FINAL DRAINAGE REPORT

For

"ASPEN MEADOWS FILING NO. 2"

SAND CREEK
DRAINAGE BASIN

Prepared for:
City of Colorado Springs
Engineering Development Review Division Team
30 North Nevada Avenue, Suite 401
Colorado Springs, CO 80903

On Behalf of:
COLA, LLC.
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Colorado Springs, CO 80921

Prepared by:

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March 2021

MDG Project No. 21.886.034

Engineer's Statement:

This report and plan for the drainage design of Aspen Meadows Filing No. 2 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 Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

_____ _____

Brady A. Shyrock Date
Registered Professional Engineer
State of Colorado
No. 38164

Developer's Statement:

COLA, LLC hereby certifies that the drainage facilities for Aspen Meadows Filing No. 2 shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs 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 Colorado Springs pursuant to section 7.7.906 of the City Code; and cannot, on behalf of Aspen Meadows Filing No. 2, guarantee that final drainage design review will absolve **COLA, LLC** 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.

COLA, LLC
Business Name

By: _____ _____
Timothy Buschar Date

Title: COO

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

City of Colorado Springs:

Filed in accordance with section 7-7-906 of the Code of the City of Colorado Springs, 2001, as amended.

_____ _____
For the City Engineer Date

Conditions:

TABLE OF CONTENTS

I. INTRODUCTION

The Aspen Meadows Filing No. 2 development is located within the 90.24-acre Aspen Meadows Subdivision, which is located in northeastern Colorado Springs, El Paso County, state of Colorado. The proposed development is comprised of a total of 13.88 acres of single-family residential, open space, and public right-of-way.

Figure 1 - Project Location

II. PURPOSE AND SCOPE OF STUDY

The purpose of this Final Drainage Report (FDR) is to identify and evaluate the offsite and onsite drainage patterns associated with Aspen Meadows Filing No. 2rails at Aspen Ridge development (13.88 acres, 73 Lots) and to provide hydrologic and hydraulic analyses of this area to ensure compliance with the City of Colorado Springs Drainage Criteria Manual (DCM) and the most recent MDDP and PDR Amendments, as well as provide effective, safe routing to downstream outfalls.

III. GENERAL LOCATION AND DESCRIPTION

Aspen Meadows Filing No. 2 is within the Woodmen Heights Master Plan area, Aspen Meadows subdivision, which extends from the Northpark Commercial site and Forest Meadows Filings 1-7 on the west to Sand Creek Channel on the east and south, to Sterling Ranch to the north. Aspen Meadows subdivision is bisected by two roadways, Marksheffel Road (running north-south) and Cowpoke Road (running east-west). More specifically, the study area is located as follows:

A. <u>General Location:</u> The northwest ¼ of Section 4, Township 13 South, Range 65 West of the 6th P.M. in the City of Colorado Springs, County of El Paso, State of Colorado.

B. Surrounding Streets and Developments:

a. North: Sterling Ranch, single family development. This area is located in El Paso County (development of this subdivision is in process).

b. East: Aspen Meadows Filing No. 1.

c. South: Future Aspen Meadows Filing No. 4, Regional Detention Basin No. 3 and Sand Creek Channel.

d. West: Northpark commercial landscape and Forest Meadows Filing Nos. 1-7 are all currently built out at this time.

C. Drainageway: This site is within the Sand Creek Drainage Basin.

D. Irrigation Facilities

No known functioning irrigation facilities are within the project area.

E. Utilities and Encumbrances

a) Storm Sewer: A 36" RCP storm sewer is stubbed out to the future west Cowpoke Road R.O.W. from the intersection of Cowpoke Road and Forest Meadows Avenue. This location will be the outfall for the Aspen Meadows Filing No. 2 development.

b) Sanitary Sewer: Sanitary sewer planning for future development has been stubbed out along Cowpoke Road at the south boundary of this filing.

c) Gas: There are three transmission mains (2-20" mains and a 6" main) running north to south along the eastern edge of the proposed development within a 145-foot easement. There is also an existing CSU gas main running east to west immediately south of the site within the future Cowpoke Road R.O.W.

d) Water: An existing 24-inch water transmission main associated with development in the area crosses from east to west just south of Aspen Meadows Filing No. 2 within future R.O.W. for Cowpoke Road.

e) Electric: There are no known electric encumbrances on the project site.

IV. Referenced Drainage Reports

This site is within the Woodmen Heights Master Plan area, Aspen Meadows subdivision. This study looks at Aspen Meadows Filing No. 2, which takes up the northwest 13.88 acres of the Aspen Meadows Subdivision. The four reports below were used as references for this report.

*"Master Development Drainage Plan for Woodmen Heights Master Plan", by Classic Consulting Engineers and Surveyors, LLC, June 2004. (***WHMP-MDDP***)*

*"Master Development Drainage Plan Update for Woodmen Heights and Final Drainage Report for Forest Meadows Filing No. 1 and No. 4", by Engineering and Surveying, Inc., February 2006 (***MDDP Update***)*

*"Final Drainage Report for Sterling Ranch Filing No. 2", El Paso County, by M & S Civil Consultants, Inc., December 2017. (***SR-FDR***)*

*"Preliminary Drainage Report for Aspen Meadows Filing No. 2 and No. 4", completed by Matrix Design Group, Dated January 2021. (***PDR-Matrix***) In progress.*

*"Amendment Letter to the Final Drainage Report for Forest Meadows Filing No. 6 & No. 6A and Final Drainage Report for Forest Meadows Filing No. 7 & No. 7A", by M&S Civil Consultants, Inc., September 2014. (***FDR-FM-7A***)*

*"Channel Design Report: Sand Creek Stabilization at Aspen Meadows Subdivision Filing No. 1", by Matrix Design Group, March 2021 (In progress). (***CDR-Matrix***)*

V. Land Uses

Land uses for the proposed development will be multi-family residential, public roads, and open space.

VI. SOIL CONDITIONS

Soils can be classified in four different hydrologic groups, A, B, C, or D to help predict stormwater 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 C. Table 3.1 on the following page lists the soil types present in the development area:

Table 3.1 – NRCS Soil Survey for El Paso County

SOIL ID NUMBER	***SOIL***	***HYDROLOGIC CLASSIFICATION***	***PERMEABILITY***	***PERCENT ON SITE***
8	Blakeland loamy sand, 1 to 9 percent slopes	A	Well Drained	6.7%
9	Blakeland-Fluvaquentic Haplaquolls	A	Well Drained	6.6%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	Well Drained	86.7%

Predevelopment site conditions are undeveloped and ground cover consists of sparse natural vegetative land cover.

VII. Project Characteristics

Aspen Meadows Filing No. 2:

a. **Onsite Flows:** Filing No. 2 contains 13.88 acres of area within the Sand Creek Drainage Basin. Under predevelopment conditions flows in this area generally flow south and to the west. After development, flows will generally sheet flow to curb and gutter within Vibrant Drive in the center of the development, where they will be conveyed downstream via gutter flow towards a pair of at-grade inlets which will capture the flows. Alternately flows may sheet flow towards swales along the outside boundaries of the development which will convey the captured flows downstream. Ultimately onsite flows will be conveyed to the proposed Pond-1 via storm sewer.

b. **Offsite Flows:** 25.03 acres at the southwestern portion of the Sterling Ranch development are located within the Sand Creek Drainage Basin. Presently, the runoff from this area is conveyed to the gas transmission main easement via sheet flow and continues to the south. When the offsite area within Sterling Ranch develops, runoff will be routed to the Sterling Ranch detention facility to be located north of Aspen Meadows Filing No. 1 to the east. Until the Sterling Ranch area develops, runoff sheet flows to the gas transmission main west at slopes ranging from 1.0% to 1.7%. until reaching Cowpoke Road, eventually crossing Cowpoke Road via a proposed 30-inch culvert pipe and a proposed triangular swale that conveys flows to Sand Creek Channel. Development of Filing No. 2 will capture these offsite flows and convey them downstream via storm sewer along Cowpoke Road

VIII. Regulatory Floodplain

Per the ***Flood Insurance Rate Map (FIRM)*** 08041CO533 G, effective date December 7, 2018, published by the Federal Emergency Management Agency (FEMA), no portion of Aspen Meadows Filing No. 2 lies within any designated 100-year floodplain. An annotated FIRM Panel is included in Appendix C.

IX. Drainage Design Criteria

A. Design References

As required by the City of Colorado Springs, Colorado, this report has been prepared in accordance to the criteria set forth in the *City of Colorado Springs and El Paso County Drainage Criteria Manual Volume 1 & 2* (Drainage Criteria Manual or **DCM**).

In addition to the DCM, 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).

B. Design Frequency

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

C. Design Discharge

a. Method of Analysis

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:

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 Drainage Criteria Manual 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 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.

e. StormCAD Analysis

1. HGL Profiles

StormCAD was also used to determine the Hydraulic Grade Profiles for the major and minor storms. The standard method was (or will in a future addendum be) used to calculate head loss in the system with K coefficients taken from Table 9-4 of the DCM.

Table 9-4. STORMCAD Standard Method Coefficients

Bend Loss		
Bend Angle	**K Coefficient**	
0°	0.05	
22.5°	0.10	
45°	0.40	
60°	0.64	
90°	1.32	
LATERAL LOSS		
One Lateral K Coefficient		
Bend Angle	Non-surcharged	Surcharged
45°	0.27	0.47
60°	0.52	0.90
90°	1.02	1.77
Two Laterals K Coefficient		
45°	0.96	
60°	1.16	
90°	1.52	

X. Drainage Basins and Sub-basins

A. The ***historic conditions*** for the site have been analyzed and are presented by design points (Table 6.2) and are described as follows:

Historically, onsite drainage currently flows from the northeastern corner of the site to the southwestern corner (Sub-basins EX1 (Q_5 = 1.31 cfs, Q_{100} = 8.77 cfs), EX2 (Q_5 = 3.29 cfs, Q_{100} = 22.12 cfs), & EX3-NW (Q_5 = 0.69 cfs, Q_{100} = 4.66 cfs)), both overland and through natural drainage swales and channels, and eventually discharges directly into the Sand Creek Channel. The adjacent Sterling Ranch property to the north (Sub-basin EX4) contributes offsite drainage at the north end of the proposed town home site. These minimal flows will be routed around the site via the existing gas easement. It is anticipated that, as the Sterling Ranch develops, these flows will be routed to the development's detention facility located north of Aspen Meadows Filing No. 1 to the east.

Total discharge to the Sand Creek Channel is approximately 8.90 cfs for the Q_5 event and 59.98 cfs for the Q_{100} event.

Historic conditions consider all of the areas as undeveloped. Sub-basins and Design points are summarized in the tables on the following page:

Table 6.1 Aspen Meadows Filing No. 2 FDR Historic Conditions Sub-basin Summary Table			
Area ID	**Area (Acres)**	**Q5 (cfs)**	**Q100 (cfs)**
EX4	23.05	3.26	21.88
EX3NW	3.95	0.69	4.66
EX2	24.81	3.29	22.12
EX1	8.80	1.31	8.77

Table 6.2 Aspen Meadows Filing No. 2 FDR Historic Design Point Summary				
Design Point	**Sub-Basins**	**Total Area (ac.)**	**Q(5) (cfs)**	**Q(100) (cfs)**
EX1	EX1	8.80	1.31	8.77
EX2	EX2	24.81	3.29	22.12
EX3	EX3NW	3.95	0.69	4.66
TO SAND CREEK CHANNEL	BJR-2	**37.56**	**8.9**	**59.98**

B. The ***interim/existing conditions*** for the site have been analyzed and are presented by design points (Table 6.4) and are described as follows:

In the interim/existing condition, over-lot grading activities have taken place. No impervious surfaces have been added, runoff is directed in the same manner as the fully developed conditions. Onsite drainage will continue to flow from the northeastern corner of the site to the southwestern corner (Sub-basins PR-A (Q_5 = 0.37 cfs, Q_{100} = 2.47 cfs), PR-B (Q_5 = 1.39 cfs, Q_{100} = 9.32 cfs), PR-D (Q_5 = 0.19 cfs, Q_{100} = 1.25 cfs),& PR-E (Q_5 = 0.17 cfs, Q_{100} = 1.15 cfs)), both overland and through graded drainage swales that route through a proposed sediment basin before being conveyed through Aspen Meadows Filing No. 4, and eventually discharges directly into the Sand Creek Channel. For further information please reference ***PDR-Matrix*** which has detailed analysis of these conditions.

Total discharge to Aspen Meadows Filing No. 2 sediment basin is approximately 1.56 cfs for the Q_5 event and 10.51 cfs for the Q_{100} event.

Interim/existing conditions continue to consider all of the areas as undeveloped. Sub-basins and Design points are summarized in the tables on the following page:

Table 6.3 **Aspen Meadows Filing No. 2** **FDR** **Interim/Existing Conditions Sub-basin Summary Table**			
Area ID	**Area (Acres)**	**Q5 (cfs)**	**Q100 (cfs)**
OS-1	23.05	**3.87**	**25.98**
PR-A	1.11	**0.37**	**2.47**
PR-B	6.34	**1.39**	**9.32**
PR-C	4.61	**0.93**	**6.24**
PR-D	0.51	**0.19**	**1.25**
PR-E	0.56	**0.17**	**1.15**
PR-F	1.16	**0.39**	**2.59**
PR-G	0.87	**0.28**	**1.91**
PR-H	8.74	**2.01**	**13.50**
PR-I	12.65	**2.47**	**16.59**
PR-J	1.01	**0.23**	**1.55**

Table 6.4 **Aspen Meadows Filing No. 2** **FDR** **Interim/Existing Design Point Summary**				
Design Point	**Sub-Basins**	**Total Area (ac.)**	**Q(5) (cfs)**	**Q(100) (cfs)**
1	OS-1	23.05	**3.87**	**25.98**
2	OS-1, PR-C	27.66	**3.72**	**25.02**
3	PR-A, PR-B	7.45	**1.71**	**11.48**
4	DP3, PR-D	7.96	**1.56**	**10.51**
5	DP2, DP4	35.62	**4.73**	**31.77**
*6	PR-G	0.87	**0.28**	**1.91**
*7	DP5, PR-J	36.63	**3.90**	**26.20**
*8	DP6, PR-H	9.61	**1.31**	**8.78**
*9	PR-I	12.65	**2.47**	**16.59**
TO SAND CREEK CHANNEL	Aspen Meadows Flg No. 2	**37.34**	**6.21**	**42.28**
*=Part of Aspen Meadows Flg No. 4				

C. The ***fully developed conditions*** for the site are as follows:

Under proposed conditions, final development will have taken place. Impervious surfaces have been added. Townhomes will be in place, streets will be paved, sidewalks and driveways will be finished, utilities will have been installed, detailed grading has taken place. Runoff will be directed to ultimate build out conditions via curb and gutter and storm sewer infrastructure. Onsite drainage will flow from the northeastern portion of the site to the southwestern corner where runoff flows are directed to a proposed detention pond (Pond-1).

Treated flows are then discharged from the proposed Pond-1 (Full Spectrum Detention Pond) via a proposed 18-inch RCP (Private) and will combine with offsite flows from the existing gas easement area. These flows are then conveyed downstream to the proposed low-point location in Cowpoke Road (DP14 or FDR-FM-7A: DP 16 and 16A), just east from Forest Meadows Avenue via proposed 30-inch RCP (Public).

Captured storm water at the low-point in Cowpoke Road (DP14 or FDR-FM-7A: DP 16 and 16A) is then conveyed downstream within a proposed 36-inch storm pipe (Public) to an existing manhole (Public) within Forest Meadows Avenue (66-inch RCP Storm Pipe) and are discharged to Regional Pond-3 within the existing Forest Meadows Storm Sewer.

The additional offsite area (OS-1) added to the tributary area of this existing storm sewer is offset by the provision of onsite detention in this filing. Originally FDR-FM-7A anticipated 65 cfs for the major event. This filing is anticipating 35.4 cfs which is well below the originally anticipated flows indicating that the downstream infrastructure should have no issues with the added flow.

Please note that runoff from Sub-basin PS-1 will have Water Quality Treatment provided in the Marksheffel WQ pond just north of Sand Creek and west of Marksheffel Road. This item will be addressed in the Addendum to the Aspen Meadows Filing No. 1 FDR. Based on Rational Calculations for Sub-basin PS-1 the difference between undeveloped and developed conditions is 0.37 cfs. Pond-1 will therefore need to over detain by 0.37 cfs to make up for the increase in developed flows to Sand Creek.

Sub-basins and Design Points for the fully developed conditions are summarized in Tables 6.5, 6.6 and 6.7 below and on the following pages.

Total flows to Aspen Meadows Filing No. 2 Pond-1 are approximately 13.55 cfs for the Q_5 event and 30.68 cfs for the Q_{100} event.

