
Deer Creek Road

Final Drainage Report



Prepared for:



El Paso County
Department of Public Works
Transportation Division

AECOM

Prepared by:

2315 Briargate Pkwy
Colorado Springs, CO 80920

September 2024

TABLE OF CONTENTS

DRAINAGE CERTIFICATION:

Design Engineer's Statement:

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



03/02/2026

William Carrier, P.E.

Date

State of Colorado
No. 37119

The findings in this report have been partly based on data from the previously performed drainage analyses listed in this report. AECOM has relied on this information as furnished and is neither responsible for nor has confirmed the accuracy of this information.

Owner/Developer's Statement:

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

El Paso County/ECM Administrator

Date

El Paso County
2315 Briargate Pkwy, Colorado Springs, CO 80920

El Paso County:

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

El Paso County/ECM Administrator

Date

El Paso County
2315 Briargate Pkwy, Colorado Springs, CO 80920

1. Section 1 ONE Introduction 2

1.1 General 2

1.2 Site Location and description 2

1.3 Project Mapping 2

2. section 2 TWO Hydrology 3

2.1 Design criteria references 3

2.2 Hydrologic Criteria 3

2.2.1 Design Flood Frequency 3

2.2.2 Rational Method 3

2.3 Existing Basin Description 3

2.3.1 Flood History 4

2.4 Proposed Basin Description 4

2.4.1 Major Drainage Basins 5

2.4.2 Major Drainage Basin Routing 5

2.4.3 Minor Drainage Basins 5

2.5 Prediction of design discharges 5

3. Section 3 THREE Hydraulics 5

3.1 Hydraulic Design Criteria 5

3.1.1 General Concept 5

3.1.2 Proposed Roadway Inlets and Storm Drains 5

3.1.3 Roadside Ditches 6

3.1.4 Culverts 6

3.1.5 Hydraulic Analysis 6

3.2 Existing Structure Descriptions 6

3.2.1 Utilities 7

3.3 Proposed improvements 7

3.3.1 Design Documents 8

4. Section 4 FOUR Erosion and Water Quality 8

4.1 Erosion Control Plan 8

4.2 Post Construction Water Quality 8

5. Section 5 FIVE Conclusion 10

5.1 Conclusion 10

6. Section 6 SIX References 6-1

List of Tables

Table 2.1 Runoff Coefficients

Table 2.2 Summary Runoff Tables

Table 3.1 Summary of Existing Culverts

Table 3.2 Summary of Proposed Culverts

List of Figures

Figure 1 Location Map

List of Appendices

Appendix A NRCS Soils Data

Appendix B FEMA FIRMETTES page

Appendix C Hydrology

Appendix D Hydraulics

Appendix E Plans

The scope of services performed during the preparation of this document may not be appropriate to satisfy the needs of other users, and any use or re-use of this document or of the findings, conclusions, or recommendations presented herein is at the sole risk of said user.

Background information, design bases, and other data have been furnished to AECOM by third parties, which AECOM has used in preparing this report. AECOM has relied on this information as furnished and is neither responsible for nor has confirmed the accuracy of the information.

This report has been prepared based on certain key assumptions made by AECOM which substantially affect the conclusions and recommendations of this report. These assumptions, although thought to be reasonable and appropriate, may not prove to be true in the future. The conclusions and recommendations of AECOM are conditioned upon these assumptions.

1.1 GENERAL

This report presents proposed drainage improvements near the Town of Monument, in Unincorporated El Paso County, Colorado for the Deer Creek Road Project (Project) between Monument Hill Road and Woodmoor Drive. This project also consists of drainage improvements for Base Camp Road and Microscope Way. The primary goal of this report is to document the project's drainage design and assist El Paso County's review process. Analysis of the on-site and off-site Project drainage basins has been conducted to estimate runoff peak discharges used for designing structures to convey stormwater off and under the roadway. The disturbed area for the project is 5.14 acres.

1.2 SITE LOCATION AND DESCRIPTION

The project alignment location is shown in Figure 1.

Roadway, Stationing & Length:	Base Camp Road Station 100+00 to Station 107+80, approximately 0.15 miles
	Microscope Way Station 200+00 to Station 207+00, approximately 0.13 miles
	Deer Creek Road Station 400+00 to Station 420+20, approximately 0.38 miles
	Woodmoor Drive Station 300+85 to Station 304+90, approximately 0.08 miles
Major Roadway Structures:	Crystal Creek CSP
Intersections:	Deer Creek Road/Base Camp Road, Deer Creek Road/Microscope Way, Deer Creek Road/Woodmoor Drive
Drainageways:	Crystal Creek
County:	El Paso County
Legal Description:	The Project limits lie within the NE1/4 of the SW1/4 of Section 11, Township 11 South, Range 67 West of the 6th Principal Meridian.

1.3 PROJECT MAPPING

AECOM originally surveyed the project site in January/February 2022 to 1-foot contour interval accuracy. Additional survey was collected in Late April 2022. This mapping was supplemented for drainage purposes with publicly available maps, aerial photographs, and Light Detection and Ranging (LiDAR) flown in 2018. The survey was completed based on a modified state plane using US feet & a vertical datum of NAVD88.

Figure 1 Location Map



Monument Hill Road to Base Camp Road has a general slope of 5 to 10 percent and storm runoff generally flows from northeast to southwest. Vegetation in this area is mostly grass with a few trees along with commercial development. From Base Camp Road to Crystal Creek the ground is relatively flat around the commercial buildings with grass and trees. To the east of the buildings the ground slopes around 30 percent with shrubs and grasses as it descends to Crystal Creek. Storm runoff generally flows from northwest to southeast in this area. From the eastern side of Crystal Creek to the western edge of Microscope Way, storm runoff generally flows from northeast to southwest with an average slope of 5 to 10 percent. Just west of Microscope Way, the ground slopes vary up to 50 percent as it drops off into the channel of Crystal Creek. This area is primarily covered with shrubs and grass. Flows east of Microscope Way also run from northeast to southwest but has an average slope around 25 percent the ground covered with trees and grass. The ultimate receiving water is Crystal Creek, located in the center of the project (approximately Deer Creek Station 409+00). The drainage area is a mix of undeveloped land, businesses, and paved and gravel roads. Stormwater flow is conveyed overland from the roadway to roadside swales and through culverts.

Soils data was obtained from the National Resources Conversation Service (NRCS) Web Soil Survey. The site is composed of hydrologic soil group Type B. Specifically, the project site contains Kettle gravelly loamy sand, Pring coarse sandy loam, Tomah-Crowfoot loamy sand and Tomah-Crowfoot complex. For Type B soils, the NRCS Web Soil Survey states: "Soils having a moderate infiltration rate when thoroughly wet. Type B soils consist chiefly of moderately deep or deep, moderately well drained, or well drained soils that have moderately fine texture to moderately coarse texture and have a moderate rate of water transmission."

The hydrologic soils map and data are located in Appendix A.

The project site is located on Panel 08041C0276G of the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), December 7, 2018. The site is predominantly located in a Zone X area, defined as an area

outside the 500-year flood, which means that the area has a less than 0.2 percent chance of flooding annually. Between Base Camp Road and Microscope Way, Deer Creek Road crosses Crystal Creek. At this crossing, Deer Creek Road passes through a Zone AE floodplain with floodway. Zone AE is defined as the base floodplain where base flood elevations are provided. The floodway is defined as the area of conveyance that must be preserved to discharge the base flood without increasing the water surface elevation more than a designated height. In the state of Colorado, that height is identified as 0.5 foot. Previously, the height was identified as 1-foot; the effective floodplain was completed using a 1-foot floodway. The FEMA FIRM has been included in Appendix B.

Currently Crystal Creek is going through a Letter of Map Revision (LOMR) for the Monument Hill Road Project. This LOMR covers the Deer Creek project area and the approved LOMR model was used for modeling purposes. This model has been obtained and the river was analyzed using Hydraulic Engineering Center – River Analysis System (HEC-RAS) 5.07 software.

2.1 DESIGN CRITERIA REFERENCES

Drainage analysis is based on the project configuration, contributing basin peak flows, historic drainage patterns, and the following technical criteria requirements:

- El Paso County Drainage Criteria Manual, Vol. 1; (DCM); October 31, 2018.
- City of Colorado Springs Drainage Criteria Manual, Vol. 1 Chapter 6 and Section 3.2.1 of Chapter 13; (COSDCM); updated January 2021, referenced by sections of the El Paso County DCM.
- El Paso County Engineering Criteria Manual (ECM), October 14, 2020.

2.2 HYDROLOGIC CRITERIA

The hydrologic analysis has been conducted in conformance with the El Paso County Drainage Criteria Manual (DCM). Volume 1 Update, Chapter 6 - Hydrology. Design flows were calculated using the Rational Method and used to size the proposed storm sewer inlets, pipes, and culverts.

2.2.1 Design Flood Frequency

The 5-year and 100-year design storms are the minor and major hydrologic storm events according to the El Paso County ECM. The FEMA regulatory Crystal Creek 100-year flows were used for the replacement culvert sizing at Deer Creek Road. The existing and proposed drainage basin maps and calculations are included in Appendix C.

2.2.2 Rational Method

The hydrology for the sub-basin and drainage elements for this project was developed for the minor and major storms using the Rational Method. The Rational Method is valid for basins up to 130 acres. All the proposed roadway drainage basins related to the Deer Creek Road project are less than 130 acres.

Time of Concentration

The time of concentration (Tc) for the Rational Method for each sub-basin was calculated using the method outlined in the COSDCM. The time of concentration consists of the initial time of overland flow and travel time in channel flow. Minimum travel time shall not be less than 5 minutes.

Rainfall Intensity

Rainfall intensities per Figure 6-5 referenced from the COSDCM for use in the Rational Method were calculated based on Intensity-Duration-Frequency curves. The curves are based on the rainfall depths for an

elevation of 6,840 feet in the Colorado Springs area. Figure 6-5 of the COSDCM provides the following IDF Equations.

$$I_5 = -1.50 \ln(D) + 7.583$$

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

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

I = Rainfall Intensity (inches per hour)

D = Duration (minutes) (minimum of 5 minutes)

Runoff Coefficients

Rational Method runoff coefficients (C) were taken from Table 6-6 of the DCM for sub-basins which contribute runoff to the project area, including paved roads, gravel roads, business - commercial, and undeveloped areas. A weighted C value was then determined for each sub-basin area. Calculations for weighted C values are included in the appendices.

Table 6-6

Runoff Coefficients

Runoff C Values	5-year	100-year
	A/B	A/B
Streets - Paved	0.90	0.96
Streets - Gravel	0.59	0.70
Business - Commercial	0.81	0.88
Business - Neighborhood	0.49	0.62
Undeveloped – Pastures/Meadow	0.08	0.35
Residential – ½ Acre	0.22	0.46

2.3 EXISTING BASIN DESCRIPTION

The existing sub-basins in the Project area are made up of off-site basins from adjacent business/residential developments and undeveloped areas and on-site roadway basins. El Paso County contours, and aerial imagery were used to delineate the large off-site basins. The flows for the existing basins were calculated based on the Rational Method. Existing Basin Maps can be found in Appendix C.

There are 18 design points located within the Project Limits. Design points are locations where flows are collected and conveyed offsite.

Design Point 1 (DP1) consists of basins O-105, 106, 400N and 403N, and are located on the north side of Deer Creek Road and east of the intersection with Monument Hill Road. Basin 400N runoff is collected via a closed storm system within the off-site development and conveyed to a pond prior to reaching DP1. Flow from basins O-105, 106 and 403N is collected via roadside ditches along Deer Creek Road and Monument Hill Road eventually entering a storm system at the northeast corner of the intersection of Deer Creek Road and Monument Hill Road. The storm system outfalls into a ditch on the west side of Monument Hill Road.

Design Point 2 (DP2) is located on the east side of Monument Hill Road approximately 400' south of Deer Creek Road. This DP collects flow from basins 403 and 405 via roadside ditches and cross culverts. Flows from basin 405 bypass basin 404 through a culvert which connects to the ditch for basin 403. Basin 400S is conveyed through the off-site

development to a pond prior to discharging to DP2. Flow is then conveyed south along Monument Hill Road and ultimately enters Crystal Creek downstream of our project area via cross culverts and a storm system.

Design Point 3 (DP3) is located on the northeast side of Deer Creek Road and Basecamp Road and collects flow from basins 101, 103, 104, and 107 via roadside ditches and culverts. Flow is then conveyed to Crystal Creek via roadside ditches.

Design Point 4 (DP4) is located on the northwest side of Deer Creek Road and Microscope Way. This design point collects runoff from basins 200, 201, 202, and 415 and discharges into Crystal Creek via culverts and overland flow.

Design Point 5 (DP5) is located on the north side of Deer Creek Road, approximately 260 feet west of the intersection with Woodmoor Drive. This design point collects flow from basins 414 and 417 via roadside ditches and then conveys flow underneath Deer Creek Road via an existing storm system. This system flows southwest and outfalls into a ditch to the west of the Lewis Palmer Middle School track. Flow appears to be carried west by another culvert and eventually to Crystal Creek.

Design Point 6 (DP6) is located on the west side of Microscope Way approximately 150 feet south of the cul-de-sac. This design point consists of runoff from basins 203 and 206. Flow is collected using roadside ditches and a culvert to convey the flow to the west side of Microscope Way. From there the runoff will sheet flow to Crystal Creek.

Design Point 7 (DP7) is located on the south side of Deer Creek Road at Crystal Creek. This design point conveys runoff from basins 410, and 413 to Crystal creek via roadside ditches and overland flow.

Design Point 8 (DP8) is located on the south side of Deer Creek Road. It is where Crystal Creek crosses under Deer Creek Road and has a drainage basin of (.58 square miles) 371.2 acres. This area is from the FEMA Flood Insurance Study for El Paso County. See Appendix B for the FEMA Firmette page.

Design Point 9 (DP9) is located on the south side of Deer Creek Road, approximately 260 feet west of the intersection with Woodmoor Drive. Runoff from the road sheet flows from basins 418 and 420 then captured in ditches and conveyed to a riprap rundown at DP9. The riprap rundown continues southwest where it will eventually contribute to Crystal Creek approximately 400 feet southwest of the basin location.

Design Point 10 (DP10) is located approximately 180 feet south of Deer Creek Road on the east side of Woodmoor Drive. Basin 419 is conveyed south via overland flow and a roadside ditch that runs along Woodmoor Drive. At the northeast corner of the intersection of Woodmoor Drive and Deer Creek Road, the existing ditch ends with a minor sump and no existing storm to convey the flow. Runoff from Basin 419 will overtop Deer Creek Road and continue south into the existing ditch. Basin 421 consists of roadway runoff that will sheet flow into the existing ditch which appears to continue south running parallel to Woodmoor Drive.

Design Point 11 (DP11) is located north of Deer Creek Road and east of Woodmoor Drive. This design point conveys runoff from Basin 423 east via an existing roadside ditch.

Design Point 12 (DP12) is located south of Deer Creek Road and east of Woodmoor Drive. Basin 422 roadway runoff will sheet flow and be captured in a small roadside ditch that is then conveyed east off site.

Design Point 13 (DP13) is located on the south side of Deer Creek and approximately 60 feet east of Woodmoor Drive. Basin 424 roadway runoff will flow off-site via overland sheet flow to the south.

Design Point 14 (DP14) is located on the west side of Woodmoor Drive approximately 180 feet south of Deer Creek. Runoff from basin 425 will sheet flow to an existing ditch that is conveyed south along the outside edge of the Lewis Palmer Middle School track.

Design Point (DP15) is located along the south side of Deer Creek Road approximately 200 feet east of Microscope Way. This design point consists of basin 416 which is runoff from an existing driveway. The runoff will sheet flow south and ultimately into Crystal Creek.

Design Point 16 (DP16) is located at the northwest side of the Microscope Way cul-de-sac. Runoff from basin O-204 will sheet flow off-site and ultimately into Crystal Creek.

Design Point 17 (DP17) is located along the south side of Deer Creek Road, west of the crossing with Crystal Creek. Runoff from basin 407 will sheet flow off-site and ultimately into Crystal Creek.

Design Point 18 (DP18) is located along the south side of Deer Creek Road, approximately 400 feet east of Monument Hill Road. Roadway runoff from the basin 404 will sheet flow south off-site.

2.3.1 Flood History

There is no recorded history of the existing structures within the Project corridor experiencing flood related problems.

2.4 PROPOSED BASIN DESCRIPTION

The Project will maintain historical flow patterns. New roadway basins were delineated for the proposed storm systems and off-site basins were modified as necessary for the updated grading.

The proposed drainage pattern matches the existing conditions with the following exceptions. Basin 413 sheet flows across Deer Creek Road and contributes to DP7 in existing conditions. In proposed conditions Basin 413 will be conveyed in a cross pan to the west to DP4. In proposed conditions, existing basin 407 is split into two basins (basin 407 and 408). Proposed basin 408 will be conveyed via a closed storm system to DP7.

Design Point 1 has a decrease in peak runoff rates of 2.06 cfs and 2.98 cfs for the minor and major storms respectively. The reduction is due to the increased time of concentration with the addition of curb and gutter and roadside ditches.

Design Points 2 and 5 have a minor decrease in peak runoff rates for both storm events. The reduction is due to the decrease in tributary area and increased time of concentration. DP2 collects flow from basins 403 and 405 via roadside ditches and cross culverts. Flows from basin 405 bypass basin 404 through a culvert which connects to the ditch for basin 403. Basin 400S is conveyed through the off-site development to a pond prior to discharging to DP2.

Design Points 3, 4 and 7 have minor increases in peak flow into Crystal Creek. DP7 will have a minor decrease in the major storm event. The minor increases will not have an impact to the stream's water surface elevation as the project site's peak runoff will have passed through prior to the stream's peak flow.

Design Point 6 will have an increase in peak runoff rates of 0.49 cfs and 0.48 cfs for the minor and major storm events, respectively. The increase is due to the additional pavement along Microscope Way. Runoff will follow existing flow patterns via overland and into Crystal Creek. The increased flow will not have an impact to the stream's water surface elevation as the project site's peak flow will have passed through prior to the stream's peak flow.

Design Point 8 flows remain the same as in the existing conditions. The difference in size of the project site and the size of the drainage area for Crystal Creek are large enough that the peak flows from the project will pass before the peak flow from the Crystal Creek drainage basin..

Design Point 9 will have an increase in peak runoff rates of 0.63 cfs and 0.87 cfs for the minor and major storm events, respectively. The increase is due to the additional pavement along Deer Creek Road for basin 418 which discharges directly into a concrete rundown that connects to an existing riprap rundown. It is not anticipated that the increased runoff will negatively impact the existing riprap rundown. Basin 420 which is conveyed in the ditch along the north side of the Lewis Palmer Middle School track will have a decrease in runoff.

Design Point 10 will have a minor increase in peak runoff rates of 0.22 cfs and 0.36 cfs for the minor and major storm events, respectively. The minor increases are not expected to have an impact to the downstream roadside ditch capacity. The downstream ditch is estimated to have a capacity of 17.7 cfs. The flow from our project is the bulk of

the flow that would get into the ditch just downstream of the project limits. The total proposed flow is 10.5 cfs in the major storm which is less than the capacity.

Design Points 11 and 12 will have negligible changes to peak runoff rates.

Design Point 13 will have an increase in peak runoff rates of 0.04 cfs and 0.07 cfs for the minor and major storm events, respectively. The increases are not expected to have any downstream impacts since the flow will continue to sheet flow overland.

Design Point 14 will have an increase in peak runoff rates of 0.06 cfs and 0.07 cfs for the minor and major storm events, respectively. The minor increases are not expected to have an impact to the downstream ditch capacity.

Design Point 15 will have a decrease in peak runoff due to the addition of a cross pan to prevent Deer Creek Road runoff from sheet flowing off-site at the driveway. The roadway flow diverted by the cross pan will be carried by curb and gutter west along Deer Creek and flow into DP7.

Design Point 16 will have an increase in peak runoff rates of 0.09 cfs and 0.07 cfs for the minor and major storm events, respectively. The increase is due to the additional pavement along Microscope Way. Runoff will follow existing flow patterns via overland and into Crystal Creek. The increased flow will not have an impact to the stream's water surface elevation as the project site's peak flow will have passed through prior to the stream's peak flow.

Design Point 17 will have a decrease in peak runoff due to the addition of a closed storm system that will convey basin 408 to DP7.

Design Point 18 will have a decrease in peak runoff due to the updated grading and configuration of the road, less of Deer Creek Road runoff will sheet flow off-site at the driveway.

2.4.1 Major Drainage Basins

The major drainage basins will not significantly change, and the existing flow patterns are maintained. The Drainage Basin Planning Study was prepared by Kiowa Engineering in September 1993 for El Paso County Department of Public Works.

2.4.2 Major Drainage Basin Routing

Basin routing will not change in the proposed conditions.

2.4.3 Minor Drainage Basins

The minor basins are generally limited to roadway drainage. The installation of roadside ditches and some curb and gutter will require that the roadway runoff be captured and conveyed in inlets/culverts.

These basins are summarized within Appendix C.

2.5 PREDICTION OF DESIGN DISCHARGES

Peak design flows are summarized below for each design point and are also included on the drainage basin maps in Appendix C.

Design Flows

Existing and proposed peak runoff rates used for designing Project storm drain systems and cross culverts are listed for each design point in Table 2.2 and are included on the drainage basin maps included in Appendix C.

Table 2.2
Summary Runoff Tables

Design Point	Drainage Area		Routed Peak Flow Rate			
	Existing	Proposed	Existing		Proposed	
	(ac)	(ac)	Q ₅ (cfs)	Q ₁₀₀ (cfs)	Q ₅ (cfs)	Q ₁₀₀ (cfs)
DP1	8.76	8.96	20.01	40.15	17.95	37.16
DP2	3.92	3.91	12.29	23.37	12.26	23.20
DP3	5.22	5.18	9.64	20.11	9.88	20.64
DP4	1.97	2.28	3.58	8.36	4.52	10.09
DP5	3.52	3.45	10.77	21.09	10.46	20.33
DP6	3.60	3.62	4.85	14.46	5.35	14.94
DP7	1.85	1.83	4.72	10.53	5.00	10.42
DP8	371.20	371.20	-	530.00	-	530.00
DP9	0.99	0.97	0.84	3.04	1.47	3.91
DP10	3.60	3.61	3.28	10.18	3.50	10.54
DP11	0.45	0.44	0.47	1.50	0.46	1.46
DP12	0.05	0.05	0.12	0.27	0.12	0.28
DP13	0.02	0.03	0.10	0.18	0.14	0.25
DP14	0.18	0.18	0.16	0.58	0.22	0.64
DP15	0.08	0.05	0.29	0.57	0.15	0.31
DP16	0.21	0.20	0.38	1.02	0.47	1.08
DP17	0.17	0.10	0.28	0.78	0.17	0.45
DP18	0.02	0.01	0.08	0.15	0.06	0.11

3.1 HYDRAULIC DESIGN CRITERIA

3.1.1 General Concept

The proposed inlets and culverts were designed to convey the 5-year design flow and analyzed for impact during the 100-year flow per the DCM. The proposed storm drain improvements have been located based on collecting drainage with the proposed grading improvements and minimizing existing and future utility conflicts, where possible. Proposed Project grading and drainage improvements do not significantly change the general drainage flow patterns in the area. Existing culvert locations were replaced, as needed, with the appropriately sized culverts to meet current design standards. Hydraulic calculations are included in Appendix D.

3.1.2 Proposed Roadway Inlets and Storm Drains

Roadway inlet selection and placement conforms to the requirements of El Paso County. Capacity of the area grate inlets were calculated following criteria outlined in Chapter 7 of the DCM. Storm drain pipes have a minimum size of 18-inches, are designed for H-20 loading, and a minimum velocity of 2.5 feet per second. Storm drains were analyzed using Bentley OpenFlows StormCAD Connect Edition, Update 3.

Deer Creek Road, Woodmoor Drive, Base Camp, and Microscope Way are classified as Type A & B (Local/Residential and Collector with Roadside ditch). The spread requirements are as shown below from DCM Table 6-1, section 6.2.3:

Street Classification	Use of Streets for Initial and Major Storms		Cross Flow In Streets For Initial and Major Storms	
	Initial Storm	Major Storm	Initial Storm	Major Storm
Type A (Local with Roadside Ditch)	Flow must not encroach upon street shoulder area.	Residential dwellings, public, commercial and industrial buildings shall not be inundated at the ground line. The depth of flow shall not exceed 6 inches at the shoulder.	Requires culvert. Flow shall not encroach upon street shoulder.	Requires culvert, depth of flow shall not exceed 6 inches at the street shoulder.
Type B (Collector or Minor Arterial)	No curb overtopping. Flow spread must be limited to a maximum 20 foot spread from each curb face.	Same as Type A (Local/Residential) above.	Where cross pans are allowed, depth of flow shall not exceed 6 inches at flow line	12 inches of depth at gutter flow line
Type B (Collector or Minor Arterial with Roadside Ditch)	Flow must not encroach upon street shoulder area.	Same as Type A (Local with Roadside Ditch) above.	Requires culvert. Flow shall not encroach upon street shoulder.	Requires culvert. Depth of flow shall not exceed 6 inches at the street shoulder.

feet per second. Culverts will include end treatments and outlet protection. Standard end sections will be utilized for most of the pipe culverts and headwall used only where required due to topography or conflicts. End sections provide sufficient outlet protection in conjunction with riprap outlet paving to prevent erosion at the outlet. Table 3.1 lists the existing culverts within the project limits.

Deer Creek Road and Woodmoor Drive are classified as rural collectors while Base Camp Road and Microscope Way are classified rural local roads. The DCM Section 6.4.1, Table 6-4 criteria will be applied to the design of proposed culverts.

Deer Creek Road and Woodmoor Drive: Type A & B (Local/Residential and Collector with Roadside ditch). The HW/D ratio shall be less than the pipe height for the design storm and maximum depth at the street shall be six inches or less during the major event.

Base Camp Road and Microscope Way: Type A & B (Local/Residential and Collector with Roadside ditch). The HW/D ratio shall be less than the pipe height for the design storm and maximum depth at the street shall be six inches or less during the major event.

3.1.5 Hydraulic Analysis

Bentley StormCAD Connect was used to analyze the proposed storm drain systems throughout the project. The StormCAD calculations were used to size drainage pipes, determine hydraulic grade lines, and calculate flow velocities.

The StormCAD calculations differ slightly from the Rational Method spreadsheet calculations used in the Excel spreadsheets and StormCAD produces the higher value, due to rounding and interpolation of the flow calculations. The basin areas and average C values from the Rational Method spreadsheet were used as StormCAD inputs.

3.2 EXISTING STRUCTURE DESCRIPTIONS

Within the Project site, there are ten existing culverts. Culverts are conveyance beneath driveways and under Deer Creek Road or Microscope Way. Existing culverts within the project area were analyzed for conveyance capacity and compliance with current criteria and are summarized in Table 3-1.

3.1.3 Roadside Ditches

Roadside ditches will be utilized to convey flow from the roadway to storm systems and culverts. Deer Creek Road is classified as a rural collector and Base Camp Road and Microscope Way are rural locals. The DCM Section 6.4.1, Table 6-1 criteria will be applied to the design of proposed roadside ditches.

Deer Creek Road and Woodmoor Drive: Type A & B (Local/Residential and Collector with Roadside ditch). Flow must not encroach upon street shoulder during the minor storm event. For the major storm event residential dwellings, public, commercial, and industrial buildings shall not be inundated at the ground line. The depth of flow shall not exceed 6 inches at the shoulder.

Base Camp and Microscope Way: Type A & B (Local/Residential and Collector with Roadside ditch). Flow must not encroach upon street shoulder during the minor storm event. For the major storm event residential dwellings, public, commercial, and industrial buildings shall not be inundated at the ground line. The depth of flow shall not exceed 6 inches at the shoulder.

3.1.4 Culverts

Design of culverts follows the DCM Chapter 2, 6 and 9 and ECM Chapter 3 guidance. The minimum culvert size will be 18-inches, are designed for H-20 loading, and minimum velocity is 2.5 feet per second with a maximum velocity of 12

Table 3-1 Summary of Existing Culverts

Culvert ID	Approx. Location	Basin ID	Pipe Size in	Pipe Material	Minor Storm				Major Storm			
					Q _s	Design HW/D	Design HW Elev	Outlet Velocity	Q ₁₀₀	Design HW/D	Design HW Elev	Outlet Velocity
					cfs		feet	fps	cfs		feet	fps
EX-CV-101	Base Camp Sta 101+50 RT	103*	15	CSP	9.42	1.35	7136.88	5.00	19.39	1.53	7137.11	5.21
EX-CV-104A	Base Camp Sta 104+20 RT	104*	18	CSP	8.60	1.01	7142.21	5.30	17.36	1.12	7142.39	5.71
EX-CV-104B	Base Camp Sta 104+80 RT	107	18	RCP	0.63	0.28	7142.37	3.99	1.40	0.42	7142.58	5.05
EX-CV-204	Microscope Way Sta 204+80	206	24	CSP	3.92	0.62	7140.12	4.05	12.33	1.13	7141.14	5.90
EX-CV-404	Deer Creek Sta 404+30 RT	405	18	RCP	0.31	0.19	7128.05	2.99	0.84	0.32	7128.25	4.02
EX-CV-409 ¹	Deer Creek Sta 409+00	-	60	CMP	-	-	-	-	530	1.58	7127.70	13.49

Culvert ID	Approx. Location	Basin ID	Pipe Size in	Pipe Material	Minor Storm				Major Storm			
					Q ₅	Design HW/D	Design HW Elev	Outlet Velocity	Q ₁₀₀	Design HW/D	Design HW Elev	Outlet Velocity
					cfs		feet	fps	cfs		feet	fps
EX-CV-410	Deer Creek Sta 410+50	201*	18	CSP	3.26	0.79	7128.95	5.52	7.63	1.34	7129.77	6.86
EX-CV-412	Deer Creek Sta 412+00 LT	202*	18	CSP	3.21	0.79	7136.26	6.73	7.44	1.32	7137.06	8.44
EX-CV-414	Deer Creek Sta 414+40 LT	415	18	CMP	2.27	0.65	7148.50	6.30	4.13	0.91	7148.90	7.47
EX-CV-415	Deer Creek Sta 415+70	414*	18	CMP	10.77	1.94	7147.91	6.55	21.09	2.05	7148.06	6.67
EX-CV-416	Deer Creek Sta 416+20 LT	417	12	CMP	6.68	1.72	7147.95	1.54	13.47	1.87	7148.10	0.65

¹Crystal Creek crossing, 100-year storm event used as design storm.

* Indicates a routed flow from specified basin and contributing upstream basins. See existing hydrology calculations.

3.2.1 Utilities

Utilities that will be encountered include, but not limited to, fiber optic, gas, underground and overhead electrical lines, sanitary, and water. A preliminary Subsurface Utility Investigation (SUE) has been conducted to locate utilities horizontally in compliance with ASCE Standard 38. The utility information contains utilities mapped from Quality Level D up to Quality Level B.

3.3 PROPOSED IMPROVEMENTS

As part of the proposed roadway improvements, the roadway corridors will remain as rural. Roadway runoff will be conveyed via roadside ditches, culverts, and a few closed storm systems.

Line 101 replaces a 15-inch corrugated steel pipe (CSP) with a 30-inch by 19-inch horizontal elliptical reinforced concrete pipe (HERCP). The upstream culverts are both 18-inches in diameter. Flow direction for the culvert will not change.

Line 204 replaces an undersized culvert which flows west under Microscope Way. The existing pipe is a 24-inch CSP and will be replaced with a 30-inch by 19-inch HERCP to meet cover criteria. Flow direction for the culvert will not change.

Line 408 is added to prevent concentrated roadway runoff from flowing off-site. The system will capture roadway runoff and convey the flow under a driveway and discharge directly into Crystal Creek.

Line 409 is a 12-foot by 6-foot box culvert that will replace an undersized 60-inch corrugated metal pipe (CMP). The culvert will convey Crystal Creek under Deer Creek Road.

Line 410 replaces an existing 18-inch CSP culvert under a driveway. There is not enough distance between the roadway and the wall to get a ditch deep enough to get a culvert to fit so an inlet was placed at the upstream end with an 18-inch reinforced concrete pipe (RCP).

Line 412 replaces an existing undersized culvert under Microscope Way. It will carry flow west under Microscope Way towards Line 410 on the north side of Deer Creek Road. The existing culvert is an 18-inch CSP and will be replaced with a 23-inch by 14-inch HERCP.

Line 415 will replace an undersized culvert. This culvert will convey flow under Deer Creek Road and tie into an existing storm system. The existing 18-inch CSP will be replaced with a 30-inch by 19-inch HERCP. The downstream existing

pipe to remain is an 18-inch plastic pipe. The existing pipe was analyzed in StormCAD which shows that it has capacity for the flow contributing to it.

Line 416 replaces an existing undersized culvert under driveway 416. The existing 12-inch CMP will be replaced with a 30-inch by 19-inch HERCP. It will carry flow west to Line 415 on the north side of Deer Creek Road. The downstream side will have a headwall due to the grading and prevent a conflict with the end section of Line 415.

Line 419 is located to convey the roadside ditch at the northeast corner of Deer Creek Road and Woodmoor Drive south under Deer Creek Road. Currently there is a sump in the existing ditch with no storm drain to convey the flow, so it overtops Deer Creek Road. The new storm system will maintain existing flow patterns by discharging south into the roadside ditch that runs parallel to Woodmoor Drive.

Table 3-2 Summary of Proposed Culverts

Culvert ID	Approx. Location	Basin ID	Pipe Size in	Pipe Material	Minor Storm				Major Storm				
					Q ₅	Design HW/D	HW Elev / HGL	HW/D < Pipe Height ³	Q ₁₀₀	Design HW/D	HW Elev / HGL	EOP ⁴ Elev	HW Elev < EOP Elev + 6" ³
					cfs		feet		cfs		feet	feet	
CV-101	Base Camp Sta 101+50 RT	103*	30x19	HERCP	9.63	0.84	7136.28	Yes	19.86	1.13	7136.74	7136.40	Yes
CV-204	Microscope Way Sta 204+80	206	30x19	HERCP	4.36	0.56	7139.40	Yes	12.83	1.01	7140.12	7141.47	Yes
CV-408 ²	Deer Creek Sta 407+84	407	18	RCP	0.17	-	7122.30	-	0.45	-	7122.40	7129.00	-
CV-409	Deer Creek Sta 409+00	-	12'x6'	RCBC	530 ¹	1.15	7126.67	Yes	530 ¹	1.15	7126.67	7128.12	Yes
CV-410 ²	Deer Creek Sta 410+99	201*	18	RCP	3.76	-	7126.53	-	8.54	-	7127.20	7129.90	-
CV-412	Deer Creek Sta 412+00LT	202*	23x14	HERCP	3.49	0.74	7136.32	Yes	7.90	1.21	7136.88	7138.40	Yes
CV-415	Deer Creek Sta 415+70	414*	30x19	HERCP	10.46	0.89	7146.35	Yes	20.33	1.43	7147.23	7147.80	Yes
CV-416	Deer Creek Sta 416+20 LT	417	30x19	HERCP	7.34	0.75	7146.75	Yes	14.56	1.10	7147.31	7148.01	Yes
CV-419 ²	Deer Creek Sta 410+99	419	18	RCP	2.96	-	7149.97	-	9.37	-	7150.00	7152.50	-

¹Crystal Creek crossing, 100-year storm event used as design storm.

²Storm line has an inlet at upstream end so HW/D was not calculated.

³DCM Table 6-4 Criteria Requirement.

⁴Edge of Pavement

* Indicates a routed flow from specified basin and contributing upstream basins. See proposed hydrology calculations.

Hydraulic calculations can be found in Appendix D.

A majority of the off-site runoff in the Project area will continue to be conveyed via roadside ditches and culverts. Project improvements will not change culvert crossing locations. Lines 408 and 410 will have area inlets added to meet both pipe cover and roadside ditch grading requirements. Existing undersized culverts, mentioned at the beginning of this section, will be replaced to meet current design standards and/or replaced due to the proposed roadway improvements and grading.

A proposed embankment protector type 5 is placed at the sump on the south side of Deer Creek Road at station 415+75. This will convey roadway runoff southwest to an existing riprap ditch and eventually outfall into Crystal Creek.

Crystal Creek crosses under Deer Creek Road at approximately station 409+00. Per the FEMA Flood Insurance Study, the 100-year flow at this crossing is 530 cfs with a basin of 371.2 acres. The recommended culvert at Crystal Creek, CV-409, is a 12x6 foot concrete box culvert (CBC). The culvert has been analyzed to convey the regulatory flow (100-year flow) through the opening without overtopping the road. The HEC-RAS model used for the Letter of Map Revision (LOMR) for the Monument Hill Road Project was obtained and is used as the existing conditions. The proposed conditions are the same model but modified by adding the culvert (Cross section 33), a new cross section just upstream of the culvert (Cross section 33.1) and another just downstream (Cross section 32.7). The intent of the increased culvert size under Deer Creek Road is to eliminate roadway overtopping. The analysis indicates that the water surface elevation will decrease at the updated cross sections. The water surface matches existing conditions at cross section 32. A Certificate of No Rise will be completed as the design progresses. The County and AECOM are working toward completing a full study of Crystal Creek which will likely affect what is shown in this report. Existing and proposed condition cross section tables are located in Appendix D.

