DRAINAGE LETTER
FOR
STERLING RANCH ROAD AND BRIARGATE PARKWAY INTERIM PLAN

Prepared For:

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March 11, 2021
Project No. 25188.03
PCD Filing No: CDR221

Prepared By:

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719-593-2593

Remove Preliminary

JR RESPONDED: REMOVED

ENGINEER'S STATEMENT:

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

_____

Mike Bramlett, Colorado P.E. 32314
For and On Behalf of JR Engineering, LLC

DEVELOPER'S STATEMENT:

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

Business Name: SR Land, LLC

By: _____

Title: _____

Address: 20 Boulder Crescent, Suite 200
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 Engineering Criteria Manual, as amended.

_____ _____

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

Conditions:

Update TOC & Appendix

updated

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PURPOSE

This document is the Drainage Letter for Sterling Ranch Road and Briargate Parkway Interim Plan. The purpose of this report is to identify on-site and off-site drainage patterns, storm sewer, culvert and inlet locations, areas tributary to the site, and to safely route developed storm water to adequate outfall facilities during the interim condition of development and the construction of Sterling Ranch Road and Briargate Parkway.

GENERAL SITE DESCRIPTION

GENERAL LOCATION

Sterling Ranch and Briargate Parkway Interim Plan (hereby referred to as the "site") is a proposed development within the Sterling Ranch master planned community with a total area of approximately 376 acres that are presently undeveloped.

The site is located in portions of Section 33 & 34, Township 12 South, Range 65 West of the Sixth Principal Meridian in El Paso County, State of Colorado. The site is bounded by Sand Creek to the west, Sterling Ranch Road cuts through the site, and future development land borders the site to the south, north and east. Refer to the vicinity map in Appendix A for additional information.

DESCRIPTION OF PROPERTY

In the interim condition, the property will be roadway (approximately 17 acres), open space and drainage tracts (approximately 359 acres). The site is comprised of variable sloping grasslands that generally slope(s) downward to the southwest at 1 to 6% towards the Sand Creek tributary basin.

Soils for this project are classified as Blakeland Loamy Sand (8) and Gravelly Sandy Loam (19). These soils are characterized as hydrologic soil types Type A. Group A soils exhibit high infiltration rates when thoroughly wet, and consist mainly of deep, well drained to excessively drained sands or gravelly sands. Pring Coarse Sandy Loam (71) is characterized as Hydrologic Soil Types "B". Group B soils exhibit moderate infiltration rate when thoroughly wet, and consist primarily of deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. Refer to the soil survey map in Appendix A for additional information.

Sand Creek runs west of the site and crosses Briargate Parkway at the north edge and Sterling ranch Road at the southern edge. The site is a tributary to Sand Creek. Currently, Kiowa Engineering Corp. is performing studies and plans to address Sand Creek stabilization.

There are no known irrigation facilities located on the project site.

FLOODPLAIN STATEMENT

Based on the FEMA FIRM Maps number 08041C0533G, dated December 7, 2018, the far western portion of the project site that is adjacent to the existing drainage way lies within Zone AE. Zone AE is defined as area subject to inundation by the 1-percent-annual-chance flood event. All of the proposed development lies within Zone X. Zone X is defined as area outside the Special Flood Hazard Area (SFHA) and higher than the elevation of the 0.2-percent-annual-chance (or 500-year) flood. No grading operations are proposed within the Zone AE at this time. FIRM Maps have been presented in Appendix A.

EXISTING DRAINAGE CONDITIONS

MAJOR BASIN DESCRIPTIONS

The site lies within the upper Sand Creek Drainage Basin based **o**n the "Sand Creek Drainage Basin Planning Study" (DBPS) completed by Kiowa Engineering Corporation in January 1993, revised March 1996. The Sand Creek Drainage Basin covers approximately 54 square miles and is divided into 7 major sub-basins. The site is within the respective upper basin Sand Creek sub-basin as shown in Appendix C. The Sand Creek DBPS assumed the Sterling Ranch East of Sand Creek property to have a "single family residential" use for the majority of the site.

The site was also previously studied in the Master Development Drainage Plan (MDDP) for Sterling Ranch prepared by M&S Civil Consultants, INC in October 2018. Excerpts from this report can be found in Appendix C. The Sterling Ranch MDDP assumed a mix of low density to medium density and single family residential lots ranging in size from 0.1 to 1.0 acres for the Sterling Ranch Phase 3 site. The proposed Sterling Ranch master plan is a mix of; school, multi-family, single-family, and parks and open space. The proposed drainage on the site closely follows the approved "Master Development Drainage Plan for Sterling Ranch", (MDDP). The site is tributary to Pond FSD14A, and Pond FSD11B as well as future ponds FSD16A AND FSD14B. Interim ponds will be developed before final site design and are shown in this report.

The site generally drains from north to southwest. Currently, the site is used as pasture land for cattle. Sand Creek is located west of the site running north to south. This reach of drainage conveyance is not currently improved. Currently, Kiowa is performing studies and plans to address Sand Creek stabilization adjacent to the site.

EXISTING SUB-BASIN DRAINAGE

The existing / predeveloped condition of the site was broken into four major basins. The basin and sub-basin delineation is shown in the existing drainage map in Appendix E and is described as follows:

Sub-basin EX1 (Q_5= 24.0cfs, Q_{100}=176.3cfs) is 178.68 acres and 2 percent impervious consists of the northern portion of Sterling Ranch Phase 3. Runoff from this basin sheet flows from the north to south to design point EX1 at the northern edge of future Briargate Parkway.

Sub-basin EX2 (Q_5= 2.8cfs, Q_{100}=20.6cfs) is 14.67 acres and 2 percent impervious and consists the northeast portion of Sterling Ranch Phase 3. Runoff from this basin sheet flows south to design point EX2 located just north of future Briargate Parkway.

Sub-basin EX3 (Q_5= 21.7cfs, Q_{100}=159.2cfs) is 160.58 acres and 2 percent impervious and is located onsite in the central part of the site. Runoff from this basin drains southwest to design point EX3 along the eastern edge of Sand Creek.

Sub-basin EX4 (Q_5= 6.0cfs, Q_{100}=44.3cfs) is 36.46 and is 2 percent impervious and is located on the eastern portion of the site. Runoff from this basin sheet flows southwest to design point EX4 located just east of future Sterling Ranch Road.

PROPOSED DRAINAGE CONDITIONS

PROPOSED SUB-BASIN DRAINAGE

The proposed site was broken into two major basins: Basin A (Briargate Parkway), Basin B (Sterling Ranch Road), and two offsite basins. The proposed basin (and sub-basin) delineation is shown on the drainage basin map within Appendix E and is described as follows.

Basin A1 (Q_5= 10.5 cfs, Q_{100}=21.2cfs) is 4.95 acres and 67 percent impervious and is comprised of Briargate Parkway. Runoff from this basin drains to design point 1, an on grade inlet at the northeast corner of the basin. Collected runoff is piped east to pond FSD16 and will outfall to Sand Creek.

Basin A2 (Q_5= 10.4 cfs, Q_{100}=21.1 cfs) is 4.97 acres and 68 percent impervious is comprised of Briargate Parkway. Runoff from this basin drains to design point 2, an on grade inlet on the southeast corner of the basin. Collected runoff is piped east to pond FSD16 and will outfall to Sand Creek.

Basin A3 (Q_5= 5.1 cfs, Q_{100}=10.5 cfs) is 2.01 acres and 62 percent impervious is comprised of Briargate Parkway. Runoff from this basin drains to an on grade inlet located at design point 6 in confluence with uncaptured upstream flows from basin A2. Collected runoff from the inlet as well as fro DP5, will be piped to northeast pond FSD16 and will outfall to Sand Creek.

Basin A4 (Q_5= 4.1 cfs, Q_{100}=8.5 cfs) is 1.63 acres and 66 percent impervious is comprised of Briargate Parkway. Runoff from this basin drains to an on grade inlet located at design point 4 in

confluence with uncaptured upstream flows from basin A1, Collected runoff is piped north to a proposed manhole at design point 5. The flow will be piped to future detention pond FSD16 and will outfall to Sand Creek.

Basin B1 (Q_5= 5.2 cfs, Q_{100}=10.7 cfs) is 1.9 acres and 65 percent impervious is comprised of Sterling Ranch Road. Runoff from this basin drains to an on grade inlet at design point 8 in confluence with uncaptured upstream flows from basin A4. Collected runoff is piped southwest then conveyed via a proposed swale to pond FSD14A and will outfall to Sand Creek.

Basin B2 (Q_5= 5.1 cfs, Q_{100}=10.9 cfs) is 2.06 acres and 60 percent impervious is comprised of Sterling Ranch Road. Runoff from this basin drains to an on grade inlet at design point 7. Collected runoff is piped southwest then conveyed via a proposed swale to pond FSD14A and will outfall to Sand Creek.

Basin B3 (Q_5= 3.3 cfs, Q_{100}=6.8 cfs) is 1.27 acres and 64 percent impervious is comprised of Sterling Ranch Road. The runoff from this basin drains to an on grade inlet located at design point 11 in confluence with uncaptured upstream flows from basin B1. The flow will be piped northwest to design point 11 then conveyed via a proposed swale to detention pond FSD14A and will outfall to Sand Creek.

Basin B4 (Q_5= 3.3 cfs, Q_{100}=6.8 cfs) 1.33 acres and 61 percent impervious is comprised of Sterling Ranch Road. The runoff from this basin drains to an on grade inlet located at design point 10 in confluence with uncaptured upstream flows from basin B2. The flow will be piped northwest to design point 11then conveyed via the proposed swale to detention pond FSD14A and will outfall to Sand Creek.

Basin B5 (Q_5= 2.3cfs, Q_{100}=4.9 cfs) 0.89 acres and 61 percent impervious is comprised of Sterling Ranch Road. The runoff from this basin drains to an on grade inlet located at design point 15 in confluence with uncaptured upstream flows from basin B3. The flow will be piped northwest to design point 17 then conveyed via a proposed swale to detention pond FSD14A and will outfall to Sand Creek.

Basin B6 (Q_5= 2.5 cfs, Q_{100}=5.2 cfs) 0.91 acres and 63 percent impervious is comprised of a Sterling Ranch Road. The runoff from this basin drains to an on grade inlet located at design point 14 in confluence with uncaptured upstream flows from basin B4. The flow will be piped northwest to design point 17 then conveyed via a proposed swale to detention pond FSD14A and will outfall to Sand Creek.

Basin B7 (Q_5= 2.4 cfs, Q_{100}=5.3 cfs) is 1.08 acres and 52 percent impervious is comprised of Sterling Ranch Road. The runoff from basin B7 drains to an on grade inlet located at design point 19 in confluence with uncaptured upstream flows from basin B5. The flow will be piped northwest to

design point 20 then conveyed via a proposed swale to detention pond FSD14A and will outfall to Sand Creek.

Basin B8 (Q_5= 2.9 cfs, Q_{100}=6.2 cfs) is 1.16 acres and 58 percent impervious is comprised of Sterling Ranch Road. Runoff from basin B8 drains to an on grade inlet located at design point 18 in confluence with uncaptured upstream flows from basin B6. The flow will be piped north to design point 20 then conveyed via a proposed swale to detention pond FSD14A and will outfall to Sand Creek.

Basin B9 (Q_5= 4.3 cfs, Q_{100}=9.7 cfs) is 1.98 acres and 51 percent impervious is comprised of Sterling Ranch Road. Runoff from basin B9 drains to a sump inlet located at design point 23 in confluence with uncaptured upstream flows from basin B7. The flow will be piped to detention pond FSD14A and will outfall to Sand Creek.

Basin B10 (Q_5= 5.0 cfs, Q_{100}=11.0 cfs) is 2.19 acres and 53 percent impervious is comprised of Sterling Ranch Road. Runoff from basin B10 drains to a sump inlet located at design point 22 in confluence with uncaptured upstream flows from basin B8. The flow will be piped to detention pond FSD14A and will outfall to Sand Creek.

Basin B11 (Q_5=16.6cfs, Q_{100}=121.6cfs) is 126.23 acres and 2 percent impervious is comprised of open space. Runoff from basin B11 drains to a detention pond at design point 25. Runoff from Basin B11 sheet flow southwest and will be conveyed via a proposed swale to detention pond FSD14A and will outfall to Sand Creek.

Basin C1 (Q_5=1.6 cfs, Q_{100}=11.8 cfs) is 5.87 acres and 2 percent impervious is comprised of open space. Runoff from basin C1 will be conveyed via a proposed swale to design point 26 then piped southwest to detention pond FSD14A. The swale is to convey runoff from the east side of Sterling Ranch Road south to future pond PSD14B as well as to our interim pond FSD14A with ultimate outfall location of Sand Creek. Water quality will be provided in pond FSD14A, in the future water quality will be provide in pond FSD14SB.

Basin OS1 (Q_5= 23.8 cfs, Q_{100}=174.5 cfs) is 176.86 acres and 2 percent impervious and is comprised of future development including open space area, single family residential lots and local roads. Basin OS1 is located north of Briargate Parkway. Runoff from this basin drains southeast and is conveyed via a proposed swale to Pond FSD16.

Basin OS2 (Q_5= 7.7cfs, Q_{100}=56.7 cfs) is 39.27 acres and 2 percent impervious and is comprised of open space area. Basin OS2 is located northeast of t
Ranch Road. Runoff from this basin drains southwe

JR responded: note added that final design for pond occur later

If Basin is to be developed, C-values should reflect that to ensure all storm facilities can handle final design flows. Same for Basins OS-2 & B-11. If Final design of ponds is occurring later, then add note regarding future conditions.

DRAINAGE DESIGN CRITERIA

DEVELOPMENT CRITERIA REFERENCE

Storm drainage analysis and design criteria for this project were taken from the "*City of Colorado Springs/El Paso County Drainage Criteria Manual*" Volumes 1 and 2 (EPCDCM), dated October 12, 1994, the "*Urban Storm Drainage Criteria Manual*" Volumes 1 to 3 (USDCM) and Chapter 6 and Section 3.2.1 of Chapter 13 of the "*Colorado Springs Drainage Criteria Manual*" (CSDCM), dated May 2014, as adopted by El Paso County.

HYDROLOGIC CRITERIA

All hydrologic data was obtained from the "*El Paso Drainage Criteria Manual*" Volumes 1 and 2, and the "*Urban Drainage and Flood Control District Urban Storm Drainage Criteria Manual*" Volumes 1, 2, and 3. Onsite drainage improvements were designed based on the 5 year (minor) storm event and the 100-year (major) storm event. Runoff was calculated using the Rational Method, and rainfall intensities for the 5-year and the 100-year storm return frequencies were obtained from Table 6-2 of the CSDCM. One hour point rainfall data for the storm events is identified in the chart below. Runoff coefficients were determined based on proposed land use and from data in Table 6-6 from the CSDCM. Time of concentrations were developed using equations from CSDCM. All runoff calculations and applicable charts and graphs are included in the Appendices.

Table 2 - 1-hr Point Rainfall Data

Storm	Rainfall (in.)
5-year	1.50
100-year	2.52

HYDRAULIC CRITERIA

The Rational Method and USDCM's SF-2 and SF-3 forms were used to determine the runoff from the minor and major storms on the site. Sumps and on-grade inlets were sized using UDFCD UD-Inlet v4.06 as shown in Appendix C. Manning's equation was used to size the proposed pipes in this report and StormCAD was used to model the proposed storm sewer system and to analyze the proposed HGL calculations for the Construction Drawings. Per ECM Section 3.3.1.b.2, all storm pipes located within Briargate Parkway will need to have an extended service life of 100 years.

Table 2 - StormCAD Standard Method Conversions

StormCAD Conversion Table			
Bend Loss	Bend Angle	K coefficient Conversion	
	0	0.05	
	22.5	0.1	
	45	0.4	
	60	0.64	
	90	1.32	
Lateral Loss	1 Lateral K coefficient Conversion		
	Bend Angle	Non Surcharged	Surcharged
	45	0.27	0.47
	60	0.52	0.9
	90	1.02	1.77
	2 Laterals K coefficient Conversion		
	45	0.96	
	60	1.16	
	90	1.52	

DRAINAGE FACILITY DESIGN

GENERAL CONCEPT

The proposed stormwater conveyance system was designed to convey the developed Sterling Ranch – East of Sand Creek roadway runoff and treat the interim condition in the interim, full spectrum water quality and detention ponds via storm sewer. The proposed interim ponds were designed to release at less than historic rates to minimize adverse impacts downstream. Treated water will outfall directly into the Sand Creek drainage way, where it will eventually outfall into Fountain Creek. A proposed drainage map is presented in Appendix D showing locations of the ponds.

FOUR STEP PROCESS TO MINIMIZE ADVERSE IMPACTS OF URBANIZATION

In accordance with the El Paso County Drainage Criteria Manual Volume 2, this site has implemented the four step process to minimize adverse impacts of urbanization. The four step process includes reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainage ways, and implementing long-term source controls.

Step 1 – Reducing Runoff Volumes: The Sterling Ranch East of Sand Creek development project consists of Sterling Ranch Road and Briargate Parkway with open spaces and lawn areas interspersed within the development which helps disconnect impervious areas and reduce runoff volumes.

Step 2 – Stabilize Drainageways: The site lies within the Sand Creek Drainage Basin. Basin and bridge fees will be due at time of platting. These funds will be used for the channel stabilization being designed by Kiowa adjacent to the site and on future projects within the basin to stabilize

drainageways. The site does not discharge directly into the open drainageway of Sand Creek, therefore no downstream stabilization will be accomplished with this project.

Step 3 – Treat the WQCV: Water Quality treatment for this site is provided in the proposed full spectrum water quality detention ponds. The runoff from this site will be collected within inlets and conveyed to the proposed ponds via storm sewer and/ or swales. The outlet structure will be designed to detain the water quality capture volume (WQCV) for 40 hours, and the extended urban runoff volume (EURV) for 72 hours. All flows released from the ponds will be reduced to less than historic rates.

Step 4 –BMPs will be utilized to minimize off-site contaminants and to protect the downstream receiving waters. The permanent erosion control BMPs include asphalt drives, storm inlets and storm pipe, four full spectrum water quality and detention ponds, and permanent vegetation.

WATER QUALITY

JR responded: future revisions comment added

CM, full spectrum water quality and detention
n into two temporary Full Spectrum Drainage
s as well as all pond volume, water quality, and
C of this report. A summary of Interim Pond
ference. Ponds FSD14A and
ponding future development
e construction of Briargate
ality and 100yr detention for
ds will be provided with th
design.

Include note that there may need to be revisions to the interim ponds at final design, if not providing for what the full developed flows/areas are with this report. (Basins B11, OS1 & OS2 still show as undeveloped, when final ponds will have these basins as developed.) If not providing all the parts for full-spectrum at this pond, a deviation will be needed to address this.

JR UPDATED

Release rate is larger than allowable. Revise to meet allowable release rate

4.857 Ac & 6.636 Ac per spreadsheets

JR UPDATED

Table 3. Pond Volumes & Release Rates

	REQUIRED VOLUME (AC-FT)	VOLUME PROVIDED (AC-FT)	WQCV (AC-FT)	EURV (AC-FT)	100-YEAR RELEASE (CFS)	ALLOWABLE 100-YEAR RELEASE (CFS)
POND FSD14A	4.67	8.3	0.67	1.1	146.9	142.2
POND FSD16	6.56	11.4	0.79	1.2	151.0	156.6

OPERATION & MAINTENANCE

In order to ensure the function and effectiveness of the stormwater infrastructure, maintenance activities such as inspection, routine maintenance, restorative maintenance, rehabilitation and repair, are required. The district shall be responsible for the inspection, maintenance, rehabilitation and repair of stormwater and erosion control facilities located on the property unless another party accepts such responsibility in writing and responsibility is properly assigned through legal

This is construction documents. Please provide O&M manual.

JR Response: O&M manual provided

documentation. Access is provided from onsite facilities and easements for proposed infrastructure located offsite. We respectfully request that the Operation & Maintenance Manual be submitted in conjunction with the construction documents, prior to obtaining a grading permit.

DRAINAGE AND BRID

JR RESPONDED: TITLE CHANGED. VALUES UPDATED

The site lies within the cipated drainage and bridge fees are presented below and will be due at time of platting (depending on date of plat submittal):.

Use 2022 fees

2020 DRAINAGE AND BRIDGE FEES – STERLING RANCH PHASE 3				
Impervious Acres (ac)	Drainage Fee (Per Imp. Acre)	Bridge Fee (Per Imp. Acre)	Sterling Ranch Drainage Fee	Sterling Ranch Bridge Fee
17.38	$21,814	$8,923	$379,127	$6,589,233

SUMMARY

The proposed Sterling Ranch East of Sand Creek drainage improvements were designed to meet or exceed the El Paso County Drainage Criteria. The proposed development will not adversely affect the offsite drainage ways or surrounding development. This report is in conformance and meets the latest El Paso County Storm Drainage Criteria requirements for this site.

REFERENCES

1. "El Paso County and City of Colorado Springs Drainage Criteria Manual, Vol I & II".

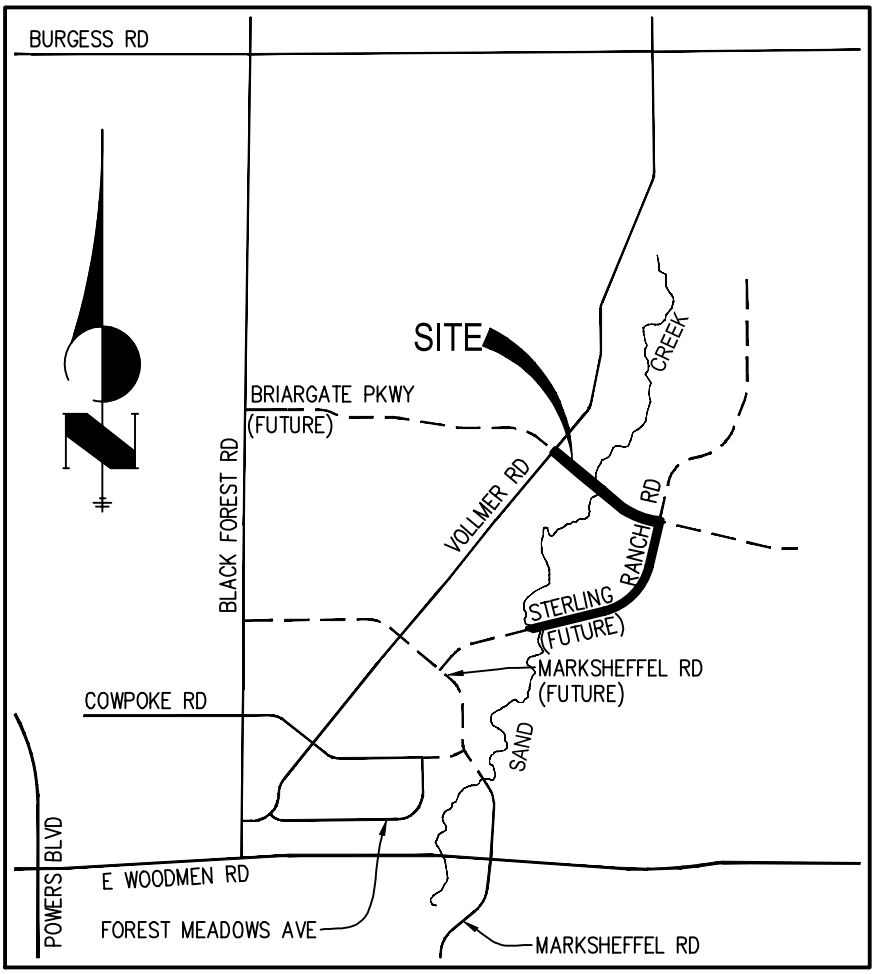
2. Final Bridge and Channel Design Report, prepared by Kiowa Engineering Corporation, May 19, 2020 (not yet approved)

3. "Master Development Drainage Plan for Sterling Ranch", (MMDP) prepared by M&S Civil Consultants, Inc., dated October 24, 2018.

4. Sand Creek Drainage Basin Planning Study, prepared Kiowa Engineering Corporation, January 1993, revised March 1996.

5. Urban Storm Drainage Criteria Manual (Volumes 1, 2, and 3), Urban Drainage and Flood Control District, June 2001.

Appendix A
Vicinity Map, Soil Descriptions, FEMA Floodplain Map



VICINITY MAP

N.T.S.

VICINITY MAP
STERLING RANCH ROAD
JOB NO. 25188.03
12/17/2021
SHEET 1 OF 1

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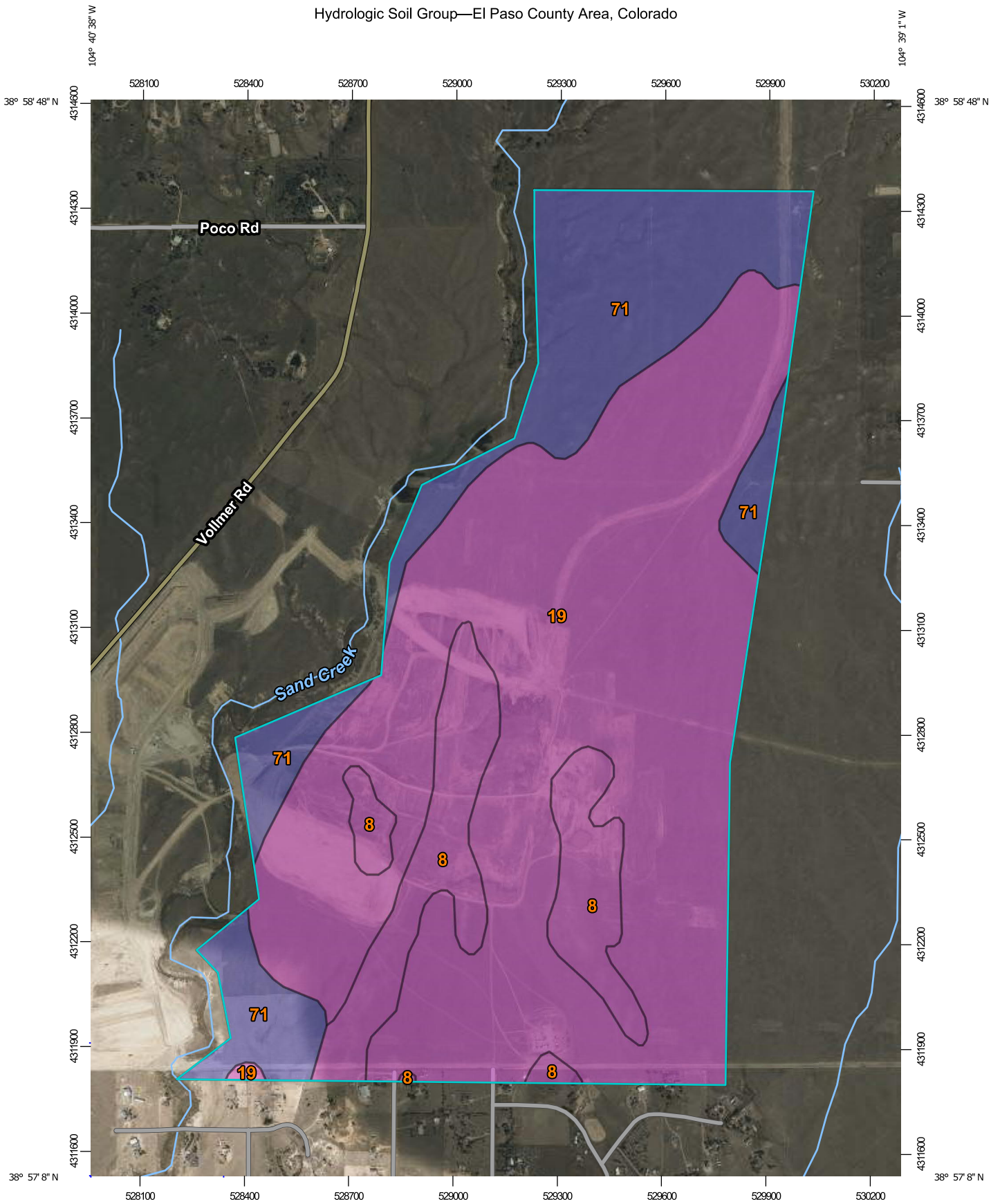
Hydrologic Soil Group—El Paso County Area, Colorado



Map Scale: 1:15,000 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 200 400 800 1200

Feet: 0 500 1000 2000 3000

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.

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 18, Jun 5, 2020

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—May 26, 2019

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

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	89.8	12.7%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	464.8	65.6%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	153.8	21.7%
Totals for Area of Interest			**708.4**	**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

NOTES TO USERS

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

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

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

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

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

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

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

NGS Information Services
NOAA, NNGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

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

Base Map Information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, and Aerodyne Consulting Engineers, Inc. These data are current as of 2005.

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

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

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

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

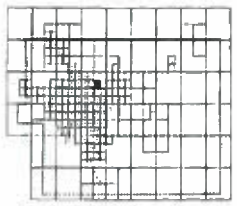
If you have questions about this map or questions concerning the National Flood Insurance Program in general, please call 1-877-FEMA MAP (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Vertical Datum | Offset (ft)
Flooding Source | Offset (ft)

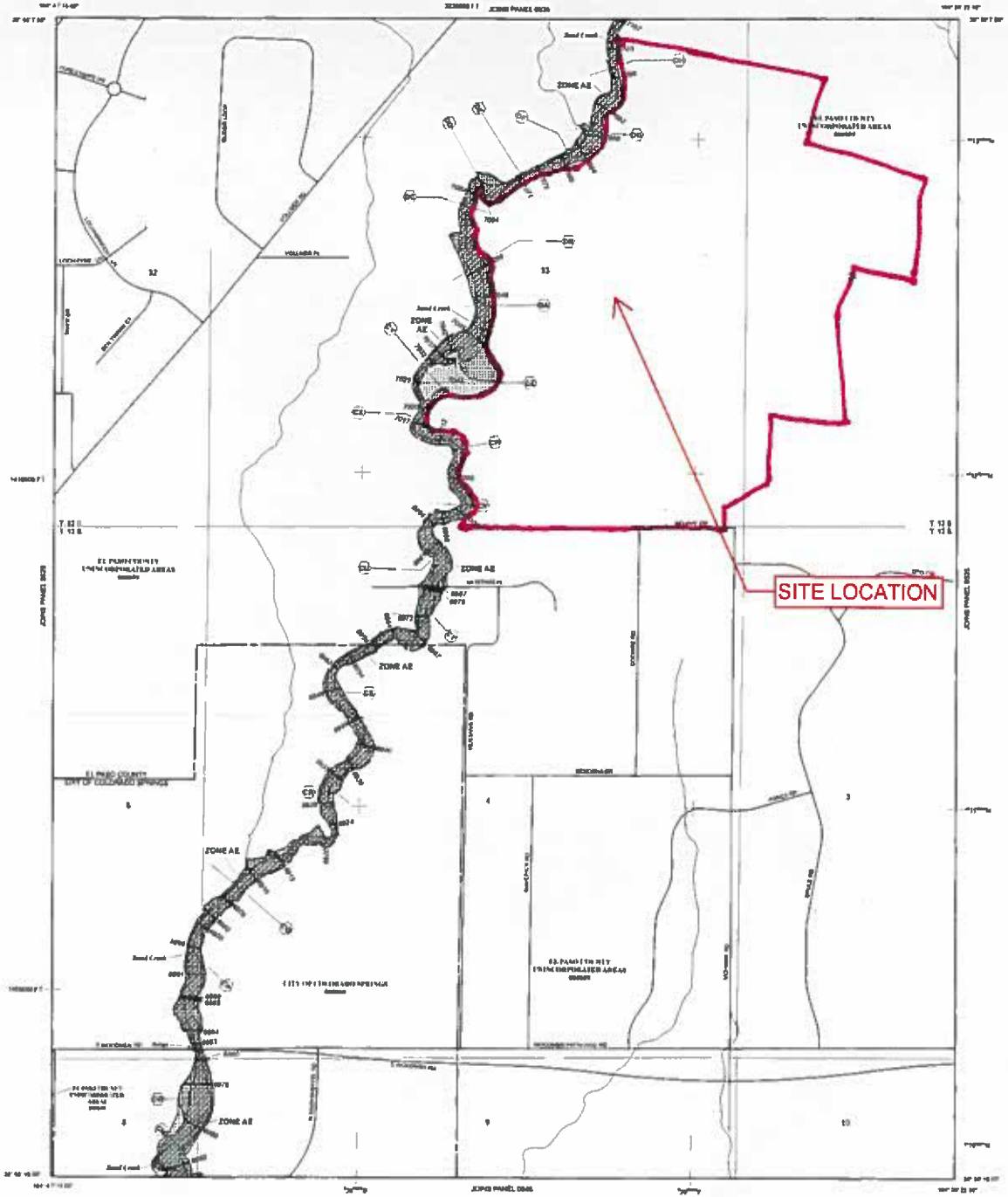
REFER TO SECTION 2.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

Panel Location Map



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

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



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 66 WEST, AND TOWNSHIP 13 SOUTH, RANGE 66 WEST

LEGEND

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

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A1-A30, and VE. The Regulatory Floodway is the area regulated by Federal, State or local agencies for the purpose of preserving the 1% annual chance flood.

ZONE A — No Base Flood Elevations determined.

ZONE AE — Base Flood Elevations determined.

ZONE AH — Flood depths of 1 to 3 feet (usually shallow ponding); Base Flood Elevations determined.

ZONE AO — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR — Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.

ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

Floodplain boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary

Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

Base Flood Elevation value where uniform within zone; elevation in feet* (EL 987)

Depth Flood Elevation value where uniform within zone; elevation in feet* (AO x)

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

(A) — (A) Cross section line

23 — 23 Transect line

97° 07' 30.00" 32° 22' 30.00" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)

1000-meter Universal Transverse Mercator grid values, zone 13

5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic projection

DX5510 — Bench mark (see explanation in notes to users)

M1.5 — River mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - To update corporate limits, to change Base Flood Elevations, to change Special Flood Hazard Areas, to incorporate new topographic data, to incorporate previously issued Letters of Map Revision

For communities/panels shown in the Community Map History table located in the Flood Insurance Study report for this jurisdiction, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

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

MAP SCALE 1" = 500'

NFIP — NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0833G

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 833 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL
[illegible]	[illegible]	[illegible]

MAP NUMBER 08041C0833G

MAP REVISED DECEMBER 7, 2018

Federal Emergency Management Agency

Appendix B
Hydrologic Calculations

COMPOSITE % IMPERVIOUS & COMPOSITE EXISTING RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Sterling Ranch Subdivision- Existing
Location: El Paso County

Project Name: Sterling Ranch Phase 3
Project No.: 25188.03
Calculated By: CGV
Checked By: RAB
Date: 10/8/20

Basin ID	Total Area (ac)	Streets (100% Impervious)				Residential (65% Impervious)				Light Commercial (80% Impervious)				Historical Analysis (2% Impervious)				Basins Total Weighted C Values		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
EX1	178.68	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	178.68	2.0%	0.09	0.36	2.0%
EX2	14.67	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	14.67	2.0%	0.09	0.36	2.0%
EX4	36.46	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	36.46	2.0%	0.09	0.36	2.0%
EX3	160.58	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	160.58	2.0%	0.09	0.36	2.0%
EX5	4.28	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	4.28	2.0%	0.09	0.36	2.0%
EX6	0.56	0.90	0.96	0.00	0.0%	0.45	0.59	0.00	0.0%	0.59	0.70	0.00	0.0%	0.09	0.36	0.56	2.0%	0.09	0.36	2.0%
TOTAL (EX1-EX6)	**395.23**																			**2.0%**
TOTAL	**395.23**																			**2.0%**

EXISTING
STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Sterling Ranch Subdivision- Existing
Location: El Paso County

Project Name: Sterling Ranch Phase 3
Project No.: 25188.03
Calculated By: CGV
Checked By: RAB
Date: 10/8/20

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	Cv	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
EX1	178.68	A	2%	0.09	0.36	300	10.5%	14.5	3159	1.6%	10.0	1.3	41.2	55.7	3459.0	29.2	29.2
EX2	14.67	A	2%	0.09	0.36	300	10.0%	14.8	1352	1.0%	10.0	1.0	22.1	36.9	1652.0	19.2	19.2
EX4	36.46	A	2%	0.09	0.36	300	8.3%	15.7	1678	0.8%	10.0	0.9	30.6	46.3	1978.0	21.0	21.0
EX3	160.58	A	2%	0.09	0.36	300	6.9%	16.7	2566	1.3%	10.0	1.2	37.0	53.7	2866.0	25.9	25.9
EX5	4.28	A	2%	0.09	0.36	300	6.9%	16.7	884	3.9%	10.0	2.0	7.5	24.2	1184.0	16.6	16.6
EX6	0.56	A	2%	0.09	0.36	141	14.6%	8.9	151	22.7%	10.0	4.8	0.5	9.5	292.0	11.6	9.5

NOTES:

$$t_c = t_i + t_t \quad \text{(Eq. 6-7)}$$

Where:

t_c = time of concentration (min)
t_i = overland (initial) flow time (min)
t_t = travel time in the ditch, channel, gutter, storm sewer, etc. (min)

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \quad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

$$V = C_v S_w^{0.5} \quad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)
C_v = conveyance coefficient (from Table 6-7)
S_w = watercourse slope (ft/ft)

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t} \quad \text{Equation 6-4}$$

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

$$t_c = \frac{L}{180} + 10 \quad \text{(Eq. 6-10)}$$

Where:

t_c = maximum time of concentration at the first design point in an urban watershed (min)
L = waterway length (ft)

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

*For buried riprap, select C_v value based on type of vegetative cover.

STANDARD FORM SF-3 - EXISTING

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Subdivision- Existing
Location: El Paso County
Design Storm: 5-Year

Project Name: Sterling Ranch Phase 3
Project No.: 25188.03
Calculated By: CGV
Checked By: RAB
Date: 10/8/20

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	EX1	EX1	178.68	0.09	29.2	16.08	2.52	40.5															
	EX2	EX2	14.67	0.09	19.2	1.32	3.15	4.2															
	EX3	EX3	160.58	0.09	25.9	14.45	2.70	39.0															
	EX4	EX4	36.46	0.09	21.0	3.28	3.02	9.9															
	EX5	EX5	4.28	0.09	16.6	0.39	3.37	1.3															
	EX6	EX6	0.56	0.09	9.5	0.05	4.21	0.2															

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.

STANDARD FORM SF-3 - EXISTING

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Subdivision- Existing
Location: El Paso County
Design Storm: 100-Year

Project Name: Sterling Ranch Phase 3
Project No.: 25188.03
Calculated By: CGV
Checked By: RAB
Date: 10/8/20

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	EX1	EX1	178.68	0.36	29.2	64.32	4.23	272.1															
	EX2	EX2	14.67	0.36	19.2	5.28	5.29	27.9															
	EX3	EX3	160.58	0.36	25.9	57.81	4.53	262.0															
	EX4	EX4	36.46	0.36	21.0	13.13	5.06	66.5															
	EX5	EX5	4.28	0.36	16.6	1.54	5.66	8.7															
	EX6	EX6	0.56	0.36	9.5	0.20	7.07	1.4															

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.

COMPOSITE % IMPERVIOUS & COMPOSITE PROPOSED RUNOFF COEFFICIENT CALCULATIONS

Subdivision: Sterling Ranch Rd & Briargate Pkwy
Location: El Paso County

Project Name: Sterling Ranch Phase 3
Project No.: 25188.03
Calculated By: CGV
Checked By: RAB
Date: 12/2/21

Basin ID	Total Area (ac)	Streets/ Walks (100% Impervious)				Lawn/ Historic (2% Impervious)				Basins Total Weighted C Values		Basins Total Weighted % Imp.
		C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	Area (ac)	Weighted % Imp.	C_5	C_{100}	
A1	4.95	0.90	0.96	3.28	66.3%	0.09	0.36	1.67	0.7%	0.63	0.76	66.9%
A2	4.97	0.90	0.96	3.33	67.0%	0.09	0.36	1.64	0.7%	0.63	0.76	67.7%
A3	2.01	0.90	0.96	1.23	61.2%	0.09	0.36	0.78	0.8%	0.59	0.73	62.0%
A4	1.63	0.90	0.96	1.06	65.0%	0.09	0.36	0.57	0.7%	0.62	0.75	65.7%
B1	1.90	0.90	0.96	1.23	64.7%	0.09	0.36	0.67	0.7%	0.61	0.75	65.4%
B2	2.06	0.90	0.96	1.21	58.7%	0.09	0.36	0.85	0.8%	0.57	0.71	59.6%
B3	1.27	0.90	0.96	0.80	63.0%	0.09	0.36	0.47	0.7%	0.60	0.74	63.7%
B4	1.33	0.90	0.96	0.80	60.2%	0.09	0.36	0.53	0.8%	0.58	0.72	60.9%
B5	0.89	0.90	0.96	0.54	60.7%	0.09	0.36	0.35	0.8%	0.58	0.72	61.5%
B6	0.91	0.90	0.96	0.57	62.6%	0.09	0.36	0.34	0.7%	0.60	0.74	63.4%
B7	1.08	0.90	0.96	0.55	50.9%	0.09	0.36	0.53	1.0%	0.50	0.67	51.9%
B8	1.16	0.90	0.96	0.66	56.9%	0.09	0.36	0.50	0.9%	0.55	0.70	57.8%
B9	1.98	0.90	0.96	0.98	49.5%	0.09	0.36	1.00	1.0%	0.49	0.66	50.5%
B10	2.19	0.90	0.96	1.14	52.1%	0.09	0.36	1.05	1.0%	0.51	0.67	53.0%
B11	126.23	0.90	0.96	0.00	0.0%	0.09	0.36	126.23	2.0%	0.09	0.36	2.0%
C1	5.87	0.90	0.96	0.00	0.0%	0.09	0.36	5.87	2.0%	0.09	0.36	2.0%
OS1	176.86	0.90	0.96	0.00	0.0%	0.09	0.36	176.86	2.0%	0.09	0.36	2.0%
OS2	39.27	0.90	0.96	0.00	0.0%	0.09	0.36	39.27	2.0%	0.09	0.36	2.0%
Pond FSD 16 (Total of A and OS)	**229.69**											**5.8%**
Pond FSD 14A (Total of B and C)	**146.87**											**7.7%**
TOTAL	**376.56**											**5.4%**

These basins should be considered developed as storm infrastructure will need to accomodate developed flows.

JR RESPONDED: These basins will be conveyed to detention ponds before reaching the proposed storm network. the proposed storm network is designed to accommodate max release rates from ponds and the developed basin runoff from Sterling Ranch Road and Briargate Parkway

PROPOSED
STANDARD FORM SF-2
TIME OF CONCENTRATION

Subdivision: Sterling Ranch Rd & Briargate Pkwy
Location: El Paso County

Project Name: Sterling Ranch Phase 3
Project No.: 25188.03
Calculated By: CGV
Checked By: RAB
Date: 12/2/21

SUB-BASIN DATA						INITIAL/OVERLAND (T_i)			TRAVEL TIME (T_t)					*tc* CHECK (URBANIZED BASINS)			FINAL
BASIN ID	D.A. (ac)	Hydrologic Soils Group	Impervious (%)	C_5	C_{100}	L (ft)	S_o (%)	t_i (min)	L_t (ft)	S_t (%)	Cv	VEL. (ft/s)	t_t (min)	COMP. t_c (min)	TOTAL LENGTH (ft)	Urbanized t_c (min)	t_c (min)
A1	4.95	A	66.9%	0.63	0.76	37	2.5%	3.8	1330	0.8%	20.0	1.8	12.5	16.4	1367.0	17.6	16.4
A2	4.97	A	67.7%	0.63	0.76	37	2.5%	3.8	1332	0.7%	20.0	1.7	13.2	17.0	1369.0	17.6	17.0
A3	2.01	A	62.0%	0.59	0.73	50	4.0%	4.2	552	1.0%	20.0	2.0	4.6	8.8	602.0	13.3	8.8
A4	1.63	A	65.7%	0.62	0.75	50	2.3%	4.7	590	0.9%	20.0	1.9	5.3	10.0	640.0	13.6	10.0
B1	1.90	A	65.4%	0.61	0.75	30	2.7%	3.5	745	2.1%	20.0	2.9	4.3	7.7	775.0	14.3	7.7
B2	2.06	A	59.6%	0.57	0.71	30	2.7%	3.8	757	2.1%	20.0	2.9	4.4	8.2	787.0	14.4	8.2
B3	1.27	A	63.7%	0.60	0.74	30	2.3%	3.8	714	1.5%	20.0	2.4	4.9	8.6	744.0	14.1	8.6
B4	1.33	A	60.9%	0.58	0.72	30	2.3%	3.9	760	1.5%	20.0	2.5	5.1	9.0	790.0	14.4	9.0
B5	0.89	A	61.5%	0.58	0.72	30	2.5%	3.8	559	1.5%	20.0	2.4	3.8	7.6	589.0	13.3	7.6
B6	0.91	A	63.4%	0.60	0.74	30	2.5%	3.7	495	1.5%	20.0	2.4	3.4	7.1	525.0	12.9	7.1
B7	1.08	A	51.9%	0.50	0.67	30	2.5%	4.4	531	1.5%	20.0	2.4	3.6	8.0	561.0	13.1	8.0
B8	1.16	A	57.8%	0.55	0.70	30	2.5%	4.0	526	1.5%	20.0	2.4	3.6	7.6	556.0	13.1	7.6
B9	1.98	A	50.5%	0.49	0.66	30	2.5%	4.5	628	2.3%	20.0	3.0	3.4	7.9	658.0	13.7	7.9
B10	2.19	A	53.0%	0.51	0.67	30	2.5%	4.3	645	2.3%	20.0	3.0	3.5	7.8	675.0	13.8	7.8
B11	126.23	A	2.0%	0.09	0.36	300	2.0%	25.1	2740	2.0%	20.0	2.8	16.1	41.3	3040.0	26.9	26.9
C1	5.87	A	2.0%	0.09	0.36	150	20.0%	8.3	1300	2.0%	20.0	2.8	7.7	16.0	1450.0	18.1	16.0
OS1	176.86	A	2.0%	0.09	0.36	300	2.0%	25.1	3159	1.6%	20.0	2.6	20.6	45.7	3459.0	29.2	29.2
OS2	39.27	A	2.0%	0.09	0.36	300	1.8%	26.0	889	2.3%	20.0	3.0	4.9	30.9	1189.0	16.6	16.6

NOTES:

$$t_c = t_i + t_t \quad \text{(Eq. 6-7)}$$

Where:

t_c = time of concentration (min)
t_i = overland (initial) flow time (min)
t_t = travel time in the ditch, channel, gutter, storm sewer, etc. (min)

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \quad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

$$V = C_v S_w^{0.5} \quad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)
C_v = conveyance coefficient (from Table 6-7)
S_w = watercourse slope (ft/ft)

Use a minimum t_c value of 5 minutes for urbanized areas and a minimum t_c value of 10 minutes for areas that are not considered urban. Use minimum values even when calculations result in a lesser time of concentration.

