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from first review are
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**FINAL DRAINAGE REPORT
FOR
STIMPLE SUBDIVISION
FILING NO. 1**

Prepared for:
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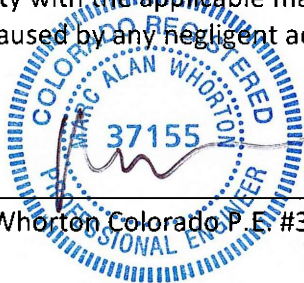
PCD Project No. MS-244



**FINAL DRAINAGE REPORT FOR
STIMPLE SUBDIVISION FILING NO. 1**

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 applicable 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.



Marc A. Whorton, Colorado, P. E. #37155

9/27/2024

Date

OWNER'S/DEVELOPER'S STATEMENT:

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

Business Name: STIMPLE FAMILY, LLLP

By: 

Title: GP

Address: 2138 Flying Horse Club Drive

Colorado Springs, CO 80921

EL PASO COUNTY:

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.

Joshua Palmer, P.E.
County Engineer, / ECM Administrator

Date

Conditions:



FINAL DRAINAGE REPORT FOR STIMPLE SUBDIVISION FILING NO. 1

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FINAL DRAINAGE REPORT FOR STIMPLE SUBDIVISION FILING NO. 1

PURPOSE

The purpose of this Final Drainage Report is to address on-site and off-site drainage patterns and identify specific drainage improvements and facilities required to minimize impacts to the adjacent properties.

GENERAL DESCRIPTION

The Stimple Subdivision Filing No. 1 is 7.585-acre site located in portions sections 21 and 22, township 12 south, range 65 west of the sixth principal meridian. The site is bounded on the south by Arroya Lane, to the north and west by property buffer owned by Black Forest Trails Assoc. and Vollmer Road and to the east by unplatted large-lot rural residential property zoned RR-5. The site is in the upper portion of the Sand Creek Drainage Basin. One (1) single family rural residential lot is proposed in this Filing.

The average soil condition reflects Hydrologic Group “B” (Pring coarse sandy loam) as determined by the “Web Soil Survey of El Paso County Area,” prepared by the Natural Resources Conservation Service (see map in Appendix).

EXISTING DRAINAGE CONDITIONS

This property was recently studied as a part of the Retreat at TimberRidge Filing No. 3 development. (SF-2241) The parcel is located in the upper portion of the Sand Creek drainage basin on the south edge of Black Forest. The majority of the site, other than the extreme southeast edge of the property directly adjacent to Sand Creek, is mainly covered with native grasses with few or no pine trees. However, there is a natural ridge running NW/SE across the site where the significant vegetation and pine trees buffer the Sand Creek channel corridor. This ridge serves as the site’s major drainage basin where the property west of this ridge naturally drains toward Arroya Lane and the property east of the ridge is directly tributary to the Sand Creek corridor. Portions of the east half of Vollmer Road drain across this property



towards Sand Creek. Approximately 800' north of Arroya Lane an existing 36" CMP culvert crosses Vollmer Road and discharges historic flows across the property towards Sand Creek. (Reference Basin EX-2 below). A small basin and natural ravine just west of Vollmer feeds this facility. From a recent field visit, this small facility seems to be in good working condition, however, not labeled in the DBPS. Approximately another 700' north along Vollmer a much larger basin exists west of the roadway. This off-site basin is approximately 350+ acres northwest of Vollmer Road (See Off-site Drainage Map). As shown within the DBPS, this existing crossing is a 60" CMP culvert with some very dense and tall vegetation at both the entrance and exit of this facility. But, based on a recent field visit this facility seems to be in good working condition. The DBPS depicts this facility and recommends an additional 60" CMP at this location. However, there are no signs of erosion or over topping the road at this location at this time based on the current development within the tributary area to this facility. Based on the existing surrounding topography and roadway configuration, the 100 yr. historic flows at this location would appear to spill over the roadway and continue in their historic drainage pattern downstream within the upper reach of Sand Creek. These flows discharge directly onto the adjacent property owned by Michael Turner and then travel in a southerly direction in a 100'+ wide natural channel towards the main stem of Sand Creek (Reach SC-9). This entire Reach of Sand Creek traverses the Turner property all the way down to Arroya Lane as evident by the two separate parcels created, both owned by Michael Turner.

Several wetland delineation reports have been prepared covering this stretch of Sand Creek for the Retreat at TimberRidge development. ("Impact Identification Report" by CORE Consultants, Inc., March 2017 and "Wetland Delineation Report" by Bristlecone Ecology, February 2024) These documents reflect wetlands within this Reach of the Sand Creek channel as shown on the attached drainage maps. This site has also been previously studied in the "Sand Creek Drainage Basin Planning Study" (DBPS) prepared by Kiowa Engineering Corporation, March 1996. The portion of Sand Creek that traverses the site is defined as Reach SC-9 in the DBPS. 1000+ acres north of this property is tributary to this reach of the channel. (See Off-site Drainage Map in Appendix) According to the DBPS, this reach of Sand Creek all contained within the channel has



the following flow characteristics at Arroya Lane: $Q_{10} = 630$ cfs $Q_{100} = 2170$ cfs. However, Sterling Ranch finalized their MDDP which includes modeling of this property as well as the large acreage north up to the top of the Sand Creek Basin. The MDDP suggests developed flows within Sand Creek that are significantly lower than the DBPS currently shows. These flows are as follows: At Arroya Lane crossing (SR MDDP DP-77) $Q_{10} = 581$ cfs $Q_{100} = 1468$ cfs. Roadway and drainage improvements to Arroya Lane were approved with Retreat at TimberRidge Filing No. 3 and are currently under construction. These improvements include widening and paving of Arroya Lane along with dual 6'x12' concrete box culverts and associated headwalls/wingwalls at the Sand Creek crossing.

The following descriptions represent the pre-development flow design points for the property excluding the major off-site flows within Sand Creek just described:

Basin EX-1 ($Q_5 = 7$ cfs, $Q_{100} = 37$ cfs) consists of a 27.6 Ac. off-site basin west of Vollmer Road (not a part of this development) that drains under Vollmer into the Retreat at TimberRidge property via an existing 48" CMP culvert and then within a natural ravine that routes the off-site flow towards the existing dual 30" RCP culverts crossing Aspen Valley within TimberRidge Filing 2 at EX DP-1.

Basin EX-2 ($Q_5 = 5$ cfs, $Q_{100} = 27$ cfs) consists of an 18.0 Ac. off-site basin west of Vollmer Road (not a part of this development) that drains under Vollmer via an existing 36" CMP culvert directly onto the Black Forest Trails Assoc. property just east of Vollmer and then across the north end of the Stimple property (Basin EX-4). These historic flows then sheet flow towards the Sand Creek Corridor and the Michael Turner property.

Basin EX-3 ($Q_5 = 3$ cfs, $Q_{100} = 11$ cfs) is a 5.9 Ac. basin consisting of the east half of Vollmer Road, the Black Forest Trails Assoc. parcel and the southern half of the Stimple property that sheet flows in a southeasterly direction towards Arroya Lane. With the current construction of the

Arroya Lane improvements, these flows are then routed via the sideroad ditch and rip-rap rundown towards Sand Creek.

Basin EX-4 ($Q_5 = 3$ cfs, $Q_{100} = 14$ cfs) is a 6.7 Ac. consisting of again the east half of Vollmer Road, the Black Forest Trails Assoc. parcel and the northern half of the Stimple property. As described above, the off-site flows from the existing 36" CMP culvert release into this basin, combine with the on-site flows and then sheet show towards the Sand Creek corridor.

PROPOSED DRAINAGE CONDITIONS

Proposed development within the Stimple Subdivision Filing No. 1 will consist of a single, large lot, rural residential property within the RR-5 zone. This lot is adjacent to Arroya Lane and will have direct access to this public paved street. A residential driveway permit will be required. Development of this rural lot will consist of utility service installation (water, elec., gas, telecom) and on-site septic and excavation for home and driveway construction. Based on fire code requirements, the proposed home will be located within 500' of the existing fire hydrant on the SW corner of the intersection of Aspen Valley Road and Arroya Lane. The remaining undisturbed area of the property, north of this max. 500' location, will be left generally in its natural condition with minimal disturbance for possible landscaping/fencing. Per the El Paso County ECM, Section I.7.1.B.5, rural lots of 2.5 ac. and larger and less than 10% impervious are not required to provide Water Quality Capture Volume (WQCV) and Section I.7.1.C.1.a, 20% exclusion up to 1 acre and driveway access.

The following describes how this development proposes to handle both the off-site and on-site drainage conditions:



Basin PR3A ($Q_5 = 2$ cfs, $Q_{100} = 6$ cfs) is a 2.5 Ac. basin consisting of the adjacent roadway improvements for Vollmer and Arroya Lane (0.70 ac.) along with a 100' native buffer area owned by the Black Forest Trails Assoc. This basin sheet flows in a southeasterly direction towards Arroya Lane and ultimately towards Design Point 1. This basin meets the requirements for the exclusion found in Section I.7.1.C.1 of the ECM. (See Developed Drainage Map) This remains consistent with what was presented in the approved Final Drainage Report for Retreat at TimberRidge Filing No. 3 (SF2241).

Basin PR3B ($Q_5 = 1$ cfs, $Q_{100} = 5$ cfs) is a 3.4 Ac. basin consisting of the southerly portion of the proposed lot 1 where a single home and driveway to Arroya Lane will be located. This basin has total impervious area of 7% and sheet flows in a southeasterly direction towards Arroya Lane and ultimately towards Design Point 1. This basin meets the requirements for the exclusion found in Section I.7.1.B.5 of the ECM – Large Lot single family sites with a total lot impervious area less than 10%. (See Developed Drainage Map)

Design Point 1 ($Q_5 = 3$ cfs, $Q_{100} = 11$ cfs) represents the current construction of the north half of Arroya Lane (constructed as a part of Retreat at TimberRidge Filing No. 3) and the developed flows from the southern portion of the property that sheet flow in a southeasterly direction towards Arroya Lane. At this location, the developed flows will be routed directly to Sand Creek via a rip-rap rundown dissipator at the outfall location (Construction with Retreat at TimberRidge Filing No. 3). These flows remain consistent with the Retreat at TimberRidge Filing No. 3 EDR and thus, the rip-rap rundown will function adequately as designed.

Unresolved:
Include statement about TR 3 stating future rain garden would be provided but based upon what is being proposed now, it is no longer needed.

No structures or improvements are proposed within the northern portion of the property. This area will all be within a drainage esmt. and no build area (See Final Plat) to allow the off-site historic flows from Basin EX-2 and the 36" CMP culvert to continue to sheet flow across the property towards Sand Creek.

DETENTION / STORMWATER QUALITY FACILITIES

As described earlier and allowed per the El Paso County ECM, Section I.7.1.B.5, rural lots of 2.5 ac. and larger with a total impervious area of less than 10% are not required to provide Water Quality Capture Volume (WQCV) and Section I.7.1.C.1.a, 20% exclusion up to 1 acre and driveway access. Thus, no permanent SWQ features are required with the development of this proposed large lot, rural residential parcel. The Retreat at TimberRidge Filing No. 3 approved FDR mentioned a future Rain Garden possibly being required for this property. However, based on single lot proposed and the two exclusions described above this is no longer needed.

SAND CREEK CHANNEL IMPROVEMENTS

As stated in the Sand Creek DBPS, this Reach SC-9 is recommended as a floodplain preservation design concept. Given the fact of the current upstream development condition of rural, large lot residential properties within the RR-5 zone, the existing Sand Creek drainageway adjacent to this property is expected to remain stable. Please reference the HEC-RAS model provided in the appendix as presented in the Retreat at TimberRidge Filing No. 3 FDR (SF2241), approved July 2024. Channel velocities through this portion of the reach just north of the Arroya Lane crossing range from 1.3 – 2.6 ft/s and the shear stress range from 0.35 – 1.3 lb/sq ft. Also, based on the findings from the “Wetland Delineation Report” by Bristlecone Ecology, no significant erosion or channel degradation within the creek adjacent to this property currently exists at this time.

A single grade control structure was specified in the DBPS adjacent to this property (See excerpt from DBPS below) in order to slow the channel velocity to the DBPS recommended 7 feet per

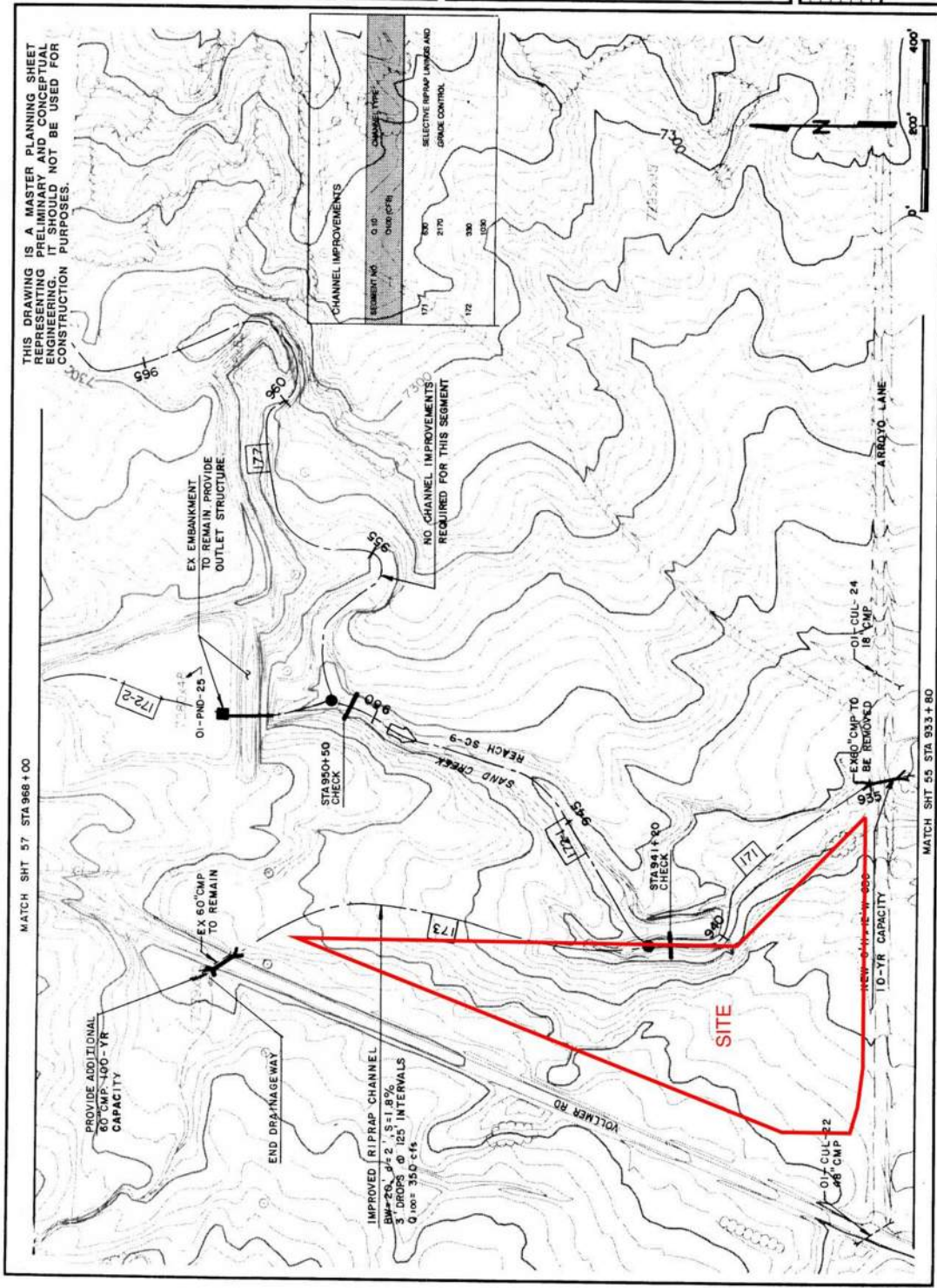


Kiowa Engineering Corporation
 419 W. Bijou Street
 Colorado Springs, Colorado
 80905-1308

