EPC STORMWATER REVIEW COMMENTS ARE SHOWN IN ORANGE BOXES WITH BLACK TEXT

PRELIMINARY DRAINAGE REPORT AMENDMENT
for
MAYBERRY, COLORADO SPRINGS – PHASE 1 PUD

Prepared for:

Colorado Springs Mayberry, LLC
32823 Temecula Parkway
Temecula, CA 92592

May 5, 2021

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JPS Project No. 030502
EPC Project No. SP-21-___

SP219

Please revise to only indicate preliminary drainage report

PRELIMINARY & FINAL DRAINAGE REPORT
MAYBERRY, COLORADO SPRINGS – FILING NO. 1-4
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revise per previous comment

MAYBERRY, COLORADO SPRINGS – PHASE 1 PUD
PRELIMINARY & FINAL DRAINAGE REPORT
EXECUTIVE SUMMARY

A. Background

- Mayberry, Colorado Springs (fka "Ellicott Town Center") is a mixed-use development with an approved PUD consisting of 1,048 residential units, 32-acres of commercial space, and associated land uses. The project is located on a 550.6-acre parcel on the south side of SH94 west of Ellicott.
- The Mayberry, Colorado Springs Phase 1 PUD consists of 240 single-family residential units in the northeast area of the development. Filing No. 1 consists of the first 98 residential lots and Filing No. 4 comprises the remaining 142 lots on the east side of the Phase 1 PUD.
- The initial phase of the project will also include development of the commercial area in the northeast corner of the site, consisting of Filing No. 2 (3 lots) and Filing No. 3 (8 lots).
- The Mayberry, Colorado Springs Phase 1 PUD site is located entirely within the Ellicott Consolidated Drainage Basin, which comprises about 13 square miles.

B. General Drainage Concept

- Historic drainage from off-site areas upstream of the site will be conveyed through the development within grass-lined drainage swales and channels serving as "greenways" with trails meandering through dedicated open space areas.
- Developed drainage within the site will be conveyed through paved streets with curb and gutter and storm sewers, as well as grass-lined channels and drainage swales through open space areas.

C. Drainage Impacts

- Developed flows from Mayberry, Colorado Springs Filings No. 1-4 will be detained to historic levels through on-site detention ponds designed to mitigate developed drainage impacts.
- Drainage facilities within public roads will be designed and constructed to El Paso County standards and dedicated to the County for maintenance.
- Drainage facilities such as channels running through private open space areas and detention ponds will be owned and maintained by the metropolitan district.

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.

4/28/20

John P. Schwab, P.E. #29891

COLORADO REGISTERED JOHN P. SCHWAB 29891 PROFESSIONAL ENGINEER

Developer's Statement:

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

By: Rick Scott

4-27-2020

Printed Name: Date

Colorado Springs Mayberry LLC
32823 Temecula Parkway, Temecula, CA 92592

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.

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

Conditions:

I. GENERAL LOCATION AND DESCRIPTION

A. Background

Mayberry, Colorado Springs (formerly known as "Ellicott Town Center") is a proposed subdivision located west of Ellicott, Colorado in El Paso County. The development is located on the south side of State Highway 94, approximately 1-1/2 miles west of Ellicott Highway, as shown in Figure A1 (Appendix F). The approved Ellicott Town Center Sketch Plan and Overall PUD includes a total of 1,048 single-family dwelling units and 32 acres of commercial space. Mayberry, Colorado Springs Filing No. 1, recorded in December 2020, consists of the initial 98 single-family residential units on 228.0-acres near the north boundary of the project.

Major milestones in the entitlement history of the Mayberry, Colorado Springs project are summarized as follows:

- Ellicott Town Center - Overall PUD: Recorded 10/6/06 (PUD-05-021)
- Ellicott Town Center - Phase 1 PUD: Recorded 10/6/06
- Ellicott Town Center Phase 1 Preliminary Plan: Approved 10/6/06
- Ellicott Town Center Filing No. 1: Approved by BOCC 4/12/07 (Resolution No. 07-132)
- Mayberry, Colorado Springs Filing No. 1 Final Plat: Recorded 12/23/20
- Mayberry, Colorado Springs Filing No. 2 Final Plat: Approved by BOCC 12/22/20

The proposed Amended PUD for Mayberry, Colorado Springs Phase 1 maintains the previously approved total of 240 lots in the initial phase of development, and there are no changes in the overall site layout (no changes to collector/arterial road alignments). Based on current residential market demands, the primary focus of the Amended PUD is to revise the lot layout to provide conventional lots to replace the alley-loaded lots shown in the previously approved plan.

There will be no changes to the northwesterly part of the recorded Filing No. 1 area. The PUD Amendment reflects extensions of Indian Grass Street and Blanket Flower Street between Village Main Street and Mayberry Drive to eliminate the alley-loaded lots in the previous plans. Following approval of the Amended Phase 1 PUD, a replat will be processed to incorporate the street and lot revisions within Filing No. 1.

Filing No. 2 (commercial) will also be re-platted to change the roadway on the west side of Springs Road to a cul-de-sac, eliminating the westerly connection to Cattlemen Run that was previously shown.

Filing No. 4 comprises the easterly 142 residential lots in the Amended PUD area. Local street alignments within Filing No. 4 have been revised to accommodate the desired conventional residential lot types.

As a follow-up to the Amended Phase 1 PUD process, the developer will be pursuing a re-zoning of the area at the northeast corner of the subdivision to Commercial Service (CS) for proposed

Please revise as this shall be a preliminary drainage report.

commercial / industrial use. The proposed re-zoning is an extension of the approved 2020 commercial re-zoning (CS-19-002) which included 9.5 acres on the south side of the intersection of SH94 and Springs Road. The proposed re-zoning action consists of extending the CS-zoned area to the east boundary of the property. The proposed 8 commercial / industrial lots along Cattlemen Run east of Springs Road will be platted as Mayberry, Colorado Springs Filing No. 3.

B. Scope

This report has been prepared in support of the Amended PUD application for Mayberry, Colorado Springs Phase One, along with the Filing No. 3 Commercial Re-Zone, replats for Filings No. 1 and 2, and new Final Plats for Filings No. 3 and 4. The report is intended to fulfill the El Paso County requirements for a Preliminary and Final Drainage Report (FDR), providing applicable updates to the previously approved "Preliminary & Final Drainage Report for Mayberry, Colorado Springs - Filing No. 1," by JPS Engineering, dated October 27, 2020.

The report will provide a summary of site drainage issues impacting the proposed development, including analysis of impacts from upstream drainage patterns, site-specific developed drainage patterns, and impacts on downstream facilities. This drainage report was prepared based on the guidelines and criteria presented in the El Paso County Drainage Criteria Manual, providing final design of required drainage facilities for this phase of the project.

C. Site Location and Description

The Mayberry, Colorado Springs (Ellicott Town Center) parcel comprises the west half of Section 14 along with the contiguous east quarter of Section 15, as well the west half of the northeast quarter of Section 14, Township 14 South, Range 63 West of the 6th Principal Meridian. The site is located at an elevation of approximately 6,060 feet above mean sea level. The 550.6-acre site is currently undeveloped, with the exception of the existing Viewpoint Water Tank site at the northwest corner of the parcel. Filing No. 1 comprises 228.0-acres at the north end of the Ellicott Town Center development.

State Highway 94 borders the parcel to the north, and unplatted agricultural properties (zoned A35) border this parcel on the east and south sides. Unplatted property zoned RR3 borders this parcel to the west. The existing 2-1/2-acre lot Viewpoint Estates subdivision (72 lots on 236 acres) is located immediately northwest of this parcel, across State Highway 94. The 5-acre lot Antelope Park Ranchettes subdivision (44 lots on 240 acres) borders Viewpoint Estates to the northwest.

The overall Mayberry, Colorado Springs PUD will ultimately include 1,048 residential lots, along with associated commercial / mixed-use development and an elementary school. Filings No. 1-4 include a total of 240 single-family residential lots in the northeast part of the overall development site. Subdivision improvements will include overlot grading and curb, gutter, and asphalt paving of the roads within the site.

How about filings 2 through 4?

The primary access to Mayberry, Colorado Springs will be provided by construction of New Log Road, which will run through the site from north to south as a minor arterial roadway (120' right-of-way). New Log Road will ultimately intersect with the anticipated extension of Handle Road at the southerly site boundary, which will extend east to the existing Log Road south of SH94. Primary access to Filing No. 1 will be provided through construction of the New Log Road intersection at SH94. Secondary access will be provided through the proposed Springs Road, which will improve an existing access point east of New Log Road along the frontage of the former "Springs East Village" parcel. The secondary access will consist of gravel road extensions of Mayberry Drive and Springs Road with Filing No. 1. The secondary access road extensions will be paved with the adjoining future filing.

The intermittent streams throughout this area drain into the Black Squirrel Creek Basin which ultimately outfalls into the Arkansas River. The entire Filing No. 1 site is located within the Ellicott Consolidated Drainage Basin (CHBS1200). This basin conveys surface drainage to the West Fork of Black Squirrel Creek, which is located east of this parcel between the site and Ellicott Highway.

The terrain is generally flat with gentle northwest to southeast slopes ranging from one to two percent. Historic drainage patterns from the site are conveyed overland to the south and east boundaries of the site. The entire site is covered with native grasses, except for the existing water tank site at the northwest corner of the parcel.

D. General Soil Conditions

According to the Soil Survey of El Paso County prepared by the Soil Conservation Service, on-site soils are comprised primarily of "Blakeland series (type 8)" soils (see Figure A2). The Blakeland soils are characterized as well-drained loamy sand with rapid permeability, slow surface runoff rates, and moderate hazard of erosion. These soils are classified as hydrologic soils group "A" for drainage analysis purposes.

E. References

City of Colorado Springs & El Paso County "Drainage Criteria Manual," revised October 12, 1994.

City of Colorado Springs "Drainage Criteria Manual, Volumes 1 and 2," revised May, 2014.

CDOT, "CDOT Drainage Design Manual," 2004.

David R. Sellon & Associates Inc., "Antelope Park Ranchettes Interior Drainage Plan," March, 1972.

El Paso County Planning Department, "Ellicott Valley Comprehensive Plan," March, 1989.

El Paso County "Engineering Criteria Manual," January 9, 2006.

El Paso County Resolution No. 15-042 (El Paso County adoption of "Chapter 6: Hydrology" and "Chapter 13, Section 3.2.1: Full Spectrum Detention" of the City of Colorado Springs Drainage Criteria Manual dated May 2014).

JPS Engineering, "Master Development Drainage Plan for Ellicott Town Center," November 22, 2005 (approved by El Paso County 12/02/05).

JPS Engineering, "Master Development Drainage Plan and Preliminary Drainage Report for Springs East Village," March 21, 2002 (approved by El Paso County 10/23/02).

JPS Engineering, "Master Development Drainage Plan and Preliminary Drainage Report for Viewpoint Village," January 28, 2002 (approved by El Paso County 9/11/02).

JPS Engineering, "Preliminary Drainage Report for Ellicott Town Center - Phase 1," January 15, 2007.

JPS Engineering, "Preliminary & Final Drainage Report for Mayberry, Colorado Springs - Filing No. 1," revised October 27, 2020 (approved by El Paso County November 5, 2020).

Leigh Whitehead & Associates, Inc., "Master Development Drainage Plan for Sunset Village," May, 2000 (approved by El Paso County 8/31/00).

Pacific Summits Engineering, "Final Drainage Report for Viewpoint Estates," January 6, 1998 (approved by El Paso County 10/6/99).

United Planning and Engineering, "Preliminary Drainage Plan & Report for Springs East," November 19, 1999.

United Planning and Engineering, "Drainage Plan & Report for Viewpoint Subdivision," May, 2000.

USDA/NRCS, "Soil Survey of El Paso County Area, Colorado," June, 1981.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Basin Description

The proposed development lies primarily within the Ellicott Consolidated Drainage Basin (CHBS1200) as classified by El Paso County. This basin is comprised of the area tributary to the West Fork of Black Squirrel Creek, with the majority of the basin bounded by SH94 to the north and Ellicott Highway to the east. No drainage planning study has been completed for the Ellicott Consolidated Drainage Basin or any adjacent drainage basins. El Paso County approved the "Sunset Village Master Development Drainage Plan (MDDP)" prepared by Leigh Whitehead. This MDDP covers the adjacent Telephone Exchange Drainage Basin, which borders the Mayberry parcel to the west. Based on the Drainage Report for Viewpoint Estates, stormwater detention ponds were

constructed to maintain historic flows leaving the upstream developed areas. As such, the drainage analysis for major basins impacting the site will assume that historic flows enter this parcel from upstream.

The major drainage basins lying in and around the proposed development are depicted in Figure EX1. Mayberry, Colorado Springs is located primarily within the Ellicott Consolidated Drainage Basin, which comprises a tributary area of about 13 square miles, or 8,320 acres. The proposed subdivision represents a total of 551 acres of development, or 7 percent of the total basin area. An "on-site" drainage planning approach has been proposed based on the relatively small developed area in comparison to the remaining undeveloped basin area, which is primarily agricultural land.

The existing site topography has several off-site drainage basins that enter the north and west boundaries of the Mayberry parcel. Triple 30-inch CMP culverts cross SH94 at several locations along the north boundary of the site. These off-site basins combine with on-site flows, following existing grass-lined swales southeasterly through the site. The site historically consists of five major basins conveying flows towards the south and eastern boundaries of the site, as shown in Figure EX2. Flows from the majority of the site (Basins B-E) combine with the tributary areas downstream of the site, flowing southeasterly to an existing natural channel towards Black Squirrel Creek.

This western tributary downstream of the Mayberry parcel overtops Ellicott Highway at a low point 2-1/2 miles south of SH94 and combines with the West Fork of Black Squirrel Creek on the east side of Ellicott Highway. The roadway crossing significantly downstream of this site is an existing deficiency, and a future culvert should be constructed at the low point in Ellicott Highway in conjunction with future County roadway improvements.

Flows from the southwest corner of the site (Basins A and BB) combine with the tributary area in the Telephone Exchange Basin identified as Basin A32 (2.89 sm; Q_5 = 92 cfs, Q_{100} = 438 cfs) in the Sunset Village MDDP. This basin flows southeasterly and ultimately crosses Enoch Road and Ellicott Highway at the northeast corner of the Sunset Village Development.

B. Floodplain Impacts

Mayberry, Colorado Springs is located approximately one mile southwest of the 100-year floodplain limits for the West Fork of Black Squirrel Creek, as delineated by the Federal Emergency Management Agency (FEMA). The floodplain limits in the vicinity of the site are shown in Flood Insurance Rate Map (FIRM) Number 08041C0810G, dated December 7, 2018 (see Figure A3).

C. Sub-Basin Description

The developed drainage basins lying within the proposed development are depicted in Figure D1. The interior site layout has been delineated into several drainage basins (A-E) based on the proposed interior road layout and grading scheme. The natural drainage patterns will be impacted through development by site grading and concentration of runoff in subdivision street gutters, storm drains, and channels. The majority of sub-basins drain to the southeast, collecting in the interior roads and drainage channels. On-site flows will be diverted to proposed detention ponds located at the south and east boundaries of the site, and detained runoff flows will discharge to the southeast, following historic drainage paths.

III. DRAINAGE DESIGN CRITERIA

A. Development Criteria Reference

The Ellicott Consolidated Drainage Basin has not had a Drainage Basin Planning Study performed for the basin. The majority of areas within the basin are comprised of agricultural lands and rural residential uses.

A "Master Development Drainage Plan (MDDP) for Ellicott Town Center" was approved concurrent with the original Overall PUD, and a Preliminary Drainage Report for Ellicott Town Center Phase One was approved with the original Phase One PUD and Preliminary Plan.

JPS Engineering prepared the "Preliminary & Final Drainage Report for Mayberry, Colorado Springs - Filing No. 1," revised October 27, 2020 (approved by El Paso County November 5, 2020) in support of the final approval and recording of Filing No. 1.

This Amendment to the "Preliminary & Final Drainage Report for Mayberry, Colorado Springs - Phase One PUD" fully conforms to the previously approved MDDP and Preliminary Drainage Reports.

B. Hydrologic Criteria

SCS procedures were utilized for analysis of major basin flows impacting the site. In accordance with El Paso County drainage criteria, SCS hydrologic calculations were based on the following assumptions:

- Design storm (minor) — 5-year
- Design storm (major) — 100-year
- Storm distribution — SCS Type IIA (eastern Colorado)
- 100-year, 24-hour rainfall — 4.4 inches per hour (NOAA isopluvial map)
- 5-year, 24-hour rainfall — 2.6 inches per hour (NOAA isopluvial map)
- Hydrologic soil type — B
-

- SCS curve number - undeveloped conditions 61 (pasture / range)
- SCS curve number - developed conditions 80 (1/8-1/4 acre lots)
- SCS curve number - developed conditions 92 (commercial areas)

Rational method procedures were utilized for calculation of peak flows within the on-site drainage basins. 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	A	
	C5	C100
• Runoff Coefficients - undeveloped:		
Existing pasture/range areas	0.25	0.35
• Runoff Coefficients - developed:		
Proposed Residential (1/8-1/4 acre lots)	0.375	0.545
Proposed Neighborhood Commercial	0.49	0.62

Composite runoff coefficients for the developed residential areas have been calculated based on average lot sizes between 1/8-acre and 1/4-acre. Hydrologic calculations are enclosed in Appendix B, and peak design flows are identified on the drainage basin 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 DCM Volume 2, 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

- Minimize Impacts: The approved Planned Unit Development includes significant open space, play areas, and parks, resulting in a moderate level of impervious site development.
- Minimize Directly Connected Impervious Areas (MDCIA): The proposed development will include landscaped areas adjoining the proposed building and parking lots, providing for impervious areas to drain across pervious areas where feasible.

- Grass Swales: The proposed drainage plan incorporates grass-lined swales in selected locations to encourage stormwater infiltration while providing positive drainage through the site.

Step 2: Stabilize Drainageways

- Proper erosion control measures will be implemented along the grass-lined drainage channels to provide stabilized drainageways within the site.

Step 3: Provide Water Quality Capture Volume (WQCV)

- EDB: The developed areas of the site will drain through proposed Full-Spectrum Extended Detention Basins (EDB) southeast of the developed areas. Site drainage will be routed through the extended detention basins, which will capture and slowly release the WQCV over an extended release period.
- Stormwater detention and WQCV for Filing No. 1 will be provided by EDB-C1.
- Stormwater detention and WQCV for Filings No. 2-4 will be provided by EDB-D.

Step 4: Consider Need for Industrial and Commercial BMPs

- No industrial or commercial land uses are proposed as part of the Filing No. 1 and Filing No. 4 residential developments.
- The proposed commercial uses within Filings No. 2 and 3 will implement Stormwater Management Plans including proper housekeeping and spill containment procedures.

Please state that additional commercial BMPs will be assessed prior to development of Filing 2 and 3.

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.

Site grading and drainage improvements performed as a part of subdivision infrastructure development includes overlot grading and subdivision drainage improvements depicted on the subdivision construction drawings. Individual lot grading is the sole responsibility of the individual builders and property owners. Final grading of each home site should establish proper protective slopes and positive drainage in accordance with HUD guidelines and building codes. In general, main floor elevations for each home should be established approximately 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

Consistent with generally accepted practices in eastern El Paso County, the general concept for management of stormwater from development of Mayberry, Colorado Springs will be to construct several stormwater detention ponds along the south and east boundaries of the site to mitigate the impacts of developed runoff flows from the site.

Development of the Mayberry, Colorado Springs project will require site grading and paving, resulting in additional impervious areas across the site. The general drainage pattern will consist of grading away from home sites to swales and gutters along the internal roads within the subdivision, conveying runoff flows through the site. Runoff from the site will flow by street gutters to curb inlets at low points and road intersections, thence by storm drains and drainage channels to the proposed detention ponds. The storm inlets and storm sewer system within the development will be designed as the "minor" drainage system, sized for 5-year developed peak flows. The internal road system, drainage channels, and detention ponds will be designed as the "major" drainage system, sized for 100-year peak flows. Street flows within subdivision streets will be maintained below allowable levels in accordance with El Paso County drainage criteria.

B. Specific Details

1. Existing Drainage Conditions

Historic drainage conditions are depicted in Figure EX2. The site has been divided into six major basins (A, B, BB, C, D, and E). The undeveloped site currently has no drainage facilities within the parcel. The existing off-site drainage basins northwest of the site generally combine with on-site basins as shown on Figure EX2, flowing southeasterly through the site within existing grass-lined drainage swales and channels.

The Viewpoint Estates subdivision northwest of this site included two stormwater detention ponds on the north side of State Highway 94. As detailed in Appendix B1, rational method drainage calculations for upstream off-site Basins OA2 and EC12 have been calculated based on equivalent areas to reflect the design pond discharge rates as presented in the approved drainage report for Viewpoint Estates.

The site is impacted by several large off-site drainage areas within the Ellicott Consolidated Drainage Basin. Off-site flows from Basin EC11 north of this property cross State Highway 94 in a triple 30-inch CMP culvert crossing, and continue flowing southeasterly through an existing grass-lined swale across Basin D to Design Point #5, with historic peak flows of Q_5 = 30.6 cfs and Q_{100} = 174.9 cfs (SCS Method).

Off-site flows from Basin EC10 north of this property cross State Highway 94 in another triple 30-inch CMP culvert crossing near the northeast corner of this site. These flows drain through an existing grass-lined swale across Basin E to Design Point #6, with historic peak flows of Q_5 = 19.1 cfs and Q_{100} = 111.4 cfs (SCS Method). As shown on Sheet EX2, two existing driveway culverts on the south side of SH94 convey flows from the roadside ditch on the south side of SH94 easterly to converge with the existing swale on the downstream side of the triple 30-inch CMP culverts, combining with Basin EC10. These flows continue southeasterly in the existing swale within Basin E.

Drainage from Basins A-C continues flowing southeasterly off-site within existing broad natural channels through the adjoining properties to the south and east. The downstream drainage continues southeast to a more defined natural channel, forming the West Tributary to the Middle Fork of Black Squirrel Creek. Historic drainage from Basins D and E flows southeast to the westerly ditch along "Old" Log Road, then turns east and follows the southerly ditch of Handle Road to its confluence with the main channel of the Middle Fork of Black Squirrel Creek.

2. Developed Drainage Conditions

The developed drainage basins and projected flows are shown in Figures D1, D1.01, and D1.11 (Appendix F). The developed site has been divided into five major basins (A-E) and six major design points (DP1-DP6), as shown on the enclosed Drainage Plan. Hydrologic flow schematics and calculations are enclosed in Appendix B. The development of Mayberry, Colorado Springs Phase One lies within Basins C, D, and E, and developed flows from the initial phase of the project impact Design Points #5 and #6.

Off-site Basin EC11 will combine with flows from on-site Basins C and D at Design Point #5, with undetained developed peak flows of Q_5 = 226.6 cfs and Q_{100} = 461.4 cfs. Developed flows at this location will be detained to historic levels by routing flows through the proposed Detention Ponds C1 and D prior to discharging at the easterly site boundary. Detention Pond C1 will be located at the southeast corner of the Filing No. 1 development area, and this pond will be constructed with the initial phase of development. Detention Pond D will be located at the southeast corner of the Phase 1 development area, and this pond will be constructed with Filing No. 4.

As summarized in Appendix B2, based on the calculated detention pond discharge rates, the flows from off-site Basin EC11 and detained discharges from Detention Ponds C1 and D combine at Design Point #5 with total detained peak flows of Q_5 = 27.1 cfs and Q_{100} = 174.2 cfs (below historic rates).

<u>Filing No. 1</u>

Off-site flows from Basin EC11 will be conveyed southerly through Culvert EC11 flowing south within Atchison Way along the east side of Filing No. 1.

Storm sewer C1.2-C1.5A consists of a 30”-42” RCP system extending east on Village Main Street from Market Place Drive to connect with Storm Sewer C1.6 at the east boundary of Filing No. 1. Flows from Basins C1.2, C1.3, C1.4, C1.5, and C1.6 will be intercepted by storm inlets discharging into this system.

Storm sewer C1.8 consists of a 24-inch RCP storm sewer extending east on Mayberry Drive from Garden Park Avenue to connect with Storm Sewer C1.9 at the east boundary of Filing No. 1.

Combined Filing No. 1 flows from Basins C1.1-C1.9 will drain to Detention Pond C1 at the southeast corner of Filing No. 1. Developed peak flows entering Detention Pond C1 at Design Point #C1.10A are calculated as Q_5 = 37.2 cfs and Q_{100} = 90.6 cfs (Rational Method).

Filing No. 4

C2.9 as there does not appear to be a C2.10 on the drainage plan

The west side of Filing No. 4, including the Filing No. 2 commercial area, has been delineated as Developed Basins C2.1-C2.10.

Basins C2.1-C2.3 will generally flow south along Galveston Terrace, ultimately flowing to Inlet C2.5 at the low point along the north side of Mayberry Drive.

Basin C2.4 flows to Inlet C2.4 at the southeast corner of Solaire Loop. Storm Sewer C2.4 conveys the flow from Inlet C2.4 to Inlet C2.5, and Storm Sewer C2.5 will convey the combined flow south to Channel C2.

Basins C2.6-C2.8 sheet flow southeasterly to a storm sewer system at the intersection of Springs Road and Besseyi Way.

Inlet C2.8B captures flow from Basin C2.8B at the southwest corner of this intersection, and Storm Sewer C2.8 extends easterly along Besseyi Way to the Tee Intersection, where the storm sewer turns south and flows through Inlets C2.9A-C2.9B in the southwesterly knuckle of El Reno Lane. Storm Sewer C2.9 flows south to Mayberry Drive, and then turns east along the north side of Mayberry Drive, flowing to Inlet D1.5A.

Combined flows from Basins C2.6-C2.9 will drain to Storm Sewer C2.9. Developed peak flows at Design Point #C2.9C are calculated as Q_5 = 17.7 cfs and Q_{100} = 41.2 cfs (Rational Method).

Please show this design point on the drainage plan

The east side of Filing No. 4, including the Filing No. 3 commercial area, has been delineated as Developed Basins D1.1-D1.5. Storm Sewer D1.1-D1.5 consists of a 24”-42” RCP storm sewer system collecting developed flows from these basins and conveying the developed flows south to Channel D, which flows to Detention Pond D.

Basin D1.1 comprises the northwest part of the Filing No. 3 commercial area, which flows to Inlets D1.1A and D1.1B at the low point in Cattlemen Run. Storm Sewer D1.1 conveys the flow from these inlets easterly along Cattlemen Run to Inlets D1.2A-D1.2B near the easterly boundary of the subdivision. Basin D1.2 comprises the northeast part of the Filing No. 3 commercial area, flowing to Inlets D1.2A and D1.2B.

Basin D1.3 flows southeast to Inlets D1.3A and D1.3B, and Storm Sewer D1.2B consists of a 30" RCP extending south in the Drainage and Utility Tract from Cattlemen Run to Inlet D1.3A in Union Pacific Way.

