FINAL DRAINAGE REPORT FOR WATERBURY FILINGS NO. 1 & 2 EL PASO COUNTY, COLORADO

PUDSP-21-005

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FINAL DRAINAGE REPORT FOR
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DESIGN ENGINEER'S STATEMENT:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable 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.

_____ _____
Quentin Armijo, P.E. 37170 Date
On behalf of Terra Nova Engineering, Inc.

OWNER/DEVELOPER'S STATEMENT:

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

_____ _____
Authorized Signature Date

_____
Printed Name, Title

_____
Business Name

_____
Address

EL PASO COUNTY:

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

_____ _____
Jennifer Irvine, P.E. Date
County Engineer / ECM Administrator

Conditions:

FINAL DRAINAGE REPORT FOR WATERBURY FILINGS NO. 1 & 2 EL PASO COUNTY, COLORADO

INTRODUCTION

The purpose of this Final Drainage Report is to identify and analyze the proposed drainage patterns, determine proposed runoff quantities, size drainage structures for conveyance of developed runoff based upon the overall development of single-family homes along with all the supporting infrastructure to go along with the Construction Drawings, while following the guidelines of the 4-step process.

This site was previously submitted as Waterbury Phase 1 Preliminary Plan with 3 separate filings by Classic Consulting Engineers & Surveyors, LLC. The Final Drainage Report for Filing 1 along with the construction drawings were approved in September of 2016 by EL Paso County Development Services and the Final Drainage Report for Filing 2 along with the construction drawings were submitted for review in September of 2017 and comments given back in September of 2017. Filing 3 had been preliminary designed but nothing submitted to EL Paso County. Since this time the owner has revised the lot layout and removed the alleys shown in Filings 1 & 2. All the public roadways have remained the same with the exception of the ROW for Saybrook Road from Stapleton to Bayshore Way, where the it changed from 65' to 89'. The site will now be developed in 2 Filings, Filing 1 & Filing 2. With these changes El Paso County Development Services has requested that we submit a new Preliminary Plan and the associated MDDP for these revisions. The recently submitted "Master Development Drainage Plan and Preliminary Drainage Report for Waterbury Filings No. 1 & 2"and is under concurrent review with this Final Drainage Report.

GENERAL DESCRIPTION

Waterbury Filings 1 & 2 consists of 61.93 acres and is part of a larger development of 322.0 acres to be developed over time and in multiple filings. A PUD Development Plan, Zoning and Conceptual plans have all been previously processed and approved with El Paso County. Filing 1 is 29.44 acres with 108 single family units, while Filing 2 is 32.44 acres 93 single family lots.

The site is in the SE 1/4 of Sections 28, SE ¼ 29 & NW 1/4 33, Township 12 South, Range 64 West of the 6th Principal Meridian within El Paso County, Colorado. The site is bounded to the west by natural channel and 4-Way Ranch Filing No. 1. To the south by Stapleton Drive. To the north by unplatted land consisting of future Waterbury Filings, and to the west by a natural channel unplatted land consisting of future Waterbury Filings (See vicinity map, Appendix A).

The site consists of 100% Columbine Gravelly (19) per the USDA, NRCS web soil survey. The hydrologic soil group "A" was used to represent the soil types and determine the onsite basin overland flow. (See map in appendix)

The study area consists of undeveloped land that has existing vegetation consisting of established native grasses. A ridge running north to south splits the site with the west 1/3 draining southwest with average slopes of 0% to 3% and the remaining 2/3 drains southwest with average slopes of 0% to 3%. There are no existing on-site improvements.

The site has been analyzed in several approved studies including the following "Revision to the MDDP for Meridian Ranch, EL Paso County, Colorado", approved October 2005, and prepared by PBS&J. "Final Drainage Report for 4-Way Ranch Phase 1" by JR Engineering Dated March 2006. The "Geick Ranch Drainage Basin Planning Study" dated February 2008, and preprepared by Drexel Barrel & Co. The "Preliminary/Final Drainage Report for Meridian Ranch filing No. 3" by Tech Contractors, November 2011. The "Master Development Drainage Plan, 4-Way Ranch – Phase 1" by Advanced Design Professionals, Inc. dated January 2012. The "Preliminary Drainage Report for Waterbury (Phase 1 Preliminary Plan) dated June 2013 by Classic Consulting analyzes this area in more detail and then Classic followed up with the "Final Drainage Report for Waterbury Filing No. 1" dated September 2016 which studied a portion of the area now being developed. The most recent study is the "Master Development Drainage Plan and Preliminary Drainage Report for Waterbury Filings No. 1 & 2" submitted concurrently with this report.

As-built field survey data is the basis for the design of the drainage basins.

The Waterbury site lies within the Geick Ranch and the Haegler Drainage Basins, storm runoff drains

southerly via 2 existing natural waterways, one bordering the site on the east (Haegler Drainage Basin) and one on the west (Geick Ranch Drainage Basin). These 2 channels eventually drain to Black Squirrel Creek and ultimately the Arkansas River.

EXISTING DRAINAGE CONDITIONS

As mentioned above here are 2 major drainage ways on the east and west side of the site. In the previously approved "Final Drainage Report for Waterbury Filing 1" dated September 2016 prepared by Classic Consulting Engineering & Surveying the floodplain along the west side of the site was determined by Kiowa Engineering in a 2004 LOMR (04-08-0012) using a HEC-RAS analysis modeling developed flows along the channel from the 3-42" culverts under Eastonville Road south to the existing stock pond (Design Point 13) south of Stapleton Drive with proposed and existing improvements such as the proposed 42" dual culverts located at the Gilbert Road crossing and existing dual 4' x 8' box culverts at Stapleton Drive (see appendix for HEC-RAS model). As part of the revised Preliminary Plan submittal for the site revisions an analysis of the eastern channel by ECO Systems found that this drainage channel is a jurisdictional waters of the U.S. with associated jurisdictional wetland habitat. Therefore, to comply with Section 404 of the Clean Water Act, we must meet the 404(b)(1) project review criteria, which include impact avoidance and minimization. The option the client plan to take is to minimize Project-wide impacts to 0.5-acre or less such that the pre-approved Nationwide Permits (NWP) may be used.

In the existing condition runoff from Filing 2 sheet flows south onto Filing 1 and from here the runoff is directed southwest and southeast overland to the existing channels on the west and eastside of the site. Below is a description of the existing condition's Design Points, Basins and site runoff.

There are 3 offsite basins that drain existing runoff onto the site from the north under Eastonville Road through culverts. There is also unplatted open space just north of the proposed Waterbury Filing No. 1 & 2.

At Design Point 10A 3-42" RCP that routes runoff from a temporary sediment pond south onto the property (Basin OS-5). The "Preliminary/Final Drainage Report for Meridian Ranch Filing No. 3" and shows flows of Q_5 = 28 cfs, Q_{100} = 153 cfs while the Meridian Ranch MDDP shows a 100-year

flow of 185 cfs. This larger flow is used in the HEC-RAS model for downstream channel analysis and culvert design. As mentioned above in the Floodplain Statement section the natural channel along the west side of the site is a recognized FEMA floodplain. This channel in the Haegler Creek Basin drains south to Stapleton Drive where dual 4' x 8' concrete box culverts route the water south in its natural path.

Design Point EX1 consist of onsite Basin EXA's 9.62 acres and offsite Basin OS-5's 6.74 acres, which both consist of undeveloped open space prairie and the FEMA flood channel and the runoff form Design Point EX10A mentioned above travel in the channel south to the southern boundary of our site. the combined flow from these upstream basins and our onsite basins that contribute to the flow is Q_5 = 38 cfs, Q_{100} = 198 cfs. This report does not analyze the flow coming from the adjacent Subdivision as the culverts were previously sized and installed in the approved Classic Consulting "Final Drainage Report for Waterbury Filing No. 1" dated September 2016.

Design Point EX2 is a point at the southern boundary of Filing 1 where runoff (Q_5 = 1 cfs, Q_{100} = 9 cfs) from Basin EXB's 4.09 acres of undeveloped prairie flow into Stapleton Road.

Design Point EX3 consists of a shallow swale that leave the site at the south east boundary. Runoff (Q_5 = 0 cfs, Q_{100} = 1 cfs) from Basin OS-4's 0.29 acres is directed south onto Basin EXC. The runoff (Q_5 = 7 cfs, Q_{100} = 45 cfs) form Basin EXC's 24.80 acres is combined with the Basin's OS-4. The combined runoff (Q_5 = 7 cfs, Q_{100} = 45 cfs) is directed offsite and shortly later in the existing channel in the Geick Ranch Basin.

Design Point EX4 is a point at the southern boundary of Filing 1 where runoff (Q_5 = 0 cfs, Q_{100} = 1 cfs) from Basin OS-3's 1.11 acres of undeveloped prairie flows south onto Basin EXD's 15.87 acres (Q_5 = 5 cfs, Q_{100} = 31 cfs). The combined flow (Q_5 = 5 cfs, Q_{100} = 33 cfs) travels south and drains into the existing channel along the eastern boundary.

At Design Point EX10 a 36" RCP culvert that drains from north to south under Eastonville Road (Basin OS-8) onto the undeveloped open space north (Basin OS-2) of the proposed Filing 2 layout. The Meridian Ranch MDDP states the runoff is Q_5 = 5 cfs, Q_{100} = 11 cfs.

Design Point EX5 consists of a swale that leave the site at the south east boundary. Runoff (Q_5 = 3 cfs, Q_{100} = 22 cfs) from Basin OS-2's 11.40 acres and Design Point EX10 is directed south onto Basin EXE. The runoff (Q_5 = 2 cfs, Q_{100} = 14 cfs) form Basin EXE's 5.83 acres is combined with the Basin's OS-4. The combined runoff (Q_5 = 5 cfs, Q_{100} = 33 cfs) of the 3 basins is directed offsite and into the existing channel in the Geick Ranch Basin.

At Design Point EX10 a 36" RCP culvert that drains from north to south under Eastonville Road (Basin OS-8) onto the undeveloped open space north of the proposed Filing 2 layout. The Meridian Ranch MDDP states the runoff is Q_5 = 5 cfs, Q_{100} = 11 cfs.

At Design Point EX9 (Basin OS-9) is another 36" RCP that routes the runoff (Q_5 = 8 cfs, Q_{100} = 19 cfs) under Eastonville Road and onto the open space in Basin OS-1. The runoff (Q_5 = 13 cfs, Q_{100} = 85 cfs) from Basin OS-1's 45.02 acres is routed south via the existing channel located in the Geick Ranch Basin. An analysis found that this drainage channel is a jurisdictional waters of the U.S. with associated jurisdictional wetland habitat. Basin EXF's 1.62 acres is a small area consisting of open space prairies located at the north east corner of the site. Runoff Q_5 = 1 cfs, Q_{100} = 4 cfs) from Basin EXF is directed onto Basin OS-1 along the eastern boundary at Design Point EX6.

Design Point EX7 is a point in the channel that corresponds to the proposed Design Point 30. The combined flow of Basin OS-1, Design Points EX5, EX 7, & EX9 at DP EX7 is Q_5 = 21 cfs, Q_{100} = 107 cfs).

PROPOSED DRAINAGE DESCRIPTION

The overall site will be developed in several Filings with each filing requiring its own final drainage report. The Proposed Major Basin Descriptions below is for Waterbury Filings 1 & 2 development and the preliminary layout of the future filings to the north tributary to the storm drain system and detention ponds in Filings 1 & 2. This future area is shown as fully developed to analyze the ultimate storm drain capacity and pond volumes. In the section below labeled Hydrologic Analysis for Filing 1 FDR the interim condition will be discussed and how runoff is captured and routed safely to the proposed private EDB for Filings 1 & 2 construction. See the Proposed MDDP Drainage Map in the

appendix for a visual representation of the below Basin descriptions.

Design Point 1 is a proposed public 6' D10-R sump inlet located in the west flowline of Saybrook drive just north of the roundabout. Basin A's 3.39 acres consists of roadway and single-family development. Runoff (Q_5 = 5 cfs, Q_{100} = 12 cfs) sheet flows into street sections and then is routed south via c&g where the inlet captures the flow.

Design Point 2 is a proposed public 4' D10-R sump inlet located in the west flowline of Saybrook drive opposite of DP 1. Basin C's 0.86 acres is comprised of roadway and single-family development. Runoff (Q_5 = 2 cfs, Q_{100} = 4 cfs) drains overland to the street and then to the inlet. Pipe run 1 an 18" RCP routes the flow to a junction at DP 1. Pipe Run 2 a public 24" RCP routes the combined flow (Q_5 = 7 cfs, Q_{100} = 15 cfs) of DP 1 & 2 down Saybrook Road and then down Bayshore Drive over to manhole junction in Sandy Neck Way.

Design Point 3 is a proposed public 4' D10-R sump inlet located in the east flowline of Sandy Neck Way. Basin B1's 2.30 acres consists of roadway and single-family development. Runoff (Q_5 = 4 cfs, Q_{100} = 8 cfs) is directed south to Design Point 3. The 4' D10-R sump inlet captures the entire flow. Pipe run 3 an 18" public RCP storm sewer routes the flow west to a manhole junction with Pipe run 4.

Design Point 4 is a proposed public 4' D10-R sump inlet located in the west flowline of Sandy Neck Way opposite of DP 3. Basin B2's 2.69 acres consists of roadway and single-family development. Runoff (Q_5 = 4 cfs, Q_{100} = 9 cfs) is routed to Design Point 4. The 4' D10-R sump inlet captures the entire flow. Pipe run 4 an 18" public RCP storm sewer routes the flow west to a manhole junction with Pipe run 3. Pipe run 5 a 24" RCP routes the combined (Q_5 = 8 cfs, Q_{100} = 17 cfs) flow of Pipe runs 3 & 4 south down Sandy Neck Way to the manhole junction with Pipe run 2. Pipe run 6 a public 30" RCP then routes the combined (Q_5 = 15 cfs, Q_{100} = 32 cfs) flow of Pipe runs 2 & 5 south down Sandy Neck Way to a junction at Design Point 5.

Design Point 5 is a proposed public 6' D10-R sump inlet located in the west flowline of Sandy Neck Way. Runoff (Q_5 = 4 cfs, Q_{100} = 9 cfs) from Basin F's 2.18 acres consisting of single-family

development is directed to the east flow line of Sandy Neck Way and then south to the cul-de-sac bulb low point. Runoff (Q_5 = 2 cfs, Q_{100} = 5 cfs) from Basin H's 1.13 acres consisting of single-family development is directed to the west flow line of Sandy Neck Way and then south to the cul-de-sac bulb low point. The combined flow (Q_5 = 6 cfs, Q_{100} = 14 cfs) at DP 5 is captured in the 6' D10-R sump inlet and then is routed to the pond along with the flow from Pipe Run 6 via a proposed 36" public RCP storm sewer (Pipe run 7) to Design Point a junction with Pipe run 3. If this inlet were blocked, runoff would overtop the curb and flow sown the storm drain tract and into the proposed FSD Pond 1 (Design Point 8).

Design Point 6 is a proposed public 4' D10-R sump inlet located in the west flowline of Saybrook Road. Runoff (Q_5 = 4 cfs, Q_{100} = 8 cfs) from Basin D's 2.11 acres consisting of single-family development is directed to the low point in Saybrook Road. It is then routed via a proposed 18" public RCP storm sewer (Pipe run 8) to a manhole junction with Pipe run 9.

Design Point 7 is a proposed public 4' D10-R sump inlet located opposite of DP 6 in Saybrook Road. Runoff (Q_5 = 4 cfs, Q_{100} = 8 cfs) from Basin E's 2.18 acres consisting of roadway and single-family lots is directed via side lot line swales and C&G to the proposed inlet. The 4' inlet captures all of the flow and Pipe run 9 a public 18" diameter RCP storm sewer routes the flow to a manhole junction at with Pipe run 8. The combined flows (Q_5 = 7 cfs, Q_{100} = 15 cfs) of Pipe runs 8 & 9 are routed south down Saybrook Road to the proposed FSD Pond 1 Design (Design Point 8).

Design Point 8 is a proposed private Full Spectrum Detention Basin called Pond 1. Design Points 1-7 are routed to the pond and treated for Water Quality and Detention along with Basin K's 3.06 acres consisting mainly of the EDB area and rear yards. Runoff (Q_5 = 3 cfs, Q_{100} = 11 cfs) sheet flows into the EDB. The basins tributary to Design Point 21 are Basins A, B1, B2, C, D, E, F, H & K with a total area of 19.91 acres. The 100-year effective impervious area of 48.7% was calculated using UD-BMP Version 3.07 IRF spreadsheet. This information was entered into the UD-Detention_v4.03 spreadsheet and the calculation yielded a required a WQCV of 0.324 ac-ft, a EURV of 0.703 ac-ft and a 100-year detention volume of 0.650ac-ft. This gave a total required volume of 1.667 ac-ft. The top of pond is set at 6930.00, with a bottom of pond at 6923.50. The pipes and swales to the pond discharge into 2 concrete forebays (3% WQCV see calcs in appendix) with 18" high walls and a 3"

notch to release minor flows into 2' wide concrete tickle channel. The trickle channel directs runoff to the proposed concrete micro-pool at the surcharge elevation of 6923.83. The bottom of the micro-pool is set at 6921.00 and the top set at 6923.50. A proposed 4' x 4' outlet box with the grate set at 6926.56, an outlet plate on the front to meet the 3-orifice requirement and an 18" outlet pipe with a restrictor plate set 7.0" above the invert will route all runoff from the pond. The metal plate will have 1 column containing 3 rows of 1-13/16" diameter orifice holes spaced 12.9" apart starting at 6923.50. The WQCV release is 0.20 cfs with a ponding elevation of 6925.14 and takes 40 hours to release. The EURV release is 0.4 cfs, with an elevation of 6926.54 and takes 70 hours to release. The 100-year detention release is 8.3 cfs, with an elevation of 6927.29 and takes 71 hours to release. A 30' long riprap emergency spillway set at 6928.00 will allow the 100-year developed peak in flow (Q_{100}= 29.1 cfs) with a depth of 0.46' (top of water = 6928.46) to be routed west into the natural channel. 1.00' freeboard is provided (see appendix). The spillway and downhill slope will be armored with d50= VH 24" riprap. Pipe Run 10A a private 18" RCP will route the pond release into the existing natural channel. (See Pond Calculations in appendix).

Design Point 9 is an existing 36" RCP culvert under Eastonville Road where Offsite Basin OS-9 discharges onto offsite Basin OS-2. Runoff (Q_5 = 8 cfs, Q_{100} = 19 cfs) from Basin OS-9's 11.80 acres consists of historic flow based upon upstream detention. Further breakdown of this flow will be discussed with analysis of Design Point 29 and the discussion for Tributary flow to the FSD Pond 3.

Design Point 10 is an existing 36" RCP culvert under Eastonville Road south of the existing High School Pond where Offsite Basin OS-8 discharges onto a future Waterbury Filing. Runoff (Q_5 = 5 cfs, Q_{100} = 11 cfs) from Basin OS-10's 3.41 acres consists of historic flow based upon upstream detention. In the ultimate buildout this flow will be piped west to the existing natural channel along the westside of Waterbury and to Offsite Basin OS-5. Until the future filings are built this flow will follow its natural channel south to the existing channel located along the eastern boundary of Filings 1 & 2. This will be discussed again in the Preliminary Drainage Report section below.

Design Point 10A is another crossing under Eastonville Road where existing 3-42" RCP culverts route the flow (Q_5 = 28 cfs, Q_{100} = 135 cfs) from the temporary Meridian Ranch pond per the Meridian Ranch MDDP. The pipes discharge onto Offsite Basin OS-5. Offsite Basin OS-5's 5.64

acres consists of future Waterbury rear lots, open space and the natural channel. Runoff (Q_5 = 10 cfs, Q_{100} = 23 cfs) from OS-5 sheet flows to the channel. The flow is then routed south to Design Point 11

Design Point 11 is a proposed crossing under the proposed continuation of Gilbert Drive with dual 42" RCP culverts. Basin I's 5.66 acres consists of rear lots and the natural channel. Runoff (Q_5 = 5 cfs, Q_{100} = 19 cfs) sheet flows to the channel and is directed south Design Points 11. As mentioned above Kiowas Engineering did a HEC-RAS analysis modeling developed flows along the channel. There have been no design or layout changes to affect this model therefore this report will reference the original output data computed by this model. The combined flow of Design Points 10 & 10A along with Basins OS-5 and I is Q_5 = 53 cfs, Q_{100} = 212 cfs. This flow is routed south under Gilbert drive and onto Basin J. Basin I's runoff is treated downstream in a proposed EDB at Design Point 13

Design Point 12 is a proposed 18" RCP culvert under Gilbert Drive that routes the runoff (Q_5 = 2 cfs, Q_{100} = 4 cfs) from offsite Basin OS-6's 1.06 acres that is comprised of the eastern half of Thatcher Court located int 4-Way Ranch Filing 1 to the existing natural channel.

Basin J's 1.99 acres is comprised of rear lots and the existing channel along the west boundary. Runoff (Q_5 = 4 cfs, Q_{100} = 8 cfs) sheet flows into the channel and then is routed south to Design Point 13, an on-line existing stock pond that is being converted to an EDB to provide water quality for part of 4-Way Ranch Filing No. 1 and Waterbury Basins I, J & N.

Basin N's 0.22 acres is comprised of the proposed extension of Gilbert road form 4-Way Ranch into Waterbury. Runoff (Q_5 = 1 cfs, Q_{100} = 1 cfs) sheet flows into the channel and then is routed south to Design Point 13, an on-line existing stock pond that is being converted to an EDB to provide water quality for part of 4-Way Ranch Filing No. 1 and Waterbury Basins I, J & N.

In the previously approved "Final Drainage Report for Waterbury Filing No. 1" by Classic Consulting it was stated that there were 3 Stormwater Quality Ponds that needed to be provided for the adjacent 4-Way Ranch per conditions set forth by the Board of County Commissioners at approval of the Waterbury PUD Development Plan. Because there have been no changes to the tributary areas to

these 3 Ponds and they have already been designed and constructed this report will reference the original work done by Classic Consulting. Below is a brief description of the 3 Stormwater Quality Ponds. The original approved calculations and results can be found in the appendix of the original report along with the Basin Exhibit Map.

Stormwater Quality Pond 1 treats 56.8 acres of 4-Way Ranch Filing No. 1 from their Basins H, I, J, S, R & 60% of L. An EDB was designed between the existing Lots 15 and 35 using a 4' x 4' outlet set at 6924.00 with an orifice plate with 1 column of 10-15/16" diameter holes spaced 4" apart. The forebay top is set at 6920.5 with the bottom at 6918.00. The required volume was calculated to be 0.52 ac-ft and the design volume shown is 0.66 ac-ft. The release out of the pond was calculated to be Q_5 = 13 cfs, Q_{100} = 131 cfs.

Stormwater Quality Pond 2 treats 37.2 acres of 4-Way Ranch Filing No. 1 from their Basins F, G, K, & M. An EDB was designed along the south edge of existing Lot 15 using a 4' x 4' outlet set at 6918.00 with an orifice plate with 1 column of 9-13/16" diameter holes spaced 4" apart. The forebay top is set at 6915.00 with the bottom at 6914.75. The required volume was calculated to be 0.34 ac-ft and the design volume shown is 0.60 ac-ft. The release out of the pond was calculated to be Q_5 = 0.4 cfs, Q_{100} = 51 cfs.

Design Point 13 is Stormwater Quality Pond 3, an existing stock pond south of Stapleton Drive that will be converted to a EDB and treat 40.4 acres of 4-Way Ranch Filing No. 1 from their Basins OS-5, Os-6, D, E, N 40% of L, 50% of O, Q & basins I, J & N of Waterbury Filing No. 1. The EDB was designed using a 4' x 4' outlet set at 6907.50 with an orifice plate with 1 column of 8-1/8" diameter holes spaced 4" apart. The forebay top is set at 6915.00 with the bottom at 6914.75. The required volume was calculated to be 0.66 ac-ft and the design volume shown is 1.20 ac-ft. The release out of the pond was calculated to be Q_5 = 69 cfs, Q_{100} = 396 cfs.

Basin M1's 2.90 acres is comprised of the rear yards & open space tract along Stapleton Drive along with a portion of Saybrook Drive. Runoff (Q_5 = 5 cfs, Q_{100} = 12 cfs) sheet flows over the back yard and open space tract onto Stapleton Drive the channel and then is routed south overland. As mentioned in the "Final Drainage Report for Waterbury Filing No. 2" the area consists or pervious rear yards

that sheet flow over pervious area. El Paso County reviewers commented to provide a variance for this area not treated for Water Quality.

Basin M2's 0.47 acres is comprised of the rear yards adjacent to undeveloped land east of the site. Runoff (Q_5 = 1 cfs, Q_{100} = 2 cfs) sheet flows from the back yard onto the undeveloped. This area is not treated for water quality but is pervious area.

Design Point 14 is a low point in the knuckle of Beech Creek Drive with a proposed public 10' D10-R sump inlet. Runoff (Q_5 = 8 cfs, Q_{100} = 18 cfs) from Basin L1's 5.27 acres consisting of roadway and single-family lots is directed via side lot line swales and C&G to the proposed inlet. The 10' inlet captures all of the flow and Pipe run 11 a public 24" diameter RCP storm sewer routes the flow to a manhole junction with Pipe run 12.

Design Point 15 is a proposed public 4' D10-R sump inlet opposite of DP 14 in Beech Creek Drive Runoff (Q_5 = 8 cfs, Q_{100} = 18 cfs) from Basin L1's 5.27 acres consisting of roadway and single-family lots is directed via side lot line swales and C&G to the proposed inlet. The 4' inlet captures all of the flow and Pipe run 12 a public 18" diameter RCP storm sewer routes the flow to a manhole junction with Pipe run 11. Pipe run 13 a 30" RCP routes the combined flow (Q_5 = 11 cfs, Q_{100} = 24 cfs) of Pipe Runs 11 & 12 north in Beech Creek Drive to a manhole junction with Pipe run 14.

Design Point 16 is a proposed public 6' D10-R sump inlet located in the proposed western half of the private street of Beech Creek Drive. Runoff (Q_5 = 5 cfs, Q_{100} = 11 cfs) from Basin O1's 1.27 acres consisting of roadway and single-family lots is directed via side lot line swales and C&G to the proposed inlet. The 6' inlet captures all of the flow and Pipe run 14 a public 24" diameter RCP storm sewer routes the flow to a manhole junction with Pipe run 13. Pipe run 15 a 36" RCP routes the combined flow (Q_5 = 15 cfs, Q_{100} = 34 cfs) of Pipe Runs 13 & 14 west to a manhole junction with Pipe run 16.

Design Point 17 is a proposed public 4' D10-R sump inlet located opposite of DP 14 in Beech Creek Drive. Runoff (Q_5 = 1 cfs, Q_{100} = 3 cfs) from Basin O2's 0.94 acres consisting of roadway, parking, roof and landscape area sheet flows to the east flowline of Beech Creek Drive and to the proposed

inlet. After being captured by the inlet Pipe run 16. Pipe run 17 routes the combined flows (Q_5 = 17 cfs, Q_{100} = 37 cfs) of Pipe runs 15 and 16 are routed west offsite via a private 36" diameter RCP to Design Point 18 a proposed private temporary EDB. This is the FSD Pond 2.

Design Point 18 is a proposed temporary private Full Spectrum Detention Basin called Pond 2. Design Points 14-17 are routed to the pond and treated for Water Quality and Detention along with the Basin OS-4's 10.90 acres consisting of the EDB area and undeveloped upstream tributary area. Runoff (Q_5 = 2 cfs, Q_{100} = 16 cfs) from Basin OS-4 sheet flows into the EDB. The basins tributary to Design Point are L1, L2, O1, O2 and OS-4 with a total area of 21.93 acres. The 100-year effective impervious area of 24.5% was calculated using UD-BMP Version 3.07 IRF spreadsheet. This information was entered into the UD-Detention_v4.03 spreadsheet and the calculation yielded a required a WQCV of 0.243 ac-ft, a EURV of 0.264 ac-ft and a 100-year detention volume of 0.516 ac-ft. This gave a total required volume of 1.023 ac-ft. The top of pond is set at 6906.00, with a bottom of pond at 6899.00. The pipes and swales to the pond discharge into a concrete forebay (3% WQCV see calcs in appendix) with 18" high walls and a 3" notch to release minor flows into 2' wide concrete tickle channel. The trickle channel directs runoff to the proposed concrete micro-pool at the surcharge elevation of 6899.33. The bottom of the micro-pool is set at 6896.50 and the top set at 6899.00. A proposed 4' x 4' outlet box with the grate set at 6902.06, an outlet plate on the front to meet the 3-orifice requirement and an 18" outlet pipe with a restrictor plate set 12.0" above the invert will route all runoff from the pond. The metal plate will have 1 column containing 3 rows of 1-5/16" diameter orifice holes spaced 12.2" apart starting at 6899.00. The WQCV release is 0.10 cfs with a ponding elevation of 6901.22 and takes 40 hours to release. The EURV release is 0.2 cfs, with an elevation of 6902.06 and takes 58 hours to release. The 100-year detention release is 10.6 cfs, with an elevation of 6902.66 and takes 58 hours to release. A 20' long riprap emergency spillway set at 6904.00 will allow the 100-year developed peak in flow (Q_{100}= 20.7 cfs) with a depth of 0.47' (top of water = 6904.47) to be routed west into the natural channel. 1.00' freeboard is provided (see appendix). The spillway and downhill slope will be armored with d50= VH 24" riprap. Pipe Run 17A a private 18" RCP will route the pond release into the existing natural channel. (See Pond Calculations in appendix). When future filings are developed this temporary Pond 2 will be replaced with a permanent Pond as shown in the "Conceptual Drainage Report for Waterbury PUD Plan" prepared by Classic Consulting and dated November 2012.

The development of the overall Waterbury site will occur in several platting phases. The MDDP/PDR Waterbury Filings 1 & 2 analyzed the upstream tributary area as fully developed with future Waterbury Filings site. This allowed the sizing of the receiving storm drain infrastructure and EDB 3 to account for the increase in runoff from the developed upstream areas. With the design of Waterbury Filings 1 & 2 the site will have an interim condition where the area to the north will be unplatted natural open space with drainage patterns differing from the future full build out analysis in the MDDP/PDR report until such time that it is developed. The following is a description of the Design Points 19-30 altered by the interim state of undeveloped land upstream. In all cases the design flow is less than the ultimate build-out and therefore the inlets and pipes can capture and route the flow safely. See the "Master Development Drainage Plan and Preliminary Drainage Report for Waterbury Filings No. 1 & 2" for calculations showing the higher runoff values. The ultimate runoff quantities from the MDDP are also discussed for use in the UD-Sewer models.

Design Point 19 is a proposed 8' D10-R sump inlet located in the south curb of Muddy Pond Street. Runoff (Q_5 = 0 cfs, Q_{100} = 1 cfs) from Basin OS-Q1's 0.33 acres consists of undeveloped land and will sheet flow onto Basin Q1. Runoff (Q_5 = 2 cfs, Q_{100} = 4 cfs) from Basin Q1's 1.04 acres is directed to the 8' inlet. The combined flow (Q_5 = 2 cfs, Q_{100} = 5 cfs) is captured in the inlet and Pipe run 18 a 24" RCP diameter storm routes the flows to a manhole junction with Pipe run 19. For the design of Pipe run 18 Q_5 = 7 cfs, Q_{100} = 15 cfs were used.

Design Point 20 is a proposed 4' D10-R sump inlet located opposite of DP 19. Runoff (Q_5 = 0 cfs, Q_{100} = 1 cfs) from Basin OS-Q2's 0.22 acres consists of undeveloped land and will sheet flow onto Basin Q2. Runoff (Q_5 = 2 cfs, Q_{100} = 5 cfs) from Basin Q2's 1.10 acres is directed to the 4' inlet. The combined flow (Q_5 = 2 cfs, Q_{100} = 5 cfs) is captured in the inlet and Pipe run 19 an 18" RCP diameter storm routes the flows to a manhole junction with Pipe run 18. Pipe Run 20 a 24" RCP storm routes the combined flow (Q_5 = 4 cfs, Q_{100} = 9 cfs) of Pipe runs 19 & 20 east down Muddy Pond Street east down Muddy Pond Street to a manhole junction with Pipe run 21. For the design of Pipe run 19 Q_5 = 3 cfs, Q_{100} = 8 cfs were used. For the design of Pipe run 20 Q_5 = 10 cfs, Q_{100} = 21 cfs were used.

Design Point 21 is a proposed 12' D10-R at-grade inlet located in the north curb of Muddy Pond Street just east of Masonboro Way intersection. Offsite Basin OS-8' runoff of Q_5 = 5 cfs, Q_{100} = 11 cfs is discharged onto the undeveloped Basin OS-R. Runoff (Q_5 = 3 cfs, Q_{100} = 21 cfs) from Basin OS-R's 10.11 acres consists of undeveloped land and will sheet flow onto Basin R. Runoff (Q_5 = 0 cfs, Q_{100} = 1 cfs) from Basin R's 0.13 acres is directed to the 12' inlet. The combined flow (Q_5 = 9 cfs, Q_{100} = 35 cfs) is routed to the inlet and Q_5 = 5 cfs, Q_{100} = 11 cfs is captured. Pipe run 21 an 18" RCP diameter storm routes the captured flow to a manhole junction with Pipe run 20. Pipe run 22 routes the combined flow (Q_5 = 9 cfs, Q_{100} = 20 cfs) of Pipe runs 20 & 21 east down Muddy Pond Street to a manhole junction with Pipe run 25. The bypass flow (Q_5 = 4 cfs, Q_{100} = 24 cfs) at DP 21 travels in the north flow line of Muddy Pond Street to Design Point 22. For the design of Pipe run 21 Q_5 = 5 cfs, Q_{100} = 9 cfs were used. For the design of Pipe run 22 Q_5 = 14 cfs, Q_{100} = 27 cfs were used.

Design Point 22 is a proposed 10' D10-R sump inlet located in the west curb of Megansett Way. Runoff (Q_5 = 0 cfs, Q_{100} = 0 cfs) from Basin OS-S1's 0.14 acres consists of undeveloped land and will sheet flow onto Basin S1. Runoff (Q_5 = 3 cfs, Q_{100} = 7 cfs) from Basin S1's 1.55 acres is directed to the 4' inlet. The combined flow (Q_5 = 5 cfs, Q_{100} = 23 cfs) of Basins OS-S1, S1 & the bypass flow from DP 21 is routed to the low point.

Design Point 23 is a proposed 10' D10-R sump inlet located opposite of DP 22. Runoff (Q_5 = 1 cfs, Q_{100} = 4 cfs) from Basin OS-S2's 1.92 acres consists of future single-family development and will be directed via lot line swales and c&g onto Basin S2. Runoff (Q_5 = 0 cfs, Q_{100} = 1 cfs) from Basin S2's 0.13 acres is directed to the 10' inlet. The combined flow at DP 23 is Q_5 = 1 cfs, Q_{100} = 5 cfs. Pipe run 23 a 24" RCP diameter storm routes the flow (Q_5 = 3 cfs, Q_{100} = 13 cfs) from the inlet at DP 22 to a manhole junction with Pipe run 24. Pipe Run 24 a 24" RCP storm routes the flow (Q_5 = 3 cfs, Q_{100} = 13 cfs) to the manhole junction with Pipe run 23. Pipe Run 25 a 30" RCP routes the combined flow (Q_5 = 6 cfs, Q_{100} = 27 cfs) of Pipe runs 23 & 24 south to a manhole junction with Pipe run 22 in Muddy Pond Street. Pipe run 26 a 36" RCP then routes the combined flow (Q_5 = 13 cfs, Q_{100} = 43 cfs) of Pipe runs 22 & 25 east in Muddy Pond to a manhole junction with Pipe runs 27 & 28. It is presumed that the combined flow (Q_5 = 6 cfs, Q_{100} = 27 cfs) at DP 22 & 23 is evenly split between

the 2-10' D10-R sump inlets in the ultimate condition. For the design of Pipe run 23 Q_5 = 8 cfs, Q_{100} = 19 cfs were used. For the design of Pipe run 24 Q_5 = 8 cfs, Q_{100} = 19 cfs were used. For the design of Pipe run 25 Q_5 = 16 cfs, Q_{100} = 38 cfs were used. For the design of Pipe run 25 Q_5 = 27 cfs, Q_{100} = 59 cfs were used.

Design Point 24 is a proposed 4' D10-R sump inlet located in the south curb of Muddy Pond Street. Runoff (Q_5 = 3 cfs, Q_{100} = 6 cfs) from Basin T1's 1.42 acres consists of single-family development and will be directed via lot line swales and c&g to the 4' inlet. Pipe run 27 an 18" RCP diameter storm routes the flow from the inlet to a manhole junction with Pipe runs 26 & 28. For the design of Pipe run 27 Q_5 = 3 cfs, Q_{100} = 6 cfs were used.

Design Point 25 is a proposed 4' D10-R sump inlet located opposite of DP 24. Runoff (Q_5 = 0 cfs, Q_{100} = 2 cfs) from Basin OS-T2's 0.76 acres consists of future single-family development and will be directed via lot line swales and c&g onto Basin T2. Runoff (Q_5 = 2 cfs, Q_{100} = 5 cfs) from Basin T2's 1.23 acres is directed to the 4' inlet. The combined flow at DP 25 is Q_5 = 2 cfs, Q_{100} = 6 cfs. Pipe run 28 an 18" RCP diameter storm routes the flow from the inlet to a manhole junction with Pipe runs 27 & 28. Pipe run 29 a 36" RCP then routes the combined flow (Q_5 = 17 cfs, Q_{100} = 52 cfs) of Pipe runs 26, 27 & 28 east in Muddy Pond Street and then south down Fish Camp Circle to a manhole junction with Pipe run 30. For the design of Pipe run 28 Q_5 = 3 cfs, Q_{100} = 7 cfs were used. For the design of Pipe run 29 Q_5 = 32 cfs, Q_{100} = 69 cfs were used.

Design Point 26 is a proposed 10' D10-R sump inlet located in the west curb of Fish Camp Circle near the Knuckle. Runoff (Q_5 = 7 cfs, Q_{100} = 16 cfs) from Basin U1's 4.38 acres consists of single-family development and will be directed via lot line swales and c&g to the 10' inlet. Pipe run 30 a 24" RCP diameter storm routes the flow from the inlet to a manhole junction with Pipe run 29. Pipe run 31 transports the combined flow (Q_5 = 22 cfs, Q_{100} = 64 cfs) of Pipe runs 29 & 30. For the design of Pipe run 30 Q_5 = 7 cfs, Q_{100} = 16 cfs were used. For the design of Pipe run 31 Q_5 = 37 cfs, Q_{100} = 81 cfs were used.

Design Point 27 is a proposed 6' D10-R sump inlet located opposite of DP 26. Runoff (Q_5 = 3 cfs, Q_{100} = 7 cfs) from Basin U2's 1.89 acres consists of future single-family development and will be

directed via lot line swales to the 6' inlet. Pipe run 32 an 18" RCP diameter storm routes the flow from the inlet to a manhole junction with Pipe runs 31. Pipe run 33 a 36" RCP then routes the combined flow (Q_5 = 25 cfs, Q_{100} = 70 cfs) of Pipe runs 31 & 32 east through a Drainage Tract to FSD Pond 3. For the design of Pipe run 32 Q_5 = 3 cfs, Q_{100} = 7 cfs were used. For the design of Pipe run 33 Q_5 = 40 cfs, Q_{100} = 87 cfs were used.

Design Point 28 is a proposed 10' D10-R sump inlet located in the future north curb of Sunken Meadow Road. This inlet is offsite in a future phase and will be built within a proposed drainage easement. The offsite curb and gutter in this area will also need to be built along with some temporary asphalt to direct runoff to the 10' inlet. Runoff (Q_5 = 8 cfs, Q_{100} = 18 cfs) from Basin W's 5.20 acres is captured in the inlet and routed to Pond 3 via Pipe run 24" RCP.

