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Karman Line
Hydrologic Assessment

April 3, 2023

HR Green Project No: 2202783

Prepared For:

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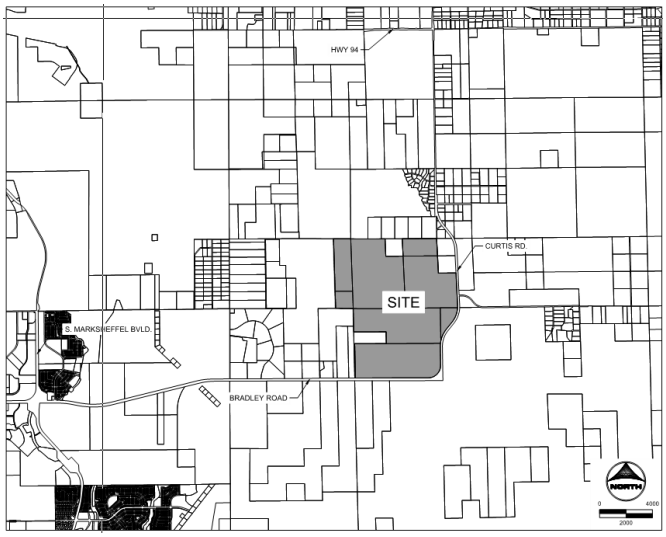
Hydrologic Assessment – Karman Line

I. Overview

a. General Project Description

Karman Line is in El Paso County and is proposing to be annexed into the City of Colorado Springs. The development is east of South Meridian Road, west of and bordering Curtis Road, north of and bordering Bradley Road and south of and bordering Barbwire Lane. The area contains approximately 1,595 acres, partially within Sections 32, 33 and 34, Township 14 South, Range 64 West of the Sixth Principal Meridian, and partially within Sections 3, 4 and 5, Township 15 South, and Range 64 West of the Sixth Principal Meridian.

FIGURE 1: VICINITY MAP



b. Purpose and Scope

The purpose of this Hydrology Report is to describe the onsite and offsite drainage patterns, existing storm infrastructure, tributary areas and the Drainage Basin Planning Studies (DBPS) associated with the future Karman Line project. The items discussed in this report are conceptual in nature and final drainage calculations and design will be required as annexation and development proceeds.

c. Agency Jurisdictions

The following jurisdictions were referenced for this study:

- City of Colorado Springs
- Federal Emergency Management Agency (FEMA)

The following data sources were referenced for this study:

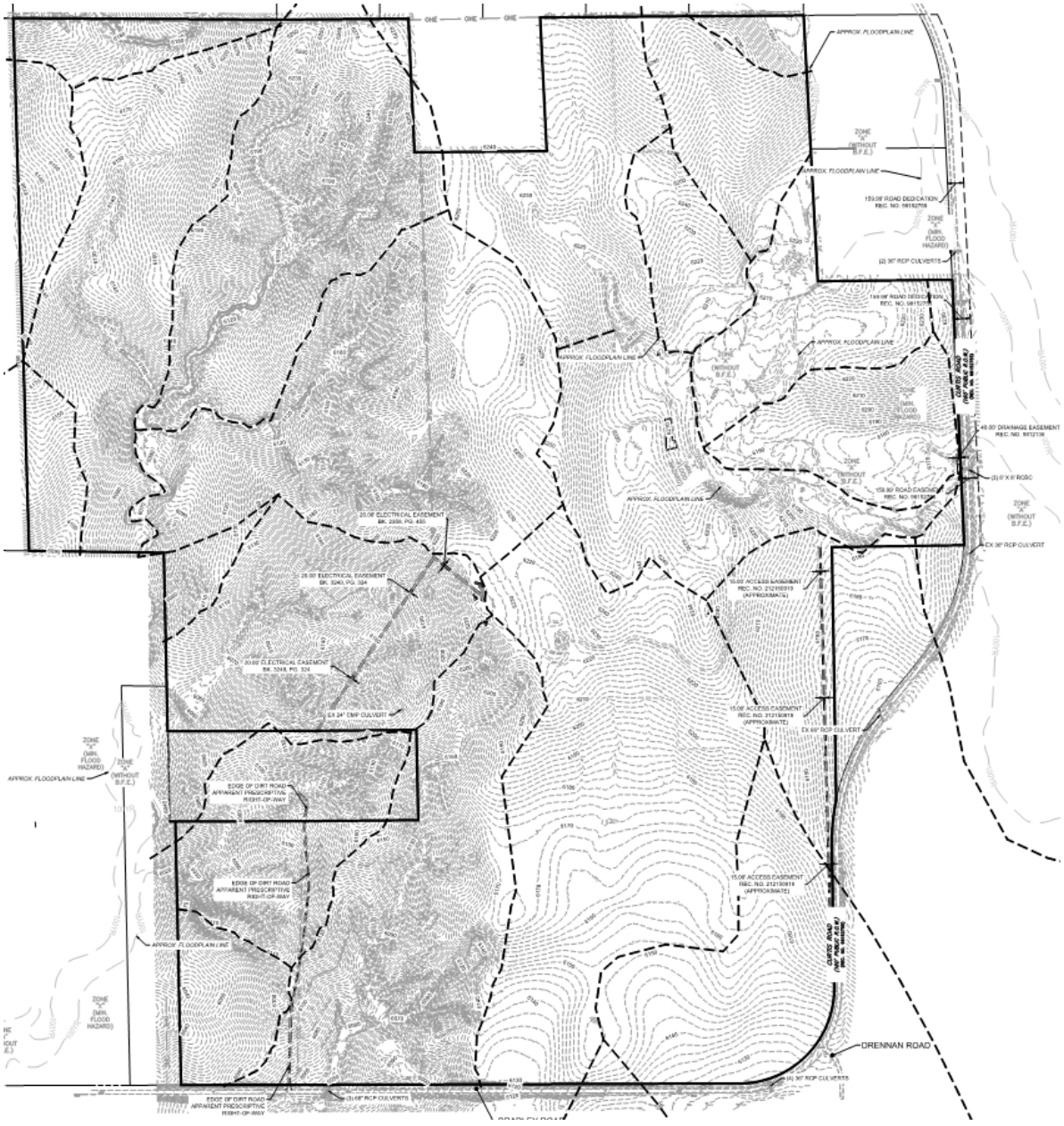
- City of Colorado Springs Drainage Criteria Manual (DCM)
- NOAA Atlas 14
- NRCS Soil Survey for El Paso County Area, Colorado
- FEMA FIRM 08041C0795G and FIRM 08041C0790G (eff. 12/7/2018)

II. Site Characteristics

d. Existing Subbasin Description

The site's flows start on the upper reaches of five of the six major drainage basins within the Arkansas River Basin, flowing southerly. The Upper East Tributary of Chico Creek enters the site near the northeast corner and generally flows south/southeast and is considered a Zone A mapped floodplain. Williams Creek is the next closest major drainageway mapped by FEMA that is located directly west of the site. Please see Appendix A for FEMA Firm Maps. Multiple smaller ephemeral drainages exist throughout the site with minor head-cutting erosion. General subbasin breakouts with the site topographic characteristics are shown in the figure below.

FIGURE 2: EXISTING DRAINAGE MAP



e. Site Characteristics

Per the NRCS web soil survey, the site is made up Type A, B and D soils. The site is divided into several major drainage basins that include the Jimmy Camp Creek, Upper East Chico, Upper Williams Creek, Upper Chico Creek, Upper Williams Tributary, and Middle East Chico. The portion of site that is within the Jimmy Camp Creek Drainage Basin, which is the northwestern corner of the site, is predominately Razor-Midway complex. This type of soil is Type D and has a very slow infiltration rate when wet. The remainder of the site is Type A and B soils that consist of sandy loams and have high infiltration rates when wet.

Current ground cover is predominantly short and tall grasses across the site. There are very few, if any, trees and a minimal number of shrubs due to the sandy soils. Please see the NRCS survey for the site in Appendix B.

f. Major Drainage Ways and Structures

One major drainageway exists on the site (Upper East Tributary of Chico Creek); however, small tertiary tributaries are within the site currently and function to convey flows to unnamed tributaries east and west of the site.

Culverts that cross beneath Bradley and Curtis Road accept drainage from the easterly portion of the site and convey flows to downstream areas offsite. The impact that the existing and proposed runoff volumes have on the downstream property is to be assessed following annexation of the property. It is anticipated that the future developed flow will be detained to historic rates and upstream areas will be stabilized to equalize sediment transport consistent with the natural state of the tributaries and creeks.

