September 1, 2022

El Paso County Planning and Community Development Department
2880 International Circle, Suite 110
Colorado Springs, CO 80190

RE: EPC SF2219 – Mayberry Filing 3 Drainage Report Comment Response

The intent of this letter is to give a broad overview of changes between the initial Filing 3 Drainage Report submission and the 2nd submission. Responses to individual comments can be found on the marked up PDF following this letter. A broad overview of the changes are as follows:

- Overall, the previous drainage report submission contained multiple references to areas of the overall Mayberry development that were irrelevant to the analysis of the Filing 3 design. This resubmittal of the Filing 3 Drainage Report provides a tighter focus on Filing 3 and references other areas of the overall Mayberry development as needed.

- More defined channels are shown as part of this resubmittal where channels were shown to abruptly terminate previously. More specifically, channels C2 and E were extended to provide adequate outfalls. A new channel (Channel F) provides a stable conveyance for flows leaving Pond D. Previously, this was shown as a flow arrow with a note to daylight.

- Detention Pond D was redesigned to provide 3% slopes to trickle channels within the pond

- An additional forebay and trickle channel was added where Channel C2 discharges into the pond

- Some calculation methods differ as compared to the initial submittal:

    - Peak flow calculations using SCS curve numbers – Hydraflow Hydrographs
    - Storm Sewer Capacity – Bentley StormCAD
    - Culvert Capacity – Hydraflow Express
    - Channel Capacity – Hydraflow Express
    - Detailed inlet analysis provided using UD_Inlet

Clif Dayton, PE
R&R Engineers-Surveyors, Inc.
Department Manager
(303) 753-6730
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EPC STORMWATER REVIEW COMMENTS ARE SHOWN IN ORANGE BOXES WITH BLACK TEXT

FINAL DRAINAGE REPORT
for
MAYBERRY, COLORADO SPRINGS – FILING NO. 3

Prepared for:

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

May 17, 2022

Prepared by:

JPS ENGINEERING

revised

SF2219

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JPS Project No. 030502
EPC Project No. SF-22-___

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APPENDICES

DRAINAGE STATEMENT

Engineer's Statement:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for liability caused by negligent acts, errors or omissions on my part in preparing this report.

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.

Rick Scott

By: 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:

Please revise to Joshua Palmer, Interim County Engineer/ECM Administrator

revised

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. The Amended Mayberry, Colorado Springs Phase 1 PUD was approved by BOCC in April, 2022, which maintained the originally approved 240 Phase 1 lots, but revised various street and lot configurations based on current market conditions. Filing No. 3 comprises the easterly 142 residential lots within the Amended Phase 1 PUD.

B. Scope

This report has been prepared in support of the Final Plat application for Mayberry, Colorado Springs Filing No. 3. The report is intended to fulfill the El Paso County requirements for a Final Drainage Report (FDR).

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 preliminary 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. 3 comprises 105.8-acres in the northeast area of the Mayberry 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. 1-3 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.

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. 3 will be provided through construction of the New Log Road intersection at SH94. Secondary access will be provided through the Springs Road connection to SH94.

The intermittent streams throughout this area drain into the Black Squirrel Creek Basin which ultimately outfalls into the Arkansas River. The entire Phase 1 site (Filings No. 1-4) 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.

This should also include the prelim drainage report approved with the recent PUDSP amendment. Please add

revised

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 "Final Drainage Report for Mayberry, Colorado Springs – Filing No. 3" fully conforms to the previously approved MDDP and Preliminary/Final Drainage Reports, along with the "Preliminary Drainage Report Amendment for Mayberry, Colorado Springs Phase 1 PUD" dated February, 2022 prepared in support of the Phase 1 PUD Amendment.

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 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. 3 residential development.

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 drainage swales and gutters along the internal roads within the subdivision, conveying runoff flows through the site. The Amended PUD includes 4-foot minimum side-lot drainage easements, and the proposed easements are adequate for the required side-lot drainage swales to accommodate proper grading of the individual home sites.

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

Please clarify/elaborate regarding the outfall of Basin D. Per the existing drainage map the flow turns east into the Gillespie parcel at the southeast corner of the site due to a berm at this location. A comment has been provided on the drainage map to show the appropriate flow arrow on the map.

the outfall has been revised to convey water through a defined channel as opposed to the previous design

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.

Please provide sheet D2.1.

sheets have been renumbered

2. Developed Drainage Conditions

The developed drainage basins and pro[illegible] in Figures D1, D1.1, and D2.1-D2.2 (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[illegible] initial phase of the project impact Design Points #5 and #6.

EC11 does not impact Filing 3, therefore it has been removed from the report

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.

Please clarify. Flows from EC11 bypass Ponds C1 and D and combine with the pond flows at DP-5

filing 3

revised

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. Total detained peak flows at Design Point #5 are calculated as $Q_5 = 27.1$ cfs and $Q_{100} = 174.2$ cfs (below historic rates).

Are EC11 flows bypassing the ponds and outfalling onto Gillespie parcel at DP-6?

EC11 flows will not enter Pond D

These flows were updated in the recent filing 1 vacate replat drainage report to 27.1 cfs and 170.6 cfs. Please verify and ensure that the correct flows are represented in the report.

Filing No. 3

The west side of Filing No. 3, including the Filing No. 2 commercial area, has been delineated as Developed Basins C2.1-C2.9.

EC11 does not impact Filing 3, therefore it has been removed from the report

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.

via curb and gutter (typ)

Discuss the combined Qs

revised

writeup added at beginning of developed drainage basin section per the drainage plan and construction drawings, the runoff is conveyed on the south side to Inlet D1.5B. Please revise accordingly.

Please ensure that Basin C2.9, D1.3 & storm sewers C2.9, D1.3 account for flow from basin D1.1 as the grading for Positive Place and the inlets in Positive Place will not be constructed until Filing 4. Basin D1.1.

revised

revised

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.

Please identify that these are future inlets and storm sewers and that flow from this basin will sheet flow to Basins C2.9 and D1.3. Please be aware that further review of this storm system will be provided when filing 4 is submitted.

Combined flows from Basins C2.6-C2.9 will drain to Storm Sewer C2.9. Developed peak flows at Design Point #C2.9C (see Sh. D2.2, Appendix F) are calculated as Q_5 = 17.5 cfs and Q_{100} = 40.5 cfs (Rational Method).

The east side of Filing No. 3, including the Filing No. 4 commercial area, has been delineated as Developed Basins D1.1-D1.5. Storm Sewer D1.1-D1.5 con[illegible] 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.

revised

Basin D1.1 comprises the northwest part of the Filing No. 4 commercial area, which flows to Inlets D1.1A and D1.1B at the low point in Positive Place. Storm Sewer D1.1 conveys the flow from these inlets easterly along Positive Place to Inlets D1.2A-D1.2B near the easterly boundary of the subdivision. Basin D1.2 comprises the northeast part of the Filing No. 4 commercial area, flowing to Inlets D1.2A and D1.2B.

Please also indicate that flow from this basin will be conveyed to channel E in the interim as Positive place grading and these inlets are future facilities.

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

revised

Basin D1.4 flows southeast to Inlets D1.4A and D1.4B in E[illegible]ne, and Storm Sewer D1.3B consists of a 36" RCP extending south from Inlet D1.3B to Inlet D1.4A in El Reno Lane.

Basin D1.5 flows southeast to Inlet D1.5A in Mayberry Drive, and Storm Sewer D1.4B consists of a 36" RCP extending south in the Drainage and Utility Tract from Inlet D1.4B to Storm Manhole D1.5C 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. 3. Developed peak flows at Design Point #D1.5B are calculated as Q_5 = 34.7 cfs and Q_{100} = 77.3 cfs (Rational Method). Channel D will convey these flows south to Detention Pond D.

Basin C3 is the future park area south of Phase 1, which will generally flow southeasterly to Design Point #5, and Basin D2 encompasses the future residential area south of Phase 1 which will also flow into Detention Basin D.

Basin E encompasses the northeasterly fringe of the site. Off-site flows from Basin EC10 combine with flows from Basin E at Design Point #6, with developed peak flows calculated as Q_5 = 19.0 cfs and Q_{100} = 111.0 cfs (SCS Method). Off-site flows from the existing culvert crossing SH94 will be conveyed southeasterly through Channel E to the existing drainage swale along the east boundary of the subdivision.

C1 removed from Filing 3 report as it is irrelevant

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

Detention Pond C1 is 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. 3.

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} = 165.6 cfs (below historic rates).

Page 9 above indicates flows of 174.2 cfs. Revise accordingly.

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 [illegible] flows would sheet flow southeasterly along the public streets, flowing into Channels C2-C3, and Detention Pond D.

removed from Filing 3 report as it is irrelevant

There are no significant upstream developed areas and no existing off-site detention facilities impacting the Phase 1 area. In accordance with guidance in the City of Colorado Springs Drainage Criteria Manual (Chapter 6, Section 12.0), off-site Basin EC11 has been evaluated to ensure that the fully developed emergency conditions off-site flows can be safely conveyed through the Atchison Way corridor within the Mayberry site. As detailed in the HEC-HMS calculations in Appendix B2, the fully developed flows from Basin EC11 have been calculated as Q_5 = 49.2 cfs and Q_{100} = 196.0 cfs (SCS Method). In addition to the capacity of the 30" Storm Drain EC11, Atchison Way provides an allowable 100-year street capacity of approximately 215.2 cfs (see street capacity calculations in Appendix D1), which is sufficient to convey the emergency conditions off-site flows through the site within the right-of-way.

Please also analyze the fully developed emergency conditions for off-site flow from Basin EC10. Staffs concern at this stage is whether channel E has the capacity to contain this flow such that it would not affect the lots on the east side of Filing 3.

Per call with El Paso County on August 3, these upstream basins will have detention features when developed and flows will be reaching our site as less than the 100 year pre-developed rate. Therefore, developed flows were not used for our analysis of Basin EC10

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. Detention Pond C1 is a part of the Filing No. 1 development, and Detention Pond D will be constructed as part of the Filing No. 3 infrastructure.

The previously approved Final Drainage Reports for Filings No. 1 and 2 included a temporary Detention Pond C2.8 at the northwest corner of Springs Road and Besseyi Way to mitigate developed drainage impacts from the Filing No. 2 area. As stated in the Filing No. 2 Final Drainage Report, Temporary Detention Pond C2.8 "will meet stormwater detention and water quality requirements for the interim developed areas east of the Filing No. 1 lots until Detention Pond D is constructed during a future development phase. Future Detention Pond D will ultimately mitigate developed drainage impacts from the development areas south and east of Filing No. 1." At this time, the Mayberry developer plans to complete construction of Detention Pond D prior to completion of the first building within Filing No. 2, so Temporary Detention Pond C2.8 is not anticipated to be needed. However, the developer has previously posted financial assurances for construction of Temporary Detention Pond C2.8, and the temporary detention pond can be completed if needed based on project phasing.

Final pond sizing for Detention Pond D was performed based on a pond routing analysis utilizing the "MH-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)
D	144.2	6.4	12.3

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.

While conceptual locations for future detention ponds are depicted on Sh. D1 (Appendix E), the siting and capacity of future detention facilities will need to be further evaluated and confirmed with future phases of development.

E. On-Site Drainage Facility Design

revised

please delete

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

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

As this is not part of filing 3, it should be removed.

removed from Filing 3 report as it is irrelevant

<u>Filing No. 3</u>

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

Inlet D1.5B and/or the manhole before that

revised

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.

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"-24" RCP) will convey the flow from Inlets C2.4A-C2.4B south and west to Inlet C2.5 on Mayberry Drive.

Street drainage from Basin C2.5 will flow westerly along Solaire Loop to Galveston Terrace, and then flow south along the east side of Galveston Terrace to Mayberry Drive. Inlet C2.5 (15' Type R) will intercept surface drainage from the low point on the north side of Mayberry Drive, and Storm Sewer C2.5 (36" 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 = 13.5 cfs and Q_{100} = 33.7 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.

revised

36" is indicated on the drainage plan. revise accordingly,

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 = 17.5 cfs and Q_{100} = 40.5 cfs.

revised

south

The east side of Filing No. 3, including the Filing No. 4 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 36" RCP extending south in the Drainage and Utility Tract from Positive Place to Inlet D1.3A in Union Pacific Way.

Basin D1.4 flows southeast to Inlets D1.4A and D1.4B in El Reno Lane, and Storm Sewer D1.3B consists of a 36" RCP extending south from Inlet D1.3B to Inlet D1.4A in El Reno Lane.

Basin D1.5 flows southeast to Inlet D1.5A, 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 = 34.5 cfs and Q_{100} = 77.3 cfs (Rational Method). Channel D 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.

Hydraulic calculations for the proposed Culvert EC11 (30" RCP) which conveys the off-site flow from Basin EC11 south along Atchison Way to Channel C1 are detailed in Appendix D2. Historic flows from Basin EC11 are calculated as Q_5 = 24.4 cfs and Q_{100} = 149.5 cfs (SCS Method calculations per Appendix B2; note that this design flow w[illegible] on the Drainage Plan within the previous Filing No. 1 FDR). Recogn[illegible] allowable street capacity of Atchison Way (allowable 100-year [illegible] approximately 215.2 cfs per Appendix D1), the proposed 30" RCP culve[illegible] capacity to convey the off-site flow within the allowable criteria for loca[illegible]

channels will be lined with grass seed mixes as described in the revised report/plans

we have seen a lot of issues with ECB in the ditch flowlines, consider using TRM or permanent lining

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 estimate for Filing No. 3 drainage improvements is approximately $531,065.

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 drainage 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. The residential lots are platted within Filings No. 1 and 4, while Filings No. 2 and 3 consist of commercial / industrial development in the northeast corner of the subdivision. Filing No. 3 consists of 142 residential lots in the northeast area of the Mayberry development. The Mayberry, Colorado Springs development will generate an increase in developed runoff from the site, which will be mitigated through on-site stormwater detention and water quality facilities.

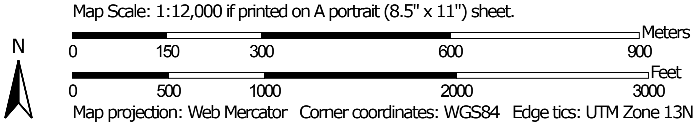
The proposed drainage patterns will remain consistent with historic conditions, and new drainage facilities constructed to El Paso County standards will safely convey runoff to adequate outfalls. Construction of the proposed Detention Ponds C1 and D southeast of the Phase 1 development areas will ensure 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.



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, side-oats 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, side-oats 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	Hydro-logic 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 maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

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

3.2.2 Travel Time

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

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

Where:

V = velocity (ft/s)

C_v = conveyance coefficient (from Table 6-7)

S_w = watercourse slope (ft/ft)

Table 6-7. Conveyance Coefficient, C_v

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

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

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

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

3.2.3 First Design Point Time of Concentration in Urban Catchments

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

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

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.

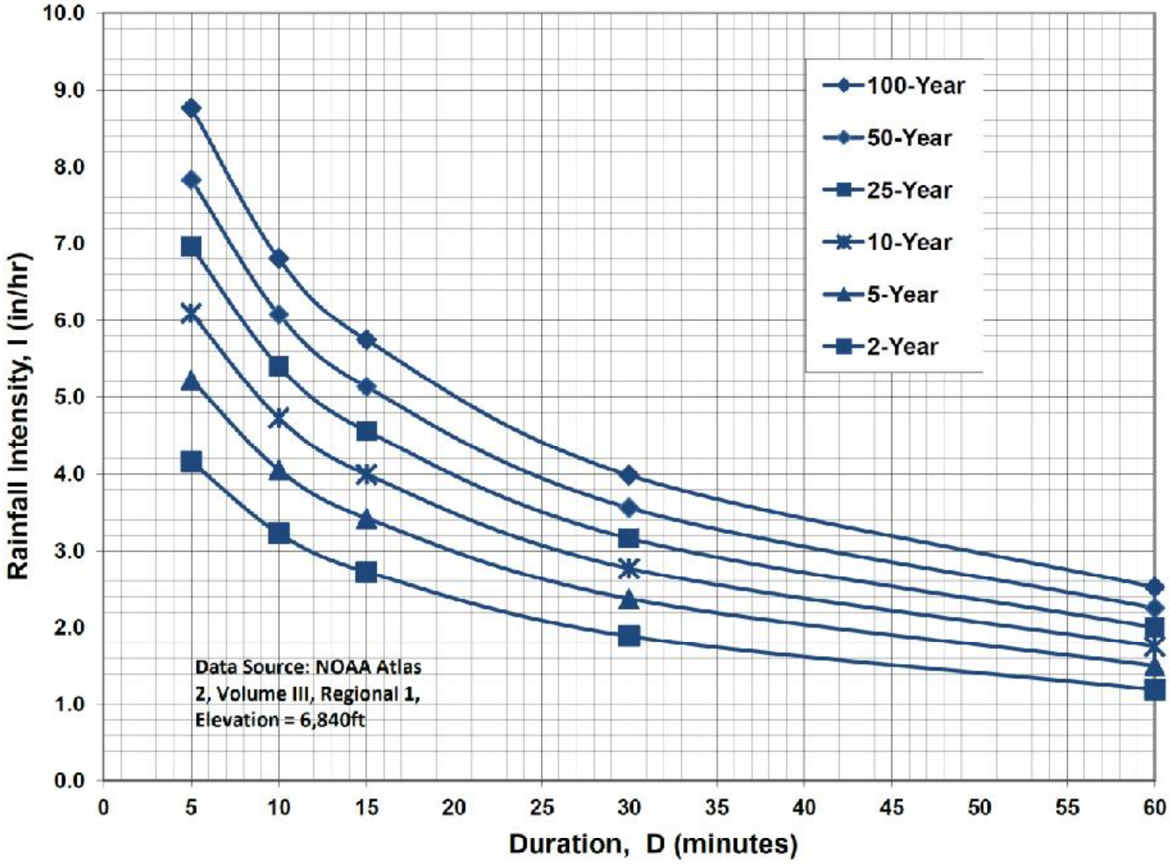
3.2.4 Minimum Time of Concentration

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	6.43	6.4	SF LOTS (1/6-AC)	0.375							0.375
C2.1-C2.3,C2.5	13.98										0.354
C2.4	2.89	2.9	SF LOTS (1/6-AC)	0.375							0.375
C2.1-C2.5	16.87										0.358
C3	20.25	20.3	PARK / OS	0.08							0.080
C2.1-C2.5,C3	37.12										0.206

C2.6	4.56	3.9	SF LOTS (1/6-AC)	0.375	0.7	LANDSCAPE / OS	0.08				0.330
C2.7	2.14	2.1	COMM / LT INDUSTRIAL	0.59							0.590
C2.8A	1.90	0.6	SF LOTS (1/6-AC)	0.375	1.4	COMM / LT INDUSTRIAL	0.59				0.528
C2.6-C2.8A	8.60										0.438
C2.8B	1.25	1.3	SF LOTS (1/6-AC)	0.375							0.375
C2.6-C2.8B	9.85										0.430
C2.9	5.52	5.0	SF LOTS (1/6-AC)	0.375	0.5	COMM / LT INDUSTRIAL	0.59				0.394
C2.6-C2.9	15.37										0.417
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	4.74	3.4	SF LOTS (1/6-AC)	0.375	1.3	COMM / LT INDUSTRIAL	0.59				0.434
D1.1-D1.3	12.25										0.530
D1.4	2.04	2.0	SF LOTS (1/6-AC)	0.375							0.375
D1.1-D1.4	14.29										0.508
D1.5	2.28	2.3	SF LOTS (1/6-AC)	0.375							0.375
D1.1-D1.5	16.57										0.489
C2.6-C2.9,D1.1-D1.5	31.94										0.455
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	76.52										0.389
C2,C3,D	**113.64**										**0.329**
C1-C3,D	**158.45**										**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	6.43	6.4	SF LOTS (1/6-AC)	0.545							0.545
C2.1-C2.3,C2.5	13.98										0.531
C2.4	2.89	2.9	SF LOTS (1/6-AC)	0.545							0.545
C2.1-C2.5	16.87										0.533
C3	20.25	20.3	PARK / OS	0.35							0.350
C2.1-C2.5,C3	37.12										0.433

C2.6	4.56	3.9	SF LOTS (1/6-AC)	0.545	0.7	LANDSCAPE / OS	0.35				0.515
C2.7	2.14	2.1	COMM / LT INDUSTRIAL	0.7							0.700
C2.8A	1.90	0.6	SF LOTS (1/6-AC)	0.545	1.4	COMM / LT INDUSTRIAL	0.7				0.655
C2.6-C2.8A	8.60										0.592
C2.8B	1.25	1.3	SF LOTS (1/6-AC)	0.545							0.545
C2.6-C2.8B	9.85										0.586
C2.9	5.52	5.0	SF LOTS (1/6-AC)	0.545	0.5	COMM / LT INDUSTRIAL	0.7				0.559
C2.6-C2.9	15.37										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	4.74	3.4	SF LOTS (1/6-AC)	0.545	1.3	COMM / LT INDUSTRIAL	0.7				0.588
D1.1-D1.3	12.25										0.656
D1.4	2.04	2.0	SF LOTS (1/6-AC)	0.545							0.545
D1.1-D1.4	14.29										0.641
D1.5	2.28	2.3	SF LOTS (1/6-AC)	0.545							0.545
D1.1-D1.5	16.57										0.627
C2.6-C2.9,D1.1-D1.5	31.94										0.603
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	76.52										0.556
C2,C3,D	**113.64**										**0.516**
C1-C3,D	**158.45**										**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

