MASTER DEVELOPMENT DRAINAGE PLAN AND PRELIMINARY DRAINAGE REPORT FOR WATERBURY FILINGS NO. 1 & 2 EL PASO COUNTY, COLORADO

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See comment letter also

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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:

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INTRODUCTION

PURPOSE

The purpose of this Master Development Drainage Plan 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, 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'. 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 site will now be developed in 2 Filings, Filing 1 & Filing 2. A Final Drainage Report will be submitted with the Final Plat and Construction drawings. With the Preliminary Plan submittal an Early Grading Permit is also being submitted. The overall proposed drainage patterns do not differ much and follow the previous studies closely.

DBPS

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 west (Haegler Drainage Basin) and one on the east (Geick Ranch Drainage Basin). The "Haegler Drainage Basin Planning Study" was prepared by URS and approved in June of 2009. Drexel Barrel & Co prepared the "Geick Ranch Drainage Basin Planning Study" submitted for approval February 2008 but it has yet to be

Haegler

approved by El Paso County, and therefore there are no drainage fees in this basin. In the Hagler DBPS it is noted that "a portion of the Haegler Ranch as delineated by the County map was found to be part of the Geick Ranch Drainage Basin at Judge Orr Road, due to a the lack of a roadway culvert at the crossing. This is excluded from the Haegler Ranch DBPS and is included as part of the Geick Ranch DBPS, per the County." These 2 channels eventually drain to Black Squirrel Creek and ultimately the Arkansas River.

PROJECT CHARACTERISTICS

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.

198 total on updated plan

The site is in the SW 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 prepared 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. Kiowa Engineering also prepared a 2004 LOMR (04-08-0012).

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

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 FEMA 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). At the time of Final Platting the Base Floodplain Elevations are required to be shown on the Final Plat.

HYDROLOGIC ANALYSIS FOR MDDP

MAJOR DRAINAGE BASIN

The Waterbury Filing 1 & 2 site lies within the Geick Ranch and Haegler Drainage Basin, storm runoff drains southerly to Black Squirrel Creek via a public piped system and then into Fountain Creek. "Geick Ranch Drainage Basin Planning Study" dated February 2008, and ~~pro~~prepared by Drexel Barrel & Co. has been drafted but not yet approved by El Paso County. The Haegler Ranch

(diversion to Geick)

DBPS, the Drainage Basin Planning Study on file for this basin was prepared by URS and approved in June of 2009. Drainage and Bridge fees for the part of the site that lies with Haegler Ranch Basin will need to paid at the time of Final Plat

(other subdivisions in this diversion area have not paid)

METHODOLOGY

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 per the EPC DCM1 Update resolution. 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).

EXISTING MAJOR SUBBASIN DESCRIPTION (FOR MDDP)

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 east side of the site. Below is a description of the existing condition's Design Points, Basins and site runoff.

There are 4 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 of 185 cfs 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' high x 8' wide 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 from 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} = 219 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 easthern boundary of Filing 1 where runoff (Q_5 = 0 cfs, Q_{100} = 2 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" CMP culvert (corresponds to DP10 in the MDDP) 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) from Basin EXE's 5.83 acres is combined with Basin's OS-2 & Design Point EX10. The combined runoff (Q_5 = 10 cfs, Q_{100} = 44 cfs) of the 3 basins is

directed offsite and into the existing channel in the Geick Ranch Basin.

At Design Point EX9 (Basin OS-9) is another 36" DONE culvert (corresponds to DP9 in the MDDP) 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, EX6, & EX9 at DP EX7 is Q_5 = 31 cfs, Q_{100} = 151 cfs).

EARLY GRADING PERMIT SUBBASIN DESCRIPTION

The developer/owner is applying for an Early Grading Permit with the PUD and Final Plat submittal. Per El Paso County Standards, the site must be analyzed for this step in the process. All the flow will be treated via temporary BMP's. These BMP's include silt fence for areas along the site boundary that cannot be routed to a Temporary Sediment Basin (TSB). The larger open areas being graded will be routed via natural and temporary diversion swales to a TSB. All the diversion swales are trapezoidal swales 2' deep, 2'-4' bottom width with 4:1 side slopes (see appendix for calcs) and will have Sediment Control Logs to help control sediment runoff. The velocities in these swales are less than the 7 fps and therefore will be stable. All TSBs will allow sediment to settle out and runoff will be routed via 6" PVC pipe wrapped in rock or in the bigger storm via the riprap armored weir. Below is a description of the site for the Initial Grading Phase.

Basin PRE-A's 4.61 acres consists of small open space prairie along the western boundary that cannot be routed to a Temporary Sediment Basin, and the existing channel floodplain. Runoff (Q_5 = 1 cfs, Q_{100} = 10 cfs) will sheet flow to Silt Fence BMPs prior to draining into the channel.

Design Point PRE1 is Temporary Sediment Basin 1 (TSB1) located at the southwestern corner of the site and will become a permanent Full Spectrum Detention Basin (FSD 1) when construction starts. Offsite Basin OS-4's 0.56 acres will sheet flow (Q_5 = 0 cfs, Q_{100} = 1 cfs) onto Basin PRE-B. Runoff (Q_5 = 4 cfs, Q_{100} = 24 cfs) from Basin PRE-B's 12.35 acres will combine with the upstream offsite Basin OS-4. The combined flow (Q_5 = 4 cfs, Q_{100} = 25 cfs) will be routed overland and via temporary diversion swale A-A to TSB where the water will be treated prior to leaving the site. The swale is a 2' wide bottom 2' deep swale with 4:1 side slopes. The 100-Y highwater depth in the swale is 1.00' (See Appendix for calcs).

Design Point PRE2 is Temporary Sediment Basin 2 (TSB2) located at the southeastern corner of the site. Runoff (Q_5 = 6 cfs, Q_{100} = 38 cfs) from Basin PRE-C's 19.08 acres will be routed overland and via 2 temporary diversion swales B-B to the TSB where the water will be treated prior to leaving the site. it is assumed that the flow is split between the 2 swales. The flows of Q_5 = 3 cfs, Q_{100} = 19 cfs are used in the swale calculations. The swales are a 2' wide bottom, 2' deep swale with 4:1 side slopes. The 100-Y highwater depth in the swale is 0.89' (See Appendix for calcs).

Design Point PRE3 is Temporary Sediment Basin 3 (TSB3) located on the eastern boundary of the site. Offsite Basin OS-3's 1.11 acres will sheet flow (Q_5 = 0 cfs, Q_{100} = 3 cfs) onto Basin PRE-D. Runoff (Q_5 = 5 cfs, Q_{100} = 30 cfs) from Basin PRE-D's 15.52 acres will combine with the upstream offsite Basin OS-3. The combined flow (Q_5 = 5 cfs, Q_{100} = 33 cfs) will be routed overland and via temporary Diversion Swale C-C that is located along the Boundary between Filing 1 & 2, to the TSB where the water will be treated prior to leaving the site. The swale is a 3' wide bottom, 2' deep swale with 4:1 side slopes. The 100-Y highwater depth in the swale is 1.04' (See Appendix for calcs).

Design Point PRE4 is Temporary Sediment Basin 4 (TSB4) located on the eastern boundary of the site just north of TSB3. Offsite Basin OS-1's 0.75 acres will sheet flow (Q_5 = 0 cfs, Q_{100} = 2 cfs) onto Basin PRE-E. Runoff (Q_5 = 2 cfs, Q_{100} = 16 cfs) from Basin PRE-E's 6.33 acres will combine with the upstream offsite Basin OS-1. The combined flow (Q_5 = 3 cfs, Q_{100} = 18 cfs) will be routed overland and via temporary Diversion Swale D-D to the TSB where the water will be treated prior to leaving the site. The swale is a 2' wide bottom 2' deep swale with 4:1 side slopes. The 100-Y highwater depth in the swale is 0.86' (See Appendix for calcs).

Design Point PRE5 is downstream of an existing stock pond located just north of Filing 2 boundary in a future Waterbury Phase. Offsite Basin OS-8's 2.56 acres flow (Q_5 = 5 cfs, Q_{100} = 11 cfs) under Eastonville Road via a 36" CMP culvert onto Basin OS-2. Offsite Basin OS-2's 11.15 acres flow (Q_5 = 8 cfs, Q_{100} = 19 cfs) into the existing stock pond. The combined flow (Q_5 = 9 cfs, Q_{100} = 35 cfs) of the 2 basins will be routed overland in a proposed Diversion Swale E-E north of the Filing 2 Boundary to the existing channel that runs along the eastern boundary, while keeping it off of the proposed development. The swale is a 4' wide bottom 2' deep swale with 4:1 side slopes. The 100-Y highwater depth in the swale is 0.99' (See Appendix for calcs).

Design Point PRE6 is a point located at the southern boundary of the site in Stapleton Drive. Basin PRE-F's 0.62 acres consists of small open space prairie that cannot be routed to a Temporary Sediment Basin. Runoff (Q_5 = 0 cfs, Q_{100} = 2 cfs) will sheet flow to Silt Fence BMPs prior to draining offsite in its historic path.

Design Point PRE7 is a point located at the eastern boundary of the site in the existing channel in the Geick Ranch Basin. Basin PRE-G's 2.00 acres consists of small open space prairie next to the channel and wetlands in Filing 1 that cannot be routed to a Temporary Sediment Basin. Runoff (Q_5 = 1 cfs, Q_{100} = 4 cfs) will sheet flow to Silt Fence BMPs prior to draining offsite in it' historic path. Basin PRE-H's 1.33 acres consists of small open space prairie next to the channel and wetlands in Filing 2 that cannot be routed to a Temporary Sediment Basin. Runoff (Q_5 = 1 cfs, Q_{100} = 4 cfs) will sheet flow to Silt Fence BMPs prior to draining offsite in its historic path. Along with these 2 Basins, runoff discharged from PRE2, PRE3, PRE4, & PRE5 for a combined runoff of Q_5 = 25 cfs, Q_{100} = 147 cfs that is routed to the existing channel.

PROPOSED MAJOR SUBBASIN DESCRIPTION (FOR MDDP)

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 10' CDOT TYPE 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 all the flow.

Design Point 2 is a proposed public 5' CDOT TYPE 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 where it is fully captured. 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 5' CDOT TYPE 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 5' CDOT TYPE 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 5' CDOT TYPE 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 5' CDOT TYPE 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 10' CDOT TYPE R sump inlet located in the flowline of Sandy Neck Way cul-de-sac. 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 10' CDOT TYPE 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, Q_5 = 20 cfs, Q_{100} = 44 cfs) to Design Point 8. If this inlet were blocked, runoff would overtop the curb and flow down the storm drain tract and into the proposed FSD Pond 1 (Design Point 8).

Design Point 6 is a proposed public 5' CDOT TYPE 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 where the entire flow is captured. 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 5' CDOT TYPE 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 5' 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 in Pipe run 10 a public 24' diameter RCP to the proposed FSD Pond 1 Design (Design Point 8).

Design Point 7A is a proposed public 5' CDOT TYPE R at-grade inlet located in the east flowline of Saybrook Road at the south boundary. Runoff (Q_5 = 1 cfs, Q_{100} = 3 cfs) from Basin G1's 0.53 acres consisting of single-family development is directed to the at-grade inlet. The entire flow is captured. It is then routed via a proposed 15" public RCP storm sewer (Pipe run 10A) to a Design Point 7B.

Design Point 7B is a proposed public 5' CDOT TYPE R at-grade inlet located opposite of DP 7A in Saybrook Road. Runoff (Q_5 = 2 cfs, Q_{100} = 4 cfs) from Basin G2's 0.69 acres consisting of roadway and single-family lots is directed via side lot line swales and C&G to the proposed inlet. The 5' inlet captures all of the flow and Pipe run 10B a public 18" diameter RCP storm sewer routes the combined flows (Q_5 = 7 cfs, Q_{100} = 15 cfs) of Pipe runs 10A & Design Point 7B are routed west to the proposed FSD Pond 1 Design (Design Point 8).

Design Point 8 is a proposed private Full Spectrum Detention Basin called FSD Pond 1. Design Points 1-7B 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 8 are Basins A, B1, B2, C, D, E, F, G1, G2, H & K with a total area of 21.12 acres. The 100-year effective impervious area of 55.5% 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 0.391 ac-ft, a EURV of 1.002 ac-ft and a 100-year total required volume of 2.154 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' grate set at 6926.90 on top of a concrete outlet box, an outlet plate on the front to meet the 3-orifice requirement and an 18" outlet pipe with a restrictor plate set 7.5" above the invert will route all runoff from the pond. The metal plate will have 1 column containing 3 rows of 1-15/16" diameter orifice holes spaced 14.0" apart starting at 6923.50. The WQCV release is 0.20 cfs with a ponding elevation of 6925.28 and takes 40 hours to release. The EURV release is 0.5 cfs, with an elevation of 6926.99 and takes 74 hours to release. The 100-year detention release is 8.2 cfs, with an elevation of 6927.86 and takes 76 hours to release. A 30' long riprap emergency spillway set at 6928.00 will allow the 100-year developed peak in flow (Q_{100}= 38.5 cfs) with a depth of 0.55' (top of water = 6928.55) to be routed west into the natural channel. 1.00' freeboard is provided (see appendix for all pond calcs). The spillway and downhill slope will be armored with d50= VH 24" riprap. Pipe Run 10C a private 24" RCP will route the pond release into the existing natural channel. (See Pond Calculations in appendix).

Calculations for forebay missing 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 2.56 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 where existing 3-42" RCP culverts from the temporary Meridian Ranch Pond cross under Eastonville Road per 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. 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 13 in this report corresponds to Design Point 13 in Classic Consulting's previously approved "Final Drainage Report for Waterbury Filing 1" dated September 2016. Design Point 13 is an existing Stormwater Quality Pond 3 (SWQ Pond 3) that was an existing stock pond south of Stapleton Drive that has been converted to an 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 (See Classic Consulting

Did not see a copy of this map in the appendix. Please include.

Drainage Map in Appendix). This online EDB is no longer considered a viable solution to treating for WQCV for Waterbury Filing 1 & 2 basins I, J & N.

Design Point 11 is a proposed crossing under the proposed continuation of Gilbert Drive with dual 42" RCP culverts. Basin I's 5.99 acres consists of rear lots and the natural channel. Runoff (Q_5 = 6 cfs, Q_{100} = 20 cfs) sheet flows to the channel and is directed south to Design Points 11. As mentioned above Kiowas Engineering did a HEC-RAS analysis modeling developed flows along the channel. Tera Nova Engineering has done a new HEC-RAS analysis modeling developed flows. This information can be found under the Hydraulic analysis section below. The combined flow of Design Point 10A along with Basins OS-5 and I is Q_5 = 36 cfs, Q_{100} = 213 cfs. This flow is routed south under Gilbert drive and onto Basin J. Basin I's runoff as mentioned above was intended to be treated downstream in the existing EDB at Design Point 13. This online EDB is no longer considered a viable solution to treating for WQCV due to new regulations. Therefore, the UD-BMP Version 3.07 Runoff Reduction was used to show that this area can be treated using Runoff Reduction. The results show that we have a 100% WQCV reduction for Basin I. The Preliminary Plan/PUD also places impervious restrictions on the rear yards of lots in this Basin area.

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 in 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 was converted to an EDB to provide water quality for part of 4-Way Ranch Filing No. 1 and Waterbury Basins I, J & N. As mentioned above this online EDB is no longer considered a viable solution to treating for WQCV. Therefore, the UD-BMP Version 3.07 Runoff Reduction was used to show that this area can be treated using Runoff Reduction. The results show that we have a 100% WQCV reduction for Basin J. The Preliminary Plan/PUD also places impervious restrictions on the rear yards of lots in this Basin area.

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. Once again, this online EDB is no longer considered a viable solution to treating for WQCV. Therefore, the UD-BMP Version 3.07 Runoff Reduction was used to show that this area can be treated using Runoff Reduction. The results show that we have a 100% WQCV reduction for Basin N. The Preliminary Plan/PUD also places impervious restrictions on this Basin area.

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. The original approved calculations and results can be found in the appendix of the original report by Classic Consulting along with the Basin Exhibit Map.

Basin M1's 1.41 acres is comprised of the rear yards & open space tract along Stapleton Drive along. Runoff (Q_5 = 2 cfs, Q_{100} = 6 cfs) sheet flows over the back yard and open space tract onto Stapleton Drive and then is routed east via curb & gutter to an existing storm drain system from here it is routed to the eastern channel located in the Geick Ranch Basin. The area consists roof area and pervious rear yards that sheet flow over pervious area. The UD-BMP Version 3.07 Runoff Reduction was used to show that this area has 100% WQCV reduction based upon the Unconnected Impervious Area being routed over the Receiving Pervious Area. The Preliminary Plan/PUD also places impervious restrictions on this Basin area.

Basin M2's 0.45 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. The UD-BMP Version 3.07 Runoff Reduction was used to show that this area has 100% WQCV reduction based upon the Unconnected Impervious Area being routed over the Receiving Pervious Area. The Preliminary Plan/PUD also places impervious restrictions on this Basin area.

Still need to show calcs for this basin on pdf pg 196.

Basin P's 0.70 acres is comprised of open space Tract I adjacent to undeveloped land east of the site. Runoff (Q_5 = 0 cfs, Q_{100} = 2 cfs) sheet flows from the open space onto the undeveloped. This area is not treated for water quality but is pervious undeveloped area. The UD-BMP Version 3.07 Runoff Reduction was used to show that this area has 100% WQCV reduction based upon area being Separate Pervious Area.

Design Point 14 is a low point in the knuckle of Beech Creek Drive with a proposed public 10' CDOT TYPE R sump inlet. Runoff (Q_5 = 5 cfs, Q_{100} = 11 cfs) from Basin L1's 3.27 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 5' CDOT TYPE R sump inlet opposite of DP 14 in Beech Creek Drive Runoff (Q_5 = 3 cfs, Q_{100} = 7 cfs) from Basin L2's 2.00 acres consisting of roadway and single-family lots is directed via side lot line swales and C&G to the proposed inlet. The 5' inlet captures all of the flow and Pipe run 12 a public 24" diameter RCP storm sewer routes the flow to a manhole junction with Pipe run 11. Pipe run 13 a 30" R[illegible] bined flow (Q_5 = 8 cfs, Q_{100} = 18 cfs) of Pipe Runs 11 & 12 north in Beech ~~Creek~~ [illegible]le junction with Pipe run 14.

10' inlet per calculations in apprendix

Design Point 16 is a proposed public 5' CDOT TYPE R sump inlet located in the proposed western half of the private street of Beech Creek Drive. Runoff (Q_5 = 5 cfs, Q_{100} = 10 cfs) from Basin O1's 2.82 acres consisting of roadway and single-family lots is directed via side lot line swales and C&G to the proposed inlet. The 5' inlet captures all of the flow and Pipe run 14 a public 30" diameter RCP storm sewer routes the flow to a manhole junction with Pipe run 13. Pipe run 15 a 30" RCP routes the combined flow (Q_5 = 12 cfs, Q_{100} = 27 cfs) of Pipe Runs 13 & 14 west to a manhole junction with Pipe run 16.

Design Point 17 is a proposed public 5' CDOT TYPE R sump inlet located opposite of DP 16 in Beech Creek Drive. Runoff (Q_5 = 1 cfs, Q_{100} = 2 cfs) from Basin O2's 0.71 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 all the flow is captured by the inlet Pipe run 16 routes the runoff to a junction with Pipe run 15. Pipe run 17 routes the combined flows (Q_5 = 14 cfs, Q_{100} = 32 cfs) of Pipe runs 15, 16, 39 & 40 and is routed west offsite via a private 36" diameter RCP to Design Point 18 a proposed private temporary EDB to be in place until future final design of a pond accommodates the new Waterbury development tributary to this pond. This is the FSD Pond 2.

Design Point 33 consists of 4-18" diameter area inlets located at the rear lot line in the downhill side yard swale. A 1' high berm along the back of Lots 46-49 in Basin O3's 0.45 acres will keep runoff (Q_5 = 1 cfs, Q_{100} = 2 cfs) from back yards and rear lot downspouts from sheet flowing into the existing wetlands untreated. Each area inlet can capture 1.40 cfs based upon a head of 0.25'. Therefore the 4 inlets can capture all of the flow. Pipe run 39 a 15" HDPE will route the captured flow to pipe run 17.

Design Point 34 consists of 3-18" diameter area inlets located at the rear lot line in the downhill side yard swale. A 1' high berm along the back of Lots 43-45 in Basin O4's 0.38 acres will keep runoff (Q_5 = 1 cfs, Q_{100} = 2 cfs) from back yards and rear lot downspouts from sheet flowing into the existing wetlands untreated. Each area inlet can capture 1.40 cfs based upon a head of 0.25'. Therefore the 3 inlets can capture all of the flow. Pipe run 40 a 15" HDPE will route the captured flow to pipe run 17.

Design Point 18 is a proposed temporary private Full Spectrum Detention Basin called FSD Pond 2. This pond will be replaced and resized when future filings to the east are final designed. There are no set time frames at this time to when the final design of the permanent pond will happen. 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 18 are L1, L2, O1, O2 and OS-4 with a total area of 20.31 acres. The 100-year effective impervious area of 27.2% 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 0.241 ac-ft, a EURV of 0.297 ac-ft and a 100-year detention total required volume of 1.041 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

Calculations for forebay missing in appendix

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' grate set at 6902.13 on top of a concrete outlet box, an outlet plate on the front to meet the 3-orifice requirement and an 18" outlet pipe with a restrictor plate set 11" 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 12.5" apart starting at 6899.00. The WQCV release is 0.10 cfs with a ponding elevation of 6901.21 and takes 40 hours to release. The EURV release is 0.2 cfs, with an elevation of 6902.13 and takes 61 hours to release. The 100-year detention release is 10.1 cfs, with an elevation of 6902.69 and takes 60 hours to release. A 20' long riprap emergency spillway set at 6904.00 will allow the 100-year developed peak in flow (Q_{100}= 11.0 cfs) with a depth of 0.46' (top of water = 6904.46) 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 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.

For Design Points 19-25 this MDDP assumes the offsite basins upstream are fully developed with future Waterbury Filings.

10' inlet

Design Point 19 is a proposed 10' CDOT TYPE R sump inlet located in the south curb of Muddy Pond Street. Runoff (Q_5 = 6 cfs, Q_{100} = 12 cfs) from Basin OS-Q1's 4.31 acres consists of future single-family development and will be directed via lot line swales and c&g onto Basin Q1. Runoff (Q_5 = 2 cfs, Q_{100} = 4 cfs) from Basin Q1's 1.06 acres is directed to the 8' inlet. The combined flow (Q_5 = 7 cfs, Q_{100} = 15 cfs) is fully captured in the inlet and Pipe run 18 a 24" RCP diameter storm routes the flows to a manhole junction with Pipe run 19.

Design Point 20 is a proposed 5' CDOT TYPE R sump inlet located opposite of DP 19. Runoff (Q_5 = 2 cfs, Q_{100} = 4 cfs) from Basin OS-Q2's 0.96 acres consists of future single-family development and will be directed via lot line swales and c&g 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 = 3 cfs, Q_{100} = 8 cfs) is fully

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 = 10 cfs, Q_{100} = 21 cfs) of Pipe runs 19 & 20 east down Muddy Pond Street to a manhole junction with Pipe run 21.

10' inlet

Design Point 21 is a proposed 10' CDOT TYPE R at-grade inlet located in the north curb of Muddy Pond Street just east of Masonboro Way intersection. Runoff (Q_5 = 11 cfs, Q_{100} = 24 cfs) from Basin OS-R's 6.05 acres consists of future single-family development and will be directed via lot line swales and c&g onto Basin R. Runoff (Q_5 = 2 cfs, Q_{100} = 4 cfs) from Basin R's 1.02 acres is directed to the 12' inlet. The combined flow (Q_5 = 12 cfs, Q_{100} = 28 cfs) is routed to the inlet at Design Point 21 and Q_5 = 8 cfs, Q_{100} = 14 cfs is captured by the at-grad inlet. The bypass flow (Q_5 = 4 cfs, Q_{100} = 14 cfs) at DP 21 travels in the north flow line of Muddy Pond Street to Design Point 22. 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 = 13 cfs, Q_{100} = 34 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} = 14 cfs) at DP 21 travels in the north flow line of Muddy Pond Street to Design Point 22.

Design Point 22 is a proposed 10' CDOT TYPE R sump inlet located in the west curb of Megansett Wat. Runoff (Q_5 = 8 cfs, Q_{100} = 18 cfs) from Basin OS-S1's 5.59 acres consists of future single-family development and will be directed via lot line swales and c&g onto Basin S1. Runoff (Q_5 = 3 cfs, Q_{100} = 7 cfs) from Basin S1's 1.55 acres is directed to the 10' inlet. The combined flow (Q_5 = 15 cfs, Q_{100} = 32 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' CDOT TYPE R sump inlet located opposite of DP 22. Runoff (Q_5 = 0 cfs, Q_{100} = 1 cfs) from Basin OS-S2's 0.17 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} = 1 cfs. It is presumed that the combined flow (Q_5 = 15 cfs, Q_{100} = 33 cfs) at DP 22 & 23 is evenly split between the 2-10' CDOT TYPE R sump inlets. Pipe run 23 a 24" RCP diameter storm routes the flow (Q_5 = 8 cfs, Q_{100} = 17cfs) 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 = 8 cfs, Q_{100} = 17 cfs) to the manhole junction with Pipe run 23. Pipe Run 25 a 30" RCP routes the combined flow (Q_5 = 15 cfs, Q_{100} = 33 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 = 31 cfs, Q_{100} = 62 cfs) of Pipe runs 22 & 25 east in Muddy Pond to a manhole junction with Pipe runs 27 & 28.

5'

Design Point 24 is a proposed 5' CDOT TYPE 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 fully captured flow from the inlet to a manhole junction with Pipe runs 26 & 28.

Design Point 25 is a proposed 5' CDOT TYPE R sump inlet located opposite of DP 24. Runoff (Q_5 = 1 cfs, Q_{100} = 3 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 5' inlet. The combined flow at DP 25 is Q_5 = 3 cfs, Q_{100} = 7 cfs. Pipe run 28 an 18" RCP diameter storm routes the fully captured flow from the inlet to a manhole junction with Pipe runs 26 & 27. Pipe run 29 a 36" RCP then routes the combined flow (Q_5 = 35 cfs, Q_{100} = 72 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.

Design Point 26 is a proposed 10' CDOT TYPE 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 fully captured flow from the inlet to a manhole junction with Pipe run 29. Pipe run 31 a 42" RCP transports the combined flow (Q_5 = 41 cfs, Q_{100} = 84 cfs) of Pipe runs 29 & 30.

Design Point 27 is a proposed 5' CDOT TYPE 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 5' inlet. Pipe run 32 an 18" RCP diameter storm routes the fully captured flow from the inlet to a manhole junction with Pipe runs 31.

Design Point 28 are 2 proposed 10' CDOT TYPE R sump inlets located in the north and south curb of Sunken Meadow Road. These inlets are 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 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 assumed to be evenly split between the 2 inlets and fully captured by them. Pipe run 34 a 24" RCP routes the captured runoff (Q_5 = 4 cfs, Q_{100} = 9 cfs) from the south inlet to the north inlet. Pipe run 34A a 30" RCP routes the combined flow from Design Points 28 & 32, described below via Pipe run 34A a 24" RCP.

2 different pipe sizes called out for same pipe run.

Design Point 31 consists of 3-18" diameter area inlets located at the rear lot line in the downhill side yard swale. A 1' high berm along the back of Lots 90-92 in Basin V's 0.54 acres will keep runoff (Q_5 = 1 cfs, Q_{100} = 3 cfs) from back yards and rear lot downspouts from sheet flowing into the existing wetlands untreated. Each area inlet can capture 1.40 cfs based upon a head of 0.25'. Therefore the 3 inlets can capture all of the flow. Pipe run 37 a 15" HDPE will route the captured flow to pipe run 33. Pipe run 33 a 42" RCP then routes the combined flow (Q_5 = 44 cfs, Q_{100} = 91 cfs) of Pipe runs 31, 32 & 37 east through a Drainage Tract to FSD Pond 3.

Design Point 32 consists of 2-18" diameter area inlets located at the rear lot line in the downhill side yard swale. A 1' high berm along the back of Lots 88-89 in Basin X's 0.43 acres will keep runoff (Q_5 = 1 cfs, Q_{100} = 2 cfs) from back yards and rear lot downspouts from sheet flowing into the existing wetlands untreated. Each area inlet can capture 1.40 cfs based upon a head of 0.25'. Therefore the 2 inlets can capture all of the flow. Pipe run 38 a 15" HDPE will route the fully captured flow to Design point 28. Pipe run 34 a 30" RCP will route the combined flow (Q_5 = 9 cfs, Q_{100} = 20 cfs) of Design Point 28 and Pipe run 32 to FSD Pond 3.

The following Basin are for future Waterbury Filings to the north and east that will be tributary to FSD Pond 3. All the basin descriptions are the same, they are comprised of future single-family development and will be directed via lot line swales and c&g to future storm drain systems the future drain systems will be routed to FSD Pond 3. The exact routes and design have not been finalized at this time but will be with a future Final Drainage Report at the time of development. Below is the summary of the flow and acreage.

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Basin OS-1: 11.81 acres, Runoff (Q_5 = 18 cfs, Q_{100} = 41 cfs)

Basin OS-2: 11.53 acres Runoff (Q_5 = 6 cfs, Q_{100} = 36 cfs)

Basin OS-3A: 0.79 acres Runoff (Q_5 = 1 cfs, Q_{100} = 3 cfs)

Basin OS-3B: 5.66 acres Runoff (Q_5 = 9 cfs, Q_{100} = 20 cfs)

As mentioned above Design Point 9 is an existing 36" CMP 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. Runoff will be directed through the future Waterbury filings and into FSD Pond 3.

Design Point 29 is a proposed private Full Spectrum Detention Basin called FSD Pond 3. Design Points 19-28 and Offsite Basins OS-1, OS-2, OS-3A, OS-3B, & OS-9 along with Basin OS-7's 2.82 acres consisting of the EDB area. Runoff (Q_5 = 1 cfs, Q_{100} = 9 cfs) sheet flows into the EDB with a total area of 82.02 acres routed to the pond and treated for Water Quality and Detention. The 100-year effective impervious area of 49.3% 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 1.396 ac-ft, a EURV of 3.245 ac-ft and a 100-year total required detention volume of 7.405 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' grate set at 6926.59 on top of a concrete outlet box, an outlet plate on the front to meet the 3-orifice requirement and a 36" outlet pipe with a restrictor plate set 26.10" above the invert will route all runoff from the pond. The metal plate will have 1 column containing 3 rows of 2.62" x 2.62" orifice holes spaced 19.4" apart starting at 6922.00. The WQCV release is 0.70 cfs with a ponding elevation of 6925.03 and takes 40 hours to release. The EURV release is 1.2 cfs, with an elevation of 6926.85 and takes 78 hours to release. The 100-year detention release is 58.1 cfs, with an elevation of 6927.94and takes 79 hours to release. A 75' long riprap emergency spillway set at 6928.20 will allow the 100-year developed peak in flow (Q_{100}= 204.3 cfs) with a depth of 0.91' (top

Forebay calcs missing in appendix

of water = 6928.88) to be routed west into the natural channel. 0.89' 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).

Still need to show calcs for this basin on pdf pg 196.

Design Point 30 is a triple 36" RCP culvert crossing under Sunken Meadow Road. Offsite Basin OS-10's 3.41 acres consists of open space containing the natural channel. Runoff (Q_5 = 1 cfs, Q_{100} = 8 cfs) is directed south through the wetlands to the culverts. Basin V's 0.54 acres is comprised of open space tracts adjacent to the existing natural channel along the west side of the site to avoid disturbing wetlands. Runoff (Q_5 = 1 cfs, Q_{100} = 3 cfs) sheet flows from the back yard onto the undeveloped area. This area is not treated for water quality but per the UD-BMP Version 3.07 Runoff Reduction spreadsheet shows that this area has 100% WQCV reduction based upon the Unconnected Impervious Area being routed over the Receiving Pervious Area. The combined flow (Q_5 = 2 cfs, Q_{100} = 9 cfs) at DP 30 does not warrant the triple 36" RCP culverts alone but in case of failure in the Pond 3 outlet runoff from the emergency spillway (Q_{100} = 204 cfs) will be safely routed through the triple 36" RCP culverts (See appendix).

HYDRAULIC ANALYSIS

MAJOR DRAINAGEWAYS

As mentioned above there 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. Terra Nova engineering has done a new HEC-RAS study for the floodplain to establish base flood elevations (see appendix for HEC-RAS model). These channels will be contained in proposed Tracts dedicated to drainage that will allow the 4-Way Ranch Metro District to provide maintenance.

Areas above 0.9 (and V>5) need to be identified and if necessary, stabilized.

and diversion of OS-2 flows to a point higher in the channel

A HEC-RAS analysis was done of the east channel using the existing topo and the proposed contours sampled from these AutoCAD files along with the developed 100-year flow of 151 cfs. The output information shows that the channel velocities are in the range of 0.71 fps to 5. 57 fps. This is below the suggested velocities of 7 fps from the DCM Manual chapter 12 for 100-year event. The Froude numbers vary from 0.07 to 1.02. This is slightly larger than the suggested value of 0.80 for the 100-year event. The shear stress varies from 0.01 to 0.83 lbs/q ft, which is under the 1.0 lbs/sq ft listed in the DCM. As mentioned above this is an existing channel that is not being altered with the exception of the road crossing with the 2-42" culverts. These numbers are for an existing condition. The velocity at Cross-section 1200 just upstream of the culvert crossing is 0.71 fps, the Froude number is 0.07 and the shear stress is 0.01 lbs/sq ft. This shows that the crossing is not detrimental to the channel.

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 water 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. No channel grading or redesign is proposed for the channels; with the exception of the Sunken Meadow Crossing where 3-36" culverts are being placed. The rest of the channel is to remain natural.