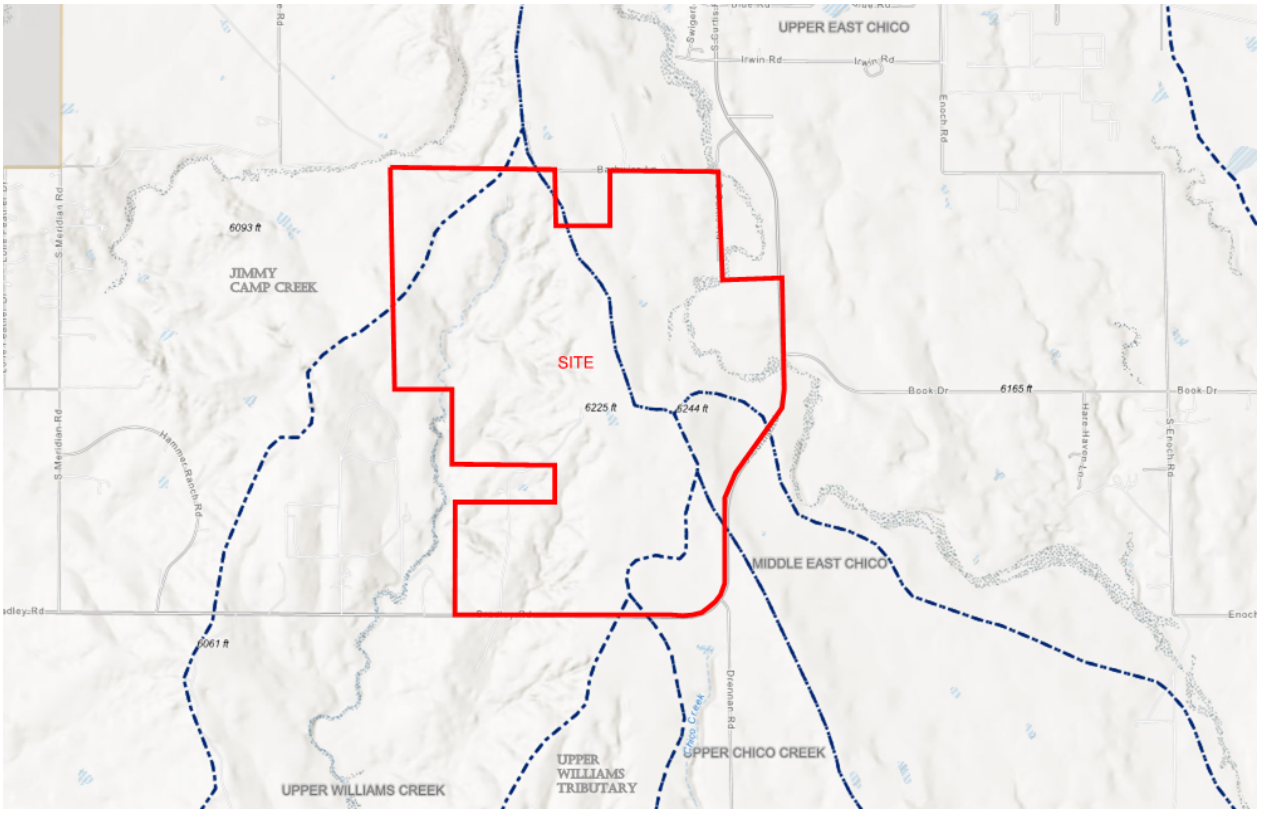
g. DBPS Investigations

Karman Line is withing the Arkansas River Basin, spanning across six basins and is located near the upper watershed of each of these basins. Approximate areas are broken down as follows:

- Jimmy Camp Creek: 78 acres
- Upper East Chico: 397 acres
- Upper Williams Creek: 953 acres
- Upper Williams Tributary: 3 acres
- Upper Chico Creek: 88 acres
- Middle East Chico: 76 acres

Jimmy Camp Creek is the only basin of the six basins that has a DBPS. Please see Figure 3 on the next page for a map of these basins.

