Final Drainage Report

Hale Sand Pit Expansion
El Paso County, Colorado

Prepared for:
S&K NO1, LLC
PO Box 49681
Colorado Springs, CO 80949
(719) 491-2287

Prepared by:
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Project #: 096769000

Prepared: January 25, 2019
Resubmitted: March 25, 2019
Resubmitted: May 7, 2019

PCD File No. AL1829
File No. PPR1914

Kimley»Horn

CERTIFICATION

DESIGN 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 master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparation of this report.

SIGNATURE (Affix Seal): _____

John Heiberger, P.E. Date
Colorado P.E. No. 50096

OWNER/DEVELOPER'S STATEMENT

I, the developer, have read and will comply with all of the requirements specified in this Drainage Report and Plan.

_____
Name of Developer

_____
Authorized Signature Date

_____
Printed Name

_____
Title

_____
Address:

EL PASO COUNTY STATEMENT

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

_____ _____
Jennifer Irvine, P.E. Date
County Engineer/ECM Administrator

Conditions:

TABLE OF CONTENTS

PURPOSE AND SCOPE OF STUDY

The purpose of this Final Drainage Report (FDR) is to provide the hydrologic and hydraulic calculations and to document and finalize the drainage design methodology in support of the proposed Hale Sand Pit Expansion ("the Project") for S&K NO1, LLC. The Project is located within the jurisdictional limits of El Paso County ("the County"). Thus, the guidelines for the hydrologic and hydraulic design components were based on the criteria for the County and City of Colorado Springs, described below.

GENERAL LOCATON AND DESCRIPTION

LOCATION

The proposed Hale Sand Pit Expansion is located on a 150-acre tract of land approximately seven miles east from the town of Peyton off of McClelland Road. It is located at W2SWR, W2E2SW4, SE4NE4SQ4, E2SE4SW4 SEC 24-12-63 County of El Paso, State of Colorado. It is bound by McClelland road to the west and private property (undeveloped/agricultural) on all other sides. A vicinity map has been provided in this report.

The site is owned and will be mined by S&K NO1, LLC.

DESCRIPTION OF PROPERTY

The site currently contains a 9.9-acre sand mining area located at the southwest corner of the property. The proposed expansion will permit an additional 52.5 acres of land for sand mining. The proposed expansion will be performed in 10-acre maximum blocks. Each block will be disturbed, mined, and then reclaimed before mining activities begin in the next block. Brackett Creek passes through the site from west to east and is designated as Zone A (subject to flooding during 100-year storm events) per FEMA Floodplain Map Number 08041C0585G (effective date December 7, 2018). Brackett Creek is dry creek bed that flows temporarily during storm events.

From the south portion of the site (where the 40-acre mining area will be) flows generally travel to the north and east at approximately 1.0%. From the north portion of the site (where the 12.5-acre mining area will be) flows generally travel south at approximately 1.0%. The existing site consists of undeveloped grassland.

NRCS soil data is available for this Site and it has been noted that soils onsite are generally USCS Type A and B. Reference the Custom Soil Resource Report from NRCS and 1981 Geologic Report for additional information located in the appendix on specific soil types and other geotechnical information.

Mining activities will occur on site. When mining activities commence, the topsoil from the site will be used to create an earthen berm and diversion dike along the Brackett Creek Floodplain boundary. The diversion dike will transport runoff to a proposed sediment basin that will detain, allow for desilting, and release at historical rates into Brackett Creek. This will reduce stormwater sediment pollution to the creek. A Stormwater Management Report and Grading and Erosion Control Plans will be in place to identify necessary best management practices.

DRAINAGE BASINS AND SUB-BASINS

MAJOR BASIN DESCRIPTIONS

There are no previous drainage studies, master plans or site constraints for this Site. The drainage basin is located in the Upper Bracket Creek CHBR0600 basin.

A portion of the Project is located within the 100-year floodplain as determined by the Flood Insurance Rate Map (FIRM) numbers 08041C0585G, effective date December 7, 2018 (see Appendix).

EXISTING SUB-BASIN DESCRIPTIONS

The entire site historically drains either south (north portion of land) or north (south portion of land) into Brackett Creek. These conditions will not be changed because of the mining activities. When mining is active, flows will be routed to the temporary sediment basin and released at a controlled rate into the creek bed. Final conditions will closely match existing conditions except for minor changes in the finished grade where mining operations occurred. There will be a minor dip in the finished grade which will be seeded and reclaimed to natural vegetative conditions.

Off-site flows that enter the Project site sheet flow into Brackett Creek to match on-site historical flow patterns. The Project does not propose to change the routing of these off-site flows

The existing site was divided into one sub-basin E1 which contains the entire site area of 52.5 acres. This sub-basin consists of undeveloped grassland both north and south of Brackett Creek. The runoff developed within this existing basin follows historical flows into Brackett Creek. The cumulative runoff for existing conditions is 87.22 cubic feet per second (cfs) for the 100-year event.

An Existing Drainage Conditions Map and hydrologic calculations are included in the Appendix of this report for reference.

DRAINAGE DESIGN CRITERIA

DEVELOPMENT CRITERIA REFERENCE

The proposed storm facilities are designed to be in compliance with the City of Colorado Springs and El Paso County “Drainage Criteria Manual (DCM)” dated November 1991 (”the MANUAL”), the El Paso County “Engineering Criteria Manual” (“the Engineering Manual”). Site drainage is not significantly impacted by such constraints as utilities or existing development.

HYDROLOGIC CRITERIA

The 10-year and 100-year design storm events were used in determining rainfall and runoff for the proposed drainage analysis per the MANUAL. Table 6-2 of the Colorado Springs MANUAL is the source for rainfall data for the 10-year and 100-year design storm events. Design runoff was calculated using the Rational Method for developed conditions as established in the MANUAL.