			C		Overland Flow			Channel flow							INTENSITY (5)		PEAK FLOW	
BASIN	DESIGN POINT	AREA (AC)	5-YEAR	100-YEAR	LENGTH (FT)	SLOPE (FT/FT)	Tco (1) (MIN)	CHANNEL LENGTH (FT)	CONVEYANCE COEFFICIENT C	SLOPE (FT/FT)	SCS (2) VELOCITY (FT/S)	Tt (3) (MIN)	TOTAL Tc (4) (MIN)	TOTAL 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	C1.6C	12.39	0.262	0.471									32.2	32.2	2.38	3.99	7.72	23.28
C1.1-C1.7	C1.7C	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
C1.1-C1.7, C1.9	C1.9A	39.10	0.375	0.545				272	20	0.01	2.00	2.3	34.4	34.4	2.27	3.82	33.35	81.34
Tt C1.7C 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										
BASIN	DESIGN POINT	AREA (AC)	C 5-YEAR	C 100-YEAR	LENGTH (FT)	SLOPE (FT/FT)	Tco (1) (MIN)	CHANNEL LENGTH (FT)	CONVEYANCE COEFFICIENT C	SLOPE (FT/FT)	SCS (2) VELOCITY (FT/S)	Tt (3) (MIN)	TOTAL Tc (4) (MIN)	TOTAL Tc (4) (MIN)	INTENSITY (5) 5-YR (IN/HR)	INTENSITY (5) 100-YR (IN/HR)	PEAK FLOW Q5 (6) (CFS)	PEAK FLOW Q100 (6) (CFS)
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	6.43	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	7.91	19.29
Tt C2.2 to C2.5								850	20	0.01	2.00	7.1						
C2.1-C2.3,C2.5	C2.5A	13.98	0.354	0.531									35.4	35.4	2.23	3.75	11.05	27.82
C2.4	C2.4	2.89	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	3.81	9.30
C2.1-C2.5	**C2.5B**	**16.87**	**0.358**	**0.533**									**35.4**	**35.4**	**2.23**	**3.75**	**13.49**	**33.70**
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	37.12	0.206	0.433									35.4	35.4	2.23	3.75	17.08	60.24
C2.6		4.56	0.330	0.515	100	0.020	11.2	860	20	0.01	2.00	7.2	18.4	18.4	3.22	5.40	4.84	12.69
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		1.90	0.528	0.655			0.0	250	20	0.012	2.19	1.9	1.9	5.0	5.17	8.68	5.19	10.80
Tt C2.6 to C2.8								250	20	0.032	3.58	1.2						
C2.6-C2.8A	C2.8A	8.60	0.438	0.592									19.5	19.5	3.13	5.25	11.77	26.71
C2.8B	C2.8B	1.25	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	1.79	4.37
C2.6-C2.8	C2.8C	9.85	0.430	0.586									19.5	19.5	3.13	5.25	13.24	30.28
C2.9	C2.9	5.52	0.394	0.559	100	0.010	12.9	710	20	0.01	2.00	5.9	18.8	18.8	3.18	5.34	6.91	16.47
PIPE C2.8-C2.9								510	20	0.005	1.41	6.0						
C2.6-C2.9	**C2.9C**	**15.37**	**0.417**	**0.576**									**25.5**	**25.5**	**2.72**	**4.57**	**17.45**	**40.46**
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	4.74	0.434	0.588	100	0.010	12.2	600	20	0.01	2.00	5.0	17.2	17.2	3.32	5.57	6.82	15.52
PIPE D1.3								330	20	0.01	2.00	2.8						
D1.1-D1.3	D1.3C	12.25	0.530	0.656									19.1	19.1	3.16	5.30	20.51	42.62
D1.4	D1.4	2.04	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	2.72	6.63
PIPE D1.4								270	20	0.01	2.00	2.3						
D1.1-D1.4	D1.4C	14.29	0.508	0.641									21.3	21.3	2.99	5.02	21.72	46.00
D1.5	D1.5	2.28	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	2.94	7.18
PIPE D1.5								210	20	0.02	2.83	1.2						
D1.1-D1.5	D1.5A	16.57	0.489	0.627									22.6	22.6	2.91	4.88	23.56	50.70
PIPE C2.9-D1.5								760	20	0.01	2.00	6.3						
C2.6-C2.9,D1.1-D1.5	**D1.5B**	**31.94**	**0.455**	**0.603**									**31.9**	**31.9**	**2.39**	**4.01**	**34.74**	**77.27**

					Overland Flow			Channel flow										
BASIN	DESIGN POINT	AREA (AC)	C 5-YEAR	C 100-YEAR	LENGTH (FT)	SLOPE (FT/FT)	Tco (1) (MIN)	CHANNEL LENGTH (FT)	CONVEYANCE COEFFICIENT C	SLOPE (FT/FT)	SCS (2) VELOCITY (FT/S)	Tt (3) (MIN)	TOTAL Tc (4) (MIN)	TOTAL Tc (4) (MIN)	INTENSITY (5) 5-YR (IN/HR)	INTENSITY (5) 100-YR (IN/HR)	PEAK FLOW Q5 (6) (CFS)	PEAK FLOW Q100 (6) (CFS)
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	76.52	0.389	0.556									62.6	62.6	1.38	2.31	41.01	98.28
C2,C3,D	**D2B**	**113.64**	**0.329**	**0.516**									62.6	**62.6**	**1.38**	**2.31**	**51.51**	**135.45**
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	Average % Impervious 3/	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					
1/8 acre or less (handwritten: <1/4-1/8 ac. lots)	65	77*	85 (handwritten: <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.

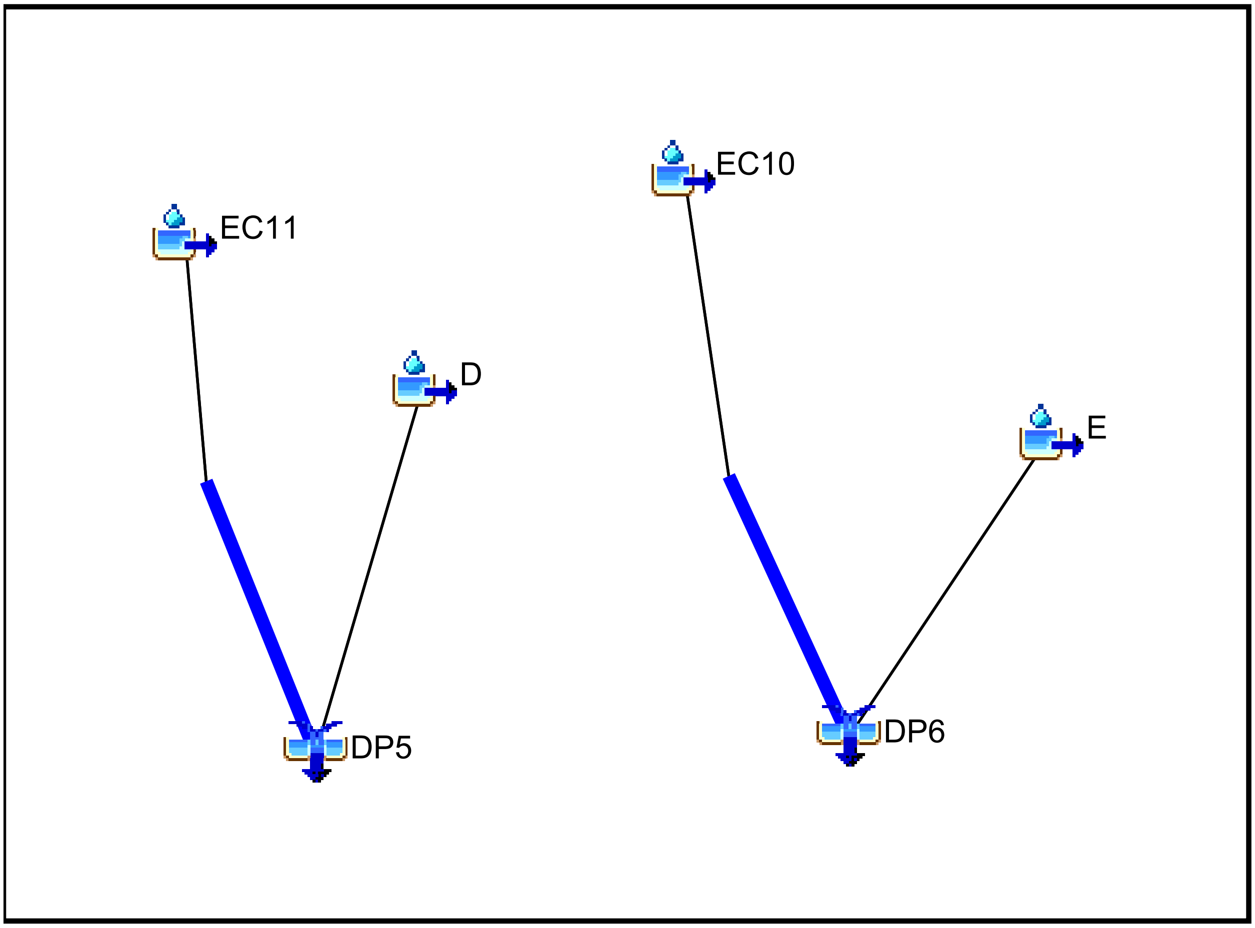
* Not to be used wherever overlot grading or filling is to occur.

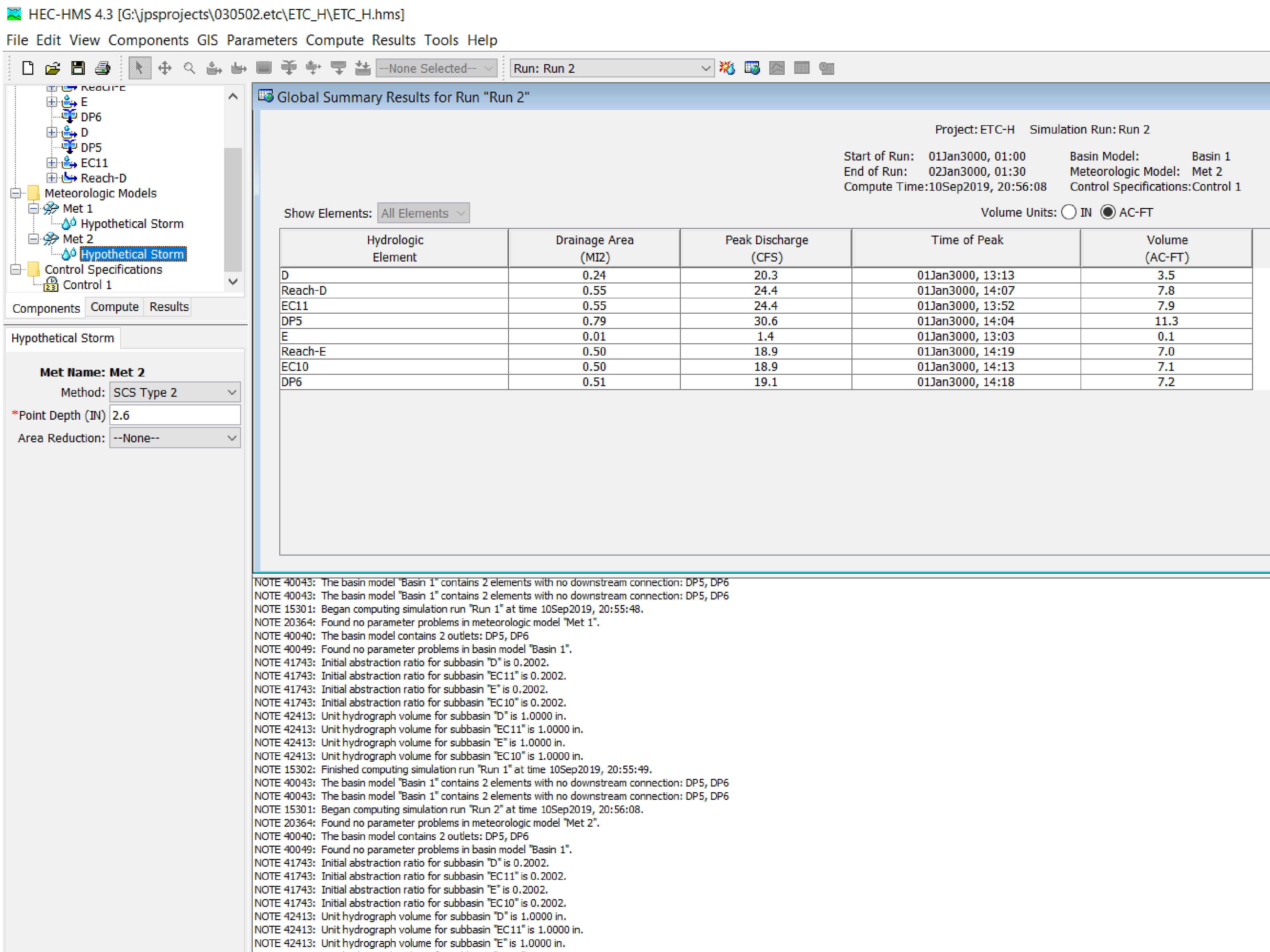
MAYBERRY, COLORADO SPRINGS (ELLICOTT TOWN CENTER)
COMPOSITE RUNOFF CURVE NUMBERS

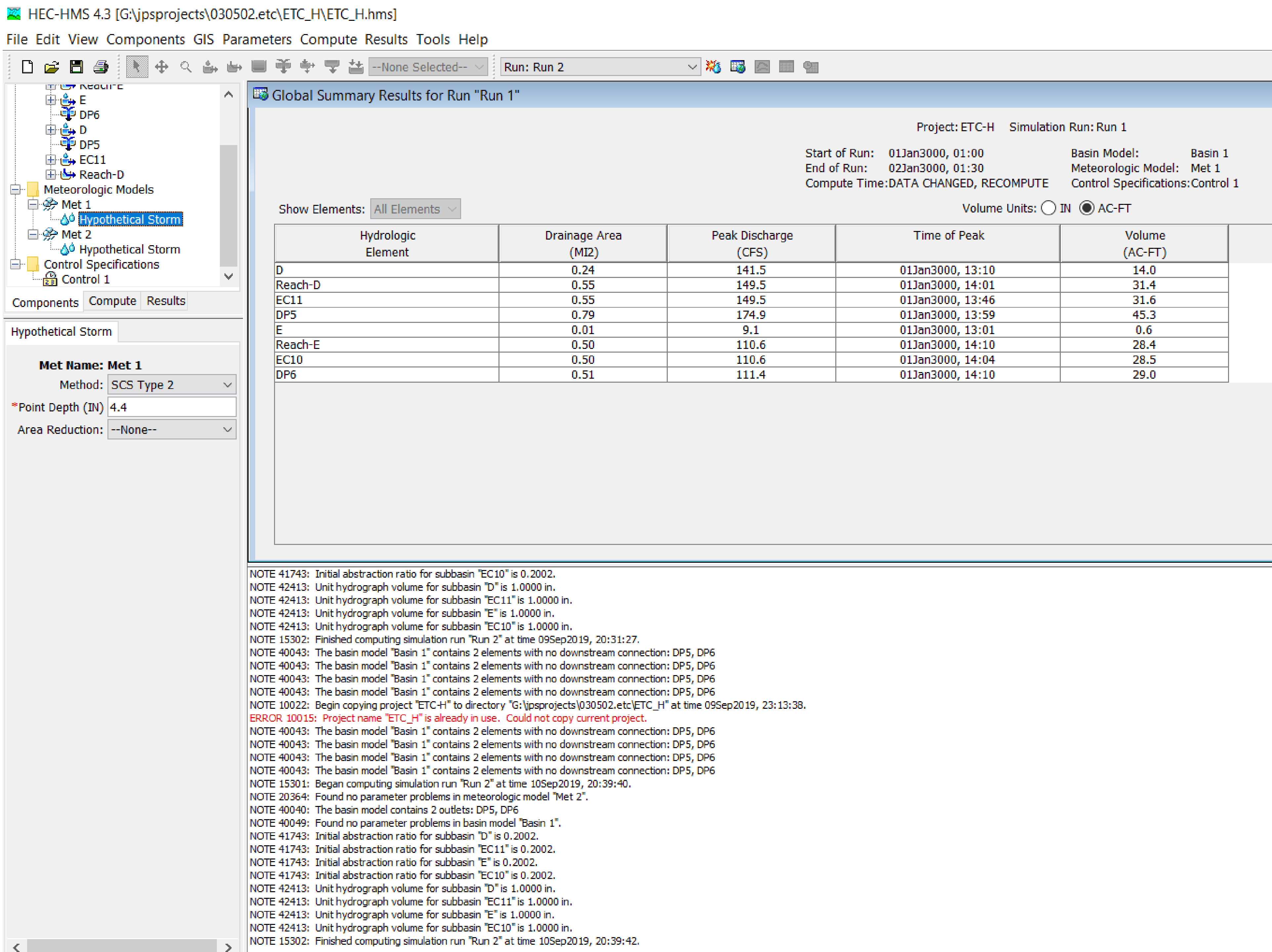
DEVELOPED CONDITIONS
CN-VALUES

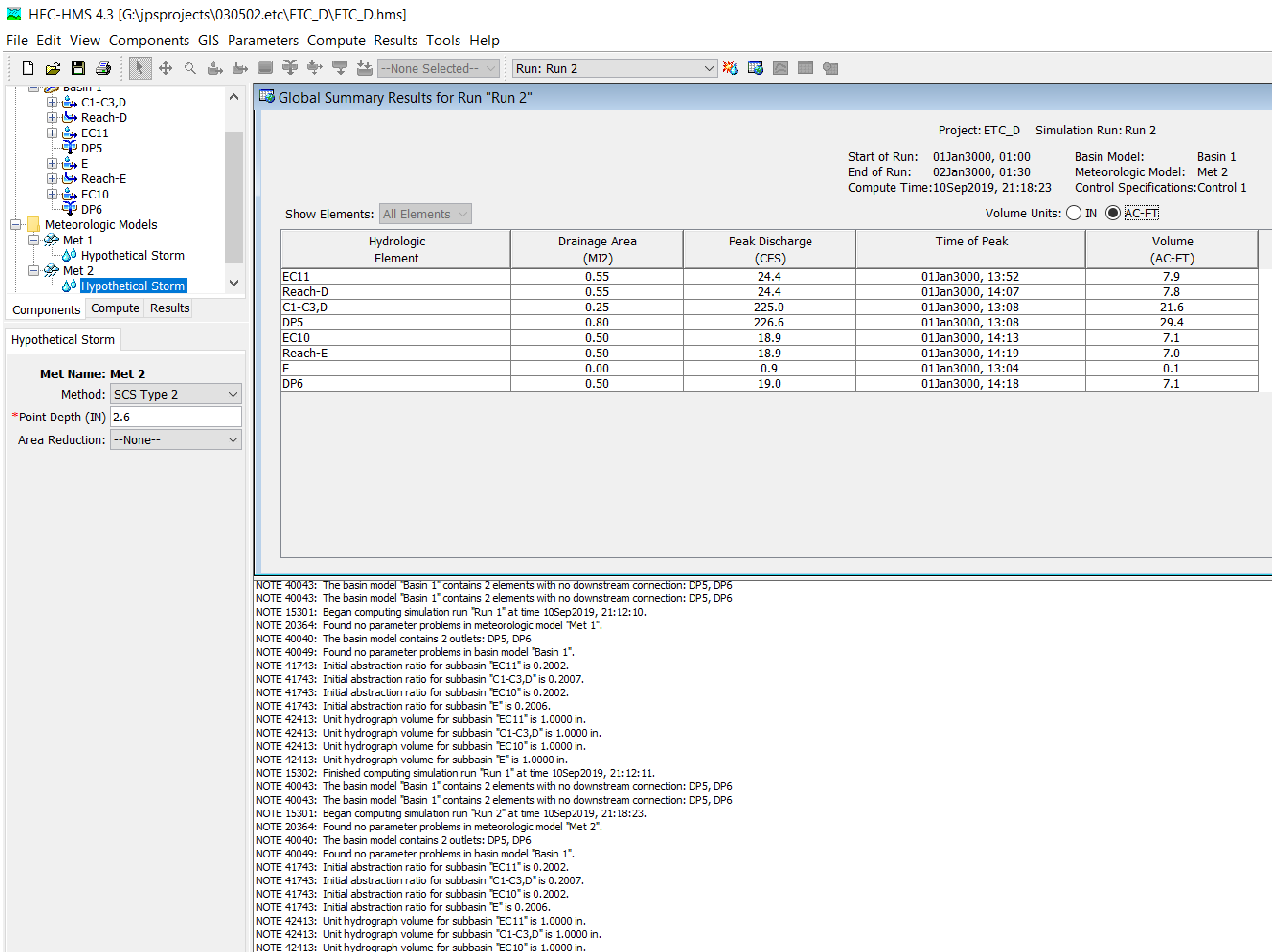
BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	CN	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	CN	(AC)	SUB-AREA 3)EVELOPMENT/ COVER	CN	WEIGHTED CN-VALUE
OA2	15.1	15.1	MEADOW	61							61.000
OA1	66.8	66.8	MEADOW	61							61.000
A	60.0	43.6	RESIDENTIAL	80	16.4	OPEN SPACE	61				74.805
OA2,OA1, A	141.9										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 (HISTORIC)	353.6	353.6	MEADOW	61							61.000
FOR EMERGENCY CONDITIONS UPSTREAM ANALYSIS:											
EC11 (DEVELOPED)	353.6	353.6	RURAL RES. (5-AC/DU)	63							63.000
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	3.01	3.0	SF LOTS (1/6-AC)	80							80.000
C1.1,C1.6	12.39										73.194
C1.1-C1.7	34.71										81.826
C1.8	3.89	3.9	SF LOTS (1/6-AC)	80							80.000
C1.9	4.39	4.4	SF LOTS (1/6-AC)	80							80.000
C1.8-C1.9	8.28										80.000
C1.1-C1.9	42.99										**81.475**
C1.10	1.82	1.8	SF LOTS (1/6-AC)	80							80.000
C1.1-C1.10	44.81										**81.415**

