FINAL DRAINAGE REPORT
FOR
FOUNTAIN VALLEY SALVATION ARMY
208 CUNNINGHAM DRIVE
COLORADO SPRINGS, CO 80911

Prepared for:

Fountain Valley Salvation Army Corps
208 Cunningham Drive
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Prepared by:

R&R Engineers-Surveyors

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Signature Page – Fountain Valley Salvation Army

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

________________________________ ________________

Darvin Wilson, P.E. #62385 Date

Owner/Developer's Statement:

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

________________________________ ________________

Quiana Varags, Director of Programs Date
The Salvation Army Fountain Valley Corps
208 Cunningham Drive, Colorado Springs, CO 80911

El Paso County:

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

__________________________________ ____________

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

Conditions:

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1. General Location and Description

a. Site Location

The existing Fountain Valley Salvation Army (hereafter, the Site) is located on Lot 4, Block 5, 1 Refill Security, Colorado Addition 4 within a portion of the Northeast Quarter of Section 11, Township 15 South, Range 66 West of the Sixth P.M., City of Colorado Springs, El Paso County, Colorado (see Vicinity Map in Appendix A). The Site is located at 208 Cunningham Drive and is approximately 2.04 acres in size.

The Site is bounded by Cunningham Drive to the east, Sproul Junior Highschool to the west, and adjacent residential properties to the north and south.

b. Description of Property

The total area of the property is 2.04 acres and the total area to be disturbed is 0.83 acres. The existing Site ground coverage consists primarily of native grasses, brush, and vegetation but also includes a gravel parking lot, and a building with associated concrete walks. Under existing conditions, the majority of the Site's stormwater runoff surface flows offsite to the south and west toward adjacent properties.

The Soil Survey of El Paso County Area, Colorado, prepared by the U.S. Department of Agriculture Soil Conservation Service, shows the Site is entirely underlain by Blakeland loamy sand – Hydrologic Group A. The existing terrain of the Site generally slopes from the north to south at grades ranging from 1% to 9%.

To the best of our knowledge, there are no existing irrigation facilities, canals, or existing storm infrastructure on and adjacent to the Site.

2. Drainage Basins and Sub-Basins

a. Major Basin Description

Existing available drainage studies that impact the Site are:

- Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM). El Paso County, Panel 763 Map No. 08041C0763G (December 2018).

b. Existing Sub-Basin Description

Sub-basin OS1 is 14.78 acres and comprised of existing residential homes, associated concrete driveways/sidewalks and existing landscaping/vegetation. Flows from this basin reach Design Point 1 and drain to Cunningham Drive ROW. The 5- and 100-years flows are 8.54 cfs and 24.13 cfs respectively.

Sub-basin EX1 is 2.02 acres and comprised of the Site, which includes the existing building, associated concrete driveways/sidewalks, existing landscaping/vegetation as well as a gravel lot. Flows from this basin reach Design Point 2 and are believed to flood the area due to a retaining wall stopping the flow from leaving the Site. The 5- and 100-years flows are 0.69 cfs and 2.68 cfs respectively.

Sub-basin EX2 is 0.09 acres and comprised of Cunningham Drive ROW, which includes existing landscaping/vegetation, sidewalk, and gravel driveway. Flows from this basin flow onsite and reach Design Point 2 and are believed to flood the area due to a retaining wall stopping the flow from leaving the Site. The 5- and 100-years flows are 0.02 cfs and 0.11 cfs respectively.

Sub-basin EX3 is 0.02 acres and comprised of a retaining wall and existing landscaping/vegetation. Flows from this basin reach Design Point 3 and flow offsite to Leta Drive ROW. The 5- and 100-years flows are 0.00 cfs and 0.02 cfs respectively.

c. Existing Site Runoff Concerns

The Salvation Army building has flooded twice during the summer of 2020 due to two high volume storm events. During these same events, the neighboring properties to the south have also experienced flooding when water discharges from the Site. The Site is located at the downhill (southern) end of Cunningham Drive. A retaining wall was built by the neighbor to the south on the Salvation Army property. This retaining wall was built in an easement and is blocking flow from leaving the Site. This is a major cause of the flooding on the Site and neighboring sites.

d. Proposed Sub-Basin Description

Sub-Basin C1 is 1.97 acres and comprised of the existing salvation army building, existing landscaping/vegetation as well as the proposed asphalt parking lot and proposed porous landscape detention. Flow will drain the southern corner of the property where a porous landscape detention (PLD) is proposed. Flow will be captured by the PLD (with adequate energy dissipation) and 3" HP underdrain and discharged through the proposed Type C outlet structure (design Point 1). Flow will be conveyed at or below historic values through a proposed 12" HP storm pipe and discharge through a proposed sidewalk grate drain (with adequate energy dissipation) and into Leta Drive. The 5- and 100-year flows entering the PLD are 1.32 cfs and 3.80 cfs respectively. The 5- and 100-year flows leaving the PLD are 0.01 cfs and 1.0 CFS respectively.

Sub-Basin OFF-1C is an offsite basin that is 0.09 acres and comprised of Cunningham ROW, which includes existing landscaping/vegetation, sidewalk and the asphalt drive aisle. Flow will drain onsite to basin C1 and drain to the proposed PLD. Flow will be captured by the PLD (with adequate energy dissipation) and 3" HP underdrain and discharged through the proposed Type C outlet structure (design Point 1). Flow will be conveyed at or below historic values through a proposed 12” HP storm pipe and discharge through a proposed sidewalk grate drain (with adequate energy dissipation) and into Leta Drive. The 5- and 100-year flows of basin OFF-1C are 0.02 cfs and 0.11 cfs respectively. The 5- and 100-year flows leaving the PLD are 0.01 cfs and 1.0 CFS respectively.

Sub-Basin UD-1C is an onsite undetained basin that is 0.07 acres and comprised of an existing retaining wall and existing landscaping/vegetation. Flow will drain offsite undetained Leta Drive ROW (Design Point 2). The 5- and 100-year flows of basin OFF-1C are 0.02 cfs and 0.11 cfs respectively.

3. Drainage Design Criteria

a. Four Step Process

Step 1 – Employ Runoff Reduction Practices

In step 1 the applicant is asked to identify areas of the Site that can be used to reduce runoff and implement LID practices such as permeable pavement, green roofs, grass buffers, grass swales, and bioretention. To meet the requirements of step 1, the disconnection of impervious areas shall be implemented to the greatest extent possible. Runoff from the building’s roofs and will flow across grassed landscaped areas before flowing into the proposed PLD and 12” HP Storm pipe. Runoff from the asphalt parking lot will flow through a concrete pan and into the proposed PLD before entering the proposed storm system. The Runoff Reduction worksheet, produced by Mile High Flood District, is included in Appendix D.

Step 2 – Implement BMPs That Provide a Water Quality Capture volume with Slow Release

In step 2 the applicant is asked to treat the runoff from the Site through the capture and slow release of the WQCV. The runoff from the Site is collected by a proposed PLD that will provide water quality by slowly releasing the WQCV over a 12-hour period. The flow released from the PLD will then be sent to a sub-regional Extended Detention Basin. This sub-regional facility has been designed to provide water quality by slowly releasing the WQCV over a 40-hour period. The PLD worksheet and calculations are included in Appendix D.

Step 3 – Stabilized Drainageways

In step 3 the applicant is asked to examine the downstream drainageways to ensure channel stability. Although this Site is technically within the Cottonwood Creek Drainage Basin, flows from the sub-regional extended detention basin will be discharged to the north to an existing storm sewer system which runs under N Powers Blvd to the west. That storm sewer system consists of approximately 1-mile of storm piping until it reaches the eventual outfall to Pine Creek. Adjacent drainage ways will not be disturbed by this project. Improvements throughout the drainage basin are funded in part by fees previously paid into the Cottonwood Creek Drainage Basin fund when this Site platted.

