PRELIMINARY/FINAL DRAINAGE REPORT

FOR

JACKSON OFFICE WAREHOUSE & STORAGE BUILDINGS DEVELOPMENT

ROCKY MOUNTAIN INDUSTRIAL PARK
FILING NO. 1A, LOT 2

Prepared For:
Jackson Developmental Solutions, LLC
55963 Maroon Mesa Drive
Colorado Springs, CO 80918

Prepared By:
Associated Design Professionals, Inc.
3520 Austin Bluffs Parkway Suite 102
Colorado Springs, CO 80918
719.266-5212

ADP Project No.170602
January 31, 2018
PCD File No. PPR-17-057

ADP CIVIL
ENGINEERING FOR THE FUTURE

ADPCIVIL
ENGINEERING FOR THE FUTURE

ENGINEER'S STATEMENT:

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

COLORADO REGISTERED
MICHAEL A. BARTUSEK
23329
1/25/16
PROFESSIONAL ENGINEER

Michael A. Bartusek, P.E. #23329

DEVELOPER'S STATEMENT:

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

By: _____

Title: President

Address: Jackson Development Solutions, LLC
5963 Maroon Mesa Drive
Colorado Springs, CO 80918

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

_____ _____

Jennifer Irvine, County Engineer/ECM Administrator Date

Conditions:

PRELIMINARY/FINAL DRAINAGE REPORT
JACKSON OFFICE WAREHOUSE & STORAGE BUILDINGS DEVELOPMENT
ROCKY MOUNTAIN INDUSTRIAL PARK FILING NO. 1A, LOT 2

PROJECT DESCRIPTION

This drainage report is for the development of the Rocky Mountain Industrial Park Filing No. 1A, Lot 2. The currently vacant 2.09 acre site is located north of Constitution Avenue and east of Capital Drive on the north side of Sandy Court at the end of the cul-de-sac. It is further described as a portion of Section 33, Township 13 South, Range 65 West of the 6th Principal Meridian in El Paso County, Colorado.

All of this lot is located in Sand Creek drainage basin. An existing storm sewer is located within Sandy Court which empties into an existing riprap lined channel located along the east edge of the property.

SOILS

The soil on the site can be described as having a rapid permeability, medium-surface runoff, and moderate to high hazard of erosion. The soils within the site are Blendon sandy loams. These soils are classified as Hydrologic Group 'B'.

FLOODPLAIN STATEMENT

A small portion of the developed site is located within a designated FEMA 100-year floodplain according to the information published in the Federal Emergency Management Agency Flood Plain Map N. 08041C0756F, dated March 17, 1997, LOMR 04-08-0062P dated November 18, 2004. This area falls within the existing riprap channel.

METHOD OF COMPUTATION

The methodology utilized for this report is in accordance with the *City Drainage Criteria Manual, Volumes 1*, dated May 2014. The Rational Method for computation of runoff was used for determining Sub-Basin flows.

$Q = cia$

Where
- Q = maximum rate of runoff in cubic feet per second
- c = runoff coefficient representing drainage area characteristics
- i = average rainfall intensity, in inches per hour, for the duration required for the runoff to become established
- a = drainage basin size in acres

EXISTING DRAINAGE CONDITIONS

The existing site has been overlot grades and is covered with rangeland. The site slopes in a southeasterly direction with most flows directed onto Sandy Court where they are intercepted by an existing 10' sump window inlet. The inlet flows into a 30" RCP storm sewer which empties into the east tributary of Sand Creek. The remainder of the site drains directly into the riprap-lined collector channel which will be privately maintained by the property owner. This channel then flows into the east fork of Sand Creek.

No flows enter the site from the east; however, a small portion of the lot from the north enters the site. The off-site sub-basin OS1 only drains the existing landscape area and produces flows of 0.2 cfs for the 5-year storm and 1.1 cfs for the 100-year storm. Sub-basin AEX drains to the

western portion of the undeveloped site. It produces flows of 0.8 cfs and 5.7 cfs respectively. These flows combine with the flows from OS1 at DP1 to produce flows to Sandy Court of 0.8 cfs for the 5-year storm and 6.3 cfs for the 100-year storm.

The estimated runoff amounts produced for the project under existing conditions are shown in Table 1 below.

TABLE 1 – EXISTING CONDITIONS		
Sub-Basin	**Q_5CFS**	**Q_{100} CFS**
OS1	0.2	1.1
AEX	0.8	5.7
DP1 (OS1 + AEX)	0.8	6.3

DEVELOPED DRAINAGE CONDITIONS

The development of this site includes the addition of two (2) 5,067 sf office/warehouse buildings in the center of the site and a 3,000 sf vehicle storage building in the northwest corner of the site.

The lower portion of the lot will be paved with asphalt while the upper portion will be covered with gravel. The site will be regraded to direct the flows around the proposed office/warehouse buildings.

Flows from the northern area will be directed to curbs and cross pans in the southern area and directed into a sand filter water quality basin.

As stated in the previous section, a small amount of off-site flow enters the site from a grass-covered berm on the north side of the site. Sub-basin OS1 drains the western part of this berm and produces flows of 0.1 cfs for the 5-year storm and 0.7 cfs for the 100-year storm. These flows drain onto Sub-basin A1.

The western portion of the developed site is designated as Sub-basin A1. This sub-basin will produce flows of 2.5 cfs and 5.2 cfs respectively. These flows combine with the flows from OS1 at DP1 to produce flows of 2.6 cfs for the 5-year storm and 5.7 cfs for the 100-year storm. Flows from DP1 continue to the east and into Sub-basin A2.