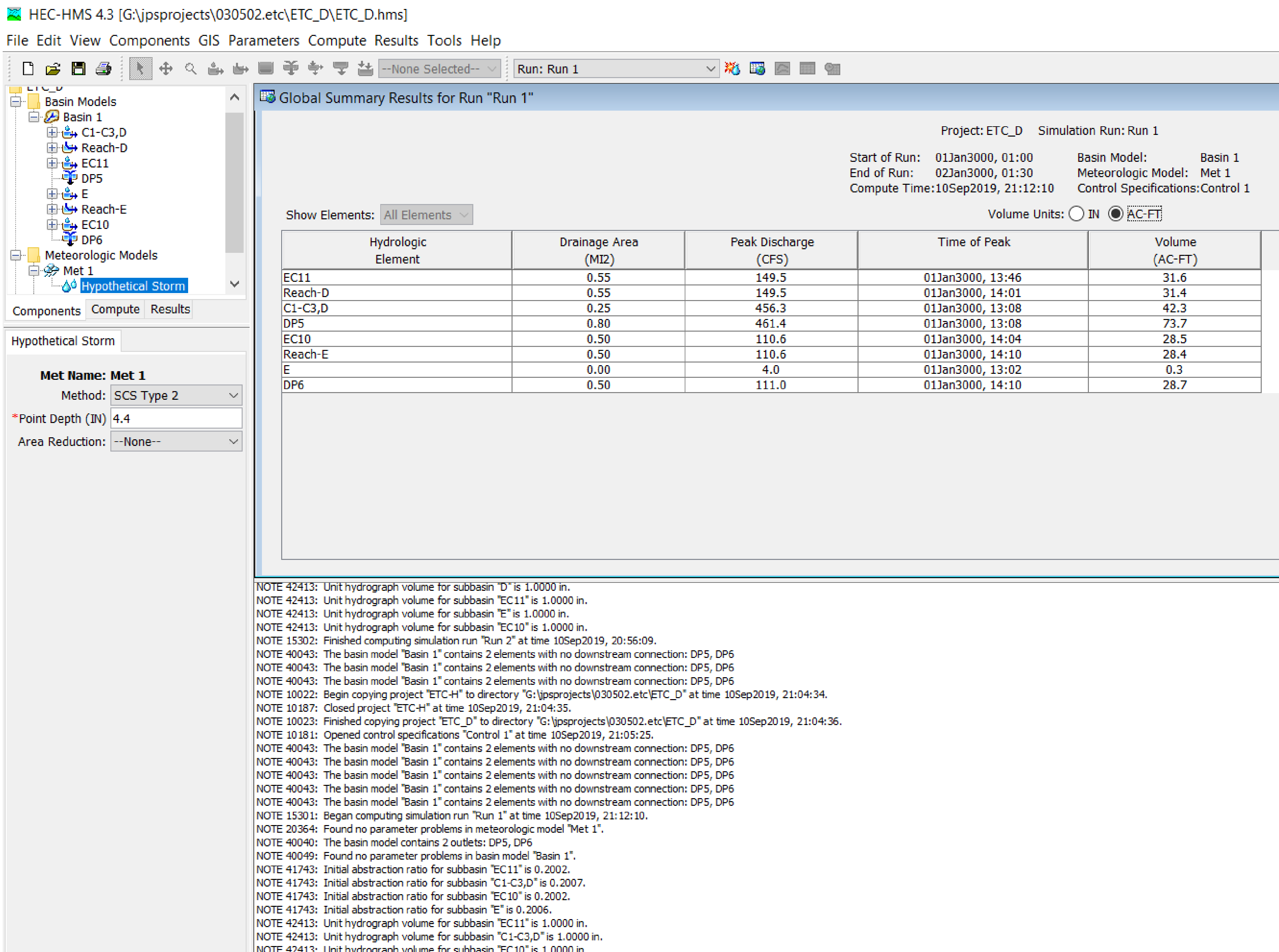
C2.1	2.55	1.6	SF LOTS (1/6-AC)	80	1.0	OPEN SPACE	61				72.549
C2.2	1.99	2.0	SF LOTS (1/6-AC)	80							80.000
C2.1-C2.3	4.54										75.815
C2.3	3.01	3.0	SF LOTS (1/6-AC)	80							80.000
C2.5	6.43	6.4	SF LOTS (1/6-AC)	80							80.000
C2.1-C2.3,C2.5	13.98										78.641
C2.4	2.89	2.9	SF LOTS (1/6-AC)	80							80.000
C2.1-C2.5	16.87										78.874
C3	20.25	20.3	PARK / OS	0.35							0.350
C2.1-C2.5,C3	37.12										36.037
C2.6	4.56	3.9	SF LOTS (1/6-AC)	80	0.7	LANDSCAPE / OS	61				77.083
C2.7	2.14	2.1	COMM / LT INDUSTRIAL	0.7							0.700
C2.8A	1.90	0.6	SF LOTS (1/6-AC)	80	1.4	COMM / LT INDUSTRIAL	92				88.526
C2.6-C2.8A	8.60										60.604
C2.8B	1.25	1.3	SF LOTS (1/6-AC)	80							80.000
C2.6-C2.8B	9.85										63.066
C2.9	5.52	5.0	SF LOTS (1/6-AC)	80	0.5	COMM / LT INDUSTRIAL	92				81.087
C2.6-C2.9	15.37										69.538
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	4.74	3.4	SF LOTS (1/6-AC)	80	1.3	COMM / LT INDUSTRIAL	92				83.291
D1.1-D1.3	12.25										32.658
D1.4	2.04	2.0	SF LOTS (1/6-AC)	80							80.000
D1.1-D1.4	14.29										39.416
D1.5	2.28	2.3	SF LOTS (1/6-AC)	80							80.000
D1.1-D1.5	16.57										45.000
C2.6-C2.9,D1.1-D1.5	31.94										56.808
D2	44.58	39.5	MDR-RESIDENTIAL	80	5.1	LANDSCAPE/OS	61				77.826
C2.6-C2.8,D1.1-D1.6,D2	76.52										69.053
C2,C3,D	**113.64**										**58.269**
C1-C3,D	**158.45**										**64.814**
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
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
End of Run: 02Jan3000, 01:30
Compute Time: 10Sep2019, 20:56:08
Basin Model: Basin 1
Meteorologic Model: Met 2
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.


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



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

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**

FULLY DEVELOPED FLOWS - FOR UPSTREAM EMERGENCY CONDITIONS ANALYSIS ONLY

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	63	5.87	1.17	7	1000	6.0	32.0	6180	6067	113	8945	1.69	1.3%	46.37	78.34	0.78	47.00	49.2	196.0

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**	**9.7**
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**	**6.4**
EC11,C,D - DETAINED	5d	511.6	0.80																			**27.1**	**165.6**

* 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 4.8 (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	2.89	2.9	SF LOTS (1/6-AC)	52.5							52.500
C2.5	6.43	6.4	SF LOTS (1/6-AC)	52.5							52.500
C2.1-C2.5	16.87										49.388
C3	20.25	20.3	PARK / OS	0							0.000
C2.1-C2.5,C3	37.12										22.445
C2.6	4.56	3.9	SF LOTS (1/6-AC)	52.5	0.7	LANDSCAPE / OS	0				44.441
C2.7	2.14	2.1	COMM / LT INDUSTRIAL	80							80.000
C2.8A	1.90	0.6	SF LOTS (1/6-AC)	52.5	1.4	COMM / LT INDUSTRIAL	80				72.039
C2.6-C2.8A	8.60										59.387
C2.8B	1.25	1.3	SF LOTS (1/6-AC)	52.5							52.500
C2.6-C2.8B	9.85										58.513
C2.9	5.52	5.0	SF LOTS (1/6-AC)	52.5	0.5	COMM / LT INDUSTRIAL	80				54.991
C2.6-C2.9	15.37										57.248

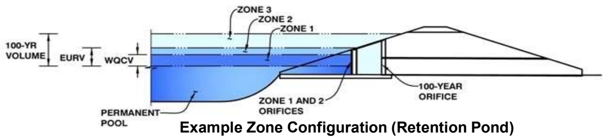
D1.1	4.89	4.9	COMM / LT INDUSTRIAL	80							80.000
D1.2	2.62	2.6	COMM / LT INDUSTRIAL	80							80.000
D1.1,D1.2	7.51										80.000
D1.3	4.74	3.4	SF LOTS (1/6-AC)	52.5	1.3	COMM / LT INDUSTRIAL	80				60.042
D1.1-D1.3	12.25										72.278
D1.4	2.04	2.0	SF LOTS (1/6-AC)	52.5							52.500
D1.1-D1.4	14.29										69.454
D1.5	2.28	2.3	SF LOTS (1/6-AC)	52.5							52.500
D1.1-D1.5	16.57										67.121
C2.6-C2.9,D1.1-D1.5	31.94										62.370
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	76.52										53.121
C2,C3,D	**113.64**										**43.101**
C1-C3,D	**158.45**										**45.530**
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 D



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	113.64	acres
Watershed Length =	4,300	ft
Watershed Length to Centroid =	2,150	ft
Watershed Slope =	0.010	ft/ft
Watershed Imperviousness =	43.10%	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) =	1.780	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	5.417	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	4.115	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	5.514	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	6.629	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	8.600	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	10.523	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	13.020	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	18.418	acre-feet	3.14	inches
Approximate 2-yr Detention Volume =	3.461	acre-feet		
Approximate 5-yr Detention Volume =	4.574	acre-feet		
Approximate 10-yr Detention Volume =	5.621	acre-feet		
Approximate 25-yr Detention Volume =	6.941	acre-feet		
Approximate 50-yr Detention Volume =	7.814	acre-feet		
Approximate 100-yr Detention Volume =	8.976	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.780	acre-feet
Zone 2 Volume (EURV - Zone 1) =	3.637	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	3.558	acre-feet
Total Detention Basin Volume =	8.976	acre-feet

Depth Increement = 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	--	--	--	69,877	1.604	34,941	0.802
	--	2.00	--	--	--	74,143	1.702	106,951	2.455
	--	4.00	--	--	--	82,977	1.905	264,071	6.062
	--	6.00	--	--	--	92,213	2.117	439,261	10.084
Spillway=6033.0	--	7.00	--	--	--	96,982	2.226	533,859	12.256
Top EL=6035.0	--	9.00	--	--	--	106,520	2.445	737,361	16.927
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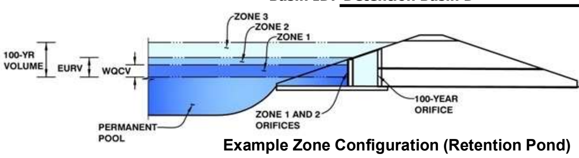
DETENTION BASIN OUTLET STRUCTURE DESIGN

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)	1.60	1.780	Orifice Plate
Zone 2 (EURV)	3.66	3.637	Orifice Plate
Zone 3 (100-year)	5.47	3.558	Weir&Pipe (Restrict)
Total (all zones)		8.976	

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	3.66	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	17.70	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.22	2.44					
Orifice Area (sq. inches)	15.75	14.00	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 =	5.00	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 =	5.00	N/A	feet
Overflow Weir Slope Length =	6.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	48.59	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 =	6.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.52	N/A	ft^2
Outlet Orifice Centroid =	0.29	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.23	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	48.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.95	feet
Stage at Top of Freeboard =	8.95	feet
Basin Area at Top of Freeboard =	2.44	acres
Basin Volume at Top of Freeboard =	16.81	acre-ft

Routed Hydrograph Results

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

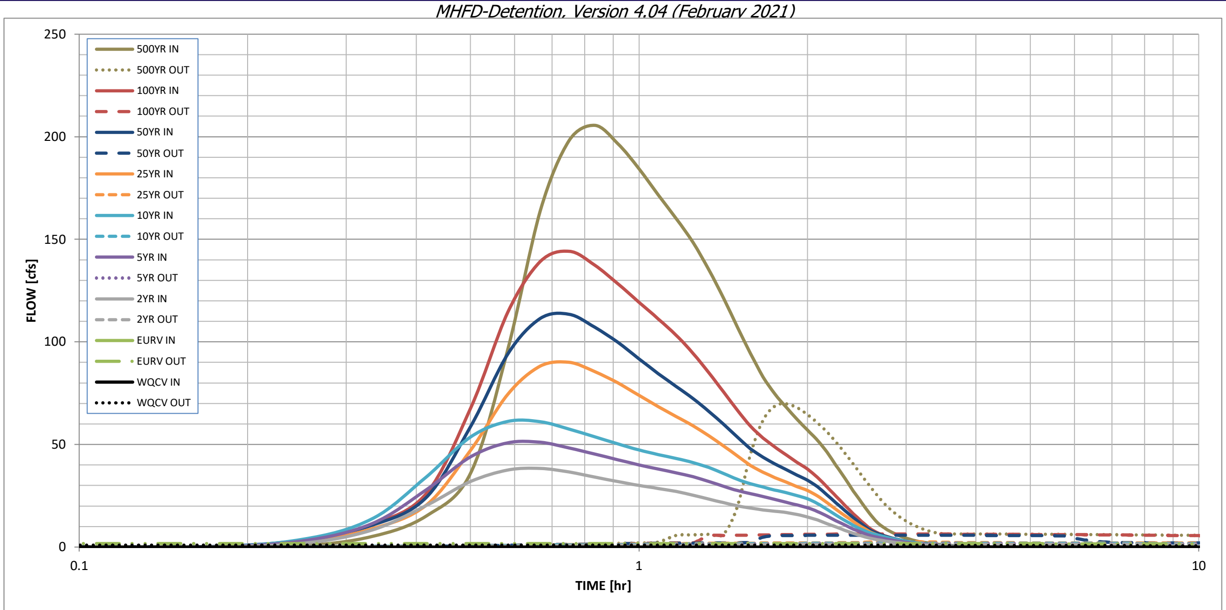
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.14
CUHP Runoff Volume (acre-ft) =	1.780	5.417	4.115	5.514	6.629	8.600	10.523	13.020	18.418
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	4.115	5.514	6.629	8.600	10.523	13.020	18.418
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.5	1.0	1.4	12.9	25.9	43.2	80.7
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	0.11	0.23	0.38	0.71
Peak Inflow Q (cfs) =	N/A	N/A	38.3	51.1	61.2	90.0	113.5	144.2	205.5
Peak Outflow Q (cfs) =	1.0	1.8	1.5	1.7	1.9	2.7	5.8	6.4	69.8
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.7	1.3	0.2	0.2	0.1	0.9
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Plate	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.0	0.1	0.2	0.2
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	67	59	68	74	84	85	88	84
Time to Drain 99% of Inflow Volume (hours) =	**40**	71	63	72	79	90	92	96	95
Maximum Ponding Depth (ft) =	1.60	3.66	2.78	3.52	4.09	5.06	5.82	6.89	7.56
Area at Maximum Ponding Depth (acres) =	1.66	1.87	1.78	1.86	1.91	2.02	2.10	2.21	2.29
Maximum Volume Stored (acre-ft) =	1.782	5.420	3.796	5.141	6.215	8.121	9.684	12.011	13.520

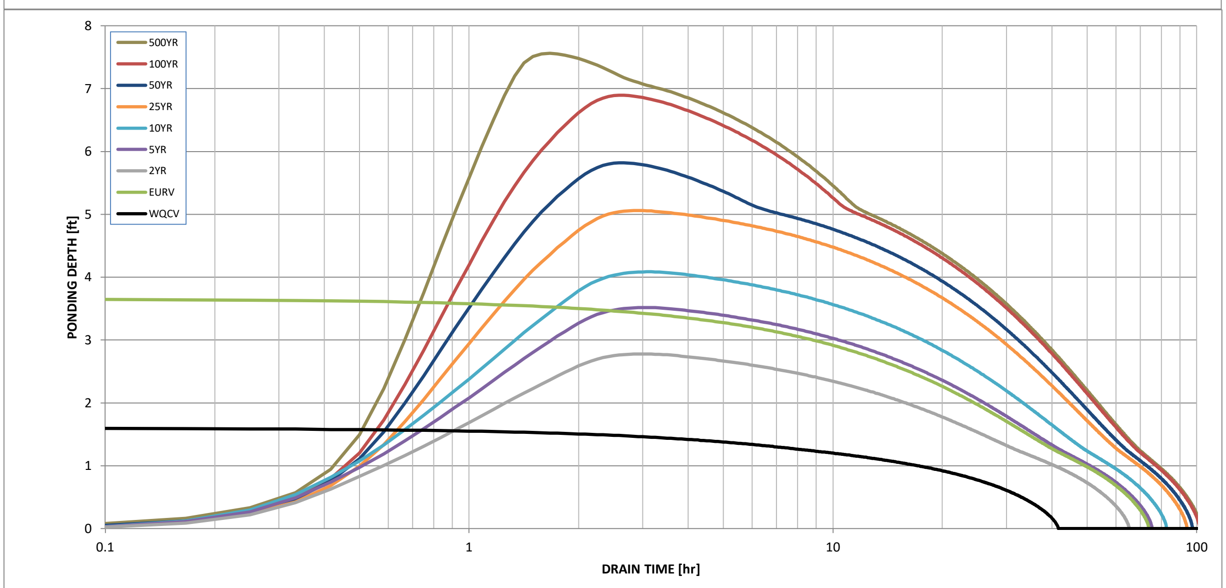
Ratio should be less than or equal to 1.

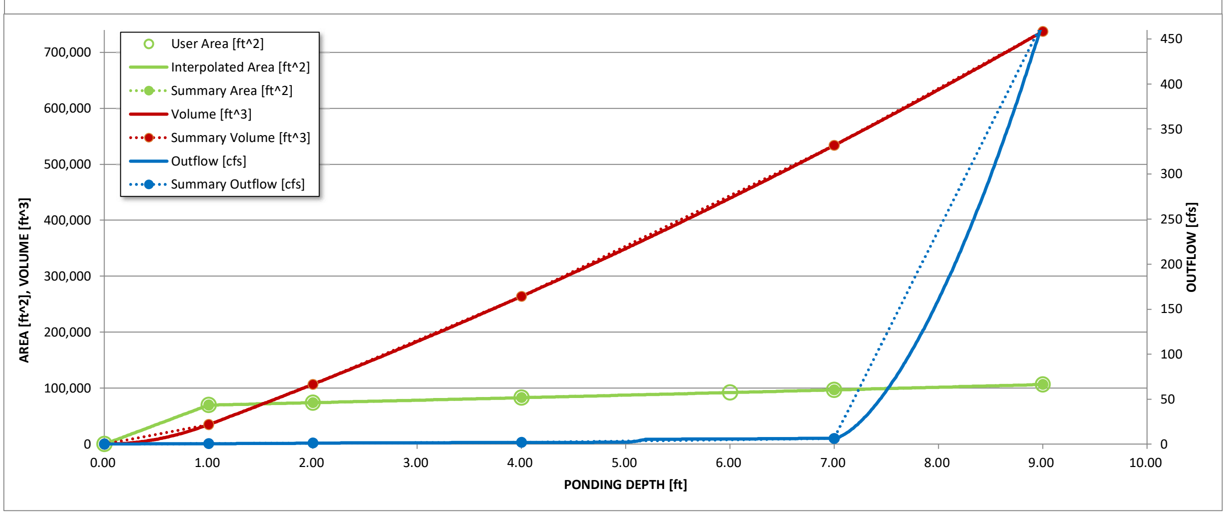
revised

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.

