

**PRELIMINARY/FINAL**  
**DRAINAGE REPORT**  
**FOR**  
**WALKER RESERVE**

**Prepared For:**  
**G3 Investments, Inc**  
**3980 Walker Road**  
**Colorado Springs, CO 80908**

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

**ADP Project No. 180404**  
**July 23, 2019**





**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 City/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.

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:   
George E. Hess III  
Title: President

Address: G3 Investments, Inc.  
3980 Walker Road  
Colorado Springs, CO 80908

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

\_\_\_\_\_  
Jennifer Irvine, COUNTY ENGINEER/ECM Administrator

\_\_\_\_\_  
Date

Conditions:

**WALKER RESERVE  
PRELIMINARY/FINAL  
DRAINAGE REPORT**

**GENERAL**

This project is for the platting of a 40.77-acre site into three (3) individual lots. The project is located east of SH 83 and north of Walker Road. The project is further described as being in the western quarter of Section 11, Township 11 South, Range 66 West of the 6<sup>th</sup> Principal Meridian in El Paso County, Colorado.

Drainage from the site is tributary to West Cherry Creek. No portion of this subdivision is contained within a FEMA 100-year floodplain as delineated on the Flood Insurance Rate Map (FIRM) No. 08041C0305G and No. 08041C0285G, dated December 7, 2018. The soil on the site is classified as Kettle gravelly loamy sand and Tomah-Crowfoot loamy sand by the *Soil Survey of El Paso County Area, Colorado*, prepared by the Soil Conservation Service. The soils are classified as Hydrologic Soil Group B.

**METHOD OF COMPUTATION**

The methodology utilized for this report is in accordance with *County Drainage Criteria Manual*. The Rational Method for computation of runoff was used for areas of 20 acres or less.

$Q = c i a$

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

The overall drainage for the area including off-site flows was calculated using TR-20 Program for Project Formulated Hydrology, developed by the Soil Conservation Service (NRCS).

Times of concentration were estimated using the SCS procedures described in the DCM, based upon the hydrologic soil type, the natural conditions found in the basins and the runoff curve numbers (CN) chart from Table 5-4 of the DCM.

The 100-year, 24-hour storm precipitation selected from the NOAA isopleth map in Figure 5-4e from the DCM was 4.6 inches. The ten-year, 24-hour storm precipitation selected from the rainfall depth-duration relationship chart in Figure 5-6 from the DCM was 3.1 inches. The five-year, 24-hour storm precipitation was derived from Figure 5-6 of the *County Drainage Criteria Manual*. The calculated rainfall amount was 2.6 inches. These numbers, along with SCS information, were used as input.

**EXISTING AND DEVELOPED DRAINAGE CHARACTERISTICS**

The proposed site is located within Black Forest and is comprised mostly of meadows. The 40.77-acre area contains a residence and some outbuildings. Several broad swales traverse the area along with a broad drainageway. The site has been divided into two (2) drainage basins which flow southwesterly. They are tributary to West Cherry Creek, which flows into Douglas County.

The southeastern portion of the site receives runoff from Sub-Basin A. This sub-basin produces runoff of 4.7 cfs for the five-year storm and 33.4 cfs for the 100-year storm. The runoff continues west along Walker Road to the channel.

Sub-Basin B is tributary to the southwestern part of the site. The sub-basin produces runoff amounts of 1.9 cfs for the five-year storm and 13.9 cfs for the 100-year storm. The storm runoff flows east through a broad swale into the channel. Storm runoff from the two basins combine at DP1 and produce total runoff of 6.0 cfs and 43.2 cfs for the five- and 100-year storms, respectively.

Sub-Basin C drains the remainder of the site and produces runoff amounts of 4.2 cfs for the five-year storm and 30.3 cfs for the 100-year storm. The combined runoff of the three sub-basins at DP2 is 9.7 cfs and 69.2 cfs for the five- and 100-year storms, respectively.

The drainageway which flows through the site drains approximately 850 acres of mostly rangeland with a few homes and ranches scattered through the basin. The estimated flows through the proposed site are 137 cfs for the five-year storm and 600 cfs for the 100-year storm. Based on these flows the estimated flow depth within the drainageway is 3.2 ft. with a 100-year velocity of 3.7 fps.

The estimated existing and developed on-site runoff produced by these basins is shown in Table 1 below.

<b>Sub-Basin</b>	<b>5-Year Storm Runoff (cfs)</b>	<b>100-Year Storm Runoff (cfs)</b>
A	4.7	33.4
B	1.9	13.9
C	4.2	30.3
DP1(A+B)	6.0	43.2
DP2(DP1+C)	9.7	69.2
OVERALL BASIN	137	600

**BASIN FEE DETERMINATION**

The unplatted site consists of 40.77 acres in northern El Paso County. The project is tributary to West Cherry Creek, which is an unstudied basin that flows into Douglas County. There are no drainage basin fees associated with the project.

**CONCLUSION**

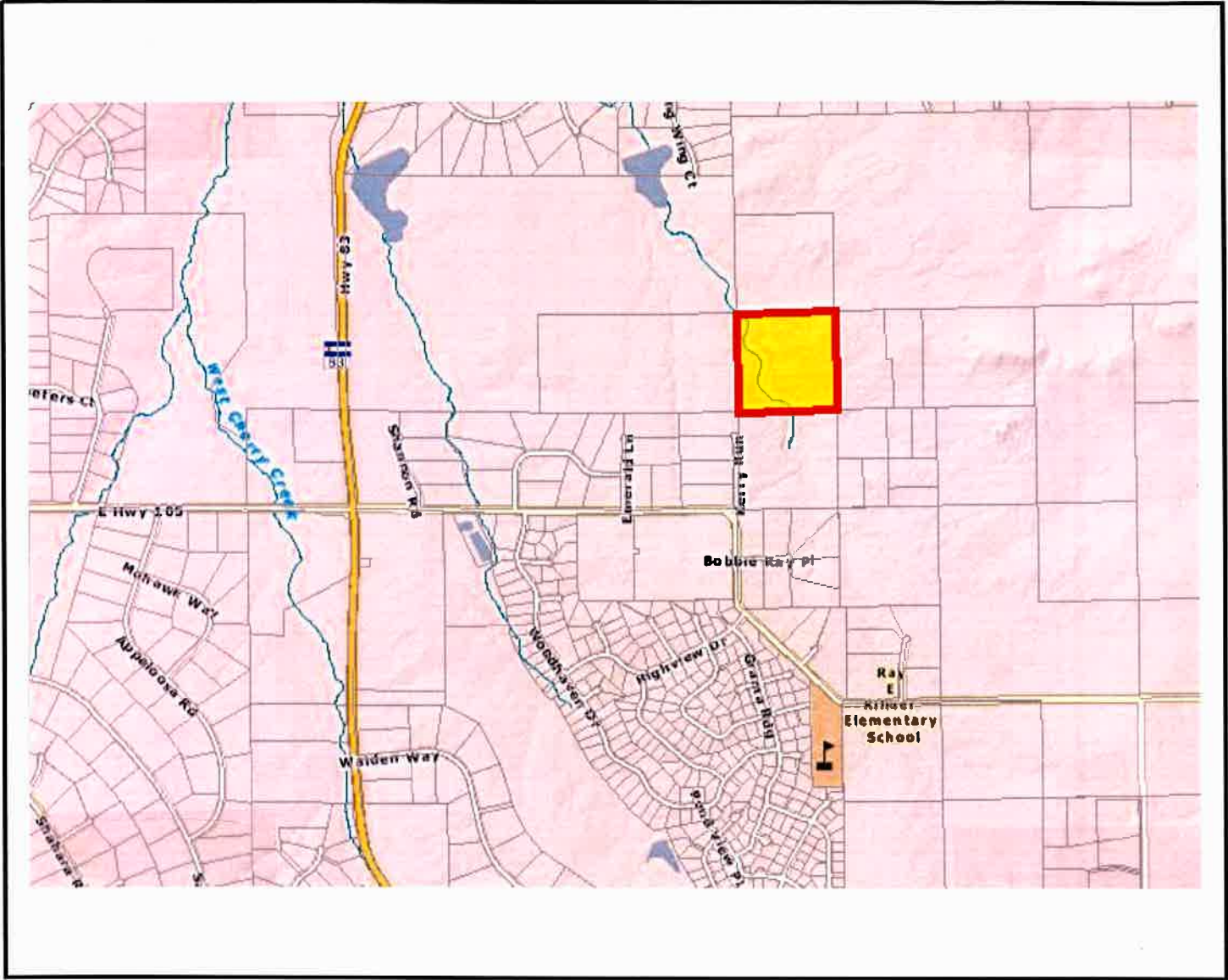
The platting of the 40.77 acres into three (3) individual lots has no impact on the downstream facilities. Only a minor increase in the imperviousness of the area – less than one percent (1%) – is expected. Consequently, no drainage improvements are required at this time.