Sub-basin OS2 drains the eastern part of this berm and produces flows of 0.1 cfs for the 5-year storm and 0.4 cfs for the 100-year storm. These flows drain onto Sub-basin A2.

The eastern portion of the developed site is designated as Sub-basin A2. This sub-basin will produce flows of 2.1 cfs and 4.2 cfs respectively. These flows combine with the flows from OS2 at DP2 to produce flows of 2.1 cfs for the 5-year storm and 4.6 cfs for the 100-year storm.

Flows from DP2 combine with the flows from DP1 at DP3 to produce total flows into the sand filter basin of 4.7 cfs for the 5-year storm and 10.2 cfs for the 100-year storm.

Sub-basin B drains the eastern swale and the landscape area south of the developed site. This area produces flows of 0.3 cfs and 1.1 cfs respectively. These flows combine with the flows from DP3 at DP4 to produce total site flows of 4.9 cfs for the 5-year storm and 11.2 cfs for the 100-year storm.

State whether or not DP4 is in conformance with the Rocky Mountain Industrial Park Filing 1 FDR.

Table 2 shows the estimated runoff which will be produced for the project under developed conditions.

TABLE 2 – PHASE I DEVELOPED CONDITIONS		
Sub-Basin	Q_5 CFS	Q_{100} CFS
OS1	0.1	0.7
Os2	0.1	0.4
A1	2.5	5.2
A2	2.1	4.2
B	0.3	1.1
DP1 (OS1 + A1)	2.6	5.7
DP2 (OS2 + A2)	2.1	4.6
DP3 (DP1 + DP2)	4.7	10.2
DP3 (DP3 + B)	4.9	11.2

Add DP4.

WATER QUALITY

Water quality for the site will be achieved through a 1,190 cf sand filter basin (SFB) with a four-inch slotted underdrain tied into a "Type C" inlet with an 18" HDPE pipe outlet. This SFB will be privately owned and maintained by the property owner. Detention is not required since these flows are tributary to a Regional Detention Facility.

Explain why on-site flood control detention is not required.

Unresolved. See the last paragraph of the "Hydrology Analysis" section and the last paragraph of the "General" section of the Rocky Mountain Industrial Park Fil 1 FDR.

PRIVATE DRAINAGE FACILITIES

Item	Unit	Quantity	Unit Cost
18" HDPE FES	EA	1	$400
18" HDPE	LF	15	$40
Outlet Structure	EA	1	$5,000
Emergency Spillway	EA	1	$1,500
			Sub-
			15% Contingency & Engine
			TOTAL $8,625

DRAINAGE BASIN FEES

The entire project was previously platted and lies within the Sand Creek Drainage Basin; therefore, no fees are due.

CONCLUSION

The proposed development and subsequent lot developments follow the "Four Step Process" as mandated by the EPA as follows:

Step 1: Runoff has been reduced by disconnecting impervious areas where possible, eliminating "unnecessary" impervious areas and encouraging infiltration into suitable soils.

Step 2: All drainageways, ditches and channels have been stabilized by the following methods:

- Tributaries have been left in their relatively natural state where possible.
- New drainageways and swales have been stabilized with either riprap or erosion control fabric depending on the erosion potential.
- No new roadside ditches are proposed for the development.

Step 3: The proposed development will disturb approximately 2.0 acres.

Step 4: The development of this project will not affect sensitive waters.

The development of this site will have little impact on downstream properties once the water quality is constructed.

