AN AMENDMENT TO THE
MASTER DRAINAGE DEVELOPMENT PLAN
FOR
WATERVIEW

WATERVIEW NORTH

EL PASO COUNTY, COLORADO

June 2020

PREPARED FOR:

CPR Entitlements, LLC
31 N. Tejon, Suite 500
Colorado Springs, CO 80903

PREPARED BY:

Dakota Springs Engineering
31 N. Tejon Street, Suite 518
Colorado Springs, CO 80903
719.227.7388

PROJECT NO. 02-19-05

Add PCD File No SKP202

CERTIFICATIONS

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. This drainage report has been prepared to satisfy criteria established and set forth by El Paso County for drainage reports. This drainage report is in conformance 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.

_____ Seal

Charles K. Cothern, P.E. #24997

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.

By (signature): _____ Date: _____

Title: CPR Entitlements, LLC

P.A. Koscielski, Manager

Address: 31 N. Tejon, Suite 500

Colorado Springs, CO 80903

El Paso County:

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

_____ _____

Jennifer Irvine, P.E., Date

County Engineer / ECM Administrator

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INTRODUCTION

Waterview North is a proposed multi-use development located within the greater Waterview Subdivision, in El Paso County, Colorado. The Waterview North site encompasses approximately 116.5 acres of development that include Light Industrial, Commercial Retail, a Recreational Vehicle Park, and Multi-Family Residential with varying density.

Purpose & Scope of Study

This report is presented in conjunction with the Sketch Plan Amendment for Waterview as an Amendment to the Master Drainage and Development Plan for Waterview. Improvements proposed as part of Waterview North, Phase III of development on the Waterview Sketch Plan Amendment, are included as reference material in Appendix B. The purpose of this Amendment is to append findings presented with previously approved MDDP Amendments as well as the original Master Development and Drainage Plan (MDDP) for Waterview. Proposed changes to Land Use associated with the Amended Sketch Plan for Waterview are accompanied by updated hydrology calculations, updated Water Quality and Detention Pond Designs, and updated hydraulic calculations. Developments shown on the referenced, Amended Sketch Plan for Waterview are proposed in a manner that satisfies the requirements and criteria set forth by El Paso County's Engineering Criteria Manual as well as Volumes 1 and 2 of the Drainage Criteria Manual. Runoff quantities and proposed facilities have been calculated and sized using current El Paso County Development Standards and Drainage Criteria.

GENERAL DESCRIPTION AND LOCATION

Waterview North is located within the Waterview Subdivision, which encompasses approximately 721.8 acres. Waterview North occupies approximately 116.5 acres of the Northeast corner of the Waterview Sketch Plan. The Southwest Corner of the property coincides with the Northeast Corner of the intersection at Powers Boulevard and Bradley Road, in El Paso County, Colorado. The site is bound on the west and south by Powers Boulevard and Bradley Road, respectively. The Colorado Springs Airport lies to north, beyond a 3400' swath of undeveloped property. The Colorado Springs City Limits coincide with the northern boundary of Waterview North.

The eastern boundary of the site and the Widefield Transportation Center D3 to the east are separated by a 1200-foot wide swath of undeveloped land and Foreign Trade Zone Blvd.

Of the 116.5 acres that is Waterview North, Residential accounts for 69 acres, Light Industrial covers 28.5 acres, Commercial occupies 18.6 acres.

Climate

The climate of the site is typical of a sub-humid to semiarid climate with mild summers and winters. The average temperature is 31F degrees in the winter and 68.4F degrees in the summer. Total annual precipitation is 15.21 inches.

Floodplain Statement

Update reference to "G" FIRM

The Flood Insurance Rate Map (FIRM No. 08041C0768-F dated 12/07/2018) indicates that there is no floodplain in the vicinity of the proposed site. Please refer to the Annotated FIRM Panel, located in Appendix A at the back of this report.

Utilities & Other Encumbrances

There is an existing petroleum line that runs north / south in the westerly portion of Waterview North.

Referenced Drainage Studies

Waterview North occupies the northeast quadrant of the greater Waterview Subdivision and straddles two major drainage basins as identified by El Paso County. A DBPS for each of the 2 major basins were referenced in addition to two Final Drainage Reports for nearly adjacent portions of the Waterview Subdivision and one Amendment to the MDDP for Waterview. A listing of the referenced Studies and Reports is as follows:

- ***Jimmy Camp Creek Drainage Basin Planning Study: Development of Alternatives and Design of Selected Plan Report"***, by Kiowa Engineering, dated March 2015.
- ***West Fork Jimmy Camp Creek Drainage Basin Planning Study"***, by Kiowa Engineering, dated October 2003
- ***"Amendment to the MDDP for Waterview ",*** completed by Springs Engineering and approved in July of 2014.
- ***"Final Drainage Report for Trails at Aspen Ridge, Filing No. 1",*** completed by Matrix Design Group and approved in Januatry of 2020.
- ***"Final Drainage Report for Trails at Aspen Ridge, Filing No. 2",*** completed by Matrix Design Group and approved in February of 2020.

SOIL CONDITIONS

Soils that underly the project site and the site's offsite tributary areas are analyzed and classified by their by Hydrologic Soil Type. Soils can be classified into four different hydrologic groups; A, B, C, & D. This manner of classification is applied to account for a soils' potential to produce runoff. Hydrologic group "A" is characterized by well-drained coarse-grained soils that have a rapid infiltration rate even when fully saturated and, thus, have a low runoff potential. Group "D" typically has a clay layer at or near to the surface, or a very shallow depth to impervious bedrock. As such, Type D soils have very slow infiltration rates and a high runoff potential. Please refer to the Soils Map, included in Appendix A. The table on the following page summarizes site soils by Hydrologic Type.

Pre-Development site conditions include undeveloped high desert terrain with ground cover consisting of sparse natural vegetative cover. About a third of onsite soils are classified as type A. It should be noted that post development consideration of onsite areas does not recognize type A soil. All type A soils, onsite, are to be considered as Type B Soils for post development conditions.

Site Soil Summary Table

Map Unit Symbol	Map Unit Name	Hydrologic Soil Type	Acreage of AOI	Percentage of AOI
8	*Blakeland loamy sand, 1 to 9 % slopes*	A	43.7	32.50%
31	*Fort Collins loam, 3 to 8 % slopes*	B	33.2	24.70%
56	*Nelson-Tassel fine sandy loams 3 to 18% slopes*	B	33.4	24.80%
86	*Stoneham sandy loam, 3 to 8 % slopes*	B	19.8	14.70%
95	*Truckton loamy sand, 1 to 9% slopes*	A	0.2	0.10%
108	*Wiley silt loam, 3 to 9 % slopes*	B	4.4	3.30%
		Totals for Area of Interest	134.7	100%

DRAINAGE BASINS & SUB-BASINS

The Waterview North development site is located within 2 major drainage basins; Big Johnson/Crews Gulch and Jimmy Camp Creek. The sites location lies in the upper reaches of each of the mentioned major watersheds. Portions of the site that belong to the Big Johnson/Crews Gulch Basin Tributary occupy western and northwestern reaches of the property. The western portion of the offsite tributary to Waterview North also belongs to the Big Johnson/Crews Gulch Basin Tributary. A portion of the site that covers the western boundary of Waterview North, characterized as Basin BJD-EX14 on the Pre-Dev Basin Map, presently drains to the west over and across Powers Boulevard and ultimately into Big Johnson/Crews Gulch Basin. CDOT construction of Powers Boulevard Improvements will result in a hydraulic barrier to surface runoff generated over Basin BJD-EX14, as it presently conveys. Post Development conditions refer to the subject area as Basin BJDEV-14. While runoff generated over Basin BJDEV14 will not continue to convey in historic fashion as surface flow that crosses Powers Blvd., it is assumed that construction of the Powers Blvd. Improvements will maintain the historic drainage pattern in some form or fashion, and Basin BJDEV14 runoff will continue to convey to Big Johnson/Crews Gulch Basin.

The remainder of Waterview North lies within one of two sub-basins belonging to the Jimmy Camp Creek Tributary. A 10-acre piece that occupies the southwest corner of the property is part of the West Fork Tributary to Jimmy Camp Creek. The remainder of the site, as well as the eastern portion of the offsite tributary are part of the MarkSheffel Tributary to Jimmy Camp Creek.

Basin IDs used in this study agree with those established for each of the Tributaries in the reference material. Areas ultimately tributary to Big Johnson/Crews Gulch Basin are labelled with a "BJD" prefix, those tributary to Jimmy Camp Creek have a "JCD" prefix. Concentration points and Ponds are all labelled to be consistent with the reference material with the exception of Design Pt. A, which corresponds to Design Point "1-OS" as referenced from the Final Drainage Reports for Trails at Aspen Ridge, Filing No. 1 & Trails at Aspen Ridge, Filing No. 2.

Approximately 82 acres of Waterview North lie in the upper reaches of the Marksheffel Tributary to Jimmy Camp Creek. This drainage basin was studied in the ***"Jimmy Camp Creek Drainage Basin Planning Study: Development of Alternatives and Design of Selected Plan Report"***, by Kiowa Engineering, dated March 2015.

Approximately 16.2 acres of Waterview North lie in the upper reaches of the West Fork Tributary to Jimmy Camp Creek. This drainage basin was studied in the ***"West Fork Jimmy Camp Creek Drainage Basin Planning Study"***, by Kiowa Engineering, dated October 2003, and in The FDRs for Trails at Aspen Ridge, Filing No.1 and Filing No.2.

Development of Waterview North will comply to the findings presented in each of the above-mentioned Studies by providing onsite detention and water quality treatment for developed runoff. Offsite areas that lie upstream of Waterview North will be required to provide onsite detention and water quality treatment as they develop.

Design, phasing, responsibility and maintenance of any proposed improvements will be discussed in future drainage reports, at a later time. Fees will be assessed and paid according to current rates at the time of platting for each filing.

Sub-Basin Description

Historic Drainage Patterns

The historic drainage patterns of the site were analyzed in the Master Development Drainage Plan for Waterview by Merrick and Company. Offsite tributary areas are re-examined in this study. The offsite tributary to Waterview North lies to the north. A portion of the offsite tributary, approximately 63 acres, lies within the Big Johnson/Crews Gulch Basin Tributary. The remaining portion of the offsite tributary amounts to 56.7 acres and lies within the Marksheffel Tributary to Jimmy Camp Creek. The reason that the offsite tributary was re-examined is because review of the existing topography along the north boundary of the site revealed a depression whose volume exceeds 35 acre-feet. Most of the Big Johnson/Crews Gulch offsite tributary area (54 out of 63 acres, area BJD-12a) appears to drain into this depression. Soils in this region are classified as Hydrologic Type A. The hydraulic conductivity for soils that coincide with the offsite pond's location translates to a percolation rate that exceeds 8-inches per hour. The remainder of the offsite tributary to Big Johnson/Crews Gulch Basin drains to an existing Box Culvert Crossing along Powers Blvd.
Ten acres of onsite area that coincide with the southwest corner of the property, characterized as Basin JCDEX-3.3, produce runoff that conveys to an existing dual 42-inch CMP crossing under Bradley Road where it discharges from the site and continues to convey south.

Runoff produced over the Marksheffel tributary to Jimmy Camp Creek accounts for the majority of onsite runoff generated. The portion of the Marksheffel Tributary considered with this analysis is represented by offsite Basins JCD OS-1A & JCD OS-1B, and by onsite Basins JCDEX-3.1 & JCDEX-3.2. Runoff produced on JCDEX-3.2 conveys along the north side of Bradley Road then discharges across the eastern boundary of the site. Flows generated over the other 3 basins discharge across the eastern site boundary as well, concentrating at Design Point JCD-D. Please refer to the Pre-Development Drainage Map, included in Appendix B.

Off-Site Drainage

There are two off-site basins for Waterview North. One of them is located in the Big Johnson/Crews Gulch Tributary and the other lies within the Marksheffel Tributary to Jimmy Camp Creek. this basin was analyzed in the MDDP for Waterview by Merrick. The calculations for said tributary have been re-calculated in this study since review of the mentioned reference material revealed alternate rainfall values and rainfall distribution.

DRAINAGE DESIGN CRITERIA

Development Criteria Reference

The El Paso County Drainage Criteria Manual (DCM), Volumes 1 & 2 were used in preparation of this report in conjunction with El Paso County's Engineering Criteria Manual (ECM) and Resolutions 15-042 and 19-245.

In addition to the DCM, Denver's Urban Storm Drainage Criteria Manuals, Volumes 1-3, published by the Urban Drainage and Flood Control District, latest update, have been used to supplement the DCM for water quality capture criteria.

Hydrologic Criteria

Revise. Per City chapter 6 table 6-1 rational method can be used for basins less than 130 ac.

Rational Method

Peak flow rates for this project were calculated using the Rational Method, as recommended by the Drainage Criteria Manual, for the minor and major storms for drainage basins less than 100 acres in size. The Rational Method uses the following equation:

$Q=C*i*A$

Where:
Q = Maximum runoff rate in cubic feet per second (cfs)
C = Runoff coefficient
i = Average rainfall intensity (inches per hour)
A = Area of drainage sub-basin (acres)

b. Runoff Coefficients

Rational Method coefficients from Table 6-6 of the Drainage Criteria Manual for developed land were utilized in the Rational Method calculations. Please refer to the Runoff Coefficient Exhibit, included in Appendix B.

Adjust to also note 10 minutes for undeveloped conditions per City DCM Chapter 6 section 3.2.4.

c. Time of Concentration

The time of concentration consists of the initial time of overland flow and the travel time in a channel to the inlet or point of interest. A minimum time of concentration of 10-minutes is used for non-urban areas and a minimum Tc of 5 minutes is utilized for urban areas.

d. Rainfall Intensity

The hypothetical rainfall depths for the 1-hour storm duration were taken from Table 6-2 of the Drainage Criteria Manual. Table 6.2 lists the rainfall depth for the Major and Minor 1-hour storm events. The referenced table may be found in the front portion of Appendix B.

3.2.4 Minimum Time of Concentration

Dal

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

Identify on-site storm drain system will be sized based on the rational method.

The rational method was used to determine onsite flows, as required by the current City of Colorado Springs/El Paso County Drainage Criteria Manual (DCM). Both the 5-year and 100-year storm events were considered in these analyses. Runoff coefficients appropriate to both proposed land use and for soil type were selected from Table 5-1 of the DCM. Please refer to the Runoff Coefficient Exhibit, included in Appendix B. The time of concentration was calculated per DCM requirements. Rational Method analyses and results are included in Appendix B, at the back of the report, and are reflected on each of the drainage exhibits.

Unit Hydrograph Method

A unit hydrograph analysis was performed for the site for sake of comparison to flows presented in some of reference material. The analysis utilized an SCS TYPE II Distribution with rainfall values referenced from Table 6.2 of the DCM. Routing for both conditions was performed using the Muskingham-Cunge procedure. Pre-Development Routing utilized an antecedent moisture condition of 1 while the post development routing used an AMC value of 2, per the dictates of the DCM.
Time of concentration values were calculated using the Lag/CN method.

Culvert Design

Culverts are proposed with each of the onsite Detention Ponds. Ponds and culverts were sized based on the 100-year storm. Fully developed flows, once detained and treated, will be directed to existing culvert crossings at or below historic rates. Culvert calculations included herein, in Appendix D, are executed using HY-8 and model existing culvert crossings along Powers Boulevard and along Bradley Road. The culverts proposed with each of the onsite detention ponds are modelled using the MHFD-Detention_v4 02 spreadsheet workbook.

Detention Storage Criteria

This report addresses the preliminary design of the detention / water quality ponds within the proposed development. Proposed ponds are designed as Full Spectrum. Pond hydraulics, treatment efficacy, and outlet structure performance are modelled with MHFD's software, MHFD-Detention_v4 02.

Storage volumes and outflows have been calculated for all proposed detention facilities. A final design for each pond will be completed and submitted for approval with a Final Drainage Report at a later time.

HYDROLOGIC ANALYSES

Pre-Development Drainage Analysis

Big Johnson/Crews Gulch Basin & Jimmy Camp Creek Basins

Adjacent portions of the Big Johnson/Crews Gulch and Jimmy Camp Creek watersheds are presented on the Pre-Development Drainage Map, included in Appendix B.

Big Johnson/Crews Gulch Basin Tributary

The portion of the site that belongs to Big Johnson/Crews Gulch Tributary produces runoff that concentrates at Design Point BJD-K. There is also an offsite basin, BJD-12b, that covers 9.54 acres and produces runoff that conveys to Design Point BJD-K. The peak flow rate that occurs at Design Point BJD-K during pre-development conditions is equal to 1 cfs and 18 cfs for the 5 and 100-year storms, respectively.

Offsite Basin BJD-12a runoff conveys into an existing 34+ acre-foot depression. The volume of the depression exceeds the volume of runoff for both 5 and 100-yr events. A basin calculation using the MHFD-Detention_v4 02 spreadsheet is included in Appendix C and shows the volume of runoff for the various events versus the volume of the existing offsite pond/depression. Runoff produced over Basin BJD-12a is not accepted onsite and does not impact Design Point BJD-K.

Runoff produced over Basin BJDEX14 conveys to the south and west, as sheet flow, over and across Powers Boulevard.

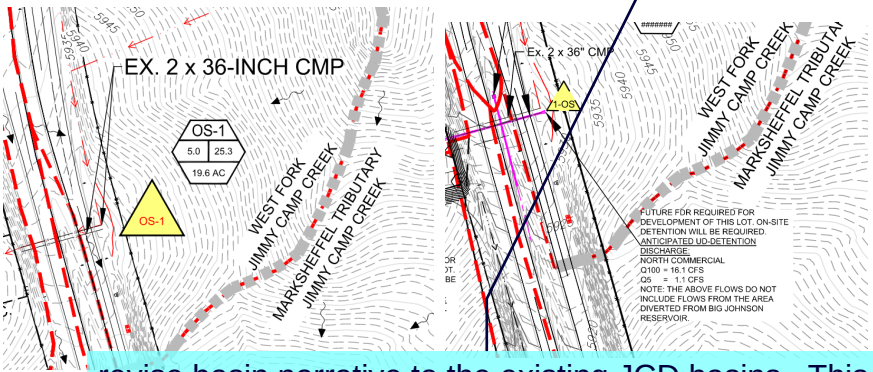
Jimmy Camp Basin

The historic basins for both tributaries of Jimmy Camp Creek are analyzed with rational calculations and with a unit hydrograph analysis. Flows shown with the basin identifiers on the Drainage Exhibits reflect the results of the rational analysis. The Pre-Dev Drainage Basin Map and calculations are included in Appendix B for reference and are summarized below:

- Design Point A (Q_5=1cfs, Q_{100}=24cfs) is located on the north side of the adjacent western portion of Bradley Road. Design Pt. A receives runoff generated over Basin JCDEX-3.3. These flows convey south, across Bradley Road via an existing dual 42" CMP Culvert Crossing. Flows conveyed by the dual culvert crossing discharge into an existing swale on the south side of Bradley and continue to convey south. Design Point A is represented by Design Point 1-OS in the referenced MDDP Amendment for Trails at Aspen Ridge. Referenced peak flow rate values at Design Point 1-OS equal 11.8cfs and 47.4cfs for the 5 & 100year events, respectively. Flows discharged from Design Pt. A feed the West Fork Tributary to Jimmy Camp Creek.

- Design Point JCD-D is located along the eastern boundary of the site, to the north of Bradley Road. Design Point JCD-D is the location where runoff from onsite Basins JCDEV3.1 & JCDEV3.2 and from offsite Basins JCD-OS1A & JCD-OS1B combine and convey east to feed the Marksheffel Tributary to Jimmy Camp Creek. Major and minor flows at Design Point JCD-D equal 106cfs & 6cfs, respectively.

Revise. The Trails drainage report noted existing condition cfs of 5.0 and 25.3 with developed condition requiring a detention facility for this basin in the developed condition



revise basin narrative to the existing JCD basins. This narrative is under the "Pre-development Drainage Analysis" sub-header.

Post Development Drainage Analysis

Big Johnson/Crews Gulch Basin

Onsite runoff generated over areas that belong to the Big Johnson/Crews Gulch Basin Tributary are captured and conveyed into Pond BJD-K, with the exception of onsite Basin BJDEV-14.

The portion of the site that covers the western boundary of Waterview North, characterized as Basin BJDEV14 on the Post Development Drainage Plan, presently drains to the west over and across Powers Boulevard and ultimately into Big Johnson/Crews Gulch Basin. CDOT construction of Powers Boulevard Improvements will result in a hydraulic barrier to surface runoff generated over Basin BJD-EX14, as it presently conveys. Post Development conditions refer to the subject area as Basin BJDEV-14. While runoff generated over Basin BJDEV14 will not continue to convey in historic fashion, as surface flow that crosses Powers Blvd., it is assumed that construction of the Powers Improvements will see the historic drainage pattern maintained in some form or fashion, and Basin BJDEV14 runoff will continue to convey to Big Johnson/Crews Gulch Basin. Developed Flows from BJDEV-14 will be treated prior to being discharged and will not exceed historic peak rates of discharge.

Revise. 3-stage outlet structure not permitted. Outlet structure must be designed for FSD.

Pond BJD-K

Flows generated over onsite Basin BJD-12c convey into Pond BJD-K. Pond BJD-K is located about 70 feet to the north of the existing RCBC Powers crossing. Pond BJD-K has 8.454 Ac-Ft of volume and a 3-stage outlet structure. The containment berm for the pond is almost entirely above grade. The model and calculations for Pond BJD-K are located in Appendix C. Pond BJD-K serves to offset developed peak flows from the site to below historic levels and provides full spectrum treatment of onsite runoff. Runoff generated over offsite Basin BJD-12b bypasses Pond BJD-K and conveys as channel flow directly to the existing 10' by 6' RCBC Culvert crossing under Powers Boulevard.

The pre-developed rate of discharge from the site at Design Point BJD-K was determined to be 1 and 18cfs for the 5 and 100-year events. The post development peak rate of discharge at the same location is 1 and 18cfs for the 5 and 100-year events, respectively. In the Amendment to the MDDP for Waterview, completed by Springs Engineering and approved in July of 2014, post development flows at the same location were shown to be 239cfs and 215cfs for the major and minor storms, respectively. The depression shown to the north of the Waterview North site on the pre & post development Drainage Exhibits is not accounted for in the referenced analysis.

Jimmy Camp Creek Basin

There are 2 onsite and 2 offsite drainage basins located within the Marksheffel Tributary to Jimmy Camp Creek. Onsite developed flows will convey to Pond JCD-D where runoff will be treated, and peak flows attenuated to at or below historic levels prior to discharging from the site. Pond JCD-D is situated along the eastern boundary of the site. Onsite runoff is generated over 2 basins; JCDEV-3.1 & JCDEV-3.2. Runoff from JCDEV-3.2 will convey south, gather along the roadside ditch that follows the north side of Bradley Road, then discharge into Pond JCD-D either by way of a culvert crossing, or through proposed storm drain improvements for the area. Runoff produced over area JCDEV-3.1 will convey to Pond JCD-D as a combination of surface flows and storm drain discharge. Basins JCDEV-3.1 & JCDEV-3.2 account for approximately 82 acres of onsite development.

Pond JCD-D

Pond JCD-D has a volume 8.454 Acre-Feet and is designed to provide Full Spectrum Treatment to onsite developed runoff. The Water Quality Capture Volume (WQCV) for the pond is 1.548 Acre-Ft and the Excess Urban Runoff Volume (EURV) is 5.057 Acre-Ft. The outlet structure for Pond JCD-D is 3-stage and the containment berm, which is has a height of approximately 7.5 feet, is almost entirely above grade. The peak outflow from Pond JCD-D, given a 100-yr event, is equal to 100cfs. Flows from the Pond convey through a culvert from the outlet structure and discharge into an earthen channel / ditch that follows the [illegible] Road and conveys to the east.

Revise reference to the Filing 1 FDR which provided more details regarding drainage. The report discussed replacing the dual 42" cmp.

Pond A

Detention Pond A, shown on the post d[illegible] to be located along the north side of the western portion of Bradley Road, [illegible]ate runoff generated over the commercially zoned portion of the site. [illegible]d treatment of runoff generated over commercially zoned areas will be lot sp[illegible]mercially zoned lot will be responsible for treating and balancing their own runoff. Detention Pond A Discharges from the site through an existing dual 42" CMP crossing under Bradley Road. Given this existing crossings' proximity to a proposed entrance to the site, the high side of the culvert crossing will likely be appended with a junction structure. The outlet pipe from Pond A will terminate into said junction structure where flows will convey south to the low side of the culvert crossing. This culvert crossing was analyzed in the MDDP for Trails at Aspen Ridge. Design Point A in the Pre-Development Analysis included with this study coincides with Design Point 1-OS from the referenced Study. On page 11 of the report included with the approved MDDP, the basin and the culvert crossing are mentioned in the Basin Hydrology description for the West Fork Jimmy Camp Creek Tributrary. Flows to the Dual 42" CMP crossing amount to 11.8 CFS & 47.4 CFS for the 5 & 100-year events, respectively.

Offsite Basins JCDOS-1A & JCDOS-1B account for 56.7 acres of undeveloped offsite tributary. Runoff generated from these basins will convey to a proposed diversion channel that follows the northern property boundary. The proposed diversion channel begins where Offsite Basin JCD-OS1A flows meet with the northern property boundary, approximately 1950' from the eastern boundary of the site. Said channel will serve to convey runoff from both offsite basins eastward to the northern reach of the eastern property boundary. The proposed diversion channel will turn south to follow the eastern property boundary for approximately 150 feet before it terminates by sloping up to meet existing grade. The depth of flows conveyed in the diversion channel will rise where the channel terminates and discharge as weir flow across the eastern boundary of the site, at Design Point JCDOSA, which corresponds to the historic location at which the diverted runoff discharges from the site. Flows that discharge from the site at Design Point JCDOSA will occur in un-concentrated fashion with non-erosive velocities.

As commercial, industrial and residential development begins in this area, storm drain improvements will be implemented and drainage systems designed. Each Phase of residential and/or commercial development will require site-specific Preliminary and/or Final Drainage Studies to ensure that new developments do not increase peak rates of discharge or result in adverse effect to surrounding, upstream or downstream properties or facilities. Development of each industrial lot will also require a preliminary and or final drainage study as each lot will be required to balance its developed runoff.

what is the anticipated width of the spreader?
Add a statement that the diversion channel design will include access roads meeting ECM Section 3.3.3.K.1.
State whether or not the channel is anticipated to be placed in a tract or a drainage easement? Restrictions for no build, no storage of material and no fencing will be placed on the drainage easement containing the diversion channel.

REFERENCE MATERIALS

1. "City of Colorado Springs/El Paso County Drainage Criteria Manual" September 1987, Revised November 1991, Revised October 1994.

2. "City of Colorado Springs/El Paso County Drainage Criteria Manual, Volume 2: Stormwater Quality Policies, Procedures and Best Management Practices" November 1, 2002.

3. Soils Survey of El Paso County Area, Natural Resources Conservation Services of Colorado.

4. ***"Master Development Drainage Plan for Waterview"***, by Merrick & Co., May 2006

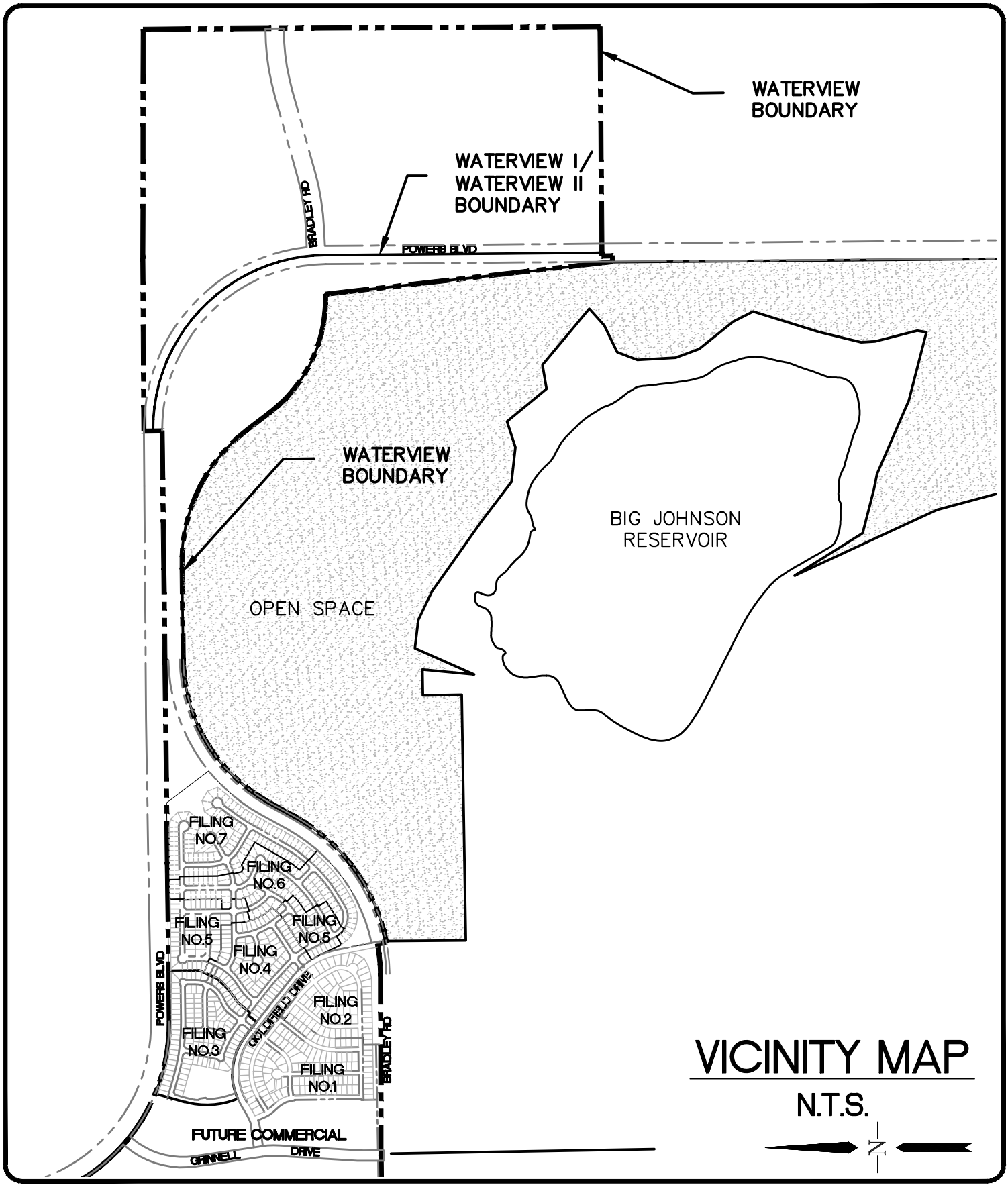
5. ***"Big Johnson/Crews Gulch Basin/Crews Gulch Drainage Basin Planning Study***", Kiowa Engineering Corporation, September 1991.

6. ***"Final Drainage Report for Trails at Aspen Ridge, Filing No. 1***" by The Matrix Design Group, January, 2020.

7. ***"Final Drainage Report for Trails at Aspen Ridge, Filing No. 2***" by The Matrix Design Group, February, 2020.

8. ***"Amendment to the MDDP for Waterview"*** by Springs Engineering, July, 2014.

APPENDIX A



WATERVIEW MDDP AMEND

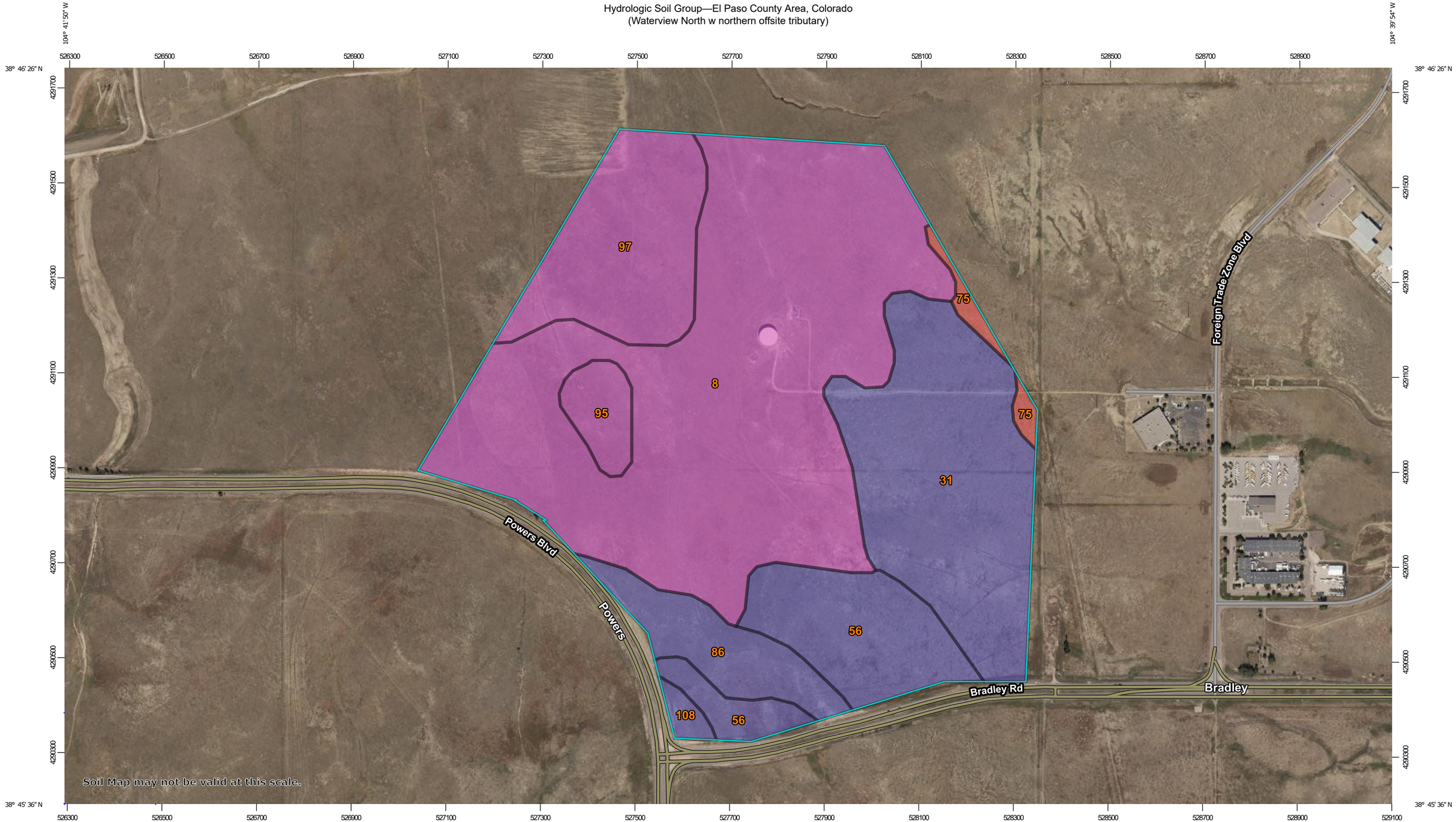
VICINITY MAP

DSE Dakota Springs Engineering
31 N. TEJON, SUITE 518
COLORADO SPRINGS, CO 80918
P: (719) 227-7388
F: (719) 227-7392

FIGURE 1

PROJECT NO. 19-05

Hydrologic Soil Group—El Paso County Area, Colorado
(Waterview North w northern offsite tributary)



Map Scale: 1:7,560 if printed on B landscape (17" x 11") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 350 700 1400 2100

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 17, Sep 13, 2019

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

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

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	A	139.1	49.1%
31	Fort Collins loam, 3 to 8 percent slopes	B	56.6	20.0%
56	Nelson-Tassel fine sandy loams, 3 to 18 percent slopes	B	29.1	10.3%
75	Razor-Midway complex	D	3.1	1.1%
86	Stoneham sandy loam, 3 to 8 percent slopes	B	15.5	5.5%
95	Truckton loamy sand, 1 to 9 percent slopes	A	6.6	2.3%
97	Truckton sandy loam, 3 to 9 percent slopes	A	31.6	11.1%
108	Wiley silt loam, 3 to 9 percent slopes	B	2.0	0.7%
Totals for Area of Interest			**283.5**	**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.

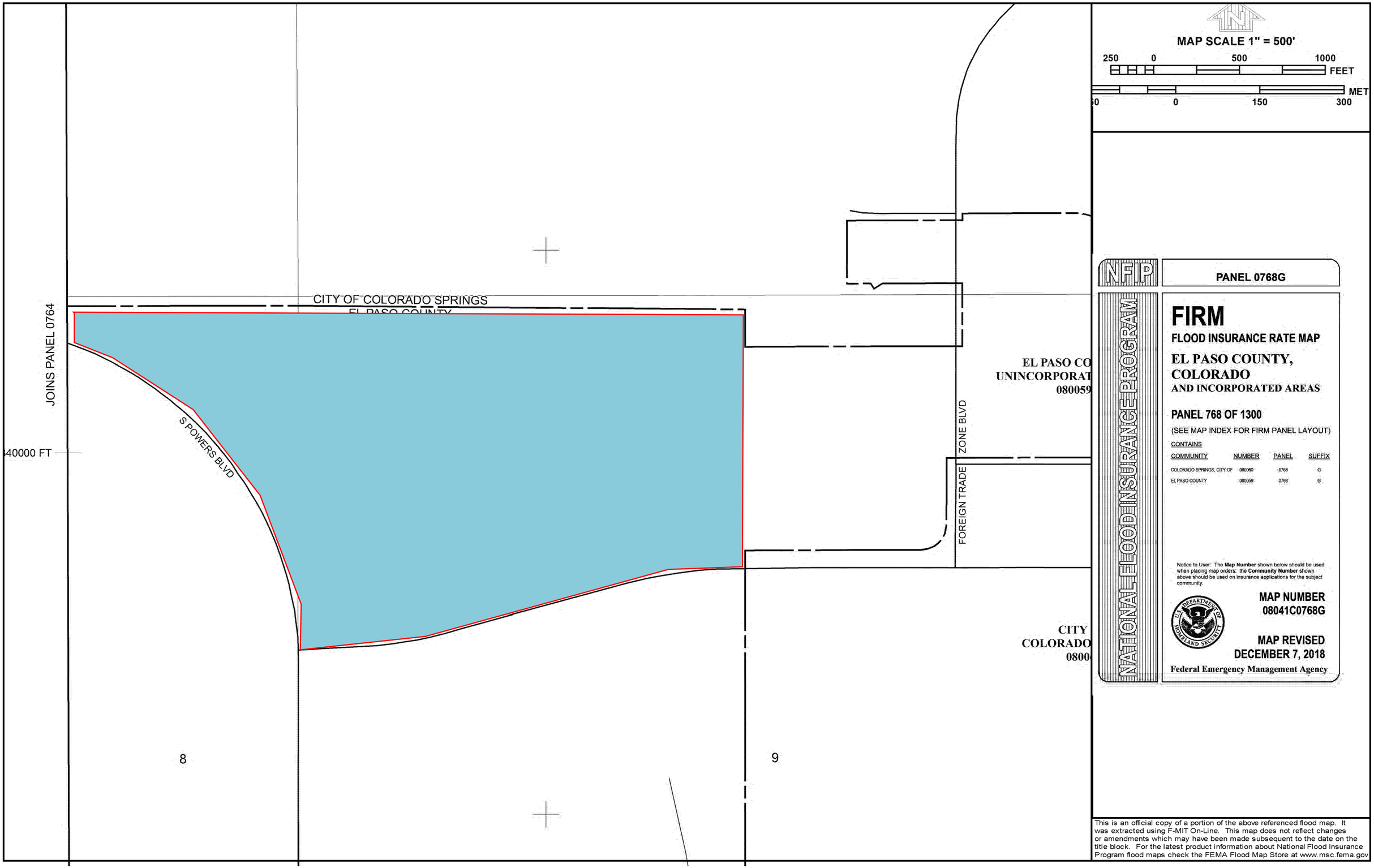
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



NFIP

PANEL 0768G

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 768 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0768	G
EL PASO COUNTY	080059	0768	G

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

MAP NUMBER
08041C0768G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

APPENDIX B

EL PASO COUNTY REFERENCE INFO
RATIONAL ANALYSIS

Identify the land use characteristics used.

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis--Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

?

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

For Colorado Springs and much of the Fountain Creek watershed, the 1-hour depths are fairly uniform and are summarized in Table 6-2. Depending on the location of the project, rainfall depths may be calculated using the described method and the NOAA Atlas maps shown in Figures 6-6 through 6-17.

Table 6-2. Rainfall Depths for Colorado Springs

Return Period	1-Hour Depth	6-Hour Depth	24-Hour Depth
2	1.19	1.70	2.10
5	1.50	2.10	2.70
10	1.75	2.40	3.20
25	2.00	2.90	3.60
50	2.25	3.20	4.20
100	2.52	3.50	4.60

Where Z= 6,840 ft/100

These depths can be applied to the design storms or converted to intensities (inches/hour) for the Rational Method as described below. However, as the basin area increases, it is unlikely that the reported point rainfalls will occur uniformly over the entire basin. To account for this characteristic of rain storms an adjustment factor, the Depth Area Reduction Factor (DARF) is applied. This adjustment to rainfall depth and its effect on design storms is also described below. The UDFCD UD-Rain spreadsheet, available on UDFCD's website, also provides tools to calculate point rainfall depths and Intensity-Duration-Frequency curves[2] and should produce similar depth calculation results.

2.2 Design Storms

Design storms are used as input into rainfall/runoff models and provide a representation of the typical temporal distribution of rainfall events when the creation or routing of runoff hydrographs is required. It has long been observed that rainstorms in the Front Range of Colorado tend to occur as either short-duration, high-intensity, localized, convective thunderstorms (cloud bursts) or longer-duration, lower-intensity, broader, frontal (general) storms. The significance of these two types of events is primarily determined by the size of the drainage basin being studied. Thunderstorms can create high rates of runoff within a relatively small area, quickly, but their influence may not be significant very far downstream. Frontal storms may not create high rates of runoff within smaller drainage basins due to their lower intensity, but tend to produce larger flood flows that can be hazardous over a broader area and extend further downstream.

- **Thunderstorms**: Based on the extensive evaluation of rain storms completed in the Carlton study (Carlton 2011), it was determined that typical thunderstorms have a duration of about 2 hours. The study evaluated over 300,000 storm cells using gage-adjusted NEXRAD data, collected over a 14-year period (1994 to 2008). Storms lasting longer than 3 hours were rarely found. Therefore, the results of the Carlton study have been used to define the shorter duration design storms.

  To determine the temporal distribution of thunderstorms, 22 gage-adjusted NEXRAD storm cells were studied in detail. Through a process described in a technical memorandum prepared by the City of Colorado Springs (City of Colorado Springs 2012), the results of this analysis were interpreted and normalized to the 1-hour rainfall depth to create the distribution shown in Table 6-3 with a 5 minute time interval for drainage basins up to 1 square mile in size. This distribution represents the rainfall

PRE-DEVELOPMENT RATIONAL ANALYSIS

SUMMARY

Remove Regional Tc. Not a part of the DCM

Calculation of Peak Runoff using Rational Method

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.