Sub-basins and Design points are summarized in the tables on the following page:

Table 6.5
Aspen Meadows Filing No. 2
FDR
Fully Developed Conditions - Sub-basin Summary

Basin	Area	Q5	Q100
	acres	cfs	cfs
OS-1	23.05	**3.87**	**25.98**
PS-1	0.14	**0.35**	**0.75**
PS-1 (Undeveloped)	0.14	**0.06**	**0.38**
PS-2	0.65	**1.16**	**2.46**
PS-3	1.64	**3.35**	**7.12**
PS-4	1.51	**2.79**	**5.94**
PS-5	0.64	**1.20**	**2.54**
PS-6	4.70	**0.98**	**6.60**
PS-7	1.99	**4.01**	**8.53**
PS-8	0.91	**1.88**	**4.00**
PS-9	0.61	**1.17**	**2.49**
PS-10	0.65	**0.34**	**2.00**
PS-11	0.92	**3.60**	**6.45**

Table 6.6
Aspen Meadows Filing No. 2
FDR
Fully Developed Conditions – Design Point Summary

Design Point	Total Drainage Area	Storm Sewer		Downstream Design Point
		Q5 (cfs)	Q100 (cfs)	
1	23.05	**3.87**	**25.98**	2
2	27.75	**3.73**	**25.09**	13
3	0.65	**1.16**	**2.46**	4
4	2.29	**4.06**	**8.64**	7
5	0.64	**1.20**	**2.54**	6
6	2.14	**4.32**	**9.19**	7
7	4.43	**8.94**	**19.00**	9
8	1.99	**4.01**	**8.53**	9
9	6.43	**11.69**	**24.85**	10
10	7.34	**13.35**	**28.38**	11
11	8.61	**14.58**	**31.95**	12 (Pond Outfall)
12	8.61	**0.20**	**3.90**	13
13	36.35	**3.93**	**28.99**	14
14	37.28	**7.53**	**35.44**	EX 66-inch Forest Meadows Ave. (Public)

Table 6.7 DESIGN POINT DESCRIPTIONS Aspen Meadows Filing No. 2		
Design Point	**Description**	**Downstream Design Point**
1	30-inch flared end section (FES) capturing flows from offsite basin OS-1. Flows are conveyed downstream via 30-inch RCP (Private) and sheet flow (gas easement)	2
2	30-inch flared end section (FES) capturing flows from sub-basins OS-1 & PS-6. Flows are conveyed downstream via 30-inch RCP (Private)	13
3	18-inch flared end section (FES) capturing flows from sub-basin PS-2. Flows are conveyed downstream via 18-inch RCP (Public)	4
4	6' Type R sump inlet (Public) capturing flows from sub-basin PS-3. Flows are conveyed downstream via 24-inch RCP (Public)	7
5	CDOT Type C Inlet (Public) capturing flows from sub-basin PS-5. Flows are conveyed downstream via 18-inch RCP (Public).	6
6	6' Type R sump inlet (Public) capturing flows from sub-basin PS-4. Flows are conveyed downstream via 18-inch RCP (Public)	7
7	Manhole (Public) combining flows from DPs 4 & 6. Flows are conveyed downstream via 24-inch RCP (Public).	9
8	6' Type R sump inlet (Public) capturing flows from sub-basin PS-7. Flows are conveyed downstream via 18-inch RCP (Public)	9
9	Manhole (Public) combining flows from DPs 7 & 8. Flows are conveyed downstream via 30-inch RCP (Public).	10
10	6' Type R sump inlet (Public) capturing flows from sub-basin PS-8. Flows are conveyed downstream via 30-inch RCP (Public)	11
11	Pond-1 (Private) combining flows from DP 10 and sub-basins PS-9 and PS-10. Flows are conveyed downstream via 24-inch RCP (Public).	12 (Outfall)
12	Outlet structure (Private) releasing flows from Pond-1. Flows are conveyed downstream via 24-inch RCP (Public).	13
13	Manhole (Public) combining flows from DPs 12 & 2. Flows are conveyed downstream via 30-inch RCP (Public).	14
14	Manhole (Public) combining flows from DP 13 and sub-basin PS-11. Flows are conveyed downstream via 36-inch RCP (Public). *Note: The anticipated discharge to the existing manhole in Forest Meadows Avenue is less than those originally described in FDR-FM-7A (DP16 & DP16A).*	EX 66-inch Forest Meadows Ave. (Public)

- Generally, flows will sheet flow off developed lots towards adjacent streets or swales which will capture flows and direct them downstream to the nearest inlets. After capture in inlets the flows will be conveyed onwards towards the downstream detention basin via storm sewer.

  Hydraflow Express was utilized to check the velocity of the anticipated Full Buildout Q_{100} Discharge and calculated a velocity in the 24" outfall pipe of 12.9 feet per second.

  Hydraflow calculations were also performed for the rear-lot swales (Sub-basins PS-2, PS-5, and PS-9) conveying minimal runoff flows southward to points of collection and Pond-1. The results of these calculations indicated that the anticipated worst-case scenario for the velocity of a Q_5 event in the swales is around 2.3 feet per second and for a Q_{100} event is around 3.8 feet per second. Both of which are well below the maximum 5-year and 100-year velocities indicated for erosive soils in Table 12-3 (shown below) of the DCM regarding Hydraulic Design Criteria for natural unlined channels. Additionally, the outfalls for each of the swales will discharge to a rip rap lined low tailwater basin and/or rip rap run down designed in accordance with UDFCD criteria.

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."

The Web Soil Survey for the site indicates that the Soils for the receiving swale are are classified as Columbine gravelly sandy loam which is likely an erosive soil.

The proposed southwest rear-lot swale (in Sub-Basin PS-9) will convey the stormwater to the northwest corner of Pond-1.

XI. Drainage Facility Design

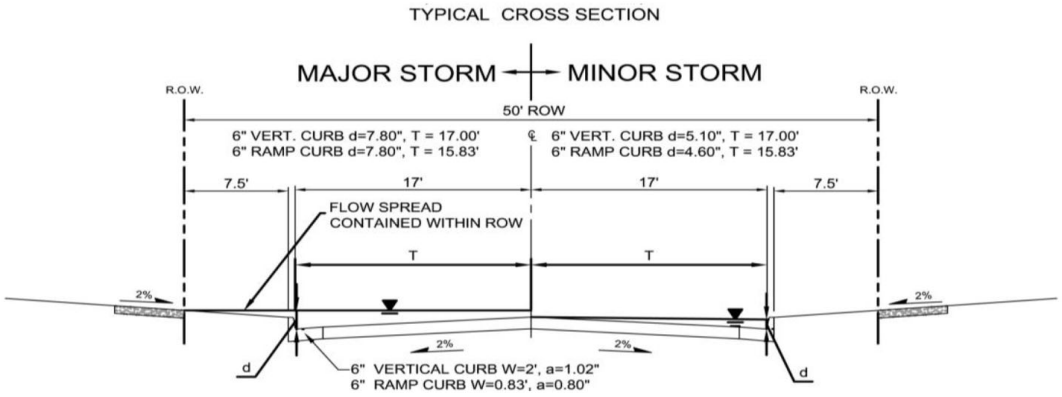
A. Street Capacity

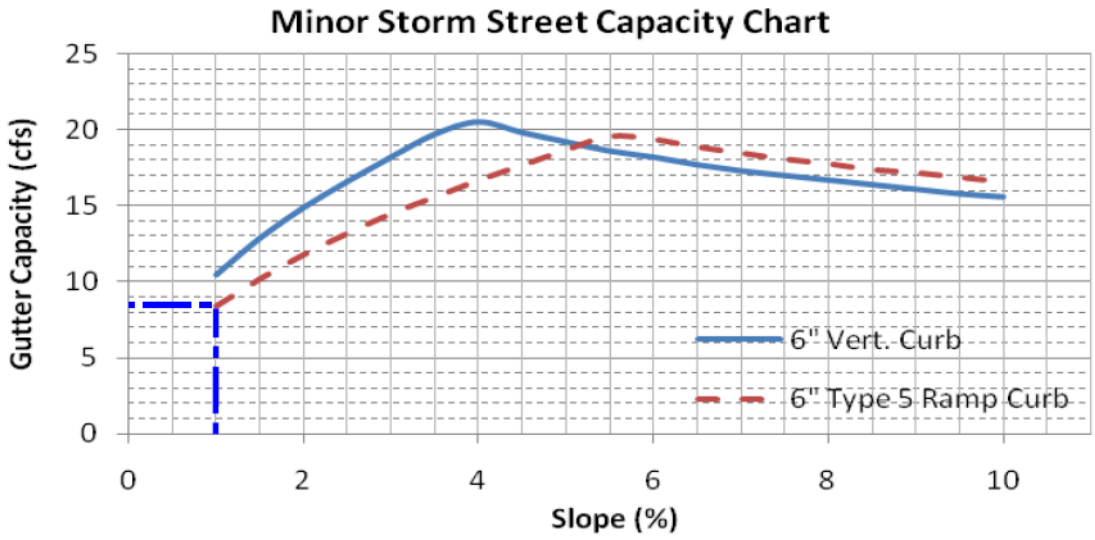
The width of the typical section for streets within Filing No. 2 will be 35 feet from back of curb to back of curb. Curb heights will be 6-inch. These streets will generally utilize City of Colorado Springs Type 5 residential curb and gutter with Type 2 6" vertical curb and gutter used for parking areas and the curb radii through intersections. The following table (Table 7.1) lists streets and capacities by Design Point:

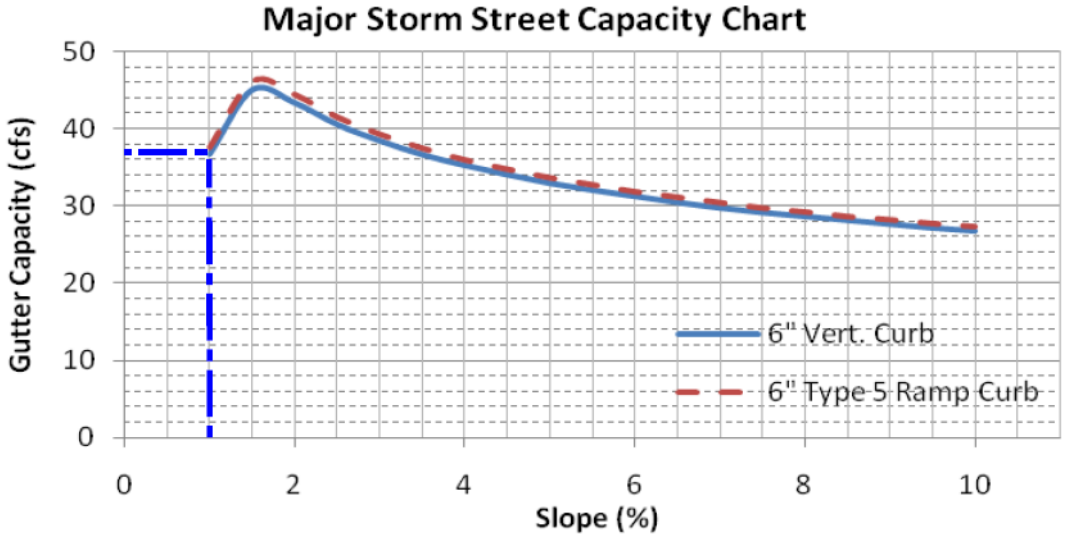
Table 7.1 ***STREET CAPACITIES***							
Aspen Meadows Filing No. 2							
Street	***Location***	***DESIGN POINT***	***Slope %***	***ROAD CAPACITY MINOR STORM (cfs)***	***Q_5 TOTAL FLOW (cfs)***	***ROAD CAPACITY MAJOR STORM (cfs)***	***Q_{100} TOTAL FLOW (cfs)***
Grey Bark Way	Grey Bark Way East Mid-block	4	1.25	**9.0**	**3.35**	**41.0**	**7.12**
Grey Bark Way	Grey Bark Way West Mid-block	6	1.25	**9.0**	**2.79**	**41.0**	**5.94**
Grey Bark Way	Grey Bark Way Southeast Sump	8	1.25	**9.0**	**4.01**	**41.0**	**8.53**
Grey Bark Way	Grey Bark Way Southwest Sump	10	1.25	**9.0**	**1.88**	**41.0**	**4.00**

Figure 7-7 from the DCM is shown below and on the following page:

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







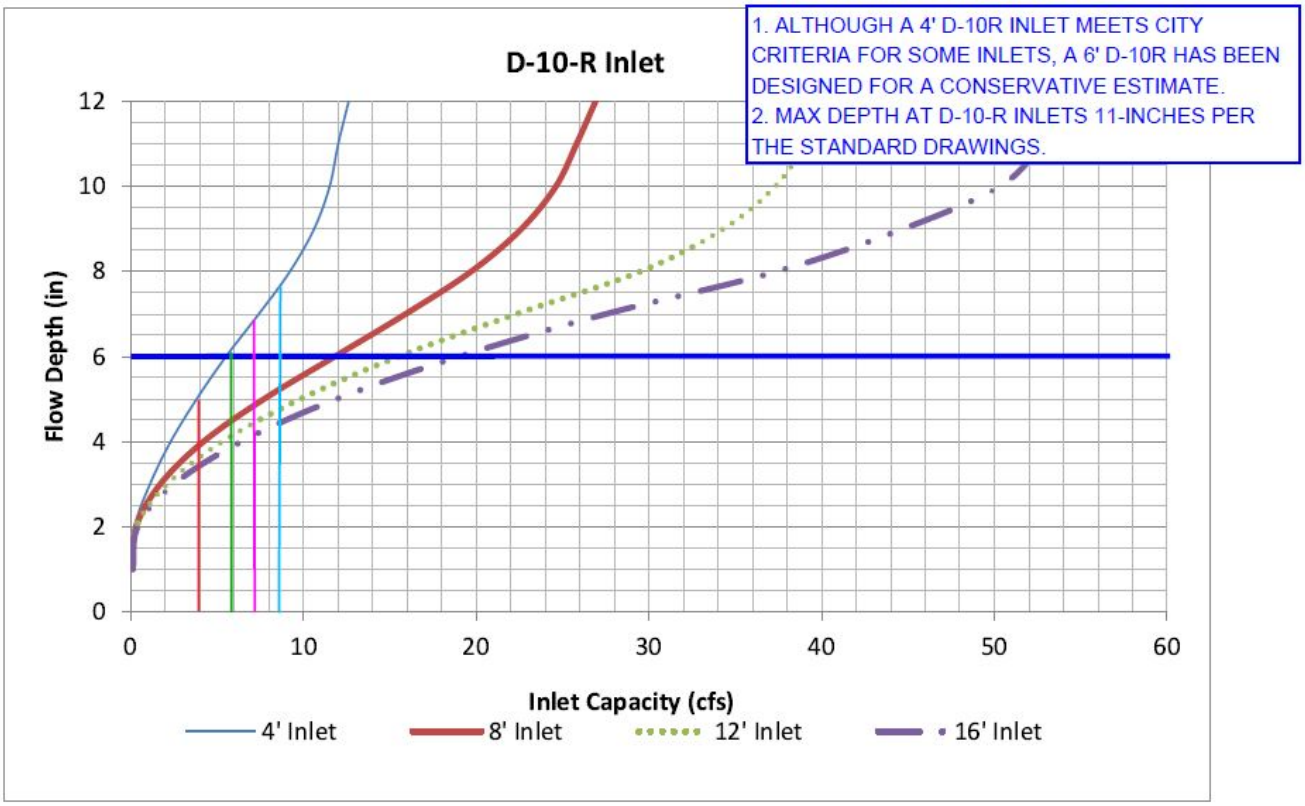
Notes:

- City of Colorado Springs Type 5 residential curb and gutter was used for all streets.
- The nomograph (Figure 7-7) above was used to calculate capacities for the City of Colorado Springs Type 5 residential (Local/Residential) streets within the project area.

B. Inlet Capacity

In accordance with the DCM, this project will use City of Colorado Springs Type D10-R inlets and a CDOT Type C inlet. Sump inlet capacities were determined utilizing DCM Figure 8-12 shown below. The following Table 7.2 lists inlets by design point and corresponding capacity. Table 7.3 describes overflow routing for each sump inlet.

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



INLET DP4: Q(5) = **3.35** cfs; Q(100) = **7.12** cfs>> 6' D-10R
INLET DP6: Q(5) = **2.79** cfs; Q(100) = **5.94** cfs>> 6' D-10R
INLET DP8: Q(5) = **4.01** cfs; Q(100) = **8.53** cfs>> 6' D-10R
INLET DP10: Q(5) = **1.88** cfs; Q(100) = **4.00** cfs>> 6' D-10R

Please see Appendix C for CDOT standard M-604-10 for Type C inlet.

Table 7.2 ***PROPOSED INLET SUMMARY*** ***Aspen Meadows - Filing No. 2***											
DESIGN POINT	***SUB-BASIN***	***TOTAL AREA (AC)***	***INLET***			***Q(5) BYPASS FLOWS (cfs)***	***Q(5) TOTAL INFLOW***	***Q(100) BYPASS FLOWS (cfs)***	***Q(100) TOTAL INFLOW (cfs)***	***INLET CAPACITY***	***NOTES:***
			SIZE (Ft.)	***TYPE***	***CONDITION***						
4	PS-3	1.64	**6**	R	**SUMP**	**0.0**	**3.35**	**0.0**	7.12	**8.5**	***Mid-block parking***
5	PS-5	0.64	**6**	**C**	**SUMP**	**0.0**	**1.20**	**0.0**	**2.54**	**8.5**	***Rear lots swale***
6	PS-4	1.51	**6**	R	**SUMP**	**0.0**	**2.79**	**0.0**	**5.94**	**8.5**	***Mid-block parking***
8	PS-7	1.99	**8**	R	**SUMP**	**0.0**	**4.01**	**0.0**	**8.53**	**12.0**	***SE Sump***
10	PS-8	0.91	**6**	R	**SUMP**	**0.0**	**1.88**	**0.0**	**4.00**	**8.5**	***SW Sump***

Table 7.3 ***Overflow Routing*** ***Aspen Meadows, Filing No. 2***	
Inlet	***Overflow Routing Under Inlet Blockage Conditions***
DP4	If this inlet is blocked flows will surcharge the curb and gutter at the mid-block parking area and be carried downstream (southward) via curb & gutter to inlet DP8.
DP5	If this inlet is blocked flows will surcharge the swale along the rear property line and continue downstream (southward) to Pond-1 via the continuing rear-lot swale.
DP6	If this inlet is blocked flows will surcharge the curb and gutter at the mid-block parking area and be carried downstream (southward) via curb & gutter to inlet DP10.
DP8	If this inlet is blocked flows will surcharge the crown of the road and enter either Pond-1 or enter into Cowpoke Road and enter the sump inlets just east of Forest Meadows Ave.
DP10	If this inlet is blocked flows will surcharge the crown of the road and enter either Pond-1 or enter into Cowpoke Road and enter the sump inlets just east of Forest Meadows Ave.