Time Interval: 5.00 min

SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
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]
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	0.68
0:15:00	0.00	0.00	1.81	2.94	3.67	2.48	3.32	3.08	5.09
0:20:00	0.00	0.00	8.23	11.36	13.63	8.81	10.60	11.02	15.13
0:25:00	0.00	0.00	20.20	27.89	34.17	20.42	24.08	26.06	35.79
0:30:00	0.00	0.00	31.91	43.94	53.58	47.08	58.59	67.41	96.48
0:35:00	0.00	0.00	37.56	50.82	61.20	74.55	94.13	114.45	163.77
0:40:00	0.00	0.00	38.31	51.07	61.07	88.17	111.36	139.08	198.03
0:45:00	0.00	0.00	36.55	48.34	57.49	90.00	113.49	144.20	205.52
0:50:00	0.00	0.00	34.12	45.35	53.77	85.54	107.16	137.45	196.71
0:55:00	0.00	0.00	31.93	42.60	50.39	80.03	99.82	128.42	184.44
1:00:00	0.00	0.00	30.02	39.98	47.33	74.02	91.81	119.42	171.51
1:05:00	0.00	0.00	28.58	37.96	45.10	68.44	84.53	111.16	159.96
1:10:00	0.00	0.00	27.07	36.20	43.16	63.57	78.25	103.08	148.30
1:15:00	0.00	0.00	25.29	34.26	41.16	59.00	72.29	94.33	135.16
1:20:00	0.00	0.00	23.43	31.98	38.74	54.18	66.11	84.97	121.18
1:25:00	0.00	0.00	21.63	29.62	35.87	49.24	59.80	75.52	107.15
1:30:00	0.00	0.00	20.08	27.52	32.99	44.39	53.63	66.73	94.22
1:35:00	0.00	0.00	18.95	26.01	30.87	39.81	47.86	58.85	82.85
1:40:00	0.00	0.00	18.13	24.66	29.24	36.48	43.77	53.18	74.64
1:45:00	0.00	0.00	17.45	23.23	27.81	33.87	40.53	48.79	68.13
1:50:00	0.00	0.00	16.81	21.83	26.47	31.61	37.72	44.92	62.35
1:55:00	0.00	0.00	15.89	20.50	25.12	29.51	35.09	41.36	57.07
2:00:00	0.00	0.00	14.69	19.17	23.54	27.55	32.62	37.98	52.07
2:05:00	0.00	0.00	13.17	17.33	21.22	24.91	29.38	33.93	46.27
2:10:00	0.00	0.00	11.43	15.08	18.39	21.67	25.47	29.32	39.80
2:15:00	0.00	0.00	9.75	12.84	15.58	18.41	21.54	24.76	33.45
2:20:00	0.00	0.00	8.15	10.72	12.94	15.27	17.76	20.33	27.31
2:25:00	0.00	0.00	6.70	8.79	10.59	12.42	14.33	16.26	21.63
2:30:00	0.00	0.00	5.42	7.09	8.57	9.82	11.17	12.48	16.37
2:35:00	0.00	0.00	4.38	5.73	7.02	7.55	8.44	9.16	11.97
2:40:00	0.00	0.00	3.62	4.76	5.88	5.93	6.62	7.00	9.13
2:45:00	0.00	0.00	3.03	4.01	4.95	4.78	5.33	5.52	7.13
2:50:00	0.00	0.00	2.53	3.36	4.14	3.90	4.34	4.38	5.58
2:55:00	0.00	0.00	2.12	2.80	3.44	3.17	3.52	3.47	4.37
3:00:00	0.00	0.00	1.77	2.32	2.85	2.59	2.87	2.75	3.42
3:05:00	0.00	0.00	1.47	1.91	2.35	2.11	2.34	2.18	2.68
3:10:00	0.00	0.00	1.23	1.58	1.94	1.74	1.92	1.76	2.15
3:15:00	0.00	0.00	1.01	1.29	1.59	1.42	1.56	1.44	1.75
3:20:00	0.00	0.00	0.82	1.04	1.27	1.14	1.26	1.16	1.41
3:25:00	0.00	0.00	0.66	0.82	1.01	0.91	1.00	0.93	1.13
3:30:00	0.00	0.00	0.51	0.64	0.78	0.71	0.77	0.72	0.87
3:35:00	0.00	0.00	0.38	0.48	0.59	0.53	0.58	0.54	0.65
3:40:00	0.00	0.00	0.27	0.34	0.43	0.39	0.42	0.39	0.46
3:45:00	0.00	0.00	0.18	0.23	0.29	0.26	0.28	0.26	0.30
3:50:00	0.00	0.00	0.11	0.15	0.18	0.16	0.17	0.15	0.18
3:55:00	0.00	0.00	0.06	0.09	0.09	0.09	0.09	0.08	0.08
4:00:00	0.00	0.00	0.02	0.04	0.04	0.03	0.03	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

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	10	0.000	0	0.000	0.00
Bot EL=6027.0	1.00	69,877	1.604	34,941	0.802	0.53
	2.00	74,143	1.702	106,951	2.455	1.16
	4.00	82,977	1.905	264,071	6.062	1.85
Spillway=6033.0	7.00	96,982	2.226	533,859	12.256	6.43
	9.00	106,520	2.445	737,361	16.927	468.93

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**JPS**
Company:	**JPS**
Date:	**May 14, 2022**
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 = 113.640 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}= 1.779 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: $EURV_{C/D} = 1.20 * i^{1.08}$	$EURV_{DESIGN}$ = 5.411 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} = 135.50 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 2.71 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: May 14, 2022
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} = 30.25 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} = 233 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 = 1,111 square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.) Other (Y/N): N	*S.S. Well Screen with 60% Open Area*
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 1851 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 3.66 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 71.92 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 25.7 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**JPS**
Company:	**JPS**
Date:	**May 14, 2022**
Project:	**Mayberry, Colorado Springs**
Location:	**Detention Basin D**

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:

APPENDIX D1

STREET CAPACITY & STORM SEWER HYDRAULIC CALCULATIONS

TABLE 6 - 1

Allowable Use of Streets in El Paso County

Street Classification	Use of Streets: Initial Storm	Use of Streets: Major Storm	Cross Flow In Streets: Initial Storm	Cross Flow In Streets: 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.

JPS ENGINEERING

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*
Springs Road (C2.8A)	1.0%	10.9	27.5	Yes
El Reno Lane (D1.4A)	1.0%	10.9	8.5	No*

*Inlets provided at sump locations

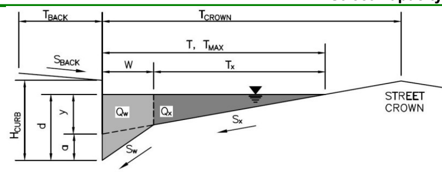
Version 4.05 Released March 2017

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. 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)
FLG. 3:									
C2.4A	C2.4	3.8	9.3	70	2.7	6.5	SUMP TYPE R	5.0	12.3
C2.4B	C2.4	3.8	9.3	30	1.1	2.8	SUMP TYPE R	5.0	12.3
C2.5A	C2.5A	11.1	27.8	100	11.1	27.8	SUMP TYPE R	15.0	39.1
C2.8A	C2.8A	11.8	26.7	100	11.8	26.7	SUMP TYPE R	15.0	39.1
C2.8B	C2.8B	1.8	4.4	100	1.8	4.4	SUMP TYPE R	5.0	12.3
C2.9A	C2.9	6.9	16.5	15	1.0	2.5	SUMP TYPE R	5.0	12.3
C2.9B	C2.9	6.9	16.5	85	5.9	14.0	SUMP TYPE R	10.0	25.5
FLG. 4 (COMM):									
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
FLG. 3:									
D1.3A	D1.3	6.8	15.5	85	5.8	13.2	SUMP TYPE R	5.0	12.3
D1.3B	D1.3	6.8	15.5	15	1.0	2.3	SUMP TYPE R	5.0	12.3
D1.4A	D1.4	2.7	6.6	85	2.3	5.6	SUMP TYPE R	5.0	12.3
D1.4B	D1.4	2.7	6.6	15	0.4	1.0	SUMP TYPE R	5.0	12.3
D1.5A	D1.5	2.9	7.2	100	2.9	7.2	SUMP TYPE R	5.0	12.3

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

As the capacity of the inlet is 12.3 cfs please identify where the flow-by will be conveyed to.

revised, we have included a specific inlet capacity analysis using UD_Inlet for each individual inlet in the revised report

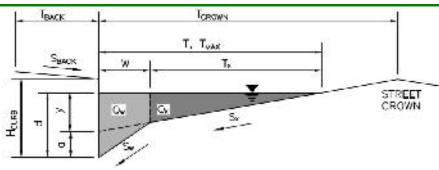
Version 4.05 Released March 2017

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)

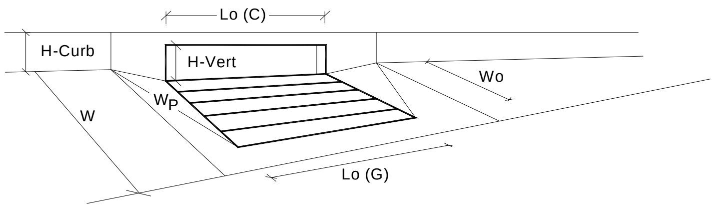
Description	Symbol	Value	Unit
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	12.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter 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

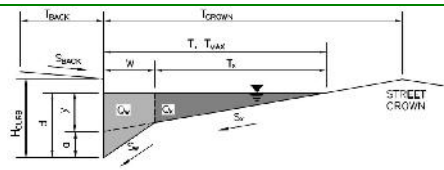
Version 4.05 Released March 2017

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)

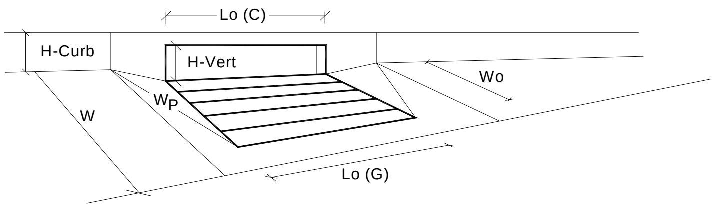
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	12.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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

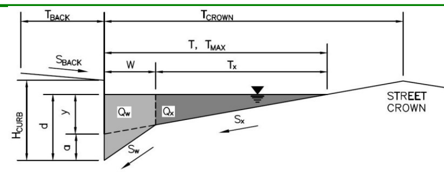
Version 4.05 Released March 2017

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)

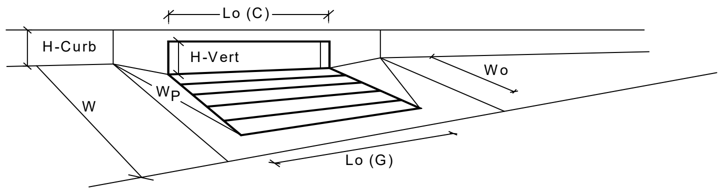
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	12.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
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

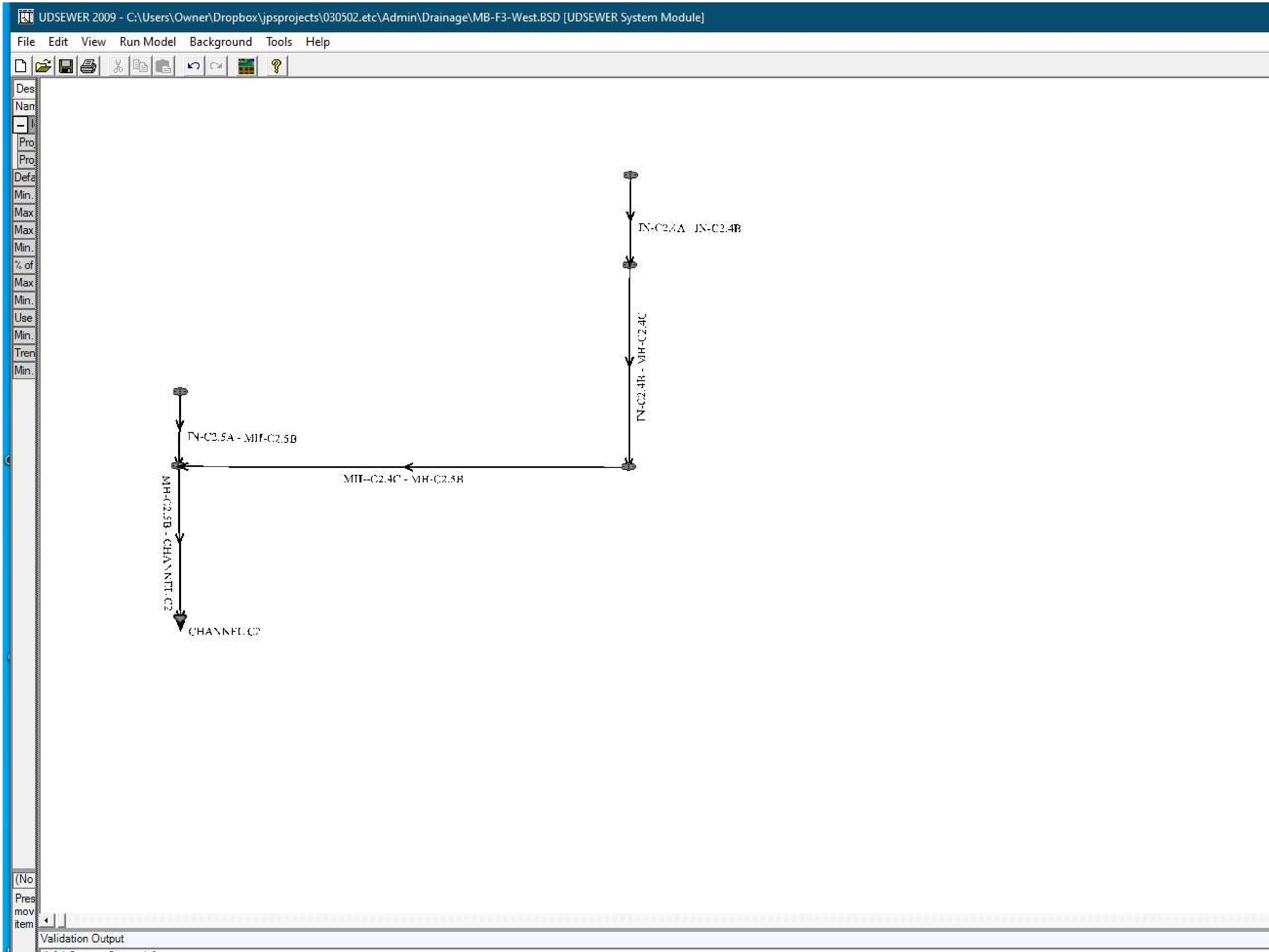


		MINOR	MAJOR	
Design Information (Input)	CDOT Type R Curb Opening			
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (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. 2-4
STORM SEWER SIZING SUMMARY

	PIPE FLOW			PIPE CAPACITY		
PIPE	INLETS / DP	Q5 FLOW (CFS)	Q100 FLOW (CFS)	PIPE SIZE	MIN. PIPE SLOPE	FULL PIPE CAPACITY (CFS)
FLG. 3:						
C2.4A	C2.4A	2.7	6.5	18	0.5%	7.4
C2.4B	C2.4A-C2.4B	3.8	9.3	24	0.5%	16.0
C2.5A	C2.5A	11.1	27.8	30	0.5%	29.0
C2.5B	DP-C2.5B	13.5	33.7	36	0.5%	47.2
C2.8A	C2.8A	11.8	26.7	30	0.5%	29.0
C2.8B	C2.8B	1.8	4.4	18	0.5%	7.4
C2.8C	DP-C2.8C	13.2	30.3	30	0.6%	31.8
C2.9A	C2.9	1.0	2.5	18	0.5%	7.4
C2.9B	DP-C2.9C	17.5	40.5	36	0.5%	47.2
FLG. 4 (COMM):						
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	D1.2A	4.2	8.3	18	1.0%	10.5
D1.2B	DP-D1.2C	15.0	29.9	30	0.8%	36.7
FLG. 3:						
D1.3A	DP-D1.3C	20.5	42.6	30	1.1%	43.0
D1.3B	DP-D1.3C	20.5	42.6	30	1.1%	43.0
D1.4A	DP-D1.4C	21.7	46.0	36	0.5%	47.2
D1.4B	DP-D1.4C	21.7	46.0	36	0.5%	47.2
D1.5A	DP-D1.5A	23.6	50.7	36	0.6%	51.7
D1.5B	DP-D1.5B	34.7	77.3	42	0.6%	77.9

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


UDSEWER 2009 - C:\Users\Owner\Dropbox\jpsprojects\030502.etc\Admin\Drainage\MB-F3-West.BSD [UDSEWER System Module]
File Edit View Run Model Background Tools Help
IN-C2.5A - MH-C2.5B
MH-C2.5B - CHANNEL-C2
CHANNEL-C2
Validation Output

UDSewer Results Summary - Mayberry F3 – West SD – 100-Yr Analysis

Project Title: New UDSEWER System Module
Project Description: Default system

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System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in): 2.52
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 12.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6046.15

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
CHANNEL C2	6050.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH-C2.5B - CHANNEL C2	6050.70	33.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IN-C2.5A - MH-C2.5B	6050.70	27.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH--C2.4C - MH-C2.5B	6053.08	9.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IN-C2.4B - MH-C2.4C	6054.60	9.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IN-C2.4A - IN-C2.4B	6054.46	6.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
CHANNEL C2	0.00	0.00	0.00	0.00	0.00	2.96	11.40	0.40	33.70	
MH-C2.5B - CHANNEL C2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.70	
IN-C2.5A - MH-C2.5B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.80	
MH--C2.4C - MH-C2.5B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.30	
IN-C2.4B - MH-C2.4C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.30	
IN-C2.4A - IN-C2.4B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.50	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
MH-C2.5B - CHANNEL C2	114.50	6045.00	0.5	6045.57	0.013	0.03	1.00	CIRCULAR	36.00 in	36.00 in
IN-C2.5A - MH-C2.5B	6.00	6046.07	1.0	6046.13	0.013	0.05	1.00	CIRCULAR	30.00 in	30.00 in
MH--C2.4C - MH-C2.5B	313.27	6046.57	0.6	6048.50	0.013	1.32	1.00	CIRCULAR	24.00 in	24.00 in
IN-C2.4B - MH-C2.4C	135.29	6048.60	0.5	6049.28	0.013	0.05	1.00	CIRCULAR	24.00 in	24.00 in
IN-C2.4A - IN-C2.4B	38.33	6049.78	0.9	6050.11	0.013	0.05	1.00	CIRCULAR	18.00 in	18.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
MH-C2.5B - CHANNEL C2	47.18	6.67	22.62	7.21	22.50	7.25	1.01	Supercritical	33.70	0.00	
IN-C2.5A - MH-C2.5B	41.13	8.38	21.57	7.36	18.07	9.00	1.41	Supercritical	27.80	0.00	
MH--C2.4C - MH-C2.5B	17.81	5.67	13.07	5.32	12.31	5.73	1.12	Supercritical	9.30	0.00	
IN-C2.4B - MH-C2.4C	16.08	5.12	13.07	5.32	13.10	5.30	1.00	Subcritical	9.30	0.00	
IN-C2.4A - IN-C2.4B	9.77	5.53	11.83	5.28	10.73	5.92	1.21	Supercritical	6.50	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	Peak Flow (cfs)	Cross Section	Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	Comment
MH-C2.5B - CHANNEL C2	33.70	CIRCULAR	36.00 in	36.00 in	33.00 in	33.00 in	36.00 in	36.00 in	7.07	
IN-C2.5A - MH-C2.5B	27.80	CIRCULAR	30.00 in	30.00 in	27.00 in	27.00 in	30.00 in	30.00 in	4.91	
MH--C2.4C - MH-C2.5B	9.30	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	
IN-C2.4B - MH-C2.4C	9.30	CIRCULAR	24.00 in	24.00 in	21.00 in	21.00 in	24.00 in	24.00 in	3.14	
IN-C2.4A - IN-C2.4B	6.50	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	

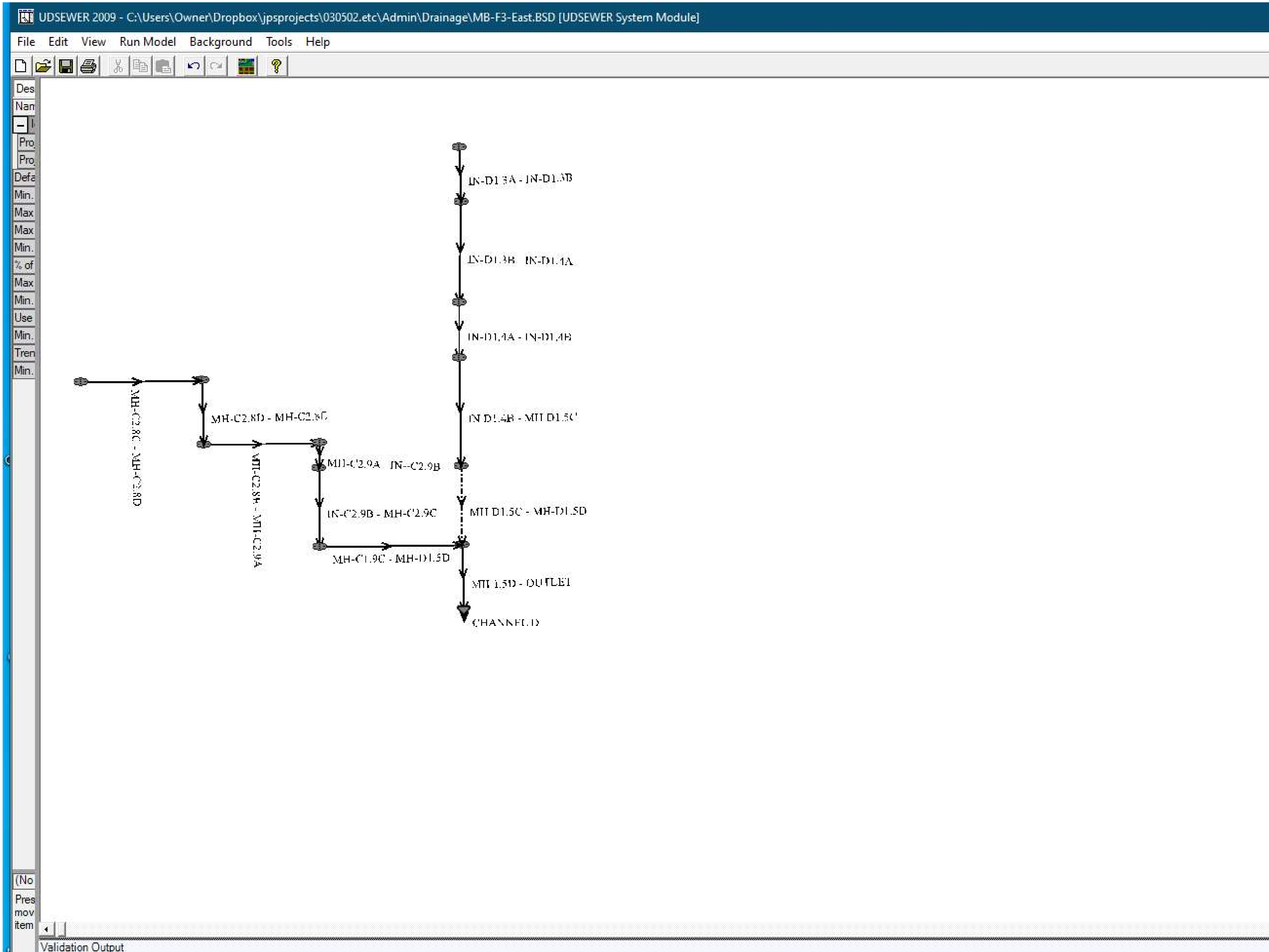
- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6046.15

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	**Downstream (ft)**	**Upstream (ft)**	**Bend Loss (ft)**	**Lateral Loss (ft)**	**Downstream (ft)**	**Upstream (ft)**	**Downstream (ft)**	**Friction Loss (ft)**	**Upstream (ft)**
MH-C2.5B - CHANNEL C2	6045.00	6045.57	0.00	0.00	6046.87	6047.45	6047.69	0.57	6048.26
IN-C2.5A - MH-C2.5B	6046.07	6046.13	0.02	0.00	6047.58	6048.19	6048.83	0.00	6048.83
MH--C2.4C - MH-C2.5B	6046.57	6048.50	0.18	0.22	6048.52	6049.59	6048.66	1.37	6050.03
IN-C2.4B - MH-C2.4C	6048.60	6049.28	0.01	0.00	6049.69	6050.37	6050.13	0.68	6050.81
IN-C2.4A - IN-C2.4B	6049.78	6050.11	0.01	0.00	6050.67	6051.10	6051.22	0.31	6051.53

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.


