A DISTANCE OF 1128.76 FEET TO THE POINT OF BEGINNING,

EXCLUDING THEREFROM ANY PORTION OF THAT PARCEL CONVEYED IN WARRANTY DEED RECORDED JANUARY 21, 2014 AT RECEPTION NO. 214004738 AND

EXCLUDING THE NORTHERLY 30 FEET AND THE EASTERLY 30 FEET OF SECTION 1 FOR PUBLIC RIGHT-OF-WAY FOR DRENNAN ROAD AND MERIDIAN ROAD.

PARCEL A CONTAINS A CALCULATED NET AREA OF 21,741,190 S.F. (499.109 ACRES MORE OR LESS).

PARCEL B

A TRACT OF LAND BEING A PORTION OF SECTIONS 12, AND 13, TOWNSHIP 15 SOUTH, RANGE 65 WEST OF THE 6TH PRINCIPAL MERIDIAN, COUNTY OF EL PASO, STATE OF COLORADO, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BASIS OF BEARINGS: THE EAST LINE OF THE NORTHEAST ONE-QUARTER OF SAID SECTION 12, BEING MONUMENTED AT THE NORTH END BY A 3.50 INCH ALUMINIUM CAP IN RANGE BOX STAMPED "LS 17496" AND MONUMENTED AT THE SOUTH END BY A 3.50 INCH ALUMINIUM CAP STAMPED "LS 12103". WITH THE LINE CONSIDERED TO BEAR SOUTH 00 DEGREES 16 MINUTES 58 SECONDS EAST. (THE SOUTH MONUMENT WAS NOT FOUND, SEE NOTE 1)

COMMENCING AT THE NORTHEAST CORNER OF SAID SECTION 12;
THENCE SOUTH 00 DEGREES 16 MINUTES 58 SECONDS EAST (AM S00°16'31"E) AND ALONG THE EAST LINE OF THE NORTHEAST ONE-QUARTER OF SECTION 12 A DISTANCE OF 179.72 FEET (179.82' AM) TO THE POINT OF BEGINNING;

THENCE CONTINUING SOUTH 00 DEGREES 16 MINUTES 58 SECONDS EAST (AM S00°16'45"E) AND ALONG THE EAST LINE OF THE NORTHEAST ONE-QUARTER OF SECTION 12 A DISTANCE OF 2455.51 FEET (2455.53' AM) TO THE EAST ONE-QUARTER CORNER OF SECTION 12;

THENCE SOUTH 00 DEGREES 18 MINUTES 37 SECONDS EAST (AM S00°18'32"E) AND ALONG THE EAST LINE OF THE SOUTHEAST ONE-QUARTER OF SECTION 12 A DISTANCE OF 2635.48 FEET (2635.48' AM) TO THE SOUTHEAST CORNER OF SECTION 12;

THENCE SOUTH 00 DEGREES 19 MINUTES 49 SECONDS EAST (AM S00°20'17"E) AND ALONG THE EAST LINE OF THE NORTHEAST ONE-QUARTER OF SECTION 13 A DISTANCE OF 2687.08 FEET (2687.06' AM) TO THE EAST ONE-QUARTER CORNER OF SECTION 13 AND THE NORTHEAST CORNER OF "THE RIDGE AT LORSON RANCH FILING NO. 3" AS RECORDED UNDER RECEPTION NO. 223715152 IN THE RECORDS OF EL PASO COUNTY, COLORADO;

THENCE SOUTH 89 DEGREES 26 MINUTES 00 SECONDS WEST (AM S89°25'44"W) ALONG THE NORTH LINE AND ITS WESTERLY EXTENSION 2662.93 FEET (2663.29' AM) TO THE CENTER ONE-QUARTER CORNER OF SECTION 13;

THENCE NORTH 00 DEGREES 21 MINUTES 41 SECONDS WEST (AM N00°20'11"W) AND ALONG THE WEST LINE OF THE NORTHEAST ONE-QUARTER OF SECTION 13 A DISTANCE OF 2636.75 FEET (2636.75' AM) TO THE NORTH ONE-QUARTER CORNER OF SECTION 13;

THENCE SOUTH 89 DEGREES 25 MINUTES 09 SECONDS WEST (AM S89°29'02"W) AND ALONG THE SOUTH LINE OF THE EAST ONE-HALF OF SECTION 12 A DISTANCE OF 1323.33 FEET (1323.33' AM) TO THE SOUTHWEST CORNER OF THE EAST ONE-HALF OF THE SOUTHWEST ONE-QUARTER OF SECTION 12;

THENCE NORTH 00 DEGREES 07 MINUTES 57 SECONDS WEST (AM N00°08'59"W) AND ALONG THE WEST LINE OF THE EAST ONE-HALF OF THE SOUTHWEST ONE-QUARTER OF SECTION 12 A DISTANCE OF 2644.55 FEET (2643.25' AM) TO THE NORTHWEST CORNER OF THE EAST ONE-HALF OF THE SOUTHWEST ONE-QUARTER OF SECTION 12;

THENCE S89°17'26"W A DISTANCE OF 256.96 FEET;

THENCE N17°44'19"W A DISTANCE OF 965.15 FEET TO A POINT OF CURVE;

THENCE ALONG THE ARC OF A CURVE TO THE RIGHT HAVING A DELTA OF 36°53'56", A RADIUS OF 743.44 FEET, AND A LENGTH OF 490.03 FEET TO A POINT OF TANGENT;

THENCE N20°01'39"E ALONG SAID TANGENT 522.11 FEET TO A POINT ON THE SOUTH RIGHT OF WAY LINE OF BRADLEY ROAD AS RECORDED IN THE EL PASO COUNTY RECORDS UNDER RECEPTION NO. 98124132;

THENCE EASTERLY AND ALONG THE SOUTH RIGHT-OF-WAY LINE OF BRADLEY ROAD THE FOLLOWING THREE COURSES;

1. NORTH N76°10'55"E ALONG SAID RIGHT-OF-WAY LINE 2110.25 FEET TO A POINT OF CURVE;
2. THENCE ALONG THE ARC OF A CURVE TO THE RIGHT HAVING A DELTA OF 13 DEGREES 39 MINUTES 41 SECONDS (AM 13°39'39"), A RADIUS OF 4895.00 FEET, AND A LENGTH OF 1167.15 FEET (1167.09' AM) TO THE POINT OF TANGENT;
3. NORTH 89 DEGREES 50 MINUTES 39 SECONDS EAST (AM N89°50'34"E) A DSITANCE OF 1124.39 FEET (1124.54' AM) TO THE POINT OF BEGINNING.

THE PROPERTY CONTAINS 27,782,841 S.F. (637.806 ACRES) MORE OR LESS AS SURVEYED.

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, and Anderson Consulting Engineers, Inc. These data are current as of 2008.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

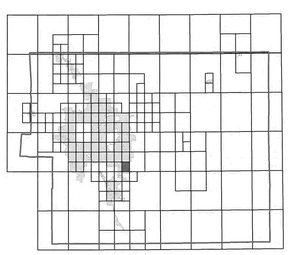
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

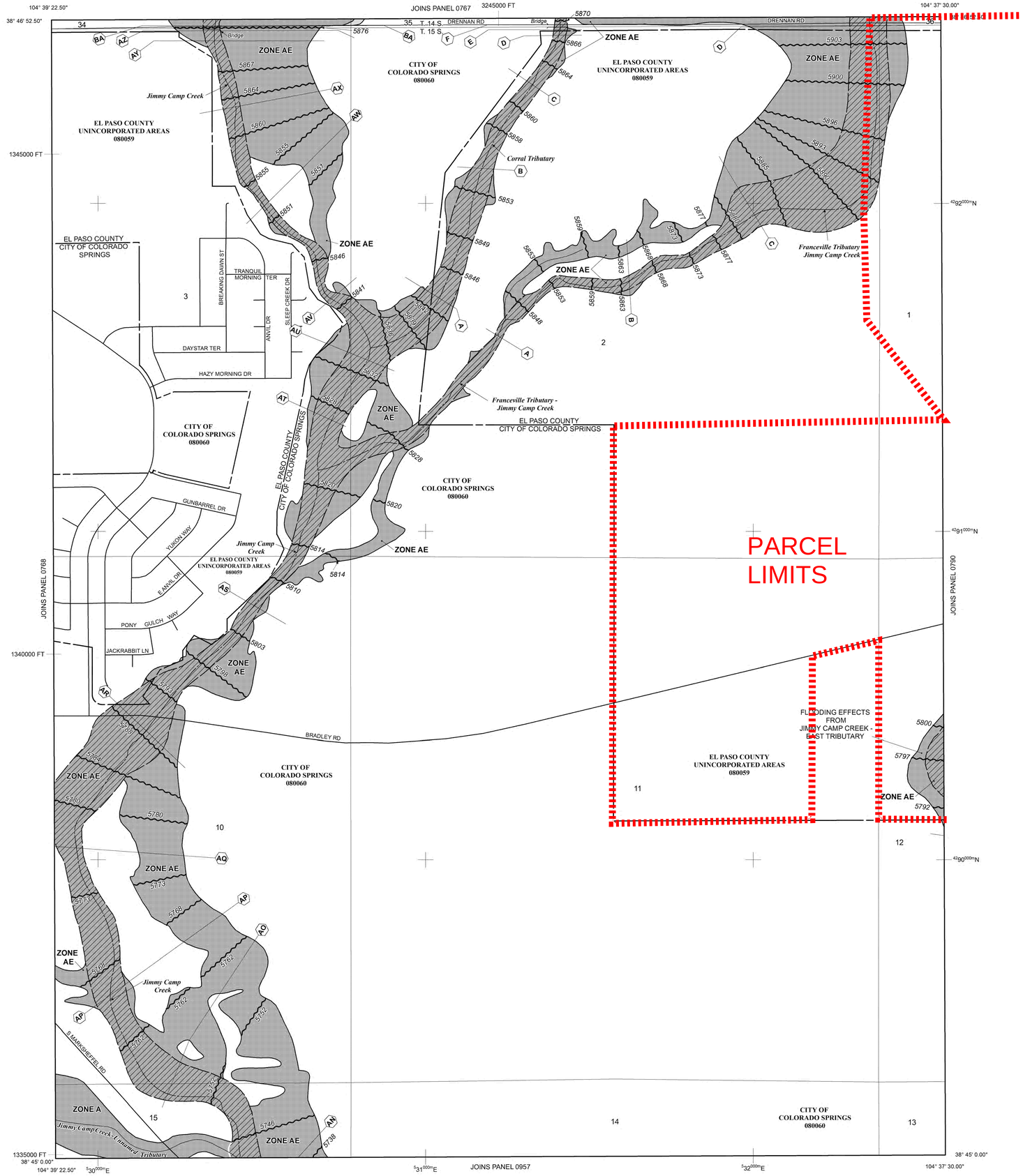
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 14 SOUTH, RANGE 65 WEST, AND TOWNSHIP 15 SOUTH, RANGE 65 WEST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	Floodplain boundary
	Floodway boundary
	Zone D Boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 - - - - 23	Transect line
97° 07' 30.00" 32° 22' 30.00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN	1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT	5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0769G

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 769 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0769	G
EL PASO COUNTY	080059	0769	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0769G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, and Anderson Consulting Engineers, Inc. These data are current as of 2008.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

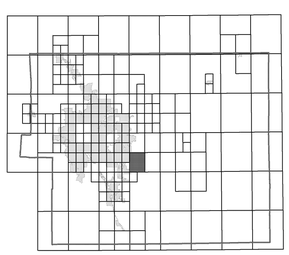
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

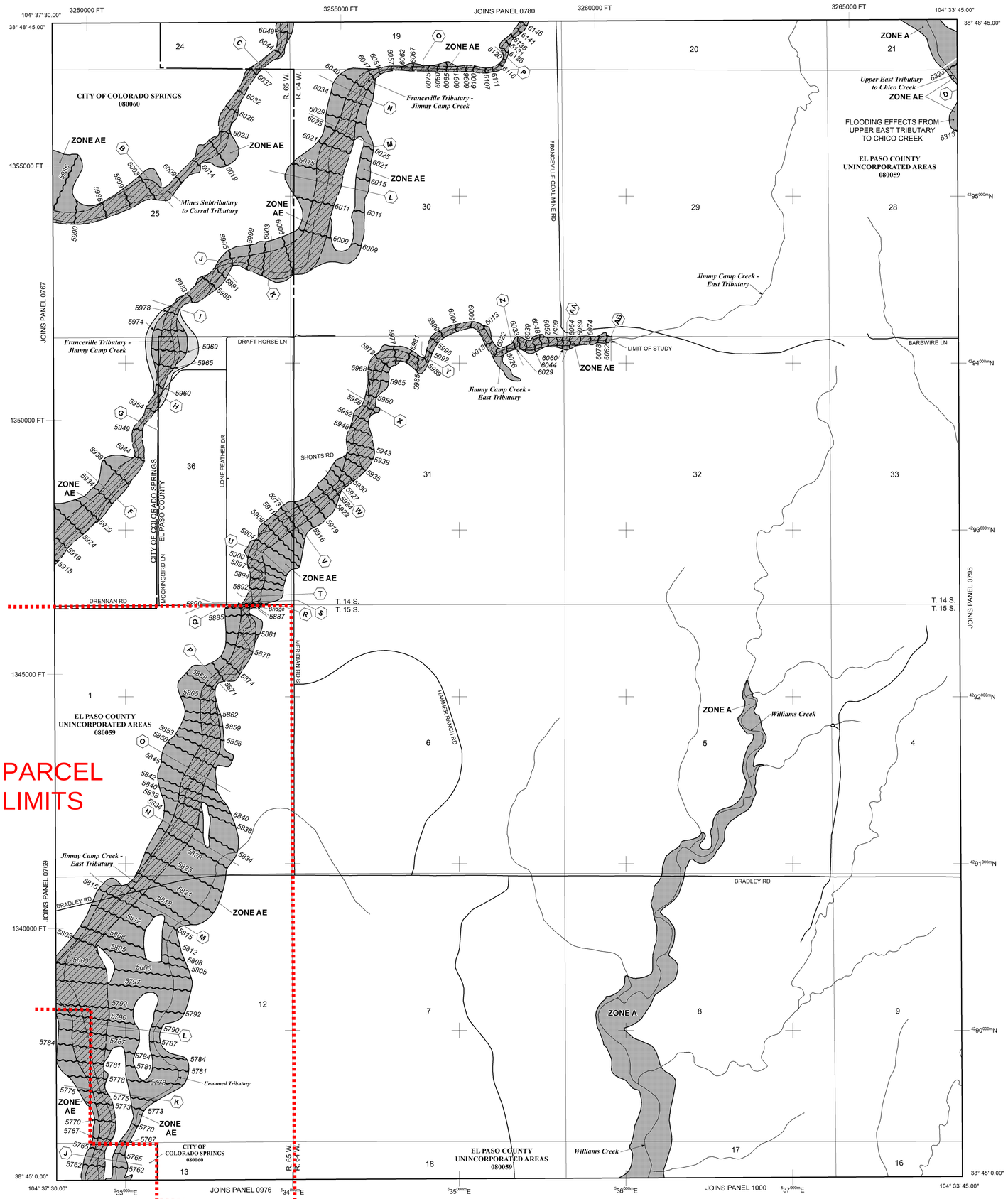
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	Floodplain boundary
	Floodway boundary
	Zone D Boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
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* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 - - - - - 23	Transect line
97° 07' 30.00" 32° 22' 30.00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
$^{42}75^{000m}$N	1000-meter Universal Transverse Mercator grid ticks, zone 13
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DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

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MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

PANEL 0790G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 790 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0790	G
EL PASO COUNTY	080059	0790	G

Notice: This map was reissued on 05/15/2020 to make a correction.This version replaces any previous versions. See the Notice-to-User Letter that accompanied this correction for details.

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0790G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

NOTES TO USERS

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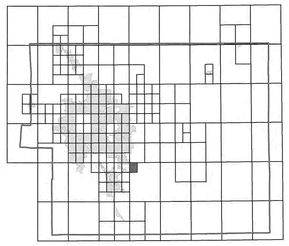
Panel Location Map



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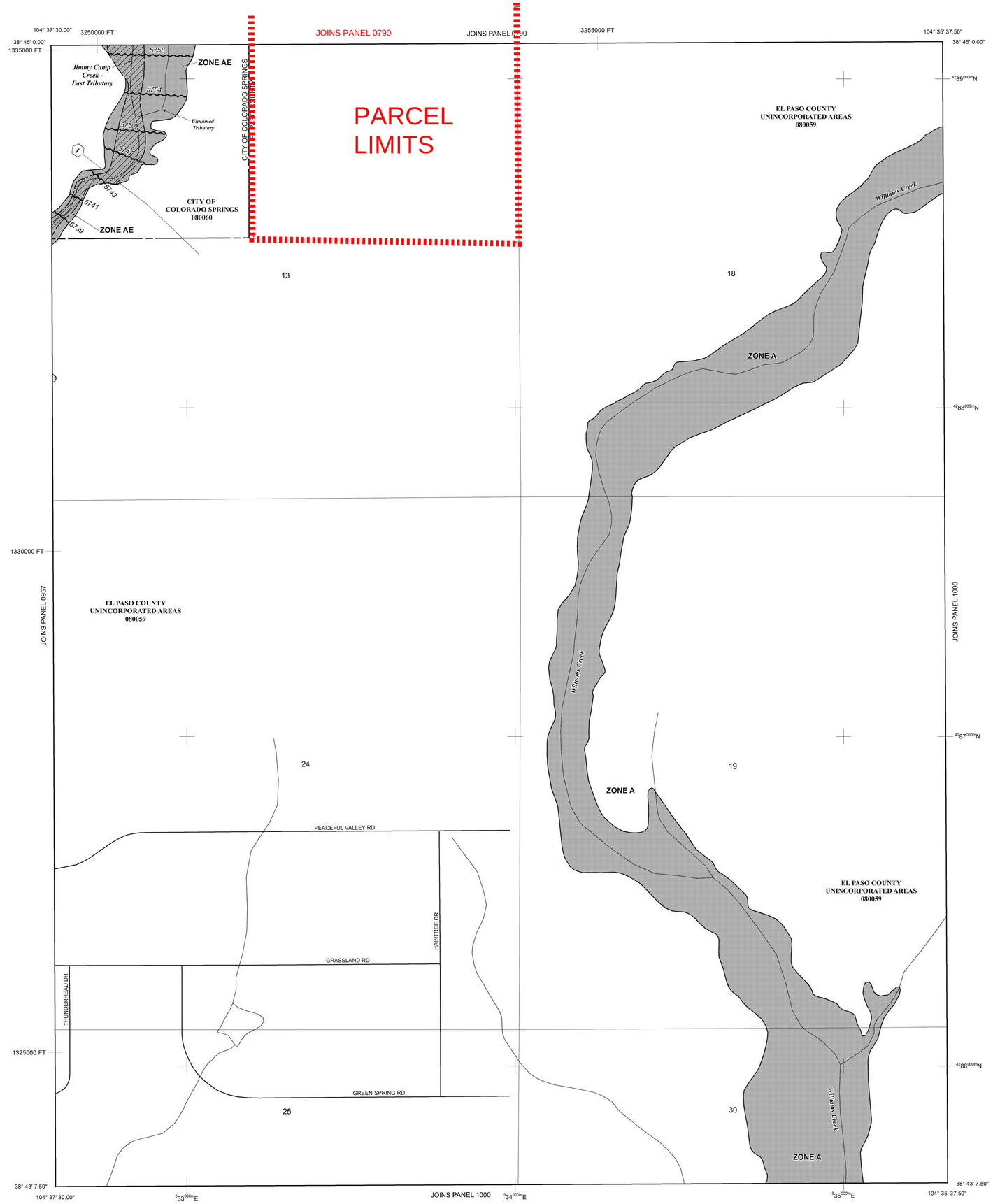

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 15 SOUTH, RANGE 64 WEST, AND TOWNSHIP 15 SOUTH, RANGE 65 WEST.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

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FLOODWAY AREAS IN ZONE AE

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COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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	Floodway boundary
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6000000 FT	5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
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● M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

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MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0976G

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 976 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0976	G
EL PASO COUNTY	080059	0976	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0976G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

212 N WAHSATCH AVE, STE 305
COLORADO SPRINGS, CO
80903
MAIL TO: PO BOX
1360
COLORADO SPRINGS, CO
80901
719.955.5485

DP LEGAL DESCRIPTIONS
43133 ROLLING HILLS

PARCEL A:

A TRACT OF LAND BEING A PORTION OF SECTIONS 1, 2, 11 AND 12, T15S, R65W OF THE 6TH P.M., EL PASO COUNTY, COLORADO, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

COMMENCING AT THE NORTHEAST CORNER OF SAID SECTION 1 SAID POINT BEING THE POINT OF BEGINNING;

THENCE S00°04'50"E AND ALONG THE EAST LINE OF THE NORTHEAST ONE-QUARTER OF SECTION 1 A DISTANCE OF 2643.48 FEET TO THE EAST ONE-QUARTER CORNER OF SECTION 1;

THENCE S00°04'54"E AND ALONG THE EAST LINE OF THE SOUTHEAST ONE-QUARTER OF SECTION 1 A DISTANCE OF 2609.71 FEET TO A POINT ON THE NORTH RIGHT-OF-WAY LINE OF BRADLEY ROAD AS RECORDED IN THE EL PASO COUNTY RECORDS UNDER RECEPTION NO. 098124132;

THENCE WESTERLY AND ALONG THE NORTH RIGHT-OF-WAY LINE OF BRADLEY ROAD THE FOLLOWING THREE (3) COURSES;

(1) THENCE S89°50'56"W A DISTANCE OF 1123.99 FEET TO A POINT OF CURVE;

(2) THENCE ALONG THE ARC OF CURVE TO THE LEFT, SAID CURVE HAVING A CENTRAL ANGLE OF 13°39'40", A RADIUS OF 5105.00 FEET, AND A LENGTH OF 1217.20 TO A POINT OF TANGENT;

(3) THENCE S76°10'56"W A DISTANCE OF 5797.68 FEET TO A POINT ON THE WEST LINE OF THE NORTHEAST QUARTER OF SECTION 11;

THENCE N00°09'56"W AND ALONG THE WEST LINE OF THE NORTHEAST ONE-QUARTER OF SECTION 11 A DISTANCE OF 1392.61 FEET TO THE NORTH QUARTER CORNER OF SECTION 11;

THENCE N00°23'35"W AND ALONG THE EAST LINE OF THE SOUTHWEST ONE-QUARTER OF SECTION 2 A DISTANCE OF 1319.07 FEET TO THE NORTHEAST CORNER OF THE SOUTH ONE-HALF OF SECTION 2, SAID POINT BEING ON THE SOUTH LINE OF THAT PARCEL DESCRIBED IN A SPECIAL WARRANTY DEED UNDER RECEPTION NO. 214004738;

THENCE N89°38'06"E ALONG THE SOUTH LINE THEREOF 2668.39 FEET;

THENCE N89°37'47"E ALONG SAID SOUTH LINE 880.43 FEET TO THE WEST LINE OF ROLLING HILLS RANCH DISTRICT 9 AS RECORDED UNDER RECEPTION NO. 207001688;

THENCE S46°04’43”E ALONG THE SOUTWESTERLY LINE OF ROLLING HILLS RANCH DISTRICTS 9 AND 10 AND THE SOUTHEASTERLY EXTENSION OF SAID LINE 1498.91 FEET;

THENCE 178.50 FEET ALONG THE ARC OF A CURVE TO THE LEFT, SAID CURVE HAVING A RADIUS OF 250.00 FEET, A CENTRAL ANGLE OF 40°54’37”, AND A CHORD OF 174.74 FEET WHICH BEARS N52°29’48”E TO A POINT OF TANGENT;

THENCE N32°02’30”E ALONG SAID TANGENT 885.42 FEET TO A POINT OF CURVE;

THENCE 132.95 FEET ALONG THE ARC OF A CURVE TO THE LEFT, SAID CURVE HAVING A RADIUS OF 250.00 FEET, A CENTRAL ANGLE OF 30°28’10” TO A POINT OF TANGENT;

THENCE N01°34’19”E ALONG SAID TANGENT 1187.48 FEET TO A POINT OF CURVE;

THENCE 311.09 FEET ALONG THE ARC OF A CURVE TO THE RIGHT, SAID CURVE HAVING A RADIUS OF 1067.32 FEET, A CENTRAL ANGLE OF 16°42’00” TO A POINT OF TANGENT;

THENCE N18°16’19”E ALONG SAID TANGENT 629.02 FEET TO A POINT OF CURVE;

THENCE 477.82 FEET ALONG THE ARC OF A CURVE TO THE RIGHT, SAID CURVE HAVING A RADIUS OF 953.04 FEET, A CENTRAL ANGLE OF 28°43’34” TO A POINT OF TANGENT;

THENCE N46°59’53”E ALONG SAID TANGENT 1196.80 FEET TO A POINT OF CURVE;

THENCE 364.22 FEET ALONG THE ARC OF A CURVE TO THE LEFT, SAID CURVE HAVING A RADIUS OF 450.00 FEET, A CENTRAL ANGLE OF 46°22’26” TO A POINT OF TANGENT;

THENCE N00°37’26”E ALONG SAID TANGENT 469.63 FEET TO THE NORTH LINE OF AFORESAID SECTION 1;

THENCE N89°19'27"E ALONG THE NORTH LINE OF THE NORTHEAST QUARTER OF SECTION 1 A DISTANCE OF 1128.76 FEET TO THE POINT OF BEGINNING,

EXCLUDING THEREFROM ANY PORTION OF THAT PARCEL CONVEYED IN WARRANTY DEED RECORDED JANUARY 21, 2014 AT RECEPTION NO. 214004738 AND

EXCLUDING THE NORTHERLY 30 FEET AND THE EASTERLY 30 FEET OF SECTION 1 FOR PUBLIC RIGHT-OF-WAY FOR DRENNAN ROAD AND MERIDIAN ROAD.

PARCEL A CONTAINS A CALCULATED NET AREA OF 21,741,190 S.F. (499.109 ACRES MORE OR LESS).

PARCEL B

A TRACT OF LAND BEING A PORTION OF SECTIONS 12, AND 13, TOWNSHIP 15 SOUTH, RANGE 65 WEST OF THE 6TH PRINCIPAL MERIDIAN, COUNTY OF EL PASO, STATE OF COLORADO, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BASIS OF BEARINGS: THE EAST LINE OF THE NORTHEAST ONE-QUARTER OF SAID SECTION 12, BEING MONUMENTED AT THE NORTH END BY A 3.50 INCH ALUMINIUM CAP IN RANGE BOX STAMPED "LS 17496" AND MONUMENTED AT THE SOUTH END BY A 3.50 INCH ALUMINIUM CAP STAMPED "LS 12103". WITH THE LINE CONSIDERED TO BEAR SOUTH 00 DEGREES 16 MINUTES 58 SECONDS EAST. (THE SOUTH MONUMENT WAS NOT FOUND, SEE NOTE 1)

COMMENCING AT THE NORTHEAST CORNER OF SAID SECTION 12;
THENCE SOUTH 00 DEGREES 16 MINUTES 58 SECONDS EAST (AM S00°16'31"E) AND ALONG THE EAST LINE OF THE NORTHEAST ONE-QUARTER OF SECTION 12 A DISTANCE OF 179.72 FEET (179.82' AM) TO THE POINT OF BEGINNING;

THENCE CONTINUING SOUTH 00 DEGREES 16 MINUTES 58 SECONDS EAST (AM S00°16'45"E) AND ALONG THE EAST LINE OF THE NORTHEAST ONE-QUARTER OF SECTION 12 A DISTANCE OF 2455.51 FEET (2455.53' AM) TO THE EAST ONE-QUARTER CORNER OF SECTION 12;

THENCE SOUTH 00 DEGREES 18 MINUTES 37 SECONDS EAST (AM S00°18'32"E) AND ALONG THE EAST LINE OF THE SOUTHEAST ONE-QUARTER OF SECTION 12 A DISTANCE OF 2635.48 FEET (2635.48' AM) TO THE SOUTHEAST CORNER OF SECTION 12;

THENCE SOUTH 00 DEGREES 19 MINUTES 49 SECONDS EAST (AM S00°20'17"E) AND ALONG THE EAST LINE OF THE NORTHEAST ONE-QUARTER OF SECTION 13 A DISTANCE OF 2687.08 FEET (2687.06' AM) TO THE EAST ONE-QUARTER CORNER OF SECTION 13 AND THE NORTHEAST CORNER OF "THE RIDGE AT LORSON RANCH FILING NO. 3" AS RECORDED UNDER RECEPTION NO. 223715152 IN THE RECORDS OF EL PASO COUNTY, COLORADO;

THENCE SOUTH 89 DEGREES 26 MINUTES 00 SECONDS WEST (AM S89°25'44"W) ALONG THE NORTH LINE AND ITS WESTERLY EXTENSION 2662.93 FEET (2663.29' AM) TO THE CENTER ONE-QUARTER CORNER OF SECTION 13;

THENCE NORTH 00 DEGREES 21 MINUTES 41 SECONDS WEST (AM N00°20'11"W) AND ALONG THE WEST LINE OF THE NORTHEAST ONE-QUARTER OF SECTION 13 A DISTANCE OF 2636.75 FEET (2636.75' AM) TO THE NORTH ONE-QUARTER CORNER OF SECTION 13;

THENCE SOUTH 89 DEGREES 25 MINUTES 09 SECONDS WEST (AM S89°29'02"W) AND ALONG THE SOUTH LINE OF THE EAST ONE-HALF OF SECTION 12 A DISTANCE OF 1323.33 FEET (1323.33' AM) TO THE SOUTHWEST CORNER OF THE EAST ONE-HALF OF THE SOUTHWEST ONE-QUARTER OF SECTION 12;

THENCE NORTH 00 DEGREES 07 MINUTES 57 SECONDS WEST (AM N00°08'59"W) AND ALONG THE WEST LINE OF THE EAST ONE-HALF OF THE SOUTHWEST ONE-QUARTER OF SECTION 12 A DISTANCE OF 2644.55 FEET (2643.25' AM) TO THE NORTHWEST CORNER OF THE EAST ONE-HALF OF THE SOUTHWEST ONE-QUARTER OF SECTION 12;

THENCE S89°17'26"W A DISTANCE OF 256.96 FEET;

THENCE N17°44'19"W A DISTANCE OF 965.15 FEET TO A POINT OF CURVE;

THENCE ALONG THE ARC OF A CURVE TO THE RIGHT HAVING A DELTA OF 36°53'56", A RADIUS OF 743.44 FEET, AND A LENGTH OF 490.03 FEET TO A POINT OF TANGENT;

THENCE N20°01'39"E ALONG SAID TANGENT 522.11 FEET TO A POINT ON THE SOUTH RIGHT OF WAY LINE OF BRADLEY ROAD AS RECORDED IN THE EL PASO COUNTY RECORDS UNDER RECEPTION NO. 98124132;

THENCE EASTERLY AND ALONG THE SOUTH RIGHT-OF-WAY LINE OF BRADLEY ROAD THE FOLLOWING THREE COURSES;

1. NORTH N76°10'55"E ALONG SAID RIGHT-OF-WAY LINE 2110.25 FEET TO A POINT OF CURVE;
2. THENCE ALONG THE ARC OF A CURVE TO THE RIGHT HAVING A DELTA OF 13 DEGREES 39 MINUTES 41 SECONDS (AM 13°39'39"), A RADIUS OF 4895.00 FEET, AND A LENGTH OF 1167.15 FEET (1167.09' AM) TO THE POINT OF TANGENT;
3. NORTH 89 DEGREES 50 MINUTES 39 SECONDS EAST (AM N89°50'34"E) A DSITANCE OF 1124.39 FEET (1124.54' AM) TO THE POINT OF BEGINNING.

THE PROPERTY CONTAINS 27,782,841 S.F. (637.806 ACRES) MORE OR LESS AS SURVEYED.

APPENDIX B – HYDROLOGY CALCULATIONS

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: JULY 3, 2023
Checked By: Leonard Beasley

Job No: 100.300
Project: Bull Hill/Rolling Meadows MDDP
Design Storm: **5 - Year Event (Current)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	∑ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
ET-18a			16.28	0.16	40.6	2.60	2.03	5.3													
ET-18b			27.69	0.18	25.3	4.98	2.74	13.6													
ET-19			24.44	0.19	35.9	4.64	2.21	10.3													
(ET-18a,18b & ET-19)	**S5a**	68.41							45.0	12.23	1.87	22.9									
ET-24			23.89	0.15	27.8	3.51	2.60	9.1													
ET-25			127.20	0.13	41.3	16.54	2.00	33.1													
ET-27			181.14	0.09	41.2	16.30	2.01	32.7													
ET-28			69.31	0.13	32.8	9.01	2.35	21.2													
(ET-25,27,28)	**S4a**	377.65							41.3	41.85	2.00	83.8									
ET-32			111.97	0.14	38.0	15.68	2.13	33.3													
ET-31			28.35	0.15	23.2	4.25	2.86	12.2													
ET-38		602.40							60.5	TR-20		306.4									
ET-46a			9.57	0.15	15.1	1.44	3.51	5.0													
ET-48a			27.54	0.11	30.5	3.03	2.46	7.4													
EX-N1			43.58	0.13	54.4	5.67	1.59	9.0													
(ET-48a & EX-N1)	**DP-N1**	71.12							65.5	8.69	1.31	11.4									
EX-N2			110.90	0.10	43.8	11.09	1.91	21.2													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: JULY 3, 2023
Checked By: Leonard Beasley

Job No: 100.300
Project: Bull Hill/Rolling Meadows MDDP
Design Storm: **5 - Year Event (Current)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	∑ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
(ET-46a & EX-N2)	**DP-N2**	120.47							43.8	12.53	1.91	24.0									
EX-N3			64.59	0.11	30.2	7.10	2.47	17.6													
(ET-38+ EX-N3)	**DP-N3**	666.99							69.6	TR-20		344.0									
EX-N4			169.59	0.10	58.8	16.96	1.47	25.0													
EX-N5			81.59	0.12	41.9	9.79	1.98	19.4													
(ET-32,EX-N5)	**DP-N4**	193.56							58.1	TR-20		130.1									
EX-N6			8.42	0.08	15.9	0.67	3.43	2.3													
EX-N7			100.60	0.08	39.2	8.05	2.08	16.7													
(EX-N6+N7)	**DP-N5**	109.02							39.2	8.72	2.08	18.1									
EX-N8			112.67	0.10	47.7	11.27	1.78	20.1													
EX-N9			96.77	0.11	52.2	10.64	1.65	17.6													
EX-N10			13.64	0.08	29.2	1.09	2.52	2.8													
EX-N11			81.68	0.10	34.8	8.17	2.26	18.4													
(EX-N10+N11)	**DP-N6**	95.32							34.8	9.26	2.26	20.9									
EX-S1			2.05	0.90	7.2	1.85	4.62	8.5													
EX-S2			11.00	0.08	29.2	0.88	2.52	2.2													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: JULY 3, 2023
Checked By: Leonard Beasley

Job No: 100.300
Project: Bull Hill/Rolling Meadows MDDP
Design Storm: **5 - Year Event (Current)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	∑ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
EX-S3			62.45	0.10	37.4	6.25	2.15	13.4													
EX-S4			84.39	0.12	43.8	10.13	1.91	19.4													
(ET-31 & EX-S4)	**DP-S1**	112.74							52.0	14.38	1.66	23.8									
(ET-31,32 & EX-N5 & EX-S4)	**DP-S2**	306.30							63.0	TR-20		175.7									
EX-S5			94.81	0.11	49.7	10.43	1.73	18.0													
(ET-31,32 & EX-N5 & EX-S4 & S5)	**DP-S3**	401.11							76.6	TR-20		189.8									
EX-S6			207.92	0.09	72.4	18.71	1.16	21.7													
EX-S7			213.32	0.11	83.3	23.47	0.95	22.3													
(ET-24,25,27, ET-28,EX-S7)	**DP-S4**	614.86							79.4	TR-20		337.5									
EX-S8			136.49	0.15	28.0	20.47	2.59	53.0													
(ET-18a,18b,19 EX-S8)	**DP-S5**	204.90							45.0	32.71	1.87	61.3									
EX-S9			10.27	0.10	41.2	1.03	2.01	2.1													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: July 3, 2023
Checked By: Leonard Beasley

Job No: 100.300
Project: Bull Hill/Rolling Meadows MDDP
Design Storm: **100-Year Event (Current)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	∑ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
ET-18a			16.28	0.43	40.6	7.00	3.40	23.8													
ET-18b			27.69	0.45	25.3	12.46	4.59	57.2													
ET-19			24.44	0.46	35.9	11.24	3.71	41.7													
(ET-18a,18b & ET-19)	**S5a**	68.41							45.0	30.70	3.14	96.5									
ET-24			23.89	0.50	27.8	11.95	4.36	52.1													
ET-25			127.20	0.46	41.3	58.51	3.36	196.5													
ET-27			181.14	0.38	41.2	68.83	3.36	231.6													
ET-28			69.31	0.46	32.8	31.88	3.94	125.7													
(ET-25,27,28)	**DP-S4a**	377.65							41.3	159.23	3.36	534.8									
ET-32			111.97	0.48	38.0	53.75	3.57	191.6													
ET-31			28.35	0.50	23.2	14.18	4.81	68.1													
ET-38		602.40							60.5	TR-20		747.7									
ET-46a			9.57	0.50	15.1	4.79	5.89	28.2													
ET-48a			27.54	0.42	30.5	11.57	4.12	47.7													
EX-N1			43.58	0.46	54.4	20.05	2.66	53.4													
(ET-48a & EX-N1)	**DP-N1**	71.12							65.5	31.61	2.20	69.4									
EX-N2			110.90	0.39	43.8	43.25	3.21	138.9													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: July 3, 2023
Checked By: Leonard Beasley

Job No: 100.300
Project: Bull Hill/Rolling Meadows MDDP
Design Storm: **100-Year Event (Current)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	$\sum$ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
(ET-46a & EX-N2)	**DP-N2**	120.47							43.8	48.04	3.21	154.2									
EX-N3			64.59	0.42	30.2	27.13	4.15	112.5													
(ET-38 + EX-N3)	**DP-N3**	666.99							69.6	TR-20		835.7									
EX-N4			169.59	0.40	58.8	67.84	2.47	167.5													
EX-N5			81.59	0.45	41.9	36.72	3.32	122.0													
(ET-32 & EX-N5)	**DP-N4**	193.56							48.4	TR-20		301.5									
EX-N6			8.42	0.35	15.9	2.95	5.76	17.0													
EX-N7			100.60	0.35	39.2	35.21	3.49	122.8													
(EX-N6+N7)	**DP-N5**	109.02							39.2	38.16	3.49	133.2									
EX-N8			112.67	0.39	47.7	43.94	2.99	131.5													
EX-N9			96.77	0.41	52.2	39.68	2.77	109.8													
EX-N10			13.64	0.35	29.2	4.77	4.23	20.2													
EX-N11			81.68	0.39	34.8	31.86	3.79	120.7													
(EX-N10+N11)	**DP-N6**	95.32							34.8	36.63	3.79	138.8									
EX-S1			2.05	0.96	7.2	1.97	7.76	15.3													
EX-S2			11.00	0.35	29.2	3.85	4.23	16.3													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: July 3, 2023
Checked By: Leonard Beasley

Job No: 100.300
Project: Bull Hill/Rolling Meadows MDDP
Design Storm: **100-Year Event (Current)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	Σ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
EX-S3			62.45	0.39	37.4	24.36	3.61	88.0													
EX-S4			84.39	0.43	43.8	36.29	3.21	116.6													
(ET-31 & EX-S4)	**DP-S1**	112.74							52.0	50.46	2.78	140.3									
(ET-31,32 & EX-N5 & EX-S4)	**DP-S2**	306.30							63.0	TR-20		413.0									
EX-S5			94.81	0.41	49.7	38.87	2.89	112.5													
(ET-31,32 & EX-N5 & EX-S4 & S5)	**DP-S3**	401.11							76.6	TR-20		457.2									
EX-S6			207.92	0.38	72.4	79.01	1.94	153.6													
EX-S7			213.32	0.42	83.3	89.59	1.59	142.6													
(ET-24,25,27, ET-28,EX-S7)	**DP-S4**	614.86							79.4	TR-20		777.1									
EX-S8			136.49	0.47	28.0	64.15	4.34	278.5													
(ET-18a,18b,19 & EX-S8)	**DP-S5**	204.90							45.0	94.85	3.14	298.0									
EX-S9			10.27	0.38	41.2	3.90	3.37	13.1													

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	306.43	6	396	2,210,438	------	------	------	ET-38
2	SCS Runoff	344.00	6	396	2,473,942	------	------	------	DP-N3
3	SCS Runoff	130.14	6	390	790,369	------	------	------	DP-N4
4	SCS Runoff	175.70	6	396	1,235,143	------	------	------	DP-S2
5	SCS Runoff	189.83	6	402	1,469,822	------	------	------	DP-S3
6	SCS Runoff	337.48	6	402	2,533,408	------	------	------	DP-S4
7	SCS Runoff	166.21	6	390	976,687	------	------	------	DP-S5
8	SCS Runoff	111.38	6	378	500,049	------	------	------	ET-32
9	SCS Runoff	279.88	6	378	1,350,138	------	------	------	DP-S4a

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	747.65	6	396	4,926,143	------	------	------	ET-38
2	SCS Runoff	835.65	6	396	5,495,964	------	------	------	DP-N3
3	SCS Runoff	301.52	6	384	1,699,061	------	------	------	DP-N4
4	SCS Runoff	412.97	6	396	2,678,219	------	------	------	DP-S2
5	SCS Runoff	457.18	6	402	3,244,978	------	------	------	DP-S3
6	SCS Runoff	777.05	6	402	5,407,974	------	------	------	DP-S4
7	SCS Runoff	365.91	6	384	2,010,340	------	------	------	DP-S5
8	SCS Runoff	252.47	6	372	1,057,256	------	------	------	ET-32
9	SCS Runoff	703.63	6	378	3,100,579	------	------	------	DP-S4a

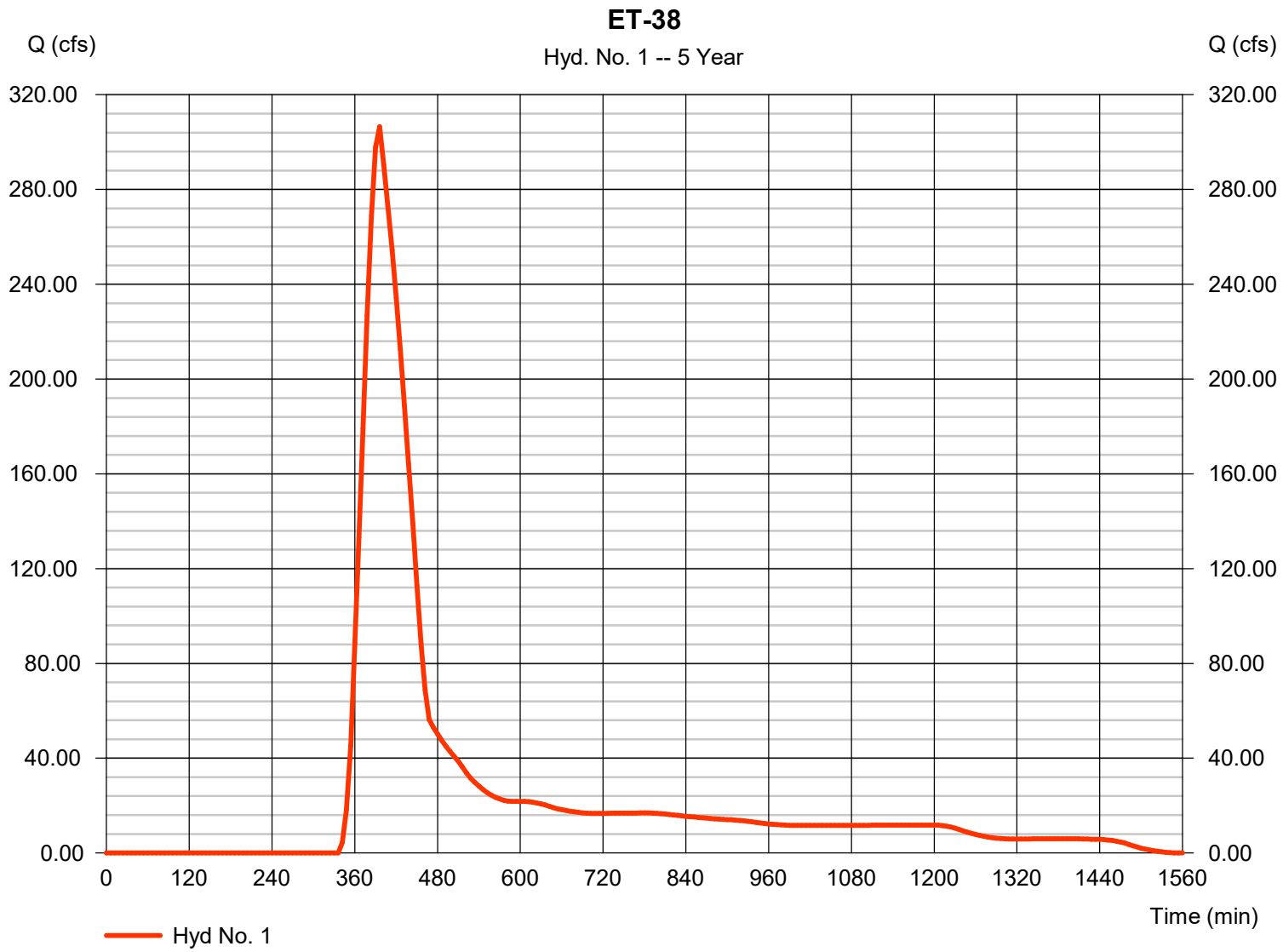
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Wednesday, 07 / 12 / 2023

Hyd. No. 1

ET-38

Hydrograph type	= SCS Runoff	Peak discharge	= 306.43 cfs
Storm frequency	= 5 yrs	Time to peak	= 396 min
Time interval	= 6 min	Hyd. volume	= 2,210,438 cuft
Drainage area	= 602.400 ac	Curve number	= 78.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 60.50 min
Total precip.	= 2.80 in	Distribution	= Custom
Storm duration	= CSpring_IIA-6min.cds	Shape factor	= 484



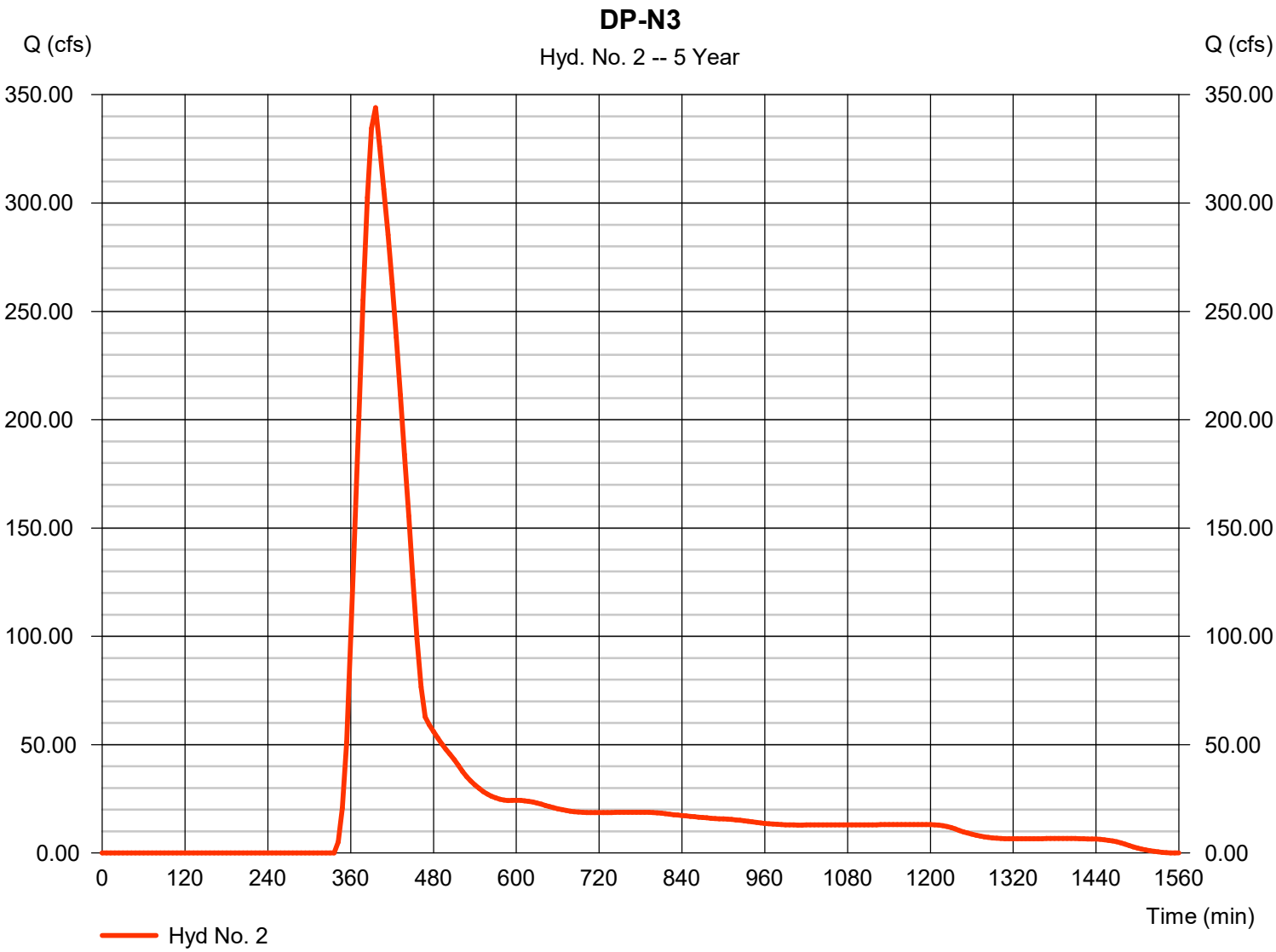
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Wednesday, 07 / 12 / 2023

Hyd. No. 2

DP-N3

Hydrograph type	= SCS Runoff	Peak discharge	= 344.00 cfs
Storm frequency	= 5 yrs	Time to peak	= 396 min
Time interval	= 6 min	Hyd. volume	= 2,473,942 cuft
Drainage area	= 666.990 ac	Curve number	= 78.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 69.60 min
Total precip.	= 2.80 in	Distribution	= Custom
Storm duration	= CSpring_IIA-6min.cds	Shape factor	= 484



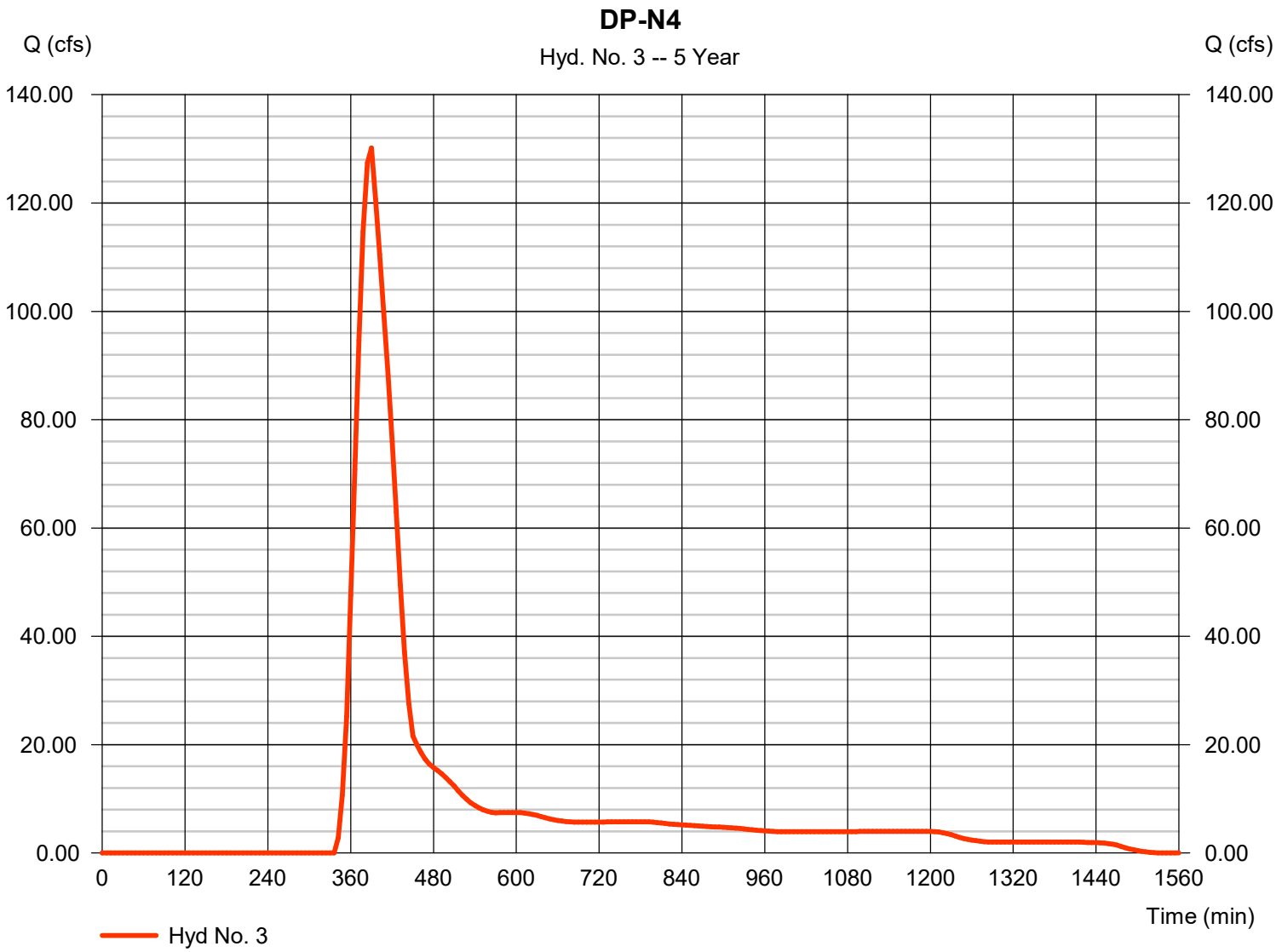
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Wednesday, 07 / 12 / 2023

Hyd. No. 3

DP-N4

Hydrograph type	= SCS Runoff	Peak discharge	= 130.14 cfs
Storm frequency	= 5 yrs	Time to peak	= 390 min
Time interval	= 6 min	Hyd. volume	= 790,369 cuft
Drainage area	= 193.560 ac	Curve number	= 80.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 58.10 min
Total precip.	= 2.80 in	Distribution	= Custom
Storm duration	= CSpring_IIA-6min.cds	Shape factor	= 484



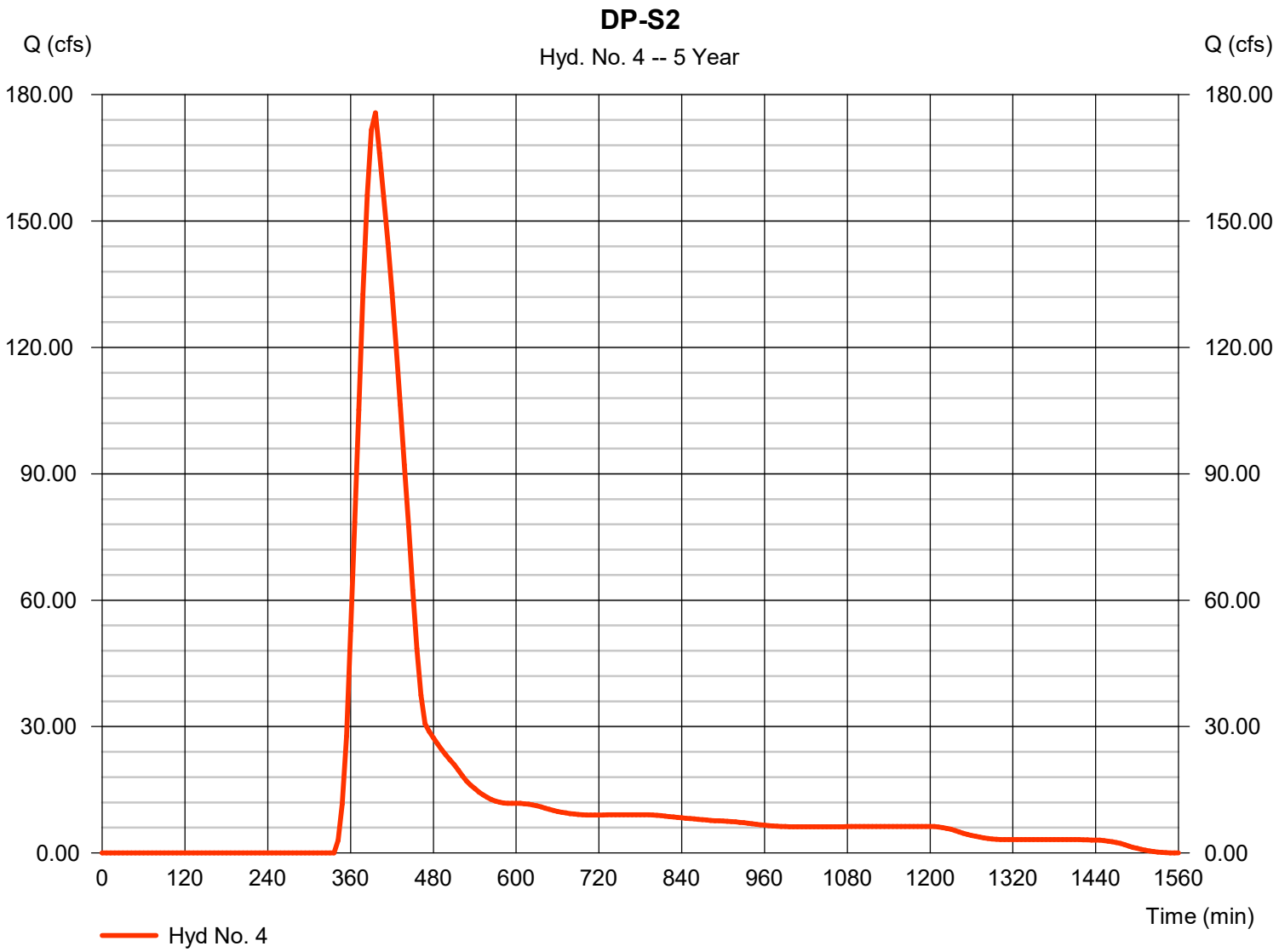
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Wednesday, 07 / 12 / 2023

Hyd. No. 4

DP-S2

Hydrograph type	= SCS Runoff	Peak discharge	= 175.70 cfs
Storm frequency	= 5 yrs	Time to peak	= 396 min
Time interval	= 6 min	Hyd. volume	= 1,235,143 cuft
Drainage area	= 306.300 ac	Curve number	= 79.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 63.00 min
Total precip.	= 2.80 in	Distribution	= Custom
Storm duration	= CSpring_IIA-6min.cds	Shape factor	= 484



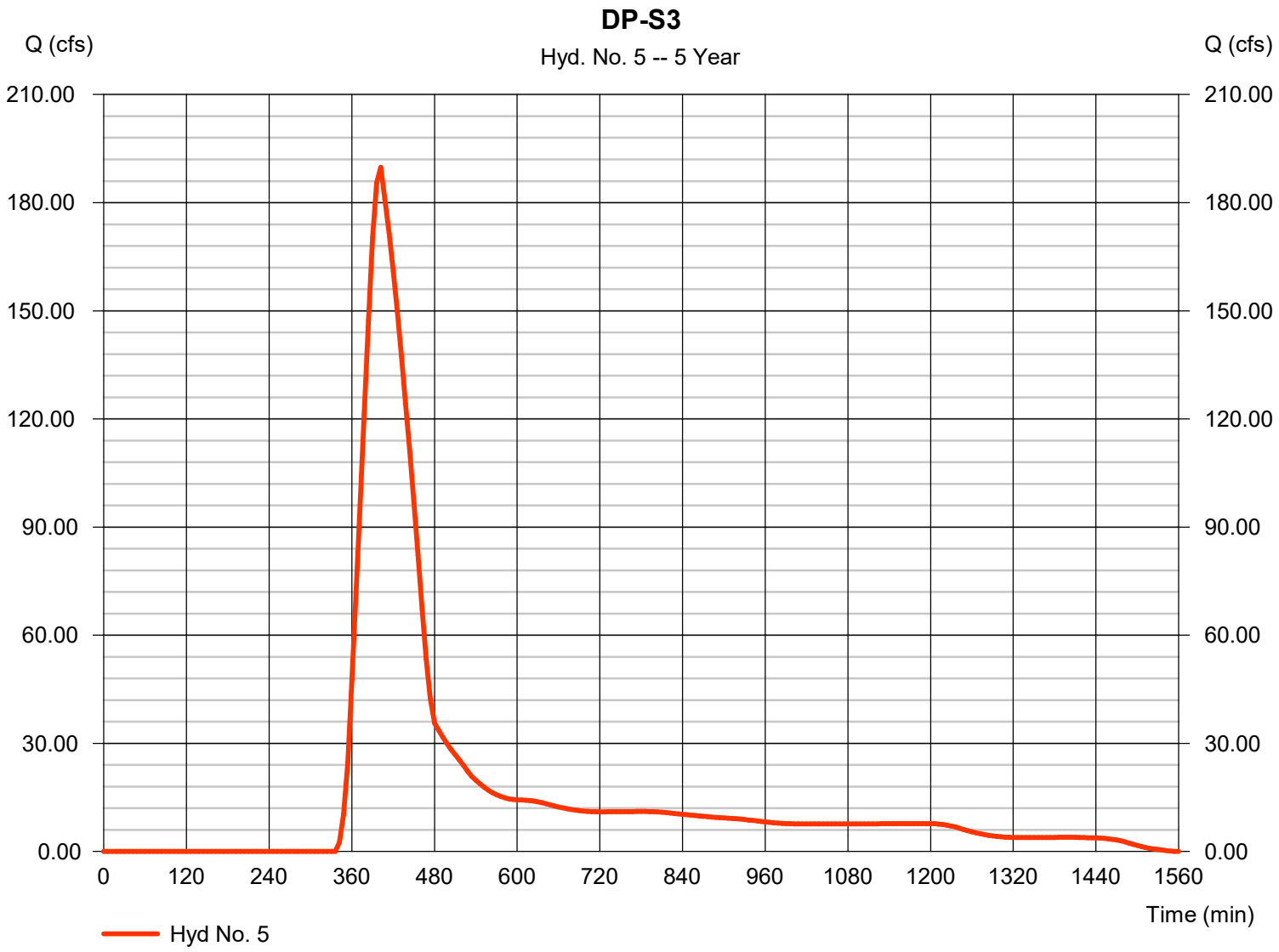
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Wednesday, 07 / 12 / 2023