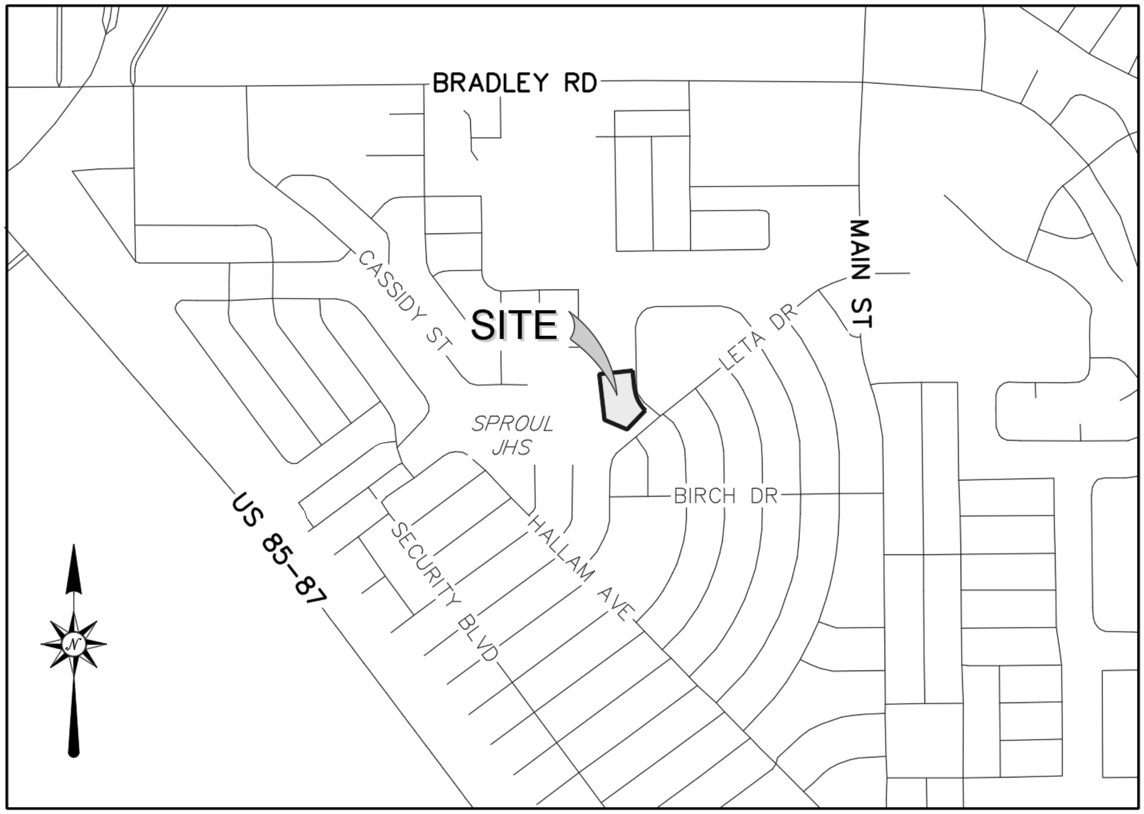
Step 4 – Implement Site Specific and Other Source Control BMPs
In step 4 the applicant is asked to examine Site specific needs such as material storage or other Site operations that will require targeted source control BMPs. A porous landscape detention is proposed to reduce flow and provide water quality onsite before discharging flow to Leta Drive ROW. A PLD will be proposed as a targeted source control BMPs.

4. Drainage Facility Design

A porous landscape detention will be proposed onsite to help with the flooding issues and combat the increase in impervious with the proposed parking lot onsite. As seen in the existing routing spreadsheet, the 100-year combined flow at design point 2 is 2.77 cfs. The proposed parking lot within the Site increases the combined 100-year flow by 1.13 cfs. As seen in the proposed routing spreadsheet, the 100-year combined flow at design point 1 is 3.90 cfs. The flow will be captured and released slowly be the outlet control structure in the PLD. The 100-year flow leaving the outlet control structure and eventually entering Leta Drive ROW through a proposed 12" HP storm pipe, 12" FES, Type L Riprap, and a sidewalk grate drain is 1.0 cfs. This is a significant decrease in total runoff and will not cause a negative impact on the existing downstream conditions.

However, part of the Site will continue to discharge at the southern property corner and eventually flow to Leta Drive ROW south of our property due to Site constraints. An existing retaining wall was built by the southern neighbors on the Site and due to the existing grade, the flow cannot be completely reversed away from the southern property corner. This portion of the Site consists of 0.07 acres (3.4% of the site) and is almost all landscape area, besides the retaining wall. The 100-year flow leaving the Site undetained is 0.11 cfs, which is a significant decrease from the existing 2.77 cfs that is currently draining to that area. Therefore, implementing a PLD will help the flooding in the area and not cause a negative impact on the existing downstream conditions.

APPENDIX A- VICINITY MAP, SOILS REPORT, AND FEMA MAP



VICINITY MAP
SCALE: 1" = 1,000'

USDA 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

Fountain Valley Salvation Army

October 5, 2021

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.

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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: 1:2,690 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 35, 70, 140, 210

Feet: 0, 100, 200, 400, 600

N

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 Survey Areas
- 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 19, Aug 31, 2021

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 2018

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8	Blakeland loamy sand, 1 to 9 percent slopes	23.3	100.0%
Totals for Area of Interest		**23.3**	**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: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Hills, flats
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
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

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

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United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

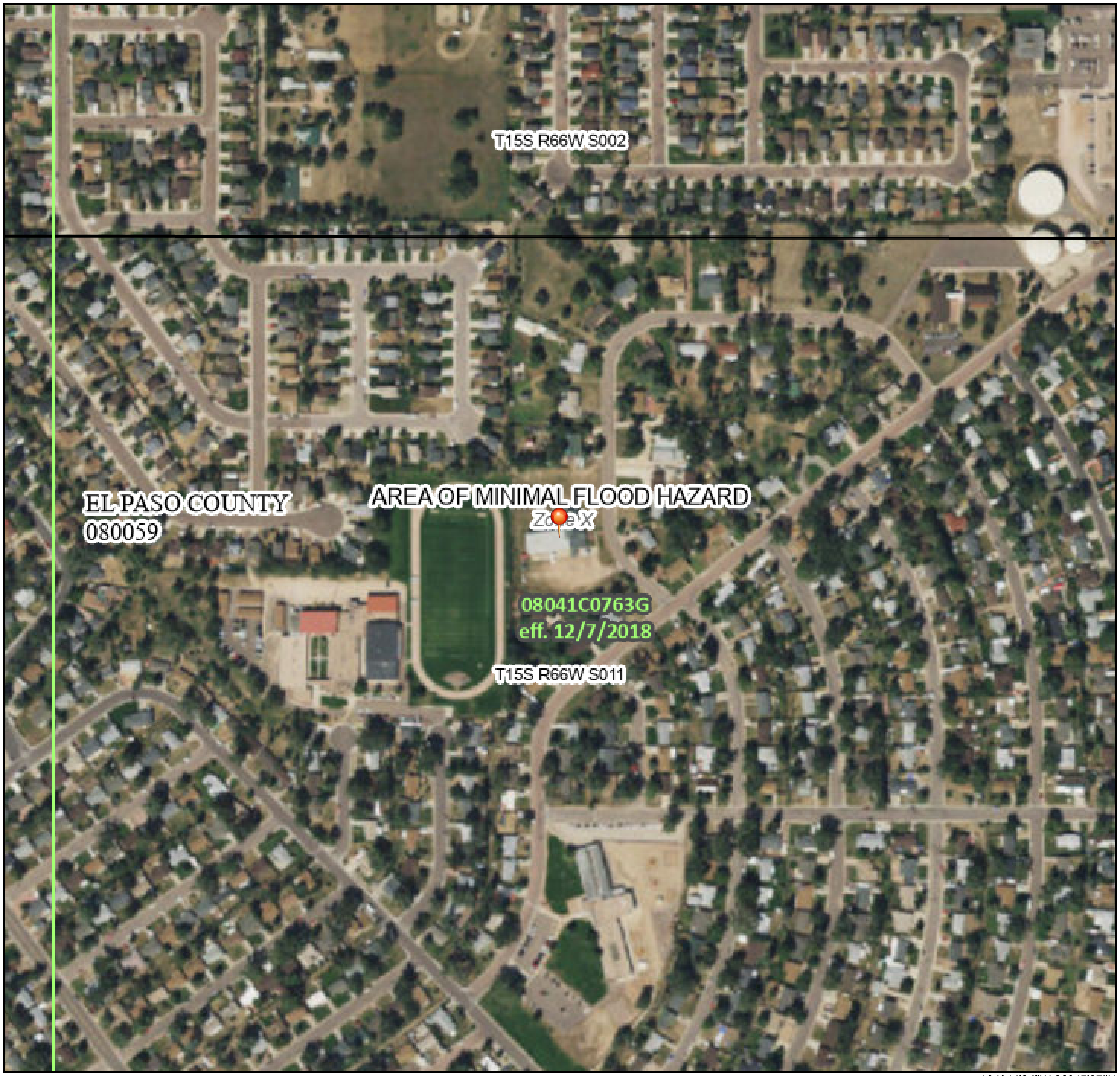
United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

National Flood Hazard Layer FIRMette

FEMA

104°45'2"W 38°46'5"N



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

1:6,000

104°44'24"W 38°45'37"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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 10/5/2021 at 4:37 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.

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, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

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.