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

*For buried riprap, select C_v value based on type of vegetative cover.

$$t_t = \frac{L_t}{60K\sqrt{S_w}} = \frac{L_t}{60V_t} \quad \text{Equation 6-4}$$

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_w = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_w}$
K = NRCS conveyance factor (see Table 6-2)

$$t_c = \frac{L}{180} + 10 \quad \text{(Eq. 6-10)}$$

Where:

t_c = maximum time of concentration at the first design point in an urban watershed (min)
L = waterway length (ft)

STANDARD FORM SF-3 - PROPOSED

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Rd & Briargate Pkwy
Location: El Paso County
Design Storm: 5-Year

Project Name: Sterling Ranch Phase 3
Project No.: 25188.03
Calculated By: CGV
Checked By: RAB
Date: 12/2/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	OS1	OS1	176.86	0.09	29.2	15.92	2.52	40.1								40.1	15.92	0.9	60	800	1.9	7.0	Future Development to Pond FSD16
	2	A2	4.97	0.63	17.0	3.14	3.34	10.5					0.1	0.03	0.9	10.4	3.11	0.5	18	65	1.4	0.8	On-grade inlet, bypass to DP6 Capture to DP1
	1	A1	4.95	0.63	16.4	3.10	3.39	10.5	17.7	6.21	3.27	20.3	0.0	0	0.9	20.3	6.21	0.5	24	860	1.4	10.1	On-grade inlet, bypass to DP4 Capture to DP5
	4	A4	1.63	0.62	10.0	1.01	4.14	4.2	27.9	1.01	2.59	2.6	0.0	0	0.9	2.6	1.01	0.5	18	25	1.4	0.3	On-grade inlet, bypass to future Briargate Pkwy Capture to DP5
	5								27.9	7.22	2.59	18.7				18.7	7.22	0.5	24	96	1.4	1.1	Manhole Piped to DP6
	6	A3	2.01	0.59	8.8	1.18	4.33	5.1	29.0	8.43	2.53	21.3	0.0	0	0.9	21.3	8.43	0.3	36	333	1.1	5.1	On-grade inlet, bypass to future Briargate Pkwy Capture to DP6.1
	OS2	OS2	39.27	0.09	16.6	3.53	3.37	11.9	36.2	27.88	2.20	61.3											Future Development to Interim Pond FSD16
	OS2.1															16.4	3.06	1.5	48	2740	2.4	18.6	Pond FSD16 Outfall Piped to DP26.A
	7	B2	2.06	0.57	8.2	1.17	4.43	5.2					0.0	0	0.9	5.2	1.17	0.5	18	59	1.4	0.7	On-grade inlet, bypass to DP10 Capture to DP8
	8	B1	1.90	0.61	7.7	1.17	4.51	5.3	10.3	2.34	4.09	9.6	0.0	0	0.9	9.6	2.34	2.2	18	1000	3.0	5.6	On-grade inlet, bypass to DP11 Capture conveyed via swale to DP13
	10	B4	1.33	0.58	9.0	0.77	4.28	3.3	9.0	0.77	4.28	3.3	0.0	0	0.9	3.3	0.77	0.5	18	60	1.4	0.7	On-grade inlet, bypass to DP14 Capture to DP12
	11	B3	1.27	0.60	8.6	0.76	4.35	3.3	13.4	1.53	3.69	5.7	0.0	0	0.9	5.7	1.53	4.0	18	200	4.0	0.8	On-grade inlet, bypass to DP15 Capture to DP12
	13								15.9	3.87	3.44	13.3				13.3	3.87	2.0	60	560	2.8	3.3	Inlet outflow Converyed via swale to Pond FSD14A
	14	B6	0.91	0.60	7.1	0.54	4.65	2.5	9.7	0.54	4.17	2.3	1.0	0.24	0.9	1.3	0.30	0.5	18	60	1.4	0.7	On-grade inlet, bypass to DP18 Capture to DP16
	15	B5	0.89	0.58	7.6	0.52	4.54	2.4	14.2	0.82	3.60	3.0	1.0	0.28	0.9	2.0	0.54	7.0	18	170	5.3	0.5	On-grade inlet, bypass to DP19 Capture to DP17

JR RESPONDED: CHANGED

16.8 cfs per pond spreadsheet

STANDARD FORM SF-3 - PROPOSED

STORM DRAINAGE SYSTEM DESIGN

(RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Rd & Briargate Pkwy
Location: El Paso County
Design Storm: 5-Year

Project Name: Sterling Ranch Phase 3
Project No.: 25188.03
Calculated By: CGV
Checked By: RAB
Date: 12/2/21

STREET	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (Ac)	Runoff Coeff.	t_c (min)	C*A (Ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	17								19.2	4.41	3.15	13.9				13.9	4.41	2.0	60	700	2.8	4.1	Outlet structure Captured conveyed via a swale to Pond Fsd14a
	18	B8	1.16	0.55	7.6	0.64	4.54	2.9	10.4	0.88	4.06	3.6	1.0	0.25	0.9	2.6	0.63	5.0	18	54	4.5	0.2	On-grade inlet, bypass to DP22 Capture to DP20
	19	B7	1.08	0.50	8.0	0.54	4.47	2.4	14.7	1.70	3.55	6.0	1.0	0.28	0.9	5.0	1.42	5.0	18	103	4.5	0.4	On-grade inlet, bypass to DP23 Capture to DP20
	20								19.2	5.29	3.15	16.7				16.7	5.29	2.5	60	300	3.2	1.6	Inlet outflow Captured conveyed via a swale to Pond FSD14A
	22	B10	2.19	0.51	7.8	1.12	4.49	5.0	10.6	1.37	4.04	5.5				5.5	1.37	0.5	18	53	1.4	0.6	Sump Inlet Piped to DP23
	23	B9	1.98	0.49	7.9	0.97	4.49	4.4	15.1	2.62	3.51	9.2				9.2	2.62	0.5	18	328	1.4	3.9	Sump Inlet Piped to Pond FSD14A
	25	B11	126.23	0.09	26.9	11.36	2.65	30.1	26.9	19.26	2.65	51.0											Pond FSD14A
	26	C1	5.87	0.09	16.0	0.53	3.43	1.8								1.8	0.53						To Pond FSD 14B
	26.1								16.0	0.53	3.43	1.8				0.3	0.02	4.0	18	84	4.0	0.4	Outflow from future pond FSD14B Piped to DP26A
	26A								18.6	3.59	3.19	11.5				11.5	3.59	1.8	54	2280	2.7	14.2	Manhole. Flow from MDDP DP21 Piped to DP27
	25.1															6.5	0.59	0.5	48	168	1.4	2.0	Outflow from Pond FSD14B Piped to DP27
	27								32.8	4.18	2.35	9.8											Manhole Confluenced flow from Pond FSD14A and DP26A

Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.

STANDARD FORM SF-3 - PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Rd & Briargate Pkwy
Location: El Paso County
Design Storm: 100-Year

Project Name: Sterling Ranch Phase 3
Project No.: 25188.03
Calculated By: CGV
Checked By: RAB
Date: 12/2/21

How is direct runoff so much higher than total runoff? Verify input information

JR RESPONDED: EQUATION UPDATED

Description	Design Point	DIRECT RUNOFF							STREET/SWALE						PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	t_c (min)	C*A	I (in/hr)	Q (cfs)	Q_{street}	C*A	Slope	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	OS1	OS1	176.86	0.36	29.2	63.67	4.23	269.4								269.4	63.67	0.9	60	800	1.9	7.0	Future Development to Pond FSD16
	2	A2	4.97	0.76	17.0	3.79	5.60	21.2					3.3	0.589	0.9	17.9	3.20	0.5	18	65	1.4	0.8	On-grade inlet, bypass to DP6 Capture to DP1
	1	A1	4.95	0.76	16.4	3.75	5.69	21.3	17.7	6.95	5.49	38.2	1.3	0.237	0.9	36.9	6.71	0.5	24	860	1.4	10.1	On-grade inlet, bypass to DP4 Capture to DP5
	4	A4	1.63	0.75	10.0	1.22	6.94	8.5	27.9	1.46	4.35	6.3	2.0	0.46	0.9	4.3	1.00	0.5	18	25	1.4	0.3	On-grade inlet, bypass to future Briargate Pkwy Capture to DP5
	5								26.5	7.71	4.47	34.5				34.5	7.71	0.5	24	96	1.4	1.1	Manhole Piped to DP6
	6	A3	2.01	0.73	8.8	1.46	7.27	10.6	26.5	9.76	4.47	43.7	2.5	0.559	0.9	41.2	9.20	0.3	36	333	1.1	5.1	On-grade inlet, bypass to future Briargate Pkwy Capture to DP6.1
	OS2	OS2	39.27	0.36	16.6	14.14	5.65	80.0	36.2	87.01	3.69	320.9											Future Development to Interim Pond FSD16
	OS2.1															147.9	27.58	1.5	48	2740	2.4	18.6	Pond FSD16 Outfall Piped to DP26.A
	7	B2	2.06	0.71	8.2	1.47	7.44	10.9					1.3	0.175	0.9	9.6	1.30	0.5	18	59	1.4	0.7	On-grade inlet, bypass to DP10 Capture to DP8
	8	B1	1.90	0.75	7.7	1.42	7.58	10.8	10.3	3.35	6.87	23.0	2.3	0.335	0.9	20.7	3.01	2.2	18	1000	3.0	5.6	On-grade inlet, bypass to DP11 Capture conveyed via swale to DP13
	10	B4	1.33	0.72	9.0	0.96	7.19	6.9	9.0	1.13	7.19	8.2	2.7	0.376	0.9	5.5	0.76	0.5	18	60	1.4	0.7	On-grade inlet, bypass to DP14 Capture to DP12
	11	B3	1.27	0.74	8.6	0.94	7.31	6.9	13.4	2.03	6.20	12.6	1.2	0.193	0.9	11.4	1.84	4.0	18	200	4.0	0.8	On-grade inlet, bypass to DP15 Capture to DP12
	13								15.9	4.86	5.77	28.0				28.0	4.86	2.0	60	560	2.8	3.3	Inlet outflow Converyed via swale to Pond FSD14A
	14	B6	0.91	0.74	7.1	0.67	7.81	5.2	9.7	1.05	7.00	7.3	1.0	0.143	0.9	6.3	0.90	0.5	18	60	1.4	0.7	On-grade inlet, bypass to DP18 Capture to DP16
	15	B5	0.89	0.72	7.6	0.64	7.63	4.9	14.2	1.74	6.05	10.5	1.0	0.165	0.9	9.5	1.57	7.0	18	170	5.3	0.5	On-grade inlet, bypass to DP19 Capture to DP17

151.0 cfs per pond spreadsheet

JR RESPONDED: CHANGED

STANDARD FORM SF-3 - PROPOSED
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

Subdivision: Sterling Ranch Rd & Briargate Pkwy
Location: El Paso County
Design Storm: 100-Year

Project Name: Sterling Ranch Phase 3
Project No.: 25188.03
Calculated By: CGV
Checked By: RAB
Date: 12/2/21

Description	Design Point	DIRECT RUNOFF							TOTAL RUNOFF				STREET/SWALE			PIPE				TRAVEL TIME			REMARKS
		Basin ID	Area (ac)	Runoff Coeff.	t_c (min)	C*A (ac)	I (in/hr)	Q (cfs)	tc (min)	C*A (ac)	I (in/hr)	Q (cfs)	$Q_{street/swale}$ (cfs)	C*A (ac)	Slope (%)	Q_{pipe} (cfs)	C*A (ac)	Slope (%)	Pipe Size (inches)	Length (ft)	Velocity (fps)	t_t (min)	
	17								19.2	6.43	5.29	34.0				34.0	6.43	2.0	60	700	2.8	4.1	Outlet structure Captured conveyed via a swale to Pond Fsd14a
	18	B8	1.16	0.70	7.6	0.81	7.63	6.2	10.4	0.95	6.82	6.5	1.0	0.147	0.9	5.5	0.81	5.0	18	54	4.5	0.2	On-grade inlet, bypass to DP22 Capture to DP20
	19	B7	1.08	0.67	8.0	0.72	7.50	5.4	14.7	1.69	5.96	10.1	1.0	0.168	0.9	9.1	1.52	5.0	18	103	4.5	0.4	On-grade inlet, bypass to DP23 Capture to DP20
	20								23.3	7.95	4.80	38.2				38.2	7.95	2.5	60	300	3.2	1.6	Inlet outflow Captured conveyed via a swale to Pond FSD14A
	22	B10	2.19	0.67	7.8	1.47	7.54	11.1	10.6	1.62	6.77	11.0				11.0	1.62	0.5	18	53	1.4	0.6	Sump Inlet Piped to DP23
	23	B9	1.98	0.66	7.9	1.30	7.53	9.8	15.1	3.08	5.89	18.2				18.2	3.08	0.5	18	328	1.4	3.9	Sump Inlet Piped to Pond FSD14A
	25	B11	126.23	0.36	26.9	45.44	4.44	201.7	26.9	56.47	4.44	250.7				250.7	56.47						Pond FSD14A
	26	C1	5.87	0.36	16.0	2.11	5.75	12.1								12.1	2.11						To Pond FSD 14B
	26.1								16.0	2.11	5.75	12.1				12.1	0.79	4.0	18	84	4.0	0.4	Outflow from future pond FSD14B Piped to DP26A
	26A								18.6	29.69	5.36	159.2				159.2	29.69	1.8	54	2280	2.7	14.2	Manhole. Flow from MDDP DP21 Piped to DP27
	25.1															126.3	11.47	0.5	24	168	1.4	2.0	Outflow from Pond FSD14B Piped to DP27
	27								32.8	41.16	3.94	162.1											Manhole Confluenced flow from Pond FSD14A and DP26A

Notes:
Street and Pipe C*A values are determined by Q/i using the catchment's intensity value.
All pipes are private and RCP unless otherwise noted. Pipe size shown in table column.

Majority of pipes are shown as public on CD's and drainage map.

JR RESPONDED: updated as public

Include DP 27

JR RESPONDED: DP 27 ADDED

Flows shown are less than flows in proposed hydrology spreadsheet. Future flows are not included to compare against

JR RESPONDED: In the future condition these outfall locations will not exist and will be connected with storm piped through the subdivision to the proposed ponds. Future storm pipe and outfall riprap will be sized with future condition.

PIPE OUTFALL RIPRAP SIZING CALCULATIONS

ivision: Sterling Ranch Rd & Briargate Pkwy
cation: El Paso County

Project Name: Sterling Ranch Phase 3
Project No.: 25188.03
Calculated By: CGV
Checked By: RAB
Date: 12/2/21

	STORM DRAIN SYSTEM			
	DESIGN POINT 13	**DESIGN POINT 17**	**DESIGN POINT 20**	**Notes**
	12.6	10.5	10.1	Flows are the greater of proposed vs. future
	Pipe	Pipe	Pipe	
	18	18	18	
	N/A			
	N/A			
	0.60	0.60	0.60	If unknown, use Y_t/D_c (or H)=0.4
Y_t/Dc or Y_t/H	0.40	0.40	0.40	
$Q/D^{2.5}$ or $Q/(WH^{3/2})$	4.58	3.81	3.66	
Supercritical?	No	No	No	
Y_n, Normal Depth (ft) [Supercritical]:				
D_a, H_a (in) [Supercritical]:	N/A	N/A	N/A	$D_a=(D_c+Y_n)/2$
Riprap d_{50} (in) [Supercritical]:	N/A	N/A	N/A	
Riprap d_{50} (in) [Subcritical]:	5.69	4.74	4.55	
Required Riprap Size:	**L**	**L**	**L**	**Fig. 9-38 or Fig. 9-36**
d_{50} (in):	**9**	**9**	**9**	
Expansion Factor, $1/(2\tan\theta)$:	3.00	3.50	4.00	Read from Fig. 9-35 or 9-36
θ:	0.17	0.14	0.12	
Erosive Soils?	No			
Area of Flow, A_t (ft^2):	1.80	1.50	1.44	$A_t=Q/V$
Length of Protection, L_p (ft):	4.5	3.5	3.6	L=(1/(2 tan θ))(At/Yt - D)
Min Length (ft)	4.5	4.5	4.5	Min L=3D or 3H
Max Length (ft)	15.0	15.0	15.0	Max L=10D or 10H
Min Bottom Width, T (ft):	3.0	2.5	2.4	$T=2*(L_p*\tan\theta)+W$
Design Length (ft)	**5.0**	**4.5**	**4.5**	
Design Width (ft)	**3.0**	**2.5**	**2.4**	
Riprap Depth (in)	**18**	**18**	**18**	Depth=2(d_{50})
Type II Bedding Depth (in)*	6	6	6	*Not used if Soil Riprap
Cutoff Wall	No			
Cutoff Wall Depth (ft)				Depth of Riprap and Base
Cutoff Wall Width (ft)				

Note: No Type II Base to be used if Soil Riprap is specified within the plans

* For use when the flow in the culvert is supercritical (and less than full).

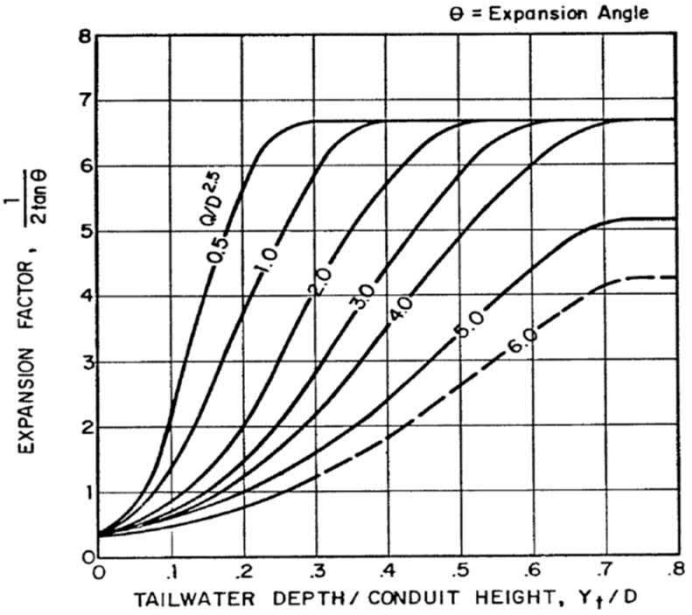


Figure 9-35. Expansion factor for circular conduits

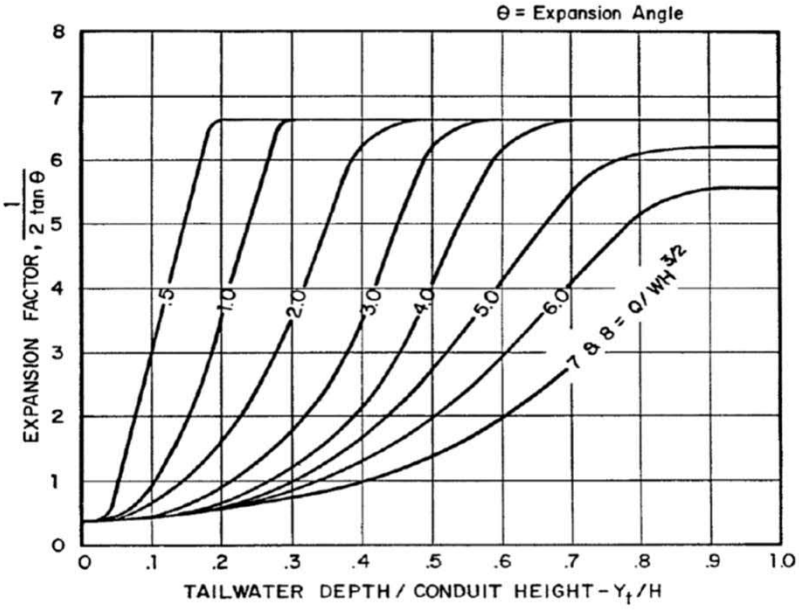


Figure 9-36. Expansion factor for rectangular conduits

Flows shown are less than flows in proposed hydrology spreadsheet. Future flows are not included to compare against

JR RESPONDED: In the future condition these outfall locations will not exist and will be connected with storm piped through the subdivision to the proposed ponds. Future storm pipe and outfall riprap will be sized with future condition.

PIPE OUTFALL RIPRAP SIZING CALCULATIONS

sion: Sterling Ranch Rd & Briargate Pkwy
tion: El Paso County

Project Name: Sterling Ranch Phase 3
Project No.: 25188.03
Calculated By: CGV
Checked By: RAB
Date: 12/2/21

	STORM DRAIN SYSTEM			
	DESIGN POINT 8	**DESIGN POINT 23**	**DESIGN POINT 6**	**Notes**
	10.8	18.2	41.2	Flows are the greater of proposed vs. future
	Pipe	Pipe	Pipe	
	18	18	36	
	N/A			
	N/A			
	0.60	0.60	1.20	If unknown, use Y_t/D_c (or H)=0.4
Y_t/Dc or Y_t/H	0.40	0.40	0.40	
$Q/D^{2.5}$ or $Q/(WH^{3/2})$	3.90	6.59	2.64	
Supercritical?	No	No	No	
Y_n, Normal Depth (ft) [Supercritical]:				
D_a, H_a (in) [Supercritical]:	N/A	N/A	N/A	$D_a=(D_c+Y_n)/2$
Riprap d_{50} (in) [Supercritical]:	N/A	N/A	N/A	
Riprap d_{50} (in) [Subcritical]:	4.85	8.20	6.57	
Required Riprap Size:	**L**	**L**	**L**	**Fig. 9-38 or Fig. 9-36**
d_{50} (in):	**9**	**9**	**9**	
Expansion Factor, $1/(2\tan\theta)$:	3.50	1.50	5.00	Read from Fig. 9-35 or 9-36
θ:	0.14	0.32	0.10	
Erosive Soils?	No	No	No	
Area of Flow, A_t (ft^2):	1.54	2.60	5.88	$A_t=Q/V$
Length of Protection, L_p (ft):	3.7	4.2	9.5	L=(1/(2 tan θ))(At/Yt - D)
Min Length (ft)	4.5	4.5	9.0	Min L=3D or 3H
Max Length (ft)	15.0	15.0	30.0	Max L=10D or 10H
Min Bottom Width, T (ft):	2.6	4.2	4.9	$T=2*(L_p*\tan\theta)+W$
Design Length (ft)	**4.5**	**4.5**	**10.0**	
Design Width (ft)	**2.6**	**4.2**	**4.9**	
Riprap Depth (in)	**18**	**18**	**18**	Depth=2(d_{50})
Type II Bedding Depth (in)*	6	6	6	*Not used if Soil Riprap
Cutoff Wall	No			
Cutoff Wall Depth (ft)				Depth of Riprap and Base
Cutoff Wall Width (ft)				

Note: No Type II Base to be used if Soil Riprap is specified within the plans

* For use when the flow in the culvert is supercritical (and less than full).

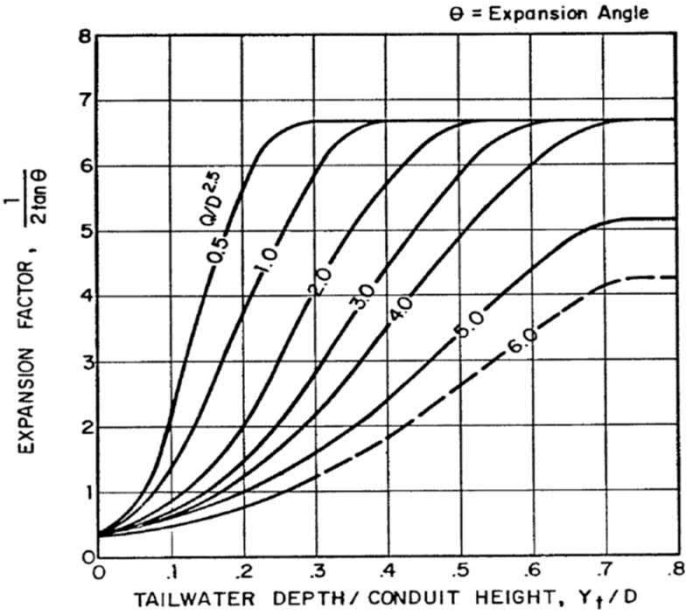


Figure 9-35. Expansion factor for circular conduits

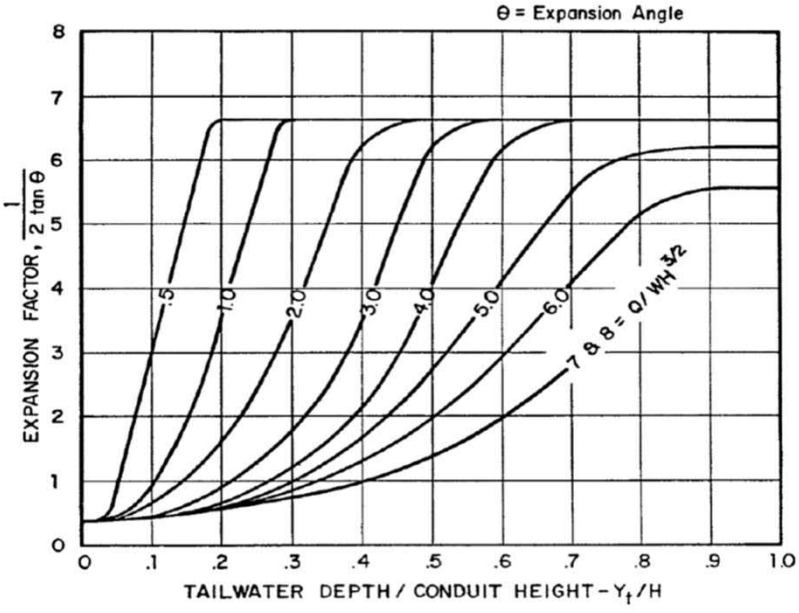


Figure 9-36. Expansion factor for rectangular conduits

Appendix C
Hydraulic Calculations

JR Calcs provided

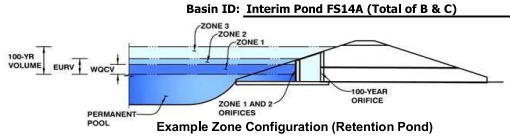
Include design calcs for spillway riprap

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Sterling Ranch - East of Sand Creek

Basin ID: Interim Pond FS14A (Total of B & C)



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	147.00	acres
Watershed Length =	3,300	ft
Watershed Length to Centroid =	1,350	ft
Watershed Slope =	0.034	ft/ft
Watershed Imperviousness =	7.90%	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) =	0.669	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.071	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.734	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	4.043	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	6.377	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	10.639	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	13.499	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	17.662	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 4 in.) =	35.931	acre-feet	4.00	inches
Approximate 2-yr Detention Volume =	0.667	acre-feet		
Approximate 5-yr Detention Volume =	1.068	acre-feet		
Approximate 10-yr Detention Volume =	2.473	acre-feet		
Approximate 25-yr Detention Volume =	3.580	acre-feet		
Approximate 50-yr Detention Volume =	3.716	acre-feet		
Approximate 100-yr Detention Volume =	4.866	acre-feet		

Define Zones and Basin Geometry

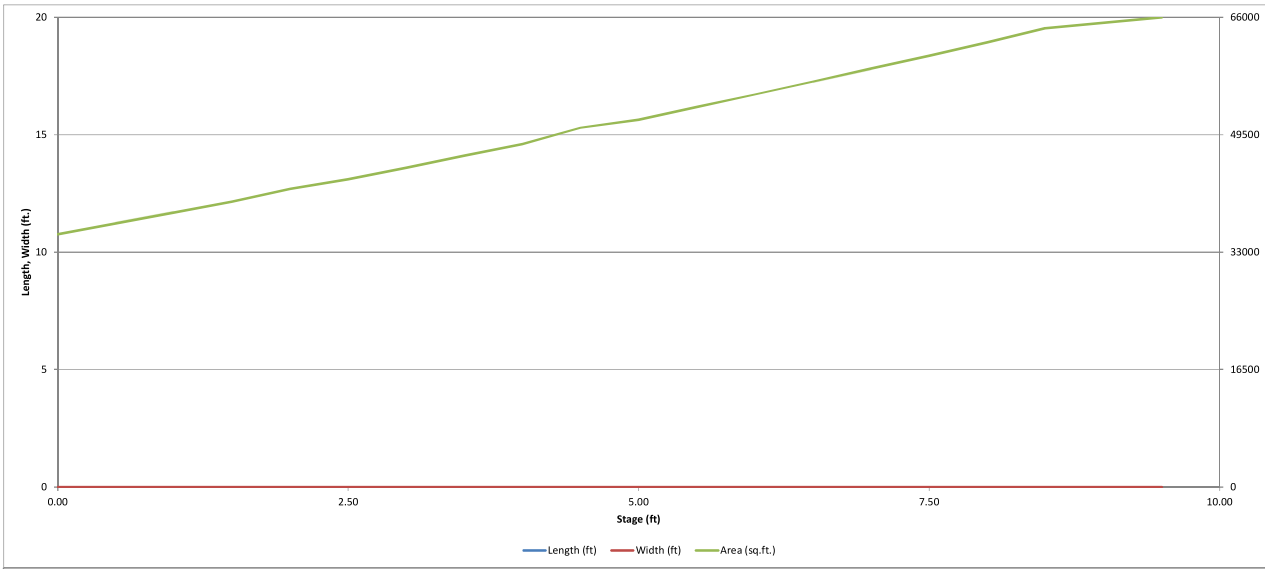
Zone 1 Volume (WQCV) =	0.669	acre-feet
Zone 2 Volume (100-year - Zone 1) =	4.197	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	4.866	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

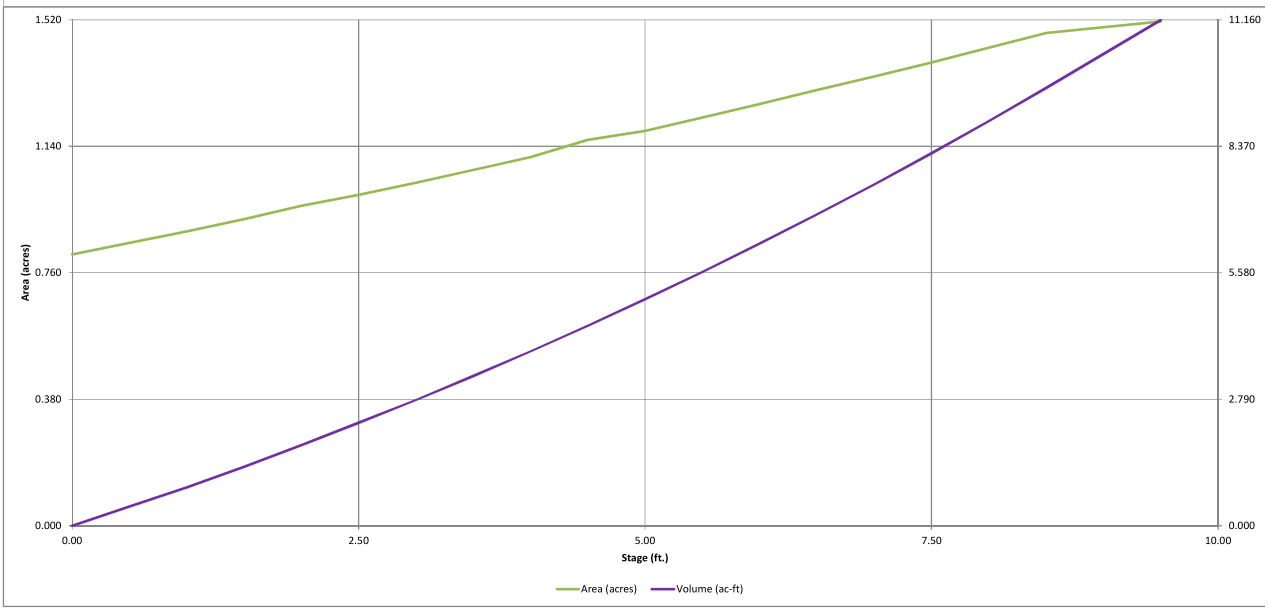
Depth Increment = 0.50 ft

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	--	--	--	35,513	0.815		
7010.5	--	0.50	--	--	--	37,022	0.850	18,134	0.416
7011	--	1.00	--	--	--	38,551	0.885	37,027	0.850
7011.5	--	1.50	--	--	--	40,104	0.921	56,691	1.301
7012	--	2.00	--	--	--	41,871	0.961	77,184	1.772
7012.5	--	2.50	--	--	--	43,283	0.994	98,473	2.261
7013	--	3.00	--	--	--	44,909	1.031	120,521	2.767
7013.5	--	3.50	--	--	--	46,560	1.069	143,388	3.292
7014	--	4.00	--	--	--	48,236	1.107	167,087	3.836
7014.5	--	4.50	--	--	--	50,507	1.159	191,773	4.403
7015	--	5.00	--	--	--	51,660	1.186	217,315	4.989
7015.5	--	5.50	--	--	--	53,409	1.226	243,582	5.592
7016	--	6.00	--	--	--	55,182	1.267	270,730	6.215
7016.5	--	6.50	--	--	--	56,980	1.308	298,771	6.859
7017	--	7.00	--	--	--	58,803	1.350	327,716	7.523
7017.5	--	7.50	--	--	--	60,650	1.392	357,579	8.209
7018	--	8.00	--	--	--	62,521	1.435	388,372	8.916
7018.5	--	8.50	--	--	--	64,486	1.480	420,124	9.645
7019.5	--	9.50	--	--	--	66,000	1.515	485,367	11.142

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



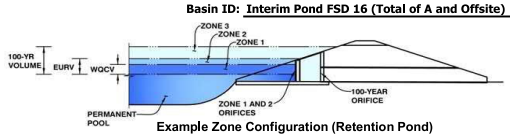


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Sterling Ranch - East of Sand Creek

Basin ID: Interim Pond FSD 16 (Total of A and Offsite)



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	229.69	acres
Watershed Length =	4,600	ft
Watershed Length to Centroid =	3,200	ft
Watershed Slope =	0.034	ft/ft
Watershed Imperviousness =	5.80%	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) =	0.793	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	1.199	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.358	acre-feet	1.19 inches
5-yr Runoff Volume (P1 = 1.5 in.) =	5.857	acre-feet	1.50 inches
10-yr Runoff Volume (P1 = 1.75 in.) =	9.449	acre-feet	1.75 inches
25-yr Runoff Volume (P1 = 2 in.) =	16.170	acre-feet	2.00 inches
50-yr Runoff Volume (P1 = 2.25 in.) =	20.605	acre-feet	2.25 inches
100-yr Runoff Volume (P1 = 2.52 in.) =	27.138	acre-feet	2.52 inches
500-yr Runoff Volume (P1 = 4 in.) =	55.586	acre-feet	4.00 inches
Approximate 2-yr Detention Volume =	0.723	acre-feet	
Approximate 5-yr Detention Volume =	1.187	acre-feet	
Approximate 10-yr Detention Volume =	3.244	acre-feet	
Approximate 25-yr Detention Volume =	4.878	acre-feet	
Approximate 50-yr Detention Volume =	4.997	acre-feet	
Approximate 100-yr Detention Volume =	6.636	acre-feet	

Define Zones and Basin Geometry

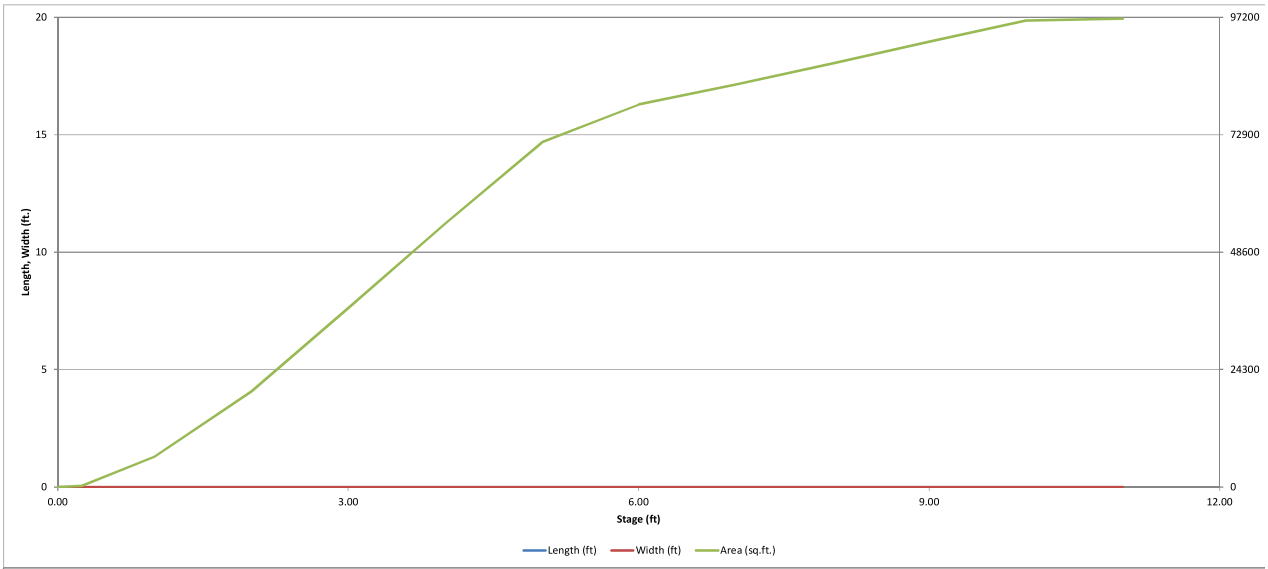
Zone 1 Volume (WQCV) =	0.793	acre-feet
Zone 2 Volume (100-year - Zone 1) =	5.843	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	6.636	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

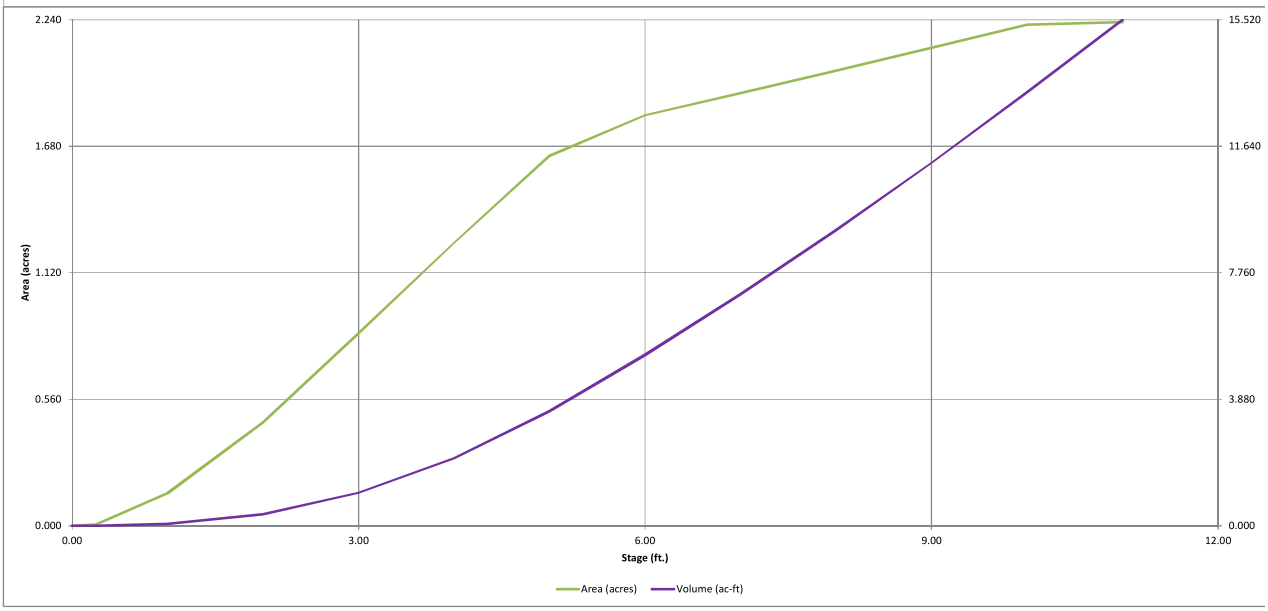
Depth Increment = 1.00 ft

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	--	--	--	0	0.000		
7093	--	0.25	--	--	--	247	0.006	31	0.001
7094	--	1.00	--	--	--	6,288	0.144	2,481	0.057
7095	--	2.00	--	--	--	19,829	0.455	15,540	0.357
7096	--	3.00	--	--	--	36,992	0.849	43,951	1.009
7097	--	4.00	--	--	--	54,484	1.251	89,689	2.059
7098	--	5.00	--	--	--	71,338	1.638	152,600	3.503
7099	--	6.00	--	--	--	79,154	1.817	227,846	5.231
7100	--	7.00	--	--	--	83,341	1.913	309,093	7.096
7101	--	8.00	--	--	--	87,657	2.012	394,592	9.059
7102	--	9.00	--	--	--	92,163	2.116	484,502	11.123
7103	--	10.00	--	--	--	96,555	2.217	578,861	13.289
7104	--	11.00	--	--	--	97,000	2.227	675,638	15.511

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)



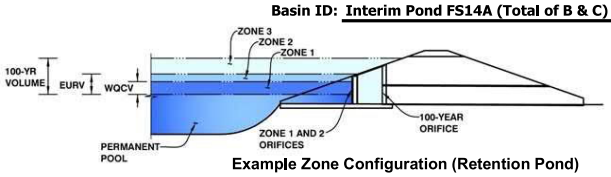


DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Sterling Ranch - East of Sand Creek**

Basin ID: **Interim Pond FS14A (Total of B & C)**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.80	0.669	Orifice Plate
Zone 2 (100-year)	4.90	4.197	Weir&Pipe (Restrict)
Zone 3			
Total (all zones)		4.866	

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

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

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 =	8.375E-02	ft^2
Depth at top of Zone using Orifice Plate =	4.90	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 =	12.06	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.75	1.50	2.25				
Orifice Area (sq. inches)	12.06	12.06	12.06	12.06				

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

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

	Zone 2 Weir	Not Selected			Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.75		ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	5.86		feet
Overflow Weir Front Edge Length =	7.00		feet	Overflow Weir Slope Length =	12.80		feet
Overflow Weir Grate Slope =	4.00		H:V	Grate Open Area / 100-yr Orifice Area =	6.33	N/A	
Horiz. Length of Weir Sides =	12.42		feet	Overflow Grate Open Area w/o Debris =	70.89	N/A	ft^2
Overflow Grate Type =	Close Mesh Grate	N/A		Overflow Grate Open Area w/ Debris =	17.72	N/A	ft^2
Debris Clogging % =	75%		%				

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

	Zone 2 Restrictor	Not Selected			Zone 2 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	3.35		ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	11.19		ft^2
Outlet Pipe Diameter =	48.00		inches	Outlet Orifice Centroid =	1.80		feet
Restrictor Plate Height Above Pipe Invert =	40.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.30	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.50	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.71	feet
Spillway Crest Length =	120.00	feet	Stage at Top of Freeboard =	9.21	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.51	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	10.70	acre-ft