**SAND CREEK DRAINAGE
 BASIN PLANNING STUDY
 PRELIMINARY DESIGN PLANS**

PROJECT NO.	90-04-09
DATE	9/92
DRAWN BY	EAK
CHECKED BY	RMW
APPROVED BY	

56



second and to prevent localized and long-term stream degradation affecting channel linings and overbanks. However, based on recent site visits, the stretch of Sand Creek north of Arroya Lane was walked and photographed for documentation purposes and confirmation of the HEC-RAS modeling. As discovered in the field and documented in the photos taken along the corridor, this portion of the reach appears very stable with no signs of erosion within the main channel or channel overbanks. This is mainly due to the significant vegetal cover throughout the reach. In many areas the vegetation is too dense and tall to even navigate through. Installation of the recommended check structure would result in disturbance of much of the significant vegetation that currently is providing stability for the channel and overbanks along this reach. With an in depth look at Preliminary Design Plan (Sheet 56 – excerpt above) within the 1996 DBPS, it appears that the main channel stationing just below 940+00 should have been shown further east up into Segment 172-1 within Reach SC-9 rather than shown west up Segment 173 and then crossing over the well-defined natural ridge. The recent site visit confirms that this natural ridge definitely exists and that the majority of the theoretical flows at the top of the Sand Creek basin are routed through the existing natural stock pond designated at PND-25 as shown on this same sheet. Incidentally, the recommended check structure, mentioned earlier, shown at Station 941+20 would be more appropriately located east of this natural ridge within Reach SC-9. The final factor to consider is the age of this DBPS (28 years old), which is currently being updated by both the City of Colorado Springs and El Paso County. More appropriate recommendations meeting current stormwater criteria and modeling techniques would certainly affect any required improvements.

The other difficult aspect of installing the recommended check structure, in either location, is that it would require easements from the adjacent property owner (Michael Turner). Previous negotiation attempts to acquire easements for the Arroya Lane culvert crossing (Retreat at TimberRidge Filing No. 3) were met with unreasonable demands. The same situation would likely result with any request for easements within the Sand Creek corridor.



Thus, given the various factors mentioned above, we believe we are meeting the intent of the ECM and not significantly affecting down-stream properties. No further channel improvements adjacent to this property are warranted based on the following:

- Upstream basin is nearly built-out and zoned RR-5 within Black Forest
- Substantial vegetation within channel providing stability for reduction of velocities and shear
- No evidence of flooding, erosion or channel degradation in this Reach
- Construction of channel improvements would disturb natural vegetation and stability
- Channel improvements would require cooperation and easements from adjacent property

DRAINAGE CRITERIA

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014. Individual on-site developed basin design calculated using the Rational Method. Runoff Coefficients are based on the imperviousness of the particular land use and the hydrologic soil type in accordance with Table 6-6. The average rainfall intensity, by recurrence interval found in the Intensity-Duration-Frequency (IDF) curves in Figure 6-5. (See Appendix)

The City of Colorado Springs/El Paso County DCM requires the Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainage ways, and implementing long-term source controls. The Four Step Process pertains to management of smaller, frequently occurring storm events, as opposed to larger storms for which drainage and flood control infrastructure are sized. Implementation of these four steps helps to achieve storm water permit requirements.



This site adheres to this **Four Step Process** as follows:

1. **Employ Runoff Reduction Practices:** Proposed rural lot impervious area (roof tops, patios and driveway) will sheet flow across lengthy landscape/natural areas within the 7.58 ac. property to slow runoff and increase time of concentration prior to being conveyed to the existing sideroad ditch along Arroya Lane. This will minimize directly connected impervious areas within the project site.
2. **Stabilize Drainageways:** After developed flows utilize the runoff reduction practices through the large property, developed flows will travel via a roadside ditch and eventually into Sand Creek via existing rip-rap rundown constructed with the Retreat at TimberRidge Filing No. 3 development. The Sand Creek channel corridor adjacent to this property is very well vegetated and stable and the existing channel improvements provided with the TimberRidge development help to reduce velocities to erosive levels.
3. **Provide Water Quality Capture Volume (WQCV):** Per the El Paso County ECM, Section I.7.1.B.5, rural lots of 2.5 ac. and larger with a total lot area of less than 10% impervious are not required to provide Water Quality Capture Volume (WQCV) and Section I.7.1.C.1.a, 20% exclusion up to 1 acre and driveway access.
4. **Consider need for Industrial and Commercial BMPs:** No industrial or commercial uses are proposed within this development.

FLOODPLAIN STATEMENT

No portion of this site is located within a floodplain as determined by the Flood Insurance Rate Maps (F.I.R.M.) Map Number 08041C 0535G with effective date of December 7, 2018 and LOMR 08-08-0541P with an effective date of July 23, 2009. (See Appendix).



DRAINAGE AND BRIDGE FEES

This site lies entirely within the Sand Creek Drainage Basin boundaries.

The fees are calculated using the following impervious acreage method approved by El Paso County. **The Stimple Subdivision Filing No. 1 has a total area of 7.58 acres** with the following land use proposed:

Fees for Residential 5.0 Ac. lots

(Per El Paso County Percent Impervious Chart: 7% with 25% fee reduction for 2.5 ac. lots planned – ECM 3.10.2a) – *Reduction for Drainage Fees only*

7.58 Ac. x 7% x 75% = **0.40 Impervious Ac.** (Drainage Fees)

7.58 Ac. x 7% = **0.53 Impervious Ac.** (Bridge Fees)

The following calculations are based on the 2024 Sand Creek drainage/bridge fees:

ESTIMATED FEE TOTALS

Bridge Fees

\$ 10,484.00 x 0.53 Impervious Ac. = **\$ 5,556.52**

Drainage Fees

\$ 25,632.00 x 0.40 Impervious Ac. = **\$ 10,252.80**

SUMMARY

The proposed Stimple Subdivision Filing No. 1 is within the Sand Creek Drainage Basin. Recommendations are made within this report concerning necessary improvements that will be required as a result of development of this property. The points of storm water release from the proposed site are required to be at or below the calculated historic flow quantities. The development of the proposed site does not significantly impact any downstream facility or property to an extent greater than that which currently exists in the pre-development conditions.



PREPARED BY:

Classic Consulting Engineers & Surveyors, LLC



Marc A. Whorton, P.E.
Project Manager

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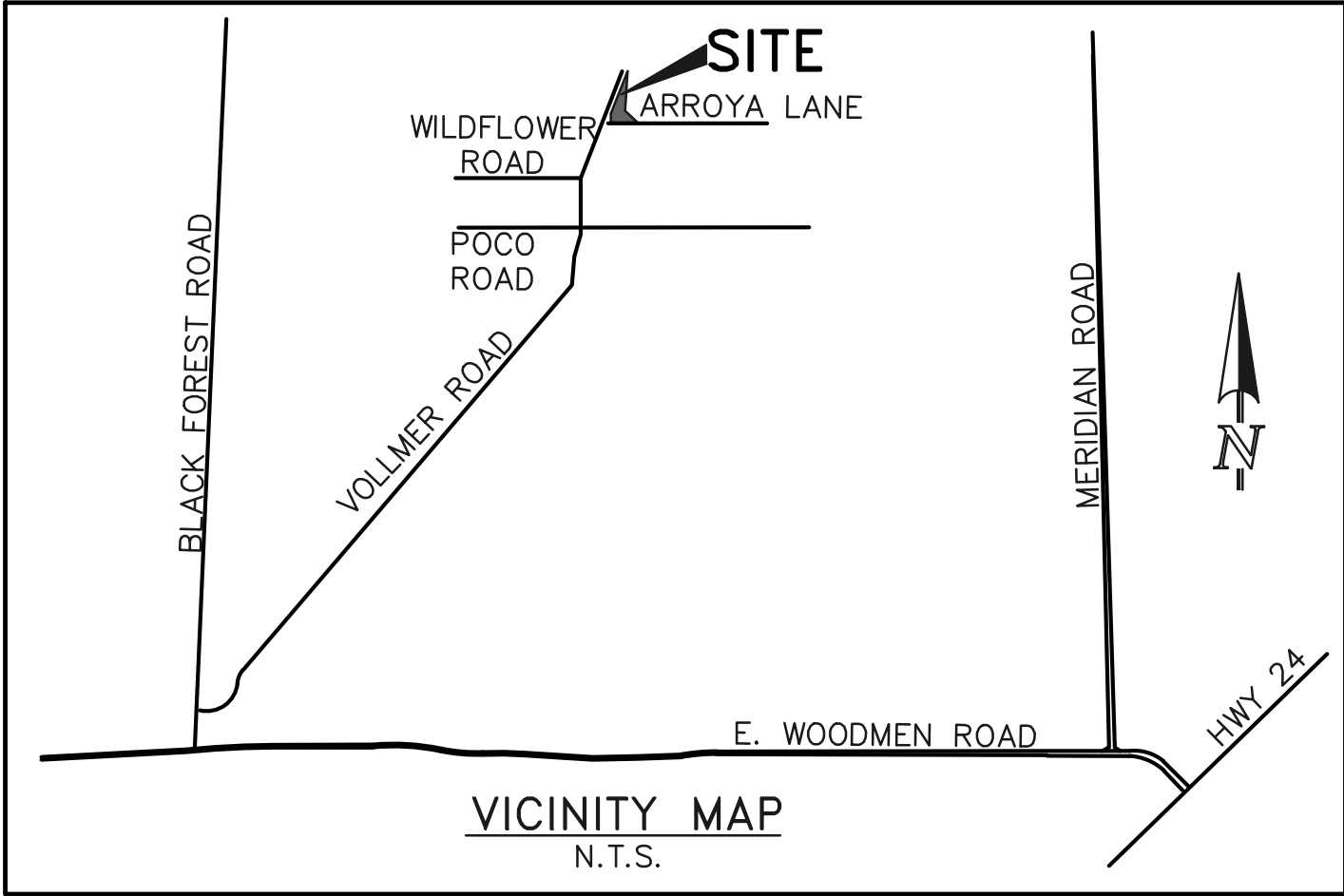


REFERENCES

1. City of Colorado Springs/County of El Paso Drainage Criteria Manual as revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014.
2. "Urban Storm Drainage Criteria Manual Volume 1, 2 & 3" Urban Drainage and Flood Control District, dated January 2016.
3. "Final Drainage Report for Forest Gate Subdivision" Law & Mariotti Consultants, Inc. dated October 2004.
4. "Sand Creek Drainage Basin Planning Study," Kiowa Engineering Corporation, dated March 1996.
5. "Master Development Drainage Plan for The Retreat at TimberRidge", Classic Consulting, approved March 2018.
6. "2018 Sterling Ranch MDDP", M&S Civil Consultants, Inc., June 2018
7. "Impact Identification Report for Retreat at TimberRidge Residential Development", CORE Consultants, March, 2017.
8. "Wetland Delineation Report", Bristlecone Ecology, February, 2024.
9. "Final Drainage Report for Retreat at TimberRidge Filing No. 3", Classic Consulting, approved July, 2024.

APPENDIX

VICINITY MAP

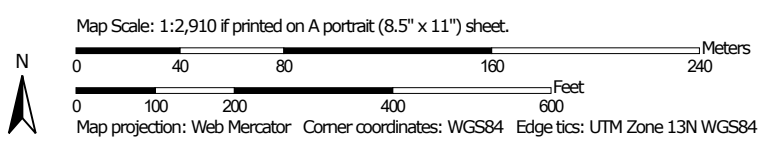


SOILS MAP (S.C.S SURVEY)

Soil Map—El Paso County Area, Colorado



Soil Map may not be valid at this scale.