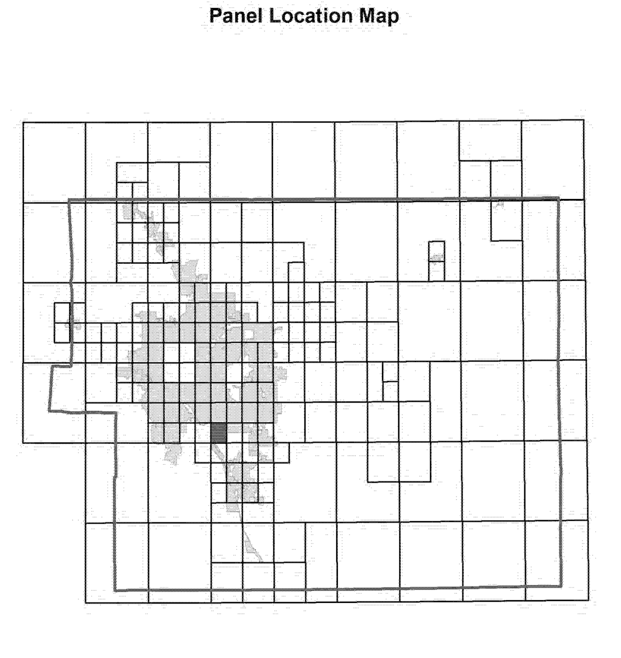
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this 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

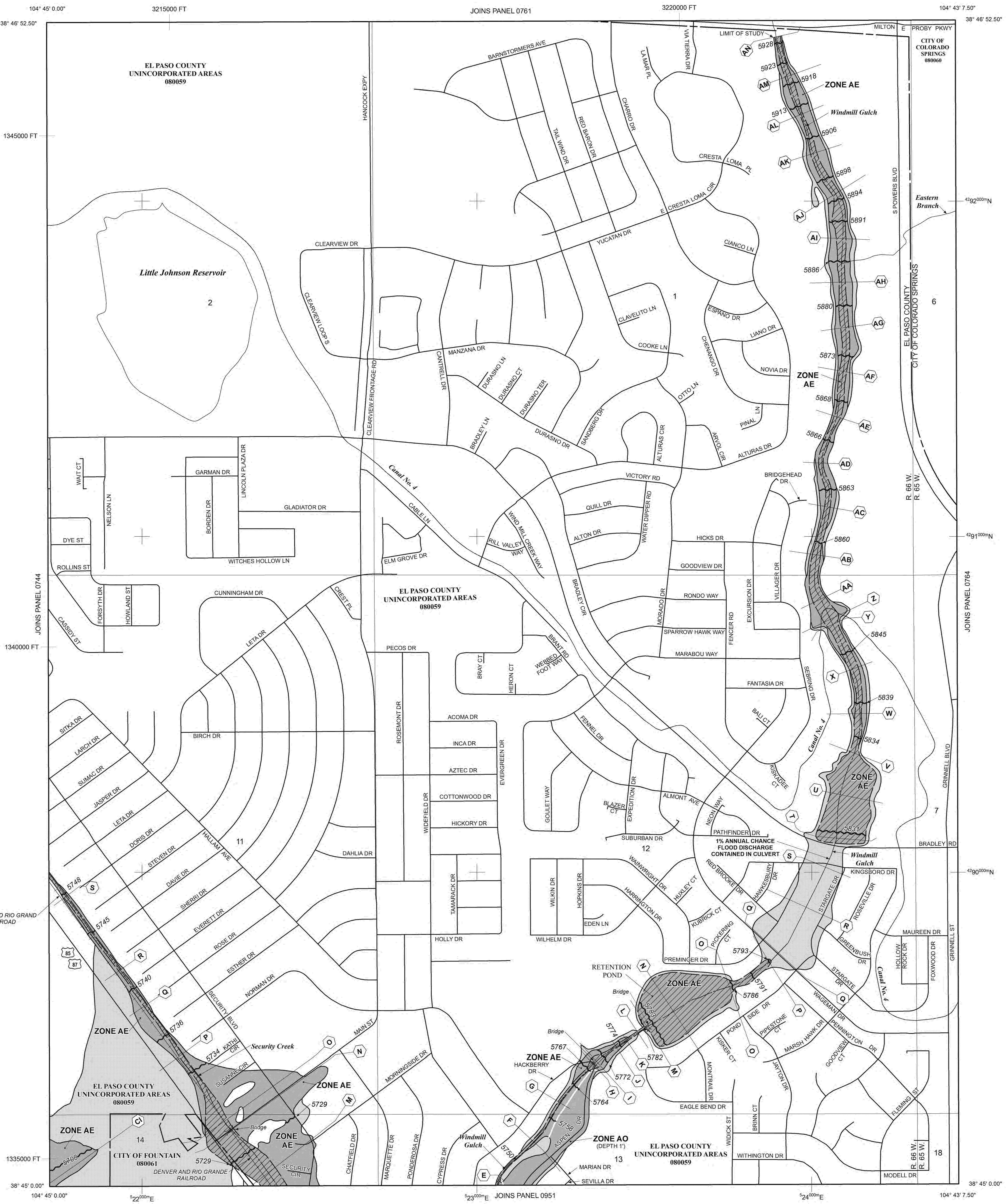
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

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.



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 15 SOUTH, RANGE 65 WEST, AND TOWNSHIP 15 SOUTH, RANGE 66 WEST.

LEGEND

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

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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

ZONE 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" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0763G

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

PANEL 763 OF 1300
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0763	G
EL PASO COUNTY	080059	0763	G
FOUNTAIN, CITY OF	080061	0763	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
08041C0763G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

APPENDIX B- EXISTING ROUTING CALCULATIONS AND DRAINAGE MAP

FOUNTAIN VALLEY SALVATION ARMY
CONSTRUCTION DOCUMENTS

LOCATED IN LOT 4, BLOCK 5, 1 REFILL SECURITY, COLORADO ADDITION 4 WITHIN A PORTION OF THE NORTHEAST QUARTER OF SECTION 11, TOWNSHIP 15 SOUTH, RANGE 66 WEST OF THE SIXTH P.M., COLORADO SPRINGS, EL PASO COUNTY, STATE OF COLORADO

811 Know what's **below.** **Call** before you dig.

DRAINAGE BASIN BOUNDARY

Tc FLOW PATH

BASIN SUMMARY TABLE

Basin	Area (acres)	5-yr (cfs)	100-yr (cfs)
OS1	14.78	8.54	24.13
EX1	2.02	0.69	2.68
EX2	0.09	0.02	0.11
EX3	0.02	0.00	0.02

DESIGN POINT SUMMARY TABLE

Design Point	Contributing Basins	Area (acres)	5-yr (cfs)	100-yr (cfs)
1	OS1	14.78	8.54	24.13
2	EX1, EX2	2.11	0.70	2.77
3	EX3	0.09	0.02	0.02
4	EX1, EX2,EX3, OS1	16.91	9.16	26.56

0 60' 120' 180'

SCALE: 1" = 60'

NO.	REVISION	BY	DATE

R&R ENGINEERS SURVEYORS INC

R&R ENGINEERS-SURVEYORS, INC.
1635 WEST 13TH AVENUE, SUITE 310
DENVER, COLORADO 80204
PHONE: 303-753-6730

WWW.RRENGINEERS.COM

FOUNTAIN VALLEY SALVATION ARMY

SITE ADDRESS:
208 CUNNINGHAM DRIVE
COLORADO SPRINGS, CO 80911

PREPARED FOR:
FOUNTAIN VALLEY SALVATION ARMY
208 CUNNINGHAM DR
COLORADO SPRINGS, CO 80911

CONSTRUCTION DOCUMENTS

JOB NO. FV21181

ORG. SUBM. DATE 10/5/2021

DWN: GWH CHKD: CD

NAME

PRE DEVELOPMENT DRAINAGE MAP

NO. 1

EXISTING C VALUES

Designer: JMP
Company: R&R Engineers-Surveyors
Date: 12/18/2023
Project: FOUNTAIN VALLEY SALVATION ARMY
Location: EL PASO COUNTY

Global Parameters[1]	
Land Use	% Imp.
Open Space/Landscaping	2
Hardscape	100
Roof	90
Gravel	40

Summary	
Total Area (ac)	16.91
Composite Impervious	33.7%

Cells of this color are for required user-input
Cells of this color are for optional user-input

[1] From Table 6-3 in MHFD Volume 1
[2] From Table 6-4 in MHFD Volume 1

Basin Name	Area (ac)	NRCS Hydrologic Soil Group	Open Space/Landscaping		Hardscape		Roof		Gravel		% Check	Percent Imperviousness	Runoff Coefficient, C[2]			
			Area (ac)	%	Area (ac)	%	Area (ac)	%	Area (ac)	%			2-yr	5-yr	10-yr	100-yr
OS1	14.78	A	9.72	65.8%	5.06	34.2%	0.00	0.0%	0.00	0.0%	100.00%	35.6%	0.22	0.23	0.24	0.39
EX1	2.02	A	1.37	67.8%	0.05	2.5%	0.22	10.8%	0.38	18.9%	100.00%	21.1%	0.11	0.12	0.13	0.27
EX2	0.09	A	0.08	88.9%	0.01	11.1%	0.00	0.0%	0.00	0.0%	100.00%	12.9%	0.06	0.06	0.07	0.21
EX3	0.02	A	0.02	100.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	100.00%	2.0%	0.01	0.01	0.01	0.13

