PRELIMINARY/FINAL DRAINAGE REPORT
FOR
JUDGE ORR RANCHETTES

October, 2017

Prepared for:

John Jennings
2030 Tabor Ct.
Colorado Springs, CO 80919

Prepared By:

CATAMOUNT ENGINEERING
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Woodland Park, CO 80863
719-426-2124

PCD FILE NO's: SP-17-011
SF-17-021

PRELIMINARY/FINAL DRAINAGE REPORT
JUDGE ORR RANCHETTES

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 the criteria established for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

Certification Statement:
This report and plan for the preliminary and final drainage design for the Judge Orr Ranchettes was prepared by me (or under my direct supervision) in accordance with the provisions of City of Colorado Springs/El Paso County Drainage Criteria Manual Volumes 1 and 2 Drainage Design and Technical Criteria for the owners thereof. I understand that El Paso County does not and will not assume liability for drainage facilities designed by others.

_____ _____
David L. Mijares, Colorado PE #40510 Date
For and on behalf of Catamount Engineering

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

John Jennings hereby certifies that the drainage facilities for Judge Orr Ranchettes shall be constructed according to the design presented in this report. I understand that El Paso County does not and will not assume liability for the drainage facilities designed and or certified by my engineer and that the El Paso County reviews drainage plans pursuant to Colorado Revised Statues, Title 30, Article 28; but cannot, on behalf of Judge Orr Ranchettes, guarantee that final drainage design review will absolve John Jennings and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

John R. Jennings
Business Name

By: _____

Title: _____

Address: 2030 Tabor Ct.

Colorado Springs, CO 80919

El Paso County:
Filed in accordance with the requirements of the El Paso County land Development Code and the Drainage Criteria manual Volumes 1 and 2, and the El Paso County Engineering Criteria Manual, latest revision.

_____ _____
Jennifer Irvine, PE Date
County Engineer/ECM Administrator

Conditions:

PRELIMINARY/FINAL DRAINAGE REPORT for JUDGE ORR RANCHETTES

PURPOSE

The purpose of this drainage report is to identify existing drainage patterns, quantify developed storm water runoff, and establish outfall scenarios from the proposed development. Additionally this analysis will establish compliance with previous drainage studies.

GENERAL LOCATION AND DESCRIPTION

The subject 40.67 acres is proposed to be platted into 7 residential lots and public ROW and is located within the southeast ¼ of Section 33, Township 12 South, Range 64 West of the 6th principal meridian El Paso County, Colorado.

The parcel is bounded on the north by unplatted land and Stapleton Drive, on the east by unplatted residential parcels, on the south by Judge Orr Road, and on the west by residential parcels.

The site is sparsely vegetated with native grasses. Some volunteer shrubs and trees are evident within the roadside ditch along the north side of Judge Orr Road. The existing terrain generally slopes to the east and southeast at a 1.9% grade. A swale along the south edge of the project running from west to east has been formed adjacent to the Judge Orr Road embankment. The site lies within the Haegler Ranch Basin.

Soils in the development parcel consist of Columbine gravelly sandy loam and Blakeland loamy sand, both Hydrologic Group 'A' soils, as determined by the Natural Resources Conservation Service Web Soil Survey. Hydrologic Group A soils were used in analysis.

A portion of the development lies within an F.E.M.A. designated floodplain, Zone AE with base flood elevations determined, per FIRM 08041C0575 F, as revised to reflect LOMR Case No16-08-1065P. The revised F.E.M.A. Flood Insurance Rate Map and LOMR determination have been provided in the appendix. The area identified as Zone AE has been included in a no build easement to be dedicated to El Paso County with plat recordation.

EXISTING DRAINAGE CONDITIONS

The site was previously studied in the "GIECK RANCH DRAINAGE BASIN PLANNING STUDY", prepared by Drexel, Barrell & Co., revised February 10, 2010. In the DBPS the parcel is indicated as the parcel is identified as tributary to reach HD-R4 of the Haegler basin diversion. The estimated major storm event exhibits a flow of Q_{100}=468 cfs at the eastern end of the reach. The reach was not proposed to receive structural improvements in implementation of the DBPS plan.

Flows through the reach were further studied with development of LOMR case No. 16-08-1065P, developed by Kiowa Engineering for implementation of Stapleton Road Improvements. The Kiowa LOMR finalized in Stapleton road crossing. The LOMR analysis, Effective Date June 15, 2017, provided base flood elevations for the reach through the Judge Orr Ranchettes property. Flows of Q_{100}=592 cfs were utilized in analysis of the reach identified as Haegler Ranch Tributary 2 in the LOMR. Flows of 592 CFS were accepted in the Preliminary/Final Drainage Report for Judge Orr Ranchettes.

A swale exists along the western edge of the property conveying offsite flows from the northern portion of the property to reach HD-R4 of Haegler Creek. An additional small swale is evident along the southern portion of the property conveying offsite flows to the roadside ditch along Judge Orr Rd. At the north easterly limit of the parcel a dual 36" RCP crossing was installed with Stapleton Road Improvements conveying flows across Stapleton to the west prior to entering the property. A small offsite basin tributary to the northerly limits of the parcel, Basin OS-A (2.22 Acres, Q_2=0.1 cfs, Q_5=0.4 cfs, Q_{10}=0.9 cfs, Q_{25}=1.6 cfs, Q_{50}=2.2 cfs, and Q_{100}=2.8 cfs), was modeled as this basin will be diverted to the dual 36" RCP crossing with installation of temporary gravel roadway until El Paso County secures right of way to develop permanent connection to Stapleton Road.

Off-site Basin OS-B (8.00 Acres, Q_2=0.5 cfs, Q_5=1.4 cfs, Q_{10}=2.9 cfs, Q_{25}=4.9 cfs, Q_{50}=6.6 cfs, and Q_{100}=8.5 cfs) represents the southerly limits of the Haegler Basin tributary to the existing roadside ditch north of Judge Orr Road. Existing basins were modeled as agricultural land as the tributary portions of upstream properties to basin OS-A and OS-B remain largely in an undeveloped state.

The northern portion of the parcel modeled as basin EX-A (31.32 Acres, Q_2=0.9 cfs, Q_5=3.2 cfs, Q_{10}=7.1 cfs, Q_{25}=12.5 cfs, Q_{50}=16.7 cfs, and Q_{100}=21.7 cfs) sheet flows to the southeast and is intercepted either by reach HD-R4 of Haegler Creek or Stapleton Road improvements and is conveyed to the dual 4'x8' box culvert crossing of Stapleton Drive.

The southern portion of the parcel modeled as basin EX-B (9.31 Acres, Q_2=1.0 cfs, Q_5=2.3 cfs, Q_{10}=4.3 cfs, Q_{25}=7.0 cfs, Q_{50}=9.3 cfs, and Q_{100}=11.8 cfs) sheet flows to the southeast and is tributary to the existing Judge Orr Road side ditch. Combined flows from basin EX-B and OS-B at design point 3 of Q_2=1.2 cfs, Q_5=3.0 cfs, Q_{10}=5.9 cfs, Q_{25}=9.8 cfs, Q_{50}=12.9 cfs, and Q_{100}=16.6 cfs are conveyed in the roadside ditches of Judge Orr Road and Stapleton Road to the Box Culvert Crossing of Stapleton Drive.

DEVELOPED DRAINAGE BASINS

Due to the 5.0 minimum lot size developed basins were modeled as predominantly agricultural land with 1.0 acre of each parcel to be developed at a residential density. Roadways and shoulders were modeled as pavement and gravel roadways where proposed.

Basin A-1 (0.81 Acres, Q_2=1.4 cfs, Q_5=1.8 cfs, Q_{10}=2.2 cfs, Q_{25}=2.6 cfs, Q_{50}=2.9 cfs, and Q_{100}=3.3 cfs) represents the westerly portion of the proposed roadway north of Haegler Creek. Runoff generated within this basin will be collected in the roadside swale and conveyed south to Haegler Creek.

Basin A-2 (30.33 Acres, Q_2=1.9 cfs, Q_5=4.8 cfs, Q_{10}=9.2 cfs, Q_{25}=15.2 cfs, Q_{50}=20.2 cfs, and Q_{100}=25.6 cfs) consists of the easterly half of the roadway, the southerly portion of the proposed temporary access, and proposed 5 acre lots north of Haegler Creek. Runoff generated within basin A-1 will sheetflow to the southeast and is intercepted either by reach HD-R4 of Haegler Creek or Stapleton Road improvements and is conveyed to the dual 4'x8' box culvert crossing of Stapleton Drive. Runoff from Basin A-2 represents a minor increase in flows to undeveloped flows from basin EX-A.

Basin A-3 (0.18 Acres, Q_2=0.4 cfs, Q_5=0.5 cfs, Q_{10}=0.6 cfs, Q_{25}=0.7 cfs, Q_{50}=0.8 cfs, and Q_{100}=0.9 cfs) consist of the northerly half of the proposed temporary gravel roadway. Flows from Basin A-3 will be conveyed in a constructed roadside ditch with flows from Basin OS-A to the existing dual 36" RCP outfall at Design Point P1. Design Point P-1 representing off-site and site addition to the existing crossing of Stapleton is Q_2=0.3 cfs, Q_5=0.6 cfs, Q_{10}=1.2 cfs, Q_{25}=2.0 cfs, Q_{50}=2.6 cfs, and Q_{100}=3.3 cfs).

Basin B-1 (0.54 Acres, Q_2=1.2 cfs, Q_5=1.6 cfs, Q_{10}=1.9 cfs, Q_{25}=2.3 cfs, Q_{50}=2.6 cfs, and Q_{100}=2.9 cfs) consists of the westerly half of the proposed roadway south of Haegler Creek. Runoff generated within this basin will be collected in the roadside swale and conveyed south to the existing Judge Orr Road ditch. Runoff from Basin B-1 will be combined with runoff from Basin OS-B at design point P4. Flows from design point P-4 of Q_2=1.0 cfs, Q_5=2.1 cfs, Q_{10}=3.7 cfs, Q_{25}=5.9 cfs, Q_{50}=7.7 cfs, and Q_{100}=9.7 cfs will be conveyed in a 30" RCP culvert under the proposed roadway and continue in the Judge Orr Road ditch to design point P3.

Basin B-2 (8.76 Acres, Q_2=1.1 cfs, Q_5=2.6 cfs, Q_{10}=4.6 cfs, Q_{25}=7.4 cfs, Q_{50}=9.7 cfs, and Q_{100}=12.2 cfs) consist of the easterly half of the proposed roadway and proposed 5 acre residential lots south of Haegler Creek and tributary to the Judge Orr Roadside ditch. Runoff from basin B-2 will sheetflow to the southeast and the Judge Orr Roadside ditch to design point P3. Anticipated flows at design point P-3 of Q_2=1.7 cfs, Q_5=3.6 cfs, Q_{10}=6.4 cfs, Q_{25}=10.3 cfs, Q_{50}=13.4 cfs, and Q_{100}=17.0 cfs represents a minor increase in flows at Design Point P3.

CONVEYANCE

DP-P1-
100-Yr flow of 3.3 cfs will be conveyed to the existing dual 36" RCP crossing of Stapleton Boulevard in a proposed 17' wide roadside swale with 4:1 side slopes and a longitudinal slope of 2% at a depth of 0.55' with a velocity of 3.5 ft/s.