Design Point 29 is a proposed private Full Spectrum Detention Basin called FSD Pond 3. This pond is designed using the future upstream area layout to account for the full build out area tributary to FSD Pond 3 to make sure the capacity can account for the tributary area upstream. Therefore, the flowing analysis to size FSD Pond 3 is from the "Master Development Drainage Plan and Preliminary Drainage Report for Waterbury Filings No. 1 & 2". When the future Waterbury Filings upstream are developed a Final Drainage Report will need to re-analyze FSD Pond 3 and make sure the new development is still in conformance with this design. Design Points 19-28 and Offsite Basins OS-1, 2, 3A, 3B, 7, & 9 with a total area of 84.64 acres are routed to the pond and treated for Water Quality and Detention. The 100-year effective impervious area of 47.5% was calculated using UD-BMP Version 3.07 IRF spreadsheet. This information was entered into the UD-Detention_v4.03 spreadsheet and the calculation yielded a required a WQCV of 1.200 ac-ft, a EURV of 2.000 ac-ft and a 100-year detention volume of 4.165 ac-ft. This gave a total required volume of 7.365 ac-ft. The top of pond is set at 6930.00, with a bottom of pond at 6922.00. The pipes and swales to the pond discharge into a concrete forebay (3% WQCV see calcs in appendix) with 18" high walls and a 3" notch to release minor flows into 2' wide concrete tickle channel. The trickle channel directs runoff to the proposed concrete micro-pool at the surcharge elevation of 6922.33. The bottom of the micro-pool is set at 6899.50 and the top set at 6922.00. A proposed 6' x 6' outlet box with the grate set at 6926.59, an outlet plate on the front to meet the 3-orifice requirement and a 36" outlet pipe with a restrictor plate set 28.0" above the invert will route all runoff from the pond. The metal plate will

have 1 column containing 3 rows of 2" x 3" orifice holes spaced 18.3" apart starting at 6922.00. The WQCV release is 0.60 cfs with a ponding elevation of 6924.99 and takes 40 hours to release. The EURV release is 1.0 cfs, with an elevation of 6926.59 and takes 67 hours to release. The 100-year detention release is 60.7 cfs, with an elevation of 6927.75 and takes 67 hours to release. A 60' long riprap emergency spillway set at 6928.00 will allow the 100-year developed peak in flow (Q_{100}= 155.2 cfs) with a depth of 0.88' (top of water = 6928.88) to be routed west into the natural channel. 1.12' freeboard is provided (see appendix). The spillway and downhill slope will be armored with d50= VH 24" riprap. Pipe Run 35 a private 36" RCP will route the pond release into the existing natural channel. (See Pond Calculations in appendix).

Design Point 30 is a triple 36" RCP culvert crossing under Sunken Meadow Road. Offsite Basin OS-9 discharges onto Offsite Basin OS-1. Runoff (Q_5 = 3 cfs, Q_{100} = 18 cfs) from Basin OS-9's 11.80 acres consists of historic flow based upon upstream detention. Offsite Basin OS-1's 41.36 acres consists of undeveloped land and open space containing the natural channel. Runoff (Q_5 = 11 cfs, Q_{100} = 74 cfs) is directed south through the wetlands to the culverts. Basin V's 1.32 acres is comprised of the rear yards adjacent to the existing natural channel along the west side of the site. Runoff (Q_5 = 1 cfs, Q_{100} = 2 cfs) sheet flows from the back yard onto the undeveloped. This area is not treated for water quality but is pervious area that does not need water quality. The combined flow (Q_5 = 21 cfs, Q_{100} = 96 cfs) at DP 30 will be safely routed through the triple 36" RCP culverts (See appendix).

In an effort to protect receiving water and as part of the "four step process to minimize adverse impacts of urbanization" this site was analyzed in the following manner:

1. Reduce Runoff- The proposed impervious areas on the site are surrounded by landscaping and green space areas. Additionally, the new improvements and impervious areas on the site will be routed to a proposed private Extended Detention Basin. These items will reduce the volume of runoff using ponding and infiltration.
2. Stabilize Drainageways- There are 2 existing drainageways onsite. The westerly channel has been studied in HEC-RAS model and based upon calculations velocities are within the range for stabilized flow. The easterly channel has wetlands that allow the channel to stay stabilized.
3. Provide Water Quality Capture Volume (WQCV)- The 6 Extended Detention Basin have been sized and designed to sufficiently capture the required WQCV and slowly release it though

the three-hole outlet, thereby allowing solids and contaminants to settle out.

4. Consider Need for Industrial and Commercial BMPs- The proposed development is single family site; therefore, no Industrial and Commercial BMPs have been proposed.

HYDROLOGIC CALCULATIONS

The El Paso County Drainage Criteria Manual (EPCDCM), dated May 1994 was the resource used in this analysis with the exception for calculating the 5-year and 100-year design storm events. Chapter 6 of the City of Colorado Springs Drainage Criteria Manual (CSDCM) was referenced in determining rainfall and runoff for the proposed drainage system. Runoff was calculated using the Rational Method for developed conditions (see appendix). Runoff coefficients were calculated using weighted impervious values for each specific basin base upon Table 6.6 of the CSDCM. Table 6.5 was used for calculating intensity (see appendix). The Mile High Flood District Criteria Manuals was used to calculate the detention and water quality volume.

HYDRAULIC CALCULATIONS

Hydraulic calculations were estimated using the Manning's Formula and the methods described in the El Paso County Storm Drainage Design Criteria Manual – Volumes 1 & 2, latest editions. The pertinent data sheets are included in the appendix of this report.

For swale design the NRCS Open Channel Flow Calc Spreadsheet was used in the design of the swales. For inlet calculations El Paso County DCM Volume 1 Section 7.6.1. equations were used to check inlet capacity. HGL calculations were performed using the software UD-SEWER. Several culverts are proposed for the site. Design calculations using the Mile High Flood District Criteria Manual have been included for the proposed culverts.

FLOODPLAIN STATEMENT

A portion of this site along the western edge is within a designated F.E.M.A. floodplain, as determined by Flood Insurance Rate Map No. 08041C0552G December 7, 2018 (see appendix). The floodplain is shown on the proposed Drainage Map in the appendix along with the FEAM Firmette. Lots from Filings 1 & 2 abut the channel with rear lots lines, but are set to be outside of the floodplain. As mentioned in the previously approved "Final Drainage Report for Waterbury Filing 1" dated

September 2016 prepared by Classic Consulting Engineering & Surveying the floodplain was determined by Kiowa Engineering in a 2004 LOMR (04-08-0012) using a HEC-RAS analysis modeling developed flows along the channel from the 3-42" culverts under Eastonville Road south to the existing stock pond (Design Point 13) south of Stapleton Drive with proposed and existing improvements such as the proposed 42" dual culverts located at the Gilbert Road crossing and existing dual 4' x 8' box culverts at Stapleton Drive (see appendix for HEC-RAS model).

WATER QUALITY

The 3 proposed EDBs provides water quality treatment for a majority of the proposed development. Runoff from Basins I, J, M1 M2, N, P, & V are not captured by the proposed detention basins. These Basins consists or rear yards that flow directly into the 2 channels along the eastern and western boundary of the site. Section I.7.1.C.1 of the ECM allows up to 20%, not to exceed 1 acre, of a development site to not be treated for water quality. Therefore, the UD-BMP Version 3.07 Runoff Reduction spreadsheet was used to show that these areas have 100% WQCV reduction.

DRAINAGE FEES

The site lies within the Haegler Ranch & Geick Ranch Drainage Basins. Haegler Ranch Drainage Basin has an approved DBPS and the associated Drainage Basin Fees. There is no approved DBPS for Geick Ranch Drainage Basin and therefore no Drainage Basin Fees are listed for it.

WATERBURY FILING NO. 1

Haegler Ranch Total acreage of:

13.34 ac / 55 = 0.24 ac / lot

(Per El Paso County% impervious Chart 30%)

13.34 x 30% = 4.00 Impervious acres

The following calculations are based upon the 2021 Drainage & Bridge fees:

Drainage Fees:	$11,113 x 4.00 = **$44,452**
Bridge Fees:	$ 1,640 x 4.00 = **$ 6,560**

Fee Reduction (Assumed 50% construction costs for Detention Facilities)

FSD Detention Pond 1	$68,676 x 50% = $34,338

Total Deduction = $34,338 (Actual costs may vary this will be finalized prior to approval)

Filing 1 Drainage Fee Total: $44,452 - $34.338 = **$10,114**

Filing 1 Bridge Fee Total: $6,560

WATERBURY FILING NO. 2

Total acreage of:

6.56 ac / 35 = 0.19 ac / lot

(Per El Paso County% impervious Chart 30%)

6.56 x 30% = 1.97 Impervious acres

The following calculations are based upon the 2021 Drainage & Bridge fees:

Drainage Fees:	$11,113 x 1.97 = **$21,892**
Bridge Fees:	$ 1,640 x 1.97 = **$ 3,231**

Fee Reduction (Assumed 50% construction costs for Detention Facilities)

FSD Detention Pond 2	$35,845 x 50% = $17,923

Total Deduction = $34,338 (Actual costs may vary this will be finalized prior to approval)

Filing 2 Drainage Fee Total: $21,892 - $17,923 = **$3,969**

Filing 2 Bridge Fee Total: $3,231

MAINTENANCE

The 3 Extended Detention Basins are private and will be maintained by the Metro District. The proposed storm sewers are public and will be maintained by El Paso County.

SUMMARY

Site runoff and storm drain and appurtenances associated with the development of the Waterbury Filing No. 1 & 2 site will not adversely affect the surrounding and downstream developments. Runoff will be routed to the proposed detention basins and reduce the runoff to be at or below historic rates mentioned above in the report via Full Spectrum Detention while slowly treating the water quality

capture volume and in turn helping to stabilize the downstream channel banks. Terra Nova Engineering requests that this report satisfy the submittal requirements for the drainage analysis for Waterbury. This report and findings are in general conformance with all previously approved reports for this site.

PREPARED BY:
TERRA NOVA ENGINEERING, INC.

Quentin N. Armijo, P.E.
Vice President
Jobs/1715.00/drainage/1715.00 FDR 1-2

BIBLIOGRAPHY

"City of Colorado Springs Drainage Criteria Manual Volume 1", approved May 2014 and prepared by City of Colorado Springs

SCS Soils Map for El Paso County

"Revision to the MDDP for Meridian Ranch, EL Paso County, Colorado", approved October 2005, and prepared by PBS&J

"Final Drainage Report for 4-Way Ranch Phase 1" approved March 2006 prepared by JR Engineering

The "Geick Ranch Drainage Basin Planning Study" approved February 2008, preprepared by Drexel Barrel & Co

"Preliminary/Final Drainage Report for Meridian Ranch filing No. 3" approved November 2011 prepared by Tech Contractors

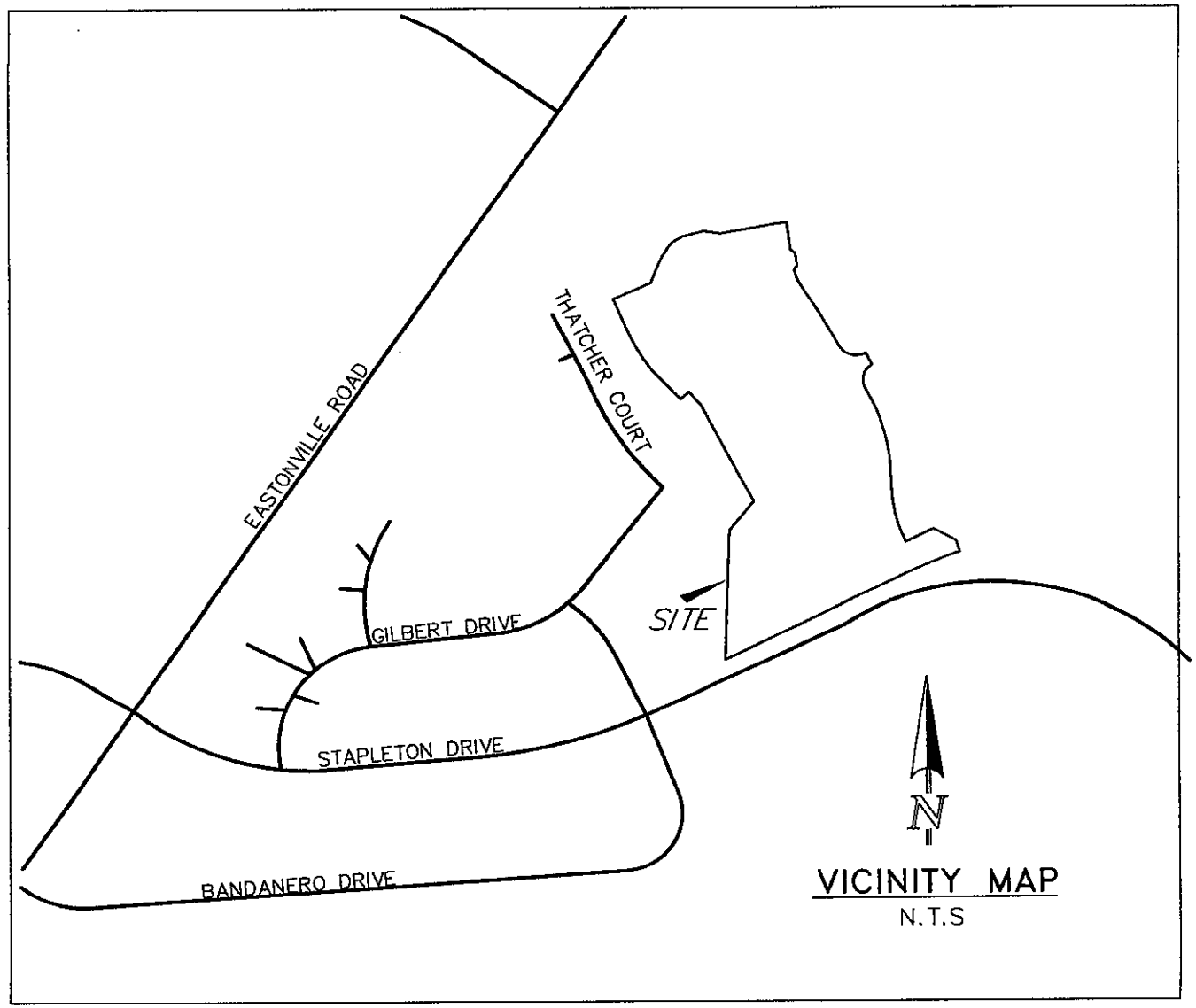
"Master Development Drainage Plan, 4-Way Ranch – Phase 1" approved January 2012 prepared by Advanced Design Professionals, Inc.

"Preliminary Drainage Report for Waterbury (Phase 1 Preliminary Plan) approved June 2013 prepared by Classic Consulting

"Final Drainage Report for Waterbury Filing No. 1" approved September 2016 prepared by Classic Consulting

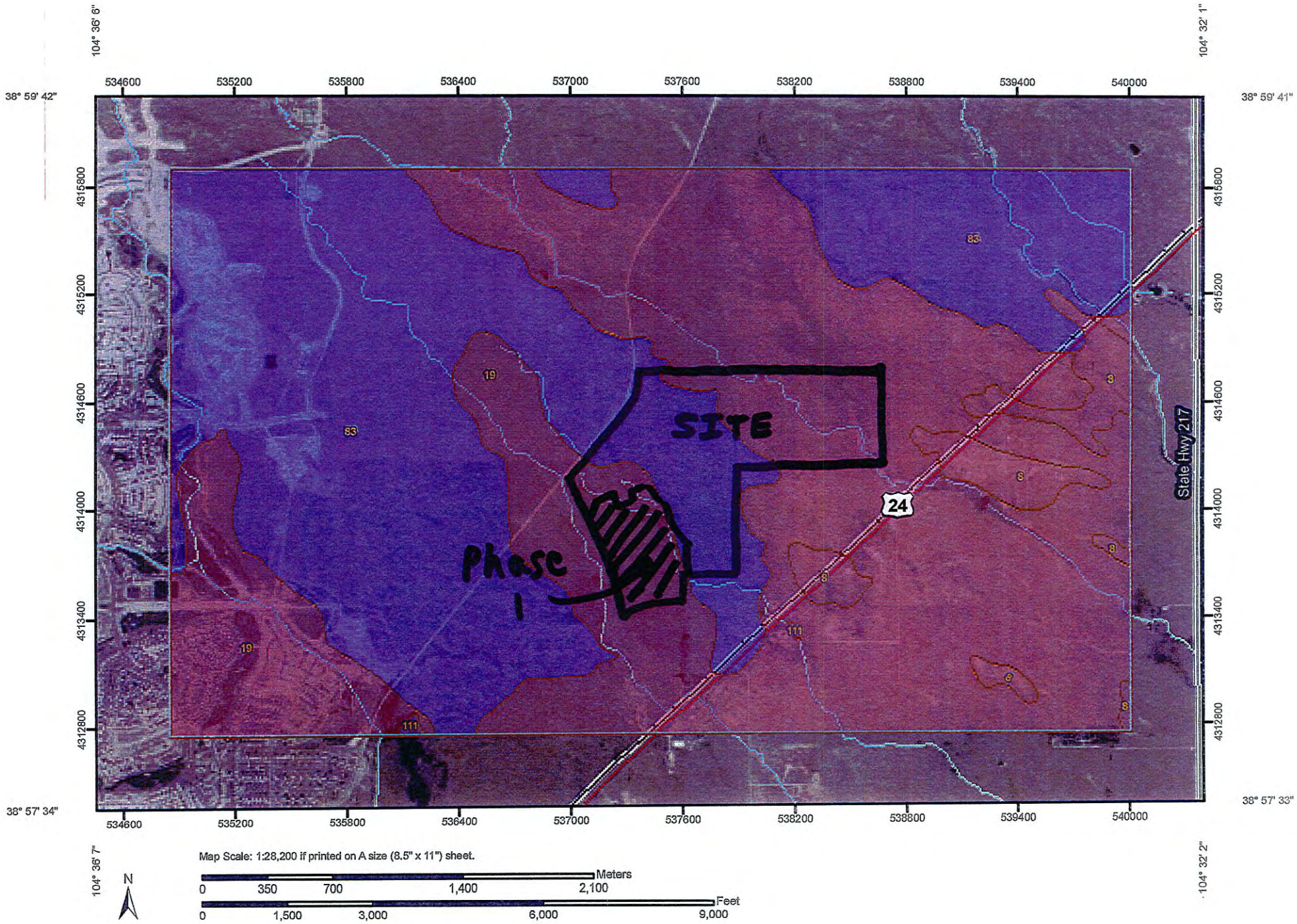
APPENDIX

VICINTY MAP



VICINITY MAP
N.T.S

NRCS SOILS MAP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104° 32' 1"
38° 59' 42"
38° 59' 41"
38° 57' 34"
38° 57' 33"
534600
535200
535800
536400
537000
537600
538200
538800
539400
540000
4315800
4315200
4314600
4314000
4313400
4312800
SITE
Phase 1
24
State Hwy 217
83
19
111
8
104° 36' 7"
104° 32' 2"
N
Map Scale: 1:28,200 if printed on A size (8.5" x 11") sheet.
Meters
0
350
700
1,400
2,100
Feet
0
1,500
3,000
6,000
9,000

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Units

Soil Ratings

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Political Features

Cities

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

MAP INFORMATION

Map Scale: 1:28,200 if printed on A size (8.5" × 11") sheet.

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

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 8, Apr 6, 2011

Date(s) aerial images were photographed: 7/29/2005; 8/17/2005; 7/2/2005

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.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — El Paso County Area, Colorado (CO625)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
8	Blakeland loamy sand, 1 to 9 percent slopes	A	155.7	3.9%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	2,095.1	52.1%
83	Stapleton sandy loam, 3 to 8 percent slopes	B	1,768.2	44.0%
111	Water		3.8	0.1%
Totals for Area of Interest			**4,022.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

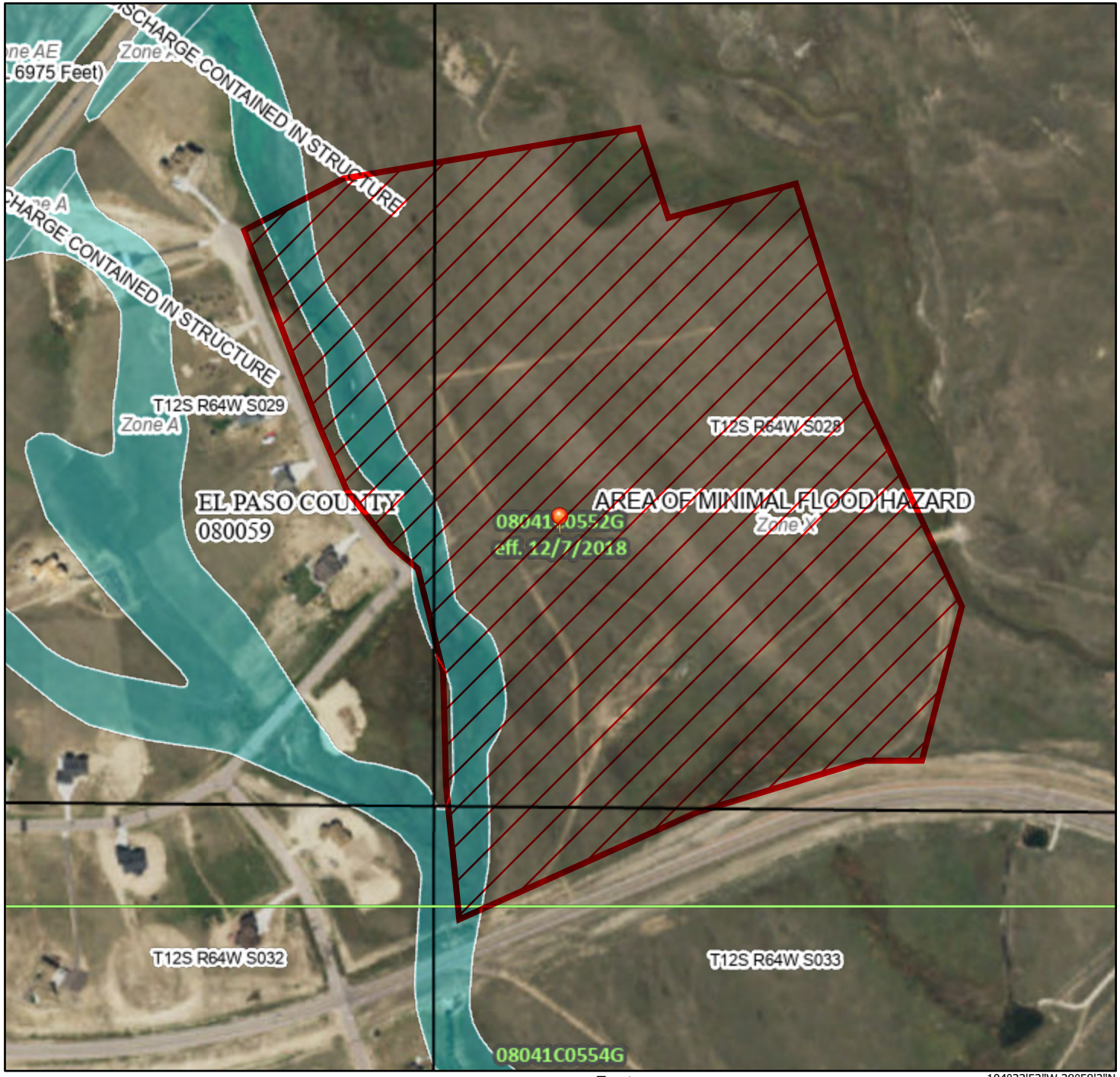
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

FEMA FIRM MAP

National Flood Hazard Layer FIRMette

FEMA

104°34'31"W 38°58'31"N



104°33'53"W 38°58'3"N

Feet 1:6,000

0 250 500 1,000 1,500 2,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS

- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD

- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS

- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES

- B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS

- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 8/27/2021 at 4:44 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Federal Emergency Management Agency

Washington, D.C. 20472

FEB 19 2004

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

The Honorable Chuck Brown
Chairman, El Paso County
Board of Commissioners
27 East Vermijo Avenue
Colorado Springs, CO 80903-2208

IN REPLY REFER TO:
Case No.: 04-08-0012P
Community Name: El Paso County, CO
Community No.: 080059
Effective Date of This Revision: **MAR 19 2004**

Dear Mr. Brown:

The Flood Insurance Rate Map for your community has been revised by this Letter of Map Revision (LOMR). Please use the enclosed annotated map panel(s) revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals issued in your community.

Additional documents are enclosed which provide information regarding this LOMR. Please see the List of Enclosures below to determine which documents are included. Other attachments specific to this request may be included as referenced in the Determination Document. If you have any questions regarding floodplain management regulations for your community or the National Flood Insurance Program (NFIP) in general, please contact the Consultation Coordination Officer for your community. If you have any technical questions regarding this LOMR, please contact the Director, Federal Insurance and Mitigation Division of the Department of Homeland Security's Federal Emergency Management Agency (FEMA) in Denver, Colorado, at (303) 235-4830, or the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP). Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Sincerely,

Kevin C. Long

Kevin C. Long, CFM, Project Engineer
Hazard Identification Section
Mitigation Division
Emergency Preparedness
and Response Directorate

For: Doug Bellomo, P.E., CFM, Acting Chief
Hazard Identification Section
Mitigation Division
Emergency Preparedness
and Response Directorate

List of Enclosures:
- Letter of Map Revision Determination Document
- Annotated Flood Insurance Rate Map

cc: Mr. Kevin Stilson, P.E., CFM
Floodplain Administrator
Pikes Peak Regional Building Department

Mr. Richard N. Wray, P.E.
Principal
Kiowa Engineering Corporation

 | Issue Date: FEB 19 2004 | Effective Date: MAR 19 2004 | Case No.: 04-08-0012P | LOMR-APP

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	El Paso County Colorado (Unincorporated Areas)	NO PROJECT	HYDROLOGIC ANALYSIS HYDRAULIC ANALYSIS NEW TOPOGRAPHIC DATA
	COMMUNITY NO.: 080059		
IDENTIFIER	Fourway Ranch Letter of Map Revision	APPROXIMATE LATITUDE & LONGITUDE: 39.974, -104.566 SOURCE: USGS QUADRANGLE DATUM: NAD 83	
FLOODING SOURCE(S) & REVISED REACH(ES)	**Haegler Ranch Tributary 1** – from approximately 1,200 feet upstream of the Cadillac and Lake City Railroad to just upstream of Eastonville Road **Haegler Ranch Tributary 1A** – from the confluence with Haegler Ranch Tributary 1 to just upstream of Eastonville Road **Haegler Ranch Tributary 2** – from the confluence with Haegler Ranch Tributary 1 to just upstream of Eastonville Road **Geick Ranch Tributary 1** – from approximately 600 feet upstream to approximately 4,000 feet upstream of the Cadillac and Lake City Railroad **Geick Ranch Tributary 2** – from approximately 600 feet upstream to approximately 2,600 feet upstream of the Cadillac and Lake City Railroad		

SUMMARY OF REVISIONS

Effective Flooding: Zone A
Revised Flooding: Zone A
Increases: YES
Decreases: YES

* BFEs – Base Flood Elevations

ANNOTATED MAPPING ENCLOSURES	ANNOTATED STUDY ENCLOSURES
TYPE: FIRM* NO.: 08041C0575 F Date: March 17, 1997	NO REVISION TO THE FLOOD INSURANCE STUDY REPORT

* FIRM – Flood Insurance Rate Map; ** FBFM – Flood Boundary and Floodway Map; *** FHBM – Flood Hazard Boundary Map

DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2677 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Doug Bellomo, P.E., CFM, Acting Chief
Hazard Identification Section
Mitigation Division
Emergency Preparedness and Response Directorate

102061 D.A04080012 102IC

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION

APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

COMMUNITY REMINDERS

We based this determination on the 1-percent-annual-chance discharges computed in the submitted hydrologic model. Future development of projects upstream could cause increased discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on discharges and could, therefore, indicate that greater flood hazards exist in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2677 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Doug Bellomo, P.E., CFM, Acting Chief
Hazard Identification Section
Mitigation Division
Emergency Preparedness and Response Directorate

102061 D.A04080012 102IC

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION (CONTINUED)

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Mr. Steve L. Olsen
Director, Federal Insurance and Mitigation Division
Federal Emergency Management Agency, Region VIII
Denver Federal Center, Building 710
P.O. Box 25267
Denver, CO 80225-0267
(303) 235-4830

STATUS OF THE COMMUNITY NFIP MAPS

We will not physically revise and republish the FIRM and FIS report for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panel and FIS report warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2677 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Doug Bellomo, P.E., CFM, Acting Chief
Hazard Identification Section
Mitigation Division
Emergency Preparedness and Response Directorate

102061 D.A04080012 102IC

Federal Emergency Management Agency
Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

PUBLIC NOTIFICATION OF REVISION

This revision will become effective 30 days from the date of this letter. Any requests to review or alter this determination should be made within 30 days and must be based on scientific or technical data.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2677 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at http://www.fema.gov/nfip.

Doug Bellomo, P.E., CFM, Acting Chief
Hazard Identification Section
Mitigation Division
Emergency Preparedness and Response Directorate 102061 D.A04080012 102IC

HYDROLOGIC CALCULATIONS

EXISTING CONDITIONS

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALCULATED BY: *QNA*

DRAINAGE REPORT ~ EXISTING BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	IMPERVIOUS / DEVELOPED AREA			NONIMPERVIOUS / UNDEVELOPED AREA			WEIGHTED		**WEIGHTED CA**	
		AREA (AC)	C(5)	C(100)	AREA (AC)	C(5)	C(100)	C(5)	C(100)	**CA(5)**	**CA(100)**
EXA	9.62	0.00	0.45	0.59	9.62	0.09	0.36	0.09	0.36	**0.87**	**3.46**
EXB	4.09	0.00	0.45	0.59	4.09	0.09	0.36	0.09	0.36	**0.37**	**1.47**
EXC	24.80	0.00	0.45	0.59	24.80	0.09	0.36	0.09	0.36	**2.23**	**8.93**
EXD	15.87	0.00	0.45	0.59	15.87	0.09	0.36	0.09	0.36	**1.43**	**5.71**
EXE	5.83	0.00	0.45	0.59	5.83	0.09	0.36	0.09	0.36	**0.52**	**2.10**
EXF	1.62	0.00	0.45	0.59	1.62	0.09	0.36	0.09	0.36	**0.15**	**0.58**
OS-1	45.02	0.00	0.45	0.59	45.02	0.09	0.36	0.09	0.36	**4.05**	**16.21**
OS-2	11.40	0.00	0.45	0.59	11.40	0.09	0.36	0.09	0.36	**1.03**	**4.11**
OS-3	1.11	0.00	0.45	0.59	1.11	0.09	0.36	0.09	0.36	**0.10**	**0.40**
OS-4	0.29	0.00	0.45	0.59	0.29	0.09	0.36	0.09	0.36	**0.03**	**0.11**
OS-5	6.74	0.00	0.45	0.59	6.74	0.09	0.36	0.09	0.36	**0.61**	**2.43**
OS-8	2.56	FLOW TAKEN FROM MERIDAIN RANCH MDDP									
OS-9	11.80	FLOW TAKEN FROM MERIDAIN RANCH MDDP									

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALC'D BY: *QNA*

EXISTING BASIN RUNOFF SUMMARY

BASIN	WEIGHTED CA(5)	WEIGHTED CA(100)	OVERLAND C(5)	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND Tc (min)	STREET / CHANNEL FLOW Length (ft)	STREET / CHANNEL FLOW Slope (%)	STREET / CHANNEL FLOW Velocity (fps)	STREET / CHANNEL FLOW Tc (min)	Tc TOTAL (min)	INTENSITY I(5) (in/hr)	INTENSITY I(100) (in/hr)	TOTAL FLOWS Q(5) (cfs)	TOTAL FLOWS Q(100) (cfs)
EXA	0.87	3.46	0.25	100	3	11.1	1193	1.7%	4.5	4.4	15.4	3.43	5.81	3	20
EXB	0.37	1.47	0.25	100	2	12.6	623	2.2%	5.2	2.0	14.6	3.51	5.96	1	9
EXC	2.23	8.93	0.25	100	2.5	11.7	2420	1.7%	4.6	8.9	20.6	3.01	5.01	7	45
EXD	1.43	5.71	0.25	100	2	12.6	1615	2.6%	5.6	4.8	17.4	3.25	5.47	5	31
EXE	0.52	2.10	0.25	100	8	8.0	1063	2.1%	5.0	3.5	11.5	3.86	6.66	2	14
EXF	0.15	0.58	0.25	100	6	8.8	400	2.5%	5.5	1.2	10.0	4.06	7.07	1	4
OS-1	4.05	16.21	0.25	100	6	8.8	3219	2.3%	5.3	10.1	18.9	3.13	5.24	13	85
OS-2	1.03	4.11	0.25	100	2	12.6	1203	1.0%	3.5	5.7	18.4	3.17	5.32	3	22
OS-3	0.10	0.40	0.25	100	2	12.6	330	2.6%	5.6	1.0	13.6	3.61	6.17	0	2
OS-4	0.03	0.11	0.25	100	2	12.6	230	2.6%	5.7	0.7	13.3	3.64	6.23	0	1
OS-5	0.61	2.43	0.25	80	5	7.8	1000	2.5%	5.5	3.0	10.8	3.96	6.85	2	17
OS-8	FLOW TAKEN FROM MERIDAIN RANCH MDDP													5	11
OS-9	FLOW TAKEN FROM MERIDAIN RANCH MDDP													8	19

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALCULATED BY: *QNA*

EXISTING SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Area (AC)	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Facility Size
						I(5)	I(100)	Q(5)	Q(100)	
EX1	EXA, OS-5, DP-10A & DP-10	18.92	1.47	5.89	15.4	3.43	5.81	38	180	3-42" CULVERTS
EX2	EXB	4.09	0.37	1.47	14.6	3.51	5.96	1	9	STAPLETON ROAD
EX3	EXC & OS-4	25.10	2.26	9.03	20.6	3.01	5.01	7	45	EAST BOUNDARY
EX4	EXD & OS-3	16.98	1.53	6.11	17.4	3.25	5.47	5	33	EAST BOUNDARY
EX5	EXE, OS-2 & OS-8	17.23	1.55	6.20	18.4	3.17	5.32	5	33	EAST BOUNDARY
EX6	EXF	1.62	0.15	0.58	11.4	3.87	6.69	1	4	EAST BOUNDARY
EX7	EXF, OS-1 & OS-9	58.45	4.20	16.79	18.9	3.13	5.24	21	107	DP 30 PROP CONDITION

FDR HYDROLOGIC CALCULATIONS

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *09/25/21*
CALCULATED BY: *QNA*

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	IMPERVIOUS / DEVELOPED AREA			NONIMPERVIOUS / UNDEVELOPED AREA			WEIGHTED		**WEIGHTED CA**	
		AREA (AC)	C(5)	C(100)	AREA (AC)	C(5)	C(100)	C(5)	C(100)	**CA(5)**	**CA(100)**
A	3.39	3.39	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**1.52**	**2.00**
B1	2.30	2.30	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**1.03**	**1.36**
B2	2.69	2.69	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**1.21**	**1.59**
C	0.86	0.86	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.39**	**0.51**
D	2.11	2.11	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.95**	**1.24**
E	2.18	2.18	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.98**	**1.29**
F	2.18	2.18	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.98**	**1.29**
G	0.66	0.66	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.30**	**0.39**
H	1.13	1.13	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.51**	**0.67**
I	5.66	2.14	0.45	0.59	3.53	0.09	0.36	0.23	0.45	**1.28**	**2.53**
J	1.99	1.99	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.90**	**1.17**
K	3.06	1.14	0.45	0.59	1.92	0.09	0.36	0.22	0.45	**0.69**	**1.37**
L1	5.27	5.27	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**2.37**	**3.11**
L2	2.00	2.00	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.90**	**1.18**
M1	2.90	2.90	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**1.31**	**1.71**
M2	0.47	0.47	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.21**	**0.28**
N	0.22	0.22	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.10**	**0.13**
O1	2.82	2.82	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**1.27**	**1.66**
O2	0.94	0.94	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.42**	**0.56**
P	1.18	1.18	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.53**	**0.70**
Q1	1.04	1.04	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.47**	**0.61**
Q2	1.10	1.10	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.49**	**0.65**
R	0.13	0.13	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.06**	**0.08**
S1	1.55	1.55	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.70**	**0.91**
S2	0.13	0.13	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.06**	**0.08**
T1	1.42	1.42	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.64**	**0.84**

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *09/25/21*
CALCULATED BY: *QNA*

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	IMPERVIOUS / DEVELOPED AREA			NONIMPERVIOUS / UNDEVELOPED AREA			WEIGHTED		**WEIGHTED CA**	
		AREA (AC)	C(5)	C(100)	AREA (AC)	C(5)	C(100)	C(5)	C(100)	**CA(5)**	**CA(100)**
T2	1.23	1.23	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.55**	**0.73**
U1	4.38	4.38	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**1.97**	**2.58**
U2	1.89	1.89	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.85**	**1.11**
W	5.20	5.20	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**2.34**	**3.07**
V	1.32	1.32	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.59**	**0.78**
OS-1*	**51.92**	**0.00**	**0.45**	**0.59**	**51.92**	**0.09**	**0.36**	**0.09**	**0.36**	**4.67**	**18.69**
OS-4	10.90	0.00	0.45	0.59	10.90	0.09	0.36	0.09	0.36	**0.98**	**3.92**
OS-5	5.64	5.64	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**2.54**	**3.33**
OS-6	1.06	1.06	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.48**	**0.63**
OS-7*	**3.64**	**0.00**	**0.45**	**0.59**	**3.64**	**0.09**	**0.36**	**0.09**	**0.36**	**0.33**	**1.31**
OS-8	2.56	FLOW TAKEN FROM MERIDAIN RANCH MDDP									
OS-9	11.80	FLOW TAKEN FROM MERIDAIN RANCH MDDP									
OS-Q1*	**0.33**	**0.00**	**0.45**	**0.59**	**0.33**	**0.09**	**0.36**	**0.09**	**0.36**	**0.03**	**0.12**
OS-Q2*	**0.22**	**0.00**	**0.45**	**0.59**	**0.22**	**0.09**	**0.36**	**0.09**	**0.36**	**0.02**	**0.08**
OS-R	**1.04**	**0.00**	**0.45**	**0.59**	**1.04**	**0.09**	**0.36**	**0.09**	**0.36**	**0.09**	**0.38**
OS-S1*	**0.31**	**0.00**	**0.45**	**0.59**	**0.31**	**0.09**	**0.36**	**0.09**	**0.36**	**0.03**	**0.11**
OS-S2*	**0.13**	**0.00**	**0.45**	**0.59**	**0.13**	**0.09**	**0.36**	**0.09**	**0.36**	**0.01**	**0.05**
OS-T2*	**0.30**	**0.00**	**0.45**	**0.59**	**0.30**	**0.09**	**0.36**	**0.09**	**0.36**	**0.03**	**0.11**