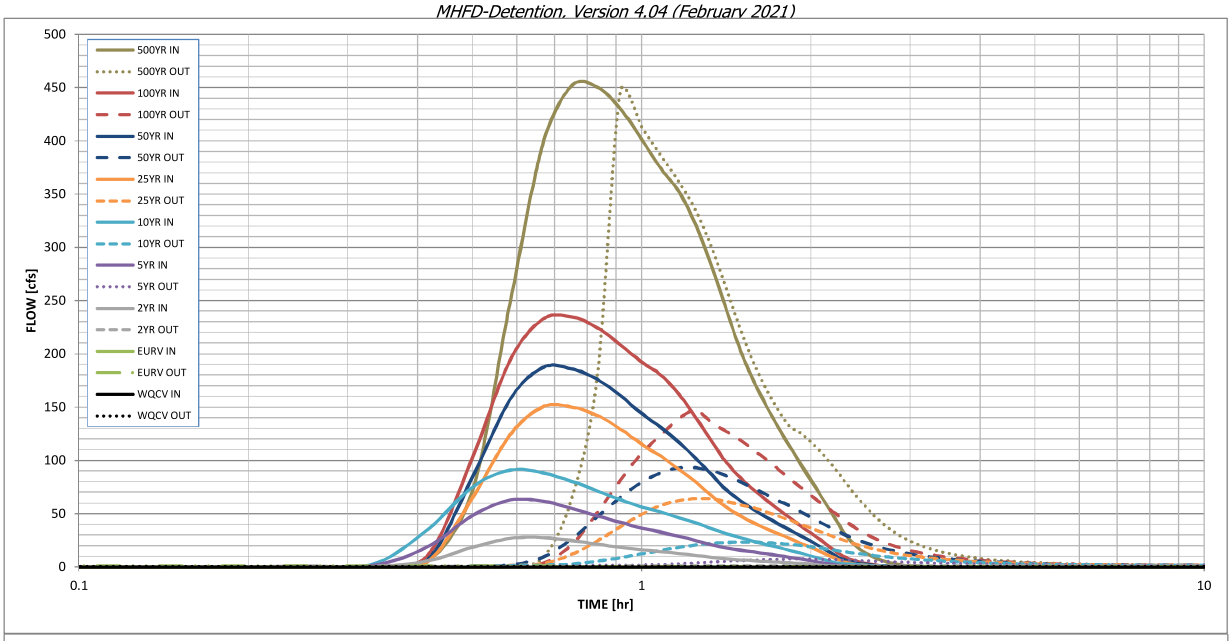
Routed Hydrograph Results

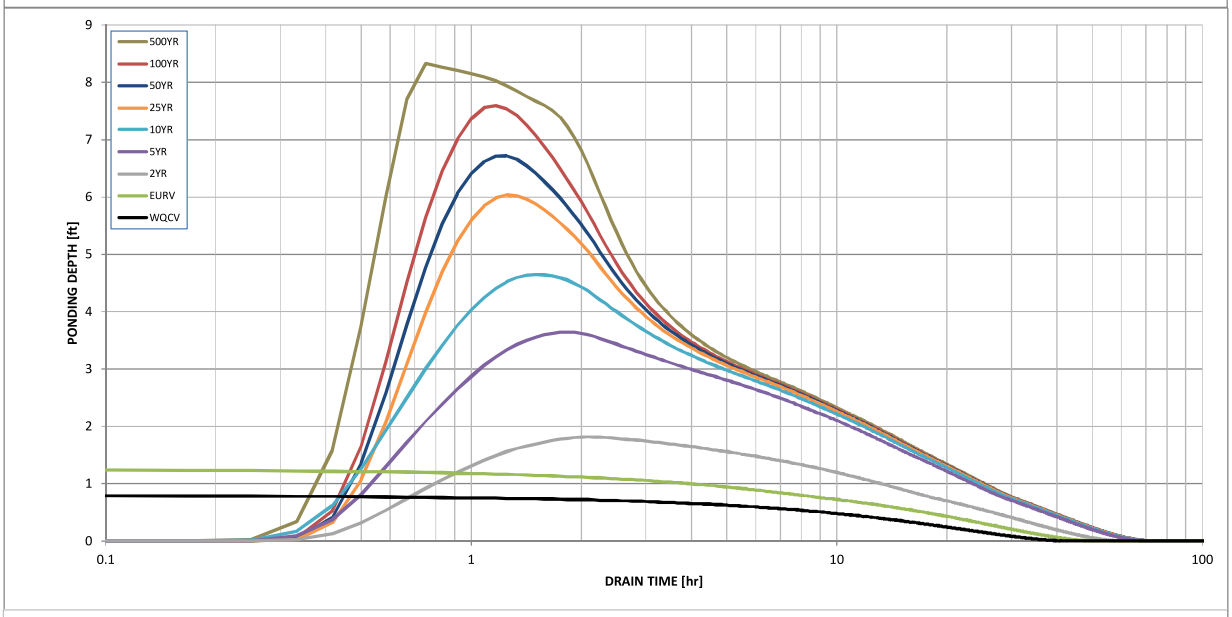
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

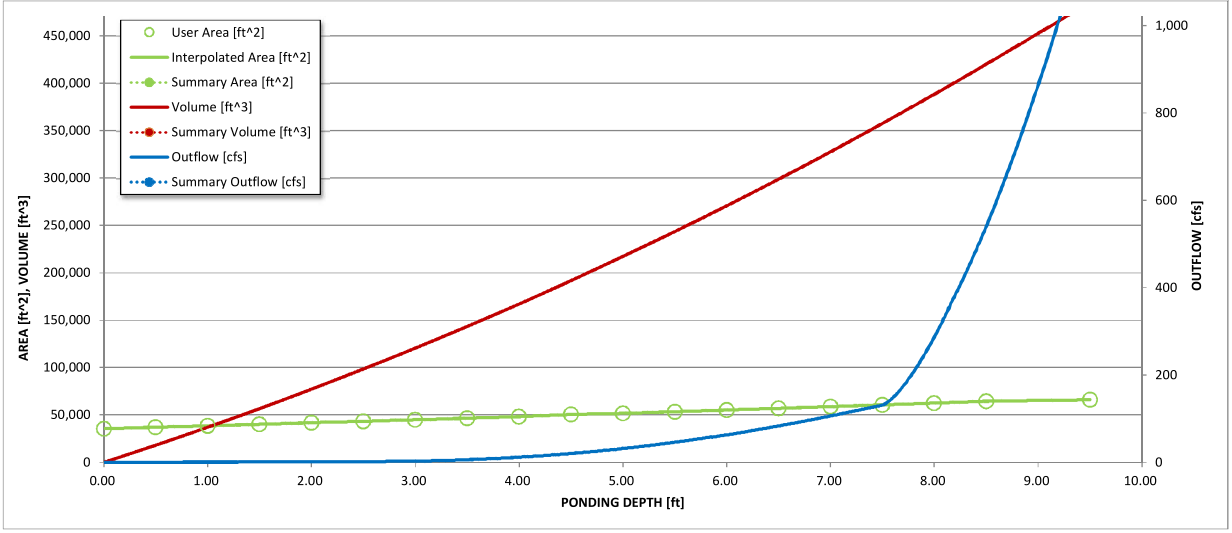
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	4.00
CUHP Runoff Volume (acre-ft) =	0.669	1.071	1.734	4.043	6.377	10.639	13.499	17.662	35.931
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	1.734	4.043	6.377	10.639	13.499	17.662	35.931
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	19.5	53.6	80.5	143.4	179.6	228.4	445.4
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.13	0.36	0.55	0.98	1.22	1.55	3.03
Peak Inflow Q (cfs) =	N/A	N/A	27.6	62.7	90.8	150.2	187.2	235.0	451.4
Peak Outflow Q (cfs) =	0.4	0.7	1.2	7.5	23.2	64.3	93.1	146.9	446.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.3	0.4	0.5	0.6	1.0
Structure Controlling Flow =	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	0.1	0.3	0.9	1.3	1.9	2.3
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) =	37	43	49	53	49	43	39	34	21
Time to Drain 99% of Inflow Volume (hours) =	**40**	47	55	61	59	56	54	51	41
Maximum Ponding Depth (ft) =	0.80	1.25	1.82	3.64	4.65	6.04	6.72	7.60	8.33
Area at Maximum Ponding Depth (acres) =	0.87	0.90	0.95	1.08	1.17	1.27	1.33	1.40	1.46
Maximum Volume Stored (acre-ft) =	0.674	1.074	1.591	3.442	4.565	6.253	7.135	8.335	9.380

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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	0.01	0.00	0.11
	0:15:00	0.00	0.00	0.13	0.21	0.26	0.17	0.22	0.21	0.50
	0:20:00	0.00	0.00	0.53	1.51	2.73	0.55	0.66	0.74	5.19
	0:25:00	0.00	0.00	5.62	18.97	35.23	5.35	7.03	11.05	70.75
	0:30:00	0.00	0.00	18.47	48.23	74.81	64.61	84.08	102.30	247.51
	0:35:00	0.00	0.00	26.76	62.71	90.80	123.75	156.94	193.88	395.99
	0:40:00	0.00	0.00	27.62	61.79	88.29	150.18	187.20	232.42	451.44
	0:45:00	0.00	0.00	24.80	54.97	80.38	150.23	186.03	235.01	450.57
	0:50:00	0.00	0.00	21.45	48.07	71.44	142.31	176.15	224.62	430.19
	0:55:00	0.00	0.00	18.56	41.86	63.03	129.45	160.88	208.64	401.41
	1:00:00	0.00	0.00	16.26	36.74	56.58	115.14	144.11	192.30	373.62
	1:05:00	0.00	0.00	14.52	32.59	51.34	103.61	130.79	179.96	351.80
	1:10:00	0.00	0.00	12.70	28.67	46.34	91.68	116.59	161.80	320.25
	1:15:00	0.00	0.00	10.80	24.67	41.41	79.29	101.65	139.69	282.17
	1:20:00	0.00	0.00	8.96	20.69	35.80	66.96	86.24	117.50	240.57
	1:25:00	0.00	0.00	7.48	17.69	31.04	55.81	72.05	97.74	202.86
	1:30:00	0.00	0.00	6.57	15.75	27.27	47.81	61.91	83.48	174.06
	1:35:00	0.00	0.00	5.84	14.10	23.98	41.42	53.74	72.25	150.90
	1:40:00	0.00	0.00	5.17	12.41	21.02	36.04	46.81	62.71	131.02
	1:45:00	0.00	0.00	4.51	10.69	18.28	31.17	40.54	54.10	113.14
	1:50:00	0.00	0.00	3.86	9.02	15.66	26.73	34.83	46.18	96.72
	1:55:00	0.00	0.00	3.20	7.39	13.04	22.46	29.34	38.74	81.29
	2:00:00	0.00	0.00	2.54	5.79	10.36	18.34	24.08	31.77	66.84
	2:05:00	0.00	0.00	1.88	4.20	7.68	14.28	18.86	25.09	52.72
	2:10:00	0.00	0.00	1.21	2.64	5.14	10.21	13.62	18.36	38.69
	2:15:00	0.00	0.00	0.67	1.54	3.50	6.29	8.60	11.94	26.61
	2:20:00	0.00	0.00	0.42	1.03	2.62	3.88	5.57	7.83	18.68
	2:25:00	0.00	0.00	0.30	0.77	2.03	2.46	3.72	5.25	13.35
	2:30:00	0.00	0.00	0.23	0.59	1.58	1.60	2.53	3.47	9.41
	2:35:00	0.00	0.00	0.18	0.46	1.22	1.01	1.69	2.20	6.48
	2:40:00	0.00	0.00	0.13	0.36	0.92	0.66	1.15	1.32	4.29
	2:45:00	0.00	0.00	0.10	0.27	0.67	0.42	0.75	0.71	2.66
	2:50:00	0.00	0.00	0.08	0.20	0.48	0.25	0.48	0.34	1.58
	2:55:00	0.00	0.00	0.06	0.14	0.33	0.18	0.33	0.23	1.06
	3:00:00	0.00	0.00	0.05	0.10	0.22	0.13	0.24	0.18	0.74
	3:05:00	0.00	0.00	0.04	0.07	0.16	0.09	0.18	0.14	0.59
	3:10:00	0.00	0.00	0.03	0.05	0.12	0.07	0.14	0.11	0.46
	3:15:00	0.00	0.00	0.02	0.03	0.09	0.05	0.10	0.08	0.34
	3:20:00	0.00	0.00	0.01	0.02	0.06	0.04	0.07	0.06	0.25
	3:25:00	0.00	0.00	0.01	0.01	0.04	0.02	0.05	0.04	0.17
	3:30:00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.02	0.10
	3:35:00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.05
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	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 4.04 (February 2021)

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.

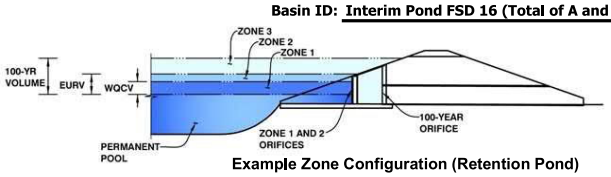
Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Sterling Ranch - East of Sand Creek**

Basin ID: **Interim Pond FSD 16 (Total of A and Offsite)**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.73	0.793	Orifice Plate
Zone 2 (100-year)	6.76	5.843	Weir&Pipe (Restrict)
Zone 3			
Total (all zones)		6.636	

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	ft²
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	2.160E-02	ft²
Depth at top of Zone using Orifice Plate =	2.73	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 =	3.11	sq. inches (diameter = 2 inches)	Elliptical Slot Area =	N/A	ft²

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	1.00	2.00					
Orifice Area (sq. inches)	3.11	3.11	3.11					

	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 =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =			ft²
Depth at top of Zone using Vertical Orifice =			ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =			feet
Vertical Orifice Diameter =			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 2 Weir	Not Selected			Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.50		ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.00		feet
Overflow Weir Front Edge Length =	6.00		feet	Overflow Weir Slope Length =	10.31		feet
Overflow Weir Grate Slope =	4.00		H:V	Grate Open Area / 100-yr Orifice Area =	5.31		
Horiz. Length of Weir Sides =	10.00		feet	Overflow Grate Open Area w/o Debris =	48.92		ft²
Overflow Grate Type =	Close Mesh Grate			Overflow Grate Open Area w/ Debris =	12.23		ft²
Debris Clogging % =	75%		%				

Calculated Parameters for Overflow Weir

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

	Zone 2 Restrictor	Not Selected			Zone 2 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	4.00		ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	9.21		ft²
Outlet Pipe Diameter =	48.00		inches	Outlet Orifice Centroid =	1.54		feet
Restrictor Plate Height Above Pipe Invert =	33.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.96	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	9.20	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.98	feet
Spillway Crest Length =	88.00	feet	Stage at Top of Freeboard =	11.18	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	2.23	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	15.51	acre-ft

Calculated Parameters for Spillway

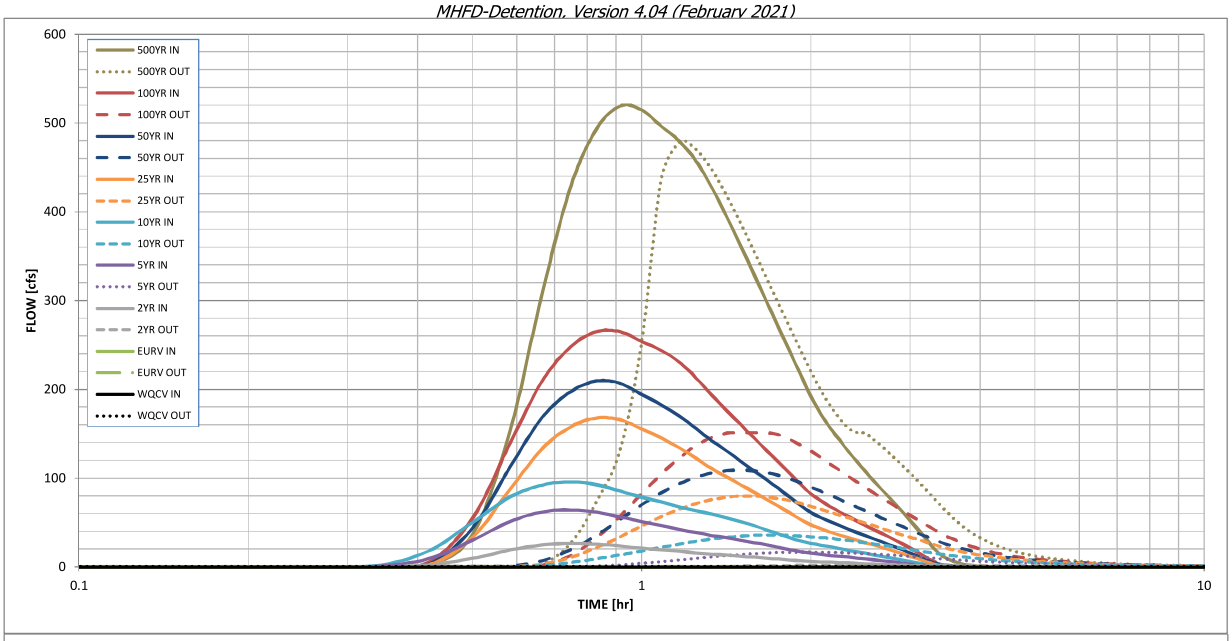
Routed Hydrograph Results

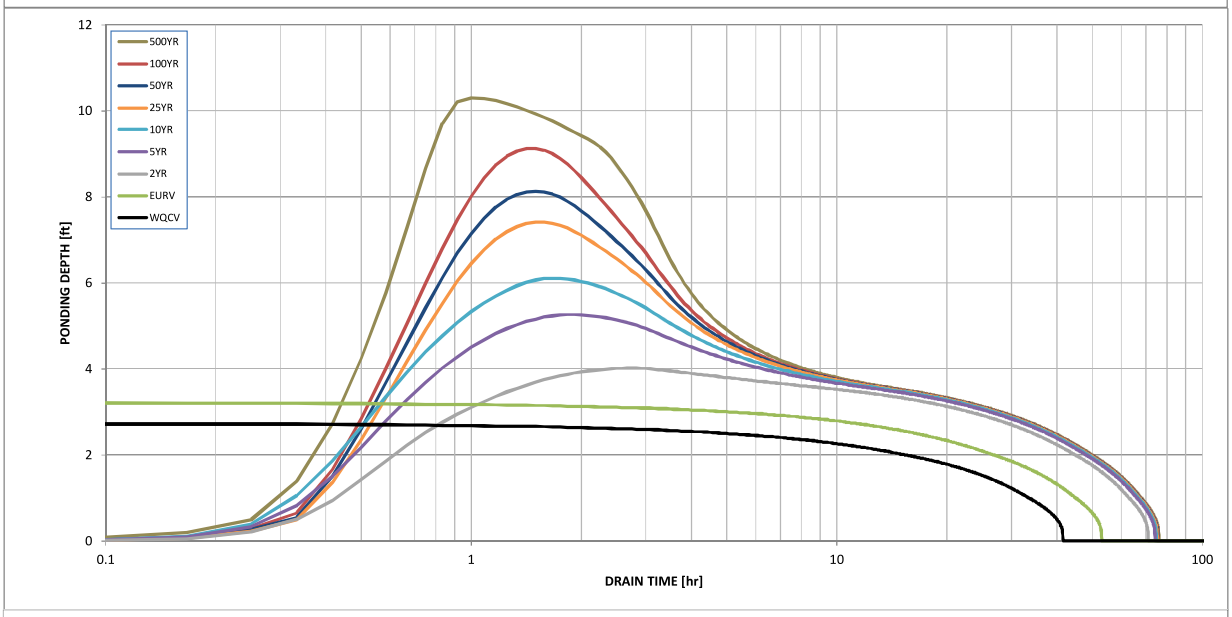
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

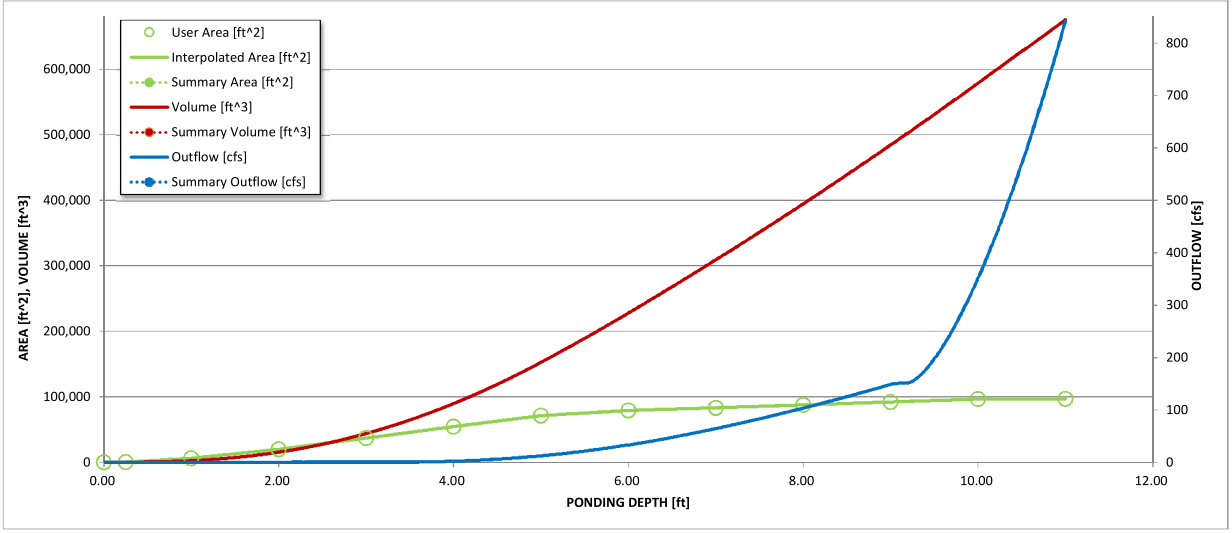
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	4.00
CUHP Runoff Volume (acre-ft) =	0.793	1.199	2.358	5.857	9.449	16.170	20.605	27.138	55.586
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.358	5.857	9.449	16.170	20.605	27.138	55.586
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	20.4	57.7	88.9	161.0	202.4	260.1	511.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.09	0.25	0.39	0.70	0.88	1.13	2.23
Peak Inflow Q (cfs) =	N/A	N/A	26.5	64.3	95.6	167.9	209.4	265.3	519.1
Peak Outflow Q (cfs) =	0.4	0.5	2.2	16.8	36.1	79.8	109.1	151.0	478.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.4	0.5	0.5	0.6	0.9
Structure Controlling Flow =	Plate	Plate	Overflow Weir 1	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	0.03	0.3	0.7	1.6	2.2	3.1	3.2
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	48	62	58	52	44	40	34	12
Time to Drain 99% of Inflow Volume (hours) =	**40**	51	67	66	64	60	57	54	42
Maximum Ponding Depth (ft) =	2.73	3.22	4.02	5.26	6.11	7.42	8.13	9.13	10.31
Area at Maximum Ponding Depth (acres) =	0.74	0.94	1.26	1.68	1.83	1.95	2.03	2.13	2.22
Maximum Volume Stored (acre-ft) =	0.794	1.206	2.084	3.935	5.431	7.889	9.321	11.377	13.954

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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	0.00	0.00	0.03
	0:15:00	0.00	0.00	0.03	0.06	0.07	0.05	0.06	0.06	0.16
	0:20:00	0.00	0.00	0.17	0.58	1.04	0.19	0.23	0.29	2.02
	0:25:00	0.00	0.00	2.19	9.01	17.54	2.10	2.76	4.82	36.22
	0:30:00	0.00	0.00	9.72	29.96	50.11	33.16	43.44	54.33	152.98
	0:35:00	0.00	0.00	19.11	51.14	78.63	87.29	112.20	139.06	310.49
	0:40:00	0.00	0.00	24.89	62.14	92.34	133.44	168.71	209.84	430.56
	0:45:00	0.00	0.00	26.46	64.28	95.64	158.08	197.94	248.58	494.41
	0:50:00	0.00	0.00	25.69	61.72	92.46	167.86	209.44	265.30	519.14
	0:55:00	0.00	0.00	23.58	56.41	85.24	165.74	206.70	264.88	514.82
	1:00:00	0.00	0.00	21.18	50.97	78.61	155.42	194.39	253.89	496.57
	1:05:00	0.00	0.00	19.37	46.59	73.12	145.13	182.67	243.99	479.59
	1:10:00	0.00	0.00	17.65	42.43	67.85	134.24	170.01	230.90	457.09
	1:15:00	0.00	0.00	15.96	38.63	63.38	122.27	155.84	212.59	427.06
	1:20:00	0.00	0.00	14.51	35.48	59.56	110.89	142.13	193.45	394.50
	1:25:00	0.00	0.00	13.31	32.76	55.46	101.33	130.25	176.27	362.09
	1:30:00	0.00	0.00	12.19	30.13	50.98	92.51	119.02	160.22	329.95
	1:35:00	0.00	0.00	11.10	27.53	46.41	84.17	108.32	145.33	299.39
	1:40:00	0.00	0.00	10.03	24.90	41.86	76.26	98.15	131.58	270.74
	1:45:00	0.00	0.00	8.96	22.21	37.39	68.56	88.27	118.28	243.14
	1:50:00	0.00	0.00	7.91	19.50	33.08	60.98	78.60	105.36	216.66
	1:55:00	0.00	0.00	6.92	17.10	29.40	53.58	69.19	92.96	192.21
	2:00:00	0.00	0.00	6.19	15.40	26.71	47.39	61.39	82.57	172.21
	2:05:00	0.00	0.00	5.70	14.18	24.55	42.83	55.63	74.66	156.36
	2:10:00	0.00	0.00	5.27	13.09	22.56	39.10	50.80	68.00	142.55
	2:15:00	0.00	0.00	4.86	12.05	20.68	35.81	46.49	62.05	129.95
	2:20:00	0.00	0.00	4.46	11.03	18.87	32.81	42.55	56.62	118.33
	2:25:00	0.00	0.00	4.07	10.05	17.12	30.02	38.86	51.58	107.49
	2:30:00	0.00	0.00	3.68	9.08	15.43	27.32	35.32	46.85	97.34
	2:35:00	0.00	0.00	3.30	8.12	13.79	24.72	31.94	42.45	87.90
	2:40:00	0.00	0.00	2.93	7.18	12.20	22.18	28.66	38.21	78.89
	2:45:00	0.00	0.00	2.56	6.25	10.68	19.66	25.41	33.99	70.09
	2:50:00	0.00	0.00	2.19	5.33	9.18	17.15	22.20	29.79	61.40
	2:55:00	0.00	0.00	1.83	4.41	7.70	14.65	19.00	25.59	52.74
	3:00:00	0.00	0.00	1.46	3.50	6.22	12.15	15.81	21.40	44.09
	3:05:00	0.00	0.00	1.09	2.60	4.75	9.66	12.62	17.21	35.46
	3:10:00	0.00	0.00	0.73	1.71	3.30	7.17	9.44	13.03	26.88
	3:15:00	0.00	0.00	0.40	0.95	2.12	4.71	6.30	8.93	18.92
	3:20:00	0.00	0.00	0.19	0.53	1.47	2.78	3.86	5.68	12.91
	3:25:00	0.00	0.00	0.12	0.37	1.12	1.70	2.50	3.73	9.07
	3:30:00	0.00	0.00	0.09	0.28	0.87	1.05	1.64	2.45	6.38
	3:35:00	0.00	0.00	0.07	0.22	0.68	0.65	1.08	1.56	4.39
	3:40:00	0.00	0.00	0.05	0.17	0.52	0.40	0.71	0.94	2.91
	3:45:00	0.00	0.00	0.04	0.13	0.39	0.25	0.46	0.51	1.83
	3:50:00	0.00	0.00	0.03	0.10	0.28	0.15	0.29	0.24	1.06
	3:55:00	0.00	0.00	0.02	0.07	0.19	0.09	0.18	0.12	0.63
	4:00:00	0.00	0.00	0.02	0.05	0.12	0.06	0.13	0.09	0.42
	4:05:00	0.00	0.00	0.01	0.04	0.08	0.05	0.09	0.07	0.30
	4:10:00	0.00	0.00	0.01	0.02	0.06	0.03	0.07	0.06	0.24
	4:15:00	0.00	0.00	0.01	0.01	0.05	0.02	0.05	0.04	0.18
	4:20:00	0.00	0.00	0.01	0.01	0.03	0.02	0.04	0.03	0.14
	4:25:00	0.00	0.00	0.00	0.01	0.02	0.01	0.03	0.02	0.09
	4:30:00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.06
	4:35:00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.03
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
	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 4.04 (February 2021)

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.

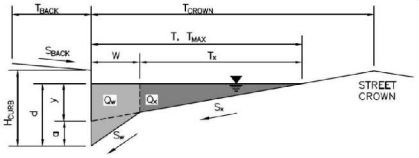
Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Sterling Ranch Road & Briargate Parkway - East of Sand Creek**

Inlet ID: **DP1**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	17.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	39.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.009	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	27.0	27.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

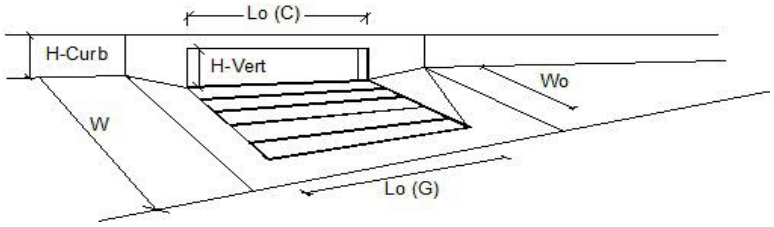
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**16.1**	**42.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

WARNING: MAJOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



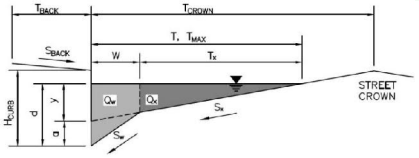
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	4	4	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**10.4**	**16.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**4.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**99**	**80**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Sterling Ranch Road & Briargate Parkway - East of Sand Creek**

Inlet ID: **DP2**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	17.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	39.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.009	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	27.0	27.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

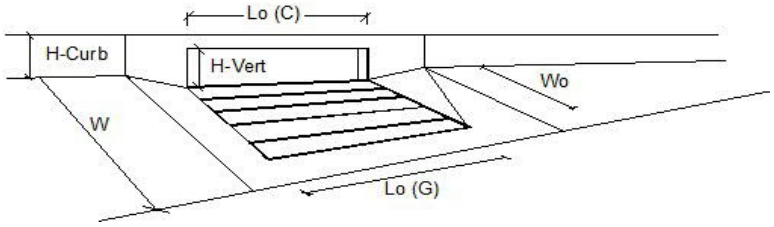
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**16.1**	**42.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

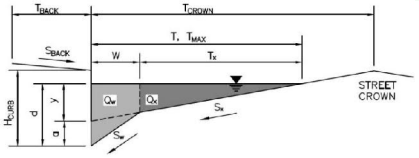


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	4	4	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**10.4**	**16.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.1**	**4.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**99**	**80**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Sterling Ranch Road & Briargate Parkway - East of Sand Creek
Inlet ID: DP4



Gutter Geometry:			
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	17.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	39.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.009	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

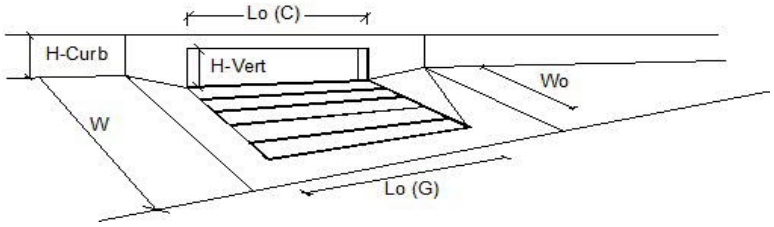
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	27.0	27.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**16.1**	**42.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



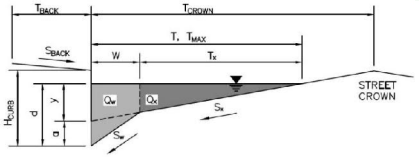
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**4.3**	**10.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**2.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**81**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Sterling Ranch Road & Briargate Parkway - East of Sand Creek

Inlet ID: DP6



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	17.5	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	39.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.009	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	27.0	27.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

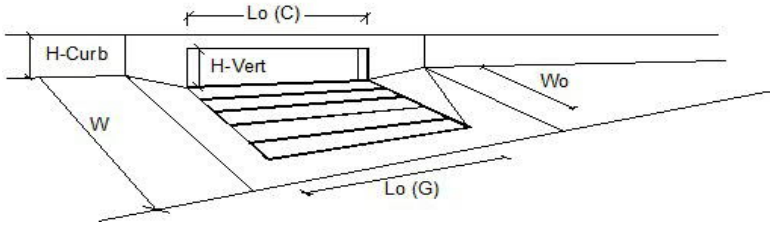
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	Q_{allow} =	**16.1**	**42.8**	**cfs**

WARNING: MINOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'

WARNING: MAJOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



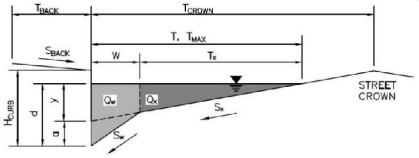
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.2**	**11.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**3.5**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**76**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Sterling Ranch Road & Briargate Parkway - East of Sand Creek**

Inlet ID: **DP7**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	39.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.022	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

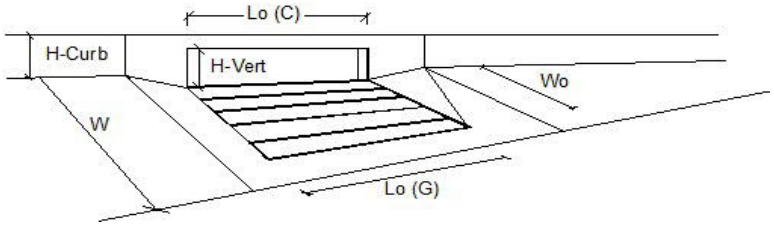
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**24.0**	**51.9**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



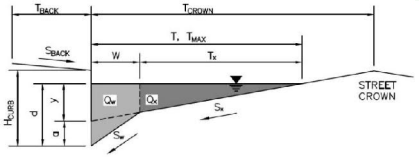
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.2**	**9.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**88**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Sterling Ranch Road & Briargate Parkway - East of Sand Creek

Inlet ID: DP8



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	39.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

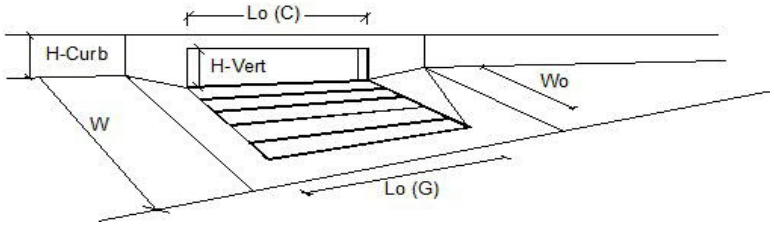
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**20.8**	**20.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**5.3**	**10.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**2.5**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**81**	**%**

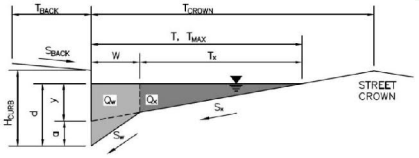
MHFD-Inlet, Version 5.01 (April 2021)

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Sterling Ranch Road & Briargate Parkway - East of Sand Creek

Inlet ID: DP10



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	39.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	29.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

26'

JR CHANGED

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

MINOR STORM Allowable Capacity is based on Depth Criterion

MAJOR STORM Allowable Capacity is based on Depth Criterion

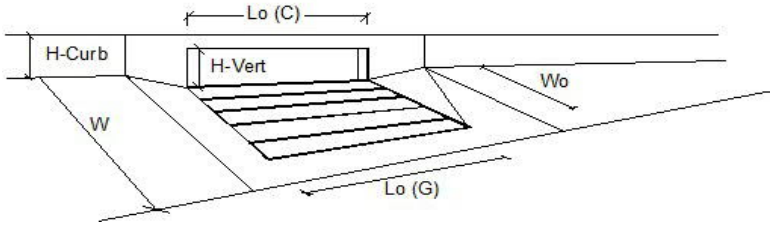
	Minor Storm	Major Storm	
Q_{allow} =	**24.0**	**24.0**	**cfs**

WARNING: MINOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'

WARNING: MAJOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

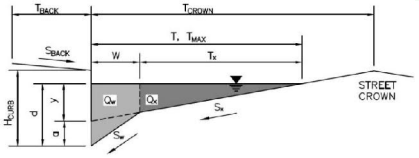


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.3**	**6.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**2.0**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**75**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Sterling Ranch Road & Briargate Parkway - East of Sand Creek
Inlet ID: DP11



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	39.0	ft	26'
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft	
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013		JR CHANGED
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches	
Distance from Curb Face to Street Crown	T_{CROWN} =	29.0	ft	
Gutter Width	W =	2.00	ft	
Street Transverse Slope	S_X =	0.020	ft/ft	
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft	
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.020	ft/ft	
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013		

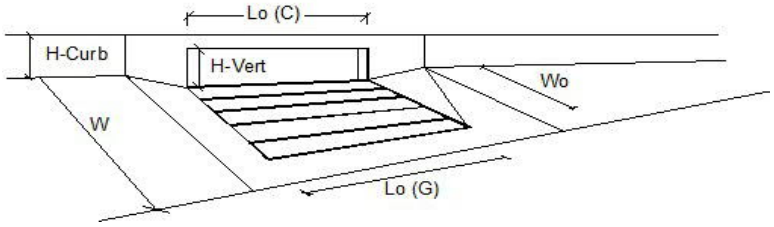
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**24.0**	**24.0**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

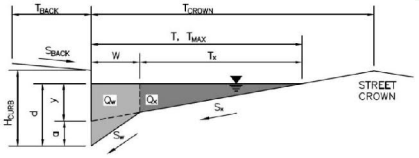


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**3.3**	**5.6**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**82**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Sterling Ranch Road & Briargate Parkway - East of Sand Creek
Inlet ID: DP14



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	39.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	29.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

26'

JR CHANGED

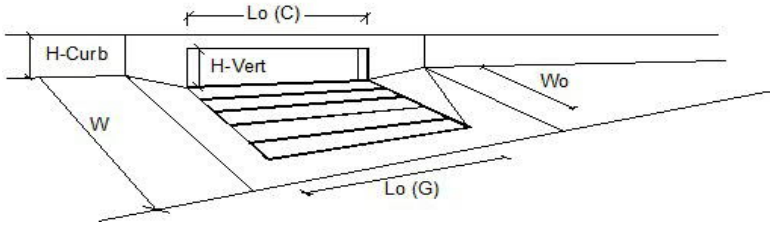
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**20.8**	**20.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)

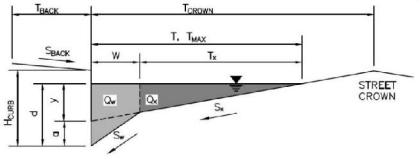


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.5**	**5.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.5**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**80**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Sterling Ranch Road & Briargate Parkway - East of Sand Creek
Inlet ID: DP15



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	39.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	29.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

26'

JR CHANGED

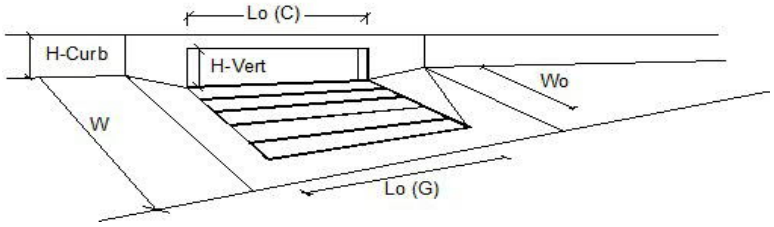
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**20.8**	**20.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



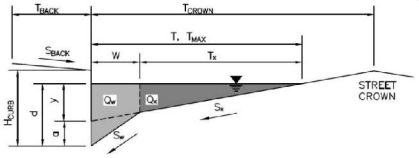
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.4**	**5.3**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.9**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**85**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Sterling Ranch Road & Briargate Parkway - East of Sand Creek**

Inlet ID: **DP18**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	39.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

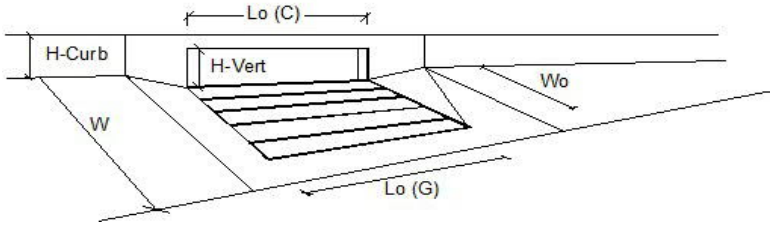
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**20.8**	**20.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



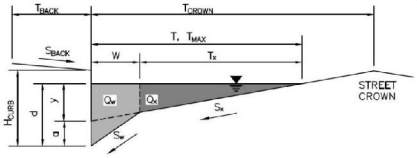
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.9**	**6.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.7**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**78**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Sterling Ranch Road & Briargate Parkway - East of Sand Creek**

Inlet ID: **DP19**



Gutter Geometry:

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	39.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.015	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)		☐	☐	

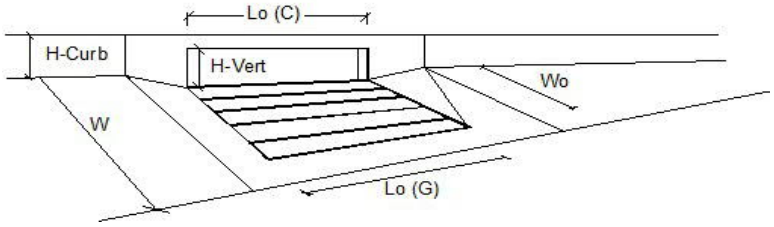
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**20.8**	**20.8**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.01 (April 2021)



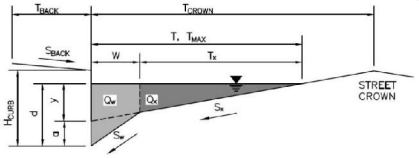
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**2.4**	**4.8**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**0.6**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**89**	**%**

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Sterling Ranch Road & Briargate Parkway - East of Sand Creek**

Inlet ID: **DP22**



Gutter Geometry:

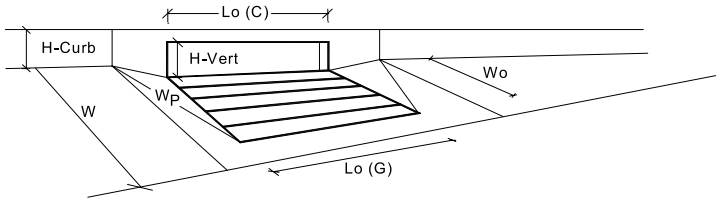
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	39.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.025	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



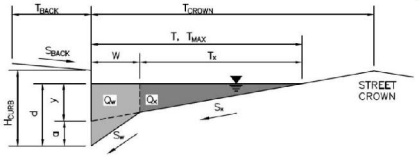
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	0.57	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	0.79	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**13.5**	**13.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	5.0	12.8	cfs

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Sterling Ranch Road & Briargate Parkway - East of Sand Creek**

Inlet ID: **DP23**



Gutter Geometry:

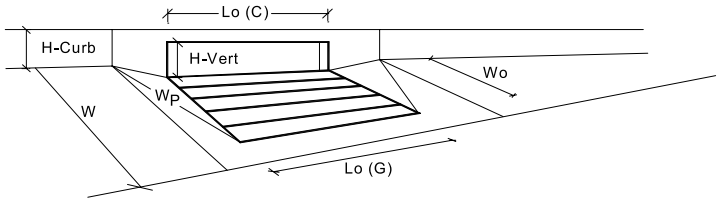
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	39.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.025	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.01 (April 2021)



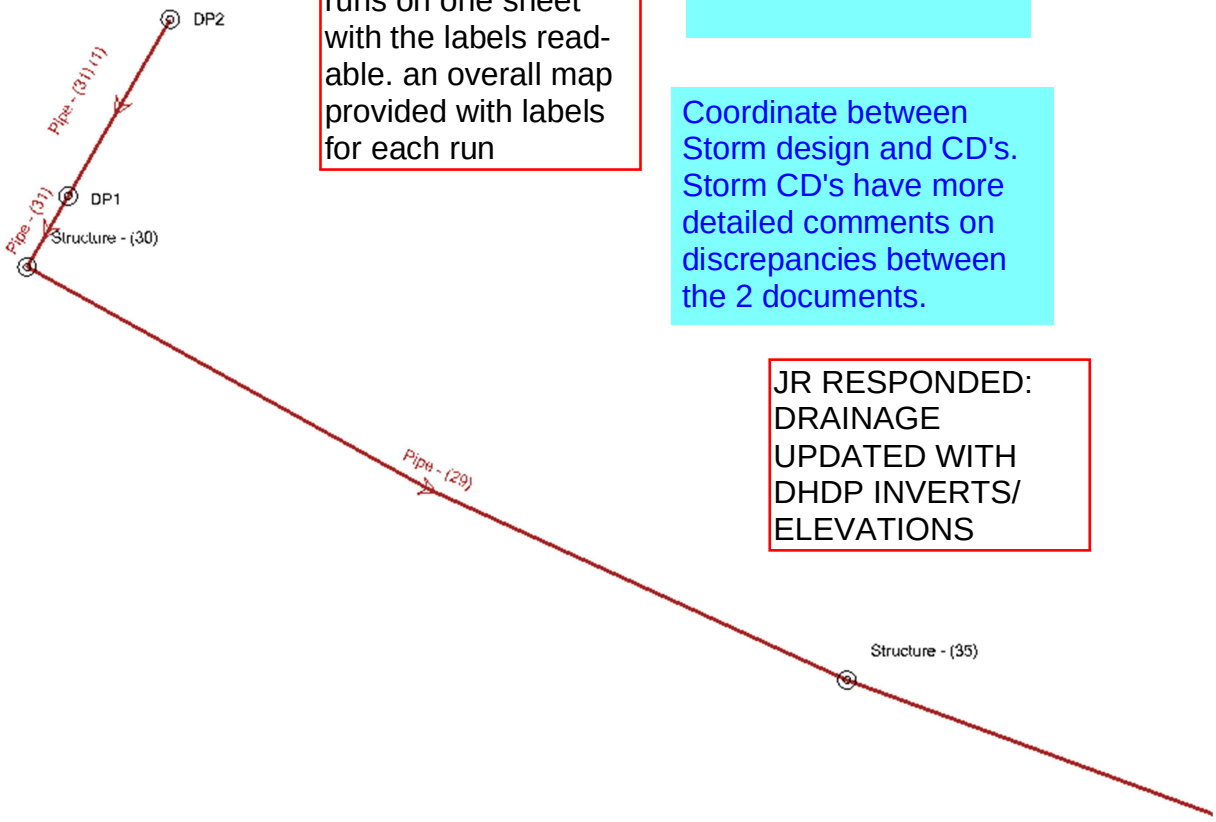
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	2	2	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	6.0	inches
Grate Information		MINOR	MAJOR	☐ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.33	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	0.57	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	0.93	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**10.5**	**10.5**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	4.4	10.4	cfs