C. Storm Sewer Capacities

Storm sewer capacities and HGL's will be submitted with a future drainage addendum. These will be analyzed utilizing StormCAD software. Interim pipe calculations can be found in Appendix A.

D. Detention

Summary information for Pond-1 is listed below. Supporting UD-Detention spreadsheets can be found in Appendix A. Pond-1 will provide full spectrum detention for the filing and will be privately owned and maintained by the Woodmen Heights Metropolitan District. Note that the pond over detains by 0.5 cfs to account for the portion of Vibrant Drive which will be directed through the Marksheffel Road WQ Pond located west of Marksheffel and north of Sand Creek.

Table 7.4
Pond Summary Table

Major Basin	Pond ID	Analysis Method	Contributing Basins	Approximate Detention Volumes			EX 5 Year	Proposed 5 Year	EX 100 Year	Proposed 100 Year
				WQCV	EURV	Q100				
				Ac.-Ft.	Ac.-Ft.	Ac.-Ft.	(CFS)	(CFS)	(CFS)	(CFS)
Sand Creek	Pond-1	UD-Detention	PS-1, PS-2, PS-3, PS-4, PS-5, PS-7, PS-8, PS-9, PS-10	0.183	0.513	1.057	0.01	**0.2**	4.4	**3.9**

Emergency Overflows

Table 7.5
Emergency Overflow Weirs

Major Basin	Pond ID	Description of Emergency Overflow Weir
Sand Creek	Pond-1	The emergency overflow weir for this pond will release emergency overflows to Cowpoke Road along the southern edge of the development boundary and direct the flows westward to two D10-R sump inlets that capture flows into the 36-inch and 66-inch storm system. Flows will then follow historic patterns to the south into Regional Pond #3.

Outfall Analysis

Pond-1

The emergency spillway for Pond-1 was analyzed utilizing Figure 13-12b and Figure 13-12d (see following page).

Figure 13-12b. Emergency Spillway Profile at Embankment

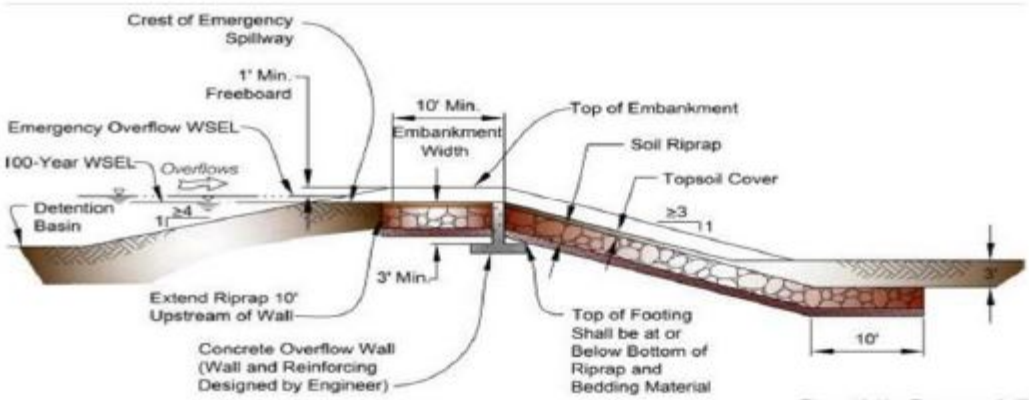
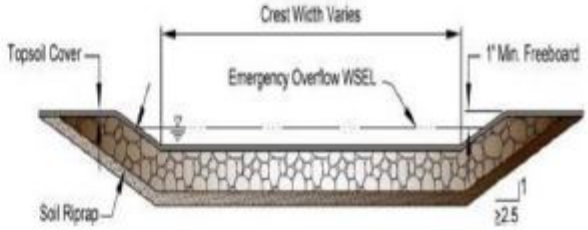


Figure 13-12c. Emergency Spillway Protection

ROAD EMBANKMENT PROTECTION CALCULATION
Q=30.68 CFS
LENGTH=40
UNIT FLOW RATE: 0.8 CFS/FT

=> TYPE VL RIP RAP



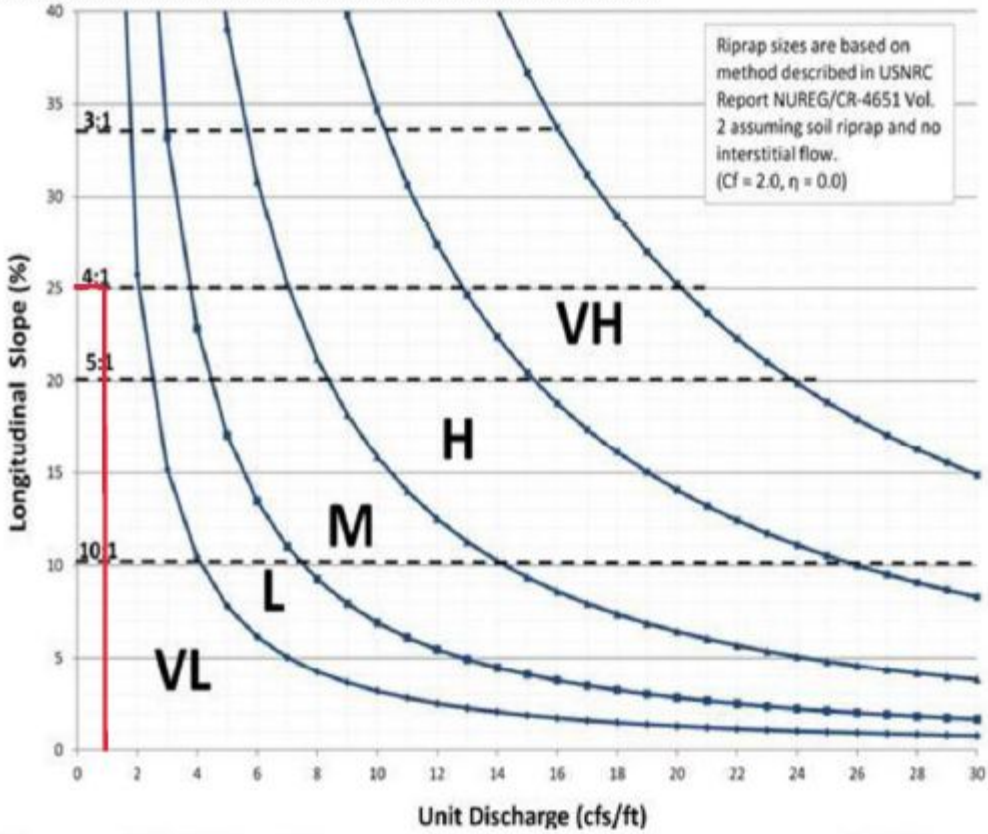


Figure 13-12d. Riprap Types for Emergency Spillway Protection

Pond-1 Phasing:

Pond-1 was essentially initiated for construction as part of the over-lot grading operations as one of the temporary sediment basins in the **PDR-Matrix**. The pond was built to the size required for treatment of upstream tributary area. Expansion of the pond volume will be completed as part of the fully developed conditions in Aspen Meadows Filing No. 2.

XII. Environmental Evaluations

A. WETLAND IMPACTS

There are no designated wetland or riparian areas on site, and no anticipated impacts.

B. STORMWATER QUALITY

The on-site detention facility shall be 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 Chapter 6, Section 7.1, of the City of Colorado Springs DCM, Volume 2, the DCM requires a 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: Employ Runoff Reduction Practices

- 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. This can be seen in the swales called for along the outside borders of the subdivision.

Step 2: Treat and Slowly Release the WQCV

- Pond-1 meets the DCM standards for the release rates of Full Spectrum Detention Ponds for Water Quality Capture Volumes.

Step 3: Stabilize Stream Channels.

- The site is in the Sand Creek drainage basin. Drainage fees, to be paid by the Aspen Meadows Filing No. 2 developers at the time of platting, will help fund future channel improvements. CDR-Matrix describes the proposed improvements to Sand Creek which will provide for a stabilized stream channel.

Step 4: Implement Source Controls

- Dumping of waste materials in the proposed storm system is not permitted.
- 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.
- There are no plans for outdoor stockpiling of materials onsite after construction has been completed, therefore, no other source control BMPs are anticipated at this time.

XIII. PERMITTING REQUIREMENTS

No additional permitting requirements are expected at this time.

XIV. Erosion Control Plan

A grading and erosion control plan (GEC) for Aspen Meadows Filing No. 2 will be completed. The GEC incorporates 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. Please refer to the GEC for procedural information. An over-lot grading GEC for Aspen Meadows Filings No. 2 and 4 has also been completed.

XV. Drainage Fees

TRAILS AT ASPEN RIDGE FILING NO. 2 Final Drainage Report 2021 Drainage and Bridge Fees						
	Impervious Area (ac.)	Fee/ Imp. Acre	Fee Due	Reimbursable Const. Costs	Fee Due at Platting	Drainage Fee Credit
Sand Creek						
Drainage Fee	13.885	$18,841.00	$261,607.29	$0.00	$261,607.29	$0.00
				$0.00	***$261,607.29***	

XVI. Construction Cost Opinion

Engineer's Estimate of Probable Construction Costs				
Aspen Meadows Filing No. 2				
Public Non-Reimbursable				
Item	**Unit**	**Quantity**	**Unit Cost**	**Extension**
18" RCP/HP	LF	360	$65/LF	$23,400.00
24" RCP/HP	LF	585	$78/LF	$45,630.00
30" RCP/HP	LF	350	$97/LF	$33,950.00
36" RCP/HP	LF	485	$120/LF	$58,200.00
6' D10-R Inlet	EA	5	$5,750/EA	$28,750.00
8' D10-R Inlet	EA	1	$7,600/EA	$7,600.00
Type C Inlet	EA	1	$4,640/EA	$4,640.00
6'-4" Type I Storm MH	EA	6	$11,625/EA	$69,750.00
			Sub Total	$271,920.00
Private Non-Reimbursable				
Full Spectrum Detention Pond	L.S.	1	$300,000 L.S.	$300,000.00
24" RCP/HP	LF	68	$78/LF	$5,304.00
			Sub Total	$305,304.00
			Total Estimated Construction Costs	$577,224.00
			10% Contingency	$57,722.40
			TOTAL:	$634,946.40

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 opinions of probable cost.

XVII. Summary

The above report has demonstrated that the proposed development will comply with the governing DCM, previous drainage reports, and the City of Colorado Springs MS4 permit. No adverse effect on downstream infrastructure is anticipated. Therefore, we recommend approval of the proposed development.

XVIII. References

1. ***City of Colorado Springs Drainage Criteria Manual, Volume 1 & 2***, El Paso County, May 2014
2. ***Web Soil Survey of El Paso County Area, Colorado. Unites States Department of Agriculture Soil Conservation Service***.
3. ***Flood Insurance Rate Maps for El Paso County, Colorado and Incorporated Areas, Panel 533 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. ***"Master Development Drainage Plan for Woodmen Heights Master Plan",*** by Classic Consulting Engineers and Surveyors, LLC, June 2004. *(***WHMP-MDDP***)*
6. ***"Master Development Drainage Plan Update for Woodmen Heights and Final Drainage Report for Forest Meadows Filing No. 1 and No. 4",*** by Engineering and Surveying, Inc., February 2006 *(***MDDP Update***)*
7. ***"Final Drainage Report for Sterling Ranch Filing No. 2",*** El Paso County, by M & S Civil Consultants, Inc., December 2017 *(***SR-FDR***)*
8. ***"Preliminary Drainage Report for Aspen Meadows Filing No. 2 and No. 4",*** completed by Matrix Design Group, Dated January 2021 *(***PDR-Matrix***)* (Approval Pending)
9. ***"Amendment Letter to the Final Drainage Report for Forest Meadows Filing No. 6 & No. 6A and Final Drainage Report for Forest Meadows Filing No. 7 & No. 7A",*** *by M&S Civil Consultants, Inc., September 2014. (***FDR-FM-7A***)*
10. ***"Channel Design Report: Sand Creek Stabilization at Aspen Meadows Subdivision Filing No. 1",*** *by Matrix Design Group, March 2021 (In progress). (***CDR-Matrix***)*

XIX. Appendices

APPENDIX A

HYDROLOGIC AND HYDRAULIC CALCULATIONS

Project Name:	Aspen Meadows Filing No. 2
Project Location:	Colorado Springs, CO
Designer	BAS
Notes:	Existing Condition

Average Channel Velocity	4	ft/s
Average Slope for Initial Flow	0.04	ft/ft

(If specific channel vel is used, this will be ignored)
(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					
				Surface Type 1 (Residential 1/8 Acre Lots)			Surface Type 2 (Impervious)			Surface Type 3 (Undeveloped)			Composite		Initial	True Initial	Channel	True Channel	Average (decimal)	Initial	Average (%)	Channel Flow Type (See Key above)	Velocity	Channel	Total	i2	Q2	i5	Q5	i100	Q100
Sub-basin	**Comments**	sf	acres	C5	C100	Area (SF)	C5	C100	Area (SF)	C5	C100	Area	C5	C100	ft	Length ft	ft	Length ft	Slope	Tc (min)	Slope	Ground Type	(ft/s)	Tc (min)	(min)	in/hr	cfs	in/hr	cfs	in/hr	cfs
EX-1		383,376	8.80	0.45	0.59		0.90	0.96		0.09	0.36	383,376	0.09	0.36	100	100.00	1630	1630.00	0.009	18.69	2.02	4	1.0	27.4	46.1	1.5	**1.2**	1.9	**1.49**	3.1	**10.05**
EX-2		1,080,724	24.81	0.45	0.59		0.90	0.96		0.09	0.36	1,080,724	0.09	0.36	200	200.0	2155	2155.0	0.029	18.11	2.14	4	1.0	35.4	53.5	1.4	**3.0**	1.7	**3.84**	2.9	**25.78**
EX-3-NW		172,062	3.95	0.45	0.59		0.90	0.96		0.09	0.36	172,062	0.09	0.36	200	200.00	1131	1131.00	0.023	19.39	2.44	4	1.1	17.4	36.8	1.7	**0.6**	2.2	**0.77**	3.6	**5.18**
EX-4		1,004,058	23.05	0.45	0.59		0.90	0.96		0.09	0.36	1,004,058	0.09	0.36	200	100.0	1510	1610.0	0.020	20.41	1.77	4	0.9	29.4	49.8	1.4	**3.0**	1.8	**3.73**	3.0	**25.07**
DESIGN POINTS	***INCLUDED SUB-BASINS***																														
EX1	***EX1***	383,376	8.80	0.45	0.59		0.90	0.96		0.09	0.36	383,376	0.09	0.36	100	100.0	1630	1630.0	0.009	18.69	2.02	4	1.0	27.4	46.1	1.5	**1.2**	1.9	**1.49**	3.1	**10.05**
EX2	***EX2, EX4***	2,084,782	47.86	0.45	0.59		0.90	0.96		0.09	0.36	2,084,782	0.09	0.36	200	100.00	4156	4256.00	0.029	18.03	2.04	4	1.0	71.7	89.7	1.0	**4.2**	1.2	**5.25**	2.0	**35.31**
EX3	***EX3***	172,062	3.95	0.45	0.59		0.90	0.96		0.09	0.36	172,062	0.09	0.36	200	200.00	1131	1131.00	0.023	19.39	2.44	4	1.1	17.4	36.8	1.7	**0.6**	2.2	**0.77**	3.6	**5.18**
	TOTAL AREA	2,640,220	60.61							0.09	0.36	2,640,220	0.09	0.36	200	200.00	4156	4256.00	0.029	18.03	2.04	4	1.0	71.7	89.7	1.0	**5.3**	1.2	**6.65**	2.0	**44.72**

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

Project Name: Aspen Meadows Filing No. 2
Project Location: Colorado Springs, CO
Designer BAS
Notes: Interim Condition

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

Average Channel Velocity 4 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)
Flow Length: True Initial Max 100 ft Developed
Max 300 ft Undeveloped