Version 2.00 released May 2017

Cells of this color are for required user-input
Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$$

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

$$\text{Computed } t_c = t_i + t_t$$

$$\text{Regional } t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

$t_{minimum}$ = 5 (urban)
$t_{minimum}$ = 10 (non-urban)

$$\text{Selected } t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	1.19	1.50	1.75	2.00	2.25	2.52	

	a	b	c
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786

$$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$$

$$Q(cfs) = CIA$$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland (Initial) Flow Time: Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)
BJD-12a	54.28	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	300.00			0.043	20.90
BJD-12b	9.54	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	295.00			0.028	23.87
BJD-12c	18.23	B	5.0	0.03	0.03	0.10	0.28	0.36	0.45	0.55	300.00			0.030	23.22
				0.02	0.02	0.03	0.07	0.12	0.20	0.33					23.50
BJDEX-14	6.16	B	5.0	0.03	0.03	0.10	0.28	0.36	0.45	0.55	112.00			0.098	9.60
JCD-OS1A	36.00	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	247.00			0.040	19.42
JCD-OS1B	20.70	B	5.0	0.03	0.03	0.10	0.28	0.36	0.45	0.55	200.00			0.085	13.45
				0.02	0.02	0.05	0.12	0.17	0.26	0.38					13.61
JCDEX-3.1	68.60	B	5.0	0.03	0.03	0.10	0.28	0.36	0.45	0.55	300.00			0.083	16.60
				0.02	0.03	0.07	0.20	0.27	0.36	0.47					16.64
JCDEX-3.2	13.21	B	5.0	0.03	0.03	0.10	0.28	0.36	0.45	0.55	244.00			0.090	14.57
JCDEX-3.3	10.00	B	5.0	0.03	0.03	0.10	0.28	0.36	0.45	0.55	297.00			0.118	14.70

Subcatchment Name	Channelized (Travel) Flow Time: Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Time of Concentration: Computed t_c (min)	Regional t_c (min)	Selected t_c (min)
BJD-12a	1784.00			0.035	10	1.87	15.89	36.79	41.55	36.79
BJD-12b	355.00			0.062	10	2.49	2.38	26.25	27.60	26.25
BJD-12c	1103.00			0.015	10	1.22	15.01	38.23	40.62	38.23
								38.51		
BJDEX-14	353.00			0.091	10	3.02	1.95	11.55	27.16	11.55
JCD-OS1A	2544.00			0.045	10	2.12	19.99	39.40	45.76	39.40
JCD-OS1B	1167.00			0.058	10	2.41	8.08	21.52	33.48	21.52
								21.69		
JCDEX-3.1	2633.00			0.035	10	1.87	23.46	40.05	49.33	40.05
								40.10		
JCDEX-3.2	985.00			0.065	10	2.55	6.44	21.01	31.79	21.01
JCDEX-3.3	398.00			0.075	10	2.74	2.42	17.13	27.65	17.13

Subcatchment Name	Rainfall Intensity, I (in/hr) 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Peak Flow, Q (cfs) 2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
BJD-12a	1.65	2.08	2.43	2.77	3.12	3.50		1.51	2.11	2.84	4.55	11.41	28.20	
BJD-12b	2.02	2.54	2.97	3.39	3.81	4.27		0.33	0.46	0.62	0.99	2.46	6.07	
BJD-12c	1.61	2.03	2.37	2.71	3.05	3.41		0.74	1.22	4.21	13.85	19.77	27.95	
								0.59	0.74	1.30	3.46	6.67	12.44	
BJDEX-14	3.04	3.83	4.46	5.10	5.74	6.43		0.47	0.78	2.68	8.81	12.58	17.79	
JCD-OS1A	1.58	1.99	2.33	2.66	2.99	3.35		0.97	1.35	1.82	2.92	7.29	17.96	
JCD-OS1B	2.25	2.84	3.31	3.78	4.26	4.77		1.17	1.93	6.67	21.96	31.36	44.34	
								0.93	1.17	3.43	9.40	14.98	25.66	
JCDEX-3.1	1.57	1.97	2.30	2.63	2.96	3.31		2.70	4.46	15.37	50.61	72.26	102.16	
								2.15	4.06	11.05	36.10	54.82	81.87	
JCDEX-3.2	2.28	2.87	3.35	3.83	4.31	4.83		0.76	1.25	4.31	14.20	20.27	28.66	
JCDEX-3.3	2.53	3.19	3.73	4.26	4.79	5.37		0.64	1.05	3.63	11.94	17.05	24.10	

These do not coincide with any values in Table 6-6. Identify the land use characteristics used from table 6-6

Under the drainage design criteria section (pg 9) add a narrative identifying why nearly bare ground is assumed for existing condition. Include what is assumed for the conveyance coefficient in the developed condition.

Revise to match the City DCM

IDF Equations

I_{100} = -2.52 ln(D) + 12.735

I_{50} = -2.25 ln(D) + 11.375

I_{25} = -2.00 ln(D) + 10.111

I_{10} = -1.75 ln(D) + 8.847

I_{5} = -1.50 ln(D) + 7.583

I_{2} = -1.19 ln(D) + 6.035

Note: Values calculated by equations may not precisely duplicate values read from figure.

PRE DEVELOPMENT RATIONAL ANALYSIS

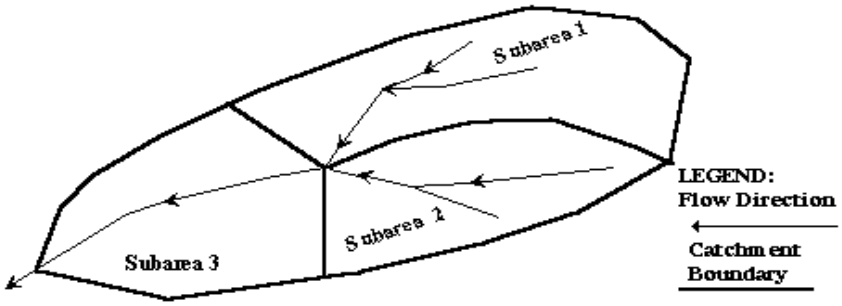
WEIGHTED RUNOFF COEFFICIENT CALCS

Calculations for only 3 basins were provided.
Provide the rest of the subbasin calculation

Area-Weighted Runoff Coefficient Calculations

Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/22/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name
BJD-12c

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See sheet "Design Info" for imperviousness-based runoff coefficient values.

Sub-Area ID	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1	15.07	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29
2	3.16	B	5.0	0.03	0.03	0.10	0.28	0.36	0.45	0.55
Total Area (ac)	18.23		Area-Weighted C	0.02	0.02	0.03	0.07	0.12	0.20	0.33
			Area-Weighted Override C	0.02	0.02	0.03	0.07	0.12	0.20	0.33

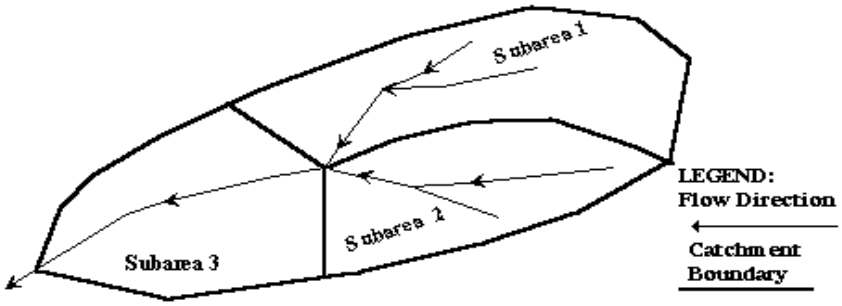
These values does not reflect any values listed in Table 6-6.

Update all runoff coefficient calculation

Area-Weighted Runoff Coefficient Calculations

Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name
JCDEX-3.1

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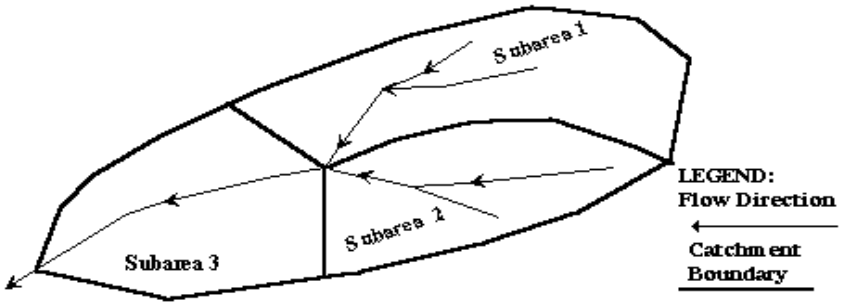
See sheet "Design Info" for imperviousness-based runoff coefficient values.

Sub-Area ID	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1	20.79	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29
2	47.81	B	5.0	0.03	0.03	0.10	0.28	0.36	0.45	0.55
Total Area (ac)	68.60		Area-Weighted C	0.02	0.03	0.07	0.20	0.27	0.36	0.47
			Area-Weighted Override C	0.02	0.03	0.07	0.20	0.27	0.36	0.47

Area-Weighted Runoff Coefficient Calculations

Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/22/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name
JCD-OS1B

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Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

See sheet "Design Info" for imperviousness-based runoff coefficient values.

Sub-Area ID	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1	13.43	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29
2	7.81	B	5.0	0.03	0.03	0.10	0.28	0.36	0.45	0.55
Total Area (ac)	21.24		Area-Weighted C	0.02	0.02	0.05	0.12	0.17	0.26	0.38
			Area-Weighted Override C	0.02	0.02	0.05	0.12	0.17	0.26	0.38

Total area does not match the drainage map. Update either one to be consistent

PRE DEVELOPMENT RATIONAL ANALYSIS

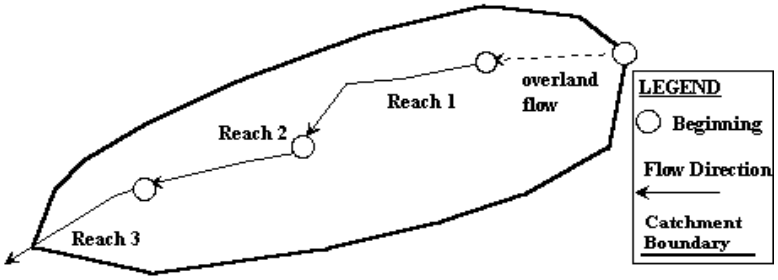
WEIGHTED SLOPE CALCS

Calculation for Basin JBDEX14 is missing

Length-Weighted Slope Calculations

Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
BJD-12a	3.57

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)
OVERLAND FLOW	300.00	6054.00	6043.00	0.037

Total Overland Length (ft)	300.00	Length-Weighted Slope (ft/ft)	0.037

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)
SC1	789.00	6043.00	6003.00	0.051
SC2	995.00	6003.00	5981.00	0.022

Total Channelized Length (ft)	1784.00	Length-Weighted Slope (ft/ft)	0.035

Length-Weighted Slope Calculations

Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
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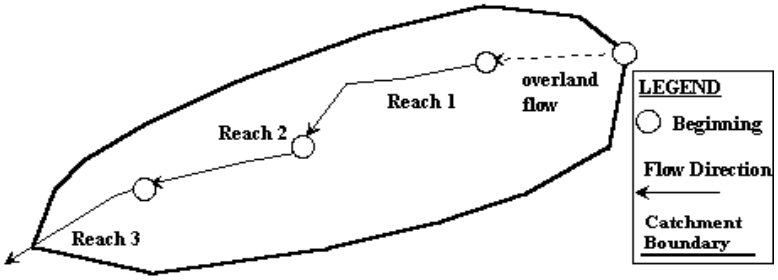


Subcatchment Name	Percent Imperviousness (%)
BJD-12b	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)
OVERLAND FLOW	295.00	6018.30	6010.00	0.028

Total Overland Length (ft)	295.00	Length-Weighted Slope (ft/ft)	0.028

CHANNELIZED FLOW

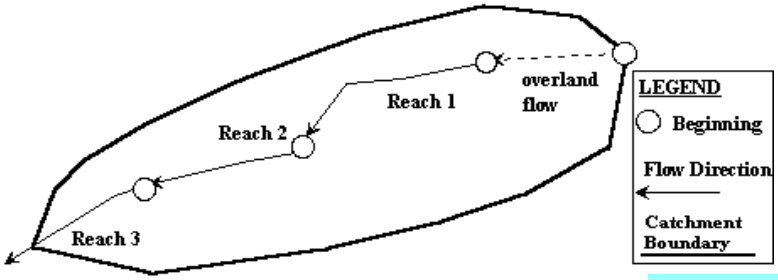
Reach ID	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)
SC1	355.00	6010.00	5988.00	0.062

Total Channelized Length (ft)	355.00	Length-Weighted Slope (ft/ft)	0.062

Length-Weighted Slope Calculations

Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
BJD-12c	80

Revise. % impervious is high for per-development.

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)
OVERLAND FLOW	300.00	5999.50	5990.50	0.030
Total Overland Length (ft)	**300.00**		**Length-Weighted Slope (ft/ft)**	**0.030**

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)
SC1	655.00	5990.50	5975.90	0.022
SC2	448.00	5975.90	5973.90	0.004
Total Channelized Length (ft)	**1103.00**		**Length-Weighted Slope (ft/ft)**	**0.015**

Length-Weighted Slope Calculations

Version 2.00 released May 2017

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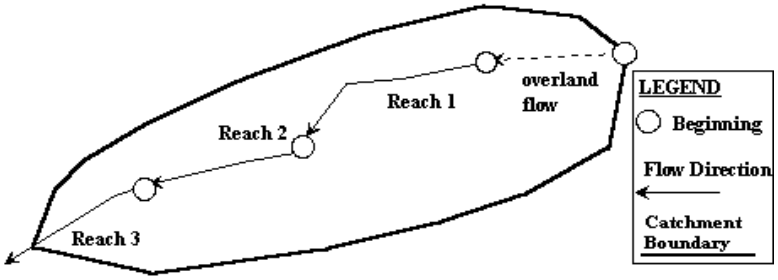


Subcatchment Name	Percent Imperviousness (%)
JCD-EX3.1	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)
OVERLAND FLOW	300.00	5996.00	5971.00	0.083
Total Overland Length (ft)	**300.00**		**Length-Weighted Slope (ft/ft)**	**0.083**

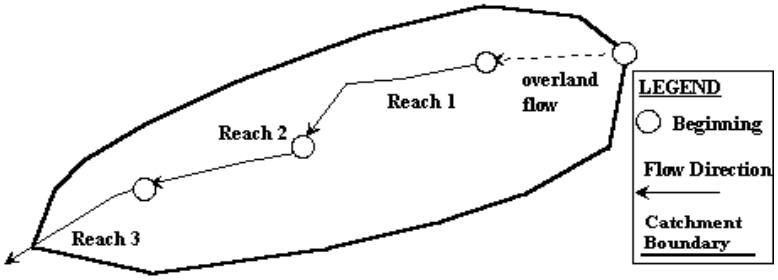
CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)
SC1	899.00	5971.00	5930.50	0.045
SC2	1734.00	5930.50	5880.00	0.029
Total Channelized Length (ft)	**2633.00**		**Length-Weighted Slope (ft/ft)**	**0.035**

Length-Weighted Slope Calculations

Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
JCDEX3.2	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)
OVERLAND FLOW	244.00	5994.00	5972.00	0.090

Total Overland Length (ft)	244.00	Length-Weighted Slope (ft/ft)	0.090

CHANNELIZED FLOW

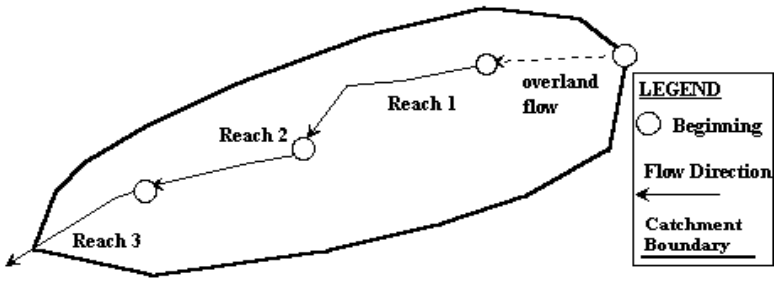
Reach ID	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)
SC1	985.00	5972.00	5908.00	0.065

Total Channelized Length (ft)	985.00	Length-Weighted Slope (ft/ft)	0.065

Length-Weighted Slope Calculations

Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
JCD EX-3.3	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)
OVERLAND FLOW	297.00	5995.00	5960.00	0.118

Total Overland Length (ft)	297.00	Length-Weighted Slope (ft/ft)	0.118

CHANNELIZED FLOW

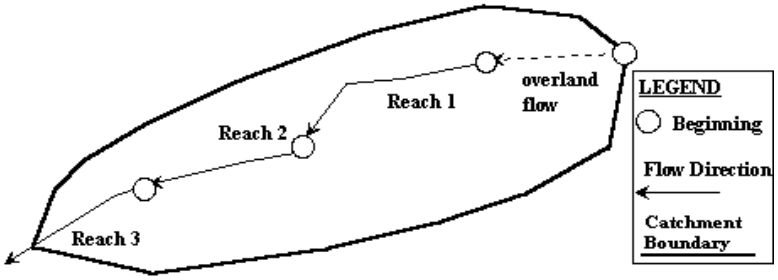
Reach ID	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)
SC1	398.00	5960.00	5930.00	0.075

Total Channelized Length (ft)	398.00	Length-Weighted Slope (ft/ft)	0.075

Length-Weighted Slope Calculations

Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
JCD OS-1A	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)
OVERLAND FLOW	247.00	6076.00	6066.00	0.040

Total Overland Length (ft)	247.00	Length-Weighted Slope (ft/ft)	0.040

CHANNELIZED FLOW

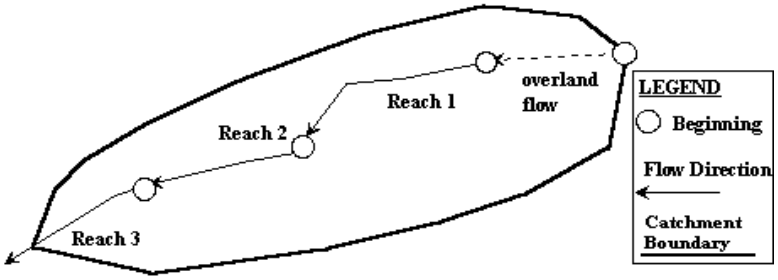
Reach ID	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)
SC1	2545.00	6066.00	5950.00	0.046

Total Channelized Length (ft)	2545.00	Length-Weighted Slope (ft/ft)	0.046

Length-Weighted Slope Calculations

Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
JCD OS-1B	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)
OVERLAND FLOW	200.00	6013.50	6000.00	0.068

Total Overland Length (ft)	200.00	Length-Weighted Slope (ft/ft)	0.068

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)
SC1	1167.00	6000.00	5932.00	0.058

Total Channelized Length (ft)	1167.00	Length-Weighted Slope (ft/ft)	0.058

PRE DEVELOPMENT RATIONAL ANALYSIS

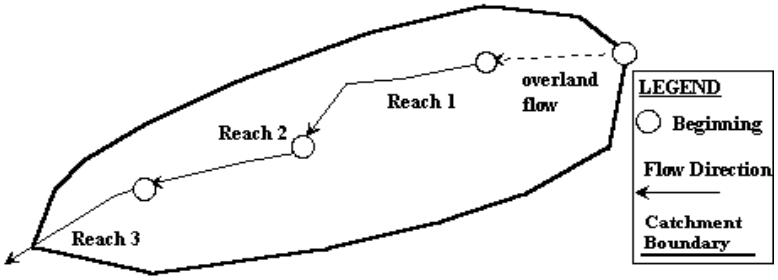
WEIGHTED Tc CALCS

JCDEX3.2 calculation is missing

Reach-Weighted Time of Concentration Calculations

Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
BJD-12a	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	5-yr Runoff Coefficient, C_5	Overland Flow Time t_i (min)
OVERLAND FLOW	300.00	0.037	0.02	21.93
Weighted Totals	**300.00**	**0.037**	**Total t_i (min)**	**21.93**

CHANNELIZED FLOW

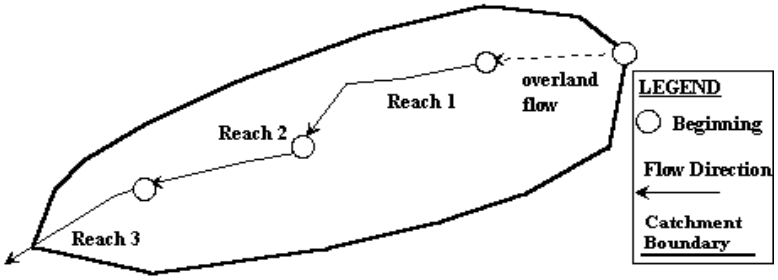
Reach ID	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t_t (min)
SC-1	789.00	0.043	10	6.34
SC-2	995.00	0.013	7	20.78
Weighted Totals	**1784.00**	**0.026**	**Total t_t (min)**	**27.12**

Computed t_c (min)	**49.05**
Regional t_c (min)	**44.06**
Selected t_c (min)	**44.06**

Reach-Weighted Time of Concentration Calculations

Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
BJD-12b	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	5-yr Runoff Coefficient, C_5	Overland Flow Time t_i (min)
OVERLAND FLOW	295.00	0.028	0.02	23.84
Weighted Totals	**295.00**	**0.028**	**Total t_i (min)**	**23.84**

CHANNELIZED FLOW

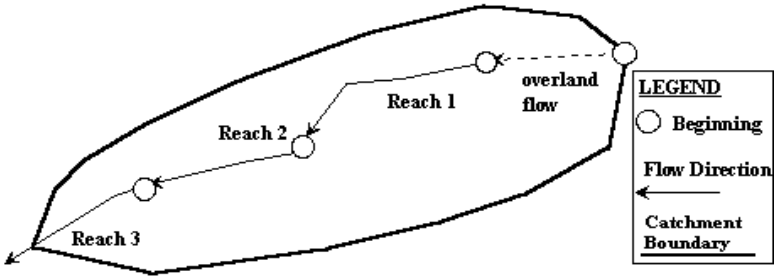
Reach ID	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t_t (min)
SC-1	355.00	0.062	10	2.38
Weighted Totals	**355.00**	**0.062**	**Total t_t (min)**	**2.38**

Computed t_c (min)	**26.22**
Regional t_c (min)	**27.60**
Selected t_c (min)	**26.22**

Reach-Weighted Time of Concentration Calculations

Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
BJD-12c	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	5-yr Runoff Coefficient, C_5	Overland Flow Time t_i (min)
OVERLAND FLOW	300.00	0.030	0.02	23.50
Weighted Totals	**300.00**	**0.030**	**Total t_i (min)**	**23.50**

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t_t (min)
SC-1	1103.00	0.015	10	15.01
Weighted Totals	**1103.00**	**0.015**	**Total t_t (min)**	**15.01**

Computed t_c (min)	**38.51**
Regional t_c (min)	**40.62**
Selected t_c (min)	**38.51**

Reach-Weighted Time of Concentration Calculations

Version 2.00 released May 2017

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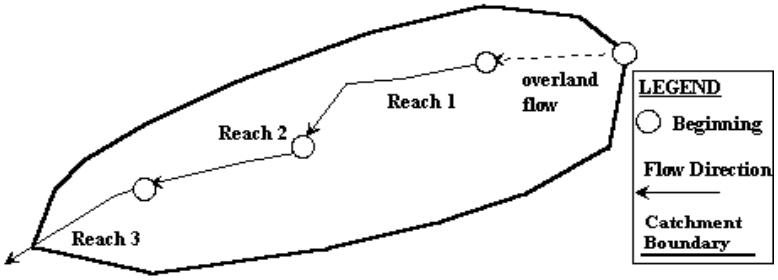
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
BJDEX14	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	5-yr Runoff Coefficient, C_5	Overland Flow Time t_i (min)
OVERLAND FLOW	112.00	0.098	0.03	9.63
Weighted Totals	**112.00**	**0.098**	**Total t_i (min)**	**9.63**

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t_t (min)
SC-1	353.00	0.091	10	1.95
Weighted Totals	**353.00**	**0.091**	**Total t_t (min)**	**1.95**

Computed t_c (min)	**11.58**
Regional t_c (min)	**27.16**
Selected t_c (min)	**11.58**

Reach-Weighted Time of Concentration Calculations

Version 2.00 released May 2017

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Project: Waterview North
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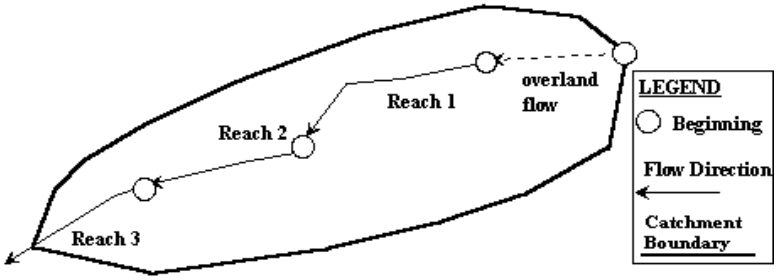

Subcatchment Name	Percent Imperviousness (%)
JCD OS-1A	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	5-yr Runoff Coefficient, C_5	Overland Flow Time t_i (min)
OVERLAND FLOW	247.00	0.040	0.02	19.39
Weighted Totals	**247.00**	**0.040**	**Total t_i (min)**	**19.39**

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t_t (min)
SC-1	2545.00	0.046	10	19.78
Weighted Totals	**2545.00**	**0.046**	**Total t_t (min)**	**19.78**

Computed t_c (min)	**39.17**
Regional t_c (min)	**45.54**
Selected t_c (min)	**39.17**

Reach-Weighted Time of Concentration Calculations

Version 2.00 released May 2017

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Company: Dakota Springs Engineering
Date: 3/28/2020
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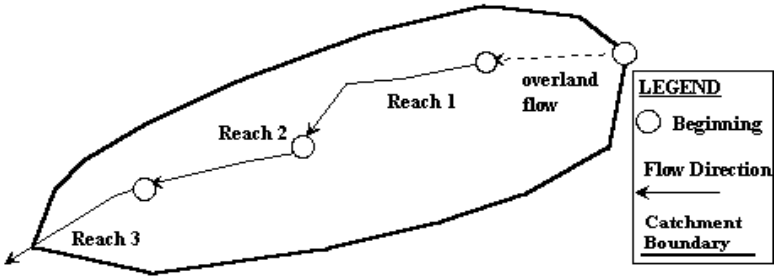
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
JCD OS-1B	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	5-yr Runoff Coefficient, C_5	Overland Flow Time t_i (min)
OVERLAND FLOW	200.00	0.085	0.02	13.61
Weighted Totals	**200.00**	**0.085**	**Total t_i (min)**	**13.61**

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t_t (min)
SC-1	1167.00	0.058	10	8.08
Weighted Totals	**1167.00**	**0.058**	**Total t_t (min)**	**8.08**

Computed t_c (min)	**21.69**
Regional t_c (min)	**33.48**
Selected t_c (min)	**21.69**

Reach-Weighted Time of Concentration Calculations

Version 2.00 released May 2017

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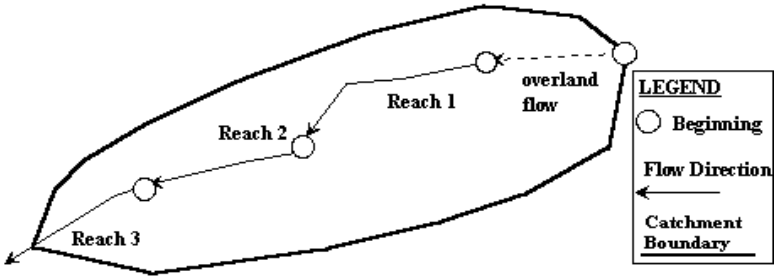
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
JCDEX3.1	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	5-yr Runoff Coefficient, C_5	Overland Flow Time t_i (min)
OVERLAND FLOW	300.00	0.083	0.03	16.64
Weighted Totals	**300.00**	**0.083**	**Total t_i (min)**	**16.64**

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t_t (min)
SC-1	899.00	0.045	10	7.06
SC-2	1734.00	0.030	10	16.69
Weighted Totals	**2633.00**	**0.035**	**Total t_t (min)**	**23.75**

Computed t_c (min)	**40.39**
Regional t_c (min)	**49.29**
Selected t_c (min)	**40.39**

Reach-Weighted Time of Concentration Calculations

Version 2.00 released May 2017

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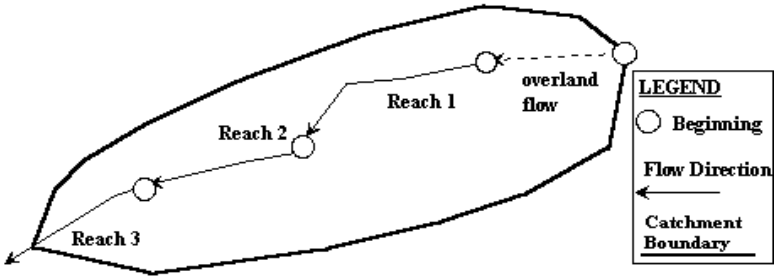
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
JCDEX3.3	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	5-yr Runoff Coefficient, C_5	Overland Flow Time t_i (min)
OVERLAND FLOW	297.00	0.118	0.03	14.74
Weighted Totals	**297.00**	**0.118**	**Total t_i (min)**	**14.74**

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t_t (min)
SC-1	309.00	0.075	10	1.88
Weighted Totals	**309.00**	**0.075**	**Total t_t (min)**	**1.88**

Computed t_c (min)	**16.63**
Regional t_c (min)	**27.09**
Selected t_c (min)	**16.63**

POST DEVELOPMENT RATIONAL ANALYSIS

SUMMARY

Calculation of Peak Runoff using Rational Method

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 6/16/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.

Version 2.00 released May 2017

Cells of this color are for required user-input
Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$$

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

Computed $t_c = t_i + t_t$

Regional $t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$

$t_{minimum}$= 5 (urban)
$t_{minimum}$= 10 (non-urban)

Selected $t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

1-hour rainfall depth, P1 (in) =	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
	1.19	1.50	1.75	2.00	2.25	2.52	

Rainfall Intensity Equation Coefficients =	a	b	c
$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$	28.50	10.00	0.786

$Q(cfs) = CIA$

Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time							Time of Concentration			Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
BJD-12a	54.28	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	300.00			0.043	20.90	1784.00			0.035	10	1.87	15.89	36.79	41.55	36.79	1.65	2.08	2.43	2.77	3.12	3.50		1.51	2.11	2.84	4.55	11.41	28.20	
																									37.87	1.62	2.04	2.38	2.72	3.07	3.43		1.48	2.07	2.79	4.47	11.21	27.70	
BJD-12b	9.54	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	295.00			0.028	23.87	355.00			0.062	10	2.49	2.38	26.25	27.60	26.25	2.02	2.54	2.97	3.39	3.81	4.27		0.33	0.46	0.62	0.99	2.46	6.07	
BJD-12c	18.23	B	72.0	0.57	0.60	0.64	0.70	0.73	0.76	0.80	300.00			0.023	11.89	1103.00			0.015	20	2.45	7.50	19.40	21.63	19.40	2.38	3.00	3.50	4.00	4.50	5.04		24.66	32.76	40.69	51.10	59.83	69.86	
					0.59				0.70						12.12								19.62		21.71	2.24	2.82	3.30	3.77	4.24	4.75		23.24	30.38	38.33	48.14	56.37	60.56	
BJDEV-14	6.16	B	89.0	0.73	0.75	0.78	0.81	0.82	0.84	0.86	112.00			0.098	3.10	353.00			0.091	20	6.03	0.98	4.08	11.78	5.00	4.04	5.09	5.94	6.78	7.63	8.55		18.12	23.66	28.35	33.76	38.77	44.22	
									0.83																													43.70	
JCD-OS1A	36.00	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	247.00			0.040	19.42	2545.00			0.046	10	2.14	19.78	39.19	45.54	39.19	1.59	2.00	2.33	2.67	3.00	3.36		0.97	1.36	1.83	2.93	7.31	18.02	
JCD-OS1B	20.70	A	5.0	0.02	0.02	0.02	0.03	0.07	0.15	0.29	200.00			0.068	14.66	1167.00			0.058	10	2.41	8.08	22.74	33.48	22.74	2.19	2.75	3.21	3.67	4.13	4.63		0.77	1.07	1.45	2.32	5.79	14.27	
				0.02	0.02	0.05	0.12	0.17	0.26	0.38					14.65								22.73															0.90	1.14	3.33	9.12	14.54	24.91	
JCDEV-3.1	68.60	B	73.4	0.58	0.61	0.65	0.71	0.74	0.77	0.80	300.00			0.083	7.59	2633.00			0.034	20	3.69	11.90	19.49	25.87	19.49	2.37	2.99	3.49	3.99	4.49	5.02		94.68	125.60	155.43	194.22	226.99	264.48	
					0.50										9.33								21.23		21.35	2.26	2.85	3.33	3.80	4.28	4.79		90.23	97.77	148.13	185.09	216.33	252.06	
JCDEV-3.2	13.21	B	70.0	0.55	0.58	0.62	0.69	0.72	0.75	0.79	244.00			0.094	6.98	984.00			0.066	20	5.14	3.19	10.17	17.50	10.17	3.20	4.03	4.70	5.37	6.05	6.77		23.24	30.95	38.63	48.88	57.39	67.22	
					0.50				0.65						8.08								11.27		9.64	3.27	4.12	4.80	5.49	6.17	6.92		23.74	27.19	39.45	49.93	58.61	59.38	
JCDEV-3.3	10.00	B	90.0	0.74	0.76	0.78	0.81	0.83	0.84	0.87	300.00			0.083	5.22	572.00			0.044	20	4.20	2.27	7.50	12.80	7.50	3.58	4.51	5.26	6.01	6.76	7.57		26.40	34.45	41.20	48.94	56.14	63.96	
					0.74				0.83						5.60								7.87															33.36				62.86	

See comments on the pre-development spreadsheet.

Revise overland flow length to 100' max. The project is developed as an urban land use.

Remove override values or explain in the narrative.

POST DEVELOPMENT RATIONAL ANALYSIS

WEIGHTED RUNOFF COEFFICIENT CALCS

POST DEVELOPMENT WEIGHTED CURVE NUMBER & RUNOFF COEFFICIENT CALCULATIONS

Waterview North

Composite % Impervious

BASIN ID	Total Area (Ac.)	HSG A/B	% IMPERV	DESIGNATED LAND USE (% OF BASIN) I-2	CS	RVP	RS-5000	RM-12	WEIGHTED RESULTANT VALUES CN	C_5	C_{100}	ca-equivalent CA_5	CA_{100}
BJD-12a	54.28	A	5.0										
									49.6	0.02	0.15		
BJD-12b	9.54	A	5.0										
									49.6	0.02	0.15	0.1908	1.43
BJD-12c	18.23	B	72.0	18.23									
				1					88	0.59	0.7	10.7557	12.76
BJDEV-14	6.16	B	89.0	1.61	4.55								
				0.26	0.74				91.0	0.75	0.83	4.6354	5.13
JCD-OS1A	36.00	A	5.0										
									49.6	0.02	0.15	0.72	5.40
JCD-OS1B	20.70	A	5.0										
									54.0	0.02	0.26	0.414	5.38
JCDEV-3.1	68.60	B	54.8	8.36	6.86	17.83	29.68	6.47					
				0.12	0.10	0.26	0.43	0.09	82.9	0.4	0.59	29.2196	40.56
JCDEV-3.2	13.21	B	69.4				1.34	11.86					
							0.10	0.90	87.6	0.49	0.64	6.533	8.50
JCDEV-3.3	10.00	B	89.4		7.77			2.23					
					0.78			0.22	91.1	0.74	0.83	7.4087	8.29

Land Use ID	% Imp.	5-yr (C) HSG A & B	100-yr (C) HSG A & B	CN HSG A	CN HSG B
I-2	72	0.59	0.7	81	88
CS	95	0.81	0.88	89	92
RVP	7	0.12	0.39	49	69
RS-5000	65	0.45	0.59	77	85
RM-12	70	0.5	0.65	80	88

Adjust to match table 6-6. Example: Light industrial is 80%

Is RVP and RV park? Revise, value appears to be extremely low.

POST DEVELOPMENT RATIONAL ANALYSIS

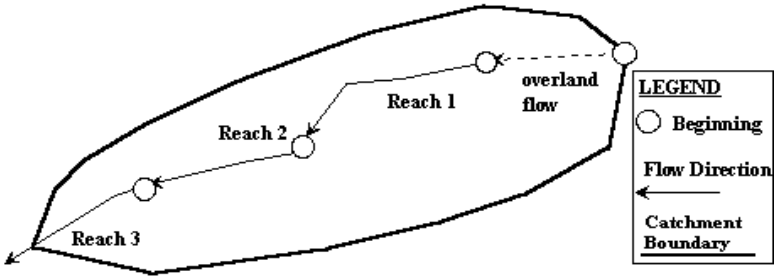
WEIGHTED SLOPE CALCS

missing two of the sub-basin calcs

Length-Weighted Slope Calculations

Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
BJD-12a	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)
OVERLAND FLOW	300.00	6056.00	6043.00	0.043

Total Overland Length (ft)	300.00	Length-Weighted Slope (ft/ft)	0.043

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)
SC1	789.00	6043.00	6003.00	0.051
SC2	995.00	6003.00	5981.00	0.022

Total Channelized Length (ft)	1784.00	Length-Weighted Slope (ft/ft)	0.035

Length-Weighted Slope Calculations

Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/28/2020
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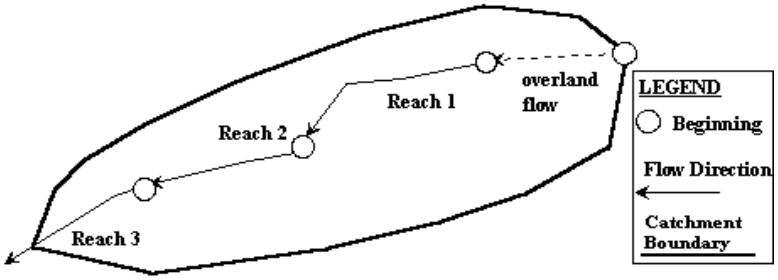

Subcatchment Name	Percent Imperviousness (%)
BJD-12b	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)
OVERLAND FLOW	295.00	6018.30	6010.00	0.028

Total Overland Length (ft)	295.00	Length-Weighted Slope (ft/ft)	0.028

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)
SC1	355.00	6010.00	5988.00	0.062

Total Channelized Length (ft)	355.00	Length-Weighted Slope (ft/ft)	0.062

Length-Weighted Slope Calculations

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Company: Dakota Springs Engineering
Date: 3/28/2020
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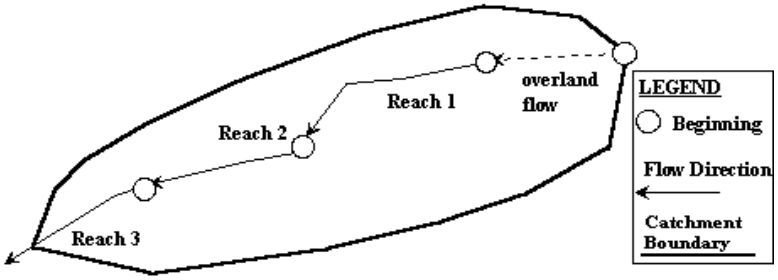

Subcatchment Name	Percent Imperviousness (%)
BJD-12c	72

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)
OVERLAND FLOW	300.00	5999.50	5990.50	0.030

Total Overland Length (ft)	300.00	Length-Weighted Slope (ft/ft)	0.030

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)
SC1	665.00	5990.50	5975.90	0.022
sc2	448.00	5975.90	5973.90	0.004

Total Channelized Length (ft)	1113.00	Length-Weighted Slope (ft/ft)	0.015

Length-Weighted Slope Calculations

Version 2.00 released May 2017

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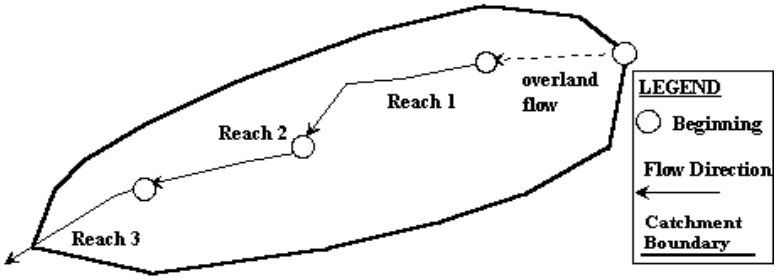

Subcatchment Name	Percent Imperviousness (%)
JCDEV-3.1	67

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)
OVERLAND FLOW	300.00	5996.00	5971.00	0.083

Total Overland Length (ft)	300.00	Length-Weighted Slope (ft/ft)	0.083

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)
SC1	899.00	5971.00	5930.50	0.045
SC2	1734.00	5930.50	5880.00	0.029

Total Channelized Length (ft)	2633.00	Length-Weighted Slope (ft/ft)	0.035

Length-Weighted Slope Calculations

Version 2.00 released May 2017

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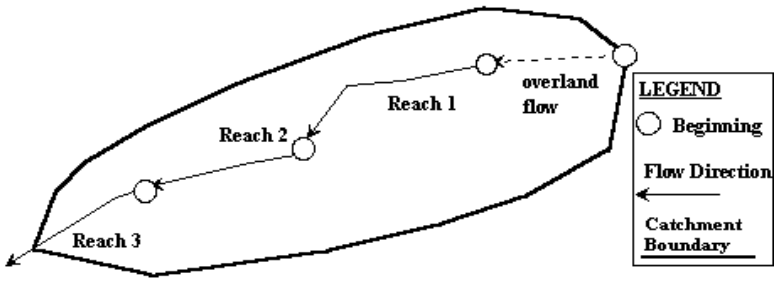

Subcatchment Name	Percent Imperviousness (%)
JCDEV-3.3	72

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)
OVERLAND FLOW	297.00	5995.00	5960.00	0.118
Total Overland Length (ft)	**297.00**		**Length-Weighted Slope (ft/ft)**	**0.118**

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)
SC1	398.00	5960.00	5930.00	0.075
Total Channelized Length (ft)	**398.00**		**Length-Weighted Slope (ft/ft)**	**0.075**

Length-Weighted Slope Calculations

Version 2.00 released May 2017

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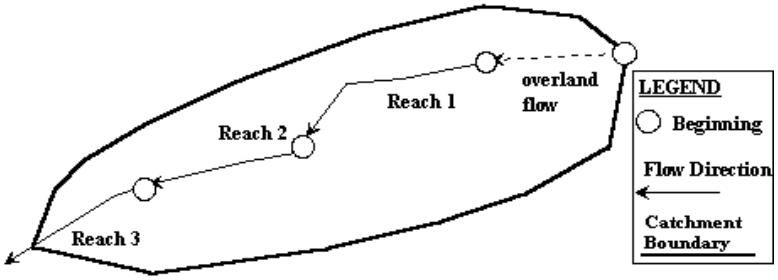
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
JCD-OS1A	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)
OVERLAND FLOW	247.00	6076.00	6066.00	0.040

Total Overland Length (ft)	247.00	Length-Weighted Slope (ft/ft)	0.040

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)
SC1	2545.00	6066.00	5950.00	0.046

Total Channelized Length (ft)	2545.00	Length-Weighted Slope (ft/ft)	0.046

Length-Weighted Slope Calculations

Version 2.00 released May 2017

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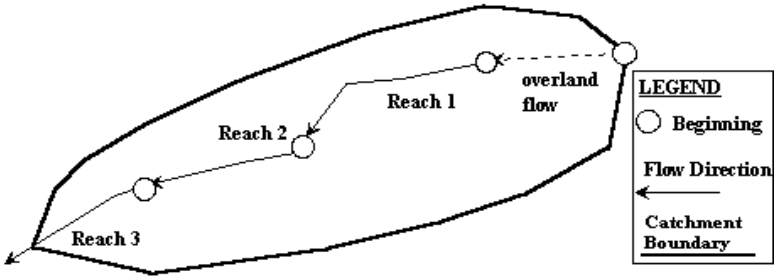
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
JCD-OS1B	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)
OVERLAND FLOW	200.00	6013.50	6000.00	0.068