BASIN* = BASIN AREA REVISED FROM MDDP IN PRELIMINARY CONDITION DUE TO UNDEVELOPED UPSTREAM

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *09/25/21*
CALC'D BY: *QNA*

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED CA(5)	WEIGHTED CA(100)	OVERLAND C(5)	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND Tc (min)	STREET / CHANNEL FLOW Length (ft)	STREET / CHANNEL FLOW Slope (%)	STREET / CHANNEL FLOW Velocity (fps)	STREET / CHANNEL FLOW Tc (min)	Tc TOTAL (min)	INTENSITY I(5) (in/hr)	INTENSITY I(100) (in/hr)	TOTAL FLOWS Q(5) (cfs)	TOTAL FLOWS Q(100) (cfs)
A	1.52	2.00	0.25	100	2	12.6	420	1.5%	4.3	1.6	14.3	3.54	6.03	5	12
B1	1.03	1.36	0.25	100	2	12.6	400	1.5%	4.3	1.6	14.2	3.55	6.05	4	8
B2	1.21	1.59	0.25	100	2	12.6	550	1.5%	4.3	2.1	14.8	3.49	5.93	4	9
C	0.39	0.51	0.25	20	0.5	5.3	500	2.0%	4.9	1.7	6.9	4.58	8.14	2	4
D	0.95	1.24	0.25	80	2	10.5	300	2.5%	5.5	0.9	11.4	3.87	6.69	4	8
E	0.98	1.29	0.25	100	2	12.6	400	2.5%	5.5	1.2	13.8	3.59	6.12	4	8
F	0.98	1.29	0.25	50	2	7.1	620	1.5%	4.3	2.4	9.5	4.14	7.22	4	9
G	0.30	0.39	0.25	25	2	4.0	620	1.0%	3.4	3.0	7.0	4.57	8.12	1	3
H	0.51	0.67	0.25	50	2	7.1	525	1.5%	4.3	2.0	9.2	4.19	7.33	2	5
I	1.28	2.53	0.25	80	4	8.4	250	2.0%	4.9	0.8	9.2	4.18	7.32	5	19
J	0.90	1.17	0.25	90	6	8.1	850	2.0%	4.9	2.9	10.9	3.94	6.81	4	8
K	0.69	1.37	0.25	100	18	6.1	80	1.0%	3.5	0.4	6.5	4.67	8.33	3	11
L1	2.37	3.11	0.25	100	2	12.6	860	1.4%	4.1	3.5	16.1	3.36	5.69	8	18
L2	0.90	1.18	0.25	55	1.1	9.4	860	1.4%	4.1	3.5	12.8	3.70	6.34	3	7
M1	1.31	1.71	0.25	70	1.5	10.3	200	2.0%	4.9	0.7	11.0	3.92	6.79	5	12
M2	0.21	0.28	0.25	65	3	7.7	0	0.0%	0.0	0.0	7.7	4.43	7.83	1	2
N	0.10	0.13	0.25								5.0	5.00	9.06	1	1
O1	1.27	1.66	0.25	100	3	11.1	460	1.5%	4.3	1.8	12.8	3.70	6.34	5	11
O2	0.42	0.56	0.25	100	2	12.6	850	2.0%	4.9	2.9	15.5	3.42	5.80	1	3
P	0.53	0.70	0.25	65	3	7.7	0	0.0%	0.0	0.0	7.7	4.43	7.83	2	5
Q1	0.47	0.61	0.25	55	1.3	8.9	445	2.0%	5.0	1.5	10.4	4.01	6.97	2	4
Q2	0.49	0.65	0.25	55	1.3	8.9	445	2.0%	5.0	1.5	10.4	4.01	6.97	2	5
R	0.06	0.08	0.25	100	4	10.1	700	2.0%	4.9	2.4	12.4	3.75	6.44	0	1
S1	0.70	0.91	0.25	100	6	8.8	175	2.0%	4.9	0.6	9.4	4.16	7.26	3	7

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *09/25/21*
CALC'D BY: *QNA*

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED CA(5)	CA(100)	OVERLAND C(5)	Length (ft)	Height (ft)	Tc (min)	STREET / CHANNEL FLOW Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	INTENSITY I(5) (in/hr)	I(100) (in/hr)	TOTAL FLOWS Q(5) (cfs)	Q(100) (cfs)
S2	0.06	0.08	0.25								5.0	5.00	9.06	0.3	1
T1	0.64	0.84	0.25	55	1.1	9.4	390	2.0%	4.9	1.3	10.7	3.97	6.88	3	6
T2	0.55	0.73	0.25	100	2	12.6	245	2.0%	5.0	0.8	13.5	3.63	6.20	2	5
U1	1.97	2.58	0.25	100	2	12.6	520	2.3%	5.3	1.6	14.3	3.54	6.03	7	16
U2	0.85	1.11	0.25	100	2	12.6	385	2.3%	5.4	1.2	13.8	3.59	6.12	3	7
W	2.34	3.07	0.25	100	2	12.6	630	1.6%	4.4	2.4	15.0	3.47	5.89	8	18
V	0.59	0.78	0.25	95	6	8.4					8.4	4.31	7.58	3	6
OS-1*	**4.67**	**18.69**	**0.25**	**100**	**2**	**12.6**	**2700**	**2.3%**	**5.3**	**8.5**	**21.1**	**2.97**	**4.94**	**14**	**92**
OS-4	0.98	3.92	0.25	800	26	30.5					30.5	2.46	4.01	2	16
OS-5	2.54	3.33	0.25	600	18	27.1					27.1	2.62	4.30	7	14
OS-6	0.48	0.63	0.25	30	0.6	6.9	900	1.8%	4.7	3.2	10.1	4.05	7.04	2	4
OS-7*	**0.33**	**1.31**	**0.25**								**5.0**	**5.00**	**9.06**	**2**	**12**
OS-8	FLOW TAKEN FROM MERIDAIN RANCH MDDP													5	11
OS-9	FLOW TAKEN FROM MERIDAIN RANCH MDDP													8	19
OS-Q1*	**0.03**	**0.12**	**0.25**	**100**	**2**	12.6	**135**	1.8%	4.7	0.5	13.1	3.67	6.28	0	1
OS-Q2*	**0.02**	**0.08**	**0.25**	**50**	**1**	8.9	**135**	1.8%	4.7	0.5	9.4	4.15	7.25	0	1
OS-R	**0.09**	**0.38**	**0.25**	**100**	**2**	12.6	**50**	1.8%	4.7	0.2	12.8	3.70	6.35	0	2
OS-S1*	**0.03**	**0.11**									**5.0**	5.00	9.06	0	1
OS-S2*	**0.01**	**0.05**									**5.0**	5.00	9.06	0	0
OS-T2*	**0.03**	**0.11**									**5.0**	5.00	9.06	0	1

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *09/25/21*
CALCULATED BY: *QNA*

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Area (AC)	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Facility Size
						I(5)	I(100)	Q(5)	Q(100)	
1	A	3.39	1.52	2.00	14.3	3.54	6.03	5	12	6' Type R Sump Inlet
2	C	0.86	0.39	0.51	6.9	4.58	8.14	2	4	4' Type R Sump Inlet
3	B1	2.30	1.03	1.36	14.2	3.55	6.05	4	8	4' Type R Sump Inlet
4	B2	2.69	1.21	1.59	14.8	3.49	5.93	4	9	4' Type R Sump Inlet
5	F & H	3.31	1.49	1.95	9.5	4.14	7.22	6	14	6' Type R Sump Inlet
6	D	2.11	0.95	1.24	11.4	3.87	6.69	4	8	4' Type R Sump Inlets
7	E	2.18	0.98	1.29	13.8	3.59	6.12	4	8	4' Type R Sump Inlets
8	DESIGN POINTS 1-7	16.84	7.58	9.94	14.8	3.49	5.93	26	59	FSD Pond 1
9	OS-9	0.31	0.03	0.11	5.0	5.00	9.06	0	1	EX 36" CMP Culvert
10	OS-8	1.04	0.09	0.38	12.8	3.70	6.35	0	2	EX 36" CMP Culvert
10A	MERIDIAN POND E RELEASE							28	135	EX 3-42" RCP Culverts
11	OS-5, I, OS-& MERIDIAN POND E RELEASE	SCS MODEL						53	212	PR 2-42" RCP Culverts
12	OS-6	0.33	0.48	0.63	10.1	4.05	7.04	2	4	18"' RCP Culvert
13	TOTAL OFFISITE EX. STOCK POND INFLOW	SCS MODEL						69	396	EX STOCK POND
14	L1	5.27	2.37	3.11	16.1	3.36	5.69	8	18	10' Type R Sump Inlet
15	L2	2.00	0.90	1.18	12.8	3.70	6.34	3	7	4' Type R Sump Inlet

JOB NAME: *WATERBURY FDR*
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DATE: *09/25/21*
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FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Area (AC)	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	Intensity I(100)	Flow Q(5)	Flow Q(100)	Facility Size
16	O1	2.82	1.27	1.66	12.8	3.70	6.34	5	11	6' Type R Sump Inlet
17	O2	0.94	0.42	0.56	15.5	3.42	5.80	1	3	4' Type R Sump Inlet
18	DESIGN POINTS 7-10 & BASIN 0S-4	21.93	4.97	6.51	16.1	3.36	5.69	17	37	Interim FSD Pond 2
19*	**Q1 & OS-Q1**	**1.36**	**0.50**	**0.73**	**13.1**	**3.67**	**6.28**	**2**	**5**	**8' Type R Sump Inlet**
20*	**Q2 & OS-Q2**	**1.32**	**0.51**	**0.73**	**9.4**	**4.15**	**7.25**	**2**	**5**	**4' Type R Sump Inlet**
21*	**R & OS-R**	**1.18**	**0.15**	**0.45**	**12.4**	**3.75**	**6.44**	**1**	**3**	**12' Type R At-grade Inlet**
22*	**S1 & OS-S1 & DP 21 FLOW BY**	**1.86**	**0.74**	**1.16**	**12.4**	**3.75**	**6.44**	**3**	**7**	**10' Type R Sump Inlet**
23*	**S2 & OS-S2**	**0.27**	**0.07**	**0.13**	**5.0**	**5.00**	**9.06**	**0**	**1**	**10' Type R Sump Inlet**
24*	**T1**	**1.42**	**0.64**	**0.84**	**10.7**	**3.97**	**6.88**	**3**	**6**	**4' Type R Sump Inlets**
25*	**T2 & OS-T2**	**1.54**	**0.58**	**0.84**	**13.5**	**3.63**	**6.20**	**2**	**5**	**4' Type R Sump Inlets**
26*	**U1**	**4.38**	**1.97**	**2.58**	**14.3**	**3.54**	**6.03**	**7**	**16**	**10' Type R Sump Inlets**
27*	**U2**	**1.89**	**0.85**	**1.11**	**13.8**	**3.59**	**6.12**	**3**	**7**	**6' Type R Sump Inlets**
28*	**W**	**5.20**	**2.34**	**3.07**	**15.0**	**3.47**	**5.89**	**8**	**18**	**10' Type R Sump Inlets**
29*	**DESIGN POINTS 19-28 & OS-7**	**21.72**	**8.94**	**12.42**	**15.0**	**3.47**	**5.89**	**31**	**73**	**FSD POND**
30*	**V, OS-1, OS-8 & OS-9**	**67.60**	**5.27**	**19.47**	**21.1**	**2.97**	**4.94**	**24**	**115**	**Triple 36" RCP Culverts**

DESIGN POINT* = DESIGN POINT REVISED FROM MDDP IN PRELIMINARY CONDITION DUE TO UNDEVELOPED UPSTREAM

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *09/25/21*
CALCULATED BY: *QNA*

* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE.
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

Pipe Run	Contributing Design Points/Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Pipe Size*
					I(5)	I(100)	Q(5)	Q(100)	
1	DP 2	0.39	0.51	6.9	4.58	8.14	2	4	18" RCP
2	DP 1 & 2	1.91	2.51	14.3	3.54	6.03	7	15	24" RCP
3	DP 3	1.03	1.36	14.2	3.55	6.05	4	8	18" RCP
4	DP-4	1.21	1.59	14.8	3.49	5.93	4	9	18" RCP
5	DP 3 & 4	2.25	2.94	14.8	3.49	5.93	8	17	24" RCP
6	DP 1-4	4.16	5.45	14.8	3.49	5.93	15	32	30" RCP
7	DP-1-5	5.65	7.41	14.8	3.49	5.93	20	44	36" RCP
8	DP-6	0.95	1.24	11.4	3.87	6.69	4	8	18" RCP
9	DP-7	0.98	1.29	13.8	3.59	6.12	4	8	18" RCP
10	DP-6 & 7	1.93	2.53	13.8	3.59	6.12	7	15	18" RCP
10A	Pond 1 Release						2.2	8.0	18" RCP
11	DP-14	2.37	3.11	16.1	3.36	5.69	8	18	24" RCP
12	DP-15	0.90	1.18	12.8	3.70	6.34	3	7	18" RCP
13	DP 14 & 15	3.27	4.29	16.1	3.36	5.69	11	24	30" RCP
14	DP 16	1.27	1.66	12.8	3.70	6.34	5	11	24" RCP
15	DP 14, 15 & 16	4.54	5.95	16.1	3.36	5.69	15	34	36" RCP
16	DP 17	0.42	0.56	15.5	3.42	5.80	1	3	18" RCP

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *09/25/21*
CALCULATED BY: *QNA*

* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE.
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

					Intensity		Flow		
Pipe Run	Contributing Design Points/Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	I(5)	I(100)	Q(5)	Q(100)	Pipe Size*
17	DP 14, 15, 16, & 17	4.97	6.51	16.1	3.36	5.69	17	37	36" RCP
17A	Pond 2 Release						0.2	10.6	18" RCP
18*	**DP 19**	**0.50**	**0.73**	**13.1**	**3.67**	**6.28**	**2**	**5**	**24" RCP**
19*	**DP 20**	**0.51**	**0.73**	**9.4**	**4.15**	**7.25**	**2**	**5**	**18" RCP**
20*	**DP 19 & 20**	**1.01**	**1.46**	**13.1**	**3.67**	**6.28**	**4**	**9**	**24" RCP**
21*	**DP 21 PICK UP**	**0.14**	**0.32**	**12.4**	**3.75**	**6.44**	**1**	**2**	**18" RCP**
22*	**DP 19, 20 & 21**	**1.15**	**1.77**	**13.1**	**3.67**	**6.28**	**4**	**11**	**30" RCP**
23*	**DP 22**	**0.74**	**1.16**	**12.4**	**3.75**	**6.44**	**3**	**7**	**24" RCP**
24*	**DP 23**	**0.07**	**0.13**	**5.0**	**5.00**	**9.06**	**0**	**1**	**24" RCP**
25*	**DP 22 & 23**	**0.81**	**1.29**	**12.4**	**3.75**	**6.44**	**3**	**8**	**24" RCP**
26*	**DP 19 -23**	**1.96**	**3.06**	**13.1**	**3.67**	**6.28**	**7**	**19**	**36" RCP**
27*	**DP 24**	**0.64**	**0.84**	**10.7**	**3.97**	**6.88**	**3**	**6**	**18" RCP**
28*	**DP 25**	**0.58**	**0.84**	**13.5**	**3.63**	**6.20**	**2**	**5**	**18" RCP**
29*	**DP 19-25**	**3.18**	**4.74**	**13.5**	**3.63**	**6.20**	**12**	**29**	**36" RCP**
30*	**DP 26**	**1.97**	**2.58**	**14.3**	**3.54**	**6.03**	**7**	**16**	**24" RCP**
31*	**DP 19-26**	**5.15**	**7.32**	**14.3**	**3.54**	**6.03**	**18**	**44**	**42" RCP**
32*	**27**	**0.85**	**1.11**	**13.8**	**3.59**	**6.12**	**3**	**7**	**18" RCP**
33*	**DP 19-27**	**6.00**	**8.43**	**14.3**	**3.54**	**6.03**	**21**	**51**	**42" RCP**
34	DP 28	2.34	3.07	21.1	2.97	4.94	7	15	24" RCP
35*	**Pond 3 Release**	**0.00**	**0.00**	**0.0**	**7.12**	**14.19**	**1.0**	**60.7**	**TRIPLE 36" RCP**

PIPE RUN* = PIPE RUN REVISED FROM MDDP IN PRELIMINARY CONDITION DUE TO UNDEVELOPED UPSTREAM

MDDP HYDROLOGIC
FOR ULITIMATE PIPERUNS

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *09/25/21*
CALCULATED BY: *QNA*

* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE.
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

MDDP ~ PIPE ROUTING SUMMARY

Pipe Run	Contributing Design Points/Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Pipe Size*
					I(5)	I(100)	Q(5)	Q(100)	
1	DP 2	0.39	0.51	6.9	4.58	8.14	2	4	18" RCP
2	DP 1 & 2	1.91	2.51	14.3	3.54	6.03	7	15	24" RCP
3	DP 3	1.03	1.36	14.2	3.55	6.05	4	8	18" RCP
4	DP-4	1.21	1.59	14.8	3.49	5.93	4	9	18" RCP
5	DP 3 & 4	2.25	2.94	14.8	3.49	5.93	8	17	24" RCP
6	DP 1-4	4.16	5.45	14.8	3.49	5.93	15	32	30" RCP
7	DP-1-5	5.65	7.41	14.8	3.49	5.93	20	44	36" RCP
8	DP-6	0.95	1.24	11.4	3.87	6.69	4	8	18" RCP
9	DP-7	0.98	1.29	13.8	3.59	6.12	4	8	18" RCP
10	DP-6 & 7	1.97	2.58	13.8	3.59	6.12	7	16	18" RCP
10A	POND 1 RELEASE	2.95	3.87	13.8	3.59	6.12	2.2	8.0	18" RCP
11	DP-14	2.37	3.11	16.1	3.36	5.69	8	18	24" RCP
12	DP-15	0.90	1.18	12.8	3.70	6.34	3	7	18" RCP
13	DP 14 & 15	3.27	4.29	16.1	3.36	5.69	11	24	30" RCP
14	DP 16	1.27	1.66	12.8	3.70	6.34	5	11	24" RCP
15	DP 14, 15 & 16	4.54	5.95	16.1	3.36	5.69	15	34	36" RCP
16	DP 17	0.42	0.56	15.5	3.42	5.80	1	3	18" RCP
17	DP 14, 15, 16, & 17	4.97	6.51	16.1	3.36	5.69	17	37	36" RCP

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *09/21/21*
CALCULATED BY: *QNA*

* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE.
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

MDDP ~ PIPE ROUTING SUMMARY

Pipe Run	Contributing Design Points/Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Pipe Size*
					I(5)	I(100)	Q(5)	Q(100)	
17A	POND 2 RELEASE						0.2	10.6	18" RCP
18	DP 19	2.40	3.15	22.4	2.88	4.78	7	15	24" RCP
19	DP 20	0.91	1.20	12.4	3.75	6.43	3	8	18" RCP
20	DP 19 & 20	3.32	4.35	22.4	2.88	4.78	10	21	24" RCP
21	DP 21 PICK UP	1.38	1.31	11.4	3.87	6.69	5	9	18" RCP
22	DP 19, 20 & 21	4.70	5.66	22.4	2.88	4.78	14	27	24" RCP
23	DP 22	2.37	3.36	16.7	3.32	5.60	8	19	24" RCP
24	DP 23	2.37	3.36	16.7	3.32	5.60	8	19	24" RCP
25	DP 22 & 23	4.75	6.73	16.7	3.32	5.60	16	38	30" RCP
26	DP 19 -23	9.45	12.39	22.4	2.88	4.78	27	59	36" RCP
27	DP 24	0.64	0.84	10.7	3.97	6.88	3	6	18" RCP
28	DP 25	0.90	1.18	13.5	3.63	6.20	3	7	18" RCP
29	DP 19-25	10.99	14.40	22.4	2.88	4.78	32	69	36" RCP
30	DP 26	1.97	2.58	14.3	3.54	6.03	7	16	24" RCP
31	DP 19-26	12.96	16.99	22.4	2.89	4.79	37	81	42" RCP
32	DP 27	0.85	1.11	13.8	3.59	6.12	3	7	18" RCP
33	DP 19-27	13.80	18.10	22.4	2.88	4.78	40	87	36" RCP
34	28	2.34	3.07	15.0	3.47	5.89	8	18	24" RCP
35	Pond 3 Release	0.90	2.00	13.5	3.62	6.19	1.0	60.7	36" RCP

HYDRAULIC CALCULATIONS

FDR
INLET CALCULATIONS

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*12/17/20*
CALCULATED BY:	*QNA*

DESIGN POINT 1

Total Flow:

Q_5	=	**5**	cfs
Q_{100}	=	**12**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **6** foot inlet required

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*12/17/20*
CALCULATED BY:	*QNA*

DESIGN POINT 2

Total Flow:

Q_5	=	**2**	cfs
Q_{100}	=	**4**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

JOB NAME:	***WATERBURY MDDP***
JOB NUMBER:	***1715.00***
DATE:	***12/17/20***
CALCULATED BY:	***QNA***

DESIGN POINT 3

Total Flow:

Q_5	=	**4**	cfs
Q_{100}	=	**8**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

JOB NAME:	***WATERBURY MDDP***
JOB NUMBER:	***1715.00***
DATE:	***12/17/20***
CALCULATED BY:	***QNA***

DESIGN POINT 4

Total Flow:

Q_5	=	**4**	cfs
Q_{100}	=	**9**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*12/17/20*
CALCULATED BY:	*QNA*

DESIGN POINT 5

Total Flow:

Q_5 = **6** cfs

Q_{100} = **14** cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5 = 0.50 ft.

D_{100} = 0.75 ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **6** foot inlet required

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*12/17/20*
CALCULATED BY:	*QNA*

DESIGN POINT 6

Total Flow:

Q_5	=	**4**	cfs
Q_{100}	=	**8**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*12/17/20*
CALCULATED BY:	*QNA*

DESIGN POINT 7

Total Flow:

Q_5	=	**4**	cfs
Q_{100}	=	**8**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*12/17/20*
CALCULATED BY:	*QNA*

DESIGN POINT 14

Total Flow:

Q_5 = **8** cfs

Q_{100} = **18** cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5 = 0.50 ft.

D_{100} = 0.75 ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **6** foot inlet required

100-Year Event: **10** foot inlet required

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*12/17/20*
CALCULATED BY:	*QNA*

DESIGN POINT 15

Total Flow:

Q_5	=	**3**	cfs
Q_{100}	=	**7**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*12/17/20*
CALCULATED BY:	*QNA*

DESIGN POINT 16

Total Flow:

Q_5	=	**5**	cfs
Q_{100}	=	**11**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*12/17/20*
CALCULATED BY:	*QNA*

DESIGN POINT 17

Total Flow:

Q_5	=	**1**	cfs
Q_{100}	=	**3**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

JOB NAME:	*WATERBURY FDR*
JOB NUMBER:	*1715.00*
DATE:	*09/23/21*
CALCULATED BY:	*QNA*

DESIGN POINT 20

Total Flow:

Q_5	=	**4**	cfs
Q_{100}	=	**10**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

JOB NAME:	*WATERBURY FDR*
JOB NUMBER:	*1715.00*
DATE:	*09/23/21*
CALCULATED BY:	*QNA*

DESIGN POINT 22

Total Flow:

Q_5	=	**3**	cfs
Q_{100}	=	**6**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

Using 12' D10 Sump Inlet

JOB NAME:	*WATERBURY FDR*
JOB NUMBER:	*1715.00*
DATE:	*09/23/21*
CALCULATED BY:	*QNA*

DESIGN POINT 23

Total Flow:

Q_5	=	**0**	cfs
Q_{100}	=	**1**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

Using 12' D10 Sump Inlet

JOB NAME:	***WATERBURY FDR***
JOB NUMBER:	***1715.00***
DATE:	***09/23/21***
CALCULATED BY:	***QNA***

DESIGN POINT 24

Total Flow:

Q_5	=	**3**	cfs
Q_{100}	=	**6**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

JOB NAME:	***WATERBURY FDR***
JOB NUMBER:	***1715.00***
DATE:	***09/23/21***
CALCULATED BY:	***QNA***

DESIGN POINT 25

Total Flow:

Q_5	=	**2**	cfs
Q_{100}	=	**5**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

JOB NAME:	*WATERBURY FDR*
JOB NUMBER:	*1715.00*
DATE:	*09/23/21*
CALCULATED BY:	*QNA*

DESIGN POINT 26

Total Flow:

Q_5	=	**7**	cfs
Q_{100}	=	**16**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **6** foot inlet required

100-Year Event: **8** foot inlet required

JOB NAME:	*WATERBURY FDR*
JOB NUMBER:	*1715.00*
DATE:	*09/23/21*
CALCULATED BY:	*QNA*

DESIGN POINT 27

Total Flow:

Q_5	=	**3**	cfs
Q_{100}	=	**7**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

JOB NAME:	***WATERBURY FDR***
JOB NUMBER:	***1715.00***
DATE:	***09/23/21***
CALCULATED BY:	***QNA***

DESIGN POINT 28

Total Flow:

Q_5	=	**8**	cfs
Q_{100}	=	**18**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **6** foot inlet required

100-Year Event: **10** foot inlet required

MDDP ULTIMATE CONDITIONS
INLET CALCULATIONS

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*12/17/20*
CALCULATED BY:	*QNA*

DESIGN POINT 19

Total Flow:

Q_5 = **7** cfs

Q_{100} = **15** cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5 = 0.50 ft.

D_{100} = 0.75 ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **6** foot inlet required

100-Year Event: **8** foot inlet required

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*12/17/20*
CALCULATED BY:	*QNA*

DESIGN POINT 20

Total Flow:

Q_5	=	**3**	cfs
Q_{100}	=	**8**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

DESIGN POINT 21

5-YR FLOW

Q(5)	11	I(5)	3.9		
DEPTH	0.37	Fr	1.78	Inlet size ? L(i) =	**12**
SPREAD	17.6	L(1)	24.1	If Li < L(2) then Qi =	5
CROSS SLOPE	2.0%	L(2)	14.5	If Li > L(2) then Qi =	6
STREET SLOPE	1.8%	L(3)	51.7	FB =	5
				CA(eqv.)=	1.40

100-YR FLOW

Q(100)	24	I(100)	6.7		
DEPTH	0.49	Fr	1.88	Inlet size ? L(i) =	**12**
SPREAD	23.1	L(1)	33.4	If Li < L(2) then Qi =	9
CROSS SLOPE	2.0%	L(2)	20.1	If Li > L(2) then Qi =	12
STREET SLOPE	1.8%	L(3)	71.6	FB =	16
				CA(eqv.)=	2.34

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*12/17/20*
CALCULATED BY:	*QNA*

DESIGN POINT 22 & 23 SPLIT

Total Flow: Q_5 = **8** cfs

Q_{100} = **19** cfs

(Assume even split of flows at lowpoint for prelim. inlet sizing)

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5 = 0.50 ft.

D_{100} = 0.75 ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **6** foot inlet required

100-Year Event: **10** foot inlet required

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*12/17/20*
CALCULATED BY:	*QNA*

DESIGN POINT 22 & 23 SPLIT

Total Flow: Q_5 = **8** cfs

Q_{100} = **19** cfs

(Assume even split of flows at lowpoint inlet sizing)

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5 = 0.50 ft.

D_{100} = 0.75 ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **6** foot inlet required

100-Year Event: **10** foot inlet required

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*12/17/20*
CALCULATED BY:	*QNA*

DESIGN POINT 24

Total Flow:

Q_5	=	**3**	cfs
Q_{100}	=	**6**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*12/17/20*
CALCULATED BY:	*QNA*

DESIGN POINT 25

Total Flow:

Q_5	=	**3**	cfs
Q_{100}	=	**7**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*12/17/20*
CALCULATED BY:	*QNA*

DESIGN POINT 26

Total Flow:

Q_5	=	**7**	cfs
Q_{100}	=	**16**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **6** foot inlet required

100-Year Event: **8** foot inlet required

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*12/17/20*
CALCULATED BY:	*QNA*

DESIGN POINT 27

Total Flow: Q_5 = **3** cfs

Q_{100} = **7** cfs

(Assume even split of flows at lowpoint for prelim. inlet sizing)

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5 = 0.50 ft.

D_{100} = 0.75 ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

Curb inlet sizing:

5-Year Event: **4** foot inlet required

100-Year Event: **4** foot inlet required

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*12/17/20*
CALCULATED BY:	*QNA*

DESIGN POINT 28

Total Flow:

Q_5	=	**8**	cfs
Q_{100}	=	**18**	cfs

Max. allowable ponding depth:
(Residential street, ramp curb)

D_5	=	0.50	ft.
D_{100}	=	0.75	ft.

Std. Type R curb inlet detail:

Qi = 1.7(Li+1.8(W))(dmax + a)^1.85

W = 2 ft.
a = 3 in.

Clogging Factor = 1.25
Li (1.25) = Length of inlet opening

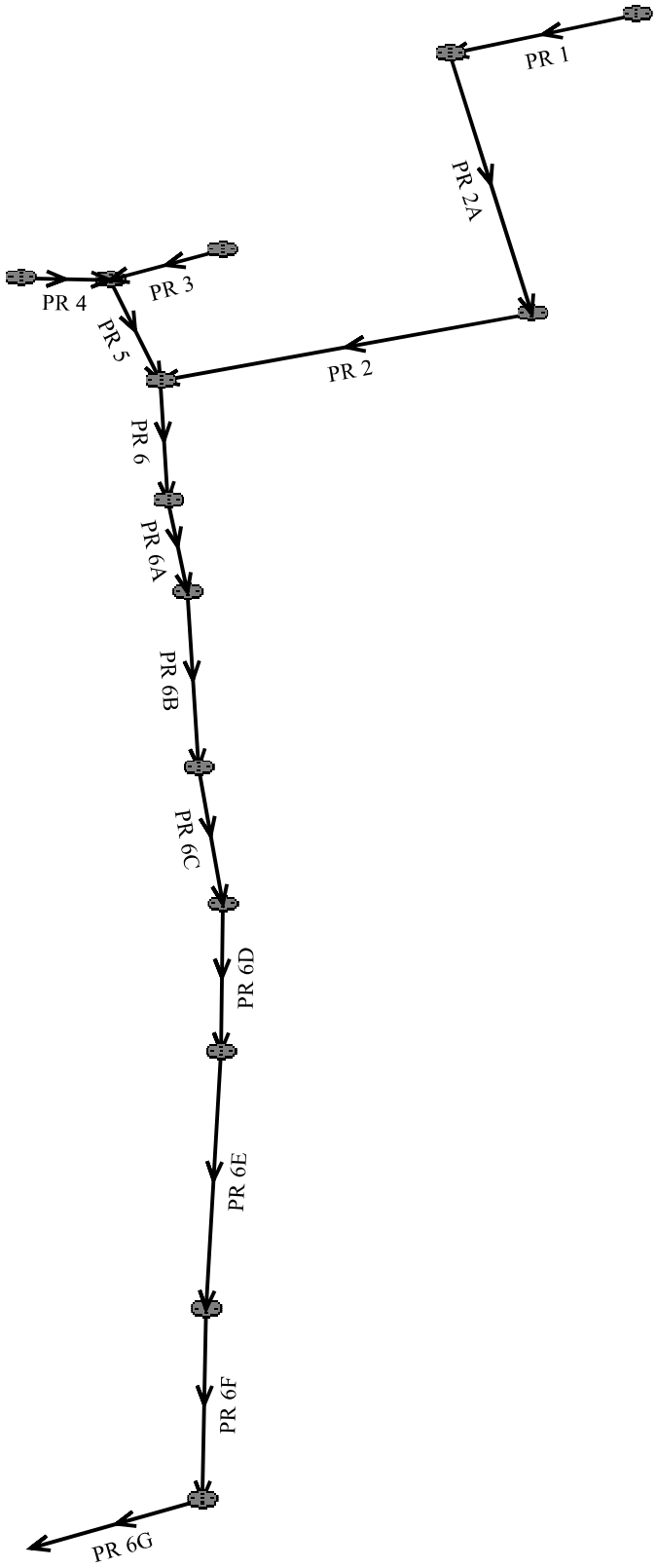
Curb inlet sizing:

5-Year Event: **6** foot inlet required

100-Year Event: **10** foot inlet required

MDDP ULTIMATE
HGL CALCULATIONS

PIPERUNS 1-7


PR 6G
PR 6F
PR 6E
PR 6D
PR 6C
PR 6B
PR 6A
PR 6
PR 5
PR 4
PR 3
PR 2
PR 2A
PR 1

Program:
UDSEWER Math Model Interface 2.1.1.4
Run Date:
9/25/2021 1:11:28 PM

UDSewer Results Summary

Project Title: New UDSEWER System Module
Project Description: Default system

PIPERUNS 1-7

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6927.70

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	**Ground Elevation (ft)**	**Total Known Flow (cfs)**	**Local Contribution (cfs)**	**Drainage Area (Ac.)**	**Runoff Coefficient**	**5yr Coefficient**	**Overland Length (ft)**	**Overland Slope (%)**	**Gutter Length (ft)**	**Gutter Velocity (fps)**
FSD 1	6925.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 7	6932.90	44.00	12.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 6G	6933.90	32.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 6F	6936.71	32.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 6E	6938.56	32.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 6D	6939.06	32.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 6C	6939.59	32.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 6B	6940.10	32.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 6A	6941.78	32.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 6	6941.39	32.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 2	6943.00	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 2A	6943.20	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 1	6943.20	4.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 5	6940.83	17.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 3	6941.09	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 4	6941.09	9.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution				Total Design Flow				

Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
FSD 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Surface Water Present (Upstream)
PR 7	0.00	0.00	0.00	0.00	12.00	0.00	0.00	0.00	44.00	Surface Water Present (Downstream)
PR 6G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.00	
PR 6F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.00	
PR 6E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.00	
PR 6D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.00	
PR 6C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.00	
PR 6B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.00	
PR 6A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.00	
PR 6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.00	
PR 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	
PR 2A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	
PR 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.00	
PR 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.00	
PR 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	
PR 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.00	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
PR 7	150.76	6925.47	0.8	6926.68	0.013	0.03	0.00	CIRCULAR	36.00 in	36.00 in
PR 6G	32.50	6927.18	1.0	6927.50	0.013	0.12	0.00	CIRCULAR	36.00 in	36.00 in
PR 6F	205.81	6928.06	1.2	6930.53	0.013	0.85	0.00	CIRCULAR	36.00 in	36.00 in
PR 6E	120.18	6930.58	1.2	6932.02	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
PR 6D	30.31	6932.52	0.7	6932.73	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
PR 6C	32.90	6932.73	0.7	6932.96	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
PR 6B	32.35	6932.95	0.7	6933.18	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
PR 6A	121.85	6933.18	0.7	6934.03	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
PR 6	54.42	6934.01	0.7	6934.39	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
PR 2	300.04	6934.79	0.8	6937.19	0.013	1.32	0.00	CIRCULAR	30.00 in	30.00 in
PR 2A	160.91	6937.19	0.6	6938.16	0.013	1.32	0.00	CIRCULAR	30.00 in	30.00 in
PR 1	35.02	6938.67	1.0	6939.02	0.013	1.32	0.00	CIRCULAR	18.00 in	18.00 in
PR 5	52.76	6935.39	1.5	6936.18	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
PR 3	26.98	6935.18	2.0	6935.72	0.013	1.32	0.00	CIRCULAR	18.00 in	18.00 in
PR 4	5.25	6936.68	1.9	6936.78	0.013	1.32	0.00	CIRCULAR	18.00 in	18.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
PR 7	59.82	8.46	25.93	8.07	22.95	9.25	1.27	Supercritical	44.00	0.00	
PR 6G	66.88	9.46	22.02	7.06	17.54	9.36	1.54	Supercritical	32.00	0.00	
PR 6F	73.26	10.36	22.02	7.06	16.64	10.01	1.71	Supercritical	32.00	0.00	
PR 6E	73.26	10.36	22.02	7.06	16.64	10.01	1.71	Supercritical	32.00	0.00	
PR 6D	55.95	7.92	22.02	7.06	19.51	8.18	1.26	Supercritical	32.00	0.00	
PR 6C	55.95	7.92	22.02	7.06	19.51	8.18	1.26	Supercritical	32.00	0.00	
PR 6B	55.95	7.92	22.02	7.06	19.51	8.18	1.26	Supercritical	32.00	0.00	
PR 6A	55.95	7.92	22.02	7.06	19.51	8.18	1.26	Supercritical	32.00	0.00	
PR 6	55.95	7.92	22.02	7.06	19.51	8.18	1.26	Supercritical	32.00	0.00	
PR 2	36.79	7.49	15.67	5.78	13.34	7.11	1.36	Supercritical	15.00	0.00	
PR 2A	31.86	6.49	15.67	5.78	14.48	6.39	1.16	Supercritical	15.00	0.00	
PR 1	10.53	5.96	9.18	4.41	7.69	5.55	1.40	Supercritical	4.00	0.00	
PR 5	27.78	8.84	17.83	6.79	13.56	9.29	1.70	Supercritical	17.00	0.00	
PR 3	14.90	8.43	13.15	5.78	9.39	8.58	1.92	Pressurized	8.00	26.98	
PR 4	14.51	8.21	13.93	6.13	10.26	8.65	1.82	Pressurized	9.00	5.25	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.

- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	Peak Flow (cfs)	Cross Section	Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	Comment
PR 7	44.00	CIRCULAR	36.00 in	36.00 in	33.00 in	33.00 in	36.00 in	36.00 in	7.07	
PR 6G	32.00	CIRCULAR	36.00 in	36.00 in	30.00 in	30.00 in	36.00 in	36.00 in	7.07	
PR 6F	32.00	CIRCULAR	36.00 in	36.00 in	27.00 in	27.00 in	36.00 in	36.00 in	7.07	
PR 6E	32.00	CIRCULAR	36.00 in	36.00 in	27.00 in	27.00 in	36.00 in	36.00 in	7.07	
PR 6D	32.00	CIRCULAR	36.00 in	36.00 in	30.00 in	30.00 in	36.00 in	36.00 in	7.07	
PR 6C	32.00	CIRCULAR	36.00 in	36.00 in	30.00 in	30.00 in	36.00 in	36.00 in	7.07	
PR 6B	32.00	CIRCULAR	36.00 in	36.00 in	30.00 in	30.00 in	36.00 in	36.00 in	7.07	
PR 6A	32.00	CIRCULAR	36.00 in	36.00 in	30.00 in	30.00 in	36.00 in	36.00 in	7.07	
PR 6	32.00	CIRCULAR	36.00 in	36.00 in	30.00 in	30.00 in	36.00 in	36.00 in	7.07	
PR 2	15.00	CIRCULAR	30.00 in	30.00 in	24.00 in	24.00 in	30.00 in	30.00 in	4.91	
PR 2A	15.00	CIRCULAR	30.00 in	30.00 in	24.00 in	24.00 in	30.00 in	30.00 in	4.91	
PR 1	4.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PR 5	17.00	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	
PR 3	8.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PR 4	9.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6927.70

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PR 7	6925.47	6926.68	0.00	0.00	6927.70	6928.84	6928.72	1.14	6929.85
PR 6G	6927.18	6927.50	0.04	0.00	6928.88	6929.33	6930.00	0.11	6930.11
PR 6F	6928.06	6930.53	0.27	0.00	6929.61	6932.36	6931.00	2.14	6933.14
PR 6E	6930.58	6932.02	0.02	0.00	6932.38	6933.85	6933.52	1.11	6934.63
PR 6D	6932.52	6932.73	0.02	0.00	6934.14	6934.56	6935.18	0.16	6935.34
PR 6C	6932.73	6932.96	0.02	0.00	6934.58	6934.79	6935.39	0.17	6935.57
PR 6B	6932.95	6933.18	0.02	0.00	6934.81	6935.01	6935.62	0.17	6935.79
PR 6A	6933.18	6934.03	0.02	0.00	6935.03	6935.86	6935.84	0.80	6936.64
PR 6	6934.01	6934.39	0.02	0.00	6935.88	6936.22	6936.67	0.33	6937.00
PR 2	6934.79	6937.19	0.19	0.00	6937.03	6938.50	6937.19	1.82	6939.02
PR 2A	6937.19	6938.16	0.19	0.00	6938.95	6939.47	6939.21	0.78	6939.99
PR 1	6938.67	6939.02	0.11	0.00	6940.00	6940.00	6940.09	0.08	6940.17
PR 5	6935.39	6936.18	0.02	0.00	6936.52	6937.67	6937.86	0.52	6938.38
PR 3	6935.18	6935.72	0.42	0.00	6938.48	6938.64	6938.80	0.16	6938.96
PR 4	6936.68	6936.78	0.53	0.00	6938.51	6938.55	6938.91	0.04	6938.95

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

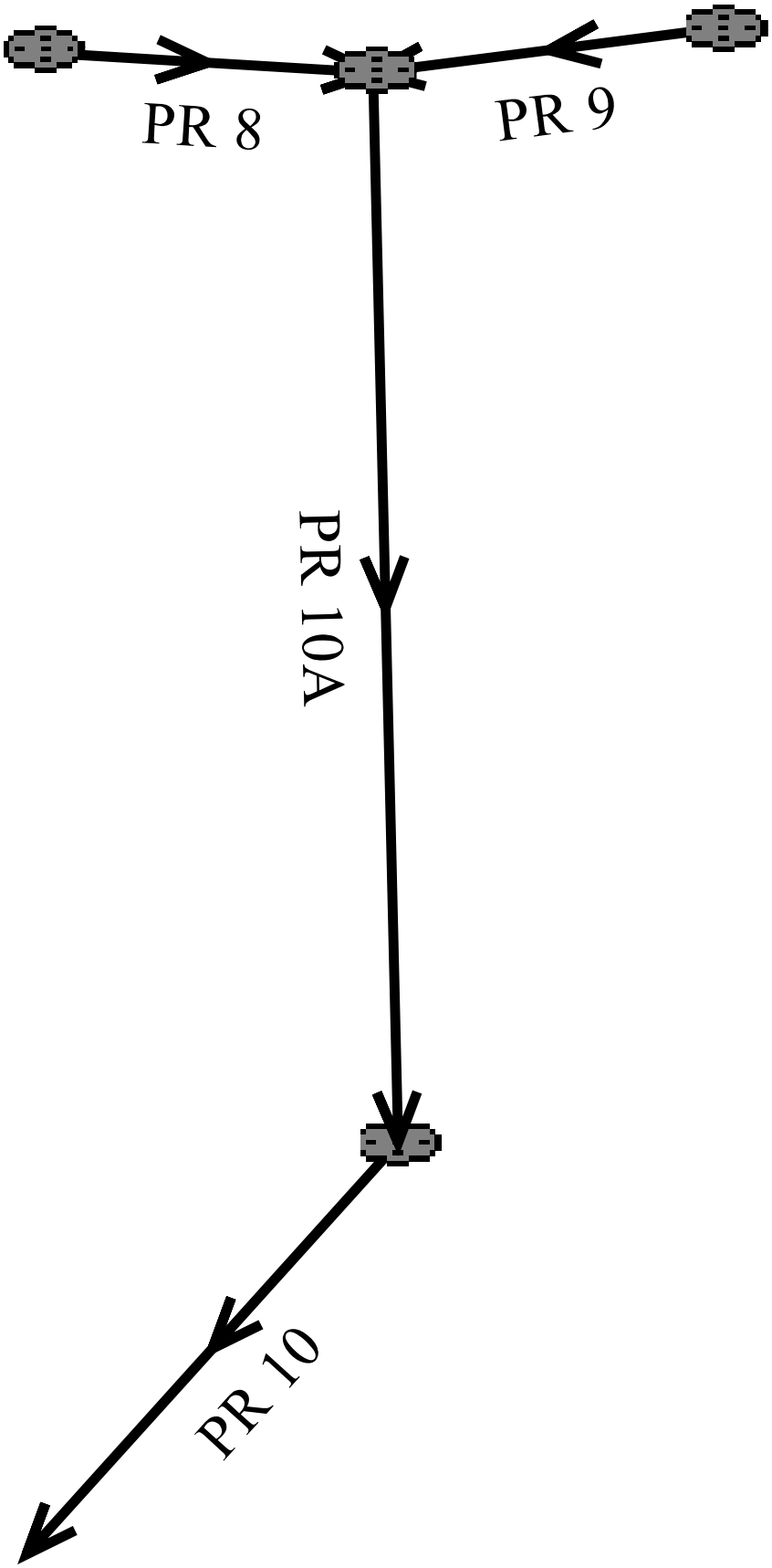
					Downstream			Upstream				
Element Name	Length (ft)	Wall (in)	Bedding (in)	Bottom Width (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Volume (cu. yd)	Comment
PR 7	150.76	4.00	6.00	6.67	0.00	0.86	0.00	10.44	7.05	2.89	157.21	Sewer Too Shallow

PR 6G	32.50	4.00	6.00	6.67	9.45	6.56	2.39	10.80	7.23	3.07	59.07	
PR 6F	205.81	4.00	6.00	6.67	9.68	6.67	2.51	10.36	7.01	2.85	369.40	
PR 6E	120.18	4.00	6.00	6.67	10.26	6.97	2.80	11.08	7.37	3.21	230.78	
PR 6D	30.31	4.00	6.00	6.67	10.08	6.88	2.71	10.66	7.16	3.00	56.41	
PR 6C	32.90	4.00	6.00	6.67	10.66	7.16	3.00	11.26	7.46	3.30	65.05	
PR 6B	32.35	4.00	6.00	6.67	11.27	7.47	3.30	11.84	7.75	3.59	67.98	
PR 6A	121.85	4.00	6.00	6.67	11.85	7.76	3.59	13.50	8.58	4.42	287.27	
PR 6	54.42	4.00	6.00	6.67	13.54	8.60	4.44	12.00	7.83	3.67	129.51	
PR 2	300.04	3.50	6.00	6.08	11.70	7.39	3.81	10.12	6.60	3.02	539.46	
PR 2A	160.91	3.50	6.00	6.08	10.11	6.60	3.01	8.58	5.83	2.25	242.03	
PR 1	35.02	2.50	4.00	4.92	8.56	5.07	2.82	7.86	4.72	2.47	34.78	
PR 5	52.76	3.00	4.00	5.50	11.00	6.58	3.75	8.30	5.23	2.40	72.82	
PR 3	26.98	2.50	4.00	4.92	10.80	6.19	3.94	10.24	5.91	3.66	37.59	
PR 4	5.25	2.50	4.00	4.92	7.80	4.69	2.44	8.12	4.85	2.60	5.01	

Total earth volume for sewer trenches = 2354 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

PIPERUNS 8-10



Program:
UDSEWER Math Model Interface 2.1.1.4
Run Date:
9/25/2021 12:42:04 PM

UDSewer Results Summary

Project Title: New UDSEWER System Module
Project Description: Default system

PIPERUNS 8-10

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6927.70

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
FSD 1	6927.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 10	6931.50	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 10A	6933.86	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 9	6933.88	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 8	6933.98	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
FSD 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Surface Water Present (Upstream)
PR 10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	Surface Water Present (Downstream)
PR 10A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	
PR 9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	
PR 8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
PR 10	69.76	6927.00	0.6	6927.42	0.013	0.03	0.00	CIRCULAR	24.00 in	24.00 in
PR 10A	235.56	6927.42	0.6	6928.83	0.013	0.38	0.00	CIRCULAR	30.00 in	30.00 in
PR 9	59.04	6929.29	1.0	6929.88	0.013	1.32	0.00	CIRCULAR	18.00 in	18.00 in
PR 8	12.46	6929.34	1.0	6929.46	0.013	1.32	0.00	CIRCULAR	18.00 in	18.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
PR 10	17.57	5.59	16.75	6.41	17.06	6.28	0.96	Subcritical	15.00	0.00	
PR 10A	31.86	6.49	15.67	5.78	14.48	6.39	1.16	Supercritical	15.00	0.00	
PR 9	10.53	5.96	13.15	5.78	11.73	6.56	1.25	Supercritical	8.00	0.00	
PR 8	10.53	5.96	13.15	5.78	11.73	6.56	1.25	Supercritical	8.00	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	Peak Flow (cfs)	Cross Section	Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	Comment
PR 10	15.00	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
PR 10A	15.00	CIRCULAR	30.00 in	30.00 in	24.00 in	24.00 in	30.00 in	30.00 in	4.91	
PR 9	8.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PR 8	8.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6927.70

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PR 10	6927.00	6927.42	0.00	0.00	6928.40	6928.86	6929.03	0.42	6929.46
PR 10A	6927.42	6928.83	0.06	0.00	6929.29	6930.14	6929.51	1.14	6930.66
PR 9	6929.29	6929.88	0.42	0.00	6930.75	6930.98	6931.08	0.42	6931.50
PR 8	6929.34	6929.46	0.42	0.00	6930.74	6930.74	6931.08	0.05	6931.12

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

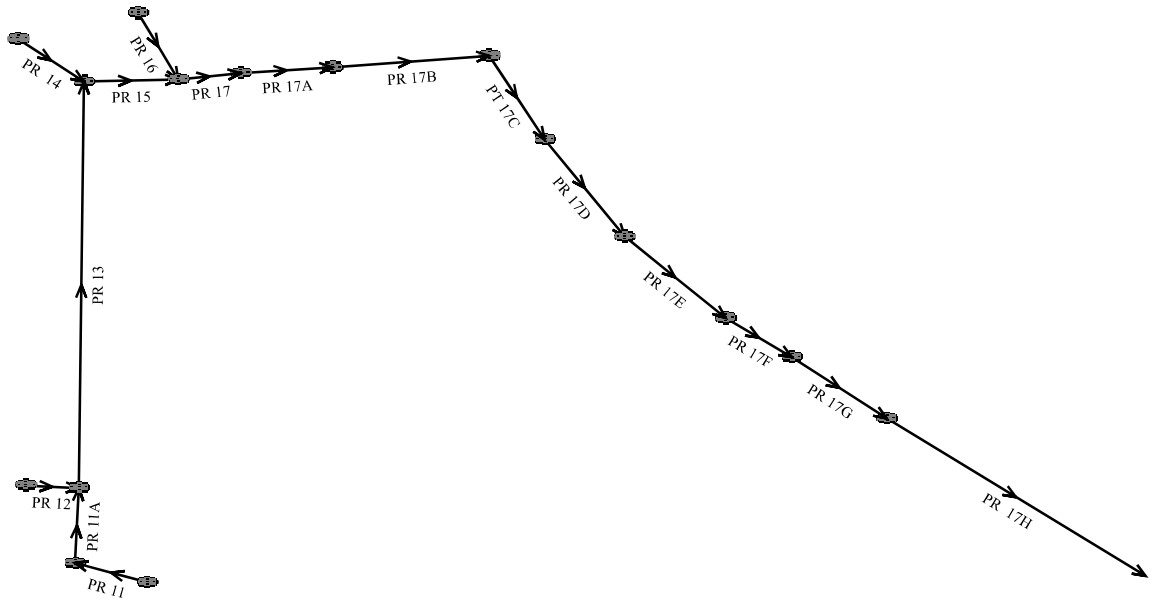
					Downstream			Upstream				
Element Name	Length (ft)	Wall (in)	Bedding (in)	Bottom Width (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Volume (cu. yd)	Comment
PR 10	69.76	3.00	4.00	5.50	0.00	0.58	0.00	7.16	4.66	1.83	38.16	Sewer Too Shallow
PR 10A	235.56	3.50	6.00	6.08	6.67	4.88	1.29	8.56	5.82	2.24	290.92	Sewer Too Shallow
PR 9	59.04	2.50	4.00	4.92	8.64	5.11	2.86	7.50	4.54	2.29	57.51	

PR 8	12.46	2.50	4.00	4.92	8.55	5.07	2.82	8.54	5.06	2.81	13.01	

Total earth volume for sewer trenches = 400 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

PIPERUNS 11-17



Program:
UDSEWER Math Model Interface 2.1.1.4
Run Date:
9/23/2021 5:50:40 PM

UDSewer Results Summary

Project Title: New UDSEWER System Module
Project Description: Default system

PIPERUNS 11-17

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6902.66

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	**Ground Elevation (ft)**	**Total Known Flow (cfs)**	**Local Contribution (cfs)**	**Drainage Area (Ac.)**	**Runoff Coefficient**	**5yr Coefficient**	**Overland Length (ft)**	**Overland Slope (%)**	**Gutter Length (ft)**	**Gutter Velocity (fps)**
FSD 2	6899.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 17I	6907.90	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 17H	6911.55	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 17G	6912.25	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 17F	6913.00	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 17E	6914.00	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 17D	6914.75	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PT 17C	6916.00	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 17B	6921.50	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 17A	6923.25	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 17	6923.00	37.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 16	6922.51	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 15	6922.35	34.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 13	6922.07	24.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 12	6922.18	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 11A	6921.65	18.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 11	6921.81	18.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 14	6922.51	11.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
FSD 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Surface Water Present (Upstream)
PR 17I	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.00	Surface Water Present (Downstream)
PR 17H	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.00	
PR 17G	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.00	
PR 17F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.00	
PR 17E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.00	
PR 17D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.00	
PT 17C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.00	
PR 17B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.00	
PR 17A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.00	
PR 17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.00	
PR 16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00	
PR 15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	34.00	
PR 13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.00	
PR 12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	
PR 11A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.00	
PR 11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.00	
PR 14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.00	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
PR 17I	153.11	6901.00	0.7	6902.07	0.013	0.03	0.00	CIRCULAR	36.00 in	36.00 in
PR 17H	248.15	6902.17	0.7	6903.91	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
PR 17G	75.41	6904.01	0.7	6904.54	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
PR 17F	23.28	6904.54	0.7	6904.70	0.013	0.06	0.00	CIRCULAR	36.00 in	36.00 in
PR 17E	40.75	6904.69	0.7	6904.98	0.013	0.06	0.00	CIRCULAR	36.00 in	36.00 in
PR 17D	40.75	6904.98	0.7	6905.27	0.013	0.06	0.00	CIRCULAR	36.00 in	36.00 in
PT 17C	40.26	6905.27	0.7	6905.55	0.013	0.06	0.00	CIRCULAR	36.00 in	36.00 in
PR 17B	231.50	6905.65	0.7	6907.27	0.013	1.32	0.00	CIRCULAR	36.00 in	36.00 in
PR 17A	50.50	6907.27	9.7	6912.16	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
PR 17	28.17	6912.16	1.0	6912.44	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
PR 16	15.44	6913.19	17.8	6915.94	0.013	0.38	0.00	CIRCULAR	18.00 in	18.00 in
PR 15	31.83	6912.44	1.0	6912.76	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
PR 13	277.53	6913.26	1.0	6916.04	0.013	1.32	0.00	CIRCULAR	36.00 in	36.00 in
PR 12	21.44	6917.91	1.0	6918.12	0.013	1.32	0.00	CIRCULAR	18.00 in	18.00 in
PR 11A	29.17	6916.44	1.0	6916.73	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
PR 11	16.92	6916.90	1.0	6917.07	0.013	1.32	0.00	CIRCULAR	24.00 in	24.00 in
PR 14	15.96	6917.60	1.0	6917.76	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
PR 17I	55.95	7.92	23.74	7.48	21.38	8.46	1.22	Supercritical	37.00	0.00	
PR 17H	55.95	7.92	23.74	7.48	21.38	8.46	1.22	Supercritical	37.00	0.00	
PR 17G	55.95	7.92	23.74	7.48	21.38	8.46	1.22	Supercritical	37.00	0.00	
PR 17F	55.95	7.92	23.74	7.48	21.38	8.46	1.22	Supercritical	37.00	0.00	
PR 17E	55.95	7.92	23.74	7.48	21.38	8.46	1.22	Supercritical	37.00	0.00	
PR 17D	55.95	7.92	23.74	7.48	21.38	8.46	1.22	Supercritical	37.00	0.00	
PT 17C	55.95	7.92	23.74	7.48	21.38	8.46	1.22	Supercritical	37.00	0.00	
PR 17B	55.95	7.91	23.74	7.48	21.38	8.46	1.22	Supercritical	37.00	0.00	
PR 17A	208.11	29.44	23.74	7.48	10.28	22.23	5.00	Supercritical	37.00	0.00	Velocity is Too High
PR 17	66.65	9.43	23.74	7.48	19.16	9.67	1.51	Pressurized	37.00	28.17	
PR 16	44.45	25.15	7.90	4.02	3.17	14.33	5.90	Supercritical Jump	3.00	6.72	

PR 15	67.04	9.48	22.72	7.23	18.15	9.52	1.54	Supercritical Jump	34.00	17.01	
PR 13	66.94	9.47	18.94	6.37	14.90	8.69	1.58	Supercritical	24.00	0.00	
PR 12	10.42	5.90	12.29	5.45	10.80	6.32	1.28	Supercritical	7.00	0.00	
PR 11A	22.62	7.20	18.34	6.99	16.18	7.99	1.28	Supercritical	18.00	0.00	
PR 11	22.73	7.24	18.34	6.99	16.12	8.02	1.29	Pressurized	18.00	16.92	
PR 14	22.69	7.22	14.27	5.65	11.79	7.17	1.44	Supercritical	11.00	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	**Peak Flow (cfs)**	**Cross Section**	**Rise**	**Span**	**Rise**	**Span**	**Rise**	**Span**	**Area (ft^2)**	**Comment**
PR 17I	37.00	CIRCULAR	36.00 in	36.00 in	33.00 in	33.00 in	36.00 in	36.00 in	7.07	
PR 17H	37.00	CIRCULAR	36.00 in	36.00 in	33.00 in	33.00 in	36.00 in	36.00 in	7.07	
PR 17G	37.00	CIRCULAR	36.00 in	36.00 in	33.00 in	33.00 in	36.00 in	36.00 in	7.07	
PR 17F	37.00	CIRCULAR	36.00 in	36.00 in	33.00 in	33.00 in	36.00 in	36.00 in	7.07	
PR 17E	37.00	CIRCULAR	36.00 in	36.00 in	33.00 in	33.00 in	36.00 in	36.00 in	7.07	
PR 17D	37.00	CIRCULAR	36.00 in	36.00 in	33.00 in	33.00 in	36.00 in	36.00 in	7.07	
PT 17C	37.00	CIRCULAR	36.00 in	36.00 in	33.00 in	33.00 in	36.00 in	36.00 in	7.07	
PR 17B	37.00	CIRCULAR	36.00 in	36.00 in	33.00 in	33.00 in	36.00 in	36.00 in	7.07	
PR 17A	37.00	CIRCULAR	36.00 in	36.00 in	21.00 in	21.00 in	36.00 in	36.00 in	7.07	
PR 17	37.00	CIRCULAR	36.00 in	36.00 in	30.00 in	30.00 in	36.00 in	36.00 in	7.07	
PR 16	3.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PR 15	34.00	CIRCULAR	36.00 in	36.00 in	30.00 in	30.00 in	36.00 in	36.00 in	7.07	
PR 13	24.00	CIRCULAR	36.00 in	36.00 in	27.00 in	27.00 in	36.00 in	36.00 in	7.07	
PR 12	7.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PR 11A	18.00	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
PR 11	18.00	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
PR 14	11.00	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6902.66

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	**Downstream (ft)**	**Upstream (ft)**	**Bend Loss (ft)**	**Lateral Loss (ft)**	**Downstream (ft)**	**Upstream (ft)**	**Downstream (ft)**	**Friction Loss (ft)**	**Upstream (ft)**
PR 17I	6901.00	6902.07	0.00	0.00	6902.78	6904.05	6903.89	1.03	6904.92
PR 17H	6902.17	6903.91	0.02	0.00	6904.07	6905.89	6905.07	1.69	6906.76
PR 17G	6904.01	6904.54	0.02	0.00	6905.91	6906.52	6906.90	0.48	6907.39
PR 17F	6904.54	6904.70	0.03	0.00	6906.54	6906.68	6907.43	0.12	6907.55
PR 17E	6904.69	6904.98	0.03	0.00	6906.70	6906.96	6907.59	0.24	6907.83
PR 17D	6904.98	6905.27	0.03	0.00	6906.98	6907.25	6907.88	0.24	6908.12
PT 17C	6905.27	6905.55	0.03	0.00	6907.27	6907.53	6908.16	0.24	6908.40
PR 17B	6905.65	6907.27	0.56	0.00	6908.52	6909.25	6908.96	1.16	6910.12
PR 17A	6907.27	6912.16	0.02	0.00	6909.27	6915.38	6915.80	0.00	6915.80
PR 17	6912.16	6912.44	0.02	0.00	6915.40	6915.48	6915.82	0.09	6915.91
PR 16	6913.19	6915.94	0.02	0.00	6915.88	6916.60	6915.93	0.92	6916.85
PR 15	6912.44	6912.76	0.02	0.00	6915.57	6915.60	6915.93	0.04	6915.97
PR 13	6913.26	6916.04	0.24	0.00	6916.01	6917.62	6916.21	2.04	6918.25
PR 12	6917.91	6918.12	0.32	0.00	6918.81	6919.14	6919.43	0.17	6919.60
PR 11A	6916.44	6916.73	0.03	0.00	6917.79	6918.26	6918.78	0.24	6919.02
PR 11	6916.90	6917.07	0.67	0.00	6919.18	6919.29	6919.69	0.11	6919.80
PR 14	6917.60	6917.76	0.01	0.00	6918.58	6918.95	6919.38	0.07	6919.44

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.

- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

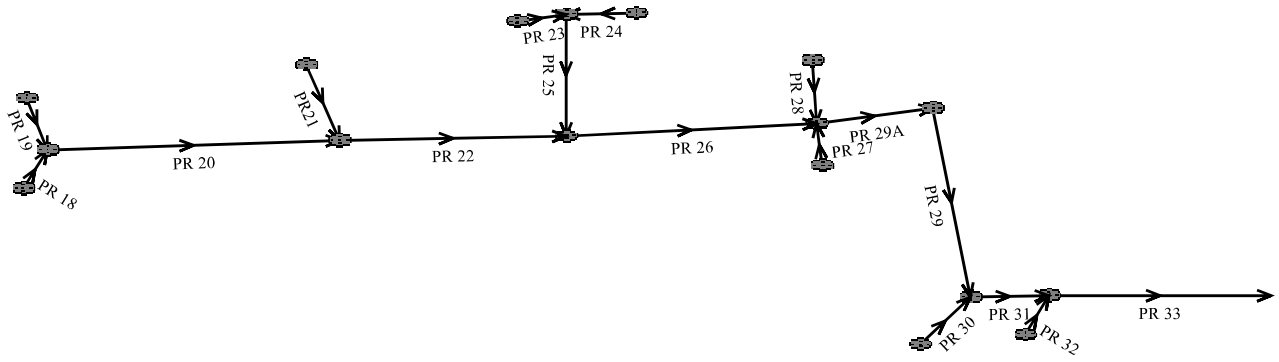
The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	**Length (ft)**	**Wall (in)**	**Bedding (in)**	**Bottom Width (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Volume (cu. yd)**	**Comment**
PR 17I	153.11	4.00	6.00	6.67	0.00	0.00	0.00	9.66	6.66	2.50	132.30	Sewer Too Shallow
PR 17H	248.15	4.00	6.00	6.67	9.45	6.56	2.39	13.28	8.47	4.31	519.74	
PR 17G	75.41	4.00	6.00	6.67	13.08	8.37	4.20	13.42	8.54	4.38	187.74	
PR 17F	23.28	4.00	6.00	6.67	13.43	8.55	4.38	14.60	9.13	4.97	62.52	
PR 17E	40.75	4.00	6.00	6.67	14.61	9.14	4.97	16.04	9.85	5.69	124.03	
PR 17D	40.75	4.00	6.00	6.67	16.03	9.85	5.68	16.96	10.31	6.15	137.96	
PT 17C	40.26	4.00	6.00	6.67	16.96	10.32	6.15	18.90	11.28	7.12	155.01	
PR 17B	231.50	4.00	6.00	6.67	18.70	11.18	7.02	26.46	15.06	10.90	1325.23	
PR 17A	50.50	4.00	6.00	6.67	26.46	15.06	10.90	20.18	11.92	7.76	302.54	
PR 17	28.17	4.00	6.00	6.67	20.18	11.92	7.76	19.12	11.39	7.23	125.13	
PR 16	15.44	2.50	4.00	4.92	19.12	10.35	8.10	12.64	7.11	4.86	43.23	
PR 15	31.83	4.00	6.00	6.67	19.12	11.39	7.23	17.18	10.42	6.26	124.87	
PR 13	277.53	4.00	6.00	6.67	16.18	9.92	5.76	10.06	6.86	2.70	706.26	
PR 12	21.44	2.50	4.00	4.92	7.82	4.70	2.45	7.62	4.60	2.35	19.72	
PR 11A	29.17	3.00	4.00	5.50	10.26	6.21	3.38	8.84	5.50	2.67	39.38	
PR 11	16.92	3.00	4.00	5.50	8.50	5.33	2.50	8.48	5.32	2.49	19.77	
PR 14	15.96	3.00	4.00	5.50	8.50	5.33	2.50	8.50	5.33	2.50	18.67	

Total earth volume for sewer trenches = 4044 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

PIPERUNS 18-33



Program:
UDSEWER Math Model Interface 2.1.1.4
Run Date:
9/24/2021 1:56:42 PM

UDSewer Results Summary

Project Title: New UDSEWER System Module
Project Description: Default system

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6927.75

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	**Ground Elevation (ft)**	**Total Known Flow (cfs)**	**Local Contribution (cfs)**	**Drainage Area (Ac.)**	**Runoff Coefficient**	**5yr Coefficient**	**Overland Length (ft)**	**Overland Slope (%)**	**Gutter Length (ft)**	**Gutter Velocity (fps)**
FSD 3	6924.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 33	6935.00	87.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 32	6935.06	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 31	6934.70	81.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 29	6941.90	69.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 29A	6941.40	69.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 27	6941.66	6.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 28	6941.66	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 26	6947.10	59.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 25	6945.70	38.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 24	6945.98	19.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 23	6945.98	19.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 22	6952.18	27.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
PR 20	6952.70	21.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 18	6953.15	15.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 19	6953.14	8.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR21	6952.61	9.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 30	6935.06	16.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
FSD 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Surface Water Present (Upstream)
PR 33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	87.00	Surface Water Present (Downstream)
PR 32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	
PR 31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	81.00	
PR 29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	69.00	
PR 29A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	69.00	
PR 27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.00	
PR 28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	
PR 26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	59.00	
PR 25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.00	
PR 24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.00	
PR 23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.00	
PR 22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.00	
PR 20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.00	
PR 18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.00	
PR 19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00	
PR21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.00	
PR 30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.00	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
PR 33	290.10	6924.25	1.0	6927.15	0.013	0.03	0.00	CIRCULAR	42.00 in	42.00 in
PR 32	11.86	6928.15	11.7	6929.54	0.013	0.38	0.00	CIRCULAR	18.00 in	18.00 in
PR 31	35.39	6927.15	1.0	6927.50	0.013	0.05	0.00	CIRCULAR	42.00 in	42.00 in
PR 29	274.51	6927.98	1.7	6932.65	0.013	1.32	0.00	CIRCULAR	36.00 in	36.00 in
PR 29A	83.18	6932.99	1.7	6934.40	0.013	1.32	0.00	CIRCULAR	36.00 in	36.00 in
PR 27	5.17	6935.80	2.9	6935.95	0.013	1.32	0.00	CIRCULAR	18.00 in	18.00 in
PR 28	25.17	6934.29	3.0	6935.05	0.013	1.32	0.00	CIRCULAR	18.00 in	18.00 in
PR 26	345.95	6934.75	1.3	6939.25	0.013	0.05	0.00	CIRCULAR	36.00 in	36.00 in
PR 25	105.89	6939.75	1.0	6940.81	0.013	1.32	0.00	CIRCULAR	30.00 in	30.00 in
PR 24	25.67	6941.31	1.0	6941.57	0.013	1.32	0.00	CIRCULAR	24.00 in	24.00 in
PR 23	5.99	6941.31	1.0	6941.37	0.013	1.32	0.00	CIRCULAR	24.00 in	24.00 in
PR 22	289.84	6939.75	1.8	6945.11	0.013	0.05	0.00	CIRCULAR	30.00 in	30.00 in
PR 20	174.56	6946.11	1.0	6947.86	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
PR 18	7.33	6948.16	1.0	6948.23	0.013	0.38	0.00	CIRCULAR	24.00 in	24.00 in
PR 19	26.19	6946.86	1.0	6947.12	0.013	0.83	0.00	CIRCULAR	18.00 in	18.00 in
PR21	26.19	6946.62	2.0	6947.14	0.013	0.38	0.00	CIRCULAR	18.00 in	18.00 in
PR 30	12.69	6928.99	4.3	6929.54	0.013	0.38	0.00	CIRCULAR	24.00 in	24.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
PR 33	100.88	10.49	34.81	10.20	30.09	11.80	1.36	Supercritical Jump	87.00	0.39	
PR 32	36.03	20.39	12.29	5.45	5.38	15.79	4.90	Pressurized	7.00	11.86	
PR 31	100.88	10.49	33.72	9.78	28.49	11.66	1.41	Supercritical	81.00	0.00	
PR 29	87.20	12.34	31.73	10.46	24.16	13.68	1.80	Supercritical Jump	69.00	250.13	
PR 29A	87.20	12.34	31.73	10.46	24.16	13.68	1.80	Pressurized	69.00	83.18	
PR 27	17.94	10.15	11.35	5.11	7.17	9.14	2.41	Pressurized	6.00	5.17	
PR 28	18.24	10.32	12.29	5.45	7.74	9.64	2.43	Pressurized	7.00	25.17	
PR 26	76.25	10.79	29.80	9.43	23.78	11.91	1.59	Supercritical Jump	59.00	201.55	
PR 25	41.13	8.38	25.00	8.69	22.76	9.51	1.23	Pressurized	38.00	105.89	
PR 24	22.68	7.22	18.82	7.19	16.81	8.09	1.26	Pressurized	19.00	25.67	

PR 23	22.68	7.22	18.82	7.19	16.81	8.09	1.26	Pressurized	19.00	5.99	
PR 22	55.93	11.39	21.26	7.26	14.69	11.29	2.04	Supercritical Jump	27.00	29.45	
PR 20	22.68	7.22	19.70	7.61	18.24	8.20	1.18	Supercritical	21.00	0.00	
PR 18	22.68	7.22	16.75	6.41	14.25	7.72	1.37	Supercritical Jump	15.00	4.39	
PR 19	10.53	5.96	13.15	5.78	11.73	6.56	1.25	Pressurized	8.00	26.19	
PR21	14.90	8.43	13.93	6.13	10.09	8.82	1.88	Supercritical	9.00	0.00	
PR 30	47.04	14.97	17.30	6.60	9.65	13.54	3.07	Supercritical	16.00	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	**Peak Flow (cfs)**	**Cross Section**	**Rise**	**Span**	**Rise**	**Span**	**Rise**	**Span**	**Area (ft^2)**	**Comment**
PR 33	87.00	CIRCULAR	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	9.62	
PR 32	7.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PR 31	81.00	CIRCULAR	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	9.62	
PR 29	69.00	CIRCULAR	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	7.07	
PR 29A	69.00	CIRCULAR	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	7.07	
PR 27	6.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PR 28	7.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PR 26	59.00	CIRCULAR	36.00 in	36.00 in	33.00 in	33.00 in	36.00 in	36.00 in	7.07	
PR 25	38.00	CIRCULAR	30.00 in	30.00 in	30.00 in	30.00 in	30.00 in	30.00 in	4.91	
PR 24	19.00	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
PR 23	19.00	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
PR 22	27.00	CIRCULAR	30.00 in	30.00 in	24.00 in	24.00 in	30.00 in	30.00 in	4.91	
PR 20	21.00	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
PR 18	15.00	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	
PR 19	8.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PR21	9.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PR 30	16.00	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6927.75

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	**Downstream (ft)**	**Upstream (ft)**	**Bend Loss (ft)**	**Lateral Loss (ft)**	**Downstream (ft)**	**Upstream (ft)**	**Downstream (ft)**	**Friction Loss (ft)**	**Upstream (ft)**
PR 33	6924.25	6927.15	0.00	0.00	6927.75	6930.05	6929.02	2.65	6931.67
PR 32	6928.15	6929.54	0.09	0.00	6931.52	6931.57	6931.76	0.05	6931.81
PR 31	6927.15	6927.50	0.06	0.00	6930.62	6930.62	6931.72	0.14	6931.86
PR 29	6927.98	6932.65	1.95	0.00	6932.57	6935.29	6934.05	2.94	6936.99
PR 29A	6932.99	6934.40	1.95	0.00	6937.47	6938.35	6938.95	0.89	6939.83
PR 27	6935.80	6935.95	0.24	0.00	6939.89	6939.91	6940.07	0.02	6940.08
PR 28	6934.29	6935.05	0.32	0.00	6939.91	6940.02	6940.15	0.11	6940.26
PR 26	6934.75	6939.25	0.05	0.00	6938.80	6941.73	6939.89	3.23	6943.11
PR 25	6939.75	6940.81	1.23	0.00	6943.41	6944.32	6944.34	0.90	6945.25
PR 24	6941.31	6941.57	0.75	0.00	6945.43	6945.61	6946.00	0.18	6946.18
PR 23	6941.31	6941.37	0.75	0.00	6945.43	6945.47	6946.00	0.04	6946.04
PR 22	6939.75	6945.11	0.02	0.00	6942.67	6946.88	6943.14	4.56	6947.70
PR 20	6946.11	6947.86	0.03	0.00	6947.63	6949.50	6948.68	1.72	6950.40
PR 18	6948.16	6948.23	0.13	0.00	6950.18	6950.20	6950.54	0.02	6950.55
PR 19	6946.86	6947.12	0.26	0.00	6950.35	6950.50	6950.67	0.15	6950.82
PR21	6946.62	6947.14	0.15	0.00	6947.46	6948.30	6948.67	0.22	6948.88
PR 30	6928.99	6929.54	0.15	0.00	6930.77	6932.24	6932.65	0.00	6932.65

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	**Length (ft)**	**Wall (in)**	**Bedding (in)**	**Bottom Width (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Volume (cu. yd)**	**Comment**
PR 33	290.10	4.50	6.00	7.25	0.00	0.88	0.00	13.20	8.73	3.98	421.49	Sewer Too Shallow
PR 32	11.86	2.50	4.00	4.92	13.20	7.39	5.14	10.54	6.06	3.81	20.02	
PR 31	35.39	4.50	6.00	7.25	13.21	8.73	3.98	11.90	8.08	3.33	89.20	
PR 29	274.51	4.00	6.00	6.67	11.43	7.55	3.38	16.50	10.08	5.92	749.36	
PR 29A	83.18	4.00	6.00	6.67	15.83	9.75	5.58	12.00	7.83	3.67	223.81	
PR 27	5.17	2.50	4.00	4.92	10.70	6.14	3.89	10.92	6.25	4.00	7.50	
PR 28	25.17	2.50	4.00	4.92	13.71	7.65	5.40	12.72	7.15	4.90	50.02	
PR 26	345.95	4.00	6.00	6.67	11.29	7.48	3.31	13.70	8.68	4.52	803.90	
PR 25	105.89	3.50	6.00	6.08	13.20	8.14	4.56	8.28	5.68	2.10	192.06	
PR 24	25.67	3.00	4.00	5.50	7.77	4.97	2.14	7.82	4.99	2.16	27.30	
PR 23	5.99	3.00	4.00	5.50	7.78	4.97	2.14	8.22	5.19	2.36	6.55	
PR 22	289.84	3.50	6.00	6.08	13.20	8.14	4.56	12.64	7.86	4.28	648.17	
PR 20	174.56	3.00	4.00	5.50	11.13	6.65	3.82	8.68	5.42	2.59	248.43	
PR 18	7.33	3.00	4.00	5.50	8.09	5.13	2.29	8.84	5.50	2.67	8.54	
PR 19	26.19	2.50	4.00	4.92	11.18	6.38	4.13	11.54	6.56	4.31	40.95	
PR21	26.19	2.50	4.00	4.92	10.63	6.11	3.86	10.44	6.01	3.76	36.55	
PR 30	12.69	3.00	4.00	5.50	10.41	6.29	3.46	10.04	6.10	3.27	18.65	

Total earth volume for sewer trenches = 3593 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

PIPERUN 34

Program:
UDSEWER Math Model Interface 2.1.1.4
Run Date:
9/25/2021 5:50:17 PM

UDSewer Results Summary

Project Title: New UDSEWER System Module
Project Description: Default system

PIPERUN 34

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6928.25

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
FSD 3	6922.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 18	6926.28	18.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
FSD 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Surface Water Present (Upstream)
PR 18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.00	Surface Water Present (Downstream)

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
PR 18	135.58	6922.70	0.6	6923.51	0.013	0.03	0.00	CIRCULAR	24.00 in	24.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
PR 18	17.57	5.59	24.00	5.73	24.00	5.73	0.00	Pressurized	18.00	135.58	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	Peak Flow (cfs)	Cross Section	Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	Comment
PR 18	18.00	CIRCULAR	24.00 in	24.00 in	27.00 in	27.00 in	24.00 in	24.00 in	3.14	Existing height is smaller than the suggested height. Existing width is smaller than the suggested width. Exceeds max. Depth/Rise

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6928.25

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PR 18	6922.70	6923.51	0.00	0.00	6928.25	6929.10	6928.76	0.85	6929.61

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

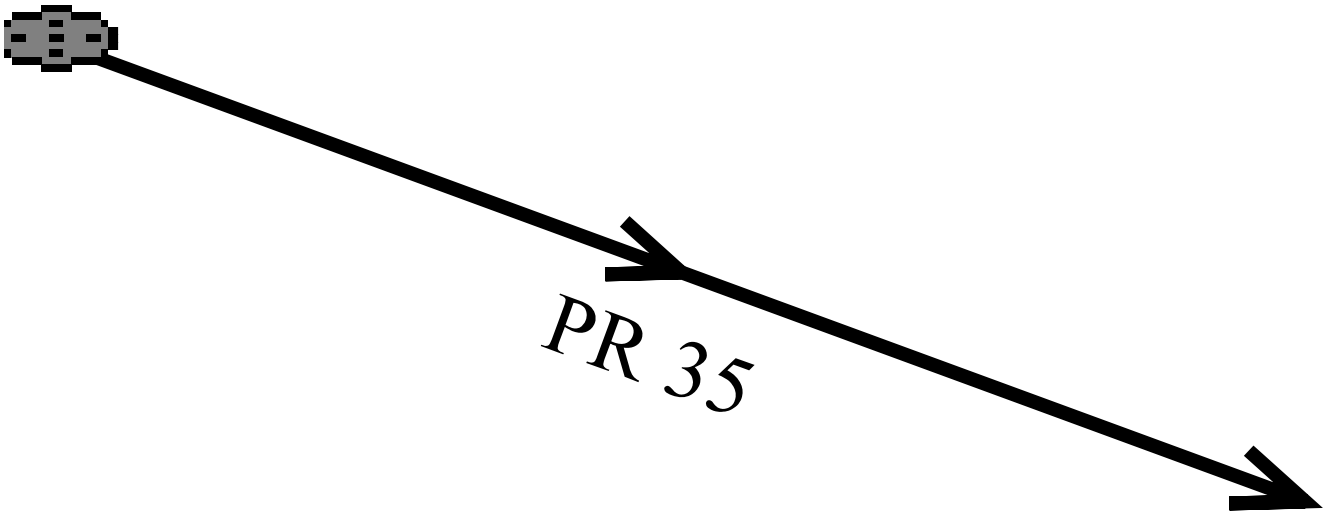
The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	Length (ft)	Wall (in)	Bedding (in)	Bottom Width (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Volume (cu. yd)	Comment
PR 18	135.58	3.00	4.00	5.50	0.00	0.59	0.00	5.50	3.35	0.52	47.23	Sewer Too Shallow

Total earth volume for sewer trenches = 47 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