A HEC-RAS analysis was done of the east channel using the existing topo and the proposed contours sampled from these AutoCAD files along with the developed 100-year flow of 213 cfs. The output information shows that the channel velocities are in the range of 0.52 fps to 5.97 fps. This is below the suggested velocities of 7 fps from the DCM Manual chapter 12 for 100-year event. The Froude numbers vary from 0.05 to 1.02. This is slightly larger than the suggested value of 0.80 for the 100-year event. The shear stress varies from 0.01 to 0.85 lbs/q ft, which is under the 1.0 lbs/sq ft listed in the DCM. As mentioned above this is an existing channel that is not being altered with the exception of the road crossing with the 3-36" culverts. These numbers for an existing condition. The velocity at Cross-section 1200 just upstream of the culvert crossing is 0.52 fps, the Froude number is 0.05 and the shear stress is 0.01 lbs/sq ft. This shows that the crossing is not detrimental to the channel.

developed flows

The 100-year high water elevations and limits for the east and west channels were checked against the adjacent proposed lots and the finished grade. All lot grades are set above the adjacent 100-year highwater elevation. The lots along the west channel are all set out side of the FEMA Floodplain and the calculated 100-year high water elevations and limits. The lots along the east channel are all placed outside the calculated 100-year high water elevations with the exception of Lot 45 where the corner of the lot is bisected by the 100-year high water limits but the building setback is set out side of this line.

This lot needs to be adjusted to be out of the calculated floodplain

HYDROLOGIC ANALYSIS FOR FILING 1 & 2 PDR

PROPSOED BASIN DESCRIPTION (FOR PDR)

The development of the overall Waterbury site will occur in several platting phases. 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 section until such time that it is developed. Below is a description of the Design Points and the overall proposed drainage characteristics for the development of only Waterbury Filing 1 & 2. Design Points 1-18 do not have any changes to them from the description above in the MDDP section therefore these basins will not be described below. 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

Design Point 19 is a proposed 10' CDOT TYPE 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 1.06 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.

Design Point 20 is a proposed 5' CDOT TYPE 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} = 4 cfs) from Basin Q2's 0.96 acres is directed to the 4' inlet. The combined flow (Q_5 = 2 cfs, Q_{100} = 5 cfs) is fully 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.

delete repeated text

Design Point 21 is a proposed 10' CDOT TYPE R at-grade inlet located in the north curb of Muddy Pond Street just east of Masonboro Way intersection. Runoff (Q_5 = 0 cfs, Q_{100} = 2 cfs) from Basin OS-R's 1.04 acres consists of undeveloped land and will sheet flow onto Basin R. Runoff (Q_5 = 2 cfs, Q_{100} = 4 cfs) from Basin R's 1.02 acres is directed to the 10' inlet. The combined flow (Q_5 = 2 cfs, Q_{100} = 6 cfs) is routed to the inlet and the flow is fully 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 = 6 cfs, Q_{100} = 15 cfs) of Pipe runs 20 & 21 east down Muddy Pond Street to a manhole junction with Pipe run 25. The bypass flow (Q_5 = 0 cfs, Q_{100} = 1 cfs) at DP 21 travels in the north flow line of Muddy Pond Street to Design Point 22.

Design Point 22 is a proposed 10' CDOT TYPE R sump inlet located in the west curb of Megansett Way. Runoff (Q_5 = 0 cfs, Q_{100} = 1 cfs) from Basin OS-S1's 0.31 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 10' inlet. The combined flow (Q_5 = 3 cfs, Q_{100} = 7 cfs) of Basins OS-S1 & S1 is routed via Pipe run 23 to a junction with Pipe run 24.

Design Point 23 is a proposed 10' CDOT TYPE R sump inlet located opposite of DP 22. Runoff (Q_5 = 0 cfs, Q_{100} = 0 cfs) from Basin OS-S2's 0.13 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 = 0 cfs, Q_{100} = 1 cfs. Pipe run 24 a 24" RCP diameter storm routes the flow (Q_5 = 0 cfs, Q_{100} = 1 cfs) from the inlet at DP 22 to a manhole junction with Pipe run 23. Pipe Run 25 a 30" RCP routes the combined flow (Q_5 = 3 cfs, Q_{100} = 7 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 = 8 cfs, Q_{100} = 22 cfs) of Pipe runs 22 & 25 east in Muddy Pond to a manhole junction with Pipe runs 27 & 28.

Design Point 24 is a proposed 5' CDOT TYPE 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 5' inlet. Pipe run 27 an 18" RCP diameter storm routes the flow from the inlet to a manhole junction with Pipe runs 26 & 28.

Design Point 25 is a proposed 5' CDOT TYPE R sump inlet located opposite of DP 24. Runoff (Q_5 = 0 cfs, Q_{100} = 1 cfs) from Basin OS-T2's 0.30 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} = 5 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 = 13 cfs, Q_{100} = 32 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.

Design Point 26 is a proposed 10' CDOT TYPE 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 a 42" RCP transports the combined flow (Q_5 = 19 cfs, Q_{100} = 47 cfs) of Pipe runs 29 & 30.

Design Point 27 is a proposed 5' CDOT TYPE 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 42" RCP then routes the combined flow (Q_5 = 23 cfs, Q_{100} = 55 cfs) of Pipe runs 31 & 32 east through a Drainage Tract to FSD Pond 3.

Design Point E-E is a proposed 4' wide swale, 2' deep with 4:1 side slopes. Offsite Basin OS-8's 2.56 acres flow (Q_5 = 5 cfs, Q_{100} = 11 cfs) under Eastonville Road via a 36" CMP culvert onto Basin OS-2. Offsite Basin OS-2's 12.02 undeveloped acres flow (Q_5 = 3 cfs, Q_{100} = 23 cfs) south into the existing stock pond. The combined flow (Q_5 = 8 cfs, Q_{100} = 33 cfs) of the 2 basins will be routed

overland in a proposed Diversion Swale E-E north of the Filing 2 Boundary to the existing channel that runs along the eastern boundary, while keeping it from entering the proposed development. The swale is a 4' wide bottom 2' deep swale with 4:1 side slopes. The 100-Y highwater depth in the swale is 0.99' (See Appendix for calcs).

Still need to show calcs for this basin on pdf pg 196.

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 = 8 cfs, Q_{100} = 19 cfs) from Basin OS-9's 11.80 acres consists of historic flow based upon upstream detention. Offsite Basin OS-1's 41.09 acres consists of undeveloped land and open space containing the natural channel. Runoff (Q_5 = 11 cfs, Q_{100} = 73 cfs) from Basin OS-1 is directed south through the wetlands to the culverts. Basin Y's 0.35 acres is comprised of undeveloped open space Tracts adjacent to the existing natural channel along the east side of the site. Runoff (Q_5 = 1 cfs, Q_{100} = 2 cfs) from Basin Y sheet flows from the back yard onto the undeveloped. This area is not treated for water quality but is accounted for using Runoff Reduction as mentioned in the MDDP discussion mentioned above. Also entering the channel is the Diversion Swale E-E. The combined flow (Q_5 = 36 cfs, Q_{100} = 120 cfs) at DP 30 of Basins OS-1, Os-2, OS-8, OS-9, & Y will be safely routed through the triple 36" RCP culverts (See appendix).

Include discussion for maintenance & easements for all swales.

Basin description shows that in the interim condition all runoff can be safely routed through the proposed storms drain system.

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.

diversion

DRAINAGE FEES

This site lies within the Haegler Ranch Drainage Basin and Geick Ranch Basin. There is no approved Drainage Basin Planning study on file done with fees for Geick Ranch Basin. At the time of the Final Drainage Report Basin fee calculations will be done for the portion in the Haegler Ranch Basin.

See comment on page 7

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 existing and 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/1717.00/drainage/1715.00 MMDP-FDR 1-2

BIBLIOGRAPHY

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

"Drainage Criteria Manual County of El Paso, Colorado Volume 1" approved October 2018 and prepared by El Paso County

"Drainage Criteria Manual County of El Paso, Colorado Volume 2" approved October 2018 and prepared by El Paso County

"Drainage Criteria Manual County of El Paso, Colorado Volume 1 update Chapter 6" approved October 2018 and prepared by El Paso County

"El Paso County Stormwater Drainage Facilities Maintenance Policy" approved October 2018 and prepared by El Paso County

NRCS 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

104° 36' 6"
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.

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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: *03/07/22*
CALCULATED BY: *QNA*

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									

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *03/07/22*
CALC'D BY: *QNA*

MDDP ~ 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: *03/07/22*
CALCULATED BY: *QNA*

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-EX10A	18.92	1.47	5.89	15.4	3.43	5.81	33	219	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	10	44	EAST BOUNDARY
EX6	EXF	1.62	0.15	0.58	13.8	3.59	6.12	1	4	EAST BOUNDARY
EX7	EXE, EXF, OS-1, OS-2, OS-8 & OS-9	78.24	5.75	23.00	18.9	3.13	5.24	31	151	DP 30 PROP CONDITION
EX9	OS-9	11.80						8	19	DP 30 PROP CONDITION
EX10	OS-8	2.56						5	11	DP 30 PROP CONDITION
EX10A	MERIDIAN POND E RELEASE	Meridaian Ranch Filing 3 FDR Calculated Flows						28	185	EX 3-42" RCP Culverts

EARLY GRADING CONDITIONS

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *03/03/22*
CALCULATED BY: *QNA*

MDDP DRAINAGE REPORT ~ EARLY GRADING 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)**
PRE-A	4.61	0.00	0.45	0.59	4.61	0.09	0.36	0.09	0.36	**0.41**	**1.66**
PRE-B	12.35	0.00	0.45	0.59	12.35	0.09	0.36	0.09	0.36	**1.11**	**4.45**
PRE-C	19.08	0.00	0.45	0.59	19.08	0.09	0.36	0.09	0.36	**1.72**	**6.87**
PRE-D	15.52	0.00	0.45	0.59	15.52	0.09	0.36	0.09	0.36	**1.40**	**5.59**
PRE-E	6.33	0.00	0.45	0.59	6.33	0.09	0.36	0.09	0.36	**0.57**	**2.28**
PRE-F	0.62	0.00	0.45	0.59	0.62	0.09	0.36	0.09	0.36	**0.06**	**0.22**
PRE-G	2.00	0.00	0.45	0.59	2.00	0.09	0.36	0.09	0.36	**0.18**	**0.72**
PRE-H	1.33	0.00	0.45	0.59	1.33	0.09	0.36	0.09	0.36	**0.12**	**0.48**
OS-1	0.75	0.00	0.45	0.59	0.75	0.09	0.36	0.09	0.36	**0.07**	**0.27**
OS-2	11.15	0.00	0.45	0.59	11.15	0.09	0.36	0.09	0.36	**1.00**	**4.01**
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	0.56	0.00	0.45	0.59	0.56	0.09	0.36	0.09	0.36	**0.05**	**0.20**
OS-8	2.56	FLOW TAKEN FROM MERIDAIN RANCH MDDP									

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*03/03/22*
CALC'D BY:	*QNA*

MDDP ~ EARLY GRADING 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)
PRE-A	0.41	1.66	0.25	100	2.5	11.7	909	1.4%	4.2	3.6	15.4	3.43	5.82	**1**	**10**
PRE-B	1.11	4.45	0.25	100	2.5	11.7	1612	1.3%	4.0	6.7	18.5	3.16	5.31	**4**	**24**
PRE-C	1.72	6.87	0.25	100	2.5	11.7	1308	1.3%	4.0	5.5	17.2	3.27	5.50	**6**	**38**
PRE-D	1.40	5.59	0.25	100	2	12.6	1297	1.6%	4.5	4.9	17.5	3.24	5.46	**5**	**30**
PRE-E	0.57	2.28	0.25	100	8	8.0	752	2.1%	5.1	2.5	10.5	4.00	6.94	**2**	**16**
PRE-F	0.06	0.22	0.25	64	2	8.7					8.7	4.26	7.47	**0**	**2**
PRE-G	0.18	0.72	0.25	161	5	13.9					13.9	3.58	6.12	**1**	**4**
PRE-H	0.12	0.48	0.25	67	2	9.1					9.1	4.21	7.36	**1**	**4**
OS-1	0.07	0.27	0.25	85	2	11.0	75	1.3%	4.0	0.3	11.4	3.88	6.70	**0**	**2**
OS-2	1.00	4.01	0.25	76	2	10.1	1427	2.1%	5.1	4.7	14.8	3.49	5.94	**4**	**24**
OS-3	0.10	0.40	0.25	100	9	7.7	329	2.5%	5.5	1.0	8.7	4.27	7.49	**0**	**3**
OS-4	0.05	0.20	0.25	100	2	12.6	127	2.4%	5.4	0.4	13.0	3.68	6.30	**0**	**1**
OS-8	FLOW TAKEN FROM MERIDAIN RANCH MDDP													**5**	**11**

Missing Basin OS-9 as shown on basin map. Please include

JOB NAME:	*WATERBURY MDDP*
JOB NUMBER:	*1715.00*
DATE:	*03/03/22*
CALCULATED BY:	*QNA*

MDDP ~ EARLY GRADING 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)	
PRE1	PRE-B & OS-4	4.65	1.16	4.65	18.5	3.16	5.31	4	25	TSB 1
PRE2	PRE-C	19.08	1.72	6.87	17.2	3.27	5.50	6	38	TSB 2
PRE3	PRE-D & OS-3	16.63	1.50	5.99	17.5	3.24	5.46	5	33	TSB 3
PRE4	PRE-E & OS-1	7.07	0.64	2.55	10.5	4.00	6.94	3	18	TSB 4
PRE5	OS-8 & OS-2	13.71	1.00	4.01	14.8	3.49	5.94	9	35	EASTERN CHANNEL
PRE6	PRE-F	0.62	0.06	0.22	8.7	4.26	7.47	0	2	STAPLETON ROAD
PRE7	PRE-G, PRE-H & DPS PRE2-PRE5	59.82	5.15	20.61	17.5	3.24	5.46	25	147	EX GEICK RANCH CHANNEL

Design Points EX10 , 9 and 13 are shown on drainage map but are missing from table. Please include.

MDDP CALCULATIONS

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
DATE: *03/08/22*
CALCULATED BY: *QNA*

MDDP DRAINAGE REPORT ~ PROPOSED 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**
G1	0.53	0.53	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.24**	**0.31**
G2	0.69	0.69	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.31**	**0.41**
H	1.13	1.13	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.51**	**0.67**
I	5.99	2.46	0.45	0.59	3.53	0.09	0.36	0.24	0.45	**1.43**	**2.72**
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	3.27	3.27	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**1.47**	**1.93**
L2	2.00	2.00	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.90**	**1.18**
M1	1.41	1.41	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.63**	**0.83**
M2	0.45	0.45	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.20**	**0.26**
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	0.71	0.71	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.32**	**0.42**
O3	0.45	0.45	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.20**	**0.27**
O4	0.38	0.38	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.17**	**0.23**
P	0.70	0.00	0.45	0.59	0.70	0.09	0.36	0.09	0.36	**0.06**	**0.25**
Q1	1.06	1.06	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.48**	**0.62**
Q2	0.96	0.96	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.43**	**0.56**
R	1.02	1.02	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.46**	**0.60**
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 MDDP*
JOB NUMBER: *1715.00*
DATE: *03/08/22*
CALCULATED BY: *QNA*

MDDP DRAINAGE REPORT ~ PROPOSED 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**
V	0.54	0.54	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.24**	**0.32**
W	5.20	5.20	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**2.34**	**3.07**
X	0.43	0.43	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.19**	**0.25**
Y	0.35	0.35	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.16**	**0.21**
OS-1	11.81	11.81	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**5.31**	**6.97**
OS-2	11.53	11.53	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**5.19**	**6.80**
0S-3A	0.79	0.79	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.35**	**0.47**
0S-3B	5.66	5.66	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**2.55**	**3.34**
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	0.00	0.45	0.59	5.64	0.09	0.36	0.09	0.36	**0.51**	**2.03**
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	2.82	0.00	0.45	0.59	2.82	0.09	0.36	0.09	0.36	**0.25**	**1.01**
OS-8	2.56	FLOW TAKEN FROM MERIDAIN RANCH MDDP									
OS-9	11.80	FLOW TAKEN FROM MERIDAIN RANCH MDDP									
OS-10	3.41	0.00	0.45	0.59	3.41	0.09	0.36	0.09	0.36	**0.31**	**1.23**
OS-Q1	4.31	4.31	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**1.94**	**2.54**
OS-Q2	0.94	0.94	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.42**	**0.55**
OS-R	6.05	6.05	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**2.72**	**3.57**
OS-S1	5.59	5.59	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**2.51**	**3.30**
OS-S2	0.17	0.17	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.08**	**0.10**
OS-T2	0.76	0.76	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.34**	**0.45**

JOB NAME: *WATERBURY MDDP*
JOB NUMBER: *1715.00*
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MDDP ~ PROPOSED 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
G1	0.24	0.31	0.25								5.0	5.00	9.06	1	3
G2	0.31	0.41	0.25								5.0	5.00	9.06	2	4
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	1.43	2.72	0.25	80	4	8.4	250	2.0%	4.9	0.8	9.2	4.18	7.32	6	14
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	1.47	1.93	0.25	100	2	12.6	860	1.4%	4.1	3.5	16.1	3.36	5.69	5	11
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	0.63	0.83	0.25	70	1.5	10.3	200	2.0%	4.9	0.7	11.0	3.92	6.79	2	6
M2	0.20	0.26	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	2.5	11.7	460	1.5%	4.3	1.8	13.5	3.62	6.19	5	10
O2	0.32	0.42	0.25	100	2	12.6	850	2.0%	4.9	2.9	15.5	3.42	5.80	1	2
O3	0.20	0.27	0.25								5.0	5.00	9.06	1	2
O4	0.17	0.23	0.25								5.0	5.00	9.06	1	2

JOB NAME: *WATERBURY MDDP*
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MDDP ~ PROPOSED 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)
P	0.06	0.25	0.25								5.0	5.00	9.06	0	2
Q1	0.48	0.62	0.25	55	1.3	8.9	445	2.0%	5.0	1.5	10.4	4.01	6.97	2	4
Q2	0.43	0.56	0.25	55	1.3	8.9	445	2.0%	5.0	1.5	10.4	4.01	6.97	2	4
R	0.46	0.60	0.25	100	4	10.1	700	2.0%	4.9	2.4	12.4	3.75	6.44	2	4
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
S2	0.06	0.08	0.25								5.0	5.00	9.06	0	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
V	0.24	0.32	0.25								5.0	5.00	9.06	1	3
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
X	0.19	0.25	0.25								5.0	5.00	9.06	1	2
Y	0.16	0.21	0.25								5.0	5.00	9.06	1	2
OS-1	5.31	6.97	0.25	100	2	12.6	690	2.0%	5.0	2.3	15.0	3.47	5.90	18	41
OS-2	5.19	6.80	0.25	100	2	12.6	1700	1.8%	4.6	6.1	18.7	3.14	5.27	16	36
0S-3A	0.35	0.47	0.25	55	1.1	9.4	480	1.3%	3.9	2.0	11.4	3.87	6.68	1	3
0S-3B	2.55	3.34	0.25	100	2	12.6	480	1.3%	3.9	2.0	14.7	3.50	5.95	9	20
OS-4	0.98	3.92	0.25	800	26	30.5					30.5	2.46	4.01	2	16
OS-5	0.51	2.03	0.25	80	5	7.8	1000	2.5%	5.5	3.0	10.8	3.96	6.85	2	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	0.25	1.01									5.0	5.00	9.06	1	9
OS-8	FLOW TAKEN FROM MERIDAIN RANCH MDDP													5	11
OS-9	FLOW TAKEN FROM MERIDAIN RANCH MDDP													8	19
OS-10	0.31	1.23	0.25	100	2	12.6	300	2.7%	5.7	0.9	13.5	3.62	6.19	1	8

JOB NAME:	*WATERBURY MDDP*
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MDDP ~ PROPOSED 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)
OS-Q1	1.94	2.54	0.25	200	5	16.6	1500	1.5%	4.3	5.8	22.4	2.88	4.78	**6**	**12**
OS-Q2	0.42	0.55	0.25	50	1	8.9	900	1.5%	4.3	3.5	12.4	3.75	6.43	**2**	**4**
OS-R	2.72	3.57	0.25	50	1	8.9	850	2.7%	5.8	2.5	11.4	3.87	6.69	**11**	**24**
OS-S1	2.51	3.30	0.25	100	2	12.6	920	1.2%	3.8	4.0	16.7	3.32	5.60	**8**	**18**
OS-S2	0.08	0.10	0.25	100	2	12.6					12.6	3.72	6.39	**0**	**1**
OS-T2	0.34	0.45	0.25	100	2	12.6					12.6	3.72	6.39	**1**	**3**

JOB NAME:	*WATERBURY MDDP*
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MDDP ~ PROPOSED 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	10' Type R Sump Inlet
2	C	0.86	0.39	0.51	6.9	4.58	8.14	2	4	5' Type R Sump Inlet
3	B1	2.30	1.03	1.36	14.2	3.55	6.05	4	8	5' Type R Sump Inlet
4	B2	2.69	1.21	1.59	14.8	3.49	5.93	4	9	5' Type R Sump Inlet
5	F & H	3.31	1.49	1.95	9.5	4.14	7.22	6	14	10' Type R Sump Inlet
6	D	2.11	0.95	1.24	11.4	3.87	6.69	4	8	5' Type R Sump Inlets
7	E	2.18	0.98	1.29	13.8	3.59	6.12	4	8	5' Type R Sump Inlets
7A	G1	0.53	0.24	0.31	5.0	5.00	9.06	1	3	5' Type R At-grade Inlet
7B	G2	0.69	0.31	0.41	5.0	5.00	9.06	2	4	5' Type R At-grade Inlet
8	DESIGN POINTS 1-7 & K	16.84	7.58	9.94	14.8	3.49	5.93	26	59	FSD Pond 1
9	OS-9	11.80						8	19	EX 36" CMP Culvert
10	OS-8	2.56						5	11	EX 36" CMP Culvert
10A	MERIDIAN POND E RELEASE	Meridaian Ranch Filing 3 FDR Calculated Flows						28	185	EX 3-42" RCP Culverts
11	OS-5, I, DP10A (MERIDIAN POND E RELEASE)	Sum of Basins						36	213	PR 2-42" RCP Culverts
12	OS-6	1.06	0.48	0.63	10.1	4.05	7.04	2	4	18"' RCP Culvert
13	TOTAL OFFISITE EX. STOCK POND INFLOW	Per "Final Drainage Report for Waterbury Filing No. 1" dated September 2016, by Classic Consulting						69	396	EX STOCK POND

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MDDP ~ PROPOSED 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)	
14	L1	3.27	1.47	1.93	16.1	3.36	5.69	5	11	10' Type R Sump Inlet
15	L2	2.00	0.90	1.18	12.8	3.70	6.34	3	7	5' Type R Sump Inlet
16	O1	2.82	1.27	1.66	13.5	3.62	6.19	5	10	10' Type R Sump Inlet
17	O2	0.71	0.32	0.42	15.5	3.42	5.80	1	2	5' Type R Sump Inlet
18	DESIGN POINTS 14-17 & BASIN 0S-4	19.71	4.94	5.20	16.1	3.36	5.69	17	30	Interim FSD Pond 2
19	Q1 & OS-Q1	5.37	2.41	3.17	22.4	2.88	4.78	7	15	10' Type R Sump Inlet
20	Q2 & OS-Q2	1.89	0.85	1.12	12.4	3.75	6.43	3	7	5' Type R Sump Inlet
21	R & OS-R	7.06	3.18	4.17	11.4	3.87	6.69	12	28	10' Type R At-grade Inlet
22	S1 & OS-S1 & DP 21 FLOW BY	8.34	4.42	5.64	16.7	3.32	5.60	15	32	10' Type R Sump Inlet
23	S2 & OS-S2	0.31	0.14	0.18	12.6	3.72	6.39	1	1	10' Type R Sump Inlet
22 & 23 SPLIT	S1, OS-S1, S2, OS-S2, & DP 21 FLOW BY	8.65	4.56	5.82	16.7	3.32	5.60	8	16	2-10' Type R Sump Inlets
24	T1	1.42	0.64	0.84	10.7	3.97	6.88	3	6	5' Type R Sump Inlets
25	T2 & OS-T2	1.99	0.90	1.18	13.5	3.63	6.20	3	7	5' 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	5' Type R Sump Inlets
28	W	5.20	2.34	3.07	15.0	3.47	5.89	8	18	2-10' Type R Sump Inlets
29	DPS 19-28, 31-32, OFFSITE BASINS OS-1, 2, 3A, 3B, 7, & 9	82.02	35.91	47.46	22.4	2.88	4.78	112	246	FSD POND

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MDDP ~ PROPOSED 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)	
30	Y & OS-10	3.76	0.46	1.43	13.5	3.62	6.19	2	9	Triple 36" RCP Culverts
30	FSD POND 3 EMERGCNEY SPILLWAY RELEASE	MHFD DETENTION 100Y PEAK INFLOW							204	Triple 36" RCP Culverts
31	V	0.54	0.24	0.32	5.0	5.00	9.06	1	3	18" DIA INLETS
32	X	0.43	0.19	0.25	5.0	5.00	9.06	1	2	18" DIA INLETS
33	O-3	0.45	0.20	0.27	5.0	5.00	9.06	1	2	18" DIA INLETS
34	O-4	0.38	0.17	0.23	5.0	5.00	9.06	1	2	18" DIA INLETS

JOB NAME: *WATERBURY MDDP*
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* 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	24" RCP
10A	DP-7A	0.24	0.31	5.0	5.00	9.06	1	3	24" RCP
10B	DP-7A & 7B	0.55	0.72	5.0	5.00	9.06	3	7	24" RCP
10C	POND 1 RELEASE	2.95	3.87	13.8	3.59	6.12	0.4	8.2	18" RCP
11	DP-14	1.47	1.93	16.1	3.36	5.69	5	11	24" RCP
12	DP-15	0.90	1.18	12.8	3.70	6.34	3	7	18" RCP
13	DP 14 & 15	2.37	3.11	16.1	3.36	5.69	8	18	30" RCP
14	DP 16	1.27	1.66	13.5	3.62	6.19	5	10	24" RCP
15	DP 14, 15 & 16	3.64	4.77	16.1	3.36	5.69	12	27	36" RCP
16	DP 17	0.32	0.42	15.5	3.42	5.80	1	2	18" RCP

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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)	
17	DP 14, 15, 16, 17, 33, & 34	4.34	5.69	16.1	3.36	5.69	15	32	36" RCP
17A	POND 2 RELEASE								18" RCP
18	DP 19	2.41	3.17	22.4	2.88	4.78	7	15	24" RCP
19	DP 20	0.85	1.12	12.4	3.75	6.43	3	7	18" RCP
20	DP 18 & 19	3.27	4.28	22.4	2.88	4.78	9	20	24" RCP
21	DP 21 PICK UP						8	14	18" RCP
22	DP 19, 20 & 21	6.04	7.21	22.4	2.88	4.78	17	34	30" RCP
23	DP 22	2.28	2.91	16.7	3.32	5.60	8	16	24" RCP
24	DP 23	2.28	2.91	16.7	3.32	5.60	8	16	24" RCP
25	DP 22 & 23	4.56	5.82	16.7	3.32	5.60	15	33	30" RCP
26	DP 19 -23	10.60	13.03	22.4	2.88	4.78	31	62	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	12.13	15.05	22.4	2.88	4.78	35	72	36" RCP
30	DP 26	1.97	2.58	14.3	3.54	6.03	7	16	24" RCP
31	DP 19-26	14.10	17.63	22.4	2.89	4.79	41	84	42" RCP
32	DP 27	0.85	1.11	13.8	3.59	6.12	3	7	18" RCP
33	DP 19-27, & 31	15.19	19.06	22.4	2.88	4.78	44	91	42" RCP
34	DP 28 SPLIT	1.17	1.53	15.0	3.47	5.89	4	9	18" RCP

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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)	
34A	29 & 32	2.53	3.32	15.0	3.47	5.89	9	20	18" RCP
35	Pond 3 Release	MHFD UD-DETENTION POND RELEASE					1.2	58.1	36" RCP
36	DP 30	FSD POND 3 EMERGCNEY SPILLWAY RELEASE						204.3	TRIPLE 36" RCP
37	DP 31	0.24	0.32	5.00	5.00	9.06	1.2	3	15" HDPE
38	DP 32	0.19	0.25	5.00	5.00	9.06	1.2	2	15" HDPE
39	DP 33	0.20	0.27	5.00	5.00	9.06	1.2	2	15" HDPE
40	DP 34	0.17	0.23	5.00	5.00	9.06	1.2	2	15" HDPE

PDR CALCULATIONS

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *03/08/22*
CALCULATED BY: *QNA*

PELIMNARY 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**
G1	0.53	0.53	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.24**	**0.31**
G2	0.69	0.69	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.31**	**0.41**
H	1.13	1.13	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.51**	**0.67**
I	5.99	2.46	0.45	0.59	3.53	0.09	0.36	0.24	0.45	**1.43**	**2.72**
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	3.04	3.04	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**1.37**	**1.79**
L2	2.00	2.00	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.90**	**1.18**
M1	1.64	1.64	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.74**	**0.97**
M2	0.45	0.45	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.20**	**0.26**
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	0.71	0.71	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.32**	**0.42**
O3	0.45	0.45	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.20**	**0.27**
O4	0.38	0.38	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.17**	**0.23**
P	0.70	0.00	0.45	0.59	0.70	0.09	0.36	0.09	0.36	**0.06**	**0.25**
Q1	1.06	1.06	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.48**	**0.62**
Q2	0.96	0.96	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.43**	**0.56**
R	1.02	1.02	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.46**	**0.60**
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: *03/08/22*
CALCULATED BY: *QNA*

PELIMNARY 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**
V	0.54	0.54	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.24**	**0.32**
W	5.20	5.20	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**2.34**	**3.07**
X	0.43	0.43	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.19**	**0.25**
Y	0.35	0.35	0.45	0.59	0.00	0.09	0.36	0.45	0.59	**0.16**	**0.21**
OS-1*	**41.09**	**0.00**	**0.45**	**0.59**	**41.09**	**0.09**	**0.36**	**0.09**	**0.36**	**3.70**	**14.79**
OS-2*	**12.02**	**0.00**	**0.45**	**0.59**	**12.02**	**0.09**	**0.36**	**0.09**	**0.36**	**1.08**	**4.33**
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	0.00	0.45	0.59	5.64	0.09	0.36	0.09	0.36	**0.51**	**2.03**
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: *03/08/22*
CALC'D BY: *QNA*

PELIMINARY 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)
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
G1	0.24	0.31	0.25								5.0	5.00	9.06	1	3
G2	0.31	0.41	0.25								5.0	5.00	9.06	2	4
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	1.43	2.72	0.25	80	4	8.4	250	2.0%	4.9	0.8	9.2	4.18	7.32	6	20
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	1.37	1.79	0.25	100	2	12.6	860	1.4%	4.1	3.5	16.1	3.36	5.69	5	10
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	0.74	0.97	0.25	70	1.5	10.3	200	2.0%	4.9	0.7	11.0	3.92	6.79	3	7
M2	0.20	0.26	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	0.32	0.42	0.25	100	2	12.6	850	2.0%	4.9	2.9	15.5	3.42	5.80	1	2
O3	0.20	0.27	0.25								5.0	5.00	9.06	1	2
O4	0.17	0.23	0.25								5.0	5.00	9.06	1	2
P	0.06	0.25	0.25								5.0	5.00	9.06	0	2
Q1	0.48	0.62	0.25	55	1.3	8.9	445	2.0%	5.0	1.5	10.4	4.01	6.97	2	4

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *03/08/22*
CALC'D BY: *QNA*

PELIMINARY 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)
Q2	0.43	0.56	0.25	55	1.3	8.9	445	2.0%	5.0	1.5	10.4	4.01	6.97	2	4
R	0.46	0.60	0.25	100	4	10.1	700	2.0%	4.9	2.4	12.4	3.75	6.44	2	4
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
S2	0.06	0.08	0.25								5.0	5.00	9.06	0	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
V	0.24	0.32	0.25	100	2	12.6	630	1.6%	4.4	2.4	15.0	3.47	5.89	1	2
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
X	0.19	0.25	0.25	95	6	8.4					8.4	4.31	7.58	1	2
Y	0.16	0.21	0.25	95	6	8.4					8.4	4.31	7.58	1	2
OS-1*	**3.70**	**14.79**	**0.25**	**100**	**2**	**12.6**	**2700**	**2.3%**	**5.3**	**8.5**	**21.1**	**2.97**	**4.94**	**11**	**73**
OS-2*	**1.08**	**4.33**	**0.25**	**100**	**2**	**12.6**	**1203**	**1.0%**	**3.5**	**5.7**	**18.4**	**3.17**	**5.32**	**3**	**23**
OS-4	0.98	3.92	0.25	800	26	30.5					30.5	2.46	4.01	2	16
OS-5	0.51	2.03	0.25	600	18	27.1					27.1	2.62	4.30	1	9
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**	**1.5%**	**4.3**	**0.5**	**13.2**	**3.66**	**6.27**	**0**	**1**
OS-Q2*	**0.02**	**0.08**	**0.25**	**50**	**1**	**8.9**	**135**	**1.5%**	**4.3**	**0.5**	**9.5**	**4.14**	**7.24**	**0**	**1**
OS-R*	**0.09**	**0.38**	**0.25**	**100**	**2**	**12.6**	**50**	**2.7%**	**5.8**	**0.1**	**12.8**	**3.70**	**6.35**	**0**	**2**
OS-S1*	**0.03**	**0.11**	**0.25**								**5.0**	**5.00**	**9.06**	**0**	**1**

JOB NAME:	*WATERBURY FDR*
JOB NUMBER:	*1715.00*
DATE:	*03/08/22*
CALC'D BY:	*QNA*

PELIMINARY DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED CA(5)	CA(100)	C(5)	OVERLAND 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)
OS-S2*	**0.01**	**0.05**	**0.25**								**5.0**	**5.00**	**9.06**	**0**	**0**
OS-T2*	**0.03**	**0.11**	**0.25**								**5.0**	**5.00**	**9.06**	**0**	**1**

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

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *03/08/22*
CALCULATED BY: *QNA*

PELIMINARY 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	10' Type R Sump Inlet
2	C	0.86	0.39	0.51	6.9	4.58	8.14	2	4	5' Type R Sump Inlet
3	B1	2.30	1.03	1.36	14.2	3.55	6.05	4	8	5' Type R Su
4	B2	2.69	1.21	1.59	14.8	3.49	5.93	4	9	5' Type R Su
5	F & H	3.31	1.49	1.95	9.5	4.14	7.22	6	14	10' Type R Sump Inlet
6	D	2.11	0.95	1.24	11.4	3.87	6.69	4	8	5' Type R Sump Inlets
7	E	2.18	0.98	1.29	13.8	3.59	6.12	4	8	5' Type R Sump Inlets
7A	G1	0.53	0.24	0.31	5.0	5.00	9.06	1	3	5' Type R At-grade Inlet
7B	G2	0.69	0.31	0.41	5.0	5.00	9.06	2	4	5' Type R At-grade Inlet
8	DESIGN POINTS 1-7 & K	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	Meridaian Ranch Filing 3 FDR Calculated Flows						28	185	EX 3-42" RCP Culverts
11	OS-5, I, OS-& MERIDIAN POND E RELEASE	Sum of Basins						35	214	PR 2-42" RCP Culverts
12	OS-6	0.33	5.19	6.80	18.7	3.14	5.27	16	36	18"' RCP Culvert

HOw did these
change from M
no change to b

JOB NAME:	*WATERBURY FDR*
JOB NUMBER:	*1715.00*
DATE:	*03/08/22*
CALCULATED BY:	*QNA*

PELIMINARY 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)	
13	TOTAL OFFISITE EX. STOCK POND INFLOW	Per "Final Drainage Report for Waterbury Filing No. 1" dated September 2016, by Classic Consulting						69	396	EX STOCK POND

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *03/08/22*
CALCULATED BY: *QNA*

Flow doesn't match with Basin O1

PELIMINARY 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
14	L1	3.04	1.37	1.79	16.1	3.36	5.69	5	10	10' Type R Sump Inlet
15	L2	2.00	0.90	1.18	16.1	3.36	5.69	3	7	5' Type R Sump Inlet
16	O1	2.82	1.27	1.66	5.0	5.00	9.06	6	15	10' Type R Sump Inlet
17	O2	0.71	0.32	0.42	13.5	3.62	6.19	1	3	5' Type R Sump Inlet
18	DESIGN POINTS 14-17 & BASIN 0S-4	19.48	3.86	5.06	16.1	3.36	5.69	13	29	Interim FSD Pond 2
19*	**Q1 & OS-Q1**	**1.39**	**0.51**	**0.74**	**13.2**	**3.66**	**6.27**	**2**	**5**	**10' Type R Sump Inlet**
20*	**Q2 & OS-Q2**	**1.18**	**0.45**	**0.65**	**9.5**	**4.14**	**7.24**	**2**	**5**	**5' Type R Sump Inlet**
21*	**R & OS-R**	**2.06**	**0.55**	**0.98**	**12.4**	**3.75**	**6.44**	**2**	**6**	**10' Type R At-grade Inlet**
22*	**S1 & OS-S1**	**1.86**	**0.72**	**1.02**	**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**				**10' Type R Sump Inlet**
24*	**T1**	**1.42**	**0.64**	**0.84**	**10.7**	**3.97**	**6.88**	**3**	**6**	**2-10' Type R Sump Inlets**
25*	**T2 & OS-T2**	**1.54**	**0.58**	**0.84**	**13.5**	**3.63**	**6.20**	**2**	**5**	**5' Type R Sump Inlets**
26*	**U1**	**4.38**	**1.97**	**2.58**	**14.3**	**3.54**	**6.03**	**7**	**16**	**5' Type R Sump Inlets**
27*	**U2**	**1.89**	**0.85**	**1.11**	**13.8**	**3.59**	**6.12**	**3**	**7**	**10' Type R Sump Inlets**
28	**W**	**2.34**	**2.34**	**3.07**	**15.0**	**3.47**	**5.89**	**8**	**18**	**5' Type R Sump Inlets**

5' inlet in appendix

In appendix show 2-10' inlets

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *03/08/22*
CALCULATED BY: *QNA*

Why so much lower than MHFD sheet?