Total Overland Length (ft)	200.00	Length-Weighted Slope (ft/ft)	0.068

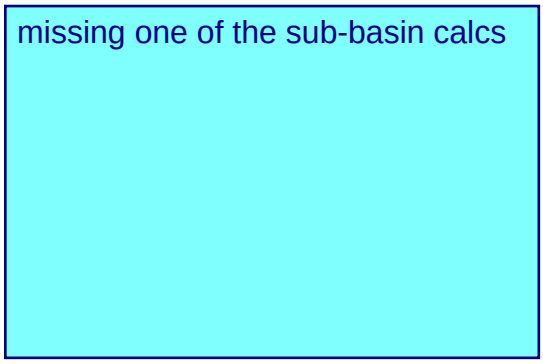
CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)
SC1	1167.00	6000.00	5932.00	0.058

Total Channelized Length (ft)	1167.00	Length-Weighted Slope (ft/ft)	0.058

POST DEVELOPMENT RATIONAL ANALYSIS

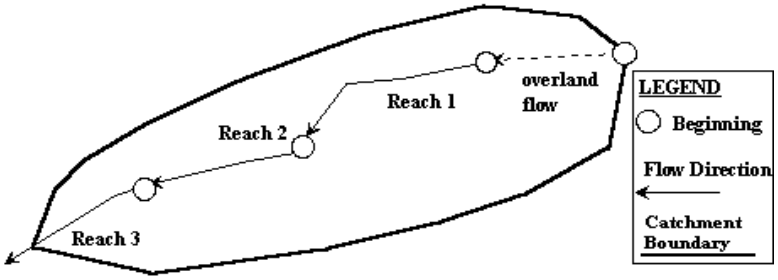
WEIGHTED Tc CALCS



Reach-Weighted Time of Concentration Calculations

Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
BJD-12a	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	5-yr Runoff Coefficient, C_5	Overland Flow Time t_i (min)
OVERLAND FLOW	300.00	0.043	0.02	20.87
Weighted Totals	**300.00**	**0.043**	**Total t_i (min)**	**20.87**

CHANNELIZED FLOW

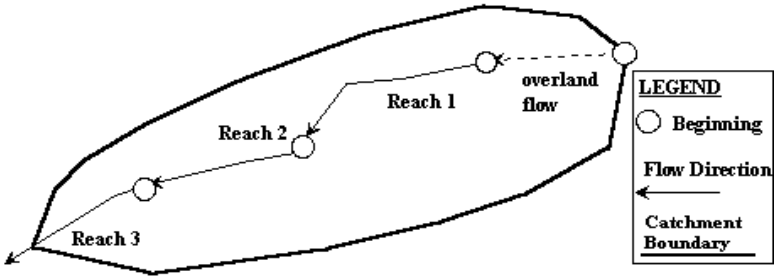
Reach ID	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t_t (min)
SC-1	789.00	0.051	10	5.82
SC-2	995.00	0.022	10	11.18
Weighted Totals	**1784.00**	**0.035**	**Total t_t (min)**	**17.00**

Computed t_c (min)	**37.87**
Regional t_c (min)	**41.58**
Selected t_c (min)	**37.87**

Reach-Weighted Time of Concentration Calculations

Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
BJD-12b	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	5-yr Runoff Coefficient, C_5	Overland Flow Time t_i (min)
OVERLAND FLOW	295.00	0.028	0.02	23.84
Weighted Totals	**295.00**	**0.028**	**Total t_i (min)**	**23.84**

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t_t (min)
SC-1	355.00	0.062	10	2.38
Weighted Totals	**355.00**	**0.062**	**Total t_t (min)**	**2.38**

Computed t_c (min)	**26.22**
Regional t_c (min)	**27.60**
Selected t_c (min)	**26.22**

Reach-Weighted Time of Concentration Calculations

Version 2.00 released May 2017

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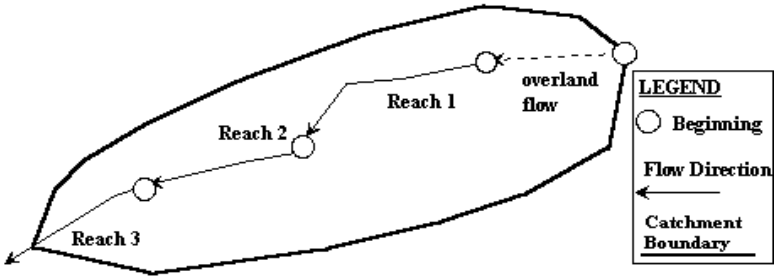
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
BJD-12c	72

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	5-yr Runoff Coefficient, C_5	Overland Flow Time t_i (min)
OVERLAND FLOW	300.00	0.023	0.60	11.88
Weighted Totals	**300.00**	**0.023**	**Total t_i (min)**	**11.88**

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t_t (min)
SC-1	655.00	0.022	20	3.68
SC-2	448.00	0.004	10	11.81
Weighted Totals	**1103.00**	**0.015**	**Total t_t (min)**	**15.49**

Computed t_c (min)	**27.36**
Regional t_c (min)	**21.71**
Selected t_c (min)	**21.71**

Reach-Weighted Time of Concentration Calculations

Version 2.00 released May 2017

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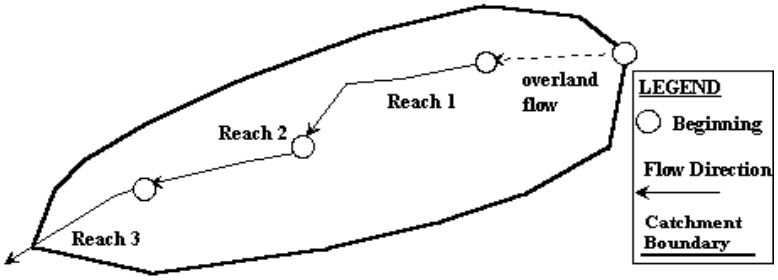


Subcatchment Name	Percent Imperviousness (%)
BJDEV-14	82

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	5-yr Runoff Coefficient, C_5	Overland Flow Time t_i (min)
OVERLAND FLOW	112.00	0.098	0.73	3.33
Weighted Totals	**112.00**	**0.098**	**Total t_i (min)**	**3.33**

CHANNELIZED FLOW

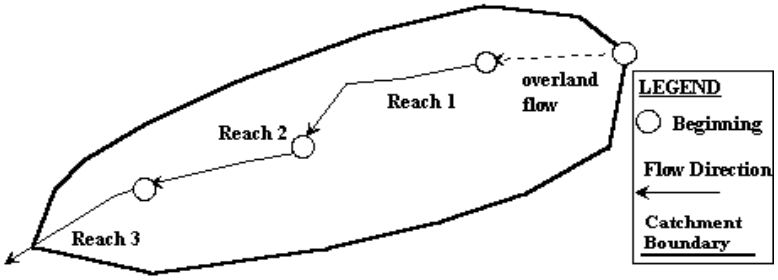
Reach ID	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t_t (min)
SC-1	353.00	0.091	20	0.98
Weighted Totals	**353.00**	**0.091**	**Total t_t (min)**	**0.98**

Computed t_c (min)	**4.30**
Regional t_c (min)	**13.01**
Selected t_c (min)	**5.00**

Reach-Weighted Time of Concentration Calculations

Version 2.00 released May 2017

Designer: Chad Binder
Company: Dakota Springs Engineering
Date: 3/28/2020
Project: Waterview North
Location: NE Corner at Powers Blvd & Bradley Rd.



Subcatchment Name	Percent Imperviousness (%)
JCDEV3.1	67

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	5-yr Runoff Coefficient, C_5	Overland Flow Time t_i (min)
OVERLAND FLOW	300.00	0.083	0.50	9.33
Weighted Totals	**300.00**	**0.083**	**Total t_i (min)**	**9.33**

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t_t (min)
SC-1	899.00	0.045	20	3.53
SC-2	1734.00	0.029	20	8.49
Weighted Totals	**2633.00**	**0.034**	**Total t_t (min)**	**12.02**

Computed t_c (min)	**21.35**
Regional t_c (min)	**27.47**
Selected t_c (min)	**21.35**

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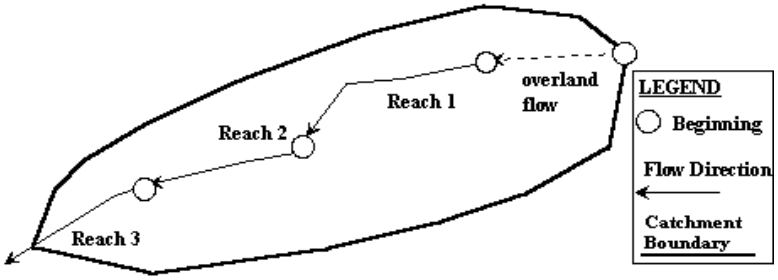

Subcatchment Name	Percent Imperviousness (%)
JCDEV3.2	75

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	5-yr Runoff Coefficient, C_5	Overland Flow Time t_i (min)
OVERLAND FLOW	244.00	0.090	0.63	6.42
Weighted Totals	**244.00**	**0.090**	**Total t_i (min)**	**6.42**

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t_t (min)
SC-1	985.00	0.065	20	3.22
Weighted Totals	**985.00**	**0.065**	**Total t_t (min)**	**3.22**

Computed t_c (min)	**9.64**
Regional t_c (min)	**16.55**
Selected t_c (min)	**9.64**

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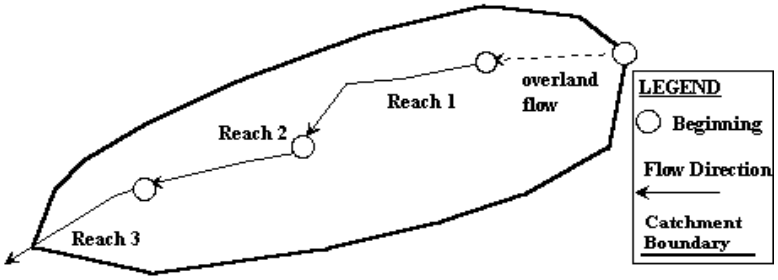

Subcatchment Name	Percent Imperviousness (%)
JCD-OS1A	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	5-yr Runoff Coefficient, C_5	Overland Flow Time t_i (min)
OVERLAND FLOW	247.00	0.040	0.02	19.39
Weighted Totals	**247.00**	**0.040**	**Total t_i (min)**	**19.39**

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t_t (min)
SC-1	2545.00	0.046	10	19.78
Weighted Totals	**2545.00**	**0.046**	**Total t_t (min)**	**19.78**

Computed t_c (min)	**39.17**
Regional t_c (min)	**45.54**
Selected t_c (min)	**39.17**

Reach-Weighted Time of Concentration Calculations

Version 2.00 released May 2017

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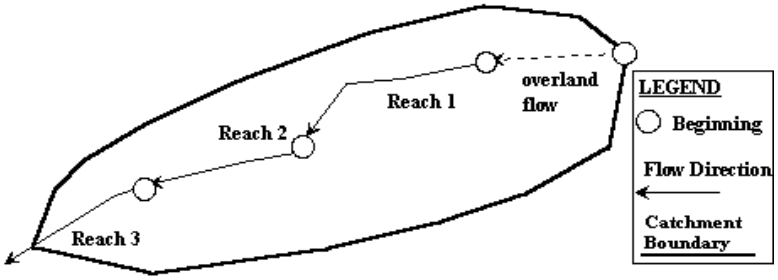


Subcatchment Name	Percent Imperviousness (%)
JCD-OS1B	5

OVERLAND FLOW

Reach ID	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	5-yr Runoff Coefficient, C_5	Overland Flow Time t_i (min)
OVERLAND FLOW	200.00	0.068	0.02	14.65
Weighted Totals	**200.00**	**0.068**	**Total t_i (min)**	**14.65**

CHANNELIZED FLOW

Reach ID	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Time t_t (min)
SC-1	1167.00	0.058	10	8.08
Weighted Totals	**1167.00**	**0.058**	**Total t_t (min)**	**8.08**

Computed t_c (min)	**22.73**
Regional t_c (min)	**33.48**
Selected t_c (min)	**22.73**

SCS UNIT HYDROGRAPH ANALYSIS

Pre-Development

Table 6-9. NRCS Curve Numbers for Pre-Development Thunderstorms Conditions (ARC I)

Fully Developed Urban Areas (vegetation established)[1]	Treatment	Hydrologic Condition	% I	Pre-Development CN			
				HSG A	HSG B	HSG C	HSG D
Open space (lawns, parks, golf courses, cemeteries, etc.):							
Poor condition (grass cover < 50%)	-----	-----	---	47	61	72	77
Fair condition (grass cover 50% to 75%)	-----	-----	---	29	48	61	69
Good condition (grass cover > 75%)	-----	-----	---	21	40	54	63
Impervious areas:							
Paved parking lots, roofs, driveways, etc. (excluding right-of-way	-----	-----	---	95	95	95	95
Streets and roads:							
Paved; curbs and storm sewers (excluding right-of-way)	-----	-----	---	95	95	95	95
Paved; open ditches (including right-of-way)	-----	-----	---	67	77	83	85
Gravel (including right-of-way)	-----	-----	---	57	70	77	81
Dirt (including right-of-way)	-----	-----	---	52	66	74	77
Western desert urban areas:							
Natural desert landscaping (pervious areas only)	-----	-----	---	42	58	70	75
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)	-----	-----	---	91	91	91	91
Developing Urban Areas[1]	**Treatment[2]**	**Hydrologic Condition[3]**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Newly graded areas (pervious areas only, no vegetation)	-----	-----	---	58	72	81	87
Cultivated Agricultural Lands[1]	**Treatment**	**Hydrologic Condition**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Fallow	Bare soil	-----	---	58	72	81	87
	Crop residue cover (CR)	Poor	---	57	70	79	85
		Good	---	54	67	75	79
Row crops	Straight row (SR)	Poor	---	52	64	75	81
		Good	---	46	60	70	77
	SR + CR	Poor	---	51	63	74	79
		Good	---	43	56	66	70
	Contoured (C)	Poor	---	49	61	69	75
		Good	---	44	56	66	72
	C + CR	Poor	---	48	60	67	74
		Good	---	43	54	64	70
	Contoured & terraced (C&T)	Poor	---	45	54	63	66
		Good	---	41	51	60	64
	C&T+ CR	Poor	---	44	53	61	64
		Good	---	40	49	58	63
Small grain	SR	Poor	---	44	57	69	75
		Good	---	42	56	67	74
	SR + CR	Poor	---	43	56	67	72
		Good	---	39	52	63	69
	C	Poor	---	42	54	66	70
		Good	---	40	53	64	69
	C + CR Poor	Poor	---	41	53	64	69
		Good	---	39	52	63	67
	C&T	Poor	---	40	52	61	66
		Good	---	38	49	60	64
	C&T+ CR	Poor	---	39	51	60	64
		Good	---	37	48	58	63
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	---	45	58	70	77
		Good	---	37	52	64	70
	C	Poor	---	43	56	67	70
		Good	---	34	48	60	67
	C&T	Poor	---	42	53	63	67
		Good	---	30	46	57	63

Table 6-9. (continued)

Other Agricultural Lands[1]	Treatment	Hydrologic Condition	% I	HSG A	HSG B	HSG C	HSG D
Pasture, grassland, or range—continuous forage for grazing[4]	-----	Poor	---	47	61	72	77
	-----	Fair	---	29	48	61	69
	-----	Good	---	21	40	54	63
Meadow—continuous grass, protected from grazing and generally mowed for hay	-----	-----	---	15	37	51	60
Brush—brush-weed-grass mixture with brush the major element[5]	-----	Poor	---	28	46	58	67
	-----	Fair	---	18	35	49	58
	-----	Good	---	15	28	44	53
Woods—grass combination (orchard or tree farm)[6]	-----	Poor	---	36	53	66	72
	-----	Fair	---	24	44	57	66
	-----	Good	---	17	37	52	61
Woods[7]	-----	Poor	---	26	45	58	67
	-----	Fair	---	19	39	53	61
	-----	Good	---	15	34	49	58
Farmsteads—buildings, lanes, driveways, and surrounding lots	-----	-----	---	38	54	66	72
Arid and Semi-arid Rangelands[1]	**Treatment**	**Hydrologic Condition[8]**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element	-----	Poor	---	-----	63	74	85
	-----	Fair	---	-----	51	64	77
	-----	Good	---	-----	41	54	70
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush	-----	Poor	---	-----	45	54	61
	-----	Fair	---	-----	28	36	42
	-----	Good	---	-----	15	23	28
Pinyon-juniper—pinyon, juniper, or both; grass understory	-----	Poor	---	-----	56	70	77
	-----	Fair	---	-----	37	53	63
	-----	Good	---	-----	23	40	51
Sagebrush with grass understory	-----	Poor	---	-----	46	63	70
	-----	Fair	---	-----	30	42	49
	-----	Good	---	-----	18	27	34
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus	-----	Poor	---	42	58	70	75
	-----	Fair	---	34	52	64	72
	-----	Good	---	29	47	61	69

[1.] Average runoff condition, and Ia = 0.1S.

[2.] Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.

[3.] Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness. Poor: Factors impair infiltration and tend to increase runoff. Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

[4.] Poor: <50%) ground cover or heavily grazed with no mulch. Fair: 50 to 75% ground cover and not heavily grazed. Good: > 75% ground cover and lightly or only occasionally grazed.

[5.] Poor: <50% ground cover. Fair: 50 to 75% ground cover. Good: >75% ground cover.

[6.] CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[7.] Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning. Fair: Woods are grazed but not burned, and some forest litter covers the soil. Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

[8.] Poor: <30% ground cover (litter, grass, and brush overstory). Fair: 30 to 70% ground cover. Good: > 70% ground cover.

Table 6-10. NRCS Curve Numbers for Frontal Storms & Thunderstorms for Developed Conditions (ARCII)

Fully Developed Urban Areas (vegetation established)[1]	Treatment	Hydrologic Condition	% I	Pre-Development CN			
				HSG A	HSG B	HSG C	HSG D
Open space (lawns, parks, golf courses, cemeteries, etc.):							
Poor condition (grass cover < 50%)	-----	-----	---	68	79	86	89
Fair condition (grass cover 50% to 75%)	-----	-----	---	49	69	79	84
Good condition (grass cover > 75%)	-----	-----	---	39	61	74	80
Impervious areas:							
Paved parking lots, roofs, driveways, etc. (excluding right-of-way	-----	-----	---	98	98	98	98
Streets and roads:							
Paved; curbs and storm sewers (excluding right-of-way)	-----	-----	---	98	98	98	98
Paved; open ditches (including right-of-way)	-----	-----	---	83	89	92	93
Gravel (including right-of-way)	-----	-----	---	76	85	89	91
Dirt (including right-of-way)	-----	-----	---	72	82	87	89
Western desert urban areas:							
Natural desert landscaping (pervious areas only)	-----	-----	---	63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)	-----	-----	---	96	96	96	96
Urban districts:							
Commercial and business	-----	-----	85	89	92	94	95
Industrial	-----	-----	72	81	88	91	93
Residential districts by average lot size:							
1/8 acre or less (town houses)	-----	-----	65	77	85	90	92
1/4 acre	-----	-----	38	61	75	83	87
1/3 acre	-----	-----	30	57	72	81	86
1/2 acre	-----	-----	25	54	70	80	85
1 acre	-----	-----	20	51	68	79	84
2 acres	-----	-----	12	46	65	77	82
Developing Urban Areas[1]	**Treatment[2]**	**Hydrologic Condition[3]**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Newly graded areas (pervious areas only, no vegetation)	-----	-----	---	77	86	91	94
Cultivated Agricultural Lands[1]	**Treatment**	**Hydrologic Condition**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Fallow	Bare soil	-----	---	77	86	91	94
	Crop residue cover (CR)	Poor	---	76	85	90	93
		Good	---	74	83	88	90
Row crops	Straight row (SR)	Poor	---	72	81	88	91
		Good	---	67	78	85	89
	SR + CR	Poor	---	71	80	87	90
		Good	---	64	75	82	85
	Contoured (C)	Poor	---	70	79	84	88
		Good	---	65	75	82	86
	C + CR	Poor	---	69	78	83	87
		Good	---	64	74	81	85
	Contoured & terraced (C&T)	Poor	---	66	74	80	82
		Good	---	62	71	78	81
	C&T+ CR	Poor	---	65	73	79	81
		Good	---	61	70	77	80
Small grain	SR	Poor	---	65	76	84	88
		Good	---	63	75	83	87
	SR + CR	Poor	---	64	75	83	86
		Good	---	60	72	80	84
	C	Poor	---	63	74	82	85
		Good	---	61	73	81	84
	C + CR Poor	Poor	---	62	73	81	84
		Good	---	60	72	80	83
	C&T	Poor	---	61	72	79	82
		Good	---	59	70	78	81
	C&T+ CR	Poor	---	60	71	78	81
		Good	---	58	69	77	80

Table 6-10. (continued)

Other Agricultural Lands[1]	Treatment	Hydrologic Condition	% I	HSG A	HSG B	HSG C	HSG D
Pasture, grassland, or range—continuous forage for grazing[4]	-----	Poor	---	68	79	86	89
	-----	Fair	---	49	69	79	84
	-----	Good	---	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay	-----	-----	---	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element[5]	-----	Poor	---	48	67	77	83
	-----	Fair	---	35	56	70	77
	-----	Good	---	30	48	65	73
Woods—grass combination (orchard or tree farm)[6]	-----	Poor	---	57	73	82	86
	-----	Fair	---	43	65	76	82
	-----	Good	---	32	58	72	79
Woods[7]	-----	Poor	---	45	66	77	83
	-----	Fair	---	36	60	73	79
	-----	Good	---	30	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots	-----	-----	---	59	74	82	86
Arid and Semi-arid Rangelands[1]	**Treatment**	**Hydrologic Condition[8]**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element	-----	Poor	---	-----	80	87	93
	-----	Fair	---	-----	71	81	89
	-----	Good	---	-----	62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush	-----	Poor	---	-----	66	74	79
	-----	Fair	---	-----	48	57	63
	-----	Good	---	-----	30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory	-----	Poor	---	-----	75	85	89
	-----	Fair	---	-----	58	73	80
	-----	Good	---	-----	41	61	71
Sagebrush with grass understory	-----	Poor	---	-----	67	80	85
	-----	Fair	---	-----	51	63	70
	-----	Good	---	-----	35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus	-----	Poor	---	63	77	85	88
	-----	Fair	---	55	72	81	86
	-----	Good	---	49	68	79	84

Ia = 0.1 S

2. Crop residue cover applies only if residue is on at least 5% of the surface throughout the year.

3. Hydraulic condition is based on combination factors that affect infiltration and runoff, including (a) density and canopy of vegetative areas, (b) amount of year-round cover, (c) amount of grass or close-seeded legumes, (d) percent of residue cover on the land surface (good ≥ 20%), and (e) degree of surface roughness. Poor: Factors impair infiltration and tend to increase runoff. Good: Factors encourage average and better than average infiltration and tend to decrease runoff.

4. Poor: <50%) ground cover or heavily grazed with no mulch. Fair: 50 to 75% ground cover and not heavily grazed. Good: > 75% ground cover and lightly or only occasional

5. Poor: <50% ground cover. Fair: 50 to 75% ground cover. Good: >75% ground cover.

6. CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods

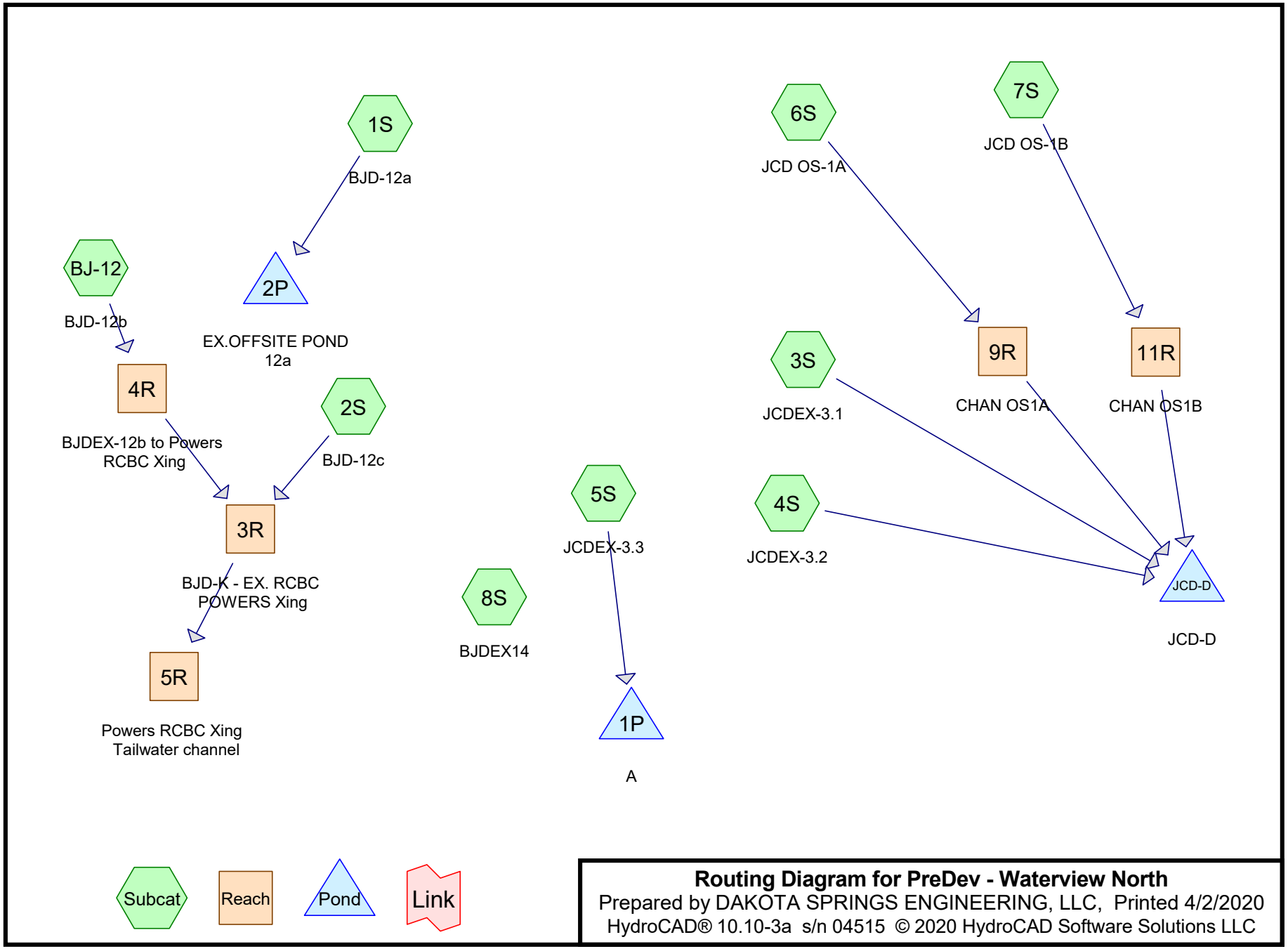
7. Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning. Fair: Woods are grazed but not burned, and some forest litter covers the soil. Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

8. Poor: <30% ground cover (litter, grass, and brush overstory). Fair: 30 to 70% ground cover. Good: > 70% ground cover.

4.6 Lag Time

While the NRCS curve numbers are used to calculate the volume of runoff and magnitude of losses, to transform the volume of runoff into a hydrograph using the NRCS dimensionless unit hydrograph, the lag time must be specified. The lag time is defined as the time from the centroid of the rainfall distribution of a storm to the peak discharge produced by the watershed. For this Manual, the lag time is defined as a fraction of the time of concentration (t_c) as shown in Equation 6-13.

$$t_{lag} = 0.6 \cdot t_c \qquad \text{(Eq. 6-13)}$$

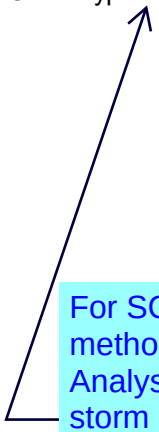


Routing Diagram for PreDev - Waterview North

Prepared by DAKOTA SPRINGS ENGINEERING, LLC, Printed 4/2/2020

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (minutes)	B/B	Depth (inches)	AMC
1	2yr	Type II 24-hr Tabular		Default	1,440.00	1	2.10	2
2	5yr	Type II 24-hr Tabular		Default	1,440.00	1	2.70	2
3	5yrAMC1	Type II 24-hr Tabular		Default	1,440.00	1	2.70	1
4	10yr	Type II 24-hr Tabular		Default	1,440.00	1	3.20	2
5	25yr	Type II 24-hr Tabular		Default	1,440.00	1	3.60	2
6	50yr	Type II 24-hr Tabular		Default	1,440.00	1	4.20	2
7	100yr	Type II 24-hr Tabular		Default	1,440.00	1	4.60	2
8	100yrAMC1	Type II 24-hr Tabular		Default	1,440.00	1	4.60	1



For SCS method, update the design criteria to describe using the SCS method. Identify the criterias and assumptions used.
Analysis should also include the thunderstorms in addition to the frontal storm used above. The conservative result is used.

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
170.065	68	(2S, 3S, 4S, 5S, 6S, 7S, 8S)
3.315	98	(6S, 7S, BJ-12)
2.710	98	0 (1S)
60.630	68	Pasture/grassland/range, Poor, HSG A (1S, BJ-12)
236.720	**69**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
60.630	HSG A	1S, BJ-12
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
176.090	Other	1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, BJ-12
236.720		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	173.380	173.380		2S, 3S, 4S, 5S, 6S, 7S, 8S, BJ-12
0.000	0.000	0.000	0.000	2.710	2.710	0	1S
60.630	0.000	0.000	0.000	0.000	60.630	Pasture/grassland/range, Poor	1S, BJ-12
60.630	**0.000**	**0.000**	**0.000**	**176.090**	**236.720**	**TOTAL AREA**	

Land-Use Listing (all nodes)

Area (acres)	Land Use	Subcatchment Numbers
157.860	(undefined)	1S, 3S, 4S, 5S, 6S, 7S, 8S, BJ-12
18.230	Industrial	2S
60.630	Pasture	1S, BJ-12
236.720	**TOTAL**	

Time span=1.00-24.00 hrs, dt=0.05 hrs, 461 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Muskingum-Cunge method - Pond routing by Stor-Ind method

Subcatchment 1S: BJD-12a Runoff Area=54.280 ac 4.99% Impervious Runoff Depth>0.30"
Tc=36.8 min AMC Adjusted CN=WQ Runoff=8.78 cfs 1.361 af

Subcatchment 2S: BJD-12c Runoff Area=18.230 ac 0.00% Impervious Runoff Depth>0.21"
Tc=38.2 min AMC Adjusted CN=48 Runoff=1.68 cfs 0.313 af

Subcatchment 3S: JCDEX-3.1 Runoff Area=68.600 ac 0.00% Impervious Runoff Depth>0.21"
Tc=40.0 min AMC Adjusted CN=WQ Runoff=6.13 cfs 1.175 af

Subcatchment 4S: JCDEX-3.2 Runoff Area=13.210 ac 0.00% Impervious Runoff Depth>0.21"
Tc=21.0 min AMC Adjusted CN=48 Runoff=1.81 cfs 0.229 af

Subcatchment 5S: JCDEX-3.3 Runoff Area=10.000 ac 0.00% Impervious Runoff Depth>0.21"
Tc=17.1 min AMC Adjusted CN=48 Runoff=1.56 cfs 0.174 af

Subcatchment 6S: JCD OS-1A Runoff Area=36.000 ac 5.00% Impervious Runoff Depth>0.30"
Tc=39.2 min AMC Adjusted CN=WQ Runoff=5.59 cfs 0.902 af

Subcatchment 7S: JCD OS-1B Runoff Area=20.700 ac 5.00% Impervious Runoff Depth>0.30"
Tc=22.7 min AMC Adjusted CN=WQ Runoff=4.56 cfs 0.522 af

Subcatchment 8S: BJDEX14 Runoff Area=6.160 ac 0.00% Impervious Runoff Depth>0.21"
Tc=11.6 min AMC Adjusted CN=48 Runoff=1.17 cfs 0.107 af

Subcatchment BJ-12: BJD-12b Runoff Area=9.540 ac 5.03% Impervious Runoff Depth>0.30"
Tc=26.2 min AMC Adjusted CN=WQ Runoff=1.92 cfs 0.241 af

Reach 3R: BJD-K - EX. RCBC POWERS Xing Avg. Flow Depth=0.10' Max Vel=3.68 fps Inflow=3.48 cfs 0.553 af
n=0.015 L=170.0' S=0.0088 '/' Capacity=1,089.90 cfs Outflow=3.48 cfs 0.553 af

Reach 4R: BJDEX-12b to Powers RCBC Xing Avg. Flow Depth=0.27' Max Vel=1.38 fps Inflow=1.92 cfs 0.241 af
n=0.030 L=475.0' S=0.0042 '/' Capacity=1,452.67 cfs Outflow=1.89 cfs 0.240 af

Reach 5R: Powers RCBC Xing Tailwater channel Avg. Flow Depth=0.16' Max Vel=1.63 fps Inflow=3.48 cfs 0.553 af
n=0.030 L=283.0' S=0.0062 '/' Capacity=6,846.44 cfs Outflow=3.48 cfs 0.552 af

Reach 9R: CHAN OS1A Avg. Flow Depth=0.18' Max Vel=3.19 fps Inflow=5.59 cfs 0.902 af
n=0.030 L=2,312.0' S=0.0303 '/' Capacity=843.16 cfs Outflow=5.59 cfs 0.896 af

Reach 11R: CHAN OS1B Avg. Flow Depth=0.14' Max Vel=3.27 fps Inflow=4.56 cfs 0.522 af
n=0.030 L=1,649.0' S=0.0321 '/' Capacity=20,990.55 cfs Outflow=4.50 cfs 0.520 af

Pond 1P: A Inflow=1.56 cfs 0.174 af
Primary=1.56 cfs 0.174 af

Pond 2P: EX.OFFSITE POND 12a Peak Elev=5,982.03' Storage=0.059 af Inflow=8.78 cfs 1.361 af
Outflow=8.35 cfs 1.358 af

Pond JCD-D: JCD-D Inflow=15.24 cfs 2.819 af
Primary=15.24 cfs 2.819 af

Total Runoff Area = 236.720 ac Runoff Volume = 5.024 af Average Runoff Depth = 0.25"
97.45% Pervious = 230.695 ac 2.55% Impervious = 6.025 ac

Summary for Subcatchment 1S: BJD-12a

Runoff = 8.78 cfs @ 12.39 hrs, Volume= 1.361 af, Depth> 0.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Tabular 5yrAMC1 Rainfall=2.70", AMC=1, Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Adj	Description	Land Use
	51.570	68	48	Pasture/grassland/range, Poor, HSG A	Pasture
*	2.710	98	94	0	
	54.280			Weighted Average	
	51.570	68	48	95.01% Pervious Area, AMC Adjusted	
	2.710	98	94	4.99% Impervious Area, AMC Adjusted	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.8					**Direct Entry,**

Summary for Subcatchment 2S: BJD-12c

Runoff = 1.68 cfs @ 12.47 hrs, Volume= 0.313 af, Depth> 0.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Tabular 5yrAMC1 Rainfall=2.70", AMC=1, Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Adj	Description	Land Use
*	18.230	68	48		Industrial
	18.230			Weighted Average	
	18.230	68	48	100.00% Pervious Area, AMC Adjusted	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
38.2					**Direct Entry,**

Summary for Subcatchment 3S: JCDEX-3.1

Runoff = 6.13 cfs @ 12.49 hrs, Volume= 1.175 af, Depth> 0.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Tabular 5yrAMC1 Rainfall=2.70", AMC=1, Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Adj	Description	Land Use
*	47.810	68	48		
*	20.790	68	48		
	68.600			Weighted Average	
	68.600	68	48	100.00% Pervious Area, AMC Adjusted	

Update all initial abstraction values based on equation 6-12 in the City DCM

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.0					D

$$Ia = 0.1\ [(1000/CN) - 10] \qquad \text{(Eq. 6-12)}$$

Summary for Subcatchment 4S: JCDEX-3.2

Runoff = 1.81 cfs @ 12.21 hrs, Volume= 0.229 af, Depth> 0.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Tabular 5yrAMC1 Rainfall=2.70", AMC=1, Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Adj	Description	Land Use
*	13.210	68	48		
	13.210			Weighted Average	
	13.210	68	48	100.00% Pervious Area, AMC Adjusted	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.0					**Direct Entry,**

Summary for Subcatchment 5S: JCDEX-3.3

Runoff = 1.56 cfs @ 12.16 hrs, Volume= 0.174 af, Depth> 0.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Tabular 5yrAMC1 Rainfall=2.70", AMC=1, Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Adj	Description	Land Use
*	10.000	68	48		
	10.000			Weighted Average	
	10.000	68	48	100.00% Pervious Area, AMC Adjusted	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.1					**Direct Entry,**

Summary for Subcatchment 6S: JCD OS-1A

Runoff = 5.59 cfs @ 12.42 hrs, Volume= 0.902 af, Depth> 0.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Tabular 5yrAMC1 Rainfall=2.70", AMC=1, Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Adj	Description	Land Use
*	34.200	68	48		
*	1.800	98	94		
	36.000			Weighted Average	
	34.200	68	48	95.00% Pervious Area, AMC Adjusted	
	1.800	98	94	5.00% Impervious Area, AMC Adjusted	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.2					**Direct Entry,**

Summary for Subcatchment 7S: JCD OS-1B

Runoff = 4.56 cfs @ 12.20 hrs, Volume= 0.522 af, Depth> 0.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Tabular 5yrAMC1 Rainfall=2.70", AMC=1, Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Adj	Description	Land Use
*	19.665	68	48		
*	1.035	98	94		
	20.700			Weighted Average	
	19.665	68	48	95.00% Pervious Area, AMC Adjusted	
	1.035	98	94	5.00% Impervious Area, AMC Adjusted	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7					**Direct Entry,**

Summary for Subcatchment 8S: BJDEX14

Runoff = 1.17 cfs @ 12.09 hrs, Volume= 0.107 af, Depth> 0.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Tabular 5yrAMC1 Rainfall=2.70", AMC=1, Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Adj	Description	Land Use
*	6.160	68	48		
	6.160			Weighted Average	
	6.160	68	48	100.00% Pervious Area, AMC Adjusted	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6					**Direct Entry,**

Summary for Subcatchment BJ-12: BJD-12b

Runoff = 1.92 cfs @ 12.25 hrs, Volume= 0.241 af, Depth> 0.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Tabular 5yrAMC1 Rainfall=2.70", AMC=1, Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Adj	Description	Land Use
	9.060	68	48	Pasture/grassland/range, Poor, HSG A	Pasture
*	0.480	98	94		
	9.540			Weighted Average	
	9.060	68	48	94.97% Pervious Area, AMC Adjusted	
	0.480	98	94	5.03% Impervious Area, AMC Adjusted	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.2					**Direct Entry,**

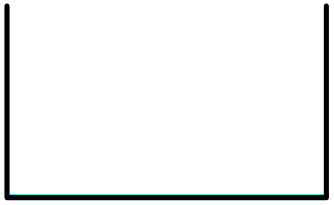
Summary for Reach 3R: BJD-K - EX. RCBC POWERS Xing

Inflow Area = 27.770 ac, 1.73% Impervious, Inflow Depth > 0.24" for 5yrAMC1 event
Inflow = 3.48 cfs @ 12.39 hrs, Volume= 0.553 af
Outflow = 3.48 cfs @ 12.41 hrs, Volume= 0.553 af, Atten= 0%, Lag= 0.8 min

Routing by Muskingum-Cunge method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Reference Flow= 2.61 cfs Estimated Depth= 0.12' Velocity= 2.20 fps
m= 1.655, c= 3.64 fps, dt= 3.0 min, dx= 170.0' / 1 = 170.0', K= 0.8 min, X= 0.476
Max. Velocity= 3.68 fps, Min. Travel Time= 0.8 min
Avg. Velocity = 3.63 fps, Avg. Travel Time= 0.8 min

Peak Storage= 163 cf @ 12.40 hrs
Average Depth at Peak Storage= 0.10' , Surface Width= 10.00'
Bank-Full Depth= 6.00' Flow Area= 60.0 sf, Capacity= 1,089.90 cfs

10.00' x 6.00' deep channel, n= 0.015
Length= 170.0' Slope= 0.0088 '/'
Inlet Invert= 5,973.25', Outlet Invert= 5,971.75'



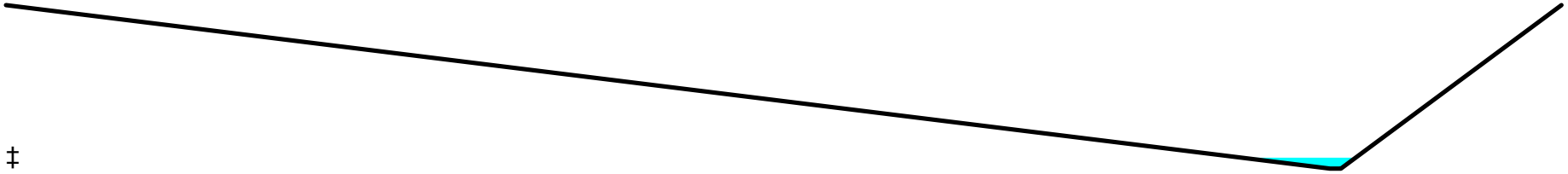
Summary for Reach 4R: BJDEX-12b to Powers RCBC Xing

Inflow Area = 9.540 ac, 5.03% Impervious, Inflow Depth > 0.30" for 5yrAMC1 event
Inflow = 1.92 cfs @ 12.25 hrs, Volume= 0.241 af
Outflow = 1.89 cfs @ 12.36 hrs, Volume= 0.240 af, Atten= 2%, Lag= 6.6 min

Routing by Muskingum-Cunge method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Reference Flow= 1.44 cfs Estimated Depth= 0.27' Velocity= 0.90 fps
m= 1.342, c= 1.21 fps, dt= 3.0 min, dx= 475.0' / 2 = 237.5', K= 3.3 min, X= 0.398
Max. Velocity= 1.38 fps, Min. Travel Time= 5.8 min
Avg. Velocity = 1.20 fps, Avg. Travel Time= 6.6 min

Peak Storage= 732 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.27' , Surface Width= 10.42'
Bank-Full Depth= 4.00' Flow Area= 284.0 sf, Capacity= 1,452.67 cfs

1.00' x 4.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 30.0 5.0 '/' Top Width= 141.00'
Length= 475.0' Slope= 0.0042 '/'
Inlet Invert= 5,973.50', Outlet Invert= 5,971.50'



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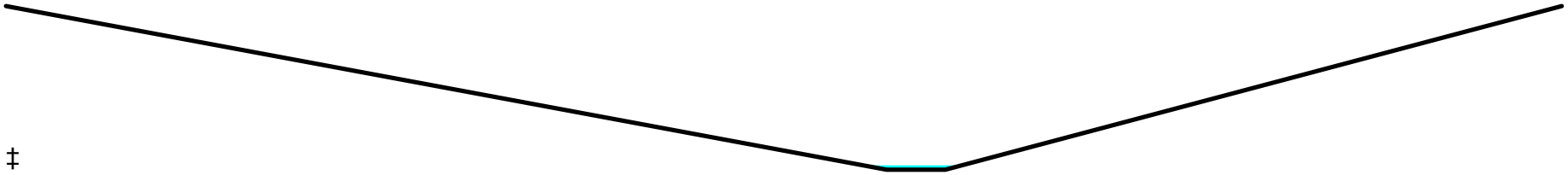
Summary for Reach 5R: Powers RCBC Xing Tailwater channel

Inflow Area = 27.770 ac, 1.73% Impervious, Inflow Depth > 0.24" for 5yrAMC1 event
Inflow = 3.48 cfs @ 12.41 hrs, Volume= 0.553 af
Outflow = 3.48 cfs @ 12.46 hrs, Volume= 0.552 af, Atten= 0%, Lag= 3.0 min

Routing by Muskingum-Cunge method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Reference Flow= 2.61 cfs Estimated Depth= 0.18' Velocity= 1.05 fps
m= 1.485, c= 1.56 fps, dt= 3.0 min, dx= 283.0' / 1 = 283.0', K= 3.0 min, X= 0.465
Max. Velocity= 1.63 fps, Min. Travel Time= 2.9 min
Avg. Velocity = 1.55 fps, Avg. Travel Time= 3.0 min

Peak Storage= 626 cf @ 12.44 hrs
Average Depth at Peak Storage= 0.16' , Surface Width= 16.93'
Bank-Full Depth= 6.00' Flow Area= 825.0 sf, Capacity= 6,846.44 cfs

10.00' x 6.00' deep channel, n= 0.030
Side Slope Z-value= 25.0 17.5 '/' Top Width= 265.00'
Length= 283.0' Slope= 0.0062 '/'
Inlet Invert= 5,971.75', Outlet Invert= 5,970.00'



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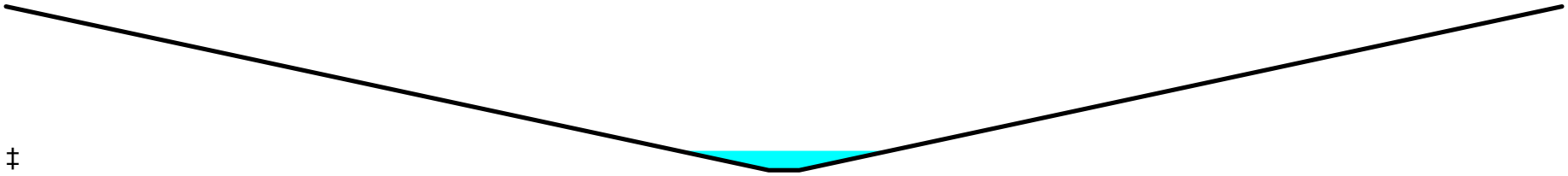
Summary for Reach 9R: CHAN OS1A

Inflow Area = 36.000 ac, 5.00% Impervious, Inflow Depth > 0.30" for 5yrAMC1 event
Inflow = 5.59 cfs @ 12.42 hrs, Volume= 0.902 af
Outflow = 5.59 cfs @ 12.67 hrs, Volume= 0.896 af, Atten= 0%, Lag= 15.0 min

Routing by Muskingum-Cunge method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Reference Flow= 4.19 cfs Estimated Depth= 0.18' Velocity= 1.90 fps
m= 1.351, c= 2.57 fps, dt= 3.0 min, dx= 2,312.0' / 5 = 462.4', K= 3.0 min, X= 0.495
Max. Velocity= 3.19 fps, Min. Travel Time= 12.1 min
Avg. Velocity = 2.48 fps, Avg. Travel Time= 15.5 min

Peak Storage= 4,857 cf @ 12.56 hrs
Average Depth at Peak Storage= 0.18' , Surface Width= 20.71'
Bank-Full Depth= 1.50' Flow Area= 117.0 sf, Capacity= 843.16 cfs

3.00' x 1.50' deep channel, n= 0.030
Side Slope Z-value= 50.0 '/' Top Width= 153.00'
Length= 2,312.0' Slope= 0.0303 '/'
Inlet Invert= 5,950.00', Outlet Invert= 5,880.00'



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Summary for Reach 11R: CHAN OS1B

Inflow Area = 20.700 ac, 5.00% Impervious, Inflow Depth > 0.30" for 5yrAMC1 event
Inflow = 4.56 cfs @ 12.20 hrs, Volume= 0.522 af
Outflow = 4.50 cfs @ 12.39 hrs, Volume= 0.520 af, Atten= 1%, Lag= 11.3 min

in the design criteria narrative, explain the assumptions used for this reach cross sections.