PIPERUN 35



Program:
UDSEWER Math Model Interface 2.1.1.4
Run Date:
9/25/2021 6:09:30 PM

UDSewer Results Summary

Project Title: New UDSEWER System Module
Project Description: Default system

PIPERUN 35

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in):
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 18.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6922.00

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
OUTFALL 1	6921.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PR 35	6926.54	60.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Surface Water Present (Upstream)
PR 35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.70	Surface Water Present (Downstream)

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
PR 35	216.23	6918.01	1.8	6921.90	0.013	0.03	0.00	CIRCULAR	36.00 in	36.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
PR 35	89.73	12.69	30.17	9.60	21.70	13.63	1.95	Supercritical Jump	60.70	101.63	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	Peak Flow (cfs)	Cross Section	Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	Comment
PR 35	60.70	CIRCULAR	36.00 in	36.00 in	33.00 in	33.00 in	36.00 in	36.00 in	7.07	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6922.00

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PR 35	6918.01	6921.90	0.00	0.00	6922.00	6924.41	6923.15	2.70	6925.84

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

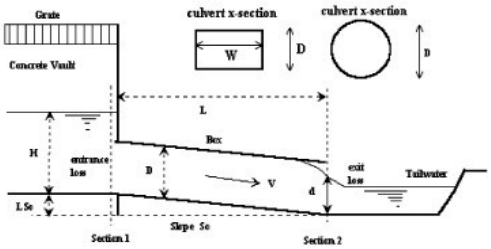
					Downstream			Upstream				
Element Name	Length (ft)	Wall (in)	Bedding (in)	Bottom Width (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Volume (cu. yd)	Comment
PR 35	216.23	4.00	6.00	6.67	0.00	3.83	0.00	7.28	5.47	1.31	248.61	Sewer Too Shallow

Total earth volume for sewer trenches = 249 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: WATERBURY FILING 1
Basin ID: Design Point 11- Dual 42" RCP Culverts
Status:



Design Information (Input):

Circular Culvert:	Barrel Diameter in Inches	D =	42	inches
	Inlet Edge Type (choose from pull-down list)		Grooved End Projection	
OR:				
Box Culvert:	Barrel Height (Rise) in Feet	Height (Rise) =		ft.
	Barrel Width (Span) in Feet	Width (Span) =		ft.
	Inlet Edge Type (choose from pull-down list)		Square Edge w/ 90-15 Deg. Headwall	
	Number of Barrels	No =	2	
	Inlet Elevation at Culvert Invert	Inlet Elev =	7270.37	ft. elev.
	Outlet Elevation at Culvert Invert **OR** Slope of Culvert (ft v./ft h.)	Outlet Elev =	7269.7	ft. elev.
	Culvert Length in Feet	L =	80	ft.
	Manning's Roughness	n =	0.013	
	Bend Loss Coefficient	K_b =	0	
	Exit Loss Coefficient	K_x =	1	

Design Information (calculated):

Entrance Loss Coefficient	K_e =	0.20
Friction Loss Coefficient	K_f =	0.47
Sum of All Loss Coefficients	K_s =	1.67
Orifice Inlet Condition Coefficient	C_d =	0.95
Minimum Energy Condition Coefficient	KE_{low} =	-0.0198

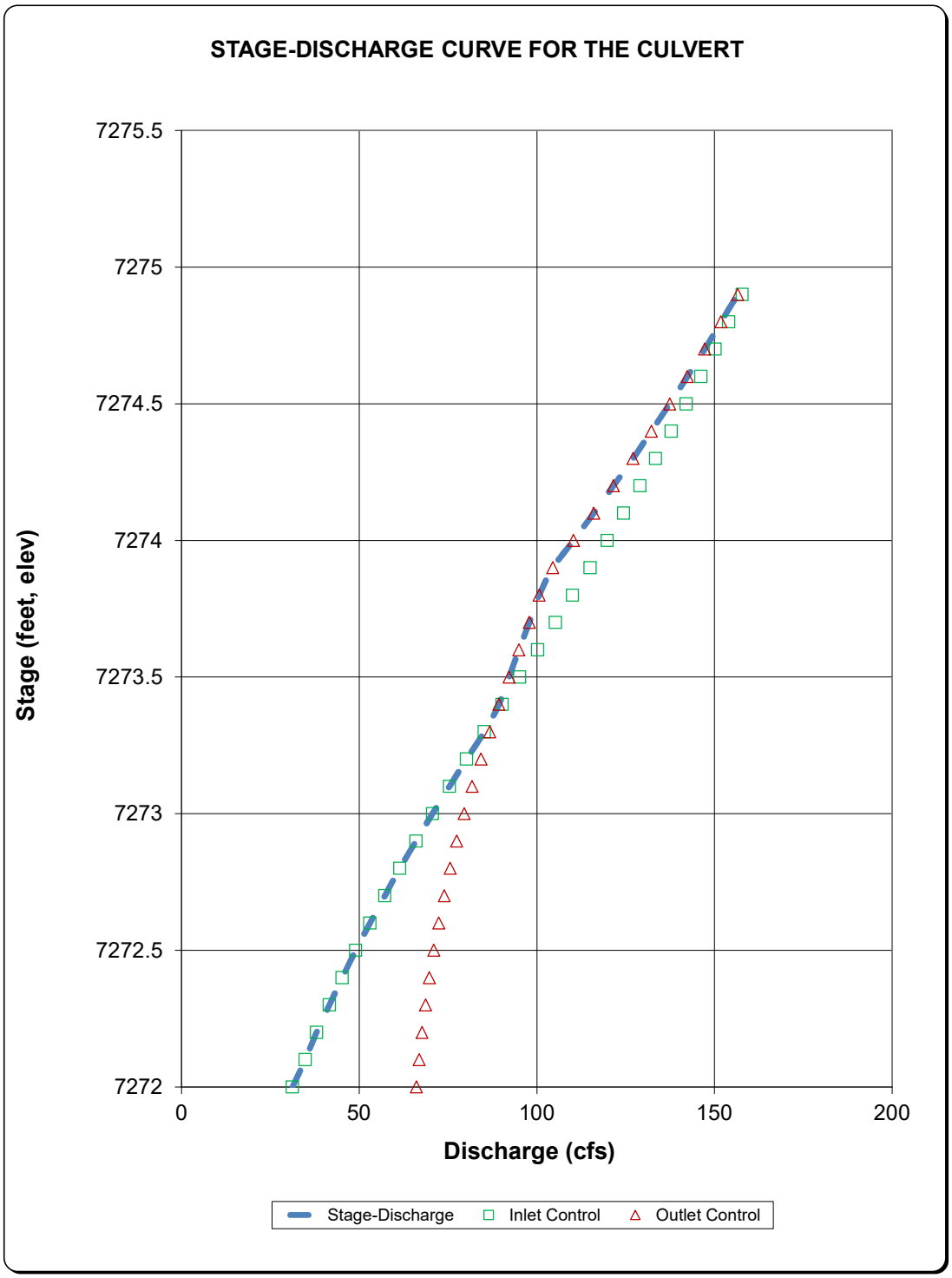
Calculations of Culvert Capacity (output):

Water Surface Elevation (ft., linked)	Tailwater Surface Elevation ft	Culvert Inlet-Control Flowrate cfs	Culvert Outlet-Control Flowrate cfs	Controlling Culvert Flowrate cfs (output)	Inlet Equation Used:	Flow Control Used
7272.00		31.20	66.11	**31.20**	Min. Energy. Eqn.	INLET
7272.10		34.80	66.85	**34.80**	Min. Energy. Eqn.	INLET
7272.20		38.00	67.67	**38.00**	Regression Eqn.	INLET
7272.30		41.60	68.69	**41.60**	Regression Eqn.	INLET
7272.40		45.20	69.70	**45.20**	Regression Eqn.	INLET
7272.50		49.00	70.99	**49.00**	Regression Eqn.	INLET
7272.60		53.00	72.37	**53.00**	Regression Eqn.	INLET
7272.70		57.20	73.93	**57.20**	Regression Eqn.	INLET
7272.80		61.40	75.59	**61.40**	Regression Eqn.	INLET
7272.90		66.00	77.43	**66.00**	Regression Eqn.	INLET
7273.00		70.60	79.55	**70.60**	Regression Eqn.	INLET
7273.10		75.40	81.76	**75.40**	Regression Eqn.	INLET
7273.20		80.20	84.25	**80.20**	Regression Eqn.	INLET
7273.30		85.20	86.73	**85.20**	Regression Eqn.	INLET
7273.40		90.20	89.31	**89.31**	Regression Eqn.	OUTLET
7273.50		95.20	92.17	**92.17**	Regression Eqn.	OUTLET
7273.60		100.20	94.93	**94.93**	Regression Eqn.	OUTLET
7273.70		105.20	97.87	**97.87**	Regression Eqn.	OUTLET
7273.80		110.00	100.64	**100.64**	Regression Eqn.	OUTLET
7273.90		115.00	104.50	**104.50**	Regression Eqn.	OUTLET
7274.00		119.80	110.30	**110.30**	Regression Eqn.	OUTLET
7274.10		124.40	116.01	**116.01**	Regression Eqn.	OUTLET
7274.20		129.00	121.54	**121.54**	Regression Eqn.	OUTLET
7274.30		133.40	127.06	**127.06**	Regression Eqn.	OUTLET
7274.40		137.80	132.22	**132.22**	Regression Eqn.	OUTLET
7274.50		142.00	137.37	**137.37**	Regression Eqn.	OUTLET
7274.60		146.20	142.35	**142.35**	Regression Eqn.	OUTLET
7274.70		150.20	147.22	**147.22**	Regression Eqn.	OUTLET
7274.80		154.00	151.83	**151.83**	Regression Eqn.	OUTLET
7274.90		157.80	156.52	**156.52**	Regression Eqn.	OUTLET

Processing Time: 00.90 Seconds

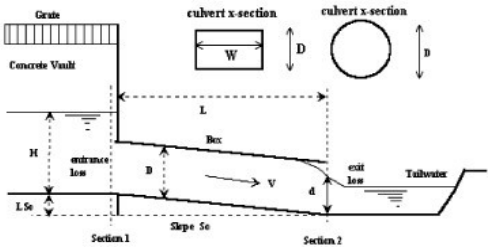
CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: WATERBURY FILING 1
Basin ID: Design Point 11- Dual 42" RCP Culverts



CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: WATERBURY FILING 1
Basin ID: Design Point 12- 18" RCP Culvert
Status:



Design Information (Input):

Circular Culvert:	Barrel Diameter in Inches	D =	42	inches
	Inlet Edge Type (choose from pull-down list)		Grooved End Projection	
OR:				
Box Culvert:	Barrel Height (Rise) in Feet	Height (Rise) =		ft.
	Barrel Width (Span) in Feet	Width (Span) =		ft.
	Inlet Edge Type (choose from pull-down list)		Square Edge w/ 90-15 Deg. Headwall	
	Number of Barrels	No =	2	
	Inlet Elevation at Culvert Invert	Inlet Elev =	7270.37	ft. elev.
	Outlet Elevation at Culvert Invert **OR** Slope of Culvert (ft v./ft h.)	Outlet Elev =	7269.7	ft. elev.
	Culvert Length in Feet	L =	80	ft.
	Manning's Roughness	n =	0.013	
	Bend Loss Coefficient	K_b =	0	
	Exit Loss Coefficient	K_x =	1	

Design Information (calculated):

Entrance Loss Coefficient	K_e =	0.20
Friction Loss Coefficient	K_f =	0.47
Sum of All Loss Coefficients	K_s =	1.67
Orifice Inlet Condition Coefficient	C_d =	0.95
Minimum Energy Condition Coefficient	KE_{low} =	-0.0198

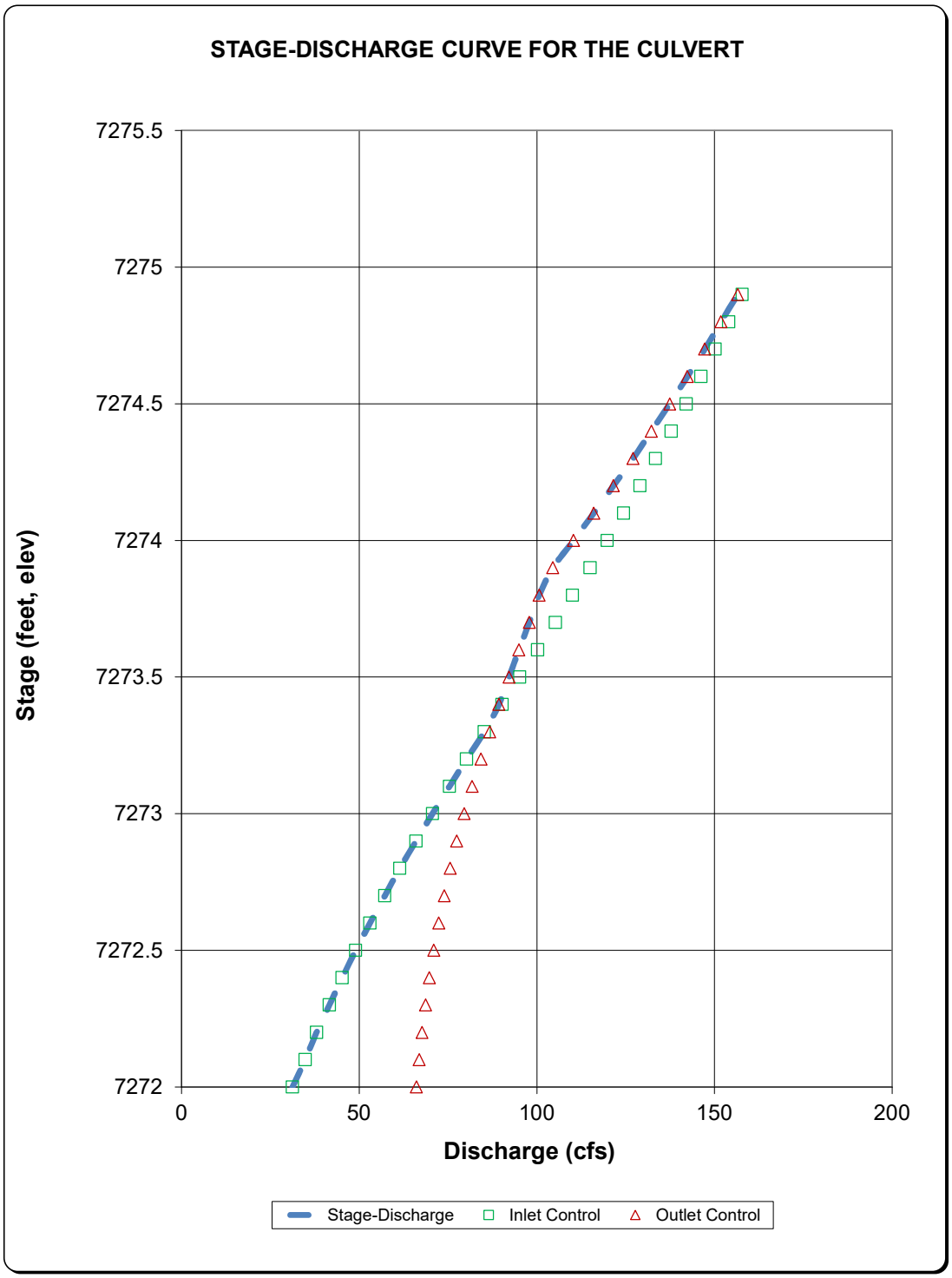
Calculations of Culvert Capacity (output):

Water Surface Elevation (ft., linked)	Tailwater Surface Elevation ft	Culvert Inlet-Control Flowrate cfs	Culvert Outlet-Control Flowrate cfs	Controlling Culvert Flowrate cfs (output)	Inlet Equation Used:	Flow Control Used
7272.00		31.20	66.11	**31.20**	Min. Energy. Eqn.	INLET
7272.10		34.80	66.85	**34.80**	Min. Energy. Eqn.	INLET
7272.20		38.00	67.67	**38.00**	Regression Eqn.	INLET
7272.30		41.60	68.69	**41.60**	Regression Eqn.	INLET
7272.40		45.20	69.70	**45.20**	Regression Eqn.	INLET
7272.50		49.00	70.99	**49.00**	Regression Eqn.	INLET
7272.60		53.00	72.37	**53.00**	Regression Eqn.	INLET
7272.70		57.20	73.93	**57.20**	Regression Eqn.	INLET
7272.80		61.40	75.59	**61.40**	Regression Eqn.	INLET
7272.90		66.00	77.43	**66.00**	Regression Eqn.	INLET
7273.00		70.60	79.55	**70.60**	Regression Eqn.	INLET
7273.10		75.40	81.76	**75.40**	Regression Eqn.	INLET
7273.20		80.20	84.25	**80.20**	Regression Eqn.	INLET
7273.30		85.20	86.73	**85.20**	Regression Eqn.	INLET
7273.40		90.20	89.31	**89.31**	Regression Eqn.	OUTLET
7273.50		95.20	92.17	**92.17**	Regression Eqn.	OUTLET
7273.60		100.20	94.93	**94.93**	Regression Eqn.	OUTLET
7273.70		105.20	97.87	**97.87**	Regression Eqn.	OUTLET
7273.80		110.00	100.64	**100.64**	Regression Eqn.	OUTLET
7273.90		115.00	104.50	**104.50**	Regression Eqn.	OUTLET
7274.00		119.80	110.30	**110.30**	Regression Eqn.	OUTLET
7274.10		124.40	116.01	**116.01**	Regression Eqn.	OUTLET
7274.20		129.00	121.54	**121.54**	Regression Eqn.	OUTLET
7274.30		133.40	127.06	**127.06**	Regression Eqn.	OUTLET
7274.40		137.80	132.22	**132.22**	Regression Eqn.	OUTLET
7274.50		142.00	137.37	**137.37**	Regression Eqn.	OUTLET
7274.60		146.20	142.35	**142.35**	Regression Eqn.	OUTLET
7274.70		150.20	147.22	**147.22**	Regression Eqn.	OUTLET
7274.80		154.00	151.83	**151.83**	Regression Eqn.	OUTLET
7274.90		157.80	156.52	**156.52**	Regression Eqn.	OUTLET

Processing Time: 00.90 Seconds

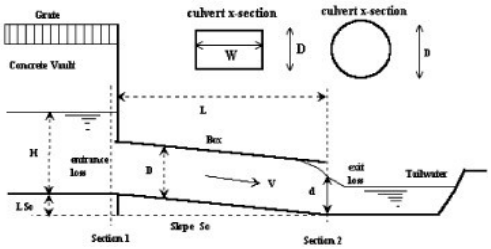
CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: WATERBURY FILING 1
Basin ID: Design Point 12- 18" RCP Culvert



CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: WATERBURY FILING 1
Basin ID: Design Point 30- Triple 36" RCP Culverts
Status:



Design Information (Input):

Circular Culvert:	Barrel Diameter in Inches	D =	36	inches
	Inlet Edge Type (choose from pull-down list)		Grooved End Projection	
OR:				
Box Culvert:	Barrel Height (Rise) in Feet	Height (Rise) =		ft.
	Barrel Width (Span) in Feet	Width (Span) =		ft.
	Inlet Edge Type (choose from pull-down list)		Square Edge w/ 90-15 Deg. Headwall	
	Number of Barrels	No =	3	
	Inlet Elevation at Culvert Invert	Inlet Elev =	6920	ft. elev.
	Outlet Elevation at Culvert Invert **OR** Slope of Culvert (ft v./ft h.)	Outlet Elev =	6919	ft. elev.
	Culvert Length in Feet	L =	130	ft.
	Manning's Roughness	n =	0.013	
	Bend Loss Coefficient	K_b =	0	
	Exit Loss Coefficient	K_x =	1	

Design Information (calculated):

Entrance Loss Coefficient	K_e =	0.20
Friction Loss Coefficient	K_f =	0.93
Sum of All Loss Coefficients	K_s =	2.13
Orifice Inlet Condition Coefficient	C_d =	0.95
Minimum Energy Condition Coefficient	KE_{low} =	-0.0132

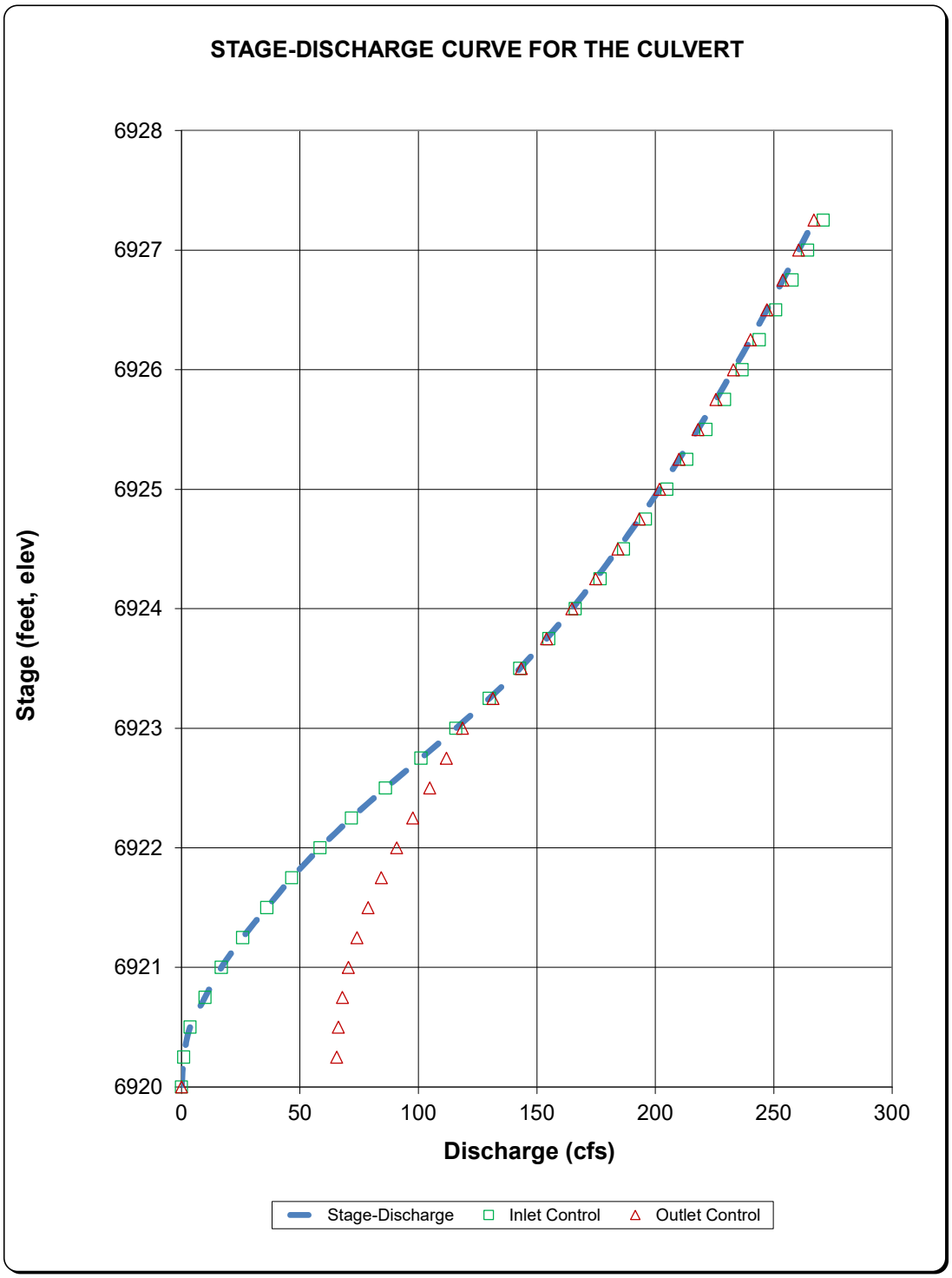
Calculations of Culvert Capacity (output):

Water Surface Elevation (ft., linked)	Tailwater Surface Elevation ft	Culvert Inlet-Control Flowrate cfs	Culvert Outlet-Control Flowrate cfs	Controlling Culvert Flowrate cfs (output)	Inlet Equation Used:	Flow Control Used
6920.00		0.00	0.00	**0.00**	No Flow (WS < inlet)	N/A
6920.25		0.90	65.46	**0.90**	Min. Energy. Eqn.	INLET
6920.50		3.60	66.25	**3.60**	Min. Energy. Eqn.	INLET
6920.75		9.90	67.92	**9.90**	Min. Energy. Eqn.	INLET
6921.00		16.80	70.46	**16.80**	Min. Energy. Eqn.	INLET
6921.25		25.80	74.06	**25.80**	Min. Energy. Eqn.	INLET
6921.50		36.00	78.71	**36.00**	Min. Energy. Eqn.	INLET
6921.75		46.50	84.33	**46.50**	Regression Eqn.	INLET
6922.00		58.50	90.82	**58.50**	Regression Eqn.	INLET
6922.25		71.70	97.66	**71.70**	Regression Eqn.	INLET
6922.50		86.10	104.77	**86.10**	Regression Eqn.	INLET
6922.75		101.10	111.79	**101.10**	Regression Eqn.	INLET
6923.00		115.80	118.55	**115.80**	Regression Eqn.	INLET
6923.25		129.90	131.45	**129.90**	Regression Eqn.	INLET
6923.50		142.80	143.38	**142.80**	Regression Eqn.	INLET
6923.75		155.10	154.08	**154.08**	Regression Eqn.	OUTLET
6924.00		166.20	164.79	**164.79**	Regression Eqn.	OUTLET
6924.25		176.70	174.79	**174.79**	Regression Eqn.	OUTLET
6924.50		186.60	184.18	**184.18**	Regression Eqn.	OUTLET
6924.75		195.90	193.22	**193.22**	Regression Eqn.	OUTLET
6925.00		204.90	201.82	**201.82**	Regression Eqn.	OUTLET
6925.25		213.30	209.98	**209.98**	Regression Eqn.	OUTLET
6925.50		221.40	217.97	**217.97**	Regression Eqn.	OUTLET
6925.75		229.20	225.60	**225.60**	Regression Eqn.	OUTLET
6926.00		236.70	232.97	**232.97**	Regression Eqn.	OUTLET
6926.25		243.90	240.17	**240.17**	Regression Eqn.	OUTLET
6926.50		250.80	247.10	**247.10**	Regression Eqn.	OUTLET
6926.75		257.70	253.85	**253.85**	Regression Eqn.	OUTLET
6927.00		264.30	260.52	**260.52**	Regression Eqn.	OUTLET
6927.25		270.90	266.93	**266.93**	Regression Eqn.	OUTLET

Processing Time: 00.91 Seconds

CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: WATERBURY FILING 1
Basin ID: Design Point 30- Triple 36" RCP Culverts



MDDP
FULL SPECTRUM DETENTION & WATER QUALITY CALCULATIONS

POND TRIBUTARY AREA

POND 1 TRIB AREA (DP 8)	**19.91** AC	BASINS A, B1, B2, C, D ,E, F, H, & K	DCIA	4.68
			UIA	6.57
			RPA	0.71
			SPA	7.94
			Total	**19.91**
POND 2 TRIB AREA (DP 18)	**21.93** AC	BASINS L1, L2, O1, O2, & OS-4	DCIA	2.58
			UIA	4.13
			RPA	0.68
			SPA	14.55
			Total	**21.93**
POND 3 TRIB AREA (DP 29)	**84.64** AC	BASINS Q1, Q2, R, S1, S2, T1, T2, U1, U2, W, OS-1, OS-2, OS-3A, 0S-3B, OS-Q1, OS-Q2, OS-4, OS-S1, OS-S2, OS-T2, OS-7, & OS-9	DCIA	19.50
			UIA	22.09
			RPA	11.31
			SPA	31.74
			Total	**84.64**

Worksheet Protected

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.43	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer:	**QNA**
Company:	**Terra Nova Engineering**
Date:	**September 20, 2021**
Project:	**WATERBURY FILING 1 POND 1**
Location:	**POND 1 Design Point 8 Full Spectrum Detention 19.91 Acres**

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**DP 9 FSD**													
Receiving Pervious Area Soil Type	Loamy Sand													
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	19.91													
Directly Connected Impervious Area (DCIA, acres)	4.68													
Unconnected Impervious Area (UIA, acres)	6.57													
Receiving Pervious Area (RPA, acres)	0.71													
Separate Pervious Area (SPA, acres)	7.94													
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C													

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	19.905													
Directly Connected Impervious Area (DCIA, %)	23.5%													
Unconnected Impervious Area (UIA, %)	33.0%													
Receiving Pervious Area (RPA, %)	3.5%													
Separate Pervious Area (SPA, %)	39.9%													
A_R (RPA / UIA)	0.107													
I_a Check	0.900													
f / I for WQCV Event:	4.5													
f / I for 5-Year Event:	0.5													
f / I for 100-Year Event:	0.4													
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	0.89													
IRF for 5-Year Event:	0.97													
IRF for 100-Year Event:	0.98													
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	56.6%													
Effective Imperviousness for WQCV Event:	52.8%													
Effective Imperviousness for 5-Year Event:	55.6%													
Effective Imperviousness for 100-Year Event:	55.9%													
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	4.9%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	1.2%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**56.6%**
Total Site Effective Imperviousness for WQCV Event:	**52.8%**
Total Site Effective Imperviousness for 5-Year Event:	**55.6%**
Total Site Effective Imperviousness for 100-Year Event:	**55.9%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected Worksheet Protected

Stormwater Facility Name: **Waterbury Filing No. 1 & 2 EDB Pond 1 D8 8**

Facility Location & Jurisdiction: **Stapleton Dr. & Bandernero Dr Intersection**

User Input: Watershed Characteristics

Watershed Slope =	0.012	ft/ft
Watershed Length =	1935	ft
Watershed Area =	19.91	acres
Watershed Imperviousness =	55.9%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent

Location for 1-hr Rainfall Depths (use dropdown):

User Input

WQCV Treatment Method = Extended Detention

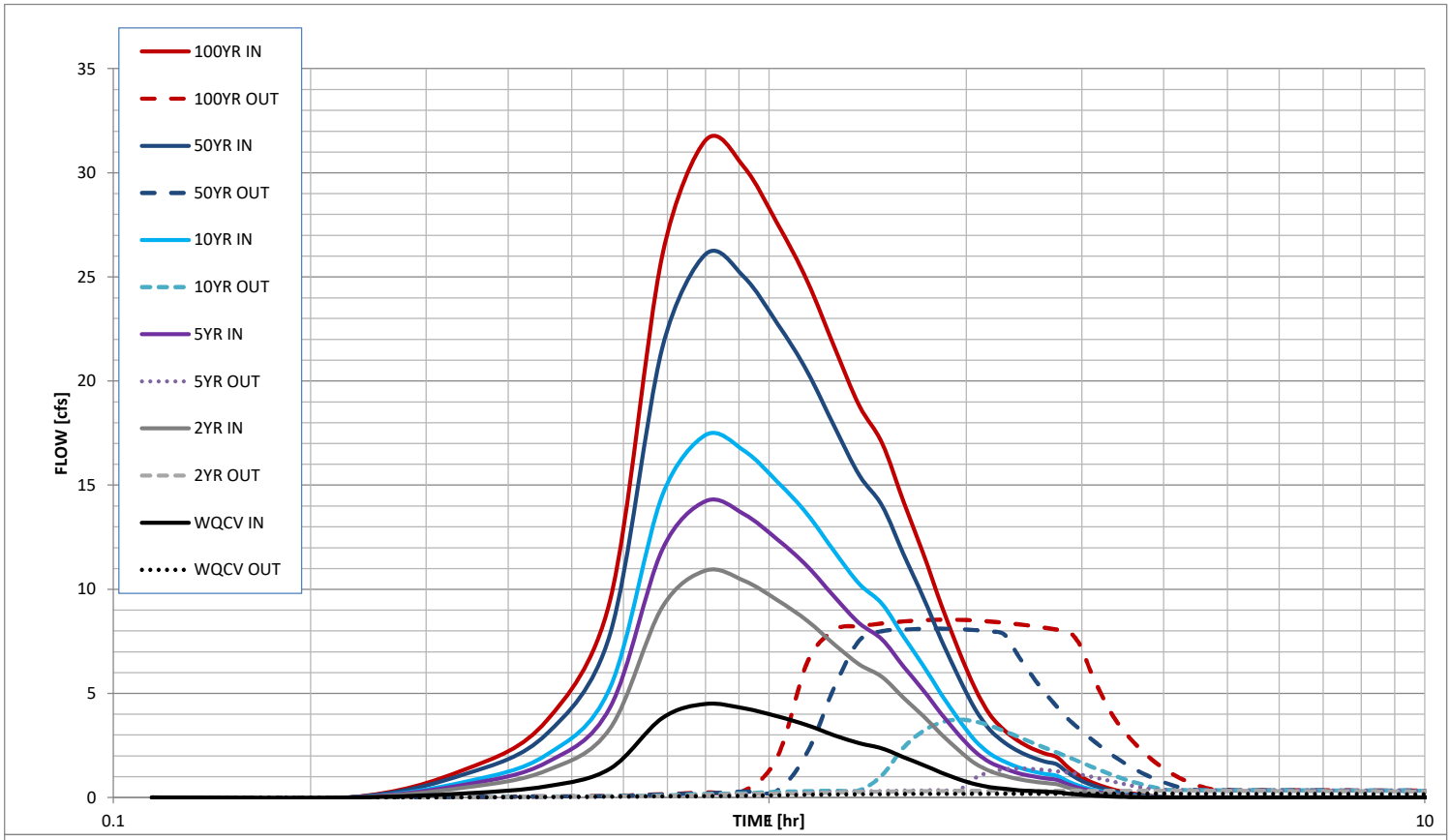
User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	100	0.00	0.00
0.25	3,176	0.25	0.04
0.50	6,253	0.50	0.06
0.75	8,372	0.75	0.07
1.00	10,492	1.00	0.09
1.25	12,612	1.25	0.14
1.50	14,732	1.50	0.17
1.75	16,852	1.75	0.19
2.00	18,972	2.00	0.21
2.25	21,092	2.25	0.27
2.50	23,212	2.50	0.30
2.75	25,435	2.75	0.33
3.00	27,658	3.00	0.36
3.25	29,881	3.25	3.70
3.50	32,105	3.50	7.91
3.75	34,328	3.75	8.21
4.00	36,551	4.00	8.50
4.25	38,744	4.25	8.78
4.50	40,997	4.50	9.06
4.75	43,176	4.75	20.80
5.00	45,355	5.00	42.67
5.25	47,534	5.25	71.79
5.50	49,712	5.50	107.27
5.75	51,891	5.75	148.67
6.00	54,070	6.00	195.73
6.25	56,249	6.25	248.30
6.50	58,428	6.50	306.29

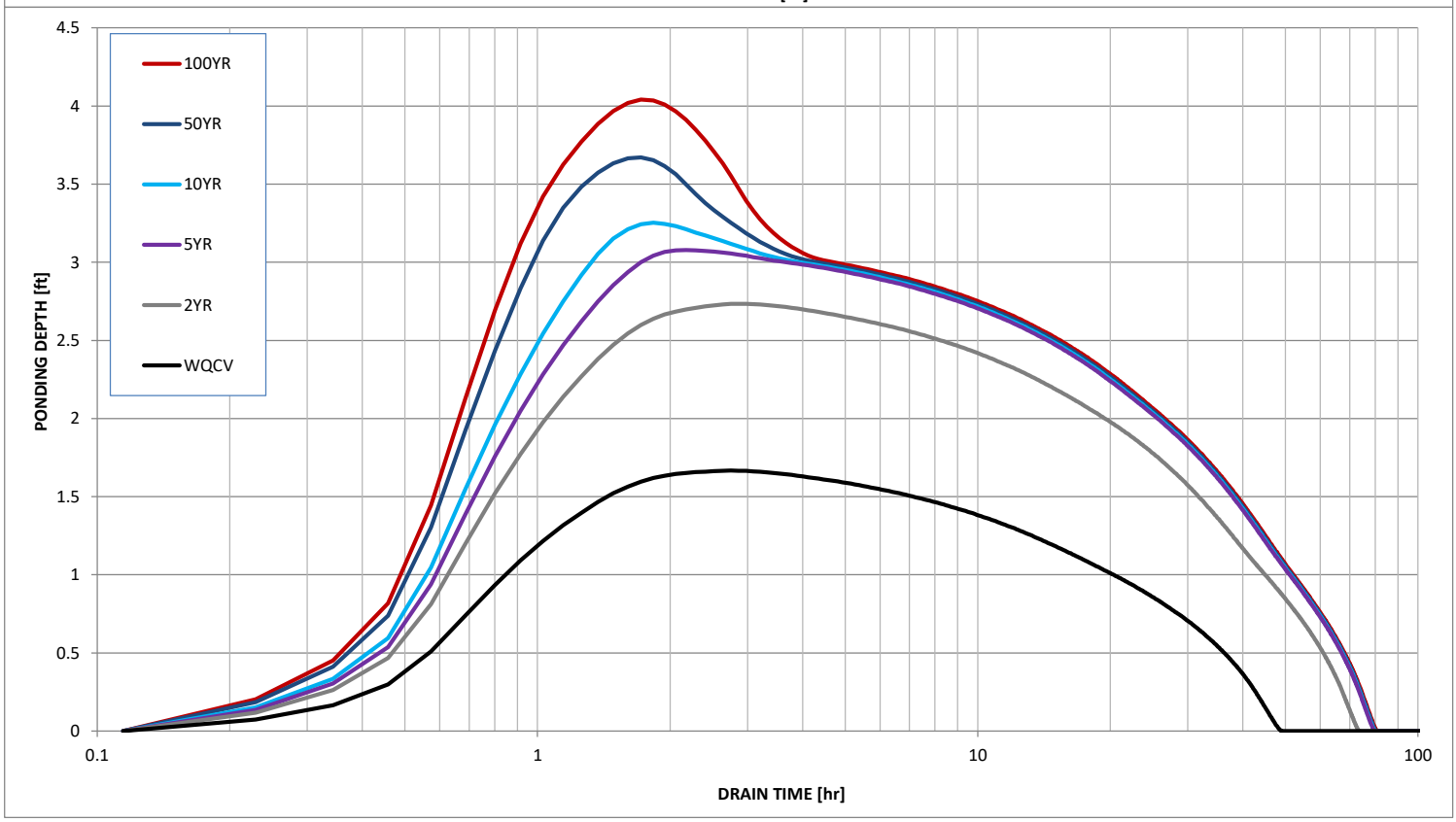
After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.53	1.19	1.50	1.75	2.25	2.52	in
Calculated Runoff Volume =	0.370	0.905	1.187	1.454	2.191	2.659	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.370	0.905	1.186	1.454	2.191	2.659	acre-ft
Time to Drain 97% of Inflow Volume =	42.2	62.8	**67.2**	65.8	62.0	60.0	hours
Time to Drain 99% of Inflow Volume =	45.0	67.5	72.8	72.4	70.9	**70.2**	hours
Maximum Ponding Depth =	1.67	2.73	3.08	3.25	3.67	4.04	ft
Maximum Ponded Area =	0.37	0.58	0.65	0.69	0.77	**0.85**	acres
Maximum Volume Stored =	0.334	0.842	1.050	1.168	1.471	1.771	acre-ft

Stormwater Detention and Infiltration Design Data Sheet



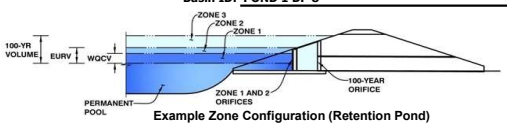


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: **WATERBURY**

Basin ID: **POND 1 DP 8**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	19.91	acres
Watershed Length =	1,935	ft
Watershed Length to Centroid =	800	ft
Watershed Slope =	0.012	ft/ft
Watershed Imperviousness =	55.86%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