Pond?

PELIMINARY 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)	
29*	DESIGN POINTS 19-28 & OS-7	5.20	11.02	15.02	15.0	3.47	5.89	38	88	2-10' Type R Sump Inlets
E-E*	OS-2 & OS-8	14.58	2.66	6.20	18.4	3.17	5.32	8	33	DIVERSION SWALE E-E
30*	Y, OS-1, OS-2, OS-8 & OS-9	67.82	9.32	20.34	21.1	2.97	4.94	36	120	Triple 36" RCP Culverts
31	V	0.54	0.24	0.32	5.0	5.00	9.06	1	3	18" DIA INLETS
32	X	0.43	0.19	0.25	5.0	5.00	9.06	1	2	18" DIA INLETS
33	O-3	0.45	0.20	0.27	5.0	5.00	9.06	1	2	18" DIA INLETS
34	O-4	0.38	0.17	0.23	5.0	5.00	9.06	1	2	18" DIA INLETS

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

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *03/08/22*
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.

PELIMINARY 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	24" RCP
10A	DP-7A						1.2	2.8	24" RCP
10B	DP-7A & 7B						1.2	2.8	24" RCP
10C	Pond 1 Release						1.2	2.8	18" RCP
11	DP-14	1.37	1.79	16.1	3.36	5.69	5	10	24" RCP

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *03/08/22*
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.

PELIMINARY 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)	
12	DP-15	0.90	1.18	16.1	3.36	5.69	3	7	18" RCP
13	DP 14 & 15	2.27	2.98	16.1	3.36	5.69	8	17	30" RCP
14	DP 16	1.27	1.66	5.0	5.00	9.06	6	15	24" RCP
15	DP 14, 15 & 16	3.54	4.64	16.1	3.36	5.69	12	26	36" RCP
16	DP 17	0.32	0.42	13.5	3.62	6.19	1	3	18" RCP
17	DP 14, 15, 16, & 17	3.86	5.06	16.1	3.36	5.69	13	29	36" RCP
17A	Pond 2 Release						1.1	2.4	18" RCP
18*	**DP 19**	**0.51**	**0.74**	**13.2**	**3.66**	**6.27**	**2**	**5**	**24" RCP**
19*	**DP 20**	**0.45**	**0.65**	**9.5**	**4.14**	**7.24**	**2**	**5**	**18" RCP**
20*	**DP 19 & 20**	**0.96**	**1.39**	**13.2**	**3.66**	**6.27**	**4**	**9**	**24" RCP**
21*	**DP 21 PICK UP**						**2**	**6**	**18" RCP**
22*	**DP 19, 20 & 21**	**1.50**	**2.35**	**13.2**	**3.66**	**6.27**	**6**	**15**	**24" RCP**
23*	**DP 22**	**0.72**	**1.02**	**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**

JOB NAME: *WATERBURY FDR*
JOB NUMBER: *1715.00*
DATE: *03/08/22*
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.

PELIMINARY 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)	
25*	**DP 22 & 23**	**0.80**	**1.15**	**12.4**	**3.75**	**6.44**	**3**	**7**	**30" RCP**
26*	**DP 19 -23**	**2.30**	**3.50**	**13.2**	**3.66**	**6.27**	**8**	**22**	**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**	**3.52**	**5.17**	**13.5**	**3.63**	**6.20**	**13**	**32**	**36" RCP**
30*	**DP 26**	**1.97**	**2.58**	**14.3**	**3.54**	**6.03**	**7**	**16**	**24" RCP**
31*	**DP 19-26**	**5.49**	**7.75**	**14.3**	**3.54**	**6.03**	**19**	**47**	**42" RCP**
32*	**DP 27**	**0.85**	**1.11**	**13.8**	**3.59**	**6.12**	**3**	**7**	**18" RCP**
33*	**DP 19-27 & 31**	**6.58**	**9.18**	**14.3**	**3.54**	**6.03**	**23**	**55**	**42" RCP**
34	DP 28	2.34	3.07	21.1	2.97	4.94	7	15	18" RCP
34A	29 & 32	2.43	4.02	14.3	3.54	6.03	9	24	18" RCP
35	Pond 3 Release	MHFD UD-DETENTION POND RELEASE					1	58	36" RCP
36*	DP 30	SUM OF BASINS					36	120	TRIPLE 36" RCP
37	DP 31	0.24	0.32	5.00	5.00	9.06	1	3	15" HDPE
38	DP 32	0.19	0.25	5.00	5.00	9.06	1	2	15" HDPE
39	DP 33	0.20	0.27	5.00	5.00	9.06	1	2	15" HDPE
40	DP 34	0.17	0.23	5.00	5.00	9.06	1	2	15" HDPE

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

HYDRAULIC CALCULATIONS

PRELIMINARY GRADING SWALES

MANNING'S EQUATION for OPEN CHANNEL FLOW

Project:	**WATERBURY 1&2 MDP/PDR**	Location:	DP-PRE1 DIVERSIONS SWALE A-A
By:	QNA	Date:	3/1/2022
Chk By:		Date:	

version 12-2004

Mannings Formula

$Q = (1.486/n)AR_h^{2/3}S^{1/2}$

R = A/P

A = cross sectional area

P= wetted perimeter

S = slope of channel

n = Manning's roughness coefficient

$V = (1.49/n)R_h^{2/3}S^{1/2}$

Q = V x A

	INPUT
z (sideslope)=	4
z (sideslope)=	4
b (btm width, ft)=	2
d (depth, ft)=	1
S (slope, ft/ft)	0.02
n_{low} =	0.02
n_{high} =	0.035

Clear Data Entry Cells

Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Low N Velocity, fps	Low N Flow, cfs	High N Velocity, fps	High N Flow, cfs		
1	6.00	10.25	0.59	7.35452611	44.1272	4.202586	25.2155	T =	10
								Dm =	0.600
				Sc low =	0.0071	Sc high =	0.0218		
				.7 Sc	1.3 Sc	.7 Sc	1.3 Sc		
				0.0050	0.0093	0.0153	0.0284		

s_c = critical slope ft / ft

T = top width of the stream

d_m = a/T = mean depth of flow

Created by: Mike O'Shea

MANNING'S EQUATION for OPEN CHANNEL FLOW

Project:	**WATERBURY 1&2 MDP/PDR**	Location:	DP-PRE2 DIVERSIONS SWALE B-B
By:	QNA	Date:	3/1/2022
Chk By:		Date:	

version 12-2004

Mannings Formula

$Q = (1.486/n)AR_h^{2/3}S^{1/2}$

R = A/P

A = cross sectional area

P= wetted perimeter

S = slope of channel

n = Manning's roughness coefficient

$V = (1.49/n)R_h^{2/3}S^{1/2}$

Q = V x A

	INPUT
z (sideslope)=	4
z (sideslope)=	4
b (btm width, ft)=	2
d (depth, ft)=	0.89
S (slope, ft/ft)	0.02
n_{low} =	0.02
n_{high} =	0.035

Clear Data Entry Cells

Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Low N Velocity, fps	Low N Flow, cfs	High N Velocity, fps	High N Flow, cfs		
0.89	4.95	9.34	0.53	6.88018733	34.0459	3.931536	19.4548	T =	9.12
								Dm =	0.543
				Sc low =	0.0074	Sc high =	0.0226		
				.7 Sc	1.3 Sc	.7 Sc	1.3 Sc		
				0.0052	0.0096	0.0158	0.0293		

s_c = critical slope ft / ft

T = top width of the stream

d_m = a/T = mean depth of flow

Flow is 38 cfs per hydrology spreadsheet

Created by: Mike O'Shea

MANNING'S EQUATION for OPEN CHANNEL FLOW

Project:	**WATERBURY 1&2 MDP/PDR**	Location:	DP-PRE3 DIVERSIONS SWALE C-C
By:	QNA	Date:	3/1/2022
Chk By:		Date:	

version 12-2004

Mannings Formula

$Q = (1.486/n)AR_h^{2/3}S^{1/2}$

R = A/P

A = cross sectional area

P= wetted perimeter

S = slope of channel

n = Manning's roughness coefficient

$V = (1.49/n)R_h^{2/3}S^{1/2}$

Q = V x A

	INPUT
z (sideslope)=	4
z (sideslope)=	4
b (btm width, ft)=	3
d (depth, ft)=	1.04
S (slope, ft/ft)	0.02
n_{low} =	0.02
n_{high} =	0.035

Clear Data Entry Cells

Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Low N Velocity, fps	Low N Flow, cfs	High N Velocity, fps	High N Flow, cfs		
1.04	7.45	11.58	0.64	7.82986896	58.3043	4.474211	33.3168	T =	11.32
								Dm =	0.658
				Sc low =	0.0069	Sc high =	0.0211		
				.7 Sc	1.3 Sc	.7 Sc	1.3 Sc		
				0.0048	0.0090	0.0148	0.0275		

s_c = critical slope ft / ft

T = top width of the stream

d_m = a/T = mean depth of flow

Created by: Mike O'Shea

MANNING'S EQUATION for OPEN CHANNEL FLOW

Project:	**WATERBURY 1&2 MDP/PDR**	Location:	DP-PRE4 DIVERSIONS SWALE D-D
By:	QNA	Date:	3/1/2022
Chk By:		Date:	

version 12-2004

Mannings Formula

$Q = (1.486/n)AR_h^{2/3}S^{1/2}$

R = A/P

A = cross sectional area

P= wetted perimeter

S = slope of channel

n = Manning's roughness coefficient

$V = (1.49/n)R_h^{2/3}S^{1/2}$

Q = V x A

	INPUT
z (sideslope)=	4
z (sideslope)=	4
b (btm width, ft)=	2
d (depth, ft)=	0.86
S (slope, ft/ft)	0.02
n_{low} =	0.02
n_{high} =	0.035

Clear Data Entry Cells

Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Low N Velocity, fps	Low N Flow, cfs	High N Velocity, fps	High N Flow, cfs		
0.86	4.68	9.09	0.51	6.74726399	31.5664	3.855579	18.0379	T =	8.88
								Dm =	0.527
				Sc low =	0.0074	Sc high =	0.0228		
				.7 Sc	1.3 Sc	.7 Sc	1.3 Sc		
				0.0052	0.0097	0.0160	0.0296		

s_c = critical slope ft / ft

T = top width of the stream

d_m = a/T = mean depth of flow

Created by: Mike O'Shea

MANNING'S EQUATION for OPEN CHANNEL FLOW

Project:	**WATERBURY 1&2 MDP/PDR**	Location:	DP-PRE5 DIVERSIONS SWALE E-E
By:	QNA	Date:	3/1/2022
Chk By:		Date:	

version 12-2004

Mannings Formula

$Q = (1.486/n)AR_h^{2/3}S^{1/2}$

R = A/P

A = cross sectional area

P= wetted perimeter

S = slope of channel

n = Manning's roughness coefficient

$V = (1.49/n)R_h^{2/3}S^{1/2}$

Q = V x A

	INPUT
z (sideslope)=	4
z (sideslope)=	4
b (btm width, ft)=	4
d (depth, ft)=	0.99
S (slope, ft/ft)	0.02
n_{low} =	0.02
n_{high} =	0.035

Clear Data Entry Cells

Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Low N Velocity, fps	Low N Flow, cfs	High N Velocity, fps	High N Flow, cfs		
0.99	7.88	12.16	0.65	7.86716151	61.9964	4.495521	35.4265	T =	11.92
								Dm =	0.661
				Sc low =	0.0069	Sc high =	0.0210		
				.7 Sc	1.3 Sc	.7 Sc	1.3 Sc		
				0.0048	0.0089	0.0147	0.0273		

s_c = critical slope ft / ft

T = top width of the stream

d_m = a/T = mean depth of flow

Created by: Mike O'Shea

MDDP
INLET CALCULATIONS

Figure 8-11. Inlet Capacity Chart Sump Conditions , Curb Opening (Type R) Inlet

10 cfs 16 cfs 25 cfs

DP1: Q_{100} = 12 cfs → 10' Inlet
DP2: Q_{100} = 4 cfs → 5' Inlet
DP3: Q_{100} = 8 cfs → 5' Inlet
DP4: Q_{100} = 9 cfs → 5' Inlet
DP5: Q_{100} = 14 cfs → 10' Inlet
DP6: Q_{100} = 8 cfs → 5' Inlet
DP7: Q_{100} = 8 cfs → 5' Inlet
DP14: Q_{100} = 10 cfs → 10' Inlet
DP15 Q_{100} = 7 cfs → 5' Inlet
DP16 Q_{100} = 10 cfs → 10' Inlet

DP17 Q_{100} = 2 cfs → 5' Inlet
DP19 Q_{100} = 15 cfs → 10' Inlet
DP20 Q_{100} = 7 cfs → 5' Inlet
DP22 Q_{100} = 16 cfs → 10' Inlet
DP23 Q_{100} = 16 cfs → 10' Inlet
DP24 Q_{100} = 6 cfs → 5' Inlet
DP25 Q_{100} = 7 cfs → 5' Inlet
DP26 Q_{100} = 16 cfs → 10' Inlet
DP27 Q_{100} = 7 cfs → 5' Inlet

Notes:

1. The standard inlet parameters must apply to use this chart.

DP 7A 5' At-Grade Inlet
Q_5 = 1 cfs, Q_{100} = 3 cfs
Sagbrook Slope = 3.11%

Figure 8-7. Inlet Capacity Chart Continuous Grade Conditions, Residential (Local)
(Attached and Detached Sidewalk)

Street Section Data: Street Width Flowline to Flowline = 34'
Type of Curb and Gutter: D-10-R = 8" vertical
Type 16 = 6" vertical

5 cfs ≥ 1
ok
Full Capture

6.5 ≥ 3
ok
Full Capture

The standard street section parameters as defined in Chapter 7 must apply to use these charts. For non-standard sections, the inlet capacity shall be calculated using the UDFCD spreadsheets. The maximum spread width is limited by the curb height based on no curb overtopping during a minor storm and flow being contained within the public right-of-way during the major storm. Calculations were done using UD-Inlet 3.00.xls, Mar., 2011 with the default clogging factors.

DP 7B 5' At-Grade Inlet
$Q_5 = 2$ cfs, $Q_{100} = 4$ cfs
Daylight Slope = 2.90%

Figure 8-7. Inlet Capacity Chart Continuous Grade Conditions, Residential (Local)
(Attached and Detached Sidewalk)

Street Section Data: Street Width Flowline to Flowline = 34'
Type of Curb and Gutter: D-10-R = 8" vertical
Type 16 = 6" vertical

5<2
OK
Full Capture

6.4<4
OK
Full Capture

The standard street section parameters as defined in Chapter 7 must apply to use these charts. For non-standard sections, the inlet capacity shall be calculated using the UDFCD spreadsheets. The maximum spread width is limited by the curb height based on no curb overtopping during a minor storm and flow being contained within the public right-of-way during the major storm. Calculations were done using UD-Inlet 3.00.xls, Mar., 2011 with the default clogging factors.

DP-21 10' TYPE R - At Grade
$Q_5 = 12$, $Q_{100} = 28$
Muddy Pond Slope = 1.75%

Figure 8-7. Inlet Capacity Chart Continuous Grade Conditions, Residential (Local)
(Attached and Detached Sidewalk)

Street Section Data: Street Width Flowline to Flowline = 34'
Type of Curb and Gutter: D-10-R = 8" vertical
Type 16 = 6" vertical

Captured:
$Q_5 = 8.0$ cfs
$Q_{100} = 14.0$ cfs

By Pass:
$Q_5 = 4.0$ cfs
Q_{100} 14.00 cfs

The standard street section parameters as defined in Chapter 7 must apply to use these charts. For non-standard sections, the inlet capacity shall be calculated using the UDFCD spreadsheets. The maximum spread width is limited by the curb height based on no curb overtopping during a minor storm and flow being contained within the public right-of-way during the major storm. Calculations were done using UD-Inlet 3.00.xls, Mar., 2011 with the default clogging factors.

Nyloplast 18" Drop In Grate Inlet Capacity Chart

DP 33 Q_{100} = 2 cfs 4 inlets Capacity = 4 x 1.4 = 5.6 cfs
DP 34 Q_{100} = 2 cfs 3 inlets Capacity = 3 x 1.4 = 4.2 cfs
DP 31 Q_{100} = 2 cfs 2 inlets Capacity = 2 x 1.4 = 2.8 cfs
DP 32 Q_{100} = 3 cfs 3 inlets Capacity = 3 x 1.4 = 4.2 cfs

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MDDP
PIPE CALCULATIONS

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

Pipe run 1

18" RCP @ 1.00%

Inputs

Pipe diameter, d_0	18	in
Manning roughness, n	.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	43	%

Results

Flow, Q	4.0349	cfs
Velocity, v	5.5533	ft/sec
Velocity head, h_v	0.4793	ft H2O
Flow area	0.7266	ft^2
Wetted perimeter	2.1455	ft
Hydraulic radius	0.3387	ft
Top width, T	1.4852	ft
Froude number, F	1.40	
Shear stress (tractive force), tau	0.2114	psf

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 2

30" RCP" @ 0.60%

Inputs

Pipe diameter, d_0	30	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	.6	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	48.5	%

Results

Flow, Q (See notes)	15.0788	cfs
Velocity, v	6.3878	ft/sec
Velocity head, h_v	0.6342	ft H2O
Flow area	2.3607	ft^2
Wetted perimeter	3.8519	ft
Hydraulic radius	0.6128	ft
Top width, T	2.4988	ft
Froude number, F	1.16	
Average shear stress (tractive force), tau	0.2296	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Check out our spreadsheet version of this calculator Download Spreadsheet Open Google Sheets version View All Spreadsheets

Pipe run 3

18" RCP @ 2.00%

Inputs

Pipe diameter, d_0	18	in
Manning roughness, n	.013	
Pressure slope (possibly ? equal to pipe slope), S_0	2	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	52.3	%

Results

Flow, Q	8.0101	cfs
Velocity, v	8.5644	ft/sec
Velocity head, h_v	1.1400	ft H2O
Flow area	0.9353	ft^2
Wetted perimeter	2.4252	ft
Hydraulic radius	0.3857	ft
Top width, T	1.4984	ft
Froude number, F	1.91	
Shear stress (tractive force), tau	0.4815	psf

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 4

18" RCP" @ 1.90%

Inputs

Pipe diameter, d_0	18	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.9	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	57.1	%

Results

Flow, Q (See notes)	9.0044	cfs
Velocity, v	8.6352	ft/sec
Velocity head, h_v	1.1589	ft H2O
Flow area	1.0428	ft^2
Wetted perimeter	2.5699	ft
Hydraulic radius	0.4058	ft
Top width, T	1.4848	ft
Froude number, F	1.82	
Average shear stress (tractive force), tau	0.4813	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

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Pipe run 5

24" RCP @ 1.5%

Inputs

Pipe diameter, d_0	24	in
Manning roughness, n	.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.5	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	56.7	%

Results

Flow, Q	17.0392	cfs
Velocity, v	9.2708	ft/sec
Velocity head, h_v	1.3358	ft H2O
Flow area	1.8380	ft^2
Wetted perimeter	3.4104	ft
Hydraulic radius	0.5389	ft
Top width, T	1.9819	ft
Froude number, F	1.70	
Shear stress (tractive force), tau	0.5047	psf

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 6

36" RCP" @ 0.70%

Inputs

Pipe diameter, d_0	36	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	.7	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	54.3	%

Results

Flow, Q (See notes)	32.0084	cfs
Velocity, v	8.1640	ft/sec
Velocity head, h_v	1.0359	ft H2O
Flow area	3.9209	ft^2
Wetted perimeter	4.9707	ft
Hydraulic radius	0.7888	ft
Top width, T	2.9889	ft
Froude number, F	1.26	
Average shear stress (tractive force), tau	0.3447	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

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Pipe run 7

36" RCP @ 0.74%

Inputs

Pipe diameter, d_0	36	in
Manning roughness, n	.013	
Pressure slope (possibly ? equal to pipe slope), S_0	.74	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	65.7	%

Results

Flow, Q	44.0607	cfs
Velocity, v	8.9490	ft/sec
Velocity head, h_v	1.2446	ft H2O
Flow area	4.9238	ft^2
Wetted perimeter	5.6705	ft
Hydraulic radius	0.8683	ft
Top width, T	2.8482	ft
Froude number, F	1.20	
Shear stress (tractive force), tau	0.4011	psf

Manning Formula Uniform Pipe Flow at Given Slope and Depth

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Pipe run 8

18" RCP @ 1.00%

Inputs

Pipe diameter, d_0	18	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	65.4	%

Results

Flow, Q	8.0145	cfs
Velocity, v	6.5452	ft/sec
Velocity head, h_v	0.6658	ft H2O
Flow area	1.2245	ft^2
Wetted perimeter	2.8258	ft
Hydraulic radius	0.4333	ft
Top width, T	1.4271	ft
Froude number, F	1.25	
Shear stress (tractive force), tau	0.2705	psf

Manning Formula Uniform Pipe Flow at Given Slope and Depth

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Pipe run 9

18" RCP @ 1.00%

Inputs

Pipe diameter, d_0	18	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	65.4	%

Results

Flow, Q	8.0145	cfs
Velocity, v	6.5452	ft/sec
Velocity head, h_v	0.6658	ft H2O
Flow area	1.2245	ft^2
Wetted perimeter	2.8258	ft
Hydraulic radius	0.4333	ft
Top width, T	1.4271	ft
Froude number, F	1.25	
Shear stress (tractive force), tau	0.2705	psf

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 10

24" RCP" @ 0.60%

Inputs

Pipe diameter, d_0	24	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	.6	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	75.1	%

Results

Flow, Q (See notes)	16.0022	cfs
Velocity, v	6.3230	ft/sec
Velocity head, h_v	0.6214	ft H2O
Flow area	2.5309	ft^2
Wetted perimeter	4.1934	ft
Hydraulic radius	0.6035	ft
Top width, T	1.7297	ft
Froude number, F	0.92	
Average shear stress (tractive force), tau	0.2261	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Missing pipe runs for
10A, 10B & 10C

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe Run 12

24" RCP 1.00%

Inputs

Pipe diameter, d_0	24	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	49.2	%

Results

Flow, Q (See notes)	11.0036	cfs
Velocity, v	7.1510	ft/sec
Velocity head, h_v	0.7947	ft H2O
Flow area	1.5388	ft^2
Wetted perimeter	3.1096	ft
Hydraulic radius	0.4949	ft
Top width, T	1.9997	ft
Froude number, F	1.44	
Average shear stress (tractive force), tau	0.3089	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 12

24" RCP" @ 1.00%

Inputs

Pipe diameter, d_0	24	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	38.2	%

Results

Flow, Q (See notes)	7.0037	cfs
Velocity, v	6.3486	ft/sec
Velocity head, h_v	0.6264	ft H2O
Flow area	1.1032	ft^2
Wetted perimeter	2.6651	ft
Hydraulic radius	0.4139	ft
Top width, T	1.9435	ft
Froude number, F	1.49	
Average shear stress (tractive force), tau	0.2584	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Duplicate sheet for Pipe Run 12.
Please delete whichever one is not needed.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe Run 13

30" RCP 1.00%

Inputs

Pipe diameter, d_0	30	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	46.5	%

Results

Flow, Q (See notes)	18.0963	cfs
Velocity, v	8.0942	ft/sec
Velocity head, h_v	1.0182	ft H2O
Flow area	2.2358	ft^2
Wetted perimeter	3.7518	ft
Hydraulic radius	0.5959	ft
Top width, T	2.4938	ft
Froude number, F	1.51	
Average shear stress (tractive force), tau	0.3720	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 14

24" RCP" @ 1.00%

Inputs

Pipe diameter, d_0	24	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	46.6	%

Results

Flow, Q (See notes)	10.0183	cfs
Velocity, v	6.9821	ft/sec
Velocity head, h_v	0.7576	ft H2O
Flow area	1.4349	ft^2
Wetted perimeter	3.0055	ft
Hydraulic radius	0.4774	ft
Top width, T	1.9954	ft
Froude number, F	1.45	
Average shear stress (tractive force), tau	0.2981	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe Run 15

36" RCP 1.00%

Inputs

Pipe diameter, d_0	36	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	48.9	%

Results

Flow, Q (See notes)	32.1044	cfs
Velocity, v	9.3457	ft/sec
Velocity head, h_v	1.3575	ft H2O
Flow area	3.4353	ft^2
Wetted perimeter	4.6463	ft
Hydraulic radius	0.7393	ft
Top width, T	2.9992	ft
Froude number, F	1.54	
Average shear stress (tractive force), tau	0.4616	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

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Pipe run 16

18" RCP @ 17.80%

Inputs

Pipe diameter, d_0	18	in
Manning roughness, n	.013	
Pressure slope (possibly ? equal to pipe slope), S_0	17.8	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	14.7	%

Results

Flow, Q	2.0660	cfs
Velocity, v	12.7995	ft/sec
Velocity head, h_v	2.5462	ft H2O
Flow area	0.1614	ft^2
Wetted perimeter	1.1804	ft
Hydraulic radius	0.1367	ft
Top width, T	1.0623	ft
Froude number, F	5.83	
Shear stress (tractive force), tau	1.5195	psf

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe Run 17

36" RCP 0.70%

Inputs

Pipe diameter, d_0	36	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	.7	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	54.3	%

Results

Flow, Q (See notes)	32.0084	cfs
Velocity, v	8.1640	ft/sec
Velocity head, h_v	1.0359	ft H2O
Flow area	3.9209	ft^2
Wetted perimeter	4.9707	ft
Hydraulic radius	0.7888	ft
Top width, T	2.9889	ft
Froude number, F	1.26	
Average shear stress (tractive force), tau	0.3447	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Missing pipe run for 17A

Manning Formula Uniform Pipe Flow at Given Slope and Depth

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Pipe run 18

24" RCP @ 1.00%

Inputs

Pipe diameter, d_0	24	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	59.5	%

Results

Flow, Q	15.0032	cfs
Velocity, v	7.7001	ft/sec
Velocity head, h_v	0.9215	ft H2O
Flow area	1.9485	ft^2
Wetted perimeter	3.5239	ft
Hydraulic radius	0.5529	ft
Top width, T	1.9635	ft
Froude number, F	1.36	
Shear stress (tractive force), tau	0.3452	psf

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 19

18" RCP" @ 1.00%

Inputs

Pipe diameter, d_0	18	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.0	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	60	%

Results

Flow, Q (See notes)	7.0566	cfs
Velocity, v	6.3743	ft/sec
Velocity head, h_v	0.6315	ft H2O
Flow area	1.1071	ft^2
Wetted perimeter	2.6582	ft
Hydraulic radius	0.4165	ft
Top width, T	1.4697	ft
Froude number, F	1.29	
Average shear stress (tractive force), tau	0.2600	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 20

24" RCP" @ 1.00%

Inputs

Pipe diameter, d_0	24	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.0	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	73.2	%

Results

Flow, Q (See notes)	20.0390	cfs
Velocity, v	8.1319	ft/sec
Velocity head, h_v	1.0277	ft H2O
Flow area	2.4644	ft^2
Wetted perimeter	4.1066	ft
Hydraulic radius	0.6001	ft
Top width, T	1.7717	ft
Froude number, F	1.22	
Average shear stress (tractive force), tau	0.3746	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 21

18" RCP" @ 2.00%

Inputs

Pipe diameter, d_0	18	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	2	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	77.3	%

Results

Flow, Q (See notes)	14.0127	cfs
Velocity, v	9.5603	ft/sec
Velocity head, h_v	1.4205	ft H2O
Flow area	1.4658	ft^2
Wetted perimeter	3.2225	ft
Hydraulic radius	0.4548	ft
Top width, T	1.2567	ft
Froude number, F	1.56	
Average shear stress (tractive force), tau	0.5679	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 22

30" RCP @ 1.85%

Inputs

Pipe diameter, d_0	30	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.85	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	56.4	%

Results

Flow, Q (See notes)	34.0208	cfs
Velocity, v	11.9238	ft/sec
Velocity head, h_v	2.2097	ft H2O
Flow area	2.8533	ft^2
Wetted perimeter	4.2478	ft
Hydraulic radius	0.6717	ft
Top width, T	2.4794	ft
Froude number, F	1.96	
Average shear stress (tractive force), tau	0.7758	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 23

24" RCP" @ 1.00%

Inputs

Pipe diameter, d_0	24	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.0	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	62.2	%

Results

Flow, Q (See notes)	16.0460	cfs
Velocity, v	7.8127	ft/sec
Velocity head, h_v	0.9486	ft H2O
Flow area	2.0539	ft^2
Wetted perimeter	3.6345	ft
Hydraulic radius	0.5651	ft
Top width, T	1.9395	ft
Froude number, F	1.34	
Average shear stress (tractive force), tau	0.3528	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 24

24" RCP" @ 1.00%

Inputs

Pipe diameter, d_0	24	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.0	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	62.2	%

Results

Flow, Q (See notes)	16.0460	cfs
Velocity, v	7.8127	ft/sec
Velocity head, h_v	0.9486	ft H2O
Flow area	2.0539	ft^2
Wetted perimeter	3.6345	ft
Hydraulic radius	0.5651	ft
Top width, T	1.9395	ft
Froude number, F	1.34	
Average shear stress (tractive force), tau	0.3528	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 25

30" RCP" @ 1.00%

Inputs

Pipe diameter, d_0	30	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.0	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	68	%

Results

Flow, Q (See notes)	33.0363	cfs
Velocity, v	9.2943	ft/sec
Velocity head, h_v	1.3426	ft H2O
Flow area	3.5546	ft^2
Wetted perimeter	4.8476	ft
Hydraulic radius	0.7332	ft
Top width, T	2.3324	ft
Froude number, F	1.33	
Average shear stress (tractive force), tau	0.4578	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 26

36" RCP" @ 1.36%

Inputs

Pipe diameter, d_0	36	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.35	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	67.7	%

Results

Flow, Q (See notes)	62.0431	cfs
Velocity, v	12.1815	ft/sec
Velocity head, h_v	2.3062	ft H2O
Flow area	5.0934	ft^2
Wetted perimeter	5.7979	ft
Hydraulic radius	0.8785	ft
Top width, T	2.8057	ft
Froude number, F	1.59	
Average shear stress (tractive force), tau	0.7404	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

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Pipe run 27

18" RCP @ 3.00%

Inputs

Pipe diameter, d_0	18	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	3.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	39.8	%

Results

Flow, Q	6.0746	cfs
Velocity, v	9.2649	ft/sec
Velocity head, h_v	1.3341	ft H2O
Flow area	0.6557	ft^2
Wetted perimeter	2.0480	ft
Hydraulic radius	0.3201	ft
Top width, T	1.4684	ft
Froude number, F	2.45	
Shear stress (tractive force), tau	0.5996	psf

Manning Formula Uniform Pipe Flow at Given Slope and Depth

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Pipe run 28

18" RCP @ 3.00%

Inputs

Pipe diameter, d_0	18	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	3.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	43.1	%

Results

Flow, Q	7.0177	cfs
Velocity, v	9.6292	ft/sec
Velocity head, h_v	1.4411	ft H2O
Flow area	0.7288	ft^2
Wetted perimeter	2.1485	ft
Hydraulic radius	0.3392	ft
Top width, T	1.4856	ft
Froude number, F	2.42	
Shear stress (tractive force), tau	0.6353	psf