Per FHWA's HEC-22 coincidental convergence, the project basins and the basin for Crystal Creek, the project area to total basin area ratio is approximately 30:1. This indicates that the peak project flows for the 100-year storm will be analyzed using the 25-year water surface elevation in the creek as the tailwater elevation. The system is also analyzed with the 25-year storm event using the 100-year creek water surface elevation. The increase of flows from the roadway improvements are not significant and will peak before the channel will peak will not cause a change downstream.

Roadside ditches are designed to meet criteria. Ditches were sized to convey the 5-year and 100-year storm events without encroaching on the roadway where feasible. In areas with limited width, ditches were sized per the criteria where they have capacity for the 5-year event and the 100-year event is allowed to encroach onto the roadway. Calculations for culverts and ditches are included in Appendix D.

3.3.1 Design Documents

A plan layout and profiles are included in Appendix E.

4.1 EROSION CONTROL PLAN

Erosion and Sediment Control plans for this project identify best management practices (BMP) for use during construction and for final stabilization. These BMPs will be installed according to the Colorado Department of Transportation's Erosion Control Manual and specifications in Section 208 of the Standard Specifications.

Active areas of earthwork operations will be watered and compacted according to the earthwork specifications contained in the contract. Disturbed areas where construction activities do not occur for 14 days or more shall be stabilized with temporary seeding. Throughout construction, as unpaved areas are completed, topsoil placement and permanent seeding will follow.

Mud and dirt tracked onto existing paved streets will be prevented by installing stabilized construction entrances and sweeping of paved surfaces as necessary.

Wind erosion from all active unpaved roads for this Project will be controlled through water application, mulch, tackifier, and erosion control blankets.

The selected construction contractor will be responsible for updating and revising the erosion controls based on their specific impacts, sequencing, and timing. Accordingly, some of the information included in the erosion control sheets

will likely be superseded and expanded on by the contractor to reflect their construction approach and methodology. Erosion control plan sheets will be included in future submittals.

4.2 POST CONSTRUCTION WATER QUALITY

El Paso County has in place a Four Step Process for identifying and selecting Permanent Best Management Practices (PBMPs) for new development and redevelopment. These steps are to employ runoff reduction practices, stabilize drainageways, provide water quality capture volume (WQCV), and consider the need for industrial and commercial BMPs. (Section 1.7 of ECM)

Step 1 of the Four Step Process is to employ runoff reduction practices. These practices reduce runoff peaks, volumes, and pollutant loads by reducing unnecessary impervious areas and routing runoff from impervious surfaces over permeable areas to slow runoff and promote infiltration. Permeable pavement, grass swales, and rain gardens are examples of practical ways to achieve this step. This step was achieved using grass ditches and buffers along the Project corridor.

The second step of the Four Step Process is the implementation of best management practices (BMPs) that provide capture and slow release of the water quality capture volume (WQCV). This step is best utilized when stormwater quality needs are considered early in the development process, stormwater is in contact with the landscape and soil, and treatment occurs in several site locations rather than in one larger BMP. Capture and slow release of the WQCV is implemented throughout the Project with the use of grass buffers.

The total area of disturbance on this project is 5.15 acres. Per exclusion 3 of the ECM, Appendix I section 1.7.1; 2.45 acres of existing pavement is excluded from the water quality requirement. The project will increase the paved area to 3.31 acres, of which 0.86 acres of new pavement and a total disturbed area of 1.66 acres that will require water quality treatment. Per exclusion 2, sites can be excluded if the project adds less than 1 acre of paved area per mile to an existing roadway. Base Camp Road and Microscope Way will be excluded as they both add less than 1 acre per mile of pavement along each road. Exclusion 2 results in 1.04 acres of the project area to be excluded. Due to right-of-way (ROW) and topography constraints, there are portions the project where it is not practicable to treat the runoff from Deer Creek so the county has approved the use of overtreatment where feasible to meet criteria.

Using the MHFD SCM-Design runoff reduction method, the grass ditches and grass buffers are providing WQCV reduction of 60% for 1.68 acres. There is 0.02 acres of disturbed area that falls under exclusions 2 and 3 that will be overtreated to provide the minimum of 60% WQCV reduction required. Additionally, as the flow patterns are being maintained, additional flow is negligible, downstream capacity is not being exceeded, so 100-year detention is not required. Calculations are included in Appendix D.2.

Step 3 of the Four Step Process is to stabilize natural drainageways to reduce bed and bank erosion. By employing targeted fortification of a stream during and following development, more costly measures such as repairing and regrading a degraded channel can be prevented. It is required for all new and re-development projects to either construct or else participate in the funding of the construction of applicable channel stabilization measures as required by the stream's DBPS or master plan. Flows from the project site will be discharged into Crystal Creek. Grass ditches and buffers are implemented to allow flow to infiltrate and reduce the flow rate. This will aid in stabilizing Crystal Creek during storm events. At the entrance and exit of the box culvert that conveys Crystal Creek under Deer Creek Road, a concrete apron is proposed to prevent channel scour at the culvert. Crystal Creek is well vegetated, so it is recommended to maintain the vegetation to aid in the reduction of velocities and potential for scour.

Within the ditch sections, shear stress calculations were completed to determine what lining would be needed. For most of the ditch sections, the shear stress only requires soil retention blanket. There are 4 ditch sections that require turf reinforcement mat. Shear Stress calculations are included in Appendix D.

The final step in the Four Step Process is to implement targeted source control BMPs. Site specific and/or source control BMPs must be implemented during construction to protect the County's MS4 from potential pollutant sources. Practical applications of this step include covering storage and handling areas as well as spill containment and control. Source control measures for the Project are included in the Stormwater Management Plan (SWMP). BMPs will be used for temporary stormwater treatment. The selected BMPs could include, but are not limited to inlet protection, culvert protection, check dams, grass buffers, grass swales, earthen berms, sediment logs and rock socks.

5.1 CONCLUSION

The proposed drainage design and the design methods are in compliance with the El Paso County Drainage Criteria Manual. There are no significant changes in the historic drainage patterns, nor are there any new flooding impacts created by the proposed Project. The proposed drainage improvements are designed to not adversely affect downstream and surrounding properties.

Proposed drainage and erosion control designs are included in the Project's plan set (Appendix E).

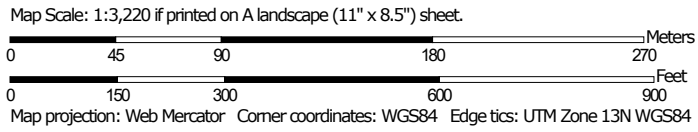
-
1. Web Soil Survey of El Paso County, Colorado. Version 9, September 17, 2019. United States Department of Agriculture-Natural Resources Conservation Service (NRCS). November 2019. <<http://websoilsurvey.nrcs.usda.gov>>.
 2. "El Paso County Drainage Criteria Manual." El Paso County Colorado. Volume 1 (October 31, 2018).
 3. "El Paso County Engineering Criteria Manual." El Paso County Colorado. (December 2016).
 4. "City of Colorado Springs Drainage Criteria Manual." City of Colorado Springs. Colorado Springs, CO: Volume 1 Chapter 6 (January 2021).
 5. Bentley FlowMaster, Connect Edition Update 2, Bentley Systems Inc. 27 Siemen Company Drive, Suite 200W, Watertown CT 06795.
 6. Bentley Culvert Master, Connect Edition Update 2, Bentley Systems Inc. 27 Siemen Company Drive, Suite 200W, Watertown CT 06795.
 7. Colorado Department of Transportation Erosion Control and Stormwater Quality Guide. Colorado Department of Transportation, 2011.
 8. Bentley InRoads V8i (SELECTseries 2) V08.11.07.615.
 9. Federal Highway Administration. HY8 7.30. Aug 13, 2014.
 10. "Design of Roadside Channels with Flexible Linings." Federal Highway Administration HEC No. 15. 3rd Edition. (September 2005)
-

Appendix A
NRCS Soils Data

































Hydrologic Soil Group—El Paso County Area, Colorado



Soil Map may not be valid at this scale.



MAP LEGEND

- Area of Interest (AOI)**
 -  Area of Interest (AOI)
- Soils**
 - Soil Rating Polygons**
 -  A
 -  A/D
 -  B
 -  B/D
 -  C
 -  C/D
 -  D
 -  Not rated or not available
 - Soil Rating Lines**
 -  A
 -  A/D
 -  B
 -  B/D
 -  C
 -  C/D
 -  D
 -  Not rated or not available
 - Soil Rating Points**
 -  A
 -  A/D
 -  B
 -  B/D
- Water Features**
 -  Streams and Canals
- Transportation**
 -  Rails
 -  Interstate Highways
 -  US Routes
 -  Major Roads
 -  Local Roads
- Background**
 -  Aerial Photography
- Other**
 -  C
 -  C/D
 -  D
 -  Not rated or not available

MAP INFORMATION

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

Warning: Soil Map may not be valid at this scale.
 Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado
 Survey Area Data: Version 19, Aug 31, 2021

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

Date(s) aerial images were photographed: Jun 9, 2021—Jun 12, 2021

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	B	1.4	2.6%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	25.9	49.1%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	B	20.5	38.9%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	B	5.0	9.4%
Totals for Area of Interest			52.8	100.0%

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix B
FEMA FIRMETTES

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the **same vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov/> or contact the National Geodetic Survey at the following address:

NGS Information Services
 NOAA, NINGS 12
 National Geodetic Survey
 SSMC-3, #5202
 1315 East-West Highway
 Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its website at <http://www.ngs.noaa.gov/>.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

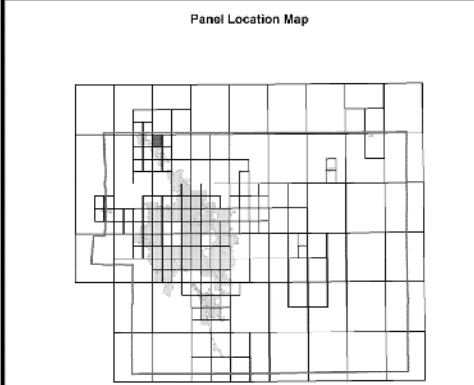
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels, community map repository addresses, and a listing of communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact **FEMA Map Service Center (MSC)** via the FEMA Map Information eXchange (FMI/X) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at <http://www.msc.fema.gov/>.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call 1-877-FEMA MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/business/nfp>.

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

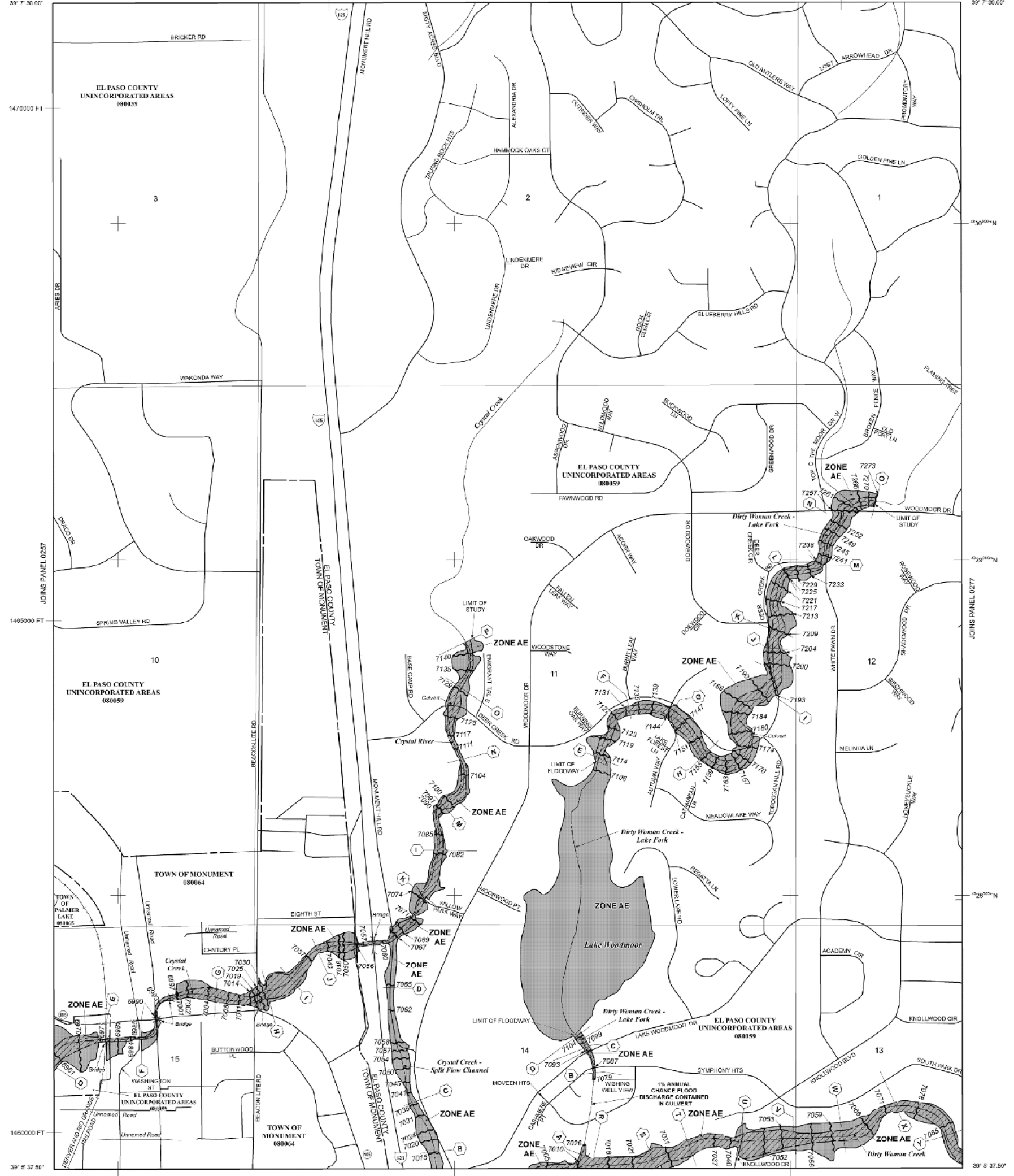
Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).



Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



ZONE A No Base Flood Elevations determined.

ZONE AF Base Flood Elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

ZONE AI Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE AR Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently declassified. Zone AR indicates that the former flood control system is being retained to provide protection from the 1% annual chance or greater flood.

ZONE A99 Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

Floodplain boundary
 Floodway boundary
 Zone D boundary
 CBRS and OPA boundary
 Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities
 Base Flood Elevation line and value; elevation in feet
 Base Flood Elevation value where uniform with in zone; elevation in feet

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A-A Cross section line
 23-23 Transsect line
 07° 01' 30.00" 33° 22' 30.00" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
 49° 00' N 100-meter Universal Transverse Mercator grid ticks, zone 13
 000000 FT 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
 DX5510 X Bench mark (see explanation in Notes to Users section of this FIRM panel)
 M1.5 River Mile

MAP REPOSITORIES
 Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTY-WIDE FLOOD INSURANCE RATE MAP
 MARCH 17, 1997

FOR FURTHER INFORMATION CONTACT THE PANEL REVISION HISTORY FOR THIS PANEL:
 DECEMBER 7, 2016 - To update corporate limits, to change flood hazard elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For anniversary revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-338-6626.

MAP SCALE 1" = 500'

NFIP PANEL 0276G

FIRM FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 276 OF 1300
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	08069	3076	G
MOUNTAIN VIEW OF	08069	3076	G
MOUNTAIN VIEW OF	08069	3076	G

Note: This map was revised on 05/15/2020 to make corrections to the map information and to update the National Flood Insurance Program (NFIP) map information. See the National Flood Insurance Program (NFIP) website for details.

Note to User: The Map Number shown below should be used when placing map orders. The Community Number shown below should be used to determine the correct map information.

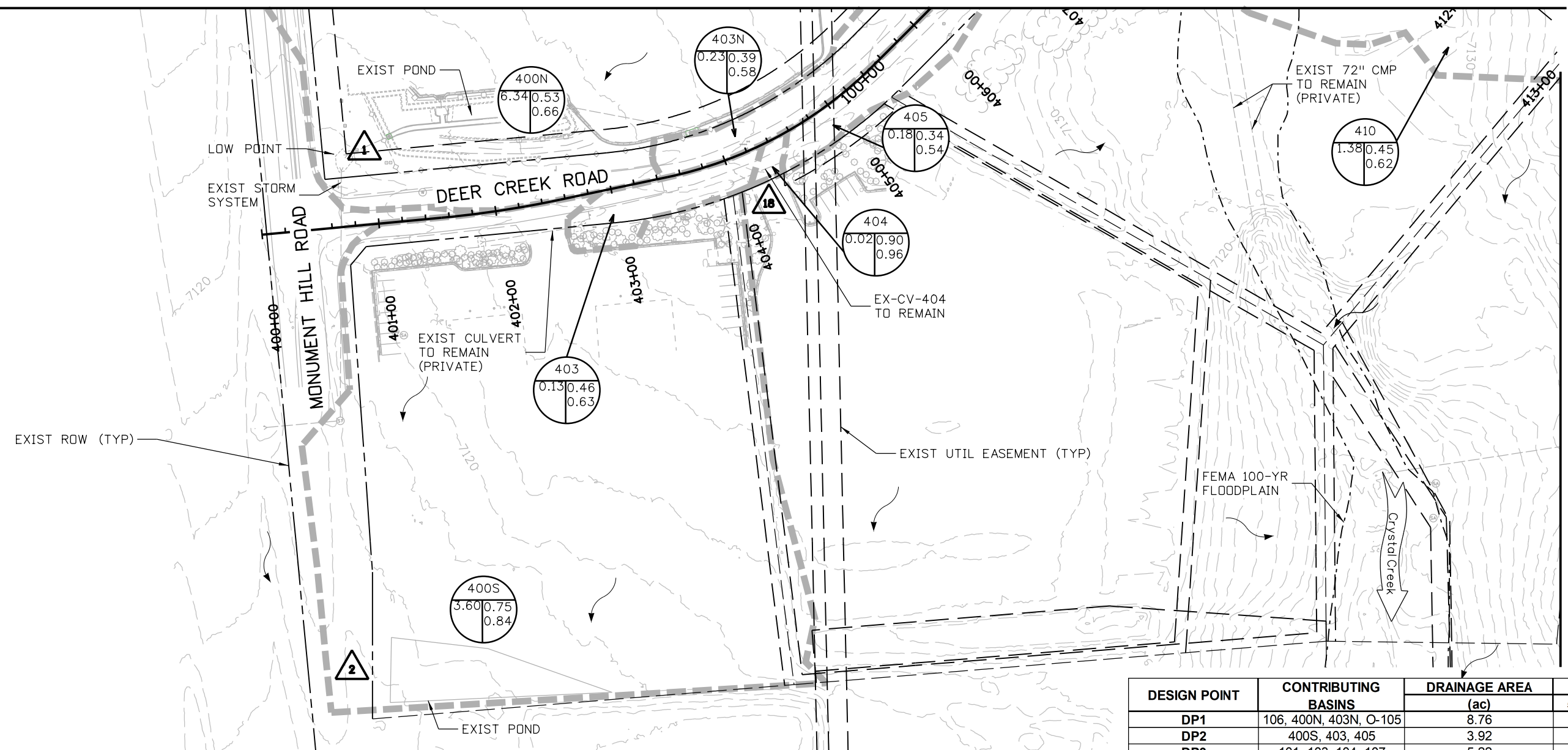
MAP NUMBER 08041C0276G

MAP REVISED

Appendix C
Hydrology

SEE SHEET 02

jessica.barr 9:42:42 AM p:\aecom\nc-pw\entley.com\AECOM_USA_Colorado\Documents\60673398-Deer Creek Rd\900-CAD\910-CAD\06_SHEETS\03_Hydrology-Drainage\Basin Maps\Existing Basin Map_Sheet 1.dgn



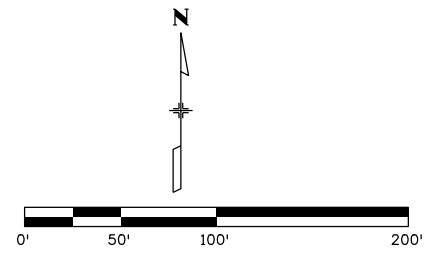
SEE SHEET 03

LEGEND

- EXISTING BASIN
- EXISTING 2' LIDAR CONTOURS
- EXISTING CULVERT
- FLOW ARROW
- ROW EASEMENT
- DP DESIGN POINT

AREA (ACRES) #
Area
C5
C100 BASIN ID

RUNOFF COEFFICIENT



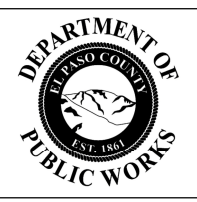
CULVERT ID	PIPE SIZE	PIPE MATERIAL	PUBLIC	PRIVATE
	in			
EX-CV-404	18	RCP		X

DESIGN POINT	CONTRIBUTING BASINS	DRAINAGE AREA	PEAK DISCHARGE (CFS)	
		(ac)	5-YEAR	100-YEAR
DP1	106, 400N, 403N, O-105	8.76	20.01	40.15
DP2	400S, 403, 405	3.92	12.29	23.37
DP3	101, 103, 104, 107	5.22	9.64	20.11
DP4	200, 201, 202, 415	1.97	3.58	8.36
DP5	414, 417	3.52	10.77	21.09
DP6	203, 206	3.60	4.85	14.46
DP7	410, 413	1.85	4.72	10.53
DP8	Crystal Creek	371.20	-	530.00
DP9	418, 420	0.99	0.84	3.04
DP10	419, 421	3.60	3.28	10.18
DP11	423	0.45	0.47	1.50
DP12	422	0.05	0.12	0.27
DP13	424	0.02	0.10	0.18
DP14	425	0.18	0.16	0.58
DP15	416	0.08	0.29	0.57
DP16	O-204	0.21	0.38	1.02
DP17	407	0.17	0.28	0.78
DP18	404	0.02	0.08	0.15

Computer File Information	
Print Date: 9/17/2024	
File Name: Existing Basin Map_Sheet 1.dgn	
Last Modification Date: 9/17/2024	
Designer: Detailer: IC Checker: WC	
11x17 Scale: 1" = 100 Units: Survey Feet	

Index of Revisions		
Date:	Comments	Init.

El Paso County
 Department of Public Works
 3275 Akers Dr
 Phone: 719-520-6460
 Fax: 719-520-6879



AECOM
 2315 Briargate Pkwy #150
 Colorado Springs, CO 80920
 Phone: 719-531-0001
 Fax: 719-531-0007
 AECOM #60673398

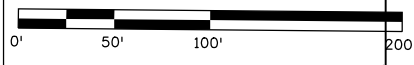
DEER CREEK ROAD INTERSECTION IMPROVEMENTS	
EXISTING BASIN MAP	1 of 3
Sheet Number	

jessica.barr 9:43:11 AM pw:\aecom-na-pw\beniley.com\AECOM_USA_Colorado\Documents\60673398-Deer Creek Rd\900-CAD\910-CAD\06-SHEETS\03_Hydrology-Drainage\Basin Maps\Existing Basin Map_Sheet 2.dgn

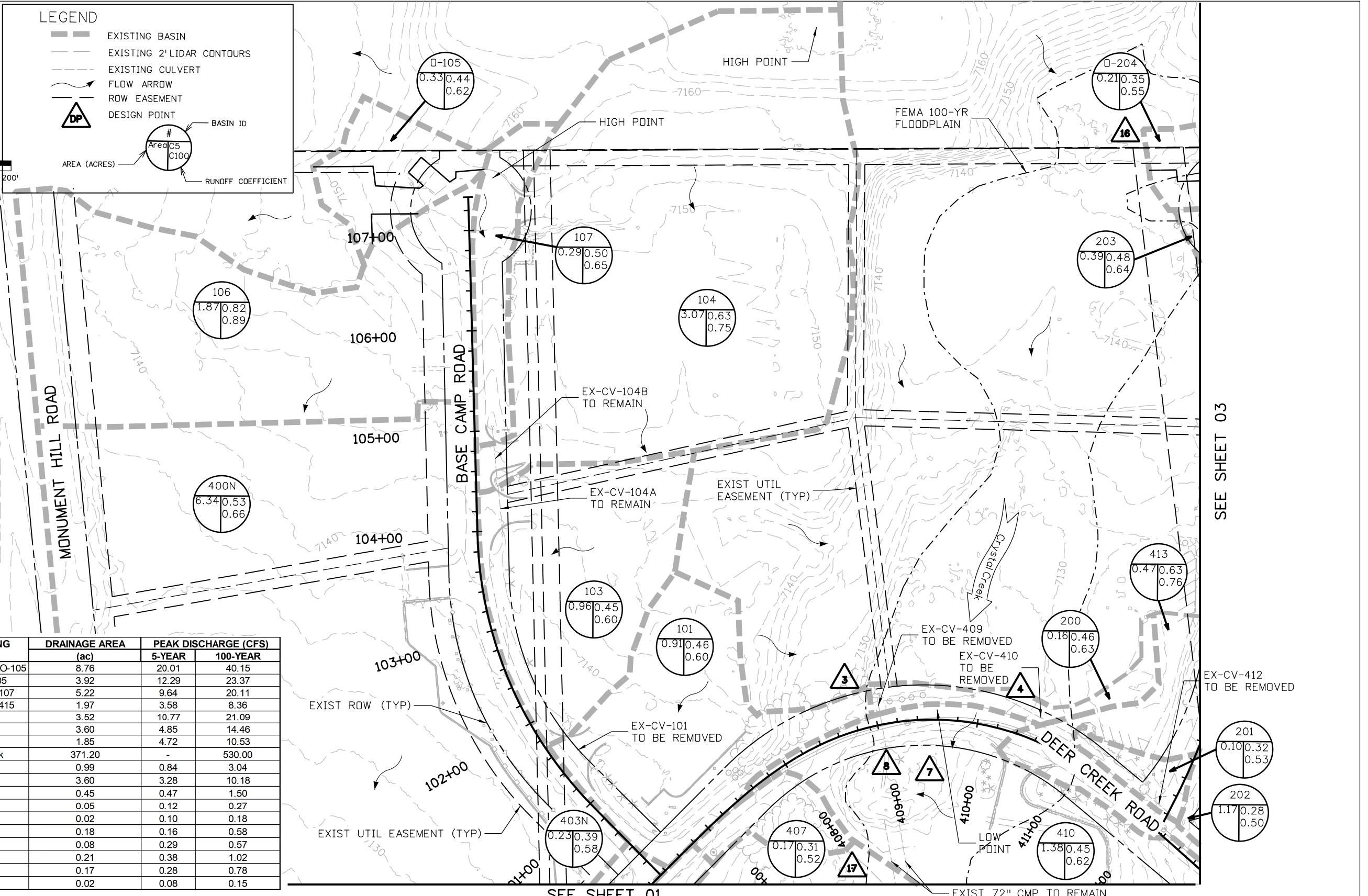
CULVERT ID	PIPE SIZE in	PIPE MATERIAL	PUBLIC	PRIVATE
EX-CV-101	15	CSP		X
EX-CV-104A	18	CSP		X
EX-CV-104B	18	RCP		X
EX-CV-404	18	RCP		X
EX-CV-409 ¹	60	CMP	X	
EX-CV-410	18	CSP		X
EX-CV-412	18	CSP	X	

LEGEND

- EXISTING BASIN
- EXISTING 2' LIDAR CONTOURS
- EXISTING CULVERT
- FLOW ARROW
- ROW EASEMENT
- DESIGN POINT
- BASIN ID
- AREA (ACRES)
- RUNOFF COEFFICIENT



DESIGN POINT	CONTRIBUTING BASINS	DRAINAGE AREA (ac)	PEAK DISCHARGE (CFS)	
			5-YEAR	100-YEAR
DP1	106, 400N, 403N, O-105	8.76	20.01	40.15
DP2	400S, 403, 405	3.92	12.29	23.37
DP3	101, 103, 104, 107	5.22	9.64	20.11
DP4	200, 201, 202, 415	1.97	3.58	8.36
DP5	414, 417	3.52	10.77	21.09
DP6	203, 206	3.60	4.85	14.46
DP7	410, 413	1.85	4.72	10.53
DP8	Crystal Creek	371.20	-	530.00
DP9	418, 420	0.99	0.84	3.04
DP10	419, 421	3.60	3.28	10.18
DP11	423	0.45	0.47	1.50
DP12	422	0.05	0.12	0.27
DP13	424	0.02	0.10	0.18
DP14	425	0.18	0.16	0.58
DP15	416	0.08	0.29	0.57
DP16	O-204	0.21	0.38	1.02
DP17	407	0.17	0.28	0.78
DP18	404	0.02	0.08	0.15



SEE SHEET 01

SEE SHEET 03

Computer File Information

Print Date: 9/17/2024	<input type="checkbox"/>
File Name: Existing Basin Map_Sheet 2.dgn	<input type="checkbox"/>
Last Modification Date: 9/17/2024	<input type="checkbox"/>
Designer: JB Detailer: IC Checker: WC	<input type="checkbox"/>
11x17 Scale: 1"= 100 Units: Survey Feet	<input type="checkbox"/>

Index of Revisions

Date:	Comments	Init.

El Paso County
Department of Public Works
3275 Akers Dr
Phone: 719-520-6460
Fax: 719-520-6879



AECOM
2315 Briargate Pkwy #150
Colorado Springs, CO 80920
Phone: 719-531-0001
Fax: 719-531-0007
AECOM #60673398

DEER CREEK ROAD INTERSECTION IMPROVEMENTS

EXISTING BASIN MAP

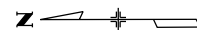
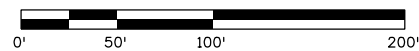
2 of 3

Sheet Number

jessica.barr 9:44:33 AM p:\aecom\nc-pw\entire\com\aedom_usa_colorado\Documents\60673398-Deer Creek Rd\900-CAD\910-CAD\06-SHEETS\03-Hydrology-Drainage\Basin Maps\Existing Basin Map_Sheet 3.dgn

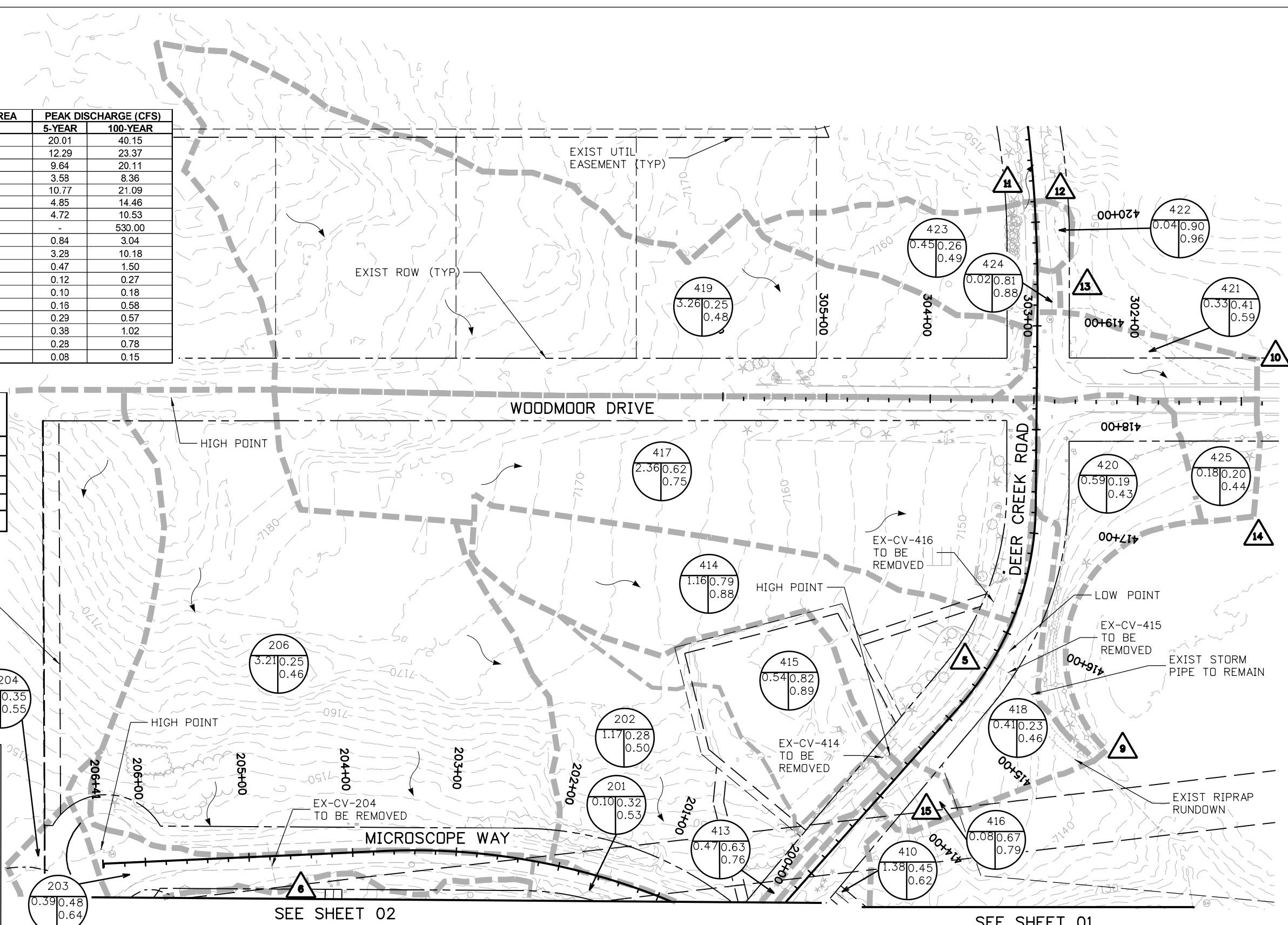
DESIGN POINT	CONTRIBUTING BASINS	DRAINAGE AREA (ac)	PEAK DISCHARGE (CFS)	
			5-YEAR	100-YEAR
DP1	106, 400N, 403N, O-105	8.76	20.01	40.15
DP2	400S, 403, 405	3.92	12.29	23.37
DP3	101, 103, 104, 107	5.22	9.64	20.11
DP4	200, 201, 202, 415	1.97	3.58	8.36
DP5	414, 417	3.52	10.77	21.09
DP6	203, 206	3.60	4.85	14.46
DP7	410, 413	1.85	4.72	10.53
DP8	Crystal Creek	371.20	-	530.00
DP9	418, 420	0.99	0.84	3.04
DP10	419, 421	3.60	3.28	10.18
DP11	423	0.45	0.47	1.50
DP12	422	0.05	0.12	0.27
DP13	424	0.02	0.10	0.18
DP14	425	0.18	0.18	0.58
DP15	416	0.08	0.29	0.57
DP16	O-204	0.21	0.38	1.02
DP17	407	0.17	0.28	0.78
DP18	404	0.02	0.08	0.15

CULVERT ID	PIPE SIZE	PIPE MATERIAL	PUBLIC	PRIVATE
	in			
EX-CV-204	24	CSP	X	
EX-CV-404	18	RCP		X
EX-CV-414	18	CMP		X
EX-CV-415	18	CMP		X
EX-CV-416	12	CMP	X	



LEGEND

- EXISTING BASIN
- EXISTING 2' LIDAR CONTOURS
- EXISTING CULVERT
- FLOW ARROW
- ROW EASEMENT
- DESIGN POINT
- BASIN ID
- AREA (ACRES)
- RUNOFF COEFFICIENT



SEE SHEET 02

SEE SHEET 01

Computer File Information

Print Date: 9/17/2024
File Name: Existing Basin Map_Sheet 3.dgn
Last Modification Date: 9/17/2024
Designer: JB Detailer: IC Checker: WC
11x17 Scale: 1"= 100 Units: Survey Feet

Index of Revisions

Date:	Comments	Init.