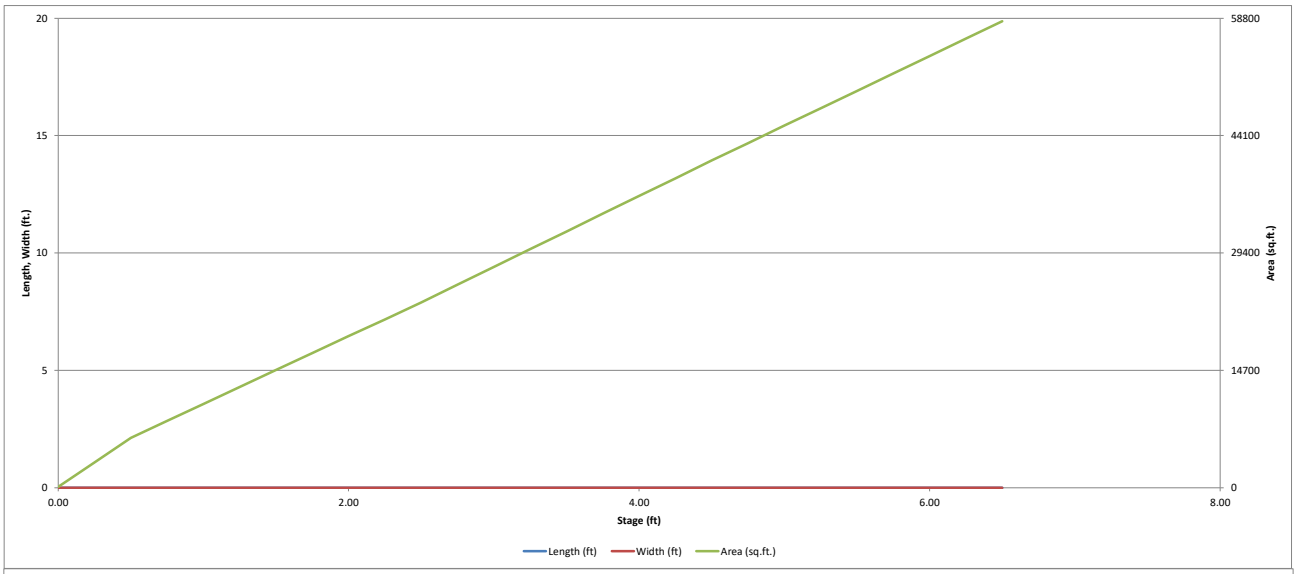
			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.324	acre-feet	0.324	acre-feet
Excess Urban Runoff Volume (EURV) =	1.027	acre-feet	1.027	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.990	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.308	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.564	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.933	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.296	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.748	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	3.502	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	0.855	acre-feet		
Approximate 5-yr Detention Volume =	1.122	acre-feet		
Approximate 10-yr Detention Volume =	1.362	acre-feet		
Approximate 25-yr Detention Volume =	1.654	acre-feet		
Approximate 50-yr Detention Volume =	1.836	acre-feet		
Approximate 100-yr Detention Volume =	2.043	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.324	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.703	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.016	acre-feet
Total Detention Basin Volume =	2.043	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	--	--	--	100	0.002		
6923.75	--	0.25	--	--	--	3,176	0.073	409	0.009
6924.00	--	0.50	--	--	--	6,253	0.144	1,588	0.036
6924.25	--	0.75	--	--	--	8,372	0.192	3,416	0.078
6924.50	--	1.00	--	--	--	10,492	0.241	5,774	0.133
6924.75	--	1.25	--	--	--	12,612	0.290	8,662	0.199
6925.00	--	1.50	--	--	--	14,732	0.338	12,080	0.277
6925.25	--	1.75	--	--	--	16,852	0.387	16,028	0.368
6925.50	--	2.00	--	--	--	18,972	0.436	20,506	0.471
6925.75	--	2.25	--	--	--	21,092	0.484	25,514	0.586
6926.00	--	2.50	--	--	--	23,212	0.533	31,052	0.713
6926.25	--	2.75	--	--	--	25,435	0.584	37,133	0.852
6926.50	--	3.00	--	--	--	27,658	0.635	43,769	1.005
6926.75	--	3.25	--	--	--	29,881	0.686	50,962	1.170
6927.00	--	3.50	--	--	--	32,105	0.737	58,710	1.348
6927.25	--	3.75	--	--	--	34,328	0.788	67,014	1.538
6927.50	--	4.00	--	--	--	36,551	0.839	75,874	1.742
6927.75	--	4.25	--	--	--	38,744	0.889	85,286	1.958
6928.00	--	4.50	--	--	--	40,997	0.941	95,254	2.187
6928.25	--	4.75	--	--	--	43,176	0.991	105,775	2.428
6928.50	--	5.00	--	--	--	45,355	1.041	116,842	2.682
6928.75	--	5.25	--	--	--	47,534	1.091	128,453	2.949
6929.00	--	5.50	--	--	--	49,712	1.141	140,608	3.228
6929.25	--	5.75	--	--	--	51,891	1.191	153,309	3.519
6929.50	--	6.00	--	--	--	54,070	1.241	166,554	3.824
6929.75	--	6.25	--	--	--	56,249	1.291	180,344	4.140
6930.00	--	6.50	--	--	--	58,428	1.341	194,678	4.469


20
15
10
5
0
58800
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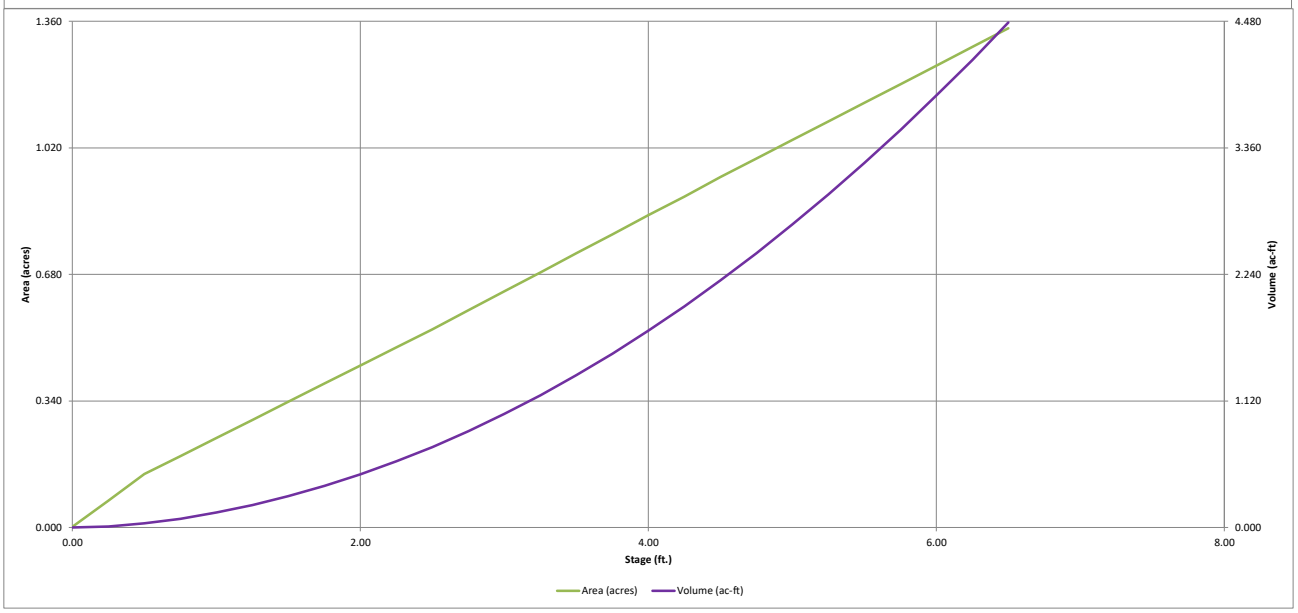
29400
14700
0
0.00
2.00
4.00
6.00
8.00
Length, Width (ft.)
Area (sq.ft.)
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)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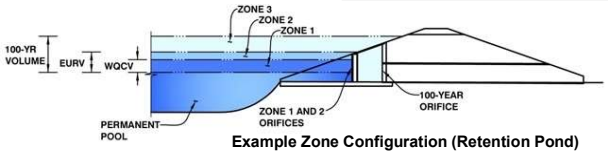
0.340
0.000
4.480
3.360
2.240
1.120
0.000
0.00
2.00
4.00
6.00
8.00
Area (acres)
Volume (ac-ft)
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: **WATERBURY**

Basin ID: **POND 1 DP 8**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.64	0.324	Orifice Plate
Zone 2 (EURV)	3.04	0.703	Orifice Plate
Zone 3 (100-year)	4.35	1.016	Weir&Pipe (Restrict)
Total (all zones)		2.043	

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

Underdrain Orifice Invert Depth =		ft (distance below the filtration media surface)	Underdrain Orifice Area =		ft^2
Underdrain Orifice Diameter =		inches	Underdrain Orifice Centroid =		feet

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.792E-02	ft^2
Depth at top of Zone using Orifice Plate =	3.04	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	12.20	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	2.58	sq. inches (diameter = 1-13/16 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	1.01	2.03					
Orifice Area (sq. inches)	2.58	2.58	2.58					

	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	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.04	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	3.04	N/A	feet
Overflow Weir Front Edge Length =	3.00	N/A	feet	Overflow Weir Slope Length =	3.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	7.51	N/A	
Horiz. Length of Weir Sides =	3.00	N/A	feet	Overflow Grate Open Area w/o Debris =	6.30	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	3.15	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.10	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.84	N/A	ft^2
Outlet Pipe Diameter =	24.00	N/A	inches	Outlet Orifice Centroid =	0.37	N/A	feet
Restrictor Plate Height Above Pipe Invert =	7.50		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.19	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.46	feet
Spillway Crest Length =	30.00	feet	Stage at Top of Freeboard =	5.96	feet
Spillway End Slopes =	3.00	H:V	Basin Area at Top of Freeboard =	1.23	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	3.77	acre-ft

Calculated Parameters for Spillway

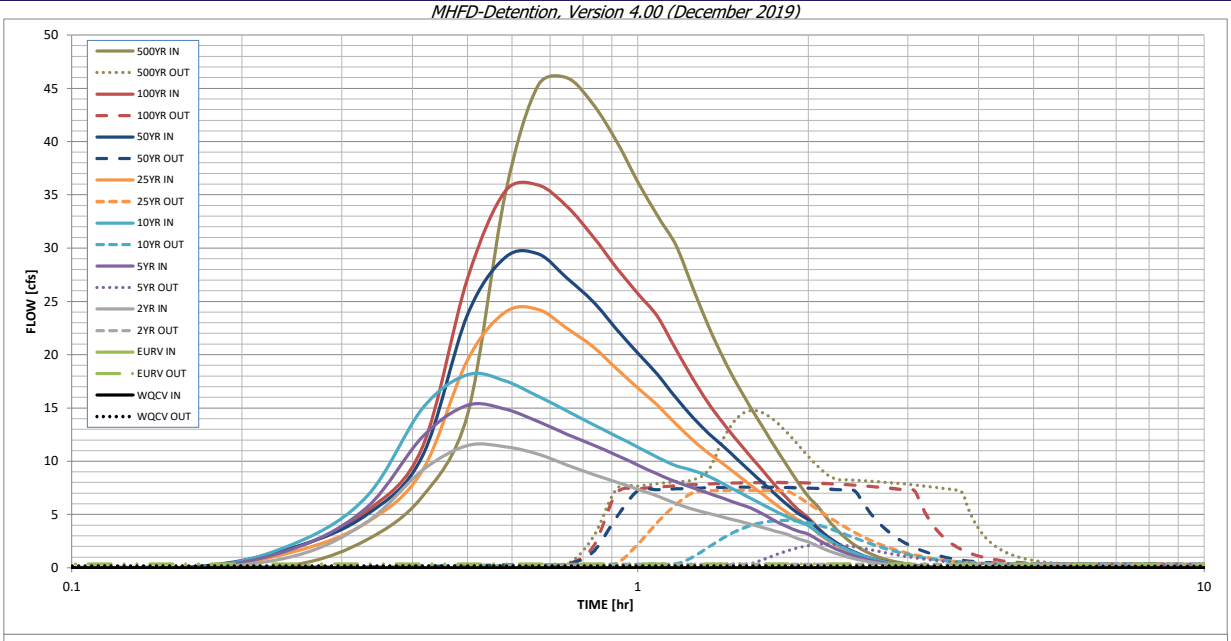
Routed Hydrograph Results

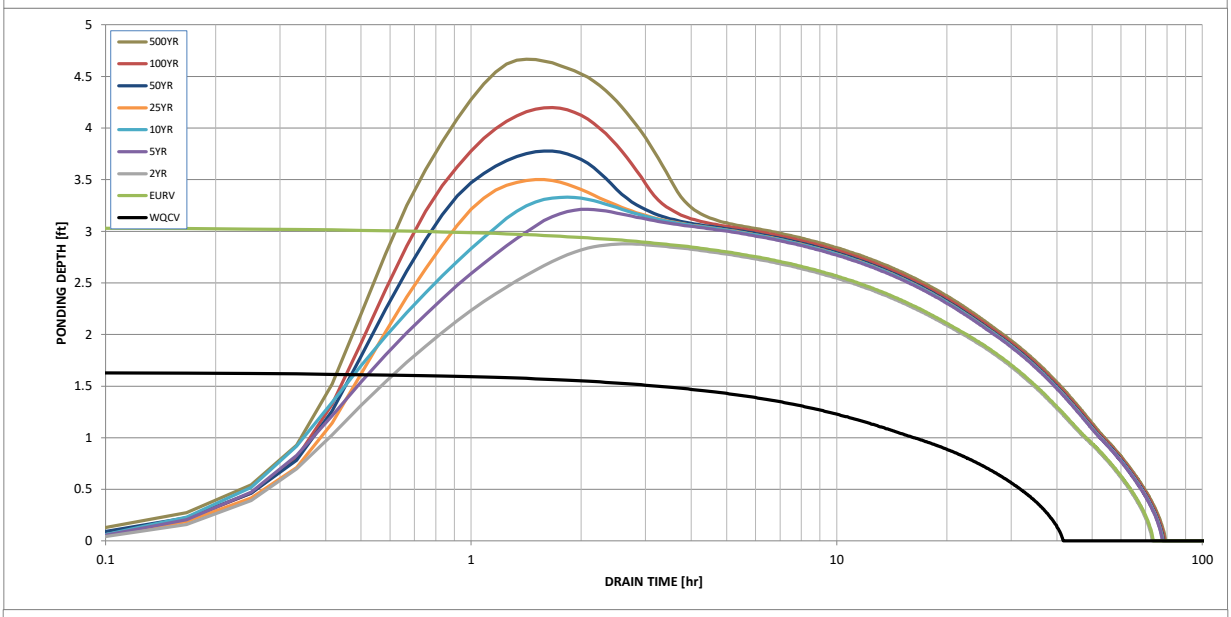
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

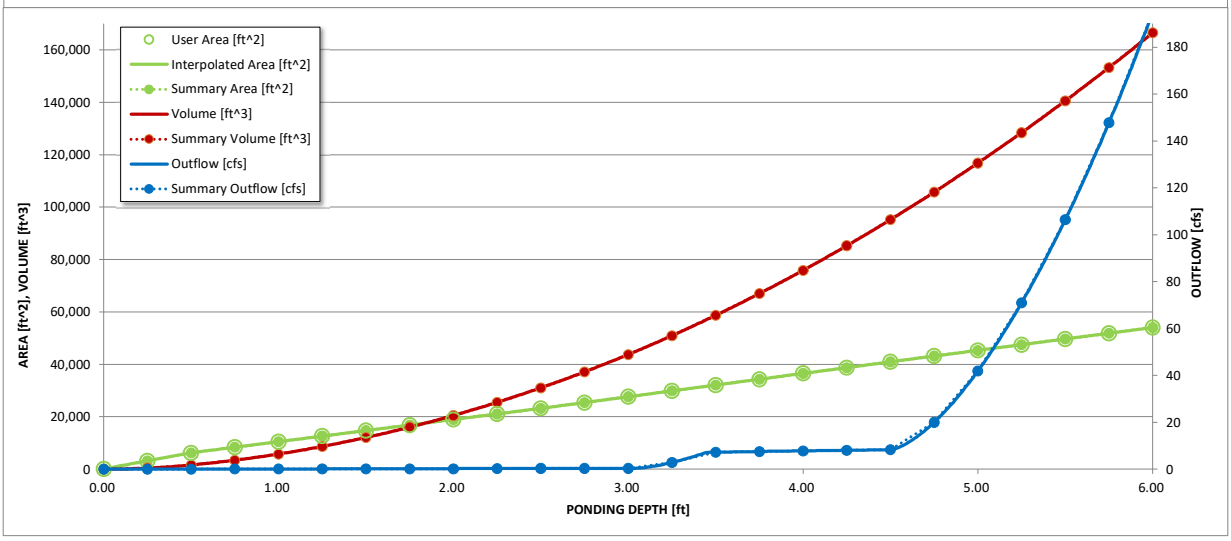
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
CUHP Runoff Volume (acre-ft) =	0.324	1.027	0.990	1.308	1.564	1.933	2.296	2.748	3.502
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.990	1.308	1.564	1.933	2.296	2.748	3.502
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.3	2.5	5.0	8.4	13.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.01	0.13	0.25	0.42	0.69
Peak Inflow Q (cfs) =	N/A	N/A	11.5	15.2	18.1	24.2	29.4	35.9	46.0
Peak Outflow Q (cfs) =	0.2	0.4	0.3	2.2	4.4	7.3	7.6	8.0	14.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	11.3	16.1	2.9	1.5	0.9	1.1
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.3	0.6	1.1	1.1	1.2	1.3
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	65	65	68	66	64	63	61	58
Time to Drain 99% of Inflow Volume (hours) =	**40**	70	69	73	73	72	71	71	70
Maximum Ponding Depth (ft) =	1.64	3.04	2.88	3.21	3.33	3.50	3.78	4.20	4.67
Area at Maximum Ponding Depth (acres) =	0.37	0.64	0.61	0.68	0.70	0.74	0.79	0.88	0.97
Maximum Volume Stored (acre-ft) =	0.327	1.030	0.924	1.143	1.225	1.348	1.554	1.905	2.340

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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	0.13	0.01	0.34
	0:15:00	0.00	0.00	1.18	1.92	2.38	1.60	2.02	1.96	2.67
	0:20:00	0.00	0.00	4.35	5.75	6.79	4.31	5.05	5.38	6.71
	0:25:00	0.00	0.00	9.15	12.29	14.94	9.11	10.47	11.32	14.37
	0:30:00	0.00	0.00	11.47	15.24	18.11	19.50	23.75	27.13	35.08
	0:35:00	0.00	0.00	11.37	14.88	17.52	23.99	29.14	35.34	45.28
	0:40:00	0.00	0.00	10.66	13.72	16.09	24.25	29.45	35.91	45.98
	0:45:00	0.00	0.00	9.64	12.51	14.71	22.45	27.17	33.89	43.51
	0:50:00	0.00	0.00	8.77	11.53	13.44	20.76	25.00	31.09	40.05
	0:55:00	0.00	0.00	8.05	10.57	12.36	18.70	22.42	28.18	36.22
	1:00:00	0.00	0.00	7.37	9.64	11.32	16.88	20.14	25.72	33.04
	1:05:00	0.00	0.00	6.74	8.78	10.37	15.25	18.13	23.56	30.30
	1:10:00	0.00	0.00	6.03	8.08	9.59	13.51	15.98	20.52	26.29
	1:15:00	0.00	0.00	5.50	7.51	9.13	12.00	14.12	17.76	22.66
	1:20:00	0.00	0.00	5.10	6.99	8.59	10.76	12.63	15.43	19.63
	1:25:00	0.00	0.00	4.74	6.50	7.87	9.73	11.39	13.53	17.15
	1:30:00	0.00	0.00	4.41	6.05	7.17	8.71	10.16	11.90	15.01
	1:35:00	0.00	0.00	4.08	5.61	6.52	7.74	9.00	10.42	13.09
	1:40:00	0.00	0.00	3.76	5.00	5.90	6.84	7.92	9.03	11.29
	1:45:00	0.00	0.00	3.44	4.39	5.31	5.99	6.89	7.73	9.60
	1:50:00	0.00	0.00	3.15	3.86	4.79	5.20	5.95	6.53	8.05
	1:55:00	0.00	0.00	2.74	3.45	4.34	4.52	5.13	5.49	6.71
	2:00:00	0.00	0.00	2.42	3.15	3.96	3.99	4.51	4.70	5.71
	2:05:00	0.00	0.00	2.00	2.62	3.30	3.23	3.64	3.73	4.52
	2:10:00	0.00	0.00	1.63	2.13	2.69	2.58	2.90	2.93	3.53
	2:15:00	0.00	0.00	1.32	1.72	2.18	2.06	2.31	2.29	2.75
	2:20:00	0.00	0.00	1.06	1.39	1.76	1.64	1.84	1.79	2.14
	2:25:00	0.00	0.00	0.85	1.12	1.41	1.31	1.46	1.40	1.66
	2:30:00	0.00	0.00	0.68	0.89	1.11	1.03	1.15	1.08	1.28
	2:35:00	0.00	0.00	0.53	0.70	0.87	0.80	0.90	0.83	0.99
	2:40:00	0.00	0.00	0.42	0.54	0.67	0.62	0.69	0.65	0.77
	2:45:00	0.00	0.00	0.33	0.42	0.52	0.48	0.54	0.51	0.60
	2:50:00	0.00	0.00	0.26	0.32	0.41	0.38	0.42	0.40	0.47
	2:55:00	0.00	0.00	0.19	0.24	0.31	0.29	0.32	0.31	0.36
	3:00:00	0.00	0.00	0.14	0.18	0.23	0.22	0.24	0.23	0.27
	3:05:00	0.00	0.00	0.09	0.12	0.16	0.15	0.17	0.16	0.19
	3:10:00	0.00	0.00	0.06	0.08	0.10	0.10	0.11	0.10	0.12
	3:15:00	0.00	0.00	0.03	0.05	0.06	0.06	0.06	0.06	0.07
	3:20:00	0.00	0.00	0.01	0.02	0.03	0.03	0.03	0.03	0.03
	3:25:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	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

Worksheet Protected

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.43	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer:	**QNA**
Company:	**Terra Nova Engineering**
Date:	**September 20, 2021**
Project:	**WATERBURY FILING 1 POND 2**
Location:	**POND 2 Design Point 18 Full Spectrum Detention 19.91 Acres**

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**DP 9 FSD**													
Receiving Pervious Area Soil Type	Loamy Sand													
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	21.93													
Directly Connected Impervious Area (DCIA, acres)	2.58													
Unconnected Impervious Area (UIA, acres)	4.13													
Receiving Pervious Area (RPA, acres)	0.68													
Separate Pervious Area (SPA, acres)	14.55													
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C													

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	21.935													
Directly Connected Impervious Area (DCIA, %)	11.8%													
Unconnected Impervious Area (UIA, %)	18.8%													
Receiving Pervious Area (RPA, %)	3.1%													
Separate Pervious Area (SPA, %)	66.3%													
A_R (RPA / UIA)	0.164													
I_a Check	0.860													
f / I for WQCV Event:	4.5													
f / I for 5-Year Event:	0.5													
f / I for 100-Year Event:	0.4													
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	0.84													
IRF for 5-Year Event:	0.96													
IRF for 100-Year Event:	0.97													
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	30.6%													
Effective Imperviousness for WQCV Event:	27.6%													
Effective Imperviousness for 5-Year Event:	29.8%													
Effective Imperviousness for 100-Year Event:	30.0%													
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	6.2%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	1.9%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**30.6%**
Total Site Effective Imperviousness for WQCV Event:	**27.6%**
Total Site Effective Imperviousness for 5-Year Event:	**29.8%**
Total Site Effective Imperviousness for 100-Year Event:	**30.0%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected Worksheet Protected

Stormwater Facility Name: **Waterbury Filing No. 1 & 2 EDB Pond 3 DP 29**

Facility Location & Jurisdiction: **Stapleton Dr. & Bandernero Dr Intersection**

User Input: Watershed Characteristics

Watershed Slope =	0.022	ft/ft
Watershed Length =	2265	ft
Watershed Area =	84.64	acres
Watershed Imperviousness =	47.5%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent

Location for 1-hr Rainfall Depths (use dropdown):

User Input

WQCV Treatment Method = Extended Detention

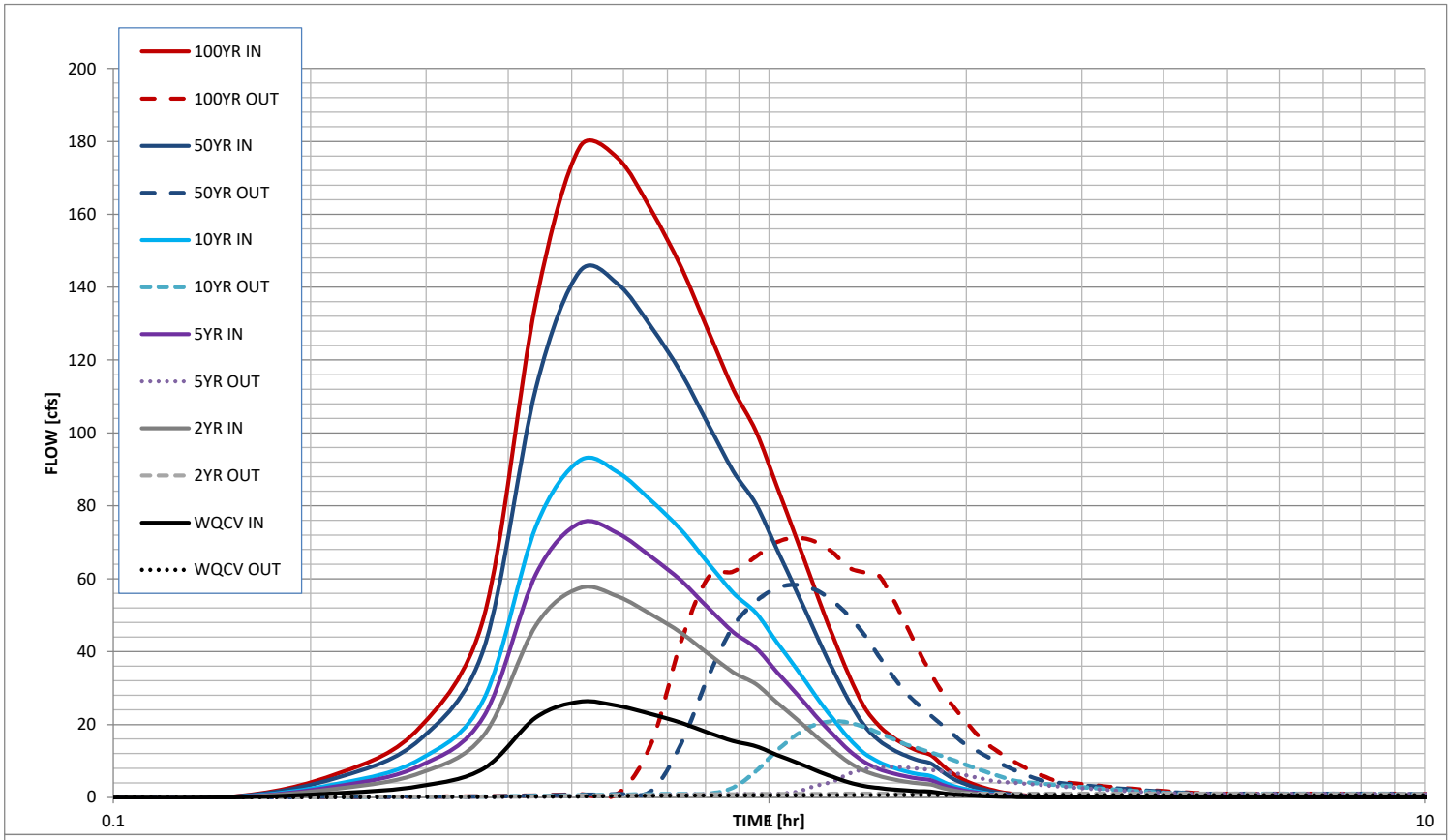
User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	100	0.00	0.00
0.25	2,785	0.25	0.10
0.50	5,470	0.50	0.14
0.75	8,155	0.75	0.18
1.00	10,840	1.00	0.20
1.25	13,525	1.25	0.23
1.50	16,210	1.50	0.25
1.75	18,895	1.75	0.37
2.00	21,580	2.00	0.43
2.25	26,334	2.25	0.48
2.50	31,088	2.50	0.53
2.75	35,842	2.75	0.57
3.00	40,596	3.00	0.60
3.25	45,530	3.25	0.73
3.50	50,105	3.50	0.81
3.75	54,895	3.75	0.87
4.00	59,613	4.00	0.93
4.25	62,301	4.25	0.98
4.50	64,989	4.50	1.03
4.75	67,677	4.75	4.39
5.00	70,365	5.00	14.71
5.25	73,504	5.25	28.91
5.50	75,742	5.50	46.13
5.75	78,430	5.75	60.71
6.00	81,118	6.00	62.35
6.25	82,113	6.25	74.47
6.50	83,503	6.50	111.77
6.75	84,696	6.75	163.81
7.00	85,888	7.00	227.74
7.25	87,081	7.25	302.17
7.50	88,274	7.50	386.27
7.75	89,466	7.75	479.48
8.00	90,659	8.00	581.41

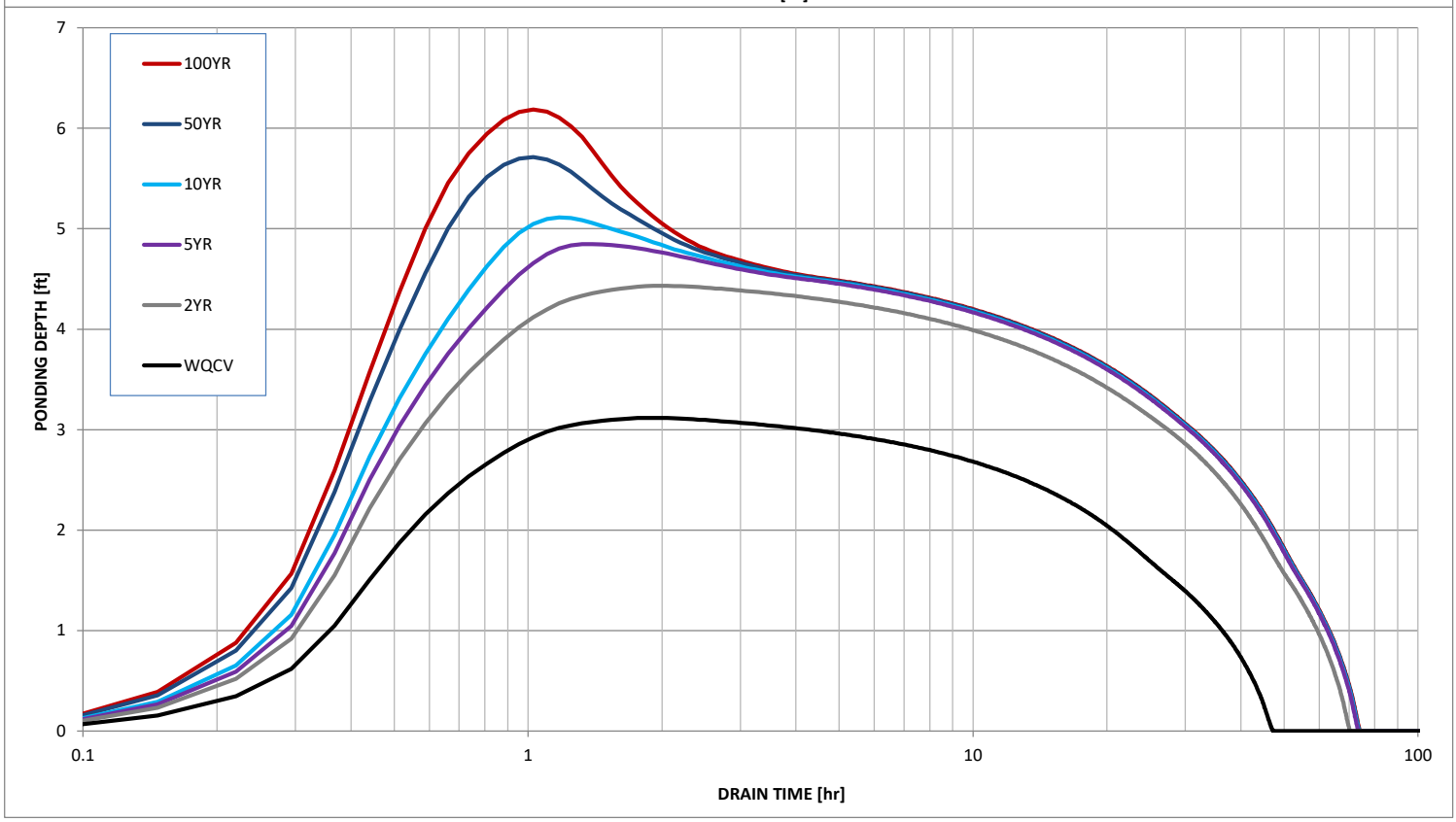
After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.53	1.19	1.50	1.75	2.25	2.52	in
Calculated Runoff Volume =	1.407	3.112	4.098	5.057	7.980	9.934	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	1.407	3.112	4.097	5.051	7.979	9.930	acre-ft
Time to Drain 97% of Inflow Volume =	41.9	61.4	**62.8**	61.3	56.9	54.2	hours
Time to Drain 99% of Inflow Volume =	44.5	65.9	68.3	67.8	65.9	**64.8**	hours
Maximum Ponding Depth =	3.12	4.43	4.85	5.11	5.71	6.19	ft
Maximum Ponded Area =	0.98	1.47	1.58	1.65	1.79	**1.88**	acres
Maximum Volume Stored =	1.316	2.969	3.604	4.033	5.054	5.934	acre-ft

Stormwater Detention and Infiltration Design Data Sheet



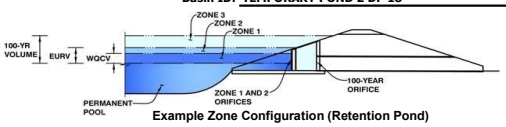


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: **WATERBURY**

Basin ID: **TEMPORARY POND 2 DP 18**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	21.93	acres
Watershed Length =	1,425	ft
Watershed Length to Centroid =	650	ft
Watershed Slope =	0.014	ft/ft
Watershed Imperviousness =	30.02%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

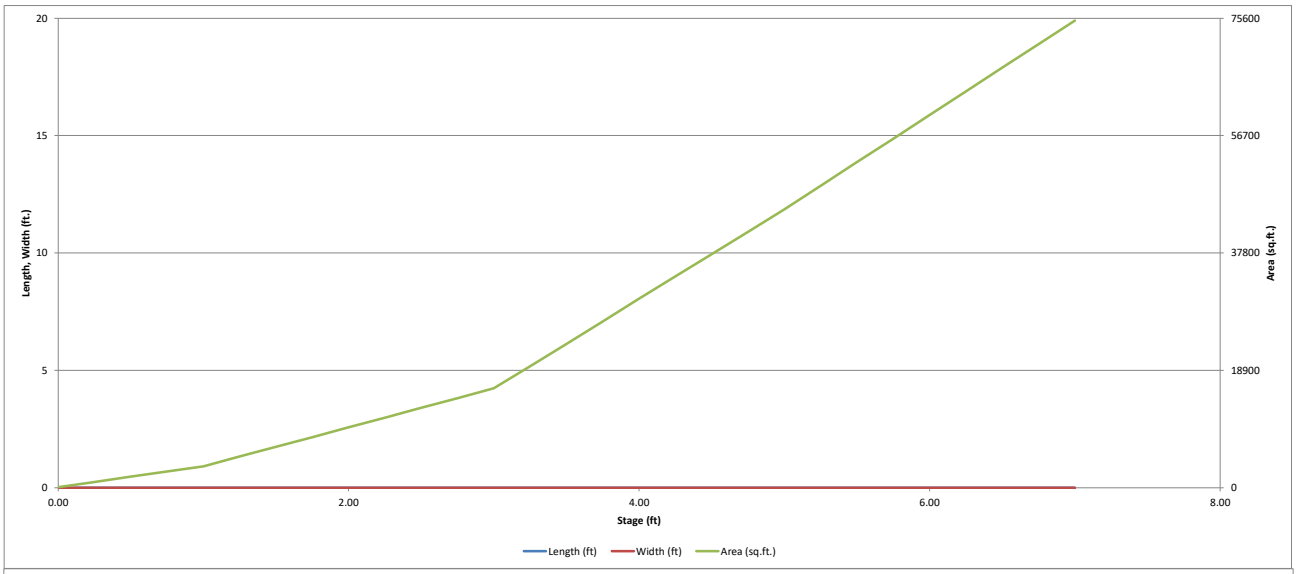
			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.243	acre-feet	0.243	acre-feet
Excess Urban Runoff Volume (EURV) =	0.507	acre-feet	0.507	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.337	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.474	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.597	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.949	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.281	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.730	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	2.464	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	0.414	acre-feet		
Approximate 5-yr Detention Volume =	0.552	acre-feet		
Approximate 10-yr Detention Volume =	0.690	acre-feet		
Approximate 25-yr Detention Volume =	0.872	acre-feet		
Approximate 50-yr Detention Volume =	1.008	acre-feet		
Approximate 100-yr Detention Volume =	1.227	acre-feet		