REFERENCES

1. City of Colorado Springs and El Paso County (1994). ***Drainage Criteria Manual Volume 1*** (DCM).

2. City of Colorado Springs and El Paso County (1994). ***Drainage Criteria Manual Volume II*** (DCM).

3. Soil Survey of El Paso County Area, Colorado by USDA, NRCS.

4. ***El Paso County (January 2006) Engineering Criteria Manual.***

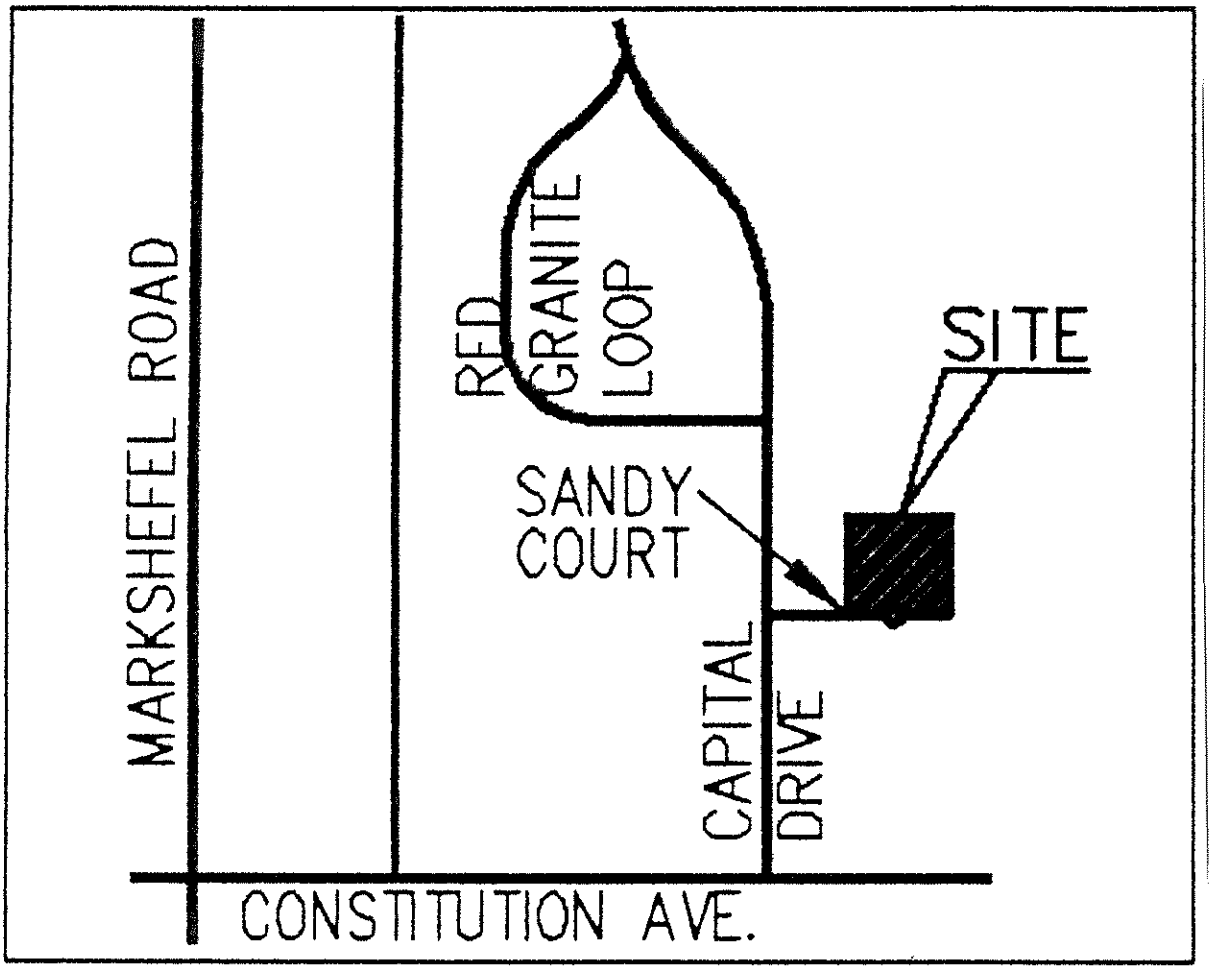
5. Urban Drainage and Flood Control District (June 2011). ***Urban Storm Drainage Criteria Manual, Volume 1-3.***

6. Rocky Mountain Industrial Park Filing No. 1 Final Drainage Plan by Kiowa Engineering Corporation, dated February 2002.

7. Rocky Mountain Industrial Park Filing No. 1A by Land Development Consultants, Inc., dated March, 2009.

APPENDIX A

MAPS



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VICINITY MAP

N.T.S.

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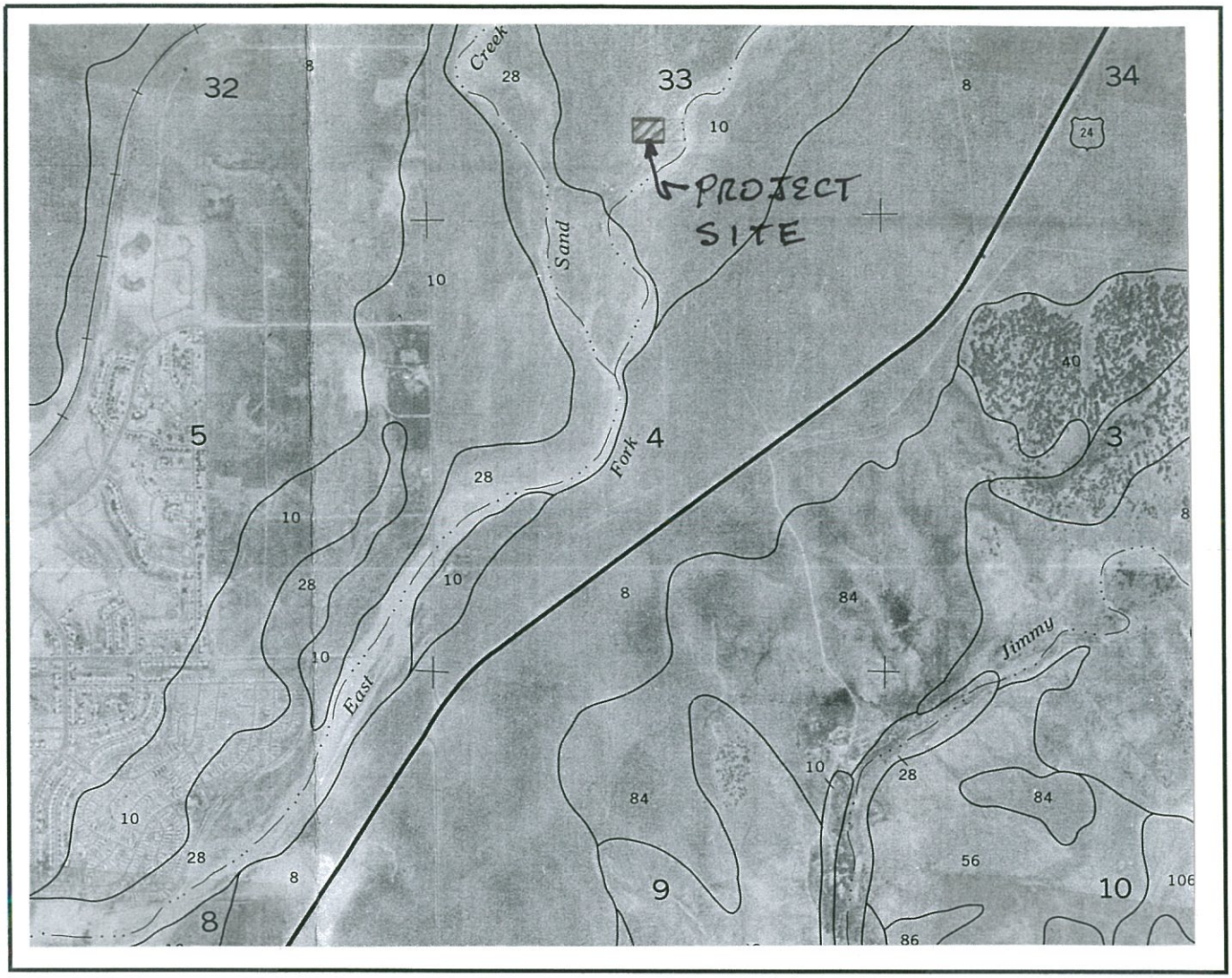

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SOILS MAP

N.T.S.