UDSEWER 2009 - C:\Users\Owner\Dropbox\jpsprojects\030502.etc\Admin\Drainage\MB-F3-East.BSD [UDSEWER System Module]
File Edit View Run Model Background Tools Help
IN-D1.3A - IN-D1.3B
IN-D1.3B - IN-D1.4A
IN-D1.4A - IN-D1.4B
IN-D1.4B - MH-D1.5C
MH-D1.5C - MH-D1.5D
MH-D1.5D - OUTLET
CHANNEL D
MH-C2.8C - MH-C2.8D
MH-C2.8D - MH-C2.8C
MH-C2.8B - MH-C2.9A
MH-C2.9A - IN-C2.9B
IN-C2.9B - MH-C2.9C
MH-C1.9C - MH-D1.5D
Validation Output

UDSewer Results Summary – Mayberry F3 – East SD – 100-Yr Analysis

Project Title: New UDSEWER System Module
Project Description: Default system

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System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in): 2.52
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 12.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6035.45

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
CHANNEL D	6039.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH 1.5D - OUTLET	6039.41	77.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH D1.5C - MH-D1.5D	6039.41	50.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IN D1.4B - MH D1.5C	6041.67	46.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IN-D1.4A - IN-D1.4B	6041.67	46.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IN-D1.3B - IN-D1.4A	6045.22	42.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IN-D1.3A - IN-D1.3B	6045.22	42.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH-C1.9C - MH-D1.5D	6048.74	40.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IN-C2.9B - MH-C2.9C	6044.73	40.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH-C2.9A - IN--C2.9B	6044.73	40.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

MH-C2.8E - MH-C2.9A	6044.91	30.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH-C2.8D - MH-C2.8E	6048.63	30.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MH-C2.8C - MH-C2.8D	6048.30	30.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	**Overland Time (min)**	**Gutter Time (min)**	**Basin Tc (min)**	**Intensity (in/hr)**	**Local Contrib (cfs)**	**Coeff. Area**	**Intensity (in/hr)**	**Manhole Tc (min)**	**Peak Flow (cfs)**	**Comment**
CHANNEL D	0.00	0.00	0.00	0.00	0.00	6.61	11.70	0.06	77.30	
MH 1.5D - OUTLET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	77.30	
MH D1.5C - MH-D1.5D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.70	
IN D1.4B - MH D1.5C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.00	
IN-D1.4A - IN-D1.4B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.00	
IN-D1.3B - IN-D1.4A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.60	
IN-D1.3A - IN-D1.3B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.60	
MH-C1.9C - MH-D1.5D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.50	
IN-C2.9B - MH-C2.9C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.50	
MH-C2.9A - IN--C2.9B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.50	
MH-C2.8E - MH-C2.9A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.30	
MH-C2.8D - MH-C2.8E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.30	
MH-C2.8C - MH-C2.8D	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.30	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
MH 1.5D - OUTLET	30.27	6033.86	0.6	6034.04	0.013	0.03	1.00	CIRCULAR	42.00 in	42.00 in
MH D1.5C - MH-D1.5D	63.00	6034.14	0.6	6034.52	0.013	0.05	0.00	ELLIPSE	34.00 in	53.00 in
IN D1.4B - MH D1.5C	135.08	6034.52	0.7	6035.51	0.013	0.05	1.00	CIRCULAR	36.00 in	36.00 in
IN-D1.4A - IN-D1.4B	38.33	6035.51	0.5	6035.71	0.013	0.05	1.00	CIRCULAR	36.00 in	36.00 in
IN-D1.3B - IN-D1.4A	231.79	6036.21	1.1	6038.70	0.013	0.05	1.00	CIRCULAR	36.00 in	36.00 in
IN-D1.3A - IN-D1.3B	38.33	6038.76	0.8	6039.07	0.013	0.05	1.00	CIRCULAR	36.00 in	36.00 in
MH-C1.9C - MH-D1.5D	626.90	6034.54	0.5	6037.68	0.013	1.32	1.00	CIRCULAR	36.00 in	36.00 in
IN-C2.9B - MH-C2.9C	198.34	6037.68	0.5	6038.67	0.013	0.05	1.00	CIRCULAR	36.00 in	36.00 in
MH-C2.9A - IN--C2.9B	5.50	6038.75	0.5	6038.78	0.013	0.05	1.00	CIRCULAR	36.00 in	36.00 in
MH-C2.8E - MH-C2.9A	133.58	6039.28	0.7	6040.18	0.013	0.05	1.00	CIRCULAR	30.00 in	30.00 in
MH-C2.8D - MH-C2.8E	144.00	6040.28	0.6	6041.14	0.013	0.05	1.00	CIRCULAR	30.00 in	30.00 in
MH-C2.8C - MH-C2.8D	230.90	6041.24	1.0	6043.55	0.013	0.05	1.00	CIRCULAR	30.00 in	30.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
MH 1.5D - OUTLET	78.14	8.12	33.00	9.53	34.02	9.26	0.94	Subcritical	77.30	0.00	
MH D1.5C - MH-D1.5D	81.91	9.46	26.43	7.73	24.05	8.66	1.20	Pressurized	50.70	63.00	
IN D1.4B - MH D1.5C	57.25	8.10	26.51	8.24	24.44	9.00	1.18	Pressurized	46.00	135.08	
IN-D1.4A - IN-D1.4B	48.33	6.84	26.51	8.24	28.06	7.78	0.89	Pressurized	46.00	38.33	
IN-D1.3B - IN-D1.4A	69.32	9.81	25.51	7.95	20.40	10.31	1.54	Supercritical	42.60	0.00	
IN-D1.3A - IN-D1.3B	60.15	8.51	25.51	7.95	22.37	9.23	1.29	Supercritical	42.60	0.00	
MH-C1.9C - MH-D1.5D	47.33	6.70	24.87	7.78	25.63	7.52	0.94	Pressurized	40.50	626.90	
IN-C2.9B - MH-C2.9C	47.24	6.68	24.87	7.78	25.67	7.51	0.94	Pressurized	40.50	198.34	
MH-C2.9A - IN--C2.9B	49.22	6.96	24.87	7.78	24.87	7.77	1.00	Pressurized	40.50	5.50	
MH-C2.8E - MH-C2.9A	33.77	6.88	22.51	7.67	22.20	7.78	1.03	Pressurized	30.30	133.58	
MH-C2.8D - MH-C2.8E	31.79	6.48	22.51	7.67	23.41	7.37	0.92	Subcritical	30.30	0.00	
MH-C2.8C - MH-C2.8D	41.13	8.38	22.51	7.67	19.14	9.16	1.38	Supercritical	30.30	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.

- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	Peak Flow (cfs)	Cross Section	Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	Comment
MH 1.5D - OUTLET	77.30	CIRCULAR	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	42.00 in	9.62	
MH D1.5C - MH-D1.5D	50.70	ELLIPSE	34.00 in	53.00 in	36.00 in	36.00 in	34.00 in	53.00 in	8.65	Existing height is smaller than the suggested height.
IN D1.4B - MH D1.5C	46.00	CIRCULAR	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	7.07	
IN-D1.4A - IN-D1.4B	46.00	CIRCULAR	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	7.07	
IN-D1.3B - IN-D1.4A	42.60	CIRCULAR	36.00 in	36.00 in	33.00 in	33.00 in	36.00 in	36.00 in	7.07	
IN-D1.3A - IN-D1.3B	42.60	CIRCULAR	36.00 in	36.00 in	33.00 in	33.00 in	36.00 in	36.00 in	7.07	
MH-C1.9C - MH-D1.5D	40.50	CIRCULAR	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	7.07	
IN-C2.9B - MH-C2.9C	40.50	CIRCULAR	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	7.07	
MH-C2.9A - IN--C2.9B	40.50	CIRCULAR	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	36.00 in	7.07	

MH-C2.8E - MH-C2.9A	30.30	CIRCULAR	30.00 in	30.00 in	30.00 in	30.00 in	30.00 in	30.00 in	4.91	
MH-C2.8D - MH-C2.8E	30.30	CIRCULAR	30.00 in	30.00 in	30.00 in	30.00 in	30.00 in	30.00 in	4.91	
MH-C2.8C - MH-C2.8D	30.30	CIRCULAR	30.00 in	30.00 in	27.00 in	27.00 in	30.00 in	30.00 in	4.91	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6035.45

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	**Downstream (ft)**	**Upstream (ft)**	**Bend Loss (ft)**	**Lateral Loss (ft)**	**Downstream (ft)**	**Upstream (ft)**	**Downstream (ft)**	**Friction Loss (ft)**	**Upstream (ft)**
MH 1.5D - OUTLET	6033.86	6034.04	0.00	0.00	6036.61	6036.88	6038.02	0.19	6038.21
MH D1.5C - MH-D1.5D	6034.14	6034.52	0.03	0.00	6037.70	6037.85	6038.23	0.14	6038.38
IN D1.4B - MH D1.5C	6034.52	6035.51	0.03	0.00	6037.88	6038.52	6038.54	0.64	6039.17

IN-D1.4A - IN-D1.4B	6035.51	6035.71	0.03	0.00	6038.55	6038.73	6039.21	0.18	6039.39
IN-D1.3B - IN-D1.4A	6036.21	6038.70	0.03	0.09	6038.85	6040.83	6039.56	2.25	6041.81
IN-D1.3A - IN-D1.3B	6038.76	6039.07	0.03	0.00	6040.85	6041.20	6041.95	0.23	6042.18
MH-C1.9C - MH-D1.5D	6034.54	6037.68	0.67	0.49	6038.86	6041.16	6039.37	2.30	6041.67
IN-C2.9B - MH-C2.9C	6037.68	6038.67	0.03	0.00	6041.19	6041.91	6041.70	0.73	6042.42
MH-C2.9A - IN--C2.9B	6038.75	6038.78	0.03	0.00	6041.94	6041.96	6042.45	0.02	6042.47
MH-C2.8E - MH-C2.9A	6039.28	6040.18	0.03	0.00	6041.99	6042.71	6042.58	0.73	6043.31
MH-C2.8D - MH-C2.8E	6040.28	6041.14	0.03	0.00	6042.74	6043.38	6043.34	0.70	6044.04
MH-C2.8C - MH-C2.8D	6041.24	6043.55	0.03	0.00	6043.41	6045.43	6044.14	2.20	6046.34

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

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

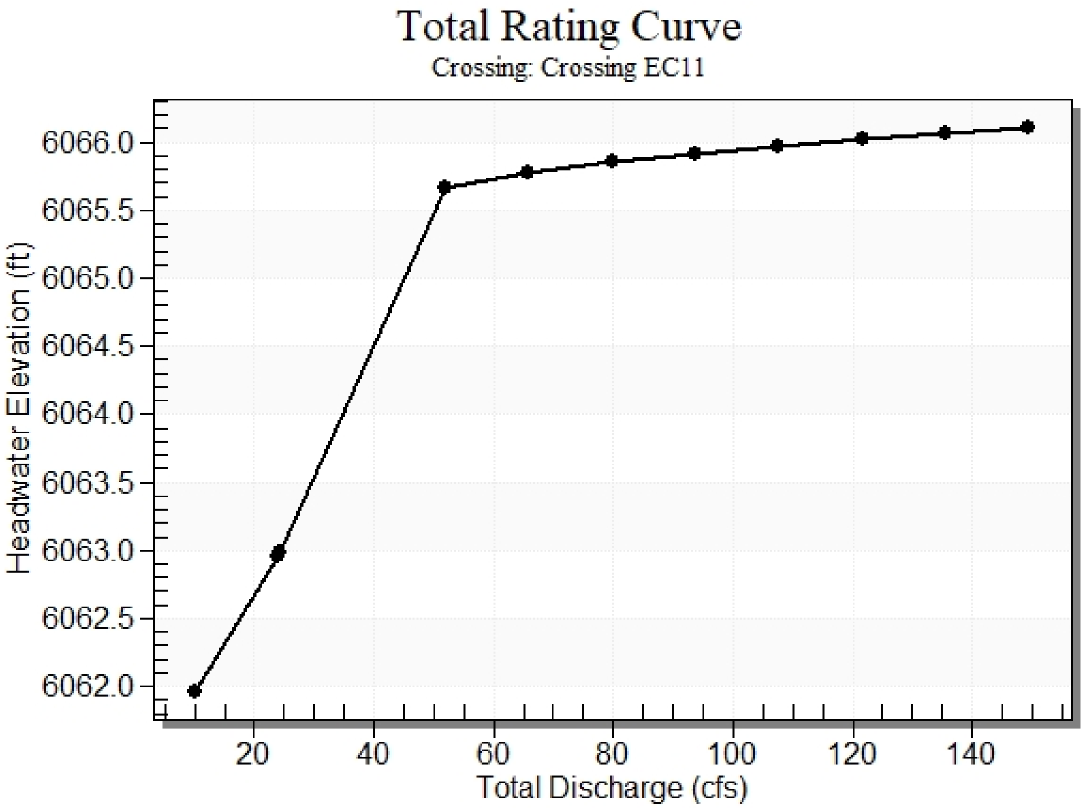


Table 2 - Culvert Summary Table: Culvert EC11

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.

****

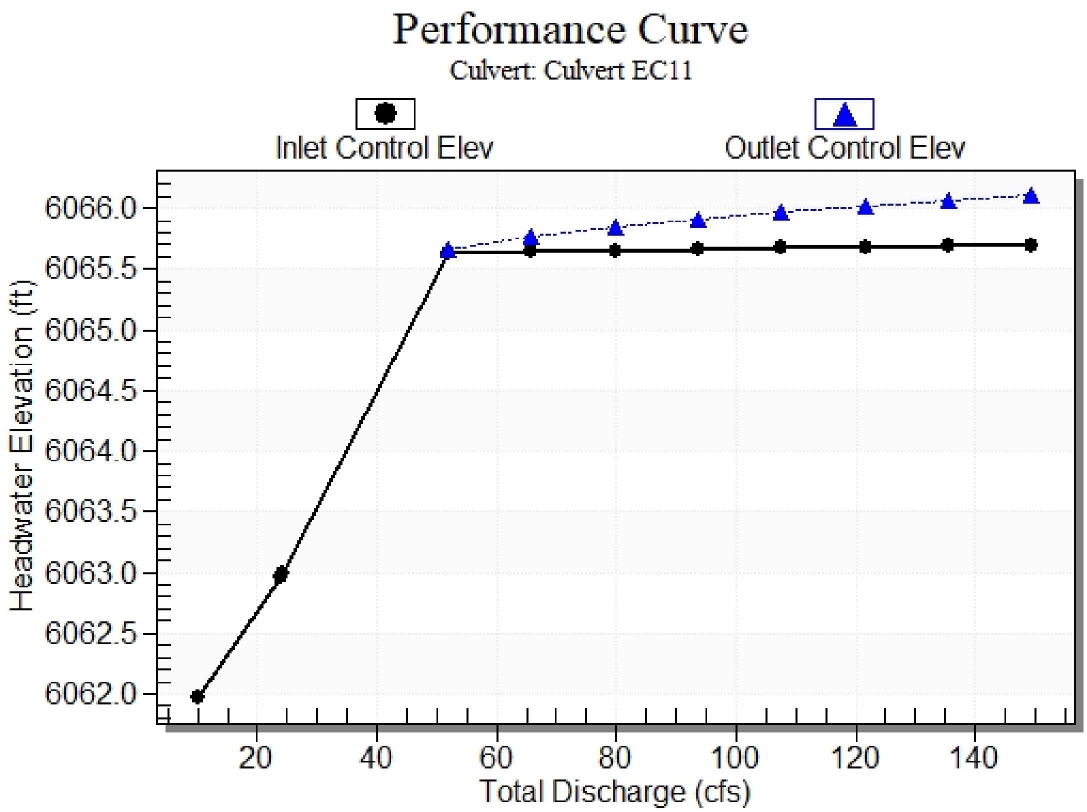
Straight Culvert

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

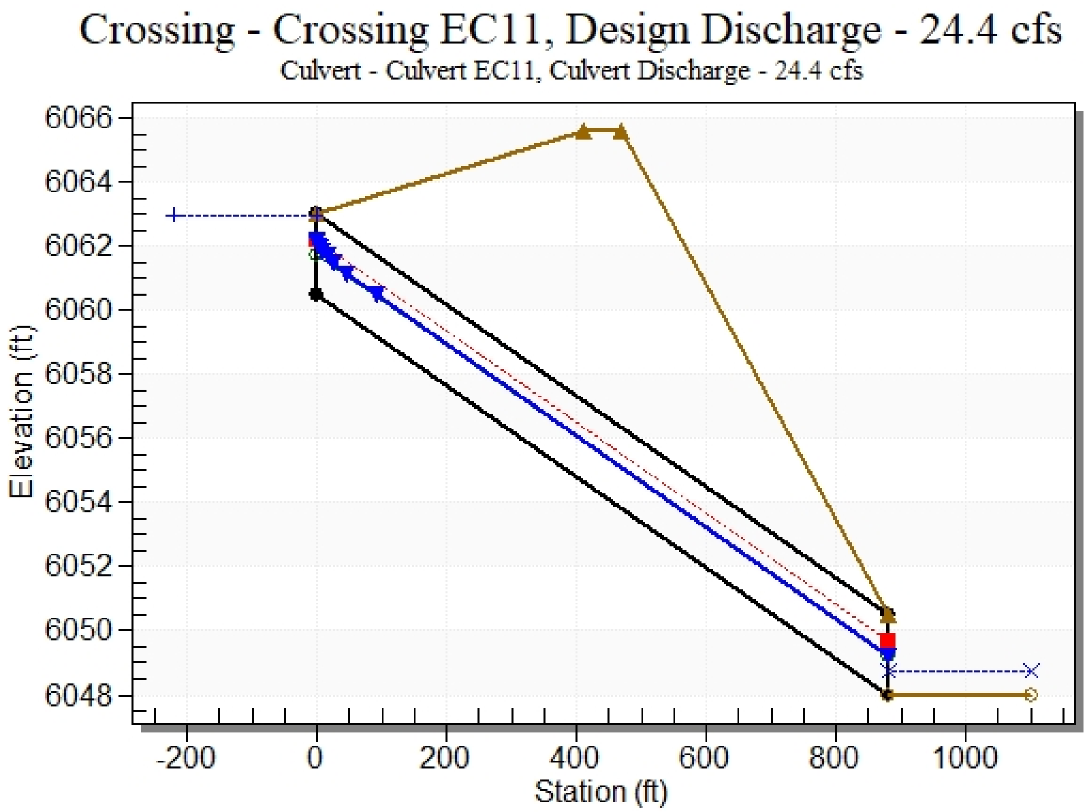
Culvert Length: 880.09 ft, Culvert Slope: 0.0142

****

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

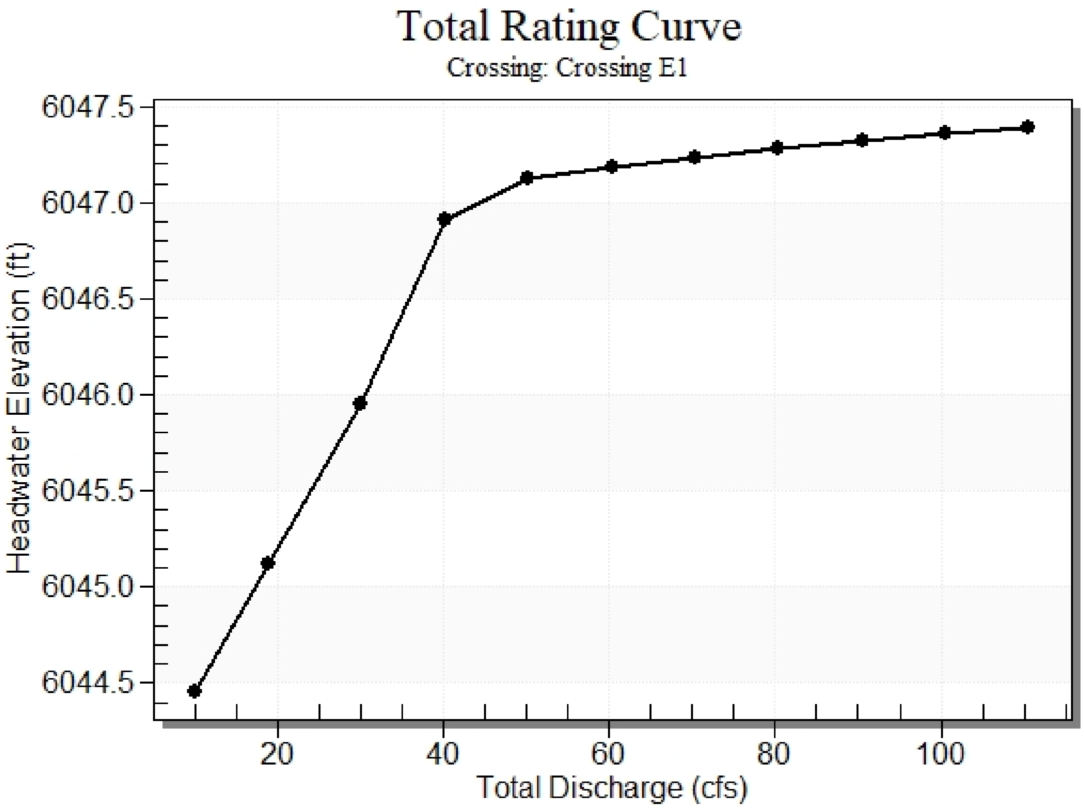


Table 5 - Culvert Summary Table: Culvert E1

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.