DP-P3-
100-Yr flow of 17.0 cfs will be conveyed in the existing Judge Orr Road ditch to design point DP-P3. The existing roadside ditch was modeled from the topographic survey as approximately 30' wide from top of bank on the north to pavement edge as approximately 30' wide with an

average depth of 6.0'. The existing ditch has an approximately 2.5:1 cross slope and a longitudinal slope of .033%. 100-YR flows will be conveyed at a depth of 1.16' and a velocity of 5.12 ft/s.

DP-P4-
100-yr flow of 9.7 cfs will be conveyed in a proposed 17' wide roadside swale with 4:1 side slopes and a longitudinal slope of 1.6% at a depth of 0.84' with a velocity of 4.1 ft/s to the proposed 30" RCP culvert. The proposed 30" RCP culvert will convey developed flows generating an approximate headwater depth of 1.5'.

See Appendix for Calculations.

List each step and provide a narrative for how each step was implemented or considered.

WATER QUALITY/4-STEP PROCESS

The development addresses Low Impact Development strategies primarily through the utilization of large impervious areas and utilization of landscape swales receiving runoff generated within impervious roadways. Impervious areas generated within home sites will flow across pervious disconnected areas prior to offsite discharge.

A Grading, Erosion Control, and Stormwater Quality Plan and narrative have been submitted concurrently for the development and will be subject to county approval prior to any soil disturbance. The erosion control plan included specific source control BMP's as well defined overall site management practices for the construction period.

COST ESTIMATE

Private Improvements Non-reimbursable

30" RCP	75 LF	@$	65/LF	$	4,875
30" FES	2 EA	@$	350/EA	$	700
Rip Rap Outfall	1 EA	@$	300/EA	$	300
		SUBTOTAL		**$**	**5,875**
		15% CONTINGENCY		*$*	*881*
		TOTAL		**$**	**6,756**

DRAINAGE FEE CALCULATION

The development proposes to plat 40.67 acres within El Paso County, all contained within the Haegler Drainage Basin. ECM Appendix L part 1 Section 3.10.2a allows for a 25% reduction in drainage fees for low density lots.

Impervious Acreage Calculation:

Area	Area	% Impervious	Impervious Acres
Residential Lots	36.10	20%	7.22
Right Of Way	4.57	51%	2.33
Total Area	40.67		9.55

Drainage Fee:
(9.55 Impervious Acres X 75% X $9,676/ac) = $ 69,304

Bridge Fee:
(9.55 Impervious Acres X $1,428/ac) = $ 13,637

Revise rates to 2017. Drainage and bridge fees are based on established rates at the time of initial submittal.

25% reduction also applies to the bridge fee

TOTAL **$ 82,942**

DRAINAGE METHODOLOGY

This drainage report was prepared in accordance to the criteria established in the City of Colorado Springs/El Paso County Drainage Criteria Manual Volumes 1 and 2, as revised May 2014.

The rational method for drainage basin study areas of less than 100 acres was utilized in the analysis. For the Rational Method, flows were calculated for the 2, 5, 10, 25, 50, and 100-year recurrence intervals. The average runoff coefficients, 'C' values, are taken from Table 6-6 and the Intensity-Duration-Frequency curves are taken from Figure 6-5 of the City Drainage Criteria Manual. Time of concentration for overland flow and storm drain or gutter flow are calculated per Section 3.2 of the City Drainage Criteria Manual. Calculations for the Rational Method are shown in the Appendix of this report. Flows developed in LOMR Case No. 16-08-1065P were accepted for the reach of Haegler Creek flowing through the parcel.

SUMMARY

The Judge Orr Ranchettes Development consists of large lot development with minor increases in impervious areas consistent with development proposed in the Drainage Basin Planning Study. The development proposes no development and a setback approach in regards to the reach of the Haegler drainage within the parcel. A no-build easement has been established

outside of the limits of the 100-YR floodplain. Development of the parcel is in conformance of current El Paso County criteria and will not adversely affect downstream properties or facilities.

REFERENCES:

City of Colorado Springs Engineering Division Drainage Criteria Manual Volumes 1 and 2, revised May 2014

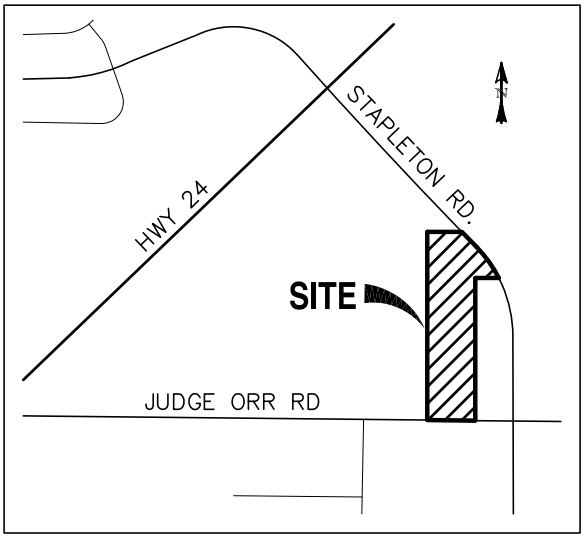
"Geick Ranch Drainage Basin Planning Study El Paso County, Colorado", prepared by Drexel, Barrell & Co., revised February 10, 2010.

"Conditional Letter of Map Revision (CLOMR) Stapleton Drive", prepared by Kiowa Engineering Corporation, dated December 20, 2013

Flood Insurance rate map 08041C0575 F, as revised to reflect LOMR Case No. 16-08-1065P

Natural Resources Conservation Service Web Soil Survey

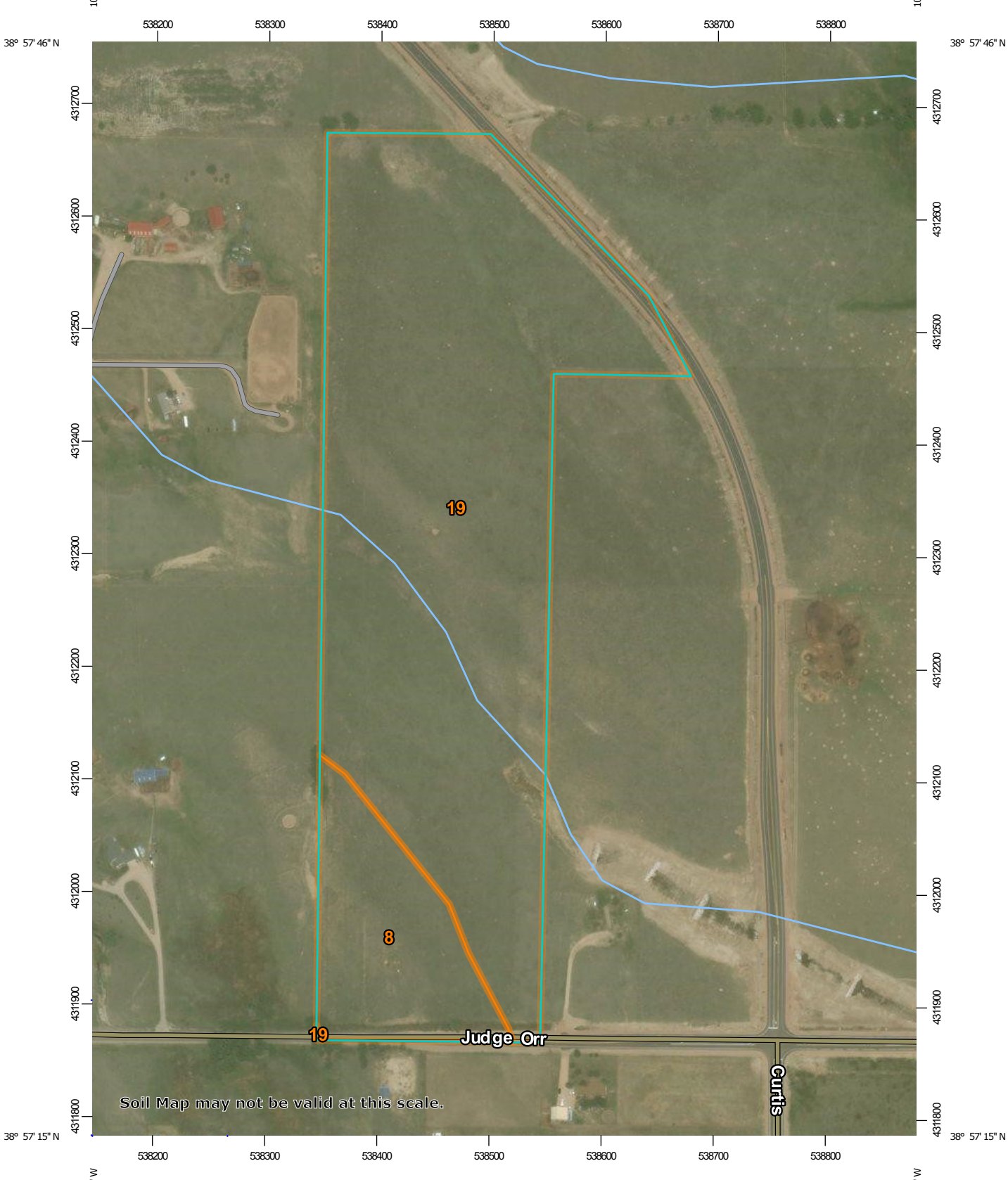
APPENDIX



VICINITY MAP

SCALE: N.T.S.

Custom Soil Resource Report
Soil Map



Map Scale: 1:4,740 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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 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 14, Sep 23, 2016

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

Date(s) aerial images were photographed: May 22, 2016—Mar 9, 2017

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

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
8	Blakeland loamy sand, 1 to 9 percent slopes	6.4	15.0%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	36.4	85.0%
Totals for Area of Interest		**42.8**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the

El Paso County Area, Colorado

8—Blakeland loamy sand, 1 to 9 percent slopes

Map Unit Setting

National map unit symbol: 369v
Elevation: 4,600 to 5,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Flats, hills
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock and/or eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 11 inches: loamy sand
AC - 11 to 27 inches: loamy sand
C - 27 to 60 inches: sand

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Sandy Foothill (R049BY210CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

19—Columbine gravelly sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 367p
Elevation: 6,500 to 7,300 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Columbine and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Columbine

Setting

Landform: Flood plains, fan terraces, fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 14 inches: gravelly sandy loam
C - 14 to 60 inches: very gravelly loamy sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Gravelly Foothill (R049BY214CO)
Hydric soil rating: No

Minor Components

Fluvaquentic haplaquolls

Percent of map unit:
Landform: Swales
Hydric soil rating: Yes

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

Percent of map unit:
Landform: Depressions
Hydric soil rating: Yes

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)	CHANNELIZATION CULVERT	HYDRAULIC ANALYSIS UPDATED TOPOGRAPHIC DATA
	COMMUNITY NO.: 080059		
IDENTIFIER	Stapleton Drive LOMR	APPROXIMATE LATITUDE AND LONGITUDE: 38.961, -104.559 SOURCE: USGS QUADRANGLE DATUM: NAD 83	

ANNOTATED MAPPING ENCLOSURES	ANNOTATED STUDY ENCLOSURES
TYPE: FIRM* NO.: 08041C0575F DATE: March 17, 1997	DATE OF EFFECTIVE FLOOD INSURANCE STUDY: August 23, 1999 PROFILES: 367P, 367P(a)

Enclosures reflect changes to flooding sources affected by this revision.
* FIRM - Flood Insurance Rate Map

FLOODING SOURCE AND REVISED REACH

Haegler Ranch Tributary 2 – from approximately 3,300 feet upstream of the confluence with Geick Ranch West Tributary to U.S. Highway 24

SUMMARY OF REVISIONS

Flooding Source	Effective Flooding	Revised Flooding	Increases	Decreases
Haegler Ranch Tributary 2	Zone A	Zone AE	YES	YES
	No BFEs*	BFEs	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 panel 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 Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605. Additional information about the NFIP is available on our website at http://www.fema.gov/national-flood-insurance-program.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

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.