Hyd. No. 5

DP-S3

Hydrograph type	= SCS Runoff	Peak discharge	= 189.83 cfs
Storm frequency	= 5 yrs	Time to peak	= 402 min
Time interval	= 6 min	Hyd. volume	= 1,469,822 cuft
Drainage area	= 401.110 ac	Curve number	= 78.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 76.60 min
Total precip.	= 2.80 in	Distribution	= Custom
Storm duration	= CSpring_IIA-6min.cds	Shape factor	= 484



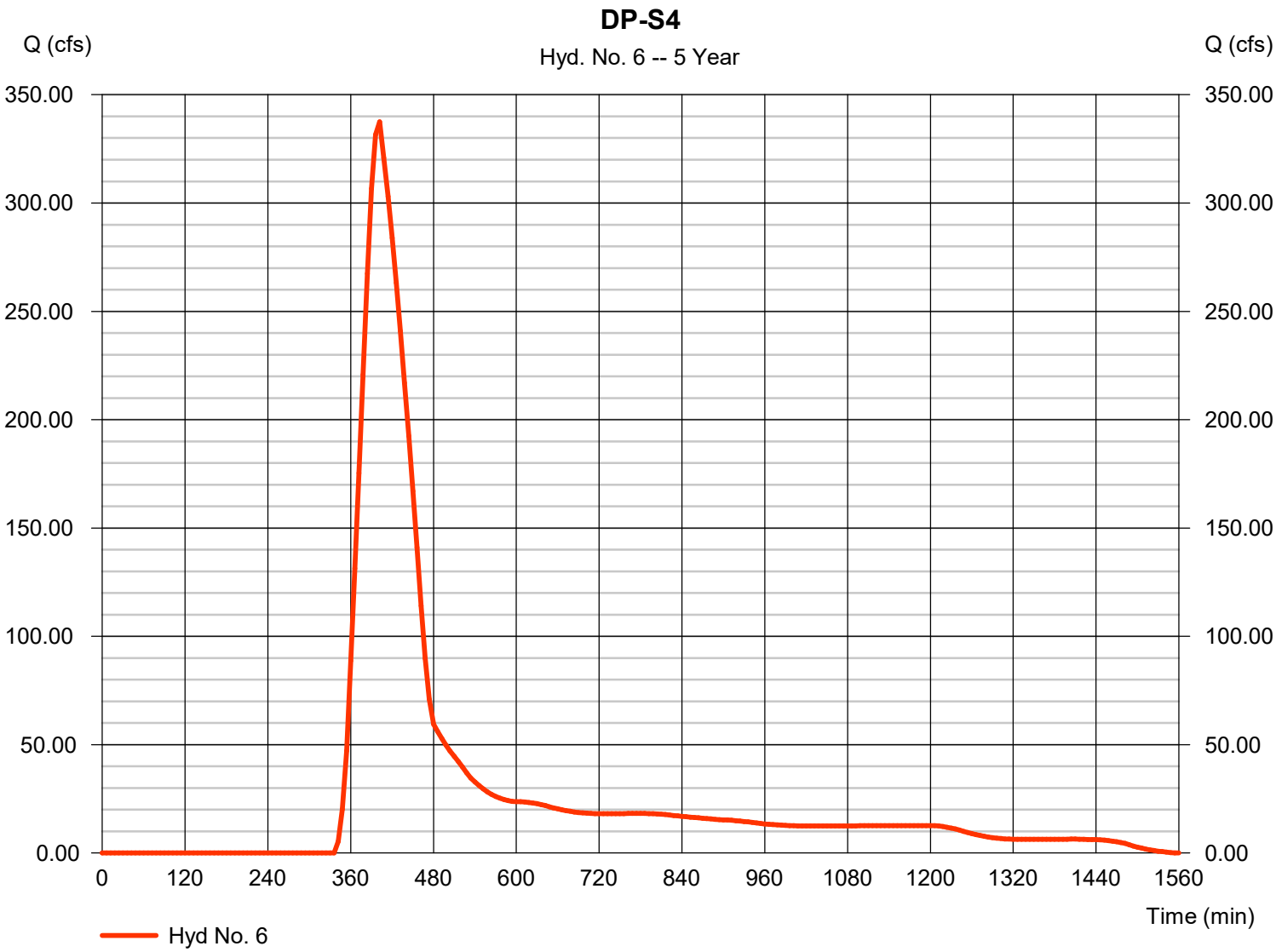
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Wednesday, 07 / 12 / 2023

Hyd. No. 6

DP-S4

Hydrograph type	= SCS Runoff	Peak discharge	= 337.48 cfs
Storm frequency	= 5 yrs	Time to peak	= 402 min
Time interval	= 6 min	Hyd. volume	= 2,533,408 cuft
Drainage area	= 614.860 ac	Curve number	= 81
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 79.40 min
Total precip.	= 2.80 in	Distribution	= Custom
Storm duration	= CSpring_IIA-6min.cds	Shape factor	= 484



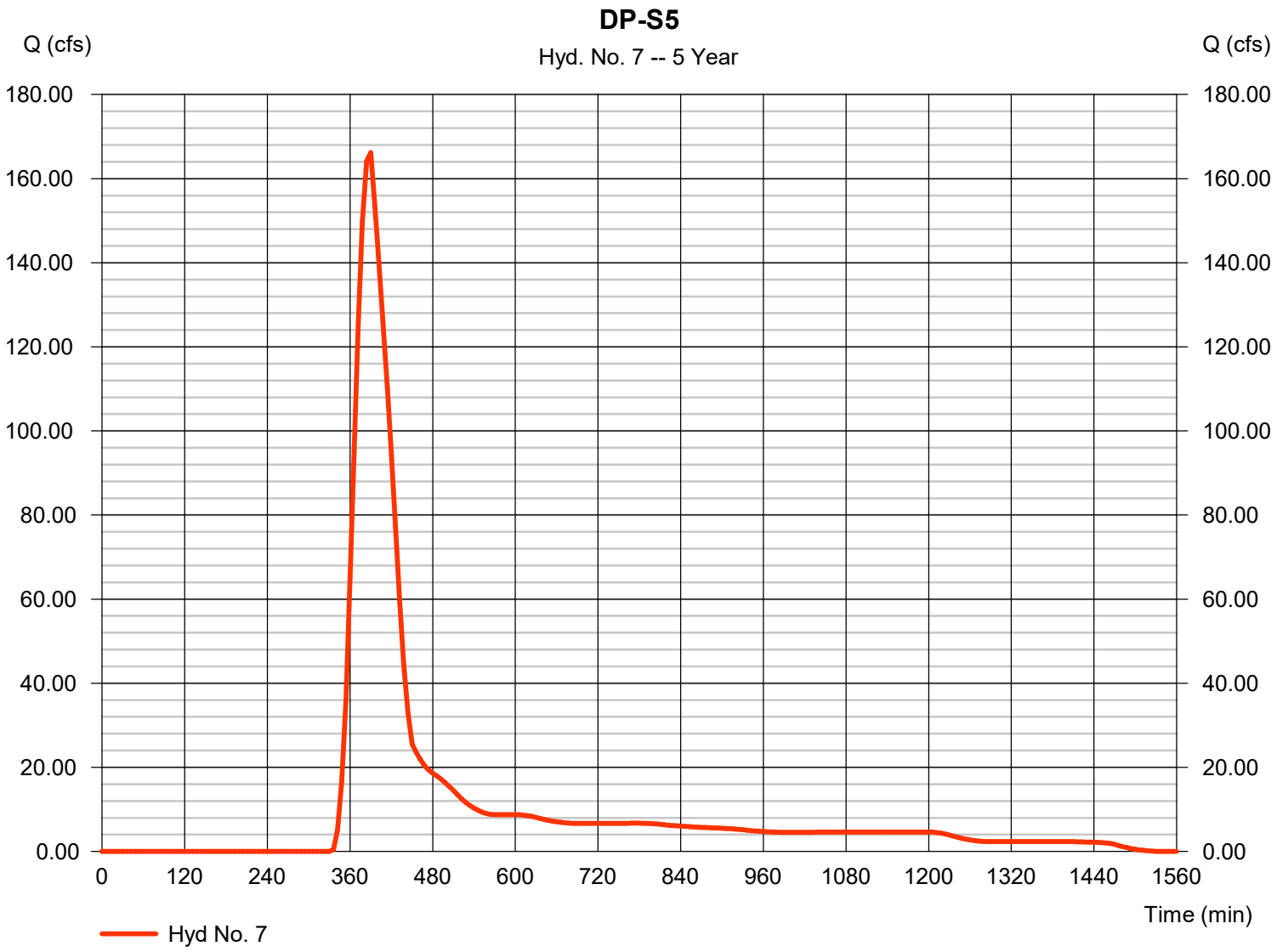
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Wednesday, 07 / 12 / 2023

Hyd. No. 7

DP-S5

Hydrograph type	= SCS Runoff	Peak discharge	= 166.21 cfs
Storm frequency	= 5 yrs	Time to peak	= 390 min
Time interval	= 6 min	Hyd. volume	= 976,687 cuft
Drainage area	= 209.320 ac	Curve number	= 83.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 57.70 min
Total precip.	= 2.80 in	Distribution	= Custom
Storm duration	= CSpring_IIA-6min.cds	Shape factor	= 484



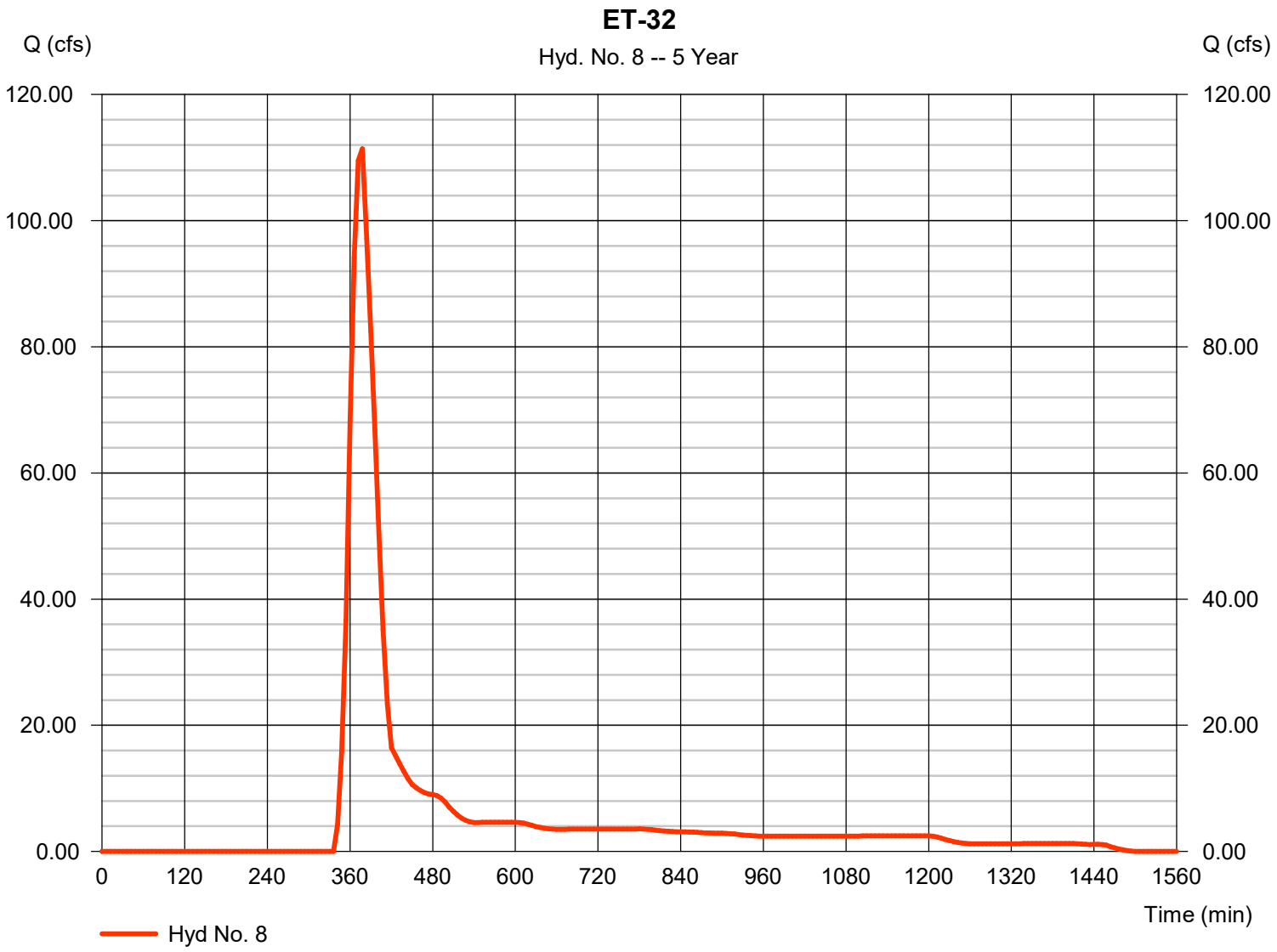
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Wednesday, 07 / 12 / 2023

Hyd. No. 8

ET-32

Hydrograph type	= SCS Runoff	Peak discharge	= 111.38 cfs
Storm frequency	= 5 yrs	Time to peak	= 378 min
Time interval	= 6 min	Hyd. volume	= 500,049 cuft
Drainage area	= 111.970 ac	Curve number	= 81.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 38.60 min
Total precip.	= 2.80 in	Distribution	= Custom
Storm duration	= CSpring_IIA-6min.cds	Shape factor	= 484



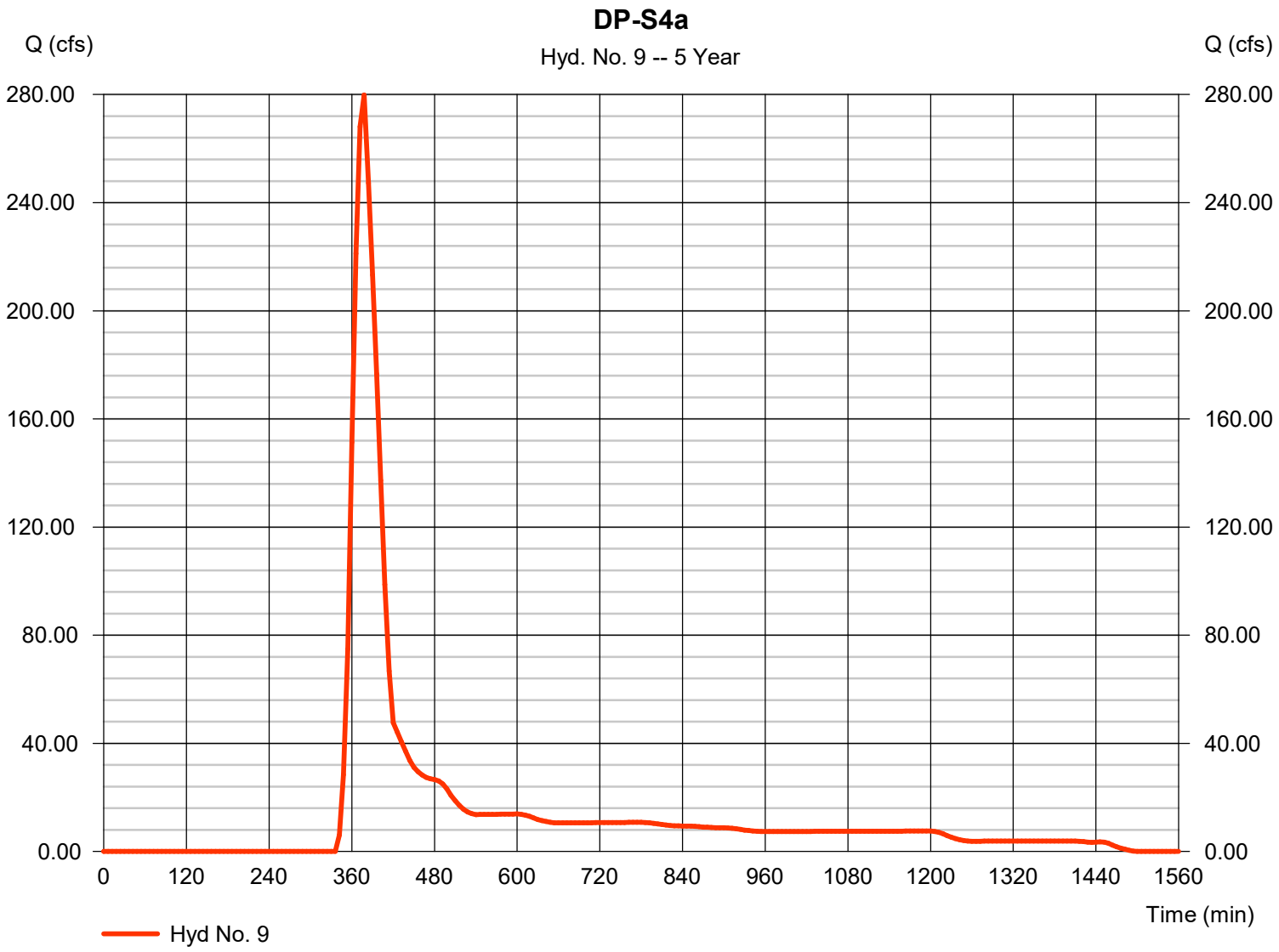
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Wednesday, 07 / 12 / 2023

Hyd. No. 9

DP-S4a

Hydrograph type	= SCS Runoff	Peak discharge	= 279.88 cfs
Storm frequency	= 5 yrs	Time to peak	= 378 min
Time interval	= 6 min	Hyd. volume	= 1,350,138 cuft
Drainage area	= 401.540 ac	Curve number	= 76.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 39.80 min
Total precip.	= 2.80 in	Distribution	= Custom
Storm duration	= CSpring_IIA-6min.cds	Shape factor	= 484



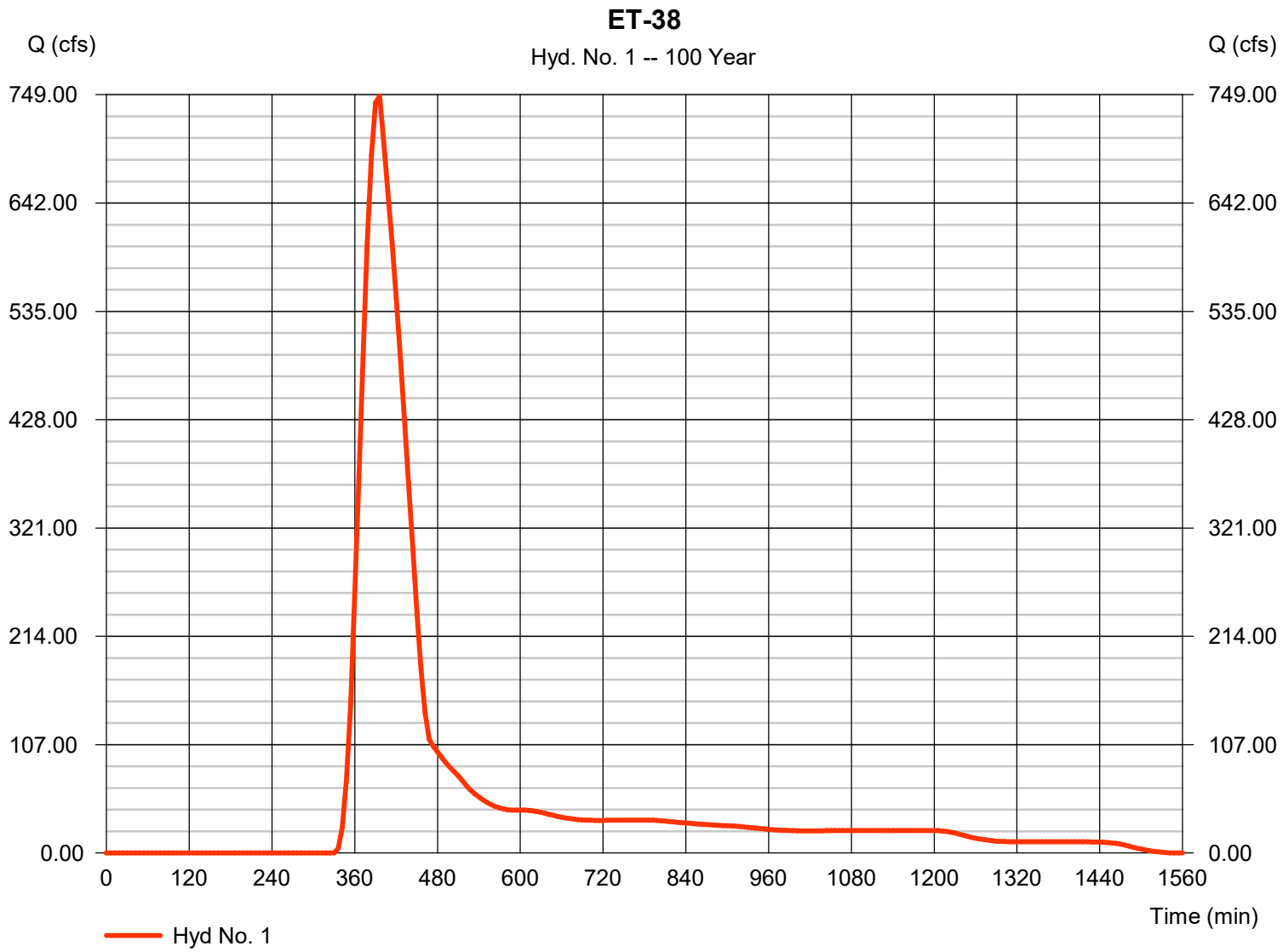
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Wednesday, 07 / 12 / 2023

Hyd. No. 1

ET-38

Hydrograph type	= SCS Runoff	Peak discharge	= 747.65 cfs
Storm frequency	= 100 yrs	Time to peak	= 396 min
Time interval	= 6 min	Hyd. volume	= 4,926,143 cuft
Drainage area	= 602.400 ac	Curve number	= 78.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 60.50 min
Total precip.	= 4.40 in	Distribution	= Custom
Storm duration	= CSpring_IIA-6min.cds	Shape factor	= 484



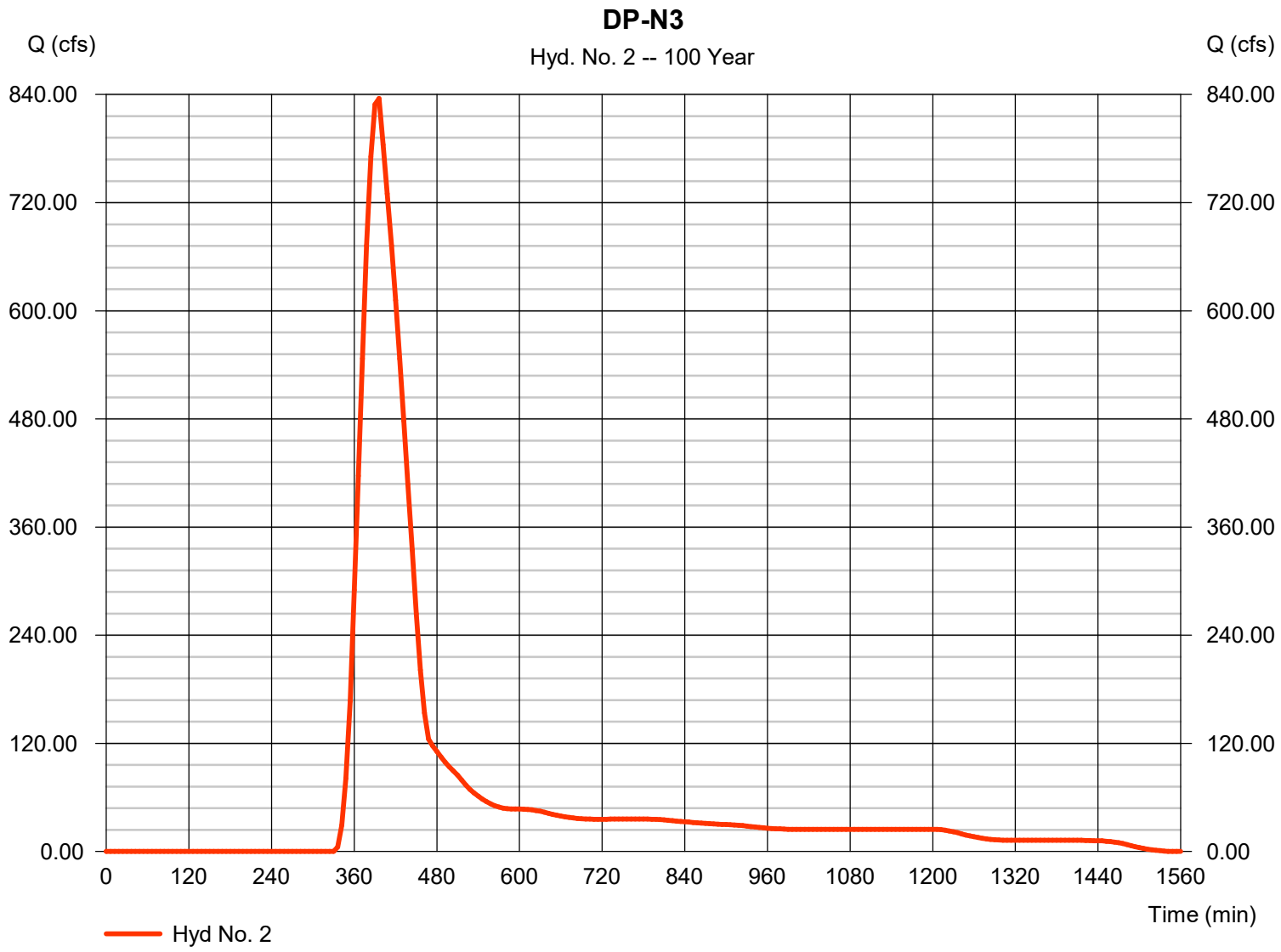
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Wednesday, 07 / 12 / 2023

Hyd. No. 2

DP-N3

Hydrograph type	= SCS Runoff	Peak discharge	= 835.65 cfs
Storm frequency	= 100 yrs	Time to peak	= 396 min
Time interval	= 6 min	Hyd. volume	= 5,495,964 cuft
Drainage area	= 666.990 ac	Curve number	= 78.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 69.60 min
Total precip.	= 4.40 in	Distribution	= Custom
Storm duration	= CSpring_IIA-6min.cds	Shape factor	= 484



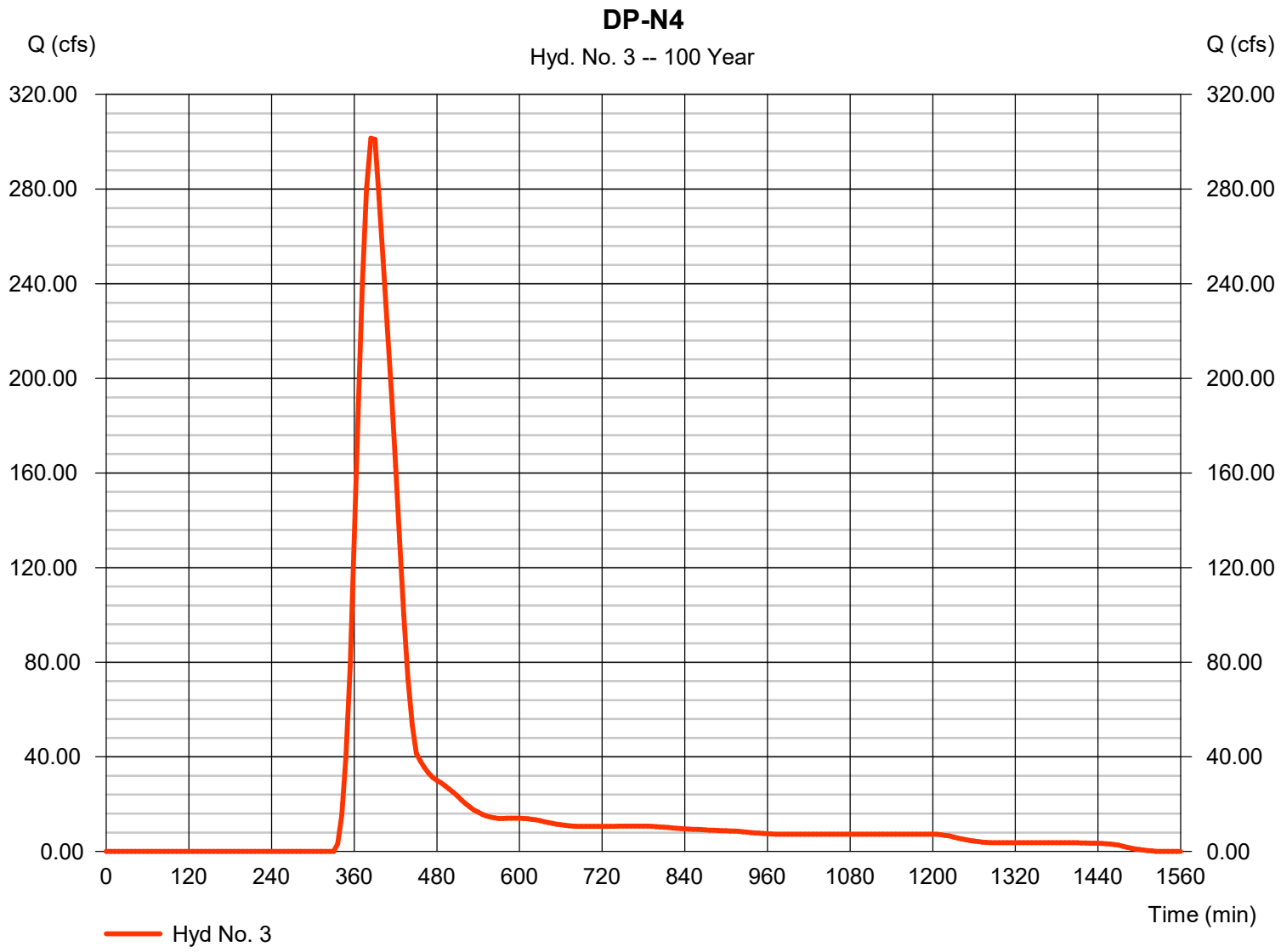
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Wednesday, 07 / 12 / 2023

Hyd. No. 3

DP-N4

Hydrograph type	= SCS Runoff	Peak discharge	= 301.52 cfs
Storm frequency	= 100 yrs	Time to peak	= 384 min
Time interval	= 6 min	Hyd. volume	= 1,699,061 cuft
Drainage area	= 193.560 ac	Curve number	= 80.5
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 58.10 min
Total precip.	= 4.40 in	Distribution	= Custom
Storm duration	= CSpring_IIA-6min.cds	Shape factor	= 484



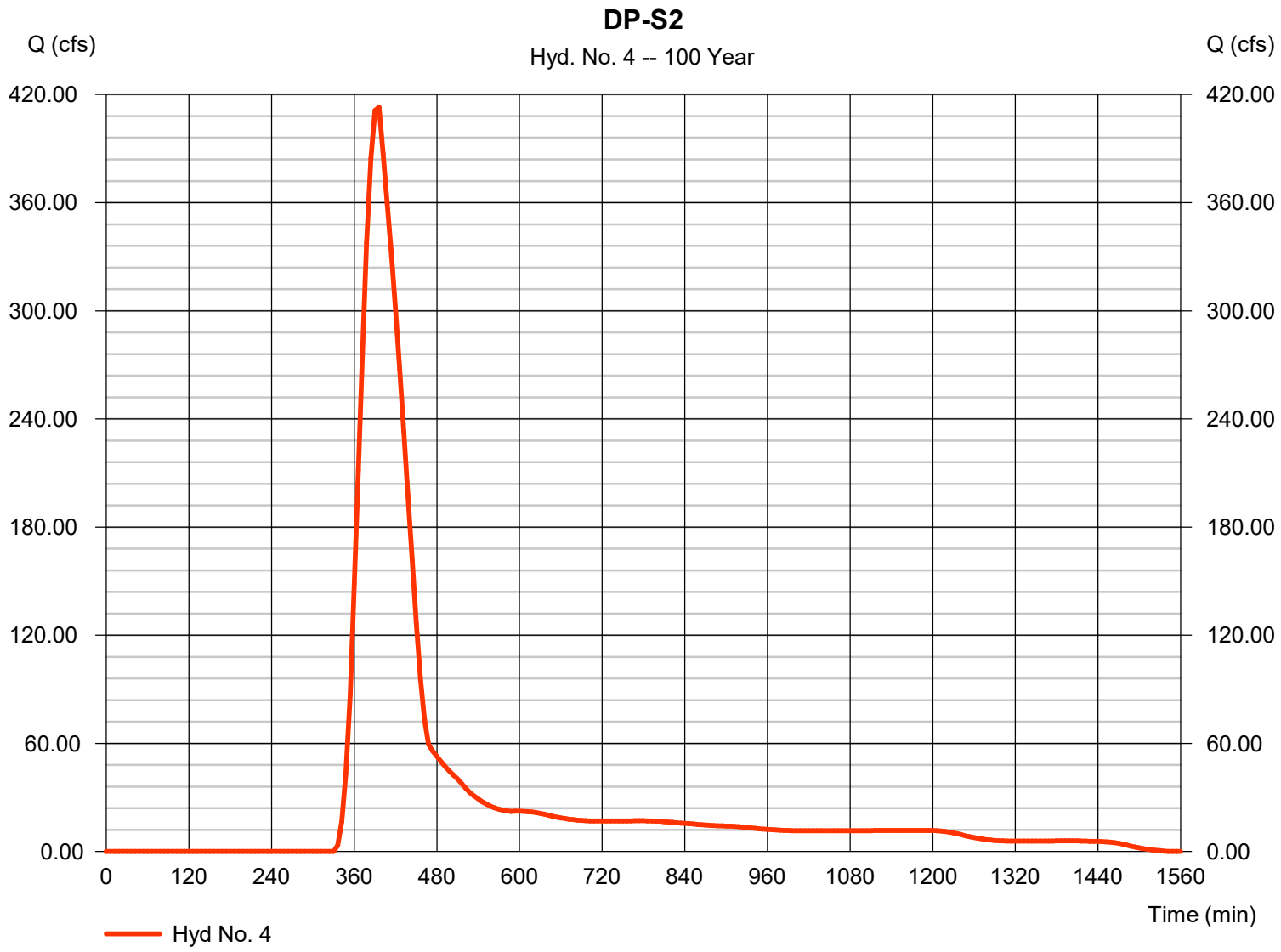
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Wednesday, 07 / 12 / 2023

Hyd. No. 4

DP-S2

Hydrograph type	= SCS Runoff	Peak discharge	= 412.97 cfs
Storm frequency	= 100 yrs	Time to peak	= 396 min
Time interval	= 6 min	Hyd. volume	= 2,678,219 cuft
Drainage area	= 306.300 ac	Curve number	= 79.9
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 63.00 min
Total precip.	= 4.40 in	Distribution	= Custom
Storm duration	= CSpring_IIA-6min.cds	Shape factor	= 484



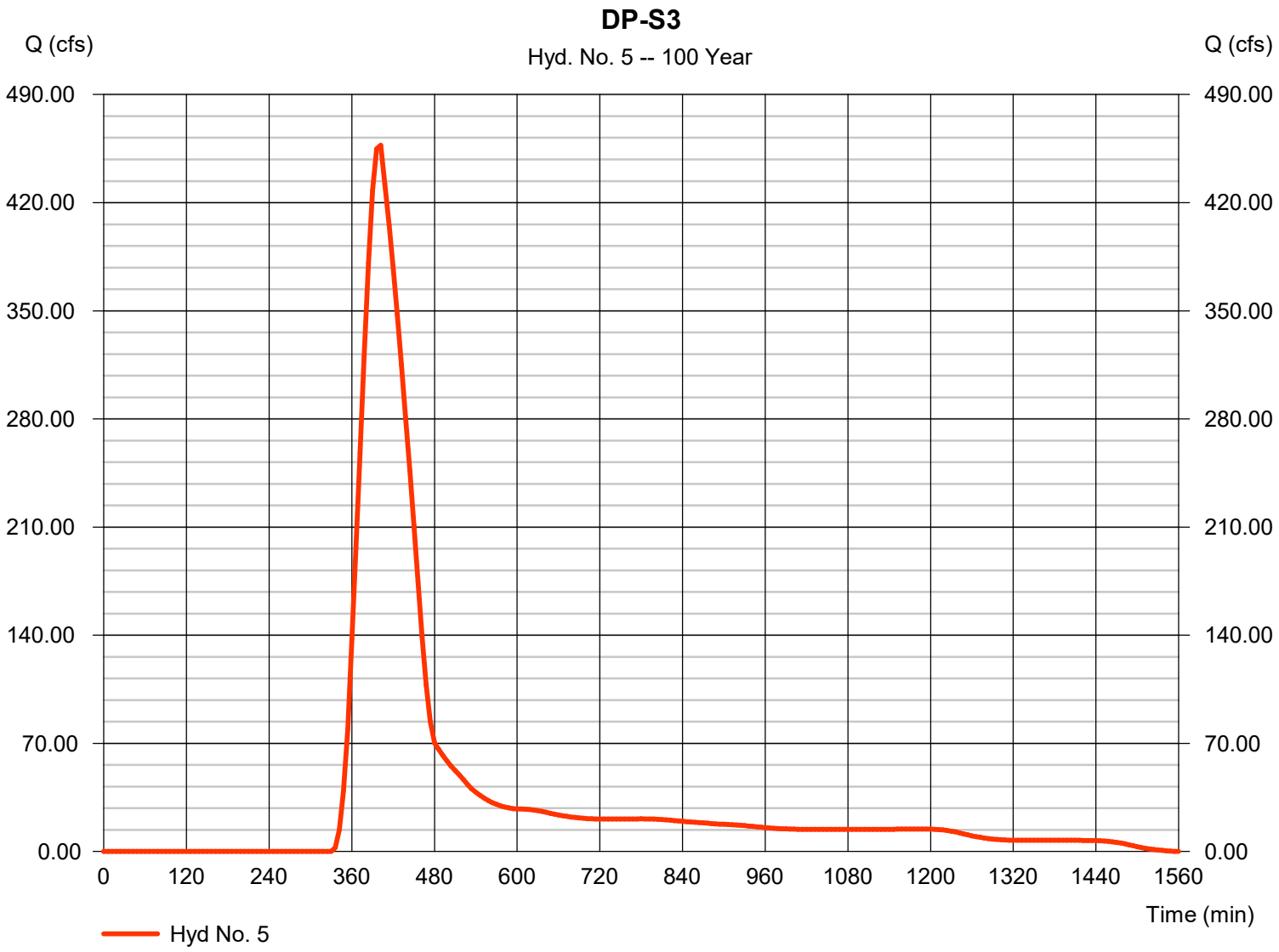
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Wednesday, 07 / 12 / 2023

Hyd. No. 5

DP-S3

Hydrograph type	= SCS Runoff	Peak discharge	= 457.18 cfs
Storm frequency	= 100 yrs	Time to peak	= 402 min
Time interval	= 6 min	Hyd. volume	= 3,244,978 cuft
Drainage area	= 401.110 ac	Curve number	= 78.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 76.60 min
Total precip.	= 4.40 in	Distribution	= Custom
Storm duration	= CSpring_IIA-6min.cds	Shape factor	= 484



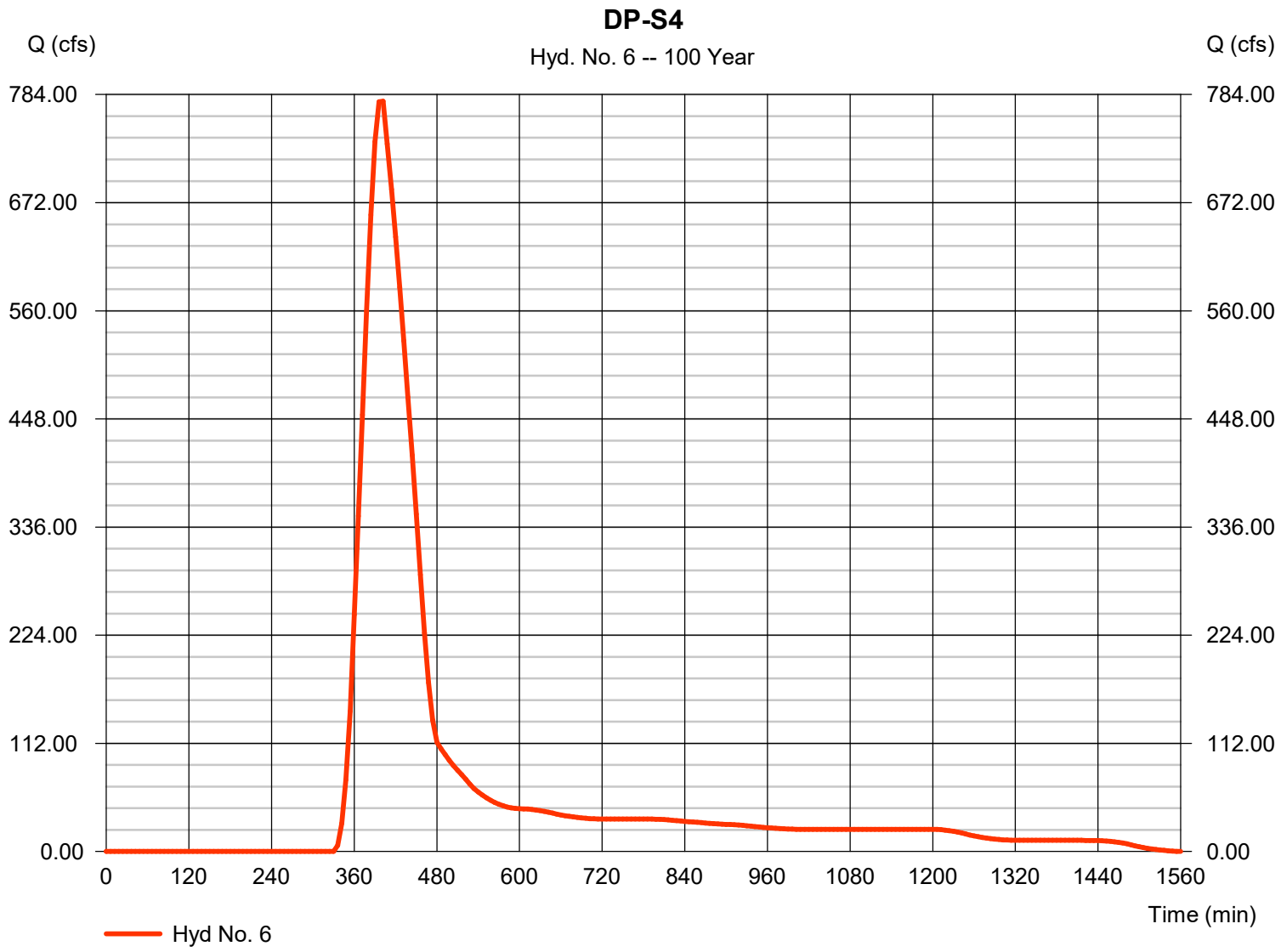
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Wednesday, 07 / 12 / 2023

Hyd. No. 6

DP-S4

Hydrograph type	= SCS Runoff	Peak discharge	= 777.05 cfs
Storm frequency	= 100 yrs	Time to peak	= 402 min
Time interval	= 6 min	Hyd. volume	= 5,407,974 cuft
Drainage area	= 614.860 ac	Curve number	= 81
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 79.40 min
Total precip.	= 4.40 in	Distribution	= Custom
Storm duration	= CSpring_IIA-6min.cds	Shape factor	= 484



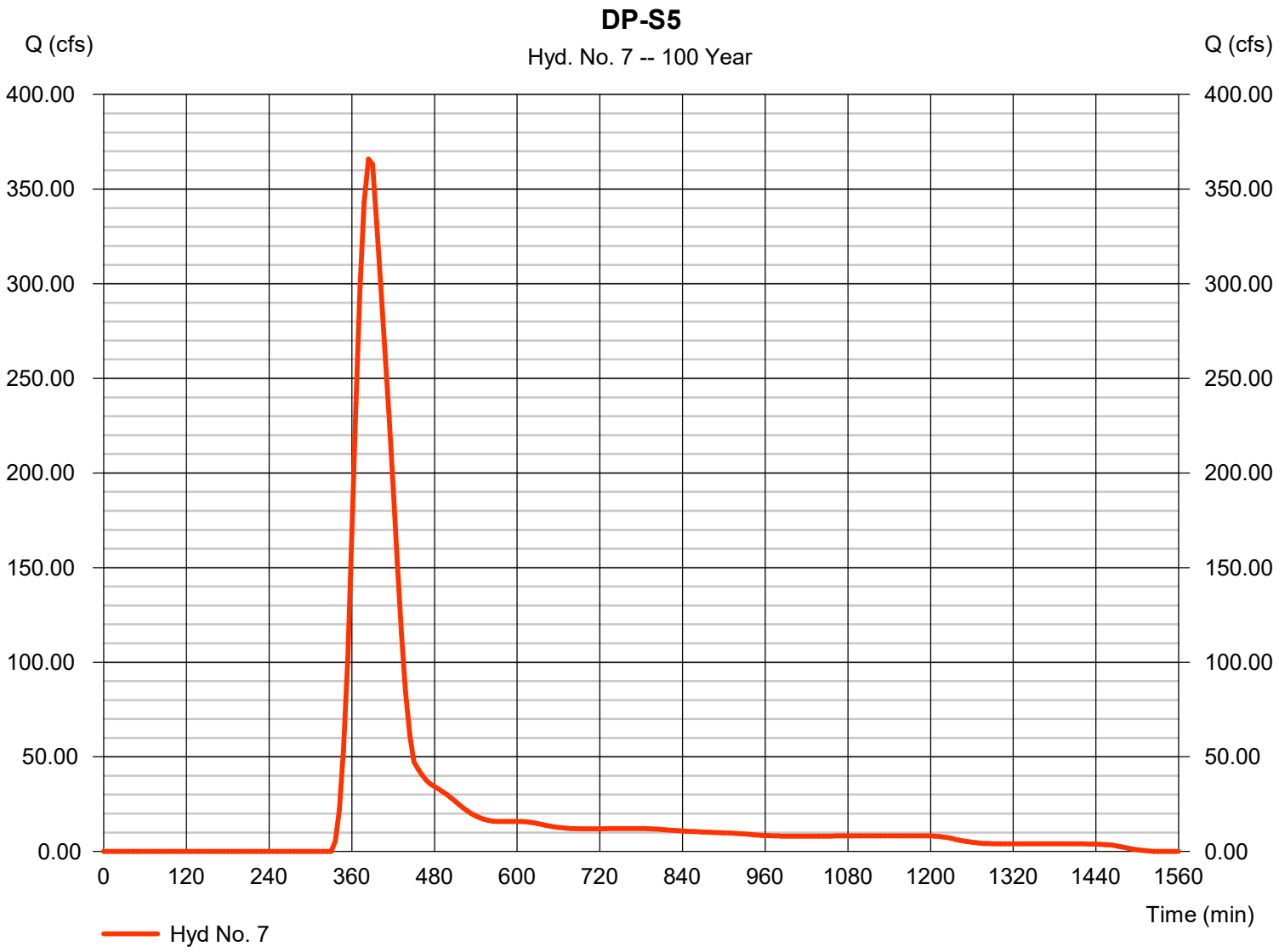
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Wednesday, 07 / 12 / 2023

Hyd. No. 7

DP-S5

Hydrograph type	= SCS Runoff	Peak discharge	= 365.91 cfs
Storm frequency	= 100 yrs	Time to peak	= 384 min
Time interval	= 6 min	Hyd. volume	= 2,010,340 cuft
Drainage area	= 209.320 ac	Curve number	= 83.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 57.70 min
Total precip.	= 4.40 in	Distribution	= Custom
Storm duration	= CSpring_IIA-6min.cds	Shape factor	= 484



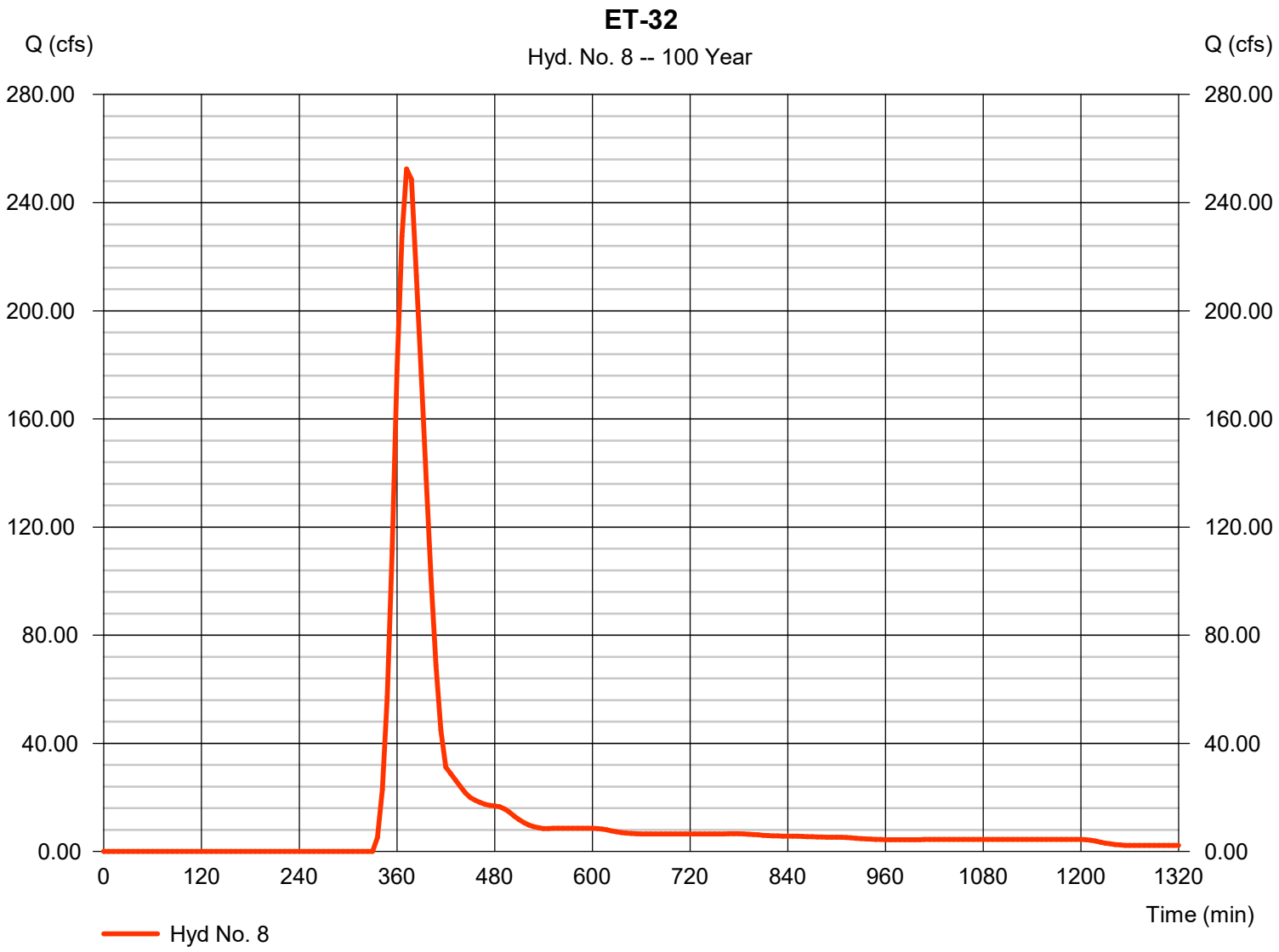
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Wednesday, 07 / 12 / 2023

Hyd. No. 8

ET-32

Hydrograph type	= SCS Runoff	Peak discharge	= 252.47 cfs
Storm frequency	= 100 yrs	Time to peak	= 372 min
Time interval	= 6 min	Hyd. volume	= 1,057,256 cuft
Drainage area	= 111.970 ac	Curve number	= 81.7
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 38.60 min
Total precip.	= 4.40 in	Distribution	= Custom
Storm duration	= CSpring_IIA-6min.cds	Shape factor	= 484



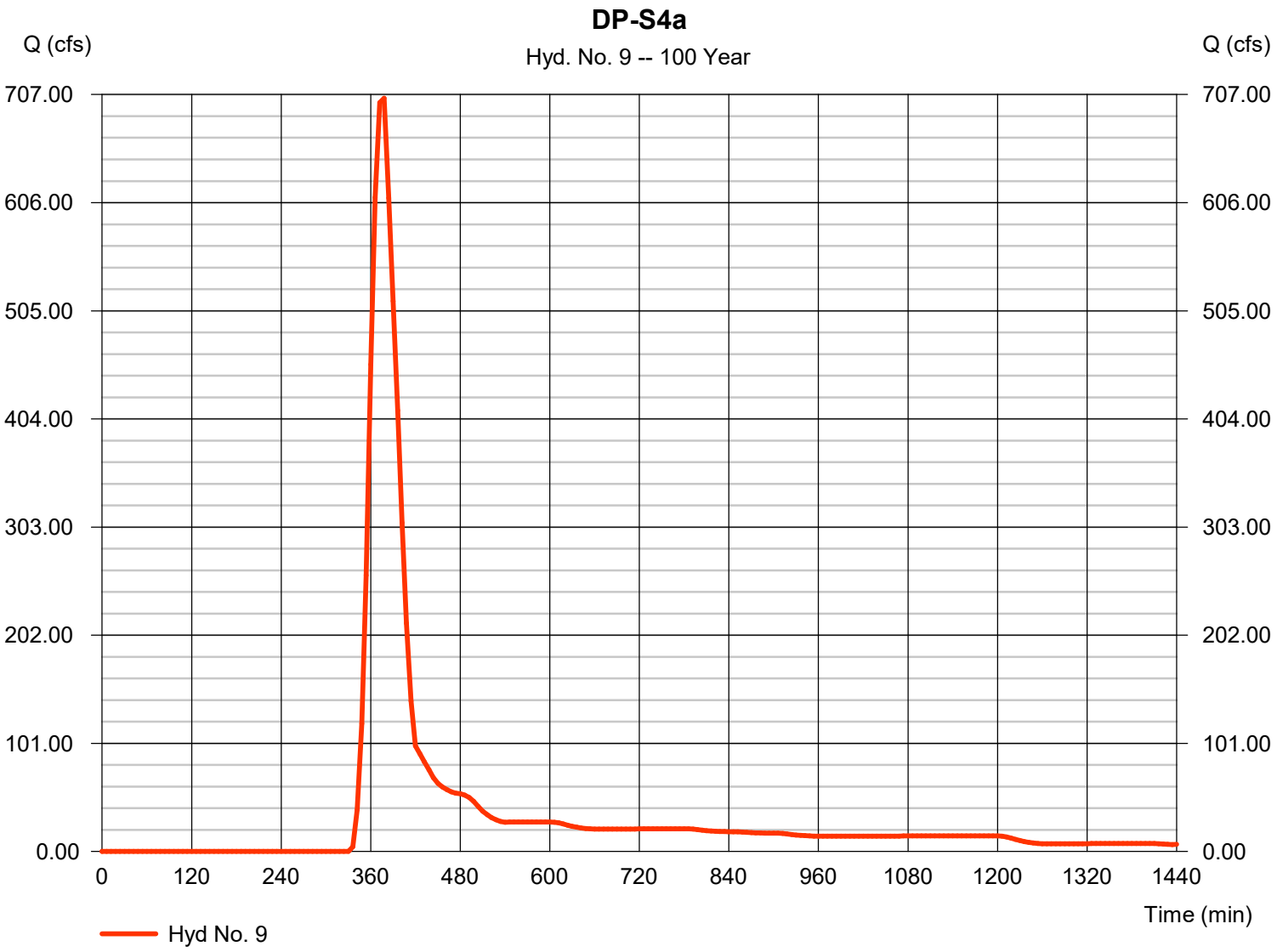
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Wednesday, 07 / 12 / 2023

Hyd. No. 9

DP-S4a

Hydrograph type	= SCS Runoff	Peak discharge	= 703.63 cfs
Storm frequency	= 100 yrs	Time to peak	= 378 min
Time interval	= 6 min	Hyd. volume	= 3,100,579 cuft
Drainage area	= 401.540 ac	Curve number	= 76.3
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 39.80 min
Total precip.	= 4.40 in	Distribution	= Custom
Storm duration	= CSpring_IIA-6min.cds	Shape factor	= 484



CORE ENGINEERING GROUP
15004 1st Avenue South
Burnsville, MN 55306

PROJECT NAME: *Rollong Hills MDDP*
PROJECT NUMBER: *100.300*
ENGINEER: *LAB*
DATE: *July 3 , 2023*

Master Development Drainage Plan
CURRENT CONDITIONS COEFFICIENT "C" CALCULATIONS

BASIN	Soil No.	Hydro Group	Area	Cover (%)	C5	Wtd. C5	C100	Wtd. C100	CN	Wtd. CN	Impervious	Type of Cover
ET-18a	56	B	5.58	34.28%	0.08	0.03	0.35	0.12	69	23.65	0%	Pasture/Range
	75	D	10.70	65.72%	0.20	0.13	0.47	0.31	84	55.21	0%	Pasture/Range
			16.28	100.00%		0.16		0.43		78.86		
ET-18b	108	B	4.31	15.57%	0.08	0.01	0.35	0.05	69	10.74	0%	Pasture/Range
	75	D	23.38	84.43%	0.20	0.17	0.47	0.40	84	70.93	0%	Pasture/Range
			27.69	100.00%		0.18		0.45		81.67		
ET-19	108	B	2.76	11.29%	0.08	0.01	0.35	0.04	69	7.79	0%	Pasture/Range
	75	D	21.68	88.71%	0.20	0.18	0.47	0.42	84	74.51	0%	Pasture/Range
			24.44	100.00%		0.19		0.46		82.31		
ET-24	75	D	23.89	100.00%	0.20		0.47		84	84.00	0%	Pasture/Range
ET-25	124	B	31.23	24.55%	0.08	0.02	0.35	0.09	69	16.94	0%	Pasture/Range
	75	D	95.97	75.45%	0.15	0.11	0.50	0.38	84	63.38	0%	Pasture/Range
			127.20	100.00%		0.13		0.46		80.32		
ET-27	124	B	149.23	82.38%	0.08	0.07	0.35	0.29	69	56.84	0%	Pasture/Range
	89	D	31.91	17.62%	0.15	0.03	0.50	0.09	84	14.80	0%	Pasture/Range
			181.14	100.00%		0.09		0.38		71.64		
ET-28	105	A	2.33	3.36%	0.08	0.00	0.35	0.01	49	1.65	0%	Pasture/Meadow
	108/124	B	17.04	24.59%	0.08	0.02	0.35	0.09	69	16.96	0%	Pasture/Meadow
	89	D	49.94	72.05%	0.15	0.11	0.50	0.36	84	60.52	0%	Pasture/Meadow
			69.31	100.00%		0.13		0.46		79.14		
ET-31	89	D	28.35	100.00%	0.15		0.50		84	84.00	0%	Pasture/Range
ET-32	2/56/108	B	16.50	14.74%	0.08	0.01	0.35	0.05	69	10.17	0%	Pasture/Range
	89	D	95.47	85.26%	0.15	0.13	0.50	0.43	84	71.62	0%	Pasture/Range
			111.97	100.00%		0.14		0.48		81.79		
ET-38	97/104/105	A	99.84	16.57%	0.08	0.01	0.35	0.06	69	11.44	0%	Pasture/Meadow
	2/56/108	B	417.22	69.26%	0.08	0.06	0.35	0.24	79	54.72	0%	Pasture/Meadow
	54/89/94	D	85.34	14.17%	0.15	0.02	0.50	0.07	84	11.90	0%	Pasture/Meadow
			602.40	100.00%		0.09		0.37		78.05		
ET-46a	89	D	9.57	100.00%	0.15		0.50		84	84.00	0%	Pasture/Range
ET-48a	108	B	14.50	52.65%	0.08	0.04	0.35	0.18	69	36.33	0%	Pasture/Meadow
	89	D	13.04	47.35%	0.15	0.07	0.50	0.24	84	39.77	0%	Pasture/Meadow
			27.54	100.00%		0.11		0.4210		76.10		

CORE ENGINEERING GROUP
15004 1st Avenue South
Burnsville, MN 55306

PROJECT NAME: Rollong Hills MDDP
PROJECT NUMBER: 100.300
ENGINEER: LAB
DATE: July 3 , 2023