Routing by Muskingum-Cunge method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs / 3
Reference Flow= 3.42 cfs Estimated Depth= 0.15' Velocity= 1.83 fps
m= 1.374, c= 2.51 fps, dt= 1.0 min, dx= 1,649.0' / 11 = 149.9', K= 1.0 min, X= 0.489
Max. Velocity= 3.27 fps, Min. Travel Time= 8.4 min
Avg. Velocity = 2.45 fps, Avg. Travel Time= 11.2 min

Peak Storage= 2,825 cf @ 12.30 hrs
Average Depth at Peak Storage= 0.14' , Surface Width= 19.08'
Bank-Full Depth= 5.00' Flow Area= 1,275.0 sf, Capacity= 20,990.55 cfs

5.00' x 5.00' deep channel, n= 0.030
Side Slope Z-value= 50.0 '/' Top Width= 505.00'
Length= 1,649.0' Slope= 0.0321 '/'
Inlet Invert= 5,933.00', Outlet Invert= 5,880.00'

‡

Summary for Pond 1P: A

Inflow Area = 10.000 ac, 0.00% Impervious, Inflow Depth > 0.21" for 5yrAMC1 event
Inflow = 1.56 cfs @ 12.16 hrs, Volume= 0.174 af
Primary = 1.56 cfs @ 12.16 hrs, Volume= 0.174 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond 2P: EX.OFFSITE POND 12a

Inflow Area = 54.280 ac, 4.99% Impervious, Inflow Depth > 0.30" for 5yrAMC1 event
Inflow = 8.78 cfs @ 12.39 hrs, Volume= 1.361 af
Outflow = 8.35 cfs @ 12.48 hrs, Volume= 1.358 af, Atten= 5%, Lag= 5.3 min
Discarded = 8.35 cfs @ 12.48 hrs, Volume= 1.358 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 5,982.03' @ 12.48 hrs Surf.Area= 2.216 ac Storage= 0.059 af

Plug-Flow detention time= 5.2 min calculated for 1.355 af (100% of inflow)
Center-of-Mass det. time= 3.9 min (896.6 - 892.8)

Volume	Invert	Avail.Storage	Storage Description
#1	5,982.00'	33.440 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
5,982.00	2.190	0.000	0.000
5,983.00	3.160	2.675	2.675
5,984.00	4.380	3.770	6.445
5,985.00	5.450	4.915	11.360
5,986.00	6.630	6.040	17.400
5,987.00	8.000	7.315	24.715
5,988.00	9.450	8.725	33.440

Device	Routing	Invert	Outlet Devices
#1	Discarded	5,982.00'	**8.200 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 100.00'

Discarded OutFlow Max=18.32 cfs @ 12.48 hrs HW=5,982.03' (Free Discharge)
1=Exfiltration (Controls 18.32 cfs)

Summary for Pond JCD-D: JCD-D

Inflow Area = 138.510 ac, 2.05% Impervious, Inflow Depth > 0.24" for 5yrAMC1 event
Inflow = 15.24 cfs @ 12.50 hrs, Volume= 2.819 af
Primary = 15.24 cfs @ 12.50 hrs, Volume= 2.819 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Time span=1.00-24.00 hrs, dt=0.05 hrs, 461 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Muskingum-Cunge method - Pond routing by Stor-Ind method

Subcatchment 1S: BJD-12a Runoff Area=54.280 ac 4.99% Impervious Runoff Depth>1.00"
Tc=36.8 min AMC Adjusted CN=WQ Runoff=35.76 cfs 4.544 af

Subcatchment 2S: BJD-12c Runoff Area=18.230 ac 0.00% Impervious Runoff Depth>0.85"
Tc=38.2 min AMC Adjusted CN=48 Runoff=9.73 cfs 1.290 af

Subcatchment 3S: JCDEX-3.1 Runoff Area=68.600 ac 0.00% Impervious Runoff Depth>0.85"
Tc=40.0 min AMC Adjusted CN=WQ Runoff=35.69 cfs 4.852 af

Subcatchment 4S: JCDEX-3.2 Runoff Area=13.210 ac 0.00% Impervious Runoff Depth>0.86"
Tc=21.0 min AMC Adjusted CN=48 Runoff=10.40 cfs 0.942 af

Subcatchment 5S: JCDEX-3.3 Runoff Area=10.000 ac 0.00% Impervious Runoff Depth>0.86"
Tc=17.1 min AMC Adjusted CN=48 Runoff=8.75 cfs 0.714 af

Subcatchment 6S: JCD OS-1A Runoff Area=36.000 ac 5.00% Impervious Runoff Depth>1.00"
Tc=39.2 min AMC Adjusted CN=WQ Runoff=22.73 cfs 3.012 af

Subcatchment 7S: JCD OS-1B Runoff Area=20.700 ac 5.00% Impervious Runoff Depth>1.01"
Tc=22.7 min AMC Adjusted CN=WQ Runoff=18.57 cfs 1.742 af

Subcatchment 8S: BJDEX14 Runoff Area=6.160 ac 0.00% Impervious Runoff Depth>0.86"
Tc=11.6 min AMC Adjusted CN=48 Runoff=6.31 cfs 0.441 af

Subcatchment BJ-12: BJD-12b Runoff Area=9.540 ac 5.03% Impervious Runoff Depth>1.01"
Tc=26.2 min AMC Adjusted CN=WQ Runoff=7.86 cfs 0.803 af

Reach 3R: BJD-K - EX. RCBC POWERS Xing Avg. Flow Depth=0.25' Max Vel=6.79 fps Inflow=17.16 cfs 2.092 af
n=0.015 L=170.0' S=0.0088 '/' Capacity=1,089.90 cfs Outflow=17.16 cfs 2.091 af

Reach 4R: BJDEX-12b to Powers RCBC Xing Avg. Flow Depth=0.48' Max Vel=1.90 fps Inflow=7.86 cfs 0.803 af
n=0.030 L=475.0' S=0.0042 '/' Capacity=1,452.67 cfs Outflow=7.75 cfs 0.801 af

Reach 5R: Powers RCBC Xing Tailwater channel Avg. Flow Depth=0.39' Max Vel=2.43 fps Inflow=17.16 cfs 2.091 af
n=0.030 L=283.0' S=0.0062 '/' Capacity=6,846.44 cfs Outflow=17.13 cfs 2.089 af

Reach 9R: CHAN OS1A Avg. Flow Depth=0.32' Max Vel=4.34 fps Inflow=22.73 cfs 3.012 af
n=0.030 L=2,312.0' S=0.0303 '/' Capacity=843.16 cfs Outflow=22.73 cfs 2.999 af

Reach 11R: CHAN OS1B Avg. Flow Depth=0.27' Max Vel=4.39 fps Inflow=18.57 cfs 1.742 af
n=0.030 L=1,649.0' S=0.0321 '/' Capacity=20,990.55 cfs Outflow=18.39 cfs 1.737 af

Pond 1P: A Inflow=8.75 cfs 0.714 af
Primary=8.75 cfs 0.714 af

Pond 2P: EX.OFFSITE POND 12a Peak Elev=5,982.26' Storage=0.605 af Inflow=35.76 cfs 4.544 af
Outflow=20.20 cfs 4.535 af

Pond JCD-D: JCD-D Inflow=75.30 cfs 10.529 af
Primary=75.30 cfs 10.529 af

Total Runoff Area = 236.720 ac Runoff Volume = 18.339 af Average Runoff Depth = 0.93"
97.45% Pervious = 230.695 ac 2.55% Impervious = 6.025 ac

Summary for Subcatchment 1S: BJD-12a

Runoff = 35.76 cfs @ 12.36 hrs, Volume= 4.544 af, Depth> 1.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Tabular 100yrAMC1 Rainfall=4.60", AMC=1, Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Adj	Description	Land Use
	51.570	68	48	Pasture/grassland/range, Poor, HSG A	Pasture
*	2.710	98	94	0	
	54.280			Weighted Average	
	51.570	68	48	95.01% Pervious Area, AMC Adjusted	
	2.710	98	94	4.99% Impervious Area, AMC Adjusted	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.8					**Direct Entry,**

Summary for Subcatchment 2S: BJD-12c

Runoff = 9.73 cfs @ 12.39 hrs, Volume= 1.290 af, Depth> 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Tabular 100yrAMC1 Rainfall=4.60", AMC=1, Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Adj	Description	Land Use
*	18.230	68	48		Industrial
	18.230			Weighted Average	
	18.230	68	48	100.00% Pervious Area, AMC Adjusted	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
38.2					**Direct Entry,**

Summary for Subcatchment 3S: JCDEX-3.1

Runoff = 35.69 cfs @ 12.41 hrs, Volume= 4.852 af, Depth> 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Tabular 100yrAMC1 Rainfall=4.60", AMC=1, Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Adj	Description	Land Use
*	47.810	68	48		
*	20.790	68	48		
	68.600			Weighted Average	
	68.600	68	48	100.00% Pervious Area, AMC Adjusted	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.0					**Direct Entry,**

Summary for Subcatchment 4S: JCDEX-3.2

Runoff = 10.40 cfs @ 12.17 hrs, Volume= 0.942 af, Depth> 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Tabular 100yrAMC1 Rainfall=4.60", AMC=1, Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Adj	Description	Land Use
*	13.210	68	48		
	13.210			Weighted Average	
	13.210	68	48	100.00% Pervious Area, AMC Adjusted	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.0					**Direct Entry,**

Summary for Subcatchment 5S: JCDEX-3.3

Runoff = 8.75 cfs @ 12.12 hrs, Volume= 0.714 af, Depth> 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Tabular 100yrAMC1 Rainfall=4.60", AMC=1, Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Adj	Description	Land Use
*	10.000	68	48		
	10.000			Weighted Average	
	10.000	68	48	100.00% Pervious Area, AMC Adjusted	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.1					**Direct Entry,**

Summary for Subcatchment 6S: JCD OS-1A

Runoff = 22.73 cfs @ 12.39 hrs, Volume= 3.012 af, Depth> 1.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Tabular 100yrAMC1 Rainfall=4.60", AMC=1, Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Adj	Description	Land Use
*	34.200	68	48		
*	1.800	98	94		
	36.000			Weighted Average	
	34.200	68	48	95.00% Pervious Area, AMC Adjusted	
	1.800	98	94	5.00% Impervious Area, AMC Adjusted	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.2					**Direct Entry,**

Summary for Subcatchment 7S: JCD OS-1B

Runoff = 18.57 cfs @ 12.18 hrs, Volume= 1.742 af, Depth> 1.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Tabular 100yrAMC1 Rainfall=4.60", AMC=1, Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Adj	Description	Land Use
*	19.665	68	48		
*	1.035	98	94		
	20.700			Weighted Average	
	19.665	68	48	95.00% Pervious Area, AMC Adjusted	
	1.035	98	94	5.00% Impervious Area, AMC Adjusted	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7					**Direct Entry,**

Summary for Subcatchment 8S: BJDEX14

Runoff = 6.31 cfs @ 12.06 hrs, Volume= 0.441 af, Depth> 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Tabular 100yrAMC1 Rainfall=4.60", AMC=1, Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Adj	Description	Land Use
*	6.160	68	48		
	6.160			Weighted Average	
	6.160	68	48	100.00% Pervious Area, AMC Adjusted	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6					**Direct Entry,**

Summary for Subcatchment BJ-12: BJD-12b

Runoff = 7.86 cfs @ 12.22 hrs, Volume= 0.803 af, Depth> 1.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Tabular 100yrAMC1 Rainfall=4.60", AMC=1, Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Adj	Description	Land Use
	9.060	68	48	Pasture/grassland/range, Poor, HSG A	Pasture
*	0.480	98	94		
	9.540			Weighted Average	
	9.060	68	48	94.97% Pervious Area, AMC Adjusted	
	0.480	98	94	5.03% Impervious Area, AMC Adjusted	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.2					**Direct Entry,**

Summary for Reach 3R: BJD-K - EX. RCBC POWERS Xing

Inflow Area = 27.770 ac, 1.73% Impervious, Inflow Depth > 0.90" for 100yrAMC1 event
Inflow = 17.16 cfs @ 12.34 hrs, Volume= 2.092 af
Outflow = 17.16 cfs @ 12.35 hrs, Volume= 2.091 af, Atten= 0%, Lag= 0.4 min

Routing by Muskingum-Cunge method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Reference Flow= 12.87 cfs Estimated Depth= 0.31' Velocity= 4.11 fps
m= 1.642, c= 6.75 fps, dt= 3.0 min, dx= 170.0' / 1 = 170.0', K= 0.4 min, X= 0.437
Max. Velocity= 6.79 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 6.74 fps, Avg. Travel Time= 0.4 min

Peak Storage= 432 cf @ 12.35 hrs
Average Depth at Peak Storage= 0.25' , Surface Width= 10.00'
Bank-Full Depth= 6.00' Flow Area= 60.0 sf, Capacity= 1,089.90 cfs

10.00' x 6.00' deep channel, n= 0.015
Length= 170.0' Slope= 0.0088 '/'
Inlet Invert= 5,973.25', Outlet Invert= 5,971.75'

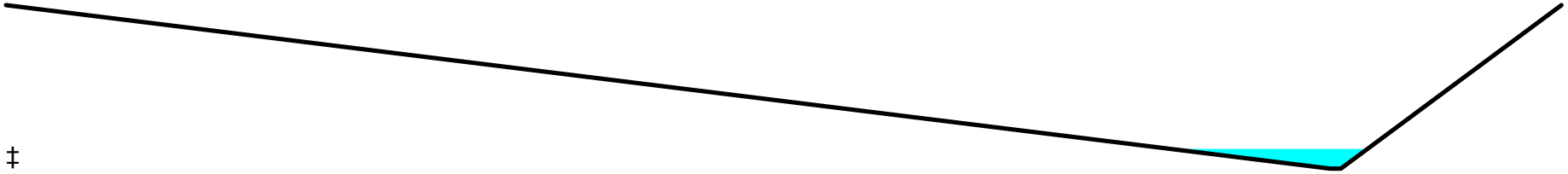
Summary for Reach 4R: BJDEX-12b to Powers RCBC Xing

Inflow Area = 9.540 ac, 5.03% Impervious, Inflow Depth > 1.01" for 100yrAMC1 event
Inflow = 7.86 cfs @ 12.22 hrs, Volume= 0.803 af
Outflow = 7.75 cfs @ 12.30 hrs, Volume= 0.801 af, Atten= 1%, Lag= 4.8 min

Routing by Muskingum-Cunge method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Reference Flow= 5.90 cfs Estimated Depth= 0.48' Velocity= 1.29 fps
m= 1.337, c= 1.72 fps, dt= 3.0 min, dx= 475.0' / 2 = 237.5', K= 2.3 min, X= 0.319
Max. Velocity= 1.90 fps, Min. Travel Time= 4.2 min
Avg. Velocity = 1.71 fps, Avg. Travel Time= 4.6 min

Peak Storage= 2,126 cf @ 12.27 hrs
Average Depth at Peak Storage= 0.48' , Surface Width= 17.73'
Bank-Full Depth= 4.00' Flow Area= 284.0 sf, Capacity= 1,452.67 cfs

1.00' x 4.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 30.0 5.0 '/' Top Width= 141.00'
Length= 475.0' Slope= 0.0042 '/'
Inlet Invert= 5,973.50', Outlet Invert= 5,971.50'



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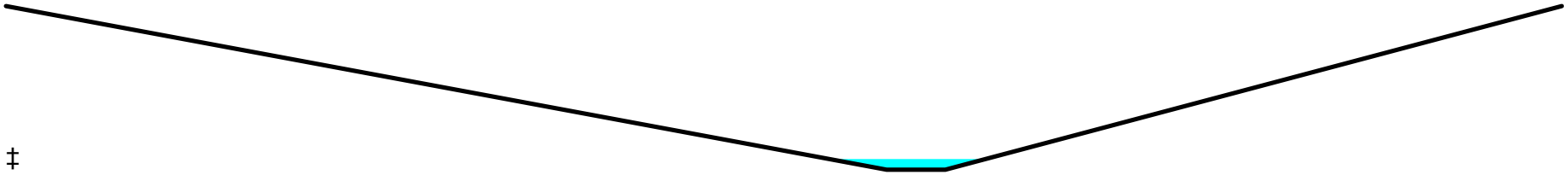
Summary for Reach 5R: Powers RCBC Xing Tailwater channel

Inflow Area = 27.770 ac, 1.73% Impervious, Inflow Depth > 0.90" for 100yrAMC1 event
Inflow = 17.16 cfs @ 12.35 hrs, Volume= 2.091 af
Outflow = 17.13 cfs @ 12.38 hrs, Volume= 2.089 af, Atten= 0%, Lag= 2.0 min

Routing by Muskingum-Cunge method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Reference Flow= 12.87 cfs Estimated Depth= 0.41' Velocity= 1.67 fps
m= 1.416, c= 2.36 fps, dt= 3.0 min, dx= 283.0' / 1 = 283.0', K= 2.0 min, X= 0.417
Max. Velocity= 2.43 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 2.35 fps, Avg. Travel Time= 2.0 min

Peak Storage= 2,052 cf @ 12.37 hrs
Average Depth at Peak Storage= 0.39' , Surface Width= 26.73'
Bank-Full Depth= 6.00' Flow Area= 825.0 sf, Capacity= 6,846.44 cfs

10.00' x 6.00' deep channel, n= 0.030
Side Slope Z-value= 25.0 17.5 '/' Top Width= 265.00'
Length= 283.0' Slope= 0.0062 '/'
Inlet Invert= 5,971.75', Outlet Invert= 5,970.00'



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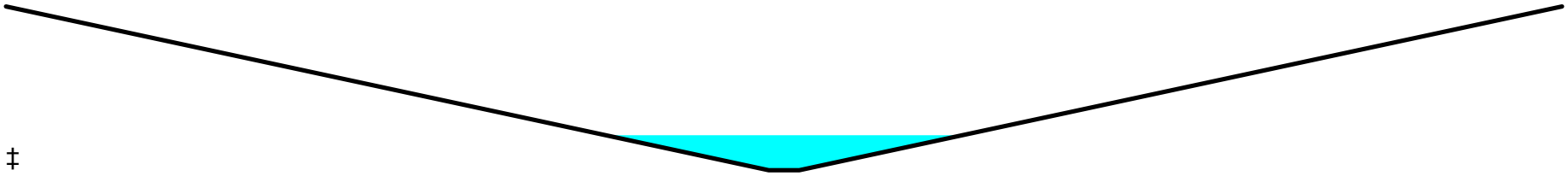
Summary for Reach 9R: CHAN OS1A

Inflow Area = 36.000 ac, 5.00% Impervious, Inflow Depth > 1.00" for 100yrAMC1 event
Inflow = 22.73 cfs @ 12.39 hrs, Volume= 3.012 af
Outflow = 22.73 cfs @ 12.57 hrs, Volume= 2.999 af, Atten= 0%, Lag= 10.6 min

Routing by Muskingum-Cunge method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Reference Flow= 17.05 cfs Estimated Depth= 0.33' Velocity= 2.71 fps
m= 1.341, c= 3.64 fps, dt= 3.0 min, dx= 2,312.0' / 4 = 578.0', K= 2.6 min, X= 0.493
Max. Velocity= 4.34 fps, Min. Travel Time= 8.9 min
Avg. Velocity = 3.54 fps, Avg. Travel Time= 10.9 min

Peak Storage= 14,169 cf @ 12.49 hrs
Average Depth at Peak Storage= 0.32' , Surface Width= 35.13'
Bank-Full Depth= 1.50' Flow Area= 117.0 sf, Capacity= 843.16 cfs

3.00' x 1.50' deep channel, n= 0.030
Side Slope Z-value= 50.0 '/' Top Width= 153.00'
Length= 2,312.0' Slope= 0.0303 '/'
Inlet Invert= 5,950.00', Outlet Invert= 5,880.00'



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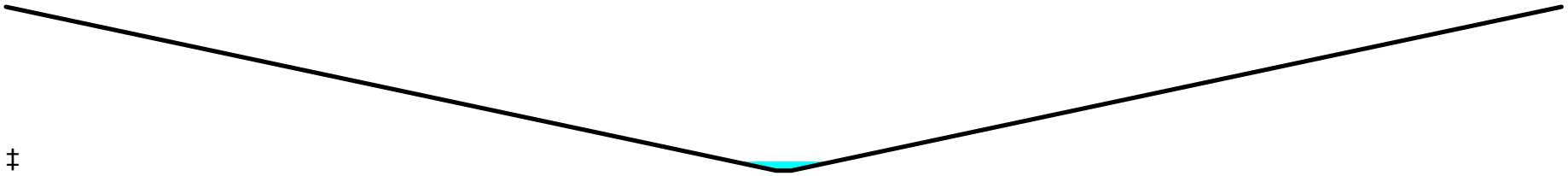
Summary for Reach 11R: CHAN OS1B

Inflow Area = 20.700 ac, 5.00% Impervious, Inflow Depth > 1.01" for 100yrAMC1 event
Inflow = 18.57 cfs @ 12.18 hrs, Volume= 1.742 af
Outflow = 18.39 cfs @ 12.31 hrs, Volume= 1.737 af, Atten= 1%, Lag= 7.8 min

Routing by Muskingum-Cunge method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs / 3
Reference Flow= 13.93 cfs Estimated Depth= 0.28' Velocity= 2.62 fps
m= 1.353, c= 3.54 fps, dt= 1.0 min, dx= 1,649.0' / 8 = 206.1', K= 1.0 min, X= 0.484
Max. Velocity= 4.39 fps, Min. Travel Time= 6.3 min
Avg. Velocity = 3.47 fps, Avg. Travel Time= 7.9 min

Peak Storage= 8,381 cf @ 12.25 hrs
Average Depth at Peak Storage= 0.27' , Surface Width= 32.18'
Bank-Full Depth= 5.00' Flow Area= 1,275.0 sf, Capacity= 20,990.55 cfs

5.00' x 5.00' deep channel, n= 0.030
Side Slope Z-value= 50.0 '/' Top Width= 505.00'
Length= 1,649.0' Slope= 0.0321 '/'
Inlet Invert= 5,933.00', Outlet Invert= 5,880.00'



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Summary for Pond 1P: A

Inflow Area = 10.000 ac, 0.00% Impervious, Inflow Depth > 0.86" for 100yrAMC1 event
Inflow = 8.75 cfs @ 12.12 hrs, Volume= 0.714 af
Primary = 8.75 cfs @ 12.12 hrs, Volume= 0.714 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Summary for Pond 2P: EX.OFFSITE POND 12a

Inflow Area = 54.280 ac, 4.99% Impervious, Inflow Depth > 1.00" for 100yrAMC1 event
Inflow = 35.76 cfs @ 12.36 hrs, Volume= 4.544 af
Outflow = 20.20 cfs @ 12.72 hrs, Volume= 4.535 af, Atten= 44%, Lag= 21.3 min
Discarded = 20.20 cfs @ 12.72 hrs, Volume= 4.535 af

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 5,982.26' @ 12.72 hrs Surf.Area= 2.443 ac Storage= 0.605 af

Plug-Flow detention time= 9.8 min calculated for 4.535 af (100% of inflow)
Center-of-Mass det. time= 8.7 min (882.6 - 874.0)

Volume	Invert	Avail.Storage	Storage Description
#1	5,982.00'	33.440 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
5,982.00	2.190	0.000	0.000
5,983.00	3.160	2.675	2.675
5,984.00	4.380	3.770	6.445
5,985.00	5.450	4.915	11.360
5,986.00	6.630	6.040	17.400
5,987.00	8.000	7.315	24.715
5,988.00	9.450	8.725	33.440

Device	Routing	Invert	Outlet Devices
#1	Discarded	5,982.00'	**8.200 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 100.00'

Discarded OutFlow Max=20.20 cfs @ 12.72 hrs HW=5,982.26' (Free Discharge)
1=Exfiltration (Controls 20.20 cfs)

Summary for Pond JCD-D: JCD-D

Inflow Area = 138.510 ac, 2.05% Impervious, Inflow Depth > 0.91" for 100yrAMC1 event
Inflow = 75.30 cfs @ 12.40 hrs, Volume= 10.529 af
Primary = 75.30 cfs @ 12.40 hrs, Volume= 10.529 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-24.00 hrs, dt= 0.05 hrs

Events for Subcatchment 1S: BJD-12a

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
5yrAMC1	2.70	8.78	1.361	0.30
100yrAMC1	**4.60**	**35.76**	**4.544**	**1.00**

Events for Subcatchment 2S: BJD-12c

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
5yrAMC1	2.70	1.68	0.313	0.21
100yrAMC1	**4.60**	**9.73**	**1.290**	**0.85**

Events for Subcatchment 3S: JCDEX-3.1

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
5yrAMC1	2.70	6.13	1.175	0.21
100yrAMC1	**4.60**	**35.69**	**4.852**	**0.85**

Events for Subcatchment 4S: JCDEX-3.2

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
5yrAMC1	2.70	1.81	0.229	0.21
100yrAMC1	**4.60**	**10.40**	**0.942**	**0.86**

Events for Subcatchment 5S: JCDEX-3.3

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
5yrAMC1	2.70	1.56	0.174	0.21
100yrAMC1	**4.60**	**8.75**	**0.714**	**0.86**

Events for Subcatchment 6S: JCD OS-1A

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
5yrAMC1	2.70	5.59	0.902	0.30
100yrAMC1	**4.60**	**22.73**	**3.012**	**1.00**

Events for Subcatchment 7S: JCD OS-1B

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
5yrAMC1	2.70	4.56	0.522	0.30
100yrAMC1	**4.60**	**18.57**	**1.742**	**1.01**

Events for Subcatchment 8S: BJDEX14

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
5yrAMC1	2.70	1.17	0.107	0.21
100yrAMC1	**4.60**	**6.31**	**0.441**	**0.86**

Events for Subcatchment BJ-12: BJD-12b

Event	Rainfall (inches)	Runoff (cfs)	Volume (acre-feet)	Depth (inches)
5yrAMC1	2.70	1.92	0.241	0.30
100yrAMC1	**4.60**	**7.86**	**0.803**	**1.01**

Events for Reach 3R: BJD-K - EX. RCBC POWERS Xing

Event	Inflow (cfs)	Outflow (cfs)	Elevation (feet)	Storage (cubic-feet)
5yrAMC1	3.48	3.48	5,973.35	163
100yrAMC1	**17.16**	**17.16**	**5,973.50**	**432**

Events for Reach 4R: BJDEX-12b to Powers RCBC Xing

Event	Inflow (cfs)	Outflow (cfs)	Elevation (feet)	Storage (cubic-feet)
5yrAMC1	1.92	1.89	5,973.77	732
100yrAMC1	**7.86**	**7.75**	**5,973.98**	**2,126**

Events for Reach 5R: Powers RCBC Xing Tailwater channel

Event	Inflow (cfs)	Outflow (cfs)	Elevation (feet)	Storage (cubic-feet)
5yrAMC1	3.48	3.48	5,971.91	626
100yrAMC1	**17.16**	**17.13**	**5,972.14**	**2,052**

Events for Reach 9R: CHAN OS1A

Event	Inflow (cfs)	Outflow (cfs)	Elevation (feet)	Storage (cubic-feet)
5yrAMC1	5.59	5.59	5,950.18	4,857
100yrAMC1	**22.73**	**22.73**	**5,950.32**	**14,169**

Events for Reach 11R: CHAN OS1B

Event	Inflow (cfs)	Outflow (cfs)	Elevation (feet)	Storage (cubic-feet)
5yrAMC1	4.56	4.50	5,933.14	2,825
100yrAMC1	**18.57**	**18.39**	**5,933.27**	**8,381**

Events for Pond 1P: A

Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
5yrAMC1	1.56	1.56	**0.00**	**0.000**
100yrAMC1	**8.75**	**8.75**	0.00	0.000

Events for Pond JCD-D: JCD-D

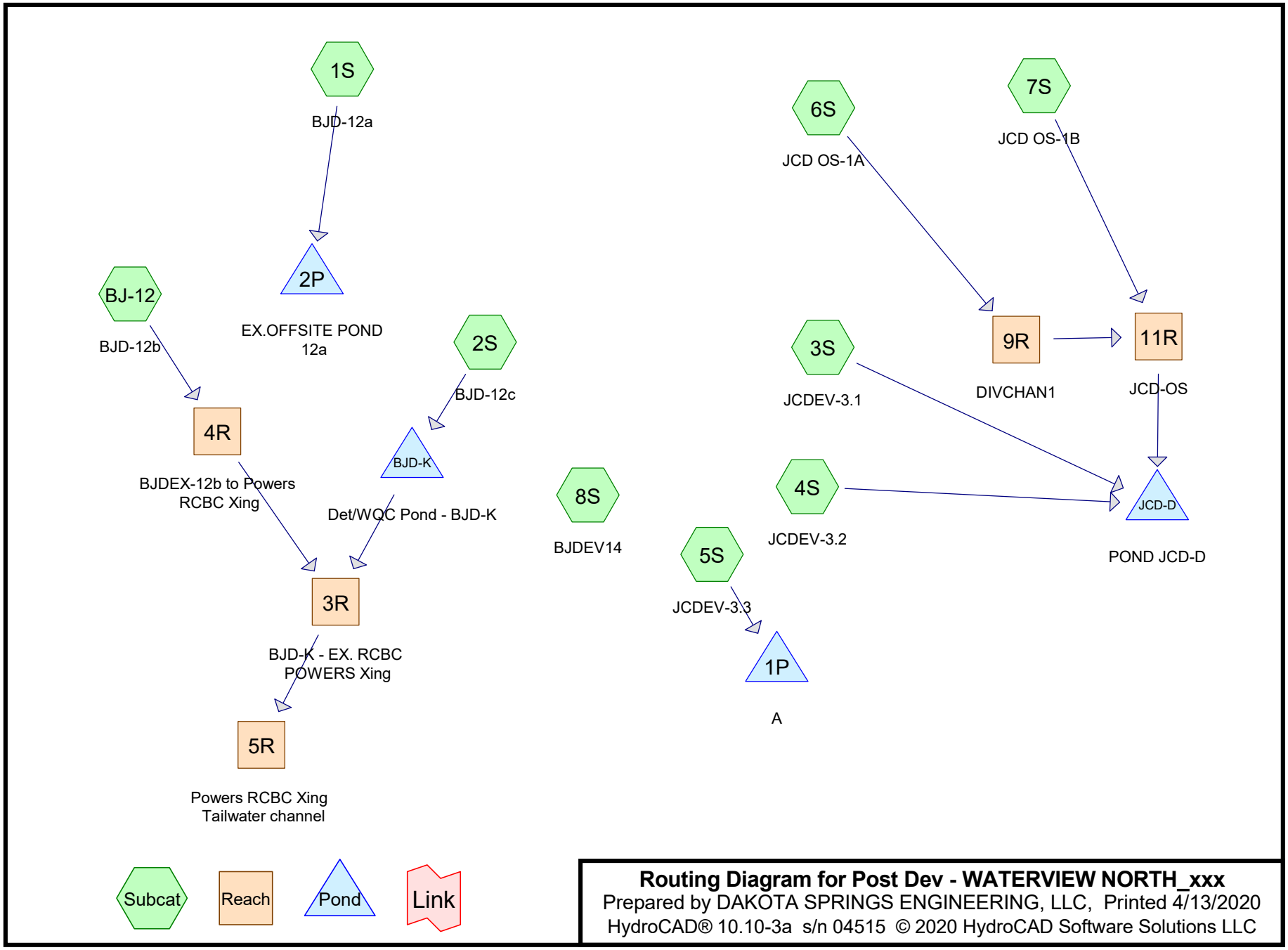
Event	Inflow (cfs)	Primary (cfs)	Elevation (feet)	Storage (acre-feet)
5yrAMC1	15.24	15.24	**0.00**	**0.000**
100yrAMC1	**75.30**	**75.30**	0.00	0.000

SCS UNIT HYDROGRAPH ANALYSIS

Post Development

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (minutes)	B/B	Depth (inches)	AMC
1	2yr	Type II 24-hr Tabular		Default	1,440.00	1	2.10	2
2	5yr	Type II 24-hr Tabular		Default	1,440.00	1	2.70	2
3	10yr	Type II 24-hr Tabular		Default	1,440.00	1	3.20	2
4	25yr	Type II 24-hr Tabular		Default	1,440.00	1	3.60	2
5	50yr	Type II 24-hr Tabular		Default	1,440.00	1	4.20	2
6	100yr	Type II 24-hr Tabular		Default	1,440.00	1	4.60	2



Routing Diagram for Post Dev - WATERVIEW NORTH_xxx

Prepared by DAKOTA SPRINGS ENGINEERING, LLC, Printed 4/13/2020

Summary for Subcatchment 1S: BJD-12a

Runoff = 4.73 cfs @ 12.77 hrs, Volume= 1.117 af, Depth= 0.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Type II 24-hr Tabular 5yr Rainfall=2.70", Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Description	Land Use
*	51.570	47	Pasture/grassland/range, Poor, HSG A	Pasture
*	2.710	98	0	
	54.280	50	Weighted Average	
	51.570	47	95.01% Pervious Area	
	2.710	98	4.99% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
59.5	2,084	0.0459	0.58		**Lag/CN Method,** Contour Length= 54,269' Interval= 2'

Summary for Subcatchment 2S: BJD-12c

Runoff = 29.01 cfs @ 12.17 hrs, Volume= 2.542 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Type II 24-hr Tabular 5yr Rainfall=2.70", Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Description	Land Use
*	18.230	88	Urban industrial, 72% imp, HSG B	Industrial
	5.104	62	28.00% Pervious Area	
	13.126	98	72.00% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.0	1,403	0.0190	1.02		**Lag/CN Method,**

Summary for Subcatchment 3S: JCDEV-3.1

Runoff = 68.08 cfs @ 12.31 hrs, Volume= 7.589 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Type II 24-hr Tabular 5yr Rainfall=2.70", Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Description	Land Use
*	8.360	88	54.8% Impervious	
*	6.860	92		
*	17.830	69		
*	29.680	85		
*	6.470	88		
	69.200	82	Weighted Average	
	69.200	82	100.00% Pervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.8	2,933	0.0410	1.40		**Lag/CN Method,**

Summary for Subcatchment 4S: JCDEV-3.2

Runoff = 28.01 cfs @ 12.02 hrs, Volume= 1.841 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Type II 24-hr Tabular 5yr Rainfall=2.70", Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Description	Land Use
*	1.340	85	69.4% Impervious	
*	11.860	88		
	13.200	88	Weighted Average	
	13.200	88	100.00% Pervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	1,228	0.0690	1.89		**Lag/CN Method,**

Summary for Subcatchment 5S: JCDEV-3.3

Runoff = 24.82 cfs @ 11.99 hrs, Volume= 1.570 af, Depth= 1.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Type II 24-hr Tabular 5yr Rainfall=2.70", Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Description	Land Use
*	7.770	92	89.4% Impervious	Commercial
*	2.230	88		
	10.000	91	Weighted Average	
	10.000	91	100.00% Pervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	872	0.0480	1.66		**Lag/CN Method,**

Summary for Subcatchment 6S: JCD OS-1A

Runoff = 2.64 cfs @ 13.04 hrs, Volume= 0.741 af, Depth= 0.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Type II 24-hr Tabular 5yr Rainfall=2.70", Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Description	Land Use
*	34.200	47	5% impervious	
*	1.800	98		
	36.000	50	Weighted Average	
	32.490	44	90.25% Pervious Area	
	3.510	98	9.75% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
76.7	2,788	0.0440	0.61		**Lag/CN Method,**

Summary for Subcatchment 7S: JCD OS-1B

Runoff = 2.51 cfs @ 12.43 hrs, Volume= 0.426 af, Depth= 0.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Type II 24-hr Tabular 5yr Rainfall=2.70", Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Description	Land Use
*	19.665	47		
*	1.035	98	5% impervious	
	20.700	50	Weighted Average	
	20.648	49	99.75% Pervious Area	
	0.052	98	0.25% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.8	1,367	0.0610	0.62		**Lag/CN Method,**

Summary for Subcatchment 8S: BJDEV14

Runoff = 16.24 cfs @ 11.94 hrs, Volume= 0.967 af, Depth= 1.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Type II 24-hr Tabular 5yr Rainfall=2.70", Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Description	Land Use
*	1.550	88	89% IMPERVIOUS	
*	4.610	92		
	6.160	91	Weighted Average	
	6.160	91	100.00% Pervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	465	0.0900	2.01		**Lag/CN Method,**
3.9	465	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment BJ-12: BJD-12b

Runoff = 1.49 cfs @ 12.25 hrs, Volume= 0.196 af, Depth= 0.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Type II 24-hr Tabular 5yr Rainfall=2.70", Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Description	Land Use
*	9.060	47	Pasture/grassland/range, Poor, HSG A	Pasture
*	0.480	98		
	9.540	50	Weighted Average	
	9.060	47	94.97% Pervious Area	
	0.480	98	5.03% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.5	650	0.0420	0.44		**Lag/CN Method,**

Summary for Reach 3R: BJD-K - EX. RCBC POWERS Xing

Inflow Area = 27.770 ac, 48.99% Impervious, Inflow Depth = 1.19" for 5yr event
Inflow = 21.52 cfs @ 12.38 hrs, Volume= 2.755 af
Outflow = 21.52 cfs @ 12.39 hrs, Volume= 2.755 af, Atten= 0%, Lag= 0.4 min

Routing by Muskingum-Cunge method, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs / 3
Reference Flow= 16.14 cfs Estimated Depth= 0.34' Velocity= 4.79 fps
m= 1.640, c= 7.86 fps, dt= 2.0 min, dx= 170.0' / 1 = 170.0', K= 0.4 min, X= 0.445
Max. Velocity= 8.21 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 7.86 fps, Avg. Travel Time= 0.4 min

Peak Storage= 465 cf @ 12.38 hrs
Average Depth at Peak Storage= 0.27' , Surface Width= 10.00'
Bank-Full Depth= 6.00' Flow Area= 60.0 sf, Capacity= 1,216.92 cfs

10.00' x 6.00' deep channel, n= 0.015
Length= 170.0' Slope= 0.0110 '/'
Inlet Invert= 5,973.25', Outlet Invert= 5,971.38'

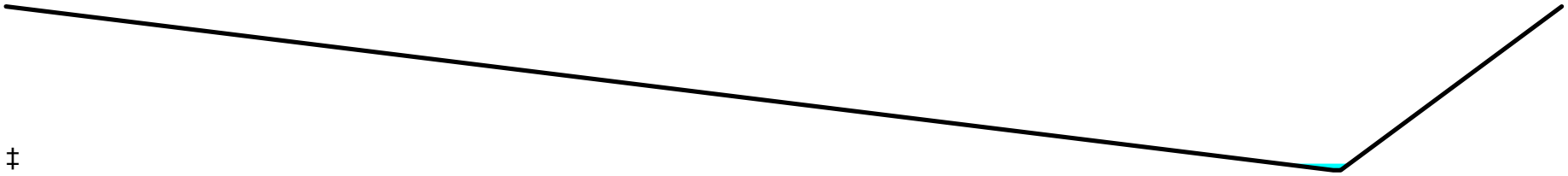
Summary for Reach 4R: BJDEX-12b to Powers RCBC Xing

Inflow Area = 9.540 ac, 5.03% Impervious, Inflow Depth = 0.25" for 5yr event
Inflow = 1.49 cfs @ 12.25 hrs, Volume= 0.196 af
Outflow = 1.44 cfs @ 12.38 hrs, Volume= 0.196 af, Atten= 3%, Lag= 7.6 min

Routing by Muskingum-Cunge method, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs / 3
Reference Flow= 1.12 cfs Estimated Depth= 0.25' Velocity= 0.85 fps
m= 1.342, c= 1.14 fps, dt= 2.0 min, dx= 475.0' / 3 = 158.3', K= 2.3 min, X= 0.363
Max. Velocity= 1.80 fps, Min. Travel Time= 4.4 min
Avg. Velocity = 1.15 fps, Avg. Travel Time= 6.9 min