NFIP regulations Subparagraph 60.3(b)(7) requires communities to ensure that the flood-carrying capacity within the altered or relocated portion of any watercourse is maintained. This provision is incorporated into your community's existing floodplain management ordinances; therefore, responsibility for maintenance of the altered or relocated watercourse, including any related appurtenances such as bridges, culverts, and other drainage structures, rests with your community. We may request that your community submit a description and schedule of maintenance activities necessary to ensure this requirement.

COMMUNITY REMINDERS

We based this determination on the 1-percent-annual-chance flood discharges computed in Letter of Map Revision 04-08-0587P, 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 Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605. Additional information about the NFIP is available on our website at http://www.fema.gov/national-flood-insurance-program.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration

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 are processing a revised FIRM and FIS report for El Paso County in our countywide format; therefore, we will not physically revise and republish the FIRM and FIS report for your community to incorporate the modifications made by this LOMR at this time. Preliminary copies of the countywide FIRM and FIS report, which present information from the effective FIRMs and FIS reports for your community and other incorporated communities in El Paso County, were submitted to your community for review on July 29, 2015. We will incorporate the modifications made by this LOMR into the countywide FIRM and FIS report before they become effective.

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 Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605. Additional information about the NFIP is available on our website at http://www.fema.gov/national-flood-insurance-program.

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Federal Insurance and Mitigation Administration

Federal Emergency Management Agency

Washington, D.C. 20472

LETTER OF MAP REVISION
DETERMINATION DOCUMENT (CONTINUED)

PUBLIC NOTIFICATION OF REVISION

A notice of changes will be published in the *Federal Register*. This information also will be published in your local newspaper on or about the dates listed below, and through FEMA's Flood Hazard Mapping website at https://www.floodmaps.fema.gov/fhm/bfe_status/bfe_main.asp.

LOCAL NEWSPAPER

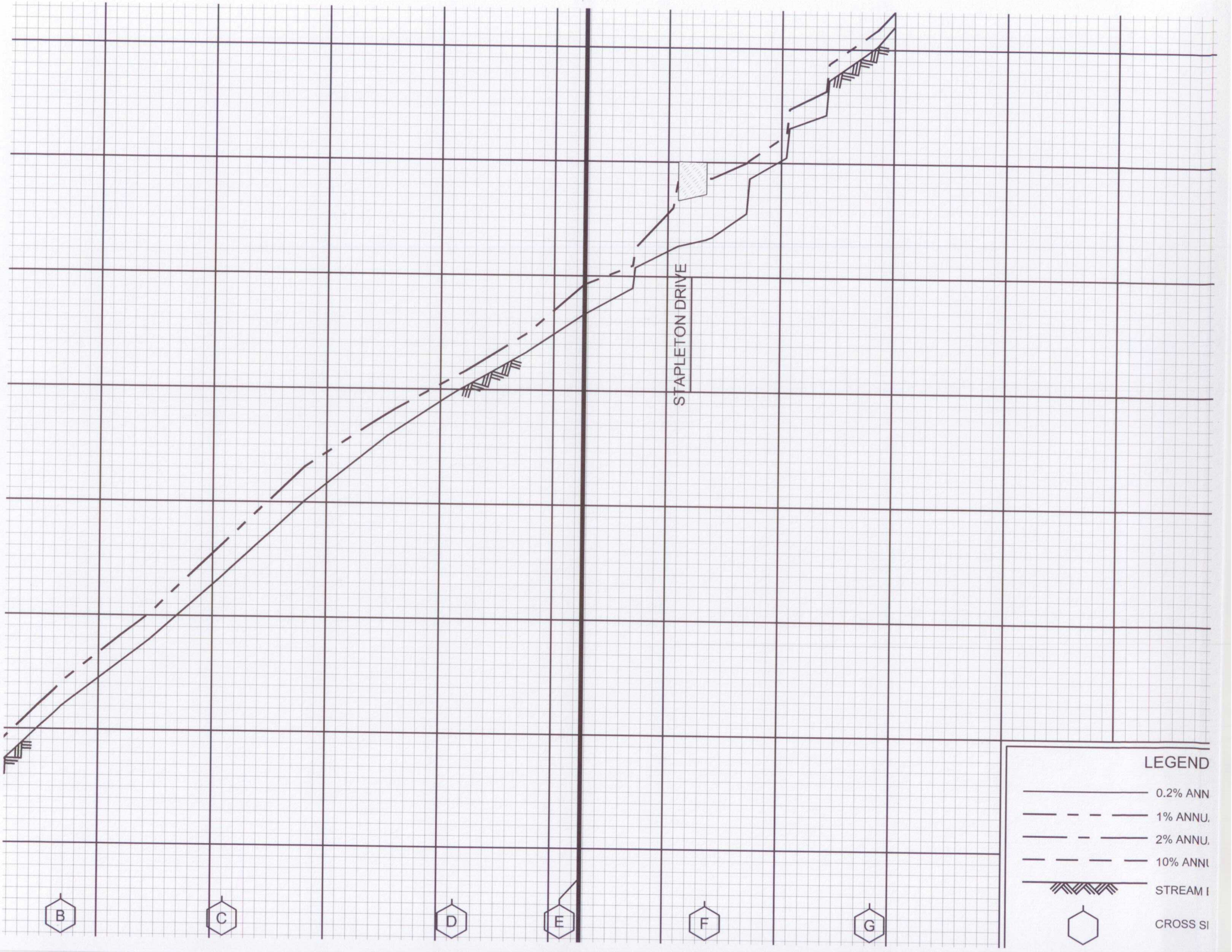
Name: *The Colorado Springs Gazette*

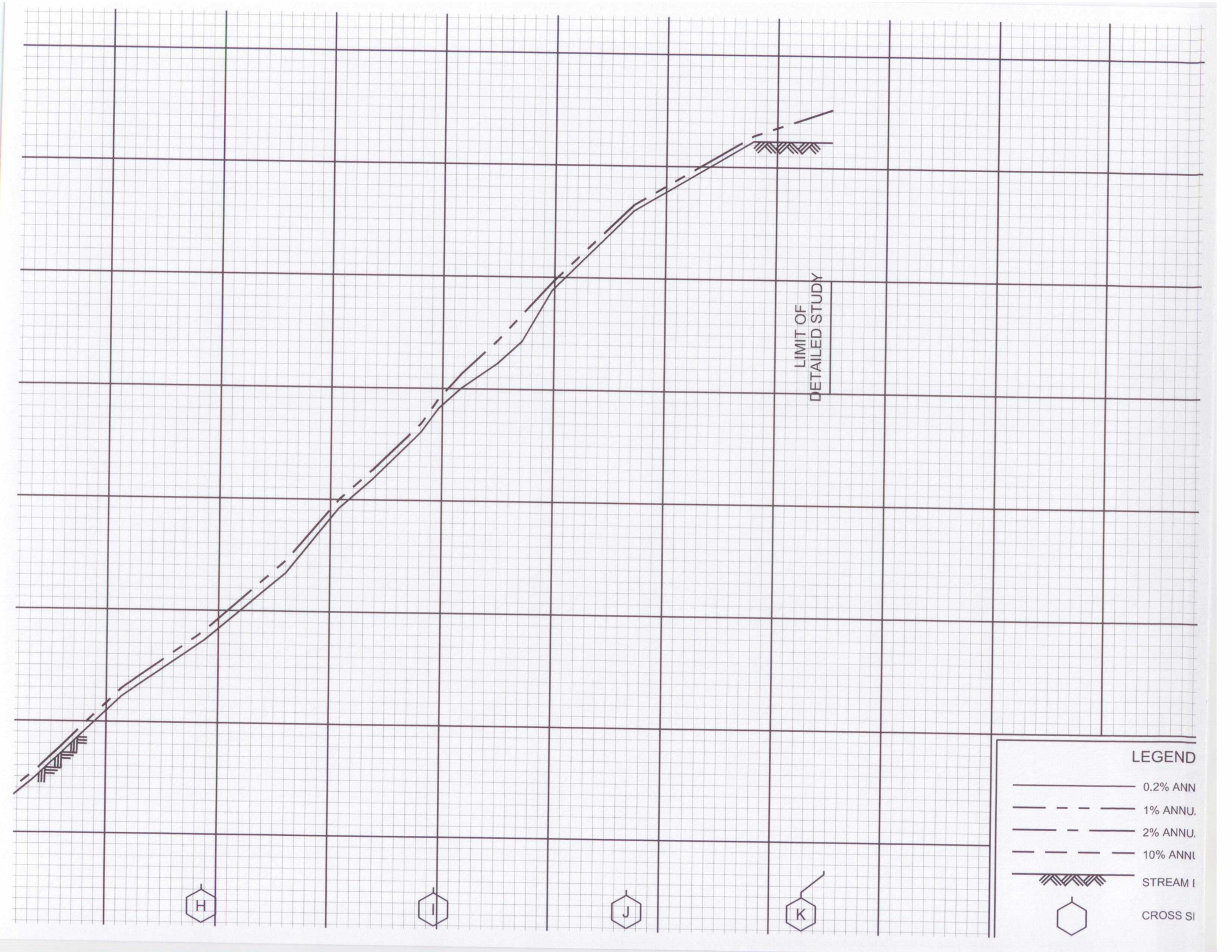
Dates: February 8, 2017 and February 15, 2017