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

Water Features



Streams and Canals

Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

Background



Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
 Survey Area Data: Version 21, Aug 24, 2023

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—Jun 12, 2021

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
71	Pring coarse sandy loam, 3 to 8 percent slopes	42.7	100.0%
Totals for Area of Interest		42.7	100.0%

El Paso County Area, Colorado

71—Pring coarse sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 369k

Elevation: 6,800 to 7,600 feet

Farmland classification: Not prime farmland

Map Unit Composition

Pring and similar soils: 85 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pring

Setting

Landform: Hills

Landform position (three-dimensional): Side slope

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

A - 0 to 14 inches: coarse sandy loam

C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): High
(2.00 to 6.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3e

Hydrologic Soil Group: B

Ecological site: R048AY222CO - Loamy Park

Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit:

Landform: Depressions

Hydric soil rating: Yes

Other soils

Percent of map unit:

Hydric soil rating: No

Data Source Information

Soil Survey Area: El Paso County Area, Colorado

Survey Area Data: Version 21, Aug 24, 2023

F.E.M.A. MAP / LOMR (08-08-0541P)



NOTES TO USERS

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

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

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

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

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

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

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

NGS Information Services
NOAA, NUNCS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

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

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

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

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

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

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

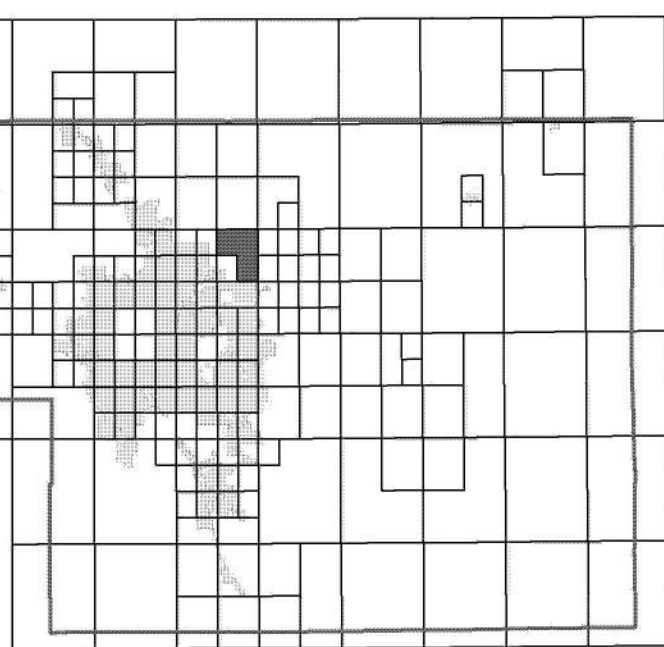
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call 1-877-FEMA MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/business/nfp>.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

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

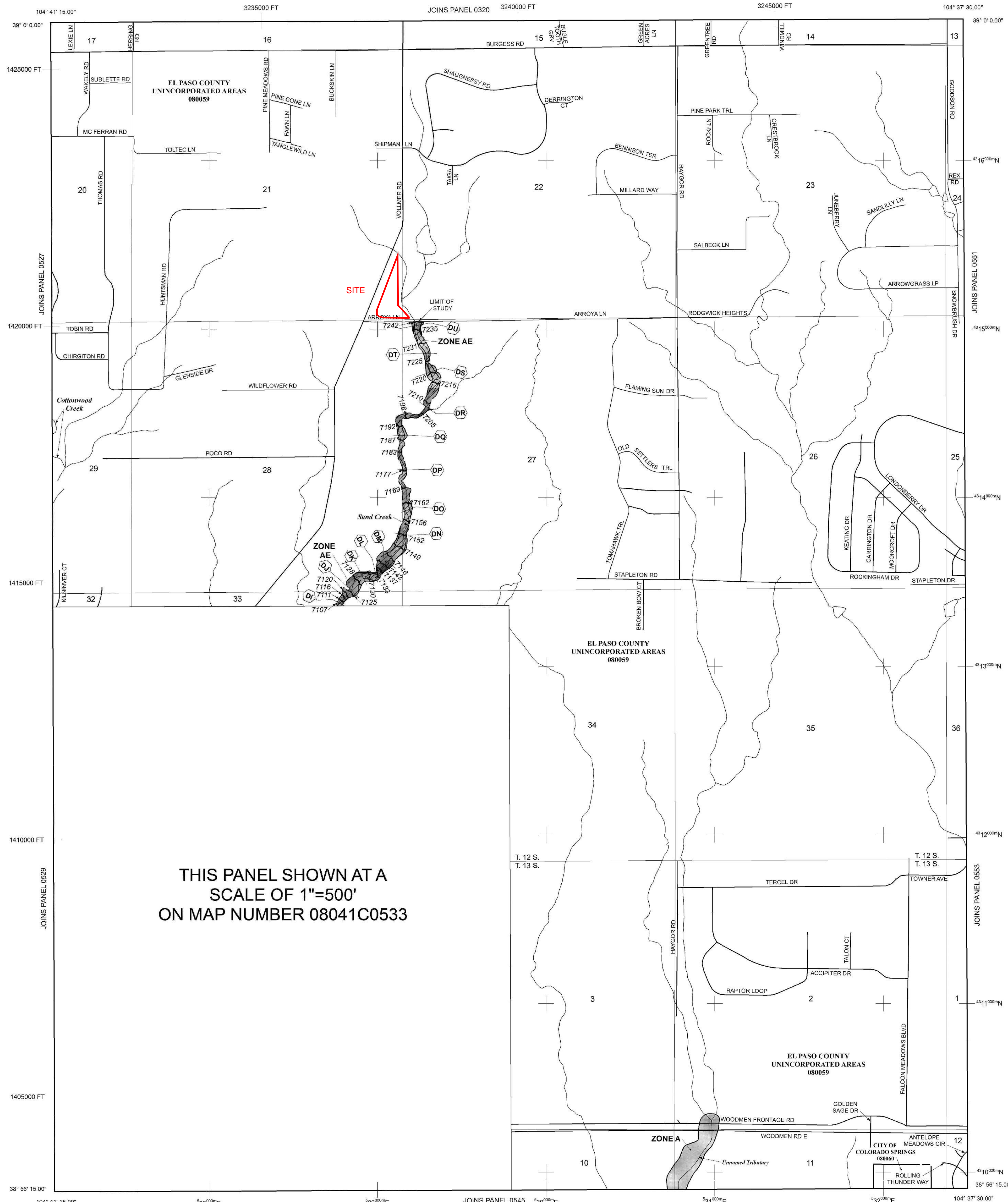
Panel Location Map



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



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



THIS PANEL SHOWN AT A SCALE OF 1"=500' ON MAP NUMBER 08041C0533

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 65 WEST, AND TOWNSHIP 13 SOUTH, RANGE 65 WEST.

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 D Areas determined to be outside the 0.2% annual chance floodplain. 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.
Base Flood Elevation value where uniform within zone; elevation in feet*
(EL 987)

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

57' 07" 30.00" 32' 22" 30.00" Cross section line

23-23 Transsect line

97° 07' 30.00" 32° 22' 30.00" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)

4757000N 1000-meter Universal Transverse Mercator grid ticks, zone 13

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

DX5510 Bench mark (see explanation in Notes to Users section of this FIRM panel)

M1.5 River Mile

MAP REPOSITORIES Refer to Map Repositories list on Map Index

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

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

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

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

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET
300 0 300 600 METERS



PANEL 0535G

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

PANEL 535 OF 1300
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080366	0535	G
EL PASO COUNTY	080259	0535	G

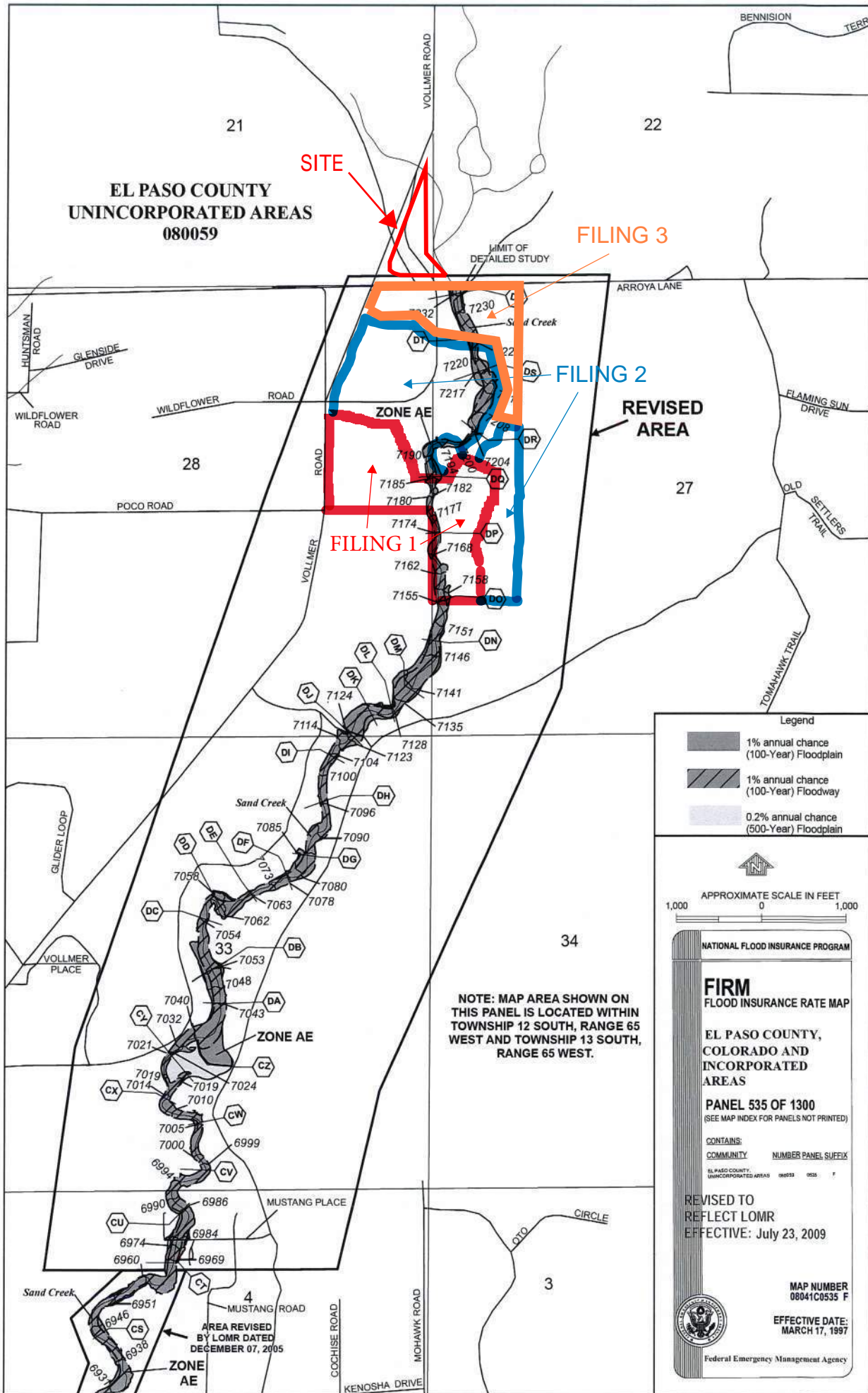
Notice to User: The Map Number shown below should be used when placing map orders. The Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0535G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency







Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT

COMMUNITY AND REVISION INFORMATION		PROJECT DESCRIPTION	BASIS OF REQUEST
COMMUNITY	El Paso County Colorado (Unincorporated Areas)	NO PROJECT	HYDRAULIC ANALYSIS NEW TOPOGRAPHIC DATA
	COMMUNITY NO.: 080059		
IDENTIFIER	Sand Creek Letter of Map Revision, Mustang Place to Arroya Lane	APPROXIMATE LATITUDE & LONGITUDE: 38.971, -104.668 SOURCE: USGS QUADRANGLE DATUM: NAD 27	
ANNOTATED MAPPING ENCLOSURES		ANNOTATED STUDY ENCLOSURES	
TYPE: FIRM* NO.: 08041C0535 F DATE: March 17, 1997		DATE OF EFFECTIVE FLOOD INSURANCE STUDY: August 23, 1999 PROFILE(S): 204P(a), 204P(b), 204P(c) AND 204P(d) FLOODWAY DATA TABLE: 5	

Enclosures reflect changes to flooding sources affected by this revision.

* FIRM - Flood Insurance Rate Map; ** FBFM - Flood Boundary and Floodway Map; *** FHBM - Flood Hazard Boundary Map

FLOODING SOURCE(S) & REVISED REACH(ES)

Sand Creek - from approximately 360 feet downstream of Mustang Place to just downstream of Arroya Lane

SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
Sand Creek	Zone A	Zone AE	YES	YES
	No BFEs*	BFEs	YES	NONE
	No Floodway	Floodway	YES	NONE

* BFEs - Base Flood Elevations

DETERMINATION

This document provides the determination from the Department of Homeland Security's Federal Emergency Management Agency (FEMA) regarding a request for a Letter of Map Revision (LOMR) for the area described above. Using the information submitted, we have determined that a revision to the flood hazards depicted in the Flood Insurance Study (FIS) report and/or National Flood Insurance Program (NFIP) map is warranted. This document revises the effective NFIP map, as indicated in the attached documentation. Please use the enclosed annotated map panels revised by this LOMR for floodplain management purposes and for all flood insurance policies and renewals in your community.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

David N. Bascom, Program Specialist
Engineering Management Branch
Mitigation Directorate



Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

COMMUNITY INFORMATION

APPLICABLE NFIP REGULATIONS/COMMUNITY OBLIGATION

We have made this determination pursuant to Section 206 of the Flood Disaster Protection Act of 1973 (P.L. 93-234) and in accordance with the National Flood Insurance Act of 1968, as amended (Title XIII of the Housing and Urban Development Act of 1968, P.L. 90-448), 42 U.S.C. 4001-4128, and 44 CFR Part 65. Pursuant to Section 1361 of the National Flood Insurance Act of 1968, as amended, communities participating in the NFIP are required to adopt and enforce floodplain management regulations that meet or exceed NFIP criteria. These criteria, including adoption of the FIS report and FIRM, and the modifications made by this LOMR, are the minimum requirements for continued NFIP participation and do not supersede more stringent State/Commonwealth or local requirements to which the regulations apply.

We provide the floodway designation to your community as a tool to regulate floodplain development. Therefore, the floodway revision we have described in this letter, while acceptable to us, must also be acceptable to your community and adopted by appropriate community action, as specified in Paragraph 60.3(d) of the NFIP regulations.

COMMUNITY REMINDERS

We based this determination on the 1-percent-annual-chance flood discharges computed in the FIS for your community without considering subsequent changes in watershed characteristics that could increase flood discharges. Future development of projects upstream could cause increased flood discharges, which could cause increased flood hazards. A comprehensive restudy of your community's flood hazards would consider the cumulative effects of development on flood discharges subsequent to the publication of the FIS report for your community and could, therefore, establish greater flood hazards in this area.

Your community must regulate all proposed floodplain development and ensure that permits required by Federal and/or State/Commonwealth law have been obtained. State/Commonwealth or community officials, based on knowledge of local conditions and in the interest of safety, may set higher standards for construction or may limit development in floodplain areas. If your State/Commonwealth or community has adopted more restrictive or comprehensive floodplain management criteria, those criteria take precedence over the minimum NFIP requirements.

We will not print and distribute this LOMR to primary users, such as local insurance agents or mortgage lenders; instead, the community will serve as a repository for the new data. We encourage you to disseminate the information in this LOMR by preparing a news release for publication in your community's newspaper that describes the revision and explains how your community will provide the data and help interpret the NFIP maps. In that way, interested persons, such as property owners, insurance agents, and mortgage lenders, can benefit from the information.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

A handwritten signature in cursive script that reads "David N. Bascom".

David N. Bascom, Program Specialist
Engineering Management Branch
Mitigation Directorate



Federal Emergency Management Agency
Washington, D.C. 20472

**LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)**

We have designated a Consultation Coordination Officer (CCO) to assist your community. The CCO will be the primary liaison between your community and FEMA. For information regarding your CCO, please contact:

Ms. Jeanine D. Petterson
Director, Mitigation Division
Federal Emergency Management Agency, Region VIII
Denver Federal Center, Building 710
P.O. Box 25267
Denver, CO 80225-0267
(303) 235-4830

STATUS OF THE COMMUNITY NFIP MAPS

We will not physically revise and republish the FIRM and FIS report for your community to reflect the modifications made by this LOMR at this time. When changes to the previously cited FIRM panel(s) and FIS report warrant physical revision and republication in the future, we will incorporate the modifications made by this LOMR at that time.