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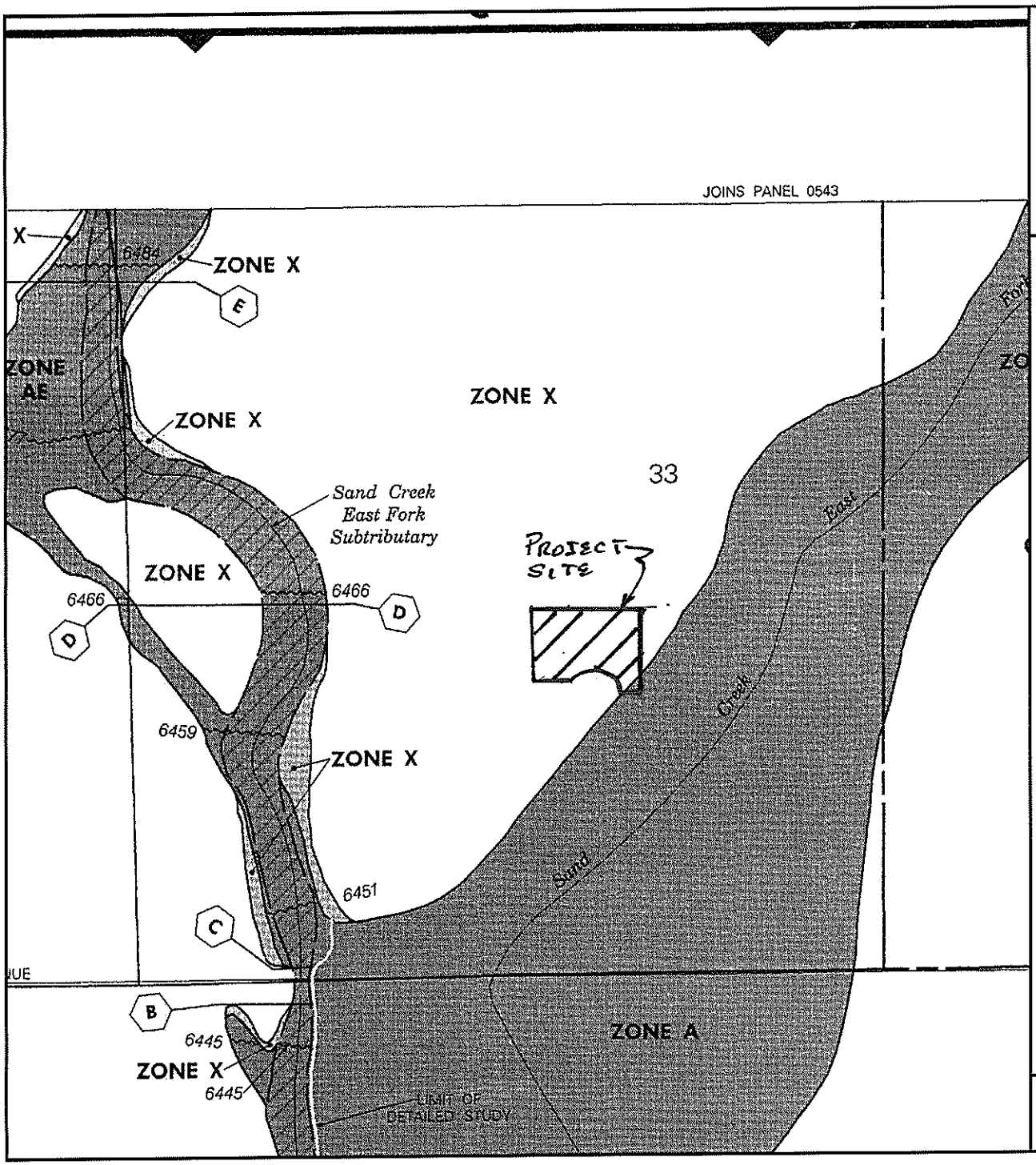


APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 756 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0756	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0756	F

