



FINAL DRAINAGE REPORT FOR NORTHERN DELIVERY SYSTEM BOOSTER PUMP STATION



PREPARED BY

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PREPARED FOR

Triview Metropolitan District
16055 Old Forest Point STE 300
Monument, CO 80132

April 2023

Project 224.29

Add PCD File No. PPR2262





ENGINEER'S STATEMENT

This report and plan for the drainage design of Northern Delivery System Booster Pump Station, 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 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 understand that El Paso County 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.

Richard Gallegos, P.E.

Date

Registered Professional Engineer State of Colorado No. 36247

DEVELOPER'S STATEMENT

The Triview Metropolitan District hereby certifies that the drainage facilities for the Northern Delivery System Booster Pump Station shall be constructed according to the design presented in this report. I understand that El Paso County does not, and will not, assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to El Paso County; and cannot, on behalf of the Northern Delivery System Booster Pump Station guarantee that final drainage design review will absolve the Triview Metropolitan District 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.

Authorized Signature

Date

Printed Name

Title

Address:

EL PASO COUNTY STATEMENT

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

For the County Engineer

Date



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1.0 PURPOSE

This drainage report is for the design of the Northern Delivery System Booster Pump Station. The site is located along Highway 83, Colorado Springs, Colorado in central El Paso County. See Vicinity Map in the Appendix below for reference. It is further described as the Southwest One-Quarter of the Northwest One-Quarter of Section 3, Township 12 South, Range 66 West of the 6th P.M. This 9.75-acre site is located within the Black Squirrel Creek – FOMO3600 basin.

One Drainage Basin Planning Study for Black Squirrel Creek was found within the County's files that included the project site:

- *Black Squirrel Creek Drainage Basin Planning Study Final Report*, City of Colorado Springs and El Paso County, January of 1989

The site is bounded to the west by Highway 83. Work will include the construction of a 1500 square foot (sf) pump station and asphalt driveway. With an area of disturbance less than 1 acre, detention will not be required for the site per El Paso County Engineering Criteria Manual (ECM) Appendix I.7, 1.B. No portion of the site is located within a FEMA designated 100-year floodplain per Map No. 08041C0295G that was effective on December 7th, 2018.

Unresolved from review 1. Remove the inaccurate statement. Criteria does not imply detention will not be required for disturbance that is less than 1 acre per appendix I.

2.0 SOIL CONDITIONS

According to the El Paso County Area Soil Survey, the soil on the site is classified as follows:

SOIL #	SOIL TYPE	HYDROLOGIC CLASSIFICATION	PERCENT OF SITE
41	Kettle Gravelly Loamy Sand, 8 to 40 Percent Slopes	B	10.8%
69	Peyton-Pring Complex, 8 to 15 Percent Slopes	B	0.0%
71	Pring Coarse Sandy Loam, 3 to 8 Percent Slopes	B	89.2%

The Kettle Gravelly soil can be described as having a high permeability, low surface runoff, and slight hazard of erosion. The Pring Coarse Sandy soils is described, similarly, as having high permeability and low surface runoff. The hydrologic soil classification used for this study is 'B'. See Soils Map in the Appendix for reference.

3.0 HYDROLOGIC CRITERIA

The methodology utilized for this report is in accordance with the *El Paso County Drainage Criteria Manual*. All references from the *El Paso County Drainage Criteria Manual* can be found in Appendix C. The Rational Method for computation of runoff was used.



FYI minor flows are 5 year per our criteria. You may change the 10 year analysis to the 5 year if you like. If change in analysis is done please change throughout report.

$Q = CIA$

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

The storm recurrence intervals, used to determine swale capacity, for this study were the 10-year storm and the 100-year storm. ManningSolver Version 1.019 was used in this analysis to calculate the Manning's normal depth.

4.0 EXISTING DRAINAGE CONDITIONS

The overall site consists of 9.75 acres. The site includes an existing water storage tank and gravel driveway. The areas of the site not covered by the potable water tank or gravel driveway are covered with scrub oak, grass, willows and pine trees. These undeveloped areas include slopes that range from 4.9% to 34.1%. The overall existing site is 3.5% impervious. See Existing Drainage Map in the Back Pocket for reference.

Flows from Sub-basin OS1, Sub-basin OS2, and Sub-basin Aex through Sub-basin Gex are tributary to the Black Squirrel Creek – FOMO3600 drainage basin.

Sub-basin OS1 contains 3.85 acres and drains southeast towards a stream that is tributary to Black Squirrel Creek. This sub-basin produces existing flows of 3.5 cfs for the 10-year storm and 9.2 cfs for the 100-year storm. These flows sheetflow to the southeast over nearly bare ground.

Sub-basin OS2 consists of 3.69 acres and drains southeast towards a stream that is tributary to Black Squirrel Creek. This sub-basin produces existing flows of 2.8 cfs for the 10-year storm and 8.5 cfs for the 100-year storm. These flows sheetflow to the southeast. Flows from Sub-basin OS2 combine with flows from Sub-basin Eex, Sub-basin Fex, and Sub-basin Gex to produce total flows of 7.5 cfs for the 10-year storm and 20.8 cfs for the 100-year storm at Design Point 1 (DP1). These flows proceed into the stream tributary to Black Squirrel Creek that is located southeast of the site.

Sub-basin Aex contains 3.89 acres and drains south towards a private access road. This sub-basin produces existing flows of 2.4 cfs for the 10-year storm and 7.8 cfs for the 100-year storm. These flows sheetflow to the south.

Sub-basin Bex consists of 2.37 acres and drains south along a private access road. This sub-basin produces existing flows of 2.1 cfs for the 10-year storm and 5.9 cfs for the 100-year storm. These flows sheetflow in the southerly direction.

Sub-basin Cex contains 7.96 acres and drains south towards a private access road. This sub-basin produces existing flows of 5.4 cfs for the 10-year storm and 17.4 cfs for the 100-year storm. These flows sheetflow to the south.



Sub-basin Dex consists of 3.98 acres and drains southeast towards a stream that is tributary to Black Squirrel Creek. It produces flows of 2.7 cfs for the 10-year storm and 9.2 cfs for the 100-year storm. These flows sheetflow to the southeast, ultimately ending up in the stream noted on the Existing Drainage Plan in the Back Pocket. Flows from Sub-basin Dex combine with flows from Sub-basin Cex, Sub-basin OS1, and Design Point 1 (DP1) to produce total flows of 15.8 cfs for the 10-year storm and 46.9 cfs for the 100-year storm at Design Point 2 (DP2). These flows continue along the stream towards Black Squirrel Creek.

Sub-basin Eex contains 2.79 acres and drains east towards Sub-basin OS2. It produces flows of 3.3 cfs for the 10-year storm and 8.3 cfs for the 100-year storm. These flows sheetflow to the east, ultimately ending up in the stream that is tributary to Black Squirrel Creek.

Sub-basin Fex contains 1.15 acres and drains southeast towards Sub-basin OS2. It produces flows of 1.4 cfs for the 10-year storm and 3.4 cfs for the 100-year storm. These flows sheetflow to the southeast, ultimately ending up in the stream that is tributary to Black Squirrel Creek.

Sub-basin Gex consists of 0.96 acres and drains southeast towards Sub-basin OS1. It produces flows of 0.7 cfs for the 10-year storm and 2.5 cfs for the 100-year storm. These flows sheetflow to the southeast into the stream that is tributary to Black Squirrel Creek.

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

TABLE 1 – EXISTING CONDITIONS		
Sub-basin	Q₁₀ (CFS)	Q₁₀₀ (CFS)
OS1	3.5	9.2
OS2	2.8	8.5
Aex	2.4	7.8
Bex	2.1	5.9
Cex	5.4	17.4
Dex	2.7	9.2
Eex	3.3	8.3
Fex	1.4	3.4
Gex	0.7	2.5
DP1 (Eex + Fex + Gex + OS2)	7.5	20.8
DP2 (DP1 + Cex + Dex + OS1)	15.8	46.9

5.0 DEVELOPED DRAINAGE CONDITIONS

The overall site consists of 9.75 acres, of which 0.9 acres will be disturbed for permanent improvements as part of this project. A booster pump station building and 15' wide asphalt access road is proposed on the east side of the site. A secondary gate access road is also proposed on the south end of the site



along that connects the site to the existing private asphalt driveway. Proposed Conditions Map is located below in the Back Pocket for reference.