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

A handwritten signature in cursive script that reads "David N. Bascom".

David N. Bascom, Program Specialist
Engineering Management Branch
Mitigation Directorate



Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION DETERMINATION DOCUMENT (CONTINUED)

PUBLIC NOTIFICATION OF REVISION

PUBLIC NOTIFICATION

FLOODING SOURCE	LOCATION OF REFERENCED ELEVATION	BFE (FEET NGVD 29)		MAP PANEL NUMBER(S)
		EFFECTIVE	REVISED	
Sand Creek	Just upstream of Mustang Place	None	6,984	08041C0535 F
	Just downstream of Arroya Lane	None	7,238	08041C0535 F

Within 90 days of the second publication in the local newspaper, a citizen may request that we reconsider this determination. Any request for reconsideration must be based on scientific or technical data. Therefore, this letter will be effective only after the 90-day appeal period has elapsed and we have resolved any appeals that we receive during this appeal period. Until this LOMR is effective, the revised BFEs presented in this LOMR may be changed.

A notice of changes will be published in the *Federal Register*. A short notice also will be published in your local newspaper on or about the dates listed below. Please refer to FEMA's website at https://www.floodmaps.fema.gov/fhm/Scripts/bfe_main.asp for a more detailed description of proposed BFE changes, which will be posted within a week of the date of this letter.

LOCAL NEWSPAPER

Name: *El Paso County News*
Dates: 03/18/09 03/25/09

This determination is based on the flood data presently available. The enclosed documents provide additional information regarding this determination. If you have any questions about this document, please contact the FEMA Map Assistance Center toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMR Depot, 3601 Eisenhower Avenue, Alexandria, VA 22304. Additional Information about the NFIP is available on our website at <http://www.fema.gov/nfip>.

David N. Bascom, Program Specialist
Engineering Management Branch
Mitigation Directorate

HYDROLOGIC CALCULATIONS

For Colorado Springs and much of the Fountain Creek watershed, the 1-hour depths are fairly uniform and are summarized in Table 6-2. Depending on the location of the project, rainfall depths may be calculated using the described method and the NOAA Atlas maps shown in Figures 6-6 through 6-17.

Table 6-2. Rainfall Depths for Colorado Springs

Return Period	1-Hour Depth	6-Hour Depth	24-Hour Depth
2	1.19	1.70	2.10
5	1.50	2.10	2.70
10	1.75	2.40	3.20
25	2.00	2.90	3.60
50	2.25	3.20	4.20
100	2.52	3.50	4.60

Where $Z = 6,840 \text{ ft}/100$

These depths can be applied to the design storms or converted to intensities (inches/hour) for the Rational Method as described below. However, as the basin area increases, it is unlikely that the reported point rainfalls will occur uniformly over the entire basin. To account for this characteristic of rain storms an adjustment factor, the Depth Area Reduction Factor (DARF) is applied. This adjustment to rainfall depth and its effect on design storms is also described below. The UDFCD UD-Rain spreadsheet, available on UDFCD's website, also provides tools to calculate point rainfall depths and Intensity-Duration-Frequency curves² and should produce similar depth calculation results.

2.2 Design Storms

Design storms are used as input into rainfall/runoff models and provide a representation of the typical temporal distribution of rainfall events when the creation or routing of runoff hydrographs is required. It has long been observed that rainstorms in the Front Range of Colorado tend to occur as either short-duration, high-intensity, localized, convective thunderstorms (cloud bursts) or longer-duration, lower-intensity, broader, frontal (general) storms. The significance of these two types of events is primarily determined by the size of the drainage basin being studied. Thunderstorms can create high rates of runoff within a relatively small area, quickly, but their influence may not be significant very far downstream. Frontal storms may not create high rates of runoff within smaller drainage basins due to their lower intensity, but tend to produce larger flood flows that can be hazardous over a broader area and extend further downstream.

- **Thunderstorms:** Based on the extensive evaluation of rain storms completed in the Carlton study (Carlton 2011), it was determined that typical thunderstorms have a duration of about 2 hours. The study evaluated over 300,000 storm cells using gage-adjusted NEXRAD data, collected over a 14-year period (1994 to 2008). Storms lasting longer than 3 hours were rarely found. Therefore, the results of the Carlton study have been used to define the shorter duration design storms.

To determine the temporal distribution of thunderstorms, 22 gage-adjusted NEXRAD storm cells were studied in detail. Through a process described in a technical memorandum prepared by the City of Colorado Springs (City of Colorado Springs 2012), the results of this analysis were interpreted and normalized to the 1-hour rainfall depth to create the distribution shown in Table 6-3 with a 5 minute time interval for drainage basins up to 1 square mile in size. This distribution represents the rainfall

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													
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													
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

3.2 Time of Concentration

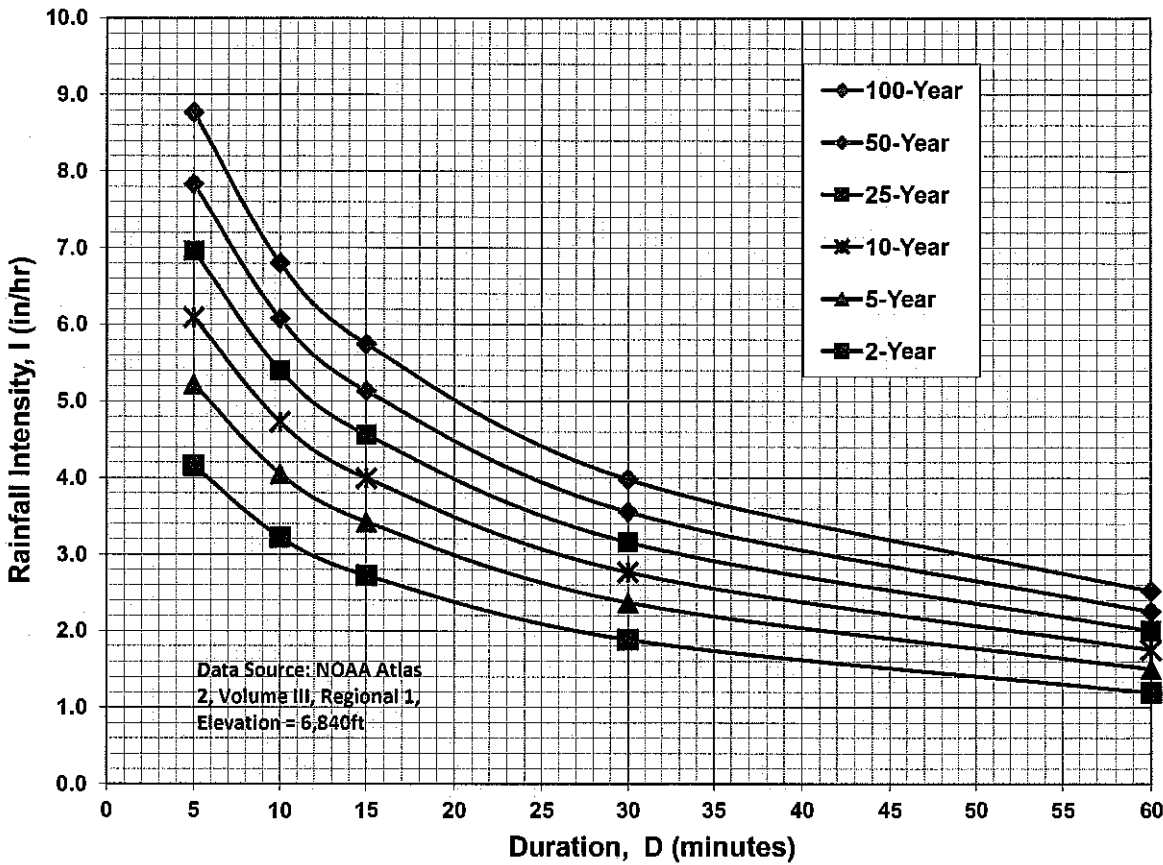
One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

Table 6-10. NRCS Curve Numbers for Frontal Storms & Thunderstorms for Developed Conditions (ARCII)

Fully Developed Urban Areas (vegetation established) ¹	Treatment	Hydrologic Condition	% I	Pre-Development CN			
				HSG A	HSG B	HSG C	HSG D
Open space (lawns, parks, golf courses, cemeteries, etc.):							
Poor condition (grass cover < 50%)	-----	-----	---	68	79	86	89
Fair condition (grass cover 50% to 75%)	-----	-----	---	49	69	79	84
Good condition (grass cover > 75%)	-----	-----	---	39	61	74	80
Impervious areas:							
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	-----	-----	---	98	98	98	98
Streets and roads:							
Paved; curbs and storm sewers (excluding right-of-way)	-----	-----	---	98	98	98	98
Paved; open ditches (including right-of-way)	-----	-----	---	83	89	92	93
Gravel (including right-of-way)	-----	-----	---	76	85	89	91
Dirt (including right-of-way)	-----	-----	---	72	82	87	89
Western desert urban areas:							
Natural desert landscaping (pervious areas only)	-----	-----	---	63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)	-----	-----	---	96	96	96	96
Urban districts:							
Commercial and business	-----	-----	85	89	92	94	95
Industrial	-----	-----	72	81	88	91	93
Residential districts by average lot size:							
1/8 acre or less (town houses)	-----	-----	65	77	85	90	92
1/4 acre	-----	-----	38	61	75	83	87
1/3 acre	-----	-----	30	57	72	81	86
1/2 acre	-----	-----	25	54	70	80	85
1 acre	-----	-----	20	51	68	79	84
2 acres	-----	-----	12	46	65	77	82
Developing Urban Areas¹	Treatment²	Hydrologic Condition³	% I	HSG A	HSG B	HSG C	HSG D
Newly graded areas (pervious areas only, no vegetation)	-----	-----	---	77	86	91	94
Cultivated Agricultural Lands¹	Treatment	Hydrologic Condition	% I	HSG A	HSG B	HSG C	HSG D
Fallow	Bare soil	-----	---	77	86	91	94
	Crop residue cover (CR)	Poor	---	76	85	90	93
Row crops	Straight row (SR)	Good	---	74	83	88	90
		Poor	---	72	81	88	91
	SR + CR	Good	---	67	78	85	89
		Poor	---	71	80	87	90
	Contoured (C)	Good	---	64	75	82	85
		Poor	---	70	79	84	88
	C + CR	Good	---	65	75	82	86
		Poor	---	69	78	83	87
	Contoured & terraced (C&T)	Good	---	64	74	81	85
		Poor	---	66	74	80	82
	C&T+ CR	Good	---	62	71	78	81
		Poor	---	65	73	79	81
Small grain	SR	Good	---	61	70	77	80
		Poor	---	65	76	84	88
	SR + CR	Good	---	63	75	83	87
		Poor	---	64	75	83	86
	C	Good	---	60	72	80	84
		Poor	---	63	74	82	85
	C + CR Poor	Good	---	61	73	81	84
		Poor	---	62	73	81	84
	C&T	Good	---	60	72	80	83
		Poor	---	61	72	79	82
	C&T+ CR	Good	---	59	70	78	81
		Poor	---	60	71	78	81
		Good	---	58	69	77	80

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.

JOB NAME: STIMPLE SUBDIVISION FILING NO. 1
 JOB NUMBER: 1185.80
 DATE: 09/25/24
 CALCULATED BY: MAW

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	IMPERVIOUS AREA / STREETS				LANDSCAPE/DEVELOPED AREAS				WEIGHTED			WEIGHTED CA			EFFECTIVE IMPERVIOUS (%)
		AREA (AC)	C(2)	C(5)	C(100)	AREA (AC)	C(2)	C(5)	C(100)	C(2)	C(5)	C(100)	CA(2)	CA(5)	CA(100)	
EX-1	27.6	0.00	0.89	0.90	0.96	27.6	0.05	0.12	0.39	0.05	0.12	0.39	1.38	3.31	10.76	7.0%
EX-2	18.0	0.00	0.89	0.90	0.96	18.0	0.05	0.12	0.39	0.05	0.12	0.39	0.90	2.16	7.02	7.0%
EX-3	5.9	0.50	0.89	0.90	0.96	5.4	0.03	0.09	0.36	0.10	0.16	0.41	0.61	0.94	2.42	9.5%
EX-4	6.7	0.25	0.89	0.90	0.96	6.5	0.03	0.09	0.36	0.06	0.12	0.38	0.42	0.81	2.56	5.3%
PR3A	2.5	0.50	0.89	0.90	0.96	2.0	0.03	0.09	0.36	0.20	0.25	0.48	0.51	0.63	1.20	19.6%
PR3B	3.4	0.00	0.89	0.90	0.96	3.4	0.05	0.12	0.39	0.05	0.12	0.39	0.15	0.39	1.31	7.0%

JOB NAME: STIMPLE SUBDIVISION FILING NO. 1
 JOB NUMBER: 1185.80
 DATE: 09/25/24
 CALC'D BY: MAW

Return Period	1-Hour Depth
2	1.19
5	1.50
10	1.75
25	2.00
50	2.25
100	2.52

$$t_i = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}}$$

$$V = C_v S_w^{0.5} \quad T_c = L/V$$

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	$t_c = \frac{L}{180} + 10$ 6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

*For buried riprap, select C_v value based on type of vegetative cover.

