FINAL DRAINAGE REPORT

for

KANG STORAGE – 11401 E. HIGHWAY 24
LOT 1, ABIDING WORD LUTHERAN CHURCH SUBDIVISION

Prepared for:

Hammers Construction, Inc.
1411 Woolsey Heights
Colorado Springs, CO 80915

June 22, 2026

Prepared by:

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DRAINAGE STATEMENT

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 liability caused by negligent acts, errors or omissions on my part in preparing this report.

____

John P. Schwab, P.E. #29891

Developer's Statement:

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

By:

____

Date

Hammers Construction
1411 Woolsey Heights, Colorado Springs, CO 80915

El Paso County's 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.

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

Conditions:

I. INTRODUCTION

A. Property Location and Description

Mr. Steve Kang (property owner) is planning to develop the proposed Kang Storage project on the vacant site at 11041 E. Highway 24 in the Falcon area of El Paso County, Colorado. The project site (El Paso County Assessor's Parcel Number 53130-01-013) is a 12.3-acre property located at the southeast corner of US Highway 24 and Falcon Highway. The property is platted as Lot 1, Abiding Word Lutheran Church Subdivision, and the site is zoned CS (Commercial Service). The property is located in the North Half of Section 13, Township 13 South, Range 65 West of the 6th Principal Meridian, El Paso County, Colorado.

The west boundary of the property adjoins US Highway 24 (US24), which is an asphalt-paved arterial CDOT highway. In preparation for upcoming highway improvements, CDOT has acquired a strip of right-of-way along the west boundary of the site. CDOT has also acquired a corridor along the eastern boundary of this site for a proposed private road to be constructed by CDOT for access to properties to the south, minimizing direct access connections to US24.

The north boundary of the property adjoins Falcon Highway, which is an asphalt-paved arterial County roadway. The east boundary of the property adjoins an unplatted 16.1-acre ranch property (Zoned RR5; Rural Residential), and the southwest boundary adjoins another unplatted 5-acre ranch property (Zoned RR5; Rural Residential).

The proposed site improvements consist of crushed asphalt paving of the majority of the developed site for uncovered storage use. Additionally, gated storage yards will be enclosed with fencing along the southwest side of the property. The proposed site improvements will have minimal impacts on the existing Mountain View Electric Association (MVEA) easement along the southwest boundary of the property. Access to the site will be provided by a driveway connection to the proposed private road along the east boundary of the property.

The site is located in the Sand Creek Drainage Basin, and surface drainage from this site sheet flows southwesterly to an existing drainage swale at the south boundary of the property, draining to an existing public double 24-inch culvert crossing US24 beyond the southwest corner of the property.

B. Scope

This report will provide a summary of site drainage issues impacting the proposed commercial site development. The report will analyze upstream drainage patterns, site-specific developed drainage patterns, and impacts on downstream facilities. This report is based on the guidelines and criteria presented in the El Paso County Drainage Criteria Manual, and the report is intended to fulfill the requirements for a "Final Drainage Report" for this property.

C. References

City of Colorado Springs & El Paso County "Drainage Criteria Manual," revised October 31, 2018.

City of Colorado Springs "Drainage Criteria Manual, Volume 1," revised January, 2021.

City of Colorado Springs "Drainage Criteria Manual, Volume 2," revised December, 2020.

El Paso County "Engineering Criteria Manual," revised July 18, 2023.

Mile High Flood District, "Urban Storm Drainage Criteria Manual, Volume 1," revised August, 2018.

Mile High Flood District, "Urban Storm Drainage Criteria Manual, Volume 2," revised September, 2017.

Mile High Flood District, "Urban Storm Drainage Criteria Manual, Volume 3," revised January, 2021.

MVE, Inc., "Abiding Word Lutheran Church Subdivision" Drainage Report, July 10, 2006 (approved by County 10/25/06).

II. EXISTING / PROPOSED DRAINAGE CONDITIONS

A. Existing Drainage Conditions

According to the Custom Soil Resource Report for this site (see details in Appendix A) provided by the Natural Resources Conservation Service (NRCS), on-site soils are comprised of the following:

- "Type 9: Blakeland-Fluvaquentic Haplaquolls" soils. These soils are classified as hydrologic soils group "A" (high infiltration rate).
- "Type 97: Truckton sandy loam" soils (majority of site). These soils are classified as hydrologic soils group "A" (high infiltration rate).

As shown on the enclosed Existing Conditions Drainage Plan (Figure EX1, Appendix E), the property has been delineated as a single on-site drainage basin (Basin A, 12.36-acres), which sheet flows to the southwest corner of the site. Existing peak flows from Bain A are calculated as $Q_5 = 3.0$ cfs and $Q_{100} = 22.3$ cfs.

The adjoining CDOT private road corridor along the east boundary of the site has been delineated as Off-site Basin OA1 (1.64-acres), which contributes off-site drainage flowing into Basin A. Existing peak flows from Bain OA1 are calculated as $Q_5 = 0.4$ cfs and $Q_{100} = 3.0$ cfs.

Drainage from Basin OA1 combines with Basin A at Design Point #1, with existing peak flows calculated as $Q_5 = 3.4$ cfs and $Q_{100} = 25.2$cfs.

B. Developed Drainage Plan

Developed flows have been calculated based on the impervious areas associated with the proposed parking and storage area improvements. Developed drainage from Basin A will continue to sheet flow southwesterly across the site.

Sub-Basin A1

The majority of the developed site has been delineated as Sub-Basin A1 (10.79-acres), and this area has been planned for compacted crushed asphalt surfacing and use as uncovered outdoor storage areas. Sub-Basin A1 will sheet flow southwesterly to the proposed private stormwater detention pond at the southwest corner of the property. Site drainage from Basin A1 will flow southwest to Design Point #A1 (Detention Pond A1), with developed peak flows calculated as $Q_5 = 24.5$ cfs and $Q_{100} = 49.2$ cfs.

The 18" HDPE discharge pipe from Detention Pond A1 (along with overflows from the pond spillway) will drain southwesterly to the existing downstream drainage swale at the southwest boundary of the property. A riprap apron will be provided for erosion control at the pipe outlet.

Sub-Basin A2

The vegetated areas along the south and west edges of the developed site has been delineated as Sub-Basin A2 (1.55-acres), which will sheet flow southwesterly to the adjoining grass-lined drainage swales along the perimeter of the property. Developed peak flows from Sub-Basin A2 are calculated as $Q_5 = 0.4$ cfs and $Q_{100} = 3.0$ cfs.

Sub-Basin A2 is excluded from permanent water quality requirements based on ECM Appendix I, which allows for 20%, not to exceed 1-acre, of the applicable development site area to not be captured. The disturbed area within Basin A2 is limited to 0.6 acres.

Combined Flows and Developed Drainage Impact

Site drainage from Basins A1 and A2 will continue to flow southwest to Design Point #1, with developed peak flows calculated as $Q_5 = 24.8$ cfs and $Q_{100} = 52.0$ cfs.

Developed drainage impacts will be mitigated by routing developed flows through the proposed Detention Pond A1, and the resulting detained flows at Design Point #1 are calculated as $Q_5 = 0.7$ cfs and $Q_{100} = 10.2$ cfs. The detained flows discharged downstream of the property will be significantly lower than the historic flows.

Hydrologic and hydraulic calculations for the site are detailed in Appendix B, and peak flows are identified on Figure D1 (Appendix D).

III. DRAINAGE PLANNING FOUR STEP PROCESS

El Paso County Drainage Criteria require drainage planning to include a Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long-term source controls.

As stated in ECM Appendix I.7., the Four Step Process is applicable to all new and re-development projects with construction activities that disturb 1 acre or greater or that disturb less than 1 acre but are part of a larger common plan of development. The Four Step Process has been implemented as follows in the planning of this project:

<u>Step 1: Employ Runoff Reduction Practices</u>

- Extended Detention Basin: Developed flows from the site will be routed through the proposed on-site detention basin, which will be grass-lined to encourage stormwater infiltration.

<u>Step 2: Stabilize Drainageways</u>

- There are no major drainageways within this project site. Implementation of the proposed on-site drainage improvements and detention basin will minimize downstream drainage impacts from this site.

<u>Step 3: Provide Water Quality Capture Volume (WQCV)</u>

- EDB: The developed site will drain through an on-site Private Extended Detention Basin (EDB-A1) at the southwest corner of the property. The extended detention basin which will capture and slowly release the WQCV over an extended release period.

<u>Step 4: Consider Need for Industrial and Commercial BMPs</u>

- The property owner will implement a Stormwater Management Plan including proper housekeeping practices and spill containment procedures.
- On-site drainage will be routed through the Full-Spectrum Extended Detention Basin (EDB-A1) to minimize introduction of contaminants to the downstream drainage system.

IV. FLOODPLAIN IMPACTS

According to the FEMA floodplain map for this area, El Paso County FIRM Panel No. 08041C0561G, dated December 7, 2018, the site is located beyond the limits of any delineated 100-year floodplains.