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 29

36" RCP" @ 1.67%

Inputs

Pipe diameter, d_0	36	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.67	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	69.9	%

Results

Flow, Q (See notes)	72.0225	cfs
Velocity, v	13.6493	ft/sec
Velocity head, h_v	2.8955	ft H2O
Flow area	5.2769	ft^2
Wetted perimeter	5.9403	ft
Hydraulic radius	0.8883	ft
Top width, T	2.7521	ft
Froude number, F	1.74	
Average shear stress (tractive force), tau	0.9261	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 30

24" RCP" @ 4.26%

Inputs

Pipe diameter, d_0	24	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	4.26	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	40.4	%

Results

Flow, Q (See notes)	16.0217	cfs
Velocity, v	13.4735	ft/sec
Velocity head, h_v	2.8214	ft H2O
Flow area	1.1892	ft^2
Wetted perimeter	2.7552	ft
Hydraulic radius	0.4316	ft
Top width, T	1.9628	ft
Froude number, F	3.05	
Average shear stress (tractive force), tau	1.1479	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 31

42" RCP" @ 1.00%

Inputs

Pipe diameter, d_0	42	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	69.9	%

Results

Flow, Q (See notes)	84.0687	cfs
Velocity, v	11.7053	ft/sec
Velocity head, h_v	2.1294	ft H2O
Flow area	7.1824	ft^2
Wetted perimeter	6.9304	ft
Hydraulic radius	1.0363	ft
Top width, T	3.2108	ft
Froude number, F	1.38	
Average shear stress (tractive force), tau	0.6470	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 32

18" RCP" @ 11.70%

Inputs

Pipe diameter, d_0	18	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	11.70	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	30	%

Results

Flow, Q (See notes)	7.0356	cfs
Velocity, v	15.7797	ft/sec
Velocity head, h_v	3.8699	ft H2O
Flow area	0.4459	ft^2
Wetted perimeter	1.7389	ft
Hydraulic radius	0.2564	ft
Top width, T	1.3748	ft
Froude number, F	4.90	
Average shear stress (tractive force), tau	1.8729	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 33

42" RCP" @ 1.00%

Inputs

Pipe diameter, d_0	42	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	74.5	%

Results

Flow, Q (See notes)	91.0199	cfs
Velocity, v	11.8412	ft/sec
Velocity head, h_v	2.1792	ft H2O
Flow area	7.6871	ft^2
Wetted perimeter	7.2900	ft
Hydraulic radius	1.0544	ft
Top width, T	3.0510	ft
Froude number, F	1.32	
Average shear stress (tractive force), tau	0.6583	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 34

24" RCP" @ 0.40%

Inputs

Pipe diameter, d_0	24	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	0.4	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	57.6	%

Results

Flow, Q (See notes)	9.0211	cfs
Velocity, v	4.8149	ft/sec
Velocity head, h_v	0.3603	ft H2O
Flow area	1.8736	ft^2
Wetted perimeter	3.4467	ft
Hydraulic radius	0.5436	ft
Top width, T	1.9767	ft
Froude number, F	0.87	
Average shear stress (tractive force), tau	0.1357	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 34A

30" RCP" @ 0.40%

Inputs

Pipe diameter, d_0	30	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	0.4	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	66	%

Results

Flow, Q (See notes)	20.0495	cfs
Velocity, v	5.8336	ft/sec
Velocity head, h_v	0.5289	ft H2O
Flow area	3.4371	ft^2
Wetted perimeter	4.7413	ft
Hydraulic radius	0.7249	ft
Top width, T	2.3685	ft
Froude number, F	0.85	
Average shear stress (tractive force), tau	0.1810	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 35

36" RCP @ 1.34%

Inputs

Pipe diameter, d_0	36	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.34	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	64.8	%

Results

Flow, Q (See notes)	58.1391	cfs
Velocity, v	11.9963	ft/sec
Velocity head, h_v	2.2366	ft H2O
Flow area	4.8466	ft^2
Wetted perimeter	5.6138	ft
Hydraulic radius	0.8633	ft
Top width, T	2.8655	ft
Froude number, F	1.63	
Average shear stress (tractive force), tau	0.7222	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 37

15" HDPE @ 1%

Inputs

Pipe diameter, d_0	15	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	48	%

Results

Flow, Q (See notes)	3.0116	cfs
Velocity, v	5.1715	ft/sec
Velocity head, h_v	0.4157	ft H2O
Flow area	0.5824	ft^2
Wetted perimeter	1.9135	ft
Hydraulic radius	0.3043	ft
Top width, T	1.2490	ft
Froude number, F	1.34	
Average shear stress (tractive force), tau	0.1900	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 38

15" HDPE @ 1%

Inputs

Pipe diameter, d_0	15	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	38.3	%

Results

Flow, Q (See notes)	2.0096	cfs
Velocity, v	4.6470	ft/sec
Velocity head, h_v	0.3356	ft H2O
Flow area	0.4325	ft^2
Wetted perimeter	1.6682	ft
Hydraulic radius	0.2592	ft
Top width, T	1.2153	ft
Froude number, F	1.37	
Average shear stress (tractive force), tau	0.1618	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 39

15" HDPE @ 1%

Inputs

Pipe diameter, d_0	15	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	38.3	%

Results

Flow, Q (See notes)	2.0096	cfs
Velocity, v	4.6470	ft/sec
Velocity head, h_v	0.3356	ft H2O
Flow area	0.4325	ft^2
Wetted perimeter	1.6682	ft
Hydraulic radius	0.2592	ft
Top width, T	1.2153	ft
Froude number, F	1.37	
Average shear stress (tractive force), tau	0.1618	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 40

15" HDPE @ 1%

Inputs

Pipe diameter, d_0	15	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	38.3	%

Results

Flow, Q (See notes)	2.0096	cfs
Velocity, v	4.6470	ft/sec
Velocity head, h_v	0.3356	ft H2O
Flow area	0.4325	ft^2
Wetted perimeter	1.6682	ft
Hydraulic radius	0.2592	ft
Top width, T	1.2153	ft
Froude number, F	1.37	
Average shear stress (tractive force), tau	0.1618	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

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 =	6935.82	ft. elev.
	Outlet Elevation at Culvert Invert **OR** Slope of Culvert (ft v./ft h.)	Outlet Elev =	6934.18	ft. elev.
	Culvert Length in Feet	L =	128	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 =	0.75
Sum of All Loss Coefficients	K_s =	1.95
Orifice Inlet Condition Coefficient	C_d =	0.95
Minimum Energy Condition Coefficient	KE_{low} =	-0.0310

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
6939.32		113.80	142.47	**113.80**	Regression Eqn.	INLET
6939.57		125.60	152.60	**125.60**	Regression Eqn.	INLET
6939.82		136.80	162.28	**136.80**	Regression Eqn.	INLET
6940.07		147.20	171.28	**147.20**	Regression Eqn.	INLET
6940.32		157.00	180.05	**157.00**	Regression Eqn.	INLET
6940.57		166.20	188.25	**166.20**	Regression Eqn.	INLET
6940.82		175.00	196.11	**175.00**	Regression Eqn.	INLET
6941.07		183.20	203.85	**183.20**	Regression Eqn.	INLET
6941.32		191.00	211.14	**191.00**	Regression Eqn.	INLET
6941.57		198.60	218.20	**198.60**	Regression Eqn.	INLET
6941.82		205.80	225.15	**205.80**	Regression Eqn.	INLET
6942.07		212.60	231.86	**212.60**	Regression Eqn.	INLET
6942.32		219.40	238.36	**219.40**	Regression Eqn.	INLET
6942.57		225.80	244.62	**225.80**	Regression Eqn.	INLET
6942.82		232.00	250.88	**232.00**	Regression Eqn.	INLET
6943.07		238.20	256.81	**238.20**	Regression Eqn.	INLET
6943.32		244.20	262.73	**244.20**	Regression Eqn.	INLET
6943.57		250.00	268.42	**250.00**	Regression Eqn.	INLET
6943.82		255.60	274.12	**255.60**	Regression Eqn.	INLET
6944.07		261.20	279.58	**261.20**	Regression Eqn.	INLET
6944.32		266.60	285.05	**266.60**	Regression Eqn.	INLET
6944.57		272.00	290.40	**272.00**	Regression Eqn.	INLET
6944.82		277.20	295.64	**277.20**	Regression Eqn.	INLET
6945.07		282.40	300.76	**282.40**	Regression Eqn.	INLET
6945.32		287.40	305.77	**287.40**	Regression Eqn.	INLET
6945.57		292.40	310.67	**292.40**	Regression Eqn.	INLET
6945.82		297.40	315.57	**297.40**	Regression Eqn.	INLET
6946.07		302.20	320.35	**302.20**	Regression Eqn.	INLET
6946.32		307.00	325.13	**307.00**	Regression Eqn.	INLET
6946.57		311.40	329.80	**311.40**	Orifice Eqn.	INLET

Processing Time: 27.79 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

Determination of Culvert Headwater and Outlet Protection

Project: Timberridge Estates
Basin ID: Design Point 11- Dual 42" RCP Culverts

Soil Type:
Choose One:
(●) Sandy
( ) Non-Sandy

Design Information (Input):

Design Discharge	Q =	213	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	24	inches
Inlet Edge Type (Choose from pull-down list)	Grooved End Projection		
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	Height (Rise) =		ft
Barrel Width (Span) in Feet	Width (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	No =	2	
Inlet Elevation	Elev IN =	6935.82	ft
Outlet Elevation **OR** Slope	Elev OUT =	6934.18	ft
Culvert Length	L =	128	ft
Manning's Roughness	n =	0.013	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Elev Y_t =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Required Protection (Output):

Tailwater Surface Height	Y_t =	0.80	ft
Flow Area at Max Channel Velocity	A_t =	21.28	ft^2
Culvert Cross Sectional Area Available	A =	3.14	ft^2
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	1.58	
Sum of All Losses Coefficients	k_s =	2.78	ft
Culvert Normal Depth	Y_n =	0.56	ft
Culvert Critical Depth	Y_c =	2.00	ft
Tailwater Depth for Design	d =	2.00	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	-	ft
Expansion Factor	1/(2*tan(Θ)) =	1.85	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	18.81	$ft^{0.5}/s$
Froude Number	Fr =	-	**Pressure flow!**
Tailwater/Adjusted Diameter **OR** Tailwater/Adjusted Rise	Yt/D =	0.40	
Inlet Control Headwater	HW_I =	40.47	ft
Outlet Control Headwater	HW_O =	49.90	
Design Headwater Elevation	**HW =**	**6,985.72**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**24.95**	**HW/D > 1.5!**
Minimum Theoretical Riprap Size	d_{50} =	31	in
Nominal Riprap Size	d_{50} =	-	in
UDFCD Riprap Type	**Type =**	**Very Big**	
Length of Protection	**L_p =**	**27**	**ft**
Width of Protection	**T =**	**17**	**ft**

STAGE-DISCHARGE CURVE FOR THE CULVERT
Stage (feet, elev)
6950.02
6949.02
6948.02
6947.02
6946.02
6945.02
6944.02
6943.02
6942.02
0
5
10
15
20
25
30
35
Discharge (cfs)
Stage-Discharge
Inlet Control
Outlet Control

Determination of Culvert Headwater and Outlet Protection

Project: Timberridge Estates
Basin ID: Design Point 12- 18" RCP Culvert

Missing Culvert Stage-Discharge Sizing sheet with graph. Please add back in.

Soil Type:
Choose One:
(●) Sandy
( ) Non-Sandy

Supercritical Flow! Using Da to calculate protection type.

Design Information (Input):

Design Discharge	Q =	4	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	18	inches
Inlet Edge Type (Choose from pull-down list)		Grooved End Projection	
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	Height (Rise) =		ft
Barrel Width (Span) in Feet	Width (Span) =		ft
Inlet Edge Type (Choose from pull-down list)			
Number of Barrels	No =	1	
Inlet Elevation	Elev IN =	6940.52	ft
Outlet Elevation **OR** Slope	Elev OUT =	6934.07	ft
Culvert Length	L =	200	ft
Manning's Roughness	n =	0.013	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Elev Y_t =		ft
Max Allowable Channel Velocity	V =	5	ft/s

Per hydrology spreadsheet Q is 7 cfs and 24" rcp per pipe sizing calculations.

Required Protection (Output):

Tailwater Surface Height	Y_t =	0.60	ft
Flow Area at Max Channel Velocity	A_t =	0.88	ft^2
Culvert Cross Sectional Area Available	A =	1.77	ft^2
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	3.62	
Sum of All Losses Coefficients	k_s =	4.82	ft
Culvert Normal Depth	Y_n =	0.49	ft
Culvert Critical Depth	Y_c =	0.80	ft
Tailwater Depth for Design	d =	1.15	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	1.00	ft
Expansion Factor	1/(2*tan(Θ)) =	6.70	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	1.60	$ft^{0.5}/s$
Froude Number	Fr =	2.57	**Supercritical!**
Tailwater/Adjusted Diameter **OR** Tailwater/Adjusted Rise	Yt/D =	0.60	
Inlet Control Headwater	HW_I =	1.13	ft
Outlet Control Headwater	HW_O =	-4.83	
Design Headwater Elevation	**HW =**	**6,941.65**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**0.76**	
Minimum Theoretical Riprap Size	d_{50} =	2	in
Nominal Riprap Size	d_{50} =	6	in
UDFCD Riprap Type	**Type =**	**VL**	
Length of Protection	**L_p =**	**5**	**ft**
Width of Protection	**T =**	**3**	**ft**

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:

Update to DP 36

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

Determination of Culvert Headwater and Outlet Protection

Project: Timberridge Estates
Basin ID: Design Point 30- Triple 36" RCP Culverts

Soil Type:
Choose One:
(●) Sandy
( ) Non-Sandy

Design Information (Input):

	Design Discharge	Q =	204.31	cfs
Circular Culvert:				
	Barrel Diameter in Inches	D =	36	inches
	Inlet Edge Type (Choose from pull-down list)	Grooved End Projection		
Box Culvert:		**OR**		
	Barrel Height (Rise) in Feet	Height (Rise) =		ft
	Barrel Width (Span) in Feet	Width (Span) =		ft
	Inlet Edge Type (Choose from pull-down list)			
	Number of Barrels	No =	3	
	Inlet Elevation	Elev IN =	6920	ft
	Outlet Elevation **OR** Slope	Elev OUT =	6919	ft
	Culvert Length	L =	133.5	ft
	Manning's Roughness	n =	0.013	
	Bend Loss Coefficient	k_b =	0	
	Exit Loss Coefficient	k_x =	1	
	Tailwater Surface Elevation	Elev Y_t =	6920	ft
	Max Allowable Channel Velocity	V =	5	ft/s

Required Protection (Output):

Tailwater Surface Height	Y_t =	1.00	ft
Flow Area at Max Channel Velocity	A_t =	13.62	ft^2
Culvert Cross Sectional Area Available	A =	7.07	ft^2
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	0.96	
Sum of All Losses Coefficients	k_s =	2.16	ft
Culvert Normal Depth	Y_n =	2.11	ft
Culvert Critical Depth	Y_c =	2.63	ft
Tailwater Depth for Design	d =	2.82	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	-	ft
Expansion Factor	1/(2*tan(Θ)) =	2.32	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	4.37	$ft^{0.5}/s$
Froude Number	Fr =	-	**Pressure flow!**
Tailwater/Adjusted Diameter **OR** Tailwater/Adjusted Rise	Yt/D =	0.33	
Inlet Control Headwater	HW_I =	4.99	ft
Outlet Control Headwater	HW_O =	4.93	
Design Headwater Elevation	**HW =**	**6,924.99**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**1.66**	**HW/D > 1.5!**
Minimum Theoretical Riprap Size	d_{50} =	14	in
Nominal Riprap Size	d_{50} =	18	in
UDFCD Riprap Type	**Type =**	**H**	
Length of Protection	**L_p =**	**25**	**ft**
Width of Protection	**T =**	**14**	**ft**

PDR
INLET CALCULATIONS

Figure 8-11. Inlet Capacity Chart Sump Conditions , Curb Opening (Type R) Inlet

10 cfs 16 cfs 25 cfs

DP19 Q_{100} = 5 cfs < 10 cfs → 10' Inlet ok
DP20 Q_{100} = 5 cfs < 10 cfs → 5' Inlet ok
~~DP21 Q_{100} = 6 cfs < 10 cfs~~
DP 22 Q_{100} = 7 cfs < 10 cfs → 10' Inlet ok
DP 23 Q_{100} = 1 cfs < 10 cfs → 10' Inlet ok
DP 24 Q_{100} = 6 cfs < 10 cfs → 5' Inlet ok
DP 25 Q_{100} = 5 cfs < 10 cfs → 10' Inlet ok
DP 26 Q_{100} = 16 cfs ≤ 16 cfs → 10' Inlet ok
DP 27 Q_{100} = 7 cfs < 10 cfs → 5' Inlet ok
DP28 Q_{100} = 18 cfs/2 = 9 cfs → 2-10' Inlets

Notes:

1. The standard inlet parameters must apply to use this chart.

PDR

DP21 10' Type R At-Grade
Q5 = 2 cfs Q100 = 6 cfs
Muddy Pond Slope = 1.75%

Figure 8-7. Inlet Capacity Chart Continuous Grade Conditions, Residential (Local)
(Attached and Detached Sidewalk)

Street Section Data: Street Width Flowline to Flowline = 34'
Type of Curb and Gutter: D-10-R = 8" vertical
Type 16 = 6" vertical

The standard street section parameters as defined in Chapter 7 must apply to use these charts. For non-standard sections, the inlet capacity shall be calculated using the UDFCD spreadsheets. The maximum spread width is limited by the curb height based on no curb overtopping during a minor storm and flow being contained within the public right-of-way during the major storm. Calculations were done using UD-Inlet 3.00.xls, Mar., 2011 with the default clogging factors.

PDR
PIPE CALCULATIONS

MANNING'S EQUATION for OPEN CHANNEL FLOW

Project:	**WATERBURY 1&2 MDP/PDR**	Location:	DP-PRE5 DIVERSIONS SWALE E-E PDR
By:	QNA	Date:	3/1/2022
Chk By:		Date:	

version 12-2004

Mannings Formula

$Q = (1.486/n)AR_h^{2/3}S^{1/2}$

R = A/P

A = cross sectional area

P= wetted perimeter

S = slope of channel

n = Manning's roughness coefficient

$V = (1.49/n)R_h^{2/3}S^{1/2}$

Q = V x A

	INPUT
z (sideslope)=	4
z (sideslope)=	4
b (btm width, ft)=	4
d (depth, ft)=	0.99
S (slope, ft/ft)	0.02
n_{low} =	0.02
n_{high} =	0.035

Clear Data Entry Cells

Depth, ft	Area, sf	Wetted Perimeter, ft	Hydraulic Radius, ft	Low N Velocity, fps	Low N Flow, cfs	High N Velocity, fps	High N Flow, cfs		
0.99	7.88	12.16	0.65	7.86716151	61.9964	4.495521	35.4265	T =	11.92
								Dm =	0.661
				Sc low =	0.0069	Sc high =	0.0210		
				.7 Sc	1.3 Sc	.7 Sc	1.3 Sc		
				0.0048	0.0089	0.0147	0.0273		

s_c = critical slope ft / ft

T = top width of the stream

d_m = a/T = mean depth of flow

Created by: Mike O'Shea

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 18 PDR

24" RCP @ 1.0%

Inputs

Pipe diameter, d_0	24	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	32	%

Results

Flow, Q (See notes)	5.0161	cfs
Velocity, v	5.7880	ft/sec
Velocity head, h_v	0.5207	ft H2O
Flow area	0.8667	ft^2
Wetted perimeter	2.4050	ft
Hydraulic radius	0.3603	ft
Top width, T	1.8659	ft
Froude number, F	1.50	
Average shear stress (tractive force), tau	0.2250	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 19 PDR

18" RCP @ 1.0%

Inputs

Pipe diameter, d_0	18	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	48.8	%

Results

Flow, Q (See notes)	5.0384	cfs
Velocity, v	5.8822	ft/sec
Velocity head, h_v	0.5378	ft H2O
Flow area	0.8566	ft^2
Wetted perimeter	2.3202	ft
Hydraulic radius	0.3692	ft
Top width, T	1.4996	ft
Froude number, F	1.37	
Average shear stress (tractive force), tau	0.2305	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 20 PDR

24" RCP @ 1.0%

Inputs

Pipe diameter, d_0	24	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	44	%

Results

Flow, Q (See notes)	9.0539	cfs
Velocity, v	6.8006	ft/sec
Velocity head, h_v	0.7188	ft H2O
Flow area	1.3314	ft^2
Wetted perimeter	2.9010	ft
Hydraulic radius	0.4589	ft
Top width, T	1.9855	ft
Froude number, F	1.46	
Average shear stress (tractive force), tau	0.2865	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 21 PDR

18" RCP @ 2.0%

Inputs

Pipe diameter, d_0	18	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	2.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	44.3	%

Results

Flow, Q (See notes)	6.0176	cfs
Velocity, v	7.9643	ft/sec
Velocity head, h_v	0.9858	ft H2O
Flow area	0.7556	ft^2
Wetted perimeter	2.1848	ft
Hydraulic radius	0.3458	ft
Top width, T	1.4902	ft
Froude number, F	1.97	
Average shear stress (tractive force), tau	0.4318	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 22 PDR

30" RCP @ 1.85%

Inputs

Pipe diameter, d_0	30	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.85	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	35.5	%

Results

Flow, Q (See notes)	15.0647	cfs
Velocity, v	9.6511	ft/sec
Velocity head, h_v	1.4476	ft H2O
Flow area	1.5610	ft^2
Wetted perimeter	3.1914	ft
Hydraulic radius	0.4891	ft
Top width, T	2.3925	ft
Froude number, F	2.11	
Average shear stress (tractive force), tau	0.5649	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 23 PDR

24" RCP @ 1.00%

Inputs

Pipe diameter, d_0	24	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	38.3	%

Results

Flow, Q (See notes)	7.0376	cfs
Velocity, v	6.3570	ft/sec
Velocity head, h_v	0.6281	ft H2O
Flow area	1.1071	ft^2
Wetted perimeter	2.6692	ft
Hydraulic radius	0.4148	ft
Top width, T	1.9445	ft
Froude number, F	1.49	
Average shear stress (tractive force), tau	0.2589	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 24 PDR

24" RCP @ 1.00%

Inputs

Pipe diameter, d_0	24	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	14.5	%

Results

Flow, Q (See notes)	1.0252	cfs
Velocity, v	3.6443	ft/sec
Velocity head, h_v	0.2064	ft H2O
Flow area	0.2813	ft^2
Wetted perimeter	1.5626	ft
Hydraulic radius	0.1800	ft
Top width, T	1.4084	ft
Froude number, F	1.44	
Average shear stress (tractive force), tau	0.1124	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 25 PDR

30" RCP @ 1.00%

Inputs

Pipe diameter, d_0	30	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	28	%

Results

Flow, Q (See notes)	7.0227	cfs
Velocity, v	6.2419	ft/sec
Velocity head, h_v	0.6055	ft H2O
Flow area	1.1251	ft^2
Wetted perimeter	2.7880	ft
Hydraulic radius	0.4036	ft
Top width, T	2.2450	ft
Froude number, F	1.55	
Average shear stress (tractive force), tau	0.2519	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 26 PDR

36" RCP @ 1.00%

Inputs

Pipe diameter, d_0	36	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.35	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	36.5	%

Results

Flow, Q (See notes)	22.0448	cfs
Velocity, v	9.4445	ft/sec
Velocity head, h_v	1.3863	ft H2O
Flow area	2.3342	ft^2
Wetted perimeter	3.8922	ft
Hydraulic radius	0.5997	ft
Top width, T	2.8886	ft
Froude number, F	1.85	
Average shear stress (tractive force), tau	0.5054	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 27 PDR

18" RCP @ 1.00%

Inputs

Pipe diameter, d_0	18	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	54.2	%

Results

Flow, Q (See notes)	6.0071	cfs
Velocity, v	6.1426	ft/sec
Velocity head, h_v	0.5864	ft H2O
Flow area	0.9780	ft^2
Wetted perimeter	2.4823	ft
Hydraulic radius	0.3940	ft
Top width, T	1.4947	ft
Froude number, F	1.34	
Average shear stress (tractive force), tau	0.2460	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 28 PDR

18" RCP @ 1.00%

Inputs

Pipe diameter, d_0	18	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	48.7	%

Results

Flow, Q (See notes)	5.0207	cfs
Velocity, v	5.8770	ft/sec
Velocity head, h_v	0.5368	ft H2O
Flow area	0.8543	ft^2
Wetted perimeter	2.3172	ft
Hydraulic radius	0.3687	ft
Top width, T	1.4995	ft
Froude number, F	1.37	
Average shear stress (tractive force), tau	0.2302	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 29 PDR

36" RCP @ 1.00%

Inputs

Pipe diameter, d_0	36	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.67	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	42.2	%

Results

Flow, Q (See notes)	32.0090	cfs
Velocity, v	11.2904	ft/sec
Velocity head, h_v	1.9812	ft H2O
Flow area	2.8352	ft^2
Wetted perimeter	4.2424	ft
Hydraulic radius	0.6683	ft
Top width, T	2.9632	ft
Froude number, F	2.04	
Average shear stress (tractive force), tau	0.6967	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 30 PDR

24" RCP @ 4.26%

Inputs

Pipe diameter, d_0	24	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	4.26	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	40.4	%

Results

Flow, Q (See notes)	16.0217	cfs
Velocity, v	13.4735	ft/sec
Velocity head, h_v	2.8214	ft H2O
Flow area	1.1892	ft^2
Wetted perimeter	2.7552	ft
Hydraulic radius	0.4316	ft
Top width, T	1.9628	ft
Froude number, F	3.05	
Average shear stress (tractive force), tau	1.1479	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 31 PDR

42" RCP @ 1.00%

Inputs

Pipe diameter, d_0	42	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	48.1	%

Results

Flow, Q (See notes)	47.0731	cfs
Velocity, v	10.2831	ft/sec
Velocity head, h_v	1.6434	ft H2O
Flow area	4.5779	ft^2
Wetted perimeter	5.3647	ft
Hydraulic radius	0.8533	ft
Top width, T	3.4974	ft
Froude number, F	1.58	
Average shear stress (tractive force), tau	0.5327	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 32 PDR

18" RCP @ 11.70%

Inputs

Pipe diameter, d_0	18	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	11.7	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	30	%

Results

Flow, Q (See notes)	7.0356	cfs
Velocity, v	15.7797	ft/sec
Velocity head, h_v	3.8699	ft H2O
Flow area	0.4459	ft^2
Wetted perimeter	1.7389	ft
Hydraulic radius	0.2564	ft
Top width, T	1.3748	ft
Froude number, F	4.90	
Average shear stress (tractive force), tau	1.8729	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

Manning Formula Uniform Pipe Flow at Given Slope and Depth

Pipe run 33 PDR

42" RCP @ 1.00%

Inputs

Pipe diameter, d_0	42	in
Manning roughness, n	0.013	
Pressure slope (possibly ? equal to pipe slope), S_0	1.00	% rise/run
Percent of (or ratio to) full depth (100% or 1 if flowing full)	52.8	%

Results

Flow, Q (See notes)	55.1123	cfs
Velocity, v	10.6947	ft/sec
Velocity head, h_v	1.7776	ft H2O
Flow area	5.1534	ft^2
Wetted perimeter	5.6938	ft
Hydraulic radius	0.9051	ft
Top width, T	3.4945	ft
Froude number, F	1.55	
Average shear stress (tractive force), tau	0.5650	psf

Notes:

This is the flow and depth *inside* the pipe.
Getting the flow into the pipe may require significantly higher headwater depth. Add at least 1.5 times the velocity head to get the headwater depth or see my 2-minute tutorial for standard culvert headwater calculations using HY-8.

MDDP
FULL SPECTRUM DETENTION & WATER QUALITY CALCULATIONS

POND TRIBUTARY AREA

POND 1 TRIB AREA (DP 8)	**21.12** AC	BASINS A, B1, B2, C, D ,E, F, H, G1, G2, & K	DCIA	5.03
			UIA	6.92
			RPA	1.24
			SPA	7.94
			Total	**21.12**
POND 2 TRIB AREA (DP 18)	**20.31** AC	BASINS L1, L2, O1, O2, O-3, O-4 & OS-4	DCIA	2.34
			UIA	3.23
			RPA	0.19
			SPA	14.55
			Total	**20.31**
POND 3 TRIB AREA (DP 29)	**82.02** AC	BASINS Q1, Q2, R, S1, S2, T1, T2, U1, U2, V, W, X, 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	8.68
			SPA	31.74
			Total	**82.02**

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:	**March 2, 2022**
Project:	**WATERBURY FILING 1 POND 1**
Location:	**POND 1 Design Point 8 Full Spectrum Detention**

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**DP 8 FSD**													
Receiving Pervious Area Soil Type	Loamy Sand													
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	21.12													
Directly Connected Impervious Area (DCIA, acres)	5.03													
Unconnected Impervious Area (UIA, acres)	6.92													
Receiving Pervious Area (RPA, acres)	1.24													
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)	21.124													
Directly Connected Impervious Area (DCIA, %)	23.8%													
Unconnected Impervious Area (UIA, %)	32.7%													
Receiving Pervious Area (RPA, %)	5.9%													
Separate Pervious Area (SPA, %)	37.6%													
A_R (RPA / UIA)	0.179													
I_a Check	0.850													
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:	0.83													
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}	56.6%													
Effective Imperviousness for WQCV Event:	51.0%													
Effective Imperviousness for 5-Year Event:	55.1%													
Effective Imperviousness for 100-Year Event:	55.5%													
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	7.2%	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:	1.8%	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:	**51.0%**
Total Site Effective Imperviousness for 5-Year Event:	**55.1%**
Total Site Effective Imperviousness for 100-Year Event:	**55.5%**
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

Do not include SDI sheets in the report.

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 =	21.12	acres
Watershed Imperviousness =	55.5%	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	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 =	0.391	0.953	1.250	1.532	2.312	2.808	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.391	0.953	1.249	1.531	2.311	2.807	acre-ft
Time to Drain 97% of Inflow Volume =	43.4	64.2	**66.8**	65.4	61.5	59.3	hours
Time to Drain 99% of Inflow Volume =	46.2	69.0	72.7	72.1	70.6	**69.9**	hours
Maximum Ponding Depth =	1.72	2.81	3.12	3.30	3.77	4.17	ft
Maximum Ponded Area =	0.38	0.60	0.66	0.69	0.79	**0.87**	acres
Maximum Volume Stored =	0.355	0.887	1.079	1.199	1.553	1.881	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)

check these - see comment next sheet

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	21.12	acres
Watershed Length =	1,935	ft
Watershed Length to Centroid =	800	ft
Watershed Slope =	0.012	ft/ft
Watershed Imperviousness =	55.12%	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) =	0.391	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.392	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.043	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.379	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.648	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	2.039	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.423	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.902	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	3.700	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	0.900	acre-feet		
Approximate 5-yr Detention Volume =	1.181	acre-feet		
Approximate 10-yr Detention Volume =	1.434	acre-feet		
Approximate 25-yr Detention Volume =	1.743	acre-feet		
Approximate 50-yr Detention Volume =	1.935	acre-feet		
Approximate 100-yr Detention Volume =	2.154	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.391	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.002	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.762	acre-feet
Total Detention Basin Volume =	2.154	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	--	--	--	3,201	0.073	412	0.009
6924.00	--	0.50	--	--	--	6,302	0.145	1,600	0.037
6924.25	--	0.75	--	--	--	8,582	0.197	3,461	0.079
6924.50	--	1.00	--	--	--	10,862	0.249	5,891	0.135
6924.75	--	1.25	--	--	--	13,142	0.302	8,892	0.204
6925.00	--	1.50	--	--	--	15,422	0.354	12,462	0.286
6925.25	--	1.75	--	--	--	17,702	0.406	16,603	0.381
6925.50	--	2.00	--	--	--	19,981	0.459	21,313	0.489
6925.75	--	2.25	--	--	--	22,262	0.511	26,593	0.611
6926.00	--	2.50	--	--	--	24,542	0.563	32,444	0.745
6926.25	--	2.75	--	--	--	26,599	0.611	38,837	0.892
6926.50	--	3.00	--	--	--	28,655	0.658	45,743	1.050
6926.75	--	3.25	--	--	--	30,713	0.705	53,164	1.220
6927.00	--	3.50	--	--	--	32,770	0.752	61,100	1.403
6927.25	--	3.75	--	--	--	34,826	0.799	69,549	1.597
6927.50	--	4.00	--	--	--	36,883	0.847	78,513	1.802
6927.75	--	4.25	--	--	--	38,940	0.894	87,991	2.020
6928.00	--	4.50	--	--	--	40,997	0.941	97,983	2.249
6928.25	--	4.75	--	--	--	43,397	0.996	108,532	2.492
6928.50	--	5.00	--	--	--	45,797	1.051	119,681	2.748
6928.75	--	5.25	--	--	--	48,198	1.106	131,431	3.017
6929.00	--	5.50	--	--	--	50,598	1.162	143,780	3.301
6929.25	--	5.75	--	--	--	52,988	1.216	156,728	3.598
6929.50	--	6.00	--	--	--	55,398	1.272	170,277	3.909
6929.75	--	6.25	--	--	--	57,798	1.327	184,426	4.234
6930.00	--	6.50	--	--	--	60,198	1.382	199,176	4.572

Length, Width (ft.)
Area (sq.ft.)
Stage (ft)
20
15
10
5
0
60400
45300
30200
15100
0
0.00
2.00
4.00
6.00
8.00
Length (ft)
Width (ft)
Area (sq.ft.)