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED			OVERLAND				STREET / CHANNEL FLOW				Tc TOTAL (min)	INTENSITY			TOTAL FLOWS		
	CA(2)	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)		I(2) (in/hr)	I(5) (in/hr)	I(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
EX-1	1.38	3.31	10.76	0.12	300	12	19.4	1300	2.2%	1.0	21.0	40.4	1.63	2.03	3.41	2	7	37
EX-2	0.90	2.16	7.02	0.12	300	10	20.6	1100	2.0%	1.4	13.0	33.6	1.85	2.31	3.88	2	5	27
EX-3	0.61	0.94	2.42	0.09	300	10	21.2	350	2.0%	1.4	4.1	25.4	2.19	2.73	4.59	1	3	11
EX-4	0.42	0.81	2.56	0.09	300	26	15.5	300	2.0%	1.4	3.5	19.0	2.53	3.16	5.31	1	3	14
PR3A	0.51	0.63	1.20	0.09	150	4	16.2	500	2.5%	1.6	5.3	21.4	2.39	2.99	5.01	1	2	6
PR3B	0.15	0.39	1.31	0.09	300	10	21.2	250	2.5%	1.6	2.6	23.9	2.26	2.82	4.74	1	1	5

JOB NAME: STIMPLE SUBDIVISION FILING NO. 1
 JOB NUMBER: 1185.80
 DATE: 09/25/24
 CALCULATED BY: MAW

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Inlet Size
					I(5)	I(100)	Q(5)	Q(100)	
1	PR3A and PR3B	1.02	2.51	23.9	2.82	4.74	3	11	EX. RIP-RAP RUNDOWN

SAND CREEK PHOTOS

STIMPLE SUBDIVISION FILING NO. 1



Stimple Property looking north – Natural ridge with Sand Creek corridor east of the trees



SAND CREEK REACH 9 – Looking south just north of Arroya Lane

STIMPLE SUBDIVISION FILING NO. 1



SAND CREEK REACH 9 – Looking southeast just north of Arroya Lane



SAND CREEK REACH 9 – Looking north

STIMPLE SUBDIVISION FILING NO. 1



SAND CREEK REACH 9 – Looking northeast



SAND CREEK REACH 9 – Looking north at natural ridge within the creek

STIMPLE SUBDIVISION FILING NO. 1



SAND CREEK REACH 9 – Looking west towards the north end of the Stimple property



SAND CREEK REACH 9 – Looking southwest

STIMPLE SUBDIVISION FILING NO. 1



SAND CREEK REACH 9 – Looking south



SAND CREEK REACH 9 – Looking northeast

STIMPLE SUBDIVISION FILING NO. 1



SAND CREEK REACH 9 – Looking south



SAND CREEK REACH 9 – Looking northwest towards Vollmer Rd.

REFERENCE MATERIALS



INNOVATIVE DESIGN. CLASSIC RESULTS.

**FINAL DRAINAGE REPORT
FOR
RETREAT AT TIMBERRIDGE
FILING NO. 3**

Prepared for:
TIMBERRIDGE DEVELOPMENT GROUP, LLC
2138 FLYING HORSE CLUB DRIVE
COLORADO SPRINGS CO 80921
(719) 592-9333

Prepared by:
CLASSIC CONSULTING
619 N. CASCADE AVE SUITE 200
COLORADO SPRINGS CO 80903
(719) 785-0790

Job No. 1185.30

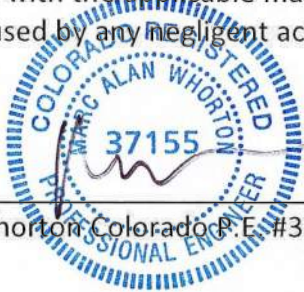
PCD Project No. SF-22-041



**FINAL DRAINAGE REPORT FOR
RETREAT AT TIMBERRIDGE FILING NO. 3**

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 applicable 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.



Marc A. Whorton, Colorado P.E. #37155

4/22/2024

Date

OWNER'S/DEVELOPER'S STATEMENT:

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

Business Name: TIMBERRIDGE DEVELOPMENT GROUP, LLC

By: LOREN J. MARELAND

Title: VICE PRESIDENT

Address: 2138 Flying Horse Club Drive
Colorado Springs, CO 80921

EL PASO COUNTY:

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.

Gilbert LaForce, P.E.

Digitally signed by Gilbert LaForce, P.E.
Reason: Authorized signatory as County
Engineer designee
Date: 2024.07.16 08:27:56-06'00'

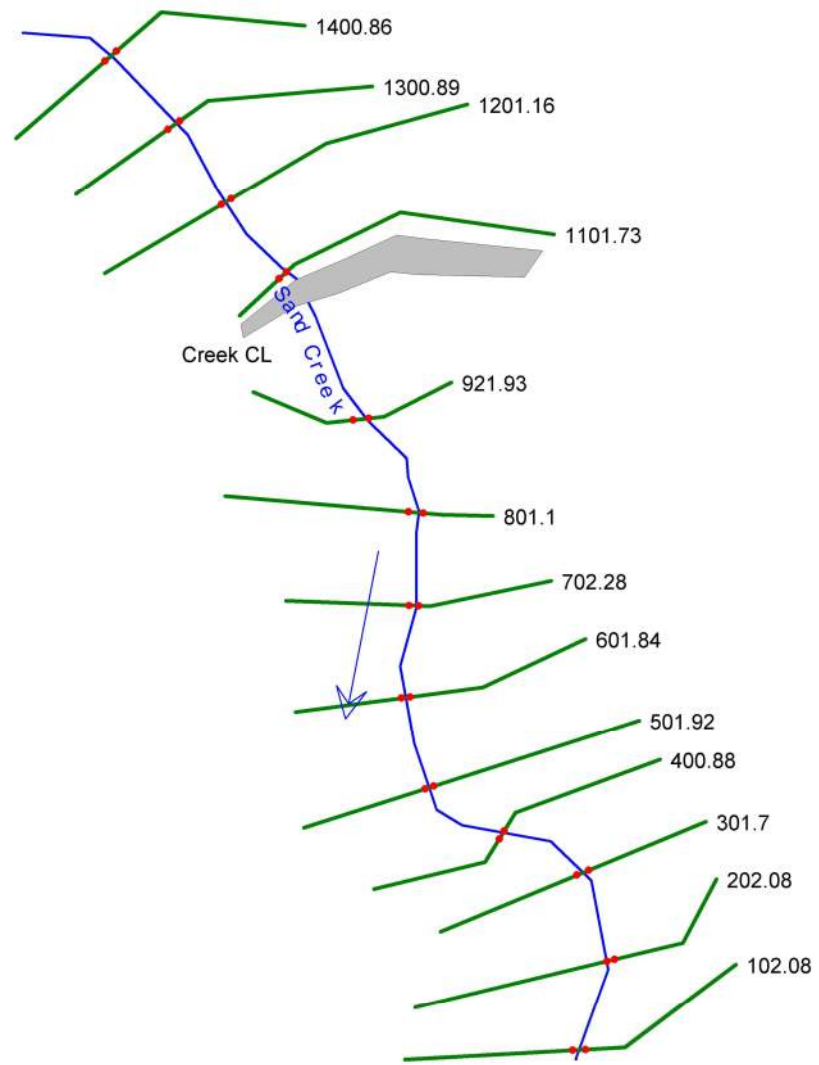
07/16/2024

Joshua Palmer, P.E.
County Engineer, / ECM Administrator

Date

Conditions:





HEC-RAS Model (Ver. 6.3.1) Input Data

Input based on the following:

Table 10-1 & 10-2 from DCM

Table 3 from USGS Guide for selecting Manning's Roughness Coefficients

Site visits and photographic documentation of the channel

Classification of Vegetal covers from HEC-15

SCS Retardance Class form HEC-15

Flows based on current approved Sand Creek DBPS, FEMA and SR MDDP

Manning's n Values: 0.12 overbank

0.07 channel

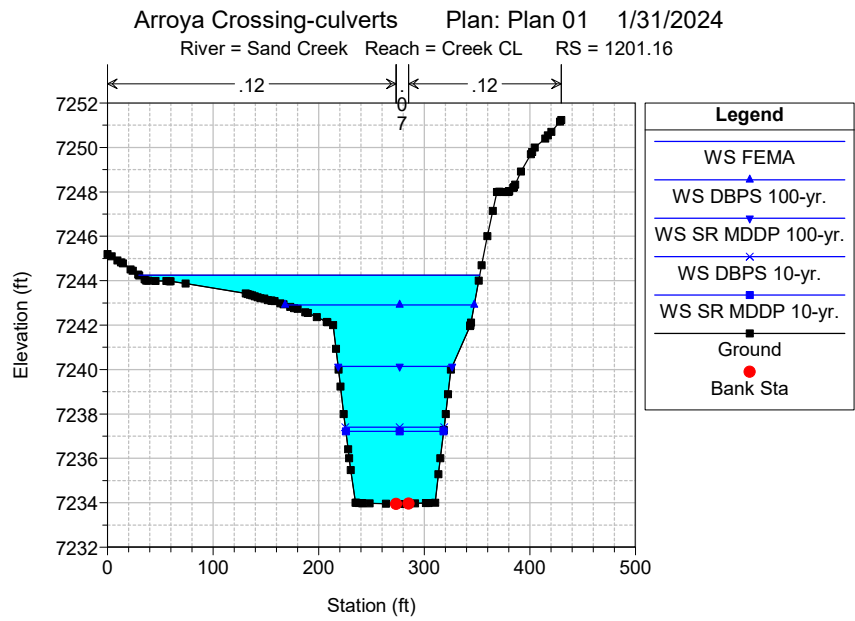
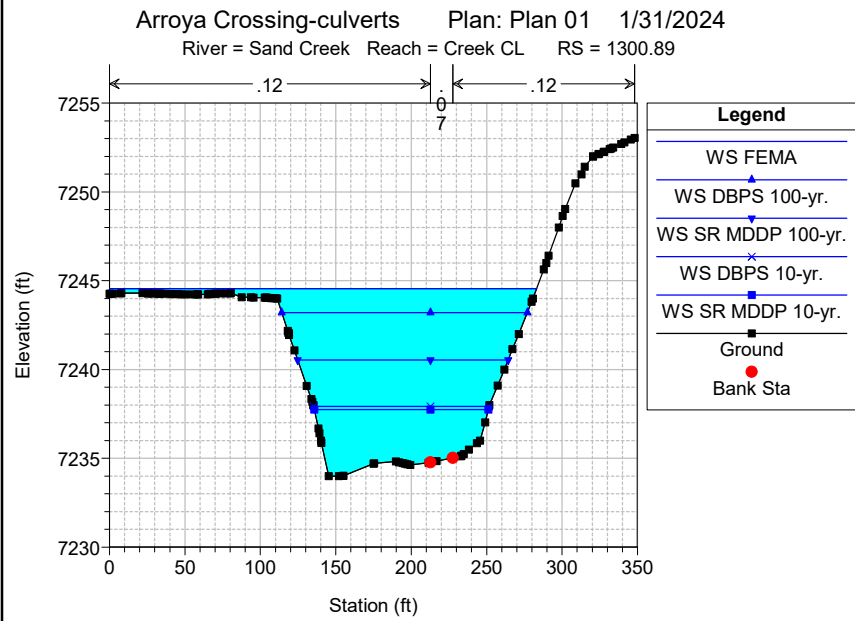
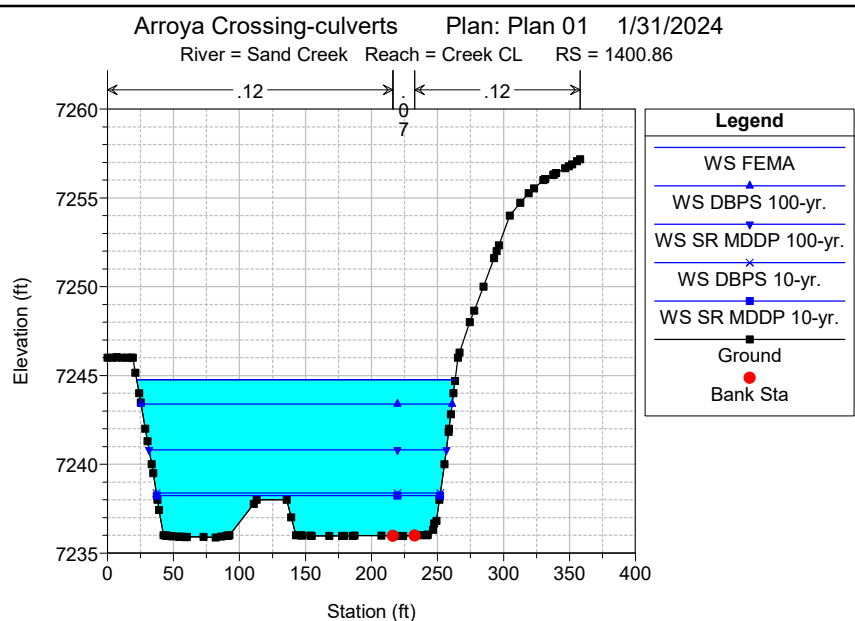
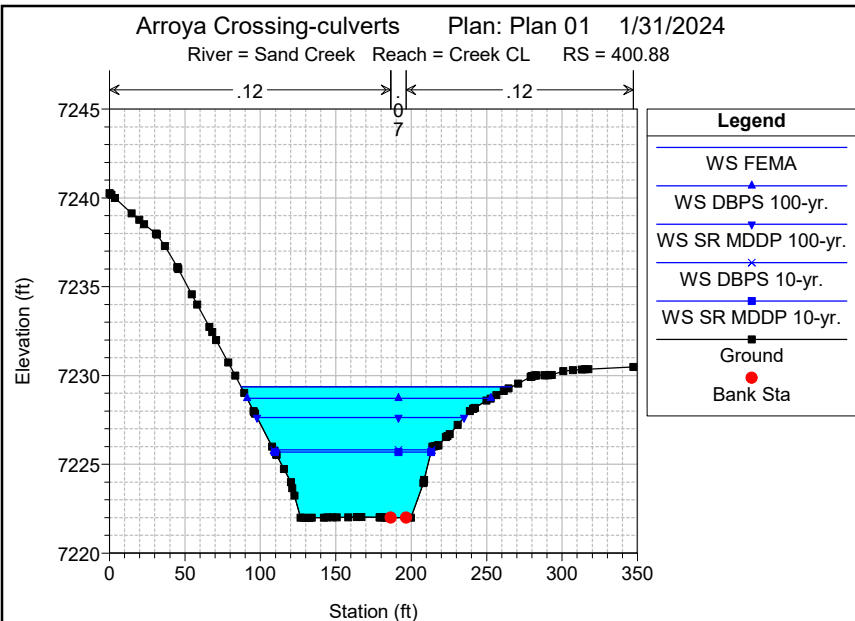
Standard Channel coefficients: Contraction 0.1