MAP NUMBER
08041C0756 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency

APPENDIX B

DESIGN CALCULATIONS

8140 SANDY CT

PROJ. #170703

DRAINAGE CALCULATION SHEET

file:sandy ct dr

09/28/17

							Initial Tci			Travel Time								length	vel.		
AREA	AREA	C5	C100	C5 X A	C100 X A		Slope	ti		Slope	V	Tt	TC	I5	I100	Q5	Q100	L	V	^t	AREA
DESIG.	(acre)	(5 yr)	(100 yr)			L (ft)	(%)	(min)	L (ft)	(%)	(fps)	(min)	(min)	(in/hr)	(in/hr)	(cfs)	(cfs)	(feet)	(fps)	(min)	DESIG.
EXISTING CONDITIONS																					
OS1	0.35	0.08	0.35	0.03	0.12	50	25.00	4.66	0	2.50	1.70	0.00	5.00	5.19	9.06	0.15	1.11	350	1.50	3.89	OS1
Aex	2.09	0.08	0.35	0.17	0.73	20	25.00	2.95	350	1.70	1.20	4.86	7.81	4.47	7.80	0.75	5.71				Aex
DP1	2.44			0.20	0.85								8.89	4.25	7.42	0.83	6.34				DP1
DEVELOPED CONDITIONS																					
OS1	0.22	0.08	0.35	0.02	0.08	50	25.00	4.66	0	2.50	1.70	0.00	5.00	5.19	9.06	0.09	0.70	260	1.00	4.33	OS1
A1	0.97	0.62	0.74	0.60	0.71	60	2.50	5.12	260	1.00	1.00	4.33	9.45	4.15	7.24	2.50	5.16				A1
DP1	1.19			0.62	0.79								9.45	4.15	7.24	2.57	5.72				DP1
OS2	0.13	0.08	0.35	0.01	0.05	50	25.00	4.66	0	2.50	1.70	0.00	5.00	5.19	9.06	0.05	0.41	300	1.00	5.00	OS2
A2	0.78	0.65	0.76	0.51	0.59	60	2.50	4.79	300	1.00	1.00	5.00	9.79	4.09	7.14	2.08	4.23				A2
DP2	0.91			0.52	0.64								9.79	4.09	7.14	2.12	4.56	125	1.50	1.39	DP2
DP3	2.10			1.14	1.43								9.79	4.09	7.14	4.66	10.20				DP3
B	0.34	0.16	0.41	0.06	0.14	15	2.50	5.02	280	2.50	1.70	2.75	7.77	4.48	7.82	0.25	1.09				B
DP4	2.44			1.20	1.57								9.79	4.09	7.14	4.89	11.19				DP4

Value is low. Per City DCM Chapter 6 Section 3.1 (adopted by resolution): "Gravel parking aeas, storage areas, and access drives proposed on Site Development Plans shall be analyzed based on an imperviousness of 80%"

The majority of the site consists of gravel, pavement and building.

Design Procedure Form: Sand Filter (SF)

ember 2016) Sheet 1 of 2

A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of sand filter)	I_a = 50.3 %
B) Tributary Area's Imperviousness Ratio (i = I_a/100)	i = 0.503
C) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time WQCV= 0.8 * (0.91* i^3 - 1.19 * i^2 + 0.78 * i)	WQCV = 0.17 watershed inches
D) Contributing Watershed Area (including sand filter area)	Area = 91,475 sq ft
E) Water Quality Capture Volume (WQCV) Design Volume V_{WQCV} = WQCV / 12 * Area	V_{WQCV} = 1,263 cu ft
F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.40 in
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume	$V_{WQCV\ OTHER}$ = 1,175 cu ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$ = 1,295 cu ft
2. Basin Geometry	
A) WQCV Depth	D_{WQCV} = 1.7 ft
B) Sand Filter Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred). Use "0" if sand filter has vertical walls.	Z = 4.00 ft / ft
C) Minimum Filter Area (Flat Surface Area)	A_{Min} = 575 sq ft
D) Actual Filter Area	A_{Actual} = 580 sq ft
E) Volume Provided	V_T = 1295 cu ft
3. Filter Material	Choose One ● 18" CDOT Class B or C Filter Material ○ Other (Explain):
4. Underdrain System	
A) Are underdrains provided?	Choose One ● YES ○ NO
B) Underdrain system orifice diameter for 12 hour drain time	
i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice	y = 1.8 ft
ii) Volume to Drain in 12 Hours	Vol_{12} = 1,295 cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = 13 / 16 in

Design Procedure Form: Sand Filter (SF)

Designer: Michael A Bartusek
Company: Associated Design Professionals
Date: January 25, 2018
Project: Jackson Office/Warehouse Storage Buildings Development
Location: Rocky Mountain Industrial Park Fil 1A Lot 2

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?	Choose One O YES ● NO
6-7. Inlet / Outlet Works A) Describe the type of energy dissipation at inlet points and means of conveying flows in excess of the WQCV through the outlet	Riprap rundowns into basin with riprap emergency spillway. Type C inlet w/18" HDPE pie outlet structure.

Notes:

APPENDIX C

DESIGN CHARTS

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

Figure 6-25. Estimate of Average Concentrated Shallow Flow

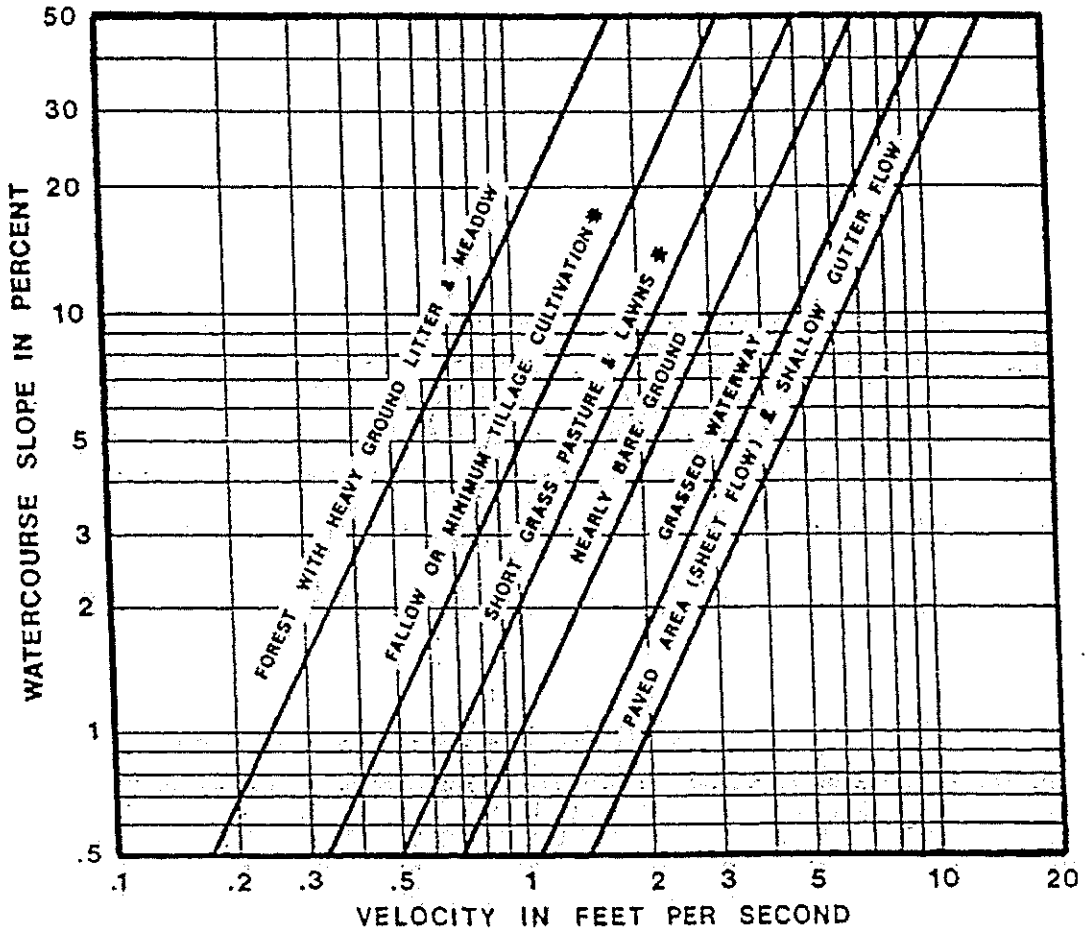
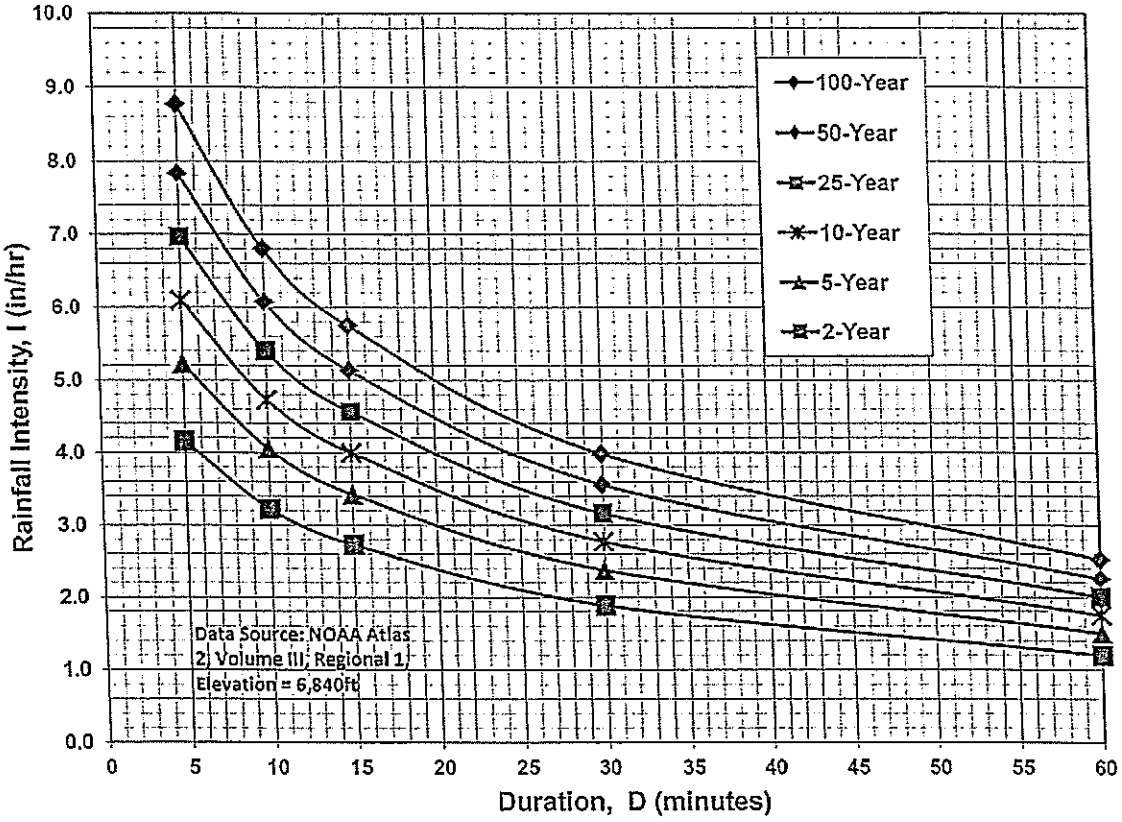


Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

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

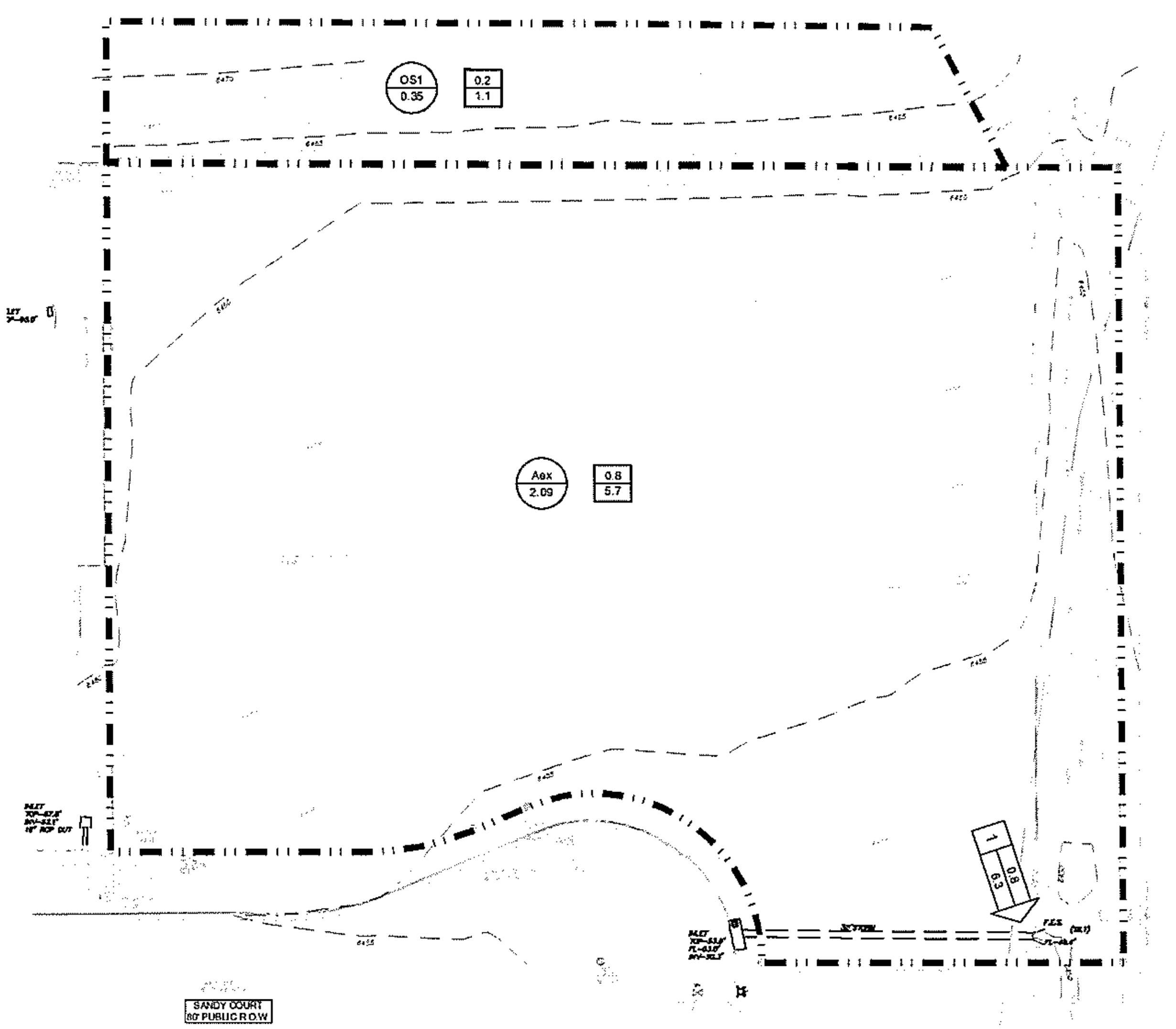
$I_{25} = -2.00 \ln(D) + 10.111$

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

$I_5 = -1.50 \ln(D) + 7.583$

$I_2 = -1.19 \ln(D) + 6.035$

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



EXISTING CONDITIONS

LEGEND:

BASIN DESIGNATION
BASIN AREA, ACRES

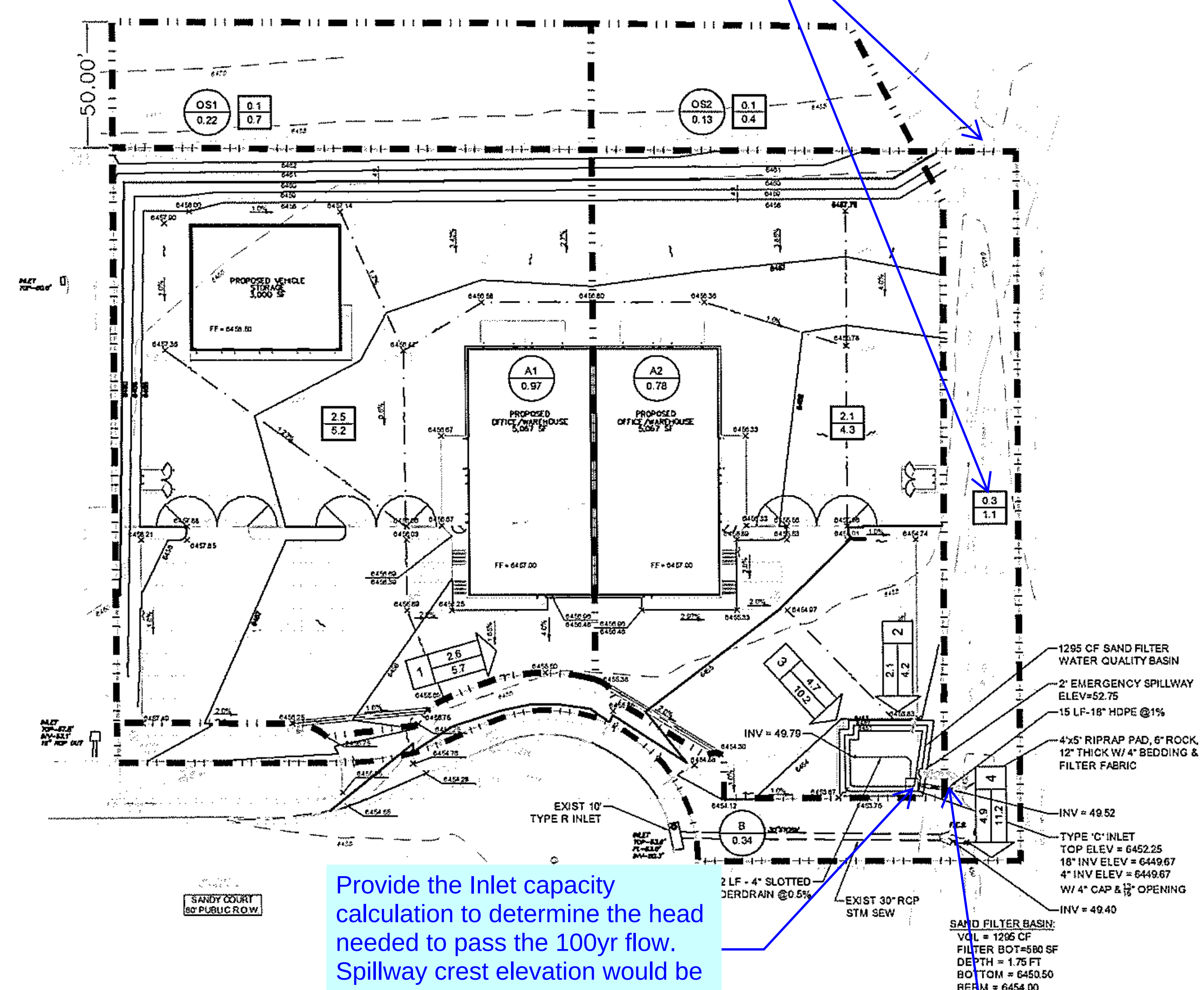
5 YEAR STORM, CFS
100 YEAR STORM, CFS

DESIGN POINT — 5 YEAR ACCUMULATED FLOW, CFS / 100 YEAR ACCUMULATED FLOW, CFS

SUB-BASIN BOUNDARY

DIRECTION OF DRAINAGE FLOW

Adjust the offsite flow being conveyed by the channel upstream of DP4. See the Rock Mountain FDR proposed condition DP2.



Provide the Inlet capacity calculation to determine the head needed to pass the 100yr flow. Spillway crest elevation would be set at this pressure head.

PROPOSED CONDITIONS

Callout what the developed condition flow is at this point w/in the Rocky Mountain FDR .

The DP4 flow rate must be equal to or less than the Rocky Mountain FDR or else the SFB may need to restrict the release rate to equal the Rocky Mountain FDR.

Submit the drainage as full size instead of 11x17

LEGEND:

PROPOSED MAJOR CONTOUR
PROPOSED MINOR CONTOUR
EXISTING MAJOR CONTOUR
EXISTING MINOR CONTOUR
EXISTING WATER VALVES
EXISTING FIRE HYDRANT
EXISTING SANITARY MANHOLE

BENCHMARK:
CP# ____
N ____
E ____
ELEV ____

GRAPHIC SCALE

30 0 15 30 60 120

(IN FEET)
1 inch = 30 ft.

DESIGNED BY MAB
PROJECT ENGINEER MAB
PROJECT MANAGER MAB
SCALE: HORZ. 1" = 30' VERT. XX" = XX'
DATE 10/06/17
JOB NO. 170602
CAD FILE NO. 170602-Drainage
DRAWN BY HJG

PREPARED BY:
ADP CIVIL
ENGINEERING FOR THE FUTURE
3520 Austin Bluffs Parkway
Suite 102
Colorado Springs, CO 80918
(719) 266-5212
fax (719) 266-6341

NO.	DATE	REVISION	BY

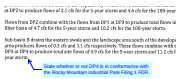
JACKSON OFFICE WAREHOUSE & STORAGE BLDGS
8140 SANDY COURT
EL PASO COUNTY, COLORADO

EXIST & DEVELOPED DRAINAGE PLAN

SHEET 1 of 1

Markup Summary

dsdlaforce (8)



Subject: Callout
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Author: dsdlaforce
Date: 3/22/2018 2:53:10 PM
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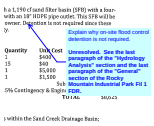
State whether or not DP4 is in conformance with the Rocky Mountain Industrial Park Filing 1 FDR.



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Author: dsdlaforce
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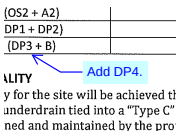
Explain why on-site flood control detention is not required.

Unresolved. See the last paragraph of the "Hydrology Analysis" section and the last paragraph of the "General" section of the Rocky Mountain Industrial Park Fil 1 FDR.



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Add DP4.

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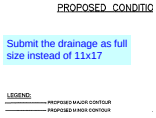
Value is low. Per City DCM Chapter 6 Section 3.1 (adopted by resolution): "Gravel parking aeas, storage areas, and access drives proposed on Site Development Plans shall be analyzed based on an imperviousness of 80%"

The majority of the site consists of gravel, pavement and building.



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Submit the drainage as full size instead of 11x17

Subject: Callout
Page Label: 19
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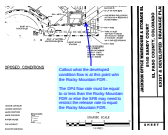
Adjust the offsite flow being conveyed by the channel upstream of DP4. See the Rock Mountain FDR proposed condition DP2.



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Callout what the developed condition flow is at this point w/in the Rocky Mountain FDR .

The DP4 flow rate must be equal to or less than the Rocky Mountain FDR or else the SFB may need to restrict the release rate to equal the Rocky Mountain FDR.

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Provide the Inlet capacity calculation to determine the head needed to pass the 100yr flow. Spillway crest elevation would be set at this pressure head.