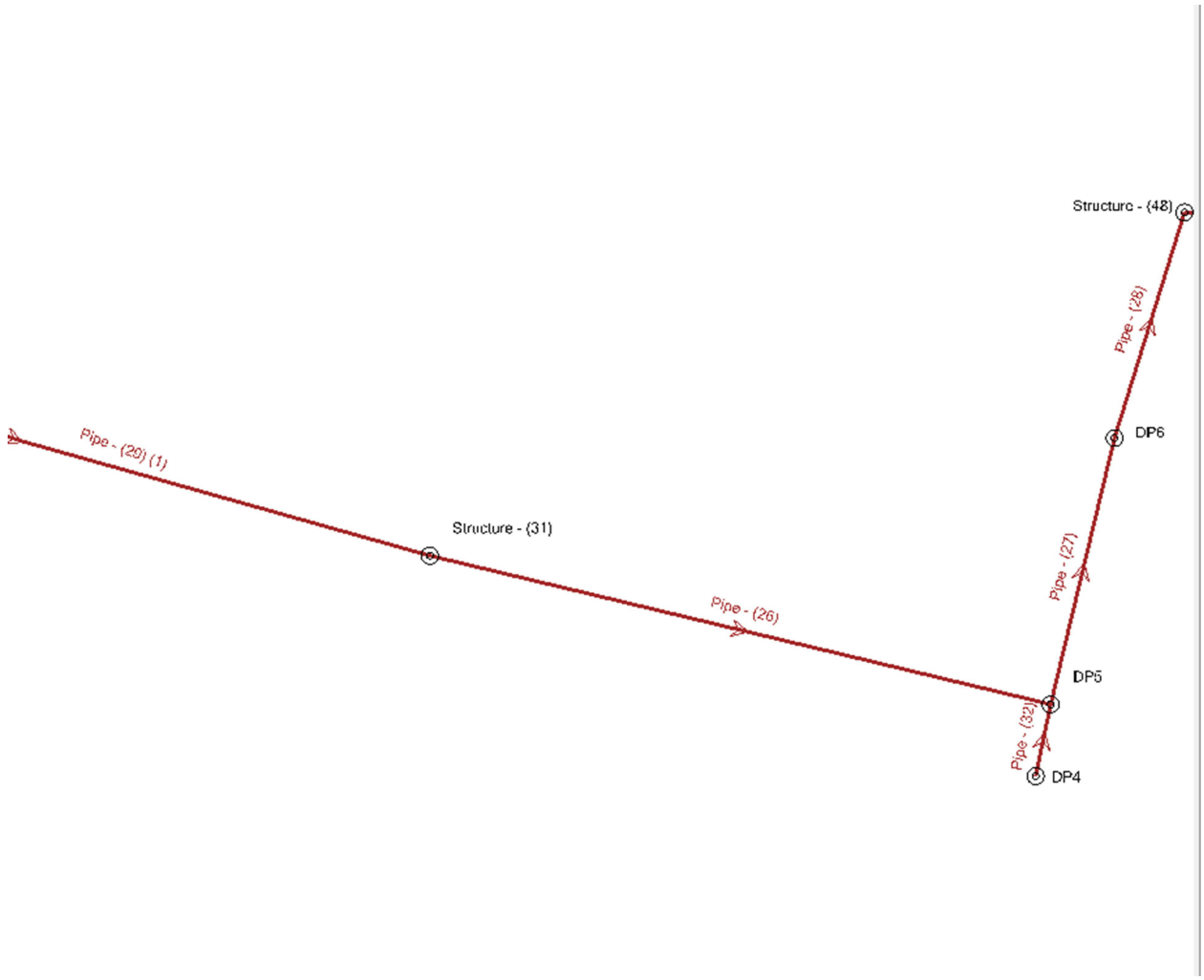
JR Response: it is hard to fit the long runs on one sheet with the labels read-able. an overall map provided with labels for each run

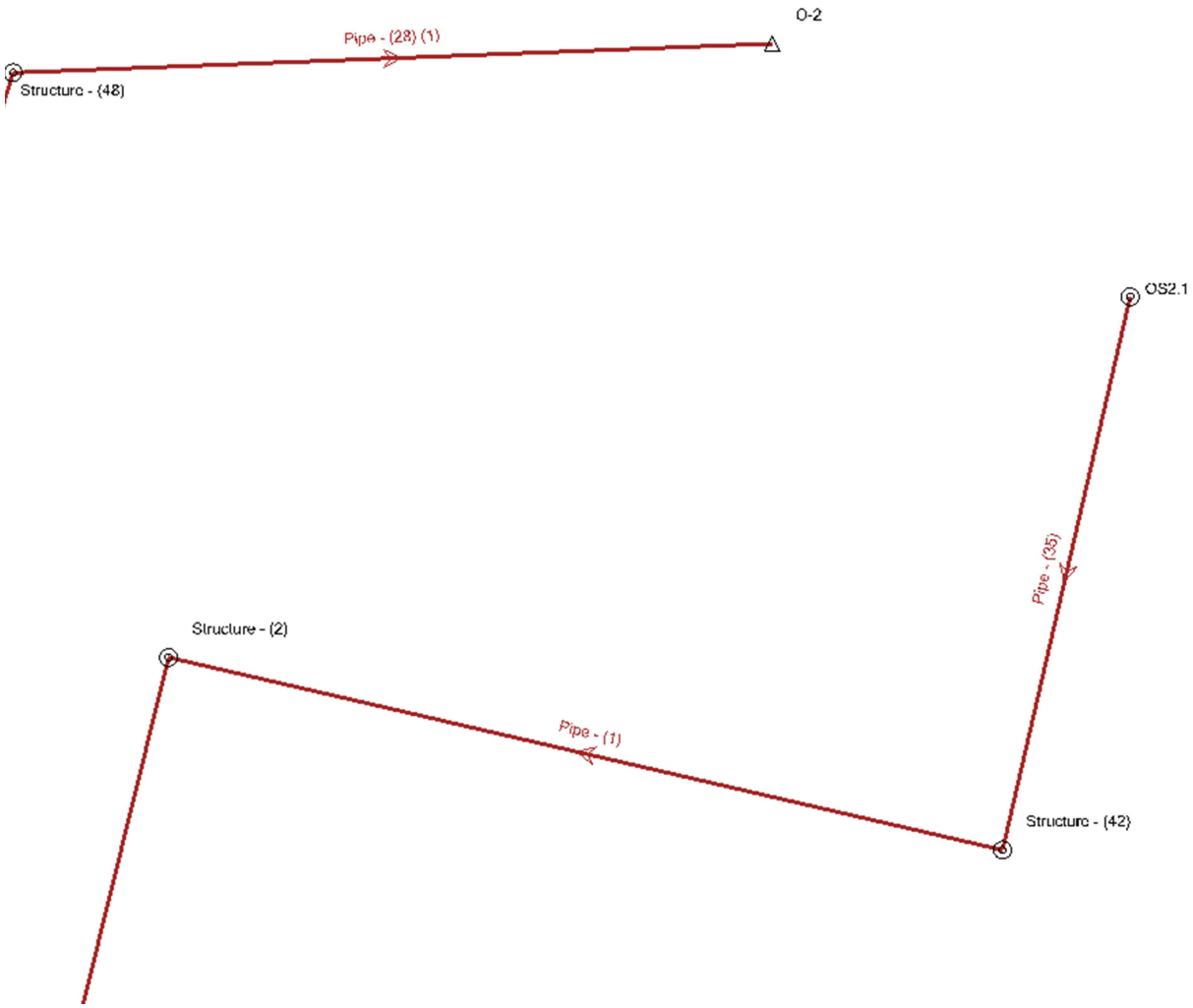
Each Storm Layout should be on single sheet.

Coordinate between Storm design and CD's. Storm CD's have more detailed comments on discrepancies between the 2 documents.

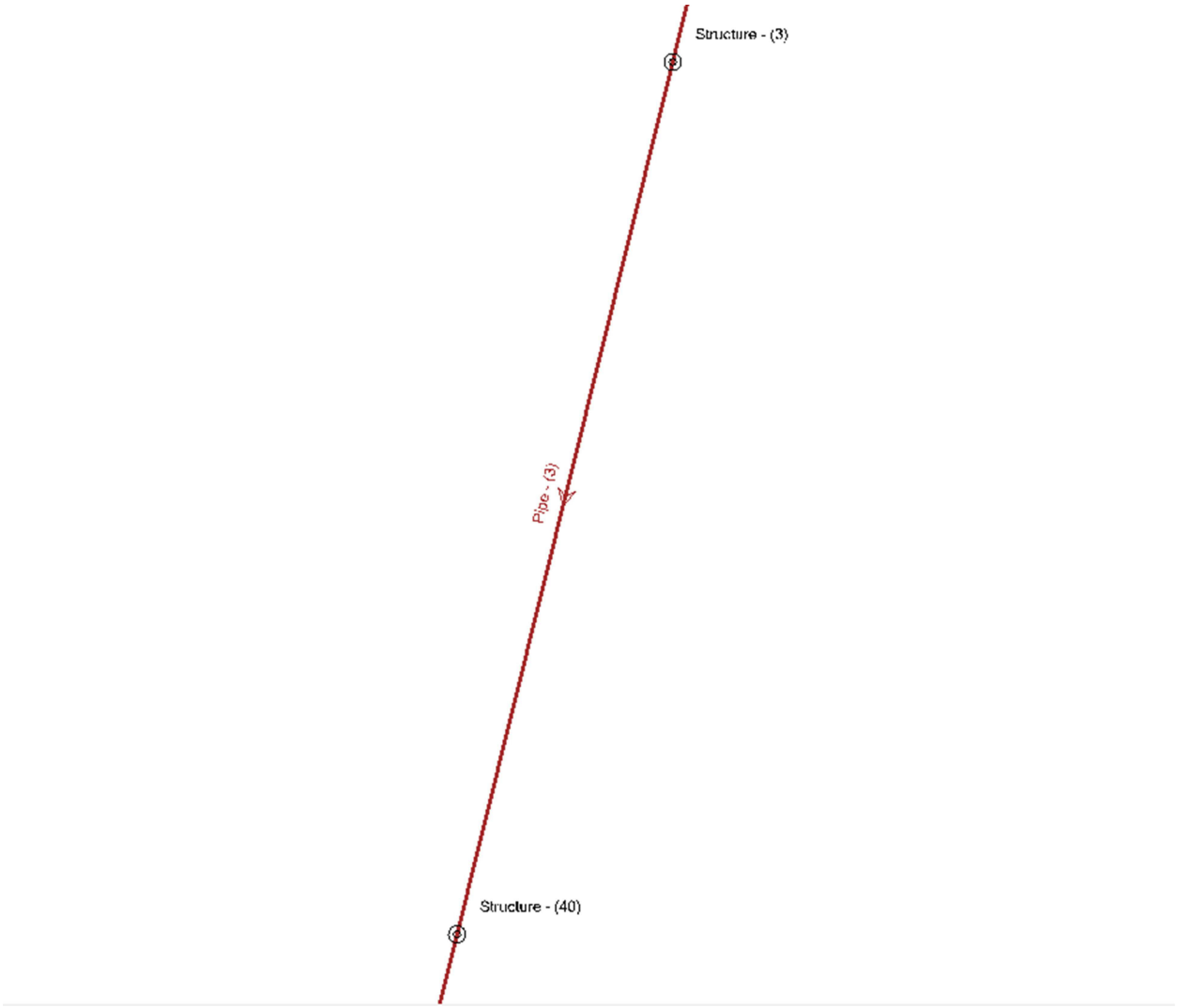
JR RESPONDED: DRAINAGE UPDATED WITH DHDP INVERTS/ ELEVATIONS

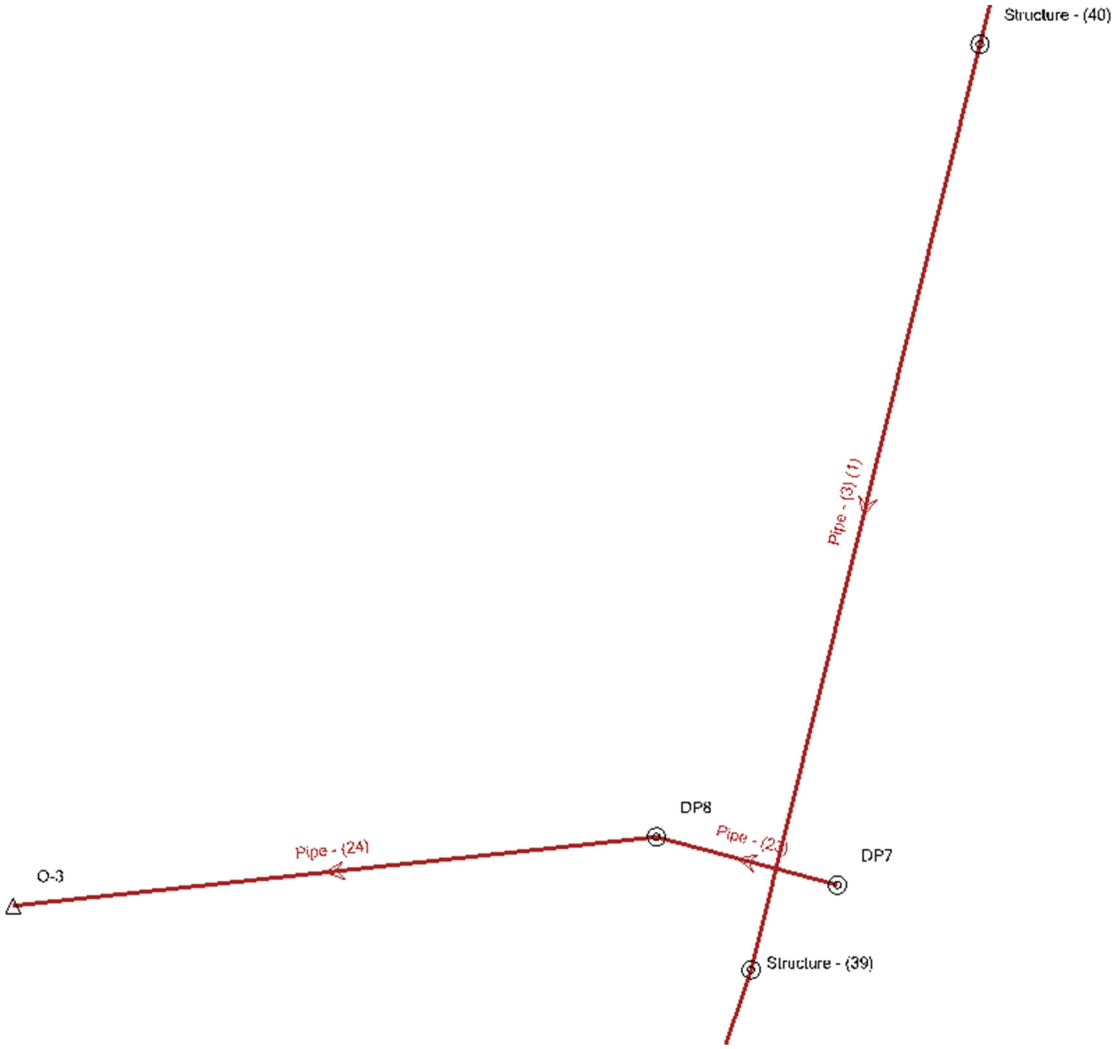


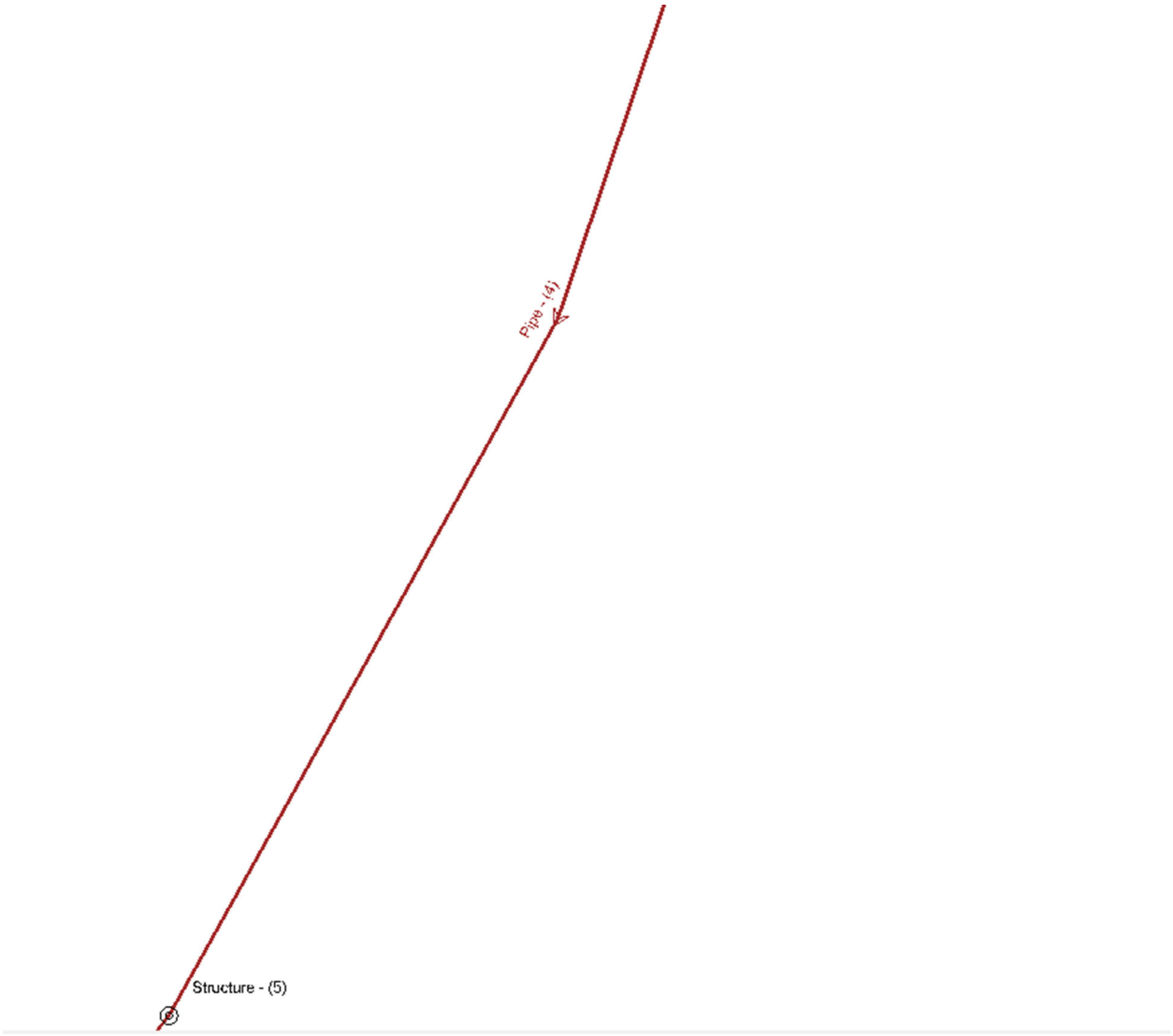

Structure - (48)
Pipe - (28)
DP6
Pipe - (20) (1)
Structure - (31)
Pipe - (27)
Pipe - (26)
DP5
Pipe - (32)
DP4

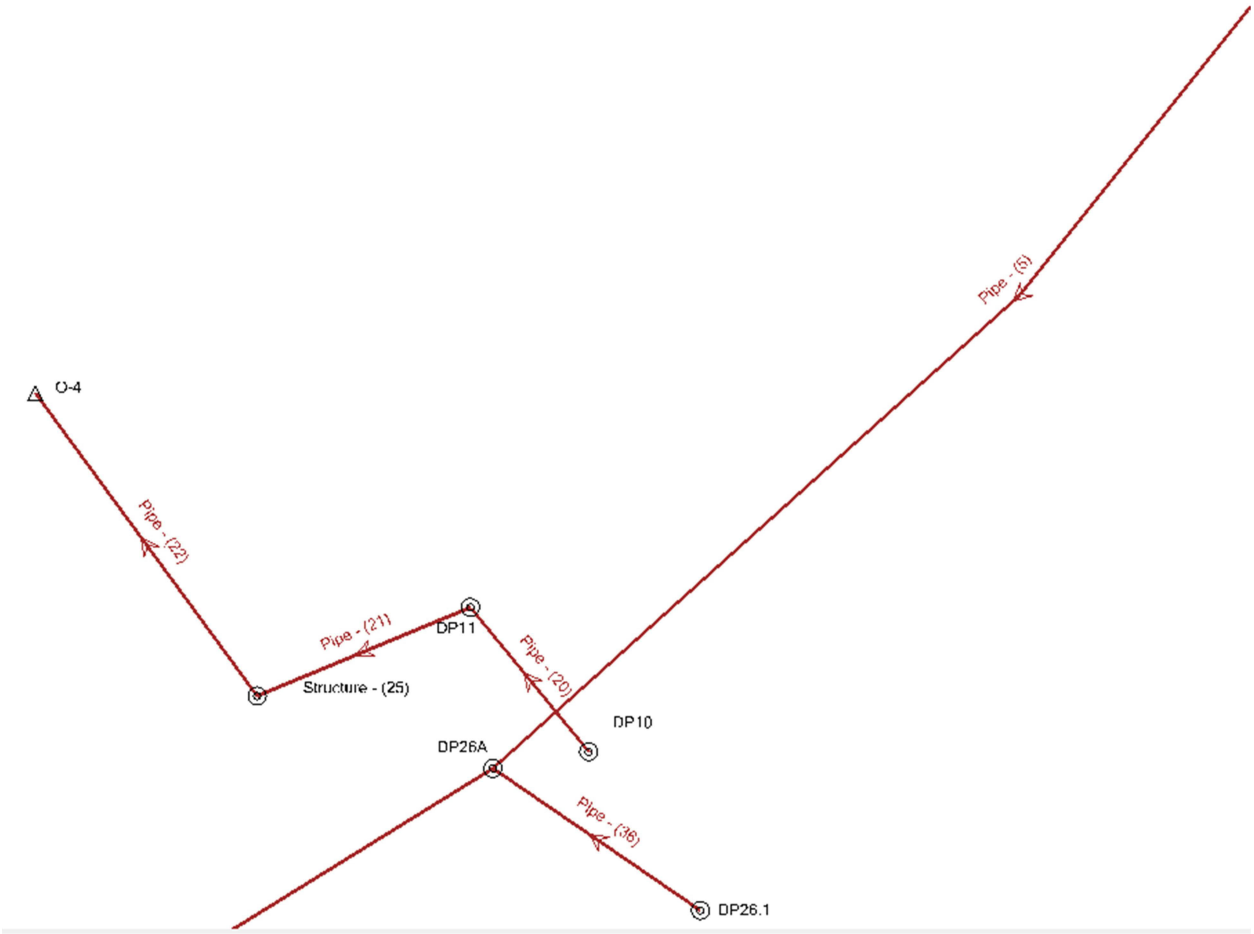

O-2
Pipe - (28) (1)
Structure - (48)
OS2.1
Pipe - (35)
Structure - (2)
Pipe - (1)
Structure - (42)

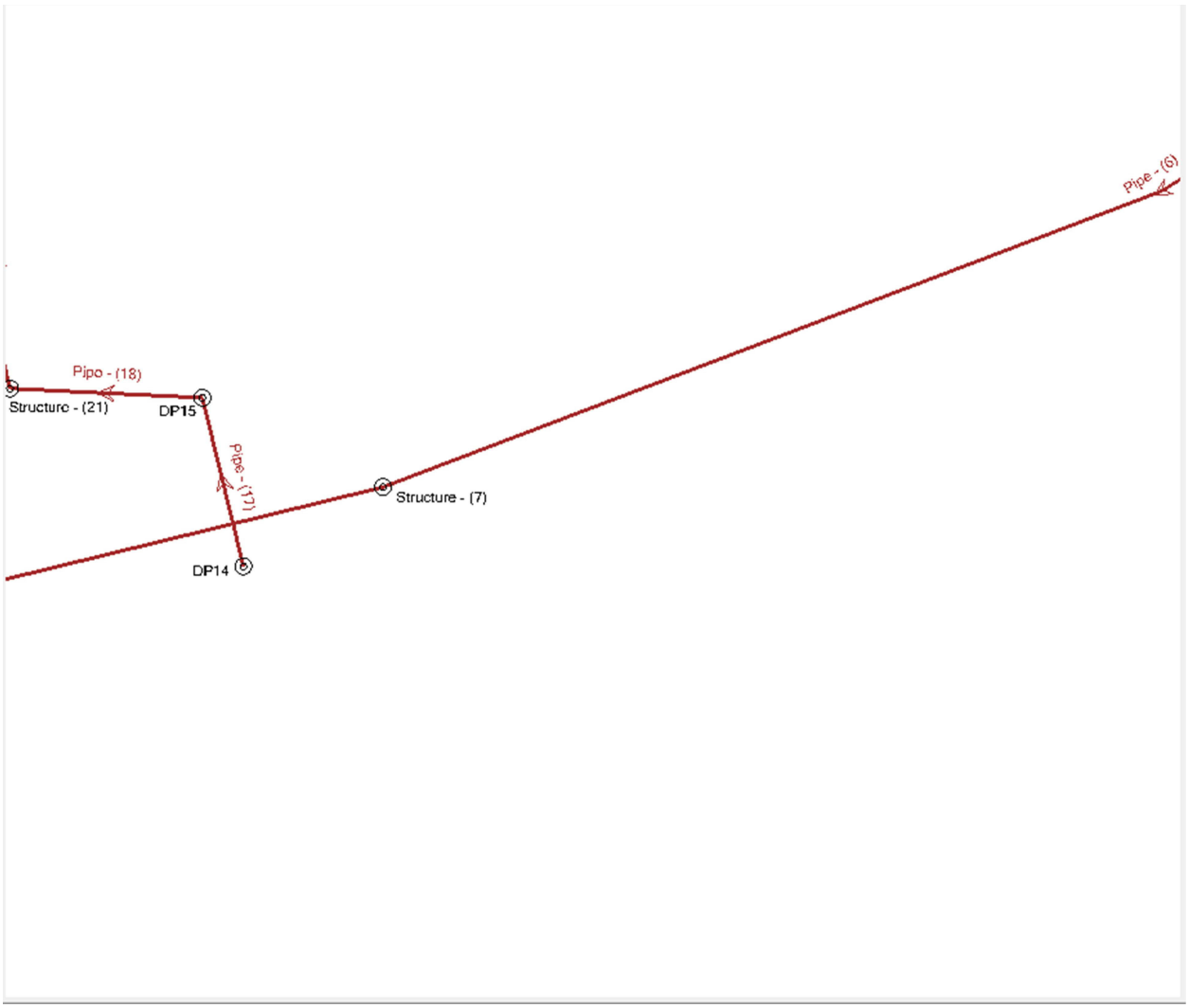
Pipe - (2)
Structure - (3)

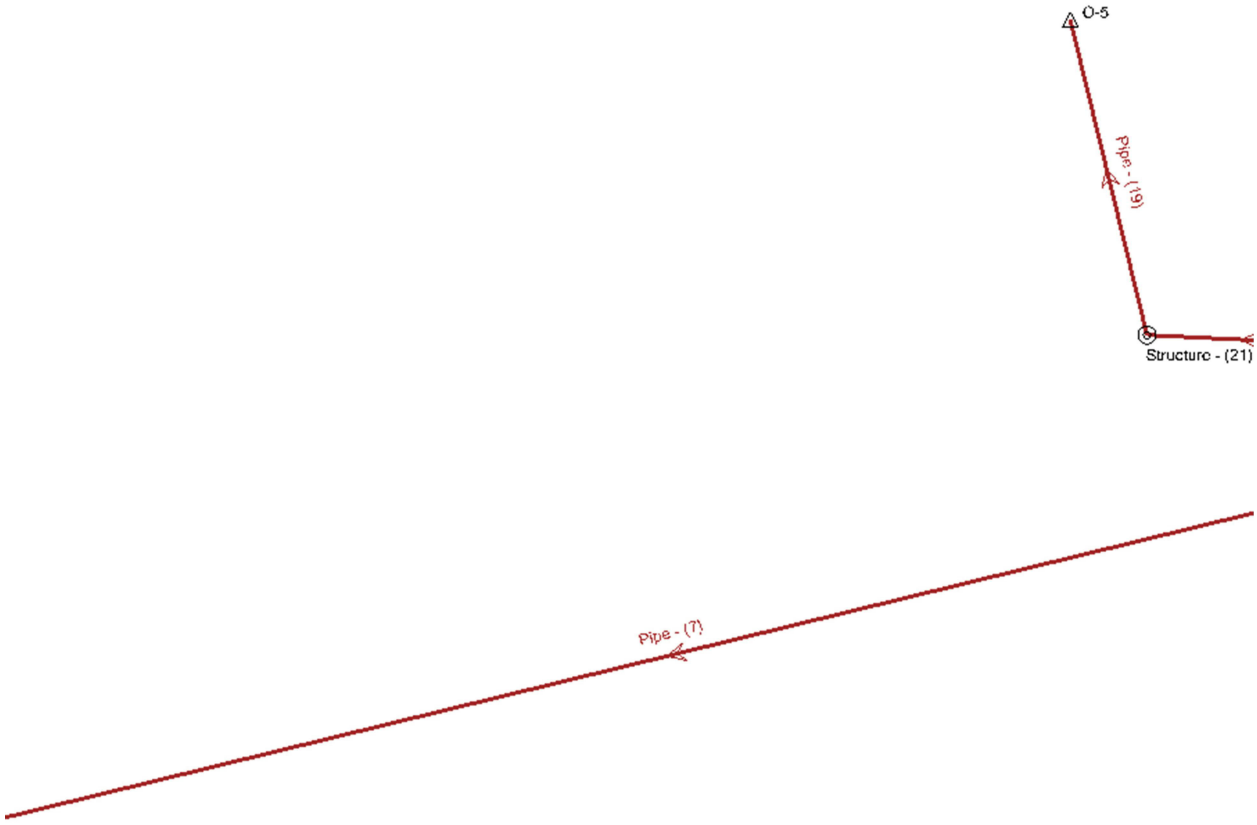

Structure - (3)
Pipe - (3)
Structure - (40)

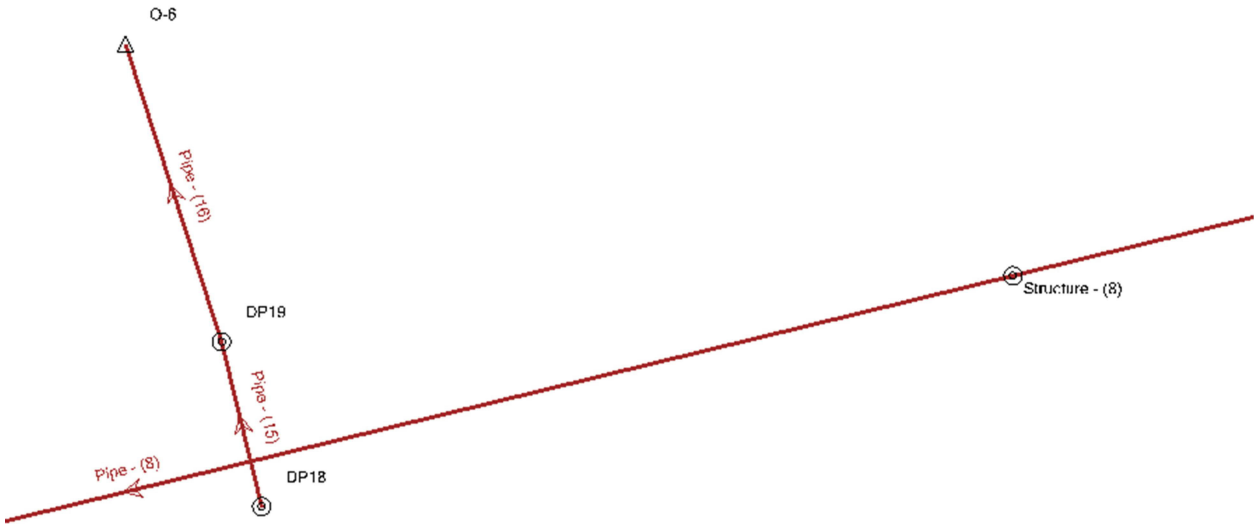

Structure - (40)
Pipe - (3) (1)
DP8
Pipe - (24)
Pipe - (23)
DP7
O-3
Structure - (39)

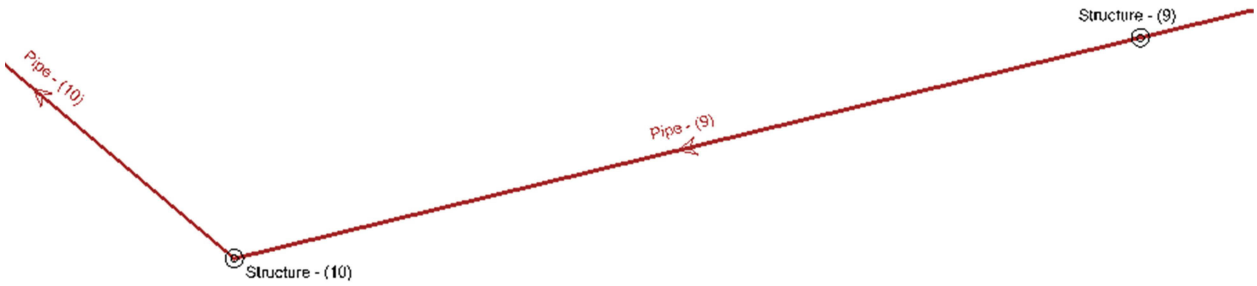

Pipe - (4)
Structure - (5)

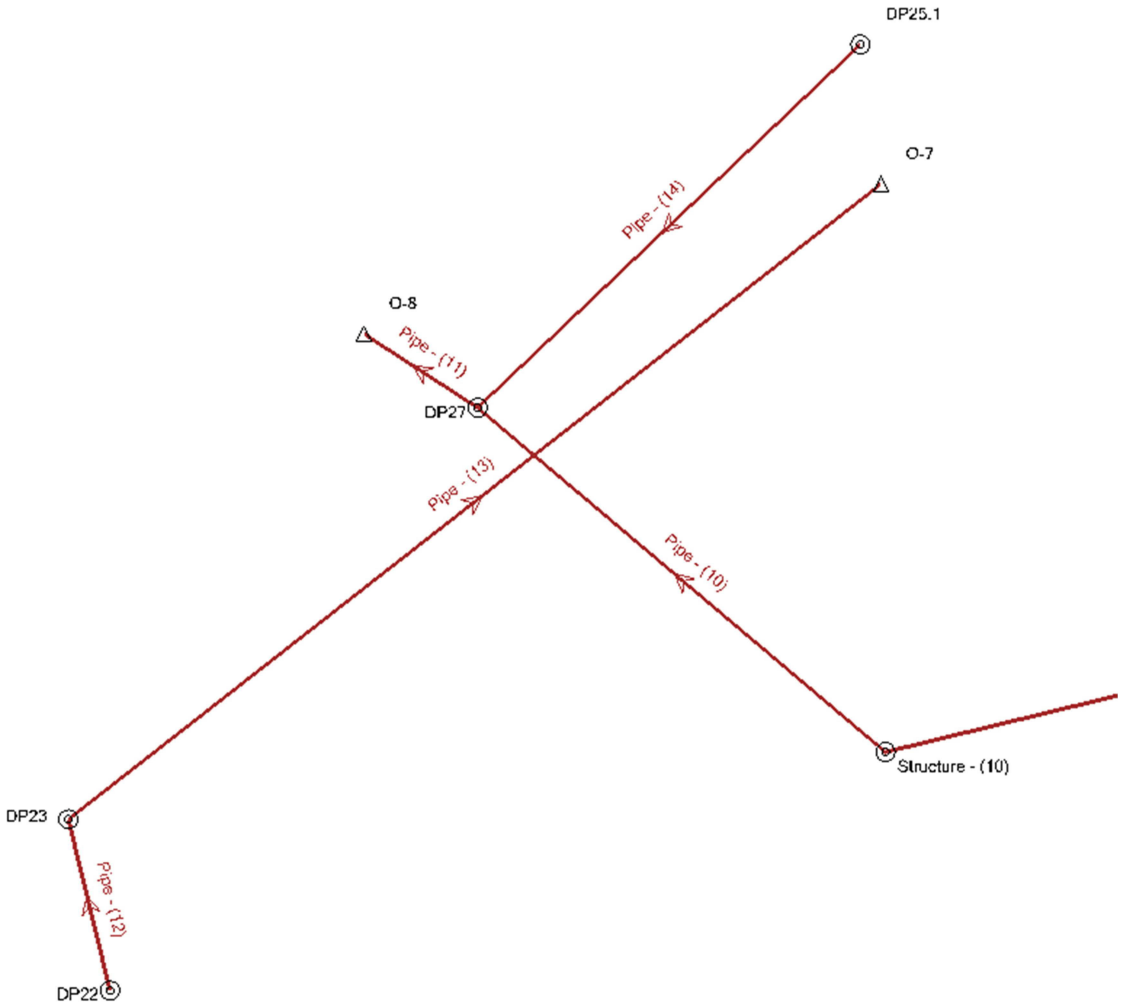

O-4
Pipe - (22)
Pipe - (21)
DP11
Structure - (25)
Pipe - (20)
DP10
Pipe - (5)
DP26A
Pipe - (36)
DP26.1


Pipe - (6)
Pipo - (18)
Structure - (21)
DP15
Pipe - (17)
Structure - (7)
DP14


O-5
Pipe - (19)
Structure - (21)
Pipe - (7)


O-6
Pipe - (16)
DP19
Pipe - (15)
Pipe - (8)
DP18
Structure - (8)


Structure - (9)
Pipe - (10)
Pipe - (9)
Structure - (10)


DP25.1
O-7
Pipe - (14)
O-8
Pipe - (11)
DP27
Pipe - (13)
Pipe - (10)
Structure - (10)
DP23
Pipe - (12)
DP22

Scenario: 5-year
Current Time Step: 0.000 h
FlexTable: Conduit Table

Label	Diameter (in)	Manning's n	Invert (Start) (ft)	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
Pipe - (1)	48.0	0.013	7,086.75	7,085.88	291.3	0.003	16.40	4.95	78.67	7,087.99	7,087.44
Pipe - (2)	48.0	0.013	7,085.68	7,075.54	599.8	0.017	16.40	9.15	186.75	7,086.87	7,076.35
Pipe - (3)	48.0	0.013	7,075.34	7,069.01	316.6	0.020	16.40	9.71	203.11	7,076.53	7,069.78
Pipe - (3) (1)	48.0	0.013	7,068.81	7,064.05	317.1	0.015	16.40	8.77	175.91	7,070.00	7,064.88
Pipe - (4)	48.0	0.013	7,063.85	7,055.58	551.6	0.015	16.40	8.77	175.87	7,065.04	7,056.41
Pipe - (5)	48.0	0.013	7,055.38	7,048.25	475.2	0.015	16.40	8.77	175.91	7,056.57	7,049.68
Pipe - (6)	48.0	0.013	7,048.16	7,039.26	599.8	0.015	11.50	7.87	174.89	7,049.15	7,039.96
Pipe - (7)	54.0	0.013	7,038.76	7,027.36	600.1	0.019	11.50	8.46	271.02	7,039.72	7,028.00
Pipe - (8)	54.0	0.013	7,027.16	7,015.16	600.1	0.020	11.50	8.61	278.06	7,028.12	7,015.79
Pipe - (9)	54.0	0.013	7,013.15	7,006.91	312.2	0.020	11.50	8.61	277.99	7,014.11	7,007.90
Pipe - (10)	54.0	0.013	7,006.73	7,003.32	170.2	0.020	11.50	8.61	278.06	7,007.68	7,004.42
Pipe - (11)	54.0	0.013	7,003.13	7,002.69	43.2	0.010	9.80	6.44	196.63	7,004.01	7,003.39
Pipe - (12)	21.0	0.013	7,012.44	7,012.16	56.2	0.005	5.50	4.64	11.20	7,013.36	7,013.33
Pipe - (13)	21.0	0.013	7,011.66	7,010.01	328.8	0.005	9.20	5.20	11.20	7,012.87	7,011.14
Pipe - (14)	48.0	0.013	7,006.65	7,003.61	168.2	0.018	6.50	7.12	193.10	7,007.39	7,004.42
Pipe - (15)	18.0	0.013	7,030.14	7,027.33	56.2	0.050	2.60	8.75	23.47	7,030.75	7,027.67
Pipe - (16)	18.0	0.013	7,026.19	7,021.01	103.6	0.050	5.00	10.56	23.47	7,027.05	7,021.48
Pipe - (17)	18.0	0.013	7,044.83	7,044.52	62.3	0.005	1.30	3.16	7.43	7,045.26	7,045.07
Pipe - (18)	18.0	0.013	7,044.32	7,039.48	69.4	0.070	2.00	9.12	27.76	7,044.86	7,040.02
Pipe - (19)	18.0	0.013	7,039.27	7,034.92	108.6	0.040	2.00	7.50	21.02	7,039.81	7,035.23
Pipe - (20)	18.0	0.013	7,055.26	7,054.95	62.5	0.005	3.30	4.08	7.43	7,056.14	7,056.10
Pipe - (21)	18.0	0.013	7,054.75	7,050.89	77.5	0.050	5.70	10.95	23.47	7,055.68	7,052.03
Pipe - (22)	18.0	0.013	7,050.68	7,046.73	125.9	0.031	5.70	9.27	18.62	7,051.61	7,047.30
Pipe - (23)	18.0	0.013	7,070.99	7,070.68	62.3	0.005	5.20	4.55	7.43	7,071.93	7,071.74
Pipe - (24)	18.0	0.013	7,070.48	7,065.06	215.2	0.025	9.60	9.77	16.67	7,071.68	7,065.88
Pipe - (26)	30.0	0.013	7,100.17	7,099.04	226.9	0.005	20.30	6.39	29.00	7,101.72	7,100.57
Pipe - (27)	36.0	0.013	7,098.39	7,097.91	97.4	0.005	18.70	6.29	47.16	7,099.78	7,099.42
Pipe - (28)	30.0	0.013	7,097.69	7,097.27	83.9	0.005	21.30	6.46	29.01	7,099.39	7,099.26
Pipe - (28) (1)	36.0	0.013	7,097.08	7,095.68	258.5	0.005	21.30	6.69	49.03	7,098.56	7,097.07
Pipe - (29)	30.0	0.013	7,103.64	7,102.11	306.2	0.005	20.30	6.39	29.00	7,105.18	7,103.64
Pipe - (29) (1)	30.0	0.013	7,101.90	7,100.37	306.2	0.005	20.30	6.39	29.00	7,103.45	7,101.90
Pipe - (31)	30.0	0.013	7,104.14	7,104.27	27.3	-0.005	20.30	6.39	29.00	7,106.05	7,106.02
Pipe - (31) (1)	30.0	0.013	7,104.47	7,104.81	68.0	-0.005	10.50	5.43	29.00	7,106.07	7,106.07
Pipe - (32)	18.0	0.013	7,099.07	7,098.99	26.1	0.003	2.60	3.17	5.75	7,100.50	7,100.48
Pipe - (35)	48.0	0.013	7,086.94	7,095.25	193.2	-0.043	16.40	12.71	297.90	7,096.44	7,088.50
Pipe - (36)	18.0	0.013	7,050.75	7,054.25	84.3	-0.041	0.30	4.29	21.37	7,054.45	7,050.88