V. STORMWATER DETENTION AND WATER QUALITY

Proposed drainage improvements will include construction of a new Private Full-Spectrum Extended Detention Basin (EDB-A1) to meet current full-spectrum detention design standards. The proposed detention facility has been designed to provide the required stormwater detention and water quality mitigation for the overall site in accordance with current El Paso County drainage criteria. The required on-site detention volume has been calculated based on the developed impervious area of the site. While the current development plan shows proposed crushed asphalt paving over the majority of the site, the detention pond has been conservatively designed assuming potential future asphalt pavement of the full developed site area.

The proposed Detention Basin has been designed utilizing the Denver Mile High Flood District's "MH-Detention_v4.07" software package. Calculations and details for the proposed Detention Basin are enclosed in Appendix C, and design parameters for the Detention Basin are summarized as follows:

Detention Basin	Tributary Drainage Basins	Tributary Area (ac)	Impervious Percentage	Min. 100-Yr FSD Vol. (af)	Design Volume (af)
A1	OA1-A1	12.4	68.0	1.6	1.9

The proposed on-site Full-Spectrum Detention Pond EDB-A1 provides a storage volume of 1.9 acre-feet, which meets the required 100-year detention and WQCV volume.

The proposed detention pond will include an outlet structure with a water quality orifice plate to maintain discharges below the allowable release rates. The pond outlet structure has been designed for a 40-hour release of the WQCV, and outlet structure sizing to maintain maximum allowable release rates from the pond. The detention pond will have a grass-lined bottom to encourage infiltration of stormwater prior to discharging into the downstream drainage system.

Forebays are not required due to the sheet flow (minimal concentrated flows) entering the proposed detention pond. Concrete trickle channels will be provided along the bottom of the pond.

The new on-site Detention Basin will be privately owned and maintained by the property owner, and maintenance access will be provided from the existing gravel driveway within the site.

As detailed in the detention basin calculations in Appendix C, detained peak flows from at Design Point #A1 are calculated as Q_5 = 0.7 cfs and Q_{100} = 10.2 cfs, well below the calculated historic flows.

The estimated cost for the proposed private detention facilities is approximately $28,232 (see estimate in Appendix C).

<u>Areas Excluded from Water Quality Facilities</u>

As discussed in Section II.B. above, Sub-Basin A2 (1.55-acres) is excluded from permanent water quality requirements based on ECM Appendix I, which allows for 20%, not to exceed 1-acre, of the applicable development site area to not be captured. The disturbed area within Basin A2 is limited to 0.6 acres.

VI. DRAINAGE BASIN FEES

The proposed site development will include construction of private stormwater detention and water quality facilities. No public drainage improvements are required.

The site lies entirely within the Sand Creek Drainage Basin, which is tributary to Fountain Creek.

Drainage and bridge fees are not applicable at this time as this site is a previously platted property (Lot 1, Abiding Word Lutheran Church Subdivision).

VII. SUMMARY

The developed drainage patterns for the proposed Kang Storage site development at 11401 E. Highway 24 will remain consistent with the historic drainage patterns for this site. Developed flows from the site will drain through a Private Full-Spectrum Detention Pond at the southwest corner of the property prior to discharging to the existing downstream drainage system. The existing grass-lined drainage swale downstream of the proposed detention pond outlet pipe and spillway (southwest corner of the property) is in stable, well-vegetated condition, and the existing swale serves as a suitable drainage outfall.

The proposed on-site Detention Pond has been designed to provide both stormwater detention and water quality requirements for the site in accordance with El Paso County Drainage Criteria Manual standards. Construction and proper maintenance of the on-site drainage facilities and Extended Detention Basin, in conjunction with proper erosion control practices, will ensure that this developed site has no significant adverse drainage impact on downstream or surrounding areas.

APPENDIX A

SOILS INFORMATION

United States Department of Agriculture

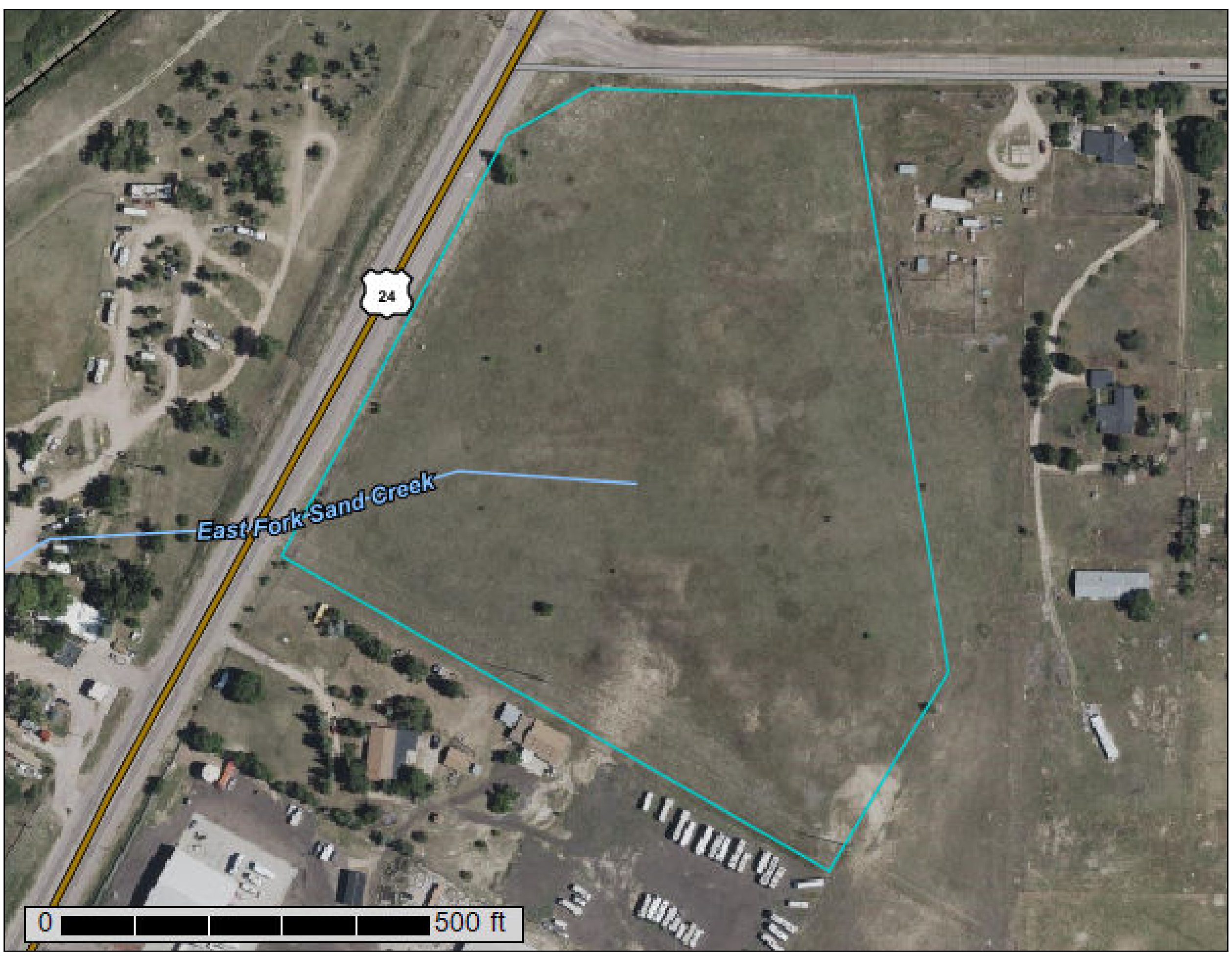
NRCS

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



March 16, 2026

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.