The Project provides sediment control and detention for active mining areas (disturbed areas that will not exceed 10 acres) through the use of temporary sediment basins. These basins will be removed once permanent stabilization through revegetation has been achieved.

There are no additional provisions selected or deviations from the criteria in both the MANUAL and Engineering Manual.

HYDRAULIC CRITERIA

No hydraulic analysis is required as there will be no permanent stormwater sewers, channels, or facilities on site.

DRAINAGE FACILITY DESIGN

Per criteria flow shall be at or below historic levels. It appears this is un-detained flow that is not accounting for the sediment basins that would capture runoff and slowly release it.

GENERAL CONCEPT

There are no permanent drainage facilities required for this site. Temporary sediment basins will be provided downstream of disturbed areas to detain and release at controlled rates. Flows will be conveyed to the sediment basins via temporary diversion dikes along the boundary of the approved mining area. The maximum disturbed area at any one time will be 10-acres. Stabilization through re-vegetation will occur prior to disturbing the next area. Design information regarding these BMPs can be found in the Grading and Erosion Control Plan and the Storm Water Management Report.

The site was divided into three sub-basins, F1, F2, and I1. Sub-Basins F1 and F2 represent the final conditions of the reclaimed site. I1 represents the 10-acre disturbed mining site that will occur in increments. The total cumulative flow when mining operations are taking place in 10-acre increments is 97.98 cfs for the 100 year event. This flow is ultimately conveyed to Brackett Creek (Design Point C).

Calculations and drainage plan indicates sub-basin F1 as 30 acres. Revise accordingly.

SPECIFIC DETAILS

Sub-Basin F1

Sub-Basin F1 is 40.0 acres and consists of the reclaimed area south of Brackett Creek. The runoff developed within this sub-basin will follow historical patterns and sheet flow north to Brackett Creek. The runoff from this sub-basin is 49.84 cfs for the 100-year event.

Sub-Basin F2

Sub-Basin F2 is 12.50 acres and consists of the reclaimed area north of Brackett Creek. The runoff developed within this sub-basin will follow historical patterns and sheet flow south to Brackett Creek. The runoff from this sub-basin is 20.77 cfs for the 100-year event.

Sub-Basin I1

Sub-Basin I1 is 10.0 acres and consists of the intermediately mined area at one time. The runoff developed within this sub-basin will be directed with earth berms to diversion dikes which will route flow to the temporary sediment basins. The runoff from this sub-basin is 25.12 cfs for the 100-year event.

DRAINAGE FACILITY DESIGN

Four-Step Process

The four-step process per the Engineering Manual provides guidance and requirements for the selection of siting of structural Best Management Practices (BMPs) for new development and significant redevelopment.

Step 1: Employ Runoff Reduction Practices
Currently the site is vacant agricultural land. Development of the site will not increase current runoff conditions. Final conditions will closely match existing conditions with respect to imperviousness and grading.

Step 2: Stabilize Drainageways
There is a floodplain (Brackett Creek) passing through the Site. The proposed Project will not disturb any area within the floodplain. Sediment control measures (temporary sediment basins, diversion dikes, silt fences) are proposed to prevent destabilization of the drainageway.

Step 3: Provide Water Quality Capture Volume (WQCV)
Water quality capture volume will not be provided on site. WQCV is not provided for this site because no infrastructure is proposed. Mining operations will occur in 10-acre increments and then will be reclaimed with native vegetation prior to moving to the next 10-acre location. Therefore, the imperviousness of the final site, at the conclusion of all mining activities, will not be changed from the existing conditions. The temporary sediment basins provide sediment control and are designed per Urban Drainage Flood Control District Criteria Manual 3.

Step 4: Consider need for Industrial and Commercial BMPs
The Site does not require “Covering of Storage/Handling Areas” or “Spill Containment and Control” (specialized BMPs) in the final constructed condition.

SUMMARY

The proposed drainage design is to temporarily detain and treat runoff from mining areas and then return the land to its historic state and drainage pattern. Runoff from the Site will flow overland to Brackett Creek. The drainage design presented within this report conforms to the criteria presented in both the MANUAL and the Engineering Manual. Additionally, the Site runoff will not adversely affect the downstream and surrounding developments.

REFERENCES

1. City of Colorado Springs and El Paso County “Drainage Criteria Manual (DCM)”, dated November 1991

2. El Paso County “Engineering Criteria Manual” Revision 6, dated December 13, 2016

3. Chapter 6 and Section 3.2.1. of Chapter 13-City of Colorado Springs Drainage Criteria Manual, May 2014.

4. Urban Drainage and Flood Control District Drainage Criteria Manual (UDFCDCM), Vol. 1, prepared by Wright-McLaughlin Engineers, June 2001, with latest revisions.

5. Flood Insurance Rate Map, El Paso County, Colorado and Incorporated Areas, Map Number 08041C1058G, Effective Date December 7, 2018, prepared by the Federal Emergency Management Agency (FEMA).

6. Hydrologic Response of Solar Farms, prepared by Lauren M. Cook and Richard H. McCuen, University of Maryland, May 2018.

APPENDIX

FEMA FIRM MAP

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, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

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

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 (FMIX) 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/.

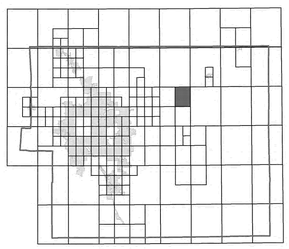
If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

Flooding Source	Vertical Datum Offset (ft)

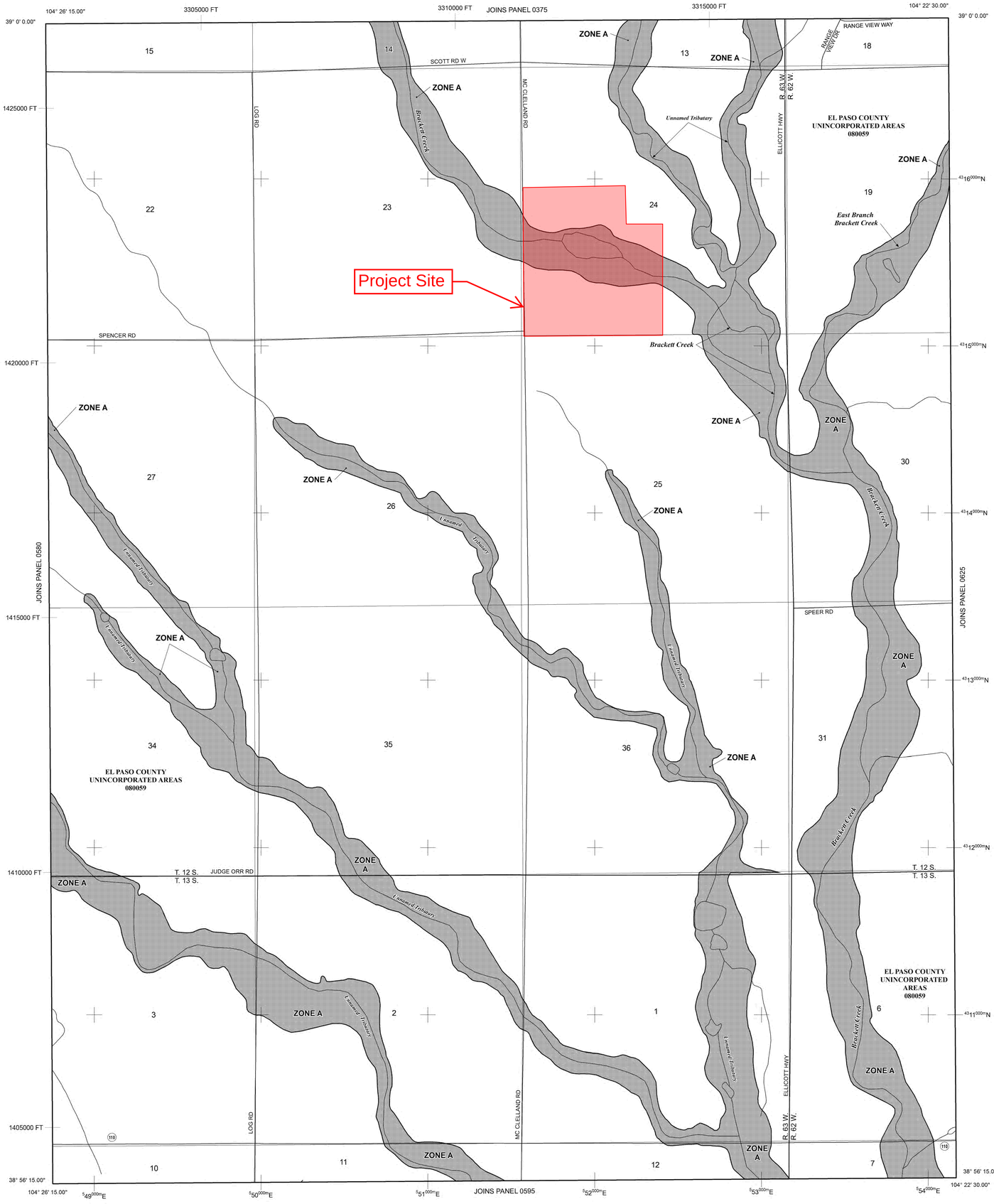
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION

Panel Location Map



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.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	Floodplain boundary
	Floodway boundary
	Zone D Boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

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

A — A	Cross section line
23 — 23	Transect line
97° 07' 30.00" 32° 22' 30.00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN	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

NFIP

PANEL 0585G

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 585 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0585	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 08041C0585G

MAP REVISED DECEMBER 7, 2018

Federal Emergency Management Agency

SOILS MAP

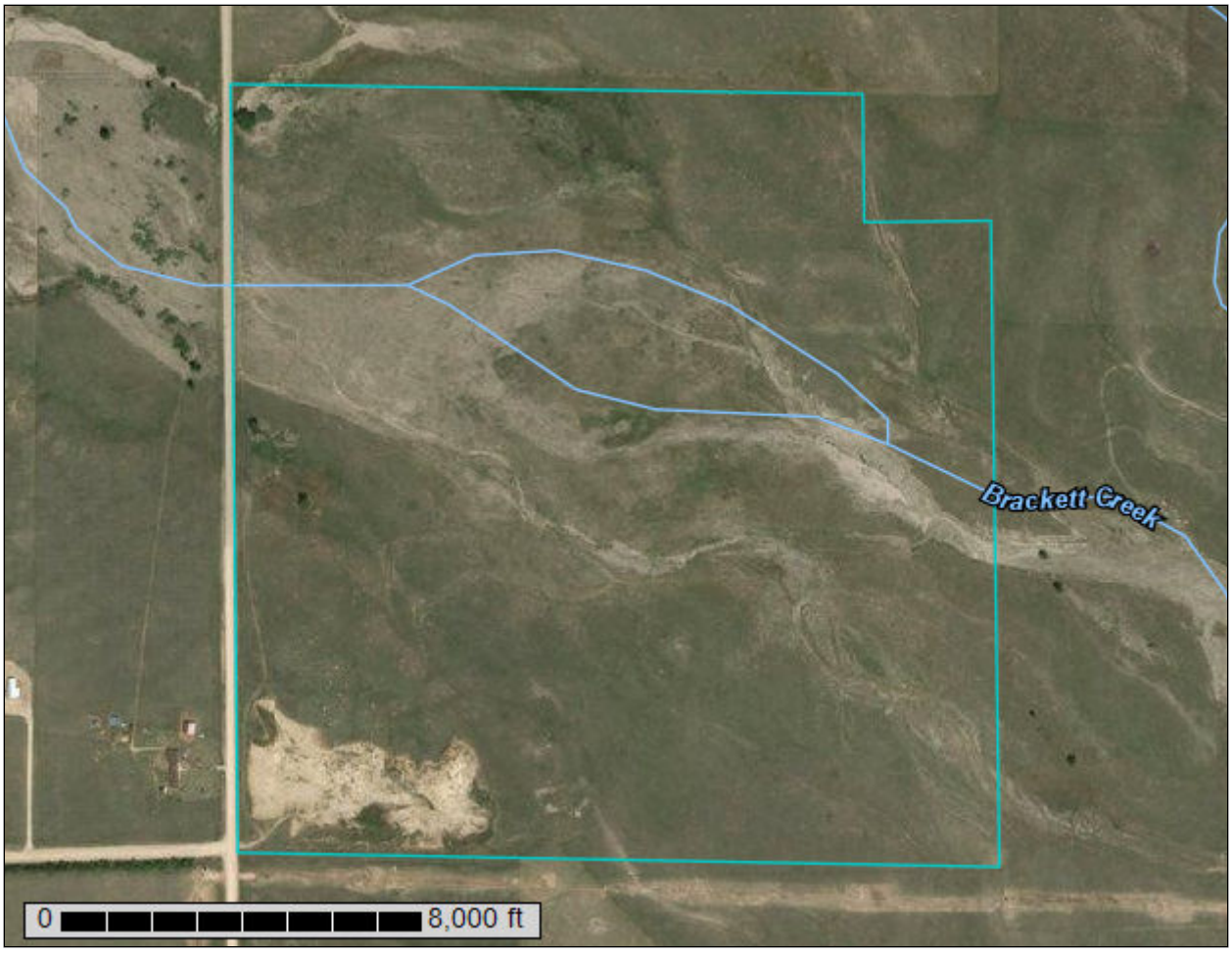
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for El Paso County Area, Colorado



September 19, 2018

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

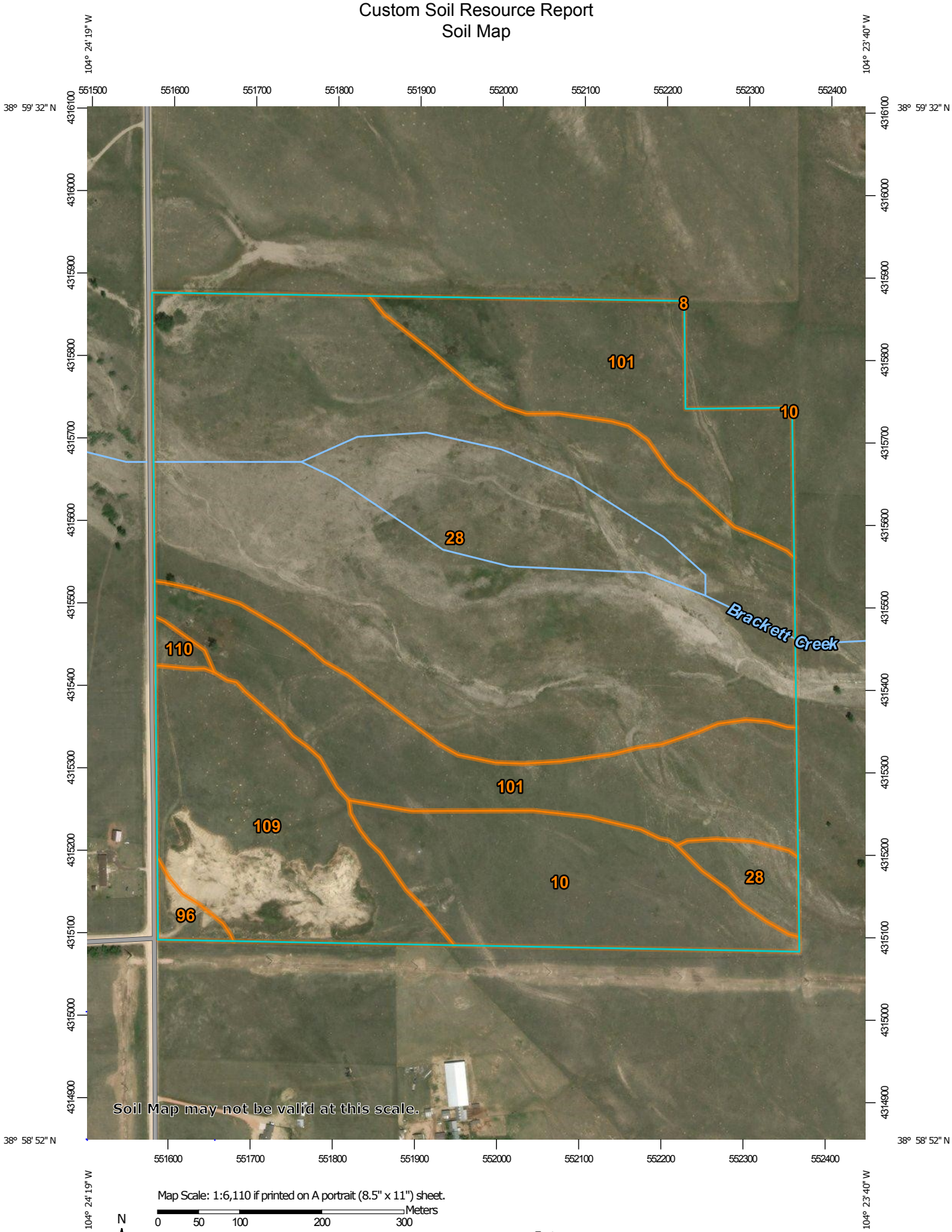
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



Map Scale: 1:6,110 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

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 15, Oct 10, 2017

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

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	0.0	0.0%
10	Blendon sandy loam, 0 to 3 percent slopes	15.7	10.6%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	77.0	52.1%
96	Truckton sandy loam, 0 to 3 percent slopes	1.1	0.7%
101	Ustic Torrifluvents, loamy	35.6	24.1%
109	Yoder gravelly sandy loam, 1 to 8 percent slopes	17.7	12.0%
110	Yoder gravelly sandy loam, 8 to 25 percent slopes	0.7	0.4%
Totals for Area of Interest		**147.7**	**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 development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

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

10—Blendon sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 3671
Elevation: 6,000 to 6,800 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

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

Description of Blendon

Setting

Landform: Alluvial fans, terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose

Typical profile

A - 0 to 10 inches: sandy loam
Bw - 10 to 36 inches: sandy loam
C - 36 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 2 percent
Available water storage in profile: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
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

28—Ellicott loamy coarse sand, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 3680
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Ellicott

Setting

Landform: Flood plains, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium

Typical profile

A - 0 to 4 inches: loamy coarse sand
C - 4 to 60 inches: stratified coarse sand to sandy loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively 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: Frequent
Frequency of ponding: None
Available water storage in profile: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A
Ecological site: Sandy Bottomland LRU's A & B (R069XY031CO)
Other vegetative classification: SANDY BOTTOMLAND (069AY031CO)
Hydric soil rating: No

Minor Components

Fluvaquentic haplaquoll

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

96—Truckton sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 36bf
Elevation: 6,000 to 7,000 feet
Mean annual precipitation: 14 to 15 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60

Map Unit Composition

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

Description of Truckton

Setting

Landform: Flats
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Arkosic alluvium derived from sedimentary rock and/or arkosic residuum weathered from sedimentary rock

Typical profile

A - 0 to 8 inches: sandy loam

Bt - 8 to 24 inches: sandy loam
C - 24 to 60 inches: coarse sandy loam

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 (1.98 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
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

101—Ustic Torrifluvents, loamy

Map Unit Setting

National map unit symbol: 3673
Elevation: 5,500 to 7,000 feet
Mean annual precipitation: 13 to 16 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 125 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Ustic Torrifluvents

Setting

Landform: Flood plains, stream terraces

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy, clayey, stratified loamy

Typical profile

A - 0 to 6 inches: variable
C - 6 to 60 inches: stratified loamy sand to clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: Saline Overflow LRU's A & B (R069XY037CO)
Other vegetative classification: OVERFLOW (069BY036CO)
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

109—Yoder gravelly sandy loam, 1 to 8 percent slopes

Map Unit Setting

National map unit symbol: 367c
Elevation: 6,200 to 6,900 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

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

Description of Yoder

Setting

Landform: Flats, hills
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Noncalcareous alluvium derived from arkose

Typical profile

A - 0 to 6 inches: gravelly sandy loam
Bt - 6 to 12 inches: gravelly sandy clay loam
2C - 12 to 60 inches: very gravelly loamy coarse sand

Properties and qualities

Slope: 1 to 8 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 (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 storage in profile: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Gravelly Foothill (R049BY214CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

110—Yoder gravelly sandy loam, 8 to 25 percent slopes

Map Unit Setting

National map unit symbol: 367f
Elevation: 6,200 to 6,900 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

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

Description of Yoder

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Noncalcareous alluvium derived from arkose

Typical profile

A - 0 to 6 inches: gravelly sandy loam
Bt - 6 to 12 inches: gravelly sandy clay loam
2C - 12 to 60 inches: very gravelly loamy coarse sand

Properties and qualities

Slope: 8 to 25 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 (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 storage in profile: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Gravelly Foothill (R049BY214CO)
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

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SEDIMENT BASIN CALCULATIONS

South Pond Volume Calculations

Method: Use the average-end area method to determine volume of storage of the pond and determine the 100-year storm high water level

Where: Volume = (1/2)*(Area of top contour + Area of bottom contour)*depth increment

High Water Elevation feet

High Water Elevation + 1' freeboard feet

Goal: Calculated 100-yr storage 144,000 cubic feet (From UDFCD Detail SC-7 3,600 ft^3/acre x 40 acres)

Calculations:

	Elevation (feet)	Area (sq. ft.)	Incremental Volume (cubic ft.)	Incremental Volume (ac. ft.)	Total Volume (ac. ft.)	Total Volume (cubic ft.)
	6464.00	44,464.0				
	6465.00	47,942.0	46,203.0	1.061	1.061	46,203
	6466.00	51,521.0	49,731.5	1.142	2.202	95,935
High Water Elevation	6467.00	55,200.0	53,360.5	1.225	3.427	149,295
High Water Elevation + 1' freeboard	6468.00	58,981.0	57,090.5	1.311	4.738	206,386

Elevations do not match what is shown on the drainage plan. Revise.

North Pond Volume Calculations

Method: Use the average-end area method to determine volume of storage of the pond and determine the 100-year storm high water level

Where: Volume = (1/2)*(Area of top contour + Area of bottom contour)*depth increment

High Water Elevation feet

High Water Elevation + 1' freeboard feet

Goal: Calculated 100-yr storage 45,000 cubic feet (From UDFCD Detail SC-7 3,600 ft^3/acre x 12.5 acres)

Calculations:

	Elevation (feet)	Area (sq. ft.)	Incremental Volume (cubic ft.)	Incremental Volume (ac. ft.)	Total Volume (ac. ft.)	Total Volume (cubic ft.)
	6464.00	12,390.0				
	6465.00	14,186.0	13,288.0	0.305	0.305	13,288
	6466.00	16,082.0	15,134.0	0.347	0.652	28,422
High Water Elevation	6467.00	18,078.0	17,080.0	0.392	1.045	45,502
High Water Elevation + 1' freeboard	6468.00	20,175.0	19,126.5	0.439	1.484	64,629

Elevations do not match what is shown on the drainage plan.

EXISTING DRAINAGE CALCULATIONS AND DRAINAGE MAP

$$I = \frac{28.5\ P_1}{(10+T_D)^{0.786}}$$

Where:

I = rainfall intensity (inches per hour)

P_1 = one-hour rainfall depth (inches) from Table 6-2 One-hour Point Rainfall Depth City of Colorado Springs Drainage Design

T_C = storm duration (minutes)

	2-yr	5-yr	10-yr	100-yr
P_1 =	1.19	1.50	1.75	2.52

Time Intensity Frequency Tabulation

TIME	2 YR	5 YR	10 YR	100 YR
5	4.04	5.09	5.94	8.55
10	3.22	4.06	4.73	6.82
15	2.70	3.41	3.97	5.72
30	1.87	2.35	2.75	3.95
60	1.20	1.52	1.77	2.55
120	0.74	0.93	1.09	1.57

Weighted Imperviousness Calculations

SUB-BASIN	AREA (SF)	AREA (Acres)	GRASSLAND AREA	PASTURE/MEADOW IMPERVIOUSNESS	C10	C100
E1	2,286,900	52.50	2,286,900	2%	0.25	0.35
TOTAL	2,286,900	52.50	2,286,900	2%	0.25	0.35

10675 McClelland Road - Hale Sand Pit Expansion
Existing Runoff Calculations
Time of Concentration

Watercourse Coefficient

Forest & Meadow	2.50	Short Grass Pasture & Lawns	7.00	Grassed Waterway	15.00
Fallow or Cultivation	5.00	Nearly Bare Ground	10.00	Paved Area & Shallow Gutter	20.00

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(10)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
E1	E1	2,286,900	52.50	0.25	1000	1.0%	49.2	1100	1.0%	7.00	0.7	26.2	75.4	2100	21.7	21.7

10675 McClelland Road - Hale Sand Pit Expansion
Existing Runoff Calculations *Design Storm 100 Year*
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
E1	E1	52.50	0.35	21.7	18.38	4.75	87.22					

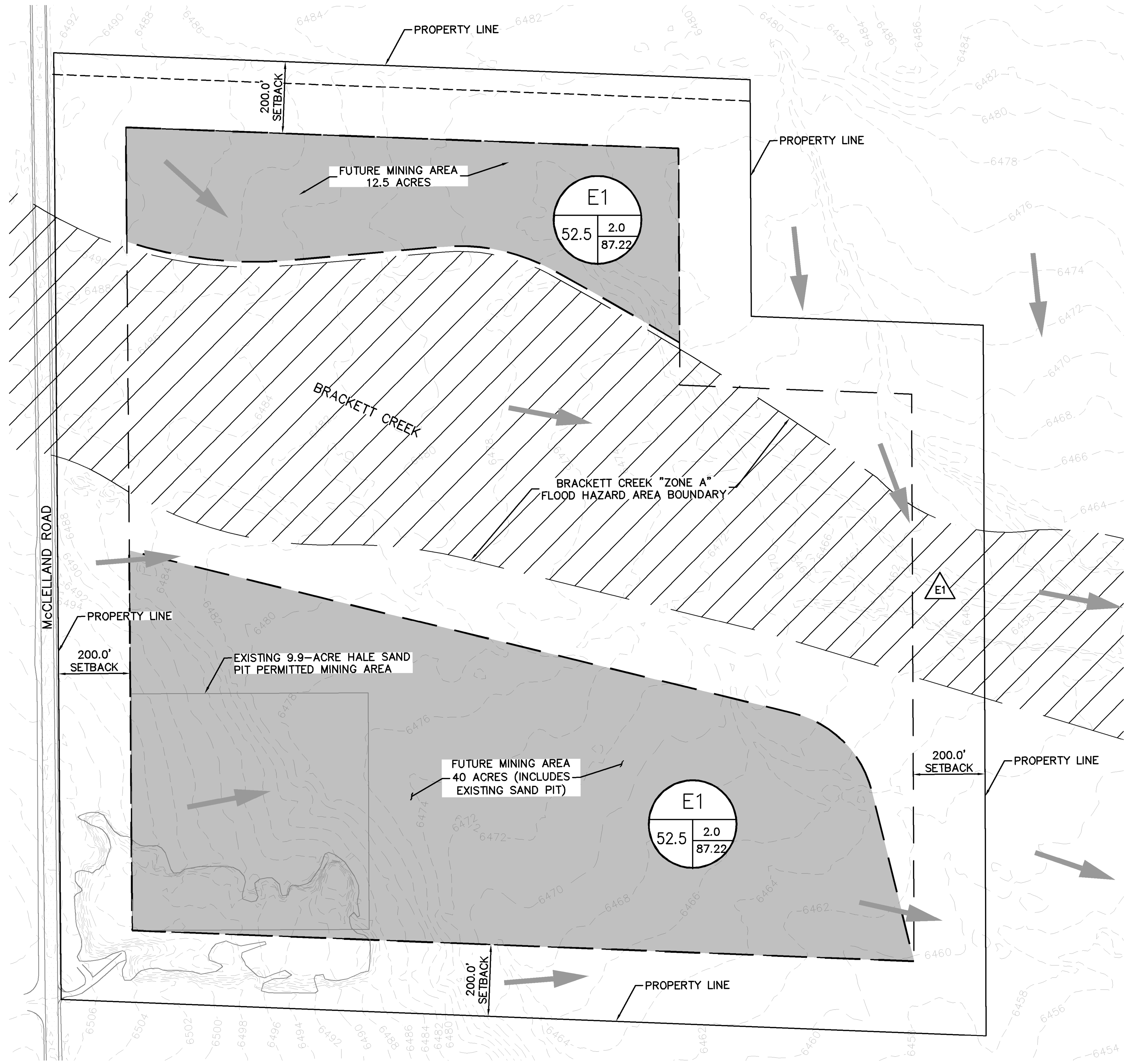
10675 McClelland Road - Hale Sand Pit Expansion
Existing Runoff Calculations *Design Storm 10 Year*
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF			
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs
E1	E1	52.5	0.25	21.7	13.125	2.24	29.42

FYI: Per Resolution 15-042, the County adopted Chapter 6(hydrology) of City of Colorado Springs DCMV1. Chapter 6 indicates the minor storm as a 5 year storm runoff. No action is required but you may change your calculations if you like.

SUMMARY - EXISTING RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	CUMULATIVE 100-YR RUNOFF (CFS)	CUMULATIVE 10-YR RUNOFF (CFS)
E1	E1	52.50	87.22	29.42



Update FEMA FIRM number.

LEGEND

- DRAINAGE BASIN DELINEATION
- PROPERTY LINE
- 200' SETBACK LINE
- EXISTING GRAVEL ROAD
- "ZONE A" SPECIAL FLOOD HAZARD AREA PER FEMA MAP NUMBER 08041C0600 F PANEL 24
- PROPOSED MINING AREA
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- HISTORIC FLOW ARROW

A = BASIN DESIGNATION
B = AREA (ACRES)
C = BASIN IMPERVIOUSNESS
D = 100YR DESIGN STORM RUNOFF (CFS)

= DESIGN POINT

SUMMARY - EXISTING RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	CUMULATIVE 100-YR RUNOFF (CFS)	CUMULATIVE 10-YR RUNOFF (CFS)
E1	E1	52.50	87.22	29.42

NORTH

GRAPHIC SCALE IN FEET
0 100 200 400

EXISTING DRAINAGE MAP

05/07/2019

Kimley»Horn

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INTERMEDIATE/FINAL DRAINAGE CALCULATIONS AND DRAINAGE MAP

$$I = \frac{28.5\ P_1}{(10+T_D)^{0.786}}$$

Where:

I = rainfall intensity (inches per hour)

P_1 = one-hour rainfall depth (inches) from Table 6-2 One-hour Point Rainfall Depth City of Colorado Springs Drainage Design

T_C = storm duration (minutes)

	2-yr	5-yr	10-yr	100-yr
P_1 =	1.19	1.50	1.75	2.52

Time Intensity Frequency Tabulation

TIME	2 YR	5 YR	10 YR	100 YR
5	4.04	5.09	5.94	8.55
10	3.22	4.06	4.73	6.82
15	2.70	3.41	3.97	5.72
30	1.87	2.35	2.75	3.95
60	1.20	1.52	1.77	2.55
120	0.74	0.93	1.09	1.57

Weighted Imperviousness Calculations

SUB-BASIN	AREA (SF)	AREA (Acres)	GRASSLAND AREA	MINING AREA	MINING AREA IMPERVIOUSNESS	MINING AREA		PASTURE/MEADOW IMPERVIOUSNESS	PASTURE/MEADOW	
						C10	C100		C10	C100
F1	1,306,800	30.00	1,306,800	0	40%	0.38	0.48	2%	0.25	0.35
F2	544,500	12.50	544,500	0	40%	0.38	0.48	2%	0.25	0.35
I1	435,600	10.00	0	435,600	40%	0.38	0.48	2%	0.25	0.35
TOTAL	2,286,900	52.50	1,851,300	435,600	40%	0.38	0.48	2%	0.25	0.35

10675 McClelland Road - Hale Sand Pit Expansion
Existing Runoff Calculations
Time of Concentration

Watercourse Coefficient

Forest & Meadow	2.50	Short Grass Pasture & Lawns	7.00	Grassed Waterway	15.00
Fallow or Cultivation	5.00	Nearly Bare Ground	10.00	Paved Area & Shallow Gutter	20.00

	SUB-BASIN DATA				INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAIN BASIN	AREA sq. ft.	AREA ac.	C(10)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
F1	F1	1,306,800	30.00	0.25	1000	1.0%	49.2	1100	1.0%	5.00	0.5	36.7	85.9	2100	21.7	21.7
F2	F2	544,500	12.50	0.25	1000	1.0%	49.2	1100	1.0%	5.00	0.5	36.7	85.9	2100	21.7	21.7
I1	I1	435,600	10.00	0.25	1000	1.0%	49.2	435	1.0%	7.00	0.7	10.4	59.6	1435	18.0	18.0