Peak Storage= 600 cf @ 12.33 hrs
Average Depth at Peak Storage= 0.24' , Surface Width= 9.46'
Bank-Full Depth= 6.00' Flow Area= 636.0 sf, Capacity= 4,256.20 cfs

1.00' x 6.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 30.0 5.0 '/' Top Width= 211.00'
Length= 475.0' Slope= 0.0042 '/'
Inlet Invert= 5,973.50', Outlet Invert= 5,971.50'



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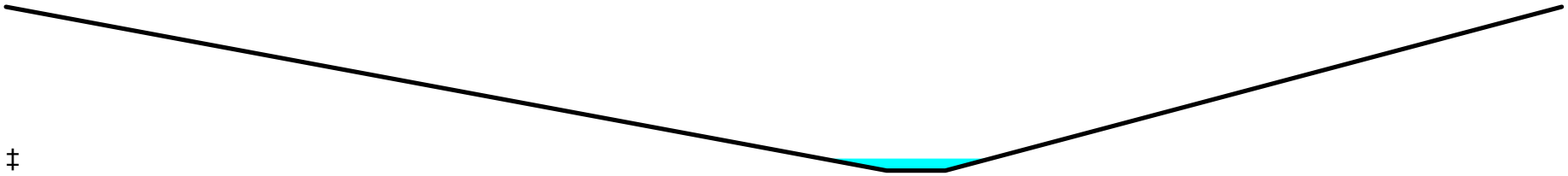
Summary for Reach 5R: Powers RCBC Xing Tailwater channel

Inflow Area = 27.770 ac, 48.99% Impervious, Inflow Depth = 1.19" for 5yr event
Inflow = 21.52 cfs @ 12.39 hrs, Volume= 2.755 af
Outflow = 21.49 cfs @ 12.42 hrs, Volume= 2.755 af, Atten= 0%, Lag= 2.1 min

Routing by Muskingum-Cunge method, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs / 3
Reference Flow= 16.14 cfs Estimated Depth= 0.46' Velocity= 1.77 fps
m= 1.408, c= 2.49 fps, dt= 2.0 min, dx= 283.0' / 1 = 283.0', K= 1.9 min, X= 0.407
Max. Velocity= 2.99 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 2.49 fps, Avg. Travel Time= 1.9 min

Peak Storage= 2,439 cf @ 12.41 hrs
Average Depth at Peak Storage= 0.44' , Surface Width= 28.83'
Bank-Full Depth= 6.00' Flow Area= 825.0 sf, Capacity= 6,846.44 cfs

10.00' x 6.00' deep channel, n= 0.030
Side Slope Z-value= 25.0 17.5 '/' Top Width= 265.00'
Length= 283.0' Slope= 0.0062 '/'
Inlet Invert= 5,971.75', Outlet Invert= 5,970.00'



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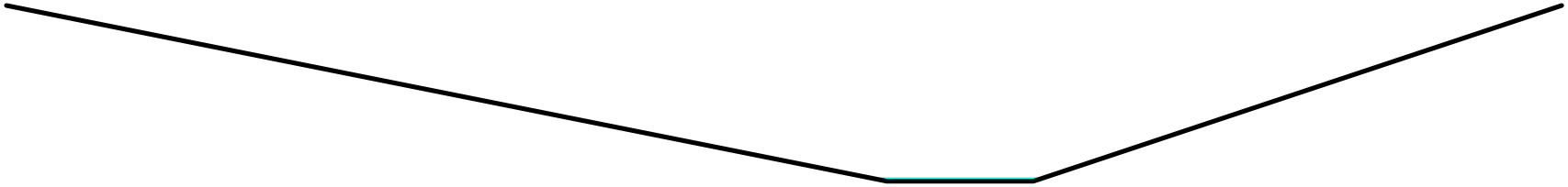
Summary for Reach 9R: DIVCHAN1

Inflow Area = 36.000 ac, 9.75% Impervious, Inflow Depth = 0.25" for 5yr event
Inflow = 2.64 cfs @ 13.04 hrs, Volume= 0.741 af
Outflow = 2.64 cfs @ 13.08 hrs, Volume= 0.741 af, Atten= 0%, Lag= 2.5 min

Routing by Muskingum-Cunge method, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Reference Flow= 1.98 cfs Estimated Depth= 0.15' Velocity= 2.26 fps
m= 1.578, c= 3.57 fps, dt= 6.0 min, dx= 565.0' / 1 = 565.0', K= 2.6 min, X= 0.497
Max. Velocity= 3.85 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 3.57 fps, Avg. Travel Time= 2.6 min

Peak Storage= 418 cf @ 13.06 hrs
Average Depth at Peak Storage= 0.13' , Surface Width= 6.07'
Bank-Full Depth= 6.00' Flow Area= 174.0 sf, Capacity= 3,238.84 cfs

5.00' x 6.00' deep channel, n= 0.030
Side Slope Z-value= 5.0 3.0 '/' Top Width= 53.00'
Length= 565.0' Slope= 0.0301 '/'
Inlet Invert= 5,950.00', Outlet Invert= 5,933.00'



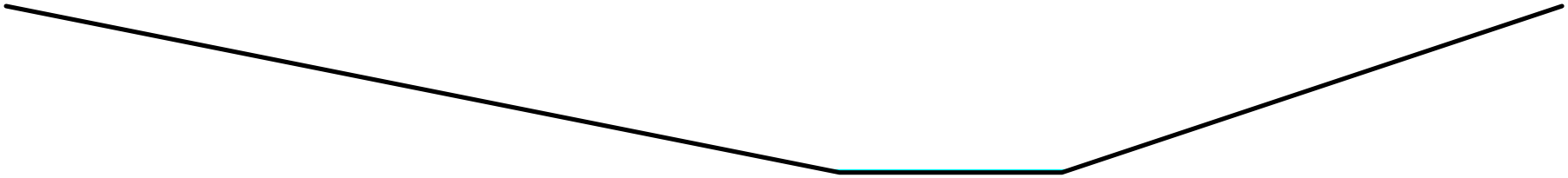
Summary for Reach 11R: JCD-OS

Inflow Area = 56.700 ac, 6.28% Impervious, Inflow Depth = 0.25" for 5yr event
Inflow = 3.83 cfs @ 12.86 hrs, Volume= 1.167 af
Outflow = 3.83 cfs @ 12.96 hrs, Volume= 1.167 af, Atten= 0%, Lag= 6.0 min

Routing by Muskingum-Cunge method, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs / 3
Reference Flow= 2.88 cfs Estimated Depth= 0.14' Velocity= 2.43 fps
m= 1.610, c= 3.91 fps, dt= 2.0 min, dx= 1,394.0' / 3 = 464.7', K= 2.0 min, X= 0.498
Max. Velocity= 4.60 fps, Min. Travel Time= 5.1 min
Avg. Velocity = 3.95 fps, Avg. Travel Time= 5.9 min

Peak Storage= 1,366 cf @ 12.90 hrs
Average Depth at Peak Storage= 0.12' , Surface Width= 8.93'
Bank-Full Depth= 6.00' Flow Area= 192.0 sf, Capacity= 4,139.55 cfs

8.00' x 6.00' deep channel, n= 0.030
Side Slope Z-value= 5.0 3.0 '/' Top Width= 56.00'
Length= 1,394.0' Slope= 0.0380 '/'
Inlet Invert= 5,933.00', Outlet Invert= 5,880.00'



Summary for Pond 1P: A

Inflow Area = 10.000 ac, 0.00% Impervious, Inflow Depth = 1.88" for 5yr event
Inflow = 24.82 cfs @ 11.99 hrs, Volume= 1.570 af
Primary = 24.82 cfs @ 11.99 hrs, Volume= 1.570 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs

Summary for Pond 2P: EX.OFFSITE POND 12a

Inflow Area = 54.280 ac, 4.99% Impervious, Inflow Depth = 0.25" for 5yr event
Inflow = 4.73 cfs @ 12.77 hrs, Volume= 1.117 af
Outflow = 4.63 cfs @ 12.86 hrs, Volume= 1.117 af, Atten= 2%, Lag= 5.4 min
Discarded = 4.63 cfs @ 12.86 hrs, Volume= 1.117 af

Routing by Stor-Ind method, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Peak Elev= 5,982.01' @ 12.86 hrs Surf.Area= 2.205 ac Storage= 0.033 af

Plug-Flow detention time= 5.2 min calculated for 1.116 af (100% of inflow)
Center-of-Mass det. time= 5.2 min (966.3 - 961.1)

Volume	Invert	Avail.Storage	Storage Description
#1	5,982.00'	33.440 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
5,982.00	2.190	0.000	0.000
5,983.00	3.160	2.675	2.675
5,984.00	4.380	3.770	6.445
5,985.00	5.450	4.915	11.360
5,986.00	6.630	6.040	17.400
5,987.00	8.000	7.315	24.715
5,988.00	9.450	8.725	33.440

Device	Routing	Invert	Outlet Devices
#1	Discarded	5,982.00'	**8.200 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 100.00'

Discarded OutFlow Max=18.23 cfs @ 12.86 hrs HW=5,982.01' (Free Discharge)
↑**1=Exfiltration** (Controls 18.23 cfs)

Summary for Pond BJD-K: Det/WQC Pond - BJD-K

Inflow Area = 18.230 ac, 72.00% Impervious, Inflow Depth = 1.67" for 5yr event
Inflow = 29.01 cfs @ 12.17 hrs, Volume= 2.542 af
Outflow = 20.08 cfs @ 12.10 hrs, Volume= 2.559 af, Atten= 31%, Lag= 0.0 min
Primary = 20.08 cfs @ 12.10 hrs, Volume= 2.559 af

Routing by Stor-Ind method, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Peak Elev= 5,976.83' @ 12.34 hrs Surf.Area= 39,143 sf Storage= 6,437 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.9 min (822.7 - 821.8)

Volume	Invert	Avail.Storage	Storage Description
#1	5,976.50'	337,996 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5,976.50	0	0	0
5,977.00	59,509	14,877	14,877
5,977.50	62,116	30,406	45,284
5,978.00	64,772	31,722	77,006
5,978.50	67,478	33,063	110,068
5,979.00	70,234	34,428	144,496
5,979.50	73,041	35,819	180,315
5,980.00	75,897	37,235	217,549
5,980.50	78,803	38,675	256,224
5,981.00	81,759	40,141	296,365
5,981.50	84,766	41,631	337,996

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**pond k stage discharge** Elev. (feet) 0.00 0.40 0.60 1.20 1.73 2.00 2.40 2.63 3.00 3.60 4.00 4.80 5.06 5.40 6.00 6.53 6.60 7.20 7.80 8.40 Disch. (cfs) 0.000 0.060 0.070 0.100 0.120 0.130 0.220 0.250 0.290 0.340 0.370 0.780 0.850 3.620 17.590 18.170 18.250 18.880 19.490 20.080

Primary OutFlow Max=20.08 cfs @ 12.10 hrs HW=5,976.66' (Free Discharge)
1=pond k stage discharge (Custom Controls 20.08 cfs)

Summary for Pond JCD-D: POND JCD-D

Inflow Area = 139.100 ac, 2.56% Impervious, Inflow Depth = 0.91" for 5yr event
Inflow = 76.22 cfs @ 12.29 hrs, Volume= 10.597 af
Outflow = 31.75 cfs @ 12.82 hrs, Volume= 10.597 af, Atten= 58%, Lag= 31.8 min
Primary = 31.75 cfs @ 12.82 hrs, Volume= 10.597 af

Routing by Stor-Ind method, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Peak Elev= 5,885.17' @ 12.82 hrs Surf.Area= 258,831 sf Storage= 142,848 cf

Plug-Flow detention time= 71.3 min calculated for 10.585 af (100% of inflow)
Center-of-Mass det. time= 71.5 min (928.3 - 856.8)

Volume	Invert	Avail.Storage	Storage Description
#1	5,884.00'	1,810,772 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5,884.00	0	0	0
5,885.00	204,788	102,394	102,394
5,886.00	514,463	359,626	462,020
5,887.00	224,338	369,401	831,420
5,888.00	234,413	229,376	1,060,796
5,889.00	244,688	239,551	1,300,346
5,890.00	255,163	249,926	1,550,272
5,891.00	265,838	260,501	1,810,772

Device	Routing	Invert	Outlet Devices
#1	Primary	5,884.00'	**42.8" Vert. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=31.71 cfs @ 12.82 hrs HW=5,885.17' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 31.71 cfs @ 3.69 fps)

TABLE OF CONTENTS

Summary for Subcatchment 1S: BJD-12a

Runoff = 23.87 cfs @ 12.68 hrs, Volume= 4.310 af, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Type II 24-hr Tabular 100yr Rainfall=4.60", Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Description	Land Use
*	51.570	47	Pasture/grassland/range, Poor, HSG A	Pasture
*	2.710	98	0	
	54.280	50	Weighted Average	
	51.570	47	95.01% Pervious Area	
	2.710	98	4.99% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
59.5	2,084	0.0459	0.58		**Lag/CN Method,** Contour Length= 54,269' Interval= 2'

Summary for Subcatchment 2S: BJD-12c

Runoff = 58.53 cfs @ 12.16 hrs, Volume= 5.194 af, Depth= 3.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Type II 24-hr Tabular 100yr Rainfall=4.60", Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Description	Land Use
*	18.230	88	Urban industrial, 72% imp, HSG B	Industrial
	5.104	62	28.00% Pervious Area	
	13.126	98	72.00% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.0	1,403	0.0190	1.02		**Lag/CN Method,**

Summary for Subcatchment 3S: JCDEV-3.1

Runoff = 152.23 cfs @ 12.31 hrs, Volume= 16.828 af, Depth= 2.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Type II 24-hr Tabular 100yr Rainfall=4.60", Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Description	Land Use
*	8.360	88	54.8% Impervious	
*	6.860	92		
*	17.830	69		
*	29.680	85		
*	6.470	88		
	69.200	82	Weighted Average	
	69.200	82	100.00% Pervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.8	2,933	0.0410	1.40		**Lag/CN Method,**

Summary for Subcatchment 4S: JCDEV-3.2

Runoff = 56.30 cfs @ 12.01 hrs, Volume= 3.761 af, Depth= 3.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Type II 24-hr Tabular 100yr Rainfall=4.60", Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Description	Land Use
*	1.340	85	69.4% Impervious	
*	11.860	88		
	13.200	88	Weighted Average	
	13.200	88	100.00% Pervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	1,228	0.0690	1.89		**Lag/CN Method,**

Summary for Subcatchment 5S: JCDEV-3.3

Runoff = 47.33 cfs @ 11.99 hrs, Volume= 3.075 af, Depth= 3.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Type II 24-hr Tabular 100yr Rainfall=4.60", Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Description	Land Use
*	7.770	92	89.4% Impervious	Commercial
*	2.230	88		
	10.000	91	Weighted Average	
	10.000	91	100.00% Pervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	872	0.0480	1.66		**Lag/CN Method,**

Summary for Subcatchment 6S: JCD OS-1A

Runoff = 13.17 cfs @ 12.92 hrs, Volume= 2.859 af, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Type II 24-hr Tabular 100yr Rainfall=4.60", Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Description	Land Use
*	34.200	47	5% impervious	
*	1.800	98		
	36.000	50	Weighted Average	
	32.490	44	90.25% Pervious Area	
	3.510	98	9.75% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
76.7	2,788	0.0440	0.61		**Lag/CN Method,**

Summary for Subcatchment 7S: JCD OS-1B

Runoff = 12.76 cfs @ 12.37 hrs, Volume= 1.644 af, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Type II 24-hr Tabular 100yr Rainfall=4.60", Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Description	Land Use
*	19.665	47		
*	1.035	98	5% impervious	
	20.700	50	Weighted Average	
	20.648	49	99.75% Pervious Area	
	0.052	98	0.25% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.8	1,367	0.0610	0.62		**Lag/CN Method,**

Summary for Subcatchment 8S: BJDEV14

Runoff = 31.08 cfs @ 11.93 hrs, Volume= 1.894 af, Depth= 3.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Type II 24-hr Tabular 100yr Rainfall=4.60", Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Description	Land Use
*	1.550	88	89% IMPERVIOUS	
*	4.610	92		
	6.160	91	Weighted Average	
	6.160	91	100.00% Pervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.9	465	0.0900	2.01		**Lag/CN Method,**
3.9	465	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment BJ-12: BJD-12b

Runoff = 7.64 cfs @ 12.21 hrs, Volume= 0.758 af, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Type II 24-hr Tabular 100yr Rainfall=4.60", Ia/S=0.10, Smoothing=Off

	Area (ac)	CN	Description	Land Use
*	9.060	47	Pasture/grassland/range, Poor, HSG A	Pasture
*	0.480	98		
	9.540	50	Weighted Average	
	9.060	47	94.97% Pervious Area	
	0.480	98	5.03% Impervious Area	

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.5	650	0.0420	0.44		**Lag/CN Method,**

Summary for Reach 3R: BJD-K - EX. RCBC POWERS Xing

Inflow Area = 27.770 ac, 48.99% Impervious, Inflow Depth = 2.59" for 100yr event
Inflow = 27.41 cfs @ 12.30 hrs, Volume= 5.989 af
Outflow = 27.38 cfs @ 12.30 hrs, Volume= 5.989 af, Atten= 0%, Lag= 0.3 min

Routing by Muskingum-Cunge method, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs / 3
Reference Flow= 20.56 cfs Estimated Depth= 0.39' Velocity= 5.26 fps
m= 1.636, c= 8.61 fps, dt= 2.0 min, dx= 170.0' / 1 = 170.0', K= 0.3 min, X= 0.436
Max. Velocity= 8.90 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 8.61 fps, Avg. Travel Time= 0.3 min

Peak Storage= 541 cf @ 12.30 hrs
Average Depth at Peak Storage= 0.32' , Surface Width= 10.00'
Bank-Full Depth= 6.00' Flow Area= 60.0 sf, Capacity= 1,216.92 cfs

10.00' x 6.00' deep channel, n= 0.015
Length= 170.0' Slope= 0.0110 '/'
Inlet Invert= 5,973.25', Outlet Invert= 5,971.38'

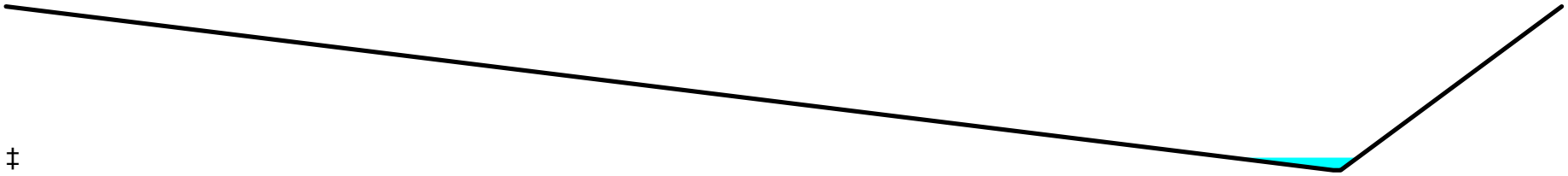
Summary for Reach 4R: BJDEX-12b to Powers RCBC Xing

Inflow Area = 9.540 ac, 5.03% Impervious, Inflow Depth = 0.95" for 100yr event
Inflow = 7.64 cfs @ 12.21 hrs, Volume= 0.758 af
Outflow = 7.33 cfs @ 12.30 hrs, Volume= 0.758 af, Atten= 4%, Lag= 5.0 min

Routing by Muskingum-Cunge method, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs / 3
Reference Flow= 5.73 cfs Estimated Depth= 0.48' Velocity= 1.28 fps
m= 1.336, c= 1.71 fps, dt= 2.0 min, dx= 475.0' / 2 = 237.5', K= 2.3 min, X= 0.321
Max. Velocity= 2.30 fps, Min. Travel Time= 3.4 min
Avg. Velocity = 1.72 fps, Avg. Travel Time= 4.6 min

Peak Storage= 2,011 cf @ 12.26 hrs
Average Depth at Peak Storage= 0.46' , Surface Width= 17.22'
Bank-Full Depth= 6.00' Flow Area= 636.0 sf, Capacity= 4,256.20 cfs

1.00' x 6.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 30.0 5.0 '/' Top Width= 211.00'
Length= 475.0' Slope= 0.0042 '/'
Inlet Invert= 5,973.50', Outlet Invert= 5,971.50'



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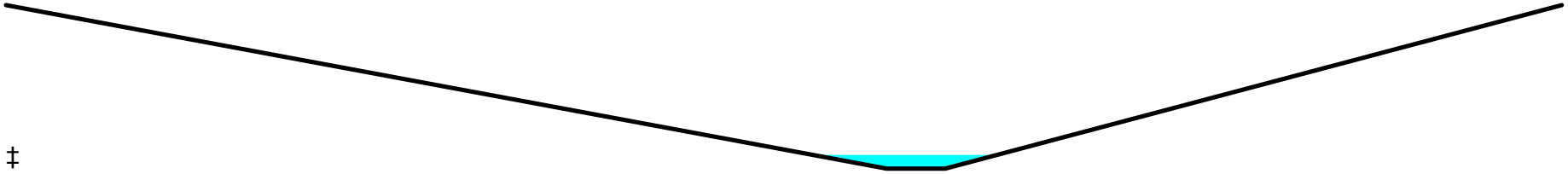
Summary for Reach 5R: Powers RCBC Xing Tailwater channel

Inflow Area = 27.770 ac, 48.99% Impervious, Inflow Depth = 2.59" for 100yr event
Inflow = 27.38 cfs @ 12.30 hrs, Volume= 5.989 af
Outflow = 27.19 cfs @ 12.33 hrs, Volume= 5.989 af, Atten= 1%, Lag= 1.7 min

Routing by Muskingum-Cunge method, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs / 3
Reference Flow= 20.54 cfs Estimated Depth= 0.52' Velocity= 1.89 fps
m= 1.400, c= 2.65 fps, dt= 2.0 min, dx= 283.0' / 1 = 283.0', K= 1.8 min, X= 0.395
Max. Velocity= 3.13 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 2.65 fps, Avg. Travel Time= 1.8 min

Peak Storage= 2,914 cf @ 12.32 hrs
Average Depth at Peak Storage= 0.50' , Surface Width= 31.20'
Bank-Full Depth= 6.00' Flow Area= 825.0 sf, Capacity= 6,846.44 cfs

10.00' x 6.00' deep channel, n= 0.030
Side Slope Z-value= 25.0 17.5 '/' Top Width= 265.00'
Length= 283.0' Slope= 0.0062 '/'
Inlet Invert= 5,971.75', Outlet Invert= 5,970.00'



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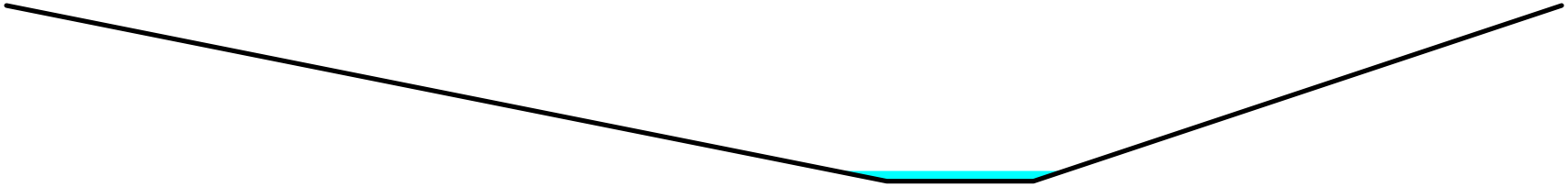
Summary for Reach 9R: DIVCHAN1

Inflow Area = 36.000 ac, 9.75% Impervious, Inflow Depth = 0.95" for 100yr event
Inflow = 13.17 cfs @ 12.92 hrs, Volume= 2.859 af
Outflow = 13.16 cfs @ 12.95 hrs, Volume= 2.859 af, Atten= 0%, Lag= 1.7 min

Routing by Muskingum-Cunge method, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Reference Flow= 9.88 cfs Estimated Depth= 0.38' Velocity= 3.91 fps
m= 1.509, c= 5.90 fps, dt= 6.0 min, dx= 565.0' / 1 = 565.0', K= 1.6 min, X= 0.493
Max. Velocity= 6.21 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 5.90 fps, Avg. Travel Time= 1.6 min

Peak Storage= 1,261 cf @ 12.94 hrs
Average Depth at Peak Storage= 0.35' , Surface Width= 7.79'
Bank-Full Depth= 6.00' Flow Area= 174.0 sf, Capacity= 3,238.84 cfs

5.00' x 6.00' deep channel, n= 0.030
Side Slope Z-value= 5.0 3.0 '/' Top Width= 53.00'
Length= 565.0' Slope= 0.0301 '/'
Inlet Invert= 5,950.00', Outlet Invert= 5,933.00'



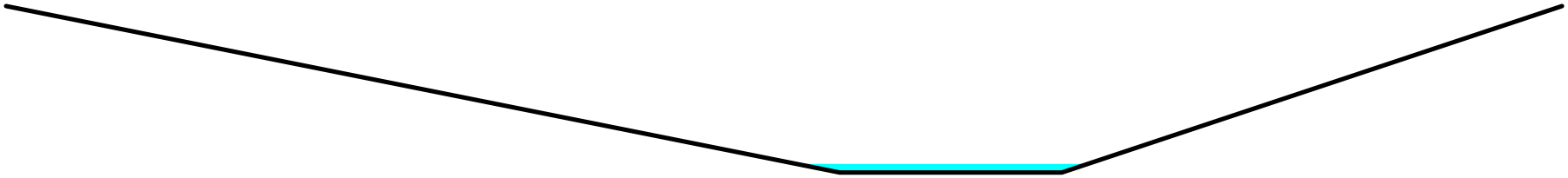
Summary for Reach 11R: JCD-OS

Inflow Area = 56.700 ac, 6.28% Impervious, Inflow Depth = 0.95" for 100yr event
Inflow = 19.53 cfs @ 12.57 hrs, Volume= 4.503 af
Outflow = 19.52 cfs @ 12.64 hrs, Volume= 4.503 af, Atten= 0%, Lag= 4.0 min

Routing by Muskingum-Cunge method, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs / 3
Reference Flow= 14.65 cfs Estimated Depth= 0.35' Velocity= 4.38 fps
m= 1.556, c= 6.82 fps, dt= 2.0 min, dx= 1,394.0' / 2 = 697.0', K= 1.7 min, X= 0.496
Max. Velocity= 7.61 fps, Min. Travel Time= 3.1 min
Avg. Velocity = 6.79 fps, Avg. Travel Time= 3.4 min

Peak Storage= 3,989 cf @ 12.62 hrs
Average Depth at Peak Storage= 0.31' , Surface Width= 10.48'
Bank-Full Depth= 6.00' Flow Area= 192.0 sf, Capacity= 4,139.55 cfs

8.00' x 6.00' deep channel, n= 0.030
Side Slope Z-value= 5.0 3.0 '/' Top Width= 56.00'
Length= 1,394.0' Slope= 0.0380 '/'
Inlet Invert= 5,933.00', Outlet Invert= 5,880.00'



Summary for Pond 1P: A

Inflow Area = 10.000 ac, 0.00% Impervious, Inflow Depth = 3.69" for 100yr event
Inflow = 47.33 cfs @ 11.99 hrs, Volume= 3.075 af
Primary = 47.33 cfs @ 11.99 hrs, Volume= 3.075 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs

Summary for Pond 2P: EX.OFFSITE POND 12a

Inflow Area = 54.280 ac, 4.99% Impervious, Inflow Depth = 0.95" for 100yr event
Inflow = 23.87 cfs @ 12.68 hrs, Volume= 4.310 af
Outflow = 19.09 cfs @ 12.99 hrs, Volume= 4.310 af, Atten= 20%, Lag= 18.6 min
Discarded = 19.09 cfs @ 12.99 hrs, Volume= 4.310 af

Routing by Stor-Ind method, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Peak Elev= 5,982.12' @ 12.99 hrs Surf.Area= 2.308 ac Storage= 0.274 af

Plug-Flow detention time= 6.2 min calculated for 4.306 af (100% of inflow)
Center-of-Mass det. time= 6.2 min (924.6 - 918.4)

Volume	Invert	Avail.Storage	Storage Description
#1	5,982.00'	33.440 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
5,982.00	2.190	0.000	0.000
5,983.00	3.160	2.675	2.675
5,984.00	4.380	3.770	6.445
5,985.00	5.450	4.915	11.360
5,986.00	6.630	6.040	17.400
5,987.00	8.000	7.315	24.715
5,988.00	9.450	8.725	33.440

Device	Routing	Invert	Outlet Devices
#1	Discarded	5,982.00'	**8.200 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 100.00'

Discarded OutFlow Max=19.08 cfs @ 12.99 hrs HW=5,982.12' (Free Discharge)
↑—**1=Exfiltration** (Controls 19.08 cfs)

Summary for Pond BJD-K: Det/WQC Pond - BJD-K

Inflow Area = 18.230 ac, 72.00% Impervious, Inflow Depth = 3.42" for 100yr event
Inflow = 58.53 cfs @ 12.16 hrs, Volume= 5.194 af
Outflow = 20.08 cfs @ 11.90 hrs, Volume= 5.231 af, Atten= 66%, Lag= 0.0 min
Primary = 20.08 cfs @ 11.90 hrs, Volume= 5.231 af

Routing by Stor-Ind method, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Peak Elev= 5,977.54' @ 12.53 hrs Surf.Area= 62,312 sf Storage= 47,580 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 12.5 min (816.5 - 804.0)

Volume	Invert	Avail.Storage	Storage Description
#1	5,976.50'	337,996 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5,976.50	0	0	0
5,977.00	59,509	14,877	14,877
5,977.50	62,116	30,406	45,284
5,978.00	64,772	31,722	77,006
5,978.50	67,478	33,063	110,068
5,979.00	70,234	34,428	144,496
5,979.50	73,041	35,819	180,315
5,980.00	75,897	37,235	217,549
5,980.50	78,803	38,675	256,224
5,981.00	81,759	40,141	296,365
5,981.50	84,766	41,631	337,996

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**pond k stage discharge** Elev. (feet) 0.00 0.40 0.60 1.20 1.73 2.00 2.40 2.63 3.00 3.60 4.00 4.80 5.06 5.40 6.00 6.53 6.60 7.20 7.80 8.40 Disch. (cfs) 0.000 0.060 0.070 0.100 0.120 0.130 0.220 0.250 0.290 0.340 0.370 0.780 0.850 3.620 17.590 18.170 18.250 18.880 19.490 20.080

Primary OutFlow Max=20.08 cfs @ 11.90 hrs HW=5,976.60' (Free Discharge)
↑**1=pond k stage discharge** (Custom Controls 20.08 cfs)

Summary for Pond JCD-D: POND JCD-D

Inflow Area = 139.100 ac, 2.56% Impervious, Inflow Depth = 2.16" for 100yr event
Inflow = 178.69 cfs @ 12.29 hrs, Volume= 25.092 af
Outflow = 67.96 cfs @ 12.91 hrs, Volume= 25.092 af, Atten= 62%, Lag= 36.8 min
Primary = 67.96 cfs @ 12.91 hrs, Volume= 25.092 af

Routing by Stor-Ind method, Time Span= 1.00-96.00 hrs, dt= 0.10 hrs
Peak Elev= 5,885.78' @ 12.91 hrs Surf.Area= 446,483 sf Storage= 356,546 cf

Plug-Flow detention time= 77.6 min calculated for 25.065 af (100% of inflow)
Center-of-Mass det. time= 77.7 min (919.7 - 842.0)

Volume	Invert	Avail.Storage	Storage Description
#1	5,884.00'	1,810,772 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
5,884.00	0	0	0
5,885.00	204,788	102,394	102,394
5,886.00	514,463	359,626	462,020
5,887.00	224,338	369,401	831,420
5,888.00	234,413	229,376	1,060,796
5,889.00	244,688	239,551	1,300,346
5,890.00	255,163	249,926	1,550,272
5,891.00	265,838	260,501	1,810,772

Device	Routing	Invert	Outlet Devices
#1	Primary	5,884.00'	**42.8" Vert. Orifice/Grate X 3.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=67.93 cfs @ 12.91 hrs HW=5,885.78' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 67.93 cfs @ 4.54 fps)

TABLE OF CONTENTS

Current Event

APPENDIX C

POND DESIGNS & ANALYSES

POND DESIGN & ANALYSIS

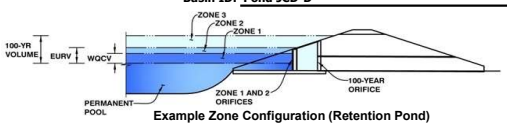
Proposed Pond JCD-D

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: **Waterview North**

Basin ID: **Pond JCD-D**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	81.81	acres
Watershed Length =	2,933	ft
Watershed Length to Centroid =	1,574	ft
Watershed Slope =	0.039	ft/ft
Watershed Imperviousness =	57.20%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	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) =	1.548	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	5.057	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	4.743	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	6.610	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	8.224	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	10.301	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	12.033	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	14.188	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	18.626	acre-feet		inches
Approximate 2-yr Detention Volume =	3.869	acre-feet		
Approximate 5-yr Detention Volume =	5.244	acre-feet		
Approximate 10-yr Detention Volume =	6.805	acre-feet		
Approximate 25-yr Detention Volume =	7.379	acre-feet		
Approximate 50-yr Detention Volume =	7.698	acre-feet		
Approximate 100-yr Detention Volume =	8.454	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.548	acre-feet
Zone 2 Volume (EURV - Zone 1) =	3.508	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	3.397	acre-feet
Total Detention Basin Volume =	8.454	acre-feet
Initial Surcharge Volume (ISV) =	202	ft^3
Initial Surcharge Depth (ISD) =	0.40	ft
Total Available Detention Depth (H_{total}) =	6.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S_{main}) =	3	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	

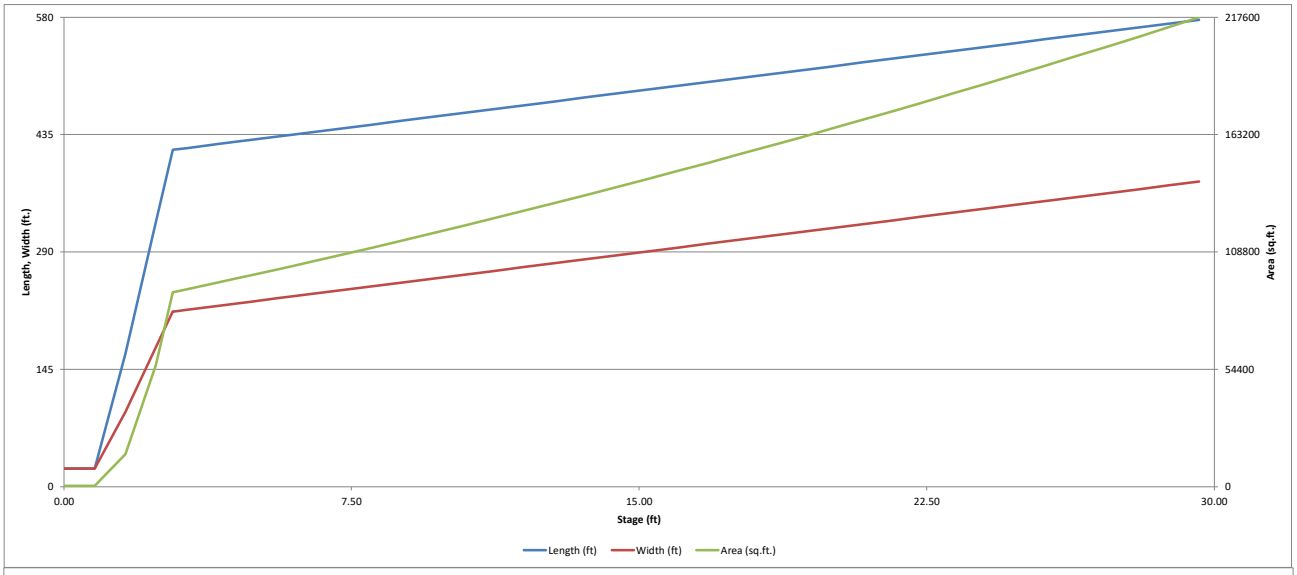
Initial Surcharge Area (A_{ISV}) =	506	ft^2
Surcharge Volume Length (L_{ISV}) =	22.5	ft
Surcharge Volume Width (W_{ISV}) =	22.5	ft
Depth of Basin Floor (H_{FLOOR}) =	1.94	ft
Length of Basin Floor (L_{FLOOR}) =	416.3	ft
Width of Basin Floor (W_{FLOOR}) =	216.5	ft
Area of Basin Floor (A_{FLOOR}) =	90,128	ft^2
Volume of Basin Floor (V_{FLOOR}) =	62,976	ft^3
Depth of Main Basin (H_{MAIN}) =	3.16	ft
Length of Main Basin (L_{MAIN}) =	435.3	ft
Width of Main Basin (W_{MAIN}) =	235.5	ft
Area of Main Basin (A_{MAIN}) =	102,485	ft^2
Volume of Main Basin (V_{MAIN}) =	304,119	ft^3
Calculated Total Basin Volume (V_{total}) =	**8.438**	acre-feet

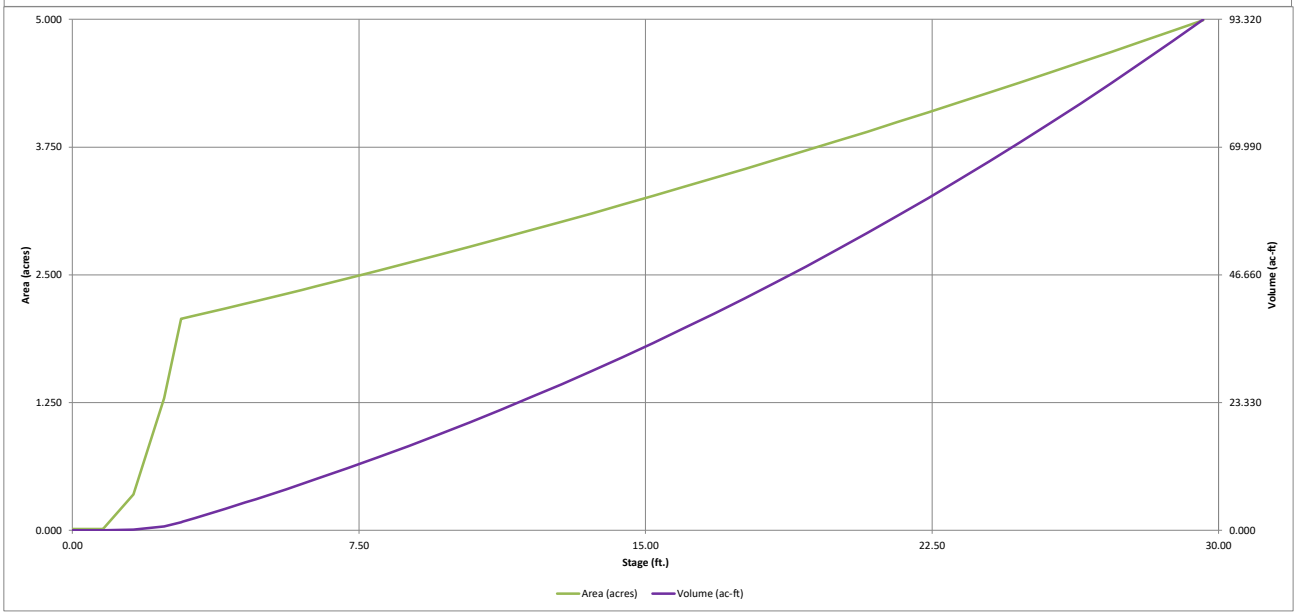
Depth Increment = 0.80 ft

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		22.5	22.5	506		0.012		
ISV	0.40		22.5	22.5	506		0.012	202	0.005
	0.80		22.5	22.5	506		0.012	405	0.009
	1.60		164.6	92.5	15,223		0.349	4,800	0.110
	2.40		327.0	172.5	56,403		1.295	31,718	0.728
Floor	2.84		416.3	216.5	90,128		2.069	63,667	1.462
Zone 1 (WQCV)	2.89		416.6	216.8	90,318		2.073	68,178	1.565
	3.20		418.5	218.7	91,499		2.101	96,359	2.212
	4.00		423.3	223.5	94,580		2.171	170,788	3.921
Zone 2 (EURV)	4.52		426.4	226.6	96,608		2.218	220,496	5.062
	4.80		428.1	228.3	97,708		2.243	247,700	5.686
	5.60		432.9	233.1	100,881		2.316	327,133	7.510
Zone 3 (100-year)	6.01		435.3	235.5	102,525		2.354	368,831	8.467
	6.40		437.7	237.9	104,101		2.390	409,122	9.392
	7.20		442.5	242.7	107,366		2.465	493,706	11.334
	8.00		447.3	247.5	110,678		2.541	580,921	13.336
	8.80		452.1	252.3	114,035		2.618	670,803	15.400
	9.60		456.9	257.1	117,439		2.696	763,390	17.525
	10.40		461.7	261.9	120,889		2.775	858,718	19.713
	11.20		466.5	266.7	124,385		2.855	956,824	21.966
	12.00		471.3	271.5	127,927		2.937	1,057,746	24.283
	12.80		476.1	276.3	131,515		3.019	1,161,520	26.665
	13.60		480.9	281.1	135,149		3.103	1,268,183	29.113
	14.40		485.7	285.9	138,830		3.187	1,377,771	31.629
	15.20		490.5	290.7	142,556		3.273	1,490,323	34.213
	16.00		495.3	295.5	146,328		3.359	1,605,873	36.866
	16.80		500.1	300.3	150,147		3.447	1,724,460	39.588
	17.60		504.9	305.1	154,012		3.536	1,846,121	42.381
	18.40		509.7	309.9	157,922		3.625	1,970,891	45.245
	19.20		514.5	314.7	161,879		3.716	2,098,809	48.182
	20.00		519.3	319.5	165,882		3.808	2,229,910	51.192
	20.80		524.1	324.3	169,931		3.901	2,364,232	54.275
	21.60		528.9	329.1	174,026		3.995	2,501,811	57.434
	22.40		533.7	333.9	178,167		4.090	2,642,685	60.668
	23.20		538.5	338.7	182,354		4.186	2,786,890	63.978
	24.00		543.3	343.5	186,587		4.283	2,934,464	67.366
	24.80		548.1	348.3	190,866		4.382	3,085,442	70.832
	25.60		552.9	353.1	195,192		4.481	3,239,862	74.377
	26.40		557.7	357.9	199,563		4.581	3,397,761	78.002
	27.20		562.5	362.7	203,981		4.683	3,559,176	81.707
	28.00		567.3	367.5	208,444		4.785	3,724,143	85.495
	28.80		572.1	372.3	212,954		4.889	3,892,699	89.364
	29.60		576.9	377.1	217,510		4.993	4,064,882	93.317

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)



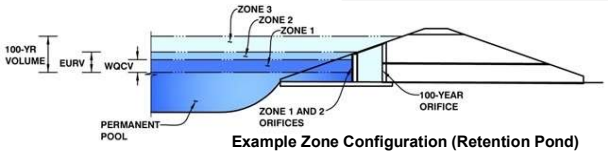


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: **Waterview North**

Basin ID: **Pond JCD-D**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.89	1.548	Orifice Plate
Zone 2 (EURV)	4.52	3.508	Orifice Plate
Zone 3 (100-year)	6.01	3.397	Weir&Pipe (Restrict)
Total (all zones)		8.454	

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 =	4.188E-02	ft^2
Depth at top of Zone using Orifice Plate =	4.70	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	6.03	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	1.50	3.00	4.00				
Orifice Area (sq. inches)	6.03	6.03	6.03	6.03				