Master Development Drainage Plan
CURRENT CONDITIONS COEFFICIENT "C" CALCULATIONS

BASIN	Soil No.	Hydro Group	Area	Cover (%)	C5	Wtd. C5	C100	Wtd. C100	CN	Wtd. CN	Impervious	Type of Cover
EX-N1	28	A	9.64	22.12%	0.08	0.02	0.35	0.08	49	10.84	0%	Pasture/Meadow
	108	B	0.79	1.81%	0.08	0.00	0.35	0.01	69	1.25	0%	Pasture/Meadow
	89	D	33.15	76.07%	0.15	0.11	0.50	0.38	84	63.90	0%	Pasture/Meadow
			43.58	100.00%		0.13		0.46		75.99		
EX-N2	28	A	13.72	12.37%	0.08	0.01	0.35	0.04	49	6.06	0%	Pasture/Meadow
	56/78	B	66.76	60.20%	0.08	0.05	0.35	0.21	69	41.54	0%	Pasture/Meadow
	89	D	30.42	27.43%	0.15	0.04	0.50	0.14	84	23.04	0%	Pasture/Meadow
			110.90	100.00%		0.10		0.39		70.64		
EX-N3	28	A	0.28	0.43%	0.08	0.00	0.35	0.00	49	0.21	0%	Pasture/Meadow
	2/78	B	33.13	51.29%	0.08	0.04	0.35	0.18	69	35.39	0%	Pasture/Meadow
	89	D	31.18	48.27%	0.15	0.07	0.50	0.24	84	40.55	0%	Pasture/Meadow
			64.59	100.00%		0.11		0.4224		76.15		
DP-N3	97/104/105	A	100.12	15.01%	0.08	0.01	0.35	0.05	69	10.36	0%	Pasture/Meadow
	2/56/108	B	450.35	67.52%	0.08	0.05	0.35	0.24	79	53.34	0%	Pasture/Meadow
	54/89/94	D	116.52	17.47%	0.15	0.03	0.50	0.09	84	14.67	0%	Pasture/Meadow
			666.99	100.00%		0.09		0.38		78.37		
EX-N4	56/78	B	109.17	64.37%	0.08	0.05	0.35	0.23	69	44.42	0%	Pasture/Range
	89	D	60.42	35.63%	0.15	0.05	0.50	0.18	84	29.93	0%	Pasture/Range
			169.59	100.00%		0.10		0.40		74.34		
EX-N5	78	B	29.49	36.14%	0.08	0.03	0.35	0.13	69	24.94	0%	Pasture/Range
	89	D	52.10	63.86%	0.15	0.10	0.50	0.32	84	53.64	0%	Pasture/Range
			81.59	100.00%		0.12		0.45		78.58		
DP-N4	2/56/108	B	45.49	23.50%	0.08	0.02	0.35	0.08	69	16.22	0%	Pasture/Range
	89	D	148.07	76.50%	0.15	0.11	0.50	0.38	84	64.26	0%	Pasture/Range
			193.56	100.00%		0.13		0.46		80.47		
EX-N6	56	B	8.42	100.00%	0.08		0.35		69	69.00	0%	Pasture/Range
EX-N7	56	B	100.60	100.00%	0.08		0.35		69	69.00	0%	Pasture/Range
EX-N8	56/78	B	84.33	74.85%	0.08	0.06	0.35	0.26	69	51.64	0%	Pasture/Range
	89	D	28.34	25.15%	0.15	0.04	0.50	0.13	84	21.13	0%	Pasture/Range
			112.67	100.00%		0.10		0.39		72.77		
EX-N9	56	B	59.64	61.63%	0.08	0.05	0.35	0.22	69	42.53	0%	Pasture/Meadow
	52	C	5.20	5.37%	0.15	0.01	0.50	0.03	79	4.25	0%	Pasture/Meadow
	89	D	31.93	33.00%	0.15	0.05	0.50	0.16	84	27.72	0%	Pasture/Meadow
			96.77	100.00%		0.11		0.41		74.49		
EX-N10	56	B	13.64	100.00%	0.08		0.35		69	69.00	0%	Pasture/Range
EX-N11	56/86	B	62.40	76.40%	0.08	0.06	0.35	0.27	69	52.71	0%	Pasture/Range

CORE ENGINEERING GROUP
15004 1st Avenue South
Burnsville, MN 55306

PROJECT NAME: *Rollong Hills MDDP*
PROJECT NUMBER: *100.300*
ENGINEER: *LAB*
DATE: *July 3*, *2023*

Master Development Drainage Plan
CURRENT CONDITIONS COEFFICIENT "C" CALCULATIONS

BASIN	Soil No.	Hydro Group	Area	Cover (%)	C5	Wtd. C5	C100	Wtd. C100	CN	Wtd. CN	Impervious	Type of Cover
	89	D	19.28	23.60%	0.15	0.04	0.50	0.12	84	19.83	0%	Pasture/Range
			81.68	100.00%		0.10		0.39		72.54		
EX-S1	86	B	2.05	100.00%	0.90		0.96		69	69.00	95%	Existing Road
EX-S2	43	B	11.00	100.00%	0.08		0.35		69	69.00	0%	Pasture/Range
EX-S3	52/56/86	B	46.65	74.70%	0.08	0.06	0.35	0.26	69	51.54	0%	Pasture/Range
	52	C	15.80	25.30%	0.15	0.04	0.50	0.13	79	19.99	0%	Pasture/Range
			62.45	100.00%		0.10		0.39		71.53		
EX-S4	78	B	38.92	34.52%	0.08	0.03	0.35	0.12	69	23.82	0%	Pasture/Range
	89	D	73.82	65.48%	0.15	0.10	0.50	0.33	84	55.00	0%	Pasture/Range
			112.74	100.00%		0.13		0.45		78.82		
DP-S2	2/56/108	B	84.91	25.37%	0.08	0.02	0.35	0.09	69	17.51	0%	Pasture/Range
	89	D	249.74	74.63%	0.15	0.11	0.50	0.37	84	62.69	0%	Pasture/Range
			334.65	100.00%		0.13		0.46		80.19		
EX-S5	78	B	57.29	60.43%	0.08	0.05	0.35	0.21	69	41.69	0%	Pasture/Range
	89	D	37.52	39.57%	0.15	0.06	0.50	0.20	84	33.24	0%	Pasture/Range
			94.81	100.00%		0.11		0.41		74.94		
DP-S3	2/56/108	B	142.20	33.11%	0.08	0.03	0.35	0.12	69	22.85	0%	Pasture/Range
	89	D	287.26	66.89%	0.15	0.10	0.50	0.33	84	56.19	0%	Pasture/Range
			429.46	100.00%		0.13		0.45		79.03		
EX-S6	56/78	B	169.64	81.59%	0.08	0.07	0.35	0.29	69	56.30	0%	Pasture/Range
	52	C	38.28	18.41%	0.15	0.03	0.50	0.09	79	14.54	0%	Pasture/Range
			207.92	100.00%		0.09		0.38		70.84		
EX-S7	78/124	B	119.70	56.11%	0.08	0.04	0.35	0.20	69	38.72	0%	Pasture/Range
	75/89	D	93.62	43.89%	0.15	0.07	0.50	0.22	84	36.87	0%	Pasture/Range
			213.32	100.00%		0.11		0.42		75.58		
DP-S4	97/104/105	A	2.33	0.38%	0.08	0.00	0.35	0.00	69	0.26	0%	Pasture/Meadow
	2/56/108	B	347.20	56.47%	0.08	0.05	0.35	0.20	79	44.61	0%	Pasture/Meadow
	54/89/94	D	265.33	43.15%	0.15	0.06	0.50	0.22	84	36.25	0%	Pasture/Meadow
			614.86	100.00%		0.11		0.41		81.12		
EX-S8	75	D	136.49	100.00%	0.20		0.47		84	84.00	0%	Pasture/Range
DP-S5	108	B	12.65	6.17%	0.08	0.00	0.35	0.02	69	4.26	0%	Pasture/Range
	75	D	192.25	93.83%	0.20	0.19	0.47	0.44	84	78.81	0%	Pasture/Range
			204.90	100.00%		0.19		0.46		83.07		
EX-S9	56	B	8.06	78.48%	0.08	0.06	0.35	0.27	69	54.15	0%	Pasture/Range

CORE
ENGINEERING GROUP

15004 1st Avenue South
Burnsville, MN 55306

PROJECT NAME: *Rollong Hills MDDP*
PROJECT NUMBER: *100.300*
ENGINEER: *LAB*
DATE: *July 3 , 2023*

Master Development Drainage Plan
CURRENT CONDITIONS COEFFICIENT "C" CALCULATIONS

BASIN	Soil No.	Hydro Group	Area	Cover (%)	C5	Wtd. C5	C100	Wtd. C100	CN	Wtd. CN	Impervious	Type of Cover
	75	D	2.21	21.52%	0.20	0.04	0.47	0.10	84	18.08	0%	Pasture/Range
			10.27	100.00%		0.11		0.38		72.23		

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Current

Calculated By: Leonard Beasley
Date: Feb. 12, 2022
Checked By: Leonard Beasley

Job No: 100.300
Project: Rolling Hills MDDP

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	USDCM Recommended t_c=t_i+t_t (min)
ET-18a	0.16	16.28	7.0	300.00	3.33%	0.25	19.83	1111.00	2.25%	1.05	17.63		
			15.0					511.00	3.33%	2.74	3.11	40.58	40.58
ET-18b	0.18	27.69	7.0	300.00	9.84%	0.37	13.53	1146.00	5.35%	1.62	11.80	25.33	25.33
ET-19	0.19	24.44	7.0	300.00	6.50%	0.33	15.34	1836.00	4.52%	1.49	20.56	35.91	35.91
DP-S5a	0.18	68.41	7.0	300.00	3.33%	0.26	19.43	1149.00	2.25%	1.05	18.24		
			15.0					433.00	3.33%	2.74	2.64		
			15.0					618.00	2.18%	2.21	4.65	44.96	44.96
ET-24	0.20	23.89	7.0	300.00	6.33%	0.33	15.31	1072.00	4.20%	1.43	12.45	27.76	27.76
ET-25	0.13	127.20	15.0	300.00	4.80%	0.28	18.13	330.00	6.97%	3.96	1.39		
(DP-S4a)			15.0					2940.00	2.25%	2.25	21.78	41.30	41.30
ET-27	0.13	181.14	15.0	300.00	7.00%	0.31	16.00	3000.00	4.94%	3.33	15.00		
			15.0					1190.00	1.68%	1.94	10.20	41.20	41.20
ET-28	0.13	69.31	15.0	300.00	7.00%	0.31	16.00	1633.00	6.12%	3.71	7.33		
			15.0					1806.00	4.54%	3.20	9.42	32.76	32.76
ET-31	0.15	28.35	5.0	300.00	8.33%	0.34	14.80	522.00	7.09%	1.33	6.53		
			15.0					402.00	5.47%	3.51	1.91	23.24	23.24

Standard Form SF-1. Time of Concentration-Current

CORE ENGINEERING GROUP

Calculated By: Leonard Beasley
Date: Feb. 12, 2022
Checked By: Leonard Beasley

Job No: 100.300
Project: Rolling Hills MDDP

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	USDCM Recommended t_c=t_i+t_t (min)
ET-32	0.14	111.97	15.0	300.00	6.67%	0.31	16.09	2315.00	5.49%	3.51	10.98		
			CMP					177.00	2.26%	6.05	0.49		
			15.0					1564.00	2.75%	2.49	10.48	38.04	38.04
ET-46a	0.15	9.57	7.0	300.00	14.00%	0.40	12.46	180.00	8.89%	2.09	1.44		
			15.0					110.00	1.00%	1.50	1.22	15.12	15.12
ET-48a	0.11	27.54	7.0	300.00	6.00%	0.29	17.14	1204.00	4.62%	1.50	13.34	30.48	30.48
EX-N1	0.13	43.58	7.0	300.00	3.23%	0.24	20.67	1020.00	1.84%	0.95	17.90		
			15.0					1148.00	0.65%	1.21	15.82	54.40	54.40
DP-N1	0.13	71.12	7.0	300.00	6.00%	0.30	16.84	2524.00	3.35%	1.28	32.83		
(ET-48a & EX-N1)			15.0					1148.00	0.65%	1.21	15.82	65.50	65.50
EX-N2	0.10	110.90	7.0	300.00	9.00%	0.33	15.18	1978.00	4.30%	1.45	22.71		
			15.0					551.00	1.09%	1.57	5.86	43.76	43.76
DP-N2	0.10	120.47	7.0	300.00	9.00%	0.33	15.18	1978.00	4.30%	1.45	22.71		
(ET-46a & EX-N2)			15.0					551.00	1.09%	1.57	5.86	43.76	43.76
EX-N3	0.10	64.59	7.0	300.00	9.67%	0.34	14.82	518.00	5.60%	1.66	5.21		
			15.0					971.00	1.13%	1.59	10.15	30.19	30.19
EX-N4	0.11	169.59	10.0	300.00	9.67%	0.34	14.68	1962.00	5.30%	2.30	14.20		
			15.0					2678.00	0.99%	1.49	29.91	58.79	58.79

Standard Form SF-1. Time of Concentration-Current

CORE ENGINEERING GROUP

Calculated By: Leonard Beasley
Date: Feb. 12, 2022
Checked By: Leonard Beasley

Job No: 100.300
Project: Rolling Hills MDDP

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	USDCM Recommended t_c=t_i+t_t (min)
EX-N5	0.12	81.59	15.0	300.00	6.00%	0.29	17.01	1741.00	2.99%	2.59	11.19		
			15.0					1228.00	0.99%	1.49	13.71	41.91	41.91
EX-N6	0.08	8.42	15.0	300.00	11.33%	0.35	14.32	345.00	5.80%	3.61	1.59	15.91	15.91
EX-N7	0.08	100.60	15.0	300.00	8.00%	0.31	16.10	1323.00	4.38%	3.14	7.02		
			10.0					1216.00	3.50%	1.87	10.83		
			15.0					552.00	1.36%	1.75	5.26	39.22	39.22
EX-N8	0.10	112.67	7.0	300.00	6.50%	0.30	16.91	1058.00	4.82%	1.54	11.47		
			15.0					2967.00	2.90%	2.55	19.36	47.74	47.74
EX-N9	0.11	96.77	15.0	300.00	5.33%	0.28	17.88	1838.00	3.43%	2.78	11.03		
			7.0					934.00	0.91%	0.67	23.31	52.21	52.21
EX-N10	0.08	13.64	7.0	300.00	5.17%	0.27	18.55	1025.00	5.22%	1.60	10.68	29.23	29.23
EX-N11	0.10	81.68	7.0	300.00	4.60%	0.26	18.90	1321.00	3.91%	1.38	15.91	34.81	34.81
EX-S1	0.90	2.05	15.0	35.00	12.86%	0.63	0.92	508.00	0.81%	1.35	6.27	7.19	7.19
EX-S2	0.08	11.00	5.0	300.00	3.33%	0.23	21.45	636.00	7.39%	1.36	7.80	29.24	29.24
EX-S3	0.10	62.45	7.0	300.00	5.33%	0.28	18.00	1791.00	4.86%	1.54	19.34	37.35	37.35
EX-S4	0.12	84.39	7.0	300.00	5.67%	0.29	17.34	965.00	3.83%	1.37	11.74		
			15.0					1518.00	1.32%	1.72	14.68	43.76	43.76
EX-S5	0.11	94.81	15.0	300.00	4.50%	0.26	18.91	1981.00	3.71%	2.89	11.43		
			15.0					1093.00	0.73%	1.28	14.21		
			15.0					291.00	0.40%	0.95	5.11	49.66	49.66

CORE ENGINEERING GROUP

Standard Form SF-1. Time of Concentration-Current

Calculated By: Leonard Beasley
Date: Feb. 12, 2022
Checked By: Leonard Beasley

Job No: 100.300
Project: Rolling Hills MDDP

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	t_t minutes	Computed t_c Minutes	USDCM Recommended t_c=t_i+t_t (min)
DP-S1	0.13	112.74	5.0	300.00	8.33%	0.33	15.11	522.00	7.09%	1.33	6.53		
(ET-31 & EX-S4)			15.0					402.00	5.47%	3.51	1.91		
			7.0					1516.00	3.83%	1.37	18.44		
			15.0					1088.00	1.47%	1.82	9.97	51.97	51.97
EX-S6	0.09	207.92	15.0	45.00	15.56%	0.15	4.95	1982.00	2.22%	2.23	14.78		
			15.0					3466.00	1.99%	2.12	27.30		
			15.0					1270.00	0.31%	0.84	25.34	72.38	72.38
EX-S7	0.11	213.32	15.0	300.00	4.17%	0.26	19.39	1436.00	3.97%	2.99	8.01		
			7.0					1857.00	2.05%	1.00	30.88		
			15.0					1961.00	0.76%	1.31	24.99	83.27	83.27
EX-S8	0.20	136.49	7.0	300.00	5.17%	0.31	16.37	1116.00	5.22%	1.60	11.63	28.00	28.00
EX-S9	0.10	10.27	5.0	300.00	4.60%	0.26	18.90	1323.00	3.91%	0.99	22.30	41.20	41.20

CORE
ENGINEERING GROUP
212 N. Wahsatch Ave., Suite 206
Colorado Springs, Colorado 80903

PROJECT NAME: *Rolling Hills MDDP*
PROJECT NUMBER: *100.300*
ENGINEER: *LAB*
DATE: *July 3, 2023*

Master Development Drainage Plan
EXISTING CONDITIONS HYDROLOGY CALCULATIONS

BASIN	"P" or "K"	"n" or "c"	Area	"WP" or	HIGH	LOW	LENGTH	HEIGHT	SLOPE	" V "	" TT "	COMMENTS
ET-38	2.10	0.13	602.40		6165.0	6130.0	300	35.0	11.67%	0.39	12.83	*TR 55 Initial Overland Flow*
					6130.0	5980.0	2060	150.0	7.28%	4.35	7.89	*Unpaved Surface*
					5980.0	5865.0	5542	115.0	2.08%	2.32	39.74	*Unpaved Surface*
							7902				60.46	
DP-N3	2.10	0.13	666.99		6165.0	6130.0	300	35.0	11.67%	0.39	12.83	*TR 55 Initial Overland Flow*
					6130.0	5980.0	2060	150.0	7.28%	4.35	7.89	*Unpaved Surface*
					5980.0	5865.0	5542.00	115.00	0.02	2.32	39.74	*Unpaved Surface*
	182.19	0.05	187.00	1.03	5865.0	5844.0	1800	21.0	1.17%	3.27	9.18	*Channel*
							9702				69.64	
ET-32	2.10	0.13	111.97		6021.0	6000.0	300	21.0	7.00%	0.32	15.74	*TR 55 Initial Overland Flow*
					6000.0	5918.0	2315	82.0	3.54%	3.04	12.71	Unpaved Surface
		0.027		1.50	5918.0	5914.0	177	4.0	2.26%	4.30	0.69	18" CMP
					5914.0	5872.0	1519	42.00	2.76%	2.68	9.44	*Unpaved Surface*
							4311				38.57	
EX-N4	2.10	0.13	169.59		5975.0	5944.0	300	31.0	10.33%	0.37	13.47	*TR 55 Initial Overland Flow*
					5944.0	5810.0	4025	134.0	3.33%	2.94	22.79	Unpaved Surface
							4325				36.25	

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DATE: *July 3, 2023*

Master Development Drainage Plan
EXISTING CONDITIONS HYDROLOGY CALCULATIONS

BASIN	"P" or "K"	"n" or "c"	Area	"WP" or	HIGH	LOW	LENGTH	HEIGHT	SLOPE	" V "	" TT "	COMMENTS
DP-N4	2.10	0.13	193.56		6021.0	6000.0	300	21.0	7.00%	0.32	15.74	*TR 55 Initial Overland Flow*
					6000.0	5918.0	2315	127.0	5.49%	3.78	10.21	*Unpaved Surface*
		0.027		1.50	5918.0	5914.0	177	4.0	2.26%	4.30	0.69	18" CMP
					5914.0	5871.0	1654	43.0	2.60%	2.60	10.60	*Unpaved Surface*
					5871.0	5818.0	2789	53.0	1.90%	2.22	20.90	*Unpaved Surface*
							7235				58.13	
DP-S2	2.10	0.13	193.56		6021.0	6000.0	300	21.0	7.00%	0.32	15.74	*TR 55 Initial Overland Flow*
(DP-S1 & DP-N4)					6000.0	5918.0	2315	127.0	5.49%	3.78	10.21	*Unpaved Surface*
		0.027		1.50	5918.0	5914.0	177	4.0	2.26%	4.30	0.69	18" CMP
					5914.0	5872.0	1654	42.0	2.54%	2.57	10.72	*Unpaved Surface*
		0.027		2.50	5872.0	5868.0	61	4.0	6.56%	10.30	0.10	30" CMP
					5868.0	5820.0	2789	48.0	1.72%	2.12	21.96	*Unpaved Surface*
		0.13		5.50	5820.0	5817.0	61	3.0	4.92%	3.13	0.32	2-66" RCP's
	182.19	0.05	187.00	1.03	5817.0	5803.0	786	14.0	1.78%	4.04	3.25	*Channel*
							8143				62.98	
EX-S6	2.10	0.13	207.92		5888.0	5883.0	45	5.0	11.11%	0.26	2.87	*TR 55 Initial Overland Flow*
					5883.0	5786.0	4170	23.0	0.55%	1.20	58.00	*Unpaved Surface*
					5786.0	5758.0	1756	28.0	1.59%	2.04	14.36	*Unpaved Surface*
							5971				75.23	

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DATE: *July 3, 2023*

Master Development Drainage Plan
EXISTING CONDITIONS HYDROLOGY CALCULATIONS

BASIN	"P" or "K"	"n" or "c"	Area	"WP" or	HIGH	LOW	LENGTH	HEIGHT	SLOPE	" V "	" TT "	COMMENTS
DP-S3	2.10	0.13	193.56		6021.0	6000.0	300	21.0	7.00%	0.32	15.74	*TR 55 Initial Overland Flow*
(ET-31, 32, EX-N5, EX-S4&S5)					6000.0	5918.0	2315	127.0	5.49%	3.78	10.21	*Unpaved Surface*
		0.027		1.50	5918.0	5914.0	177	4.0	2.26%	4.30	0.69	18" CMP
					5914.0	5872.0	1654	42.0	2.54%	2.57	10.72	*Unpaved Surface*
		0.027		2.50	5872.0	5868.0	61	4.0	6.56%	10.30	0.10	30" CMP
					5868.0	5820.0	2789	48.0	1.72%	2.12	21.96	*Unpaved Surface*
		0.13		5.50	5820.0	5817.0	61	3.0	4.92%	3.13	0.32	2-66" RCP's
	182.19	0.05	187.00	1.03	5817.0	5803.0	786	14.0	1.78%	4.04	3.25	*Channel*
	145.00	0.05	194.00	1.34	5803.0	5785.0	2505	18.0	0.72%	3.06	13.65	*Channel*
							10648				76.63	
EX-S7	2.10	0.13	213.32		5881.0	5869.0	300	12.0	4.00%	0.25	19.69	*TR 55 Initial Overland Flow*
					5869.0	5812.0	1401	57.0	4.07%	3.25	7.17	Unpaved Surface
					5812.0	5773.5	1852	38.5	2.08%	2.33	13.27	Unpaved Surface
	115.28	0.05	230.00	2.00	5773.5	5763.8	1381	9.7	0.70%	3.95	5.83	*Channel*
	173.19	0.05	346.00	2.00	5763.8	5759.0	580	4.8	0.83%	4.29	2.25	*Channel*
							5514				48.21	

CORE
ENGINEERING GROUP
212 N. Wahsatch Ave., Suite 206
Colorado Springs, Colorado 80903

PROJECT NAME: *Rolling Hills MDDP*
PROJECT NUMBER: *100.300*
ENGINEER: *LAB*
DATE: *July 3, 2023*

Master Development Drainage Plan
EXISTING CONDITIONS HYDROLOGY CALCULATIONS

BASIN	"P" or "K"	"n" or "c"	Area	"WP" or	HIGH	LOW	LENGTH	HEIGHT	SLOPE	" V "	" TT "	COMMENTS
DP-S4	2.10	0.13	401.54		6021.0	6000.0	300	21.0	7.00%	0.32	15.74	*TR 55 Initial Overland Flow*
					6000.0	5900.0	1633	100.0	6.12%	3.99	6.82	*Unpaved Surface*
					5900.0	5834.0	1806	66.0	3.65%	3.08	9.76	*Unpaved Surface*
					5834.0	5795.5	2547	38.5	1.51%	1.98	21.40	Unpaved Surface
					5795.5	5763.8	2533	31.7	1.25%	1.80	23.39	Unpaved Surface
	173.19	0.05	346.00	2.00	5763.8	5759.0	580	4.8	0.83%	4.29	2.25	*Channel*
							9399				79.36	
DP-S5	2.10	0.13	209.32		5882.0	5872.0	300	10.0	3.33%	0.24	21.18	*TR 55 Initial Overland Flow*
					5872.0	5847.0	1111	25.0	2.25%	2.42	7.65	*Unpaved Surface*
					5847.0	5830.0	481	17.0	3.53%	3.03	2.64	*Unpaved Surface*
					5830.0	5801.0	1032	29.0	2.81%	2.70	6.36	Unpaved Surface
					5801.0	5766.0	2351	35.0	1.49%	1.97	19.90	Unpaved Surface
							5275				57.73	

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: January, 2024
Checked By: Leonard Beasley

Job No: 100.300
Project: Bull Hill/Rolling Meadows MDDP
Design Storm: **5 - Year Event (Developed)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	∑ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
ET-18a			16.28	0.16	40.4	2.60	2.03	5.3													
ET-18b			27.69	0.18	25.3	4.98	2.74	13.6													
ET-19			24.44	0.19	35.9	4.64	2.21	10.3													
(ET-18a-ET19)	**A1a**	68.41							45.0	12.23	1.87	22.9									
A1			83.55	0.49	25.0	40.94	2.75	112.7													
A2			36.38	0.49	18.8	17.83	3.18	56.8													
(A1-A2)		119.93							25.0	58.77	2.75	161.8									
A3			12.70	0.49	19.4	6.22	3.13	19.5													
A4			21.76	0.37	14.3	8.05	3.60	29.0													
(A1-A4)		154.39							25.0	73.04	2.75	201.1									
AB			4.81	0.15	19.1	0.72	3.16	2.3													
ET-28			66.06	0.13	31.8	8.59	2.39	20.6													
ET-27			176.51	0.09	40.4	15.89	2.03	32.3													
ET-24			20.13	0.20	25.7	4.03	2.72	10.9													
ET-25			123.63	0.13	39.5	16.07	2.07	33.3													
(ET-28, 27, 24 & 25)	**B1a**	386.33							47.5	44.57	1.79	79.9									

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: January, 2024
Checked By: Leonard Beasley

Job No: 100.300
Project: Bull Hill/Rolling Meadows MDDP
Design Storm: **5 - Year Event (Developed)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	∑ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	tt	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
B1			9.10	0.49	11.7	4.46	3.89	17.4													
B2			52.04	0.46	28.0	23.94	2.58	61.9													
(B1-B2)	**B2a**	61.14							28.0	28.40	2.58	73.4									
B3			5.02	0.45	12.3	2.26	3.82	8.6													
(B1-B3)	**B3a**	66.16							28.0	30.66	2.58	79.2									
B4			38.33	0.49	28.1	18.78	2.58	48.4													
B5			24.58	0.46	24.1	11.31	2.81	31.8													
(B1-B5)		129.07							28.1	60.74	2.58	156.6									
(B1a+B5)	**B4a**	410.91							48.6	55.88	1.76	98.2									
(B1a+B1-B5)	**B5a**	515.40							48.7	105.32	1.75	184.7									
B6			21.06	0.47	18.5	9.90	3.21	31.8													
B7			41.68	0.45	23.5	18.76	2.85	53.4													
B8			15.94	0.45	20.7	7.17	3.04	21.8													
B9			21.25	0.13	17.8	2.76	3.27	9.0													
C1			11.79	0.60	10.1	7.07	4.11	29.1													
C2			118.78	0.49	18.4	58.20	3.22	187.2													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: January, 2024
Checked By: Leonard Beasley

Job No: 100.300
Project: Bull Hill/Rolling Meadows MDDP
Design Storm: **5 - Year Event (Developed)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	∑ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
C3			32.38	0.51	28.2	16.51	2.57	42.5													
D1			69.37	0.48	16.8	33.30	3.35	111.7													
D2			11.73	0.29	13.1	3.40	3.73	12.7													
D3			4.09	0.90	13.1	3.68	3.73	13.7													
D4	Did not use this basin																				
D5			43.05	0.09	38.2	3.87	2.12	8.2													
E1			75.97	0.46	27.7	34.95	2.60	90.9													
E2			21.94	0.48	12.7	10.53	3.77	39.7													
E3			34.58	0.48	27.1	16.60	2.63	43.7													
E1-E3		132.49							31.6	62.08	2.40	149.2									
F1			20.84	0.46	14.2	9.59	3.60	34.5													
F2			6.25	0.48	10.9	3.00	4.00	12.0													
F3			19.80	0.49	16.3	9.70	3.40	33.0													
F4			8.84	0.49	11.6	4.33	3.91	16.9													
F5			13.51	0.47	16.3	6.35	3.39	21.6													
F1,F3-F5		62.99							18.8	29.97	3.19	95.5									

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: January, 2024
Checked By: Leonard Beasley

Job No: 100.300
Project: Bull Hill/Rolling Meadows MDDP
Design Storm: **5 - Year Event (Developed)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	∑ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
G			5.23	0.45	21.0	2.35	3.01	7.1													
J1			15.00	0.46	24.5	6.90	2.79	19.2													
J2			61.86	0.46	24.5	28.46	2.79	79.3													
J1-J2		76.86							26.0	35.36	2.69	95.3									
K			75.88	0.45	25.8	34.15	2.71	92.5													
L1			36.95	0.45	18.4	16.63	3.21	53.4													
L2			48.87	0.47	23.3	22.97	2.86	65.8													
L3			50.27	0.26	21.6	13.07	2.98	38.9													
L1-L3		136.09							26.4	52.67	2.67	140.7									
M			95.89	0.10	51.0	9.59	1.68	16.2													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: January, 2024
Checked By: Leonard Beasley

Job No: 100.300
Project: Bull Hill/Rolling Meadows MDDP
Design Storm: **100 - Year Event (Developed)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	∑ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
ET-18a			16.28	0.43	40.4	7.00	3.41	23.9													
ET-18b			27.69	0.45	25.3	12.46	4.59	57.2													
ET-19			24.44	0.46	35.9	11.24	3.71	41.7													
(ET-18a-ET19)	**A1a**	68.41							45.0	30.70	3.14	96.5									
A1			83.55	0.65	25.0	54.31	4.62	250.9													
A2			36.38	0.65	18.8	23.65	5.34	126.4													
(A1-A2)		119.93							25.0	77.95	4.62	360.2									
A3			12.70	0.65	19.4	8.26	5.26	43.4													
A4			21.76	0.60	14.3	13.06	6.04	78.8													
(A1-A4)		154.39							25.0	99.27	4.62	458.6									
AB			4.81	0.40	19.1	1.92	5.30	10.2													
ET-28			66.06	0.46	31.8	30.39	4.02	122.0													
ET-27			176.51	0.38	40.4	67.07	3.41	228.9													
ET-24			20.13	0.47	25.7	9.46	4.56	43.1													
ET-25			123.63	0.46	39.4	56.87	3.48	197.7													
(ET-28, 27, 24 & 25)	**B1a**	386.33							47.5	163.79	3.01	492.3									

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: January, 2024
Checked By: Leonard Beasley

Job No: 100.300
Project: Bull Hill/Rolling Meadows MDDP
Design Storm: **100 - Year Event (Developed)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	∑ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
B1			9.10	0.65	11.7	5.92	6.54	38.7													
B2			52.04	0.61	28.0	31.74	4.34	137.7													
(B1-B2)	**B2a**	61.14							28.0	37.66	4.34	163.3									
B3			5.02	0.59	12.3	2.96	6.42	19.0													
(B1-B3)	**B3a**	66.16							28.0	40.62	4.34	176.2									
B4			38.33	0.65	28.1	24.91	4.33	107.8													
B5			24.58	0.61	24.1	14.99	4.72	70.8													
(B1-B5)		129.07							28.1	80.53	4.33	348.4									
(B1a + B5)	**B4a**	410.91							48.6	178.79	2.95	527.1									
(B1a + B1-B5)	**B5a**	515.40							48.7	244.32	2.94	718.9									
B6			21.06	0.62	18.5	13.06	5.39	70.4													
B7			41.68	0.60	23.5	25.01	4.78	119.6													
B8			15.94	0.59	20.7	9.40	5.10	47.9													
B9			21.25	0.41	17.8	8.71	5.48	47.8													
C1			11.79	0.71	10.1	8.37	6.90	57.8													
C2			118.78	0.63	18.4	74.83	5.40	404.0													

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: January, 2024
Checked By: Leonard Beasley

Job No: 100.300
Project: Bull Hill/Rolling Meadows MDDP
Design Storm: **100 - Year Event (Developed)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	∑ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
C3			32.38	0.64	28.2	20.72	4.32	89.5													
D1			69.37	0.63	16.8	43.70	5.63	246.1													
D2			11.73	0.50	13.1	5.87	6.25	36.7													
D3			4.09	0.96	13.1	3.93	6.26	24.6													
D4	Did not use this basin																				
D5			43.05	0.36	38.2	15.50	3.56	55.1													
E1			75.97	0.61	27.7	46.34	4.37	202.4													
E2			21.94	0.64	12.7	14.04	6.33	88.9	31.6	61.84	4.03	249.5									
E3			34.58	0.64	27.1	22.13	4.42	97.8													
E1-E3		132.49							31.6	82.51	4.03	332.9									
F1			20.84	0.61	14.2	12.71	6.05	76.9													
F2			6.25	0.63	10.9	3.94	6.72	26.5													
F3			19.80	0.65	16.3	12.87	5.71	73.4													
F4			8.84	0.65	11.6	5.75	6.56	37.7													
F5			13.51	0.63	16.3	8.51	5.70	48.5													
F1,F3-F5		62.99							18.8	43.78	5.35	234.1									

CORE ENGINEERING GROUP

Standard Form SF-2. Storm Drainage System Design (Rational Method Procedure)

Calculated By: Leonard Beasley
Date: January, 2024
Checked By: Leonard Beasley

Job No: 100.300
Project: Bull Hill/Rolling Meadows MDDP
Design Storm: **100 - Year Event (Developed)**

Street or Basin	Design Point	Direct Runoff							Total Runoff				Street		Pipe			Travel Time			Remarks
		Area Design	Area (A)	Runoff Coeff. (C)	t_c	CA	i	Q	t_c	∑ (CA)	i	Q	Slope	Street Flow	Design Flow	Slope	Pipe Size	Length	Velocity	t_t	
			ac.		min.		in/hr	cfs	min		in/hr	cfs	%	cfs	cfs	%	in	ft	ft/sec	min	
G			5.23	0.59	21.0	3.09	5.06	15.6													
J1			15.00	0.61	15.0	9.15	5.91	54.0													
J2			61.86	0.60	24.5	37.12	4.68	173.5													
J1-J2		76.86							26.0	46.27	4.52	209.2									
K			75.88	0.59	25.8	44.77	4.55	203.6													
L1			36.95	0.59	18.4	21.80	5.40	117.6													
L2			48.87	0.62	23.3	30.30	4.81	145.6													
L3			50.27	0.48	21.6	24.13	5.00	120.5													
L1-L3		136.09							26.4	76.23	4.48	341.8									
M			95.89	0.38	51.0	36.44	2.83	103.0													

CORE
ENGINEERING GROUP
15004 1st Avenue South
Burnsville, MN 55306

PROJECT NAME: *Rolling Hills MDDP*
PROJECT NUMBER: *100.300*
ENGINEER: *LAB*
DATE:January, 2024

Master Development Drainage Plan
PROPOSED CONDITIONS COEFFICIENT "C" CALCULATIONS

BASIN	Soil No.	Hydro Group	Area	Cover (%)	C5	Wtd. C5	C100	Wtd. C100	CN	Wtd. CN	Impervious	Type of Cover
ET-18a	56	B	5.58	34.28%	0.08	0.03	0.35	0.12	69	23.6	0%	Pasture/Range
	75	D	10.70	65.72%	0.20	0.13	0.47	0.31	84	55.2	0%	Pasture/Range
			16.28	100.00%		0.16		0.43		78.9		
ET-18b	108	B	4.31	15.57%	0.08	0.01	0.35	0.05	69	10.7	0%	Pasture/Range
	75	D	23.38	84.43%	0.20	0.17	0.47	0.40	84	70.9	0%	Pasture/Range
			27.69	100.00%		0.18		0.45		81.7		
ET-19	108	B	2.76	11.29%	0.08	0.01	0.35	0.04	69	7.8	0%	Pasture/Range
	75	D	21.68	88.71%	0.20	0.18	0.47	0.42	84	74.5	0%	Pasture/Range
			24.44	100.00%		0.19		0.46		82.3		
A2	56	B	2.47	6.79%	0.45	0.03	0.59	0.04	85	5.8	65%	1/8 ac. Single Family
	75	C	33.91	93.21%	0.49	0.46	0.65	0.61	90	83.9	65%	1/8 ac. Single Family
			36.38	100.00%		0.49		0.65		89.7		
A4	75	C	8.38	38.51%	0.19	0.07	0.52	0.20	79	30.4	7%	Pond/Park
	75	C	13.38	61.49%	0.49	0.30	0.65	0.40	90	55.3	65%	school
			21.76	100.00%		0.37		0.60		85.8		
ET-28	105	A	2.33	3.53%	0.08	0.00	0.35	0.01	49	1.7	0%	Pasture/Meadow
	108/124	B	16.24	24.58%	0.08	0.02	0.35	0.09	69	17.0	0%	Pasture/Meadow
	89	D	47.49	71.89%	0.15	0.11	0.50	0.36	84	60.4	0%	Pasture/Meadow
			66.06	100.00%		0.13		0.46		79.1		
ET-27	124	B	144.60	81.92%	0.08	0.07	0.35	0.29	69	56.5	0%	Pasture/Range
	89	D	31.91	18.08%	0.15	0.03	0.50	0.09	84	15.2	0%	Pasture/Range
			176.51	100.00%		0.09		0.38		71.7		
ET-24	75	D	20.13	100.00%	0.20		0.47		84	84.0	0%	Pasture/Range
ET-25	124	B	30.35	24.55%	0.08	0.02	0.35	0.09	69	16.9	0%	Pasture/Range
	75	D	93.28	75.45%	0.15	0.11	0.50	0.38	84	63.4	0%	Pasture/Range
			123.63	100.00%		0.13		0.46		80.3		
B1	89	D	9.10	100.00%	0.49		0.65		92	92.0	65%	1/8 ac. Single Family
B2	89	D	19.51	37.49%	0.49	0.18	0.65	0.24	92	34.5	65%	1/8 ac. Single Family

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	124	B	32.53	62.51%	0.45	0.28	0.59	0.37	85	53.1	65%	1/8 ac. Single Family
			52.04	100.00%		0.46		0.61		87.6		
B3	124	B	5.02	100.00%	0.45		0.59		85	85.0	65%	1/8 ac. Single Family
B4	75	D	35.26	91.99%	0.49	0.45	0.65	0.60	92	84.6	65%	1/8 ac. Single Family
	125	B	3.07	8.01%	0.45	0.04	0.59	0.05	85	6.8	65%	1/8 ac. Single Family
			38.33	100.00%		0.49		0.65		91.4		
B5	75	D	6.37	25.92%	0.49	0.13	0.65	0.17	92	23.8	65%	1/8 ac. Single Family
	124	B	18.21	74.08%	0.45	0.33	0.59	0.44	85	63.0	65%	1/8 ac. Single Family
			24.58	100.00%		0.46		0.61		86.8		
B6	75	D	11.71	55.60%	0.49	0.27	0.65	0.36	92	51.2	65%	1/8 ac. Single Family
	78/124	B	9.35	44.40%	0.45	0.20	0.59	0.26	85	37.7	65%	1/8 ac. Single Family
			21.06	100.00%		0.47		0.62		88.9		
B7	89	D	4.93	11.83%	0.49	0.06	0.65	0.08	92	10.9	65%	1/8 ac. Single Family
	78/124	B	36.75	88.17%	0.45	0.40	0.59	0.52	85	74.9	65%	1/8 ac. Single Family
			41.68	100.00%		0.45		0.60		85.8		
B8	78	B	15.94	100.00%	0.45		0.59		84	84.0	65%	1/8 ac. Single Family
B9	75	D	2.88	13.55%	0.19	0.03	0.52	0.07	84	11.4	0%	Pond/Park
	78	B	18.37	86.45%	0.12	0.10	0.39	0.34	69	59.6	0%	Pond/Park
			21.25	100.00%		0.13		0.41		71.0		
C1	78	B	7.80	66.16%	0.59	0.39	0.70	0.46	92	60.9	80%	School
	89	D	3.99	33.84%	0.63	0.21	0.74	0.25	95	32.2	80%	School
			11.79	100.00%		0.60		0.71		93.0		
C2	78	B	68.68	57.82%	0.45	0.26	0.59	0.34	85	49.1	65%	1/8 ac. Single Family
	78	B	8.73	7.35%	0.49	0.04	0.62	0.05	88	6.5	70%	Townhomes
	78	B	7.66	6.45%	0.90	0.06	0.96	0.06	98	6.3	100%	Roadway
	89	D	33.71	28.38%	0.49	0.14	0.65	0.18	92	26.1	65%	1/8 ac. Single Family
			118.78	100.00%		0.49		0.63		88.0		
C3	78	B	18.59	57.41%	0.45	0.26	0.59	0.34	85	48.8	65%	1/8 ac. Single Family
	78	B	13.79	42.59%	0.59	0.25	0.70	0.30	92	39.2	80%	Commercial/Industrial

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			32.38	100.00%		0.51		0.64		88.0		
D 1	78	B	18.86	27.19%	0.45	0.12	0.59	0.16	85	23.1	65%	1/8 ac. Single Family
	89	D	50.51	72.81%	0.49	0.36	0.65	0.47	92	67.0	65%	1/8 ac. Single Family
			69.37	100.00%		0.48		0.63		90.1		
D 2	78	B	5.93	50.55%	0.09	0.05	0.36	0.18	69	34.9	2%	Open Space
	78	B	5.80	49.45%	0.49	0.24	0.65	0.32	92	45.5	80%	Substation ravel)
			11.73	100.00%		0.29		0.50		80.4		
D3	78	B	4.09	100.00%	0.90		0.96		98	98.0	65%	Roadway
D 4	Did not use this basin											
D 5	2/56/78	B	42.96	100.00%	0.09		0.36		69	69.0	2%	Greenbelt/Channel
E 1	78	B	55.25	72.73%	0.45	0.33	0.59	0.43	85	61.8	65%	1/8 ac. Single Family
	89	D	20.72	27.27%	0.49	0.13	0.65	0.18	92	25.1	65%	1/8 ac. Single Family
			75.97	100.00%		0.46		0.61		86.9		
E2	2/78	B	5.18	23.61%	0.45	0.11	0.59	0.14	85	20.1	65%	1/8 ac. Single Family
	89	D	16.76	76.39%	0.49	0.37	0.65	0.50	92	70.3	65%	1/8 ac. Single Family
			21.94	100.00%		0.48		0.64		90.3		
E3	78	B	4.87	14.08%	0.45	0.06	0.59	0.08	85	12.0	65%	1/8 ac. Single Family
	89	D	29.71	85.92%	0.49	0.42	0.65	0.56	92	79.0	65%	1/8 ac. Single Family
			34.58	100.00%		0.48		0.64		91.0		
F1	78	B	13.70	65.74%	0.45	0.30	0.59	0.39	85	55.9	65%	1/8 ac. Single Family
	89	D	7.14	34.26%	0.49	0.17	0.65	0.22	92	31.5	65%	1/8 ac. Single Family
			20.84	100.00%		0.46		0.61		87.4		
F2	28	A	0.97	15.52%	0.45	0.07	0.59	0.09	77	12.0	65%	1/8 ac. Single Family
	108	B	0.80	12.80%	0.45	0.06	0.59	0.08	85	10.9	65%	1/8 ac. Single Family
	89	D	4.48	71.68%	0.49	0.35	0.65	0.47	92	65.9	65%	1/8 ac. Single Family
			6.25	100.00%		0.48		0.63		88.8		

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F3	89	D	19.80	100.00%		0.49		0.65	92	92.0	65%	1/8 ac. Single Family
F4	89	D	8.84	100.00%		0.49		0.65	92	92.0	65%	1/8 ac. Single Family
F5	2/78	B	5.61	41.52%	0.45	0.19	0.59	0.24	85	35.3	65%	1/8 ac. Single Family
	89	D	7.90	58.48%	0.49	0.29	0.65	0.38	92	53.8	65%	1/8 ac. Single Family
			13.51	100.00%		0.47		0.63		89.1		
G	78	B	5.23	100.00%	0.45		0.59		92	92.0	65%	1/8 ac. Single Family
J1	56	B	10.84	72.27%	0.45	0.33	0.59	0.43	85	61.4	65%	1/8 ac. Single Family
	52	C	4.16	27.73%	0.49	0.14	0.65	0.18	90	25.0	65%	1/8 ac. Single Family
			15.00	100.00%		0.46		0.61		86.4		
J2	56/86	B	46.97	75.93%	0.45	0.34	0.59	0.45	85	64.5	65%	1/8 ac. Single Family
	52	C	14.89	24.07%	0.49	0.12	0.65	0.16	90	21.7	65%	1/8 ac. Single Family
			61.86	100.00%		0.46		0.60		86.2		
K	56	B	75.88	100.00%	0.45		0.59		92	92.0	65%	1/8 ac. Single Family
L1	56	B	36.95	100.00%	0.45		0.59		85	85.0	65%	1/8 ac. Single Family
L2	56/78	B	24.27	49.66%	0.45	0.22	0.59	0.29	85	42.2	65%	1/8 ac. Single Family
	89	D	24.60	50.34%	0.49	0.25	0.65	0.33	92	46.3	65%	1/8 ac. Single Family
			48.87	100.00%		0.47		0.62		88.5		
L3	56	B	30.20	60.08%	0.12	0.07	0.39	0.23	69	41.5	7%	Park & Cemeteries
	56	B	8.22	16.35%	0.45	0.07	0.59	0.10	85	13.9	65%	1/8 ac. Single Family
	89	D	11.85	23.57%	0.49	0.12	0.65	0.15	92	21.7	65%	1/8 ac. Single Family
			50.27	100.00%		0.26		0.48		77.0		
M	28/56/78	A/B	80.66	84.12%	0.09	0.08	0.36	0.30	69	58.0	2%	Greenbelt/Channel
	89	D	15.23	15.88%	0.16	0.03	0.51	0.08	84	13.3	2%	Greenbelt/Channel
			95.89	100.00%		0.10		0.38		71.4		

Standard Form SF-1. Time of Concentration-Proposed

CORE ENGINEERING GROUP

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Checked By: Leonard Beasley

Job No: 100.300
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Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	τ_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	τ_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $\tau_c=\tau_i+\tau_t$ (min)
ET-18a	0.16	16.28	7.0	300.00	3.33%	0.25	19.83	1149.00	2.25%	1.05	18.24				
			15.0					433.00	3.33%	2.74	2.64	40.71			40.71
ET-18b	0.18	27.69	7.0	300.00	9.84%	0.37	13.53	1146.00	5.35%	1.62	11.80	25.33			25.33
ET-19	0.19	24.44	7.0	300.00	6.50%	0.33	15.34	1836.00	4.52%	1.49	20.56	35.91			35.91
DP-S5a	0.18	68.41	7.0	300.00	3.33%	0.26	19.43	1149.00	2.25%	1.05	18.24				
			15.0					433.00	3.33%	2.74	2.64				
			15.0					618.00	2.18%	2.21	4.65	44.96			44.96
A1	0.49	83.55	15.0	25.00	2.00%	0.09	4.40	1374.00	2.22%	2.23	10.25				
			15.0					885.00	2.53%	2.39	6.18				
			RCP					2995.00	1.70%	12.30	4.06				
			RCP					114.00	2.00%	13.34	0.14	25.03	5393.00	39.96	25.03
A2	0.49	36.38	15.0	36.00	2.00%	0.11	5.28	85.00	1.80%	2.01	0.70				
			20.0					2084.00	1.84%	2.71	12.80	18.78	2205.00	22.25	18.78
A3	0.49	12.70	15.0	61.00	2.20%	0.15	6.66	134.00	1.00%	1.50	1.49				
			15.0					1242.00	1.54%	1.86	11.12				
			RCP					260.00	3.00%	9.50	0.46	19.72	1697.00	19.43	19.43
A4	0.37	21.76	20.0	100.00	4.00%	0.20	8.37	1105.00	2.44%	3.12	5.90	14.26	1205.00	16.69	14.26

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Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	τ_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	τ_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $\tau_c=\tau_i+\tau_t$ (min)
AB	0.15	4.81	15.0	100.00	2.00%	0.12	13.70	484.00	2.10%	2.17	3.71				
			20.0					443.00	4.74%	4.35	1.70	19.11	1027.00	15.71	19.11
ET-28	0.13	69.31	15.0	300.00	7.00%	0.31	16.00	1633.00	6.12%	3.71	7.33				
			15.0					1624.00	4.54%	3.20	8.47	31.81			31.81
ET-27	0.09	181.14	15.0	300.00	7.00%	0.30	16.66	3000.00	4.94%	3.33	15.00				
			15.0					1021.00	1.68%	1.94	8.75	40.41			40.41
ET-24	0.20	23.89	7.0	300.00	6.33%	0.33	15.31	890.00	4.20%	1.43	10.34	25.65			25.65
ET-25	0.13	181.14	15.0	300.00	4.80%	0.28	18.13	330.00	6.97%	3.96	1.39				
			15.0					2696.00	2.25%	2.25	19.97	39.49			39.49
B1	0.49	9.10	15.0	39.00	3.85%	0.15	4.42	92.00	3.26%	2.71	0.57				
			20.0					1166.00	2.10%	2.90	6.71	11.69	1297.00	17.21	11.69
B2	0.46	52.04	7.0	100.00	5.80%	0.26	6.49	764.00	3.95%	1.39	9.15				
			7.0					44.00	11.36%	2.36	0.31				
			15.0					94.00	2.13%	2.19	0.72				
			20.0					2239.00	1.04%	2.04	18.30	34.96	3241.00	28.01	28.01
B3	0.45	5.02	15.0	22.00	2.00%	0.08	4.40	57.00	2.00%	2.12	0.45				
			20.0					995.00	1.25%	2.24	7.42	12.26	1074.00	15.97	12.26

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Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	τ_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	τ_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $\tau_c=\tau_i+\tau_t$ (min)
B4	0.49	38.33	15.0	100.00	3.00%	0.22	7.69	1030.00	1.41%	1.78	9.64				
			15.0					95.00	2.63%	2.43	0.65				
			20.0					2039.00	1.00%	2.00	16.99	34.97	3264.00	28.13	28.13
B5	0.46	24.58	7.0	100.00	2.50%	0.19	8.57	606.00	2.39%	1.08	9.33				
			15.0					610.00	1.18%	1.63	6.24				
			7.0					152.00	1.18%	0.76	3.33				
			15.0					66.00	6.82%	3.92	0.28				
			15.0					996.00	1.56%	1.87	8.86	36.62	2530.00	24.06	24.06
DP-B4a (B1 & B5)	0.14	410.91	15.0	300.00	7.00%	0.32	15.84	3000.00	4.94%	3.33	15.00				
			15.0					1021.00	1.68%	1.94	8.75				
			15.0					542.00	0.60%	1.16	7.77				
			RCB					1490.00	1.60%	20.00	1.24	48.60			48.60
DP-B5a	0.14	515.40	15.0	300.00	7.00%	0.32	15.84	3000.00	4.94%	3.33	15.00				
(B1a + B1-B5)			15.0					1021.00	1.68%	1.94	8.75				
			15.0					542.00	0.60%	1.16	7.77				
			RCB					1616.00	1.60%	20.00	1.35	48.71			48.71

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Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	τ_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	τ_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $\tau_c=\tau_i+\tau_t$ (min)
B6	0.47	21.06	15.0	34.00	2.94%	0.12	4.66	100.00	2.00%	2.12	0.79				
			20.0					1792.00	1.37%	2.34	12.76				
			RCP					107.00	1.00%	7.20	0.25	18.45	2033.00	21.29	18.45
B7	0.45	41.68	15.0	41.00	2.93%	0.13	5.29	90.00	1.84%	2.03	0.74				
			20.0					2195.00	0.74%	1.72	21.26				
			RCP					100.00	1.00%	8.30	0.20	27.49	2426.00	23.48	23.48
B8	0.45	15.94	15.0	43.00	2.00%	0.12	6.15	92.00	2.00%	2.12	0.72				
			20.0					1797.00	0.80%	1.79	16.74	23.61	1932.00	20.73	20.73
B9	0.13	21.25	7.0	57.00	10.53%	0.16	6.09	32.00	18.75%	3.03	0.18				
			7.0					67.00	2.00%	0.99	1.13				
			15.0					1243.00	0.50%	1.06	19.53	26.93	1399.00	17.77	17.77
C1	0.60	11.79	15.0	100.00	5.00%	0.31	5.32	551.00	3.45%	2.79	3.30				
			20.0					170.00	0.88%	1.88	1.51	10.13	821.00	14.56	10.13
C2	0.49	118.78	15.0	18.00	27.78%	0.19	1.56	801.00	2.12%	2.18	6.11				
			20.0					1195.00	1.42%	2.38	8.36				
			RCP					367.00	1.00%	13.96	0.44				
			RCP					1169.00	1.00%	11.43	1.70				
			RCP					298.00	3.40%	24.46	0.20	18.38	3848.00	31.38	18.38

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Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	τ_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	τ_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $\tau_c=\tau_i+\tau_t$ (min)
C3	0.51	32.38	7.0	66.00	2.00%	0.16	6.91	17.00	26.67%	3.62	0.08				
			15.0					1380.00	0.60%	1.16	19.80				
			20.0					1682.00	0.80%	1.79	15.67				
			RCP					132.00	2.00%	13.34	0.16	42.62	3277.00	28.21	28.21
D1	0.48	69.37	15.0	96.00	8.85%	0.30	5.35	82.00	1.83%	2.03	0.67				
			20.0					1195.00	1.17%	2.16	9.21				
			RCP					1715.00	2.20%	24.83	1.53	16.76	3088.00	27.16	16.76
D2	0.29	11.73	7.0	100.00	1.30%	0.12	13.47	456.00	2.24%	1.05	7.25	20.72	556.00	13.09	13.09
D3	0.90	4.09	7.0	100.00	4.70%	0.77	2.17	451.00	0.80%	0.63	12.01	14.18	551.00	13.06	13.06
D4	DID NOT USE														
D5	0.09	43.03	15.0	98.00	8.88%	0.19	8.80	4970.00	1.10%	1.57	52.65	61.45	5068.00	38.16	38.16
E1	0.46	75.97	7.0	100.00	3.91%	0.23	7.39	156.00	3.91%	1.38	1.88				
			20.0					1743.00	0.80%	1.79	16.24				
			RCP					450.00	3.50%	17.65	0.42				
			20.0					733.00	0.55%	1.48	8.24	34.17	3182.00	27.68	27.68
E2	0.48	21.94	7.0	100.00	4.20%	0.24	6.99	90.00	4.20%	1.43	1.05				
			20.0					1050.00	3.52%	3.75	4.66	12.70	1240.00	16.89	12.70

Standard Form SF-1. Time of Concentration-Proposed

CORE ENGINEERING GROUP

Calculated By: Leonard Beasley
Date: January, 2024
Checked By: Leonard Beasley

Job No: 100.300
Project: Bull Hill/Rolling Meadows MDDP

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	τ_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	τ_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $\tau_c=\tau_i+\tau_t$ (min)
E3	0.48	34.58	7.0	100.00	6.90%	0.28	5.93	44.00	6.90%	1.84	0.40				
			20.0					2940.00	1.22%	2.21	22.18	28.51	3084.00	27.13	27.13
DP-E, (E1-F3)	0.47	132.49	7.0	100.00	4.20%	0.23	7.12	90.00	4.20%	1.43	1.05				
			20.0					1050.00	3.52%	3.75	4.66				
			20.0					1462.00	1.22%	2.21	11.03				
			RCP					450.00	3.50%	17.65	0.42				
			20.0					733.00	0.55%	1.48	8.24	32.52	3885.00	31.58	31.58
F1	0.46	20.84	7.0	100.00	5.14%	0.25	6.75	75.00	5.14%	1.59	0.79				
			20.0					1049.00	2.57%	3.21	5.45				
			RCP					112.00	5.00%	17.65	0.11				
			20.0					120.00	0.80%	1.79	1.12	14.22	1456.00	18.09	14.22
F2	0.48	6.25	7.0	100.00	4.62%	0.25	6.78	73.00	4.62%	1.50	0.81				
			20.0					458.00	4.15%	4.07	1.87				
			20.0					25.00	12.00%	6.93	0.06				
			20.0					115.00	0.50%	1.41	1.36	10.87	771.00	14.28	10.87
F3	0.49	19.80	7.0	100.00	5.18%	0.26	6.42	93.00	5.20%	1.60	0.97				
			20.0					1292.00	1.47%	2.42	8.88	16.27	1485.00	18.25	16.27

Standard Form SF-1. Time of Concentration-Proposed

CORE ENGINEERING GROUP

Calculated By: Leonard Beasley
Date: January, 2024
Checked By: Leonard Beasley

Job No: 100.300
Project: Bull Hill/Rolling Meadows MDDP

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	τ_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	τ_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $\tau_c=\tau_i+\tau_t$ (min)
F4	0.49	8.84	7.0	100.00	2.90%	0.21	7.78	38.00	2.90%	1.19	0.53				
			20.0					793.00	4.00%	4.00	3.30	11.61	931.00	15.17	11.61
F5	0.47	13.51	7.0	100.00	3.28%	0.22	7.71	144.00	3.28%	1.27	1.89				
			20.0					1235.00	2.35%	3.07	6.71	16.32	1479.00	18.22	16.32
DP-F1, (F1,F3-F5)	0.48	59.99	7.0	100.00	5.18%	0.25	6.57	93.00	5.20%	1.60	0.97				
			20.0					859.00	1.47%	2.42	5.90				
			20.0					635.00	2.57%	3.21	3.30				
			RCP					767.00	1.17%	14.35	0.89				
			20.0					120.00	0.80%	1.79	1.12	18.75	2574.00	24.30	18.75
G	0.45	5.23	20.0	62.00	25.00%	0.32	3.20	1924.00	0.68%	1.65	19.44	22.64	1986.00	21.03	21.03
J1	0.46	15.00	20.0	55.00	2.00%	0.13	6.84	1440.00	2.15%	2.93	8.18	15.03	1495.00	18.31	15.03
J2	0.46	61.86	7.0	100.00	4.76%	0.24	6.93	89.00	4.76%	1.53	0.97				
			20.0					2237.00	2.50%	3.16	11.79				
			RCP					190.00	1.00%	10.46	0.30				
			20.0					390.00	0.52%	1.44	4.50	24.49	3006.00	26.70	24.49

Standard Form SF-1. Time of Concentration-Proposed

CORE ENGINEERING GROUP

Calculated By: Leonard Beasley
Date: January, 2024
Checked By: Leonard Beasley

Job No: 100.300
Project: Bull Hill/Rolling Meadows MDDP

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	τ_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	τ_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $\tau_c=\tau_i+\tau_t$ (min)
K	0.45	75.88	7.0	100.00	4.20%	0.23	7.33	236.00	4.10%	1.42	2.78				
			20.0					2644.00	2.90%	3.41	12.94				
			RCP					257.00	2.60%	19.94	0.21				
			20.0					300.00	1.00%	2.00	2.50	25.76	3537.00	29.65	25.76
L 1	0.45	36.95	7.0	100.00	6.10%	0.26	6.48	96.00	6.20%	1.74	0.92				
			20.0					2287.00	3.00%	3.46	11.00	18.40	2483.00	23.79	18.40
L2	0.47	48.87	7.0	100.00	1.60%	0.17	9.78	222.00	1.50%	0.86	4.32				
			20.0					821.00	3.29%	3.63	3.77				
			15.0					811.00	4.01%	3.00	4.50				
			RCP					87.00	3.00%	19.80	0.07				
			20.0					344.00	0.87%	1.87	3.07	25.52	2385.00	23.25	23.25
L3	0.26	50.27	7.0	100.00	16.00%	0.27	6.09	1983.00	5.05%	1.57	21.01	27.10	2083.00	21.57	21.57
DP-L	0.39	136.09	7.0	100.00	6.10%	0.24	7.08	96.00	6.20%	1.74	0.92				
			20.0					2287.00	3.00%	3.46	11.00				
			20.0					956.00	3.50%	3.74	4.26				
			RCP					87.00	3.00%	14.35	0.10				
			20.0					344.00	0.87%	1.87	3.07	26.43	3870.00	31.50	26.43

Standard Form SF-1. Time of Concentration-Proposed

CORE ENGINEERING GROUP

Calculated By: Leonard Beasley
Date: January, 2024
Checked By: Leonard Beasley

Job No: 100.300
Project: Bull Hill/Rolling Meadows MDDP

Sub-Basin Data				Initial Overland Time (t_i)				Travel Time (t_t)					t_c Check (urbanized Basins)		Final t_c
BASIN or DESIGN	C_5	AREA (A) acres	NRCS Convey.	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	τ_i minutes	LENGTH (L) feet	SLOPE (S) %	VELOCITY (V) ft/sec	τ_t minutes	Computed t_c Minutes	TOTAL LENGTH (L) feet	Regional tc tc=(L/180)+10 minutes	USDCM Recommended $\tau_c=\tau_i+\tau_t$ (min)
M	0.10	95.89	7.0	100.00	6.00%	0.17	10.02	221.00	5.20%	1.60	2.31				
			15.0					7060.00	1.00%	1.50	78.44	90.78	7381.00	51.01	51.01