****

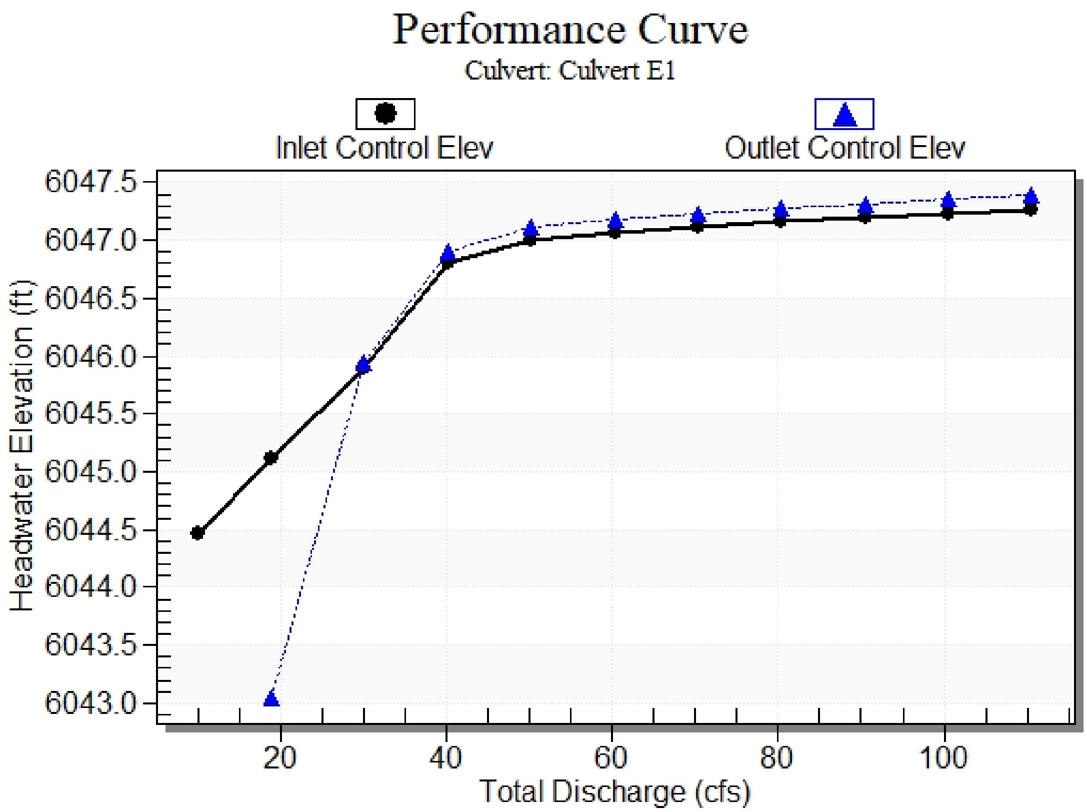
Straight Culvert

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

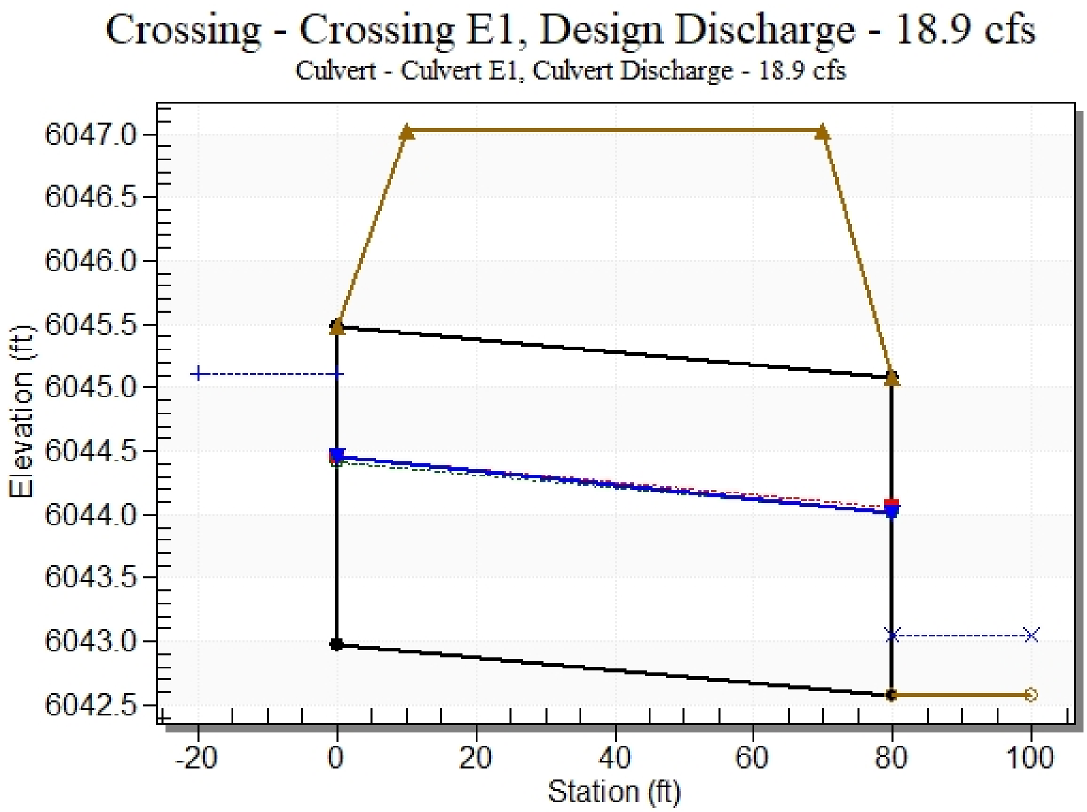
Culvert Length: 80.00 ft, Culvert Slope: 0.0050

****

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

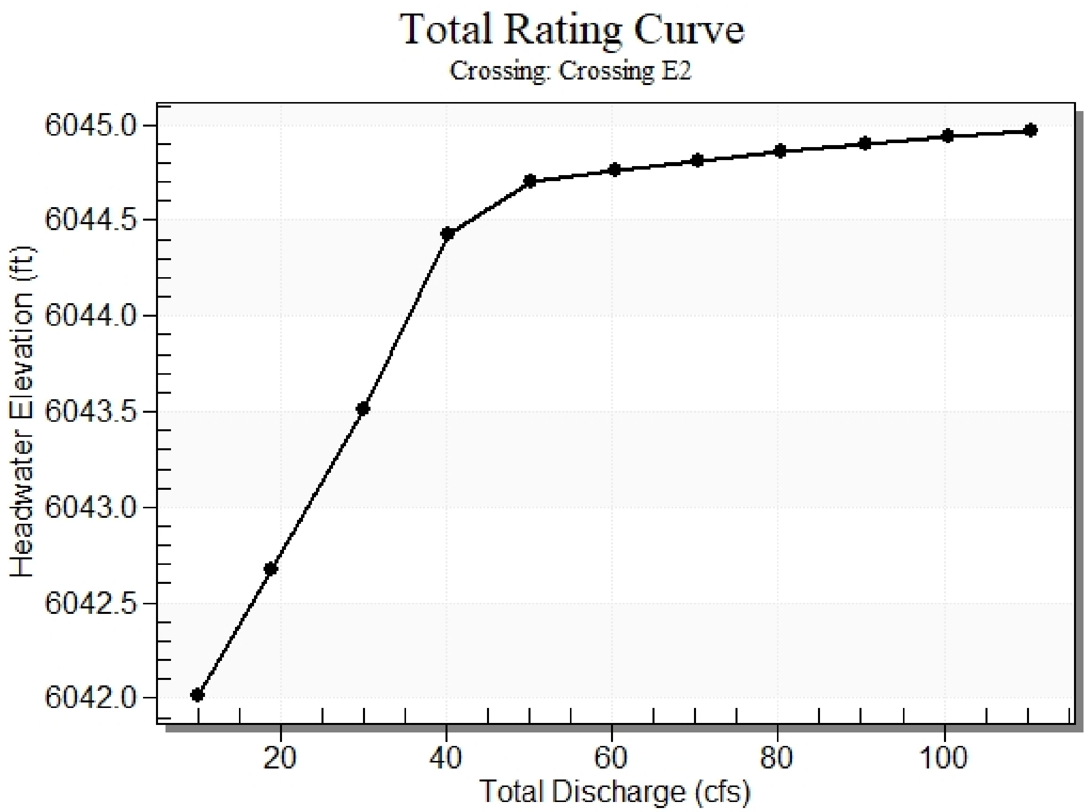


Table 8 - Culvert Summary Table: Culvert E2

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

****

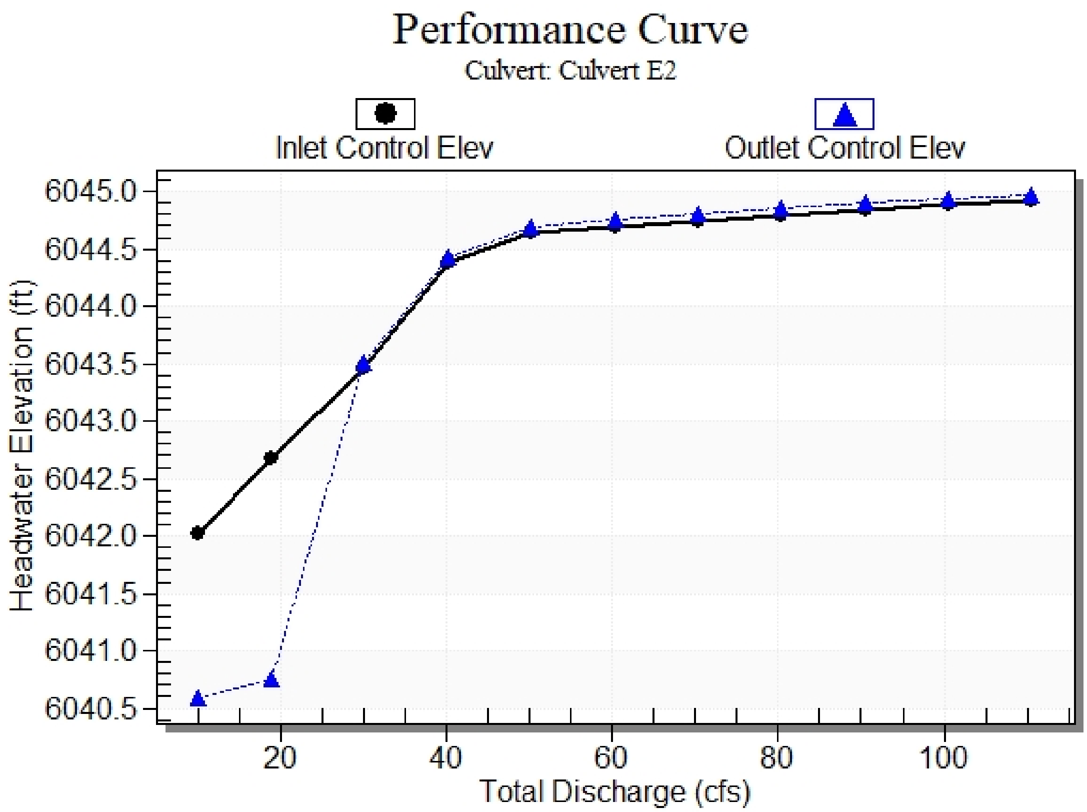
Straight Culvert

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

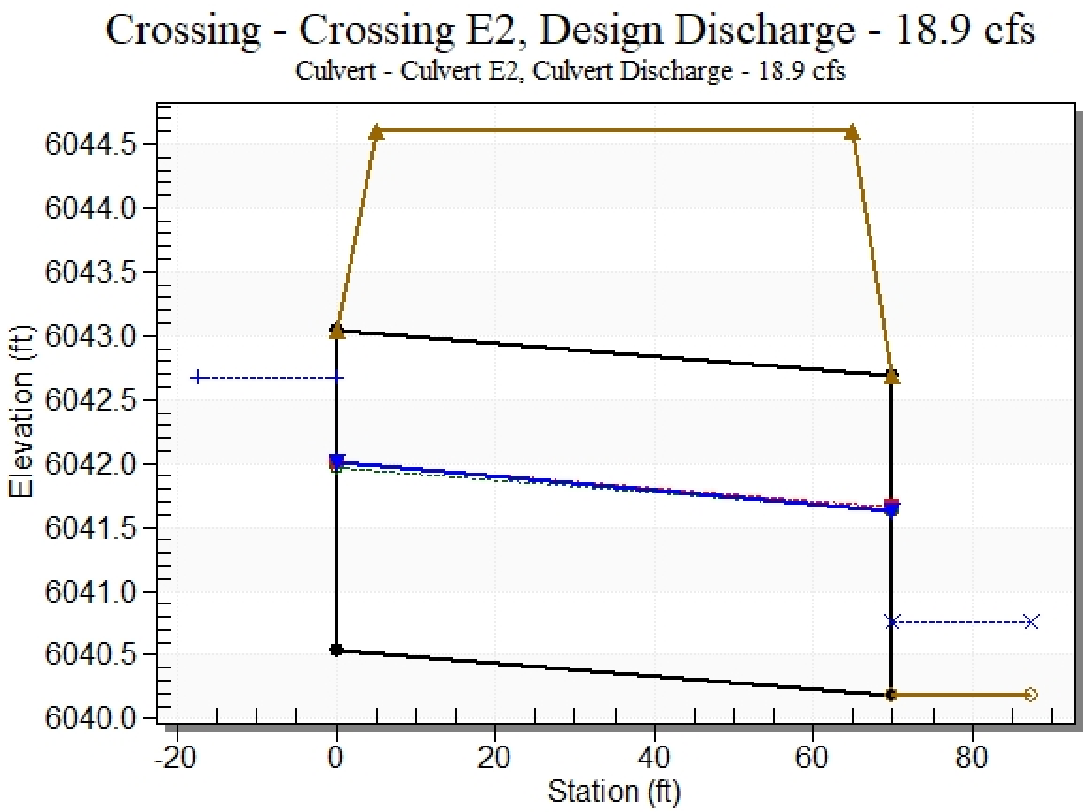
Culvert Length: 70.00 ft, Culvert Slope: 0.0050