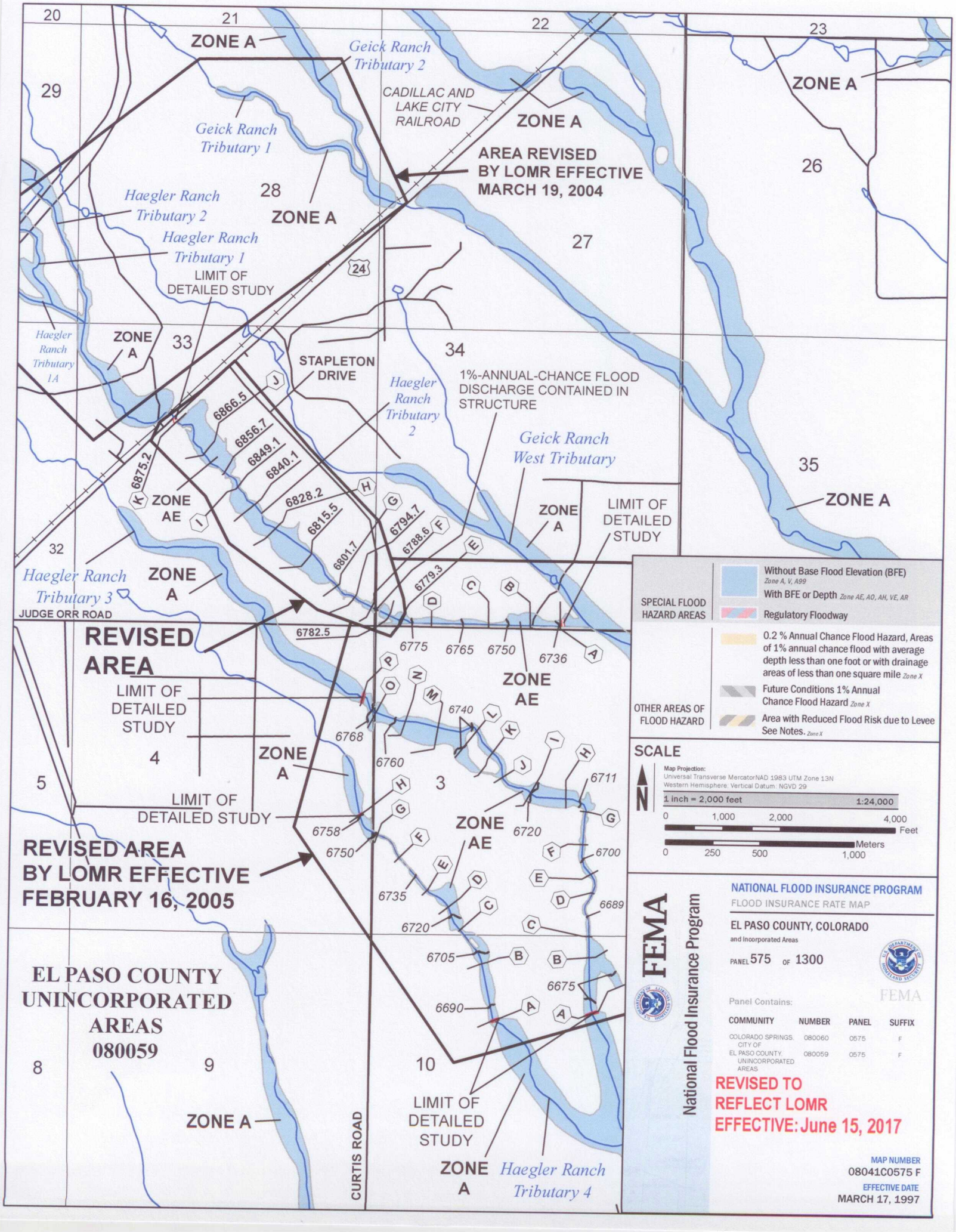
Within 90 days of the second publication in the local newspaper, any interested party may request that we reconsider this determination. Any request for reconsideration must be based on scientific or technical data. Therefore, this letter will be effective only after the 90-day appeal period has elapsed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

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 Information eXchange toll free at 1-877-336-2627 (1-877-FEMA MAP) or by letter addressed to the LOMC Clearinghouse, 847 South Pickett Street, Alexandria, VA 22304-4605. Additional information about the NFIP is available on our website at http://www.fema.gov/national-flood-insurance-program.

Patrick "Rick" F. Sacbibit, P.E., Branch Chief
Engineering Services Branch
Federal Insurance and Mitigation Administration


STAPLETON DRIVE
B
C
D
E
F
G
LEGEND
0.2% ANN
1% ANNU.
2% ANNU.
10% ANNU
STREAM I
CROSS SI


LIMIT OF
DETAILED STUDY
H
I
J
K
LEGEND
0.2% ANN
1% ANNU.
2% ANNU.
10% ANNU
STREAM I
CROSS SI


20
21
22
23
29
28
27
26
33
34
35
32
4
5
3
10
8
9
ZONE A
ZONE AE
Geick Ranch Tributary 2
Geick Ranch Tributary 1
CADILLAC AND LAKE CITY RAILROAD
AREA REVISED BY LOMR EFFECTIVE MARCH 19, 2004
Haegler Ranch Tributary 2
Haegler Ranch Tributary 1
LIMIT OF DETAILED STUDY
24
Haegler Ranch Tributary 1A
STAPLETON DRIVE
1%-ANNUAL-CHANCE FLOOD DISCHARGE CONTAINED IN STRUCTURE
Haegler Ranch Tributary 2
Geick Ranch West Tributary
6866.5
6856.7
6849.1
6840.1
6828.2
6815.5
6801.7
6794.7
6788.6
6779.3
6875.2
Haegler Ranch Tributary 3
JUDGE ORR ROAD
6782.5
REVISED AREA
6775
6765
6750
6736
6768
6760
6740
6711
6758
6750
6720
6700
6735
6689
6720
6705
6675
6690
REVISED AREA BY LOMR EFFECTIVE FEBRUARY 16, 2005
EL PASO COUNTY UNINCORPORATED AREAS 080059
CURTIS ROAD
Haegler Ranch Tributary 4
SPECIAL FLOOD HAZARD AREAS
Without Base Flood Elevation (BFE) Zone A, V, A99
With BFE or Depth Zone AE, AO, AH, VE, AR
Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD
0.2 % Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
Future Conditions 1% Annual Chance Flood Hazard Zone X
Area with Reduced Flood Risk due to Levee See Notes. Zone X
SCALE
N
Map Projection:
Universal Transverse MercatorNAD 1983 UTM Zone 13N
Western Hemisphere: Vertical Datum: NGVD 29
1 inch = 2,000 feet
1:24,000
0
1,000
2,000
4,000
Feet
0
250
500
1,000
Meters
FEMA
National Flood Insurance Program
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP
EL PASO COUNTY, COLORADO
and Incorporated Areas
PANEL 575 OF 1300
Panel Contains:
COMMUNITY
NUMBER
PANEL
SUFFIX
COLORADO SPRINGS, CITY OF
080060
0575
F
EL PASO COUNTY, UNINCORPORATED AREAS
080059
0575
F
REVISED TO REFLECT LOMR EFFECTIVE: June 15, 2017
MAP NUMBER
08041C0575 F
EFFECTIVE DATE
MARCH 17, 1997

EXISTING HYDROLOGY

											CONVEYANCE TC						TT	INTENSITY						TOTAL FLOWS					
BASIN	**AREA TOTAL (Acres)**	**C_2**	**C_5**	**C_{10}**	**C_{25}**	**C_{50}**	**C_{100}**	**Length (ft)**	**Height (ft)**	**TI (min)**	**Length (ft)**	**Height (ft)**	**C_V**	**Slope (%)**	**Velocity (fps)**	**TC (min)**	**TOTAL (min)**	**I_2 (in/hr)**	**I_5 (in/hr)**	**I_{10} (in/hr)**	**I_{25} (in/hr)**	**I_{50} (in/hr)**	**I_{100} (in/hr)**	**Q_2 (c.f.s.)**	**Q_5 (c.f.s.)**	**Q_{10} (c.f.s.)**	**Q_{25} (c.f.s.)**	**Q_{50} (c.f.s.)**	**Q_{100} (c.f.s.)**
OS-A	2.22	**0.03**	**0.09**	**0.17**	**0.26**	**0.31**	**0.36**	200	5	20.2	788	16	5	2.0%	0.7	18.4	38.6	1.7	2.1	2.5	2.8	3.2	3.5	**0.1**	**0.4**	**0.9**	**1.6**	**2.2**	**2.8**
AGRICULTURE																													
OS-B	8.00	**0.04**	**0.10**	**0.18**	**0.27**	**0.32**	**0.37**	200	6	18.8	1278	24	5	1.9%	0.7	31.1	49.9	1.4	1.7	2.0	2.3	2.6	2.9	**0.5**	**1.4**	**2.9**	**4.9**	**6.6**	**8.5**
AGRICULTURE	7.90	0.03	0.09	0.17	0.26	0.31	0.36			DP-3	*663*	*7*	*15*	1.1%	1.5	7.2													
ROADWAY	0.10	0.89	0.90	0.92	0.94	0.95	0.96																						
EX-A	31.32	**0.03**	**0.09**	**0.17**	**0.26**	**0.31**	**0.36**	200	4	21.7	1058	5	5	0.5%	0.3	51.3	73.0	0.9	1.1	1.3	1.5	1.7	1.9	**0.9**	**3.2**	**7.1**	**12.5**	**16.7**	**21.7**
AGRICULTURE																													
EX-B	9.31	**0.07**	**0.12**	**0.20**	**0.29**	**0.34**	**0.39**	200	4	21.0	922	19	5	2.1%	0.7	21.4	42.4	1.6	2.0	2.3	2.6	2.9	3.3	**1.0**	**2.3**	**4.3**	**7.0**	**9.3**	**11.8**
ACRICULTURE	8.91	0.03	0.09	0.17	0.26	0.31	0.36																						
ROADWAY	0.40	0.89	0.90	0.92	0.94	0.95	0.96																						

Calculated by: DLM

Date: 10/1/2017

		WEIGHTED						TT	INTENSITY						TOTAL FLOWS					
DESIGN POINT	**AREA TOTAL (Acres)**	**C_2**	**C_5**	**C_{10}**	**C_{25}**	**C_{50}**	**C_{100}**	**TOTAL (min)**	**I_2 (in/hr)**	**I_5 (in/hr)**	**I_{10} (in/hr)**	**I_{25} (in/hr)**	**I_{50} (in/hr)**	**I_{100} (in/hr)**	**Q_2 (c.f.s.)**	**Q_5 (c.f.s.)**	**Q_{10} (c.f.s.)**	**Q_{25} (c.f.s.)**	**Q_{50} (c.f.s.)**	**Q_{100} (c.f.s.)**
DP-1 BASIN OS-A	**2.22**	**0.03**	**0.09**	**0.17**	**0.26**	**0.31**	**0.36**	38.6	1.7	2.1	2.5	2.8	3.2	3.5	**0.1**	**0.4**	**0.9**	**1.6**	**2.2**	**2.8**
DP-2 LOMR																				**592.0**
DP-3	**17.31**	**0.05**	**0.11**	**0.19**	**0.28**	**0.33**	**0.38**	57.1	1.2	1.5	1.8	2.0	2.3	2.5	**1.2**	**3.0**	**5.9**	**9.8**	**12.9**	**16.6**
BASIN OS-B	8.00	0.04	0.10	0.18	0.27	0.32	0.37													
BASIN EX-B	9.31	0.07	0.12	0.20	0.29	0.34	0.39													

Calculated by: DLM

Date: 10/1/2017

PROPOSED HYDROLOGY

											CONVEYANCE TC						TT	INTENSITY						TOTAL FLOWS					
BASIN	**AREA TOTAL (Acres)**	**C_2**	**C_5**	**C_{10}**	**C_{25}**	**C_{50}**	**C_{100}**	**Length (ft)**	**Height (ft)**	**TI (min)**	**Length (ft)**	**Height (ft)**	**C_V**	**Slope (%)**	**Velocity (fps)**	**TC (min)**	**TOTAL (min)**	**I_2 (in/hr)**	**I_5 (in/hr)**	**I_{10} (in/hr)**	**I_{25} (in/hr)**	**I_{50} (in/hr)**	**I_{100} (in/hr)**	**Q_2 (c.f.s.)**	**Q_5 (c.f.s.)**	**Q_{10} (c.f.s.)**	**Q_{25} (c.f.s.)**	**Q_{50} (c.f.s.)**	**Q_{100} (c.f.s.)**
OS-A	2.22	**0.03**	**0.09**	**0.17**	**0.26**	**0.31**	**0.36**	200	5	20.2	788	16	5	2.0%	0.7	18.4	38.6	1.7	2.1	2.5	2.8	3.2	3.5	**0.1**	**0.4**	**0.9**	**1.6**	**2.2**	**2.8**
AGRICULTURE																													
OS-B	8.00	**0.04**	**0.10**	**0.18**	**0.27**	**0.32**	**0.37**	200	6	18.8	1278	24	5	1.9%	0.7	31.1	49.9	1.4	1.7	2.0	2.3	2.6	2.9	**0.5**	**1.4**	**2.9**	**4.9**	**6.6**	**8.5**
AGRICULTURE	7.90	0.03	0.09	0.17	0.26	0.31	0.36			DP-3	*663*	*7*	*15*	1.1%	1.5	7.2													
ROADWAY	0.10	0.89	0.90	0.92	0.94	0.95	0.96																						
A-1	0.81	**0.72**	**0.74**	**0.77**	**0.79**	**0.81**	**0.82**	15	1	1.4	1088	9	10	0.8%	0.9	19.9	21.4	2.4	3.0	3.5	4.0	4.5	5.0	**1.4**	**1.8**	**2.2**	**2.6**	**2.9**	**3.3**
GRAVEL	0.43	0.57	0.59	0.63	0.66	0.68	0.70																						
ROADWAY	0.38	0.89	0.90	0.92	0.94	0.95	0.96																						
A-2	30.33	**0.06**	**0.12**	**0.20**	**0.28**	**0.33**	**0.38**	100	2	15.0	1043	5	5	0.5%	0.3	50.2	65.2	1.1	1.3	1.5	1.8	2.0	2.2	**1.9**	**4.8**	**9.2**	**15.2**	**20.0**	**25.6**
ACRICULTURE	24.88	0.03	0.09	0.17	0.26	0.31	0.36																						
RESIDENTIAL	5.00	0.12	0.20	0.27	0.35	0.40	0.44																						
ROADWAY	0.45	0.89	0.90	0.92	0.94	0.95	0.96																						
A-3	0.18	**0.57**	**0.59**	**0.63**	**0.66**	**0.68**	**0.70**	15	1	2.0	372	4	10	1.1%	1.0	6.0	8.0	3.6	4.5	5.2	6.0	6.7	7.5	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
GRAVEL																													
B-1	0.54	**0.72**	**0.73**	**0.76**	**0.79**	**0.81**	**0.82**	15	1	1.4	784	14	10	1.8%	1.3	9.8	11.2	3.2	4.0	4.6	5.3	5.9	6.6	**1.2**	**1.6**	**1.9**	**2.3**	**2.6**	**2.9**
GRAVEL	0.29	0.57	0.59	0.63	0.66	0.68	0.70																						
ROADWAY	0.25	0.89	0.90	0.92	0.94	0.95	0.96																						
B-2	8.76	**0.07**	**0.13**	**0.20**	**0.29**	**0.33**	**0.37**	100	2	14.7	907	19	5	2.1%	0.7	20.9	35.6	1.8	2.2	2.6	3.0	3.3	3.7	**1.1**	**2.6**	**4.6**	**7.4**	**9.7**	**12.2**
ACRICULTURE	6.01	0.03	0.09	0.17	0.26	0.31	0.36																						
RESIDENTIAL	2.00	0.12	0.20	0.27	0.35	0.40	0.44																						
ROADWAY	0.25	0.89	0.90	0.92	0.94	0.95	0.96																						

Calculated by: DLM

Date: 10/1/2017

		WEIGHTED						TT	INTENSITY						TOTAL FLOWS					
DESIGN POINT	**AREA TOTAL (Acres)**	**C_2**	**C_5**	**C_{10}**	**C_{25}**	**C_{50}**	**C_{100}**	**TOTAL (min)**	**I_2 (in/hr)**	**I_5 (in/hr)**	**I_{10} (in/hr)**	**I_{25} (in/hr)**	**I_{50} (in/hr)**	**I_{100} (in/hr)**	**Q_2 (c.f.s.)**	**Q_5 (c.f.s.)**	**Q_{10} (c.f.s.)**	**Q_{25} (c.f.s.)**	**Q_{50} (c.f.s.)**	**Q_{100} (c.f.s.)**
DP-P1	**2.22**	**0.08**	**0.14**	**0.22**	**0.31**	**0.37**	**0.42**	38.6	1.7	2.1	2.5	2.8	3.2	3.5	**0.3**	**0.6**	**1.2**	**2.0**	**2.6**	**3.3**
BASIN OS-A	2.22	0.03	0.09	0.17	0.26	0.31	0.36													
Basin A3	0.18	0.57	0.59	0.63	0.66	0.68	0.70													
DP-2																				**592.0**
LOMR																				
DP-P3	**17.30**	**0.08**	**0.14**	**0.21**	**0.29**	**0.34**	**0.39**	57.1	1.2	1.5	1.8	2.0	2.3	2.5	**1.7**	**3.6**	**6.4**	**10.3**	**13.4**	**17.0**
Basin B-2	8.76	0.07	0.13	0.20	0.29	0.33	0.37													
DP-P4	8.54	0.08	0.14	0.22	0.30	0.35	0.40													
DP-P4	**8.54**	**0.08**	**0.14**	**0.22**	**0.30**	**0.35**	**0.40**	49.9	1.4	1.7	2.0	2.3	2.6	2.9	**1.0**	**2.1**	**3.7**	**5.9**	**7.7**	**9.7**
Bosin OS-B	8.00	0.04	0.10	0.18	0.27	0.32	0.37													
Basin B-1	0.54	0.72	0.73	0.76	0.79	0.81	0.82													

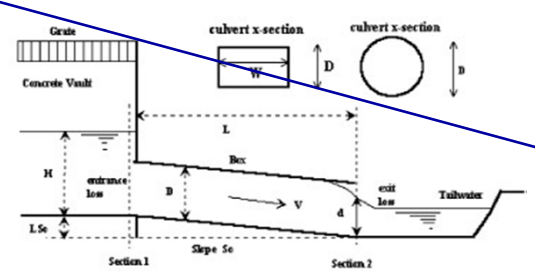
Calculated by: DLM

Date: 10/1/2017

HYDRAULIC CALCULATIONS

CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

Project: JUDGE ORR RANCHETTES
Basin ID: DP-P3
Status:



Based on the elevation this appears to be for DP-P4. Update the Basin ID.

Design Information (Input):

Circular Culvert:	Barrel Diameter in Inches	D =	30	inches
	Inlet Edge Type (choose from pull-down list)		Grooved End Projection	
OR:				
Box Culvert:	Barrel Height (Rise) in Feet	Height (Rise) =		ft.
	Barrel Width (Span) in Feet	Width (Span) =		ft.
	Inlet Edge Type (choose from pull-down list)		Square Edge w/ 30-78 deg. Flared Wingwall	
	Number of Barrels	No =	1	
	Inlet Elevation at Culvert Invert	Inlet Elev =	6803	ft. elev.
	Outlet Elevation at Culvert Invert **OR** Slope of Culvert (ft v./ft h.)	Outlet Elev =	6802.25	ft. elev.
	Culvert Length in Feet	L =	75	ft.
	Manning's Roughness	n =	0.012	
	Bend Loss Coefficient	K_b =	0	
	Exit Loss Coefficient	K_x =	1	

Design Information (calculated):

Entrance Loss Coefficient	K_e =	0.20
Friction Loss Coefficient	K_f =	0.59
Sum of All Loss Coefficients	K_s =	1.79
Orifice Inlet Condition Coefficient	C_d =	0.95
Minimum Energy Condition Coefficient	KE_{low} =	-0.0373

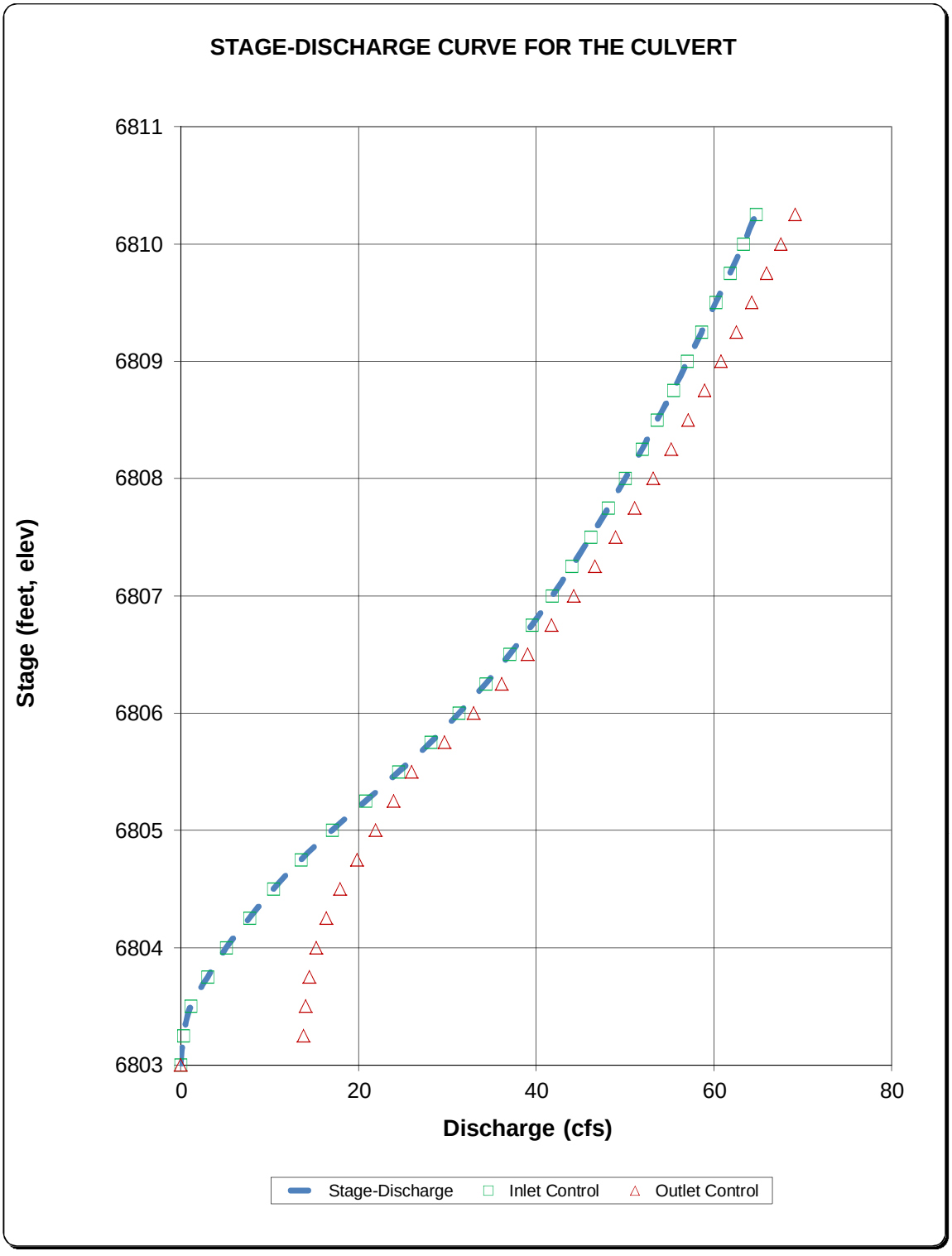
Calculations of Culvert Capacity (output):