APPENDIX C – HYDRAULIC CALCULATIONS

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jul 18 2023

Des.Pt A1a - 42in RCP

Circular

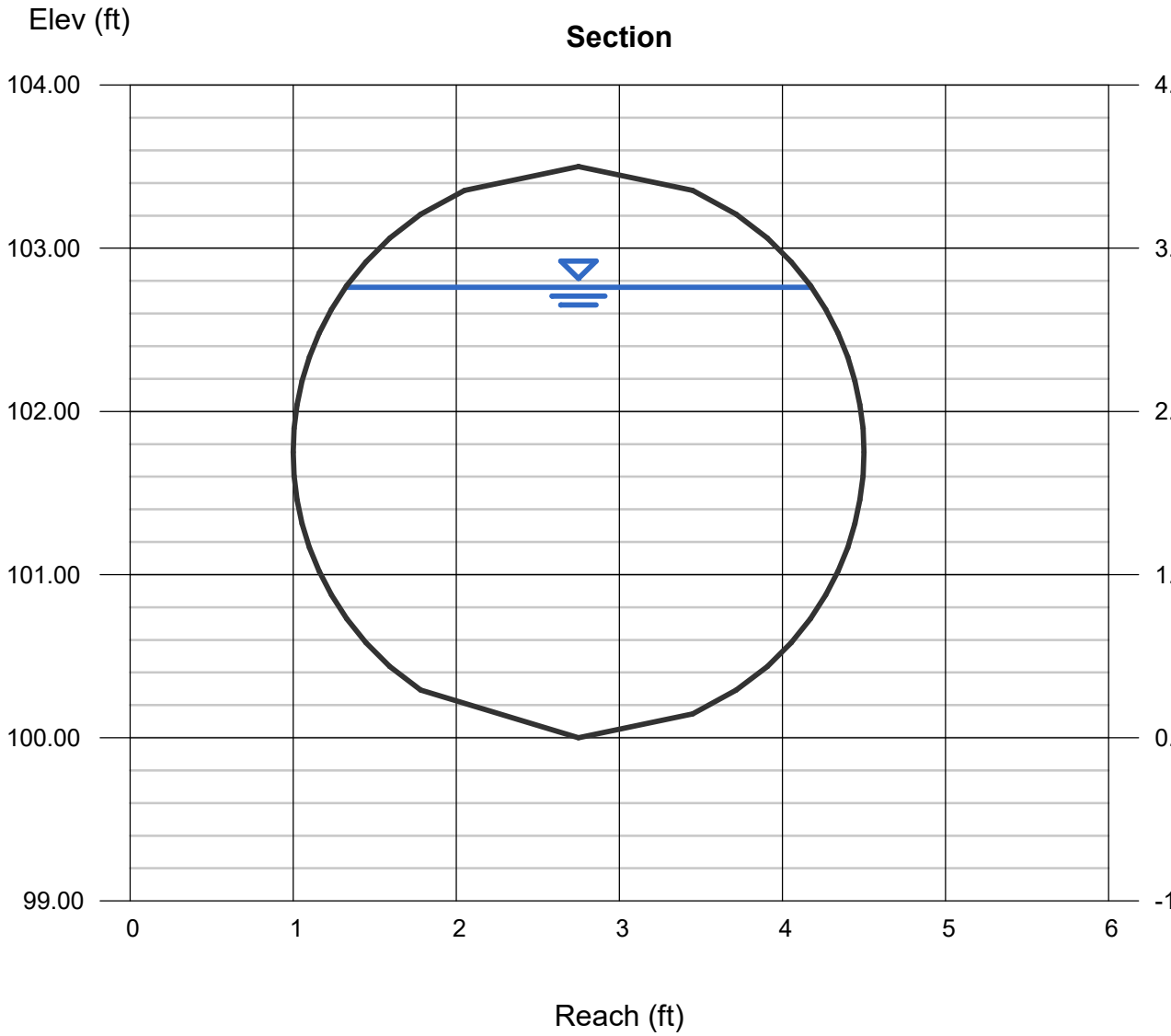
Diameter (ft)	= 3.50
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 97.00

Highlighted

Depth (ft)	= 2.76
Q (cfs)	= 97.00
Area (sqft)	= 8.15
Velocity (ft/s)	= 11.90
Wetted Perim (ft)	= 7.67
Crit Depth, Yc (ft)	= 3.03
Top Width (ft)	= 2.85
EGL (ft)	= 4.96



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jul 18 2023

Des.Pt A2a - 66in RCP

Circular

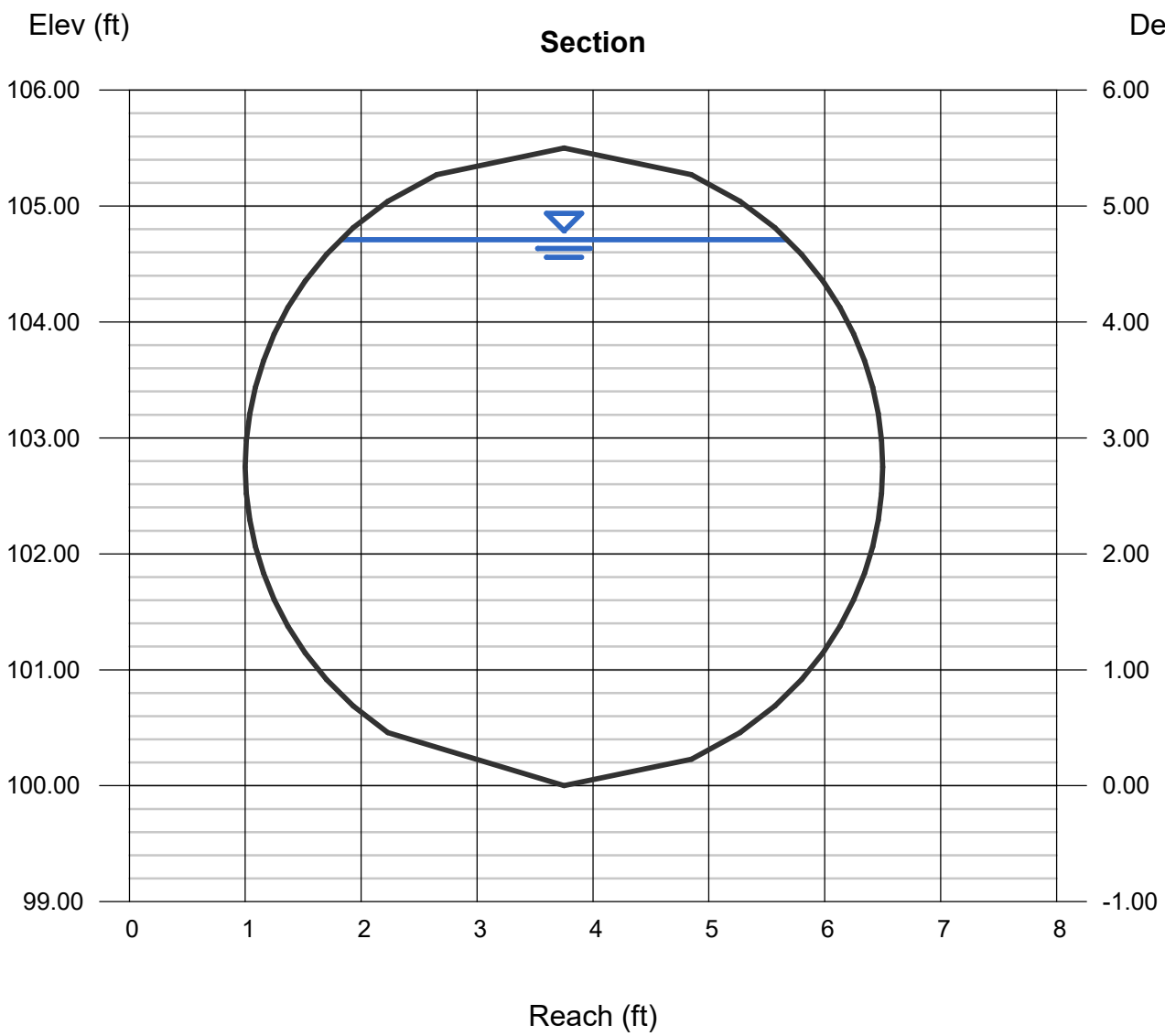
Diameter (ft)	=	5.50
Invert Elev (ft)	=	100.00
Slope (%)	=	1.00
N-Value	=	0.013

Calculations

Compute by:		Known Q
Known Q (cfs)	=	348.00

Highlighted

Depth (ft)	=	4.71
Q (cfs)	=	348.00
Area (sqft)	=	21.67
Velocity (ft/s)	=	16.06
Wetted Perim (ft)	=	13.01
Crit Depth, Yc (ft)	=	5.01
Top Width (ft)	=	3.85
EGL (ft)	=	8.72



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Jul 18 2023

Des.Pt A3a - 72in RCP

Circular

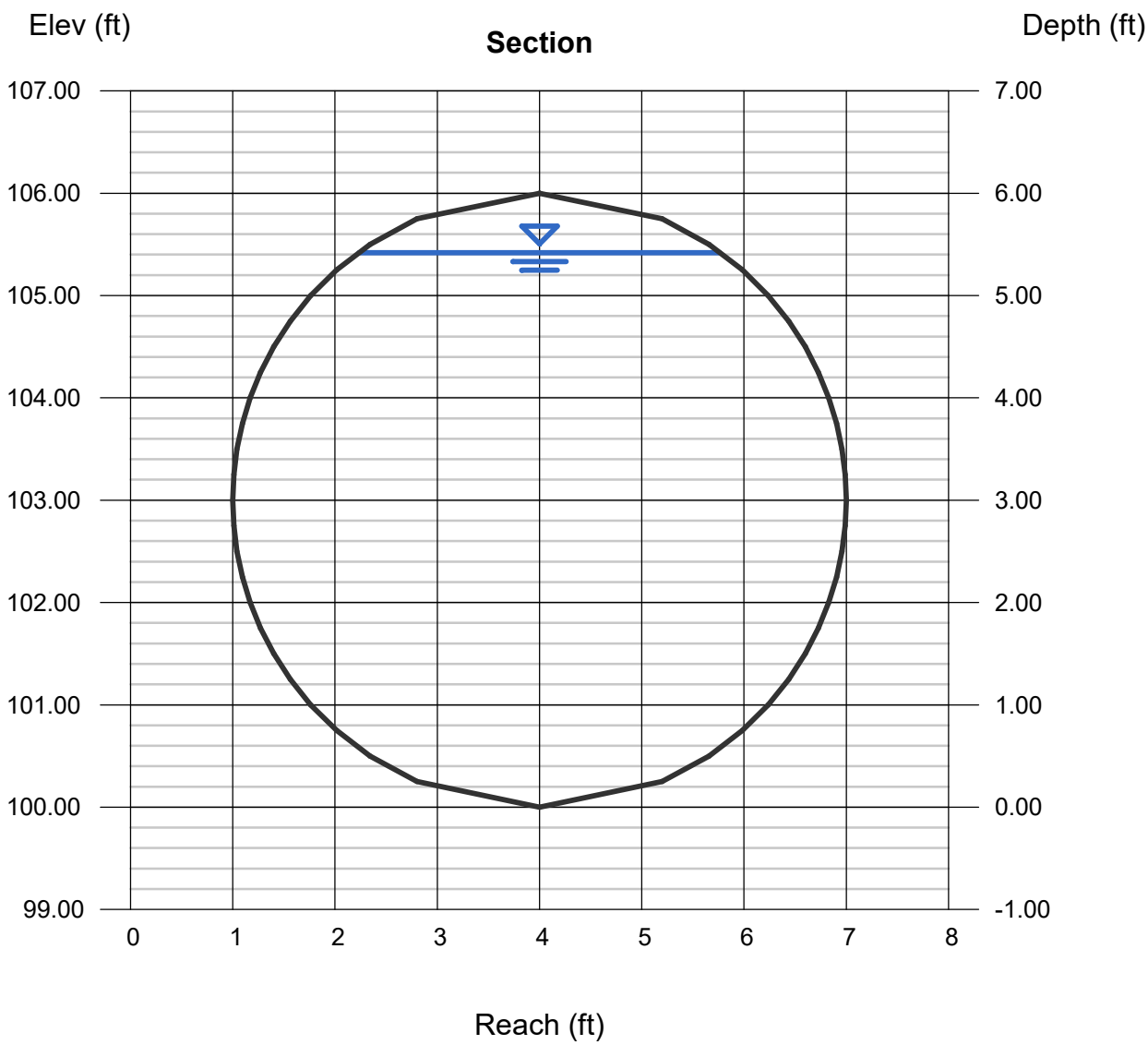
Diameter (ft)	= 6.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.10
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 474.00

Highlighted

Depth (ft)	= 5.42
Q (cfs)	= 474.00
Area (sqft)	= 26.88
Velocity (ft/s)	= 17.63
Wetted Perim (ft)	= 15.06
Crit Depth, Yc (ft)	= 5.61
Top Width (ft)	= 3.54
EGL (ft)	= 10.25



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jul 13 2023

Swale 'A' - 520cfs

Trapezoidal

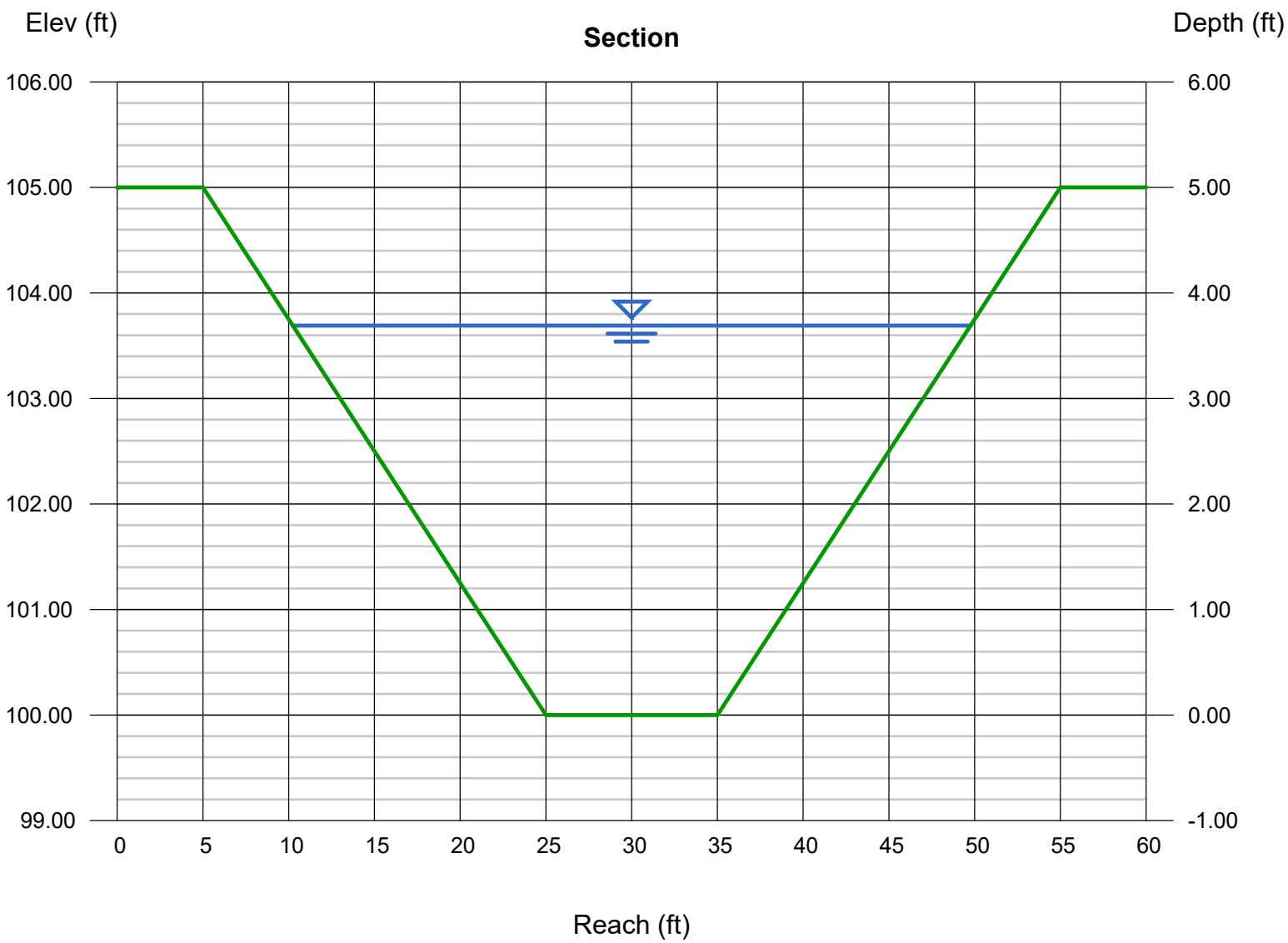
Bottom Width (ft)	=	10.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	5.00
Invert Elev (ft)	=	100.00
Slope (%)	=	0.20
N-Value	=	0.020

Calculations

Compute by:		Known Q
Known Q (cfs)	=	520.00

Highlighted

Depth (ft)	=	3.69
Q (cfs)	=	520.00
Area (sqft)	=	91.36
Velocity (ft/s)	=	5.69
Wetted Perim (ft)	=	40.43
Crit Depth, Yc (ft)	=	3.00
Top Width (ft)	=	39.52
EGL (ft)	=	4.19



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jul 13 2023

Swale 'A' - 1300cfs

Trapezoidal

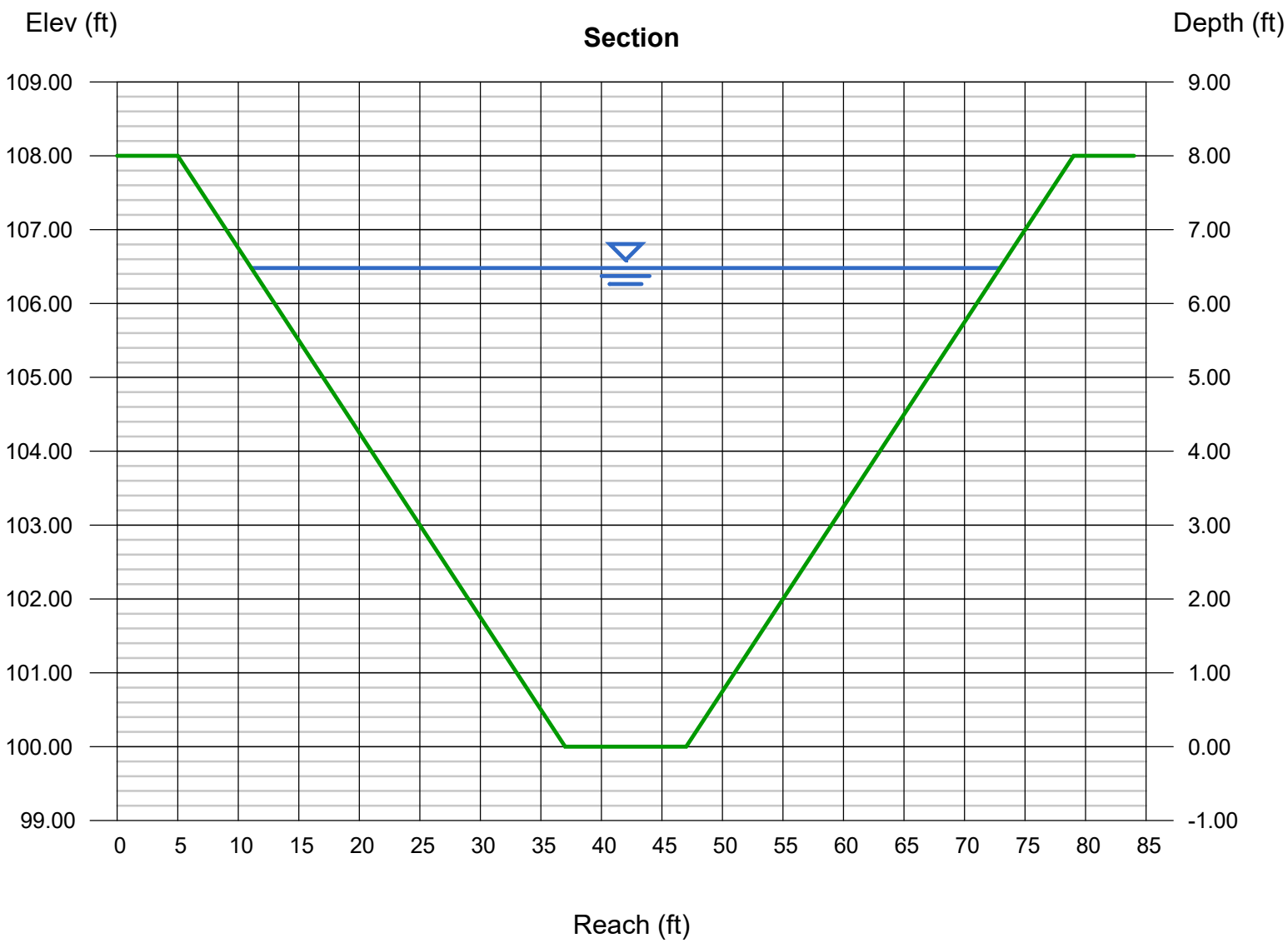
Bottom Width (ft)	=	10.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	8.00
Invert Elev (ft)	=	100.00
Slope (%)	=	0.10
N-Value	=	0.020

Calculations

Compute by:		Known Q
Known Q (cfs)	=	1300.00

Highlighted

Depth (ft)	=	6.48
Q (cfs)	=	1,300
Area (sqft)	=	232.76
Velocity (ft/s)	=	5.59
Wetted Perim (ft)	=	63.44
Crit Depth, Yc (ft)	=	4.71
Top Width (ft)	=	61.84
EGL (ft)	=	6.97



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jul 13 2023

Design Pt. B1a box culvert

Invert Elev Dn (ft)	=	5784.00
Pipe Length (ft)	=	80.00
Slope (%)	=	0.70
Invert Elev Up (ft)	=	5784.56
Rise (in)	=	60.0
Shape	=	Box
Span (in)	=	84.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

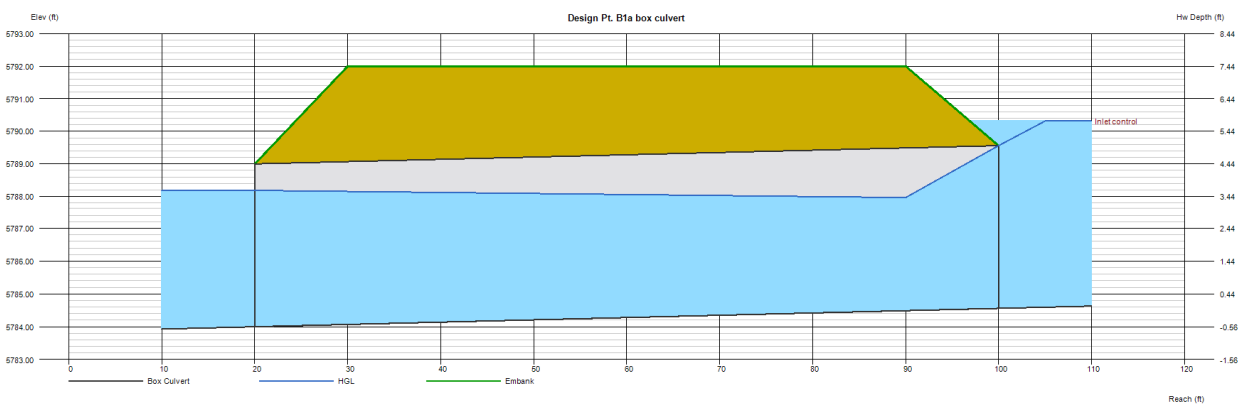
Top Elevation (ft)	=	5792.00
Top Width (ft)	=	60.00
Crest Width (ft)	=	200.00

Calculations

Qmin (cfs)	=	492.00
Qmax (cfs)	=	493.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	493.00
Qpipe (cfs)	=	493.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.41
Veloc Up (ft/s)	=	10.44
HGL Dn (ft)	=	5788.19
HGL Up (ft)	=	5787.93
Hw Elev (ft)	=	5790.31
Hw/D (ft)	=	1.15
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jul 13 2023

Design Pt. B4a box culvert

Invert Elev Dn (ft)	=	5784.00
Pipe Length (ft)	=	80.00
Slope (%)	=	1.00
Invert Elev Up (ft)	=	5784.80
Rise (in)	=	60.0
Shape	=	Box
Span (in)	=	84.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

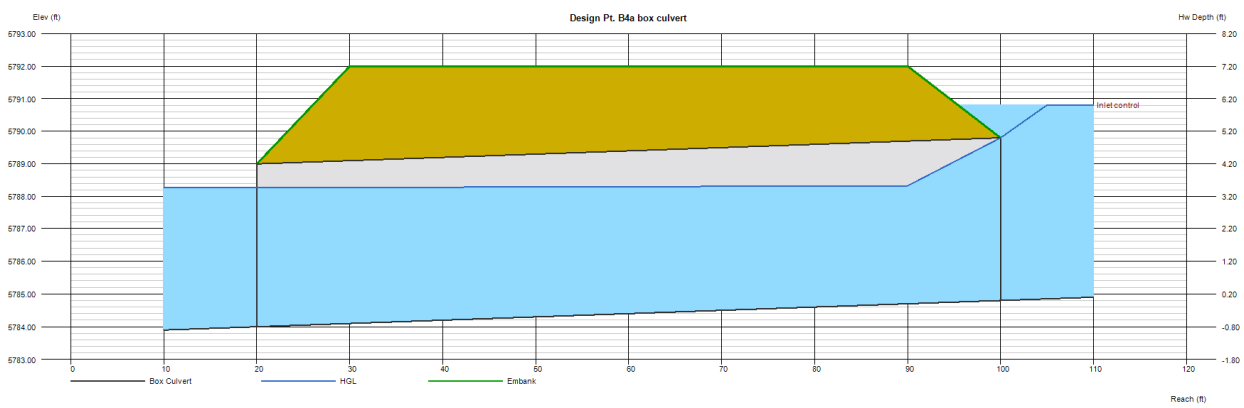
Top Elevation (ft)	=	5792.00
Top Width (ft)	=	60.00
Crest Width (ft)	=	200.00

Calculations

Qmin (cfs)	=	529.00
Qmax (cfs)	=	530.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	529.00
Qpipe (cfs)	=	529.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.85
Veloc Up (ft/s)	=	10.68
HGL Dn (ft)	=	5788.27
HGL Up (ft)	=	5788.34
Hw Elev (ft)	=	5790.81
Hw/D (ft)	=	1.20
Flow Regime	=	Inlet Control



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jul 13 2023

Swale 'B1' - 530cfs

Trapezoidal

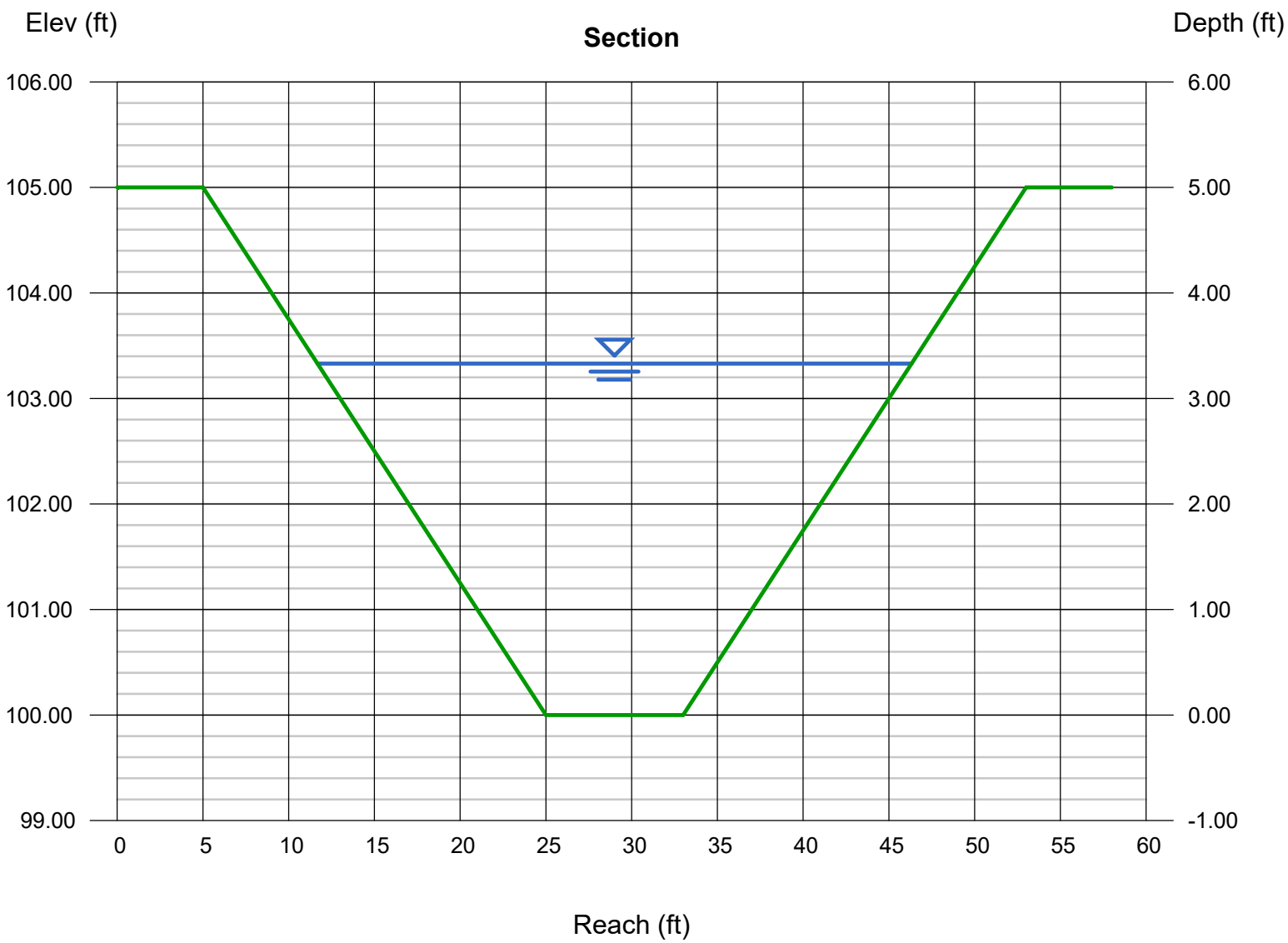
Bottom Width (ft)	=	8.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	5.00
Invert Elev (ft)	=	100.00
Slope (%)	=	0.40
N-Value	=	0.020

Calculations

Compute by:		Known Q
Known Q (cfs)	=	530.00

Highlighted

Depth (ft)	=	3.33
Q (cfs)	=	530.00
Area (sqft)	=	71.00
Velocity (ft/s)	=	7.47
Wetted Perim (ft)	=	35.46
Crit Depth, Yc (ft)	=	3.20
Top Width (ft)	=	34.64
EGL (ft)	=	4.20



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jul 13 2023

Swale 'B2' - 720cfs

Trapezoidal

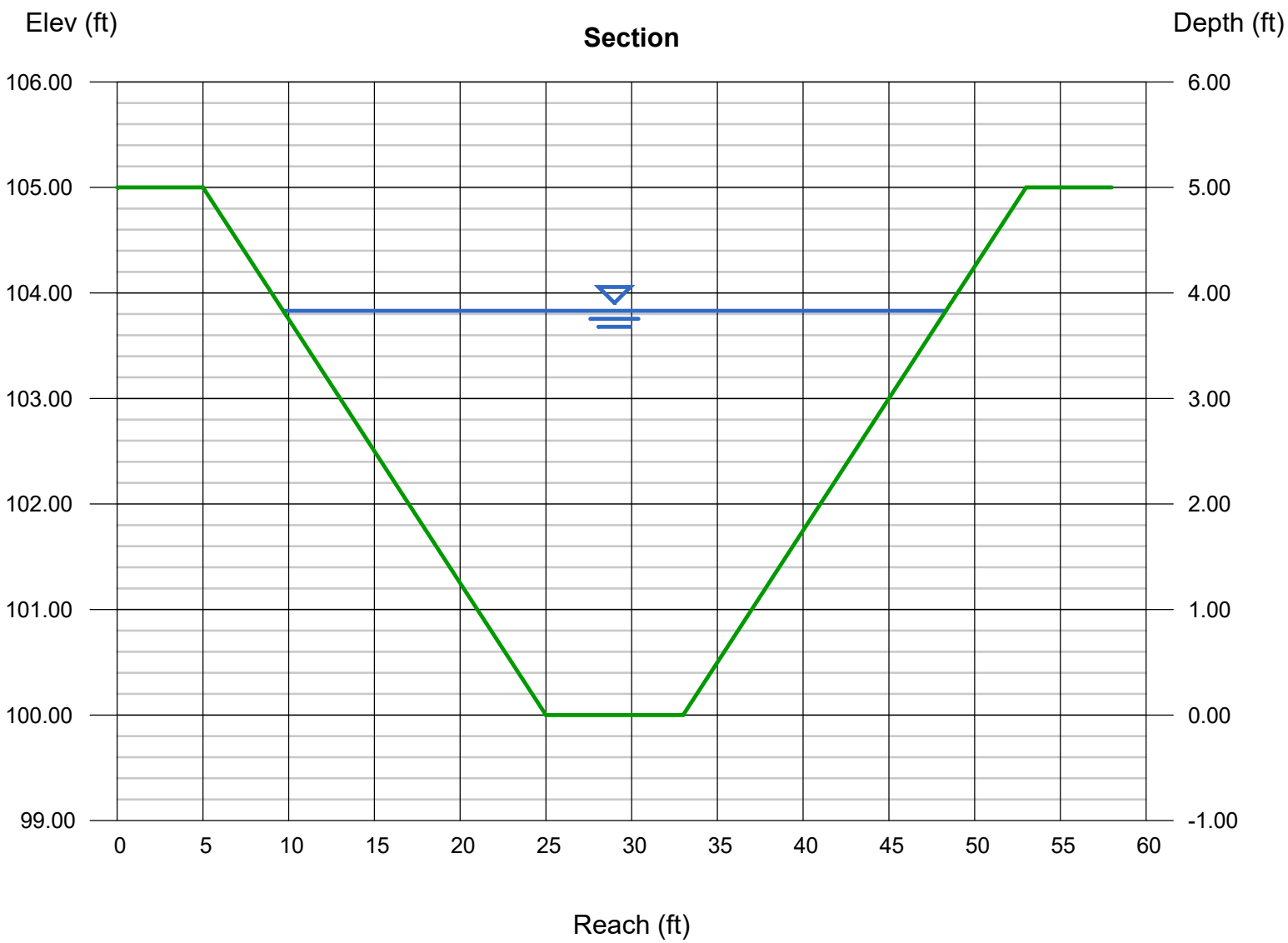
Bottom Width (ft)	=	8.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	5.00
Invert Elev (ft)	=	100.00
Slope (%)	=	0.40
N-Value	=	0.020

Calculations

Compute by:		Known Q
Known Q (cfs)	=	720.00

Highlighted

Depth (ft)	=	3.83
Q (cfs)	=	720.00
Area (sqft)	=	89.32
Velocity (ft/s)	=	8.06
Wetted Perim (ft)	=	39.58
Crit Depth, Yc (ft)	=	3.71
Top Width (ft)	=	38.64
EGL (ft)	=	4.84



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Jul 17 2023

36in STUB TO ET-31

Circular

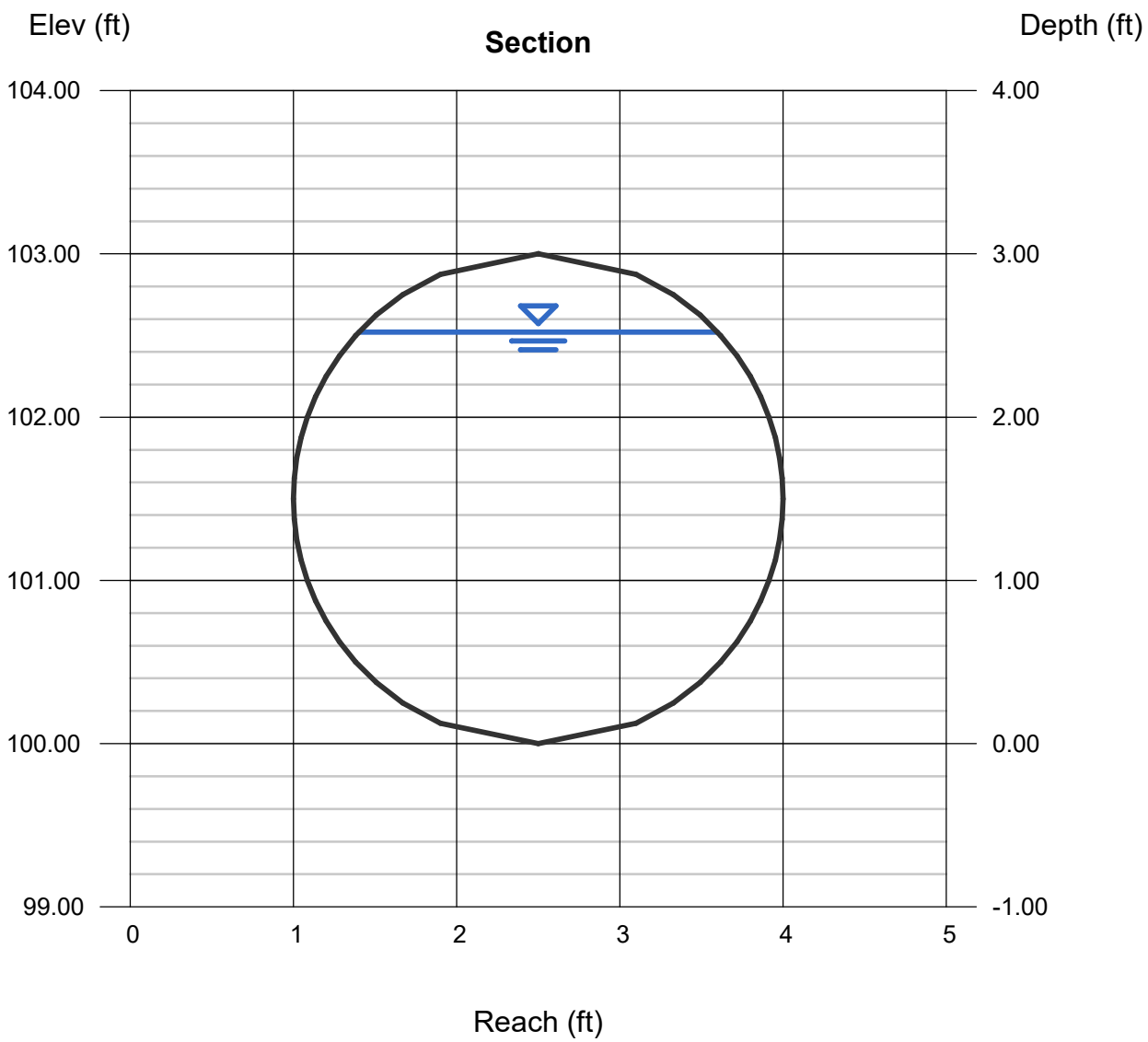
Diameter (ft)	= 3.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 68.10

Highlighted

Depth (ft)	= 2.52
Q (cfs)	= 68.10
Area (sqft)	= 6.34
Velocity (ft/s)	= 10.74
Wetted Perim (ft)	= 6.96
Crit Depth, Yc (ft)	= 2.64
Top Width (ft)	= 2.20
EGL (ft)	= 4.31



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jan 11 2024

Culverts at Des.Pt. D4a

Invert Elev Dn (ft)	=	5804.60
Pipe Length (ft)	=	130.00
Slope (%)	=	0.70
Invert Elev Up (ft)	=	5805.51
Rise (in)	=	48.0
Shape	=	Circular
Span (in)	=	48.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

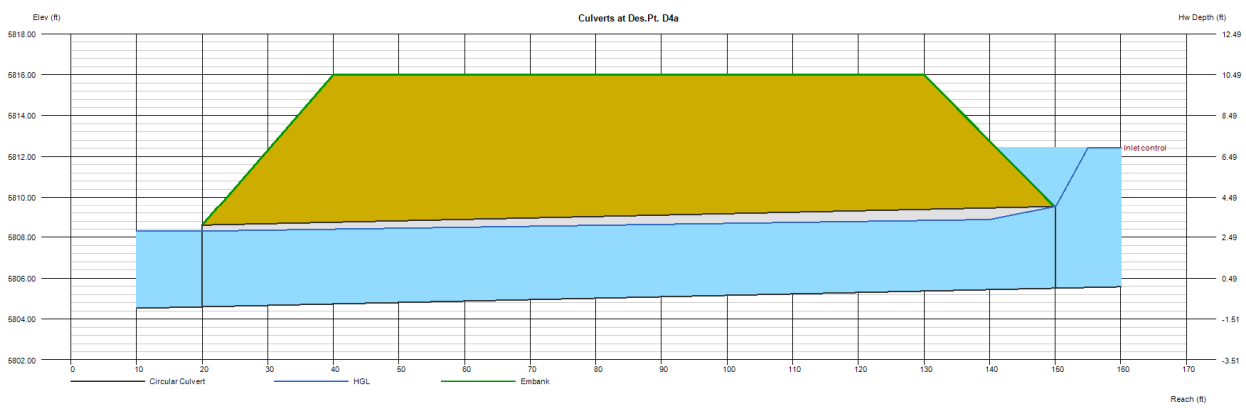
Top Elevation (ft)	=	5816.00
Top Width (ft)	=	90.00
Crest Width (ft)	=	30.00

Calculations

Qmin (cfs)	=	250.00
Qmax (cfs)	=	260.50
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	260.00
Qpipe (cfs)	=	260.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.70
Veloc Up (ft/s)	=	11.39
HGL Dn (ft)	=	5808.31
HGL Up (ft)	=	5808.92
Hw Elev (ft)	=	5812.44
Hw/D (ft)	=	1.73
Flow Regime	=	Inlet Control



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jan 11 2024

Swale 'D' - 260cfs

Trapezoidal

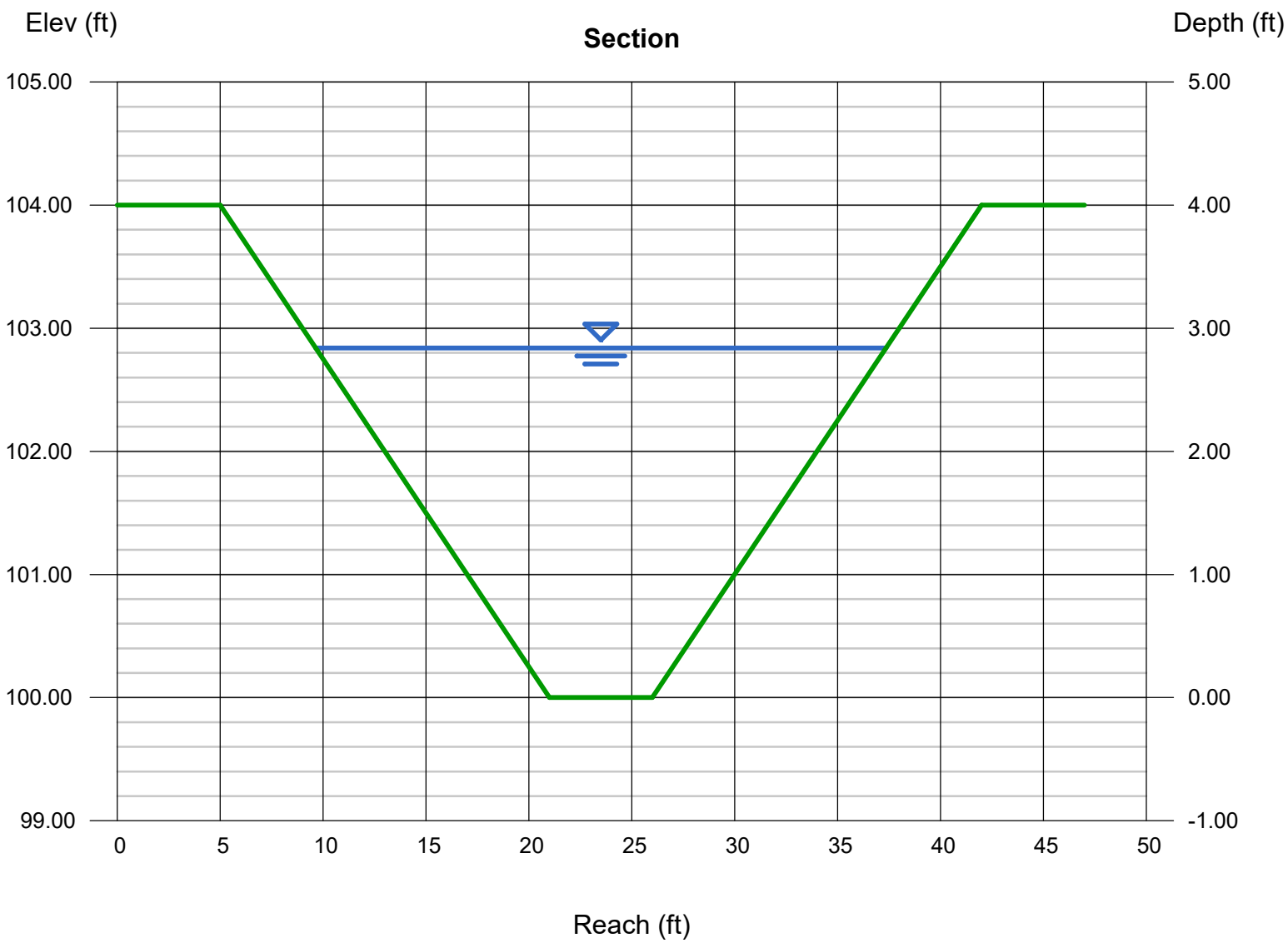
Bottom Width (ft)	=	5.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	4.00
Invert Elev (ft)	=	100.00
Slope (%)	=	0.30
N-Value	=	0.020

Calculations

Compute by:		Known Q
Known Q (cfs)	=	260.50

Highlighted

Depth (ft)	=	2.84
Q (cfs)	=	260.50
Area (sqft)	=	46.46
Velocity (ft/s)	=	5.61
Wetted Perim (ft)	=	28.42
Crit Depth, Yc (ft)	=	2.51
Top Width (ft)	=	27.72
EGL (ft)	=	3.33



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Jul 17 2023

54in STUB TO ET-32

Circular

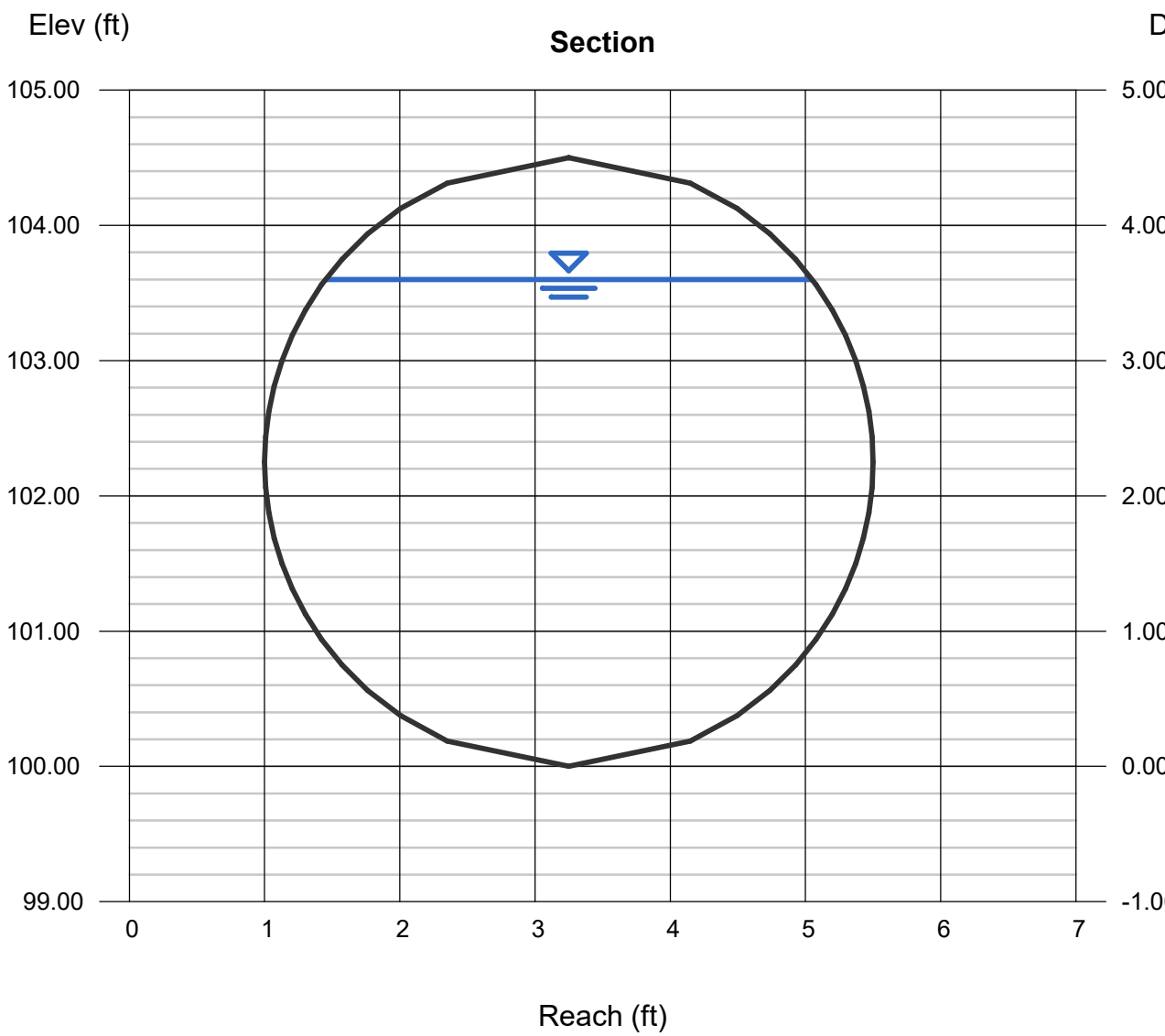
Diameter (ft)	= 4.50
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.013

Calculations

Compute by:	Known Q
Known Q (cfs)	= 192.00

Highlighted

Depth (ft)	= 3.60
Q (cfs)	= 192.00
Area (sqft)	= 13.64
Velocity (ft/s)	= 14.07
Wetted Perim (ft)	= 9.97
Crit Depth, Yc (ft)	= 3.98
Top Width (ft)	= 3.60
EGL (ft)	= 6.68



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Jul 17 2023

DESPT E1a CULVERT-300cfs

Invert Elev Dn (ft)	=	5811.90
Pipe Length (ft)	=	150.00
Slope (%)	=	2.40
Invert Elev Up (ft)	=	5815.50
Rise (in)	=	66.0
Shape	=	Circular
Span (in)	=	66.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

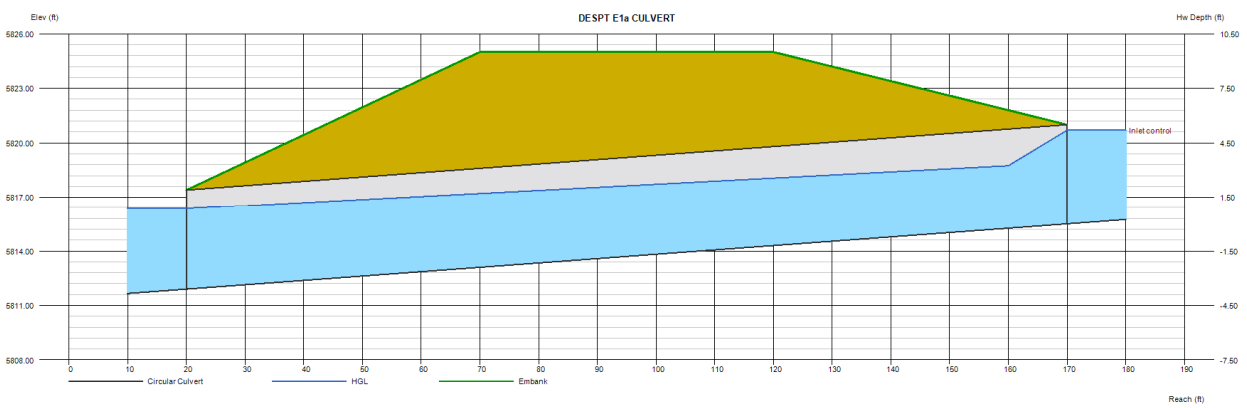
Top Elevation (ft)	=	5825.00
Top Width (ft)	=	50.00
Crest Width (ft)	=	500.00

Calculations

Qmin (cfs)	=	200.00
Qmax (cfs)	=	300.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	300.00
Qpipe (cfs)	=	300.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.27
Veloc Up (ft/s)	=	9.68
HGL Dn (ft)	=	5816.36
HGL Up (ft)	=	5818.91
Hw Elev (ft)	=	5820.70
Hw/D (ft)	=	0.94
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jul 19 2023

Design Pt. E3a box culvert

Invert Elev Dn (ft)	=	5858.00
Pipe Length (ft)	=	80.00
Slope (%)	=	1.00
Invert Elev Up (ft)	=	5858.80
Rise (in)	=	60.0
Shape	=	Box
Span (in)	=	84.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

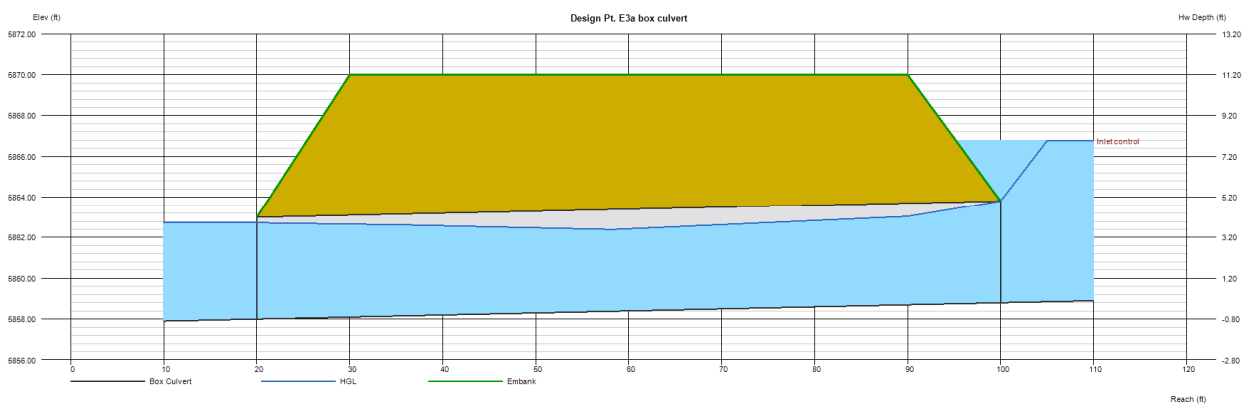
Top Elevation (ft)	=	5870.00
Top Width (ft)	=	60.00
Crest Width (ft)	=	200.00

Calculations

Qmin (cfs)	=	746.00
Qmax (cfs)	=	747.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	746.00
Qpipe (cfs)	=	746.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	11.28
Veloc Up (ft/s)	=	11.98
HGL Dn (ft)	=	5862.72
HGL Up (ft)	=	5863.25
Hw Elev (ft)	=	5866.77
Hw/D (ft)	=	1.59
Flow Regime	=	Inlet Control



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jul 19 2023

Swale 'E' - 750cfs

Trapezoidal

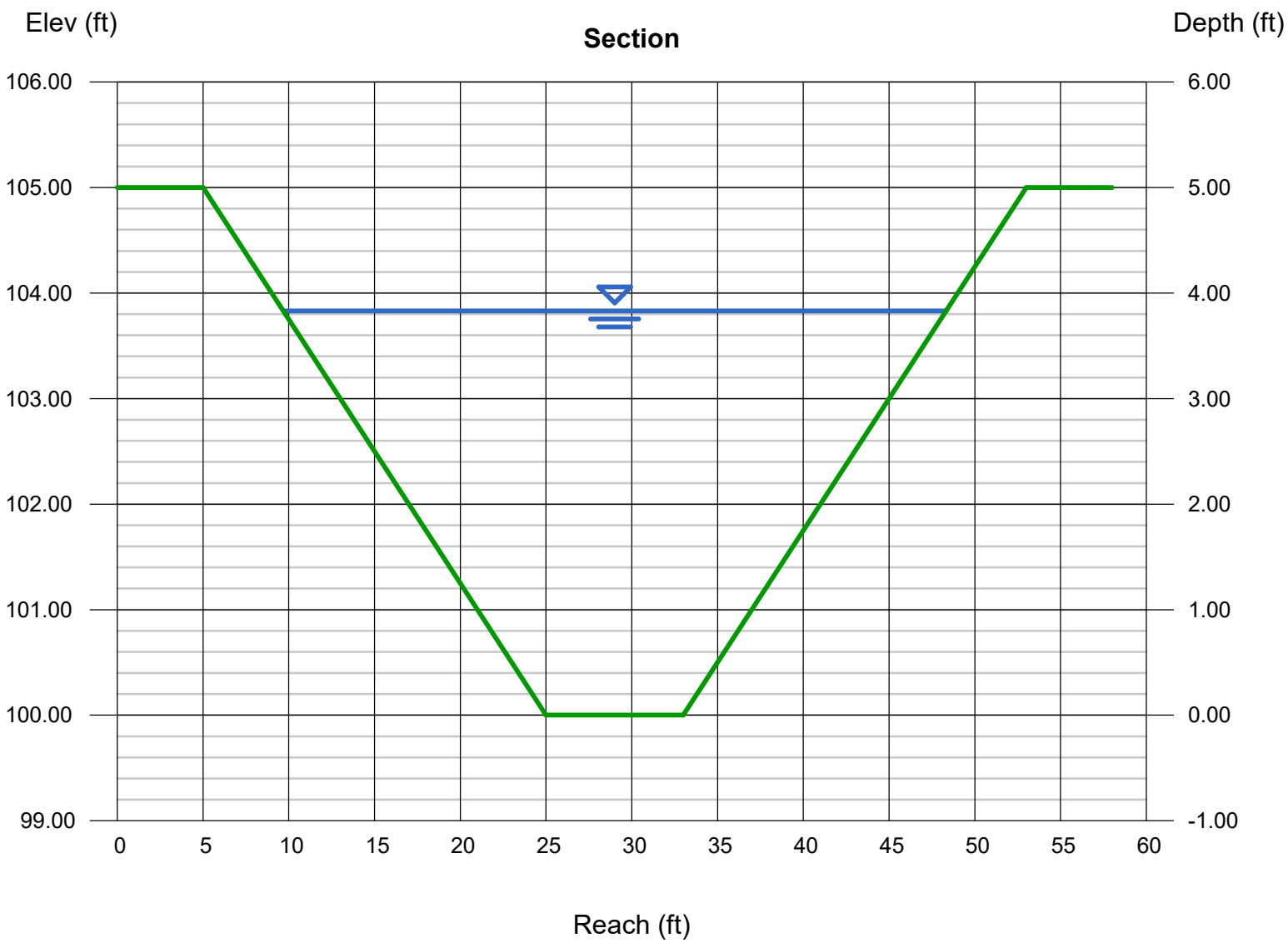
Bottom Width (ft)	=	8.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	5.00
Invert Elev (ft)	=	100.00
Slope (%)	=	0.40
N-Value	=	0.020

Calculations

Compute by:		Known Q
Known Q (cfs)	=	720.00

Highlighted

Depth (ft)	=	3.83
Q (cfs)	=	720.00
Area (sqft)	=	89.32
Velocity (ft/s)	=	8.06
Wetted Perim (ft)	=	39.58
Crit Depth, Yc (ft)	=	3.71
Top Width (ft)	=	38.64
EGL (ft)	=	4.84