## 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.*

## **APPENDIX A**

### **MAPS**



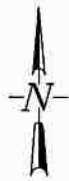
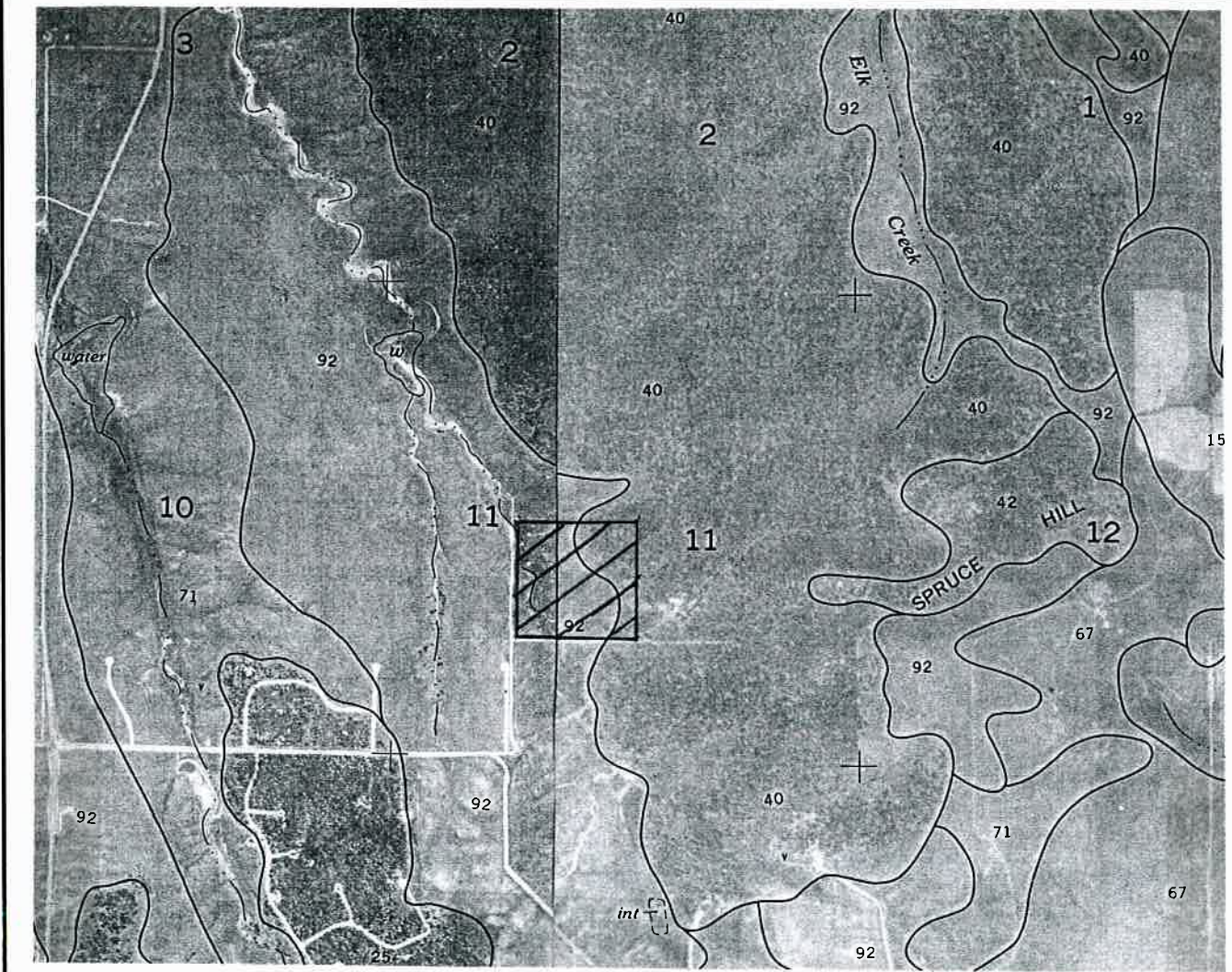
VICINITY MAP

N.T.S.



3520 Austin Bluffs Pkwy, Suite 102  
Colorado Springs, CO 80918  
(719) 266-5212  
fax: (719) 266-5341





SOILS MAP

N.T.S.