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.52	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.52	N/A	feet
Overflow Weir Front Edge Length =	17.00	N/A	feet	Overflow Weir Slope Length =	4.12	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	6.24	N/A	
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	49.06	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	49.06	N/A	ft^2
Debris Clogging % =	0%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	7.87	N/A	ft^2
Outlet Pipe Diameter =	42.00	N/A	inches	Outlet Orifice Centroid =	1.47	N/A	feet
Restrictor Plate Height Above Pipe Invert =	32.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.12	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.01	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.98	feet
Spillway Crest Length =	81.00	feet	Stage at Top of Freeboard =	7.99	feet
Spillway End Slopes =	3.00	H:V	Basin Area at Top of Freeboard =	2.54	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	13.31	acre-ft

Calculated Parameters for Spillway

Routed Hydrograph Results

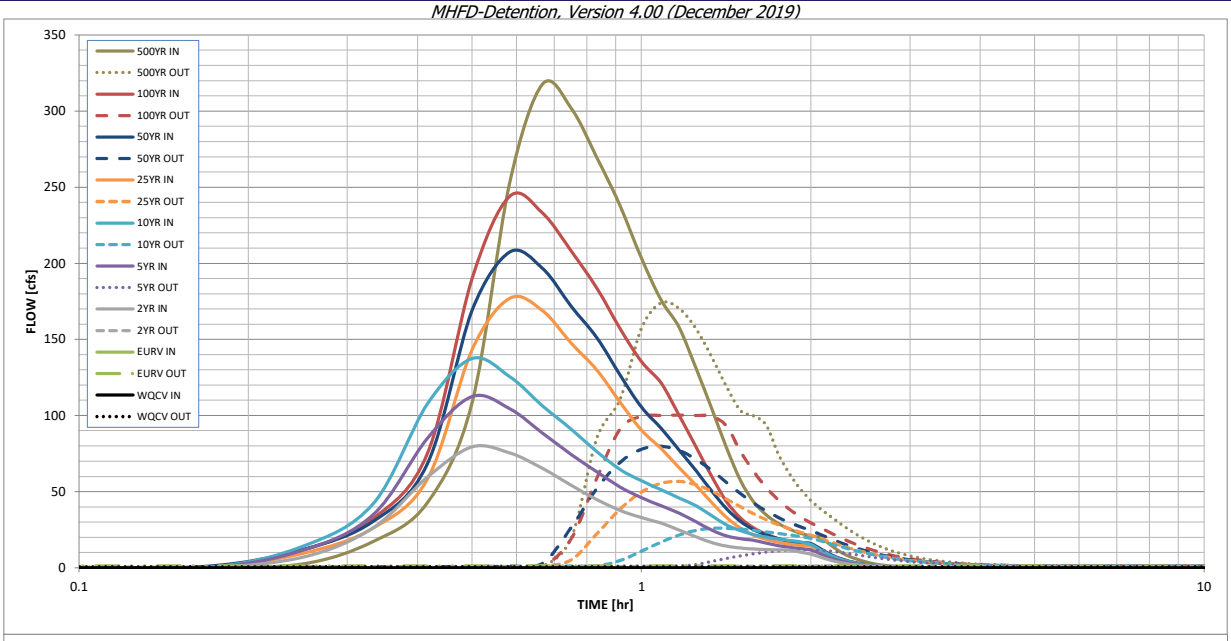
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

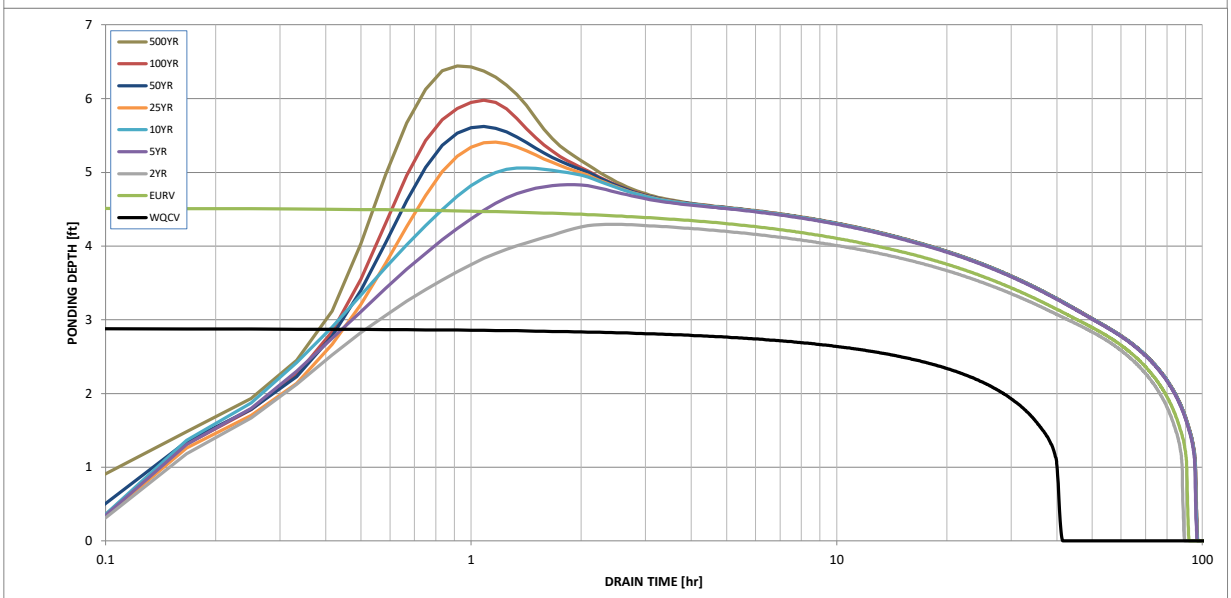
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	1.548	5.057	4.743	6.610	8.224	10.301	12.033	14.188	18.626
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	4.743	6.610	8.224	10.301	12.033	14.188	18.626
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	9.0	25.1	38.1	68.1	85.5	108.5	151.3
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.11	0.31	0.47	0.83	1.04	1.33	1.85
Peak Inflow Q (cfs) =	N/A	N/A	79.3	112.5	137.3	177.0	207.4	244.0	317.7
Peak Outflow Q (cfs) =	0.6	1.2	1.1	11.7	25.9	56.7	79.8	100.3	174.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.7	0.8	0.9	0.9	1.1
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	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	0.2	0.5	1.1	1.6	2.0	2.1
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	85	82	88	87	85	83	82	78
Time to Drain 99% of Inflow Volume (hours) =	**40**	89	86	93	92	91	91	90	89
Maximum Ponding Depth (ft) =	2.89	4.52	4.30	4.83	5.06	5.41	5.62	5.98	6.44
Area at Maximum Ponding Depth (acres) =	2.07	2.22	2.20	2.25	2.27	2.30	2.32	2.35	2.39
Maximum Volume Stored (acre-ft) =	1.565	5.062	4.554	5.754	6.250	7.049	7.556	8.397	9.488

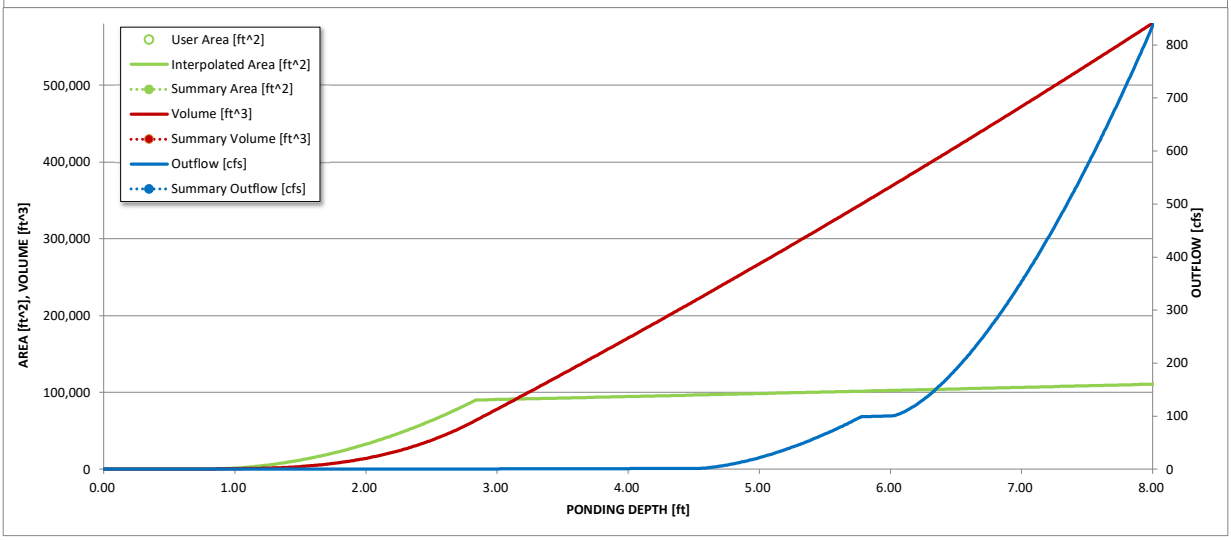
On the FDR outlet structure will need to be revised to drain the 2yr and 5yr design storm within 72hrs.

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	0.79	0.08	2.54
	0:15:00	0.00	0.00	6.97	11.39	14.11	9.48	11.98	11.57	17.07
	0:20:00	0.00	0.00	26.12	34.80	42.04	25.98	30.34	32.35	42.90
	0:25:00	0.00	0.00	59.68	85.16	107.74	58.38	68.50	75.25	108.12
	0:30:00	0.00	0.00	79.34	112.48	137.34	143.09	168.96	189.85	253.05
	0:35:00	0.00	0.00	75.36	104.50	125.51	177.03	207.38	244.02	317.68
	0:40:00	0.00	0.00	65.22	88.48	106.42	168.90	196.69	233.09	301.95
	0:45:00	0.00	0.00	54.23	74.46	90.98	147.53	171.68	208.10	269.57
	0:50:00	0.00	0.00	44.75	63.07	76.30	129.87	151.13	183.61	237.64
	0:55:00	0.00	0.00	37.61	52.98	64.47	108.62	126.52	156.98	203.34
	1:00:00	0.00	0.00	32.86	45.94	57.04	90.29	105.45	135.32	175.89
	1:05:00	0.00	0.00	29.29	40.67	51.30	78.28	91.68	121.36	157.97
	1:10:00	0.00	0.00	24.70	35.80	45.79	65.83	77.23	100.25	131.11
	1:15:00	0.00	0.00	20.22	30.24	40.62	54.26	63.79	79.45	104.66
	1:20:00	0.00	0.00	16.56	24.67	34.19	42.83	50.30	59.97	78.95
	1:25:00	0.00	0.00	14.14	20.95	28.15	33.11	38.79	43.53	57.35
	1:30:00	0.00	0.00	12.87	19.02	24.24	25.98	30.37	32.64	43.21
	1:35:00	0.00	0.00	12.25	17.92	21.77	21.42	24.92	26.12	34.66
	1:40:00	0.00	0.00	11.92	16.14	20.01	18.59	21.49	21.97	29.12
	1:45:00	0.00	0.00	11.69	14.52	18.77	16.68	19.16	19.09	25.29
	1:50:00	0.00	0.00	11.52	13.39	17.90	15.45	17.65	17.14	22.67
	1:55:00	0.00	0.00	10.23	12.56	16.86	14.60	16.59	15.75	20.79
	2:00:00	0.00	0.00	8.90	11.63	15.24	14.02	15.87	14.88	19.61
	2:05:00	0.00	0.00	6.83	8.95	11.58	10.91	12.32	11.53	15.16
	2:10:00	0.00	0.00	4.93	6.39	8.20	7.73	8.71	8.18	10.73
	2:15:00	0.00	0.00	3.53	4.57	5.84	5.53	6.22	5.89	7.71
	2:20:00	0.00	0.00	2.52	3.23	4.16	3.95	4.43	4.23	5.54
	2:25:00	0.00	0.00	1.75	2.21	2.89	2.74	3.08	2.95	3.85
	2:30:00	0.00	0.00	1.18	1.48	1.98	1.89	2.12	2.03	2.64
	2:35:00	0.00	0.00	0.76	1.00	1.32	1.29	1.45	1.38	1.80
	2:40:00	0.00	0.00	0.44	0.62	0.80	0.81	0.90	0.86	1.12
	2:45:00	0.00	0.00	0.22	0.33	0.41	0.44	0.49	0.46	0.59
	2:50:00	0.00	0.00	0.08	0.14	0.16	0.18	0.20	0.19	0.23
	2:55:00	0.00	0.00	0.02	0.03	0.03	0.03	0.03	0.03	0.04
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Summary Stage-Area-Volume-Discharge Relationships

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

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

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

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

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

POND DESIGN & ANALYSIS

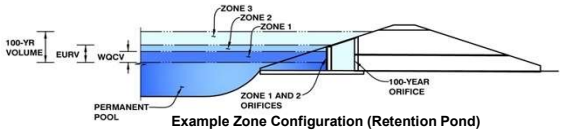
Proposed Pond A

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: **Waterview North**

Basin ID: **Proposed Pond A**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	10.00	acres
Watershed Length =	872	ft
Watershed Length to Centroid =	242	ft
Watershed Slope =	0.057	ft/ft
Watershed Imperviousness =	90.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.335	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.008	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.791	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.030	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.224	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.427	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.624	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.842	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	2.333	acre-feet		inches
Approximate 2-yr Detention Volume =	0.809	acre-feet		
Approximate 5-yr Detention Volume =	1.055	acre-feet		
Approximate 10-yr Detention Volume =	1.293	acre-feet		
Approximate 25-yr Detention Volume =	1.385	acre-feet		
Approximate 50-yr Detention Volume =	1.437	acre-feet		
Approximate 100-yr Detention Volume =	1.493	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.335	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.674	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.484	acre-feet
Total Detention Basin Volume =	1.493	acre-feet
Initial Surcharge Volume (ISV) =	60	ft^3
Initial Surcharge Depth (ISD) =	0.33	ft
Total Available Detention Depth (H_{total}) =	7.00	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S_{main}) =	3	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2.5	

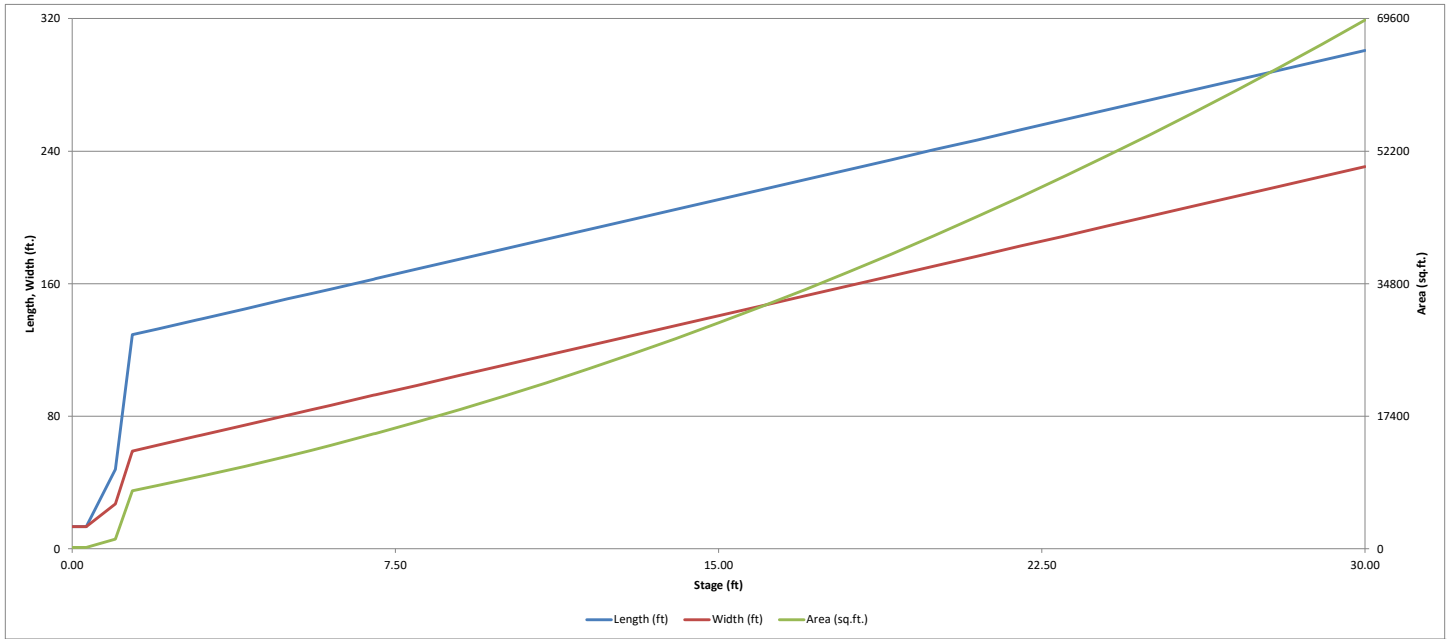
Initial Surcharge Area (A_{ISV}) =	182	ft^2
Surcharge Volume Length (L_{ISV}) =	13.5	ft
Surcharge Volume Width (W_{ISV}) =	13.5	ft
Depth of Basin Floor (H_{FLOOR}) =	0.57	ft
Length of Basin Floor (L_{FLOOR}) =	129.2	ft
Width of Basin Floor (W_{FLOOR}) =	59.1	ft
Area of Basin Floor (A_{FLOOR}) =	7,633	ft^2
Volume of Basin Floor (V_{FLOOR}) =	1,709	ft^3
Depth of Main Basin (H_{MAIN}) =	5.60	ft
Length of Main Basin (L_{MAIN}) =	162.8	ft
Width of Main Basin (W_{MAIN}) =	92.7	ft
Area of Main Basin (A_{MAIN}) =	15,088	ft^2
Volume of Main Basin (V_{MAIN}) =	62,447	ft^3
Calculated Total Basin Volume (V_{total}) =	**1.476**	acre-feet

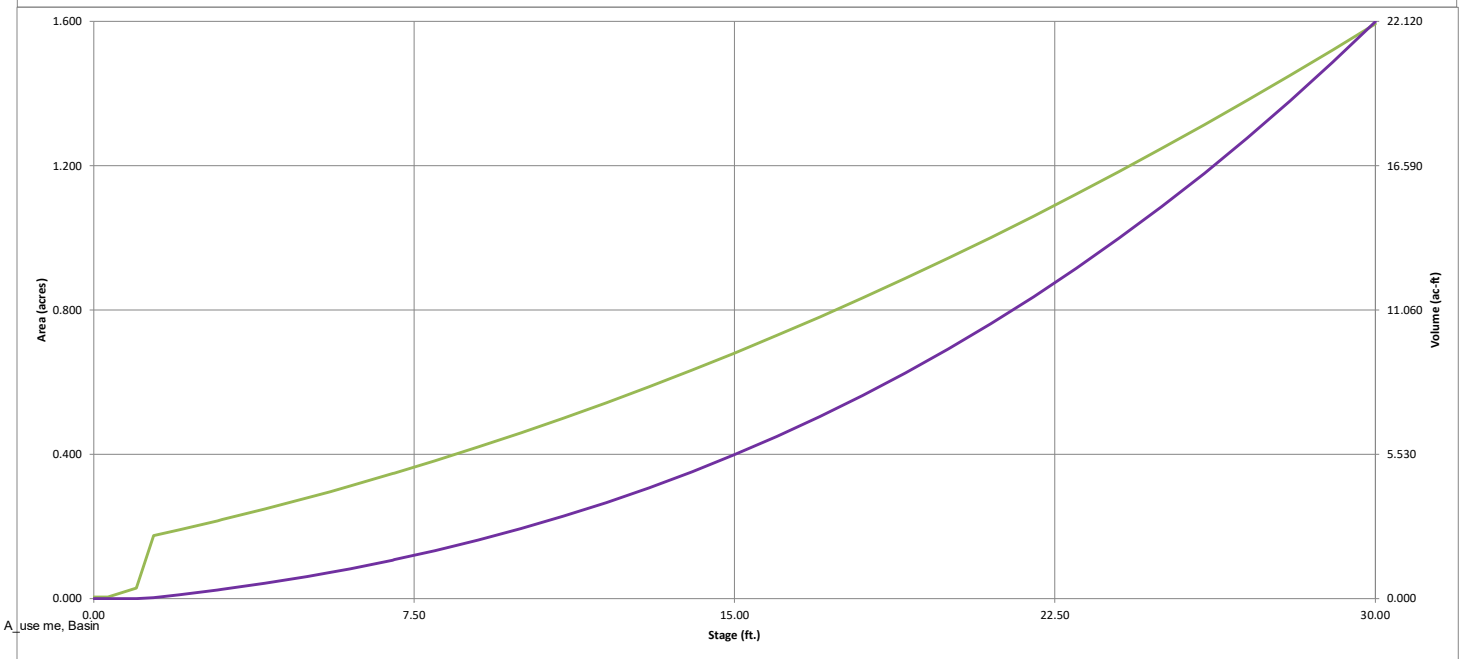
Depth Increment = 1.00 ft

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		13.5	13.5	182		0.004		
ISV	0.33		13.5	13.5	182		0.004	60	0.001
	1.00		48.0	27.1	1,300		0.030	264	0.006
Floor	1.40		129.2	59.1	7,633		0.175	1,877	0.043
	2.00		132.8	62.7	8,324		0.191	6,663	0.153
Zone 1 (WQCV)	2.90		138.2	68.1	9,409		0.216	14,638	0.336
	3.00		138.8	68.7	9,533		0.219	15,585	0.358
	4.00		144.8	74.7	10,814		0.248	25,753	0.591
	5.00		150.8	80.7	12,167		0.279	37,237	0.855
Zone 2 (EURV)	5.54		154.0	83.9	12,927		0.297	44,011	1.010
	6.00		156.8	86.7	13,592		0.312	50,110	1.150
	7.00		162.8	92.7	15,088		0.346	64,444	1.479
Zone 3 (100-year)	7.04		163.0	92.9	15,150		0.348	65,049	1.493
	8.00		168.8	98.7	16,657		0.382	80,311	1.844
	9.00		174.8	104.7	18,298		0.420	97,783	2.245
	10.00		180.8	110.7	20,011		0.459	116,931	2.684
	11.00		186.8	116.7	21,796		0.500	137,829	3.164
	12.00		192.8	122.7	23,653		0.543	160,547	3.686
	13.00		198.8	128.7	25,582		0.587	185,158	4.251
	14.00		204.8	134.7	27,582		0.633	211,734	4.861
	15.00		210.8	140.7	29,655		0.681	240,347	5.518
	16.00		216.8	146.7	31,800		0.730	271,069	6.223
	17.00		222.8	152.7	34,017		0.781	303,971	6.978
	18.00		228.8	158.7	36,306		0.833	339,127	7.785
	19.00		234.8	164.7	38,667		0.888	376,607	8.646
	20.00		240.8	170.7	41,100		0.944	416,485	9.561
	21.00		246.8	176.7	43,605		1.001	458,831	10.533
	22.00		252.8	182.7	46,181		1.060	503,718	11.564
	23.00		258.8	188.7	48,830		1.121	551,217	12.654
	24.00		264.8	194.7	51,551		1.183	601,402	13.806
	25.00		270.8	200.7	54,344		1.248	654,344	15.022
	26.00		276.8	206.7	57,209		1.313	710,114	16.302
	27.00		282.8	212.7	60,146		1.381	768,786	17.649
	28.00		288.8	218.7	63,155		1.450	830,430	19.064
	29.00		294.8	224.7	66,235		1.521	895,119	20.549
	30.00		300.8	230.7	69,388		1.593	962,925	22.106

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)



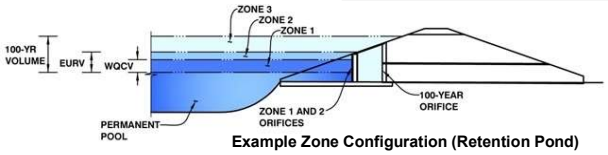


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: **Waterview North**

Basin ID: **Proposed Pond A**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.90	0.335	Orifice Plate
Zone 2 (EURV)	5.54	0.674	Orifice Plate
Zone 3 (100-year)	7.04	0.484	Weir&Pipe (Restrict)
Total (all zones)		1.493	

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

Underdrain Orifice Invert Depth = ft (distance below the filtration media surface)

Underdrain Orifice Diameter = inches

Calculated Parameters for Underdrain

Underdrain Orifice Area = ft^2

Underdrain Orifice Centroid = feet

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	1.285E-02	ft^2
Depth at top of Zone using Orifice Plate =	5.30	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	24.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	1.85	sq. inches (diameter = 1-1/2 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	2.00	4.00					
Orifice Area (sq. inches)	1.85	1.85	1.85					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.30	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.18	N/A	feet
Overflow Weir Front Edge Length =	8.00	N/A	feet	Overflow Weir Slope Length =	3.61	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	15.16	N/A	
Horiz. Length of Weir Sides =	3.50	N/A	feet	Overflow Grate Open Area w/o Debris =	20.20	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	20.20	N/A	ft^2
Debris Clogging % =	0%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	1.33	N/A	ft^2
Outlet Pipe Diameter =	18.00	N/A	inches	Outlet Orifice Centroid =	0.59	N/A	feet
Restrictor Plate Height Above Pipe Invert =	12.70		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.99	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

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=	0.89 feet
Spillway Crest Length =	16.00	feet	Stage at Top of Freeboard =	8.09 feet
Spillway End Slopes =	3.00	H:V	Basin Area at Top of Freeboard =	0.39 acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	1.88 acre-ft

Calculated Parameters for Spillway

Routed Hydrograph Results

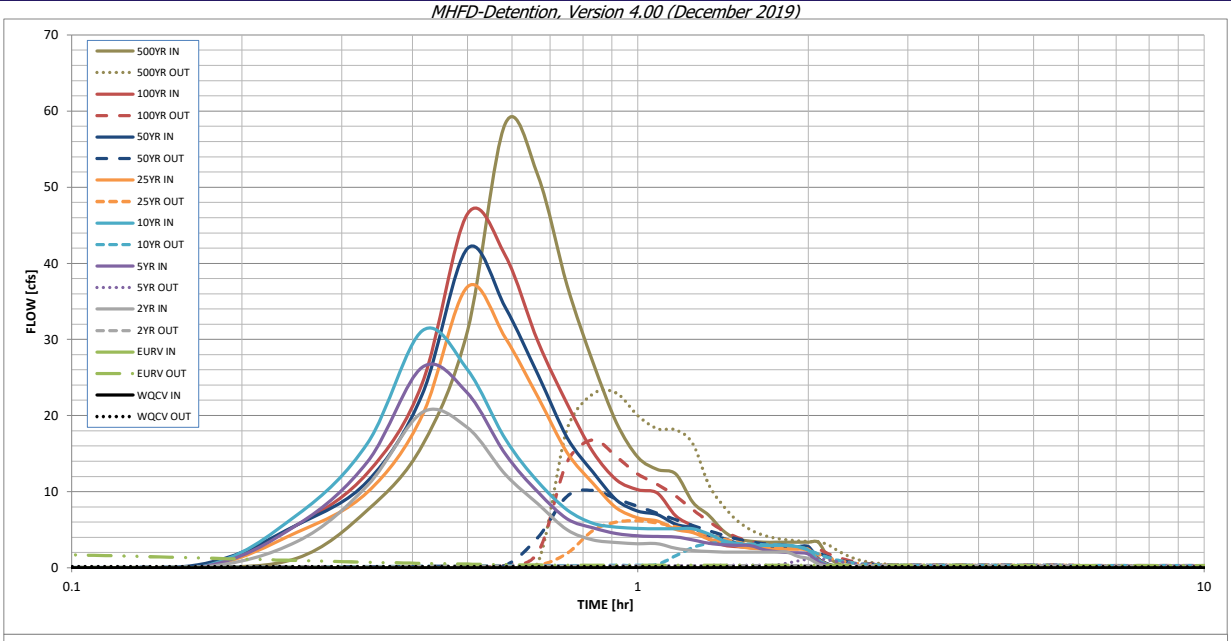
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

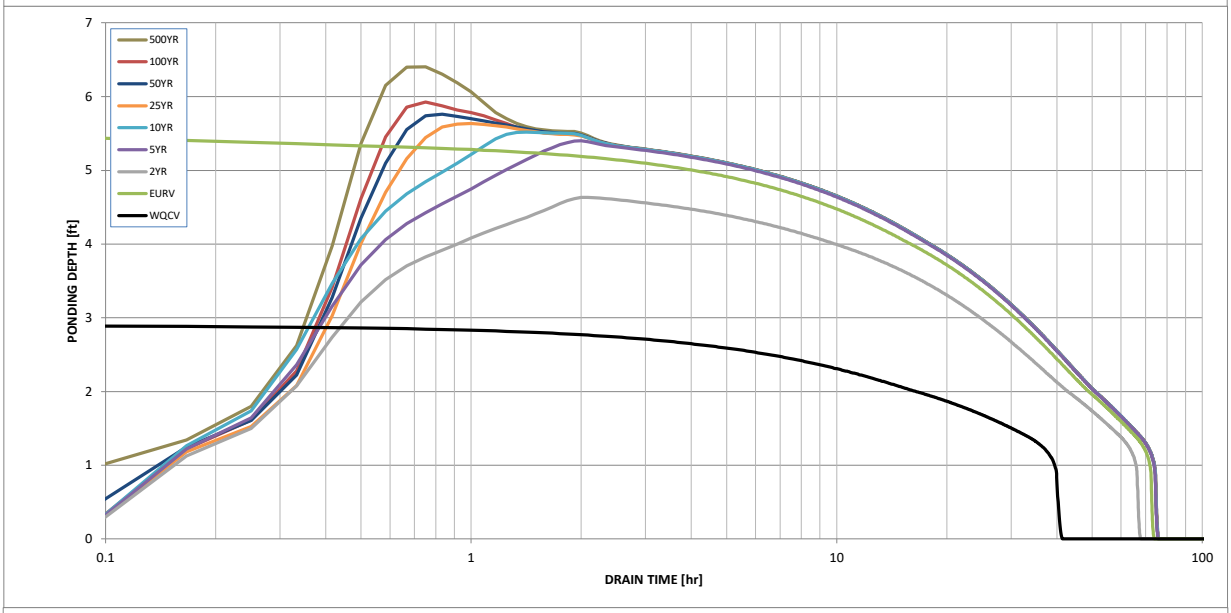
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.335	1.008	0.791	1.030	1.224	1.427	1.624	1.842	2.333
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.791	1.030	1.224	1.427	1.624	1.842	2.333
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.8	4.9	7.5	12.5	15.6	19.7	27.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.18	0.49	0.75	1.25	1.56	1.97	2.74
Peak Inflow Q (cfs) =	N/A	N/A	20.4	26.4	31.2	36.9	42.0	46.5	58.4
Peak Outflow Q (cfs) =	0.2	2.9	0.3	1.2	3.3	6.2	10.2	16.8	23.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.4	0.5	0.7	0.9	0.8
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.17	N/A	0.0	0.1	0.3	0.5	0.8	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) =	39	68	63	69	69	68	67	66	63
Time to Drain 99% of Inflow Volume (hours) =	**40**	71	66	73	73	72	72	72	71
Maximum Ponding Depth (ft) =	2.90	5.54	4.63	5.40	5.52	5.63	5.76	5.93	6.40
Area at Maximum Ponding Depth (acres) =	0.22	0.30	0.27	0.29	0.30	0.30	0.30	0.31	0.33
Maximum Volume Stored (acre-ft) =	0.336	1.010	0.754	0.966	1.001	1.037	1.073	1.126	1.278

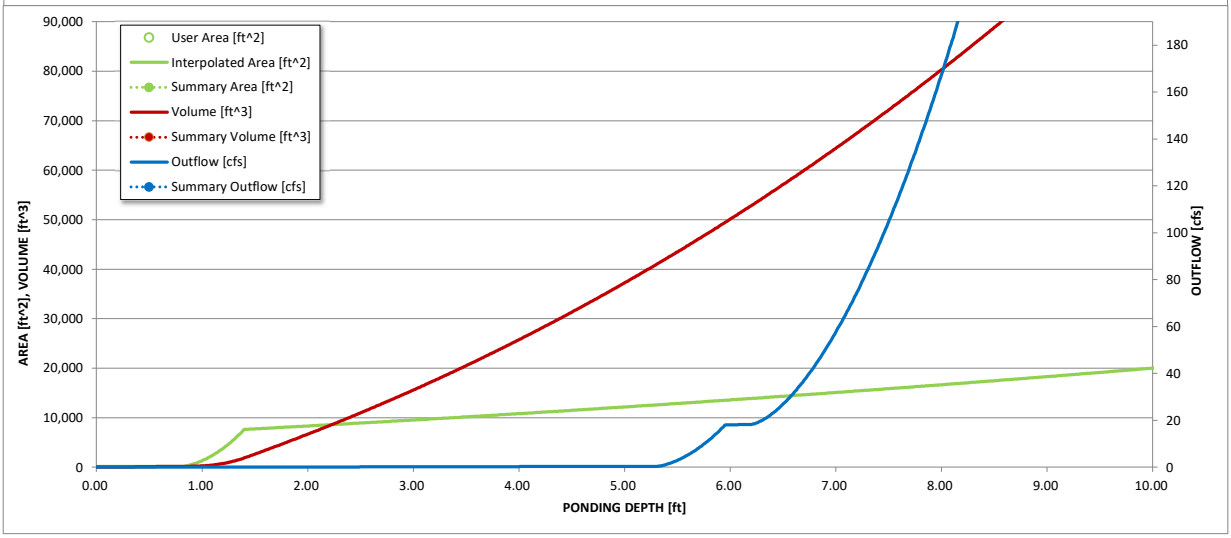
Update the narrative for Pond A to describe if the discharge is in conformance with the Trails Fil 1 drainage report and whether or not the storm system will have sufficient capacity. (Per the snippet in page 11, it appears to match).

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	0.39	0.04	1.24
	0:15:00	0.00	0.00	3.46	5.62	6.94	4.65	5.63	5.64	7.58
	0:20:00	0.00	0.00	10.85	13.96	16.41	9.94	11.37	12.47	16.11
	0:25:00	0.00	0.00	20.44	26.36	31.17	20.06	22.84	24.31	31.12
	0:30:00	0.00	0.00	18.39	22.93	26.03	36.92	41.95	46.50	58.37
	0:35:00	0.00	0.00	12.27	14.95	16.94	30.23	34.23	41.03	51.40
	0:40:00	0.00	0.00	8.37	9.90	11.28	22.36	25.30	29.63	37.11
	0:45:00	0.00	0.00	4.98	6.44	7.61	15.14	17.13	21.56	26.99
	0:50:00	0.00	0.00	3.67	5.24	5.86	11.10	12.55	15.23	19.10
	0:55:00	0.00	0.00	3.30	4.49	5.35	7.88	8.93	11.56	14.53
	1:00:00	0.00	0.00	3.17	4.20	5.17	6.57	7.45	10.26	12.92
	1:05:00	0.00	0.00	3.17	4.10	5.12	6.14	6.97	9.78	12.32
	1:10:00	0.00	0.00	2.55	4.05	5.12	5.03	5.72	6.79	8.59
	1:15:00	0.00	0.00	2.26	3.65	5.12	4.61	5.24	5.46	6.93
	1:20:00	0.00	0.00	2.13	3.23	4.45	3.79	4.30	3.79	4.81
	1:25:00	0.00	0.00	2.07	3.03	3.59	3.40	3.85	2.99	3.79
	1:30:00	0.00	0.00	2.07	2.94	3.19	2.84	3.22	2.77	3.50
	1:35:00	0.00	0.00	2.07	2.92	3.00	2.58	2.92	2.65	3.35
	1:40:00	0.00	0.00	2.07	2.38	2.94	2.49	2.82	2.65	3.35
	1:45:00	0.00	0.00	2.07	2.12	2.94	2.44	2.77	2.65	3.35
	1:50:00	0.00	0.00	2.07	2.01	2.94	2.44	2.77	2.65	3.35
	1:55:00	0.00	0.00	1.49	1.95	2.75	2.44	2.77	2.65	3.35
	2:00:00	0.00	0.00	1.22	1.81	2.31	2.44	2.77	2.65	3.35
	2:05:00	0.00	0.00	0.52	0.79	1.00	1.08	1.22	1.17	1.48
	2:10:00	0.00	0.00	0.19	0.32	0.39	0.44	0.49	0.47	0.60
	2:15:00	0.00	0.00	0.06	0.10	0.12	0.15	0.17	0.16	0.20
	2:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Summary Stage-Area-Volume-Discharge Relationships

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

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

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

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

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

POND DESIGN & ANALYSIS

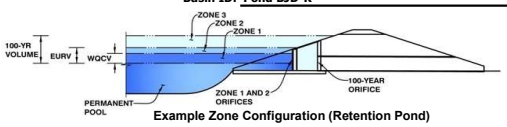
Proposed Pond BJD-K

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)

Project: Waterview North

Basin ID: Pond BJD-K



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	18.23	acres
Watershed Length =	1,403	ft
Watershed Length to Centroid =	778	ft
Watershed Slope =	0.018	ft/ft
Watershed Imperviousness =	80.00%	percent
Percentage Hydrologic Soil Group A =	17.3%	percent
Percentage Hydrologic Soil Group B =	82.7%	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) =	0.499	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.671	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.422	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.882	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.257	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	2.690	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	3.084	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	3.543	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	4.535	acre-feet		inches
Approximate 2-yr Detention Volume =	1.279	acre-feet		
Approximate 5-yr Detention Volume =	1.681	acre-feet		
Approximate 10-yr Detention Volume =	2.073	acre-feet		
Approximate 25-yr Detention Volume =	2.261	acre-feet		
Approximate 50-yr Detention Volume =	2.371	acre-feet		
Approximate 100-yr Detention Volume =	2.509	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.499	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.172	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.838	acre-feet
Total Detention Basin Volume =	2.509	acre-feet
Initial Surcharge Volume (ISV) =	65	ft^3
Initial Surcharge Depth (ISD) =	0.40	ft
Total Available Detention Depth (H_{total}) =	6.50	ft
Depth of Trickle Channel (H_{TC}) =	0.50	ft
Slope of Trickle Channel (S_{TC}) =	0.005	ft/ft
Slopes of Main Basin Sides (S_{main}) =	3	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	2	

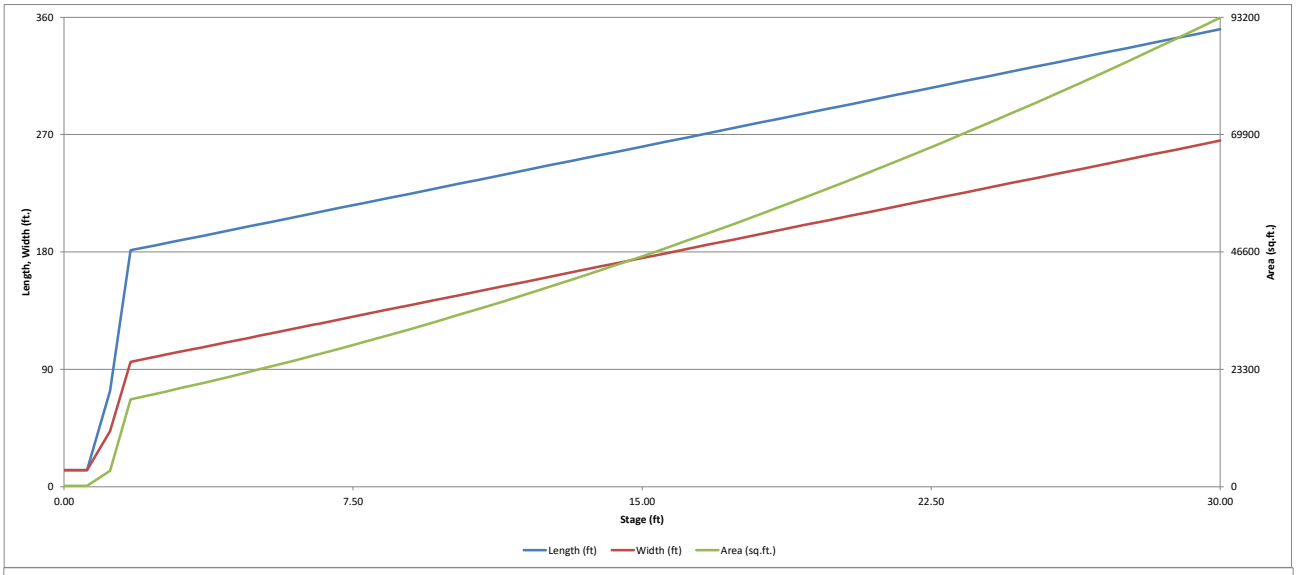
Initial Surcharge Area (A_{ISV}) =	163	ft^2
Surcharge Volume Length (L_{ISV}) =	12.8	ft
Surcharge Volume Width (W_{ISV}) =	12.8	ft
Depth of Basin Floor (H_{FLOOR}) =	0.83	ft
Length of Basin Floor (L_{FLOOR}) =	181.3	ft
Width of Basin Floor (W_{FLOOR}) =	95.8	ft
Area of Basin Floor (A_{FLOOR}) =	17,358	ft^2
Volume of Basin Floor (V_{FLOOR}) =	5,313	ft^3
Depth of Main Basin (H_{MAIN}) =	4.77	ft
Length of Main Basin (L_{MAIN}) =	209.9	ft
Width of Main Basin (W_{MAIN}) =	124.4	ft
Area of Main Basin (A_{MAIN}) =	26,105	ft^2
Volume of Main Basin (V_{MAIN}) =	102,953	ft^3
Calculated Total Basin Volume (V_{total}) =	**2.489**	acre-feet

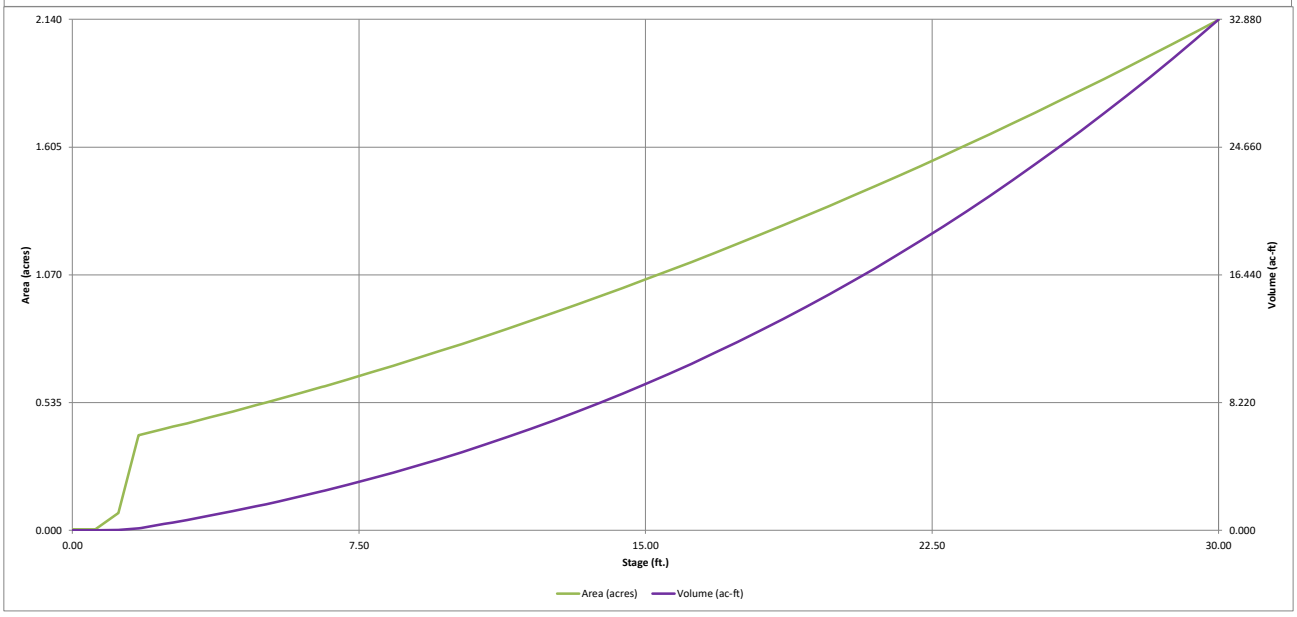
Depth Increment = 0.60 ft

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		12.8	12.8	163		0.004			
ISV	0.40		12.8	12.8	163		0.004	65	0.00150	
	0.60		12.8	12.8	163		0.004	98	0.00224	
	1.20		73.7	42.8	3,150		0.072	552	0.01268	
Floor	1.73		181.3	95.8	17,358		0.398	5,483	0.12588	
	1.80		181.7	96.2	17,474		0.401	6,702	0.15387	
	2.40		185.3	99.8	18,488		0.424	17,490	0.40151	
Zone 1 (WQCV)	2.63		186.7	101.2	18,883		0.433	21,787	0.50017	
	3.00		188.9	103.4	19,527		0.448	28,893	0.66329	
	3.60		192.5	107.0	20,592		0.473	40,927	0.93956	
	4.20		196.1	110.6	21,683		0.498	53,608	1.23068	
	4.80		199.7	114.2	22,800		0.523	66,952	1.53701	
Zone 2 (EURV)	5.06		201.2	115.7	23,292		0.535	72,944	1.67456	
	5.40		203.3	117.8	23,943		0.550	80,974	1.85890	
	6.00		206.9	121.4	25,112		0.576	95,689	2.19671	
Zone 3 (100-year)	6.53		210.1	124.6	26,166		0.601	109,276	2.50863	
	6.60		210.5	125.0	26,306		0.604	111,113	2.55079	
	7.20		214.1	128.6	27,527		0.632	127,261	2.92152	
	7.80		217.7	132.2	28,773		0.661	144,150	3.30923	
	8.40		221.3	135.8	30,046		0.690	161,795	3.71429	
	9.00		224.9	139.4	31,344		0.720	180,210	4.13706	
	9.60		228.5	143.0	32,669		0.750	199,413	4.57789	
	10.20		232.1	146.6	34,019		0.781	219,418	5.03714	
	10.80		235.7	150.2	35,395		0.813	240,241	5.51516	
	11.40		239.3	153.8	36,797		0.845	261,897	6.01232	
	12.00		242.9	157.4	38,225		0.878	284,402	6.52897	
4.12	12.60		246.5	161.0	39,679		0.911	307,772	7.06547	
	13.20		250.1	164.6	41,159		0.945	332,022	7.62217	
	13.80		253.7	168.2	42,664		0.979	357,167	8.19944	
	14.40		257.3	171.8	44,196		1.015	383,224	8.79762	
	15.00		260.9	175.4	45,754		1.050	410,208	9.41708	
	15.60		264.5	179.0	47,337		1.087	438,134	10.05817	
	16.20		268.1	182.6	48,947		1.124	467,018	10.72125	
	16.80		271.7	186.2	50,582		1.161	496,875	11.40668	
	17.40		275.3	189.8	52,243		1.199	527,721	12.11481	
	18.00		278.9	193.4	53,930		1.238	559,572	12.84600	
	18.60		282.5	197.0	55,643		1.277	592,443	13.60061	
	19.20		286.1	200.6	57,382		1.317	626,349	14.37900	
	19.80		289.7	204.2	59,147		1.358	661,307	15.18151	
	20.40		293.3	207.8	60,938		1.399	697,331	16.00852	
	21.00		296.9	211.4	62,755		1.441	734,438	16.86037	
	21.60		300.5	215.0	64,598		1.483	772,642	17.73743	
	22.20		304.1	218.6	66,466		1.526	811,960	18.64004	
	22.80		307.7	222.2	68,361		1.569	852,407	19.56857	
	23.40		311.3	225.8	70,281		1.613	893,998	20.52338	
	24.00		314.9	229.4	72,228		1.658	936,750	21.50482	
	24.60		318.5	233.0	74,200		1.703	980,677	22.51324	
	25.20		322.1	236.6	76,198		1.749	1,025,795	23.54901	
	25.80		325.7	240.2	78,222		1.796	1,072,120	24.61248	
	26.40		329.3	243.8	80,272		1.843	1,119,667	25.70402	
	27.00		332.9	247.4	82,348		1.890	1,168,452	26.82396	
	27.60		336.5	251.0	84,450		1.939	1,218,490	27.97269	
	28.20		340.1	254.6	86,578		1.988	1,269,797	29.15054	
	28.80		343.7	258.2	88,732		2.037	1,322,389	30.35788	
	29.40		347.3	261.8	90,911		2.087	1,376,281	31.59506	
	30.00		350.9	265.4	93,117		2.138	1,431,488	32.86244	

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.02 (February 2020)



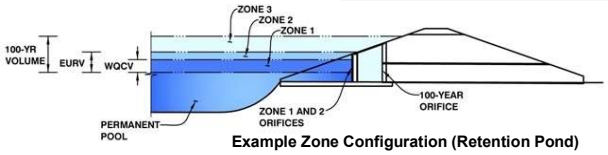


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Project: **Waterview North**

Basin ID: **Pond BJD-K**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.14	0.432	Orifice Plate
Zone 2 (EURV)	6.53	1.053	Orifice Plate
Zone 3 (User)			Weir&Pipe (Restrict)
Total (all zones)		1.485	

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 =	1.528E-02	ft^2
Depth at top of Zone using Orifice Plate =	5.00	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	24.00	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	2.20	sq. inches (diameter = 1-11/16 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	2.00	4.00					
Orifice Area (sq. inches)	2.20	2.20	2.20					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	6.53	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	7.78	N/A	feet
Overflow Weir Front Edge Length =	8.00	N/A	feet	Overflow Weir Slope Length =	5.15	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	46.99	N/A	
Horiz. Length of Weir Sides =	5.00	N/A	feet	Overflow Grate Open Area w/o Debris =	28.86	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	28.86	N/A	ft^2
Debris Clogging % =	0%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.00	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.61	N/A	ft^2
Outlet Pipe Diameter =	24.00	N/A	inches	Outlet Orifice Centroid =	0.29	N/A	feet
Restrictor Plate Height Above Pipe Invert =	6.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.05	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.52	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.91	feet
Spillway Crest Length =	18.00	feet	Stage at Top of Freeboard =	10.43	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.52	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	3.21	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).