****

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

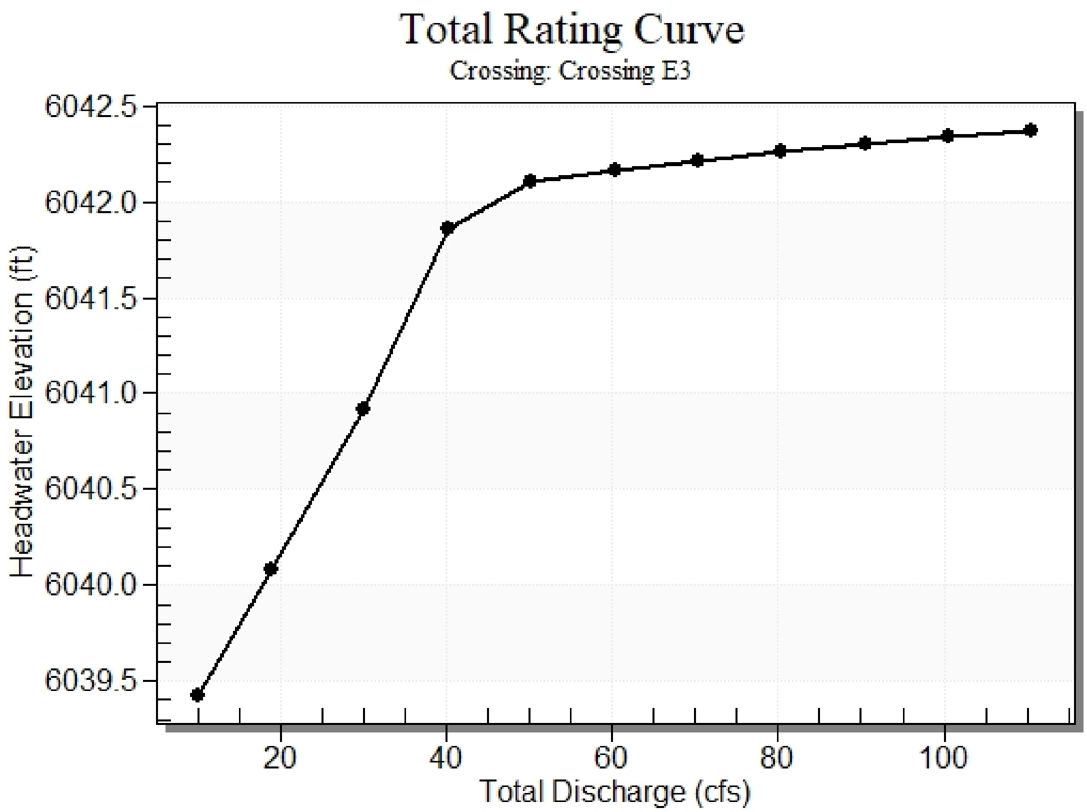


Table 11 - Culvert Summary Table: Culvert E3

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

****

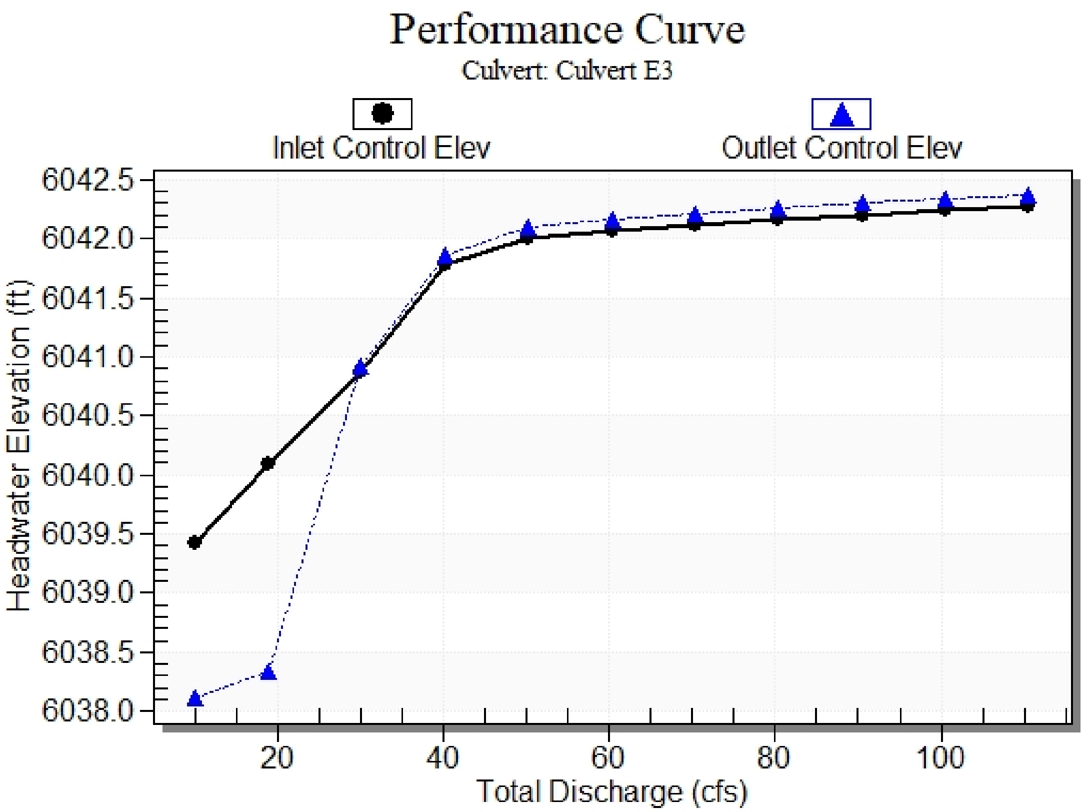
Straight Culvert

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

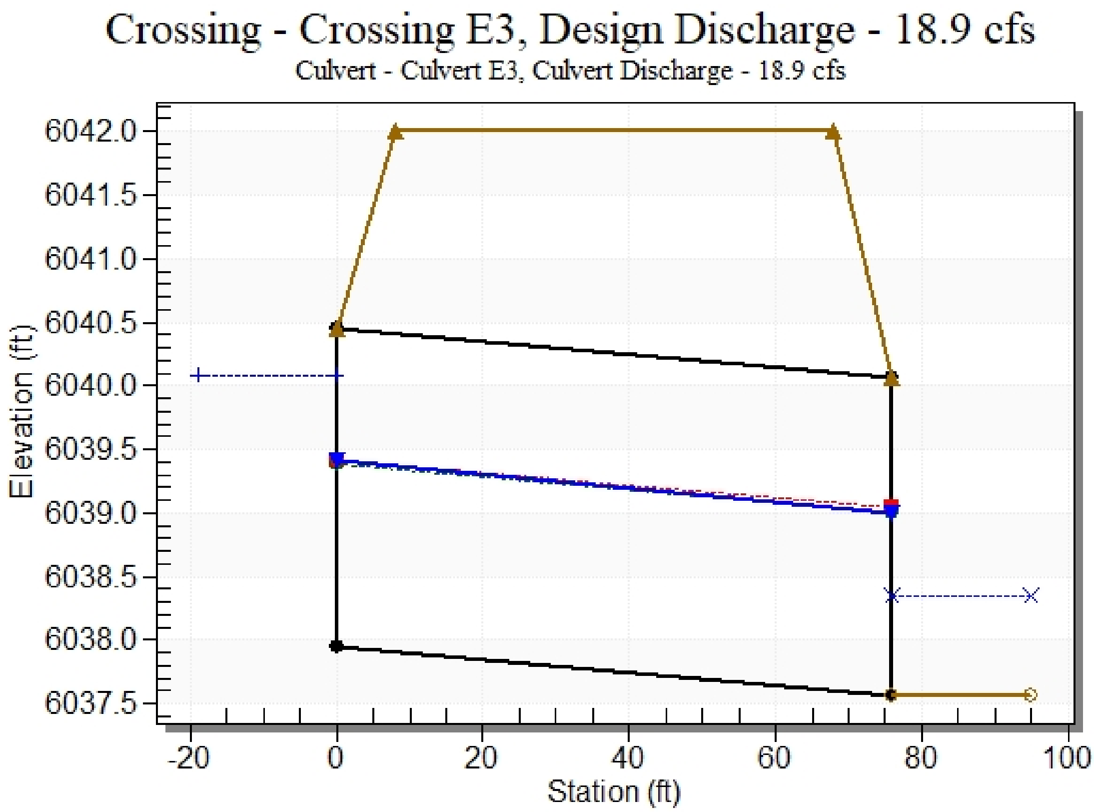
Culvert Length: 76.00 ft, Culvert Slope: 0.0050

****

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 - FILING NO. 3
(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
C2	C2.5B	0.28	8	4:1	2.0	0.030	33.7	1.2	2.3	0.3	GRASS
D	D1.5B	0.40	8	4:1	2.0	0.030	77.3	1.6	3.3	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-Flg-3-Channels

Designer: JPS

Project Date: Thursday, July 19, 2018

Project Units: U.S. Customary Units

Notes:

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: 0.0028 ft/ft

Manning's n: 0.0300

Flow: 33.7000 cfs

Result Parameters

Depth: 1.1531 ft

Area of Flow: 14.5430 ft^2

Wetted Perimeter: 17.5085 ft

Hydraulic Radius: 0.8306 ft

Average Velocity: 2.3173 ft/s

Top Width: 17.2246 ft

Froude Number: 0.4444

Critical Depth: 0.7222 ft

Critical Velocity: 4.2855 ft/s

Critical Slope: 0.0161 ft/ft

Critical Top Width: 13.78 ft

Calculated Max Shear Stress: 0.2015 lb/ft^2

Calculated Avg Shear Stress: 0.1451 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: 77.3000 cfs

Result Parameters

Depth: 1.6100 ft

Area of Flow: 23.2483 ft^2

Wetted Perimeter: 21.2764 ft

Hydraulic Radius: 1.0927 ft

Average Velocity: 3.3250 ft/s

Top Width: 20.8800 ft

Froude Number: 0.5553

Critical Depth: 1.1657 ft

Critical Velocity: 5.2366 ft/s

Critical Slope: 0.0141 ft/ft

Critical Top Width: 17.33 ft

Calculated Max Shear Stress: 0.4019 lb/ft^2

Calculated Avg Shear Stress: 0.2727 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

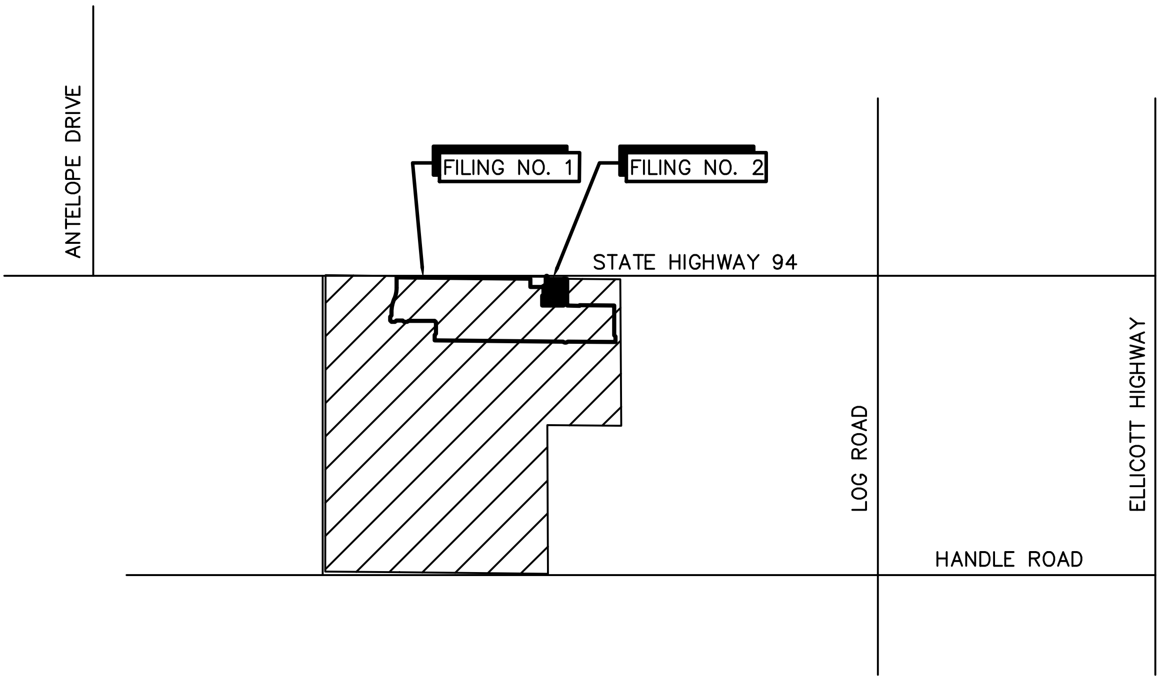
COST ESTIMATE

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

Item No.	Item	Quantity	Unit	Unit Cost ($$$)	Total Cost ($$$)
506	Riprap (d50 = 12")	7	CY	$125	$875
603	18" RCP / HDPE Storm Sewer	170	LF	$70	$11,900
603	24" RCP Storm Sewer	449	LF	$83	$37,267
603	30" RCP Storm Sewer	572	LF	$104	$59,488
603	36" RCP Storm Sewer	1391	LF	$128	$178,048
603	42" RCP Storm Sewer	93	LF	$171	$15,903
603	18" RCP FES	1	EA	$420	$420
603	36" RCP FES	1	EA	$768	$768
603	42" RCP FES	2	EA	$1,254	$2,508
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	9	EA	$6,619	$59,571
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				$461,796
	Contingency @ 15%				$69,269
	TOTAL				**$531,065**

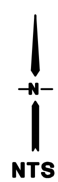
APPENDIX F

FIGURES



VICINITY MAP

NTS



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

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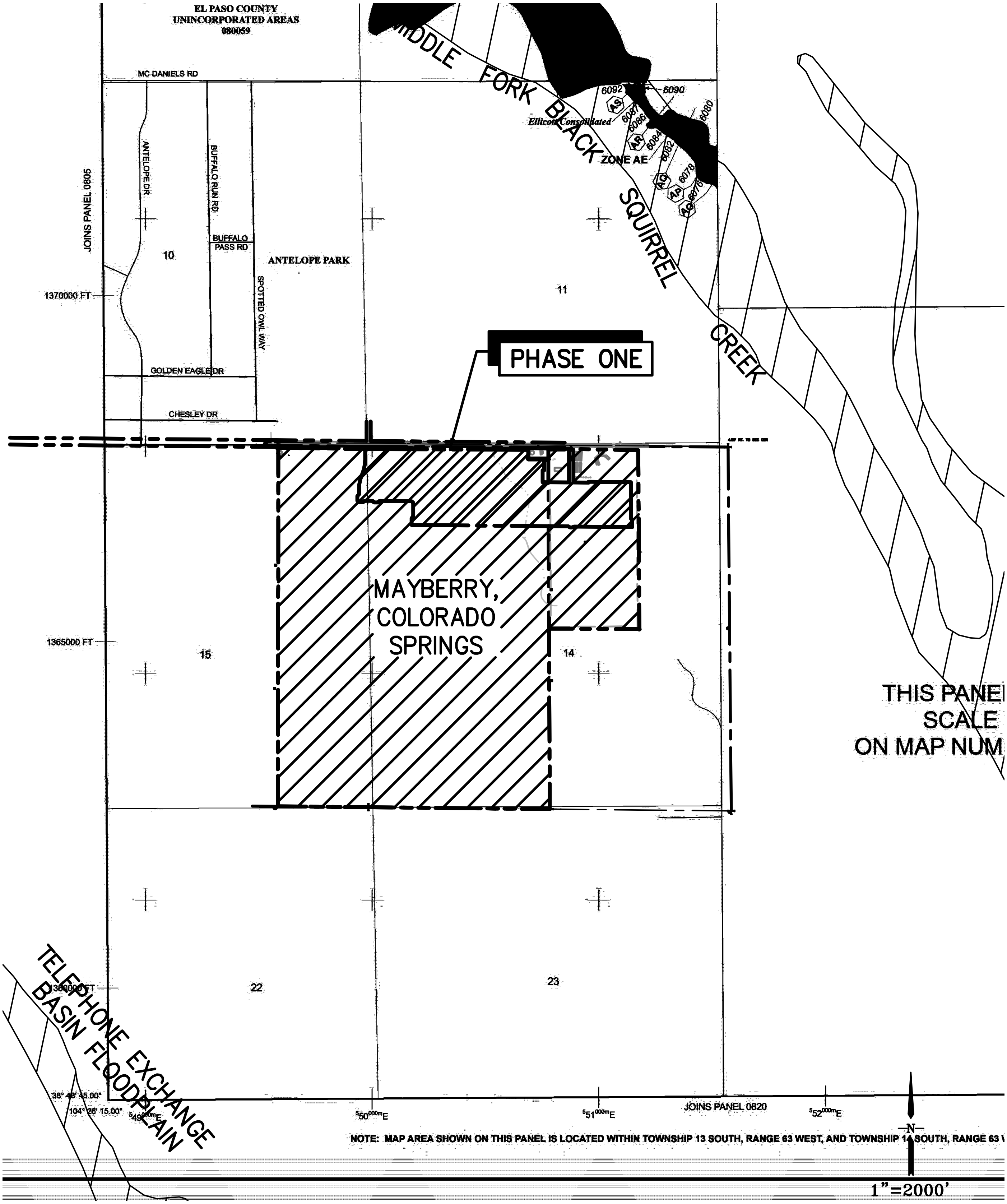


REF: FIRM PANEL 08041C0810G, DATED 12/07/18

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

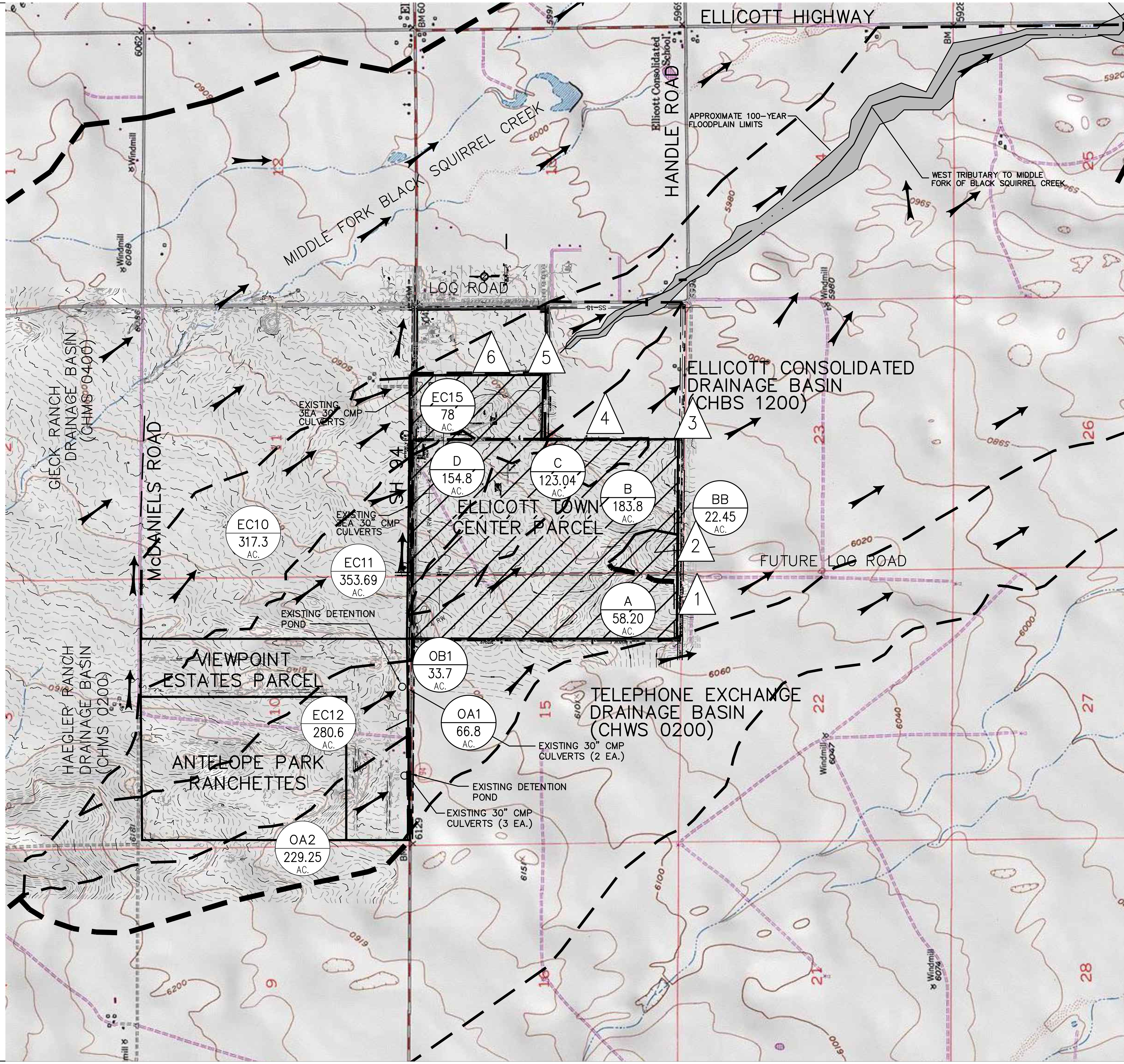
MAYBERRY, COLORADO SPRINGS

JPS ENGINEERING

FLOODPLAIN MAP

FIGURE A3

JPS PROJ NO. 090001



SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q_5 (CFS)	Q_{100} (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

ORIGINAL SCALE: 1"=1000'

1000 0 1000 2000

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john@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

ELLICOTT TOWN CENTER

MAJOR BASIN / HISTORIC DRAINAGE PLAN

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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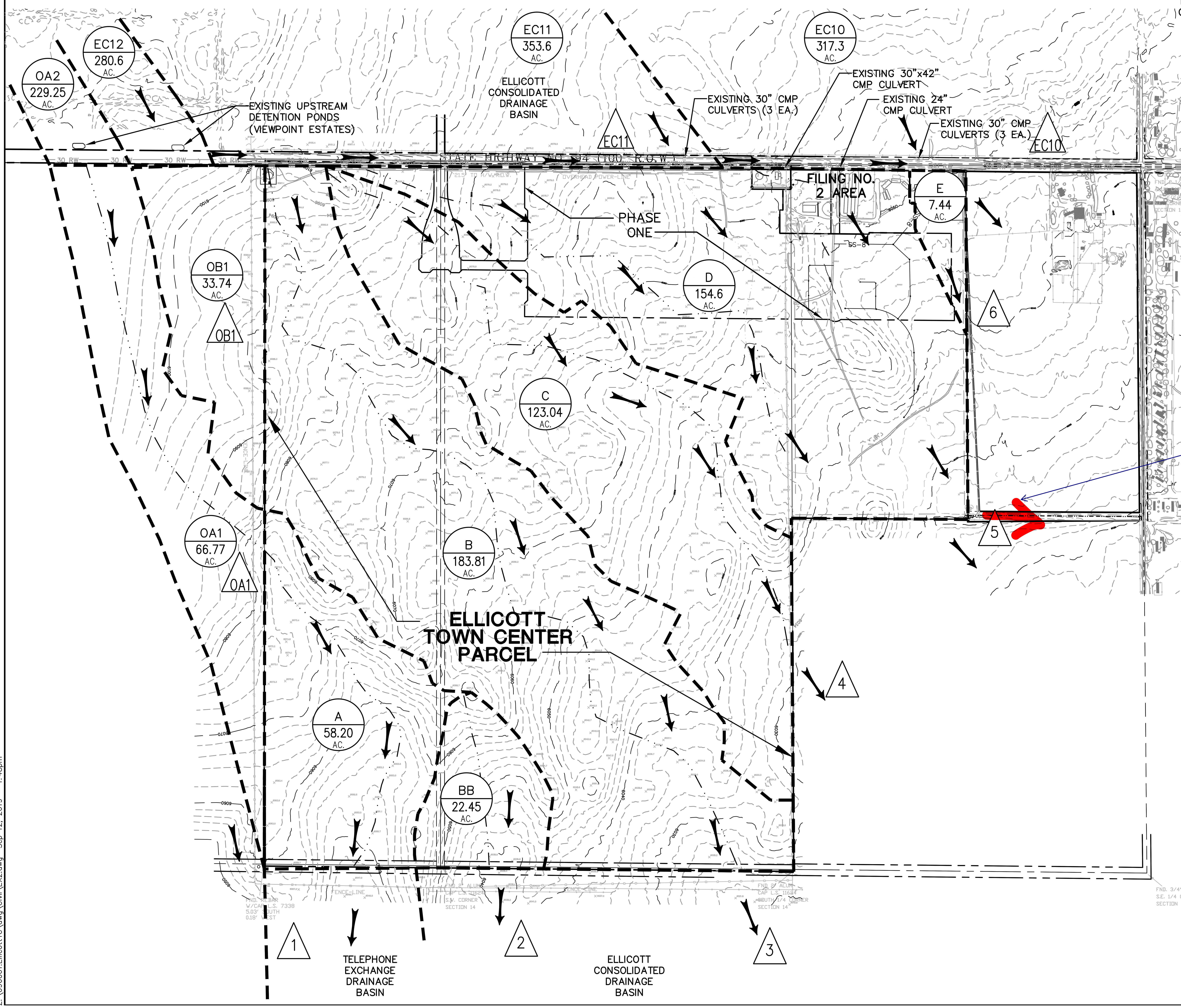