Basin D1.4 flows southeast to Inlets D1.4A and D1.4B, and Storm Sewer D1.3B consists of a 30" RCP extending south from Inlet D1.3B to Inlet D1.4A in El Reno Lane.

Basin D1.5 flows southeast to Inlets D1.5A and D1.5B, and Storm Sewer D1.4B consists of a 36" RCP extending south in the Drainage and Utility Tract from Inlet D1.4B to Inlet D1.5A in Mayberry Drive.

Combined flows from Basins C2.6-D1.5 will drain to Storm Sewer D1.5 at the southeast corner of Filing No. 4. Developed peak flows at Design Point #D1.5B are calculated as Q_5 = 35.1 cfs and Q_{100} = 78.0 cfs (Rational Method). Channel D1 will convey these flows south to Detention Pond D.

Detention Ponds C1.1 and D will mitigate developed drainage impacts from the development areas south and east of Phase 1, and the net discharge downstream of Design Point #5 will remain at historic levels.

Please discuss basin E and basins C3 and D2.

3. Emergency Conditions Analysis

In the event of clogging, the storm inlets within the Phase 1 development area will overflow to the adjoining public streets, which all generally flow southeasterly. Emergency overflows would sheet flow southeasterly along the public streets, flowing into Detention Pond C1, Channels C1-C3, and Detention Pond D.

There are no significant upstream developed areas and no off-site detention facilities impacting the Phase 1 area.

C. Comparison of Developed to Historic Discharges

Based on the hydrologic calculations in Appendix B, the total developed flows from the site will exceed historic flows from the parcel. Due to the increased impervious areas in the developed site, the total undetained flow from the site would be significantly higher than the historic flow. The increase in developed flows will be mitigated by on-site stormwater detention ponds. The comparison of developed to historic discharges at key design points is summarized as follows:

Design Point	Historic Flow			Developed Flow			Comparison of Developed to Historic Flow (Q_5%/Q_{100}%)
	Area (ac)	Q_5 (cfs)	Q_{100} (cfs)	Area (ac)	Q_5 (cfs)	Q_{100} (cfs)	
5	508.2	30.6	174.9	512.9	226.6	461.4	741% / 264% (increase) [1]
6	324.7	19.1	111.4	319.7	19.0	111.0	99.5% / 99.6% (decrease)

[1] Calculated developed flows to be detained to historic levels through on-site detention ponds

[2] Calculated 100-year historic flows of approx. 0.2-0.3 cfs/acre are generally consistent with pre-development flow estimates in Colorado Springs 2014 DCM Table 13-2

D. Detention Ponds

The total developed storm runoff downstream of the Filing No. 1-4 development area will be maintained at historic levels by routing flows through the proposed Detention Pond C1 located southeast of the Filing No. 1 development area and the proposed Detention Pond D in the southeast corner of the subdivision. The proposed detention facilities have been sized to attenuate peak flows through the ponds, mitigating developed drainage impacts.

Final pond sizing was performed based on a pond routing analysis utilizing the "UD-Detention" software package (see Appendix C), resulting in the following pond sizing parameters:

Pond	Peak Inflow (Q_{100}, cfs)	Peak Outflow (Q_{100}, cfs)	Volume (ac-ft)
C1	71.1	13.3	4.4
D	143.2	11.4	12.1

The proposed detention ponds will be privately owned and maintained by the Metropolitan District, under the terms of a "Private Detention Basin Maintenance Agreement" recorded during final platting. Gravel maintenance access roads will be provided around the perimeter of the detention ponds to facilitate maintenance access.

The pond outlet structures have been designed to release historic flows southeast of the site towards the existing natural swales downstream. Based on the proposed approach of reducing developed flows to historic levels at the site boundaries, no significant downstream drainage impacts are anticipated, and no downstream drainage improvements are proposed.

E. On-Site Drainage Facility Design

Developed sub-basins and proposed drainage improvements are depicted in the enclosed Drainage Plan (Figure D1, D1.1, D2.1, and D2.2). Hydraulic calculations for sizing of on-site drainage facilities are enclosed in Appendix D, and summarized as follows:

Hydraulic Calculations are not reviewed at this stage as construction drawings are not provided until the final plat stage.

1. Street / Curb & Gutter Capacity

The interior roads on this relatively flat parcel will be graded with a minimum longitudinal slope of 1.0 percent. In accordance with the El Paso County Drainage Criteria, the allowable minor storm street capacity for residential streets at minimum slope is approximately 11 cfs per side (see calculation in Appendix D1). Storm inlets will be installed at low points and intersections, and other locations where allowable street capacities are exceeded.

2. Storm Sewer System Layout

Filing No. 1

Street flow patterns within Filing No. 1 are depicted on Sh. D2.1 (Appendix F). Street drainage will flow easterly along the north side of Cattlemen Run to DP-C1.1 (Q_5 = 5.4 cfs and Q_{100} = 18.0 cfs), where these flows will be intercepted by Inlet C1.1 (10' Type R). Inlet C1.6A (5' Type R) will intercept flow from the south curb line of Cattlemen Run, and these combined flows will be conveyed south through Storm Sewer C1.6A (24") to junction Manhole C1.6C at the intersection with Village Main Street.

Street drainage will flow southerly along the west side of Marketplace Drive and easterly along the north side of Village Main Street to DP-C1.2 (Q_5 = 16.9 cfs and Q_{100} = 35.9 cfs), where these flows will be intercepted by Inlet C1.2 (10' Type R). An interim culvert will extend northwesterly from the back side of Inlet C1.2 to intercept sheet flow from the future development tract to the northwest. Flows from Inlets C1.7A, C1.7B, and C1.2 will combine in junction Manhole C1.2D, and the combined flows will be conveyed easterly through Storm Sewer C1.2D (36" RCP) to junction Manhole C1.3A at the intersection with Indian Grass Street.

Street drainage will flow southerly along the west side of Indian Grass Street and easterly along the north side of Village Main Street to DP-C1.3 (Q_5 = 5.9 cfs and Q_{100} = 14.3 cfs), where these flows will be intercepted by Inlet C1.3 (10' Type R), and conveyed to junction Manhole C1.3A. The combined flows will continue easterly through Storm Sewer C1.3A (36" RCP) to junction Manhole C1.4A at the intersection with Garden Park Avenue.

Street drainage will flow southerly along the west side of Garden Park Avenue and easterly along the north side of Village Main Street to DP-C1.4 (Q_5 = 6.3 cfs and Q_{100} = 15.3 cfs), where these flows will be intercepted by Inlet C1.4 (10' Type R), and conveyed to junction Manhole C1.4A. The combined flows will continue easterly through Storm Sewer C1.4A (42" RCP) to junction Manhole C1.5A at the intersection with Blanket Flower Street.

Street drainage will flow southerly along the west side of Blanket Flower Street and easterly along the north side of Village Main Street to DP-C1.5 (Q_5 = 6.2 cfs and Q_{100} = 15.6 cfs), where these flows will be intercepted by Inlet C1.5 (10' Type R), and conveyed to junction Manhole C1.5A. The combined flows will continue easterly through Storm Sewer C1.5A

please discuss the flows along the new extensions Indian grass St and Blanket Flower St

(42" RCP) to junction Manhole C1.6C at the intersection with Storm Sewer C1.6B, flowing south to Detention Pond C1.

Street drainage will flow southerly along the west side of Garden Park Avenue and easterly along the north side of Mayberry Drive to DP-C1.8 (Q_5 = 7.5 cfs and Q_{100} = 18.4 cfs), where these flows will be intercepted by Inlet C1.8 (10' Type R) and conveyed to Manhole C1.8. Storm Sewer C1.8 (24" RCP) will flow easterly to junction Manhole C1.9C at the intersection with Storm Sewer C1.6C.

On the east side of Garden Park Avenue, street drainage will flow easterly along the north side of Mayberry Drive to DP-C1.9 (Q_5 = 8.5 cfs and Q_{100} = 20.8 cfs) at the southeast corner of the Filing No. 1 residential area, where these flows will be intercepted by Inlet C1.9A (10' Type R) and conveyed to junction Manhole 1.9C. The combined flows will continue south through Storm Sewer C1.9C (60" RCP) into Detention Pond C1.

Basin C2.6 is also in filing 2. Please include description of the flow in this basin.

Filing No. 2

Street flow patterns within Filing No. 2 and 3 are depicted on Sh. D2.2 (Appendix F). Drainage within Filing No. 2 (Basins C2.7 and C2.8A) will sheet flow southeasterly to Cattlemen Run, which drains east to Springs Road, and then follows the west curb and gutter south to Inlet C2.8A (15' Type R) at the northwest corner of Springs Road and Besseyi Way. These flows will be conveyed southeasterly by Storm Sewer C2.8, ultimately flowing to Detention Pond D.

Filing No. 3

The northwest part of the Filing No. 3 commercial area has been delineated as Basin D1.1, which flows to Inlets D1.1A (10' Type R) and D1.1B (5' Type R) at the low point in Cattlemen Run. Storm Sewer D1.1 (24" RCP) will convey the flow from these inlets easterly along Cattlemen Run to Inlets D1.2A (10' Type R) and D1.2B (5' Type R) near the easterly boundary of the subdivision. Storm Sewer D1.2B-D1.5 (30"-42" RCP) will convey the combined flows south through the east edge of Filing No. 4 to Channel D, ultimately flowing to Detention Pond D. Storm Sewer D1.2B consists of a 30" RCP extending south in the Drainage and Utility Tract from Cattlemen Run to Inlet D1.3A in Union Pacific Way.

Filing No. 4

Street flow patterns and the proposed storm sewer layout within Filing No. 4 are depicted on Sh. D2.2 (Appendix F).

Street drainage from Basins C2.1-C2.3 will flow south along Galveston Terrace, and then turn east along the north side of Mayberry Drive, flowing to Inlet C2.5 (15' Type R) at the low point in the road profile.

Please provide description of flow for basin C2.5

Inlets C2.4A (5' Type R) and C2.4B (5' Type R) will intercept surface drainage from Basin C2.4 at the southeast corner of Solaire Loop. Storm Sewer C2.4A-C2.4B (18" RCP) will convey the flow from Inlets C2.4A-C2.4B south and west to Inlet C2.5 on Mayberry Drive, and Storm Sewer C2.5 (30" RCP) will convey the combined flow south to Channel C2, ultimately draining to Detention Pond D. Combined peak flows at Inlet C2.5 (DP-C2.5B) are calculated as Q_5 = 35.1 cfs and Q_{100} = 78.0 cfs.

Street drainage from Basins C2.6-C2.8A will flow southeasterly along Solaire Loop and Besseyi Way and southerly along Springs Road to Storm Inlet C2.8A (15' Type R) at the northwest corner of Springs Road and Besseyi Way.

Inlet C2.8B (5' Type R) will capture flow from Basin C2.8B at the southwest corner of this intersection, and Storm Sewer C2.8 (30" RCP) will extend easterly along Besseyi Way to the Tee Intersection, where the storm sewer turns south and flows through Inlets C2.9A-C2.9B (5' Type R) in the southwesterly knuckle of El Reno Lane. Storm Sewer C2.9 (30" RCP) will flow south to Mayberry Drive, and then turn east along the north side of Mayberry Drive, flowing to Inlet D1.5A. Developed peak flows at Design Point #C2.9C are calculated as Q_5 = 17.7 cfs and Q_{100} = 41.2 cfs.

The east side of Filing No. 4, including the Filing No. 3 commercial area, has been delineated as Developed Basins D1.1-D1.5. Storm Sewer D1.1-D1.5 consists of a 24"-42" RCP storm sewer system collecting developed flows from these basins and conveying the developed flows south to Channel D, which flows to Detention Pond D.

Street drainage within Basin D1.3 will flow east along Union Pacific Way to Inlets D1.3A (10' Type R) and D1.3B (5' Type R), and Storm Sewer D1.2B consists of a 30" RCP extending south in the Drainage and Utility Tract from Cattlemen Run to Inlet D1.3A in Union Pacific Way.

Basin D1.4 flows southeast to Inlets D1.4A and D1.4B, and Storm Sewer D1.3B consists of a 30" RCP extending south from Inlet D1.3B to Inlet D1.4A in El Reno Lane.

Basin D1.5 flows southeast to Inlets D1.5A and D1.5B, and Storm Sewer D1.4B consists of a 36" RCP extending south in the Drainage and Utility Tract from Inlet D1.4B to Inlet D1.5A in Mayberry Drive.

Combined flows from Basins C2.6-D1.5 will drain to Storm Sewer D1.5 at the southeast corner of Filing No. 4. Developed peak flows at Design Point #D1.5B are calculated as Q_5 = 35.1 cfs and Q_{100} = 78.0 cfs (Rational Method). Channel D1 will convey these flows south to Detention Pond D.

3. Storm Sewer System Design

CDOT Type R curb-opening inlets will be specified where required along the interior streets. These inlets will convey runoff to a storm sewer system consisting of reinforced concrete pipe (RCP) pipe, with a minimum pipe diameter of 18-inches. Inlet sizes have been determined based on a maximum allowable ponding depth of 12 inches for the major (100-year) storm, including a 20 percent clogging factor. Storm sewer sizing has been developed assuming full flow conditions with minor storm flows at the proposed minimum slope for each pipe segment. Storm sewer pipe slopes were set based on proposed street grades and detention pond bottom elevations at the storm sewer system outfall.

Riprap outlet protection sized for the 100-year storm event will be provided for erosion control at culvert and storm sewer pipe outlets. Sizing parameters and hydraulic grade line (HGL) calculations for the proposed storm sewer system are detailed in Appendix D1.

Hydraulic calculations for the proposed culvert pipes are detailed in Appendix D2.

4. Open Channels

Major drainage channels running through the proposed open space areas to the detention ponds at the site boundaries. These channels will generally be designed as stable grass-lined channels with subcritical flow regimes. Drainage channels will be designed to convey 100-year flows, with trapezoidal cross-sections, side slopes of 4:1, and minimum freeboard of 1-foot. The proposed channels will be seeded with native grasses for erosion control, and erosion control blanket (ECB) linings will be provided where needed based on calculated velocities. Hydraulic calculations for sizing the open channels are enclosed in Appendix D3, assuming a Manning's "n" value of 0.030 for non-irrigated native grass channels.

F. Analysis of Existing and Proposed Downstream Facilities

The general concept of the proposed drainage plan is to attenuate peak flows from the developed site by routing flows through the proposed on-site detention ponds. Combined flows from the Ellicott Town Center site flow southeasterly towards the existing Middle Fork of Black Squirrel Creek. The existing channels downstream of the site consist of broad grass-lined swales with no signs of active erosion. As previously discussed, there is an existing drainage crossing of Ellicott Highway approximately 2-1/2 miles downstream of this site where a future culvert should be installed. Recognizing that this historically deficient crossing is miles downstream of the site, no cost contribution to this off-site drainage improvement was requested during previous approval of the Ellicott Town Center MDDP, and no contribution is proposed at this time.

On-site stormwater detention ponds will be provided to mitigate developed drainage impacts, so no off-site or downstream drainage improvements are proposed.

G. Anticipated Drainage Problems and Solutions

The proposed stormwater detention ponds are designed to mitigate the impacts of developed drainage from this project. The overall drainage plan for the subdivision includes a system of improved public streets with curb and gutter, storm inlets, and storm sewers conveying developed flows to improved drainage channels running through the site. The primary drainage problems anticipated within this development will consist of maintenance of these storm sewer systems, culverts, drainage channels, and detention pond facilities. Care will need to be taken to implement proper erosion control measures in the proposed channels and swales, which will be designed to meet allowable velocity criteria.

A trail system will be constructed along the major drainage channels to provide maintenance access to the drainage facilities throughout the development. Proper construction and maintenance of the proposed detention facilities will minimize downstream drainage impacts. The proposed public streets will be owned and maintained by El Paso County. The proposed detention ponds and channels running through open space tracts and storm drains through private alleys will be privately owned and maintained by the homeowners association or metropolitan district.

VII. EROSION CONTROL

The Contractor will be required to implement best management practices (BMP's) for erosion control during construction. The proposed erosion control plan is included in the Grading & Erosion Control (GEC) Plans submitted with the subdivision construction drawings. Erosion control measures will include installation of silt fence at the toe of disturbed slopes and hay bales protecting drainage ditches. Cut and fill slopes will be stabilized during excavation if necessary and vegetation will be established for stabilization of the disturbed areas. All ditches have been designed to meet El Paso County criteria for slope and velocity.

Additionally, gravel vehicle tracking pads will be installed at construction access points and inlet protection will be provided to minimize conveyance of sediment into storm inlets.

Construction of the proposed stormwater detention pond will be phased at the beginning of overlot grading work to serve as a temporary sediment pond during the construction phase. Accumulated sediment will have to be removed from the pond prior to completion of sitework to restore design capacity of the detention pond.

VIII. COST ESTIMATE AND DRAINAGE FEES

The developer will pay all capital costs for roadway and drainage improvements. As detailed in Appendix E, the engineer's cost estimate for Filing No. 1 drainage improvements is approximately $594,090, the engineer's estimate for Filing No. 3 drainage improvements is approximately $124,829, and the engineer's estimate for Filing No. 4 drainage improvements is approximately $425,295.

The Mayberry, Colorado Springs Phase 1 development area (Filings No. 1 – 4) is located entirely within the Ellicott Consolidated Drainage Basin, which currently does not have a drainage or bridge fee requirement. As such, no basin fees are applicable.

IX. MAINTENANCE

All proposed road and drainage construction within the Mayberry, Colorado Springs project will be performed to El Paso County Standards. Interior roads will be dedicated as public right-of-way. Roads and drainage facilities within the public right-of-way will be maintained by El Paso County upon final acceptance of these facilities after the warranty period. The Metropolitan District will maintain drainage channels and stormwater detention ponds within the proposed open space areas.

X. SUMMARY

The Mayberry, Colorado Springs (fka "Ellicott Town Center") Phase 1 PUD consists of 240 residential lots in the northeast part of the development, with access connections to State Highway 94 at New Log Road and Springs Road. Filings No. 2 and 3 consists of commercial / industrial development in the northeast corner of the subdivision. The Mayberry, Colorado Springs development will generate an increase in undetained developed runoff from the site, which will be mitigated through on-site stormwater detention facilities.

The proposed drainage patterns will remain consistent with historic conditions, and new drainage facilities constructed to El Paso County standards will safely convey runoff to adequate outfalls. Construction of the proposed Detention Ponds C1 and D southeast of the Phase 1 development areas will ensure that developed flows remain below historic levels. Construction and proper maintenance of the proposed drainage and erosion control facilities will ensure that this subdivision has no significant adverse drainage impacts on downstream or surrounding areas.

APPENDIX A

SCS SOILS INFORMATION

Hydrologic Soil Group—El Paso County Area, Colorado
(Ellicott Town Center)

Map Scale: 1:12,000 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 150 300 600 900

Feet: 0 500 1000 2000 3000

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

is severely eroded and blowouts have developed, the new seeding should be fertilized.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing is the main limitation for the establishment of trees and shrubs. This limitation can be overcome by cultivating only in the tree rows and leaving a strip of vegetation between the rows. Supplemental irrigation may be necessary when planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

This soil is suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. In cropland areas, habitat favorable for ring-necked pheasant, mourning dove, and many nongame species can be developed by establishing areas for nesting and escape cover. For pheasant, the provision of undisturbed nesting cover is vital and should be included in plans for habitat development. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

This soil has good potential for use as homesites. Shallow excavation is severely limited because cut banks cave in. This sandy soil requires special management practices to reduce water erosion and soil blowing. Capability subclasses IIIe, irrigated, and IVe, nonirrigated.

7—Bijou sandy loam, 3 to 8 percent slopes. This deep, well drained soil is on flood plains, terraces, and uplands. It formed in sandy alluvium and eolian material derived from arkose deposits. Elevation ranges from 5,400 to 6,200 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 49 degrees F, and the average frost-free period is about 145 days.

Typically, the surface layer is brown sandy loam about 4 inches thick. The subsoil is brown or grayish brown sandy loam about 24 inches thick. The substratum is pale brown loamy coarse sand.

Included with this soil in mapping are small areas of Olney sandy loam, 3 to 5 percent slopes; Valent sand, 1 to 9 percent slopes; Vona sandy loam, 3 to 9 percent slopes; and Wigton loamy sand, 1 to 8 percent slopes.

Permeability of this Bijou soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Organic matter content of the surface layer is low. Surface runoff is slow, and the hazards of erosion and soil blowing are moderate.

Almost all areas of this soil are used for range.

This soil is suited to the production of native vegetation suitable for grazing. Because of the hazards of water erosion and soil blowing, the soil is not suited to nonirrigated crops.

Native vegetation is dominantly blue grama, sand dropseed, needleandthread, side-oats grama, and buckwheat.

Seeding is a suitable practice if the range has deteriorated. Seeding the native grasses is a good practice. If the range is severely eroded and blowouts have developed, the new seeding should be fertilized. Brush control and grazing management may be needed to improve the depleted range. Grazing should be managed so that enough forage is left standing to protect the soil from blowing, to increase infiltration of water, and to catch and hold snow.

Windbreaks and environmental plantings are generally suited to this soil. Soil blowing is the main limitation for the establishment of trees and shrubs. This limitation can be overcome by cultivating only in the tree rows and leaving a strip of vegetation between the rows. Supplemental irrigation may be needed when planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

This soil is suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, by properly managing livestock grazing, and by reseeding range where needed.

This soil has good potential for use as homesites. Shallow excavation is severely limited because cut banks cave in. This soil requires special management practices to reduce water erosion and soil blowing. Capability subclass VIe.

8—Blakeland loamy sand, 1 to 9 percent slopes. This deep, somewhat excessively drained soil formed in alluvial and eolian material derived from arkosic sedimentary rock on uplands. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is dark grayish brown loamy sand about 11 inches thick. The substratum, to a depth of 27 inches, is brown loamy sand; it grades to pale brown sand that extends to a depth of 60 inches.

Included with this soil in mapping are small areas of Bresser sandy loam, 0 to 3 percent slopes; Bresser sandy loam, 3 to 5 percent slopes; Truckton sandy loam, 0 to 3 percent slopes; Truckton sandy loam, 3 to 9 percent slopes; and Stapleton sandy loam, 3 to 8 percent slopes. In some areas, mainly north of Colorado Springs in the Cottonwood Creek area, arkosic beds of sandstone and shale are at a depth of 0 to 40 inches.

Permeability of this Blakeland soil is rapid. Effective rooting depth is 60 inches or more. Available water capacity is low to moderate. Organic matter content of the surface layer is medium. Surface runoff is slow, the hazard of erosion is moderate, and the hazard of soil blowing is severe.

Most areas of this soil are used for range, homesites, and wildlife habitat.

Native vegetation is dominantly western wheatgrass, side-oats grama, and needleandthread. This soil is best suited to deep-rooted grasses.

Proper range management is necessary to prevent excessive removal of plant cover from the soil. Interseeding improves the existing vegetation. Deferment of grazing in spring increases plant vigor and soil stability. Proper location of livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings are fairly well suited to this soil. Blowing sand and low available water capacity are the main limitations for the establishment of trees and shrubs. The soil is so loose that trees need to be planted in shallow furrows and plant cover needs to be maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

This soil is suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

This soil has good potential for urban development. Soil blowing is a hazard if protective vegetation is removed. Special erosion control practices must be provided to minimize soil losses. Capability subclass VIe.

9—Blakeland complex, 1 to 9 percent slopes. This complex is on uplands, mostly in the Falcon area. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the frost-free period is about 135 days.

This complex is about 60 percent Blakeland loamy sand, about 30 percent Fluvaquentic Haplaquolls, and 10 percent other soils.

Included with these soils in mapping are areas of Columbine gravelly sandy loam, 0 to 3 percent slopes, Ellicott loamy coarse sand, 0 to 5 percent slopes, and Ustic Torrifluvents, loamy.

The Blakeland soil is in the more sloping areas. It is deep and somewhat excessively drained. It formed in sandy alluvium and eolian material derived from arkosic sedimentary rock. Typically, the surface layer is dark grayish brown loamy sand about 11 inches thick. The substratum, to a depth of 27 inches, is brown loamy sand; it grades to pale brown sand that extends to a depth of 60 inches or more.

Permeability of the Blakeland soil is rapid. The effective rooting depth is more than 60 inches. The available water capacity is moderate to low. Surface runoff is slow, and the hazard of erosion is moderate.

The Fluvaquentic Haplaquolls are in swale areas. They are deep, poorly drained soils. They formed in alluvium derived from arkosic sedimentary rock. Typically, the surface layer is brown. The texture is variable throughout. The water table is at a depth of 0 to 3 feet.

The Blakeland soil is well suited to deep-rooted grasses. Native vegetation is dominantly western wheatgrass, side-oats grama, and needleandthread. Rangeland vegetation on the Fluvaquentic Haplaquolls is dominantly tall grasses, including sand bluestem, switchgrass, prairie cordgrass, little bluestem, and sand reedgrass. Cattails and bulrushes are common in the swampy areas.

Proper range management is needed to prevent excess removal of plant cover from these soils. It is also needed to maintain the productive grasses. Interseeding improves the existing vegetation. Deferment of grazing during the growing season increases plant vigor and soil stability, and it helps to maintain and improve range condition. Proper location of livestock watering facilities helps to control grazing of animals.

Windbreaks and environmental plantings are fairly well suited to these soils. Blowing sand and low available water capacity are the main limitations to the establishment of trees and shrubs. The soils are so loose that trees need to be planted in shallow furrows and plant cover needs to be maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

The Blakeland soil is well suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed. Wetland wildlife can be attracted to the Fluvaquentic Haplaquolls and the wetland habitat can be enhanced by several means. Shallow water developments can be created by digging or by blasting potholes to create open-water areas. Fencing to control livestock grazing is beneficial, and it allows wetland plants such as cattails, reed canarygrass, and rushes to grow. Control of unplanned burning and prevention of drainage that would remove water from the wetlands are good practices. Openland wildlife use the vegetation on these soils for nesting and escape cover. These shallow marsh areas are especially important for winter cover if natural vegetation is allowed to grow.

The Blakeland soil has good potential for homesites, roads, and streets. It needs to be protected from erosion when vegetation has been removed from building sites. The Fluvaquentic Haplaquolls have poor potential for homesites. Their main limitations for this use are the high water table and the hazard of flooding. Capability subclass VIe.

10—Blendon sandy loam, 0 to 3 percent slopes. This deep, well drained soil formed in sandy arkosic alluvium on alluvial fans and terraces. The average annual precipitation is about 15 inches, the mean annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Permeability of the Crowfoot soil is moderate. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is medium, and the hazard of erosion is moderate. Some gullies are present in some drainageways and along stock trails.

The soils in this complex are used as rangeland, for recreation and wildlife habitat, and as homesites.