El Paso County
Department of Public Works
3275 Akers Dr
Phone: 719-520-6460
Fax: 719-520-6879



AECOM
2315 Briargate Pkwy #150
Colorado Springs, CO 80920
Phone: 719-531-0001
Fax: 719-531-0007
AECOM #60673398

DEER CREEK ROAD INTERSECTION IMPROVEMENTS

EXISTING BASIN MAP

3 of 3

Sheet Number

Existing Channel Travel Time

Basin	Design Point	1 Cv	2 Length	Upstream Elevation	Downstream Elevation	Sw, Slope	3 V	4 T	
			ft			ft/ft			ft/sec
101	DP3	11.0	456	7141.0	7124.0	0.037	2.12	3.58	
103	DP3	20.0	351	7144.0	7136.0	0.023	3.02	1.94	
103*	DP3	16.0	886	7165.0	7136.0	0.033	2.89	5.11	
104	DP3	20.0	628	7165.0	7142.0	0.037	3.83	2.73	
104*	DP3	20.0	628	7165.0	7142.0	0.037	3.83	2.73	
106	DP1	16.6	540	7153.0	7142.0	0.020	2.37	3.80	
107	DP3	16.1	225	7157.3	7142.6	0.065	4.12	0.91	
200	DP4	20.0	107	7133.0	7127.5	0.051	4.54	0.39	
201	DP4	15.0	81	7133.0	7128.0	0.062	3.72	0.36	
201*	DP4	17.4	627	7166.5	7128.0	0.061	4.30	2.43	
202	DP4	13.6	455	7171.6	7136.0	0.078	3.79	2.00	
202*	DP4	18.0	491	7166.5	7136.0	0.062	4.49	1.82	
203	DP6	Assumed Minimum Tc							
206	DP6	8.6	557	7186.0	7140.9	0.081	2.44	3.80	
400N	DP1	17.8	658	7142.2	7116.0	0.040	3.55	3.09	
400S	DP2	20.0	583	7126.0	7114.0	0.021	2.87	3.38	
403	DP2	15.0	148	7129.3	7123.2	0.041	3.04	0.81	
403*	DP2	15.0	420	7135.1	7123.2	0.028	2.52	2.78	
403N	DP1	15.0	279	7136.2	7128.0	0.029	2.57	1.81	
404	DP18	Assumed Minimum Tc							
405	DP2	15.0	225	7135.1	7128.2	0.031	2.63	1.42	
407	DP17	15.0	196	7135.1	7125.5	0.049	3.32	0.98	
410	DP7	16.5	452	7147.8	7116.0	0.070	4.36	1.73	
413	DP7	20.0	320	7133.5	7125.8	0.024	3.10	1.72	
414	DP5	19.4	424	7170.0	7146.0	0.057	4.63	1.53	
415	DP4	20.0	297	7166.5	7149.8	0.056	4.74	1.04	
416	DP15	Assumed Minimum Tc							
417	DP5	15.0	844	7184.0	7147.0	0.044	3.14	4.48	
418	DP9	15.0	247	7146.0	7137.5	0.034	2.79	1.47	
419	DP10	9.2	860	7200.0	7152.0	0.056	2.18	6.58	
420	DP9	15.0	245	7137.0	7135.5	0.006	1.17	3.47	
421	DP10	11.8	183	7150.0	7145.4	0.025	1.88	1.63	
422	DP12	20.0	102	7151.5	7149.6	0.019	2.78	0.61	
423	DP11	10.0	272	7161.0	7149.5	0.042	2.06	2.20	
424	DP13	Assumed Minimum Tc							
425	DP14	15.0	42	7137.8	7136.8	0.024	2.31	0.30	
O-105	DP1	Assumed Minimum Tc							
O-204	DP16	Assumed Minimum Tc							
DP1	DP1	16.5	1135	7153.0	7116.0	0.033	2.98	6.35	
DP2	DP2	15.0	971	7135.1	7114.0	0.022	2.21	7.32	
DP3	DP3	13.0	1285	7165.0	7124.0	0.032	2.33	9.20	
DP4	DP4	18.2	627	7166.5	7128.0	0.061	4.52	2.32	
DP5	DP5	15.0	923	7184.0	7146.0	0.041	3.04	5.05	
DP6	DP6	8.6	557	7186.0	7140.9	0.081	2.44	3.80	
DP7	DP7	16.5	452	7147.8	7116.0	0.070	4.37	1.72	
DP9	DP9	12.4	245	7146.0	7135.5	0.043	2.57	1.59	
DP10	DP10	9.3	1082	7200.0	7145.4	0.050	2.10	8.60	

Figure 6-25. Estimate of Average Concentrated Shallow Flow

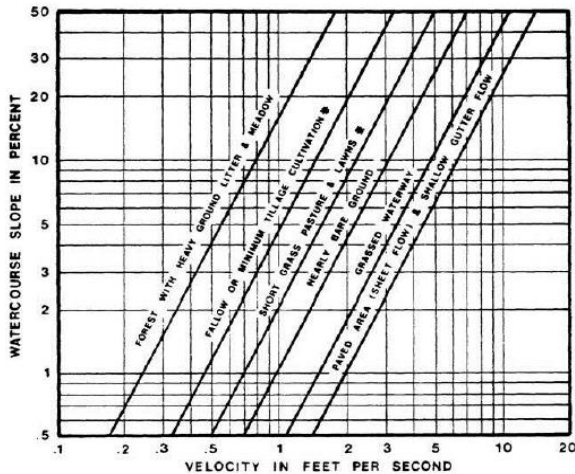
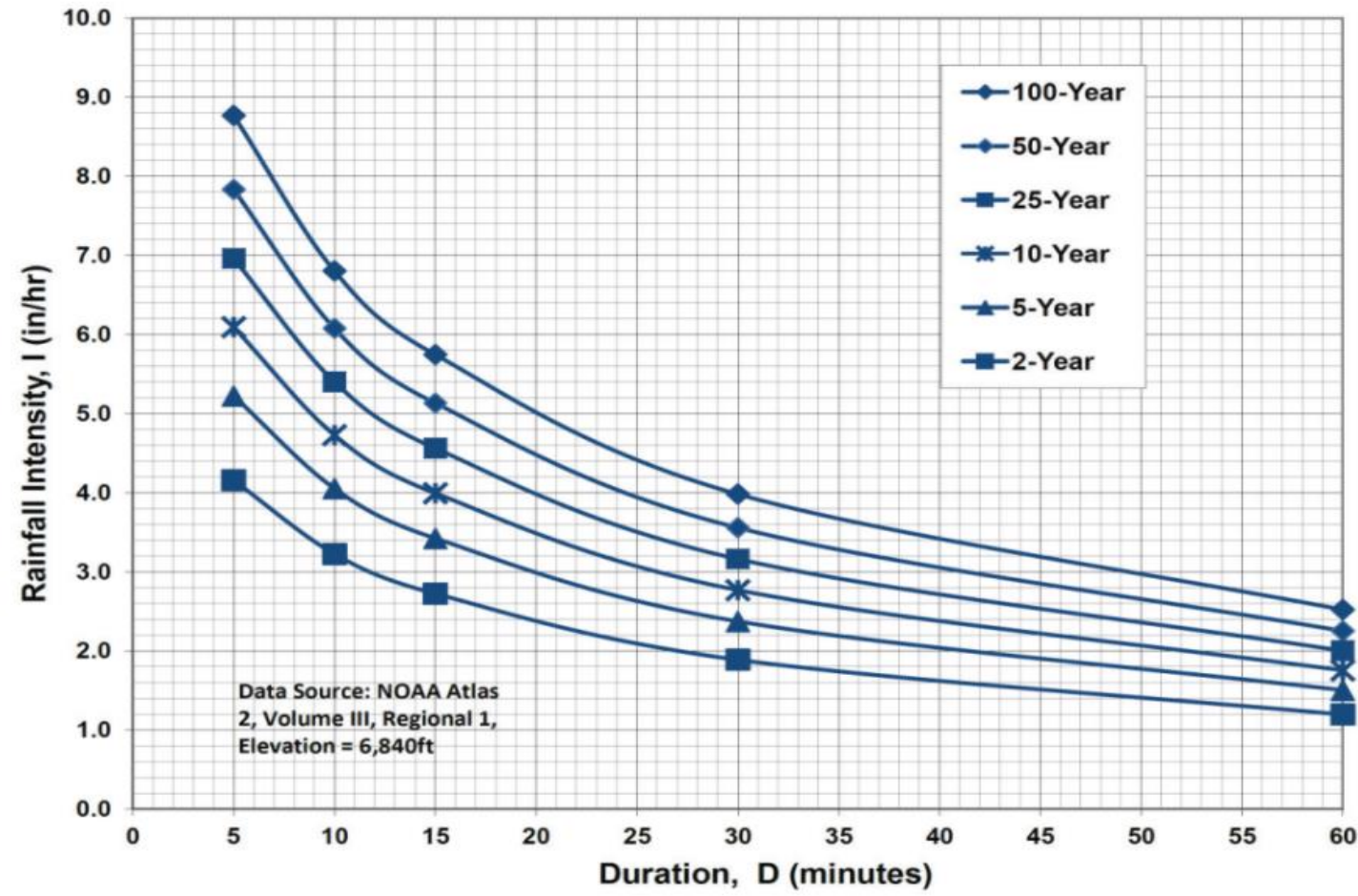


Table 6-7. Conveyance Coefficient, Cv

Type of Land Surface	Cv
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 Cv value based on type of vegetative cover.

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

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

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

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

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

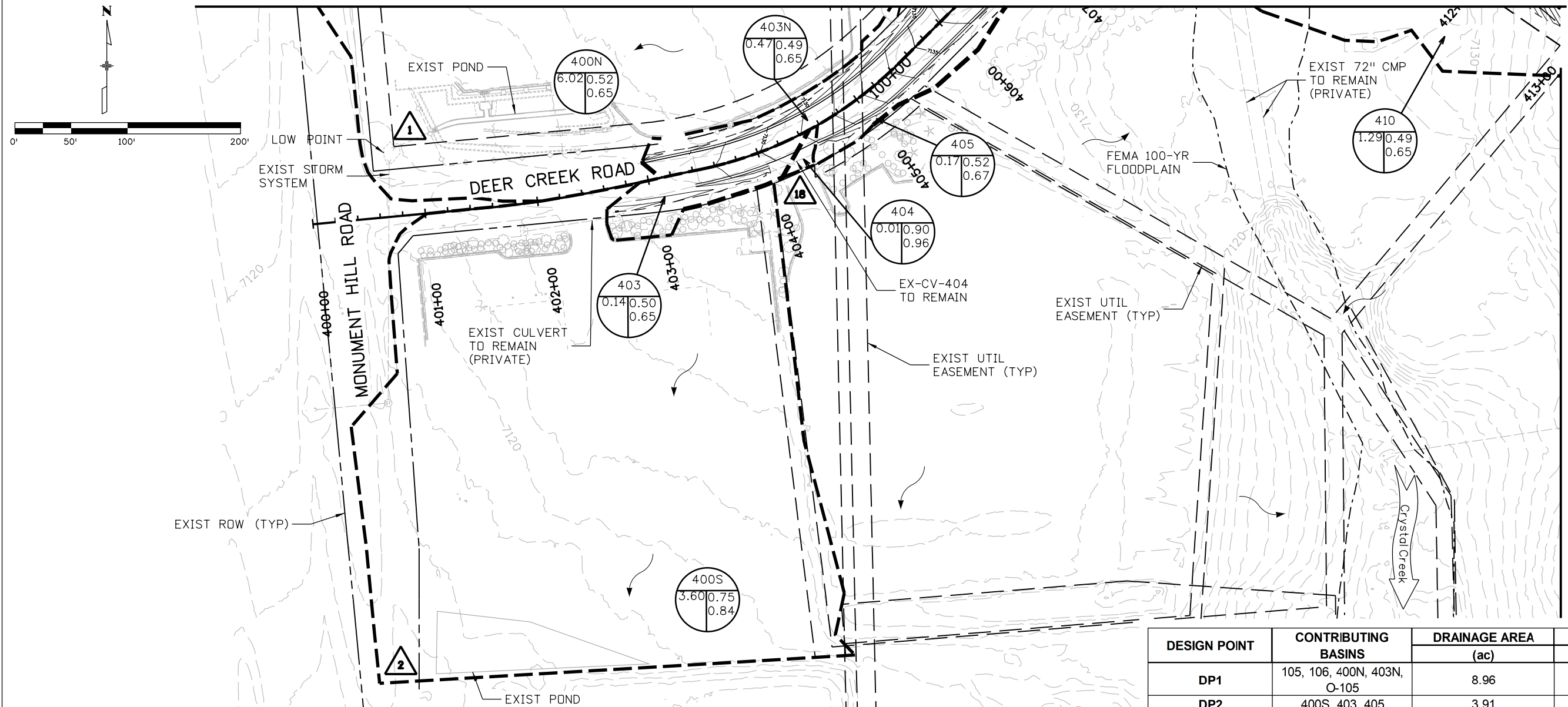
$I_5 = -1.50 \ln(D) + 7.583$

$I_2 = -1.19 \ln(D) + 6.035$

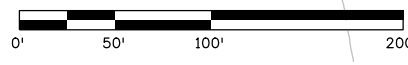
Note: Values calculated by equations may not precisely duplicate values read from figure.

DESIGN POINT	CONTRIBUTING BASINS	DRAINAGE AREA	PEAK DISCHARGE (CFS)	
		(ac)	5-YEAR	100-YEAR
DP1	106, 400N, 403N, O-105	8.76	20.01	40.15
DP2	400S, 403, 405	3.92	12.29	23.37
DP3	101, 103, 104, 107	5.22	9.64	20.11
DP4	200, 201, 202, 415	1.97	3.58	8.36
DP5	414, 417	3.52	10.77	21.09
DP6	203, 206	3.60	4.85	14.46
DP7	410, 413	1.85	4.72	10.53
DP8	Crystal Creek	371.20	-	530.00
DP9	418, 420	0.99	0.84	3.04
DP10	419, 421	3.60	3.28	10.18
DP11	423	0.45	0.47	1.50
DP12	422	0.05	0.12	0.27
DP13	424	0.02	0.10	0.18
DP14	425	0.18	0.16	0.58
DP15	416	0.08	0.29	0.57
DP16	O-204	0.21	0.38	1.02
DP17	407	0.17	0.28	0.78
DP18	404	0.02	0.08	0.15

SEE SHEET 02



SEE SHEET 03



LEGEND

- PROPOSED BASIN
- EXISTING 2' LIDAR CONTOURS
- EXISTING CULVERT
- FLOW ARROW
- ROW EASEMENT
- DP DESIGN POINT

Area/C5
C100
AREA (ACRES)

BASIN ID
RUNOFF COEFFICIENT

DESIGN POINT	CONTRIBUTING BASINS	DRAINAGE AREA (ac)	PEAK DISCHARGE (CFS)	
			5-YEAR	100-YEAR
DP1	105, 106, 400N, 403N, O-105	8.96	17.95	37.16
DP2	400S, 403, 405	3.91	12.26	23.20
DP3	101, 103, 104, 107	5.18	9.88	20.64
DP4	200, 201, 202, 413, 415	2.28	4.52	10.09
DP5	414, 417	3.45	10.46	20.33
DP6	203, 204, 206	3.62	5.35	14.94
DP7	408, 410, 411	1.83	5.00	10.42
DP8	Crystal Creek	371.20	-	530.00
DP9	418, 420	0.97	1.47	3.91
DP10	419, 421	3.61	3.50	10.54
DP11	423	0.44	0.46	1.46
DP12	422	0.05	0.12	0.28
DP13	424	0.03	0.14	0.25
DP14	425	0.18	0.22	0.64
DP15	416	0.05	0.15	0.31
DP16	O-204	0.20	0.47	1.08
DP17	407	0.10	0.17	0.45
DP18	404	0.01	0.06	0.11

CULVERT ID	PIPE SIZE	PIPE MATERIAL	PUBLIC	PRIVATE
	in			
EX-CV-404	18	RCP		X

jessica.barr 3:55:39 PM p:\aecom\m-pw.bentley.com\AECOM_USA_Colorado\Documents\60673398-Deer Creek Rd\900-CAD\910-CAD\06_SHEETS\03_Hydrology\Proposed Basin Map_Sheet 1.dgn

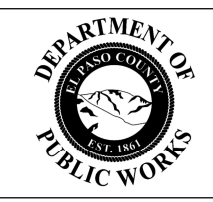
Computer File Information

Print Date: 9/17/2024
File Name: Proposed Basin Map_Sheet 1.dgn
Last Modification Date: 9/17/2024
Designer: Detailer: IC Checker: WC
11x17 Scale: 1"= 100 Units: Survey Feet

Index of Revisions

Date:	Comments	Init.

El Paso County
 Department of Public Works
 3275 Akers Dr
 Phone: 719-520-6460
 Fax: 719-520-6879



AECOM
 2315 Briargate Pkwy #150
 Colorado Springs, CO 80920
 Phone: 719-531-0001
 Fax: 719-531-0007
 AECOM #60673398

DEER CREEK ROAD INTERSECTION IMPROVEMENTS

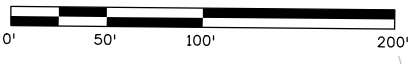
PROPOSED BASIN MAP	1 of 3
Sheet Number	

jessica.barr 3:55:57 PM p:\aecom-na-pw.bentley.com\AECOM_USA_Colorado\Documents\60673398-Deer Creek Rd\900-CAD\910-CAD\06_SHEETS\03_Hydrology\Drainage\Basin Maps\Proposed Basin Map_Sheet 2.dgn

LEGEND

- PROPOSED BASIN
- EXISTING 2' LIDAR CONTOURS
- EXISTING CULVERT
- FLOW ARROW
- ROW EASEMENT
- DESIGN POINT

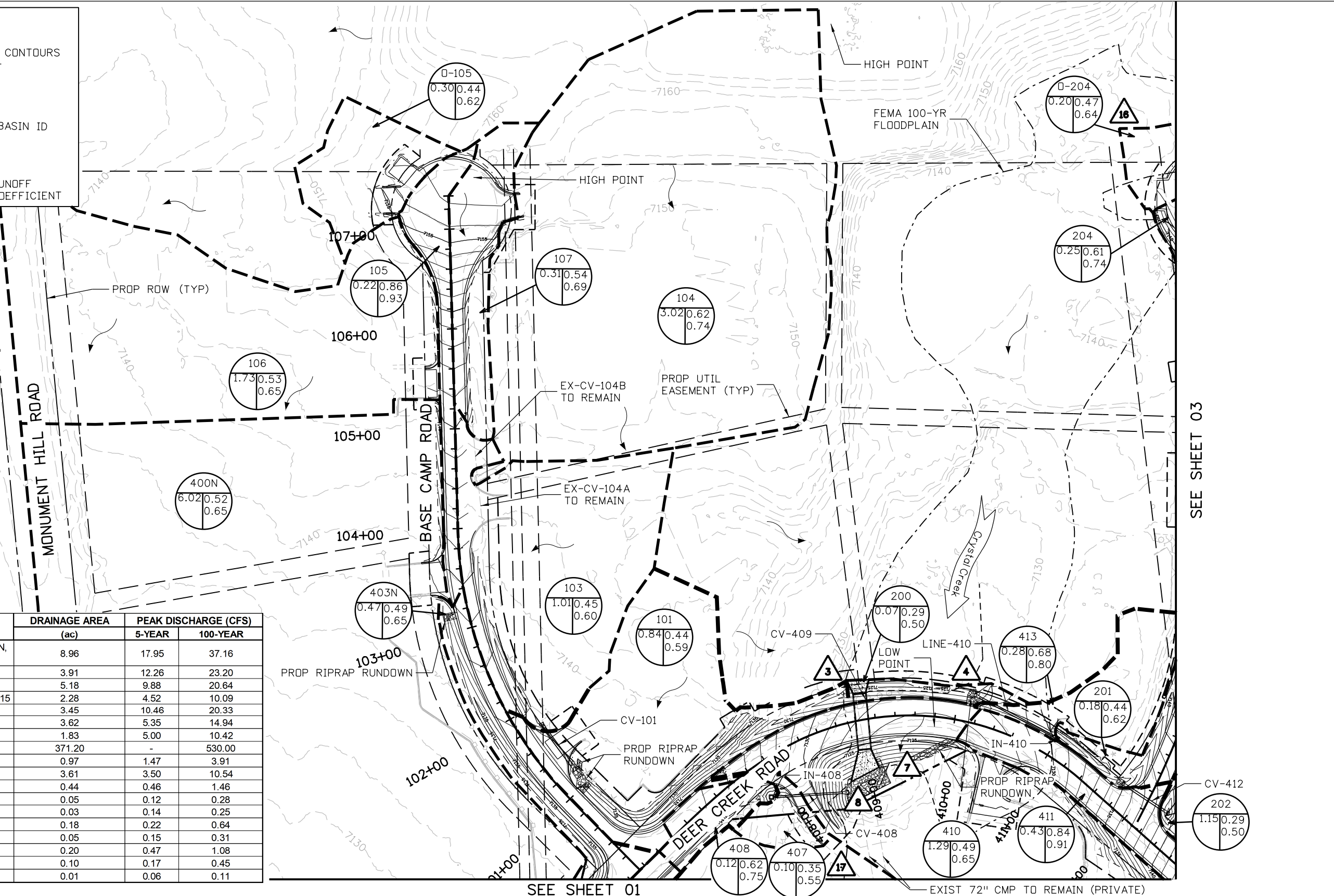
#	BASIN ID
Area	C5
C100	RUNOFF COEFFICIENT



CULVERT ID	PIPE SIZE	PIPE MATERIAL	PUBLIC	PRIVATE
	in			
EX-CV-104A	18	CSP		X
EX-CV-104B	18	RCP		X
CV-101	30x19	HERCP		X
CV-408	18	RCP	X	
CV-409	12"x6"	RCBC	X	
CV-410	18	RCP		X
CV-412	23x14	HERCP	X	

CULVERT ID	INLET TYPE	PUBLIC	PRIVATE
IN-408	TYPE C	X	
IN-410	TYPE C		X

DESIGN POINT	CONTRIBUTING BASINS	DRAINAGE AREA (ac)	PEAK DISCHARGE (CFS)	
			5-YEAR	100-YEAR
DP1	105, 106, 400N, 403N, O-105	8.96	17.95	37.16
DP2	400S, 403, 405	3.91	12.26	23.20
DP3	101, 103, 104, 107	5.18	9.88	20.64
DP4	200, 201, 202, 413, 415	2.28	4.52	10.09
DP5	414, 417	3.45	10.46	20.33
DP6	203, 204, 206	3.62	5.35	14.94
DP7	408, 410, 411	1.83	5.00	10.42
DP8	Crystal Creek	371.20	-	530.00
DP9	418, 420	0.97	1.47	3.91
DP10	419, 421	3.61	3.50	10.54
DP11	423	0.44	0.46	1.46
DP12	422	0.05	0.12	0.28
DP13	424	0.03	0.14	0.25
DP14	425	0.18	0.22	0.64
DP15	416	0.05	0.15	0.31
DP16	O-204	0.20	0.47	1.08
DP17	407	0.10	0.17	0.45
DP18	404	0.01	0.06	0.11



SEE SHEET 03

SEE SHEET 01

Computer File Information

Print Date: 9/17/2024	<input type="checkbox"/>
File Name: Proposed Basin Map_Sheet 2.dgn	<input type="checkbox"/>
Last Modification Date: 9/17/2024	<input type="checkbox"/>
Designer: JB Detailer: IC Checker: WC	<input type="checkbox"/>
11x17 Scale: 1" = 100 Units: Survey Feet	<input type="checkbox"/>

Index of Revisions

Date:	Comments	Init.

El Paso County
 Department of Public Works
 3275 Akers Dr
 Phone: 719-520-6460
 Fax: 719-520-6879



AECOM
 2315 Briargate Pkwy #150
 Colorado Springs, CO 80920
 Phone: 719-531-0001
 Fax: 719-531-0007
 AECOM #60673398

DEER CREEK ROAD INTERSECTION IMPROVEMENTS

PROPOSED BASIN MAP

2 of 3

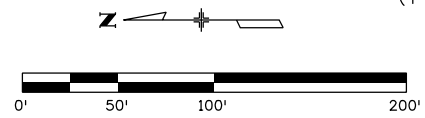
Sheet Number

jessica.barr 3:57:22 PM p:\aecom-na-pw\bentley.com\AECOM_USA_Colorado\Documents\60673398-Deer Creek Rd\900-CAD\910-CAD\06_SHEETS\03_Hydrology\Drainage\Basin Maps\Proposed Basin Map_Sheet 3.dgn

DESIGN POINT	CONTRIBUTING BASINS	DRAINAGE AREA (ac)	PEAK DISCHARGE (CFS)	
			5-YEAR	100-YEAR
DP1	105, 106, 400N, 403N, O-105	8.96	17.95	37.16
DP2	400S, 403, 405	3.91	12.26	23.20
DP3	101, 103, 104, 107	5.18	9.88	20.64
DP4	200, 201, 202, 413, 415	2.28	4.52	10.09
DP5	414, 417	3.45	10.46	20.33
DP6	203, 204, 206	3.62	5.35	14.94
DP7	408, 410, 411	1.83	5.00	10.42
DP8	Crystal Creek	371.20	-	530.00
DP9	418, 420	0.97	1.47	3.91
DP10	419, 421	3.61	3.50	10.54
DP11	423	0.44	0.46	1.46
DP12	422	0.05	0.12	0.28
DP13	424	0.03	0.14	0.25
DP14	425	0.18	0.22	0.64
DP15	416	0.05	0.15	0.31
DP16	O-204	0.20	0.47	1.08
DP17	407	0.10	0.17	0.45
DP18	404	0.01	0.06	0.11

CULVERT ID	INLET TYPE	PUBLIC	PRIVATE
IN-419	TYPE C	X	

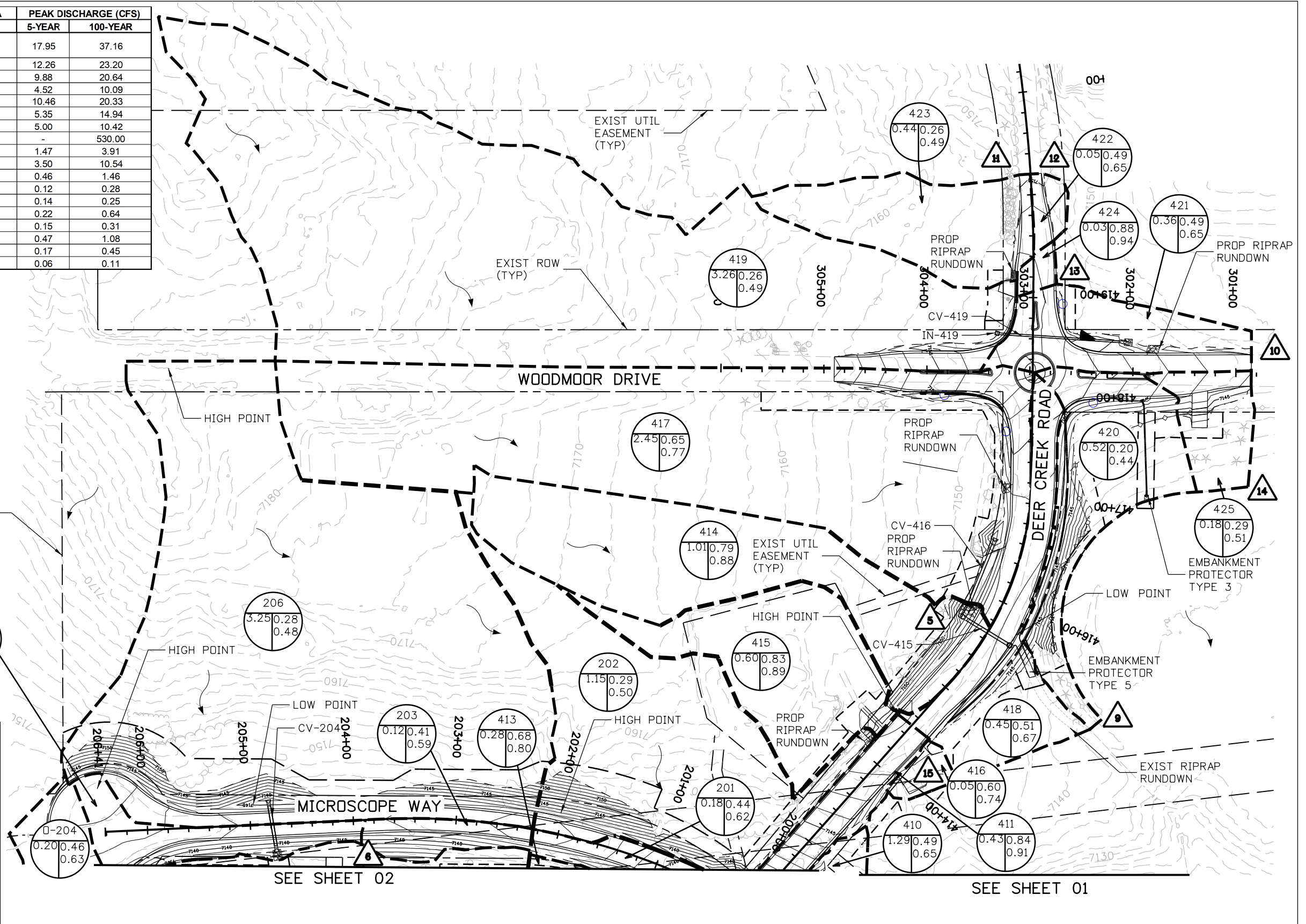
CULVERT ID	PIPE SIZE	PIPE MATERIAL	PUBLIC	PRIVATE
	in			
CV-204	30x19	HERCP	X	
CV-415	30x19	HERCP	X	
CV-416	30x19	HERCP		X
CV-419	18	RCP	X	



LEGEND

- PROPOSED BASIN
- EXISTING 2' LIDAR CONTOURS
- EXISTING CULVERT
- FLOW ARROW
- ROW EASEMENT
- DESIGN POINT

DESIGN POINT
 BASIN ID
 AREA (ACRES) / C100 RUNOFF COEFFICIENT



Computer File Information

Print Date: 9/17/2024

File Name: Proposed Basin Map_Sheet 3.dgn

Last Modification Date: 9/17/2024

Designer: Detailer: IC Checker: WC

11x17 Scale: 1" = 100 Units: Survey Feet

Index of Revisions

Date:	Comments	Init.

El Paso County
 Department of Public Works
 3275 Akers Dr
 Phone: 719-520-6460
 Fax: 719-520-6879



AECOM
 2315 Briargate Pkwy #150
 Colorado Springs, CO 80920
 Phone: 719-531-0001
 Fax: 719-531-0007
 AECOM #60673398

DEER CREEK ROAD INTERSECTION IMPROVEMENTS

PROPOSED BASIN MAP	3 of 3
Sheet Number	

	User Entered Data
	Calculated/Linked Cells

Travel Time									
Basin	Design Point	1 Cv	2 Length	Upstream Elevation	Downstream Elevation	Sw, Slope	3 V	4 T	
			ft			ft/ft	ft/sec	min	
101	DP3	15.6	527.00	7141.00	7126.50	0.028	2.58	3.40	
103	DP3	20.0	350.84	7144.00	7136.00	0.023	3.02	1.94	
103*	DP3	18.5	884.85	7165.00	7136.00	0.033	3.36	4.39	
104	DP3	20.0	627.78	7165.00	7142.00	0.037	3.83	2.73	
104*	DP3	20.0	627.78	7165.00	7142.00	0.037	3.83	2.73	
105	DP1	20.0	377.34	7155.50	7139.30	0.043	4.14	1.52	
106	DP1	15.6	449.00	7147.80	7132.00	0.035	2.92	2.56	
107	DP3	15.9	229.00	7157.20	7142.60	0.064	4.02	0.95	
200	DP4	15.0	89.50	7126.00	7123.00	0.034	2.75	0.54	
201	DP4	15.0	272.46	7141.40	7128.20	0.048	3.30	1.38	
201*	DP4	17.4	621.00	7166.50	7128.20	0.062	4.32	2.40	
202	DP4	16.3	442.37	7171.60	7138.50	0.075	4.45	1.66	
202*	DP4	18.0	493.62	7166.50	7138.50	0.057	4.29	1.92	
203	DP6	No Channelized Flow							
204	DP6	15.0	169.00	7141.80	7139.50	0.014	1.75	1.61	
206	DP6	7.5	553.27	7186.00	7140.00	0.083	2.18	4.24	
400N	DP1	18.3	631.00	7141.00	7116.00	0.040	3.64	2.89	
400S	DP2	20.0	582.53	7126.00	7114.00	0.021	2.87	3.38	
403	DP2	15.0	144.25	7129.00	7123.20	0.040	3.01	0.80	
403*	DP2	15.0	404.67	7136.00	7123.20	0.032	2.67	2.53	
403N	DP1	15.0	554.38	7136.00	7127.60	0.015	1.85	5.00	
403N*	DP1	17.0	949.72	7155.50	7127.60	0.029	2.91	5.44	
404	DP18	Assumed Minimum Tc							
405	DP2	15.0	211.74	7136.00	7128.20	0.037	2.88	1.23	
407	DP7	15.0	60.00	7129.00	7125.50	0.058	3.62	0.28	
408	DP17	15.0	123.00	7135.90	7130.00	0.048	3.29	0.62	
410	DP7	14.9	345.30	7133.50	7116.00	0.051	3.35	1.72	
411	DP7	20.0	431.80	7148.50	7126.20	0.052	4.55	1.58	
413	DP4	20.0	301.54	7133.50	7127.80	0.019	2.75	1.83	
414	DP5	19.4	425.84	7170.00	7146.00	0.056	4.61	1.54	
415	DP4	20.0	297.00	7166.50	7150.00	0.056	4.71	1.05	
416	DP15	Assumed Minimum Tc							
417	DP5	15.0	834.55	7184.00	7147.00	0.044	3.16	4.40	
418	DP9	17.0	327.11	7149.82	7137.50	0.038	3.30	1.65	
419	DP10	8.0	819.00	7200.30	7152.00	0.059	1.93	7.07	
420	DP9	17.2	473.70	7150.13	7135.50	0.031	3.02	2.61	
421	DP10	17.6	225.82	7152.00	7145.96	0.027	2.88	1.31	
422	DP12	Assumed Minimum Tc							
423	DP11	9.9	271.00	7161.00	7149.50	0.042	2.04	2.21	
424	DP13	Assumed Minimum Tc							
425	DP14	15.0	152.30	7150.13	7145.96	0.027	2.48	1.02	
O-105	DP1	Assumed Minimum Tc							
O-204	DP16	Assumed Minimum Tc							
DP1	DP1	16.5	1226.00	7155.50	7116.00	0.032	2.97	6.88	
DP2	DP2	15.0	955.99	7136.00	7114.00	0.023	2.28	7.00	
DP3	DP3	15.9	1285.49	7165.00	7126.50	0.030	2.75	7.80	
DP4	DP4	17.5	804.50	7166.50	7123.00	0.054	4.07	3.29	
DP5	DP5	15.0	911.73	7166.50	7146.00	0.022	2.25	6.76	
DP6	DP6	7.5	553.27	7186.00	7140.00	0.083	2.18	4.24	
DP7	DP7	14.9	431.80	7148.50	7126.20	0.052	3.39	2.12	
DP9	DP9	17.2	473.70	7150.13	7135.50	0.031	3.02	2.61	
DP10	DP10	9.9	1067.00	7200.30	7145.96	0.051	2.24	7.92	

Figure 6-25. Estimate of Average Concentrated Shallow Flow

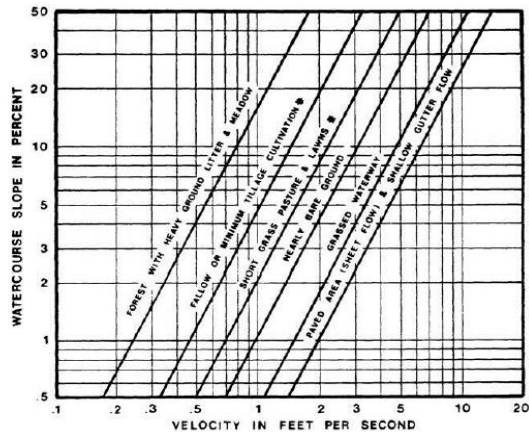
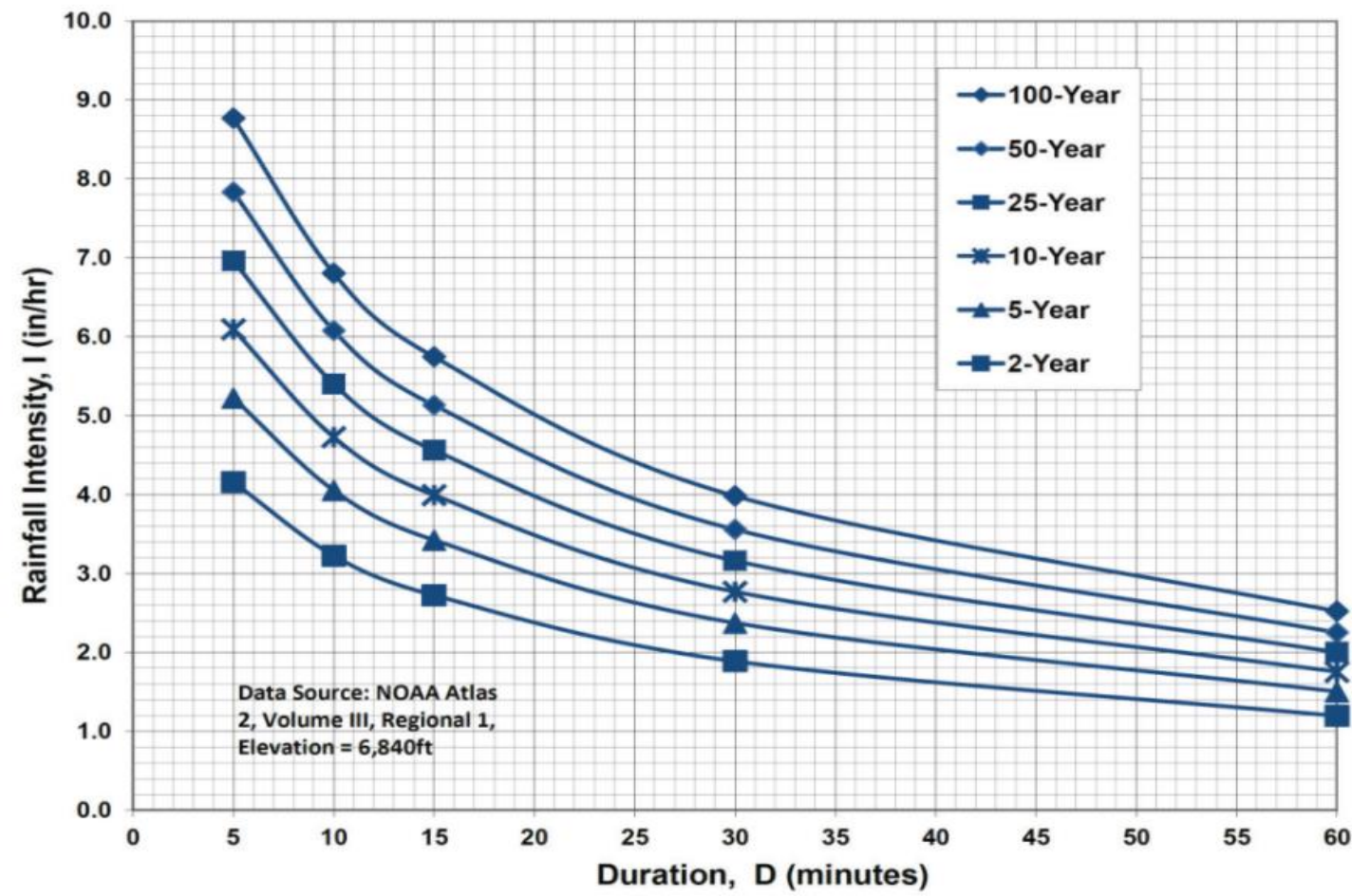


Table 6-7. Conveyance Coefficient, C_v

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.