Water Surface Elevation (ft., linked)	Tailwater Surface Elevation ft	Culvert Inlet-Control Flowrate cfs	Culvert Outlet-Control Flowrate cfs	Controlling Culvert Flowrate cfs (output)	Inlet Equation Used:	Flow Control Used
6803.00		0.00	0.00	**0.00**	No Flow (WS < inlet)	N/A
6803.25		0.30	13.82	**0.30**	Min. Energy. Eqn.	INLET
6803.50		1.10	14.02	**1.10**	Min. Energy. Eqn.	INLET
6803.75		3.00	14.49	**3.00**	Min. Energy. Eqn.	INLET
6804.00		5.10	15.24	**5.10**	Min. Energy. Eqn.	INLET
6804.25		7.70	16.40	**7.70**	Min. Energy. Eqn.	INLET
6804.50		10.40	17.95	**10.40**	Regression Eqn.	INLET
6804.75		13.50	19.84	**13.50**	Regression Eqn.	INLET
6805.00		17.00	21.91	**17.00**	Regression Eqn.	INLET
6805.25		20.80	23.95	**20.80**	Regression Eqn.	INLET
6805.50		24.50	25.95	**24.50**	Regression Eqn.	INLET
6805.75		28.10	29.68	**28.10**	Regression Eqn.	INLET
6806.00		31.30	32.97	**31.30**	Regression Eqn.	INLET
6806.25		34.30	36.10	**34.30**	Regression Eqn.	INLET
6806.50		37.00	39.01	**37.00**	Regression Eqn.	INLET
6806.75		39.50	41.70	**39.50**	Regression Eqn.	INLET
6807.00		41.80	44.24	**41.80**	Regression Eqn.	INLET
6807.25		44.00	46.61	**44.00**	Regression Eqn.	INLET
6807.50		46.10	48.90	**46.10**	Regression Eqn.	INLET
6807.75		48.10	51.06	**48.10**	Regression Eqn.	INLET
6808.00		50.00	53.14	**50.00**	Regression Eqn.	INLET
6808.25		51.90	55.17	**51.90**	Regression Eqn.	INLET
6808.50		53.60	57.10	**53.60**	Regression Eqn.	INLET
6808.75		55.40	58.97	**55.40**	Regression Eqn.	INLET
6809.00		57.00	60.79	**57.00**	Regression Eqn.	INLET
6809.25		58.60	62.54	**58.60**	Regression Eqn.	INLET
6809.50		60.20	64.25	**60.20**	Regression Eqn.	INLET
6809.75		61.80	65.92	**61.80**	Regression Eqn.	INLET
6810.00		63.30	67.54	**63.30**	Regression Eqn.	INLET
6810.25		64.70	69.14	**64.70**	Regression Eqn.	INLET

Processing Time: 00.79 Seconds

CULVERT STAGE-DISCHARGE SIZING (INLET vs. OUTLET CONTROL WITH TAILWATER EFFECTS)

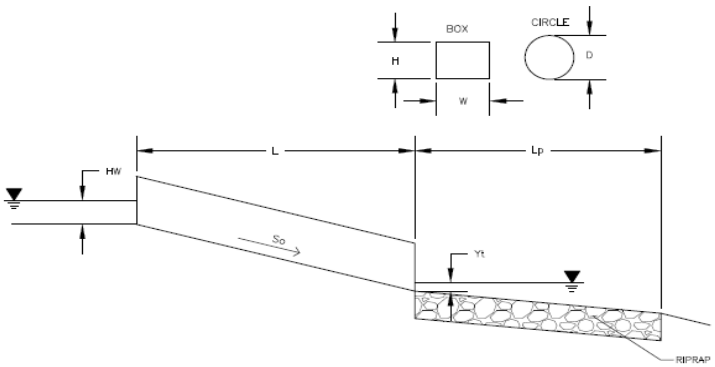
Project: JUDGE ORR RANCHETTES
Basin ID: DP-P3



Determination of Culvert Headwater and Outlet Protection

Project: Judge Orr Ranchettes

Basin ID: Design Point P3 (30" Culvert)



Soil Type:
Choose One:
- (•) Sandy
- ( ) Non-Sandy

Supercritical Flow! Using Da to calculate protection type.

Design Information (Input):

Design Discharge	Q =	9.7	cfs
Circular Culvert:			
Barrel Diameter in Inches	D =	30	inches
Inlet Edge Type (Choose from pull-down list)		Grooved End Projection	
Box Culvert:		**OR**	
Barrel Height (Rise) in Feet	Height (Rise) =		ft
Barrel Width (Span) in Feet	Width (Span) =		ft
Inlet Edge Type (Choose from pull-down list)		1.5 : 1 Bevel w/ 18-34 Deg. Flared Wingwall	
Number of Barrels	No =	1	
Inlet Elevation	Elev IN =	6803	ft
Outlet Elevation **OR** Slope	Elev OUT =	6802.25	ft
Culvert Length	L =	75	ft
Manning's Roughness	n =	0.012	
Bend Loss Coefficient	k_b =	0	
Exit Loss Coefficient	k_x =	1	
Tailwater Surface Elevation	Elev Y_t =	6803.25	ft
Max Allowable Channel Velocity	V =	5	ft/s

Required Protection (Output):

Tailwater Surface Height	Y_t =	1.00	ft
Flow Area at Max Channel Velocity	A_t =	1.94	ft^2
Culvert Cross Sectional Area Available	A =	4.91	ft^2
Entrance Loss Coefficient	k_e =	0.20	
Friction Loss Coefficient	k_f =	0.59	
Sum of All Losses Coefficients	k_s =	1.79	ft
Culvert Normal Depth	Y_n =	0.79	ft
Culvert Critical Depth	Y_c =	1.04	ft
Tailwater Depth for Design	d =	1.77	ft
Adjusted Diameter **OR** Adjusted Rise	D_a =	1.65	ft
Expansion Factor	1/(2*tan(Θ)) =	6.70	
Flow/Diameter$^{2.5}$ **OR** Flow/(Span * Rise$^{1.5}$)	Q/D^2.5 =	0.98	$ft^{0.5}/s$
Froude Number	Fr =	1.69	**Supercritical!**
Tailwater/Adjusted Diameter **OR** Tailwater/Adjusted Rise	Yt/D =	0.61	
Inlet Control Headwater	HW_I =	1.45	ft
Outlet Control Headwater	HW_O =	1.13	
Design Headwater Elevation	**HW =**	**6,804.45**	**ft**
Headwater/Diameter OR Headwater/Rise Ratio	**HW/D =**	**0.58**	
Minimum Theoretical Riprap Size	d_{50} =	2	in
Nominal Riprap Size	d_{50} =	6	in
UDFCD Riprap Type	**Type =**	**VL**	
Length of Protection	**L_p =**	**8**	**ft**
Width of Protection	**T =**	**4**	**ft**

DESIGN POINT P4

Other Calculators

- Air Flow Conversion Calculator
- Atmospheric Calculator
- Block Wall Calculator
- Concrete Column Calculator
- Concrete Volume Calculator
- Energy Conversion Calculator
- Isentropic Flow Relations Calculator
- Laser Real Time Unit Converter
- Normal Flow Relations Calculator
- Oblique Flow Relations Calculator
- Open-channel Flow Calculator
- Properties of Welds Treated as Lines Calculator
- Shaft Speed Calculator
- Torque Transmitted by Clutch Calculator
- Water Pump Engineering
- Back to ENGINEERING.com

Open-Channel Flow

This calculator uses Chézy and Manning's formula to calculate the wetted perimeter, hydraulic radius, flow area, Chézy coefficient and flow velocity.

For experimental values of Manning's **n** factor, **click here**

Required Information

Enter the Slope:	.016	**Enter the Channel Top Width (ft):**	17
Enter the Channel Bottom Width (ft):	0	**Enter the Channel Height (ft):**	2.5
Enter the Flow Depth (ft):	.84	**Enter the n value:**	.025

Results

The wetted perimeter is 5.95393 **ft**

The flow area is 2.39904 **ft²**

The hydraulic radius is 0.40293 **ft**

The C value is 51.22144

The flow is 9.866565 **ft³/s**

The flow is 4428.11454 **gal/min**

The velocity is 4.112714 **ft/s**

Calculate Reset

DESIGN POINT P1

Other Calculators

- Air Flow Conversion Calculator
- Atmospheric Calculator
- Block Wall Calculator
- Concrete Column Calculator
- Concrete Volume Calculator
- Energy Conversion Calculator
- Isentropic Flow Relations Calculator
- Laser Real Time Unit Converter
- Normal Flow Relations Calculator
- Oblique Flow Relations Calculator
- Open-channel Flow Calculator
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Open-Channel Flow

This calculator uses Chézy and Manning's formula to calculate the wetted perimeter, hydraulic radius, flow area, Chézy coefficient and flow velocity.

For experimental values of Manning's **n** factor, **click here**

Required Information

Enter the Slope:	.02	**Enter the Channel Top Width (ft):**	17
Enter the Channel Bottom Width (ft):	0	**Enter the Channel Height (ft):**	2.5
Enter the Flow Depth (ft):	.55	**Enter the n value:**	.025

Results

The wetted perimeter is 3.89840 **ft**

The flow area is 1.02850 **ft²**

The hydraulic radius is 0.26382 **ft**

The C value is 47.73083

The flow is 3.565962 **ft³/s**

The flow is 1600.40388 **gal/min**

The velocity is 3.467148 **ft/s**

Calculate Reset

DESIGN POINT P3

Other Calculators

- Air Flow Conversion Calculator
- Atmospheric Calculator
- Block Wall Calculator
- Concrete Column Calculator
- Concrete Volume Calculator
- Energy Conversion Calculator
- Isentropic Flow Relations Calculator
- Laser Real Time Unit Converter
- Normal Flow Relations Calculator
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- Open-channel Flow Calculator
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- Back to ENGINEERING.com

Open-Channel Flow

This calculator uses Chézy and Manning's formula to calculate the wetted perimeter, hydraulic radius, flow area, Chézy coefficient and flow velocity.