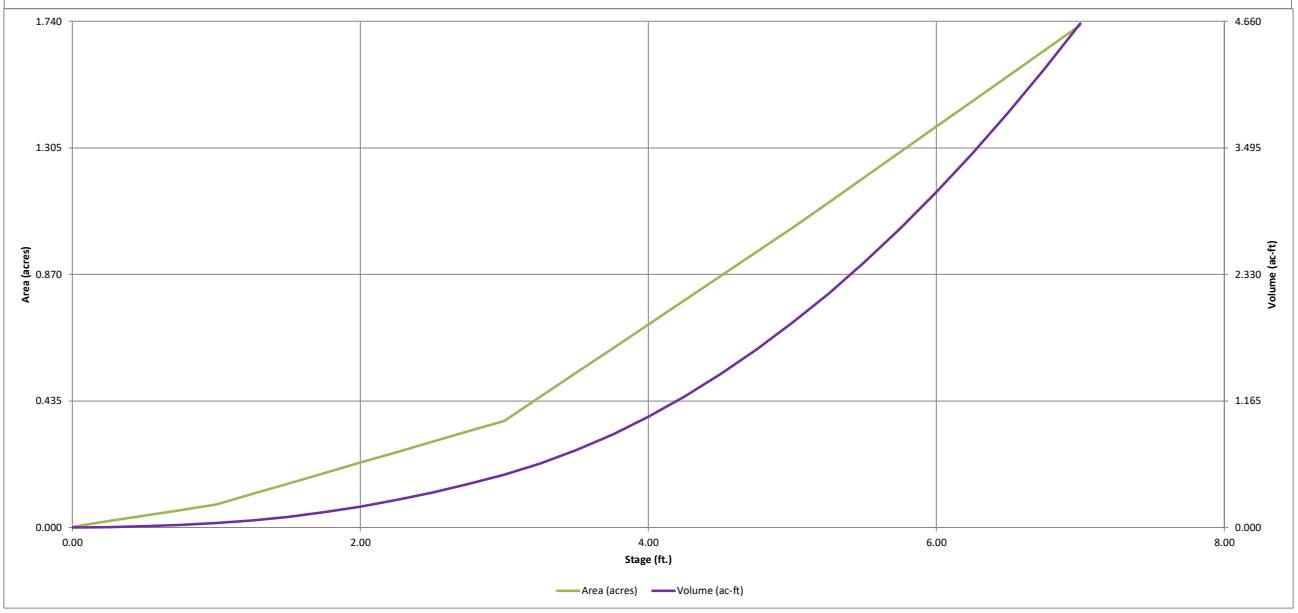
Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.243	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.264	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.720	acre-feet
Total Detention Basin Volume =	1.227	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	--	--	--	100	0.002		
6899.25	--	0.25	--	--	--	942	0.022	130	0.003
6899.50	--	0.50	--	--	--	1,784	0.041	471	0.011
6899.75	--	0.75	--	--	--	2,626	0.060	1,022	0.023
6900.00	--	1.00	--	--	--	3,468	0.080	1,784	0.041
6900.25	--	1.25	--	--	--	5,034	0.116	2,847	0.065
6900.50	--	1.50	--	--	--	6,600	0.152	4,301	0.099
6900.75	--	1.75	--	--	--	8,166	0.187	6,147	0.141
6901.00	--	2.00	--	--	--	9,732	0.223	8,384	0.192
6901.25	--	2.25	--	--	--	11,297	0.259	11,013	0.253
6901.50	--	2.50	--	--	--	12,863	0.295	14,033	0.322
6901.75	--	2.75	--	--	--	14,429	0.331	17,444	0.400
6902.00	--	3.00	--	--	--	15,995	0.367	21,247	0.488
6902.25	--	3.25	--	--	--	19,602	0.450	25,697	0.590
6902.50	--	3.50	--	--	--	23,209	0.533	31,048	0.713
6902.75	--	3.75	--	--	--	26,815	0.616	37,301	0.856
6903.00	--	4.00	--	--	--	30,422	0.698	44,456	1.021
6903.25	--	4.25	--	--	--	34,029	0.781	52,512	1.206
6903.50	--	4.50	--	--	--	37,636	0.864	61,470	1.411
6903.75	--	4.75	--	--	--	41,243	0.947	71,330	1.638
6904.00	--	5.00	--	--	--	44,850	1.030	82,092	1.885
6904.25	--	5.25	--	--	--	48,650	1.117	93,779	2.153
6904.50	--	5.50	--	--	--	52,450	1.204	106,417	2.443
6904.75	--	5.75	--	--	--	56,251	1.291	120,004	2.755
6905.00	--	6.00	--	--	--	60,051	1.379	134,542	3.089
6905.25	--	6.25	--	--	--	63,851	1.466	150,030	3.444
6905.50	--	6.50	--	--	--	67,652	1.553	166,468	3.822
6905.75	--	6.75	--	--	--	71,452	1.640	183,856	4.221
6906.00	--	7.00	--	--	--	75,252	1.728	202,194	4.642


20
15
10
5
0
Length, Width (ft.)
75600
56700
37800
18900
0
Area (sq.ft.)
0.00
2.00
4.00
6.00
8.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)


1.740
1.305
0.870
0.435
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Area (acres)
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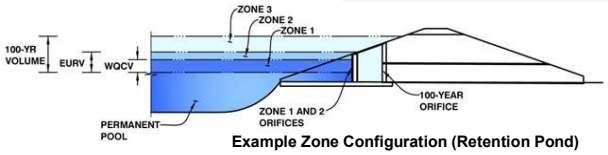
3.495
2.330
1.165
0.000
Volume (ac-ft)
0.00
2.00
4.00
6.00
8.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: **WATERBURY**

Basin ID: **TEMPORARY POND 2 DP 18**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.22	0.243	Orifice Plate
Zone 2 (EURV)	3.06	0.264	Orifice Plate
Zone 3 (100-year)	4.28	0.720	Weir&Pipe (Restrict)
Total (all zones)		1.227	

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)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	9.306E-03	ft^2
Depth at top of Zone using Orifice Plate =	3.06	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	12.20	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.34	sq. inches (diameter = 1-5/16 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	1.02	2.04					
Orifice Area (sq. inches)	1.34	1.34	1.34					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

User Input: Overflow Weir (Dropbox 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 =	3.06	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.06	N/A	feet
Overflow Weir Slope Length =	4.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	8.95	N/A	
Overflow Grate Open Area w/o Debris =	11.20	N/A	ft^2
Overflow Grate Open Area w/ Debris =	5.60	N/A	ft^2

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 Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	12.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.25	N/A	ft^2
Outlet Orifice Centroid =	0.56	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.91	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.47	feet
Spillway Crest Length =	20.00	feet	Stage at Top of Freeboard =	6.47	feet
Spillway End Slopes =	3.00	H:V	Basin Area at Top of Freeboard =	1.54	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	3.78	acre-ft

Calculated Parameters for Spillway

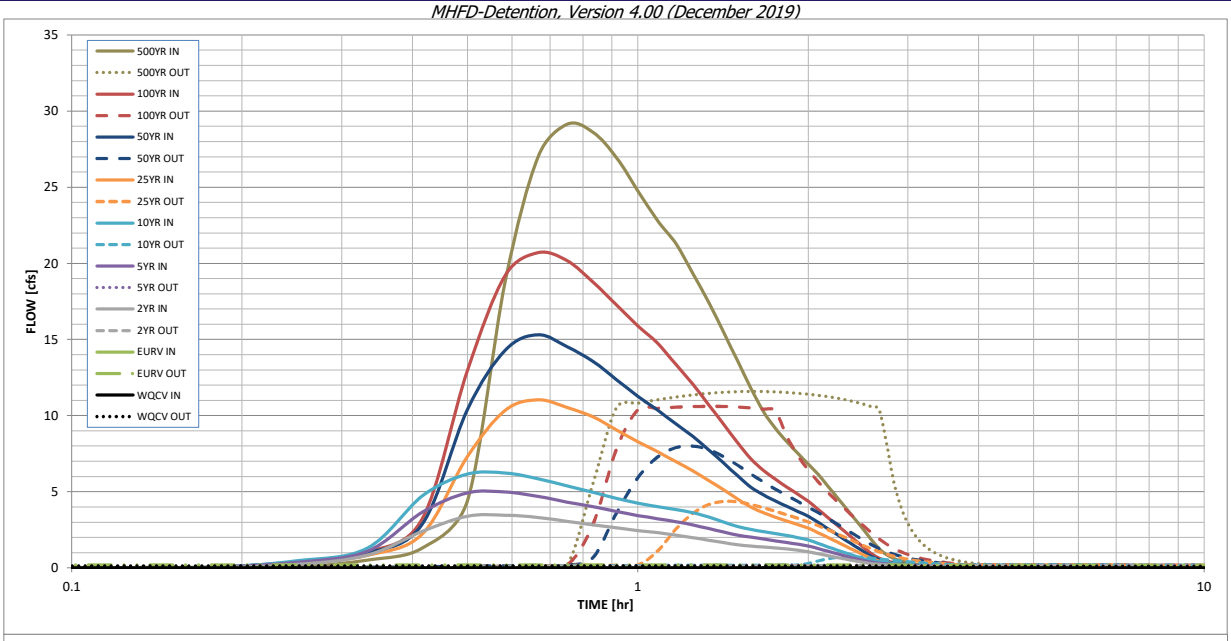
Routed Hydrograph Results

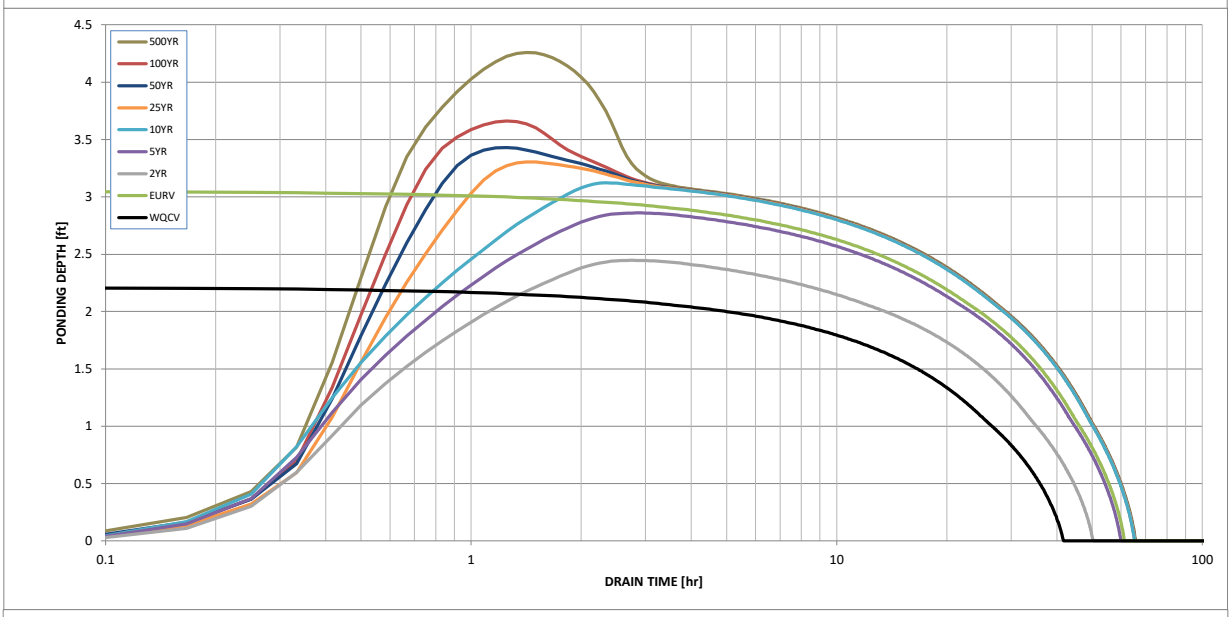
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

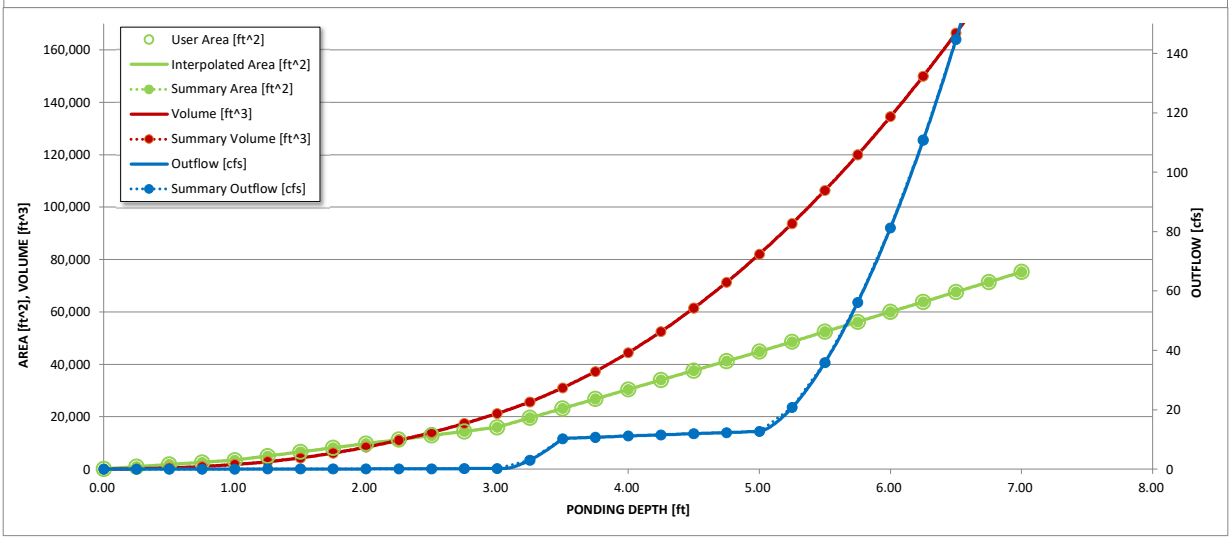
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
CUHP Runoff Volume (acre-ft) =	0.243	0.507	0.337	0.474	0.597	0.949	1.281	1.730	2.464
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.337	0.474	0.597	0.949	1.281	1.730	2.464
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.3	0.4	3.8	7.5	12.3	19.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.17	0.34	0.56	0.90
Peak Inflow Q (cfs) =	N/A	N/A	3.5	5.0	6.2	11.0	15.3	20.7	29.1
Peak Outflow Q (cfs) =	0.1	0.2	0.2	0.2	0.7	4.4	8.0	10.6	11.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.6	1.8	1.2	1.1	0.9	0.6
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.4	0.7	0.9	1.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	37	54	45	53	57	54	51	48	44
Time to Drain 99% of Inflow Volume (hours) =	**40**	58	48	57	62	60	59	58	55
Maximum Ponding Depth (ft) =	2.22	3.06	2.45	2.86	3.12	3.30	3.43	3.66	4.26
Area at Maximum Ponding Depth (acres) =	0.26	0.39	0.29	0.35	0.41	0.47	0.51	0.59	0.78
Maximum Volume Stored (acre-ft) =	0.245	0.510	0.305	0.434	0.534	0.613	0.676	0.802	1.213

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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	0.03	0.00	0.07
	0:15:00	0.00	0.00	0.23	0.37	0.46	0.31	0.39	0.38	0.52
	0:20:00	0.00	0.00	0.84	1.11	1.31	0.83	0.98	1.04	1.30
	0:25:00	0.00	0.00	2.40	3.66	4.73	2.23	2.87	3.24	4.42
	0:30:00	0.00	0.00	3.39	4.92	6.15	7.31	10.40	12.97	18.83
	0:35:00	0.00	0.00	3.46	4.97	6.23	10.35	14.30	19.22	27.01
	0:40:00	0.00	0.00	3.31	4.69	5.84	11.03	15.31	20.70	29.14
	0:45:00	0.00	0.00	3.05	4.32	5.38	10.53	14.52	20.17	28.62
	0:50:00	0.00	0.00	2.82	4.01	4.95	9.91	13.57	18.77	26.95
	0:55:00	0.00	0.00	2.62	3.70	4.57	9.06	12.37	17.27	24.77
	1:00:00	0.00	0.00	2.45	3.44	4.25	8.28	11.27	15.90	22.81
	1:05:00	0.00	0.00	2.31	3.23	4.02	7.63	10.36	14.75	21.31
	1:10:00	0.00	0.00	2.15	3.04	3.82	6.98	9.46	13.37	19.34
	1:15:00	0.00	0.00	1.98	2.82	3.63	6.37	8.64	12.07	17.47
	1:20:00	0.00	0.00	1.82	2.58	3.34	5.74	7.76	10.73	15.50
	1:25:00	0.00	0.00	1.66	2.35	3.01	5.14	6.90	9.45	13.61
	1:30:00	0.00	0.00	1.52	2.14	2.72	4.53	6.05	8.23	11.81
	1:35:00	0.00	0.00	1.42	2.02	2.53	3.99	5.30	7.16	10.27
	1:40:00	0.00	0.00	1.36	1.89	2.38	3.62	4.79	6.40	9.17
	1:45:00	0.00	0.00	1.30	1.77	2.25	3.33	4.39	5.82	8.29
	1:50:00	0.00	0.00	1.25	1.66	2.12	3.08	4.04	5.31	7.52
	1:55:00	0.00	0.00	1.15	1.55	1.99	2.84	3.71	4.83	6.81
	2:00:00	0.00	0.00	1.06	1.44	1.83	2.61	3.39	4.38	6.14
	2:05:00	0.00	0.00	0.93	1.26	1.60	2.30	2.98	3.84	5.37
	2:10:00	0.00	0.00	0.80	1.09	1.38	2.00	2.57	3.31	4.63
	2:15:00	0.00	0.00	0.68	0.92	1.16	1.70	2.18	2.81	3.91
	2:20:00	0.00	0.00	0.57	0.76	0.96	1.41	1.80	2.31	3.21
	2:25:00	0.00	0.00	0.46	0.62	0.78	1.14	1.44	1.84	2.54
	2:30:00	0.00	0.00	0.36	0.48	0.61	0.88	1.09	1.37	1.88
	2:35:00	0.00	0.00	0.28	0.37	0.48	0.64	0.77	0.94	1.27
	2:40:00	0.00	0.00	0.23	0.30	0.39	0.45	0.54	0.64	0.86
	2:45:00	0.00	0.00	0.19	0.26	0.33	0.34	0.40	0.46	0.62
	2:50:00	0.00	0.00	0.16	0.21	0.28	0.27	0.32	0.35	0.46
	2:55:00	0.00	0.00	0.14	0.18	0.23	0.22	0.25	0.26	0.34
	3:00:00	0.00	0.00	0.11	0.15	0.19	0.17	0.20	0.20	0.26
	3:05:00	0.00	0.00	0.10	0.12	0.16	0.14	0.16	0.16	0.19
	3:10:00	0.00	0.00	0.08	0.10	0.13	0.12	0.13	0.12	0.15
	3:15:00	0.00	0.00	0.07	0.08	0.11	0.09	0.11	0.10	0.12
	3:20:00	0.00	0.00	0.05	0.07	0.08	0.08	0.09	0.08	0.09
	3:25:00	0.00	0.00	0.04	0.05	0.07	0.06	0.07	0.06	0.07
	3:30:00	0.00	0.00	0.03	0.04	0.05	0.05	0.05	0.05	0.06
	3:35:00	0.00	0.00	0.02	0.03	0.04	0.04	0.04	0.04	0.04
	3:40:00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.03
	3:45:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.02
	3:50:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	3:55:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	4:00:00	0.00	0.00	0.00	0.00	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

Worksheet Protected

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.43	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event		
Max Intensity for Optional User Defined Storm	0		

Designer:	**QNA**
Company:	**Terra Nova Engineering**
Date:	**September 20, 2021**
Project:	**WATERBURY FILING 1 POND 2**
Location:	**POND 3 Design Point 29 Full Spectrum Detention 76.61 Acres**

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**DP 9 FSD**													
Receiving Pervious Area Soil Type	Loamy Sand													
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	84.64													
Directly Connected Impervious Area (DCIA, acres)	19.50													
Unconnected Impervious Area (UIA, acres)	22.09													
Receiving Pervious Area (RPA, acres)	11.31													
Separate Pervious Area (SPA, acres)	31.74													
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C													

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	84.645													
Directly Connected Impervious Area (DCIA, %)	23.0%													
Unconnected Impervious Area (UIA, %)	26.1%													
Receiving Pervious Area (RPA, %)	13.4%													
Separate Pervious Area (SPA, %)	37.5%													
A_R (RPA / UIA)	0.512													
I_a Check	0.660													
f / I for WQCV Event:	4.5													
f / I for 5-Year Event:	0.5													
f / I for 100-Year Event:	0.4													
f / I for Optional User Defined Storm CUHP:														
IRF for WQCV Event:	0.70													
IRF for 5-Year Event:	0.92													
IRF for 100-Year Event:	0.94													
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	49.1%													
Effective Imperviousness for WQCV Event:	41.2%													
Effective Imperviousness for 5-Year Event:	47.0%													
Effective Imperviousness for 100-Year Event:	47.5%													
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	10.2%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	3.3%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**49.1%**
Total Site Effective Imperviousness for WQCV Event:	**41.2%**
Total Site Effective Imperviousness for 5-Year Event:	**47.0%**
Total Site Effective Imperviousness for 100-Year Event:	**47.5%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Stormwater Detention and Infiltration Design Data Sheet

Workbook Protected Worksheet Protected

Stormwater Facility Name: **Waterbury Filing No. 1 & 2 EDB Pond 2 DP 18**

Facility Location & Jurisdiction: **Stapleton Dr. & Bandernero Dr Intersection**

User Input: Watershed Characteristics

Watershed Slope =	0.014	ft/ft
Watershed Length =	1425	ft
Watershed Area =	21.93	acres
Watershed Imperviousness =	30.0%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent

Location for 1-hr Rainfall Depths (use dropdown):

User Input

WQCV Treatment Method = Extended Detention

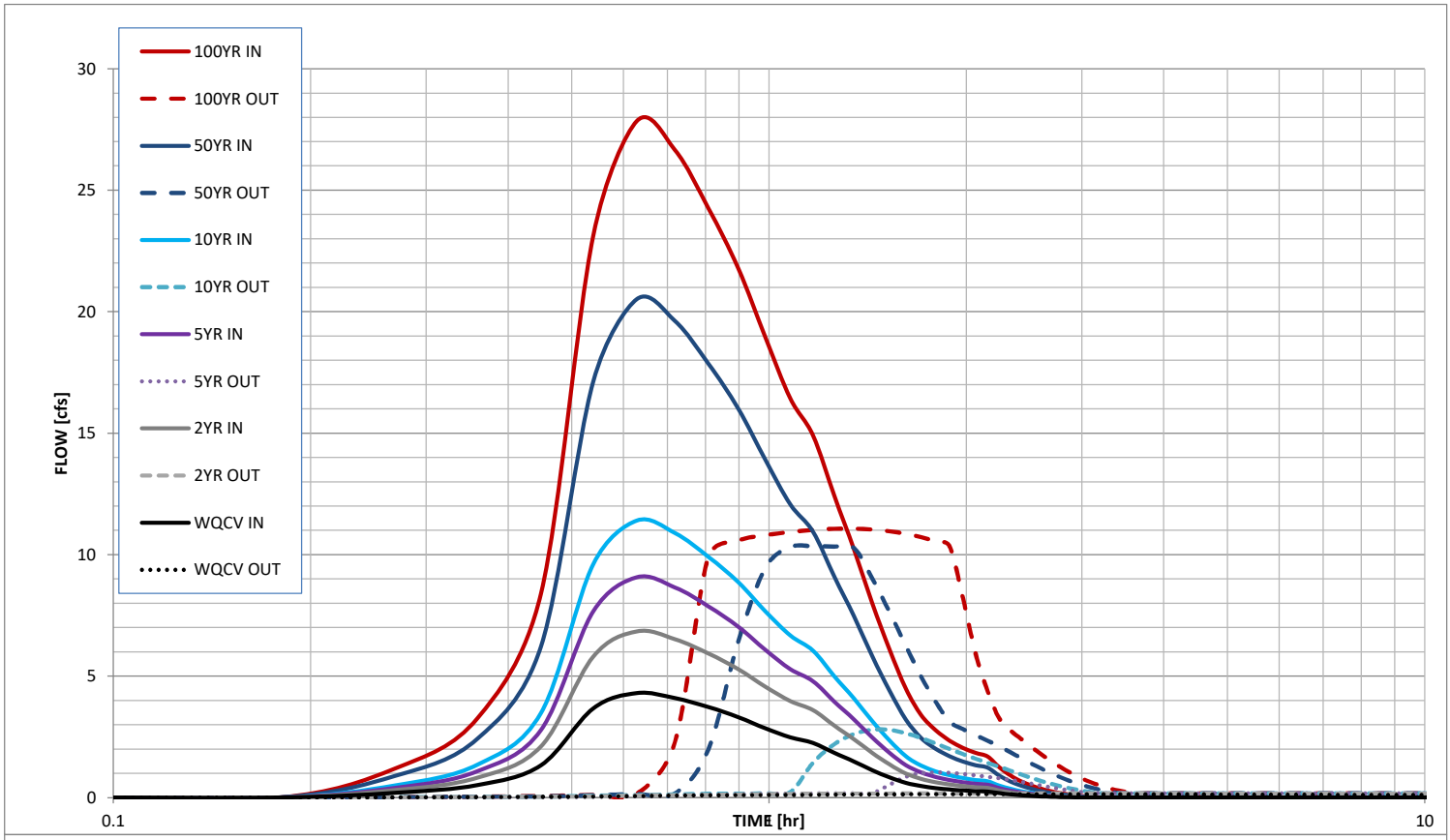
User Defined Stage [ft]	User Defined Area [ft^2]	User Defined Stage [ft]	User Defined Discharge [cfs]
0.00	100	0.00	0.00
0.25	942	0.25	0.02
0.50	1,784	0.50	0.03
0.75	2,626	0.75	0.04
1.00	3,468	1.00	0.04
1.25	5,034	1.25	0.07
1.50	6,600	1.50	0.09
1.75	8,166	1.75	0.10
2.00	9,732	2.00	0.11
2.25	11,297	2.25	0.14
2.50	12,863	2.50	0.16
2.75	14,429	2.75	0.17
3.00	15,995	3.00	0.18
3.25	19,602	3.25	3.05
3.50	23,209	3.50	10.28
3.75	26,815	3.75	10.76
4.00	30,422	4.00	11.17
4.25	34,029	4.25	11.57
4.50	37,636	4.50	11.96
4.75	41,243	4.75	12.33
5.00	44,850	5.00	12.70
5.25	48,650	5.25	20.77
5.50	52,450	5.50	35.88
5.75	56,251	5.75	56.20
6.00	60,051	6.00	81.25
6.25	63,851	6.25	110.80
6.50	67,652	6.50	144.75
6.75	71,452	6.75	183.06
7.00	75,252	7.00	225.73

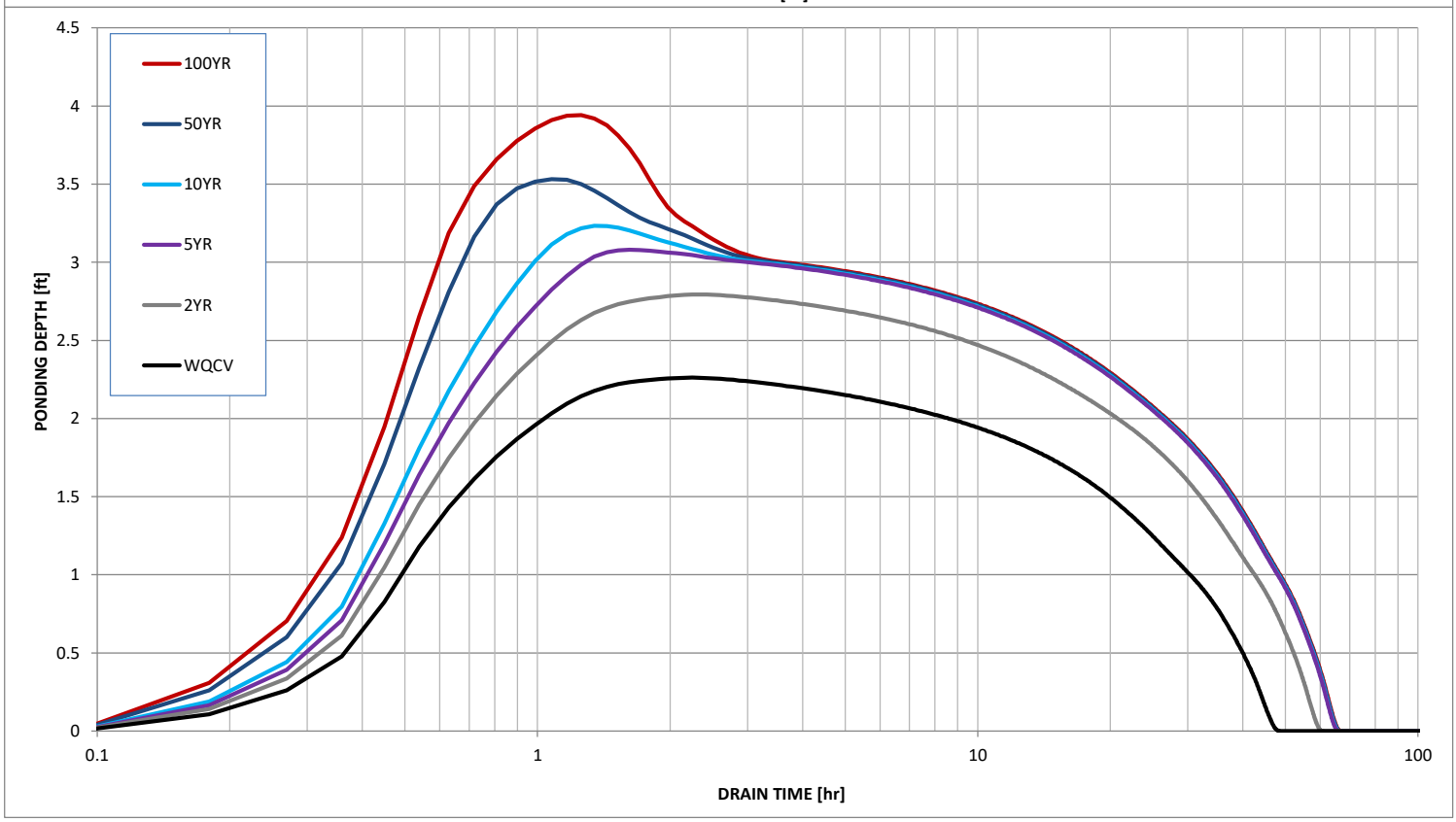
After completing and printing this worksheet to a pdf, go to:
https://maperture.digitaldataservices.com/gvh/?viewer=cswdif
create a new stormwater facility, and
attach the pdf of this worksheet to that record.

Routed Hydrograph Results

Design Storm Return Period =	WQCV	2 Year	5 Year	10 Year	50 Year	100 Year	
One-Hour Rainfall Depth =	0.53	1.19	1.50	1.75	2.25	2.52	in
Calculated Runoff Volume =	0.277	0.442	0.589	0.741	1.343	1.830	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.276	0.442	0.588	0.741	1.343	1.829	acre-ft
Time to Drain 97% of Inflow Volume =	41.1	51.3	**55.1**	53.9	48.7	45.2	hours
Time to Drain 99% of Inflow Volume =	43.9	55.1	59.9	59.3	57.1	**55.5**	hours
Maximum Ponding Depth =	2.26	2.79	3.08	3.23	3.53	3.94	ft
Maximum Ponded Area =	0.26	0.34	0.39	0.44	0.54	**0.68**	acres
Maximum Volume Stored =	0.254	0.413	0.516	0.580	0.727	0.975	acre-ft

Stormwater Detention and Infiltration Design Data Sheet



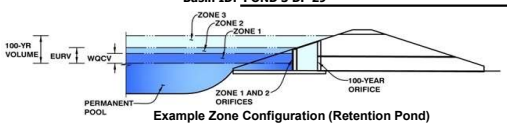


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: **WATERBURY**

Basin ID: **POND 3 DP 29**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	84.64	acres
Watershed Length =	2,265	ft
Watershed Length to Centroid =	850	ft
Watershed Slope =	0.022	ft/ft
Watershed Imperviousness =	47.50%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	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.

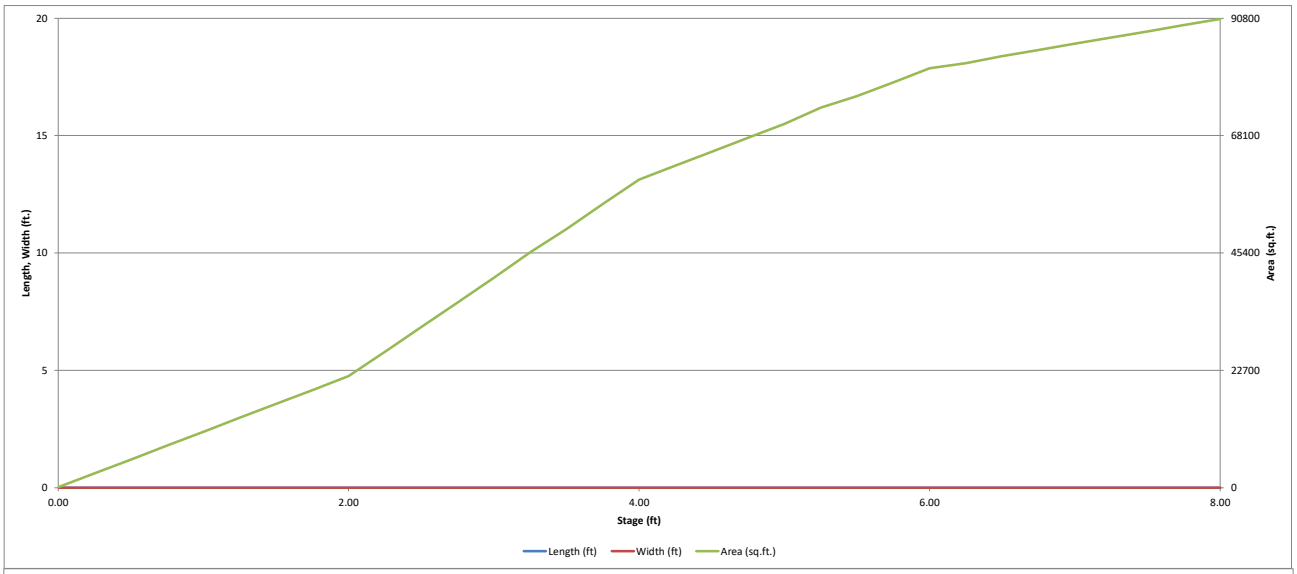
			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	1.200	acre-feet	1.200	acre-feet
Excess Urban Runoff Volume (EURV) =	3.200	acre-feet	3.200	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.401	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	3.253	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.937	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	5.380	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	6.757	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	8.573	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	11.534	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	2.932	acre-feet		
Approximate 5-yr Detention Volume =	3.865	acre-feet		
Approximate 10-yr Detention Volume =	4.728	acre-feet		
Approximate 25-yr Detention Volume =	5.803	acre-feet		
Approximate 50-yr Detention Volume =	6.495	acre-feet		
Approximate 100-yr Detention Volume =	7.365	acre-feet		

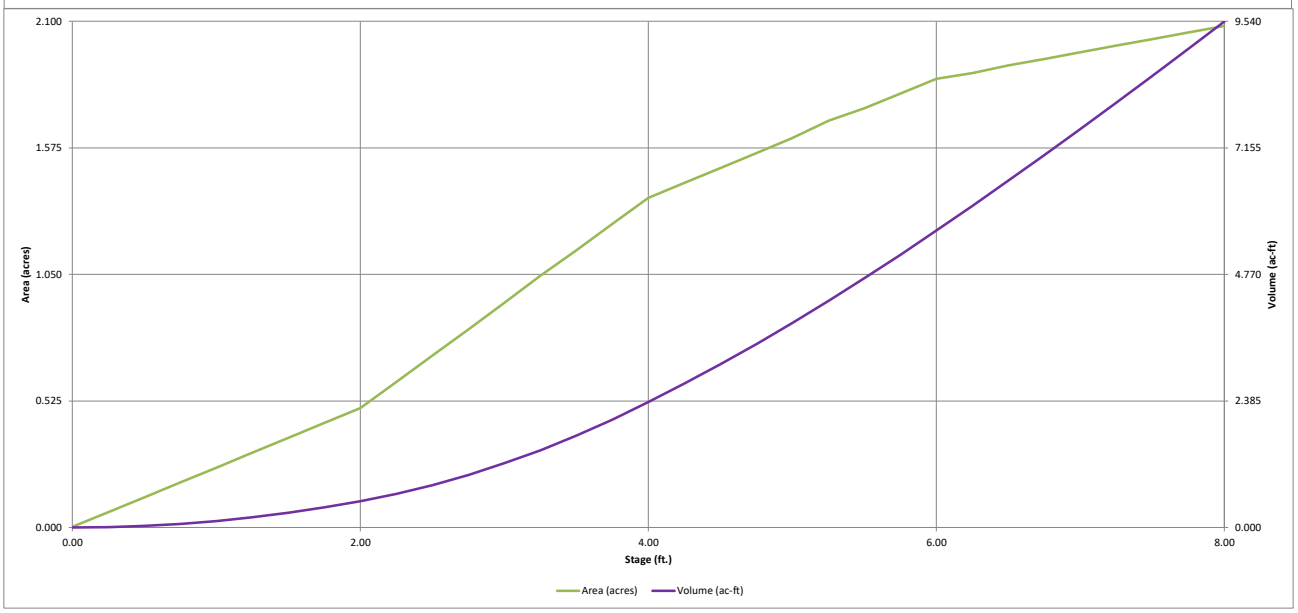
Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.200	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.000	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	4.165	acre-feet
Total Detention Basin Volume =	7.365	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	--	--	--	100	0.002		
6922.25	--	0.25	--	--	--	2,785	0.064	360	0.008
6922.50	--	0.50	--	--	--	5,470	0.126	1,392	0.032
6922.75	--	0.75	--	--	--	8,155	0.187	3,095	0.071
6923.00	--	1.00	--	--	--	10,840	0.249	5,470	0.126
6923.25	--	1.25	--	--	--	13,525	0.310	8,515	0.195
6923.50	--	1.50	--	--	--	16,210	0.372	12,232	0.281
6923.75	--	1.75	--	--	--	18,895	0.434	16,620	0.382
6924.00	--	2.00	--	--	--	21,580	0.495	21,680	0.498
6924.25	--	2.25	--	--	--	26,334	0.605	27,669	0.635
6924.50	--	2.50	--	--	--	31,088	0.714	34,847	0.800
6924.75	--	2.75	--	--	--	35,842	0.823	43,213	0.992
6925.00	--	3.00	--	--	--	40,596	0.932	52,768	1.211
6925.25	--	3.25	--	--	--	45,530	1.045	63,533	1.459
6925.50	--	3.50	--	--	--	50,105	1.150	75,488	1.733
6925.75	--	3.75	--	--	--	54,895	1.260	88,613	2.034
6926.00	--	4.00	--	--	--	59,613	1.369	102,926	2.363
6926.25	--	4.25	--	--	--	62,301	1.430	118,166	2.713
6926.50	--	4.50	--	--	--	64,989	1.492	134,077	3.078
6926.75	--	4.75	--	--	--	67,677	1.554	150,660	3.459
6927.00	--	5.00	--	--	--	70,365	1.615	167,915	3.855
6927.25	--	5.25	--	--	--	73,504	1.687	185,899	4.268
6927.50	--	5.50	--	--	--	75,742	1.739	204,555	4.696
6927.75	--	5.75	--	--	--	78,430	1.801	223,826	5.138
6928.00	--	6.00	--	--	--	81,118	1.862	243,770	5.596
6928.25	--	6.25	--	--	--	82,113	1.885	264,174	6.065
6928.50	--	6.50	--	--	--	83,503	1.917	284,876	6.540
6928.75	--	6.75	--	--	--	84,696	1.944	305,900	7.023
6929.00	--	7.00	--	--	--	85,888	1.972	327,223	7.512
6929.25	--	7.25	--	--	--	87,081	1.999	348,845	8.008
6929.50	--	7.50	--	--	--	88,274	2.026	370,764	8.512
6929.75	--	7.75	--	--	--	89,466	2.054	392,981	9.022
6930.00	--	8.00	--	--	--	90,659	2.081	415,497	9.538


20
15
10
5
0
Length, Width (ft.)
90800
68100
45400
22700
0
Area (sq.ft.)
0.00
2.00
4.00
6.00
8.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

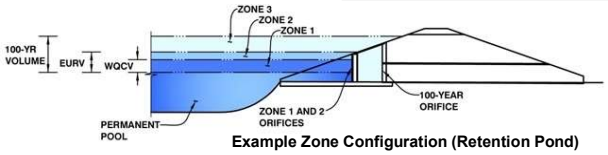

2.100
1.575
1.050
0.525
0.000
Area (acres)
9.540
7.155
4.770
2.385
0.000
Volume (ac-ft)
0.00
2.00
4.00
6.00
8.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: **WATERBURY**

Basin ID: **POND 3 DP 29**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.99	1.200	Orifice Plate
Zone 2 (EURV)	4.59	2.000	Orifice Plate
Zone 3 (100-year)	6.93	4.165	Weir&Pipe (Restrict)
Total (all zones)		7.365	

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

Underdrain Orifice Invert Depth =		ft (distance below the filtration media surface)	Underdrain Orifice Area =		ft^2
Underdrain Orifice Diameter =		inches	Underdrain Orifice Centroid =		feet

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	4.250E-02	ft^2
Depth at top of Zone using Orifice Plate =	4.59	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	18.40	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	6.12	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	1.53	3.06					
Orifice Area (sq. inches)	6.12	6.12	6.12					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

User Input: Overflow Weir (Dropbox 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 =	4.59	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	6.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.59	N/A	feet
Overflow Weir Slope Length =	6.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	4.27	N/A	
Overflow Grate Open Area w/o Debris =	25.20	N/A	ft^2
Overflow Grate Open Area w/ Debris =	12.60	N/A	ft^2