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Jul 19 2023

Des.Pt. F2a 30in culvert - 48cfs

Circular

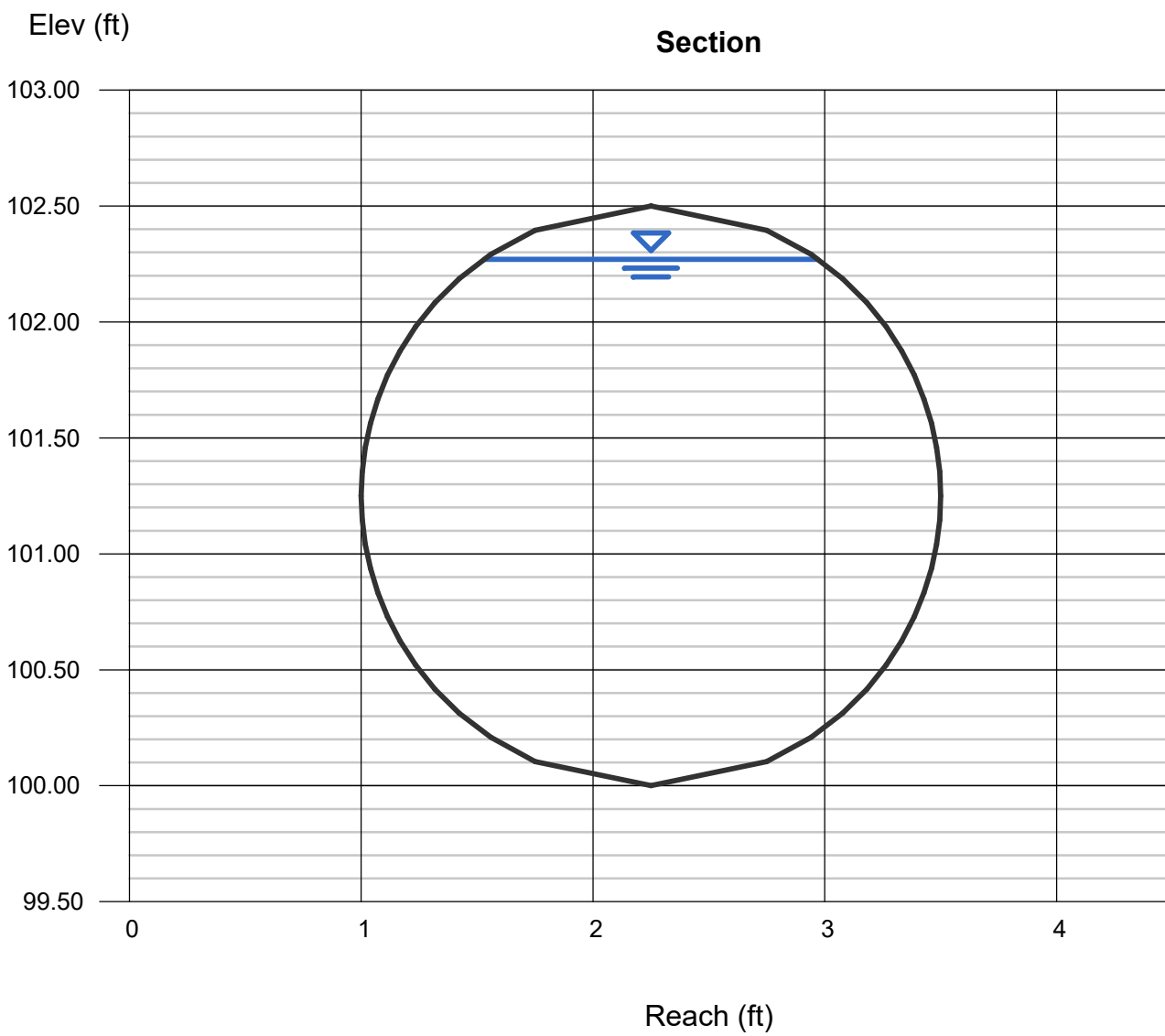
Diameter (ft)	=	2.50
Invert Elev (ft)	=	100.00
Slope (%)	=	1.20
N-Value	=	0.013

Calculations

Compute by:		Known Q
Known Q (cfs)	=	48.00

Highlighted

Depth (ft)	=	2.27
Q (cfs)	=	48.00
Area (sqft)	=	4.69
Velocity (ft/s)	=	10.24
Wetted Perim (ft)	=	6.33
Crit Depth, Yc (ft)	=	2.27
Top Width (ft)	=	1.44
EGL (ft)	=	3.90



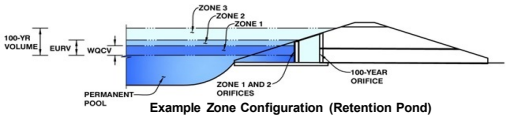
APPENDIX D – DETENTION POND & WATER QUALITY CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill / Rolling Meadows MDDP**

Basin ID: **Pond A**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	222.80	acres
Watershed Length =	4,500	ft
Watershed Length to Centroid =	2,100	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	39.40%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	7.3%	percent
Percentage Hydrologic Soil Groups C/D =	92.7%	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) =	3.309	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	8.225	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	10.153	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	15.339	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	19.873	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	25.383	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	30.195	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	36.239	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	48.376	acre-feet		inches
Approximate 2-yr Detention Volume =	7.076	acre-feet		
Approximate 5-yr Detention Volume =	11.010	acre-feet		
Approximate 10-yr Detention Volume =	12.768	acre-feet		
Approximate 25-yr Detention Volume =	14.067	acre-feet		
Approximate 50-yr Detention Volume =	14.657	acre-feet		
Approximate 100-yr Detention Volume =	17.240	acre-feet		

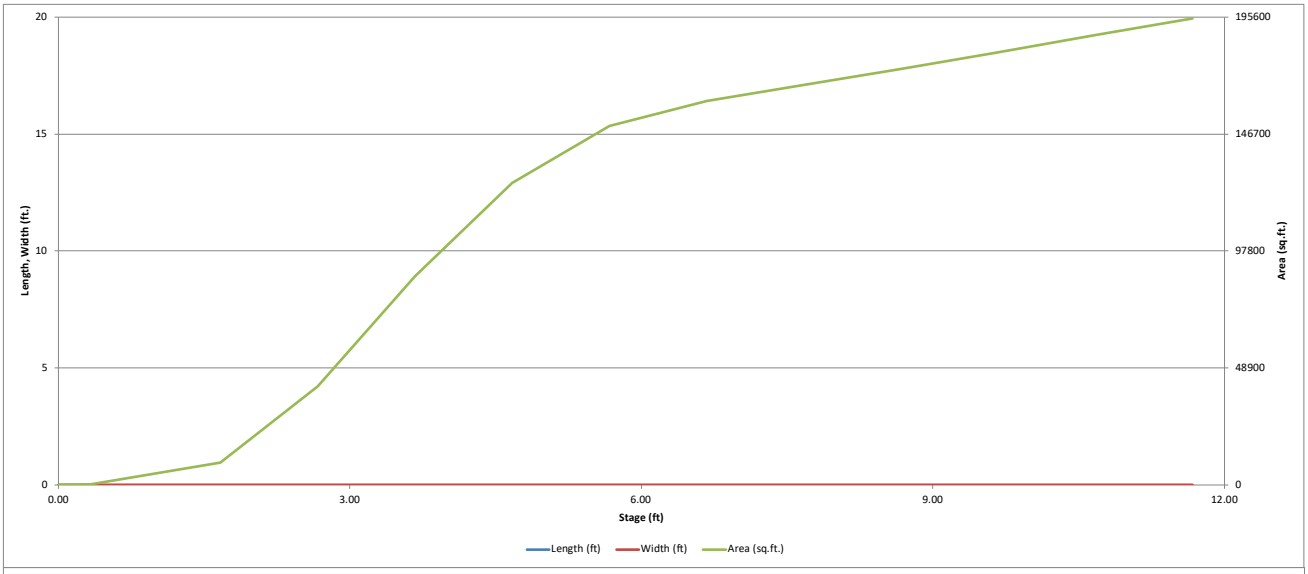
Define Zones and Basin Geometry

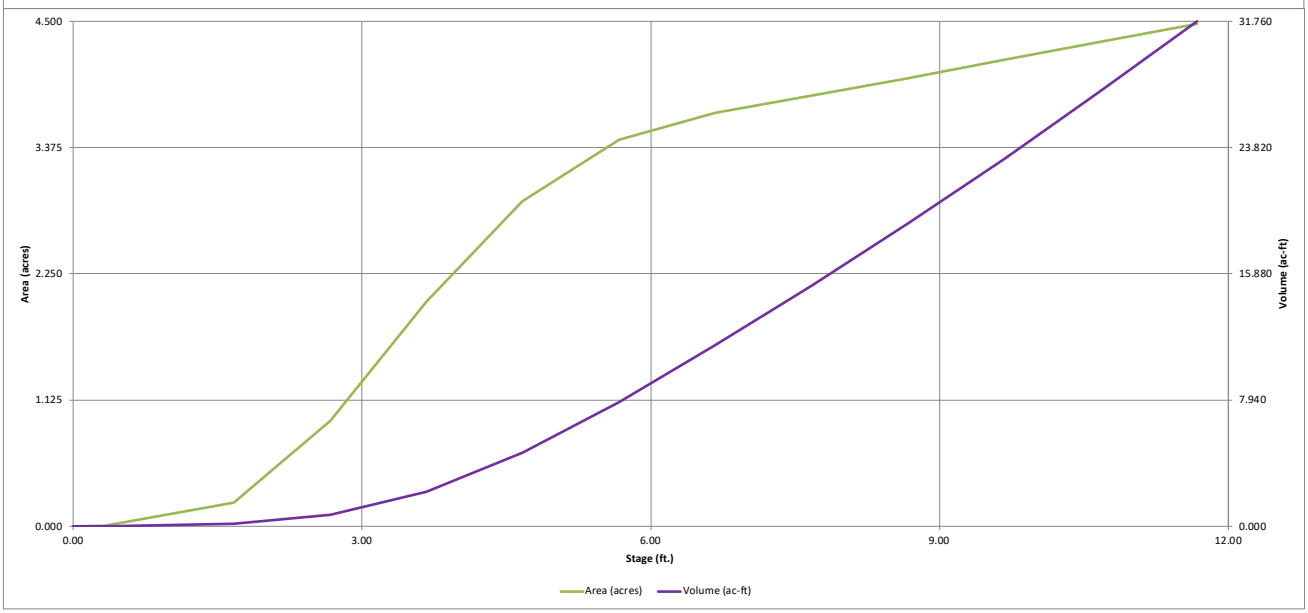
Zone 1 Volume (WQCV) =	3.309	acre-feet
Zone 2 Volume (EURV - Zone 1) =	4.916	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	10.669	acre-feet
Total Detention Basin Volume =	18.895	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention 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

micropool=5756.67

Depth Increment = 0.20 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	--	--	--	30	0.001		
5757	--	0.33	--	--	--	100	0.002	21	0.000
5758	--	1.67	--	--	--	9,102	0.209	6,187	0.142
5759	--	2.67	--	--	--	40,940	0.940	31,207	0.716
5760	--	3.67	--	--	--	87,092	1.999	95,223	2.186
5761	--	4.67	--	--	--	126,256	2.898	201,897	4.635
5762	--	5.67	--	--	--	150,143	3.447	340,097	7.808
5763	--	6.67	--	--	--	160,382	3.682	495,359	11.372
5764	--	7.67	--	--	--	167,090	3.836	659,095	15.131
5765	--	8.67	--	--	--	173,927	3.993	829,604	19.045
5766	--	9.67	--	--	--	180,981	4.155	1,007,058	23.119
5767	--	10.67	--	--	--	187,983	4.315	1,191,540	27.354
5768	--	11.67	--	--	--	195,204	4.481	1,383,133	31.752


20
15
10
5
0
Length, Width (ft.)
195600
146700
97800
48900
0
Area (sq.ft.)
0.00
3.00
6.00
9.00
12.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

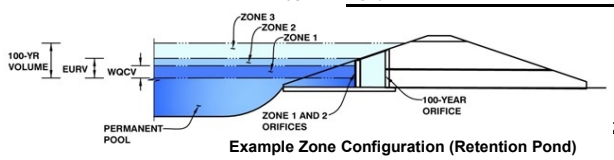

4.500
3.375
2.250
1.125
0.000
Area (acres)
31.760
23.820
15.880
7.940
0.000
Volume (ac-ft)
0.00
3.00
6.00
9.00
12.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill / Rolling Meadows MDDP**

Basin ID: **Pond A**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.18	3.309	Orifice Plate
Zone 2 (EURV)	5.80	4.916	Weir&Pipe (Restrict)
Z3 (100+1/2WQCV)	8.64	10.669	Weir (No Pipe)
Total (all zones)		18.895	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.18	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	16.70	inches
Orifice Plate: Orifice Area per Row =	8.71	sq. inches (use rectangular openings)

Calculated Parameters for Plate

WQ Orifice Area per Row =	6.049E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.39	2.79					
Orifice Area (sq. inches)	8.71	8.71	8.71					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifi

	Not Selected	Not Selected
Vertical Orifice Area =	N/A	N/A
Vertical Orifice Centroid =	N/A	N/A

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	
Overflow Weir Front Edge Height, Ho =	4.50	5.80	ft (relative to basin bottom at Stage = 0 ft)
Weir Front Edge Length OR Weir Bottom Length	15.00	30.00	feet
Weir Grate Slope OR Weir Side Slopes	0.00	4.00	H:V
Horiz. Length of Weir Sides =	6.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow We

	Zone 2 Weir	Zone 3 Weir
Height of Grate Upper Edge, H_t =	4.50	N/A
Overflow Weir Slope Length =	6.00	N/A
Grate Open Area / 100-yr Orifice Area =	7.58	N/A
Overflow Grate Open Area w/o Debris =	62.64	N/A
Overflow Grate Open Area w/ Debris =	31.32	N/A

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

	Zone 2 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	48.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	30.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

	Zone 2 Restrictor	Not Selected
Outlet Orifice Area =	8.26	N/A
Outlet Orifice Centroid =	1.41	N/A
Half-Central Angle of Restrictor Plate on Pipe =	1.82	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.80	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	30.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet
	Overlapping	

Calculated Parameters for Spillway

Spillway Design Flow Depth=	2.71	feet
Stage at Top of Freeboard =	9.51	feet
Basin Area at Top of Freeboard =	4.13	acres
Basin Volume at Top of Freeboard =	22.46	acre-ft

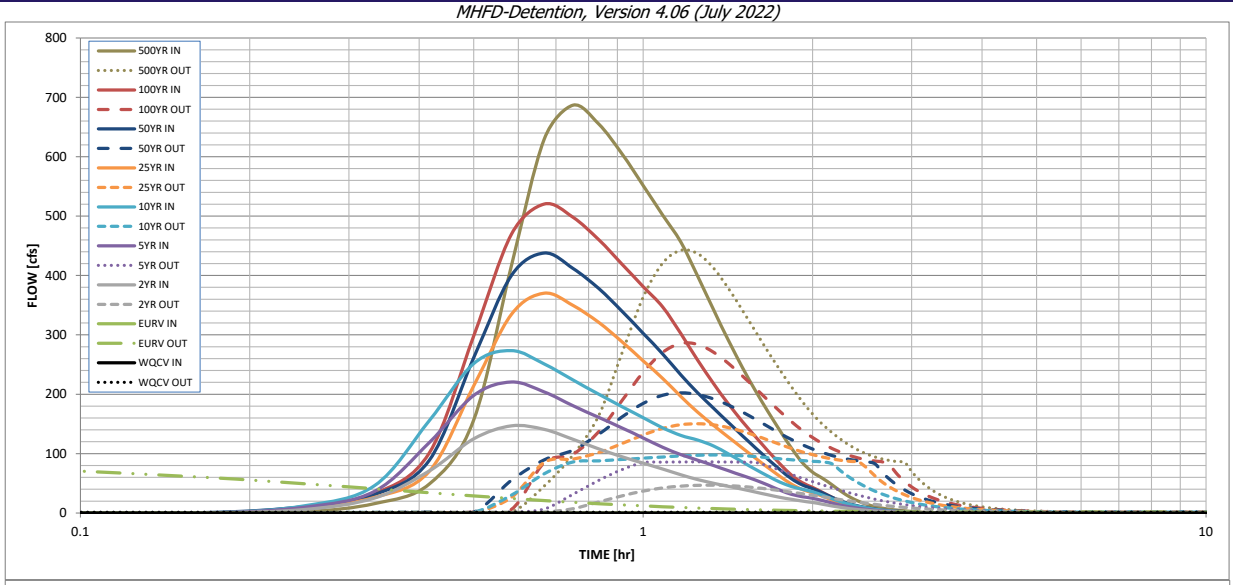
Routed Hydrograph Results

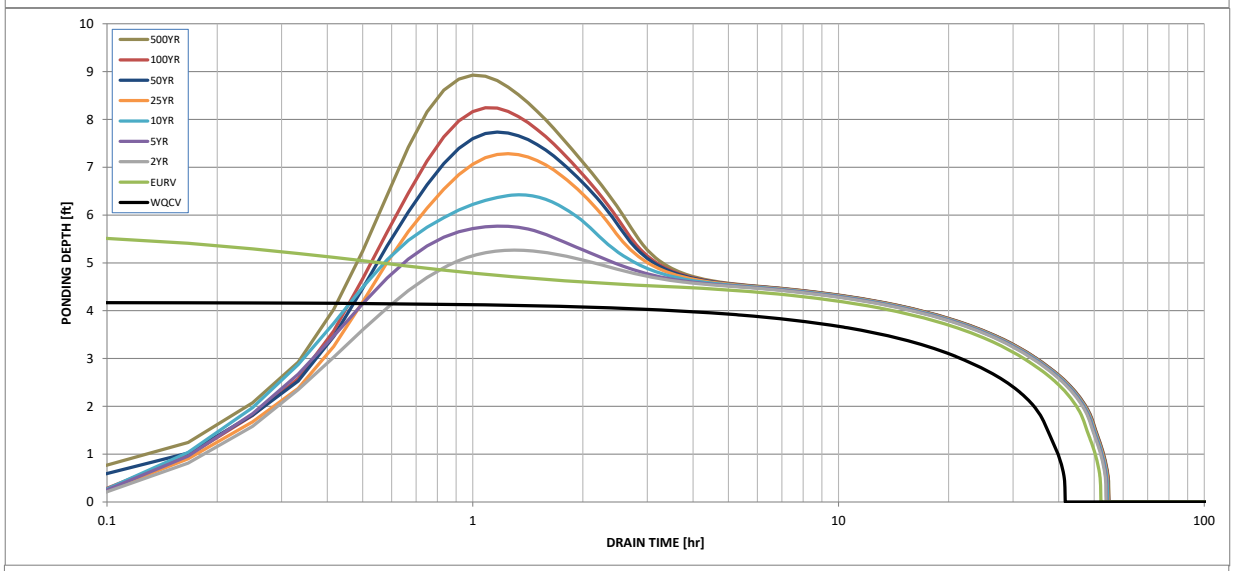
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

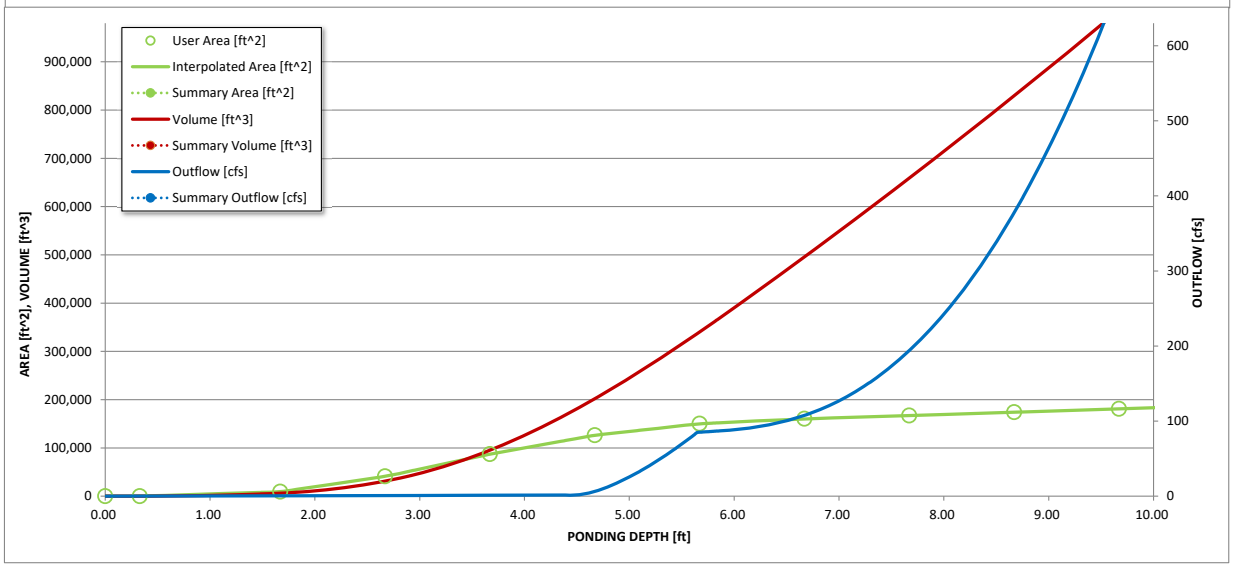
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	3.309	8.225	10.153	15.339	19.873	25.383	30.195	36.239
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	10.153	15.339	19.873	25.383	30.195	36.239
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	42.8	90.6	126.5	201.2	248.1	310.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.19	0.41	0.57	0.90	1.11	1.39
Peak Inflow Q (cfs) =	N/A	N/A	146.8	220.6	273.5	370.1	437.7	520.2
Peak Outflow Q (cfs) =	1.4	85.5	46.8	86.1	97.8	150.3	202.4	285.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.0	0.8	0.7	0.8	0.9
Structure Controlling Flow =	Plate	Outlet Plate 1	Overflow Weir 1	Outlet Plate 1	Spillway	Spillway	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	N/A	1.35	0.72	1.3	1.4	1.5	1.6	1.7
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) =	38	45	46	43	41	39	37	35
Time to Drain 99% of Inflow Volume (hours) =	**40**	49	50	49	48	47	46	45
Maximum Ponding Depth (ft) =	4.18	5.80	5.26	5.77	6.42	7.28	7.73	8.24
Area at Maximum Ponding Depth (acres) =	2.46	3.48	3.22	3.47	3.62	3.78	3.85	3.93
Maximum Volume Stored (acre-ft) =	3.323	8.258	6.440	8.119	10.459	13.646	15.361	17.343

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	0.68	0.07	2.19
	0:15:00	0.00	0.00	5.94	9.74	12.09	8.14	10.64	9.99	15.82
	0:20:00	0.00	0.00	25.20	36.72	46.25	26.36	31.31	32.84	48.62
	0:25:00	0.00	0.00	70.75	118.48	155.29	70.04	88.72	100.89	156.63
	0:30:00	0.00	0.00	124.89	198.09	251.52	214.12	261.47	298.26	416.79
	0:35:00	0.00	0.00	146.82	220.55	273.47	334.55	400.06	469.50	629.17
	0:40:00	0.00	0.00	140.74	204.03	250.94	370.05	437.69	520.19	686.67
	0:45:00	0.00	0.00	124.15	180.64	224.22	349.60	412.05	498.08	655.11
	0:50:00	0.00	0.00	108.02	161.05	200.03	321.21	378.21	460.49	605.14
	0:55:00	0.00	0.00	94.75	143.42	179.21	288.41	339.99	419.27	551.48
	1:00:00	0.00	0.00	83.90	126.39	160.46	256.31	302.61	381.27	501.61
	1:05:00	0.00	0.00	74.08	110.59	143.42	226.66	267.90	346.86	456.19
	1:10:00	0.00	0.00	64.44	98.40	130.71	196.21	232.59	301.88	398.65
	1:15:00	0.00	0.00	56.36	88.96	122.72	169.74	202.43	257.16	342.37
	1:20:00	0.00	0.00	50.16	79.98	112.93	147.64	176.44	218.02	291.33
	1:25:00	0.00	0.00	44.89	71.25	99.75	128.02	152.77	184.02	245.72
	1:30:00	0.00	0.00	40.04	63.16	86.05	109.52	130.41	154.44	205.78
	1:35:00	0.00	0.00	35.30	55.55	73.50	92.27	109.68	128.42	170.74
	1:40:00	0.00	0.00	30.67	47.02	62.11	76.34	90.60	104.58	138.70
	1:45:00	0.00	0.00	26.41	38.37	52.06	61.73	73.10	82.80	109.56
	1:50:00	0.00	0.00	23.03	31.55	44.71	48.80	57.80	64.08	85.16
	1:55:00	0.00	0.00	20.10	27.56	40.00	39.65	47.27	51.11	68.74
	2:00:00	0.00	0.00	17.69	24.87	35.81	34.23	40.99	43.09	58.43
	2:05:00	0.00	0.00	14.79	21.05	30.05	28.23	33.88	34.76	47.35
	2:10:00	0.00	0.00	11.86	16.71	23.88	21.87	26.26	26.32	35.94
	2:15:00	0.00	0.00	9.32	13.00	18.63	16.64	19.97	19.43	26.57
	2:20:00	0.00	0.00	7.34	10.18	14.46	12.73	15.25	14.30	19.57
	2:25:00	0.00	0.00	5.73	7.92	11.09	9.67	11.57	10.50	14.38
	2:30:00	0.00	0.00	4.47	6.09	8.38	7.34	8.75	7.87	10.77
	2:35:00	0.00	0.00	3.48	4.61	6.26	5.52	6.56	5.95	8.10
	2:40:00	0.00	0.00	2.68	3.46	4.70	4.14	4.92	4.52	6.14
	2:45:00	0.00	0.00	2.04	2.59	3.58	3.15	3.75	3.49	4.74
	2:50:00	0.00	0.00	1.53	1.90	2.69	2.40	2.84	2.66	3.60
	2:55:00	0.00	0.00	1.09	1.34	1.93	1.76	2.08	1.94	2.62
	3:00:00	0.00	0.00	0.72	0.91	1.30	1.22	1.44	1.33	1.79
	3:05:00	0.00	0.00	0.44	0.58	0.80	0.77	0.91	0.84	1.12
	3:10:00	0.00	0.00	0.23	0.33	0.42	0.43	0.50	0.46	0.61
	3:15:00	0.00	0.00	0.09	0.15	0.17	0.19	0.22	0.20	0.25
	3:20:00	0.00	0.00	0.03	0.04	0.04	0.05	0.05	0.04	0.05
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

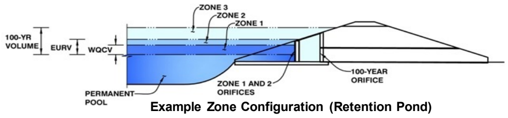
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill / Rolling Meadows MDDP**

Basin ID: **Pond B**



Example Zone Configuration (Retention Pond)

micropool=5758.67

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	615.00	acres
Watershed Length =	7,800	ft
Watershed Length to Centroid =	4,300	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	20.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	54.2%	percent
Percentage Hydrologic Soil Groups C/D =	45.8%	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) =	5.929	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	11.576	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	15.434	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	27.199	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	38.770	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	55.169	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	67.649	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	84.742	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	117.426	acre-feet		inches
Approximate 2-yr Detention Volume =	8.703	acre-feet		
Approximate 5-yr Detention Volume =	14.487	acre-feet		
Approximate 10-yr Detention Volume =	20.218	acre-feet		
Approximate 25-yr Detention Volume =	24.305	acre-feet		
Approximate 50-yr Detention Volume =	25.577	acre-feet		
Approximate 100-yr Detention Volume =	32.126	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	5.929	acre-feet
Zone 2 Volume (EURV - Zone 1) =	5.647	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	23.514	acre-feet
Total Detention Basin Volume =	35.090	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	--	--	--	30	0.001		
5759	--	0.33	--	--	--	30	0.001	10	0.000
5760	--	1.33	--	--	--	3,391	0.078	1,720	0.039
5761	--	2.33	--	--	--	26,478	0.608	16,655	0.382
5762	--	3.33	--	--	--	71,282	1.636	65,534	1.504
5763	--	4.33	--	--	--	137,656	3.160	170,003	3.903
5764	--	5.33	--	--	--	218,915	5.026	348,289	7.996
5765	--	6.33	--	--	--	303,668	6.971	609,580	13.994
5766	--	7.33	--	--	--	393,827	9.041	958,327	22.000
5767	--	8.33	--	--	--	475,830	10.924	1,393,156	31.982
5768	--	9.33	--	--	--	488,673	11.218	1,875,407	43.053
5769	--	10.33	--	--	--	501,640	11.516	2,370,564	54.421
5770	--	11.33	--	--	--	514,731	11.817	2,878,749	66.087
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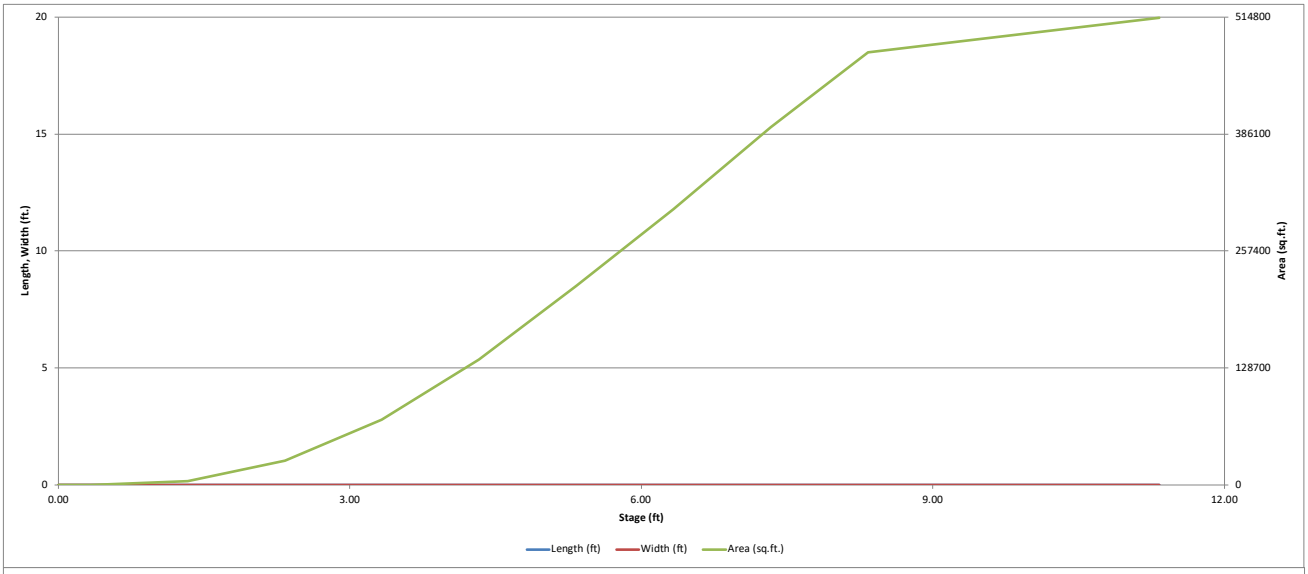
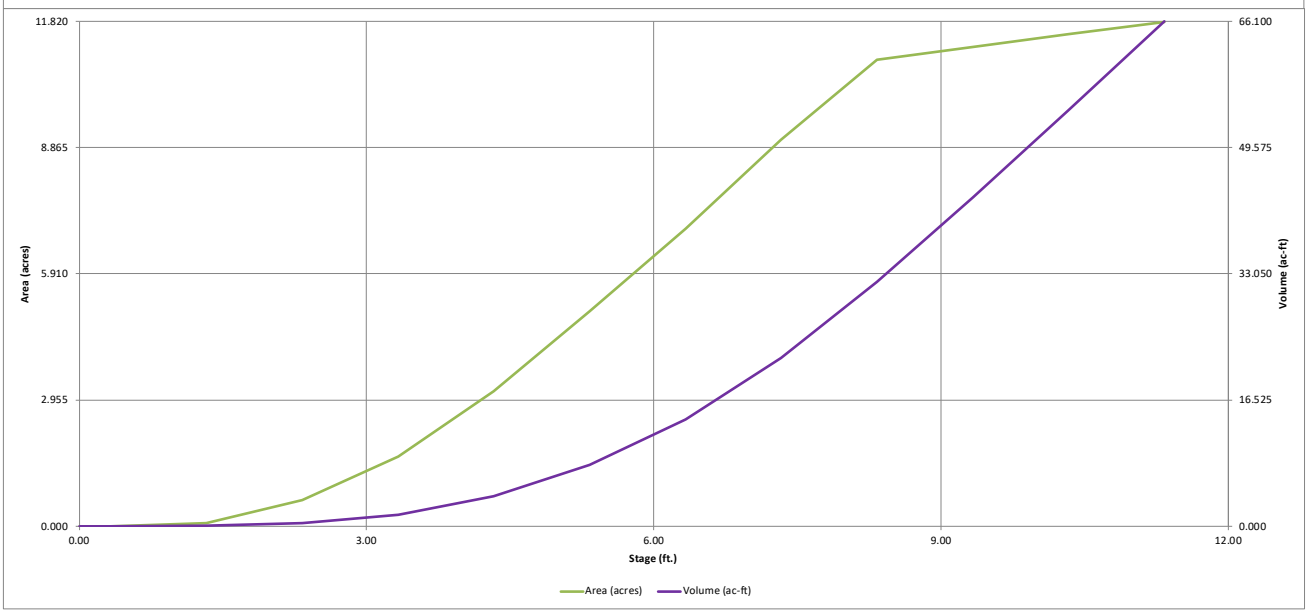

20
15
10
5
0
Length, Width (ft.)
514800
386100
257400
128700
0
Area (sq.ft.)
0.00
3.00
6.00
9.00
12.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

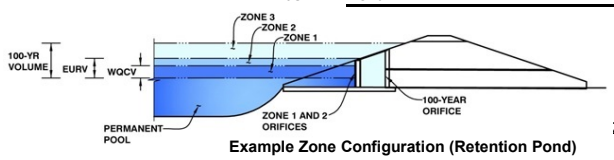

11.820
8.865
5.910
2.955
0.000
Area (acres)
66.100
49.575
33.050
16.525
0.000
Volume (ac-ft)
0.00
3.00
6.00
9.00
12.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill / Rolling Meadows MDDP**

Basin ID: **Pond B**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.89	5.929	Orifice Plate
Zone 2 (EURV)	5.97	5.647	Weir&Pipe (Restrict)
Z3 (100+1/2WQCV)	8.62	23.514	Weir (No Pipe)
Total (all zones)		35.090	

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 =	9.681E-02	ft^2
Depth at top of Zone using Orifice Plate =	4.89	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	19.60	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	13.94	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	1.63	3.26					
Orifice Area (sq. inches)	13.94	13.94	13.94					

	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 =	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 Orifi

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 =	5.00	6.00	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.00	N/A
Weir Front Edge Length OR Weir Bottom Length	25.00	50.00	feet	Overflow Weir Slope Length =	6.00	N/A
Weir Grate Slope OR Weir Side Slopes	0.00	4.00	H:V	Grate Open Area / 100-yr Orifice Area =	6.99	N/A
Horiz. Length of Weir Sides =	6.00	N/A	feet	Overflow Grate Open Area w/o Debris =	104.40	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	52.20	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow We

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

	Zone 2 Restrictor	Not Selected			Zone 2 Restrictor	Not Selected
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	14.94	N/A
Outlet Pipe Diameter =	54.00	N/A	inches	Outlet Orifice Centroid =	2.12	N/A
Restrictor Plate Height Above Pipe Invert =	48.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.46	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	2.67	feet
Spillway Crest Length =	50.00	feet	Stage at Top of Freeboard =	9.67	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	11.32	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	46.88	acre-ft
	Overlapping				

Calculated Parameters for Spillway

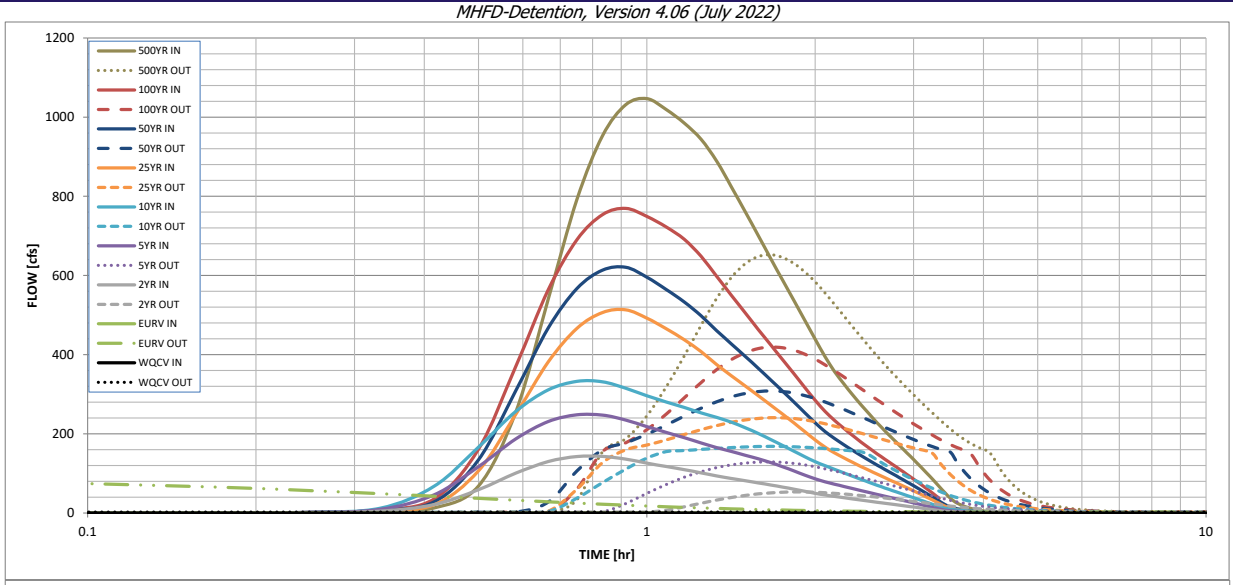
Routed Hydrograph Results

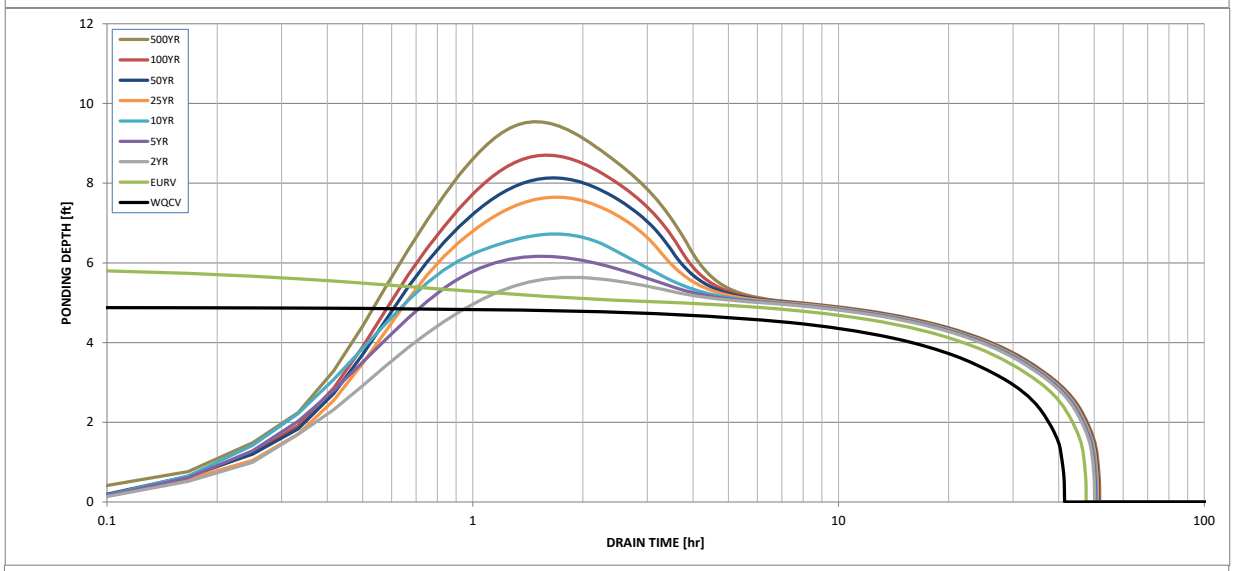
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

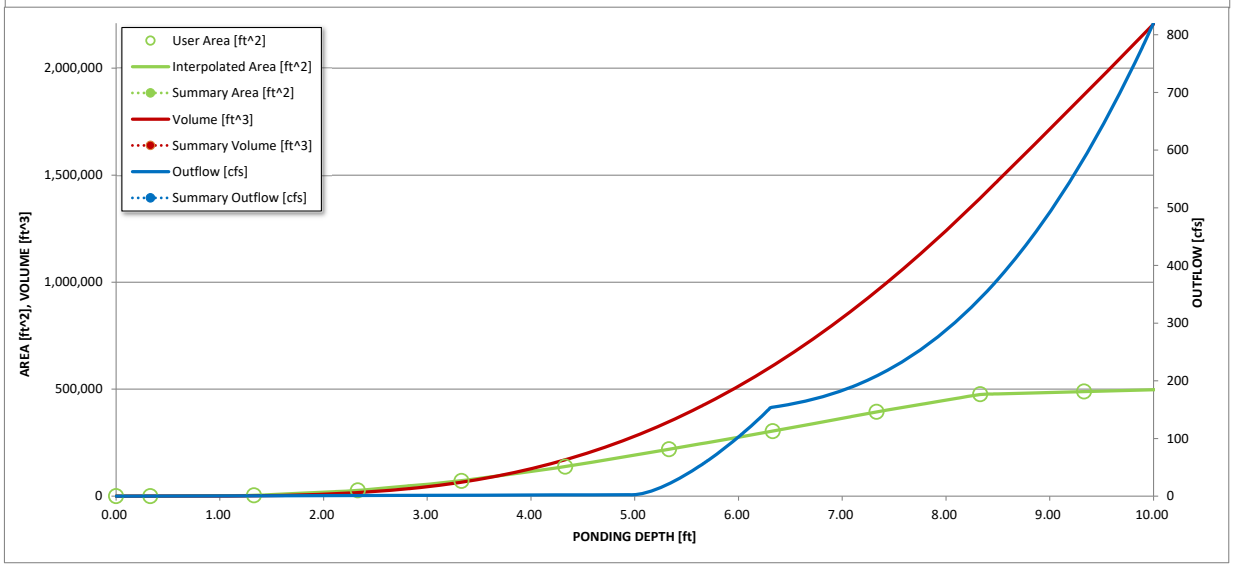
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	5.929	11.576	15.434	27.199	38.770	55.169	67.649	84.742
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	15.434	27.199	38.770	55.169	67.649	84.742
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	68.7	164.5	245.2	420.7	523.2	668.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.11	0.27	0.40	0.68	0.85	1.09
Peak Inflow Q (cfs) =	N/A	N/A	143.0	248.0	332.4	513.2	620.7	769.4
Peak Outflow Q (cfs) =	2.5	90.2	53.2	129.1	168.3	240.7	308.3	419.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	0.7	0.6	0.6	0.6
Structure Controlling Flow =	Plate	Overflow Weir 1	Overflow Weir 1	Spillway	Spillway	Spillway	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.91	0.48	1.2	1.5	1.6	1.7	1.8
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) =	38	42	43	40	37	34	31	28
Time to Drain 99% of Inflow Volume (hours) =	**40**	45	47	46	45	44	43	41
Maximum Ponding Depth (ft) =	4.89	5.97	5.63	6.17	6.72	7.65	8.13	8.70
Area at Maximum Ponding Depth (acres) =	4.20	6.27	5.61	6.64	7.78	9.62	10.55	11.03
Maximum Volume Stored (acre-ft) =	5.965	11.610	9.591	12.837	16.870	24.893	29.835	36.044

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	0.31
	0:15:00	0.00	0.00	0.82	1.35	1.68	1.13	1.57	1.40	2.52
	0:20:00	0.00	0.00	4.61	9.03	12.10	4.80	6.79	7.73	12.98
	0:25:00	0.00	0.00	21.50	46.20	67.74	21.13	28.04	35.53	68.24
	0:30:00	0.00	0.00	58.86	117.18	166.55	106.49	134.40	161.26	256.33
	0:35:00	0.00	0.00	100.82	187.35	257.16	249.96	309.72	371.28	540.72
	0:40:00	0.00	0.00	129.87	231.08	311.28	381.69	467.36	564.14	792.04
	0:45:00	0.00	0.00	142.60	247.99	332.37	466.33	566.94	690.40	952.82
	0:50:00	0.00	0.00	143.01	247.27	331.48	506.51	613.44	753.65	1031.14
	0:55:00	0.00	0.00	136.03	234.83	315.05	513.25	620.72	769.36	1046.72
	1:00:00	0.00	0.00	126.07	218.33	296.12	492.38	595.64	749.14	1018.99
	1:05:00	0.00	0.00	117.38	203.64	280.57	465.48	564.67	722.49	984.70
	1:10:00	0.00	0.00	109.53	190.23	266.48	437.82	533.07	691.25	944.14
	1:15:00	0.00	0.00	101.42	177.06	253.04	407.54	498.39	648.52	888.94
	1:20:00	0.00	0.00	93.78	165.34	241.46	375.13	460.65	597.89	823.93
	1:25:00	0.00	0.00	87.32	155.39	229.38	346.73	427.06	550.03	760.81
	1:30:00	0.00	0.00	81.54	146.03	215.54	320.91	395.69	505.39	700.19
	1:35:00	0.00	0.00	76.05	136.79	200.66	296.17	365.25	463.14	641.98
	1:40:00	0.00	0.00	70.73	127.16	185.56	272.42	335.89	424.18	587.83
	1:45:00	0.00	0.00	65.47	116.91	170.56	249.57	307.62	387.24	536.30
	1:50:00	0.00	0.00	60.24	106.29	156.04	227.26	280.15	351.58	486.77
	1:55:00	0.00	0.00	54.94	95.73	142.06	205.47	253.39	317.16	439.11
	2:00:00	0.00	0.00	49.76	86.24	129.51	184.60	227.87	284.69	394.95
	2:05:00	0.00	0.00	45.42	78.89	119.41	166.35	205.78	256.55	357.36
	2:10:00	0.00	0.00	41.94	72.86	110.32	151.94	188.21	233.93	326.42
	2:15:00	0.00	0.00	38.68	67.17	101.50	139.31	172.60	214.04	298.73
	2:20:00	0.00	0.00	35.60	61.72	93.01	127.84	158.30	195.87	273.22
	2:25:00	0.00	0.00	32.64	56.53	84.94	117.22	145.02	179.14	249.62
	2:30:00	0.00	0.00	29.82	51.62	77.27	107.33	132.63	163.58	227.63
	2:35:00	0.00	0.00	27.14	46.93	70.03	97.97	120.94	149.11	207.19
	2:40:00	0.00	0.00	24.59	42.40	63.15	89.08	109.87	135.65	188.19
	2:45:00	0.00	0.00	22.15	38.01	56.62	80.54	99.25	122.83	170.09
	2:50:00	0.00	0.00	19.76	33.77	50.41	72.20	88.94	110.27	152.47
	2:55:00	0.00	0.00	17.41	29.64	44.45	64.04	78.88	97.90	135.17
	3:00:00	0.00	0.00	15.10	25.58	38.60	55.98	68.94	85.60	117.98
	3:05:00	0.00	0.00	12.81	21.59	32.82	47.98	59.08	73.36	100.87
	3:10:00	0.00	0.00	10.56	17.67	27.11	40.03	49.29	61.17	83.87
	3:15:00	0.00	0.00	8.35	13.83	21.51	32.17	39.60	49.09	67.02
	3:20:00	0.00	0.00	6.23	10.16	16.20	24.42	30.09	37.22	50.55
	3:25:00	0.00	0.00	4.38	7.20	12.12	17.09	21.14	26.10	35.75
	3:30:00	0.00	0.00	3.15	5.41	9.63	11.76	14.84	18.20	25.59
	3:35:00	0.00	0.00	2.51	4.36	7.92	8.50	10.93	13.12	18.84
	3:40:00	0.00	0.00	2.07	3.57	6.54	6.34	8.26	9.54	13.93
	3:45:00	0.00	0.00	1.74	2.92	5.37	4.77	6.27	6.88	10.20
	3:50:00	0.00	0.00	1.44	2.38	4.36	3.64	4.80	4.91	7.37
	3:55:00	0.00	0.00	1.18	1.93	3.47	2.79	3.67	3.43	5.22
	4:00:00	0.00	0.00	0.96	1.53	2.71	2.12	2.78	2.39	3.69
	4:05:00	0.00	0.00	0.78	1.19	2.07	1.64	2.13	1.81	2.79
	4:10:00	0.00	0.00	0.64	0.91	1.57	1.29	1.65	1.43	2.16
	4:15:00	0.00	0.00	0.51	0.69	1.20	1.00	1.28	1.14	1.71
	4:20:00	0.00	0.00	0.39	0.50	0.91	0.77	0.99	0.89	1.34
	4:25:00	0.00	0.00	0.29	0.35	0.68	0.58	0.75	0.68	1.02
	4:30:00	0.00	0.00	0.20	0.24	0.48	0.43	0.55	0.49	0.74
	4:35:00	0.00	0.00	0.13	0.15	0.32	0.30	0.38	0.34	0.50
	4:40:00	0.00	0.00	0.08	0.10	0.19	0.19	0.24	0.21	0.31
	4:45:00	0.00	0.00	0.04	0.05	0.09	0.10	0.13	0.11	0.16
	4:50:00	0.00	0.00	0.02	0.02	0.03	0.04	0.05	0.05	0.06
	4:55:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

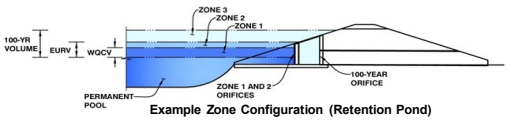
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill / Rolling Meadows MDDP**

Basin ID: **Pond C**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**			
Watershed Area =	158.00	acres		
Watershed Length =	3,000	ft		
Watershed Length to Centroid =	1,350	ft		
Watershed Slope =	0.030	ft/ft		
Watershed Imperviousness =	58.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	76.0%	percent		
Percentage Hydrologic Soil Groups C/D =	24.0%	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) =	3.024	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	9.640	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	9.368	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	13.003	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	16.180	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	20.078	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	23.422	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	27.525	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	36.082	acre-feet		inches
Approximate 2-yr Detention Volume =	7.646	acre-feet		
Approximate 5-yr Detention Volume =	10.525	acre-feet		
Approximate 10-yr Detention Volume =	13.213	acre-feet		
Approximate 25-yr Detention Volume =	14.283	acre-feet		
Approximate 50-yr Detention Volume =	14.861	acre-feet		
Approximate 100-yr Detention Volume =	16.346	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	3.024	acre-feet
Zone 2 Volume (EURV - Zone 1) =	6.616	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	8.218	acre-feet
Total Detention Basin Volume =	17.858	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

micropool=5775.00

Depth Increment = ft

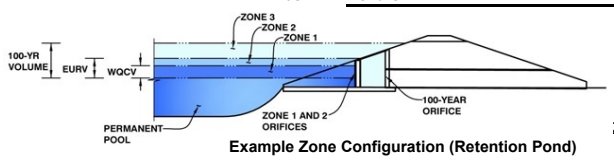
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	30	0.001		
5775.33	--	0.33	--	--	--	30	0.001	10	0.000
5776	--	1.00	--	--	--	742	0.017	269	0.006
5777	--	2.00	--	--	--	20,643	0.474	10,961	0.252
5778	--	3.00	--	--	--	70,920	1.628	56,742	1.303
5779	--	4.00	--	--	--	130,484	2.996	157,444	3.614
5780	--	5.00	--	--	--	180,723	4.149	313,047	7.187
5781	--	6.00	--	--	--	214,459	4.923	510,638	11.723
5782	--	7.00	--	--	--	232,690	5.342	734,213	16.855
5783	--	8.00	--	--	--	246,647	5.662	973,881	22.357
5784	--	9.00	--	--	--	257,597	5.914	1,226,003	28.145
5785	--	10.00	--	--	--	268,413	6.162	1,489,008	34.183

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill / Rolling Meadows MDDP**

Basin ID: **Pond C**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.80	3.024	Orifice Plate
Zone 2 (EURV)	5.57	6.616	Rectangular Orifice
Z3 (100+1/2WQCV)	7.19	8.218	Weir&Pipe (Restrict)
Total (all zones)		17.858	

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 =	5.500E-02	ft^2
Depth at top of Zone using Orifice Plate =	3.80	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	15.20	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	7.92	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	1.27	2.53					
Orifice Area (sq. inches)	7.92	7.92	7.92					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected				
Invert of Vertical Orifice =	3.80	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	3.47	N/A
Depth at top of Zone using Vertical Orifice =	5.57	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.50	N/A
Vertical Orifice Height =	12.00	N/A	inches			
Vertical Orifice Width =	41.69		inches			

Calculated Parameters for Vertical Orifi

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

	Zone 3 Weir	Not Selected				
Overflow Weir Front Edge Height, Ho =	6.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.00	N/A
Overflow Weir Front Edge Length =	25.00	N/A	feet	Overflow Weir Slope Length =	6.00	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	5.32	N/A
Horiz. Length of Weir Sides =	6.00	N/A	feet	Overflow Grate Open Area w/o Debris =	104.40	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	52.20	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow We

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

	Zone 3 Restrictor	Not Selected				
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	19.63	N/A
Outlet Pipe Diameter =	60.00	N/A	inches	Outlet Orifice Centroid =	2.50	N/A
Restrictor Plate Height Above Pipe Invert =	60.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	1.80	feet
Spillway Crest Length =	70.00	feet	Stage at Top of Freeboard =	9.80	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	6.11	acres
Freeboard above Max Water Surface =	0.50	feet	Basin Volume at Top of Freeboard =	32.96	acre-ft

micropool=5775.00

Calculated Parameters for Spillway

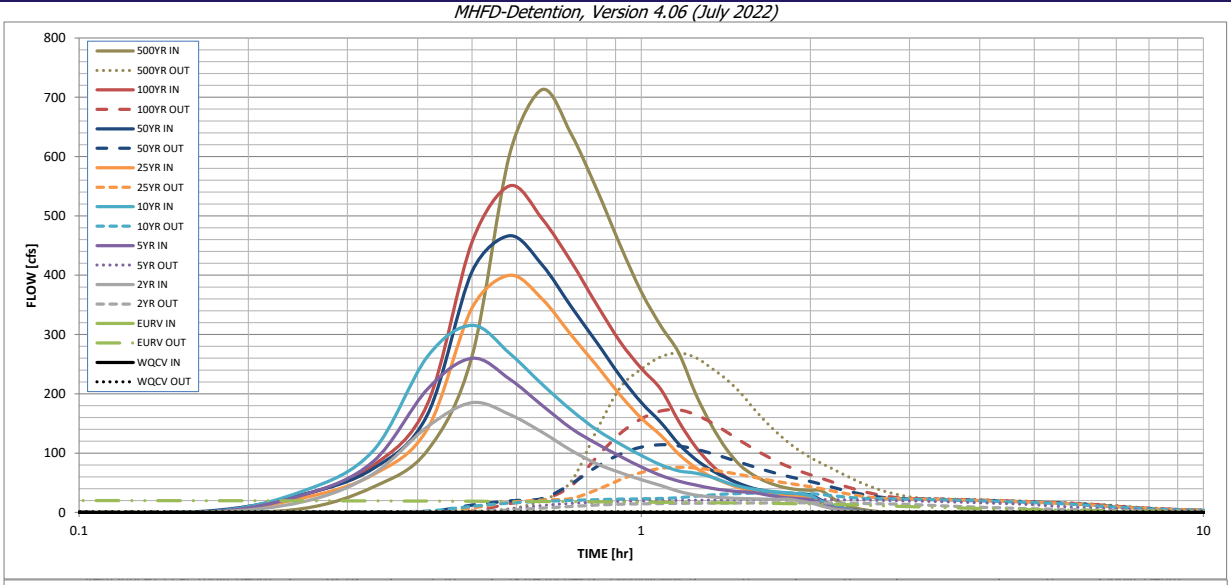
Routed Hydrograph Results

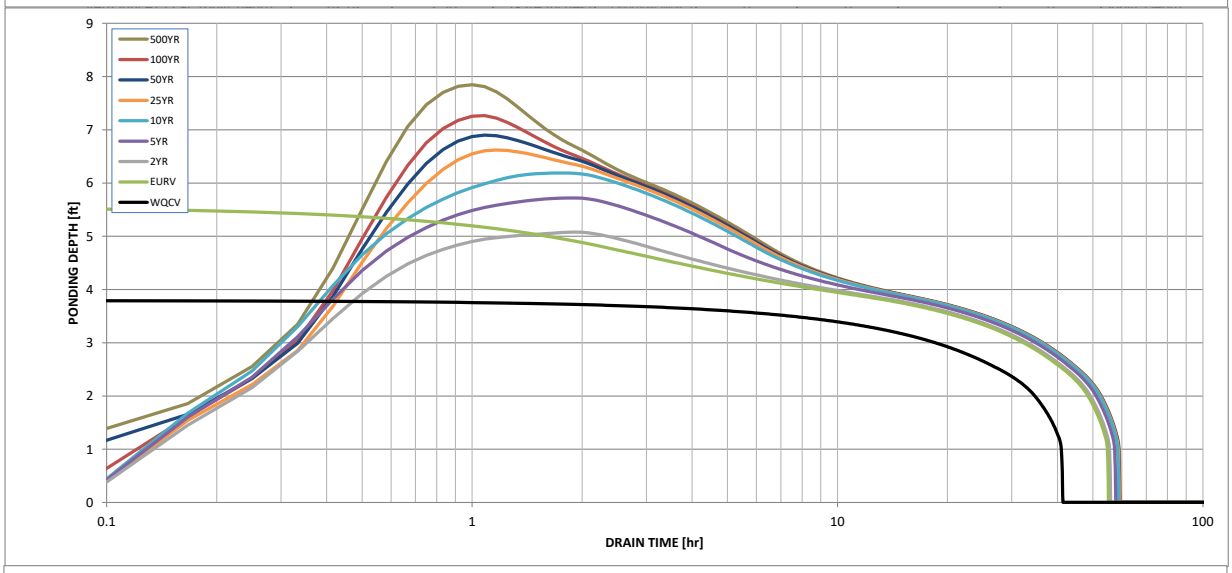
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

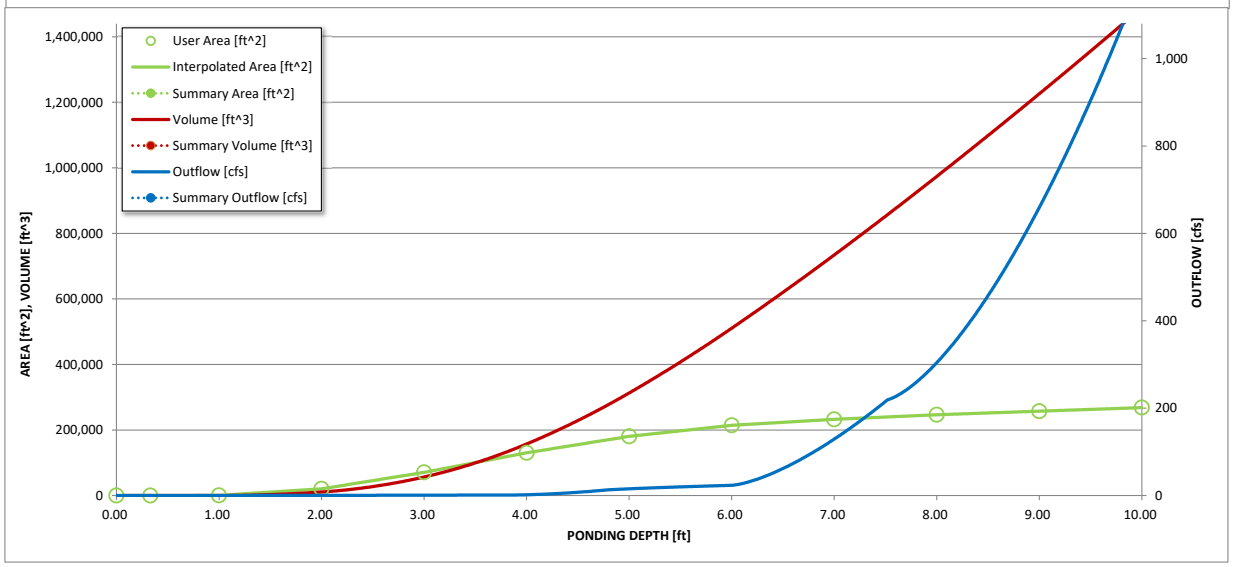
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	3.024	9.640	9.368	13.003	16.180	20.078	23.422	27.525
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	9.368	13.003	16.180	20.078	23.422	27.525
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	26.3	63.9	96.0	162.3	202.0	255.5
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.17	0.40	0.61	1.03	1.28	1.62
Peak Inflow Q (cfs) =	N/A	N/A	185.1	259.9	315.5	399.8	466.6	550.7
Peak Outflow Q (cfs) =	1.2	20.3	16.3	21.6	32.8	76.1	114.1	172.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.3	0.5	0.6	0.7
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.5	0.8	1.4
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) =	38	48	49	48	48	46	44	43
Time to Drain 99% of Inflow Volume (hours) =	**40**	52	53	54	54	54	53	52
Maximum Ponding Depth (ft) =	3.80	5.57	5.08	5.72	6.19	6.62	6.90	7.26
Area at Maximum Ponding Depth (acres) =	2.72	4.59	4.20	4.70	5.00	5.18	5.30	5.43
Maximum Volume Stored (acre-ft) =	3.043	9.677	7.479	10.327	12.616	14.856	16.270	18.255