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.

DESIGN POINT	CONTRIBUTING BASINS	DRAINAGE AREA	PEAK DISCHARGE (CFS)	
		(ac)	5-YEAR	100-YEAR
DP1	105, 106, 400N, 403N, O-105	8.96	17.95	37.16
DP2	400S, 403, 405	3.91	12.26	23.20
DP3	101, 103, 104, 107	5.18	9.88	20.64
DP4	200, 201, 202, 413, 415	2.28	4.52	10.09
DP5	414, 417	3.45	10.46	20.33
DP6	203, 204, 206	3.62	5.35	14.94
DP7	408, 410, 411	1.83	5.00	10.42
DP8	Crystal Creek	371.20	-	530.00
DP9	418, 420	0.97	1.47	3.91
DP10	419, 421	3.61	3.50	10.54
DP11	423	0.44	0.46	1.46
DP12	422	0.05	0.12	0.28
DP13	424	0.03	0.14	0.25
DP14	425	0.18	0.22	0.64
DP15	416	0.05	0.15	0.31
DP16	O-204	0.20	0.47	1.08
DP17	407	0.10	0.17	0.45
DP18	404	0.01	0.06	0.11

Appendix D
Hydraulics

Culvert Analysis Report

EX-CV-101 - Q100

Comments: Basin 103*

Analysis Component			
Storm Event	Check	Discharge	19.39 cfs

Peak Discharge Method: User-Specified			
Design Discharge	19.39 cfs	Check Discharge	19.39 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	0.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-15 inch Circular	4.93 cfs	7,137.11 ft	5.21 ft/s
Weir	Roadway	14.48 cfs	7,137.11 ft	N/A
Total	-----	19.42 cfs	7,137.11 ft	N/A

Culvert Analysis Report

EX-CV-101 - Q100

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,137.11 ft	Discharge	4.93 cfs
Inlet Control HW Elev.	7,136.80 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,137.11 ft	Control Type	Outlet Control
Headwater Depth/Height	1.53		
Grades			
Upstream Invert	7,135.19 ft	Downstream Invert	7,134.87 ft
Length	44.41 ft	Constructed Slope	0.007206 ft/ft
Hydraulic Profile			
Profile	CompositeM2PressureProfile	Depth, Downstream	0.90 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	0.90 ft
Velocity Downstream	5.21 ft/s	Critical Slope	0.026340 ft/ft
Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.25 ft
Section Size	15 inch	Rise	1.25 ft
Number Sections	1		
Outlet Control Properties			
Outlet Control HW Elev.	7,137.11 ft	Upstream Velocity Head	0.25 ft
Ke	0.20	Entrance Loss	0.05 ft
Inlet Control Properties			
Inlet Control HW Elev.	7,136.80 ft	Flow Control	N/A
Inlet Type	Projecting	Area Full	1.2 ft ²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report

EX-CV-101 - Q100

Component: Weir

Hydraulic Component(s): Roadway

Discharge	14.48 cfs	Allowable HW Elevation	7,137.11 ft
Roadway Width	36.01 ft	Overtopping Coefficient	2.95 US
Low Point	7,136.55 ft	Headwater Elevation	7,137.11 ft
Discharge Coefficient (Cr)	2.95	Submergence Factor (Kt)	1.00
Tailwater Elevation	0.00 ft		

Sta (ft)	Elev. (ft)
0.00	7,138.07
12.64	7,137.85
26.00	7,137.18
36.70	7,136.55
47.90	7,136.74

Culvert Analysis Report

EX-CV-101 - Q5

Comments: Basin 103*

Analysis Component				
Storm Event	Design	Discharge	9.42 cfs	

Peak Discharge Method: User-Specified				
Design Discharge	9.42 cfs	Check Discharge	9.42 cfs	

Tailwater Conditions: Constant Tailwater				
Tailwater Elevation	0.00 ft			

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-15 inch Circular	4.51 cfs	7,136.88 ft	5.00 ft/s
Weir	Roadway	4.92 cfs	7,136.88 ft	N/A
Total	-----	9.43 cfs	7,136.88 ft	N/A

Culvert Analysis Report

EX-CV-101 - Q5

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,136.88 ft	Discharge	4.51 cfs
Inlet Control HW Elev.	7,136.69 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,136.88 ft	Control Type	Outlet Control
Headwater Depth/Height	1.35		

Grades			
Upstream Invert	7,135.19 ft	Downstream Invert	7,134.87 ft
Length	44.41 ft	Constructed Slope	0.007206 ft/ft

Hydraulic Profile			
Profile	CompositeM2PressureProfile	Depth, Downstream	0.86 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	0.86 ft
Velocity Downstream	5.00 ft/s	Critical Slope	0.024750 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.25 ft
Section Size	15 inch	Rise	1.25 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,136.88 ft	Upstream Velocity Head	0.21 ft
Ke	0.20	Entrance Loss	0.04 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,136.69 ft	Flow Control	N/A
Inlet Type	Projecting	Area Full	1.2 ft ²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report

EX-CV-101 - Q5

Component: Weir

Hydraulic Component(s): Roadway			
Discharge	4.92 cfs	Allowable HW Elevation	7,136.88 ft
Roadway Width	36.01 ft	Overtopping Coefficient	2.93 US
Low Point	7,136.55 ft	Headwater Elevation	7,136.88 ft
Discharge Coefficient (Cr)	2.93	Submergence Factor (Kt)	1.00
Tailwater Elevation	0.00 ft		

Sta (ft)	Elev. (ft)
0.00	7,138.07
12.64	7,137.85
26.00	7,137.18
36.70	7,136.55
47.90	7,136.74

Culvert Analysis Report

EX-CV-104A- Q100

Comments: Basin 104*

Analysis Component			
Storm Event	Check	Discharge	17.36 cfs

Peak Discharge Method: User-Specified			
Design Discharge	17.36 cfs	Check Discharge	17.36 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	0.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	7.80 cfs	7,142.39 ft	5.71 ft/s
Weir	Roadway	9.60 cfs	7,142.39 ft	N/A
Total	-----	17.40 cfs	7,142.39 ft	N/A

Culvert Analysis Report

EX-CV-104A- Q100

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,142.39 ft	Discharge	7.80 cfs
Inlet Control HW Elev.	7,142.35 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,142.39 ft	Control Type	Outlet Control
Headwater Depth/Height	1.12		

Grades			
Upstream Invert	7,140.70 ft	Downstream Invert	7,139.76 ft
Length	44.45 ft	Constructed Slope	0.021149 ft/ft

Hydraulic Profile			
Profile	M2	Depth, Downstream	1.08 ft
Slope Type	Mild	Normal Depth	1.16 ft
Flow Regime	Subcritical	Critical Depth	1.08 ft
Velocity Downstream	5.71 ft/s	Critical Slope	0.024822 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.50 ft
Section Size	18 inch	Rise	1.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,142.39 ft	Upstream Velocity Head	0.44 ft
Ke	0.20	Entrance Loss	0.09 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,142.35 ft	Flow Control	Transition
Inlet Type	Beveled ring, 33.7° (1.5:1) bevels	Area Full	1.8 ft ²
K	0.00180	HDS 5 Chart	3
M	2.50000	HDS 5 Scale	B
C	0.02430	Equation Form	1
Y	0.83000		

Culvert Analysis Report

EX-CV-104A- Q100

Component: Weir

Hydraulic Component(s): Roadway			
Discharge	9.60 cfs	Allowable HW Elevation	7,142.39 ft
Roadway Width	36.48 ft	Overtopping Coefficient	2.96 US
Low Point	7,141.92 ft	Headwater Elevation	7,142.39 ft
Discharge Coefficient (Cr)	2.96	Submergence Factor (Kt)	1.00
Tailwater Elevation	0.00 ft		

Sta (ft)	Elev. (ft)
0.00	7,142.30
11.67	7,142.34
38.80	7,142.24
41.30	7,141.92
50.90	7,142.20

Culvert Analysis Report

EX-CV-104A - Q5

Comments: Basin 104*

Analysis Component			
Storm Event	Design	Discharge	8.60 cfs

Peak Discharge Method: User-Specified			
Design Discharge	8.60 cfs	Check Discharge	8.60 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	0.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	6.57 cfs	7,142.21 ft	5.30 ft/s
Weir	Roadway	2.04 cfs	7,142.21 ft	N/A
Total	-----	8.61 cfs	7,142.21 ft	N/A

Culvert Analysis Report

EX-CV-104A - Q5

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,142.21 ft	Discharge	6.57 cfs
Inlet Control HW Elev.	7,142.16 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,142.21 ft	Control Type	Outlet Control
Headwater Depth/Height	1.01		

Grades			
Upstream Invert	7,140.70 ft	Downstream Invert	7,139.76 ft
Length	44.45 ft	Constructed Slope	0.021149 ft/ft

Hydraulic Profile			
Profile	M2	Depth, Downstream	0.99 ft
Slope Type	Mild	Normal Depth	1.01 ft
Flow Regime	Subcritical	Critical Depth	0.99 ft
Velocity Downstream	5.30 ft/s	Critical Slope	0.022225 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.50 ft
Section Size	18 inch	Rise	1.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,142.21 ft	Upstream Velocity Head	0.42 ft
Ke	0.20	Entrance Loss	0.08 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,142.16 ft	Flow Control	Unsubmerged
Inlet Type	Beveled ring, 33.7° (1.5:1) bevels	Area Full	1.8 ft ²
K	0.00180	HDS 5 Chart	3
M	2.50000	HDS 5 Scale	B
C	0.02430	Equation Form	1
Y	0.83000		

Culvert Analysis Report

EX-CV-104A - Q5

Component: Weir

Hydraulic Component(s): Roadway			
Discharge	2.04 cfs	Allowable HW Elevation	7,142.21 ft
Roadway Width	36.48 ft	Overtopping Coefficient	2.93 US
Low Point	7,141.92 ft	Headwater Elevation	7,142.21 ft
Discharge Coefficient (Cr)	2.93	Submergence Factor (Kt)	1.00
Tailwater Elevation	0.00 ft		

Sta (ft)	Elev. (ft)
0.00	7,142.30
11.67	7,142.34
38.80	7,142.24
41.30	7,141.92
50.90	7,142.20

Culvert Analysis Report

EX-CV-104B- Q 100

Comments: Basin 107

Analysis Component			
Storm Event	Check	Discharge	1.40 cfs

Peak Discharge Method: User-Specified			
Design Discharge	1.40 cfs	Check Discharge	1.40 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	0.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	1.40 cfs	7,142.58 ft	5.05 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Analysis Report

EX-CV-104B- Q 100

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,142.58 ft	Discharge	1.40 cfs
Inlet Control HW Elev.	7,142.54 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,142.58 ft	Control Type	Entrance Control
Headwater Depth/Height	0.42		

Grades			
Upstream Invert	7,141.95 ft	Downstream Invert	7,141.10 ft
Length	48.40 ft	Constructed Slope	0.017562 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	0.32 ft
Slope Type	Steep	Normal Depth	0.32 ft
Flow Regime	Supercritical	Critical Depth	0.44 ft
Velocity Downstream	5.05 ft/s	Critical Slope	0.004905 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.50 ft
Section Size	18 inch	Rise	1.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,142.58 ft	Upstream Velocity Head	0.16 ft
Ke	0.20	Entrance Loss	0.03 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,142.54 ft	Flow Control	Unsubmerged
Inlet Type	Groove end projecting	Area Full	1.8 ft ²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Analysis Report

EX-CV-104B - Q 5

Comments: Basin 107

Analysis Component			
Storm Event	Design	Discharge	0.63 cfs

Peak Discharge Method: User-Specified			
Design Discharge	0.63 cfs	Check Discharge	0.63 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	0.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	0.63 cfs	7,142.37 ft	3.99 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Analysis Report

EX-CV-104B - Q 5

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,142.37 ft	Discharge	0.63 cfs
Inlet Control HW Elev.	7,142.33 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,142.37 ft	Control Type	Entrance Control
Headwater Depth/Height	0.28		

Grades			
Upstream Invert	7,141.95 ft	Downstream Invert	7,141.10 ft
Length	48.40 ft	Constructed Slope	0.017562 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	0.22 ft
Slope Type	Steep	Normal Depth	0.22 ft
Flow Regime	Supercritical	Critical Depth	0.29 ft
Velocity Downstream	3.99 ft/s	Critical Slope	0.005051 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.50 ft
Section Size	18 inch	Rise	1.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,142.37 ft	Upstream Velocity Head	0.10 ft
Ke	0.20	Entrance Loss	0.02 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,142.33 ft	Flow Control	Unsubmerged
Inlet Type	Groove end projecting	Area Full	1.8 ft ²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Analysis Report

EX-CV-204 - Q 100

Comments: Basin 206

Analysis Component			
Storm Event	Check	Discharge	12.33 cfs

Peak Discharge Method: User-Specified			
Design Discharge	12.33 cfs	Check Discharge	12.33 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	0.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-24 inch Circular	12.33 cfs	7,141.14 ft	5.90 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Analysis Report

EX-CV-204 - Q 100

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,141.14 ft	Discharge	12.33 cfs
Inlet Control HW Elev.	7,141.00 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,141.14 ft	Control Type	Outlet Control
Headwater Depth/Height	1.13		

Grades			
Upstream Invert	7,138.88 ft	Downstream Invert	7,137.75 ft
Length	40.00 ft	Constructed Slope	0.000000 ft/ft

Hydraulic Profile			
Profile	H2	Depth, Downstream	1.26 ft
Slope Type	Horizontal	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.26 ft
Velocity Downstream	5.90 ft/s	Critical Slope	0.019264 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,141.14 ft	Upstream Velocity Head	0.24 ft
Ke	0.20	Entrance Loss	0.05 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,141.00 ft	Flow Control	Unsubmerged
Inlet Type	Projecting	Area Full	3.1 ft ²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report

EX-CV-204 - Q 5

Comments: Basin 206

Analysis Component			
Storm Event	Design	Discharge	3.92 cfs

Peak Discharge Method: User-Specified			
Design Discharge	3.92 cfs	Check Discharge	3.92 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	0.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-24 inch Circular	3.92 cfs	7,140.12 ft	4.05 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Analysis Report

EX-CV-204 - Q 5

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,140.12 ft	Discharge	3.92 cfs
Inlet Control HW Elev.	7,139.88 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,140.12 ft	Control Type	Outlet Control
Headwater Depth/Height	0.62		

Grades			
Upstream Invert	7,138.88 ft	Downstream Invert	7,137.75 ft
Length	40.00 ft	Constructed Slope	0.000000 ft/ft

Hydraulic Profile			
Profile	H2	Depth, Downstream	0.69 ft
Slope Type	Horizontal	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	0.69 ft
Velocity Downstream	4.05 ft/s	Critical Slope	0.015278 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	2.00 ft
Section Size	24 inch	Rise	2.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,140.12 ft	Upstream Velocity Head	0.08 ft
Ke	0.90	Entrance Loss	0.07 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,139.88 ft	Flow Control	Unsubmerged
Inlet Type	Projecting	Area Full	3.1 ft ²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report

EX-CV-404 - Q 100

Comments: Basin 405

Analysis Component			
Storm Event	Check	Discharge	0.84 cfs

Peak Discharge Method: User-Specified			
Design Discharge	0.84 cfs	Check Discharge	0.84 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	0.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	0.84 cfs	7,128.25 ft	4.02 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Analysis Report

EX-CV-404 - Q 100

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,128.25 ft	Discharge	0.84 cfs
Inlet Control HW Elev.	7,128.21 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,128.25 ft	Control Type	Entrance Control
Headwater Depth/Height	0.32		
Grades			
Upstream Invert	7,127.76 ft	Downstream Invert	7,126.95 ft
Length	57.20 ft	Constructed Slope	0.014161 ft/ft
Hydraulic Profile			
Profile	S2	Depth, Downstream	0.26 ft
Slope Type	Steep	Normal Depth	0.26 ft
Flow Regime	Supercritical	Critical Depth	0.34 ft
Velocity Downstream	4.02 ft/s	Critical Slope	0.004973 ft/ft
Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.50 ft
Section Size	18 inch	Rise	1.50 ft
Number Sections	1		
Outlet Control Properties			
Outlet Control HW Elev.	7,128.25 ft	Upstream Velocity Head	0.12 ft
Ke	0.20	Entrance Loss	0.02 ft
Inlet Control Properties			
Inlet Control HW Elev.	7,128.21 ft	Flow Control	Unsubmerged
Inlet Type	Groove end projecting	Area Full	1.8 ft ²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Analysis Report

EX-CV-404 - Q 5

Comments: Basin 405

Analysis Component				
Storm Event	Design	Discharge	0.31 cfs	

Peak Discharge Method: User-Specified				
Design Discharge	0.31 cfs	Check Discharge	0.31 cfs	

Tailwater Conditions: Constant Tailwater				
Tailwater Elevation	0.00 ft			

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	0.31 cfs	7,128.05 ft	2.99 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Analysis Report

EX-CV-404 - Q 5

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,128.05 ft	Discharge	0.31 cfs
Inlet Control HW Elev.	7,128.03 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,128.05 ft	Control Type	Entrance Control
Headwater Depth/Height	0.19		

Grades			
Upstream Invert	7,127.76 ft	Downstream Invert	7,126.95 ft
Length	57.20 ft	Constructed Slope	0.014161 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	0.16 ft
Slope Type	Steep	Normal Depth	0.16 ft
Flow Regime	Supercritical	Critical Depth	0.21 ft
Velocity Downstream	2.99 ft/s	Critical Slope	0.005389 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.50 ft
Section Size	18 inch	Rise	1.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,128.05 ft	Upstream Velocity Head	0.07 ft
Ke	0.20	Entrance Loss	0.01 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,128.03 ft	Flow Control	Unsubmerged
Inlet Type	Groove end projecting	Area Full	1.8 ft ²
K	0.00450	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

Culvert Analysis Report

EX-CV-409 - Q 100

Comments: Crystal Creek basin

Analysis Component			
Storm Event	Design	Discharge	530.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	530.00 cfs	Check Discharge	530.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	7,118.90 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-60 inch Circular	191.69 cfs	7,127.70 ft	13.49 ft/s
Weir	Roadway	338.04 cfs	7,127.70 ft	N/A
Total	-----	529.72 cfs	7,127.70 ft	N/A

Culvert Analysis Report

EX-CV-409 - Q 100

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,127.70 ft	Discharge	191.69 cfs
Inlet Control HW Elev.	7,127.70 ft	Tailwater Elevation	7,118.90 ft
Outlet Control HW Elev.	7,127.66 ft	Control Type	Inlet Control
Headwater Depth/Height	1.58		

Grades			
Upstream Invert	7,119.80 ft	Downstream Invert	7,118.17 ft
Length	54.30 ft	Constructed Slope	0.030018 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	3.40 ft
Slope Type	Steep	Normal Depth	3.33 ft
Flow Regime	Supercritical	Critical Depth	3.96 ft
Velocity Downstream	13.49 ft/s	Critical Slope	0.019724 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	5.00 ft
Section Size	60 inch	Rise	5.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,127.66 ft	Upstream Velocity Head	2.05 ft
Ke	0.90	Entrance Loss	1.85 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,127.70 ft	Flow Control	N/A
Inlet Type	Projecting	Area Full	19.6 ft ²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report

EX-CV-409 - Q 100

Component: Weir

Hydraulic Component(s): Roadway			
Discharge	338.04 cfs	Allowable HW Elevation	7,127.70 ft
Roadway Width	25.30 ft	Overtopping Coefficient	3.03 US
Low Point	7,126.43 ft	Headwater Elevation	7,127.70 ft
Discharge Coefficient (Cr)	3.03	Submergence Factor (Kt)	1.00
Tailwater Elevation	7,118.90 ft		

Sta (ft)	Elev. (ft)
0.00	7,128.00
23.10	7,127.22
46.80	7,126.74
96.40	7,126.43
135.10	7,127.00

Culvert Analysis Report

EX-CV-410 - Q 100

Comments: Basin 201*

Analysis Component			
Storm Event	Check	Discharge	7.63 cfs

Peak Discharge Method: User-Specified			
Design Discharge	7.63 cfs	Check Discharge	7.63 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	0.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	7.63 cfs	7,129.77 ft	6.86 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Analysis Report

EX-CV-410 - Q 100

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,129.77 ft	Discharge	7.63 cfs
Inlet Control HW Elev.	7,129.64 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,129.77 ft	Control Type	Entrance Control
Headwater Depth/Height	1.34		

Grades			
Upstream Invert	7,127.76 ft	Downstream Invert	7,124.60 ft
Length	80.40 ft	Constructed Slope	0.039303 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	0.90 ft
Slope Type	Steep	Normal Depth	0.90 ft
Flow Regime	Supercritical	Critical Depth	1.07 ft
Velocity Downstream	6.86 ft/s	Critical Slope	0.024425 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.50 ft
Section Size	18 inch	Rise	1.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,129.77 ft	Upstream Velocity Head	0.50 ft
Ke	0.90	Entrance Loss	0.45 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,129.64 ft	Flow Control	Transition
Inlet Type	Projecting	Area Full	1.8 ft ²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report

EX-CV-410 - Q 5

Comments: Basin 201*

Analysis Component			
Storm Event	Design	Discharge	3.26 cfs

Peak Discharge Method: User-Specified			
Design Discharge	3.26 cfs	Check Discharge	3.26 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	0.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	3.26 cfs	7,128.95 ft	5.52 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Analysis Report

EX-CV-410 - Q 5

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,128.95 ft	Discharge	3.26 cfs
Inlet Control HW Elev.	7,128.78 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,128.95 ft	Control Type	Entrance Control
Headwater Depth/Height	0.79		
Grades			
Upstream Invert	7,127.76 ft	Downstream Invert	7,124.60 ft
Length	80.40 ft	Constructed Slope	0.039303 ft/ft
Hydraulic Profile			
Profile	S2	Depth, Downstream	0.55 ft
Slope Type	Steep	Normal Depth	0.55 ft
Flow Regime	Supercritical	Critical Depth	0.69 ft
Velocity Downstream	5.52 ft/s	Critical Slope	0.017702 ft/ft
Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.50 ft
Section Size	18 inch	Rise	1.50 ft
Number Sections	1		
Outlet Control Properties			
Outlet Control HW Elev.	7,128.95 ft	Upstream Velocity Head	0.26 ft
Ke	0.90	Entrance Loss	0.24 ft
Inlet Control Properties			
Inlet Control HW Elev.	7,128.78 ft	Flow Control	Unsubmerged
Inlet Type	Projecting	Area Full	1.8 ft ²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report

EX-CV-412 - Q 100

Comments: Basin 202*

Analysis Component			
Storm Event	Check	Discharge	7.44 cfs

Peak Discharge Method: User-Specified			
Design Discharge	7.44 cfs	Check Discharge	7.44 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	0.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	7.44 cfs	7,137.06 ft	8.44 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Analysis Report

EX-CV-412 - Q 100

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,137.06 ft	Discharge	7.44 cfs
Inlet Control HW Elev.	7,136.90 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,137.06 ft	Control Type	Entrance Control
Headwater Depth/Height	1.32		
Grades			
Upstream Invert	7,135.08 ft	Downstream Invert	7,131.90 ft
Length	46.26 ft	Constructed Slope	0.068742 ft/ft
Hydraulic Profile			
Profile	S2	Depth, Downstream	0.75 ft
Slope Type	Steep	Normal Depth	0.75 ft
Flow Regime	Supercritical	Critical Depth	1.06 ft
Velocity Downstream	8.44 ft/s	Critical Slope	0.023994 ft/ft
Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.50 ft
Section Size	18 inch	Rise	1.50 ft
Number Sections	1		
Outlet Control Properties			
Outlet Control HW Elev.	7,137.06 ft	Upstream Velocity Head	0.49 ft
Ke	0.90	Entrance Loss	0.44 ft
Inlet Control Properties			
Inlet Control HW Elev.	7,136.90 ft	Flow Control	Unsubmerged
Inlet Type	Projecting	Area Full	1.8 ft ²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report

EX-CV-412 - Q 5

Comments: Basin 202*

Analysis Component				
Storm Event	Design	Discharge	3.21 cfs	

Peak Discharge Method: User-Specified				
Design Discharge	3.21 cfs	Check Discharge	3.21 cfs	

Tailwater Conditions: Constant Tailwater				
Tailwater Elevation	0.00 ft			

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	3.21 cfs	7,136.26 ft	6.73 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Analysis Report

EX-CV-412 - Q 5

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,136.26 ft	Discharge	3.21 cfs
Inlet Control HW Elev.	7,136.06 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,136.26 ft	Control Type	Entrance Control
Headwater Depth/Height	0.79		
Grades			
Upstream Invert	7,135.08 ft	Downstream Invert	7,131.90 ft
Length	46.26 ft	Constructed Slope	0.068742 ft/ft
Hydraulic Profile			
Profile	S2	Depth, Downstream	0.47 ft
Slope Type	Steep	Normal Depth	0.47 ft
Flow Regime	Supercritical	Critical Depth	0.68 ft
Velocity Downstream	6.73 ft/s	Critical Slope	0.017656 ft/ft
Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.50 ft
Section Size	18 inch	Rise	1.50 ft
Number Sections	1		
Outlet Control Properties			
Outlet Control HW Elev.	7,136.26 ft	Upstream Velocity Head	0.26 ft
Ke	0.90	Entrance Loss	0.24 ft
Inlet Control Properties			
Inlet Control HW Elev.	7,136.06 ft	Flow Control	Unsubmerged
Inlet Type	Projecting	Area Full	1.8 ft ²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report

EX-CV-414 - Q 100

Comments: Basin 415

Analysis Component			
Storm Event	Check	Discharge	4.13 cfs

Peak Discharge Method: User-Specified			
Design Discharge	4.13 cfs	Check Discharge	4.13 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	0.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	4.13 cfs	7,148.90 ft	7.47 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Analysis Report

EX-CV-414 - Q 100

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,148.90 ft	Discharge	4.13 cfs
Inlet Control HW Elev.	7,148.70 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,148.90 ft	Control Type	Entrance Control
Headwater Depth/Height	0.91		

Grades			
Upstream Invert	7,147.53 ft	Downstream Invert	7,145.26 ft
Length	30.05 ft	Constructed Slope	0.075541 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	0.53 ft
Slope Type	Steep	Normal Depth	0.53 ft
Flow Regime	Supercritical	Critical Depth	0.78 ft
Velocity Downstream	7.47 ft/s	Critical Slope	0.018595 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.50 ft
Section Size	18 inch	Rise	1.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,148.90 ft	Upstream Velocity Head	0.31 ft
Ke	0.90	Entrance Loss	0.28 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,148.70 ft	Flow Control	Unsubmerged
Inlet Type	Projecting	Area Full	1.8 ft ²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report

EX-CV-414 - Q 5

Comments: Basin 415

Analysis Component				
Storm Event	Design	Discharge	2.27 cfs	
Peak Discharge Method: User-Specified				
Design Discharge	2.27 cfs	Check Discharge	2.27 cfs	
Tailwater Conditions: Constant Tailwater				
Tailwater Elevation	0.00 ft			
Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	2.27 cfs	7,148.50 ft	6.30 ft/s
Weir	Not Considered	N/A	N/A	N/A

Culvert Analysis Report

EX-CV-414 - Q 5

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,148.50 ft	Discharge	2.27 cfs
Inlet Control HW Elev.	7,148.31 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,148.50 ft	Control Type	Entrance Control
Headwater Depth/Height	0.65		
Grades			
Upstream Invert	7,147.53 ft	Downstream Invert	7,145.26 ft
Length	30.05 ft	Constructed Slope	0.075541 ft/ft
Hydraulic Profile			
Profile	S2	Depth, Downstream	0.39 ft
Slope Type	Steep	Normal Depth	0.39 ft
Flow Regime	Supercritical	Critical Depth	0.57 ft
Velocity Downstream	6.30 ft/s	Critical Slope	0.016983 ft/ft
Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.50 ft
Section Size	18 inch	Rise	1.50 ft
Number Sections	1		
Outlet Control Properties			
Outlet Control HW Elev.	7,148.50 ft	Upstream Velocity Head	0.21 ft
Ke	0.90	Entrance Loss	0.19 ft
Inlet Control Properties			
Inlet Control HW Elev.	7,148.31 ft	Flow Control	Unsubmerged
Inlet Type	Projecting	Area Full	1.8 ft ²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report

EX-CV-415 - Q 100

Comments: DP5

Analysis Component			
Storm Event	Check	Discharge	21.09 cfs

Peak Discharge Method: User-Specified			
Design Discharge	21.09 cfs	Check Discharge	21.09 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	0.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	10.43 cfs	7,148.06 ft	6.67 ft/s
Weir	Roadway	10.72 cfs	7,148.06 ft	N/A
Total	-----	21.15 cfs	7,148.06 ft	N/A

Culvert Analysis Report

EX-CV-415 - Q 100

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,148.06 ft	Discharge	10.43 cfs
Inlet Control HW Elev.	7,147.71 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,148.06 ft	Control Type	Outlet Control
Headwater Depth/Height	2.05		

Grades			
Upstream Invert	7,144.99 ft	Downstream Invert	7,144.20 ft
Length	43.74 ft	Constructed Slope	0.018061 ft/ft

Hydraulic Profile			
Profile	CompositeM2PressureProfile	Depth, Downstream	1.24 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.24 ft
Velocity Downstream	6.67 ft/s	Critical Slope	0.033024 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.50 ft
Section Size	18 inch	Rise	1.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,148.06 ft	Upstream Velocity Head	0.54 ft
Ke	0.90	Entrance Loss	0.49 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,147.71 ft	Flow Control	Submerged
Inlet Type	Projecting	Area Full	1.8 ft ²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report

EX-CV-415 - Q 100

Component: Weir

Hydraulic Component(s): Roadway			
Discharge	10.72 cfs	Allowable HW Elevation	7,148.06 ft
Roadway Width	21.00 ft	Overtopping Coefficient	2.94 US
Low Point	7,147.82 ft	Headwater Elevation	7,148.06 ft
Discharge Coefficient (Cr)	2.94	Submergence Factor (Kt)	1.00
Tailwater Elevation	0.00 ft		

Sta (ft)	Elev. (ft)
0.00	7,147.82
21.70	7,147.90
42.60	7,147.92
56.00	7,148.00
66.90	7,148.10

Culvert Analysis Report

EX-CV-415 - Q 5

Comments: DP5

Analysis Component			
Storm Event	Design	Discharge	10.77 cfs

Peak Discharge Method: User-Specified			
Design Discharge	10.77 cfs	Check Discharge	10.77 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	0.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-18 inch Circular	10.13 cfs	7,147.91 ft	6.55 ft/s
Weir	Roadway	0.65 cfs	7,147.91 ft	N/A
Total	-----	10.78 cfs	7,147.91 ft	N/A

Culvert Analysis Report

EX-CV-415 - Q 5

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,147.91 ft	Discharge	10.13 cfs
Inlet Control HW Elev.	7,147.61 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,147.91 ft	Control Type	Outlet Control
Headwater Depth/Height	1.94		
Grades			
Upstream Invert	7,144.99 ft	Downstream Invert	7,144.20 ft
Length	43.74 ft	Constructed Slope	0.018061 ft/ft
Hydraulic Profile			
Profile	CompositeM2PressureProfile	Depth, Downstream	1.23 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	1.23 ft
Velocity Downstream	6.55 ft/s	Critical Slope	0.031875 ft/ft
Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.50 ft
Section Size	18 inch	Rise	1.50 ft
Number Sections	1		
Outlet Control Properties			
Outlet Control HW Elev.	7,147.91 ft	Upstream Velocity Head	0.51 ft
Ke	0.90	Entrance Loss	0.46 ft
Inlet Control Properties			
Inlet Control HW Elev.	7,147.61 ft	Flow Control	Submerged
Inlet Type	Projecting	Area Full	1.8 ft ²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report

EX-CV-415 - Q 5

Component: Weir

Hydraulic Component(s): Roadway			
Discharge	0.65 cfs	Allowable HW Elevation	7,147.91 ft
Roadway Width	21.00 ft	Overtopping Coefficient	2.91 US
Low Point	7,147.82 ft	Headwater Elevation	7,147.91 ft
Discharge Coefficient (Cr)	2.91	Submergence Factor (Kt)	1.00
Tailwater Elevation	0.00 ft		

Sta (ft)	Elev. (ft)
0.00	7,147.82
21.70	7,147.90
42.60	7,147.92
56.00	7,148.00
66.90	7,148.10

Culvert Analysis Report

EX-CV-416 - Q 100

Comments: Basin 417

Analysis Component			
Storm Event	Check	Discharge	13.47 cfs

Peak Discharge Method: User-Specified			
Design Discharge	13.47 cfs	Check Discharge	13.47 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	7,148.04 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-12 inch Circular	0.51 cfs	7,148.10 ft	0.65 ft/s
Weir	Roadway	12.97 cfs	7,148.10 ft	N/A
Total	-----	13.48 cfs	7,148.10 ft	N/A

Culvert Analysis Report

EX-CV-416 - Q 100

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,148.10 ft	Discharge	0.51 cfs
Inlet Control HW Elev.	7,148.04 ft	Tailwater Elevation	7,148.04 ft
Outlet Control HW Elev.	7,148.10 ft	Control Type	Outlet Control
Headwater Depth/Height	1.87		

Grades			
Upstream Invert	7,146.23 ft	Downstream Invert	7,143.15 ft
Length	69.88 ft	Constructed Slope	0.044076 ft/ft

Hydraulic Profile			
Profile	Pressure Profile	Depth, Downstream	4.89 ft
Slope Type	N/A	Normal Depth	0.24 ft
Flow Regime	N/A	Critical Depth	0.30 ft
Velocity Downstream	0.65 ft/s	Critical Slope	0.019136 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.00 ft
Section Size	12 inch	Rise	1.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,148.10 ft	Upstream Velocity Head	0.01 ft
Ke	0.90	Entrance Loss	0.01 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,148.04 ft	Flow Control	N/A
Inlet Type	Projecting	Area Full	0.8 ft ²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report

EX-CV-416 - Q 100

Component: Weir

Hydraulic Component(s): Roadway			
Discharge	12.97 cfs	Allowable HW Elevation	7,148.10 ft
Roadway Width	51.40 ft	Overtopping Coefficient	2.95 US
Low Point	7,147.63 ft	Headwater Elevation	7,148.10 ft
Discharge Coefficient (Cr)	2.95	Submergence Factor (Kt)	1.00
Tailwater Elevation	7,148.04 ft		

Sta (ft)	Elev. (ft)
0.00	7,149.00
15.20	7,148.14
22.70	7,147.99
34.90	7,147.63
45.30	7,147.82

Culvert Analysis Report

EX-CV-416 - Q 5

Comments: Basin 417

Analysis Component			
Storm Event	Design	Discharge	6.68 cfs

Peak Discharge Method: User-Specified			
Design Discharge	6.68 cfs	Check Discharge	6.68 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	7,147.61 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-12 inch Circular	1.21 cfs	7,147.95 ft	1.54 ft/s
Weir	Roadway	5.47 cfs	7,147.95 ft	N/A
Total	-----	6.68 cfs	7,147.95 ft	N/A

Culvert Analysis Report

EX-CV-416 - Q 5

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,147.95 ft	Discharge	1.21 cfs
Inlet Control HW Elev.	7,147.61 ft	Tailwater Elevation	7,147.61 ft
Outlet Control HW Elev.	7,147.95 ft	Control Type	Outlet Control
Headwater Depth/Height	1.72		

Grades			
Upstream Invert	7,146.23 ft	Downstream Invert	7,143.15 ft
Length	69.88 ft	Constructed Slope	0.044076 ft/ft

Hydraulic Profile			
Profile	Pressure Profile	Depth, Downstream	4.46 ft
Slope Type	N/A	Normal Depth	0.37 ft
Flow Regime	N/A	Critical Depth	0.46 ft
Velocity Downstream	1.54 ft/s	Critical Slope	0.020343 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.024
Section Material	CMP	Span	1.00 ft
Section Size	12 inch	Rise	1.00 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,147.95 ft	Upstream Velocity Head	0.04 ft
Ke	0.90	Entrance Loss	0.03 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,147.61 ft	Flow Control	N/A
Inlet Type	Projecting	Area Full	0.8 ft ²
K	0.03400	HDS 5 Chart	2
M	1.50000	HDS 5 Scale	3
C	0.05530	Equation Form	1
Y	0.54000		

Culvert Analysis Report

EX-CV-416 - Q 5

Component: Weir

Hydraulic Component(s): Roadway			
Discharge	5.47 cfs	Allowable HW Elevation	7,147.95 ft
Roadway Width	51.40 ft	Overtopping Coefficient	2.93 US
Low Point	7,147.63 ft	Headwater Elevation	7,147.95 ft
Discharge Coefficient (Cr)	2.93	Submergence Factor (Kt)	1.00
Tailwater Elevation	7,147.61 ft		

Sta (ft)	Elev. (ft)
0.00	7,149.00
15.20	7,148.14
22.70	7,147.99
34.90	7,147.63
45.30	7,147.82

DP10 Exist Downstream Ditch

Project Description	
Friction Method	Manning Formula
Solve For	Discharge
Input Data	
Roughness Coefficient	0.030
Channel Slope	0.032 ft/ft
Normal Depth	9.2 in
Left Side Slope	7.000 H:V
Right Side Slope	6.000 H:V
Bottom Width	0.00 ft
Results	
Discharge	17.72 cfs
Flow Area	3.8 ft ²
Wetted Perimeter	10.1 ft
Hydraulic Radius	4.5 in
Top Width	9.97 ft
Critical Depth	10.3 in
Critical Slope	0.018 ft/ft
Velocity	4.64 ft/s
Velocity Head	0.33 ft
Specific Energy	1.10 ft
Froude Number	1.321
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	9.2 in
Critical Depth	10.3 in
Channel Slope	0.032 ft/ft
Critical Slope	0.018 ft/ft

5-year Culvert Analysis Report CV-101

Comments: Flow taken from basin 103*

Analysis Component			
Storm Event	Design	Discharge	9.63 cfs
Peak Discharge Method: User-Specified			
Design Discharge	9.63 cfs	Check Discharge	19.86 cfs
Tailwater Conditions: Constant Tailwater			
Tailwater Elevation	0.00 ft		

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-19x30 inch Horiz Ellipse	9.64 cfs	7,136.28 ft	5.62 ft/s
Weir	Roadway	0.00 cfs	7,136.28 ft	N/A
Total	-----	9.64 cfs	7,136.28 ft	N/A

5-year Culvert Analysis Report

CV-101

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,136.28 ft	Discharge	9.64 cfs
Inlet Control HW Elev.	7,136.24 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,136.28 ft	Control Type	Entrance Control
Headwater Depth/Height	0.84		

Grades			
Upstream Invert	7,134.93 ft	Downstream Invert	7,134.60 ft
Length	46.31 ft	Constructed Slope	0.007126 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	0.80 ft
Slope Type	Steep	Normal Depth	0.80 ft
Flow Regime	Supercritical	Critical Depth	0.89 ft
Velocity Downstream	5.62 ft/s	Critical Slope	0.004078 ft/ft

Section			
Section Shape	Horizontal Ellipse	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.52 ft
Section Size	19x30 inch	Rise	1.60 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,136.28 ft	Upstream Velocity Head	0.39 ft
Ke	0.20	Entrance Loss	0.08 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,136.24 ft	Flow Control	Unsubmerged
Inlet Type	Groove end projecting (horizontal ellipse)	Area Full	3.3 ft ²
K	0.00450	HDS 5 Chart	29
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

5-year Culvert Analysis Report

CV-101

Component: Weir

Hydraulic Component(s): Roadway			
Discharge	0.00 cfs	Allowable HW Elevation	7,136.28 ft
Roadway Width	36.10 ft	Overtopping Coefficient	2.90 US
Low Point	7,136.40 ft	Headwater Elevation	N/A ft
Discharge Coefficient (Cr)	2.90	Submergence Factor (Kt)	1.00
Tailwater Elevation	0.00 ft		

Sta (ft)	Elev. (ft)
0.00	7,136.61
10.55	7,136.40
25.05	7,137.16
47.78	7,138.01

5-year Culvert Analysis Report CV-204

Comments: Flow taken from basin 206

Analysis Component			
Storm Event	Design	Discharge	4.36 cfs
Peak Discharge Method: User-Specified			
Design Discharge	4.36 cfs	Check Discharge	12.83 cfs
Tailwater Conditions: Constant Tailwater			
Tailwater Elevation	0.00 ft		

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-19x30 inch Horiz Ellipse	4.36 cfs	7,139.40 ft	6.13 ft/s
Weir	Roadway	0.00 cfs	7,139.40 ft	N/A
Total	-----	4.36 cfs	7,139.40 ft	N/A

5-year Culvert Analysis Report

CV-204

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,139.40 ft	Discharge	4.36 cfs
Inlet Control HW Elev.	7,139.34 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,139.40 ft	Control Type	Entrance Control
Headwater Depth/Height	0.56		
Grades			
Upstream Invert	7,138.50 ft	Downstream Invert	7,137.85 ft
Length	39.19 ft	Constructed Slope	0.016586 ft/ft
Hydraulic Profile			
Profile	S2	Depth, Downstream	0.44 ft
Slope Type	Steep	Normal Depth	0.44 ft
Flow Regime	Supercritical	Critical Depth	0.62 ft
Velocity Downstream	6.13 ft/s	Critical Slope	0.004084 ft/ft
Section			
Section Shape	Horizontal Ellipse	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.52 ft
Section Size	19x30 inch	Rise	1.60 ft
Number Sections	1		
Outlet Control Properties			
Outlet Control HW Elev.	7,139.40 ft	Upstream Velocity Head	0.23 ft
Ke	0.20	Entrance Loss	0.05 ft
Inlet Control Properties			
Inlet Control HW Elev.	7,139.34 ft	Flow Control	Unsubmerged
Inlet Type	Groove end projecting (horizontal ellipse)	Area Full	3.3 ft ²
K	0.00450	HDS 5 Chart	29
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

5-year Culvert Analysis Report

CV-204

Component: Weir

Hydraulic Component(s): Roadway			
Discharge	0.00 cfs	Allowable HW Elevation	7,139.40 ft
Roadway Width	26.00 ft	Overtopping Coefficient	2.90 US
Low Point	7,141.47 ft	Headwater Elevation	N/A ft
Discharge Coefficient (Cr)	2.90	Submergence Factor (Kt)	1.00
Tailwater Elevation	0.00 ft		

Sta (ft)	Elev. (ft)
0.00	7,141.47
13.00	7,141.73
26.00	7,141.47

5-year Culvert Analysis Report CV-412

Comments: Flow taken from basin 202*

Analysis Component				
Storm Event	Design	Discharge	3.49 cfs	
Peak Discharge Method: User-Specified				
Design Discharge	3.49 cfs	Check Discharge	7.90 cfs	
Tailwater Conditions: Constant Tailwater				
Tailwater Elevation	0.00 ft			
Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-14x23 inch Horiz Ellipse	3.49 cfs	7,136.32 ft	9.02 ft/s
Weir	Not Considered	N/A	N/A	N/A

5-year Culvert Analysis Report

CV-412

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,136.32 ft	Discharge	3.49 cfs
Inlet Control HW Elev.	7,136.26 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,136.32 ft	Control Type	Entrance Control
Headwater Depth/Height	0.74		
Grades			
Upstream Invert	7,135.44 ft	Downstream Invert	7,133.22 ft
Length	43.00 ft	Constructed Slope	0.051628 ft/ft
Hydraulic Profile			
Profile	S2	Depth, Downstream	0.32 ft
Slope Type	Steep	Normal Depth	0.32 ft
Flow Regime	Supercritical	Critical Depth	0.59 ft
Velocity Downstream	9.02 ft/s	Critical Slope	0.004674 ft/ft
Section			
Section Shape	Horizontal Ellipse	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.90 ft
Section Size	14x23 inch	Rise	1.19 ft
Number Sections	1		
Outlet Control Properties			
Outlet Control HW Elev.	7,136.32 ft	Upstream Velocity Head	0.24 ft
Ke	0.20	Entrance Loss	0.05 ft
Inlet Control Properties			
Inlet Control HW Elev.	7,136.26 ft	Flow Control	Unsubmerged
Inlet Type	Groove end projecting (horizontal ellipse)	Area Full	1.8 ft ²
K	0.00450	HDS 5 Chart	29
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

5-year Culvert Analysis Report CV-415

Comments: Flow taken from basin DP5

Analysis Component				
Storm Event	Design	Discharge	10.46 cfs	
Peak Discharge Method: User-Specified				
Design Discharge	10.46 cfs	Check Discharge	20.33 cfs	
Tailwater Conditions: Constant Tailwater				
Tailwater Elevation	7,145.57 ft			
Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-19x30 inch Horiz Ellipse	10.46 cfs	7,146.35 ft	3.47 ft/s
Weir	Not Considered	N/A	N/A	N/A

5-year Culvert Analysis Report

CV-415

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,146.35 ft	Discharge	10.46 cfs
Inlet Control HW Elev.	7,146.30 ft	Tailwater Elevation	7,145.57 ft
Outlet Control HW Elev.	7,146.35 ft	Control Type	Entrance Control
Headwater Depth/Height	0.89		

Grades			
Upstream Invert	7,144.93 ft	Downstream Invert	7,144.20 ft
Length	48.03 ft	Constructed Slope	0.015199 ft/ft

Hydraulic Profile			
Profile	CompositeS1S2	Depth, Downstream	1.37 ft
Slope Type	Steep	Normal Depth	0.69 ft
Flow Regime	N/A	Critical Depth	0.93 ft
Velocity Downstream	3.47 ft/s	Critical Slope	0.004153 ft/ft

Section			
Section Shape	Horizontal Ellipse	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.52 ft
Section Size	19x30 inch	Rise	1.60 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,146.35 ft	Upstream Velocity Head	0.41 ft
Ke	0.20	Entrance Loss	0.08 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,146.30 ft	Flow Control	Unsubmerged
Inlet Type	Groove end projecting (horizontal ellipse)	Area Full	3.3 ft ²
K	0.00450	HDS 5 Chart	29
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

5-year Culvert Analysis Report CV-416

Comments: Flow taken from basin 417

Analysis Component			
Storm Event	Design	Discharge	7.34 cfs
Peak Discharge Method: User-Specified			
Design Discharge	7.34 cfs	Check Discharge	14.56 cfs
Tailwater Conditions: Constant Tailwater			
Tailwater Elevation	7,146.33 ft		

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-19x30 inch Horiz Ellipse	7.34 cfs	7,146.75 ft	3.00 ft/s
Weir	Roadway	0.00 cfs	7,146.75 ft	N/A
Total	-----	7.34 cfs	7,146.75 ft	N/A

5-year Culvert Analysis Report

CV-416

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,146.75 ft	Discharge	7.34 cfs
Inlet Control HW Elev.	7,146.70 ft	Tailwater Elevation	7,146.33 ft
Outlet Control HW Elev.	7,146.75 ft	Control Type	Entrance Control
Headwater Depth/Height	0.75		

Grades			
Upstream Invert	7,145.55 ft	Downstream Invert	7,145.23 ft
Length	63.82 ft	Constructed Slope	0.005014 ft/ft

Hydraulic Profile			
Profile	CompositeS1S2	Depth, Downstream	1.10 ft
Slope Type	Steep	Normal Depth	0.77 ft
Flow Regime	N/A	Critical Depth	0.80 ft
Velocity Downstream	3.00 ft/s	Critical Slope	0.004305 ft/ft

Section			
Section Shape	Horizontal Ellipse	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.52 ft
Section Size	19x30 inch	Rise	1.60 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,146.75 ft	Upstream Velocity Head	0.33 ft
Ke	0.20	Entrance Loss	0.07 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,146.70 ft	Flow Control	Unsubmerged
Inlet Type	Groove end projecting (horizontal ellipse)	Area Full	3.3 ft ²
K	0.00450	HDS 5 Chart	29
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

5-year Culvert Analysis Report CV-416

Component: Weir

Hydraulic Component(s): Roadway			
Discharge	0.00 cfs	Allowable HW Elevation	7,146.75 ft
Roadway Width	58.00 ft	Overtopping Coefficient	2.90 US
Low Point	7,148.01 ft	Headwater Elevation	N/A ft
Discharge Coefficient (Cr)	2.90	Submergence Factor (Kt)	1.00
Tailwater Elevation	7,146.33 ft		

Sta (ft)	Elev. (ft)
0.00	7,148.40
24.18	7,148.01
40.00	7,148.74

5-year Culvert Analysis Report CV-416

Component: Weir

Hydraulic Component(s): Roadway			
Discharge	0.00 cfs	Allowable HW Elevation	7,147.31 ft
Roadway Width	58.00 ft	Overtopping Coefficient	2.90 US
Low Point	7,148.01 ft	Headwater Elevation	N/A ft
Discharge Coefficient (Cr)	2.90	Submergence Factor (Kt)	1.00
Tailwater Elevation	7,146.33 ft		

Sta (ft)	Elev. (ft)
0.00	7,148.40
24.18	7,148.01
40.00	7,148.74

100-year Culvert Analysis Report CV-101

Comments: Flow taken from basin 103*

Analysis Component			
Storm Event	Check	Discharge	19.86 cfs

Peak Discharge Method: User-Specified			
Design Discharge	9.63 cfs	Check Discharge	19.86 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	0.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-19x30 inch Horiz Ellipse	15.16 cfs	7,136.73 ft	6.81 ft/s
Weir	Roadway	4.72 cfs	7,136.74 ft	N/A
Total	-----	19.88 cfs	7,136.73 ft	N/A

100-year Culvert Analysis Report CV-101

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,136.74 ft	Discharge	15.16 cfs
Inlet Control HW Elev.	7,136.71 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,136.74 ft	Control Type	Entrance Control
Headwater Depth/Height	1.13		

Grades			
Upstream Invert	7,134.93 ft	Downstream Invert	7,134.60 ft
Length	46.31 ft	Constructed Slope	0.007126 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	1.01 ft
Slope Type	Steep	Normal Depth	1.00 ft
Flow Regime	Supercritical	Critical Depth	1.14 ft
Velocity Downstream	6.81 ft/s	Critical Slope	0.004939 ft/ft

Section			
Section Shape	Horizontal Ellipse	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.52 ft
Section Size	19x30 inch	Rise	1.60 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,136.74 ft	Upstream Velocity Head	0.55 ft
Ke	0.20	Entrance Loss	0.11 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,136.71 ft	Flow Control	Transition
Inlet Type	groove end projecting (horizontal ellipse)	Area Full	3.3 ft ²
K	0.00450	HDS 5 Chart	29
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

100-year Culvert Analysis Report CV-101

Component: Weir

Hydraulic Component(s): Roadway			
Discharge	4.72 cfs	Allowable HW Elevation	7,136.74 ft
Roadway Width	36.10 ft	Overtopping Coefficient	2.94 US
Low Point	7,136.40 ft	Headwater Elevation	7,136.74 ft
Discharge Coefficient (Cr)	2.94	Submergence Factor (Kt)	1.00
Tailwater Elevation	0.00 ft		

Sta (ft)	Elev. (ft)
0.00	7,136.61
10.55	7,136.40
25.05	7,137.16
47.78	7,138.01

100-year Culvert Analysis Report CV-204

Comments: Flow taken from basin 206

Analysis Component			
Storm Event	Check	Discharge	12.83 cfs

Peak Discharge Method: User-Specified			
Design Discharge	4.36 cfs	Check Discharge	12.83 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	0.00 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-19x30 inch Horiz Ellipse	12.84 cfs	7,140.12 ft	8.08 ft/s
Weir	Roadway	0.00 cfs	7,140.12 ft	N/A
Total	-----	12.84 cfs	7,140.12 ft	N/A

100-year Culvert Analysis Report CV-204

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,140.12 ft	Discharge	12.84 cfs
Inlet Control HW Elev.	7,140.08 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,140.12 ft	Control Type	Entrance Control
Headwater Depth/Height	1.01		

Grades			
Upstream Invert	7,138.50 ft	Downstream Invert	7,137.85 ft
Length	39.19 ft	Constructed Slope	0.016586 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	0.80 ft
Slope Type	Steep	Normal Depth	0.75 ft
Flow Regime	Supercritical	Critical Depth	1.04 ft
Velocity Downstream	8.08 ft/s	Critical Slope	0.004472 ft/ft

Section			
Section Shape	Horizontal Ellipse	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.52 ft
Section Size	19x30 inch	Rise	1.60 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,140.12 ft	Upstream Velocity Head	0.48 ft
Ke	0.20	Entrance Loss	0.10 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,140.08 ft	Flow Control	Unsubmerged
Inlet Type	Groove end projecting (horizontal ellipse)	Area Full	3.3 ft ²
K	0.00450	HDS 5 Chart	29
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

100-year Culvert Analysis Report CV-204

Component: Weir

Hydraulic Component(s): Roadway			
Discharge	0.00 cfs	Allowable HW Elevation	7,140.12 ft
Roadway Width	26.00 ft	Overtopping Coefficient	2.90 US
Low Point	7,141.47 ft	Headwater Elevation	N/A ft
Discharge Coefficient (Cr)	2.90	Submergence Factor (Kt)	1.00
Tailwater Elevation	0.00 ft		

Sta (ft)	Elev. (ft)
0.00	7,141.47
13.00	7,141.73
26.00	7,141.47

100-year Culvert Analysis Report CV-412

Comments: Flow taken from basin 202*

Analysis Component				
Storm Event	Check	Discharge	7.90 cfs	

Peak Discharge Method: User-Specified				
Design Discharge	3.49 cfs	Check Discharge	7.90 cfs	

Tailwater Conditions: Constant Tailwater				
Tailwater Elevation	0.00 ft			

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-14x23 inch Horiz Ellipse	7.90 cfs	7,136.88 ft	10.91 ft/s
Weir	Not Considered	N/A	N/A	N/A

100-year Culvert Analysis Report CV-412

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,136.88 ft	Discharge	7.90 cfs
Inlet Control HW Elev.	7,136.84 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	7,136.88 ft	Control Type	Entrance Control
Headwater Depth/Height	1.21		

Grades			
Upstream Invert	7,135.44 ft	Downstream Invert	7,133.22 ft
Length	43.00 ft	Constructed Slope	0.051628 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	0.51 ft
Slope Type	Steep	Normal Depth	0.48 ft
Flow Regime	Supercritical	Critical Depth	0.90 ft
Velocity Downstream	10.91 ft/s	Critical Slope	0.006048 ft/ft

Section			
Section Shape	Horizontal Ellipse	Mannings Coefficient	0.013
Section Material	Concrete	Span	1.90 ft
Section Size	14x23 inch	Rise	1.19 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,136.88 ft	Upstream Velocity Head	0.45 ft
Ke	0.20	Entrance Loss	0.09 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,136.84 ft	Flow Control	Submerged
Inlet Type	Groove end projecting (horizontal ellipse)	Area Full	1.8 ft ²
K	0.00450	HDS 5 Chart	29
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

100-year Culvert Analysis Report CV-415

Comments: Flow taken from basin DP5

Analysis Component			
Storm Event	Check	Discharge	20.33 cfs

Peak Discharge Method: User-Specified			
Design Discharge	10.46 cfs	Check Discharge	20.33 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	7,145.57 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-19x30 inch Horiz Ellipse	20.33 cfs	7,147.23 ft	9.15 ft/s
Weir	Not Considered	N/A	N/A	N/A

100-year Culvert Analysis Report CV-415

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,147.23 ft	Discharge	20.33 cfs
Inlet Control HW Elev.	7,147.23 ft	Tailwater Elevation	7,145.57 ft
Outlet Control HW Elev.	7,147.15 ft	Control Type	Inlet Control
Headwater Depth/Height	1.43		

Grades			
Upstream Invert	7,144.93 ft	Downstream Invert	7,144.20 ft
Length	48.03 ft	Constructed Slope	0.015199 ft/ft

Hydraulic Profile			
Profile	CompositeS1S2	Depth, Downstream	1.01 ft
Slope Type	Steep	Normal Depth	0.94 ft
Flow Regime	N/A	Critical Depth	1.32 ft
Velocity Downstream	9.15 ft/s	Critical Slope	0.006694 ft/ft

Section			
Section Shape	Horizontal Ellipse	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.52 ft
Section Size	19x30 inch	Rise	1.60 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,147.15 ft	Upstream Velocity Head	0.76 ft
Ke	0.20	Entrance Loss	0.15 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,147.23 ft	Flow Control	N/A
Inlet Type	Groove end projecting (horizontal ellipse)	Area Full	3.3 ft ²
K	0.00450	HDS 5 Chart	29
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

100-year Culvert Analysis Report CV-416

Comments: Flow taken from basin 417

Analysis Component			
Storm Event	Check	Discharge	14.56 cfs

Peak Discharge Method: User-Specified			
Design Discharge	7.34 cfs	Check Discharge	14.56 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	7,146.33 ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	1-19x30 inch Horiz Ellipse	14.57 cfs	7,147.31 ft	5.97 ft/s
Weir	Roadway	0.00 cfs	7,147.31 ft	N/A
Total	-----	14.57 cfs	7,147.31 ft	N/A

100-year Culvert Analysis Report CV-416

Component: Culvert-1

Culvert Summary			
Computed Headwater Elevation	7,147.31 ft	Discharge	14.57 cfs
Inlet Control HW Elev.	7,147.28 ft	Tailwater Elevation	7,146.33 ft
Outlet Control HW Elev.	7,147.31 ft	Control Type	Entrance Control
Headwater Depth/Height	1.10		

Grades			
Upstream Invert	7,145.55 ft	Downstream Invert	7,145.23 ft
Length	63.82 ft	Constructed Slope	0.005014 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	1.10 ft
Slope Type	Steep	Normal Depth	1.10 ft
Flow Regime	Supercritical	Critical Depth	1.12 ft
Velocity Downstream	5.97 ft/s	Critical Slope	0.004802 ft/ft

Section			
Section Shape	Horizontal Ellipse	Mannings Coefficient	0.013
Section Material	Concrete	Span	2.52 ft
Section Size	19x30 inch	Rise	1.60 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	7,147.31 ft	Upstream Velocity Head	0.53 ft
Ke	0.20	Entrance Loss	0.11 ft

Inlet Control Properties			
Inlet Control HW Elev.	7,147.28 ft	Flow Control	N/A
Inlet Type	groove end projecting (horizontal ellipse)	Area Full	3.3 ft ²
K	0.00450	HDS 5 Chart	29
M	2.00000	HDS 5 Scale	3
C	0.03170	Equation Form	1
Y	0.69000		

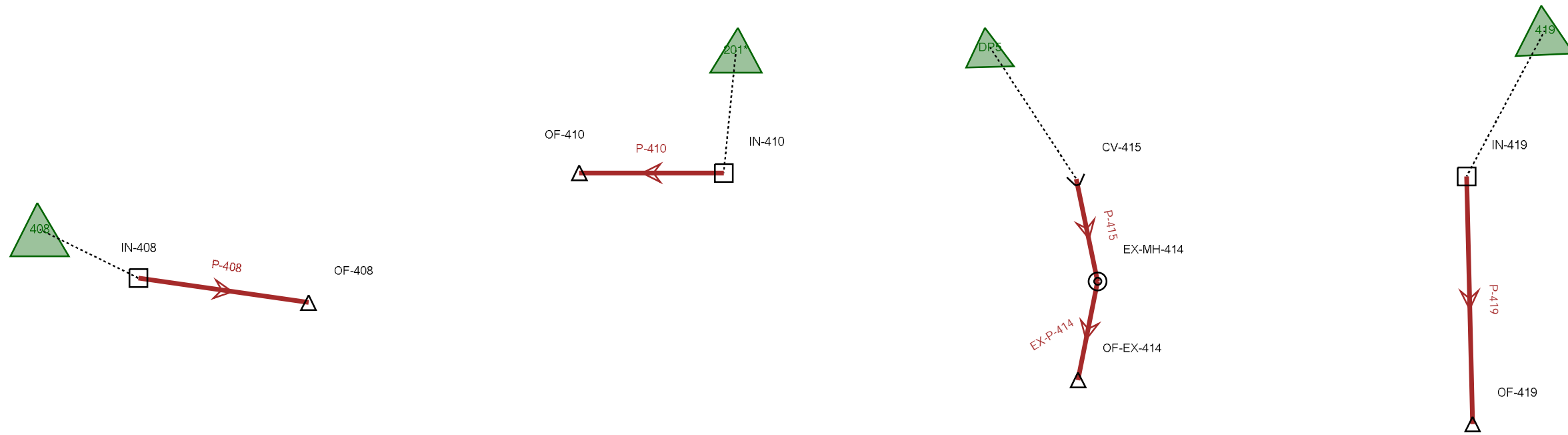
100-year Culvert Analysis Report CV-416

Component: Weir

Hydraulic Component(s): Roadway			
Discharge	0.00 cfs	Allowable HW Elevation	7,147.31 ft
Roadway Width	58.00 ft	Overtopping Coefficient	2.90 US
Low Point	7,148.01 ft	Headwater Elevation	N/A ft
Discharge Coefficient (Cr)	2.90	Submergence Factor (Kt)	1.00
Tailwater Elevation	7,146.33 ft		

Sta (ft)	Elev. (ft)
0.00	7,148.40
24.18	7,148.01
40.00	7,148.74

Scenario: 5-YR
Active Scenario: 5-YR



FlexTable: Catchment Table
Active Scenario: 5-YR

Label	Outflow Element	Area (User Defined) (acres)	Time of Concentration (min)	Runoff Coefficient (Rational)	Runoff Method	Flow (Total Out) (cfs)
201*	IN-410	1.940	9.93	0.470	Rational Method	3.80
408	IN-408	0.120	5.00	0.620	Rational Method	0.39
419	IN-419	3.260	15.11	0.260	Rational Method	3.00
DP5	CV-415	3.450	8.52	0.690	Rational Method	10.48

FlexTable: Catch Basin Table

Active Scenario: 5-YR

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Inlet Type	Inlet Location	Depth (Structure) (ft)	Flow (Captured) (cfs)	Headloss Method	HEC-22 Benching Method	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
IN-408	7,128.84	7,122.07	Full Capture	In Sag	6.77	0.39	HEC-22 Energy (Second Edition)	Flat	7,122.30	7,122.30	7,122.38	7,122.38
IN-410	7,129.33	7,125.78	Full Capture	In Sag	3.55	3.80	HEC-22 Energy (Second Edition)	Flat	7,126.53	7,126.53	7,126.82	7,126.82
IN-419	7,152.38	7,148.31	Full Capture	In Sag	4.07	3.00	HEC-22 Energy (Second Edition)	Flat	7,148.97	7,148.97	7,149.22	7,149.22

FlexTable: Conduit Table
Active Scenario: 5-YR

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Section Type	Span (ft)	Rise (ft)	Diameter (in)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Material	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
EX-P-414	EX-MH-414	7,144.10	OF-EX-414	7,129.05	Circle			18.0	202.6	0.074	PVC	10.44	18.08	37.22	7,145.34	7,129.59
P-408	IN-408	7,122.07	OF-408	7,118.14	Circle			18.0	70.0	0.056	Concrete	0.39	5.18	24.90	7,122.30	7,118.27
P-410	IN-410	7,125.78	OF-410	7,124.72	Circle			18.0	86.3	0.012	Concrete	3.80	5.89	11.64	7,126.53	7,125.31
P-415	CV-415	7,144.93	EX-MH-414	7,144.20	Ellipse	2.5	1.6		46.0	0.016	Concrete	10.48	8.10	27.45	7,145.91	7,145.59
P-419	IN-419	7,148.31	OF-419	7,147.72	Circle			18.0	117.9	0.005	Concrete	3.00	3.98	7.43	7,148.97	7,148.38

FlexTable: Outfall Table
 Active Scenario: 5-YR

Label	Elevation (Invert) (ft)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)
OF-408	7,118.14	Free Outfall		7,118.27	0.38
OF-410	7,124.72	Free Outfall		7,125.31	3.77
OF-419	7,147.72	Free Outfall		7,148.38	2.96

FlexTable: Catchment Table
 Active Scenario: 100-YR

Label	Outflow Element	Area (User Defined) (acres)	Time of Concentration (min)	Runoff Coefficient (Rational)	Runoff Method	Flow (Total Out) (cfs)
201*	IN-410	1.940	9.93	0.640	Rational Method	8.70
408	IN-408	0.120	5.00	0.750	Rational Method	0.79
419	IN-419	3.260	15.11	0.490	Rational Method	9.49
DP5	CV-415	3.450	8.52	0.800	Rational Method	20.41

FlexTable: Catch Basin Table

Active Scenario: 100-YR

Label	Elevation (Rim) (ft)	Elevation (Invert) (ft)	Inlet Type	Inlet Location	Depth (Structure) (ft)	Flow (Captured) (cfs)	Headloss Method	HEC-22 Benching Method	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)
IN-408	7,128.84	7,122.07	Full Capture	In Sag	6.77	0.79	HEC-22 Energy (Second Edition)	Flat	7,122.40	7,122.40	7,122.52	7,122.52
IN-410	7,129.33	7,125.78	Full Capture	In Sag	3.55	8.70	HEC-22 Energy (Second Edition)	Flat	7,127.20	7,127.20	7,127.59	7,127.59
IN-419	7,152.38	7,148.31	Full Capture	In Sag	4.07	9.49	HEC-22 Energy (Second Edition)	Flat	7,150.00	7,150.00	7,150.45	7,150.45

FlexTable: Conduit Table
Active Scenario: 100-YR

Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Section Type	Span (ft)	Rise (ft)	Diameter (in)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Material	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
EX-P-414	EX-MH-414	7,144.10	OF-EX-414	7,129.05	Circle			18.0	202.6	0.074	PVC	20.31	21.52	37.22	7,145.57	7,129.84
P-408	IN-408	7,122.07	OF-408	7,118.14	Circle			18.0	70.0	0.056	Concrete	0.79	6.39	24.90	7,122.40	7,120.50
P-410	IN-410	7,125.78	OF-410	7,124.72	Circle			18.0	86.3	0.012	Concrete	8.70	7.22	11.64	7,127.26	7,126.67
P-415	CV-415	7,144.93	EX-MH-414	7,144.20	Ellipse	2.5	1.6		46.0	0.016	Concrete	20.41	6.57	27.45	7,146.79	7,146.39
P-419	IN-419	7,148.31	OF-419	7,147.72	Circle			18.0	117.9	0.005	Concrete	9.49	5.37	7.43	7,150.00	7,148.91

FlexTable: Outfall Table
Active Scenario: 100-YR

Label	Elevation (Invert) (ft)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)
OF-408	7,118.14	User Defined Tailwater	7,120.50	7,120.50	0.78
OF-410	7,124.72	User Defined Tailwater	7,126.67	7,126.67	8.64
OF-419	7,147.72	Free Outfall		7,148.91	9.39

Circular Conduit

Location	Name	Q ¹	D ²	Yt ³	V ⁴	Yt/D	Q/D ^{1.5}	Q/D ^{2.5}	Riprap Size*
		cfs	ft	ft	fps				in
BASECAMP	CV 101	9.63	2.00	0.40	5.62	0.20	3.40	1.70	L
MICROSCOPE	CV 204	4.36	2.00	0.40	6.13	0.20	1.54	0.77	L
DEER CREEK	CV 408	0.39	1.50	0.76	5.18	0.51	0.21	0.14	L
DEER CREEK	CV 410	3.80	1.50	0.40	5.89	0.27	2.07	1.38	L
DEER CREEK	CV 412	3.49	1.50	0.40	8.78	0.27	1.90	1.27	L
DEER CREEK	CV 416	7.34	2.00	1.23	3.00	0.62	2.60	1.30	L
DEER CREEK	CV 419	3.00	2.00	0.40	3.98	0.20	1.06	0.53	L

Box Conduit

Location	Name	Q ¹	W ⁵	H ⁶	H _a ⁷	Yt ³	V ⁸	Yt/H _a	Q/WH ^{1.5}	Q/WH ^{0.5}	Riprap Size*	Lp ⁹	1/2tanθ	A _t ¹⁰	T ¹¹
		cfs	ft	ft	ft	ft	fps					in	ft		ft ²
DEER CREEK	CV 409	530.00	12.00	6.00	3.90	2.55	17.31	0.65	5.75	22.38	L	19	3.5	44	17

*12" Riprap specified throughout plan sheets

- 1 Discharge (cfs), 5yr
- 2 Diameter of circular culvert (ft) (or equivalent if pipe is elliptical)
- 3 Tailwater depth (ft)
- 4 Velocity (assumes subcritical flow)
- 5 Box span (ft)
- 6 Box height (ft)
- 7 Parameter used in place of H in Figure 9-39 when flow is supercritical (ft)
- 8 Velocity (supercritical)
- 9 Minimum length of protection (ft)
- 10 Required area of flow at allowable velocity (ft²)
- 11 Minimum width of protection (ft)

NOTES: From Urban Drainage and Flood Control District Manual V.2 Figure 9-38 Riprap Erosion Protection at Circular outlet

Circular Conduit Outlet Valid for $Q/D^{2.5} < 6$

From Urban Drainage and Flood Control District Manual V.2 Figure 9-39 Riprap Erosion Protection at box outlet

Box Conduit Outlet Valid for $Q/WH^{1.5} < 8$

DEER CREEK DITCHES - 5 YEAR CAPACITY

Label	Start Station	End Station	Alignment	Location	Roughness Coefficient	Min Channel Slope (ft/ft)	Min Normal Depth (ft)	Left Side Slope (ft/ft (H:V))	Right Side Slope (ft/ft (H:V))	Bottom Width (ft)	Discharge (ft ³ /s)	Max Capacity (ft ³ /s)	Max Ditch Depth (ft)	Actual Freeboard (ft)	Flow Area (ft ²)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Top Width (ft)	Critical Depth (ft)	Critical Slope (ft/ft)	Velocity (ft/s)	Froude Number	Flow Type	Basin
102B	101+80	104+00	Base Camp Rd.	Right	0.03	0.015	0.90	4	3	0	9.63	23.68	1.25	0.35	2.80	6.50	0.40	6.25	0.90	0.02	3.45	0.91	Subcritical	Basin 103*
105B	105+00	106+80	Base Camp Rd.	Right	0.03	0.042	0.30	4	3	0	0.76	17.50	0.92	0.62	0.30	2.10	0.10	1.99	0.30	0.03	2.69	1.26	Supercritical	Basin 107
200M	200+30	202+30	Microscope Way	Right	0.03	0.012	0.40	4	3	0	1.14	15.06	1.10	0.70	0.60	3.00	0.20	2.93	0.40	0.02	1.86	0.72	Subcritical	Basin D-202N
204M	204+80	206+40	Microscope Way	Left	0.03	0.010	0.40	3	4	0	0.69	1.68	0.50	0.10	0.40	2.60	0.20	2.51	0.30	0.03	1.53	0.64	Subcritical	Basin 204
206M-N	204+80	206+40	Microscope Way	Right	0.03	0.015	0.50	4	3	0	1.68	16.84	1.10	0.60	0.80	3.40	0.20	3.25	0.40	0.02	2.23	0.82	Subcritical	Basin D-206N
206M-S	202+30	204+80	Microscope Way	Right	0.03	0.009	0.60	4	3	0	2.12	13.04	1.10	0.50	1.10	4.10	0.30	3.90	0.50	0.02	1.95	0.65	Subcritical	Basin D-206S
402D	403+40	404+00	Deer Creek Rd.	Right	0.03	0.012	0.40	4	3	0	0.77	16.96	1.15	0.75	0.50	2.60	0.20	2.54	0.30	0.03	1.67	0.69	Subcritical	Basin 403*
403D	403+40	103+20	Deer Creek Rd. / Base Camp Rd.	Left	0.03	0.005	0.60	3	3	0	1.68	3.90	0.83	0.23	1.10	3.80	0.30	3.64	0.50	0.02	1.52	0.49	Subcritical	Basin 403N*
404D	404+50	406+60	Deer Creek Rd.	Right	0.03	0.018	0.30	4	3	0	0.44	2.25	0.50	0.20	0.30	2.00	0.10	1.90	0.30	0.03	1.71	0.82	Subcritical	Basin 405
407D	406+60	408+00	Deer Creek Rd.	Right	0.03	0.014	0.30	4	3	0	0.37	1.99	0.50	0.20	0.20	1.90	0.10	1.87	0.20	0.03	1.49	0.72	Subcritical	Basin 408
409D	101+30	409+00	Deer Creek Rd. / Base Camp Rd.	Right / Left	0.03	0.005	1.10	3	4	0	9.88	29.60	1.67	0.57	4.30	8.10	0.50	7.75	0.90	0.02	2.30	0.55	Subcritical	Basin DP3
411D	411+00	202+30	Deer Creek Rd. / Microscope Way	Left	0.03	0.035	0.50	3	4	0	3.76	11.00	0.80	0.30	1.00	3.90	0.30	3.75	0.60	0.02	3.75	1.28	Supercritical	Basin 201*
412D	412+30	414+20	Deer Creek Rd.	Left	0.03	0.028	0.50	3	4	0	2.52	6.89	0.70	0.20	0.80	3.50	0.20	3.36	0.50	0.02	3.12	1.12	Supercritical	Basin D-202S*
415D	414+60	415+80	Deer Creek Rd.	Left	0.03	0.017	0.60	3	4	0	4.12	25.21	1.25	0.65	1.40	4.60	0.30	4.46	0.60	0.02	2.91	0.91	Subcritical	Basin 414
416D	416+60	418+20	Deer Creek Rd. / Woodmoor Dr	Left	0.03	0.045	0.70	3	4	0	7.34	10.50	0.75	0.05	1.50	4.80	0.30	4.60	0.80	0.02	4.87	1.50	Supercritical	Basin 417
419N	304+90	419+00	Woodmoor Dr / Deer Creek Rd.	Right / Left	0.03	0.042	0.40	4	4	0	2.96	5.88	0.58	0.18	0.80	3.70	0.20	3.59	0.50	0.02	3.68	1.37	Supercritical	Basin 419
421D	301+20	302+00	Woodmoor Dr	Right	0.03	0.018	0.60	4	3	0	3.50	84.04	2.00	1.40	1.20	4.10	0.30	3.95	0.60	0.02	2.91	0.93	Subcritical	Basin DP10
423D	419+20	420+20	Deer Creek Rd.	Left	0.03	0.020	0.30	4	4	0	0.46	9.57	0.80	0.50	0.30	2.10	0.10	2.05	0.20	0.03	1.75	0.86	Subcritical	Basin 423

DEER CREEK DITCHES - 100 YEAR CAPACITY

Label	Start Station	End Station	Alignment	Location	Roughness Coefficient	Min Channel Slope (ft/ft)	Min Normal Depth (ft)	Left Side Slope (ft/ft (H:V))	Right Side Slope (ft/ft (H:V))	Bottom Width (ft)	Discharge (ft ³ /s)	Max Capacity (ft ³ /s)	Max Ditch Depth (ft)	Actual Freeboard (ft)	Flow Area (ft ²)	Wetted Perimeter (ft)	Hydraulic Radius (ft)	Top Width (ft)	Critical Depth (ft)	Critical Slope (ft/ft)	Velocity (ft/s)	Froude Number	Flow Type	Basin
102B	101+80	104+00	Base Camp Rd.	Right	0.03	0.015	1.20	4	3	0	19.86	23.68	1.25	0.05	4.80	8.50	0.60	8.20	1.10	0.02	4.13	0.95	Subcritical	Basin 103*
105B	105+00	106+80	Base Camp Rd.	Right	0.03	0.042	0.40	4	3	0	1.62	17.50	0.92	0.52	0.50	2.70	0.20	2.64	0.40	0.02	3.25	1.32	Supercritical	Basin 107
200M	200+20	202+30	Microscope Way	Right	0.03	0.012	0.60	4	3	0	3.29	15.06	1.10	0.50	1.40	4.50	0.30	4.36	0.60	0.02	2.43	0.77	Subcritical	Basin D-202N
204M	204+80	206+40	Microscope Way	Left	0.03	0.010	0.50	3	4	0	1.40	1.68	0.50	0.00	0.80	3.40	0.20	3.27	0.40	0.02	1.83	0.67	Subcritical	Basin 204
206M-N	204+80	206+40	Microscope Way	Right	0.03	0.015	0.70	4	3	0	5.47	16.84	1.10	0.40	1.80	5.30	0.30	5.06	0.70	0.02	3.00	0.88	Subcritical	Basin D-206N
206M-S	202+30	204+80	Microscope Way	Right	0.03	0.009	0.80	4	3	0	5.82	13.04	1.10	0.30	2.30	5.90	0.40	5.70	0.70	0.02	2.51	0.69	Subcritical	Basin D-206S
402D	403+40	404+00	Deer Creek Rd.	Right	0.03	0.012	0.50	4	3	0	1.69	16.96	1.15	0.65	0.80	3.60	0.20	3.42	0.40	0.02	2.03	0.72	Subcritical	Basin 403*
403D	403+40	103+20	Deer Creek Rd. / Base Camp Rd.	Left	0.03	0.005	0.80	3	3	0	3.44	3.90	0.83	0.03	1.90	5.00	0.40	4.76	0.60	0.02	1.82	0.51	Subcritical	Basin 403N*
404D	404+50	406+60	Deer Creek Rd.	Right	0.03	0.018	0.40	4	3	0	0.97	2.25	0.50	0.10	0.50	2.70	0.20	2.55	0.30	0.03	2.08	0.86	Subcritical	Basin 405
407D	406+60	408+00	Deer Creek Rd.	Right	0.03	0.014	0.30	4	3	0	0.76	1.99	0.50	0.20	0.40	2.50	0.20	2.44	0.30	0.03	1.78	0.75	Subcritical	Basin 408
409D	101+30	409+00	Base Camp Rd. / Deer Creek Rd.	Right / Left	0.03	0.005	1.50	3	4	0	20.64	29.60	1.67	0.17	7.50	10.60	0.70	10.22	1.20	0.02	2.77	0.57	Subcritical	Basin DP3
411D	411+00	202+30	Deer Creek Rd. / Microscope Way	Left	0.03	0.035	0.70	3	4	0	8.54	11.00	0.80	0.10	1.90	5.30	0.30	5.10	0.80	0.02	4.60	1.34	Supercritical	Basin 201*
412D	412+30	414+20	Deer Creek Rd.	Left	0.03	0.028	0.60	3	4	0	4.88	6.89	0.70	0.10	1.30	4.50	0.30	4.31	0.70	0.02	3.68	1.17	Supercritical	Basin D-202S*
415D	414+60	415+80	Deer Creek Rd.	Left	0.03	0.017	0.80	3	4	0	7.68	13.90	1.00	0.20	2.20	5.80	0.40	5.61	0.80	0.02	3.42	0.95	Subcritical	Basin 414
416D	416+60	418+20	Deer Creek Rd.	Left	0.03	0.045	0.80	3	4	0	14.56	22.62	1.00	0.20	2.50	6.20	0.40	5.94	1.00	0.02	5.78	1.56	Supercritical	Basin 417
419N	304+90	419+00	Woodmoor Dr / Deer Creek Rd.	Right / Left	0.03	0.042	0.70	4	4	0	9.37	5.88	0.58	-0.12	1.90	5.70	0.30	5.53	0.80	0.02	4.90	1.47	Supercritical	Basin 419
421D	301+20	302+00	Woodmoor Dr	Right	0.03	0.018	0.90	4	3	0	10.54	84.04	2.00	1.10	2.70	6.30	0.40	5.97	0.90	0.02	3.84	1.00	Subcritical	Basin DP10
423D	419+20	420+20	Deer Creek Rd.	Left	0.03	0.020	0.40	4	4	0	1.46	9.57	0.80	0.40	0.60	3.30	0.20	3.17	0.40	0.02	2.33	0.92	Subcritical	Basin 423

(-) Freeboard indicates that flow encroaches the should of the road. Flow shall not exceed 6" of depth at shoulder.

FHWA CHANNEL LINING

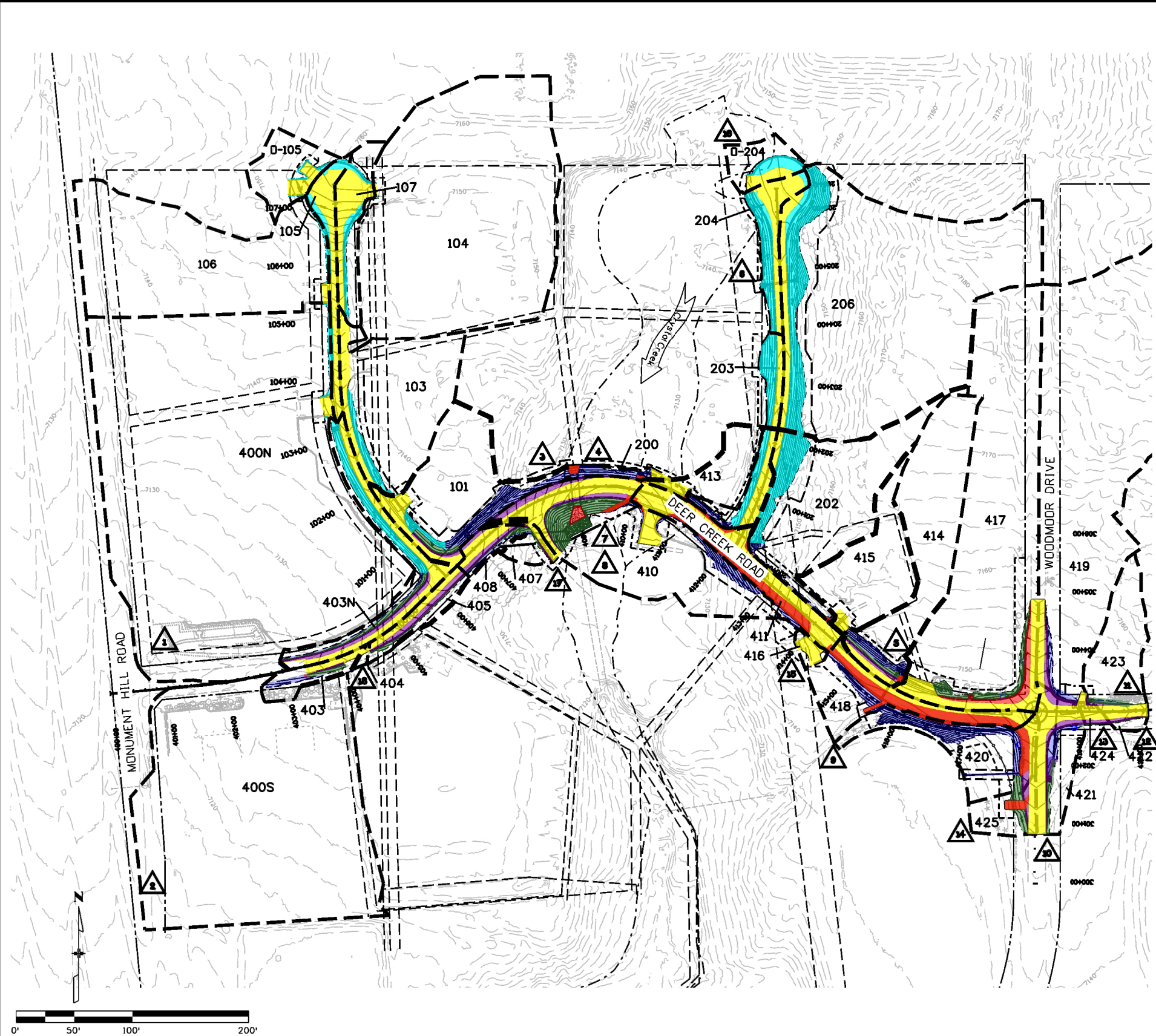
Label	100 YR Discharge	Velocity	γ	Normal Depth	Max Channel Slope	τ_d	Minimum Channel Lining
	(ft ³ /s)	(ft/s)	(lb/ft ³)	(ft)	(ft/ft)	(lb/ft ²)	
102B	19.86	4.13	62.40	1.20	0.015	1.12	Class 2 SRB
105B	1.62	3.25	62.40	0.40	0.042	1.05	Class 3 TRM
200M	3.29	2.43	62.40	0.60	0.012	0.45	Class 1 SRB
204M	1.40	1.83	62.40	0.50	0.010	0.31	Class 1 SRB
206M-N	5.47	3.00	62.40	0.70	0.015	0.66	Class 1 SRB
206M-S	5.82	2.51	62.40	0.80	0.009	0.45	Class 1 SRB
402D	1.69	2.03	62.40	0.50	0.012	0.37	Class 1 SRB
403D	3.44	1.82	62.40	0.80	0.005	0.25	Class 1 SRB
404D	0.97	2.08	62.40	0.40	0.018	0.45	Class 1 SRB
407D	0.76	1.78	62.40	0.30	0.014	0.26	Class 1 SRB
409D	20.64	2.77	63.40	1.50	0.005	0.48	Class 1 SRB
411D	8.54	4.60	64.40	0.70	0.035	1.58	Class 2 TRM
412D	4.88	3.68	63.35	0.60	0.028	1.06	Class 1 TRM
415D	7.68	3.42	63.46	0.80	0.017	0.86	Class 1 SRB
416D	14.56	5.78	64.46	0.80	0.045	2.32	Class 3 TRM
419N	9.37	4.90	65.46	0.70	0.042	1.92	Class 3 TRM
421D	10.54	3.84	66.46	0.90	0.018	1.08	Class 1 SRB
423D	1.46	2.33	63.57	0.40	0.020	0.51	Class 1 TRM

TRM 3 is caluated purely based on longitudinal slope. Class 1 SRB is sufficient and recommended for 105B as the flow and shear stress are low.

$$\tau_d = \gamma d S_o \quad \text{FHWA HEC NO. 15 3RD EDITION. EQUATION 3.1}$$

- τ_d : Shear Stress
 γ : Unit Weight of Water
 d : Normal Depth
 S_o : Channel Longitudinal Slope

jessico.barr 10/25/07 AM p:\1\voecom-no-pw.bentley.com\AECOM_USA_Colorado\Documents\60673398-Deer Creek Rd\900-CAD\910_CAD\06_SHEETS\03_Hydrology-Drainage\Water Quality\WQ Treatment Overview Map.dgn



LEGEND	
	PROPOSED BASIN
	EXISTING 2' LIDAR CONTOURS
	FEMA 100-YR FLOODPLAIN
	PROPOSED 5' CONTOURS
	DESIGN POINT
	UIA (UNCONNECTED IMPERVIOUS AREA)
	RPA (RECEIVING PERVIOUS AREA)
	DCIA (DIRECTLY CONNECTED IMPERVIOUS AREA)
	SPA (SEPARATED PERVIOUS AREA)
	EXCLUSION 1.7.B.2
	EXCLUSION 1.7.B.3

Design Point	Basin ID	Total Area (ac)	Total Proposed Disturbed Area (ac)	Existing Impervious (ac)	Proposed Impervious (ac)	Disturbed Area Treated via Runoff Reduction (ac)	Disturbed Area Excluded from WQ per ECM App 1.7.1.B.2 (ac)	Disturbed Area Excluded from WQ per ECM App 1.7.1.B.3 (ac)
DP3	101	0.84	0.25	0.09	0.10	0.14	0.04	0.09
	103	1.01	0.14	0.09	0.10	0.00	0.05	0.09
	104	3.02	0.00	0.00	0.00	0.00	0.00	0.00
	107	0.31	0.17	0.13	0.15	0.00	0.05	0.13
DP1	105	0.22	0.22	0.16	0.21	0.00	0.05	0.16
	106	1.73	0.02	0.01	0.00	0.00	0.01	0.01
	400N	6.02	0.04	0.02	0.00	0.00	0.02	0.02
	403N	0.47	0.37	0.18	0.24	0.09	0.10	0.18
DP2	O-105	0.30	0.05	0.04	0.03	0.00	0.01	0.04
	400S	3.60	0.00	0.00	0.00	0.00	0.00	0.00
	403	0.14	0.06	0.03	0.03	0.03	0.00	0.03
DP17	405	0.17	0.11	0.05	0.09	0.06	0.00	0.05
	407	0.10	0.04	0.03	0.03	0.01	0.00	0.03
	408	0.12	0.10	0.05	0.08	0.05	0.00	0.05
DP7	410	1.29	0.48	0.20	0.28	0.28	0.00	0.20
	411	0.43	0.42	0.29	0.40	0.13	0.00	0.29
	200	0.07	0.06	0.01	0.01	0.05	0.00	0.01
DP4	201	0.18	0.15	0.08	0.09	0.02	0.05	0.08
	202	1.15	0.18	0.02	0.02	0.02	0.13	0.02
	413	0.28	0.03	0.03	0.03	0.00	0.00	0.03
DP15	415	0.60	0.02	0.02	0.02	0.00	0.00	0.02
	416	0.05	0.03	0.03	0.03	0.00	0.00	0.03
	414	1.01	0.11	0.03	0.05	0.08	0.00	0.03
DP5	417	2.45	0.28	0.15	0.22	0.12	0.00	0.15
	418	0.45	0.26	0.09	0.22	0.17	0.00	0.09
DP9	420	0.52	0.24	0.03	0.07	0.21	0.00	0.03
	425	0.18	0.07	0.03	0.05	0.04	0.00	0.03
DP14	419	3.26	0.10	0.05	0.06	0.05	0.00	0.05
	421	0.36	0.22	0.14	0.17	0.09	0.00	0.14
DP11	423	0.44	0.03	0.02	0.02	0.01	0.00	0.02
	422	0.05	0.03	0.02	0.02	0.01	0.00	0.02
DP12	424	0.03	0.03	0.02	0.03	0.01	0.00	0.02
	203	0.12	0.12	0.04	0.05	0.00	0.07	0.04
DP6	204	0.25	0.25	0.13	0.16	0.00	0.11	0.13
	206	3.25	0.40	0.11	0.15	0.00	0.29	0.11
	404	0.01	0.00	0.00	0.00	0.00	0.00	0.00
DP18	O-204	0.20	0.08	0.03	0.07	0.00	0.04	0.03
DP16								
Total		34.65	5.15	2.45	3.31	1.68	1.04	2.45

Computer File Information

Print Date: 9/16/2024
File Name: WQ Treatment Overview Map.dgn
Last Modification Date: 9/16/2024
Designer: JB Detailer: AM Checker: WC
11x17 Scale: 1" = 200' Units: Survey Feet

Index of Revisions

Date:	Comments	Init.

El Paso County
 Department of Public Works
 3275 Akers Dr
 Phone: 719-520-6460
 Fax: 719-520-6879



AECOM
 2315 Briargate Pkwy #150
 Colorado Springs, CO 80920
 Phone: 719-531-0001
 Fax: 719-531-0007
 AECOM #60673398

DEER CREEK ROAD INTERSECTION IMPROVEMENTS

WATER QUALITY TREATMENT
 OVERVIEW MAP

1 of 1
 Sheet Number

FINAL - NOT FOR CONSTRUCTION

Water Quality Treatment Summary Table

Design Point	Basin ID	Total Area (ac)	Total Proposed Disturbed Area (ac)	Existing Impervious (ac)	Proposed Impervious (ac)	Disturbed Area Treated via Runoff Reduction (ac)	Disturbed Area Excluded from WQ per ECM App 1.7.1.B.2 (ac)	Disturbed Area Excluded from WQ per ECM App 1.7.1.B.3 (ac)	Notes
DP3	101	0.84	0.25	0.09	0.10	0.14	0.04	0.09	0.02 acres of Basin 101 along Basecamp at the intersection with Deer Creek fall under exclusions B.2 and B.3 is also being overtreated via runoff reduction.
	103	1.01	0.14	0.09	0.10	0.00	0.05	0.09	
	104	3.02	0.00	0.00	0.00	0.00	0.00	0.00	
	107	0.31	0.17	0.13	0.15	0.00	0.05	0.13	
DP1	105	0.22	0.22	0.16	0.21	0.00	0.05	0.16	
	106	1.73	0.02	0.01	0.00	0.00	0.01	0.01	
	400N	6.02	0.04	0.02	0.00	0.00	0.02	0.02	
	403N	0.47	0.37	0.18	0.24	0.09	0.10	0.18	
	O-105	0.30	0.05	0.04	0.03	0.00	0.01	0.04	
DP2	400S	3.60	0.00	0.00	0.00	0.00	0.00	0.00	
	403	0.14	0.06	0.03	0.03	0.03	0.00	0.03	
	405	0.17	0.11	0.05	0.09	0.06	0.00	0.05	
DP17	407	0.10	0.04	0.03	0.03	0.01	0.00	0.03	
DP7	408	0.12	0.10	0.05	0.08	0.05	0.00	0.05	
	410	1.29	0.48	0.20	0.28	0.28	0.00	0.20	
	411	0.43	0.42	0.29	0.40	0.13	0.00	0.29	
DP4	200	0.07	0.06	0.01	0.01	0.05	0.00	0.01	
	201	0.18	0.15	0.08	0.09	0.02	0.05	0.08	
	202	1.15	0.18	0.02	0.02	0.02	0.13	0.02	
	413	0.28	0.03	0.03	0.03	0.00	0.00	0.03	
	415	0.60	0.02	0.02	0.02	0.00	0.00	0.02	
DP15	416	0.05	0.03	0.03	0.03	0.00	0.00	0.03	
DP5	414	1.01	0.11	0.03	0.05	0.08	0.00	0.03	
	417	2.45	0.28	0.15	0.22	0.12	0.00	0.15	
DP9	418	0.45	0.26	0.09	0.22	0.17	0.00	0.09	
	420	0.52	0.24	0.03	0.07	0.21	0.00	0.03	
DP14	425	0.18	0.07	0.03	0.05	0.04	0.00	0.03	
DP10	419	3.26	0.10	0.05	0.06	0.05	0.00	0.05	
	421	0.36	0.22	0.14	0.17	0.09	0.00	0.14	
DP11	423	0.44	0.03	0.02	0.02	0.01	0.00	0.02	
DP12	422	0.05	0.03	0.02	0.02	0.01	0.00	0.02	
DP13	424	0.03	0.03	0.02	0.03	0.01	0.00	0.02	
DP6	203	0.12	0.12	0.04	0.05	0.00	0.07	0.04	
	204	0.25	0.25	0.13	0.16	0.00	0.11	0.13	
	206	3.25	0.40	0.11	0.15	0.00	0.29	0.11	
DP18	404	0.01	0.00	0.00	0.00	0.00	0.00	0.00	
DP16	O-204	0.20	0.08	0.03	0.07	0.00	0.04	0.03	
	Total	34.65	5.15	2.45	3.31	1.68	1.04	2.45	
Comments			[For each row, the sum of the values in Columns M-Z must be greater than or equal			[See RR calc spreadsheet.]			

Net Treatment

Total Proposed Disturbed Area (ac)		Total Proposed Treated Area (ac)	Total Proposed Disturbed Area Excluded from WQ (ac)	Minimum Area to be Treated (ac)	-0.02
5.15		1.68	3.49	1.66	[Negative value indicates over-treatment, positive value indicates under-treatment.]

[If this value is within 0 to 1 acres of the Total

[Value must ≤ Total Proposed Treated Area.]

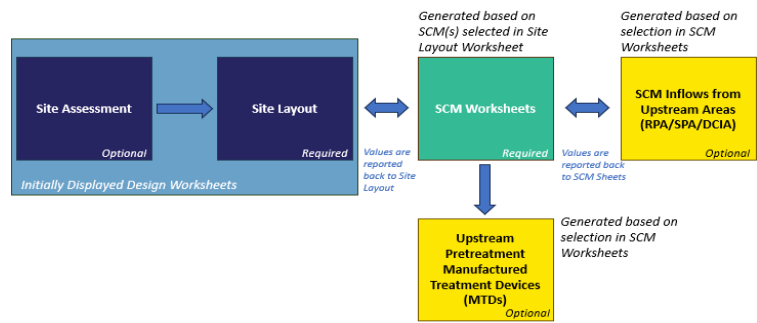


MILE HIGH FLOOD DISTRICT
STORMWATER CONTROL MEASURE (SCM) DESIGN WORKBOOK

SCM Design, Version 4.00 (April 2024)
 Mile High Flood District
 Denver, Colorado
 www.mhfd.org

- Purpose:** This workbook is used as a design aid in the preliminary stages of SCM design for a site and to demonstrate the achievement of design standards as dictated in MS4 permits.
- Function:** This workbook provides the designer with tools to incorporate MHFD Volume 3 Chapter 4 SCM criteria and sizing into the site assessment, site layout, and preliminary design; and to calculate the downstream benefits of runoff reduction on WQCV requirements.
- Compatibility:** This SCM Design workbook is intended to be compatible with MHFD-Detention, which allows the user to develop SCM basin geometries (depth, area, and volume), calculate orifice opening dimensions and other outlet structure components for the WQCV event and larger storms, and route storm hydrographs through SCMs. User input cells are provided in this workbook for areas, volumes, and outlet dimensions when incorporation of MHFD-Detention results is appropriate.

Content: The workbook consists of the following worksheets (see flow chart below which describes worksheet interaction):



- Site Assessment** The Site Assessment worksheet (optional) evaluates an entire site with respect to physical characteristics, opportunities for runoff reduction, and suitability for infiltration-based SCMs.
- Site Layout** The Site Layout worksheet (required) is the primary hub for evaluating a site and serves as the gateway to all other SCM worksheets listed below. The user can define multiple outfalls from the site and then evaluate different MS4 Standards and SCM Types for each outfall. When a user selects an SCM type, a new worksheet of that type will be created with the corresponding Outfall ID (*ID#*). Water quality results from the SCM worksheet will then be carried back to the Site Layout worksheet for that Outfall ID column. At the bottom of the Site Layout worksheet, all outfalls will be summed to provide water quality results for the entire site.
- SCM Worksheets** New SCM worksheets (*SCM ID#*), generated from the Site Layout worksheet, allow the user to develop a preliminary design in accordance with MHFD criteria provided in Chapter 4 of the USDCM. Two additional worksheets can be generated from within most SCM worksheets to design and account for runoff reduction through RPA treatment upstream of the SCM and/or a pretreatment Sedimentation MTD.
- Example Site** The Example Site worksheet includes a demonstration of how the Site Layout worksheet can be applied to a project site. The example includes 10 different outfalls with various paired SCM worksheets including RPA, Rooftop Systems, BR, SF, and EDB. The example further demonstrates how the RPA worksheet can be paired with an EDB worksheet to define upstream runoff reduction for inflows to the EDB.

Worksheet Naming Convention		SCM Worksheet Title	Fact Sheet
Upstream Treatment SCMs			
<i>SCM ID#</i> Inflows	SCM Inflows from Upstream Receiving Pervious Areas (RPA) Including Grass Buffers and Grass Swales		T-1
<i>SCM ID#</i> HDS Inflow#	Sedimentation Manufactured Treatment Device (Sedimentation MTD) - Hydrodynamic Separator (HDS)		T-8
SCMs			
<i>RPA ID#</i>	Receiving Pervious Areas (RPA) Including Grass Buffers and Grass Swales		T-1
<i>GreenRoof ID#</i>	Green Roof Systems (GreenRoof)		T-2
<i>BlueRoof ID#</i>	Blue Roof Systems (BlueRoof)		T-2
<i>BR ID#</i>	Bioretention Systems (BR)		T-3
<i>SF ID#</i>	Sand Filters (SF)		T-4
<i>PPS ID#</i>	Permeable Pavement Systems (PPS)		T-5
<i>EDB ID#</i>	Extended Detention Basins (EDB)		T-6
<i>RP ID#</i>	Retention Ponds (RP)		T-7
<i>CWP ID#</i>	Constructed Wetland Ponds (CWP)		T-7
<i>HRMF ID#</i>	Filtration Manufactured Treatment Device (Filtration MTD) - High Rate Media Filtration (HRMF)		T-8
<i>HRBF ID#</i>	Filtration Manufactured Treatment Device (Filtration MTD) - High Rate Biofiltration (HRBF)		T-8

Acknowledgements: Spreadsheet Development Team:
 Derek N. Rapp, P.E.
 Peak Stormwater Engineering, LLC

Candice Owen, P.E.
 Cerulean Consulting, LLC

Holly Piza, P.E. and Brik Zivkovich, P.E.
 Mile High Flood District

**Comments?
 Revisions?**

Direct all comments regarding this spreadsheet workbook to:
 Check for revised versions of this or any other workbook at:

[MHFD email](#)
[Downloads](#)

Site Layout

SCM Design, Version 4.00 (April 2024)

Designer: **Jessica Barr**

Company: **AECOM**

Date: **September 16, 2024**

Project: **Deer Creek Rd.**

Location: **Elpaso County, CO**

SITE LAYOUT INFO (User Input in Blue Cells)

Water Quality Event (WQE) inches

Outfall ID	DP3	DP1	DP2	DP17	DP7	DP4	DP15	DP5	DP9	DP14	DP10	DP11
Total Tributary Area (ft ²)	6,054	4,034	3,859	615	19,811	4,355	74	8,557	16,525	1,867	5,992	532
Imperviousness (%)	7.7%	7.7%	51.6%	58.9%	28.3%	12.6%	0.0%	38.3%	2.0%	54.4%	48.2%	53.5%
MS4 Design Standard	Runoff	Runoff	Runoff	Runoff	Runoff	Runoff	Runoff	Runoff	Runoff	Runoff	Runoff	Runoff
SCM Type	RPA	RPA	RPA	RPA	RPA	RPA	RPA	RPA	RPA	RPA	RPA	RPA

Notes:

OUTFALL RESULTS

SCM Worksheet Name	RPA_DP3	RPA_DP1	RPA_DP2	RPA_DP17	RPA_DP7	RPA_DP4	RPA_DP15	RPA_DP5	RPA_DP9	RPA_DP14	RPA_DP10	RPA_DP11
Untreated Area (ft ²)	0	0	0	0	5,795	549	0	2,781	7,628	627	0	0
Default WQCV (ft ³)	27	18	68	12	241	29	0	125	20	34	101	10
WQCV Reduction (ft ³)	27	89	62	15	175	0	0	28	13	16	60	11
Remaining WQCV (ft ³)	0	0	6	0	67	29	0	97	7	18	41	0
WQCV Reduction (%)	100%	100%	91%	100%	72%	0%	0%	22%	66%	48%	59%	100%
Design WQCV of SCM (ft ³)	0	0	0	0	0	0	0	0	0	0	0	0
Pollutant Removal (ft ³)	0	0	0	0	0	0	0	0	0	0	0	0
Untreated WQCV (ft ³)	0	0	6	0	67	29	0	97	7	18	41	0

TOTAL SITE RESULTS (Sums results from all Outfalls)

Total Site Area	73,063	ft ²	1.68	acres
Treated Area	55,683	ft ²	1.28	acres
Untreated Area	17,380	ft ²	0.40	acres
Total Site Imperviousness	24.3%	%		
Default WQCV	710	ft ³	0.016	acre-feet
Remaining WQCV	281	ft ³	0.006	acre-feet
WQCV Reduction	60%	%		
Design WQCV	0	ft ³	0.000	acre-feet
Untreated WQCV	281	ft ³	0.006	acre-feet

Site Layout

SCM Design, Version 4.00 (April :

Designer: Jessica Barr

Company: AECOM

Date: September 16, 2024

Project: Deer Creek Rd.

Location: Elpaso County, CA

SITE LAYOUT INFO

Water Quality Event (WQE)

Outfall ID	DP12	DP13	
Total Tributary Area (ft ²)	362	425	
Imperviousness (%)	81.3%	91.7%	
MS4 Design Standard	Runoff	Runoff	
SCM Type	RPA	RPA	

Notes:

OUTFALL RESULTS

SCM Worksheet Name	RPA_DP12	RPA_DP13	
Untreated Area (ft ³)	0	0	
Default WQCV (ft ³)	10	15	
WQCV Reduction (ft ³)	6	3	
Remaining WQCV (ft ³)	4	12	
WQCV Reduction (%)	58%	20%	
Design WQCV of SCM (ft ³)	0	0	
Pollutant Removal (ft ³)	0	0	
Untreated WQCV (ft ³)	4	12	

TOTAL SITE RESULTS

Total Site Area
 Treated Area
 Untreated Area
 Total Site Imperviousness
 Default WQCV
 Remaining WQCV
 WQCV Reduction
 Design WQCV
 Untreated WQCV

Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.00 (April 2024)

Designer: Jessica Barr
Company: AECOM
Date: September 16, 2024
Project: Deer Creek Rd.
Location: Elpaso County, CO
Outfall ID: DP3

DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	DP3	101-RPA	101-UIA	101-SPA					
Area Type	RPA	RPA_Buffer	UIA	SPA					
Downstream Design Point ID	--	DP3	101-RPA	DP3					
DCIA (ft ²)	--	--	--	--					
UIA (ft ²)	--	--	467	--					
RPA (ft ²)	--	882	--	--					
SPA (ft ²)	--	--	--	4,705					

2. Protect the RPA from Traffic

RPA Protection Type	--	Other	--	--					
---------------------	----	-------	----	----	--	--	--	--	--

3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	0.0%	--	--					
HSG B (%)	--	100.0%	--	--					
HSG C/D (%)	--	0.0%	--	--					

4. Select Appropriate Vegetation

RPA Vegetation Type	--	Seed	--	--					
Irrigation Type	--	Temporary	--	--					

Notes:

GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	Curbless	--	--					
Is Concrete Edger used?	--	NO	--	--					
Spacing between slots (ft)	--	--	--	--					
Slot Opening Length (in)	--	--	--	--					
Blind Swale Type	--	--	--	--					
Spreader Energy Dissipation	--	--	--	--					
Total Area of UIA:RPA (ft ²)	--	1,349	--	--					
UIA:RPA Ratio	--	0.5	--	--					
UIA:RPA Interface Width (ft)	--	100	--	--					
L / W Ratio of UIA:RPA	--	0.13	--	--					

2. Buffer Length

Average Buffer Length (ft)	--	9	--	--					
----------------------------	----	---	----	----	--	--	--	--	--

3. Buffer Slope

Average Buffer Slope (ft/ft)	--	0.250	--	--					
Effective Distance (ft)	--	17	--	--					
Number of Level Spreaders	--	1	--	--					

4. Provide a Vertical Drop

Vertical Drop (in)	--	0.00	--	--					
Mowing Strip Provided?	--	NO	--	--					

5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	34.6%	--	--					
UIA:RPA Runoff (in)	--	0.00	--	--					
UIA:RPA Runoff (ft ³)	--	0	--	--					

6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft ³)	--	19	--	--					
Runoff Reduction (ft ³)	--	19	--	--					
Runoff Reduction (%)	--	100.0%	--	--					

Notes:

GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Delineate Areas Tributary to Swale

Total Tributary Area (ft ²)	--	--	--	--						
Imperviousness (%)	--	--	--	--						

2. Swale Inflows

Concentrated Flow Type	--	--	--	--						
Blind Swale Type	--	--	--	--						
Spreader Energy Dissipation	--	--	--	--						
Vertical Drop (in)	--	--	--	--						
Gutter Depression (in)	--	--	--	--						
Curb Opening Length (ft)	--	--	--	--						
Concrete Sediment Pad	--	--	--	--						
Min. Forebay Volume (ft ³)	--	--	--	--						
Design Forebay Volume (ft ³)	--	--	--	--						
Max. Forebay Depth (in)	--	--	--	--						
Design Forebay Depth (in)	--	--	--	--						
Calculated Notch Width (in)	--	--	--	--						
Design Notch Width (in)	--	--	--	--						
Drain Time (minutes)	--	--	--	--						
Energy Dissipation Type	--	--	--	--						

3. Swale Cross Section

Length of Swale (ft)	--	--	--	--						
Bottom Width (ft)	--	--	--	--						
Bottom Area (ft ²)	--	--	--	--						
Side Slopes (horiz/vert)	--	--	--	--						

4. Longitudinal Slope

Available Slope (ft/ft)	--	--	--	--						
Design Slope (ft/ft)	--	--	--	--						
Total Drop Height (ft)	--	--	--	--						
Underdrains Provided?	--	--	--	--						

5. Calculate Runoff from Tributary Area

Tributary Runoff (ft ³)	--	--	--	--						
Reduced Trib. Runoff (ft ³)	--	--	--	--						

6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft ³)	--	--	--	--						
Swale Discharge (ft ³)	--	--	--	--						
Runoff Reduction (%)	--	--	--	--						

7. Design Discharge

2-year Discharge, Q2 (cfs)	--	--	--	--						
----------------------------	----	----	----	----	--	--	--	--	--	--

8. Design Velocity

Vegetal Retardance Curve	--	--	--	--						
Velocity, V2 (fps)	--	--	--	--						

9. Design Flow Depth

Flow Depth, D2 (ft)	--	--	--	--						
Flow Area, A (ft ²)	--	--	--	--						
Wetted Perimeter, P (ft)	--	--	--	--						
Top Width, T (ft)	--	--	--	--						
Hydraulic Radius, Rh (ft)	--	--	--	--						
VR Product (ft ² /sec)	--	--	--	--						
Manning's n value	--	--	--	--						
Hydraulic Depth, Dh (ft)	--	--	--	--						
Froude Number	--	--	--	--						

10. Swale Outflows

Outflows Considered?	--	--	--	--						
----------------------	----	----	----	----	--	--	--	--	--	--

Notes:

DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

Design Point ID	DP3	101-RPA	101-UIA	101-SPA						
Total Area (ft ²)	6,054	1,349	467	4,705						
Imperviousness (%)		34.6%	100.0%	0.0%						
Tributary Runoff (ft ³)	19	19	19	0						
Runoff Reduction (ft ³)	19	19	0	0						
Runoff Remaining (ft ³)	0	0	19	0						

Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.00 (April 2024)

Designer: Jessica Barr
Company: AECOM
Date: September 16, 2024
Project: Deer Creek Rd.
Location: Elpaso County, CO
Outfall ID: DP1

DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	DP1	403N-RPA	403N-UIA	403N-SPA					
Area Type	RPA	RPA_Buffer	UIA	SPA					
Downstream Design Point ID	--	DP1	403N-RPA	DP1					
DCIA (ft ²)	--	--	--	--					
UIA (ft ²)	--	--	2,136	--					
RPA (ft ²)	--	1,366	--	--					
SPA (ft ²)	--	--	--	531					