Proposed site imperviousness is 5.4%, versus 3.5% in the existing conditions. Proposed flows are tributary to the Black Squirrel Creek – FOMO3600 drainage basin.

Sub-basin OS1 contains 3.85 acres and drains southeast towards a stream that is tributary to Black Squirrel Creek. This sub-basin produces existing flows of 3.5 cfs for the 10-year storm and 9.2 cfs for the 100-year storm. These flows sheetflow to the southeast over nearly bare ground.

Sub-basin OS2 contains 3.68 acres and drains southeast towards a stream that is tributary to Black Squirrel Creek. This sub-basin produces existing flows of 2.8 cfs for the 10-year storm and 8.5 cfs for the 100-year storm. These flows sheetflow to the southeast. Flows from Sub-basin OS2 combine with flows from Sub-basin E, Sub-basin F, and Sub-basin G to produce total flows of 8.2 cfs for the 10-year storm and 22.0 cfs for the 100-year storm at Design Point 1 (DP1). These flows proceed into the stream tributary to Black Squirrel Creek that is located southeast of the site.

Sub-basin A consists of 3.89 acres and drains south towards a private access road. This sub-basin produces existing flows of 2.4 cfs for the 10-year storm and 7.8 cfs for the 100-year storm. These flows sheetflow to the south.

Sub-basin B contains 2.37 acres and drains south along a private access road. This sub-basin produces existing flows of 2.3 cfs for the 10-year storm and 6.1 cfs for the 100-year storm. These flows sheetflow in the southerly direction.

Sub-basin C consists of 7.96 acres and drains south towards a private access road. This sub-basin produces existing flows of 5.4 cfs for the 10-year storm and 17.4 cfs for the 100-year storm. These flows sheetflow to the south over all roads (existing and proposed).

Sub-basin D contains 3.98 acres and drains southeast towards a stream that is tributary to Black Squirrel Creek. It produces flows of 3.1 cfs for the 10-year storm and 9.8 cfs for the 100-year storm. These flows sheetflow to the southeast over the proposed access road, ultimately ending up in the stream noted on the Existing Drainage Plan in the Back Pocket. Flows from Sub-basin D combine with flows from Sub-basin C, Sub-basin OS1, and Design Point 1 (DP1) to produce total flows of 16.8 cfs for the 10-year storm and 48.3 cfs for the 100-year storm at Design Point 2 (DP2). These flows continue along the stream towards Black Squirrel Creek.

Sub-basin E contains 2.83 acres and drains east towards the proposed pump station. It produces flows of 3.8 cfs for the 10-year storm and 9.1 cfs for the 100-year storm. Two 1.25' deep triangular swales with 4:1 side slopes route these flows around the proposed pump station. These flows sheetflow to the east, ultimately ending up in the stream that is tributary to Black Squirrel Creek.

Sub-basin F consists of 1.15 acres and drains southeast towards Sub-basin OS2. It produces flows of 1.4 cfs for the 10-year storm and 3.4 cfs for the 100-year storm. These flows sheetflow to the southeast, ultimately ending up in the stream that is tributary to Black Squirrel Creek.



Sub-basin G contains 0.96 acres and drains southeast towards Sub-basin OS1. It produces flows of 1.1 cfs for the 10-year storm and 3.0 cfs for the 100-year storm. These flows sheetflow to the southeast over the proposed access road and into the stream that is tributary to Black Squirrel Creek.

The estimated runoff amounts produced for the project under Proposed Conditions are shown in Table 2 below.

TABLE 2 – PROPOSED CONDITIONS		
Sub-basin	Q ₁₀ (CFS)	Q ₁₀₀ (CFS)
OS1	3.5	9.2
OS2	2.8	8.5
A	2.4	7.8
B	2.3	6.1
C	5.4	17.4
D	3.1	9.8
E	3.8	9.1
F	1.4	3.4
G	1.1	3.0
DP1 (E + F + G + OS2)	8.3	22.1
DP2 (DP1 + C + D + OS1)	16.8	48.3

6.0 WATER QUALITY

The total disturbance for this development will be 0.9 acres. According to the El Paso County Engineering Criteria Manual (ECM), “The following types of sites and associated land disturbances are excluded from the requirements of this Section 1.7”. Furthermore, in El Paso County ECM Appendix I.7, 1.B, a “County Growth Areas” are excluded from the requirements defined in Section 1.7. Since this site will be considered a “Commercial or industrial development site or larger common plans of development for which associated construction activities results in a land disturbance of less than or equal to 10 acres, the site can be excluded from water quality control measure requirements.

El Paso County does not apply the County Growth Areas exclusion for any Sites within the County. In addition, Appendix I.7.1.b. refers to post-construction water quality requirements, not ESQCP applicability.

The proposed work is adjacent to a sensitive area and will therefore require an ESQCP. unresolved.

the site is less than 1 acre of disturbance and therefore does not need WQ

7.0 EROSION CONTROL PLAN

The site construction consists of constructing a new pump station and an asphalt access road, disturbing 0.9 acres of area. This does not require an Erosion and Stormwater Quality Control Permit. However, a Grading and Erosion Control Plan will be submitted in separate Construction Plans.

8.0 FLOODPLAIN STATEMENT

No 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 No.



08041C0295G dated December 7th, 2018. No portion of the site lies within the Zone 'A' of Black Squirrel Creek as noted on Map No. 08041C0295G.

9.0 DRAINAGE BASIN FEES

The proposed development is located within the Black Squirrel Drainage Basin, which assesses drainage and bridge fees at the time of platting. A plat is not proposed as part of this project, so do drainage or bridge fees are due.

10.0 CONSTRUCTION COST OPINION

Flows will either sheet flow or be directed to outfall points via ditch. A single 12" HDPE culvert will be needed at the 15' wide access road. A cost opinion is as follows:

Item	Quantity	Unit	Unit Cost	Total
12" HDPE	34	LF	\$20	\$680
15% Engineering & Cont.				\$102
Grand Total				\$782

11.0 CONCLUSIONS

For this 9.75-acre site, work will include constructing a booster pump station and 15' wide asphalt access road. Additionally, a secondary gate access road will be constructed that will allow access from the site from the private driveway south of the property. The total anticipated disturbance of the site will be 0.9 acres. The development increases total routed flows exiting the site at Design Point 2 (DP2) from 15.9 cfs to 16.8 cfs for the 10-year storm, while the 100-year storm flow increases from 46.9 cfs to 48.4 cfs. These increases do not warrant the need for detention. All developed flows will continue to flow along existing drainage patterns.

Disturbed areas shall be permanently stabilized as soon as construction activities are completed. Areas to be re-vegetated shall be treated with soil amendments to provide an adequate growth medium to sustain vegetation and shall match the pre-existing, pre-disturbed vegetation cover. Erosion control measures will be installed during construction of the proposed site per the approved Grading and Erosion Control Plan to be submitted separately for review and approval. Site runoff, storm drains, and appurtenances associated with the development of the Triview Metropolitan District Northern Delivery System Booster Pump Station will not adversely affect the downstream and surrounding developments.



12.0 REFERENCES

Black Squirrel Creek Drainage Basin Planning Study Final Report, City of Colorado Springs and El Paso County, January of 1989

Flood Insurance Rate Map Number 08041C0295G, Federal Emergency Management Agency Floodplain Data, revised December 7, 2018

Municipal Code Corporation (2018). *Drainage Criteria Manual of El Paso County, Colorado (DPM)*

Urban Drainage and Flood Control District (June 2017). *Urban Storm Drainage Criteria Manual, Volume 1-3*.

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

Show the "Four-Step Process" for selecting structural BMPs (ECM Section 1.7.2 BMP Selection). Under each step, summarize how the step was considered or implemented.