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	2.02	0.20	6.49
	0:15:00	0.00	0.00	17.82	29.11	36.04	24.20	30.33	29.51	42.78
	0:20:00	0.00	0.00	64.68	85.46	103.71	63.42	73.72	78.99	104.66
	0:25:00	0.00	0.00	144.75	207.98	263.19	141.01	165.07	183.14	263.30
	0:30:00	0.00	0.00	185.09	259.95	315.47	344.81	405.94	455.97	603.88
	0:35:00	0.00	0.00	165.07	224.81	268.10	399.81	466.58	550.67	712.93
	0:40:00	0.00	0.00	135.07	180.27	215.90	359.54	417.18	494.76	638.45
	0:45:00	0.00	0.00	104.68	141.98	172.67	299.43	347.18	423.01	544.41
	0:50:00	0.00	0.00	81.95	115.72	139.22	247.34	286.50	350.20	451.12
	0:55:00	0.00	0.00	67.13	94.72	115.42	198.12	230.09	288.00	372.02
	1:00:00	0.00	0.00	55.14	76.76	96.18	158.97	185.27	242.91	314.23
	1:05:00	0.00	0.00	45.38	62.29	80.05	129.89	151.75	207.57	268.50
	1:10:00	0.00	0.00	35.39	52.62	69.94	97.95	115.04	152.99	199.59
	1:15:00	0.00	0.00	29.18	46.10	66.25	75.38	89.44	110.49	146.80
	1:20:00	0.00	0.00	26.20	40.78	59.68	59.83	71.02	80.27	107.23
	1:25:00	0.00	0.00	24.49	37.17	50.52	49.42	58.42	59.36	79.32
	1:30:00	0.00	0.00	23.58	34.89	43.78	41.00	48.09	47.06	62.86
	1:35:00	0.00	0.00	22.95	33.45	39.36	34.95	40.62	38.99	52.00
	1:40:00	0.00	0.00	22.49	29.75	36.41	31.34	36.13	33.75	44.97
	1:45:00	0.00	0.00	22.20	26.43	34.45	28.88	33.07	30.40	40.45
	1:50:00	0.00	0.00	22.10	24.32	33.05	27.46	31.28	28.79	38.21
	1:55:00	0.00	0.00	19.13	22.91	31.04	26.67	30.26	28.22	37.35
	2:00:00	0.00	0.00	16.27	21.36	27.81	26.23	29.71	28.03	37.08
	2:05:00	0.00	0.00	11.49	15.21	19.65	18.97	21.46	20.38	26.93
	2:10:00	0.00	0.00	7.35	9.69	12.66	12.17	13.75	13.10	17.30
	2:15:00	0.00	0.00	4.74	6.18	8.17	7.93	8.96	8.53	11.25
	2:20:00	0.00	0.00	2.89	3.79	5.04	4.92	5.55	5.28	6.95
	2:25:00	0.00	0.00	1.67	2.33	3.03	3.04	3.43	3.26	4.29
	2:30:00	0.00	0.00	0.85	1.30	1.63	1.71	1.93	1.83	2.40
	2:35:00	0.00	0.00	0.35	0.57	0.68	0.77	0.86	0.81	1.06
	2:40:00	0.00	0.00	0.09	0.14	0.16	0.19	0.21	0.20	0.26
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

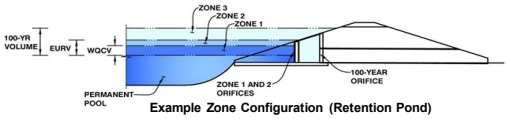
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill/Rolling Meadows MDDP**

Basin ID: **Pond C1 - school**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	12.00	acres
Watershed Length =	800	ft
Watershed Length to Centroid =	375	ft
Watershed Slope =	0.025	ft/ft
Watershed Imperviousness =	80.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	70.0%	percent
Percentage Hydrologic Soil Groups C/D =	30.0%	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) =	0.328	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.029	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.910	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.203	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.448	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.712	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.963	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.247	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	2.874	acre-feet		inches
Approximate 2-yr Detention Volume =	0.847	acre-feet		
Approximate 5-yr Detention Volume =	1.128	acre-feet		
Approximate 10-yr Detention Volume =	1.369	acre-feet		
Approximate 25-yr Detention Volume =	1.462	acre-feet		
Approximate 50-yr Detention Volume =	1.512	acre-feet		
Approximate 100-yr Detention Volume =	1.595	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.328	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.701	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	0.730	acre-feet
Total Detention Basin Volume =	1.759	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

micropool=5790.00

Depth Increment = ft

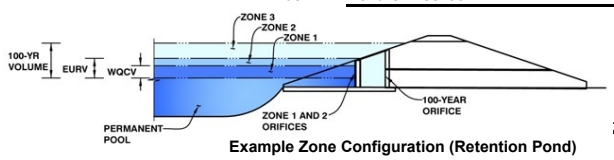
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	30	0.001		
5790.33	--	0.30	--	--	--	30	0.001	9	0.000
5791	--	1.00	--	--	--	100	0.002	54	0.001
5792	--	2.00	--	--	--	7,997	0.184	4,103	0.094
5793	--	3.00	--	--	--	9,873	0.227	13,038	0.299
5794	--	4.00	--	--	--	11,932	0.274	23,940	0.550
5795	--	5.00	--	--	--	14,176	0.325	36,994	0.849
5796	--	6.00	--	--	--	16,604	0.381	52,384	1.203
5797	--	7.00	--	--	--	19,216	0.441	70,294	1.614
5798	--	8.00	--	--	--	22,013	0.505	90,909	2.087
5799	--	9.00	--	--	--	25,000	0.574	114,415	2.627

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill/Rolling Meadows MDDP**

Basin ID: **Pond C1 - school**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.13	0.328	Orifice Plate
Zone 2 (EURV)	5.53	0.701	Rectangular Orifice
Z3 (100+1/2WQCV)	7.33	0.730	Weir&Pipe (Restrict)
Total (all zones)		1.759	

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 =	7.153E-03	ft^2
Depth at top of Zone using Orifice Plate =	3.13	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	11.20	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.03	sq. inches (diameter = 1-1/8 inches)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	1.04	2.09					
Orifice Area (sq. inches)	1.03	1.03	1.03					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected				
Invert of Vertical Orifice =	3.13	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.11	N/A
Depth at top of Zone using Vertical Orifice =	5.53	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.17	N/A
Vertical Orifice Height =	4.00	N/A	inches			
Vertical Orifice Width =	3.83		inches			

Calculated Parameters for Vertical Orifi

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

	Zone 3 Weir	Not Selected				
Overflow Weir Front Edge Height, Ho =	5.60	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.60	N/A
Overflow Weir Front Edge Length =	4.00	N/A	feet	Overflow Weir Slope Length =	4.00	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	7.25	N/A
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	11.14	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	5.57	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow We

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

	Zone 3 Restrictor	Not Selected				
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.54	N/A
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.66	N/A
Restrictor Plate Height Above Pipe Invert =	14.60		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.24	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.89	feet
Spillway Crest Length =	16.00	feet	Stage at Top of Freeboard =	8.89	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.57	acres
Freeboard above Max Water Surface =	0.50	feet	Basin Volume at Top of Freeboard =	2.56	acre-ft

micropool=5775.00

Calculated Parameters for Spillway

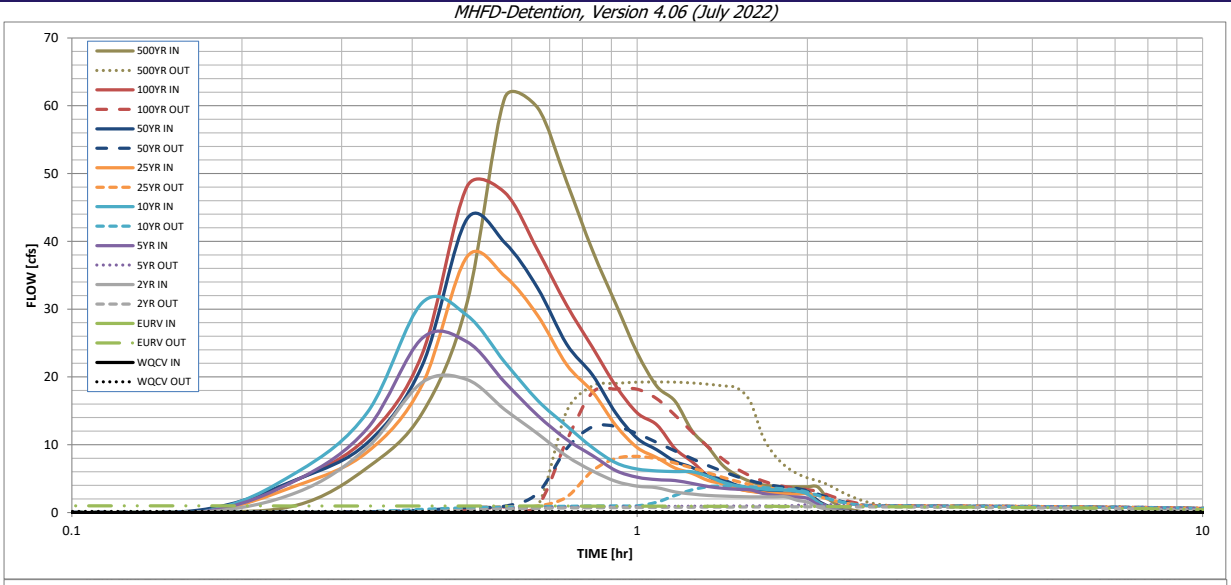
Routed Hydrograph Results

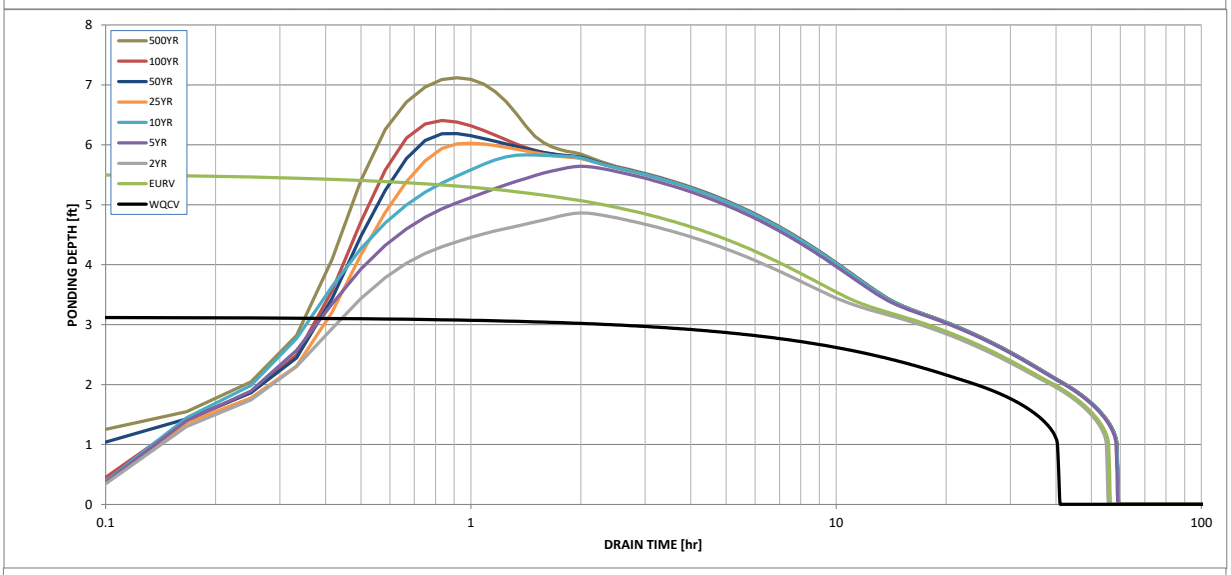
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

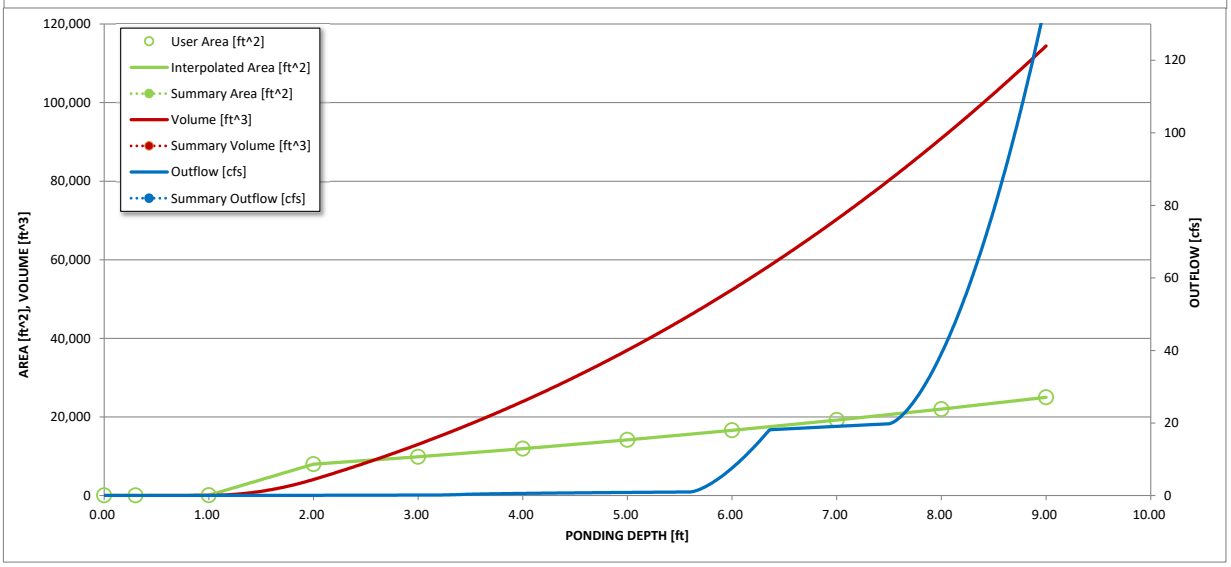
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.328	1.029	0.910	1.203	1.448	1.712	1.963	2.247
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.910	1.203	1.448	1.712	1.963	2.247
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	2.2	5.3	7.7	13.0	16.2	20.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.18	0.44	0.64	1.09	1.35	1.68
Peak Inflow Q (cfs) =	N/A	N/A	19.6	25.7	31.0	37.7	43.3	48.1
Peak Outflow Q (cfs) =	0.1	1.0	0.8	1.2	3.9	8.3	12.7	18.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.5	0.6	0.8	0.9
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.3	0.7	1.0	1.5
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) =	38	50	50	51	50	49	48	47
Time to Drain 99% of Inflow Volume (hours) =	**40**	54	53	56	56	55	55	54
Maximum Ponding Depth (ft) =	3.13	5.53	4.86	5.64	5.83	6.03	6.19	6.41
Area at Maximum Ponding Depth (acres) =	0.23	0.35	0.32	0.36	0.37	0.38	0.39	0.41
Maximum Volume Stored (acre-ft) =	0.329	1.030	0.804	1.069	1.139	1.210	1.272	1.360

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	0.33	0.03	1.06
	0:15:00	0.00	0.00	2.96	4.81	5.95	3.99	4.87	4.84	6.62
	0:20:00	0.00	0.00	9.59	12.41	14.77	8.94	10.29	11.16	14.67
	0:25:00	0.00	0.00	19.21	25.71	30.96	18.88	21.70	23.40	30.95
	0:30:00	0.00	0.00	19.59	25.17	29.06	37.74	43.32	48.10	61.19
	0:35:00	0.00	0.00	15.16	19.19	22.15	34.84	39.79	47.18	59.70
	0:40:00	0.00	0.00	11.64	14.33	16.55	29.06	33.11	38.68	48.83
	0:45:00	0.00	0.00	8.32	10.78	12.78	21.82	24.85	30.60	38.65
	0:50:00	0.00	0.00	6.14	8.39	9.58	17.81	20.29	24.35	30.75
	0:55:00	0.00	0.00	4.59	6.18	7.33	12.84	14.64	18.65	23.56
	1:00:00	0.00	0.00	3.90	5.20	6.41	9.58	10.94	14.69	18.61
	1:05:00	0.00	0.00	3.66	4.85	6.14	8.08	9.25	12.92	16.41
	1:10:00	0.00	0.00	3.04	4.71	6.03	6.56	7.54	9.42	12.05
	1:15:00	0.00	0.00	2.72	4.29	6.00	5.77	6.66	7.50	9.66
	1:20:00	0.00	0.00	2.52	3.84	5.35	4.74	5.45	5.40	6.95
	1:25:00	0.00	0.00	2.42	3.58	4.47	4.23	4.84	4.28	5.50
	1:30:00	0.00	0.00	2.35	3.43	3.94	3.52	4.03	3.55	4.57
	1:35:00	0.00	0.00	2.31	3.34	3.63	3.12	3.58	3.17	4.07
	1:40:00	0.00	0.00	2.31	2.82	3.45	2.91	3.32	3.03	3.89
	1:45:00	0.00	0.00	2.31	2.54	3.34	2.79	3.19	2.97	3.80
	1:50:00	0.00	0.00	2.31	2.37	3.30	2.74	3.13	2.96	3.80
	1:55:00	0.00	0.00	1.81	2.28	3.13	2.71	3.11	2.96	3.80
	2:00:00	0.00	0.00	1.53	2.09	2.73	2.71	3.10	2.96	3.80
	2:05:00	0.00	0.00	0.86	1.18	1.56	1.55	1.77	1.69	2.17
	2:10:00	0.00	0.00	0.48	0.66	0.87	0.88	1.01	0.96	1.23
	2:15:00	0.00	0.00	0.23	0.35	0.45	0.46	0.53	0.50	0.64
	2:20:00	0.00	0.00	0.10	0.17	0.21	0.24	0.27	0.26	0.33
	2:25:00	0.00	0.00	0.04	0.06	0.07	0.08	0.09	0.09	0.11
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

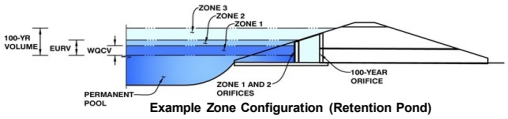
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill / Rolling Meadows MDDP**

Basin ID: **Pond D**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	97.30	acres
Watershed Length =	3,000	ft
Watershed Length to Centroid =	1,500	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	47.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	25.0%	percent
Percentage Hydrologic Soil Groups C/D =	75.0%	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) =	1.607	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	4.445	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	4.990	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	7.244	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	9.229	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	11.620	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	13.704	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	16.297	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	21.601	acre-feet		inches
Approximate 2-yr Detention Volume =	3.752	acre-feet		
Approximate 5-yr Detention Volume =	5.543	acre-feet		
Approximate 10-yr Detention Volume =	6.570	acre-feet		
Approximate 25-yr Detention Volume =	7.161	acre-feet		
Approximate 50-yr Detention Volume =	7.446	acre-feet		
Approximate 100-yr Detention Volume =	8.505	acre-feet		

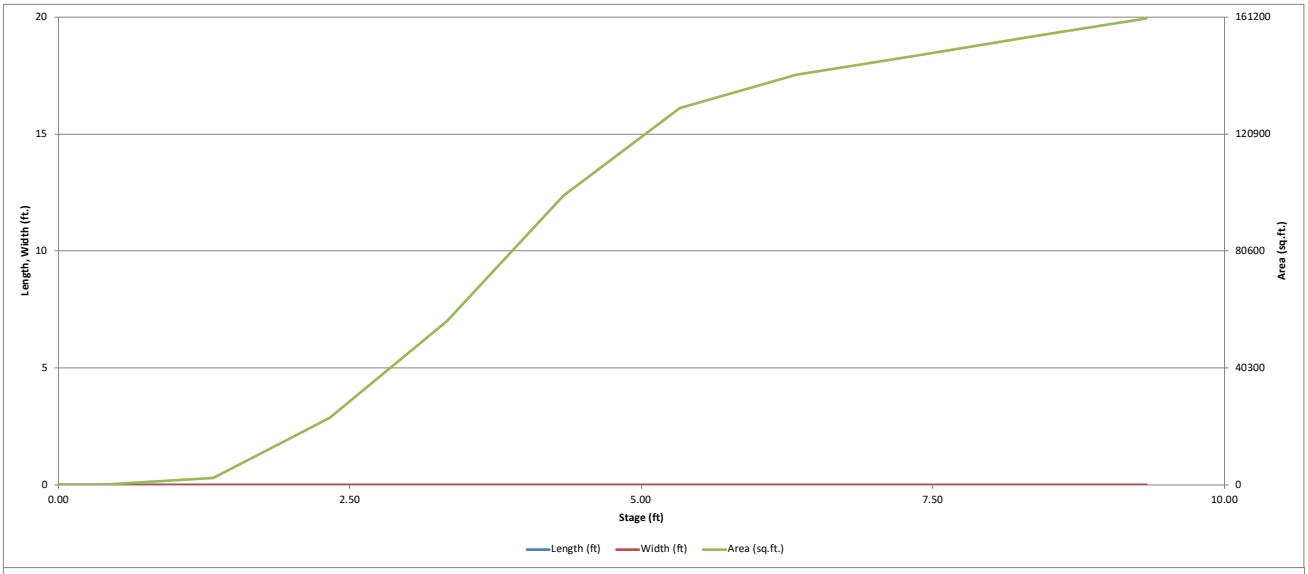
Define Zones and Basin Geometry

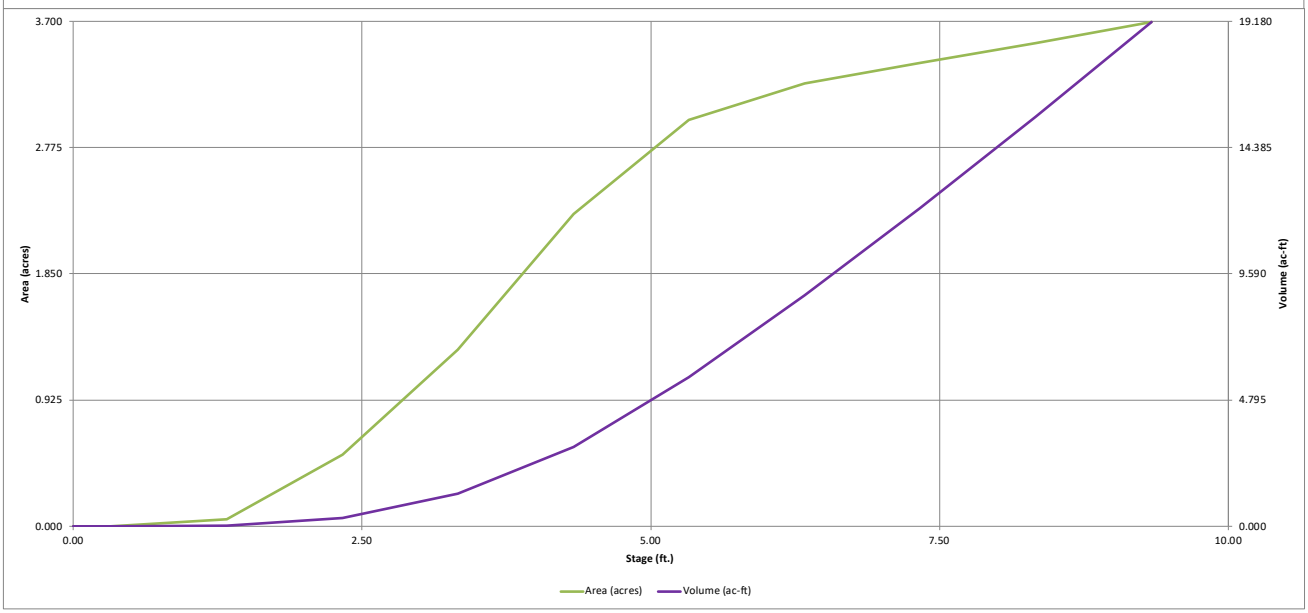
Zone 1 Volume (WQCV) =	1.607	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.838	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	4.863	acre-feet
Total Detention Basin Volume =	9.308	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention 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

micropool = 5807.67

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	--	--	--	30	0.001		
5808	--	0.33	--	--	--	30	0.001	10	0.000
5809	--	1.33	--	--	--	2,216	0.051	1,133	0.026
5810	--	2.33	--	--	--	22,911	0.526	13,696	0.314
5811	--	3.33	--	--	--	56,419	1.295	53,361	1.225
5812	--	4.33	--	--	--	99,617	2.287	131,379	3.016
5813	--	5.33	--	--	--	129,746	2.979	246,060	5.649
5814	--	6.33	--	--	--	141,383	3.246	381,625	8.761
5815	--	7.33	--	--	--	147,773	3.392	526,203	12.080
5816	--	8.33	--	--	--	154,296	3.542	677,237	15.547
5817	--	9.33	--	--	--	160,951	3.695	834,861	19.166


20
15
10
5
0
Length, Width (ft.)
161200
120900
80600
40300
0
Area (sq.ft.)
0.00
2.50
5.00
7.50
10.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

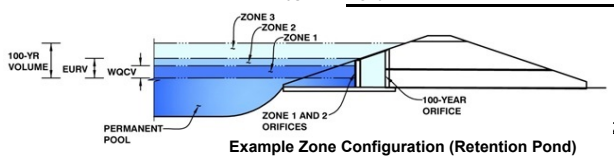

3.700
2.775
1.850
0.925
0.000
Area (acres)
19.180
14.385
9.590
4.795
0.000
Volume (ac-ft)
0.00
2.50
5.00
7.50
10.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill / Rolling Meadows MDDP**

Basin ID: **Pond D**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.60	1.607	Orifice Plate
Zone 2 (EURV)	4.91	2.838	Rectangular Orifice
Z3 (100+1/2WQCV)	6.50	4.863	Weir (No Pipe)
Total (all zones)		9.308	

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

			Calculated Parameters for Underdrain		
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

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)

			Calculated Parameters for Plate		
Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	3.000E-02	ft^2
Depth at top of Zone using Orifice Plate =	3.60	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	14.40	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	4.32	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.20	2.40					
Orifice Area (sq. inches)	4.32	4.32	4.32					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected		Calculated Parameters for Vertical Orifi	Zone 2 Rectangular	Not Selected
Invert of Vertical Orifice =	3.60	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	1.28	N/A
Depth at top of Zone using Vertical Orifice =	4.91	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.33	N/A
Vertical Orifice Height =	8.00	N/A	inches			
Vertical Orifice Width =	23.09		inches			

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		Calculated Parameters for Overflow We	Zone 3 Weir	Not Selected
Overflow Weir Front Edge Height, Ho =	5.00	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	N/A	N/A
Overflow Weir Bottom Length =	10.00	N/A	feet	Overflow Weir Slope Length =	N/A	N/A
Overflow Weir Side Slopes =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	N/A	N/A
Horiz. Length of Weir Sides =	N/A	N/A	feet	Overflow Grate Open Area w/o Debris =	N/A	N/A
Overflow Grate Type =	N/A	N/A		Overflow Grate Open Area w/ Debris =	N/A	N/A
Debris Clogging % =	N/A	N/A	%			

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

	Not Selected	Not Selected		Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla	Not Selected	Not Selected
Depth to Invert of Outlet Pipe =	N/A	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	N/A	N/A
Circular Orifice Diameter =	N/A	N/A	inches	Outlet Orifice Centroid =	N/A	N/A
				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=	6.80	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	1.55	feet
Spillway Crest Length =	40.00	feet	Stage at Top of Freeboard =	8.85	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	3.62	acres
Freeboard above Max Water Surface =	0.50	feet	Basin Volume at Top of Freeboard =	17.41	acre-ft
Spillway position relative to Overflow Weir =	Overlapping	micropool=5807.67			

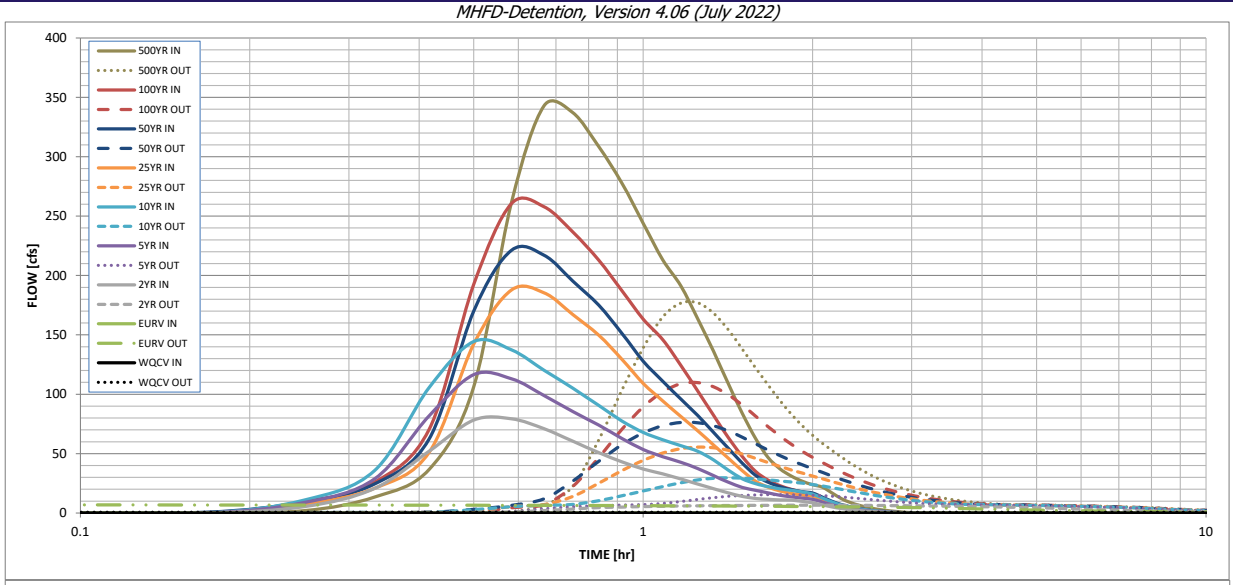
Routed Hydrograph Results

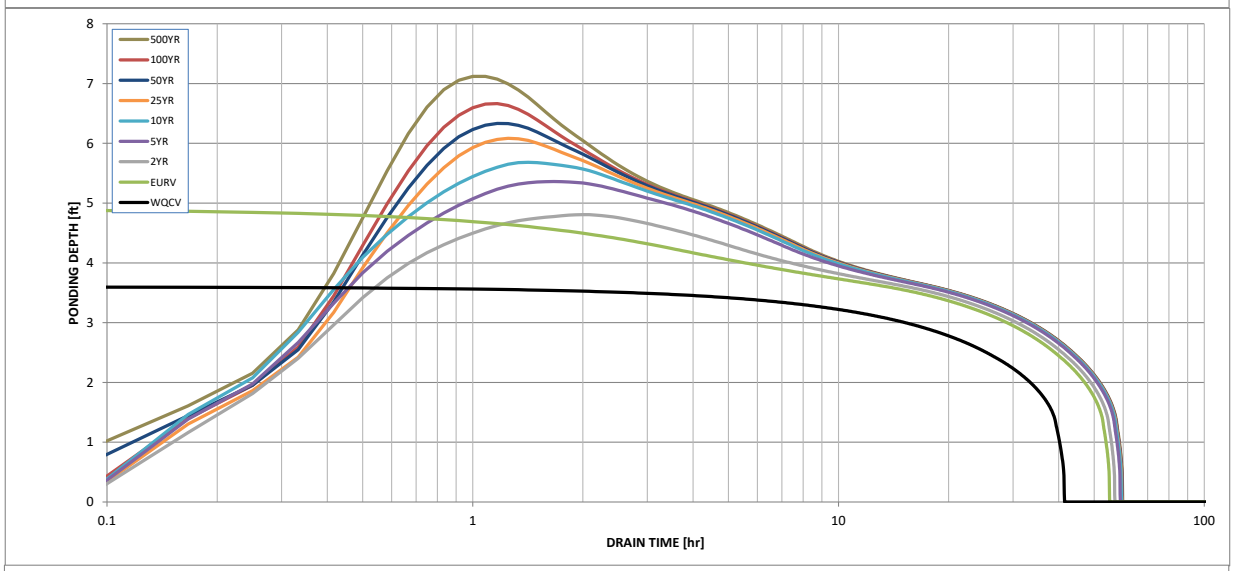
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

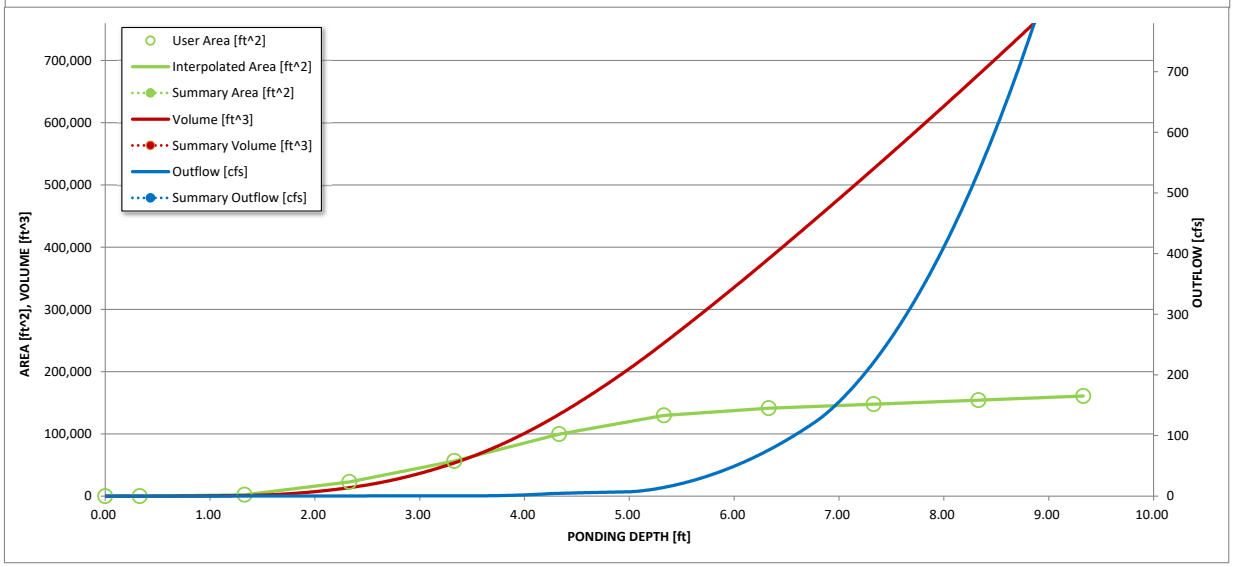
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	1.607	4.445	4.990	7.244	9.229	11.620	13.704	16.297
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	4.990	7.244	9.229	11.620	13.704	16.297
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	18.3	40.2	56.7	90.7	112.0	140.0
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.19	0.41	0.58	0.93	1.15	1.44
Peak Inflow Q (cfs) =	N/A	N/A	79.4	116.5	144.4	187.7	221.2	260.5
Peak Outflow Q (cfs) =	0.7	6.9	6.6	15.5	29.6	55.5	76.2	109.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.5	0.6	0.7	0.8
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1
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) =	38	48	50	49	48	45	44	42
Time to Drain 99% of Inflow Volume (hours) =	**40**	52	54	55	54	53	53	52
Maximum Ponding Depth (ft) =	3.60	4.91	4.81	5.36	5.68	6.08	6.33	6.66
Area at Maximum Ponding Depth (acres) =	1.56	2.69	2.61	2.98	3.07	3.18	3.25	3.29
Maximum Volume Stored (acre-ft) =	1.611	4.459	4.167	5.708	6.708	7.958	8.761	9.840

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	0.62	0.06	1.98
	0:15:00	0.00	0.00	5.40	8.83	10.95	7.36	9.37	9.00	13.48
	0:20:00	0.00	0.00	20.74	28.77	35.85	20.89	24.49	26.03	36.75
	0:25:00	0.00	0.00	52.12	81.94	105.76	51.12	62.45	70.58	106.24
	0:30:00	0.00	0.00	78.26	116.48	144.37	142.27	170.00	192.52	261.44
	0:35:00	0.00	0.00	79.36	113.06	137.36	187.72	221.20	260.54	342.95
	0:40:00	0.00	0.00	70.93	98.88	120.18	185.41	217.02	257.82	336.99
	0:45:00	0.00	0.00	60.43	85.33	105.06	167.03	195.23	236.55	308.61
	0:50:00	0.00	0.00	50.88	74.07	90.61	149.81	175.07	213.03	277.77
	0:55:00	0.00	0.00	43.14	62.80	77.49	129.38	151.31	187.20	243.96
	1:00:00	0.00	0.00	37.08	53.52	67.85	109.14	127.88	163.30	213.17
	1:05:00	0.00	0.00	32.94	47.43	61.69	94.41	110.98	146.00	191.17
	1:10:00	0.00	0.00	28.63	42.74	56.73	81.18	95.84	124.24	163.46
	1:15:00	0.00	0.00	24.37	37.40	51.95	69.27	82.15	102.83	136.13
	1:20:00	0.00	0.00	20.51	31.45	44.72	57.29	67.91	82.23	108.91
	1:25:00	0.00	0.00	16.99	26.00	36.13	46.19	54.59	63.60	83.98
	1:30:00	0.00	0.00	14.05	21.58	28.88	35.65	42.06	47.63	62.89
	1:35:00	0.00	0.00	12.27	19.18	24.73	26.84	31.80	35.09	46.81
	1:40:00	0.00	0.00	11.50	16.95	22.20	21.81	25.92	27.72	37.22
	1:45:00	0.00	0.00	11.09	14.98	20.38	18.62	22.16	23.08	31.10
	1:50:00	0.00	0.00	10.85	13.59	19.10	16.54	19.69	19.86	26.83
	1:55:00	0.00	0.00	9.77	12.55	17.80	15.08	17.95	17.60	23.83
	2:00:00	0.00	0.00	8.57	11.54	15.96	14.14	16.81	15.99	21.67
	2:05:00	0.00	0.00	6.79	9.18	12.53	11.26	13.37	12.41	16.82
	2:10:00	0.00	0.00	5.08	6.80	9.22	8.23	9.76	8.91	12.07
	2:15:00	0.00	0.00	3.82	5.05	6.76	6.08	7.18	6.58	8.88
	2:20:00	0.00	0.00	2.83	3.73	4.92	4.47	5.27	4.87	6.55
	2:25:00	0.00	0.00	2.08	2.69	3.58	3.25	3.84	3.58	4.82
	2:30:00	0.00	0.00	1.50	1.89	2.58	2.32	2.74	2.58	3.47
	2:35:00	0.00	0.00	1.06	1.32	1.84	1.68	1.98	1.86	2.50
	2:40:00	0.00	0.00	0.72	0.91	1.27	1.19	1.40	1.31	1.76
	2:45:00	0.00	0.00	0.45	0.60	0.81	0.78	0.92	0.86	1.15
	2:50:00	0.00	0.00	0.24	0.35	0.46	0.46	0.54	0.51	0.67
	2:55:00	0.00	0.00	0.10	0.17	0.21	0.23	0.26	0.24	0.32
	3:00:00	0.00	0.00	0.04	0.05	0.06	0.07	0.08	0.08	0.10
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

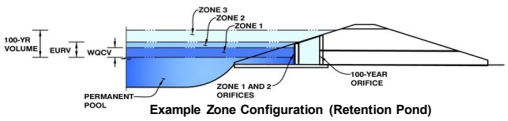
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill/Rolling Meadows MDDP**

Basin ID: **Pond E1**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	245.00	acres
Watershed Length =	7,100	ft
Watershed Length to Centroid =	3,500	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	36.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	27.0%	percent
Percentage Hydrologic Soil Groups C/D =	73.0%	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) =	3.451	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	8.413	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	10.070	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	15.503	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	20.419	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	26.600	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	31.775	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	38.448	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	51.728	acre-feet		inches
Approximate 2-yr Detention Volume =	6.953	acre-feet		
Approximate 5-yr Detention Volume =	10.781	acre-feet		
Approximate 10-yr Detention Volume =	13.035	acre-feet		
Approximate 25-yr Detention Volume =	14.528	acre-feet		
Approximate 50-yr Detention Volume =	15.185	acre-feet		
Approximate 100-yr Detention Volume =	17.983	acre-feet		

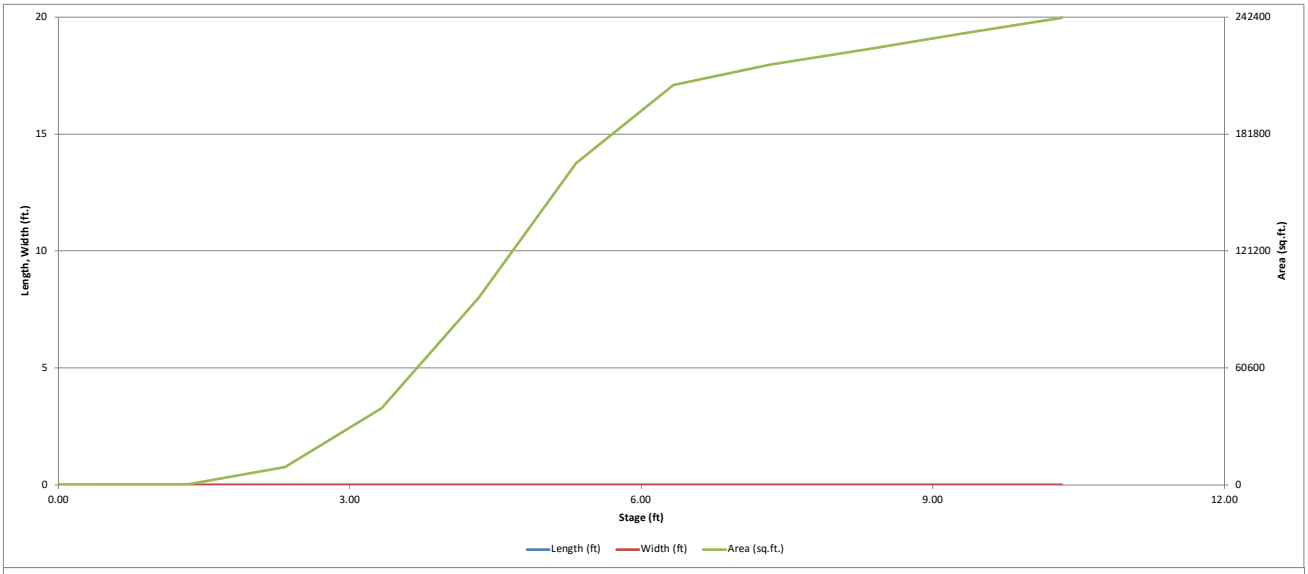
Define Zones and Basin Geometry

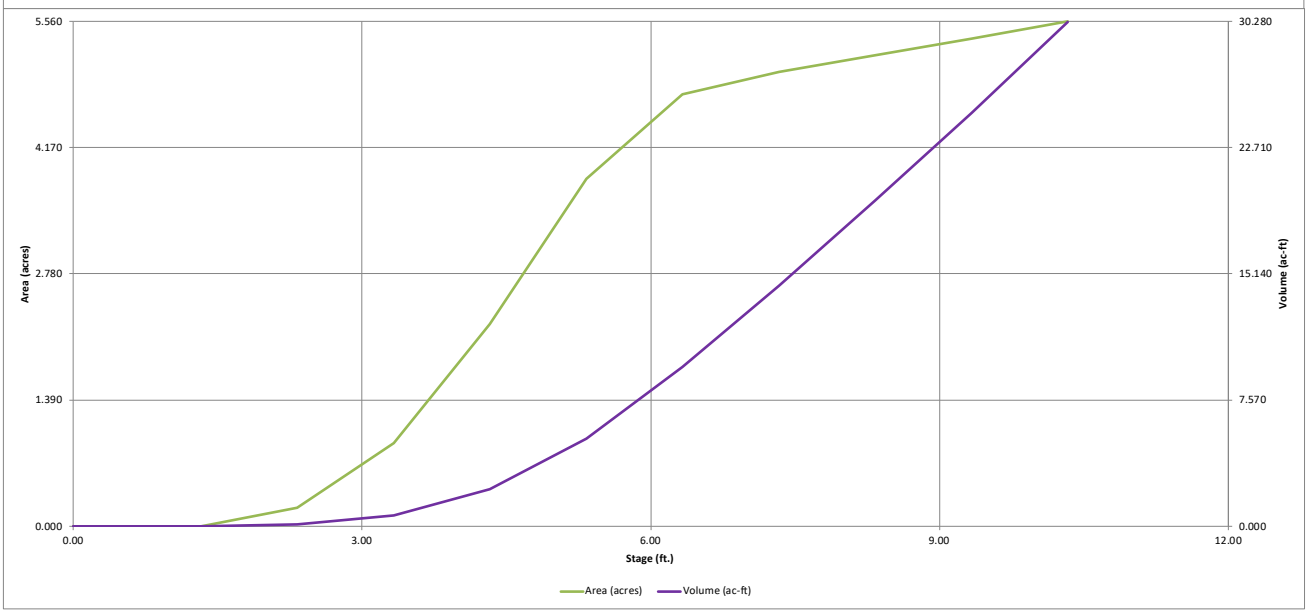
Zone 1 Volume (WQCV) =	3.451	acre-feet
Zone 2 Volume (EURV - Zone 1) =	4.962	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	11.295	acre-feet
Total Detention Basin Volume =	19.708	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention 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

micropool=5816.00

Depth Increment = 0.20 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	--	--	--	30	0.001		
5816.33	--	0.33	--	--	--	30	0.001	10	0.000
5817	--	1.33	--	--	--	50	0.001	50	0.001
5818	--	2.33	--	--	--	8,895	0.204	4,522	0.104
5819	--	3.33	--	--	--	39,730	0.912	28,835	0.662
5820	--	4.33	--	--	--	96,981	2.226	97,190	2.231
5821	--	5.33	--	--	--	166,736	3.828	229,048	5.258
5822	--	6.33	--	--	--	207,111	4.755	415,972	9.549
5823	--	7.33	--	--	--	217,901	5.002	628,478	14.428
5824	--	8.33	--	--	--	225,825	5.184	850,341	19.521
5825	--	9.33	--	--	--	233,970	5.371	1,080,238	24.799
5826	--	10.33	--	--	--	242,189	5.560	1,318,318	30.264


20
15
10
5
0
Length, Width (ft.)
242400
181800
121200
60600
0
Area (sq.ft.)
0.00
3.00
6.00
9.00
12.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

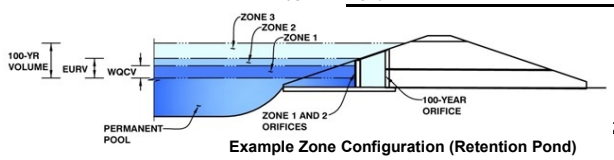

5.560
4.170
2.780
1.390
0.000
Area (acres)
30.280
22.710
15.140
7.570
0.000
Volume (ac-ft)
0.00
3.00
6.00
9.00
12.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill/Rolling Meadows MDDP**

Basin ID: **Pond E1**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.80	3.451	Orifice Plate
Zone 2 (EURV)	6.09	4.962	Rectangular Orifice
Z3 (100+1/2WQCV)	8.37	11.295	Weir&Pipe (Restrict)
Total (all zones)		19.708	

8

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 =	5.243E-02	ft^2
Depth at top of Zone using Orifice Plate =	4.80	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	19.20	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	7.55	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	1.60	3.20					
Orifice Area (sq. inches)	7.55	7.55	7.55					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected				
Invert of Vertical Orifice =	4.80	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	3.47	N/A
Depth at top of Zone using Vertical Orifice =	6.09	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.50	N/A
Vertical Orifice Height =	12.00	N/A	inches			
Vertical Orifice Width =	41.68		inches			

Calculated Parameters for Vertical Orifi

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

	Zone 3 Weir	Not Selected				
Overflow Weir Front Edge Height, Ho =	6.09	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.09	N/A
Overflow Weir Front Edge Length =	15.00	N/A	feet	Overflow Weir Slope Length =	6.00	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	4.98	N/A
Horiz. Length of Weir Sides =	6.00	N/A	feet	Overflow Grate Open Area w/o Debris =	62.64	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	31.32	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow We

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

	Zone 3 Restrictor	Not Selected				
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	12.57	N/A
Outlet Pipe Diameter =	48.00	N/A	inches	Outlet Orifice Centroid =	2.00	N/A
Restrictor Plate Height Above Pipe Invert =	48.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	2.29	feet
Spillway Crest Length =	30.00	feet	Stage at Top of Freeboard =	10.29	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	5.55	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	30.04	acre-ft

Calculated Parameters for Spillway

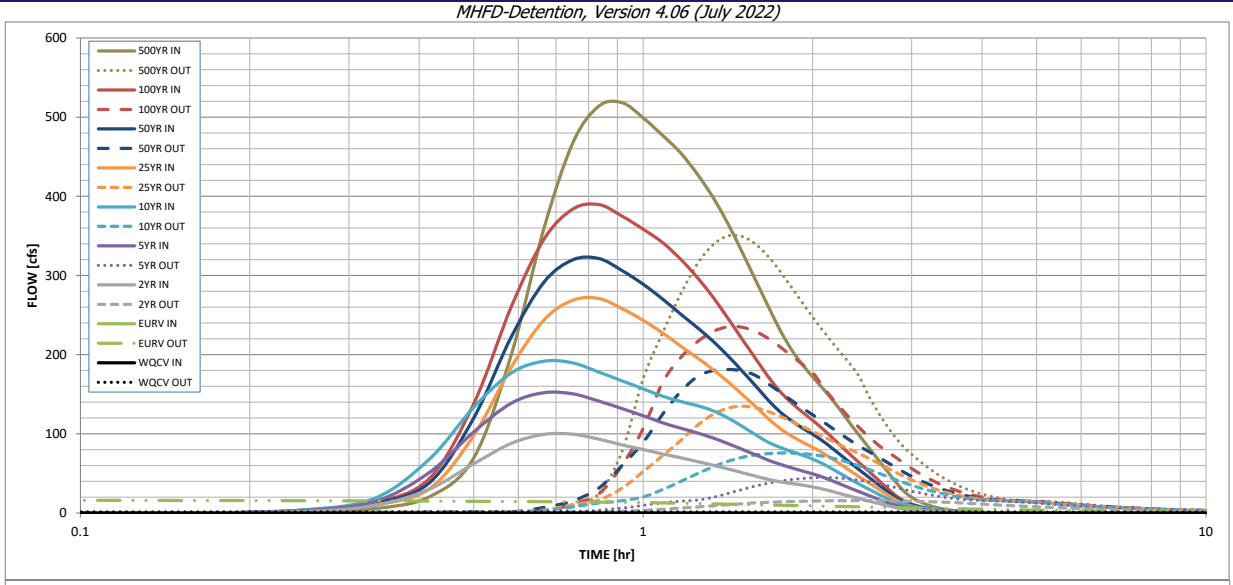
Routed Hydrograph Results

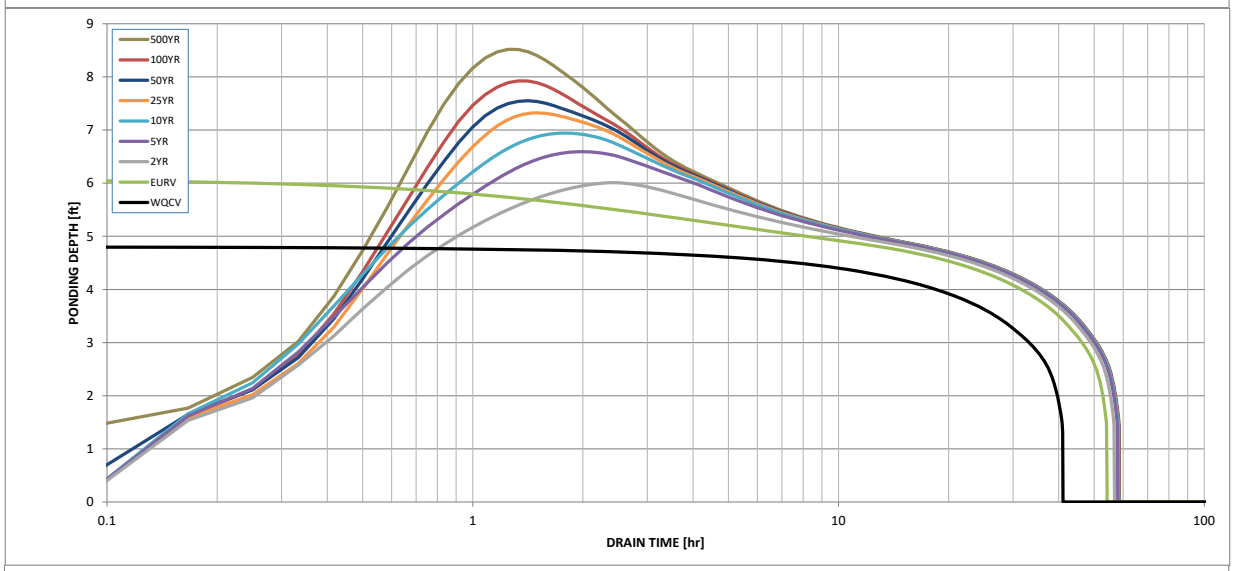
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

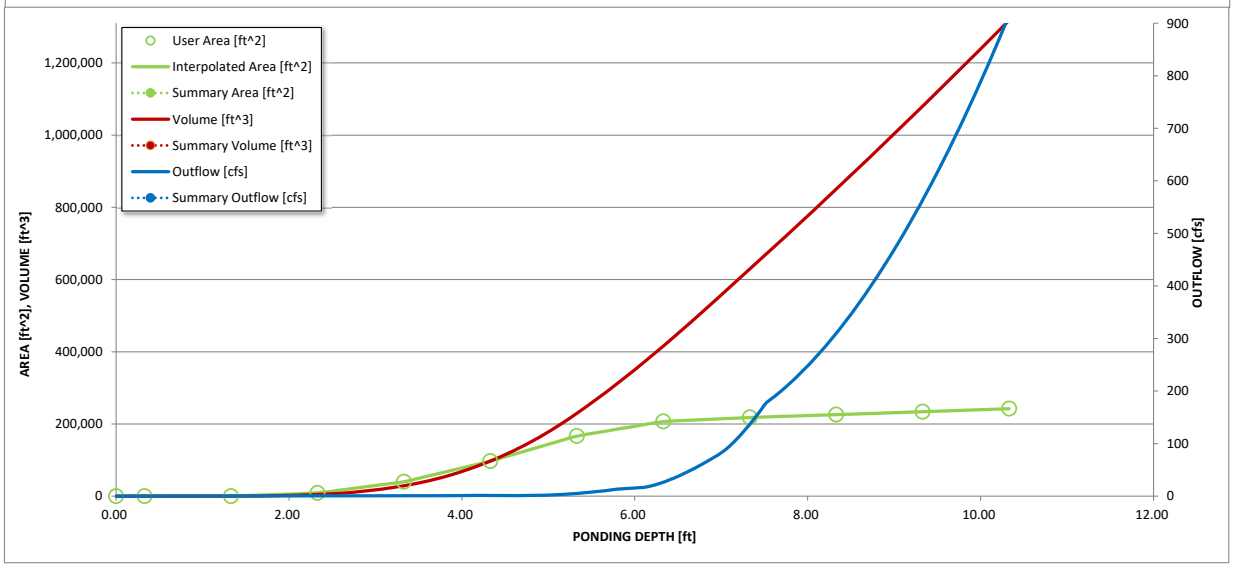
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	3.451	8.413	10.070	15.503	20.419	26.600	31.775	38.448
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	10.070	15.503	20.419	26.600	31.775	38.448
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	28.1	64.2	92.5	153.1	189.7	242.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.11	0.26	0.38	0.63	0.77	0.99
Peak Inflow Q (cfs) =	N/A	N/A	99.5	152.0	191.7	271.0	321.4	389.6
Peak Outflow Q (cfs) =	1.3	16.3	15.6	44.7	75.7	134.9	181.3	235.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.7	0.8	0.9	1.0	1.0
Structure Controlling Flow =	Vertical Orifice 1	Overflow Weir 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Spillway	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.4	0.8	1.5	1.8	1.9
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) =	39	49	51	49	47	45	43	41
Time to Drain 99% of Inflow Volume (hours) =	**40**	52	54	54	54	53	52	51
Maximum Ponding Depth (ft) =	4.80	6.09	6.01	6.59	6.94	7.32	7.55	7.92
Area at Maximum Ponding Depth (acres) =	2.98	4.53	4.45	4.82	4.90	5.00	5.04	5.11
Maximum Volume Stored (acre-ft) =	3.454	8.435	8.031	10.794	12.447	14.378	15.482	17.411

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	0.22	0.02	0.73
	0:15:00	0.00	0.00	1.93	3.19	3.97	2.68	3.64	3.31	5.69
	0:20:00	0.00	0.00	9.41	14.59	18.55	10.34	12.54	13.30	20.35
	0:25:00	0.00	0.00	30.17	51.01	67.77	30.56	37.96	43.51	69.52
	0:30:00	0.00	0.00	62.23	102.47	133.57	97.97	120.09	138.08	200.66
	0:35:00	0.00	0.00	88.01	138.82	176.97	184.62	222.94	260.98	360.21
	0:40:00	0.00	0.00	99.29	151.99	191.69	243.91	291.76	346.07	467.64
	0:45:00	0.00	0.00	99.50	150.44	189.59	268.76	319.84	383.93	513.69
	0:50:00	0.00	0.00	93.40	141.39	178.09	270.98	321.45	389.57	518.30
	0:55:00	0.00	0.00	86.12	131.87	166.94	258.26	306.26	375.08	499.03
	1:00:00	0.00	0.00	80.10	122.82	156.88	243.30	288.84	358.37	476.79
	1:05:00	0.00	0.00	74.57	113.93	147.43	227.25	270.14	341.44	454.40
	1:10:00	0.00	0.00	69.63	107.01	140.80	210.55	250.95	320.16	427.33
	1:15:00	0.00	0.00	64.92	100.93	135.46	195.48	233.71	296.90	397.60
	1:20:00	0.00	0.00	60.21	94.46	128.81	180.66	216.36	271.71	364.63
	1:25:00	0.00	0.00	55.59	87.50	119.84	165.40	198.09	245.28	329.27
	1:30:00	0.00	0.00	50.98	80.37	109.43	149.76	179.23	219.38	294.30
	1:35:00	0.00	0.00	46.58	73.51	98.92	134.46	160.74	195.26	261.58
	1:40:00	0.00	0.00	42.53	66.87	89.54	119.62	142.93	172.63	231.34
	1:45:00	0.00	0.00	39.44	61.53	82.96	106.77	127.82	153.64	206.64
	1:50:00	0.00	0.00	37.36	57.16	77.81	97.41	116.72	139.45	187.82
	1:55:00	0.00	0.00	35.28	53.20	73.04	89.74	107.55	127.59	171.91
	2:00:00	0.00	0.00	32.98	49.46	68.13	83.06	99.53	117.08	157.76
	2:05:00	0.00	0.00	30.26	45.34	62.33	76.05	91.07	106.47	143.36
	2:10:00	0.00	0.00	27.18	40.71	55.75	68.46	81.89	95.32	128.12
	2:15:00	0.00	0.00	24.06	35.96	49.07	60.71	72.51	84.26	112.99
	2:20:00	0.00	0.00	21.11	31.39	42.69	53.23	63.47	73.79	98.67
	2:25:00	0.00	0.00	18.32	27.04	36.72	46.14	54.90	63.94	85.17
	2:30:00	0.00	0.00	15.69	22.97	31.18	39.43	46.82	54.52	72.31
	2:35:00	0.00	0.00	13.17	19.06	25.96	32.94	39.02	45.34	59.82
	2:40:00	0.00	0.00	10.73	15.33	21.03	26.70	31.53	36.44	47.73
	2:45:00	0.00	0.00	8.44	11.91	16.51	20.78	24.42	27.92	36.27
	2:50:00	0.00	0.00	6.41	9.10	12.97	15.33	17.97	20.23	26.38
	2:55:00	0.00	0.00	4.95	7.26	10.57	11.38	13.51	14.96	19.84
	3:00:00	0.00	0.00	4.04	5.98	8.74	8.73	10.44	11.32	15.17
	3:05:00	0.00	0.00	3.35	4.95	7.23	6.81	8.18	8.58	11.56
	3:10:00	0.00	0.00	2.82	4.09	5.97	5.34	6.42	6.49	8.79
	3:15:00	0.00	0.00	2.37	3.38	4.92	4.24	5.10	4.91	6.68
	3:20:00	0.00	0.00	1.98	2.79	4.01	3.39	4.06	3.71	5.05
	3:25:00	0.00	0.00	1.64	2.28	3.22	2.69	3.21	2.82	3.85
	3:30:00	0.00	0.00	1.35	1.83	2.55	2.14	2.55	2.24	3.06
	3:35:00	0.00	0.00	1.11	1.45	1.99	1.69	2.01	1.79	2.43
	3:40:00	0.00	0.00	0.89	1.13	1.55	1.33	1.58	1.43	1.94
	3:45:00	0.00	0.00	0.69	0.86	1.20	1.03	1.22	1.12	1.51
	3:50:00	0.00	0.00	0.52	0.63	0.90	0.78	0.92	0.84	1.13
	3:55:00	0.00	0.00	0.38	0.44	0.64	0.57	0.67	0.61	0.81
	4:00:00	0.00	0.00	0.25	0.30	0.43	0.39	0.45	0.41	0.54
	4:05:00	0.00	0.00	0.16	0.19	0.26	0.25	0.28	0.25	0.32
	4:10:00	0.00	0.00	0.08	0.11	0.14	0.13	0.15	0.13	0.16
	4:15:00	0.00	0.00	0.04	0.05	0.05	0.06	0.06	0.05	0.05
	4:20:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

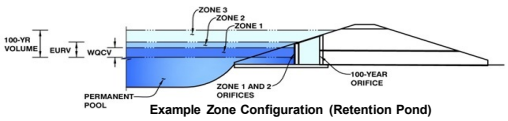
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill/Rolling Meadows MDDP**

Basin ID: **Pond F1**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	63.00	acres
Watershed Length =	2,600	ft
Watershed Length to Centroid =	1,100	ft
Watershed Slope =	0.030	ft/ft
Watershed Imperviousness =	65.00%	percent
Percentage Hydrologic Soil Group A =	1.0%	percent
Percentage Hydrologic Soil Group B =	68.0%	percent
Percentage Hydrologic Soil Groups C/D =	31.0%	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) =	1.334	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	4.317	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	4.168	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	5.685	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	6.987	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	8.520	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	9.877	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	11.503	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	14.959	acre-feet		inches
Approximate 2-yr Detention Volume =	3.488	acre-feet		
Approximate 5-yr Detention Volume =	4.757	acre-feet		
Approximate 10-yr Detention Volume =	5.857	acre-feet		
Approximate 25-yr Detention Volume =	6.298	acre-feet		
Approximate 50-yr Detention Volume =	6.539	acre-feet		
Approximate 100-yr Detention Volume =	7.093	acre-feet		