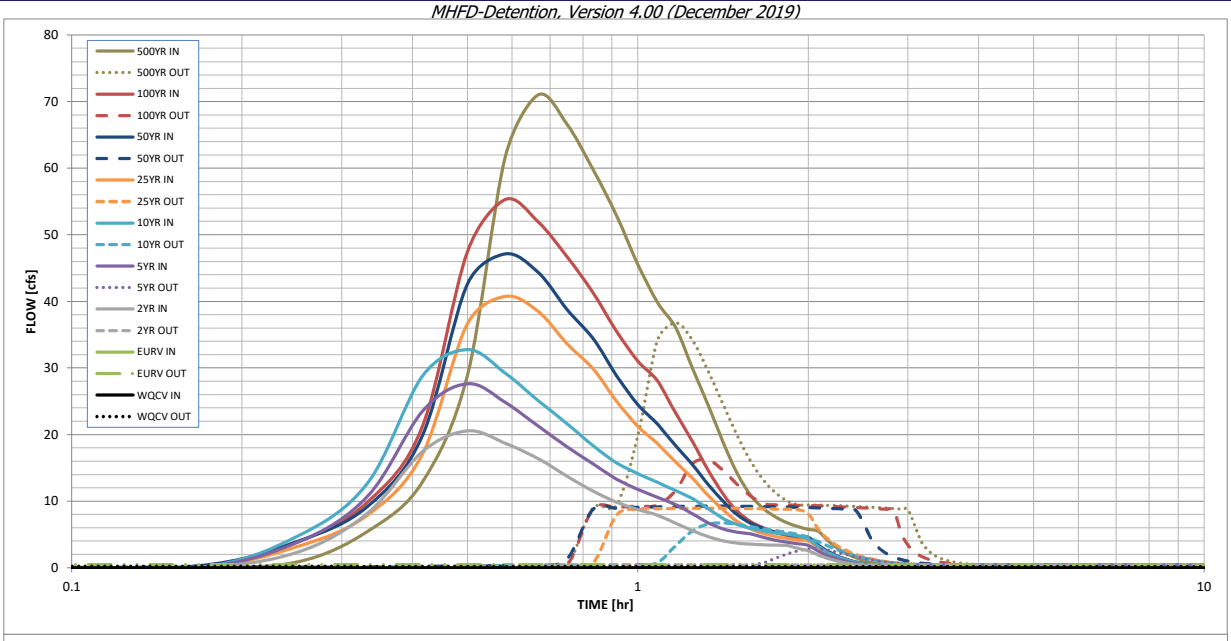
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.432	1.485	1.278	1.718	2.080	2.525	2.914	3.382	4.366
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.278	1.718	2.080	2.525	2.914	3.382	4.366
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.6	3.7	6.0	11.7	15.1	19.7	27.9
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.03	0.20	0.33	0.64	0.83	1.08	1.53
Peak Inflow Q (cfs) =	N/A	N/A	20.5	27.6	32.8	40.8	47.1	55.3	71.0
Peak Outflow Q (cfs) =	0.2	0.5	0.4	2.8	6.7	8.9	9.3	16.2	36.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	1.1	0.8	0.6	0.8	1.3
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.00	N/A	0.1	0.2	0.3	0.3	0.3	0.3
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	73	69	75	74	72	71	69	66
Time to Drain 99% of Inflow Volume (hours) =	**40**	77	73	80	80	79	79	78	77
Maximum Ponding Depth (ft) =	3.14	6.54	5.76	6.72	6.88	7.44	8.08	8.76	9.11
Area at Maximum Ponding Depth (acres) =	0.26	0.37	0.34	0.37	0.38	0.40	0.42	0.45	0.47
Maximum Volume Stored (acre-ft) =	0.433	1.489	1.209	1.555	1.612	1.835	2.095	2.393	2.558

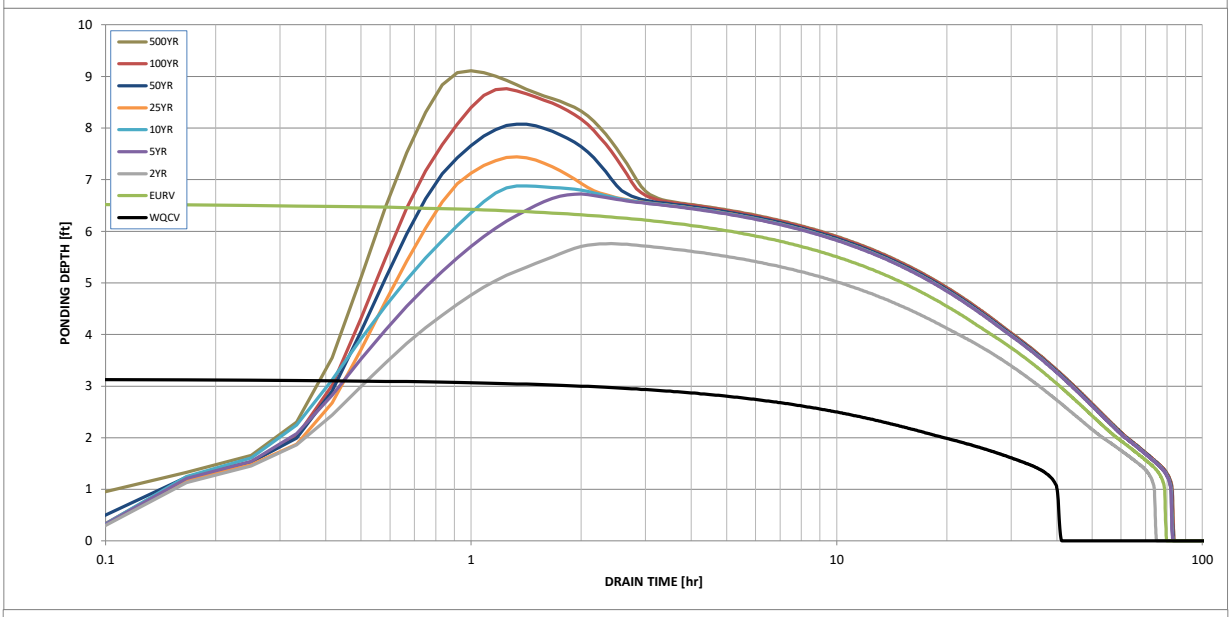
final design must release within 72 hrs.

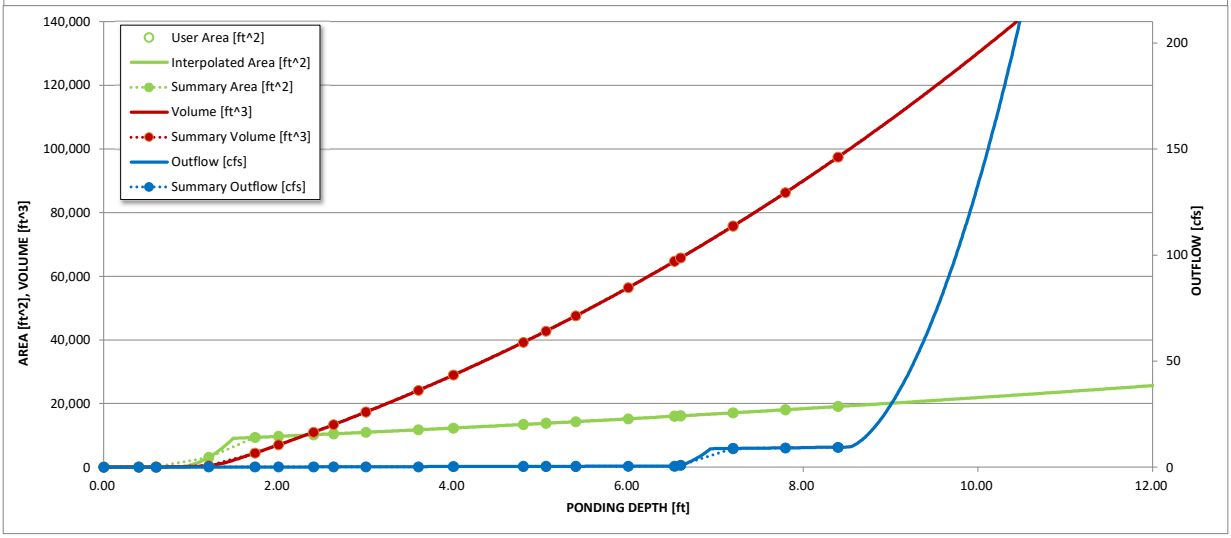
final design must be equal to or less than historic.

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: *Pond BJD-K Outlfow hydrographs*

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	0.26	0.03	0.84
	0:15:00	0.00	0.00	2.32	3.79	4.68	3.14	3.91	3.82	5.46
	0:20:00	0.00	0.00	8.19	10.74	12.72	7.93	9.22	9.88	12.88
	0:25:00	0.00	0.00	17.45	23.49	28.79	17.07	19.85	21.21	28.92
	0:30:00	0.00	0.00	20.55	27.65	32.76	36.64	42.62	47.48	61.67
	0:35:00	0.00	0.00	18.70	24.81	29.23	40.76	47.11	55.29	71.03
	0:40:00	0.00	0.00	16.38	21.27	25.10	38.48	44.35	51.95	66.58
	0:45:00	0.00	0.00	13.73	18.15	21.64	33.63	38.75	46.68	59.82
	0:50:00	0.00	0.00	11.51	15.61	18.33	29.90	34.45	41.33	52.94
	0:55:00	0.00	0.00	9.85	13.32	15.78	25.04	28.88	35.53	45.55
	1:00:00	0.00	0.00	8.75	11.78	14.14	21.22	24.50	31.02	39.84
	1:05:00	0.00	0.00	7.89	10.58	12.83	18.64	21.56	28.04	36.04
	1:10:00	0.00	0.00	6.69	9.45	11.56	15.86	18.31	23.18	29.82
	1:15:00	0.00	0.00	5.58	8.07	10.35	13.39	15.44	18.88	24.33
	1:20:00	0.00	0.00	4.65	6.73	8.83	10.79	12.43	14.56	18.71
	1:25:00	0.00	0.00	4.03	5.82	7.37	8.64	9.95	10.98	14.08
	1:30:00	0.00	0.00	3.70	5.34	6.48	6.90	7.92	8.45	10.84
	1:35:00	0.00	0.00	3.53	5.07	5.92	5.83	6.67	6.93	8.89
	1:40:00	0.00	0.00	3.44	4.55	5.52	5.15	5.88	5.98	7.65
	1:45:00	0.00	0.00	3.38	4.14	5.23	4.70	5.35	5.31	6.78
	1:50:00	0.00	0.00	3.34	3.84	5.03	4.40	4.99	4.86	6.19
	1:55:00	0.00	0.00	2.91	3.62	4.77	4.19	4.74	4.53	5.76
	2:00:00	0.00	0.00	2.56	3.35	4.32	4.05	4.57	4.31	5.48
	2:05:00	0.00	0.00	1.92	2.51	3.22	3.04	3.43	3.22	4.08
	2:10:00	0.00	0.00	1.41	1.82	2.32	2.20	2.48	2.33	2.95
	2:15:00	0.00	0.00	1.02	1.32	1.67	1.59	1.79	1.70	2.15
	2:20:00	0.00	0.00	0.73	0.94	1.20	1.15	1.29	1.23	1.56
	2:25:00	0.00	0.00	0.51	0.65	0.85	0.81	0.91	0.87	1.10
	2:30:00	0.00	0.00	0.35	0.44	0.59	0.56	0.63	0.61	0.76
	2:35:00	0.00	0.00	0.23	0.30	0.40	0.39	0.44	0.42	0.53
	2:40:00	0.00	0.00	0.14	0.19	0.25	0.25	0.28	0.27	0.34
	2:45:00	0.00	0.00	0.07	0.11	0.13	0.14	0.16	0.15	0.19
	2:50:00	0.00	0.00	0.03	0.05	0.06	0.06	0.07	0.07	0.08
	2:55:00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.02
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.02 (February 2020)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.
The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
Top of Micrpool	0.00	141	0.003	0	0.000	0.00
ISV	0.40	141	0.003	56	0.001	0.05
	0.60	141	0.003	85	0.002	0.06
	1.20	3,048	0.070	514	0.012	0.08
Floor	1.73	9,359	0.215	4,437	0.102	0.10
	2.00	9,690	0.222	7,008	0.161	0.10
	2.40	10,190	0.234	10,984	0.252	0.16
Zone 1	2.63	10,482	0.241	13,361	0.307	0.18
	3.00	10,960	0.252	17,327	0.398	0.20
	3.60	11,757	0.270	24,141	0.554	0.23
	4.00	12,303	0.282	28,953	0.665	0.25
	4.80	13,429	0.308	39,243	0.901	0.35
Zone 2	5.06	13,804	0.317	42,783	0.982	0.37
	5.40	14,303	0.328	47,561	1.092	0.39
	6.00	15,204	0.349	56,412	1.295	0.43
Zone 3	6.53	16,021	0.368	64,685	1.485	0.46
	6.60	16,130	0.370	65,811	1.511	0.97
	7.20	17,083	0.392	75,773	1.740	8.82
	7.80	18,061	0.415	86,315	1.982	9.12
	8.40	19,065	0.438	97,451	2.237	9.40

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

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

APPENDIX D

CULVERT ANALYSES

HY-8 Culvert Analysis Report
Ex. 10x6 RCBC Xing under Powers Blvd.

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 50 cfs

Design Flow: 98 cfs

Maximum Flow: 250 cfs

Flows at Crossing: Powers Blvd - Ex.10'x6' RCBC

Headwater Elevation (ft)	*Total Discharge (cfs)*	*Culvert 1 Discharge (cfs)*	*Roadway Discharge (cfs)*	*Iterations*
5974.65	*50.00*	*50.00*	*0.00*	*1*
5975.00	*70.00*	*70.00*	*0.00*	*1*
5975.44	*98.00*	*98.00*	*0.00*	*1*
5975.62	*110.00*	*110.00*	*0.00*	*1*
5975.90	*130.00*	*130.00*	*0.00*	*1*
5976.16	*150.00*	*150.00*	*0.00*	*1*
5976.43	*170.00*	*170.00*	*0.00*	*1*
5976.68	*190.00*	*190.00*	*0.00*	*1*
5976.92	*210.00*	*210.00*	*0.00*	*1*
5977.15	*230.00*	*230.00*	*0.00*	*1*
5977.38	*250.00*	*250.00*	*0.00*	*1*
5984.00	*798.03*	*798.03*	*0.00*	*Overtopping*

Rating Curve Plot for Crossing: Powers Blvd - Ex.10'x6' RCBC

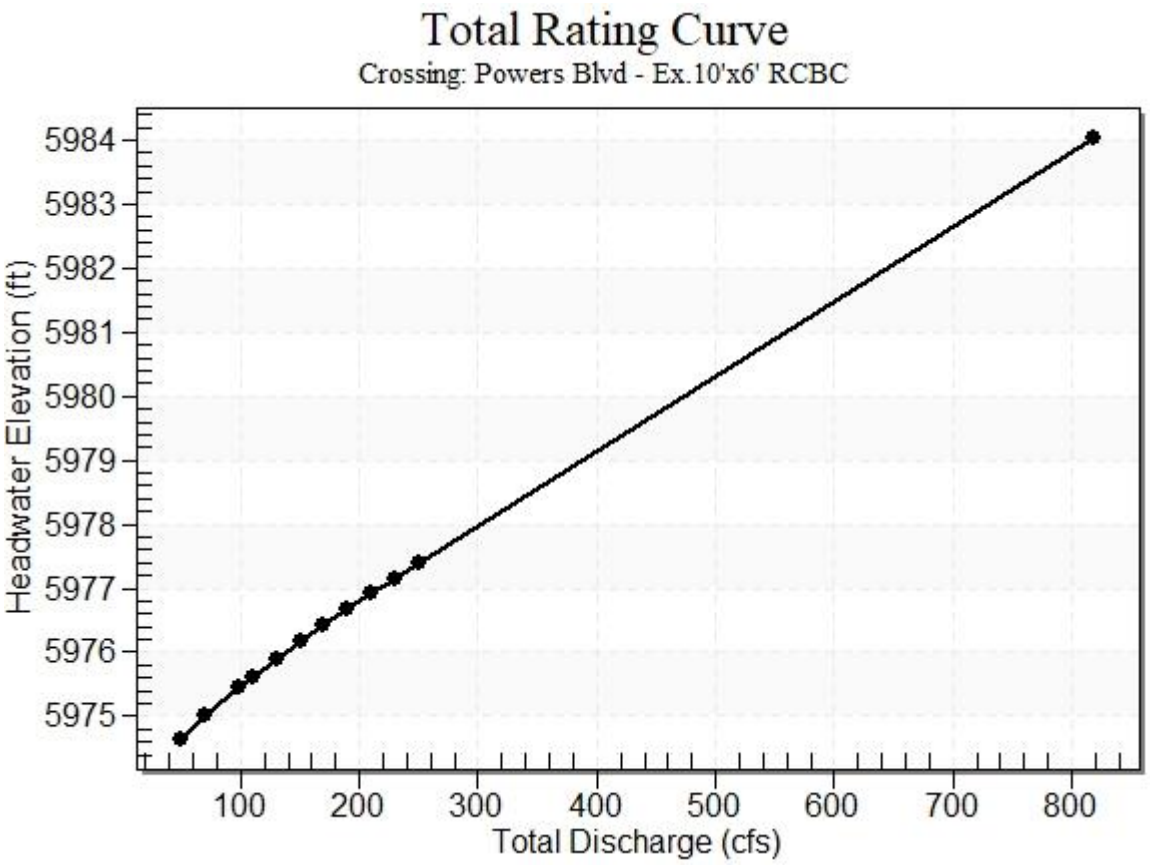
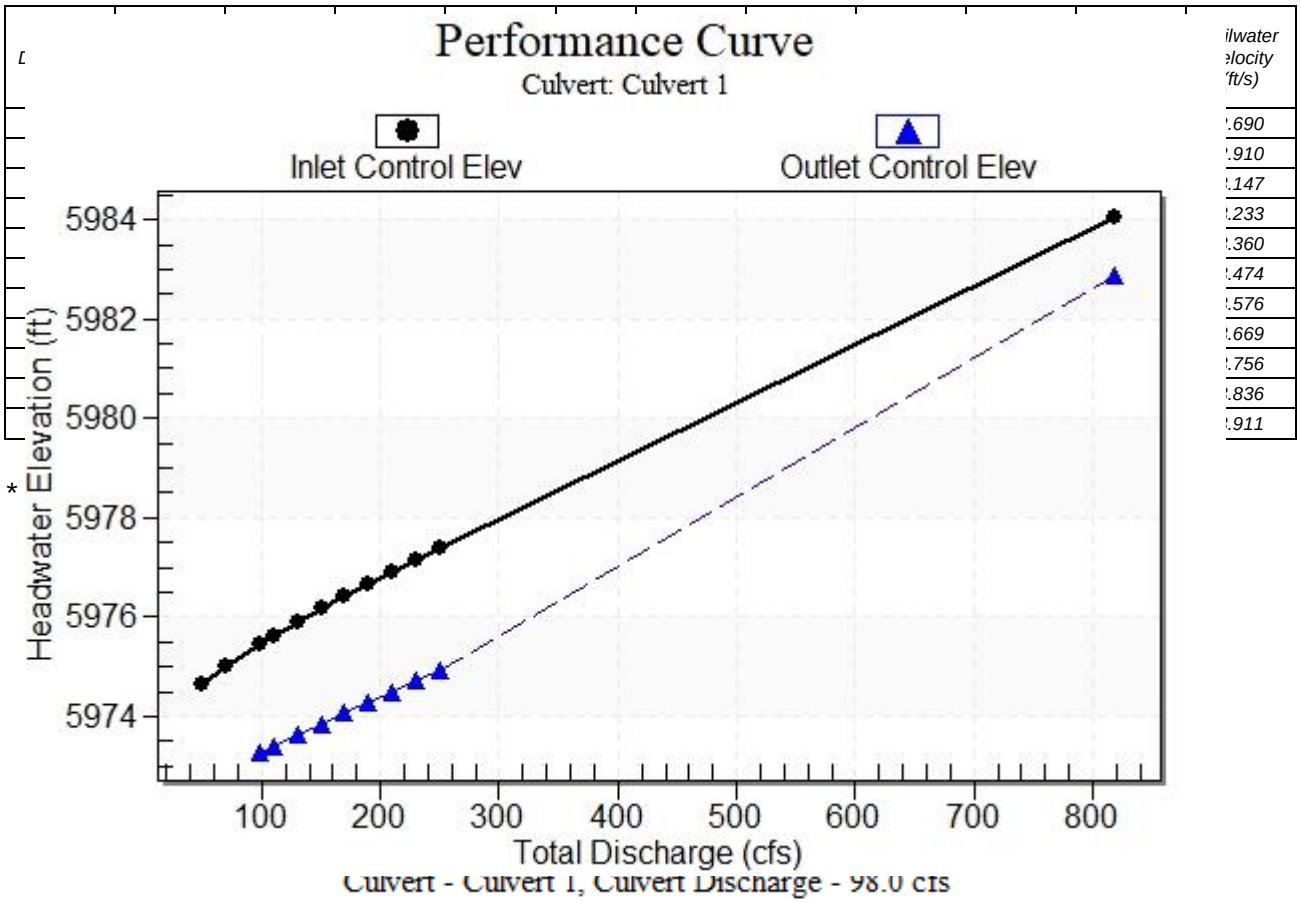
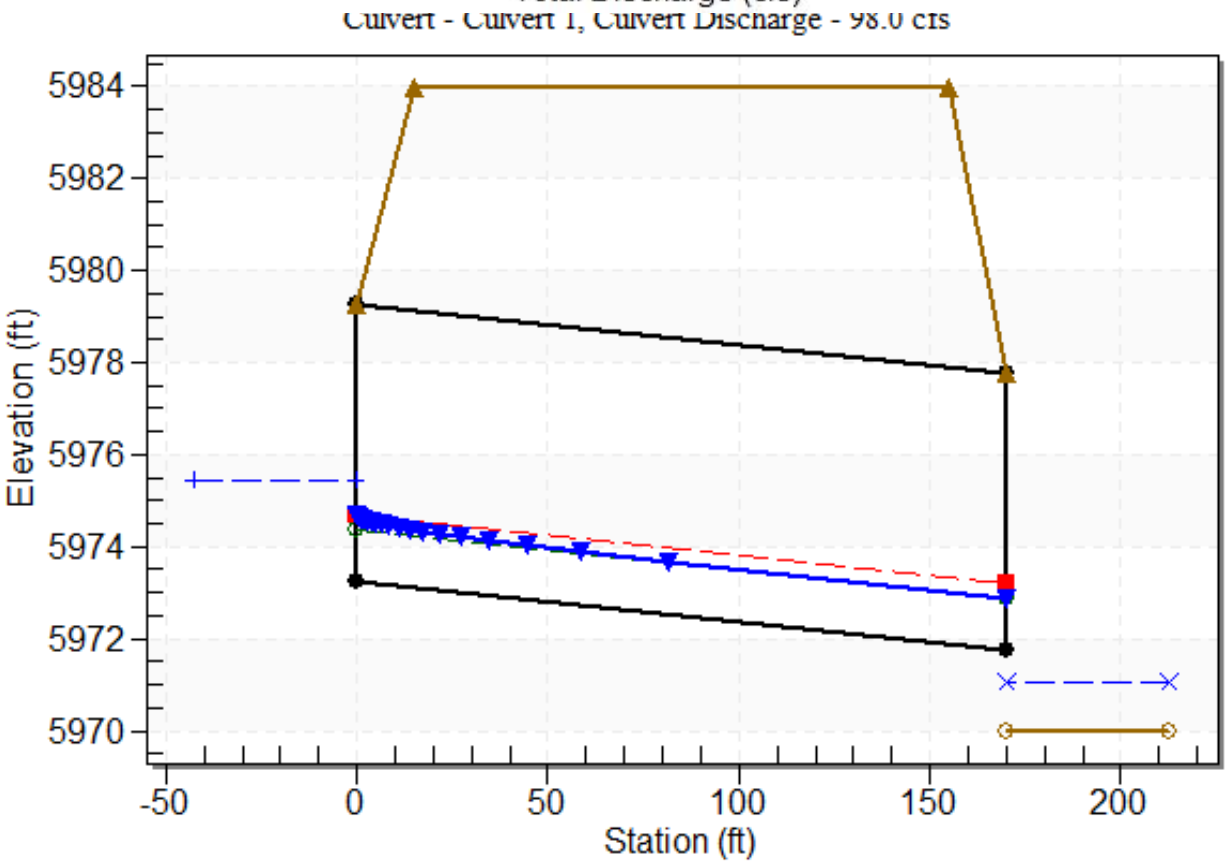


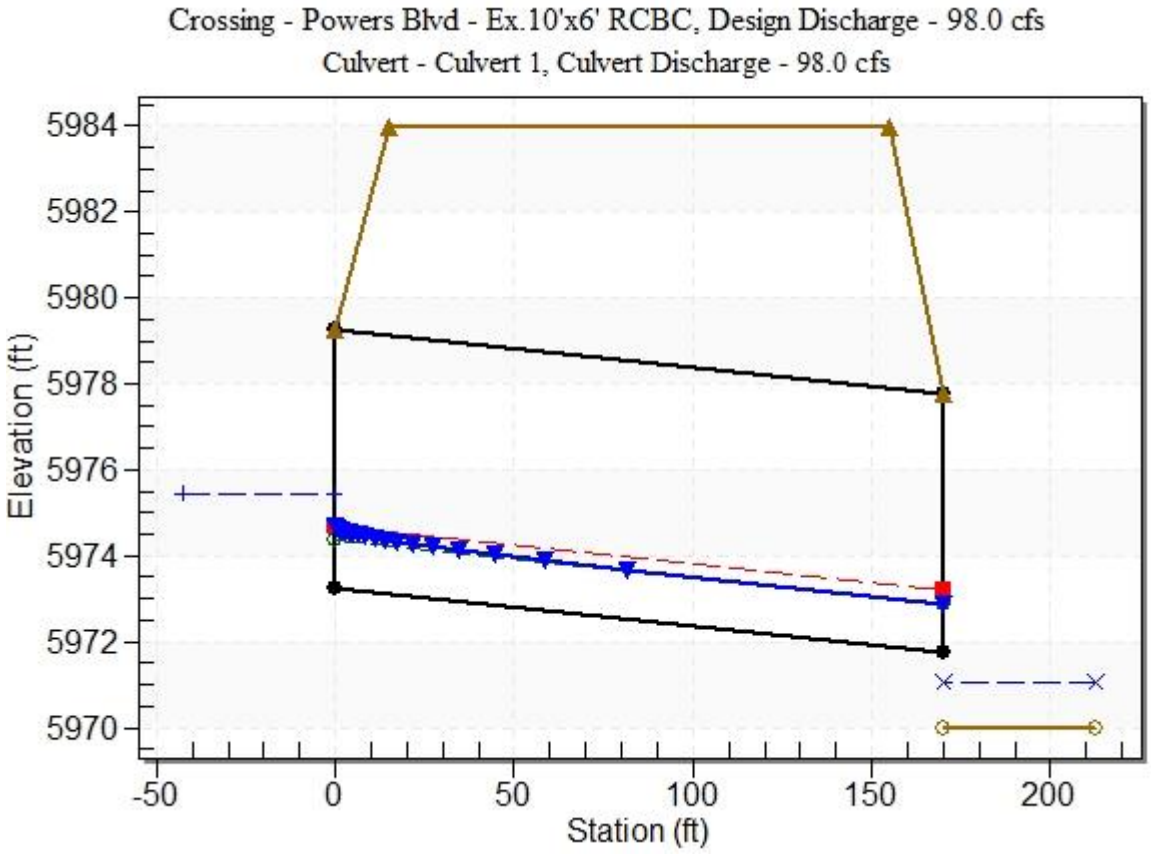
Table 2 - Culvert Summary Table: Culvert 1





Culvert Performance Curve Plot: Culvert 1

Water Surface Profile Plot for Culvert: Culvert 1



Site Data - Culvert 1

Site Data Option: *Culvert Invert Data*

Inlet Station: *0.00 ft*

Inlet Elevation: *5973.25 ft*

Outlet Station: *170.00 ft*

Outlet Elevation: *5971.75 ft*

Number of Barrels: *1*

Culvert Data Summary - Culvert 1

Barrel Shape: *Concrete Box*

Barrel Span: *10.00 ft*

Barrel Rise: *6.00 ft*

Barrel Material: *Concrete*

Embedment: *0.00 in*

Barrel Manning's n: *0.0150*

Culvert Type: *Straight*

Inlet Configuration: *Square Edge (30-75º flare) Wingwall*

Inlet Depression: *None*

Table 3 - Downstream Channel Rating Curve (Crossing: Powers Blvd - Ex.10'x6' RCBC)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
50.00	5970.77	0.77	2.69	0.30	0.70
70.00	5970.89	0.89	2.91	0.35	0.71
98.00	5971.04	1.04	3.15	0.41	0.72
110.00	5971.09	1.09	3.23	0.43	0.72
130.00	5971.17	1.17	3.36	0.46	0.72
150.00	5971.25	1.25	3.47	0.49	0.73
170.00	5971.32	1.32	3.58	0.52	0.73
190.00	5971.38	1.38	3.67	0.54	0.73
210.00	5971.44	1.44	3.76	0.57	0.74
230.00	5971.50	1.50	3.84	0.59	0.74
250.00	5971.56	1.56	3.91	0.61	0.74

Tailwater Channel Data - Powers Blvd - Ex.10'x6' RCBC

Tailwater Channel Option: Irregular Channel

Channel Slope: 0.0063

User Defined Channel Cross-Section:

Coord No.	Station (ft)	Elevation (ft)	Manning's n
1	0.00	5974.00	0.0300
2	112.00	5972.00	0.0300
3	147.00	5970.00	0.0250
4	155.00	5970.00	0.0300
5	205.00	5972.00	0.0300
6	330.00	5974.00	0.0000

Roadway Data for Crossing: Powers Blvd - Ex.10'x6' RCBC

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 510.00 ft

Crest Elevation: 5984.00 ft

Roadway Surface: Paved

Roadway Top Width: 140.00 ft

HY-8 Culvert Analysis Report

Ex. DUAL 42” CMP CULVERT CROSSING
BRADLEY ROAD

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 5 cfs

Design Flow: 47 cfs

Maximum Flow: 80 cfs

Table 1 - Summary of Culvert Flows at Crossing: BRADLEY XING DUAL 42 CMP

Headwater Elevation (ft)	*Total Discharge (cfs)*	*Culvert 2 Discharge (cfs)*	*Roadway Discharge (cfs)*	*Iterations*
5924.35	*5.00*	*5.00*	*0.00*	*1*
5924.38	*12.50*	*12.50*	*0.00*	*1*
5924.40	*20.00*	*20.00*	*0.00*	*1*
5924.43	*27.50*	*27.50*	*0.00*	*1*
5924.45	*35.00*	*35.00*	*0.00*	*1*
5924.47	*42.50*	*42.50*	*0.00*	*1*
5924.48	*47.00*	*47.00*	*0.00*	*1*
5924.53	*57.50*	*57.50*	*0.00*	*1*
5924.73	*65.00*	*65.00*	*0.00*	*1*
5924.93	*72.50*	*72.50*	*0.00*	*1*
5925.14	*80.00*	*80.00*	*0.00*	*1*
5930.00	*182.33*	*182.33*	*0.00*	*Overtopping*

Rating Curve Plot for Crossing: BRADLEY XING DUAL 42 CMP

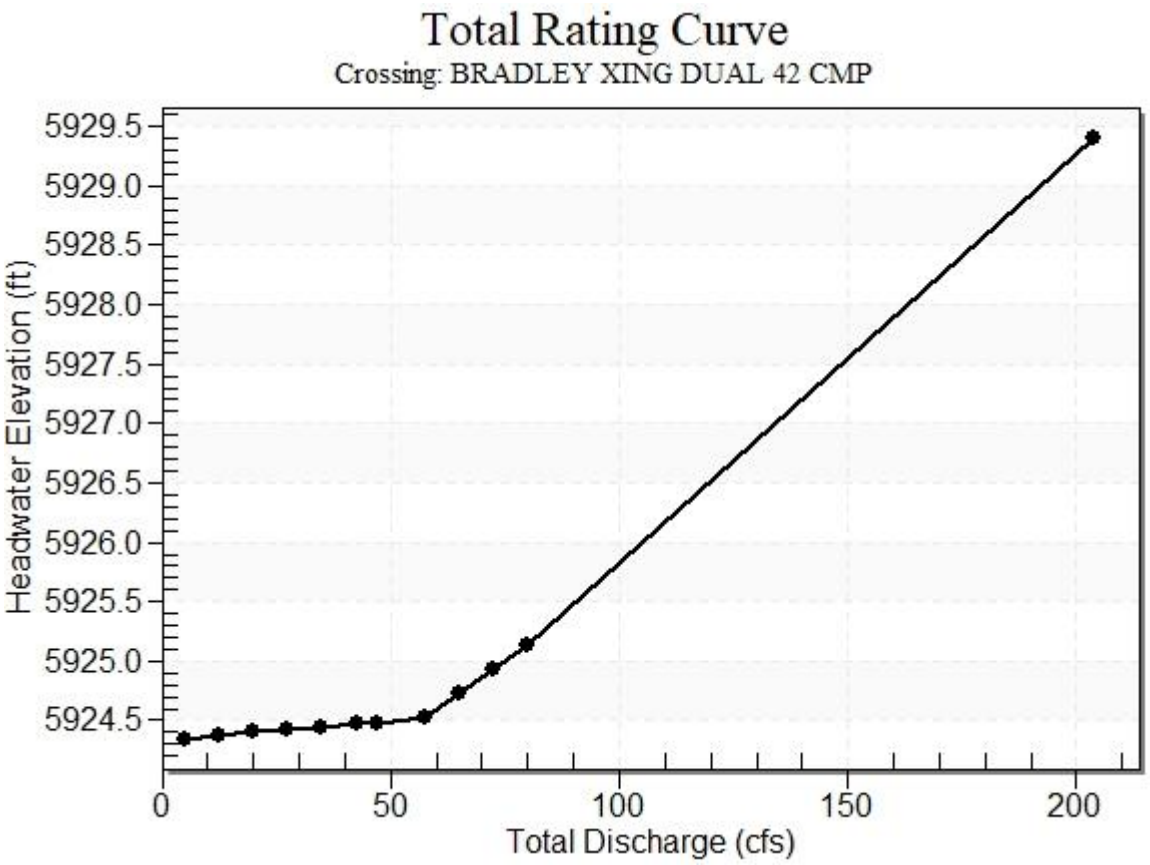


Table 2 - Culvert Summary Table: Culvert 2

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
5.00	5.00	5924.35	2.347	0.0*	1-S2n	0.413	0.471	0.413	0.041	3.903	1.210
12.50	12.50	5924.38	2.379	0.0*	1-S2n	0.647	0.752	0.647	0.071	5.108	1.730
20.00	20.00	5924.40	2.405	0.0*	1-S2n	0.817	0.957	0.817	0.093	5.857	2.076
27.50	27.50	5924.43	2.427	0.0*	1-S2n	0.959	1.127	0.959	0.113	6.422	2.345
35.00	35.00	5924.45	2.448	0.0*	1-S2n	1.087	1.277	1.087	0.130	6.874	2.571
42.50	42.50	5924.47	2.467	0.0*	1-S2n	1.203	1.413	1.203	0.146	7.260	2.767
47.00	47.00	5924.48	2.478	0.0*	1-S2n	1.269	1.489	1.269	0.155	7.463	2.874
57.50	57.50	5924.53	2.525	0.0*	1-S2n	1.415	1.655	1.415	0.175	7.884	3.100
65.00	65.00	5924.73	2.730	0.0*	1-S2n	1.515	1.764	1.515	0.188	8.145	3.245
72.50	72.50	5924.93	2.934	0.0*	1-S2n	1.611	1.868	1.611	0.200	8.380	3.381
80.00	80.00	5925.14	3.139	0.0*	1-S2n	1.705	1.967	1.705	0.212	8.594	3.506