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 =	0.10	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	36.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	28.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	5.90	N/A	ft^2
Outlet Orifice Centroid =	1.28	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.16	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	60.00	feet
Spillway End Slopes =	3.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.88	feet
Stage at Top of Freeboard =	7.88	feet
Basin Area at Top of Freeboard =	2.07	acres
Basin Volume at Top of Freeboard =	9.29	acre-ft

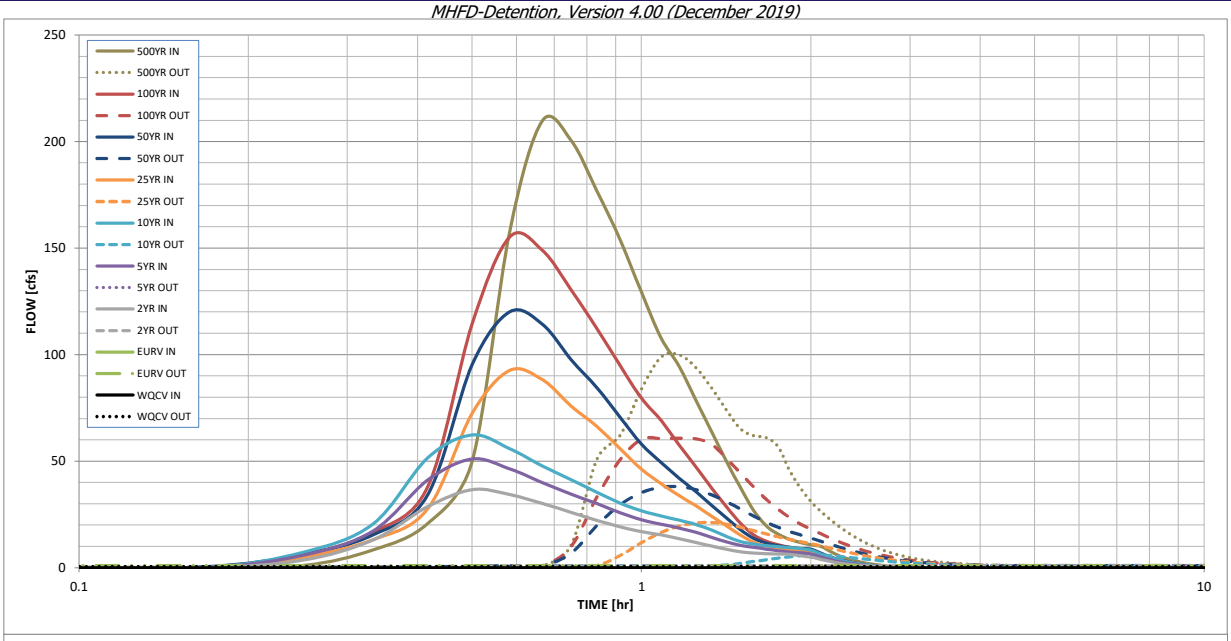
Routed Hydrograph Results

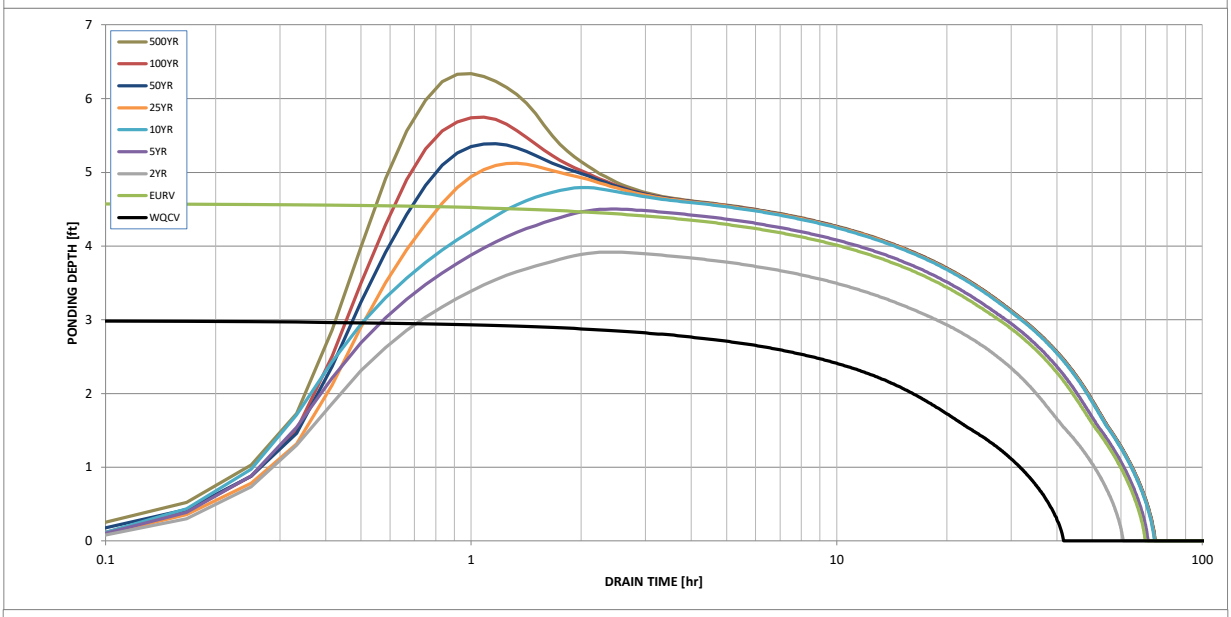
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

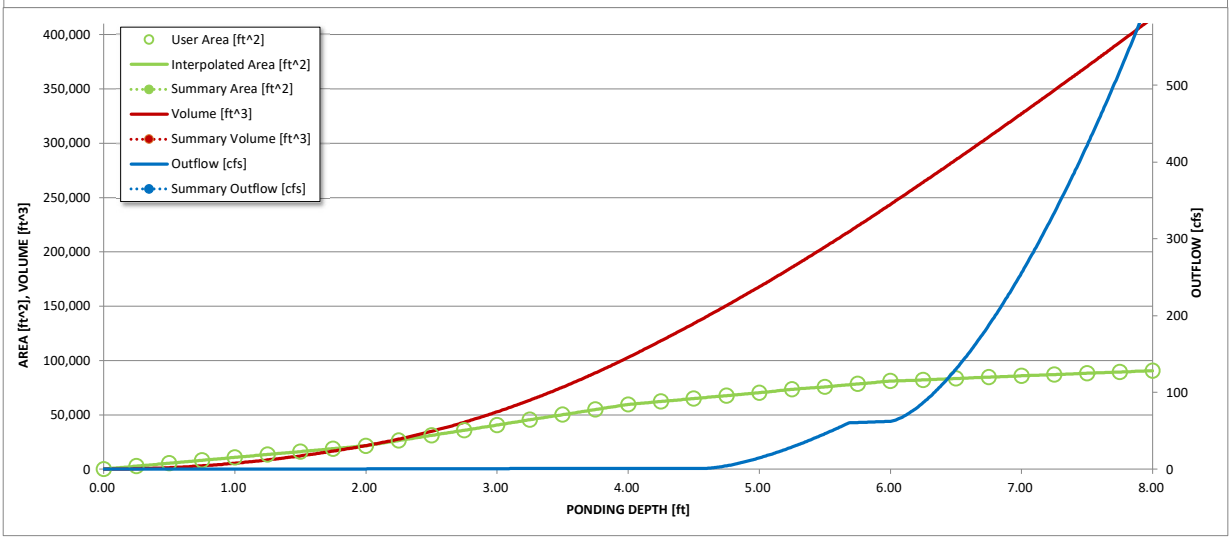
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.00
CUHP Runoff Volume (acre-ft) =	1.200	3.200	2.401	3.253	3.937	5.380	6.757	8.573	11.534
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.401	3.253	3.937	5.380	6.757	8.573	11.534
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.8	1.6	2.2	20.4	40.4	66.1	105.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.03	0.24	0.48	0.78	1.24
Peak Inflow Q (cfs) =	N/A	N/A	36.6	51.0	62.3	92.6	120.1	155.2	209.7
Peak Outflow Q (cfs) =	0.6	1.0	0.9	1.0	5.9	21.2	38.0	60.7	99.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.7	2.7	1.0	0.9	0.9	0.9
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	0.8	1.5	2.4	2.5
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	62	54	63	64	62	60	57	54
Time to Drain 99% of Inflow Volume (hours) =	**40**	66	58	67	70	69	68	67	65
Maximum Ponding Depth (ft) =	2.99	4.59	3.92	4.50	4.79	5.12	5.39	5.75	6.34
Area at Maximum Ponding Depth (acres) =	0.93	1.51	1.33	1.49	1.56	1.65	1.71	1.80	1.90
Maximum Volume Stored (acre-ft) =	1.202	3.213	2.241	3.078	3.521	4.051	4.489	5.120	6.216

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







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	0.41	0.04	1.05
	0:15:00	0.00	0.00	3.55	5.78	7.24	4.91	6.22	6.07	8.29
	0:20:00	0.00	0.00	13.09	17.30	20.59	13.13	15.43	16.55	20.61
	0:25:00	0.00	0.00	28.60	41.05	51.54	27.53	34.09	37.77	49.74
	0:30:00	0.00	0.00	36.64	50.97	62.26	72.28	95.24	114.31	157.81
	0:35:00	0.00	0.00	34.27	46.36	55.81	92.55	120.15	155.21	209.73
	0:40:00	0.00	0.00	30.17	39.93	47.69	88.19	114.23	148.90	200.50
	0:45:00	0.00	0.00	25.93	34.54	41.27	75.85	97.57	130.35	176.81
	0:50:00	0.00	0.00	22.24	30.07	35.44	66.27	84.49	112.23	153.86
	0:55:00	0.00	0.00	19.19	25.79	30.31	55.81	70.55	94.82	129.19
	1:00:00	0.00	0.00	16.92	22.52	26.70	46.18	57.98	79.53	107.82
	1:05:00	0.00	0.00	15.39	20.38	24.34	39.43	49.42	69.13	94.59
	1:10:00	0.00	0.00	13.57	18.64	22.31	33.84	42.05	57.65	78.55
	1:15:00	0.00	0.00	11.79	16.56	20.30	29.04	35.64	47.27	63.76
	1:20:00	0.00	0.00	10.14	14.22	17.65	24.11	29.23	37.40	49.89
	1:25:00	0.00	0.00	8.65	12.12	14.65	19.63	23.40	28.58	37.60
	1:30:00	0.00	0.00	7.48	10.46	12.26	15.30	17.82	20.87	26.87
	1:35:00	0.00	0.00	6.84	9.63	11.03	11.93	13.70	15.36	19.61
	1:40:00	0.00	0.00	6.57	8.73	10.33	10.10	11.52	12.39	15.70
	1:45:00	0.00	0.00	6.41	7.95	9.82	9.08	10.31	10.71	13.33
	1:50:00	0.00	0.00	6.31	7.39	9.46	8.44	9.54	9.62	11.79
	1:55:00	0.00	0.00	5.64	6.96	9.02	8.00	9.02	8.88	10.76
	2:00:00	0.00	0.00	4.98	6.48	8.28	7.72	8.69	8.35	10.02
	2:05:00	0.00	0.00	3.90	5.10	6.48	6.08	6.81	6.43	7.64
	2:10:00	0.00	0.00	2.93	3.81	4.82	4.49	5.01	4.69	5.55
	2:15:00	0.00	0.00	2.20	2.85	3.58	3.33	3.72	3.47	4.09
	2:20:00	0.00	0.00	1.64	2.12	2.64	2.47	2.75	2.58	3.04
	2:25:00	0.00	0.00	1.21	1.55	1.93	1.80	2.00	1.88	2.20
	2:30:00	0.00	0.00	0.87	1.10	1.39	1.29	1.42	1.35	1.57
	2:35:00	0.00	0.00	0.62	0.78	1.00	0.93	1.03	0.97	1.13
	2:40:00	0.00	0.00	0.42	0.54	0.69	0.65	0.72	0.67	0.78
	2:45:00	0.00	0.00	0.26	0.36	0.44	0.43	0.46	0.43	0.49
	2:50:00	0.00	0.00	0.14	0.21	0.25	0.25	0.26	0.24	0.27
	2:55:00	0.00	0.00	0.06	0.10	0.11	0.12	0.12	0.11	0.11
	3:00:00	0.00	0.00	0.02	0.03	0.03	0.03	0.03	0.03	0.02
	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

RUNOFF REDUCTION

AREA NOT TRIBUTARY TO WQ PONDS FOR RUNOFF REDUCTION

						AREA > 80,000
BASIN I	**5.66** AC	BASIN I	DCIA	0.00	0.00
	246748.53 SQ FT		UIA	38987.12	9746.78
			RPA	10413.58	2603.40
			SPA	197347.83	49336.96
			Total	**246748.53**	61687.13
BASIN J	**1.99** AC	BASIN J	DCIA	0.00	0.00
	86638.12 SQ FT		UIA	19060.56	9530.28
			RPA	5039.06	2519.53
			SPA	62538.50	31269.25
			Total	**86638.12**	43319.06
BASIN N	**0.22** AC	BASIN N	DCIA	0.00	
	9795.98 SQ FT		UIA	5504.67	
			RPA	2173.63	
			SPA	2117.68	
			Total	**9795.98**	
BASIN M1	**2.90** AC	BASIN N	DCIA	0.00	0.00
	126442.54 SQ FT		UIA	47732.98	23866.49
			RPA	12939.55	6469.78
			SPA	65770.01	32885.01
			Total	**126442.54**	63221.27
BASIN M2	**0.47** AC	BASIN N	DCIA	0.00	
	20667.55 SQ FT		UIA	8546.78	
			RPA	2867.91	
			SPA	9252.86	
			Total	**20667.55**	
BASIN P	**1.18** AC	BASIN N	DCIA	0.00	0.00
	51440.65 SQ FT		UIA	15769.44	15769.44
			RPA	6561.79	35671.21
			SPA	29109.42	0.00
			Total	**51440.65**	**51440.65**
BASIN V	**1.32** AC	BASIN N	DCIA	0.00	0.00
	57387.62 SQ FT		UIA	32204.59	32204.59
			RPA	7784.50	25183.03
			SPA	17398.53	0.00
			Total	**57387.62**	**57387.62**

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Designer:	**Quentin Armijo**
Company:	**Terra Nova Engineering, Inc.**
Date:	**September 21, 2021**
Project:	**Waterbury Filings 1 & 2**
Location:	**BASIN I, J & N WESTERN CHANNEL DIRECT RELEASE BROKE DOWN TO MEET 80,000 SQ FT**

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth: 0.60 inches

Depth of Average Runoff Producing Storm, d_6 = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA					
Area ID	IA	IB	IC	ID	JA	JB	N					
Downstream Design Point ID	WEST CH	WEST CH	WEST CH	WEST CH	WEST CH	WEST CH	WEST CH					
Downstream BMP Type	None	None	None	None	None	None	None					
DCIA (ft^2)	--	--	--	--	--	--	--					
UIA (ft^2)	9,747	9,747	9,747	9,747	9,530	9,530	5,505					
RPA (ft^2)	2,603	2,603	2,603	2,603	2,520	2,520	2,174					
SPA (ft^2)	--	--	--	--	--	--	--					
HSG A (%)	100%	100%	100%	100%	100%	100%	100%					
HSG B (%)	0%	0%	0%	0%	0%	0%	0%					
HSG C/D (%)	0%	0%	0%	0%	0%	0%	0%					
Average Slope of RPA (ft/ft)	0.020	0.020	0.020	0.020	0.020	0.020	0.020					
UIA:RPA Interface Width (ft)	10.00	10.00	10.00	10.00	10.00	10.00	100.00					

CALCULATED RUNOFF RESULTS

Area ID	IA	IB	IC	ID	JA	JB	N					
UIA:RPA Area (ft^2)	12,350	12,350	12,350	12,350	12,050	12,050	7,678					
L / W Ratio	16.00	16.00	16.00	16.00	16.00	16.00	0.77					
UIA / Area	0.7892	0.7892	0.7892	0.7892	0.7909	0.7909	0.7169					
Runoff (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.00					
Runoff (ft^3)	0	0	0	0	0	0	0					
Runoff Reduction (ft^3)	406	406	406	406	397	397	229					

CALCULATED WQCV RESULTS

Area ID	IA	IB	IC	ID	JA	JB	N					
WQCV (ft^3)	406	406	406	406	397	397	229					
WQCV Reduction (ft^3)	406	406	406	406	397	397	229					
WQCV Reduction (%)	100%	100%	100%	100%	100%	100%	100%					
Untreated WQCV (ft^3)	0	0	0	0	0	0	0					

CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	WEST CH											
DCIA (ft^2)	0											
UIA (ft^2)	63,552											
RPA (ft^2)	17,626											
SPA (ft^2)	0											
Total Area (ft^2)	81,179											
Total Impervious Area (ft^2)	63,552											
WQCV (ft^3)	2,648											
WQCV Reduction (ft^3)	2,648											
WQCV Reduction (%)	100%											
Untreated WQCV (ft^3)	0											

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	81,179
Total Impervious Area (ft^2)	63,552
WQCV (ft^3)	2,648
WQCV Reduction (ft^3)	2,648
WQCV Reduction (%)	100%
Untreated WQCV (ft^3)	0

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Designer:	**QUENTIN ARMIJO**
Company:	**TERRA NOVA ENGINEERING, INC.**
Date:	**September 21, 2021**
Project:	**WATERBURY FILING 1 & 2**
Location:	**BASIN M1 STAPELTON DRIVE DIRECT RELEASE**

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth	0.60	inches
Depth of Average Runoff Producing Storm, d_6 =	0.43	inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	UIA:RPA	UIA:RPA										
Area ID	M1A	M1B										
Downstream Design Point ID	M1	M1										
Downstream BMP Type	None	None										
DCIA (ft^2)	--	--										
UIA (ft^2)	23,866	23,866										
RPA (ft^2)	6,470	6,470										
SPA (ft^2)	--	--										
HSG A (%)	100%	100%										
HSG B (%)	0%	0%										
HSG C/D (%)	0%	0%										
Average Slope of RPA (ft/ft)	0.040	0.020										
UIA:RPA Interface Width (ft)	10.00	10.00										

CALCULATED RUNOFF RESULTS

Area ID	M1A	M1B										
UIA:RPA Area (ft^2)	30,336	30,336										
L / W Ratio	16.00	16.00										
UIA / Area	0.7867	0.7867										
Runoff (in)	0.00	0.00										
Runoff (ft^3)	0	0										
Runoff Reduction (ft^3)	994	994										

CALCULATED WQCV RESULTS

Area ID	M1A	M1B										
WQCV (ft^3)	994	994										
WQCV Reduction (ft^3)	994	994										
WQCV Reduction (%)	100%	100%										
Untreated WQCV (ft^3)	0	0										

CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	M1	M1										
DCIA (ft^2)	0	0										
UIA (ft^2)	23,866	23,866										
RPA (ft^2)	6,470	6,470										
SPA (ft^2)	0	0										
Total Area (ft^2)	30,336	30,336										
Total Impervious Area (ft^2)	23,866	23,866										
WQCV (ft^3)	994	994										
WQCV Reduction (ft^3)	994	994										
WQCV Reduction (%)	100%	100%										
Untreated WQCV (ft^3)	0	0										

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	60,673
Total Impervious Area (ft^2)	47,733
WQCV (ft^3)	1,989
WQCV Reduction (ft^3)	1,989
WQCV Reduction (%)	100%
Untreated WQCV (ft^3)	0

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Designer:	**QUENTIN ARMIJO**
Company:	**TERRA NOVA ENGINEERING, INC.**
Date:	**September 21, 2021**
Project:	**WATERBURY FILING 1 & 2**
Location:	**BASINS M2, P & V EASTERN CHANNEL DIRECT RELEASE**

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth: 0.60 inches

Depth of Average Runoff Producing Storm, d_6 = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	UIA:RPA	UIA:RPA	UIA:RPA									
Area ID	M2	P	V									
Downstream Design Point ID	EAST CH	EAST CH	EAST CH									
Downstream BMP Type	None	None	None									
DCIA (ft^2)	--	--	--									
UIA (ft^2)	8,547	15,769	32,205									
RPA (ft^2)	2,868	6,562	7,785									
SPA (ft^2)	--	--	--									
HSG A (%)	100%	100%	100%									
HSG B (%)	0%	0%	0%									
HSG C/D (%)	0%	0%	0%									
Average Slope of RPA (ft/ft)	0.020	0.020	0.020									
UIA:RPA Interface Width (ft)	10.00	10.00	10.00									

CALCULATED RUNOFF RESULTS

Area ID	M2	P	V									
UIA:RPA Area (ft^2)	11,415	22,331	39,989									
L / W Ratio	16.00	16.00	16.00									
UIA / Area	0.7488	0.7062	0.8053									
Runoff (in)	0.00	0.00	0.00									
Runoff (ft^3)	0	0	0									
Runoff Reduction (ft^3)	356	657	1342									

CALCULATED WQCV RESULTS

Area ID	M2	P	V									
WQCV (ft^3)	356	657	1342									
WQCV Reduction (ft^3)	356	657	1342									
WQCV Reduction (%)	100%	100%	100%									
Untreated WQCV (ft^3)	0	0	0									

CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	EAST CH											
DCIA (ft^2)	0											
UIA (ft^2)	56,521											
RPA (ft^2)	17,214											
SPA (ft^2)	0											
Total Area (ft^2)	73,735											
Total Impervious Area (ft^2)	56,521											
WQCV (ft^3)	2,355											
WQCV Reduction (ft^3)	2,355											
WQCV Reduction (%)	100%											
Untreated WQCV (ft^3)	0											

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	73,735
Total Impervious Area (ft^2)	56,521
WQCV (ft^3)	2,355
WQCV Reduction (ft^3)	2,355
WQCV Reduction (%)	100%
Untreated WQCV (ft^3)	0

DRAINAGE MAPS

MDDP DRAINAGE REPORT ~ EXISTING BASIN RUNOFF COEFFICIENT SUMMARY

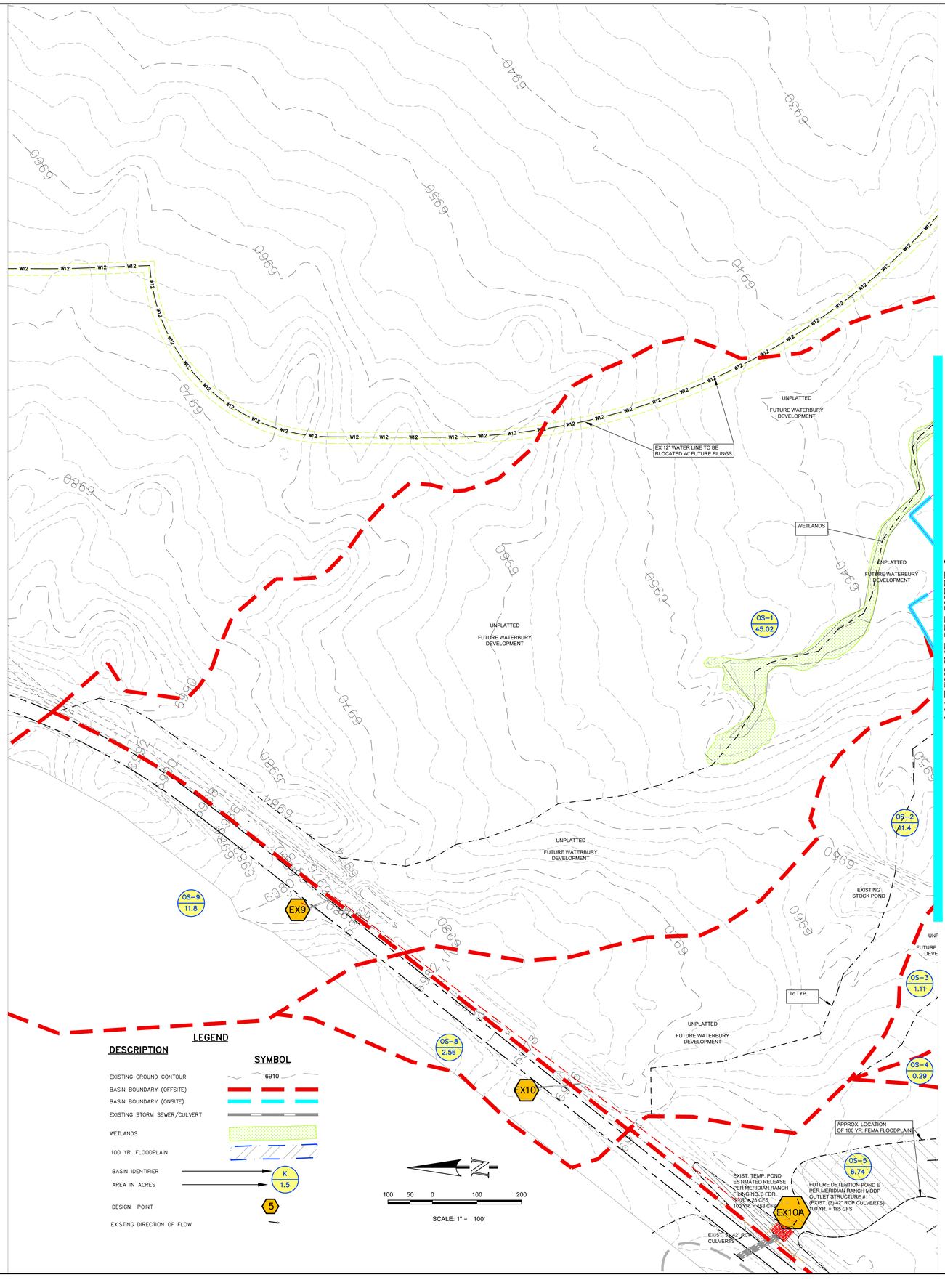
BASIN	TOTAL AREA (AC)	IMPERVIOUS / DEVELOPED AREA			NONIMPERVIOUS / UNDEVELOPED AREA			WEIGHTED		WEIGHTED CA	
		AREA (AC)	C(5)	C(100)	AREA (AC)	C(5)	C(100)	C(5)	C(100)	CA(5)	CA(100)
EXA	9.62	0.00	0.45	0.59	9.62	0.09	0.36	0.09	0.36	**0.87**	**3.46**
EXB	4.09	0.00	0.45	0.59	4.09	0.09	0.36	0.09	0.36	**0.37**	**1.47**
EXC	24.80	0.00	0.45	0.59	24.80	0.09	0.36	0.09	0.36	**2.23**	**8.93**
EXD	15.87	0.00	0.45	0.59	15.87	0.09	0.36	0.09	0.36	**1.43**	**5.71**
EXE	5.83	0.00	0.45	0.59	5.83	0.09	0.36	0.09	0.36	**0.52**	**2.10**
EXF	1.62	0.00	0.45	0.59	1.62	0.09	0.36	0.09	0.36	**0.15**	**0.58**
OS-1	45.02	0.00	0.45	0.59	45.02	0.09	0.36	0.09	0.36	**4.05**	**16.21**
OS-2	11.40	0.00	0.45	0.59	11.40	0.09	0.36	0.09	0.36	**1.03**	**4.11**
OS-3	1.11	0.00	0.45	0.59	1.11	0.09	0.36	0.09	0.36	**0.10**	**0.40**
OS-4	0.29	0.00	0.45	0.59	0.29	0.09	0.36	0.09	0.36	**0.03**	**0.11**
OS-5	6.74	0.00	0.45	0.59	6.74	0.09	0.36	0.09	0.36	**0.61**	**2.43**
OS-8	2.56	FLOW TAKEN FROM MERIDAIN RANCH MDDP									
OS-9	11.80	FLOW TAKEN FROM MERIDAIN RANCH MDDP									
OS-10A	12.80	FLOW TAKEN FROM MERIDAIN RANCH MDDP									

MDDP ~ EXISTING BASIN RUNOFF SUMMARY

BASIN	WEIGHTED		OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY		TOTAL FLOWS	
	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(5) (in/hr)	I(100) (in/hr)	Q(5) (cfs)	Q(100) (cfs)
EXA	0.87	3.46	0.25	100	3	11.1	1193	1.7%	4.5	4.4	15.4	3.43	5.81	**3**	**20**
EXB	0.37	1.47	0.25	100	2	12.6	623	2.2%	5.2	2.0	14.6	3.51	5.96	**1**	**9**
EXC	2.23	8.93	0.25	100	2.5	11.7	2420	1.7%	4.6	8.9	20.6	3.01	5.01	**7**	**45**
EXD	1.43	5.71	0.25	100	2	12.6	1615	2.6%	5.6	4.8	17.4	3.25	5.47	**5**	**31**
EXE	0.52	2.10	0.25	100	8	8.0	1063	2.1%	5.0	3.5	11.5	3.86	6.66	**2**	**14**
EXF	0.15	0.58	0.25	100	6	8.8	400	2.5%	5.5	1.2	10.0	4.06	7.07	**1**	**4**
OS-1	4.05	16.21	0.25	100	6	8.8	3219	2.3%	5.3	10.1	18.9	3.13	5.24	**13**	**85**
OS-2	1.03	4.11	0.25	100	2	12.6	1203	1.0%	3.5	5.7	18.4	3.17	5.32	**3**	**22**
OS-3	0.10	0.40	0.25	100	2	12.6	330	2.6%	5.6	1.0	13.6	3.61	6.17	**0**	**2**
OS-4	0.03	0.11	0.25	100	2	12.6	230	2.6%	5.7	0.7	13.3	3.64	6.23	**0**	**1**
OS-5	0.61	2.43	0.25	80	5	7.8	1000	2.5%	5.5	3.0	10.8	3.96	6.85	**2**	**17**
OS-8	FLOW TAKEN FROM MERIDAIN RANCH MDDP													**5**	**11**
OS-9	FLOW TAKEN FROM MERIDAIN RANCH MDDP													**8**	**19**

MDDP ~ EXISTING SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Area (AC)	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Facility Size
						I(5)	I(100)	Q(5)	Q(100)	
EX1	EXA, OS-5, DP-10A & DP-10	18.92	1.47	5.89	15.4	3.43	5.81	38	180	3-42" CULVERTS
EX2	EXB	4.09	0.37	1.47	14.6	3.51	5.96	1	9	STAPLeTON ROAD
EX3	EXC & OS-4	25.10	2.26	9.03	20.6	3.01	5.01	7	45	EAST BOUNDARY
EX4	EXD & OS-3	16.98	1.53	6.11	17.4	3.25	5.47	5	33	EAST BOUNDARY
EX5	EXE, OS-2 & OS-8	17.23	1.55	6.20	18.4	3.17	5.32	5	33	EAST BOUNDARY
EX6	EXF	1.62	0.15	0.58	11.4	3.87	6.69	1	4	EAST BOUNDARY
EX7	EXF, OS-1 & OS-9	58.45	4.20	16.79	18.9	3.13	5.24	21	107	DP 30 PROP CONDITION
EX9	EXF, OS-1 & OS-11	2.56						5	11	DP 30 PROP CONDITION
EX10	EXF, OS-1 & OS-12	11.80						8	19	DP 30 PROP CONDITION
EX10A	MERIDIAN POND E RELEASE							28	135	EX 3-42" RCP Culverts



REVISIONS

NO.	DESCRIPTION	DATE

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WATERBURY FILING 1 & 2

EXISTING MDDP DRAINAGE MAP 1
OFFSITE MAP

DESIGNED BY	QNA
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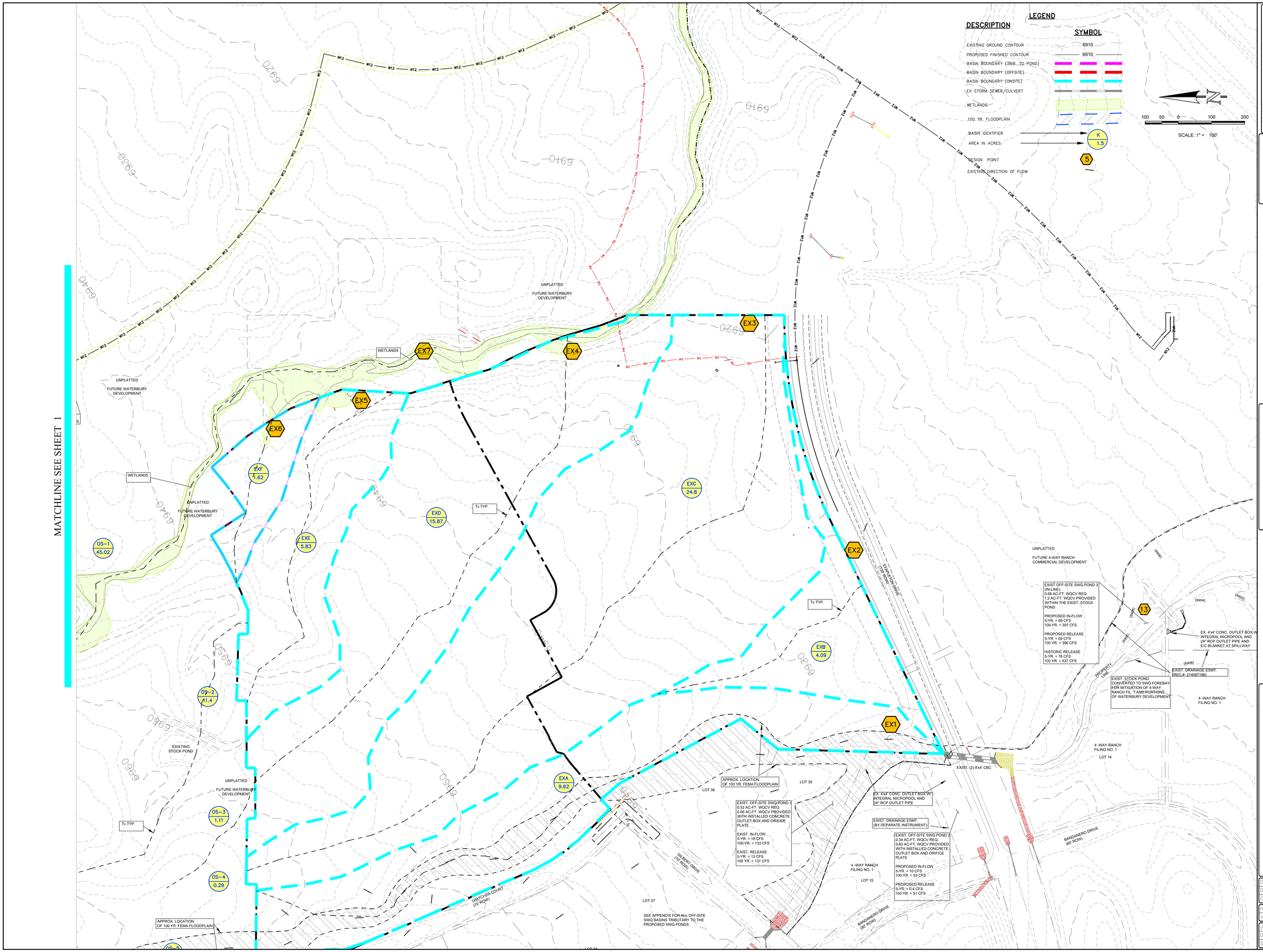
H-SCALE	1"=100'
V-SCALE	
JOB NO.	1715.00
DATE ISSUED	9/22/21
SHEET NO.	1 OF 2



REVISIONS

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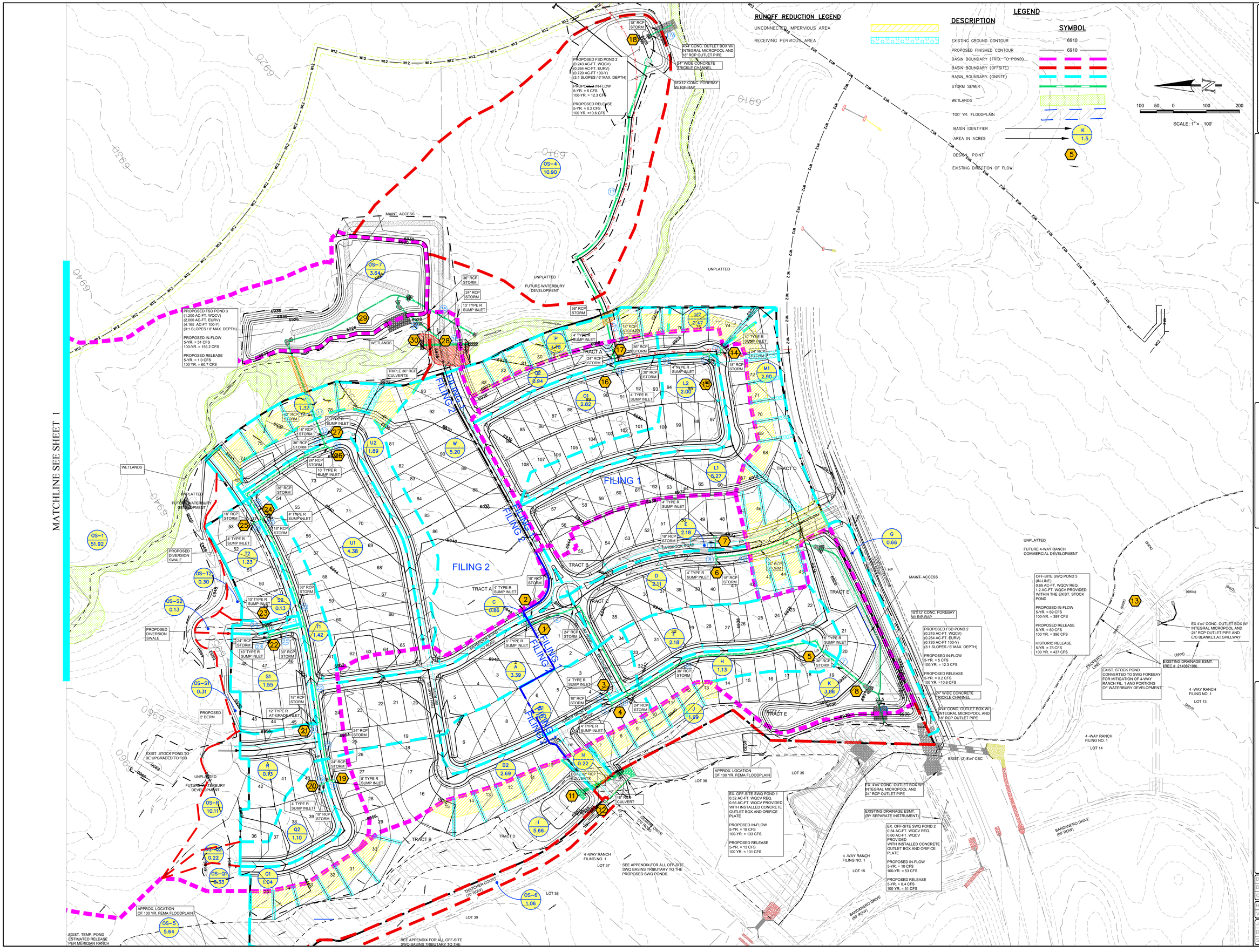
WATERBURY FILING 1 & 2

EXISITING MDDP DRAINAGE MAP 2
ONSITE MAP

DESIGNED BY QNA
DRAWN BY QNA
CHECKED BY
H-SCALE 1"=100'
V-SCALE
JOB NO. 1715.00
DATE ISSUED 9/22/21
SHEET NO. 2 OF 2



REVISIONS

NO.	DESCRIPTION	DATE

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WATERBURY FILING NO. 1 & 2

PROPOSED DRAINAGE MAP ON-SITE

DESIGNED BY	QNA
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H-SCALE	1"=100
V-SCALE	NA
JOB NO.	1715.00
DATE ISSUED	9/22/21
SHEET NO.	2 OF 2