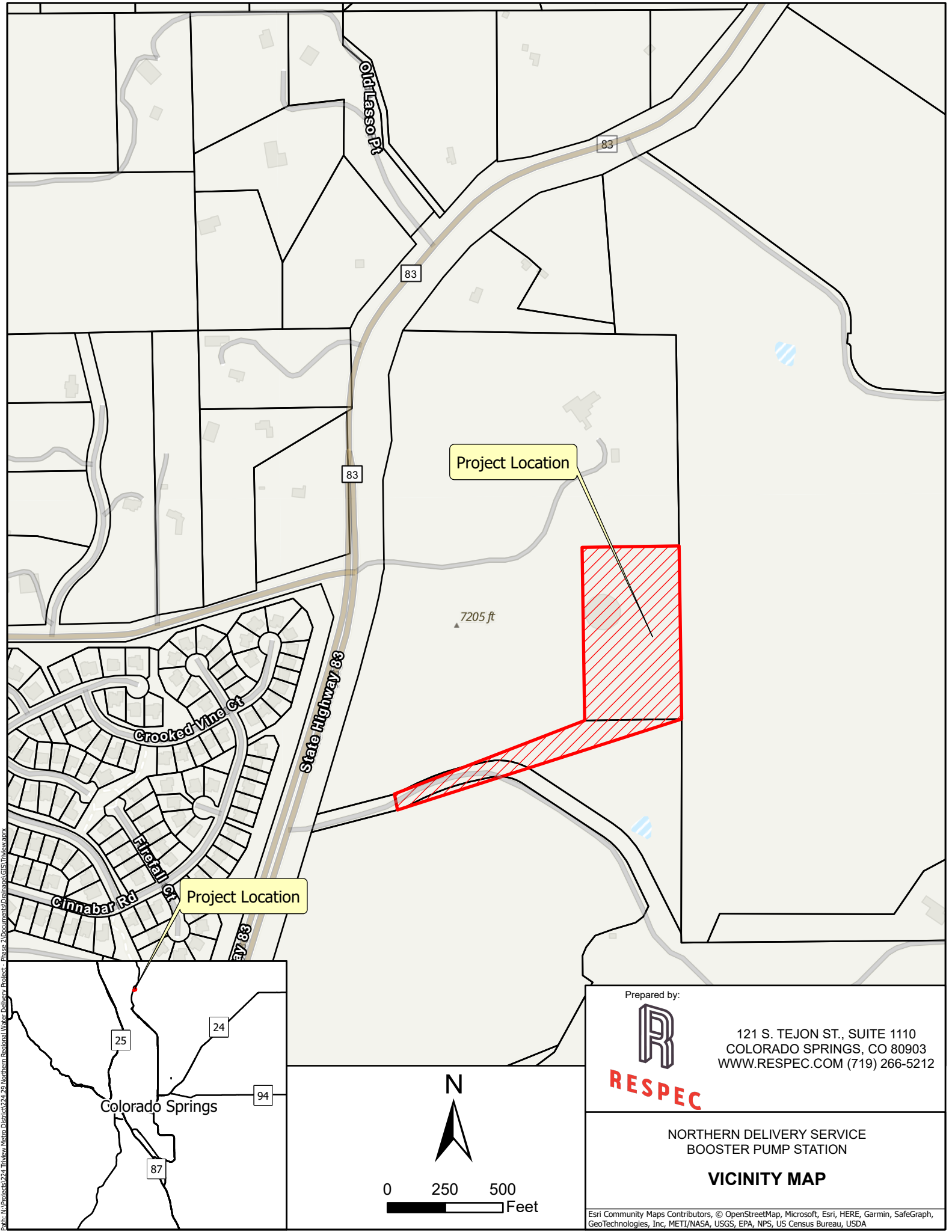
(Employ runoff reduction practices, stabilize drainageways, provide WQCV, and other specialized BMPs)

unresolved.



APPENDIX A

MAPS

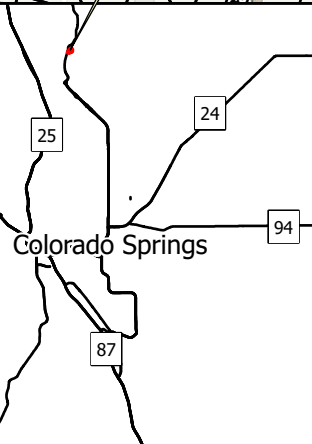


Project Location

Project Location

7205 ft

Path: N:\Projects\244 Tiview Metro District\244_23 Northern Regional Water Delivery Project - Phase 2\Documents\Drawings\GIS\Tiview\vicinity



0 250 500 Feet

Prepared by:



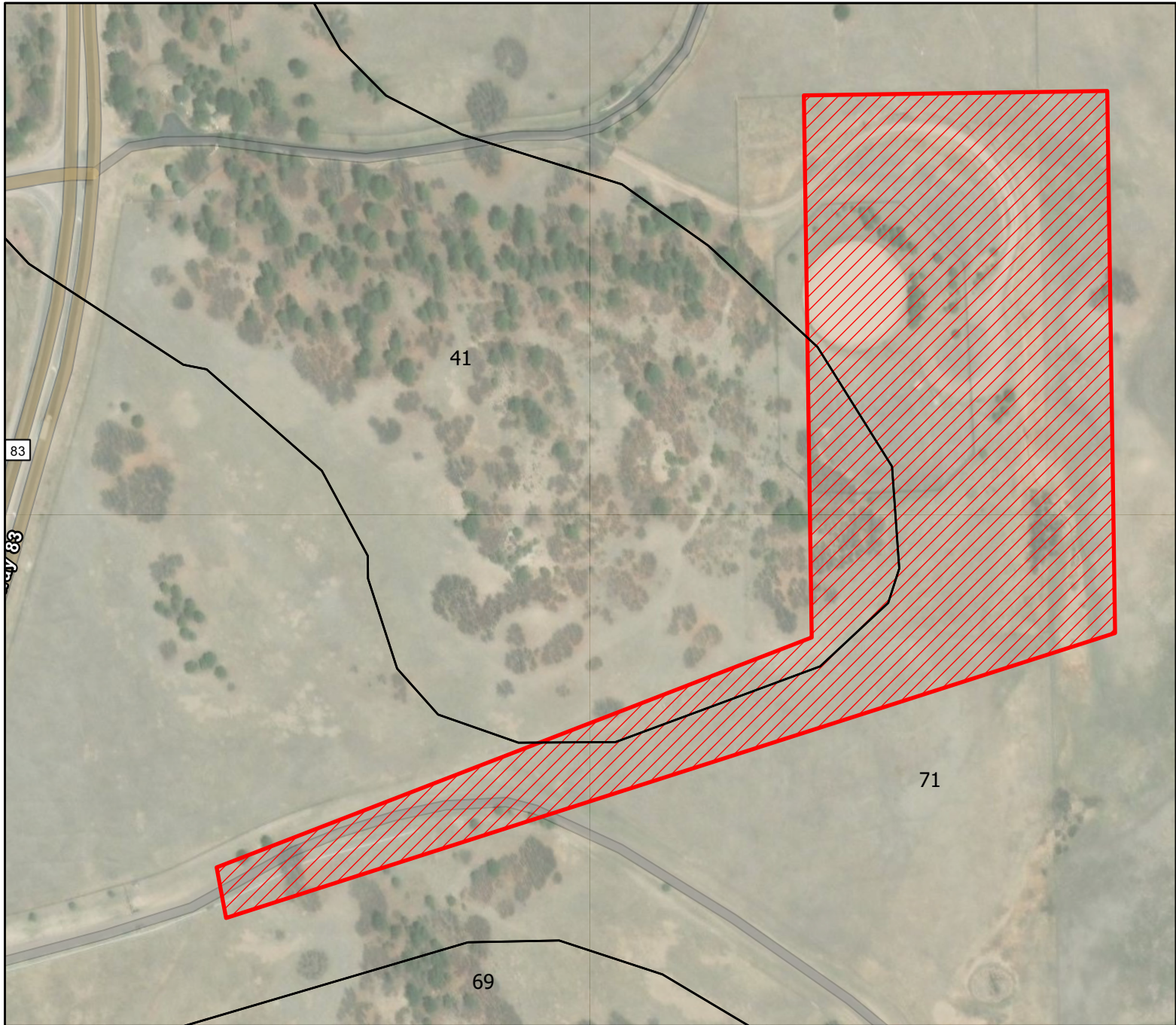
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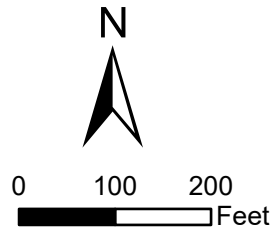
NORTHERN DELIVERY SERVICE
BOOSTER PUMP STATION