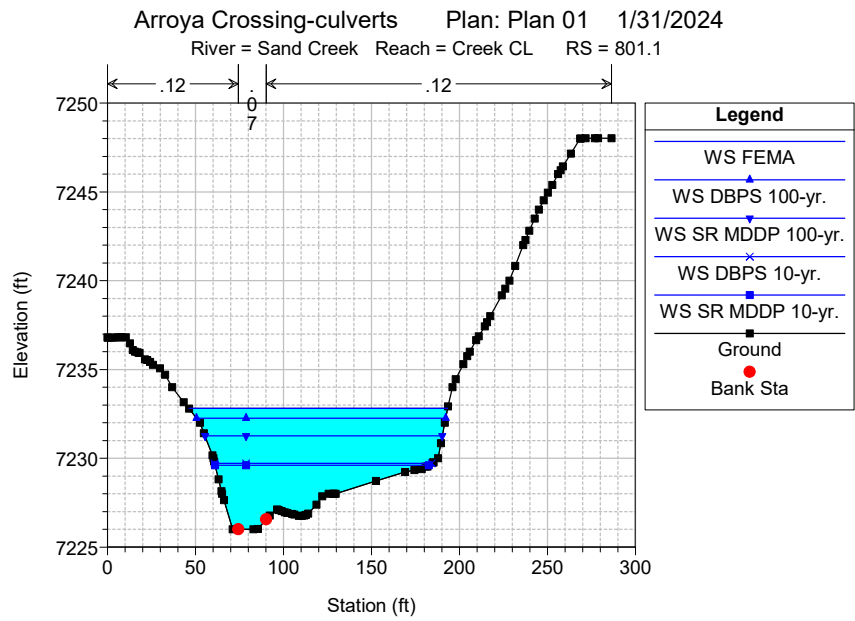
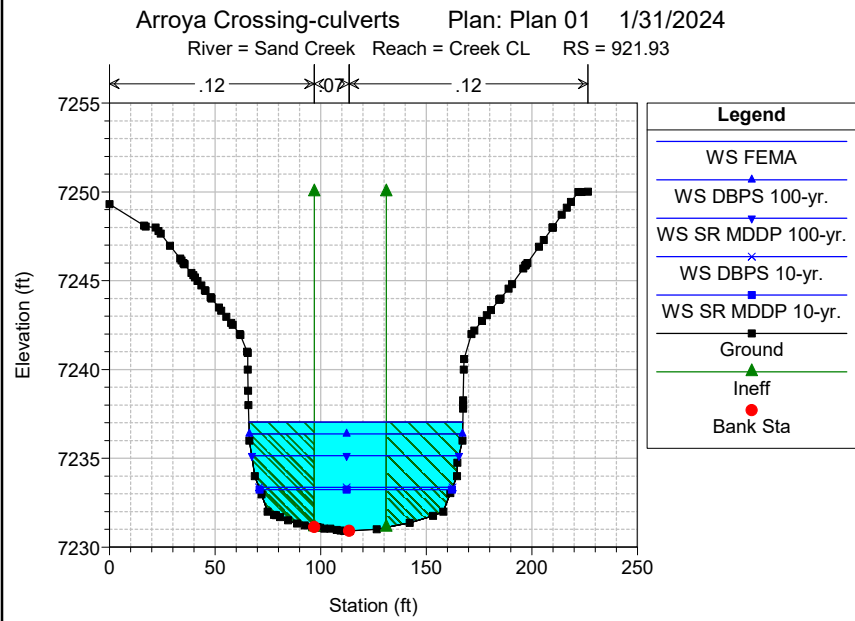
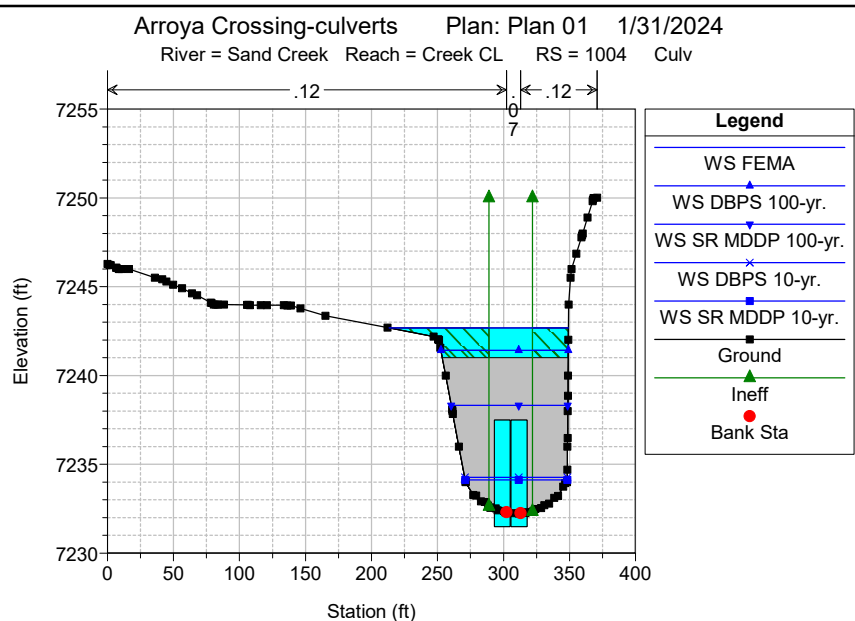
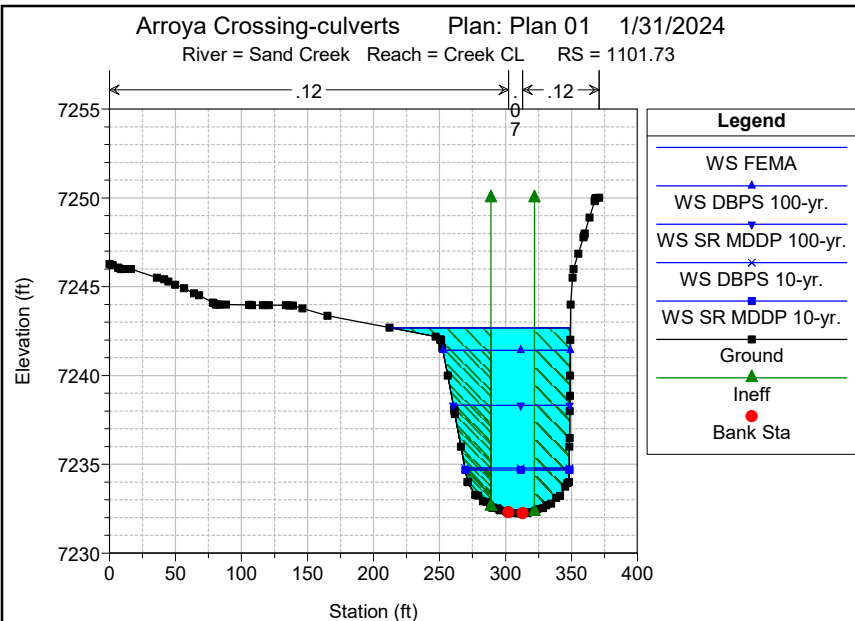
Expansion 0.3

Flows modeled:	FEMA 100-yr	2600 cfs
	DBPS 100-yr	2170 cfs
	SR MDDP 100-yr	1468 cfs
	DBPS 10-yr	630 cfs
	SR MDDP 10-yr	581 cfs

HEC-RAS Plan: Plan 01 River: Sand Creek Reach: Creek CL

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	Max Chl Dpth (ft)	Hydr Radius (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Total (ft/s)	Shear Total (lb/sq ft)	Flow Area (sq ft)	Top Width (ft)	Froude # XS
Creek CL	1400.86	FEMA	2600.00	7235.97	7244.76		8.87	7.68	7244.80	0.000722	1.38	0.35	1886.47	241.25	0.09
Creek CL	1400.86	DBPS 100-yr.	2170.00	7235.97	7243.39		7.50	6.51	7243.42	0.000918	1.39	0.37	1558.68	235.67	0.10
Creek CL	1400.86	SR MDDP 100-yr.	1468.00	7235.97	7240.83		4.94	4.26	7240.87	0.001909	1.51	0.51	969.07	225.15	0.14
Creek CL	1400.86	DBPS 10-yr.	630.00	7235.97	7238.39		2.50	2.00	7238.43	0.004763	1.46	0.59	432.13	215.16	0.20
Creek CL	1400.86	SR MDDP 10-yr.	581.00	7235.97	7238.24		2.35	1.85	7238.28	0.005206	1.45	0.60	399.92	214.56	0.21
Creek CL	1300.89	FEMA	2600.00	7234.78	7244.55		10.55	4.71	7244.67	0.002272	1.93	0.67	1347.91	283.17	0.22
Creek CL	1300.89	DBPS 100-yr.	2170.00	7234.78	7243.21		9.21	6.57	7243.29	0.001713	2.00	0.70	1084.31	162.80	0.16
Creek CL	1300.89	SR MDDP 100-yr.	1468.00	7234.78	7240.53		6.53	4.81	7240.63	0.003020	2.16	0.91	679.36	139.51	0.20
Creek CL	1300.89	DBPS 10-yr.	630.00	7234.78	7237.92		3.92	2.94	7237.98	0.004209	1.83	0.77	345.04	116.32	0.20
Creek CL	1300.89	SR MDDP 10-yr.	581.00	7234.78	7237.75		3.75	2.79	7237.81	0.004316	1.79	0.75	325.08	115.36	0.20
Creek CL	1201.16	FEMA	2600.00	7233.95	7244.25		10.30	3.85	7244.41	0.002920	2.07	0.70	1253.97	322.68	0.29
Creek CL	1201.16	DBPS 100-yr.	2170.00	7233.95	7242.91		8.96	5.09	7243.06	0.003106	2.34	0.99	925.81	179.16	0.24
Creek CL	1201.16	SR MDDP 100-yr.	1468.00	7233.95	7240.14		6.18	5.12	7240.27	0.004057	2.60	1.30	564.50	108.08	0.23
Creek CL	1201.16	DBPS 10-yr.	630.00	7233.95	7237.40		3.45	3.06	7237.49	0.005593	2.17	1.07	290.06	93.44	0.24
Creek CL	1201.16	SR MDDP 10-yr.	581.00	7233.95	7237.22		3.27	2.91	7237.31	0.005734	2.13	1.04	273.08	92.53	0.25
Creek CL	1101.73	FEMA	2600.00	7232.23	7242.68	7238.62	10.45	10.33	7243.81	0.011020	7.62	7.11	341.09	135.88	0.47
Creek CL	1101.73	DBPS 100-yr.	2170.00	7232.23	7241.42	7237.89	9.19	9.07	7242.44	0.011851	7.25	6.71	299.36	96.42	0.47
Creek CL	1101.73	SR MDDP 100-yr.	1468.00	7232.23	7238.31	7236.62	6.08	5.97	7239.39	0.021835	7.45	8.13	196.92	88.24	0.60
Creek CL	1101.73	DBPS 10-yr.	630.00	7232.23	7234.78	7234.78	2.55	2.44	7236.00	0.078460	7.83	11.93	80.41	78.93	1.00
Creek CL	1101.73	SR MDDP 10-yr.	581.00	7232.23	7234.68	7234.68	2.45	2.33	7235.81	0.077299	7.55	11.24	76.91	78.65	0.98
Creek CL	1004		Culvert												
Creek CL	921.93	FEMA	2600.00	7230.92	7237.04	7237.04	6.12	6.04	7240.06	0.052481	12.66	19.79	205.40	101.28	1.00
Creek CL	921.93	DBPS 100-yr.	2170.00	7230.92	7236.38	7236.38	5.46	5.38	7239.03	0.053777	11.86	18.06	182.96	100.99	0.99
Creek CL	921.93	SR MDDP 100-yr.	1468.00	7230.92	7235.15	7235.15	4.23	4.15	7237.19	0.058423	10.40	15.14	141.19	98.12	0.99
Creek CL	921.93	DBPS 10-yr.	630.00	7230.92	7233.36	7233.36	2.44	2.36	7234.52	0.070760	7.85	10.43	80.29	91.70	0.99
Creek CL	921.93	SR MDDP 10-yr.	581.00	7230.92	7233.24	7233.24	2.32	2.24	7234.33	0.071638	7.62	10.02	76.21	90.95	0.99
Creek CL	801.1	FEMA	2600.00	7226.00	7232.81		6.81	4.40	7233.21	0.010288	3.97	2.83	655.02	146.93	0.42
Creek CL	801.1	DBPS 100-yr.	2170.00	7226.00	7232.27		6.27	4.02	7232.63	0.010344	3.76	2.60	576.68	141.67	0.42
Creek CL	801.1	SR MDDP 100-yr.	1468.00	7226.00	7231.27		5.27	3.22	7231.57	0.010538	3.35	2.12	438.72	134.87	0.43
Creek CL	801.1	DBPS 10-yr.	630.00	7226.00	7229.72		3.72	1.91	7229.95	0.010921	2.65	1.30	237.33	123.27	0.49
Creek CL	801.1	SR MDDP 10-yr.	581.00	7226.00	7229.61		3.61	1.83	7229.83	0.010877	2.60	1.24	223.41	121.51	0.49
Creek CL	702.28	FEMA	2600.00	7225.93	7231.54		5.60	4.27	7231.96	0.015564	4.55	4.15	571.27	132.13	0.45
Creek CL	702.28	DBPS 100-yr.	2170.00	7225.93	7230.97		5.04	3.89	7231.36	0.016116	4.35	3.91	498.38	126.81	0.45
Creek CL	702.28	SR MDDP 100-yr.	1468.00	7225.93	7229.93		4.00	3.15	7230.25	0.017513	3.96	3.45	371.10	116.69	0.45
Creek CL	702.28	DBPS 10-yr.	630.00	7225.93	7228.28		2.34	2.05	7228.48	0.021117	3.21	2.71	196.19	94.86	0.44
Creek CL	702.28	SR MDDP 10-yr.	581.00	7225.93	7228.15		2.22	1.97	7228.34	0.021572	3.15	2.65	184.67	93.34	0.44
Creek CL	601.84	FEMA	2600.00	7223.93	7230.57		6.65	4.62	7230.80	0.008293	3.37	2.39	772.26	165.36	0.32
Creek CL	601.84	DBPS 100-yr.	2170.00	7223.93	7229.94		6.02	4.18	7230.16	0.008719	3.24	2.28	670.44	158.93	0.32
Creek CL	601.84	SR MDDP 100-yr.	1468.00	7223.93	7228.80		4.88	3.49	7228.98	0.009075	2.94	1.98	499.28	141.84	0.32
Creek CL	601.84	DBPS 10-yr.	630.00	7223.93	7226.96		3.04	2.38	7227.07	0.009722	2.37	1.45	265.56	110.79	0.31
Creek CL	601.84	SR MDDP 10-yr.	581.00	7223.93	7226.82		2.90	2.30	7226.93	0.009731	2.32	1.40	250.58	108.34	0.30
Creek CL	501.92	FEMA	2600.00	7223.54	7229.99		6.97	5.40	7230.14	0.005104	2.89	1.72	898.54	164.00	0.24





MASTER DEVELOPMENT DRAINAGE PLAN FOR STERLING RANCH

OCTOBER 2018

Prepared for:

Morley-Bentley Investments, LLC
20 Boulder Crescent, 2nd Floor
Colorado Springs, CO 80903
(719) 471-1742

Prepared by:



20 Boulder Crescent, Suite 110
Colorado Springs, CO 80903
(719) 955-5485

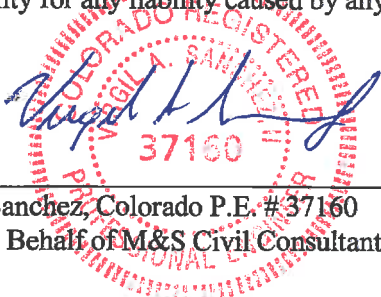
Project #09-002
SKP-18-003
SF-17-024

MASTER DEVELOPMENT DRAINAGE PLAN FOR STERLING RANCH

DRAINAGE PLAN STATEMENTS

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 applicable 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.