FIGURE 3: MAJOR DRAINAGE BASIN MAP



The following is a breakdown of the requirements associated with each of the six basins:

Jimmy Camp Creek: The portion located within Jimmy Camp Creek will follow that DBPS and owe the corresponding drainage fees per the City's drainage, bridge and pond fees schedule. It appears that no channels exist on the property within this major basin (i.e., there should be no channel improvements required in Jimmy Camp Creek)

Upper East Chico: There are channels located within this major basin for which channel stabilization /improvements will be required; a hydrologic study of this basin will be required and will be submitted in the channel design report. No formal DBPS will be required for this basin. Drainage fees will be owed according to the Miscellaneous fee on the City's drainage fees schedule. The cost of channel improvements can be used to reduce / offset the drainage fees owed at the time of platting. No reimbursement will be available for costs exceeding the drainage fees.

Middle East Chico: No DBPS will be required. Miscellaneous drainage fees will be due at the time of platting. If there are any channels located within this major basin, then they would need to be improved. Improvements could be offset against drainage fees. No reimbursement will be available for costs exceeding the drainage fees.

Upper Chico Creek: No DBPS will be required. Miscellaneous drainage fees will be due at the time of platting. If there are any channels located within this major basin, then they would need to be improved. Improvements could be offset against drainage fees. No reimbursement will be available for costs exceeding the drainage fees.

Upper Williams Tributary: No DBPS will be required. Miscellaneous drainage fees will be due at the time of platting. If there are any channels located within this major basin, then they would need to be improved. Improvements could be offset against drainage fees. No reimbursement will be available for costs exceeding the drainage fees.

Upper Williams Creek: No DBPS will be required. Miscellaneous drainage fees will be due at the time of platting. If there are any channels located within this major basin, then they would need to be improved. Improvements could be offset against drainage fees. No reimbursement will be available for costs exceeding the drainage fees.

III. Summary

Karman Line is proposed to be a master planned community consisting of various densities of dwelling units to include single family homes, multifamily homes, parks, institutional sites, and commercial areas. Due to development increased runoff will occur. To mitigate downstream impacts, large full spectrum detention facilities will be built to reduce the runoff rate to near historic levels. These detention facilities will provide water quality enhancements to account for the increased urbanization of the upstream catchment areas. Natural drainage to tributaries will be stabilized as necessary to promote a naturalized stream environment.

Additional analysis will be required and completed to review the hydrology of the site and be included in future submittals. The proposed design, as described in this report, is not anticipated to cause any adverse impact to downstream properties however as noted previously due to the increased volume of water, downstream tributaries will see increases in the volume of flow. Downstream planning efforts should allow for the natural migration and movement of the channel by continuing to provide large floodplain areas to allow movement of the channel.

Appendix A: FEMA Firm Maps

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.

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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/.

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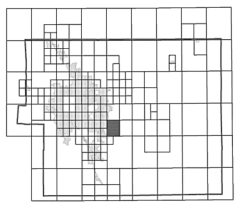
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