		Area		Rational 'C' Values											Flow Lengths				Initial Flow		Channel Flow				Tc	Rainfall Intensity & Rational Flow Rate					
				Surface Type 1 (Residential 1/8 Acre Lots)			Surface Type 2 (Impervious)			Surface Type 3 (Vegetated Areas)			Composite		Initial	True Initial	Channel	True Channel	Average (decimal)	Initial	Average (%)	Channel Flow Type (See Key above)	Velocity	Channel	Total	i2	Q2	i5	Q5	i100	Q100
Basin	Area Description	sf	acres	C5	C100	Area (SF)	C5	C100	Area (SF)	C5	C100	Area	C5	C100	ft	Length ft	ft	Length ft	Slope	Tc (min)	Slope	Ground Type	(ft/s)	Tc (min)	(min)	in/hr	cfs	in/hr	cfs	in/hr	cfs
OS-1	Offsite sub-basin north of project site	1,004,058	23.05	0.45	0.59		0.90	0.96		0.09	0.36	1,004,058	0.09	0.36	300	100.0	1,385	1585.0	0.025	23.20	2.50	4	1.1	23.9	47.1	1.5	3.1	1.8	**3.87**	3.1	**25.98**
A	Northwest sub-basin	48,352	1.11	0.45	0.59		0.90	0.96		0.09	0.36	48,352	0.09	0.36	50	50.0	188	188.0	0.020	10.20	1.00	5	1.0	3.1	13.3	2.9	0.3	3.6	**0.37**	6.1	**2.47**
B	Northwest mid-Sub-Basin	276,170	6.34	0.45	0.59		0.90	0.96		0.09	0.36	276,170	0.09	0.36	100	100.0	950	950.0	0.020	14.43	1.00	5	1.0	15.8	30.3	1.9	1.1	2.4	**1.39**	4.0	**9.32**
C	Gas Main Easement Central	200,812	4.61	0.45	0.59		0.90	0.96		0.09	0.36	200,812	0.09	0.36	150	100.0	972	1022.0	0.020	17.67	2.00	4	1.0	17.2	34.9	1.8	0.7	2.2	**0.93**	3.7	**6.24**
D	Proposed Detention Pond	22,216	0.51	0.45	0.59		0.90	0.96		0.09	0.36	22,216	0.09	0.36	25	25.0	141	141.4	0.020	7.21	1.00	4	0.7	3.4	10.6	3.2	0.1	4.0	**0.19**	6.7	**1.25**
E	Southeast Towne Home Sub-Basin	24,394	0.56	0.45	0.59		0.90	0.96		0.09	0.36	24,394	0.09	0.36	75	75.0	143	143.0	0.020	12.50	1.00	4	0.7	3.4	15.9	2.7	0.1	3.4	**0.17**	5.7	**1.15**
F	East Cowpoke Road	50,530	1.16	0.45	0.59		0.90	0.96		0.09	0.36	50,530	0.09	0.36	25	25.0	511	511.0	0.020	7.21	2.00	5	1.4	6.0	13.2	2.9	0.3	3.7	**0.39**	6.2	**2.59**
G	West Cowpoke Road	37,897	0.87	0.45	0.59		0.90	0.96		0.09	0.36	37,897	0.09	0.36	25	25.0	394	394.0	0.020	7.21	1.00	5	1.0	6.6	13.8	2.9	0.2	3.6	**0.28**	6.0	**1.91**
H	North Small Lot P.U.D.	380,714	8.74	0.45	0.59		0.90	0.96		0.09	0.36	380,714	0.09	0.36	50	50.0	958	958.0	0.020	10.20	1.72	4	0.9	17.5	27.7	2.0	1.6	2.5	**2.01**	4.3	**13.50**
I	South Small Lot P.U.D.	551,034	12.65	0.45	0.59		0.90	0.96		0.09	0.36	551,034	0.09	0.36	50	50.0	1,195	1496.0	0.020	10.20	1.82	4	0.9	26.5	36.8	1.7	2.0	2.2	**2.47**	3.6	**16.59**
J	Gas Main Swale	43,996	1.01	0.45	0.59		0.90	0.96		0.09	0.36	43,996	0.09	0.36	50	50.0	1,045	1300.0	0.020	10.20	3.07	4	1.2	17.9	28.1	2.0	0.2	2.5	**0.23**	4.2	**1.55**
Design Points	***Contributing Sub-basins***																														
1	OS-1	1,004,058	23.05	0.45	0.59		0.90	0.96		0.09	0.36	1,004,058	0.09	0.36	300	100.0	1,385	1585.0	0.025	23.20	2.50	4	1.1	23.9	47.1	1.5	3.1	1.8	**3.87**	3.1	**25.98**
2	OS-1, PR-C	1,204,870	27.66	0.45	0.59		0.90	0.96		0.09	0.36	1,204,870	0.09	0.36	300	100.0	2,357	2557.0	0.025	23.20	2.00	4	1.0	43.0	66.3	1.2	3.0	1.5	**3.72**	2.5	**25.02**
3	PR-A, PR-B	324,522	7.45	0.45	0.59		0.90	0.96		0.09	0.36	324,522	0.09	0.36	100	100.0	1,138	1138.0	0.020	14.43	2.00	5	1.4	13.4	27.8	2.0	1.4	2.5	**1.71**	4.2	**11.48**
4	DP3, PR-D	346,738	7.96	0.45	0.59		0.90	0.96		0.09	0.36	346,738	0.09	0.36	100	100.0	1,303	1303.0	0.020	14.43	2.00	4	1.0	21.9	36.4	1.7	1.2	2.2	**1.56**	3.6	**10.51**
5	DP2, DP4	1,551,607	35.62	0.45	0.59		0.90	0.96		0.09	0.36	1,551,607	0.09	0.36	300	100.0	2,441	2641.0	0.025	23.20	2.00	4	1.0	44.5	67.7	1.2	3.8	1.5	**4.73**	2.5	**31.77**
6	PR-G	37,897	0.87	0.45	0.59		0.90	0.96		0.09	0.36	37,897	0.09	0.36	25	25.0	394	394.0	0.020	7.21	1.00	5	1.0	6.6	13.8	2.9	0.2	3.6	**0.28**	6.0	**1.91**
7	DP5, PR-J	1,595,603	36.63	0.45	0.59		0.90	0.96		0.09	0.36	1,595,603	0.09	0.36	300	100.0	3,341	3541.0	0.020	24.99	1.50	4	0.9	68.8	93.8	0.9	3.1	1.2	**3.90**	2.0	**26.20**
8	DP6, PR-H	418,612	9.61	0.45	0.59		0.90	0.96		0.09	0.36	418,612	0.09	0.36	50	1352.0	3,012	3012.0	0.020	10.20	1.72	4	0.9	55.0	65.2	1.2	1.0	1.5	**1.31**	2.5	**8.78**
9	PR-I	551,034	12.65	0.45	0.59		0.90	0.96		0.09	0.36	551,034	0.09	0.36	50	50.0	1,195	1496.0	0.020	10.20	1.82	4	0.9	26.5	36.8	1.7	2.0	2.2	**2.47**	3.6	**16.59**
				Percent Impervious		65%			100%			2%		Total Impervious Area																		
Filing No. 2	On-site Town Homes	371,131	8.52			0			0			371131		***2.00%***																		
Filing No. 4	Future Small Lot P.U.D.	931,748	21.39			0			0			931748		***2.00%***																		
	TOTAL AREA	2,640,172	60.61							0.09	0.36	2,640,172	0.09	0.36	300	100.0	3,341	3541.0	0.020	24.99	1.50	4	0.9	68.8	93.8	0.9	5.1	1.2	**6.45**	2.0	**43.35**

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

Project Name:	Aspen Meadows Filing No. 2
Project Location:	Colorado Springs, CO
Designer	BAS
Notes:	Proposed Condition

Average Channel Velocity		4	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)
Flow Length: True Initial	Max	100	ft	Developed
	Max	300	ft	Undeveloped

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					
				Surface Type 1 (Business Neghborhood)			Surface Type 2 (Impervious)			Surface Type 3 (Vegetated Areas)			Composite		Initial	True Initial	Channel	True Channel	Average (decimal)	Initial	Average (%)	Channel Flow Type (See Key above)	Velocity	Channel	Total	i2	Q2	i5	Q5	i100	Q100
Basin	**Area Description**	sf	acres	C5	C100	Area (SF)	C5	C100	Area (SF)	C5	C100	Area	C5	C100	ft	Length ft	ft	Length ft	Slope	Tc (min)	Slope	Ground Type	(ft/s)	Tc (min)	(min)	in/hr	cfs	in/hr	cfs	in/hr	cfs
OS-1	Offsite sub-basin north of project site. (Ultimate Sterling Ranch condition will route this basin to the proposed detention facility to be located north of Aspen Meadows Filing NO. 1)	1,004,058	23.05	0.49	0.62		0.90	0.96		0.09	0.36	1,004,058	0.09	0.36	300	100.0	1,385	1585.0	0.025	23.20	2.5	4	1.1	23.9	47.1	1.5	3.1	1.8	**3.87**	3.1	**25.98**
PS-1	Vibrant Draining to Marksheffel	6,098	0.14	0.49	0.62	6,098	0.90	0.96		0.09	0.36		0.49	0.62	25	25.0	100	100.0	0.050	3.21	1.0	7	2.0	0.8	5.0	4.0	0.3	5.1	**0.35**	8.6	**0.75**
PS-1 (Undeveloped)	Vibrant Draining to Marksheffel	6,098	0.14	0.49	0.62		0.90	0.96		0.09	0.36	6,098	0.09	0.36	25	25.0	100	100.0	0.050	5.32	1.0	4	0.7	2.4	7.7	3.6	0.0	4.5	**0.06**	7.6	**0.38**
PS-2	Townhomes Northeast (East portion of lots)	28,410	0.65	0.49	0.62	28,410	0.90	0.96		0.09	0.36		0.49	0.62	54	54.0	440	440.0	0.020	6.40	2.0	4	1.0	7.4	13.8	2.9	0.9	3.6	**1.16**	6.0	**2.46**
PS-3	Townhomes Northeast (West portion of lots)	71,325	1.64	0.49	0.62	71,325	0.90	0.96		0.09	0.36		0.49	0.62	100	100.0	630	630.0	0.050	6.42	2.5	7	3.2	3.3	9.7	3.3	2.7	4.1	**3.35**	7.0	**7.12**
PS-4	Townhomes Northwest (Draining east to street)	65,658	1.51	0.49	0.62	65,658	0.90	0.96		0.09	0.36		0.49	0.62	100	100.0	643	643.0	0.020	8.71	2.0	7	2.8	3.8	12.5	3.0	2.2	3.8	**2.79**	6.3	**5.94**
PS-5	Townhomes Northwest (Draining east to street)	27,733	0.64	0.49	0.62	27,733	0.90	0.96		0.09	0.36		0.49	0.62	53	53.0	492	492.0	0.050	4.67	2.5	4	1.1	7.4	12.1	3.0	0.9	3.8	**1.20**	6.4	**2.54**
PS-6	Gas Main Easement	204,573	4.70	0.49	0.62		0.90	0.96		0.09	0.36	204,573	0.09	0.36	100	100.0	1,085	1085.0	0.020	14.43	2.0	4	1.0	18.3	32.7	1.8	0.8	2.3	**0.98**	3.9	**6.60**
PS-7	Townhomes Southeast /Cowpoke Road	86,826	1.99	0.49	0.62	86,826	0.90	0.96		0.09	0.36		0.49	0.62	100	100.0	495	495.0	0.050	6.42	1.25	7	2.2	3.8	10.2	3.2	3.2	4.1	**4.01**	6.8	**8.53**
PS-8	Southwest Townhomes Draining to Street/Cowpoke Rd	39,801	0.91	0.49	0.62	39,801	0.90	0.96		0.09	0.36		0.49	0.62	84	84.0	484	484.0	0.050	5.89	1.25	7	2.2	3.7	9.6	3.3	1.5	4.2	**1.88**	7.0	**4.00**
PS-9	Townhomes Southwest (Draining West)	26,772	0.61	0.49	0.62	26,772	0.90	0.96		0.09	0.36		0.49	0.62	50	50.0	328	328.0	0.050	4.54	1.25	4	0.8	7.1	11.7	3.1	0.9	3.9	**1.17**	6.5	**2.49**
PS-10	Pond 1	28,437	0.65	0.49	0.62	1,160	0.90	0.96		0.09	0.36	27,277	0.11	0.37	25	25.0	246	246.0	0.250	3.06	0.5	7	1.4	2.9	6.0	3.9	0.3	4.9	**0.34**	8.2	**2.00**
PS-11	Cowpoke Road	40,195	0.92	0.49	0.62		0.90	0.96	40,195	0.09	0.36		0.90	0.96	25	25.0	886	886.0	0.020	1.43	1.0	7	2.0	7.4	8.8	3.4	2.9	4.3	**3.60**	7.2	**6.45**
Design Points	***Contributing Sub-basins***																															
1	OS-1	1,004,058	23.05	0.49	0.62	0	0.90	0.96	0	0.09	0.36	1,004,058	0.09	0.36	300	100.0	1,385	1585.0	0.025	23.20	2.50	4	1.1	23.9	47.1	1.5	3.1	1.8	**3.87**	3.1	**25.98**
2	OS-1, PS-6	1,208,631	27.75	0.49	0.62	0	0.90	0.96	0	0.09	0.36	1,208,631	0.09	0.36	300	100.0	2,357	2557.0	0.025	23.20	2.00	4	1.0	43.0	66.3	1.2	3.0	1.5	**3.73**	2.5	**25.09**
3	PS-2	28,410	0.65	0.49	0.62	28,410	0.90	0.96	0	0.09	0.36	0	0.49	0.62	54	54.0	440	440.0	0.020	6.40	2.00	4	1.0	7.4	13.8	2.9	0.9	3.6	**1.16**	6.0	**2.46**
4	PS-2, PS-3	99,735	2.29	0.49	0.62	99,735	0.90	0.96	0	0.09	0.36	0	0.49	0.62	54	54.0	440	440.0	0.020	6.40	2.00	4	1.0	7.4	13.8	2.9	3.2	3.6	**4.06**	6.0	**8.64**
5	PS-5	27,733	0.64	0.49	0.62	27,733	0.90	0.96	0	0.09	0.36	0	0.49	0.62	53	53.0	492	492.0	0	4.67	3	4	1.1	7.4	12.1	3.0	0.9	3.8	**1.20**	6.4	**2.54**
6	PS-4, PS-5	93,392	2.14	0.49	0.62	93,392	0.90	0.96	0	0.09	0.36	0	0.49	0.62	53	53.0	643	643.0	0.020	6.34	2.00	7	2.8	3.8	10.1	3.2	3.4	4.1	**4.32**	6.9	**9.19**
7	DP4, DP6	193,127	4.43	0.49	0.62	193,127	0.90	0.96	0	0.09	0.36	0	0.49	0.62	53	53.0	643	643.0	0.020	6.34	2.00	7	2.8	3.8	10.1	3.2	7.1	4.1	**8.94**	6.9	**19.00**
8	PS-7	86,826	1.99	0.49	0.62	86,826	0.90	0.96	0	0.09	0.36	0	0.49	0.62	100	100.0	495	495.0	0.050	6.42	1.25	7	2.2	3.8	10.2	3.2	3.2	4.1	**4.01**	6.8	**8.53**
9	DP7, DP8	279,953	6.43	0.49	0.62	279,953	0.90	0.96	0	0.09	0.36	0	0.49	0.62	53	53.0	1,138	1138.0	0.020	6.34	2.00	7	2.8	6.7	13.1	2.9	9.3	3.7	**11.69**	6.2	**24.85**
10	DP9, PS-8	319,754	7.34	0.49	0.62	319,754	0.90	0.96	0	0.09	0.36	0	0.49	0.62	53	53.0	1,138	1138.0	0.020	6.34	2.00	7	2.8	6.7	13.1	2.9	10.6	3.7	**13.35**	6.2	**28.38**
11	Pond 1: DP10, PS-9, PS-10	374,963	8.61	0.49	0.62	347,686	0.90	0.96	0	0.09	0.36	27,277	0.46	0.60	53	53.0	1,138	1138.0	0.020	6.65	2.00	7	2.8	6.7	13.4	2.9	11.6	3.6	**14.58**	6.1	**31.95**
12	Pond 1: Discharge	374,963	8.61	0.49	0.62		0.90	0.96	0	0.09	0.36	374,963	0.09	0.36	53	53.0	1,138	1138.0	0.020	10.50	2.00	7	2.8	6.7	17.2	2.6	2.0	3.2	**0.20**	5.5	**3.90**
13	DP2, DP12	1,583,594	36.35	0.49	0.62	0	0.90	0.96	0	0.09	0.36	1,583,594	0.09	0.36	53	53.0	2,357	2357.0	0.025	9.75	2.00	7	2.8	13.9	23.6	2.2	7.2	2.8	**3.93**	4.6	**28.99**
14	DP13, PS-11	1,623,789	37.28	0.49	0.62	0	0.90	0.96	40,195	0.09	0.36	1,583,594	0.11	0.37	53	53.0	3,243	3243.0	0.025	9.56	2.00	7	2.8	19.1	28.7	2.0	8.2	2.5	**7.53**	4.2	**35.44**
				Percent Impervious		70%			100%			2%		Total Impervious for Pond																		
Total Pond Inflow Areas	On-site Townhome Pond	374,963	8.61			347,686			0			27,277		***65%***																		

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

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	**Designer:**	**Brady Shyrock**
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches	**Company:**	**Matrix Design Group**
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches	**Date:**	**March 23, 2021**
Optional User Defined Storm	CUHP			**Project:**	**Aspen Meadows Filing No. 2**
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event	2.52		**Location:**	**Colorado Springs, CO**

Max Intensity for Optional User Defined Storm: 2.51496

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	PS-2	PS-3	PS-4	PS-5	PS-7	PS-8	PS-9	PS-10						
Receiving Pervious Area Soil Type	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam						
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	0.652	1.637	1.507	0.637	1.993	0.914	0.615	0.653						
Directly Connected Impervious Area (DCIA, acres)	0.000	1.146	1.055	0.000	1.395	0.640	0.000	0.000						
Unconnected Impervious Area (UIA, acres)	0.457	0.000	0.000	0.446	0.000	0.000	0.430	0.031						
Receiving Pervious Area (RPA, acres)	0.196	0.000	0.000	0.191	0.000	0.000	0.184	0.622						
Separate Pervious Area (SPA, acres)	0.000	0.491	0.452	0.000	0.598	0.274	0.000	0.000						
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	C	C	C	C	C						

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	0.652	1.637	1.507	0.637	1.993	0.914	0.615	0.653						
Directly Connected Impervious Area (DCIA, %)	0.0%	70.0%	70.0%	0.0%	70.0%	70.0%	0.0%	0.0%						
Unconnected Impervious Area (UIA, %)	70.0%	0.0%	0.0%	70.0%	0.0%	0.0%	70.0%	4.8%						
Receiving Pervious Area (RPA, %)	30.0%	0.0%	0.0%	30.0%	0.0%	0.0%	30.0%	95.2%						
Separate Pervious Area (SPA, %)	0.0%	30.0%	30.0%	0.0%	30.0%	30.0%	0.0%	0.0%						
A_R (RPA / UIA)	0.429	0.000	0.000	0.429	0.000	0.000	0.429	19.947						
I_a Check	0.700	1.000	1.000	0.700	1.000	1.000	0.700	0.050						
f / I for WQCV Event:	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7						
f / I for 5-Year Event:	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5						
f / I for 100-Year Event:	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3						
f / I for Optional User Defined Storm CUHP:	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31						
IRF for WQCV Event:	0.75	1.00	1.00	0.75	1.00	1.00	0.75	0.13						
IRF for 5-Year Event:	0.93	1.00	1.00	0.93	1.00	1.00	0.93	0.21						
IRF for 100-Year Event:	0.96	1.00	1.00	0.96	1.00	1.00	0.96	0.22						
IRF for Optional User Defined Storm CUHP:	0.96	1.00	1.00	0.96	1.00	1.00	0.96	0.22						
Total Site Imperviousness: I_{total}	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	4.8%						
Effective Imperviousness for WQCV Event:	52.5%	70.0%	70.0%	52.5%	70.0%	70.0%	52.5%	0.6%						
Effective Imperviousness for 5-Year Event:	65.1%	70.0%	70.0%	65.1%	70.0%	70.0%	65.1%	1.0%						
Effective Imperviousness for 100-Year Event:	67.2%	70.0%	70.0%	67.2%	70.0%	70.0%	67.2%	1.1%						
Effective Imperviousness for Optional User Defined Storm CUHP:	67.2%	70.0%	70.0%	67.2%	70.0%	70.0%	67.2%	1.1%						

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	22.5%	0.0%	0.0%	22.5%	0.0%	0.0%	22.5%	86.1%	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	3.8%	0.0%	0.0%	3.8%	0.0%	0.0%	3.8%	135.3%	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:	5.2%	0.0%	0.0%	5.2%	0.0%	0.0%	5.2%	36.1%						

Total Site Imperviousness:	**65.1%**
Total Site Effective Imperviousness for WQCV Event:	**60.9%**
Total Site Effective Imperviousness for 5-Year Event:	**63.7%**
Total Site Effective Imperviousness for 100-Year Event:	**64.2%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	**64.2%**

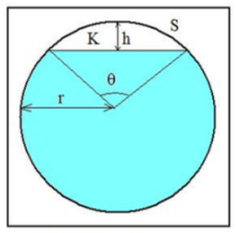
Notes:

* 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

INITIAL STORM SEWER CAPACITY CALCULATIONS - MANNINGS CHANNEL FLOW METHOD Design Point	Notes		Max Q (Q100) Proposed	Capacity Analysis	Storm Pipe Calculated Max Q for Pipe (CFS)	Percent of Pipe Capacity Used	n(full)	Slope (ft/ft)	n	Pipe Diameter (ft)	Width (ft) Box Culvert Only	Pipe Depth (inches)	Optimum Flow Depth (+/- 0.94 x D)	Θ (Radians)	Λ (Sq. Ft.)	Wetted Perimeter (ft)	Velocity at Max Pipe Capacity
1			**26.0**	Adequate	43.0	60%	0.013	0.010	0.013	2.5		30	2.35	0.990	4.788	6.617	8.97
2			**25.1**	Adequate	43.0	58%	0.013	0.010	0.013	2.5		30	2.35	0.990	4.788	6.617	8.97
3			**2.5**	Adequate	12.3	20%	0.013	0.0125	0.013	1.5		18	1.41	0.990	1.724	3.970	7.13
4			**8.6**	Adequate	26.5	33%	0.013	0.0125	0.013	2		24	1.88	0.990	3.065	5.293	8.64
5			**2.5**	Adequate	12.3	21%	0.013	0.0125	0.013	1.5		18	1.41	0.990	1.724	3.970	7.13
6			**9.2**	Adequate	12.3	75%	0.013	0.0125	0.013	1.5		18	1.41	0.990	1.724	3.970	7.13
7			**19.0**	Adequate	26.5	72%	0.013	0.0125	0.013	2		24	1.88	0.990	3.065	5.293	8.64
8			**8.5**	Adequate	11.0	78%	0.013	0.010	0.013	1.5		18	1.41	0.990	1.724	3.970	6.38
9			**24.8**	Adequate	43.0	58%	0.013	0.010	0.013	2.5		30	2.35	0.990	4.788	6.617	8.97
10			**28.4**	Adequate	43.0	66%	0.013	0.010	0.013	2.5		30	2.35	0.990	4.788	6.617	8.97
12			**3.9**	Adequate	11.0	35%	0.013	0.010	0.013	1.5		18	1.41	0.990	1.724	3.970	6.38
13			**29.0**	Adequate	43.0	68%	0.013	0.010	0.013	2.5		30	2.35	0.990	4.788	6.617	8.97
14			**35.4**	Adequate	69.8	51%	0.013	0.010	0.013	3		36	2.82	0.990	6.895	7.940	10.13



Partially Full Pipe Flow Parameters
(More Than Half Full)

r = D/2

h = 2r - y

(hydraulic radius)

R = A/P

(Manning Equation)

$Q = (1.49/n)(A)(R^{2/3})(S^{1/2})$

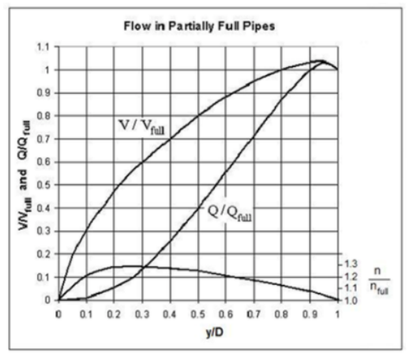
V = Q/A P

$$\theta = 2\arccos\left(\frac{r-h}{r}\right)$$

$$A = \pi r^2 - \frac{r^2(\theta - \sin\theta)}{2}$$

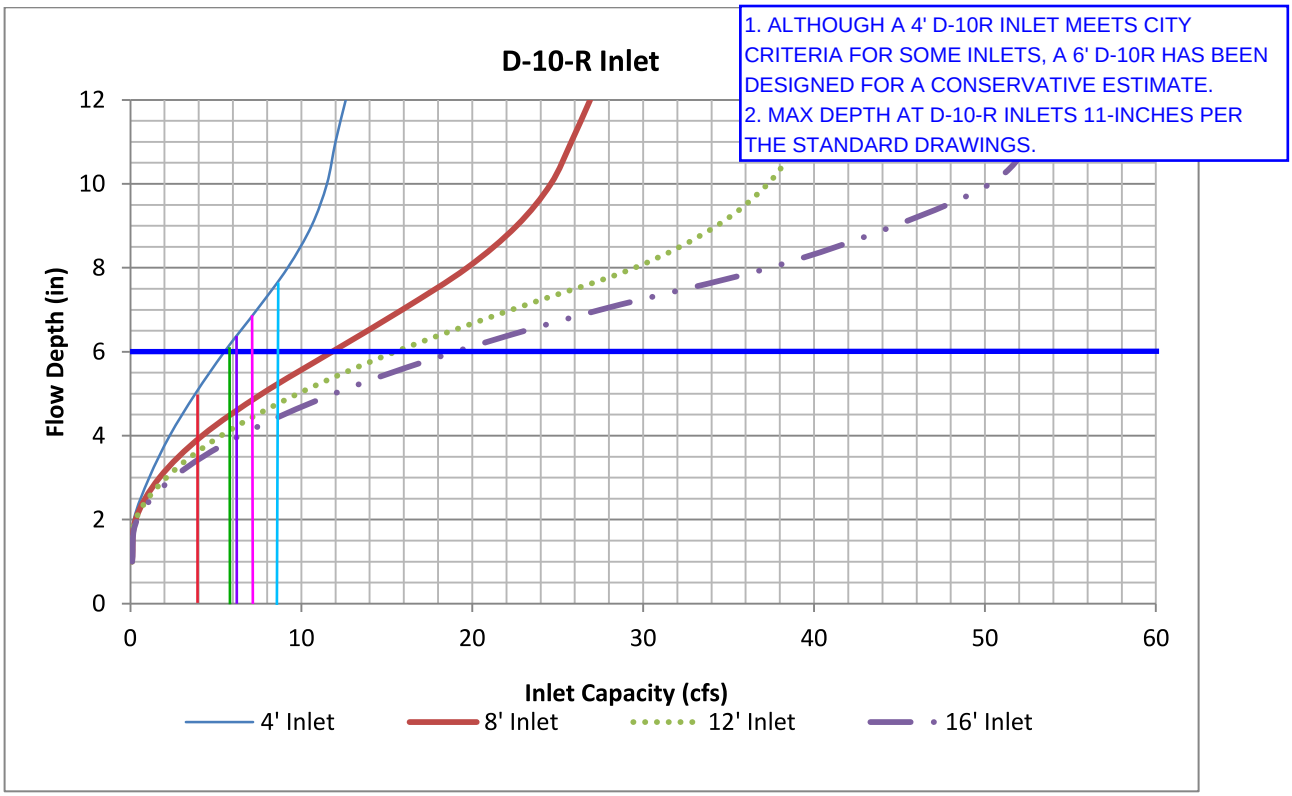
$$P = 2\pi r - r*\theta$$

Equation used for n/n_{full}: $\mathbf{n/n_{full} = 1.25 - (y/D - 0.5)^{*}0.5}$ (for $0.5 \leq y/D \leq 1$)



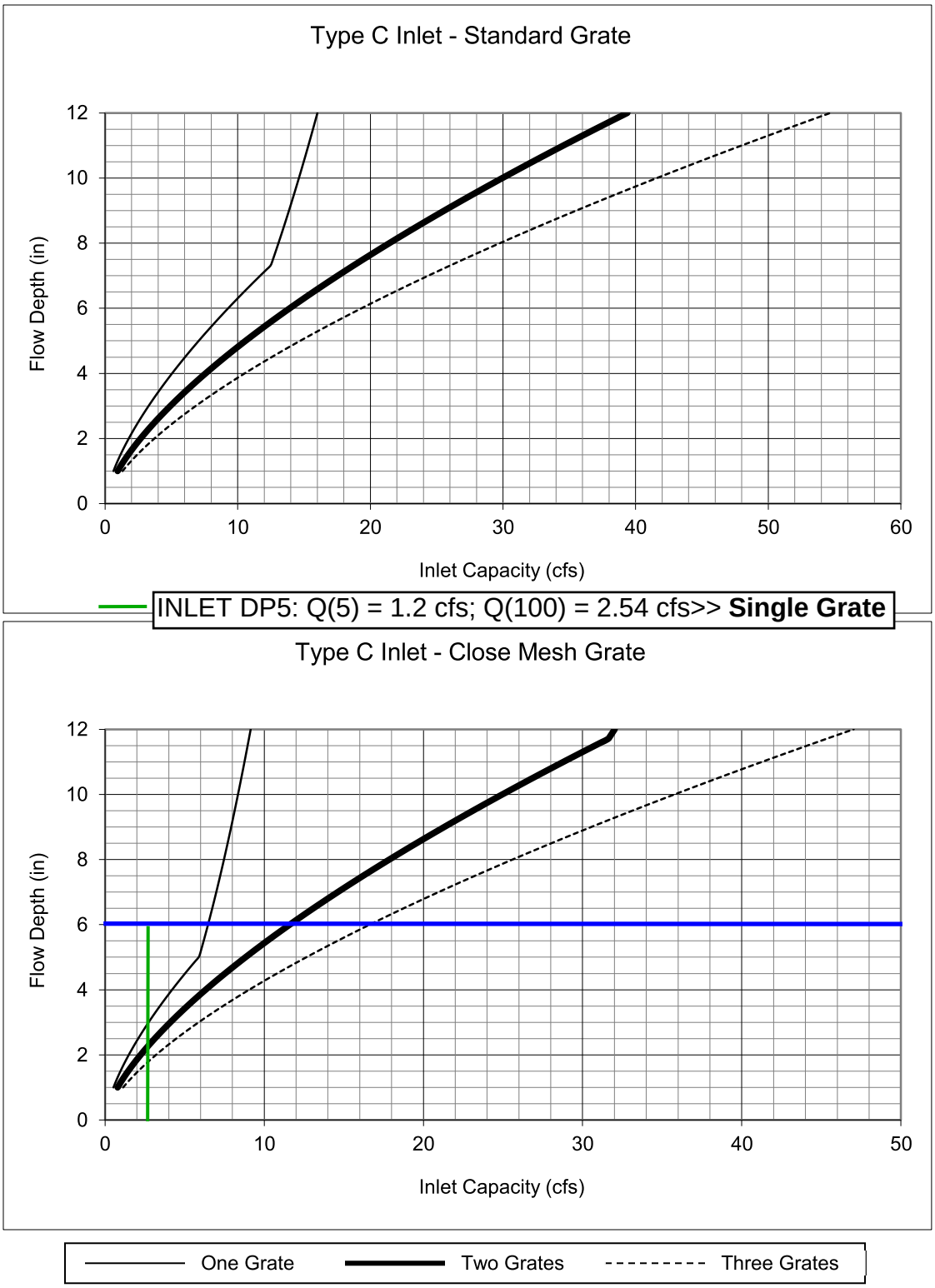
Flow In Partially Full Pipes

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



INLET DP4: Q(5) = **3.35** cfs; Q(100) = **7.12** cfs>> 6' D-10R
INLET DP6: Q(5) = **2.79** cfs; Q(100) = **5.94** cfs>> 6' D-10R
INLET DP8: Q(5) = **4.01** cfs; Q(100) = **8.53** cfs>> 8' D-10R
INLET DP10: Q(5) = **1.88** cfs; Q(100) = **4.00** cfs>> 6' D-10R
INLET DP16: Q(5) = **3.2** cfs; Q(100) = **6.2** cfs>> 6' D-10R
INLET DP16A: Q(5) = **3.2** cfs; Q(100) = **6.2** cfs>> 6' D-10R

Figure 8-10. Inlet Capacity Chart Sump Conditions, Area (Type C) Inlet



Notes:
1. The standard inlet parameters must apply to use these charts.

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Mar 17 2021

N BOUNDARY SWALE

Trapezoidal

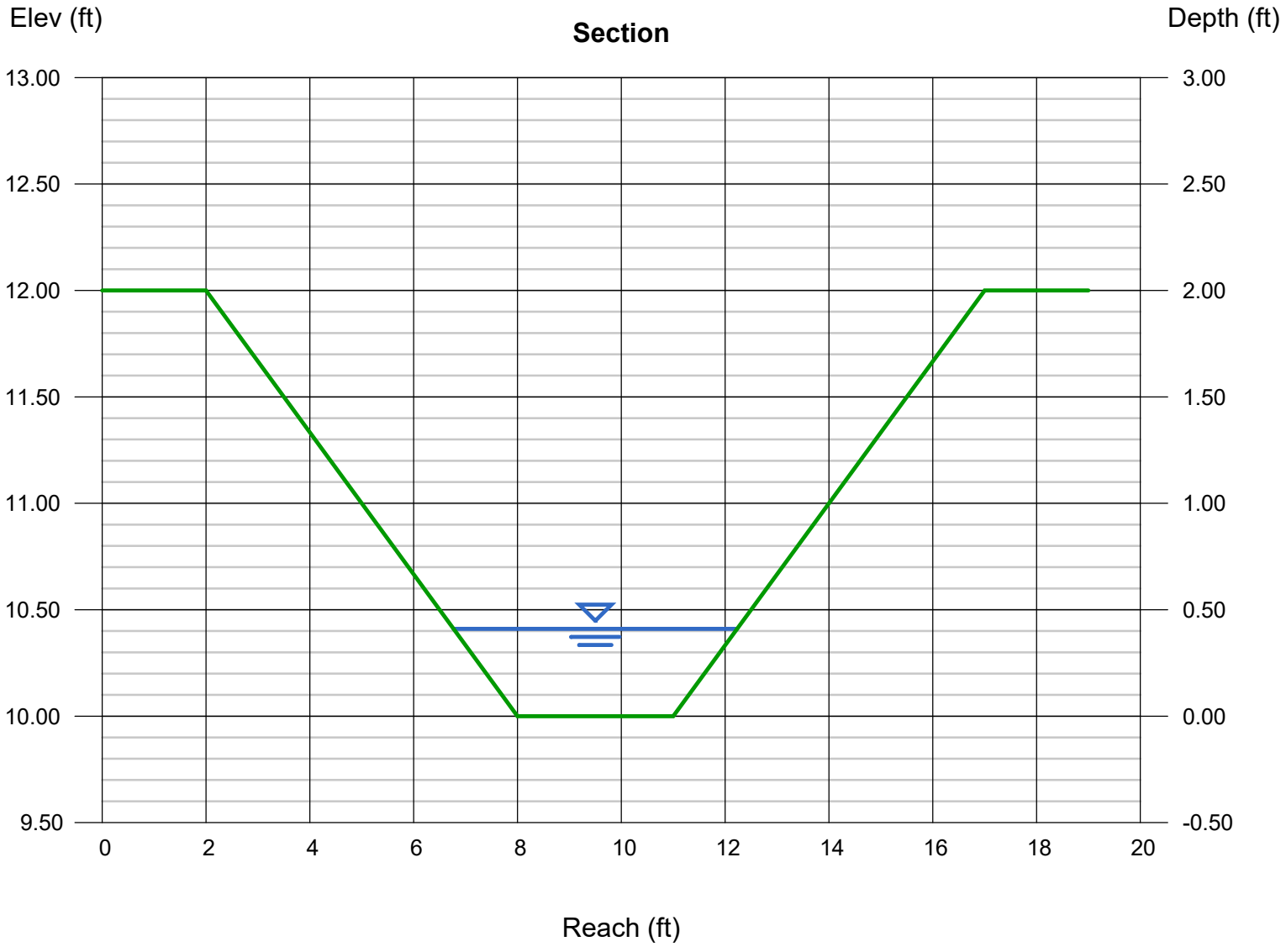
Bottom Width (ft)	= 3.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 3.87