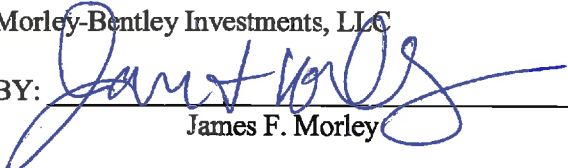
Virgil A. Sanchez, Colorado P.E. #37160
For and on Behalf of M&S Civil Consultants, Inc.

DATE: 10/24/18

DEVELOPER'S STATEMENT

I, the owner/developer, have read and will comply with all the requirements specified in this drainage report and plan.

Morley-Bentley Investments, LLC

BY: 
James F. Morley


DATE: 10/24/18

TITLE: Manager
BUSINESS NAME: Morley-Bentley Investments, LLC
ADDRESS: 20 Boulder Crescent, 2nd Floor
Colorado Springs, 80903

EL PASO COUNTY

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

Approved
by Elizabeth Nijkamp
El Paso County Planning and Community Development
on behalf of Jennifer Irvine, County Engineer, ECM Administrator



11/15/2018 1:46:07 PM

DATE: _____

County Engineer / ECM
Administrator

CONDITIONS:

Sterling Ranch Master Development Drainage Plan
Sand Creek & East Sand Creek Basins - Predevelopment Conditions - Lag Time Calculations
8/21/2018

Basin ID	OVERLAND FLOW					SHALLOW GUTTER FLOW				SHALLOW CHANNEL FLOW				STORM SEWER FLOW				CHANNELIZED FLOW				Tc Total (min)	Tlag 0.6*Tc (min)
	P2 (in)	n	Length (ft)	Slope (%)	Tt (min)	Length (ft)	Slope (%)	Vel (fps)	Tt (min)	Length (ft)	Slope (%)	Vel (fps)	Tt (min)	Length (ft)	Slope (%)	Vel (fps)	Tt (min)	Length (ft)	Slope (%)	Vel (fps)	Tt (min)		
EX-0	2.1	0.15	160	2.5	16.1	0	0	0	0	1200	20	2.0	10.0	0	0	0	0.0	0	0.0	0.0	0.0	26.1	15.7
EX-1	2.1	0.15	200	2.0	21.1	0	0	0	0	1450	32	2.3	10.5	0	0	0	0.0	0	0.0	0.0	0.0	31.6	18.9
EX-2	2.1	0.15	200	1.5	23.6	0	0	0	0	1050	27	2.5	7.0	0	0	0	0.0	0	0.0	0.0	0.0	30.6	18.4
EX-3	2.1	0.15	300	5.3	19.7	0	0	0	0.0	1100	40	2.9	6.3	0	0	0	0.0	3540	2.7	4.1	14.4	40.4	24.2
EX-3A	2.1	0.15	200	3.0	17.9	0	0	0	0.0	1200	26	2.3	8.7	0	0	0	0.0	3360	2.1	4.5	12.4	39.0	23.4
EX-4	2.1	0.15	300	4.7	20.8	0	0	0	0.0	770	22	2.7	4.8	0	0	0	0.0	3900	3.0	4.0	16.3	41.8	25.1
EX-4A	2.1	0.15	200	3.0	17.9	0	0	0	0.0	250	8	2.8	1.5	0	0	0	0.0	5190	1.9	4.3	20.1	39.5	23.7
EX-5	2.1	0.15	200	4.0	16.0	0	0	0	0.0	1050	34	2.8	6.3	0	0	0	0.0	4425	2.3	3.8	19.4	41.6	25.0
EX-6	2.1	0.15	300	5.0	20.2	0	0	0	0.0	250	11	3.2	1.3	0	0	0	0.0	3490	2.3	3.8	15.3	36.8	22.1
EX-7	2.1	0.15	300	2.0	29.1	0	0	0	0.0	1650	42	2.4	11.5	0	0	0	0.0	3950	2.1	4.2	15.7	56.3	33.8
EX-8	2.1	0.15	200	2.0	21.1	0	0	0	0.0	1600	35	2.3	11.6	0	0	0	0.0	0	0.0	0.0	0.0	32.7	19.6
EX-9	2.1	0.15	200	2.0	21.1	0	0	0	0.0	800	26	2.8	4.8	0	0	0	0.0	3775	2.1	4.0	15.7	41.5	24.9
EX-10	2.1	0.15	300	5.3	19.7	0	0	0	0.0	880	32	2.9	5.1	0	0	0	0.0	6133	2.2	4.6	22.2	47.0	28.2
EX-10A	2.1	0.15	200	2.0	21.1	0	0	0	0.0	1440	35	2.4	10.0	0	0	0	0.0	5500	2.0	3.5	26.2	57.2	34.3
EX-11	2.1	0.15	200	4.0	16.0	0	0	0	0.0	1620	44	2.6	10.4	0	0	0	0.0	3000	2.7	4.0	12.5	38.8	23.3
EX-12	2.1	0.15	200	3.0	17.9	0	0	0	0.0	250	8	2.8	1.5	0	0	0	0.0	820	2.7	2.6	5.3	24.7	14.8
EX-13	2.1	0.15	200	9.0	11.5	0	0	0	0.0	250	12	3.4	1.2	0	0	0	0.0	4325	2.9	3.7	19.5	32.2	19.3
EX-20	2.1	0.15	300	3.8	22.5	0	0	0	0.0	730	40	3.5	3.5	0	0	0	0.0	2200	3.6	4.3	8.5	34.5	20.7
EX-20A	2.1	0.15	300	4.0	22.1	0	0	0	0.0	650	20	2.7	4.0	0	0	0	0.0	4450	1.8	4.2	17.7	43.7	26.2
EX-21	2.1	0.15	200	4.5	15.2	0	0	0	0.0	1175	42	2.9	6.8	0	0	0	0.0	915	1.7	2.5	6.1	28.1	16.8
EX-24	2.1	0.15	200	4.4	15.3	0	0	0	0.0	0	0	0.0	0.0	0	0	0	0.0	2400	2.3	3.1	12.9	28.2	16.9
EX-25	2.1	0.15	150	4.0	12.7	0	0	0	0.0	0	0	0.0	0.0	0	0	0	0.0	2700	1.6	3.1	14.5	27.2	16.3
EX-73	2.1	0.15	300	3.3	23.7	0	0	0	0.0	1650	3.3	2.9	9.5	0	0	0	0.0	1230	3.3	4.2	4.9	38.1	22.9
EX-74	2.1	0.15	300	4.7	20.8	0	0	0	0.0	2000	3.5	2.8	11.9	0	0	0	0.0	770	2.6	3.9	3.3	35.9	21.6
EX-75	2.1	0.15	300	3.3	23.7	0	0	0	0.0	1200	4.1	2.7	7.4	0	0	0	0.0	2300	2.8	3.1	12.4	43.5	26.1
EX-76	2.1	0.15	300	3.3	23.7	0	0	0	0.0	1160	3.4	3.1	6.2	0	0	0	0.0	3025	2.6	3.6	14.0	44.0	26.4
EX-77	2.1	0.15	300	4.7	20.8	0	0	0	0.0	1600	4.0	3.4	7.8	0	0	0	0.0	4850	2.1	5.1	15.8	44.4	26.7
EX-78	2.1	0.15	300	3.3	23.7	0	0	0	0.0	1560	4.1	3.3	7.9	0	0	0	0.0	1850	3.2	4.5	6.9	38.5	23.1
EX-79	2.1	0.15	300	4.0	22.1	0	0	0	0.0	1740	5.6	3.5	8.3	0	0	0	0.0	1100	1.8	3.0	6.1	36.5	21.9
EX-80	2.1	0.15	300	5.0	20.2	0	0	0	0.0	1625	4.9	3.4	8.0	0	0	0	0.0	2140	2.8	4.1	8.7	36.9	22.1
EX-81	2.1	0.15	300	6.7	18.0	0	0	0	0.0	2000	5.0	3.4	9.8	0	0	0	0.0	3600	3.1	4.9	12.2	40.0	24.0
EX-82	2.1	0.15	300	3.3	23.7	0	0	0	0.0	2000	4.7	3.3	10.1	0	0	0	0.0	625	3.2	4.1	2.5	36.4	21.8
EX-88	2.1	0.15	300	4.7	20.8	0	0	0	0.0	1750	4.1	3.4	8.6	0	0	0	0.0	2760	3.1	4.0	11.5	40.8	24.5

DCM TABLE 6-25 WAS USED FOR SHALLOW CONCENTRATED SWALE & GUTTER FLOW
N VALUE FOR OVERLAND FLOW WAS ASSUMED TO BE 0.17 FOR ALL BASINS
A ROUGHNESS COEFFICIENT OF 0.050 WAS USED FOR EARTHEN CHANNEL BOTTOMS
A ROUGHNESS COEFFICIENT OF 0.020 WAS USED FOR CONCRETE LINED CONVEYANCES

Sterling Ranch Master Development Drainage Plan

Sand Creek and East Fork Sand Creek Basins - Predevelopment Conditions - Initial Abstraction Values

8/21/2018

Basin ID	Composite CN Value	Initial Abstraction (in)
EX-0	62	0.613
EX-1	62	0.613
EX-2	62	0.613
EX-3	62	0.613
EX-3A	51	0.961
EX-4	62	0.613
EX-4A	60	0.667
EX-5	62	0.613
EX-6	62	0.613
EX-7	45	1.222
EX-8	41	1.439
EX-9	43	1.326
EX-10	59	0.695
EX-10A	41	1.439
EX-11	43	1.326
EX-12	41	1.439
EX-13	55	0.818
EX-20	62	0.613
EX-20A	63	0.587
EX-21	62	0.613
EX-24	54	0.852
EX-25	43	1.326
EX-73	62	0.613
EX-74	62	0.613
EX-75	62	0.613
EX-76	62	0.613
EX-77	62	0.613
EX-78	62	0.613
EX-79	62	0.613
EX-80	62	0.613
EX-81	62	0.613
EX-82	62	0.613
EX-88	62	0.613

Sterling Ranch and Creek Channel Study - Mustang Road to Pond 3
Hydrologic Study - Predevelopment Conditions - Reach Data
8/21/2018

Reach ID	Reach Length L1 (ft)	Reach Vert. Drop H1 (ft)	Reach Slope S1 (%)	Mannings N Value n	Reach Side Slope SS (H/V)	Bottom Width BW (ft)	Diameter D (ft)
RT-1	3975	100	2.5%	0.05	10	6	N/A
RT-2	4570	120	2.6%	0.05	10	6	N/A
RT-3	2360	65	2.8%	0.05	10	6	N/A
RT-4	2695	65	2.4%	0.05	10	6	N/A
RT-5	4100	92	2.2%	0.05	6	10	N/A
RT-6	3030	100	3.3%	0.05	10	6	N/A
RT-7	6145	122	2.0%	0.05	10	6	N/A
RT-8	2160	42	1.9%	0.05	6	15	N/A
RT-9	3565	66	1.9%	0.05	6	30	N/A
RT-10	3165	68	2.1%	0.05	6	6	N/A
RT-11	6400	96	1.5%	0.05	4	40	N/A
RT-12	4375	74	1.7%	0.05	6	40	N/A
RT-13	1480	22	1.5%	0.05	6	40	N/A
RT-14	6365	136	2.1%	0.05	4	6	N/A
RT-15	3130	74	2.4%	0.05	4	8	N/A
RT-16	5575	138	2.5%	0.05	10	6	N/A
RT-17A	2675	72	2.7%	0.05	6	6	N/A
RT-17B	1300	32	2.5%	0.05	6	6	N/A
RT-18	3400	74	2.2%	0.05	10	6	N/A
RT-19	1670	22	1.3%	0.05	6	6	N/A

Sterling Ranch MDDP
 ARC I vs ARC II Comparison
 Condition : Predevelopment

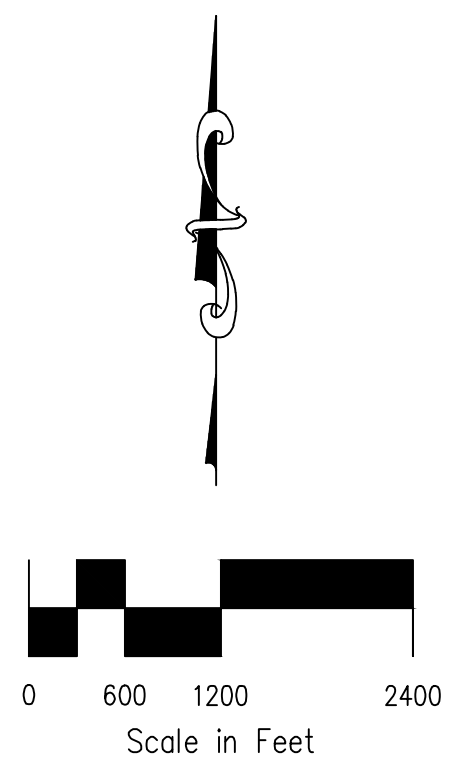
CNs	ARC I			CNs	ARC II		
	A	Q		A	Q		
Basin	acres	cfs	cfs/acre	acres	cfs	cfs/acre	
EX-0	23.8	32.2	1.4	23.8	0.1	0.0	
EX-1	25.7	30.9	1.2	25.7	0.1	0.0	
EX-2	5.5	7.1	1.3	5.5	0.0	0.0	
EX-3	136.8	143.1	1.0	136.8	45.5	0.3	
EX-3A	188.1	119.4	0.6	188.1	13.6	0.1	
EX-4	192	197.3	1.0	192	62.0	0.3	
EX-4A	151.5	147.2	1.0	151.5	42.2	0.3	
EX-5	153.9	158.2	1.0	153.9	49.8	0.3	
EX-6	90.2	100.5	1.1	90.2	31.6	0.4	
EX-7	165	56.1	0.3	165	2.3	0.0	
EX-8	42	14.7	0.4	42	0.1	0.0	
EX-9	131.9	46.8	0.4	131.9	0.9	0.0	
EX-10	270.7	226	0.8	270.7	60.4	0.2	
EX-10A	179.3	43.1	0.2	179.3	0.6	0.0	
EX-11	209.3	77.5	0.4	209.3	1.4	0.0	
EX-12	39.5	16.3	0.4	39.5	0.1	0.0	
EX-13	89.3	78.4	0.9	89.3	15.0	0.2	
EX-20	143.4	166.2	1.2	143.4	30.8	0.2	
EX-20A	179.7	187.3	1.0	179.7	3.8	0.0	
EX-21	33.3	43.6	1.3	33.3	13.7	0.4	
EX-24	63.1	57.8	0.9	63.1	10.0	0.2	
EX-25	54.4	25.1	0.5	54.4	0.4	0.0	
EX-73	90	98	1.1	90	31.0	0.3	
EX-74	119.7	135.2	1.1	119.7	42.2	0.4	
EX-75	79.3	79.6	1.0	79.3	24.9	0.3	
EX-76	86.4	86	1.0	86.4	27.0	0.3	
EX-77	230.6	227.7	1.0	230.6	71.6	0.3	
EX-78	155.6	167.6	1.1	155.6	53.1	0.3	
EX-79	189	211.5	1.1	189	66.3	0.4	
EX-80	147.7	164.7	1.1	147.7	51.7	0.4	
EX-81	262.9	275.7	1.0	262.9	87.8	0.3	
EX-82	117.8	132.3	1.1	117.8	41.4	0.4	
EX-88	139.2	144.4	1.0	139.2	45.7	0.3	