3520 Austin Bluffs Pkwy, Suite 102  
Colorado Springs, CO 80918  
(719) 266-5212  
fax: (719) 266-5341



# National Flood Hazard Layer FIRMette



39°53'2.54"N

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

## Legend

### SPECIAL FLOOD HAZARD AREAS



**Without Base Flood Elevation (BFE)**  
Zone A, V, AG9  
**With BFE or Depth** Zone AE, AO, AH, VE, AR  
**Regulatory Floodway**

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

### OTHER AREAS OF FLOOD HAZARD

Area of Minimal Flood Hazard Zone X  
Effective LOMRS  
Area of Undetermined Flood Hazard Zone

### OTHER AREAS

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

### GENERAL STRUCTURES

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

### OTHER FEATURES

Digital Data Available  
No Digital Data Available  
Unmapped

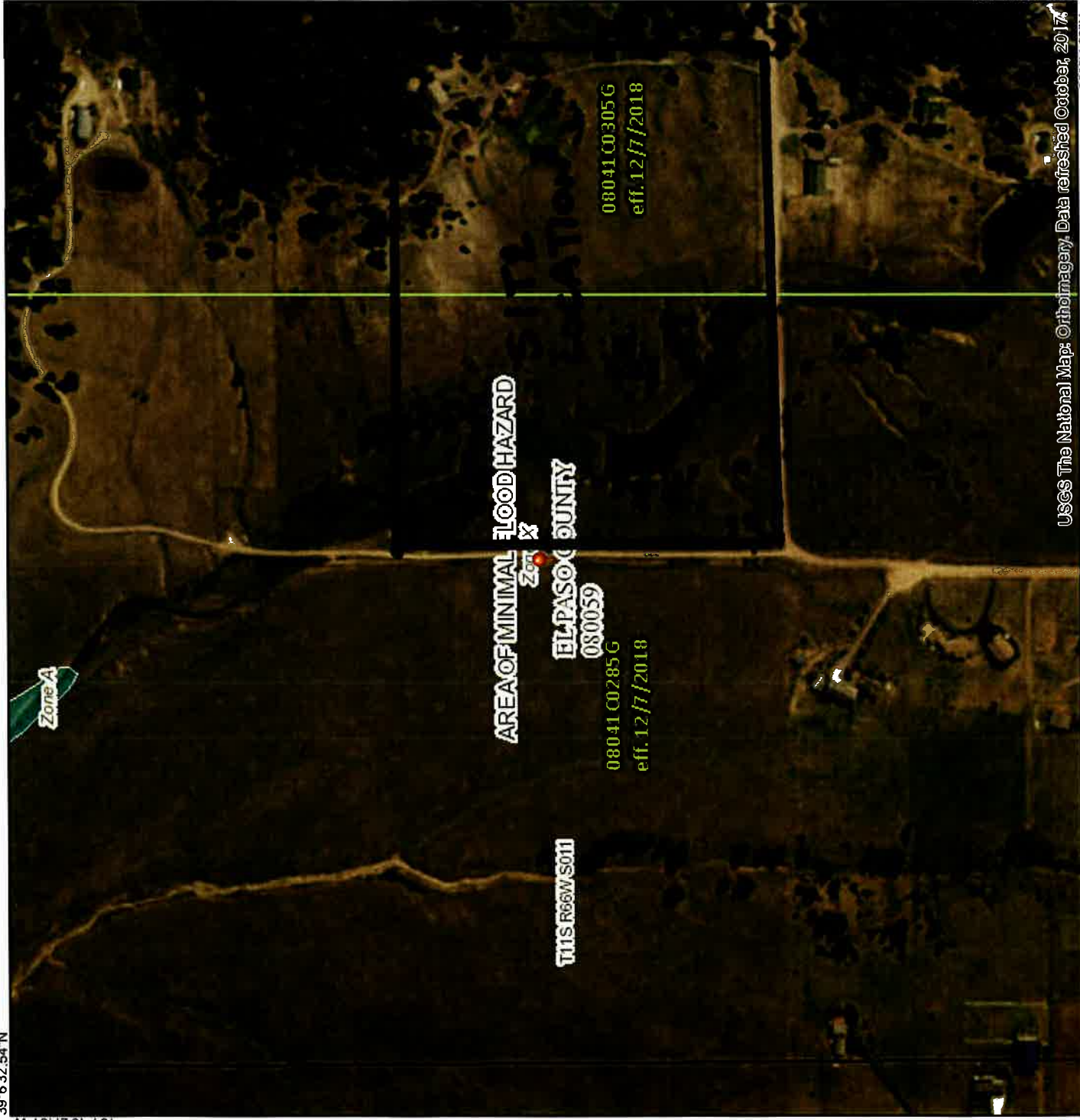
### MAP PANELS

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/22/2019 at 1:09:22 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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



104°44'50.15"W

39°5'4.62"N

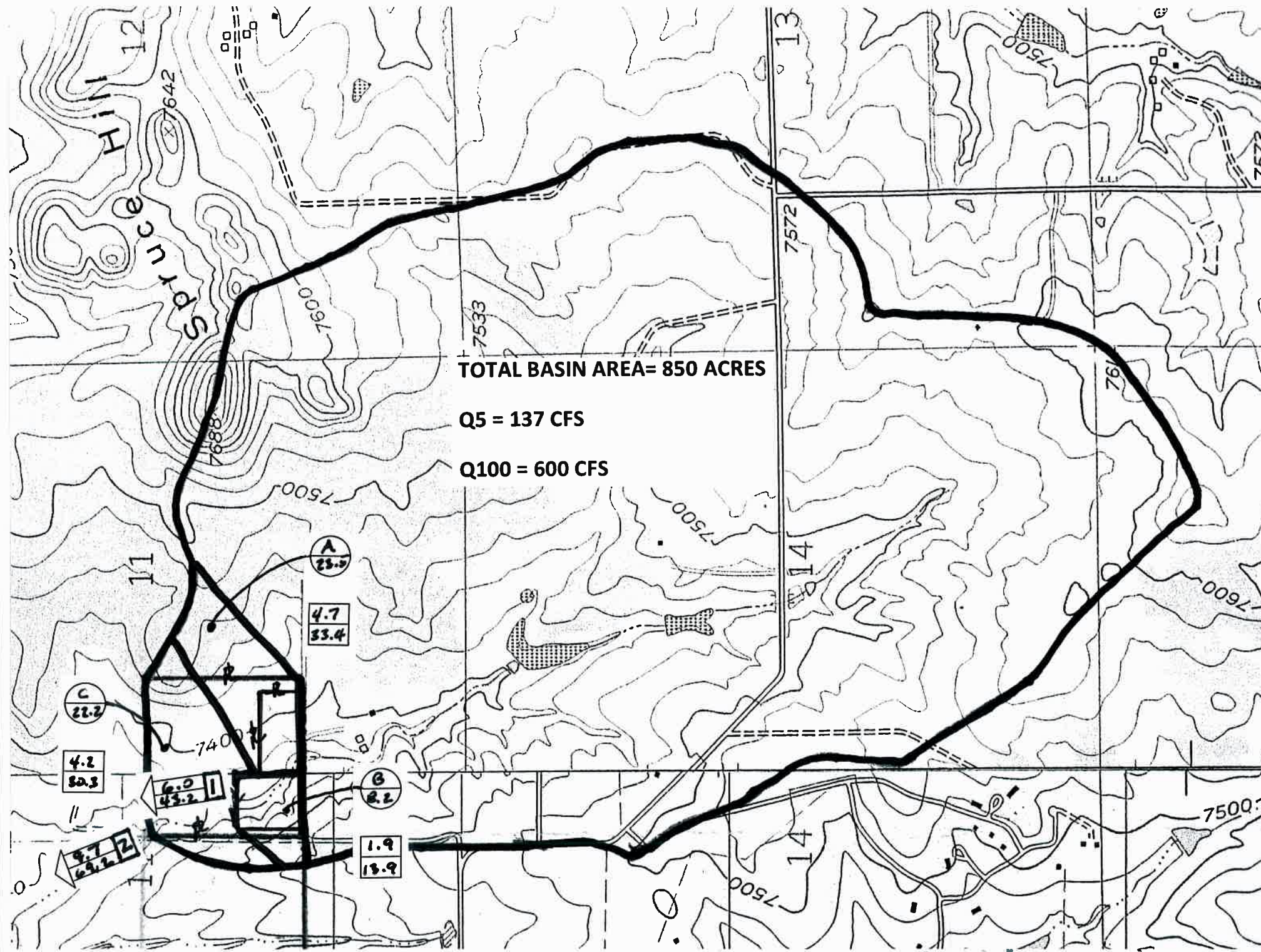
USGS The National Map: Orthoimagery, Data refreshed October, 2017

Feet 1:6,000

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

**APPENDIX B**  
**CALCULATIONS**





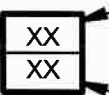

TOTAL BASIN AREA= 850 ACRES

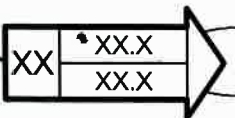
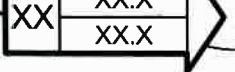
Q5 = 137 CFS

Q100 = 600 CFS

**LEGEND:**

 BASIN DESIGNATION  
 BASIN AREA, ACRES

 5 YEAR STORM, CFS  
 100 YEAR STORM, CFS

 5 YEAR ACCUMULATED FLOW, CFS  
 100 YEAR ACCUMULATED FLOW, CFS

DESIGN POINT

 SUB-BASIN BOUNDARY

 DIRECTION OF DRAINAGE FLOW



SCALE: 1" = 1000'

DESIGNED BY MAB DATE 4/19/18	PROJECT ENGINEER MAB JOB NO. 18044	PROJECT MANAGER MAB CAD FILE NO. MAB	SCALE: HORZ. 1"=1000' VERT. N/A	DRAWN BY H.J.G.
<b>ADPCIVIL</b> ENGINEERING FOR THE FUTURE				
3520 Austin Bluffs Parkway Suite 102 Colorado Springs, CO 80918 (719) 266-5212 fax: (719) 266-5311				
<b>3980 WALKER ROAD</b> <b>COLORADO SPRINGS, COLORADO</b> <b>DRAINAGE PLAN</b>				
SHEET <b>1 of 1</b>				

3980 WALKER ROAD

PROJ. #180404  
 DRAINAGE CALCULATION SHEET  
 file:3980 walker dr  
 04/27/18

AREA DESIG.	AREA (acre)	C5 (5 yr)	C100 (100 yr)	C5 X A	C100 X A	Initial Tc		Travel Time				length		vel. V (fps)	AREA DESIG.						
						L (ft)	Slope (%)	ti (min)	L (ft)	Slope (%)	V (fps)	Tt (min)	TC (min)			I5 (in/hr)	I100 (in/hr)	Q5 (cfs)	Q100 (cfs)	L (feet)	V (fps)
<b>EXISTING &amp; DEVELOPED CONDITIONS</b>																					
A	23.50	0.09	0.35	2.03	8.33	300	6.00	18.17	1700	6.00	2.30	12.32	30.49	2.30	4.01	4.67	33.42	500	3.70	2.25	A
B	8.20	0.09	0.35	0.71	2.91	300	6.00	18.17	600	6.00	2.30	4.35	22.52	2.73	4.77	1.94	13.88				B
DP1	31.70			2.74	11.24								32.74	2.20	3.84	6.03	43.20	750	3.70	3.38	DP1
C	22.20	0.09	0.35	1.92	7.87	300	6.00	18.17	2000	6.00	2.30	14.49	32.67	2.20	3.85	4.23	30.30				C
DP2	53.90			4.66	19.11								36.12	2.07	3.62	9.66	69.17				DP2
<b>TR20 CALCULATIONS</b>																					
A = 850 Ac = 1.30 SM																					
Elev Diff = 310 Ft																					
L = 9700 Ft																					
Soil Type = B																					
CN = 61																					
TI = 10 Min																					
Tt = 34.2 Min																					
TC = 44.2 Min + 0.737 Hr																					
Q5 = 137 CFS																					
Q100 = 600 CFS																					
<b>CHANNEL CALCULATIONS</b>																					
b = 40ft																					
z = 3:1																					
n = 0.08																					
s = 1.1%																					
Q100 = 600 CFS																					
d = 3.2 Ft																					
v = 3.7 FPS																					

WALKER.OUT

1

\*\*\*\*\*80-80 LIST OF INPUT DATA FOR TR-20 HYDROLOGY\*\*\*\*\*

```

JOB TR-20
TITLE 3980 WALKER RD - TR20 RUN 24 HR.5&100YR. STORM
TITLE DEVELOPED CONDITIONS INPUT : walker
5 RAINFL 7 0.5
8 0.0000 0.0040 0.0080 0.0100 0.0140
8 0.0190 0.0220 0.0260 0.0300 0.0450
8 0.0600 0.1000 0.7100 0.7500 0.7750
8 0.8000 0.8200 0.8300 0.8400 0.8500
8 0.8600 0.8700 0.8750 0.8850 0.8900
8 0.9000 0.9050 0.9100 0.9200 0.9250
8 0.9300 0.9350 0.9400 0.9450 0.9500
8 0.9550 0.9600 0.9650 0.9700 0.9730
8 0.9750 0.9800 0.9830 0.9870 0.9900
8 0.9930 0.9960 0.9999 1.0000 1.0000
9 ENDTBL
2 XSECTN 005 1.0
8 7330.00 0.0 0.00
8 7331.14 100.0 49.65
8 7332.91 500.0 141.99
8 7334.30 1000.0 227.61
8 7336.28 2000.0 369.35
9 ENDTBL
2 XSECTN 010 1.0
8 7340.00 0.0 0.00
8 7341.14 100.0 49.65
8 7342.91 500.0 141.99
8 7344.30 1000.0 227.61
8 7346.28 2000.0 369.35
9 ENDTBL
6 RUNOFF 1 010 2 1.3000 61.0 0.737 1 1
6 REACH 3 005 2 1 100.0 1 1
ENDATA
7 INCREM 6 0.1
7 COMPUT 7 010 005 0.0 3.00 1.0 7 2 01 01
ENDCMP 1
7 COMPUT 7 010 005 0.0 4.60 1.0 7 2 01 02
ENDCMP 1
ENDJOB 2