VICINITY MAP

Esri Community Maps Contributors, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA



Map Unit Symbol	Map Unit Name	Rating	Percent of Site, %
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	B	10.8
69	Peyton-Pring complex, 8 to 15 percent slopes	B	0.0
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	89.2

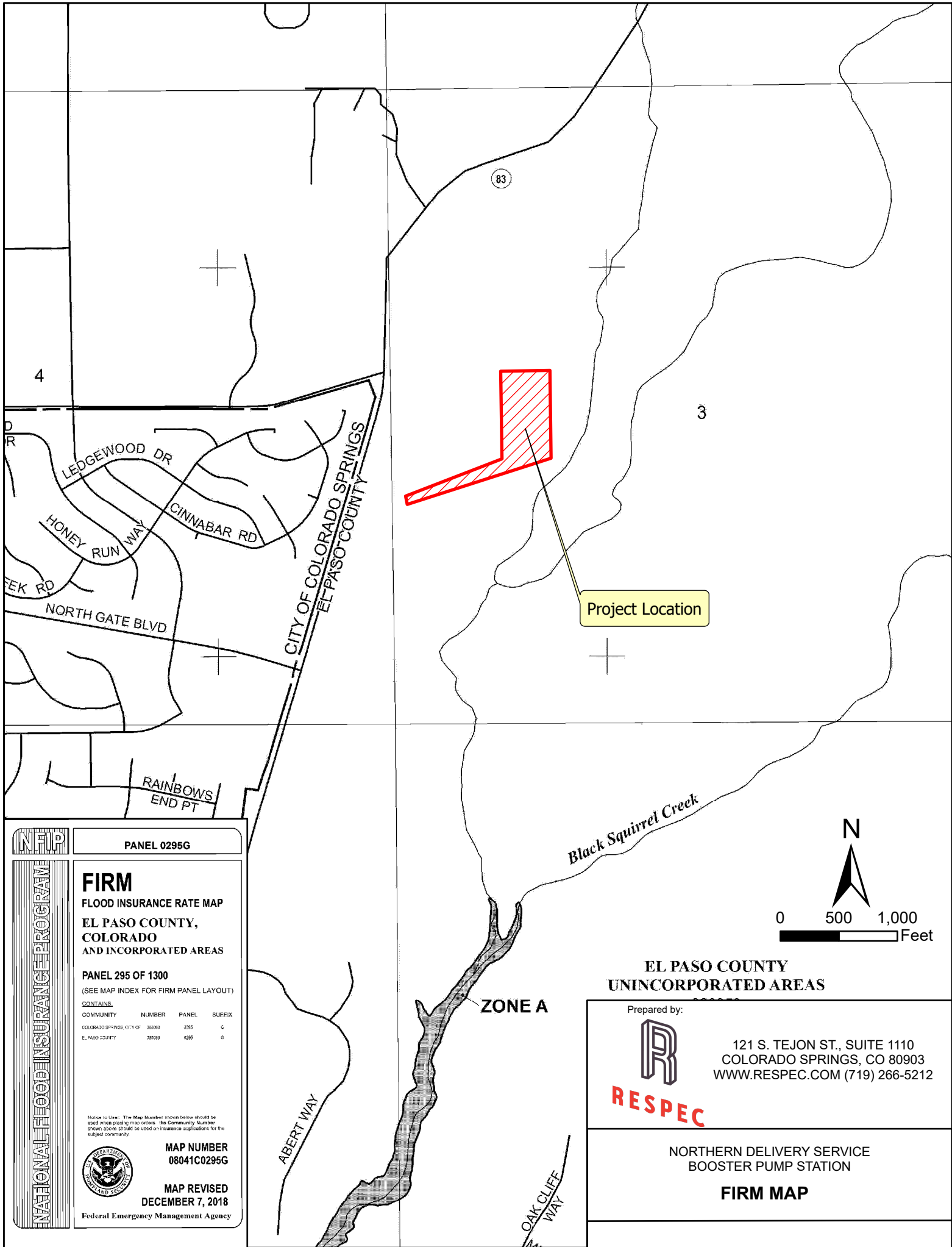


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NORTHERN DELIVERY SERVICE
 BOOSTER PUMP STATION
SOILS MAP



83

4

3

Project Location

Black Squirrel Creek



0 500 1,000 Feet

ZONE A

EL PASO COUNTY UNINCORPORATED AREAS

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NORTHERN DELIVERY SERVICE
 BOOSTER PUMP STATION

FIRM MAP

NIP

PANEL 0295G

FIRM
 FLOOD INSURANCE RATE MAP
 EL PASO COUNTY,
 COLORADO
 AND INCORPORATED AREAS

PANEL 295 OF 1300
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS	COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS CITY OF	30300	0295	G	
EL PASO COUNTY	30303	0295	G	

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

MAP NUMBER
 08041C0295G

MAP REVISED
 DECEMBER 7, 2018

Federal Emergency Management Agency

ABERT WAY

OAK CLIFF WAY

D
R

LEDGEWOOD DR

HONEY RUN WAY

CINNABAR RD

FEK RD

NORTH GATE BLVD

RAINBOWS
 END PT

CITY OF COLORADO SPRINGS
 EL PASO COUNTY



APPENDIX B

CALCULATIONS

Northern Delivery Service Booster Pump Station									
PROJ.224.29									
C FACTOR CALCULATION SHEET									
EXISTING CONDITIONS									
RUNOFF COEFICIENT									
TYPE A/B SOILS									
LAND USE		Imperv %	10 YR	100 YR					
UNDEV		0	0.15	0.35					
GRAVEL ROAD		80	0.63	0.7					
ASPHALT ROAD		100	0.92	0.96					
ROOFS		90	0.75	0.81					
EXISTING CONDITIONS									
	TOTAL	SURFACE CONDITION AREAS				CALCULATED C			
AREA	AREA	UNDEV	GRAVEL	ASPHALT	ROOFS	10	100	% IMPERVIOUS	
DESIG.	(acre)		ROAD	ROAD		YR	YR		
OS1	3.85	3.27	0.58	0.00	0.00	0.22	0.40		12.05
OS2	3.68	3.54	0.14	0.00	0.00	0.17	0.36		3.04
Aex	3.89	3.79	0.10	0.00	0.00	0.16	0.36		2.06
Bex	2.37	2.15	0.22	0.00	0.00	0.19	0.38		7.43
Cex	7.96	7.75	0.21	0.00	0.00	0.16	0.36		2.11
Dex	3.98	3.98	0.00	0.00	0.00	0.15	0.35		0.00
Eex	2.79	2.52	0.02	0.00	0.25	0.22	0.39		8.64
Fex	1.15	0.99	0.03	0.00	0.13	0.25	0.41		12.26
Gex	0.96	0.96	0.00	0.00	0.00	0.15	0.35		0.00
Site Percent Impervious, %		3.49							