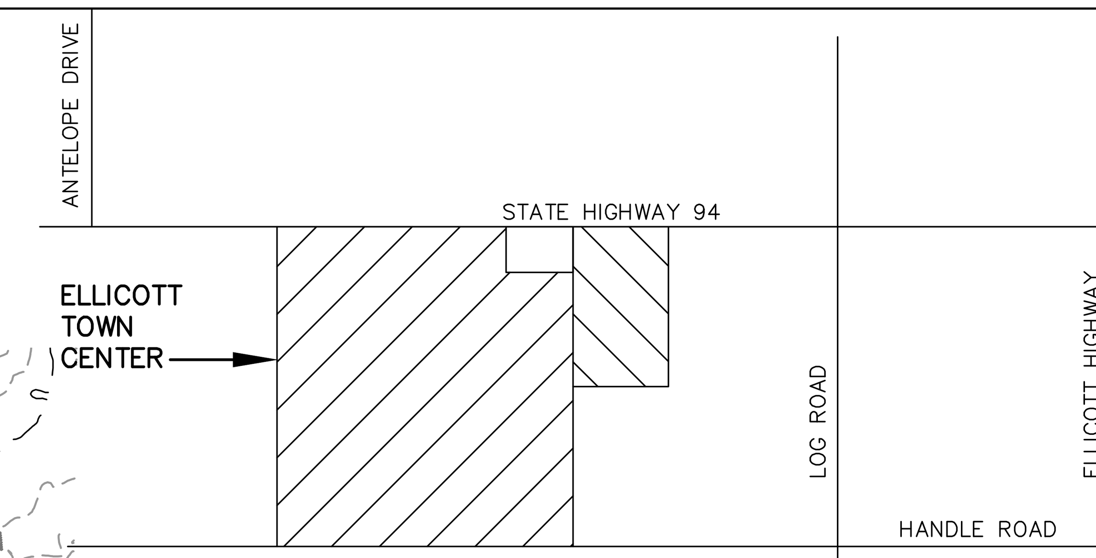

VICINITY MAP
NTS

LEGEND

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

please provide a flow arrow depicting the flow going to the east as there appears to be a berm at this location

revised

SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q_5 (CFS)	Q_{100} (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'

Z:\090001.EllicottTC\dwg\Civil\EX2.dwg Sep 12, 2019 - 1:48pm

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No.	REVISION	BY	DATE

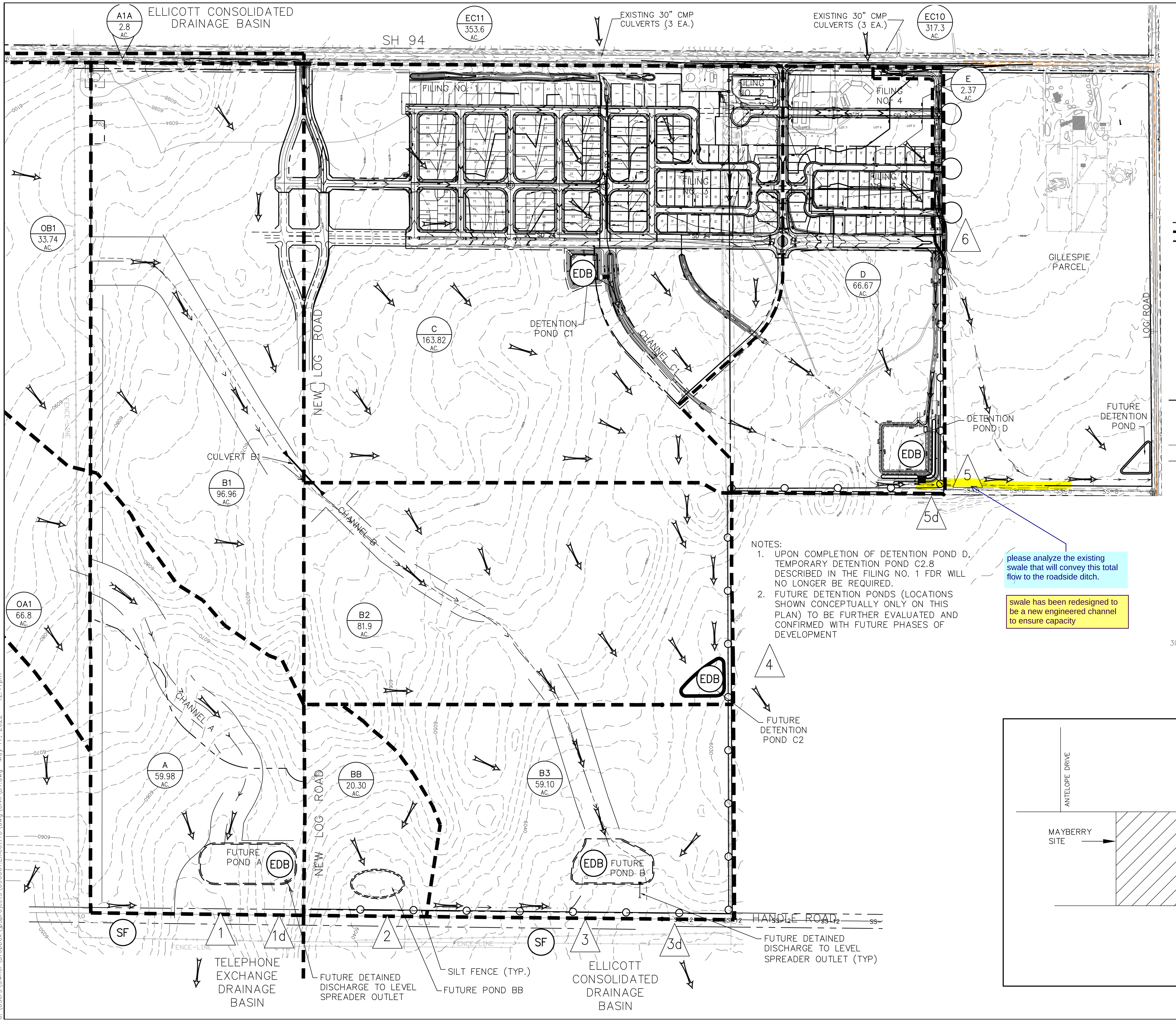
ELLICOTT TOWN CENTER

HISTORIC DRAINAGE PLAN

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		

MAYBERRY, COLORADO SPRINGS

MASTER DEVELOPMENT DRAINAGE PLAN



NOTES:
1. UPON COMPLETION OF DETENTION POND D, TEMPORARY DETENTION POND C2.8 DESCRIBED IN THE FILING NO. 1 FDR WILL NO LONGER BE REQUIRED.
2. FUTURE DETENTION PONDS (LOCATIONS SHOWN CONCEPTUALLY ONLY ON THIS PLAN) TO BE FURTHER EVALUATED AND CONFIRMED WITH FUTURE PHASES OF DEVELOPMENT

please analyze the existing swale that will convey this total flow to the roadside ditch.

swale has been redesigned to be a new engineered channel to ensure capacity

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

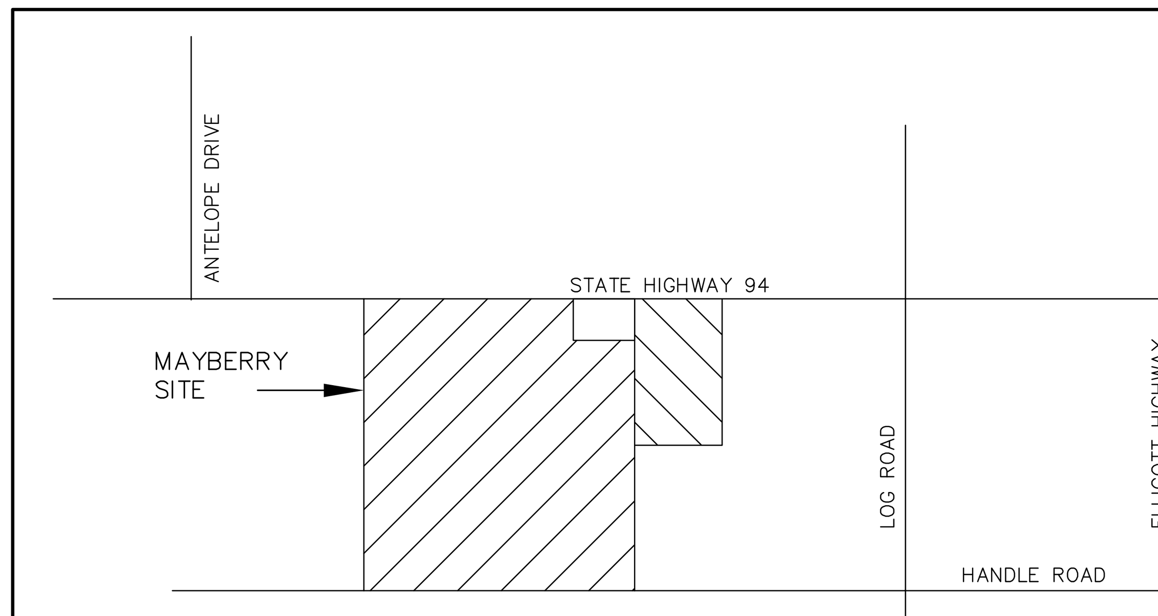
LEGEND:

- PROPERTY LINES
- DRAINAGE BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- PROPOSED FLOW DIRECTION ARROW
- 5 DESIGN POINT
- 5d "DETAINED" FLOW FROM DESIGN POINT
- OA1 66.8 AC. DEVELOPED BASIN DESIGNATION; BASIN AREA (ACRES); * 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
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No.	REVISION	BY	DATE

HORZ. SCALE:	1"=300'	DRAWN:	BJJ
VERT. SCALE:	N/A	DESIGNED:	JPS
SURVEYED:	R&R	CHECKED:	JPS
CREATED:	12/03/00	LAST MODIFIED:	5/17/22
PROJECT NO:	090001	MODIFIED BY:	JPS
SHEET:	D1		

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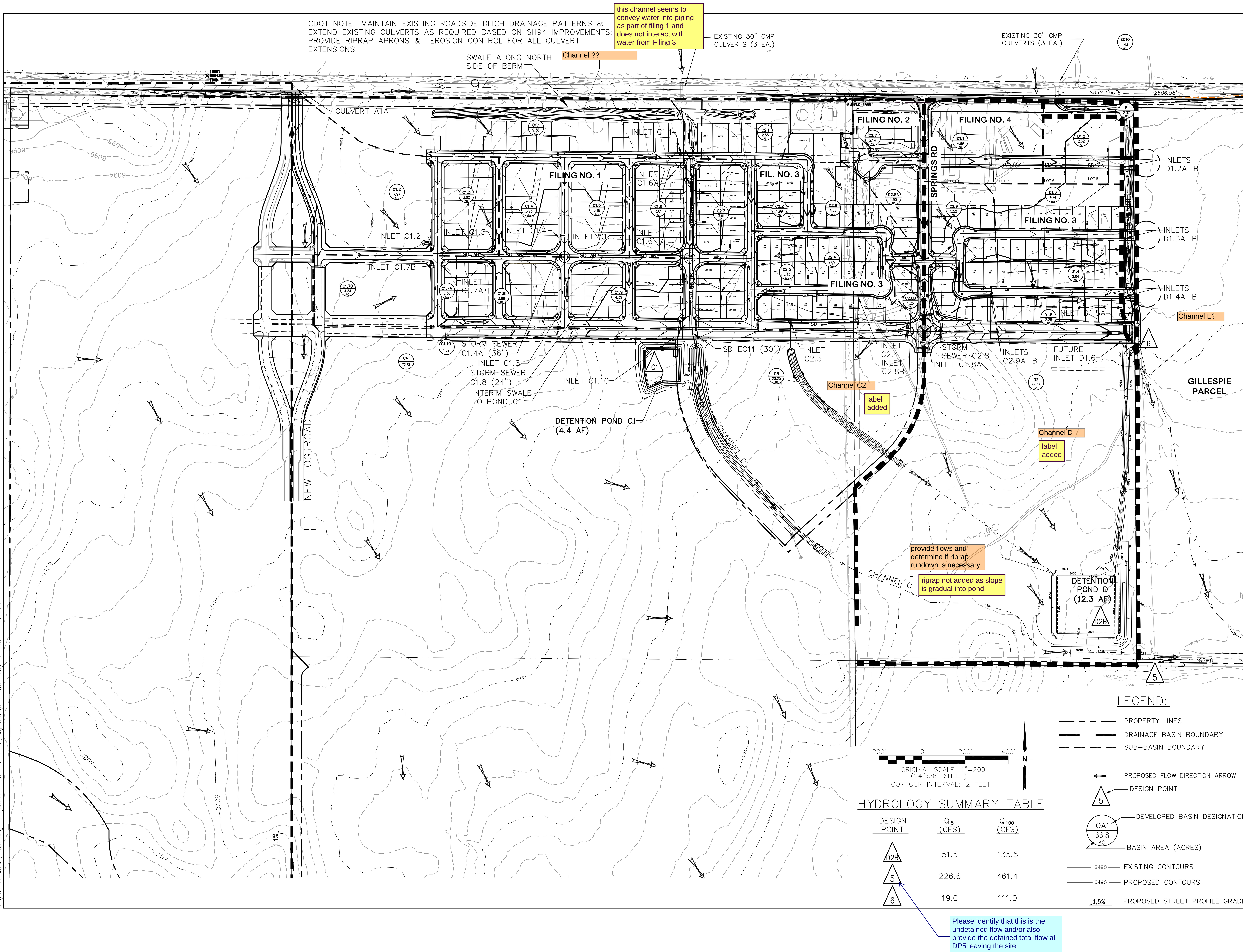

LEGEND:

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

HYDROLOGY SUMMARY TABLE

DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
D2B	51.5	135.5
5	226.6	461.4
6	19.0	111.0

MAYBERRY, COLORADO SPRINGS

PHASE 1 PUD DEVLOPED DRAINAGE PLAN

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HORZ. SCALE: 1"=200'	DRAWN: BJJ	VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: R&R	CHECKED: JPS	CREATED: 12/03/00	LAST MODIFIED: 5/17/22
PROJECT NO: 090001	MODIFIED BY: JPS	SHEET: D1.1	

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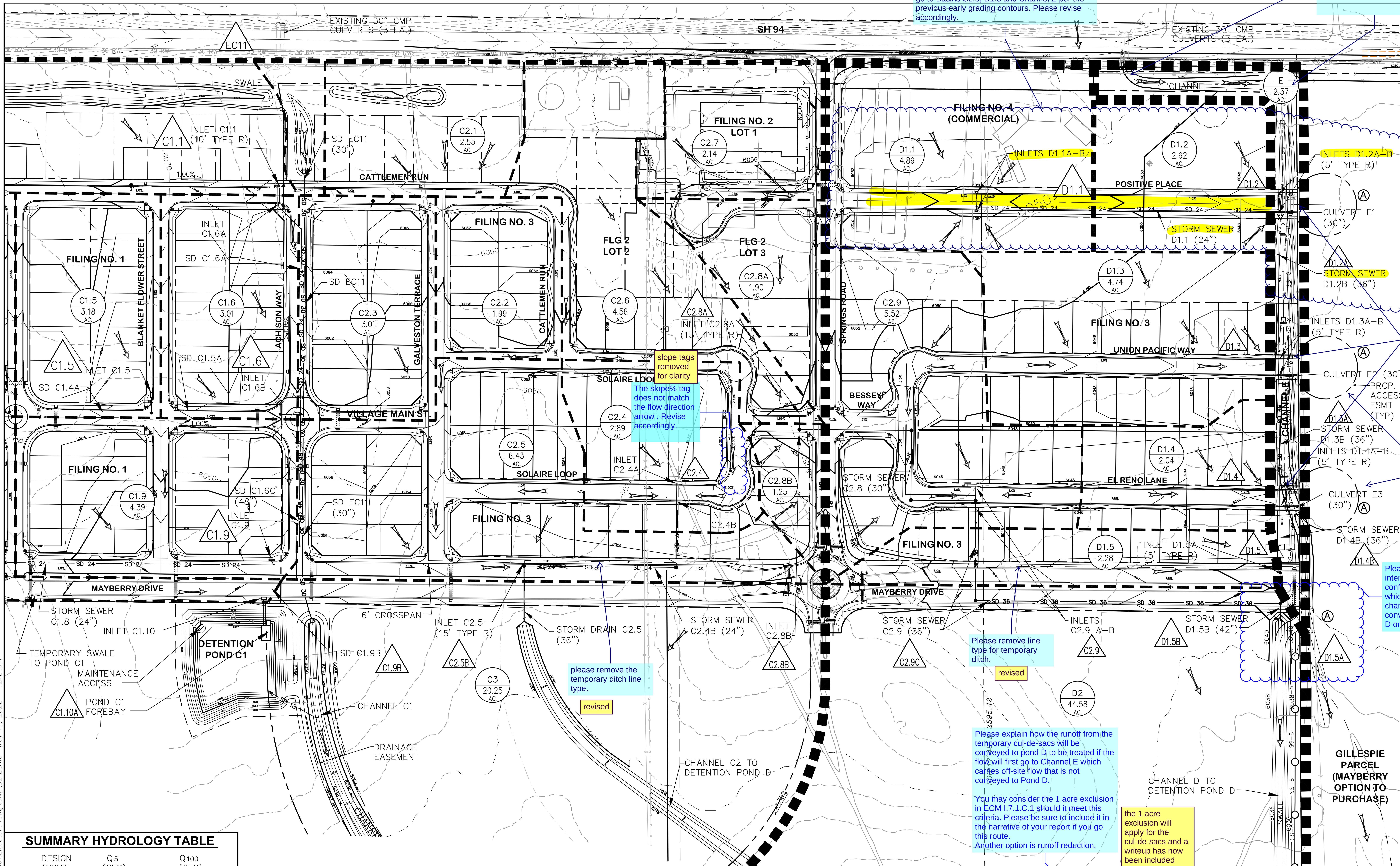

The street grading, inlets storm sewers should not be shown as they do not reflect actual conditions for Filing 3. Flow from these basins will go to Basins C2.9, D1.3 and Channel E per the previous early grading contours. Please revise accordingly.

future grading and storm removed

Please provide hydraulic analysis at the bend. See ECM 3.3.3.E and DCM 10.5.6

analysis added to report

slope tags removed for clarity

The slope% tag does not match the flow direction arrow . Revise accordingly.

Please discuss the overtopping that will occur at the culvert/roadway. Is the intent for this channels flow to enter the adjacent inlets? Do they account for this flow?

culverts no longer proposed

please show the proposed grading/finished conditions and drainage of the temp. cul-de-sacs.

grading now shown

Please clarify your intent as there are conflicting contours. which way will the channel flow be conveyed to, Channel D or Gillespie parcel?

area has been redesigned and should now be more clear

please remove the temporary ditch line type.

revised

Please remove line type for temporary ditch.

revised

Please explain how the runoff from the temporary cul-de-sacs will be conveyed to pond D to be treated if the flow will first go to Channel E which carries off-site flow that is not conveyed to Pond D.

You may consider the 1 acre exclusion in ECM I.7.1.C.1 should it meet this criteria. Please be sure to include it in the narrative of your report if you go this route.
Another option is runoff reduction.

the 1 acre exclusion will apply for the cul-de-sacs and a writeup has now been included with the report

SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q5 (CFS)	Q100 (CFS)
C2.4	3.8	9.3
C2.5	7.9	19.3
C2.5B	13.5	33.7
C2.8A	5.2	10.8
C2.8B	1.8	4.4
C2.9	6.9	16.5
C2.9C	17.5	40.5
D1.1	11.4	22.8
D1.2	6.0	11.9
D1.3	6.8	15.5
D1.4	2.7	6.6
D1.5	2.9	7.2
D1.5B	34.7	77.3

LEGEND:

- PROPERTY LINES
- DRAINAGE BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- PROPOSED FLOW DIRECTION ARROW
- 6490 EXISTING CONTOURS
- 6490 PROPOSED CONTOURS
- 1.5% PROPOSED STREET PROFILE GRADE
- C1.9 DESIGN POINT
- OA1 DEVELOPED BASIN DESIGNATION
- 66.8 AC. BASIN AREA (ACRES)

KEYED NOTES

(A) TEMPORARY DITCHES TO CONVEY DEVELOPED FLOWS FROM INTERIM CUL-DE-SACS TO CHANNEL D FOR STORMWATER TREATMENT IN DETENTION POND D UNTIL FUTURE DETENTION POND IS CONSTRUCTED WITHIN GILLESPIE PARCEL

MAYBERRY, COLORADO SPRINGS

FILING NO. 2-4
DEVELOPED DRAINAGE PLAN

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REVISION	BY	DATE

HORZ. SCALE: 1"=100'	DRAWN: BJJ
VERT. SCALE: N/A	DESIGNED: JPS
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PROJECT NO: 090001	MODIFIED BY: JPS
SHEET: D2.2	