```

0\*\*\*\*\*END OF 80-80 LIST\*\*\*\*\*

EXECUTIVE CONTROL OPERATION INCREM RECORD ID

+ MAIN TIME INCREMENT = .10 HOURS

EXECUTIVE CONTROL OPERATION COMPUT RECORD ID

+ FROM XSECTION 10 TO XSECTION 5

+ STARTING TIME = .00 RAIN DEPTH = 3.00 RAIN DURATION= 1.00 RAIN

TABLE NO.= 7 ANT. MOIST. COND= 2

ALTERNATE NO.= 1 STORM NO.= 1 MAIN TIME INCREMENT = .10 HOURS

OPERATION RUNOFF CROSS SECTION 10



ELEVATION(FEET)	PEAK TIME(HRS)	WALKER.OUT PEAK DISCHARGE(CFS)	PEAK
	6.41	137.10	(RUNOFF)
	10.48	15.51	(RUNOFF)
	11.71	13.68	(RUNOFF)
	12.71	13.87	(RUNOFF)
	14.23	13.97	(RUNOFF)
	18.95	9.10	(RUNOFF)
	20.77	7.58	(RUNOFF)
	21.70	6.96	(RUNOFF)
	23.59	6.59	(RUNOFF)

TIME (HRS)	FIRST HYDROGRAPH POINT =	.00 HOURS	TIME INCREMENT =	.10
HOURS	DRAINAGE AREA = 1.30 SQ.MI.			
5.00	DISCHG .00	.00	.00	.00
.00	.00	.35	5.34	
6.00	DISCHG 23.62	57.37	99.22	128.30
114.72	94.63	78.59	66.98	137.04
7.00	DISCHG 58.03	50.88	45.69	41.99
36.58	35.51	34.40	33.26	39.49
8.00	DISCHG 32.11	30.85	29.27	27.24
20.61	18.94	17.72	16.88	24.95
9.00	DISCHG 16.30	15.90	15.62	15.44
15.23	15.22	15.23	15.26	15.33
10.00	DISCHG 15.29	15.33	15.37	15.42
15.43	15.08	14.33	13.26	15.47
11.00	DISCHG 12.11	11.17	10.68	10.87
13.29	13.68	13.42	12.67	11.59
12.00	DISCHG 11.76	10.99	10.64	10.93
13.48	13.87	13.64	12.93	11.71
13.00	DISCHG 12.01	11.10	10.33	9.77
9.10	9.42	10.17	11.26	9.38
14.00	DISCHG 12.45	13.44	13.94	13.81
11.36	10.59	10.02	9.63	13.16
15.00	DISCHG 9.36	9.16	9.03	8.93
8.80	8.78	8.77	8.77	8.87
16.00	DISCHG 8.77	8.77	8.78	8.79
8.82	8.83	8.85	8.86	8.80
17.00	DISCHG 8.87	8.88	8.90	8.91
8.95	8.96	8.97	8.98	8.92
18.00	DISCHG 8.99	9.01	9.02	9.03
9.07	9.08	9.09	9.10	9.04
19.00	DISCHG 9.10	9.04	8.86	8.50
6.94	6.43	5.95	5.49	8.01
20.00	DISCHG 5.09	4.83	4.85	8.01
7.13	7.51	7.57	7.37	8.01
21.00	DISCHG 7.04	6.73	6.52	8.01
6.90	6.96	6.89	6.71	8.01
22.00	DISCHG 6.50	6.28	6.10	8.01
5.77	5.74	5.72	5.71	8.01
23.00	DISCHG 5.70	5.73	5.81	8.01
6.58	6.41	5.82	4.92	8.01
24.00	DISCHG 3.91	2.96	2.16	8.01
.60	.43	.30	.22	8.01
25.00	DISCHG .15	.11	.08	8.01
.01	.01	.00		8.01

\*\*\* WARNING REACH 5 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER  
 REDUCING MAIN TIME INCREMENT \*\*\*  
 1

TR20 XEQ 04-27-18 07:20  
 REV PC 09/83(.2)

WALKER.OUT  
 3980 WALKER RD - TR20 RUN 24 HR.5&100YR. STORM  
 JOB 1 PASS 1  
 DEVELOPED CONDITIONS INPUT : walker  
 PAGE 1

OPERATION REACH CROSS SECTION 5

ELEVATION(FEET)	PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK
	6.41	137.10	7331.30
	10.48	15.51	7330.18
	11.71	13.68	7330.16
	12.71	13.87	7330.16
	14.23	13.97	7330.16
	18.95	9.10	7330.10
	20.77	7.58	7330.09
	21.70	6.96	7330.08
	23.59	6.59	7330.08

TIME(HRS)	FIRST HYDROGRAPH POINT =	.00 HOURS	TIME INCREMENT =	.10
HOURS	DRAINAGE AREA = 1.30 SQ.MI.			
5.00	DISCHG .00	.00	.00	.00
.00	.00 .35 5.34			
6.00	DISCHG 23.62 57.37	99.22	128.30	137.04 130.86
114.72	94.63 78.59 66.98			
7.00	DISCHG 58.03 50.88	45.69	41.99	39.49 37.81
36.58	35.51 34.40 33.26			
8.00	DISCHG 32.11 30.85	29.27	27.24	24.95 22.68
20.61	18.94 17.72 16.88			
9.00	DISCHG 16.30 15.90	15.62	15.44	15.33 15.26
15.23	15.22 15.23 15.26			
10.00	DISCHG 15.29 15.33	15.37	15.42	15.47 15.51
15.43	15.08 14.33 13.26			
11.00	DISCHG 12.11 11.17	10.68	10.87	11.59 12.51
13.29	13.68 13.42 12.67			
12.00	DISCHG 11.76 10.99	10.64	10.93	11.71 12.67
13.48	13.87 13.64 12.93			
13.00	DISCHG 12.01 11.10	10.33	9.77	9.38 9.13
9.10	9.42 10.17 11.26			
14.00	DISCHG 12.45 13.44	13.94	13.81	13.16 12.27
11.36	10.59 10.02 9.63			
15.00	DISCHG 9.36 9.16	9.03	8.93	8.87 8.83
8.80	8.78 8.77 8.77			
16.00	DISCHG 8.77 8.77	8.78	8.79	8.80 8.81
8.82	8.83 8.85 8.86			
17.00	DISCHG 8.87 8.88	8.90	8.91	8.92 8.93
8.95	8.96 8.97 8.98			
18.00	DISCHG 8.99 9.01	9.02	9.03	9.04 9.05
9.07	9.08 9.09 9.10			
19.00	DISCHG 9.10 9.04	8.86	8.50	8.01 7.47
6.94	6.43 5.95 5.49			
20.00	DISCHG 5.09 4.83	4.85	5.19	5.80 6.51
7.13	7.51 7.57 7.37			
21.00	DISCHG 7.04 6.73	6.52	6.48	6.58 6.75
6.90	6.96 6.89 6.71			
22.00	DISCHG 6.50 6.28	6.10	5.97	5.88 5.82
5.77	5.74 5.72 5.71			
23.00	DISCHG 5.70 5.73	5.81	5.98	6.23 6.47
6.58	6.41 5.82 4.92			
24.00	DISCHG 3.91 2.96	2.16	1.57	1.14 .83