2. Protect the RPA from Traffic

RPA Protection Type	--	Other	--	--					
---------------------	----	-------	----	----	--	--	--	--	--

3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	0.0%	--	--					
HSG B (%)	--	100.0%	--	--					
HSG C/D (%)	--	0.0%	--	--					

4. Select Appropriate Vegetation

RPA Vegetation Type	--	Seed	--	--					
Irrigation Type	--	Temporary	--	--					

Notes:

GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	Curbless	--	--					
Is Concrete Edger used?	--	NO	--	--					
Spacing between slots (ft)	--	--	--	--					
Slot Opening Length (in)	--	--	--	--					
Blind Swale Type	--	--	--	--					
Spreader Energy Dissipation	--	--	--	--					
Total Area of UIA:RPA (ft ²)	--	3,502	--	--					
UIA:RPA Ratio	--	1.6	--	--					
UIA:RPA Interface Width (ft)	--	200	--	--					
L / W Ratio of UIA:RPA	--	0.09	--	--					

2. Buffer Length

Average Buffer Length (ft)	--	7	--	--					
----------------------------	----	---	----	----	--	--	--	--	--

3. Buffer Slope

Average Buffer Slope (ft/ft)	--	0.250	--	--					
Effective Distance (ft)	--	17	--	--					
Number of Level Spreaders	--	1	--	--					

4. Provide a Vertical Drop

Vertical Drop (in)	--	0.00	--	--					
Mowing Strip Provided?	--	NO	--	--					

5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	61.0%	--	--					
UIA:RPA Runoff (in)	--	0.00	--	--					
UIA:RPA Runoff (ft ³)	--	0	--	--					

6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft ³)	--	89	--	--					
Runoff Reduction (ft ³)	--	89	--	--					
Runoff Reduction (%)	--	100.0%	--	--					

Notes:

GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Delineate Areas Tributary to Swale

Total Tributary Area (ft ²)	--	--	--	--						
Imperviousness (%)	--	--	--	--						

2. Swale Inflows

Concentrated Flow Type	--	--	--	--						
Blind Swale Type	--	--	--	--						
Spreader Energy Dissipation	--	--	--	--						
Vertical Drop (in)	--	--	--	--						
Gutter Depression (in)	--	--	--	--						
Curb Opening Length (ft)	--	--	--	--						
Concrete Sediment Pad	--	--	--	--						
Min. Forebay Volume (ft ³)	--	--	--	--						
Design Forebay Volume (ft ³)	--	--	--	--						
Max. Forebay Depth (in)	--	--	--	--						
Design Forebay Depth (in)	--	--	--	--						
Calculated Notch Width (in)	--	--	--	--						
Design Notch Width (in)	--	--	--	--						
Drain Time (minutes)	--	--	--	--						
Energy Dissipation Type	--	--	--	--						

3. Swale Cross Section

Length of Swale (ft)	--	--	--	--						
Bottom Width (ft)	--	--	--	--						
Bottom Area (ft ²)	--	--	--	--						
Side Slopes (horiz/vert)	--	--	--	--						

4. Longitudinal Slope

Available Slope (ft/ft)	--	--	--	--						
Design Slope (ft/ft)	--	--	--	--						
Total Drop Height (ft)	--	--	--	--						
Underdrains Provided?	--	--	--	--						

5. Calculate Runoff from Tributary Area

Tributary Runoff (ft ³)	--	--	--	--						
Reduced Trib. Runoff (ft ³)	--	--	--	--						

6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft ³)	--	--	--	--						
Swale Discharge (ft ³)	--	--	--	--						
Runoff Reduction (%)	--	--	--	--						

7. Design Discharge

2-year Discharge, Q2 (cfs)	--	--	--	--						
----------------------------	----	----	----	----	--	--	--	--	--	--

8. Design Velocity

Vegetal Retardance Curve	--	--	--	--						
Velocity, V2 (fps)	--	--	--	--						

9. Design Flow Depth

Flow Depth, D2 (ft)	--	--	--	--						
Flow Area, A (ft ²)	--	--	--	--						
Wetted Perimeter, P (ft)	--	--	--	--						
Top Width, T (ft)	--	--	--	--						
Hydraulic Radius, Rh (ft)	--	--	--	--						
VR Product (ft ² /sec)	--	--	--	--						
Manning's n value	--	--	--	--						
Hydraulic Depth, Dh (ft)	--	--	--	--						
Froude Number	--	--	--	--						

10. Swale Outflows

Outflows Considered?	--	--	--	--						
----------------------	----	----	----	----	--	--	--	--	--	--

Notes:

DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

Design Point ID	DP1	403N-RPA	403N-UJA	403N-SPA						
Total Area (ft ²)	4,034	3,502	2,136	531						
Imperviousness (%)		61.0%	100.0%	0.0%						
Tributary Runoff (ft ³)	71	71	71	0						
Runoff Reduction (ft ³)	89	89	0	0						
Runoff Remaining (ft ³)	-18	-18	71	0						

Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.00 (April 2024)

Designer: Jessica Barr
Company: AECOM
Date: September 16, 2024
Project: Deer Creek Rd.
Location: Elpaso County, CO
Outfall ID: DP2

DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	DP2	403-RPA	403-UIA	403-SPA	405-RPA	405-UIA	405-SPA				
Area Type	RPA	RPA_Buffer	UIA	SPA	RPA_Buffer	UIA	SPA				
Downstream Design Point ID	--	DP2	403-RPA	DP2	DP2	405-RPA	DP2				
DCIA (ft ²)	--	--	--	--	--	--	--				
UIA (ft ²)	--	--	184	--	--	1,807	--				
RPA (ft ²)	--	450	--	--	643	--	--				
SPA (ft ²)	--	--	--	761	--	--	14				

2. Protect the RPA from Traffic

RPA Protection Type	--	Other	--	--	Other	--	--				
---------------------	----	-------	----	----	-------	----	----	--	--	--	--

3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	0.0%	--	--	0.0%	--	--				
HSG B (%)	--	100.0%	--	--	100.0%	--	--				
HSG C/D (%)	--	0.0%	--	--	0.0%	--	--				

4. Select Appropriate Vegetation

RPA Vegetation Type	--	Seed	--	--	Seed	--	--				
Irrigation Type	--	Temporary	--	--	Temporary	--	--				

Notes:

GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	Curbless	--	--	Curbless	--	--				
Is Concrete Edger used?	--	NO	--	--	NO	--	--				
Spacing between slots (ft)	--	--	--	--	--	--	--				
Slot Opening Length (in)	--	--	--	--	--	--	--				
Blind Swale Type	--	--	--	--	--	--	--				
Spreader Energy Dissipation	--	--	--	--	--	--	--				
Total Area of UIA:RPA (ft ²)	--	634	--	--	2,450	--	--				
UIA:RPA Ratio	--	0.4	--	--	2.8	--	--				
UIA:RPA Interface Width (ft)	--	67	--	--	150	--	--				
L / W Ratio of UIA:RPA	--	0.14	--	--	0.11	--	--				

2. Buffer Length

Average Buffer Length (ft)	--	7	--	--	4	--	--				
----------------------------	----	---	----	----	---	----	----	--	--	--	--

3. Buffer Slope

Average Buffer Slope (ft/ft)	--	0.250	--	--	0.250	--	--				
Effective Distance (ft)	--	17	--	--	17	--	--				
Number of Level Spreaders	--	1	--	--	1	--	--				

4. Provide a Vertical Drop

Vertical Drop (in)	--	0.00	--	--	0.00	--	--				
Mowing Strip Provided?	--	NO	--	--	NO	--	--				

5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	29.1%	--	--	73.7%	--	--				
UIA:RPA Runoff (in)	--	0.00	--	--	0.10	--	--				
UIA:RPA Runoff (ft ³)	--	0	--	--	21	--	--				

6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft ³)	--	8	--	--	75	--	--				
Runoff Reduction (ft ³)	--	8	--	--	54	--	--				
Runoff Reduction (%)	--	100.0%	--	--	72.1%	--	--				

Notes:

GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Delineate Areas Tributary to Swale

Total Tributary Area (ft ²)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Imperviousness (%)	--	--	--	--	--	--	--	--	--	--	--	--	--	--

2. Swale Inflows

Concentrated Flow Type	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Blind Swale Type	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Spreader Energy Dissipation	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Vertical Drop (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Gutter Depression (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Curb Opening Length (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Concrete Sediment Pad	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Min. Forebay Volume (ft ³)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Design Forebay Volume (ft ³)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Max. Forebay Depth (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Design Forebay Depth (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Calculated Notch Width (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Design Notch Width (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Drain Time (minutes)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Energy Dissipation Type	--	--	--	--	--	--	--	--	--	--	--	--	--	--

3. Swale Cross Section

Length of Swale (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bottom Width (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bottom Area (ft ²)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Side Slopes (horiz/vert)	--	--	--	--	--	--	--	--	--	--	--	--	--	--

4. Longitudinal Slope

Available Slope (ft/ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Design Slope (ft/ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Drop Height (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Underdrains Provided?	--	--	--	--	--	--	--	--	--	--	--	--	--	--

5. Calculate Runoff from Tributary Area

Tributary Runoff (ft ³)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Reduced Trib. Runoff (ft ³)	--	--	--	--	--	--	--	--	--	--	--	--	--	--

6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft ³)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Swale Discharge (ft ³)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Runoff Reduction (%)	--	--	--	--	--	--	--	--	--	--	--	--	--	--

7. Design Discharge

2-year Discharge, Q2 (cfs)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
----------------------------	----	----	----	----	----	----	----	----	----	----	----	----	----	----

8. Design Velocity

Vegetal Retardance Curve	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Velocity, V2 (fps)	--	--	--	--	--	--	--	--	--	--	--	--	--	--

9. Design Flow Depth

Flow Depth, D2 (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Flow Area, A (ft ²)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Wetted Perimeter, P (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Top Width, T (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hydraulic Radius, Rh (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
VR Product (ft ² /sec)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manning's n value	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hydraulic Depth, Dh (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Froude Number	--	--	--	--	--	--	--	--	--	--	--	--	--	--

10. Swale Outflows

Outflows Considered?	--	--	--	--	--	--	--	--	--	--	--	--	--	--
----------------------	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Notes:

DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

Design Point ID	DP2	403-RPA	403-UIA	403-SPA	405-RPA	405-UIA	405-SPA							
Total Area (ft ²)	3,859	634	184	761	2,450	1,807	14							
Imperviousness (%)	29.1%	100.0%	100.0%	0.0%	73.7%	100.0%	0.0%							
Tributary Runoff (ft ³)	66	6	6	0	60	60	0							
Runoff Reduction (ft ³)	62	8	0	0	54	0	0							
Runoff Remaining (ft ³)	4	-2	6	0	6	60	0							

Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.00 (April 2024)

Designer: Jessica Barr
Company: AECOM
Date: September 16, 2024
Project: Deer Creek Rd.
Location: Elpaso County, CO
Outfall ID: DP17

DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	DP17	407-RPA	407-UIA	407-SPA					
Area Type	RPA	RPA_Buffer	UIA	SPA					
Downstream Design Point ID	--	DP17	407-RPA	DP17					
DCIA (ft ²)	--	--	--	--					
UIA (ft ²)	--	--	362	--					
RPA (ft ²)	--	206	--	--					
SPA (ft ²)	--	--	--	47					

2. Protect the RPA from Traffic

RPA Protection Type	--	Other	--	--					
---------------------	----	-------	----	----	--	--	--	--	--

3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	0.0%	--	--					
HSG B (%)	--	100.0%	--	--					
HSG C/D (%)	--	0.0%	--	--					

4. Select Appropriate Vegetation

RPA Vegetation Type	--	Seed	--	--					
Irrigation Type	--	Temporary	--	--					

Notes:

GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	Curbless	--	--					
Is Concrete Edger used?	--	NO	--	--					
Spacing between slots (ft)	--	--	--	--					
Slot Opening Length (in)	--	--	--	--					
Blind Swale Type	--	--	--	--					
Spreader Energy Dissipation	--	--	--	--					
Total Area of UIA:RPA (ft ²)	--	568	--	--					
UIA:RPA Ratio	--	1.8	--	--					
UIA:RPA Interface Width (ft)	--	80	--	--					
L / W Ratio of UIA:RPA	--	0.09	--	--					

2. Buffer Length

Average Buffer Length (ft)	--	3	--	--					
----------------------------	----	---	----	----	--	--	--	--	--

3. Buffer Slope

Average Buffer Slope (ft/ft)	--	0.250	--	--					
Effective Distance (ft)	--	17	--	--					
Number of Level Spreaders	--	1	--	--					

4. Provide a Vertical Drop

Vertical Drop (in)	--	0.00	--	--					
Mowing Strip Provided?	--	NO	--	--					

5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	63.8%	--	--					
UIA:RPA Runoff (in)	--	0.00	--	--					
UIA:RPA Runoff (ft ³)	--	0	--	--					

6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft ³)	--	15	--	--					
Runoff Reduction (ft ³)	--	15	--	--					
Runoff Reduction (%)	--	100.0%	--	--					

Notes:

GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Delineate Areas Tributary to Swale

Total Tributary Area (ft ²)	--	--	--	--						
Imperviousness (%)	--	--	--	--						

2. Swale Inflows

Concentrated Flow Type	--	--	--	--						
Blind Swale Type	--	--	--	--						
Spreader Energy Dissipation	--	--	--	--						
Vertical Drop (in)	--	--	--	--						
Gutter Depression (in)	--	--	--	--						
Curb Opening Length (ft)	--	--	--	--						
Concrete Sediment Pad	--	--	--	--						
Min. Forebay Volume (ft ³)	--	--	--	--						
Design Forebay Volume (ft ³)	--	--	--	--						
Max. Forebay Depth (in)	--	--	--	--						
Design Forebay Depth (in)	--	--	--	--						
Calculated Notch Width (in)	--	--	--	--						
Design Notch Width (in)	--	--	--	--						
Drain Time (minutes)	--	--	--	--						
Energy Dissipation Type	--	--	--	--						

3. Swale Cross Section

Length of Swale (ft)	--	--	--	--						
Bottom Width (ft)	--	--	--	--						
Bottom Area (ft ²)	--	--	--	--						
Side Slopes (horiz/vert)	--	--	--	--						

4. Longitudinal Slope

Available Slope (ft/ft)	--	--	--	--						
Design Slope (ft/ft)	--	--	--	--						
Total Drop Height (ft)	--	--	--	--						
Underdrains Provided?	--	--	--	--						

5. Calculate Runoff from Tributary Area

Tributary Runoff (ft ³)	--	--	--	--						
Reduced Trib. Runoff (ft ³)	--	--	--	--						

6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft ³)	--	--	--	--						
Swale Discharge (ft ³)	--	--	--	--						
Runoff Reduction (%)	--	--	--	--						

7. Design Discharge

2-year Discharge, Q2 (cfs)	--	--	--	--						
----------------------------	----	----	----	----	--	--	--	--	--	--

8. Design Velocity

Vegetal Retardance Curve	--	--	--	--						
Velocity, V2 (fps)	--	--	--	--						

9. Design Flow Depth

Flow Depth, D2 (ft)	--	--	--	--						
Flow Area, A (ft ²)	--	--	--	--						
Wetted Perimeter, P (ft)	--	--	--	--						
Top Width, T (ft)	--	--	--	--						
Hydraulic Radius, Rh (ft)	--	--	--	--						
VR Product (ft ² /sec)	--	--	--	--						
Manning's n value	--	--	--	--						
Hydraulic Depth, Dh (ft)	--	--	--	--						
Froude Number	--	--	--	--						

10. Swale Outflows

Outflows Considered?	--	--	--	--						
----------------------	----	----	----	----	--	--	--	--	--	--

Notes:

DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

Design Point ID	DP17	407-RPA	407-UIA	407-SPA						
Total Area (ft ²)	615	568	362	47						
Imperviousness (%)		63.8%	100.0%	0.0%						
Tributary Runoff (ft ³)	12	12	12	0						
Runoff Reduction (ft ³)	15	15	0	0						
Runoff Remaining (ft ³)	-3	-3	12	0						

Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.00 (April 2024)

Designer: Jessica Barr
Company: AECOM
Date: September 16, 2024
Project: Deer Creek Rd.
Location: El Paso County, CO
Outfall ID: DP7

DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	DP7	408-RPA	408-UIA	408-SPA	410-RPA	410-UIA	410-SPA	410-DCIA	411-SPA	411-DCIA	
Area Type	RPA	RPA_Buffer	UIA	SPA	RPA_Buffer	UIA	SPA	DCIA	SPA	DCIA	
Downstream Design Point ID	--	DP7	408-RPA	DP7	DP7	410-RPA	DP7	DP7	DP7	DP7	
DCIA (ft ²)	--	--	--	--	--	--	--	1,037	--	4,758	
UIA (ft ²)	--	--	1,384	--	--	3,187	--	--	--	--	
RPA (ft ²)	--	495	--	--	5,009	--	--	--	--	--	
SPA (ft ²)	--	--	--	373	--	--	2,780	--	787	--	

2. Protect the RPA from Traffic

RPA Protection Type	--	Other	--	--	Other	--	--	--	--	--	
---------------------	----	-------	----	----	-------	----	----	----	----	----	--

3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	0.0%	--	--	0.0%	--	--	--	--	--	
HSG B (%)	--	100.0%	--	--	100.0%	--	--	--	--	--	
HSG C/D (%)	--	0.0%	--	--	0.0%	--	--	--	--	--	

4. Select Appropriate Vegetation

RPA Vegetation Type	--	Seed	--	--	Seed	--	--	--	--	--	
Irrigation Type	--	Temporary	--	--	Temporary	--	--	--	--	--	

Notes:

GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	Curbless	--	--	Curbless	--	--	--	--	--	
Is Concrete Edger used?	--	NO	--	--	NO	--	--	--	--	--	
Spacing between slots (ft)	--	--	--	--	--	--	--	--	--	--	
Slot Opening Length (in)	--	--	--	--	--	--	--	--	--	--	
Blind Swale Type	--	--	--	--	--	--	--	--	--	--	
Spreader Energy Dissipation	--	--	--	--	--	--	--	--	--	--	
Total Area of UIA:RPA (ft ²)	--	1,879	--	--	8,197	--	--	--	--	--	
UIA:RPA Ratio	--	2.8	--	--	0.6	--	--	--	--	--	
UIA:RPA Interface Width (ft)	--	115	--	--	220	--	--	--	--	--	
L / W Ratio of UIA:RPA	--	0.14	--	--	0.17	--	--	--	--	--	

2. Buffer Length

Average Buffer Length (ft)	--	4	--	--	23	--	--	--	--	--	
----------------------------	----	---	----	----	----	----	----	----	----	----	--

3. Buffer Slope

Average Buffer Slope (ft/ft)	--	0.250	--	--	0.250	--	--	--	--	--	
Effective Distance (ft)	--	17	--	--	17	--	--	--	--	--	
Number of Level Spreaders	--	1	--	--	2	--	--	--	--	--	

4. Provide a Vertical Drop

Vertical Drop (in)	--	0.00	--	--	0.00	--	--	--	--	--	
Mowing Strip Provided?	--	NO	--	--	NO	--	--	--	--	--	

5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	73.6%	--	--	38.9%	--	--	--	--	--	
UIA:RPA Runoff (in)	--	0.10	--	--	0.00	--	--	--	--	--	
UIA:RPA Runoff (ft ³)	--	16	--	--	0	--	--	--	--	--	

6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft ³)	--	58	--	--	133	--	--	--	--	--	
Runoff Reduction (ft ³)	--	42	--	--	133	--	--	--	--	--	
Runoff Reduction (%)	--	72.4%	--	--	100.0%	--	--	--	--	--	

Notes:

GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Delineate Areas Tributary to Swale

Total Tributary Area (ft ²)	--	--	--	--	--	--	--	--	--	--	--
Imperviousness (%)	--	--	--	--	--	--	--	--	--	--	--

2. Swale Inflows

Concentrated Flow Type	--	--	--	--	--	--	--	--	--	--	--
Blind Swale Type	--	--	--	--	--	--	--	--	--	--	--
Spreader Energy Dissipation	--	--	--	--	--	--	--	--	--	--	--
Vertical Drop (in)	--	--	--	--	--	--	--	--	--	--	--
Gutter Depression (in)	--	--	--	--	--	--	--	--	--	--	--
Curb Opening Length (ft)	--	--	--	--	--	--	--	--	--	--	--
Concrete Sediment Pad	--	--	--	--	--	--	--	--	--	--	--
Min. Forebay Volume (ft ³)	--	--	--	--	--	--	--	--	--	--	--
Design Forebay Volume (ft ³)	--	--	--	--	--	--	--	--	--	--	--
Max. Forebay Depth (in)	--	--	--	--	--	--	--	--	--	--	--
Design Forebay Depth (in)	--	--	--	--	--	--	--	--	--	--	--
Calculated Notch Width (in)	--	--	--	--	--	--	--	--	--	--	--
Design Notch Width (in)	--	--	--	--	--	--	--	--	--	--	--
Drain Time (minutes)	--	--	--	--	--	--	--	--	--	--	--
Energy Dissipation Type	--	--	--	--	--	--	--	--	--	--	--

3. Swale Cross Section

Length of Swale (ft)	--	--	--	--	--	--	--	--	--	--	--
Bottom Width (ft)	--	--	--	--	--	--	--	--	--	--	--
Bottom Area (ft ²)	--	--	--	--	--	--	--	--	--	--	--
Side Slopes (horiz/vert)	--	--	--	--	--	--	--	--	--	--	--

4. Longitudinal Slope

Available Slope (ft/ft)	--	--	--	--	--	--	--	--	--	--	--
Design Slope (ft/ft)	--	--	--	--	--	--	--	--	--	--	--
Total Drop Height (ft)	--	--	--	--	--	--	--	--	--	--	--
Underdrains Provided?	--	--	--	--	--	--	--	--	--	--	--

5. Calculate Runoff from Tributary Area

Tributary Runoff (ft ³)	--	--	--	--	--	--	--	--	--	--	--
Reduced Trib. Runoff (ft ³)	--	--	--	--	--	--	--	--	--	--	--

6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft ³)	--	--	--	--	--	--	--	--	--	--	--
Swale Discharge (ft ³)	--	--	--	--	--	--	--	--	--	--	--
Runoff Reduction (%)	--	--	--	--	--	--	--	--	--	--	--

7. Design Discharge

2-year Discharge, Q2 (cfs)	--	--	--	--	--	--	--	--	--	--	--
----------------------------	----	----	----	----	----	----	----	----	----	----	----

8. Design Velocity

Vegetal Retardance Curve	--	--	--	--	--	--	--	--	--	--	--
Velocity, V2 (fps)	--	--	--	--	--	--	--	--	--	--	--

9. Design Flow Depth

Flow Depth, D2 (ft)	--	--	--	--	--	--	--	--	--	--	--
Flow Area, A (ft ²)	--	--	--	--	--	--	--	--	--	--	--
Wetted Perimeter, P (ft)	--	--	--	--	--	--	--	--	--	--	--
Top Width, T (ft)	--	--	--	--	--	--	--	--	--	--	--
Hydraulic Radius, Rh (ft)	--	--	--	--	--	--	--	--	--	--	--
VR Product (ft ² /sec)	--	--	--	--	--	--	--	--	--	--	--
Manning's n value	--	--	--	--	--	--	--	--	--	--	--
Hydraulic Depth, Dh (ft)	--	--	--	--	--	--	--	--	--	--	--
Froude Number	--	--	--	--	--	--	--	--	--	--	--

10. Swale Outflows

Outflows Considered?	--	--	--	--	--	--	--	--	--	--	--
----------------------	----	----	----	----	----	----	----	----	----	----	----

Notes:

DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

Design Point ID	DP7	408-RPA	408-UIA	408-SPA	410-RPA	410-UIA	410-SPA	410-DCIA	411-SPA	411-DCIA
Total Area (ft ²)	19,811	1,879	1,384	373	8,197	3,187	2,780	1,037	787	4,758
Imperviousness (%)	73.6%	100.0%	100.0%	0.0%	38.9%	100.0%	0.0%	100.0%	0.0%	100.0%
Tributary Runoff (ft ³)	432	58	58	0	133	133	0	43	0	198
Runoff Reduction (ft ³)	175	42	0	0	133	0	0	0	0	0
Runoff Remaining (ft ³)	257	16	58	0	0	133	0	43	0	198

Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.00 (April 2024)

Designer: Jessica Barr
Company: AECOM
Date: September 16, 2024
Project: Deer Creek Rd.
Location: Elpaso County, CO
Outfall ID: DP4

DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	DP4	200-SPA	200-DCIA	413-SPA	413-DCIA	201-SPA	202-SPA	202-DCIA	415-SPA	415-DCIA	
Area Type	RPA	SPA	DCIA	SPA	DCIA	SPA	SPA	DCIA	SPA	DCIA	
Downstream Design Point ID	--	DP4	DP4	DP4	DP4	DP4	DP4	DP4	DP4	DP4	
DCIA (ft ²)	--	--	392	--	77	--	--	72	--	9	
UIA (ft ²)	--	--	--	--	--	--	--	--	--	--	
RPA (ft ²)	--	--	--	--	--	--	--	--	--	--	
SPA (ft ²)	--	1,918	--	59	--	943	870	--	16	--	

2. Protect the RPA from Traffic

RPA Protection Type	--	--	--	--	--	--	--	--	--	--	
---------------------	----	----	----	----	----	----	----	----	----	----	--

3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	--	--	--	--	--	--	--	--	--	
HSG B (%)	--	--	--	--	--	--	--	--	--	--	
HSG C/D (%)	--	--	--	--	--	--	--	--	--	--	

4. Select Appropriate Vegetation

RPA Vegetation Type	--	--	--	--	--	--	--	--	--	--	
Irrigation Type	--	--	--	--	--	--	--	--	--	--	

Notes:

GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	--	--	--	--	--	--	--	--	--	
Is Concrete Edger used?	--	--	--	--	--	--	--	--	--	--	
Spacing between slots (ft)	--	--	--	--	--	--	--	--	--	--	
Slot Opening Length (in)	--	--	--	--	--	--	--	--	--	--	
Blind Swale Type	--	--	--	--	--	--	--	--	--	--	
Spreader Energy Dissipation	--	--	--	--	--	--	--	--	--	--	
Total Area of UIA:RPA (ft ²)	--	--	--	--	--	--	--	--	--	--	
UIA:RPA Ratio	--	--	--	--	--	--	--	--	--	--	
UIA:RPA Interface Width (ft)	--	--	--	--	--	--	--	--	--	--	
L / W Ratio of UIA:RPA	--	--	--	--	--	--	--	--	--	--	

2. Buffer Length

Average Buffer Length (ft)	--	--	--	--	--	--	--	--	--	--	
----------------------------	----	----	----	----	----	----	----	----	----	----	--

3. Buffer Slope

Average Buffer Slope (ft/ft)	--	--	--	--	--	--	--	--	--	--	
Effective Distance (ft)	--	--	--	--	--	--	--	--	--	--	
Number of Level Spreaders	--	--	--	--	--	--	--	--	--	--	

4. Provide a Vertical Drop

Vertical Drop (in)	--	--	--	--	--	--	--	--	--	--	
Mowing Strip Provided?	--	--	--	--	--	--	--	--	--	--	

5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	--	--	--	--	--	--	--	--	--	
UIA:RPA Runoff (in)	--	--	--	--	--	--	--	--	--	--	
UIA:RPA Runoff (ft ³)	--	--	--	--	--	--	--	--	--	--	

6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft ³)	--	--	--	--	--	--	--	--	--	--	
Runoff Reduction (ft ³)	--	--	--	--	--	--	--	--	--	--	
Runoff Reduction (%)	--	--	--	--	--	--	--	--	--	--	

Notes:

GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Delineate Areas Tributary to Swale

Total Tributary Area (ft ²)	--	--	--	--	--	--	--	--	--	--	--
Imperviousness (%)	--	--	--	--	--	--	--	--	--	--	--

2. Swale Inflows

Concentrated Flow Type	--	--	--	--	--	--	--	--	--	--	--
Blind Swale Type	--	--	--	--	--	--	--	--	--	--	--
Spreader Energy Dissipation	--	--	--	--	--	--	--	--	--	--	--
Vertical Drop (in)	--	--	--	--	--	--	--	--	--	--	--
Gutter Depression (in)	--	--	--	--	--	--	--	--	--	--	--
Curb Opening Length (ft)	--	--	--	--	--	--	--	--	--	--	--
Concrete Sediment Pad	--	--	--	--	--	--	--	--	--	--	--
Min. Forebay Volume (ft ³)	--	--	--	--	--	--	--	--	--	--	--
Design Forebay Volume (ft ³)	--	--	--	--	--	--	--	--	--	--	--
Max. Forebay Depth (in)	--	--	--	--	--	--	--	--	--	--	--
Design Forebay Depth (in)	--	--	--	--	--	--	--	--	--	--	--
Calculated Notch Width (in)	--	--	--	--	--	--	--	--	--	--	--
Design Notch Width (in)	--	--	--	--	--	--	--	--	--	--	--
Drain Time (minutes)	--	--	--	--	--	--	--	--	--	--	--
Energy Dissipation Type	--	--	--	--	--	--	--	--	--	--	--

3. Swale Cross Section

Length of Swale (ft)	--	--	--	--	--	--	--	--	--	--	--
Bottom Width (ft)	--	--	--	--	--	--	--	--	--	--	--
Bottom Area (ft ²)	--	--	--	--	--	--	--	--	--	--	--
Side Slopes (horiz/vert)	--	--	--	--	--	--	--	--	--	--	--

4. Longitudinal Slope

Available Slope (ft/ft)	--	--	--	--	--	--	--	--	--	--	--
Design Slope (ft/ft)	--	--	--	--	--	--	--	--	--	--	--
Total Drop Height (ft)	--	--	--	--	--	--	--	--	--	--	--
Underdrains Provided?	--	--	--	--	--	--	--	--	--	--	--

5. Calculate Runoff from Tributary Area

Tributary Runoff (ft ³)	--	--	--	--	--	--	--	--	--	--	--
Reduced Trib. Runoff (ft ³)	--	--	--	--	--	--	--	--	--	--	--

6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft ³)	--	--	--	--	--	--	--	--	--	--	--
Swale Discharge (ft ³)	--	--	--	--	--	--	--	--	--	--	--
Runoff Reduction (%)	--	--	--	--	--	--	--	--	--	--	--

7. Design Discharge

2-year Discharge, Q ₂ (cfs)	--	--	--	--	--	--	--	--	--	--	--
--	----	----	----	----	----	----	----	----	----	----	----

8. Design Velocity

Vegetal Retardance Curve	--	--	--	--	--	--	--	--	--	--	--
Velocity, V ₂ (fps)	--	--	--	--	--	--	--	--	--	--	--

9. Design Flow Depth

Flow Depth, D ₂ (ft)	--	--	--	--	--	--	--	--	--	--	--
Flow Area, A (ft ²)	--	--	--	--	--	--	--	--	--	--	--
Wetted Perimeter, P (ft)	--	--	--	--	--	--	--	--	--	--	--
Top Width, T (ft)	--	--	--	--	--	--	--	--	--	--	--
Hydraulic Radius, R _h (ft)	--	--	--	--	--	--	--	--	--	--	--
VR Product (ft ² /sec)	--	--	--	--	--	--	--	--	--	--	--
Manning's n value	--	--	--	--	--	--	--	--	--	--	--
Hydraulic Depth, D _h (ft)	--	--	--	--	--	--	--	--	--	--	--
Froude Number	--	--	--	--	--	--	--	--	--	--	--

10. Swale Outflows

Outflows Considered?	--	--	--	--	--	--	--	--	--	--	--
----------------------	----	----	----	----	----	----	----	----	----	----	----

Notes:

DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

Design Point ID	DP4	200-SPA	200-DCIA	413-SPA	413-DCIA	201-SPA	202-SPA	202-DCIA	415-SPA	415-DCIA
Total Area (ft ²)	4,355	1,918	392	59	77	943	870	72	16	9
Imperviousness (%)	0.0%	0.0%	100.0%	0.0%	100.0%	0.0%	0.0%	100.0%	0.0%	100.0%
Tributary Runoff (ft ³)	18	0	13	0	3	0	0	2	0	0
Runoff Reduction (ft ³)	0	0	0	0	0	0	0	0	0	0
Runoff Remaining (ft ³)	18	0	13	0	3	0	0	2	0	0

Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.00 (April 2024)

Designer: Jessica Barr
Company: AECOM
Date: September 16, 2024
Project: Deer Creek Rd.
Location: Elpaso County, CO
Outfall ID: DP15

DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	DP15	416-SPA								
Area Type	RPA	SPA								
Downstream Design Point ID	--	DP15								
DCIA (ft ²)	--	--								
UIA (ft ²)	--	--								
RPA (ft ²)	--	--								
SPA (ft ²)	--	74								

2. Protect the RPA from Traffic

RPA Protection Type	--	--								
---------------------	----	----	--	--	--	--	--	--	--	--

3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	--								
HSG B (%)	--	--								
HSG C/D (%)	--	--								

4. Select Appropriate Vegetation

RPA Vegetation Type	--	--								
Irrigation Type	--	--								

Notes:

GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	--								
Is Concrete Edger used?	--	--								
Spacing between slots (ft)	--	--								
Slot Opening Length (in)	--	--								
Blind Swale Type	--	--								
Spreader Energy Dissipation	--	--								
Total Area of UIA:RPA (ft ²)	--	--								
UIA:RPA Ratio	--	--								
UIA:RPA Interface Width (ft)	--	--								
L / W Ratio of UIA:RPA	--	--								

2. Buffer Length

Average Buffer Length (ft)	--	--								
----------------------------	----	----	--	--	--	--	--	--	--	--

3. Buffer Slope

Average Buffer Slope (ft/ft)	--	--								
Effective Distance (ft)	--	--								
Number of Level Spreaders	--	--								

4. Provide a Vertical Drop

Vertical Drop (in)	--	--								
Mowing Strip Provided?	--	--								

5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	--								
UIA:RPA Runoff (in)	--	--								
UIA:RPA Runoff (ft ³)	--	--								

6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft ³)	--	--								
Runoff Reduction (ft ³)	--	--								
Runoff Reduction (%)	--	--								

Notes:

GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Delineate Areas Tributary to Swale

Total Tributary Area (ft ²)	--	--								
Imperviousness (%)	--	--								

2. Swale Inflows

Concentrated Flow Type	--	--								
Blind Swale Type	--	--								
Spreader Energy Dissipation	--	--								
Vertical Drop (in)	--	--								
Gutter Depression (in)	--	--								
Curb Opening Length (ft)	--	--								
Concrete Sediment Pad	--	--								
Min. Forebay Volume (ft ³)	--	--								
Design Forebay Volume (ft ³)	--	--								
Max. Forebay Depth (in)	--	--								
Design Forebay Depth (in)	--	--								
Calculated Notch Width (in)	--	--								
Design Notch Width (in)	--	--								
Drain Time (minutes)	--	--								
Energy Dissipation Type	--	--								

3. Swale Cross Section

Length of Swale (ft)	--	--								
Bottom Width (ft)	--	--								
Bottom Area (ft ²)	--	--								
Side Slopes (horiz/vert)	--	--								

4. Longitudinal Slope

Available Slope (ft/ft)	--	--								
Design Slope (ft/ft)	--	--								
Total Drop Height (ft)	--	--								
Underdrains Provided?	--	--								

5. Calculate Runoff from Tributary Area

Tributary Runoff (ft ³)	--	--								
Reduced Trib. Runoff (ft ³)	--	--								

6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft ³)	--	--								
Swale Discharge (ft ³)	--	--								
Runoff Reduction (%)	--	--								

7. Design Discharge

2-year Discharge, Q ₂ (cfs)	--	--								
--	----	----	--	--	--	--	--	--	--	--

8. Design Velocity

Vegetal Retardance Curve	--	--								
Velocity, V ₂ (fps)	--	--								

9. Design Flow Depth

Flow Depth, D ₂ (ft)	--	--								
Flow Area, A (ft ²)	--	--								
Wetted Perimeter, P (ft)	--	--								
Top Width, T (ft)	--	--								
Hydraulic Radius, R _h (ft)	--	--								
VR Product (ft ² /sec)	--	--								
Manning's n value	--	--								
Hydraulic Depth, D _h (ft)	--	--								
Froude Number	--	--								

10. Swale Outflows

Outflows Considered?	--	--								
----------------------	----	----	--	--	--	--	--	--	--	--

Notes:

DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

Design Point ID	DP15	416-SPA								
Total Area (ft ²)	74	74								
Imperviousness (%)		0.0%								
Tributary Runoff (ft ³)	0	0								
Runoff Reduction (ft ³)	0	0								
Runoff Remaining (ft ³)	0	0								

Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.00 (April 2024)

Designer: Jessica Barr
Company: AECOM
Date: September 16, 2024
Project: Deer Creek Rd.
Location: Elpaso County, CO
Outfall ID: DP5

DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	DP5	414-RPA	414-UIA	414-DCIA	414-SPA	417-SPA	417-DCIA				
Area Type	RPA	RPA_Buffer	UIA	DCIA	SPA	SPA	DCIA				
Downstream Design Point ID	--	DP5	414-RPA	DP5	DP5	DP5	DP5				
DCIA (ft ²)	--	--	--	172	--	--	2,609				
UIA (ft ²)	--	--	672	--	--	--	--				
RPA (ft ²)	--	672	--	--	--	--	--				
SPA (ft ²)	--	--	--	--	1,800	2,632	--				

2. Protect the RPA from Traffic

RPA Protection Type	--	Other	--	--	--	--	--				
---------------------	----	-------	----	----	----	----	----	--	--	--	--

3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	0.0%	--	--	--	--	--				
HSG B (%)	--	100.0%	--	--	--	--	--				
HSG C/D (%)	--	0.0%	--	--	--	--	--				

4. Select Appropriate Vegetation

RPA Vegetation Type	--	Seed	--	--	--	--	--				
Irrigation Type	--	Temporary	--	--	--	--	--				

Notes:

GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	Curbless	--	--	--	--	--				
Is Concrete Edger used?	--	NO	--	--	--	--	--				
Spacing between slots (ft)	--	--	--	--	--	--	--				
Slot Opening Length (in)	--	--	--	--	--	--	--				
Blind Swale Type	--	--	--	--	--	--	--				
Spreader Energy Dissipation	--	--	--	--	--	--	--				
Total Area of UIA:RPA (ft ²)	--	1,344	--	--	--	--	--				
UIA:RPA Ratio	--	1.0	--	--	--	--	--				
UIA:RPA Interface Width (ft)	--	116	--	--	--	--	--				
L / W Ratio of UIA:RPA	--	0.10	--	--	--	--	--				

2. Buffer Length

Average Buffer Length (ft)	--	6	--	--	--	--	--				
----------------------------	----	---	----	----	----	----	----	--	--	--	--

3. Buffer Slope

Average Buffer Slope (ft/ft)	--	0.250	--	--	--	--	--				
Effective Distance (ft)	--	17	--	--	--	--	--				
Number of Level Spreaders	--	1	--	--	--	--	--				

4. Provide a Vertical Drop

Vertical Drop (in)	--	0.00	--	--	--	--	--				
Mowing Strip Provided?	--	NO	--	--	--	--	--				

5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	50.0%	--	--	--	--	--				
UIA:RPA Runoff (in)	--	0.00	--	--	--	--	--				
UIA:RPA Runoff (ft ³)	--	0	--	--	--	--	--				

6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft ³)	--	28	--	--	--	--	--				
Runoff Reduction (ft ³)	--	28	--	--	--	--	--				
Runoff Reduction (%)	--	100.0%	--	--	--	--	--				

Notes:

GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Delineate Areas Tributary to Swale

Total Tributary Area (ft ²)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Imperviousness (%)	--	--	--	--	--	--	--	--	--	--	--	--	--	--

2. Swale Inflows

Concentrated Flow Type	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Blind Swale Type	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Spreader Energy Dissipation	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Vertical Drop (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Gutter Depression (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Curb Opening Length (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Concrete Sediment Pad	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Min. Forebay Volume (ft ³)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Design Forebay Volume (ft ³)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Max. Forebay Depth (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Design Forebay Depth (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Calculated Notch Width (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Design Notch Width (in)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Drain Time (minutes)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Energy Dissipation Type	--	--	--	--	--	--	--	--	--	--	--	--	--	--

3. Swale Cross Section

Length of Swale (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bottom Width (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Bottom Area (ft ²)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Side Slopes (horiz/vert)	--	--	--	--	--	--	--	--	--	--	--	--	--	--

4. Longitudinal Slope

Available Slope (ft/ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Design Slope (ft/ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Drop Height (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Underdrains Provided?	--	--	--	--	--	--	--	--	--	--	--	--	--	--

5. Calculate Runoff from Tributary Area

Tributary Runoff (ft ³)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Reduced Trib. Runoff (ft ³)	--	--	--	--	--	--	--	--	--	--	--	--	--	--

6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft ³)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Swale Discharge (ft ³)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Runoff Reduction (%)	--	--	--	--	--	--	--	--	--	--	--	--	--	--

7. Design Discharge

2-year Discharge, Q2 (cfs)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
----------------------------	----	----	----	----	----	----	----	----	----	----	----	----	----	----

8. Design Velocity

Vegetal Retardance Curve	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Velocity, V2 (fps)	--	--	--	--	--	--	--	--	--	--	--	--	--	--

9. Design Flow Depth

Flow Depth, D2 (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Flow Area, A (ft ²)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Wetted Perimeter, P (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Top Width, T (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hydraulic Radius, Rh (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
VR Product (ft ² /sec)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Manning's n value	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Hydraulic Depth, Dh (ft)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Froude Number	--	--	--	--	--	--	--	--	--	--	--	--	--	--

10. Swale Outflows

Outflows Considered?	--	--	--	--	--	--	--	--	--	--	--	--	--	--
----------------------	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Notes:

DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

Design Point ID	DP5	414-RPA	414-UIA	414-DCIA	414-SPA	417-SPA	417-DCIA							
Total Area (ft ²)	8,557	1,344	672	172	1,800	2,632	2,609							
Imperviousness (%)		50.0%	100.0%	100.0%	0.0%	0.0%	100.0%							
Tributary Runoff (ft ³)	115	22	22	6	0	0	87							
Runoff Reduction (ft ³)	28	28	0	0	0	0	0							
Runoff Remaining (ft ³)	87	-6	22	6	0	0	87							

Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.00 (April 2024)

Designer: Jessica Barr
Company: AECOM
Date: September 16, 2024
Project: Deer Creek Rd.
Location: Elpaso County, CO
Outfall ID: DP9

DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	DP9	418-SPA	418-DCIA	420-RPA	420-UIA	420-SPA	420-DCIA				
Area Type	RPA	SPA	DCIA	RPA_Buffer	UIA	SPA	DCIA				
Downstream Design Point ID	--	DP9	DP9	DP9	420-RPA	DP9	DP9				
DCIA (ft ²)	--	--	6,013	--	--	--	1,615				
UIA (ft ²)	--	--	--	--	324	--	--				
RPA (ft ²)	--	--	--	392	--	--	--				
SPA (ft ²)	--	1,575	--	--	--	6,606	--				

2. Protect the RPA from Traffic

RPA Protection Type	--	--	--	Other	--	--	--				
---------------------	----	----	----	-------	----	----	----	--	--	--	--

3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	--	--	0.0%	--	--	--				
HSG B (%)	--	--	--	100.0%	--	--	--				
HSG C/D (%)	--	--	--	0.0%	--	--	--				

4. Select Appropriate Vegetation

RPA Vegetation Type	--	--	--	Seed	--	--	--				
Irrigation Type	--	--	--	Temporary	--	--	--				

Notes:

GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	--	--	Curbless	--	--	--				
Is Concrete Edger used?	--	--	--	NO	--	--	--				
Spacing between slots (ft)	--	--	--	--	--	--	--				
Slot Opening Length (in)	--	--	--	--	--	--	--				
Blind Swale Type	--	--	--	--	--	--	--				
Spreader Energy Dissipation	--	--	--	--	--	--	--				
Total Area of UIA:RPA (ft ²)	--	--	--	716	--	--	--				
UIA:RPA Ratio	--	--	--	0.8	--	--	--				
UIA:RPA Interface Width (ft)	--	--	--	30	--	--	--				
L / W Ratio of UIA:RPA	--	--	--	0.80	--	--	--				

2. Buffer Length

Average Buffer Length (ft)	--	--	--	13	--	--	--				
----------------------------	----	----	----	----	----	----	----	--	--	--	--

3. Buffer Slope

Average Buffer Slope (ft/ft)	--	--	--	0.250	--	--	--				
Effective Distance (ft)	--	--	--	17	--	--	--				
Number of Level Spreaders	--	--	--	1	--	--	--				

4. Provide a Vertical Drop

Vertical Drop (in)	--	--	--	0.00	--	--	--				
Mowing Strip Provided?	--	--	--	NO	--	--	--				

5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	--	--	45.2%	--	--	--				
UIA:RPA Runoff (in)	--	--	--	0.00	--	--	--				
UIA:RPA Runoff (ft ³)	--	--	--	0	--	--	--				

6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft ³)	--	--	--	13	--	--	--				
Runoff Reduction (ft ³)	--	--	--	13	--	--	--				
Runoff Reduction (%)	--	--	--	100.0%	--	--	--				

Notes:

Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.00 (April 2024)

Designer: Jessica Barr
Company: AECOM
Date: September 16, 2024
Project: Deer Creek Rd.
Location: Elpaso County, CO
Outfall ID: DP14

DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	DP14	425-RPA	425-UIA	425-DCIA						
Area Type	RPA	RPA_Buffer	UIA	DCIA						
Downstream Design Point ID	--	DP14	425-RPA	DP14						
DCIA (ft ²)	--	--	--	627						
UIA (ft ²)	--	--	388	--						
RPA (ft ²)	--	852	--	--						
SPA (ft ²)	--	--	--	--						

2. Protect the RPA from Traffic

RPA Protection Type	--	Other	--	--						
---------------------	----	-------	----	----	--	--	--	--	--	--

3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	0.0%	--	--						
HSG B (%)	--	100.0%	--	--						
HSG C/D (%)	--	0.0%	--	--						

4. Select Appropriate Vegetation

RPA Vegetation Type	--	Seed	--	--						
Irrigation Type	--	Temporary	--	--						

Notes:

GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	Curbless	--	--						
Is Concrete Edger used?	--	NO	--	--						
Spacing between slots (ft)	--	--	--	--						
Slot Opening Length (in)	--	--	--	--						
Blind Swale Type	--	--	--	--						
Spreader Energy Dissipation	--	--	--	--						
Total Area of UIA:RPA (ft ²)	--	1,240	--	--						
UIA:RPA Ratio	--	0.5	--	--						
UIA:RPA Interface Width (ft)	--	54	--	--						
L / W Ratio of UIA:RPA	--	0.43	--	--						

2. Buffer Length

Average Buffer Length (ft)	--	16	--	--						
----------------------------	----	----	----	----	--	--	--	--	--	--

3. Buffer Slope

Average Buffer Slope (ft/ft)	--	0.250	--	--						
Effective Distance (ft)	--	17	--	--						
Number of Level Spreaders	--	1	--	--						

4. Provide a Vertical Drop

Vertical Drop (in)	--	0.00	--	--						
Mowing Strip Provided?	--	NO	--	--						

5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	31.3%	--	--						
UIA:RPA Runoff (in)	--	0.00	--	--						
UIA:RPA Runoff (ft ³)	--	0	--	--						

6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft ³)	--	16	--	--						
Runoff Reduction (ft ³)	--	16	--	--						
Runoff Reduction (%)	--	100.0%	--	--						

Notes:

GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Delineate Areas Tributary to Swale

Total Tributary Area (ft ²)	--	--	--	--						
Imperviousness (%)	--	--	--	--						

2. Swale Inflows

Concentrated Flow Type	--	--	--	--						
Blind Swale Type	--	--	--	--						
Spreader Energy Dissipation	--	--	--	--						
Vertical Drop (in)	--	--	--	--						
Gutter Depression (in)	--	--	--	--						
Curb Opening Length (ft)	--	--	--	--						
Concrete Sediment Pad	--	--	--	--						
Min. Forebay Volume (ft ³)	--	--	--	--						
Design Forebay Volume (ft ³)	--	--	--	--						
Max. Forebay Depth (in)	--	--	--	--						
Design Forebay Depth (in)	--	--	--	--						
Calculated Notch Width (in)	--	--	--	--						
Design Notch Width (in)	--	--	--	--						
Drain Time (minutes)	--	--	--	--						
Energy Dissipation Type	--	--	--	--						

3. Swale Cross Section

Length of Swale (ft)	--	--	--	--						
Bottom Width (ft)	--	--	--	--						
Bottom Area (ft ²)	--	--	--	--						
Side Slopes (horiz/vert)	--	--	--	--						

4. Longitudinal Slope

Available Slope (ft/ft)	--	--	--	--						
Design Slope (ft/ft)	--	--	--	--						
Total Drop Height (ft)	--	--	--	--						
Underdrains Provided?	--	--	--	--						

5. Calculate Runoff from Tributary Area

Tributary Runoff (ft ³)	--	--	--	--						
Reduced Trib. Runoff (ft ³)	--	--	--	--						

6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft ³)	--	--	--	--						
Swale Discharge (ft ³)	--	--	--	--						
Runoff Reduction (%)	--	--	--	--						

7. Design Discharge

2-year Discharge, Q2 (cfs)	--	--	--	--						
----------------------------	----	----	----	----	--	--	--	--	--	--

8. Design Velocity

Vegetal Retardance Curve	--	--	--	--						
Velocity, V2 (fps)	--	--	--	--						

9. Design Flow Depth

Flow Depth, D2 (ft)	--	--	--	--						
Flow Area, A (ft ²)	--	--	--	--						
Wetted Perimeter, P (ft)	--	--	--	--						
Top Width, T (ft)	--	--	--	--						
Hydraulic Radius, Rh (ft)	--	--	--	--						
VR Product (ft ² /sec)	--	--	--	--						
Manning's n value	--	--	--	--						
Hydraulic Depth, Dh (ft)	--	--	--	--						
Froude Number	--	--	--	--						

10. Swale Outflows

Outflows Considered?	--	--	--	--						
----------------------	----	----	----	----	--	--	--	--	--	--

Notes:

DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

Design Point ID	DP14	425-RPA	425-UIA	425-DCIA						
Total Area (ft ²)	1,867	1,240	388	627						
Imperviousness (%)		31.3%	100.0%	100.0%						
Tributary Runoff (ft ³)	42	16	16	26						
Runoff Reduction (ft ³)	16	16	0	0						
Runoff Remaining (ft ³)	26	0	16	26						

Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.00 (April 2024)

Designer: Jessica Barr
Company: AECOM
Date: September 16, 2024
Project: Deer Creek Rd.
Location: Elpaso County, CO
Outfall ID: DP10

DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	DP10	421-RPA	421-Ditch	421-UIA	421-UIA2	419-UIA	421-SPA	419-SPA		
Area Type	RPA	RPA_Buffer	RPA_Swale	UIA	UIA	UIA	SPA	SPA		
Downstream Design Point ID	--	DP10	DP10	421-RPA	421-Ditch	421-Ditch	DP10	DP10		
DCIA (ft ²)	--	--	--	--	--	--	--	--		
UIA (ft ²)	--	--	--	228	1,663	999	--	--		
RPA (ft ²)	--	280	503	--	--	--	--	--		
SPA (ft ²)	--	--	--	--	--	--	1,134	1,184		

2. Protect the RPA from Traffic

RPA Protection Type	--	Other	Other	--	--	--	--	--		
---------------------	----	-------	-------	----	----	----	----	----	--	--

3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	0.0%	0.0%	--	--	--	--	--		
HSG B (%)	--	100.0%	100.0%	--	--	--	--	--		
HSG C/D (%)	--	0.0%	0.0%	--	--	--	--	--		

4. Select Appropriate Vegetation

RPA Vegetation Type	--	Seed	Seed	--	--	--	--	--		
Irrigation Type	--	Temporary	Temporary	--	--	--	--	--		

Notes:

GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	Curbless	--	--	--	--	--	--		
Is Concrete Edger used?	--	NO	--	--	--	--	--	--		
Spacing between slots (ft)	--	--	--	--	--	--	--	--		
Slot Opening Length (in)	--	--	--	--	--	--	--	--		
Blind Swale Type	--	--	--	--	--	--	--	--		
Spreader Energy Dissipation	--	--	--	--	--	--	--	--		
Total Area of UIA:RPA (ft ²)	--	509	--	--	--	--	--	--		
UIA:RPA Ratio	--	0.8	--	--	--	--	--	--		
UIA:RPA Interface Width (ft)	--	50	--	--	--	--	--	--		
L / W Ratio of UIA:RPA	--	0.20	--	--	--	--	--	--		

2. Buffer Length

Average Buffer Length (ft)	--	6	--	--	--	--	--	--		
----------------------------	----	---	----	----	----	----	----	----	--	--

3. Buffer Slope

Average Buffer Slope (ft/ft)	--	0.250	--	--	--	--	--	--		
Effective Distance (ft)	--	17	--	--	--	--	--	--		
Number of Level Spreaders	--	1	--	--	--	--	--	--		

4. Provide a Vertical Drop

Vertical Drop (in)	--	0.00	--	--	--	--	--	--		
Mowing Strip Provided?	--	NO	--	--	--	--	--	--		

5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	44.9%	--	--	--	--	--	--		
UIA:RPA Runoff (in)	--	0.00	--	--	--	--	--	--		
UIA:RPA Runoff (ft ³)	--	0	--	--	--	--	--	--		

6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft ³)	--	10	--	--	--	--	--	--		
Runoff Reduction (ft ³)	--	10	--	--	--	--	--	--		
Runoff Reduction (%)	--	100.0%	--	--	--	--	--	--		

Notes:

GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Delineate Areas Tributary to Swale

Total Tributary Area (ft ²)	--	--	3,165	--	--	--	--	--	--	--
Imperviousness (%)	--	--	84.1%	--	--	--	--	--	--	--

2. Swale Inflows

Concentrated Flow Type	--	--	Other	--	--	--	--	--	--	--
Blind Swale Type	--	--	--	--	--	--	--	--	--	--
Spreader Energy Dissipation	--	--	--	--	--	--	--	--	--	--
Vertical Drop (in)	--	--	--	--	--	--	--	--	--	--
Gutter Depression (in)	--	--	--	--	--	--	--	--	--	--
Curb Opening Length (ft)	--	--	--	--	--	--	--	--	--	--
Concrete Sediment Pad	--	--	--	--	--	--	--	--	--	--
Min. Forebay Volume (ft ³)	--	--	--	--	--	--	--	--	--	--
Design Forebay Volume (ft ³)	--	--	--	--	--	--	--	--	--	--
Max. Forebay Depth (in)	--	--	--	--	--	--	--	--	--	--
Design Forebay Depth (in)	--	--	--	--	--	--	--	--	--	--
Calculated Notch Width (in)	--	--	--	--	--	--	--	--	--	--
Design Notch Width (in)	--	--	--	--	--	--	--	--	--	--
Drain Time (minutes)	--	--	--	--	--	--	--	--	--	--
Energy Dissipation Type	--	--	Rock	--	--	--	--	--	--	--

3. Swale Cross Section

Length of Swale (ft)	--	--	190.00	--	--	--	--	--	--	--
Bottom Width (ft)	--	--	0.00	--	--	--	--	--	--	--
Bottom Area (ft ²)	--	--	0	--	--	--	--	--	--	--
Side Slopes (horiz/vert)	--	--	4.00	--	--	--	--	--	--	--

4. Longitudinal Slope

Available Slope (ft/ft)	--	--	0.020	--	--	--	--	--	--	--
Design Slope (ft/ft)	--	--	0.020	--	--	--	--	--	--	--
Total Drop Height (ft)	--	--	0.00	--	--	--	--	--	--	--
Underdrains Provided?	--	--	NO	--	--	--	--	--	--	--

5. Calculate Runoff from Tributary Area

Tributary Runoff (ft ³)	--	--	136	--	--	--	--	--	--	--
Reduced Trib. Runoff (ft ³)	--	--	136	--	--	--	--	--	--	--

6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft ³)	--	--	50	--	--	--	--	--	--	--
Swale Discharge (ft ³)	--	--	86	--	--	--	--	--	--	--
Runoff Reduction (%)	--	--	37.0%	--	--	--	--	--	--	--

7. Design Discharge

2-year Discharge, Q2 (cfs)	--	--	2.2	--	--	--	--	--	--	--
----------------------------	----	----	-----	----	----	----	----	----	----	----

8. Design Velocity

Vegetal Retardance Curve	--	--	E	--	--	--	--	--	--	--
Velocity, V2 (fps)	--	--	1.9	--	--	--	--	--	--	--

9. Design Flow Depth

Flow Depth, D2 (ft)	--	--	0.54	--	--	--	--	--	--	--
Flow Area, A (ft ²)	--	--	1.2	--	--	--	--	--	--	--
Wetted Perimeter, P (ft)	--	--	4.5	--	--	--	--	--	--	--
Top Width, T (ft)	--	--	4.3	--	--	--	--	--	--	--
Hydraulic Radius, Rh (ft)	--	--	0.26	--	--	--	--	--	--	--
VR Product (ft ² /sec)	--	--	0.49	--	--	--	--	--	--	--
Manning's n value	--	--	0.046	--	--	--	--	--	--	--
Hydraulic Depth, Dh (ft)	--	--	0.27	--	--	--	--	--	--	--
Froude Number	--	--	0.11	--	--	--	--	--	--	--

10. Swale Outflows

Outflows Considered?	--	--	YES	--	--	--	--	--	--	--
----------------------	----	----	-----	----	----	----	----	----	----	----

Notes:

DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

Design Point ID	DP10	421-RPA	421-Ditch	421-UIA	421-UIA2	419-UIA	421-SPA	419-SPA		
Total Area (ft ²)	5,992	509	3,165	228	1,663	999	1,134	1,184		
Imperviousness (%)	44.9%		84.1%	100.0%	100.0%	100.0%	0.0%	0.0%		
Tributary Runoff (ft ³)	146	10	136	10	69	42	0	0		
Runoff Reduction (ft ³)	60	10	50	0	0	0	0	0		
Runoff Remaining (ft ³)	86	0	86	10	69	42	0	0		

Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.00 (April 2024)

Designer: Jessica Barr
Company: AECOM
Date: September 16, 2024
Project: Deer Creek Rd.
Location: Elpaso County, CO
Outfall ID: DP11

DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	DP11	423-RPA	423-UIA	423-SPA					
Area Type	RPA	RPA_Buffer	UIA	SPA					
Downstream Design Point ID	--	DP11	423-RPA	DP11					
DCIA (ft ²)	--	--	--	--					
UIA (ft ²)	--	--	285	--					
RPA (ft ²)	--	129	--	--					
SPA (ft ²)	--	--	--	118					

2. Protect the RPA from Traffic

RPA Protection Type	--	Other	--	--					
---------------------	----	-------	----	----	--	--	--	--	--

3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	0.0%	--	--					
HSG B (%)	--	100.0%	--	--					
HSG C/D (%)	--	0.0%	--	--					

4. Select Appropriate Vegetation

RPA Vegetation Type	--	Seed	--	--					
Irrigation Type	--	Temporary	--	--					

Notes:

GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	Curbless	--	--					
Is Concrete Edger used?	--	NO	--	--					
Spacing between slots (ft)	--	--	--	--					
Slot Opening Length (in)	--	--	--	--					
Blind Swale Type	--	--	--	--					
Spreader Energy Dissipation	--	--	--	--					
Total Area of UIA:RPA (ft ²)	--	414	--	--					
UIA:RPA Ratio	--	2.2	--	--					
UIA:RPA Interface Width (ft)	--	60	--	--					
L / W Ratio of UIA:RPA	--	0.12	--	--					

2. Buffer Length

Average Buffer Length (ft)	--	2	--	--					
----------------------------	----	---	----	----	--	--	--	--	--

3. Buffer Slope

Average Buffer Slope (ft/ft)	--	0.250	--	--					
Effective Distance (ft)	--	17	--	--					
Number of Level Spreaders	--	1	--	--					

4. Provide a Vertical Drop

Vertical Drop (in)	--	0.00	--	--					
Mowing Strip Provided?	--	NO	--	--					

5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	68.8%	--	--					
UIA:RPA Runoff (in)	--	0.04	--	--					
UIA:RPA Runoff (ft ³)	--	1	--	--					

6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft ³)	--	12	--	--					
Runoff Reduction (ft ³)	--	11	--	--					
Runoff Reduction (%)	--	88.8%	--	--					

Notes:

GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Delineate Areas Tributary to Swale

Total Tributary Area (ft ²)	--	--	--	--						
Imperviousness (%)	--	--	--	--						

2. Swale Inflows

Concentrated Flow Type	--	--	--	--						
Blind Swale Type	--	--	--	--						
Spreader Energy Dissipation	--	--	--	--						
Vertical Drop (in)	--	--	--	--						
Gutter Depression (in)	--	--	--	--						
Curb Opening Length (ft)	--	--	--	--						
Concrete Sediment Pad	--	--	--	--						
Min. Forebay Volume (ft ³)	--	--	--	--						
Design Forebay Volume (ft ³)	--	--	--	--						
Max. Forebay Depth (in)	--	--	--	--						
Design Forebay Depth (in)	--	--	--	--						
Calculated Notch Width (in)	--	--	--	--						
Design Notch Width (in)	--	--	--	--						
Drain Time (minutes)	--	--	--	--						
Energy Dissipation Type	--	--	--	--						

3. Swale Cross Section

Length of Swale (ft)	--	--	--	--						
Bottom Width (ft)	--	--	--	--						
Bottom Area (ft ²)	--	--	--	--						
Side Slopes (horiz/vert)	--	--	--	--						

4. Longitudinal Slope

Available Slope (ft/ft)	--	--	--	--						
Design Slope (ft/ft)	--	--	--	--						
Total Drop Height (ft)	--	--	--	--						
Underdrains Provided?	--	--	--	--						

5. Calculate Runoff from Tributary Area

Tributary Runoff (ft ³)	--	--	--	--						
Reduced Trib. Runoff (ft ³)	--	--	--	--						

6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft ³)	--	--	--	--						
Swale Discharge (ft ³)	--	--	--	--						
Runoff Reduction (%)	--	--	--	--						

7. Design Discharge

2-year Discharge, Q2 (cfs)	--	--	--	--						
----------------------------	----	----	----	----	--	--	--	--	--	--

8. Design Velocity

Vegetal Retardance Curve	--	--	--	--						
Velocity, V2 (fps)	--	--	--	--						

9. Design Flow Depth

Flow Depth, D2 (ft)	--	--	--	--						
Flow Area, A (ft ²)	--	--	--	--						
Wetted Perimeter, P (ft)	--	--	--	--						
Top Width, T (ft)	--	--	--	--						
Hydraulic Radius, Rh (ft)	--	--	--	--						
VR Product (ft ² /sec)	--	--	--	--						
Manning's n value	--	--	--	--						
Hydraulic Depth, Dh (ft)	--	--	--	--						
Froude Number	--	--	--	--						

10. Swale Outflows

Outflows Considered?	--	--	--	--						
----------------------	----	----	----	----	--	--	--	--	--	--

Notes:

DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

Design Point ID	DP11	423-RPA	423-UIA	423-SPA						
Total Area (ft ²)	532	414	285	118						
Imperviousness (%)	68.8%	100.0%	100.0%	0.0%						
Tributary Runoff (ft ³)	12	12	12	0						
Runoff Reduction (ft ³)	11	11	0	0						
Runoff Remaining (ft ³)	1	1	12	0						

Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.00 (April 2024)

Designer: Jessica Barr
Company: AECOM
Date: September 16, 2024
Project: Deer Creek Rd.
Location: Elpaso County, CO
Outfall ID: DP12

DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	DP12	422-RPA	422-UIA						
Area Type	RPA	RPA_Buffer	UIA						
Downstream Design Point ID	--	DP12	422-RPA						
DCIA (ft ²)	--	--	--						
UIA (ft ²)	--	--	294						
RPA (ft ²)	--	68	--						
SPA (ft ²)	--	--	--						

2. Protect the RPA from Traffic

RPA Protection Type	--	Other	--						
---------------------	----	-------	----	--	--	--	--	--	--

3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	0.0%	--						
HSG B (%)	--	100.0%	--						
HSG C/D (%)	--	0.0%	--						

4. Select Appropriate Vegetation

RPA Vegetation Type	--	Seed	--						
Irrigation Type	--	Temporary	--						

Notes:

GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	Curbless	--						
Is Concrete Edger used?	--	NO	--						
Spacing between slots (ft)	--	--	--						
Slot Opening Length (in)	--	--	--						
Blind Swale Type	--	--	--						
Spreader Energy Dissipation	--	--	--						
Total Area of UIA:RPA (ft ²)	--	362	--						
UIA:RPA Ratio	--	4.3	--						
UIA:RPA Interface Width (ft)	--	50	--						
L / W Ratio of UIA:RPA	--	0.14	--						

2. Buffer Length

Average Buffer Length (ft)	--	1	--						
----------------------------	----	---	----	--	--	--	--	--	--

3. Buffer Slope

Average Buffer Slope (ft/ft)	--	0.250	--						
Effective Distance (ft)	--	17	--						
Number of Level Spreaders	--	1	--						

4. Provide a Vertical Drop

Vertical Drop (in)	--	0.00	--						
Mowing Strip Provided?	--	NO	--						

5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	81.3%	--						
UIA:RPA Runoff (in)	--	0.21	--						
UIA:RPA Runoff (ft ³)	--	6	--						

6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft ³)	--	12	--						
Runoff Reduction (ft ³)	--	6	--						
Runoff Reduction (%)	--	48.4%	--						

Notes:

GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Delineate Areas Tributary to Swale

Total Tributary Area (ft ²)	--	--	--							
Imperviousness (%)	--	--	--							

2. Swale Inflows

Concentrated Flow Type	--	--	--							
Blind Swale Type	--	--	--							
Spreader Energy Dissipation	--	--	--							
Vertical Drop (in)	--	--	--							
Gutter Depression (in)	--	--	--							
Curb Opening Length (ft)	--	--	--							
Concrete Sediment Pad	--	--	--							
Min. Forebay Volume (ft ³)	--	--	--							
Design Forebay Volume (ft ³)	--	--	--							
Max. Forebay Depth (in)	--	--	--							
Design Forebay Depth (in)	--	--	--							
Calculated Notch Width (in)	--	--	--							
Design Notch Width (in)	--	--	--							
Drain Time (minutes)	--	--	--							
Energy Dissipation Type	--	--	--							

3. Swale Cross Section

Length of Swale (ft)	--	--	--							
Bottom Width (ft)	--	--	--							
Bottom Area (ft ²)	--	--	--							
Side Slopes (horiz/vert)	--	--	--							

4. Longitudinal Slope

Available Slope (ft/ft)	--	--	--							
Design Slope (ft/ft)	--	--	--							
Total Drop Height (ft)	--	--	--							
Underdrains Provided?	--	--	--							

5. Calculate Runoff from Tributary Area

Tributary Runoff (ft ³)	--	--	--							
Reduced Trib. Runoff (ft ³)	--	--	--							

6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft ³)	--	--	--							
Swale Discharge (ft ³)	--	--	--							
Runoff Reduction (%)	--	--	--							

7. Design Discharge

2-year Discharge, Q2 (cfs)	--	--	--							
----------------------------	----	----	----	--	--	--	--	--	--	--

8. Design Velocity

Vegetal Retardance Curve	--	--	--							
Velocity, V2 (fps)	--	--	--							

9. Design Flow Depth

Flow Depth, D2 (ft)	--	--	--							
Flow Area, A (ft ²)	--	--	--							
Wetted Perimeter, P (ft)	--	--	--							
Top Width, T (ft)	--	--	--							
Hydraulic Radius, Rh (ft)	--	--	--							
VR Product (ft ² /sec)	--	--	--							
Manning's n value	--	--	--							
Hydraulic Depth, Dh (ft)	--	--	--							
Froude Number	--	--	--							

10. Swale Outflows

Outflows Considered?	--	--	--							
----------------------	----	----	----	--	--	--	--	--	--	--

Notes:

DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

Design Point ID	DP12	422-RPA	422-UIA							
Total Area (ft ²)	362	362	294							
Imperviousness (%)		81.3%	100.0%							
Tributary Runoff (ft ³)	12	12	12							
Runoff Reduction (ft ³)	6	6	0							
Runoff Remaining (ft ³)	6	6	12							

Receiving Pervious Areas (Including Grass Buffers and Grass Swales)

SCM Design, Version 4.00 (April 2024)

Designer: Jessica Barr
Company: AECOM
Date: September 16, 2024
Project: Deer Creek Rd.
Location: Elpaso County, CO
Outfall ID: DP13

DESIGN PROCEDURE AND CRITERIA FOR ALL RPAs (User Input in Blue Cells)

1. Apply Four-Cover Land Use Model to Site Layout

Design Point ID	DP13	424-RPA	424-UIA							
Area Type	RPA	RPA_Buffer	UIA							
Downstream Design Point ID	--	DP13	424-RPA							
DCIA (ft ²)	--	--	--							
UIA (ft ²)	--	--	390							
RPA (ft ²)	--	35	--							
SPA (ft ²)	--	--	--							

2. Protect the RPA from Traffic

RPA Protection Type	--	None	--							
---------------------	----	------	----	--	--	--	--	--	--	--

3. Characterize On-site Topsoil and Determine Suitability for the RPA

HSG A (%)	--	0.0%	--							
HSG B (%)	--	100.0%	--							
HSG C/D (%)	--	0.0%	--							

4. Select Appropriate Vegetation

RPA Vegetation Type	--	Seed	--							
Irrigation Type	--	Temporary	--							

Notes:

GRASS BUFFER ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Define the UIA:RPA pair, Ratio, and Interface Width

Sheet Flow Inflow Feature	--	Curbless	--							
Is Concrete Edger used?	--	NO	--							
Spacing between slots (ft)	--	--	--							
Slot Opening Length (in)	--	--	--							
Blind Swale Type	--	--	--							
Spreader Energy Dissipation	--	--	--							
Total Area of UIA:RPA (ft ²)	--	425	--							
UIA:RPA Ratio	--	11.1	--							
UIA:RPA Interface Width (ft)	--	40	--							
L / W Ratio of UIA:RPA	--	0.27	--							

2. Buffer Length

Average Buffer Length (ft)	--	1	--							
----------------------------	----	---	----	--	--	--	--	--	--	--

3. Buffer Slope

Average Buffer Slope (ft/ft)	--	0.250	--							
Effective Distance (ft)	--	17	--							
Number of Level Spreaders	--	1	--							

4. Provide a Vertical Drop

Vertical Drop (in)	--	0.00	--							
Mowing Strip Provided?	--	NO	--							

5. Calculate Runoff for UIA and RPA Pair

Imperviousness (%)	--	91.7%	--							
UIA:RPA Runoff (in)	--	0.38	--							
UIA:RPA Runoff (ft ³)	--	13	--							

6. Compare Runoff from UIA:RPA Pair to Runoff from UIA Only

UIA Runoff (ft ³)	--	16	--							
Runoff Reduction (ft ³)	--	3	--							
Runoff Reduction (%)	--	18.1%	--							

Notes:

GRASS SWALE ADDITIONAL DESIGN PROCEDURE AND CRITERIA (User Input in Blue Cells)

1. Delineate Areas Tributary to Swale

Total Tributary Area (ft ²)	--	--	--							
Imperviousness (%)	--	--	--							

2. Swale Inflows

Concentrated Flow Type	--	--	--							
Blind Swale Type	--	--	--							
Spreader Energy Dissipation	--	--	--							
Vertical Drop (in)	--	--	--							
Gutter Depression (in)	--	--	--							
Curb Opening Length (ft)	--	--	--							
Concrete Sediment Pad	--	--	--							
Min. Forebay Volume (ft ³)	--	--	--							
Design Forebay Volume (ft ³)	--	--	--							
Max. Forebay Depth (in)	--	--	--							
Design Forebay Depth (in)	--	--	--							
Calculated Notch Width (in)	--	--	--							
Design Notch Width (in)	--	--	--							
Drain Time (minutes)	--	--	--							
Energy Dissipation Type	--	--	--							

3. Swale Cross Section

Length of Swale (ft)	--	--	--							
Bottom Width (ft)	--	--	--							
Bottom Area (ft ²)	--	--	--							
Side Slopes (horiz/vert)	--	--	--							

4. Longitudinal Slope

Available Slope (ft/ft)	--	--	--							
Design Slope (ft/ft)	--	--	--							
Total Drop Height (ft)	--	--	--							
Underdrains Provided?	--	--	--							

5. Calculate Runoff from Tributary Area

Tributary Runoff (ft ³)	--	--	--							
Reduced Trib. Runoff (ft ³)	--	--	--							

6. Calculate Runoff Reduction through Swale Bottom

Volume Infiltrated (ft ³)	--	--	--							
Swale Discharge (ft ³)	--	--	--							
Runoff Reduction (%)	--	--	--							

7. Design Discharge

2-year Discharge, Q2 (cfs)	--	--	--							
----------------------------	----	----	----	--	--	--	--	--	--	--

8. Design Velocity

Vegetal Retardance Curve	--	--	--							
Velocity, V2 (fps)	--	--	--							

9. Design Flow Depth

Flow Depth, D2 (ft)	--	--	--							
Flow Area, A (ft ²)	--	--	--							
Wetted Perimeter, P (ft)	--	--	--							
Top Width, T (ft)	--	--	--							
Hydraulic Radius, Rh (ft)	--	--	--							
VR Product (ft ² /sec)	--	--	--							
Manning's n value	--	--	--							
Hydraulic Depth, Dh (ft)	--	--	--							
Froude Number	--	--	--							

10. Swale Outflows

Outflows Considered?	--	--	--							
----------------------	----	----	----	--	--	--	--	--	--	--

Notes:

DESIGN POINT RESULT (Sums results for current column and all upstream design point columns.)

Design Point ID	DP13	424-RPA	424-UIA							
Total Area (ft ²)	425	425	390							
Imperviousness (%)		91.7%	100.0%							
Tributary Runoff (ft ³)	16	16	16							
Runoff Reduction (ft ³)	3	3	0							
Runoff Remaining (ft ³)	13	13	16							

Appendix E
Plans