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Can't drop a pipe size

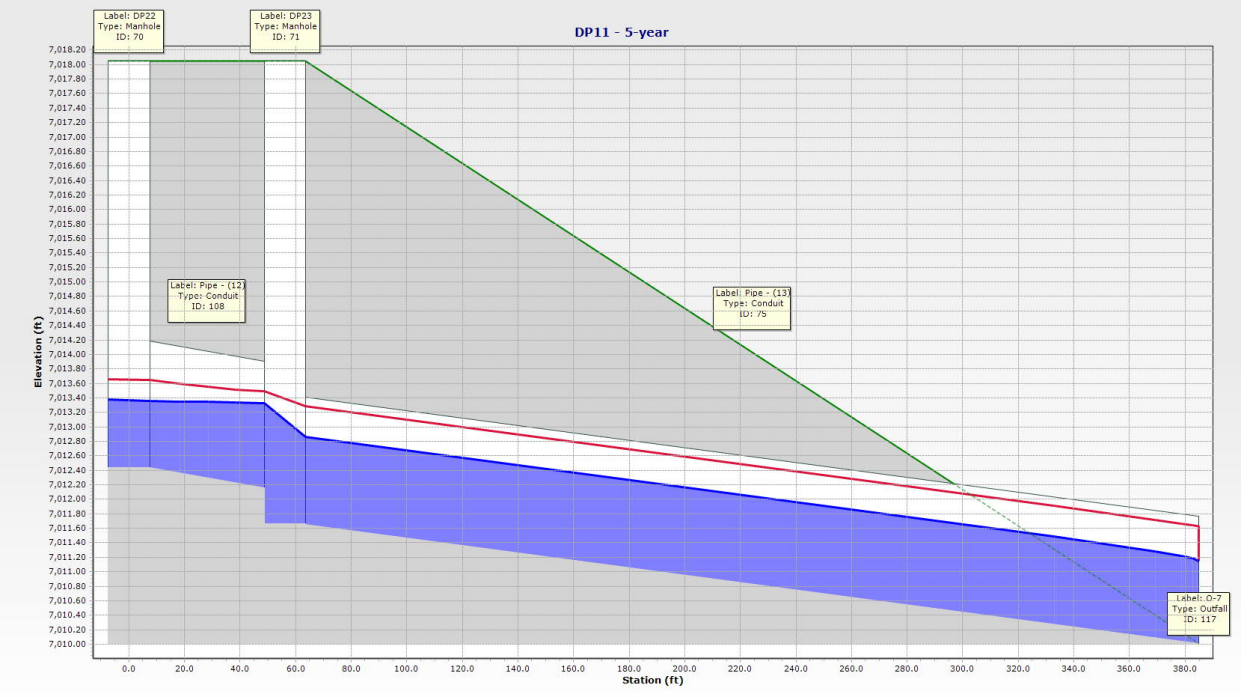
jr responded: 36' pipe

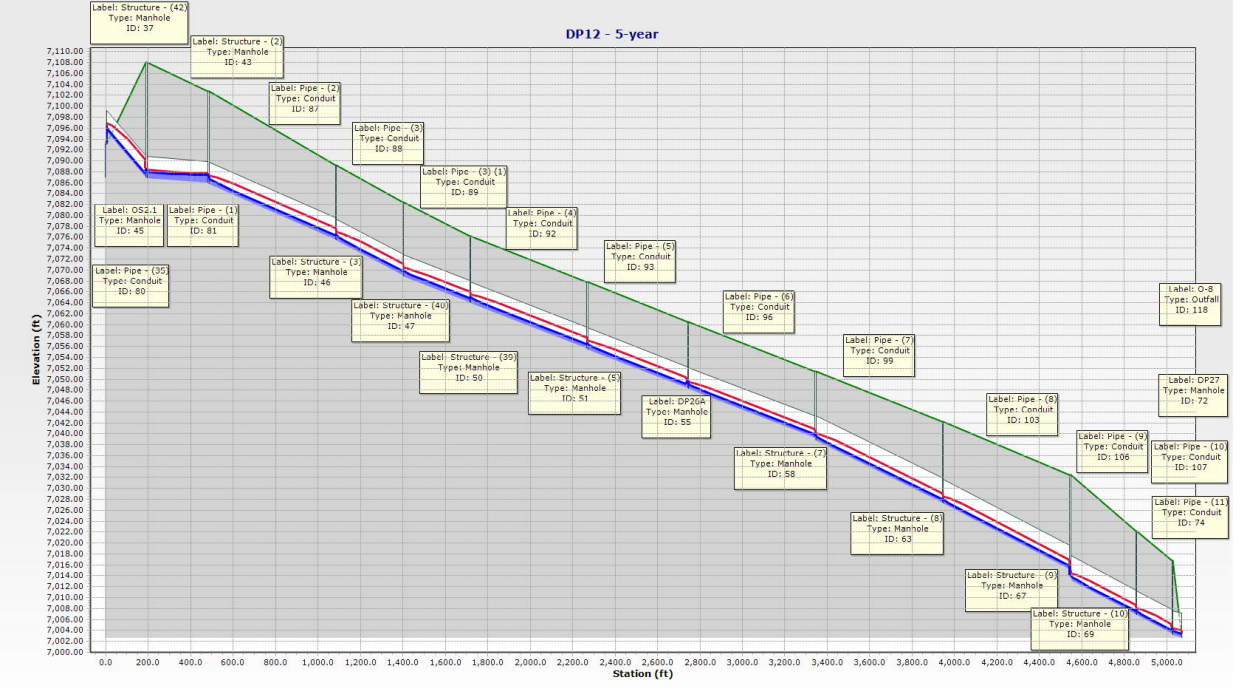
Pipes appear to be flowing wrong direction

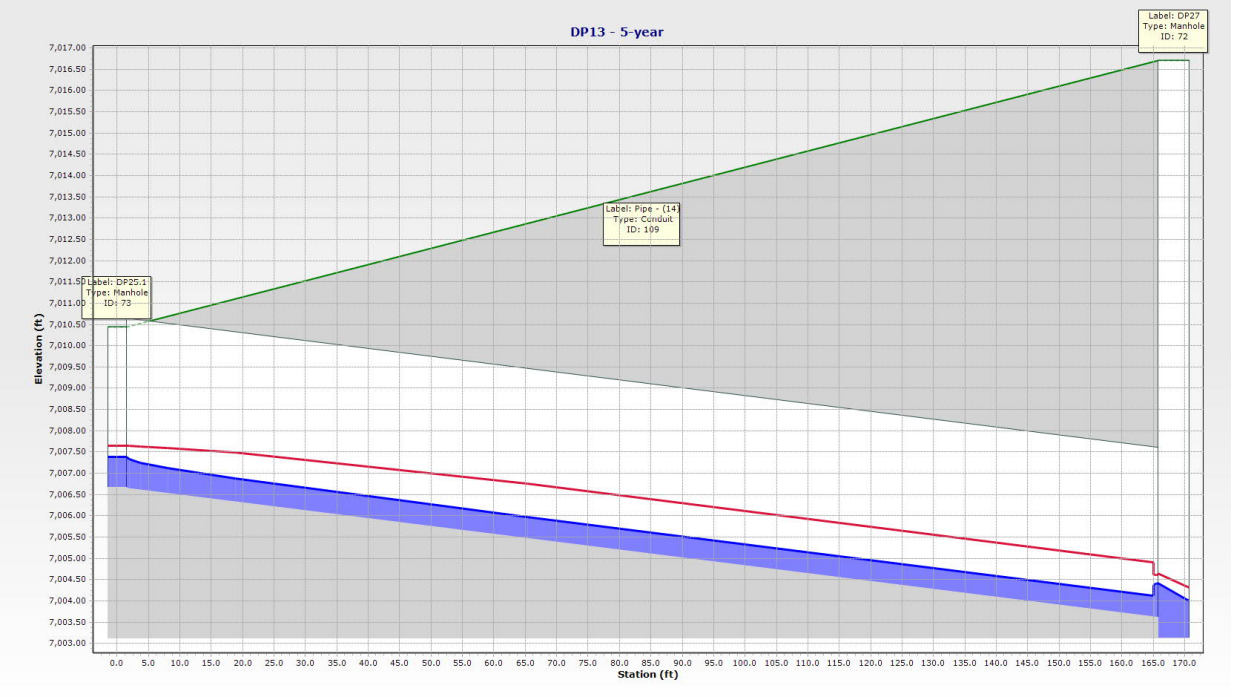
jr reponded: inverts and elevations updated with dhdp

Scenario: 5-year
Current Time Step: 0.000 h
FlexTable: Manhole Table

Label	Flow (Total Out) (cfs)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Elevation (Ground) (ft)	Elevation (Invert) (ft)
Structure - (30)	20.30	7,106.43	7,105.81	7,106.02	7,105.18	7,112.47	7,103.64
DP1	20.30	7,106.23	7,106.51	7,106.07	7,106.05	7,112.36	7,104.27
Structure - (35)	20.30	7,104.12	7,104.08	7,103.48	7,103.45	7,109.81	7,101.90
DP2	10.50	7,106.36	7,106.35	7,106.08	7,106.07	7,109.81	7,104.81
Structure - (42)	16.40	7,088.70	7,088.37	7,088.50	7,087.99	7,108.01	7,086.75
Structure - (31)	20.30	7,102.39	7,102.35	7,101.75	7,101.72	7,106.31	7,100.17
DP5	18.70	7,100.52	7,100.31	7,100.48	7,099.78	7,103.58	7,098.39
DP6	21.30	7,099.85	7,099.95	7,099.42	7,099.39	7,103.12	7,097.69
DP4	2.60	7,100.53	7,100.53	7,100.50	7,100.50	7,103.06	7,099.07
Structure - (48)	21.30	7,099.66	7,099.14	7,099.26	7,098.56	7,102.82	7,097.08
Structure - (2)	16.40	7,087.64	7,087.30	7,087.44	7,086.87	7,102.69	7,085.68
OS2.1	16.40	7,093.57	7,093.55	7,093.14	7,093.12	7,093.12	7,086.94
Structure - (3)	16.40	7,077.85	7,076.96	7,076.55	7,076.53	7,089.15	7,075.34
Structure - (40)	16.40	7,071.48	7,070.43	7,070.02	7,070.00	7,082.43	7,068.81
DP8	9.60	7,071.98	7,072.31	7,071.74	7,071.68	7,077.01	7,070.48
DP7	5.20	7,072.26	7,072.24	7,071.94	7,071.93	7,076.99	7,070.99
Structure - (39)	16.40	7,066.26	7,065.47	7,065.06	7,065.04	7,076.23	7,063.85
Structure - (5)	16.40	7,057.78	7,057.00	7,056.59	7,056.57	7,067.85	7,055.38
DP10	3.30	7,056.29	7,056.29	7,056.15	7,056.14	7,061.26	7,055.26
DP11	5.70	7,056.18	7,056.06	7,056.10	7,055.68	7,061.25	7,054.75
DP26A	11.50	7,049.94	7,049.50	7,049.68	7,049.15	7,060.56	7,048.16
Structure - (25)	5.70	7,052.27	7,052.00	7,052.03	7,051.61	7,060.21	7,050.68
DP26.1	0.30	7,054.52	7,054.52	7,054.45	7,054.45	7,055.95	7,054.25
Structure - (7)	11.50	7,040.70	7,040.06	7,039.74	7,039.72	7,051.41	7,038.76
DP14	1.30	7,045.42	7,045.41	7,045.27	7,045.26	7,050.83	7,044.83
DP15	2.00	7,045.15	7,045.05	7,045.07	7,044.86	7,050.83	7,044.32
Structure - (21)	2.00	7,040.21	7,040.00	7,040.02	7,039.81	7,050.22	7,039.27
Structure - (8)	11.50	7,029.23	7,028.46	7,028.12	7,028.12	7,042.20	7,027.16
DP18	2.60	7,030.99	7,030.98	7,030.77	7,030.75	7,038.47	7,030.14
DP19	5.00	7,028.26	7,027.40	7,027.07	7,027.05	7,038.47	7,026.19
Structure - (9)	11.50	7,015.28	7,014.44	7,014.12	7,014.11	7,032.45	7,014.97
Structure - (10)	11.50	7,008.21	7,008.02	7,007.90	7,007.68	7,022.16	7,006.73
DP22	5.50	7,013.66	7,013.65	7,013.38	7,013.36	7,018.05	7,012.44
DP23	9.20	7,013.49	7,013.29	7,013.33	7,012.87	7,018.05	7,011.66
DP27	9.80	7,004.65	7,004.32	7,004.42	7,004.01	7,016.70	7,003.13
DP25.1	6.50	7,007.65	7,007.65	7,007.39	7,007.39	7,010.45	7,006.67


DP11 - 5-year
Label: DP22
Type: Manhole
ID: 70
Label: DP23
Type: Manhole
ID: 71
Label: Pipe - (12)
Type: Conduit
ID: 108
Label: Pipe - (13)
Type: Conduit
ID: 75
Label: O-7
Type: Outfall
ID: 117
Elevation (ft)
Station (ft)
7,018.20
7,018.00
7,017.80
7,017.60
7,017.40
7,017.20
7,017.00
7,016.80
7,016.60
7,016.40
7,016.20
7,016.00
7,015.80
7,015.60
7,015.40
7,015.20
7,015.00
7,014.80
7,014.60
7,014.40
7,014.20
7,014.00
7,013.80
7,013.60
7,013.40
7,013.20
7,013.00
7,012.80
7,012.60
7,012.40
7,012.20
7,012.00
7,011.80
7,011.60
7,011.40
7,011.20
7,011.00
7,010.80
7,010.60
7,010.40
7,010.20
7,010.00
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
220.0
240.0
260.0
280.0
300.0
320.0
340.0
360.0
380.0


DP12 - 5-year
Label: Structure - (42)
Type: Manhole
ID: 37
Label: Structure - (2)
Type: Manhole
ID: 43
Label: Pipe - (2)
Type: Conduit
ID: 87
Label: Pipe - (3)
Type: Conduit
ID: 88
Label: Pipe - (3) (1)
Type: Conduit
ID: 89
Label: Pipe - (4)
Type: Conduit
ID: 92
Label: Pipe - (5)
Type: Conduit
ID: 93
Label: Pipe - (6)
Type: Conduit
ID: 96
Label: Pipe - (7)
Type: Conduit
ID: 99
Label: Pipe - (8)
Type: Conduit
ID: 103
Label: Pipe - (9)
Type: Conduit
ID: 106
Label: Pipe - (10)
Type: Conduit
ID: 107
Label: Pipe - (11)
Type: Conduit
ID: 74
Label: O-8
Type: Outfall
ID: 118
Label: DP27
Type: Manhole
ID: 72
Label: OS2.1
Type: Manhole
ID: 45
Label: Pipe - (1)
Type: Conduit
ID: 81
Label: Pipe - (35)
Type: Conduit
ID: 80
Label: Structure - (3)
Type: Manhole
ID: 46
Label: Structure - (40)
Type: Manhole
ID: 47
Label: Structure - (39)
Type: Manhole
ID: 50
Label: Structure - (5)
Type: Manhole
ID: 51
Label: DP2GA
Type: Manhole
ID: 55
Label: Structure - (7)
Type: Manhole
ID: 58
Label: Structure - (8)
Type: Manhole
ID: 63
Label: Structure - (9)
Type: Manhole
ID: 67
Label: Structure - (10)
Type: Manhole
ID: 69
Elevation (ft)
7,110.00
7,108.00
7,106.00
7,104.00
7,102.00
7,100.00
7,098.00
7,096.00
7,094.00
7,092.00
7,090.00
7,088.00
7,086.00
7,084.00
7,082.00
7,080.00
7,078.00
7,076.00
7,074.00
7,072.00
7,070.00
7,068.00
7,066.00
7,064.00
7,062.00
7,060.00
7,058.00
7,056.00
7,054.00
7,052.00
7,050.00
7,048.00
7,046.00
7,044.00
7,042.00
7,040.00
7,038.00
7,036.00
7,034.00
7,032.00
7,030.00
7,028.00
7,026.00
7,024.00
7,022.00
7,020.00
7,018.00
7,016.00
7,014.00
7,012.00
7,010.00
7,008.00
7,006.00
7,004.00
7,002.00
7,000.00
0.0
200.0
400.0
600.0
800.0
1,000.0
1,200.0
1,400.0
1,600.0
1,800.0
2,000.0
2,200.0
2,400.0
2,600.0
2,800.0
3,000.0
3,200.0
3,400.0
3,600.0
3,800.0
4,000.0
4,200.0
4,400.0
4,600.0
4,800.0
5,000.0
Station (ft)


DP13 - 5-year
Label: DP27
Type: Manhole
ID: 72
Label: Pipe - (14
Type: Conduit
ID: 109
Label: DP25.1
Type: Manhole
ID: 73
Elevation (ft)
7,017.00
7,016.50
7,016.00
7,015.50
7,015.00
7,014.50
7,014.00
7,013.50
7,013.00
7,012.50
7,012.00
7,011.50
7,011.00
7,010.50
7,010.00
7,009.50
7,009.00
7,008.50
7,008.00
7,007.50
7,007.00
7,006.50
7,006.00
7,005.50
7,005.00
7,004.50
7,004.00
7,003.50
7,003.00
0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 55.0 60.0 65.0 70.0 75.0 80.0 85.0 90.0 95.0 100.0 105.0 110.0 115.0 120.0 125.0 130.0 135.0 140.0 145.0 150.0 155.0 160.0 165.0 170.0
Station (ft)

DP14 - 5-year
Label: DP18
Type: Manhole
ID: 64
Label: DP19
Type: Manhole
ID: 65
Label: Pipe - (15)
Type: Conduit
ID: 104
Label: Pipe - (16)
Type: Conduit
ID: 105
Label: O-6
Type: Outfall
ID: 116
Elevation (ft)
7,038.50
7,038.00
7,037.50
7,037.00
7,036.50
7,036.00
7,035.50
7,035.00
7,034.50
7,034.00
7,033.50
7,033.00
7,032.50
7,032.00
7,031.50
7,031.00
7,030.50
7,030.00
7,029.50
7,029.00
7,028.50
7,028.00
7,027.50
7,027.00
7,026.50
7,026.00
7,025.50
7,025.00
7,024.50
7,024.00
7,023.50
7,023.00
7,022.50
7,022.00
7,021.50
7,021.00
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
60.0
65.0
70.0
75.0
80.0
85.0
90.0
95.0
100.0
105.0
110.0
115.0
120.0
125.0
130.0
135.0
140.0
145.0
150.0
155.0
160.0
Station (ft)

DP15 - 5-year
Label: DP14
Type: Manhole
ID: 59
Label: DP15
Type: Manhole
ID: 60
Label: Structure - (21)
Type: Manhole
ID: 61
Label: Pipe - (18)
Type: Conduit
ID: 101
Label: Pipe - (17)
Type: Conduit
ID: 100
Label: Pipe - (19)
Type: Conduit
ID: 102
Label: O-5
Type: Outfall
ID: 115
Elevation (ft)
7,051.00
7,050.50
7,050.00
7,049.50
7,049.00
7,048.50
7,048.00
7,047.50
7,047.00
7,046.50
7,046.00
7,045.50
7,045.00
7,044.50
7,044.00
7,043.50
7,043.00
7,042.50
7,042.00
7,041.50
7,041.00
7,040.50
7,040.00
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7,039.00
7,038.50
7,038.00
7,037.50
7,037.00
7,036.50
7,036.00
7,035.50
7,035.00
-10.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
210.0
220.0
230.0
240.0
Station (ft)

DP16 - 5-year
Label: DP10
Type: Manhole
ID: 53
Label: DP11
Type: Manhole
ID: 54
Label: Structure - (25)
Type: Manhole
ID: 56
Label: Pipe - (21)
Type: Conduit
ID: 95
Label: Pipe - (20)
Type: Conduit
ID: 94
Label: Pipe - (22)
Type: Conduit
ID: 98
Label: O-4
Type: Outfall
ID: 114
Elevation (ft)
7,061.50
7,061.00
7,060.50
7,060.00
7,059.50
7,059.00
7,058.50
7,058.00
7,057.50
7,057.00
7,056.50
7,056.00
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7,054.50
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7,051.50
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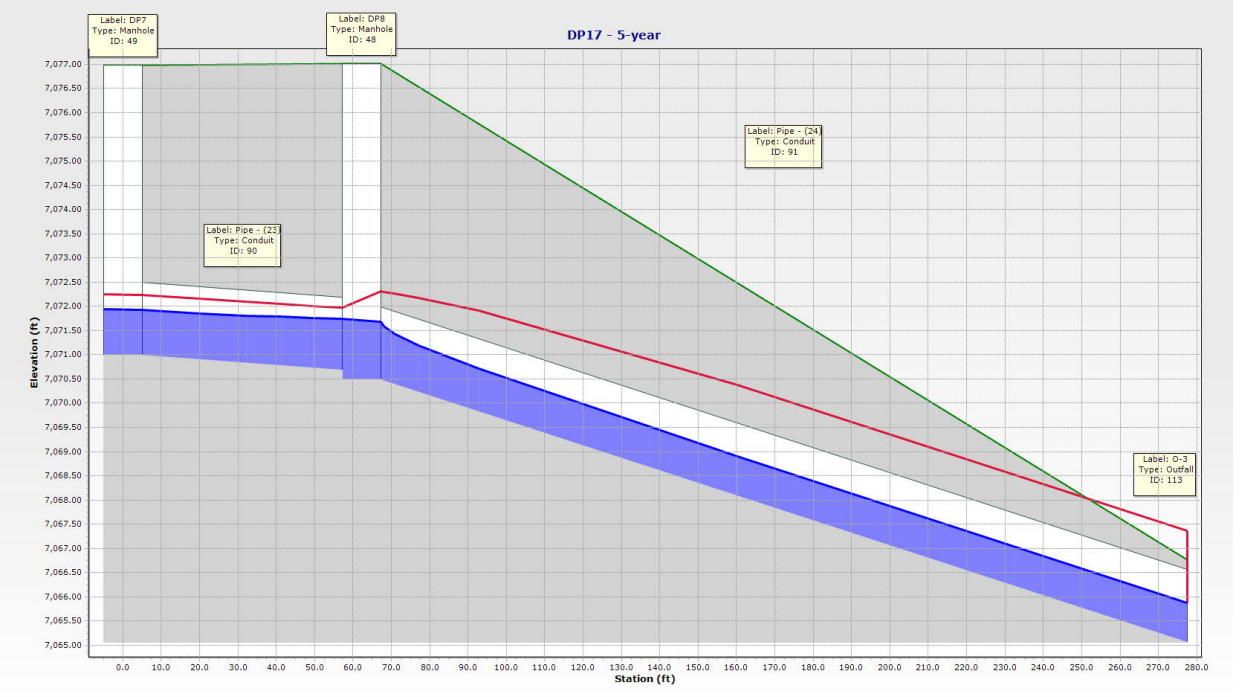
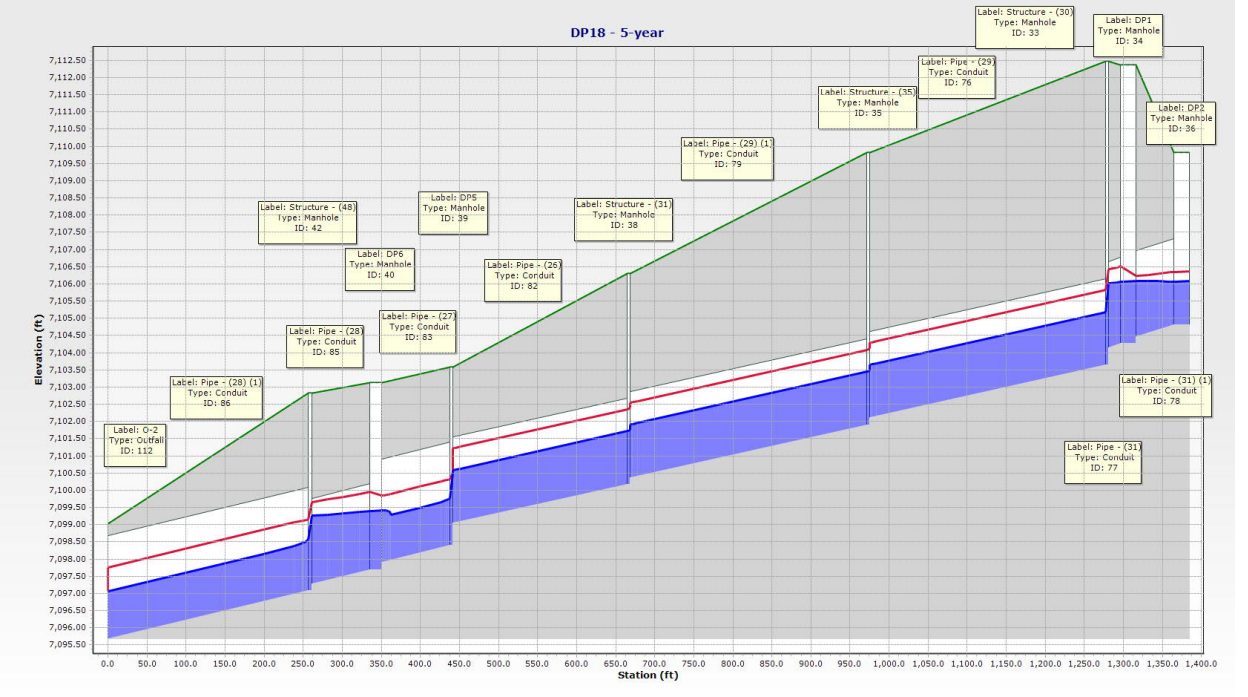
7,050.00
7,049.50
7,049.00
7,048.50
7,048.00
7,047.50
7,047.00
7,046.50
-10.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
210.0
220.0
230.0
240.0
250.0
260.0
Station (ft)


DP17 - 5-year
Label: DP7
Type: Manhole
ID: 49
Label: DP8
Type: Manhole
ID: 48
Label: Pipe - (24)
Type: Conduit
ID: 91
Label: Pipe - (23)
Type: Conduit
ID: 90
Label: O-3
Type: Outfall
ID: 113
Elevation (ft)
7,077.00
7,076.50
7,076.00
7,075.50
7,075.00
7,074.50
7,074.00
7,073.50
7,073.00
7,072.50
7,072.00
7,071.50
7,071.00
7,070.50
7,070.00
7,069.50
7,069.00
7,068.50
7,068.00
7,067.50
7,067.00
7,066.50
7,066.00
7,065.50
7,065.00
0.0 10.0 20.0 30.0 40.0 50.0 60.0 70.0 80.0 90.0 100.0 110.0 120.0 130.0 140.0 150.0 160.0 170.0 180.0 190.0 200.0 210.0 220.0 230.0 240.0 250.0 260.0 270.0 280.0
Station (ft)


DP18 - 5-year
Label: Structure - (30)
Type: Manhole
ID: 33
Label: DP1
Type: Manhole
ID: 34
Label: Pipe - (29)
Type: Conduit
ID: 76
Label: Structure - (35)
Type: Manhole
ID: 35
Label: DP2
Type: Manhole
ID: 36
Label: Pipe - (29) (1)
Type: Conduit
ID: 79
Label: Structure - (48)
Type: Manhole
ID: 42
Label: DP5
Type: Manhole
ID: 39
Label: Structure - (31)
Type: Manhole
ID: 38
Label: DP6
Type: Manhole
ID: 40
Label: Pipe - (26)
Type: Conduit
ID: 82
Label: Pipe - (27)
Type: Conduit
ID: 83
Label: Pipe - (28)
Type: Conduit
ID: 85
Label: Pipe - (28) (1)
Type: Conduit
ID: 86
Label: Pipe - (31) (1)
Type: Conduit
ID: 78
Label: O-2
Type: Outfall
ID: 112
Label: Pipe - (31)
Type: Conduit
ID: 77
Elevation (ft)
7,112.50
7,112.00
7,111.50
7,111.00
7,110.50
7,110.00
7,109.50
7,109.00
7,108.50
7,108.00
7,107.50
7,107.00
7,106.50
7,106.00
7,105.50
7,105.00
7,104.50
7,104.00
7,103.50
7,103.00
7,102.50
7,102.00
7,101.50
7,101.00
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7,100.00
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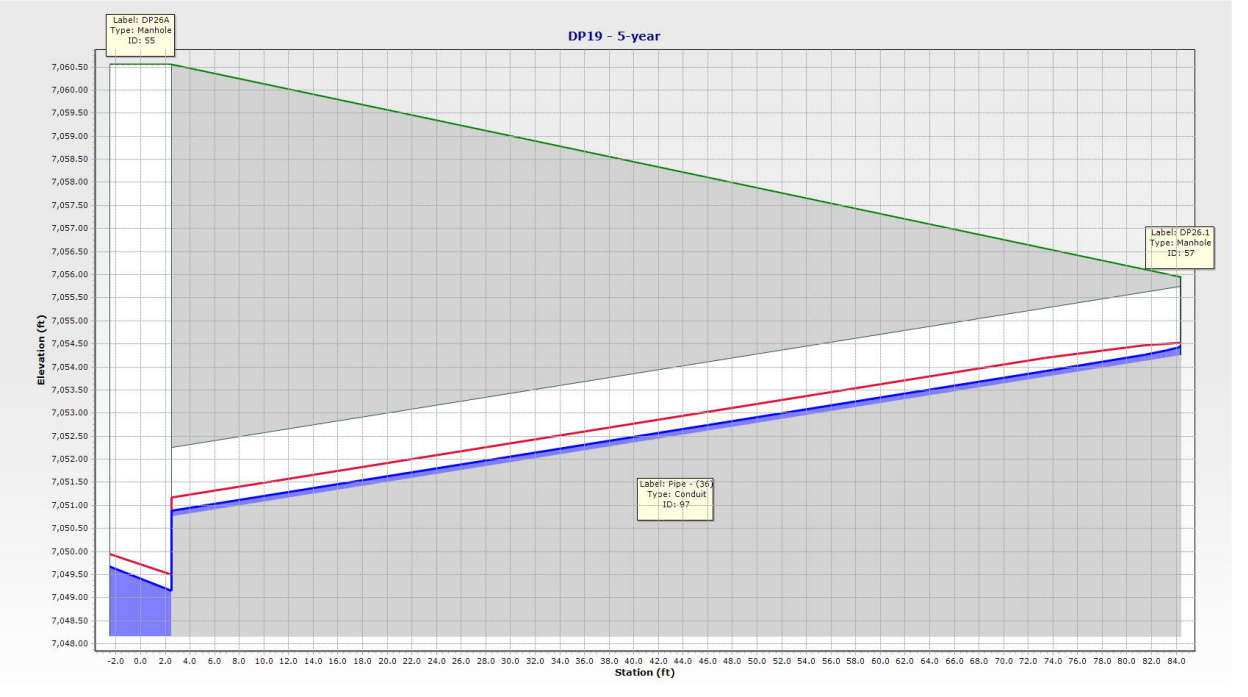
7,099.00
7,098.50
7,098.00
7,097.50
7,097.00
7,096.50
7,096.00
7,095.50
0.0
50.0
100.0
150.0
200.0
250.0
300.0
350.0
400.0
450.0
500.0
550.0
600.0
650.0
700.0
750.0
800.0
850.0
900.0
950.0
1,000.0
1,050.0
1,100.0
1,150.0
1,200.0
1,250.0
1,300.0
1,350.0
1,400.0
Station (ft)


DP19 - 5-year
Label: DP26A
Type: Manhole
ID: 55
Label: DP26.1
Type: Manhole
ID: 57
Label: Pipe - (36)
Type: Conduit
ID: 97
Elevation (ft)
7,060.50
7,060.00
7,059.50
7,059.00
7,058.50
7,058.00
7,057.50
7,057.00
7,056.50
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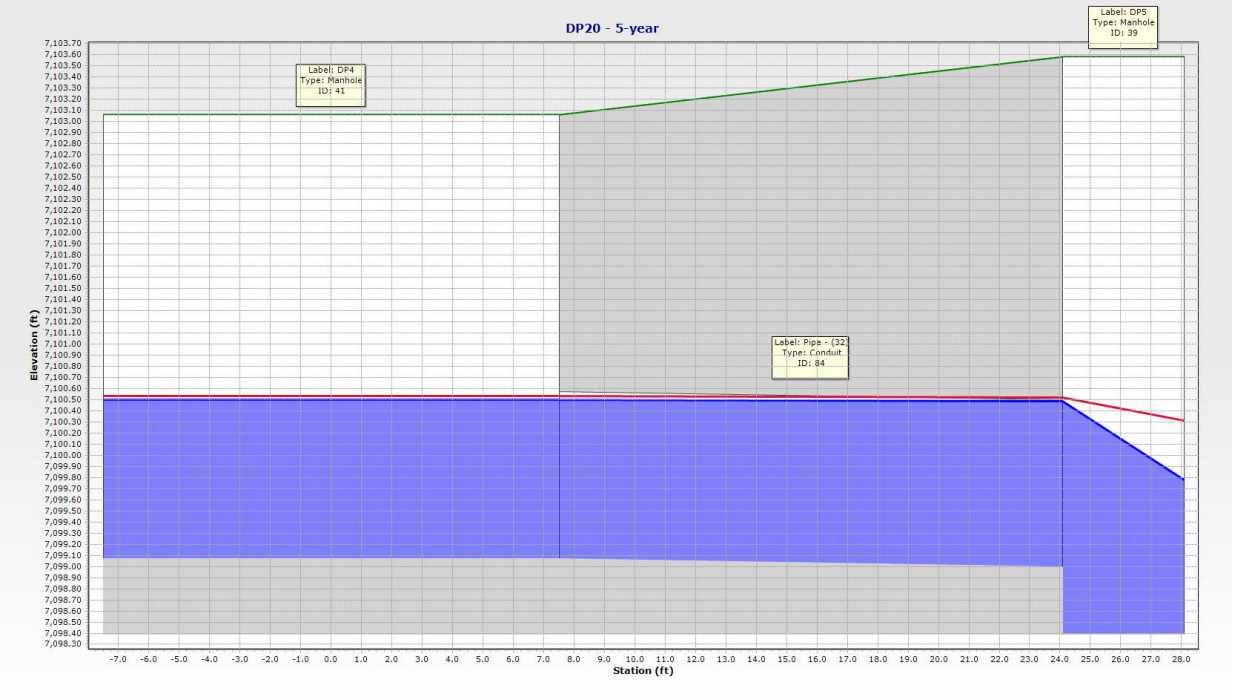
7,052.00
7,051.50
7,051.00
7,050.50
7,050.00
7,049.50
7,049.00
7,048.50
7,048.00
-2.0 0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0 36.0 38.0 40.0 42.0 44.0 46.0 48.0 50.0 52.0 54.0 56.0 58.0 60.0 62.0 64.0 66.0 68.0 70.0 72.0 74.0 76.0 78.0 80.0 82.0 84.0
Station (ft)

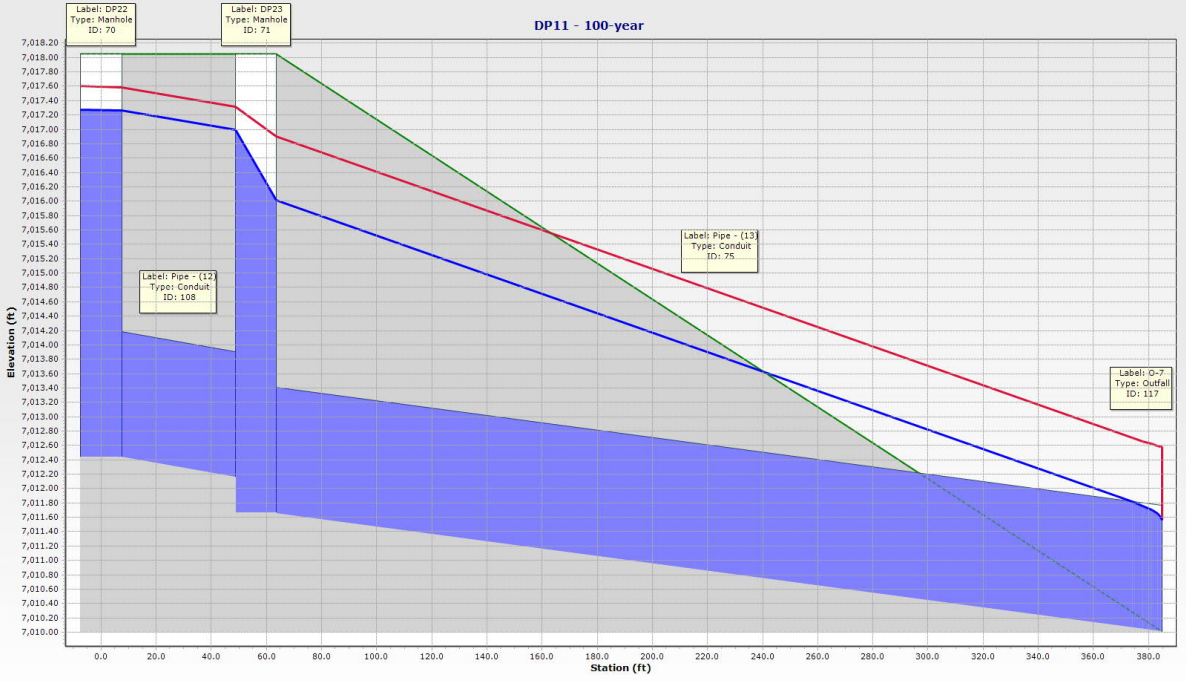

DP20 - 5-year
Label: DP5
Type: Manhole
ID: 39
Label: DP4
Type: Manhole
ID: 41
Label: Pipe - (32)
Type: Conduit
ID: 84
Elevation (ft)
7,103.70
7,103.60
7,103.50
7,103.40
7,103.30
7,103.20
7,103.10
7,103.00
7,102.90
7,102.80
7,102.70
7,102.60
7,102.50
7,102.40
7,102.30
7,102.20
7,102.10
7,102.00
7,101.90
7,101.80
7,101.70
7,101.60
7,101.50
7,101.40
7,101.30
7,101.20
7,101.10
7,101.00
7,100.90
7,100.80
7,100.70
7,100.60
7,100.50
7,100.40
7,100.30
7,100.20
7,100.10
7,100.00
7,099.90
7,099.80
7,099.70
7,099.60
7,099.50
7,099.40
7,099.30
7,099.20
7,099.10
7,099.00
7,098.90
7,098.80
7,098.70
7,098.60
7,098.50
7,098.40
7,098.30
-7.0 -6.0 -5.0 -4.0 -3.0 -2.0 -1.0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0
Station (ft)

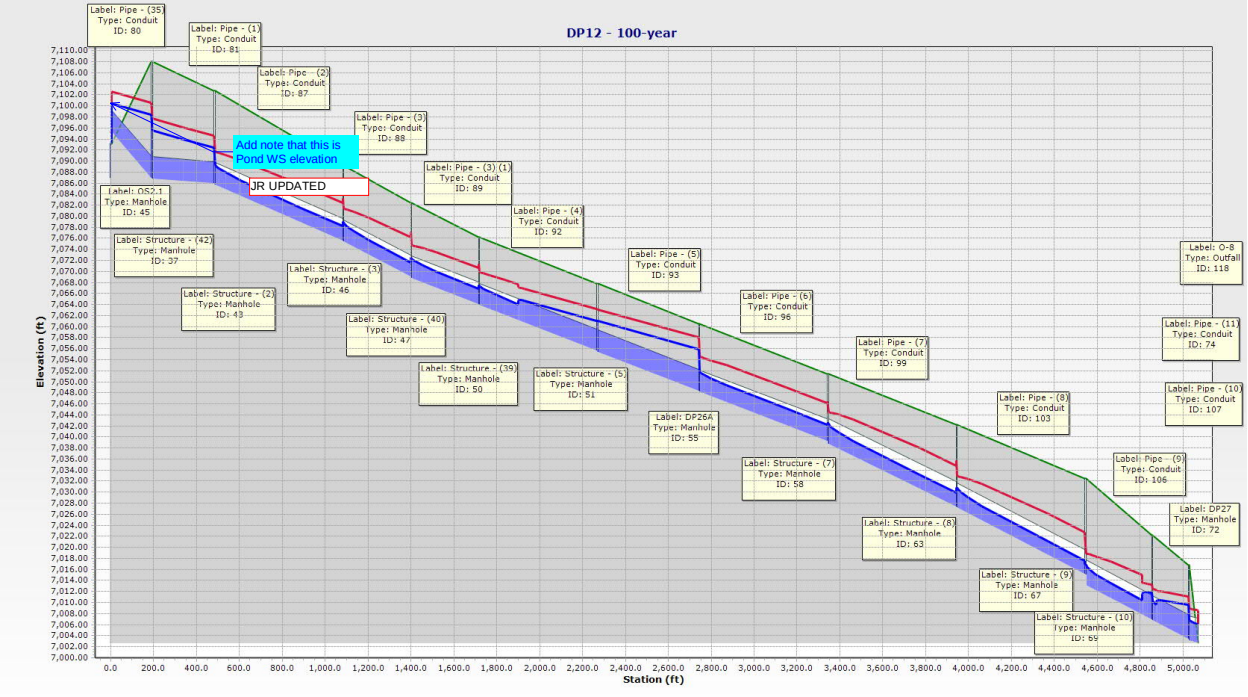
Scenario: 100-year
Current Time Step: 0.000 h
FlexTable: Conduit Table

Label	Diameter (in)	Manning's n	Invert (Start) (ft)	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
Pipe - (1)	48.0	0.013	7,086.75	7,085.88	291.3	0.003	147.90	11.77	78.67	7,095.54	7,092.45
Pipe - (2)	48.0	0.013	7,085.68	7,075.54	599.8	0.017	147.90	16.48	186.75	7,089.26	7,078.23
Pipe - (3)	48.0	0.013	7,075.34	7,069.01	316.6	0.020	147.90	17.63	203.11	7,078.92	7,071.58
Pipe - (3) (1)	48.0	0.013	7,068.81	7,064.05	317.1	0.015	147.90	15.68	175.91	7,072.39	7,066.88
Pipe - (4)	48.0	0.013	7,063.85	7,055.58	551.6	0.015	147.90	15.68	175.87	7,067.43	7,061.08
Pipe - (5)	48.0	0.013	7,055.38	7,048.25	475.2	0.015	147.90	11.77	175.91	7,060.98	7,055.94
Pipe - (6)	48.0	0.013	7,048.16	7,039.26	599.8	0.015	159.20	15.77	174.89	7,051.82	7,042.26
Pipe - (7)	54.0	0.013	7,038.76	7,027.36	600.1	0.019	159.20	17.72	271.02	7,042.46	7,029.84
Pipe - (8)	54.0	0.013	7,027.16	7,015.16	600.1	0.020	159.20	18.07	278.06	7,030.86	7,017.60
Pipe - (9)	54.0	0.013	7,013.15	7,006.91	312.2	0.020	159.20	18.07	277.99	7,016.84	7,011.71
Pipe - (10)	54.0	0.013	7,006.73	7,003.32	170.2	0.020	159.20	18.07	278.06	7,010.42	7,009.57
Pipe - (11)	54.0	0.013	7,003.13	7,002.69	43.2	0.010	162.10	13.81	196.63	7,006.85	7,006.04
Pipe - (12)	21.0	0.013	7,012.44	7,012.16	56.2	0.005	11.00	4.57	11.20	7,017.26	7,016.99
Pipe - (13)	21.0	0.013	7,011.66	7,010.01	328.8	0.005	18.20	7.57	11.20	7,016.01	7,011.56
Pipe - (14)	48.0	0.013	7,006.65	7,003.61	168.2	0.018	126.30	10.05	193.10	7,010.87	7,009.57
Pipe - (15)	18.0	0.013	7,030.14	7,027.33	56.2	0.050	5.50	10.85	23.47	7,031.05	7,027.83
Pipe - (16)	18.0	0.013	7,026.19	7,021.01	103.6	0.050	9.10	12.43	23.47	7,027.35	7,021.66
Pipe - (17)	18.0	0.013	7,044.83	7,044.52	62.3	0.005	6.30	3.57	7.43	7,046.42	7,046.20
Pipe - (18)	18.0	0.013	7,044.32	7,039.48	69.4	0.070	9.50	14.23	27.76	7,045.51	7,041.15
Pipe - (19)	18.0	0.013	7,039.27	7,034.92	108.6	0.040	9.50	11.60	21.02	7,040.46	7,035.63
Pipe - (20)	18.0	0.013	7,055.26	7,054.95	62.5	0.005	5.50	3.11	7.43	7,057.07	7,056.89
Pipe - (21)	18.0	0.013	7,054.75	7,050.89	77.5	0.050	11.40	13.19	23.47	7,056.04	7,052.82
Pipe - (22)	18.0	0.013	7,050.68	7,046.73	125.9	0.031	11.40	11.07	18.62	7,051.97	7,047.57
Pipe - (23)	18.0	0.013	7,070.99	7,070.68	62.3	0.005	9.60	5.43	7.43	7,075.64	7,075.12
Pipe - (24)	18.0	0.013	7,070.48	7,065.06	215.2	0.025	20.70	11.71	16.67	7,074.91	7,066.53
Pipe - (26)	30.0	0.013	7,100.17	7,099.04	226.9	0.005	38.20	7.78	29.00	7,103.93	7,101.96
Pipe - (27)	36.0	0.013	7,098.39	7,097.91	97.4	0.005	34.50	4.88	47.16	7,101.47	7,101.21
Pipe - (28)	30.0	0.013	7,097.69	7,097.27	83.9	0.005	41.20	8.39	29.01	7,101.16	7,100.31
Pipe - (28) (1)	36.0	0.013	7,097.08	7,095.68	258.5	0.005	41.20	7.77	49.03	7,099.19	7,097.77
Pipe - (29)	30.0	0.013	7,103.64	7,102.11	306.2	0.005	38.20	7.78	29.00	7,109.34	7,106.68
Pipe - (29) (1)	30.0	0.013	7,101.90	7,100.37	306.2	0.005	38.20	7.78	29.00	7,106.63	7,103.98
Pipe - (31)	30.0	0.013	7,104.14	7,104.27	27.3	-0.005	38.20	7.78	29.00	7,110.82	7,110.58
Pipe - (31) (1)	30.0	0.013	7,104.47	7,104.81	68.0	-0.005	21.20	4.32	29.00	7,111.05	7,110.86
Pipe - (32)	18.0	0.013	7,099.07	7,098.99	26.1	0.003	4.30	2.43	5.75	7,102.01	7,101.96
Pipe - (35)	48.0	0.013	7,086.94	7,095.25	193.2	-0.043	147.90	11.77	297.90	7,100.43	7,098.38
Pipe - (36)	18.0	0.013	7,050.75	7,054.25	84.3	-0.041	12.10	6.85	21.37	7,057.06	7,055.94