TIME OF CONCENTRATION

Designer: JMP
Company: R&R Engineers-Surveyors
Date: 12/18/2023
Project: FOUNTAIN VALLEY SALVATION ARMY
Location: EL PASO COUNTY

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$$

$$\text{Computed } t_c = t_i + t_t$$

$t_{minimum}$ = 5 (urban)
$t_{minimum}$ = 10 (non-urban)

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

$$\text{Selected } t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$$

$$\text{Regional } t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

Cells of this color are for required user-input

Subbasin Data				Overland (Initial) Flow Time			Channelized (Travel) Flow Time					Time of Concentration			
Basin	Area	% Impervious	C5	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	Remarks
OS1	14.78	35.6%	0.23	100.00	0.044	9.63	1388.77	0.037	7	1.35	17.19	26.82	28.57	26.82	
EX1	2.02	21.1%	0.12	100.00	0.043	10.95	594.55	0.020	7	0.99	10.01	20.96	28.28	20.96	
EX2	0.09	12.9%	0.06	100.00	0.030	13.03	39.00	0.030	7	1.21	0.54	13.57	24.16	13.57	
EX3	0.02	2.0%	0.01	6.92	0.014	4.65			7		0.00	4.65		5.00	

EXISTING STORM DRAINAGE SYSTEM DESIGN - 5-YEAR DESIGN STORM

Designer: JMP
Company: R&R Engineers-Surveyors
Date: 12/18/2023
Project: FOUNTAIN VALLEY SALVATION ARMY
Location: EL PASO COUNTY

Cells of this color are for required user-input
Cells of this color are for optional user-input

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

DESGIN POINT	STREET/ CONTRIBUTING BASINS	DIRECT RUNOFF							TOTAL RUNOFF					STREET BYPASS		PIPE			TRAVEL TIME				Remarks
		Basin Name	Area (ac)	Coeff C	Tc (min)	C*A (ac)	I	Q (cfs)	Tc (min)	Sum Area (ac)	Sum C*A (ac)	I in/hr	Q cfs	Slope %	Street Q cfs	Design Q cfs	Slope %	PIPE SIZE	L ft	VEL ft/sec	Tt min	Q add'l	
		OS1	14.78	0.23	26.8	3.40	2.51	8.54															
1	OS1								26.8	14.8	3.4	2.51	8.54										
		EX1	2.02	0.12	21.0	0.24	2.88	0.69															
2	EX1, EX2								21.0	2.1	0.2	2.88	0.70										
		EX2	0.09	0.06	13.6	0.01	3.57	0.02															
3	EX3								13.6	0.1	0.0	3.57	0.02										
		EX3	0.02	0.01	5.0	0.00	5.09	0.00															
4	EX1, EX2,EX3, OS1								26.8	16.9	3.6	2.51	9.16										

EXISTING STORM DRAINAGE SYSTEM DESIGN - 100-YEAR DESIGN STORM

Designer: JMP
Company: R&R Engineers-Surveyors
Date: 12/18/2023
Project: FOUNTAIN VALLEY SALVATION ARMY
Location: EL PASO COUNTY

Cells of this color are for required user-input
Cells of this color are for optional user-input

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

ENGINEERS SURVEYORS INC

DESGIN POINT	STREET/ CONTRIBUTING BASINS	DIRECT RUNOFF							TOTAL RUNOFF					STREET		PIPE			TRAVEL TIME				
		Basin Name	Area (ac)	Coeff C	Tc (min)	C*A (ac)	I	Q (cfs)	Tc (min)	Sum Area (ac)	Sum C*A (ac)	I in/hr	Q cfs	Slope %	Street Q cfs	Design Q cfs	Slope %	PIPE SIZE	L ft	VEL ft/sec	Tt min	Q add'l	Remarks
		OS1	14.78	0.39	26.8	5.72	4.22	24.13															
1	OS1								26.8	14.8	5.7	4.22	24.13										
		EX1	2.02	0.27	21.0	0.55	4.84	2.68															
2	EX1, EX2								21.0	2.1	0.57	4.84	2.77										
		EX2	0.09	0.21	13.6	0.02	5.99	0.11															
3	EX3								5.0	0.0	0.00	8.55	0.02										
		EX3	0.02	0.13	5.0	0.00	8.55	0.02															
4	EX1, EX2,EX3, OS1								26.8	16.9	6.29	4.22	26.56										

Rainfall Data

FOUNTAIN VALLEY SALVATION ARMY

EL PASO COUNTY

Recurrence Interval (yrs)	1-hr Rainfall Depth (in)
2	1.19
5	1.50
10	1.75
25	2.00
50	2.25
100	2.52

APPENDIX C- PROPOSED ROUTING CALCULATIONS AND DRAINAGE MAP

SITE DEVELOPMENT PLAN
208 CUNNINGHAM DRIVE

LOCATED IN LOT 4, BLOCK 5, 1 REFILL SECURITY, COLORADO ADDITION 4 WITHIN A PORTION OF THE NORTHEAST QUARTER OF SECTION 11, TOWNSHIP 15 SOUTH, RANGE 66 WEST OF THE SIXTH P.M., COLORADO SPRINGS, EL PASO COUNTY, STATE OF COLORADO
LOCATED AT: 208 CUNNINGHAM DR, COLORADO SPRINGS, CO 80911

811 Know what's **below.** **Call** before you dig.

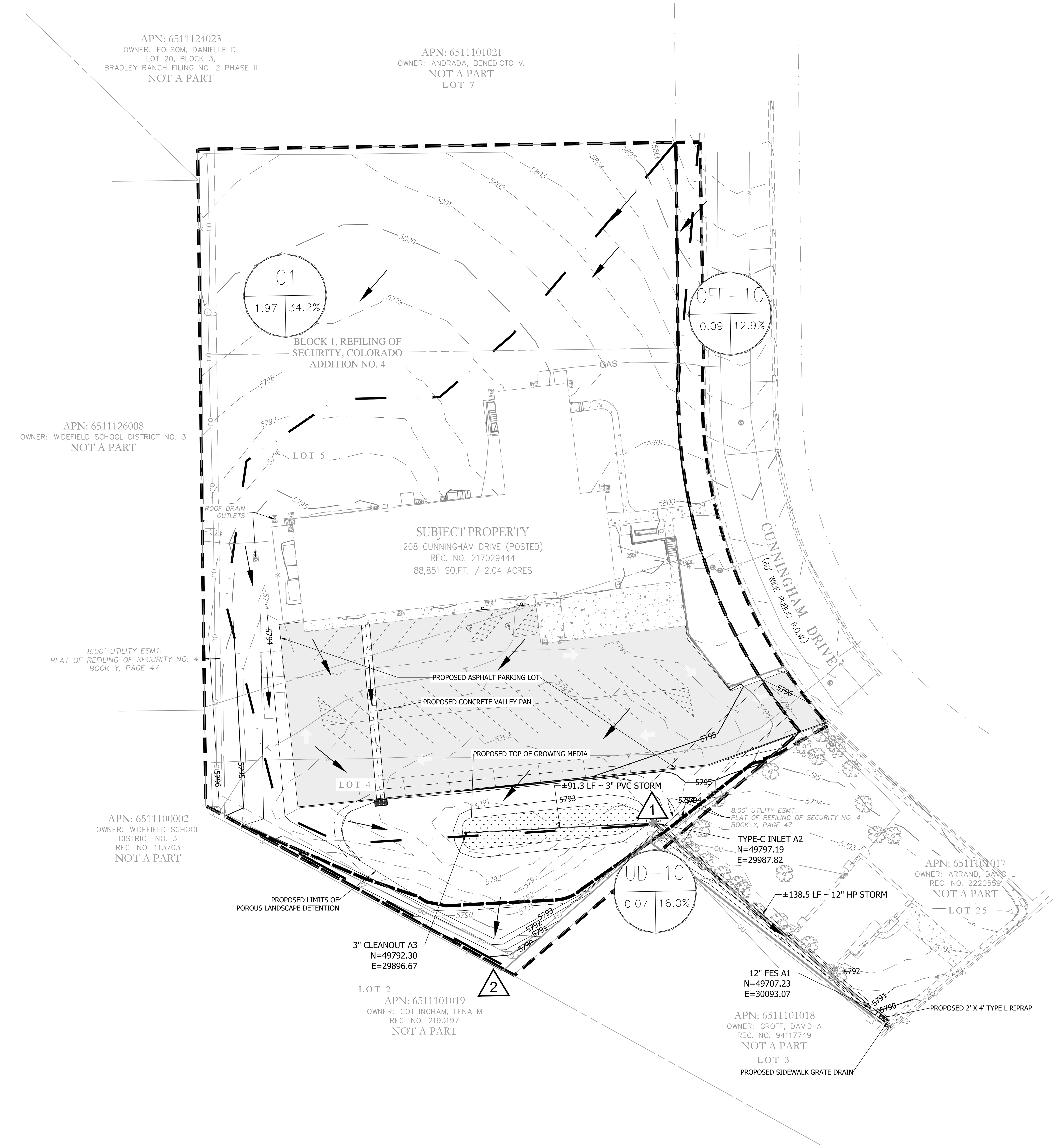
DRAINAGE BASIN BOUNDARY
Tc FLOW PATH

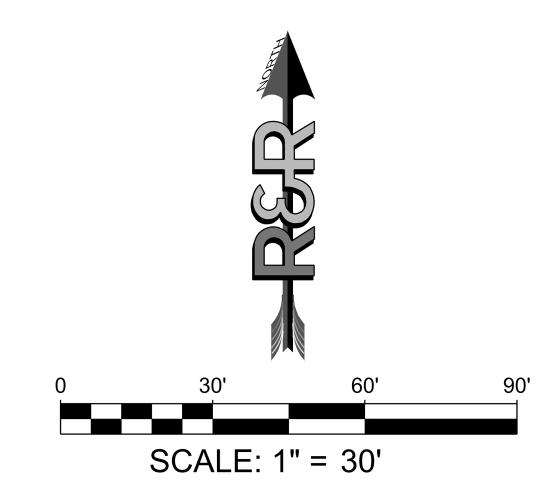
BASIN SUMMARY TABLE

Basin	Area (acres)	5-yr (cfs)	100-yr (cfs)
C1	1.97	1.32	3.80
OFF-1C	0.09	0.02	0.11
UD-1C	0.07	0.02	0.11

DESIGN POINT SUMMARY TABLE

Design Point	Contributing Basins	Area (acres)	5-yr (cfs)	100-yr (cfs)
1	C1, OFF-1C	2.06	1.33	3.90
2	UD-1C	0.07	0.02	0.11





NO.	REVISION	BY	DATE

R&R ENGINEERS SURVEYORS INC

R&R ENGINEERS-SURVEYORS, INC.
1635 WEST 13TH AVENUE, SUITE 310
DENVER, COLORADO 80204
PHONE: 303-753-6730
WWW.RRENGINEERS.COM

FOUNTAIN VALLEY SALVATION ARMY

SITE ADDRESS: 208 CUNNINGHAM DRIVE, COLORADO SPRINGS, CO 80911

PREPARED FOR: FOUNTAIN VALLEY SALVATION ARMY, 208 CUNNINGHAM DR, COLORADO SPRINGS, CO 80911

SITE DEVELOPMENT PLAN

JOB NO. FV21181
ORG. SUBM. DATE 12/22/2023
DWN: JMP CHKD: DW
NAME: POST DEVELOPMENT DRAINAGE MAP
NO. 2

PATH:P:\FV21181 208 CUNNINGHAM DR\ENGINEERING\4 DRAWINGS\PLANS\DRAINAGE\FV21181 -- DRN -- PROP.DWG, PLOT DATE:12/22/2023 11:50:12 AM, BY:JENNA PERDUE

EXISTING C VALUES

Designer:	JMP
Company:	R&R Engineers-Surveyors
Date:	12/18/2023
Project:	FOUNTAIN VALLEY SALVATION ARMY
Location:	EL PASO COUNTY

Global Parameters[1]	
Land Use	% Imp.
Open Space/Landscaping	2
Hardscape	100
Roof	90
Gravel	40

Summary	
Total Area (ac)	2.13
Composite Impervious	32.7%

Cells of this color are for required user-input

Cells of this color are for optional user-input

[1] From Table 6-3 in MHFD Volume 1

[2] From Table 6-4 in MHFD Volume 1

Basin Name	Area (ac)	NRCS Hydrologic Soil Group	Open Space/Landscaping		Hardscape		Roof		Gravel		% Check	Percent Imperviousness	Runoff Coefficient, C[2]			
			Area (ac)	%	Area (ac)	%	Area (ac)	%	Area (ac)	%			2-yr	5-yr	10-yr	100-yr
C1	1.97	A	1.30	66.0%	0.45	22.8%	0.22	11.2%	0.00	0.0%	100.00%	34.2%	0.21	0.22	0.23	0.38
OFF-1C	0.09	A	0.08	88.9%	0.01	11.1%	0.00	0.0%	0.00	0.0%	100.00%	12.9%	0.06	0.06	0.07	0.21
UD-1C	0.07	A	0.06	85.7%	0.01	14.3%	0.00	0.0%	0.00	0.0%	100.00%	16.0%	0.08	0.08	0.09	0.23

TIME OF CONCENTRATION

Designer: JMP
Company: R&R Engineers-Surveyors
Date: 12/18/2023
Project: FOUNTAIN VALLEY SALVATION ARMY
Location: EL PASO COUNTY

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$$

$$\text{Computed } t_c = t_i + t_t$$

$t_{minimum} = 5$ (urban)
$t_{minimum} = 10$ (non-urban)

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

$$\text{Selected } t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$$

$$\text{Regional } t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

Cells of this color are for required user-input

Subbasin Data				Overland (Initial) Flow Time			Channelized (Travel) Flow Time					Time of Concentration			
Basin	Area	% Impervious	C5	Overland Flow Length L_i (ft)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	Remarks
C1	1.97	34.2%	0.22	100.00	0.043	9.83	530.49	0.020	7	0.99	8.93	18.76	24.72	18.76	
OFF-1C	0.09	12.9%	0.06	100.00	0.030	13.03	17.84	0.030	7	1.21	0.25	13.27	23.97	13.27	
UD-1C	0.07	16.0%	0.08	100.00	0.050	10.80	12.24	0.200	7	3.13	0.07	10.86	23.32	10.86	

EXISTING STORM DRAINAGE SYSTEM DESIGN - 5-YEAR DESIGN STORM

Designer: JMP
Company: R&R Engineers-Surveyors
Date: 12/18/2023
Project: FOUNTAIN VALLEY SALVATION ARMY
Location: EL PASO COUNTY

Cells of this color are for required user-input
Cells of this color are for optional user-input

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

DESGIN POINT	STREET/ CONTRIBUTING BASINS	DIRECT RUNOFF							TOTAL RUNOFF					STREET BYPASS		PIPE			TRAVEL TIME				
		Basin Name	Area (ac)	Coeff C	Tc (min)	C*A (ac)	I	Q (cfs)	Tc (min)	Sum Area (ac)	Sum C*A (ac)	I in/hr	Q cfs	Slope %	Street Q cfs	Design Q cfs	Slope %	PIPE SIZE	L ft	VEL ft/sec	Tt min	Q add'l	Remarks
		C1	1.97	0.22	18.8	0.43	3.05	1.32															
1	C1, OFF-1C								18.8	2.06	0.44	3.05	1.33										
		OFF-1C	0.09	0.06	13.3	0.01	3.60	0.02															
2	UD-1C								10.9	0.07	0.01	3.93	0.02										
		UD-1C	0.07	0.08	10.9	0.01	3.93	0.02															

EXISTING STORM DRAINAGE SYSTEM DESIGN - 100-YEAR DESIGN STORM

Designer: JMP
Company: R&R Engineers-Surveyors
Date: 12/18/2023
Project: FOUNTAIN VALLEY SALVATION ARMY
Location: EL PASO COUNTY

Cells of this color are for required user-input

Cells of this color are for optional user-input

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

R&R ENGINEERS SURVEYORS INC

DESGIN POINT	STREET/ CONTRIBUTING BASINS	DIRECT RUNOFF							TOTAL RUNOFF					STREET		PIPE			TRAVEL TIME				Remarks
		Basin Name	Area (ac)	Coeff C	Tc (min)	C*A (ac)	I	Q (cfs)	Tc (min)	Sum Area (ac)	Sum C*A (ac)	I in/hr	Q cfs	Slope %	Street Q cfs	Design Q cfs	Slope %	PIPE SIZE	L ft	VEL ft/sec	Tt min	Q add'l	
		C1	1.97	0.38	18.8	0.74	5.12	3.80															
1	C1, OFF-1C								18.8	2.06	0.76	5.12	3.90										
		OFF-1C	0.09	0.21	13.3	0.02	6.05	0.11															
2	UD-1C								10.9	0.07	0.02	6.60	0.11										
		UD-1C	0.07	0.23	10.9	0.02	6.60	0.11															

Rainfall Data

FOUNTAIN VALLEY SALVATION ARMY

EL PASO COUNTY

Recurrence Interval (yrs)	1-hr Rainfall Depth (in)
2	1.19
5	1.50
10	1.75
25	2.00
50	2.25
100	2.52

APPENDIX D- HYDRAULIC CALCULATIONS

Channel Report

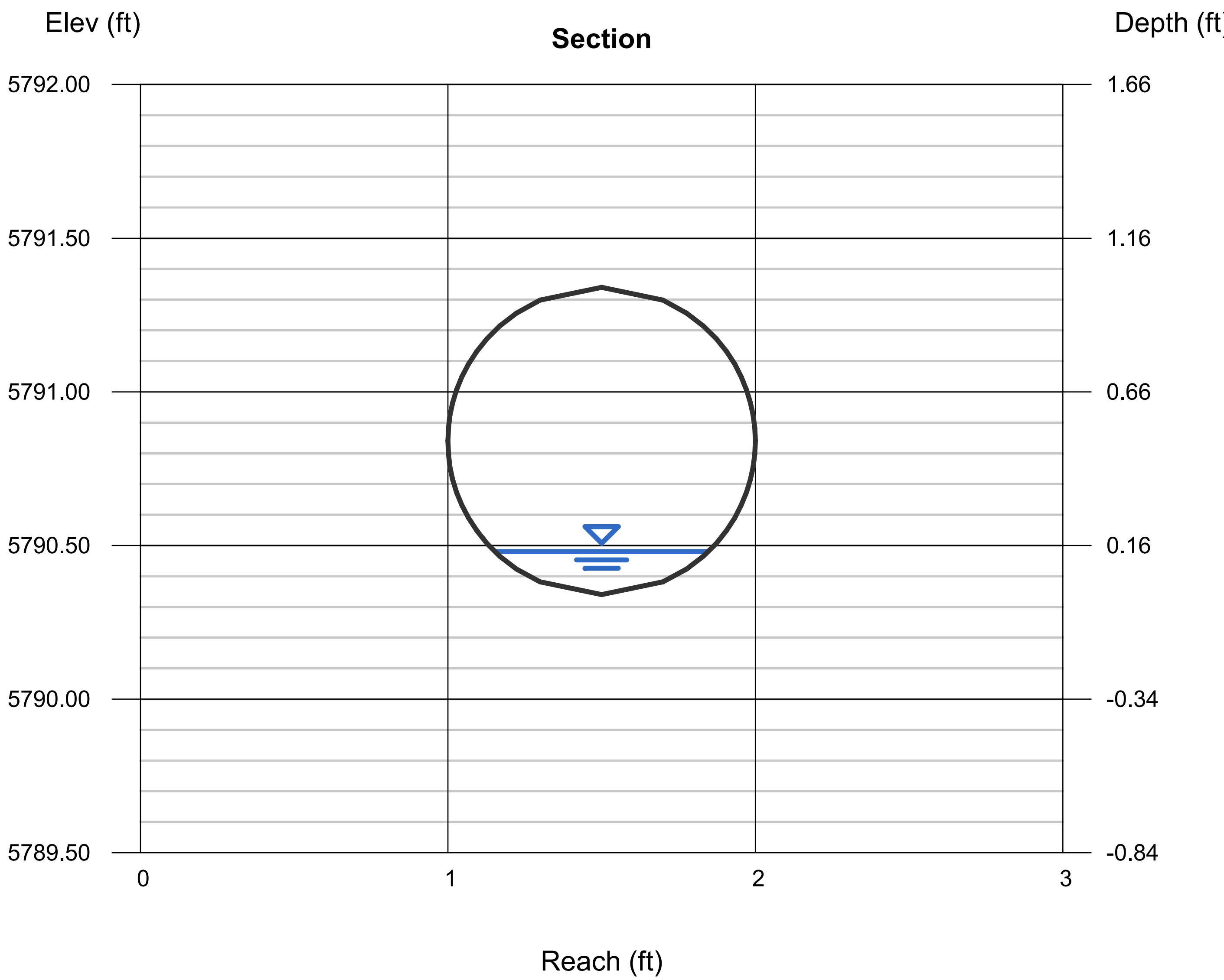
208 Cunningham- 5 year

Circular
Diameter (ft) = 1.00

Invert Elev (ft) = 5790.34
Slope (%) = 0.50
N-Value = 0.012

Calculations
Compute by: Known Q
Known Q (cfs) = 0.10

Highlighted
Depth (ft) = 0.14
Q (cfs) = 0.100
Area (sqft) = 0.07
Velocity (ft/s) = 1.48
Wetted Perim (ft) = 0.77
Crit Depth, Yc (ft) = 0.13
Top Width (ft) = 0.70
EGL (ft) = 0.17



Channel Report

208 Cunningham- 100 year

Circular

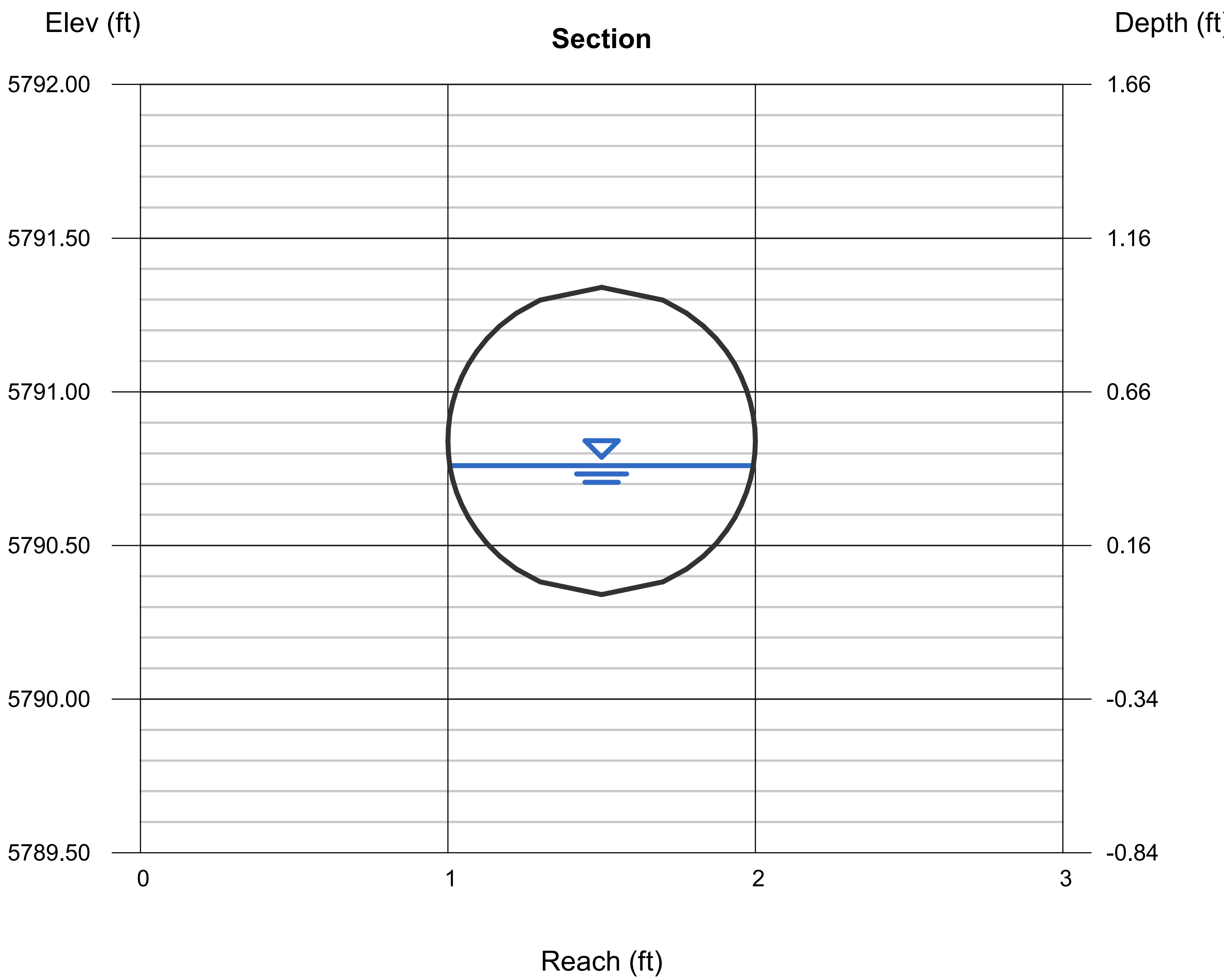
Diameter (ft)	= 1.00
Invert Elev (ft)	= 5790.34
Slope (%)	= 0.50
N-Value	= 0.012

Calculations

Compute by:	Known Q
Known Q (cfs)	= 1.00

Highlighted

Depth (ft)	= 0.42
Q (cfs)	= 1.000
Area (sqft)	= 0.32
Velocity (ft/s)	= 3.17
Wetted Perim (ft)	= 1.41
Crit Depth, Yc (ft)	= 0.42
Top Width (ft)	= 0.99
EGL (ft)	= 0.58

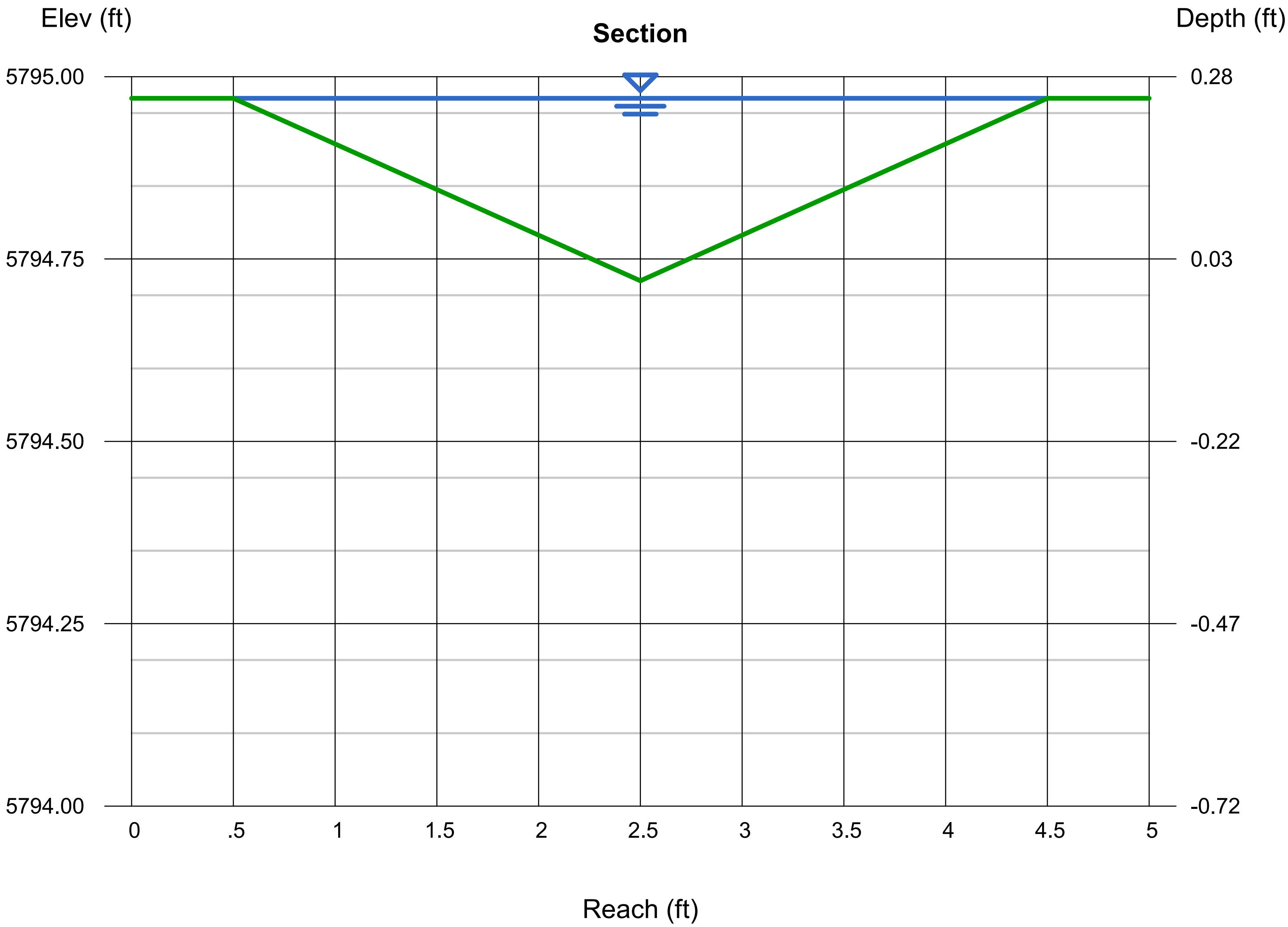


Channel Report

Concrete Valley Pan

Triangular	
Side Slopes (z:1)	= 8.00, 8.00
Total Depth (ft)	= 0.25
Invert Elev (ft)	= 5794.72
Slope (%)	= 0.85
N-Value	= 0.013
Calculations	
Compute by:	Q vs Depth
No. Increments	= 1

Highlighted	
Depth (ft)	= 0.25
Q (cfs)	= 1.310
Area (sqft)	= 0.50
Velocity (ft/s)	= 2.62
Wetted Perim (ft)	= 4.03
Crit Depth, Yc (ft)	= 0.25
Top Width (ft)	= 4.00
EGL (ft)	= 0.36

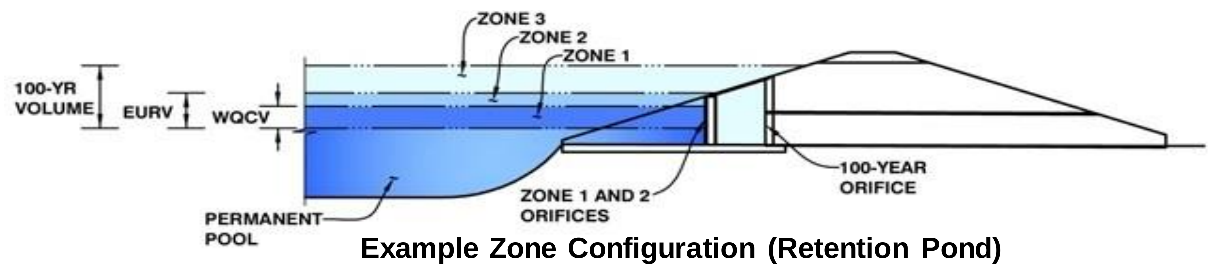


DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.06 (July 2022)

Project: **208 Cunningham Drive**

Basin ID:



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**RG**			
Watershed Area =	2.04	acres		
Watershed Length =	632	ft		
Watershed Length to Centroid =	316	ft		
Watershed Slope =	0.031	ft/ft		
Watershed Imperviousness =	32.80%	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 =	12.0	hours		
Location for 1-hr Rainfall Depths = Denver - Capitol Building				

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) =	0.022	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.069	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.048	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.066	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.081	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	0.114	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	0.146	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	0.189	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	0.280	acre-feet		inches
Approximate 2-yr Detention Volume =	0.043	acre-feet		
Approximate 5-yr Detention Volume =	0.058	acre-feet		
Approximate 10-yr Detention Volume =	0.072	acre-feet		
Approximate 25-yr Detention Volume =	0.090	acre-feet		
Approximate 50-yr Detention Volume =	0.103	acre-feet		
Approximate 100-yr Detention Volume =	0.124	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.022	acre-feet
Zone 2 Volume (100-year - Zone 1) =	0.102	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.124	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft^3
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	N/A	ft
Slope of Trickle Channel (S_{TC}) =	N/A	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	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)
Media Surface	--	0.00	--	--	--	1,263	0.029		
WQCV	--	0.52	--	--	--	2,405	0.055	954	0.022
	--	1.00	--	--	--	5,890	0.135	2,944	0.068
100YR WSEL	--	1.38	--	--	--	7,033	0.161	5,400	0.124
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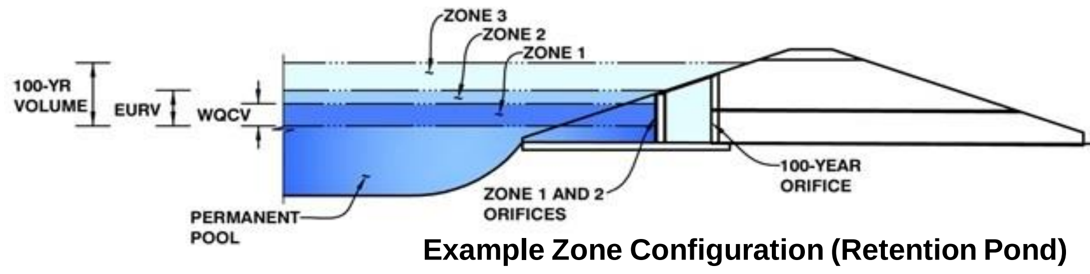
DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.06 (July 2022)

Project: 208 Cunningham Drive

Basin ID:



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.52	0.022	Filtration Media
Zone 2 (100-year)	1.38	0.102	Weir&Pipe (Restrict)
Zone 3			
Total (all zones)		0.124	

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

Underdrain Orifice Invert Depth =	2.00	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	0.73	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	0.0	ft^2
Underdrain Orifice Centroid =	0.03	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 BMP)

Centroid of Lowest Orifice =	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	N/A	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	sq. inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	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 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orif

	Not Selected	Not Selected
Vertical Orifice Area =		
Vertical Orifice Centroid =		

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

	Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	1.24		ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00		feet
Overflow Weir Grate Slope =	0.00		H:V
Horiz. Length of Weir Sides =	4.00		feet
Overflow Grate Type =	Type C Grate		
Debris Clogging % =	50%		%

Calculated Parameters for Overflow W

	Zone 2 Weir	Not Selected
Height of Grate Upper Edge, H_t =	1.24	
Overflow Weir Slope Length =	4.00	
Grate Open Area / 100-yr Orifice Area =	28.36	
Overflow Grate Open Area w/o Debris =	11.14	
Overflow Grate Open Area w/ Debris =	5.57	

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

	Zone 2 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50		ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	12.00		inches
Restrictor Plate Height Above Pipe Invert =	6.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pla

	Zone 2 Restrictor	Not Selected
Outlet Orifice Area =	0.39	
Outlet Orifice Centroid =	0.29	
Half-Central Angle of Restrictor Plate on Pipe =	1.57	N/A

User Input: Emergency Spillway (Rectangular or Trapezoidal)

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

Calculated Parameters for Spillway

Spillway Design Flow Depth=		feet
Stage at Top of Freeboard =		feet
Basin Area at Top of Freeboard =		acres
Basin Volume at Top of Freeboard =		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 Al

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52
CUHP Runoff Volume (acre-ft) =	0.022	0.069	0.048	0.066	0.081	0.114	0.146	0.189
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.048	0.066	0.081	0.114	0.146	0.189
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.3	0.6	1.0
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.02	0.15	0.30	0.49
Peak Inflow Q (cfs) =	N/A	N/A	0.5	0.6	0.8	1.3	1.7	2.2
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.0	0.1	0.5	1.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.0	0.7	0.4	0.8	1.0
Structure Controlling Flow =	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Filtration Media	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.0	0.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	12	36	26	35	42	55	55	54
Time to Drain 99% of Inflow Volume (hours) =	**13**	37	27	36	43	56	56	56
Maximum Ponding Depth (ft) =	0.53	1.02	0.79	0.94	1.05	1.26	1.31	1.35
Area at Maximum Ponding Depth (acres) =	0.06	0.14	0.10	0.13	0.14	0.15	0.16	0.16
Maximum Volume Stored (acre-ft) =	0.022	0.070	0.042	0.060	0.073	0.105	0.111	0.119

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Designer: JMP
Company: R&R Engineers
Date: December 8, 2023
Project: 208 Cunningham
Location: El Paso County

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth: 0.60 inches
Depth of Average Runoff Producing Storm, d_6 = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	UIA:RPA	SPA									
Area ID	1	2									
Downstream Design Point ID	1	2									
Downstream BMP Type	EDB	EDB									
DCIA (ft^2)	--	--									
UIA (ft^2)	28,789	--									
RPA (ft^2)	9,716	--									
SPA (ft^2)	--	50,346									
HSG A (%)	100%	100%									
HSG B (%)	0%	0%									
HSG C/D (%)	0%	0%									
Average Slope of RPA (ft/ft)	0.005	--									
UIA:RPA Interface Width (ft)	220.00	--									

CALCULATED RUNOFF RESULTS

Area ID	1	2									
UIA:RPA Area (ft^2)	38,505	--									
L / W Ratio	0.80	--									
UIA / Area	0.7477	--									
Runoff (in)	0.00	0.00									
Runoff (ft^3)	0	0									
Runoff Reduction (ft^3)	1200	2517									

CALCULATED WQCV RESULTS

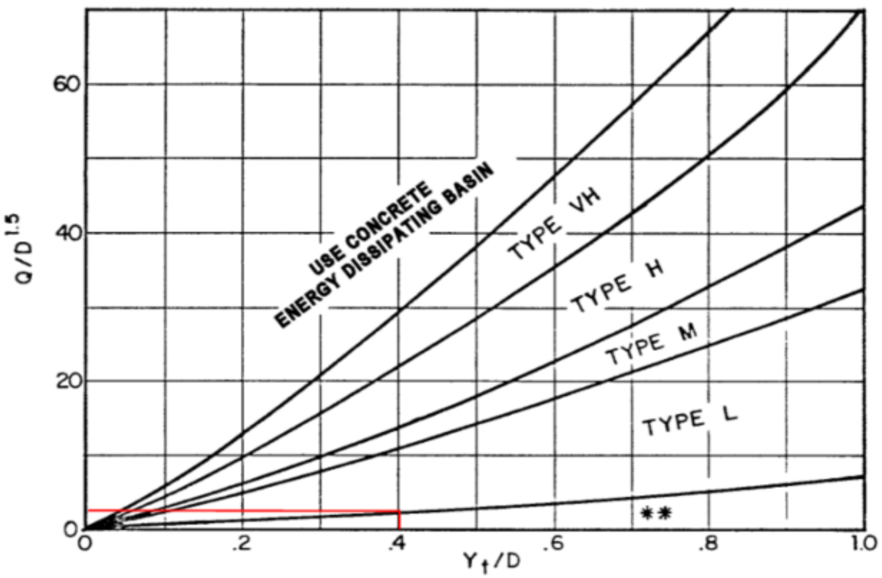
Area ID	1	2									
WQCV (ft^3)	1200	0									
WQCV Reduction (ft^3)	1200	0									
WQCV Reduction (%)	100%	0%									
Untreated WQCV (ft^3)	0	0									

CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	1	2									
DCIA (ft^2)	0	0									
UIA (ft^2)	28,789	0									
RPA (ft^2)	9,716	0									
SPA (ft^2)	0	50,346									
Total Area (ft^2)	38,505	50,346									
Total Impervious Area (ft^2)	28,789	0									
WQCV (ft^3)	1,200	0									
WQCV Reduction (ft^3)	1,200	0									
WQCV Reduction (%)	100%	0%									
Untreated WQCV (ft^3)	0	0									

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	88,851
Total Impervious Area (ft^2)	28,789
WQCV (ft^3)	1,200
WQCV Reduction (ft^3)	1,200
WQCV Reduction (%)	100%
Untreated WQCV (ft^3)	0



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

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

1. $Q/D^{1.5}$ or $Q/WH^{0.5}$ in which Q is the design discharge in cfs, D_c is the diameter of a circular conduit in feet, and W and H are the width and height of a rectangular conduit in feet.

2. Y_t/D_c or Y_t/H in which Y_t is the tailwater depth in feet, D_c is the diameter of a circular conduit in feet, and H is the height of a rectangular conduit in feet. In cases where Y_t is unknown or a hydraulic jump is suspected downstream of the outlet, use $Y_t/D_t = Y_t/H = 0.40$ when using Figures 9-38 and 9-39.

SIDEWALK GRATE DRAIN RIPRAP

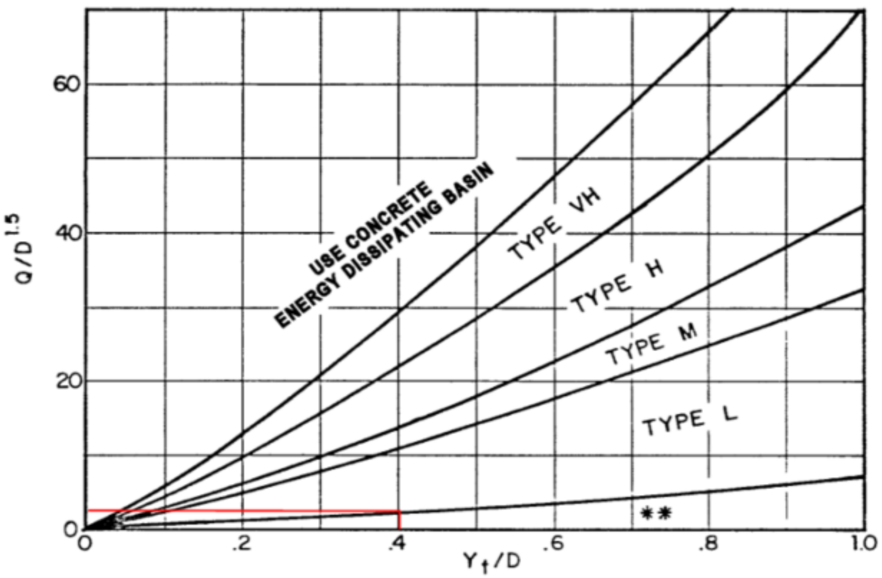
Calculations:

Q=	1	cfs
D=	1	ft
Q/D^1.5=	1	
Y/D=	0.4	

Conclusion: Use Type L RipRap

RipRap Apron Dimensions:

Length=	4	ft
Width=	2	ft



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

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

1. $Q/D^{1.5}$ or $Q/WH^{0.5}$ in which Q is the design discharge in cfs, D_c is the diameter of a circular conduit in feet, and W and H are the width and height of a rectangular conduit in feet.

2. Y_t/D_c or Y_t/H in which Y_t is the tailwater depth in feet, D_c is the diameter of a circular conduit in feet, and H is the height of a rectangular conduit in feet. In cases where Y_t is unknown or a hydraulic jump is suspected downstream of the outlet, use $Y_t/D_t = Y_t/H = 0.40$ when using Figures 9-38 and 9-39.

PLD RIPRAP

Calculations:

Q=	3.9	cfs
D=	4	ft
Q/D^1.5=	0.4875	
Y/D=	0.4	

Conclusion: Use Type L RipRap

RipRap Apron Dimensions:

Length=	6	ft
Width=	3	ft