City of Fountain
Engineering Department
116 South Main St.
Fountain, CO 80817

August 2020

RE: Aspen Ranch PDR

Dear Sir or Madam,

Please find enclosed the PDR for the proposed Aspen Ranch development. This 59-acre development will be located at the intersection of Link and Kane Roads. The site will include 225 single-family lots and have an average density of 3.8 du/acre. A park area to provide open space is also proposed, in addition to the open spaces associated with the gas easement running through the property.

Drainage analysis for the project has been completed in accordance with the current City of Colorado Springs drainage criteria manual which the city of Fountain has adopted as its governing drainage criteria. Please note that while this report has adequate information to be considered a Final Drainage Report, an addendum will be required to upgrade this document to a Final Drainage Report once the method of storm water conveyance across the property to the west has been resolved and an easement acquired.

If there are any comments or questions regarding this submittal, please feel free to contact me by phone: 719-575-0100 or email: jesse.sullivan@matrixdesigngroup.com.

Thank you,

Jesse Sullivan, P.E.

Enclosures.

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PRELIMINARY DRAINAGE REPORT

For

ASPEN RANCH FILING NO. 1

Prepared for:
City of Fountain
116 S. Main Street
Fountain, CO 80817

On Behalf of:
COLA, LLC.
555 Middle Creek Parkway, Suite 380
Colorado Springs, CO 80921

Prepared by:

2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
(719) 575-0100
fax (719) 572-0208

August 2020

Project No. 19.866.023

ENGINEER'S STATEMENT:

This report and plan for the drainage design of Aspen Ranch Filing No. 1 was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the City of Colorado Springs Drainage Criteria Manual and is in conformity with the master plan of the drainage basin. I understand that the City of Fountain does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, error or omissions on my part in preparing this report.

Signature: _____
Colorado Professional Engineer No. 55600

Date: _____

DEVELOPER'S STATEMENT:

COLA hereby certifies that the drainage facilities for Aspen Ranch Filing No. 1 shall be constructed according to the design presented in this report. I understand that the City of Fountain does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Fountain pursuant to the City Code; and cannot, on behalf of Aspen Ranch Filing No. 1, guarantee that final drainage design review will absolve COLA and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

Name of Developer: *COLA*

Authorized Signature: _____ ***Date:*** _____

Printed Name: *Tim Buschar*

Title: *Director of Land Acquisition and Development*

Address: 555 Middle Creek Parkway, Suite 380
Colorado Springs, CO 80921

CITY OF FOUNTAIN STATEMENT:
Filed in accordance with the Code of the City of Fountain, 2009, as amended.

_____ _____
For the City Engineer Date

Conditions:

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I. Introduction

A. PURPOSE AND SCOPE OF STUDY

The proposed Aspen Ranch Filing No. 1 development is located at the northeast corner of the intersection of Kane and Link road in Fountain, Colorado. This project will involve construction of roads, utilities and storm sewer infrastructure associated with single-family residential development. The purpose of this report is the identification of offsite and onsite drainage patterns and design of storm sewer infrastructure associated with the proposed development, analysis of impacts from upstream drainage, and impacts to downstream facilities. This PDR has been prepared based on the guidelines and criteria presented in the City of Colorado Springs Drainage Criteria Manual (DCM).

Aspen Ranch Filing No. 1
Project Location

FIGURE 1. PROJECT LOCATION
(NOT TO SCALE)

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B. GENERAL PROJECT DESCRIPTION

1. Drainage Area:

a. Onsite:

Aspen Ranch Filing No. 1 is a 59-acre parcel located at the northeastern intersection of Link Road and Kane Road. The Aspen Ranch Filing No. 1 ODP prepared by Thomas & Thomas dated April 16, 2018 identifies a total of 225 single-family residential units with a fire station, achieving an average density of 3.8 du/acre and includes a central open space/park and gas easement open space. Runoff from the site will be directed via storm sewer and swales into the existing detention pond at the southwest corner of the development. The detention pond will be updated to address proposed conditions.

b. Offsite:

A 207-acre drainage basin (Sub-basin OB1.1A1) upstream of the site will be directed around the site via 48-inch storm sewer. The swale carrying these flows also conveys irrigation flows from the Fountain Mutual Irrigation Company (FMIC) ditch system. The FMIC periodically releases tailwater flows within the Basin OB1.1A1 at a rate of approximately 25 cfs (see letter from FMIC in appendices). These flows follow the existing natural overland drainage swales. At the properties eastern most boundary, the Crescent Moon right of way, there is an existing barrier where flow is collected on the easterly side eventually overtopping and flowing westerly within the Black Hills Energy Gas main corridor through the site to the project low point, Historic Basin DP 1, ultimately crossing Link Road and continuing northwesterly to Jimmy Camp Creek.

2. Drainageway:

As previously mentioned, the site is in the Jimmy Camp Creek Drainage Basin and is currently undeveloped meadow. Most of the runoff from the site drains to the southwest towards the intersection of Link Road and Kane Road, where it is conveyed (through a combination of culvert systems and open channels) to the west, under Link Road, through Eagle Side Ridge development, and ultimately into the Jimmy Camp Creek Channel.

3. Utilities and Encumbrances:

- **Storm Sewer**: Existing storm sewer includes a 42" crossroad pipe just east of the intersection of Kane and Link Roads
- **Sanitary Sewer**: An existing 12-inch PVC sanitary sewer main runs along the west side of Kane Road and jogs across the Aspen Ranch Filing No. 1 property approximately 185 feet north of Link Road running parallel to Link Road for approximately 500 feet before jogging south 172 feet and turning east to run parallel to Link Road approximately 10' behind the proposed back of curb. Future work on the project will relocate the portion of sanitary sewer which is 185 feet north of Link Road to be approximately 314' north in order to provide more room for onsite detention.
- **Gas**: There is an existing 75-foot wide gas easement running through the middle of the project along an existing drainage way. This easement and the associated two- and four-inch gas mains within will remain in place and will be accounted for in the design of the project.
- **Water**: There is an existing 8-inch water main parallel to the Link Road near the west side. There appears to be a stub-out to the east at the intersection of Watchmen and Link Roads, however, no encumbrance to the project is anticipated. Another existing water main along

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Kane Road appears to have a water service connection approximately 560 feet north of Link Road and an existing fire hydrant near the proposed

- **Electric:** There is existing overhead electric power parallel to both Kane and Link Roads which will both be relocated and buried to accommodate street improvements associated with the proposed development.
- **Communications:** There appears to be an underground telephone line running parallel to Link Road. No encumbrance to the project is anticipated.

4. **Streamside Zones:**
   The site is not located in or adjacent to a streamside zone

5. **Referenced Drainage Reports**
   a. **Master Drainage Development Plan for Aspen Ranch Filing No. 1,** by Matrix Design Group, November 1, 2019. **(MDDP-Matrix)**
   b. ***Jimmy Camp Creek Drainage Basin Planning Study (DBPS),*** by Kiowa Engineering Corp. March 9, 2015. (***JCC DBPS***)
   c. ***Final Drainage Report for Eagleside View,*** by JPS Engineering, November 20, 2013. (***MDDP Eagleside View)***
   d. ***MDDP for Eagleside Ridge,*** by JPS Engineering, (withdrawn) **(MDDP Eagleside Ridge)**

C. General Location:

Northeast ¼ of Section 4, Township 16 South, Range 65 West of the 6th P.M. in the City of Fountain, County of El Paso, State of Colorado. A vicinity map can be found in Appendix D.

D. Surrounding Developments:

1. North:
   a. Vacant Land
   b. No Road or Street Right-of-Way

2. East:
   a. Vacant Land
   b. Crescent Moon Right-of-Way

3. South
   a. Vacant Land
   b. Kane Road

4. West
   a. Cumberland Green & Eagleside View
   b. Link Road

E. Land Uses

Presently, the site is unplatted and undeveloped land. Aspen Ranch Filing No. 1 is a proposed 225 lot single-family residential development on 59 acres. Development of utilities and internal roadways will be included in this parcel.

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F. Soil Conditions

Topographical information for the site was found using a combination of ***United States Geological Survey*** (USGS) mapping as well as field surveying. The ***Web Soil Survey,*** created by the ***Natural Resources Conservation Service (NRCS),*** was utilized to investigate the existing general soil types within the site. The majority of the site is currently undeveloped and consists of natural vegetative land cover.

Soils can be classified in four different hydrologic groups, A, B, C, or D to help predict storm water runoff rates. Hydrologic group "A" is characterized by deep, well-drained coarse-grained soils with a rapid infiltration rate when thoroughly wet and having a low runoff potential. Group "D" typically has a clay layer at or near to the surface, or a very shallow depth to impervious bedrock and has a very slow infiltration rate and a high runoff potential. See Soils Map; Appendix D. Table 1.1 indicates which soil types are present in the development area:

Table 1.1 – NRCS Soil Survey for El Paso County

Soil ID Number	***Soil***	***Hydrologic Classification***	***Permeability***	***Percent on Site***
3	Ascalon Sandy Loam (3% - 9% slopes)	B	Moderately Rapid	77.9%
101	Ustic Torrifluvents, Loamy	B	Moderately Rapid	22.1%

G. Drainage Design Criteria

1. **Design References**

As required by the City of Fountain, Colorado, this report has been prepared in accordance to the criteria set forth in the ***City of Colorado Springs Drainage Criteria Manual Volume 1*** (DCM), dated May 2014 and ***Volume 2 Stormwater Quality Policies, Procedures, and BMP's***, dated May 2014.

In addition to the City Criteria Manual, the ***Urban Storm Drainage Criteria Manuals, Volumes 1-3*** (UDFCD), published by the Urban Drainage and Flood Control District, latest update, have been used to supplement the Drainage Criteria Manual for water quality capture volume (WQCV).

2. **Design Frequency**

The design frequency is based on criteria within the DCM. The 100-year storm event is used as the major storm for the project, and the 5-year storm event is the minor storm.

Design Discharge

a. **Method of Analysis**

i. **Rational Method:**

The hydrology for this project uses the Rational Method as recommended by the Drainage Criteria Manual for the minor and major storms for drainage basins less than 100-acres in size. The Rational Method uses the following equation: $Q=C*i*A$

Where:

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

b. Runoff Coefficient

Rational Method coefficients from Table 6-6 of the DCM for developed land were utilized in the Rational Method calculations. See Appendix B for more information.

c. Time of Concentration

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

d. Rainfall Intensity

The hypothetical rainfall depths for the 1-hour storm duration were taken from Table 6-2 of the Colorado Springs Drainage Criteria Manual. Table 5.1, below, lists the rainfall depth for the Major and Minor 1-hour storm events.

Table 5.1 – Project Area 1-Hour Rainfall Depth

Storm Recurrence Interval	Rainfall Depth (inches)
5-year	1.50
100-year	2.52

The rainfall intensity equation for the Rational Method was taken from Drainage Criteria Manual Volume 1 Figure 6-5.

ii. SCS Method

SCS procedures were utilized for analysis of flows from the larger (Drainage Area > 130 Acres) basins impacting the site for the minor and major storms, as recommended by the DCM.

SCS hydrologic calculations were based on the following assumptions:

Storm Distribution:	SCS Type II
100-year, 24-hour rainfall:	4.36 inches per hour
5-year, 24-hour rainfall:	2.80 inches per hour
Hydrologic Soil Type:	B 100%
SCS curve number – undeveloped:	61 (pasture/range)
SCS curve number – developed:	85 (1/8 acre lots) *
Time of Concentration:	SCS TR-55 Methodology (Sheet Flow, Shallow Concentrated & Channelized Flow)

*According to the ODP submittal, the Aspen Ranch Filing No. 1 development will include approximately 225 residential dwelling units, which represents a gross density of 3.81 units per acre. The hydrologic analysis within this report has utilized developed runoff

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coefficients for 1/8 acre lots, providing for a conservative drainage system design. SCS Curve Numbers were taken from the DBPS/DCM Table 6-9 & 6-10. Hydrologic calculations are enclosed in Appendix A.

II. Hydrologic Analysis

A. Basin Hydrology

1. Existing Drainage Conditions

Under existing conditions, the site flows in a general northeast to southwest pattern with slopes ranging from 2 to 7 percent until reaching the low point within the project site at the westerly boundary adjacent to Link Road. The site is comprised primarily of a single major basin that is a portion of the larger tributary basin OB1.1A1 as referenced in the Historic Drainage Map (DR01) in Appendix D.

The site low point is the confluence point for the larger historic basins OB1.1A1 and OB1.1A2 prior to discharging westerly underneath Link Road in a 42-inch pipe to the Integrity Bank and Trust property and Cumberland Green developments upstream of Jimmy Camp Creek. At Historic Design Point 1, the tributary basin's peak runoff is calculated as Q_5 = 31.96 cfs and Q_{100} = 182.48 cfs. The reference drainage report for a withdrawn development (Eagleside Ridge) on the adjacent downstream property indicated Q_5 = 36.4 cfs and Q_{100} = 228.0 cfs at this location (MDDP Eagleside Ridge: Design Point 5). See illustration below:

SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q5 (CFS)	Q100 (CFS)
2	314.7	584.7
3	12.8	85.1
4	89.5	263.8
5	36.4	228.0

Design Point 5 from drawing D1 on Page 58 of the withdrawn Eagleside Ridge MDDP.

Also located at Existing Design Point 1 is an existing detention pond which was constructed as a part of a previous attempt to develop this parcel. At some point, the 42-inch discharge pipe across Link Road was buried by the landowner or tenant of the property west of Link Road. The drainage swale downstream of the 42-inch discharge pipe was also filled in. These items combined to create a condition where the intersection of Link and Kane Roads, under existing conditions, is often overtopped by relatively minor storm events.

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Aspen Ranch Filing No. 1 Existing Conditions Basin Summary Table			
Sub-basin ID	**Area (Acres)**	**Q5 (cfs)**	**Q100 (cfs)**
OSB1.1A1	251.0	14.0	87.0
OSB1.1A2	223.8	13.5	87.8
OSB1.1B	44.4	15.9	80.4

Aspen Ranch Filing No. 1 Existing Conditions Drainage Point Summary Table				
Design Point	**Sub-Basins**	**Total Area (ac.)**	**Q(5) (cfs)**	**Q(100) (cfs)**
OS	OSB1.1A1 & OSB1.1A2	474.78	27.5	174.8
OS2	OSB1.1B	44.38	15.9	80.4
	Totals:	519.16	43.45	255.19

Note: The Eagleside View FDR anticipates Q5: 15.7 cfs and Q100: 39.0 cfs at Existing Design Point OS2.

2. Developed Drainage Conditions

The development of the project separates the project site into three distinct basins, development occurring north of the gas easement, the gas easement and pass through of upstream offsite tributary basins, and development south of the gas easement. Also described are three offsite basins which will be routed around the development. Developed hydrology calculations for the basins and pipe networks can be referenced in Appendix A.

North Basin:

The north basin is defined from the ridgeline north of the property, Crescent Moon to the east, Link Road to the west and the gas easement to the south. In general, with the larger northern basin flows drain from the northeast to the southwest where a series of inlets and storm sewer intercept the flows and convey them westerly to Link Rd and then southerly to the full spectrum detention facility. A 36" RCP storm sewer trunk main is proposed along Link Road to the detention facility that the internal storm drain system will connect to. Sub-basins B3, and B10-B12 comprise the tributary sub-basins and are as follows:

Basin Name	Acreage	Peak Flows			
		2-Year	5-Year	10-Year	100-Year
B3a1	2.2	2.9	3.7	4.3	8.1
B3b	1.6	2.0	2.6	3.0	5.7
B10	6.6	9.0	11.3	13.2	24.9
B11	3.7	5.0	6.4	7.4	14.0
B12	2.7	5.3	6.7	7.8	13.2

Gas Easement Basin (Onsite):

Crescent Moon is anticipated to be designed to provide a low point for collection at the historic natural swale location where inlets will join the 30-inch RCP pipe crossings under the respective roadways. Flows from B5 will sheet flow to a grass lined open channel and conveyed east. Additional flows from Sub-basins B4, B6, B7, B8, and B9 will be captured by street inlets and added to the channel at the locations indicated on DR-02. At culvert roadway crossings drainage travels

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from east to west, with the ultimate discharge to the proposed full spectrum detention pond. An additional benefit of this swale is separation of impervious surfaces, which provides more opportunity for infiltration and reduction in the volume of runoff from the developed area. The tributary sub-basins within the Gas Easement Basin are as follows:

Basin Name	Acreage	Peak Flows			
		2-Year	5-Year	10-Year	100-Year
B3a2	0.1	0.2	0.3	0.3	0.6
B4	1.2	1.4	1.8	2.1	4.0
B5	6.5	2.0	2.6	3.0	11.3
B6	5.1	6.9	8.7	10.1	19.1
B7	5.2	7.2	9.0	10.6	19.9
B8	0.3	0.1	0.2	0.2	0.9
B9	2.1	4.1	5.1	6.0	10.6

South Basin:

The south basin is defined by the gas easement to the north, Crescent Moon to the East, Kane Road to the south and Link Road to the west. Internal flows from the development, and runoff from the bounding streets, drain east to west, with a series of internal collection points that are tributary to a 36" RCP that discharges to the full spectrum detention facility. Surface street flows from Crescent Moon will drain within a gutter system south to Kane Rd where they are conveyed west to an inlet collection point just prior to the intersection of Link and Kane Roads. Collected curb inlet flows are piped north via a 30-inch RCP pipe to the Full Spectrum Detention Facility. The tributary sub-basins within the South Basin are as follows:

Basin Name	Acreage	Peak Flows			
		2-Year	5-Year	10-Year	100-Year
B1a	1.5	2.0	2.5	2.9	5.9
B1b	3.5	5.0	6.3	7.3	13.6
B1c	5.9	2.8	3.5	4.1	13.4
B2a	3.3	3.0	3.8	4.4	9.5
B2b	3.7	4.5	5.7	6.6	12.4
B2c	2.5	2.6	3.3	3.9	7.3
B2d	0.3	0.4	0.4	0.5	1.0

Offsite Basin (Southeast)

The historic offsite basin OB1.1A2 drains westerly and is defined by Kane Road on the north boundary and Link Road on the west boundary. At the intersection of Link Rd and Kane Rd, the Aspen Ranch Filing No. 1 development will install a 36-inch pipe and custom end section (18-inch existing) to capture the historic flows and convey it north across Kane Road to a proposed manhole (MH-101) just downstream of the Detention Pond outlet structure. Flows from this Offsite Basin will combine with detention pond release flows, route around flows from Offsite Basin OB1.1A1, and continue westerly within a 48-inch pipe (replacing the existing 42-inch pipe) across Link Rd to the Eagleside Ridge development. The tributary basin flows are as follows:

Basin Name	Acreage	Peak Flows			
		2-Year	5-Year	10-Year	100-Year
OB1.1A2	224.0	3.1	13.5	28.2	87.8

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Offsite Basin (North)
The historic offsite basin OB1.1B (Reduced in size by the Aspen Ranch Filing No. 1 development) drains westerly and is defined by Aspen Ranch Filing No. 1 on the south boundary and Link Road on the west boundary. At the existing 30-inch x 18-inch cross road elliptical pipe, Aspen Ranch Filing No. 1 development will extend storm drain beyond the proposed widening of Link Road to allow it to continue to capture the area of historic flows (less the area within the proposed Aspen Ranch Filing No. 1 development, but still including the adjacent portion of Link Road which has historically followed this path) and convey them west across Link Road to an existing curb inlet in the Eagleside View Subdivision, Filing No. 2. The tributary basin flows are as follows:

Basin Name	Acreage	Peak Flows			
		2-Year	5-Year	10-Year	100-Year
OB1.1B (Reduced)	28.0	4.9	6.1	7.1	33.4
B13	8.3	2.0	2.5	2.9	10.5
Design Point 22	36.3	5.8	7.3	8.5	35.1

Note: The Eagleside View FDR anticipates Q5: 15.7 cfs and Q100: 39.0 cfs which are higher than the proposed values indicated by Design Point 12. The post development condition anticipated in this report shows an improvement over the previously anticipated flows due to the reduction in drainage area from 44.4 acres to 36.3 acres. The difference will be developed and conveyed to the proposed detention pond for detention and water quality treatment.

Offsite Basin (East)
The historic offsite basin OB1.1A1 (Reduced) is the portion of the original OB1.1A1 sub-basin east of the proposed development area. This sub-basin is bounded on the west by the Crescent Moon right-of-way on the west. Flows from this basin will be captured at the east boundary of the proposed development and routed around the development via 48" Storm Pipe to a manhole where the flows will be combined with discharge from the proposed detention pond, and OB1.1A2, and conveyed westerly across Link Road via a proposed 48-inch storm pipe (replacing the existing 42-inch pipe).

Basin Name	Acreage	Peak Flows			
		2-Year	5-Year	10-Year	100-Year
OB1.1A1-Reduced (Less Developed Area)	207.0	2.5	12.7	16.1	70.5

This basin also receives discharges from the Fountain Mutual Irrigation Company (FMIC). The maximum indicated discharge from the FMIC has been stated by the FMIC (See letters in appendix C) to be 25 cfs.

All of the analyzed sub-basins are described in more detail in the sub-basin table included in Appendix A.

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III. Hydraulic Analysis

A. OVERVIEW, METHODOLOGY & DESIGN

Developed sub-basins and proposed drainage improvements are depicted on the attached Developed Drainage Basin Map (DR-02) in Appendix D. Preliminary hydraulic design calculations for sizing of onsite facilities are provided for in Appendix A. In general, the hydraulic criteria and intent are summarized as follows:

In accordance with City of Fountain drainage criteria, major drainage will be conveyed through the Aspen Ranch Filing No. 1 development using a combination of open channels, underground storm sewer capacity and allowable street capacity. For local residential streets, the maximum allowable depth used for the 100-year event is 8-inches or the extent of the street right-of-way such that buildings are not inundated at the ground line.

The interior roads are graded with a minimum longitudinal slope of 1.0 percent. In accordance with the street spread calculations in the DCM, the allowable minor storm street capacities are listed in Section B, below.

City standard Type R curb opening inlets will be specified where required for at-grade and sump collection point locations. Inlets will convey runoff to a storm sewer consisting of reinforced concrete pipes (RCP) with a minimum pipe diameter of 18-inches. Riprap stilling basins will be utilized at storm pipe outfalls.

Hydraulic Grade Lines (HGLs) provided for the proposed storm sewer will be modeled in StormCAD using the standard loss method described in the DCM and will use the loss coefficients described in Table 9-4 in the DCM. HGLs have been provided for the Construction Drawings in Appendix A.

A swale within the Black Hills Energy easement will be utilized to convey onsite drainage flows and provide separation between impervious surfaces in accordance with DCM recommended post-construction stormwater treatment BMPs. See Section D for further swale information.

Hydraulic analysis has been completed as part of this study to determine the required storm pipe sizing for the site. Most proposed storm pipes have been upsized to accommodate larger flows as a conservative design. The 48" storm sewer conveying bypass flows from Sub-basin OB1.1A1 (reduced) has been sized and analyzed based on a Q100 event plus the maximum indicated FMIC flow of 25 cfs. As mentioned previously, HGLs will be calculated in StormCAD and will be provided with later construction drawing submittals. Sizing and analysis of the on-site detention pond was completed using the UDFCD UD-Detention detention pond design and analysis tools. The pond has been evaluated to determine the peak release rates from the proposed detention pond and the storage required for the 100-year storm event.

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B. ROAD CAPACITIES

Streets internal to the development will have a face of curb to face of curb width of 34.33 feet. The table below describes the various street capacities within each sub-basin and the associated storm water loading for this development

Street Capacities Aspen Ranch Filing No. 1									
Street	***Sub-basin***	***BYPASS SOURCE***	***Q(5) BYPASS FLOWS RECEIVED (cfs)***	***Slope %***	***ROAD CAPACITY MINOR STORM (cfs)***	***Q(5) TOTAL FLOW***	***Q(100) BYPASS FLOWS RECEIVED (cfs)***	***ROAD CAPACITY MAJOR STORM***	***Q(100) TOTAL FLOW (cfs)***
Link RD.	B12b	B12a	0	0.5	13.5	5.0	2.18	40	13.2
Link RD.	B1a			0.5	13.5	2.5	2.3	40	8.2
Kane RD.	B1b			1	17.2	6.3		56.7	13.6
Castleabra Frasco	B2a	DP-7b (East)	1.7	2.3	12.3	5.1	7.4	42	16.9
	B2b			1.15	8.5	5.7		42	12.4
Frasco DRs	B2c			1.15	8.5	3.3		42	7.3
Cronin	B3a			1.3	9.0	0.3		42	0.6
Treasurevalt Trail	B3b/B-3a1			2	11.3	3.7		43	8.1
Cronin	B4	DP2	1.5	1	8.0	3.3	6.8	44	10.8
Lackawanna	B6			1.2	8.7	8.7		41	19.1
Blaurock	B7			1.9	9.0	9.0		41	19.9
Crescent Moon	B9			2.3	10.0	5.1		39.5	10.6
Pinpoint Dr./Silex	B10			3.7	14.0	11.3		34	24.9
Cronin	B11			2.9	14.3	6.4		39.5	14.0
Watchmen Rd	B12a			4.6	20.0	6.7		34	13.2

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C. INLET SIZING

The table below describes the inlet capacities and sizes for the proposed development by design point.