** Full Flow Headwater elevation is below inlet invert.*

****

Straight Culvert

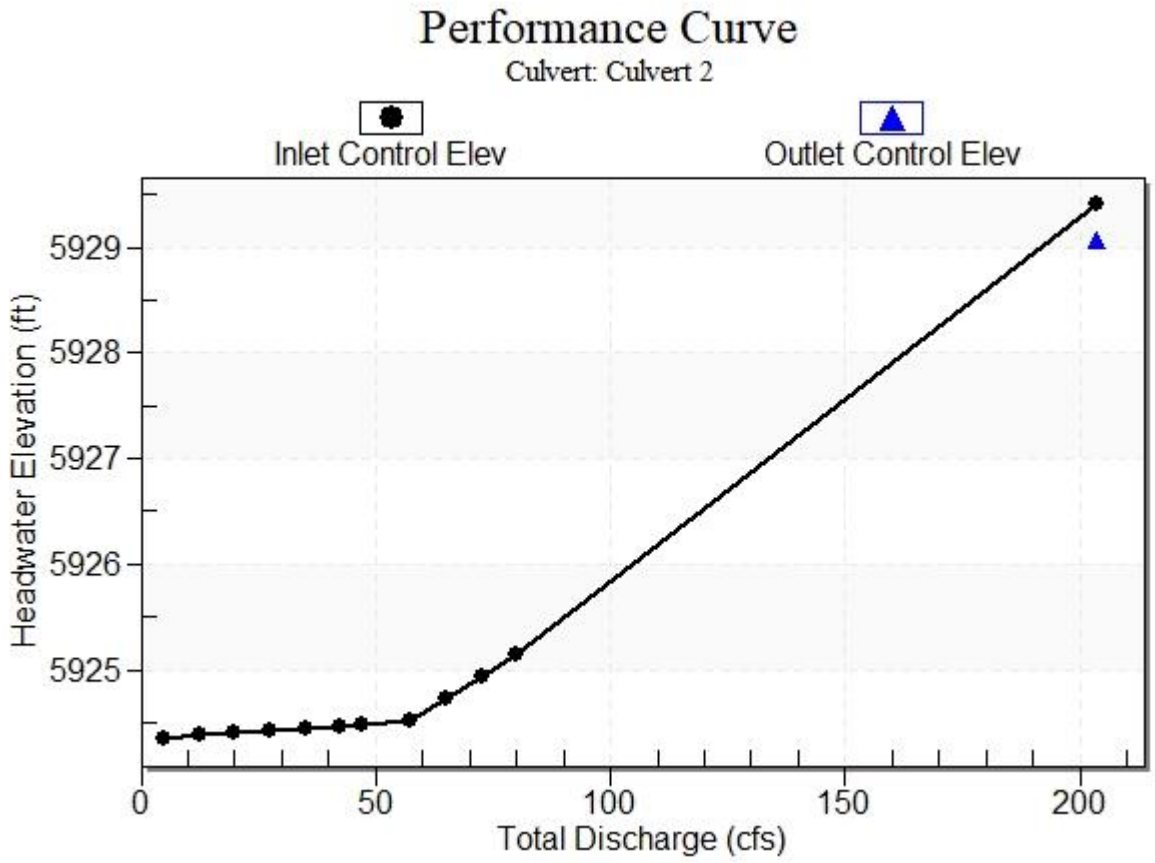
Inlet Elevation (invert): 5922.00 ft, Outlet Elevation (invert): 5918.32 ft

Culvert Length: 157.10 ft, Culvert Slope: 0.0234

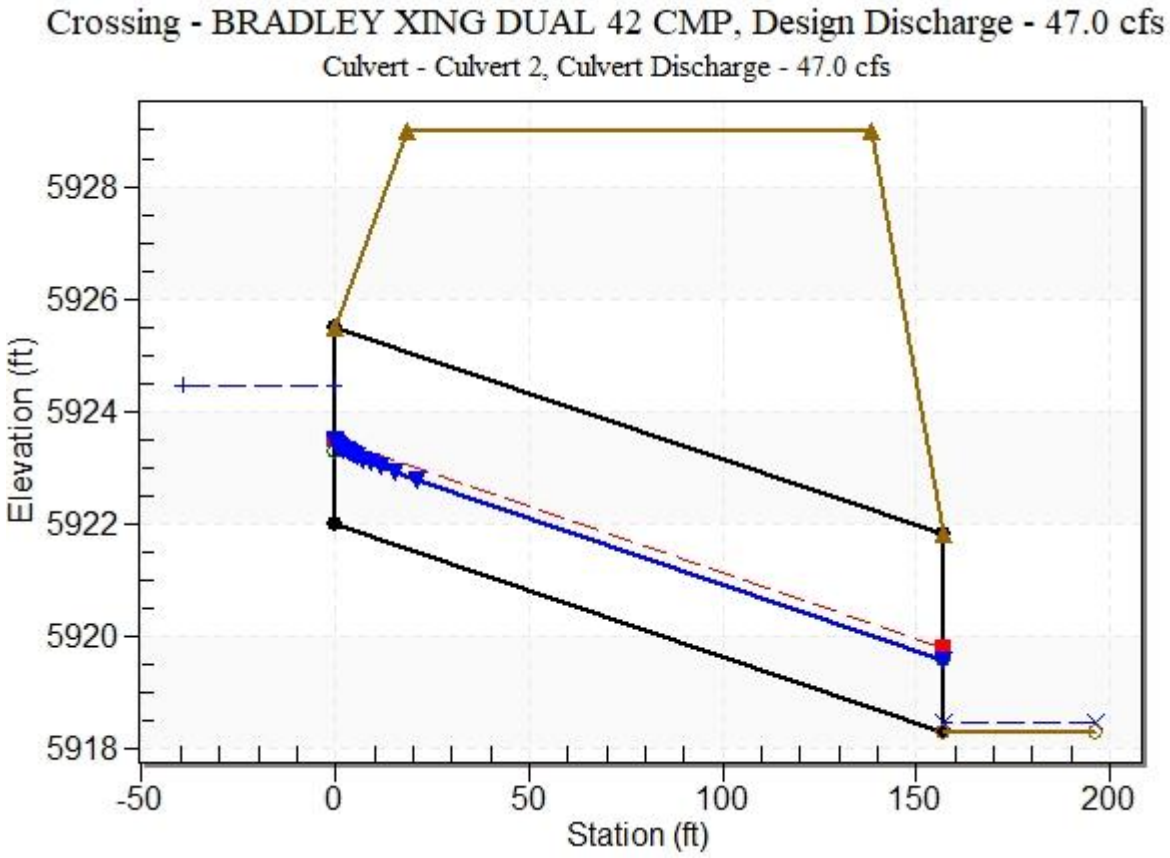
Inlet Throat Elevation: 5922.00 ft, Inlet Crest Elevation: 5924.31 ft

****

Culvert Performance Curve Plot: Culvert 2



Water Surface Profile Plot for Culvert: Culvert 2



Site Data - Culvert 2

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 5924.00 ft

Outlet Station: 157.00 ft

Outlet Elevation: 5918.32 ft

Number of Barrels: 2

Culvert Data Summary - Culvert 2

Barrel Shape: Circular

Barrel Diameter: 3.50 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: Yes

Table 3 - Downstream Channel Rating Curve (Crossing: BRADLEY XING DUAL 42 CMP)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
5.00	5918.36	0.04	1.21	0.08	1.06
12.50	5918.39	0.07	1.73	0.13	1.16
20.00	5918.41	0.09	2.08	0.17	1.22
27.50	5918.43	0.11	2.34	0.21	1.25
35.00	5918.45	0.13	2.57	0.24	1.28
42.50	5918.47	0.15	2.77	0.27	1.31
47.00	5918.48	0.16	2.87	0.29	1.32
57.50	5918.49	0.17	3.10	0.33	1.34
65.00	5918.51	0.19	3.24	0.35	1.36
72.50	5918.52	0.20	3.38	0.38	1.37
80.00	5918.53	0.21	3.51	0.40	1.39

Tailwater Channel Data - BRADLEY XING DUAL 42 CMP

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 100.00 ft

Side Slope (H:V): 35.00 (_:1)

Channel Slope: 0.0300

Channel Manning's n: 0.0250

Channel Invert Elevation: 5918.32 ft

Roadway Data for Crossing: BRADLEY XING DUAL 42 CMP

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
0	0.00	5929.00
1	60.00	5930.00
2	120.00	5929.00

Roadway Surface: Paved

Roadway Top Width: 120.00 ft

DIVERSION CHANNEL ANALYSES

Hydraulic Analysis Report

Project Data

Project Title:

Designer:

Project Date: Friday, May 29, 2020

Project Units: U.S. Customary Units

Notes:

Channel Analysis: North Diversion Channel 1

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 3.0000 ft/ft

Side Slope 2 (Z2): 3.0000 ft/ft

Channel Width: 4.0000 ft

Longitudinal Slope: 0.0309 ft/ft

Manning's n: 0.0350

Flow: 18.0000 cfs

Result Parameters

Depth: 0.6577 ft

Area of Flow: 3.9285 ft^2

Wetted Perimeter: 8.1597 ft

Hydraulic Radius: 0.4815 ft

Average Velocity: 4.5819 ft/s

Top Width: 7.9462 ft

Froude Number: 1.1484

Critical Depth: 0.7115 ft

Critical Velocity: 4.1238 ft/s

Critical Slope: 0.0229 ft/ft

Critical Top Width: 8.27 ft

Calculated Max Shear Stress: 1.2681 lb/ft^2

Calculated Avg Shear Stress: 0.9283 lb/ft^2

Channel Analysis: North Diversion Channel 2

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 3.0000 ft/ft

Side Slope 2 (Z2): 3.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0344 ft/ft

Manning's n: 0.0350

Flow: 39.0000 cfs

Result Parameters

Depth: 0.7078 ft

Area of Flow: 7.1656 ft^2

Wetted Perimeter: 12.4767 ft

Hydraulic Radius: 0.5743 ft

Average Velocity: 5.4427 ft/s

Top Width: 12.2469 ft

Froude Number: 1.2539

Critical Depth: 0.8120 ft

Critical Velocity: 4.6023 ft/s

Critical Slope: 0.0211 ft/ft

Critical Top Width: 12.87 ft

Calculated Max Shear Stress: 1.5194 lb/ft^2

Calculated Avg Shear Stress: 1.2328 lb/ft^2

Selected Profile: FHWA Profile (read-only)

Culvert Assessment Profiles

Culvert Assessment Profile Name: Standard (read-only)

Maximum Excavation Depth: 20 ft

Maximum Shallow Cover: 4 ft

Maximum Small Pipe Size: 36 in

Minimum Manned Entry Size: 48 in

Riprap Classes

Riprap Name: CLASS I

Riprap Class: I

The following values are an 'average' of the size fraction range for the selected riprap class.

d100: 12 in

d85: 9 in

d50: 6.5 in

d15: 4.5 in

Riprap Name: CLASS II

Riprap Class: II

The following values are an 'average' of the size fraction range for the selected riprap class.

d100: 18 in

d85: 13 in

d50: 9.5 in

d15: 7 in

Riprap Name: CLASS III

Riprap Class: III

The following values are an 'average' of the size fraction range for the selected riprap class.

d100: 24 in

d85: 17 in

d50: 12.5 in

d15: 9 in

Riprap Name: CLASS IV

Riprap Class: IV

The following values are an 'average' of the size fraction range for the selected riprap class.

d100: 30 in

d85: 21 in

d50: 15.5 in

d15: 10.5 in

Riprap Name: CLASS V

Riprap Class: V

The following values are an 'average' of the size fraction range for the selected riprap class.

d100: 36 in

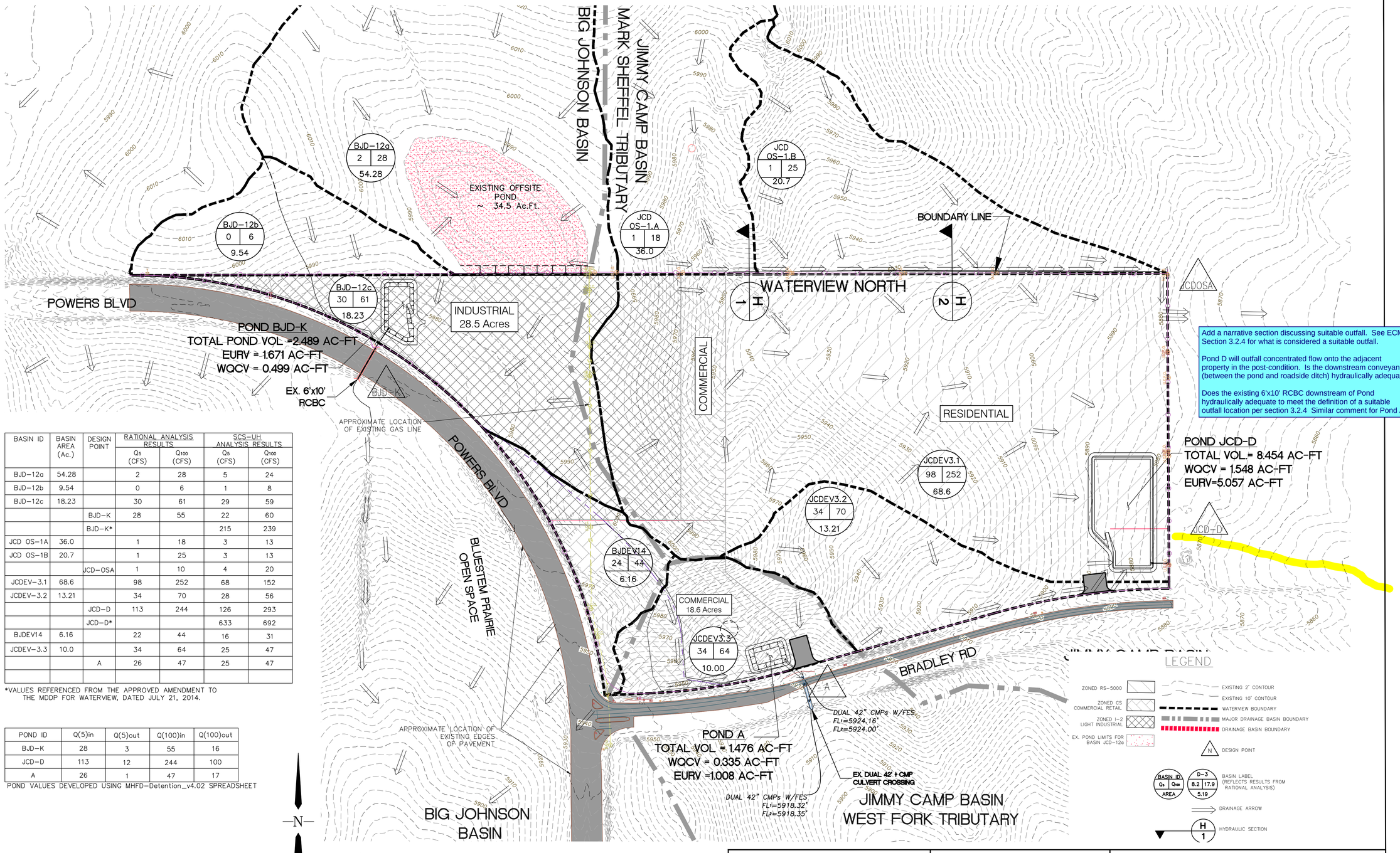
d85: 25.5 in

d50: 18.5 in

d15: 13 in

Riprap Name: CLASS VI

POST DEVELOPMENT DRAINAGE PLAN



BASIN ID	BASIN AREA (Ac.)	DESIGN POINT	RATIONAL ANALYSIS RESULTS		SCS-UH ANALYSIS RESULTS	
			Q_5 (CFS)	Q_{100} (CFS)	Q_5 (CFS)	Q_{100} (CFS)
BJD-12a	54.28		2	28	5	24
BJD-12b	9.54		0	6	1	8
BJD-12c	18.23		30	61	29	59
		BJD-K	28	55	22	60
		BJD-K*			215	239
JCD OS-1A	36.0		1	18	3	13
JCD OS-1B	20.7		1	25	3	13
		JCD-OSA	1	10	4	20
JCDEV-3.1	68.6		98	252	68	152
JCDEV-3.2	13.21		34	70	28	56
		JCD-D	113	244	126	293
		JCD-D*			633	692
BJDEV14	6.16		22	44	16	31
JCDEV-3.3	10.0		34	64	25	47
		A	26	47	25	47

*VALUES REFERENCED FROM THE APPROVED AMENDMENT TO THE MDDP FOR WATERVIEW, DATED JULY 21, 2014.

POND ID	Q(5)in	Q(5)out	Q(100)in	Q(100)out
BJD-K	28	3	55	16
JCD-D	113	12	244	100
A	26	1	47	17

POND VALUES DEVELOPED USING MHFD-Detention_v4.02 SPREADSHEET

Add a narrative section discussing suitable outfall. See ECM Section 3.2.4 for what is considered a suitable outfall.

Pond D will outfall concentrated flow onto the adjacent property in the post-condition. Is the downstream conveyance (between the pond and roadside ditch) hydraulically adequate?

Does the existing 6'x10' RCBC downstream of Pond hydraulically adequate to meet the definition of a suitable outfall location per section 3.2.4 Similar comment for Pond A

update page order.

This needs to be after the pre development drainage map

REVISIONS:

NO.	DESCRIPTION	DATE

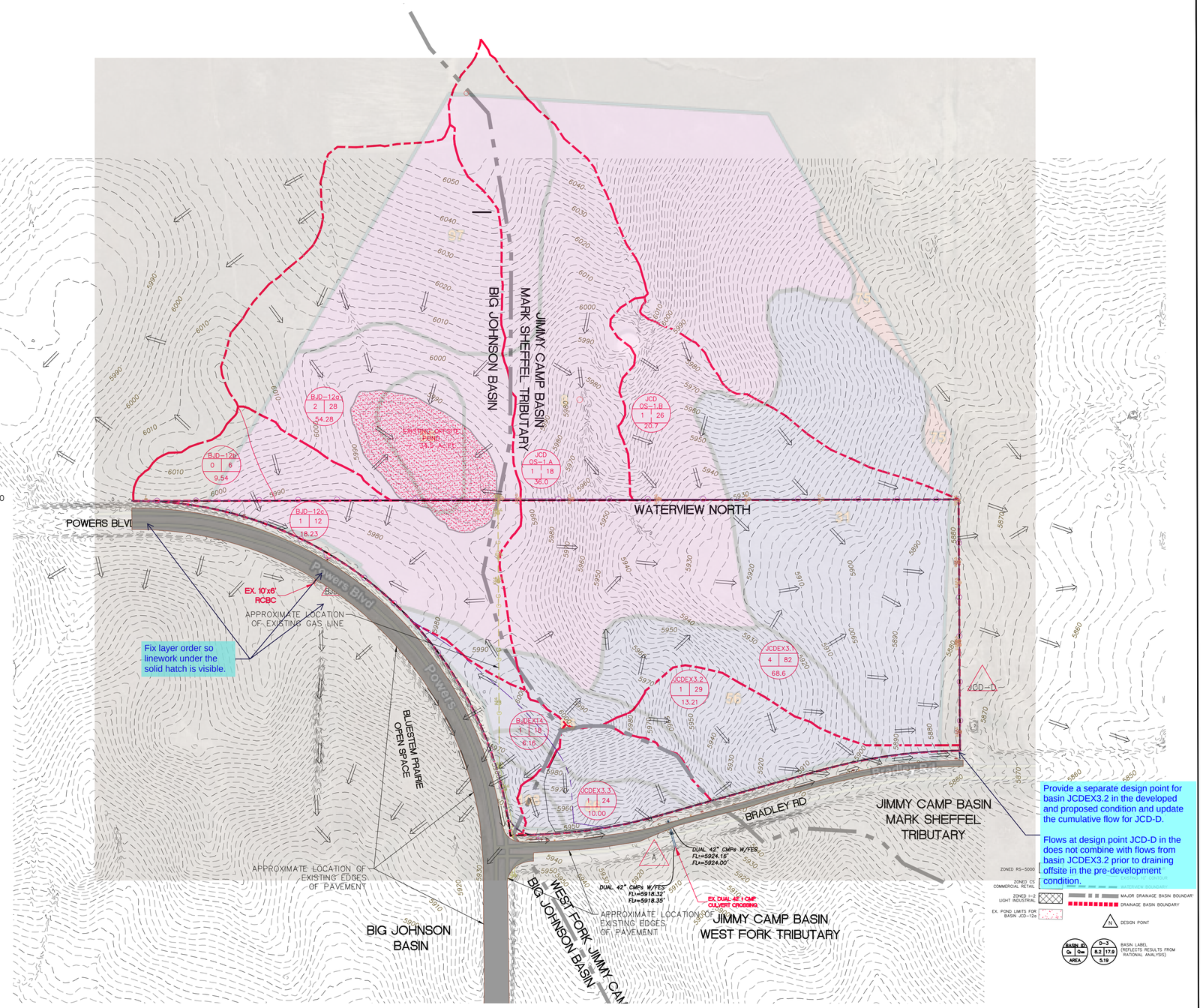
ENGINEER:
DESIGNED BY: CEB DATE: 6-16-20
DRAWN BY: CEB DATE: 6-16-20
CHECKED BY: CKC DATE: 6-16-20

48 HOURS BEFORE YOU DIG, CALL UTILITY LOCATORS
1-800-922-1987
CITY OF COLORADO SPRINGS DEPT. OF UTILITIES GAS, ELECTRIC, WATER AND WASTEWATER

DSE Dakota Springs Engineering
31 N. TEJON, SUITE 500
COLORADO SPRINGS, CO 80903
P: (719) 227-7388
F: (719) 227-7392

PROJECT WATERVIEW NORTH
SHEET TITLE POST DEVELOPMENT DRAINAGE PLAN
FROM n/a TO n/a
JOB NO. 02-19-05 SHEET 3 OF 3

PRE-DEVELOPMENT BASIN MAP



BASIN ID	BASIN AREA (Ac.)	DESIGN POINT	RATIONAL ANALYSIS RESULTS		SCS-UH ANALYSIS RESULTS	
			Q_5 (CFS)	Q_{100} (CFS)	Q_5 (CFS)	Q_{100} (CFS)
BJD-12a	54.28		2	28	3	6
BJD-12b	9.54		0	6	2	8
BJD-12c	18.23		1	12	2	9
		BJD-K	1	18	3	11
JCD OS-1A	36.0		1	18	2	4
JCD OS-1B	20.7		1	26	2	4
JCDEX-3.1	68.6		4	82	3	19
JCDEX-3.2	13.21		1	29	2	11
		JCD-D	6	106	15	27
JCDEX-3.3	10.0		1	24	2	8
		A	1	24	2	9
		A*			11.8*	47.4*
BJDEX14	6.16		1	18	1	7

A* - MODELLED AS BASIN OS-1 IN THE APPROVED MDDP AMENDMENT FOR TRAILS AT ASPEN RIDGE

Revise. Reference must be from the FDR.

Fix layer order so linework under the solid hatch is visible.

Provide a separate design point for basin JCDEX3.2 in the developed and proposed condition and update the cumulative flow for JCD-D.

Flows at design point JCD-D in the does not combine with flows from basin JCDEX3.2 prior to draining offsite in the pre-development condition.

REVISIONS:		
NO.	DESCRIPTION	DATE

ENGINEER:
DESIGNED BY: CEB DATE: 6-17-20
DRAWN BY: CEB DATE: 6-17-20
CHECKED BY: CKC DATE: 6-17-20

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CITY OF COLORADO SPRINGS DEPT. OF UTILITIES GAS, ELECTRIC, WATER AND WASTEWATER

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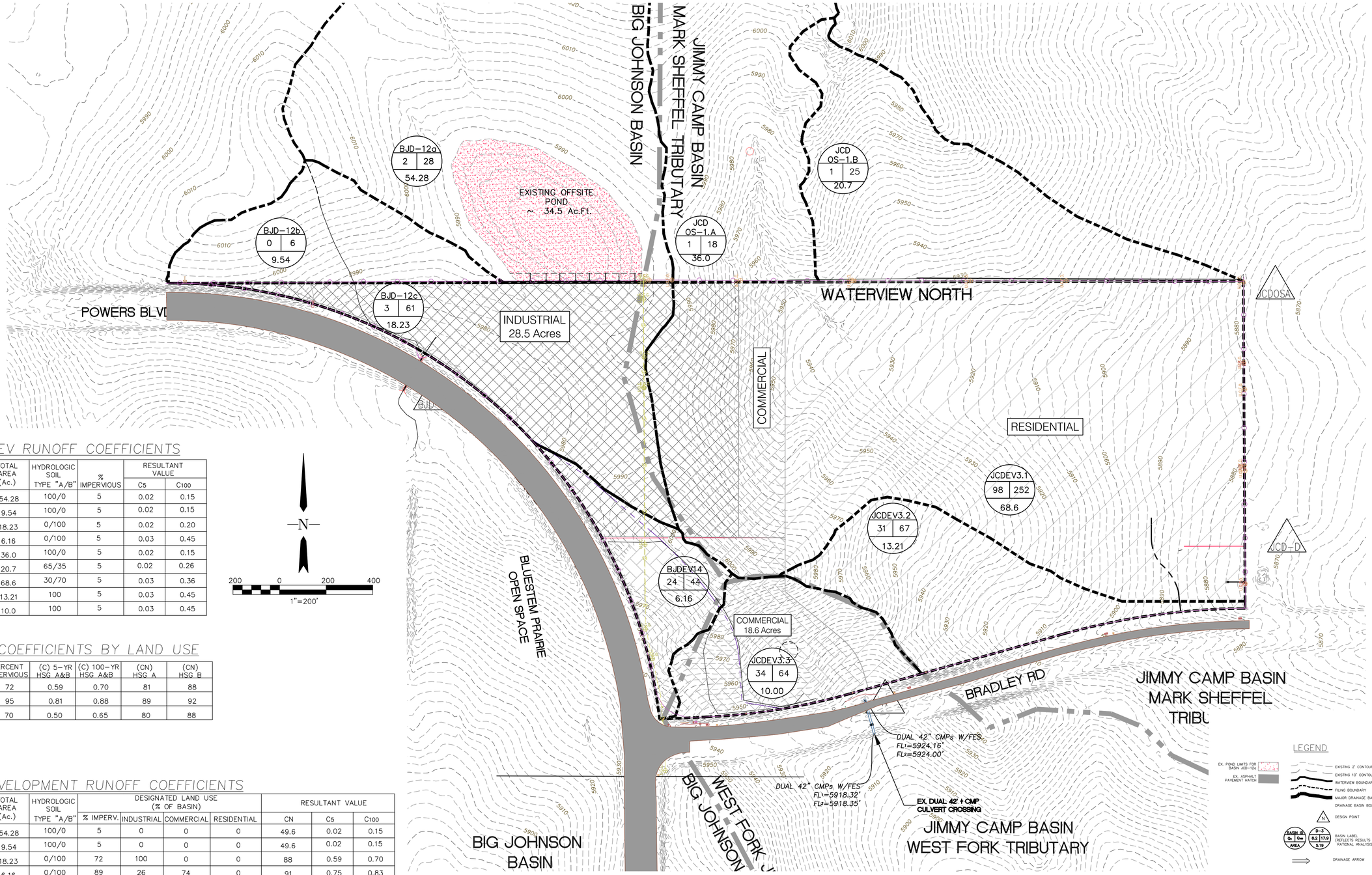
31 N. TEJON, SUITE 518
COLORADO SPRINGS, CO 80903
P: (719) 227-7388
F: (719) 227-7392

PROJECT WATERVIEW NORTH
SHEET TITLE PRE-DEVELOPMENT BASIN MAP
FROM n/a TO n/a
JOB NO. 02-19-05 SHEET 2 OF 3

RUNOFF COEFFICIENT EXHIBIT



PRE-DEV RUNOFF COEFFICIENTS

BASIN ID	TOTAL AREA (Ac.)	HYDROLOGIC SOIL TYPE "A/B"	% IMPERVIOUS	RESULTANT VALUE C5	RESULTANT VALUE C100
BJD-12a	54.28	100/0	5	0.02	0.15
BJD-12b	9.54	100/0	5	0.02	0.15
BJD-12c	18.23	0/100	5	0.02	0.20
BJDEX-14	6.16	0/100	5	0.03	0.45
JCD-OS1A	36.0	100/0	5	0.02	0.15
JCD-OS1B	20.7	65/35	5	0.02	0.26
JCDEX-3.1	68.6	30/70	5	0.03	0.36
JCDEX-3.2	13.21	100	5	0.03	0.45
JCDEX-3.3	10.0	100	5	0.03	0.45

N

200 0 200 400

1"=200'

RUNOFF COEFFICIENTS BY LAND USE

LAND USE CLASSIFICATION	PERCENT IMPERVIOUS	(C) 5-YR HSG A&B	(C) 100-YR HSG A&B	(CN) HSG A	(CN) HSG B
INDUSTRIAL	72	0.59	0.70	81	88
COMMERCIAL	95	0.81	0.88	89	92
RESIDENTIAL	70	0.50	0.65	80	88

POST DEVELOPMENT RUNOFF COEFFICIENTS

BASIN ID	TOTAL AREA (Ac.)	HYDROLOGIC SOIL TYPE "A/B"	DESIGNATED LAND USE (% OF BASIN) % IMPERV.	INDUSTRIAL	COMMERCIAL	RESIDENTIAL	RESULTANT VALUE CN	C5	C100
BJD-12a	54.28	100/0	5	0	0	0	49.6	0.02	0.15
BJD-12b	9.54	100/0	5	0	0	0	49.6	0.02	0.15
BJD-12c	18.23	0/100	72	100	0	0	88	0.59	0.70
BJDEV-14	6.16	0/100	89	26	74	0	91	0.75	0.83
JCD-OS1A	36.0	100/0	5	0	0	0	49.6	0.02	0.15
JCD-OS1B	20.7	65/35	5	0	0	0	54	0.02	0.26
JCDEV-3.1	68.6	0/100	73.4	12	10	79	89.2	0.50	0.68
JCDEV-3.2	13.21	0/100	70	0	0	100	88	0.50	0.65
JCDEV-3.3	10.0	0/100	90	0	78	22	91.1	0.74	0.83

REVISIONS:

NO.	DESCRIPTION	DATE

ENGINEER:
DESIGNED BY: CEB DATE: 6-16-20
DRAWN BY: CEB DATE: 6-16-20
CHECKED BY: CKC DATE: 6-17-20

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31 N. TEJON, SUITE 518
COLORADO SPRINGS, CO 80903
P: (719) 227-7388
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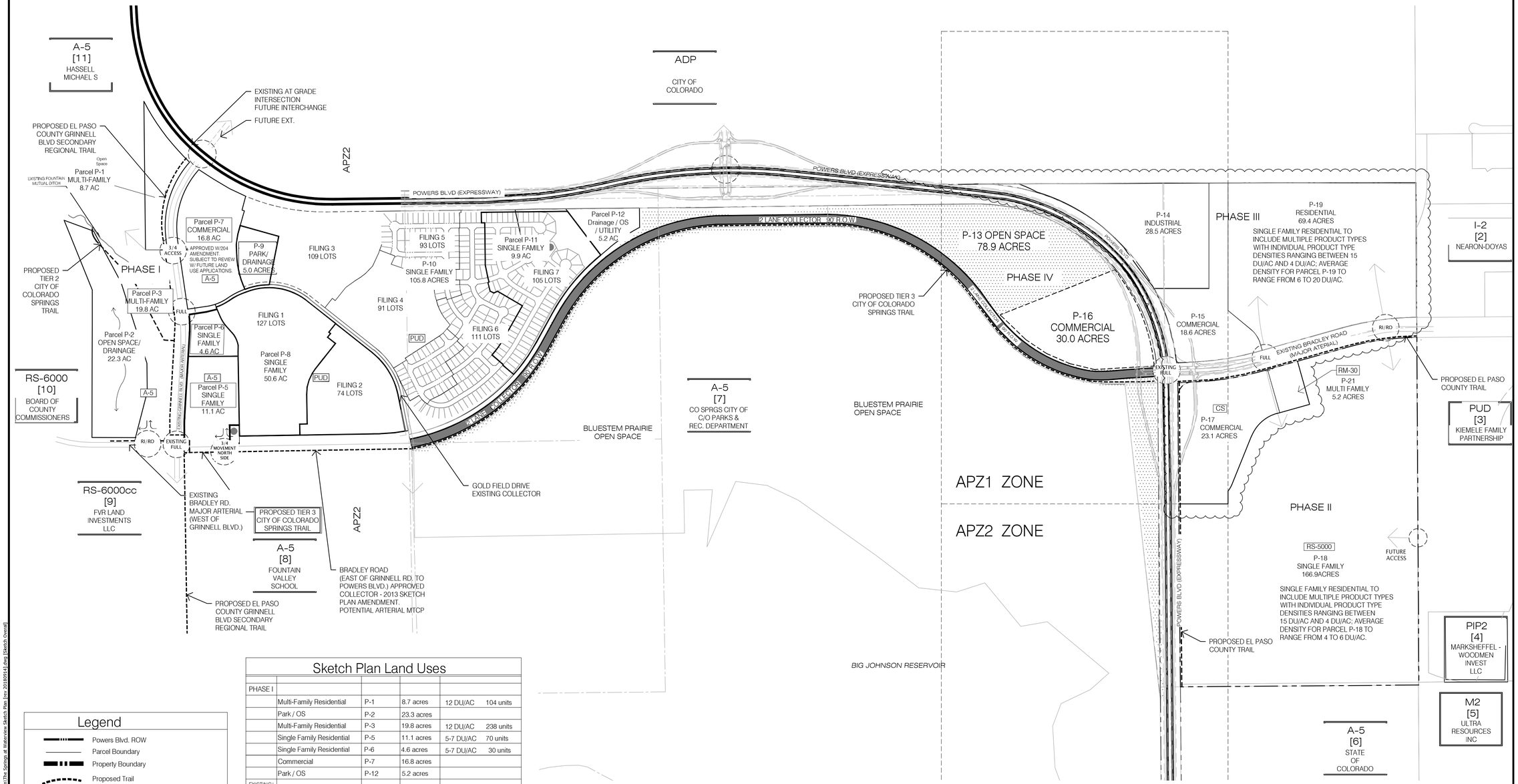
PROJECT WATERVIEW NORTH
SHEET TITLE RUNOFF COEFFICIENT EXHIBIT
FROM n/a TO n/a
JOB NO. 02-19-05 SHEET 1 OF 3



Sketch Plan Land Uses

PHASE I					
	Multi-Family Residential	P-1	8.7 acres	12 DU/AC	104 units
	Park / OS	P-2	23.3 acres		
	Multi-Family Residential	P-3	19.8 acres	12 DU/AC	238 units
	Single Family Residential	P-5	11.1 acres	5-7 DU/AC	70 units
	Single Family Residential	P-6	4.6 acres	5-7 DU/AC	30 units
	Commercial	P-7	16.8 acres		
	Park / OS	P-12	5.2 acres		
EXISTING/ DEVELOPED PHASE I	Single Family Residential	P-8	50.6 acres	4-6 DU/AC	201 units
	Park / OS	P-9	5.0 acres		
	Single Family Residential	P-10	105.8 acres	4-6 DU/AC	459 units
	Single Family Residential	P-11	9.9 acres	4-6 DU/AC	50 units
PHASE II					
	Commercial	P-17	23.1 acres		
	Single Family Residential	P-18	166.9 acres	4-6 DU/AC	865 units
	Multi-Family Residential	P-21	5.2 acres	30 DU/AC	120 units
PHASE III					
	Industrial	P-14	28.5 acres		
	Commercial	P-15	18.6 acres		
	Single Family Residential	P-19	69.4 acres	6-20 DU/AC	850 units
PHASE IV					
	Proposed Open Space	P-13	78.9 acres		

NOTE: PHASE II SINGLE FAMILY RESIDENTIAL (P-18) TO INCLUDE MULTIPLE RESIDENTIAL PRODUCT TYPES THAT CAN RANGE BETWEEN 15 DU/ACRE AND 4 DU/ACRE WITH AN AVERAGE DENSITY OF 4 TO 6 DU/ACRE.

ENTIAL PRODUCT AVERAGE

Legend

- Powers Blvd. ROW
- Parcel Boundary
- Property Boundary
- Proposed Trail
- Existing Wetlands
- Proposed Access
- Existing Fountain Mutual Company Ditch
- Intersection
- Open Space 88.2 Acres Total
- Right of way needed for Powers Blvd. 42.7 Acres Total

Phasing Plan

Phase I:	1-5 years
Phase II:	3-7 years
Phase III:	5-10 years
Phase IV:	8-15 years

NOTE:
PHASING IS BASED UPON THE MARKET AND SUBJECT TO CHANGE.

NORTH

0 250 500 1000 1500

SCALE 1"=500'

DSE Dakota Springs Engineering
31 N. TEJON, SUITE 500
COLORADO SPRINGS, CO 80903
P: (719) 227-7388
F: (719) 227-7392
J-CAD CONSULTING LLC
J-CADCONSULTING.COM
719-377-0002

2020_SKETCH_PLAN_AMENDMENT

DATE: 5/20/20
DRAWN: J-CAD
APPROVED: P.KOSCIELSKI

REVISIONS:
DATE: BY: COMMENTS:

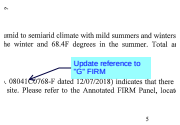
PLAN SHEET

SHEET NO. 2 OF 2 SHEETS

DSE_NO_01-02-19-05

MDDP_r1.pdf Markup Summary

dsdlaforce (43)



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Update reference to "G" FIRM

Subject: Callout
Page Label: 9
Author: dsdlaforce
Date: 7/21/2020 1:43:16 PM
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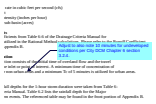
Revise. Per City chapter 6 table 6-1 rational method can be used for basins less than 130 ac.



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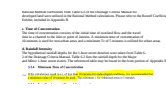
Adjust to also note 10 minutes for undeveloped conditions per City DCM Chapter 6 section 3.2.4.



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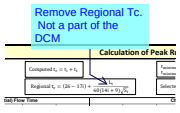

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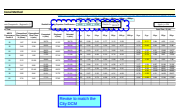
Remove Regional Tc. Not a part of the DCM



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Revise to match the City DCM

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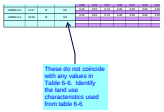

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Author: dsdlaforce
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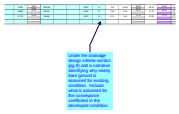
These do not coincide with any values in Table 6-6. Identify the land use characteristics used from table 6-6



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Under the drainage design criteria section (pg 9) add a narrative identifying why nearly bare ground is assumed for existing condition. Include what is assumed for the conveyance coefficient in the developed condition.

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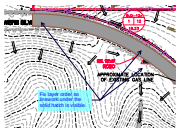

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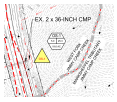
Fix layer order so linework under the solid hatch is visible.



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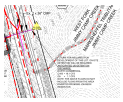

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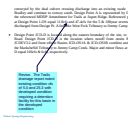

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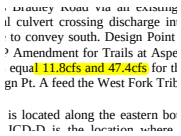
Revise. The Trails drainage report noted existing condition cfs of 5.0 and 25.3 with developed condition requiring a detention facility for this basin in the developed condition

---



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Date: 7/21/2020 2:20:25 PM
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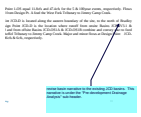
l 11.8cfs and 47.4cfs



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Author: dsdlaforce
Date: 7/21/2020 2:25:28 PM
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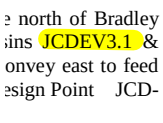
revise basin narrative to the existing JCD basins. This narrative is under the "Pre-development Drainage Analysis" sub-header.



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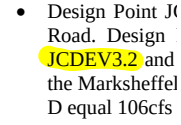

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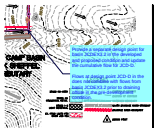

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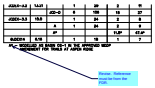
Provide a separate design point for basin JCDEX3.2 in the developed and proposed condition and update the cumulative flow for JCD-D.

Flows at design point JCD-D in the does not combine with flows from basin JCDEX3.2 prior to draining offsite in the pre-development condition.



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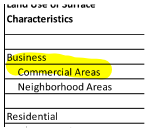
Revise. Reference must be from the FDR.



Subject: Highlight
Page Label: 24
Author: dsdlaforce
Date: 7/21/2020 2:39:00 PM
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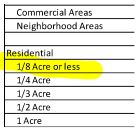

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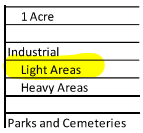

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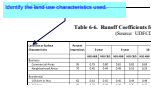

Subject: Callout
Page Label: 24
Author: dsdlaforce
Date: 7/21/2020 2:41:20 PM
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Identify the land use characteristics used.

Subject: Callout
Page Label: 12
Author: dsdlaforce
Date: 7/21/2020 2:46:27 PM
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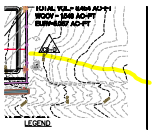
Revise. 3-stage outlet structure not permitted. Outlet structure must be designed for FSD.



Subject: Highlight
Page Label: 200
Author: dsdlaforce
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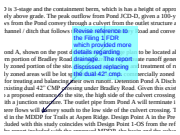

Subject: Callout
Page Label: 13
Author: dsdlaforce
Date: 7/21/2020 4:06:27 PM
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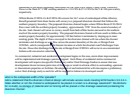
Revise reference to the Filing 1 FDR which provided more details regarding drainage. The report discussed replacing the dual 42" cmp.



Subject: Callout
Page Label: 13
Author: dsdlaforce
Date: 7/21/2020 4:18:13 PM
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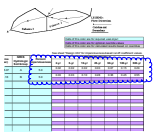
what is the anticipated width of the spreader?
Add a statement that the diversion channel design will include access roads meeting ECM Section 3.3.3.K.1.
State whether or not the channel is anticipated to be placed in a tract or a drainage easement? Restrictions for no build, no storage of material and no fencing will be placed on the drainage easement containing the diversion channel.



Subject: Cloud
Page Label: 29
Author: dsdlaforce
Date: 7/21/2020 4:27:29 PM
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Subject: Image
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Author: dsdlaforce
Date: 7/21/2020 4:29:11 PM
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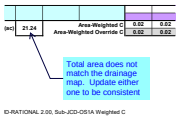

Subject: Callout
Page Label: 31
Author: dsdlaforce
Date: 7/21/2020 4:30:57 PM
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Total area does not match the drainage map. Update either one to be consistent

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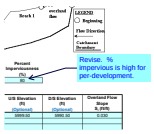

Subject: Callout
Page Label: 35
Author: dsdlaforce
Date: 7/21/2020 4:36:34 PM
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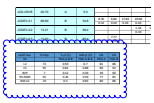
Revise. % impervious is high for per-development.



Subject: Cloud
Page Label: 53
Author: dsdlaforce
Date: 7/21/2020 4:42:06 PM
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Subject: Callout
Page Label: 53
Author: dsdlaforce
Date: 7/21/2020 4:45:11 PM
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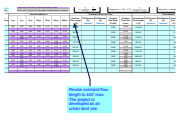
Is RVP and RV park? Revise, value appears to be extremely low.



Subject: Callout
Page Label: 51
Author: dsdlaforce
Date: 7/21/2020 4:53:15 PM
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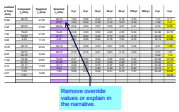
Revise overland flow length to 100' max. The project is developed as an urban land use.



Subject: Callout
Page Label: 51
Author: dsdlaforce
Date: 7/21/2020 4:54:19 PM
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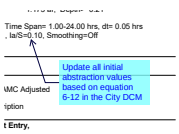
Remove override values or explain in the narrative.



Subject: Callout
Page Label: 85
Author: dsdlaforce
Date: 7/21/2020 5:32:39 PM
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Update all initial abstraction values based on equation 6-12 in the City DCM

Subject: Image
Page Label: 85
Author: dsdlaforce
Date: 7/21/2020 5:33:19 PM
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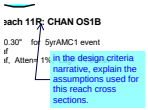

Subject: Callout
Page Label: 91
Author: dsdlaforce
Date: 7/21/2020 5:36:00 PM
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in the design criteria narrative, explain the assumptions used for this reach cross sections.

Subject: Callout
Page Label: 77
Author: dsdlaforce
Date: 7/21/2020 5:47:36 PM
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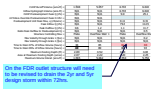
For SCS method, update the design criteria to describe using the SCS method. Identify the criterias and assumptions used.
Analysis should also include the thunderstorms in addition to the frontal storm used above. The conservative result is used.



Subject: Callout
Page Label: 160
Author: dsdlaforce
Date: 7/21/2020 5:54:58 PM
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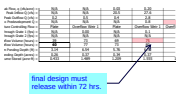
On the FDR outlet structure will need to be revised to drain the 2yr and 5yr design storm within 72hrs.



Subject: Callout
Page Label: 174
Author: dsdlaforce
Date: 7/21/2020 6:00:00 PM
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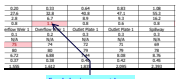
final design must release within 72 hrs.



Subject: Callout
Page Label: 174
Author: dsdlaforce
Date: 7/21/2020 6:00:20 PM
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final design must be equal to or less than historic.