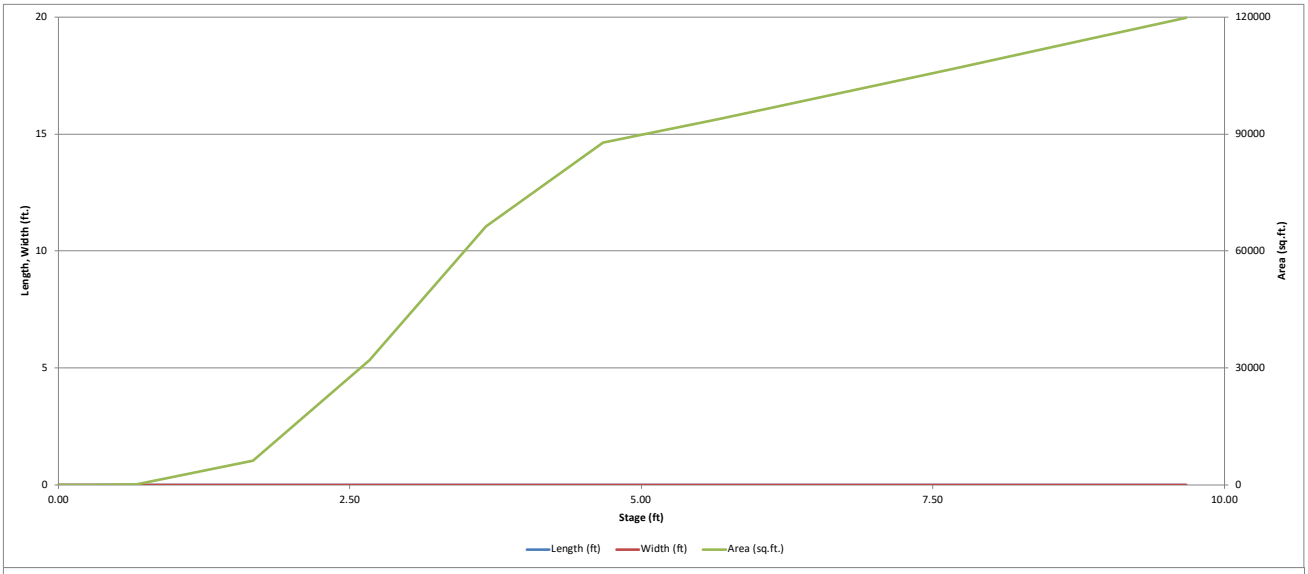
Define Zones and Basin Geometry

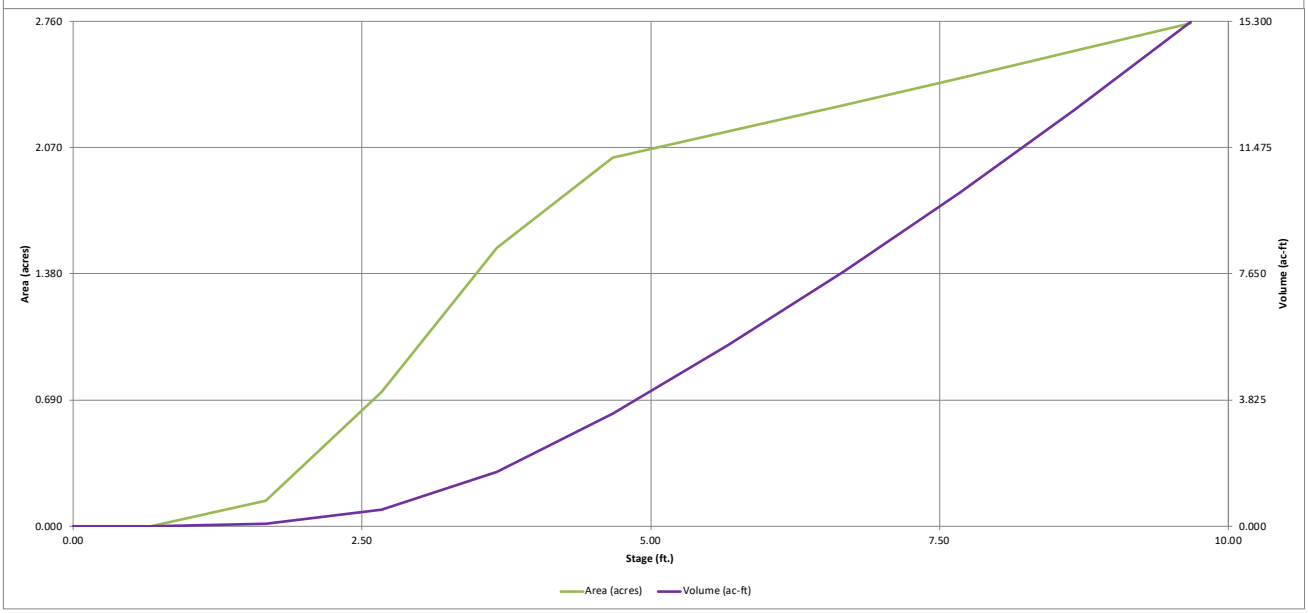
Zone 1 Volume (WQCV) =	1.334	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.983	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	3.442	acre-feet
Total Detention Basin Volume =	7.760	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention 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

micropool=5846.33

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	--	--	--	30	0.001		
5846.67	--	0.33	--	--	--	30	0.001	10	0.000
5847	--	0.67	--	--	--	50	0.001	23	0.001
5848	--	1.67	--	--	--	6,131	0.141	3,114	0.071
5849	--	2.67	--	--	--	31,958	0.734	22,158	0.509
5850	--	3.67	--	--	--	66,325	1.523	71,300	1.637
5851	--	4.67	--	--	--	87,774	2.015	148,349	3.406
5852	--	5.67	--	--	--	93,942	2.157	239,207	5.491
5853	--	6.67	--	--	--	100,233	2.301	336,295	7.720
5854	--	7.67	--	--	--	106,650	2.448	439,736	10.095
5855	--	8.67	--	--	--	113,187	2.598	549,655	12.618
5856	--	9.67	--	--	--	119,849	2.751	666,173	15.293


20
15
10
5
0
Length, Width (ft.)
120000
90000
60000
30000
0
Area (sq.ft.)
0.00
2.50
5.00
7.50
10.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

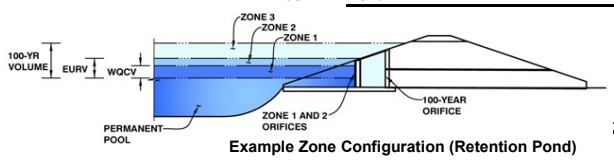

2.760
2.070
1.380
0.690
0.000
Area (acres)
15.300
11.475
7.650
3.825
0.000
Volume (ac-ft)
0.00
2.50
5.00
7.50
10.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill/Rolling Meadows MDDP**

Basin ID: **Pond F1**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.46	1.334	Orifice Plate
Zone 2 (EURV)	5.12	2.983	Rectangular Orifice
Z3 (100+1/2WQCV)	6.69	3.442	Weir&Pipe (Restrict)
Total (all zones)		7.760	

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 =	2.528E-02	ft^2
Depth at top of Zone using Orifice Plate =	3.46	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	13.80	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	3.64	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	1.15	2.31					
Orifice Area (sq. inches)	3.64	3.64	3.64					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected				
Invert of Vertical Orifice =	3.46	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.98	N/A
Depth at top of Zone using Vertical Orifice =	5.12	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.25	N/A
Vertical Orifice Height =	6.00	N/A	inches			
Vertical Orifice Width =	23.49		inches			

Calculated Parameters for Vertical Orifi

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

	Zone 3 Weir	Not Selected				
Overflow Weir Front Edge Height, Ho =	5.20	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.20	N/A
Overflow Weir Front Edge Length =	9.00	N/A	feet	Overflow Weir Slope Length =	6.00	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	3.36	N/A
Horiz. Length of Weir Sides =	6.00	N/A	feet	Overflow Grate Open Area w/o Debris =	37.58	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	18.79	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow We

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

	Zone 3 Restrictor	Not Selected				
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	11.19	N/A
Outlet Pipe Diameter =	48.00	N/A	inches	Outlet Orifice Centroid =	1.80	N/A
Restrictor Plate Height Above Pipe Invert =	40.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.30	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	1.58	feet
Spillway Crest Length =	30.00	feet	Stage at Top of Freeboard =	9.08	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	2.66	acres
Freeboard above Max Water Surface =	0.50	feet	Basin Volume at Top of Freeboard =	13.70	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
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	1.334	4.317	4.168	5.685	6.987	8.520	9.877	11.503
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	4.168	5.685	6.987	8.520	9.877	11.503
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	9.0	21.9	32.6	55.9	69.7	88.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.14	0.35	0.52	0.89	1.11	1.40
Peak Inflow Q (cfs) =	N/A	N/A	75.9	103.5	123.8	154.6	179.2	210.5
Peak Outflow Q (cfs) =	0.5	6.3	5.4	8.7	18.4	37.9	53.6	77.7
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.6	0.7	0.8	0.9
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.3	0.8	1.2	1.8
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) =	38	48	49	49	48	46	45	43
Time to Drain 99% of Inflow Volume (hours) =	**40**	52	53	54	54	53	53	52
Maximum Ponding Depth (ft) =	3.46	5.12	4.72	5.32	5.58	5.93	6.16	6.47
Area at Maximum Ponding Depth (acres) =	1.36	2.08	2.02	2.11	2.14	2.19	2.23	2.27
Maximum Volume Stored (acre-ft) =	1.334	4.327	3.486	4.724	5.276	6.035	6.543	7.240

DESIGN POINT SUMMARY TABLE				
DESIGN POINT	DRAINAGE AREA	RUNOFF 5 YR (CFS)	RUNOFF 100 YR (CFS)	COMMENTS
A1a	68.41	22.9	96.5	
A2a	151.96	135.6	347.4	
A3a	188.34	192.4	473.8	
A4a		86.1	285.6	POND OUTFLOW
B1a	386.33	79.9	492.3	
B2a	61.14	73.4	163.3	
B3a	66.16	79.2	176.2	
B4a	410.91	98.2	527.1	
B5a	515.40	184.7	718.9	
B6a		129.1	419.1	POND OUTFLOW
B7a			1289.6	SEE REPORT
C1a		21.6	172.8	POND OUTFLOW
D1a		15.5	109.9	POND OUTFLOW
D2a		19.6	43.6	
D3a				NOT USED
D4a			260.5	PIPE FLOW
E1a	111.97	33.3	191.6	
E2a		44.7	235.1	POND OUTFLOW
E3a	602.40	306.4	747.7	
E4a		306.4	747.7	PIPE FLOW
F1a		8.7	77.7	POND OUTFLOW
F2a	27.54	7.4	47.7	
F3a		1.1	13.2	POND OUTFLOW
J1a		12.8	116.3	POND OUTFLOW
K1a		10.2	116.0	POND OUTFLOW
L1a		25.8	202.9	POND OUTFLOW

EAST TRIBUTARY KIOWA DBPS FLOW DATA		
DESIGN POINT	RUNOFF 5 YR (CFS)	RUNOFF 100 YR (CFS)
ET12	90	2960
ET13	80	2860
ET14	80	2640
ET15	50	1720

NOTES:

1. ALL DETENTION PONDS, RIGHTS-OF-WAY AND STORM SEWERS PRESENTED HERE ARE SCHEMATIC IN NATURE, AND ARE SHOWN FOR INFORMATION ONLY. FINAL DESIGN OF DRAINAGE SYSTEM WILL OCCUR WITH THE DESIGN OF THE ROADS AND SUBDIVISIONS.

2. PROPOSED DETENTION PONDS WITHIN THE EXISTING 325' ELECTRICAL TRANSMISSION LINE EASEMENT WILL NEED TO BE DESIGNED WITH A 40' BUFFER FROM EXISTING POWER POLES.

CORE ENGINEERING GROUP
15004 1ST AVENUE S.
BURNSVILLE, MN 55306
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

NO.	DESCRIPTION	DATE

PREPARED FOR:
THE LANDHUIS CO
212 NORTH WAHSATCH AVE, SUITE 301
COLORADO SPRINGS, COLORADO 80903
(719) 635-3200
CONTACT: JEFF MARK

PROJECT: BULL HILL/ROLLING MEADOWS MDDP
EL PASO COUNTY, COLORADO

DRAWN: RLS
DESIGNED: LAB
CHECKED: RLS

OVERALL DEVELOPED CONDITIONS
BULL HILL / ROLLING MEADOWS MDDP
-

DATE: SEPTEMBER, 2023

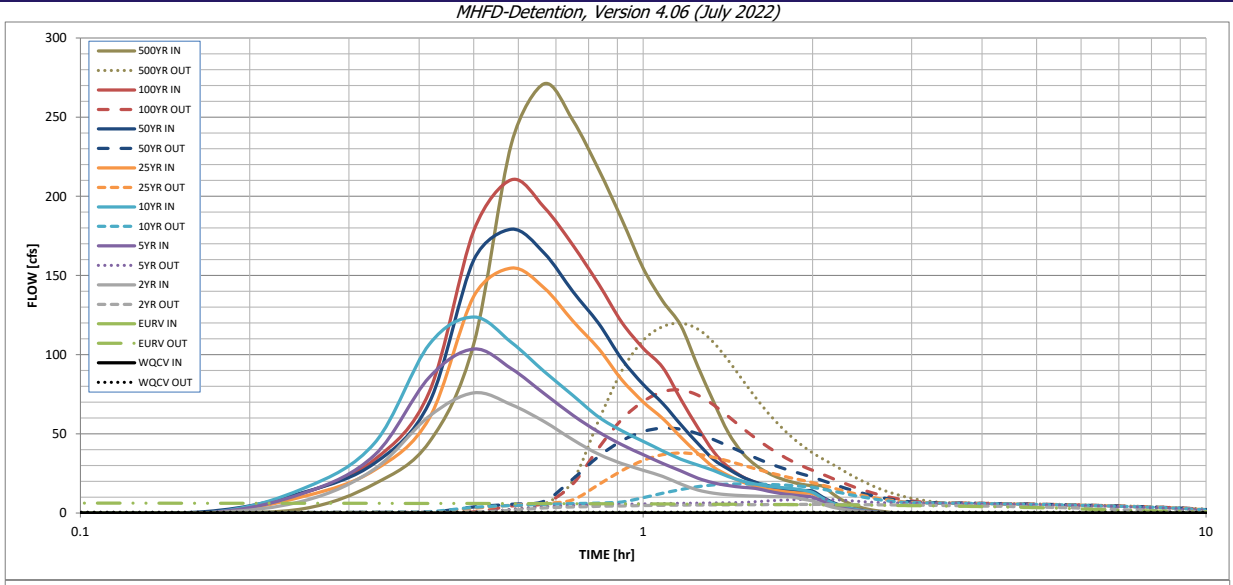
PROJECT NO. 100.300

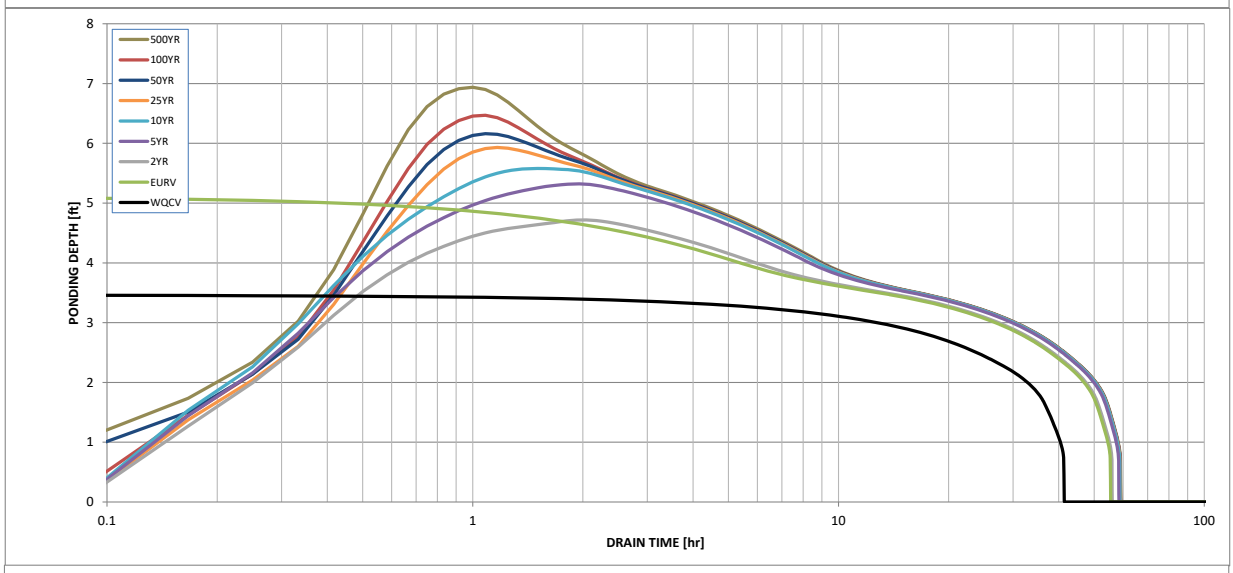
SHEET NUMBER 2

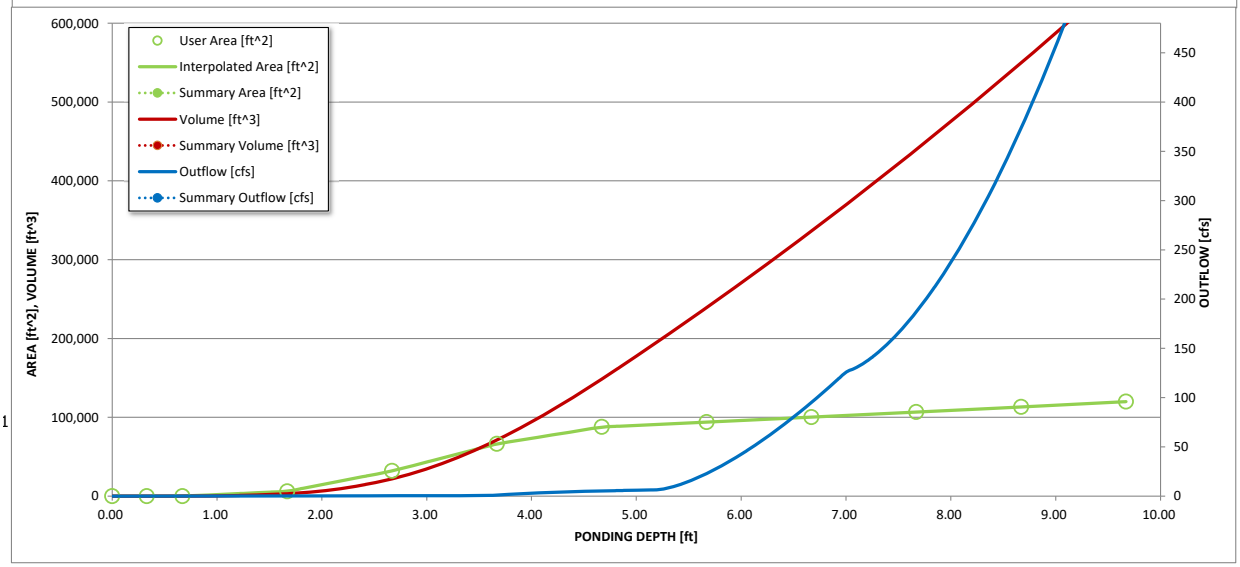
TOTAL SHEETS: 3

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	0.88	0.09	2.83
	0:15:00	0.00	0.00	7.80	12.72	15.74	10.56	13.19	12.86	18.50
	0:20:00	0.00	0.00	27.87	36.67	44.27	27.13	31.54	33.80	44.74
	0:25:00	0.00	0.00	61.13	85.72	106.45	59.76	69.61	76.39	106.70
	0:30:00	0.00	0.00	75.86	103.52	123.77	136.78	159.69	178.26	233.31
	0:35:00	0.00	0.00	68.36	91.12	107.74	154.65	179.23	210.48	271.06
	0:40:00	0.00	0.00	57.73	75.46	89.43	142.19	164.14	193.08	247.98
	0:45:00	0.00	0.00	46.22	61.74	74.25	121.18	139.84	169.10	216.92
	0:50:00	0.00	0.00	37.13	51.15	60.63	103.77	119.67	144.58	185.30
	0:55:00	0.00	0.00	31.26	43.09	51.89	84.05	97.05	120.31	154.58
	1:00:00	0.00	0.00	26.98	36.84	45.30	70.15	81.17	104.08	133.89
	1:05:00	0.00	0.00	23.10	31.30	39.23	59.67	69.18	91.89	118.27
	1:10:00	0.00	0.00	18.32	26.54	33.98	47.92	55.74	71.77	92.74
	1:15:00	0.00	0.00	14.57	22.06	30.32	37.68	44.04	54.04	70.36
	1:20:00	0.00	0.00	12.55	19.05	26.82	28.98	33.88	38.80	50.81
	1:25:00	0.00	0.00	11.55	17.34	23.01	23.77	27.75	29.03	38.11
	1:30:00	0.00	0.00	10.97	16.25	20.22	19.62	22.82	23.02	30.27
	1:35:00	0.00	0.00	10.68	15.54	18.33	16.82	19.45	19.25	25.32
	1:40:00	0.00	0.00	10.45	13.85	17.01	14.96	17.22	16.66	21.91
	1:45:00	0.00	0.00	10.28	12.45	16.11	13.80	15.81	14.95	19.66
	1:50:00	0.00	0.00	10.17	11.48	15.47	12.98	14.81	13.78	18.11
	1:55:00	0.00	0.00	8.82	10.78	14.53	12.48	14.20	13.16	17.27
	2:00:00	0.00	0.00	7.64	9.98	13.01	12.18	13.83	12.94	16.96
	2:05:00	0.00	0.00	5.54	7.27	9.36	8.93	10.12	9.52	12.46
	2:10:00	0.00	0.00	3.77	4.94	6.37	6.07	6.88	6.52	8.53
	2:15:00	0.00	0.00	2.55	3.33	4.35	4.16	4.71	4.48	5.86
	2:20:00	0.00	0.00	1.70	2.18	2.89	2.78	3.15	2.99	3.91
	2:25:00	0.00	0.00	1.07	1.39	1.87	1.81	2.04	1.94	2.54
	2:30:00	0.00	0.00	0.65	0.90	1.18	1.18	1.33	1.26	1.65
	2:35:00	0.00	0.00	0.34	0.52	0.65	0.68	0.77	0.73	0.95
	2:40:00	0.00	0.00	0.14	0.24	0.29	0.32	0.36	0.34	0.44
	2:45:00	0.00	0.00	0.04	0.07	0.08	0.09	0.10	0.10	0.13
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

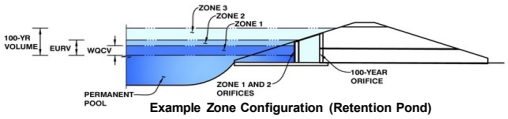
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill/Rolling Meadows MDDP**

Basin ID: **Pond F2**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	7.00	acres
Watershed Length =	660	ft
Watershed Length to Centroid =	250	ft
Watershed Slope =	0.050	ft/ft
Watershed Imperviousness =	65.00%	percent
Percentage Hydrologic Soil Group A =	13.0%	percent
Percentage Hydrologic Soil Group B =	14.0%	percent
Percentage Hydrologic Soil Groups C/D =	73.0%	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) =	0.148	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.464	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.426	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.581	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.713	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.869	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.007	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.173	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.527	acre-feet		inches
Approximate 2-yr Detention Volume =	0.389	acre-feet		
Approximate 5-yr Detention Volume =	0.541	acre-feet		
Approximate 10-yr Detention Volume =	0.632	acre-feet		
Approximate 25-yr Detention Volume =	0.686	acre-feet		
Approximate 50-yr Detention Volume =	0.714	acre-feet		
Approximate 100-yr Detention Volume =	0.779	acre-feet		

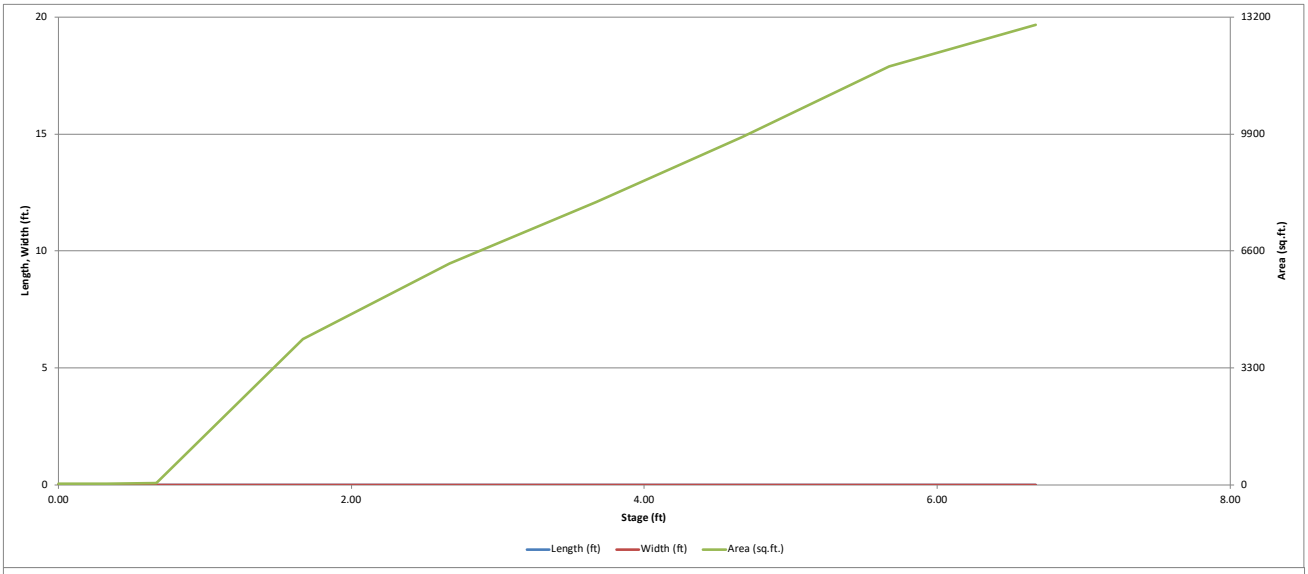
Define Zones and Basin Geometry

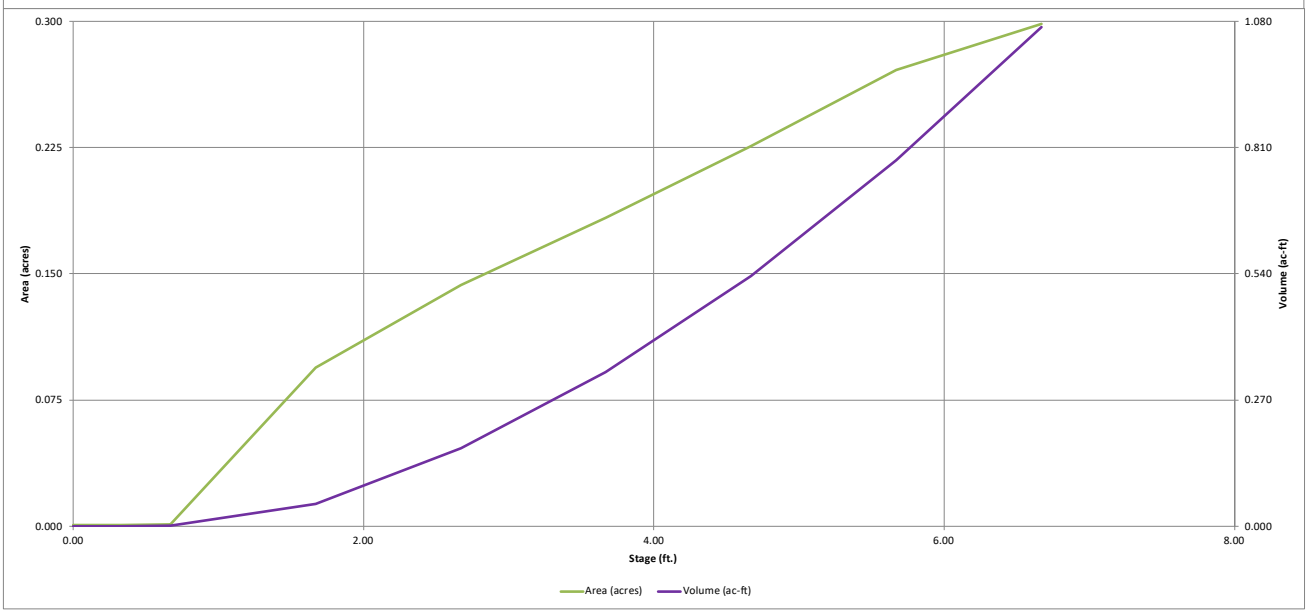
Zone 1 Volume (WQCV) =	0.148	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.316	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	0.389	acre-feet
Total Detention Basin Volume =	0.853	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention 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

micropool=5882.33

Depth Increment = 0.20 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	--	--	--	30	0.001		
5882.67	--	0.33	--	--	--	30	0.001	10	0.000
5883	--	0.67	--	--	--	50	0.001	23	0.001
5884	--	1.67	--	--	--	4,103	0.094	2,100	0.048
5885	--	2.67	--	--	--	6,247	0.143	7,275	0.167
5886	--	3.67	--	--	--	7,973	0.183	14,385	0.330
5887	--	4.67	--	--	--	9,828	0.226	23,285	0.535
5888	--	5.67	--	--	--	11,813	0.271	34,106	0.783
5889	--	6.67	--	--	--	13,000	0.298	46,512	1.068


Length, Width (ft.)
Area (sq.ft.)
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

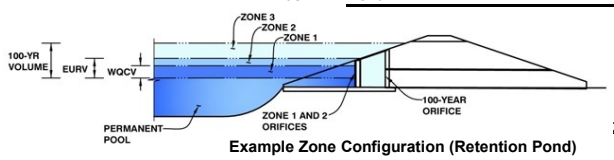

Area (acres)
Volume (ac-ft)
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill/Rolling Meadows MDDP**

Basin ID: **Pond F2**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.54	0.148	Orifice Plate
Zone 2 (EURV)	4.35	0.316	Rectangular Orifice
Z3 (100+1/2WQCV)	5.93	0.389	Weir&Pipe (Restrict)
Total (all zones)		0.853	

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 =	3.611E-03	ft^2
Depth at top of Zone using Orifice Plate =	2.54	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	10.20	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	0.52	sq. inches (diameter = 13/16 inch)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.85	1.69					
Orifice Area (sq. inches)	0.52	0.52	0.52					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected				
Invert of Vertical Orifice =	2.54	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.06	N/A
Depth at top of Zone using Vertical Orifice =	4.35	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.08	N/A
Vertical Orifice Height =	2.00	N/A	inches			
Vertical Orifice Width =	4.59		inches			

Calculated Parameters for Vertical Orifi

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

	Zone 3 Weir	Not Selected				
Overflow Weir Front Edge Height, Ho =	4.40	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.40	N/A
Overflow Weir Front Edge Length =	3.00	N/A	feet	Overflow Weir Slope Length =	6.00	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	10.01	N/A
Horiz. Length of Weir Sides =	6.00	N/A	feet	Overflow Grate Open Area w/o Debris =	12.53	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	6.26	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow We

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

	Zone 3 Restrictor	Not Selected				
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.25	N/A
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.56	N/A
Restrictor Plate Height Above Pipe Invert =	12.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.91	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.20	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.55	feet
Spillway Crest Length =	20.00	feet	Stage at Top of Freeboard =	6.25	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.29	acres
Freeboard above Max Water Surface =	0.50	feet	Basin Volume at Top of Freeboard =	0.94	acre-ft

Calculated Parameters for Spillway

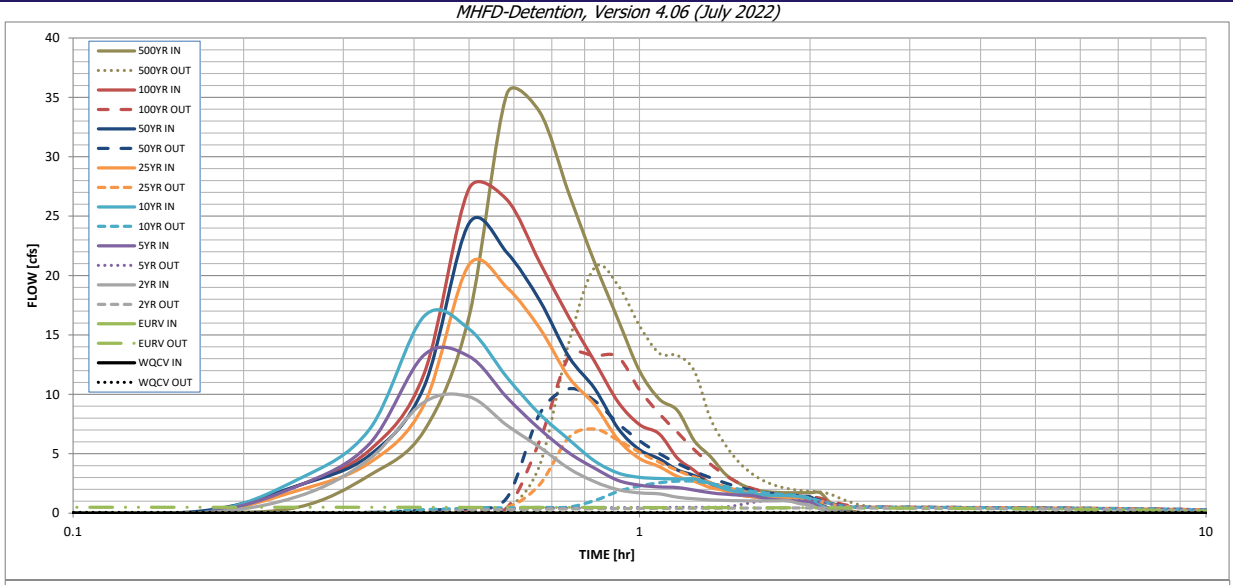
Routed Hydrograph Results

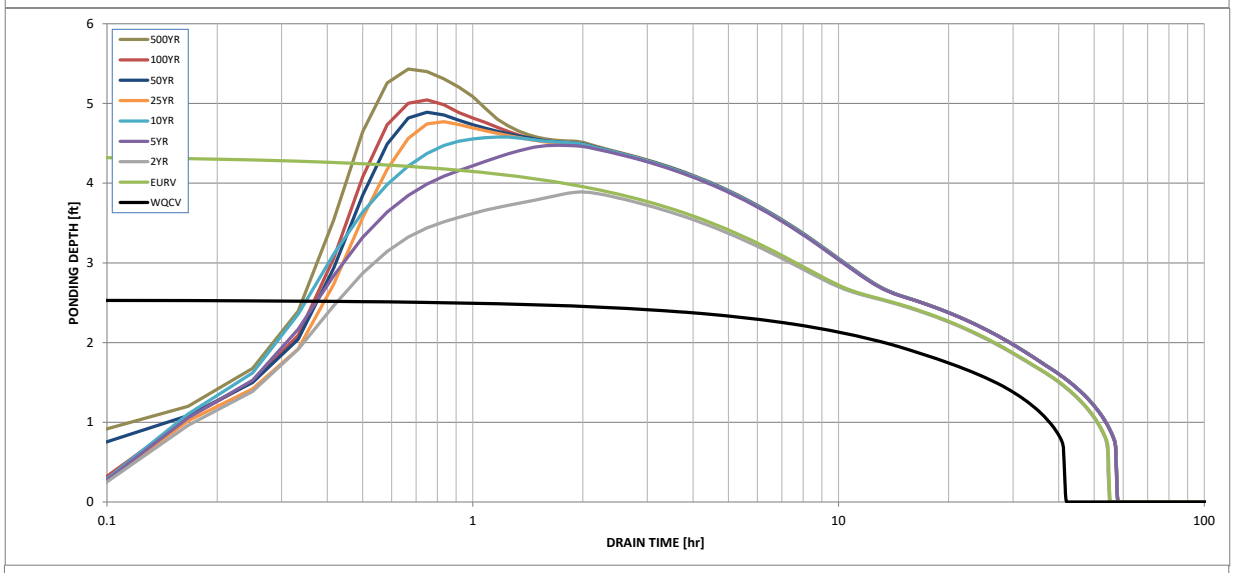
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

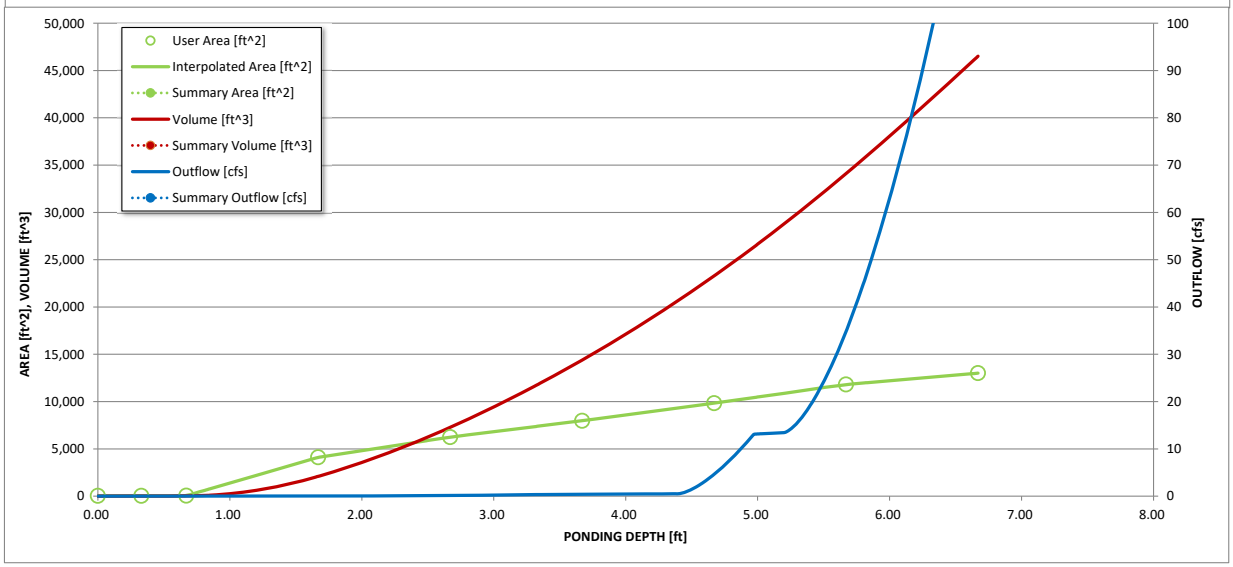
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.148	0.464	0.426	0.581	0.713	0.869	1.007	1.173
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.426	0.581	0.713	0.869	1.007	1.173
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.5	3.6	5.4	8.5	10.6	13.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.21	0.51	0.77	1.22	1.51	1.88
Peak Inflow Q (cfs) =	N/A	N/A	9.8	13.3	16.6	20.9	24.4	27.3
Peak Outflow Q (cfs) =	0.1	0.5	0.4	1.1	2.7	7.1	10.5	13.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.5	0.8	1.0	1.0
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.2	0.5	0.8	1.0
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) =	39	48	48	49	47	46	44	42
Time to Drain 99% of Inflow Volume (hours) =	**41**	52	52	54	53	53	52	51
Maximum Ponding Depth (ft) =	2.54	4.35	3.89	4.47	4.58	4.77	4.89	5.04
Area at Maximum Ponding Depth (acres) =	0.14	0.21	0.19	0.22	0.22	0.23	0.24	0.24
Maximum Volume Stored (acre-ft) =	0.149	0.465	0.370	0.490	0.512	0.557	0.583	0.621

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	0.16	0.02	0.51
	0:15:00	0.00	0.00	1.42	2.31	2.86	1.92	2.33	2.33	3.17
	0:20:00	0.00	0.00	4.55	5.81	7.02	4.22	4.85	5.28	6.93
	0:25:00	0.00	0.00	9.34	13.31	16.57	9.14	10.65	11.74	16.55
	0:30:00	0.00	0.00	9.80	13.20	15.49	20.91	24.39	27.32	35.30
	0:35:00	0.00	0.00	7.38	9.73	11.43	18.99	21.93	26.38	33.76
	0:40:00	0.00	0.00	5.55	7.08	8.34	15.55	17.89	21.10	26.94
	0:45:00	0.00	0.00	3.77	5.09	6.20	11.45	13.18	16.50	21.08
	0:50:00	0.00	0.00	2.64	3.78	4.38	9.11	10.49	12.77	16.30
	0:55:00	0.00	0.00	1.97	2.75	3.37	6.18	7.14	9.36	11.98
	1:00:00	0.00	0.00	1.71	2.35	3.02	4.60	5.34	7.45	9.61
	1:05:00	0.00	0.00	1.62	2.21	2.91	3.91	4.57	6.67	8.64
	1:10:00	0.00	0.00	1.34	2.15	2.88	3.09	3.63	4.63	6.09
	1:15:00	0.00	0.00	1.20	1.94	2.87	2.67	3.16	3.58	4.78
	1:20:00	0.00	0.00	1.12	1.71	2.49	2.15	2.53	2.48	3.29
	1:25:00	0.00	0.00	1.07	1.59	2.03	1.89	2.21	1.89	2.50
	1:30:00	0.00	0.00	1.04	1.52	1.76	1.55	1.79	1.54	2.03
	1:35:00	0.00	0.00	1.03	1.48	1.61	1.38	1.57	1.39	1.82
	1:40:00	0.00	0.00	1.03	1.24	1.52	1.29	1.46	1.33	1.74
	1:45:00	0.00	0.00	1.03	1.12	1.48	1.24	1.41	1.31	1.72
	1:50:00	0.00	0.00	1.03	1.05	1.47	1.22	1.38	1.31	1.72
	1:55:00	0.00	0.00	0.80	1.01	1.39	1.22	1.37	1.31	1.72
	2:00:00	0.00	0.00	0.67	0.92	1.20	1.22	1.37	1.31	1.72
	2:05:00	0.00	0.00	0.36	0.50	0.65	0.66	0.74	0.71	0.92
	2:10:00	0.00	0.00	0.19	0.27	0.35	0.36	0.40	0.38	0.50
	2:15:00	0.00	0.00	0.09	0.13	0.17	0.18	0.20	0.19	0.25
	2:20:00	0.00	0.00	0.03	0.06	0.07	0.08	0.09	0.08	0.11
	2:25:00	0.00	0.00	0.01	0.01	0.02	0.02	0.02	0.02	0.03
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

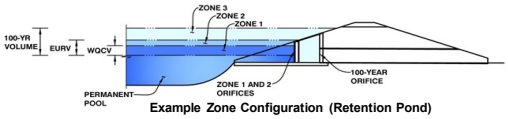
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill / Rolling Meadows MDDP**

Basin ID: **Pond J**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	91.00	acres
Watershed Length =	2,700	ft
Watershed Length to Centroid =	1,300	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	56.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	80.0%	percent
Percentage Hydrologic Soil Groups C/D =	20.0%	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) =	1.694	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	5.371	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	5.225	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	7.299	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	9.122	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	11.393	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	13.322	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	15.702	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	20.644	acre-feet		inches
Approximate 2-yr Detention Volume =	4.222	acre-feet		
Approximate 5-yr Detention Volume =	5.817	acre-feet		
Approximate 10-yr Detention Volume =	7.370	acre-feet		
Approximate 25-yr Detention Volume =	7.986	acre-feet		
Approximate 50-yr Detention Volume =	8.318	acre-feet		
Approximate 100-yr Detention Volume =	9.185	acre-feet		

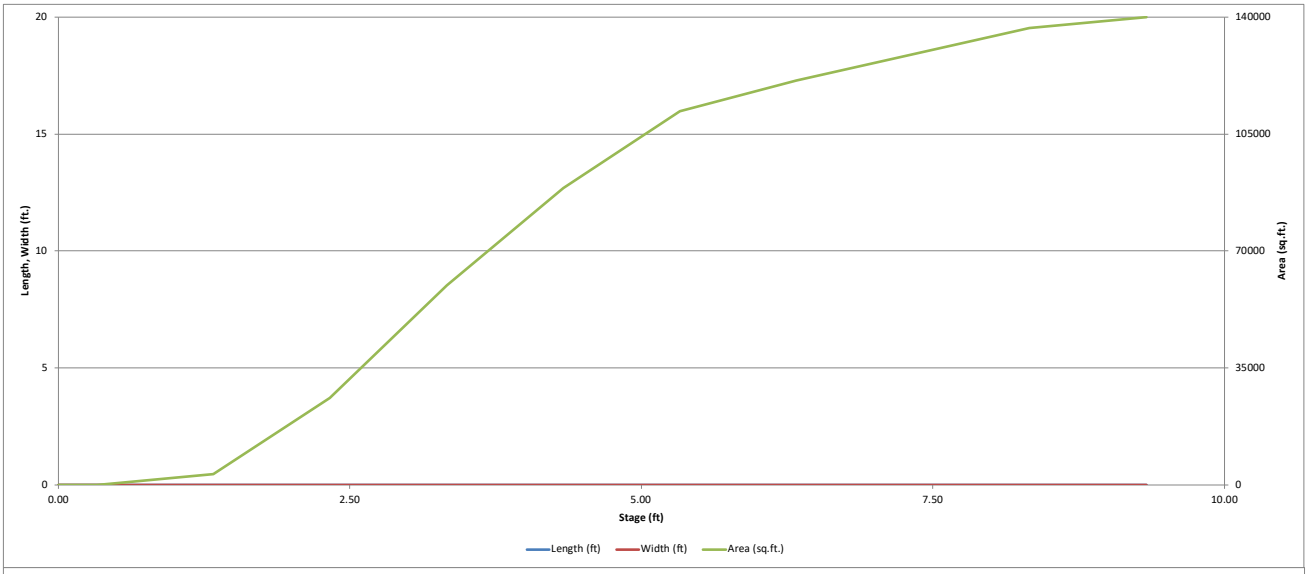
Define Zones and Basin Geometry

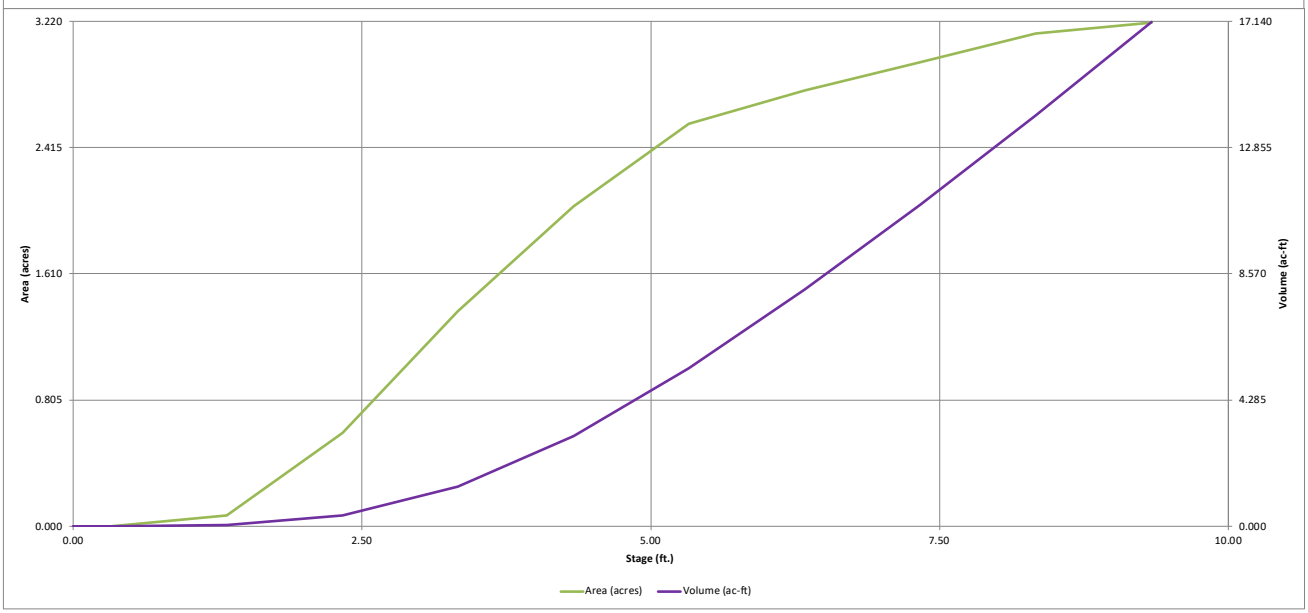
Zone 1 Volume (WQCV) =	1.694	acre-feet
Zone 2 Volume (EURV - Zone 1) =	3.677	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	4.661	acre-feet
Total Detention Basin Volume =	10.032	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention 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

micropool=5867.67

Depth Increment = 0.20 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	--	--	--	30	0.001		
5868	--	0.33	--	--	--	30	0.001	10	0.000
5869	--	1.33	--	--	--	3,075	0.071	1,562	0.036
5870	--	2.33	--	--	--	25,931	0.595	16,065	0.369
5871	--	3.33	--	--	--	59,714	1.371	58,888	1.352
5872	--	4.33	--	--	--	88,872	2.040	133,180	3.057
5873	--	5.33	--	--	--	111,735	2.565	233,484	5.360
5874	--	6.33	--	--	--	121,014	2.778	349,858	8.032
5875	--	7.33	--	--	--	128,843	2.958	474,787	10.900
5876	--	8.33	--	--	--	136,814	3.141	607,615	13.949
5877	--	9.33	--	--	--	140,000	3.214	746,022	17.126


20
15
10
5
0
Length, Width (ft.)
140000
105000
70000
35000
0
Area (sq.ft.)
0.00
2.50
5.00
7.50
10.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

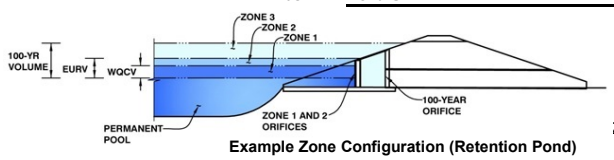

3.220
2.415
1.610
0.805
0.000
Area (acres)
17.140
12.855
8.570
4.285
0.000
Volume (ac-ft)
0.00
2.50
5.00
7.50
10.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill / Rolling Meadows MDDP**

Basin ID: **Pond J**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.57	1.694	Orifice Plate
Zone 2 (EURV)	5.34	3.677	Rectangular Orifice
Z3 (100+1/2WQCV)	7.04	4.661	Weir&Pipe (Restrict)
Total (all zones)		10.032	

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 =	3.236E-02	ft^2
Depth at top of Zone using Orifice Plate =	3.57	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	14.30	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	4.66	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	1.19	2.38					
Orifice Area (sq. inches)	4.66	4.66	4.66					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected			Zone 2 Rectangular	Not Selected
Invert of Vertical Orifice =	3.57	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	1.27	N/A
Depth at top of Zone using Vertical Orifice =	5.34	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.33	N/A
Vertical Orifice Height =	8.00	N/A	inches			
Vertical Orifice Width =	22.79		inches			

Calculated Parameters for Vertical Orifi

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 =	5.40	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.40	N/A
Overflow Weir Front Edge Length =	12.00	N/A	feet	Overflow Weir Slope Length =	6.00	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	4.30	N/A
Horiz. Length of Weir Sides =	6.00	N/A	feet	Overflow Grate Open Area w/o Debris =	50.11	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	25.06	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow We

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 =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	11.66	N/A
Outlet Pipe Diameter =	48.00	N/A	inches	Outlet Orifice Centroid =	1.87	N/A
Restrictor Plate Height Above Pipe Invert =	42.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.42	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	1.69	feet
Spillway Crest Length =	40.00	feet	Stage at Top of Freeboard =	9.19	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	3.20	acres
Freeboard above Max Water Surface =	0.50	feet	Basin Volume at Top of Freeboard =	16.68	acre-ft

Calculated Parameters for Spillway

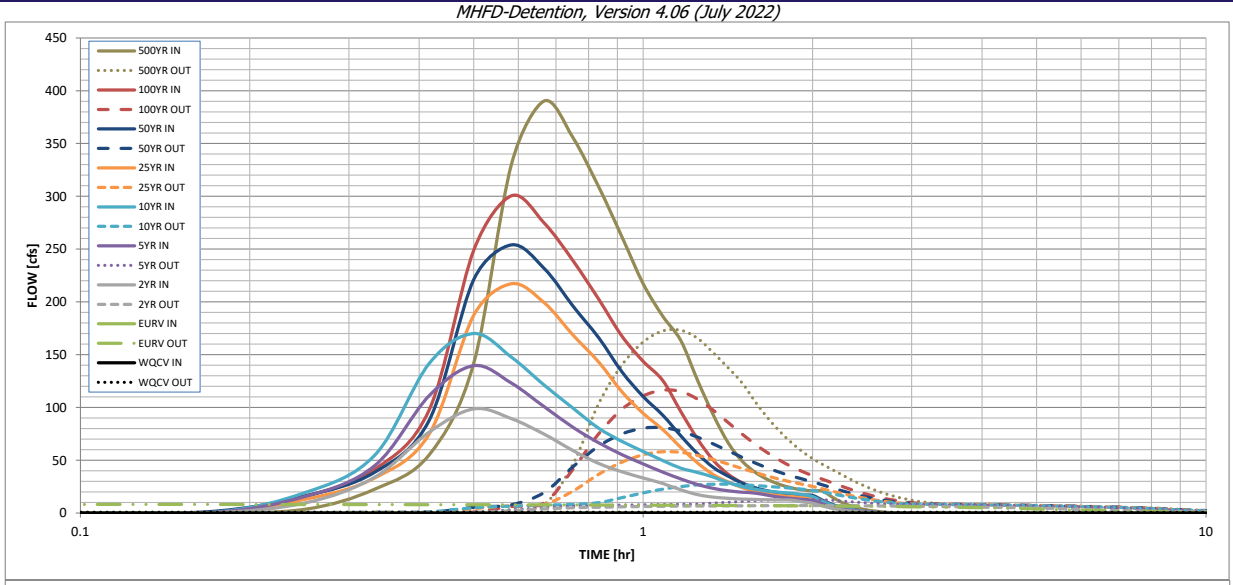
Routed Hydrograph Results

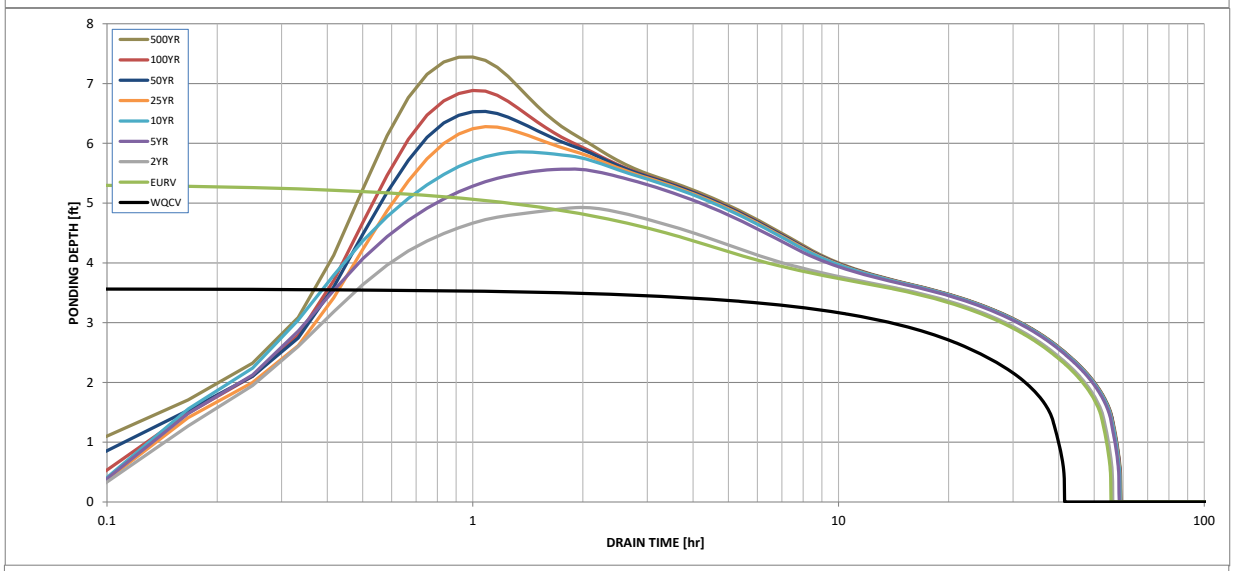
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

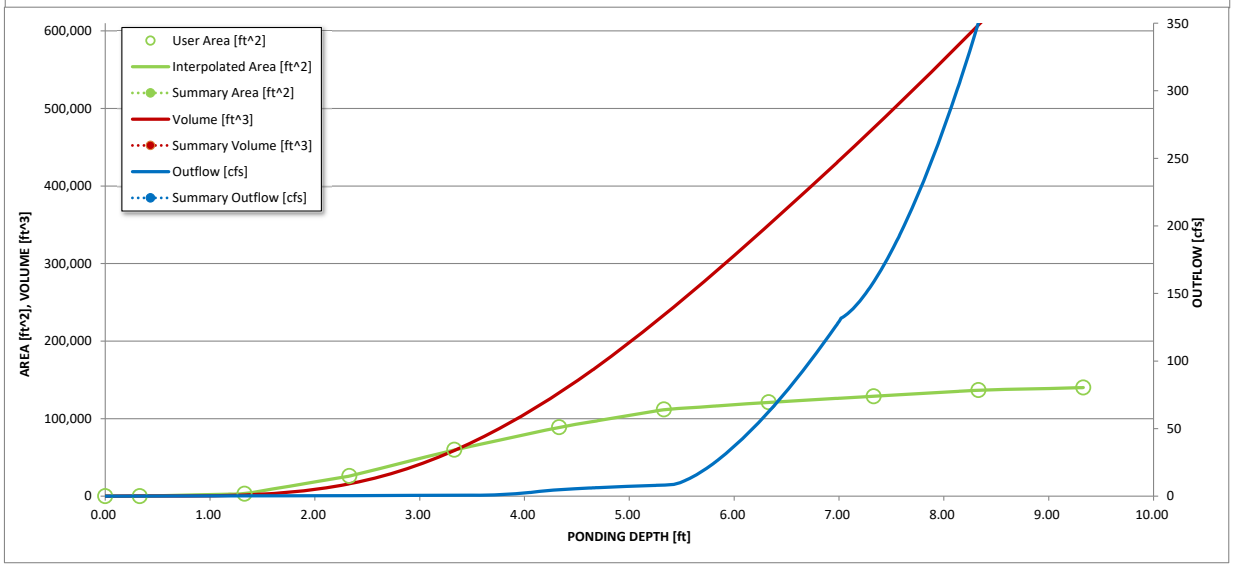
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	1.694	5.371	5.225	7.299	9.122	11.393	13.322	15.702
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	5.225	7.299	9.122	11.393	13.322	15.702
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	13.9	34.3	52.1	88.4	110.2	139.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.15	0.38	0.57	0.97	1.21	1.54
Peak Inflow Q (cfs) =	N/A	N/A	98.6	139.6	170.0	217.2	254.0	300.5
Peak Outflow Q (cfs) =	0.7	8.2	7.1	12.8	27.3	58.1	80.9	116.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.5	0.7	0.7	0.8
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.3	1.0	1.4	2.1
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) =	38	48	49	49	47	45	44	42
Time to Drain 99% of Inflow Volume (hours) =	**40**	52	53	54	54	53	52	52
Maximum Ponding Depth (ft) =	3.57	5.34	4.93	5.57	5.85	6.28	6.53	6.88
Area at Maximum Ponding Depth (acres) =	1.53	2.57	2.35	2.61	2.68	2.77	2.81	2.88
Maximum Volume Stored (acre-ft) =	1.700	5.386	4.352	5.956	6.723	7.865	8.591	9.587

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	1.07	0.11	3.44
	0:15:00	0.00	0.00	9.42	15.40	19.07	12.81	16.03	15.62	22.56
	0:20:00	0.00	0.00	33.94	44.78	54.64	33.21	38.63	41.39	55.19
	0:25:00	0.00	0.00	76.69	111.17	141.69	74.90	87.89	97.68	141.91
	0:30:00	0.00	0.00	98.65	139.59	169.99	187.29	221.16	248.85	330.38
	0:35:00	0.00	0.00	89.36	122.98	147.52	217.19	254.04	300.49	390.24
	0:40:00	0.00	0.00	74.73	100.69	121.20	199.24	231.74	274.79	355.64
	0:45:00	0.00	0.00	59.18	81.24	99.40	168.72	196.15	239.17	309.00
	0:50:00	0.00	0.00	46.98	66.59	80.37	142.97	166.09	202.61	261.64
	0:55:00	0.00	0.00	39.06	55.35	67.86	114.88	133.74	167.54	217.11
	1:00:00	0.00	0.00	33.19	46.45	58.29	94.39	110.28	143.64	186.50
	1:05:00	0.00	0.00	27.99	38.78	49.72	79.16	92.74	125.61	163.17
	1:10:00	0.00	0.00	21.89	32.33	42.48	62.01	72.96	95.94	125.30
	1:15:00	0.00	0.00	17.38	26.96	38.35	47.30	56.02	69.82	92.45
	1:20:00	0.00	0.00	15.05	23.29	33.93	36.27	43.02	49.74	66.37
	1:25:00	0.00	0.00	13.85	21.11	28.79	29.42	34.82	36.66	49.06
	1:30:00	0.00	0.00	13.20	19.73	25.02	24.09	28.34	28.62	38.37
	1:35:00	0.00	0.00	12.84	18.82	22.50	20.39	23.81	23.56	31.58
	1:40:00	0.00	0.00	12.55	16.75	20.75	18.07	20.94	20.14	26.97
	1:45:00	0.00	0.00	12.35	14.98	19.57	16.57	19.07	17.86	23.91
	1:50:00	0.00	0.00	12.23	13.77	18.73	15.54	17.80	16.40	21.94
	1:55:00	0.00	0.00	10.62	12.92	17.52	14.97	17.06	15.77	21.05
	2:00:00	0.00	0.00	9.15	11.97	15.64	14.62	16.62	15.54	20.69
	2:05:00	0.00	0.00	6.61	8.69	11.21	10.70	12.15	11.43	15.20
	2:10:00	0.00	0.00	4.43	5.81	7.53	7.16	8.12	7.69	10.22
	2:15:00	0.00	0.00	2.97	3.86	5.07	4.84	5.48	5.21	6.92
	2:20:00	0.00	0.00	1.94	2.48	3.31	3.18	3.60	3.42	4.53
	2:25:00	0.00	0.00	1.20	1.57	2.10	2.04	2.30	2.18	2.89
	2:30:00	0.00	0.00	0.70	0.99	1.28	1.28	1.45	1.37	1.81
	2:35:00	0.00	0.00	0.35	0.54	0.66	0.70	0.79	0.75	0.98
	2:40:00	0.00	0.00	0.14	0.22	0.26	0.30	0.33	0.31	0.40
	2:45:00	0.00	0.00	0.03	0.05	0.05	0.06	0.07	0.06	0.08
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