PROPOSED INLET SUMMARY											
ASPEN RANCH FILING NO. 1											
DESIGN POINT	SUB-BASINS	TOTAL AREA (AC)	INLET			Q(5) BYPASS FLOWS (cfs)	Q(5) TOTAL INFLOW (cfs)	Q(100) BYPASS FLOWS (cfs)	Q(100) TOTAL INFLOW (cfs)	INLET CAPACITY (cfs)	NOTES:
			SIZE (Ft.)	TYPE	CONDITION						
1	B-10	6.55	15	R	Sump		11.29		24.86	27.00	9" Sump Depth
2	B-11	3.68	10	R	At-Grade	1.5	6.36	6.8	14.02	10.50	DP 11a Receives Bypass
3	B-12a	2.69	15, 5	R	At-Grade (x2) 15' North 5' South		6.71	2.2	11.00	11.00	20% to south inlet
4b	B-12b	2.39	15	R	At-Grade		4.96	2.3	10.88	10.88	Recieves bypass from DP3
5a	B3a1	2.24	5	R	Sump		3.70		8.14	10.20	
5b	B-3b	3.83	5	R	Sump		2.58		5.68	10.20	
7a	B-9	2.08	10	R	Sump (x2)		5.11		10.59	16.00	
7b (west)	B-7	1.29	10	R	At-Grade		2.26		4.98	7.50	No Bypass 25% of Sub-basin B7
7b (east)	B-7	3.88	10	R	At-Grade	1.7	6.78	7.4	14.94	7.50	DP 12 Receives Bypass 75% of Sub-basin B7
8	B-6	5.11	10	R	Sump (x2)		8.69		19.14	32.00	DP 13 Receives Bypass 75% of Sub-basin B6
11a	B-4	1.24	10	R	Sump		3.30		10.77	16.00	Q5: 1.2 CFS, Q100: 6.3 CFS BYPASS FROM DP 2
11b	B-3a	0.11	5	R	Sump		0.25		0.56	10.20	
12	B-2a	3.32	10	R	Sump		5.47		16.91	19.00	6.9+5.2=12.1CFS Q100 BYPASS FLOWS RECEIVED Slightly over 8" Sump Depth
13	B-2b	3.74	10	R	Sump		5.65		12.45	16.00	
14b	B-2c, B-2d	2.77	5	R	Sump		3.76		8.28	10.20	
15a	B-1a, B-1b	4.98	15	R	Sump		8.47		21.18	22.60	

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Inlet Overflow Paths

Design Point	***Overflow Path***
1	In the case of blockage of this inlet flows will surcharge the curb and gutter and sheet flow across the tract to the west. Flows will enter the Link Road curb and gutter which will convey them downstream to the inlet at DP 4b
4b	Blockage of this inlet will direct flows either across the crown of the road and into the undeveloped property to the west or surcharge the highpoint in the Link Road curb and gutter flowing south to DP 15a
5	Blockage of the east inlet at this design point will result in runoff surcharging the crown of the road and entering the east inlet. If the east inlet is blocked, flows will surcharge the adjacent curb and will sheet flow west across the tract until reaching Link Road which will convey the flows south to DP15a.
7a	Blockage of these inlets will cause flows to surcharge the crown of the road and enter the opposite inlet. If the east inlet is blocked, then flows will surcharge the curb and gutter and sheet flow to the east. These flows will then be captured by the 48" bypass storm sewer and directed to the west.
8	Blockage of these inlets will cause flows to surcharge the crown of the road and enter the opposite inlet. If the west inlet is blocked, then flows will surcharge the curb and gutter and sheet flow south to the proposed drainage swale. Flows will continue west along the swale to DP 9
11a	Blockage of this inlet will cause flows to surcharge the bulb out and continue down Cronin to DP 12
11b	Blockage of this inlet will cause flows to surcharge the bulb out and continue down Cronin to DP 14b
12	Blockage of this inlet will cause flows to surcharge the crown of Cronin and flow to DP 14b
13	Blockage of this inlet will cause flows to surcharge the crown of Cronin and flow to DP 14b
14b	Blockage of this inlet will cause flow to surcharge the crown of Cronin and flow to DP 12 and DP 13. If all three inlets are blocked flows will surcharge the curb and sheet flow west across the adjacent tract to the detention pond.
15a	Blockage of this inlet will cause flows to surcharge the crown of Link Road and enter the property to the west. The flows will then be captured by the proposed swale and conveyed west along historic flow paths.

D. SWALE ANALYSIS

Swales are designed to comply with table 12-3 of the DCM. According to Section I.F more than 77 percent of soils in the developed area are designated a "sandy loam". Therefore, swale design for the development will comply with the criteria for erosive soils.

Table 12-3. Hydraulic Design Criteria for Natural Unlined Channels

Design Parameter	Erosive Soils or Poor Vegetation	Erosion Resistant Soils and Vegetation
Maximum Low-flow Velocity (ft/sec)	3.5 ft/sec	5.0 ft/sec
Maximum 100-year Velocity (ft/sec)	5.0 ft/sec	7.0 ft/sec
Froude No., Low-flow	0.5	0.7
Froude No., 100-year	0.6	0.8
Maximum Tractive Force, 100-year	0.60 lb/sf	1.0 lb/sf

[1] Velocities, Froude numbers and tractive force values listed are average values for the cross section.
[2] "Erosion resistant" soils are those with 30% or greater clay content. Soils with less than 30% clay content shall be considered "erosive soils."

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The table below describes the various swales included in the project:

Swale Capacities Aspen Ranch Filing No. 1								
Design Point	***Sub-basin***	***Slope %***	***SWALE CAPACITY MINOR STORM (cfs)***	***Q(5) TOTAL FLOW (cfs)***	***Q(5) VELOCTIY (FT/S)***	***SWALE CAPACITY MAJOR STORM (cfs)***	***Q(100) TOTAL FLOW (cfs)***	***Q(100) VELOCTIY (FT/S)***
9	B-5	2.3	**23.6**	**12.0**	**2.4**	**74.4**	**26.2**	**3.6**
10	B-5	2.3	**23.6**	**13.0**	**2.4**	**74.4**	**32.4**	**3.2**
Park	B-5	1.4	**86.3**	**2.6**	**1.4**	**101.5**	**11.3**	**2.1**
11b	B-5	2.3	**23.6**	**20.5**	**2.9**	**74.4**	**51.1**	**4.6**
11b (Pond)	B-5	25	**56.4**	**22.6**	**5.3**	**56.4**	**56.4**	**7.6**
21	West of Site	0.3	**108.0**	**28.2**	**2.4**	**420.0**	**155.8**	**3.8**

NOTE: Capacities determined by maximum allowable velocity (Erosive Soils: Minor Storm: 3.5 ft/s, Major Storm: 5ft/s). 11b (Pond) will be protected by Type M Rip Rap and represents the swale as it brings flows from Design Point 7b into the detention pond.

E. DETENTION

In accordance with the City of Fountain drainage criteria, the proposed Aspen Ranch Filing No. 1 development will provide onsite full spectrum detention facilities to mitigate developed drainage impacts. Detained flows will release westerly to a proposed 48-inch RCP pipe (replacing the existing 42-inch RCP and 30-inch x 19-inch HERCP pipes) crossing Link Rd and continue, as it has historically done, through the Eagleside Ranch development (specifically, through a property owned by Integrity Bank and Trust). The Emergency Spillway for the pond will be a broad crested weir discharging to Link Rd, where it will continue west across the road to Jimmy Camp Creek via historic drainage paths. Preliminary sizing for the full spectrum extended detention basin was performed utilizing UD-Detention, is enclosed in Appendix A and summarized as follows:

Selected Pond Type: Extended Detention Basin (EDB)
Tributary Area: 60.37 Acres
Required Area for Pond Footprint: 2.3 Acres

<u>Pond Volumes</u>
Water quality Capture Volume (WQCV): 1.293 Acre-Ft
Excess Urban Runoff Volume (EURV): 4.333 Acre-Ft
2-yr Detention Volume: 2.096 Acre-Ft
5-yr Detention Volume: 2.936 Acre-Ft
100-yr Detention Volume: 6.346 Acre-Ft
Micropool (0.3% of WQCV): 137.5 Cubic Feet

<u>Forebay Design Information</u>
Forebay Volumes (3% of WQCV)
North Forebay (DP 15b): 1070 Cubic Feet
East Forebay (DP 14b): 436 Cubic Feet

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Forebay Discharge Slots (per UD-BMP):
North Forebay (DP 15b): 7.5 inches
East Forebay (DP 14b): 6.6 inches

Outlet Structure:

Stage (Feet)	Outlet Component
-2.5	Floor of structure and micropool
-0.25	42" Discharge Pipe (Restrictor Plate 29.4 inches above pipe flowline)
0	1-13/16" Diameter Orifice
1.28	1-13/16" Diameter Orifice
2.57	1-13/16" Diameter Orifice
3.83	2" (Vertical) x 4.06" (Horizontal) Orifice Dimensions
6.0	Top of Structure 8' x 8' square opening with 4:1 slope from east to west

Pond Discharges
5-year: 1.1 cfs
100-year: 61.2 cfs
Note: The 5-year discharge exactly matches the MDDP while the 100-year discharge is slightly lower than the MDDP (Q100: 70.3 cfs)

Emergency Spillway Information
Shape: Trapezoidal
Crest Length: 70 feet
Depth: 1.9 feet
Emergency Flow Depth: 0.9 feet
Freeboard: 1 foot

See UD-Detention models in Appendix A. The model indicates that the discharge from the proposed detention pond will be approximately 70% of the estimated historic flows from the site.

In addition to the proposed Aspen Ranch Filing No. 1 development, the proposed detention pond is sized to handle the ultimate buildout of the portions of Link Road and Kent Road which will be captured by inlets and directed into the pond (DP 15a & 15b). The equivalent discharge to Historic Design Point 1 under proposed conditions will be Q_5: 27.5 cfs and Q_{100}: 151.2 cfs. This is less than the predevelopment values calculated in this report: Q_5 = 31.96 cfs and Q_{100} = 182.48 cfs and, also complies with the values indicated in the Eagleside Ridge MDDP: Q_5 = 36.4 cfs and Q_{100} = 228.0 cfs. The overall discharges across Link Road are slightly higher than the those indicated in the MDDP for post development conditions (Aspen Ranch MDDP Flows: Q5: 23.9 cfs and Q100: 147.4 cfs), however the difference, due to small changes in the modeling of offsite flows, is small and does not push the discharge values out of compliance with the other previous studies of the area mentioned above. Discharge from the development remains below predevelopment values.

The existing 42" pipe across Link Road was buried at some point after its installation. Function of the pond and prevention of flooding to Link and Kane Roads will require that the discharge location be uncovered, and the restoration of its drainage swale to restore the historic drainage

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paths to downstream storm sewer infrastructure. Drainage solutions and easements through this property to connect to the existing storm pipe extended from Eagleside View are currently in process as of the submittal of this PDR and will be submitted once finalized as an addendum updating this PDR to an FDR.

F. FLOODPLAINS

Per the ***Flood Insurance Rate Map (FIRM) 08041C 0958 G***, effective date December 7, 2018, published by the Federal Emergency Management Agency (FEMA), no portion of Aspen Ranch Filing No. 1 lies within any designated 100-year floodplain. A FIRMette of the project area is included in Appendix D.

G. WATER TABLE CONSIDERATIONS

At the time of this report initial investigations of the water table towards the south end of the proposed development indicate that the natural water table is around 15' below the surface of the ground and that water releases from the FMIC significantly raise the water table in the south portion of the proposed development. The below image shows the effects of the FMIC irrigation release early in May 2020 through early July at Monitoring Well 2 which is located near the existing excavation (see illustration in Appendix C).

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Matrix Environmental Services personnel performing the water table monitoring noted a clay stone layer when drilling the monitoring wells. This factor combined with observations of the rate of water table rise noted in the image above imply that excavation of the existing non-functioning detention pond may have cut through that clay layer and accelerated infiltration to the water table. (Another probable factor in this apparent quick rise in the water table is the proximity of the monitoring well to the north end of the existing detention pond which has a blocked discharge pipe).

The above items suggest that the proposed bypass storm sewer provided by the proposed Aspen Ranch Filing No. 1 development should mitigate much of the water table rise by routing the FMIC releases around the hole in the observed claystone layer created by the detention pond and also reducing the ponding of water just east of the proposed development.

Monitoring results in July 2020 (included in appendix) support the above information. Water table levels even after the FMIC water releases do not reach depths which would cause issues for the proposed development. Provision of the Bypass storm sewer will alleviate much, if not all, of the increases to the water table associated with FMIC release of irrigation waters, further supporting the conclusion that water table levels will not cause issues for this development.

IV. STORMWATER QUALITY

The on-site detention facility is designed to accommodate water quality requirements. As the development of each parcel progresses, the detention guidelines outlined in this report are to be upheld.

Per the DCM Chapter 1, Section 4, the City of Fountain requires the UDFCD Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long-term source controls.

Step 1: ***Reduce runoff by disconnecting impervious area, eliminating "unnecessary" impervious area and encouraging infiltration into soils that are suitable.***
Site specific landscaping will be done on each lot to decrease the connectivity of impervious areas. Grass lined swales will be used where possible to allow ground infiltration. The open space running along the existing gas right of way is a site-specific example of disconnection between impervious surfaces on this project.

Step 2: ***Treat and slowly release the WQCV.***
The proposed detention pond meets or exceeds the DCM standards for the release rates of Full Spectrum Detention Ponds for Water Quality Capture Volumes.

Step 3: ***Stabilize stream channels.***
The proposed project is not in a streamside zone. Fees paid at the time of platting should be utilized in the construction of stream improvements within the Jimmy Camp Creek Drainage Fee Basin, including stabilization. Drainage channels running through the site will be designed to comply with DCM criteria for grassed channels.

Step 4: ***Implement source controls.***

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During construction, the contractor will have designated concrete washout areas and will implement sediment control logs and inlet protection in order to control pollutants at their source. As on-site stockpiling of materials is not anticipated, no long-term source controls other than the proposed detention pond will be included in this development.

Water Quality Exclusions

Water quality treatment will be provided for the vast majority of proposed new pavement. A few minor exclusions will apply. Reconstruction of Kane Road will create a strip of pavement six feet in width which will replace existing pavement and will be impractical to detain. Section E.4.a.i.(A) allows for the reconstruction of roadway without requiring the provision of water quality treatment. Any additional width added to the roadway is already being treated in the proposed detention pond, therefore the 6' width which will remain untreated complies with the referenced section which allows up to 8.25 feet of additional paved width to be added to the road without requiring water quality treatment.

Approximately 0.7 acres of Sub-basin B-13 will be residentially developed land within the Aspen Ranch Filing No. 1 development. This area is tributary to Design Point 22 and, it is not practicable due to the grades and adjacent offsite runoff, to direct the runoff from this area to the proposed Aspen Ranch Detention Pond. Per Section E.4.a.iv.(A)1), which indicates that "the permittee may exclude up to 20 percent, not to exceed 1 acre, of the applicable development site area when the permittee has determined that it is not practicable to capture runoff from portions of that site", this area may be excluded from treatment for Water Quality as it is far less than 20 percent of the 59 acre development, is less than one acre, and is impracticable to detain and treat.

Areas along Link Road (Cumberland Green Basin B) which are currently and have historically been tributary to Design Point 22 will continue to be treated in downstream detention in the Cumberland Green development.

V. Erosion Control Plan

A grading and erosion control plan (GEC) and Storm Water Management Plan (SWMP) for the proposed development will be submitted for review. The GEC will incorporate straw wattles, straw bale check dams, silt fence, vehicle tracking control, inlet & outlet control, sedimentation basins and other best management practices (BMPs) identified in the DCM Volume 2.

VI. SYSTEM PRIORITIES/PHASING

No phasing of the development has been provided at this time. Once development of any portion of the site begins, the owner will be responsible for providing detention and water quality in accordance with the MDDP, this PDR and ***JCC DBPS***, before releasing downstream.

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VII. Fee Development

A. Construction Cost Opinion

Engineer's Estimate of Probable Construction Costs				
Aspen Ranch Filing No. 1				
Public Non-Reimbursable				
Item	**Unit**	**Quantity**	**Unit Cost**	**Extension**
18" RCP	LF	569	$145.00	$82,505.00
24" RCP	LF	867	$155.00	$134,385.00
30" RCP	LF	517	$165.00	$85,305.00
36" RCP	LF	572	$175.00	$100,100.00
42" RCP	LF	33	$185.00	$6,105.00
48" RCP	LF	265	$195.00	$51,675.00
60"X38" HERCP	LF	698	$200.00	$139,600.00
TYPE I MANHOLE	EA	6	$4,000.00	$24,000.00
TYPE II MANHOLE	EA	7	$3,000.00	$21,000.00
5' TYPE R INLET	EA	3	$4,500.00	$13,500.00
10' TYPE R INLET	EA	13	$8,000.00	$104,000.00
15' TYPE R INLET	EA	4	$10,000.00	$40,000.00
18" FES	EA	1	$870.00	$870.00
30" FES	EA	2	$990.00	$1,980.00
36" FES	EA	4	$1,050.00	$4,200.00
		Sub Total		$810,395.00
Private Non-Reimbursable				
48" RCP	LF	1837	$195.00	$358,215.00
TYPE II MANHOLE	EA	4	$3,000.00	$12,000.00
HEADWALL	EA	1	$4,000.00	$4,000.00
DETENTION/WQ POND (Private)	EA	1	$200,000.00	$200,000.00
		Sub Total		$574,215.00
		10% Contingency		$138,461.00
		TOTAL:		$1,523,071.00

Since the engineer has no control over the cost of labor, materials, equipment or services furnished by others, or over the contractor's method of determining prices, or over the competitive bidding or market conditions, the opinion of probable construction costs provided herein are made on the basis of the engineer's experience and qualifications and represents the best judgment as an experienced and qualified professional familiar with the construction industry. The engineer cannot, and does not guarantee that proposals, bid or actual construction costs will not vary from the opinion of probable costs.

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B. Drainage Basin Fees

The parcel is located within the Jimmy Camp Creek Drainage Basin, which has a drainage fee requirement based on City of Fountain drainage policies. The City of Fountain Municipal Code has established the 2020 Drainage Fees for Jimmy Camp Creek Drainage Basin Fees at a rate of $12,086.66 per impervious acre and a Bridge Fee at a rate of $1,967.43 per impervious acre.

Aspen Ranch Filing No. 1 Regions/Types	Area (Acres)	Impervious
Parks/Tracts/Pond	13.50	7%
Residential	44.46	65%
Future Fire Station	0.91	95%
Weighted Impervious		**52%**

Fees

	Impervious Acres	31.218
Drainage Fee	12,086.66 / Imp. Acre	$ 377,324.82
Bridge Fee	1,967.43 / Imp. Acre	$ 61,419.79
	Total Fees:	$ 438,744.61

Please note that the imperviousness of the Aspen Ranch Filing No. 1 development is slightly different from the Detention Pond's Imperviousness due to the pond including Link and Kane Road areas.

VIII. Summary

This report has shown that the proposed Aspen Ranch Filing No. 1 development will not have negative effects on the receiving drainage way, nor will it negatively affect downstream developments. Proposed discharges will be at or below historic levels and the WQCV will be treated for both the proposed development and the adjacent portions of Link and Kane Roads. The project maintains compliance with previous studies of the area (including the MDDP for Aspen Ranch, approved in November of 2019), the governing DCM, the City MS4 Permit, and downstream storm water infrastructure.

IX. References

1. ***City of Colorado Springs Drainage Criteria Manual***, City of Colorado Springs, May 2014
2. ***Web Soil Survey of El Paso County Area, Colorado. Unites States Department of Agriculture Soil Conservation Service***, November 2015.
3. ***Flood Insurance Rate Maps for El Paso County, Colorado and Incorporated Areas, Panel 958 of 1300, Federal Emergency Management Agency***, Effective Date December 7, 2018.
4. ***Urban Storm Drainage Criteria Manual, Vol. 1-3*** by Urban Drainage and Flood Control District (UDFCD), January 2016
5. ***Drainage Basin Planning Study, Jimmy Camp Creek,*** by Kiowa Engineering, March 2015.
6. ***Master Development Drainage Plan for Eagleside View,*** by JPS Engineering, November 2013.
7. ***Master Development Drainage Plan for Aspen Ranch Filing No. 1,*** by Matrix Design Group, November 2019.

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APPENDIX A

HYDROLOGIC AND HYDRAULIC CALCULATIONS

Sub-Basin Descriptions	
Sub-Basin	Description
B1a	Flows in this sub-basin will sheet flow off the back of residential lots at a 2 to 3% slope towards Link Road which will convey the runoff to the south to Design Point 15a via curb and gutter at a slope of approximately 0.4%
B1b	Flows in this sub-basin will sheet flow off the back of residential lots at a slope of 3.8%. Once reaching Kane Road flows will be conveyed west to Design Point 15a via curb and gutter at a slope of 1%
B1c	Runoff in this sub-basin will sheet flow off the back of the adjacent residential lots towards the proposed detention pond. Once reaching the detention pond flows will be conveyed to the pond outlet structure by the concrete trickle channel at a slope of 0.5%.
B2a	Runoff from the front of residential lots along Castleabra Drive will sheet flow south towards the street at a 5% slope. Flows in the street will be conveyed to the west via curb and gutter to Design Point 12 at a slope of 2.2%
B2b	Runoff in this sub-basin will sheet flow either north to Castleabra Drive or South to Frasco Drive. Once reaching these streets flows will be conveyed via curb and gutter to Design Point 13. Flows in Frasco Drive at a slope of 1.3% and flows in Castleabra at a slope of 2.2%. Flows in Frasco Drive will continue along Cronin Street at 1.3% to the location of DP 13 at the Southeast quadrant of Cronin and Castleabra.
B2c	Runoff from the front of residential lots along Frasco Drive will sheet flow north at a slope of 5% to Frasco Drive. Once reaching the street flows will be conveyed to DP 14b via curb and gutter at a slope of 1.3%. The flows will continue from the point where Frasco intersects Cronin Street, along Cronin Street at 1.3% to the location of DP 13 at the Southeast quadrant of Cronin and Castleabra
B2d	Flows in this small sub-basin will sheet flow off of the front lots along Cronin Street to the street's curb and gutter at a slope of 5%. Once reaching the street flows will be conveyed to DP 14b at a slope of 1.3%.
B3a	Flows in this sub-basin will sheet flow off of the front of the residential lots along Cronin Street at a slope of 5%. Once reaching the street, flows will be conveyed south to DP 11a at a slope of 1.3%
B3b	Flows along the outside (generally west) of Treasurevalt Trail will sheet flow to the street at a slope of 5%. Flows on the inside lots (generally east) will sheet flow at slopes varying from 2.8% to 11% to Treasurevalt Trail. Once reaching the street, the runoff will be conveyed to Design Point 5 at a slope of 2% from the north and 2.6% from the southeast.
B4	This sub-basin represents the front lots along Cronin Street which are tributary to DP11a. Flows will sheet flow off the front of the lots at a slope of 5%. Once reaching the street flows are conveyed south to DP11a at a slope of 1.3% via curb and gutter
B5	This sub-basin represents a park area as well as the back of some lots along Cronin Street and Castleabra Drive. Flows will sheet flow off the back of the lots and park area at slopes varying from 2% to 2.6% towards the grassed swales running along the west edge of the park area and running east to west along the middle of the south leg of the sub-basin. Flows in the swales will be conveyed to DP 10 at slopes of 1.4% from the north and 2.2% from the east.
B6	Flows in this sub-basin will sheet flow from the back of lots along Blaurock Drive towards Lackawanna Street at slopes varying from 1% to 5%. Once reaching the street flows are conveyed to DP8 via curb and gutter at slopes varying from 1.2% to 4%.
B7	This sub-basin represents the front lots along the west side of Blaurock Drive and the whole lots on the east side of Blaurock Drive. Flows on the west side will sheet flow off the front lots at a slope of 5% towards the street. Flows on the east side will sheet flow towards the street at slopes varying from 2.2% to 7.4%. Once reaching Blaurock Drive flows will be conveyed to DP7b at slopes ranging from 1.7% to 3.2%.
B8	This sub-basin represents a small drainage tract (Tract C). Flows will sheet flow west off of this sub-basin to Blaurock Drive which will convey the flows to DP7b at a slope of 1.7%.

Sub-Basin Descriptions	
Sub-Basin	Description
B9	This sub-basin represents the drainage area tributary to Crescent Moon along the east side of the Aspen Ranch Filing No. 1 development. Flows will sheet flow off of the adjacent right of way to the Crescent Moon curb and gutter. Once reaching the street flows will be conveyed to DP7a at a slope ranging from 1% to 4%.
B10	This sub-basin represents the area tributary to DP1. Flows in this sub-basin will sheet flow at a 5% slope to Silex Street and Pin Point Drive. Once reaching the curb and gutter the flows will be conveyed to DP1 via curb and gutter at slopes ranging from 3.7% to 4%
B11	Flows in this sub-basin will sheet flow off the back of lots along Silex Street and off the whole of lots along Tijeras Street to Tijeras street at slopes ranging from 7.4% to 5%. Once reaching Tijeras Street, flows are conveyed westward at a slope of 3.7% to Cronin Street. The east side of Cronin Street will then convey the flows south to DP2 at slopes ranging from 1.3% to 2.9%.
B12a	This sub-basin represents the area on each side of Watchmen Road and the west side of Cronin north of Watchmen. Runoff will sheet flow off the front of the lots adjacent to Cronin Street at a slope of 5% and Runoff along Watchmen will sheet flow off of Lot 218 (future Fire Station) to Watchmen at slopes ranging from 1.8% to 5%. Once reaching Cronin, Flows will be conveyed via curb and gutter at a slope of 2.9% to Watchmen Road. Watchmen Road will convey flows from Cronin and the adjacent lot at a slope of 4.6% to DP3.
B12b	This sub-basin represents flows on the east side of Link Road several hundred feet to either side of Watchmen Road. Flows in this sub-basin will sheet flow off of Lot 218 at a slope of around 5% to Link Road. Flows will also sheet flow off the back of lots along Treasurevalt Trail at a slope of 5% to Link Road. Once reaching Link Road these flows will be conveyed via curb and gutter to DP 4b at slopes ranging from 0.3% to 1.4%.
B13	This is a (mostly) offsite basin. Flows will sheet flow off of the undeveloped area north of the proposed Aspen Ranch Filing No.1 development to a proposed swale running west at slopes ranging from 1% to 7% along the north of the cut at the north boundary of the development, entering the development just east of Link Road. From here the flows will sheet flow to DP 22.
OB1.1A1-Reduced (Less Developed Area)	This represents the large sub-basin east of the project area. Flows will sheet flow off of the surrounding hills at grades of 2% to 9% towards the natural drainage way running at an estimated 2% grade towards the project area. These flows will be captured at DP 18 and be conveyed around the project via 48-inch Storm sewer sized to handle both natural flows and FMIC flows simultaneously.
OB1.1A2 (Not Reduced by Development)	This represents the large sub-basin south of the proposed project. Flows will sheet flow off of the surrounding hills at grades ranging from 3% to 9% towards a natural drainage way which terminates at the Southeast quadrant of the intersection of Link and Kane Roads. These flows will be captured by a 36-inch RCP storm sewer and be conveyed around the project via a 48-inch RCP storm sewer after crossing Kane Road.
OB1.1B-Reduced (Less Developed Area)	This is a sub-basin located to the north of the proposed project. Runoff in this undeveloped sub-basin will sheet flow off of the surrounding hills at slopes ranging from 3% to 9% into sub-basin B13 where the grades are designed to convey flows to an extended existing cross road pipe at DP 22.