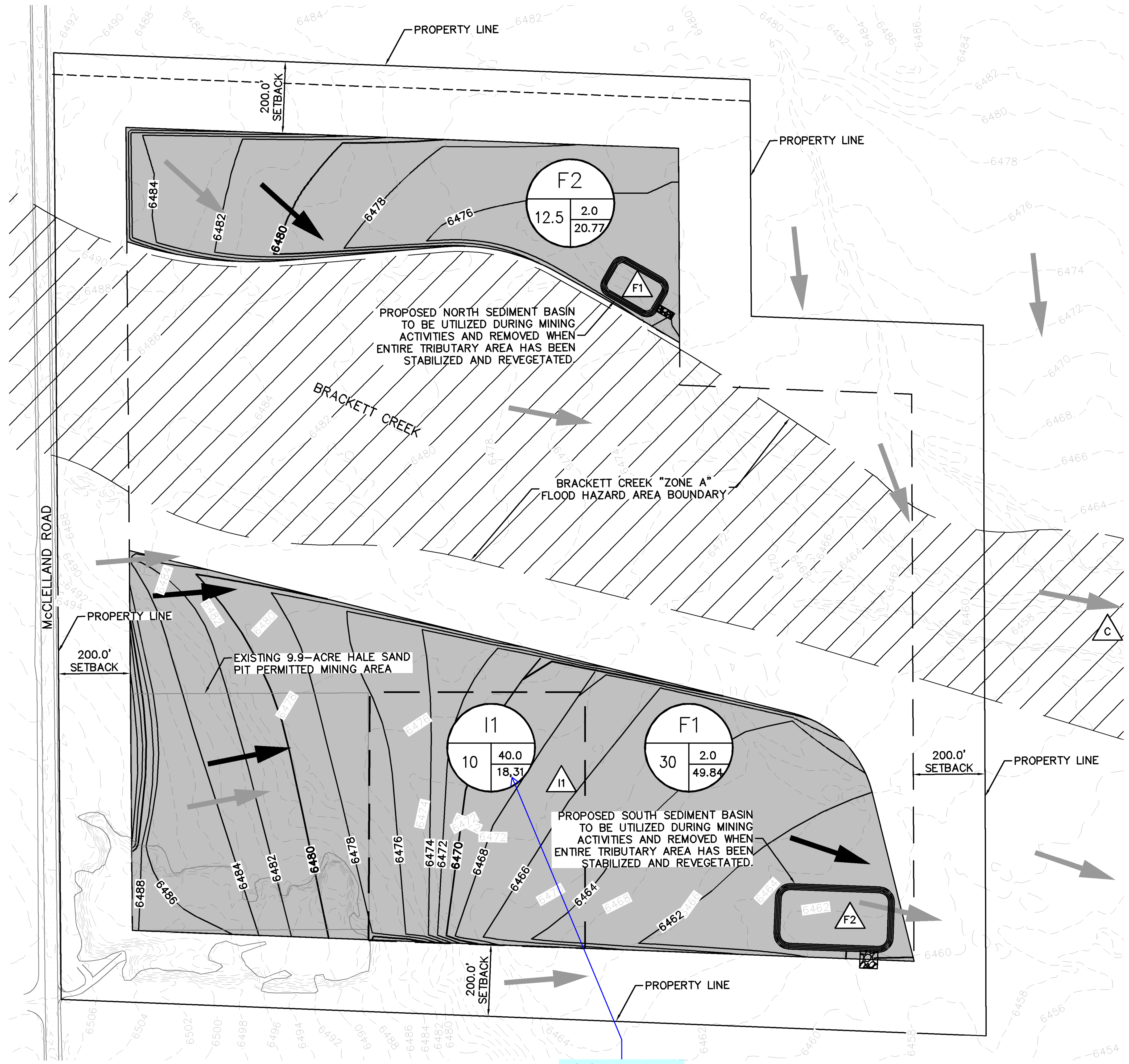
10675 McClelland Road - Hale Sand Pit Expansion
Existing Runoff Calculations *Design Storm* *100 Year*
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
F1	F1	30.00	0.35	21.7	10.50	4.75	49.84					
F2	F2	12.50	0.35	21.7	4.38	4.75	20.77					
I1	I1	10.00	0.48	18.0	4.80	5.23	25.12					
C	CREEK	52.50	--	--	--	--	--	21.7	19.68	4.98	97.98	Combined flow of Basins F1, F2, and I1 that enter Brackett Creek.

10675 McClelland Road - Hale Sand Pit Expansion
Existing Runoff Calculations *Design Storm* *10 Year*
(Rational Method Procedure)

BASIN INFORMATION				DIRECT RUNOFF				CUMULATIVE RUNOFF				
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
F1	F1	30	0.25	21.7	7.5	2.24	16.81					
F2	F2	12.5	0.25	21.7	3.125	2.24	7.01					
I1	I1	10	0.38	18	3.8	2.47	9.39					
C	CREEK	52.5	--	--	--	--	--	21.7	14.43	4.98	71.84	Combined flow of Basins F1, F2, and I1 that enter Brackett Creek.

SUMMARY - EXISTING RUNOFF TABLE				
DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	CUMULATIVE 100-YR RUNOFF (CFS)	CUMULATIVE 10-YR RUNOFF (CFS)
F1	F1	30.00	49.84	16.81
F2	F2	12.50	20.77	7.01
I1	I1	10.00	25.12	9.39
C	CREEK	52.50	97.98	71.84



LEGEND

- DRAINAGE BASIN DELINEATION
- PROPERTY LINE
- 200' SETBACK LINE
- EXISTING GRAVEL ROAD
- "ZONE A" SPECIAL FLOOD HAZARD AREA PER FEMA MAP NUMBER 08041C0600 F PANEL 24
- PROPOSED MINING AREA
- 6500 PROPOSED MAJOR CONTOUR
- 6502 PROPOSED MAJOR CONTOUR
- 6500 EXISTING MAJOR CONTOUR
- 6502 EXISTING MINOR CONTOUR
- HISTORIC FLOW ARROW
- PROPOSED FLOW ARROW
- A = BASIN DESIGNATION
- B = AREA (ACRES)
- C = BASIN IMPERVIOUSNESS
- D = 100YR DESIGN STORM RUNOFF (CFS)
- # = DESIGN POINT

Update FEMA FIRM number

intermediate/final

SUMMARY - EXISTING RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	CUMULATIVE 100-YR RUNOFF (CFS)	CUMULATIVE 10-YR RUNOFF (CFS)
F1	F1	30.00	49.84	16.81
F2	F2	12.50	20.77	7.01
I1	I1	10.00	25.12	9.39
C	CREEK	52.50	97.98	71.84

Per criteria, flow shall be at or below historic. It appears that this is un-detained flow that is not accounting for the sediment basin that would capture runoff and slowly release it. Additionally, would the mining area at time of operation (sub-basin I1) be at a lower elevation than the surrounding areas? If so then runoff might not escape this area and therefore the total flow leaving the site could be less than historic. Please revise accordingly.

NORTH

GRAPHIC SCALE IN FEET
0 100 200 400

FINAL DRAINAGE MAP
05/07/2019

Kimley»Horn

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