WALKER.OUT  
 .60 .43 .30 .22  
 25.00 DISCHG .15 .11 .08 .05 .04 .02  
 .01 .01 .00

EXECUTIVE CONTROL OPERATION ENDCMP  
 RECORD ID COMPUTATIONS COMPLETED FOR PASS 1

EXECUTIVE CONTROL OPERATION COMPUT  
 RECORD ID FROM XSECTION 10 TO XSECTION 5  
 STARTING TIME = .00 RAIN DEPTH = 4.60 RAIN DURATION= 1.00 RAIN  
 TABLE NO.= 7 ANT. MOIST. COND= 2  
 ALTERNATE NO.= 1 STORM NO.= 2 MAIN TIME INCREMENT = .10 HOURS  
 1

TR20 XEQ 04-27-18 07:20 3980 WALKER RD - TR20 RUN 24 HR.5&100YR. STORM  
 REV PC 09/83(.2) JOB 1 PASS 2 DEVELOPED CONDITIONS INPUT : walker  
 PAGE 2

OPERATION RUNOFF CROSS SECTION 10

ELEVATION(FEET)	PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK
	6.35	598.18	(RUNOFF)
	10.46	38.72	(RUNOFF)
	11.71	33.64	(RUNOFF)
	12.71	33.77	(RUNOFF)
	14.23	33.56	(RUNOFF)
	18.91	21.26	(RUNOFF)
	20.77	17.57	(RUNOFF)
	21.70	16.08	(RUNOFF)
	23.59	15.12	(RUNOFF)

TIME(HRS)	FIRST HYDROGRAPH POINT =	AREA =	DISCHG	DISCHG	DISCHG	DISCHG	DISCHG	DISCHG
HOURS	0.00 HOURS	1.30 SQ.MI.	.00	.00	.00	.00	.00	.00
5.00	17.60	69.84	185.22	346.21	503.09	587.86	587.11	527.54
6.00	279.46	229.84	192.24	163.01	141.74	126.43	115.75	108.29
7.00	93.86	89.77	98.13	85.81	81.66	76.81	71.07	64.86
8.00	45.58	43.32	48.84	41.74	40.61	39.83	39.29	38.93
9.00	38.42	38.42	38.46	38.42	38.42	38.53	38.59	38.66
10.00	35.61	32.93	37.52	30.05	27.68	26.44	26.87	28.60
11.00	32.97	31.11	33.64	28.84	26.94	26.06	26.73	28.60
12.00	33.17	31.42	33.76					30.90

WALKER.OUT

13.00	DISCHG	29.17	26.94	25.05	23.66	22.70	22.08
21.99	22.73	24.53	27.15				
14.00	DISCHG	29.98	32.32	33.50	33.15	31.57	29.41
27.23	25.36	23.99	23.03				
15.00	DISCHG	22.36	21.87	21.53	21.29	21.13	21.01
20.94	20.89	20.85	20.83				
16.00	DISCHG	20.82	20.81	20.81	20.82	20.84	20.85
20.87	20.89	20.90	20.92				
17.00	DISCHG	20.94	20.96	20.97	20.99	21.01	21.02
21.04	21.06	21.08	21.09				
18.00	DISCHG	21.11	21.13	21.14	21.16	21.18	21.19
21.21	21.23	21.24	21.26				
19.00	DISCHG	21.25	21.10	20.66	19.82	18.67	17.40
16.15	14.97	13.83	12.76				
20.00	DISCHG	11.82	11.24	11.26	12.06	13.47	15.10
16.53	17.41	17.55	17.07				
21.00	DISCHG	16.31	15.57	15.09	14.99	15.22	15.60
15.93	16.08	15.91	15.50				
22.00	DISCHG	14.99	14.49	14.07	13.77	13.56	13.40
13.30	13.22	13.17	13.14				
23.00	DISCHG	13.12	13.17	13.36	13.76	14.31	14.87
15.12	14.71	13.36	11.28				
24.00	DISCHG	8.96	6.78	4.96	3.60	2.62	1.90
1.37	.98	.69	.49				
25.00	DISCHG	.35	.25	.17	.12	.08	.05
.03	.02	.01	.00				

\*\*\* WARNING REACH 5 ATT-KIN COEFF.(C) GREATER THAN 0.667, CONSIDER REDUCING MAIN TIME INCREMENT \*\*\*

OPERATION REACH CROSS SECTION 5  
1

TR20 XEQ 04-27-18 07:20 3980 WALKER RD - TR20 RUN 24 HR.5&100YR. STORM  
JOB 1 PASS 2  
REV PC 09/83(.2) DEVELOPED CONDITIONS INPUT : walker  
PAGE 3

ELEVATION(FEET)	PEAK TIME(HRS)	PEAK DISCHARGE(CFS)	PEAK
	6.35	598.18	7333.18
	10.46	38.72	7330.44
	11.71	33.64	7330.38
	12.71	33.77	7330.38
	14.23	33.56	7330.38
	18.91	21.26	7330.24
	20.77	17.57	7330.20
	21.70	16.08	7330.18
	23.59	15.12	7330.17

TIME(HRS)	FIRST HYDROGRAPH POINT =	.00 HOURS	TIME INCREMENT =
HOURS	DRAINAGE AREA = 1.30 SQ.MI.		.10
5.00	DISCHG .00	.00	.00
.00	1.82 17.60 69.84		
6.00	DISCHG 185.22 346.21	503.09 587.86	587.11 527.54
438.87	348.26 279.46 229.84		
7.00	DISCHG 192.24 163.01	141.74 126.43	115.75 108.29
102.72	98.13 93.86 89.77		

WALKER.OUT

8.00	DISCHG	85.81	81.66	76.81	71.07	64.86	58.79
53.30	48.84	45.58	43.32				
9.00	DISCHG	41.74	40.61	39.83	39.29	38.93	38.69
38.54	38.46	38.42	38.42				
10.00	DISCHG	38.44	38.48	38.53	38.59	38.66	38.70
38.44	37.52	35.61	32.93				
11.00	DISCHG	30.05	27.68	26.44	26.87	28.60	30.83
32.72	33.64	32.97	31.11				
12.00	DISCHG	28.84	26.94	26.06	26.73	28.60	30.90
32.84	33.76	33.17	31.42				
13.00	DISCHG	29.17	26.94	25.05	23.66	22.70	22.08
21.99	22.73	24.53	27.15				
14.00	DISCHG	29.98	32.32	33.50	33.15	31.57	29.41
27.23	25.36	23.99	23.03				
15.00	DISCHG	22.36	21.87	21.53	21.29	21.13	21.01
20.94	20.89	20.85	20.83				
16.00	DISCHG	20.82	20.81	20.81	20.82	20.84	20.85
20.87	20.89	20.90	20.92				
17.00	DISCHG	20.94	20.96	20.97	20.99	21.01	21.02
21.04	21.06	21.08	21.09				
18.00	DISCHG	21.11	21.13	21.14	21.16	21.18	21.19
21.21	21.23	21.24	21.26				
19.00	DISCHG	21.25	21.10	20.66	19.82	18.67	17.40
16.15	14.97	13.83	12.76				
20.00	DISCHG	11.82	11.24	11.26	12.06	13.47	15.10
16.53	17.41	17.55	17.07				
21.00	DISCHG	16.31	15.57	15.09	14.99	15.22	15.60
15.93	16.08	15.91	15.50				
22.00	DISCHG	14.99	14.49	14.07	13.77	13.56	13.40
13.30	13.22	13.17	13.14				
23.00	DISCHG	13.12	13.17	13.36	13.76	14.31	14.87
15.12	14.71	13.36	11.28				
24.00	DISCHG	8.96	6.78	4.96	3.60	2.62	1.90
1.37	.98	.69	.49				
25.00	DISCHG	.35	.25	.17	.12	.08	.05
.03	.02	.01	.00				