Native vegetation is mainly mountain muhly, bluestem, mountain brome, needleandthread, and blue grama. These soils are subject to invasion by Kentucky bluegrass and Gambel oak. Noticeable forbs are hairy goldenrod, geranium, milkvetch, low larkspur, fringed sage, and buckwheat.

Proper location of livestock watering facilities helps to control grazing. Timely deferment of grazing is needed to protect the plant cover.

Windbreaks and environmental plantings are fairly well suited to these soils. Blowing sand and moderate available water capacity are the main limitations for the establishment of trees and shrubs. The soils are so loose that trees need to be planted in shallow furrows and plant cover needs to be maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

These soils are best suited to habitat for openland wildlife species, such as pronghorn antelope and sharp-tailed grouse. Although sharp-tailed grouse are not plentiful, they could be encouraged on these soils, especially where brush species are interspersed with grasses and forbs. If these soils are used as rangeland, wildlife production can be increased by managing livestock grazing to preclude overuse of the more desirable grass species and depletion of the various brush species.

The main limitations for urban uses are frost-action potential and slope on the Crowfoot soil and slope on the Tomah soil. Buildings and roads must be designed to overcome these limitations. Access roads must have adequate cut-slope grade and be provided with drains to control surface runoff. Maintaining the existing vegetation on building sites during construction helps to control erosion. Capability subclass VIe.

94—Travessilla-Rock outcrop complex, 8 to 90 percent slopes. This moderately sloping to extremely steep complex is mostly on rocky uplands (fig. 5). Elevation ranges from 6,200 to 6,700 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 140 days.

The Travessilla soil makes up about 45 percent of the complex. Rock outcrop about 30 percent, and included areas about 25 percent.

Included with this complex in mapping are areas of Bresser sandy loam, 5 to 9 percent slopes, Elbeth sandy loam, 8 to 15 percent slopes, Kettle gravelly loamy sand, 8 to 40 percent slopes, and Louviers silty clay loam, 3 to 18 percent slopes. The Elbeth and Kettle soils commonly are on the north-facing slopes.

The Travessilla soil is shallow and well drained. It formed in residuum derived from sandstone. Typically, the surface layer is light brownish gray sandy loam about 3 inches thick. The underlying material is pale brown sandy loam about 8 inches thick. Hard arkosic sandstone that has some fractures is at a depth of about 11 inches.

Permeability of the Travessilla soil is moderately rapid. Effective rooting depth is 6 to 20 inches. Available water capacity is low. Surface runoff is medium to rapid, and the hazard of erosion is high. Gullies are common along drainageways and trails.

Rock outcrop occurs mostly as ledges on cliffs.

This complex is used for urban development, as homesites, and for recreation and wildlife habitat.

This complex is suited to the production of ponderosa pine. The main limitations are the presence of stones and rock outcrop on the surface and a high hazard of erosion. Stones on the surface can hinder felling, yarding, and other operations involving the use of equipment. Practices must be used to minimize soil erosion when harvesting timber. The low available water capacity can influence seedling survival.

Wildlife on these soils is limited mostly to small animals such as cottontail, squirrel, and birds because of the extent of urban development. Ponderosa pine, mountain-mahogany, Gambel oak, and various grasses provide food, cover, and nesting areas.

This complex is extensively used for urban development and as homesites (fig. 6). The main limitations for these uses are depth to bedrock, rock outcrop, and steep slopes. Septic tank absorption fields do not function properly because of the depth to bedrock. Special designs for buildings and roads and streets are needed to overcome the limitations. Plans for homesite development should provide for the preservation of as many trees as possible because of their esthetic value. Capability subclass VIIe.

95—Truckton loamy sand, 1 to 9 percent slopes. This deep, well drained soil formed in alluvium and residuum derived from arkosic sedimentary rock on uplands. Elevation ranges from 6,000 to 7,000 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown loamy sand about 8 inches thick. The subsoil is brown sandy loam about 18 inches thick. The substratum is light yellowish brown coarse sandy loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Blakeland loamy sand, 1 to 9 percent slopes; Bresser sandy loam, 3 to 5 percent sloeps; Bresser sandy loam, 5 to 9 percent slopes; Truckton sandy loam, 0 to 3 percent slopes; and Truckton sandy loam, 3 to 9 percent slopes.

Permeability of this Truckton soil is moderately rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow, and the hazard of erosion is moderate to high.

Almost all areas of this soil are used as rangeland. A few areas of crops such as alfalfa and corn are grown under sprinkler irrigation.

This soil is well suited to the production of native vegetation suitable for grazing. It is best suited to deep-rooted grasses. The native vegetation is mainly cool- and warm-season grasses such as western wheatgrass, sideoats grama, and needleandthread.

Proper range management is needed to prevent excessive removal of the plant cover. Interseeding is used to improve the existing vegetation. Deferment of grazing in spring increases plant vigor and soil stability. Properly locating livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings are fairly well suited to this soil. Blowing sand is the main limitation for the establishment of trees and shrubs. The soil is so loose that trees need to be planted in shallow furrows and plant cover needs to be maintained between the rows. Supplemental irrigation may be needed to insure survival. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, and Siberian elm. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

This soil is suited to wildlife habitat. It is best suited to openland and rangeland wildlife habitat. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

This soil has good potential for use as homesites. The main limitation of this soil for roads and streets is frost action potential. Special designs for roads are needed to minimize this limitation. Practices are needed to control soil blowing and water erosion on construction sites where the plant cover has been removed. Capability subclass VIe, nonirrigated.

96—Truckton sandy loam, 0 to 3 percent slopes. This deep, well drained soil formed in alluvium and residuum derived from arkosic sedimentary rock on uplands. Elevation ranges from 6,000 to 7,000 feet. The average annual precipitation is about 15 inches, the average annual air temperatue is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown sandy loam about 5 inches thick. The next layer is dark grayish brown sandy loam about 3 inches thick. The subsoil is brown sandy loam about 16 inches thick. The substratum is light yellowish brown coarse sandy loam to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Blakeland loamy sand, 1 to 9 percent slopes; Bresser sandy loam, 0 to 3 percent slopes; Ellicott loamy coarse sand, 0 to 5 percent slopes; and Ustic Torrifluvents, loamy.

Permeability of this Truckton soil is moderately rapid. Effective rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow, and the hazards of erosion and soil blowing are moderate.

This soil is used mainly for cultivated crops. It is also used for livestock grazing, for wildlife habitat, and as homesites.

Crops are commonly grown in combination with summer fallow because moisture is insufficient for annual cropping. Alfalfa can also be grown on this soil. When this soil is used as cropland, crop residue management and minimum tillage are necessary conservation practices.

This soil is well suited to the production of native vegetation suitable for grazing (fig. 7). It favors deep-rooted grasses. The native vegetation is mainly cool- and warm-season grasses such as western wheatgrass, sideoats grama, and needleandthread.

Proper range management is needed to prevent excessive removal of the plant cover. Interseeding is used to improve the existing vegetation. Deferment of grazing in spring increases plant vigor and soil stability. Properly locating livestock watering facilities helps to control grazing.

Windbreaks and environmental plantings generally are suited to this soil. Soil blowing is the main limitation to the establishment of trees and shrubs. This limitation can be overcome by cultivating only in the tree rows and leaving a strip of vegetation between the rows. Supplemental irrigation may be needed when planting and during dry periods. Trees that are best suited and have good survival are Rocky Mountain juniper, eastern redcedar, ponderosa pine, Siberian elm, Russian-olive, and hackberry. Shrubs that are best suited are skunkbush sumac, lilac, and Siberian peashrub.

This soil is suited to wildlife habitat. It is best suited to habitat for openland and rangeland wildlife. In cropland areas, habitat favorable for ring-necked pheasant, mourning dove, and many nongame species can be developed by establishing areas for nesting and escape cover. For pheasant, undisturbed nesting cover is vital and should be provided in plans for habitat development. This is especially true in areas of intensive farming. Rangeland wildlife, such as pronghorn antelope, can be encouraged by developing livestock watering facilities, properly managing livestock grazing, and reseeding range where needed.

This soil has good potential for use as homesites. The main limitation of this soil for roads and streets is frost-action potential. Special designs for roads are needed to overcome this limitation. Capability subclasses IIIe, nonirrigated, and IIe, irrigated.

97—Truckton sandy loam, 3 to 9 percent slopes. This deep, well drained soil formed in alluvium and residuum derived from arkosic sedimentary rock on uplands. Elevation ranges from 6,000 to 7,000 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 47 degrees F, and the average frost-free period is about 135 days.

Typically, the surface layer is grayish brown sandy loam about 5 inches thick. The next layer is dark grayish brown sandy loam about 3 inches thick. The subsoil is brown sandy loam about 16 inches thick. The substratum is light yellowish brown coarse sandy loam to a depth of 60 inches or more.

TABLE 16.--SOIL AND WATER FEATURES

[Absence of an entry indicates the feature is not a concern. See "flooding" in Glossary for definition of terms as "rare," "brief," and "very brief." The symbol > means greater than]

Soil name and map symbol	Hydrologic group	Flooding			Bedrock		Potential frost action
		Frequency	Duration	Months	Depth	Hardness	
					In		
Alamosa:							
1	C	Frequent	Brief	May-Jun	>60	---	High.
Ascalon:							
2, 3	B	None	---	---	>60	---	Moderate.
Badland:							
4	D	---	---	---	---	---	---
Bijou:							
5, 6, 7	B	None	---	---	>60	---	Low.
Blakeland:							
8	A	None	---	---	>60	---	Low.
[1]9:							
Blakeland part	A	None	---	---	>60	---	Low.
Fluvaquentic Haplaquolls part	D	Common	Very brief	Mar-Aug	>60	---	High.
Blendon:							
10	B	None	---	---	>60	---	Moderate.
Bresser:							
11, 12, 13	B	None	---	---	>60	---	Low.
Brussett:							
14, 15	B	None	---	---	>60	---	Moderate.
Chaseville:							
16, 17	A	None	---	---	>60	---	Low.
[1]18:							
Chaseville part	A	None	---	---	>60	---	Low.
Midway part	D	None	---	---	10-20	Rippable	Moderate.
Columbine:							
19	A	None to rare	---	---	>60	---	Low.
Connerton:							
[1]20:							
Connerton part	B	None	---	---	>60	---	High.
Rock outcrop part	D	---	---	---	---	---	---
Cruckton:							
21	B	None	---	---	>60	---	Moderate.
Cushman:							
22, 23	C	None	---	---	20-40	Rippable	Moderate.
[1]24:							
Cushman part	C	None	---	---	20-40	Rippable	Moderate.
Kutch part	C	None	---	---	20-40	Rippable	Moderate.
Elbeth:							
25, 26	B	None	---	---	>60	---	Moderate.
[1]27:							
Elbeth part	B	None	---	---	>60	---	Moderate.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			Bedrock		Potential frost action
		Frequency	Duration	Months	Depth	Hardness	
					In		
Tomah:							
[1]92, [1]93:							
Tomah part	B	None	---	---	>60	---	Moderate.
Crowfoot part	B	None	---	---	>60	---	Moderate.
Travessilla:							
[1]94:							
Travessilla part	D	None	---	---	6-20	Hard	Low.
Rock outcrop part	D	---	---	---	---	---	---
Truckton:							
95, 96, 97	B	None	---	---	>60	---	Moderate.
[1]98:							
Truckton part	B	None	---	---	>60	---	Moderate.
Blakeland part	A	None	---	---	>60	---	Low.
[1]99, [1]100:							
Truckton part	B	None	---	---	>60	---	Moderate.
Bresser part	B	None	---	---	>60	---	Low.
Ustic Torrifluvents:							
101	B	Occasional	Very brief	Mar-Aug	>60	---	Moderate.
Valent:							
102, 103	A	None	---	---	>60	---	Low.
Vona:							
104, 105	B	None	---	---	>60	---	Moderate.
Wigton:							
106	A	None	---	---	>60	---	Low.
Wiley:							
107, 108	B	None	---	---	>60	---	Low.
Yoder:							
109, 110	B	None	---	---	>60	---	Low.

[1]This map unit is made up of two or more dominant kinds of soil. See map unit description for the composition and behavior characteristics of the map unit.

APPENDIX B1

HYDROLOGIC CALCULATIONS (RATIONAL METHOD)

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 <u>maximum</u> for non-urban land uses, 100 ft <u>maximum</u> 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.

MAYBERRY, COLORADO SPRINGS (ELLICOTT TOWN CENTER)
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
A1A	2.80	0.9	ROADWAY	0.9	1.9	GRASS	0.08				0.355
C1.2	7.97	8.0	COMMERCIAL	0.49							0.490
C1.7A	0.58	0.6	SF LOTS (1/6-AC)	0.375							0.375
C1.7B	4.34	4.3	COMMERCIAL	0.49							0.490
C1.7A,C1.7B	4.92										0.476
C1.2,C1.7	12.89										0.485
C1.3	3.02	3.0	SF LOTS (1/6-AC)	0.375							0.375
C1.2,C1.3,C1.7	15.91										0.464
C1.4	3.23	3.2	SF LOTS (1/6-AC)	0.375							0.375
C1.2-C1.4,C1.7	19.14										0.449
C1.5	3.18	3.2	SF LOTS (1/6-AC)	0.375							0.375
C1.2-C1.5,C1.7	22.32										0.438
C1.1	9.38	3.0	RESIDENTIAL	0.375	1.2	COMMERCIAL	0.49	5.2	OPEN SPACE	0.08	0.226
C1.6	3.01	3.0	SF LOTS (1/6-AC)	0.375							0.375
C1.1,C1.6	12.39										0.262
C1.1-C1.7	34.71										0.376
C1.8	3.89	3.9	SF LOTS (1/6-AC)	0.375							0.375
C1.9	4.39	4.4	SF LOTS (1/6-AC)	0.375							0.375
C1.8-C1.9	8.28										0.375
C1.1-C1.9	42.99										**0.375**
C1.10	1.82	1.8	SF LOTS (1/6-AC)	0.375							0.375
C1.1-C1.10	44.81										**0.375**
C2.1	2.55	1.6	RESIDENTIAL	0.375	1.0	OPEN SPACE	0.08				0.259
C2.2	1.99	2.0	SF LOTS (1/6-AC)	0.375							0.375
C2.1-C2.2	4.54										0.310
C2.3	3.01	3.0	SF LOTS (1/6-AC)	0.375							0.375
C2.5	6.27	6.3	SF LOTS (1/6-AC)	0.375							0.375
C2.1-C2.3,C2.5	13.82										0.354
C2.4	2.11	2.1	SF LOTS (1/6-AC)	0.375							0.375
C2.1-C2.5	15.93										0.356
C3	20.25	20.3	PARK / OS	0.08							0.080
C2.1-C2.5,C3	36.18										0.202

C2.6	3.67	3.0	SF LOTS (1/6-AC)	0.375	0.7	LANDSCAPE / OS	0.08				0.319
C2.7	2.14	2.1	COMM / LT INDUSTRIAL	0.59							0.590
C2.8A	3.11	1.8	SF LOTS (1/6-AC)	0.375	1.4	COMM / LT INDUSTRIAL	0.59				0.468
C2.6-C2.8A	8.92										0.436
C2.8B	1.40	1.4	SF LOTS (1/6-AC)	0.375							0.375
C2.6-C2.8B	10.32										0.428
C2.9	5.39	4.9	SF LOTS (1/6-AC)	0.375	0.5	COMM / LT INDUSTRIAL	0.59				0.395
C2.6-C2.9	15.71										0.416
D1.1	4.89	4.9	COMM / LT INDUSTRIAL	0.59							0.590
D1.2	2.62	2.6	COMM / LT INDUSTRIAL	0.59							0.590
D1.1,D1.2	7.51										0.590
D1.3	3.82	2.5	SF LOTS (1/6-AC)	0.375	1.3	COMM / LT INDUSTRIAL	0.59				0.448
D1.1-D1.3	11.33										0.542
D1.4	3.07	3.1	SF LOTS (1/6-AC)	0.375							0.375
D1.1-D1.4	14.40										0.507
D1.5	2.29	2.3	SF LOTS (1/6-AC)	0.375							0.375
D1.1-D1.5	16.69										0.488
C2.6-C2.9,D1.1-D1.5	32.40										0.454
D2	44.58	39.5	MDR-RESIDENTIAL	0.375	5.1	LANDSCAPE/OS	0.08				0.341
C2.6-C2.9,D1.1-D1.5,D2	76.98										0.389
C2,C3,D	**113.16**										**0.329**
C1-C3,D	**157.97**										**0.342**
C4	72.81	61.9	MDR-RESIDENTIAL	0.375	10.9	LANDSCAPE/OS	0.08				0.331
E	2.4	0.3	MDR-RESIDENTIAL	0.375	2.1	OPEN SPACE	0.08				0.114

MAYBERRY, COLORADO SPRINGS (ELLICOTT TOWN CENTER)
COMPOSITE RUNOFF COEFFICIENTS

DEVELOPED CONDITIONS
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
A1A	2.80	0.9	ROADWAY	0.96	1.9	GRASS	0.35				0.555
C1.2	7.97	8.0	COMMERCIAL	0.62							0.620
C1.7A	0.58	0.6	SF LOTS (1/6-AC)	0.545							0.545
C1.7B	4.34	4.3	COMMERCIAL	0.62							0.620
C1.7A,C1.7B	4.92										0.611
C1.2,C1.7	12.89										0.617
C1.3	3.02	3.0	SF LOTS (1/6-AC)	0.545							0.545
C1.2,C1.3,C1.7	15.91										0.603
C1.4	3.23	3.2	SF LOTS (1/6-AC)	0.545							0.545
C1.2-C1.4,C1.7	19.14										0.593
C1.5	3.18	3.2	SF LOTS (1/6-AC)	0.545							0.545
C1.2-C1.5,C1.7	22.32										0.586
C1.1	9.38	3.0	RESIDENTIAL	0.545	1.2	COMMERCIAL	0.62	5.2	OPEN SPACE	0.35	0.447
C1.6	3.01	3.0	SF LOTS (1/6-AC)	0.545							0.545
C1.1,C1.6	12.39										0.471
C1.1-C1.7	34.71										0.545
C1.8	3.89	3.9	SF LOTS (1/6-AC)	0.545							0.545
C1.9	4.39	4.4	SF LOTS (1/6-AC)	0.545							0.545
C1.8-C1.9	8.28										0.545
C1.1-C1.9	42.99										**0.545**
C1.10	1.82	1.8	SF LOTS (1/6-AC)	0.545							0.545
C1.1-C1.10	44.81										**0.545**
C2.1	2.55	1.6	SF LOTS (1/6-AC)	0.545	1.0	OPEN SPACE	0.35				0.469
C2.2	1.99	2.0	SF LOTS (1/6-AC)	0.545							0.545
C2.1-C2.3	4.54										0.502
C2.3	3.01	3.0	SF LOTS (1/6-AC)	0.545							0.545
C2.5	6.27	6.3	SF LOTS (1/6-AC)	0.545							0.545
C2.1-C2.3,C2.5	13.82										0.531
C2.4	2.11	2.1	SF LOTS (1/6-AC)	0.545							0.545
C2.1-C2.5	15.93										0.533
C3	20.25	20.3	PARK / OS	0.35							0.350
C2.1-C2.5,C3	36.18										0.430

C2.6	3.67	3.0	SF LOTS (1/6-AC)	0.545	0.7	LANDSCAPE / OS	0.35				0.508
C2.7	2.14	2.1	COMM / LT INDUSTRIAL	0.7							0.700
C2.8A	3.11	1.8	SF LOTS (1/6-AC)	0.545	1.4	COMM / LT INDUSTRIAL	0.7				0.612
C2.6-C2.8A	8.92										0.590
C2.8B	1.40	1.4	SF LOTS (1/6-AC)	0.545							0.545
C2.6-C2.8B	10.32										0.584
C2.9	5.39	4.9	SF LOTS (1/6-AC)	0.545	0.5	COMM / LT INDUSTRIAL	0.7				0.559
C2.6-C2.9	15.71										0.576
D1.1	4.89	4.9	COMM / LT INDUSTRIAL	0.7							0.700
D1.2	2.62	2.6	COMM / LT INDUSTRIAL	0.7							0.700
D1.1,D1.2	7.51										0.700
D1.3	3.82	2.5	SF LOTS (1/6-AC)	0.545	1.3	COMM / LT INDUSTRIAL	0.7				0.598
D1.1-D1.3	11.33										0.666
D1.4	3.07	3.1	SF LOTS (1/6-AC)	0.545							0.545
D1.1-D1.4	14.40										0.640
D1.5	2.29	2.3	SF LOTS (1/6-AC)	0.545							0.545
D1.1-D1.5	16.69										0.627
C2.6-C2.9,D1.1-D1.5	32.40										0.602
D2	44.58	39.5	MDR-RESIDENTIAL	0.545	5.1	LANDSCAPE/OS	0.35				0.523
C2.6-C2.8,D1.1-D1.6,D2	76.98										0.556
C2,C3,D	**113.16**										**0.516**
C1-C3,D	**157.97**										**0.524**
C4	72.81	61.9	MDR-RESIDENTIAL	0.545	10.9	LANDSCAPE/OS	0.35				0.516
E	2.4	0.3	MDR-RESIDENTIAL	0.545	2.1	OPEN SPACE	0.35				0.372

MAYBERRY, COLORADO SPRINGS (ELLICOTT TOWN CENTER)
RATIONAL METHOD - HYDROLOGIC CALCULATIONS

DEVELOPED FLOWS

					Overland Flow			Channel flow										
			C					CHANNEL	CONVEYANCE		SCS [2]		TOTAL	TOTAL	INTENSITY [5]		PEAK FLOW	
BASIN	DESIGN POINT	AREA (AC)	5-YEAR	100-YEAR	LENGTH (FT)	SLOPE (FT/FT)	Tco [1] (MIN)	LENGTH (FT)	COEFFICIENT C	SLOPE (FT/FT)	VELOCITY (FT/S)	Tt [3] (MIN)	Tc [4] (MIN)	Tc [4] (MIN)	5-YR (IN/HR)	100-YR (IN/HR)	Q5 [6] (CFS)	Q100 [6] (CFS)
FILING NO. 1																		
A1A	A1A	2.80	0.355	0.555	40	0.020	6.8	2035	15	0.011	1.57	21.6	28.4	28.4	2.56	4.30	2.55	6.68
C1.2	C1.2	7.97	0.490	0.620			0.0	1000	20	0.009	1.90	8.8	8.8	8.8	4.32	7.26	16.88	35.87
C1.7A	C1.7A	0.58	0.375	0.545			0.0	680	20	0.013	2.28	5.0	5.0	5.0	5.17	8.68	1.12	2.74
C1.7B	C1.7B	4.34	0.490	0.620	100	0.020	8.9	400	20	0.01	2.00	3.3	12.2	12.2	3.83	6.43	8.15	17.31
C1.7A,C1.7B	C1.7B1	4.92	0.476	0.611									12.2	12.2	3.83	6.43	8.97	19.33
C1.2,C1.7	C1.2D	12.89	0.485	0.617									12.2	12.2	3.83	6.43	23.95	51.15
C1.3		3.02	0.375	0.545			0.0	280	20	0.01	2.00	2.3	2.3	5.0	5.17	8.68	5.85	14.29
C1.2,C1.3,C1.7	C1.3A	15.91	0.464	0.603									14.5	14.5	3.57	5.99	26.34	57.47
C1.4		3.23	0.375	0.545			0.0	300	20	0.01	2.00	2.5	2.5	5.0	5.17	8.68	6.26	15.28
C1.2-C1.4,C1.7	C1.4A	19.14	0.449	0.593									17.0	17.0	3.33	5.59	28.62	63.45
C1.5		3.18	0.375	0.545			0.0	300	20	0.01	2.00	2.5	2.5	5.0	5.17	8.68	6.16	15.04
C1.2-C1.5,C1.7	C1.5A	22.32	0.438	0.586									19.5	19.5	3.12	5.25	30.55	68.61
C1.1	C1.1	9.38	0.226	0.447	100	0.017	13.4	1800	20	0.01	2.00	15.0	28.4	28.4	2.56	4.30	5.43	18.04
C1.6		3.01	0.375	0.545			0.0	450	20	0.01	2.00	3.8	3.8	5.0	5.17	8.68	5.83	14.24
C1.1,C1.6	C1.6B	12.39	0.262	0.471									32.2	32.2	2.38	3.99	7.72	23.28
C1.1-C1.7	C1.7A	34.71	0.376	0.545									32.2	32.2	2.38	3.99	31.02	75.46
C1.8		3.89	0.375	0.545			0.0	600	20	0.016	2.53	4.0	4.0	5.0	5.17	8.68	7.54	18.40
C1.9		4.39	0.375	0.545			0.0	580	20	0.012	2.19	4.4	4.4	5.0	5.17	8.68	8.51	20.77
C1.8,C1.9	C1.9A	8.28	0.375	0.545									8.4	8.4	4.40	7.38	13.65	33.31
Tt C1.6 to Pond C1								450	20	0.01	2.00	3.8						
C1.1-C1.9	**C1.9B**	**42.99**	**0.375**	**0.545**									**35.9**	**35.9**	**2.21**	**3.71**	**35.65**	**86.95**
C1.10	C1.10	1.82	0.375	0.545	50	0.020	7.5	1500	20	0.01	2.00	12.5	20.0	20.0	3.09	5.19	2.11	5.15
C1.1-C1.10	**C1.10A**	**44.81**	**0.375**	**0.545**									**35.9**	**35.9**	**2.21**	**3.71**	**37.16**	**90.63**