Highlighted

Depth (ft)	= 0.41
Q (cfs)	= 3.870
Area (sqft)	= 1.73
Velocity (ft/s)	= 2.23
Wetted Perim (ft)	= 5.59
Crit Depth, Yc (ft)	= 0.34
Top Width (ft)	= 5.46
EGL (ft)	= 0.49



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Mar 24 2021

N BOUNDARY SWALE-100YR

Trapezoidal

Bottom Width (ft)	= 3.00
Side Slopes (z:1)	= 3.00, 3.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 10.00
Slope (%)	= 1.00
N-Value	= 0.030

Calculations

Compute by:	Known Q
Known Q (cfs)	= 25.98

Highlighted

Depth (ft)	= 1.09
Q (cfs)	= 25.98
Area (sqft)	= 6.83
Velocity (ft/s)	= 3.80
Wetted Perim (ft)	= 9.89
Crit Depth, Yc (ft)	= 0.97
Top Width (ft)	= 9.54
EGL (ft)	= 1.31

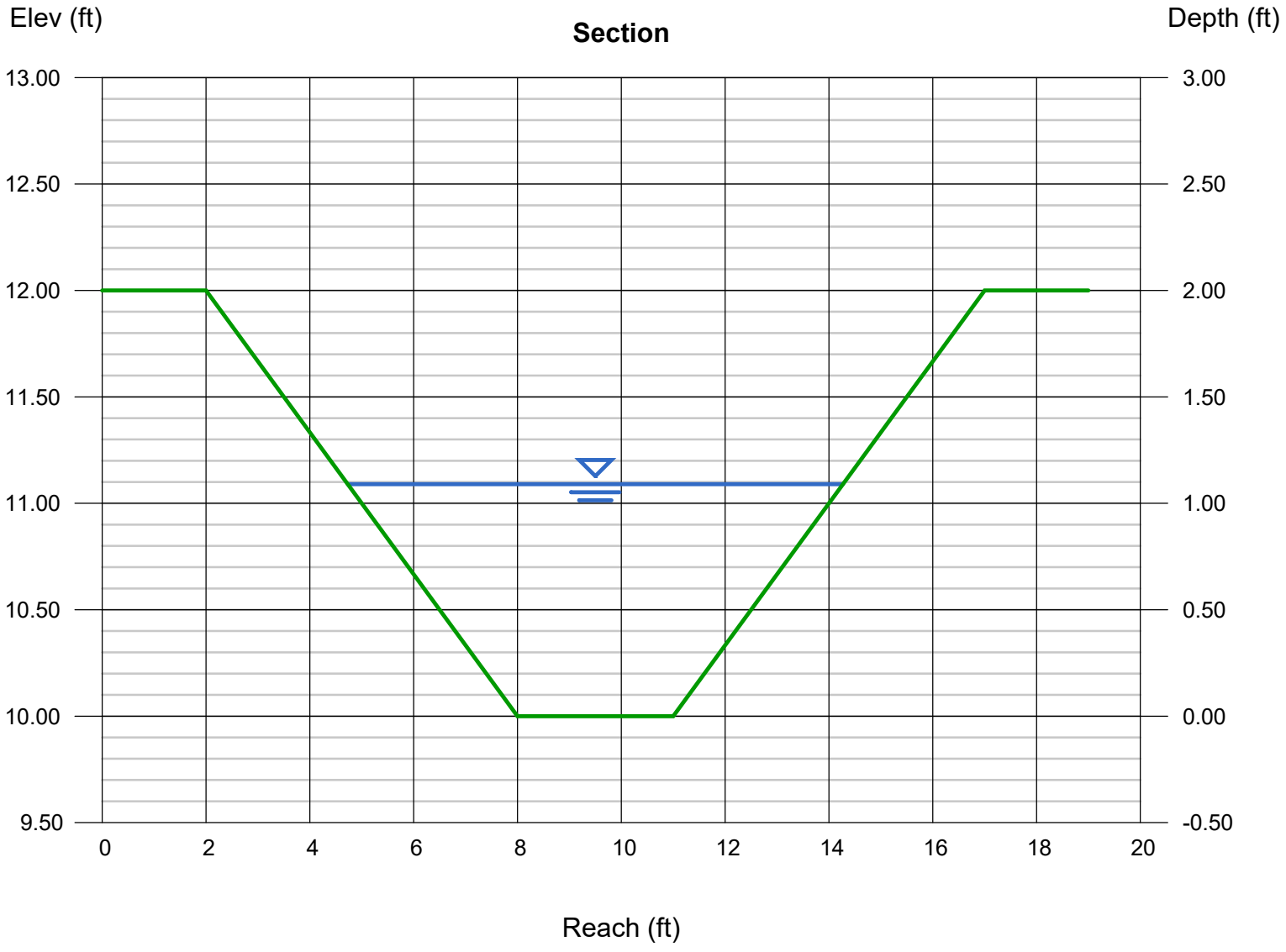


Figure 13-12b. Emergency Spillway Profile at Embankment

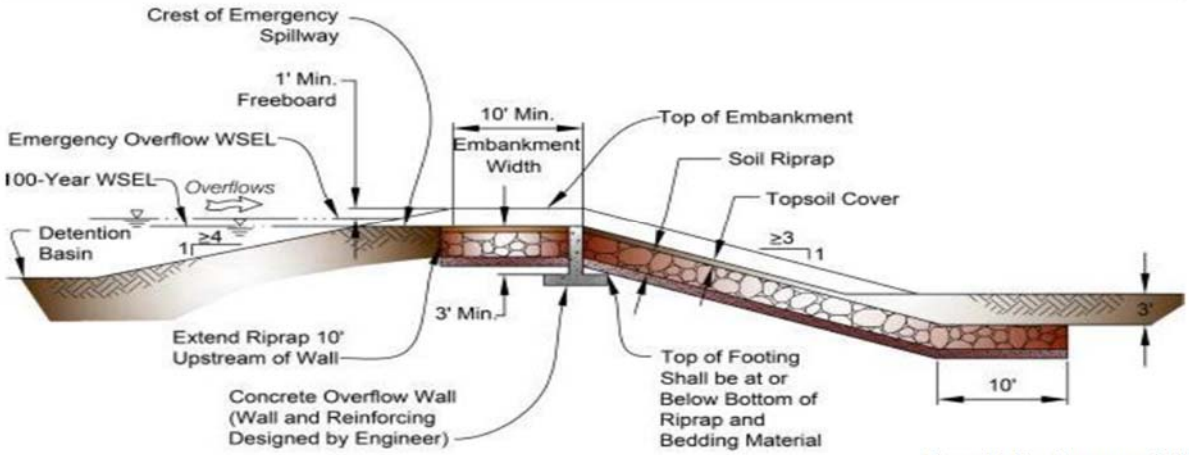
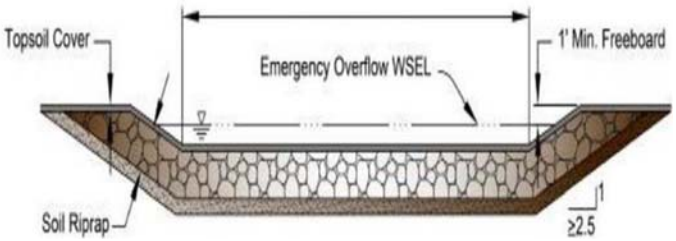


Figure 13-12c. Emergency Spillway Protection

ROAD EMBANKMENT PROTECTION CALCULATION
Q=30.68 CFS
LENGTH=40
UNIT FLOW RATE: 0.76 CFS/FT

=> TYPE VL RIP RAP

40'



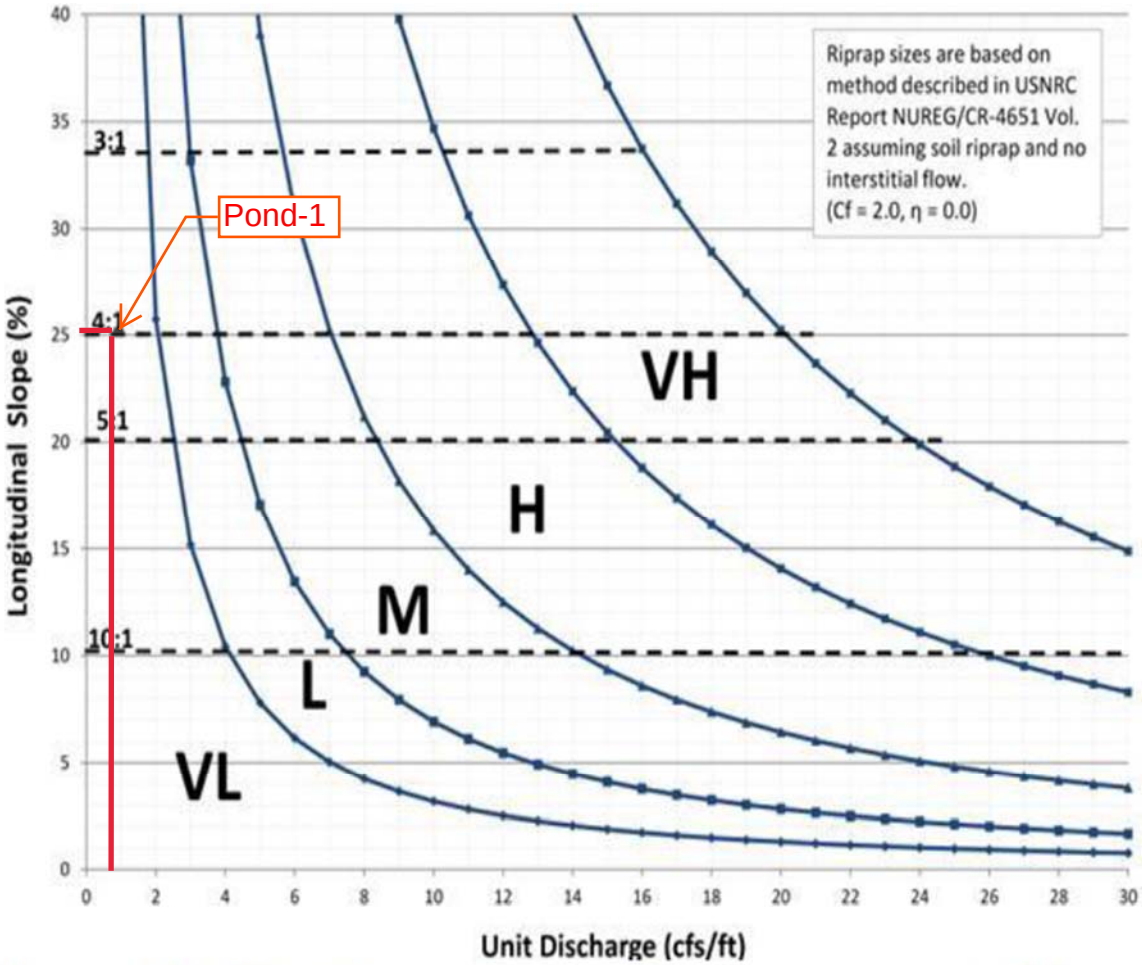


Figure 13-12d. Riprap Types for Emergency Spillway Protection

APPENDIX B

STANDARD DESIGN CHARTS AND TABLES

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.

2021 DRAINAGE, BRIDGE AND POND FEES
CITY OF COLORADO SPRINGS
March 9, 2021

Basin Name	DBPS Year	Drainage Fee/Acre	Bridge Fee/Acre	Pond Land Fee/Acre	Pond Facility Fee/Acre	Surcharge/ Acre
19th Street	1964	$4,338				
21st Street	1977	$6,621				
Bear Creek	1980	$4,261	$402			
Big Johnson, Crews	1991	$16,487	$1,355	$241		
Black Squirrel Creek	1989	$15,104		$3,739		
Camp Creek	1964	$2,443				
Cottonwood Creek[1] ,[2]	2019	$14,751	$1,216			$778
Douglas Creek	1981	$13,700	$306			
Dry Creek[3]	1966	$0				
Elkhorn Basin[4]	n/a	$0				
Fishers Canyon[5]	1991	$0				
Fountain Creek[6]	n/a	VAR				
Jimmy Camp Creek	2015	$8,584			$2,798	
Kettle Creek[7] Old Ranch Trib.	2001	$0				
Little Johnson	1988	$14,389		$1,227		
Mesa	1986	$11,516				
Middle Tributary	1987	$25,779		$1,121		
Miscellaneous[8]	n/a	$12,814				
Monument Branch[12]	1987	$0				
North Rockrimmon	1973	$6,622				
Park Vista (MDDP)	2004	$18,444				
Peterson Field	1984	$13,912	$641			
Pine Creek[9]	1988	$0				
Pope's Bluff	1976	$4,409	$755			
Pulpit Rock	1968	$7,302				
Sand Creek	2021	$18,841				
Shooks Run[10]	1994	$0				
Smith Creek[11]	2002	$0				
South Rockrimmon	1976	$5,177				
Southwest Area	1984	$14,718				
Spring Creek	1968	$11,420				
Templeton Gap	1977	$7,480	$83			
Windmill Gulch	1992	$15,709	$292	$3,055		

All Drainage, Bridge and Detention Pond Facilities Fees adjusted by 3.5% over 2020 by City Council Resolution No. 131-20 on December 8, 2020 to be effective on January 1, 2021. Land Fees are based on the Park Land Dedication Fee which is currently $76,602/acre (0% change for inflation in 2020).

[1] The 2021 Cottonwood Creek drainage fee consists of a capital improvement fee of $11,682 per acre and land fee of $3,069 per acre for a total of $14,751 per acre. These fees are adjusted annually using different procedures but are combined for collection purposes. **The surcharge fee of $778/ac is due in cash; credits for prior facility construction cannot be used to offset this fee,** which is deposited into a separate City fund known as the "Cottonwood Creek Surcharge" fund.

[2] The Wolf Ranch portion of the Cottonwood Creek Drainage Basin was approved as a "no fee" basin **as to Drainage Fees only** by City Council on August 28, 2018 by Resolution No. 96-18

[3] Dry Creek is a closed basin per City Council Resolution No.118-08 on June 24, 2008

[4] Elkhorn Basin is a closed basin per the Annexation Agreements for the area.

[5] Fishers Canyon is a closed basin per City Council Resolution No. 74-08 on April 22, 2008.

[6] Pursuant to the recommendation of the Subdivision Storm Drainage Board adopted at its meeting of September 15, 1977, there are exempted and excluded from the provisions of this part construction of the main Fountain Creek Channel from the confluence of Fountain Creek with Monument Creek northwest to the City limits. Land developments taking place adjacent to Fountain Creek shall remain responsible for dedicating rights of way necessary for the channelization of Fountain Creek, and the developers shall continue to pay to the City as a condition of subdivision plat approval the applicable drainage fees. Drainage fees are required in accordance with the appropriate basin study.

[7] Kettle Creek Old Ranch Tributary is a closed basin per City Council Resolution 139-02 on August 27, 2002.

[8] Miscellaneous fee is assessed on unstudied areas and the Roswell and Westside Basins.

[9] Pine Creek is a closed basin per City Council Resolution No.236-88 on December 13, 1988.

[10] Shooks Run is a closed basin pursuant to the recommendation of the Drainage Board, adopted at its meeting on October 15, 1963.

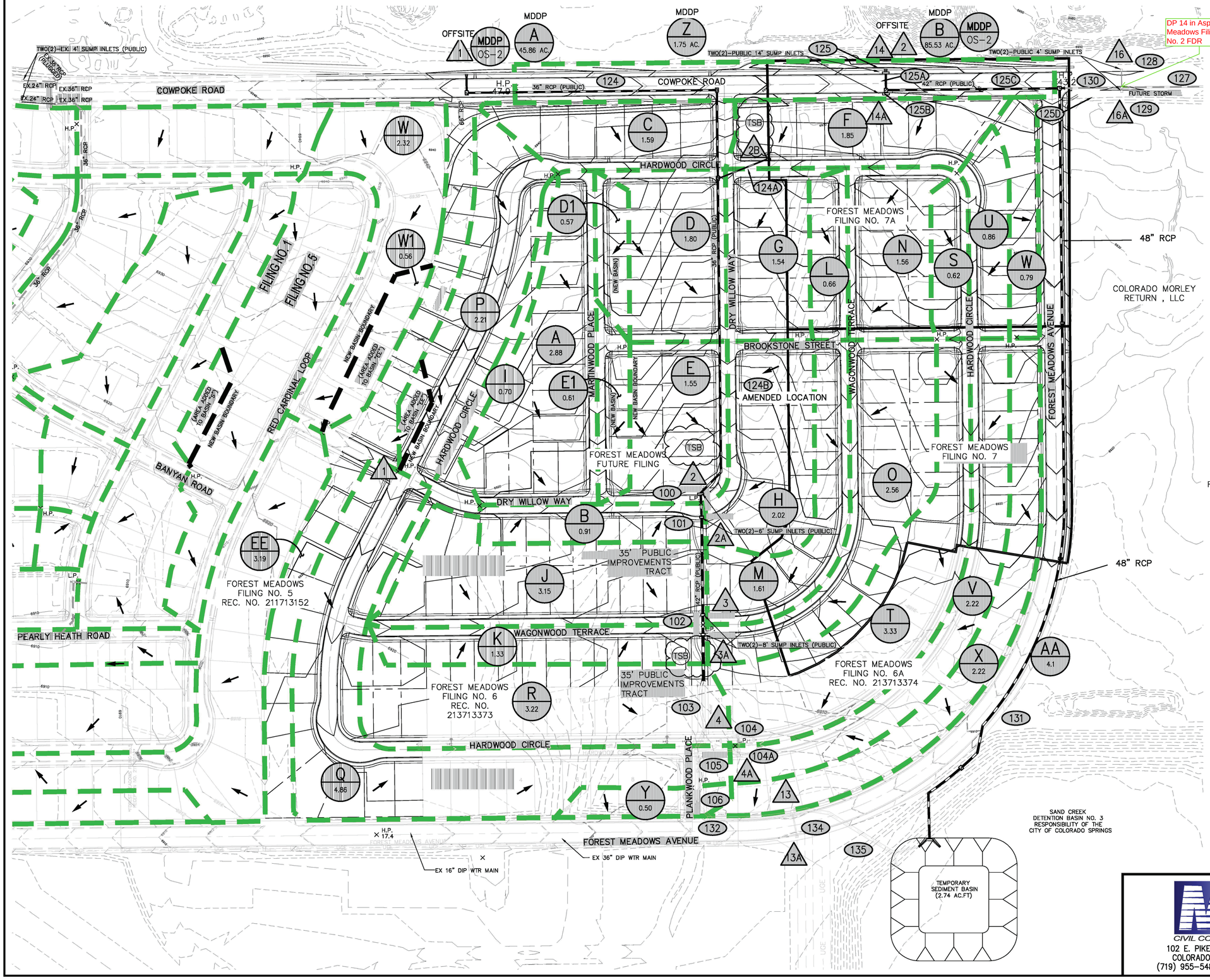
[11] Smith Creek is a closed basin per City Council Resolution 140-02 on August 27, 2002

[12] Monument Branch Basin is a closed basin per City Council Res. 177-10 on October 12, 2010

APPENDIX C

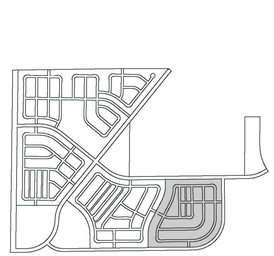
REPORT REFERENCES

FOREST MEADOWS FILING NO. 7 & 7A
DRAINAGE MAP AMENDMENT



1" = 100'

0 25 50 100 200
Scale in Feet



KEY MAP
N.T.S.