0.9

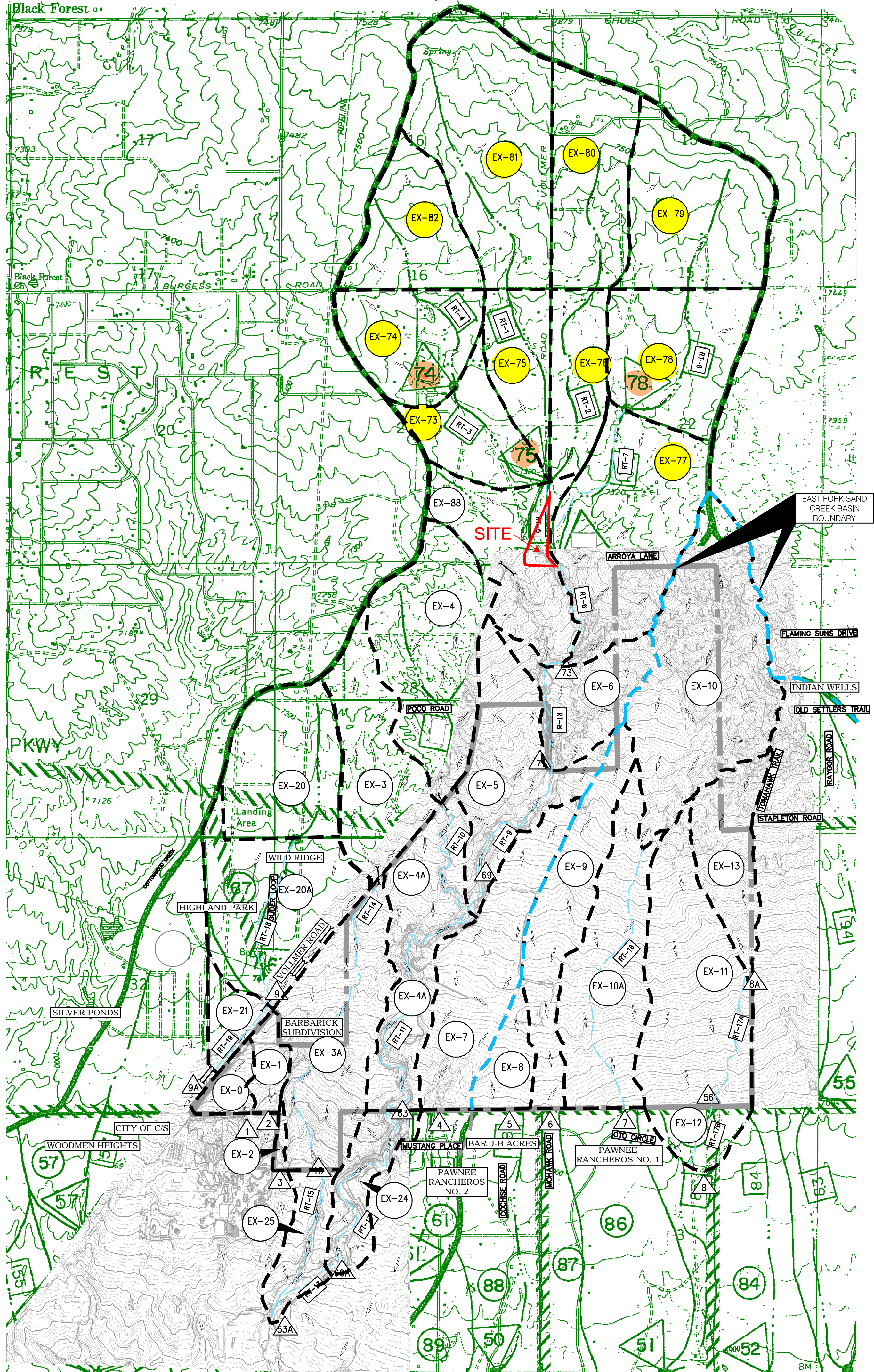
0.2

DRAINAGE MAPS

OFF-SITE DRAINAGE MAP



- LEGEND**
- BASIN ID - (C3-77)
 - DESIGN POINT - (B7)
 - REACH IDENTIFIER - (RT-17A)
 - BASIN BOUNDARY - - - - -
 - EAST FORK SAND CREEK BASIN BOUNDARY - - - - -
 - FLOW DIRECTION - →



BASIN	CN	AREA (acres)	AREA (sq ft)	Q ₅ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₅₀ (cfs)	Q ₁₀₀ (cfs)	Q ₂₀₀ (cfs)
EX-0	62	23.8	0.037	5.0	8.2	13.0	19.6	25.7	32.2
EX-1	62	25.7	0.040	4.8	7.9	12.4	18.7	24.5	30.9
EX-2	62	5.5	0.009	1.1	1.8	2.8	4.3	5.6	7.1
EX-3	62	136.8	0.214	22.0	36.4	57.6	86.9	114.0	143.1
EX-3A	51	188.1	0.294	8.1	18.1	35.9	63.1	89.7	119.4
EX-4	62	192.0	0.300	30.1	49.9	79.1	119.5	157.0	197.3
EX-4A	60	151.5	0.237	20.5	35.1	57.1	87.7	116.3	147.2
EX-5	62	153.9	0.240	24.2	40.0	63.4	95.9	125.9	158.2
EX-6	62	90.2	0.141	15.3	25.2	40.1	60.7	79.9	100.5
EX-7	45	165.0	0.258	1.6	5.2	12.7	25.8	39.6	56.1
EX-8	41	42.0	0.066	0.1	0.6	2.3	5.7	9.8	14.7
EX-9	43	131.9	0.206	0.8	3.1	9.0	20.1	32.1	46.8
EX-10	59	270.7	0.423	29.6	51.8	85.5	133.0	177.4	226.0
EX-10A	41	179.3	0.280	0.6	2.2	7.3	17.4	29.1	43.1
EX-11	43	209.3	0.327	1.2	5.0	14.9	33.2	53.5	77.5
EX-12	41	39.5	0.062	0.1	0.6	2.5	6.4	10.9	16.3
EX-13	55	89.3	0.139	7.7	15.2	27.1	44.2	60.5	78.4
EX-20	62	143.4	0.224	25.4	42.1	66.7	100.7	132.3	166.2
EX-20A	63	179.7	0.281	29.7	48.5	76.1	114.2	149.4	187.3
EX-21	62	33.3	0.052	6.6	11.0	17.5	26.4	34.7	43.6
EX-24	54	63.1	0.099	5.3	10.5	19.0	31.9	44.2	57.8
EX-25	43	84.4	0.085	0.3	1.5	4.8	10.7	17.2	25.1
EX-73	62	90.0	0.141	15.0	24.7	38.9	59.1	77.8	98.0
EX-74	62	119.7	0.187	20.4	34.0	54.0	81.8	107.5	135.2
EX-75	62	79.3	0.124	12.1	20.0	31.8	48.1	63.3	79.6
EX-76	62	86.4	0.135	13.1	21.5	34.3	52.0	68.4	86.0
EX-77	62	230.6	0.360	34.7	56.9	90.6	137.5	180.9	227.7
EX-78	62	155.6	0.243	25.7	42.3	66.7	101.0	133.1	167.6
EX-79	62	189.0	0.295	32.1	53.0	84.4	127.8	168.1	211.5
EX-80	62	147.7	0.231	25.0	41.2	65.6	99.5	130.9	164.7
EX-81	62	262.9	0.411	42.6	70.2	111.0	167.4	219.6	275.7
EX-82	62	117.8	0.184	20.0	33.2	52.8	80.0	105.1	132.3
EX-88	62	139.2	0.217	22.2	36.7	58.0	87.6	115.0	144.4

DESIGN POINT	AREA (sq ft)	Q ₅ (cfs)	Q ₁₀ (cfs)	Q ₂₅ (cfs)	Q ₅₀ (cfs)	Q ₁₀₀ (cfs)	Q ₂₀₀ (cfs)	LOCATION
DP-74	0.371	37.7	63.3	101.8	155.1	204.6	257.7	
DP-75	1.413	134.2	225.8	365.5	551.1	734.9	929.5	
DP-76	0.538	54.6	91.8	145.0	221.5	292.7	370.0	
DP-73	2.528	216.8	365.4	597.5	923.2	1231.8	1547.5	
DP-71	2.669	217.7	372.1	608.9	948.0	1249.4	1600.2	
DP-69	3.209	239.5	406.4	683.6	1070.8	1426.2	1838.0	STERLING RANCH NORTHERN BNDY
DP-63	3.446	238.5	410.2	690.6	1082.7	1455.5	1869.8	STERLING RANCH SOUTHERN BNDY
DP-10	0.508	27.0	47.9	81.4	130.3	175.1	233.3	COLORADO SPRINGS/EL PASO BNDY
DP-9A	0.557	52.7	90.6	144.8	221.7	291.4	369.4	VOLLMER/TAHITI DRIVE
DP-9	0.505	50.5	85.9	138.0	209.0	275.0	344.0	VOLLMER/LOCHWINNOCH LN
DP-8A	0.139	7.7	15.2	27.1	44.2	60.5	78.4	D/S STERLING RANCH EASTERN BNDY
DP-8	0.528	8.6	20.3	43.0	79.8	118.8	162.5	D/S STERLING RANCH SOUTHERN BNDY
DP-7	0.703	29.6	53.2	91.4	149.6	205.2	267.4	STERLING RANCH SOUTHERN BNDY
DP-6	0.206	0.8	3.1	9.0	20.1	32.1	46.8	STERLING RANCH SOUTHERN BNDY
DP-5	0.066	0.1	0.6	2.3	5.7	9.8	14.7	STERLING RANCH SOUTHERN BNDY
DP-4	0.258	1.6	5.2	12.7	25.8	39.6	56.1	STERLING RANCH SOUTHERN BNDY
DP-3	0.009	1.1	1.8	2.8	4.3	5.6	7.1	STERLING RANCH SOUTHERN BNDY
DP-2	0.040	4.8	7.9	12.4	18.7	24.5	30.9	STERLING RANCH SOUTHERN BNDY
DP-1	0.037	5.0	8.2	13.0	19.6	25.7	32.2	STERLING RANCH SOUTHERN BNDY
DP-60A	3.545	235.1	407.3	686.6	1081.2	1457.9	1869.8	FUTURE MARKSHEFFEL X-ING
DP-56	0.466	8.5	19.8	41.5	76.3	112.7	154.8	STERLING RANCH SOUTHERN BNDY
DP-53A	4.138	245.9	427.9	724.1	1146.1	1550.9	2001.0	SAND CREEK AND POND 3

DESIGN POINT	AREA (sq ft)	V ₅ (cu ft)	V ₁₀ (cu ft)	V ₂₅ (cu ft)	V ₅₀ (cu ft)	V ₁₀₀ (cu ft)	V ₂₀₀ (cu ft)	LOCATION
DP-74	0.371	5.7	8.7	13.1	19.1	24.8	30.8	
DP-75	1.413	21.3	32.7	49.3	72.3	93.5	116.4	
DP-76	0.538	8.2	12.5	18.9	27.7	35.8	44.6	
DP-73	2.528	37.6	57.8	87.4	128.3	166.0	206.6	
DP-71	2.669	39.4	60.7	91.8	134.9	174.6	217.3	STERLING RANCH NORTHERN BNDY
DP-69	3.209	46.8	72.2	109.5	161.1	208.7	259.9	
DP-63	3.446	48.1	74.6	113.9	168.3	218.8	273.0	STERLING RANCH SOUTHERN BNDY
DP-10	0.508	5.0	8.2	12.9	19.6	25.9	32.9	COLORADO SPRINGS/EL PASO BNDY
DP-9A	0.557	8.7	13.2	19.9	29.2	37.7	46.8	VOLLMER/TAHITI DRIVE
DP-9	0.505	7.9	12.1	18.2	26.6	34.3	42.6	VOLLMER/LOCHWINNOCH LN
DP-8A	0.139	1.3	2.1	3.4	5.2	6.9	8.8	D/S STERLING RANCH EASTERN BNDY
DP-8	0.528	2.1	3.9	7.0	11.7	16.4	21.7	D/S STERLING RANCH SOUTHERN BNDY
DP-7	0.703	5.5	9.1	14.7	22.8	30.6	39.2	STERLING RANCH SOUTHERN BNDY
DP-6	0.206	0.5	1.0	2.0	3.6	5.2	7.1	STERLING RANCH SOUTHERN BNDY
DP-5	0.066	0.1	0.3	0.5	1.0	1.5	2.0	STERLING RANCH SOUTHERN BNDY
DP-4	0.258	0.8	1.6	3.1	5.2	7.4	9.9	STERLING RANCH SOUTHERN BNDY
DP-3	0.009	0.1	0.2	0.3	0.3	0.6	0.8	STERLING RANCH SOUTHERN BNDY
DP-2	0.040	0.6	0.9	1.4	2.1	2.7	3.3	STERLING RANCH SOUTHERN BNDY
DP-1	0.037	0.6	0.9	1.3	1.9	2.5	3.1	STERLING RANCH SOUTHERN BNDY
DP-60A	3.545	47.9	74.6	114.1	169.2	220.4	275.5	FUTURE MARKSHEFFEL X-ING
DP-56	0.466	2.0	3.7	6.6	10.9	15.1	19.9	STERLING RANCH SOUTHERN BNDY
DP-53A	4.138	52.6	82.5	126.9	189.1	247.1	310.0	SAND CREEK AND POND 3

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2018 STERLING RANCH MDDP
PREDEV. HYDROLOGIC CONDITIONS MAP

PROJECT NO. 09-002 FILE: \\dvg\Eng Exhibits\2018-MDDP-PredevCond\WkMap-ARCI.dwg

DESIGNED BY: DLM SCALE: DATE: 08-22-18
DRAWN BY: DLM HORIZ: NTS
CHECKED BY: VAS VERT: NTS

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