Aspen Ranch
Proposed Conditions
Design Point Summary Table

Design Point: Sub-basins	Description	Upstream			Outlet Pipe			Downstream Design Point
		Area (Acres)	Q5 (cfs)	Q100 (cfs)	Size (inches)	Type	Grade (%)	
1: B10	Capture by: 15-foot sump Type-R Curb Inlet	6.6	11.3	24.9	24	RCP	1.7	4a
2: B11	Capture by: 10-foot At-grade Type-R Curb Inlet	3.7	6.4	14.0	18	RCP	2.8	2
3: B11, B12a	Capture by: 15-foot & 5-foot At-Grade Type R Curb Inlets	6.4	13.3	27.4	30	RCP	1	3
4a: B10, B11, B12a	Manhole in Link Road combining B12a & DP 3	9.1	20.5	41.6	42	RCP	0.50	4b
4b: B10, B11, B12a, 12b	Sump Inlet on Link Road and MH Combining DP 4b w/ Sub-basin B12b	11.5	22.4	45.8	42	RCP	0.30	6
5: B3a1 & B3b	On-Grade Inlets 15' Type R south, 5' Type R north	3.8	6.2	13.7	18	RCP	0.65	6
6: B3b, B10, B11, B12a, B12b	Manhole in Link Road combining DP5 & DP4b	15.3	26.7	55.8	42	RCP	0.3	15b
7a: B8, B9	Surface flow to inlet in B9	2.4	4.2	9.1	18	RCP	0.3	7b
7b: B7, B8, B9	At-Grade Inlets	7.6	11.6	25.5	36	RCP	0.3	9
8: B6	Sump Inlets	5.1	8.7	19.1	30-inch pipe.	RCP	1.5	9
9: B6, B7, B8, B9	Trapezoidal swale	12.7	12.0	26.2	8' bottom width 5:1 side slopes	Swale	2.4	10
10: B5, B6, B7, B8, B9	36-inch Flared End Section	19.2	13.0	32.4	36	RCP	1.4	11a
11a: B4, B5, B6, B7, B8, B9	10-foot At Grade Inlet	20.4	20.4	51.0	36	RCP	1.35	11b
11b: B3a2, B4, B5, B6, B7, B8, B9	5-foot At Grade Inlet	20.5	20.5	51.1	36 Swale (8' bottom width 5:1 side slopes)	RCP Swale	1.35 2.4	16
12: B2a + Flow Bypass from DP 7b	Sump Inlet	3.3	5.5	16.9	24	RCP	1	14a
13: B2b	Sump Inlet	3.7	5.7	12.4	24	RCP	2	14a
14a: B2a, B2b	Manhole combining flows from DP 12 & 13	7.1	11.0	29.1	30	RCP	1	14b
14b: B2a, B2b, B2c, B2d	Sump Inlet	9.8	13.7	35.3	30	RCP	2.35	16
15a: B1a, B1b	Link and Kane Roads	5.0	8.5	18.9	24	RCP	0.64	15b
15b: B1a, B1b, B3b, B10, B11, B12a, B12b	Northwest Forebay	20.3	8.5 30.8	18.9 66.5	24 42	RCP	3.2 0.75	16
16: B1a, B1b, B1c, B2a, B2b, B2c, B3a, B3b, B4, B5, B6, B7, B8, B9	See UD-Detention for Basin Volume Analysis	60.4	38.1	90.4	Trickle Channel	Concrete	0.5	17
17: Detention Pond Discharge	See UD-Detention for outlet structure design information	60.4	1.1	62.1	42	RCP	1	21
18: OB1.1A1	48" Storm Pipe Routing around development	207.0	12.7	70.5	48	RCP	1.1	20
18a (Sub-area within OB1.1A1)	18" FES These flows are included under DP18 and are thus **not** added again to the flows in the bypass storm sewer.	5.1	1.1	6.3	18	RCP	9.8	20
19: OB1.1A2	42" Crossroad pipe to 48" Storm Pipe Routing around development	223.8	13.5	87.8	36	RCP	2.15	20
20: OB1.1A1, OB1.1A2	48" Storm Pipe Routing around development	430.8	27.3	154.8	48	RCP	3.47	21
21: B1a, B1b, B1c, B2a, B2b, B2c, B3a, B3b, B4, B5, B6, B7, B8, B9, OB1.1A1, OB1.1A2	Crossroad discharge pipe	491.2	28.2	155.8	48 Swale(8' bottom width, 4:1 side slopes)	RCP Swale	1.84 0.25	Existing Swale
22: B13, OB1.1B-Reduced	Combination of offsite undeveloped with Sub-basin B13 (which contains only open space and offsite). Storm water will continue to be treated and detained by Existing Pond B to the west.	36.3	7.3	35.1	30 x 18	HERCP		Existing Storm Sewer

RATIONAL METHOD - EXISTING CONDITIONS

Project Name:	ASPEN RANCH
Project Location:	FOUNTAIN, CO
Designer	JTS
Notes:	Existing Conditions

Average Channel Velocity 5 ft/s (If specific channel vel is used, this will be ignored)
Average Slope for Initial Flow 0.04 ft/ft (If Elevations are used, this will be ignored)
Note:
Q2, Q5 & Q10 are based on C10;
Q25, Q50 & Q100 are based on C100

	Area		Rational 'C' Values								Flow Lengths				Initial Flow				Channel Flow					Tc	SCS Flow Rates								
			Surface Type 1 (Meadow)			Surface Type 2 (Pavement/Commercially Developed)			Weighted C-Factor		Initial	True Initial Length	Channel	True Channel Length	High Point	Low Point	Average	Initial	High Point	Low Point	Average	Velocity	Channel	Total	i2	Q2	i5	Q5	i10	Q10	i100	Q100	
Basin	**sf**	**acres**	**C5**	**C100**	**Area (SF)**	**C5**	**C100**	**Area (SF)**	**C5**	**C100**	**ft**	**ft**	**ft**	**ft**	**Elevation**	**Elevation**	**Slope**	**Tc (min)**	**Elevation**	**Elevation**	**Slope**	**(ft/s)**	**Tc (min)**	**(min)**	**in/hr**	**cfs**	**in/hr**	**cfs**	**in/hr**	**cfs**	**in/hr**	**cfs**	
OSB1.1A1	10932748	250.98	0.15	0.45	10932748	0.90	0.96		0.15	0.45	300	300	6567	6567	5760	5660	0.333	9.6	5660	5600	0.009	3.0	36.5	46.0		**3.4**		**14.0**		**28.6**		**87.0**	SCS Method
OSB1.1A2	9748453	223.79	0.15	0.45	9748453	0.90	0.96		0.15	0.45	300	300	3251	3251	5760	5660	0.333	9.6	5660	5610	0.015	3.0	18.1	27.6		**3.1**		**13.5**		**28.2**		**87.8**	
OSB1.1B	1933316	44.38	0.15	0.45	1933316	0.90	0.96		0.15	0.45	300	300	2000	2000	5685	5675	0.033	20.6	5675	5614	0.031	3.2	10.4	31.0	1.9	**12.7**	2.4	**15.9**	2.8	**18.6**	4.0	**80.4**	Rational Method
		77.04																															
Total Area within Proposed Project =	11681769	268.18																															
Total Offsite Areas =	10932748	250.98																															

Existing Conditions: Design Points	**Area**	**Area (Acres)**																								**Q2**	**i5**	**Q5**	**i10**	**Q10**	**i100**	**Q100**	
OS1 (Sub-basins OSB1.1A1 & OSB1.1A2)	20681201	474.78																								**6.5**		**27.5**		**56.8**		**174.8**	SCS Method
OS2 (Sub-basin OSB1.1B)	1933316	44.38																								**12.7**		**15.9**		**18.6**		**80.4**	Rational Method

RATIONAL METHOD - PROPOSED CONDITIONS

Project Name:	ASPEN RANCH
Project Location:	FOUNTAIN, CO
Designer	JTS
Notes:	Proposed Conditions

Matrix

Average Channel Velocity	5	ft/s	(If specific channel vel is used, this will be ignored)
Average Slope for Initial Flow	0.04	ft/ft	(If Elevations are used, this will be ignored)

Channel Flow Type Key

Heavy Meadow	2
Tillage/Field	3
Short Pasture and Lawns	4
Nearly Bare Ground	5
Grassed Waterway	6
Paved Areas	7

		Area		Rational 'C' Values														Flow Lengths				Initial Flow				Channel Flow						Tc	Rainfall Intensity & Rational Flow Rate									
				Impervious %		7		2		63				100																												
Basin	**Description**	**SF**	**Acres**	**C5**	**C100**	**Area (SF)**	**C5**	**C100**	**Area (SF)**	**C5**	**C100**	**Area**	**C5**	**C100**	**Area**	**C5**	**C100**	**Initial ft**	**True Initial Length ft**	**Channel ft**	**True Channel Length ft**	**High Point Elevation**	**Low Point Elevation**	**Average Slope**	**Initial Tc (min)**	**High Point Elevation**	**Low Point Elevation**	**Average Slope**	**Channel Flow Type (See Key above) Ground Type**	**Velocity (ft/s)**	**Channel Tc (min)**	**Total (min)**	**i2 in/hr**	**Q2 cfs**	**i5 in/hr**	**Q5 cfs**	**i10 in/hr**	**Q10 cfs**	**i100 in/hr**	**Q100 cfs**	**% Imp**	
B1a	*Pond and Kane Road*	63535	1.46	0.12	0.39	32325	0.09	0.36		0.45	0.59	10870	0.90	0.96	20340	0.43	0.61	50	50	1104	1104	5628	5626	0.040	5.6	5626	5595	2.81	7	3.3	5.5	11.1	3.1	**2.0**	3.9	**2.5**	4.6	**2.9**	6.6	**5.9**	46.7%	
B1b	*Pond and Kane Road*	153493	3.52	0.12	0.39	46339	0.09	0.36		0.45	0.59	53099	0.90	0.96	54055	0.51	0.66	50	50	1682	1682	5627	5624	0.060	4.3	5624	5595	1.72	7	2.6	10.8	15.0	2.7	**5.0**	3.5	**6.3**	4.0	**7.3**	5.8	**13.6**	59.8%	
B1c	*Pond and Kane Road*	256686	5.89	0.12	0.39	207971	0.09	0.36		0.45	0.59	48715	0.90	0.96		0.19	0.43	50	50	762	762	5627	5626	0.020	9.6	5626	5595	4.07	4	1.4	9.1	18.6	2.5	**2.8**	3.1	**3.5**	3.6	**4.1**	5.2	**13.4**	18.0%	
B2a	*Single Family Residential*	144559	3.32	0.12	0.39	40780	0.09	0.36		0.45	0.59	103779	0.90	0.96		0.36	0.54	100	100	775	775	5632	5631	0.010	13.8	5631	5616	1.94	7	2.8	4.7	18.5	2.5	**3.0**	3.1	**3.8**	3.7	**4.4**	5.3	**9.5**	48.6%	
B2b	*Single Family Residential*	163118	3.74	0.12	0.39		0.09	0.36		0.45	0.59	163118	0.90	0.96		0.45	0.59	95	95	736	736	5630	5629	0.011	11.6	5629	5616	1.77	7	2.6	4.7	16.4	2.6	**4.5**	3.3	**5.7**	3.9	**6.6**	5.6	**12.4**	65.0%	
B2c	*Single Family Residential*	108727	2.50	0.12	0.39		0.09	0.36		0.45	0.59	108727	0.90	0.96		0.45	0.59	100	100	1132	1132	5630	5629	0.010	12.2	5629	5616	1.15	7	2.1	9.0	21.1	2.3	**2.6**	2.9	**3.3**	3.4	**3.9**	4.9	**7.3**	65.0%	
B2d	*Single Family Residential*	12115	0.28	0.12	0.39		0.09	0.36		0.45	0.59	12115	0.90	0.96		0.45	0.59	50	50	201	201	5618	5618	0.003	12.8	5618	5616	1.04	7	2.0	1.7	14.5	2.8	**0.4**	3.5	**0.4**	4.1	**0.5**	5.9	**1.0**	65.0%	
B3a1	*Single Family Residential*	97624	2.24	0.12	0.39		0.09	0.36		0.45	0.59	97624	0.90	0.96		0.45	0.59	94	94	583	583	5627	5626	0.016	10.1	5626	5613	2.14	7	2.9	3.4	13.4	2.9	**2.9**	3.6	**3.7**	4.2	**4.3**	6.1	**8.1**	65.0%	
B3a2	*Single Family Residential*	4811	0.11	0.12	0.39		0.09	0.36		0.45	0.59	4811	0.90	0.96		0.45	0.59	25	25	126	126	5620	5619	0.040	3.8	5619	5618	0.79	7	1.7	1.3	5.1	4.0	**0.2**	5.1	**0.3**	5.9	**0.3**	8.5	**0.6**	65.0%	
B3b	*Single Family Residential*	69081	1.59	0.12	0.39		0.09	0.36		0.45	0.59	69081	0.90	0.96		0.45	0.59	94	94	631	631	5627	5626	0.016	10.1	5626	5613	1.98	7	2.8	3.8	13.9	2.8	**2.0**	3.6	**2.6**	4.2	**3.0**	6.0	**5.7**	65.0%	
B4	*Single Family Residential*	54121	1.24	0.12	0.39		0.09	0.36		0.45	0.59	54121	0.90	0.96		0.45	0.59	109	109	644	644	5628	5627	0.009	13.1	5627	5618	1.40	7	2.3	4.7	17.8	2.5	**1.4**	3.2	**1.8**	3.7	**2.1**	5.4	**4.0**	65.0%	
B5	*Open Space*	281095	6.45	0.12	0.39	248425	0.09	0.36		0.45	0.59	32670	0.90	0.96		0.16	0.42	173	173	999	999	5646	5638	0.046	13.9	5638	5614	2.40	4	1.1	15.4	29.2	2.0	**2.0**	2.5	**2.6**	2.9	**3.0**	4.1	**11.3**	13.7%	
B6	*Single Family Residential*	222545	5.11	0.12	0.39		0.09	0.36		0.45	0.59	222545	0.90	0.96		0.45	0.59	100	100	1093	1093	5655	5647	0.080	6.1	5647	5625	2.01	7	2.8	6.4	12.5	3.0	**6.9**	3.7	**8.7**	4.4	**10.1**	6.3	**19.1**	65.0%	
B7	*Single Family Residential*	225559	5.18	0.12	0.39		0.09	0.36		0.45	0.59	225559	0.90	0.96		0.45	0.59	100	100	1220	1220	5675	5661	0.140	5.0	5661	5632	2.38	7	3.0	6.7	11.7	3.1	**7.2**	3.9	**9.0**	4.5	**10.6**	6.5	**19.9**	65.0%	
B8	*Open Space*	14478	0.33	0.12	0.39	14478	0.09	0.36		0.45	0.59		0.90	0.96		0.12	0.39	88	88	88	88	5634	5625	0.102	7.9	5625	5623	2.27	4	1.0	1.4	9.3	3.3	**0.1**	4.2	**0.2**	4.9	**0.2**	7.1	**0.9**	7.0%	
B9	*Crescent Moon*	90758	2.08	0.12	0.39	35921	0.09	0.36		0.45	0.59		0.90	0.96	54837	0.60	0.74	20	20	1580	1580	5677	5676	0.050	2.4	5676	5631	2.85	7	3.3	7.9	10.3	3.2	**4.1**	4.1	**5.1**	4.7	**6.0**	6.8	**10.6**	63.2%	
B10	*Single Family Residential*	285479	6.55	0.12	0.39		0.09	0.36		0.45	0.59	285479	0.90	0.96		0.45	0.59	100	100	1400	1400	5674	5661	0.130	5.2	5661	5621	2.86	7	3.3	7.0	12.1	3.0	**9.0**	3.8	**11.3**	4.4	**13.2**	6.4	**24.9**	65.0%	
B11	*Single Family Residential*	160509	3.68	0.12	0.39		0.09	0.36		0.45	0.59	160509	0.90	0.96		0.45	0.59	100	100	1040	1040	5661	5655	0.060	6.7	5655	5627	2.69	7	3.2	5.4	12.1	3.0	**5.0**	3.8	**6.4**	4.4	**7.4**	6.4	**14.0**	65.0%	
B12a	*Open Space/Public Safety*	117349	2.69	0.12	0.39		0.09	0.36		0.45	0.59	66112	0.90	0.96	51237	0.65	0.76	100	100	818	818	5639	5638	0.010	8.4	5638	5610	3.42	7	3.7	3.7	12.1	3.0	**5.3**	3.8	**6.7**	4.4	**7.8**	6.4	**13.2**	80.3%	
B12b	*Open Space/Public Safety*	104287	2.39	0.12	0.39	39227	0.09	0.36	*630*	0.45	0.59	25100	0.90	0.96	39330	0.50	0.66	100	100	664	664	5627	5615	0.120	4.9	5615	5607	1.20	7	2.2	5.1	10.0	3.3	**3.9**	4.1	**5.0**	4.8	**5.8**	6.9	**11.0**	56.0%	
B13	*Open Space, Offsite Underdeveloped, Small Portion of Single Family*	361044	8.29	0.12	0.39		0.09	0.36	*302609*	0.45	0.59	43731	0.90	0.96	14704	0.17	0.42	205	205	1623	1623	5685	5684	0.005	31.6	5684	5614	4.31	4	1.5	18.6	50.3	1.4	**2.0**	1.8	**2.5**	2.1	**2.9**	3.0	**10.5**	13.6%	
OB1.1A1-Reduced (Less Developed Area)	*Offsite Sub-basin East of Development Area. SCS Calculations from AutoDesk SAS*	9017468	207.01	0.12	0.39											CN	61.00																	**2.5**		**12.7**		**16.1**		**70.5**		SCS METHOD
OB1.1A1-Kane Drainage (18a)	*Sub-basin within OB1.1A1-Reduced Used to size storm pipe capturing North portion of Kane Road to the east of Aspen Ranch*	223571	5.13	0.12	0.39	223571	0.09	0.36		0.45	0.59		0.90	0.96		0.12	0.39	300	300	928	928	5649	5646	0.010	31.7	5646	5626	2.16	4	1.0	15.2	47.0	1.5	**0.9**	1.9	**1.1**	2.2	**1.3**	3.1	**6.3**	7.0%	
OB1.1A2 (Not Reduced by Development)	*Offsite Sub-basin South of Development SCS Calculations from AutoDesk SAS*	9748453	223.79	0.12	0.39											CN	61.00																	**3.1**		**13.5**		**28.2**		**87.8**		SCS METHOD
OB1.1B-Reduced (Less Developed Area)	*Offsite Sub-basin North of Development*	1219563	28.00	0.12	0.39	1219563	0.09	0.36		0.45	0.59		0.90	0.96		0.12	0.39	300	300	2000	2000	5685	5675	0.033	21.2	5675	5614	3.05	4	1.2	27.5	48.7	1.4	**4.9**	1.8	**6.1**	2.1	**7.1**	3.0	**33.4**	7.0%	

				Rational 'C' Values														Flow Lengths				Initial Flow				Channel Flow						Tc	Rainfall Intensity & Rational Flow Rate									
PROPOSED DESIGN POINT: SUB-BASINS		**Area**		**Surface Type 1 (Parks & Cemetaries)**			**Surface Type 2 (Greenbelts & Agriculture)**			**Surface Type 3 (Single-Family 1/8 Ac. Lots)**			**Surface Type 4 (Impervious)**			**Weighted C-Factor**																										
	Description	**SF**	**Acres**	**C5**	**C100**	**Area (SF)**	**C5**	**C100**	**Area (SF)**	**C5**	**C100**	**Area**	**C10**	**C100**	**Area**	**C5**	**C100**	**Initial ft**	**True Initial Length ft**	**Channel ft**	**True Channel Length ft**	**High Point Elevation**	**Low Point Elevation**	**Average Slope**	**Initial Tc (min)**	**High Point Elevation**	**Low Point Elevation**	**Average Slope**	**Channel Flow Type (See Key above) Ground Type**	**Velocity (ft/s)**	**Channel Tc (min)**	**Total (min)**	**i2 in/hr**	**Q2 cfs**	**i5 in/hr**	**Q5 cfs**	**i10 in/hr**	**Q10 cfs**	**i100 in/hr**	**Q100 cfs**	**% Imp**	
1: B10	*Capture by: 15-foot sump Type-R Curb Inlet*	285479	6.55	0.12	0.39	0	0.09	0.36	0	0.45	0.59	285479	0.90	0.96	0	0.45	0.59	100	100	1400	1400	5674	5661	0.130	5.2	5661	5621	2.86	7	3.3	7.0	12.1	3.0	**9.0**	3.8	**11.3**	4.4	**13.2**	6.4	**24.9**	65.0%	
2: B11	*Capture by: 10-foot At-grade Type-R Curb Inlet*	160509	3.68	0.12	0.39	0	0.09	0.36	0	0.45	0.59	160509	0.90	0.96	0	0.45	0.59	100	100	1040	1040	5661	5655	0.060	6.7	5655	5627	2.69	7	3.2	5.4	12.1	3.0	**5.0**	3.8	**6.4**	4.4	**7.4**	6.4	**14.0**	65.0%	
3: B11, B12a	*Capture by: 15-foot & 5-foot At-Grade Type R Curb Inlets*	277858	6.38	0.12	0.39	0	0.09	0.36	0	0.45	0.59	226621	0.90	0.96	51237	0.54	0.66	100	100	1365	1365	5661	5654	0.070	5.5	5654	5610	3.22	7	3.6	6.4	11.8	3.0	**10.6**	3.8	**13.3**	4.5	**15.5**	6.4	**27.4**	71.5%	
4a: B10, B11, B12a	*Manhole in Link Road combining B12a & DP 3*	395207	9.07	0.12	0.39	0	0.09	0.36	0	0.45	0.59	292733	0.90	0.96	102474	0.57	0.69	100	100	1400	1400	5674	5661	0.130	4.2	5661	5621	2.86	7	3.3	7.0	11.2	3.1	**16.2**	3.9	**20.5**	4.6	**23.9**	6.6	**41.6**	74.1%	
4b: B10, B11, B12a, 12b	*Sump Inlet on Link Road and M11 Combining DP 4b w/ Sub-basin B12b*	499494	11.47	0.12	0.39	39227	0.09	0.36	*630*	0.45	0.59	317833	0.90	0.96	141804	0.56	0.68	100	100	2064	2064	5674	5661	0.130	4.3	5661	5607	2.62	7	3.2	10.7	15.0	2.8	**17.8**	3.5	**22.4**	4.0	**26.2**	5.8	**45.8**	70.3%	
5: B3a1 & B3b	*Capture by:2-5-foot sump Type R Curb Inlets*	166705	3.83	0.12	0.39	0	0.09	0.36	0	0.45	0.59	166705	0.90	0.96	0	0.45	0.59	94	94	631	631	5627	5626	0.016	10.1	5626	5613	1.98	7	2.8	3.8	13.9	2.8	**4.9**	3.6	**6.2**	4.2	**7.3**	6.0	**13.7**	65.0%	
6: B3b, B10, B11, B12a, B12b	*Manhole in Link Road combining DP5 & DP4b*	666199	15.29	0.12	0.39	39227	0.09	0.36	*630*	0.45	0.59	484538	0.90	0.96	141804	0.53	0.66	100	100	2064	2064	5674	5661	0.130	4.5	5661	5620	1.99	7	2.8	12.5	17.0	2.6	**21.2**	3.3	**26.7**	3.8	**31.1**	5.5	**55.8**	69.0%	
7a: B8, B9	*Surface flow to inlet in B9*	105236	2.42	0.12	0.39	50399	0.09	0.36	0	0.45	0.59	0	0.90	0.96	54837	0.53	0.69	88	88	1668	1668	5677	5676	0.011	9.6	5676	5623	3.18	7	3.5	7.9	17.5	2.6	**3.3**	3.2	**4.2**	3.8	**4.9**	5.4	**9.1**	55.5%	
7b: B7, B8, B9	*At-Grade Inlets*	330795	7.59	0.12	0.39	50399	0.09	0.36	0	0.45	0.59	225559	0.90	0.96	54837	0.48	0.63	88	88	1668	1668	5677	5676	0.011	10.4	5676	5623	3.18	7	3.5	7.9	18.3	2.5	**9.2**	3.2	**11.6**	3.7	**13.5**	5.3	**25.5**	62.0%	
8: B6	*Sump Inlets*	222545	5.11	0.12	0.39	0	0.09	0.36	0	0.45	0.59	222545	0.90	0.96	0	0.45	0.59	100	100	1093	1093	5655	5647	0.080	6.1	5647	5625	2.01	7	2.8	6.4	12.5	3.0	**6.9**	3.7	**8.7**	4.4	**10.1**	6.3	**19.1**	65.0%	
9: B6, B7, B8, B9	*Trapezoidal swale*	553340	12.70	0.12	0.39	50399	0.09	0.36	0	0.45	0.59	448104	0.90	0.96	54837	0.47	0.61	88	88	2108	2108	5678	5677	0.011	10.6	5677	5622	2.61	4	1.1	31.1	41.7	1.6	**9.5**	2.0	**12.0**	2.3	**14.0**	3.3	**26.2**	63.2%	
10: B5, B6, B7, B8, B9	*36-inch Flared End Section*	834435	19.16	0.12	0.39	298824	0.09	0.36	0	0.45	0.59	480774	0.90	0.96	54837	0.37	0.55	88	88	2408	2408	5677	5676	0.011	12.3	5676	5614	2.57	4	1.1	36.3	48.5	1.4	**10.3**	1.8	**13.0**	2.1	**15.1**	3.0	**32.4**	46.5%	
11a: B4, B5, B6, B7, B8, B9	*10-foot At Grade Inlet*	888556	20.40	0.12	0.39	298824	0.09	0.36	0	0.45	0.59	534895	0.90	0.96	54837	0.37	0.55	88	88	2408	2408	5677	5676	0.011	12.3	5676	5614	2.57	7	3.2	12.7	25.0	2.1	**16.2**	2.7	**20.4**	3.1	**23.8**	4.5	**51.0**	47.7%	
11b: B3a2, B4, B5, B6, B7, B8, B9	*5-foot At Grade Inlet*	893367	20.51	0.12	0.39	298824	0.09	0.36	0	0.45	0.59	539706	0.90	0.96	54837	0.37	0.55	88	88	2428	2428	5677	5676	0.011	12.3	5676	5615	2.51	7	3.2	12.8	25.1	2.1	**16.2**	2.7	**20.5**	3.1	**23.9**	4.5	**51.1**	47.7%	
12: B2a + Flow Bypass from DP 7b	*Sump Inlet*	144559	3.32	0.12	0.39	40780	0.09	0.36	0	0.45	0.59	103779	0.90	0.96	0	0.36	0.54	100	100	775	775	5632	5631	0.010	13.8	5631	5616	1.94	7	2.8	4.7	18.5	2.5	**3.0**	3.1	**5.5**	3.7	**4.4**	5.3	**16.9**	48.6%	
13: B2b	*Sump Inlet*	163118	3.74	0.12	0.39	0	0.09	0.36	0	0.45	0.59	163118	0.90	0.96	0	0.45	0.59	95	95	736	736	5630	5629	0.011	11.6	5629	5616	1.77	7	2.6	4.7	16.4	2.6	**4.5**	3.3	**5.7**	3.9	**6.6**	5.6	**12.4**	65.0%	
14a: B2a, B2b	*Manhole combining flows from DP 12 & 13*	307677	7.06	0.12	0.39	40780	0.09	0.36	0	0.45	0.59	266897	0.90	0.96	0	0.41	0.57	100	100	775	775	5630	5629	0.010	12.9	5629	5616	1.68	7	2.5	5.1	18.0	2.5	**7.4**	3.2	**11.0**	3.7	**10.8**	5.3	**29.1**	57.3%	
14b: B2a, B2b, B2c, B2d	*Sump Inlet*	428519	9.84	0.12	0.39	40780	0.09	0.36	0	0.45	0.59	387739	0.90	0.96	0	0.42	0.58	100	100	1132	1132	5630	5629	0.010	12.7	5629	5616	1.15	7	2.1	9.0	21.7	2.3	**9.5**	2.9	**13.7**	3.4	**14.0**	4.9	**35.3**	59.5%	
15a: B1a, B1b	*Link and Kane Roads*	217028	4.98	0.12	0.39	78664	0.09	0.36	0	0.45	0.59	63969	0.90	0.96	74395	0.49	0.65	50	50	1682	1682	5627	5624	0.060	4.4	5624	5595	1.72	7	2.6	10.8	15.2	2.7	**6.7**	3.4	**8.5**	4.0	**9.9**	5.8	**18.9**	56.0%	
15b: B1a, B1b, B3b, B10, B11, B12a, B12b	*Northwest Forebay*	883227	20.28	0.12	0.39	117891	0.09	0.36	*630*	0.45	0.59	548507	0.90	0.96	216199	0.52	0.66	100	100	2064	2064	5674	5661	0.130	4.6	5661	5620	1.99	7	2.8	12.5	17.1	2.6	**27.5**	3.3	**34.6**	3.8	**40.4**	5.5	**73.8**	65.8%	
16: B1a, B1b, B1c, B2a, B2b, B2c, B3a, B3b, B4, B5, B6, B7, B8, B9	*See UD-Detention for Basin Volume Analysis*	2629929	60.37	0.12	0.39	626239	0.09	0.36	0	0.45	0.59	1718934	0.90	0.96	180469	0.39	0.55	100	100	3131	3131	5677	5676	0.010	13.3	5676	5591	2.71	4	1.2	45.4	58.6	1.3	**30.3**	1.6	**38.1**	1.9	**44.5**	2.7	**90.4**	51.0%	
17: Detention Pond Discharge	*See UD-Detention for outlet structure design information*	2629929	60.37	0.12	0.39	626239	0.09	0.36	0	0.45	0.59	1718934	0.90	0.96	180469	0.39	0.55																	**0.9**		**1.1**		**1.2**		**62.1**	51.0%	
18: OB1.1A1	*48" Storm Pipe Routing around development*	9017468	207.01													CN	61.00																	**2.5**		**12.7**		**16.1**		**70.5**		SCS METHOD
19: OB1.1A2	*42" Crossroad pipe to 48" Storm Pipe Routing around development*	9748453	223.79													CN	61.00																	**3.1**		**13.5**		**28.2**		**87.8**		SCS METHOD
20: OB1.1A1, OB1.1A2	*48" Storm Pipe Routing around development*	18765921	430.81													CN	61.00																	**5.2**		**27.3**		**34.9**		**154.8**		
21: B1a, B1b, B1c, B2a, B2b, B2c, B3a, B3b, B4, B5, B6, B7, B8, B9, OB1.1A1, OB1.1A2	*Crossroad discharge pipe*	21395850	491.18																															**5.9**		**28.2**		**36.0**		**155.8**		
22: B13, OB1.1B-Reduced	*Combination of offsite underdeveloped with Sub-basin B13 (which contains only open space and offsite). Storm water will continue to be treated and detained by Existing Pond B to the west.*	1580607	36.29	0.12	0.39	1219563	0.09	0.36	*302609*	0.45	0.59	43731	0.90	0.96	14704	0.14	0.40	300	300	2000	2000	5685	5684	0.003	44.8	5684	5614	3.50	4	1.3	25.5	70.3	1.1	**5.8**	1.4	**7.3**	1.7	**8.5**	2.4	**35.1**	8.5%	

Note: Q2, Q5 & Q10 are based on C5; Q25, Q50 & Q100 are based on C100

Worksheet Protected

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

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.60	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event	2.52	
Max Intensity for Optional User Defined Storm	2.51496		

Designer:	**Jesse Sullivan**
Company:	**Matrix Design Group**
Date:	**May 20, 2020**
Project:	**FDR/PDR Aspen Ranch Filing No. 1**
Location:	**Fountain, CO**

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**Detention**													
Receiving Pervious Area Soil Type	Sandy Loam													
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	60.370													
Directly Connected Impervious Area (DCIA, acres)	30.816													
Unconnected Impervious Area (UIA, acres)	0.000													
Receiving Pervious Area (RPA, acres)	0.000													
Separate Pervious Area (SPA, acres)	29.554													
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	C	C	C	C	C	C	C	C	C	C	C
		MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT	MISSING INPUT

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	60.370													
Directly Connected Impervious Area (DCIA, %)	51.0%													
Unconnected Impervious Area (UIA, %)	0.0%													
Receiving Pervious Area (RPA, %)	0.0%													
Separate Pervious Area (SPA, %)	49.0%													
A_R (RPA / UIA)	0.000													
I_a Check	1.000													
f / I for WQCV Event:	1.7													
f / I for 5-Year Event:	0.5													
f / I for 100-Year Event:	0.3													
f / I for Optional User Defined Storm CUHP:	0.31													
IRF for WQCV Event:	1.00													
IRF for 5-Year Event:	1.00													
IRF for 100-Year Event:	1.00													
IRF for Optional User Defined Storm CUHP:	1.00													
Total Site Imperviousness: I_{total}	51.0%													
Effective Imperviousness for WQCV Event:	51.0%													
Effective Imperviousness for 5-Year Event:	51.0%													
Effective Imperviousness for 100-Year Event:	51.0%													
Effective Imperviousness for Optional User Defined Storm CUHP:	51.04%													

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	0.0%													
This line only for 10-Year Event	N/A													
100-Year Event CREDIT**: Reduce Detention By:	0.0%													
User Defined CUHP CREDIT: Reduce Detention By:	0.0%													

Total Site Imperviousness:	**51.04%**
Total Site Effective Imperviousness for WQCV Event:	**51.0%**
Total Site Effective Imperviousness for 5-Year Event:	**51.0%**
Total Site Effective Imperviousness for 100-Year Event:	**51.0%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	**51.0%**

Notes:

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

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

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

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Aspen Ranch

Basin ID: Developed Single Family

Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	60.37	acres		
Watershed Length =	2,188	ft		
Watershed Slope =	0.030	ft/ft		
Watershed Imperviousness =	51.04%	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		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	1.052	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	3.299	acre-feet		
2-yr Runoff Volume (P1 = 1 in.) =	2.240	acre-feet	1.00	inches
5-yr Runoff Volume (P1 = 1.29 in.) =	3.126	acre-feet	1.29	inches
10-yr Runoff Volume (P1 = 1.56 in.) =	4.364	acre-feet	1.56	inches
25-yr Runoff Volume (P1 = 2 in.) =	6.780	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.37 in.) =	8.522	acre-feet	2.37	inches
100-yr Runoff Volume (P1 = 2.79 in.) =	10.860	acre-feet	2.79	inches
500-yr Runoff Volume (P1 = 3.92 in.) =	16.654	acre-feet	3.92	inches
Approximate 2-yr Detention Volume =	2.096	acre-feet		
Approximate 5-yr Detention Volume =	2.936	acre-feet		
Approximate 10-yr Detention Volume =	4.018	acre-feet		
Approximate 25-yr Detention Volume =	4.926	acre-feet		
Approximate 50-yr Detention Volume =	5.422	acre-feet		
Approximate 100-yr Detention Volume =	6.346	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	1.052	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.247	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	3.046	acre-feet
Total Detention Basin Volume =	6.346	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 = 0.1 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	--	--	--	155	0.004		
5592	--	1.00	--	--	--	629	0.014	386	0.009
5593	--	2.00	--	--	--	4,545	0.104	2,934	0.067
5594	--	3.00	--	--	--	21,649	0.497	16,076	0.369
5595	--	4.00	--	--	--	47,133	1.082	50,467	1.159
5596	--	5.00	--	--	--	57,604	1.322	102,835	2.361
5597	--	6.00	--	--	--	61,812	1.419	162,543	3.731
5598	--	7.00	--	--	--	67,045	1.539	226,972	5.211
5599	--	8.00	--	--	--	71,564	1.643	296,276	6.802
5600	--	9.00	--	--	--	76,208	1.749	370,162	8.498
5601	--	10.00	--	--	--	80,956	1.858	448,744	10.302
5602	--	11.00	--	--	--	85,801	1.970	532,123	12.216
5603	--	12.00	--	--	--	90,749	2.083	620,398	14.242
5604	--	13.00	--	--	--	96,112	2.206	713,828	16.387
5605	--	14.00	--	--	--	100,421	2.305	812,095	18.643

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Aspen Ranch

Basin ID: Aspen Ranch Full Spectrum Detention

Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.90	1.052	Orifice Plate
Zone 2 (EURV)	5.70	2.247	Rectangular Orifice
Zone 3 (100-year)	7.73	3.046	Weir&Pipe (Restrict)
		6.346	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.85	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	15.40	inches
Orifice Plate: Orifice Area per Row =	2.66	sq. inches (diameter = 1-13/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.847E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.28	2.57					
Orifice Area (sq. inches)	2.66	2.66	2.66					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	3.90	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	5.70	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	2.00	N/A	inches
Vertical Orifice Width =	6.31		inches

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Not Selected	
Vertical Orifice Area =	0.09	N/A	ft^2
Vertical Orifice Centroid =	0.08	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	7.84	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	8.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	8.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	7.84	N/A	feet
Over Flow Weir Slope Length =	8.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	6.85	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	44.80	N/A	ft^2
Overflow Grate Open Area w/ Debris =	22.40	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	42.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	27.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	6.54	N/A	ft^2
Outlet Orifice Centroid =	1.27	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.86	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	11.96	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	70.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.90	feet
Stage at Top of Freeboard =	13.86	feet
Basin Area at Top of Freeboard =	2.29	acres

Routed Hydrograph Results

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) =	0.53	1.07	1.00	1.29	1.56	2.00	2.37	2.79	3.92
Calculated Runoff Volume (acre-ft) =	1.052	3.299	2.240	3.126	4.364	6.780	8.522	10.860	16.654
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	1.052	3.297	2.239	3.125	4.363	6.769	8.514	10.849	16.643
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.20	0.74	1.08	1.52	2.52
Predevelopment Peak Q (cfs) =	0.0	0.0	0.7	1.2	12.3	44.6	64.9	91.5	152.1
Peak Inflow Q (cfs) =	19.0	58.7	40.1	55.7	77.3	118.7	148.3	187.6	284.1
Peak Outflow Q (cfs) =	0.4	1.1	0.9	1.1	1.2	1.5	24.0	62.1	95.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.9	0.1	0.0	0.4	0.7	0.6
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.5	1.4	2.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	68	57	66	77	94	93	90	84
Time to Drain 99% of Inflow Volume (hours) =	**40**	72	60	70	82	101	101	100	97
Maximum Ponding Depth (ft) =	3.84	5.58	4.82	5.46	6.32	7.84	8.31	8.76	10.15
Area at Maximum Ponding Depth (acres) =	0.98	1.38	1.28	1.37	1.46	1.63	1.68	1.72	1.88
Maximum Volume Stored (acre-ft) =	0.983	3.144	2.114	2.979	4.177	6.540	7.316	8.064	10.582

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Design Point	Total Water Quality Control Volume (Cu. Ft.)	Pond Name	Pond Drainage Area (Acres)	Pond Drainage Area Less Pond Footprint and Swale (Acres)	Forebay Location	Drainage area tributary to Forebay	Proportion of Total Drainage Area	Proportional WQCV Volume (Cu. Ft.)	Forebay Volume 3% of WQCV (Cu. Ft.)	Forebay Volume 3% of WQCV (Ac. Ft.)	Q100 to Forebay (cfs)	Forebay Outlet Sizing 2% of Q100 (cfs)
15b	47001.24	Detention Pond	60.10	31.8	north	24.14	0.759	35679.56	1070	0.0246	83.3	1.7
14b	47001.24	Detention Pond	60.10	31.8	east	9.84	0.309	14543.78	436	0.0100	35.3	0.7
						-2.18						

	WQCV		Pond Footprint and Swale	
Detention Pond	1.079	Acre-Ft	28.30	Acres

Percent of WQCV for Forebay	3%	More than 5 Impervious Acres
Percent of Impervious	53.1%	
	Impervious Acres	31.931

Table EDB-4. EDB component criteria

	On-Site EDBs for Watersheds up to 1 Impervious Acre[1]	EDBs with Watersheds between 1 and 2 Impervious Acres[1]	EDBs with Watersheds up to 5 Impervious Acres	EDBs with Watersheds over 5 Impervious Acres	EDBs with Watersheds over 20 Impervious Acres
Forebay Release and Configuration	EDBs should not be used for watersheds with less than 1 impervious acre.	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe[2] configuration
Minimum Forebay Volume		1% of the WQCV	2% of the WQCV	3% of the WQCV	3% of the WQCV
Maximum Forebay Depth		12 inches	18 inches	18 inches	30 inches
Trickle Channel Capacity		≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity
Micropool		Area ≥ 10 ft^2	Area ≥ 10 ft^2	Area ≥ 10 ft^2	Area ≥ 10 ft^2
Initial Surcharge Volume		Depth ≥ 4 inches	Depth ≥ 4 inches	Depth ≥ 4 in. Volume ≥ 0.3% WQCV	Depth ≥ 4 in. Volume ≥ 0.3% WQCV

[1] EDBs are not recommended for sites with less than 2 impervious acres. Consider a sand filter or rain garden.

[2] Round up to the first standard pipe size (minimum 8 inches).

Forebay Design Information:

DP 14b (East Forebay)

5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.032 ac-ft
B) Actual Forebay Volume	V_F = 0.010 ac-ft VF < MINIMUM VF
C) Forebay Depth (D_F = 30 inch maximum)	D_F = 30.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 35.30 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 0.71 cfs
E) Forebay Discharge Design	Choose One: Berm With Pipe / Wall with Rect. Notch / Wall with V-Notch Weir
F) Discharge Pipe Size (minimum 8-inches)	Calculated D_P = in
G) Rectangular Notch Width	Calculated W_N = 6.6 in

DP15b (Northwest Forebay)

5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.032 ac-ft
B) Actual Forebay Volume	V_F = 0.025 ac-ft VF < MINIMUM VF
C) Forebay Depth (D_F = 30 inch maximum)	D_F = 30.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 83.30 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 1.67 cfs
E) Forebay Discharge Design	Choose One: Berm With Pipe / Wall with Rect. Notch / Wall with V-Notch Weir
F) Discharge Pipe Size (minimum 8-inches)	Calculated D_P = in
G) Rectangular Notch Width	Calculated W_N = 7.5 in

SITE DISCHARGE HYDROGRAPH
Q100 EVENT

Flow: Link - {Network - 1}.PIPE - 54 (1) (Aspen Ranch-FDR-PDR Q5 2020-03-06 10:51:38)
Flow (cfs)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
Time (hrs)
0
7
14
21
28
35
42
49
56
63
70

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Aug 13 2020

B13 Swale

Triangular

Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 1.00
Slope (%)	= 3.70
N-Value	= 0.040

Calculations

Compute by:	Known Q
Known Q (cfs)	= 10.50

Highlighted

Depth (ft)	= 0.93
Q (cfs)	= 10.50
Area (sqft)	= 2.59
Velocity (ft/s)	= 4.05
Wetted Perim (ft)	= 5.88
Crit Depth, Yc (ft)	= 0.95
Top Width (ft)	= 5.58
EGL (ft)	= 1.18

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jun 17 2020

DP22 Swale West of Link Road

Trapezoidal

Bottom Width (ft)	=	8.00
Side Slopes (z:1)	=	4.00, 4.00
Total Depth (ft)	=	6.00
Invert Elev (ft)	=	1.00
Slope (%)	=	0.25
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cfs)	=	155.80

Highlighted

Depth (ft)	=	2.54
Q (cfs)	=	155.80
Area (sqft)	=	46.13
Velocity (ft/s)	=	3.38
Wetted Perim (ft)	=	28.95
Crit Depth, Yc (ft)	=	1.72
Top Width (ft)	=	28.32
EGL (ft)	=	2.72

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Mar 3 2020

DP 9 Downstream Swale Capacity

User-defined

Invert Elev (ft)	= 1.84
Slope (%)	= 2.40
N-Value	= 0.040

Calculations

Compute by:	Known Q
Known Q (cfs)	= 26.20

Highlighted

Depth (ft)	= 0.77
Q (cfs)	= 26.20
Area (sqft)	= 7.38
Velocity (ft/s)	= 3.55
Wetted Perim (ft)	= 14.23
Crit Depth, Yc (ft)	= 0.72
Top Width (ft)	= 14.10
EGL (ft)	= 0.97

(Sta, El, n)-(Sta, El, n)...

(0.00, 4.00)-(10.00, 2.00, 0.040)-(14.00, 1.84, 0.040)-(18.00, 2.00, 0.040)-(28.00, 4.00, 0.040)

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 5 2020

Sub-basin 5 Park Area (Major Storm)

User-defined

Invert Elev (ft)	=	14.3
Slope (%)	=	1.40
N-Value	=	0.030

Calculations

Compute by:		Known Q
Known Q (cfs)	=	12.30

Highlighted

Depth (ft)	=	0.44
Q (cfs)	=	12.30
Area (sqft)	=	5.84
Velocity (ft/s)	=	2.11
Wetted Perim (ft)	=	26.55
Crit Depth, Yc (ft)	=	0.41
Top Width (ft)	=	26.53
EGL (ft)	=	0.51

(Sta, El, n)-(Sta, El, n)...

(0.00, 21.21)-(22.37, 20.76, 0.030)-(32.07, 19.79, 0.030)-(103.48, 21.21, 0.030)

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Aug 7 2020

DP 9

User-defined

Invert Elev (ft)	=	1.92
Slope (%)	=	2.40
N-Value	=	0.040

Calculations

Compute by:		Known Q
Known Q (cfs)	=	26.20

Highlighted

Depth (ft)	=	0.72
Q (cfs)	=	26.20
Area (sqft)	=	7.08
Velocity (ft/s)	=	3.70
Wetted Perim (ft)	=	13.28
Crit Depth, Yc (ft)	=	0.68
Top Width (ft)	=	13.12
EGL (ft)	=	0.93

(Sta, El, n)-(Sta, El, n)...

(0.00, 4.00)-(8.00, 2.00, 0.040)-(12.00, 1.92, 0.040)-(16.00, 2.00, 0.040)-(24.00, 4.00, 0.040)

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Mar 6 2020

DP10

User-defined

Invert Elev (ft)	=	1.84
Slope (%)	=	1.40
N-Value	=	0.040

Calculations

Compute by:		Known Q
Known Q (cfs)	=	32.90

Highlighted

Depth (ft)	=	0.96
Q (cfs)	=	32.90
Area (sqft)	=	10.24
Velocity (ft/s)	=	3.21
Wetted Perim (ft)	=	16.16
Crit Depth, Yc (ft)	=	0.81
Top Width (ft)	=	16.00
EGL (ft)	=	1.12

(Sta, El, n)-(Sta, El, n)...

(0.00, 4.00)-(10.00, 2.00, 0.040)-(14.00, 1.84, 0.040)-(18.00, 2.00, 0.040)-(28.00, 4.00, 0.040)

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Aug 7 2020

DP 11b (Sub-basins B-3a, 4, 5, 6, 7, 8, 9)(Swale)(Major Event)

User-defined

Invert Elev (ft)	= 1.92
Slope (%)	= 2.40
N-Value	= 0.040

Calculations

Compute by:	Known Q
Known Q (cfs)	= 52.70

Highlighted

Depth (ft)	= 1.02
Q (cfs)	= 52.70
Area (sqft)	= 11.37
Velocity (ft/s)	= 4.63
Wetted Perim (ft)	= 15.75
Crit Depth, Yc (ft)	= 1.00
Top Width (ft)	= 15.52
EGL (ft)	= 1.35

(Sta, El, n)-(Sta, El, n)...

(0.00, 4.00)-(8.00, 2.00, 0.040)-(12.00, 1.92, 0.040)-(16.00, 2.00, 0.040)-(24.00, 4.00, 0.040)

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Friday, Aug 7 2020

DP 11b (Sub-basins B-3a, 4, 5, 6, 7, 8, 9)(Swale)(Minor Event)

User-defined

Invert Elev (ft)	=	1.92
Slope (%)	=	2.40
N-Value	=	0.040

Calculations

Compute by:		Known Q
Known Q (cfs)	=	21.10

Highlighted

Depth (ft)	=	0.64
Q (cfs)	=	21.10
Area (sqft)	=	6.05
Velocity (ft/s)	=	3.49
Wetted Perim (ft)	=	12.62
Crit Depth, Yc (ft)	=	0.60
Top Width (ft)	=	12.48
EGL (ft)	=	0.83

Less than 3.5 ft/s criteria for low flow in DCM Table 12-3.

(Sta, El, n)-(Sta, El, n)...

(0.00, 4.00)-(8.00, 2.00, 0.040)-(12.00, 1.92, 0.040)-(16.00, 2.00, 0.040)-(24.00, 4.00, 0.040)

Hydraulic Analysis Report

Project Data

Project Title:

Designer:

Project Date: Wednesday, May 27, 2020

Project Units: U.S. Customary Units

Notes:

Channel Analysis: Swale Overflow to Detention Pond

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Channel Width: 20.0000 ft

Longitudinal Slope: 0.2500 ft/ft

Manning's n: 0.0342

Flow: 56.4000 cfs

Result Parameters

Max depth of Flow

Depth: 0.2906 ft

Area of Flow: 6.1498 ft^2

Wetted Perimeter: 22.3964 ft

Hydraulic Radius: 0.2746 ft

Average Velocity: 9.1710 ft/s

Top Width: 22.3248 ft

Froude Number: 3.0793

Critical Depth: 0.6015 ft

Critical Velocity: 4.1848 ft/s

Critical Slope: 0.0211 ft/ft

Critical Top Width: 24.81 ft

Calculated Max Shear Stress: 4.5334 lb/ft^2

Calculated Avg Shear Stress: 4.2836 lb/ft^2

Channel Lining Analysis: Channel Lining Design Analysis

Notes:

Lining Input Parameters

Channel Lining Type: Riprap, Cobble, or Gravel

D50: 1 ft

Report indicates that the channel is stable discharging into the pond via a 20' bottom width 3" deep swale lined with Type M (12" D50) Rip Rap.

Riprap Specific Weight: 165 lb/ft^3

Water Specific Weight: 62.4 lb/ft^3

Riprap Shape is Angular

Safety Factor: 1

Calculated Safety Factor: 1.35666

Lining Results

Angle of Repose: 41.7 degrees

Relative Flow Depth: 0.404317

Manning's n method: Bathurst

Manning's n: 0.0477831

Channel Bottom Shear Results

V*: 1.87517

Reynold's Number: 154081

Shield's Parameter: 0.12044

shear stress on channel bottom: 6.81409 lb/ft^2

Permissible shear stress for channel bottom: 10.0523 lb/ft^2

channel bottom is stable

Stable D50: 0.919628 ft

Channel Side Shear Results

K1: 0.934

K2: 1

Kb: 0

shear stress on side of channel: 6.81409 lb/ft^2

Permissible shear stress for side of channel: 10.0523 lb/ft^2

Stable Side D50: 0.858933 lb/ft^2

side of channel is stable

Channel Lining Stability Results

the channel is stable

Channel Summary

Name of Selected Channel: Swale Overflow to Detention Pond

StormCad Layout-Aspen Ranch Development

OFFSITE-NO-IRRIGATION - 5-YR
Elevation (ft)
EGL
HGL
Label: HEADWALL 1 (PR-STORM)
Type: Catch Basin
ID: 52
Label: STM MH 8 (PR-STORM)
Type: Manhole
ID: 49
Label: STM MH 6 (PR-STORM)
Type: Manhole
ID: 55
Label: STM MH 5 (PR-STORM)
Type: Manhole
ID: 66
Label: STM MH 4 (PR-STORM)
Type: Manhole
ID: 79
Label: STM MH 3 (PR-STORM)
Type: Manhole
ID: 87
Label: STM MH 1 (PR-STORM)
Type: Manhole
ID: 85
Label: PIPE 10 (PR-STORM)
Type: Conduit
ID: 105
Label: PIPE 9 (PR-STORM)
Type: Conduit
ID: 106
Label: PIPE 8 (PR-STORM)
Type: Conduit
ID: 109
Label: PIPE 7 (PR-STORM)
Type: Conduit
ID: 118
Label: PIPE 6 (PR-STORM)
Type: Conduit
ID: 129
Label: PIPE 5 (PR-STORM)
Type: Conduit
ID: 137

| | | |

ID\Label	117 \ PIPE 13 (PR-STORM)	127 \ PIPE 14 (PR-STORM)	131 \ PIPE 15 (PR-STORM)	133 \ PIPE 16 (PR-STORM)	134 \ PIPE 17 (PR-STORM)	140 \ PIPE 18 (PR-STORM)
Link Length (ft)	138.0	207.7	211.5	324.4	176.8	88.8
ise (in)\Material	24.0 \ Concrete (centrif. spun)	24.0 \ Concrete (centrif. spun)	38.0 \ Concrete	38.0 \ Concrete	38.0 \ Concrete	42.0 \ Concrete (centrif. spun)
Flow (cfs)	11.30	11.30	25.10	26.40	30.60	30.60
Slope (ft/ft)	0.020	0.021	0.003	0.003	0.003	0.032

ID\Label	145 \ INLET-1	77 \ STM MH 9 (PR-STORM)	81 \ STM MH 10 (PR-STORM)	83 \ STM MH 11 (PR-STORM)	84 \ STM MH 12 (PR-STORM)	88 \ STM MH 13 (PR-STORM)	186 \ O-4
Ground (ft)	5617.10	5613.50	5609.61	5608.38	5606.66	5604.98	5600.00
Invert (ft)	5611.72	5608.62	5603.17	5602.44	5601.37	5599.84	5597.00
Station (ft)	0.0	138.0	345.7	557.2	881.7	1058.5	1147.3

ID\Label	126 \ PIPE 22 (PR-STORM)	122 \ PIPE 21 (PR-STORM)	121 \ PIPE 20 (PR-STORM)		
Link Length (ft)	60.6	28.4	155.6		
Rise (in)\Material	24.0 \ Concrete (centrif. spun)	24.0 \ Concrete (centrif. spun)	24.0 \ Concrete (centrif. spun)		
Flow (cfs)	3.70	6.20	6.20		
Slope (ft/ft)	-0.006	-0.006	-0.006		
ID\Label	149 \ INLET-5A	150 \ INLET-5B	70 \ STM MH 14 (PR-STORM)		84 \ STM MH 12 (PR-STORM)
Ground (ft)	5612.23	5612.08	5613.16		5606.66
Invert (ft)	5604.17	5603.68	5603.20		5601.37
Station (ft)	0.0	60.6	89.0		244.5

ID\Label	113 \ PIPE 24 (PR-STORM)	130 \ PIPE 23 (PR-STORM)	
Link Length (ft)	418.7	46.8	
e (in)\Material	18.0 \ Concrete (centrif. spun)	30.0 \ Concrete (centrif. spun)	
Flow (cfs)	4.90	13.30	
Slope (ft/ft)	-0.028	0.026	
ID\Label	143 \ INLET-2	80 \ STM MH 15 (PR-STORM)	81 \ STM MH 10 (PR-STORM)
Ground (ft)	5625.98	5610.04	5609.61
Invert (ft)	5617.78	5605.07	5603.17
Station (ft)	0.0	418.7	465.5

STORM DRAIN 04 - 5-YR
Elevation (ft)
5,613.00
5,612.50
5,612.00
5,611.50
5,611.00
5,610.50
5,610.00
5,609.50
5,609.00
5,608.50
5,608.00
5,607.50
5,607.00
5,606.50
5,606.00
5,605.50
5,605.00
-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
Label: INLET-3A
Type: Catch Basin
ID: 144
Label: STM MH 15 (PR-STORM)
Type: Manhole
ID: 80
Label: INLET-3A
Type: Catch Basin
ID: 146
Label: PIPE 25 (PR-STORM)
Type: Conduit
ID: 123
Label: PIPE 26 (PR-STORM)
Type: Conduit
ID: 128
EGL
HGL

| | | |

ID\Label		119 \ PIPE 28 (PR-STORM)	
Link Length (ft)		144.7	
Rise (in)\Material		30.0 \ Concrete (centrif. spun)	
Flow (cfs)		10.60	
Slope (ft/ft)		-0.010	
ID\Label	76 \ STM MH 16 (PR-STORM)		162 \ INLET-14B
Ground (ft)	5612.01		5613.81
Invert (ft)	5602.71		5601.16
Station (ft)	0.0		144.7

ID\Label	108 \ PIPE 31 (PR-STORM)	111 \ PIPE 32 (PR-STORM)
Link Length (ft)	59.6	23.8
Rise (in)\Material	30.0 \ Concrete (centrif. spun)	30.0 \ Concrete (centrif. spun)
Flow (cfs)	5.00	8.70
Slope (ft/ft)	0.010	0.016

ID\Label	151 \ INLET-8A	152 \ INLET-8B	60 \ FES 4 (PR-STORM)
Ground (ft)	5627.19	5626.71	5624.00
Invert (ft)	5622.58	5621.79	5621.42
Station (ft)	0.0	59.6	83.4

ID\Label	124 \ PIPE 29 (PR-STORM)	125 \ PIPE 30 (PR-STORM)	
Link Length (ft)	31.3	9.3	
Rise (in)\Material	24.0 \ Concrete (centrif. spun)	18.0 \ Concrete (centrif. spun)	
Flow (cfs)	5.10	5.70	
Slope (ft/ft)	-0.010	0.020	
ID\Label	159 \ INLET-12	76 \ STM MH 16 (PR-STORM)	160 \ INLET-13
Ground (ft)	5612.35	5612.01	5612.35
Invert (ft)	5603.52	5602.71	5603.90
Station (ft)	0.0	31.3	40.7

ID\Label		141 \ PIPE 34 (PR-STORM)	99 \ PIPE 35 (PR-STORM)
Link Length (ft)		211.0	93.3
Rise (in)\Material		24.0 \ Concrete (centrif. spun)	24.0 \ Concrete (centrif. spun)
Flow (cfs)		8.50	8.50
Slope (ft/ft)		0.006	0.005
ID\Label	163 \ INLET-15A	89 \ STM MH 18 (PR-STORM)	185 \ O-3
Ground (ft)	5602.70	5603.79	5600.00
Invert (ft)	5598.35	5596.70	5596.22
Station (ft)	0.0	211.0	304.3

STORM DRAIN 09A - 5-YR
Elevation (ft)
Label: INLET-7A-2
Type: Catch Basin
ID: 153
Label: INLET-7A-1
Type: Catch Basin
ID: 154
Label: INLET-7B-2
Type: Catch Basin
ID: 155
Label: INLET-7B-1
Type: Catch Basin
ID: 156
Label: FES 7 (PR-STORM)
Type: Outfall
ID: 54
Label: PIPE 42 (PR-STORM)
Type: Conduit
ID: 107
Label: PIPE 41 (PR-STORM)
Type: Conduit
ID: 103
Label: PIPE 40 (PR-STORM)
Type: Conduit
ID: 102
Label: PIPE 39 (PR-STORM)
Type: Conduit
ID: 104
EGL
HGL

| | | |

ID\Label	116 \ PIPE 38 (PR-STORM)	115 \ PIPE 37 (PR-STORM)	114 \ PIPE 36 (PR-STORM)	
Link Length (ft)	22.9	41.7	27.5	
Rise (in)\Material	36.0 \ Concrete (centrif. spun)	36.0 \ Concrete (centrif. spun)	36.0 \ Concrete (centrif. spun)	
Flow (cfs)	13.00	20.40	20.50	
Slope (ft/ft)	-0.014	-0.013	-0.013	
ID\Label	64 \ FES 6 (PR-STORM)	157 \ INLET-11A	158 \ INLET-11B	65 \ FES 5 (PR-STORM)
Ground (ft)	5616.93	5619.01	5619.01	5615.84
Invert (ft)	5613.70	5613.29	5612.63	5612.26
Station (ft)	0.0	22.9	64.5	92.0

STORM DRAIN 10 - 5-YR
Label: STM MH 11 (PR-STORM)
Type: Manhole
ID: 83
Label: INLET-4B
Type: Catch Basin
ID: 148
Label: PIPE 19 (PR-STORM)
Type: Conduit
ID: 132
EGL
HGL
Elevation (ft)
ID\Label
132 \ PIPE 19 (PR-STORM)
Link Length (ft)
7.3
Rise (in)\Material
18.0 \ Concrete (centrif. spun)
Flow (cfs)
5.00
Slope (ft/ft)
0.010
ID\Label
148 \ INLET-4B
83 \ STM MH 11 (PR-STORM)
Ground (ft)
5607.79
5608.68
Invert (ft)
5604.44
5602.44
Station (ft)
0.0
7.5

ID\Label	120 \ PIPE 1A (PR-STORM)	100 \ PIPE 2A (PR-STORM)	
Link Length (ft)	23.8	14.5	
Rise (in)\Material	30.0 \ Concrete (centrif. spun)	30.0 \ Concrete (centrif. spun)	
Flow (cfs)	2.50	8.50	
Slope (ft/ft)	0.022	0.085	
ID\Label	68 \ FES 1A (PR-STORM)	147 \ INLET-22	187 \ O-5
Ground (ft)	5613.27	5613.16	5613.02
Invert (ft)	5610.38	5609.76	5608.52
Station (ft)	0.0	23.8	38.3

ID\Label	139 \ PIPE 4 (PR-STORM)	138 \ PIPE 3 (PR-STORM)
Link Length (ft)	21.9	49.0
Rise (in)\Material	36.0 \ Concrete (centrif. spun)	36.0 \ Concrete (centrif. spun)
Flow (cfs)	13.50	13.50
Slope (ft/ft)	-0.021	-0.031

ID\Label	90 \ FES 2 (PR-STORM)	86 \ STM MH 2 (PR-STORM)	87 \ STM MH 3 (PR-STORM)
Ground (ft)	5603.18	5604.80	5604.63
Invert (ft)	5599.55	5598.08	5595.56
Station (ft)	0.0	21.9	70.9

ID\Label	135 \ PIPE 2 (PR-STORM)	136 \ PIPE 1 (PR-STORM)
Link Length (ft)	29.8	93.5
Rise (in)\Material	42.0 \ Concrete (centrif. spun)	48.0 \ Concrete (centrif. spun)
Flow (cfs)	1.10	28.20
Slope (ft/ft)	0.010	0.018

ID\Label	94 \ OUTLET STRUCTURE 1 (PR-STORM)	85 \ STM MH 1 (PR-STORM)	96 \ FES 1 (PR-STORM)
Ground (ft)	5599.10	5605.50	5593.23
Invert (ft)	5591.24	5590.44	5588.72
Station (ft)	0.0	29.8	123.3

SE Drainage Ditch Connection - 5-YR

ID\Label	110 \ PIPE 11 (PR-STORM)
Link Length (ft)	30.6
Rise (in)\Material	18.0 \ Concrete (centrif. spun)
Flow (cfs)	1.10
Slope (ft/ft)	-0.098
ID\Label	55 \ STM MH 6 (PR-STORM) / 57 \ STM MH 7 (PR-STORM)
Ground (ft)	5626.85 / 5626.03
Invert (ft)	5613.02 / 5619.03
Station (ft)	0.0 / 30.6

Pipe Report (5yr)

	Label	Invert (Start) (ft)	Start Node	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Section Type	Diameter (in)	Manning's n	Flow (cfs)	Depth (Out) (ft)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Notes
136: PIPE 1 (PR-STORM)	PIPE 1 (PR-STORM)	5,590.44	STM MH 1 (PR-STORM)	FES 1 (PR-STORM)	5,588.72	105.5	0.016	Circle	48.0	0.013	28.20	1.09	183.40	15.4	26.5	10.57	5,592.01	5,589.81	48" RCP
120: PIPE 1A (PR-STORM)	PIPE 1A (PR-STORM)	5,610.38	FES 1A (PR-STORM)	INLET-22	5,609.86	23.8	0.022	Circle	30.0	0.013	2.50	0.89	60.65	4.1	13.9	6.08	5,610.90	5,610.75	30" RCP
135: PIPE 2 (PR-STORM)	PIPE 2 (PR-STORM)	5,591.24	OUTLET STRUCTURE 1...	STM MH 1 (PR-STORM)	5,590.94	37.8	0.008	Circle	42.0	0.013	1.10	1.85	89.63	1.2	7.8	3.18	5,592.79	5,592.79	42" RCP
100: PIPE 2A (PR-STORM)	PIPE 2A (PR-STORM)	5,609.76	INLET-22	O-5	5,608.52	14.5	0.085	Circle	30.0	0.013	8.50	0.56	119.77	7.1	18.0	14.11	5,610.73	5,609.08	30" RCP
138: PIPE 3 (PR-STORM)	PIPE 3 (PR-STORM)	5,596.56	STM MH 3 (PR-STORM)	STM MH 2 (PR-STORM)	5,598.08	49.0	-0.031	Circle	36.0	0.013	13.50	1.31	117.41	11.5	22.9	11.06	5,599.25	5,597.87	36" RCP
139: PIPE 4 (PR-STORM)	PIPE 4 (PR-STORM)	5,599.08	STM MH 2 (PR-STORM)	FES 2 (PR-STORM)	5,599.55	21.9	-0.021	Circle	36.0	0.013	13.50	0.86	97.79	13.8	25.1	9.72	5,600.72	5,599.94	36" RCP
137: PIPE 5 (PR-STORM)	PIPE 5 (PR-STORM)	5,591.44	STM MH 1 (PR-STORM)	STM MH 3 (PR-STORM)	5,595.56	118.7	-0.035	Circle	48.0	0.013	27.30	0.88	267.63	10.2	21.6	13.70	5,597.11	5,592.32	48" RCP
129: PIPE 6 (PR-STORM)	PIPE 6 (PR-STORM)	5,596.56	STM MH 3 (PR-STORM)	STM MH 4 (PR-STORM)	5,601.74	462.9	-0.011	Circle	48.0	0.013	13.80	1.31	151.95	9.1	20.4	7.52	5,602.83	5,597.87	48" RCP
118: PIPE 7 (PR-STORM)	PIPE 7 (PR-STORM)	5,601.84	STM MH 4 (PR-STORM)	STM MH 5 (PR-STORM)	5,605.61	358.4	-0.011	Circle	48.0	0.013	13.80	0.83	147.31	9.4	20.7	7.35	5,606.70	5,602.67	48" RCP
109: PIPE 8 (PR-STORM)	PIPE 8 (PR-STORM)	5,605.71	STM MH 5 (PR-STORM)	STM MH 6 (PR-STORM)	5,613.02	436.2	-0.017	Circle	48.0	0.013	13.80	0.74	185.95	7.4	18.4	8.67	5,614.11	5,606.45	48" RCP
106: PIPE 9 (PR-STORM)	PIPE 9 (PR-STORM)	5,613.32	STM MH 6 (PR-STORM)	STM MH 8 (PR-STORM)	5,622.55	543.0	-0.017	Circle	48.0	0.013	12.70	1.30	187.27	6.8	17.6	8.50	5,623.59	5,614.62	48" RCP
105: PIPE 10 (PR-STORM)	PIPE 10 (PR-STORM)	5,622.75	STM MH 8 (PR-STORM)	HEADWALL 1 (PR-ST...	5,623.64	37.2	-0.024	Circle	48.0	0.013	12.70	0.70	222.29	5.7	16.2	9.59	5,624.68	5,623.45	48" RCP
110: PIPE 11 (PR-STORM)	PIPE 11 (PR-STORM)	5,616.02	STM MH 6 (PR-STORM)	STM MH 7 (PR-STORM)	5,619.03	30.6	-0.098	Circle	18.0	0.013	1.10	0.19	32.96	3.3	12.5	8.63	5,619.42	5,616.21	18" RCP
117: PIPE 13 (PR-STORM)	PIPE 13 (PR-STORM)	5,611.72	INLET-1	STM MH 9 (PR-STORM)	5,608.92	138.0	0.020	Circle	24.0	0.013	11.30	0.82	32.22	35.1	40.9	9.35	5,612.93	5,609.74	24" RCP
127: PIPE 14 (PR-STORM)	PIPE 14 (PR-STORM)	5,607.92	STM MH 9 (PR-STORM)	STM MH 10 (PR-STO...	5,604.33	207.7	0.017	Circle	24.0	0.013	11.30	0.85	29.74	38.0	42.7	8.82	5,609.13	5,605.18	24" RCP
131: PIPE 15 (PR-STORM)	PIPE 15 (PR-STORM)	5,603.17	STM MH 10 (PR-STORM)	STM MH 11 (PR-STO...	5,602.54	211.5	0.003	Ellipse		0.013	25.10	1.82	75.56	33.2	40.4	5.34	5,604.45	5,604.36	34x60 RCPHE
133: PIPE 16 (PR-STORM)	PIPE 16 (PR-STORM)	5,602.44	STM MH 11 (PR-STORM)	STM MH 12 (PR-STO...	5,601.47	324.4	0.003	Ellipse		0.013	26.40	1.98	75.70	34.9	41.4	5.43	5,603.75	5,603.45	34x60 RCPHE
134: PIPE 17 (PR-STORM)	PIPE 17 (PR-STORM)	5,601.37	STM MH 12 (PR-STORM)	STM MH 13 (PR-STO...	5,600.84	176.8	0.003	Ellipse		0.013	30.60	1.59	75.81	40.4	44.7	5.69	5,602.78	5,602.43	34x60 RCPHE
140: PIPE 18 (PR-STORM)	PIPE 18 (PR-STORM)	5,599.84	STM MH 13 (PR-STORM)	O-4	5,597.00	88.8	0.032	Circle	42.0	0.013	30.60	1.03	179.89	17.0	27.9	13.94	5,601.55	5,598.03	48" RCP
132: PIPE 19 (PR-STORM)	PIPE 19 (PR-STORM)	5,604.44	INLET-4B	STM MH 11 (PR-STO...	5,604.11	7.3	0.045	Circle	18.0	0.013	5.00	0.62	22.39	22.3	32.1	10.21	5,605.30	5,604.73	18" RCP
121: PIPE 20 (PR-STORM)	PIPE 20 (PR-STORM)	5,602.54	STM MH 12 (PR-STORM)	STM MH 14 (PR-STO...	5,603.32	155.6	-0.005	Ellipse		0.013	6.20	0.91	28.88	21.5	32.4	4.45	5,604.01	5,603.45	24" RCP
122: PIPE 21 (PR-STORM)	PIPE 21 (PR-STORM)	5,603.62	STM MH 14 (PR-STORM)	INLET-5B	5,603.76	28.4	-0.005	Circle	24.0	0.013	6.20	0.87	15.89	39.0	43.4	4.75	5,604.64	5,604.49	24" RCP
126: PIPE 22 (PR-STORM)	PIPE 22 (PR-STORM)	5,603.86	INLET-5B	INLET-5A	5,604.17	60.6	-0.005	Circle	24.0	0.013	3.70	0.80	16.18	22.9	32.5	4.17	5,604.84	5,604.66	24" RCP
130: PIPE 23 (PR-STORM)	PIPE 23 (PR-STORM)	5,605.07	STM MH 15 (PR-STORM)	STM MH 10 (PR-STO...	5,603.83	46.8	0.026	Circle	30.0	0.013	13.30	0.81	66.76	19.9	30.3	10.61	5,606.30	5,604.64	30" RCP
113: PIPE 24 (PR-STORM)	PIPE 24 (PR-STORM)	5,606.07	STM MH 15 (PR-STORM)	INLET-2	5,617.78	418.7	-0.028	Circle	18.0	0.013	4.90	0.95	17.57	27.9	36.1	8.52	5,618.63	5,607.02	18" RCP
123: PIPE 25 (PR-STORM)	PIPE 25 (PR-STORM)	5,606.07	STM MH 15 (PR-STORM)	INLET-3A	5,606.56	48.7	-0.010	Circle	18.0	0.013	1.00	0.95	10.54	9.5	20.8	3.76	5,606.98	5,607.02	18" RCP
128: PIPE 26 (PR-STORM)	PIPE 26 (PR-STORM)	5,606.14	INLET-3A	STM MH 15 (PR-STO...	5,606.07	7.1	0.010	Circle	18.0	0.013	5.70	0.95	10.44	54.6	52.7	6.04	5,607.06	5,607.02	18" RCP
98: PIPE 27 (PR-STORM)	PIPE 27 (PR-STORM)	5,596.07	O-2	INLET-14B	5,601.16	216.3	-0.024	Circle	30.0	0.013	13.30	0.78	62.91	21.1	31.2	10.17	5,602.39	5,596.85	30" RCP
119: PIPE 28 (PR-STORM)	PIPE 28 (PR-STORM)	5,601.26	INLET-14B	STM MH 16 (PR-STO...	5,602.71	144.7	-0.010	Circle	30.0	0.013	10.60	1.15	41.06	25.8	34.7	7.02	5,603.80	5,602.41	30" RCP
124: PIPE 29 (PR-STORM)	PIPE 29 (PR-STORM)	5,603.21	STM MH 16 (PR-STORM)	INLET-12	5,603.52	31.3	-0.010	Circle	24.0	0.013	5.10	1.22	22.50	22.7	32.4	5.79	5,604.32	5,604.43	24" RCP
125: PIPE 30 (PR-STORM)	PIPE 30 (PR-STORM)	5,603.90	INLET-13	STM MH 16 (PR-STO...	5,603.71	9.3	0.020	Circle	18.0	0.013	5.70	0.74	14.99	38.0	42.8	7.90	5,604.82	5,604.45	18" RCP
108: PIPE 31 (PR-STORM)	PIPE 31 (PR-STORM)	5,622.58	INLET-8A	INLET-8B	5,621.99	59.6	0.010	Circle	30.0	0.013	5.00	0.93	40.82	12.2	23.6	5.64	5,623.32	5,622.92	30" RCP
111: PIPE 32 (PR-STORM)	PIPE 32 (PR-STORM)	5,621.79	INLET-8B	FES 4 (PR-STORM)	5,621.42	23.8	0.016	Circle	30.0	0.013	8.70	0.75	51.14	17.0	27.9	7.77	5,622.77	5,622.17	30" RCP
141: PIPE 34 (PR-STORM)	PIPE 34 (PR-STORM)	5,598.35	INLET-15A	STM MH 18 (PR-STO...	5,597.00	211.0	0.006	Circle	24.0	0.013	8.50	0.96	18.09	47.0	48.2	5.67	5,599.39	5,597.96	24" RCP
99: PIPE 35 (PR-STORM)	PIPE 35 (PR-STORM)	5,596.70	STM MH 18 (PR-STORM)	O-3	5,596.22	63.5	0.008	Circle	24.0	0.013	8.50	0.92	19.67	43.2	46.0	6.03	5,597.74	5,597.14	24" RCP
114: PIPE 36 (PR-STORM)	PIPE 36 (PR-STORM)	5,612.26	FES 5 (PR-STORM)	INLET-11B	5,612.63	27.5	-0.013	Circle	36.0	0.013	20.50	2.54	77.36	26.5	35.1	9.25	5,614.76	5,614.80	36" RCP
115: PIPE 37 (PR-STORM)	PIPE 37 (PR-STORM)	5,612.73	INLET-11B	INLET-11A	5,613.29	41.7	-0.013	Circle	36.0	0.013	20.40	2.06	77.33	26.4	35.1	9.23	5,614.74	5,614.79	36" RCP
116: PIPE 38 (PR-STORM)	PIPE 38 (PR-STORM)	5,613.39	INLET-11A	FES 6 (PR-STORM)	5,613.70	22.9	-0.014	Circle	36.0	0.013	13.00	1.41	77.67	16.7	27.7	8.16	5,614.85	5,614.80	36" RCP
104: PIPE 39 (PR-STORM)	PIPE 39 (PR-STORM)	5,622.17	FES 7 (PR-STORM)	INLET-7B-1	5,623.64	212.8	-0.007	Circle	36.0	0.013	11.60	0.93	55.43	20.9	31.0	6.20	5,624.72	5,623.10	36" RCP
102: PIPE 40 (PR-STORM)	PIPE 40 (PR-STORM)	5,623.74	INLET-7B-1	INLET-7B-2	5,623.86	38.5	-0.003	Circle	36.0	0.013	8.60	1.00	37.22	23.1	32.7	4.28	5,624.84	5,624.74	36" RCP
103: PIPE 41 (PR-STORM)	PIPE 41 (PR-STORM)	5,623.96	INLET-7B-2	INLET-7A-1	5,624.39	141.0	-0.003	Circle	36.0	0.013	4.20	0.90	36.83	11.4	22.8	3.46	5,625.07	5,624.86	36" RCP
107: PIPE 42 (PR-STORM)	PIPE 42 (PR-STORM)	5,624.49	INLET-7A-1	INLET-7A-2	5,624.60	36.8	-0.003	Circle	36.0	0.013	2.10	0.59	36.44	5.8	16.3	2.80	5,625.12	5,625.08	36" RCP

Inlet Report (5yr)

	ID	Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Headloss Method	Headloss Coefficient (Standard)	Hydraulic Grade Line (In) (ft)	Inlet Type	Length (ft)	Width (ft)	Flow (Known) (cfs)	Notes
147: INLET-22	147	INLET-22	5,613.16	5,613.16	5,609.76	Standard	0.050	5,610.75	Full Capture	5.00	4.00	8.50	5' AT GRADE TYPE-R INLET
163: INLET-15A	163	INLET-15A	5,602.70	5,602.70	5,598.35	Standard	0.050	5,599.41	Full Capture	15.00	4.00	8.50	15' AT-GRADE TYPE-R INLET
162: INLET-14B	162	INLET-14B	5,613.81	5,613.81	5,601.16	Standard	0.050	5,602.41	Full Capture	5.00	4.00	13.30	5' SUMP TYPE-R INLET
160: INLET-13	160	INLET-13	5,612.35	5,612.35	5,603.90	Standard	0.050	5,604.84	Full Capture	10.00	4.00	5.70	10' SUMP TYPE-R INLET
159: INLET-12	159	INLET-12	5,612.35	5,612.35	5,603.52	Standard	0.050	5,604.33	Full Capture	10.00	4.00	5.10	10' SUMP TYPE-R INLET
158: INLET-11B	158	INLET-11B	5,619.01	5,619.01	5,612.63	Standard	0.100	5,614.79	Full Capture	10.00	4.00	20.50	10' SUMP TYPE-R INLET
157: INLET-11A	157	INLET-11A	5,619.01	5,619.01	5,613.29	Standard	0.100	5,614.80	Full Capture	10.00	4.00	20.40	10' SUMP TYPE-R INLET
152: INLET-8B	152	INLET-8B	5,626.71	5,626.71	5,621.79	Standard	0.400	5,622.92	Full Capture	10.00	4.00	8.70	10' SUMP TYPE-R INLET
151: INLET-8A	151	INLET-8A	5,627.19	5,627.19	5,622.58	Standard	0.050	5,623.33	Full Capture	10.00	4.00	5.00	10' SUMP TYPE-R INLET
155: INLET-7B-2	155	INLET-7B-2	5,631.22	5,631.22	5,623.86	Standard	0.050	5,624.86	Full Capture	10.00	4.00	8.60	10' AT GRADE TYPE-R INLET
156: INLET-7B-1	156	INLET-7B-1	5,631.18	5,631.18	5,623.64	Standard	0.050	5,624.74	Full Capture	10.00	4.00	11.60	10' AT GRADE TYPE-R INLET
153: INLET-7A-2	153	INLET-7A-2	5,629.83	5,629.83	5,624.60	Standard	0.050	5,625.12	Full Capture	10.00	4.00	2.10	10' SUMP TYPE-R INLET
154: INLET-7A-1	154	INLET-7A-1	5,630.41	5,630.41	5,624.39	Standard	0.050	5,625.08	Full Capture	10.00	4.00	4.20	10' SUMP TYPE-R INLET
150: INLET-5B	150	INLET-5B	5,612.08	5,612.08	5,603.76	Standard	0.050	5,604.66	Full Capture	10.00	4.00	6.20	10' SUMP TYPE-R INLET
149: INLET-5A	149	INLET-5A	5,612.23	5,612.23	5,604.17	Standard	0.050	5,604.86	Full Capture	10.00	4.00	3.70	10' SUMP TYPE-R INLET
148: INLET-4B	148	INLET-4B	5,607.79	5,607.79	5,604.44	Standard	0.050	5,605.32	Full Capture	10.00	4.00	5.00	10' SUMP TYPE-R INLET
144: INLET-3A	144	INLET-3A	5,612.82	5,612.82	5,606.56	Standard	0.050	5,606.98	Full Capture	5.00	4.00	1.00	5' AT GRADE TYPE-R INLET
146: INLET-3A	146	INLET-3A	5,610.39	5,610.39	5,606.14	Standard	0.050	5,607.08	Full Capture	4.00	15.00	5.70	15' AT GRADE TYPE-R INLET
143: INLET-2	143	INLET-2	5,625.98	5,625.98	5,617.78	Standard	0.050	5,618.65	Full Capture	10.00	4.00	4.90	10' AT GRADE TYPE-R INLET
145: INLET-1	145	INLET-1	5,617.10	5,617.10	5,611.72	Standard	0.050	5,612.95	Full Capture	15.00	4.00	11.30	15' SUMP TYPE-R INLET
52: HEADWALL 1 (PR-STORM)	52	HEADWALL 1 (PR-S...	5,629.48	5,629.48	5,623.64	Standard	0.050	5,624.70	Full Capture			12.70	HEADWALL
64: FES 6 (PR-STORM)	64	FES 6 (PR-STORM)	5,616.93	5,616.93	5,613.70	Standard	0.050	5,614.87	Full Capture			13.00	36" FES
90: FES 2 (PR-STORM)	90	FES 2 (PR-STORM)	5,603.18	5,603.18	5,599.55	Standard	0.050	5,600.74	Full Capture			13.50	36" FES
68: FES 1A (PR-STORM)	68	FES 1A (PR-STORM)	5,613.27	5,613.27	5,610.38	Standard	0.050	5,610.91	Full Capture			2.50	30" FES

Manhole Report (5yr)

	ID	Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Flow (Total Out) (cfs)	Depth (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Headloss Coefficient (Standard)	Notes
49: STM MH 8 (PR-STORM)	49	STM MH 8 (PR-STORM)	5,630.58	5,630.58	5,622.55	12.70	1.04	5,623.63	5,623.59	Standard	0.100	6' TYPE II MH
55: STM MH 6 (PR-STORM)	55	STM MH 6 (PR-STORM)	5,626.85	5,626.85	5,613.02	13.80	1.09	5,614.62	5,614.11	Standard	1.320	6' TYPE II MH
57: STM MH 7 (PR-STORM)	57	STM MH 7 (PR-STORM)	5,626.03	5,626.03	5,619.03	1.10	0.39	5,619.61	5,619.42	Standard	1.320	CDOT TYPE C INLET
66: STM MH 5 (PR-STORM)	66	STM MH 5 (PR-STORM)	5,614.07	5,614.07	5,605.61	13.80	1.09	5,606.72	5,606.70	Standard	0.050	6' TYPE II MH
70: STM MH 14 (PR-STORM)	70	STM MH 14 (PR-STORM)	5,613.16	5,613.16	5,603.32	6.20	0.69	5,604.12	5,604.01	Standard	0.400	4' TYPE II MH
76: STM MH 16 (PR-STORM)	76	STM MH 16 (PR-STORM)	5,612.01	5,612.01	5,602.71	10.60	1.09	5,604.43	5,603.80	Standard	1.520	5' TYPE II MH
77: STM MH 9 (PR-STORM)	77	STM MH 9 (PR-STORM)	5,613.50	5,613.50	5,607.92	11.30	1.21	5,609.79	5,609.13	Standard	1.320	5' TYPE II MH
79: STM MH 4 (PR-STORM)	79	STM MH 4 (PR-STORM)	5,610.30	5,610.30	5,601.74	13.80	1.09	5,602.85	5,602.83	Standard	0.050	6' TYPE II MH
80: STM MH 15 (PR-STORM)	80	STM MH 15 (PR-STORM)	5,610.04	5,610.04	5,605.07	13.30	1.23	5,607.02	5,606.30	Standard	1.520	5' TYPE II MH
81: STM MH 10 (PR-STORM)	81	STM MH 10 (PR-STORM)	5,609.61	5,609.61	5,603.17	25.10	1.28	5,605.03	5,604.45	Standard	1.320	5' TYPE II MH
83: STM MH 11 (PR-STORM)	83	STM MH 11 (PR-STORM)	5,608.38	5,608.38	5,602.44	26.40	1.31	5,604.36	5,603.75	Standard	1.320	5' TYPE II MH
84: STM MH 12 (PR-STORM)	84	STM MH 12 (PR-STORM)	5,606.66	5,606.66	5,601.37	30.60	1.41	5,603.45	5,602.78	Standard	1.320	5' TYPE II MH
85: STM MH 1 (PR-STORM)	85	STM MH 1 (PR-STORM)	5,605.50	5,605.50	5,590.44	28.20	1.57	5,592.79	5,592.01	Standard	1.320	6' TYPE I DROP MH
86: STM MH 2 (PR-STORM)	86	STM MH 2 (PR-STORM)	5,604.80	5,604.80	5,598.08	13.50	1.17	5,599.27	5,599.25	Standard	0.050	5' TYPE II MH
87: STM MH 3 (PR-STORM)	87	STM MH 3 (PR-STORM)	5,604.63	5,604.63	5,595.56	27.30	1.55	5,597.87	5,597.11	Standard	1.320	6' TYPE I DROP MH
88: STM MH 13 (PR-STORM)	88	STM MH 13 (PR-STORM)	5,604.98	5,604.98	5,599.84	30.60	1.71	5,602.43	5,601.55	Standard	1.320	5' TYPE II MH
89: STM MH 18 (PR-STORM)	89	STM MH 18 (PR-STORM)	5,603.79	5,603.79	5,596.70	8.50	1.04	5,597.90	5,597.74	Standard	0.400	4' TYPE II MH
94: OUTLET STRUCTURE 1 (PR-STORM)	94	OUTLET STRUCTURE 1 (P...	5,599.10	5,599.10	5,591.24	1.10	1.55	5,592.79	5,592.79	Standard	0.050	OUTLET STRUCTURE

ID\Label	105 \ PIPE 10	106 \ PIPE 9	109 \ PIPE 8	118 \ PIPE 7	129 \ PIPE 6	137 \ PIPE 5
Link Length (ft)	46.9	543.0	436.2	358.4	462.9	118.7
Rise (in)\Material	48.0 \ Concrete (centrif. spun)	48.0 \ Concrete (centrif. spun)	48.0 \ Concrete (centrif. spun)	48.0 \ Concrete (centrif. spun)	48.0 \ Concrete (centrif. spun)	48.0 \ Concrete (centrif. spun)
Flow (cfs)	95.50	95.50	101.80	101.80	101.80	179.80
Slope (ft/ft)	-0.024	-0.017	-0.017	-0.011	-0.011	-0.035

ID\Label	52 \ HEADWALL 1	49 \ STM MH 8	55 \ STM MH 6	66 \ STM MH 5	79 \ STM MH 4	87 \ STM MH 3	85 \ STM MH 1
Ground (ft)	5629.48	5630.58	5626.85	5614.07	5610.30	5604.93	5605.50
Invert (ft)	5623.87	5622.55	5613.02	5605.61	5601.74	5595.56	5590.44
Station (ft)	0.0	46.9	589.9	1026.0	1384.5	1847.3	1966.0

ID\Label	105 \ PIPE 10	106 \ PIPE 9	109 \ PIPE 8	118 \ PIPE 7	129 \ PIPE 6	137 \ PIPE 5
Link Length (ft)	46.9	543.0	436.2	358.4	462.9	118.7
Rise (in)\Material	48.0 \ Concrete (centrif. spun)	48.0 \ Concrete (centrif. spun)	48.0 \ Concrete (centrif. spun)	48.0 \ Concrete (centrif. spun)	48.0 \ Concrete (centrif. spun)	48.0 \ Concrete (centrif. spun)
Flow (cfs)	70.50	70.50	76.80	76.80	76.80	154.80
Slope (ft/ft)	-0.024	-0.017	-0.017	-0.011	-0.011	-0.035

ID\Label	52 \ HEADWALL 1	49 \ STM MH 8	55 \ STM MH 6	66 \ STM MH 5	79 \ STM MH 4	87 \ STM MH 3	85 \ STM MH 1
Ground (ft)	5629.48	5630.58	5626.85	5614.07	5610.30	5604.93	5605.50
Invert (ft)	5623.87	5622.55	5613.02	5605.61	5601.74	5595.56	5590.44
Station (ft)	0.0	46.9	589.9	1026.0	1384.5	1847.3	1966.0

ID\Label	117 \ PIPE 13	127 \ PIPE 14	131 \ PIPE 15	133 \ PIPE 16	134 \ PIPE 17	140 \ PIPE 18
Link Length (ft)	138.0	207.7	211.5	324.4	176.8	88.8
ise (in)\Material	24.0 \ Concrete (centrif. spun)	24.0 \ Concrete (centrif. spun)	37.9 \ Concrete (centrif. spun)	37.9 \ Concrete (centrif. spun)	37.9 \ Concrete	48.0 \ Concrete (centrif. spun)
Flow (cfs)	24.90	24.90	53.10	55.90	66.10	65.70
Slope (ft/ft)	0.020	0.017	0.003	0.003	0.003	0.032

ID\Label	145 \ INLET-1	77 \ STM MH 9	81 \ STM MH 10	83 \ STM MH 11	84 \ STM MH 12	88 \ STM MH 13	186 \ O-4
Ground (ft)	5617.10	5613.50	5608.45	5608.38	5606.66	5604.98	5600.00
Invert (ft)	5611.72	5607.92	5603.17	5602.44	5601.37	5599.84	5597.00
Station (ft)	0.0	138.0	345.7	557.2	881.7	1058.5	1147.3

ID\Label	126 \ PIPE 22	122 \ PIPE 21	121 \ PIPE 20
Link Length (ft)	60.6	28.4	155.6
Rise (in)\Material	24.0 \ Concrete (centrif. spun)	24.0 \ Concrete (centrif. spun)	24.0 \ Concrete (centrif. spun)
Flow (cfs)	8.10	13.70	13.70
Slope (ft/ft)	-0.006	-0.006	-0.006

ID\Label	149 \ INLET-5A	150 \ INLET-5B	70 \ STM MH 14	84 \ STM MH 12
Ground (ft)	5612.23	5612.08	5613.16	5606.66
Invert (ft)	5604.17	5603.68	5603.20	5601.37
Station (ft)	0.0	60.6	89.0	244.5

ID\Label		113 \ PIPE 24		130 \ PIPE 23
Link Length (ft)		418.7		46.8
Rise (in)\Material		18.0 \ Concrete (centrif. spun)		30.0 \ Concrete (centrif. spun)
Flow (cfs)		7.20		27.40
Slope (ft/ft)		-0.028		0.026
ID\Label	143 \ INLET-2		80 \ STM MH 15	81 \ STM MH 10
Ground (ft)	5625.98		5610.04	5608.45
Invert (ft)	5617.78		5605.07	5603.17
Station (ft)	0.0		418.7	465.5

STORM DRAIN 04 - 100-YR
Elevation (ft)
5,613.00
5,612.50
5,612.00
5,611.50
5,611.00
5,610.50
5,610.00
5,609.50
5,609.00
5,608.50
5,608.00
5,607.50
5,607.00
5,606.50
5,606.00
5,605.50
5,605.00
-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
Label: INLET-3A
Type: Catch Basin
ID: 144
Label: PIPE 25
Type: Conduit
ID: 123
Label: STM MH 15
Type: Manhole
ID: 80
Label: INLET-3A
Type: Catch Basin
ID: 146
Label: PIPE 26
Type: Conduit
ID: 128
EGL
HGL

| | | |

ID\Label		119 \ PIPE 28	
Link Length (ft)		144.7	
Rise (in)\Material		30.0 \ Concrete (centrif. spun)	
Flow (cfs)		28.60	
Slope (ft/ft)		-0.010	
ID\Label	76 \ STM MH 16		162 \ INLET-14B
Ground (ft)	5612.01		5613.81
Invert (ft)	5602.71		5601.16
Station (ft)	0.0		144.7

ID\Label	108 \ PIPE 31	111 \ PIPE 32	
Link Length (ft)	59.6	23.8	
Rise (in)\Material	30.0 \ Concrete (centrif. spun)	30.0 \ Concrete (centrif. spun)	
Flow (cfs)	9.55	19.10	
Slope (ft/ft)	0.010	0.016	
ID\Label	151 \ INLET-8A	152 \ INLET-8B	60 \ FES 4
Ground (ft)	5627.19	5626.71	5624.00
Invert (ft)	5622.58	5621.79	5621.42
Station (ft)	0.0	59.6	83.4

ID\Label		124 \ PIPE 29	125 \ PIPE 30
Link Length (ft)		31.3	9.3
Rise (in)\Material		24.0 \ Concrete (centrif. spun)	18.0 \ Concrete (centrif. spun)
Flow (cfs)		16.90	12.40
Slope (ft/ft)		-0.010	0.020
ID\Label	159 \ INLET-12	76 \ STM MH 16	160 \ INLET-13
Ground (ft)	5612.35	5612.01	5612.35
Invert (ft)	5603.52	5602.71	5603.90
Station (ft)	0.0	31.3	40.7

ID\Label		141 \ PIPE 34	99 \ PIPE 35
Link Length (ft)		211.0	93.3
Rise (in)\Material		24.0 \ Concrete (centrif. spun)	24.0 \ Concrete (centrif. spun)
Flow (cfs)		18.90	18.90
Slope (ft/ft)		0.006	0.005
ID\Label	163 \ INLET-15A	89 \ STM MH 18	185 \ O-3
Ground (ft)	5602.70	5603.79	5600.00
Invert (ft)	5598.35	5596.70	5596.22
Station (ft)	0.0	211.0	304.3

STORM DRAIN 09A - 100-YR
Elevation (ft)
Label: INLET-7A-2
Type: Catch Basin
ID: 153
Label: INLET-7A-1
Type: Catch Basin
ID: 154
Label: INLET-7B-2
Type: Catch Basin
ID: 155
Label: INLET-7B-1
Type: Catch Basin
ID: 156
Label: FES 7
Type: Outfall
ID: 54
Label: PIPE 42
Type: Conduit
ID: 107
Label: PIPE 41
Type: Conduit
ID: 103
Label: PIPE 40
Type: Conduit
ID: 102
Label: PIPE 39
Type: Conduit
ID: 104
EGL
HGL

| | | |

ID\Label	116 \ PIPE 38	115 \ PIPE 37	114 \ PIPE 36	
Link Length (ft)	22.9	41.7	27.5	
Rise (in)\Material	36.0 \ Concrete (centrif. spun)	36.0 \ Concrete (centrif. spun)	36.0 \ Concrete (centrif. spun)	
Flow (cfs)	32.40	51.00	51.10	
Slope (ft/ft)	-0.014	-0.013	-0.013	
ID\Label	64 \ FES 6	157 \ INLET-11A	158 \ INLET-11B	65 \ FES 5
Ground (ft)	5616.93	5619.01	5619.01	5615.84
Invert (ft)	5613.70	5613.29	5612.63	5612.26
Station (ft)	0.0	22.9	64.5	92.0

ID\Label	132 \ PIPE 19	
Link Length (ft)	7.3	
Rise (in)\Material	18.0 \ Concrete (centrif. spun)	
Flow (cfs)	10.90	
Slope (ft/ft)	0.010	
ID\Label	148 \ INLET-4B	83 \ STM MH 11
Ground (ft)	5607.79	5608.68
Invert (ft)	5604.44	5602.44
Station (ft)	0.0	7.5

ID\Label	120 \ PIPE 1A	100 \ PIPE 2A	
Link Length (ft)	23.8	14.5	
Rise (in)\Material	30.0 \ Concrete (centrif. spun)	30.0 \ Concrete (centrif. spun)	
Flow (cfs)	35.10	35.10	
Slope (ft/ft)	0.022	0.085	
ID\Label	68 \ FES 1A	147 \ INLET-22	187 \ O-5
Ground (ft)	5613.27	5613.16	5613.02
Invert (ft)	5610.38	5609.76	5608.52
Station (ft)	0.0	23.8	38.3

ID\Label		139 \ PIPE 4	138 \ PIPE 3
Link Length (ft)		21.9	49.0
Rise (in)\Material		36.0 \ Concrete (centrif. spun)	36.0 \ Concrete (centrif. spun)
Flow (cfs)		87.80	87.80
Slope (ft/ft)		-0.021	-0.031
ID\Label	90 \ FES 2	86 \ STM MH 2	87 \ STM MH 3
Ground (ft)	5603.18	5604.80	5604.63
Invert (ft)	5599.55	5598.08	5595.56
Station (ft)	0.0	21.9	70.9

ID\Label		135 \ PIPE 2	136 \ PIPE 1
Link Length (ft)		29.8	93.5
Rise (in)\Material		42.0 \ Concrete (centrif. spun)	48.0 \ Concrete (centrif. spun)
Flow (cfs)		83.30	155.80
Slope (ft/ft)		0.010	0.018
ID\Label	94 \ OUTLET STRUCTURE 1	85 \ STM MH 1	96 \ FES 1
Ground (ft)	5599.10	5605.50	5593.23
Invert (ft)	5591.24	5590.44	5588.72
Station (ft)	0.0	29.8	123.3

ID\Label		110 \ PIPE 11	
Link Length (ft)		30.6	
Rise (in)\Material		18.0 \ Concrete (centrif. spun)	
Flow (cfs)		6.30	
Slope (ft/ft)		-0.074	
ID\Label	55 \ STM MH 6		57 \ INLET 18 A
Ground (ft)	5626.85		5626.03
Invert (ft)	5613.02		5619.03
Station (ft)	0.0		30.6

Pipe Report (100yr)

	Label	Invert (Start) (ft)	Start Node	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Section Type	Diameter (in)	Manning's n	Flow (cfs)	Depth (Out) (ft)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Depth (Normal) / Rise (%)	Velocity (ft/s)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Notes
136: PIPE 1	PIPE 1	5,590.44	STM MH 1	FES 1	5,588.72	105.5	0.016	Circle	48.0	0.013	155.80	3.02	183.40	85.0	70.8	16.38	5,594.08	5,591.74	48" RCP
120: PIPE 1A	PIPE 1A	5,610.38	FES 1A	INLET-22	5,609.86	23.8	0.022	Circle	30.0	0.013	35.10	1.60	60.65	57.9	54.6	12.81	5,612.39	5,611.46	30" RCP
135: PIPE 2	PIPE 2	5,591.24	OUTLET STRUCTURE 1	STM MH 1	5,590.94	37.8	0.008	Circle	42.0	0.013	62.10	6.59	89.63	69.3	61.2	6.45	5,597.68	5,597.53	42" RCP
100: PIPE 2A	PIPE 2A	5,609.76	INLET-22	O-5	5,608.52	14.5	0.085	Circle	30.0	0.013	35.10	1.32	119.77	29.3	37.1	21.19	5,611.77	5,609.84	30" RCP
138: PIPE 3	PIPE 3	5,596.56	STM MH 3	STM MH 2	5,598.08	49.0	-0.031	Circle	36.0	0.013	87.80	6.05	117.41	74.8	64.5	12.42	5,603.46	5,602.61	36" RCP
139: PIPE 4	PIPE 4	5,599.08	STM MH 2	FES 2	5,599.55	21.9	-0.021	Circle	36.0	0.013	87.80	4.50	97.79	89.8	74.0	12.42	5,603.96	5,603.58	36" RCP
137: PIPE 5	PIPE 5	5,591.44	STM MH 1	STM MH 3	5,595.56	118.7	-0.035	Circle	48.0	0.013	154.80	6.09	267.63	57.8	54.6	22.07	5,599.19	5,597.53	48" RCP
129: PIPE 6	PIPE 6	5,596.56	STM MH 3	STM MH 4	5,601.74	462.9	-0.011	Circle	48.0	0.013	76.80	6.05	151.95	50.5	50.3	12.12	5,604.39	5,602.61	48" RCP
118: PIPE 7	PIPE 7	5,601.84	STM MH 4	STM MH 5	5,605.61	358.4	-0.011	Circle	48.0	0.013	76.80	2.05	147.31	52.1	51.2	11.85	5,608.26	5,603.89	48" RCP
109: PIPE 8	PIPE 8	5,605.71	STM MH 5	STM MH 6	5,613.02	436.2	-0.017	Circle	48.0	0.013	76.80	1.79	185.95	41.3	44.8	14.09	5,615.67	5,607.50	48" RCP
106: PIPE 9	PIPE 9	5,613.32	STM MH 6	STM MH 8	5,622.55	543.0	-0.017	Circle	48.0	0.013	70.50	3.90	187.27	37.6	42.5	13.85	5,625.09	5,617.22	48" RCP
105: PIPE 10	PIPE 10	5,622.75	STM MH 8	HEADWALL 1	5,623.64	37.2	-0.024	Circle	48.0	0.013	70.50	1.88	222.29	31.7	38.7	15.70	5,626.18	5,624.63	48" RCP
110: PIPE 11	PIPE 11	5,616.77	STM MH 6	INLET 18 A	5,619.03	30.6	-0.074	Circle	18.0	0.013	6.30	0.52	28.56	22.1	31.9	12.97	5,620.00	5,617.29	18" RCP
117: PIPE 13	PIPE 13	5,611.72	INLET-1	STM MH 9	5,608.92	138.0	0.020	Circle	24.0	0.013	24.90	2.24	32.22	77.3	66.0	11.32	5,613.48	5,611.16	24" RCP
127: PIPE 14	PIPE 14	5,607.92	STM MH 9	STM MH 10	5,604.33	207.7	0.017	Circle	24.0	0.013	24.90	1.97	29.74	83.7	70.0	10.60	5,609.68	5,606.30	24" RCP
131: PIPE 15	PIPE 15	5,603.17	STM MH 10	STM MH 11	5,602.54	211.5	0.003	Ellipse		0.013	53.10	3.09	75.34	70.5	61.0	6.70	5,605.84	5,605.63	38x60 RCPHE
133: PIPE 16	PIPE 16	5,602.44	STM MH 11	STM MH 12	5,601.47	324.4	0.003	Ellipse		0.013	55.90	3.23	75.48	74.1	62.9	6.80	5,605.12	5,604.70	38x60 RCPHE
134: PIPE 17	PIPE 17	5,601.37	STM MH 12	STM MH 13	5,600.84	176.8	0.003	Ellipse		0.013	66.10	2.81	75.57	87.5	70.6	7.06	5,603.93	5,603.65	38x60 RCPHE
140: PIPE 18	PIPE 18	5,599.84	STM MH 13	O-4	5,597.00	88.8	0.032	Circle	48.0	0.013	65.70	1.53	256.83	25.6	34.5	17.10	5,602.29	5,598.53	48" RCP
132: PIPE 19	PIPE 19	5,604.44	INLET-4B	STM MH 11	5,604.11	7.3	0.045	Circle	18.0	0.013	10.90	1.52	22.39	48.7	49.2	12.59	5,605.71	5,605.63	18" RCP
121: PIPE 20	PIPE 20	5,602.54	STM MH 12	STM MH 14	5,603.32	155.6	-0.005	Ellipse		0.013	13.70	2.16	28.88	47.4	48.7	5.70	5,604.81	5,604.70	24" RCP
122: PIPE 21	PIPE 21	5,603.62	STM MH 14	INLET-5B	5,603.76	28.4	-0.005	Circle	24.0	0.013	13.70	1.33	15.89	86.2	71.6	5.69	5,605.18	5,604.95	24" RCP
126: PIPE 22	PIPE 22	5,603.86	INLET-5B	INLET-5A	5,604.17	60.6	-0.005	Circle	24.0	0.013	8.10	1.34	16.18	50.1	50.0	5.15	5,605.22	5,605.20	24" RCP
130: PIPE 23	PIPE 23	5,605.07	STM MH 15	STM MH 10	5,603.83	46.8	0.026	Circle	30.0	0.013	27.40	2.47	66.76	41.0	44.6	12.93	5,606.85	5,606.30	30" RCP
113: PIPE 24	PIPE 24	5,606.07	STM MH 15	INLET-2	5,617.78	418.7	-0.028	Circle	18.0	0.013	7.20	2.05	17.57	41.0	44.6	9.45	5,618.82	5,608.12	18" RCP
123: PIPE 25	PIPE 25	5,606.07	STM MH 15	INLET-3A	5,606.56	48.7	-0.010	Circle	18.0	0.013	1.00	2.05	10.54	9.5	20.8	0.57	5,608.12	5,608.12	18" RCP
128: PIPE 26	PIPE 26	5,606.14	INLET-3A	STM MH 15	5,606.07	7.1	0.010	Circle	18.0	0.013	10.00	2.05	10.44	95.7	78.4	5.66	5,608.18	5,608.12	18" RCP
98: PIPE 27	PIPE 27	5,596.07	O-2	INLET-14B	5,601.16	216.3	-0.024	Circle	30.0	0.013	34.60	3.29	62.91	55.0	52.9	13.12	5,603.16	5,599.36	30" RCP
119: PIPE 28	PIPE 28	5,601.26	INLET-14B	STM MH 16	5,602.71	144.7	-0.010	Circle	30.0	0.013	28.60	1.95	41.06	69.7	61.5	9.04	5,604.53	5,603.21	30" RCP
124: PIPE 29	PIPE 29	5,603.21	STM MH 16	INLET-12	5,603.52	31.3	-0.010	Circle	24.0	0.013	16.90	2.64	22.50	75.1	64.7	5.38	5,606.02	5,605.85	24" RCP
125: PIPE 30	PIPE 30	5,603.90	INLET-13	STM MH 16	5,603.71	9.3	0.020	Circle	18.0	0.013	12.40	2.14	14.99	82.7	69.4	7.02	5,605.98	5,605.85	18" RCP
108: PIPE 31	PIPE 31	5,622.58	INLET-8A	INLET-8B	5,621.99	59.6	0.010	Circle	30.0	0.013	9.55	1.53	40.82	23.4	32.9	6.79	5,623.61	5,623.52	30" RCP
111: PIPE 32	PIPE 32	5,621.79	INLET-8B	FES 4	5,621.42	23.8	0.016	Circle	30.0	0.013	19.10	1.18	51.14	37.3	42.3	9.66	5,623.27	5,622.60	30" RCP
141: PIPE 34	PIPE 34	5,598.35	INLET-15A	STM MH 18	5,597.00	211.0	0.006	Circle	24.0	0.013	18.90	3.03	18.09	104.5	86.7	6.02	5,601.50	5,600.03	24" RCP
99: PIPE 35	PIPE 35	5,596.70	STM MH 18	O-3	5,596.22	63.5	0.008	Circle	24.0	0.013	18.90	3.14	19.66	96.1	78.7	6.02	5,599.80	5,599.36	24" RCP
114: PIPE 36	PIPE 36	5,612.26	FES 5	INLET-11B	5,612.63	27.5	-0.013	Circle	36.0	0.013	51.10	2.54	77.36	66.1	59.3	11.69	5,614.96	5,614.80	36" RCP
115: PIPE 37	PIPE 37	5,612.73	INLET-11B	INLET-11A	5,613.29	41.7	-0.013	Circle	36.0	0.013	51.00	2.34	77.33	65.9	59.3	11.68	5,615.61	5,615.07	36" RCP
116: PIPE 38	PIPE 38	5,613.39	INLET-11A	FES 6	5,613.70	22.9	-0.014	Circle	36.0	0.013	32.40	2.34	77.67	41.7	45.0	10.49	5,615.55	5,615.73	36" RCP
104: PIPE 39	PIPE 39	5,622.17	FES 7	INLET-7B-1	5,623.65	212.8	-0.007	Circle	36.0	0.013	25.50	1.43	55.64	45.8	47.5	7.70	5,625.28	5,623.60	36" RCP
102: PIPE 40	PIPE 40	5,623.74	INLET-7B-1	INLET-7B-2	5,623.86	38.5	-0.003	Circle	36.0	0.013	17.43	1.57	37.22	46.8	48.1	5.18	5,625.38	5,625.31	36" RCP
103: PIPE 41	PIPE 41	5,623.96	INLET-7B-2	INLET-7A-1	5,624.39	141.0	-0.003	Circle	36.0	0.013	9.10	1.44	36.83	24.7	33.9	4.32	5,625.48	5,625.40	36" RCP
107: PIPE 42	PIPE 42	5,624.49	INLET-7A-1	INLET-7A-2	5,624.60	36.8	-0.003	Circle	36.0	0.013	4.55	1.00	36.44	12.5	23.9	3.52	5,625.51	5,625.49	36" RCP

Inlet Report (100yr)

	ID	Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Headloss Method	Headloss Coefficient (Standard)	Hydraulic Grade Line (In) (ft)	Inlet Type	Length (ft)	Width (ft)	Flow (Known) (cfs)	Notes
147: INLET-22	147	INLET-22	5,613.16	5,613.16	5,609.76	Standard	0.050	5,611.83	Full Capture	5.00	4.00	35.10	5' AT GRADE TYPE-R INLET
163: INLET-15A	163	INLET-15A	5,602.70	5,602.70	5,598.35	Standard	0.050	5,601.53	Full Capture	15.00	4.00	18.90	15' AT-GRADE TYPE-R INLET
162: INLET-14B	162	INLET-14B	5,613.81	5,613.81	5,601.16	Standard	0.050	5,603.21	Full Capture	5.00	4.00	34.60	5' SUMP TYPE-R INLET
160: INLET-13	160	INLET-13	5,612.35	5,612.35	5,603.90	Standard	0.050	5,606.01	Full Capture	10.00	4.00	12.40	10' SUMP TYPE-R INLET
159: INLET-12	159	INLET-12	5,612.35	5,612.35	5,603.52	Standard	0.050	5,606.04	Full Capture	10.00	4.00	16.90	10' SUMP TYPE-R INLET
158: INLET-11B	158	INLET-11B	5,619.01	5,619.01	5,612.63	Standard	0.100	5,615.07	Full Capture	10.00	4.00	51.10	10' SUMP TYPE-R INLET
157: INLET-11A	157	INLET-11A	5,619.01	5,619.01	5,613.29	Standard	0.100	5,615.73	Full Capture	10.00	4.00	51.00	10' SUMP TYPE-R INLET
152: INLET-8B	152	INLET-8B	5,626.71	5,626.71	5,621.79	Standard	0.400	5,623.52	Full Capture	10.00	4.00	19.10	10' SUMP TYPE-R INLET
151: INLET-8A	151	INLET-8A	5,627.19	5,627.19	5,622.58	Standard	0.050	5,623.63	Full Capture	10.00	4.00	9.55	10' SUMP TYPE-R INLET
155: INLET-7B-2	155	INLET-7B-2	5,631.22	5,631.22	5,623.86	Standard	0.050	5,625.40	Full Capture	10.00	4.00	17.43	10' AT GRADE TYPE-R INLET
156: INLET-7B-1	156	INLET-7B-1	5,631.18	5,631.18	5,623.65	Standard	0.050	5,625.31	Full Capture	10.00	4.00	25.50	10' AT GRADE TYPE-R INLET
153: INLET-7A-2	153	INLET-7A-2	5,629.83	5,629.83	5,624.60	Standard	0.050	5,625.51	Full Capture	10.00	4.00	4.55	10' SUMP TYPE-R INLET
154: INLET-7A-1	154	INLET-7A-1	5,630.41	5,630.41	5,624.39	Standard	0.050	5,625.49	Full Capture	10.00	4.00	9.10	10' SUMP TYPE-R INLET
150: INLET-5B	150	INLET-5B	5,612.08	5,612.08	5,603.68	Standard	0.050	5,605.20	Full Capture	10.00	4.00	13.70	10' SUMP TYPE-R INLET
149: INLET-5A	149	INLET-5A	5,612.23	5,612.23	5,604.17	Standard	0.050	5,605.24	Full Capture	10.00	4.00	8.10	10' SUMP TYPE-R INLET
148: INLET-4B	148	INLET-4B	5,607.79	5,607.79	5,604.44	Standard	0.050	5,605.74	Full Capture	10.00	4.00	10.90	10' SUMP TYPE-R INLET
144: INLET-3A	144	INLET-3A	5,612.82	5,612.82	5,606.56	Standard	0.050	5,608.12	Full Capture	5.00	4.00	1.00	5' AT GRADE TYPE-R INLET
146: INLET-3A	146	INLET-3A	5,610.39	5,610.39	5,606.14	Standard	0.050	5,608.21	Full Capture	4.00	15.00	10.00	15' AT GRADE TYPE-R INLET
143: INLET-2	143	INLET-2	5,625.98	5,625.98	5,617.78	Standard	0.050	5,618.84	Full Capture	10.00	4.00	7.20	10' AT GRADE TYPE-R INLET
145: INLET-1	145	INLET-1	5,617.10	5,617.10	5,611.72	Standard	0.050	5,613.54	Full Capture	15.00	4.00	24.90	15' SUMP TYPE-R INLET
52: HEADWALL 1	52	HEADWALL 1	5,629.48	5,629.48	5,623.64	Standard	0.050	5,626.23	Full Capture			70.50	HEADWALL
64: FES 6	64	FES 6	5,616.93	5,616.93	5,613.70	Standard	0.050	5,615.59	Full Capture			32.40	36" FES
90: FES 2	90	FES 2	5,603.18	5,603.18	5,599.55	Standard	0.050	5,603.30	Full Capture			87.80	36" FES
68: FES 1A	68	FES 1A	5,613.27	5,613.27	5,610.38	Standard	0.050	5,612.45	Full Capture			35.10	30" FES

Manhole Report (100yr)

	ID	Label	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Flow (Total Out) (cfs)	Depth (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Headloss Coefficient (Standard)	Notes
49: STM MH 8	49	STM MH 8	5,630.58	5,630.58	5,622.55	70.50	2.54	5,625.20	5,625.09	Standard	0.100	6' TYPE II MH
55: STM MH 6	55	STM MH 6	5,626.85	5,626.85	5,613.02	76.80	2.65	5,617.22	5,615.67	Standard	1.320	6' TYPE II MH
57: INLET 18 A	57	INLET 18 A	5,626.03	5,626.03	5,619.03	6.30	0.97	5,620.56	5,620.00	Standard	1.320	CDOT TYPE C INLET
66: STM MH 5	66	STM MH 5	5,614.07	5,614.07	5,605.61	76.80	2.65	5,608.32	5,608.26	Standard	0.050	6' TYPE II MH
70: STM MH 14	70	STM MH 14	5,613.16	5,613.16	5,603.32	13.70	1.49	5,604.88	5,604.81	Standard	0.400	4' TYPE II MH
76: STM MH 16	76	STM MH 16	5,612.01	5,612.01	5,602.71	28.60	1.82	5,605.85	5,604.53	Standard	1.520	5' TYPE II MH
77: STM MH 9	77	STM MH 9	5,613.50	5,613.50	5,607.92	24.90	1.76	5,611.16	5,609.68	Standard	1.320	5' TYPE II MH
79: STM MH 4	79	STM MH 4	5,610.30	5,610.30	5,601.74	76.80	2.65	5,604.45	5,604.39	Standard	0.050	6' TYPE II MH
80: STM MH 15	80	STM MH 15	5,610.04	5,610.04	5,605.07	27.40	1.79	5,608.12	5,606.85	Standard	1.520	5' TYPE II MH
81: STM MH 10	81	STM MH 10	5,608.45	5,608.45	5,603.17	53.10	2.67	5,606.30	5,605.84	Standard	1.320	5' TYPE II MH
83: STM MH 11	83	STM MH 11	5,608.38	5,608.38	5,602.44	55.90	2.68	5,605.63	5,605.12	Standard	1.320	5' TYPE II MH
84: STM MH 12	84	STM MH 12	5,606.66	5,606.66	5,601.37	66.10	2.56	5,604.70	5,603.93	Standard	1.320	5' TYPE II MH
85: STM MH 1	85	STM MH 1	5,605.50	5,605.50	5,590.44	155.80	3.64	5,597.53	5,594.08	Standard	1.320	6' TYPE I DROP MH
86: STM MH 2	86	STM MH 2	5,604.80	5,604.80	5,598.08	87.80	5.38	5,603.58	5,603.46	Standard	0.050	5' TYPE II MH
87: STM MH 3	87	STM MH 3	5,604.93	5,604.93	5,595.56	154.80	3.63	5,602.61	5,599.19	Standard	1.320	6' TYPE I DROP MH
88: STM MH 13	88	STM MH 13	5,604.98	5,604.98	5,599.84	65.70	2.45	5,603.65	5,602.29	Standard	1.320	5' TYPE II MH
89: STM MH 18	89	STM MH 18	5,603.79	5,603.79	5,596.70	18.90	3.10	5,600.03	5,599.80	Standard	0.400	4' TYPE II MH
94: OUTLET STRUCTURE 1	94	OUTLET STRUCTURE 1	5,599.10	5,599.10	5,591.24	62.10	6.44	5,597.71	5,597.68	Standard	0.050	OUTLET STRUCTURE

	DP 21 Site Outfall		DP 7b		DP 8		DP 11b	
Pipe Size (D)	48	Inches	36	Inches	30	Inches	36	Inches
Q	155.8	cfs	25.5	cfs	26.2	cfs	53.5	cfs
L	24	Feet	9	Feet	7.5	Feet	9	Feet
W	7	Feet	9	Feet	7.5	Feet	9	Feet
D	2	Feet	0	Feet	0	Feet	0	Feet
d_{50}	0.71	Feet	0.20	Feet	0.29	Feet	0.40	Feet
	8.58	Inches	2.42	Inches	3.43	Inches	4.79	Inches
Depth of Flow	2.71	Feet	1.85	Feet	1.5	Feet	1.9	Feet
Q/D^1.5	19.48		4.91		6.63		10.30	
Yt/D	0.68		0.62		0.59		0.65	
Rip Rap	Type L		Type L for 3 x Pipe Dia		Type L for 3 x Pipe Dia Downstream		Type L for 3 x Pipe Dia Downstream	
Length of Rock	24	Feet	9	Feet	7.5	Feet	9	Feet
Width of Rock	19.0	Feet	9.0	Feet	7.5	Feet	9.0	Feet

Use D_a instead of D whenever flow is supercritical in the barrel.
** Use Type L for a distance of 3D downstream.

CLASSIFICATION AND GRADATION OF ORDINARY RIP RAP

Rip Rap Designation by Weight	% Smaller Than Given Size (inches)	Intermediate Rock Dimension	d50* (inches)
Type VL	70 – 100	12	6**
	50 – 70	9	
	35 – 50	6	
	2 - 10	2	
Type L	70 – 100	15	9**
	50 – 70	12	
	35 – 50	9	
	2 - 10	3	
Type M	70 – 100	21	12
	50 – 70	18	
	35 – 50	12	
	2 - 10	4	
Type H	70 – 100	30	18
	50 – 70	24	
	35 – 50	18	
	2 - 10	6	
Type VH	70 – 100	42	24
	50 – 70	33	
	35 – 50	24	
	2 - 10	9	

* d50 = Mean particle size
** Bury types VL and L with native top soil and revegetate to protect from vandalism.

Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for Q/D2.5 ≤ 6.0)

PIPE SIZE OR BOX HEIGHT	D	W*	L
18" – 24"	1'–0"	4'	15'
30" – 36"	1'–6"	6'	20'
42" – 48"	2'–0"	7'	24'
54" – 60"	2'–6"	8'	28'
66" – 72"	3'–0"	9'	32'

* IF OUTLET PIPE IS A BOX CULVERT WITH A WIDTH GREATER THAN W, THEN W = CULVERT WIDTH

Figure 9-37. Low tailwater riprap basin

Figure 7-7. Street Capacity Charts Residential (Detached Sidewalk)

These charts shall only be used for the standard street sections as shown. The capacity shown is based on ½ the street section as calculated by the UD-Inlet spreadsheets. Minor storm capacities are based on no crown overtopping, curb height or maximum allowable spread widths. Major storm capacities are based on flow being containing within the public right-of-way, including conveyance capacity behind the curb. The UDFCD Safety Reduction Factor was applied. An 'n_{STREET}' of 0.016 and 'n_{BACK}' of 0.020 was used. Calculations were done using UD-Inlet 3.00.xls, March, 2011.

Figure 7-9. Street Capacity Charts Minor Residential (Attached Sidewalk)

These charts shall only be used for the standard street sections as shown. The capacity shown is based on ½ the street section as calculated by the UD-Inlet spreadsheets. Minor storm capacities are based on no crown overtopping, curb height or maximum allowable spread widths. Major storm capacities are based on flow being containing within the public right-of-way, including conveyance capacity behind the curb. The UDFCD Safety Reduction Factor was applied. An 'n_{STREET}' of 0.016 and 'n_{BACK}' of 0.020 was used. Calculations were done using UD-Inlet 3.00.xls, March, 2011.

Figure 7-5. Street Capacity Charts Collector (with Parking)

Note: Capacity Estimates also completed in UD-Inlet since Link and Kane road T dimension = 25'

These charts shall only be used for the standard street sections as shown. The capacity shown is based on ½ the street section as calculated by the UD-Inlet spreadsheets. Minor storm capacities are based on no crown overtopping, curb height or maximum allowable spread widths. Major storm capacities are based on flow being containing within the public right-of-way, including conveyance capacity behind the curb. The UDFCD Safety Reduction Factor was applied. An 'n_{STREET}' of 0.016 and 'n_{BACK}' of 0.020 was used. Calculations were done using UD-Inlet 3.00.xls, March, 2011.

Version 4.05 Released March 2017

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

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

ASPEN RANCH PDR/FDR

Inlet 4b (Link Road Capacity)

Gutter Geometry (Enter data in the blue cells)				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.0		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} =	0.016		
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00		inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.0		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 =	0.005		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	25.0	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	5.0	8.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes
MINOR STORM Allowable Capacity is based on Depth Criterion		Minor Storm	Major Storm	
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**5.2**	**26.0**	**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

Version 4.05 Released March 2017

Design Information (Input)	CDOT Type R Curb Opening	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 =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	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 =**	**5.0**	**10.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**2.3**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**83**	**%**

Version 4.05 Released March 2017

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

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

ASPEN RANCH PDR/FDR

INLET 15b (KANE RD)

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.5	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} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.0	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 =	0.010	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} =	25.0	25.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	4.8	8.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**7.9**	**44.6**	**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'

Figure 8-12. Inlet Capacity Chart Sump Conditions, Curb Opening (D-10-R) Inlet

Per D-10-R standard drawings, Inlets have 13" depth from bottom of throat to top of curb. 8" used as a conservative value

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

Per Type R standard drawings, Inlets have 9" depth from bottom of throat to top of curb. 8" used as a conservative value

Version 4.05 Released March 2017

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

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

ASPEN RANCH PDR/FDR

Inlet 2 (SUB-BASIN B-11)

Gutter Geometry (Enter data in the blue cells)				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.0		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} =	18.3		ft
Gutter Width	W =	0.53		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 =	0.029		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} =	18.3	18.3	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes
MINOR STORM Allowable Capacity is based on Spread Criterion		Minor Storm	Major Storm	
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**25.1**	**62.5**	**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

Version 4.05 Released March 2017

Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	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 =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	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 =**	**4.9**	**7.2**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.5**	**6.8**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**76**	**51**	**%**

Version 4.05 Released March 2017

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

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

ASPEN RANCH PDR/FDR

Inlet 3 (Sub-basin B-12a)

Gutter Geometry (Enter data in the blue cells)				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.0		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} =	34.8		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 =	0.046		ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.015		
		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	20.0	34.8	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes
MINOR STORM Allowable Capacity is based on Depth Criterion		Minor Storm	Major Storm	
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**16.7**	**36.3**	**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

Version 4.05 Released March 2017

Design Information (Input)	CDOT Type R Curb Opening	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 =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	15.00	15.00	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 =**	**6.7**	**11.0**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**2.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**83**	**%**

Version 4.05 Released March 2017

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

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

ASPEN RANCH PDR/FDR

Inlet 7b

Gutter Geometry (Enter data in the blue cells)				
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.0		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} =	18.3		ft
Gutter Width	W =	0.83		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 =	0.013		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} =	18.3	18.3	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	8.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes
MINOR STORM Allowable Capacity is based on Spread Criterion		Minor Storm	Major Storm	
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**17.0**	**63.3**	**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

Version 4.05 Released March 2017

Design Information (Input)	CDOT Type R Curb Opening	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 =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	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 =**	**5.1**	**7.5**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**1.7**	**7.4**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**75**	**50**	**%**

APPENDIX B

STANDARD DESIGN CHARTS AND TABLES

Drainage Criteria Manual Vol. 1

City of Colorado Springs

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

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

Table 6-9. (continued)

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

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

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

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

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

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

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

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

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

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

Fully Developed Urban Areas (vegetation established)[1]	Treatment	Hydrologic Condition	% I	Pre-Development CN			
				HSG A	HSG B	HSG C	HSG D
Open space (lawns, parks, golf courses, cemeteries, etc.):							
Poor condition (grass cover < 50%)	-----	-----	---	68	79	86	89
Fair condition (grass cover 50% to 75%)	-----	-----	---	49	69	79	84
Good condition (grass cover > 75%)	-----	-----	---	39	61	74	80
Impervious areas:							
Paved parking lots, roofs, driveways, etc. (excluding right-of-way	-----	-----	---	98	98	98	98
Streets and roads:							
Paved; curbs and storm sewers (excluding right-of-way)	-----	-----	---	98	98	98	98
Paved; open ditches (including right-of-way)	-----	-----	---	83	89	92	93
Gravel (including right-of-way)	-----	-----	---	76	85	89	91
Dirt (including right-of-way)	-----	-----	---	72	82	87	89
Western desert urban areas:							
Natural desert landscaping (pervious areas only)	-----	-----	---	63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)	-----	-----	---	96	96	96	96
Urban districts:							
Commercial and business	-----	-----	85	89	92	94	95
Industrial	-----	-----	72	81	88	91	93
Residential districts by average lot size:							
1/8 acre or less (town houses)	-----	-----	65	77	85	90	92
1/4 acre	-----	-----	38	61	75	83	87
1/3 acre	-----	-----	30	57	72	81	86
1/2 acre	-----	-----	25	54	70	80	85
1 acre	-----	-----	20	51	68	79	84
2 acres	-----	-----	12	46	65	77	82
Developing Urban Areas[1]	**Treatment[2]**	**Hydrologic Condition[3]**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Newly graded areas (pervious areas only, no vegetation)	-----	-----	---	77	86	91	94
Cultivated Agricultural Lands[1]	**Treatment**	**Hydrologic Condition**	**% I**	**HSG A**	**HSG B**	**HSG C**	**HSG D**
Fallow	Bare soil	-----	---	77	86	91	94
	Crop residue cover (CR)	Poor	---	76	85	90	93
		Good	---	74	83	88	90
Row crops	Straight row (SR)	Poor	---	72	81	88	91
		Good	---	67	78	85	89
	SR + CR	Poor	---	71	80	87	90
		Good	---	64	75	82	85
	Contoured (C)	Poor	---	70	79	84	88
		Good	---	65	75	82	86
	C + CR	Poor	---	69	78	83	87
		Good	---	64	74	81	85
	Contoured & terraced (C&T)	Poor	---	66	74	80	82
		Good	---	62	71	78	81
	C&T+ CR	Poor	---	65	73	79	81
		Good	---	61	70	77	80
Small grain	SR	Poor	---	65	76	84	88
		Good	---	63	75	83	87
	SR + CR	Poor	---	64	75	83	86
		Good	---	60	72	80	84
	C	Poor	---	63	74	82	85
		Good	---	61	73	81	84
	C + CR Poor	Poor	---	62	73	81	84
		Good	---	60	72	80	83
	C&T	Poor	---	61	72	79	82
		Good	---	59	70	78	81
	C&T+ CR	Poor	---	60	71	78	81
		Good	---	58	69	77	80
Close-seeded or broadcast legumes or rotation meadow	SR	Poor	---	66	77	85	89
		Good	---	58	72	81	85
	C	Poor	---	64	75	83	85
		Good	---	55	69	78	83
	C&T	Poor	---	63	73	80	83
		Good	---	51	67	76	80

Table 6-10. (continued)

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

: Ia = 0.1 S

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

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

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

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

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

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

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

4.6 Lag Time

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

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

$$T_i = 0.007(n \cdot L)^{0.8} / (P_2)^{0.5} S^{0.4} \quad \text{(Eq. 6-15)}$$

Where:

T_i = overland flow time (hr)

n = Manning's roughness coefficient

L = flow length (ft)

P_2 = 2-year, 24-hour rainfall (in)

S = slope of hydraulic grade line (ft/ft)

Typical roughness coefficients for the overland flow portion of the drainage basin are provided in Table 6-11. Be aware that Manning's roughness coefficients for overland flow are different from Manning's n values for open channels and conduits. Manning's n values for channels and conduits should not be used for overland flow.

Table 6-11. Roughness Coefficients (Manning's n) for NRCS Overland Flow

Surface description	n[1]
Smooth surfaces (concrete, asphalt, gravel, bare soil, etc.)	0.011
Fallow (no residue)	0.05
Cultivated Soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses [2]	0.24
Bermuda grass	0.41
Range (natural)	0.13
Woods [3]	
Light underbrush	0.40
Dense underbrush	0.80

4. [1]The values are a composite of information compiled by Engman (1986).

5. [2]Includes species such as weeping lovegrass, bluegrass, buffalograss, blue gramma grass, native grass mixtures.

6. [3]When selecting n, consider cover to a height of about 0.1 feet. This is the only part of the plant cover that will obstruct sheet flow.

4.6.2 Shallow Concentrated Flow

Flow that travels in defined flow paths, small shallow channels in undeveloped basins or in swales or gutters in developed basins normally has higher velocities than overland flow. Its travel time can be estimated by dividing its flow length by its average velocity. Average velocities for shallow concentrated flow can be estimated from Figure 6-25.

Figure 6-20. NRCS Type II 24-Hour Storm Distribution (≤ 10 mi^2)

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

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

3.2 Time of Concentration

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

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

APPENDIX C

REPORT REFERENCES

Slope direction of water table
MW-01
5616.69
MW-02
5619.84
MW-03
5591.36
Location of Ponding Water
Existing Pond Excavation
Link Road
Kane Road
5620
5615
5610
5605
5600
5595
5590
MW02
April 14 begin irrigation
April 26th
Note the steep rise in water table elevation.
Depth to Water
Temperature
Temperature (°F)
MW01
May 5th
Much slower rise in water table elevation
April 14 begin irrigation
Depth to Water
Temperature
Temperature (°F)
MW03
April 30th
Very slow change to Water Table Elevation
April 14 begin irrigation
Depth to Water
Temperature
Temperature (°F)
FIGURE
Aspen Ranch
Hydrologic Study
May 2020 Data
Matrix

FIGURE

Aspen Ranch
Hydrologic Study
July 2020 Data Download

Matrix

THE FOUNTAIN MUTUAL IRRIGATION COMPANY
P.O. BOX 75292
Colorado Springs, CO 80970-5292

March 25, 2020

City of Fountain
116 So. Main Street
Fountain, CO 80817

Attn: Ms. Kristy Marinez, Planning Supervisor

RE: Aspen Ranch Preliminary Plan

Dear Kristy:

This letter is being submitted on behalf of Fountain Mutual Irrigation Co. (FMIC) with respect to the referenced project. We received the submittal package from your office and copies of the referenced Preliminary Plan for this development project on March 20, 2020 and offer the following comments pertaining to our review of this project.

This project is generally located on the north side of Kane Road, east of Link Road and is comprised of approximately 58.9 acres of land. The project will be developed into residential lots. The natural slope of this site is from east to west with some of the on-site storm water being discharged into the existing detension pond located at the southwest corner of this site while the conveyance of both off-site and on-site storm water will be discharged into proposed storm water drainage pipes that will be discharged under Link Road.

The existing FMIC canal system lies approximately one mile to the east of this proposed development project and is still very active providing irrigation water to their shareholders in this area. Existing seepage and tailwater from this ditch system and its' lateral ditches has historically impacted lands that lie below the FMIC ditch system. The FMIC canal system typically provides irrigation water to this section of its' canal system beginning in April of every year and can have anywhere between one (1) to three (3) irrigation runs throughout the summer months.

FMIC has previously reviewed and submitted comments to the City of Fountain for Preliminary and Final plats and Preliminary Drainage Plans for this property for many years and provided similar if not exact comments to this issue referencing the FMIC ditch location, ditch seepage, and the ditch tailwater issue.

FMIC has met with Matrix Design Group personnel to discuss our concerns addressing the tailwater issue with respect to this project. Matrix has addressed FMIC's concerns with their proposed drainage improvements for this project as outlined in their Drainage Report dated March 2020.

FMIC takes no further exception to the proposed Aspen Ranch Preliminary Plan. Once again we appreciate the opportunity to review these projects within the City of Fountain that affect the FMIC ditch system. Please feel free to contact this office if you should have any questions pertaining to this information.

Respectfully,

Gary L. Steen, P.E.
Manager/Engineer for FMIC
(719) 598-9913

Excerpt from Comments Received from City of Fountain regarding Aspen Ranch Filing No. 1 March 2020 submittal:

FOUNTAIN MUTUAL IRRIGATION COMPANY (FMIC)

This letter is being submitted on behalf of Fountain Mutual Irrigation Co. (FMIC) with respect to the referenced project. We received the submittal package from your office and copies of the referenced Preliminary Plan for this development project on March 20, 2020 and offer the following comments pertaining to our review of this project.

This project is generally located on the north side of Kane Road, east of Link Road and is comprised of approximately 58.9 acres of land. The project will be developed into residential lots. The natural slope of this site is from east to west with some of the on-site storm water being discharged into the existing detention pond located at the southwest comer of this site while the conveyance of both off-site and on- site storm water will be discharged into proposed storm water drainage pipes that will be discharged under Link Road.

The existing FMIC canal system lies approximately one mile to the east of this proposed development project and is still very active providing irrigation water to their shareholders in this area. Existing seepage and tailwater from this ditch system and its' lateral ditches have historically impacted lands that lie below the FMIC ditch system. The FMIC canal system typically provides irrigation water to this section of its' canal system beginning in April of every year and can have anywhere between one (1) to three (3) irrigation runs throughout the summer months.

FMIC has previously reviewed and submitted comments to the City of Fountain for Preliminary and Final plats and Preliminary Drainage Plans for this property for many years and provided similar if not exact comments to this issue referencing the FMIC ditch location, ditch seepage, and the ditch tailwater issue.

FMIC has met with Matrix Design Group personnel to discuss our concerns addressing the tailwater issue with respect to this project. Matrix has addressed FMIC's concerns with their proposed drainage improvements for this project as outlined in their Drainage Report dated March 2020.

FMIC takes no further exception to the proposed Aspen Ranch Preliminary Plan. Once again, we appreciate the opportunity to review these projects within the City of Fountain that affect the FMIC ditch system. Please feel free to contact this office if you should have any questions pertaining to this information.

Note: Minor typos corrected

THE FOUNTAIN MUTUAL IRRIGATION COMPANY
P.O. BOX 75292
Colorado Springs, CO 80970-5292

April 25, 2019

Gregory Shaner, P.E.
Matrix Design Group, Inc.
2435 Research Parkway, Ste. 300
Colorado Springs, CO 80920

RE: Aspen Ranch Development Project, Fountain, CO

Dear Greg:

Per our discussion yesterday and your email sent to this office on April 23, 2019 referencing the proposed development proposed, I willl attempt to address the Fountain Mutual Irrigation Co. (FMIC) canal as it may affect this project.

Matrix Design Group has previously identified the location of the FMIC canal in their drainage report as it relates to this proposed development project and have identified the existance of tailwater from the canal entering this proposed development project. I have repeatedly stated in previous correspondence to the City of Fountain Planning Department over the past several years this same claim that the FMIC canal sytem has tailwater and seepage water impacting this proposed development site.

Your email is indicating that the City of Fountain is requesting that FMIC attempt to quantify their "water rights" associated with this section of the canal system that affects this proposed development project.

First and foremost, FMIC is mutual ditch system owned and operated by their shareholders. This means their water rights (nine (9) separate water rights) are owned and operated by their shareholders as well. Once these water rights are diverted off of Fountain Creek near the City of Colorado Springs Las Vegas Wastewater Treatment Facility and put into the canal system they become part of the FMIC canal system and are used by the canal company for either irrigation or augmentation purposes.

For this particular section of the canal adjacent to this proposed development project, FMIC flows approximately 25 cfs when irrigating their shareholders in this area. It is impossible for FMIC to estimate the amount of tailwater generated from this volume of water as the number of irrigators, topograghy, and lengh of the irrigation run(s) (time alloted for each shareholder to receive their water) varies for each irrigation season. FMIC typically has one (1) to three (3) irrigation seasons throughout the year, namely in the spring, mid-summer and then again in the last summer to early fall depending on water availability to the company in Fountain Creek.

I hope this information is helpful in quantifing the tailwater/canal flows adjacent to this proposed development project and explain a little of FMIC's operations in this area as well. Please let me know if you should have any additional questions pertaining to this information.

Respectfully,

Gary L. Steen, P.E.
Manager/Engineer for FMIC
(719) 598-9913

NOTE: This development has been withdrawn and there is no known approved version of this report.

MASTER DEVELOPMENT DRAINAGE PLAN
FOR
EAGLESIDE RIDGE

Prepared for:

Integrity Bank & Trust
1275 Village Ridge Point
Monument, CO 80132

February 13, 2018

Prepared by:

19 E. Willamette Ave.
Colorado Springs, CO 80903
(719)-477-9429
(719)-471-0766 fax
www.jpsengr.com

JPS Project No. 080201

E. References

City of Colorado Springs "Drainage Criteria Manual, Volumes 1 and 2," May, 2014.

CDOT, "CDOT Drainage Design Manual," July, 1995.

Drexel, Barrell & Co., "Drainage Planning Study, Jimmy Camp Creek," June 9, 2003.

FEMA, Flood Insurance Rate Map (FIRM) Number 08041C1025-F, March 17, 1997.

Finn & Associates, "Wild Oak Farms Master Drainage Plan and Report," December, 1983.

JPS Engineering, Inc., "Final Drainage Report for Cumberland Green Filing No. 1," April 8, 2005 (approved by City April 29, 2005).

JPS Engineering, Inc., "Final Drainage Report for Cumberland Green Filing No. 2," February 10, 2006.

JPS Engineering, Inc., "Final Drainage Report for Cumberland Green Filing No. 3," December 14, 2006 (approved by City June 27, 2007).

JPS Engineering, Inc., "Final Drainage Report for Eagleside View," revised October 1, 2014 (approved by City October 13, 2014).

JPS Engineering, Inc., "Master Development Drainage Plan (MDDP) and Preliminary Drainage Report for Cumberland Green," November 5, 2004.

Kiowa Engineering Corporation, "West Fork Jimmy Camp Creek Drainage Basin Planning Study," July, 2000.

Lincoln-DeVore, Inc., "Geotechnical and Hydrologic Report, Proposed Wild Oak Farms, East," August 21, 1985.

United Planning & Engineering, "Wild Oak Farms Master Plan Amendment," January 31, 1988.

USDA/NRCS, "Soil Survey of El Paso County Area, Colorado," June, 1981.

Development of the Eagleside Ridge Subdivision will require site grading and paving, resulting in additional impervious areas across the site. The general drainage pattern will consist of positive grading away from home sites to swales and gutters along the internal roads within the subdivision, conveying runoff flows through the site. Runoff from the site will be conveyed by street gutters to curb inlets at low points and road intersections, and then flow through storm drains and drainage channels to detention ponds. The storm inlets and storm sewer system within the development will be designed as the "minor" drainage system, sized for 5-year developed peak flows. The street system, drainage channels, and detention ponds will be designed as the "major" drainage system, sized for 100-year peak flows. Street flows within subdivision streets will be maintained below allowable levels in accordance with City of Fountain drainage criteria.

B. Specific Details

1. Existing Drainage Conditions

Historic drainage conditions are depicted in Figure EX1 (Appendix E). The overall Cumberland Green area has been divided into three major basins (A, B, and C). There are no significant existing drainage facilities within the undeveloped parts of the site. The proposed Eagleside Ridge annexation area consists of historic Basins OB1.2 and OC1.

The existing on-site drainage area at the north end of the Cumberland Green master plan area (Basin A) combines with an off-site drainage basin (OA1.1) entering the site from the north. Discharge from the combined basins flows southwest towards Jimmy Camp Creek. Historic peak flows at Design Point #1 are calculated as Q_5 = 10.1 cfs and Q_{100} = 67.3 cfs (SCS Method).

The large off-site basins east of Link Road and south of Squirrel Creek Road (Basins OB1.1a and OB1.1b) combine with Eagleside Ridge Basin OB1.2 and Cumberland Green Basin B, flowing westerly to the main channel. Historic peak flows at Design Point #2 are calculated as Q_5 = 46.1 cfs and Q_{100} = 274.1 cfs (SCS Method). The Fountain Mutual Irrigation Company (FMIC) ditch system periodically releases tailwater flows within the upstream drainage Basin OB1.1a, and these flows follow the existing natural drainage swales northwesterly towards Jimmy Camp Creek.

Basins OC1 and OC2 combine with Cumberland Green Basin C, sheet flowing west towards the Jimmy Camp Creek channel. Historic peak flows at Design Point #3 are calculated as Q_5 = 12.4 cfs and Q_{100} = 79.3 cfs (SCS Method).

Basins OC1 and OC2 historically flow southwesterly towards the southwest corner of the Eagleside Ridge property, where existing contours drain into the Chilcott Ditch.

- Existing 48" Storm Sewer and Street Capacity flowing northerly in Carnival Lane (Eagleside View)
- Existing 48"-60" Storm Sewer OB1 and Street Capacity flowing westerly in Firecracker Trail to Detention Pond B

The conveyance capacity of this system is more than adequate to convey the projected 100-year flows, as summarized in the following table:

Design Point	Storm Sewer Capacity (cfs)	Street Capacity (cfs)	Total Conveyance Capacity (cfs)	Design Flow (Q_{100}, cfs)
DP4	200	220.8	420.8	263.8
DP5	143.6	220.8	364.4	228.0

Developed Sub-Basins

The southeasterly part of the Eagleside Ridge property has been delineated as Basin IB1. This basin sheet flows northeasterly to the proposed full-spectrum Detention Pond IB1 at the northwest corner of Link Road and Kane Road. Developed peak flows at Design Point #IB1 are calculated as $Q_5 = 22.5$ cfs and $Q_{100} = 52.5$ cfs (Rational Method).

The northeasterly part of the Eagleside Ridge property has been delineated as Basin IB2. This basin sheet flows northwesterly to the proposed full-spectrum Detention Pond IB2 at the southwest corner of Watchmen Road and Short Fuse Lane. Developed peak flows at Design Point #IB2 are calculated as $Q_5 = 32.8$ cfs and $Q_{100} = 80.0$ cfs (Rational Method).

The drainage area located between Basin IB2 and the proposed extension of Sentry Drive has been delineated as Basin IB3. This basin flows northwesterly to a proposed full-spectrum Detention Pond IB3 at the southeast corner of Sentry Drive and Watchmen Road. Developed peak flows at Design Point #IB3 are calculated as $Q_5 = 22.0$ cfs and $Q_{100} = 54.6$ cfs (Rational Method).

The drainage basins along the west side of the Eagleside Ridge development have been identified as Basins OC1.1 and OC1.2. Basin OC1.1 consists of the southwesterly part of the development located on the south side of the proposed Ohio Avenue extension. This basin sheet flows northwesterly, with developed peak flows of $Q_5 = 13.2$ cfs and $Q_{100} = 35.4$ cfs (Rational Method).

Basin OC1.2 consists of the northwesterly part of the development. Basins OC1.1 and OC1.2 combine at the westerly site boundary, with developed peak flows at Design Point #OC1 calculated as $Q_5 = 41.2$ cfs and $Q_{100} = 104.4$ cfs (Rational Method). A full-spectrum stormwater detention facility (Pond OC1) will be constructed to release historic drainage flows along the western boundary of the site. The proposed detention pond will discharge

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CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

CUMBERLAND GREEN

MASTER DEVELOPMENT DRAINAGE PLAN

No.	REVISION	BY	DATE

HORZ. SCALE:	1"=200'	DRAWN:	BJJ
VERT. SCALE:	N/A	DESIGNED:	JPS
SURVEYED:	RAMPART	CHECKED:	JPS
CREATED:	1/08/14	LAST MODIFIED:	2/13/18
PROJECT NO:	080201	MODIFIED BY:	BJJ
SHEET:	D1		

J:\projects\080201 cumberland\dwg\Integrity Parcel\civil\D1.dwg Feb 13, 2018 - 10:12am

NEW DOC

RECEIVED
DEC 16 2013
BY:

FINAL DRAINAGE REPORT
for
EAGLESIDE VIEW

Prepared for:

Triple Bar Development
2139 Chuckwagon Road #300
Colorado Springs, CO 80919

November 20, 2013

Prepared by:

JPS ENGINEERING

19 E. Willamette Ave.
Colorado Springs, CO 80903
(719)-477-9429
(719)-471-0766 fax
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JPS Project No. 081302

CUMBERLAND GREEN MASTER DRAINAGE PLAN
RATIONAL METHOD

DEVELOPED FLOWS

					Overland Flow			Channel flow										
BASIN	DESIGN POINT	AREA (AC)	C 5-YEAR[7]	C 100-YEAR[7]	LENGTH (FT)	SLOPE (FT/FT)	Tco[1] (MIN)	CHANNEL LENGTH (FT)	CONVEYANCE COEFFICIENT C	SLOPE (FT/FT)	SCS[2] VELOCITY (FT/S)	Tt[3] (MIN)	TOTAL Tc[4] (MIN)	TOTAL Tc[4] (MIN)	INTENSITY[5] 5-YR (IN/HR)	INTENSITY[5] 100-YR (IN/HR)	PEAK FLOW Q5[6] (CFS)	PEAK FLOW Q100[6] (CFS)
OA1.1		6.70	0.250	0.350	500	0.03	24.7					0.0	24.7	24.7	2.70	4.80	4.52	11.27
OA1.2		37.80	0.679	0.753			0.0	1400	20.00	0.015	2.45	9.5	9.5	9.5	4.18	7.44	107.22	211.66
OA2.1,OA2.2		8.30	0.250	0.350	900	0.03	31.1	300	15.00	0.007	1.25	4.0	35.0	35.0	2.21	3.94	4.59	11.44
OA1.1-OA2.2	OA1.1	52.80	0.557	0.638									35.0	35.0	2.21	3.94	65.09	132.72
B1A-B1E		18.94	0.600	0.700														
A1-A8		42.70	0.600	0.700														
OA1,B1,A1-A8		114.44	0.580	0.672														
OB1.1a		473.20	0.250	0.350	1000	0.07	26.4	5250	15.00	0.022	2.22	39.3	65.7	65.7	1.50	2.65	177.45	438.89
OB1.2		73.00	0.250	0.350			0.0	2000	15.00	0.009	1.42	23.4	23.4	23.4	1.50	2.65	27.38	67.71
OB1.1a,OB1.2		546.20	0.250	0.350										89.1	1.50	2.65		
EAGLESIDE VIEW:																		
EV1	EV1	4.37	0.600	0.700	300	0.17	6.1	2250	20.00	0.01	2.00	18.8	24.9	24.9	2.69	4.78	7.05	14.63
EV2	EV2	0.91	0.600	0.700	130	0.02	9.1	850	20.00	0.005	1.41	10.0	19.1	19.1	3.08	5.49	1.68	3.49
OB1.1b		42.00	0.250	0.350	1000	0.02	43.0	3600	20.00	0.018	2.68	22.4	65.4	65.4	1.50	2.65	15.72	38.98
EV3		10.54	0.600	0.700			0.0	2250	20.00	0.013	2.24	16.8	16.8	16.8	3.29	5.85	20.79	43.16
OB1.1b, EV3	EV3	52.54	0.320	0.420									82.1	82.1	1.50	2.60	25.24	57.40
EV4		0.43	0.600	0.700	180	0.01	11.9	560	20.00	0.01	2.00	4.7	16.6	16.6	3.31	5.89	0.85	1.77
EV5	EV5	3.68	0.600	0.700	300	0.01	15.9	2300	20.00	0.01	2.00	19.2	35.0	35.0	2.21	3.94	4.89	10.15
EV6	EV6	0.88	0.600	0.700	50	0.02	5.7	2600	20.00	0.01	2.00	21.7	27.3	27.3	2.55	4.54	1.35	2.80
EV1-EV6		20.81	0.600	0.700				470	20.00	0.011	2.06	3.8	3.8	3.8				
Tt from OB1.2 to B6A																		
OB1,EV1-EV6		609.01												89.1				

EAGLESIDE VIEW

DEVELOPED DRAINAGE PLAN

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19 E. Willamette Ave.
Colorado Springs, CO 80903
PH: 719-477-9429
FAX: 719-471-0766
www.jpsengr.com

CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2 BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES

No.	REVISION	BY	DATE

HORZ. SCALE: 1"=50'	DRAWN: RMD
VERT. SCALE: 1"=5'	DESIGNED: JPS
SURVEYED: RAMPART	CHECKED: JPS
CREATED: 8/26/13	LAST MODIFIED: 11/20/13
PROJECT NO: 080201	MODIFIED BY: BJJ
SHEET: D2.1	

J:\jpsprojects\080201.cumberland\dwg\Civil\School\D2.1.dwg Nov 21, 2013 - 2:08pm

APPENDIX D

MAPS

VICINITY MAP

Matrix DESIGN GROUP
2435 Research Pkwy, Suite 300,
Colorado Springs, CO 80920
719.575.0100

Soil Map—El Paso County Area, Colorado

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 15, Oct 10, 2017

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

Date(s) aerial images were photographed: Apr 15, 2011—Mar 9, 2017

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
3	Ascalon sandy loam, 3 to 9 percent slopes	46.6	77.9%
101	Ustic Torrifluvents, loamy	13.2	22.1%
Totals for Area of Interest		**59.8**	**100.0%**

El Paso County Area, Colorado

3—Ascalon sandy loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2tlny
Elevation: 3,870 to 5,960 feet
Mean annual precipitation: 13 to 18 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 95 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Ascalon

Setting

Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind-reworked alluvium and/or calcareous sandy eolian deposits

Typical profile

Ap - 0 to 6 inches: sandy loam
Bt1 - 6 to 12 inches: sandy clay loam
Bt2 - 12 to 19 inches: sandy clay loam
Bk1 - 19 to 35 inches: fine sandy loam
Bk2 - 35 to 80 inches: fine sandy loam

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 5.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline (0.1 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 1.0
Available water storage in profile: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Sandy Plains (R067BY024CO)
Hydric soil rating: No

Minor Components

Olnest

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: Sandy Plains (R067BY024CO)
Hydric soil rating: No

Vona

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

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 15, Oct 10, 2017

El Paso County Area, Colorado

101—Ustic Torrifluvents, loamy

Map Unit Setting

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

Map Unit Composition

Ustic torrifluvents and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ustic Torrifluvents

Setting

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

Typical profile

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

Properties and qualities

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

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Saline Overflow LRU's A & B (R069XY037CO)
Other vegetative classification: OVERFLOW (069BY036CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

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

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 15, Oct 10, 2017

National Flood Hazard Layer FIRMette

FEMA

38°41'35.60"N

104°40'39.10"W

104°40'1.64"W

38°41'7.51"N

Feet 1:6,000

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

Legend

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

SPECIAL FLOOD HAZARD AREAS

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

OTHER AREAS OF FLOOD HAZARD

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

OTHER AREAS

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

GENERAL STRUCTURES

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

OTHER FEATURES

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

MAP PANELS

- Digital Data Available
- No Digital Data Available
- Unmapped

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/27/2019 at 12:43:55 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

SUMMARY HYDROLOGY TABLE

DESIGN POINT	AREA (AC.)	Q_5 (CFS)	Q_{100} (CFS)
OS1	476.1	32.0	183.3

PREPARED BY:

Matrix DESIGN GROUP
2435 Research Pkwy, Suite300
Colorado Springs, CO 80920
Phone 719.575.0100

ASPEN RANCH

DESERT VIEW HOMES
COLORADO SPRINGS, CO

HISTORIC DRAINAGE MAP

DESIGNED BY:	JO	SCALE	DATE ISSUED:	APRIL, 2018	DRAWING No.
DRAWN BY:	AL	HORIZ. 1" = 500'			
CHECKED BY:	GS	VERT. N/A	SHEET	01 OF 02	DR01

THIS DRAWING IS CURRENT AS OF PLOT DATE AND MAY BE SUBJECT TO CHANGE.
PLOT DATE: April 20, 2018 11:44 AM
FILE NAME: S:\17.886.003 Aspen Ranch\100 Dwg\104 Exhibits\Exhibit.dwg

Aspen Ranch
Proposed Conditions
Design Point Summary Table

Design Point: Sub-basins	Description	Upstream Area (Acres)	Upstream Q5 (cfs)	Upstream Q100 (cfs)	Outlet Pipe Size (inches)	Outlet Pipe Type
1: B10	Capture by: 15-foot sump Type-R Curb Inlet	6.6	11.3	24.9	24	RCP
2: B11	Capture by: 10-foot At-grade Type-R Curb Inlet	3.7	6.4	14.0	18	RCP
3: B11, B12a	Capture by: 15-foot & 5-foot At-Grade Type R Curb Inlets	6.4	13.3	27.4	30	RCP
4a: B10, B11, B12a	Manhole in Link Road combining B12a & DP 3	9.1	20.5	41.6	42	RCP
4b: B10, B11, B12a, 12b	Sump Inlet on Link Road and MH Combining DP 4b w/ Sub-basin B12b	11.5	22.4	45.8	42	RCP
5: B3a1 & B3b	On-Grade Inlets 15' Type R south, 5' Type R north	3.8	6.2	13.7	18	RCP
6: B3b, B10, B11, B12a, B12b	Manhole in Link Road combining DP5 & DP4b	15.3	26.7	55.8	42	RCP
7a: B8, B9	Surface flow to inlet in B9	2.4	4.2	9.1	18	RCP
7b: B7, B8, B9	At-Grade Inlets	7.6	11.6	25.5	36	RCP
8: B6	Sump Inlets	5.1	8.7	19.1	30-inch pipe.	RCP
9: B6, B7, B8, B9	Trapezoidal swale	12.7	12.0	26.2	8' bottom width 5:1 side slopes	Swale
10: B5, B6, B7, B8, B9	36-inch Flared End Section	19.2	13.0	32.4	36	RCP
11a: B4, B5, B6, B7, B8, B9	10-foot At Grade Inlet	20.4	20.4	51.0	36	RCP
11b: B3a2, B4, B5, B6, B7, B8, B9	5-foot At Grade Inlet	20.5	20.5	51.1	36 Swale (8' bottom width 5:1 side slopes)	RCP Swale
12: B2a + Flow Bypass from DP 7b	Sump Inlet	3.3	5.5	16.9	24	RCP
13: B2b	Sump Inlet	3.7	5.7	12.4	24	RCP
14a: B2a, B2b	Manhole combining flows from DP 12 & 13	7.1	11.0	29.1	30	RCP
14b: B2a, B2b, B2c, B2d	Sump Inlet	9.8	13.7	35.3	30	RCP
15a: B1a, B1b	Link and Kane Roads	5.0	8.5	18.9	24	RCP
15b: B1a, B1b, B3b, B10, B11, B12a, B12b	Northwest Forebay	20.3	8.5 30.8	18.9 66.5	24 42	RCP
16: B1a, B1b, B1c, B2a, B2b, B2c, B3a, B3b, B4, B5, B6, B7, B8, B9	See UD-Detention for Basin Volume Analysis	60.4	38.1	90.4	Trickle Channel	Concrete
17: Detention Pond Discharge	See UD-Detention for outlet structure design information	60.4	1.1	62.1	42	RCP
18: OB1.1A1	48" Storm Pipe Routing around development	207.0	12.7	70.5	48	RCP
18a (Sub-area within OB1.1A1)	18" FES These flows are included under DP18 and are thus **not** added again to the flows in the bypass storm sewer.	5.1	1.1	6.3	18	RCP
19: OB1.1A2	42" Crossroad pipe to 48" Storm Pipe Routing around development	223.8	13.5	87.8	36	RCP
20: OB1.1A1, OB1.1A2	48" Storm Pipe Routing around development	430.8	27.3	154.8	48	RCP
21: B1a, B1b, B1c, B2a, B2b, B2c, B3a, B3b, B4, B5, B6, B7, B8, B9, OB1.1A1, OB1.1A2	Crossroad discharge pipe	491.2	28.2	155.8	48 Swale(8' bottom width, 4:1 side slopes)	RCP Swale
22: B13, OB1.1B-Reduced	Combination of offsite undeveloped with Sub-basin B13 (which contains only open space and offsite). Storm water will continue to be treated and detained by Existing Pond B to the west.	36.3	7.3	35.1	30 x 18	HERCP

NOTES:
1. THE "REDUCED" NOTE IN THE TABLE ABOVE INDICATES THAT THE SUB-BASINS NOTED HAVE HAD THEIR AREAS REDUCED RELATIVE TO THE PRE-DEVELOPMENT CONDITION BY THE AREA OF THE PROPOSED ASPEN RANCH DEVELOPMENT WHICH HAS BEEN BROKEN OUT OF THE LARGER PRE-DEVELOPMENT SUB-BASIN FOR THE PURPOSE OF POST DEVELOPMENT ANALYSIS.
2. NO FEMA DESIGNATED REGULATORY FLOODPLAIN ON OR ADJACENT TO PROJECT SITE.

PREPARED BY:
Matrix
2435 Research Pkwy, Suite300
Colorado Springs, CO 80920
Phone 719.575.0100

ASPEN RANCH

COLA
FOUNTAIN, CO

PROPOSED CONDITIONS

DESIGNED BY: JO	SCALE	DATE ISSUED: MAY 2020	DRAWING No.
DRAWN BY: JTS	HORIZ. 1" = 100'		
CHECKED BY: GS	VERT. N/A	SHEET 02 OF 03	DR02

THIS DRAWING IS CURRENT AS OF PLOT DATE AND MAY BE SUBJECT TO CHANGE.
PLOT DATE: *August 17, 2020 9:31 AM*
FILE NAME: *S:\19.886.023 Aspen Ranch\200 Drainage\201 Drainage Reports\201A FDR-PDR\DWG\DR-02-Drainage basins(PDR-FDR).dwg*

Aspen Ranch
Proposed Conditions
Design Point Summary Table

Design Point: Sub-basins	Description	Upstream Area (Acres)	Upstream Q5 (cfs)	Upstream Q100 (cfs)	Outlet Pipe Size (inches)	Outlet Pipe Type	Outlet Pipe Grade (%)	Downstream Design Point
1: B10	Capture by: 15-foot sump Type-R Curb Inlet	6.6	11.3	24.9	24	RCP	1.7	4a
2: B11	Capture by: 10-foot At-grade Type-R Curb Inlet	3.7	6.4	14.0	18	RCP	2.8	2
3: B11, B12a	Capture by: 15-foot & 5-foot At-Grade Type R Curb Inlets	6.4	13.3	27.4	30	RCP	1	3
4a: B10, B11, B12a	Manhole in Link Road combining B12a & DP 3	9.1	20.5	41.6	42	RCP	0.50	4b
4b: B10, B11, B12a, 12b	Sump Inlet on Link Road and MH Combining DP 4b w/ Sub-basin B12b	11.5	22.4	45.8	42	RCP	0.30	6
5: B3a1 & B3b	On-Grade Inlets 15' Type R south, 5' Type R north	3.8	6.2	13.7	18	RCP	0.65	6
6: B3b, B10, B11, B12a, B12b	Manhole in Link Road combining DP5 & DP4b	15.3	26.7	55.8	42	RCP	0.3	15b
7a: B8, B9	Surface flow to inlet in B9	2.4	4.2	9.1	18	RCP	0.3	7b
7b: B7, B8, B9	At-Grade Inlets	7.6	11.6	25.5	36	RCP	0.3	9
8: B6	Sump Inlets	5.1	8.7	19.1	30-inch pipe.	RCP	1.5	9
9: B6, B7, B8, B9	Trapezoidal swale	12.7	12.0	26.2	8' bottom width 5:1 side slopes	Swale	2.4	10
10: B5, B6, B7, B8, B9	36-inch Flared End Section	19.2	13.0	32.4	36	RCP	1.4	11a
11a: B4, B5, B6, B7, B8, B9	10-foot At Grade Inlet	20.4	20.4	51.0	36	RCP	1.35	11b
11b: B3a2, B4, B5, B6, B7, B8, B9	5-foot At Grade Inlet	20.5	20.5	51.1	36 Swale (8' bottom width 5:1 side slopes)	RCP Swale	1.35 2.4	16
12: B2a + Flow Bypass from DP 7b	Sump Inlet	3.3	5.5	16.9	24	RCP	1	14a
13: B2b	Sump Inlet	3.7	5.7	12.4	24	RCP	2	14a
14a: B2a, B2b	Manhole combining flows from DP 12 & 13	7.1	11.0	29.1	30	RCP	1	14b
14b: B2a, B2b, B2c, B2d	Sump Inlet	9.8	13.7	35.3	30	RCP	2.35	16
15a: B1a, B1b	Link and Kane Roads	5.0	8.5	18.9	24	RCP	0.64	15b
15b: B1a, B1b, B3b, B10, B11, B12a, B12b	Northwest Forebay	20.3	8.5 30.8	18.9 66.5	24 42	RCP	3.2 0.75	16
16: B1a, B1b, B1c, B2a, B2b, B2c, B3a, B3b, B4, B5, B6, B7, B8, B9	See UD-Detention for Basin Volume Analysis	60.4	38.1	90.4	Trickle Channel	Concrete	0.5	17
17: Detention Pond Discharge	See UD-Detention for outlet structure design information	60.4	1.1	62.1	42	RCP	1	21
18: OB1.1A1	48" Storm Pipe Routing around development	207.0	12.7	70.5	48	RCP	1.1	20
18a (Sub-area within OB1.1A1)	18" FES These flows are included under DP18 and are thus **not** added again to the flows in the bypass storm sewer.	5.1	1.1	6.3	18	RCP	9.8	20
19: OB1.1A2	42" Crossroad pipe to 48" Storm Pipe Routing around development	223.8	13.5	87.8	36	RCP	2.15	20
20: OB1.1A1, OB1.1A2	48" Storm Pipe Routing around development	430.8	27.3	154.8	48	RCP	3.47	21
21: B1a, B1b, B1c, B2a, B2b, B2c, B3a, B3b, B4, B5, B6, B7, B8, B9, OB1.1A1, OB1.1A2	Crossroad discharge pipe	491.2	28.2	155.8	48 Swale(8' bottom width, 4:1 side slopes)	RCP Swale	1.84 0.25	Existing Swale

LEGEND

- BASIN BOUNDARY
- EXISTING CONTOUR
- PROPOSED CONTOUR
- PROPOSED STORM DRAIN PIPE
- EXISTING STORM DRAIN PIPE
- DRAINAGE CHANNEL
- EXISTING EDGE OF ROAD
- PROPOSED PROPERTY LINE
- PROPOSED FLOW DIRECTION
- DESIGN POINT
- PROPOSED WATER LINE
- PROPOSED SANITARY SEWER
- EMERGENCY FLOW PATHS

THE STORM DRAINAGE FACILITIES CONVEYING OFFSITE FLOWS FROM THE EAST SIDE OF THE DEVELOPMENT WILL BE PRIVATELY OWNED AND MAINTAINED UP TO THE MANHOLE (MH - 102) COMBINING THESE FLOWS WITH FLOWS FROM ACROSS KANE ROAD. THE PROPOSED DETENTION POND WILL ALSO BE PRIVATELY OWNED AND MAINTAINED.

STORM SEWER SHOULD BE CONSIDERED PUBLICLY OWNED UNLESS OTHERWISE INDICATED.

ALL OTHER STORM SEWER WILL BE PUBLICLY OWNED AND MAINTAINED.

N

SCALE: 1"= 100

REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	BY
####	####	####	####

REVISIONS

COMPUTER FILE MANAGEMENT

FILE NAME: S:\19.886.023 Aspen Ranch\200 Drainage\201 Drainage Reports\201A FDR-PDR\DWG\DR-02-Drainage basins(PDR-FDR).dwg
CTB FILE: ----
PLOT DATE: August 17, 2020 9:59:58 AM
THIS DRAWING IS CURRENT AS OF PLOT DATE AND MAY BE SUBJECT TO CHANGE.

SHEET KEY

PREPARED BY: Matrix DESIGN GROUP

SEAL

PRELIMINARY
THIS DRAWING HAS NOT BEEN APPROVED BY GOVERNING AGENCIES AND IS SUBJECT TO CHANGE

FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.
PROJECT No. 19.886.023

CITY OF FOUNTAIN

COLA, INC.
STORM SEWER LAYOUT

ASPEN RANCH
PDR

DESIGNED BY: JTS	SCALE	DATE ISSUED: 7/27/2020	DRAWING No.
DRAWN BY: LB	HORIZ. 1"=100'		
CHECKED BY: JTS	VERT. N/A	SHEET 3 OF 3	DR-03