PROPOSED CONDITIONS									
RUNOFF COEFICIENT									
TYPE A/B SOILS									
LAND USE		Imperv %	10 YR	100 YR					
UNDEV		0	0.15	0.35					
GRAVEL ROAD		80	0.63	0.7					
ASPHALT ROAD		100	0.92	0.96					
ROOFS		90	0.75	0.81					
PROPOSED CONDITIONS									
	TOTAL	SURFACE CONDITION AREAS				CALCULATED C			
AREA	AREA	UNDEV	GRAVEL	ASPHALT	ROOFS	10	100	% IMPERVIOUS	
DESIG.	(acre)		ROAD	ROAD		YR	YR		
OS1	3.85	3.27	0.58	0.00	0.00	0.22	0.40		12.05
OS2	3.72	3.58	0.14	0.00	0.00	0.17	0.36		3.01
A	3.89	3.79	0.10	0.00	0.00	0.16	0.36		2.06
B	2.37	2.12	0.21	0.04	0.00	0.21	0.39		8.78
C	7.96	7.72	0.21	0.03	0.00	0.16	0.36		2.49
D	3.98	3.83	0.00	0.15	0.00	0.17	0.37		3.77
E	2.83	2.45	0.00	0.10	0.28	0.25	0.42		12.44
F	1.15	0.99	0.03	0.00	0.13	0.25	0.41		12.26
G	0.96	0.85	0.00	0.11	0.00	0.22	0.42		11.46
Site Percent Impervious, %		5.35							

Northern Delivery Service Booster Pump Station																		
PROJ.224.29																		
DRAINAGE CALCULATION SHEET																		
file:North Delivery Service Booster Pump Station.xlsx																		
OCTOBER 2022																		
AREA	AREA	C10	C100	C10 X A	C100 X A	L (ft)	Initial Tci		L (ft)	Travel Time			TC	I10	I100	Q10	Q100	AREA
							Slope (%)	ti (min)		Slope (%)	V (fps)	Tt (min)						
DESIG.	(acre)	(10 yr)	(100 yr)				(%)	(min)		(%)	(fps)	(min)	(min)	(in/hr)	(in/hr)	(cfs)	(cfs)	DESIG.
EXISTING CONDITIONS																		
OS1	3.85	0.22	0.40	0.85	1.54	100	5.50	9.38	780	6.10	2.40	5.42	14.79	4.13	5.95	3.5	9.2	OS1
OS2	3.69	0.17	0.36	0.63	1.33	100	7.40	8.98	495	6.60	2.50	3.30	12.28	4.46	6.41	2.8	8.5	OS2
Aex	3.89	0.16	0.36	0.62	1.40	100	7.20	9.16	1125	5.90	2.40	7.81	16.98	3.89	5.60	2.4	7.8	Aex
Bex	2.37	0.19	0.38	0.45	0.90	80	11.40	6.82	635	5.70	2.20	4.81	11.63	4.55	6.55	2.1	5.9	Bex
Cex	7.96	0.16	0.36	1.27	2.87	100	10.60	8.07	1000	8.60	2.80	5.95	14.02	4.23	6.08	5.4	17.4	Cex
Dex	3.98	0.15	0.35	0.60	1.39	100	10.20	8.26	580	9.70	3.10	3.12	11.37	4.59	6.61	2.7	9.2	Dex
Eex	2.79	0.22	0.39	0.61	1.09	70	24.20	4.81	535	10.20	3.20	2.79	7.60	5.30	7.62	3.3	8.3	Eex
Fex	1.15	0.25	0.41	0.29	0.47	55	3.20	8.03	180	14.40	3.30	0.91	8.94	5.01	7.21	1.4	3.4	Fex
Gex	0.96	0.15	0.35	0.14	0.34	100	12.00	7.82	155	12.90	3.20	0.81	8.63	5.08	7.30	0.7	2.5	Gex
DP1 (Eex + Fex + Gex + OS2)	8.59	0.19	0.38	1.67	3.22	100	12.00	7.46	750	7.90	2.70	4.63	12.09	4.49	6.46	7.5	20.8	DP1 (Eex + Fex + Gex + OS2)
DP2 (DP1 + Cex + Dex + OS1)	24.38	0.18	0.37	4.39	9.02	100	10.60	7.89	1880	7.30	2.60	12.05	19.94	3.61	5.19	15.8	46.9	DP2 (DP1 + Cex + Dex + OS1)
PROPOSED CONDITIONS																		
OS1	3.85	0.22	0.40	0.85	1.54	100	5.50	9.38	780	6.10	2.40	5.42	14.79	4.13	5.95	3.5	9.2	OS1
OS2	3.68	0.17	0.36	0.63	1.32	100	7.40	8.98	495	6.60	2.50	3.30	12.28	4.46	6.41	2.8	8.5	OS2
A	3.89	0.16	0.36	0.62	1.40	100	7.20	9.16	1125	5.90	2.40	7.81	16.98	3.89	5.60	2.4	7.8	A
B	2.37	0.21	0.39	0.50	0.92	80	11.40	6.67	635	5.70	2.20	4.81	11.48	4.58	6.58	2.3	6.1	B
C	7.96	0.16	0.36	1.27	2.87	100	10.60	8.07	1000	8.60	2.80	5.95	14.02	4.23	6.08	5.4	17.4	C
D	3.98	0.17	0.37	0.68	1.47	100	10.20	8.08	580	9.70	3.10	3.12	11.20	4.62	6.65	3.1	9.8	D
E	2.83	0.25	0.42	0.71	1.19	70	24.20	4.65	535	10.20	3.20	2.79	7.43	5.34	7.68	3.8	9.1	E
F	1.15	0.25	0.41	0.29	0.47	55	3.20	8.03	180	14.40	3.30	0.91	8.94	5.01	7.21	1.4	3.4	F
G	0.96	0.22	0.42	0.21	0.40	100	12.00	7.25	155	12.90	3.20	0.81	8.05	5.20	7.48	1.1	3.0	G
DP1 (E + F + G + OS2)	8.62	0.21	0.39	1.82	3.39	100	12.00	7.32	750	7.90	2.70	4.63	11.95	4.51	6.48	8.2	22.0	DP1 (E + F + G + OS2)
DP2 (DP1 + C + D + OS1)	24.41	0.19	0.38	4.62	9.27	100	10.60	7.81	1880	7.30	2.60	12.05	19.87	3.62	5.20	16.7	48.2	DP2 (DP1 + C + D + OS1)

Manning Formula: Proposed Swale 10-Year Flows

Irregular Section

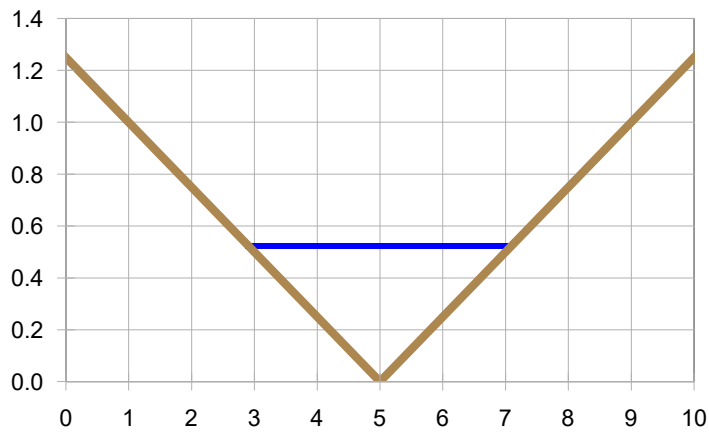
Input

Flow 3.8 cfs
Slope 0.085 ft/ft

Sta	Elev	n	Sta	Elev	n	Sta	Elev	n	Sta	Elev	n
0	1.25	0.05	5	0	0.05	10	1.25	0.05			

Output

WSElev 0.523 ft
Flow Area 1.09 sf
Velocity 3.47 fps
Velocity Head 0.187 ft
Top Width 4.18 ft
Froude Number 1.20
Critical WSElev 0.562 ft
Critical Slope ft/ft



Manning Formula:

Proposed Swale 100-Year Flows

Irregular Section

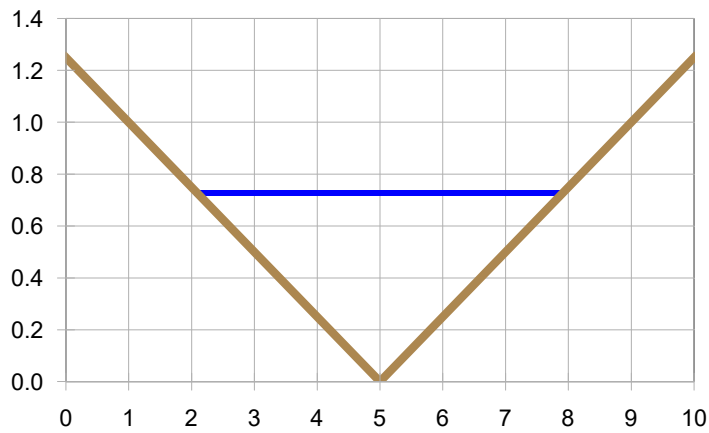
Input

Flow 9.1 cfs
Slope 0.085 ft/ft

Sta	Elev	n	Sta	Elev	n	Sta	Elev	n	Sta	Elev	n
0	1.25	0.05	5	0	0.05	10	1.25	0.05			

Output

WSElev 0.726 ft
Flow Area 2.11 sf
Velocity 4.32 fps
Velocity Head 0.290 ft
Top Width 5.81 ft
Froude Number 1.26
Critical WSElev 0.797 ft
Critical Slope ft/ft





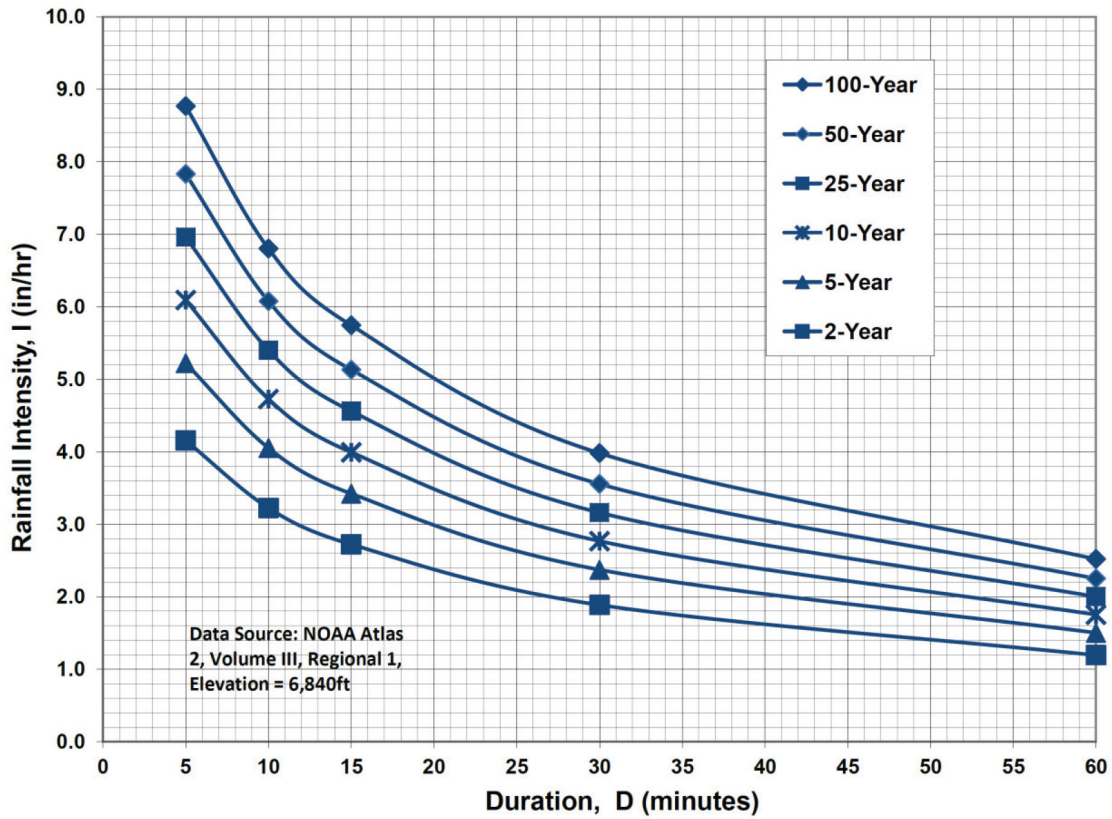
APPENDIX C

DESIGN CHARTS



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 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