Area (acres)
Volume (ac-ft)
Stage (ft.)
1.400
1.050
0.700
0.350
0.000
4.580
3.435
2.290
1.145
0.000
0.00
2.00
4.00
6.00
8.00
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)	1.78	0.391	Orifice Plate
Zone 2 (EURV)	3.49	1.002	Orifice Plate
Zone 3 (100-year)	4.40	0.762	Weir&Pipe (Restrict)
Total (all zones)		2.154	

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 =	2.111E-02	ft^2
Depth at top of Zone using Orifice Plate =	3.49	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	14.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	3.04	sq. inches (diameter = 1-15/16 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	1.16	2.33					
Orifice Area (sq. inches)	3.04	3.04	3.04					

	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 =	3.49	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 =	3.49	N/A	feet
Overflow Weir Slope Length =	4.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	13.35	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 =	0.10	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	7.50		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.84	N/A	ft^2
Outlet Orifice Centroid =	0.37	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.19	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	30.00	feet
Spillway End Slopes =	3.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.55	feet
Stage at Top of Freeboard =	6.05	feet
Basin Area at Top of Freeboard =	1.28	acres
Basin Volume at Top of Freeboard =	3.97	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) =	0.391	1.392	1.043	1.379	1.648	2.039	2.423	2.902	3.700
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.043	1.379	1.648	2.039	2.423	2.902	3.700
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.2	0.3	2.7	5.5	9.2	15.0
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	0.26	0.43	0.71
Peak Inflow Q (cfs) =	N/A	N/A	12.3	16.3	19.4	25.9	31.5	38.5	49.3
Peak Outflow Q (cfs) =	0.2	0.5	0.4	0.4	2.0	6.0	7.8	8.2	18.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.0	6.8	2.2	1.4	0.9	1.2
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.1	0.5	0.6	0.7	0.7
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	69	62	70	72	70	69	67	64
Time to Drain 99% of Inflow Volume (hours) =	**40**	74	66	75	78	77	77	76	75
Maximum Ponding Depth (ft) =	1.78	3.49	2.89	3.36	3.62	3.78	3.97	4.36	4.72
Area at Maximum Ponding Depth (acres) =	0.41	0.75	0.64	0.73	0.77	0.81	0.84	0.91	0.99
Maximum Volume Stored (acre-ft) =	0.393	1.395	0.973	1.299	1.487	1.621	1.769	2.119	2.452

59 calculated - check sheet input to approximate that minus IRF %

Should be <1

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	0.14	0.01	0.36
	0:15:00	0.00	0.00	1.27	2.06	2.56	1.72	2.17	2.11	2.87
	0:20:00	0.00	0.00	4.67	6.18	7.30	4.63	5.43	5.79	7.21
	0:25:00	0.00	0.00	9.82	13.21	16.06	9.78	11.24	12.16	15.44
	0:30:00	0.00	0.00	12.29	16.34	19.43	20.97	25.56	29.23	37.82
	0:35:00	0.00	0.00	12.13	15.88	18.70	25.76	31.32	38.03	48.76
	0:40:00	0.00	0.00	11.34	14.60	17.12	25.93	31.51	38.48	49.29
	0:45:00	0.00	0.00	10.23	13.28	15.61	23.94	28.99	36.20	46.51
	0:50:00	0.00	0.00	9.29	12.21	14.23	22.06	26.58	33.10	42.66
	0:55:00	0.00	0.00	8.49	11.16	13.04	19.82	23.78	29.92	38.50
	1:00:00	0.00	0.00	7.75	10.14	11.91	17.83	21.29	27.24	35.01
	1:05:00	0.00	0.00	7.08	9.22	10.89	16.05	19.09	24.86	31.99
	1:10:00	0.00	0.00	6.34	8.50	10.10	14.17	16.76	21.56	27.63
	1:15:00	0.00	0.00	5.78	7.91	9.62	12.61	14.85	18.67	23.84
	1:20:00	0.00	0.00	5.35	7.34	9.02	11.29	13.26	16.20	20.62
	1:25:00	0.00	0.00	4.95	6.80	8.23	10.19	11.92	14.15	17.94
	1:30:00	0.00	0.00	4.59	6.30	7.47	9.07	10.58	12.38	15.62
	1:35:00	0.00	0.00	4.23	5.81	6.75	8.01	9.31	10.76	13.52
	1:40:00	0.00	0.00	3.87	5.15	6.07	7.03	8.12	9.24	11.55
	1:45:00	0.00	0.00	3.52	4.50	5.44	6.10	7.02	7.83	9.71
	1:50:00	0.00	0.00	3.24	3.95	4.91	5.27	6.01	6.55	8.06
	1:55:00	0.00	0.00	2.84	3.57	4.51	4.56	5.16	5.47	6.65
	2:00:00	0.00	0.00	2.53	3.29	4.14	4.10	4.62	4.77	5.78
	2:05:00	0.00	0.00	2.08	2.73	3.44	3.33	3.75	3.81	4.61
	2:10:00	0.00	0.00	1.68	2.21	2.78	2.65	2.98	2.99	3.59
	2:15:00	0.00	0.00	1.36	1.77	2.25	2.11	2.36	2.33	2.79
	2:20:00	0.00	0.00	1.09	1.42	1.80	1.68	1.88	1.82	2.17
	2:25:00	0.00	0.00	0.87	1.14	1.44	1.33	1.49	1.41	1.67
	2:30:00	0.00	0.00	0.69	0.90	1.13	1.04	1.17	1.09	1.28
	2:35:00	0.00	0.00	0.54	0.70	0.88	0.81	0.90	0.84	0.99
	2:40:00	0.00	0.00	0.43	0.54	0.68	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	0.28	0.32	0.30	0.35
	3:00:00	0.00	0.00	0.13	0.17	0.22	0.21	0.23	0.22	0.25
	3:05:00	0.00	0.00	0.09	0.12	0.15	0.14	0.16	0.15	0.17
	3:10:00	0.00	0.00	0.05	0.07	0.09	0.09	0.10	0.09	0.11
	3:15:00	0.00	0.00	0.03	0.04	0.05	0.05	0.05	0.05	0.06
	3:20:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.02
	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

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:	**March 2, 2022**
Project:	**WATERBURY FILING 1 POND 2**
Location:	**POND 2 Design Point 18 Full Spectrum Detention**

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**DP 18 FSD**													
Receiving Pervious Area Soil Type	Loamy Sand													
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	20.31													
Directly Connected Impervious Area (DCIA, acres)	2.34													
Unconnected Impervious Area (UIA, acres)	3.23													
Receiving Pervious Area (RPA, acres)	0.19													
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)	20.312													
Directly Connected Impervious Area (DCIA, %)	11.5%													
Unconnected Impervious Area (UIA, %)	15.9%													
Receiving Pervious Area (RPA, %)	0.9%													
Separate Pervious Area (SPA, %)	71.6%													
A_R (RPA / UIA)	0.058													
I_a Check	0.940													
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:	0.93													
IRF for 5-Year Event:	0.98													
IRF for 100-Year Event:	0.99													
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	27.4%													
Effective Imperviousness for WQCV Event:	26.4%													
Effective Imperviousness for 5-Year Event:	27.2%													
Effective Imperviousness for 100-Year Event:	27.2%													
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	2.6%	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:	0.8%	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:	**27.4%**
Total Site Effective Imperviousness for WQCV Event:	**26.4%**
Total Site Effective Imperviousness for 5-Year Event:	**27.2%**
Total Site Effective Imperviousness for 100-Year Event:	**27.2%**
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 =	27.2%	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 =	0.261	0.389	0.519	0.657	1.228	1.712	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	0.260	0.389	0.519	0.657	1.227	1.711	acre-ft
Time to Drain 97% of Inflow Volume =	40.0	48.2	**55.6**	54.6	49.6	45.9	hours
Time to Drain 99% of Inflow Volume =	42.6	51.7	60.0	59.6	57.5	**55.8**	hours
Maximum Ponding Depth =	2.20	2.64	3.01	3.15	3.48	3.84	ft
Maximum Ponded Area =	0.25	0.31	0.37	0.41	0.52	**0.64**	acres
Maximum Volume Stored =	0.239	0.362	0.488	0.544	0.699	0.908	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 =	20.31	acres
Watershed Length =	1,425	ft
Watershed Length to Centroid =	650	ft
Watershed Slope =	0.014	ft/ft
Watershed Imperviousness =	27.24%	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) =	0.241	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.538	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.367	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.510	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.634	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.970	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.282	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.703	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	2.391	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	0.337	acre-feet		
Approximate 5-yr Detention Volume =	0.451	acre-feet		
Approximate 10-yr Detention Volume =	0.566	acre-feet		
Approximate 25-yr Detention Volume =	0.719	acre-feet		
Approximate 50-yr Detention Volume =	0.838	acre-feet		
Approximate 100-yr Detention Volume =	1.041	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.241	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.297	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.503	acre-feet
Total Detention Basin Volume =	1.041	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
0.000
Area (acres)
4.660
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)	2.21	0.241	Orifice Plate
Zone 2 (EURV)	3.13	0.297	Orifice Plate
Zone 3 (100-year)	4.03	0.503	Weir&Pipe (Restrict)
Total (all zones)		1.041	

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 =	3.13	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	12.50	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	1.04	2.09					
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 =	3.13	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 =	3.13	N/A	feet
Overflow Weir Slope Length =	4.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	9.90	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 =	0.25	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 =	11.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.13	N/A	ft^2
Outlet Orifice Centroid =	0.52	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.79	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=	0.46	feet
Spillway Crest Length =	20.00	feet	Stage at Top of Freeboard =	6.46	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 =	3.76	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) =	0.241	0.538	0.367	0.510	0.634	0.970	1.282	1.703	2.391
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.367	0.510	0.634	0.970	1.282	1.703	2.391
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.1	0.3	0.4	3.4	6.8	11.0	17.9
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	0.33	0.54	0.88
Peak Inflow Q (cfs) =	N/A	N/A	3.6	5.2	6.4	11.0	14.9	19.9	27.7
Peak Outflow Q (cfs) =	0.1	0.2	0.2	0.2	0.8	4.1	7.5	10.1	10.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.7	2.2	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	0.1	0.4	0.6	0.9	0.9
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	56	47	56	59	56	54	51	47
Time to Drain 99% of Inflow Volume (hours) =	**40**	61	51	60	64	63	62	60	58
Maximum Ponding Depth (ft) =	2.21	3.13	2.54	2.96	3.20	3.37	3.48	3.69	4.24
Area at Maximum Ponding Depth (acres) =	0.25	0.41	0.30	0.36	0.43	0.49	0.53	0.60	0.78
Maximum Volume Stored (acre-ft) =	0.243	0.538	0.334	0.470	0.564	0.641	0.702	0.820	1.198

(same comment as Pond 1 - should be closer to 29 cfs minus IRF %)

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	0.26	0.42	0.52	0.35	0.45	0.43	0.59
	0:20:00	0.00	0.00	0.96	1.26	1.50	0.95	1.12	1.19	1.49
	0:25:00	0.00	0.00	2.56	3.85	4.92	2.41	3.06	3.43	4.64
	0:30:00	0.00	0.00	3.57	5.12	6.34	7.43	10.32	12.72	18.18
	0:35:00	0.00	0.00	3.65	5.17	6.41	10.29	13.96	18.52	25.73
	0:40:00	0.00	0.00	3.52	4.90	6.04	10.96	14.92	19.90	27.70
	0:45:00	0.00	0.00	3.26	4.54	5.59	10.49	14.19	19.43	27.24
	0:50:00	0.00	0.00	3.03	4.23	5.18	9.91	13.31	18.15	25.71
	0:55:00	0.00	0.00	2.82	3.93	4.80	9.09	12.18	16.76	23.71
	1:00:00	0.00	0.00	2.64	3.67	4.48	8.34	11.14	15.49	21.92
	1:05:00	0.00	0.00	2.50	3.46	4.25	7.70	10.27	14.42	20.52
	1:10:00	0.00	0.00	2.34	3.27	4.04	7.07	9.40	13.10	18.66
	1:15:00	0.00	0.00	2.16	3.04	3.85	6.48	8.61	11.86	16.89
	1:20:00	0.00	0.00	1.99	2.80	3.55	5.87	7.76	10.57	15.02
	1:25:00	0.00	0.00	1.82	2.56	3.23	5.27	6.93	9.34	13.24
	1:30:00	0.00	0.00	1.68	2.35	2.92	4.67	6.11	8.17	11.54
	1:35:00	0.00	0.00	1.58	2.21	2.72	4.13	5.38	7.13	10.06
	1:40:00	0.00	0.00	1.51	2.08	2.57	3.75	4.87	6.39	9.00
	1:45:00	0.00	0.00	1.45	1.95	2.44	3.47	4.48	5.83	8.16
	1:50:00	0.00	0.00	1.39	1.83	2.31	3.22	4.13	5.33	7.43
	1:55:00	0.00	0.00	1.29	1.72	2.17	2.98	3.81	4.87	6.75
	2:00:00	0.00	0.00	1.18	1.59	2.01	2.76	3.50	4.43	6.11
	2:05:00	0.00	0.00	1.04	1.40	1.77	2.43	3.09	3.89	5.36
	2:10:00	0.00	0.00	0.90	1.22	1.52	2.11	2.67	3.37	4.63
	2:15:00	0.00	0.00	0.77	1.04	1.29	1.81	2.28	2.87	3.93
	2:20:00	0.00	0.00	0.65	0.87	1.08	1.51	1.89	2.38	3.25
	2:25:00	0.00	0.00	0.53	0.71	0.88	1.23	1.53	1.91	2.59
	2:30:00	0.00	0.00	0.42	0.56	0.70	0.96	1.18	1.46	1.96
	2:35:00	0.00	0.00	0.33	0.43	0.55	0.72	0.86	1.03	1.37
	2:40:00	0.00	0.00	0.27	0.35	0.45	0.52	0.61	0.71	0.94
	2:45:00	0.00	0.00	0.22	0.30	0.38	0.39	0.46	0.51	0.68
	2:50:00	0.00	0.00	0.19	0.25	0.32	0.31	0.36	0.39	0.51
	2:55:00	0.00	0.00	0.16	0.21	0.27	0.25	0.29	0.30	0.39
	3:00:00	0.00	0.00	0.13	0.17	0.22	0.20	0.23	0.23	0.29
	3:05:00	0.00	0.00	0.11	0.14	0.18	0.17	0.19	0.18	0.22
	3:10:00	0.00	0.00	0.09	0.12	0.15	0.14	0.15	0.14	0.17
	3:15:00	0.00	0.00	0.08	0.10	0.12	0.11	0.12	0.11	0.13
	3:20:00	0.00	0.00	0.06	0.08	0.10	0.09	0.10	0.09	0.11
	3:25:00	0.00	0.00	0.05	0.06	0.08	0.07	0.08	0.07	0.09
	3:30:00	0.00	0.00	0.04	0.05	0.06	0.06	0.06	0.06	0.07
	3:35:00	0.00	0.00	0.03	0.04	0.05	0.04	0.05	0.04	0.05
	3:40:00	0.00	0.00	0.02	0.03	0.03	0.03	0.04	0.03	0.04
	3:45:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	3:50:00	0.00	0.00	0.01	0.01	0.02	0.01	0.02	0.01	0.02
	3:55:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: **WATERBURY**

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

Delete duplicate sheets or relabel if this is different

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 = 0

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
0.000
Area (acres)
4.660
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:	**March 3, 2022**
Project:	**WATERBURY FILING 1 POND 3**
Location:	**POND 3 Design Point 29 Full Spectrum Detention**

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**DP 29 FSD**													
Receiving Pervious Area Soil Type	Loamy Sand													
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	82.02													
Directly Connected Impervious Area (DCIA, acres)	19.50													
Unconnected Impervious Area (UIA, acres)	22.09													
Receiving Pervious Area (RPA, acres)	8.68													
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)	82.016													
Directly Connected Impervious Area (DCIA, %)	23.8%													
Unconnected Impervious Area (UIA, %)	26.9%													
Receiving Pervious Area (RPA, %)	10.6%													
Separate Pervious Area (SPA, %)	38.7%													
A_R (RPA / UIA)	0.393													
I_a Check	0.720													
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:	0.73													
IRF for 5-Year Event:	0.93													
IRF for 100-Year Event:	0.95													
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	50.7%													
Effective Imperviousness for WQCV Event:	43.5%													
Effective Imperviousness for 5-Year Event:	48.8%													
Effective Imperviousness for 100-Year Event:	49.3%													
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	9.2%	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:	2.8%	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:	**50.7%**
Total Site Effective Imperviousness for WQCV Event:	**43.5%**
Total Site Effective Imperviousness for 5-Year Event:	**48.8%**
Total Site Effective Imperviousness for 100-Year Event:	**49.3%**
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 =	49.3%	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 =	1.441	3.266	4.295	5.293	8.263	10.226	acre-ft
OPTIONAL Override Runoff Volume =							acre-ft
Inflow Hydrograph Volume =	1.441	3.265	4.295	5.291	8.258	10.218	acre-ft
Time to Drain 97% of Inflow Volume =	42.4	62.8	**62.5**	60.9	56.4	53.8	hours
Time to Drain 99% of Inflow Volume =	45.0	67.4	68.2	67.6	65.8	**64.6**	hours
Maximum Ponding Depth =	3.15	4.53	4.91	5.17	5.77	6.25	ft
Maximum Ponded Area =	1.00	1.50	1.59	1.66	1.80	**1.89**	acres
Maximum Volume Stored =	1.350	3.111	3.701	4.123	5.152	6.062	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 =	82.02	acres
Watershed Length =	2,265	ft
Watershed Length to Centroid =	850	ft
Watershed Slope =	0.022	ft/ft
Watershed Imperviousness =	49.28%	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) =	1.396	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	4.641	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	3.480	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	4.628	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	5.544	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	7.011	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	8.441	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	10.262	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3 in.) =	13.270	acre-feet	3.00	inches
Approximate 2-yr Detention Volume =	2.982	acre-feet		
Approximate 5-yr Detention Volume =	3.927	acre-feet		
Approximate 10-yr Detention Volume =	4.796	acre-feet		
Approximate 25-yr Detention Volume =	5.873	acre-feet		
Approximate 50-yr Detention Volume =	6.560	acre-feet		
Approximate 100-yr Detention Volume =	7.405	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.396	acre-feet
Zone 2 Volume (EURV - Zone 1) =	3.245	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	2.764	acre-feet
Total Detention Basin Volume =	7.405	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	--	--	--	10,844	0.249	5,470	0.126
6923.25	--	1.25	--	--	--	13,525	0.310	8,516	0.196
6923.50	--	1.50	--	--	--	16,210	0.372	12,233	0.281
6923.75	--	1.75	--	--	--	18,895	0.434	16,621	0.382
6924.00	--	2.00	--	--	--	21,580	0.495	21,681	0.498
6924.25	--	2.25	--	--	--	29,550	0.678	28,072	0.644
6924.50	--	2.50	--	--	--	37,520	0.861	36,456	0.837
6924.75	--	2.75	--	--	--	45,490	1.044	46,832	1.075
6925.00	--	3.00	--	--	--	53,460	1.227	59,201	1.359
6925.25	--	3.25	--	--	--	61,430	1.410	73,562	1.689
6925.50	--	3.50	--	--	--	69,399	1.593	89,915	2.064
6925.75	--	3.75	--	--	--	77,369	1.776	108,261	2.485
6926.00	--	4.00	--	--	--	85,339	1.959	128,600	2.952
6926.25	--	4.25	--	--	--	86,506	1.986	150,081	3.445
6926.50	--	4.50	--	--	--	87,672	2.013	171,853	3.945
6926.75	--	4.75	--	--	--	88,389	2.029	193,860	4.450
6927.00	--	5.00	--	--	--	90,005	2.066	216,160	4.962
6927.25	--	5.25	--	--	--	91,172	2.093	238,807	5.482
6927.50	--	5.50	--	--	--	92,338	2.120	261,746	6.009
6927.75	--	5.75	--	--	--	93,505	2.147	284,976	6.542
6928.00	--	6.00	--	--	--	94,671	2.173	308,498	7.082
6928.25	--	6.25	--	--	--	95,873	2.201	332,316	7.629
6928.50	--	6.50	--	--	--	97,075	2.229	356,434	8.183
6928.75	--	6.75	--	--	--	98,726	2.266	380,910	8.744
6929.00	--	7.00	--	--	--	99,478	2.284	405,685	9.313
6929.25	--	7.25	--	--	--	100,680	2.311	430,705	9.888
6929.50	--	7.50	--	--	--	101,881	2.339	456,025	10.469
6929.75	--	7.75	--	--	--	103,083	2.366	481,645	11.057
6930.00	--	8.00	--	--	--	104,825	2.406	507,634	11.654

20
15
10
5
0
Length, Width (ft.)
105200
78900
52600
26300
0
Area (sq.ft.)
0.00
2.00
4.00
6.00
8.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)

2.420
1.815
1.210
0.605
0.000
Area (acres)
11.660
8.745
5.830
2.915
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)	3.04	1.396	Orifice Plate
Zone 2 (EURV)	4.85	3.245	Orifice Plate
Zone 3 (100-year)	6.15	2.764	Weir&Pipe (Restrict)
Total (all zones)		7.405	

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 =	4.778E-02	ft^2
Depth at top of Zone using Orifice Plate =	4.85	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	19.40	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	6.88	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	1.62	3.23					
Orifice Area (sq. inches)	6.88	6.88	6.88					

	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 =	4.85	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	7.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	7.00	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 =	4.85	N/A	feet
Overflow Weir Slope Length =	7.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	6.25	N/A	
Overflow Grate Open Area w/o Debris =	34.30	N/A	ft^2
Overflow Grate Open Area w/ Debris =	17.15	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 =	26.10		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	5.49	N/A	ft^2
Outlet Orifice Centroid =	1.21	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.04	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.20	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.91	feet
Spillway Crest Length =	75.00	feet	Stage at Top of Freeboard =	8.00	feet
Spillway End Slopes =	3.00	H:V	Basin Area at Top of Freeboard =	2.41	acres
Freeboard above Max Water Surface =	0.89	feet	Basin Volume at Top of Freeboard =	11.65	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) =	1.396	4.641	3.480	4.628	5.544	7.011	8.441	10.262	13.270
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	3.480	4.628	5.544	7.011	8.441	10.262	13.270
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.8	1.5	2.1	19.5	38.7	63.3	100.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.02	0.03	0.24	0.47	0.77	1.23
Peak Inflow Q (cfs) =	N/A	N/A	60.8	81.5	97.1	132.0	163.4	204.3	265.1
Peak Outflow Q (cfs) =	0.7	1.2	1.1	1.2	7.2	19.7	37.4	58.1	101.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	3.4	1.0	1.0	0.9	1.0
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	0.5	1.1	1.7	1.7
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	73	63	73	76	74	72	70	67
Time to Drain 99% of Inflow Volume (hours) =	**40**	78	67	78	82	81	80	79	78
Maximum Ponding Depth (ft) =	3.03	4.85	4.18	4.74	5.06	5.30	5.56	5.94	6.51
Area at Maximum Ponding Depth (acres) =	1.25	2.04	1.98	2.03	2.07	2.10	2.13	2.17	2.23
Maximum Volume Stored (acre-ft) =	1.396	4.654	3.307	4.430	5.087	5.587	6.115	6.930	8.205

(same comment as Pond 1 - should be closer to 88 cfs minus IRF %)

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	0.83	0.08	2.09
	0:15:00	0.00	0.00	7.26	11.80	14.69	9.91	12.40	12.14	16.27
	0:20:00	0.00	0.00	25.84	33.86	39.93	25.25	29.41	31.61	38.94
	0:25:00	0.00	0.00	51.92	71.23	87.34	51.44	59.65	65.08	83.29
	0:30:00	0.00	0.00	60.78	81.53	97.10	114.81	143.33	166.86	220.00
	0:35:00	0.00	0.00	53.62	70.13	82.33	131.98	163.37	204.31	265.10
	0:40:00	0.00	0.00	45.21	57.76	67.52	118.82	146.82	184.31	238.98
	0:45:00	0.00	0.00	36.55	47.45	55.70	98.34	120.90	156.32	204.07
	0:50:00	0.00	0.00	29.88	39.62	45.73	82.26	100.19	128.64	168.93
	0:55:00	0.00	0.00	25.56	33.80	39.32	65.76	79.24	103.49	135.20
	1:00:00	0.00	0.00	22.27	29.16	34.26	54.11	64.71	86.88	113.34
	1:05:00	0.00	0.00	19.24	24.96	29.56	45.42	54.02	74.77	97.93
	1:10:00	0.00	0.00	15.47	21.41	25.59	36.46	42.89	57.37	74.34
	1:15:00	0.00	0.00	12.66	18.25	23.08	28.80	33.31	42.27	53.87
	1:20:00	0.00	0.00	11.20	16.18	20.95	22.56	25.77	30.15	38.14
	1:25:00	0.00	0.00	10.44	15.01	18.52	18.97	21.52	22.81	28.55
	1:30:00	0.00	0.00	9.98	14.26	16.71	16.16	18.26	18.57	22.91
	1:35:00	0.00	0.00	9.74	13.75	15.48	14.25	16.06	15.98	19.49
	1:40:00	0.00	0.00	9.55	12.35	14.62	13.01	14.65	14.25	17.21
	1:45:00	0.00	0.00	9.41	11.19	14.04	12.22	13.75	13.10	15.69
	1:50:00	0.00	0.00	9.32	10.38	13.62	11.67	13.11	12.33	14.68
	1:55:00	0.00	0.00	8.07	9.80	12.95	11.32	12.73	11.96	14.23
	2:00:00	0.00	0.00	6.99	9.10	11.71	11.11	12.49	11.83	14.07
	2:05:00	0.00	0.00	5.05	6.62	8.41	8.10	9.09	8.63	10.25
	2:10:00	0.00	0.00	3.43	4.50	5.73	5.50	6.16	5.88	6.97
	2:15:00	0.00	0.00	2.32	3.03	3.90	3.75	4.20	4.01	4.75
	2:20:00	0.00	0.00	1.54	1.98	2.59	2.49	2.78	2.65	3.13
	2:25:00	0.00	0.00	0.97	1.27	1.67	1.61	1.80	1.71	2.02
	2:30:00	0.00	0.00	0.58	0.82	1.04	1.04	1.15	1.09	1.28
	2:35:00	0.00	0.00	0.30	0.47	0.57	0.59	0.65	0.61	0.71
	2:40:00	0.00	0.00	0.12	0.21	0.25	0.27	0.29	0.27	0.31
	2:45:00	0.00	0.00	0.04	0.06	0.06	0.07	0.07	0.07	0.07
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

RUNOFF REDUCTION

Missing table for "Area not tributary to WQ Ponds for Runoff Reduction" Please add back into report

Unresolved comment from Review #2: These sub-basins of I and J are not delineated on any of the drainage maps. Show on one of the maps, or created a new map.

V3 Update: it is still unclear which UIA/RPA region on the map (on pdf pg 277) corresponds with which Area ID on this spreadsheet . There is also RR in Basin P, V, and Y which should be shown on this spreadsheet too...

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Designer:	Quentin Armijo
Company:	Terra Nova Engineering, Inc.
Date:	March 8, 2022
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)	8,328	8,328	8,328	8,328	9,530	9,530	5,505					
RPA (ft^2)	7,177	7,177	7,177	7,177	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)	60.00	60.00	60.00	60.00	60.00	60.00	60.00					

CALCULATED RUNOFF RESULTS

Area ID	IA	IB	IC	ID	JA	JB	N					
UIA:RPA Area (ft^2)	15,505	15,505	15,505	15,505	12,050	12,050	7,678					
L / W Ratio	4.31	4.31	4.31	4.31	3.35	3.35	2.13					
UIA / Area	0.5371	0.5371	0.5371	0.5371	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)	347	347	347	347	397	397	229					

CALCULATED WQCV RESULTS

Area ID	IA	IB	IC	ID	JA	JB	N					
WQCV (ft^3)	347	347	347	347	397	397	229					
WQCV Reduction (ft^3)	347	347	347	347	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)	57,879											
RPA (ft^2)	35,920											
SPA (ft^2)	0											
Total Area (ft^2)	93,799											
Total Impervious Area (ft^2)	57,879											
WQCV (ft^3)	2,412											
WQCV Reduction (ft^3)	2,412											
WQCV Reduction (%)	100%											
Untreated WQCV (ft^3)	0											

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

Total Area (ft^2)	93,799
Total Impervious Area (ft^2)	57,879
WQCV (ft^3)	2,412
WQCV Reduction (ft^3)	2,412
WQCV Reduction (%)	100%
Untreated WQCV (ft^3)	0

Unresolved comment from Review #2: These sub-basins of M are not delineated on any of the drainage maps. Show on one of the maps, or created a new map.

V3 Update: it is still unclear which UIA/RPA region on the map (on pdf pg 277) corresponds with which Area ID on this spreadsheet . There is also RR in Basin P, V, and Y which should be shown on this spreadsheet too...

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 1

Designer:	QUENTIN ARMIJO
Company:	TERRA NOVA ENGINEERING, INC.
Date:	March 8, 2022
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)	7,083	7,083										
RPA (ft^2)	12,171	12,171										
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)	70.00	70.00										

CALCULATED RUNOFF RESULTS

Area ID	M1A	M1B										
UIA:RPA Area (ft^2)	19,254	19,254										
L / W Ratio	3.93	3.93										
UIA / Area	0.3679	0.3679										
Runoff (in)	0.00	0.00										
Runoff (ft^3)	0	0										
Runoff Reduction (ft^3)	295	295										

Is 0 correct?

CALCULATED WQCV RESULTS

Area ID	M1A	M1B										
WQCV (ft^3)	295	295										
WQCV Reduction (ft^3)	295	295										
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)	7,083	7,083										
RPA (ft^2)	12,171	12,171										
SPA (ft^2)	0	0										
Total Area (ft^2)	19,254	19,254										
Total Impervious Area (ft^2)	7,083	7,083										
WQCV (ft^3)	295	295										
WQCV Reduction (ft^3)	295	295										
WQCV Reduction (%)	100%	100%										
Untreated WQCV (ft^3)	0	0										

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

Total Area (ft^2)	38,507
Total Impervious Area (ft^2)	14,166
WQCV (ft^3)	590
WQCV Reduction (ft^3)	590
WQCV Reduction (%)	100%
Untreated WQCV (ft^3)	0

Unresolved comment from Review #2: These sub-basins of M are not delineated on any of the drainage maps. Show on one of the maps, or created a new map.

V3 Update: it is still unclear which UIA/RPA region on the map (on pdf pg 277) corresponds with which Area ID on this spreadsheet . There is also RR in Basin P, V, and Y which should be shown on this spreadsheet too...

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Designer:	QUENTIN ARMIJO
Company:	TERRA NOVA ENGINEERING, INC.
Date:	March 8, 2022
Project:	WATERBURY FILING 1 & 2
Location:	BASINS M2 DIRECT RELEASE

P & V used to be on here with the last submittal...