EXECUTIVE CONTROL OPERATION ENDCMP  
RECORD ID

+ COMPUTATIONS COMPLETED FOR PASS 2

EXECUTIVE CONTROL OPERATION ENDJOB  
RECORD ID

1

TR20 XEQ 04-27-18 07:20

REV PC 09/83(.2)

3980 WALKER RD - TR20 RUN 24 HR.5&100YR. STORM  
JOB 1 SUMMARY  
DEVELOPED CONDITIONS INPUT : walker  
PAGE 4

SUMMARY TABLE 1 - SELECTED RESULTS OF STANDARD AND EXECUTIVE CONTROL INSTRUCTIONS  
IN THE ORDER PERFORMED

(A STAR(\*) AFTER THE PEAK DISCHARGE TIME AND RATE (CFS) VALUES  
INDICATES A FLAT TOP HYDROGRAPH

A QUESTION MARK(?) INDICATES A HYDROGRAPH WITH PEAK AS LAST



WALKER.OUT

POINT.)

SECTION/ STRUCTURE RUNOFF ID	STANDARD CONTROL OPERATION ELEVATION (FT)	PEAK DISCHARGE DRAINAGE TIME (HR)	RAIN TABLE # AREA (SQ MI) RATE (CFS)	ANTEC MOIST COND RATE (CSM)	MAIN TIME INCREM (HR)	PRECIPITATION		
						BEGIN (HR)	AMOUNT (IN)	DURATION (HR)
ALTERNATE 1 STORM 1								
+ XSECTION 10	RUNOFF	1.30	7	2	.10	.0	3.00	24.00
.36	---	6.41	137.10	105.5				
XSECTION 5	REACH	1.30	7	2	.10	.0	3.00	24.00
.36	7331.30	6.41	137.10	105.5				
ALTERNATE 1 STORM 2								
+ XSECTION 10	RUNOFF	1.30	7	2	.10	.0	4.60	24.00
1.13	---	6.35	598.18	460.1				
XSECTION 5	REACH	1.30	7	2	.10	.0	4.60	24.00
1.13	7333.18	6.35	598.18	460.1				

TR20 XEQ 04-27-18 07:20  
REV PC 09/83(.2)

3980 WALKER RD - TR20 RUN 24 HR.5&100YR. STORM  
JOB 1 SUMMARY  
DEVELOPED CONDITIONS INPUT : walker  
PAGE 5

SUMMARY TABLE 2 - SELECTED MODIFIED ATT-KIN REACH ROUTINGS IN ORDER OF STANDARD EXECUTIVE CONTROL INSTRUCTIONS  
(A STAR(\*) AFTER VOLUME ABOVE BASE(IN) INDICATES A HYDROGRAPH TRUNCATED AT A VALUE EXCEEDING BASE + 10% OF PEAK  
A QUESTION MARK(?) AFTER COEFF.(C) INDICATES PARAMETERS OUTSIDE ACCEPTABLE LIMITS, SEE PREVIOUS WARNINGS)

HYDROGRAPH INFORMATION

ROUTING PARAMETERS				PEAK				VOLUME	MAIN	ITER-	Q
AND A	PEAK	S/Q	ATT-	TRAVEL	TIME	OUTFLOW+					
XSEC REACH	INFLOW	OUTFLOW	INTERV.	AREA	BASE-	ABOVE	TIME	ATION			
EQUATION	LENGTH	RATIO	@PEAK	KIN	STOR-	KINE-					
ID	LENGTH	PEAK	TIME	PEAK	TIME	PEAK	TIME	FLOW	BASE	INCR	#
COEFF	POWER	FACTOR	O/I	(K)	COEFF	AGE	MATIC	(CFS)	(IN)	(HR)	
(X)	(M)	(K*)	(Q*)	(SEC)	(C)	(HR)	(HR)				

ALTERNATE 1 STORM 1

WALKER.OUT

```

.253
+ 5 100 137 6.4 137 6.4 0 .36 .10 0
+ 1.53 .000 1.000 29 1.00? .00 .00
+
+ ALTERNATE 1 STORM 2
+
.260
+ 5 100 588 6.3 588 6.3 0 1.13 .10 0
+ 1.52 .000 1.000 18 1.00? .00 .00
+
+ 1
  
```

TR20 XEQ 04-27-18 07:20  
 REV PC 09/83(.2)

3980 WALKER RD - TR20 RUN 24 HR.5&100YR. STORM  
 JOB 1 SUMMARY  
 DEVELOPED CONDITIONS INPUT : walker  
 PAGE 6

SUMMARY TABLE 3 - DISCHARGE (CFS) AT XSECTIONS AND STRUCTURES FOR ALL STORMS AND ALTERNATES

XSECTION/ STRUCTURE ID	DRAINAGE AREA (SQ MI)	STORM NUMBERS.....	
		1	2
0 XSECTION 5	1.30		
+ ALTERNATE 1		137.10	598.18
0 XSECTION 10	1.30		
+ ALTERNATE 1		137.10	598.18

1END OF 1 JOBS IN THIS RUN

**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
<b>Business</b>													
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
<b>Residential</b>													
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	0.42	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
<b>Industrial</b>													
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
<b>Parks and Cemeteries</b>	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	0.25	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
<b>Undeveloped Areas</b>													
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 land use 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
<b>Streets</b>													
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
<b>Drive and Walks</b>	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

TABLE 5-4  
 RUNOFF CURVE NUMBERS FOR HYDROLOGIC  
 SOIL-COVER COMPLEXES--RURAL CONDITIONS  
 (Antecedent Moisture Condition II, and  $I_a = 0.2 S$ )  
 (From: U.S. Dept. of Agriculture,  
 Soil Conservation Service, 1977)

NOTE: THIS TABLE TO  
 BE USED FOR 24-HOUR  
 STORM ONLY.