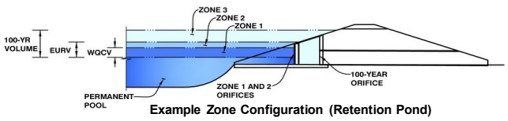
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill / Rolling Meadows MDDP**

Basin ID: **Pond K**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	76.00	acres
Watershed Length =	2,200	ft
Watershed Length to Centroid =	1,000	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	65.00%	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) =	1.610	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	5.393	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	4.920	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	6.709	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	8.232	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	10.094	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	11.703	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	13.653	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	17.751	acre-feet		inches
Approximate 2-yr Detention Volume =	4.182	acre-feet		
Approximate 5-yr Detention Volume =	5.607	acre-feet		
Approximate 10-yr Detention Volume =	7.147	acre-feet		
Approximate 25-yr Detention Volume =	7.700	acre-feet		
Approximate 50-yr Detention Volume =	8.018	acre-feet		
Approximate 100-yr Detention Volume =	8.668	acre-feet		

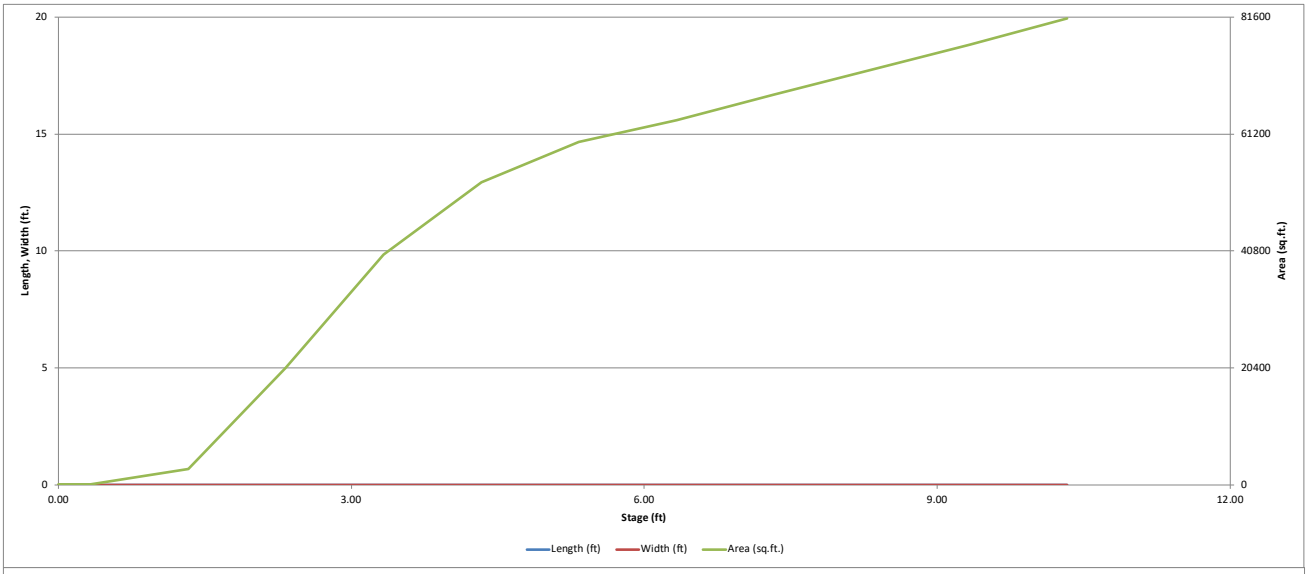
Define Zones and Basin Geometry

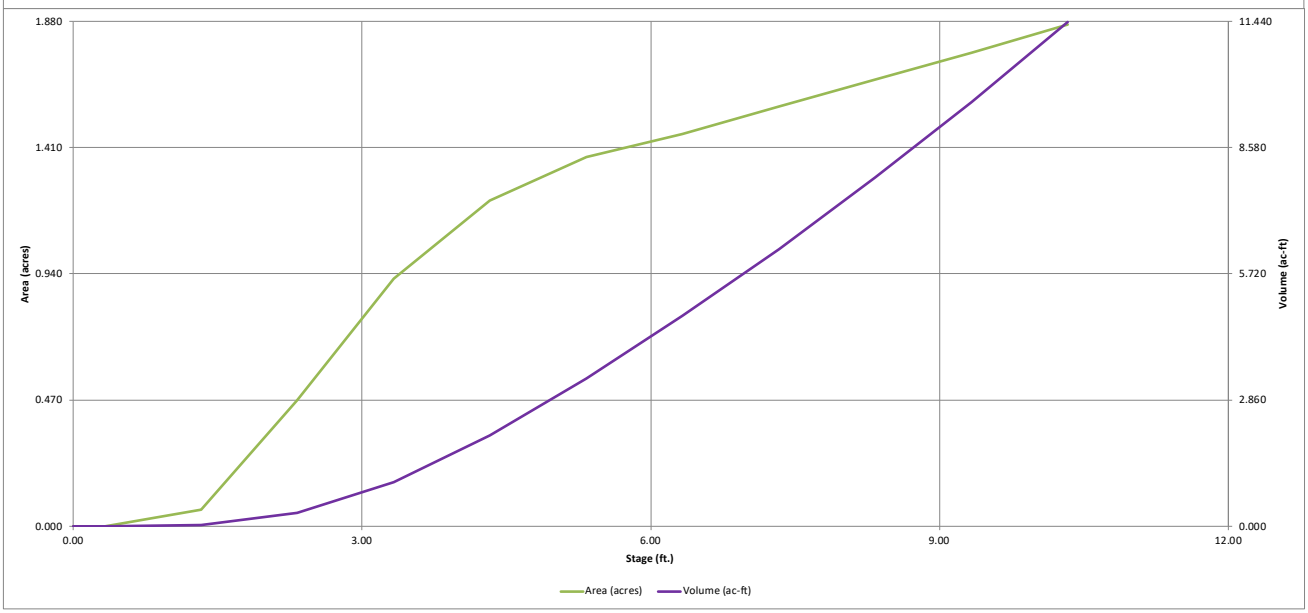
Zone 1 Volume (WQCV) =	1.610	acre-feet
Zone 2 Volume (EURV - Zone 1) =	3.784	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	4.079	acre-feet
Total Detention Basin Volume =	9.472	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention 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

micropool - 5815.67

Depth Increment = 0.20 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	--	--	--	30	0.001		
5816	--	0.33	--	--	--	30	0.001	10	0.000
5817	--	1.33	--	--	--	2,703	0.062	1,376	0.032
5818	--	2.33	--	--	--	20,417	0.469	12,936	0.297
5819	--	3.33	--	--	--	40,152	0.922	43,221	0.992
5820	--	4.33	--	--	--	52,764	1.211	89,679	2.059
5821	--	5.33	--	--	--	59,863	1.374	145,992	3.352
5822	--	6.33	--	--	--	63,619	1.460	207,733	4.769
5823	--	7.33	--	--	--	68,097	1.563	273,591	6.281
5824	--	8.33	--	--	--	72,403	1.662	343,841	7.894
5825	--	9.33	--	--	--	76,834	1.764	418,460	9.607
5826	--	10.33	--	--	--	81,391	1.868	497,572	11.423


20
15
10
5
0
Length, Width (ft.)
81600
61200
40800
20400
0
Area (sq.ft.)
0.00
3.00
6.00
9.00
12.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

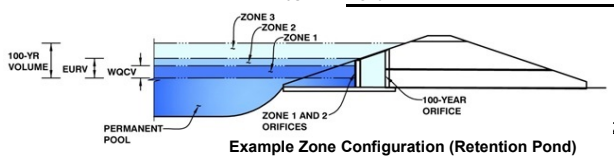

1.880
1.410
0.940
0.470
0.000
Area (acres)
11.440
8.580
5.720
2.860
0.000
Volume (ac-ft)
0.00
3.00
6.00
9.00
12.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill / Rolling Meadows MDDP**

Basin ID: **Pond K**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.95	1.610	Orifice Plate
Zone 2 (EURV)	6.76	3.784	Rectangular Orifice
Z3 (100+1/2WQCV)	9.26	4.079	Weir&Pipe (Restrict)
Total (all zones)		9.472	

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 =	3.069E-02	ft^2
Depth at top of Zone using Orifice Plate =	3.95	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	15.80	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	4.42	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	1.32	2.63					
Orifice Area (sq. inches)	4.42	4.42	4.42					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected				
Invert of Vertical Orifice =	3.95	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	1.07	N/A
Depth at top of Zone using Vertical Orifice =	6.76	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.50	N/A
Vertical Orifice Height =	12.00	N/A	inches			
Vertical Orifice Width =	12.87		inches			

Calculated Parameters for Vertical Orifi

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

	Zone 3 Weir	Not Selected				
Overflow Weir Front Edge Height, Ho =	6.80	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.80	N/A
Overflow Weir Front Edge Length =	6.00	N/A	feet	Overflow Weir Slope Length =	18.00	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	8.21	N/A
Horiz. Length of Weir Sides =	18.00	N/A	feet	Overflow Grate Open Area w/o Debris =	75.17	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	37.58	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow We

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

	Zone 3 Restrictor	Not Selected				
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	9.16	N/A
Outlet Pipe Diameter =	42.00	N/A	inches	Outlet Orifice Centroid =	1.67	N/A
Restrictor Plate Height Above Pipe Invert =	38.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.51	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	1.64	feet
Spillway Crest Length =	40.00	feet	Stage at Top of Freeboard =	10.64	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.87	acres
Freeboard above Max Water Surface =	0.50	feet	Basin Volume at Top of Freeboard =	11.42	acre-ft

Calculated Parameters for Spillway

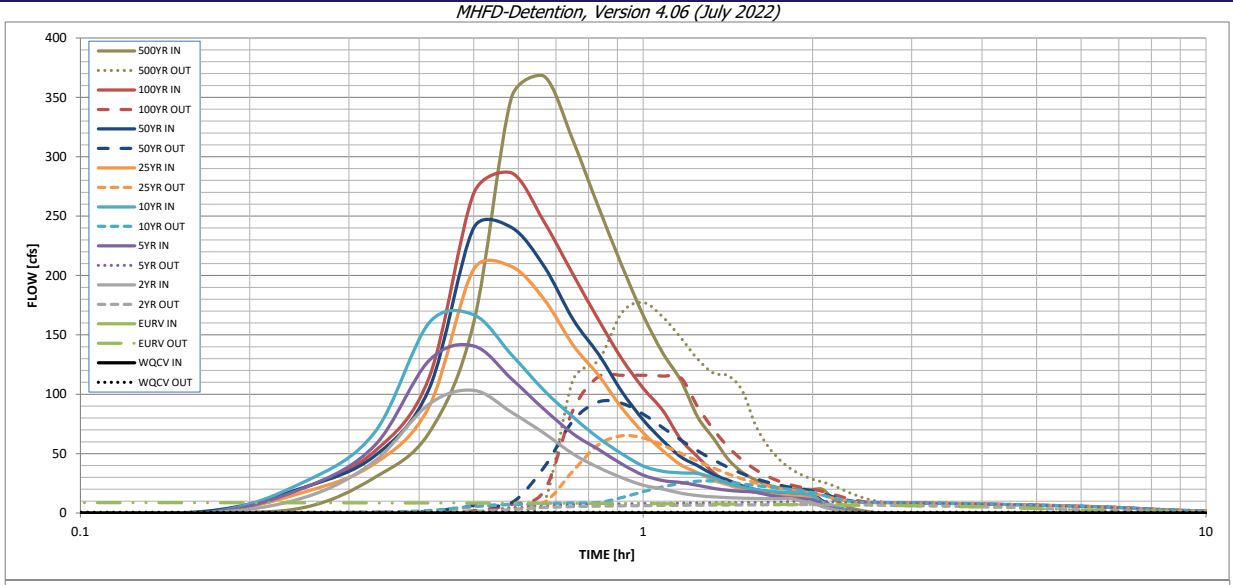
Routed Hydrograph Results

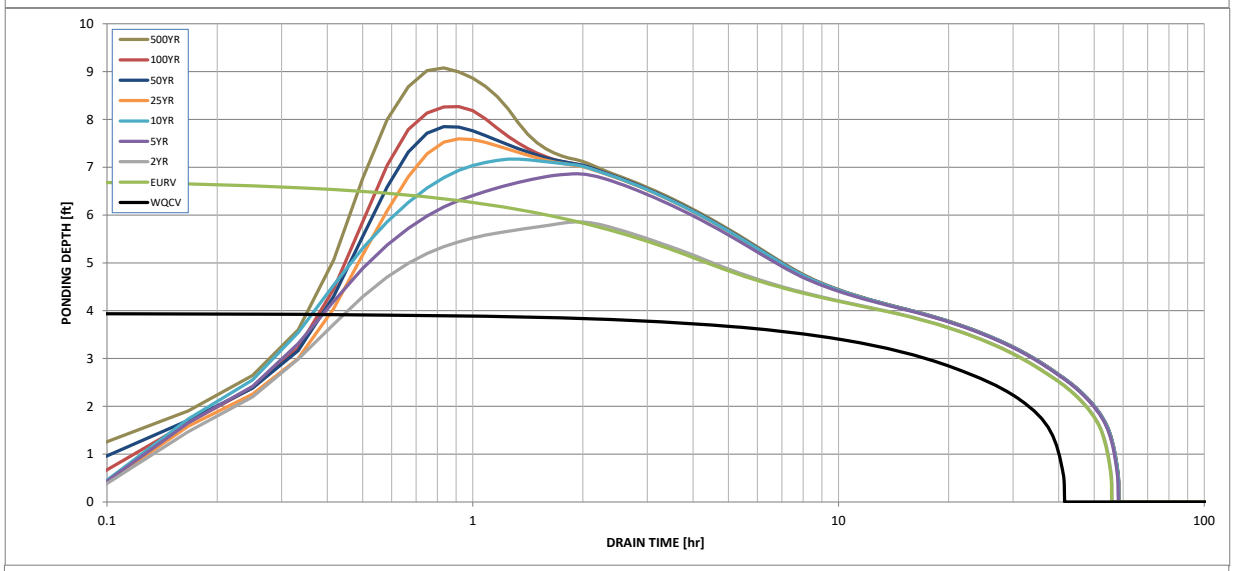
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

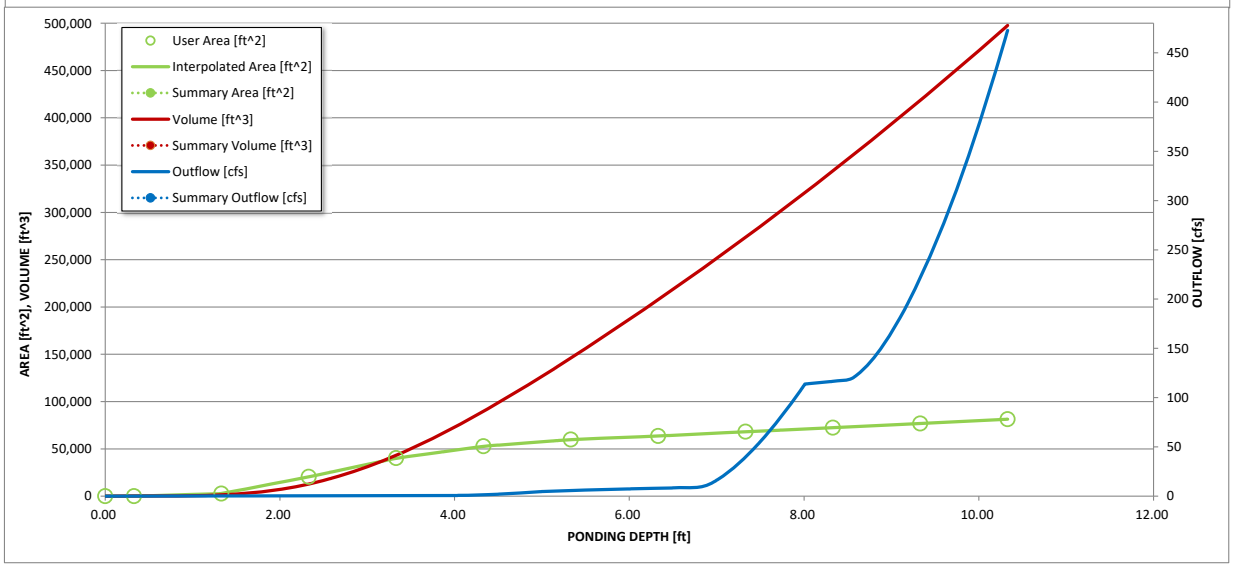
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	1.610	5.393	4.920	6.709	8.232	10.094	11.703	13.653
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	4.920	6.709	8.232	10.094	11.703	13.653
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	10.8	30.8	46.4	80.8	101.6	127.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.14	0.41	0.61	1.06	1.34	1.67
Peak Inflow Q (cfs) =	N/A	N/A	103.3	140.7	166.9	207.5	240.4	286.3
Peak Outflow Q (cfs) =	0.7	8.8	7.1	10.2	26.9	65.0	93.6	116.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.6	0.8	0.9	0.9
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.0	0.2	0.7	1.1	1.4
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) =	38	48	48	49	47	45	44	42
Time to Drain 99% of Inflow Volume (hours) =	**40**	52	52	54	53	53	52	51
Maximum Ponding Depth (ft) =	3.95	6.76	5.86	6.86	7.17	7.59	7.85	8.27
Area at Maximum Ponding Depth (acres) =	1.10	1.50	1.42	1.51	1.55	1.59	1.61	1.66
Maximum Volume Stored (acre-ft) =	1.619	5.406	4.078	5.557	6.017	6.691	7.091	7.777

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	1.47	0.15	4.73
	0:15:00	0.00	0.00	13.04	21.26	26.31	17.66	21.73	21.47	29.93
	0:20:00	0.00	0.00	43.83	56.79	67.83	41.62	48.09	51.96	67.74
	0:25:00	0.00	0.00	91.78	128.55	160.26	89.88	104.78	114.35	160.34
	0:30:00	0.00	0.00	103.27	140.68	166.92	205.34	240.03	269.12	349.72
	0:35:00	0.00	0.00	84.82	113.04	133.41	207.51	240.40	286.34	367.78
	0:40:00	0.00	0.00	67.16	87.25	103.17	179.97	207.68	245.13	313.84
	0:45:00	0.00	0.00	49.83	66.81	80.92	141.55	163.19	201.14	257.24
	0:50:00	0.00	0.00	38.22	53.46	63.14	115.88	133.61	162.52	208.26
	0:55:00	0.00	0.00	29.71	41.23	49.78	88.31	102.14	129.68	166.42
	1:00:00	0.00	0.00	23.41	31.91	39.61	67.67	78.43	105.07	134.82
	1:05:00	0.00	0.00	20.18	27.31	35.13	52.54	61.05	86.46	111.48
	1:10:00	0.00	0.00	16.69	25.69	33.75	40.49	47.30	61.81	80.82
	1:15:00	0.00	0.00	14.67	23.32	33.26	33.95	39.81	47.30	62.77
	1:20:00	0.00	0.00	13.60	20.79	29.74	27.59	32.26	34.08	45.16
	1:25:00	0.00	0.00	12.95	19.15	24.97	23.63	27.54	25.99	34.31
	1:30:00	0.00	0.00	12.54	18.19	21.81	19.83	22.88	21.17	27.81
	1:35:00	0.00	0.00	12.27	17.60	19.80	17.34	19.83	18.05	23.62
	1:40:00	0.00	0.00	12.12	15.24	18.55	15.82	17.97	16.28	21.25
	1:45:00	0.00	0.00	12.10	13.64	17.74	15.01	16.97	15.66	20.36
	1:50:00	0.00	0.00	12.10	12.69	17.24	14.55	16.40	15.38	19.95
	1:55:00	0.00	0.00	9.92	12.14	16.37	14.34	16.14	15.36	19.92
	2:00:00	0.00	0.00	8.41	11.25	14.58	14.23	16.01	15.36	19.92
	2:05:00	0.00	0.00	5.27	7.06	9.21	9.07	10.20	9.79	12.68
	2:10:00	0.00	0.00	3.16	4.22	5.56	5.52	6.20	5.94	7.69
	2:15:00	0.00	0.00	1.82	2.48	3.24	3.25	3.64	3.49	4.51
	2:20:00	0.00	0.00	0.95	1.39	1.78	1.83	2.05	1.96	2.53
	2:25:00	0.00	0.00	0.44	0.71	0.87	0.95	1.06	1.01	1.30
	2:30:00	0.00	0.00	0.16	0.25	0.29	0.35	0.38	0.36	0.46
	2:35:00	0.00	0.00	0.02	0.03	0.03	0.03	0.03	0.03	0.03
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

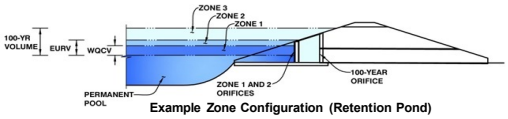
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill / Rolling Meadows MDDP**

Basin ID: **Pond L**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	144.65	acres
Watershed Length =	3,000	ft
Watershed Length to Centroid =	1,200	ft
Watershed Slope =	0.040	ft/ft
Watershed Imperviousness =	43.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	76.0%	percent
Percentage Hydrologic Soil Groups C/D =	24.0%	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) =	2.263	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	6.388	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	6.548	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	9.620	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	12.419	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	16.128	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	19.160	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	23.023	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	30.823	acre-feet		inches
Approximate 2-yr Detention Volume =	4.930	acre-feet		
Approximate 5-yr Detention Volume =	7.027	acre-feet		
Approximate 10-yr Detention Volume =	9.139	acre-feet		
Approximate 25-yr Detention Volume =	10.106	acre-feet		
Approximate 50-yr Detention Volume =	10.571	acre-feet		
Approximate 100-yr Detention Volume =	12.078	acre-feet		

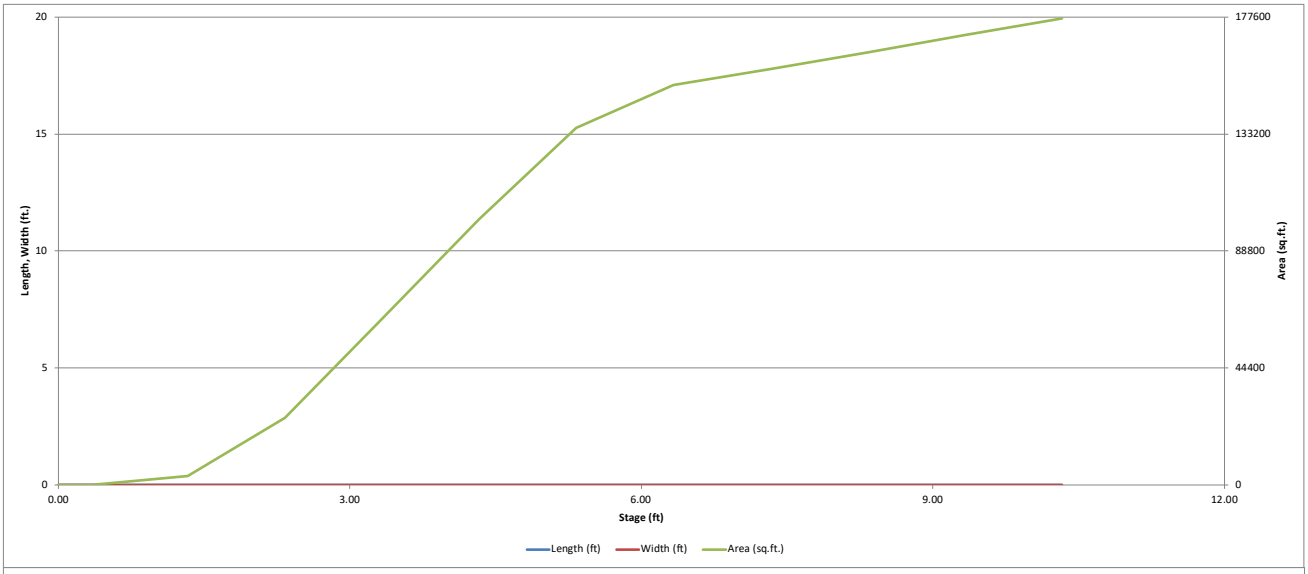
Define Zones and Basin Geometry

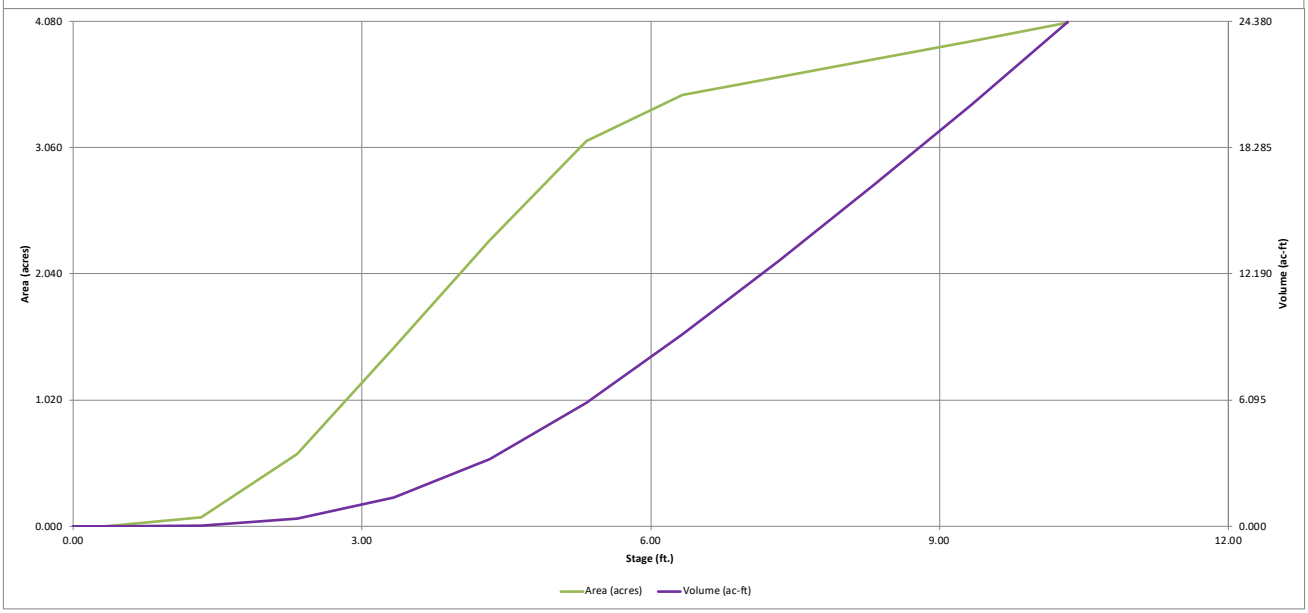
Zone 1 Volume (WQCV) =	2.263	acre-feet
Zone 2 Volume (EURV - Zone 1) =	4.125	acre-feet
Zone 3 (100yr + 1 / 2 WQCV - Zones 1 & 2) =	6.821	acre-feet
Total Detention Basin Volume =	13.210	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention 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

micropool - 5815.67

Depth Increment = 0.20 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	--	--	--	30	0.001		
5816	--	0.33	--	--	--	30	0.001	10	0.000
5817	--	1.33	--	--	--	3,228	0.074	1,639	0.038
5818	--	2.33	--	--	--	25,463	0.585	15,984	0.367
5819	--	3.33	--	--	--	62,716	1.440	60,074	1.379
5820	--	4.33	--	--	--	100,691	2.312	141,777	3.255
5821	--	5.33	--	--	--	135,576	3.112	259,910	5.967
5822	--	6.33	--	--	--	151,805	3.485	403,601	9.265
5823	--	7.33	--	--	--	157,988	3.627	558,497	12.821
5824	--	8.33	--	--	--	164,293	3.772	719,638	16.521
5825	--	9.33	--	--	--	170,721	3.919	887,145	20.366
5826	--	10.33	--	--	--	177,271	4.070	1,061,141	24.360


20
15
10
5
0
Length, Width (ft.)
177600
133200
88800
44400
0
Area (sq.ft.)
0.00
3.00
6.00
9.00
12.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

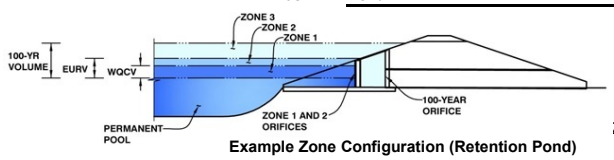

4.080
3.060
2.040
1.020
0.000
Area (acres)
24.380
18.285
12.190
6.095
0.000
Volume (ac-ft)
0.00
3.00
6.00
9.00
12.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: **Bull Hill / Rolling Meadows MDDP**

Basin ID: **Pond L**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.86	2.263	Orifice Plate
Zone 2 (EURV)	5.47	4.125	Rectangular Orifice
Z3 (100+1/2WQCV)	7.44	6.821	Weir&Pipe (Restrict)
Total (all zones)		13.210	

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 =	4.167E-02	ft^2
Depth at top of Zone using Orifice Plate =	3.86	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	15.40	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	6.00	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	1.29	2.57					
Orifice Area (sq. inches)	6.00	6.00	6.00					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected				
Invert of Vertical Orifice =	3.86	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	2.01	N/A
Depth at top of Zone using Vertical Orifice =	5.47	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.50	N/A
Vertical Orifice Height =	12.00	N/A	inches			
Vertical Orifice Width =	24.09		inches			

Calculated Parameters for Vertical Orifi

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

	Zone 3 Weir	Not Selected				
Overflow Weir Front Edge Height, Ho =	5.50	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.50	N/A
Overflow Weir Front Edge Length =	9.00	N/A	feet	Overflow Weir Slope Length =	21.00	N/A
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	7.07	N/A
Horiz. Length of Weir Sides =	21.00	N/A	feet	Overflow Grate Open Area w/o Debris =	131.54	N/A
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	65.77	N/A
Debris Clogging % =	50%	N/A	%			

Calculated Parameters for Overflow We

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

	Zone 3 Restrictor	Not Selected				
Depth to Invert of Outlet Pipe =	0.33	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	18.61	N/A
Outlet Pipe Diameter =	60.00	N/A	inches	Outlet Orifice Centroid =	2.38	N/A
Restrictor Plate Height Above Pipe Invert =	54.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.50	N/A

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	2.15	feet
Spillway Crest Length =	40.00	feet	Stage at Top of Freeboard =	10.15	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	4.04	acres
Freeboard above Max Water Surface =	0.50	feet	Basin Volume at Top of Freeboard =	23.63	acre-ft

Calculated Parameters for Spillway

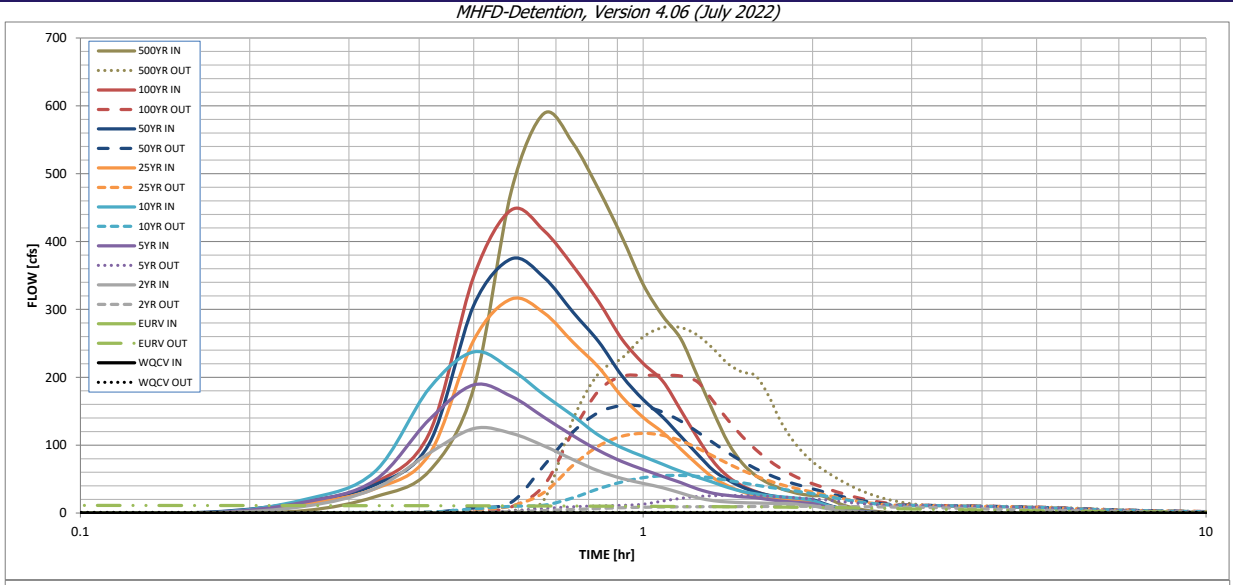
Routed Hydrograph Results

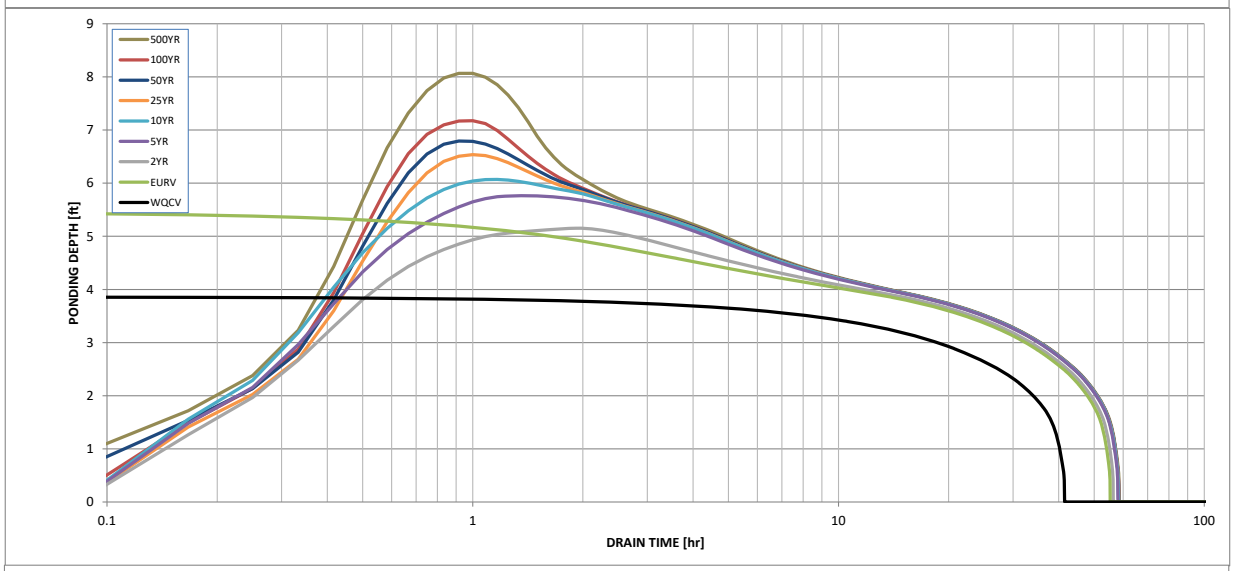
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

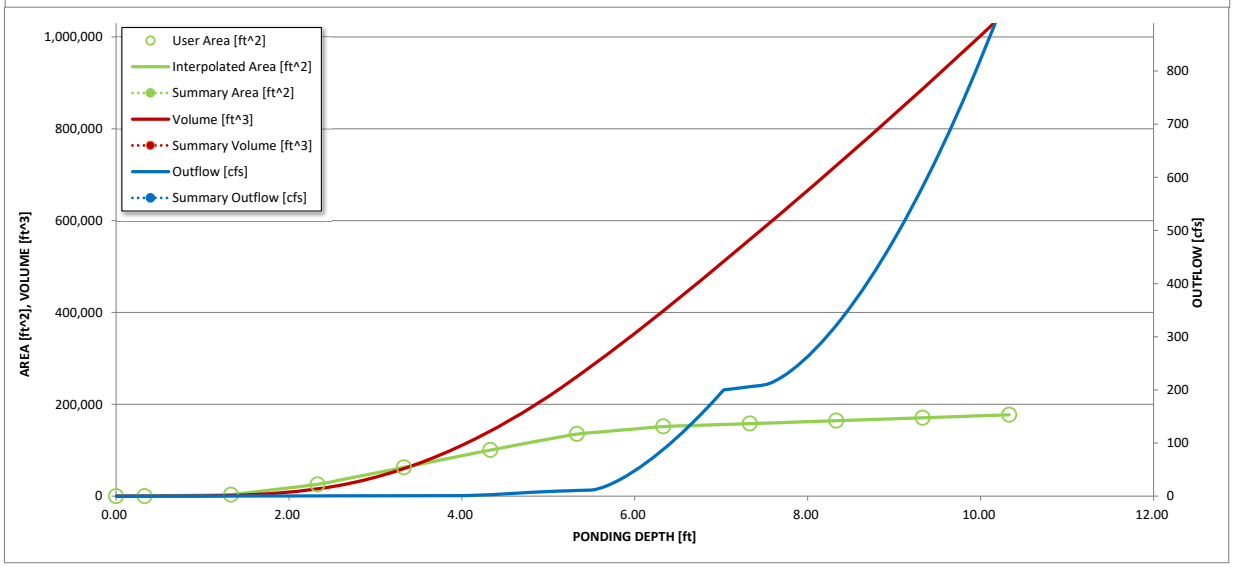
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	2.263	6.388	6.548	9.620	12.419	16.128	19.160	23.023
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	6.548	9.620	12.419	16.128	19.160	23.023
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	25.9	64.2	96.4	161.0	201.5	250.6
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.18	0.44	0.67	1.11	1.39	1.73
Peak Inflow Q (cfs) =	N/A	N/A	124.5	188.8	237.4	315.4	374.5	446.7
Peak Outflow Q (cfs) =	0.9	11.3	9.8	25.8	55.4	117.4	158.3	202.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.6	0.7	0.8	0.8
Structure Controlling Flow =	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.3	0.8	1.1	1.4
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) =	38	48	49	49	47	44	42	40
Time to Drain 99% of Inflow Volume (hours) =	**40**	52	53	54	53	52	51	50
Maximum Ponding Depth (ft) =	3.86	5.47	5.15	5.76	6.07	6.54	6.79	7.18
Area at Maximum Ponding Depth (acres) =	1.90	3.16	2.97	3.27	3.38	3.51	3.55	3.60
Maximum Volume Stored (acre-ft) =	2.265	6.406	5.419	7.339	8.338	9.965	10.884	12.243

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	1.12	0.11	3.60
	0:15:00	0.00	0.00	9.75	15.99	19.84	13.35	16.81	16.32	23.88
	0:20:00	0.00	0.00	35.89	48.09	60.82	35.64	41.56	44.47	61.65
	0:25:00	0.00	0.00	88.09	137.63	183.58	86.21	102.35	117.43	183.98
	0:30:00	0.00	0.00	124.50	188.78	237.43	254.47	306.02	348.74	475.24
	0:35:00	0.00	0.00	117.48	171.73	211.22	315.39	374.53	446.67	588.77
	0:40:00	0.00	0.00	98.79	140.88	173.97	294.63	346.95	415.78	545.06
	0:45:00	0.00	0.00	78.67	113.96	143.47	251.64	296.09	364.27	476.71
	0:50:00	0.00	0.00	61.92	92.13	114.55	214.71	252.48	311.34	406.79
	0:55:00	0.00	0.00	50.90	75.92	96.14	171.43	202.12	256.32	336.79
	1:00:00	0.00	0.00	43.65	64.15	83.40	140.87	167.00	220.31	290.33
	1:05:00	0.00	0.00	37.21	53.85	71.77	118.72	141.35	194.35	256.39
	1:10:00	0.00	0.00	29.36	44.70	61.22	94.08	112.79	151.16	200.79
	1:15:00	0.00	0.00	22.36	35.32	52.62	71.20	86.27	110.20	148.47
	1:20:00	0.00	0.00	18.21	29.06	44.94	51.50	62.61	75.49	103.20
	1:25:00	0.00	0.00	16.29	25.81	37.42	39.90	48.47	53.46	73.62
	1:30:00	0.00	0.00	15.24	23.83	31.91	31.39	38.05	40.03	55.45
	1:35:00	0.00	0.00	14.75	22.55	28.20	25.81	31.10	31.82	44.17
	1:40:00	0.00	0.00	14.38	19.98	25.64	22.07	26.44	26.15	36.35
	1:45:00	0.00	0.00	14.09	17.72	23.92	19.85	23.62	22.41	31.22
	1:50:00	0.00	0.00	13.90	16.15	22.68	18.25	21.60	19.83	27.66
	1:55:00	0.00	0.00	12.17	15.02	20.95	17.28	20.34	18.42	25.66
	2:00:00	0.00	0.00	10.52	13.83	18.51	16.76	19.65	18.02	24.97
	2:05:00	0.00	0.00	7.78	10.29	13.47	12.55	14.66	13.53	18.70
	2:10:00	0.00	0.00	5.33	6.99	9.15	8.50	9.92	9.23	12.74
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	2:20:00	0.00	0.00	2.45	3.11	4.20	3.92	4.56	4.27	5.87
	2:25:00	0.00	0.00	1.57	1.98	2.72	2.55	2.97	2.78	3.81
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	2:40:00	0.00	0.00	0.23	0.37	0.45	0.49	0.56	0.52	0.70
	2:45:00	0.00	0.00	0.08	0.12	0.13	0.16	0.18	0.16	0.22
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

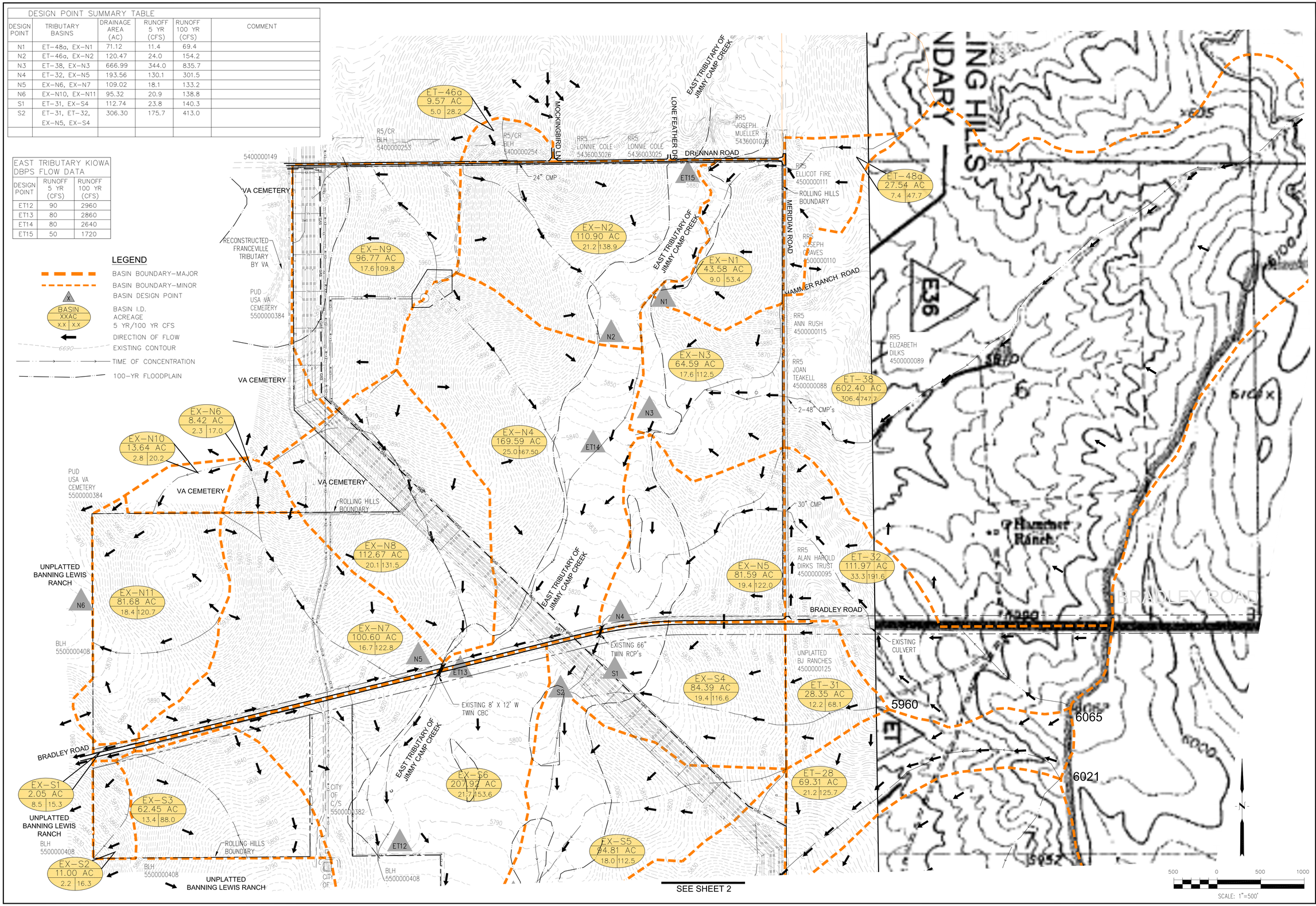
MAP POCKET

DESIGN POINT SUMMARY TABLE					
DESIGN POINT	TRIBUTARY BASINS	DRAINAGE AREA (AC)	RUNOFF 5 YR (CFS)	RUNOFF 100 YR (CFS)	COMMENT
N1	ET-48a, EX-N1	71.12	11.4	69.4	
N2	ET-46a, EX-N2	120.47	24.0	154.2	
N3	ET-38, EX-N3	666.99	344.0	835.7	
N4	ET-32, EX-N5	193.56	130.1	301.5	
N5	EX-N6, EX-N7	109.02	18.1	133.2	
N6	EX-N10, EX-N11	95.32	20.9	138.8	
S1	ET-31, EX-S4	112.74	23.8	140.3	
S2	ET-31, ET-32, EX-N5, EX-S4	306.30	175.7	413.0	

EAST TRIBUTARY KIOWA DBPS FLOW DATA		
DESIGN POINT	RUNOFF 5 YR (CFS)	RUNOFF 100 YR (CFS)
ET12	90	2960
ET13	80	2860
ET14	80	2640
ET15	50	1720

LEGEND

- BASIN BOUNDARY–MAJOR
- BASIN BOUNDARY–MINOR
- BASIN DESIGN POINT
- BASIN I.D. XXAC x.x | x.x — ACREAGE, 5 YR/100 YR CFS
- DIRECTION OF FLOW
- 6690 EXISTING CONTOUR
- TIME OF CONCENTRATION
- 100-YR FLOODPLAIN



CORE ENGINEERING GROUP
15004 1ST AVENUE S.
BURNSVILLE, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L. SCHNOLLER, P.E.
EMAIL: rich@coegi.com

NO.	DESCRIPTION	DATE

PREPARED FOR:
LORSON LLC
212 NORTH WAHSATCH AVE, SUITE 301
COLORADO SPRINGS, COLORADO 80903 (719) 635-3200
CONTACT: JEFF MARK

PROJECT:
LORSON RANCH EAST MDDP
EAST OF THE EAST TRIBUTARY
EL PASO COUNTY, COLORADO

DRAWN: LAB
DESIGNED: LAB
CHECKED: RLS

EXISTING CONDITIONS
ROLLING HILLS RANCH MDDP

DATE: SEPTEMBER, 2023

PROJECT NO. 100.300

SHEET NUMBER 1

TOTAL SHEETS: 2

DESIGN POINT SUMMARY TABLE

DESIGN POINT	TRIBUTARY BASINS	DRAINAGE AREA (AC)	RUNOFF 5 YR (CFS)	RUNOFF 100 YR (CFS)	COMMENT
N4	ET–32, EX–N5	193.56	130.1	301.5	
N5	EX–N6, EX–N7	109.02	18.1	133.2	
S1	ET–31, EX–S4	112.74	23.8	140.3	
S2	ET–31, ET–32, EX–N5, EX–S4	306.30	175.7	413.0	
S3	ET–31, ET–32, EX–N5, EX–S4 EX–S5	401.11	189.8	457.2	
S4a	ET–25, ET–27 ET–28	377.65	83.8	534.8	
S5a	ET–18a, ET–18b ET–19	68.41	22.9	96.5	
S4	ET–24, ET–25 ET–27, ET–28 EX–S7	614.86	337.5	777.1	
S5	ET–18a, ET–18b ET–19, EX–S8	204.90	61.3	298.0	

EAST TRIBUTARY KIOWA DBPS FLOW DATA

DESIGN POINT	RUNOFF 5 YR (CFS)	RUNOFF 100 YR (CFS)
ET9	100	4220
ET10	100	3990
ET11	90	2990
ET12	90	2960
ET13	80	2860

CORE ENGINEERING GROUP
15004 1ST AVENUE S.
BURNSVILLE, MN 55306
PH: 719.570.1100
CONTACT: RICHARD L. SCHNIDLER, P.E.
EMAIL: rich@ceg1.com

NO.	DESCRIPTION	DATE

PREPARED FOR:
LORSON LLC
212 NORTH WAHSATCH AVE, SUITE 301
COLORADO SPRINGS, COLORADO 80903 (719) 635-3200
CONTACT: JEFF MARK

PROJECT:
LORSON RANCH EAST MDDP
EAST OF THE EAST TRIBUTARY
EL PASO COUNTY, COLORADO

DRAWN: LAB
DESIGNED: LAB
CHECKED: RLS

EXISTING CONDITIONS ROLLING HILLS RANCH MDDP SOUTH PORTION

DATE: SEPTEMBER, 2023

PROJECT NO. 100.300

SHEET NUMBER 2

TOTAL SHEETS: 2

DESIGN POINT SUMMARY TABLE				
DESIGN POINT	DRAINAGE AREA	RUNOFF 5 YR (CFS)	RUNOFF 100 YR (CFS)	COMMENTS
A1a	68.41	22.9	96.5	
A2a	151.96	135.6	347.4	
A3a	188.34	192.4	473.8	
A4a		86.1	285.6	POND OUTFLOW
B1a	386.33	79.9	492.3	
B2a	61.14	73.4	163.3	
B3a	66.16	79.2	176.2	
B4a	410.91	98.2	527.1	
B5a	515.40	184.7	718.9	
B6a		129.1	419.1	POND OUTFLOW
B7a			1289.6	SEE REPORT
C1a		21.6	172.8	POND OUTFLOW
D1a		15.5	109.9	POND OUTFLOW
D2a		19.6	43.6	
D3a				NOT USED
D4a			260.5	PIPE FLOW
E1a	111.97	33.3	191.6	
E2a		44.7	235.1	POND OUTFLOW
E3a	602.40	306.4	747.7	
E4a		306.4	747.7	PIPE FLOW
F1a		8.7	77.7	POND OUTFLOW
F2a	27.54	7.4	47.7	
F3a		1.1	13.2	POND OUTFLOW
J1a		12.8	116.3	POND OUTFLOW
K1a		10.2	116.0	POND OUTFLOW
L1a		25.8	202.9	POND OUTFLOW

EAST TRIBUTARY KIOWA DBPS FLOW DATA		
DESIGN POINT	RUNOFF 5 YR (CFS)	RUNOFF 100 YR (CFS)
ET12	90	2960
ET13	80	2860
ET14	80	2640
ET15	50	1720

LEGEND

- BASIN BOUNDARY–MAJOR
- BASIN BOUNDARY–MINOR
- SKETCH PLAN BOUNDARY
- CONCEPTUAL STORM SEWER/INLETS
- 6690 — PROPOSED CONTOURS
- X — BASIN DESIGN POINT
- BASIN XXAC X.X | X.X — BASIN I.D. / ACREAGE / 5 YR/100 YR CFS
- DIRECTION OF FLOW
- 6690 — EXISTING CONTOUR
- EX. 100–YR FLOODPLAIN
- HP — HIGH POINT
- LP — LOW POINT
- DETENTION POND
- TIME OF CONCENTRATION

NOTES:

1. ALL DETENTION PONDS, RIGHTS–OF–WAY AND STORM SEWERS PRESENTED HERE ARE SCHEMATIC IN NATURE, AND ARE SHOWN FOR INFORMATION ONLY. FINAL DESIGN OF DRAINAGE SYSTEM WILL OCCUR WITH THE DESIGN OF THE ROADS AND SUBDIVISIONS.

2. PROPOSED DETENTION PONDS WITHIN THE EXISTING 325' ELECTRICAL TRANSMISSION LINE EASEMENT WILL NEED TO BE DESIGNED WITH A 40' BUFFER FROM EXISTING POWER POLES.

CORE ENGINEERING GROUP
15004 1ST AVENUE S.
BURNSVILLE, MN 55306
(952) 345-5670
CONTACT: RICHARD L. SCHINDLER, P.E.
EMAIL: Rich@ceg1.com

NO.	DESCRIPTION	DATE

PREPARED FOR:
THE LANDHUIS CO
212 NORTH WAHSATCH AVE, SUITE 301
COLORADO SPRINGS, COLORADO 80903
(719) 635–3200
CONTACT: JEFF MARK

PROJECT:
BULL HILL/ROLLING MEADOWS MDDP
EL PASO COUNTY, COLORADO

DRAWN: RLS
DESIGNED: LAB
CHECKED: RLS

OVERALL DEVELOPED CONDITIONS
BULL HILL / ROLLING MEADOWS MDDP
-

DATE: SEPTEMBER, 2023

PROJECT NO. 100.300

SHEET NUMBER 1

TOTAL SHEETS: 3

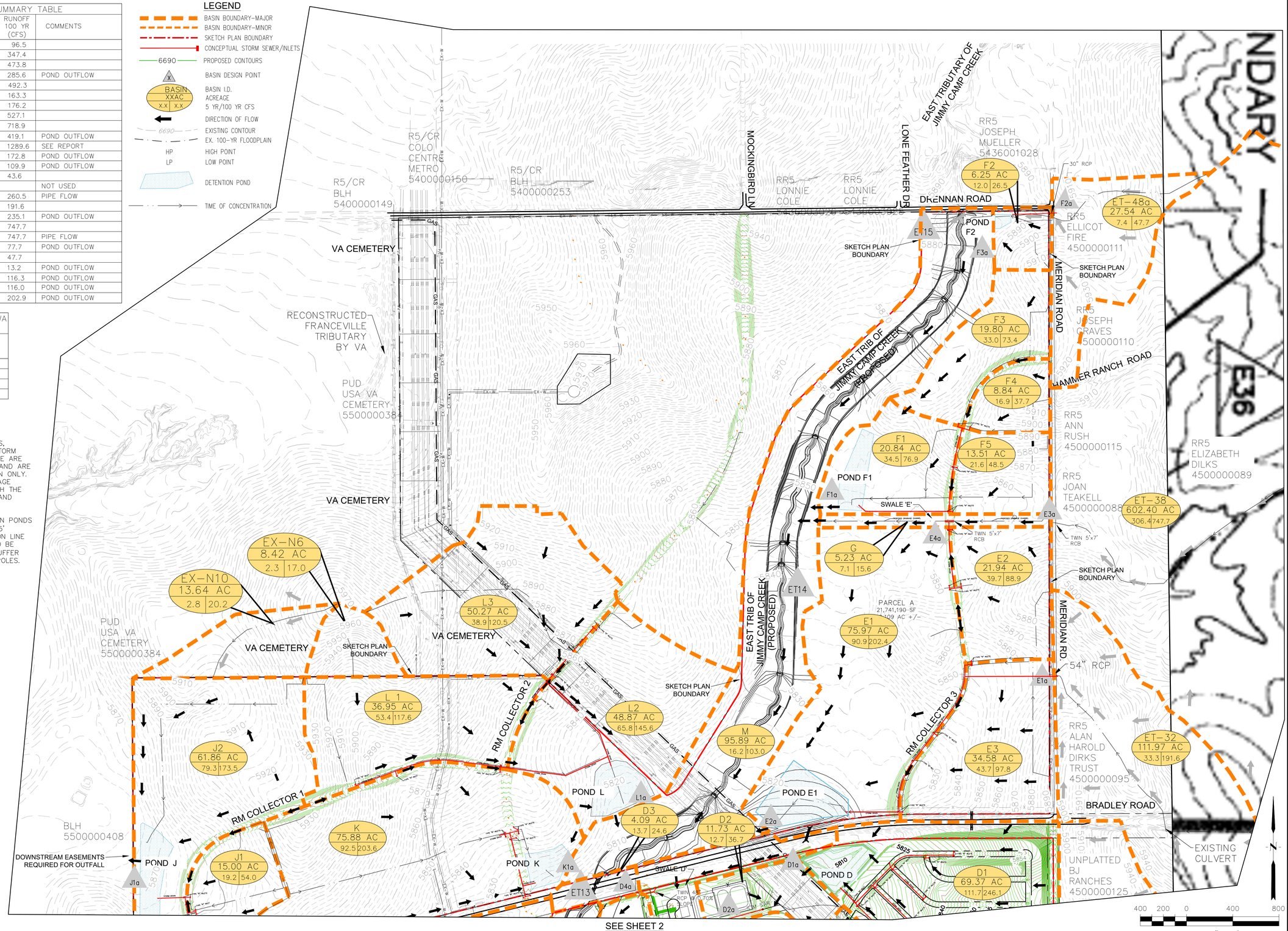
DESIGN POINT SUMMARY TABLE				
DESIGN POINT	DRAINAGE AREA	RUNOFF 5 YR (CFS)	RUNOFF 100 YR (CFS)	COMMENTS
A1a	68.41	22.9	96.5	
A2a	151.96	135.6	347.4	
A3a	188.34	192.4	473.8	
A4a		86.1	285.6	POND OUTFLOW
B1a	386.33	79.9	492.3	
B2a	61.14	73.4	163.3	
B3a	66.16	79.2	176.2	
B4a	410.91	98.2	527.1	
B5a	515.40	184.7	718.9	
B6a		129.1	419.1	POND OUTFLOW
B7a			1289.6	SEE REPORT
C1a		21.6	172.8	POND OUTFLOW
D1a		15.5	109.9	POND OUTFLOW
D2a		19.6	43.6	
D3a				NOT USED
D4a			260.5	PIPE FLOW
E1a	111.97	33.3	191.6	
E2a		44.7	235.1	POND OUTFLOW
E3a	602.40	306.4	747.7	
E4a		306.4	747.7	PIPE FLOW
F1a		8.7	77.7	POND OUTFLOW
F2a	27.54	7.4	47.7	
F3a		1.1	13.2	POND OUTFLOW
J1a		12.8	116.3	POND OUTFLOW
K1a		10.2	116.0	POND OUTFLOW
L1a		25.8	202.9	POND OUTFLOW

EAST TRIBUTARY KIOWA DBPS FLOW DATA		
DESIGN POINT	RUNOFF 5 YR (CFS)	RUNOFF 100 YR (CFS)
ET12	90	2960
ET13	80	2860
ET14	80	2640
ET15	50	1720

NOTES:

1. ALL DETENTION PONDS, RIGHTS-OF-WAY AND STORM SEWERS PRESENTED HERE ARE SCHEMATIC IN NATURE, AND ARE SHOWN FOR INFORMATION ONLY. FINAL DESIGN OF DRAINAGE SYSTEM WILL OCCUR WITH THE DESIGN OF THE ROADS AND SUBDIVISIONS.

2. PROPOSED DETENTION PONDS WITHIN THE EXISTING 325' ELECTRICAL TRANSMISSION LINE EASEMENT WILL NEED TO BE DESIGNED WITH A 40' BUFFER FROM EXISTING POWER POLES.



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BURNSVILLE, MN 55306
(952) 915-5544
CONTACT: RICHARD L. SCHINDLER, P.E.
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NO.	DESCRIPTION	DATE

PREPARED FOR:
THE LANDHUIS CO
212 NORTH WAHSATCH AVE, SUITE 301
COLORADO SPRINGS, COLORADO 80903
(719) 635-3200
CONTACT: JEFF MARK

PROJECT:
BULL HILL/ROLLING MEADOWS MDDP
EL PASO COUNTY, COLORADO

DRAWN: RLS
DESIGNED: LAB
CHECKED: RLS

OVERALL DEVELOPED CONDITIONS
BULL HILL / ROLLING MEADOWS MDDP
-

DATE:
SEPTEMBER, 2023

PROJECT NO.
100.300

SHEET NUMBER
3

TOTAL SHEETS: 3