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											
Area ID	M2											
Downstream Design Point ID	EAST CH											
Downstream BMP Type	None											
DCIA (ft^2)	--											
UIA (ft^2)	10,366											
RPA (ft^2)	9,084											
SPA (ft^2)	--											
HSG A (%)	100%											
HSG B (%)	0%											
HSG C/D (%)	0%											
Average Slope of RPA (ft/ft)	0.020											
UIA:RPA Interface Width (ft)	60.00											

CALCULATED RUNOFF RESULTS

Area ID	M2											
UIA:RPA Area (ft^2)	19,450											
L / W Ratio	5.40											
UIA / Area	0.5329											
Runoff (in)	0.00											
Runoff (ft^3)	0											
Runoff Reduction (ft^3)	432											

CALCULATED WQCV RESULTS

Area ID	M2											
WQCV (ft^3)	432											
WQCV Reduction (ft^3)	432											
WQCV Reduction (%)	100%											
Untreated WQCV (ft^3)	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)	10,366											
RPA (ft^2)	9,084											
SPA (ft^2)	0											
Total Area (ft^2)	19,450											
Total Impervious Area (ft^2)	10,366											
WQCV (ft^3)	432											
WQCV Reduction (ft^3)	432											
WQCV Reduction (%)	100%											
Untreated WQCV (ft^3)	0											

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

Total Area (ft^2)	19,450
Total Impervious Area (ft^2)	10,366
WQCV (ft^3)	432
WQCV Reduction (ft^3)	432
WQCV Reduction (%)	100%
Untreated WQCV (ft^3)	0

HEC-RAS ANALYSIS

WEST CHANNEL

Plan: Plan 01 WEST PR chan-west-pr RS: 2600 Profile: PF 1

E.G. Elev (ft)	6967.82	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.21	Wt. n-Val.		0.030	
W.S. Elev (ft)	6967.61	Reach Len. (ft)	140.00	100.00	85.90
Crit W.S. (ft)	6967.61	Flow Area (sq ft)		57.48	
E.G. Slope (ft/ft)	0.018361	Area (sq ft)		57.48	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	140.10	Top Width (ft)		140.10	
Vel Total (ft/s)	3.71	Avg. Vel. (ft/s)		3.71	
Max Chl Dpth (ft)	0.79	Hydr. Depth (ft)		0.41	
Conv. Total (cfs)	1571.9	Conv. (cfs)		1571.9	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		140.12	
Min Ch El (ft)	6966.82	Shear (lb/sq ft)		0.47	
Alpha	1.00	Stream Power (lb/ft s)		1.74	
Frctn Loss (ft)	1.39	Cum Volume (acre-ft)	0.06	3.14	0.03
C & E Loss (ft)	0.02	Cum SA (acres)	0.19	4.89	0.14

Plan: Plan 01 WEST PR chan-west-pr RS: 2500 Profile: PF 1

E.G. Elev (ft)	6965.71	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.16	Wt. n-Val.		0.030	
W.S. Elev (ft)	6965.55	Reach Len. (ft)	148.70	100.00	20.00
Crit W.S. (ft)		Flow Area (sq ft)		66.40	
E.G. Slope (ft/ft)	0.010826	Area (sq ft)		66.40	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	135.18	Top Width (ft)		135.18	
Vel Total (ft/s)	3.21	Avg. Vel. (ft/s)		3.21	
Max Chl Dpth (ft)	0.90	Hydr. Depth (ft)		0.49	
Conv. Total (cfs)	2047.1	Conv. (cfs)		2047.1	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		135.20	
Min Ch El (ft)	6964.65	Shear (lb/sq ft)		0.33	
Alpha	1.00	Stream Power (lb/ft s)		1.06	
Frctn Loss (ft)	1.38	Cum Volume (acre-ft)	0.06	3.00	0.03
C & E Loss (ft)	0.01	Cum SA (acres)	0.19	4.58	0.14

Plan: Plan 01 WEST PR chan-west-pr RS: 2400 Profile: PF 1

E.G. Elev (ft)	6964.32	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.21	Wt. n-Val.		0.030	
W.S. Elev (ft)	6964.11	Reach Len. (ft)	119.30	100.00	96.70
Crit W.S. (ft)	6964.11	Flow Area (sq ft)		57.47	
E.G. Slope (ft/ft)	0.018200	Area (sq ft)		57.47	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	139.08	Top Width (ft)		139.08	
Vel Total (ft/s)	3.71	Avg. Vel. (ft/s)		3.71	
Max Chl Dpth (ft)	0.64	Hydr. Depth (ft)		0.41	
Conv. Total (cfs)	1578.9	Conv. (cfs)		1578.9	
Length Wtd. (ft)	100.06	Wetted Per. (ft)		139.09	
Min Ch El (ft)	6963.47	Shear (lb/sq ft)		0.47	
Alpha	1.00	Stream Power (lb/ft s)		1.74	
Frctn Loss (ft)	1.72	Cum Volume (acre-ft)	0.06	2.86	0.03
C & E Loss (ft)	0.00	Cum SA (acres)	0.19	4.26	0.14

Plan: Plan 01 WEST PR chan-west-pr RS: 2300 Profile: PF 1

E.G. Elev (ft)	6962.56	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.24	Wt. n-Val.	0.045	0.030	0.045
W.S. Elev (ft)	6962.32	Reach Len. (ft)	113.10	100.00	97.60
Crit W.S. (ft)	6962.32	Flow Area (sq ft)	1.58	53.00	1.49
E.G. Slope (ft/ft)	0.016174	Area (sq ft)	1.58	53.00	1.49
Q Total (cfs)	213.00	Flow (cfs)	1.65	209.53	1.82
Top Width (ft)	128.81	Top Width (ft)	12.75	106.60	9.46
Vel Total (ft/s)	3.80	Avg. Vel. (ft/s)	1.04	3.95	1.22
Max Chl Dpth (ft)	0.96	Hydr. Depth (ft)	0.12	0.50	0.16
Conv. Total (cfs)	1674.9	Conv. (cfs)	12.9	1647.6	14.3
Length Wtd. (ft)	100.04	Wetted Per. (ft)	12.75	106.62	9.46
Min Ch El (ft)	6961.36	Shear (lb/sq ft)	0.12	0.50	0.16
Alpha	1.07	Stream Power (lb/ft s)	0.13	1.98	0.19
Frctn Loss (ft)	1.63	Cum Volume (acre-ft)	0.06	2.73	0.03
C & E Loss (ft)	0.00	Cum SA (acres)	0.17	3.98	0.13

Plan: Plan 01 WEST PR chan-west-pr RS: 2200 Profile: PF 1

E.G. Elev (ft)	6959.88	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.28	Wt. n-Val.		0.030	
W.S. Elev (ft)	6959.60	Reach Len. (ft)	170.39	200.00	195.20
Crit W.S. (ft)	6959.60	Flow Area (sq ft)		49.95	
E.G. Slope (ft/ft)	0.016348	Area (sq ft)		49.95	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	90.36	Top Width (ft)		90.36	
Vel Total (ft/s)	4.26	Avg. Vel. (ft/s)		4.26	
Max Chl Dpth (ft)	1.06	Hydr. Depth (ft)		0.55	
Conv. Total (cfs)	1665.9	Conv. (cfs)		1665.9	
Length Wtd. (ft)	200.00	Wetted Per. (ft)		90.39	
Min Ch El (ft)	6958.54	Shear (lb/sq ft)		0.56	
Alpha	1.00	Stream Power (lb/ft s)		2.40	
Frctn Loss (ft)	2.62	Cum Volume (acre-ft)	0.05	2.61	0.03
C & E Loss (ft)	0.01	Cum SA (acres)	0.15	3.76	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 2000 Profile: PF 1

E.G. Elev (ft)	6955.94	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.26	Wt. n-Val.		0.030	
W.S. Elev (ft)	6955.67	Reach Len. (ft)	99.70	100.00	116.50
Crit W.S. (ft)	6955.58	Flow Area (sq ft)		51.70	
E.G. Slope (ft/ft)	0.010768	Area (sq ft)		51.70	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	71.98	Top Width (ft)		71.98	
Vel Total (ft/s)	4.12	Avg. Vel. (ft/s)		4.12	
Max Chl Dpth (ft)	1.39	Hydr. Depth (ft)		0.72	
Conv. Total (cfs)	2052.7	Conv. (cfs)		2052.7	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		72.04	
Min Ch El (ft)	6954.28	Shear (lb/sq ft)		0.48	
Alpha	1.00	Stream Power (lb/ft s)		1.99	
Frctn Loss (ft)	1.29	Cum Volume (acre-ft)	0.05	2.38	0.03
C & E Loss (ft)	0.00	Cum SA (acres)	0.15	3.38	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 1900 Profile: PF 1

E.G. Elev (ft)	6954.65	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.28	Wt. n-Val.		0.030	
W.S. Elev (ft)	6954.37	Reach Len. (ft)	674.00	100.00	141.40
Crit W.S. (ft)	6954.37	Flow Area (sq ft)		50.23	
E.G. Slope (ft/ft)	0.015744	Area (sq ft)		50.23	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	88.96	Top Width (ft)		88.96	
Vel Total (ft/s)	4.24	Avg. Vel. (ft/s)		4.24	
Max Chl Dpth (ft)	1.70	Hydr. Depth (ft)		0.56	
Conv. Total (cfs)	1697.5	Conv. (cfs)		1697.5	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		89.11	
Min Ch El (ft)	6952.67	Shear (lb/sq ft)		0.55	
Alpha	1.00	Stream Power (lb/ft s)		2.35	
Frctn Loss (ft)	1.52	Cum Volume (acre-ft)	0.05	2.26	0.03
C & E Loss (ft)	0.02	Cum SA (acres)	0.15	3.20	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 1800 Profile: PF 1

E.G. Elev (ft)	6951.93	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.44	Wt. n-Val.		0.030	
W.S. Elev (ft)	6951.49	Reach Len. (ft)	99.30	100.00	113.30
Crit W.S. (ft)	6951.49	Flow Area (sq ft)		39.83	
E.G. Slope (ft/ft)	0.014715	Area (sq ft)		39.83	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	47.02	Top Width (ft)		47.02	
Vel Total (ft/s)	5.35	Avg. Vel. (ft/s)		5.35	
Max Chl Dpth (ft)	2.20	Hydr. Depth (ft)		0.85	
Conv. Total (cfs)	1755.9	Conv. (cfs)		1755.9	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		47.45	
Min Ch El (ft)	6949.29	Shear (lb/sq ft)		0.77	
Alpha	1.00	Stream Power (lb/ft s)		4.12	
Frctn Loss (ft)	1.42	Cum Volume (acre-ft)	0.05	2.16	0.03
C & E Loss (ft)	0.01	Cum SA (acres)	0.15	3.04	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 1700 Profile: PF 1

E.G. Elev (ft)	6949.70	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.51	Wt. n-Val.		0.030	
W.S. Elev (ft)	6949.19	Reach Len. (ft)	113.00	100.00	112.30
Crit W.S. (ft)	6949.19	Flow Area (sq ft)		37.03	
E.G. Slope (ft/ft)	0.013784	Area (sq ft)		37.03	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	37.04	Top Width (ft)		37.04	
Vel Total (ft/s)	5.75	Avg. Vel. (ft/s)		5.75	
Max Chl Dpth (ft)	2.15	Hydr. Depth (ft)		1.00	
Conv. Total (cfs)	1814.2	Conv. (cfs)		1814.2	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		37.63	
Min Ch El (ft)	6947.04	Shear (lb/sq ft)		0.85	
Alpha	1.00	Stream Power (lb/ft s)		4.87	
Frctn Loss (ft)	1.12	Cum Volume (acre-ft)	0.05	2.07	0.03
C & E Loss (ft)	0.05	Cum SA (acres)	0.15	2.95	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 1600 Profile: PF 1

E.G. Elev (ft)	6948.06	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.35	Wt. n-Val.		0.030	
W.S. Elev (ft)	6947.71	Reach Len. (ft)	113.20	100.00	83.60
Crit W.S. (ft)		Flow Area (sq ft)		44.92	
E.G. Slope (ft/ft)	0.009246	Area (sq ft)		44.92	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	45.01	Top Width (ft)		45.01	
Vel Total (ft/s)	4.74	Avg. Vel. (ft/s)		4.74	
Max Chl Dpth (ft)	1.87	Hydr. Depth (ft)		1.00	
Conv. Total (cfs)	2215.1	Conv. (cfs)		2215.1	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		45.21	
Min Ch El (ft)	6945.84	Shear (lb/sq ft)		0.57	
Alpha	1.00	Stream Power (lb/ft s)		2.72	
Frctn Loss (ft)	1.16	Cum Volume (acre-ft)	0.05	1.98	0.03
C & E Loss (ft)	0.00	Cum SA (acres)	0.15	2.85	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 1500 Profile: PF 1

E.G. Elev (ft)	6946.90	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.34	Wt. n-Val.		0.030	
W.S. Elev (ft)	6946.56	Reach Len. (ft)	110.50	100.00	89.00
Crit W.S. (ft)	6946.56	Flow Area (sq ft)		45.68	
E.G. Slope (ft/ft)	0.015089	Area (sq ft)		45.68	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	67.91	Top Width (ft)		67.91	
Vel Total (ft/s)	4.66	Avg. Vel. (ft/s)		4.66	
Max Chl Dpth (ft)	1.69	Hydr. Depth (ft)		0.67	
Conv. Total (cfs)	1734.0	Conv. (cfs)		1734.0	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		68.07	
Min Ch El (ft)	6944.87	Shear (lb/sq ft)		0.63	
Alpha	1.00	Stream Power (lb/ft s)		2.95	
Frctn Loss (ft)	1.56	Cum Volume (acre-ft)	0.05	1.87	0.03
C & E Loss (ft)	0.01	Cum SA (acres)	0.15	2.72	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 1400 Profile: PF 1

E.G. Elev (ft)	6945.17	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.31	Wt. n-Val.		0.030	
W.S. Elev (ft)	6944.86	Reach Len. (ft)	75.60	100.00	125.50
Crit W.S. (ft)	6944.86	Flow Area (sq ft)		47.75	
E.G. Slope (ft/ft)	0.016056	Area (sq ft)		47.75	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	79.66	Top Width (ft)		79.66	
Vel Total (ft/s)	4.46	Avg. Vel. (ft/s)		4.46	
Max Chl Dpth (ft)	1.07	Hydr. Depth (ft)		0.60	
Conv. Total (cfs)	1681.0	Conv. (cfs)		1681.0	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		79.71	
Min Ch El (ft)	6943.79	Shear (lb/sq ft)		0.60	
Alpha	1.00	Stream Power (lb/ft s)		2.68	
Frctn Loss (ft)	1.64	Cum Volume (acre-ft)	0.05	1.77	0.03
C & E Loss (ft)	0.02	Cum SA (acres)	0.15	2.55	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 1300 Profile: PF 1

E.G. Elev (ft)	6942.34	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.25	Wt. n-Val.		0.030	
W.S. Elev (ft)	6942.09	Reach Len. (ft)	107.40	100.00	88.80
Crit W.S. (ft)	6942.09	Flow Area (sq ft)		53.37	
E.G. Slope (ft/ft)	0.016728	Area (sq ft)		53.37	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	108.51	Top Width (ft)		108.51	
Vel Total (ft/s)	3.99	Avg. Vel. (ft/s)		3.99	
Max Chl Dpth (ft)	0.64	Hydr. Depth (ft)		0.49	
Conv. Total (cfs)	1646.9	Conv. (cfs)		1646.9	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		108.53	
Min Ch El (ft)	6941.45	Shear (lb/sq ft)		0.51	
Alpha	1.00	Stream Power (lb/ft s)		2.05	
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	0.05	1.65	0.03
C & E Loss (ft)	0.07	Cum SA (acres)	0.15	2.34	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 1200 Profile: PF 1

E.G. Elev (ft)	6942.10	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.		0.030	0.045
W.S. Elev (ft)	6942.09	Reach Len. (ft)	313.70	300.00	276.40
Crit W.S. (ft)	6939.49	Flow Area (sq ft)		301.81	0.10
E.G. Slope (ft/ft)	0.000053	Area (sq ft)		301.81	0.10
Q Total (cfs)	213.00	Flow (cfs)		213.00	0.00
Top Width (ft)	111.08	Top Width (ft)		109.26	1.81
Vel Total (ft/s)	0.71	Avg. Vel. (ft/s)		0.71	0.04
Max Chl Dpth (ft)	3.56	Hydr. Depth (ft)		2.76	0.06
Conv. Total (cfs)	29326.1	Conv. (cfs)		29325.6	0.5
Length Wtd. (ft)	300.00	Wetted Per. (ft)		109.85	1.83
Min Ch El (ft)	6938.53	Shear (lb/sq ft)		0.01	0.00
Alpha	1.00	Stream Power (lb/ft s)		0.01	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)	0.05	1.24	0.03
C & E Loss (ft)		Cum SA (acres)	0.15	2.09	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 900 Profile: PF 1

E.G. Elev (ft)	6936.38	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.13	Wt. n-Val.		0.030	
W.S. Elev (ft)	6936.25	Reach Len. (ft)	104.20	100.00	101.80
Crit W.S. (ft)		Flow Area (sq ft)		74.22	
E.G. Slope (ft/ft)	0.005198	Area (sq ft)		74.22	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	102.95	Top Width (ft)		102.95	
Vel Total (ft/s)	2.87	Avg. Vel. (ft/s)		2.87	
Max Chl Dpth (ft)	0.88	Hydr. Depth (ft)		0.72	
Conv. Total (cfs)	2954.2	Conv. (cfs)		2954.2	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		103.03	
Min Ch El (ft)	6935.37	Shear (lb/sq ft)		0.23	
Alpha	1.00	Stream Power (lb/ft s)		0.67	
Frctn Loss (ft)	0.53	Cum Volume (acre-ft)	0.05	0.90	0.03
C & E Loss (ft)	0.01	Cum SA (acres)	0.15	1.36	0.11

Plan: Plan 01 WEST PR chan-west-pr RS: 800 Profile: PF 1

E.G. Elev (ft)	6935.84	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.11	Wt. n-Val.		0.030	
W.S. Elev (ft)	6935.73	Reach Len. (ft)	96.40	100.00	114.30
Crit W.S. (ft)	6935.50	Flow Area (sq ft)		80.27	
E.G. Slope (ft/ft)	0.005448	Area (sq ft)		80.27	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	129.67	Top Width (ft)		129.67	
Vel Total (ft/s)	2.65	Avg. Vel. (ft/s)		2.65	
Max Chl Dpth (ft)	1.31	Hydr. Depth (ft)		0.62	
Conv. Total (cfs)	2885.7	Conv. (cfs)		2885.7	
Length Wtd. (ft)	99.58	Wetted Per. (ft)		129.82	
Min Ch El (ft)	6934.42	Shear (lb/sq ft)		0.21	
Alpha	1.00	Stream Power (lb/ft s)		0.56	
Frctn Loss (ft)	0.94	Cum Volume (acre-ft)	0.05	0.72	0.03
C & E Loss (ft)	0.01	Cum SA (acres)	0.15	1.09	0.11

Plan: Plan 01 WEST PR chan-west-pr RS: 700 Profile: PF 1

E.G. Elev (ft)	6934.89	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.21	Wt. n-Val.	0.045	0.030	0.045
W.S. Elev (ft)	6934.68	Reach Len. (ft)	114.30	100.00	85.80
Crit W.S. (ft)	6934.68	Flow Area (sq ft)	19.28	40.94	0.05
E.G. Slope (ft/ft)	0.020420	Area (sq ft)	19.28	40.94	0.05
Q Total (cfs)	213.00	Flow (cfs)	49.48	163.47	0.05
Top Width (ft)	144.97	Top Width (ft)	48.02	96.60	0.35
Vel Total (ft/s)	3.53	Avg. Vel. (ft/s)	2.57	3.99	1.04
Max Chl Dpth (ft)	0.72	Hydr. Depth (ft)	0.40	0.42	0.15
Conv. Total (cfs)	1490.6	Conv. (cfs)	346.3	1143.9	0.4
Length Wtd. (ft)	100.94	Wetted Per. (ft)	48.08	96.61	0.50
Min Ch El (ft)	6933.96	Shear (lb/sq ft)	0.51	0.54	0.13
Alpha	1.10	Stream Power (lb/ft s)	1.31	2.16	0.14
Frctn Loss (ft)	1.75	Cum Volume (acre-ft)	0.03	0.58	0.03
C & E Loss (ft)	0.01	Cum SA (acres)	0.10	0.83	0.11

Plan: Plan 01 WEST PR chan-west-pr RS: 600 Profile: PF 1

E.G. Elev (ft)	6932.25	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.27	Wt. n-Val.	0.045	0.030	0.045
W.S. Elev (ft)	6931.98	Reach Len. (ft)	110.80	100.00	88.00
Crit W.S. (ft)	6931.98	Flow Area (sq ft)	2.92	40.77	15.25
E.G. Slope (ft/ft)	0.014832	Area (sq ft)	2.92	40.77	15.25
Q Total (cfs)	213.00	Flow (cfs)	4.29	182.83	25.88
Top Width (ft)	133.02	Top Width (ft)	13.18	63.58	56.26
Vel Total (ft/s)	3.61	Avg. Vel. (ft/s)	1.47	4.48	1.70
Max Chl Dpth (ft)	1.12	Hydr. Depth (ft)	0.22	0.64	0.27
Conv. Total (cfs)	1749.0	Conv. (cfs)	35.2	1501.2	212.5
Length Wtd. (ft)	99.38	Wetted Per. (ft)	13.25	63.61	56.27
Min Ch El (ft)	6930.86	Shear (lb/sq ft)	0.20	0.59	0.25
Alpha	1.35	Stream Power (lb/ft s)	0.30	2.66	0.43
Frctn Loss (ft)	1.52	Cum Volume (acre-ft)	0.00	0.49	0.02
C & E Loss (ft)	0.00	Cum SA (acres)	0.02	0.64	0.06

All of the highlighted values indicate supercritical flows

Plan: Plan 01 WEST PR chan-west-pr RS: 500 Profile: PF 1

E.G. Elev (ft)	6929.85	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.32	Wt. n-Val.		0.030	
W.S. Elev (ft)	6929.52	Reach Len. (ft)	85.20	100.00	105.50
Crit W.S. (ft)	6929.52	Flow Area (sq ft)		46.76	
E.G. Slope (ft/ft)	0.015820	Area (sq ft)		46.76	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	74.75	Top Width (ft)		74.75	
Vel Total (ft/s)	4.56	Avg. Vel. (ft/s)		4.56	
Max Chl Dpth (ft)	1.12	Hydr. Depth (ft)		0.63	
Conv. Total (cfs)	1693.5	Conv. (cfs)		1693.5	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		74.79	
Min Ch El (ft)	6928.40	Shear (lb/sq ft)		0.62	
Alpha	1.00	Stream Power (lb/ft s)		2.81	
Frctn Loss (ft)	1.52	Cum Volume (acre-ft)	0.00	0.38	
C & E Loss (ft)	0.01	Cum SA (acres)	0.00	0.49	

Plan: Plan 01 WEST PR chan-west-pr RS: 400 Profile: PF 1

E.G. Elev (ft)	6927.37	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.39	Wt. n-Val.		0.030	
W.S. Elev (ft)	6926.98	Reach Len. (ft)	95.20	100.00	105.50
Crit W.S. (ft)	6926.98	Flow Area (sq ft)		42.65	
E.G. Slope (ft/ft)	0.014589	Area (sq ft)		42.65	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	55.48	Top Width (ft)		55.48	
Vel Total (ft/s)	4.99	Avg. Vel. (ft/s)		4.99	
Max Chl Dpth (ft)	2.01	Hydr. Depth (ft)		0.77	
Conv. Total (cfs)	1763.4	Conv. (cfs)		1763.4	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		55.92	
Min Ch El (ft)	6924.97	Shear (lb/sq ft)		0.69	
Alpha	1.00	Stream Power (lb/ft s)		3.47	
Frctn Loss (ft)	1.41	Cum Volume (acre-ft)	0.00	0.28	
C & E Loss (ft)	0.01	Cum SA (acres)	0.00	0.34	

Plan: Plan 01 WEST PR chan-west-pr RS: 300 Profile: PF 1

E.G. Elev (ft)	6924.77	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.50	Wt. n-Val.		0.030	
W.S. Elev (ft)	6924.27	Reach Len. (ft)	113.50	100.00	139.70
Crit W.S. (ft)	6924.27	Flow Area (sq ft)		37.57	
E.G. Slope (ft/ft)	0.013593	Area (sq ft)		37.57	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	38.43	Top Width (ft)		38.43	
Vel Total (ft/s)	5.67	Avg. Vel. (ft/s)		5.67	
Max Chl Dpth (ft)	1.93	Hydr. Depth (ft)		0.98	
Conv. Total (cfs)	1826.9	Conv. (cfs)		1826.9	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		38.63	
Min Ch El (ft)	6922.34	Shear (lb/sq ft)		0.83	
Alpha	1.00	Stream Power (lb/ft s)		4.68	
Frctn Loss (ft)	1.39	Cum Volume (acre-ft)	0.00	0.19	
C & E Loss (ft)	0.02	Cum SA (acres)	0.00	0.23	

Plan: Plan 01 WEST PR chan-west-pr RS: 200 Profile: PF 1

E.G. Elev (ft)	6921.79	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.42	Wt. n-Val.	0.000	0.030	
W.S. Elev (ft)	6921.37	Reach Len. (ft)	109.50	100.00	110.20
Crit W.S. (ft)	6921.37	Flow Area (sq ft)	0.00	41.06	
E.G. Slope (ft/ft)	0.014171	Area (sq ft)	0.00	41.06	
Q Total (cfs)	213.00	Flow (cfs)	0.00	213.00	
Top Width (ft)	50.39	Top Width (ft)	0.73	49.66	
Vel Total (ft/s)	5.19	Avg. Vel. (ft/s)	0.13	5.19	
Max Chl Dpth (ft)	1.39	Hydr. Depth (ft)	0.01	0.83	
Conv. Total (cfs)	1789.3	Conv. (cfs)	0.0	1789.3	
Length Wtd. (ft)	100.00	Wetted Per. (ft)	0.73	49.76	
Min Ch El (ft)	6919.98	Shear (lb/sq ft)		0.73	
Alpha	1.00	Stream Power (lb/ft s)		3.79	
Frctn Loss (ft)	1.36	Cum Volume (acre-ft)	0.00	0.10	
C & E Loss (ft)	0.03	Cum SA (acres)	0.00	0.13	

Plan: Plan 01 WEST PR chan-west-pr RS: 100 Profile: PF 1

E.G. Elev (ft)	6919.18	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.		0.030	
W.S. Elev (ft)	6918.84	Reach Len. (ft)			
Crit W.S. (ft)	6918.81	Flow Area (sq ft)		45.94	
E.G. Slope (ft/ft)	0.013007	Area (sq ft)		45.94	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	61.67	Top Width (ft)		61.67	
Vel Total (ft/s)	4.64	Avg. Vel. (ft/s)		4.64	
Max Chl Dpth (ft)	0.84	Hydr. Depth (ft)		0.74	
Conv. Total (cfs)	1867.6	Conv. (cfs)		1867.6	
Length Wtd. (ft)		Wetted Per. (ft)		61.77	
Min Ch El (ft)	6918.00	Shear (lb/sq ft)		0.60	
Alpha	1.00	Stream Power (lb/ft s)		2.80	
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

HEC-RAS Plan: Plan 01 River: WEST PR Reach: chan-west-pr Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
chan-west-pr	2600	PF 1	213.00	6966.82	6967.61	6967.61	6967.82	0.018361	3.71	57.48	140.10	1.02
chan-west-pr	2500	PF 1	213.00	6964.65	6965.55		6965.71	0.010826	3.21	66.40	135.18	0.81
chan-west-pr	2400	PF 1	213.00	6963.47	6964.11	6964.11	6964.32	0.018200	3.71	57.47	139.08	1.02
chan-west-pr	2300	PF 1	213.00	6961.36	6962.32	6962.32	6962.56	0.016174	3.95	56.07	128.81	0.99
chan-west-pr	2200	PF 1	213.00	6958.54	6959.60	6959.60	6959.88	0.016348	4.26	49.95	90.36	1.01
chan-west-pr	2000	PF 1	213.00	6954.28	6955.67	6955.58	6955.94	0.010768	4.12	51.70	71.98	0.86
chan-west-pr	1900	PF 1	213.00	6952.67	6954.37	6954.37	6954.65	0.015744	4.24	50.23	88.96	0.99
chan-west-pr	1800	PF 1	213.00	6949.29	6951.49	6951.49	6951.93	0.014715	5.35	39.83	47.02	1.02
chan-west-pr	1700	PF 1	213.00	6947.04	6949.19	6949.19	6949.70	0.013784	5.75	37.03	37.04	1.01
chan-west-pr	1600	PF 1	213.00	6945.84	6947.71		6948.06	0.009246	4.74	44.92	45.01	0.84
chan-west-pr	1500	PF 1	213.00	6944.87	6946.56	6946.56	6946.90	0.015089	4.66	45.68	67.91	1.00
chan-west-pr	1400	PF 1	213.00	6943.79	6944.86	6944.86	6945.17	0.016056	4.46	47.75	79.66	1.02
chan-west-pr	1300	PF 1	213.00	6941.45	6942.09	6942.09	6942.34	0.016728	3.99	53.37	108.51	1.00
chan-west-pr	1200	PF 1	213.00	6938.53	6942.09	6939.49	6942.10	0.000053	0.71	301.92	111.08	0.07
chan-west-pr	1042.5		Culvert									
chan-west-pr	900	PF 1	213.00	6935.37	6936.25		6936.38	0.005198	2.87	74.22	102.95	0.60
chan-west-pr	800	PF 1	213.00	6934.42	6935.73	6935.50	6935.84	0.005448	2.65	80.27	129.67	0.59
chan-west-pr	700	PF 1	213.00	6933.96	6934.68	6934.68	6934.89	0.020420	3.99	60.27	144.97	1.08
chan-west-pr	600	PF 1	213.00	6930.86	6931.98	6931.98	6932.25	0.014832	4.48	58.94	133.02	0.99
chan-west-pr	500	PF 1	213.00	6928.40	6929.52	6929.52	6929.85	0.015820	4.56	46.76	74.75	1.02
chan-west-pr	400	PF 1	213.00	6924.97	6926.98	6926.98	6927.37	0.014589	4.99	42.65	55.48	1.00
chan-west-pr	300	PF 1	213.00	6922.34	6924.27	6924.27	6924.77	0.013593	5.67	37.57	38.43	1.01
chan-west-pr	200	PF 1	213.00	6919.98	6921.37	6921.37	6921.79	0.014171	5.19	41.06	50.39	1.01
chan-west-pr	100	PF 1	213.00	6918.00	6918.84	6918.81	6919.18	0.013007	4.64	45.94	61.67	0.95

Stabilization / modification needs to be provided where flows are supercritical

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6970.5
6970.0
6969.5
6969.0
6968.5
6968.0
6967.5
6967.0
6966.5
0
100
200
300
400
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
6969
6968
6967
6966
6965
6964
Elevation (ft)
0
100
200
300
400
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
6968
6967
6966
6965
6964
6963
Elevation (ft)
0
100
200
300
400
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6966
6965
6964
6963
6962
6961
0
100
200
300
400
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6965
6964
6963
6962
6961
6960
6959
6958
0
100
200
300
400
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
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.03
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Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
6959
6958
6957
6956
6955
6954
Elevation (ft)
0
100
200
300
400
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6960
6959
6958
6957
6956
6955
6954
6953
6952
0
100
200
300
400
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6957
6956
6955
6954
6953
6952
6951
6950
6949
0
100
200
300
400
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
6956
6954
6952
6950
6948
6946
Elevation (ft)
0
100
200
300
400
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6953
6952
6951
6950
6949
6948
6947
6946
6945
0
100
200
300
400
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6951
6950
6949
6948
6947
6946
6945
6944
0
100
200
300
400
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6951
6950
6949
6948
6947
6946
6945
6944
6943
0
100
200
300
400
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6948
6947
6946
6945
6944
6943
6942
6941
0
100
200
300
400
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6946
6945
6944
6943
6942
6941
6940
6939
6938
0
100
200
300
400
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
DUAL 42"
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6946
6944
6942
6940
6938
6936
6934
0
100
200
300
400
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6942
6941
6940
6939
6938
6937
6936
6935
0
100
200
300
400
Station (ft)

provide station labels

west chan pr Plan: Plan 01 3/8/2022
.045
.03
0
4
5
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6941
6940
6939
6938
6937
6936
6935
6934
6933
0
50
100
150
200
250
300
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6939
6938
6937
6936
6935
6934
6933
6932
6931
6930
0
100
200
300
400
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6932.0
6931.5
6931.0
6930.5
6930.0
6929.5
6929.0
6928.5
6928.0
100
150
200
250
300
350
400
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6931
6930
6929
6928
6927
6926
6925
6924
120
140
160
180
200
220
240
260
280
300
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6934
6932
6930
6928
6926
6924
6922
0
50
100
150
200
250
300
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6930
6928
6926
6924
6922
6920
6918
0
100
200
300
400
Station (ft)

west chan pr Plan: Plan 01 3/8/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6930
6928
6926
6924
6922
6920
6918
0
100
200
300
400
Station (ft)

EAST CHANNEL

Plan: Plan 01 WEST PR chan-west-pr RS: 2600 Profile: PF 1

E.G. Elev (ft)	6967.82	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.21	Wt. n-Val.		0.030	
W.S. Elev (ft)	6967.61	Reach Len. (ft)	140.00	100.00	85.90
Crit W.S. (ft)	6967.61	Flow Area (sq ft)		57.48	
E.G. Slope (ft/ft)	0.018361	Area (sq ft)		57.48	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	140.10	Top Width (ft)		140.10	
Vel Total (ft/s)	3.71	Avg. Vel. (ft/s)		3.71	
Max Chl Dpth (ft)	0.79	Hydr. Depth (ft)		0.41	
Conv. Total (cfs)	1571.9	Conv. (cfs)		1571.9	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		140.12	
Min Ch El (ft)	6966.82	Shear (lb/sq ft)		0.47	
Alpha	1.00	Stream Power (lb/ft s)		1.74	
Frctn Loss (ft)	1.39	Cum Volume (acre-ft)	0.06	3.14	0.03
C & E Loss (ft)	0.02	Cum SA (acres)	0.19	4.89	0.14

Plan: Plan 01 WEST PR chan-west-pr RS: 2500 Profile: PF 1

E.G. Elev (ft)	6965.71	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.16	Wt. n-Val.		0.030	
W.S. Elev (ft)	6965.55	Reach Len. (ft)	148.70	100.00	20.00
Crit W.S. (ft)		Flow Area (sq ft)		66.40	
E.G. Slope (ft/ft)	0.010826	Area (sq ft)		66.40	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	135.18	Top Width (ft)		135.18	
Vel Total (ft/s)	3.21	Avg. Vel. (ft/s)		3.21	
Max Chl Dpth (ft)	0.90	Hydr. Depth (ft)		0.49	
Conv. Total (cfs)	2047.1	Conv. (cfs)		2047.1	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		135.20	
Min Ch El (ft)	6964.65	Shear (lb/sq ft)		0.33	
Alpha	1.00	Stream Power (lb/ft s)		1.06	
Frctn Loss (ft)	1.38	Cum Volume (acre-ft)	0.06	3.00	0.03
C & E Loss (ft)	0.01	Cum SA (acres)	0.19	4.58	0.14

Plan: Plan 01 WEST PR chan-west-pr RS: 2400 Profile: PF 1

E.G. Elev (ft)	6964.32	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.21	Wt. n-Val.		0.030	
W.S. Elev (ft)	6964.11	Reach Len. (ft)	119.30	100.00	96.70
Crit W.S. (ft)	6964.11	Flow Area (sq ft)		57.47	
E.G. Slope (ft/ft)	0.018200	Area (sq ft)		57.47	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	139.08	Top Width (ft)		139.08	
Vel Total (ft/s)	3.71	Avg. Vel. (ft/s)		3.71	
Max Chl Dpth (ft)	0.64	Hydr. Depth (ft)		0.41	
Conv. Total (cfs)	1578.9	Conv. (cfs)		1578.9	
Length Wtd. (ft)	100.06	Wetted Per. (ft)		139.09	
Min Ch El (ft)	6963.47	Shear (lb/sq ft)		0.47	
Alpha	1.00	Stream Power (lb/ft s)		1.74	
Frctn Loss (ft)	1.72	Cum Volume (acre-ft)	0.06	2.86	0.03
C & E Loss (ft)	0.00	Cum SA (acres)	0.19	4.26	0.14

Plan: Plan 01 WEST PR chan-west-pr RS: 2300 Profile: PF 1

E.G. Elev (ft)	6962.56	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.24	Wt. n-Val.	0.045	0.030	0.045
W.S. Elev (ft)	6962.32	Reach Len. (ft)	113.10	100.00	97.60
Crit W.S. (ft)	6962.32	Flow Area (sq ft)	1.58	53.00	1.49
E.G. Slope (ft/ft)	0.016174	Area (sq ft)	1.58	53.00	1.49
Q Total (cfs)	213.00	Flow (cfs)	1.65	209.53	1.82
Top Width (ft)	128.81	Top Width (ft)	12.75	106.60	9.46
Vel Total (ft/s)	3.80	Avg. Vel. (ft/s)	1.04	3.95	1.22
Max Chl Dpth (ft)	0.96	Hydr. Depth (ft)	0.12	0.50	0.16
Conv. Total (cfs)	1674.9	Conv. (cfs)	12.9	1647.6	14.3
Length Wtd. (ft)	100.04	Wetted Per. (ft)	12.75	106.62	9.46
Min Ch El (ft)	6961.36	Shear (lb/sq ft)	0.12	0.50	0.16
Alpha	1.07	Stream Power (lb/ft s)	0.13	1.98	0.19
Frctn Loss (ft)	1.63	Cum Volume (acre-ft)	0.06	2.73	0.03
C & E Loss (ft)	0.00	Cum SA (acres)	0.17	3.98	0.13