For experimental values of Manning's **n** factor, **click here**

Required Information

Enter the Slope:	.033	**Enter the Channel Top Width (ft):**	30
Enter the Channel Bottom Width (ft):	0	**Enter the Channel Height (ft):**	6
Enter the Flow Depth (ft):	1.16	**Enter the n value:**	.035

Results

The wetted perimeter is 6.24679 **ft** → **The flow is** 17.21989 **ft^3/s** ←

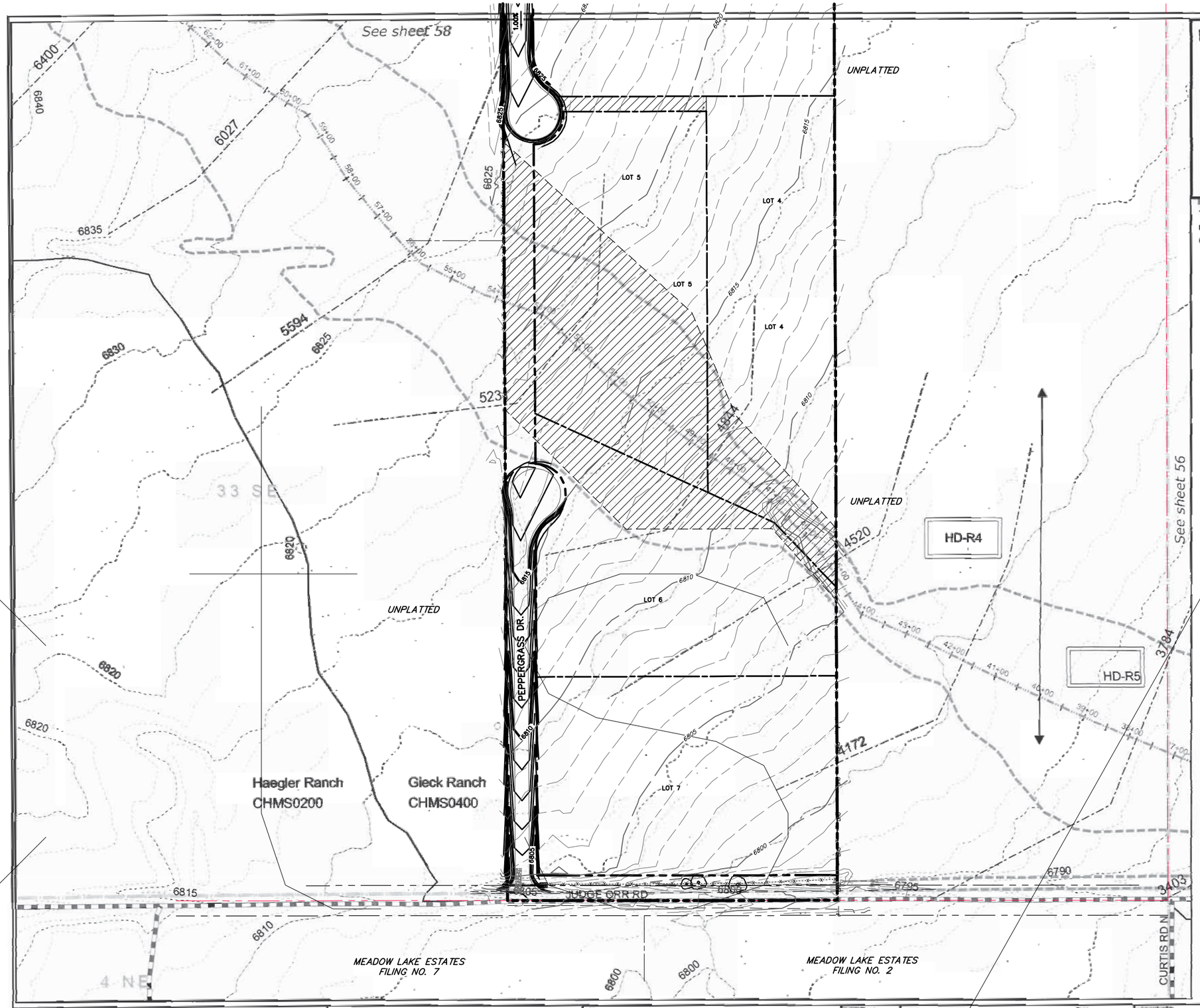
The flow area is 3.364 **ft^2** **The flow is** 7728.28913 **gal/min**

The hydraulic radius is 0.53851(**ft** **The velocity is** 5.118875(**ft/s**

The C value is 38.39883

Calculate Reset

DRAINAGE MAPS



Environmental Key

- Ponds
- Riparian: Good
- Riparian: Poor
- Potential Wetlands

The channel is considered dry unless shown as one of the above environmental categories.

Legend

- *Proposed Future Conditions 100-yr Flood Limits*
- Streams
- Reaches
- Reach Breaklines
- Cross-sections
- Roads
- Structures
- Section Lines
- 5-ft contours
- 2-ft contours

0 100 200 Feet

Reach	Slope (%)	Q_{100} (cfs)	V_{100} (ft/s)
HD-R4	1.75	429	2.71
HD-R5	1.67	468	2.87

RECOMMENDED PLAN IMPROVEMENTS

Reach	
HD-R4	Vegetation Augmentation
HD-R5	Selective Stabilization

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PREPARED BY: Drexel, Barrell & Co. Engineers · Surveyors
1609 38TH STREET, BOULDER, COLORADO 80301 (303) 442-4338
3 57TH STREET, COLORADO SPRINGS, COLORADO 80925 (719) 260-0887
6913 W 4TH STREET, GASSLEY, COLORADO 80634 (970) 351-5645
CONTACT: ROBERT BENNETT, P.E., CFM

PREPARED FOR: REALTY DEVELOPMENT SERVICES
25 NORTH TEJON STREET, SUITE 300
COLORADO SPRINGS, COLORADO 80903
CONTACT: RAY O' SULLIVAN (719) 227-1922

PROJECT INFO: GIECK RANCH
DRAINAGE BASIN PLANNING STUDY
EL PASO COUNTY, COLORADO

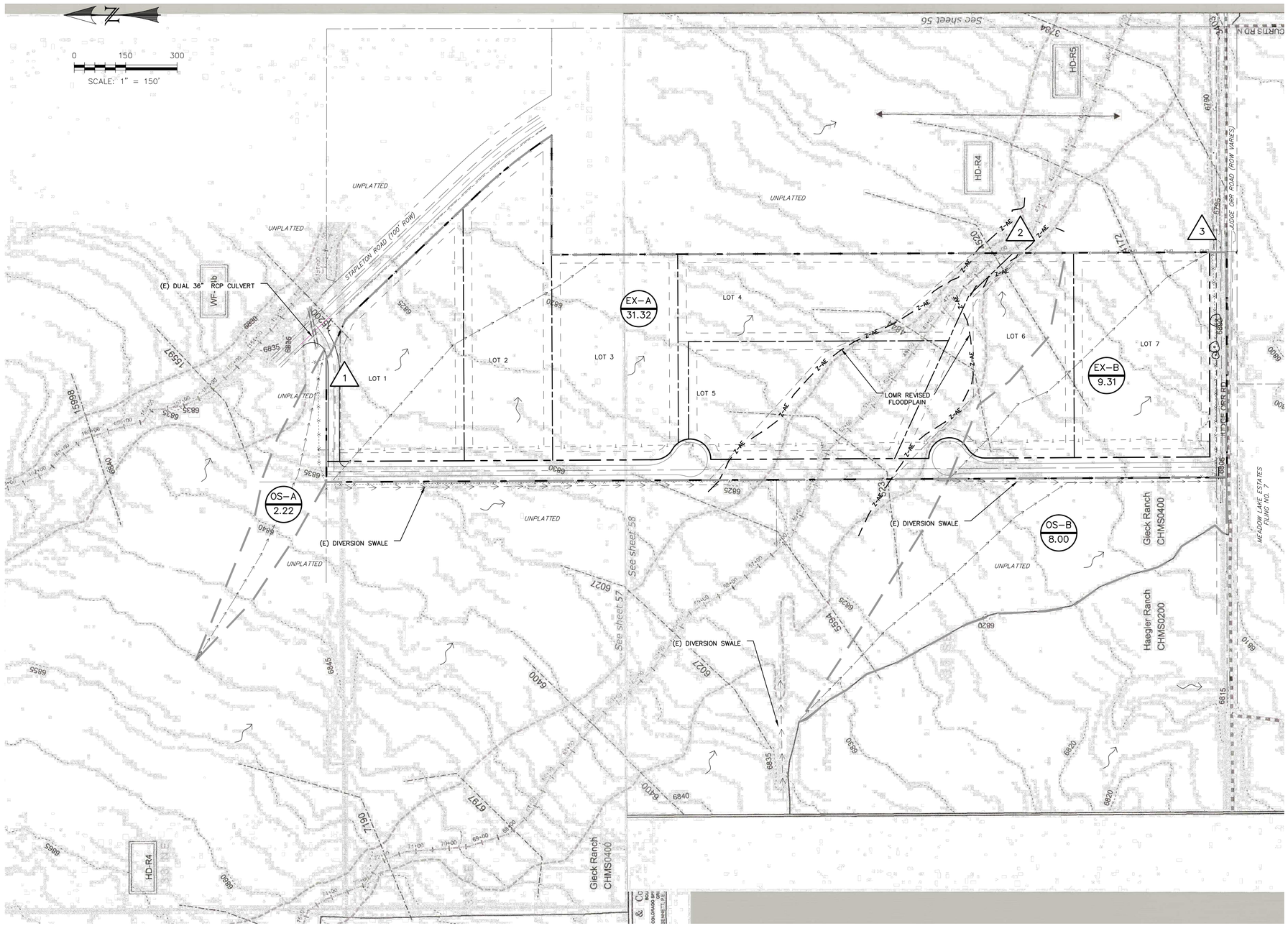
DESIGNED BY: RJB
DRAWN BY: ELF/AN/JM
CHECKED BY: RJB/TML
REVISION DESCRIPTIONS: PER EPC FINAL REVIEW
DATE: JANUARY 2010

DRAWING TITLE: GIECK RANCH DBPS
PLAN VIEW
HAEGLER DIVERSION #3

DATE: AUGUST 2007
JOB NO.: C7706-2
SCALE: 1" = 200'
DRAWING NO.: 6D 038
SHT PL
SHEET 57

JUDGE ORR RANCHETTES

EXISTING DRAINAGE MAP



EXISTING DRAINAGE BASINS							
BASIN	AREA (ACRES)	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)
OS-A	2.22	0.1	0.4	0.9	1.6	2.2	2.8
OS-B	8.00	0.5	1.4	2.9	4.9	6.6	8.5
EX-A	31.32	0.9	3.2	7.1	12.5	16.7	21.7
EX-B	9.31	1.0	2.3	4.3	7.0	9.3	11.8

EXISTING DESIGN POINTS						
DESIGN POINT	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)
DP-1	0.1	0.4	0.9	1.6	2.2	2.8
DP-2						592.0
DP-3	1.2	3.0	5.9	9.8	12.9	16.6

DRAINAGE LEGEND

- BASIN IDENTIFIER / BASIN AREA [AC] — F / 0.36
- DESIGN POINT IDENTIFIERS — 3
- DRAINAGE BASIN BOUNDARY
- SURFACE SHEET FLOW DIRECTION
- EXISTING MAJOR CONTOUR (10')
- EXISTING MINOR CONTOUR (2')
- PROPOSED MAJOR CONTOUR (10')
- PROPOSED MINOR CONTOUR (2')
- EXISTING (E)
- PROPOSED (P)
- FUTURE (F)
- SLOPE/DIRECTION 1.00%
- (E) STORM SEWER
- (P) STORM SEWER