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

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

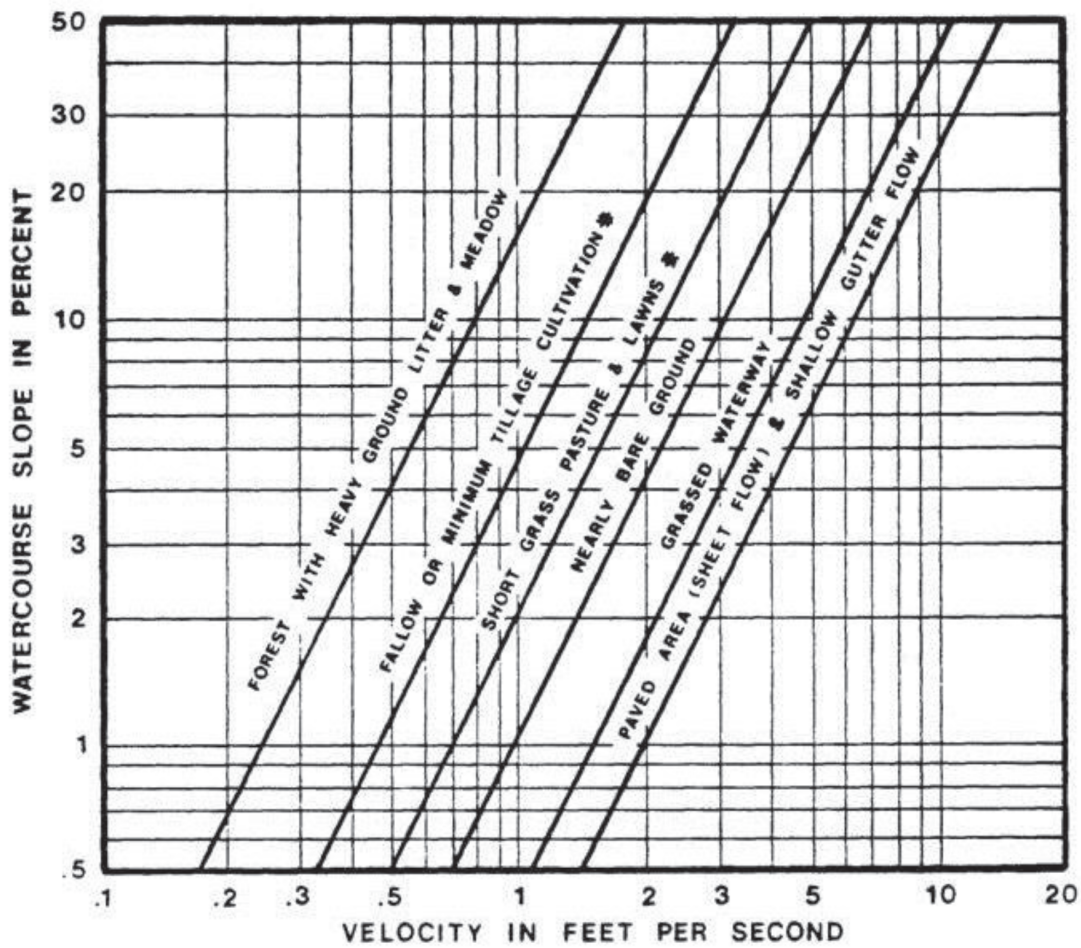
$$I_{10} = -1.75 \ln(D) + 8.847$$

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

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

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

Figure 6-25. Estimate of Average Concentrated Shallow Flow





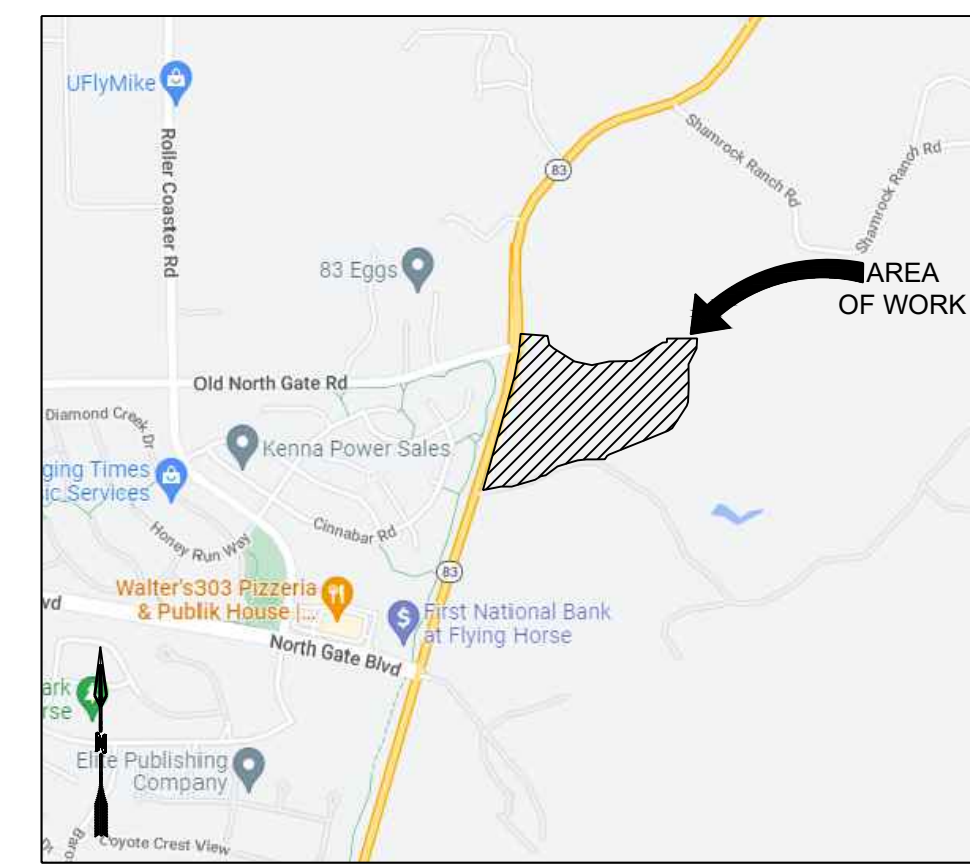
BACK POCKET

M:\Projects\224 Triview Metro District\224-29 Northern Regional Water Delivery Project - Phase 2\Documents\Drawings\DWG\1 Existing Drainage Planning



NOTES:

1. THERE IS NO FEMA FLOODPLAIN WITHIN THE PROPOSED SITE. FEMA MAP: 08041C0295G EFFECTIVE: 12/7/2018
2. MIN CONTOUR INTERVAL IS 5' AND MAX CONTOUR INTERVAL IS 10'. COUNTY CRITERIA STATES, "FOR SUBDIVISIONS INVOLVING RURAL LOTS GREATER THAN 1 ACRE, THE MAXIMUM INTERVAL MAY BE 5 FEET WHERE APPROVED, IN TERRAIN GREATER THAN 10% - 10 FEET."



BENCHMARKS

TOPOGRAPHY SURVEY CENTENAL LAND SURVEYING, LLC. SEE SURVEY FOR ESTABLISHED CONTROL. THE FOLLOWING COORDINATE SYSTEM AND DATUM RECORD IS AS FOLLOWS:

HORIZONTAL DATUM: HORIZONTAL COORDINATES ARE MODIFIED COLORADO STATE PLANE CENTRAL BASED UPON THE FOLLOWING: COORDINATES ARE SCALED FROM CONTROL POINT 5052 BEING A 2-INCH ALUMINUM CAP STAMPED AZTEC CP 52 SET AT THE TOP OF A DIRT BANK ALONG THE EAST SIDE OF GLEN EAGLE DR. APPROXIMATELY 380+ FEET NORTHERLY OF ST. LAWRENCE HWY. VALUES ARE BASED UPON A STATIC SURVEY SESSION WITH THE FOLLOWING RESULTS:

LATITUDE: 39-04-05916N; LONGITUDE: 104-49-24.82486 W

STATE PLANE NORTHING: 1,450,401.759; STATE PLANE EASTING: 3,192,049.712

SCALE FACTOR: 1.0004063250

TRUNCATE NORTHING: 1,000,000.00; TRUNCATE EASTING: 3,000,000.00

PROJECT NORTHING: 450,401.759; PROJECT EASTING: 192,049.712

VERTICAL DATUM: NAVD 88 WITH GEOID G18US; BENCHMARK: CP 5052 EL: 7213.70

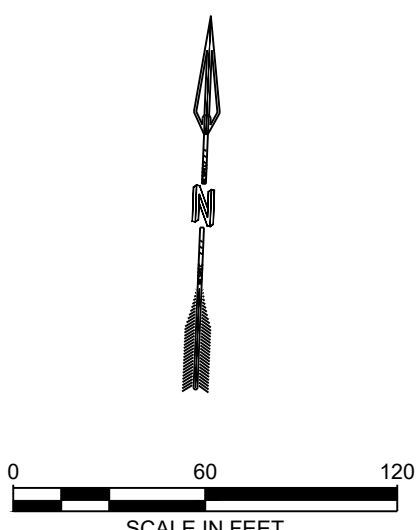
BENCHMARK: NGS CS110/DM0842 EL: 6843.25; BENCHMARK: NGS S294/KX0272 EL: 7116.72

LEGEND

- (A1A) EXIST BASIN DESIGNATION
- (XX) EXIST BASIN AREA, ACRES
- (XX) EXIST 10 YEAR STORM, CFS
- (XX) EXIST 100 YEAR STORM, CFS
- (XX) EXIST DESIGN POINT
- (XX) EXIST 10 YEAR ACCUMULATED FLOW, CFS
- (XX) EXIST 100 YEAR ACCUMULATED FLOW, CFS
- EXISTING DIRECTION OF DRAINAGE FLOW
- EXISTING EASEMENT LINE
- EXISTING SUB-BASIN BOUNDARY
- 7290- EXISTING MAJOR CONTOUR
- 7291- EXISTING MINOR CONTOUR
- EXISTING TIME OF CONCENTRATION PATH
- EXISTING PROPERTY BOUNDARY
- EXISTING FENCE
- EXISTING STREAM CENTERLINE
- EXISTING PROPERTY BOUNDARY
- EXISTING MOUSE HABITAT

EXISTING CONDITIONS			
SUB-BASIN	AREA (AC)	Q10 (CFS)	Q100 (CFS)
OS1	3.85	3.5	9.2
OS2	3.69	2.8	8.5
Aex	3.89	2.4	7.8
Bex	2.37	2.1	5.9
Cex	7.96	5.4	17.4
Dex	3.98	2.7	9.2
Eex	2.79	3.3	8.3
Fex	1.15	1.4	3.4
Gex	0.96	0.7	2.5

DESIGN POINT	AREA (AC)	Q10 (CFS)	Q100 (CFS)
DP1 (Eex + Fex + Gex + OS2)	8.59	7.5	20.8
DP2 (DP1 + Cex + Dex + OS1)	24.38	15.8	46.9



JDS-HYDRO a Division of **RESPEC**
 5540 TECH CENTER DR., SUITE 100
 COLORADO SPRINGS, COLORADO 80919
 (719) 227-0072

ISSUANCES FOR CONTRACTOR SHALL VERIFY ALL DIMENSIONS, SURFACE, AND MASSING SHALL BE REPORTED TO JDS-HYDRO, A DIVISION OF RESPEC. JDS-HYDRO ASSUMES NO LIABILITY FOR UNAUTHORIZED CHANGES AND/OR REVISIONS MADE TO PLANS.