Plan: Plan 01 WEST PR chan-west-pr RS: 2200 Profile: PF 1

E.G. Elev (ft)	6959.88	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.28	Wt. n-Val.		0.030	
W.S. Elev (ft)	6959.60	Reach Len. (ft)	170.39	200.00	195.20
Crit W.S. (ft)	6959.60	Flow Area (sq ft)		49.95	
E.G. Slope (ft/ft)	0.016348	Area (sq ft)		49.95	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	90.36	Top Width (ft)		90.36	
Vel Total (ft/s)	4.26	Avg. Vel. (ft/s)		4.26	
Max Chl Dpth (ft)	1.06	Hydr. Depth (ft)		0.55	
Conv. Total (cfs)	1665.9	Conv. (cfs)		1665.9	
Length Wtd. (ft)	200.00	Wetted Per. (ft)		90.39	
Min Ch El (ft)	6958.54	Shear (lb/sq ft)		0.56	
Alpha	1.00	Stream Power (lb/ft s)		2.40	
Frctn Loss (ft)	2.62	Cum Volume (acre-ft)	0.05	2.61	0.03
C & E Loss (ft)	0.01	Cum SA (acres)	0.15	3.76	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 2000 Profile: PF 1

E.G. Elev (ft)	6955.94	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.26	Wt. n-Val.		0.030	
W.S. Elev (ft)	6955.67	Reach Len. (ft)	99.70	100.00	116.50
Crit W.S. (ft)	6955.58	Flow Area (sq ft)		51.70	
E.G. Slope (ft/ft)	0.010768	Area (sq ft)		51.70	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	71.98	Top Width (ft)		71.98	
Vel Total (ft/s)	4.12	Avg. Vel. (ft/s)		4.12	
Max Chl Dpth (ft)	1.39	Hydr. Depth (ft)		0.72	
Conv. Total (cfs)	2052.7	Conv. (cfs)		2052.7	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		72.04	
Min Ch El (ft)	6954.28	Shear (lb/sq ft)		0.48	
Alpha	1.00	Stream Power (lb/ft s)		1.99	
Frctn Loss (ft)	1.29	Cum Volume (acre-ft)	0.05	2.38	0.03
C & E Loss (ft)	0.00	Cum SA (acres)	0.15	3.38	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 1900 Profile: PF 1

E.G. Elev (ft)	6954.65	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.28	Wt. n-Val.		0.030	
W.S. Elev (ft)	6954.37	Reach Len. (ft)	674.00	100.00	141.40
Crit W.S. (ft)	6954.37	Flow Area (sq ft)		50.23	
E.G. Slope (ft/ft)	0.015744	Area (sq ft)		50.23	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	88.96	Top Width (ft)		88.96	
Vel Total (ft/s)	4.24	Avg. Vel. (ft/s)		4.24	
Max Chl Dpth (ft)	1.70	Hydr. Depth (ft)		0.56	
Conv. Total (cfs)	1697.5	Conv. (cfs)		1697.5	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		89.11	
Min Ch El (ft)	6952.67	Shear (lb/sq ft)		0.55	
Alpha	1.00	Stream Power (lb/ft s)		2.35	
Frctn Loss (ft)	1.52	Cum Volume (acre-ft)	0.05	2.26	0.03
C & E Loss (ft)	0.02	Cum SA (acres)	0.15	3.20	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 1800 Profile: PF 1

E.G. Elev (ft)	6951.93	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.44	Wt. n-Val.		0.030	
W.S. Elev (ft)	6951.49	Reach Len. (ft)	99.30	100.00	113.30
Crit W.S. (ft)	6951.49	Flow Area (sq ft)		39.83	
E.G. Slope (ft/ft)	0.014715	Area (sq ft)		39.83	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	47.02	Top Width (ft)		47.02	
Vel Total (ft/s)	5.35	Avg. Vel. (ft/s)		5.35	
Max Chl Dpth (ft)	2.20	Hydr. Depth (ft)		0.85	
Conv. Total (cfs)	1755.9	Conv. (cfs)		1755.9	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		47.45	
Min Ch El (ft)	6949.29	Shear (lb/sq ft)		0.77	
Alpha	1.00	Stream Power (lb/ft s)		4.12	
Frctn Loss (ft)	1.42	Cum Volume (acre-ft)	0.05	2.16	0.03
C & E Loss (ft)	0.01	Cum SA (acres)	0.15	3.04	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 1700 Profile: PF 1

E.G. Elev (ft)	6949.70	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.51	Wt. n-Val.		0.030	
W.S. Elev (ft)	6949.19	Reach Len. (ft)	113.00	100.00	112.30
Crit W.S. (ft)	6949.19	Flow Area (sq ft)		37.03	
E.G. Slope (ft/ft)	0.013784	Area (sq ft)		37.03	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	37.04	Top Width (ft)		37.04	
Vel Total (ft/s)	5.75	Avg. Vel. (ft/s)		5.75	
Max Chl Dpth (ft)	2.15	Hydr. Depth (ft)		1.00	
Conv. Total (cfs)	1814.2	Conv. (cfs)		1814.2	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		37.63	
Min Ch El (ft)	6947.04	Shear (lb/sq ft)		0.85	
Alpha	1.00	Stream Power (lb/ft s)		4.87	
Frctn Loss (ft)	1.12	Cum Volume (acre-ft)	0.05	2.07	0.03
C & E Loss (ft)	0.05	Cum SA (acres)	0.15	2.95	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 1600 Profile: PF 1

E.G. Elev (ft)	6948.06	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.35	Wt. n-Val.		0.030	
W.S. Elev (ft)	6947.71	Reach Len. (ft)	113.20	100.00	83.60
Crit W.S. (ft)		Flow Area (sq ft)		44.92	
E.G. Slope (ft/ft)	0.009246	Area (sq ft)		44.92	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	45.01	Top Width (ft)		45.01	
Vel Total (ft/s)	4.74	Avg. Vel. (ft/s)		4.74	
Max Chl Dpth (ft)	1.87	Hydr. Depth (ft)		1.00	
Conv. Total (cfs)	2215.1	Conv. (cfs)		2215.1	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		45.21	
Min Ch El (ft)	6945.84	Shear (lb/sq ft)		0.57	
Alpha	1.00	Stream Power (lb/ft s)		2.72	
Frctn Loss (ft)	1.16	Cum Volume (acre-ft)	0.05	1.98	0.03
C & E Loss (ft)	0.00	Cum SA (acres)	0.15	2.85	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 1500 Profile: PF 1

E.G. Elev (ft)	6946.90	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.34	Wt. n-Val.		0.030	
W.S. Elev (ft)	6946.56	Reach Len. (ft)	110.50	100.00	89.00
Crit W.S. (ft)	6946.56	Flow Area (sq ft)		45.68	
E.G. Slope (ft/ft)	0.015089	Area (sq ft)		45.68	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	67.91	Top Width (ft)		67.91	
Vel Total (ft/s)	4.66	Avg. Vel. (ft/s)		4.66	
Max Chl Dpth (ft)	1.69	Hydr. Depth (ft)		0.67	
Conv. Total (cfs)	1734.0	Conv. (cfs)		1734.0	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		68.07	
Min Ch El (ft)	6944.87	Shear (lb/sq ft)		0.63	
Alpha	1.00	Stream Power (lb/ft s)		2.95	
Frctn Loss (ft)	1.56	Cum Volume (acre-ft)	0.05	1.87	0.03
C & E Loss (ft)	0.01	Cum SA (acres)	0.15	2.72	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 1400 Profile: PF 1

E.G. Elev (ft)	6945.17	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.31	Wt. n-Val.		0.030	
W.S. Elev (ft)	6944.86	Reach Len. (ft)	75.60	100.00	125.50
Crit W.S. (ft)	6944.86	Flow Area (sq ft)		47.75	
E.G. Slope (ft/ft)	0.016056	Area (sq ft)		47.75	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	79.66	Top Width (ft)		79.66	
Vel Total (ft/s)	4.46	Avg. Vel. (ft/s)		4.46	
Max Chl Dpth (ft)	1.07	Hydr. Depth (ft)		0.60	
Conv. Total (cfs)	1681.0	Conv. (cfs)		1681.0	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		79.71	
Min Ch El (ft)	6943.79	Shear (lb/sq ft)		0.60	
Alpha	1.00	Stream Power (lb/ft s)		2.68	
Frctn Loss (ft)	1.64	Cum Volume (acre-ft)	0.05	1.77	0.03
C & E Loss (ft)	0.02	Cum SA (acres)	0.15	2.55	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 1300 Profile: PF 1

E.G. Elev (ft)	6942.34	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.25	Wt. n-Val.		0.030	
W.S. Elev (ft)	6942.09	Reach Len. (ft)	107.40	100.00	88.80
Crit W.S. (ft)	6942.09	Flow Area (sq ft)		53.37	
E.G. Slope (ft/ft)	0.016728	Area (sq ft)		53.37	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	108.51	Top Width (ft)		108.51	
Vel Total (ft/s)	3.99	Avg. Vel. (ft/s)		3.99	
Max Chl Dpth (ft)	0.64	Hydr. Depth (ft)		0.49	
Conv. Total (cfs)	1646.9	Conv. (cfs)		1646.9	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		108.53	
Min Ch El (ft)	6941.45	Shear (lb/sq ft)		0.51	
Alpha	1.00	Stream Power (lb/ft s)		2.05	
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	0.05	1.65	0.03
C & E Loss (ft)	0.07	Cum SA (acres)	0.15	2.34	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 1200 Profile: PF 1

E.G. Elev (ft)	6942.10	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.01	Wt. n-Val.		0.030	0.045
W.S. Elev (ft)	6942.09	Reach Len. (ft)	313.70	300.00	276.40
Crit W.S. (ft)	6939.49	Flow Area (sq ft)		301.81	0.10
E.G. Slope (ft/ft)	0.000053	Area (sq ft)		301.81	0.10
Q Total (cfs)	213.00	Flow (cfs)		213.00	0.00
Top Width (ft)	111.08	Top Width (ft)		109.26	1.81
Vel Total (ft/s)	0.71	Avg. Vel. (ft/s)		0.71	0.04
Max Chl Dpth (ft)	3.56	Hydr. Depth (ft)		2.76	0.06
Conv. Total (cfs)	29326.1	Conv. (cfs)		29325.6	0.5
Length Wtd. (ft)	300.00	Wetted Per. (ft)		109.85	1.83
Min Ch El (ft)	6938.53	Shear (lb/sq ft)		0.01	0.00
Alpha	1.00	Stream Power (lb/ft s)		0.01	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)	0.05	1.24	0.03
C & E Loss (ft)		Cum SA (acres)	0.15	2.09	0.12

Plan: Plan 01 WEST PR chan-west-pr RS: 900 Profile: PF 1

E.G. Elev (ft)	6936.38	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.13	Wt. n-Val.		0.030	
W.S. Elev (ft)	6936.25	Reach Len. (ft)	104.20	100.00	101.80
Crit W.S. (ft)		Flow Area (sq ft)		74.22	
E.G. Slope (ft/ft)	0.005198	Area (sq ft)		74.22	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	102.95	Top Width (ft)		102.95	
Vel Total (ft/s)	2.87	Avg. Vel. (ft/s)		2.87	
Max Chl Dpth (ft)	0.88	Hydr. Depth (ft)		0.72	
Conv. Total (cfs)	2954.2	Conv. (cfs)		2954.2	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		103.03	
Min Ch El (ft)	6935.37	Shear (lb/sq ft)		0.23	
Alpha	1.00	Stream Power (lb/ft s)		0.67	
Frctn Loss (ft)	0.53	Cum Volume (acre-ft)	0.05	0.90	0.03
C & E Loss (ft)	0.01	Cum SA (acres)	0.15	1.36	0.11

Plan: Plan 01 WEST PR chan-west-pr RS: 800 Profile: PF 1

E.G. Elev (ft)	6935.84	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.11	Wt. n-Val.		0.030	
W.S. Elev (ft)	6935.73	Reach Len. (ft)	96.40	100.00	114.30
Crit W.S. (ft)	6935.50	Flow Area (sq ft)		80.27	
E.G. Slope (ft/ft)	0.005448	Area (sq ft)		80.27	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	129.67	Top Width (ft)		129.67	
Vel Total (ft/s)	2.65	Avg. Vel. (ft/s)		2.65	
Max Chl Dpth (ft)	1.31	Hydr. Depth (ft)		0.62	
Conv. Total (cfs)	2885.7	Conv. (cfs)		2885.7	
Length Wtd. (ft)	99.58	Wetted Per. (ft)		129.82	
Min Ch El (ft)	6934.42	Shear (lb/sq ft)		0.21	
Alpha	1.00	Stream Power (lb/ft s)		0.56	
Frctn Loss (ft)	0.94	Cum Volume (acre-ft)	0.05	0.72	0.03
C & E Loss (ft)	0.01	Cum SA (acres)	0.15	1.09	0.11

Plan: Plan 01 WEST PR chan-west-pr RS: 700 Profile: PF 1

E.G. Elev (ft)	6934.89	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.21	Wt. n-Val.	0.045	0.030	0.045
W.S. Elev (ft)	6934.68	Reach Len. (ft)	114.30	100.00	85.80
Crit W.S. (ft)	6934.68	Flow Area (sq ft)	19.28	40.94	0.05
E.G. Slope (ft/ft)	0.020420	Area (sq ft)	19.28	40.94	0.05
Q Total (cfs)	213.00	Flow (cfs)	49.48	163.47	0.05
Top Width (ft)	144.97	Top Width (ft)	48.02	96.60	0.35
Vel Total (ft/s)	3.53	Avg. Vel. (ft/s)	2.57	3.99	1.04
Max Chl Dpth (ft)	0.72	Hydr. Depth (ft)	0.40	0.42	0.15
Conv. Total (cfs)	1490.6	Conv. (cfs)	346.3	1143.9	0.4
Length Wtd. (ft)	100.94	Wetted Per. (ft)	48.08	96.61	0.50
Min Ch El (ft)	6933.96	Shear (lb/sq ft)	0.51	0.54	0.13
Alpha	1.10	Stream Power (lb/ft s)	1.31	2.16	0.14
Frctn Loss (ft)	1.75	Cum Volume (acre-ft)	0.03	0.58	0.03
C & E Loss (ft)	0.01	Cum SA (acres)	0.10	0.83	0.11

Plan: Plan 01 WEST PR chan-west-pr RS: 600 Profile: PF 1

E.G. Elev (ft)	6932.25	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.27	Wt. n-Val.	0.045	0.030	0.045
W.S. Elev (ft)	6931.98	Reach Len. (ft)	110.80	100.00	88.00
Crit W.S. (ft)	6931.98	Flow Area (sq ft)	2.92	40.77	15.25
E.G. Slope (ft/ft)	0.014832	Area (sq ft)	2.92	40.77	15.25
Q Total (cfs)	213.00	Flow (cfs)	4.29	182.83	25.88
Top Width (ft)	133.02	Top Width (ft)	13.18	63.58	56.26
Vel Total (ft/s)	3.61	Avg. Vel. (ft/s)	1.47	4.48	1.70
Max Chl Dpth (ft)	1.12	Hydr. Depth (ft)	0.22	0.64	0.27
Conv. Total (cfs)	1749.0	Conv. (cfs)	35.2	1501.2	212.5
Length Wtd. (ft)	99.38	Wetted Per. (ft)	13.25	63.61	56.27
Min Ch El (ft)	6930.86	Shear (lb/sq ft)	0.20	0.59	0.25
Alpha	1.35	Stream Power (lb/ft s)	0.30	2.66	0.43
Frctn Loss (ft)	1.52	Cum Volume (acre-ft)	0.00	0.49	0.02
C & E Loss (ft)	0.00	Cum SA (acres)	0.02	0.64	0.06

Plan: Plan 01 WEST PR chan-west-pr RS: 500 Profile: PF 1

E.G. Elev (ft)	6929.85	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.32	Wt. n-Val.		0.030	
W.S. Elev (ft)	6929.52	Reach Len. (ft)	85.20	100.00	105.50
Crit W.S. (ft)	6929.52	Flow Area (sq ft)		46.76	
E.G. Slope (ft/ft)	0.015820	Area (sq ft)		46.76	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	74.75	Top Width (ft)		74.75	
Vel Total (ft/s)	4.56	Avg. Vel. (ft/s)		4.56	
Max Chl Dpth (ft)	1.12	Hydr. Depth (ft)		0.63	
Conv. Total (cfs)	1693.5	Conv. (cfs)		1693.5	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		74.79	
Min Ch El (ft)	6928.40	Shear (lb/sq ft)		0.62	
Alpha	1.00	Stream Power (lb/ft s)		2.81	
Frctn Loss (ft)	1.52	Cum Volume (acre-ft)	0.00	0.38	
C & E Loss (ft)	0.01	Cum SA (acres)	0.00	0.49	

Plan: Plan 01 WEST PR chan-west-pr RS: 400 Profile: PF 1

E.G. Elev (ft)	6927.37	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.39	Wt. n-Val.		0.030	
W.S. Elev (ft)	6926.98	Reach Len. (ft)	95.20	100.00	105.50
Crit W.S. (ft)	6926.98	Flow Area (sq ft)		42.65	
E.G. Slope (ft/ft)	0.014589	Area (sq ft)		42.65	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	55.48	Top Width (ft)		55.48	
Vel Total (ft/s)	4.99	Avg. Vel. (ft/s)		4.99	
Max Chl Dpth (ft)	2.01	Hydr. Depth (ft)		0.77	
Conv. Total (cfs)	1763.4	Conv. (cfs)		1763.4	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		55.92	
Min Ch El (ft)	6924.97	Shear (lb/sq ft)		0.69	
Alpha	1.00	Stream Power (lb/ft s)		3.47	
Frctn Loss (ft)	1.41	Cum Volume (acre-ft)	0.00	0.28	
C & E Loss (ft)	0.01	Cum SA (acres)	0.00	0.34	

Plan: Plan 01 WEST PR chan-west-pr RS: 300 Profile: PF 1

E.G. Elev (ft)	6924.77	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.50	Wt. n-Val.		0.030	
W.S. Elev (ft)	6924.27	Reach Len. (ft)	113.50	100.00	139.70
Crit W.S. (ft)	6924.27	Flow Area (sq ft)		37.57	
E.G. Slope (ft/ft)	0.013593	Area (sq ft)		37.57	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	38.43	Top Width (ft)		38.43	
Vel Total (ft/s)	5.67	Avg. Vel. (ft/s)		5.67	
Max Chl Dpth (ft)	1.93	Hydr. Depth (ft)		0.98	
Conv. Total (cfs)	1826.9	Conv. (cfs)		1826.9	
Length Wtd. (ft)	100.00	Wetted Per. (ft)		38.63	
Min Ch El (ft)	6922.34	Shear (lb/sq ft)		0.83	
Alpha	1.00	Stream Power (lb/ft s)		4.68	
Frctn Loss (ft)	1.39	Cum Volume (acre-ft)	0.00	0.19	
C & E Loss (ft)	0.02	Cum SA (acres)	0.00	0.23	

Plan: Plan 01 WEST PR chan-west-pr RS: 200 Profile: PF 1

E.G. Elev (ft)	6921.79	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.42	Wt. n-Val.	0.000	0.030	
W.S. Elev (ft)	6921.37	Reach Len. (ft)	109.50	100.00	110.20
Crit W.S. (ft)	6921.37	Flow Area (sq ft)	0.00	41.06	
E.G. Slope (ft/ft)	0.014171	Area (sq ft)	0.00	41.06	
Q Total (cfs)	213.00	Flow (cfs)	0.00	213.00	
Top Width (ft)	50.39	Top Width (ft)	0.73	49.66	
Vel Total (ft/s)	5.19	Avg. Vel. (ft/s)	0.13	5.19	
Max Chl Dpth (ft)	1.39	Hydr. Depth (ft)	0.01	0.83	
Conv. Total (cfs)	1789.3	Conv. (cfs)	0.0	1789.3	
Length Wtd. (ft)	100.00	Wetted Per. (ft)	0.73	49.76	
Min Ch El (ft)	6919.98	Shear (lb/sq ft)		0.73	
Alpha	1.00	Stream Power (lb/ft s)		3.79	
Frctn Loss (ft)	1.36	Cum Volume (acre-ft)	0.00	0.10	
C & E Loss (ft)	0.03	Cum SA (acres)	0.00	0.13	

Plan: Plan 01 WEST PR chan-west-pr RS: 100 Profile: PF 1

E.G. Elev (ft)	6919.18	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.33	Wt. n-Val.		0.030	
W.S. Elev (ft)	6918.84	Reach Len. (ft)			
Crit W.S. (ft)	6918.81	Flow Area (sq ft)		45.94	
E.G. Slope (ft/ft)	0.013007	Area (sq ft)		45.94	
Q Total (cfs)	213.00	Flow (cfs)		213.00	
Top Width (ft)	61.67	Top Width (ft)		61.67	
Vel Total (ft/s)	4.64	Avg. Vel. (ft/s)		4.64	
Max Chl Dpth (ft)	0.84	Hydr. Depth (ft)		0.74	
Conv. Total (cfs)	1867.6	Conv. (cfs)		1867.6	
Length Wtd. (ft)		Wetted Per. (ft)		61.77	
Min Ch El (ft)	6918.00	Shear (lb/sq ft)		0.60	
Alpha	1.00	Stream Power (lb/ft s)		2.80	
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			

HEC-RAS Plan: 1 River: pr east Reach: chan-east Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
chan-east	2600	PF 1	151.00	6943.35	6944.44	6944.44	6944.68	0.013890	4.95	48.02	98.53	0.99
chan-east	2500	PF 1	151.00	6941.98	6942.70	6942.67	6942.92	0.013525	3.80	40.09	81.26	0.92
chan-east	2400	PF 1	151.00	6939.99	6941.15	6941.15	6941.46	0.015451	4.52	33.44	53.18	1.00
chan-east	2300	PF 1	151.00	6938.00	6939.10	6939.07	6939.35	0.013613	3.98	37.93	65.99	0.93
chan-east	2200	PF 1	151.00	6937.26	6938.16		6938.32	0.007658	3.29	48.99	94.76	0.71
chan-east	2100	PF 1	151.00	6935.98	6936.90	6936.90	6937.27	0.014805	4.90	30.80	41.81	1.01
chan-east	2010.89	PF 1	151.00	6934.00	6935.24	6935.24	6935.57	0.015841	4.65	32.47	50.32	1.02
chan-east	1900	PF 1	151.00	6932.00	6933.27		6933.41	0.005601	3.08	49.03	64.67	0.62
chan-east	1801.17	PF 1	151.00	6931.95	6932.32	6932.32	6932.46	0.020436	3.03	49.89	178.48	1.01
chan-east	1694.83	PF 1	151.00	6930.00	6930.68		6930.79	0.008061	2.63	57.35	125.77	0.69
chan-east	1600	PF 1	151.00	6928.61	6929.43	6929.43	6929.71	0.016551	4.25	35.51	65.13	1.02
chan-east	1500	PF 1	151.00	6924.50	6925.95	6925.95	6926.40	0.013890	5.37	28.14	31.77	1.01
chan-east	1400	PF 1	151.00	6922.61	6924.19	6924.19	6924.58	0.010327	5.12	32.60	52.79	0.89
chan-east	1300	PF 1	151.00	6921.96	6924.02		6924.06	0.000737	1.60	94.47	73.05	0.25
chan-east	1200	PF 1	151.00	6919.97	6924.04	6920.69	6924.04	0.000019	0.52	347.77	125.66	0.05
chan-east	1111.15		Culvert									
chan-east	1000	PF 1	151.00	6917.10	6918.32	6918.32	6918.77	0.012125	5.38	29.49	39.48	0.96
chan-east	900	PF 1	151.00	6915.94	6918.21		6918.27	0.000741	1.96	77.46	48.70	0.26
chan-east	800	PF 1	151.00	6913.99	6918.22		6918.24	0.000098	1.11	170.28	80.01	0.11
chan-east	700	PF 1	151.00	6913.94	6918.22		6918.23	0.000038	0.72	268.56	167.89	0.07
chan-east	600	PF 1	151.00	6917.00	6917.95	6917.95	6918.19	0.016742	3.95	38.22	80.42	1.00
chan-east	500	PF 1	151.00	6909.99	6912.09		6912.39	0.005142	4.36	34.70	26.53	0.65
chan-east	400	PF 1	151.00	6909.92	6911.08	6911.08	6911.58	0.013780	5.64	26.76	27.67	1.01
chan-east	300	PF 1	151.00	6907.98	6909.39	6909.39	6909.86	0.013560	5.51	27.40	29.10	1.00
chan-east	200	PF 1	151.00	6905.98	6907.55	6907.55	6908.10	0.013390	5.97	25.29	23.44	1.01
chan-east	100	PF 1	151.00	6904.03	6905.75	6905.75	6906.27	0.013509	5.76	26.23	25.97	1.01

verify

east chan pr Plan: Plan 01 3/7/2022
.045
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Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
6946.0
6945.5
6945.0
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6943.0
Elevation (ft)
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Station (ft)

east chan pr Plan: Plan 01 3/7/2022
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Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
6945.0
6944.5
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6943.5
6943.0
6942.5
6942.0
6941.5
Elevation (ft)
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Station (ft)

east chan pr Plan: Plan 01 3/7/2022
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Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
6944
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6939
Elevation (ft)
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Station (ft)

east chan pr Plan: Plan 01 3/7/2022
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Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
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Station (ft)

east chan pr Plan: Plan 01 3/7/2022
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Legend
EG PF 1
WS PF 1
Ground
Bank Sta
6942
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Elevation (ft)
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Station (ft)

east chan pr Plan: Plan 01 3/7/2022
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Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
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Station (ft)

east chan pr Plan: Plan 01 3/7/2022
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Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6937.0
6936.5
6936.0
6935.5
6935.0
6934.5
6934.0
0
50
100
150
200
250
Station (ft)

east chan pr Plan: Plan 01 3/7/2022
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Legend
EG PF 1
WS PF 1
Ground
Bank Sta
6935.5
6935.0
6934.5
6934.0
6933.5
6933.0
6932.5
6932.0
Elevation (ft)
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200
Station (ft)

east chan pr Plan: Plan 01 3/7/2022
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Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6939
6938
6937
6936
6935
6934
6933
6932
6931
0
100
200
300
400
500
Station (ft)

east chan pr Plan: Plan 01 3/7/2022
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Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6933.5
6933.0
6932.5
6932.0
6931.5
6931.0
6930.5
6930.0
100
150
200
250
300
350
Station (ft)

east chan pr Plan: Plan 01 3/7/2022
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Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
6932.0
6931.5
6931.0
6930.5
6930.0
6929.5
6929.0
6928.5
60
80
100
120
140
160
180
200

east chan pr Plan: Plan 01 3/7/2022
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Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6932
6931
6930
6929
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6927
6926
6925
6924
0
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100
150
200
Station (ft)

east chan pr Plan: Plan 01 3/7/2022
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Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6930
6929
6928
6927
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6925
6924
6923
6922
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100
150
200
Station (ft)

east chan pr Plan: Plan 01 3/7/2022
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Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6930
6928
6926
6924
6922
6920
0
50
100
150
200
Station (ft)

east chan pr Plan: Plan 01 3/7/2022
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.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6930
6928
6926
6924
6922
6920
6918
0
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100
150
200
Station (ft)

east chan pr Plan: Plan 01 3/7/2022
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Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6930
6928
6926
6924
6922
6920
6918
0
50
100
150
200
Station (ft)

east chan pr Plan: Plan 01 3/7/2022
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.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6926
6924
6922
6920
6918
6916
0
50
100
150
200
Station (ft)

east chan pr Plan: Plan 01 3/7/2022
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Legend
EG PF 1
WS PF 1
Ground
Bank Sta
6928
6926
6924
6922
6920
6918
6916
6914
Elevation (ft)
0
50
100
150
200
Station (ft)

east chan pr Plan: Plan 01 3/7/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
6922
6921
6920
6919
6918
6917
6916
6915
6914
6913
0
50
100
150
200
Station (ft)

east chan pr Plan: Plan 01 3/7/2022
.045
.03
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Legend
EG PF 1
WS PF 1
Ground
Bank Sta
complete the cross-section
Elevation (ft)
6924
6922
6920
6918
6916
6914
6912
0
50
100
150
200
Station (ft)

east chan pr Plan: Plan 01 3/7/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6923
6922
6921
6920
6919
6918
6917
0
50
100
150
200
Station (ft)

east chan pr Plan: Plan 01 3/7/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
6922
6920
6918
6916
6914
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6910
6908
Elevation (ft)
0
50
100
150
200
Station (ft)

east chan pr Plan: Plan 01 3/7/2022
.045
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.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6920
6918
6916
6914
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6908
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100
150
200
Station (ft)

east chan pr Plan: Plan 01 3/7/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6918
6916
6914
6912
6910
6908
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0
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100
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200
Station (ft)

east chan pr Plan: Plan 01 3/7/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6916
6914
6912
6910
6908
6906
6904
0
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100
150
200
Station (ft)

east chan pr Plan: Plan 01 3/7/2022
.045
.03
.045
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
6916
6914
6912
6910
6908
6906
6904
0
50
100
150
200
Station (ft)

Verify that cross-sections are correct

Adjust lot to be out of floodplain

Are contours missing?

LEGEND

5' EXISTING CONTOUR	6850
1' EXISTING CONTOUR	6852
5' PROPED CONTOUR	6850
1' PROPED CONTOUR	6852
LIMITS OF DISTURBANCE	
SUBDIVISION BOUNDARY	
100-Y HWL	

SCALE: 1"=100'

REVISIONS

NO.	DESCRIPTION	DATE

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY THE APPROPRIATE REVIEWING AGENCIES, TERRA NOVA ENGINEERING, INC. APPROVES THEIR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.

PREPARED FOR:
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WATERBURY FILING NO. 1 & 2

GRADING AND UTILITIES PLAN

DESIGNED BY DLF
DRAWN BY QNA
CHECKED BY QNA
H-SCALE 1" = 100'
V-SCALE N/A
JOB NO. 1715.00
DATE ISSUED 3/3/22
SHEET NO. 1 OF 1

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 MERIDAN RANCH MDDP													**5**	**11**
OS-9	FLOW TAKEN FROM MERIDAN 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-EX10A	18.92	1.47	5.89	15.4	3.43	5.81	33	219	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	10	44	EAST BOUNDARY
EX6	EXF	1.62	0.15	0.58	13.8	3.59	6.12	1	4	EAST BOUNDARY
EX7	EXE, EXF, OS-1, OS-2, OS-8 & OS-9	78.24	5.75	23.00	18.9	3.13	5.24	31	151	DP 30 PROP CONDITION
EX9	OS-9	11.80						8	19	DP 30 PROP CONDITION
EX10	OS-8	2.56						5	11	DP 30 PROP CONDITION
EX10A	MERIDIAN POND E RELEASE	Meridaian Ranch Filing 3 FDR Calculated Flows						28	185	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
DRAWN BY	QNA
CHECKED BY	
H-SCALE	1"=100'
V-SCALE	
JOB NO.	1715.00
DATE ISSUED	3/3/22
SHEET NO.	1 OF 2

REVISIONS

NO.	DESCRIPTION	DATE

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WATERBURY FILING 1 & 2

EXISITING MDDP DRAINAGE MAP 2
ONSITE MAP

DESIGNED BY QNA
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H-SCALE 1"=100'
V-SCALE
JOB NO. 1715.00
DATE ISSUED 3/3/22
SHEET NO. 2 OF 2

REVISIONS

NO.	DESCRIPTION	DATE

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WATERBURY FILING 1 & 2

EARLY GRADING 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 3/3/22
SHEET NO. 1 OF 2

MDDP DRAINAGE REPORT ~ EARLY GRADING 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)
PRE-A	4.61	0.00	0.45	0.59	4.61	0.09	0.36	0.09	0.36	0.41	1.66
PRE-B	12.35	0.00	0.45	0.59	12.35	0.09	0.36	0.09	0.36	1.11	4.45
PRE-C	19.08	0.00	0.45	0.59	19.08	0.09	0.36	0.09	0.36	1.72	6.87
PRE-D	15.52	0.00	0.45	0.59	15.52	0.09	0.36	0.09	0.36	1.40	5.59
PRE-E	6.33	0.00	0.45	0.59	6.33	0.09	0.36	0.09	0.36	0.57	2.28
PRE-F	0.62	0.00	0.45	0.59	0.62	0.09	0.36	0.09	0.36	0.06	0.22
PRE-G	2.00	0.00	0.45	0.59	2.00	0.09	0.36	0.09	0.36	0.18	0.72
PRE-H	1.33	0.00	0.45	0.59	1.33	0.09	0.36	0.09	0.36	0.12	0.48
OS-1	0.75	0.00	0.45	0.59	0.75	0.09	0.36	0.09	0.36	0.07	0.27
OS-2	11.15	0.00	0.45	0.59	11.15	0.09	0.36	0.09	0.36	1.00	4.01
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	0.56	0.00	0.45	0.59	0.56	0.09	0.36	0.09	0.36	0.05	0.20
OS-8	2.56	FLOW TAKEN FROM MERIDAIN RANCH MDDP									

MDDP ~ EARLY GRADING 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)
PRE-A	0.41	1.66	0.25	100	2.5	11.7	909	1.4%	4.2	3.6	15.4	3.43	5.82	1	10
PRE-B	1.11	4.45	0.25	100	2.5	11.7	1612	1.3%	4.0	6.7	18.5	3.16	5.31	4	24
PRE-C	1.72	6.87	0.25	100	2.5	11.7	1308	1.3%	4.0	5.5	17.2	3.27	5.50	6	38
PRE-D	1.40	5.59	0.25	100	2	12.6	1297	1.6%	4.5	4.9	17.5	3.24	5.46	5	30
PRE-E	0.57	2.28	0.25	100	8	8.0	752	2.1%	5.1	2.5	10.5	4.00	6.94	2	16
PRE-F	0.06	0.22	0.25	64	2	8.7					8.7	4.26	7.47	0	2
PRE-G	0.18	0.72	0.25	161	5	13.9					13.9	3.58	6.12	1	4
PRE-H	0.12	0.48	0.25	67	2	9.1					9.1	4.21	7.36	1	4
OS-1	0.07	0.27	0.25	85	2	11.0	75	1.3%	4.0	0.3	11.4	3.88	6.70	0	2
OS-2	1.00	4.01	0.25	76	2	10.1	1427	2.1%	5.1	4.7	14.8	3.49	5.94	4	24
OS-3	0.10	0.40	0.25	100	9	7.7	329	2.5%	5.5	1.0	8.7	4.27	7.49	0	3
OS-4	0.05	0.20	0.25	100	2	12.6	127	2.4%	5.4	0.4	13.0	3.68	6.30	0	1
OS-8	FLOW TAKEN FROM MERIDAIN RANCH MDDP													5	11