PREPARED FOR:
JOHN JENNINGS
2030 TABOR CT.
COLORADO SPRINGS, CO 80919

CATAMOUNT ENGINEERING
PO BOX 692 DIVIDE, CO 80814 (719) 429-2124

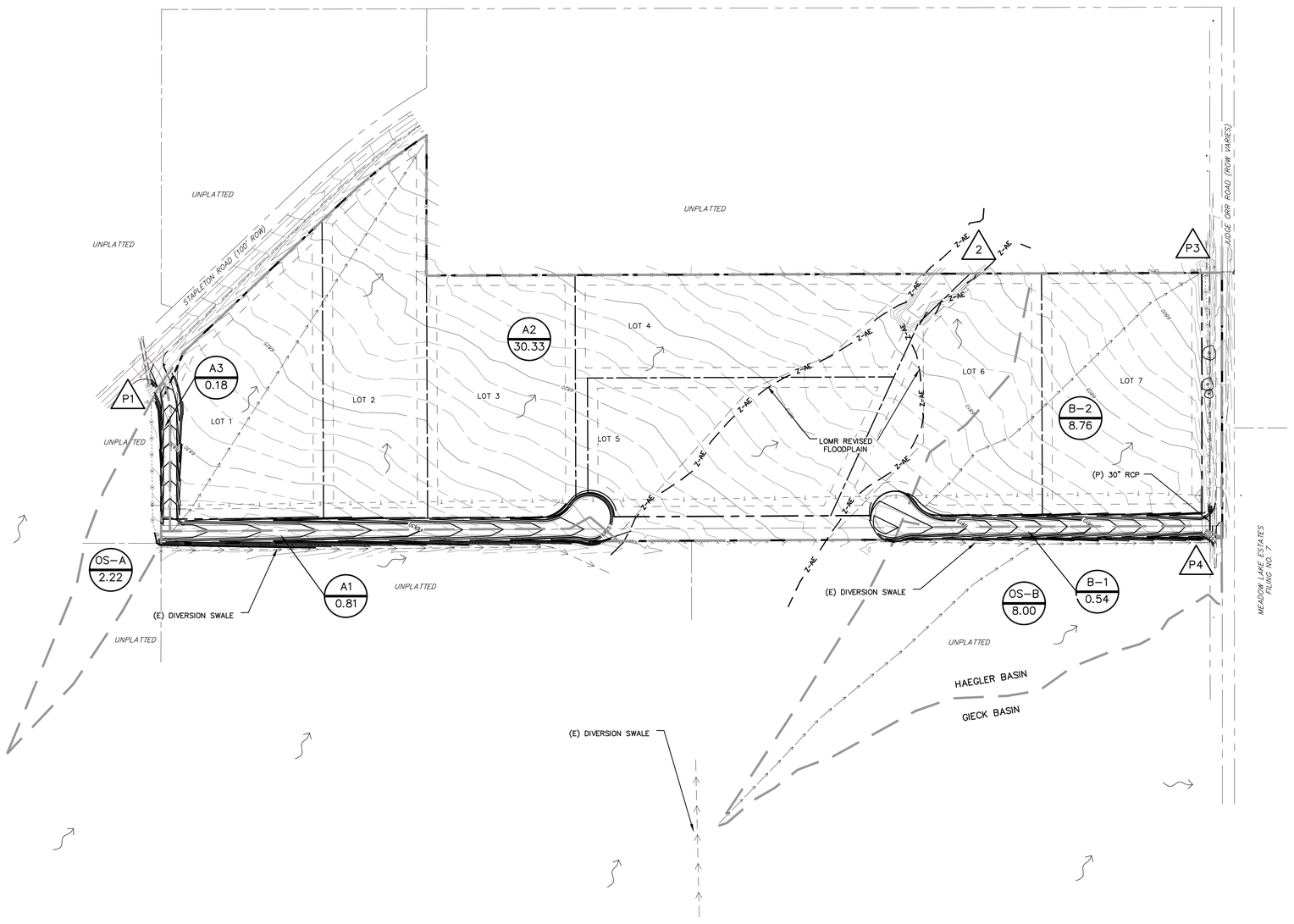
JUDGE ORR RANCHETTES

EXISTING DRAINAGE MAP

DRAWN BY: DLM
SCALE: 1"=150'
DATE: 10/01/17
JOB NUMBER: 16-093
SHEET: 1 OF 1

JUDGE ORR RANCHETTES
PROPOSED DRAINAGE MAP

0 150 300
SCALE: 1" = 150'



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OS-B	8.00	0.5	1.4	2.9	4.9	6.6	8.5
A-1	0.81	1.4	1.8	2.2	2.6	2.9	3.3
A-2	30.33	1.9	4.8	9.2	15.2	20.2	25.6
A-3	0.18	0.4	0.5	0.6	0.7	0.8	0.9
B-1	0.54	1.2	1.6	1.9	2.3	2.6	2.9
B-2	8.76	1.1	2.6	4.6	7.4	9.7	12.2

PROPOSED DESIGN POINTS						
DESIGN POINT	Q2 (CFS)	Q5 (CFS)	Q10 (CFS)	Q25 (CFS)	Q50 (CFS)	Q100 (CFS)
P1	0.3	0.6	1.2	2.0	2.6	3.3
2						592.0
P3	1.7	3.6	6.4	10.3	13.4	17.0
P4	1.0	2.1	3.7	5.9	7.7	9.7

DRAINAGE LEGEND

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- PROPOSED MAJOR CONTOUR (10') — 6900
- PROPOSED MINOR CONTOUR (2')
- EXISTING — (E)
- PROPOSED — (P)
- FUTURE — (F)
- SLOPE/DIRECTION — 1.00%
- (E) STORM SEWER
- (P) STORM SEWER

PREPARED FOR:
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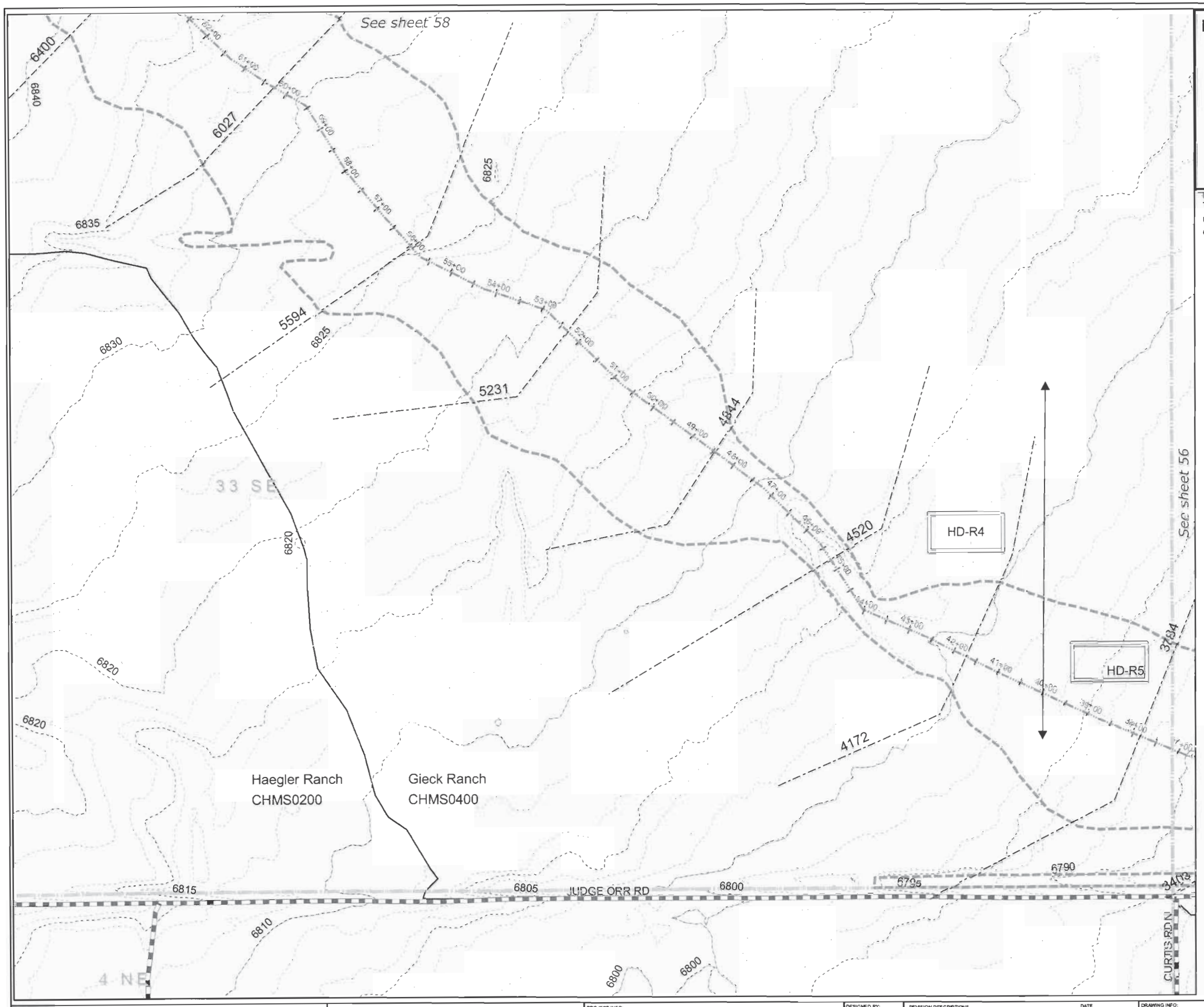
COLORADO SPRINGS, CO 80919

CATAMOUNT ENGINEERING
PO BOX 692 DIVIDE, CO 80814 (719) 426-2124

JUDGE ORR RANCHETTES

PROPOSED DRAINAGE MAP

DRAWN BY: DLM
SCALE: 1"=150'
DATE: 10/01/17
JOB NUMBER: 16-093
SHEET: 1 OF 1



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0 100 200 Feet

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DRAINAGE BASIN PLANNING STUDY
EL PASO COUNTY, COLORADO

DESIGNED BY: RJB
DRAWN BY: BLF/MLM
CHECKED BY: RJB/TML

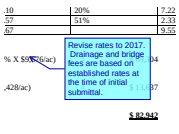
REVISION DESCRIPTIONS	DATE
PER EPC FINAL REVIEW	JANUARY 2010

DRAWING INFO: GIECK RANCH DBPS
PLAN VIEW
HAEGLER DIVERSION #3

DATE: AUGUST 2007
SCALE: H: 1" = 200' V: NONE
JOB NO: C7706-2
DRAWING NO.: 6D 038
SET PL
SHEET 57

Markup Summary

dsdlaforce (4)

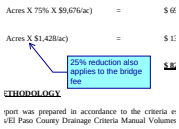


Subject: Callout
Page Label: 7
Author: dsdlaforce
Date: 8/7/2018 3:15:26 PM
Color:

Revise rates to 2017. Drainage and bridge fees are based on established rates at the time of initial submittal.

Subject: Callout
Page Label: 31
Author: dsdlaforce
Date: 8/7/2018 4:02:54 PM
Color:

Based on the elevation this appears to be for DP-P4. Update the Basin ID.



Subject: Callout
Page Label: 7
Author: dsdlaforce
Date: 8/8/2018 10:27:55 AM
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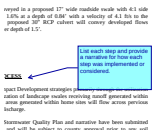
25% reduction also applies to the bridge fee



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Page Label: 6
Author: dsdlaforce
Date: 8/8/2018 10:29:32 AM
Color:

List each step and provide a narrative for how each step was implemented or considered.