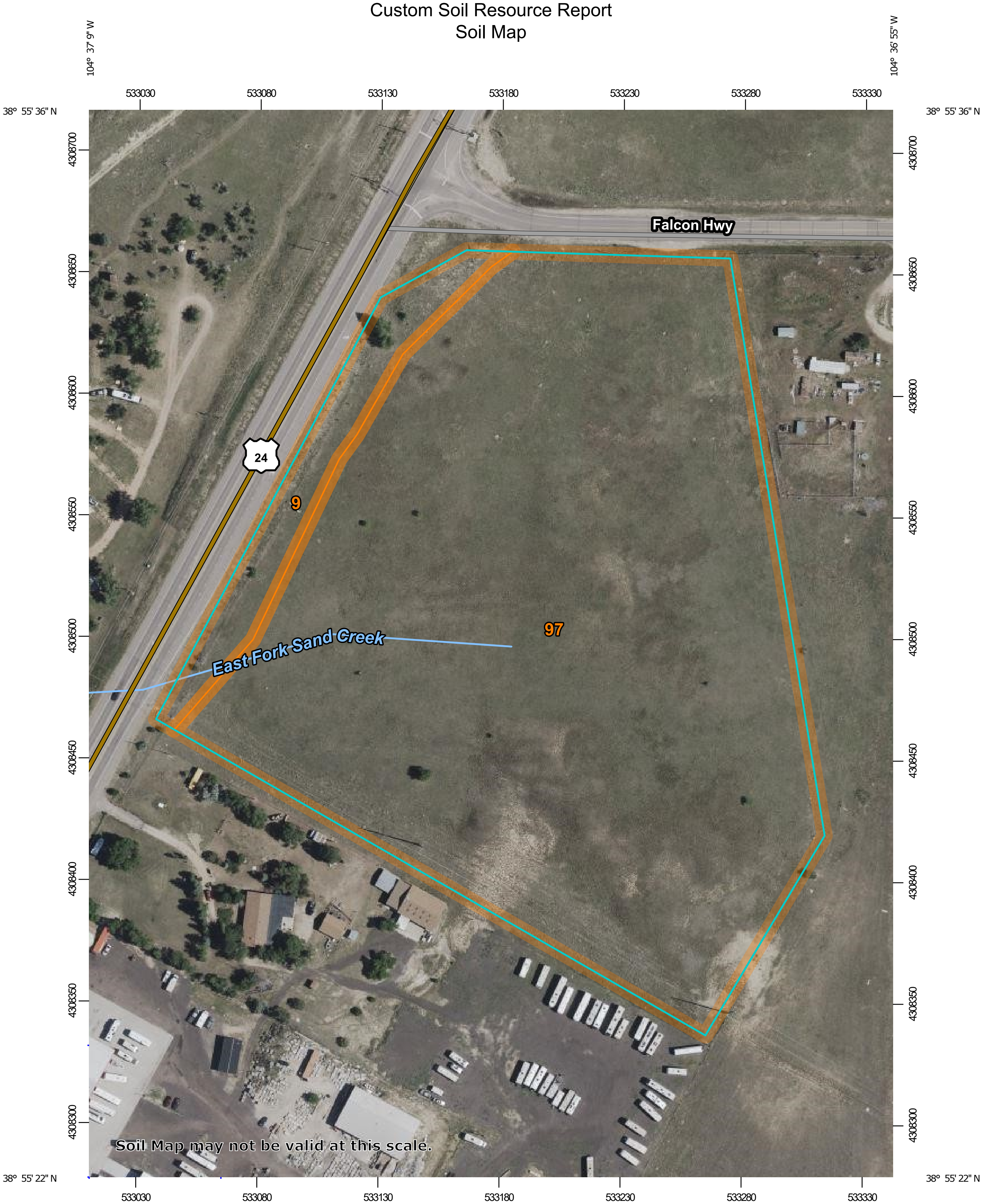
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree 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.

Soil Map



Map Scale: 1:2,140 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0, 30, 60, 120, 180

Feet: 0, 100, 200, 400, 600

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 23, Aug 29, 2025

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

Date(s) aerial images were photographed: Jul 23, 2024—Aug 4, 2024

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
9	Blakeland-Fluvaquentic Haplaquolls	1.0	7.2%
97	Truckton sandy loam, 3 to 9 percent slopes	13.2	92.8%
Totals for Area of Interest		**14.2**	**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

9—Blakeland-Fluvaquentic Haplaquolls

Map Unit Setting

National map unit symbol: 36b6
Landscape: Uplands
Elevation: 3,500 to 5,800 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 46 to 55 degrees F
Frost-free period: 110 to 165 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 60 percent
Fluvaquentic haplaquolls and similar soils: 38 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landscape: Uplands
Landform: Flats, Hills
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose and/or eolian deposits derived from arkose

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
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 content: 5 percent
Available water supply, 0 to 60 inches: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Description of Fluvaquentic Haplaquolls

Setting

Landform: Swales
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 12 inches: variable
H2 - 12 to 60 inches: stratified very gravelly sand to loam

Properties and qualities

Slope: 1 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 6.00 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): 6w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: D
Ecological site: R048AY241CO - Mountain Meadow
Hydric soil rating: Yes

Minor Components

Other soils

Percent of map unit: 1 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

97—Truckton sandy loam, 3 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2x0j2
Landscape: Uplifted piedmonts
Elevation: 5,300 to 6,850 feet
Mean annual precipitation: 14 to 19 inches

Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 85 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Truckton and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Truckton

Setting

Landscape: Uplifted piedmonts
Landform: Backslopes of hillslopes, Sideslopes of interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Re-worked alluvium derived from arkose

Typical profile

A - 0 to 4 inches: sandy loam
Bt1 - 4 to 12 inches: sandy loam
Bt2 - 12 to 19 inches: sandy loam
C - 19 to 80 inches: sandy loam

Properties and qualities

Slope: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Maximum salinity: Nonsaline (0.1 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.6 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Blakeland

Percent of map unit: 8 percent
Landscape: Uplifted piedmonts
Landform: Shoulders and backslopes of hillslopes, Sideslopes and crests of interfluves
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex, linear

Across-slope shape: Convex, linear
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Bresser

Percent of map unit: 7 percent
Landscape: Uplifted piedmonts
Landform: Toeslopes or footslopes of low hills, Baseslopes of interfluves
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

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

Map Scale: 1:2,140 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 30, 60, 120, 180

Feet: 0, 100, 200, 400, 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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 23, Aug 29, 2025

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

Date(s) aerial images were photographed: Jul 23, 2024—Aug 4, 2024

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
9	Blakeland-Fluvaquentic Haplaquolls	A	1.0	7.2%
97	Truckton sandy loam, 3 to 9 percent slopes	A	13.2	92.8%
Totals for Area of Interest			**14.2**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX B

HYDROLOGIC CALCULATIONS

Table 6-6. Runoff Coefficients for Rational Method

(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis-- Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

3.2 Time of Concentration

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

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

$$t_c = t_i + t_t \qquad \text{(Eq. 6-7)}$$

Where:

t_c = time of concentration (min)

t_i = overland (initial) flow time (min)

t_t = travel time in the ditch, channel, gutter, storm sewer, etc. (min)

3.2.1 Overland (Initial) Flow Time

The overland flow time, t_i, may be calculated using Equation 6-8.

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \qquad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)

C_v = conveyance coefficient (from Table 6-7)

S_w = watercourse slope (ft/ft)

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

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

The travel time is calculated by dividing the flow distance (in feet) by the velocity calculated using Equation 6-9 and converting units to minutes.

The time of concentration (t_c) is then the sum of the overland flow time (t_i) and the travel time (t_t) per Equation 6-7.

3.2.3 First Design Point Time of Concentration in Urban Catchments

Using this procedure, the time of concentration at the first design point (typically the first inlet in the system) in an urbanized catchment should not exceed the time of concentration calculated using Equation 6-10. The first design point is defined as the point where runoff first enters the storm sewer system.

$$t_c = \frac{L}{180} + 10 \qquad \text{(Eq. 6-10)}$$

Where:

t_c = maximum time of concentration at the first design point in an urban watershed (min)

L = waterway length (ft)

Equation 6-10 was developed using the rainfall-runoff data collected in the Denver region and, in essence, represents regional "calibration" of the Rational Method. Normally, Equation 6-10 will result in a lesser time of concentration at the first design point and will govern in an urbanized watershed. For subsequent design points, the time of concentration is calculated by accumulating the travel times in downstream drainageway reaches.

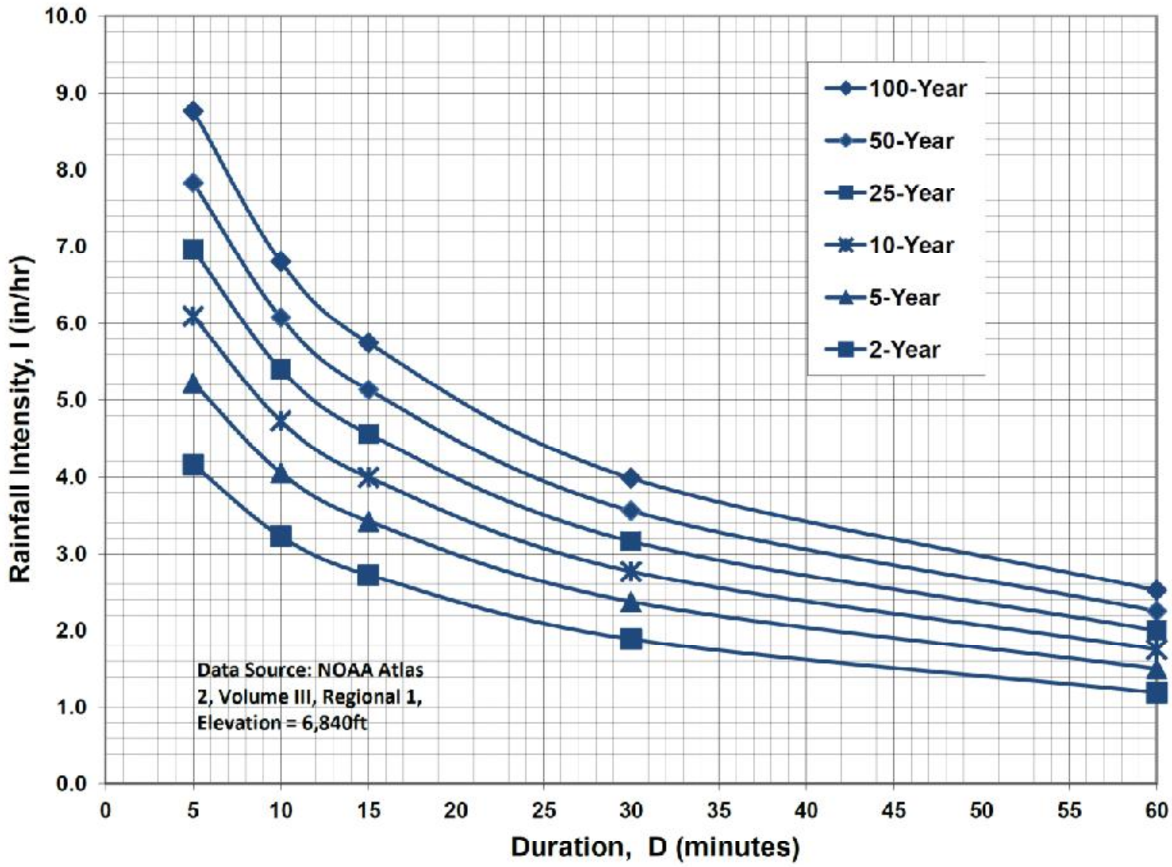
3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

3.2.5 Post-Development Time of Concentration

As Equation 6-8 indicates, the time of concentration is a function of the 5-year runoff coefficient for a drainage basin. Typically, higher levels of imperviousness (higher 5-year runoff coefficients) correspond to shorter times of concentration, and lower levels of imperviousness correspond to longer times of

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

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

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

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

$\mathbf{I_{5} = -1.50 \ln(D) + 7.583}$

$\mathbf{I_{2} = -1.19 \ln(D) + 6.035}$

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

KANG PARCEL
COMPOSITE RUNOFF COEFFICIENTS

DEVELOPED CONDITIONS

5-YEAR C VALUES

BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	C	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	C	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	C	WEIGHTED C VALUE
OA1	1.64	0.550	PAVEMENT	0.9	0.000	GRAVEL	0.59	1.090	LANDSCAPED	0.08	0.355
A1	10.79	7.894	ASPHALT / CONCRETE	0.9	0.000	GRAVEL	0.59	2.896	LANDSCAPED	0.08	0.680
OA1,A1	12.43										0.637
A2	1.55	0.000	ASPHALT / CONCRETE	0.9	0.000	GRAVEL	0.59	1.550	LANDSCAPED	0.08	0.080
OA1,A1,A2	13.98										0.575

100-YEAR C VALUES

BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	C	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	C	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	C	WEIGHTED C VALUE
OA1	1.64	0.550	PAVEMENT	0.96	0.000	GRAVEL	0.70	1.090	LANDSCAPED	0.35	0.555
A1	10.79	7.894	ASPHALT / CONCRETE	0.96	0.000	GRAVEL	0.70	2.896	LANDSCAPED	0.35	0.796
OA1,A1	12.43										0.764
A2	1.55	0.000	ASPHALT / CONCRETE	0.96	0.000	GRAVEL	0.70	1.550	LANDSCAPED	0.35	0.350
OA1,A1,A2	13.98										0.718

KANG PARCEL - LOT 1, ABIDING WORD LUTHERAN SUBDIVISION
RATIONAL METHOD HYDROLOGIC CALCULATIONS

HISTORIC CONDITIONS

BASIN	DESIGN POINT	AREA (AC)	C 5-YEAR	C 100-YEAR	Overland Flow LENGTH (FT)	Overland Flow SLOPE (FT/FT)	Overland Flow Tco (1) (MIN)	Channel flow CHANNEL LENGTH (FT)	Channel flow CONVEYANCE COEFFICIENT C	Channel flow SLOPE (FT/FT)	Channel flow SCS (2) VELOCITY (FT/S)	Channel flow Tt (3) (MIN)	TOTAL Tc (4) (MIN)	TOTAL Tc (4) (MIN)	INTENSITY (5) 5-YR (IN/HR)	INTENSITY (5) 100-YR (IN/HR)	PEAK FLOW Q5 (6) (CFS)	PEAK FLOW Q100 (6) (CFS)
OA1		1.64	0.080	0.350	100	0.010	18.7	185	20	0.008	1.79	1.7	20.4	20.4	3.06	5.14	0.40	2.95
A		12.4	0.080	0.350	100	0.020	14.8	735	20	0.013	2.28	5.4	20.2	20.2	3.07	5.16	3.04	22.33
OA1,A	**1**	**14.00**	**0.080**	**0.350**									**20.4**	**20.4**	**3.06**	**5.14**	**3.43**	**25.17**

DEVELOPED CONDITIONS

BASIN	DESIGN POINT	AREA (AC)	C 5-YEAR	C 100-YEAR	Overland Flow LENGTH (FT)	Overland Flow SLOPE (FT/FT)	Overland Flow Tco (1) (MIN)	Channel flow CHANNEL LENGTH (FT)	Channel flow CONVEYANCE COEFFICIENT C	Channel flow SLOPE (FT/FT)	Channel flow SCS (2) VELOCITY (FT/S)	Channel flow Tt (3) (MIN)	TOTAL Tc (4) (MIN)	TOTAL Tc (4) (MIN)	INTENSITY (5) 5-YR (IN/HR)	INTENSITY (5) 100-YR (IN/HR)	PEAK FLOW Q5 (6) (CFS)	PEAK FLOW Q100 (6) (CFS)
OA1		1.64	0.355	0.555	100	0.010	13.6	185	20	0.008	1.79	1.7	15.4	15.4	3.49	5.85	2.03	5.33
Tt OA1 to DP-A1								685	20	0.015	2.45	4.7						
A1		10.79	0.680	0.796	100	0.020	6.1	735	20	0.013	2.28	5.4	11.5	11.5	3.92	6.59	28.78	56.56
OA1,A1	**A1**	**12.43**	**0.637**	**0.764**									**20.0**	**20.0**	**3.09**	**5.18**	**24.45**	**49.22**
Tt DP-A1 to DP1								145	20	0.007	1.67	1.4						
A2		1.55	0.080	0.350	100	0.020	14.8	515	15	0.030	2.60	3.3	18.1	18.1	3.24	5.43	0.40	2.95
OA1,A1,A2	**1**	**13.98**	**0.575**	**0.718**									**20.0**	**20.0**	**3.09**	**5.18**	**24.82**	**52.02**

DETAINED CONDITIONS

BASIN	DESIGN POINT	AREA (AC)	C 5-YEAR	C 100-YEAR	Overland Flow LENGTH (FT)	Overland Flow SLOPE (FT/FT)	Overland Flow Tco (1) (MIN)	Channel flow CHANNEL LENGTH (FT)	Channel flow CONVEYANCE COEFFICIENT C	Channel flow SLOPE (FT/FT)	Channel flow SCS (2) VELOCITY (FT/S)	Channel flow Tt (3) (MIN)	TOTAL Tc (4) (MIN)	TOTAL Tc (4) (MIN)	INTENSITY (5) 5-YR (IN/HR)	INTENSITY (5) 100-YR (IN/HR)	PEAK FLOW Q5 (6) (CFS)	PEAK FLOW Q100 (6) (CFS)
POND A1 OUTFLOW		12.43															**0.3**	**7.2**
A2		1.55	0.080	0.350	100	0.020	14.8	515	15	0.030	2.60	3.3	18.1	18.1	3.24	5.43	0.40	2.95
A1,A2	1	13.98	0.438	0.598													**0.70**	**10.15**

1) OVERLAND FLOW Tco = (0.395*(1.1-RUNOFF COEFFICIENT)*(OVERLAND FLOW LENGTH^(0.5)/(SLOPE^(0.333))
2) SCS VELOCITY = C * ((SLOPE(FT/FT)^0.5)
C = 2.5 FOR HEAVY MEADOW
C = 5 FOR TILLAGE/FIELD
C = 7 FOR SHORT PASTURE AND LAWNS
C = 10 FOR NEARLY BARE GROUND
C = 15 FOR GRASSED WATERWAY
C = 20 FOR PAVED AREAS AND SHALLOW PAVED SWALES
3) MANNING'S CHANNEL TRAVEL TIME = L/V (WHEN CHANNEL VELOCITY IS KNOWN)
4) Tc = Tco + Tt
*** IF TOTAL TIME OF CONCENTRATION IS LESS THAN 5 MINUTES, THEN 5 MINUTES IS USED
5) INTENSITY BASED ON I-D-F EQUATIONS IN CITY OF COLORADO SPRINGS DRAINAGE CRITERIA MANUAL
$I_5 = -1.5 * \ln(Tc) + 7.583$
$I_{100} = -2.52 * \ln(Tc) + 12.735$
6) Q = CiA

APPENDIX C

DETENTION POND CALCULATIONS

KANG STORAGE
COMPOSITE IMPERVIOUS AREAS

IMPERVIOUS AREAS - INITIAL CONDITIONS

BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	WEIGHTED % IMP
OA1	1.64	0.550	PAVEMENT	100	0.000	GRAVEL	80.00	1.090	LANDSCAPED	0	33.537
A1	10.79	0.087	ASPHALT / CONCRETE	100	7.807	GRAVEL	80.00	2.896	LANDSCAPED	0	58.690
OA1,A1	12.43										55.371
A2	1.55	0.000	BUILDING / CONCRETE	100	0.000	GRAVEL	80.00	1.550	LANDSCAPED	0	0.000
OA1,A1,A2	13.98										49.232

IMPERVIOUS AREAS - POTENTIAL ULTIMATE CONDITIONS (ON-SITE STORAGE AREA FULLY PAVED)

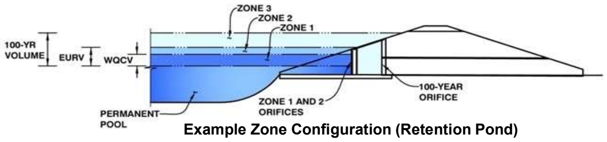
BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	WEIGHTED % IMP
OA1	1.64	0.550	PAVEMENT	100	0.000	GRAVEL	80.00	1.090	LANDSCAPED	0	33.537
A1	10.79	7.894	ASPHALT / CONCRETE	100	0.000	GRAVEL	80.00	2.896	LANDSCAPED	0	73.160
OA1,A1	**12.43**										**67.932**
A2	1.55	0.000	BUILDING / CONCRETE	100	0.000	GRAVEL	80.00	1.550	LANDSCAPED	0	0.000
OA1,A1,A2	13.98										60.401

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.07 (June 2025)

Project: **Kang Storage (11401 E. HIGHWAY 24)**

Basin ID: **EDB-A1**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected SCM Type =	**EDB**			
Watershed Area =	12.43	acres		
Watershed Length =	970	ft		
Watershed Length to Centroid =	490	ft		
Watershed Slope =	0.013	ft/ft		
Watershed Imperviousness =	68.00%	percent		
Percentage Hydrologic Soil Group A =	100.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Target WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.276	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	1.062	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.759	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.992	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.179	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.418	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.652	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.934	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	2.551	acre-feet	3.14	inches
Approximate 2-yr Detention Volume =	0.692	acre-feet		
Approximate 5-yr Detention Volume =	0.904	acre-feet		
Approximate 10-yr Detention Volume =	1.088	acre-feet		
Approximate 25-yr Detention Volume =	1.305	acre-feet		
Approximate 50-yr Detention Volume =	1.435	acre-feet		
Approximate 100-yr Detention Volume =	1.567	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.276	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.786	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.505	acre-feet
Total Detention Basin Volume =	1.567	acre-feet

Depth Increment = | | ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	10	0.000		
Bot EL=6809.0	--	1.00	--	--	--	10,369	0.238	5,189	0.119
	--	2.00	--	--	--	23,000	0.528	21,874	0.502
Spillway=6812.0	--	4.00	--	--	--	39,225	0.900	84,099	1.931
Top Berm=6814.0	--	6.00	--	--	--	73,680	1.691	197,004	4.523
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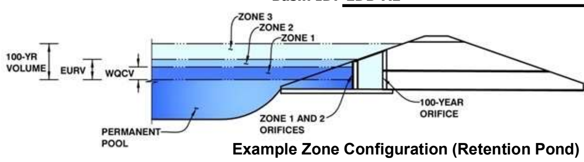
DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)

Project: **Kang Storage (11401 E. HIGHWAY 24)**

Basin ID: **EDB-A1**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.51	0.276	Orifice Plate
Zone 2 (EURV)	2.92	0.786	Orifice Plate
Zone 3 (100-year)	3.58	0.505	Weir&Pipe (Restrict)
Total (all zones)		1.567	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration SCM)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation SCM)

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.92	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	9.60	inches
Orifice Plate: Orifice Area per Row =	2.22	sq. inches (diameter = 1-11/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row =	1.542E-02	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.97	1.95					
Orifice Area (sq. inches)	2.22	2.22	2.22					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	2.50	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.00	N/A	feet
Overflow Weir Slope Length =	2.50	N/A	feet
Grate Open Area / 100-yr Orifice Area =	8.11	N/A	
Overflow Grate Open Area w/o Debris =	6.96	N/A	ft^2
Overflow Grate Open Area w/ Debris =	3.48	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	8.80		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.86	N/A	ft^2
Outlet Orifice Centroid =	0.42	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.55	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	11.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.87	feet
Stage at Top of Freeboard =	5.87	feet
Basin Area at Top of Freeboard =	1.64	acres
Basin Volume at Top of Freeboard =	4.31	acre-ft

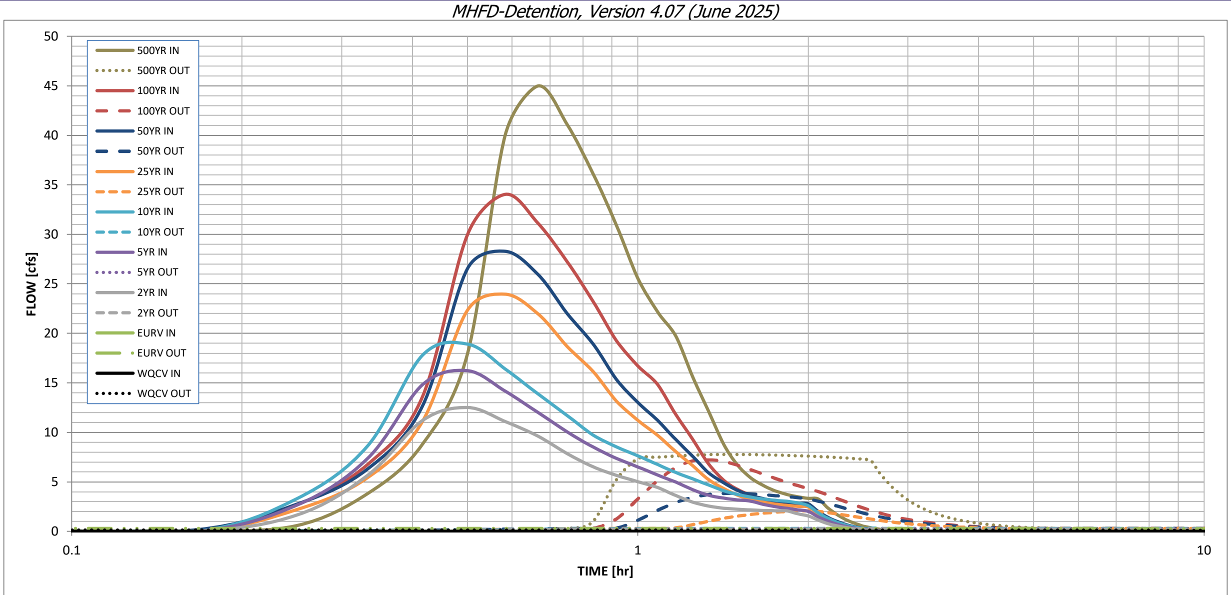
Routed Hydrograph Results

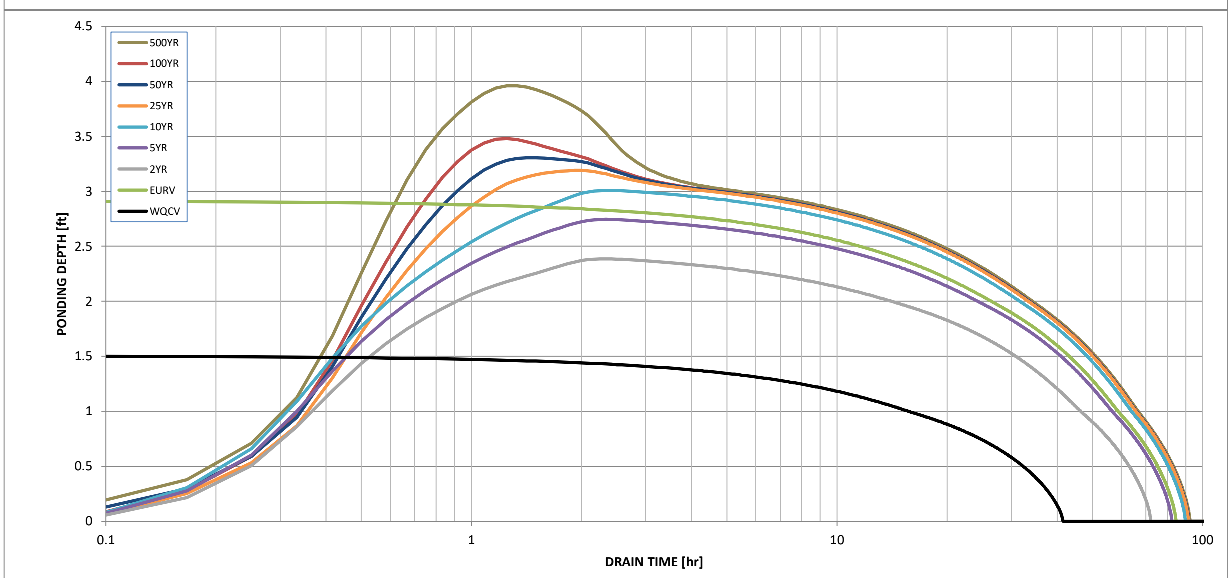
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

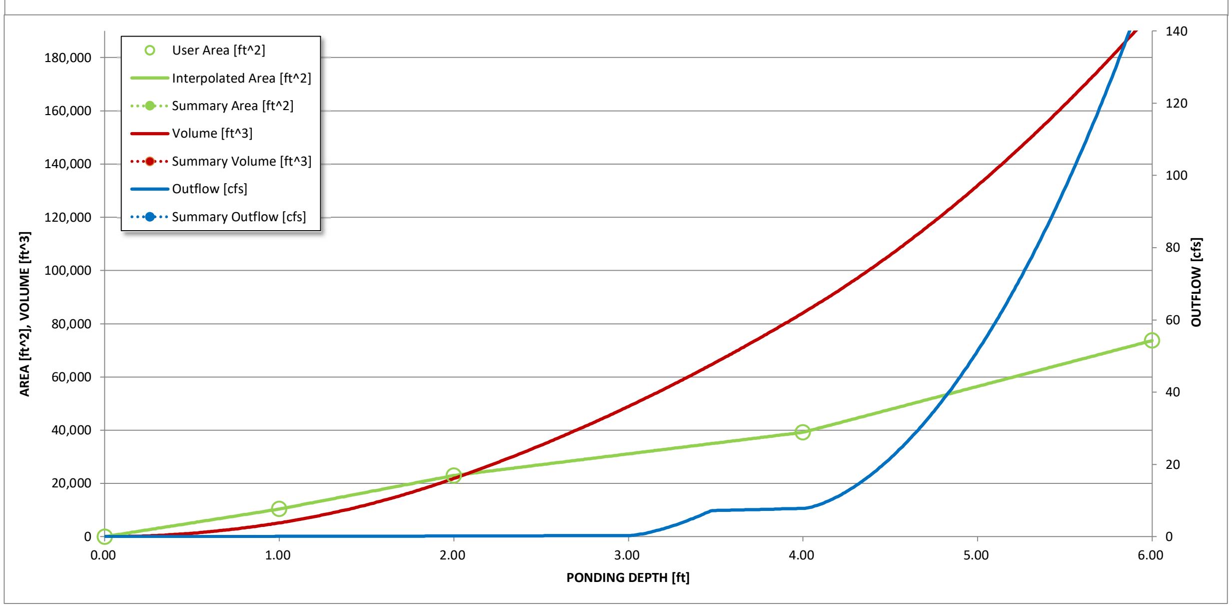
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.276	1.062	0.759	0.992	1.179	1.418	1.652	1.934	2.551
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.759	0.992	1.179	1.418	1.652	1.934	2.551
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	0.4	0.6	2.7	5.0	7.8	13.6
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.02	0.04	0.05	0.22	0.40	0.63	1.09
Peak Inflow Q (cfs) =	N/A	N/A	12.5	16.2	18.9	23.9	28.3	34.1	45.0
Peak Outflow Q (cfs) =	0.1	0.3	0.3	0.3	0.3	2.1	3.8	7.2	7.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.6	0.5	0.8	0.8	0.9	0.6
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.2	0.5	1.0	1.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	75	65	73	79	80	78	77	74
Time to Drain 99% of Inflow Volume (hours) =	**40**	80	69	78	85	86	86	85	84
Maximum Ponding Depth (ft) =	1.51	2.92	2.39	2.74	3.01	3.19	3.30	3.48	3.96
Area at Maximum Ponding Depth (acres) =	0.39	0.70	0.60	0.67	0.71	0.75	0.77	0.80	0.89
Maximum Volume Stored (acre-ft) =	0.278	1.067	0.716	0.944	1.123	1.262	1.346	1.480	1.886

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.07 (June 2025)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0	0.00	0.00	0.00	0.00	0.00	0.19	0.02	0.60
	0:15:00	0	0.00	1.64	2.67	3.31	2.22	2.75	2.71	3.82
	0:20:00	0	0.00	5.66	7.36	8.63	5.43	6.30	6.78	8.78
	0:25:00	0	0.00	11.20	14.80	17.78	11.08	12.65	13.59	17.94
	0:30:00	0	0.00	12.50	16.22	18.93	22.33	26.54	29.97	40.04
	0:35:00	0	0.00	11.10	14.15	16.41	23.94	28.28	34.05	44.98
	0:40:00	0	0.00	9.61	12.00	13.87	21.95	25.92	31.09	41.10
	0:45:00	0	0.00	7.87	10.05	11.71	18.69	22.02	27.25	36.15
	0:50:00	0	0.00	6.53	8.52	9.75	16.15	18.95	23.25	30.93
	0:55:00	0	0.00	5.67	7.38	8.55	13.18	15.36	19.28	25.57
	1:00:00	0	0.00	5.03	6.52	7.64	11.22	13.02	16.72	22.19
	1:05:00	0	0.00	4.44	5.71	6.75	9.71	11.22	14.83	19.72
	1:10:00	0	0.00	3.62	4.98	5.94	8.05	9.27	11.81	15.60
	1:15:00	0	0.00	2.96	4.21	5.30	6.62	7.57	9.29	12.15
	1:20:00	0	0.00	2.56	3.65	4.69	5.23	5.93	6.82	8.84
	1:25:00	0	0.00	2.35	3.36	4.12	4.35	4.92	5.19	6.70
	1:30:00	0	0.00	2.23	3.18	3.73	3.67	4.13	4.23	5.41
	1:35:00	0	0.00	2.16	3.06	3.46	3.24	3.64	3.65	4.63
	1:40:00	0	0.00	2.12	2.74	3.26	2.94	3.31	3.25	4.09
	1:45:00	0	0.00	2.09	2.50	3.13	2.75	3.09	2.98	3.74
	1:50:00	0	0.00	2.06	2.32	3.04	2.62	2.94	2.79	3.49
	1:55:00	0	0.00	1.77	2.19	2.88	2.53	2.84	2.67	3.33
	2:00:00	0	0.00	1.56	2.03	2.60	2.47	2.78	2.62	3.26
	2:05:00	0	0.00	1.13	1.47	1.87	1.78	2.01	1.90	2.36
	2:10:00	0	0.00	0.80	1.04	1.32	1.26	1.42	1.35	1.68
	2:15:00	0	0.00	0.55	0.72	0.93	0.89	1.00	0.95	1.18
	2:20:00	0	0.00	0.38	0.49	0.63	0.61	0.68	0.65	0.81
	2:25:00	0	0.00	0.25	0.32	0.43	0.41	0.46	0.44	0.54
	2:30:00	0	0.00	0.16	0.22	0.28	0.28	0.31	0.30	0.37
	2:35:00	0	0.00	0.09	0.13	0.17	0.17	0.19	0.18	0.23
	2:40:00	0	0.00	0.04	0.07	0.09	0.09	0.10	0.10	0.12
	2:45:00	0	0.00	0.02	0.03	0.03	0.04	0.04	0.04	0.05
	2:50:00	0	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	2:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Kang Storage
Detention Pond A1 Spillway

Figure 13-12c. Emergency Spillway Protection

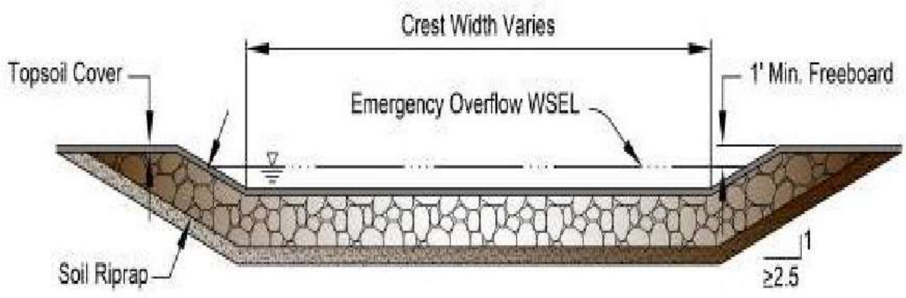
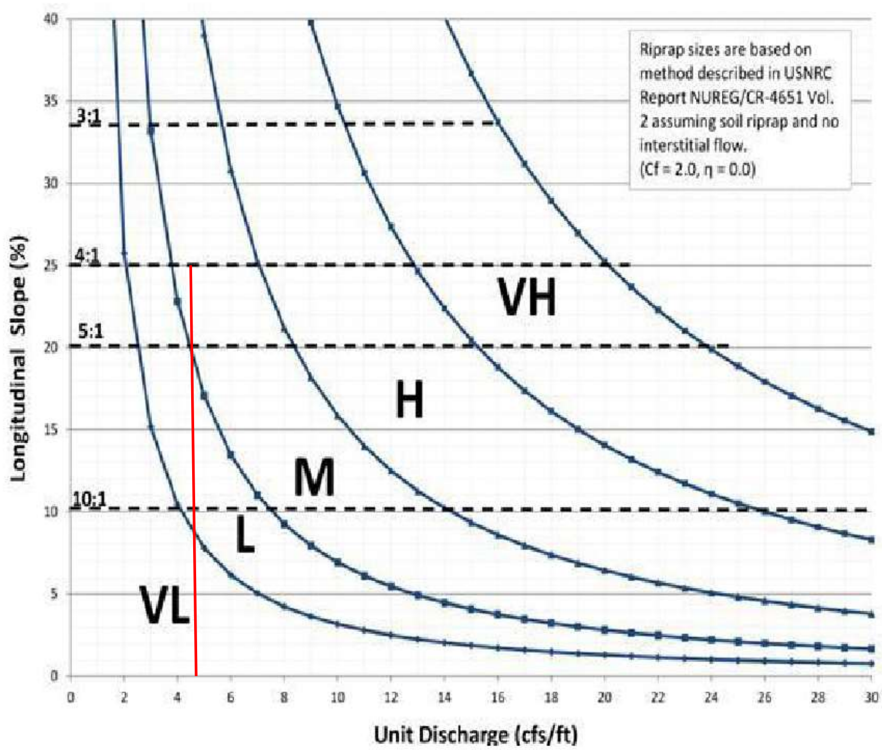


Figure 13-12d. Riprap Types for Emergency Spillway Protection



Spillway Q100 = 49.2 cfs (Undetained DP-A1)
Unit Discharge = (49.2 cfs / 11 ft) = 4.5
....Use Type M Riprap

Q100 (Pond Discharge) = 7.2 cfs; D = 1.5 ft
Q / D^1.5 = 7.2 / (1.5^1.5) = 3.9

$$H_a = \frac{(H + Y_n)}{2}$$ Equation 9-19

Where the maximum value of H_a shall not exceed H, and:

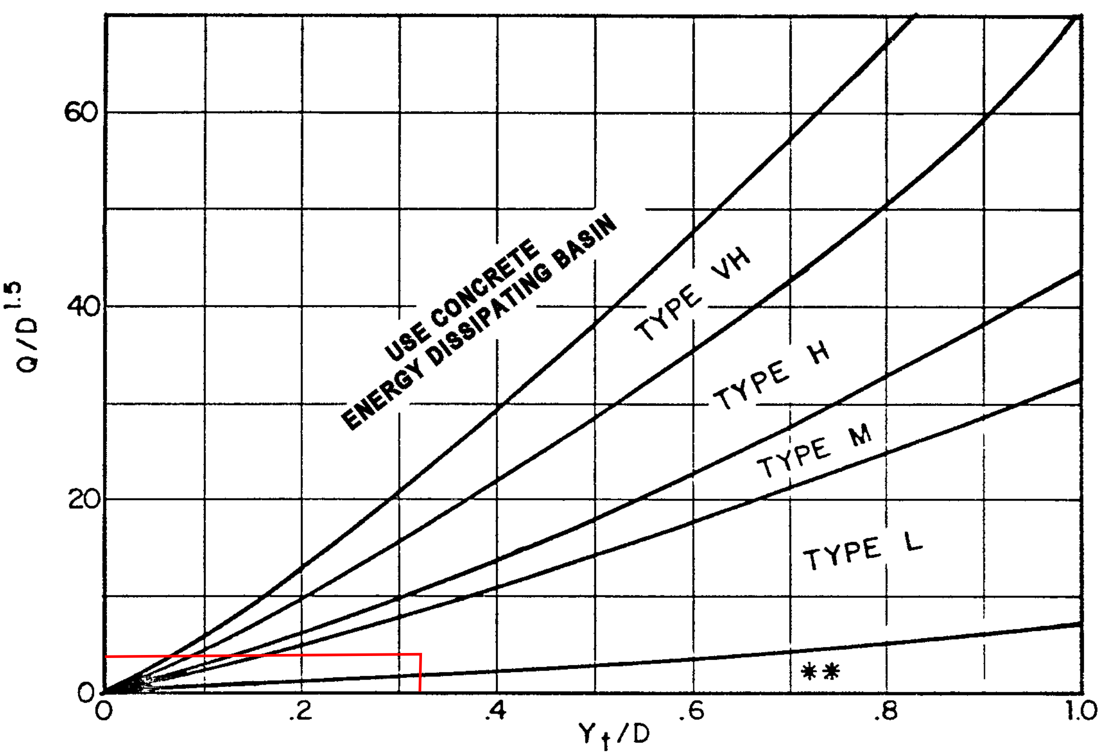
D_a = parameter to use in place of D in Figure 9-38 when flow is supercritical (ft)

D_c = diameter of circular culvert (ft)

H_a = parameter to use in place of H in Figure 9-39 when flow is supercritical (ft)

H = height of rectangular culvert (ft)

Y_n = normal depth of supercritical flow in the culvert (ft)



Yt = 0.5 ft; Yt / D = (0.5 / 1.5) = 0.33

Use D_a instead of D whenever flow is supercritical in the barrel.
** Use Type L for a distance of 3D downstream.

Use Type M (Conservative)

Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for Q/D2.5 ≤ 6.0)

KANG STORAGE - 11401 E. HIGHWAY 24
ENGINEER'S COST ESTIMATE
DRAINAGE IMPROVEMENTS - FULL-SPECTRUM DETENTION FACILITY (PRIVATE)

Item No.	Description	Quantity	Unit	Unit Cost ($$$)	Total Cost ($$$)
	PRIVATE DRAINAGE FACILITIES (NON-REIMBURSABLE)				
	Aggregate Base Course (Access Drive / Ramp)	32	CY	$61	$1,952
	Riprap Aprons (12" Riprap)	5	CY	$65	$325
	Concrete Trickle Channel	265	SY	$40	$10,600
	18" HDPE Pond Discharge Line	125	LF	$50	$6,250
	Detention Basin Outlet Structure	1	LS	$8,000	$8,000
	Buried Riprap Spillway	17	CY	$65	$1,105
	TOTAL				**$28,232**

The cost estimate submitted herein is based on time-honored practices within the construction industry. As such the engineer does not control the cost of labor, materials, equipment or a contractor's method of determining prices and competitive bidding practices or market conditions. The estimate represents our best judgement as design professionals using current information available at the time of the preparation. The engineer cannot guarantee that proposals, bids and/or construction costs will not vary from this cost estimate.

APPENDIX D

FIGURES

National Flood Hazard Layer FIRMette

FEMA

104°37'21"W 38°55'45"N

104°36'43"W 38°55'17"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

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*
		Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard *Zone X*
		Effective LOMRs
		Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	8	Coastal Transect
	513	Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped

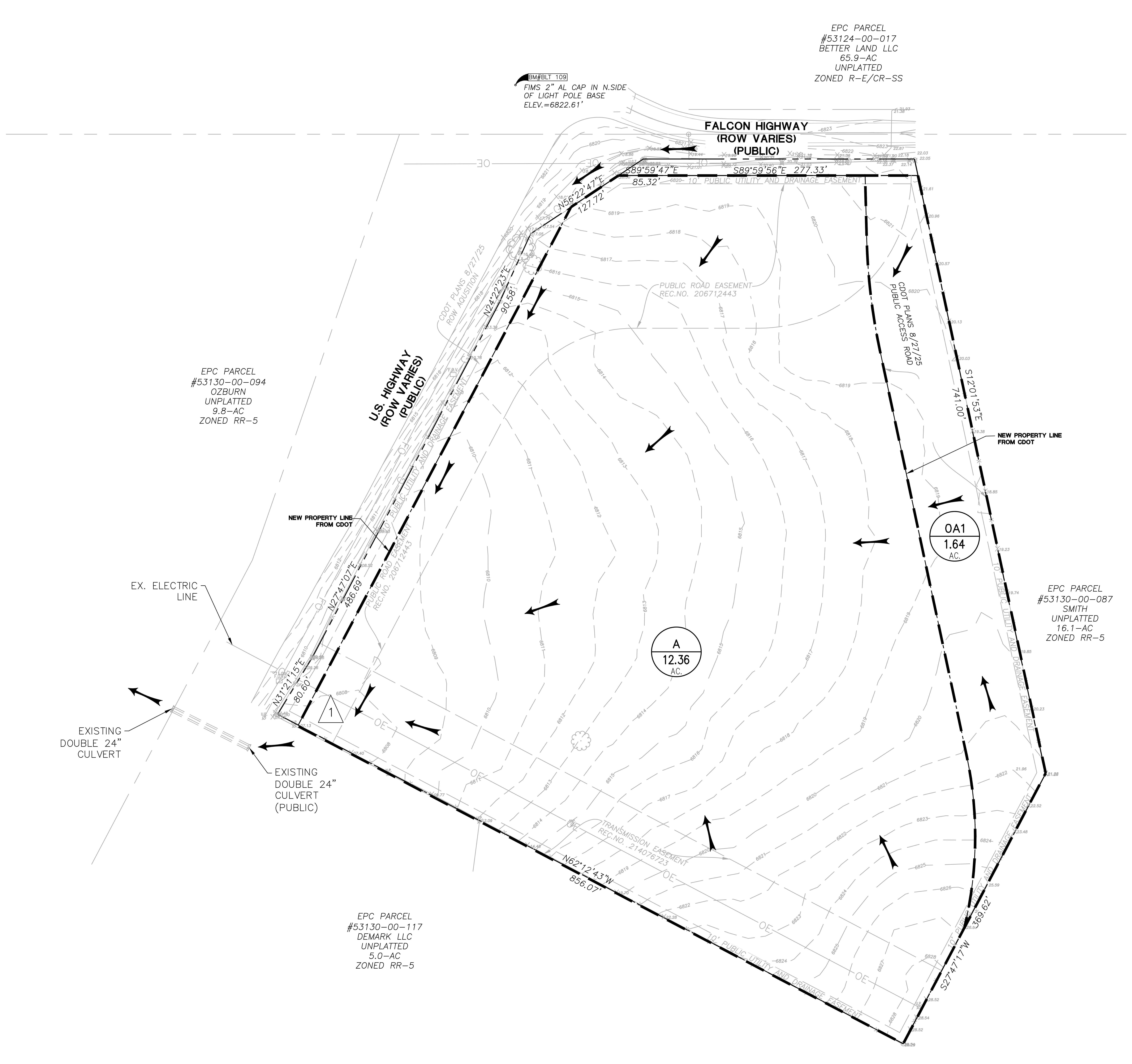
N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/21/2026 at 7:33 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