Missing Basin OS-9 in table & hydrology spreadsheet

MDDP ~ EARLY GRADING 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
PRE1	PRE-B & OS-4	4.65	1.16	4.65	18.5	3.16	5.31	4	25	TSB 1
PRE2	PRE-C	19.08	1.72	6.87	17.2	3.27	5.50	6	38	TSB 2
PRE3	PRE-D & OS-3	16.63	1.50	5.99	17.5	3.24	5.46	5	33	TSB 3
PRE4	PRE-E & OS-1	7.07	0.64	2.55	10.5	4.00	6.94	3	18	TSB 4
PRE5	OS-8 & OS-2	13.71	1.00	4.01	14.8	3.49	5.94	9	35	EASTERN CHANNEL
PRE6	PRE-F	0.62	0.06	0.22	8.7	4.26	7.47	0	2	STAPLETON ROAD
PRE7	PRE-G, PRE-H & DPS PRE2-PRE5	59.82	5.15	20.61	17.5	3.24	5.46	25	147	EX GEICK RANCH CHANNEL

Missing Design Points EX10, 9 & 13

REVISIONS

NO.	DESCRIPTION	DATE

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WATERBURY FILING 1 & 2

EARLY GRADING DRAINAGE MAP 2
OFFSITE MAP

DESIGNED BY QNA
DRAWN BY QNA
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H-SCALE 1"=100'
V-SCALE
JOB NO. 1715.00
DATE ISSUED 3/3/22
SHEET NO. 2 OF 2

MDDP ~ PROPOSED 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
1	A	3.39	1.52	2.00	14.3	3.54	6.03	5	12	10' Type R Sump Inlet
2	C	0.86	0.39	0.51	6.9	4.58	8.14	2	4	5' Type R Sump Inlet
3	B1	2.30	1.03	1.36	14.2	3.55	6.05	4	8	5' Type R Sump Inlet
4	B2	2.69	1.21	1.59	14.8	3.49	5.93	4	9	5' Type R Sump Inlet
5	F & H	3.31	1.49	1.95	9.5	4.14	7.22	6	14	10' Type R Sump Inlet
6	D	2.11	0.95	1.24	11.4	3.87	6.69	4	8	5' Type R Sump Inlets
7	E	2.18	0.98	1.29	13.8	3.59	6.12	4	8	5' Type R Sump Inlets
7A	G1	0.53	0.24	0.31	5.0	5.00	9.06	1	3	5' Type R At-grade Inlet
7B	G2	0.69	0.31	0.41	5.0	5.00	9.06	2	4	5' Type R At-grade Inlet
8	DESIGN POINTS 1-7 & K	16.84	7.58	9.94	14.8	3.49	5.93	26	59	FSD Pond 1
9	OS-9	11.80						8	19	EX 36" CMP Culvert
10	OS-8	2.56						5	11	EX 36" CMP Culvert
10A	MERIDIAN POND E RELEASE	Meridaian Ranch Filing 3 FDR Calculated Flows						28	185	EX 3-42" RCP Culverts
11	OS-5, I, DP10A (MERIDIAN POND E RELEASE)	Sum of Basins						36	213	PR 2-42" RCP Culverts
12	OS-6	1.06	0.48	0.63	10.1	4.05	7.04	2	4	18" RCP Culvert
13	TOTAL OFFSITE EX. STOCK POND INFLOW	Per "Final Drainage Report for Waterbury Filing No. 1" dated September 2016, by Classic Consulting						69	396	EX STOCK POND
14	L1	3.04	1.37	1.79	16.1	3.36	5.69	5	10	10' Type R Sump Inlet
15	L2	2.00	0.90	1.18	12.8	3.70	6.34	3	7	5' Type R Sump Inlet
16	O1	2.82	1.27	1.66	13.5	3.62	6.19	5	10	10' Type R Sump Inlet
17	O2	0.71	0.32	0.42	15.5	3.42	5.80	1	2	5' Type R Sump Inlet
18	DESIGN POINTS 14-17 & BASIN OS-4	19.48	4.84	5.06	16.1	3.36	5.69	16	29	Interim FSD Pond 2
19	Q1 & OS-Q1	5.37	2.41	3.17	22.4	2.88	4.78	7	15	10' Type R Sump Inlet
20	Q2 & OS-Q2	1.89	0.85	1.12	12.4	3.75	6.43	3	7	5' Type R Sump Inlet
21	R & OS-R	7.06	3.18	4.17	11.4	3.87	6.69	12	28	10' Type R At-grade Inlet
22	S1 & OS-S1 & DP 21 FLOW BY	8.34	4.42	5.64	16.7	3.32	5.60	15	32	10' Type R Sump Inlet
23	S2 & OS-S2	0.31	0.14	0.18	12.6	3.72	6.39	1	1	10' Type R Sump Inlet
22 & 23 SPLIT	S1, OS-S1, S2, OS-S2, & DP 21 FLOW BY	8.65	4.56	5.82	16.7	3.32	5.60	8	16	2-10' Type R Sump Inlets
24	T1	1.42	0.64	0.84	10.7	3.97	6.88	3	6	5' Type R Sump Inlets
25	T2 & OS-T2	1.99	0.90	1.18	13.5	3.63	6.20	3	7	5' 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	5' Type R Sump Inlets
28	W	5.20	2.34	3.07	15.0	3.47	5.89	8	18	2-10' Type R Sump Inlets
29	DPS 19-26, 31-32, OFFSITE BASINS OS-1, 2, 3A, 3B, T, & 9	82.02	35.91	47.46	22.4	2.88	4.78	112	246	FSD POND
30	Y & OS-10	3.76	0.46	1.43	13.5	3.62	6.19	2	9	Triple 36" RCP Culverts
30	FSD POND 3 EMERGCNEY SPILLWAY RELEASE	MHFD DETENTION 100Y PEAK INFLOW							204	Triple 36" RCP Culverts
31	V	0.54	0.24	0.32	5.0	5.00	9.06	1	3	18" DIA INLETS
32	X	0.43	0.19	0.25	5.0	5.00	9.06	1	2	18" DIA INLETS
33	O-3	0.45	0.20	0.27	5.0	5.00	9.06	1	2	18" DIA INLETS
34	O-4	0.38	0.17	0.23	5.0	5.00	9.06	1	2	18" DIA INLETS

MDDP ~ PIPE ROUTING SUMMARY

Pipe Run	Contributing Design Points/Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	Intensity I(100)	Flow Q(5)	Flow Q(100)	Pipe Size*
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	24" RCP
10A	DP-7A	0.24	0.31	5.0	5.00	9.06	1	3	24" RCP
10B	DP-7A & 7B	0.55	0.72	5.0	5.00	9.06	3	7	24" RCP
10C	POND 1 RELEASE	2.95	3.87	13.8	3.59	6.12	0.4	8.2	18" RCP
11	DP-14	1.37	1.79	16.1	3.36	5.69	5	10	24" RCP
12	DP-15	0.90	1.18	12.8	3.70	6.34	3	7	18" RCP
13	DP 14 & 15	2.27	2.98	16.1	3.36	5.69	8	17	30" RCP
14	DP 16	1.27	1.66	13.5	3.62	6.19	5	10	24" RCP
15	DP 14, 15 & 16	3.54	4.64	16.1	3.36	5.69	12	26	36" RCP
16	DP 17	0.32	0.42	15.5	3.42	5.80	1	2	18" RCP
17	DP 14, 15, 16, 17, 33, & 34	4.24	5.55	16.1	3.36	5.69	14	32	36" RCP
17A	POND 2 RELEASE						0.2	10.1	18" RCP
18	DP 19	2.41	3.17	22.4	2.88	4.78	7	15	24" RCP
19	DP 20	0.85	1.12	12.4	3.75	6.43	3	7	18" RCP
20	DP 18 & 19	3.27	4.28	22.4	2.88	4.78	9	20	24" RCP
21	DP 21 PICK UP						8	14	18" RCP
22	DP 19, 20 & 21	6.04	7.21	22.4	2.88	4.78	17	34	30" RCP
23	DP 22	2.28	2.91	16.7	3.32	5.60	8	16	24" RCP
24	DP 23	2.28	2.91	16.7	3.32	5.60	8	16	24" RCP
25	DP 22 & 23	4.56	5.82	16.7	3.32	5.60	15	33	30" RCP
26	DP 19 -23	10.60	13.03	22.4	2.88	4.78	31	62	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	12.13	15.05	22.4	2.88	4.78	35	72	36" RCP
30	DP 26	1.97	2.58	14.3	3.54	6.03	7	16	24" RCP
31	DP 19-26	14.10	17.63	22.4	2.89	4.79	41	84	42" RCP
32	DP 27	0.85	1.11	13.8	3.59	6.12	3	7	18" RCP
33	DP 19-27, & 31	15.19	19.06	22.4	2.88	4.78	44	91	42" RCP
34	DP 28 SPLIT	1.17	1.53	15.0	3.47	5.89	4	9	18" RCP
34A	29 & 32	2.53	3.32	15.0	3.47	5.89	9	20	18" RCP
35	Pond 3 Release	MHFD UD-DETENTION POND RELEASE					1.2	58.1	36" RCP
36	DP 30	FSD POND 3 EMERGCNEY SPILLWAY RELEASE						204.3	TRIPLE 36" RCP
37	DP 31	0.24	0.32	5.00	5.00	9.06	1.2	3	15" HDPE
38	DP 32	0.19	0.25	5.00	5.00	9.06	1.2	2	15" HDPE
39	DP 33	0.20	0.27	5.00	5.00	9.06	1.2	2	15" HDPE
40	DP 34	0.17	0.23	5.00	5.00	9.06	1.2	2	15" HDPE

Highlighted Pipes sizes do not match those in MDDP Pipe run calculations in appendix

Calculations missing in appendix for these pipes

Provide proposed contours

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	6910
BASIN BOUNDARY (TRIB. TO POND)	
BASIN BOUNDARY (OFFSITE)	
BASIN BOUNDARY (ONSITE)	
STORM SEWER	
WETLANDS	
100 YR. FLOODPLAIN	
BASIN IDENTIFIER	K
AREA IN ACRES	1.5
DESIGN POINT	5
PIPE RUN	17
EXISTING DIRECTION OF FLOW	
Tc PATH	

MDDP ~ PROPOSED 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	400	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
G1	0.24	0.31	0.25								5.0	5.00	9.06	1	3
G2	0.31	0.41	0.25								5.0	5.00	9.06	2	4
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	1.43	2.72	0.25	80	4	8.4	250	2.0%	4.9	0.8	9.2	4.18	7.32	6	14
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	1.37	1.79	0.25	100	2	12.6	860	1.4%	4.1	3.5	16.1	3.36	5.69	5	10
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	0.74	0.97	0.25	70	1.5	10.3	200	2.0%	4.9	0.7	11.0	3.92	6.79	3	7
M2	0.20	0.26	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	2.5	11.7	460	1.5%	4.3	1.8	13.5	3.62	6.19	5	10
O2	0.32	0.42	0.25	100	2	12.6	850	2.0%	4.9	2.9	15.5	3.42	5.80	1	2
O3	0.20	0.27	0.25								5.0	5.00	9.06	1	2
O4	0.17	0.23	0.25								5.0	5.00	9.06	1	2
P	0.06	0.25	0.25								5.0	5.00	9.06	0	2
Q1	0.48	0.62	0.25	55	1.3	8.9	445	2.0%	5.0	1.5	10.4	4.01	6.97	2	4
Q2	0.43	0.56	0.25	55	1.3	8.9	445	2.0%	5.0	1.5	10.4	4.01	6.97	2	4
R	0.46	0.60	0.25	100	4	10.1	700	2.0%	4.9	2.4	12.4	3.75	6.44	2	4
S1	0.70	0.91	0.25	100	6	8.8	175	2.0%	4.9	0.6	9.4	4.16	7.20	3	7
S2	0.06	0.08	0.25								5.0	5.00	9.06	0	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
V	0.24	0.32	0.25								5.0	5.00	9.06	1	3
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
X	0.19	0.25	0.25								5.0	5.00	9.06	1	2
Y	0.16	0.21	0.25								5.0	5.00	9.06	1	2
OS-1	5.31	6.97	0.25	100	2	12.6	690	2.0%	5.0	2.3	15.0	3.47	5.90	18	41
OS-2	5.19	6.80	0.25	100	2	12.6	1700	1.8%	4.6	6.1	18.7	3.14	5.27	16	36
OS-3A	0.35	0.47	0.25	55	1.1	9.4	480	1.3%	3.9	2.0	11.4	3.87	6.68	1	3
OS-3B	2.55	3.34	0.25	100	2	12.6	480	1.3%	3.9	2.0	14.7	3.50	5.95	9	20
OS-4	0.98	3.92	0.25	800	26	30.5					30.5	2.46	4.01	2	16
OS-5	0.51	2.03	0.25	80	5	7.8	1000	2.5%	5.5	3.0	10.8	3.96	6.85	2	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	0.25	1.01									5.0	5.00	9.06	1	9
OS-8	FLOW TAKEN FROM MERIDIAN RANCH MDDP													5	11
OS-9	FLOW TAKEN FROM MERIDIAN RANCH MDDP													8	19
OS-10	0.31	1.23	0.25	100	2	12.6	300	2.7%	5.7	0.9	13.5	3.62	6.19	1	8
OS-Q1	1.94	2.54	0.25	200	5	16.6	1500	1.5%	4.3	5.8	22.4	2.88	4.78	6	12
OS-Q2	0.42	0.55	0.25	50	1	8.9	900	1.5%	4.3	3.5	12.4	3.75	6.43	2	4
OS-R	2.72	3.57	0.25	50	1	8.9	850	2.7%	5.8	2.5	11.4	3.87	6.69	11	24
OS-S1	2.51	3.30	0.25	100	2	12.6	920	1.2%	3.8	4.0	16.7	3.32	5.60	8	18
OS-S2	0.08	0.10	0.25	100	2	12.6					12.6	3.72	6.39	0	1
OS-T2	0.34	0.45	0.25	100	2	12.6					12.6	3.72	6.39	1	3

NO.	DESCRIPTION	DATE

REVISIONS

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY ALL APPROPRIATE REVIEWING AGENCIES, THE ENGINEER AND ENGINEERING FIRM SHALL NOT BE LIABLE FOR ANY CHANGES MADE TO THESE DRAWINGS WHICH HAVE NOT BEEN APPROVED BY THE ENGINEER AND ENGINEERING FIRM OR THEIR DESIGNATED REPRESENTATIVE.

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WATERBURY FILING 1 & 2

MDDP
PROPOSED MDDP DRAINAGE MAP 1
OFFSITE MAP

DESIGNED BY QNA
DRAWN BY QNA
CHECKED BY
H-SCALE 1"=100'
V-SCALE
JOB NO. 1715.00
DATE ISSUED 3/3/22
SHEET NO. 1 OF 2

MATCHLINE SEE SHEET 1
RUNOFF REDUCTION LEGEND
UNCONNECTED IMPERVIOUS AREA
RECEIVING PERVIOUS AREA
LEGEND
DESCRIPTION
SYMBOL
EXISTING GROUND CONTOUR 6910
PROPOSED FINISHED CONTOUR 6910
BASIN BOUNDARY (TRIB. TO POND)
BASIN BOUNDARY (OFFSITE)
BASIN BOUNDARY (ONSITE)
STORM SEWER
WETLANDS
100 YR. FLOODPLAIN
BASIN IDENTIFIER K
AREA IN ACRES 1.5
DESIGN POINT 5
PIPE RUN 17
EXISTING DIRECTION OF FLOW
Tc PATH
SCALE: 1" = 100'
Consider moving overflow spillways north (less drop to channels)
PROPOSED FSD POND 2
(0.241 AC-FT. WQCV)
(0.237 AC-FT. EURV)
(1.041 AC-FT 100-Y)
(3:1 SLOPES / 6' MAX. DEPTH)
PROPOSED IN-FLOW
5-YR. = 5.2 CFS
100-YR. = 19.9 CFS
PROPOSED RELEASE
5-YR. = 0.2 CFS
100 YR. = 10.1 CFS
PROPOSED FSD POND 3
(1.396 AC-FT. WQCV)
(3.248 AC-FT. EURV)
(7.405 AC-FT 100-Y)
(3:1 SLOPES / 8' MAX. DEPTH)
PROPOSED IN-FLOW
5-YR. = 51 CFS
100-YR. = 204.3 CFS
PROPOSED RELEASE
5-YR. = 0.8 CFS
100 YR. = 58.1 CFS
Still unresolved:
It is still unclear which areas throughout the site are to be excluded from WQ treatment. For example, it appears that these three areas are to be graded but are not tributary to a pond or a runoff reduction area. Clarify which exclusion(s) apply to each area. It is really helpful to have a WQ-specific map such as the example provided below. It has different colors for each tributary area to each pond and for the different exclusions (Exclusion D for utilities, Exclusion G for land disturbance to undeveloped land that will remain undeveloped, and up to 20% not to exceed 1ac of the site can be excluded from WQ treatment.
Note that all RPA areas will need to be within a no build/drainage easement and discussed in the maintenance agreement and O&M manual. Also make sure to show the limits of the RPA's on GEC Plans (not just FDR) so our SW inspectors and the QSM know that these areas are to remain pervious and vegetated post-construction.
Update the O&M Manual accordingly and provide a Maintenance Agreement.
SEE APPENDIX FOR ALL OFF-SITE SWQ BASINS TRIBUTARY TO THE PROPOSED SWQ PONDS.
EXIST. OFF-SITE SWQ POND 1
0.52 AC-FT. WQCV REQ.
0.66 AC-FT. WQCV PROVIDED WITH INSTALLED CONCRETE OUTLET BOX AND ORIFICE PLATE
EXIST. IN-FLOW
5-YR. = 18 CFS
100-YR. = 133 CFS
EXIST. RELEASE
5-YR. = 13 CFS
100 YR. = 131 CFS
EXIST. OFF-SITE SWQ POND 2
0.34 AC-FT. WQCV REQ.
0.60 AC-FT. WQCV PROVIDED WITH INSTALLED CONCRETE OUTLET BOX AND ORIFICE PLATE
PROPOSED IN-FLOW
5-YR. = 10 CFS
100-YR. = 53 CFS
PROPOSED RELEASE
5-YR. = 0.4 CFS
100 YR. = 51 CFS
EXIST OFF-SITE SWQ POND 3
(IN-LINE)
0.66 AC-FT. WQCV REQ.
1.2 AC-FT. WQCV PROVIDED WITHIN THE EXIST. STOCK POND
PROPOSED IN-FLOW
5-YR. = 69 CFS
100-YR. = 397 CFS
PROPOSED RELEASE
5-YR. = 69 CFS
100 YR. = 396 CFS
HISTORIC RELEASE
5-YR. = 76 CFS
100 YR. = 437 CFS
PROPOSED FSD POND 1
(0.391 AC-FT. WQCV)
(1.002 AC-FT. EURV)
(2.154 AC-FT 100-Y)
(3:1 SLOPES / 6' MAX. DEPTH)
PROPOSED IN-FLOW
5-YR. = 16.3 CFS
100-YR. = 38.5 CFS
PROPOSED RELEASE
5-YR. = 0.4 CFS
100 YR. = 8.2 CFS
EXIST. STOCK POND CONVERTED TO SWQ FOREBAY FOR MITIGATION OF 4-WAY RANCH FIL. 1 AND PORTIONS OF WATERBURY DEVELOPMENT
EXIST. DRAINAGE ESMT. (REC.# 214087198)
EXIST. DRAINAGE ESMT. (BY SEPARATE INSTRUMENT)
EXIST. (2)-4' HIGH x 8' WIDE CBC
EX. 4'x4' CONC. OUTLET BOX W/ INTEGRAL MICROPOOL AND 24" RCP OUTLET PIPE AND E/C BLANKET AT SPILLWAY
24' WIDE CONCRETE TRICKLE CHANNEL
18'X12' CONC. FOREBAY W/ RIP-RAP
APPROX. LOCATION OF 100 YR. FEMA FLOODPLAIN
DUAL 42" RCP CULVERTS
18" RCP CULVERT
TRIPLE 36" RCP CULVERTS
WETLANDS
UNPLATTED
FUTURE WATERBURY DEVELOPMENT
FUTURE C&G
MAINT. ACCESS
4 -WAY RANCH FILING NO. 1
LOT 13
LOT 14
LOT 15
LOT 35
LOT 36
LOT 37
BANDANERO DRIVE (80' ROW)
OLBERG DRIVE (70' ROW)
THATCHER COURT (70' ROW)
TRACT A
TRACT B
TRACT B1
TRACT C
TRACT D
TRACT E
TRACT G
TRACT H
SKYBROOK ROAD
MANDI PARKWAY
MADONBORO WAY
MEDINA WAY
BECONIC WAY
PROPERTY LINE
REVISIONS
NO. DESCRIPTION DATE
UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY ALL APPROPRIATE REVIEWING AGENCIES, THE CONSULTING ENGINEER ASSUMES NO RESPONSIBILITY FOR THE USE OF THESE DRAWINGS BY ANY OTHER PARTY NOT DESIGNATED BY WRITTEN AUTHORIZATION.
WATERBURY FILING 1 & 2
MDDP
PROPOSED 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 3/3/22
SHEET NO. 2 OF 2

PELIMINARY DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

Pipe Run	Contributing Design Points/Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	Intensity I(100)	Flow Q(5)	Flow Q(100)	Pipe Size*
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	24" RCP
10A	DP-7A						1.2	2.8	24" RCP
10B	DP-7A & 7B						1.2	2.8	24" RCP
10C	Pond 1 Release						1.2	2.8	18" RCP
11	DP-14	1.37	1.79	16.1	3.36	5.69	5	10	24" RCP
12	DP-15	0.90	1.18	16.1	3.36	5.69	3	7	18" RCP
13	DP 14 & 15	2.27	2.98	16.1	3.36	5.69	8	17	30" RCP
14	DP 16	1.27	1.66	5.0	5.00	9.06	6	15	24" RCP
15	DP 14, 15 & 16	3.54	4.64	16.1	3.36	5.69	12	26	36" RCP
16	DP 17	0.32	0.42	13.5	3.62	6.19	1	3	18" RCP
17	DP 14, 15, 16, & 17	3.86	5.06	16.1	3.36	5.69	13	29	36" RCP
17A	Pond 2 Release						1.1	2.4	18" RCP
18*	**DP 19**	**0.51**	**0.74**	**13.2**	**3.66**	**6.27**	**2**	**5**	**24" RCP**
19*	**DP 20**	**0.45**	**0.65**	**9.5**	**4.14**	**7.24**	**2**	**5**	**18" RCP**
20*	**DP 19 & 20**	**0.96**	**1.39**	**13.2**	**3.66**	**6.27**	**4**	**9**	**24" RCP**
21*	**DP 21 PICK UP**						**2**	**6**	**18" RCP**
22*	**DP 19, 20 & 21**	**1.50**	**2.35**	**13.2**	**3.66**	**6.27**	**6**	**15**	**24" RCP**
23*	**DP 22**	**0.72**	**1.02**	**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**	**0.80**	**1.15**	**12.4**	**3.75**	**6.44**	**3**	**7**	**30" RCP**
26*	**DP 19 -23**	**2.30**	**3.50**	**13.2**	**3.66**	**6.27**	**8**	**22**	**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**	**3.52**	**5.17**	**13.5**	**3.63**	**6.20**	**13**	**32**	**36" RCP**
30*	**DP 26**	**1.97**	**2.58**	**14.3**	**3.54**	**6.03**	**7**	**16**	**24" RCP**
31*	**DP 19-26**	**5.49**	**7.75**	**14.3**	**3.54**	**6.03**	**19**	**47**	**42" RCP**
32*	**DP 27**	**0.85**	**1.11**	**13.8**	**3.59**	**6.12**	**3**	**7**	**18" RCP**
33*	**DP 19-27 & 31**	**6.58**	**9.18**	**14.3**	**3.54**	**6.03**	**23**	**55**	**42" RCP**
34	DP 28	2.34	3.07	21.1	2.97	4.94	7	15	18" RCP
34A	29 & 32	2.43	4.02	14.3	3.54	6.03	9	24	18" RCP
35	Pond 3 Release	MHFD UD-DETENTION POND RELEASE					1	58	36" RCP
36*	DP 30	SUM OF BASINS					36	120	TRIPLE 36" RCP
37	DP 31	0.24	0.32	5.00	5.00	9.06	1	3	15" HDPE
38	DP 32	0.19	0.25	5.00	5.00	9.06	1	2	15" HDPE
39	DP 33	0.20	0.27	5.00	5.00	9.06	1	2	15" HDPE
40	DP 34	0.17	0.23	5.00	5.00	9.06	1	2	15" HDPE

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

Highlighted pipe sizes do not match pipe sizes in appendix

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PELIMINARY DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED CA(5)	WEIGHTED CA(100)	C(5)	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND Tc (min)	STREET / CHANNEL FLOW Length (ft)	Slope (%)	Velocity (fps)	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
[illegible]	[illegible]	[illegible]	0.25	20	0.5	5.3	500	2.0%	4.9	1.7	6.9	4.58	8.14	2	4
[illegible]	[illegible]	[illegible]	0.25	80	2	10.5	300	2.5%	5.5	0.9	11.4	3.87	6.69	4	8
[illegible]	[illegible]	[illegible]	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
G1	0.24	0.31	0.25								5.0	5.00	9.06	1	3
G2	0.31	0.41	0.25								5.0	5.00	9.06	2	4
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	1.43	2.72	0.25	80	4	8.4	250	2.0%	4.9	0.8	9.2	4.18	7.32	6	20
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	1.37	1.79	0.25	100	2	12.6	860	1.4%	4.1	3.5	16.1	3.36	5.69	5	10
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	0.74	0.97	0.25	70	1.5	10.3	200	2.0%	4.9	0.7	11.0	3.92	6.79	3	7
M2	0.20	0.26	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	0.32	0.42	0.25	100	2	12.6	850	2.0%	4.9	2.9	15.5	3.42	5.80	1	2
O3	0.20	0.27	0.25								5.0	5.00	9.06	1	2
O4	0.17	0.23	0.25								5.0	5.00	9.06	1	2
P	0.06	0.25	0.25								5.0	5.00	9.06	0	2
Q1	0.48	0.62	0.25	55	1.3	8.9	445	2.0%	5.0	1.5	10.4	4.01	6.97	2	4
Q2	0.43	0.56	0.25	55	1.3	8.9	445	2.0%	5.0	1.5	10.4	4.01	6.97	2	4
R	0.46	0.60	0.25	100	4	10.1	700	2.0%	4.9	2.4	12.4	3.75	6.44	2	4
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
S2	0.06	0.08	0.25								5.0	5.00	9.06	0	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
V	0.24	0.32	0.25	100	2	12.6	630	1.6%	4.4	2.4	15.0	3.47	5.89	1	2
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
X	0.19	0.25	0.25	95	6	8.4					8.4	4.31	7.58	1	2
Y	0.16	0.21	0.25	95	6	8.4					8.4	4.31	7.58	1	2
OS-1*	**3.70**	**14.79**	**0.25**	**100**	**2**	**12.6**	**2700**	**2.3%**	**5.3**	**8.5**	**21.1**	**2.97**	**4.94**	**11**	**73**
OS-2*	**1.08**	**4.33**	**0.25**	**100**	**2**	**12.6**	**1203**	**1.0%**	**3.5**	**5.7**	**18.4**	**3.17**	**5.32**	**3**	**23**
OS-4	0.98	3.92	0.25	800	26	30.5					30.5	2.46	4.01	2	16
OS-5	0.51	2.03	0.25	600	18	27.1					27.1	2.62	4.30	1	9
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 MERIDIAN RANCH MDDP													**5**	**11**
OS-9	FLOW TAKEN FROM MERIDIAN RANCH MDDP													**8**	**19**
OS-Q1*	**0.03**	**0.12**	**0.25**	**100**	**2**	**12.6**	**135**	**1.5%**	**4.3**	**0.5**	**13.2**	**3.66**	**6.27**	**0**	**1**
OS-Q2*	**0.02**	**0.08**	**0.25**	**50**	**1**	**8.9**	**135**	**1.5%**	**4.3**	**0.5**	**9.5**	**4.14**	**7.24**	**0**	**1**
OS-R*	**0.09**	**0.38**	**0.25**	**100**	**2**	**12.6**	**50**	**2.7%**	**5.8**	**0.1**	**12.8**	**3.70**	**6.35**	**0**	**2**
OS-S1*	**0.03**	**0.11**	**0.25**								**5.0**	**5.00**	**9.06**	**0**	**1**
OS-S2*	**0.01**	**0.05**	**0.25**								**5.0**	**5.00**	**9.06**	**0**	**0**
OS-T2*	**0.03**	**0.11**	**0.25**								**5.0**	**5.00**	**9.06**	**0**	**1**

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

PELIMINARY 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
1	A	3.39	1.52	2.00	14.3	3.54	6.03	5	12	10' Type R Sump Inlet
2	C	0.86	0.39	0.51	6.9	4.58	8.14	2	4	5' Type R Sump Inlet
3	B1	2.30	1.03	1.36	14.2	3.55	6.05	4	8	5' Type R Sump Inlet
4	B2	2.69	1.21	1.59	14.8	3.49	5.93	4	9	5' Type R Sump Inlet
5	F & H	3.31	1.49	1.95	9.5	4.14	7.22	6	14	10' Type R Sump Inlet
6	D	2.11	0.95	1.24	11.4	3.87	6.69	4	8	5' Type R Sump Inlets
7	E	2.18	0.98	1.29	13.8	3.59	6.12	4	8	5' Type R Sump Inlets
7A	G1	0.53	0.24	0.31	5.0	5.00	9.06	1	3	5' Type R At-grade Inlet
7B	G2	0.69	0.31	0.41	5.0	5.00	9.06	2	4	5' Type R At-grade Inlet
8	DESIGN POINTS 1-7 & K	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	Meridian Ranch Filing 3 FDR Calculated Flows						28	185	EX 3-42" RCP Culverts
11	OS-5, I, OS-& MERIDIAN POND E RELEASE	Sum of Basins						35	214	PR 2-42" RCP Culverts
12	OS-6	0.33	5.19	6.80	18.7	3.14	5.27	16	36	18" RCP Culvert
13	TOTAL OFFISITE EX. STOCK POND INFLOW	Per "Final Drainage Report for Waterbury Filing No. 1" dated September 2016, by Classic Consulting						69	396	EX STOCK POND
14	L1	3.04	1.37	1.79	16.1	3.36	5.69	5	10	10' Type R Sump Inlet
15	L2	2.00	0.90	1.18	16.1	3.36	5.69	3	7	5' Type R Sump Inlet
16	O1	2.82	1.27	1.66	5.0	5.00	9.06	6	15	10' Type R Sump Inlet
17	O2	0.71	0.32	0.42	13.5	3.62	6.19	1	3	5' Type R Sump Inlet
18	DESIGN POINTS 14-17 & BASIN OS-4	19.48	3.86	5.06	16.1	3.36	5.69	13	29	Interim FSD Pond 2
19*	**Q1 & OS-Q1**	**1.39**	**0.51**	**0.74**	**13.2**	**3.66**	**6.27**	**2**	**5**	**10' Type R Sump Inlet**
20*	**Q2 & OS-Q2**	**1.18**	**0.45**	**0.65**	**9.5**	**4.14**	**7.24**	**2**	**5**	**5' Type R Sump Inlet**
21*	**R & OS-R**	**2.06**	**0.55**	**0.98**	**12.4**	**3.75**	**6.44**	**2**	**6**	**10' Type R At-grade Inlet**
22*	**S1 & OS-S1**	**1.86**	**0.72**	**1.02**	**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**	**2-10' Type R Sump Inlets**
25*	**T2 & OS-T2**	**1.54**	**0.58**	**0.84**	**13.5**	**3.63**	**6.20**	**2**	**5**	**5' Type R Sump Inlets**
26*	**U1**	**4.38**	**1.97**	**2.58**	**14.3**	**3.54**	**6.03**	**7**	**16**	**5' Type R Sump Inlets**
27*	**U2**	**1.89**	**0.85**	**1.11**	**13.8**	**3.59**	**6.12**	**3**	**7**	**10' Type R Sump Inlets**
28	**W**	**2.34**	**2.34**	**3.07**	**15.0**	**3.47**	**5.89**	**8**	**18**	**5' Type R Sump Inlets**
29*	**DESIGN POINTS 19-28 & OS-7**	**5.20**	**11.02**	**15.02**	**15.0**	**3.47**	**5.89**	**38**	**88**	**2-10' Type R Sump Inlets**
E-E*	**OS-2 & OS-8**	**14.58**	**2.66**	**6.20**	**18.4**	**3.17**	**5.32**	**8**	**33**	**DIVERSION SWALE E-E**
30*	**Y, OS-1, OS-2, OS-8 & OS-9**	**67.82**	**9.32**	**20.34**	**21.1**	**2.97**	**4.94**	**36**	**120**	**Triple 36" RCP Culverts**
31	V	0.54	0.24	0.32	5.0	5.00	9.06	1	3	18" DIA INLETS
32	X	0.43	0.19	0.25	5.0	5.00	9.06	1	2	18" DIA INLETS
33	O-3	0.45	0.20	0.27	5.0	5.00	9.06	1	2	18" DIA INLETS
34	O-4	0.38	0.17	0.23	5.0	5.00	9.06	1	2	18" DIA INLETS

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

Adjust MHFD input to approximate this

Pond 3?

REVISIONS

NO.	DESCRIPTION	DATE

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY ALL APPROPRIATE REVIEWING AGENCIES, THE ENGINEERING FIRM PREPARING THESE DRAWINGS ASSUMES NO RESPONSIBILITY FOR THEIR USE ONLY IN PROGRESS OR AS DESIGNED BY WITTEN AUTHORIZATION.

PREPARED FOR:
4-WAY RANCH JOINT VENTURE
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Terra Nova Engineering, Inc.
Creative Civil Engineering Solutions
721 S. 23RD STREET
COLORADO SPRINGS, CO 80904
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WATERBURY FILING NO. 1

PRELIMINARY
PROPOSED FINAL DRAINAGE MAP
OFF-SITE

DESIGNED BY QNA
DRAWN BY QNA
CHECKED BY
H-SCALE 1"=100
V-SCALE NA
JOB NO. 1715.00
DATE ISSUED 3/3/22
SHEET NO. 1 OF 2

REVISIONS

NO.	DESCRIPTION	DATE

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WATERBURY FILING NO. 1

PRELIMINARY
PROPOSED DRAINAGE MAP
ON-SITE

DESIGNED BY	QNA
DRAWN BY	QNA
CHECKED BY	
H-SCALE	1"=100
V-SCALE	NA
JOB NO.	1715.00
DATE ISSUED	3/3/22
SHEET NO.	2 OF 2