*STORM SEWER SIZE REVISIONS

STORM SEWER SUMMARY

	PIPE RUN	Q_5 (c.f.s.)	Q_{100} (c.f.s.)	PIPE SIZE
*	100	10	22	30"RCP
*	101	36	87	42"RCP
*	102	45	105	48"RCP
	103	54	123	EX 60"RCP
	104	17	36	EX 30"RCP
	105	34	72	EX 42"RCP
	106	78	173	EX 66"RCP
*	124	17	46	36"RCP
*	124A	4	9	18"RCP
*	124B	20	51	36" RCP
*	125	32	87	42" RCP
*	125A	34	90	42" RCP
*	125B	16	43	36" RCP
*	125C	36	94	42" RCP
*	125D	55	133	48" RCP
	127	26	55	36" RCP
	128	3	6	18" RCP
	129	3	6	18"RCP
*	130	32	65	42"RCP
*	131	51	126	48"RCP
	134	11	21	EX 30"RCP
	135	92	200	EX 72"RCP

Anticipated flows in Filing No. 2 proposed conditions are:

Q5=7.53 and Q100=35.44.

These compare favorably and no downstream storm sewer capacity issues will arise due to the proposed Aspen Meadows Filing No. 2 development.

LEGEND

- A 2.00 — BASIN LABEL ACREAGE
- 200 — PIPE REFERENCE LABEL
- 2A — SURFACE DESIGN POINT
- FLOW DIRECTION
- BASIN BOUNDARY
- 6920 — EXISTING CONTOUR
- 6920 — PROPOSED CONTOUR
- STORM SEWER PIPE
- CROSSPAN
- INLET
- MANHOLE
- FLARED END SECTION
- TSB — TEMPORARY SEDIMENT BASIN

*NO REVISIONS

BASIN SUMMARY
FILING NO 5, 6, 7, 7A, OFFSITE & ROADWAY
(AREA 4 IN ORIGINAL REPORT)

BASIN	AREA (Acres)	Q_5 (c.f.s.)	Q_{100} (c.f.s.)	
A	2.9	3.1	9.4	
B	0.9	2.4	5.0	
C	1.6	3.6	7.6	
D	1.8	4.4	9.1	
D1	0.6	1.5	3.2	
E	1.6	3.8	7.9	
E1	0.6	1.6	3.4	
F	1.9	4.2	8.7	
G	1.5	3.6	7.5	
H	2.0	4.7	9.7	
I	0.7	3.0	5.7	
J	3.2	6.9	14.3	
K	1.3	3.3	6.9	
L	0.7	1.8	3.7	
M	1.6	4.1	8.5	
N	1.6	3.7	7.6	
O	2.6	5.6	11.7	
P	2.2	4.5	9.4	
Q	4.9	9.5	19.8	
R	3.2	6.9	14.4	
S	0.6	1.7	3.5	
S	3.1	7.1	14.9	FILING 5 WEST (AREA 3)
T	3.3	7.5	15.5	
T	3.3	6.6	13.9	FILING 5 WEST (AREA 3)
U	0.9	2.2	4.6	
V	2.2	5.0	10.5	
W	0.8	2.0	4.2	
W	2.3	5.1	10.6	FILING 5 WEST (AREA 3)
X	2.2	5.0	10.5	
Y	0.5	1.3	2.7	
OS2 A	45.86	17	46	HISTORIC OFFSITE
OS2 B	85.53	32	87	HISTORIC OFFSITE
OS1	10.76	26	55	OFFSITE
X	0.3	0.3	0.8	OFFSITE
Y	1.29	5.6	10.5	ROADWAY
Z	1.75	7.7	14.4	ROADWAY

*NO REVISIONS

DESIGN POINT SUMMARY
FILING NO. 5, 6, 7, 7A, OFFSITE & ROADWAY
(AREA 4 IN ORIGINAL REPORT)

Design Point	Q_5 (c.f.s.)	Q_{100} (c.f.s.)	STRUCTURE	
2	9.85	22.0	6' D-10-R SUMP INLET	
2A	9.85	22.0	6' D-10-R SUMP INLET	
2B	7.80	16.2	4' D-10-R SUMP INLET	
3	12.8	26.3	8' D-10-R SUMP INLET	
3A	12.8	26.3	8' D-10-R SUMP INLET	
4	17.3	36.0	12' D-10-R SUMP INLET	
4A	17.3	36.0	12' D-10-R SUMP INLET	
13	11.0	21.5	6' D-10-R SUMP INLET	
13A	11.0	21.5	6' D-10-R SUMP INLET	
14	3.9	7.2	14' D-10-R SUMP INLET	
14A	3.9	7.2	14' D-10-R SUMP INLET	
16	3.2	6.2	4' D-10-R SUMP INLET	
16A	3.2	6.2	4' D-10-R SUMP INLET	

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102 E. PIKES PEAK AVE. STE 306
COLORADO SPRINGS, CO 80903
(719) 955-5485, FAX (719) 444-8427

FOREST MEADOWS FILING NO. 7 & 7A
DRAINAGE MAP AMENDMENT

PROJECT NO. 08-022		FILE: *\dwg\Dev. Plan\Drainage Plan-Amend.dwg	
DESIGNED BY:	VAS	SCALE	DATE: 9/29/14
DRAWN BY:	VAS	HORIZ: 1"=100'	SHEET 2 OF 2 — D2
CHECKED BY:	VAS	VERT: N/A	

FIRMETTE

NOTES TO USERS

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

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

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

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

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

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

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

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

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

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, and Anderson Consulting Engineers, Inc. These data are current as of 2008.

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

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

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

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

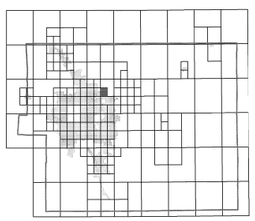
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

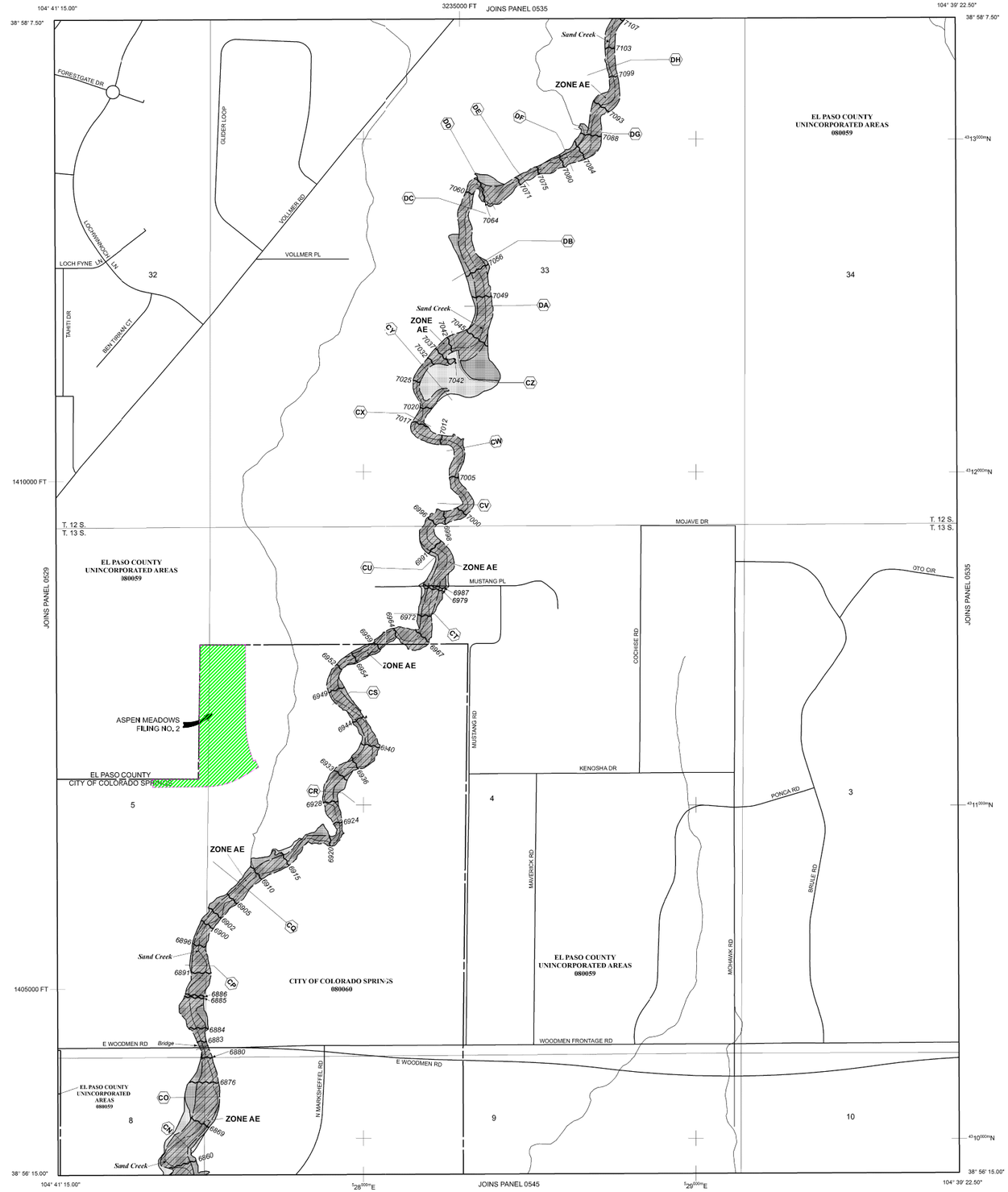
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

Panel Location Map



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

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



LEGEND

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

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

	Floodplain boundary
	Floodway boundary
	Zone D Boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

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

A — A	Cross section line
23 — 23	Transect line
97° 07' 30.00" 32° 22' 30.00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4375000mN	1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT	5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510	Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For community map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

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

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

PANEL 0533G

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 533 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0533	G
EL PASO COUNTY	080059	0533	G

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

MAP NUMBER
08041C0533G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

USDA NRCS WEB SOIL SURVEY REPORT

Map Scale: 1:2,740 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 40 80 160 240

Feet: 0 100 200 400 600

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil 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 18, Jun 5, 2020

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

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

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	1.2	6.7%
9	Blakeland-Fluvaquentic Haplaquolls	1.2	6.6%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	15.9	86.7%
Totals for Area of Interest		**18.3**	**100.0%**

El Paso County Area, Colorado

8—Blakeland loamy sand, 1 to 9 percent slopes

Map Unit Setting

National map unit symbol: 369v
Elevation: 4,600 to 5,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Hills, flats
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock and/or eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 11 inches: loamy sand
AC - 11 to 27 inches: loamy sand
C - 27 to 60 inches: sand

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water capacity: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Other soils

Percent of map unit: 1 percent
Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020

El Paso County Area, Colorado

9—Blakeland-Fluvaquentic Haplaquolls

Map Unit Setting

National map unit symbol: 36b6
Elevation: 3,500 to 5,800 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 46 to 55 degrees F
Frost-free period: 110 to 165 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 60 percent
Fluvaquentic haplaquolls and similar soils: 38 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Hills, flats
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose and/or eolian deposits derived from arkose

Typical profile

A - 0 to 11 inches: loamy sand
AC - 11 to 27 inches: loamy sand
C - 27 to 60 inches: sand

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water capacity: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill

Hydric soil rating: No

Description of Fluvaquentic Haplaquolls

Setting

Landform: Swales
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 12 inches: variable

Properties and qualities

Slope: 1 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 6.00 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)

Interpretive groups

Land capability classification (irrigated): 6w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Other soils

Percent of map unit: 1 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020

El Paso County Area, Colorado

19—Columbine gravelly sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 367p
Elevation: 6,500 to 7,300 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Columbine and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Columbine

Setting

Landform: Fans, flood plains, fan terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 14 inches: gravelly sandy loam
C - 14 to 60 inches: very gravelly loamy sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB215CO - Gravelly Foothill
Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit: 1 percent

Landform: Depressions
Hydric soil rating: Yes

Other soils
Percent of map unit: 1 percent
Hydric soil rating: No

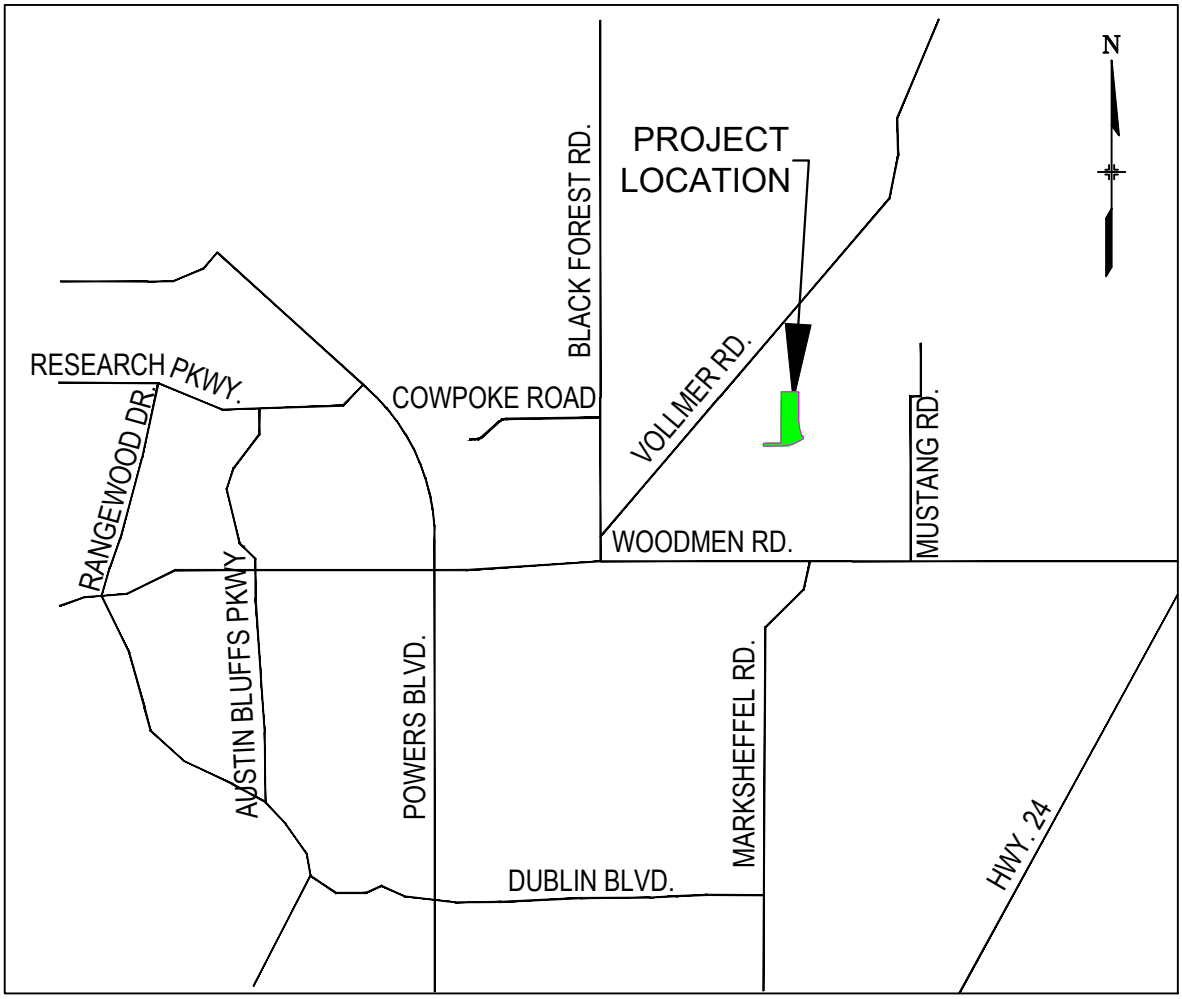
Fluvaquentic haplaquolls
Percent of map unit: 1 percent
Landform: Swales
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020

APPENDIX D

MAPS



VICINITY MAP

NORTH
N.T.S.