N

60' 0 60' 120'

ORIGINAL SCALE: 1"=60' (24"x36" SHEET)
CONTOUR INTERVAL: 2'

LEGEND

— — —	FEMA 100-YEAR FLOODWAY
— - —	FEMA 100-YR FLOODPLAIN
———	PROPERTY BOUNDARY
———	DRAINAGE BASIN BOUNDARY
6815	PROPOSED CONTOUR
6815	EXISTING CONTOUR
→	FLOWLINE
←	FLOW DIRECTION ARROW
1	DESIGN POINT
A / 0.5 AC	BASIN DESIGNATION; BASIN AREA (ACRES)
(E)	EXISTING
(P)	PROPOSED

BASIN SUMMARY TABLE

BASIN	Q_5 (CFS)	Q_{100} (CFS)
0A1	0.4	3.0
A	3.0	22.3

SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
1	3.4	25.2

BENCHMARK:
FIMS 2" AL CAP IN N. SIDE OF LIGHT POLE BASE
ELEV.=6822.61'

JPS ENGINEERING
19 E. Willamette Ave.
Colorado Springs, CO 80903
PH: 719-477-9429
FAX: 719-471-0766
www.jpsengr.com

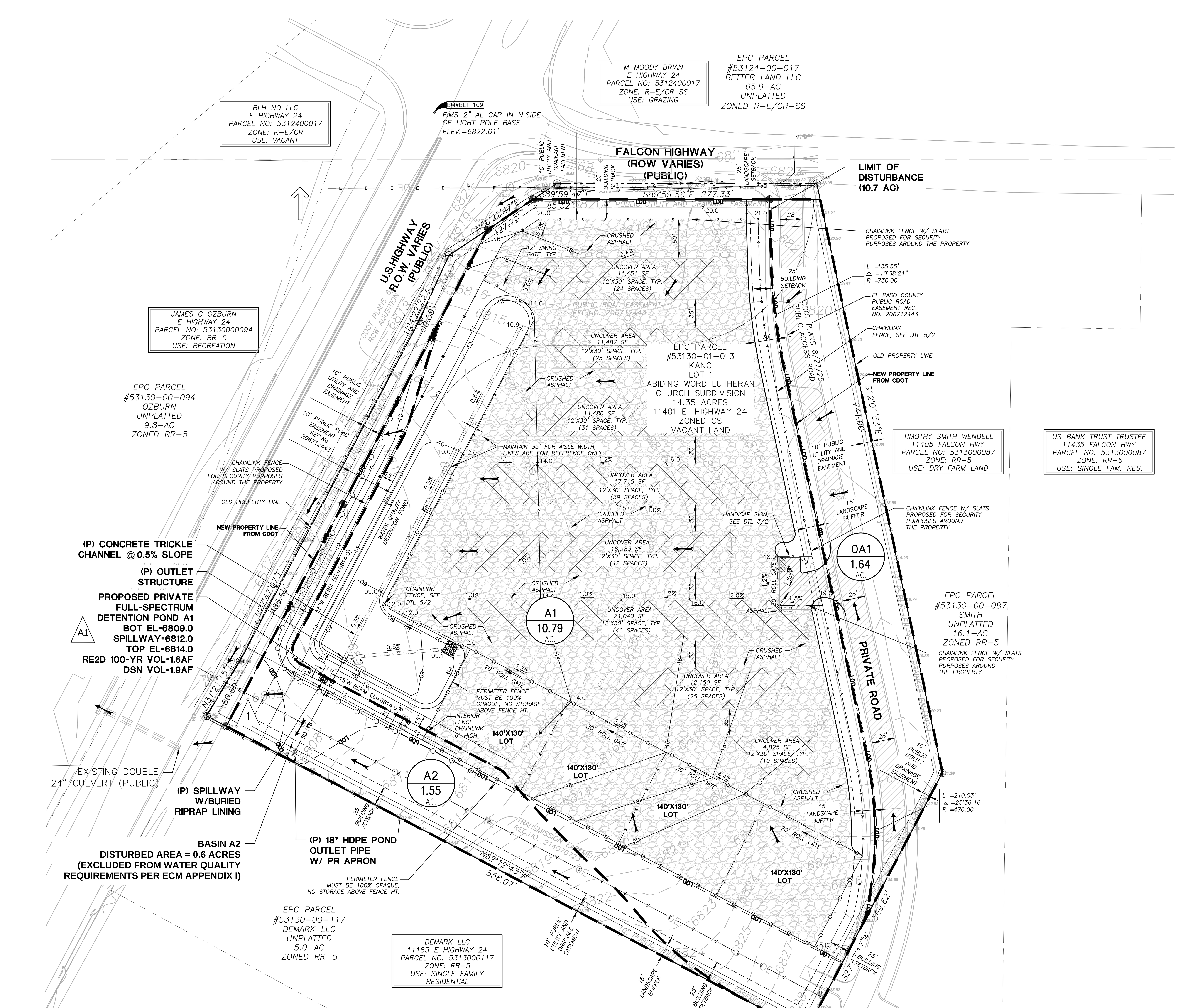
CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

No.	REVISION	BY	DATE

KANG STORAGE - 11401 E. HIGHWAY 24
LOT 1, ABIDING WORD LUTHERAN CHURCH SUBDIVISION

EXISTING CONDITIONS DRAINAGE PLAN

HORZ. SCALE: 1"=60'	DRAWN: PV
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: RIDGELINE	CHECKED: JPS
CREATED: 03/12/26	LAST MODIFIED: 06/22/26
PROJECT NO: 022601	MODIFIED BY: PV
SHEET:	EX1



⊕BENCHMARK:	
FIMS 2" AL CAP IN N. SIDE OF LIGHT POLE BASE ELEV.=6822.61'	

NOTE: PER STANDARD COUNTY DETENTION MAINTENANCE AGREEMENT, A BLANKET MAINTENANCE EASEMENT HAS BEEN PROVDED ACROSS THE PROPERTY.

ORIGINAL SCALE: 1"=60' (24"x36" SHEET)
CONTOUR INTERVAL:1'

LEGEND

- FEMA 100-YEAR FLOODWAY
- FEMA 100-YR FLOODPLAIN
- PROPERTY LINE
- DRAINAGE BASIN BOUNDARY
- EASEMENT LINE
- 6820 PROPOSED CONTOUR
- 6820 EXISTING CONTOUR
- × 49.0 PROPOSED SPOT ELEVATION (FLOWLINE)
- × 74.5 EXIST. SPOT ELEVATION
- 1.0% PROPOSED SLOPE
- TW TOP OF RETAINING WALL
- BW BOTTOM OF RETAINING WALL
- (E) EXISTING
- (P) PROPOSED
- PVT PRIVATE
- LOD LIMIT OF DISTURBANCE
- FLOWLINE
- FLOW DIRECTION ARROW
- BUILDINGS
- ASPHALT
- CONCRETE
- GRAVEL/CRUSHED ASPHALT
- GRASS/LANDSCAPED
- 1 DESIGN POINT
- A BASIN DESIGNATION
- XX AC BASIN AREA (ACRES)

BASIN SUMMARY TABLE

BASIN	Q_5 (CFS)	Q_{100} (CFS)
OA1	2.0	5.3
A1	28.8	56.6
A2	0.4	3.0

SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
A1	24.5	49.2
1 (DEV)	24.8	52.0
1 (DET)	0.7	10.2

IMPERVIOUS AREA CALCULATIONS:

BASIN A AREA = 10.79 AC.

SURFACE TYPE	AREA
ASPHALT	3,784 SF
CRUSHED ASPHALT/PAVEMENT (340,058 SF @ 80% IMPERVIOUS)	272,046 SF
BUILDING	0 SF
TOTAL IMPERVIOUS AREA	275,830 SF = 6.33 AC = 58.67%

IMPERVIOUS AREA CALCULATIONS:

BASIN OA1 AREA = 1.64 AC.

SURFACE TYPE	AREA
ASPHALT	23,941 SF
CRUSHED ASPHALT/PAVEMENT (0,000 SF @ 80% IMPERVIOUS)	0,000 SF
BUILDING	0,000 SF
TOTAL IMPERVIOUS AREA	23,941 SF = 0.55 AC = 33.54%

POND CONTOUR AREAS

CONTOUR	AREA (SF)
6809	10,369
6810	23,000
6812	39,225
6814	73,680

KANG STORAGE - 11401 E. HIGHWAY 24
LOT 1, ABIDING WORD LUTHERAN CHURCH SUBDIVISION

DEVELOPED DRAINAGE PLAN

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No.	REVISION	BY	DATE

HORZ. SCALE: 1"=60'	DRAWN: PV
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: RIDGELINE	CHECKED: JPS
CREATED: 04/23/26	LAST MODIFIED: 06/22/26
PROJECT NO: 022601	MODIFIED BY: PV
SHEET:	D1