TRIVIEW METROPOLITAN DISTRICT
 NORTHERN DELIVERY SYSTEM BOOSTER PUMP STATION
 EXISTING DRAINAGE PLAN

NO.	DESCRIPTION	BY	APP.	DATE
1				
2				
3				
4				
5				
6				
7				

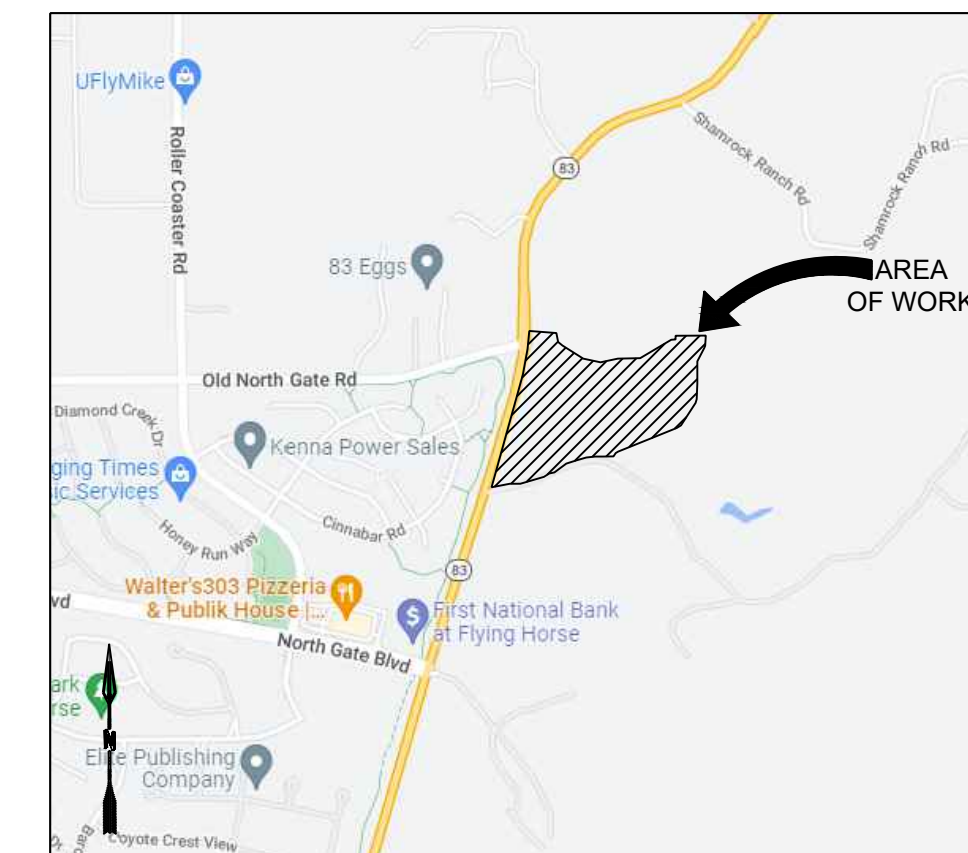
Project No.: 224-29
 Date: 04/2023
 Design: CTD
 Drawn: CTD
 Check: RGG

DR1
 SHEET 1 OF 2

M:\Projects\224 Triview Metro District\224_29 Northern Regional Water Delivery Project - Phase 2\Documents\Drawings\DWG\2 Proposed Drainage Plan.dwg
 2023/04/14 10:01 AM By: Dawn White



NOTES:
 1. THERE IS NO FEMA FLOODPLAIN WITHIN THE PROPOSED SITE.
 FEMA MAP: 08041C0295G
 EFFECTIVE: 12/7/2018
 2. MIN CONTOUR INTERVAL IS 5' AND MAX CONTOUR INTERVAL IS 10'. COUNTY CRITERIA STATES, "FOR SUBDIVISIONS INVOLVING RURAL LOTS GREATER THAN 1 ACRE, THE MAXIMUM INTERVAL MAY BE 5 FEET WHERE APPROVED, IN TERRAIN GREATER THAN 10% - 10 FEET."



BENCHMARKS
 N.T.S.
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 LATITUDE: 39-04-05916N; LONGITUDE: 104-49-242486 W
 STATE PLANE NORTHING: 1,450,401.759; STATE PLANE EASTING: 3,192,049.712
 SCALE FACTOR: 1.0004063250
 TRUNCATE NORTHING: 1,000,000.00; TRUNCATE EASTING: 3,000,000.00
 PROJECT NORTHING: 450,401.759; PROJECT EASTING: 192,049.712
 VERTICAL DATUM: NAVD 88 WITH GEOID C18US; BENCHMARK: CP 5052 EL: 7213.70
 BENCHMARK: NCS CS110/DW8842 EL: 6943.25; BENCHMARK: NCS S294/KK2272 EL: 7116.72

LEGEND

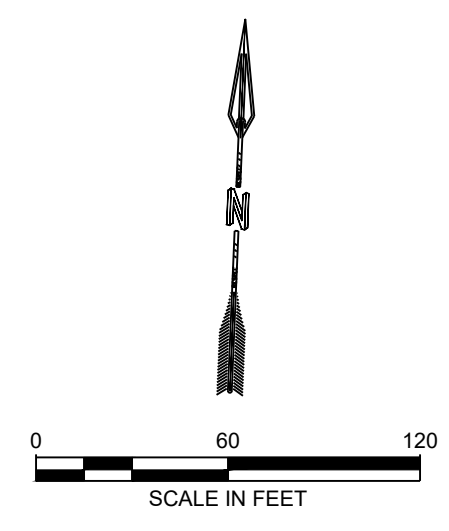
- A1A, XX: PROPOSED BASIN DESIGNATION
- XX: PROPOSED BASIN AREA, ACRES
- XX, XX: PROPOSED 10 YEAR STORM, CFS
- XX, XX: PROPOSED 100 YEAR STORM, CFS
- XX, XX.X, XX.X: PROPOSED DESIGN POINT
- XX, XX.X, XX.X: PROPOSED 10 YEAR ACCUMULATED FLOW, CFS
- XX, XX.X, XX.X: PROPOSED 100 YEAR ACCUMULATED FLOW, CFS
- Arrow: PROPOSED DIRECTION OF DRAINAGE FLOW
- Dashed line: EXISTING EASEMENT LINE
- Thick dashed line: PROPOSED SUB-BASIN BOUNDARY
- Thick solid line: PROPOSED ASPHALT PAVEMENT
- Thin solid line: PROPOSED MAJOR CONTOUR
- Thin dashed line: PROPOSED MINOR CONTOUR
- Thin solid line: EXISTING MAJOR CONTOUR
- Thin dashed line: EXISTING MINOR CONTOUR
- Blue arrow: PROPOSED TIME OF CONCENTRATION PATH
- Thin solid line: EXISTING PROPERTY BOUNDARY
- Thin dashed line: EXISTING FENCE
- Thin solid line: EXISTING STREAM CENTERLINE
- Thick dashed line: EXISTING MOUSE HABITAT
- Thin solid line: PROPOSED WATERLINE
- Thin solid line: PROPOSED UNDERGROUND ELECTRIC LINE

PROPOSED CONDITIONS

SUB-BASIN	AREA (AC)	Q10 (CFS)	Q100 (CFS)
OS1	3.85	3.5	9.2
OS2	3.68	2.8	8.5
A	3.89	2.4	7.8
B	2.37	2.3	6.1
C	7.96	5.4	17.4
D	3.98	3.1	9.8
E	2.83	3.8	9.1
F	1.15	1.4	3.4
G	0.96	1.1	3.0

DESIGN POINT

DESIGN POINT	AREA (AC)	Q10 (CFS)	Q100 (CFS)
DP1 (E + F + G + OS2)	8.66	8.3	22.1
DP2 (DP1 + C + D + OS1)	24.45	16.8	48.3



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TRIVIEW METROPOLITAN DISTRICT
 NORTHERN DELIVERY SYSTEM BOOSTER PUMP STATION
 PROPOSED DRAINAGE PLAN

REVISIONS

NO.	DESCRIPTION	BY	APP.	DATE
1				
2				
3				
4				
5				
6				
7				

Project No.: 224-29
 Date: 04/2023
 Design: CTD
 Drawn: CTD
 Check: RGG

DR2
 SHEET 2 OF 2