Land Use	Cover Treatment or Practice	Hydrologic Condition	Runoff curve number by Hydrologic soil group			
			A	B	C	D
Fallow	Straight Row	----	77	86	91	94
Row crops	Straight Row	Poor	72	81	88	91
	Straight Row	Good	67	78	85	89
	Contoured	Poor	70	79	84	88
	Contoured	Good	65	75	82	86
	Cont. and terraced	Poor	66	74	80	82
	Cont. and terraced	Good	62	71	78	81
Small grain	Straight Row	Poor	65	76	84	88
		Good	63	75	83	87
	Contoured	Poor	63	74	82	85
		Good	61	73	81	84
	Cont. and terraced	Poor	61	72	79	82
		Good	59	70	78	81
Close-seeded legumes <u>1/</u> or rotation meadow	Straight Row	Poor	66	77	85	89
		Good	58	72	81	85
	Contoured	Poor	64	75	83	85
		Good	55	69	78	83
	Cont. and terraced	Poor	63	73	80	83
		Good	51	67	76	80
Pasture or range		Poor	68	79	86	89
		Fair	49	69	79	84
		Good	39	61	74	80
	Contoured	Poor	47	67	81	88
		Fair	25	59	75	83
		Good	6	35	70	79
Meadow		Good	30	58	71	78
Woods		Poor	45	66	77	83
		Fair	36	60	73	79
		Good	25	55	70	77
Farmsteads		----	59	74	82	86
Roads (dirt) <u>2/</u> (hard surface) <u>2/</u>		----	72	82	87	89
		----	74	84	90	92

1/ Close-drilled or broadcast  
2/ Including right-of-way



Figure 6-25. Estimate of Average Concentrated Shallow Flow

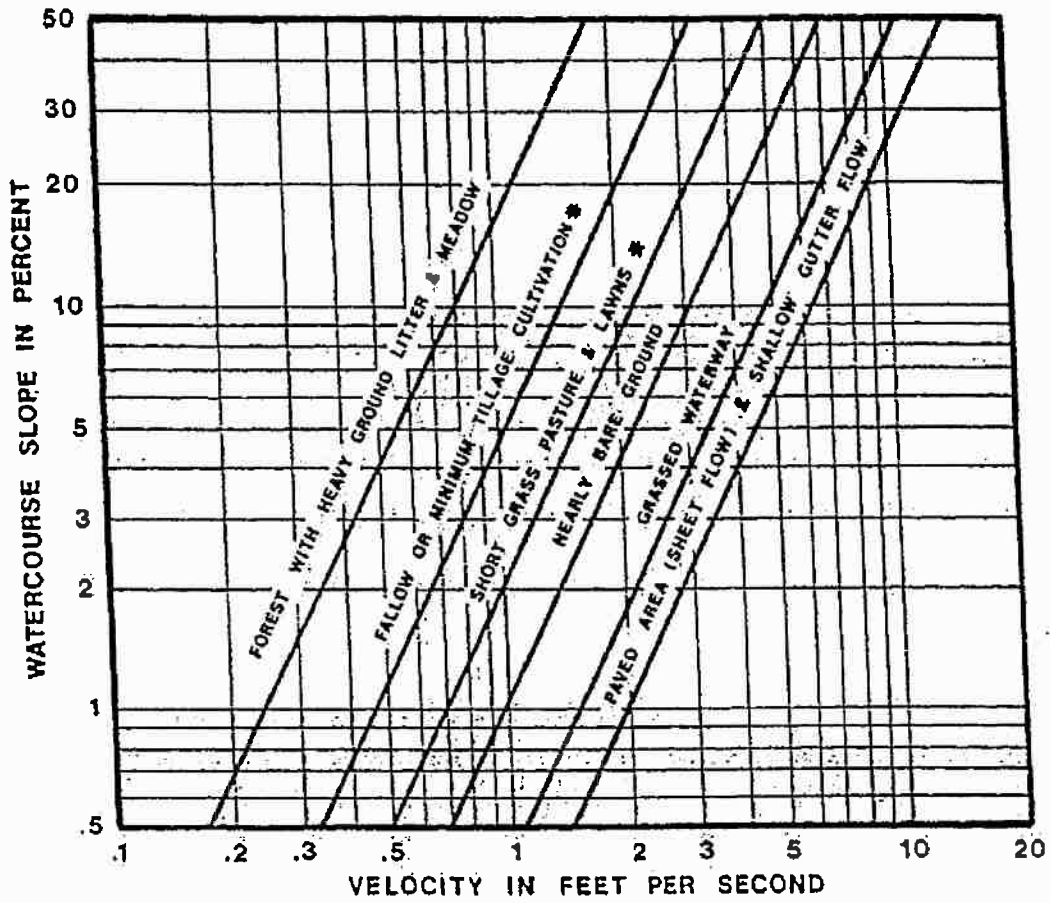
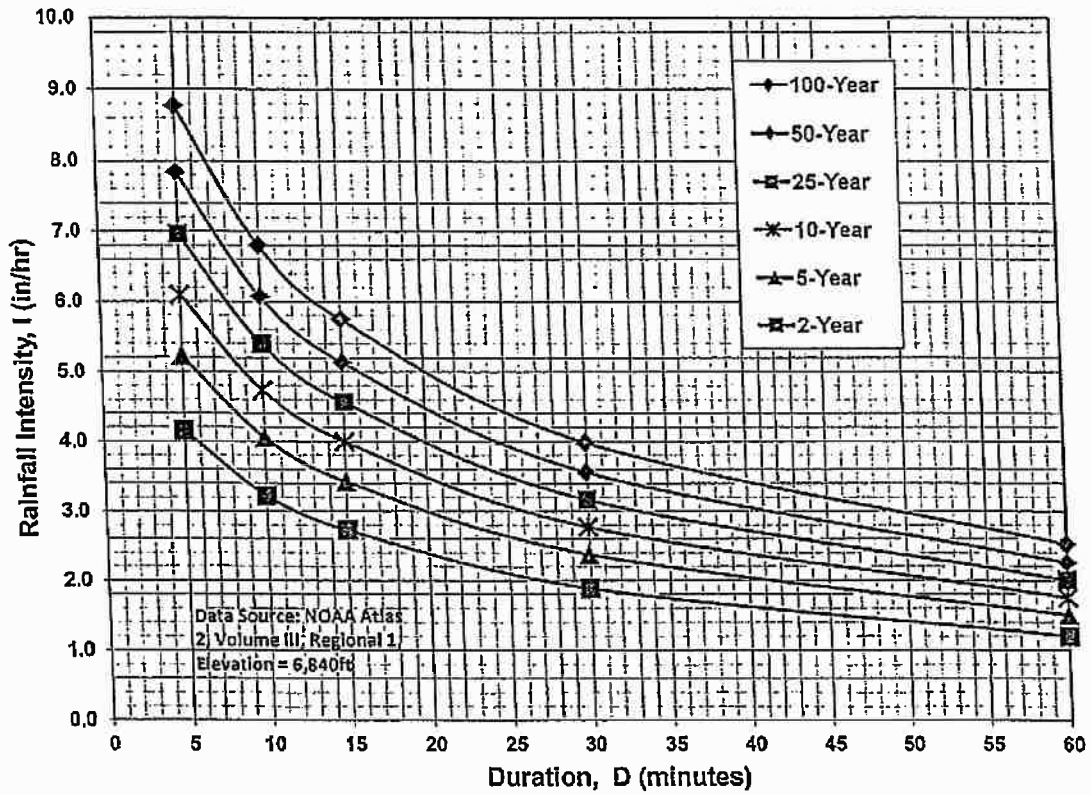


Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



**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.