					Overland Flow			Channel flow										
			C					CHANNEL	CONVEYANCE		SCS [2]		TOTAL	TOTAL	INTENSITY [5]		PEAK FLOW	
BASIN	DESIGN POINT	AREA (AC)	5-YEAR	100-YEAR	LENGTH (FT)	SLOPE (FT/FT)	Tco [1] (MIN)	LENGTH (FT)	COEFFICIENT C	SLOPE (FT/FT)	VELOCITY (FT/S)	Tt [3] (MIN)	Tc [4] (MIN)	Tc [4] (MIN)	5-YR (IN/HR)	100-YR (IN/HR)	Q5 [6] (CFS)	Q100 [6] (CFS)
FILING NO. 2-4																		
C2.1		2.55	0.259	0.469	200	0.010	21.8	450	20	0.01	2.00	3.8	25.5	25.5	2.72	4.57	1.80	5.47
C2.2		1.99	0.375	0.545	100	0.020	10.5	480	20	0.01	2.00	4.0	14.5	14.5	3.57	5.99	2.66	6.50
Tt C2.1 to C2.2								350	20	0.011	2.10	2.8						
C2.1-C2.2	C2.2A	4.54	0.310	0.502									28.3	28.3	2.57	4.31	3.61	9.82
C2.3		3.01	0.375	0.545	100	0.020	10.5	600	20	0.012	2.19	4.6	15.1	15.1	3.51	5.89	3.96	9.67
C2.5	C2.5	6.27	0.375	0.545	100	0.020	10.5	850	20	0.01	2.00	7.1	17.6	17.6	3.28	5.51	7.71	18.81
Tt C2.2 to C2.5								850	20	0.01	2.00	7.1						
C2.1-C2.3,C2.5	C2.5A	13.82	0.354	0.531									35.4	35.4	2.23	3.75	10.93	27.50
C2.4	C2.4	2.11	0.375	0.545	100	0.020	10.5	540	20	0.01	2.00	4.5	15.0	15.0	3.52	5.90	2.78	6.79
C2.1-C2.5	**C2.5B**	**15.93**	**0.356**	**0.533**									**35.4**	**35.4**	**2.23**	**3.75**	**12.67**	**31.82**
C3		20.25	0.080	0.350			0.0	1050	15	0.011	1.57	11.1	11.1	11.1	3.97	6.66	6.43	47.23
C2.1-C2.5,C3	C3.1	36.18	0.202	0.430									35.4	35.4	2.23	3.75	16.32	58.31
C2.6		3.67	0.319	0.508	100	0.020	11.4	860	20	0.01	2.00	7.2	18.5	18.5	3.20	5.38	3.75	10.03
C2.7		2.14	0.590	0.700	100	0.020	7.4	400	20	0.013	2.28	2.9	10.3	10.3	4.08	6.85	5.15	10.26
C2.8A		3.11	0.468	0.612			0.0	250	20	0.012	2.19	1.9	1.9	5.0	5.17	8.68	7.52	16.52
Tt C2.6 to C2.8								250	20	0.032	3.58	1.2						
C2.6-C2.8A	C2.8A	8.92	0.436	0.590									19.7	19.7	3.11	5.23	12.11	27.50
C2.8B	C2.8B	1.40	0.375	0.545	100	0.020	10.5	280	20	0.018	2.68	1.7	12.3	12.3	3.82	6.42	2.01	4.90
C2.6-C2.8	C2.8C	10.32	0.428	0.584									19.7	19.7	3.11	5.23	13.75	31.50
C2.9	C2.9	5.39	0.395	0.559	100	0.010	12.9	710	20	0.01	2.00	5.9	18.8	18.8	3.18	5.34	6.77	16.09
PIPE C2.8-C2.9								510	20	0.005	1.41	6.0						
C2.6-C2.9	**C2.9C**	**15.71**	**0.416**	**0.576**									**25.7**	**25.7**	**2.71**	**4.55**	**17.74**	**41.21**
D1.1	D1.1	4.89	0.590	0.700	100	0.010	9.3	270	20	0.015	2.45	1.8	11.2	11.2	3.96	6.65	11.43	22.77
D1.2	D1.2	2.62	0.590	0.700	100	0.010	9.3	420	20	0.017	2.61	2.7	12.0	12.0	3.85	6.47	5.96	11.86
PIPE D1.2								620	20	0.01	2.00	5.2						
D1.1-D1.2	D1.2C	7.51	0.590	0.700									16.3	16.3	3.39	5.70	15.03	29.94
D1.3	D1.3	3.82	0.448	0.598	100	0.010	11.9	600	20	0.01	2.00	5.0	16.9	16.9	3.34	5.60	5.71	12.80
PIPE D1.3								330	20	0.01	2.00	2.8						
D1.1-D1.3	D1.3C	11.33	0.542	0.666									19.1	19.1	3.16	5.30	19.40	40.02
D1.4	D1.4	3.07	0.375	0.545	100	0.020	10.5	500	20	0.01	2.00	4.2	14.7	14.7	3.55	5.96	4.09	9.97
PIPE D1.4								270	20	0.01	2.00	2.3						
D1.1-D1.4	D1.4C	14.40	0.507	0.640									21.3	21.3	2.99	5.02	21.84	46.29
D1.5	D1.5	2.29	0.375	0.545	100	0.020	10.5	800	20	0.016	2.53	5.3	15.8	15.8	3.44	5.78	2.96	7.21
PIPE D1.5								210	20	0.02	2.83	1.2						
D1.1-D1.5	D1.5A	16.69	0.488	0.627									22.6	22.6	2.91	4.88	23.68	51.07
PIPE C2.9-D1.5								760	20	0.01	2.00	6.3						
C2.6-C2.9,D1.1-D1.5	**D1.5B**	**32.40**	**0.454**	**0.602**									**32.0**	**32.0**	**2.38**	**4.00**	**35.06**	**78.01**

					Overland Flow			Channel flow										
			C					CHANNEL	CONVEYANCE		SCS (2)		TOTAL	TOTAL	INTENSITY (5)		PEAK FLOW	
BASIN	DESIGN POINT	AREA (AC)	5-YEAR	100-YEAR	LENGTH (FT)	SLOPE (FT/FT)	Tco (1) (MIN)	LENGTH (FT)	COEFFICIENT C	SLOPE (FT/FT)	VELOCITY (FT/S)	Tt (3) (MIN)	Tc (4) (MIN)	Tc (4) (MIN)	5-YR (IN/HR)	100-YR (IN/HR)	Q5 (6) (CFS)	Q100 (6) (CFS)
PHASE 2																		
D2		44.58	0.341	0.523	100	0.020	11.0	1750	20	0.011	2.10	13.9	24.9	24.9	2.76	4.63	41.94	107.95
Tc C2.5C TO DP-D2B								2450	15	0.01	1.50	27.2						
C2.6-C2.8,D1.1-D1.6,D2	D2A	76.98	0.389	0.556									62.6	62.6	1.38	2.31	41.25	98.87
C2,C3,D	**D2B**	**113.16**	**0.329**	**0.516**									62.6	**62.6**	**1.38**	**2.31**	**51.29**	**134.88**
C4	**C4**	**72.81**	**0.331**	**0.516**	**100**	**0.020**	**11.2**	**3000**	**20**	**0.011**	**2.10**	**23.8**	**35.0**	**35.0**	**2.25**	**3.77**	**54.21**	**141.81**
E	**E**	**2.37**	**0.114**	**0.372**			**0.0**	**1450**	**15**	**0.0083**	**1.37**	**17.7**	**17.7**	**17.7**	**3.27**	**5.50**	**0.88**	**4.85**

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 B2

HYDROLOGIC CALCULATIONS (SCS METHOD)

TABLE 5-4
RUNOFF CURVE NUMBERS FOR HYDROLOGIC SOIL
COVER COMPLEXES - RURAL CONDITIONS
(Antecedent Moisture Condition II, and Ia = 0.2 S)
(From: U.S. Dept. of Agriculture,
Soil Conservation Service, 1977)

Land Use	Cover Treatment or Practice	Hydrologic Condition	Runoff Curve Number by Hydrologic Soil Group A	B	C	D
Fallow	Straight Row	----	77	86	91	94
Row Crops	Straight Row	Poor	72	81	88	91
	Straight Row	Good	67	78	85	89
	Contoured	Poor	70	79	84	88
	Contoured	Good	65	75	82	86
	Cont. & Terraced	Poor	66	74	80	82
	Cont. & Terraced	Good	62	71	78	81
Small Grain	Straight Row	Poor	65	76	84	88
	Straight Row	Good	63	75	83	87
	Contoured	Poor	63	74	82	85
	Contoured	Good	61	73	81	84
	Cont. & Terraced	Poor	61	72	79	82
	Cont. & Terraced	Good	59	70	78	81
Close-seeded legumes 1/ or rotation meadow	Straight Row	Poor	66	77	85	89
	Straight Row	Good	58	72	81	85
	Contoured	Poor	64	75	83	85
	Contoured	Good	55	69	78	83
	Cont. & Terraced	Poor	63	73	80	83
	Cont. & Terraced	Good	51	67	76	80
Pasture or range		Poor	68	79	86	89
		Fair	49	69	79	84
		Good	39	61	74	80
	Contoured	Poor	47	67	81	88
	Contoured	Fair	25	59	75	83
	Contoured	Good	6	35	70	79
Meadow		Good	30	58	71	78
Woods		Poor	45	66	77	83
		Fair	36	60	73	79
		Good	25	55	70	77
Farmsteads		----	59	74	82	86
Roads (dirt) 2/		----	72	82	87	89
(hard surface) 2/		----	74	84	90	92

1/ Close-drilled or broadcast
2/ Including right-of-way

TABLE 5-5
RUNOFF CURVE NUMBERS FOR HYDROLOGIC SOIL COVER COMPLEXES - URBAN AND SUBURBAN CONDITIONS 1/
(Antecedent Moisture Condition II)
(From: U.S. Dept. of Agriculture, Soil Conservation Service, 1977)

Land Use		Hydrologic Soil Group A	B	C	D
Open spaces, lawns, parks, golf courses, cemeteries, etc.					
Good condition:	grass cover on 75% or more of the area	39*	61	74	80
Fair condition:	grass cover on 50% to 75% of the area	49*	69	79	84
Commercial and Business areas (85% Impervious)		89*	92	94	95
Industrial Districts 72% Impervious)		81*	88	91	93
Residential: 2/					
Acres per Dwelling Unit	Average % Impervious 3/				
1/8 acre or less <1/4-1/8 ac lots	65	77*	85 80	90	92
1/4 acre	38	61*	75	83	87
1/3 acre	30	57*	72	81	86
1/2 acre	25	54*	70	80	85
1 acre	20	51*	68	79	84
Paved parking lots, roofs, driveways, etc.		98	98	98	98
Streets and Roads:					
paved with curbs and storm sewers		98	98	98	98
gravel		76*	85	89	91
dirt		72*	82	87	89

1/ For a more detailed description of agricultural land use curve numbers, refer to the National Engineering Handbook (U.S. Dept. of Agriculture, Soil Conservation Service, 1972).
2/ Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.
3/ The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

* Not to be used wherever overlot grading or filling is to occur.

ELLICOTT TOWN CENTER
COMPOSITE RUNOFF CURVE NUMBERS

DEVELOPED CONDITIONS
CN-VALUES

BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	CN	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	CN	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	CN	WEIGHTED CN-VALUE
OA2	15.1	15.1	MEADOW	61							61.000
OA1	66.8	66.8	MEADOW	61							61.000
A	60.0	43.6	RESIDENTIAL	80	16.4	OPEN SPACE	61				74.805
OA2,OA1, A	141.9										66.836
EC12	30.3	30.3	MEADOW	61							61.000
OB1	33.7	33.7	MEADOW	61							61.000
B1	97.0	67.0	RESIDENTIAL	80	20.0	COMMERCIAL	92	10.0	OPEN SPACE	61	80.516
B2	77.4	69.5	RESIDENTIAL	80	7.9	OPEN SPACE	61				78.061
EC12,OB1,B1,B2	238.4										74.479
BB	20.3	18.3	RESIDENTIAL	80	2.0	OPEN SPACE	61				78.128
B3	59.1	50.7	RESIDENTIAL	80	8.4	OPEN SPACE	61				77.299
EC12,OB1,B1,B2	317.8										75.236
B4	4.5	4.5	RESIDENTIAL	80							80.000
EC11	353.6	353.6	MEADOW	61							61.000
C1.2	7.97	8.0	COMMERCIAL	92							92.000
C1.7A	0.58	0.6	SF LOTS (1/6-AC)	80							80.000
C1.7B	4.34	4.3	COMMERCIAL	92							92.000
C1.7A,C1.7B	4.92										90.585
C1.2,C1.7	12.89										91.460
C1.3	3.02	3.0	SF LOTS (1/6-AC)	80							80.000
C1.2,C1.3,C1.7	15.91										89.285
C1.4	3.23	3.2	SF LOTS (1/6-AC)	80							80.000
C1.2-C1.4,C1.7	19.14										87.718
C1.5	3.18	3.2	SF LOTS (1/6-AC)	80							80.000
C1.2-C1.5,C1.7	22.32										86.618
C1.1	9.38	3.0	RESIDENTIAL	80	1.2	COMMERCIAL	92	5.2	OPEN SPACE	61	71.010
C1.6	1.98	2.0	SF LOTS (1/6-AC)	80							80.000
C1.1,C1.6	11.36										72.577
C1.1-C1.7	33.68										81.882
C1.8	3.89	3.9	SF LOTS (1/6-AC)	80							80.000
C1.9	3.60	3.6	SF LOTS (1/6-AC)	80							80.000
C1.8-C1.9	7.49										80.000
C1.1-C1.9	41.17										81.540
C1.10	1.82	1.8	SF LOTS (1/6-AC)	80							80.000
C1.1-C1.10	42.99										81.475
EC11,C1.1-C1.10	396.59										63.219

C2.1	5.59	1.8	RESIDENTIAL	80	0.9	COMMERCIAL	92	2.9	OPEN SPACE	61	72.220
C2.2	4.03	4.0	SF LOTS (1/6-AC)	80							80.000
C2.3	2.76	2.8	SF LOTS (1/6-AC)	80							80.000
C2.1-C2.3	12.38										76.487
C2.4	4.98	5.0	SF LOTS (1/6-AC)	80							80.000
C2.5	4.12	4.1	SF LOTS (1/6-AC)	80							80.000
C2.1-C2.5	21.48										77.975
EC11,C1.1-C2.5	418.07										63.978
C2.6	2.76	2.2	SF LOTS (1/6-AC)	80	0.6	COMMERCIAL	92				82.609
C2.7	2.14	2.1	COMMERCIAL	92							92.000
C2.8	3.00	1.7	SF LOTS (1/6-AC)	80	1.4	COMMERCIAL	92				85.400
C2.6-C2.8	7.90										86.213
D1.2	2.99	1.6	SF LOTS (1/6-AC)	80	1.4	COMMERCIAL	92				85.418
C2.6-C2.8,D1.2	10.89										85.994
D1.1	3.60	3.6	COMMERCIAL	92							92.000
D1.3	2.87	1.6	SF LOTS (1/6-AC)	80	1.3	COMMERCIAL	92				85.394
C2.6-C2.8,D1.1-D1.3	17.36										87.141
D1.4	4.19	4.2	SF LOTS (1/6-AC)	80							80.000
D1.5	5.09	5.1	SF LOTS (1/6-AC)	80							80.000
D1.6	3.33	3.3	SF LOTS (1/6-AC)	80							80.000
C2.6-C2.8,D1.1-D1.6	29.97										84.136
C3	20.25	20.3	PARK / MEADOW	61							61.000
D2	44.58	39.5	MDR-RESIDENTIAL	80	5.1	LANDSCAPE/OS	61				77.826
C2.6-C2.8,D1.1-D1.6,D2	94.80										76.227
C2,C3,D	116.28										76.550
C1-C3,D	159.27										77.879
EC11,C1-C3,D	512.9										66.242
EC10	317.3	317.3	MEADOW	61							61.000
E	2.4	0.3	RESIDENTIAL	80	2.1	OPEN SPACE	61				63.165
EC10,E	319.7										61.016
C4	72.8	61.9	MDR-RESIDENTIAL	80	10.9	LANDSCAPE/OS	61				77.150

EC11
D
DP5
EC10
E
DP6

HEC-HMS 4.3 [G:\jpsprojects\030502.etc\ETC_H\ETC_H.hms]

File Edit View Components GIS Parameters Compute Results Tools Help

--None Selected-- | Run: Run 2

- Reach-E
- E
- DP6
- D
- DP5
- EC11
- Reach-D
- Meteorologic Models
  - Met 1
    - Hypothetical Storm
  - Met 2
    - Hypothetical Storm
- Control Specifications
  - Control 1

Components | Compute | Results

Hypothetical Storm

Met Name: Met 2

Method: SCS Type 2

*Point Depth (IN) 2.6

Area Reduction: --None--

Global Summary Results for Run "Run 2"

Project: ETC-H Simulation Run: Run 2

Start of Run: 01Jan3000, 01:00 Basin Model: Basin 1
End of Run: 02Jan3000, 01:30 Meteorologic Model: Met 2
Compute Time: 10Sep2019, 20:56:08 Control Specifications: Control 1

Show Elements: All Elements Volume Units: IN AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
D	0.24	20.3	01Jan3000, 13:13	3.5
Reach-D	0.55	24.4	01Jan3000, 14:07	7.8
EC11	0.55	24.4	01Jan3000, 13:52	7.9
DP5	0.79	30.6	01Jan3000, 14:04	11.3
E	0.01	1.4	01Jan3000, 13:03	0.1
Reach-E	0.50	18.9	01Jan3000, 14:19	7.0
EC10	0.50	18.9	01Jan3000, 14:13	7.1
DP6	0.51	19.1	01Jan3000, 14:18	7.2

```
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 15301: Began computing simulation run "Run 1" at time 10Sep2019, 20:55:48.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40040: The basin model contains 2 outlets: DP5, DP6
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "D" is 0.2002.
NOTE 41743: Initial abstraction ratio for subbasin "EC11" is 0.2002.
NOTE 41743: Initial abstraction ratio for subbasin "E" is 0.2002.
NOTE 41743: Initial abstraction ratio for subbasin "EC10" is 0.2002.
NOTE 42413: Unit hydrograph volume for subbasin "D" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "EC11" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "E" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "EC10" is 1.0000 in.
NOTE 15302: Finished computing simulation run "Run 1" at time 10Sep2019, 20:55:49.
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 15301: Began computing simulation run "Run 2" at time 10Sep2019, 20:56:08.
NOTE 20364: Found no parameter problems in meteorologic model "Met 2".
NOTE 40040: The basin model contains 2 outlets: DP5, DP6
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "D" is 0.2002.
NOTE 41743: Initial abstraction ratio for subbasin "EC11" is 0.2002.
NOTE 41743: Initial abstraction ratio for subbasin "E" is 0.2002.
NOTE 41743: Initial abstraction ratio for subbasin "EC10" is 0.2002.
NOTE 42413: Unit hydrograph volume for subbasin "D" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "EC11" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "E" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "EC10" is 1.0000 in.
```

HEC-HMS 4.3 [G:\jpsprojects\030502.etc\ETC_H\ETC_H.hms]

File Edit View Components GIS Parameters Compute Results Tools Help

--None Selected-- | Run: Run 2

- Reach-E
- E
- DP6
- D
- DP5
- EC11
- Reach-D
- Meteorologic Models
  - Met 1
    - Hypothetical Storm
  - Met 2
    - Hypothetical Storm
- Control Specifications
  - Control 1

Components | Compute | Results

Hypothetical Storm

Met Name: Met 1

Method: SCS Type 2

*Point Depth (IN) 4.4

Area Reduction: --None--

Global Summary Results for Run "Run 1"

Project: ETC-H Simulation Run: Run 1

Start of Run: 01Jan3000, 01:00
End of Run: 02Jan3000, 01:30
Compute Time: DATA CHANGED, RECOMPUTE

Basin Model: Basin 1
Meteorologic Model: Met 1
Control Specifications: Control 1

Show Elements: All Elements

Volume Units: IN AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
D	0.24	141.5	01Jan3000, 13:10	14.0
Reach-D	0.55	149.5	01Jan3000, 14:01	31.4
EC11	0.55	149.5	01Jan3000, 13:46	31.6
DP5	0.79	174.9	01Jan3000, 13:59	45.3
E	0.01	9.1	01Jan3000, 13:01	0.6
Reach-E	0.50	110.6	01Jan3000, 14:10	28.4
EC10	0.50	110.6	01Jan3000, 14:04	28.5
DP6	0.51	111.4	01Jan3000, 14:10	29.0

```
NOTE 41743: Initial abstraction ratio for subbasin "EC10" is 0.2002.
NOTE 42413: Unit hydrograph volume for subbasin "D" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "EC11" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "E" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "EC10" is 1.0000 in.
NOTE 15302: Finished computing simulation run "Run 2" at time 09Sep2019, 20:31:27.
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 10022: Begin copying project "ETC-H" to directory "G:\jpsprojects\030502.etc\ETC_H" at time 09Sep2019, 23:13:38.
ERROR 10015: Project name "ETC_H" is already in use. Could not copy current project.
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 15301: Began computing simulation run "Run 2" at time 10Sep2019, 20:39:40.
NOTE 20364: Found no parameter problems in meteorologic model "Met 2".
NOTE 40040: The basin model contains 2 outlets: DP5, DP6
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "D" is 0.2002.
NOTE 41743: Initial abstraction ratio for subbasin "EC11" is 0.2002.
NOTE 41743: Initial abstraction ratio for subbasin "E" is 0.2002.
NOTE 41743: Initial abstraction ratio for subbasin "EC10" is 0.2002.
NOTE 42413: Unit hydrograph volume for subbasin "D" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "EC11" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "E" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "EC10" is 1.0000 in.
NOTE 15302: Finished computing simulation run "Run 2" at time 10Sep2019, 20:39:42.
```

HEC-HMS 4.3 [G:\jpsprojects\030502.etc\ETC_D\ETC_D.hms]

File Edit View Components GIS Parameters Compute Results Tools Help

--None Selected-- | Run: Run 2

- Basin 1
  - C1-C3,D
  - Reach-D
  - EC11
  - DP5
  - E
  - Reach-E
  - EC10
  - DP6
- Meteorologic Models
  - Met 1
    - Hypothetical Storm
  - Met 2
    - Hypothetical Storm

Components | Compute | Results

Hypothetical Storm

Met Name: Met 2

Method: SCS Type 2

*Point Depth (IN) 2.6

Area Reduction: --None--

Global Summary Results for Run "Run 2"

Project: ETC_D Simulation Run: Run 2

Start of Run: 01Jan3000, 01:00 Basin Model: Basin 1
End of Run: 02Jan3000, 01:30 Meteorologic Model: Met 2
Compute Time: 10Sep2019, 21:18:23 Control Specifications: Control 1

Show Elements: All Elements Volume Units: IN AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
EC11	0.55	24.4	01Jan3000, 13:52	7.9
Reach-D	0.55	24.4	01Jan3000, 14:07	7.8
C1-C3,D	0.25	225.0	01Jan3000, 13:08	21.6
DP5	0.80	226.6	01Jan3000, 13:08	29.4
EC10	0.50	18.9	01Jan3000, 14:13	7.1
Reach-E	0.50	18.9	01Jan3000, 14:19	7.0
E	0.00	0.9	01Jan3000, 13:04	0.1
DP6	0.50	19.0	01Jan3000, 14:18	7.1

```
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 15301: Began computing simulation run "Run 1" at time 10Sep2019, 21:12:10.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40040: The basin model contains 2 outlets: DP5, DP6
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "EC11" is 0.2002.
NOTE 41743: Initial abstraction ratio for subbasin "C1-C3,D" is 0.2007.
NOTE 41743: Initial abstraction ratio for subbasin "EC10" is 0.2002.
NOTE 41743: Initial abstraction ratio for subbasin "E" is 0.2006.
NOTE 42413: Unit hydrograph volume for subbasin "EC11" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "C1-C3,D" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "EC10" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "E" is 1.0000 in.
NOTE 15302: Finished computing simulation run "Run 1" at time 10Sep2019, 21:12:11.
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 15301: Began computing simulation run "Run 2" at time 10Sep2019, 21:18:23.
NOTE 20364: Found no parameter problems in meteorologic model "Met 2".
NOTE 40040: The basin model contains 2 outlets: DP5, DP6
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "EC11" is 0.2002.
NOTE 41743: Initial abstraction ratio for subbasin "C1-C3,D" is 0.2007.
NOTE 41743: Initial abstraction ratio for subbasin "EC10" is 0.2002.
NOTE 41743: Initial abstraction ratio for subbasin "E" is 0.2006.
NOTE 42413: Unit hydrograph volume for subbasin "EC11" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "C1-C3,D" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "EC10" is 1.0000 in.
```

HEC-HMS 4.3 [G:\jpsprojects\030502.etc\ETC_D\ETC_D.hms]

File Edit View Components GIS Parameters Compute Results Tools Help

--None Selected-- Run: Run 1

- Basin Models
  - Basin 1
    - C1-C3,D
    - Reach-D
    - EC11
    - DP5
    - E
    - Reach-E
    - EC10
    - DP6
- Meteorologic Models
  - Met 1
    - Hypothetical Storm

Components Compute Results

Hypothetical Storm

Met Name: Met 1

Method: SCS Type 2

*Point Depth (IN) 4.4

Area Reduction: --None--

Global Summary Results for Run "Run 1"

Project: ETC_D Simulation Run: Run 1

Start of Run: 01Jan3000, 01:00 Basin Model: Basin 1
End of Run: 02Jan3000, 01:30 Meteorologic Model: Met 1
Compute Time: 10Sep2019, 21:12:10 Control Specifications: Control 1

Show Elements: All Elements Volume Units: IN AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
EC11	0.55	149.5	01Jan3000, 13:46	31.6
Reach-D	0.55	149.5	01Jan3000, 14:01	31.4
C1-C3,D	0.25	456.3	01Jan3000, 13:08	42.3
DP5	0.80	461.4	01Jan3000, 13:08	73.7
EC10	0.50	110.6	01Jan3000, 14:04	28.5
Reach-E	0.50	110.6	01Jan3000, 14:10	28.4
E	0.00	4.0	01Jan3000, 13:02	0.3
DP6	0.50	111.0	01Jan3000, 14:10	28.7

```
NOTE 42413: Unit hydrograph volume for subbasin "D" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "EC11" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "E" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "EC10" is 1.0000 in.
NOTE 15302: Finished computing simulation run "Run 2" at time 10Sep2019, 20:56:09.
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 10022: Begin copying project "ETC-H" to directory "G:\jpsprojects\030502.etc\ETC_D" at time 10Sep2019, 21:04:34.
NOTE 10187: Closed project "ETC-H" at time 10Sep2019, 21:04:35.
NOTE 10023: Finished copying project "ETC_D" to directory "G:\jpsprojects\030502.etc\ETC_D" at time 10Sep2019, 21:04:36.
NOTE 10181: Opened control specifications "Control 1" at time 10Sep2019, 21:05:25.
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 40043: The basin model "Basin 1" contains 2 elements with no downstream connection: DP5, DP6
NOTE 15301: Began computing simulation run "Run 1" at time 10Sep2019, 21:12:10.
NOTE 20364: Found no parameter problems in meteorologic model "Met 1".
NOTE 40040: The basin model contains 2 outlets: DP5, DP6
NOTE 40049: Found no parameter problems in basin model "Basin 1".
NOTE 41743: Initial abstraction ratio for subbasin "EC11" is 0.2002.
NOTE 41743: Initial abstraction ratio for subbasin "C1-C3,D" is 0.2007.
NOTE 41743: Initial abstraction ratio for subbasin "EC10" is 0.2002.
NOTE 41743: Initial abstraction ratio for subbasin "E" is 0.2006.
NOTE 42413: Unit hydrograph volume for subbasin "EC11" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "C1-C3,D" is 1.0000 in.
NOTE 42413: Unit hydrograph volume for subbasin "EC10" is 1.0000 in.
```

MAYBERRY, COLORADO SPRINGS (fka "ELLICOTT TOWN CENTER")

HISTORIC FLOWS

BASIN	DESIGN POINT	AREA (AC)	AREA (SM)	RUNOFF COEFFICIENT (C5)	CURVE No. (CN)	S	Ia	PERCENT IMPERVIOUS (%)	Overland Flow LENGTH (FT)	Overland Flow SLOPE (%)	Overland Flow Tco (1) (MIN)	Channel flow HIGH ELEV. (FT)	Channel flow LOW ELEV. (FT)	Channel flow H (FT)	Channel flow CHANNEL LENGTH (FT)	Channel flow CHANNEL LENGTH (MI)	Channel flow SLOPE (%)	Channel flow Tt (1) (MIN)	Time of Concentration Tc (2) (MIN)	Total Lag Time Tl (2) (HR)	Total Lag Time Tl (2) (MIN)	Peak Flow SCS Q5 (3) (CFS)	Peak Flow SCS Q100 (3) (CFS)
EC11	EC11	353.6	0.55	0.08	61	6.39	1.28	2	1000	6.0	32.0	6180	6067	113	8945	1.69	1.3%	46.37	78.34	0.78	47.00	24.4	149.5
D		154.6	0.24	0.08	61	6.39	1.28	2			0.0	6067	6028	39	3850	0.73	1.0%	26.38	26.38	0.26	15.83	20.3	141.5
EC11,D	5	508.2	0.79																104.72	1.05	62.83	**30.6**	**174.9**
EC10	EC10	317.3	0.50	0.08	61	6.39	1.28	2	1000	1.0	58.1	6140	6052	88	8100	1.53	1.1%	45.53	103.59	1.04	62.15	18.9	110.6
E		7.4	0.01	0.08	61	6.39	1.28	2			0.0	6052	6040	12	1200	0.23	1.0%	10.80	10.80	0.11	6.48	1.4	9.1
EC10,E	6	324.74	0.51																114.39	1.14	68.63	**19.1**	**111.4**

DEVELOPED FLOWS

BASIN	DESIGN POINT	AREA (AC)	AREA (SM)	RUNOFF COEFFICIENT (C5)	CURVE No. (CN)	S	Ia	PERCENT IMPERVIOUS (%)	Overland Flow LENGTH (FT)	Overland Flow SLOPE (%)	Overland Flow Tco (1) (MIN)	Channel flow HIGH ELEV. (FT)	Channel flow LOW ELEV. (FT)	Channel flow H (FT)	Channel flow CHANNEL LENGTH (FT)	Channel flow CHANNEL LENGTH (MI)	Channel flow SLOPE (%)	Channel flow Tt (1) (MIN)	Time of Concentration Tc (2) (MIN)	Total Lag Time Tl (2) (HR)	Total Lag Time Tl (2) (MIN)	Peak Flow SCS Q5 (3) (CFS)	Peak Flow SCS Q100 (3) (CFS)
EC11	EC11	353.6	0.55	0.08	61	6.39	1.28	2	1000	6.0	32.0	6180	6067	113	8945	1.69	1.3%	46.37	78.34	0.78	47.00	24.4	149.5
C1-C3,D		159.3	0.25	0.331	77.879	2.84	0.57	44.2			0.0	6067	6028	39	3850	0.73	1.0%	26.38	26.38	0.26	15.83	225.0	456.3
EC11,D	5	512.87	0.80																104.72	1.05	62.83	226.6	461.4
EC10	EC10	317.3	0.50	0.08	61	6.39	1.28	2	1000	1.0	58.1	6140	6052	88	8100	1.53	1.1%	45.53	103.59	1.04	62.15	18.9	110.6
E		2.4	0.00	0.114	63.165	5.83	1.17	6.0			0.0	6052	6040	12	1450	0.27	0.8%	13.44	13.44	0.13	8.07	0.9	4.0
EC10,E	6	319.67	0.50																117.03	1.17	70.22	**19.0**	**111.0**

DETAINED FLOWS

BASIN	DESIGN POINT	AREA (AC)	AREA (SM)	RUNOFF COEFFICIENT (C5)	CURVE No. (CN)	S	Ia	PERCENT IMPERVIOUS (%)	Overland Flow LENGTH (FT)	Overland Flow SLOPE (%)	Overland Flow Tco (1) (MIN)	Channel flow HIGH ELEV. (FT)	Channel flow LOW ELEV. (FT)	Channel flow H (FT)	Channel flow CHANNEL LENGTH (FT)	Channel flow CHANNEL LENGTH (MI)	Channel flow SLOPE (%)	Channel flow Tt (1) (MIN)	Time of Concentration Tc (2) (MIN)	Total Lag Time Tl (2) (HR)	Total Lag Time Tl (2) (MIN)	Peak Flow SCS Q5 (3) (CFS)	Peak Flow SCS Q100 (3) (CFS)
EC11	EC11	353.6	0.55	0.08	61	6.39	1.28	2	1000	6.0	32.0	6180	6067	113	8945	1.69	1.3%	46.37	78.34	0.78	47.00	24.4	149.5
CULVERT EC11												6180	6067	113	8945	1.69	1.3%	46.37	46.37	0.46	27.82		
C (C1.1-C1.10)	C1.10A	44.8	0.07	0.375	81.4	2.29	0.46	51.7											35.9	0.36	21.54		
POND C1 DISCHARGE		44.8	0.07																			**1.0**	**13.3**
CHANNEL C1												6048	6028	20	2800	0.53	0.7%	23.61	23.61	0.24	14.17		
REACH EC11												6180	6028	152	11745	2.22	1.3%	56.66	56.66	0.57	34.00		
C2,C3,D		113.2	0.18	0.329	58.2	7.18	1.44	43.1											62.6	0.63	37.56		
POND D DISCHARGE		113.2	0.18																			**1.7**	**11.4**
EC11,C,D - DETAINED	5d	511.6	0.80																			**27.1**	**174.2**

* Tc from Rational Method Calculation Spreadsheet
** Pond Discharge Flows from MHFD-Detention Calculations

1) OVERLAND FLOW Tco = (1.8*(1.1-RUNOFF COEFFICIENT)*(OVERLAND FLOW LENGTH^(0.5)/(SLOPE^(0.333))
2) TRAVEL TIME, Tt = ((11.9*L^3)/H)^(0.385)
3) Tc = Tco + Tt
4) SCS LAG TIME, Tl = 0.6 * Tt
5) PEAK FLOWS CALCULATED BY HEC-HMS 4.3 (TYPE 2 STORM; 5-YR; 24-HR RAINFALL = 2.6 IN; 100-YR; 24-HR RAINFALL = 4.4 IN

APPENDIX C

DETENTION POND CALCULATIONS

MAYBERRY, COLORADO SPRINGS (ELLICOTT TOWN CENTER)
IMPERVIOUS AREA CALCULATIONS

DEVELOPED CONDITIONS

BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	IMP. AREA (%)	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	IMP. AREA (%)	(AC)	SUB-AREA 3 DEVELOPMENT COVER	IMP. AREA (%)	WEIGHTED IMP. AREA (%)
A1A	2.80	0.9	ROADWAY	100	1.9	GRASS	0				33.571
C1.2	7.97	8.0	COMMERCIAL	70							70.000
C1.7A	0.58	0.6	SF LOTS (1/6-AC)	52.5							52.500
C1.7B	4.34	4.3	COMMERCIAL	70							70.000
C1.7A,C1.7B	4.92										67.937
C1.2,C1.7	12.89										69.213
C1.3	3.02	3.0	SF LOTS (1/6-AC)	52.5							52.500
C1.2,C1.3,C1.7	15.91										66.040
C1.4	3.23	3.2	SF LOTS (1/6-AC)	52.5							52.500
C1.2-C1.4,C1.7	19.14										63.755
C1.5	3.18	3.2	SF LOTS (1/6-AC)	52.5							52.500
C1.2-C1.5,C1.7	22.32										62.152
C1.1	9.38	3.0	RESIDENTIAL	52.5	1.2	COMMERCIAL	70	5.2	OPEN SPACE	0	25.672
C1.6	3.01	3.0	SF LOTS (1/6-AC)	52.5							52.500
C1.1,C1.6	12.39										32.189
C1.1-C1.7	34.71										51.456
C1.8	3.89	3.9	SF LOTS (1/6-AC)	52.5							52.500
C1.9	4.39	4.4	SF LOTS (1/6-AC)	52.5							52.500
C1.8-C1.9	8.28										52.500
C1.1-C1.9	42.99										51.657
C1.10	1.82	1.8	SF LOTS (1/6-AC)	52.5							52.500
C1.1-C1.10	**44.81**										**51.692**
C2.1	2.55	1.6	SF LOTS (1/6-AC)	52.5	1.0	OPEN SPACE	0				31.912
C2.2	1.99	2.0	SF LOTS (1/6-AC)	52.5							52.500
C2.1-C2.2	4.54										40.936
C2.3	3.01	3.0	SF LOTS (1/6-AC)	52.5							52.500
C2.4	2.11	2.1	SF LOTS (1/6-AC)	52.5							52.500
C2.5	6.27	6.3	SF LOTS (1/6-AC)	52.5							52.500
C2.1-C2.5	15.93										49.204
C3	20.25	20.3	PARK / OS	0							0.000
C2.1-C2.5,C3	36.18										21.665
C2.6	3.67	3.0	SF LOTS (1/6-AC)	52.5	0.7	LANDSCAPE / OS	0				42.486
C2.7	2.14	2.1	COMM / LT INDUSTRIAL	80							80.000
C2.8A	3.11	1.8	SF LOTS (1/6-AC)	52.5	1.4	COMM / LT INDUSTRIAL	80				64.437
C2.6-C2.8A	8.92										59.140
C2.8B	1.40	1.4	SF LOTS (1/6-AC)	52.5							52.500
C2.6-C2.8B	10.32										58.239
C2.9	5.39	4.9	SF LOTS (1/6-AC)	52.5	0.5	COMM / LT INDUSTRIAL	80				55.051
C2.6-C2.9	15.71										57.145

D1.1	4.89	4.9	COMM / LT INDUSTRIAL	80							80.000
D1.2	2.62	2.6	COMM / LT INDUSTRIAL	80							80.000
D1.1,D1.2	7.51										80.000
D1.3	3.82	2.5	SF LOTS (1/6-AC)	52.5	1.3	COMM / LT INDUSTRIAL	80				61.859
D1.1-D1.3	11.33										73.883
D1.4	3.07	3.1	SF LOTS (1/6-AC)	52.5							52.500
D1.1-D1.4	14.40										69.325
D1.5	2.29	2.3	SF LOTS (1/6-AC)	52.5							52.500
D1.1-D1.5	16.69										67.016
C2.6-C2.9,D1.1-D1.5	32.40										62.230
D2	44.58	39.5	SF LOTS (1/6-AC)	52.5	5.1	LANDSCAPE/OS	0				46.494
C2.6-C2.8,D1.1-D1.6,D2	76.98										53.117
C2,C3,D	**113.16**										**43.061**
C1-C3,D	**157.97**										**45.509**
C4	**72.81**	61.9	MDR-RESIDENTIAL	52.5	10.9	LANDSCAPE/OS	0				**44.625**
E	2.4	0.3	MDR-RESIDENTIAL	52.5	2.1	OPEN SPACE	0				5.981

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **Mayberry, Colorado Springs**

Basin ID: **Detention Basin C1**

Further review of the pond will be provided at the final plat stage.

Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	44.81	acres
Watershed Length =	2,660	ft
Watershed Length to Centroid =	1,330	ft
Watershed Slope =	0.010	ft/ft
Watershed Imperviousness =	51.69%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.788	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	2.696	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	2.026	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.688	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	3.218	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	4.035	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	4.833	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	5.841	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	8.027	acre-feet	3.14	inches
Approximate 2-yr Detention Volume =	1.736	acre-feet		
Approximate 5-yr Detention Volume =	2.283	acre-feet		
Approximate 10-yr Detention Volume =	2.782	acre-feet		
Approximate 25-yr Detention Volume =	3.396	acre-feet		
Approximate 50-yr Detention Volume =	3.784	acre-feet		
Approximate 100-yr Detention Volume =	4.247	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.788	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.908	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.552	acre-feet
Total Detention Basin Volume =	4.247	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=6048.0	--	0.50	--	--	--	22,288	0.512	5,573	0.128
	--	2.50	--	--	--	27,421	0.629	55,282	1.269
	--	4.50	--	--	--	33,080	0.759	115,783	2.658
Spillway=6054.1	--	6.60	--	--	--	39,185	0.900	191,661	4.400
Top EL=6056.1	--	8.60	--	--	--	45,300	1.040	276,146	6.339
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DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Mayberry, Colorado Springs**

Basin ID: **Detention Basin C1**

Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.71	0.788	Orifice Plate
Zone 2 (EURV)	4.55	1.908	Orifice Plate
Zone 3 (100-year)	6.43	1.552	Weir&Pipe (Restrict)
Total (all zones)		4.247	

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

Calculated Parameters for Underdrain

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)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	4.55	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	19.40	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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	1.52	3.03					
Orifice Area (sq. inches)	7.67	7.67	0.50					

	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 =	4.55	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	5.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	5.00	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 =	4.55	N/A	feet
Overflow Weir Slope Length =	5.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	15.40	N/A	
Overflow Grate Open Area w/o Debris =	17.40	N/A	ft^2
Overflow Grate Open Area w/ Debris =	8.70	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	15.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	13.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.13	N/A	ft^2
Outlet Orifice Centroid =	0.58	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.39	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	6.60	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.91	feet
Spillway Crest Length =	24.00	feet	Stage at Top of Freeboard =	8.51	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.03	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	6.25	acre-ft

Calculated Parameters for Spillway

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) =	0.788	2.696	2.026	2.688	3.218	4.035	4.833	5.841	8.027
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.026	2.688	3.218	4.035	4.833	5.841	8.027
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	0.4	0.6	5.3	10.6	17.6	32.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.01	0.01	0.12	0.24	0.39	0.73
Peak Inflow Q (cfs) =	N/A	N/A	21.5	28.4	33.7	47.1	57.9	71.1	98.3
Peak Outflow Q (cfs) =	0.4	1.0	0.8	1.0	4.4	11.6	12.3	13.3	46.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	2.4	7.7	2.2	1.2	0.8	1.4
Structure Controlling Flow =	Plate	Overflow Weir 1	Plate	Plate	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	0.6	0.6	0.7	0.7
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	64	58	65	67	65	64	63	59
Time to Drain 99% of Inflow Volume (hours) =	**40**	69	62	70	72	72	71	71	70
Maximum Ponding Depth (ft) =	1.71	4.55	3.42	4.30	4.77	5.11	5.68	6.57	7.16
Area at Maximum Ponding Depth (acres) =	0.58	0.76	0.69	0.75	0.78	0.80	0.84	0.90	0.94
Maximum Volume Stored (acre-ft) =	0.790	2.696	1.869	2.500	2.865	3.126	3.601	4.373	4.905

Please revise so that the outflow is less than or equal to predevelopment flow

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	0.62
	0:15:00	0.00	0.00	1.67	2.72	3.39	2.29	2.94	2.81	4.29
	0:20:00	0.00	0.00	6.65	8.93	10.61	6.78	8.02	8.47	11.32
	0:25:00	0.00	0.00	14.81	20.12	24.51	14.81	17.21	18.62	25.21
	0:30:00	0.00	0.00	20.35	27.31	32.74	32.46	39.75	45.49	63.54
	0:35:00	0.00	0.00	21.47	28.41	33.73	44.04	54.11	65.48	90.75
	0:40:00	0.00	0.00	20.60	26.77	31.55	47.11	57.89	71.13	98.31
	0:45:00	0.00	0.00	19.05	24.81	29.29	44.76	54.78	68.64	95.06
	0:50:00	0.00	0.00	17.54	23.09	27.07	41.99	51.19	64.18	89.32
	0:55:00	0.00	0.00	16.26	21.45	25.16	38.47	46.63	58.96	82.03
	1:00:00	0.00	0.00	15.23	20.03	23.58	35.21	42.49	54.35	75.63
	1:05:00	0.00	0.00	14.25	18.66	22.05	32.37	38.93	50.58	70.51
	1:10:00	0.00	0.00	13.00	17.32	20.54	29.44	35.28	45.61	63.41
	1:15:00	0.00	0.00	11.76	15.94	19.20	26.55	31.67	40.32	55.75
	1:20:00	0.00	0.00	10.76	14.70	17.93	23.64	28.05	34.94	48.06
	1:25:00	0.00	0.00	10.06	13.77	16.70	21.26	25.14	30.55	41.92
	1:30:00	0.00	0.00	9.50	13.02	15.54	19.27	22.74	27.18	37.16
	1:35:00	0.00	0.00	9.00	12.33	14.48	17.57	20.67	24.44	33.24
	1:40:00	0.00	0.00	8.51	11.42	13.49	16.01	18.78	21.98	29.74
	1:45:00	0.00	0.00	8.03	10.46	12.55	14.59	17.05	19.71	26.50
	1:50:00	0.00	0.00	7.55	9.52	11.64	13.23	15.39	17.54	23.42
	1:55:00	0.00	0.00	6.79	8.63	10.66	11.91	13.78	15.46	20.48
	2:00:00	0.00	0.00	5.95	7.71	9.51	10.64	12.24	13.50	17.74
	2:05:00	0.00	0.00	4.90	6.41	7.90	8.79	10.05	10.96	14.27
	2:10:00	0.00	0.00	3.94	5.15	6.37	6.89	7.80	8.38	10.80
	2:15:00	0.00	0.00	3.20	4.18	5.22	5.32	6.00	6.33	8.14
	2:20:00	0.00	0.00	2.64	3.46	4.33	4.24	4.77	4.94	6.33
	2:25:00	0.00	0.00	2.18	2.85	3.59	3.43	3.84	3.90	4.96
	2:30:00	0.00	0.00	1.79	2.35	2.96	2.78	3.11	3.09	3.90
	2:35:00	0.00	0.00	1.47	1.93	2.42	2.24	2.51	2.44	3.06
	2:40:00	0.00	0.00	1.19	1.57	1.95	1.80	2.01	1.91	2.37
	2:45:00	0.00	0.00	0.96	1.26	1.56	1.43	1.59	1.48	1.83
	2:50:00	0.00	0.00	0.78	1.00	1.25	1.13	1.26	1.17	1.43
	2:55:00	0.00	0.00	0.63	0.80	0.99	0.91	1.01	0.94	1.15
	3:00:00	0.00	0.00	0.51	0.63	0.79	0.72	0.80	0.75	0.93
	3:05:00	0.00	0.00	0.39	0.49	0.62	0.57	0.63	0.60	0.73
	3:10:00	0.00	0.00	0.30	0.37	0.47	0.43	0.48	0.46	0.56
	3:15:00	0.00	0.00	0.21	0.27	0.34	0.32	0.35	0.33	0.41
	3:20:00	0.00	0.00	0.14	0.18	0.24	0.22	0.25	0.23	0.28
	3:25:00	0.00	0.00	0.09	0.12	0.15	0.15	0.16	0.15	0.18
	3:30:00	0.00	0.00	0.05	0.07	0.08	0.08	0.09	0.08	0.10
	3:35:00	0.00	0.00	0.02	0.03	0.04	0.04	0.04	0.04	0.04
	3:40:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	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:	**April 15, 2021**
Project:	**Mayberry, Colorado Springs**
Location:	**Detention Basin C1**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 51.9 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.519
C) Contributing Watershed Area	Area = 44.810 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}= 0.790 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 = 100 %
ii) Percentage of Watershed consisting of Type B Soils	HSG_B = 0 %
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: $EURV_{C/D} = 1.20 * i^{1.08}$	$EURV_{DESIGN}$ = 2.710 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 = 2.0 : 1
3. Basin Side Slopes	
A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 4.00 ft / ft
4. Inlet	
A) Describe means of providing energy dissipation at concentrated inflow locations:	Concrete Forebay
5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.024 ac-ft
B) Actual Forebay Volume	V_F = 0.030 ac-ft
C) Forebay Depth (D_F = 30 inch maximum)	D_F = 30.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 90.60 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 1.81 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 = 7.7 in

Design Procedure Form: Extended Detention Basin (EDB)

Designer: JPS
Company: JPS
Date: April 15, 2021
Project: Mayberry, Colorado Springs
Location: Detention Basin C1

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 = 10 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} = 15.94 square inches
8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 6 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 103 cu ft
C) Initial Surcharge Provided Above Micropool	V_s= 5.0 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 558 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.)	*S.S. Well Screen with 60% Open Area*
Other (Y/N): N	
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} = 930 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 4.85 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 86.2 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: April 15, 2021
Project: Mayberry, Colorado Springs
Location: Detention Basin C1

10. Overflow Embankment A) Describe embankment protection for 100-year and greater overtopping:	Buried 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 sediment removal as required; Access ramp provided to pond bottom

Notes:

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: **Mayberry, Colorado Springs**

Basin ID: **Detention Basin D**

Example Zone Configuration (Retention Pond)

further review of the pond will be provided at the final plat stage.

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	113.16	acres
Watershed Length =	4,300	ft
Watershed Length to Centroid =	2,150	ft
Watershed Slope =	0.010	ft/ft
Watershed Imperviousness =	43.06%	percent
Percentage Hydrologic Soil Group A =	100.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

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

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	1.772	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	5.388	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	4.093	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	5.485	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	6.594	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	8.557	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	10.471	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	12.956	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	18.329	acre-feet	3.14	inches
Approximate 2-yr Detention Volume =	3.442	acre-feet		
Approximate 5-yr Detention Volume =	4.549	acre-feet		
Approximate 10-yr Detention Volume =	5.590	acre-feet		
Approximate 25-yr Detention Volume =	6.904	acre-feet		
Approximate 50-yr Detention Volume =	7.773	acre-feet		
Approximate 100-yr Detention Volume =	8.930	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.772	acre-feet
Zone 2 Volume (EURV - Zone 1) =	3.616	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	3.541	acre-feet
Total Detention Basin Volume =	8.930	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=6027.0	--	1.00	--	--	--	52,698	1.210	26,352	0.605
	--	3.00	--	--	--	60,656	1.392	139,706	3.207
	--	4.00	--	--	--	65,506	1.504	202,787	4.655
	--	6.00	--	--	--	80,128	1.839	348,421	7.999
Spillway=6034.0	--	8.00	--	--	--	99,874	2.293	528,423	12.131
Top EL=6036.0	--	10.00	--	--	--	115,000	2.640	743,297	17.064
	--		--	--	--				
	--		--	--	--				
	--		--	--	--			

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: **Mayberry, Colorado Springs**

Basin ID: **Detention Basin D**

Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.94	1.772	Orifice Plate
Zone 2 (EURV)	4.48	3.616	Orifice Plate
Zone 3 (100-year)	6.50	3.541	Weir&Pipe (Restrict)
Total (all zones)		8.930	

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

Calculated Parameters for Underdrain

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)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	4.48	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	17.70	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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)	14.63	11.00	0.50					

	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 =	5.50	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00	N/A	feet
Overflow Weir Grate Slope =	0.00	N/A	H:V
Horiz. Length of Weir Sides =	6.00	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 =	5.50	N/A	feet
Overflow Weir Slope Length =	6.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	28.36	N/A	
Overflow Grate Open Area w/o Debris =	25.06	N/A	ft^2
Overflow Grate Open Area w/ Debris =	12.53	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	9.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.88	N/A	ft^2
Outlet Orifice Centroid =	0.43	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.57	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.95	feet
Spillway Crest Length =	48.00	feet	Stage at Top of Freeboard =	9.95	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	2.63	acres
Freeboard above Max Water Surface =	1.00	feet	Basin Volume at Top of Freeboard =	16.93	acre-ft

Calculated Parameters for Spillway

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) =	1.772	5.388	4.093	5.485	6.594	8.557	10.471	12.956	18.329
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	4.093	5.485	6.594	8.557	10.471	12.956	18.329
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.5	1.0	1.4	12.8	25.8	43.0	80.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.01	0.01	0.11	0.23	0.38	0.71
Peak Inflow Q (cfs) =	N/A	N/A	38.0	50.7	60.7	89.4	112.7	143.2	204.2
Peak Outflow Q (cfs) =	0.9	1.7	1.4	1.7	1.8	9.9	10.6	11.4	67.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.7	1.3	0.8	0.4	0.3	0.8
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.3	0.3	0.4	0.4
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) =	39	68	60	69	76	81	81	81	78
Time to Drain 99% of Inflow Volume (hours) =	**41**	72	64	73	80	87	88	89	88
Maximum Ponding Depth (ft) =	1.94	4.48	3.42	4.31	4.98	5.86	6.62	7.66	8.52
Area at Maximum Ponding Depth (acres) =	1.30	1.58	1.44	1.56	1.67	1.81	1.98	2.22	2.38
Maximum Volume Stored (acre-ft) =	1.783	5.397	3.787	5.130	6.193	7.725	9.163	11.364	13.323

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	0.21	0.02	0.67
	0:15:00	0.00	0.00	1.79	2.92	3.64	2.46	3.30	3.05	5.05
	0:20:00	0.00	0.00	8.16	11.26	13.52	8.73	10.51	10.93	15.01
	0:25:00	0.00	0.00	20.03	27.67	33.90	20.25	23.88	25.85	35.51
	0:30:00	0.00	0.00	31.66	43.59	53.16	46.71	58.13	66.90	95.75
	0:35:00	0.00	0.00	37.27	50.43	60.74	73.99	93.43	113.61	162.58
	0:40:00	0.00	0.00	38.03	50.71	60.63	87.53	110.56	138.09	196.64
	0:45:00	0.00	0.00	36.31	48.02	57.12	89.38	112.73	143.23	204.16
	0:50:00	0.00	0.00	33.90	45.06	53.42	85.01	106.51	136.60	195.46
	0:55:00	0.00	0.00	31.73	42.34	50.07	79.53	99.22	127.65	183.34
	1:00:00	0.00	0.00	29.84	39.75	47.03	73.58	91.28	118.73	170.54
	1:05:00	0.00	0.00	28.41	37.73	44.83	68.03	84.04	110.52	159.06
	1:10:00	0.00	0.00	26.92	35.99	42.91	63.21	77.81	102.51	147.50
	1:15:00	0.00	0.00	25.15	34.08	40.94	58.68	71.92	93.84	134.49
	1:20:00	0.00	0.00	23.32	31.82	38.55	53.92	65.79	84.58	120.64
	1:25:00	0.00	0.00	21.53	29.49	35.70	49.03	59.54	75.21	106.73
	1:30:00	0.00	0.00	19.99	27.40	32.85	44.22	53.42	66.49	93.90
	1:35:00	0.00	0.00	18.85	25.88	30.72	39.67	47.65	58.61	82.53
	1:40:00	0.00	0.00	18.04	24.54	29.09	36.33	43.57	52.95	74.34
	1:45:00	0.00	0.00	17.36	23.12	27.67	33.73	40.35	48.59	67.87
	1:50:00	0.00	0.00	16.73	21.73	26.35	31.48	37.56	44.74	62.13
	1:55:00	0.00	0.00	15.82	20.41	25.01	29.40	34.96	41.22	56.89
	2:00:00	0.00	0.00	14.64	19.10	23.45	27.45	32.51	37.87	51.94
	2:05:00	0.00	0.00	13.13	17.28	21.15	24.84	29.31	33.86	46.18
	2:10:00	0.00	0.00	11.40	15.05	18.35	21.63	25.43	29.29	39.78
	2:15:00	0.00	0.00	9.74	12.83	15.57	18.40	21.54	24.77	33.48
	2:20:00	0.00	0.00	8.16	10.72	12.95	15.29	17.79	20.38	27.39
	2:25:00	0.00	0.00	6.71	8.80	10.61	12.46	14.38	16.35	21.75
	2:30:00	0.00	0.00	5.43	7.11	8.59	9.87	11.25	12.59	16.51
	2:35:00	0.00	0.00	4.39	5.73	7.02	7.61	8.52	9.26	12.04
	2:40:00	0.00	0.00	3.62	4.76	5.88	5.96	6.66	7.05	9.16
	2:45:00	0.00	0.00	3.03	4.01	4.95	4.80	5.35	5.55	7.15
	2:50:00	0.00	0.00	2.53	3.36	4.14	3.91	4.35	4.40	5.60
	2:55:00	0.00	0.00	2.12	2.80	3.45	3.18	3.53	3.49	4.38
	3:00:00	0.00	0.00	1.77	2.32	2.85	2.60	2.88	2.76	3.43
	3:05:00	0.00	0.00	1.48	1.92	2.36	2.12	2.34	2.19	2.69
	3:10:00	0.00	0.00	1.23	1.59	1.95	1.74	1.93	1.77	2.15
	3:15:00	0.00	0.00	1.02	1.30	1.59	1.43	1.57	1.44	1.76
	3:20:00	0.00	0.00	0.83	1.05	1.28	1.15	1.26	1.17	1.42
	3:25:00	0.00	0.00	0.66	0.83	1.02	0.91	1.00	0.94	1.13
	3:30:00	0.00	0.00	0.51	0.64	0.79	0.71	0.78	0.73	0.88
	3:35:00	0.00	0.00	0.38	0.48	0.60	0.54	0.59	0.55	0.65
	3:40:00	0.00	0.00	0.27	0.35	0.43	0.39	0.42	0.39	0.46
	3:45:00	0.00	0.00	0.18	0.24	0.29	0.27	0.29	0.26	0.31
	3:50:00	0.00	0.00	0.11	0.15	0.18	0.17	0.18	0.16	0.18
	3:55:00	0.00	0.00	0.06	0.09	0.10	0.09	0.09	0.08	0.09
	4:00:00	0.00	0.00	0.02	0.04	0.04	0.04	0.04	0.03	0.03
	4:05:00	0.00	0.00	0.01	0.01	0.01	0.01	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:	**April 15, 2021**
Project:	**Mayberry, Colorado Springs**
Location:	**Detention Basin D**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 43.1 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.431
C) Contributing Watershed Area	Area = 113.160 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}= 1.772 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 = 100 %
ii) Percentage of Watershed consisting of Type B Soils	HSG_B = 0 %
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: $EURV_{C/D} = 1.20 * i^{1.08}$	$EURV_{DESIGN}$ = 5.388 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 = 2.0 : 1
3. Basin Side Slopes	
A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 4.00 ft / ft
4. Inlet	
A) Describe means of providing energy dissipation at concentrated inflow locations:	Concrete Forebay
5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.053 ac-ft
B) Actual Forebay Volume	V_F = 0.060 ac-ft
C) Forebay Depth (D_F = 30 inch maximum)	D_F = 30.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 134.90 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 2.70 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 = 8.5 in

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**JPS**
Company:	**JPS**
Date:	**April 15, 2021**
Project:	**Mayberry, Colorado Springs**
Location:	**Detention Basin D**

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 = 10 sq ft
C) Outlet Type	Choose One: (●) Orifice Plate ( ) Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 0.50 inches
E) Total Outlet Area	A_{ot} = 26.13 square inches
8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 6 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 232 cu ft
C) Initial Surcharge Provided Above Micropool	V_s= 5.0 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 959 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.)	*S.S. Well Screen with 60% Open Area*
Other (Y/N): N	
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} = 1599 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 4.43 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 81.16 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 19.7 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: JPS
Company: JPS
Date: April 15, 2021
Project: Mayberry, Colorado Springs
Location: Detention Basin D

10. Overflow Embankment A) Describe embankment protection for 100-year and greater overtopping:	
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 sediment removal as required; Access ramp provided to pond bottom

Notes:

APPENDIX D1

STREET CAPACITY & STORM SEWER HYDRAULIC CALCULATIONS

hydraulic calculations will be reviewed with the final plat applications.

TABLE 6 - 1

Allowable Use of Streets in El Paso County

Street Classification	Use of Streets		Cross Flow In Streets	
	Initial Storm	Major Storm	Initial Storm	Major Storm
illside Local with Ramp urb & Gutter	Maximum flow spread to crown. Maximum flow rate of 15 cfs per side.	Same as Local Street with Curb & Gutter	Same as Local Street with Curb & Gutter	Same as Local Street with Curb & Gutter
illside Local with 8 in. ertical Curb & Gutter	The depth of flow shall not exceed 6 inches at the gutter flowline. Maximum flow rate of 25 cfs per side.	Same as Local Street with Curb & Gutter	Same as Local Street with Curb & Gutter	Same as Local Street with Curb & Gutter
ocal with Ramp Curb & utter	Maximum flow spread to street crown. Maximum flow rate of 20 cfs per side.	Residential dwellings, public, commercial and industrial buildings shall not be inundated at the ground line. The depth of water at the gutter flowline shall not exceed 12 inches.	Where cross pans are allowed, the depth of flow shall not exceed 6 inches at the flowline.	Where cross pans are allowed, the depth of flow shall not exceed 12 inches at the flowline.
ocal with 8 in. Vertical urb & Gutter	The depth of flow shall not exceed 6 inches at the gutter flowline. Maximum flow rate of 34 cfs per side.	Same as above.	Same as above.	Same as above.
ocal with Roadside Ditch	Flow must not encroach upon road shoulder area.	Residential dwellings, public, commercial and industrial buildings shall not be inundated at the ground line. The depth of water at the edge of road shoulder shall not exceed 6 inches.	Requires culvert. Flow shall not encroach upon the road shoulder.	Requires culvert. Depth of flow shall not exceed 6 inches at the edge of the road shoulder.
ollector with 8 in. Vertical urb & Gutter	Same as Local Streets with 8 in. Vertical Curb & Gutter	Same as Local Streets with Curb & Gutter.	Same as Local Streets with Curb & Gutter.	Same as Local Streets with Curb & Gutter.
ollector with Roadside itch	Same as Local Streets with Roadside Ditch.	Same as Local Streets with Roadside Ditch.	Same as Local Streets with Roadside Ditch.	Same as Local Streets with Roadside Ditch.
rterial with Curb & Gutter	The depth of flow shall not exceed 6 inches at the gutter flowline. Maximum flow rate of 34 cfs per side. One ten foot lane in each direction must remain free of water.	Residential dwellings, public, commercial and industrial buildings shall not be inundated at the ground line. The depth of water at the gutter flowline shall not exceed 8 inches and there shall be no curb overtopping.	No cross flow is allowed on the road surface.	12 in. max. depth at gutter flowline or 4 in. max. depth at crown, whichever is more limiting.
rterial with Roadside Ditch	Flow must not encroach upon road shoulder area.	Residential dwellings, public, commercial and industrial buildings shall not be inundated at the ground line. The depth of water shall not encroach upon the road shoulder.	Requires culvert. Flow shall not encroach upon the road shoulder.	Requires culvert. Flow shall not encroach upon the road shoulder.
ighway / Freeway	No encroachment of water is allowed on any traffic lanes.	No encroachment of water is allowed on any traffic lanes.	No cross flow is allowed on the road surface.	No cross flow is allowed on the road surface.

MAYBERRY, COLORADO SPRINGS – PHASE 1 PUD
(fka "ELLICOTT TOWN CENTER")
STREET CAPACITY ANALYSIS

TYPICAL STREET CAPACITY ASSUMPTIONS:

Road Type	Min. Slope	Asphalt Width (ft)	Minor Storm Capacity [a] (Q_5, cfs)	Major Storm Capacity [b] (Q_{100}, cfs)
Urban Local	1.0%	30'	10.9	215.2

[a] Maximum allowable spread at Q_5 is to crown of street.
[b] Maximum allowable flow depth at Q_{100} is 12-inches at flowline;
(Total Allowable 100-Year Capacity is double the half-section capacity in UD-Inlet)

Road (Design Point)	Min. Street Grade	Allowable Minor Storm Capacity (cfs)	Peak Flow (Q_5, cfs)	Inlet Required?
Filing No. 1				
Cattlemen Run (C1.1)	1.0%	10.9	5.4	No
Village Main St. (C1.2)	1.0%	10.9	35.9	Yes
Marketplace Dr (C1.7B)	1.0%	10.9	17.3	Yes
Mayberry Drive (C1.8)	1.0%	10.9	18.4	Yes
Filing No. 3-4				
Cattlemen Run (D1.1)	1.0%	10.9	11.4	Yes*
Galveston Terrace (C2.2A)	1.0%	10.9	3.6	No
Union Pacific Way (D1.3)	1.0%	10.9	5.7	No*
Mayberry Drive (D1.5)	1.0%	10.9	3.0	No*

*Inlets provided at sump locations

Please also include analysis for El Reno lane and Springs Road. This can be provided with final drainage report at the final plat application

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: **Mayberry, Colorado Springs - Typical Urban Local Street Capacity**

Inlet ID: **Street Capacity**

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 =	0.010	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
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**10.9**	**107.6**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

MAYBERRY, COLORADO SPRINGS (ELLICOTT TOWN CENTER) FILING NO. 1
STORM INLET SIZING SUMMARY

	BASIN FLOW			INLET FLOW					
INLET	DP	Q5 FLOW (CFS) [1]	Q100 FLOW (CFS) [a]	INLET FLOW % OF BASIN	Q5 FLOW (CFS)	Q100 FLOW (CFS)	INLET CONDITION / TYPE	INLET SIZE	INLET CAPACITY (CFS)
C1.2	C1.2	16.9	35.9	100	16.9	35.9	SUMP TYPE R	10.0	25.5 [b]
C1.7A	C1.7A	1.1	2.7	100	1.1	2.7	SUMP TYPE R	5.0	12.3
C1.7B	C1.7B	8.2	17.3	100	8.2	17.3	SUMP TYPE R	10.0	25.5
C1.3	C1.3	5.9	14.3	100	5.9	14.3	SUMP TYPE R	10.0	25.5
C1.4	C1.4	6.3	15.3	100	6.3	15.3	SUMP TYPE R	10.0	25.5
C1.5	C1.5	6.2	15.0	100	6.2	15.0	SUMP TYPE R	10.0	25.5
C1.1	C1.1	5.4	18.0	100	5.4	18.0	SUMP TYPE R	10.0	25.5
C1.6A	C1.6	5.8	14.2	10	0.6	1.4	SUMP TYPE R	5.0	12.3
C1.6B	C1.6	5.8	14.2	90	5.2	12.8	SUMP TYPE R	10.0	25.5
C1.8	C1.8	7.5	18.4	100	7.5	18.4	SUMP TYPE R	10.0	25.5
C1.9	C1.9	8.5	20.8	100	8.5	20.8	SUMP TYPE R	10.0	25.5

[a] REFER TO RATIONAL METOHD HYDROLOGY CALCULATIONS FOR CONTRIBUTING BASINS & DEVELOPED FLOW CALCULATIONS
[b] ADDITIONAL UPSTREAM INLET CAPACITY TO BE PROVIDED WITHIN COMMERCIAL DEVELOPMENT AREA

MAYBERRY, COLORADO SPRINGS (ELLICOTT TOWN CENTER) FILING NO. 2-4
STORM INLET SIZING SUMMARY

	BASIN FLOW			INLET FLOW					
INLET	DP	Q5 FLOW (CFS) [1]	Q100 FLOW (CFS) [a]	INLET FLOW % OF BASIN	Q5 FLOW (CFS)	Q100 FLOW (CFS)	INLET CONDITION / TYPE	INLET SIZE	INLET CAPACITY (CFS)
C2.4A	C2.4	2.8	6.8	70	2.0	4.8	SUMP TYPE R	5.0	12.3
C2.4B	C2.4	2.8	6.8	30	0.8	2.0	SUMP TYPE R	5.0	12.3
C2.5	C2.5A	10.9	27.5	100	10.9	27.5	SUMP TYPE R	15.0	39.1
C2.8A	C2.8A	12.1	27.5	100	12.1	27.5	SUMP TYPE R	15.0	39.1
C2.8B	C2.8B	2.0	4.9	100	2.0	4.9	SUMP TYPE R	5.0	12.3
C2.9A	C2.9	6.8	16.1	15	1.0	2.4	SUMP TYPE R	5.0	12.3
C2.9B	C2.9	6.8	16.1	85	5.8	13.7	SUMP TYPE R	10.0	25.5
D1.1A	D1.1	11.4	22.8	75	8.6	17.1	SUMP TYPE R	10.0	25.5
D1.1B	D1.1	11.4	22.8	25	2.9	5.7	SUMP TYPE R	5.0	12.3
D1.2A	D1.2	6.0	11.9	70	4.2	8.3	SUMP TYPE R	5.0	12.3
D1.2B	D1.2	6.0	11.9	30	1.8	3.6	SUMP TYPE R	5.0	12.3
D1.3A	D1.3	5.7	12.8	85	4.8	10.9	SUMP TYPE R	5.0	12.3
D1.3B	D1.3	5.7	12.8	15	0.9	1.9	SUMP TYPE R	5.0	12.3
D1.4A	D1.4	4.1	10.0	85	3.5	8.5	SUMP TYPE R	5.0	12.3
D1.4B	D1.4	4.1	10.0	15	0.6	1.5	SUMP TYPE R	5.0	12.3
D1.5	D1.5	3.0	7.2	100	3.0	7.2	SUMP TYPE R	5.0	12.3

[a] REFER TO RATIONAL METOHD HYDROLOGY CALCULATIONS FOR CONTRIBUTING BASINS & DEVELOPED FLOW CALCULATIONS

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: **Ellicott Town Center - Typical 5' Type R Inlet (Sump Condition)**

Inlet ID:

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	12.0	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} =	15.0	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} =	15.0	15.0	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)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		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	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} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.77	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 =**	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	4.0	8.0	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: **Ellicott Town Center - Typical 10' Type R Inlet (Sump Condition)**

Inlet ID:

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	12.0	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} =	15.0	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} =	15.0	15.0	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)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		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	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) =	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	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.57	1.00	
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**	**25.5**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Minor Storm		$Q_{PEAK\ REQUIRED}$ =	10.0	21.0	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: **Ellicott Town Center - Typical 15' Type R Inlet (Sump Condition)**

Inlet ID:

Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	12.0	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} =	15.0	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} =	15.0	15.0	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) CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet	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	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) =	15.00	15.00	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	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	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 =**	**9.7**	**39.1**	**cfs**
WARNING: Inlet Capacity less than Q Peak for Minor Storm	$Q_{PEAK\ REQUIRED}$ =	11.3	35.9	cfs

MAYBERRY, COLORADO SPRINGS (ELLICOTT TOWN CENTER) FILING NO. 1
STORM SEWER SIZING SUMMARY

	PIPE FLOW			PIPE CAPACITY		
PIPE	BASINS	Q5 FLOW (CFS)	Q100 FLOW (CFS)	PIPE SIZE	MIN. PIPE SLOPE	FULL PIPE CAPACITY (CFS)
C1.2	C1.2	16.9	35.9	30	1.0%	41.0
C1.7A	C1.7A	1.1	2.7	18	1.0%	10.5
C1.7B	C1.7A,C1.7B	9.3	20.0	24	1.0%	22.6
C1.2D	C1.2,C1.7A-B	26.2	55.9	36	0.89%	62.9
C1.3	C1.3	5.9	14.3	18	1.9%	14.5
C1.3A	C1.2,C1.3,C1.7A-B	32.1	70.2	36	1.41%	79.2
C1.4	C1.4	6.3	15.3	18	2.2%	15.6
C1.4A	C1.2-C1.4,C1.7A-B	38.4	85.5	42	0.85%	92.8
C1.5	C1.5	6.2	15.0	18	2.1%	15.2
C1.5A	C1.2-C1.5,C1.7A-B	44.6	100.5	42	1.0%	100.6
C1.1	C1.1	5.4	18.0	24	1.0%	22.6
C1.6A	C1.6	6.0	19.4	24	1.0%	22.6
C1.6B	C1.6	5.2	12.8	18	1.0%	10.5
C1.6C	C1.1,C1.2-C1.6,C1.7A-B	55.8	132.7	48	0.90%	136.3
C1.8	C1.8	7.5	18.4	24	1.0%	22.6
C1.9	C1.9	8.5	20.8	24	1.0%	22.6
C1.9C	C1.1-C1.9	71.8	171.9	60	0.50%	184.2

ASSUMPTIONS:

1. STORM DRAIN PIPE ASSUMED TO BE RCP OR HDPE

Hydraulic Analysis Report

Project Data

Project Title: ETC Filing No. 1 - SD

Designer: JPS

Project Date: Thursday, August 16, 2018

Project Units: U.S. Customary Units

Notes:

Channel Analysis: SD-C1.2

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.5000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0130

Depth: 2.5000 ft

Result Parameters

Flow: 41.0171 cfs

Area of Flow: 4.9087 ft^2

Wetted Perimeter: 7.8540 ft

Hydraulic Radius: 0.6250 ft

Average Velocity: 8.3559 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 2.1509 ft

Critical Velocity: 9.1300 ft/s

Critical Slope: 0.0093 ft/ft

Critical Top Width: 1.73 ft

Calculated Max Shear Stress: 1.5600 lb/ft^2

Calculated Avg Shear Stress: 0.3900 lb/ft^2

Channel Analysis: SD-C1.7A

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.5000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0130

Depth: 1.5000 ft

Result Parameters

Flow: 10.5043 cfs

Area of Flow: 1.7671 ft^2

Wetted Perimeter: 4.7124 ft

Hydraulic Radius: 0.3750 ft

Average Velocity: 5.9442 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.2451 ft

Critical Velocity: 6.6989 ft/s

Critical Slope: 0.0098 ft/ft

Critical Top Width: 1.13 ft

Calculated Max Shear Stress: 0.9360 lb/ft^2

Calculated Avg Shear Stress: 0.2340 lb/ft^2

Channel Analysis: SD-C1.7B

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.0000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0130

Depth: 2.0000 ft

Result Parameters

Flow: 22.6224 cfs

Area of Flow: 3.1416 ft^2

Wetted Perimeter: 6.2832 ft

Hydraulic Radius: 0.5000 ft

Average Velocity: 7.2009 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.6953 ft

Critical Velocity: 7.9674 ft/s

Critical Slope: 0.0095 ft/ft

Critical Top Width: 1.44 ft

Calculated Max Shear Stress: 1.2480 lb/ft^2

Calculated Avg Shear Stress: 0.3120 lb/ft^2

Channel Analysis: SD-C1.2D

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 3.0000 ft

Longitudinal Slope: 0.0089 ft/ft

Manning's n: 0.0130

Depth: 3.0000 ft

Result Parameters

Flow: 62.9231 cfs

Area of Flow: 7.0686 ft^2

Wetted Perimeter: 9.4248 ft

Hydraulic Radius: 0.7500 ft

Average Velocity: 8.9018 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 2.5518 ft

Critical Velocity: 9.8203 ft/s

Critical Slope: 0.0084 ft/ft

Critical Top Width: 2.14 ft

Calculated Max Shear Stress: 1.6661 lb/ft^2

Calculated Avg Shear Stress: 0.4165 lb/ft^2

Channel Analysis: SD-C1.3

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-C1.3A

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 3.0000 ft

Longitudinal Slope: 0.0141 ft/ft

Manning's n: 0.0130

Depth: 3.0000 ft

Result Parameters

Flow: 79.2000 cfs

Area of Flow: 7.0686 ft^2

Wetted Perimeter: 9.4248 ft

Hydraulic Radius: 0.7500 ft

Average Velocity: 11.2045 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 2.7627 ft

Critical Velocity: 11.6333 ft/s

Critical Slope: 0.0122 ft/ft

Critical Top Width: 1.62 ft

Calculated Max Shear Stress: 2.6395 lb/ft^2

Calculated Avg Shear Stress: 0.6599 lb/ft^2

Channel Analysis: SD-C1.4

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.5000 ft

Longitudinal Slope: 0.0220 ft/ft

Manning's n: 0.0130

Depth: 1.5000 ft

Result Parameters

Flow: 15.5805 cfs

Area of Flow: 1.7671 ft^2

Wetted Perimeter: 4.7124 ft

Hydraulic Radius: 0.3750 ft

Average Velocity: 8.8167 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.4172 ft

Critical Velocity: 9.0117 ft/s

Critical Slope: 0.0190 ft/ft

Critical Top Width: 0.68 ft

Calculated Max Shear Stress: 2.0592 lb/ft^2

Calculated Avg Shear Stress: 0.5148 lb/ft^2

Channel Analysis: SD-C1.4A

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 3.5000 ft

Longitudinal Slope: 0.0085 ft/ft

Manning's n: 0.0130

Depth: 3.5000 ft

Result Parameters

Flow: 92.7576 cfs

Area of Flow: 9.6211 ft^2

Wetted Perimeter: 10.9956 ft

Hydraulic Radius: 0.8750 ft

Average Velocity: 9.6410 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 2.9805 ft

Critical Velocity: 10.6254 ft/s

Critical Slope: 0.0080 ft/ft

Critical Top Width: 2.49 ft

Calculated Max Shear Stress: 1.8564 lb/ft^2

Calculated Avg Shear Stress: 0.4641 lb/ft^2

Channel Analysis: SD-C1.5

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.5000 ft

Longitudinal Slope: 0.0210 ft/ft

Manning's n: 0.0130

Depth: 1.5000 ft

Result Parameters

Flow: 15.2222 cfs

Area of Flow: 1.7671 ft^2

Wetted Perimeter: 4.7124 ft

Hydraulic Radius: 0.3750 ft

Average Velocity: 8.6140 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.4099 ft

Critical Velocity: 8.8307 ft/s

Critical Slope: 0.0181 ft/ft

Critical Top Width: 0.71 ft

Calculated Max Shear Stress: 1.9656 lb/ft^2

Calculated Avg Shear Stress: 0.4914 lb/ft^2

Channel Analysis: SD-C1.5A

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 3.5000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0130

Depth: 3.5000 ft

Result Parameters

Flow: 100.6098 cfs

Area of Flow: 9.6211 ft^2

Wetted Perimeter: 10.9956 ft

Hydraulic Radius: 0.8750 ft

Average Velocity: 10.4572 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 3.0762 ft

Critical Velocity: 11.2307 ft/s

Critical Slope: 0.0090 ft/ft

Critical Top Width: 2.28 ft

Calculated Max Shear Stress: 2.1840 lb/ft^2

Calculated Avg Shear Stress: 0.5460 lb/ft^2

Channel Analysis: SD-C1.1

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.0000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0130

Depth: 2.0000 ft

Result Parameters

Flow: 22.6224 cfs

Area of Flow: 3.1416 ft^2

Wetted Perimeter: 6.2832 ft

Hydraulic Radius: 0.5000 ft

Average Velocity: 7.2009 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.6953 ft

Critical Velocity: 7.9674 ft/s

Critical Slope: 0.0095 ft/ft

Critical Top Width: 1.44 ft

Calculated Max Shear Stress: 1.2480 lb/ft^2

Calculated Avg Shear Stress: 0.3120 lb/ft^2

Channel Analysis: SD-C1.6A

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.0000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0130

Depth: 2.0000 ft

Result Parameters

Flow: 22.6224 cfs

Area of Flow: 3.1416 ft^2

Wetted Perimeter: 6.2832 ft

Hydraulic Radius: 0.5000 ft

Average Velocity: 7.2009 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.6953 ft

Critical Velocity: 7.9674 ft/s

Critical Slope: 0.0095 ft/ft

Critical Top Width: 1.44 ft

Calculated Max Shear Stress: 1.2480 lb/ft^2

Calculated Avg Shear Stress: 0.3120 lb/ft^2

Channel Analysis: SD-C1.6B

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.5000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0130

Depth: 1.5000 ft

Result Parameters

Flow: 10.5043 cfs

Area of Flow: 1.7671 ft^2

Wetted Perimeter: 4.7124 ft

Hydraulic Radius: 0.3750 ft

Average Velocity: 5.9442 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.2451 ft

Critical Velocity: 6.6989 ft/s

Critical Slope: 0.0098 ft/ft

Critical Top Width: 1.13 ft

Calculated Max Shear Stress: 0.9360 lb/ft^2

Calculated Avg Shear Stress: 0.2340 lb/ft^2

Channel Analysis: SD-C1.6C

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 4.0000 ft

Longitudinal Slope: 0.0090 ft/ft

Manning's n: 0.0130

Depth: 4.0000 ft

Result Parameters

Flow: 136.2720 cfs

Area of Flow: 12.5664 ft^2

Wetted Perimeter: 12.5664 ft

Hydraulic Radius: 1.0000 ft

Average Velocity: 10.8442 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 3.4746 ft

Critical Velocity: 11.7558 ft/s

Critical Slope: 0.0082 ft/ft

Critical Top Width: 2.70 ft

Calculated Max Shear Stress: 2.2464 lb/ft^2

Calculated Avg Shear Stress: 0.5616 lb/ft^2

Channel Analysis: SD-C1.8

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.0000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0130

Depth: 2.0000 ft

Result Parameters

Flow: 22.6224 cfs

Area of Flow: 3.1416 ft^2

Wetted Perimeter: 6.2832 ft

Hydraulic Radius: 0.5000 ft

Average Velocity: 7.2009 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.6953 ft

Critical Velocity: 7.9674 ft/s

Critical Slope: 0.0095 ft/ft

Critical Top Width: 1.44 ft

Calculated Max Shear Stress: 1.2480 lb/ft^2

Calculated Avg Shear Stress: 0.3120 lb/ft^2

Channel Analysis: SD-C1.9

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.0000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0130

Depth: 2.0000 ft

Result Parameters

Flow: 22.6224 cfs

Area of Flow: 3.1416 ft^2

Wetted Perimeter: 6.2832 ft

Hydraulic Radius: 0.5000 ft

Average Velocity: 7.2009 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.6953 ft

Critical Velocity: 7.9674 ft/s

Critical Slope: 0.0095 ft/ft

Critical Top Width: 1.44 ft

Calculated Max Shear Stress: 1.2480 lb/ft^2

Calculated Avg Shear Stress: 0.3120 lb/ft^2

Channel Analysis: SD-C1.9C

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 5.0000 ft

Longitudinal Slope: 0.0050 ft/ft

Manning's n: 0.0130

Depth: 5.0000 ft

Result Parameters

Flow: 184.1607 cfs

Area of Flow: 19.6350 ft^2

Wetted Perimeter: 15.7080 ft

Hydraulic Radius: 1.2500 ft

Average Velocity: 9.3792 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 3.8843 ft

Critical Velocity: 11.2521 ft/s

Critical Slope: 0.0056 ft/ft

Critical Top Width: 4.16 ft

Calculated Max Shear Stress: 1.5600 lb/ft^2

Calculated Avg Shear Stress: 0.3900 lb/ft^2

MAYBERRY, COLORADO SPRINGS (ELLICOTT TOWN CENTER) FILING NO. 2-4
STORM SEWER SIZING SUMMARY

	PIPE FLOW			PIPE CAPACITY		
PIPE	INLETS	Q5 FLOW (CFS)	Q100 FLOW (CFS)	PIPE SIZE	MIN. PIPE SLOPE	FULL PIPE CAPACITY (CFS)
C2.4A	C2.4A	2.0	4.8	18	1.0%	10.5
C2.4B	C2.4A-C2.4B	2.8	6.8	18	1.0%	10.5
C2.5	C2.4-C2.5	13.7	34.3	30	0.7%	34.3
C2.8A	C2.8A	12.1	27.5	30	0.5%	29.0
C2.8B	C2.8A-C2.8B	14.1	32.4	30	0.8%	36.7
C2.9A	C2.8A-C2.9A	15.1	34.8	30	0.8%	36.7
C2.9B	C2.8A-C2.9B	20.9	48.5	30	1.4%	48.5
D1.1A	D1.1A	8.6	17.1	24	1.1%	23.7
D1.1B	D1.1A-D1.1B	11.4	22.8	24	1.1%	23.7
D1.2A	D1.1A-D1.2A	15.6	31.1	30	0.8%	36.7
D1.2B	D1.1A-D1.2B	17.4	34.7	30	0.8%	36.7
D1.3A	D1.1A-D1.3A	22.2	45.6	30	1.4%	48.5
D1.3B	D1.1A-D1.3B	23.1	47.5	30	1.4%	48.5
D1.4A	D1.1A-D1.4A	26.6	56.0	36	1.0%	66.7
D1.4B	D1.1A-D1.4B	27.2	57.5	36	1.0%	66.7
D1.5	C2.6-C2.9,D1.1-D1.5	51.1	113.2	42	1.3%	114.7

ASSUMPTIONS:

1. STORM DRAIN PIPE ASSUMED TO BE RCP OR HDPE

Hydraulic Analysis Report

Project Data

Project Title: Project - Mayberry Filing 2-4

Designer: JPS

Project Date: Wednesday, March 10, 2021

Project Units: U.S. Customary Units

Notes:

Channel Analysis: SD-C2.4A-B

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.5000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0130

Depth: 1.5000 ft

Result Parameters

Flow: 10.5043 cfs

Area of Flow: 1.7671 ft^2

Wetted Perimeter: 4.7124 ft

Hydraulic Radius: 0.3750 ft

Average Velocity: 5.9442 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.2451 ft

Critical Velocity: 6.6989 ft/s

Critical Slope: 0.0098 ft/ft

Critical Top Width: 1.13 ft

Calculated Max Shear Stress: 0.9360 lb/ft^2

Calculated Avg Shear Stress: 0.2340 lb/ft^2

Channel Analysis: SD-C2.5

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.5000 ft

Longitudinal Slope: 0.0070 ft/ft

Manning's n: 0.0130

Depth: 2.5000 ft

Result Parameters

Flow: 34.3174 cfs

Area of Flow: 4.9087 ft^2

Wetted Perimeter: 7.8540 ft

Hydraulic Radius: 0.6250 ft

Average Velocity: 6.9911 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.9910 ft

Critical Velocity: 8.1870 ft/s

Critical Slope: 0.0074 ft/ft

Critical Top Width: 2.01 ft

Calculated Max Shear Stress: 1.0920 lb/ft^2

Calculated Avg Shear Stress: 0.2730 lb/ft^2

Channel Analysis: SD-C2.8A

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.5000 ft

Longitudinal Slope: 0.0050 ft/ft

Manning's n: 0.0130

Depth: 2.5000 ft

Result Parameters

Flow: 29.0035 cfs

Area of Flow: 4.9087 ft^2

Wetted Perimeter: 7.8540 ft

Hydraulic Radius: 0.6250 ft

Average Velocity: 5.9085 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.8359 ft

Critical Velocity: 7.5068 ft/s

Critical Slope: 0.0063 ft/ft

Critical Top Width: 2.21 ft

Calculated Max Shear Stress: 0.7800 lb/ft^2

Calculated Avg Shear Stress: 0.1950 lb/ft^2

Channel Analysis: SD-C2.8B-C2.9A

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.5000 ft

Longitudinal Slope: 0.0080 ft/ft

Manning's n: 0.0130

Depth: 2.5000 ft

Result Parameters

Flow: 36.6868 cfs

Area of Flow: 4.9087 ft^2

Wetted Perimeter: 7.8540 ft

Hydraulic Radius: 0.6250 ft

Average Velocity: 7.4738 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 2.0520 ft

Critical Velocity: 8.5086 ft/s

Critical Slope: 0.0080 ft/ft

Critical Top Width: 1.92 ft

Calculated Max Shear Stress: 1.2480 lb/ft^2

Calculated Avg Shear Stress: 0.3120 lb/ft^2

Channel Analysis: SD-C2.9B

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.5000 ft

Longitudinal Slope: 0.0140 ft/ft

Manning's n: 0.0130

Depth: 2.5000 ft

Result Parameters

Flow: 48.5321 cfs

Area of Flow: 4.9087 ft^2

Wetted Perimeter: 7.8540 ft

Hydraulic Radius: 0.6250 ft

Average Velocity: 9.8869 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 2.2803 ft

Critical Velocity: 10.3317 ft/s

Critical Slope: 0.0122 ft/ft

Critical Top Width: 1.42 ft

Calculated Max Shear Stress: 2.1840 lb/ft^2

Calculated Avg Shear Stress: 0.5460 lb/ft^2

Channel Analysis: SD-D1.1A-B

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.0000 ft

Longitudinal Slope: 0.0110 ft/ft

Manning's n: 0.0130

Depth: 2.0000 ft

Result Parameters

Flow: 23.7266 cfs

Area of Flow: 3.1416 ft^2

Wetted Perimeter: 6.2832 ft

Hydraulic Radius: 0.5000 ft

Average Velocity: 7.5524 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.7275 ft

Critical Velocity: 8.2251 ft/s

Critical Slope: 0.0101 ft/ft

Critical Top Width: 1.37 ft

Calculated Max Shear Stress: 1.3728 lb/ft^2

Calculated Avg Shear Stress: 0.3432 lb/ft^2

Channel Analysis: SD-D1.2A-B

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.5000 ft

Longitudinal Slope: 0.0080 ft/ft

Manning's n: 0.0130

Depth: 2.5000 ft

Result Parameters

Flow: 36.6868 cfs

Area of Flow: 4.9087 ft^2

Wetted Perimeter: 7.8540 ft

Hydraulic Radius: 0.6250 ft

Average Velocity: 7.4738 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 2.0520 ft

Critical Velocity: 8.5086 ft/s

Critical Slope: 0.0080 ft/ft

Critical Top Width: 1.92 ft

Calculated Max Shear Stress: 1.2480 lb/ft^2

Calculated Avg Shear Stress: 0.3120 lb/ft^2

Channel Analysis: SD-D1.3A-B

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.5000 ft

Longitudinal Slope: 0.0140 ft/ft

Manning's n: 0.0130

Depth: 2.5000 ft

Result Parameters

Flow: 48.5321 cfs

Area of Flow: 4.9087 ft^2

Wetted Perimeter: 7.8540 ft

Hydraulic Radius: 0.6250 ft

Average Velocity: 9.8869 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 2.2803 ft

Critical Velocity: 10.3317 ft/s

Critical Slope: 0.0122 ft/ft

Critical Top Width: 1.42 ft

Calculated Max Shear Stress: 2.1840 lb/ft^2

Calculated Avg Shear Stress: 0.5460 lb/ft^2

Channel Analysis: SD-D1.4A-B

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 3.0000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0130

Depth: 3.0000 ft

Result Parameters

Flow: 66.6984 cfs

Area of Flow: 7.0686 ft^2

Wetted Perimeter: 9.4248 ft

Hydraulic Radius: 0.7500 ft

Average Velocity: 9.4359 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 2.6104 ft

Critical Velocity: 10.2152 ft/s

Critical Slope: 0.0091 ft/ft

Critical Top Width: 2.02 ft

Calculated Max Shear Stress: 1.8720 lb/ft^2

Calculated Avg Shear Stress: 0.4680 lb/ft^2

Channel Analysis: SD-D1.5

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 3.5000 ft

Longitudinal Slope: 0.0130 ft/ft

Manning's n: 0.0130

Depth: 3.5000 ft

Result Parameters

Flow: 114.7128 cfs

Area of Flow: 9.6211 ft^2

Wetted Perimeter: 10.9956 ft

Hydraulic Radius: 0.8750 ft

Average Velocity: 11.9230 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 3.2095 ft

Critical Velocity: 12.4143 ft/s

Critical Slope: 0.0113 ft/ft

Critical Top Width: 1.93 ft

Calculated Max Shear Stress: 2.8392 lb/ft^2

Calculated Avg Shear Stress: 0.7098 lb/ft^2

APPENDIX D2

CULVERT HYDRAULIC CALCULATIONS

MAYBERRY, COLORADO SPRINGS - PHASE 1 PUD
CULVERT DESIGN SUMMARY

BASIN	DESIGN POINT	RD CL ELEV	INV IN ELEV	INV OUT ELEV	PIPE LENGTH (FT)	# of CULVERTS	PIPE DIA (FT)	TOTAL Q_5 (CFS)	PER PIPE Q_5 (CFS)	Q_5 MAX ALLOWABLE HEADWATER [1]	CALC Q_5 HW ELEV	TOTAL Q_{100} (CFS)	PER PIPE Q_{100} (CFS)	Q_{100} MAX ALLOWABLE HEADWATER [2]	CALC Q_{100} HW ELEV
EC11	EC11	6065.64	6060.50	6048.00	880.0	1	**2.5**	24.4	24.4	6063.0	6063.0	149.5	149.5	6066.2	6066.1
E1	EC10	6047.03	6042.98	6042.58	80.0	1	**2.5**	18.9	18.9	6045.5	6045.1	110.6	110.6	6047.6	6047.4
E2	EC10	6044.61	6040.54	6040.19	70.0	1	**2.5**	18.9	18.9	6043.0	6042.7	110.6	110.6	6045.2	6045.0
E3	EC10	6042.01	6037.95	6037.57	76.0	1	**2.5**	18.9	18.9	6040.5	6040.1	110.6	110.6	6042.6	6042.4

[1] Q_5 MAX. ALLOWABLE HEADWATER, HW/D = 1.0

[2] Q_{100} MAX. ALLOWABLE HEADWATER = 12" DEPTH AT GUTTER FLOWLINE (PER DCM TABLE 6-1)

HY-8 Culvert Analysis Report
Mayberry, Colorado Springs Phase 1 PUD

Crossing Discharge Data – Culvert EC11

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 10 cfs

Design Flow: 24.4 cfs

Maximum Flow: 149.5 cfs

Table 1 - Summary of Culvert Flows at Crossing: Crossing EC11

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert EC11 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6061.97	10.00	10.00	0.00	1
6062.96	23.95	23.95	0.00	1
6062.99	24.40	24.40	0.00	1
6065.66	51.85	50.98	0.70	39
6065.78	65.80	51.07	14.60	7
6065.85	79.75	51.14	28.47	5
6065.91	93.70	51.21	42.31	4
6065.97	107.65	51.27	56.30	4
6066.02	121.60	51.33	70.02	3
6066.07	135.55	51.39	84.02	3
6066.11	149.50	51.44	97.98	3
6065.64	50.96	50.96	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing EC11

Table 2 - Culvert Summary Table: Culvert EC11

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
10.00	10.00	6061.97	1.467	0.0*	1-S2n	0.746	1.054	0.746	0.438	7.857	1.660
23.95	23.95	6062.96	2.459	0.0*	1-S2n	1.202	1.662	1.247	0.722	9.474	2.226
24.40	24.40	6062.99	2.489	0.0*	1-S2n	1.215	1.678	1.231	0.730	9.811	2.240
51.85	50.98	6065.66	5.129	5.158	7-M2c	2.500	2.311	2.311	1.111	10.757	2.839
65.80	51.07	6065.78	5.142	5.276	7-M2c	2.500	2.312	2.312	1.264	10.774	3.052
79.75	51.14	6065.85	5.151	5.350	7-M2c	2.500	2.312	2.312	1.402	10.787	3.232
93.70	51.21	6065.91	5.160	5.413	7-M2c	2.500	2.313	2.313	1.527	10.798	3.388
107.65	51.27	6065.97	5.169	5.468	7-M2c	2.500	2.314	2.314	1.643	10.809	3.527
121.60	51.33	6066.02	5.177	5.519	7-M2c	2.500	2.314	2.314	1.752	10.820	3.652
135.55	51.39	6066.07	5.185	5.567	7-M2c	2.500	2.315	2.315	1.853	10.831	3.767
149.50	51.44	6066.11	5.193	5.612	7-M2c	2.500	2.315	2.315	1.950	10.841	3.873

* Full Flow Headwater elevation is below inlet invert.

****

Straight Culvert

Inlet Elevation (invert): 6060.50 ft, Outlet Elevation (invert): 6048.00 ft

Culvert Length: 880.09 ft, Culvert Slope: 0.0142

****

Culvert Performance Curve Plot: Culvert EC11

Water Surface Profile Plot for Culvert: Culvert EC11

Site Data - Culvert EC11

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 6060.50 ft

Outlet Station: 880.00 ft

Outlet Elevation: 6048.00 ft

Number of Barrels: 1

Culvert Data Summary - Culvert EC11

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material:

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Grooved End Projecting

Inlet Depression: None

Table 3 - Downstream Channel Rating Curve (Crossing: Crossing EC11)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
10.00	6048.44	0.44	1.66	0.11	0.47
23.95	6048.72	0.72	2.23	0.18	0.50
24.40	6048.73	0.73	2.24	0.18	0.51
51.85	6049.11	1.11	2.84	0.28	0.54
65.80	6049.26	1.26	3.05	0.32	0.54
79.75	6049.40	1.40	3.23	0.35	0.55
93.70	6049.53	1.53	3.39	0.38	0.56
107.65	6049.64	1.64	3.53	0.41	0.56
121.60	6049.75	1.75	3.65	0.44	0.57
135.55	6049.85	1.85	3.77	0.46	0.57
149.50	6049.95	1.95	3.87	0.49	0.58

Tailwater Channel Data - Crossing EC11

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 12.00 ft

Side Slope (H:V): 4.00 (_:1)

Channel Slope: 0.0040

Channel Manning's n: 0.0300

Channel Invert Elevation: 6048.00 ft

Roadway Data for Crossing: Crossing EC11

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 6065.64 ft

Roadway Surface: Paved

Roadway Top Width: 60.00 ft

Crossing Discharge Data – Culvert E1

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 10 cfs

Design Flow: 18.9 cfs

Maximum Flow: 110.6 cfs

Table 4 - Summary of Culvert Flows at Crossing: Crossing E1

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert E1 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6044.46	10.00	10.00	0.00	1
6045.11	18.90	18.90	0.00	1
6045.95	30.12	30.12	0.00	1
6046.91	40.18	40.18	0.00	1
6047.12	50.24	41.97	8.03	9
6047.18	60.30	42.55	17.65	5
6047.23	70.36	42.93	27.26	4
6047.28	80.42	43.36	37.02	4
6047.32	90.48	43.69	46.54	3
6047.36	100.54	43.96	56.36	3
6047.40	110.60	44.26	66.24	3
6047.03	41.21	41.21	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing E1

Table 5 - Culvert Summary Table: Culvert E1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
10.00	10.00	6044.46	1.479	0.0*	1-S2n	0.985	1.054	0.985	0.322	5.375	3.345
18.90	18.90	6045.11	2.135	0.063	1-S2n	1.431	1.470	1.431	0.463	6.303	4.139
30.12	30.12	6045.95	2.917	2.968	7-M2c	2.500	1.868	1.868	0.602	7.655	4.805
40.18	40.18	6046.91	3.833	3.930	7-M2c	2.500	2.132	2.132	0.706	9.011	5.255
50.24	41.97	6047.12	4.026	4.141	7-M2c	2.500	2.169	2.169	0.798	9.278	5.626
60.30	42.55	6047.18	4.091	4.202	7-M2c	2.500	2.181	2.181	0.881	9.366	5.943
70.36	42.93	6047.23	4.134	4.254	7-M2c	2.500	2.188	2.188	0.957	9.424	6.220
80.42	43.36	6047.28	4.182	4.298	7-M2c	2.500	2.196	2.196	1.027	9.490	6.468
90.48	43.69	6047.32	4.221	4.339	7-M2c	2.500	2.202	2.202	1.093	9.543	6.693
100.54	43.96	6047.36	4.252	4.378	7-M2c	2.500	2.207	2.207	1.155	9.585	6.899
110.60	44.26	6047.40	4.287	4.415	7-M2c	2.500	2.213	2.213	1.214	9.632	7.090

* Full Flow Headwater elevation is below inlet invert.

****

Straight Culvert

Inlet Elevation (invert): 6042.98 ft, Outlet Elevation (invert): 6042.58 ft

Culvert Length: 80.00 ft, Culvert Slope: 0.0050

****

Culvert Performance Curve Plot: Culvert E1

Water Surface Profile Plot for Culvert: Culvert E1

Site Data - Culvert E1

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 6042.98 ft

Outlet Station: 80.00 ft

Outlet Elevation: 6042.58 ft

Number of Barrels: 1

Culvert Data Summary - Culvert E1

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material:

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Grooved End Projecting

Inlet Depression: None

Table 6 - Downstream Channel Rating Curve (Crossing: Crossing E1)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
10.00	6042.90	0.32	3.34	0.50	1.11
18.90	6043.04	0.46	4.14	0.72	1.17
30.12	6043.18	0.60	4.80	0.93	1.21
40.18	6043.29	0.71	5.26	1.09	1.24
50.24	6043.38	0.80	5.63	1.23	1.26
60.30	6043.46	0.88	5.94	1.36	1.28
70.36	6043.54	0.96	6.22	1.48	1.29
80.42	6043.61	1.03	6.47	1.59	1.30
90.48	6043.67	1.09	6.69	1.69	1.31
100.54	6043.73	1.15	6.90	1.79	1.32
110.60	6043.79	1.21	7.09	1.88	1.33

Tailwater Channel Data - Crossing E1

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 8.00 ft

Side Slope (H:V): 4.00 (_:1)

Channel Slope: 0.0248

Channel Manning's n: 0.0300

Channel Invert Elevation: 6042.58 ft

Roadway Data for Crossing: Crossing E1

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 6047.03 ft

Roadway Surface: Paved

Roadway Top Width: 60.00 ft

Crossing Discharge Data – Culvert E2

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 10 cfs

Design Flow: 18.9 cfs

Maximum Flow: 110.6 cfs

Table 7 - Summary of Culvert Flows at Crossing: Crossing E2

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert E2 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6042.02	10.00	10.00	0.00	1
6042.67	18.90	18.90	0.00	1
6043.51	30.12	30.12	0.00	1
6044.42	40.18	40.18	0.00	1
6044.70	50.24	42.59	7.50	11
6044.76	60.30	43.14	17.03	5
6044.81	70.36	43.58	26.58	4
6044.86	80.42	43.98	36.34	4
6044.90	90.48	44.38	45.85	3
6044.94	100.54	44.72	55.65	3
6044.97	110.60	45.03	65.48	3
6044.61	41.83	41.83	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing E2

Table 8 - Culvert Summary Table: Culvert E2

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
10.00	10.00	6042.02	1.479	0.050	1-S2n	0.985	1.054	0.985	0.400	5.375	2.608
18.90	18.90	6042.67	2.135	0.223	1-S2n	1.431	1.470	1.431	0.573	6.303	3.207
30.12	30.12	6043.51	2.917	2.966	7-M2c	2.500	1.868	1.868	0.741	7.655	3.707
40.18	40.18	6044.42	3.833	3.885	7-M2c	2.500	2.132	2.132	0.866	9.011	4.045
50.24	42.59	6044.70	4.095	4.157	7-M2c	2.500	2.181	2.181	0.976	9.372	4.322
60.30	43.14	6044.76	4.157	4.219	7-M2c	2.500	2.192	2.192	1.076	9.456	4.557
70.36	43.58	6044.81	4.208	4.270	7-M2c	2.500	2.200	2.200	1.166	9.525	4.764
80.42	43.98	6044.86	4.254	4.316	7-M2c	2.500	2.207	2.207	1.250	9.587	4.949
90.48	44.38	6044.90	4.301	4.356	7-M2c	2.500	2.215	2.215	1.328	9.651	5.116
100.54	44.72	6044.94	4.341	4.395	7-M2c	2.500	2.220	2.220	1.402	9.704	5.270
110.60	45.03	6044.97	4.379	4.432	7-M2c	2.500	2.226	2.226	1.472	9.755	5.411

****

Straight Culvert

Inlet Elevation (invert): 6040.54 ft, Outlet Elevation (invert): 6040.19 ft

Culvert Length: 70.00 ft, Culvert Slope: 0.0050

****

Culvert Performance Curve Plot: Culvert E2

Water Surface Profile Plot for Culvert: Culvert E2

Site Data - Culvert E2

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 6040.54 ft

Outlet Station: 70.00 ft

Outlet Elevation: 6040.19 ft

Number of Barrels: 1

Culvert Data Summary - Culvert E2

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material:

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Grooved End Projecting

Inlet Depression: None

Table 9 - Downstream Channel Rating Curve (Crossing: Crossing E2)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
10.00	6040.59	0.40	2.61	0.29	0.79
18.90	6040.76	0.57	3.21	0.42	0.83
30.12	6040.93	0.74	3.71	0.54	0.86
40.18	6041.06	0.87	4.05	0.63	0.87
50.24	6041.17	0.98	4.32	0.71	0.89
60.30	6041.27	1.08	4.56	0.79	0.90
70.36	6041.36	1.17	4.76	0.85	0.91
80.42	6041.44	1.25	4.95	0.91	0.92
90.48	6041.52	1.33	5.12	0.97	0.93
100.54	6041.59	1.40	5.27	1.02	0.93
110.60	6041.66	1.47	5.41	1.07	0.94

Tailwater Channel Data - Crossing E2

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 8.00 ft

Side Slope (H:V): 4.00 (_:1)

Channel Slope: 0.0117

Channel Manning's n: 0.0300

Channel Invert Elevation: 6040.19 ft

Roadway Data for Crossing: Crossing E2

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 6044.61 ft

Roadway Surface: Paved

Roadway Top Width: 60.00 ft

Crossing Discharge Data – Culvert E3

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 10 cfs

Design Flow: 18.9 cfs

Maximum Flow: 110.6 cfs

Table 10 - Summary of Culvert Flows at Crossing: Crossing E3

Headwater Elevation (ft)	Total Discharge (cfs)	Culvert E3 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
6039.43	10.00	10.00	0.00	1
6040.08	18.90	18.90	0.00	1
6040.92	30.12	30.12	0.00	1
6041.86	40.18	40.18	0.00	1
6042.10	50.24	42.29	7.81	10
6042.16	60.30	42.82	17.35	5
6042.21	70.36	43.25	26.94	4
6042.26	80.42	43.60	36.75	4
6042.30	90.48	43.95	46.50	4
6042.34	100.54	44.30	56.10	3
6042.37	110.60	44.61	65.94	3
6042.01	41.48	41.48	0.00	Overtopping

Rating Curve Plot for Crossing: Crossing E3

Table 11 - Culvert Summary Table: Culvert E3

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
10.00	10.00	6039.43	1.479	0.162	1-S2n	0.985	1.054	0.985	0.542	5.375	1.817
18.90	18.90	6040.08	2.135	0.390	1-S2n	1.431	1.470	1.431	0.770	6.303	2.215
30.12	30.12	6040.92	2.917	2.967	7-M2c	2.500	1.868	1.868	0.990	7.655	2.545
40.18	40.18	6041.86	3.833	3.912	7-M2c	2.500	2.132	2.132	1.152	9.011	2.766
50.24	42.29	6042.10	4.062	4.149	7-M2c	2.500	2.176	2.176	1.294	9.326	2.948
60.30	42.82	6042.16	4.121	4.211	7-M2c	2.500	2.186	2.186	1.420	9.407	3.103
70.36	43.25	6042.21	4.170	4.261	7-M2c	2.500	2.194	2.194	1.536	9.474	3.239
80.42	43.60	6042.26	4.210	4.309	7-M2c	2.500	2.200	2.200	1.643	9.528	3.360
90.48	43.95	6042.30	4.251	4.351	7-M2c	2.500	2.207	2.207	1.742	9.583	3.470
100.54	44.30	6042.34	4.292	4.387	7-M2c	2.500	2.213	2.213	1.835	9.639	3.571
110.60	44.61	6042.37	4.328	4.423	7-M2c	2.500	2.219	2.219	1.923	9.688	3.664

****

Straight Culvert

Inlet Elevation (invert): 6037.95 ft, Outlet Elevation (invert): 6037.57 ft

Culvert Length: 76.00 ft, Culvert Slope: 0.0050

****

Culvert Performance Curve Plot: Culvert E3

Water Surface Profile Plot for Culvert: Culvert E3

Site Data - Culvert E3

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 6037.95 ft

Outlet Station: 76.00 ft

Outlet Elevation: 6037.57 ft

Number of Barrels: 1

Culvert Data Summary - Culvert E3

Barrel Shape: Circular

Barrel Diameter: 2.50 ft

Barrel Material:

Embedment: 0.00 in

Barrel Manning's n: 0.0130

Culvert Type: Straight

Inlet Configuration: Grooved End Projecting

Inlet Depression: None

Table 12 - Downstream Channel Rating Curve (Crossing: Crossing E3)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
10.00	6038.11	0.54	1.82	0.14	0.48
18.90	6038.34	0.77	2.22	0.19	0.50
30.12	6038.56	0.99	2.54	0.25	0.52
40.18	6038.72	1.15	2.77	0.29	0.53
50.24	6038.86	1.29	2.95	0.32	0.54
60.30	6038.99	1.42	3.10	0.35	0.55
70.36	6039.11	1.54	3.24	0.38	0.55
80.42	6039.21	1.64	3.36	0.41	0.56
90.48	6039.31	1.74	3.47	0.43	0.56
100.54	6039.41	1.84	3.57	0.46	0.56
110.60	6039.49	1.92	3.66	0.48	0.57

Tailwater Channel Data - Crossing E3

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 8.00 ft

Side Slope (H:V): 4.00 (_:1)

Channel Slope: 0.0040

Channel Manning's n: 0.0300

Channel Invert Elevation: 6037.57 ft

Roadway Data for Crossing: Crossing E3

Roadway Profile Shape: Constant Roadway Elevation

Crest Length: 100.00 ft

Crest Elevation: 6042.01 ft

Roadway Surface: Paved

Roadway Top Width: 60.00 ft

APPENDIX D3

OPEN CHANNEL HYDRAULIC CALCULATIONS

TABLE 10-2 (Continued)

TYPICAL ROUGHNESS COEFFICIENTS FOR OPEN CHANNELS

Type of Channel and Description	Minimum	Normal	Maximum
c. Concrete bottom float finished with sides of			
1. Dressed stone in mortar	0.015	0.017	0.020
2. Random stone in mortar	0.017	0.020	0.024
3. Cement rubble masonry, plastered	0.016	0.020	0.024
4. Cement rubble masonry	0.020	0.025	0.030
5. Dry rubble or riprap	0.020	0.030	0.035
d. Gravel bottom with sides of			
1. Formed concrete	0.017	0.020	0.025
2. Random stone in mortar	0.020	0.023	0.026
3. Dry rubble or riprap	0.023	0.033	0.036
e. Asphalt			
1. Smooth		0.013	
2. Rough		0.016	
f. Grassed	0.030	0.040	0.050

TABLE 10-3

MAXIMUM PERMISSIBLE DESIGN OPEN CHANNEL FLOW VELOCITIES IN EARTH*

Soil Types	Permissible Mean Channel Velocity (ft/sec)
Fine Sand (noncolloidal)	2.0
Coarse Sand (noncolloidal)	4.0
Sandy Loam (noncolloidal)	2.5
Silt Loam (noncolloidal)	3.0
Ordinary Firm Loam	3.5
Silty Clay	3.5
Fine Gravel	5.0
Stiff Clay (very colloidal)	5.0
Graded, Loam to Cobbles (noncolloidal)	5.0
Graded, Silt to Cobbles (colloidal)	5.5
Alluvial Silts (noncolloidal)	3.5
Alluvial Silts (colloidal)	5.0
Coarse Gravel (noncolloidal)	6.0
Cobbles and Shingles	5.5
Hard Shales and Hard Pans	6.0
Soft Shales	3.5
Soft Sandstone	8.0
Sound rock (usu. igneous or hard metamorphic)	20.0

* These velocities shall be used in conjunction with scour calculations and as approved by City/County.

TABLE 10-4

MAXIMUM PERMISSIBLE VELOCITIES FOR EARTH CHANNELS WITH VARIED GRASS LININGS AND SLOPES

Channel Slope	Lining	Permissible Mean Channel Velocity * (ft/sec)
0 - 5%	Sodded grass	7
	Bermudagrass	6
	Reed canarygrass	5
	Tall fescue	5
	Kentucky bluegrass	5
	Grass-legume mixture	4
	Red fescue	2.5
	Redtop	2.5
	Sericea lespedeza	2.5
	Annual lespedeza	2.5
	Small grains (temporary)	2.5
5 - 10%	Sodded grass	6
	Bermudagrass	5
	Reed canarygrass	4
	Tall fescue	4
	Kentucky bluegrass	4
	Grass-legume mixture	3
Greater than 10%	Sodded grass	5
	Bermudagrass	4
	Reed canarygrass	3
	Tall fescue	3
	Kentucky bluegrass	3

* For highly erodible soils, decrease permissible velocities by 25%.

* Grass lined channels are dependent upon assurances of continuous growth and maintenance of grass.

MAYBERRY, COLORADO SPRINGS - PHASE 1 PUD
(fka "ELLICOTT TOWN CENTER")
CHANNEL CALCULATIONS
DEVELOPED FLOWS

PROPOSED CHANNELS

CHANNEL	DESIGN POINT	PROPOSED SLOPE (%)	BOTTOM WIDTH (B, FT)	SIDE SLOPE (Z)	CHANNEL DEPTH (FT)	FRICTION FACTOR (n)	Q100 FLOW (CFS)	Q100 DEPTH (FT)	Q100 VELOCITY (FT/S)	Q100 MAX. SHEAR STRESS (PSF)	CHANNEL LINING
C1	EC11A*	0.40	12	4:1	3.0	0.030	160.8	2.0	4.0	0.5	GRASS
C2	C2.5B	0.40	8	4:1	2.0	0.030	31.8	1.0	2.6	0.3	GRASS
D	D1.5B	0.40	8	4:1	2.0	0.030	54.8	1.4	3.0	0.3	GRASS
E	EC10	0.50	8	4:1	2.0	0.030	110.6	1.8	4.0	0.6	GRASS

* EC11A FLOW = DP-EC11 (Q100=149.5 cfs) + DETENTION POND C1 DISCHARGE (Q100 = 11.3 cfs)

1) Channel flow calculations based on Manning's Equation
2) Channel depth includes 1' minimum freeboard
3) n = 0.03 for grass-lined non-irrigated channels (minimum)
4) Vmax = 5.0 fps for 100-year flows w/ grass-lined channels
5) Vmax = 8.0 fps for 100-year flows w/ Erosion Control Blankets (Tensar Eronet P300 or equal)

Hydraulic Analysis Report

Project Data

Project Title: Mayberry – Phase 1 PUD -Channels

Designer: JPS

Project Date: Thursday, July 19, 2018

Project Units: U.S. Customary Units

Notes:

Channel Analysis: Channel Analysis-C1

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Channel Width: 12.0000 ft

Longitudinal Slope: 0.0040 ft/ft

Manning's n: 0.0300

Flow: 160.8000 cfs

Result Parameters

Depth: 2.0241 ft

Area of Flow: 40.6774 ft^2

Wetted Perimeter: 28.6912 ft

Hydraulic Radius: 1.4178 ft

Average Velocity: 3.9531 ft/s

Top Width: 28.1929 ft

Froude Number: 0.5800

Critical Depth: 1.4917 ft

Critical Velocity: 5.9997 ft/s

Critical Slope: 0.0129 ft/ft

Critical Top Width: 23.93 ft

Calculated Max Shear Stress: 0.5052 lb/ft^2

Calculated Avg Shear Stress: 0.3539 lb/ft^2

Channel Analysis: Channel Analysis-C2

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0040 ft/ft

Manning's n: 0.0300

Flow: 31.8000 cfs

Result Parameters

Depth: 1.0182 ft

Area of Flow: 12.2918 ft^2

Wetted Perimeter: 16.3959 ft

Hydraulic Radius: 0.7497 ft

Average Velocity: 2.5871 ft/s

Top Width: 16.1453 ft

Froude Number: 0.5225

Critical Depth: 0.6977 ft

Critical Velocity: 4.2239 ft/s

Critical Slope: 0.0162 ft/ft

Critical Top Width: 13.58 ft

Calculated Max Shear Stress: 0.2541 lb/ft^2

Calculated Avg Shear Stress: 0.1871 lb/ft^2

Channel Analysis: Channel Analysis-D

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0040 ft/ft

Manning's n: 0.0300

Flow: 54.8000 cfs

Result Parameters

Depth: 1.3526 ft

Area of Flow: 18.1383 ft^2

Wetted Perimeter: 19.1536 ft

Hydraulic Radius: 0.9470 ft

Average Velocity: 3.0212 ft/s

Top Width: 18.8205 ft

Froude Number: 0.5423

Critical Depth: 0.9590 ft

Critical Velocity: 4.8280 ft/s

Critical Slope: 0.0149 ft/ft

Critical Top Width: 15.67 ft

Calculated Max Shear Stress: 0.3376 lb/ft^2

Calculated Avg Shear Stress: 0.2364 lb/ft^2

Channel Analysis: Channel Analysis-E

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0050 ft/ft

Manning's n: 0.0300

Flow: 110.6000 cfs

Result Parameters

Depth: 1.8206 ft

Area of Flow: 27.8242 ft^2

Wetted Perimeter: 23.0134 ft

Hydraulic Radius: 1.2090 ft

Average Velocity: 3.9750 ft/s

Top Width: 22.5652 ft

Froude Number: 0.6308

Critical Depth: 1.4214 ft

Critical Velocity: 5.6855 ft/s

Critical Slope: 0.0134 ft/ft

Critical Top Width: 19.37 ft

Calculated Max Shear Stress: 0.5680 lb/ft^2

Calculated Avg Shear Stress: 0.3772 lb/ft^2

APPENDIX E

COST ESTIMATE

MAYBERRY, COLORADO SPRINGS FILING NO. 1
(fka "ELLICOTT TOWN CENTER")
ENGINEER'S COST ESTIMATE
DRAINAGE IMPROVEMENTS

Item No.	Item	Quantity	Unit	Unit Cost ($$$)	Total Cost ($$$)
208	Erosion Control Blanket Channel Lining	1,715	SY	$6	$10,290
506	Riprap (d50 = 12")	20	CY	$98	$1,960
603	18" RCP Storm Sewer	309	LF	$65	$20,085
603	24" RCP Storm Sewer	982	LF	$78	$76,596
603	30" RCP Storm Sewer	278	LF	$97	$26,966
603	36" RCP Storm Sewer	811	LF	$120	$97,320
603	42" RCP Storm Sewer	619	LF	$160	$99,040
603	48" RCP Storm Sewer	311	LF	$195	$60,645
603	60" RCP Storm Sewer	117	LF	$288	$33,696
603	18" RCP FES	1	EA	$390	$390
603	30" RCP FES	1	EA	$582	$582
603	36" RCP FES	4	EA	$720	$2,880
603	42" RCP FES	2	EA	$960	$1,920
604	5' Type R Storm Inlet	3	EA	$5,542	$16,626
604	10' Type R Storm Inlet	8	EA	$7,627	$61,016
604	15' Type R Storm Inlet	1	EA	$9,918	$9,918
604	Storm Manhole	8	EA	$6,395	$51,160
604	Detention Pond Forebay	1	EA	$4,000	$4,000
604	Detention Pond Outlet Structure	2	EA	$8,000	$16,000
604	Detention Pond Spillway	1	EA	$3,000	$3,000
	TOTAL				**$594,090**

MAYBERRY, COLORADO SPRINGS FILING NO. 3
(fka "ELLICOTT TOWN CENTER")
ENGINEER'S COST ESTIMATE
DRAINAGE IMPROVEMENTS

Item No.	Item	Quantity	Unit	Unit Cost ($$$)	Total Cost ($$$)
603	18" RCP Storm Sewer	30	LF	$67	$2,010
603	24" RCP Storm Sewer	635	LF	$81	$51,435
603	30" RCP Storm Sewer	300	LF	$100	$30,000
604	5' Type R Storm Inlet	3	EA	$5,736	$17,208
604	10' Type R Storm Inlet	1	EA	$7,894	$7,894
	SUBTOTAL				$108,547
	Contingency @ 15%				$16,282
	TOTAL				**$124,829**

MAYBERRY, COLORADO SPRINGS FILING NO. 4
(fka "ELLICOTT TOWN CENTER")
ENGINEER'S COST ESTIMATE
DRAINAGE IMPROVEMENTS

Item No.	Item	Quantity	Unit	Unit Cost ($$$)	Total Cost ($$$)
506	Riprap (d50 = 12")	10	CY	$125	$1,250
603	18" RCP Storm Sewer	495	LF	$67	$33,165
603	24" RCP Storm Sewer	30	LF	$81	$2,430
603	30" RCP Storm Sewer	1780	LF	$100	$178,000
603	36" RCP Storm Sewer	155	LF	$124	$19,220
603	42" RCP Storm Sewer	110	LF	$166	$18,260
603	30" RCP FES	1	EA	$600	$600
603	42" RCP FES	2	EA	$996	$1,992
604	5' Type R Storm Inlet	9	EA	$5,736	$51,624
604	10' Type R Storm Inlet	1	EA	$7,894	$7,894
604	15' Type R Storm Inlet	2	EA	$10,265	$20,530
604	Storm Manhole	3	EA	$6,619	$19,857
604	Detention Pond D Forebay	1	EA	$4,000	$4,000
604	Detention Pond D Outlet Structure	1	EA	$8,000	$8,000
604	Detention Pond D Spillway	1	EA	$3,000	$3,000
	SUBTOTAL				$369,822
	Contingency @ 15%				$55,473
	TOTAL				**$425,295**

APPENDIX F

FIGURES

VICINITY MAP

NTS

N

NTS

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VICINITY MAP	JPS ENGINEERING	**MAYBERRY COLORADO SPRINGS**
		FIGURE A1 JPS PROJ NO. 090001

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 13 SOUTH, RANGE 63 WEST, AND TOWNSHIP 14 SOUTH, RANGE 63

REF: FIRM PANEL 08041C0810G, DATED 12/07/18

MAYBERRY, COLORADO SPRINGS	JPS ENGINEERING	FLOODPLAIN MAP
		FIGURE A3 JPS PROJ NO. 090001

Z:\090001.EllicottTC\dwg\Civil\FIG-A3.dwg Jan 31, 2020 - 9:52am

SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q5 (CFS)	Q100 (CFS)
1	4.9	34.4
2	11.3	28.0
3	8.7	60.8
4 (REFER TO MDDP)	5.5	42.2
5	30.6	174.9
6	19.1	111.4

LEGEND

OD1 / 296 AC. — DRAINAGE BASIN AREA (AC)

5 — DESIGN POINT

MAJOR BASIN LINE

BASIN LINE

N

ORIGINAL SCALE: 1"=1000'

1000 0 1000 2000

ELLICOTT TOWN CENTER

MAJOR BASIN / HISTORIC DRAINAGE PLAN

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

HORZ. SCALE: 1"=1000'	DRAWN: MJP
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: UP&E	CHECKED: JPS
CREATED: 12/3/00	LAST MODIFIED: 9/12/19
PROJECT NO: 090001	MODIFIED BY: BJJ

SHEET: EX1

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VICINITY MAP
NTS

LEGEND

- FILING LIMITS
- DRAINAGE BASIN BOUNDARY
- FLOWLINE
- 6520 — EXISTING CONTOUR
- PROPOSED FLOW DIRECTION ARROW
- 5 — DESIGN POINT
- A / 21.22 AC. — BASIN DESIGNATION / BASIN AREA (ACRES)

SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q5 (CFS)	Q100 (CFS)
OA1	2.9	20.1
1	4.9	34.4
2	11.3	28.0
OB1	2.3	15.7
3	8.7	60.8
4	5.5	42.2
(REFER TO ELLICOTT TOWN CENTER MDDP)		
EC11	24.4	149.5
5	30.5	174.9
EC10	18.9	110.6
6	19.1	111.4
(REFER TO FIL. 1 FDR–APP. B2)		

N

ORIGINAL SCALE: 1"=400'

400' 0 400' 800'

ELLICOTT TOWN CENTER

HISTORIC DRAINAGE PLAN

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19 E. Willamette Ave.
Colorado Springs, CO
80903
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FAX: 719-471-0766
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1-800-922-1987
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No.	REVISION	BY	DATE

HORZ. SCALE: 1"=400'	DRAWN: MJP
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: UP&E	CHECKED: JPS
CREATED: 12/03/00	LAST MODIFIED: 9/12/19
PROJECT NO: 090001	MODIFIED BY: BJJ

SHEET: EX2

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SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q5 (CFS)	Q100 (CFS)
1	11.3	51.9
1d	4.9	34.4
2	0	0
3	58.0	184.7
3d	8.7	60.8
4	5.8	12.3
(REFER TO MDDP)		
5	226.6	461.4
5d	27.1	174.2
6	19.0	111.0

LEGEND:

- PROPERTY LINES
- DRAINAGE BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- PROPOSED FLOW DIRECTION ARROW
- DESIGN POINT (5)
- "DETAINED" FLOW FROM DESIGN POINT (5d)
- DEVELOPED BASIN DESIGNATION (OA1)
- BASIN AREA (ACRES) (66.8 AC.)
- * CALCULATED EQUIVALENT AREAS
- SILT FENCE
- STRAW BALES
- RIPRAP
- 6490 EXISTING CONTOURS
- 6490 PROPOSED CONTOURS
- × 99.00 PROPOSED SPOT ELEVATION (FLOWLINE)
- 1.5% PROPOSED STREET PROFILE GRADE
- EDB EXTENDED DETENTION BASIN

N

300' 0 300' 600'

ORIGINAL SCALE: 1"=300'
(24"x36" SHEET)
CONTOUR INTERVAL: 2 FEET

VICINITY MAP
NTS

MAYBERRY, COLORADO SPRINGS

MASTER DEVELOPMENT DRAINAGE PLAN

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No.	REVISION	BY	DATE

HORZ. SCALE: 1"=300'	DRAWN: BJJ
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: RAMPART	CHECKED: JPS
CREATED: 12/03/00	LAST MODIFIED: 5/07/21
PROJECT NO: 090001	MODIFIED BY: BJJ

SHEET: D1

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ORIGINAL SCALE: 1"=200' (24"x36" SHEET)

200' 0 200' 400'

CONTOUR INTERVAL: 2 FEET

N

HYDROLOGY SUMMARY TABLE

DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
D2B	51.3	134.9
5	226.6	461.4
6	19.0	111.0

LEGEND:

- PROPERTY LINES
- DRAINAGE BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- PROPOSED FLOW DIRECTION ARROW
- DESIGN POINT (5)
- DEVELOPED BASIN DESIGNATION (OA1)
- BASIN AREA (ACRES) (66.8 AC)
- 6490 EXISTING CONTOURS
- 6490 PROPOSED CONTOURS
- 1.5% PROPOSED STREET PROFILE GRADE

MAYBERRY, COLORADO SPRINGS

PHASE 1 PUD DEVLOPED DRAINAGE PLAN

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CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

No.	REVISION	BY	DATE

HORZ. SCALE: 1"=200'	DRAWN: BJJ
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: RAMPART	CHECKED: JPS
CREATED: 12/03/00	LAST MODIFIED: 5/07/21
PROJECT NO: 090001	MODIFIED BY: BJJ
SHEET: D1.1	

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Please show the design points on the plan

LEGEND:

- PROPERTY LINES
- DRAINAGE BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- PROPOSED FLOW DIRECTION ARROW
- 5 — DESIGN POINT
- OA1 66.8 AC. — DEVELOPED BASIN DESIGNATION; BASIN AREA (ACRES)
- 6490 — EXISTING CONTOURS
- 6490 — PROPOSED CONTOURS
- 1.5% — PROPOSED STREET PROFILE GRADE

VICINITY MAP
NTS

N

ORIGINAL SCALE: 1"=100'

100' 0 100' 200'

CONTOUR INTERVAL: 2 FEET

SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q5 (CFS)	Q100 (CFS)
EC11	9.6	64.0
C1.1	5.4	18.0
C1.2	16.9	35.9
C1.3	5.9	14.3
C1.4	6.3	15.3
C1.5	6.2	15.6
C1.6	3.8	9.4
C1.7A	1.1	2.7
C1.7B	8.2	17.3
C1.8	7.5	18.4
C1.9	7.0	17.0
C1.9B	37.8	92.1
C1.10A	37.2	90.6

MAYBERRY, COLORADO SPRINGS - FILING NO. 1

FILING NO. 1 DEVELOPED DRAINAGE PLAN

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No.	REVISION	BY	DATE

HORZ. SCALE:	1"=100'	DRAWN:	BJJ
VERT. SCALE:	N/A	DESIGNED:	JPS
SURVEYED:	RAMPART	CHECKED:	JPS
CREATED:	12/03/00	LAST MODIFIED:	5/07/21
PROJECT NO:	090001	MODIFIED BY:	BJJ

SHEET: D2.1

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Please update the table and provide inlet/design points to be consistent with what was done on sheet D2.1

SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q5 (CFS)	Q100 (CFS)
C2.5B	12.7	31.8
D1.5B	35.1	78.0

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No.	REVISION	BY	DATE

MAYBERRY, COLORADO SPRINGS

FILING NO. 2-4 DEVELOPED DRAINAGE PLAN

HORZ. SCALE:	1"=100'	DRAWN:	BJJ
VERT. SCALE:	N/A	DESIGNED:	JPS
SURVEYED:	RAMPART	CHECKED:	JPS
CREATED:	3/28/19	LAST MODIFIED:	5/07/21
PROJECT NO:	090001	MODIFIED BY:	BJJ

SHEET: D2.2

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spillway crest length differs from the calculations.Please ensure the pond details match the calculations.

revise so that they match. The pond calculations indicate a 15" outlet pipe.

Revise so they are consistent with each other.

NOTES:

1. DIMENSIONS SHOWN ARE MINIMUMS AND APPLY TO FOREBAYS WITHIN MODIFIED EXTENDED DETENTION BASINS. FOREBAYS IN STANDARD EXTENDED DETENTION BASINS SHALL BE SIZED BASED ON UDFCD CRITERIA.
2. FOR DEPTH > 2.5-FEET, FOREBAY REQUIRES RAMP INTO BOTTOM AND ACCESS ROAD LEADING TO STREET.

INTEGRAL FOREBAY DETAIL E

ORIFICE PLATE NOTES:

1. MINIMIZE THE NUMBER OF COLUMNS.
2. PROVIDE GASKET MATERIAL BETWEEN THE ORIFICE PLATE AND CONCRETE.
3. BOLT PLATE TO CONCRETE 12" MAX. ON CENTER.

EURV AND WQCV TRASH RACKS:

1. WELL-SCREEN TRASH RACKS (FOR CIRCULAR ORIFICES) SHALL BE ATTACHED BY INTERMITTENT WELDS ALONG THE EDGE OF THE MOUNTING FRAME.
2. STRUCTURAL DESIGN OF TRASH RACKS SHALL BE BASED ON FULL HYDROSTATIC HEAD WITH ZERO HEAD DOWNSTREAM OF THE RACK.

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.
3. TRASH RACKS SHALL BE DESIGNED SUCH THAT THE DIAGONAL DIMENSION OF EACH OPENING IS SMALLER THAN THE DIAMETER OF THE OUTLET PIPE.
4. STRUCTURAL DESIGN OF TRASH RACKS SHALL BE BASED ON FULL HYDROSTATIC HEAD WITH ZERO HEAD DOWNSTREAM OF THE RACK.

ORIFICE PLATE AND TRASH RACK DETAILS AND NOTES B
NTS

Please provide a note that the pond details are for reference only. The pond construction details are approved with the construction drawings at the final plat stage. These may be removed from this preliminary drainage report.

NOTE: THIS PLAN WAS INITIALLY APPROVED AS SH. C1.5 WITHIN THE FILING NO. 1 GEC PLANS. CURRENT PLAN REVISIONS INCORPORATE UPDATES BASED ON THE FILING NO. 1A REPLAT.

MAYBERRY, COLORADO SPRINGS - PHASE 1 PUD

DETENTION POND C1 PLAN & DETAILS

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19 E. Willamette Ave.
Colorado Springs, CO 80903
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FAX: 719-471-0766
www.jpsengr.com

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No.	REVISION	BY	DATE
B	EPC COMMENTS	JPS	1/15/19
C	EPC COMMENTS	JPS	9/12/19
D	EPC COMMENTS	JPS	1/31/20
E	EPC COMMENTS	JPS	4/17/20
F	PUD AMENDMENT	JPS	5/07/21

HORZ. SCALE: 1"=50'	DRAWN: BJJ
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: RAMPART	CHECKED: JPS
CREATED: 4/4/06	LAST MODIFIED: 5/07/21
PROJECT NO: 090001	MODIFIED BY: BJJ

SHEET: C3.0

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MAYBERRY, COLORADO SPRINGS - PHASE 1 PUD

POND D PLAN

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

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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

HORZ. SCALE: 1"=40'	DRAWN: BJJ
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: RAMPART	CHECKED: JPS
CREATED: 11/20/20	LAST MODIFIED: 5/07/21
PROJECT NO: 090001	MODIFIED BY: BJJ
SHEET:	C3.1

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The calculations indicate a 6' by 6' outlet structure. revise so that the details and calculations are consistent.

PLAN VIEW
NTS

Please provide the 100 yr water surface elevation.

the spillway crest length is identified as 48' in the pond calculations. Please revise.

SECTION

TYPICAL DETENTION POND OUTLET STRUCTURE (A)

SCALE: NTS

ELEVATION
SCALE: NTS

ORIFICE PLATE NOTES:

1. MINIMIZE THE NUMBER OF COLUMNS.
2. PROVIDE GASKET MATERIAL BETWEEN THE ORIFICE PLATE AND CONCRETE.
3. BOLT PLATE TO CONCRETE 12" MAX. ON CENTER.

EURV AND WQCV TRASH RACKS:

1. WELL-SCREEN TRASH RACKS (FOR CIRCULAR ORIFICES) SHALL BE ATTACHED BY INTERMITTENT WELDS ALONG THE EDGE OF THE MOUNTING FRAME.
2. STRUCTURAL DESIGN OF TRASH RACKS SHALL BE BASED ON FULL HYDROSTATIC HEAD WITH ZERO HEAD DOWNSTREAM OF THE RACK.

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.
3. TRASH RACKS SHALL BE DESIGNED SUCH THAT THE DIAGONAL DIMENSION OF EACH OPENING IS SMALLER THAN THE DIAMETER OF THE OUTLET PIPE.
4. STRUCTURAL DESIGN OF TRASH RACKS SHALL BE BASED ON FULL HYDROSTATIC HEAD WITH ZERO HEAD DOWNSTREAM OF THE RACK.

ORIFICE PLATE AND TRASH RACK DETAILS AND NOTES (B)

NTS

SPILLWAY SECTION (C)

SCALE: 1"=10'

RESTRICTOR PLATE DETAIL (D)

SCALE: 1"=2'

TYPICAL CONCRETE TRICKLE CHANNEL (E)

NOT TO SCALE

indicate the required notch per the calculations

NOTES:

1. DIMENSIONS SHOWN ARE MINIMUMS AND APPLY TO FOREBAYS WITHIN MODIFIED EXTENDED DETENTION BASINS. FOREBAYS IN STANDARD EXTENDED DETENTION BASINS SHALL BE SIZED BASED ON UDFCD CRITERIA.
2. FOR DEPTH > 2.5-FEET, FOREBAY REQUIRES RAMP INTO BOTTOM AND ACCESS ROAD LEADING TO STREET.

there is no pipe shown on the plans. revise accordingly

INTEGRAL FOREBAY DETAIL (F)

MAYBERRY, COLORADO SPRINGS - PHASE 1 PUD

DETENTION POND D DETAILS

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No.	REVISION	BY	DATE

HORZ. SCALE:	N/A	DRAWN:	BJJ
VERT. SCALE:	N/A	DESIGNED:	JPS
SURVEYED:	RAMPART	CHECKED:	JPS
CREATED:	3/12/21	LAST MODIFIED:	5/07/21
PROJECT NO:	090001	MODIFIED BY:	BJJ

SHEET: C3.2

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