Scenario: 100-year
Current Time Step: 0.000 h
FlexTable: Manhole Table

Label	Flow (Total Out) (cfs)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Elevation (Ground) (ft)	Elevation (Invert) (ft)
Structure - (30)	38.20	7,111.52	7,110.28	7,110.58	7,109.34	7,112.47	7,103.64
DP1	38.20	7,111.15	7,111.76	7,110.86	7,110.82	7,112.36	7,104.27
Structure - (35)	38.20	7,107.62	7,107.58	7,106.68	7,106.63	7,109.81	7,101.90
DP2	21.20	7,110.12	7,110.10	7,109.83	7,109.81	7,109.81	7,104.81
Structure - (42)	147.90	7,100.54	7,097.69	7,098.38	7,095.54	7,108.01	7,086.75
Structure - (31)	38.20	7,104.92	7,104.87	7,103.98	7,103.93	7,106.31	7,100.17
DP5	34.50	7,102.90	7,101.84	7,101.96	7,101.47	7,103.58	7,098.39
DP6	41.20	7,101.58	7,102.25	7,101.21	7,101.16	7,103.12	7,097.69
DP4	4.30	7,102.10	7,102.10	7,102.01	7,102.01	7,103.06	7,099.07
Structure - (48)	41.20	7,101.41	7,100.12	7,100.31	7,099.19	7,102.82	7,097.08
Structure - (2)	147.90	7,094.61	7,091.68	7,092.45	7,089.26	7,102.69	7,085.68
OS2.1	147.90	7,095.38	7,095.27	7,093.23	7,093.12	7,093.12	7,086.94
Structure - (3)	147.90	7,083.27	7,081.34	7,079.04	7,078.92	7,089.15	7,075.34
Structure - (40)	147.90	7,077.19	7,074.80	7,072.51	7,072.39	7,082.43	7,068.81
DP8	20.70	7,075.58	7,077.04	7,075.12	7,074.91	7,077.01	7,070.48
DP7	9.60	7,076.12	7,076.10	7,075.67	7,075.64	7,076.99	7,070.99
Structure - (39)	147.90	7,071.31	7,069.85	7,067.55	7,067.43	7,076.23	7,063.85
Structure - (5)	147.90	7,063.24	7,063.13	7,061.08	7,060.98	7,067.85	7,055.38
DP10	5.50	7,057.22	7,057.22	7,057.07	7,057.07	7,061.26	7,055.26
DP11	11.40	7,057.04	7,056.82	7,056.89	7,056.04	7,061.25	7,054.75
DP26A	159.20	7,058.09	7,054.53	7,055.94	7,051.82	7,060.56	7,048.16
Structure - (25)	11.40	7,053.47	7,052.75	7,052.82	7,051.97	7,060.21	7,050.68
DP26.1	12.10	7,056.72	7,056.68	7,055.99	7,055.96	7,055.95	7,054.25
Structure - (7)	159.20	7,046.42	7,044.48	7,042.56	7,042.46	7,051.41	7,038.76
DP14	6.30	7,046.63	7,046.62	7,046.43	7,046.42	7,050.83	7,044.83
DP15	9.50	7,046.39	7,046.13	7,046.20	7,045.51	7,050.83	7,044.32
Structure - (21)	9.50	7,041.60	7,041.08	7,041.15	7,040.46	7,050.22	7,039.27
Structure - (8)	159.20	7,035.74	7,032.88	7,030.86	7,030.86	7,042.20	7,027.16
DP18	5.50	7,031.44	7,031.43	7,031.07	7,031.05	7,038.47	7,030.14
DP19	9.10	7,029.15	7,027.95	7,027.38	7,027.35	7,038.47	7,026.19
Structure - (9)	159.20	7,022.02	7,018.86	7,016.94	7,016.84	7,032.45	7,014.97
Structure - (10)	159.20	7,013.27	7,012.44	7,011.71	7,010.42	7,022.16	7,006.73
DP22	11.00	7,017.60	7,017.59	7,017.28	7,017.26	7,018.05	7,012.44
DP23	18.20	7,017.32	7,016.90	7,016.99	7,016.01	7,018.05	7,011.66
DP27	162.10	7,011.13	7,008.91	7,009.57	7,006.85	7,016.70	7,003.13
DP25.1	126.30	7,012.02	7,012.02	7,010.45	7,010.45	7,010.45	7,006.67


DP11 - 100-year
Label: DP22
Type: Manhole
ID: 70
Label: DP23
Type: Manhole
ID: 71
Label: Pipe - (12)
Type: Conduit
ID: 108
Label: Pipe - (13)
Type: Conduit
ID: 75
Label: O-7
Type: Outfall
ID: 117
Elevation (ft)
7,018.20
7,018.00
7,017.80
7,017.60
7,017.40
7,017.20
7,017.00
7,016.80
7,016.60
7,016.40
7,016.20
7,016.00
7,015.80
7,015.60
7,015.40
7,015.20
7,015.00
7,014.80
7,014.60
7,014.40
7,014.20
7,014.00
7,013.80
7,013.60
7,013.40
7,013.20
7,013.00
7,012.80
7,012.60
7,012.40
7,012.20
7,012.00
7,011.80
7,011.60
7,011.40
7,011.20
7,011.00
7,010.80
7,010.60
7,010.40
7,010.20
7,010.00
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
200.0
220.0
240.0
260.0
280.0
300.0
320.0
340.0
360.0
380.0
Station (ft)


DP12 - 100-year
Add note that this is Pond WS elevation
JR UPDATED
Label: Pipe - (35) Type: Conduit ID: 80
Label: Pipe - (1) Type: Conduit ID: 81
Label: Pipe - (2) Type: Conduit ID: 87
Label: Pipe - (3) Type: Conduit ID: 88
Label: Pipe - (3) (1) Type: Conduit ID: 89
Label: Pipe - (4) Type: Conduit ID: 92
Label: Pipe - (5) Type: Conduit ID: 93
Label: Pipe - (6) Type: Conduit ID: 96
Label: Pipe - (7) Type: Conduit ID: 99
Label: Pipe - (8) Type: Conduit ID: 103
Label: Pipe - (9) Type: Conduit ID: 106
Label: Pipe - (10) Type: Conduit ID: 107
Label: Pipe - (11) Type: Conduit ID: 74
Label: O-8 Type: Outfall ID: 118
Label: DP27 Type: Manhole ID: 72
Label: OS2.1 Type: Manhole ID: 45
Label: Structure - (42) Type: Manhole ID: 37
Label: Structure - (2) Type: Manhole ID: 43
Label: Structure - (3) Type: Manhole ID: 46
Label: Structure - (40) Type: Manhole ID: 47
Label: Structure - (39) Type: Manhole ID: 50
Label: Structure - (5) Type: Manhole ID: 51
Label: DP26A Type: Manhole ID: 55
Label: Structure - (7) Type: Manhole ID: 58
Label: Structure - (8) Type: Manhole ID: 63
Label: Structure - (9) Type: Manhole ID: 67
Label: Structure - (10) Type: Manhole ID: 69
Elevation (ft)
7,110.00
7,108.00
7,106.00
7,104.00
7,102.00
7,100.00
7,098.00
7,096.00
7,094.00
7,092.00
7,090.00
7,088.00
7,086.00
7,084.00
7,082.00
7,080.00
7,078.00
7,076.00
7,074.00
7,072.00
7,070.00
7,068.00
7,066.00
7,064.00
7,062.00
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7,058.00
7,056.00
7,054.00
7,052.00
7,050.00
7,048.00
7,046.00
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7,042.00
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7,014.00
7,012.00
7,010.00
7,008.00
7,006.00
7,004.00
7,002.00
7,000.00
0.0
200.0
400.0
600.0
800.0
1,000.0
1,200.0
1,400.0
1,600.0
1,800.0
2,000.0
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2,400.0
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3,200.0
3,400.0
3,600.0
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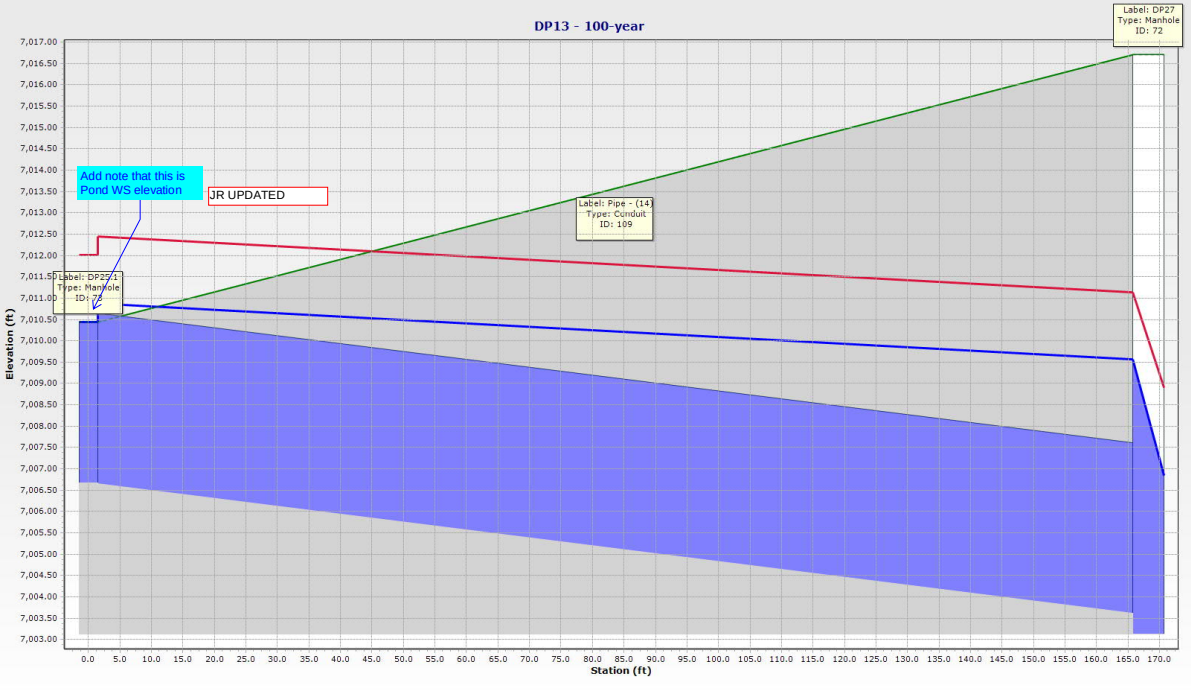
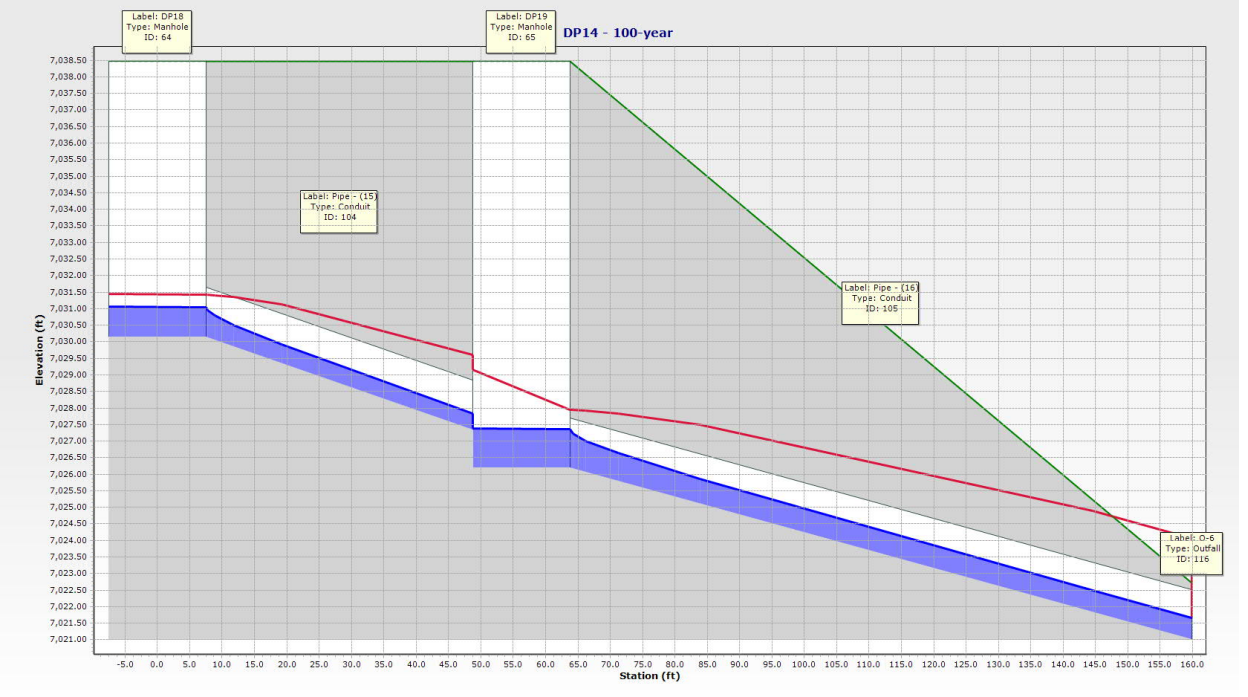
5,000.0
Station (ft)


DP13 - 100-year
Label: DP27
Type: Manhole
ID: 72
Add note that this is
Pond WS elevation
JR UPDATED
Label: Pipe - (14)
Type: Conduit
ID: 109
Label: DP25
Type: Manhole
ID: 73
Elevation (ft)
Station (ft)


DP14 - 100-year
Label: DP18
Type: Manhole
ID: 64
Label: DP19
Type: Manhole
ID: 65
Label: Pipe - (15)
Type: Conduit
ID: 104
Label: Pipe - (16)
Type: Conduit
ID: 105
Label: O-6
Type: Outfall
ID: 116
Elevation (ft)
7,038.50
7,038.00
7,037.50
7,037.00
7,036.50
7,036.00
7,035.50
7,035.00
7,034.50
7,034.00
7,033.50
7,033.00
7,032.50
7,032.00
7,031.50
7,031.00
7,030.50
7,030.00
7,029.50
7,029.00
7,028.50
7,028.00
7,027.50
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7,026.50
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7,025.50
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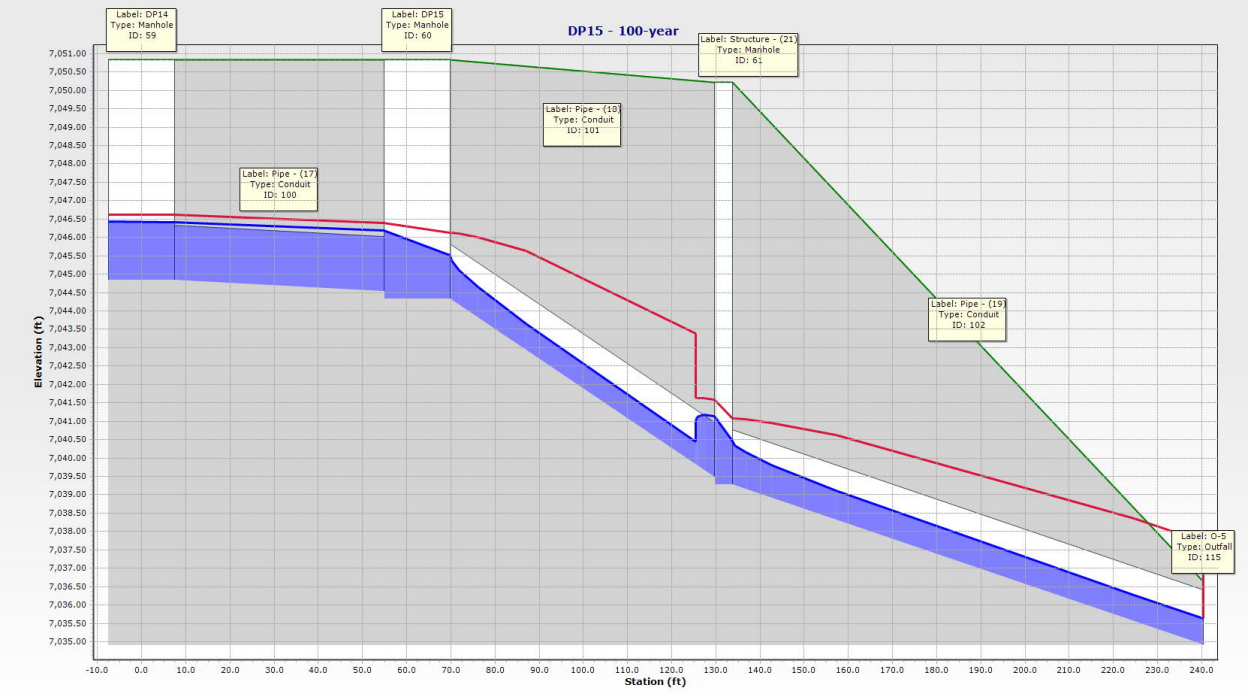
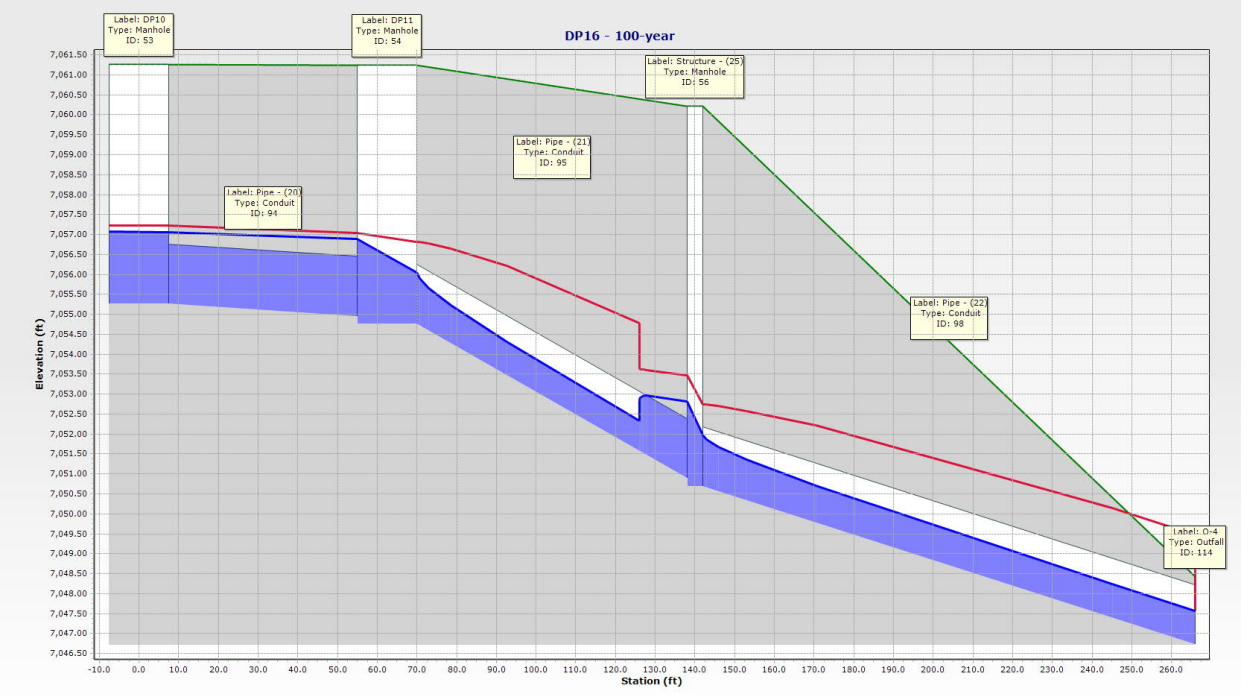
7,024.50
7,024.00
7,023.50
7,023.00
7,022.50
7,022.00
7,021.50
7,021.00
-5.0 0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 55.0 60.0 65.0 70.0 75.0 80.0 85.0 90.0 95.0 100.0 105.0 110.0 115.0 120.0 125.0 130.0 135.0 140.0 145.0 150.0 155.0 160.0
Station (ft)


DP15 - 100-year
Label: DP14
Type: Manhole
ID: 59
Label: DP15
Type: Manhole
ID: 60
Label: Structure - (21)
Type: Manhole
ID: 61
Label: Pipe - (18)
Type: Conduit
ID: 101
Label: Pipe - (17)
Type: Conduit
ID: 100
Label: Pipe - (19)
Type: Conduit
ID: 102
Label: O-5
Type: Outfall
ID: 115
Elevation (ft)
7,051.00
7,050.50
7,050.00
7,049.50
7,049.00
7,048.50
7,048.00
7,047.50
7,047.00
7,046.50
7,046.00
7,045.50
7,045.00
7,044.50
7,044.00
7,043.50
7,043.00
7,042.50
7,042.00
7,041.50
7,041.00
7,040.50
7,040.00
7,039.50
7,039.00
7,038.50
7,038.00
7,037.50
7,037.00
7,036.50
7,036.00
7,035.50
7,035.00
-10.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
210.0
220.0
230.0
240.0
Station (ft)


DP16 - 100-year
Label: DP10
Type: Manhole
ID: 53
Label: DP11
Type: Manhole
ID: 54
Label: Structure - (25)
Type: Manhole
ID: 56
Label: Pipe - (21)
Type: Conduit
ID: 95
Label: Pipe - (20)
Type: Conduit
ID: 94
Label: Pipe - (22)
Type: Conduit
ID: 98
Label: O-4
Type: Outfall
ID: 114
Elevation (ft)
7,061.50
7,061.00
7,060.50
7,060.00
7,059.50
7,059.00
7,058.50
7,058.00
7,057.50
7,057.00
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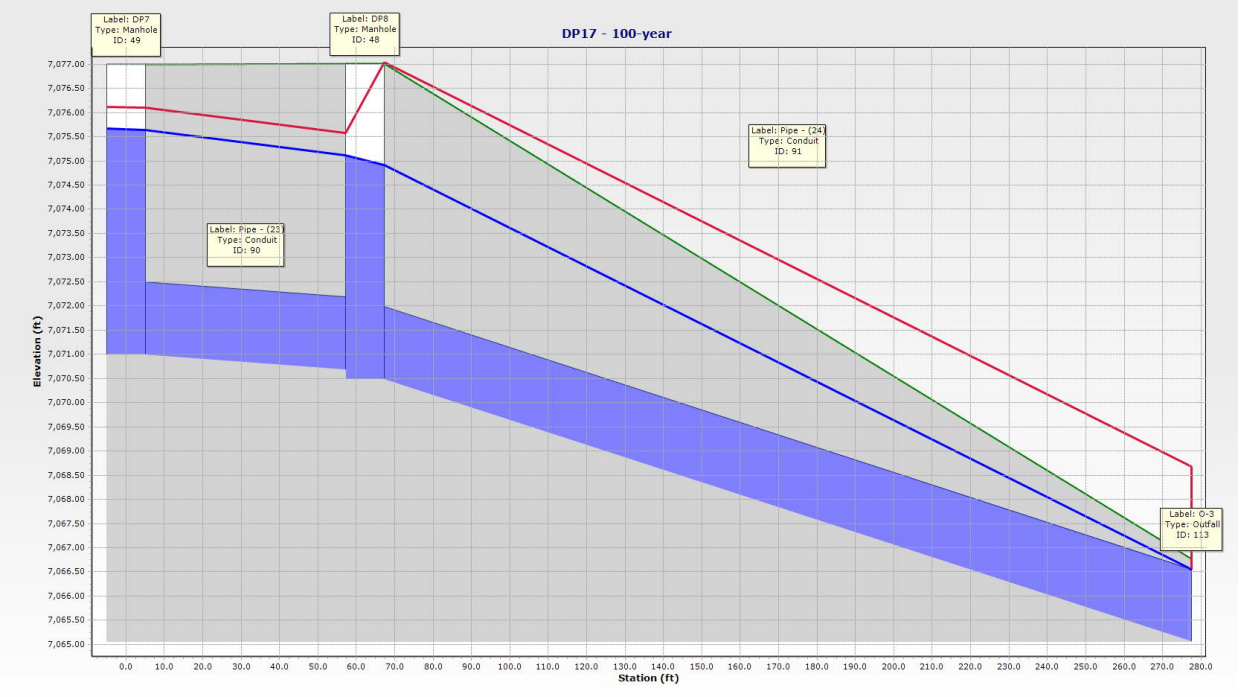
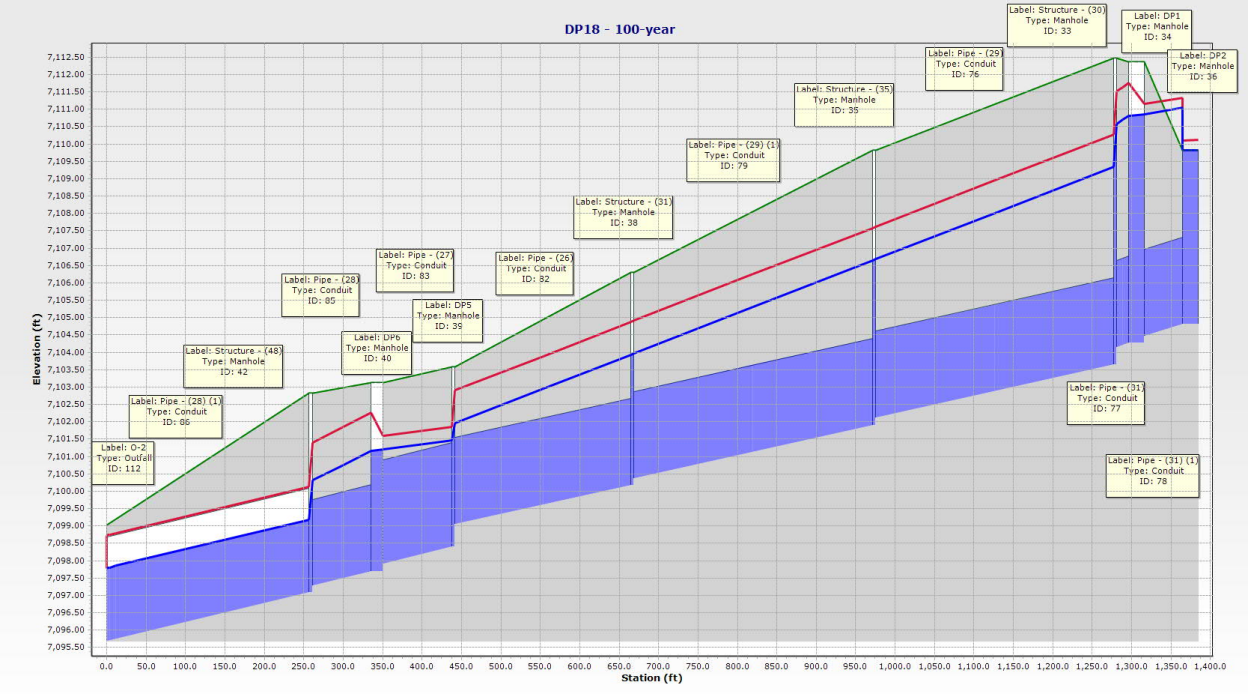
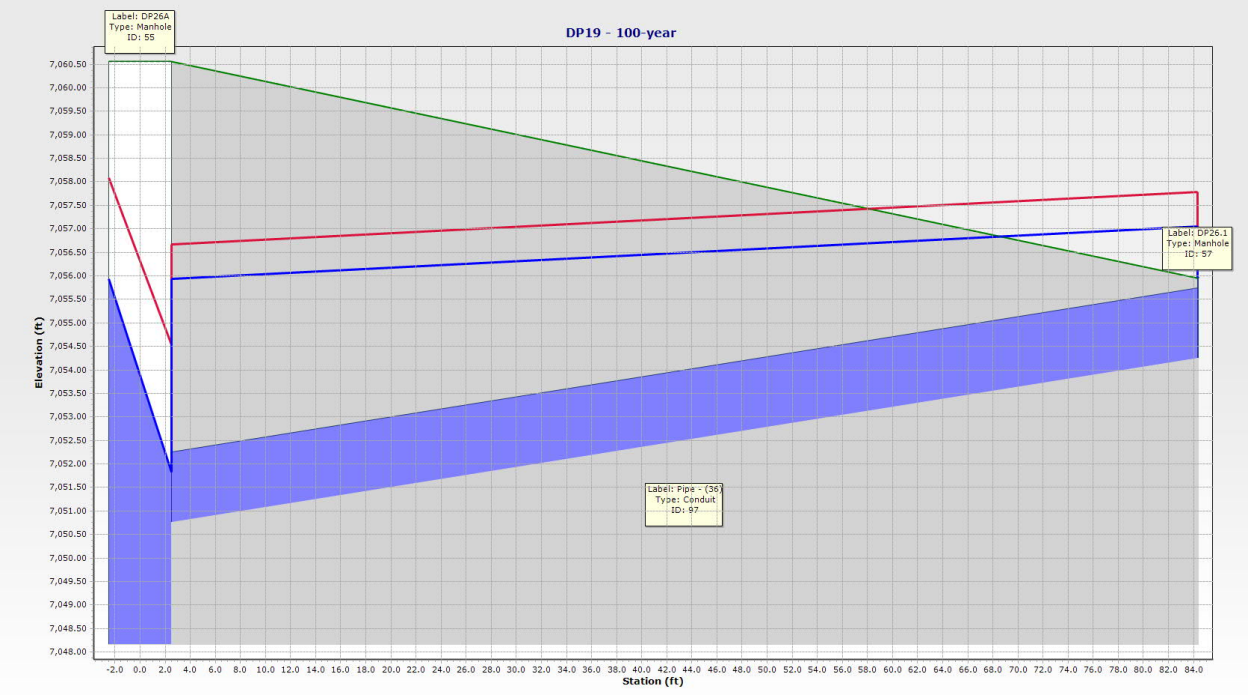
7,051.50
7,051.00
7,050.50
7,050.00
7,049.50
7,049.00
7,048.50
7,048.00
7,047.50
7,047.00
7,046.50
-10.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
210.0
220.0
230.0
240.0
250.0
260.0
Station (ft)


DP17 - 100-year
Label: DP7
Type: Manhole
ID: 49
Label: DP8
Type: Manhole
ID: 48
Label: Pipe - (24)
Type: Conduit
ID: 91
Label: Pipe - (23)
Type: Conduit
ID: 90
Label: O-3
Type: Outfall
ID: 113
Elevation (ft)
7,077.00
7,076.50
7,076.00
7,075.50
7,075.00
7,074.50
7,074.00
7,073.50
7,073.00
7,072.50
7,072.00
7,071.50
7,071.00
7,070.50
7,070.00
7,069.50
7,069.00
7,068.50
7,068.00
7,067.50
7,067.00
7,066.50
7,066.00
7,065.50
7,065.00
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
110.0
120.0
130.0
140.0
150.0
160.0
170.0
180.0
190.0
200.0
210.0
220.0
230.0
240.0
250.0
260.0
270.0
Station (ft)


DP18 - 100-year
Elevation (ft)
Station (ft)
Label: O-2
Type: Outfall
ID: 112
Label: Pipe - (28) (1)
Type: Conduit
ID: 86
Label: Structure - (48)
Type: Manhole
ID: 42
Label: Pipe - (28)
Type: Conduit
ID: 85
Label: DP6
Type: Manhole
ID: 40
Label: Pipe - (27)
Type: Conduit
ID: 83
Label: DP5
Type: Manhole
ID: 39
Label: Pipe - (26)
Type: Conduit
ID: 82
Label: Structure - (31)
Type: Manhole
ID: 38
Label: Pipe - (29) (1)
Type: Conduit
ID: 79
Label: Structure - (35)
Type: Manhole
ID: 35
Label: Pipe - (29)
Type: Conduit
ID: 76
Label: Structure - (30)
Type: Manhole
ID: 33
Label: DP1
Type: Manhole
ID: 34
Label: DP2
Type: Manhole
ID: 36
Label: Pipe - (31)
Type: Conduit
ID: 77
Label: Pipe - (31) (1)
Type: Conduit
ID: 78


DP19 - 100-year
Label: DP26A
Type: Manhole
ID: 55
Label: DP26.1
Type: Manhole
ID: 57
Label: Pipe - (36)
Type: Conduit
ID: 97
Elevation (ft)
Station (ft)
7,060.50
7,060.00
7,059.50
7,059.00
7,058.50
7,058.00
7,057.50
7,057.00
7,056.50
7,056.00
7,055.50
7,055.00
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7,053.50
7,053.00
7,052.50
7,052.00
7,051.50
7,051.00
7,050.50
7,050.00
7,049.50
7,049.00
7,048.50
7,048.00
-2.0 0.0 2.0 4.0 6.0 8.0 10.0 12.0 14.0 16.0 18.0 20.0 22.0 24.0 26.0 28.0 30.0 32.0 34.0 36.0 38.0 40.0 42.0 44.0 46.0 48.0 50.0 52.0 54.0 56.0 58.0 60.0 62.0 64.0 66.0 68.0 70.0 72.0 74.0 76.0 78.0 80.0 82.0 84.0

DP20 - 100-year
Label: DP5
Type: Manhole
ID: 39
Label: DP4
Type: Manhole
ID: 41
Label: Pipe - (32)
Type: Conduit
ID: 84
Elevation (ft)
7,103.70
7,103.60
7,103.50
7,103.40
7,103.30
7,103.20
7,103.10
7,103.00
7,102.90
7,102.80
7,102.70
7,102.60
7,102.50
7,102.40
7,102.30
7,102.20
7,102.10
7,102.00
7,101.90
7,101.80
7,101.70
7,101.60
7,101.50
7,101.40
7,101.30
7,101.20
7,101.10
7,101.00
7,100.90
7,100.80
7,100.70
7,100.60
7,100.50
7,100.40
7,100.30
7,100.20
7,100.10
7,100.00
7,099.90
7,099.80
7,099.70
7,099.60
7,099.50
7,099.40
7,099.30
7,099.20
7,099.10
7,099.00
7,098.90
7,098.80
7,098.70
7,098.60
7,098.50
7,098.40
7,098.30
-7.0 -6.0 -5.0 -4.0 -3.0 -2.0 -1.0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0
Station (ft)

Worksheet for Proposed Swale - Cross Section AA

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data		
Channel Slope	0.009	ft/ft
Discharge	269.40	cfs

Section Definitions

Station (ft)	Elevation (ft)
-0+13	7,103.00
0+00	7,099.50
0+05	7,099.50
0+18	7,103.00
0+37	7,109.00

With 4:1 side slopes, edge of swales should be at -0+14 & 0+19

JR UPDATED

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+13, 7,103.00)	(0+00, 7,099.50)	0.040
(0+00, 7,099.50)	(0+18, 7,103.00)	0.040
(0+18, 7,103.00)	(0+37, 7,109.00)	0.020

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results		
Normal Depth	37.5	in
Roughness Coefficient	0.040	
Elevation	7,102.63	ft
Elevation Range	7,099.5 to 7,109.0	ft
Flow Area	51.9	ft²
Wetted Perimeter	29.0	ft
Hydraulic Radius	21.4	in
Top Width	28.22	ft
Normal Depth	37.5	in
Critical Depth	31.1	in
Critical Slope	0.021	ft/ft
Velocity	5.19	ft/s
Velocity Head	0.42	ft
Specific Energy	3.54	ft

Worksheet for Proposed Swale - Cross Section AA

Results	
Froude Number	0.675
Flow Type	Subcritical

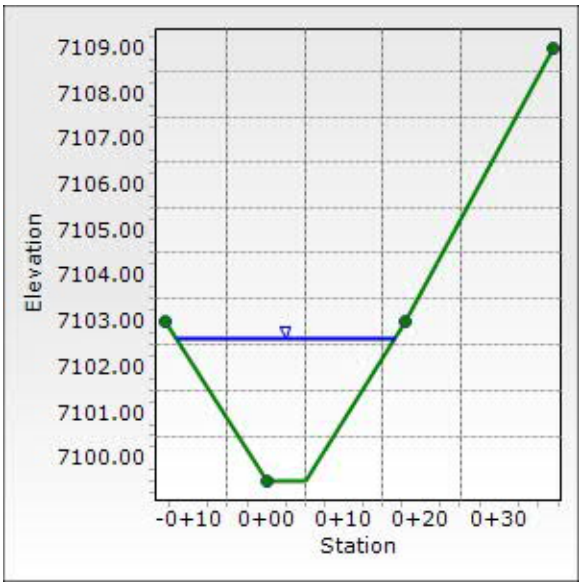
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	37.5 in
Critical Depth	31.1 in
Channel Slope	0.009 ft/ft
Critical Slope	0.021 ft/ft

Cross Section for Proposed Swale - Cross Section AA

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.009 ft/ft
Normal Depth	37.5 in
Discharge	269.40 cfs



Worksheet for Proposed Swale - Cross Section BB

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.021 ft/ft
Discharge	12.10 cfs

Section Definitions

Station (ft)	Elevation (ft)
-0+24	7,084.45
0+00	7,079.46
0+05	7,079.50
0+26	7,085.57

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+24, 7,084.45)	(0+00, 7,079.46)	0.040
(0+00, 7,079.46)	(0+26, 7,085.57)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	6.9 in
Roughness Coefficient	0.040
Elevation	7,080.03 ft
Elevation Range	7,079.5 to 7,085.6 ft
Flow Area	4.0 ft²
Wetted Perimeter	9.7 ft
Hydraulic Radius	5.0 in
Top Width	9.59 ft
Normal Depth	6.9 in
Critical Depth	6.1 in
Critical Slope	0.033 ft/ft
Velocity	3.00 ft/s
Velocity Head	0.14 ft
Specific Energy	0.71 ft
Froude Number	0.814
Flow Type	Subcritical

Worksheet for Proposed Swale - Cross Section BB

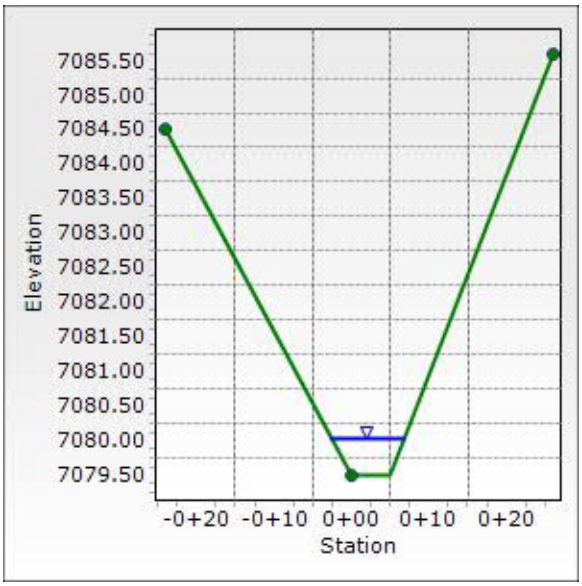
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	6.9 in
Critical Depth	6.1 in
Channel Slope	0.021 ft/ft
Critical Slope	0.033 ft/ft

Cross Section for Proposed Swale - Cross Section BB

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.021 ft/ft
Normal Depth	6.9 in
Discharge	12.10 cfs



Worksheet for Proposed Swale - Cross Section CC

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.021 ft/ft
Discharge	23.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
-0+12	7,067.00
-0+04	7,065.00
0+00	7,064.66
0+04	7,065.00
0+12	7,067.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+12, 7,067.00)	(0+04, 7,065.00)	0.040
(0+04, 7,065.00)	(0+12, 7,067.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	10.2 in
Roughness Coefficient	0.040
Elevation	7,065.51 ft
Elevation Range	7,064.7 to 7,067.0 ft
Flow Area	6.5 ft²
Wetted Perimeter	12.3 ft
Hydraulic Radius	6.4 in
Top Width	12.10 ft
Normal Depth	10.2 in
Critical Depth	9.5 in
Critical Slope	0.030 ft/ft
Velocity	3.53 ft/s
Velocity Head	0.19 ft
Specific Energy	1.05 ft
Froude Number	0.849

Worksheet for Proposed Swale - Cross Section CC

Results	
Flow Type	Subcritical

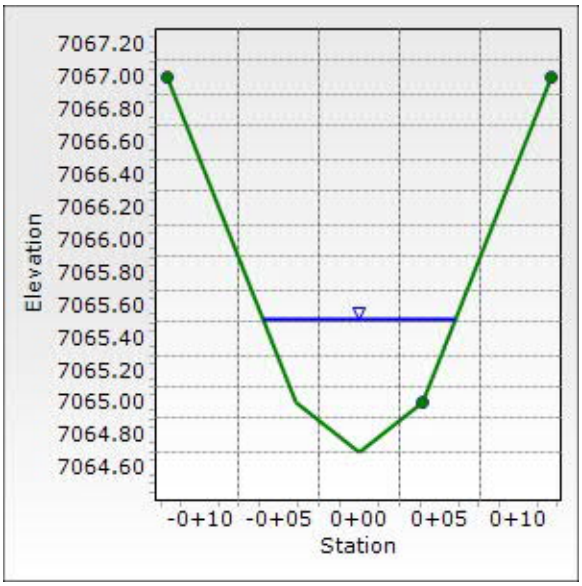
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	10.2 in
Critical Depth	9.5 in
Channel Slope	0.021 ft/ft
Critical Slope	0.030 ft/ft

Cross Section for Proposed Swale - Cross Section CC

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.021 ft/ft
Normal Depth	10.2 in
Discharge	23.00 cfs



This section does not match swale section shown on drainage map. Please reconcile between the two and update.

JR UPDATED

Worksheet for Proposed Swale - Cross Section DD

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

At least of a portion of the flow from Basin B11 should be accounted for in this swale.

Input Data	
Channel Slope	0.020 ft/ft
Discharge	28.00 cfs

JR RESPONSED. B11 flow added to total discharge

Sectio

Station (ft)	levation (ft)
-0+60	7,059.00
0+00	7,044.56
0+12	7,047.00
0+21	7,048.00
0+34	7,049.00
0+48	7,050.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+60, 7,059.00)	(0+34, 7,049.00)	0.040
(0+34, 7,049.00)	(0+48, 7,050.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	15.3 in
Roughness Coefficient	0.040
Elevation	7,045.83 ft
Elevation Range	7,044.6 to 7,059.0 ft
Flow Area	7.3 ft²
Wetted Perimeter	11.8 ft
Hydraulic Radius	7.4 in
Top Width	11.53 ft
Normal Depth	15.3 in
Critical Depth	14.3 in
Critical Slope	0.029 ft/ft
Velocity	3.82 ft/s
Velocity Head	0.23 ft
Specific Energy	1.50 ft

Worksheet for Proposed Swale - Cross Section DD

Results	
Froude Number	0.845
Flow Type	Subcritical

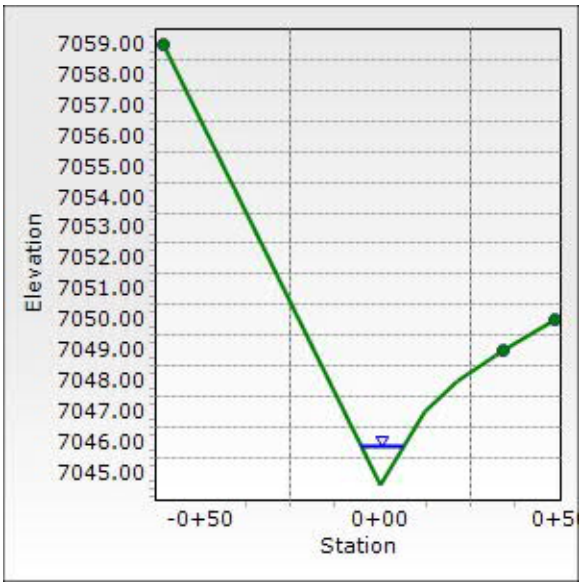
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	15.3 in
Critical Depth	14.3 in
Channel Slope	0.020 ft/ft
Critical Slope	0.029 ft/ft

Cross Section for Proposed Swale - Cross Section DD

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.020 ft/ft
Normal Depth	15.3 in
Discharge	28.00 cfs



This section does not match swale section shown on drainage map. Please reconcile between the two and update.

JR RESPONDED

Worksheet for Proposed Swale - Cross Section EE

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

At least of a portion of the flow from Basin B11 should be accounted for in this swale.

Input Data		
Channel Slope	0.020	ft/ft
Discharge	34.00	cfs

JR RESPONDED. B11 runoff added to total discharge

Section D

Station (ft)	ion
-0+80	7,051.93
0+00	7,033.54
1+27	7,049.03

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-0+80, 7,051.93)	(0+00, 7,033.54)	0.040
(0+00, 7,033.54)	(1+27, 7,049.03)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results		
Normal Depth	14.5	in
Roughness Coefficient	0.040	
Elevation	7,034.75	ft
Elevation Range	7,033.5 to 7,051.9	ft
Flow Area	9.1	ft²
Wetted Perimeter	15.4	ft
Hydraulic Radius	7.1	in
Top Width	15.15	ft
Normal Depth	14.5	in
Critical Depth	13.5	in
Critical Slope	0.029	ft/ft
Velocity	3.72	ft/s
Velocity Head	0.21	ft
Specific Energy	1.42	ft
Froude Number	0.844	
Flow Type	Subcritical	

Worksheet for Proposed Swale - Cross Section EE

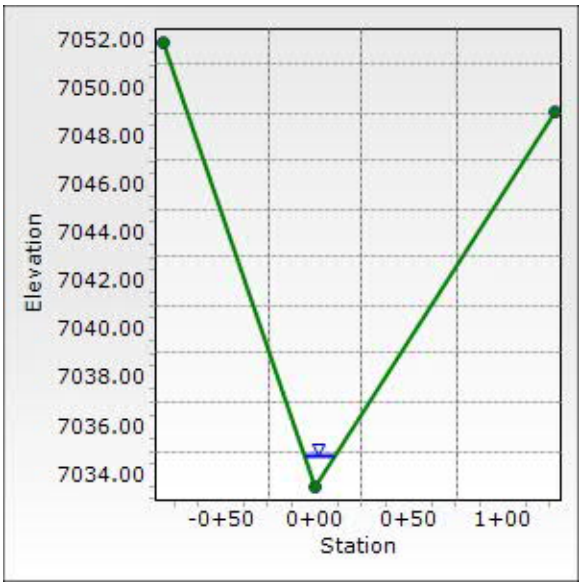
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	14.5 in
Critical Depth	13.5 in
Channel Slope	0.020 ft/ft
Critical Slope	0.029 ft/ft

Cross Section for Proposed Swale - Cross Section EE

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.020 ft/ft
Normal Depth	14.5 in
Discharge	34.00 cfs



This section does not match swale section shown on drainage map. Please reconcile between the two and update.

JR RESPONDED

Worksheet for Proposed Swale - Cross Section FF

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.023 ft/ft
Discharge	250.70 cfs

Section Definitions

Station (ft)	Elevation (ft)
-1+01	7,040.00
0+00	7,016.22
0+88	7,034.00

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(-1+01, 7,040.00)	(0+00, 7,016.22)	0.040
(0+00, 7,016.22)	(0+88, 7,034.00)	0.040

Options	
Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results	
Normal Depth	33.6 in
Roughness Coefficient	0.040
Elevation	7,019.02 ft
Elevation Range	7,016.2 to 7,040.0 ft
Flow Area	36.1 ft²
Wetted Perimeter	26.4 ft
Hydraulic Radius	16.4 in
Top Width	25.77 ft
Normal Depth	33.6 in
Critical Depth	34.1 in
Critical Slope	0.021 ft/ft
Velocity	6.95 ft/s
Velocity Head	0.75 ft
Specific Energy	3.55 ft
Froude Number	1.035
Flow Type	Supercritical

Worksheet for Proposed Swale - Cross Section FF

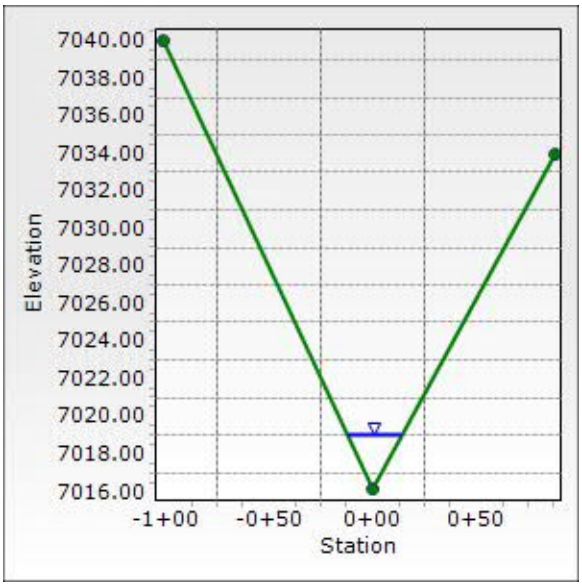
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	33.6 in
Critical Depth	34.1 in
Channel Slope	0.023 ft/ft
Critical Slope	0.021 ft/ft

Cross Section for Proposed Swale - Cross Section FF

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Channel Slope	0.023 ft/ft
Normal Depth	33.6 in
Discharge	250.70 cfs



This section does not match swale section shown on drainage map. Please reconcile between the two and update.

JR RESPONDED

Appendix D
Reference Materials

MASTER DEVELOPMENT DRAINAGE PLAN FOR STERLING RANCH

OCTOBER 2018

Prepared for:

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Project #09-002
SKP-18-003
SF-17-024

at DP87 culminating in peak runoff rates within Sand Creek of Q5 = 374.6 cfs, Q100 = 1905.9 cfs.

Basin SC3-16A (Q5 = 120.4 cfs, Q100 = 351.8 cfs) consists of a 168.1 acre area located within Sterling Ranch, that is located north of Briargate Parkway and east of Sand Creek Channel. This portion of Sterling Ranch is planned to house residential development that ranges from low density rural lots 1 acres in size to medium density urban residential with lots ranging in size from 0.1 to 0.2 acres. Runoff from the basin shall be collected and conveyed within street and storm sewer systems to a full spectrum detention pond (FSD16A), at the northwest corner of Briargate Parkway and Sterling Ranch Road. The treated detained flows from the pond will discharge to DP22 at peak flow rates of 8.8 cfs and 128.3 cfs in the 5 and 100 year events respectively.

Basin SC3-16B (Q5 = 53.7 cfs, Q100 = 143.8 cfs) consists of a 50.7 acre area located within Sterling Ranch, that is located north of Briargate Parkway and east of Sand Creek Channel. This portion of Sterling Ranch is planned for a low to medium density residential lots ranging in size from 0.1 to 0.2 acres lots and portions of roadways. Runoff from the basin shall be collected and conveyed within street and storm sewer systems to a full spectrum detention pond (FSD16B), at the northeast corner of Briargate Parkway and Sterling Ranch Road. The treated detained flows from the pond will discharge to DP22 at peak flow rates of 0.4 cfs and 28.1 cfs in the 5 and 100 year events respectively. The combined peak flow rates from SC3-16B and FSD14A (DP22, Q5=8.8 cfs and Q100=174.9 cfs) will be conveyed south via storm sewer system to DP21.

Basin SC3-14B (Q5 = 34.3 cfs, Q100 = 94.1 cfs) consists of a 34.7 acre area located within of Sterling. Ranch, that is located between south of Briargate Parkway and east of Sterling Ranch Road, east of Sand Creek. This portion of Sterling Ranch is planned for a low to medium density residential lots ranging in size from 0.1 to 0.33 acres lots and portions of roadways. Runoff from the basin shall be collected and conveyed within street and storm sewer systems to a full spectrum detention pond (FSD14B), at the south end of the basin. The treated detained flows from the pond will discharge to DP21 at peak flow rates of 0.3 cfs and 19.3 cfs in the 5 and 100 year events respectively. The combined peak flow rates from DP22 and FSD14B (DP21, Q5=8.8 cfs and Q100=174.9 cfs) will be conveyed to Pond W3 above the intersection of Sand Creek channel and Sterling Ranch Road.

Basin SC3-14A (Q5 = 175.4 cfs, Q100 = 466.3 cfs) consists of a 164.9 acre area located within of Sterling. Ranch, that is located between south of Briargate Parkway and east of Sterling Ranch Road, east of Sand Creek. This portion of Sterling Ranch is planned for a k-8 school site, several single family residential lots ranging in size from 0.2 to 0.33 acres lots as well as portions of park and open space. Runoff from the basin shall be collected and conveyed within street and storm sewer systems and directed to a full spectrum detention pond (FSD14A), at the southwest corner of the basin. The treated detained flows from the pond will discharge to Pond W3 at peak flow rates of 7.5 cfs and 142.2 cfs in the 5 and 100 year events respectively.

Basin SC3-13 (Q5 = 57.8 cfs, Q100 = 136.9 cfs) consists of a 41.0 acre area located within of Sterling. Ranch, that is located just the east of the Barbarick Subdivision and north of Sterling Ranch Road. This portion of Sterling Ranch is planned for residential lots ranging in size from 0.1 to 0.2 acres in size. Runoff from the basin shall be collected by storm sewer systems and conveyed to a full spectrum detention pond (FSD13) located in the south end of the basin, adjacent to sand creek. The treated detained flows from the pond will discharge into Sand Creek at peak flow rates of 4.2 cfs and 47.2 cfs in the 5 and 100 year events respectively.

Runoff from DP87, DP21 and from FSD Ponds 13, and 14A will combine within the Sand Creek Channel at proposed Regional Pond Detention Facility W3. The purpose of the regional pond is to reduce the post development flow rates within the Sand Creek Channel at the Southern Sterling Ranch boundary to at or below the existing flow rates calculated by this report. The pond is also necessary due to the drainage basin diversion, as discussed in other parts of this report. The total combined discharge reaching the regional facility (Pond W-3) has been calculated at 374.5 cfs and 2204.1 cfs in the 5 and 100 year events respectively.

As conceptually designed the proposed facility will utilize a check/diversion wall located upstream of the existing stock pond and proposed detention facility that will function to divert base flows within the channel to aid in retaining a fixed water surface within the existing stock pond and in larger storm events diverted flows safely around the amenity to the west side to detention Pond W3. A small controlled outlet structure along with an improved downstream embankment will be added to the existing stock pond to stabilize it and retain a fixed maximum water surface elevation. In the larger detention pond eight (8) small 24" storm sewer pipe located within a separate embankment will allow for free flow discharge of 2 year runoff and begin to detain flows of 5 years and larger events. Flows exiting the small storm pipes or overtopping the separated embankment will enter a concrete forebay that conveys drainage to two (2) cell 8'h x10'w concrete box culvert (CBC) under Proposed Sterling Ranch Road to DP68. As the anticipated flow rate leaving the pond is planned to be less than 1,500 cfs, and the proposed culvert crossing is conceptually planned to have an open area of less than 200 ft sq of open area and thus will need to meet the headwater requirements of Table 6-5 of the DCM, which in this concept design is a ratio of about ~1.3. The total combined discharge calculated to leave the regional facility (Pond W-3) has been calculated at 200.3 cfs and 1,350.6 cfs in the 5 and 100 year events respectively, with a maximum 100 year water surface of 7017.3, a

HW/D ratio of ~1.3. The peak detained volume has been estimated at 78.2 ac-ft. A low point in Sterling Ranch Road will be designed adjacent to the facility to provide a safe overflow route. An exhibit showing the concept design and its various elements is included in the appendix of this report.

As previously discussed a Condition Letter of Map Revision and Letter of Map Revision (CLOMR/LOMR) will need to be processed through the Federal Emergency Management Agency (FEMA) to revise the hydrology to the Sand Creek Channel and allow for the remapping of the revised floodplains. It should be noted that the DBPS flow rates for Reach SC-8 (Reach 163) adjacent to this location were estimate to be 2,630 cfs and that the effective FEMA 100 year flow rate is 2,600cfs. A comparison table of the various flow rates is provided later in this text and on the accompanying drainage maps.

The final design of the culvert crossing and final determination of approved rates as well as the final pond design will be discussed within the future Sterling Ranch Channel Design Report and Sand Creek CLOMR/LOMR documents. No deviations for this pond and accompanying outlet structure are anticipated at this time.

It is important to note that the planned discharge outlet pipe for the FSD pond located to the west of the pond W3 will need to be extended to the downstream outlet side of the culvert to ensure that the 100 year water surface elevation with W3 does not affect the functionality of the adjacent FSD and its storm sewer systems.

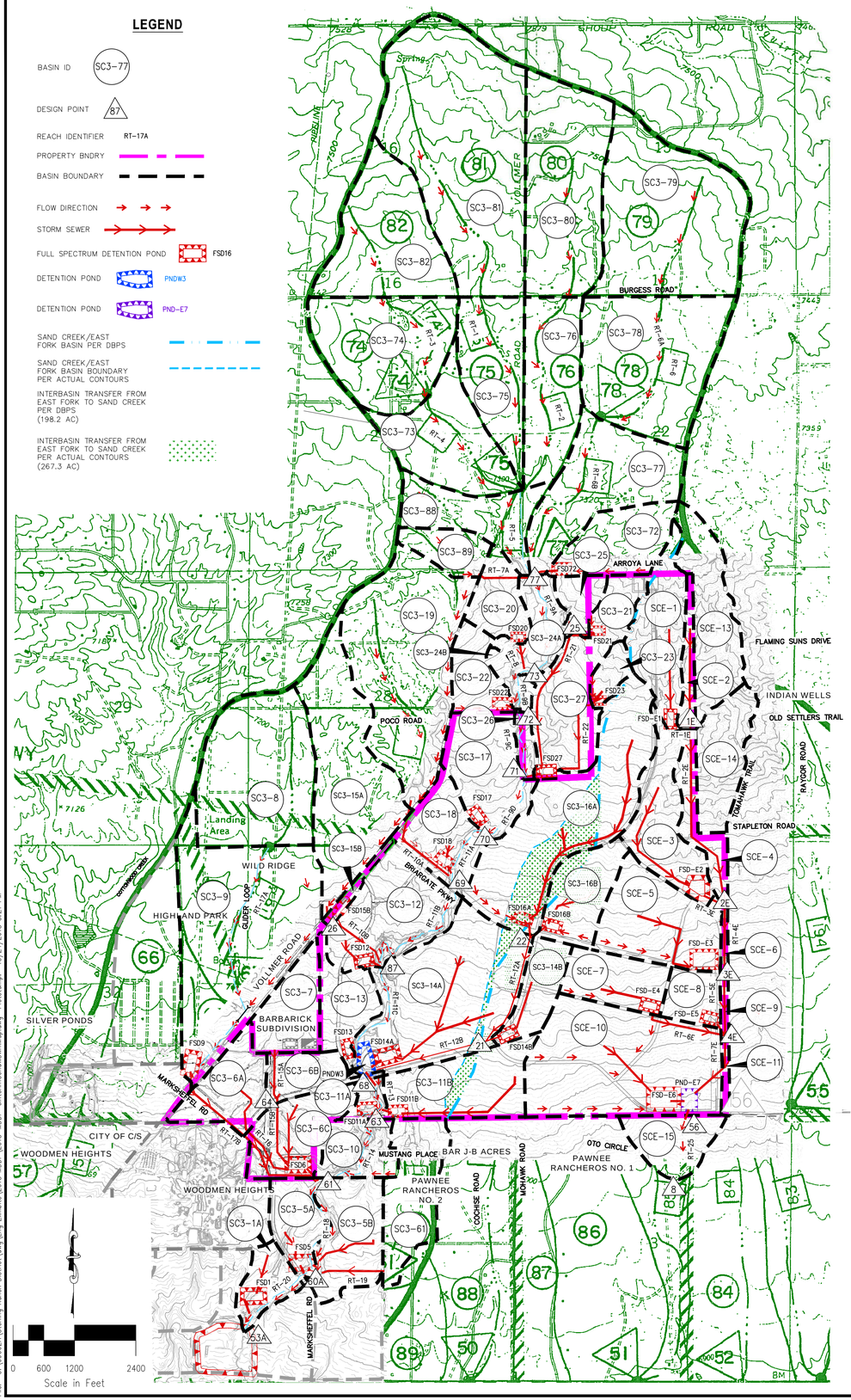
In regards to timing, the need to construction this facility can be tied to the Sand Creek Channel improvements which is discussed within this report and also within the Subdivision Improvements Agreement. In no case should runoff from the East Fork of Sand Creek be diverted to the Main Branch of the Sand Creek Channel prior to the construction and of this facility.

Basin SC3-11A (Q5 = 7.8 cfs, Q100 = 24.3 cfs) consists of a 10.7 acre area located within of Sterling. Ranch, that is south of Sterling Ranch Road, west of Sand Creek. This portion of Sterling Ranch consists of single family residential for lots ranging in size from 0.2 to 0.3 acres in size and open space associated with the Sand Creek Channel. Runoff from the developed portion of the basin shall be collected and conveyed within street and storm sewer systems to a full spectrum detention pond FSD11A. The treated detained flows from the pond will discharge into Sand Creek at peak flow rates of 0.9 cfs and 12.3 cfs in the 5 and 100 year events respectively just upstream of DP-63. It should be noted that this detention facility may not be necessary if grading can be oriented to force surface runoff to the west.

Basin SC3-11B (Q5 = 81.3 cfs, Q100 = 213.7 cfs) consists of a 76.6 acre area located within of Sterling. Ranch, that is south of Sterling Ranch Road, east of Sand Creek. This portion of Sterling Ranch consists of single family residential planned for lots ranging in size from 0.2 to 0.3 acres in size and a portion of a park site and collector roadways. Runoff from the developed portion of the basin shall be collected and conveyed within street and storm sewer systems westward to a full spectrum detention pond FSD11B. The treated detained flows from the pond will discharge into Sand Creek at peak flow rates of 4.5 cfs and 69.5 cfs in the 5 and 100 year events respectively. The runoff from DP68 and from FSD ponds 11A and 11B combine at DP63 at peak flow rates of Q5 = 201.0 cfs, Q100 = 1385.1, which is less than the anticipated existing modeled flow rates of Q5 = 430.7 cfs, Q100 = 1911.5 at DP63. Runoff from DP63 continues south within the Sand Creek Channel toward DP61.

Basin SC3-7 (Q5 = 69.9 cfs, Q100 = 157.2 cfs) consists of a 45.7 acre industrial zoned area, referred to as the Barbarick Subdivision, located outside of Sterling Ranch. Per the Final Drainage Report for Barbarick Subdivision, Portions of Lots 1, 2 and Lots 3and 4 the filing consists of four lots which upon which development will be constructed which will include adding a proposed Extended Detention Basin within Lot 4. This detention basin will provide water quality treatment for portions of Lots 1 & 2, and Lots 3 & 4. The EBD will structure will outfall at the south end of Lot 4 at the Barbarick Subdivision/Sterling Ranch property line. Per the report the proposed total outflow from the EDB pond will be Q5 = 0.3 cfs, Q100 = 45.9** cfs(**which includes pass through flows of 29.4 cfs). A second Sand Filter Basin water quality detention catchment will be provided at the southeast/downstream end of Lot 2. The SFB will outfall at the southeast corner of the Lot 2 at the Barbarick Subdivision/Sterling Ranch property line. Per the report the proposed total outflow the SFB pond will be Q5 = 0.1 cfs, Q100 = 3.6 cfs. At the initial writing of this report, neither EDB nor SFB structure has been fully constructed, and thus the assumption was made to utilize the full un-detained untreated runoff from the offsite development for onsite drainage planning purposes. Thus the downstream facilities planned within Sterling Ranch will account for the total un-detained runoff from the parcel of Q5 = 69.9 cfs, Q100 = 157.2 cfs and will plan to treat the total runoff onsite facilities. This provides a conservative approach for master planning. Runoff discharged from the property will be collected by proposed storm sewer within Sterling Ranch and routed to DP64. These facilities and their effects on drainage will be re-reviewed with subsequent drainage report and shall be implemented into final design and construction.

Basin SC3-6B (Q5=43.4 cfs, Q100=102.7 cfs) consists of a 30.9 acre area located within of Sterling Ranch, that is north of Sterling



BASIN SUMMARY

BASIN	Q1	AREA (ACRES)	AREA (SQ MI)	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)
SC3-1A	73	27.8	0.044	16.3	23.3	33.0	45.8	57.1	68.9
SC3-5A	84	39.1	0.061	28.2	40.6	53.7	71.0	92.4	110.6	129.1
SC3-5B	81	63.0	0.098	53.8	73.0	98.5	130.8	158.6	187.0
SC3-6A	88	49.3	0.077	61.4	79.3	102.2	130.1	153.6	177.1
SC3-6B	85	30.9	0.048	32.9	43.4	57.0	73.9	88.2	102.7
SC3-6C	82	58.0	0.091	53.9	72.5	97.1	128.0	154.5	181.5
SC3-7	88	45.7	0.071	54.0	69.9	90.3	115.2	136.2	157.2
SC3-8	62	143.4	0.224	25.4	42.1	66.7	100.7	132.3	166.2
SC3-9	66	217.4	0.340	45.8	71.5	108.6	158.9	204.9	254.0
SC3-10	63	36.0	0.056	7.6	12.3	19.4	29.1	38.0	47.7
SC3-11A	70	10.7	0.017	5.3	7.8	11.3	15.9	20.0	24.3
SC3-11B	80	76.6	0.120	59.4	81.3	110.8	148.1	180.5	213.7
SC3-12	81	88.2	0.138	77.8	105.6	142.5	189.1	229.1	270.0
SC3-13	85	41.0	0.064	43.9	57.8	76.0	98.5	117.6	136.9
SC3-14A	79	164.9	0.258	127.6	175.4	239.8	321.9	393.2	466.3
SC3-14B	77	34.7	0.054	24.6	34.3	47.4	64.2	79.0	94.1
SC3-15A	62	139.7	0.218	21.3	35.5	56.3	85.3	112.1	141.0
SC3-15B	87	7.9	0.012	10.8	14.0	18.2	23.3	27.6	31.9
SC3-16A	74	168.1	0.263	84.4	120.4	170.0	234.8	292.2	351.8
SC3-16B	78	50.7	0.079	39.0	53.7	73.6	99.0	121.1	143.8
SC3-17	73	70.6	0.110	41.8	59.6	85.2	119.0	149.1	180.6
SC3-18	81	53.8	0.084	49.3	67.1	91.0	121.2	147.3	174.0
SC3-19	62	184.0	0.287	28.8	47.7	75.7	114.4	150.2	188.8
SC3-20	65	34.2	0.053	9.9	15.5	23.8	35.1	45.5	56.6
SC3-21	66	23.3	0.036	7.0	10.8	16.3	23.7	30.4	37.5
SC3-22	65	33.9	0.053	9.4	14.8	22.5	32.9	42.5	52.6
SC3-23	67	14.5	0.023	5.5	8.3	12.4	18.0	23.0	28.4
SC3-24A	65	35.7	0.056	13.0	20.4	31.1	45.7	59.0	73.2
SC3-24B	65	12.2	0.019	3.4	5.3	8.1	11.8	15.2	18.9
SC3-25	66	19.0	0.030	5.8	8.9	13.4	19.5	25.1	31.0
SC3-26	63	10.0	0.016	2.5	4.0	6.2	9.2	12.1	15.1
SC3-27	71	70.0	0.109	35.1	51.2	73.8	103.7	130.3	158.3
SC3-61	63	65.5	0.102	13.7	22.0	34.4	51.6	67.6	84.8
SC3-72	64	56.2	0.088	12.8	20.2	31.4	46.7	60.9	76.0
SC3-73	63	90.0	0.141	16.4	26.4	41.3	62.1	81.3	102.0
SC3-74	63	119.7	0.187	22.3	36.5	57.3	85.9	112.3	140.7
SC3-75	63	79.3	0.124	13.1	21.5	33.7	50.5	66.1	82.8
SC3-76	63	86.4	0.135	14.2	23.1	36.4	54.6	71.4	89.6
SC3-77	62	106.9	0.167	16.6	27.6	43.8	66.2	87.0	109.4
SC3-78	63	155.6	0.243	28.1	45.3	70.6	106.2	139.1	174.5
SC3-79	63	189.0	0.295	34.9	57.0	89.5	134.3	175.6	220.1
SC3-80	63	147.7	0.231	27.3	44.3	69.6	104.5	136.8	171.4
SC3-81	62	262.9	0.411	42.6	70.2	111.0	167.4	219.6	275.7
SC3-82	62	117.8	0.184	20.0	33.2	52.8	80.0	105.1	132.3
SC3-88	62	60.2	0.094	10.5	17.4	27.6	41.8	54.9	69.0
SC3-89	62	27.5	0.043	6.1	10	15.7	23.6	30.8	38.6
SCE-1	65	64.4	0.101	23.3	35.9	53.8	79.1	102.4	127.4
SCE-2	64	15.0	0.023	4.4	7.0	10.8	15.9	20.7	25.7
SCE-3	70	67.5	0.105	30.6	45.2	65.9	93.3	118.0	143.9
SCE-4	70	29.5	0.046	13.3	19.6	28.6	40.6	257.8	62.6
SCE-5	87	85.5	0.134	100.4	130.6	169.6	217.4	257.8	298.4
SCE-6	64	3.8	0.006	1.6	2.5	3.7	5.4	7.0	8.6
SCE-7	89	44.9	0.070	58.9	75.5	96.6	122.2	143.7	165.2
SCE-8	92	25.5	0.040	38.6	48.4	60.7	75.4	87.7	99.9
SCE-9	64	4.0	0.006	1.5	2.4	3.6	5.3	6.8	8.5
SCE-10	83	174.3	0.272	7.6	189.4	19.4	29.1	398.9	467.5
SCE-11	64	5.8	0.009	2.3	3.6	5.5	8.0	10.3	12.8
SCE-13	63	78.6	0.123	19.6	31.3	48.7	73.1	95.7	120.0
SCE-14	63	52.5	0.082	13.2	21.2	33.3	49.9	65.2	81.7
SCE-15	51	39.7	0.062	2.2	5.1	10.1	17.7	25.1	33.4

DESIGN POINT SUMMARY

DESIGN POINT	AREA (SQ MI)	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)	LOCATION
DP-74	0.371	39.3	65.3	104.8	158.9	209.1	262.8	
DP-75	1.413	141.2	235.1	376.6	566.6	750.9	950.5	
DP-77	2.343	209.9	351.9	580.6	886.6	1168.4	1467.7	ARROYA LANE X-ING
DP-78	0.538	59.7	98.4	154.0	232.6	306.2	385.3	
DP-73	2.471	207.5	354.3	588.5	897.1	1187.2	1506.7	
DP-72	2.543	206.2	352.5	586.7	897.2	1195.3	1518.6	POCO ROAD X-ING
DP-71	2.757	205.9	349.3	610.5	930.2	1226.9	1612.2	STERLING RANCH NORTHERN BNDRY
DP-70	2.867	205.3	349.8	614.0	940.1	1260.6	1636.7	
DP-69	3.238	212.7	366.6	653.7	1010.6	1364.1	1775.7	BRIARGATE PARKWAY X-ING
DP-87	3.594	216.9	374.6	681.9	1072.1	1471.5	1905.9	
DP-68	4.312	214.6	374.5	714.9	1187.6	1674.9	2204.1	UPSTREAM OF POND W3
DP-64	0.119	85.9	112.1	145.9	187.5	222.6	258.0	
DP-63	4.449	154.4	201.0	375.7	815.9	1167.4	1585.1	STERLING RANCH SOUTHERN BNDRY
DP-61	5.356	156.6	223.9	428.0	928.2	1287.3	1620.1	COLORADO SPRINGS/EL PASO BNDRY
DP-60A	5.617	161.6	224.8	439.1	950.4	1320.5	1661.8	MARKSHEFFEL X-ING
DP-53A	5.661	161.6	225.7	441.8	951.1	1326.0	1668.9	SAND CREEK AND POND 3
DP-1E	0.247	23.9	38.3	70.1	132.8	173.0	220.9	
DP-2E	0.486	48.9	76.8	123.0	228.7	319.7	419.4	
DP-3E	0.626	48.5	75.7	122.2	271.1	387.1	500.1	
DP-4E	0.745	48.1	76.2	122.4	286.9	407.3	534.8	
DP-56	1.017	23.1	35.3	71.5	108.3	152.1	196.4	NEAR SE PROP CORNER
DP-8	1.079	24.1	37.2	73.5	111.3	155.4	200.7	BELOW SE PROP CORNER
DP-21	0.396	0.6	8.8	17.8	57.1	116.8	174.9	
DP-22	0.342	0.6	8.8	17.6	56.8	105.1	156.4	
DP-25	0.066	5.9	9.1	16.3	35.1	46.4	58.2	
DP-26	0.012	0.1	1.1	3.2	7.3	9.5	12.0	

DESIGN POINT SUMMARY (VOLUME)

DESIGN POINT	AREA (SQ MI)	V2 (AC-FT)	V5 (AC-FT)	V10 (AC-FT)	V25 (AC-FT)	V50 (AC-FT)	V100 (AC-FT)	LOCATION
DP-74	0.371	5.9	9.0	13.6	19.8	25.5	31.6	
DP-75	1.413	22.7	34.5	51.7	75.4	97.1	120.5	
DP-77	2.343	37.7	57.4	85.9	125.1	161.1	199.9	ARROYA LANE X-ING
DP-78	0.538	8.9	13.5	20.1	29.3	37.7	46.7	
DP-73	2.471	40.0	60.8	91.0	132.5	170.7	211.7	
DP-72	2.543	41.3	62.9	94.0	136.8	176.2	218.5	POCO ROAD X-ING
DP-71	2.757	46.3	70.0	104.3	151.3	194.5	240.8	STERLING RANCH NORTHERN BNDRY
DP-70	2.867	49.5	74.5	110.6	160.1	205.4	254.0	
DP-69	3.238	57.5	86.1	127.4	183.8	235.3	290.6	BRIARGATE PARKWAY X-ING
DP-87	3.594	66.5	98.9	145.6	209.1	267.1	329.1	
DP-68	4.312	81.8	123.7	183.9	264.9	338.0	415.8	UPSTREAM OF POND W3
DP-64	0.119	7.0	9.1	11.8	15.2	18.1	21.1	
DP-63	4.449	85.6	129.5	192.3	276.7	352.8	433.5	STERLING RANCH SOUTHERN BNDRY
DP-61	5.356	103.7	157.8	235.1	338.4	431.3	529.8	COLORADO SPRINGS/EL PASO BNDRY
DP-60A	5.617	111.0	168.6	250.4	359.5	457.7	561.5	MARKSHEFFEL X-ING
DP-53A	5.661	112.0	170.0	252.6	362.6	461.7	566.5	SAND CREEK AND POND 3
DP-1E	0.247	3.1	5.2	8.4	12.7	16.6	20.9	
DP-2E	0.480	6.1	10.4	16.9	25.7	33.7	42.2	
DP-3E	0.622	7.0	13.7	23.4	36.1	47.4	59.3	
DP-4E	0.736	7.6	15.6	27.2	43.0	57.2	72.0	
DP-56	1.017	7.7	16.1	28.6	51.3	71.7	92.9	NEAR SE PROP CORNER
DP-8	1.079	8.0	16.7	26.6	53.0	74.0	95.9	BELOW SE PROP CORNER
DP-21	0.396	6.3	11.3	18.3	27.5	35.6	44.0	
DP-22	0.736	6.3	10.7	16.7	24.6	31.5	38.7	
DP-25	1.017	1.1	1.9	2.8	4.1	5.2	6.4	
DP-26	1.079	0.7	0.9	1.2	1.5	1.8	2.1	

WATER QUALITY & DETENTION POND SUMMARY

FSD1						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	16.3	23.3	33.0	45.8	57.1	68.9
ALLOWABLE RELEASE (CFS)	0.1	1.7	3.3	10.9	17.5	25.5
MODELED RELEASE (CFS)	0.1	1.6	3.2	10.9	17.4	25.4
STORED VOLUME (AC-FT)	2.4	2.6	3.0	3.6	1.9	2.2

FSD5						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	40.6	53.7	71.0	92.4	110.6	129.1
ALLOWABLE RELEASE (CFS)	0.1	1.4	2.6	11.3	19.8	30.2
MODELED RELEASE (CFS)	0.1	1.4	2.6	11.2	19.7	30.1
STORED VOLUME (AC-FT)	3.0	3.2	3.8	4.1	4.7	5.2

FSD6						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	196.5	258.5	339.1	438.7	523.3	608.6
ALLOWABLE RELEASE (CFS)	0.5	7.6	14.6	58.4	99.6	149.7
MODELED RELEASE (CFS)	0.5	7.5	14.5	58.2	99.6	149.6
STORED VOLUME (AC-FT)	15.5	16.4	18.7	20.8	23.3	26.0

FSD9						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	64.6	105.6	169.5	252.3	327.1	410.1
ALLOWABLE RELEASE (CFS)	1.7	24.9	49.8	141.1	207.2	290.0
MODELED RELEASE (CFS)	1.7	24.9	49.8	141.1	207.0	289.9
STORED VOLUME (AC-FT)	8.7	8.7	9.6	10.8	12.3	13.8

FSD11A						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	5.3	7.8	11.3	15.9	20.0	24.3
ALLOWABLE RELEASE (CFS)	0.1	1.6	3.2	7.5	9.7	12.4
MODELED RELEASE (CFS)	0.2	0.9	3.0	7.5	9.7	12.3
STORED VOLUME (AC-FT)	0.3	0.3	0.4	0.4	0.5	0.6

FSD11B						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	59.4	81.3	110.8	148.1	180.5	213.7
ALLOWABLE RELEASE (CFS)	0.3	4.5	8.7	29.6	47.7	69.6
MODELED RELEASE (CFS)	0.3	4.5	8.6	29.5	47.7	69.5
STORED VOLUME (AC-FT)	4.8	4.9	5.5	6.4	7.3	8.2

FSD12						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	77.8	105.6	142.5	189.1	229.1	270.0
ALLOWABLE RELEASE (CFS)	0.9	13.2	26.7	62.0	80.2	103.2
MODELED RELEASE (CFS)	0.9	9.0	26.7	61.9	80.1	103.1
STORED VOLUME (AC-FT)	5.2	5.5	5.8	6.7	7.8	8.9

FSD13						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	43.9	57.8	76.0	98.5	117.6	136.9
ALLOWABLE RELEASE (CFS)	0.4	6.1	12.3	28.6	37.0	47.6
MODELED RELEASE (CFS)	0.4	4.2	12.3	28.6	36.9	47.2
STORED VOLUME (AC-FT)	3.1	3.1	3.3	3.8	4.4	5.0

FSD14A						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	127.6	175.4	239.8	321.9	393.2	466.3
ALLOWABLE RELEASE (CFS)	0.5	7.5	14.4	56.2	95.2	142.4
MODELED RELEASE (CFS)	0.5	7.5	14.4	56.2	95.1	142.2
STORED VOLUME (AC-FT)	9.9	10.6	11.9	13.5	15.3	17.3

FSD14B						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	24.6	34.3	47.4	64.2	79.0	94.1
ALLOWABLE RELEASE (CFS)	0.0	0.3	0.5	5.7	11.8	19.3
MODELED RELEASE (CFS)	0.0	0.3	0.5	4.5	11.8	19.3
STORED VOLUME (AC-FT)	1.9	2.5	3.3	3.5	3.5	3.8

FSD15B						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	10.8	14.0	18.2	23.3	27.6	31.9
ALLOWABLE RELEASE (CFS)	0.1	1.6	3.2	7.3	9.5	12.0
MODELED RELEASE (CFS)	0.1	1.1	3.2	7.3	9.5	12.0
STORED VOLUME (AC-FT)	0.6	0.6	0.7	0.8	0.9	1.0

FSD16A						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	84.4	120.4	170.0	234.8	292.2	351.8
ALLOWABLE RELEASE (CFS)	0.6	8.8	17.3	56.2	88.4	128.3
MODELED RELEASE (CFS)	0.6	8.8	17.3	56.2	88.3	128.3
STORED VOLUME (AC-FT)	7.6	7.7	8.9	10.4	12.1	13.8

SAND CREEK FLOW COMPARISON CHART

DESIGN POINT	AREA (SQ MI)	Q100 (CFS)	DESCRIPTION
DP-77	2.343	1468	PROPOSED CONDITION
	2.91	2262	SAND CREEK DBPS
		2600	FEMA
DP-71	2.757	1612	PROPOSED CONDITION
		2260	SAND CREEK DBPS
DP-63	4.449	1385	PROPOSED CONDITION
	4.33	2630	SAND CREEK DBPS
		2600	FEMA
DP-60A	5.661	1662	PROPOSED CONDITION
	5.38	3295	SAND CREEK DBPS

EFSC DBPS DESIGN POINT SUMMARY (PEAK FLOW)

DBPS DESIGN POINT	AREA (SQ MI)	Q10 (CFS) (EXISTING)	Q100 (CFS) (EXISTING)	AREA (SQ MI)	Q10 (CFS) (PROPOSED)	Q100 (CFS) (PROPOSED)
DP-50	0.32	47.0	195.7	0.32	146.7	370.3
DP-51 (BASIN 86)	0.33	17.7	74.1	0.33	110.0	233.5
DP-52	1.67	80.5	456.5	1.67	1207.9	2123.0
DP-56	0.79	63.6	265.0	0.79	513.0	908.2

Values reported from SCDBPS, (DP 50, 51, 52 Not analyzed as a part of this study)
DBPS Reach 85(Basin91)=Q10=28.6cfs Q100=115.2cfs / Q10=345.7cfs Q100=688.9cfs

WATER QUALITY & DETENTION POND SUMMARY

FSD16B						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	39.0	53.7	73.6	99.0	121.1	143.8
ALLOWABLE RELEASE (CFS)	0.0	0.4	0.7	8.3	17.2	28.2
MODELED RELEASE (CFS)	0.0	0.4	0.7	7.9	17.2	28.1
STORED VOLUME (AC-FT)	3.0	3.9	5.1	5.1	5.3	5.8

FSD17						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	41.8	59.6	85.2	119.0	149.1	180.6
ALLOWABLE RELEASE (CFS)	0.7	11.1	22.5	52.0	67.2	86.3
MODELED RELEASE (CFS)	0.7	8.4	22.4	52.0	67.2	86.1
STORED VOLUME (AC-FT)	2.6	2.6	2.8	3.4	4.0	4.7

FSD18						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	49.3	67.1	91.0	121.2	147.3	174.0
ALLOWABLE RELEASE (CFS)	0.6	9.2	18.4	42.2	54.6	69.9
MODELED RELEASE (CFS)	0.6	6.3	18.4	42.2	54.6	69.6
STORED VOLUME (AC-FT)	3.2	3.2	3.4	4.0	4.7	5.3

FSD20						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	9.9	15.5	23.8	35.1	45.5	56.6
ALLOWABLE RELEASE (CFS)	0.4	5.5	11.1	25.7	33.2	42.5
MODELED RELEASE (CFS)	0.4	2.8	10.9	25.7	33.0	42.4
STORED VOLUME (AC-FT)	0.7	0.8	0.8	0.9	1.0	1.2

FSD21						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	7.0	10.8	16.3	23.7	30.4	37.5
ALLOWABLE RELEASE (CFS)	0.3	4.0	8.0	18.3	23.7	30.3
MODELED RELEASE (CFS)	0.3	3.3	8.0	18.3	23.7	30.1
STORED VOLUME (AC-FT)	0.5	0.5	0.5	0.6	0.7	0.8

FSD22						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	9.4	14.8	22.5	32.9	42.5	52.6
ALLOWABLE RELEASE (CFS)	0.4	5.8	11.5	26.5	34.3	43.9
MODELED RELEASE (CFS)	0.4	5.8	11.4	26.5	34.3	43.8
STORED VOLUME (AC-FT)	0.6	0.6	0.7	0.8	0.9	1.0

FSD23						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	5.5	8.3	12.4	18.0	23.0	28.4
ALLOWABLE RELEASE (CFS)	0.2	2.4	4.9	11.2	14.5	18.6
MODELED RELEASE (CFS)	0.2	2.0	4.9	11.2	14.5	18.6
STORED VOLUME (AC-FT)	0.3	0.3	0.4	0.4	0.5	0.6

FSD27						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	38.8	57.6	84.1	119.7	159.2	206.3
ALLOWABLE RELEASE (CFS)	1.4	21.1	42.4	97.8	126.4	161.9
MODELED RELEASE (CFS)	1.4	18.4	42.3	97.7	126.2	161.9
STORED VOLUME (AC-FT)	2.7	2.8	2.9	3.2	3.7	4.2

FSD72						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	12.8	20.2	31.4	46.7	60.9	76.0
ALLOWABLE RELEASE (CFS)	0.6	9.6	19.3	44.4	57.4	73.4
MODELED RELEASE (CFS)	0.6	9.3	19.2	44.4	57.4	73.4
STORED VOLUME (AC-FT)	1.0	1.0	1.1	1.1	1.2	1.3

PNDW3						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	214.6	374.5	714.9	1187.6	1674.9	2204.1
MODELED RELEASE (CFS)	154.3	200.3	366.8	799.9	1085.6	1350.6
STORED VOLUME (AC-FT)	2.8	9.5	26.3	41.2	57.2	78.2

FSD-E1						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	23.3	35.9	53.8	79.1	102.4	127.4
ALLOWABLE RELEASE (CFS)	0.7	11.0	22.1	50.9	65.7	84.1
MODELED RELEASE (CFS)	0.7	5.4	19.9	48.9	62.8	84.0
STORED VOLUME (AC-FT)	1.3	1.3	1.5	1.8	2.1	2.5

FSD-E2						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	30.6	45.2	65.9	93.3	118.0	143.9
ALLOWABLE RELEASE (CFS)	0.6	9.5	19.2	45.5	59.8	77.6
MODELED RELEASE (CFS)	0.6	3.2	18.5	41.3	58.5	84.7
STORED VOLUME (AC-FT)	2.1	2.3	2.4	2.8	3.3	3.8

FSD-E3						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	100.4	130.6	169.6	217.4	257.8	298.4
ALLOWABLE RELEASE (CFS)	0.9	13.2	26.5	61.6	79.8	102.6
MODELED RELEASE (CFS)	1.0	6.8	25.7	56.0	79.8	101.3
STORED VOLUME (AC-FT)	7.0	7.2	7.7	8.9	10.1	11.4

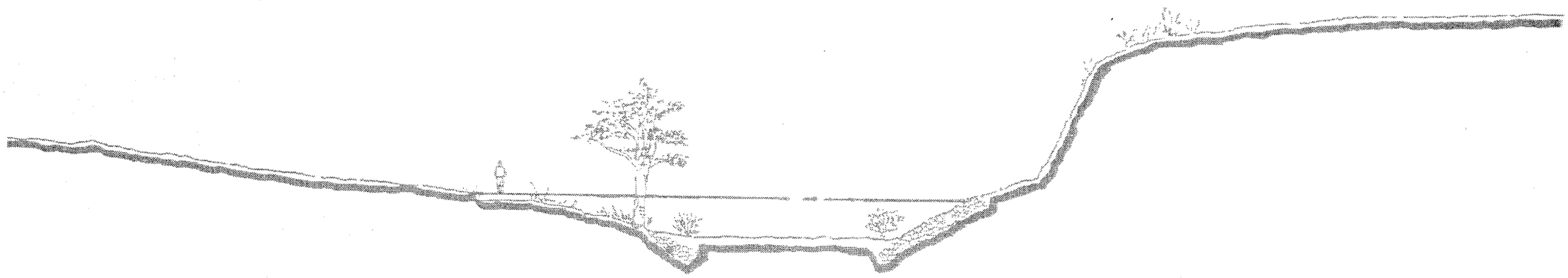
FSD-E4						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK INFLOW (CFS)	58.9	75.5	96.6	122.2	143.7	165.2
ALLOWABLE RELEASE (CFS)	0.3	4.4	8.8	23.0	32.2	43.7
MODELED RELEASE (CFS)	0.9	2.8	8.7	21.9	32.2	43.6
STORED VOLUME (AC-FT)	4.2	4.3	4.7	5.4	6.2	6.9

FSD-E5						
STORM EVENT (YR)	2	5	10	25	50	100
PEAK

SAND CREEK DRAINAGE BASIN PLANNING STUDY

PRELIMINARY DESIGN REPORT

CITY OF COLORADO SPRINGS, EL PASO COUNTY, COLORADO

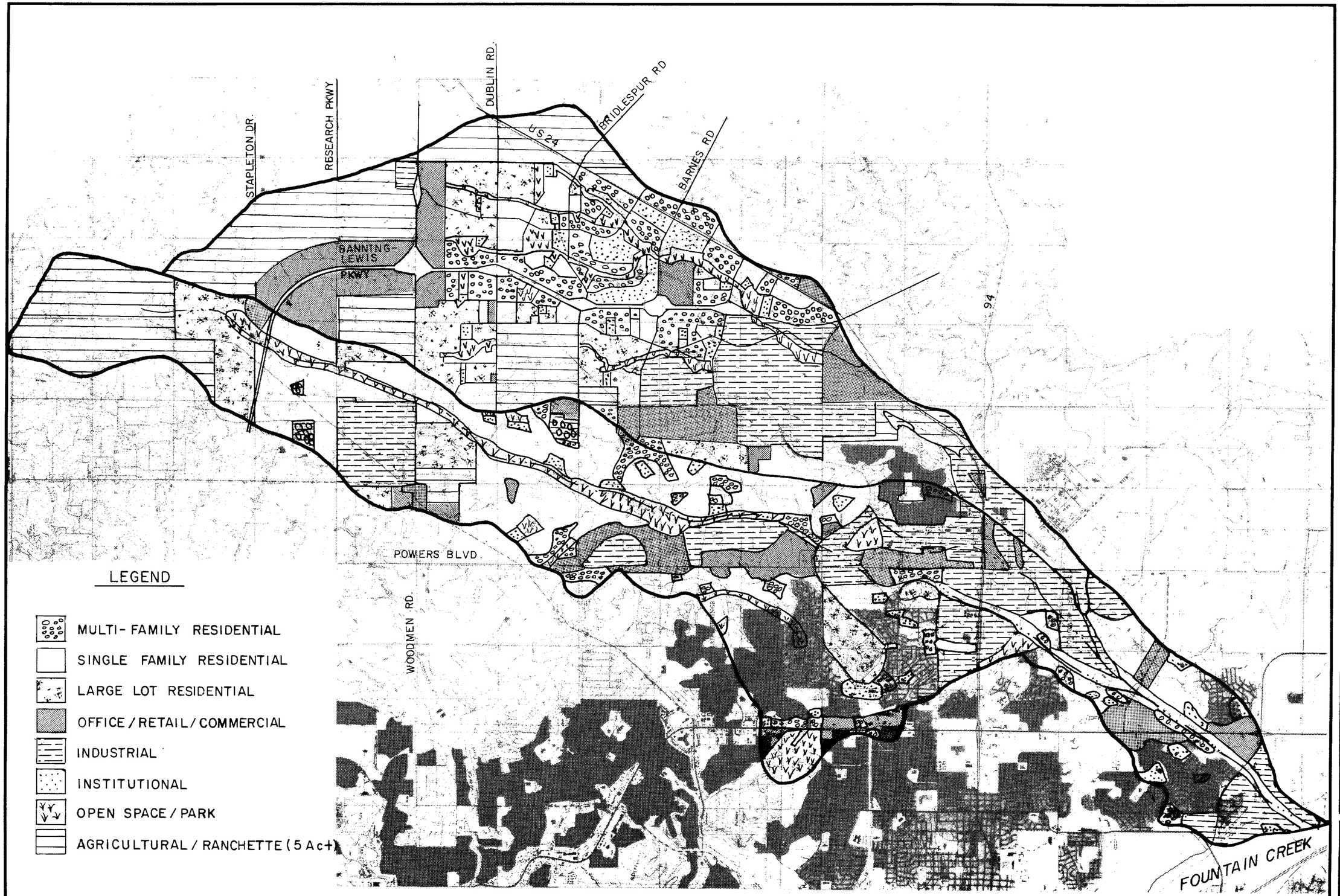


PREPARED FOR:

City of Colorado Springs
Department of Comprehensive Planning, Development and Finance
Engineering Division
30 S. Nevada
Colorado Springs, Colorado 80903

PREPARED BY:

Kiowa Engineering Corporation
1011 North Weber
Colorado Springs, CO 80903



Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY

PROPOSED LAND USE

Project No.	90-04-09
Date:	9/90
Design:	
Drawn:	EAK
Check:	
Revisions:	

7

FIG. II-3

Table III-1. Percent Impervious Values.

Land Use Classification	Percent Impervious	Land Use Density
Multi-Family Residential	65-80	10-24 DU/AC
Single-Family Residential	45-65	6-10 DU/AC
Low Density Residential	30-45	1-6 DU/AC
Large Lot Residential/ Agricultural	5-20	1 DU/AC
Office/Commercial	80-90	
Industrial	85-95	
Institutional	50-75	
Dedicated Open Space/Park	5-10	
Rangeland - Poor to Good Condition	5- 20	

NOTE: The above data was used in the preparation of the hydrologic analysis for the Sand Creek Drainage Basin Planning Study. These data are not intended to reflect future land use planning within the City or the County.

Table III-2: Summary of Peak Discharges
24-hour Duration Storm, AMC-II
Baseline Hydrologic Conditions

Design Point	Location	Area s.m.	100-year (cfs) Existing	100-year (cfs) Future	10-year (cfs) Existing	10-year (cfs) Future
	SAND CREEK (1)					
1	@ Fountain Creek	54.1	16900	25800	7470	11800
12	Hancock Blvd.	53.1	16100	25000	7250	11600
19	Fountain Blvd.	50.7	13600	22100	6230	10800
27	West Fork Sand Creek	23.0	11300	18900	5920	8790
99	C.R.I. & P. RR	16.0	5820	14530	2360	7400
20	North Carefree	13.5	4030	10260	1520	4810
37	Stetson Hills Blvd.	10.0	3230	6690	840	3060
60	Woodmen Road	5.4	2630	3300	760	950
75	Black Forest Road	1.4	1000	1030	320	350
	WEST FORK SAND CREEK					
27	@ Sand Creek	5.0	6840	6840	3200	3200
52	U. S. 24	4.8	6860	6860	3230	3230
59	Constitution Ave.	2.1	3450	3450	1680	1680
69	South Carefree	1.0	1630	1630	810	810
	CENTER TRIBUTARY SAND CREEK					
42	Airport Road	1.6	1530	2010	650	1200
43	Powers Blvd.	1.3	1300	1710	590	980
44	U. S. 24	1.1	1200	1680	580	960
45	Galley Road	0.8	1180	1340	530	650
	EAST FORK SAND CREEK					
1	@ Center Tributary	24.3	3970	15600	700	6530
9	@ East Fork Sub. Tributary	19.8	3730	13990	650	6050
29	@ W. Bierstadt Creek	10.6	2080	7460	400	3330
40	@ Tamlin Road	4.6	950	3570	210	1820
52	@ Woodmen Road	1.7	460	2120	80	1210
	EAST FORK SUB-TRIBUTARY SAND CREEK					
11	@ Constitution Avenue	5.9	1330	4100	240	1630
15	@ Chicago & Rock Island RR	5.2	1250	3540	230	1370
26	@ Confluence w/Toy Ranch	1.0	220	820	50	370
47	@ Proposed Dublin Blvd.	0.4	100	300	20	140
	WEST BIERSTADT CREEK					
31	@ Confluence w/ East Fork	1.8	480	1590	80	600
39	@ Tamlin Road	0.8	270	680	50	290
54	@ Woodmen Road	0.5	230	420	55	150
	EAST BIERSTADT CREEK					
32	@ Conf. w/W Bierstadt	2.4	520	1520	90	580
38	@ Chicago & Rock Island RR	0.4	120	350	15	130

(1) Future baseline condition discharges for Sand Creek compiled with the assumption that the discharges from the East Fork Sand Creek basin are maintained at existing rates as shown on this Table.

EAST BIERSTADT CREEK

WEST BIERSTADT CREEK

EAST FORK SAND CREEK

WOODMEN

HILLS BLVD

STETSON

CONSTITUTION

WEST TRIB TO RANCHES BASIN SAND CREEK

VOLLMER RD

MARKSHEFFEL RD

CENTER TRIBUTARY SAND CREEK

UPPER BASIN SAND CREEK

LOWER BASIN SAND CREEK

POWERS BLVD

WEST FORK SAND CREEK

FOUNTAIN

HANCOCK

GALLEY

PLATTE

FOUNTAIN CREEK

N

Kiowa Engineering Corporation
419 W. Bijou Street
Colorado Springs, Colorado
80905-1308

SAND CREEK DRAINAGE BASIN PLANNING STUDY

REGIONAL SUB-BASINS

Project No	90-04-09
Date:	11/90
Design:	
Drawn:	EAK
Check:	
Revisions:	

11

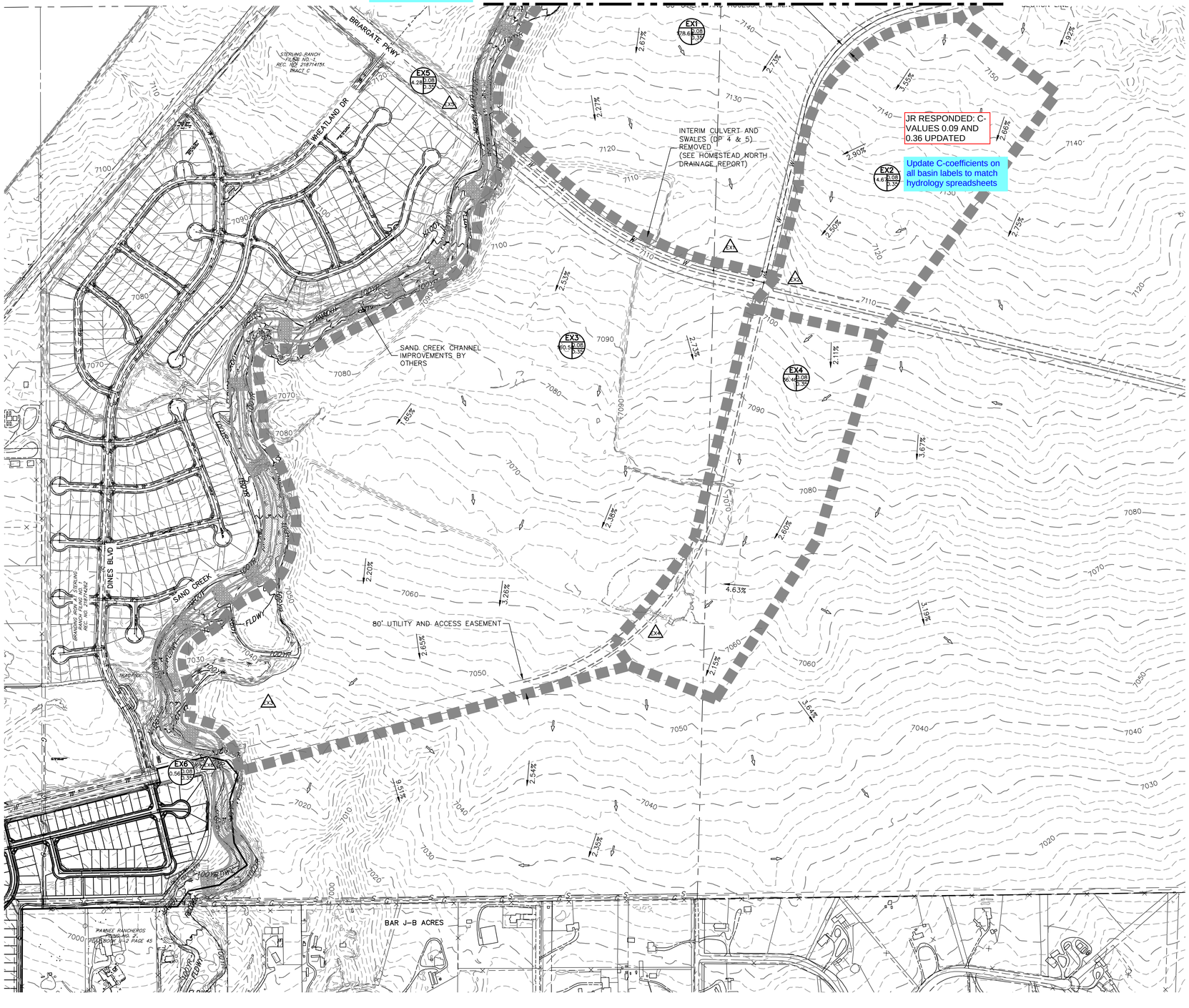
FIG. III-1

Appendix E
Drainage Maps

jr responded

Include basin boundaries for EX5 & EX6

SEE SHEET 2



jr responded

Update linetype to match plan

LEGEND:

- PROPOSED STORM SEWER
- 5000 FUTURE RD MAJOR CONTOUR
- FUTURE RD MINOR CONTOUR
- 5000 PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 5000 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- DRAINAGE BASIN
- A = BASIN DESIGNATION
  B = AREA IN ACRES
  C = 5-YR RUNOFF COEFFICIENT
  D = 100-YR RUNOFF COEFFICIENT
- DESIGN POINT
- HP HIGH POINT
- LP LOW POINT
- DRAINAGE ARROW
- EXISTING DRAINAGE ARROW
- PROPOSED DRAINAGE SWALE
- SECTION LINE
- EXISTING EASEMENT
- EXISTING FENCE
- EXISTING WATERLINE
- 100 YEAR FLOODPLAIN
- FLOODWAY
- EXISTING WETLAND

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
EX1	178.68	2%	0.09	0.36	29.2	40.5	272.1
EX2	14.67	2%	0.09	0.36	19.2	4.2	27.9
EX3	160.58	2%	0.09	0.36	25.9	39.0	262.0
EX4	36.46	2%	0.09	0.36	21.0	9.9	66.5
EX5	4.28	2%	0.09	0.36	16.6	1.3	8.7
EX6	0.56	2%	0.09	0.36	9.5	0.2	1.4

DESIGN POINT

DP	Q5 Total	Q100 Total
EX1	40.5	272.1
EX2	4.2	27.9
EX3	39.0	262.0
EX4	9.9	66.5
EX5	1.3	8.7
EX6	0.2	1.4

N

300 150 0 300 600

ORIGINAL SCALE: 1" = 300'

Know what's **below.** **Call** before you dig.

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PREPARED FOR
SR LAND, LLC
20 BOULDER CRESCENT
SUITE 201
COLORADO SPRINGS, CO 80903
JAMES F. MORLEY
(719) 471-1742

J·R ENGINEERING
A Westrian Company
Centennial 303-740-9393 • Colorado Springs 719-593-2593
Fort Collins 970-491-9888 • www.jrengineering.com

No.	REVISION	BY	DATE

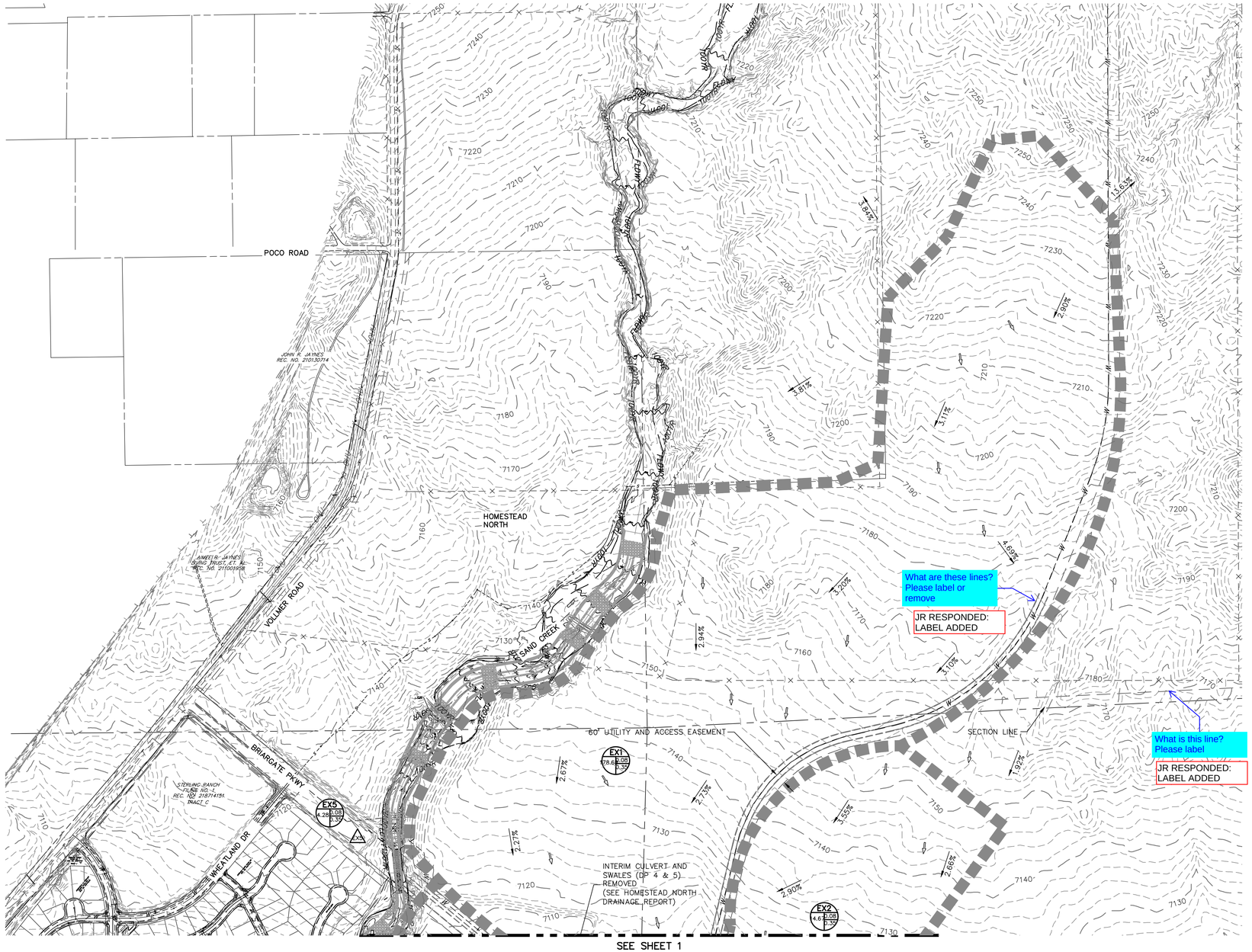
H-SCALE	1"=300'
V-SCALE	N/A
DATE	12/31/21
DESIGNED BY	RAB
DRAWN BY	CGV
CHECKED BY	

STERLING RANCH ROAD & BRIARGATE DRAINAGE MAPS

EXISTING DRAINAGE MAP

SHEET 1 OF 6

JOB NO. 25188.03



LEGEND:

- PROPOSED STORM SEWER
- 5000 FUTURE RD MAJOR CONTOUR
- FUTURE RD MINOR CONTOUR
- 5000 PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- 5000 EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- DRAINAGE BASIN
- A = BASIN DESIGNATION
  B = AREA IN ACRES
  C = 5-YR RUNOFF COEFFICIENT
  D = 100-YR RUNOFF COEFFICIENT
- DESIGN POINT
- HP HIGH POINT
- LP LOW POINT
- DRAINAGE ARROW
- EXISTING DRAINAGE ARROW
- PROPOSED DRAINAGE SWALE
- SECTION LINE
- EXISTING EASEMENT
- EXISTING FENCE
- EXISTING WATERLINE
- 100 YEAR FLOODPLAIN
- FLOODWAY
- EXISTING WETLAND

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
EX1	178.68	2%	0.09	0.36	29.2	40.5	272.1
EX2	14.67	2%	0.09	0.36	19.2	4.2	27.9
EX3	160.58	2%	0.09	0.36	25.9	39.0	262.0
EX4	36.46	2%	0.09	0.36	21.0	9.9	66.5
EX5	4.28	2%	0.09	0.36	16.6	1.3	8.7
EX6	0.56	2%	0.09	0.36	9.5	0.2	1.4

DESIGN POINT

DP	Q5 Total	Q100 Total
EX1	40.5	272.1
EX2	4.2	27.9
EX3	39.0	262.0
EX4	9.9	66.5
EX5	1.3	8.7
EX6	0.2	1.4

300 150 0 300 600
ORIGINAL SCALE: 1" = 300'

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No.	REVISION	BY	DATE

H-SCALE	1"=300'
V-SCALE	N/A
DATE	12/31/21
DESIGNED BY	RAB
DRAWN BY	CGV
CHECKED BY	

STERLING RANCH ROAD & BRIARGATE DRAINAGE MAPS

EXISTING DRAINAGE MAP

SHEET 2 OF 6

JOB NO. 25188.03

SEE SHEET 4

RUNOFF FROM VOLLMER 0.1 CFS SEE HOMESTEAD NORTH DRAINAGE REPORT

STERLING RANCH FILING NO. 1 REC. NO. 218714151 TRACT C

A1 4.95 0.62 0.79

A2 4.97 0.63 0.79

BRIARGATE PKWY

DETENTION POND BY OTHERS

OS1 176.86 0.08 0.35

Update C-coefficients in all basin labels to match hydrology spreadsheet

jr responded: values updated

JR ADDED

Channel CROSSING BY OTHERS

WHEATLAND DR

Label all streets

JR RESPONDED: STREET NAMES ADDED

Add linetype to legend

JR RESPONDED: ADDED

What is this trail, access, etc? Label accordingly. How does the catch grading work with this?

JR RESPONDED

BFE's not readable

JR RESPONDED: TEXT SIZE INCREASED

SAND CREEK CHANNEL IMPROVEMENTS BY OTHERS

NE 1/4 SEC. 33 T.12S. R65W 6TH P.M.

PUBLIC 30" RCP

60' UTILITY AND ACCESS EASEMENT

SEE SHEET 5

A3 2.01 0.58 0.77

A4 1.63 0.61 0.75

PRIVATE (SRMD) 36" RCP

PUBLIC 36" RCP

PUBLIC 18" RCP

PRIVATE (SRMD) 48" RCP

STERLING RANCH ROAD

B11 26.2 0.08 0.35

All inlets and manholes need to be labeled with at-grade/sump (inlets) type, size & public/private

JR RESPONDED: INLET AND MH LABELED W/ PUBLIC OR PRIVATE

B1 1.90 0.61 0.74

B2 2.06 0.56 0.77

PERMANENT EROSION CONTROL BLANKET V MAX SC250 OR EQUIVALENT

JR RESPONDED

Delete this portion of blanket

Include minimum depth and water surface depth on section details.

JR RESPONDED: CRITICAL AND NORMAL DEPTHS ADDED

JR RESPONDED: ADDED

Missing 25.1

Missing OS2.1

JR RESPONDED: ADDED

Existing and proposed contours should be at same interval

JR RESPONDED: MADE EXISTING SMALLER INTERVAL

SEE SHEET 6

DESIGN POINT

DP	Q5 Total	Q100 Total
1	20.3	38.2
2	10.5	21.2
4	2.6	6.3
5	18.7	34.5
6	21.3	43.7
7	5.2	10.9
8	9.6	23.0
10	3.3	8.2
11	5.7	12.6
13	13.3	28.0
14	2.3	7.3
15	3.0	10.5
17	13.9	34.0
18	3.6	6.5
19	6.0	10.1
20	16.7	38.2
22	5.5	11.0
23	9.2	18.2
25	51.0	250.7
26	1.8	12.1
26.1	1.8	12.1
26A	11.5	159.2
27	9.8	162.1
OS1	40.1	269.4
OS2	61.3	320.9
OS2	61.3	320.9

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A1	4.95	67%	0.63	0.76	16.4	10.5	21.3
A2	4.97	68%	0.63	0.76	17.0	10.5	21.2
A3	2.01	62%	0.59	0.73	8.8	5.1	10.6
A4	1.63	66%	0.62	0.75	10.0	4.2	8.5
B1	1.90	65%	0.61	0.75	7.7	5.3	10.8
B2	2.06	60%	0.57	0.71	8.2	5.2	10.9
B3	1.27	64%	0.60	0.74	8.6	3.3	6.9
B4	1.33	61%	0.58	0.72	9.0	3.3	6.9
B5	0.89	61%	0.58	0.72	7.6	2.4	4.9
B6	0.91	63%	0.60	0.74	7.1	2.5	5.2
B7	1.08	52%	0.50	0.67	8.0	2.4	5.4
B8	1.16	58%	0.55	0.70	7.6	2.9	6.2
B9	1.98	51%	0.49	0.66	7.9	4.4	9.8
B10	2.19	53%	0.51	0.67	7.8	5.0	11.1
B11	126.23	2%	0.09	0.36	26.9	30.1	201.7
C1	5.87	2%	0.09	0.36	16.0	1.8	12.1
OS1	176.86	2%	0.09	0.36	29.2	40.1	269.4
OS2	39.27	2%	0.09	0.36	16.6	11.9	80.0

LEGEND

BASIN ID
A: BASIN LABEL
B: AREA
C: C –100 YR
D: C–5 YR

DESIGN POINT

PROPOSED FLOW DIRECTION

BASIN DRAINAGE AREA

EXISTING STORM SEWER

STORM SEWER PROPOSED

PROPOSED R.O.W

PROPOSED PROPERTY LINES

PROPOSED SIDEWALK

EXISTING PROPERTY LINE

ROW EXISTING

FL EXISTING

SIDEWALK EXISTING

SECTION LINE

DRAINAGE ACCESS & MAINTENANCE EASEMENT

EXISTING 6100 PROPOSED 6100

KEY MAP
SCALE: NTS

GRASS LINED DITCH W/ TEMPORARY EROSION CONTROL BLANKET — VELOCITY 5.19 FT/S
4:1 — 5.0' — 4:1
NTS

TYPICAL DITCH CROSS SECTION A–A

GRASS LINED DITCH W/ TEMPORARY EROSION CONTROL BLANKET — VELOCITY 3.00 FT/S
4:1 — 5.0' — 4:1
NTS

TYPICAL DITCH CROSS SECTION B–B

100 50 0 100 200
ORIGINAL SCALE: 1" = 100'

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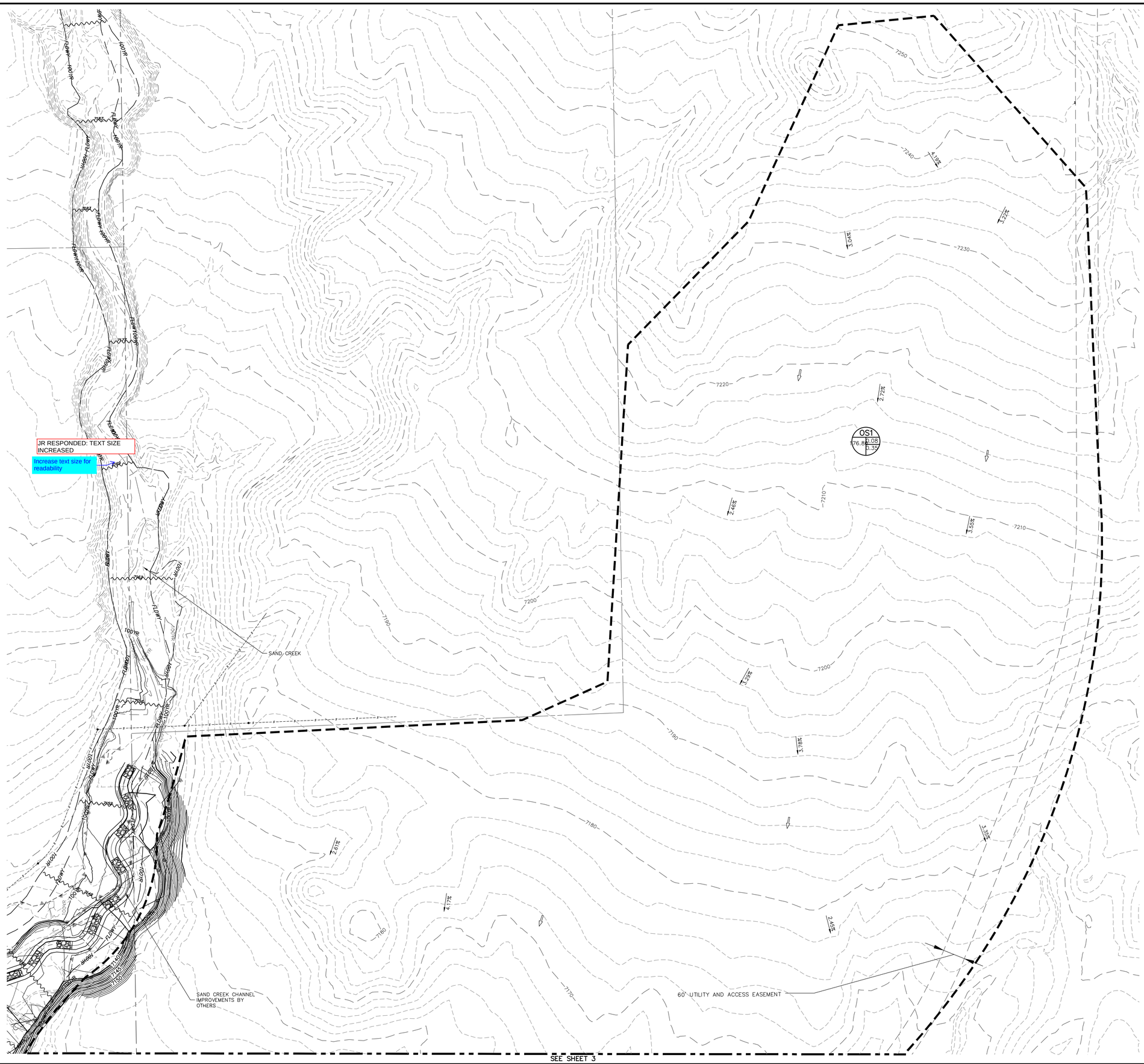
V-SCALE	N/A
DATE	12/31/21
DESIGNED BY	RAB
DRAWN BY	CGV
CHECKED BY	

STERLING RANCH ROAD & BRIARGATE DRAINAGE MAPS

PROPOSED DRAINAGE MAP

SHEET 3 OF 6

JOB NO. 25188.03



KEY MAP
SCALE: NTS

LEGEND

BASIN ID
A: BASIN LABEL
B: AREA
C: C -100 YR
D: C -5 YR

DESIGN POINT
PROPOSED FLOW DIRECTION
BASIN DRAINAGE AREA
EXISTING STORM SEWER
STORM SEWER PROPOSED
PROPOSED R.O.W
PROPOSED PROPERTY LINES
PROPOSED SIDEWALK
EXISTING PROPERTY LINE
ROW EXISTING
FL EXISTING
SIDEWALK EXISTING
SECTION LINE
DRAINAGE ACCESS & MAINTENANCE EASEMENT

EXISTING 6100 PROPOSED 6100

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A1	4.95	67%	0.63	0.76	16.4	10.5	21.3
A2	4.97	68%	0.63	0.76	17.0	10.5	21.2
A3	2.01	62%	0.59	0.73	8.8	5.1	10.6
A4	1.63	66%	0.62	0.75	10.0	4.2	8.5
B1	1.90	65%	0.61	0.75	7.7	5.3	10.8
B2	2.06	60%	0.57	0.71	8.2	5.2	10.9
B3	1.27	64%	0.60	0.74	8.6	3.3	6.9
B4	1.33	61%	0.58	0.72	9.0	3.3	6.9
B5	0.89	61%	0.58	0.72	7.6	2.4	4.9
B6	0.91	63%	0.60	0.74	7.1	2.5	5.2
B7	1.08	52%	0.50	0.67	8.0	2.4	5.4
B8	1.16	58%	0.55	0.70	7.6	2.9	6.2
B9	1.98	51%	0.49	0.66	7.9	4.4	9.8
B10	2.19	53%	0.51	0.67	7.8	5.0	11.1
B11	126.23	2%	0.09	0.36	26.9	30.1	201.7
C1	5.87	2%	0.09	0.36	16.0	1.8	12.1
OS1	176.86	2%	0.09	0.36	29.2	40.1	269.4
OS2	39.27	2%	0.09	0.36	16.6	11.9	80.0

DESIGN POINT

DP	Q5 Total	Q100 Total
1	20.3	38.2
2	10.5	21.2
4	2.6	6.3
5	18.7	34.5
6	21.3	43.7
7	5.2	10.9
8	9.6	23.0
10	3.3	8.2
11	5.7	12.6
13	13.3	28.0
14	2.3	7.3
15	3.0	10.5
17	13.9	34.0
18	3.6	6.5
19	6.0	10.1
20	16.7	38.2
22	5.5	11.0
23	9.2	18.2
25	51.0	250.7
26	1.8	12.1
26.1	1.8	12.1
26A	11.5	159.2
27	9.8	162.1
OS1	40.1	269.4
OS2	61.3	320.9
OS2	61.3	320.9

100 50 0 100 200
ORIGINAL SCALE: 1" = 100'

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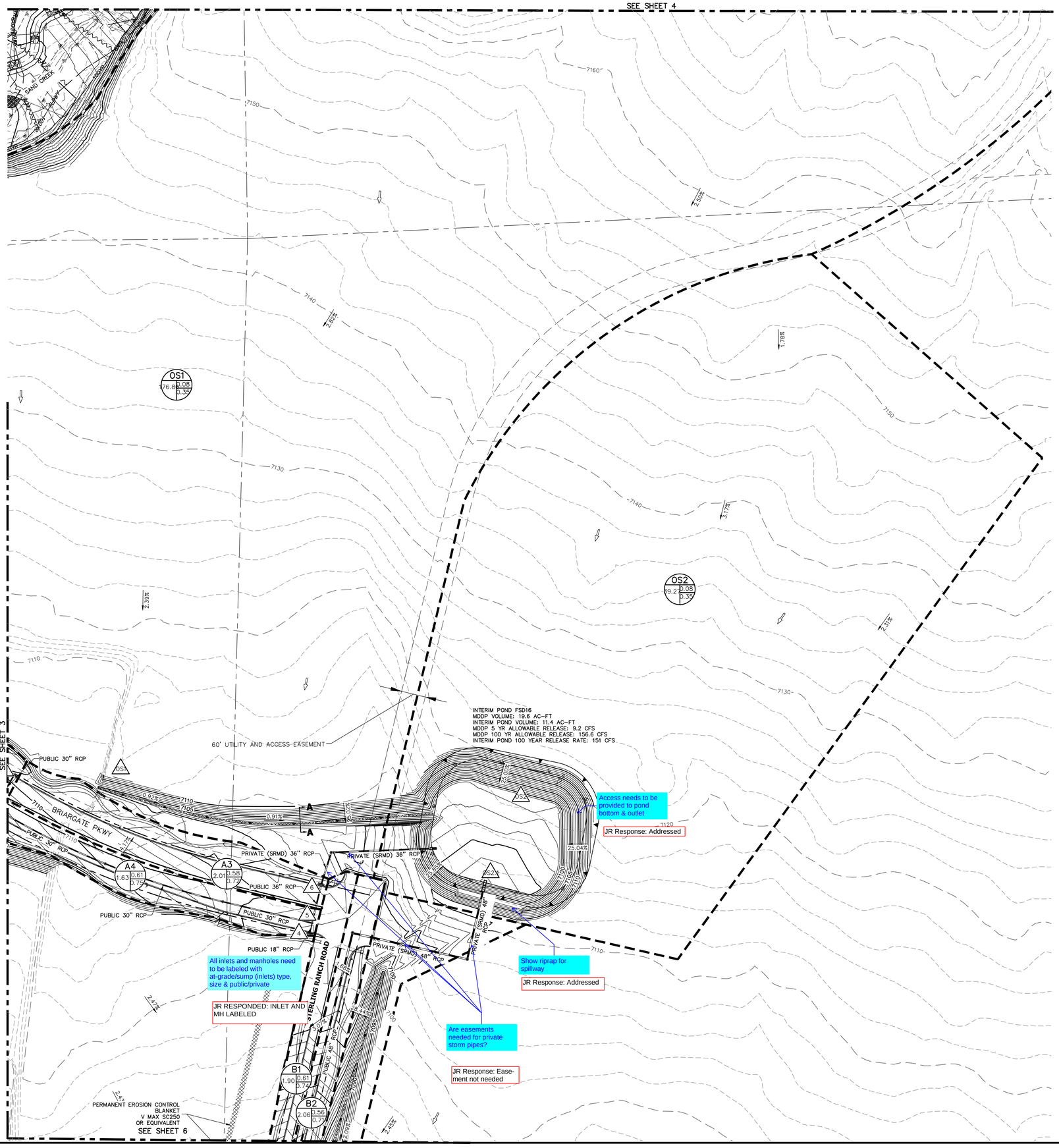
No.	REVISION	BY	DATE

H-SCALE 1"=100'
V-SCALE N/A
DATE 12/31/21
DESIGNED BY RAB
DRAWN BY CGV
CHECKED BY

STERLING RANCH ROAD & BRIARGATE
DRAINAGE MAPS

PROPOSED DRAINAGE MAP

SHEET 4 OF 6
JOB NO. 25188.03

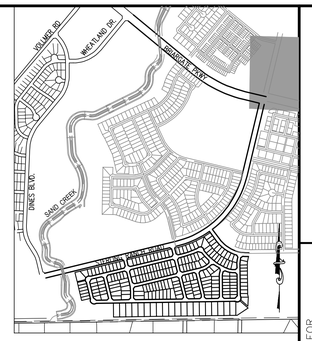


LEGEND

BASIN ID
A: BASIN LABEL
B: AREA
C: C -100 YR
D: C -5 YR

DESIGN POINT
PROPOSED FLOW DIRECTION
BASIN DRAINAGE AREA
EXISTING STORM SEWER
STORM SEWER PROPOSED
PROPOSED R.O.W
PROPOSED PROPERTY LINES
PROPOSED SIDEWALK
EXISTING PROPERTY LINE
ROW EXISTING
FL EXISTING
SIDEWALK EXISTING
SECTION LINE
DRAINAGE ACCESS & MAINTENANCE EASEMENT

EXISTING 6100 PROPOSED 6100



KEY MAP
SCALE: NTS

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A1	4.95	67%	0.63	0.76	16.4	10.5	21.3
A2	4.97	68%	0.63	0.76	17.0	10.5	21.2
A3	2.01	62%	0.59	0.73	8.8	5.1	10.6
A4	1.63	66%	0.62	0.75	10.0	4.2	8.5
B1	1.90	65%	0.61	0.75	7.7	5.3	10.8
B2	2.06	60%	0.57	0.71	8.2	5.2	10.9
B3	1.27	64%	0.60	0.74	8.6	3.3	6.9
B4	1.33	61%	0.58	0.72	9.0	3.3	6.9
B5	0.89	61%	0.58	0.72	7.6	2.4	4.9
B6	0.91	63%	0.60	0.74	7.1	2.5	5.2
B7	1.08	52%	0.50	0.67	8.0	2.4	5.4
B8	1.16	58%	0.55	0.70	7.6	2.9	6.2
B9	1.98	51%	0.49	0.66	7.9	4.4	9.8
B10	2.19	53%	0.51	0.67	7.8	5.0	11.1
B11	126.23	2%	0.09	0.36	26.9	30.1	201.7
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OS2	39.27	2%	0.09	0.36	16.6	11.9	80.0

DESIGN POINT

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18	3.6	6.5
19	6.0	10.1
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22	5.5	11.0
23	9.2	18.2
25	51.0	250.7
26	1.8	12.1
26.1	1.8	12.1
26A	11.5	159.2
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100 50 0 100 200
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No.	REVISION	BY	DATE

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V-SCALE	N/A
DATE	12/31/21
DESIGNED BY	RAB
DRAWN BY	CGV
CHECKED BY	

STERLING RANCH ROAD & BRIARGATE DRAINAGE MAPS

PROPOSED DRAINAGE MAP

SHEET 5 OF 6

JOB NO. 25188.03

BASIN SUMMARY TABLE

Tributary Sub-basin	Area (acres)	Percent Impervious	C_5	C_{100}	t_c (min)	Q_5 (cfs)	Q_{100} (cfs)
A1	4.95	67%	0.63	0.76	16.4	10.5	21.3
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A3	2.01	62%	0.59	0.73	8.8	5.1	10.6
A4	1.63	66%	0.62	0.75	10.0	4.2	8.5
B1	1.90	65%	0.61	0.75	7.7	5.3	10.8
B2	2.06	60%	0.57	0.71	8.2	5.2	10.9
B3	1.27	64%	0.60	0.74	8.6	3.3	6.9
B4	1.33	61%	0.58	0.72	9.0	3.3	6.9
B5	0.89	61%	0.58	0.72	7.6	2.4	4.9
B6	0.91	63%	0.60	0.74	7.1	2.5	5.2
B7	1.08	52%	0.50	0.67	8.0	2.4	5.4
B8	1.16	58%	0.55	0.70	7.6	2.9	6.2
B9	1.98	51%	0.49	0.66	7.9	4.4	9.8
B10	2.19	53%	0.51	0.67	7.8	5.0	11.1
B11	126.23	2%	0.09	0.36	26.9	30.1	201.7
C1	5.87	2%	0.09	0.36	16.0	1.8	12.1
OS1	176.86	2%	0.09	0.36	29.2	40.1	269.4
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DESIGN POINT

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19	6.0	10.1
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22	5.5	11.0
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25	51.0	250.7
26	1.8	12.1
26.1	1.8	12.1
26A	11.5	159.2
27	9.8	162.1
OS1	40.1	269.4
OS2	61.3	320.9
OS2	61.3	320.9

JR RESPONDED: TEMP TO PERMANENT

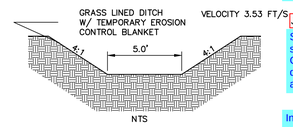
Plan view calls out for permanent EC blanket. Please reconcile between section and plan and update accordingly.

JR RESPONDED

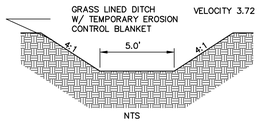
Swale sections do not match sections shown in Appendix C. Please reconcile between design and details and update accordingly.

Include minimum depth and water surface depth on section details.

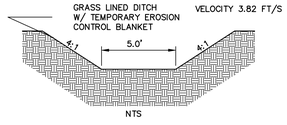
JR RESPONDED: CRITICAL AND NORMAL DEPTH



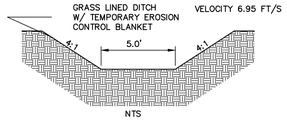
TYPICAL DITCH CROSS SECTION C–C



TYPICAL DITCH CROSS SECTION E–E



TYPICAL DITCH CROSS SECTION D–D



TYPICAL DITCH CROSS SECTION F–F

LEGEND

BASIN ID
A: BASIN LABEL
B: AREA
C: C –100 YR
D: C–5 YR

DESIGN POINT

PROPOSED FLOW DIRECTION

BASIN DRAINAGE AREA

EXISTING STORM SEWER

STORM SEWER PROPOSED

PROPOSED R.O.W

PROPOSED PROPERTY LINES

PROPOSED SIDEWALK

EXISTING PROPERTY LINE

ROW EXISTING

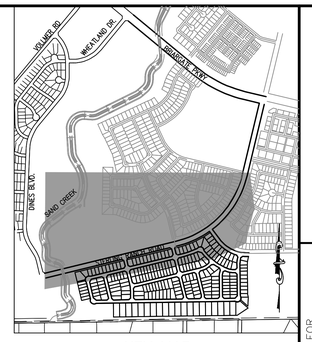
FL EXISTING

SIDEWALK EXISTING

SECTION LINE

DRAINAGE ACCESS & MAINTENANCE EASEMENT

EXISTING 6100 PROPOSED 6100



KEY MAP
SCALE: NTS

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

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SEE SHEET 3

SEE SHEET 5

SEE BELOW

SEE ABOVE

SAND CREEK

SAND CREEK CHANNEL IMPROVEMENTS BY OTHERS

EXISTING POND

JR RESPONDED
Blanket should end at pond.

JR RESPONDED: SPILLWAY ADDED

Grade & Show riprap for spillway

INTERIM POND FSD14A
MDDP VOLUME: 17.3 AC–FT
INTERIM PPND VOLUME: 8.3 AC–FT
MDDP 5–YR ALLOWABLE RELEASE: 7.5 CFS
MDDP 100–YR ALLOWABLE RELEASE: 142.2 CFS
INTERIM POND 100 YEAR RELEASE RATE: 146.9 CFS

JR ADDED
Channel CROSSING BY OTHERS

PERMANENT EROSION CONTROL BLANKET V MAX SC250 OR EQUIVALENT

Access needs to be provided to pond bottom & outlet

JR ADDED

80' UTILITY AND ACCESS EASEMENT

JR RESPONDED. ADDED

Portions of flow from Basin B11 should be accounted for at design calcs for swales D-D & E-E.

SE 1/4 SEC. 33
T.12S R65W 6TH P.M.

STERLING RANCH ROAD

End blanket at start of swale

JR RESPONDED

All inlets and manholes need to be labeled with at-grade/sump (inlets) type, size & public/private

JR RESPONDED: INLET AND MH LABELED

JR ADDED
Show and label riprap outlet protection at all outfalls.

PERMANENT EROSION CONTROL BLANKET V MAX SC250 OR EQUIVALENT

Label all streets

JR RESPONDED. Not all future street names are known. Future layout re-moved.

FUTURE POND FSD14B
MDDP VOLUME: 3.8 AC–FT
5 –YR ALLOWABLE RELEASE: 0.3 CFS
100–YR ALLOWABLE RELEASE: 19.3 CFS

B11 126.23 0.08 0.36
B9 1.98 0.49 0.66
B10 2.19 0.51 0.67
B7 1.08 0.50 0.66
B8 1.16 0.55 0.70
B5 0.89 0.58 0.72
B6 0.91 0.59 0.74
B4 1.33 0.57 0.72
B3 1.27 0.60 0.74
C1 5.87 0.08 0.36

100 50 0 100 200
ORIGINAL SCALE: 1" = 100'

811 Know what's below. Call before you dig.

No.	REVISION	BY	DATE

H–SCALE	1"=100'
V–SCALE	N/A
DATE	12/31/21
DESIGNED BY	RAB
DRAWN BY	CCV
CHECKED BY	

STERLING RANCH ROAD & BRIARGATE DRAINAGE MAPS
PROPOSED DRAINAGE MAP

SHEET 6 OF 6
JOB NO. 25188.03