FILE NAME: S:\21.886.034 (Aspen Meadows Townhomes)\200 Drainage\201 Engineering\Vicinity Map\VICINITY MAP.dwg LE: Matrix.ctb

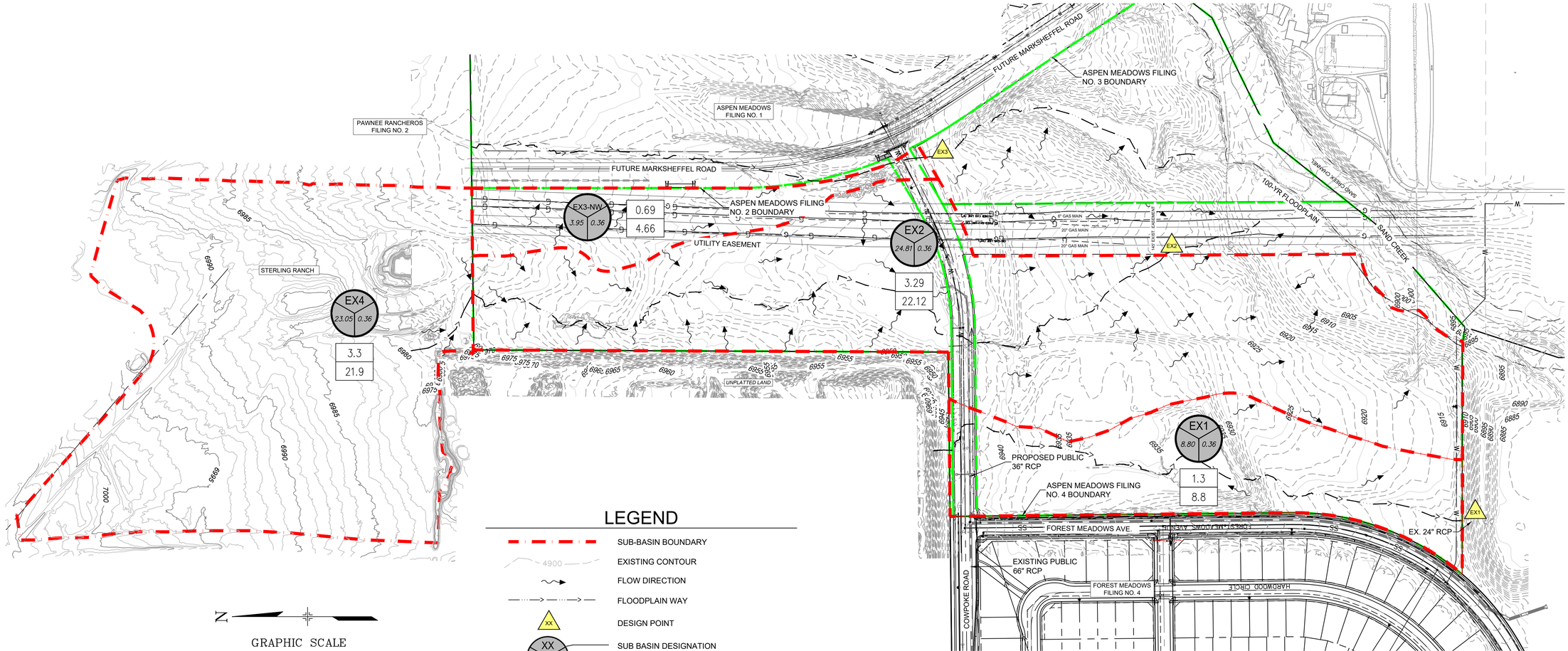
PREPARED BY:

Matrix DESIGN GROUP
AN EMPLOYEE-OWNED COMPANY

ASPEN MEADOWS FILING NO. 2

DESIGNED BY:	BAS	SCALE		DATE ISSUED:	DRAWING No.
DRAWN BY:	BAS	HORIZ.	N.T.S.		
CHECKED BY:	JAO	VERT.	NA	SHEET 1 OF 1	21.886.034

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



NOTE:
ALL STORM SEWER INFRASTRUCTURE TO BE PUBLICLY OWNED AND MAINTAINED

N

GRAPHIC SCALE

150 0 75 150 300

(IN FEET)
1 inch = 150 ft.

LEGEND

- SUB-BASIN BOUNDARY
- 4900 EXISTING CONTOUR
- FLOW DIRECTION
- FLOODPLAIN WAY
- XX DESIGN POINT
- XX / xx / 0.01 SUB BASIN DESIGNATION
- SUB BASIN RUNOFF COEFFICIENT
- SUB BASIN AREA (AC.)
- 0.0 5-YEAR STORM EVENT PEAK FLOW (CFS)
- 0.0 100-YEAR STORM EVENT PEAK FLOW (CFS)
- PROPERTY LINE

SAND CREEK SUB-BASIN SUMMARY TABLE

SUB-BASIN ID	AREA (AC.)	Q(5) (CFS)	Q(100) (CFS)
EX-1	8.80	1.31	8.77
EX-2	24.81	3.29	22.12
EX-3-NW	3.95	0.69	4.66
EX-4	23.05	3.26	21.88

SAND CREEK DESIGN POINT SURFACE FLOW SUMMARY TABLE

DESIGN POINT ID	AREA (AC.)	Q(5) (CFS)	Q(100) (CFS)	SUB-BASINS
EX1	23.05	3.87	25.98	EX-1
EX2	47.86	4.34	29.34	EX-2, EX-4
EX3	3.95	0.69	4.66	EX-3-NW

REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	BY

REVISIONS

COMPUTER FILE MANAGEMENT

FILE NAME:
CTB FILE:
PLOT DATE:
THIS DRAWING IS CURRENT AS OF PLOT DATE AND MAY BE SUBJECT TO CHANGE.

SHEET KEY

PREPARED BY: Matrix

SEAL

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

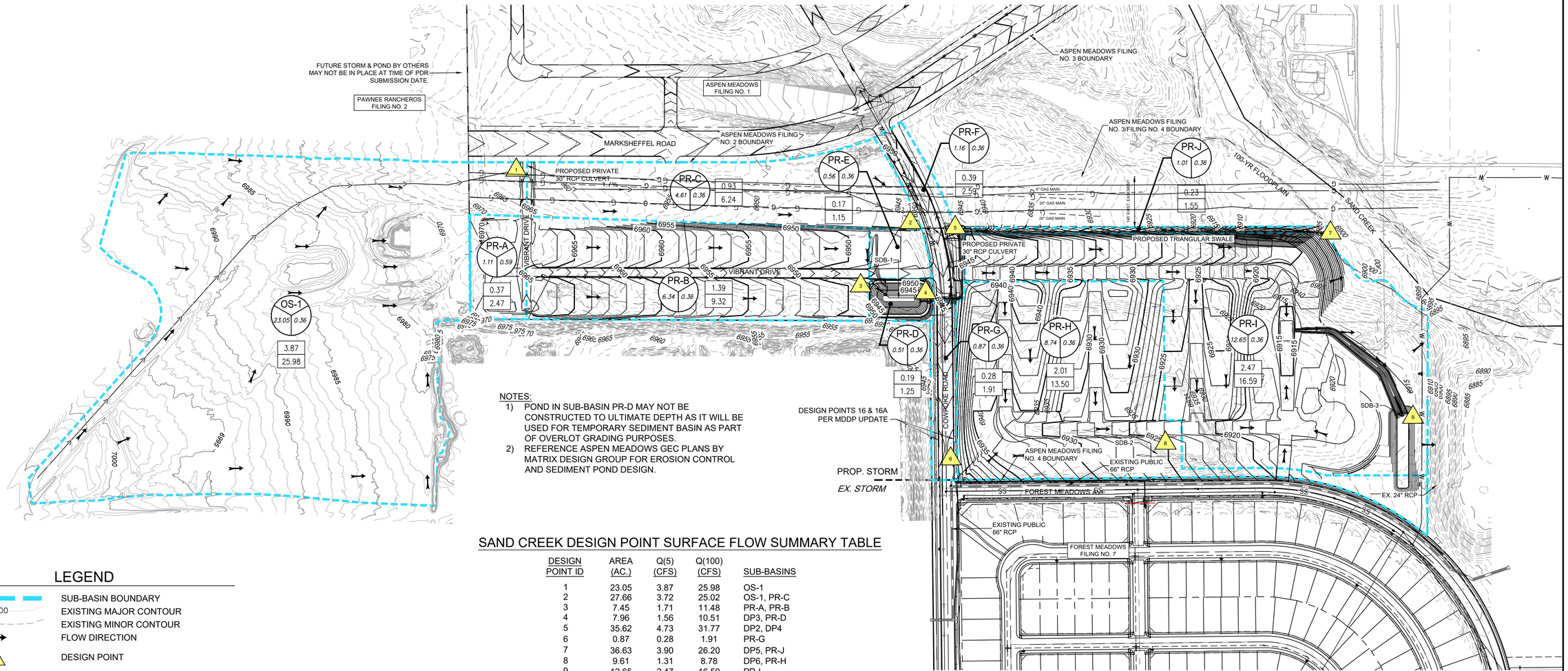
FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.
PROJECT No.

ASPEN MEADOWS FILING NO. 2

CITY OF COLORADO SPRINGS

HISTORIC CONDITIONS DRAINAGE MAP

DESIGNED BY: BAS	SCALE	DATE ISSUED: MARCH 2021	DRAWING No.
DRAWN BY: BAS	HORIZ. 1"=150'		
CHECKED BY: JAO	VERT. N/A	SHEET 1 OF 3	DP01



NOTES:

1) POND IN SUB-BASIN PR-D MAY NOT BE CONSTRUCTED TO ULTIMATE DEPTH AS IT WILL BE USED FOR TEMPORARY SEDIMENT BASIN AS PART OF OVERLOT GRADING PURPOSES.
2) REFERENCE ASPEN MEADOWS GEC PLANS BY MATRIX DESIGN GROUP FOR EROSION CONTROL AND SEDIMENT POND DESIGN.

SAND CREEK DESIGN POINT SURFACE FLOW SUMMARY TABLE

DESIGN POINT ID	AREA (AC.)	Q(5) (CFS)	Q(100) (CFS)	SUB-BASINS
1	23.05	3.87	25.98	OS-1
2	27.66	3.72	25.02	OS-1, PR-C
3	7.45	1.71	11.48	PR-A, PR-B
4	7.96	1.56	10.51	DP3, PR-D
5	35.62	4.73	31.77	DP2, DP4
6	0.87	0.28	1.91	PR-G
7	36.63	3.90	26.20	DP5, PR-J
8	9.61	1.31	8.78	DP6, PR-H
9	12.65	2.47	16.59	PR-I

LEGEND

- SUB-BASIN BOUNDARY
- 4900 — EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- FLOW DIRECTION
- X — DESIGN POINT
- XX — SUB BASIN DESIGNATION
- XX / 0.01 — SUB BASIN RUNOFF COEFFICIENT
- SUB BASIN AREA (AC.)
- X.X — 5-YEAR STORM EVENT PEAK FLOW (CFS)
- X.X — 100-YEAR STORM EVENT PEAK FLOW (CFS)
- PROPERTY LINE

N

GRAPHIC SCALE
150 0 75 150 300
(IN FEET)
1 inch = 150 ft.

REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	BY

REVISIONS

COMPUTER FILE MANAGEMENT

FILE NAME:
CTB FILE:
PLOT DATE:
THIS DRAWING IS CURRENT AS OF PLOT DATE AND MAY BE SUBJECT TO CHANGE.

SHEET KEY

PREPARED BY:
Matrix

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. 19.886.021

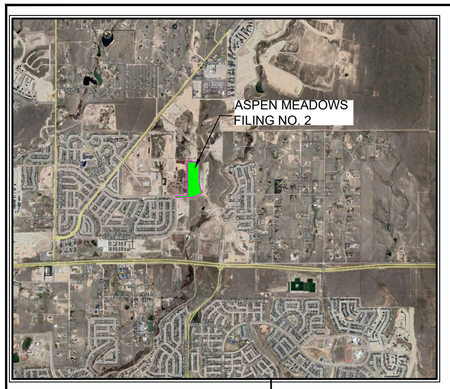
ASPEN MEADOWS FILING NO. 2

CITY OF COLORADO SPRINGS

OVERLOT GRADING INTERIM CONDITIONS DRAINAGE MAP

DESIGNED BY: BAS	SCALE	DATE ISSUED: MARCH 2021	DRAWING No.
DRAWN BY: BAS	HORIZ. 1"=150'		DP02
CHECKED BY: JAO	VERT. N/A	SHEET 1 OF 3	

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



VICINITY MAP

NORTH
N.T.S.

NOTE:
ALL STORM SEWER INFRASTRUCTURE TO BE PUBLICLY OWNED AND MAINTAINED

FUTURE STORM & POND BY OTHERS MAY NOT BE IN PLACE AT TIME OF PDR SUBMISSION DATE.

PAWNEE RANCHEROS FILING NO. 2

ASPEN MEADOWS FILING NO. 1

MARKSHEFFEL ROAD

VIBRANT DRIVE

GREY BARK WAY

UTILITY EASEMENT

PROPOSED PRIVATE 30" RCP CULVERT

6" GAS MAIN

20" GAS MAIN

20" GAS MAIN

FES DP2 (18" FES)

MH DP3 (TYPE II)

18" RCP

INLET DP4 (6' D10-R)

MH DP7 (TYPE I)

24" RCP

INLET DP6 (6' D10-R)

INLET DP5 (TYPE C)

1.1%

INLET DP8 (6' D10-R)

18" RCP

24" RCP

MH DP9 (TYPE I)

30" RCP

INLET DP10 (6' D10-R)

18" RCP

MH DP13 (TYPE I)

145' EXIST. EASEMENT

FES DP2 (30" FES)

MH DP2 (TYPE II)

PROPOSED PRIVATE 30" RCP CULVERT

POND 1

STERLING RANCH

UNPLATTED LAND

COWPOKE ROAD

36" RCP

24" RCP

MH DP14 (TYPE I)

INLET DP16 (6' D10-R)

INLET DP 16A (6' D10-R)

PROPOSED PUBLIC 36" RCP

FOREST MEADOWS AVE.

EXISTING PUBLIC 66" RCP

PS-1	0.16	0.96	0.35 / 0.75
PS-2	0.65	0.62	1.16 / 2.46
PS-3	1.64	0.62	3.35 / 7.12
PS-4	1.51	0.62	2.79 / 5.94
PS-5	0.64	0.62	1.20 / 2.54
PS-6	4.70	0.36	0.98 / 6.60
PS-7	1.99	0.62	4.01 / 8.53
PS-8	0.91	0.62	1.88 / 4.00
PS-9	0.43	0.62	1.17 / 2.49
PS-10	0.65	0.36	0.34 / 2.00
PS-11	1.28	0.96	3.60 / 6.45
OS-1	23.05	0.36	3.87 / 25.98

0.35 / 0.74

LEGEND

- SUB-BASIN BOUNDARY
- EXISTING MAJOR CONTOUR (4900)
- EXISTING MINOR CONTOUR
- FLOW DIRECTION
- DESIGN POINT (X)
- SUB BASIN DESIGNATION (XX)
- SUB BASIN RUNOFF COEFFICIENT (XX 0.01)
- SUB BASIN AREA (AC.)
- 5-YEAR STORM EVENT PEAK FLOW (CFS) (X.X)
- 100-YEAR STORM EVENT PEAK FLOW (CFS) (X.X)
- PROPERTY LINE

SAND CREEK DESIGN POINT SURFACE FLOW SUMMARY TABLE

DESIGN POINT ID	AREA (AC.)	Q(5) (CFS)	Q(100) (CFS)	SUB-BASINS
1	23.05	3.87	25.98	OS-1
2	27.75	3.73	25.09	OS-1, PS-6
3	0.65	1.16	2.46	PS-2
4	2.29	4.06	8.64	DP3, PS-3
5	0.64	1.20	2.54	PS-5
6	2.14	4.32	9.19	DP5, PS-4
7	4.43	8.94	19.00	DP4, DP6
8	1.99	4.01	8.53	PS-7
9	6.43	11.69	24.85	DP7, DP8
10	7.34	13.35	28.38	DP9, PS-8
11	8.61	14.58	31.95	DP10, PS-9, PS-10
12	8.61	0.20	3.90	POND-1 DISCHARGE
13	36.35	3.93	28.99	DP2, DP12
14	37.28	7.53	35.44	DP13, PS-11

N

GRAPHIC SCALE

100 0 50 100 200

(IN FEET)
1 inch = 100 ft.

REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	BY

REVISIONS

COMPUTER FILE MANAGEMENT

FILE NAME:
CTB FILE:
PLOT DATE:
THIS DRAWING IS CURRENT AS OF PLOT DATE AND MAY BE SUBJECT TO CHANGE.

SHEET KEY

PREPARED BY:

Matrix

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.

ASPEN MEADOWS FILING NO. 2

CITY OF COLORADO SPRINGS

FULLY DEVELOPED CONDITIONS DRAINAGE MAP

DESIGNED BY:	BAS	SCALE	DATE ISSUED:	MARCH 2021	DRAWING No.
DRAWN BY:	BAS	HORIZ. 1"=150'			
CHECKED BY:	JAO	VERT. N/A	SHEET	3 OF 3	DP03