PRELIMINARY & FINAL DRAINAGE REPORT

for

CATHEDRAL ROCK COMMONS COMMERCIAL

Prepared for:

Cathedral Rock Investments LLC
6035 Erin Park Drive
Colorado Springs, CO 80918

September 30, 2021
Revised October 14, 2022
Revised December 8, 2022
Revised March 8, 2023

Prepared by:

JPS ENGINEERING

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JPS Project No. 062102
PCD Project No. SP221 / SF2210

CATHEDRAL ROCK COMMONS COMMERCIAL
FINAL DRAINAGE REPORT
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APPENDICES

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

COLORADO REGISTERED PROFESSIONAL ENGINEER
JOHN P. SCHWAB
29891
3/8/23

Developer's Statement:

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

By: ______________________ 3-8-23
Date

Printed Name: Marvin Boyd, Manager
Cathedral Rock Investments LLC
6035 Erin Park Drive, Colorado Springs, CO 80918

El Paso County's Statement

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

Approved
By: Elizabeth Nijkamp, PE
Date:04/17/2023
El Paso County Department of Public Works

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

Conditions:

I. GENERAL LOCATION AND DESCRIPTION

A. Background

Cathedral Rock Commons Commercial is a proposed 3-lot commercial minor subdivision located in northern El Paso County, Colorado. The minor subdivision will create three commercial lots on the existing 10.2-acre parcel (El Paso County Assessor's Number 71360-02-035) located at the northeast corner of Struthers Road and Spanish Bit Drive. There are no improvements proposed to the existing Big R Retail Store on the north side of the property, which will be platted as Lot 1. The proposed Lot 2 will be developed as a 1.8-acre commercial lot and the proposed Lot 3 will be developed as a 1.0-acre commercial lot. Tract A will be dedicated as a tract for the existing on-site private detention pond.

B. Scope

This report will provide a summary of site drainage issues impacting the proposed commercial minor subdivision. 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" in support of the Final Plat process for this property.

C. Site Location and Description

Cathedral Rock Commons Commercial Subdivision is located in the Northeast Quarter of the Southeast Quarter of Section 36, Township 11 South, Range 67 West of the 6th Principal Meridian. The 10.2-acre parcel is currently a developed commercial property with an existing Big R Retail Store along with several sheds and accessory structures, and associated parking areas. The developed north side of the parcel will be platted as the 6.2-acre Lot 1, and the vacant area on the south side of the parcel will be platted as two vacant commercial lots for future development.

The property is zoned CC (community commercial), and the proposed minor subdivision is fully in conformance with the existing zoning of the site. Access to the three lots will be provided by driveway connections to Spanish Bit Drive and the existing shared private access drive between the proposed Lots 2 and 3.

The site is bordered by developed rural residential properties on the north and east sides (Lots 27 and 28, Chaparral Hills). Struthers Road is a fully improved, asphalt-paved arterial public street along the west boundary of the site, and Spanish Bit Drive is a partially improved local public street along the southeast boundary of the site. A vacant 6.6-acre parcel zoned R-4 is located across Spanish Bit Drive to the south.

The site is located in the Jackson Creek Drainage Basin, and surface drainage from this site sheet flows southwesterly to an existing public storm sewer along the west boundary of the property and an existing culvert crossing Struthers Road at the southwest corner of the site.

The terrain is relatively flat with average grades ranging from 1 to 4 percent sloping to the southwest. Ground elevations within the site range from approximately 6,800 feet above mean sea level at the northeast corner of the site down to approximately 6,765 at the southwest corner of the property.

D. General Soil 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 "Type 68: Peyton-Pring complex" soils. These soils are classified as hydrologic soils group "B" (moderate infiltration rate).

E. References

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

City of Colorado Springs "Drainage Criteria Manual, Volumes 1 and 2," revised October 31, 2018.

El Paso County "Engineering Criteria Manual," revised December 13, 2016.

FEMA, Flood Insurance Rate Map (FIRM) Number 08041C0287G, December 7, 2018.

M&S Civil Consultants, Inc., "Big R – Retail Center Final Drainage Report," February 2012.

Nolte Associates, Inc., "Struthers Road Final Drainage Report from Struthers Ranch to Baptist Road," May 16, 2005.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Basin Description

The proposed development lies within the Jackson Creek Drainage Basin (FOM 04400) as classified by El Paso County. There is currently no Drainage Basin Planning Study (DBPS) on file for this basin.

B. Floodplain Impacts

This site is not impacted by any FEMA 100-year floodplain limits. The delineated floodplain limits in vicinity of the site are shown in FEMA Flood Insurance Rate Map (FIRM) Number 08041C0287G, dated December 7, 2018 (see FIRMette exhibit in Appendix E).

C. Sub-Basin Description

Drainage planning for this site was previously studied in the "Big R – Retail Center Final Drainage Report" by M&S Civil Consultants, Inc. dated February 2012. As depicted in the "Big R Drainage Plan" by M&S (enclosed in Appendix E), the site has been delineated as six on-site sub-basins (A-F), with several adjoining off-site drainage basins (OS1-OS6).

The existing Big R Retail Center (proposed Lot 1) covers Basins A-E, and Basin F covers the proposed Lots 2 and 3, as well as the Detention Pond in Tract A.

As described in the M&S FDR, Basin A consists of the westerly fringe of the Big R property, which sheet flows west into the existing curb and gutter and public storm sewer system along the east side of Struthers Road. Basins B-C consist of the existing building and north service drive, which flow through an existing on-site 24" private storm sewer ("Pipe Run 1") connecting to an existing 30" RCP storm sewer flowing west across Struthers Road (see "Big R Drainage Plan" by M&S enclosed in Appendix E).

Basins D-F sheet flow southwesterly across the Big R parking lot into an existing private detention / water quality pond at the southwest corner of the property. The pond outlet pipe drains into existing dual 36" RCP culverts flowing south across Spanish Bit Drive.

Off-site Basins OS4-OS6 have been delineated as the off-site areas of rural residential lots to the northeast, which flow southwesterly along the roadside ditch on the north side of Spanish Bit Drive to the existing dual 36" culvert crossing on the west side of Struthers Road.

Developed runoff in the proposed minor subdivision will continue to follow the drainage paths established in the M&S FDR.

III. DRAINAGE DESIGN CRITERIA

A. Development Criteria Reference

This report is based on the guidelines and criteria presented in the El Paso County Drainage Criteria Manual.

Drainage planning for this site was previously studied in the "Big R – Retail Center Final Drainage Report" by M&S Civil Consultants, Inc. dated February 2012, which depicts the majority of the developed site flowing to an on-site private detention / water quality pond as the southwest corner of the site.

B. Hydrologic Criteria

The tributary drainage basins impacting this site are all less than 100 acres, so Rational Method Hydrology procedures were utilized for calculation of peak flows.

Rational Method hydrologic calculations were based on the following assumptions:

• Design storm (minor)	5-year	
• Design storm (major)	100-year	
• Rainfall Intensities	El Paso County I-D-F Curve	
• Hydrologic soil type	B	
	C5	C100
• Runoff Coefficients - undeveloped:		
Meadow / Forest areas	0.08	0.35
• Runoff Coefficients - developed:		
Proposed Building / Pavement Areas	0.90	0.96

(see composite runoff coefficient calculations in Appendix B)

Hydrologic calculations are enclosed in Appendix B, and peak design flows are identified on the drainage plan drawings.

IV. 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:

Step 1: Employ Runoff Reduction Practices

- Extended Detention Basin: The majority of developed flows will be routed through the on-site detention basin, which will be grass-lined to encourage stormwater infiltration.

Step 2: Stabilize Drainageways

- There are no drainageways directly adjacent to this project site. Implementation of the on-site drainage improvements and detention basin will minimize downstream drainage impacts from this site.
- Drainage basin fees will be paid at the time of recording of the subdivision plat, and these fees provide the applicable cost contribution towards regional drainage improvements.

Step 3: Provide Water Quality Capture Volume (WQCV)

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

Step 4: Consider Need for Industrial and Commercial BMPs

- No industrial uses are proposed for this site.
- The commercial properties within this project will implement a Stormwater Management Plan including proper housekeeping practices and spill containment procedures.
- On-site drainage will be routed through the Extended Detention Basin (EDB) to minimize introduction of contaminants to the County's public drainage system.

V. GENERAL DRAINAGE RECOMMENDATIONS

The developed drainage plan for the site is to provide and maintain positive drainage away from structures and conform to the established drainage patterns for the overall site. JPS Engineering recommends that positive drainage be established and maintained away from all structures within the site in conformance with applicable building codes and geotechnical engineering recommendations.

Individual lot grading is the sole responsibility of the individual builders and property owners. Final grading of each building site should establish proper protective slopes and positive drainage in accordance with HUD guidelines and building codes. In general, main floor elevations for each building should be established a minimum of 2 feet above the top of curb of the adjoining street.

In general, we recommend a minimum of 6 inches clearance from the top of concrete foundation walls to adjacent finished site grades. Positive drainage slopes should be maintained away from all structures, with a minimum recommended slope of 5 percent for the first 10 feet away from buildings in landscaped areas, a minimum recommended slope of 2 percent for the first 10 feet away from buildings in paved areas, and a minimum slope of 1 percent for paved areas beyond buildings.

VI. DRAINAGE FACILITY DESIGN

A. General Concept

Development of the proposed subdivision replat will not require any public improvements, as access to the two lots will be provided by private access drive connections to the existing Green Acres Lane along the west boundary of the subdivision. The general concept for management of developed storm runoff is to establish site grading to provide positive drainage away from the building pads and divert runoff to drainage swales following historic drainage patterns.

B. Specific Details

1. Existing Drainage Conditions

Existing site drainage conditions are depicted on the "Big R Drainage Plan" by M&S Civil Consultants, Inc. (Appendix E). The north side of the proposed subdivision property is currently developed as the Big R Retail Center, and the south side of the site is currently vacant. Existing drainage facilities within the property include a private storm sewer system serving the Big R Retail Center site and an existing private stormwater detention pond at the southwest corner of the property.

As detailed in the M&S FDR, Basins OS1, OS2, and A (west edge of site) flow to an existing 15' Type R Inlet along the east side of Struthers Road (Design Point #1; Q_5 = 14.3 cfs and Q_{100} = 31.1 cfs). Basins B and C (Big R Retail Building and north driveway) flow to an existing Storm Inlet at the northwest corner of the site (Design Point #2; Q_5 = 2.3 cfs and Q_{100} = 4.7 cfs), and a 24" Private Storm Sewer conveys these flows south along the western site boundary to an existing storm manhole connecting to a 30" RCP culvert crossing Struthers Road. The previous M&S drainage report identified the existing public storm sewer facilities as having adequate capacity to accept the developed flows from Basins A-C within the Big R site.

Drainage from off-site Basins OS4 and OS5 sheet flows southwesterly to the existing roadside ditch along the north side of Spanish Bit Drive, with calculated peak flows of Q_5 = 22.2 cfs and Q_{100} = 51.7 cfs at Design Point #3. The roadside ditch along the north side of Spanish Bit Drive flows southwesterly to the existing depression at the northeast corner of the Struthers Road intersection, where this flow enters the existing dual 36-inch culverts crossing Struthers Road at Design Point #7.

Basin D comprises the southwest parking lot of the Big R site, which sheet flows to an existing 8-foot D10R sump inlet at the southwest corner of the parking lot (Design Point #4; Q_5 = 9.8 cfs and Q_{100} = 19.4 cfs per M&S report). An existing 24" Private Storm Sewer conveys the flow from DP4 south into the detention basin at the southwest corner of the site.

The M&S FDR identifies Design Point #5 as the developed area consisting of Basins E and F which enters the east side of the detention pond. The M&S report calculated peak flows of Q_5 = 25.9 cfs and Q_{100} = 48.9 cfs at Design Point #5.

Design Point #6 represents the combined developed flow from DP4 and DP5, with total calculated peak flows of Q_5 = 32.8 cfs and Q_{100} = 62.7 cfs entering the detention pond.

Design Point #7 has been identified as the combination of flow in the roadside ditch along the northwest side of Spanish Bit Drive from DP3 and Basin OS6 (north side of Spanish Bit Drive), with calculated peak flows of Q_5 = 24.0 cfs and Q_{100} = 56.0 cfs.

The M&S FDR identifies Design Point #8 as the combined flow from DP7 and the detention pond outlet structure (DP6-detained), with calculated peak flows of Q_5 = 31.2 cfs and Q_{100} = 73.9 cfs. M&S concludes that the total flow reaching the existing depression at the northeast corner of Struthers Road and Spanish Bit Drive is "approximately equal to that of the historic value (Q_5 = 31.6 cfs and Q_{100} = 73.9 cfs). Therefore, historic flow values have been adhered to…."

2. Developed Drainage Conditions

As shown on the enclosed Drainage Plan (Figure D1, Appendix E), the site has been delineated as six on-site drainage basins matching the previous M&S FDR. Developed flows have been calculated based on the impervious areas associated with the proposed building and parking improvements.

Surface drainage swales and a private storm sewer system will convey developed flows from Basins D, E, and F1-F3 to the extended detention basin (EDB) at the corner of the site. Site grades will slope to storm inlets and curb openings at selected locations, collecting surface drainage and conveying stormwater to the detention basin. The proposed Minor Subdivision has no impact on the previously developed Big R Site drainage patterns (Basins A-E) on the north side of the property.

Basin F in the M&S FDR has been divided into Sub-Basins F1-F4 to provide further detail on final drainage patterns for the proposed commercial development areas comprising Lots 2 and 3. The proposed building pads on Lots 2 and 3 will be graded with protective slopes to provide positive drainage away from the buildings, and a private storm sewer system will convey developed flows southwesterly into Detention Basin F.

Private Storm Inlet F1A (5' Type R) will intercept surface drainage from the north side of Lot 2, and Private Storm Sewer F1A (12" HDPE) will flow southeasterly to Inlet F1B (5' Type R) in the southwest corner Lot 2. Private Storm Sewer F1B (18" HDPE) will convey the combined flow southwesterly to Inlet F2 on Lot 3.

Private Storm Inlet F2A (10' Type R) will intercept surface drainage from the parking area on the south side of Lot 3 (Basins E and F2), and Private Storm Sewer F2A (24" HDPE) will convey the combined flow westerly into a new forebay on the east side of Extended Detention Basin F. Developed peak flows at Design Point #5 (combined Basins E, F1, and F2) are calculated as Q_5 = 16.0 cfs and Q_{100} = 30.4 cfs.

The existing detention pond within Tract A has been delineated as Basin F3. Developed peak flows entering Detention Basin F (combined flows from Basins D, E, and F1-F3 at Design Point #6) are calculated as Q_5 = 23.2 cfs and Q_{100} = 45.5 cfs. After routing through Extended Detention Basin F, detained peak flows at Design Point #6d are calculated as Q_5 = 0.3 cfs and Q_{100} = 11.3 cfs (see Detention Pond Calculations in Appendix D). The existing 18" discharge pipe from Detention Basin F will continue to flow southwest into the existing dual 36" RCP public culverts crossing Struthers Road.

The narrow landscaped area within the property along the west edge (downstream) of the detention pond has been delineated as Basin F4 (0.11 acres), which sheet flows southwesterly into the existing curb and gutter along the east side of Struthers Road. Developed peak flows at Design Point #F4 are calculated as Q_5 = 0.04 cfs and Q_{100} = 0.3 cfs.

Basin F4 is excluded from permanent water quality requirements based on ECM Appendix I.7.1.C.1, which allows for 20%, not to exceed 1 acre, of the applicable development site area to not be captured.

Total detained peak flows at Design Point #8d are calculated as Q_5 = 24.9 cfs and Q_{100} = 65.5 cfs. As discussed in the "Big R – Retail Center Final Drainage Report" by M&S, the existing double 36" RCP culverts have been determined as adequate to convey the previously identified DP8 100-year flow of 73.9 cfs, so the existing culverts provide an adequate outfall for the design flows.

The roadway area of Spanish Bit Drive along the frontage of the property has been delineated as Basin OS6 (1.18 acres), which flows southwesterly along an existing roadside ditch to the existing culvert crossing on the east side of the Struthers Road intersection. Developed peak flows at Design Point #OS6 are calculated as Q_5 = 3.5 cfs and Q_{100} = 7.8 cfs (per M&S FDR).

This project will include upgrade of the Spanish Bit Drive roadway with new curb, gutter, and asphalt paving along the frontage of the site. The impervious area of the proposed roadway improvements within Basin OS6 is limited to approximately 0.46 acres, and the total area of Sub-Basin OS6.1 (basin area within limits of this project) is 0.88 acres. The combined area of Basin F4 and Sub-Basin OS6.1 is 0.99 acres. As such, these combined areas qualify for exclusion from permanent water quality requirements per ECM Appendix I.7.1.C.1, which allows for 20%, not to exceed 1 acre, of the applicable development site area to not be captured.

A new 16-foot Type D10R Storm Inlet will be installed at the upstream project limit to intercept the off-site flows at Design Point #3 and a 30" RCP storm sewer will convey the flow from Inlet-DP3 into the roadside ditch flowing southwest along the frontage of the site. The 36" RCP culvert crossing the existing Big R access drive will also be extended on each end to accommodate the new sidewalk improvements at the driveway intersection.

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

C. On-Site Drainage Facility Design

Developed drainage basins and drainage patterns are depicted on the enclosed Developed Drainage Plan (Sheet D1). Private storm inlets and storm sewer pipes will convey developed flows from Lots 2 and 3 to Detention Basin F. As discussed above, the existing double 36" RCP public culverts crossing Spanish Bit Drive on the east side of Struthers Road provide an adequate outfall in accordance with ECM Section 3.2.4.

VII. EROSION CONTROL / SEDIMENT CONTROL

Contractors and Owners will need to implement and maintain proper Best Management Practices (BMP's) and control measures for erosion and sediment control during and after construction. Erosion control measures should include installation of silt fence at the toe of disturbed areas, sediment control logs protecting drainage ditches, vehicle tracking control pads at access points, riprap protection at culvert outlets, and revegetation of disturbed areas. Cut slopes will need to be stabilized during excavation as necessary and vegetation will need to be re-established as soon as possible for stabilization of graded areas.

VIII. STORMWATER DETENTION AND WATER QUALITY

A private stormwater detention pond was constructed at the southwest corner of the site during initial development of this site for the Big R Retail Center. Proposed drainage improvements will include upgrades to the existing private Extended Detention Basin (EDB) to meet current full-spectrum detention design standards. The upgraded 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.

As detailed in the detention pond hydraulic calculations in Appendix D, the required 100-year Full-Spectrum Detention Volume has been calculated as 1.0 acre-feet. The proposed upgrades to the existing on-site Extended Detention Basin (EDB) include enlarging the existing pond to the east to provide a storage volume of 1.1 acre-feet, which meets the required full-spectrum detention volume.

Additional detention pond upgrades include a new forebay and trickle channel on the east side of the detention pond and upgrades to the existing outlet structure to provide a new water quality orifice plate and maintain discharges below the allowable release rates.

The upgraded pond outlet structure has been designed using the Mile High Flood District's "MH-Detention" calculation spreadsheets, providing for a 40-hour release of the WQCV, and outlet structure sizing to maintain maximum allowable release rates from the pond. The EDB will have a grass-lined bottom to encourage infiltration of stormwater prior to discharging into the downstream public drainage system.

The previous Final Drainage Report by M&S identified allowable release rates for the detention pond as $Q_5 = 6.1$ cfs and $Q_{100} = 16.6$ cfs. As detailed in the detention basin calculations in Appendix D, detained peak flows from the upgraded Detention Basin F are calculated as $Q_5 = 0.3$ cfs and $Q_{100} = 11.3$ cfs, well below the previous estimates.

The existing stormwater detention facility will continue to be owned and maintained by the property owners, and maintenance access will be provided from the adjacent Lot 1 parking lot.

Areas Excluded from Water Quality Facilities

The landscaped area at the southwest corner of the site (Basin F4; 0.11 acres) and the area of roadway improvements along Spanish Bit Drive (Sub-Basin OS6.1; 0.88 acres) are excluded from water quality requirements based on ECM Appendix I.7.1.C.1 (see previous discussion in Paragraph VI.B.2 for details).

IX. DRAINAGE COSTS AND DRAINAGE FEES

The developer will finance all costs for required subdivision improvements, and there are no reimbursable public drainage facilities proposed as part of this minor subdivision plat.

The property is located entirely within the Jackson Creek Drainage Basin (FOMO4400), which has a 2023 drainage basin fee of $9,135 per impervious acre and a bridge fee of $0 per impervious acre. Applicable drainage basin fees are calculated as follows:

Minor Subdivision Area =	10.246 acres
New Lot 2-3 Area =	2.9 acres
Calculated Impervious Area (Basins F1-F2 per Appendix D) =	2.36 acres

Drainage Basin Fee = (2.36 ac.) @ $9,135/ac. = <u>$21,558.60</u>

Bridge Fee = (2.36 ac.) @ $0/ac. = <u>$0</u>

X. SUMMARY

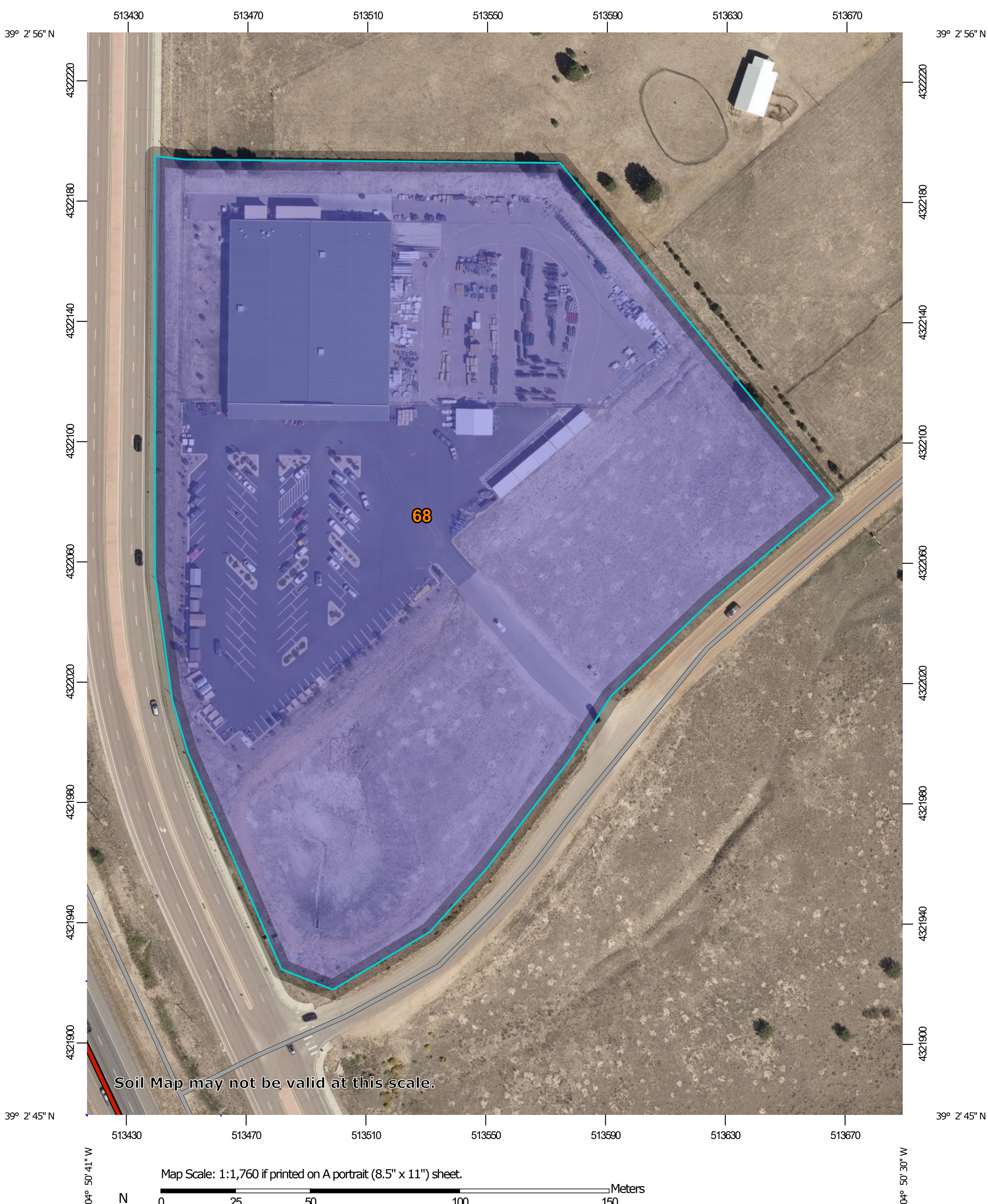
The developed drainage patterns associated with the proposed Cathedral Rock Commons Commercial subdivision at the northeast corner of Struthers Road and Spanish Bit Drive will remain consistent with existing conditions and the overall drainage plan for area. Developed flows from the site will drain through a Private Stormwater Detention Pond at the southwest corner of the property prior to discharging to the existing downstream public drainage system.

The on-site stormwater detention and water quality facilities have been designed to mitigate developed flow impacts and meet the County's stormwater detention and water quality requirements. 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

Hydrologic Soil Group—El Paso County Area, Colorado
(Cathedral Rock Commons)



Map Scale: 1:1,760 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 25, 50, 100, 150

Feet: 0, 50, 100, 200, 300

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 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 18, Jun 5, 2020

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
68	Peyton-Pring complex, 3 to 8 percent slopes	B	10.2	100.0%
Totals for Area of Interest			**10.2**	**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

United States Department of Agriculture

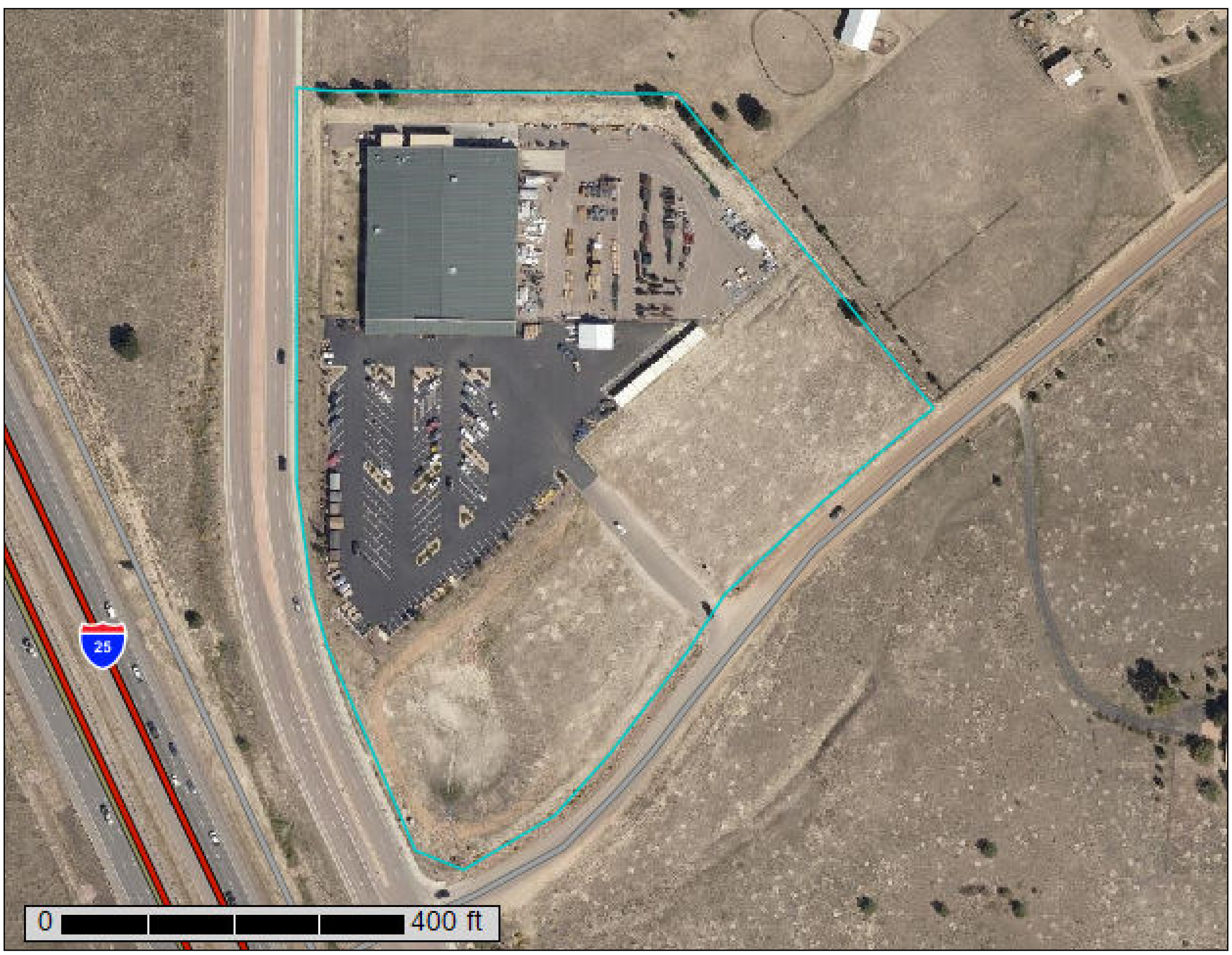
NRCS

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



July 13, 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.

Soil Map

Map Scale: 1:1,760 if printed on A portrait (8.5" x 11") sheet.

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 18, Jun 5, 2020

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
68	Peyton-Pring complex, 3 to 8 percent slopes	10.2	100.0%
Totals for Area of Interest		**10.2**	**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

68—Peyton-Pring complex, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 369f
Elevation: 6,800 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Peyton and similar soils: 40 percent
Pring and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Peyton

Setting

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

Typical profile

A - 0 to 12 inches: sandy loam
Bt - 12 to 25 inches: sandy clay loam
BC - 25 to 35 inches: sandy loam
C - 35 to 60 inches: sandy loam

Properties and qualities

Slope: 3 to 5 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): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: R049XB216CO - Sandy Divide
Hydric soil rating: No

Description of Pring

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

A - 0 to 14 inches: coarse sandy loam
C - 14 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R048AY222CO
Hydric soil rating: No

Minor Components

Pleasant

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

Other soils

Percent of map unit:
Hydric soil rating: No

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

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

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.

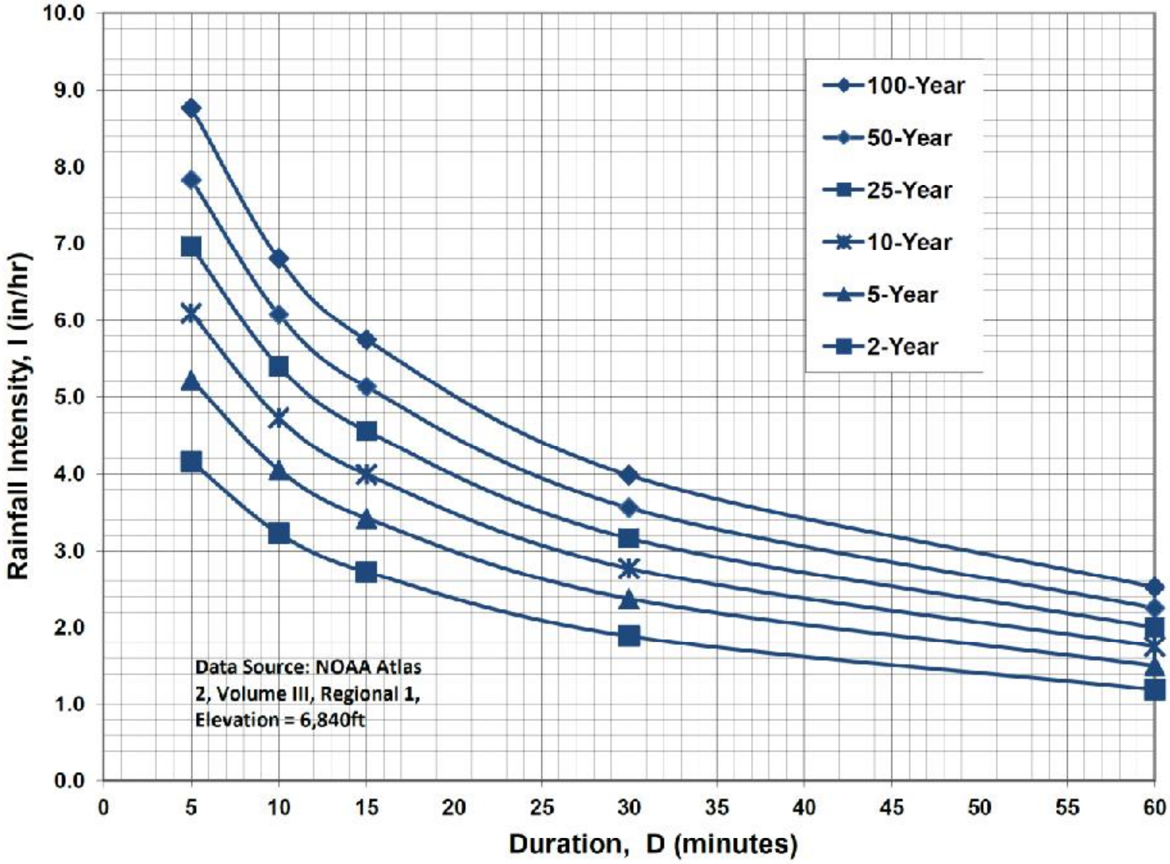
3.2.4 Minimum Time of Concentration

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

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

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

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

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

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

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

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

BIG R - RETAIL CENTER
FINAL DRAINAGE REPORT
(Area Drainage Summary)

				OVERLAND				STREET / CHANNEL FLOW				Time of Travel (T_t)	INTENSITY *		TOTAL FLOWS	
BASIN	AREA TOTAL (Acres)	C_5 (From DCM Table 5-1)	C_{100}	C_5	Length (ft)	Height (ft)	T_C (min)	Length (ft)	Slope (%)	Velocity (fps)	T_t (min)	TOTAL (min)	I_5 (in/hr)	I_{100} (in/hr)	Q_5 (c.f.s.)	Q_{100} (c.f.s.)
A	0.47	0.25	0.35	0.25	15	0.4	4.5	0	0.0%	0.0	0.0	5.0	5.1	9.1	0.6	1.5
B	0.54	0.85	0.95	0.25	0	0	0.0	380	1.0%	3.5	1.8	5.0	5.1	9.1	2.3	4.7
C	0.80	0.85	0.95	BUILDING ROOF								5.0	5.1	9.1	3.5	6.9
D	2.25	0.85	0.95	0.25	10	1	2.4	500	3.3%	6.4	1.3	5.0	5.1	9.1	9.8	19.4
E	2.02	0.85	0.90	0.25	25	10	2.4	350	3.5%	6.5	0.9	5.0	5.1	9.1	8.8	16.5
F	3.96	0.85	0.90	0.25	10	1	2.4	550	3.5%	6.5	1.4	5.0	5.1	9.1	17.2	32.4
OS1	3.50	0.29	0.38	0.29	460	14	22.5	0	0.0%	0.0	0.0	22.5	2.8	5.0	2.9	6.7
OS2	2.20	0.90	0.95	0.90	0	0	0.0	1620	3.6%	6.6	4.1	5.0	5.1	9.1	10.1	19.0
OS3	8.80	0.29	0.38	0.29	1000	60	26.5	550	3.3%	6.4	1.4	28.0	2.5	4.5	6.4	15.0
OS4	7.10	0.29	0.38	0.25	1000	80	25.3	360	3.4%	6.5	0.9	26.2	2.6	4.6	5.4	12.5
OS5	22.30	0.29	0.38	0.25	1000	90	24.3	820	3.4%	6.5	2.1	26.5	2.6	4.6	16.8	39.2
OS6	1.18	0.60	0.80	0.25	15	3	2.3	1525	4.0%	7.0	3.6	5.9	4.9	8.7	3.5	8.2

* Intensity equations assume a minimum travel time of 5 minutes.

CA_5	Basin	CA_{100}
0.12	A	0.16
0.46	B	0.51
0.68	C	0.76
1.91	D	2.14
1.72	E	1.82
3.37	F	3.56
1.02	OS1	1.33
1.98	OS2	2.09
2.55	OS3	3.34
2.06	OS4	2.70
6.47	OS5	8.47
0.71	OS6	0.94

Calculated by: VAS
Date: 2/28/2012
Checked by: ____________

BIG R - RETAIL CENTER
FINAL DRAINAGE REPORT
(Surface Routing Summary)

Design Point(s)	Contributing Basins/Design Points	Equivalent CA_5	Equivalent CA_{100}	Maximum T_C	Intensity		Flow		Comments
					I_5	I_{100}	Q_5	Q_{100}	
1	OS1, OS2, OS3 & A	5.66	6.93	28.0	2.5	4.5	***14.3***	***31.1***	***ex 15' Type R Sump Inlet***
2	B	0.46	0.51	5.0	5.1	9.1	***2.3***	***4.7***	***prop Type C Grated Inlet***
3	OS4, OS5	8.53	11.17	26.5	2.6	4.6	***22.2***	***51.7***	***off-site into roadside ditch***
4	D	1.91	2.14	5.0	5.1	9.1	***9.8***	***19.4***	***prop 8' Sump D-10-R Inlet***
5	E & F	5.08	5.38	5.0	5.1	9.1	***25.9***	***48.9***	***prop detention/WQ pond***
6	DP4 & DP5	7.00	7.52	6.8	4.7	8.3	***32.8***	***62.7***	***total inflow to detention/WQ pond***
7	DP3 & OS6	9.23	12.12	26.5	2.6	4.6	***24.0***	***56.0***	***total inflow to ex depression***
8	DP6 (OUTLET) & DP7	(SEE DETENTION/WQ POND CALCULATIONS)					***31.2***	***73.9***	***prop flow into ex system***

Calculated by: VAS
Date: 2/28/2012
Checked by:

CATHEDRAL ROCK COMMONS COMMERCIAL
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
D	2.25	2.00	PAVED/IMPERVIOUS	0.9	0.25	LANDSCAPED	0.08				0.809
E	2.02	1.70	PAVED/IMPERVIOUS	0.9	0.32	LANDSCAPED	0.08				0.770
F1	1.93	1.70	PAVED/IMPERVIOUS	0.9	0.23	LANDSCAPED	0.08				0.802
F2	1.07	0.66	PAVED/IMPERVIOUS	0.9	0.41	LANDSCAPED	0.08				0.586
E,F2	3.09										0.706
E,F1,F2	5.02										0.743
F3	0.96	0.96	LANDSCAPED	0.08							0.080
D-F3	8.23										0.684
DP3 (OS4+OS5)	29.4										0.290
OS6	1.18										0.600
DP7 (DP3+OS6)	30.58										0.302
DP8 (DP6+DP7)	38.81										0.383

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
D	2.25	2.00	PAVED/IMPERVIOUS	0.96	0.25	LANDSCAPED	0.35				0.892
E	2.02	1.70	PAVED/IMPERVIOUS	0.96	0.32	LANDSCAPED	0.35				0.863
F1	1.93	1.70	PAVED/IMPERVIOUS	0.96	0.23	LANDSCAPED	0.35				0.887
F2	1.07	0.66	PAVED/IMPERVIOUS	0.96	0.41	LANDSCAPED	0.35				0.726
E,F2	3.09										0.816
E,F1,F2	5.02										0.843
F3	0.96	0.96	LANDSCAPED	0.35							0.350
D-F3	8.23										0.799
DP3 (OS4+OS5)	29.4										0.380
OS6	1.18										0.800
DP7 (DP3+OS6)	30.58										0.396
DP8 (DP6+DP7)	38.81										0.481

CATHEDRAL ROCK COMMONS COMMERCIAL
RATIONAL METHOD

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)
D	4	2.25	0.809	0.892	10	0.100	0.8	500	20	0.033	3.63	2.3	3.1	5.0	5.17	8.68	9.41	17.42
E	E	2.02	0.770	0.863	25	0.400	0.9	350	20	0.035	3.74	1.6	2.4	5.0	5.17	8.68	8.04	15.13
F1	F1	1.93	0.802	0.887	100	0.030	3.8	400	20	0.025	3.16	2.1	5.9	5.9	4.92	8.27	7.62	14.15
F2	F2	1.07	0.586	0.726	100	0.020	7.5	160	20	0.038	3.90	0.7	8.2	8.2	4.44	7.45	2.78	5.78
E,F2	F2A	3.09	0.706	0.816									8.2	8.2	4.44	7.45	9.68	18.78
E,F1,F2	5	5.02	0.743	0.843			0.0	200	20	0.035	3.74	0.9	9.0	9.0	4.28	7.19	15.96	30.41
F3		0.96	0.080	0.350			0.0	210	15	0.052	3.42	1.0	1.0					
D-F3	6	8.23	0.684	0.799									10.1	10.1	4.12	6.92	23.19	45.47
F4	F4	0.11	0.080	0.350	50	0.080	6.6	155	20	0.01	2.00	1.3	7.9	7.9	4.48	7.53	0.04	0.29
OS4-OS5 *	3	29.4	0.290	0.380									26.5	26.5	2.67	4.48	22.74	50.01
OS6 *		1.18	0.600	0.800									5.9	5.9	4.92	8.26	3.48	7.80
OS4-OS6 *	7	30.58	0.302	0.396									26.5	26.5	2.67	4.48	24.63	54.21
OS4-OS6,D-F3 *	8	38.81	0.383	0.481									26.5	26.5	2.67	4.48	39.65	83.57

* REFER TO "BIG R RETAIL CENTER FINAL DRAINAGE REPORT" BY M&S CIVIL CONSULTANTS, INC. DATED FEB. 2012

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 F OUTFLOW	6d	8.23															0.30	11.30
OS4-OS6,D-F3	8d	38.81															24.93	65.51

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

HYDRAULIC CALCULATIONS

CATHEDRAL ROCK COMMONS COMMERCIAL
STORM INLET SIZING SUMMARY

	BASIN FLOW			INLET FLOW						
INLET	DP	Q5 FLOW (CFS)	Q100 FLOW (CFS)	INLET FLOW % OF BASIN	Q5 FLOW (CFS)	Q100 FLOW (CFS)		INLET CONDITION / TYPE	INLET SIZE (FT)	INLET CAPACITY (CFS)
F1A	F1	7.6	14.2	35	2.7	5.0		SUMP TYPE R	5.0	12.3
F1B	F1	7.6	14.2	65	4.9	9.2		SUMP TYPE R	5.0	12.3
F2A	F2A	9.7	18.8	100	9.7	18.8		SUMP TYPE R	10.0	23.5
DP3	DP3	22.7	50.0	100	22.7	50.0		SUMP TYPE D10R	16.0	49.6

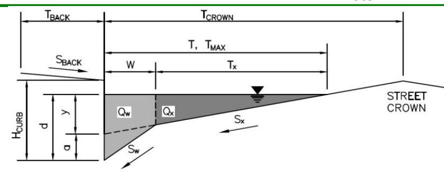
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Cathedral Rock Commons Commercial - Inlets F1A-F1B

Inlet ID: Inlets F1A-F1B



Gutter Geometry (Enter data in the blue cells)

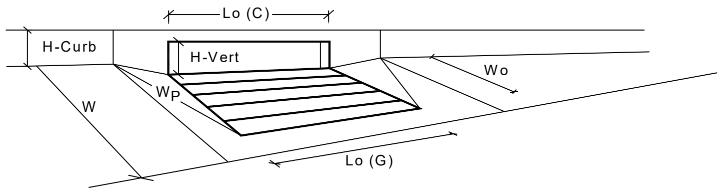
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	4.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	30.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.010	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	30.0	30.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet: CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.4	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.28	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.69	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**4.1**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	3.4	6.9	cfs

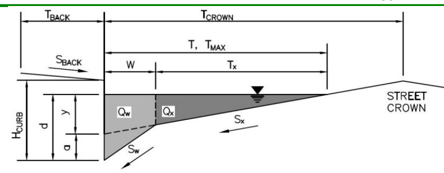
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Cathedral Rock Commons Commercial - Inlet F2

Inlet ID: Inlet F2



Gutter Geometry (Enter data in the blue cells)

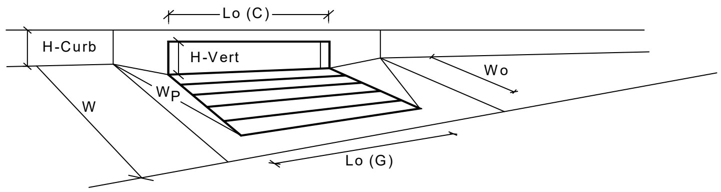
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	4.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	30.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.025	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	30.0	30.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet: CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	10.4	inches
Grate Information		MINOR	MAJOR	Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	10.00	10.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.70	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	0.98	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.93	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**8.3**	**23.5**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Minor Storm	$Q_{PEAK\ REQUIRED}$ =	9.6	18.3	cfs

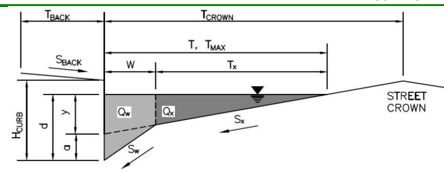
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: Cathedral Rock Commons Commercial - Inlet DP3

Inlet ID: Inlet DP3



Gutter Geometry (Enter data in the blue cells)

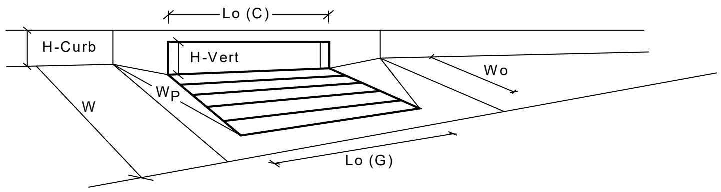
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	10.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	Q_{allow} =	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)	Colorado Springs D-10-R		MINOR	MAJOR	
Type of Inlet		Type =	Colorado Springs D-10-R		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	4.00	4.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.6	12.0	inches
Grate Information			MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate		L_o (G) =	N/A	N/A	feet
Width of a Unit Grate		W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)		A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)		C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)		C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)		C_o (G) =	N/A	N/A	
Curb Opening Information			MINOR	MAJOR	
Length of a Unit Curb Opening		L_o (C) =	16.00	16.00	feet
Height of Vertical Curb Opening in Inches		H_{vert} =	8.00	8.00	inches
Height of Curb Orifice Throat in Inches		H_{throat} =	8.00	8.00	inches
Angle of Throat (see USDCM Figure ST-5)		Theta =	81.00	81.00	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)		W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)		C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)		C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)		C_o (C) =	0.67	0.67	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.30	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.53	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.76	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**8.5**	**49.6**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Minor and Major Storms	$Q_{PEAK\ REQUIRED}$ =	22.2	51.7	cfs

CATHEDRAL ROCK COMMONS COMMERCIAL
STORM SEWER SIZING SUMMARY

	PIPE FLOW				PIPE CAPACITY		
PIPE	DESIGN POINT	Q5 FLOW (CFS)	Q100 FLOW (CFS)		PIPE SIZE	MIN. PIPE SLOPE	PIPE CAPACITY (CFS)
F1A	F1A	2.7	5.0		12	2.0%	5.0
F1B	F1	7.6	14.2		18	1.9%	14.5
F2A	DP5	16.0	30.4		24	2.0%	32.0
DP3	DP3	22.7	50.0		30	1.5%	50.2

ASSUMPTIONS:
1. STORM DRAIN PIPE ASSUMED TO BE RCP OR HDPE

Hydraulic Analysis Report

Project Data

Project Title: Project - Cathedral Rock Commons Commercial

Designer: JPS

Project Date: Friday, October 1, 2021

Project Units: U.S. Customary Units

Notes:

Channel Analysis: SD-F1A

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.0000 ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0130

Depth: 1.0000 ft

Result Parameters

Flow: 5.0386 cfs

Area of Flow: 0.7854 ft^2

Wetted Perimeter: 3.1416 ft

Hydraulic Radius: 0.2500 ft

Average Velocity: 6.4153 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 0.9189 ft

Critical Velocity: 6.6702 ft/s

Critical Slope: 0.0174 ft/ft

Critical Top Width: 0.55 ft

Calculated Max Shear Stress: 1.2480 lb/ft^2

Calculated Avg Shear Stress: 0.3120 lb/ft^2

Channel Analysis: SD-F1B

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.5000 ft

Longitudinal Slope: 0.0190 ft/ft

Manning's n: 0.0130

Depth: 1.5000 ft

Result Parameters

Flow: 14.4792 cfs

Area of Flow: 1.7671 ft^2

Wetted Perimeter: 4.7124 ft

Hydraulic Radius: 0.3750 ft

Average Velocity: 8.1936 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.3938 ft

Critical Velocity: 8.4583 ft/s

Critical Slope: 0.0164 ft/ft

Critical Top Width: 0.77 ft

Calculated Max Shear Stress: 1.7784 lb/ft^2

Calculated Avg Shear Stress: 0.4446 lb/ft^2

Channel Analysis: SD-F2A

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.0000 ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0130

Depth: 2.0000 ft

Result Parameters

Flow: 31.9929 cfs

Area of Flow: 3.1416 ft^2

Wetted Perimeter: 6.2832 ft

Hydraulic Radius: 0.5000 ft

Average Velocity: 10.1837 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.8896 ft

Critical Velocity: 10.4088 ft/s

Critical Slope: 0.0173 ft/ft

Critical Top Width: 0.91 ft

Calculated Max Shear Stress: 2.4960 lb/ft^2

Calculated Avg Shear Stress: 0.6240 lb/ft^2

Channel Analysis: SD-DP3

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.5000 ft

Longitudinal Slope: 0.0150 ft/ft

Manning's n: 0.0130

Depth: 2.5000 ft

Result Parameters

Flow: 50.2355 cfs

Area of Flow: 4.9087 ft^2

Wetted Perimeter: 7.8540 ft

Hydraulic Radius: 0.6250 ft

Average Velocity: 10.2339 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 2.3022 ft

Critical Velocity: 10.6255 ft/s

Critical Slope: 0.0130 ft/ft

Critical Top Width: 1.35 ft

Calculated Max Shear Stress: 2.3400 lb/ft^2

Calculated Avg Shear Stress: 0.5850 lb/ft^2

APPENDIX D

DETENTION POND CALCULATIONS

CATHEDRAL ROCK COMMONS COMMERCIAL

IMPERVIOUS AREAS

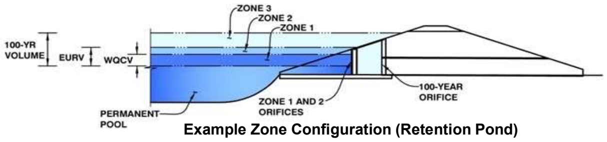
BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	WEIGHTED % IMP
A	0.47	0.47	LANDSCAPED	0							0.000
B	0.54	0.32	PAVED/IMPERVIOUS	100	0.22	LANDSCAPED	0				59.259
C	0.8	0.80	BUILDING	90							90.000
D	2.25	2.00	PAVED/IMPERVIOUS	100	0.25	LANDSCAPED	0				88.889
E	2.02	1.70	PAVED/IMPERVIOUS	100	0.32	LANDSCAPED	0				84.158
F1	1.93	1.70	PAVED/IMPERVIOUS	100	0.23	LANDSCAPED	0				88.083
F2	1.07	0.66	PAVED/IMPERVIOUS	100	0.41	LANDSCAPED	0				61.682
E,F2	3.09										76.375
E,F1,F2	5.02										80.876
F3	0.96	0.96	LANDSCAPED	0							0.000
F1,F2,F3	3.96										59.596
D-F3	8.23										73.633
A-F	10.04										70.717

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Cathedral Rock Commons

Basin ID: F



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	8.23	acres
Watershed Length =	700	ft
Watershed Length to Centroid =	350	ft
Watershed Slope =	0.029	ft/ft
Watershed Imperviousness =	73.60%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	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) =	0.200	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.668	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.572	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.765	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.927	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.114	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	1.282	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	1.480	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	1.907	acre-feet	3.14	inches
Approximate 2-yr Detention Volume =	0.525	acre-feet		
Approximate 5-yr Detention Volume =	0.696	acre-feet		
Approximate 10-yr Detention Volume =	0.873	acre-feet		
Approximate 25-yr Detention Volume =	0.937	acre-feet		
Approximate 50-yr Detention Volume =	0.974	acre-feet		
Approximate 100-yr Detention Volume =	1.037	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.200	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.467	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.369	acre-feet
Total Detention Basin Volume =	1.037	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=6767.0	--	1.75	--	--	--	4,159	0.095	3,648	0.084
	--	2.75	--	--	--	9,070	0.208	10,262	0.236
	--	4.75	--	--	--	13,330	0.306	32,662	0.750
Spillway=6771.0	--	5.75	--	--	--	15,166	0.348	46,910	1.077
Top EL=6773.0	--	7.75	--	--	--	17,000	0.390	79,076	1.815
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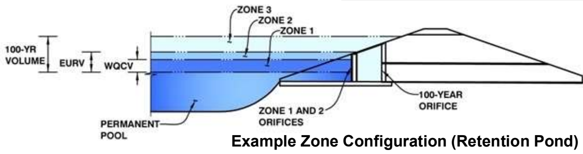
DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Cathedral Rock Commons**
Basin ID: **F**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.58	0.200	Orifice Plate
Zone 2 (EURV)	4.48	0.467	Orifice Plate
Zone 3 (100-year)	5.64	0.369	Weir&Pipe (Restrict)
Total (all zones)		1.037	

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

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 BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.48	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	17.00	inches
Orifice Plate: Orifice Area per Row =	N/A	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 (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	1.49	2.99					
Orifice Area (sq. inches)	1.15	1.05	3.00					

	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 =	4.75	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 =	4.75	N/A	feet
Overflow Weir Slope Length =	2.50	N/A	feet
Grate Open Area / 100-yr Orifice Area =	6.02	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 =	0.25	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 =	11.20		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.16	N/A	ft^2
Outlet Orifice Centroid =	0.53	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.82	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.75	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	25.00	feet
Spillway End Slopes =	3.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.52	feet
Stage at Top of Freeboard =	7.27	feet
Basin Area at Top of Freeboard =	0.38	acres
Basin Volume at Top of Freeboard =	1.63	acre-ft

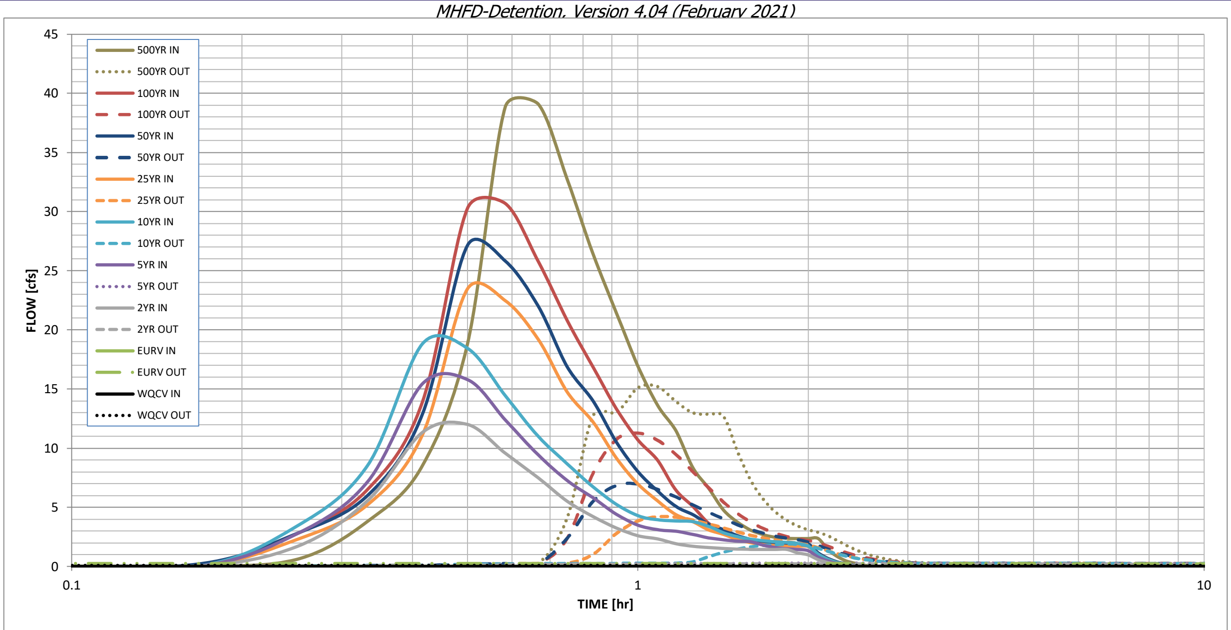
Routed Hydrograph Results

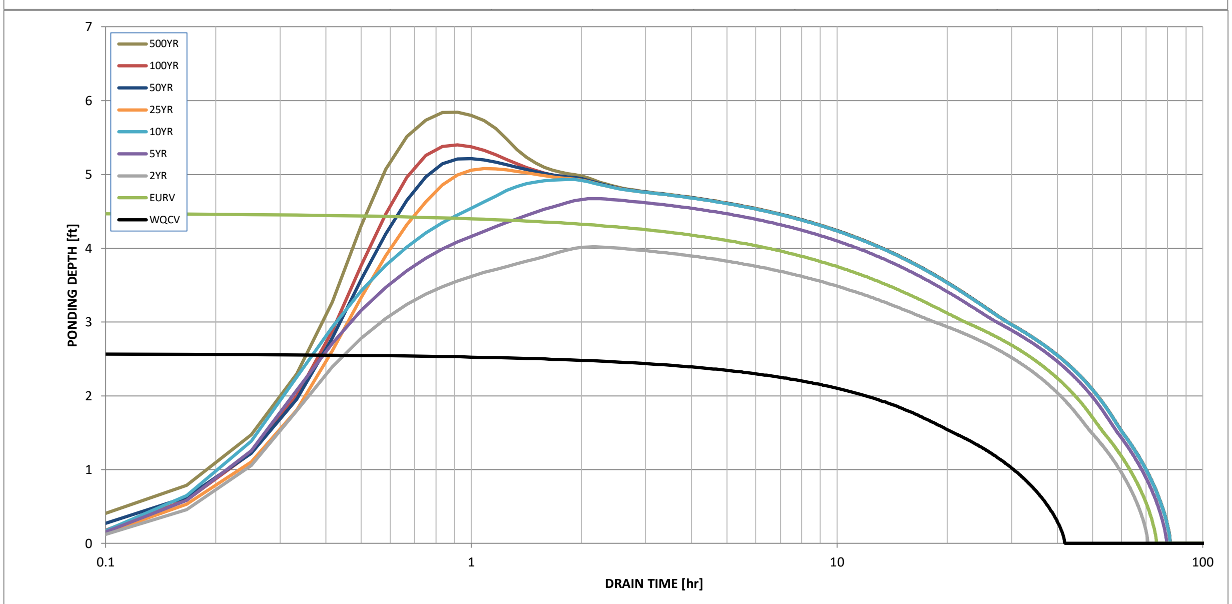
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

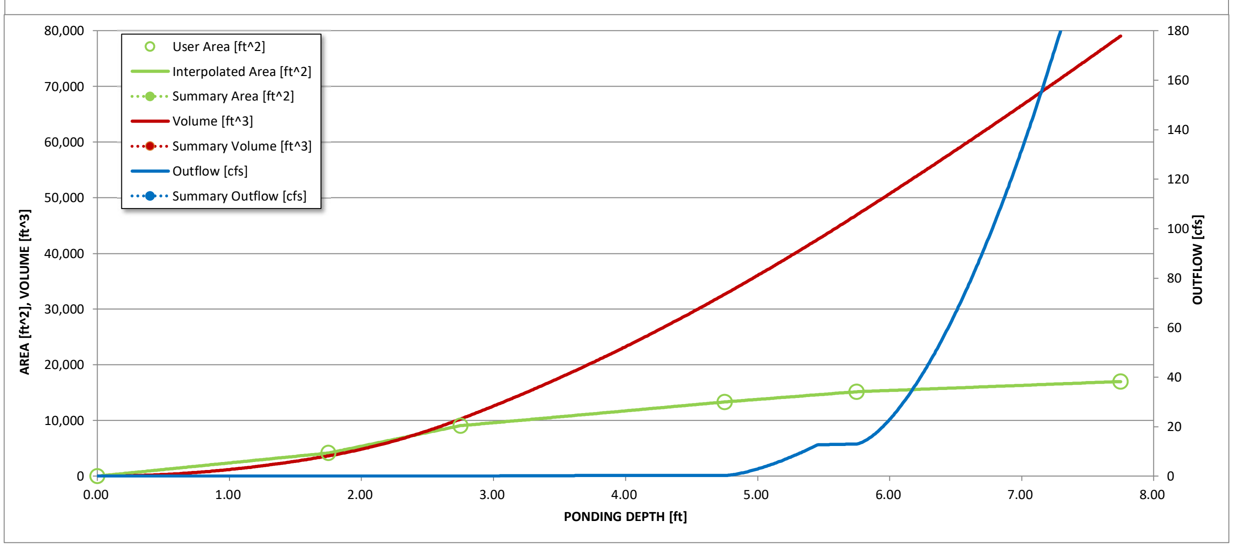
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	0.200	0.668	0.572	0.765	0.927	1.114	1.282	1.480	1.907
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.572	0.765	0.927	1.114	1.282	1.480	1.907
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.2	3.2	4.7	8.4	10.5	13.1	18.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.14	0.39	0.58	1.02	1.27	1.59	2.22
Peak Inflow Q (cfs) =	N/A	N/A	12.0	15.8	18.8	23.5	27.1	30.7	39.1
Peak Outflow Q (cfs) =	0.1	0.3	0.2	0.3	1.9	4.2	7.0	11.3	15.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.4	0.5	0.7	0.9	0.8
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	0.6	1.0	1.6	1.8
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	66	63	70	70	68	67	65	62
Time to Drain 99% of Inflow Volume (hours) =	**40**	71	67	75	76	76	75	74	73
Maximum Ponding Depth (ft) =	2.58	4.48	4.02	4.67	4.93	5.08	5.22	5.40	5.84
Area at Maximum Ponding Depth (acres) =	0.19	0.29	0.27	0.30	0.31	0.32	0.33	0.33	0.35
Maximum Volume Stored (acre-ft) =	0.202	0.669	0.537	0.725	0.806	0.850	0.895	0.954	1.108

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.02	0.61
	0:15:00	0.00	0.00	1.69	2.76	3.41	2.29	2.80	2.78	3.83
	0:20:00	0.00	0.00	5.57	7.16	8.56	5.22	6.02	6.52	8.52
	0:25:00	0.00	0.00	11.33	15.43	18.83	11.12	12.87	13.91	18.83
	0:30:00	0.00	0.00	12.00	15.81	18.44	23.46	27.14	30.27	38.84
	0:35:00	0.00	0.00	9.57	12.40	14.44	22.47	25.82	30.69	39.09
	0:40:00	0.00	0.00	7.49	9.44	11.00	19.21	22.00	25.81	32.77
	0:45:00	0.00	0.00	5.53	7.27	8.70	14.76	16.90	20.81	26.43
	0:50:00	0.00	0.00	4.23	5.82	6.74	12.22	14.00	16.87	21.44
	0:55:00	0.00	0.00	3.24	4.41	5.26	9.16	10.51	13.34	16.97
	1:00:00	0.00	0.00	2.60	3.49	4.29	6.98	8.03	10.71	13.64
	1:05:00	0.00	0.00	2.33	3.11	3.95	5.54	6.39	8.98	11.49
	1:10:00	0.00	0.00	1.93	2.98	3.84	4.40	5.08	6.47	8.37
	1:15:00	0.00	0.00	1.72	2.71	3.80	3.78	4.38	5.08	6.63
	1:20:00	0.00	0.00	1.60	2.43	3.40	3.10	3.58	3.66	4.78
	1:25:00	0.00	0.00	1.53	2.25	2.86	2.71	3.13	2.87	3.74
	1:30:00	0.00	0.00	1.48	2.15	2.52	2.27	2.61	2.37	3.07
	1:35:00	0.00	0.00	1.45	2.09	2.31	2.01	2.29	2.06	2.68
	1:40:00	0.00	0.00	1.44	1.79	2.18	1.85	2.10	1.90	2.47
	1:45:00	0.00	0.00	1.44	1.60	2.09	1.77	2.00	1.85	2.39
	1:50:00	0.00	0.00	1.44	1.49	2.05	1.72	1.94	1.83	2.36
	1:55:00	0.00	0.00	1.15	1.44	1.94	1.70	1.92	1.83	2.36
	2:00:00	0.00	0.00	0.98	1.32	1.72	1.69	1.91	1.83	2.36
	2:05:00	0.00	0.00	0.58	0.79	1.03	1.02	1.15	1.10	1.42
	2:10:00	0.00	0.00	0.35	0.47	0.61	0.61	0.69	0.66	0.85
	2:15:00	0.00	0.00	0.19	0.26	0.34	0.35	0.39	0.37	0.48
	2:20:00	0.00	0.00	0.10	0.15	0.19	0.20	0.22	0.21	0.27
	2:25:00	0.00	0.00	0.04	0.07	0.08	0.09	0.10	0.10	0.13
	2:30:00	0.00	0.00	0.01	0.02	0.02	0.03	0.03	0.03	0.04
	2:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer:	**JPS**
Company:	**JPS**
Date:	**October 14, 2022**
Project:	**Cathedral Rock Commons Commercial**
Location:	**Detention Basin F**

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a	I_a =	73.6	%
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i =	0.736	
C) Contributing Watershed Area	Area =	8.230	ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 =		in
E) Design Concept (Select EURV when also designing for flood control)	Choose One: ○ Water Quality Capture Volume (WQCV) ◉ Excess Urban Runoff Volume (EURV)		
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$)	V_{DESIGN}=	0.200	ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$	$V_{DESIGN\ OTHER}$=		ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$=		ac-ft
I) NRCS Hydrologic Soil Groups of Tributary Watershed			
i) Percentage of Watershed consisting of Type A Soils	HSG_A =	0	%
ii) Percentage of Watershed consisting of Type B Soils	HSG_B =	100	%
iii) Percentage of Watershed consisting of Type C/D Soils	$HSG_{C/D}$ =	0	%
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	$EURV_{DESIGN}$ =	0.670	ac-f t
K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired)	$EURV_{DESIGN\ USER}$=		ac-f t

2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.) — L : W = 3.0 : 1

3. Basin Side Slopes

A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred) — Z = 3.00 ft / ft

DIFFICULT TO MAINTAIN, INCREASE WHERE POSSIBLE

4. Inlet

A) Describe means of providing energy dissipation at concentrated inflow locations: Concrete Forebays

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} =	0.006	ac-ft
B) Actual Forebay Volume	V_F =	0.006	ac-ft
C) Forebay Depth (D_F = 18 inch maximum)	D_F =	18.0	in
D) Forebay Discharge			
i) Undetained 100-year Peak Discharge	Q_{100} =	45.47	cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F =	0.91	cfs
E) Forebay Discharge Design	Choose One: ○ Berm With Pipe ◉ Wall with Rect. Notch ○ Wall with V-Notch Weir		
F) Discharge Pipe Size (minimum 8-inches)	Calculated D_P =		in
G) Rectangular Notch Width	Calculated W_N =	5.4	in

Existing Forebay D Vol = 0.002 af
New Forebay F2 Vol = 0.004 af
Total Forebay Vol = 0.006 af

Flow too small for berm w/ pipe

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	JPS
Company:	JPS
Date:	October 14, 2022
Project:	Cathedral Rock Commons Commercial
Location:	Detention Basin F

6. Trickle Channel	
A) Type of Trickle Channel	Choose One: (●) Concrete ( ) Soft Bottom
F) Slope of Trickle Channel	S = 0.0050 ft / ft
7. Micropool and Outlet Structure	
A) Depth of Micropool (2.5-feet minimum)	D_M = 2.5 ft
B) Surface Area of Micropool (10 ft^2 minimum)	A_M = sq ft
C) Outlet Type	Choose One: (●) Orifice Plate ( ) Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 1.00 inches
E) Total Outlet Area	A_{ot} = 5.20 square inches
8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 4 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 26 cu ft
C) Initial Surcharge Provided Above Micropool	V_s= cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 182 square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.) Other (Y/N): N	*S.S. Well Screen with 60% Open Area*
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 303 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 4.48 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 81.76 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 12.0 inches **VALUE LESS THAN RECOMMENDED MIN. WIDTH. WIDTH HAS BEEN SET TO 12 INCHES.**

Design Procedure Form: Extended Detention Basin (EDB)

Designer: JPS
Company: JPS
Date: October 14, 2022
Project: Cathedral Rock Commons Commercial
Location: Detention Basin F

10. Overflow Embankment A) Describe embankment protection for 100-year and greater overtopping:	Riprap Spillway
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Ze = 4.00 ft / ft
11. Vegetation	Choose One ○ Irrigated ◉ Not Irrigated
12. Access A) Describe Sediment Removal Procedures	Periodic inspection and removal as needed; Access ramp provided to pond bottom

Notes:

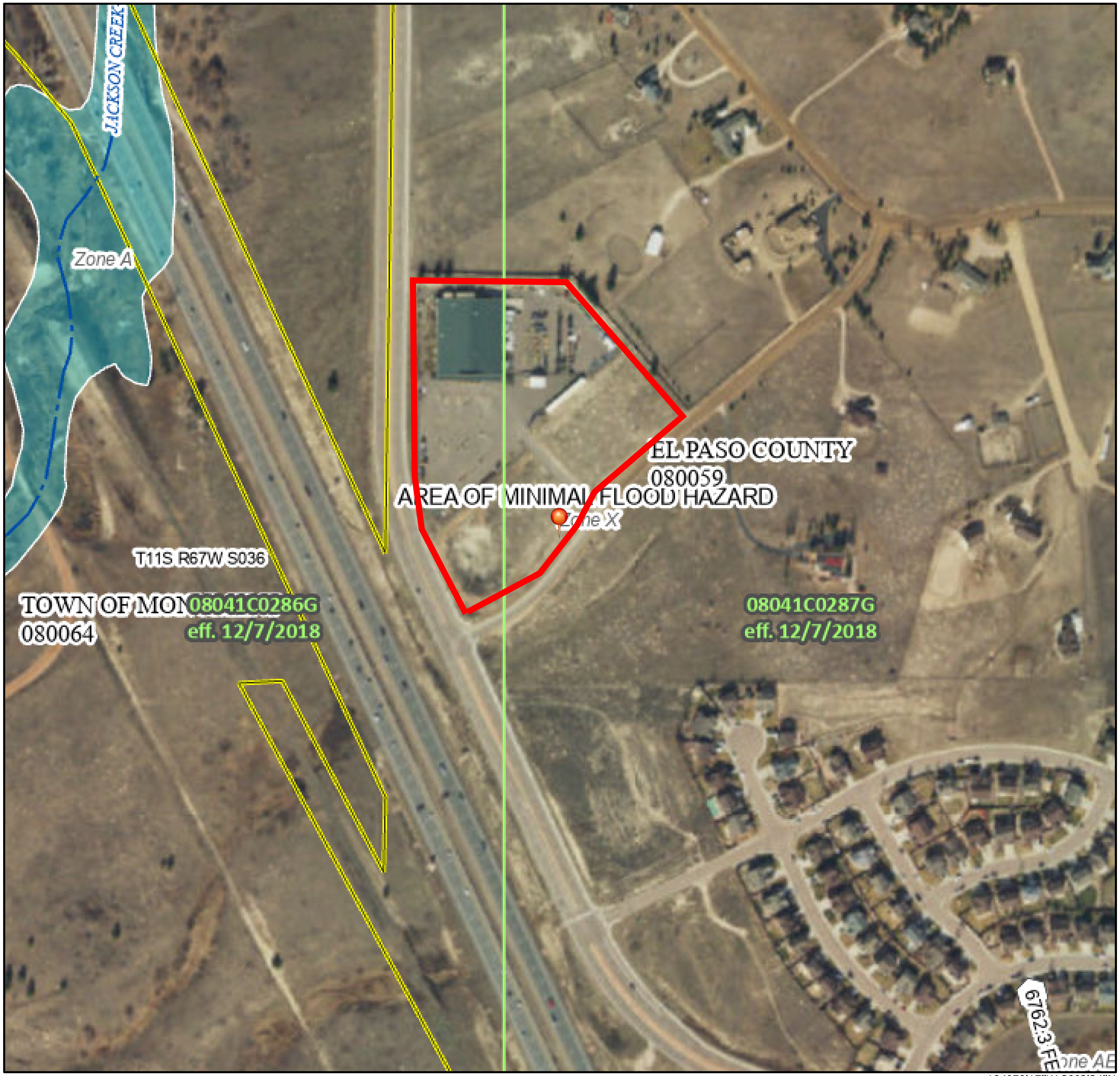
APPENDIX E

FIGURES

National Flood Hazard Layer FIRMette

FEMA

104°50'54"W 39°3'2"N



104°50'17"W 39°2'34"N

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

1:6,000

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

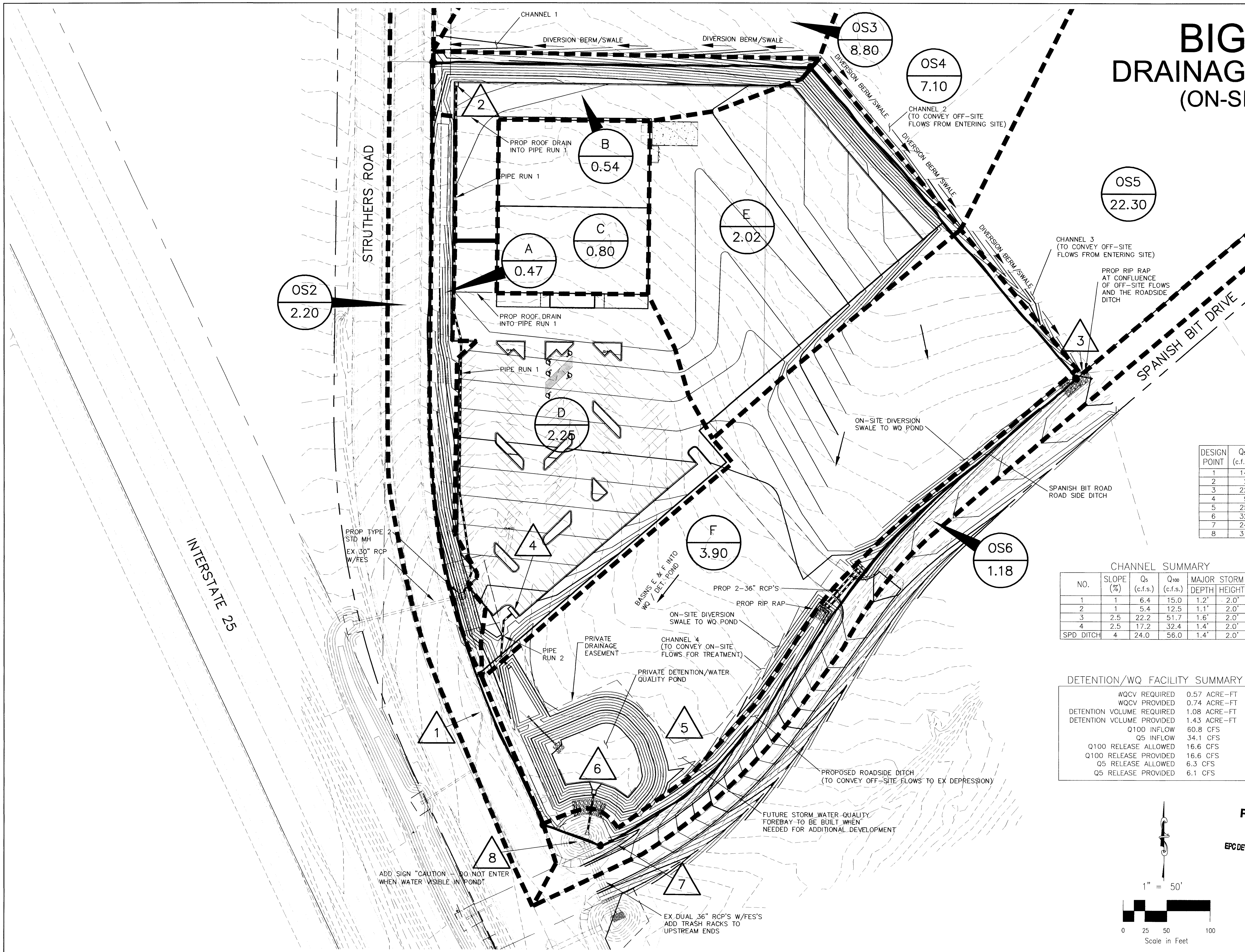
The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

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 9/28/2021 at 12:34 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.

BIG R
DRAINAGE PLAN
(ON-SITE)



BASIN SUMMARY

BASIN	AREA (Acres)	Q_5 (c.f.s.)	Q_{100} (c.f.s.)
A	0.47	0.6	1.5
B	0.54	2.3	4.7
C	0.08	3.5	6.9
D	2.25	9.8	19.4
E	2.02	8.8	16.5
F	3.96	17.2	32.4
OS1	3.50	2.9	6.7
OS2	2.20	10.1	19.0
OS3	8.80	6.4	15.0
OS4	7.10	5.4	12.5
OS5	22.30	16.8	39.2
OS6	1.18	3.5	8.2

DESIGN POINT SUMMARY

DESIGN POINT	Q_5 (c.f.s.)	Q_{100} (c.f.s.)	STRUCTURE
1	14.3	31.1	EX 15' TYPE R SUMP INLET
2	2.3	4.7	PROP TYPE C GRATED INLET
3	22.2	51.7	PROP ROADSIDE DITCH
4	9.8	19.4	PROP 8' SUMP TYPE D-10-R INLET
5	25.9	48.9	PROP DETENTION/WQ POND
6	32.8	62.7	TOTAL INFLOW TO POND
7	24.0	56.0	TOTAL INFLOW TO EX 2-36" RCP'S
8	31.2	73.9	PROP FLOW INTO EX SYSTEM

CHANNEL SUMMARY

NO.	SLOPE (%)	Q_5 (c.f.s.)	Q_{100} (c.f.s.)	MAJOR STORM	
				DEPTH	HEIGHT
1	1	6.4	15.0	1.2'	2.0'
2	1	5.4	12.5	1.1'	2.0'
3	2.5	22.2	51.7	1.6'	2.0'
4	2.5	17.2	32.4	1.4'	2.0'
SPD DITCH	4	24.0	56.0	1.4'	2.0'

PIPE RUN SUMMARY

PIPE RUN	SLOPE (%)	Q_5 (c.f.s.)	Q_{100} (c.f.s.)	STRUCTURE
1	1.0	5.8	11.6	24" PIPE
2	2.0	9.8	19.4	24" PIPE

DETENTION/WQ FACILITY SUMMARY

WQCV REQUIRED	0.57 ACRE-FT
WQCV PROVIDED	0.74 ACRE-FT
DETENTION VOLUME REQUIRED	1.08 ACRE-FT
DETENTION VOLUME PROVIDED	1.43 ACRE-FT
Q100 INFLOW	60.8 CFS
Q5 INFLOW	34.1 CFS
Q100 RELEASE ALLOWED	16.6 CFS
Q100 RELEASE PROVIDED	16.6 CFS
Q5 RELEASE ALLOWED	6.3 CFS
Q5 RELEASE PROVIDED	6.1 CFS

LEGEND

A — BASIN DESCRIPTION
0.10 — BASIN AREA, ACRES
3 — DESIGN POINT
EX MAJ CONT
EX MIN CONT
PROP MAJ CONT
PROP MIN CONT
LP — LOW POINT
HP — HIGH POINT
EX — EXISTING
FL — FLOWLINE
FLOW ARROW

RECEIVED
MAR 0 6 2012
EPC DEVELOPMENT SERVICES

1" = 50'

0 25 50 100
Scale in Feet

MS CIVIL CONSULTANTS, INC.
102 E PIKES PEAK AVENUE, SUITE 306
COLORADO SPRINGS, COLORADO 80903
v 719.955.5485
f 719.444.8427

DATE: 3/2/12

VERSION # 2
DATE 3/6/12

CATHEDRAL ROCK COMMONS COMMERCIAL

DEVELOPED DRAINAGE PLAN

50' 0 50' 100'
ORIGINAL SCALE: 1"=50' (24"x36" SHEET)
CONTOUR INTERVAL=1'

BASIN A-B AREA	= 1.01 AC.
IMPERVIOUS AREAS:	
SURFACE TYPE	AREA
PAVEMENT	13,928 SF
TOTAL	13,928 SF
	= 0.32 AC
	= 31.7% IMPERVIOUS

BASIN C-E AREA	= 5.07 AC.
IMPERVIOUS AREAS:	
SURFACE TYPE	AREA
BUILDING	39,566 SF
PAVEMENT	156,319 SF
TOTAL	195,885 SF
	= 4.50 AC
	= 88.8% IMPERVIOUS

BASIN F1 AREA	= 1.93 AC.
IMPERVIOUS AREAS:	
SURFACE TYPE	AREA
BUILDINGS	13,217 SF
SIDEWALK	12,727 SF
PAVEMENT	48,267 SF
TOTAL	74,211 SF
	= 1.70 AC
	= 88.1% IMPERVIOUS

BASIN F2 AREA	= 1.07 AC.
IMPERVIOUS AREAS:	
SURFACE TYPE	AREA
BUILDINGS	10,000 SF
SIDEWALK	1,529 SF
PAVEMENT	17,016 SF
TOTAL	28,545 SF
	= 0.66 AC
	= 61.7% IMPERVIOUS

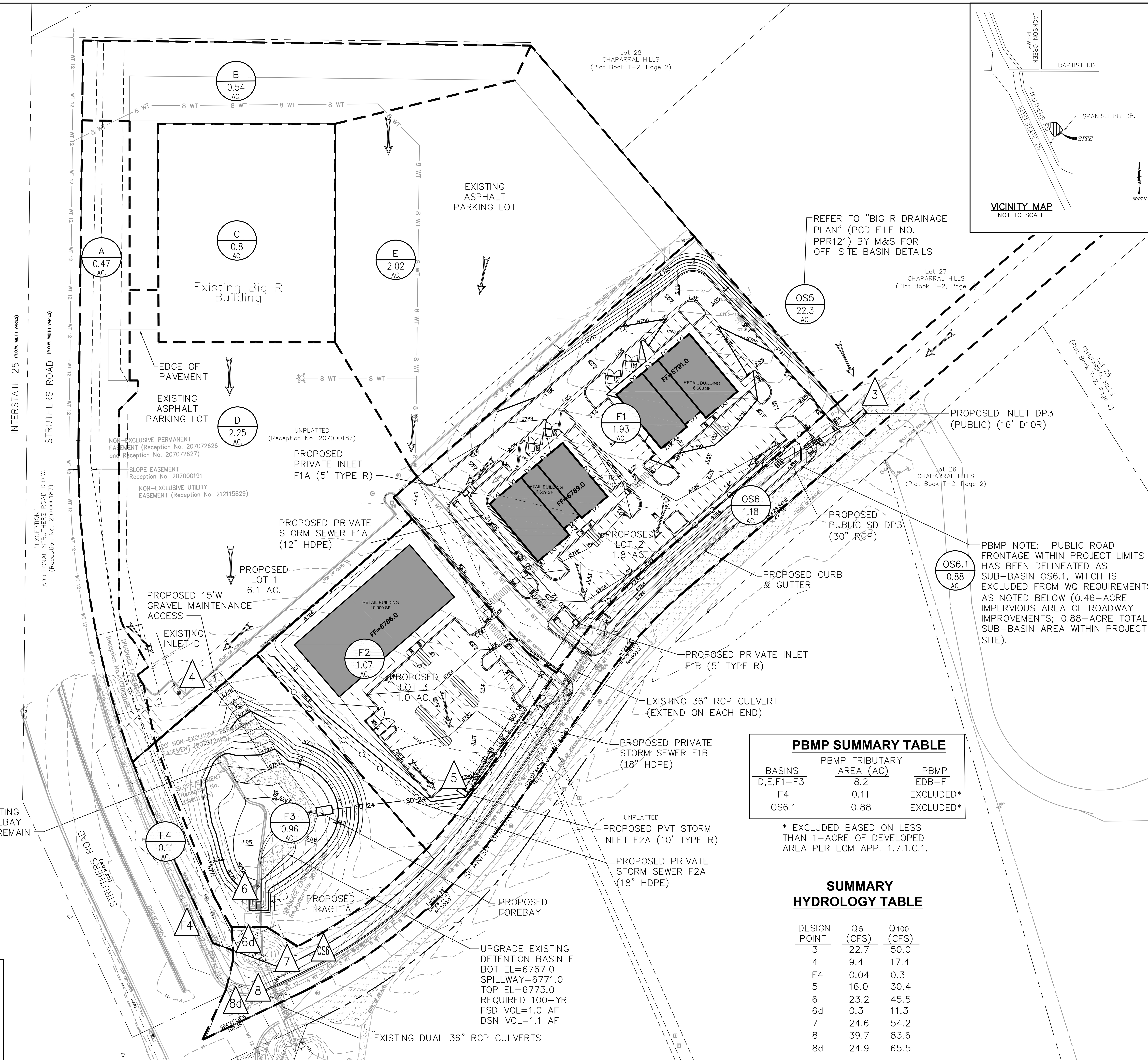
BASIN F3 AREA	= 1.31 AC.
IMPERVIOUS AREAS:	
SURFACE TYPE	AREA
NONE	0.0 SF

DRAINAGE LEGEND

- PROPERTY LINES
- FLOW DIRECTION ARROW
- FLOWLINE
- DRAINAGE BASIN BOUNDARY
- DESIGN POINT
- DEVELOPED BASIN DESIGNATION
- DEVELOPED BASIN AREA (ACRES)

BENCHMARK:

FIMS Monument Q395 is a stainless steel rod inside of an aluminum flange stamped "Q 395 1983" set by the NGS on the East side of Interstate 25, 6.75 miles North of North Academy Boulevard, 274 feet Northwest of the Northwest corner of Box Culvert Number 156.98, 184 feet North of Milepost 157, 104 feet Northeast of the centerline of the Northbound lanes, 69 feet Northeast of an "icy road" sign, 4.6 feet Southeast of a utility pole with meter attached, 1 foot Northwest of a witness post, and 4 feet above the highway surface; Elevation = 6743.41 (FIMS datum . . . NGVD 1929 and the 1960 Supplementary Adjustment).



PBMP SUMMARY TABLE

BASINS	PBMP TRIBUTARY AREA (AC)	PBMP
D,E,F1-F3	8.2	EDB-F
F4	0.11	EXCLUDED*
OS6.1	0.88	EXCLUDED*

* EXCLUDED BASED ON LESS THAN 1-ACRE OF DEVELOPED AREA PER ECM APP. 1.7.1.C.1.

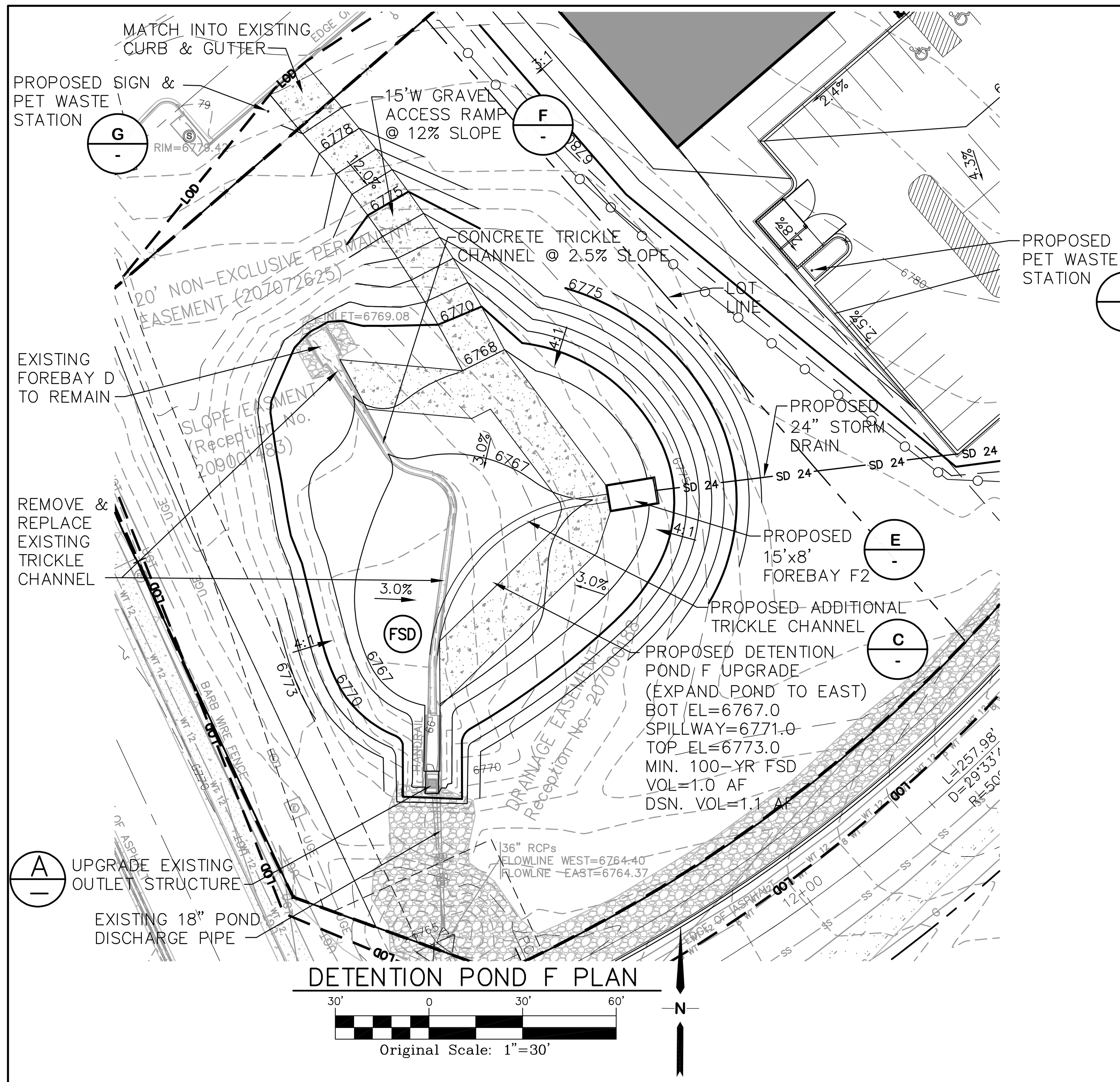
SUMMARY HYDROLOGY TABLE

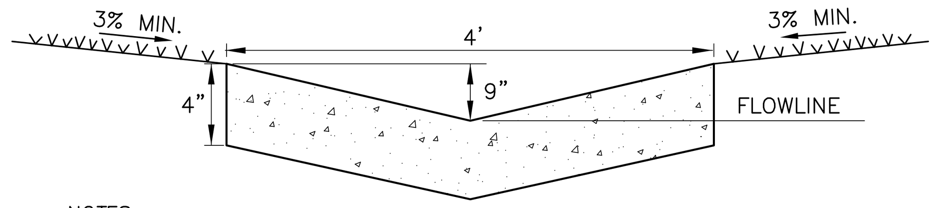
DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
3	22.7	50.0
4	9.4	17.4
F4	0.04	0.3
5	16.0	30.4
6	23.2	45.5
6d	0.3	11.3
7	24.6	54.2
8	39.7	83.6
8d	24.9	65.5

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

No.	REVISION	BY	DATE

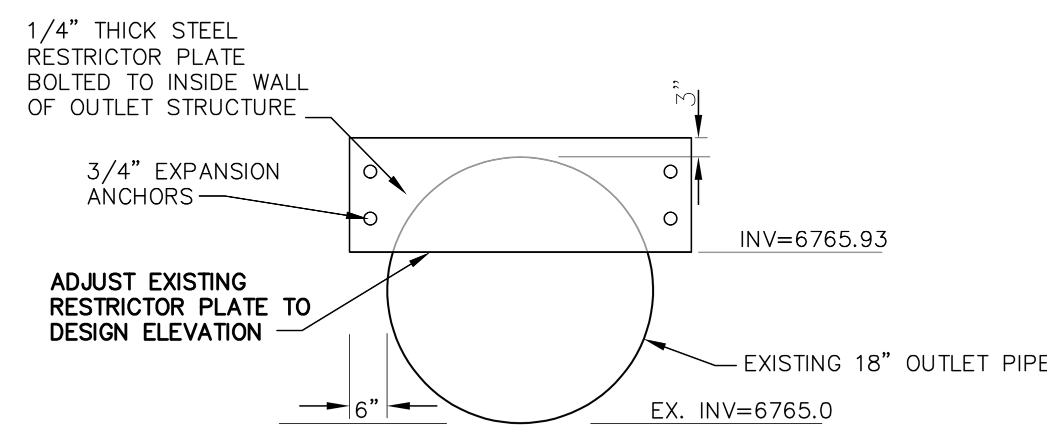
HORZ. SCALE: 1"=50'	DRAWN: BJJ
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: LDC	CHECKED: JPS
CREATED: 7/08/21	LAST MODIFIED: 3/8/23
PROJECT NO: 062102	MODIFIED BY: JPS
SHEET:	D1



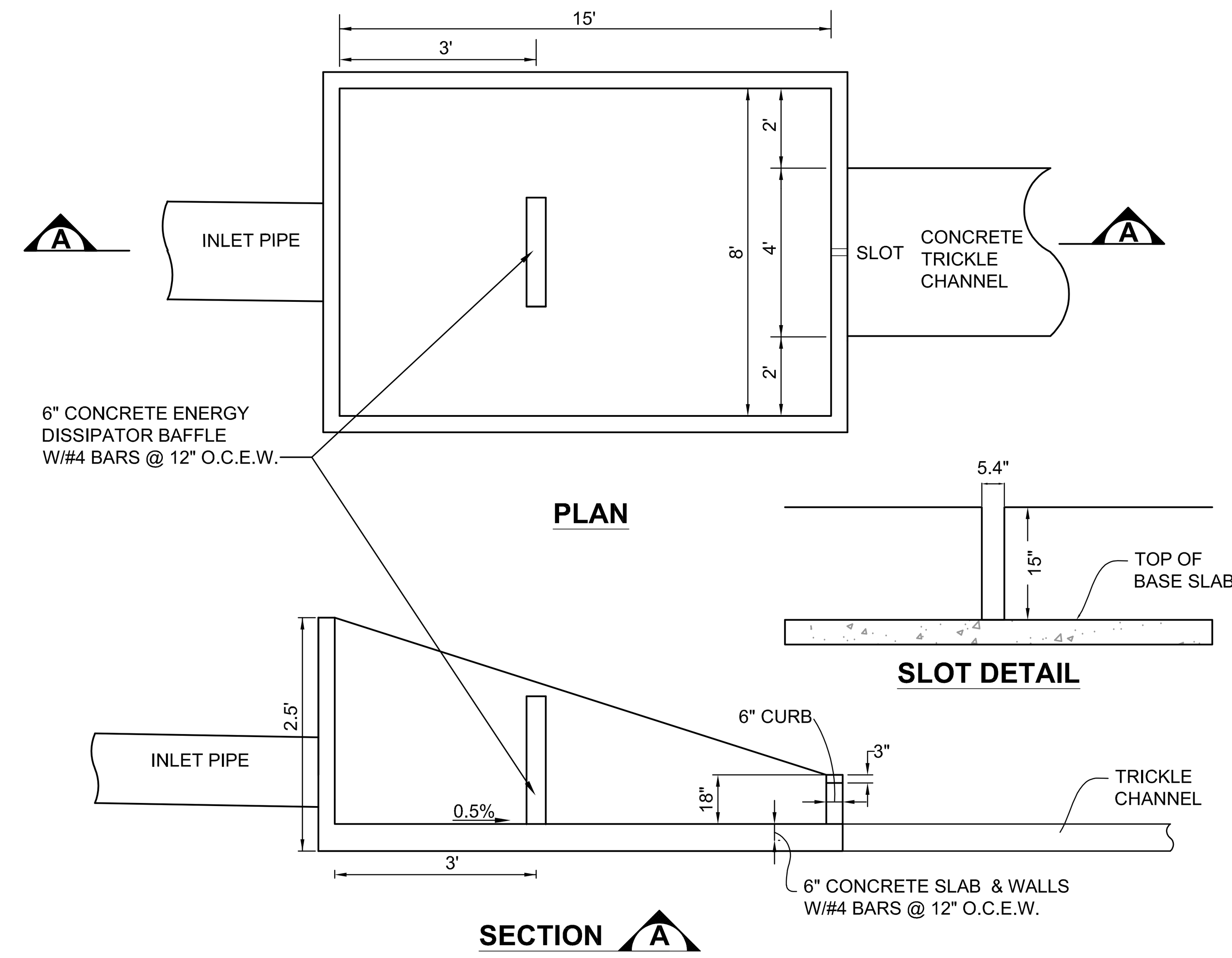


NOTES:
1. PROVIDE CONTROL JOINTS AT 10' MAX. SPACING.
2. INSTALL ROCK SOCKS WITHIN TRICKLE CHANNEL AT 20' MAX. SPACING (PERPENDICULAR TO FLOW) AS TEMPORARY CONSTRUCTION CONTROL MEASURES.

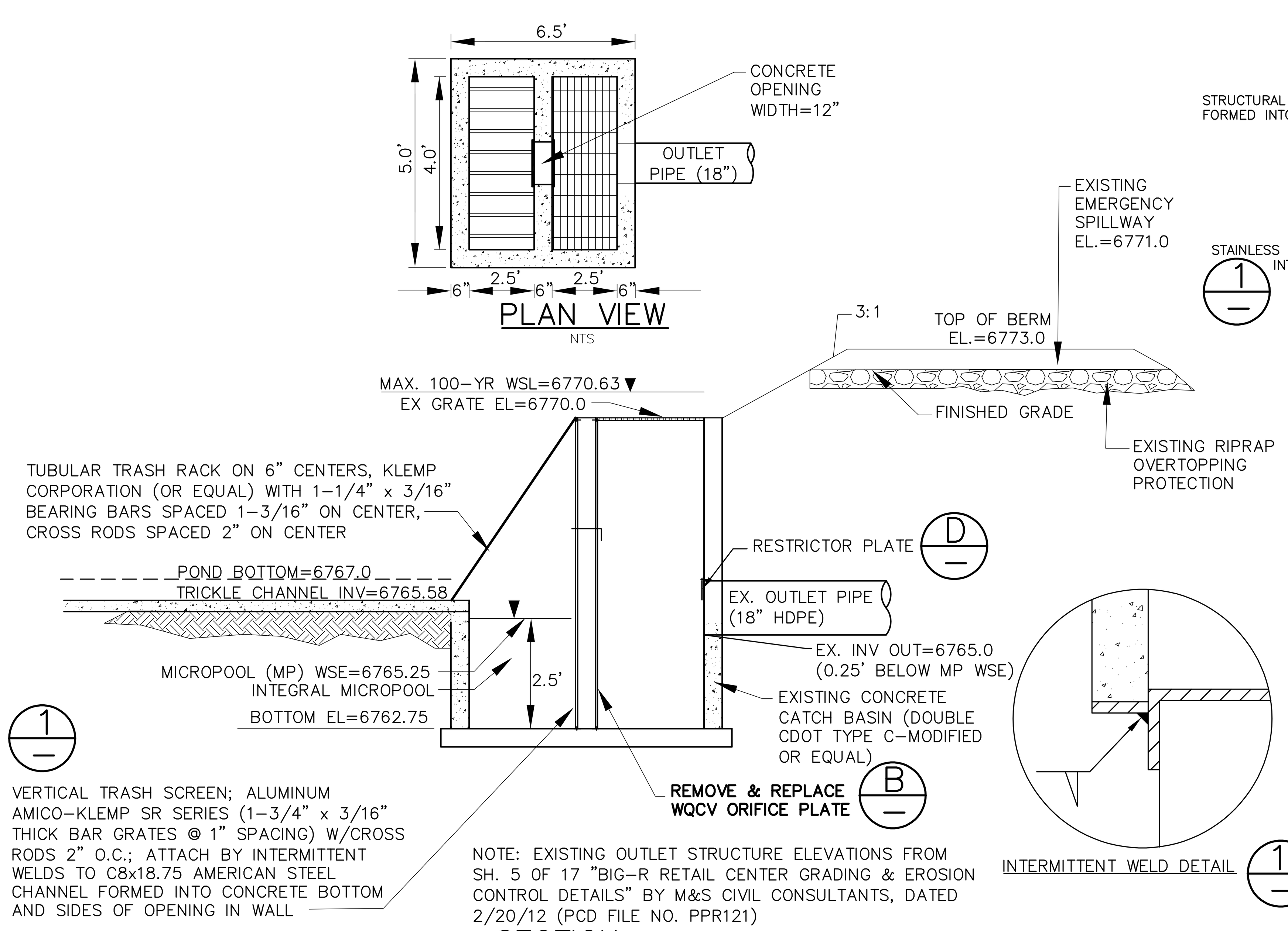
TYPICAL CONCRETE TRICKLE CHANNEL (C)



RESTRICTOR PLATE DETAIL (D)
NTS



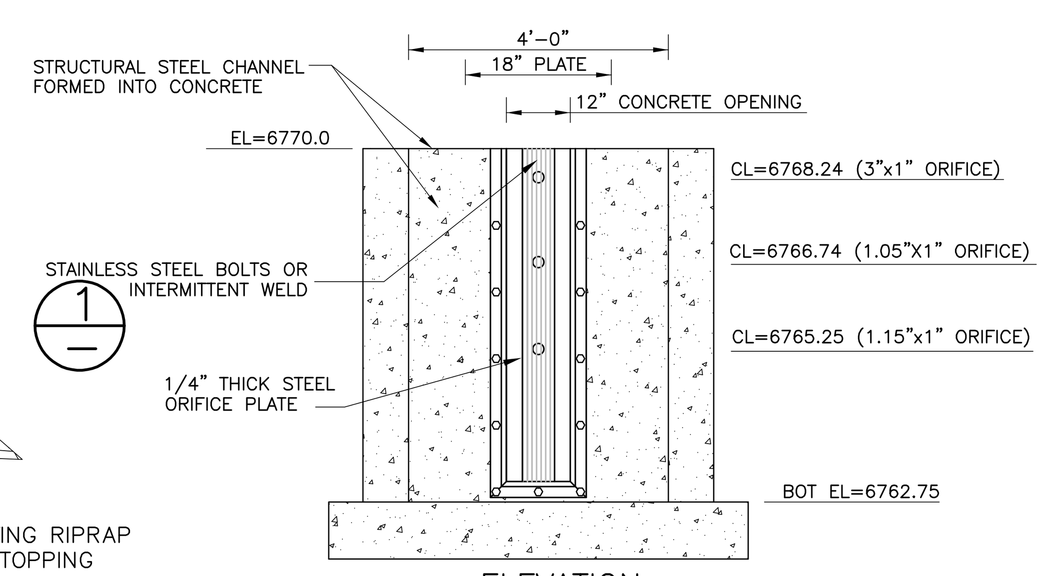
INTEGRAL FOREBAY DETAIL (E)
SCALE: NTS



NOTE: EXISTING OUTLET STRUCTURE ELEVATIONS FROM SH. 5 OF 17 "BIG-R RETAIL CENTER GRADING & EROSION CONTROL DETAILS" BY M&S CIVIL CONSULTANTS, DATED 2/20/12 (PCD FILE NO. PPR121)

SECTION

TYPICAL DETENTION POND OUTLET STRUCTURE (A)
SCALE: NTS



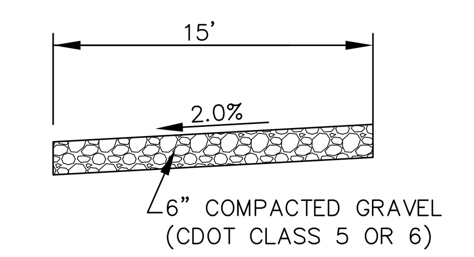
ORIFICE PLATE NOTES:
1. PROVIDE RUBBER GASKET MATERIAL BETWEEN THE ORIFICE PLATE AND CONCRETE.
2. BOLT PLATE TO CONCRETE 12" MAX. ON CENTER.

EURV AND WQCV TRASH RACKS:
1. WELL-SCREEN TRASH RACKS (FOR CIRCULAR ORIFICES) SHALL BE STAINLESS STEEL AND SHALL BE ATTACHED BY INTERMITTENT WELDS ALONG THE EDGE OF THE MOUNTING FRAME. (REFER TO DCM VOL 1; FIGURE 6-a)

OVERFLOW TRASH RACKS:
1. ALL TRASH RACKS SHALL BE MOUNTED USING STAINLESS STEEL HARDWARE AND PROVIDED WITH HINGED AND LOCKABLE OR BOLTABLE ACCESS PANELS.
2. TRASH RACKS SHALL BE STAINLESS STEEL, ALUMINUM, OR STEEL. STEEL TRASH RACKS SHALL BE HOT DIP GALVANIZED AND MAY BE HOT POWDER COATED AFTER GALVANIZING.

NOTE: ORIFICE PLATE WILL NEED TO BE REPLACED FOR FUTURE COMMERCIAL DEVELOPMENT PHASE (PER DRAINAGE REPORT)

NEW ORIFICE PLATE AND TRASH RACK DETAILS AND NOTES (B)
NTS



ACCESS RAMP (F)
NOT TO SCALE

POND SIGNAGE NOTE:

TWO SIGNS, EACH WITH A MINIMUM AREA OF 3 SQUARE FEET, SHALL BE PROVIDED AROUND THE PERIMETER OF ALL DETENTION FACILITIES. THE SIGNS SHALL BE FABRICATED OF DURABLE MATERIALS, SUCH AS METAL OR PLASTIC, USING RED LETTERING ON A WHITE BACKGROUND WITH THE FOLLOWING MESSAGE:

WARNING
THIS AREA IS A STORMWATER FACILITY
AND IS SUBJECT TO PERIODIC FLOODING
PLEASE CLEAN UP PET WASTE

NOTE: INSTALL PET WASTE STATIONS AT EACH POND SIGN LOCATION.

SIGN DETAIL (G)
NTS

PCD PROJECT NO. SP221/SF2210

CATHEDRAL ROCK COMMONS COMMERCIAL

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

DETENTION POND F PLAN & DETAILS

HORZ. SCALE:	1"=30'	DRAWN:	BJJ
VERT. SCALE:	N/A	DESIGNED:	JPS
SURVEYED:	LDC	CHECKED:	JPS
CREATED:	7/20/21	LAST MODIFIED:	3/8/23
PROJECT NO:	062102	MODIFIED BY:	BJJ
SHEET:	C3.1		