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



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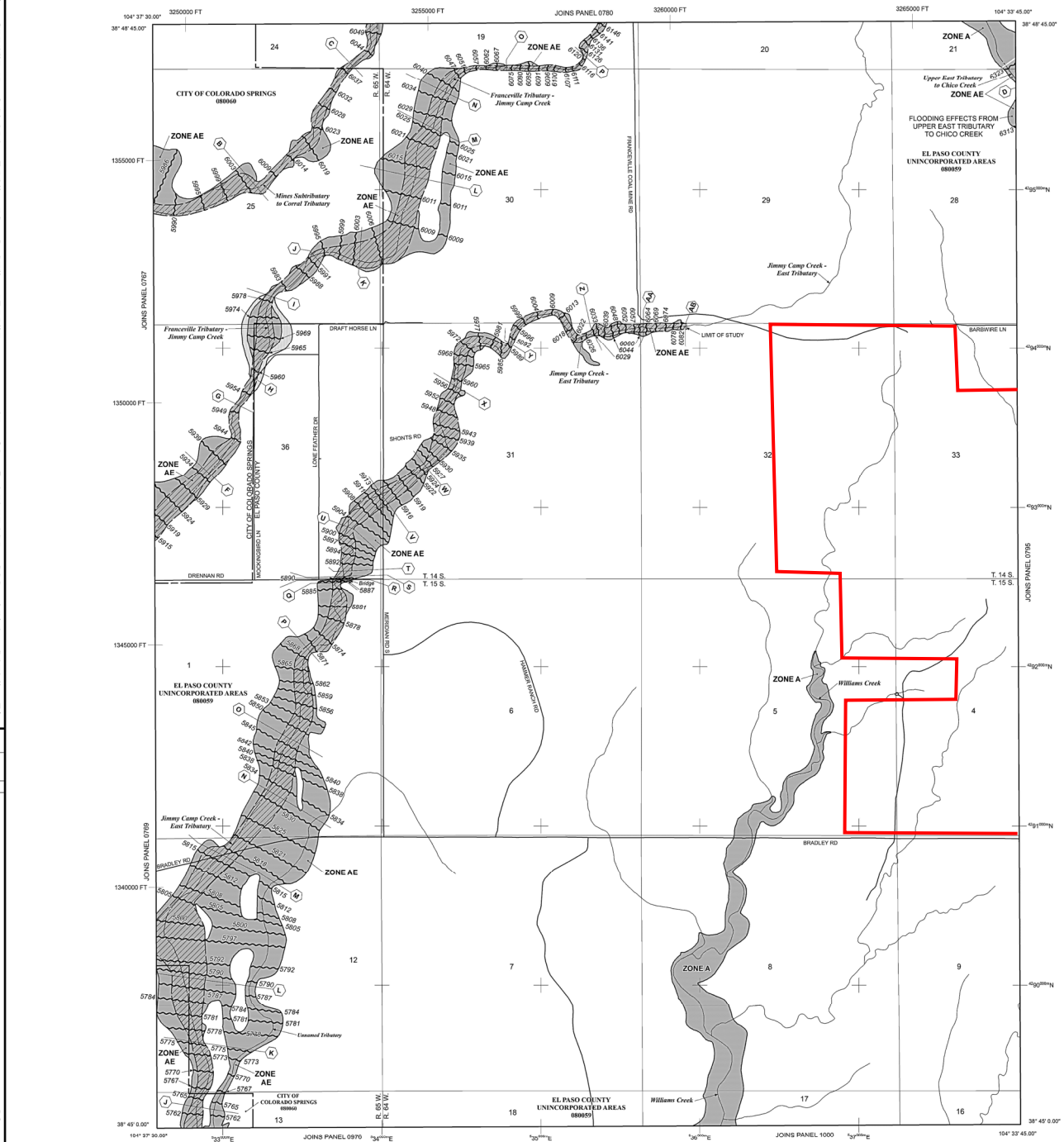
Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



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)
4279000 N	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.

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MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

PANEL 0790G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 790 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0790	G
EL PASO COUNTY	080059	0790	G

Notice: This map was reissued on 05/15/2020 to make a correction.This version replaces any previous versions. See the Notice-to-User Letter that accompanied this correction for details.

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
08041C0790G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

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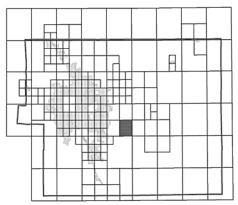

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6000000 FT — 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection

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NFIP

PANEL 0795G

FIRM

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PANEL 795 OF 1300

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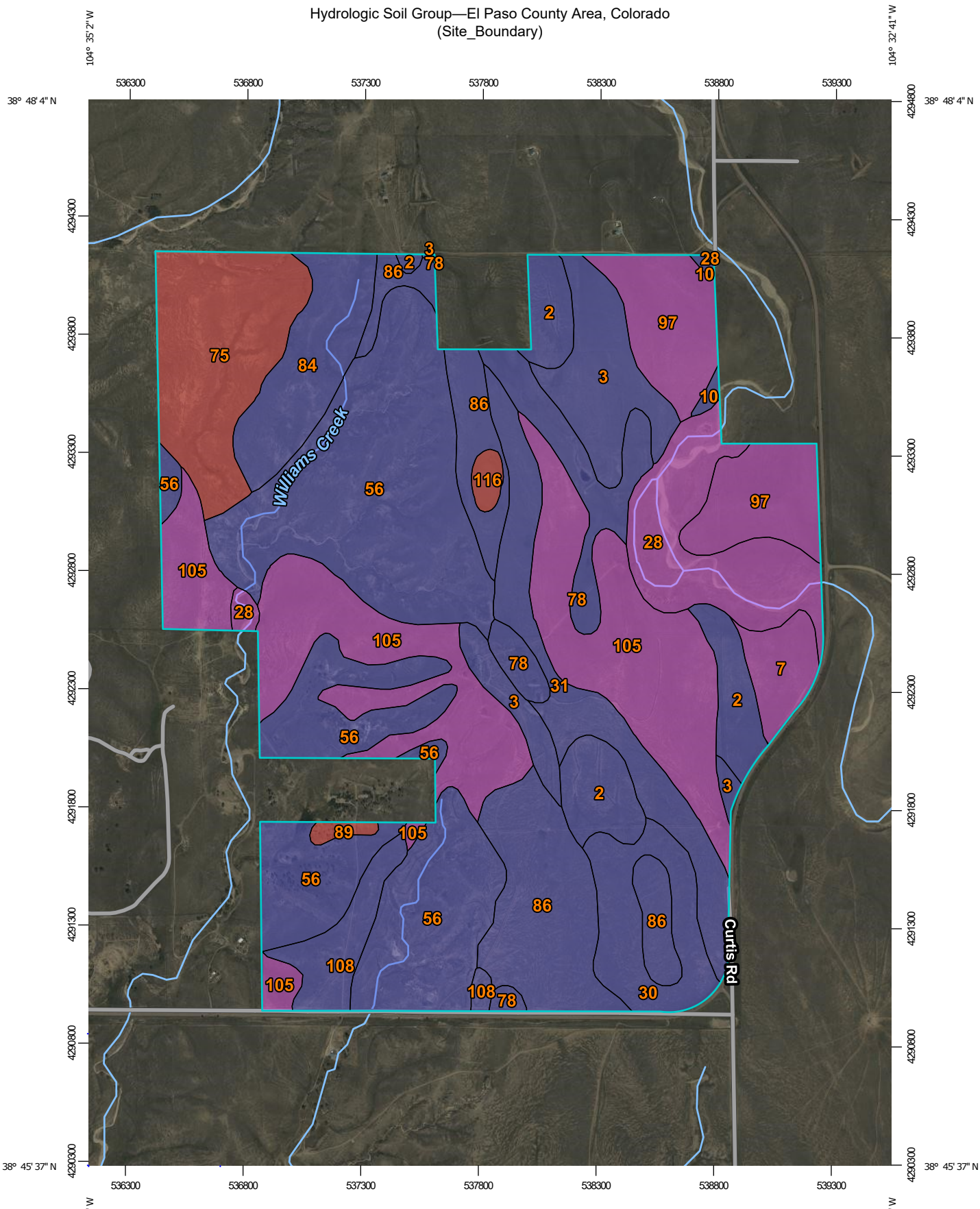
MAP NUMBER
08041C0795G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

Appendix B: NRCS Soil Survey

Hydrologic Soil Group—El Paso County Area, Colorado
(Site_Boundary)



Map Scale: 1:22,000 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 300 600 1200 1800

Feet
0 1000 2000 4000 6000

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 Rating Polygons

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Lines

A
A/D
B
B/D
C
C/D
D
Not rated or not available

Soil Rating Points

A
A/D
B
B/D
C
C/D
D
Not rated or not available

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.

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 20, Sep 2, 2022

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

Date(s) aerial images were photographed: Sep 11, 2018—Oct 20, 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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
2	Ascalon sandy loam, 1 to 3 percent slopes	B	80.7	4.6%
3	Ascalon sandy loam, 3 to 9 percent slopes	B	89.4	5.0%
7	Bijou sandy loam, 3 to 8 percent slopes	A	28.4	1.6%
10	Blendon sandy loam, 0 to 3 percent slopes	B	3.9	0.2%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	A	100.1	5.7%
30	Fort Collins loam, 0 to 3 percent slopes	B	62.5	3.5%
31	Fort Collins loam, 3 to 8 percent slopes	B	91.7	5.2%
56	Nelson-Tassel fine sandy loams, 3 to 18 percent slopes	B	434.7	24.5%
75	Razor-Midway complex	D	120.2	6.8%
78	Sampson loam, 0 to 3 percent slopes	B	64.3	3.6%
84	Stapleton sandy loam, 8 to 15 percent slopes	B	71.2	4.0%
86	Stoneham sandy loam, 3 to 8 percent slopes	B	157.8	8.9%
89	Tassel fine sandy loam, 3 to 18 percent slopes	D	4.6	0.3%
97	Truckton sandy loam, 3 to 9 percent slopes	A	109.0	6.2%
105	Vona sandy loam, warm, 3 to 6 percent slopes	A	307.4	17.4%
108	Wiley silt loam, 3 to 9 percent slopes	B	38.0	2.1%
116	Udic Haplusterts	D	7.0	0.4%
Totals for Area of Interest			**1,770.8**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher