HAY CREEK VALLEY

FINAL DRAINAGE REPORT

EPC STORMWATER REVIEW COMMENTS IN ORANGE BOXES WITH BLACK TEXT

Prepared for:

VIEW HOMES, INC.
555 Middle Creek Parkway Suite 500
Colorado Springs, CO 80921
(719) 382-9433

Prepared by:

Matrix
2435 Research Parkway, Suite 300
Colorado Springs, CO 80920
(719) 575-0100
fax (719) 572-0208

September 2023

Project No. 22.886.076

PCD File SP-23-XX

SF2324

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.

____________________________________ ______________

Jesse Sullivan Date
Registered Professional Engineer
State of Colorado
No. 55600

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.

View Homes, Inc.
Business Name

By: ____________________________________ ______________
Timothy Buschar Date

Title: Director of Land Acquisition and Development

Address: 555 Middle Creek Parkway Suite 500
Colorado Springs, CO 80921

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.

____________________________________ ________________________

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

TABLE OF CONTENTS

CERTIFICATION I

I. INTRODUCTION 1

II. HYDROLOGIC METHODOLOGY 2

III. PROJECT CHARACTERISTICS 5

IV. BASIN HYDROLOGY 6

V. HYDRAULIC ANALYSIS 12

VI. STORM WATER QUALITY 15

VII. EROSION CONTROL PLAN 16

VIII. FLOODPLAINS 16

IX. FEE DEVELOPMENT 17

X. SUMMARY 19

XI. REFERENCES 20

6. APPENDICES 21

APPENDIX

A. Hydrologic and Hydraulic Calculations

1. Rational Calculations
2. Inlet Calculations
3. Culvert Calculations
4. Runoff Reduction Calculations
5. Pond Calculations
6. HEC-HMS Results
7. StormCAD Results
8. Swale Calculations

B. Standard Design Charts and Tables

1. Runoff Coefficients
2. ECM Table 3-1
3. Shallow Flow Velocities
4. Basin Fee Schedule
5. ECM Table 10-4

C. Report References
1. HEC-2 Printout
2. FIRMette
3. Soil Survey

D. Maps
1. Vicinity Map
2. Offsite Basins Drainage Basin Map
3. Existing Conditions Drainage Basin Map
4. Proposed Conditions Drainage Basin Map

I. INTRODUCTION

The Hay Creek Valley site is comprised of approximately 214.6 acres of unplatted and mostly undeveloped land. The site is located on Smow Mountain Heights approximately 700 feet south of its intersection with Hay Creek Road. The site is currently comprised of six (6) parcels which are to be subdivided into 20 lots and three (3) tracts. The existing access road will be replaced with a private road having a 60-foot right of way that will terminate with a cul-de-sac in the southwestern section of the site.

a. PURPOSE AND SCOPE OF STUDY

The purpose of this Final Drainage Report (FDR) is to evaluate the specific drainage infrastructure requirements which will provide compliance with the approved Hay Creek Valley MDDP / Preliminary Drainage Report, by Matrix, dated August 2023 (MDDP), and the El Paso County Drainage Criteria Manual (DCM) to provide storm water conveyance for associated developments. This study will identify off-site, and on-site drainage patterns associated with respective land uses, provide hydrologic and hydraulic analysis of tributary basins and conveyance structures to a detention pond, and identify effective, safe routing to the downstream outfall. The improvements associated with this report maintain compliance with the DCM by providing full spectrum detention where necessary, which is to be constructed concurrently with the improvements associated with this FDR.

b. DBPS RELATED INVESTIGATIONS

The proposed development is located within the Beaver Creek Drainage Basin. No Drainage Basin Planning Study (DBPS) has been completed for this basin.

c. GENERAL PROJECT DESCRIPTION

The Hay Creek Valley Subdivision is located to the southwest of the intersection of Hay Creek Road and Smow Mountain Heights. The site is located as follows:

1. General Location: Southwest ¼ of Section 34 and the Southeast ¼ of Section 33, Township 11 South, Range 67 West of the 6th P.M. in the County of El Paso, State of Colorado.
2. Drainageway: The Hay Creek Subdivision is located on the southern edge of the Beaver Creek Drainage Basin. Most of the site drains north and into Hay Creek located approximately 200 feet north of the site. Hay Creek is a tributary to Beaver Creek which ultimately drains into Monument Creek. A small portion of the southeast corner of the site drains south into the Air Force Academy Major Drainage Basin.
3. Surrounding Developments: The site is bound Lots 1 through 8 Hay Creek Ranch Subdivision, and 4 unplatted parcels to the north, and by the Air Force Academy the south. The site is bound by Lot 2 Rush Subdivision and Lot 2 Block 1 Smiley Subdivision to the west, and an unplatted parcel to the east.
4. Lots to be Platted: The site is to be subdivided into 20 lots zoned RR-5 and 3 tracts.
5. Area of Disturbance: The Hay Creek Valley development is expected to disturb a total area of approximately 17.6 acres.
6. Streamside Zone: This project is not located within a streamside zone.
7. Vegetation: The Hay Creek Valley site contains a single-family residence, a barn and Smow Mountain Heights, a private road that provided access to the site from hay Creek

Road. The vegetation of the site consists of sparse, natural vegetative land cover in the form of grasses and shrubs with sparse trees throughout.

Refer to Appendix D for the Vicinity Map.

d. SOILS CONDITIONS

Soils can be classified in four different hydrologic groups, A, B, C, or D to help predict stormwater runoff rates. Hydrologic group "A" is characterized by deep, well-drained coarse-grained soils with a rapid infiltration rate when thoroughly wet and having a low runoff potential. Group "D" typically has a clay layer at or near to the surface, or a very shallow depth to impervious bedrock and has a very slow infiltration rate and a high runoff potential. See Soils Map, Appendix A. The following soil types are present in the Hay Creek Valley site:

Table 1.1 – NRCS Soil Survey for El Paso County – Hay Creek Valley

Soil ID Number	*Soil*	*Hydrologic Classification*	*Drainage Class*	*Percent of Site*
38	Jarre-Tecolote Complex, 8 to 65 percent slopes	B	Well Drained	50.8%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	Well Drained	14.5%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	B	Well Drained	34.7%

DATA SOURCES

Topographical information for the district was found using a combination of ***United States Geological Survey*** (USGS) mapping as well as field surveying. The ***Web Soil Survey,*** created by the ***Natural Resources Conservation Service,*** was utilized to investigate the existing general soil types within the district. Offsite contours are taken from the ***2018 El Paso County LIDAR*** survey and/or USGS Quad Sheets.

e. APPLICABLE CRITERIA AND STANDARDS

This report has been prepared in accordance to the criteria set forth in the City of Colorado Springs and El Paso County DCM, El Paso County Engineering Criteria Manual (ECM) and El Paso County Resolutions 15-042 and 19-245. In addition to the DCM, the **Urban Storm Drainage Criteria Manuals, Volumes 1 through 3**, dated 2016 have been used to supplement the County's Criteria Manual.

II. Hydrologic Methodology

a. MAJOR BASINS AND SUBBASINS

The majority of the Hay Creek Valley site is located within the Beaver Creek Drainage Basin with a small portion of the site tributary to the Air Force Academy Major Drainage Basin. Runoff presently flows overland until reaching an existing natural drainage swale located within the site. This drainage swale directs flows internally until discharging from near the northeastern corner of the site. Drainage from the developed road will be directed to Pond 1, where the runoff will be treated for water quality and detained to maintain the historic major event discharge rate from the site.

b. METHODOLOGY

i. UD Methods

The hydrology for this project uses both the **SCS Hydrograph Procedure** and the **Rational Method** as recommended by the Drainage Criteria Manual (DCM) for the minor and major storms. The Rational Method is used for drainage basins less than 100-acres in size. The Rational Method uses the following equation:

Q=C*i*A

Where:

Q = Maximum runoff rate in cubic feet per second (cfs)
C = Runoff coefficient
i = Average rainfall intensity (inches per hour)
A = Area of drainage sub-basin (acres)

Rational Method coefficients from 6-6 of the Drainage Criteria Manual for developed land were utilized in the Rational Method calculations. This method will be used primarily for sizing of storm sewer infrastructure. See Appendix B for more information.

Time of Concentration
The time of concentration consists of the initial time of overland flow and the travel time in a channel to the inlet or point of interest. A minimum time of concentrations of 5 minutes is utilized for urban areas. The Rational Calculation spreadsheet included in Appendix A shows an initial overland flow length, a channel or street flow length for each sub-basin, and also demonstrates the time of concentration calculations for initial (overland) and channel (or street) conditions. A maximum "True Initial" Flow Length of 300 feet will be used for pre-developed sub-basins and a maximum length of 100 feet will be used for Developed sub-basins for time of concentration calculations in compliance with the DCM.

Rainfall Intensity
The hypothetical rainfall depths for the 1-hour storm duration were derived using Table 6-2 of the Colorado Springs DCM (shown below). See Appendix B.

Table 2.1 – Project Area 1-Hour Rainfall Depth

Storm Recurrence Interval	Rainfall Depth (inches)
5-year	1.50
100-year	2.52

The rainfall intensity equation for the Rational Method was taken from Drainage Criteria Manual Volume 1 Figure 6-5.

C-Factors
C-factors for the Rational Method are based on anticipated land use and are taken from Table 6-6. Proposed single family residential is considered as the Single Family – 5 acres category. Areas which will be future open spaces or detention facilities are modeled under the Parks and Cemeteries category. Undeveloped or predevelopment areas are model under Undeveloped Areas-Historic Flow Analysis—Greenbelts, Agriculture category.

ii. HEC-HMS Methods

The DCM requires the use of the SCS Hydrograph Procedure to compute storm water runoff quantities when the drainage area is greater than 100 acres. This report uses HEC-HMS for the routing and analysis of the site conditions.

SCS Lag
The SCS lag calculations are completed as part of this report. Proposed development areas within the Hay Creek area are calculated based on the methodology indicated in the DCM Equations:

Lag time should be equal to 0.6xtc

The Time of Concentration is the sum of overland flow time and the t_t values for the various consecutive flow segments:

$$t_c = t_i + t_{t1} + t_{t2} + t_{t3} \ldots t_{tm} \qquad \text{(Eq. 6-14)}$$

Where:

t_c = time of concentration (hr)

t_i = overland (initial) flow time (hr)

t_{tm} = travel time for each flow segment (hr)

m = number of flow segments

Overland Flow:

$$T_i = 0.007(n \cdot L)^{0.8} / (P_2)^{0.5} S^{0.4} \qquad \text{(Eq. 6-15)}$$

Where:

T_i = overland flow time (hr)

n = Manning's roughness coefficient L

= flow length (ft)

P_2 = 2-year, 24-hour rainfall (in)

S = slope of hydraulic grade line (ft/ft)

Concentrated Flow:

$$T_t = L / (3600 \cdot V) \qquad \text{(Eq. 6-16)}$$

Where:

T_t = travel time (hr)

L = flow length (ft)

V = velocity (ft/s)

3,600 = conversion factor from seconds to hours

Runoff Analysis
The site has been analyzed using HEC-HMS and the NRCS SCS method. The model indicates approximately 0.1 cfs decrease for Q100 event post development of the Hay Creek site. (**EX-Q5, EX-Q100, PR-Q5, and PR-Q100)** These models look at the 5, and 100-year events for onsite detention within the Hay Creek Site and demonstrate a slight reduction for the 100-year event. Print outs from each model can be found in Appendix A.

Hydrographs for the proposed Pond 1 are taken from MHFD-Detention, where appropriate, and input to the model to represent the detention required within the development to maintain the historic flow discharge downstream of the site and provide water quality for the development in accordance with the DCM.

NRCS SCS curve numbers (CN) are taken from Table 6-10 of the DCM and weighted for each basin based on the soil and development types. As recommended in the DCM storms of 2-hour duration are used for the 5-year event. A 24-hour storm is used for the 100-year event. Lag times are calculated for the basins using the formulas from the DCM shown above.

iii. HGL Profile Methods

Preliminary sizing of storm sewer has been completed using the Manning's channel flow calculation.

To confirm DCM compliant capacity and velocity values the site has been modeled in StormCAD using the Standard head loss method and head loss values taken from Table 9-4 of the DCM. HGL profiles modeled in StormCAD are included in Appendix C.

Table 9-4. STORMCAD Standard Method Coefficients

Bend Loss		
Bend Angle	**K Coefficient**	
0°	0.05	
22.5°	0.10	
45°	0.40	
60°	0.64	
90°	1.32	
LATERAL LOSS		
One Lateral K Coefficient		
Bend Angle	Non-surcharged	Surcharged
45°	0.27	0.47
60°	0.52	0.90
90°	1.02	1.77
Two Laterals K Coefficient		
45°	0.96	
60°	1.16	
90°	1.52	

III. Project Characteristics

a. BASIN LOCATION AND FLOWS

The Hay Creek Valley site is found on the southern border of the Beaver Creek Drainage Basin. In addition to the 214.6-acre site, there are off-site basins east, west, and south of the site that contribute a total tributary area of 98.5 acres. The Hay Creek Valley Road & Storm improvements are anticipated to disturb approximately 17.6 acres.

b. MAJOR DRAINAGEWAYS

Beaver Creek
The majority of the Hay Creek Valley site is located within the Beaver Creek Drainage Basin. Runoff generated within this basin presently flows overland with slopes ranging from 5 to 50% until reaching an existing natural drainage swale located within the site. This drainage swale directs the sites flows internally until discharging from the site near the northeastern corner. Drainage from the developed road will be directed to Pond 1, where the runoff will be treated for water quality and detained to maintain the historic major event discharge rate from the site.

Air Force Academy
The area along the southeastern border of the site drains southeast into the Air Force Academy Major Drainage Basin. Runoff generated within this basin presently flows overland with slopes ranging from 15 to 45% until exiting the site to the southeast into the adjacent property.

c. *LAND USES*

Presently, the site is unplatted and consists mostly of undeveloped land. The 214.6-acre area is entirely zoned RR-5. The site will consist of residential lots containing 5-acres or more and three tracts, one containing the proposed Pond 1, one containing the proposed roadway, and the other containing the Preble's mouse habitat which is undevelopable.

IV. BASIN HYDROLOGY

a. The ***Pre-development conditions*** for the Hay Creek Valley site have been analyzed and are presented by design points and are described as follows:

Predevelopment conditions have been analyzed using both the SCS Hydrograph Procedure and the routed Rational Method. The existing conditions will discuss the entry of runoff from off-site basins as it relates to the respective design point. Runoff generated, either on-site or off-site, drains overland towards the northeastern corner of the site where it is captured by the existing natural swale that runs northeast, exiting the site and releasing flows to be collected in Hay Creek. Generally, all undeveloped basins are considered to be vegetated with sparse grasses. A delineation of the basin boundaries can be found in Appendix D in drawings DR-01 and DR-02. Runoff calculations can be found in Appendix A. The existing runoff design points are described below:

Design Point 1 (Rational (Q_5 = 3.5 cfs, Q_{100} = 18.9 cfs) HEC-HMS (Q_5 = 0.8 cfs, Q_{100} = 4.1 cfs)) (sub-basin: EX-OS1a; Area: 9.4 Ac.) (Slopes: 5 to 15%) This point represents the discharge from offsite sub-basin EX-OS1a into the site. Stormwater runoff will sheet flow to the east and into sub-basin EX-1.

Design Point 2 (Rational (Q_5 = 12.3 cfs, Q_{100} = 74.6 cfs) HEC-HMS (Q_5 = 2.6 cfs, Q_{100} = 15.7 cfs)) (sub-basin: EX-OS1b; Area: 59.2 Ac.) (Slopes: 5 to 10%) This point represents the discharge from offsite sub-basin EX-OS1b into the site. Stormwater runoff will sheet flow to the east and into sub-basin EX-2.

Design Point 3 (Rational (Q_5 = 7.8 cfs, Q_{100} = 42.0 cfs) HEC-HMS (Q_5 = 1.5 cfs, Q_{100} = 8.0 cfs)) (sub-basin: EX-OS2a; Area: 15.9 Ac.) (Slopes: 20 to 50%) This point represents the discharge from offsite sub-basin EX-OS2a into the site. Stormwater runoff will sheet flow to the north and into sub-basin EX-2.

Design Point 4 (Rational (Q_5 = 1.3 cfs, Q_{100} = 6.7 cfs) HEC-HMS (Q_5 = 0.3 cfs, Q_{100} = 1.4 cfs)) (sub-basin: EX-OS2b; Area: 2.8 Ac.) (Slopes: 10 to 40%) This point represents the discharge from offsite sub-basin EX-OS2b into the site. Stormwater runoff will sheet flow to the north and into sub-basin EX-3.

Design Point 5 (Rational (Q_5 = 1.6 cfs, Q_{100} = 8.2 cfs) HEC-HMS (Q_5 = 0.3 cfs, Q_{100} = 1.6 cfs)) (sub-basin: EX-OS2c; Area: 3.2 Ac.) (Slopes: 10 to 50%) This point represents the discharge from offsite sub-basin EX-OS2c into the site. Stormwater runoff will sheet flow to the north and into sub-basin EX-3.

Drainage map states 8.1ac

Design Point 6 (Rational (Q_5 = 2.7 cfs, Q_{100} = 17.7 cfs) HEC-HMS (Q_5 = 0.2 cfs, Q_{100} = 2.0 cfs)) (sub-basin: EX-OS3; Area: 8.2 Ac.) (Slopes: 10 to 45%) This point represents the discharge from offsite sub-basin EX-OS3 into the site. Stormwater runoff will sheet flow to the west and into sub-basin EX-5.

Design Point 7 (Rational (Q_5 = 2.3 cfs, Q_{100} = 15.6 cfs) HEC-HMS (Q_5 = 2.3 cfs, Q_{100} = 15.6 cfs)) (sub-basin: EX-4; Area: 5.9 Ac.) (Slopes: 10 to 50%) This point represents the discharge from sub-basin EX-4 into the adjacent property. Stormwater runoff will sheet flow to the south and into the adjacent property then continue south along historic paths.

Design Point 8 (Rational (Q_5 = 26.1 cfs, Q_{100} = 153.1 cfs) HEC-HMS (Q_5 = 5.4 cfs, Q_{100} = 30.9 cfs)) (sub-basins: EX-OS1b, EX-OS2a, EX-2; Area: 123.3 Ac.) (Slopes: 5 to 30%) This point represents the combined discharge from sub-basins EX-OS1b, EX-OS2a, and EX-2 into sub-basin EX-1. Stormwater runoff will sheet flow to the north to combine with the flows from sub-basin EX-1 before continuing along historic paths.

Design Point 9 (Rational (Q_5 = 17.6 cfs, Q_{100} = 106.5 cfs) HEC-HMS (Q_5 = 2.9 cfs, Q_{100} = 17.4 cfs)) (sub-basins: EX-OS2b, EX-OS2c, EX-3; Area: 67.6 Ac.) (Slopes: 5 to 60%) This point represents the combined discharge from sub-basins EX-OS2b, EX-OS2c, and EX-3 into sub-basin EX-1. Stormwater runoff will sheet flow to the north to combine with the flows from sub-basin EX-1 before continuing along historic paths.

Design Point 10 (Rational (Q_5 = 13.5 cfs, Q_{100} = 85.3 cfs) HEC-HMS (Q_5 = 1.8 cfs, Q_{100} = 11.9 cfs)) (sub-basins: EX-OS3, EX-5; Area: 51.0 Ac.) (Slopes: 5 to 50%) This point represents the combined discharge from sub-basins EX-OS3, and EX-5 into sub-basin EX-1. Stormwater runoff will sheet flow to the north to combine with the flows from sub-basin EX-1 before continuing along historic paths.

Design Point 11 (Rational (Q_5 = 35.0 cfs, Q_{100} = 210.9 cfs) HEC-HMS (Q_5 = 11.2 cfs, Q_{100} = 69.9 cfs)) (sub-basins: EX-OS1a, EX-OS1b, EX-OS2a, EX-OS2b, EX-OS2c, EX-OS3, EX-1, EX-2, EX-3, EX-5; Area: 307.3 Ac.) (Slopes: 5 to 50%) This point represents the total discharge from the site. Stormwater runoff is collected in a natural swale and directed to the northeast. The channelized flow exits the site near the northeast corner of the site and continues north before draining into Hay Creek approximately 300 feet north of the site.

Design Point HC (Q_{100} = 127 cfs) This point represents the stormwater flows in Hay Creek at the existing private 24"x36" culvert to the north of the site. The existing private 24"x36" culvert conveys the flows in Hay Creek under the existing access road. The proposed flows in Hay Creek come from the HEC-2 analysis provided by the Regional Floodplain Administrator. The HEC-2 results are included in **appendix C**.

b. The ***fully developed conditions*** for the site are as follows:

Post development conditions have been analyzed using both the SCS Hydrograph Procedure and the rational routed flow. The proposed conditions will discuss the entry of runoff from off-site basins as it relates to the respective design point. Runoff generated, either on-site or off-site, drains overland towards the northeastern corner of the site where it is captured by the existing natural swale that runs northeast, exiting the site and releasing flows to be collected in Hay Creek. Generally, the developed lots are considered to be residential lots containing 5 acres or more, having an imperviousness of 7.0%. Sub-basins PR-8a and PR-8b, which contain the proposed roadway and ditch, have an imperviousness of 66.4%. Sub basins PR-9, and PR-10, containing the proposed Pond 1 and open space are considered to have an imperviousness of 2.0%. A delineation of the basin boundaries can be found in Appendix D in drawing DR-03. Runoff calculations can be found in Appendix A. The existing runoff design points are described below:

Design Point 1 (Rational (Q_5 = 3.5 cfs, Q_{100} = 18.9 cfs) HEC-HMS (Q_5 = 0.8 cfs, Q_{100} = 3.6 cfs)) (sub-basin: OS1a; Area: 9.4 Ac.) (Slopes: 5 to 15%) This point represents the discharge from offsite sub-basin OS1a into the site. Stormwater runoff will sheet flow to the east and into sub-basin PR-1b.

Design Point 2 (Rational (Q_5 = 12.3 cfs, Q_{100} = 74.6 cfs) HEC-HMS (Q_5 = 2.6 cfs, Q_{100} = 14.2 cfs)) (sub-basin: OS1b; Area: 59.2 Ac.) (Slopes: 5 to 10%) This point represents the discharge from offsite sub-basin OS1b into the site. Stormwater runoff will sheet flow to the east and into sub-basin PR-1a.

Design Point 3 (Rational (Q_5 = 2.2 cfs, Q_{100} = 12.4 cfs) HEC-HMS (Q_5 = 0.4 cfs, Q_{100} = 1.8 cfs)) (sub-basin: OS2a; Area: 5.0 Ac.) (Slopes: 20 to 50%) This point represents the discharge from offsite sub-basin OS2a into the site. Stormwater runoff will sheet flow to the north and into sub-basin PR-1a.

Design Point 4 (Rational (Q_5 = 4.0 cfs, Q_{100} = 21.6 cfs) HEC-HMS (Q_5 = 0.7 cfs, Q_{100} = 3.2 cfs)) (sub-basin: OS2b; Area: 8.6 Ac.) (Slopes: 20 to 50%) This point represents the discharge from offsite sub-basin OS2b into the site. Stormwater runoff will sheet flow to the north and into sub-basin PR-2.

Design Point 5 (Rational (Q_5 = 1.3 cfs, Q_{100} = 6.5 cfs) HEC-HMS (Q_5 = 0.3 cfs, Q_{100} = 1.2 cfs)) (sub-basin: OS2c; Area: 2.3 Ac.) (Slopes: 20 to 50%) This point represents the discharge from offsite sub-basin OS2c into the site. Stormwater runoff will sheet flow to the north and into sub-basin PR-3.

6.0 ac per drainage map

Design Point 6 (Rational (Q_5 = 2.9 cfs, Q_{100} = 14.4 cfs) HEC-HMS (Q_5 = 0.5 cfs, Q_{100} = 2.3 cfs)) (sub-basin: OS2d, OS2e; Area: 5.9 Ac.) (Slopes: 10 to 50%) This point represents the combined discharge from offsite sub-basins OS2d and OS2e into the site. Stormwater runoff will sheet flow to the north and into sub-basin PR-4.

Design Point 7 (Rational (Q_5 = 1.5 cfs, Q_{100} = 10.1 cfs) HEC-HMS (Q_5 = 0.1 cfs, Q_{100} = 0.9 cfs)) (sub-basin: OS3a; Area: 4.9 Ac.) (Slopes: 5 to 40%) This point represents the discharge from sub-basin OS3a into the site. Stormwater runoff will sheet flow to the north and into sub-basin PR-7.

Design Point 8 (Rational (Q_5 = 1.1 cfs, Q_{100} = 7.6 cfs) HEC-HMS (Q_5 = 0.1 cfs, Q_{100} = 0.8 cfs)) (sub-basins: OS3b; Area: 3.3 Ac.) (Slopes: 10 to 45%) This point represents the discharge from sub-basin OS3b into the site. Stormwater runoff will sheet flow to the west and into sub-basin PR-10.

Design Point 9 (Rational (Q_5 = 3.1 cfs, Q_{100} = 17.0 cfs)) (sub-basins: PR-5; Area: 5.9 Ac.) (Slopes: 10 to 50%) This point represents the discharge from sub-basin PR-5 into the adjacent property. Stormwater runoff will sheet flow to the south and into the adjacent property then continue south along historic paths. Note: HEC-HMS values not calculated for this basin due to size and its not being tributary to the site infrastructure.

Design Point 10 (Rational (Q_5 = 15.0 cfs, Q_{100} = 88.8 cfs) HEC-HMS (Q_5 = 3.7 cfs, Q_{100} = 19.5 cfs)) (sub-basins: OS1b, OS2a, PR-1a; Area: 77.2 Ac.) (Slopes: 5 to 30%) This point represents the flows from sub-basins OS1b, OS2a and PR-1a that are directed to the proposed private type C inlet at DP-10. The flows collected at DP-10 are conveyed northeast via proposed private 36-inch RCP storm drain towards Design Point 11b (DP-11b).

Design Point 11a (Rational (Q_5 = 4.9 cfs, Q_{100} = 26.8 cfs) HEC-HMS (Q_5 = 1.3 cfs, Q_{100} = 6.1 cfs)) (sub-basins: OS1a, PR-1b; Area: 15.6 Ac.) (Slopes: 5 to 30%) This point represents the flows from sub-basins OS1a, and PR-1b that are directed to the proposed private type C inlet at DP-11a. The flows collected at DP-11 are combined with the flows from DP-10 at DP-11b before being conveyed to the east via proposed private 36-inch RCP storm drain which outfalls via a proposed private flared end section that directs the flows to the east along historic paths.

Design Point 11b (Rational (Q_5 = 18.4 cfs, Q_{100} = 107.5 cfs) HEC-HMS (Q_5 = 5.0 cfs, Q_{100} = 25.2 cfs)) (sub-basins: OS1a, OS2a, OS1b, PR-1a, PR-1b; Area: 92.8 Ac.) (Slopes: 5 to 30%) This point represents the combination of the flows collected at DP-10 and DP-11a. The combined flows are conveyed to the east via proposed private 36-inch RCP storm drain which outfalls via a proposed private flared end section that directs the flows to the east along historic paths.

Design Point 12 (Rational (Q_5 = 9.0 cfs, Q_{100} = 48.8 cfs) HEC-HMS (Q_5 = 2.1 cfs, Q_{100} = 9.6 cfs)) (sub-basins: OS2b, PR-2; Area: 24.7 Ac.) (Slopes: 5 to 30%) This point represents the flows from sub-basins OS2b and PR-2 that have been collected in the roadside ditch that runs along the south side of the proposed roadway. The roadside ditch located upstream of Design Point 12 will be lined with Type M Rip Rap. These flows travel northeast in the ditch before being collected in the proposed private 36-inch Flared End Section (FES) at Design Point 12 (DP-12). These flows are conveyed under the proposed roadway to the north, discharging via a proposed private 36-inch FES before continuing along historic paths.

Design Point 13 (Rational (Q_5 = 4.5 cfs, Q_{100} = 24.0 cfs) HEC-HMS (Q_5 = 1.0 cfs, Q_{100} = 4.6 cfs)) (sub-basins: OS2c, PR-3; Area: 12.1 Ac.) (Slopes: 5 to 30%) This point represents the flows from sub-basins OS2c and PR-3 that have been collected in the roadside ditch that runs along the south side of the proposed roadway. The roadside ditch along this stretch will be protected with Type L Rip Rap. These flows travel northeast in the ditch before being collected in the proposed private 30-inch FES at Design Point 13 (DP-13). These flows are conveyed under the proposed roadway to the north, discharging via a proposed private 30-inch FES before continuing along historic paths.

Design Point 14 (Rational (Q_5 = 8.7 cfs, Q_{100} = 46.8 cfs) HEC-HMS (Q_5 = 2.7 cfs, Q_{100} = 12.3 cfs)) (sub-basins: OS2d, OS2e, PR-4; Area: 34.3 Ac.) (Slopes: 5 to 60%) This point represents the flows from sub-basins OS2d, OS2e and PR-4 that have been collected in the roadside ditch that runs along the south side of the proposed roadway. The roadside ditch along this stretch will be protected with Type L Rip Rap. These flows travel northeast in the ditch before being collected in the proposed private 36-inch FES at Design Point 14 (DP-14). These flows are conveyed under the proposed roadway to the north, discharging via a proposed private 36-inch FES before continuing along historic paths.

Design Point 15 (Rational (Q_5 = 14.4 cfs, Q_{100} = 78.4 cfs) HEC-HMS (Q_5 = 3.7 cfs, Q_{100} = 17.0 cfs)) (sub-basin: PR-6; Area: 44.8 Ac.) (Slopes: 5 to 60%) This point represents the flows from sub-basin PR-6 that have been collected in the roadside ditch that runs along the south side of the proposed roadway. The roadside ditch along this stretch will be protected with Type L Rip Rap. These flows travel northeast in the ditch before being collected in the proposed private Type C Inlet at Design Point 15 (DP-15). These flows are conveyed under the proposed roadway to the north via proposed private 30" RCP, to be combined with the flows collected at Design Point 18a (DP-18a).

Design Point 16 (Rational (Q_5 = 5.6 cfs, Q_{100} = 31.9 cfs) HEC-HMS (Q_5 = 1.2 cfs, Q_{100} = 6.1 cfs)) (sub-basin: OS3a, PR-7; Area: 18.3 Ac.) (Slopes: 5 to 10%) This point represents the flows from sub-basins OS3a, and PR-7 that have been collected in the roadside ditch that runs along the south side of the proposed roadway downstream of DP-15. The roadside ditch along this stretch will be protected with Type L Rip Rap. These flows travel northeast in the ditch before being collected in the proposed private 30" FES at Design Point 16 (DP-16). These flows are conveyed under the proposed roadway to the west via proposed private 30" RCP.

Design Point 17 (Rational (Q_5 = 27.6 cfs, Q_{100} = 154.2 cfs) HEC-HMS (Q_5 = 11.8 cfs, Q_{100} = 58.1 cfs)) (sub-basins: OS1a, OS1b, OS2a, OS2b, OS2c, OS2d, OS2e, PR-1a, PR-1b, PR-1c, PR-2, PR-3, PR-4; Area: 217.0 Ac.) (Slopes: 5 to 50%) This point represents the outfall from the proposed private swale located along the northwestern border of the proposed private pond (Pond 1). The combined flows from sub-basins OS1a, OS1b, OS2a, OS2b, OS2c, OS2d, OS2e, PR-1a, PR-1b, PR-1c, PR-2, PR-3, and PR-4 are collected in the proposed swale and diverted around Pond 1 toward the proposed stilling basin at Design Point 19. The proposed swale will be lined with Type L Rip Rap.

Design Point 18a (Rational (Q_5 = 5.2 cfs, Q_{100} = 10.8 cfs) HEC-HMS (Q_5 = 3.3 cfs, Q_{100} = 7.8 cfs)) (sub-basins: PR-8a; Area: 4.7 Ac.) (Slopes: 2.8 to 6%) This point represents the Proposed Private Type-C inlet located on the north side of the proposed roadway southwest of the proposed pond (Pond 1). All flows from the proposed roadway will drain to the north and into the northern roadside ditch. All runoff from the proposed roadway will drain to the Type C inlet at Design Point 18a. The flows collected in the inlet will be conveyed downstream towards the proposed private forebay at Design Point EDB-IN via proposed private 18-inch RCP pipe.

Design Point 18b (Rational (Q_5 = 13.7 cfs, Q_{100} = 58.8 cfs) HEC-HMS (Q_5 = 6.6 cfs, Q_{100} = 24.3 cfs)) (sub-basins: PR-6, PR-8a; Area: 49.5 Ac.) (Slopes: 2.8 to 6%) This point represents the combination of flows from design points 15 and 18a. The combined flows will be conveyed downstream towards the proposed private forebay at Design Point EDB-IN via proposed private 18-inch RCP pipe.

Design Point EDB-IN (Rational (Q_5 = 14.8 cfs, Q_{100} = 62.9 cfs) HEC-HMS (Q_5 = 5.1 cfs, Q_{100} = 22.4 cfs)) (sub-basin: PR-6, PR-8a, PR-8b, PR-9; Area: 52.3 Ac.) (Slopes: 2.8 to 50%) This point represents the total discharge into the Proposed Private Extended Detention Basin (EDB). Flows will be treated for water quality and released at such a rate that the overall discharge from the site does not increase under proposed conditions.

Design Point EDB-OUT (Q_5 = 5.8 cfs, Q_{100} = 17.3 cfs) (sub-basins: PR-6, PR-8a, PR-8b, PR-9; Area: 52.3 Ac.) (Slopes: 2.8 to 50%) This point represents the discharge from the EDB. The discharge from Pond 1 will be routed downstream via proposed private 18-inch RCP pipe that will convey the flows to the proposed private stilling basin located at Design Point 19.

Design Point 19 (Rational (Q_5 = 31.7 cfs, Q_{100} 176.3 = cfs) HEC-HMS (Q_5 = 12.5 cfs, Q_{100} = 64.7 cfs) (design points: DP-EDB-OUT, DP-16, DP-17; Area: 287.6 Ac.) (Slopes: 2.8 to 50%) This point represents the proposed private stilling basin located north of proposed Pond 1. Flows from Design Points 15, 16, and EDB-OUT all discharge to the stilling basin which will release the flows at a velocity of 4.02 ft/sec.

Design Point 20 (Rational (Q_5 = 37.5 cfs, Q_{100} = 212.1 cfs) HEC-HMS (Q_5 = 13.0 cfs, Q_{100} = 68.6 cfs)) (sub-basins: DP-19, OS3b, PR-10; Area: 307.3 Ac.) (Slopes: 2.8 to 60%) This point represents the total discharge from the site. Stormwater runoff from the site will continue north in the existing channel before draining into Hay Creek, a tributary of Beaver Creek.

Design Point HC (Q_{100} = 127 cfs) This point represents the stormwater flows in Hay Creek at the proposed private 48" x 48" Box culvert to the north of the site. The proposed private 48" x 48" culvert conveys the flows in Hay Creek under the proposed access road. Culvert calculations for the existing and proposed culvert at DP-HC can be found in Appendix A. The proposed flows in Hay Creek come from the HEC-2 analysis provided by the Regional Floodplain Administrator. The HEC-2 results are included in **appendix C**.

Notes:

- **MHFD-Detention Analysis for the proposed detention pond (Pond 1) which will be constructed as part of the Improvements associated with Hay Creek Valley can be found in Appendix A of this report.**
- **Tables summarizing inlet sizes and capacities, storm pipe sizes and capacities and swale capacities for the proposed improvements can be found in Appendix A and/or in the following section.**
- **All ponds and associated infrastructure are to be owned and maintained by the HOA.**
- **The ratio of the total site discharge in proposed conditions vs existing conditions is 1.0, representing no significant increase in flows in the proposed condition.**
- **The hydraulic model for Beaver Creek indicated approximately 127 cfs from the entire Hay Creek tributary basin which contains the development. We therefore believe the above hydrological analysis with the Rational Method to be quite conservative.**

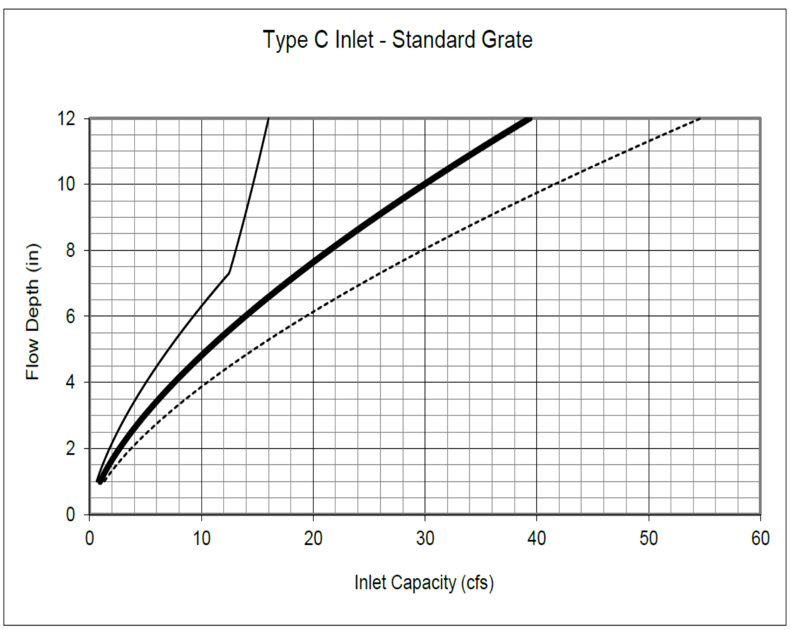
V. Hydraulic Analysis

Headwalls and Wingwalls: Given the erodible soils onsite, provide a headwall and/or wingwall for the inlet and outlet of culverts as necessary given flowrate, slope, and length (per MHFD USDCM Vol 2, Chapter 9, Section 3.0). Or based on engineering judgement, state that based on the site conditions, they are not necessary.

a. Proposed Inlets

INLET SUMMARY HAY CREEK VALLEY										
DESIGN POINT or SUB-BASIN	SUB-BASINS/ DESCRIPTION	TOTAL AREA (AC)	INLET			Q(5) TOTAL INFLOW	Q5 INLET CAPACTIY	Q(100) BYPASS FLOWS (cfs)	Q(100) TOTAL INFLOW (cfs)	MAX INLET CAPACITY
			SIZE (Ft.)	TYPE	CONDITION					
10	**OS1b, OS2a, PR-1a**	77.15	3x6	D	**SUMP**	3.7	**3.7**	**0.0**	19.5	**39.0**
11a	**OS1a, PR-1b**	15.63	3x3	C	**SUMP**	1.3	**1.3**	**0.0**	6.1	**17.0**
15	**PR-6**	44.76	3x3	C	**SUMP**	3.7	**3.7**	**0.0**	17.0	**17.0**
18a	**PR-8a**	4.73	3x3	C	**SUMP**	3.5	**3.5**	**0.0**	8.3	**17.0**

Note: Inlet sizes indicated are minimums. Larger sizes may be used in the construction plans for conservative design.



Inlet Overflow Routing	
Inlet	***Overflow Routing Under Sump Inlet Blockage Conditions***
10	Blockage of this inlet will cause runoff to surcharge the sump and direct runoff across the proposed driveway and into the type C inlet at DP-11a.
11a	Blockage of this inlet will cause runoff to surcharge the sump and direct runoff across the proposed driveway to the east before continuing along historic paths.
15	Blockage of this inlet will cause runoff to surcharge the sump and direct runoff across the proposed roadway and into the type C inlet at DP-18a.
18a	Blockage of this inlet will cause runoff to surcharge the sump and direct runoff into the proposed Extended Detention Basin.

b. Swales

The initial swale analysis was performed using Hydraflow Express to determine flow depths and velocities. Per the El Paso County DCM Volume 1, Chapter 6, section 6.5.2. Channel Velocity, "***Concrete, riprap, or soil cement linings as approved by the City/County shall be used where channel bottom velocities exceed 6.0 ft/sec***." Table 10-4 is included in Appendix B for reference. Further analysis was performed using the Federal Highway Administration (FHWA) Hydraulic Toolbox for those sections having flow velocities initially calculated to be greater than 6 ft/sec. This tool helps determine the stability of each proposed swale based on the flows, cross section, and type of lining material. Concentrated stormwater flows that drain along the existing drainage path through sub-basin PR-1c will be collected in a proposed swale north of the proposed roadside ditch. A 25-foot drainage easement will extend from proposed lot 1 to lot 9 along the existing drainage path to ensure that future developments do not impede the flow of stormwater through the site. The swale calculations have been applied to the most critical swale scenarios for the Site. The table below summarizes the various swales included as part of these improvements.

Swale Capacities						
HAY CREEK VALLEY						
Design Point	***Armoring Type***	***Anticipated Slope %***	***CHANNEL CAPACITY MAJOR STORM (cfs)***	***Q(100) TOTAL FLOW (cfs)***	***Q(100) VELOCTIY (FT/S)***	***Q100 Flow Depth (ft)***
12	Type L Rip Rap*	5.7%	**9.6**	9.6	2.66	**0.94**
13	Vegetation	2.8%	**4.6**	4.6	3.30	**0.59**
14	Type L Rip Rap*	5.0%	**12.3**	12.3	2.84	**1.04**
15	Type L Rip Rap*	5.7%	**17.0**	17.0	3.39	**1.12**
16	Type L Rip Rap*	2.8%	**6.1**	6.1	1.59	**0.98**

Per ECM 3.3.4.A, ditches in developments (roadside ditches excluded) that convey more than 15cfs should be in drainage easements. Please create drainage easements and reflect them on the plat.

Swale Capacities						
HAY CREEK VALLEY						
Design Point	Armoring Type	Anticipated Slope %	CHANNEL CAPACITY MAJOR STORM (cfs)	Q(100) TOTAL FLOW (cfs)	Q(100) VELOCTIY (FT/S)	Q100 Flow Depth (ft)
17	Type L Rip Rap*	4.5%	**58.1**	58.1	4.06	**1.14**
18 (2.8%)	Vegetation	2.8%	**7.8**	7.8	3.76	**0.72**
18 (5.0%)	Type L Rip Rap*	5.0%	**7.8**	7.8	4.62	**0.65**
18 (5.7%)	Type L Rip Rap*	5.7%	**7.8**	7.8	4.91	**0.63**

Per ECM 3.3.4.A, ditches in developments (roadside ditches excluded) that convey more than 15cfs should be in drainage easements. Please create drainage easements and reflect them on the plat. For all swales with greater than 15 cfs

* Turf Reinforcement Mat (TRM) may be used in place of Rip Rap.

Note: The values shown in the above table are based on the final design. Sections which were initially calculated to have velocities over 6 ft/s have been reevaluated using the Manning's n value (from Hydraulic Toolbox) corresponding to the armoring type used for that section. As such all velocities shown are below 6 ft/s.

c. Driveway Culverts

Upon the development of the proposed lots, it will be necessary to place culverts along the roadside ditches to convey flows through driveways. Initial calculations for driveway culvert sizing at each lot is summarized in the table below:

Driveway Culvert Sizes HAY CREEK VALLEY			
Lot	Q(100) TOTAL FLOW IN DITCH (cfs)	Anticipated Slope %	Minimum Culvert Inside Diameter (in)
1-10	12.3	2.8%	**24**
11-12	9.6	6.0%	**18**
13	4.6	2.8%	**18**
14-16	12.3	4.8%	**24**
17-19	17.0	2.8%	**24**
20	6.1	2.8%	**18**

d. Detention

Due to the development of the site and the resulting increase in imperviousness, detention will be required to limit the 100-year discharge to historic rates. The proposed private Extended Detention Basin (Pond 1) has been designed to over detain stormwater flows to reduce the total site discharge to predevelopment levels. The pond will provide detention and water quality treatment for stormwater runoff generated within the Hay Creek Valley site. The proposed private Forebay at the southwestern

Forebay calcs not found. Please complete UD-BMP tab for EDBs to show forebay calcs and other EDB design details.

corner of Pond 1 has been sized based on the untreated WQCV calculated in the UD-BMP worksheet. The forebay calculations and UD-BMP worksheet can be found in Appendix A. Pond 1 will outfall to a stilling basin to the north. Flows from the pond will combine with flows from Design Points 16 and 17 in the stilling basin which will release the flows with a velocity of 1.65 ft/sec during the 100-year storm event which is considered by the DCM to be stable for the major storm event in the context of open channel flows. The stilling basin will provide a suitable outfall for the concentrated flows into the existing natural swale. The proposed stilling basin has a depth of 24-inches and, when at max capacity, will infiltrate within 40 hours. Infiltration rates have been determined using the f_0 value for type B soils in Table 6-7 of the MHFD Drainage Criteria Manual Volume 1 (below). Design information including calculations are included in Appendix A. The table below summarizes the detention provided for this development.

Proposed Pond Summary HAY CREEK VALLEY								
Pond	Tributary Area	% Impervious	Pre-Development Peak		Pond Outflow		Pre vs. Post Ratio	
			Q5	Q100	Q5	Q100	Q5	Q100
Pond 1	52.31	12.63	11.3	51.6	5.8	17.3	0.5	0.3

Table 6-7. Recommended Horton's equation parameters

NRCS Hydrologic Soil Group	Infiltration (inches per hour)		Decay Coefficient—a
	Initial—f_i	Final—f_o	
A	5.0	1.0	0.0007
B	4.5	0.6	0.0018
C	3.0	0.5	0.0018
D	3.0	0.5	0.0018

Emergency Overflow
Pond 1: If the emergency overflow weir receives flows, these flows will continue downstream along the existing natural swale and drain into Hay Creek.

VI. Storm Water Quality

Per the DCM Volume 2, Section 4.1, El Paso County recommends the MHFD Four Step Process for receiving water protection that focuses on reducing runoff by disconnecting impervious area, eliminating "unnecessary" impervious area and encouraging infiltration into soils that are suitable, treat and slowly release the WQCV, stabilize stream channels, and implement source controls. The four-step process has been completed below.

Per DCMv2 – Chap 4.2, trickle channel should at a minimum provide capacity equal to twice the release capacity at the upstream forebay outlet. Provide these calcs in the drainage report and revise plans as needed.

Step 1: **Employ Runoff Reduction Practices.**

- The low-density nature of this development and the fact that none of the streets will have curb and gutter, means that most, if not all, runoff from impervious surfaces will sheet flow across pervious areas to grass lined swales. Runoff reduction calculations are included in Appendix A.

Step 2: **Stabilize Drainageways.**

- The site is in the Beaver Creek Drainage Fee Basin. Drainage fees, to be paid by the relevant Hay Creek Valley developers at the time of platting, will help fund proposed channel improvements. Information on planned future improvements to the Beaver Creek channel was unavailable for this report.

Step 3: **Provide Water Quality Capture Volume (WQCV).**

- As required by the DCM, runoff from the proposed streets which is feasible to detain, is directed into a proposed detention pond (Pond 1) via grass lined swale. The proposed private swale will provide water quality treatment for the impervious areas that drain to it through runoff reduction. The pond has been designed to meet the DCM standards for the release rates of Full Spectrum Detention Ponds for Water Quality Capture Volumes, and all of the other storm events listed in the MHFD-Detention spreadsheet. Exclusions are listed below:

See comments on the drainage map - this exclusion only applies to basins which are returned to the existing condition in grading and vegetation which would not be applicable

  - The lots containing large lot residential sites are excluded from WQ treatment per section I.7.1.b.5 of the ECM.
  - Disturbed areas that will return to an undeveloped state are excluded from WQ treatment per section I.7.1.B.7.
  - Disturbed areas that are not practicable to detain are excluded from WQ treatment per section I.7.1.C.1.a.

Step 4: **Consider Need for Industrial and Commercial BMPs.**

- There are no commercial or industrial components of this development, therefore no BMPs of this nature are required.

VII. Erosion Control Plan

A grading and erosion control plan (GEC) for the proposed improvements will be submitted for review as separate submittals by the various developments. These will incorporate straw wattles, straw bale check dams, silt fence, vehicle tracking control, inlet & outlet control, sedimentation basins and other best management practices (CMs) identified in the DCM Volume 2.

VIII. Floodplains

Per the ***Flood Insurance Rate Map (FIRM) 08041CO267 G***, effective date December 7, 2018, published by the Federal Emergency Management Agency (FEMA), Hay Creek, a Tributary to Beaver

Creek runs along the northern bound of the Hay Creek Valley area and has designated 100-year floodplain. The developed portion of the site is generally not touched by the 100 year floodplain, however the road improvements associated with this site will cross the FEMA floodplain at the location where the site access easement crosses Hay Creek. Draft model backed BFEs for this area have been developed as part of Phase 1 for the ongoing El Paso County, CO, Risk MAP Project. The data have been reviewed and approved through FEMA's QA/QC process (May 11, 2022) and are currently in the MIP (Case No. 19-08-0037s). This data is considered "FEMA APPROVED BFEs" This will need to be shown on the prelim plan and plat. Refer to the map in Appendix C.

IX. Fee Development

a. UNDEVELOPED PLATTABLE LAND

The Hay Creek Valley site is located within the Beaver Creek Drainage Fee Basin and within previously unplatted land. The 2023 Drainage Basin Fees for the Beaver Creek Drainage Fee Basin are: $13,797/impervious acre for the Drainage Fee and $0.00/impervious acre for the Bridge Fee. Per the ***El Paso County Engineering Criteria Manual,*** Appendix L, Section 3.10.1a Fee Reductions for Low Density Lots, with the site being developed into 5-acre lots, drainage fees may be reduced by 25%.

Hay Creek
Final Drainage Report
2023 Drainage and Bridge Fees

	Platted Area (Acres)	Imperviousness (%)	Platted Area (Imp. ac.)	Fee/ Imp. Acre	Fee Due	Drainage Fee Reduction	Fee Due at Platting
Drainage Fee	214.63	8.12	17.428	$13,797.00	$240,453.51	$60,113.38	$180,340.13
Bridge Fee	214.63	8.12	17.428	$0.00	$0.00	$0.00	$0.00
TOTAL							$180,340.13

Cost Estimate

Table 12.1

Engineer's Estimate of Probable Construction Costs				
BEAVER CREEK				
HAY CREEK VALLEY				
Private Non-Reimbursable				
Item	Unit	Quantity	Unit Cost	Extension
18" RCP/HP	LF	190	$76.00	$14,440.00
30" RCP/HP	LF	217	$114.00	$24,738.00
36" RCP/HP	LF	370	$140.00	$51,800.00
18" FES	EA	1	$456.00	$456.00
30" FES	EA	4	$684.00	$2,736.00
36" FES	EA	5	$840.00	$4,200.00
Type C Inlet	EA	2	$6,000.00	$12,000.00
Type D Inlet	EA	2	$7,000.00	$14,000.00
STM MH	EA	3	$6,600.00	$19,800.00
RIPRAP	CY	4,280	$135.00	$577,800.00
			Sub Total	$721,970.00
			10% Contingency	$72,197.00
			TOTAL:	**$794,167.00**

Engineer's Estimate of Probable Construction Costs				
BEAVER CREEK				
HAY CREEK VALLEY				
Permanent BMP (EDB): Private Non-reimbursable				
Item	Unit	Quantity	Unit Cost	Extension
DETENTION POND GRADING	EA	1	$35,000.00	$35,000.00
3' TRICKLE CHANNEL	LF	310	$250.00	$77,500.00
FOREBAY	EA	1	$40,000.00	$40,000.00
OUTLET STRUCTURE	EA	1	$40,000.00	$40,000.00
EMERGENCY SPILLWAY	EA	1	$5,000.00	$5,000.00
STILLING BASIN	EA	1	$30,000.00	$30,000.00
			Sub Total	$227,500.00
			10% Contingency	$22,750.00
			TOTAL:	**$250,250.00**
			Overall Total	**$1,044,417.00**

Since the engineer has no control over the cost of labor, materials, equipment, or services furnished by others, or over the contractor's method of determining prices, or over the competitive bidding or market conditions, the opinion of probable construction costs provided herein are made on the basis of the engineer's experience and qualifications and represents the best judgment as an experienced and qualified professional familiar with the construction industry. The engineer cannot, and does not guarantee that proposals, bid or actual construction costs will not vary from the opinion of probable costs.

X. Summary

This report demonstrates that the proposed infrastructure associated with Hay Creek Valley is in conformance with the El Paso County Drainage Criteria Manual, Volumes 1 and 2, October 2018 and all previously approved studies related to the project site. Stormwater flows will generally remain the same in post-development conditions (Rational (Q_5 = 37.5 cfs, Q_{100} = 212.1 cfs) HEC-HMS (Q_5 = 13.0 cfs, Q_{100} = 68.6 cfs)) as in pre-development conditions (Rational (Q_5 = 35.0 cfs, Q_{100} = 210.9 cfs) HEC-HMS (Q_5 = 11.2 cfs, Q_{100} = 69.9 cfs)). These proposed improvements should not adversely affect downstream or surrounding developments and are in conformance with the pertinent studies for the area.

XI. References

1. ***El Paso County and City of Colorado Springs Drainage Criteria Manual, Volume 1 & 2***, El Paso County, May 2014
2. ***El Paso County Engineering Criteria Manual,*** El Paso County, Rev. December 2016
3. ***Web Soil Survey of El Paso County Area, Colorado. Unites States Department of Agriculture Soil Conservation Service***.
4. ***Flood Insurance Rate Maps for El Paso County, Colorado and Incorporated Areas, Panel 279 of 1275, Federal Emergency Management Agency***, Effective Date December 7, 2018.
5. ***Urban Storm Drainage Criteria Manual, Vol. 1-3*** by Urban Drainage and Flood Control District (UDFCD), January 2016

Appendices

APPENDIX A

HYDROLOGIC AND HYDRAULIC CALCULATIONS

Rational Method - Existing Conditions

Project Name:	Hay Creek
Project Location:	El Paso County, Colorado
Designer	WCG
Notes:	EXISTING CONDITIONS

Avg. Channel Velocity	4 ft/s	(If specific channel vel is used, this will be ignored)
Avg. Slope for Initial Flow	0.04 ft/ft	(If Elevations are used, this will be ignored)

Channel Flow Type Key

Heavy Meadow	2
Tillage/Field	3
Short Pasture and Lawns	4
Nearly Bare Ground	5
Grassed Waterway	6
Paved Areas	7

		Area				Rational 'C' Values											
						7%			100%			2%					
Sub-basin	Comments				Soil Group	5-Acre Lots (7% Impervious)			Pavement (100% Impervious)			Undeveloped/Pervious Areas (2% Impervious)			Composite		Percent Impervious
		sf	acres	Sq. Mi.		C5	C100	Area (SF)	C5	C100	Area (SF)	C5	C100	Area	C5	C100	
EX-OS1a		407292	9.35	0.0146	B	0.12	0.39	407292	0.90	0.96		0.09	0.36		0.12	0.39	7.00%
EX-OS1b		2579029	59.21	0.0925	B	0.12	0.39	1173596	0.90	0.96		0.09	0.36	1405433	0.10	0.37	4.28%
EX-OS2a		692771	15.90	0.0248	B	0.12	0.39		0.90	0.96	25423	0.09	0.36	667348	0.12	0.38	5.60%
EX-OS2b		120503	2.77	0.0043	B				0.90	0.96	6033	0.09	0.36	114470	0.13	0.39	6.91%
EX-OS2c		137929	3.17	0.0049	B	0.12	0.39		0.90	0.96	6548	0.09	0.36	131381	0.13	0.39	6.65%
EX-OS3		354850	8.15	0.0127	B	0.12	0.39		0.90	0.96	475	0.09	0.36	354375	0.09	0.36	2.13%
EX-1		2441168	56.04	0.0876	B	0.12	0.39		0.90	0.96	30061	0.09	0.36	2411107	0.10	0.37	3.21%
EX-2		2100638	48.22	0.0754	B	0.12	0.39		0.90	0.96	46438	0.09	0.36	2054200	0.11	0.37	4.17%
EX-3		2684942	61.64	0.0963	B	0.12	0.39		0.90	0.96	31890	0.09	0.36	2653052	0.10	0.37	3.16%
EX-4		256265	5.88	0.0092	B	0.12	0.39		0.90	0.96	0	0.09	0.36	256265	0.09	0.36	2.00%
EX-5		1865454	42.82	0.0669	B	0.12	0.39		0.90	0.96	18117	0.09	0.36	1847337	0.10	0.37	2.95%
DESIGN POINTS	*Sub-basins*																
1	*EX-OS1a*	407292	9.35	0.0146	B	0.12	0.39	407292	0.90	0.96	0	0.09	0.36	0	0.12	0.39	7.0%
2	*EX-OS1b*	2579029	59.21	0.0925	B	0.12	0.39	1173596	0.90	0.96	0	0.09	0.36	1405433	0.10	0.37	4.3%
3	*EX-OS2a*	692771	15.90	0.0248	B	0.12	0.39		0.90	0.96	25423	0.09	0.36	667348	0.12	0.38	5.6%
4	*EX-OS2b*	120503	2.77	0.0043	B	0.12	0.39		0.90	0.96	6033	0.09	0.36	114470	0.13	0.39	6.9%
5	*EX-OS2c*	137929	3.17	0.0049	B	0.12	0.39		0.90	0.96	6548	0.09	0.36	131381	0.13	0.39	6.7%
6	*EX-OS3*	354850	8.15	0.0127	B	0.12	0.39		0.90	0.96	475	0.09	0.36	354375	0.09	0.36	2.1%
7	*EX-4*	256265	5.88	0.0092	B	0.12	0.39		0.90	0.96	0	0.09	0.36	256265	0.09	0.36	2.0%
8	*EX-OS1b, EX-OS2a, EX-2*	5372438	123.33	0.1927	B	0.12	0.39	1173596	0.90	0.96	71861	0.09	0.36	4126981	0.11	0.37	4.4%
9	*EX-OS2b, EX-OS2c, EX-3*	2943374	67.57	0.1056	B	0.12	0.39		0.90	0.96	44471	0.09	0.36	2898903	0.10	0.37	3.5%
10	*EX-OS3, EX-5*	2220304	50.97	0.0796	B	0.12	0.39		0.90	0.96	18592	0.09	0.36	2201712	0.10	0.37	2.8%
11	*DP-8, DP-9, DP-10, EX-OS1a, EX-1*	13384576	307.27	0.4801	B	0.12	0.39	1580888	0.90	0.96	164985	0.09	0.36	11638703	0.10	0.37	3.8%
HC	*From PPRBD Regional floodplane Administrator*																

Flow Lengths										Tc	Rainfall Intensity & Rational Flow Rate						
Initial	True Initial	Channel	True Channel	Average (decimal)	Initial	Average (%)	Channel Flow Type (See Key above)	Velocity	Channel	Total	i5	Q5	HEC-HMS Q5	i100	Q100	HEC-HMS Q100	Sub-basin
ft	Length ft	ft	Length ft	Slope	Tc (min)	Slope	Ground Type	(ft/s)	Tc (min)	(min)	in/hr	cfs	cfs	in/hr	cfs	cfs	
300	300	672	672	0.10	14.23	9.9	4	2.20	5.09	19.31	3.07	**3.5**	**0.8**	5.15	**18.9**	**4.1**	*EX-OS1a*
300	300	2754	2754	0.07	16.48	6.7	4	1.81	25.33	41.80	1.99	**12.3**	**2.6**	3.34	**74.6**	**15.7**	*EX-OS1b*
300	300	84	84	0.31	9.70	31.3	4	3.50	0.40	10.10	4.09	**7.8**	**1.5**	6.87	**42.0**	**8.0**	*EX-OS2a*
300	300	113	113	0.15	12.31	14.8	4	2.69	0.70	13.00	3.69	**1.3**	**0.3**	6.20	**6.7**	**1.4**	*EX-OS2b*
268	268	0	0	0.17	11.09	17.2	4	2.90	0.00	11.09	3.94	**1.6**	**0.3**	6.62	**8.2**	**1.6**	*EX-OS2c*
300	300	265	265	0.16	12.54	15.8	4	2.78	1.59	14.12	3.56	**2.7**	**0.2**	5.98	**17.7**	**2.0**	*EX-OS3*
300	300	4763	4763	0.05	18.23	5.0	4	1.57	50.72	68.94	1.44	**8.2**	**1.6**	2.43	**50.4**	**9.9**	*EX-1*
300	300	2795	2795	0.06	16.66	6.4	4	1.77	26.31	42.96	1.96	**10.3**	**2.0**	3.29	**59.7**	**11.2**	*EX-2*
300	300	2002	2002	0.11	13.86	11.4	4	2.36	14.12	27.97	2.52	**15.6**	**2.3**	4.23	**96.6**	**14.7**	*EX-3*
206	206	0	0	0.29	8.53	28.6	4	3.50	0.00	8.53	4.35	**2.3**	**2.3**	7.30	**15.6**	**15.6**	*EX-4*
300	300	1427	1427	0.11	14.18	10.7	4	2.29	10.39	24.56	2.71	**11.4**	**1.5**	4.55	**71.8**	**10.0**	*EX-5*
																	DESIGN POINTS
300	300	672	672	0.10	14.23	9.9	4	2.20	5.09	19.31	3.07	**3.5**	**0.8**	5.15	**18.9**	**4.1**	*1*
300	300	2754	2754	0.07	16.48	6.7	4	1.81	25.33	41.80	1.99	**12.3**	**2.6**	3.34	**74.6**	**15.7**	*2*
300	300	84	84	0.31	9.70	31.3	4	3.50	0.40	10.10	4.09	**7.8**	**1.5**	6.87	**42.0**	**8.0**	*3*
300	300	113	113	0.15	12.31	14.8	4	2.69	0.70	13.00	3.69	**1.3**	**0.3**	6.20	**6.7**	**1.4**	*4*
268	268	0	0	0.17	11.09	17.2	4	2.90	0.00	11.09	3.94	**1.6**	**0.3**	6.62	**8.2**	**1.6**	*5*
300	300	265	265	0.16	12.54	15.8	4	2.78	1.59	14.12	3.56	**2.7**	**0.2**	5.98	**17.7**	**2.0**	*6*
206	206	0	0	0.29	8.53	28.6	4	3.50	0.00	8.53	4.35	**2.3**	**2.3**	7.30	**15.6**	**15.6**	*7*
300	300	2795	2795	0.06	16.67	6.4	4	1.77	26.31	42.97	1.96	**26.1**	**5.4**	3.29	**153.1**	**30.9**	*8*
300	300	2002	2002	0.11	13.82	11.4	4	2.36	14.12	27.93	2.52	**17.6**	**2.9**	4.24	**106.5**	**17.4**	*9*
300	300	1427	1427	0.11	14.19	10.7	4	2.29	10.39	24.58	2.71	**13.5**	**1.8**	4.55	**85.3**	**11.9**	*10*
300	300	8062	8062	0.05	18.17	5.0	4	1.57	85.84	104.01	1.09	**35.0**	**11.2**	1.84	**210.9**	**69.9**	*11*
															127.0	**127.0**	*HC*

Rational Method - Proposed Conditions

Project Name:	Hay Creek
Project Location:	El Paso County, Colorado
Designer	WCG
Notes:	Proposed Condition

Average Channel Velocity 4.00 ft/s (If specific channel vel is used, this will be ignored)
Average Slope for Initial Flow 0.04 ft/ft (If Elevations are used, this will be ignored)

Channel Flow Type Key	
Heavy Meadow	2
Tillage/Field	3
Short Pasture and Lawns	4
Nearly Bare Ground	5
Grassed Waterway	6
Paved Areas	7

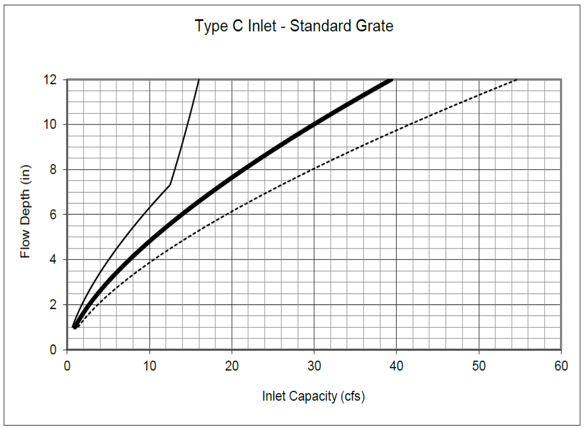
		Area				**Rational 'C' Values**											
						7%			100%			2%					
Sub-basin	**Comments**	sf	acres	Sq. Mi.	Soil Group	5-Acre Lots (7% Impervious) C5	C100		Pavement (100% Impervious) C5	C100	Area (SF)	Undeveloped/Pervious Areas (2% Impervious) C5	C100	Area	Composite C5	C100	Percent Impervious
OS1a		407292	9.35	0.0146	B	0.12	0.39	407292	0.90	0.96		0.09	0.36		0.12	0.39	7.00%
OS1b		2579029	59.21	0.0925	B	0.12	0.39	1173596	0.90	0.96		0.09	0.36	1405433	0.10	0.37	4.28%
OS2a		218316	5.01	0.0078	B	0.12	0.39		0.90	0.96	6435	0.09	0.36	211881	0.11	0.38	4.89%
OS2b		373332	8.57	0.0134	B	0.12	0.39		0.90	0.96	13773	0.09	0.36	359559	0.12	0.38	5.62%
OS2c		99203	2.28	0.0036	B	0.12	0.39		0.90	0.96	5222	0.09	0.36	93981	0.13	0.39	7.16%
OS2d		120503	2.77	0.0043	B	0.12	0.39		0.90	0.96	6033	0.09	0.36	114470	0.13	0.39	6.91%
OS2e		137929	3.17	0.0049	B	0.12	0.39		0.90	0.96	6548	0.09	0.36	131381	0.13	0.39	6.65%
OS3a		212463	4.88	0.0076	B	0.12	0.39		0.90	0.96		0.09	0.36	212463	0.09	0.36	2.00%
OS3b		143157	3.29	0.0051	B	0.12	0.39		0.90	0.96		0.09	0.36	143157	0.09	0.36	2.00%
PR-1a		563521	12.94	0.0202	B	0.12	0.39	563521	0.90	0.96		0.09	0.36		0.12	0.39	7.00%
PR-1b		273497	6.28	0.0098	B	0.12	0.39	273497	0.90	0.96		0.09	0.36		0.12	0.39	7.00%
PR-1c		2318386	53.22	0.0832	B	0.12	0.39	2318386	0.90	0.96		0.09	0.36		0.12	0.39	7.00%
PR-2		700274	16.08	0.0251	B	0.12	0.39	700274	0.90	0.96		0.09	0.36		0.12	0.39	7.00%
PR-3		425946	9.78	0.0153	B	0.12	0.39	425946	0.90	0.96		0.09	0.36		0.12	0.39	7.00%
PR-4		1235031	28.35	0.0443	B	0.12	0.39	1235031	0.90	0.96		0.09	0.36		0.12	0.39	7.00%
PR-5		255265	5.86	0.0092	B	0.12	0.39	255265	0.90	0.96		0.09	0.36		0.12	0.39	7.00%
PR-6		1949910	44.76	0.0699	B	0.12	0.39	1949910	0.90	0.96		0.09	0.36	0	0.12	0.39	7.00%
PR-7		585132	13.43	0.0210	B	0.12	0.39	585132	0.90	0.96		0.09	0.36		0.12	0.39	7.00%
PR-8a		206019	4.73	0.0074	B	0.12	0.39		0.90	0.96	129912	0.09	0.36	76107	0.60	0.74	63.80%
PR-8b		17696	0.41	0.0006	B	0.12	0.39		0.90	0.96	17173	0.09	0.36	523	0.88	0.94	97.10%
PR-9		105045	2.41	0.0038	B	0.12	0.39		0.90	0.96		0.09	0.36	130492	0.11	0.45	2.48%
PR-10		713346	16.38	0.0256	B	0.12	0.39		0.90	0.96	11977	0.09	0.36	701369	0.10	0.37	3.65%
DESIGN POINTS	*Sub-Basins*																
1	*OS1a*	407292	9.35	0.0146	B	0.12	0.39	407292	0.90	0.96	0	0.09	0.36	0	0.12	0.39	7.00%
2	*OS1b*	2579029	59.21	0.0925	B	0.12	0.39	1173596	0.90	0.96	0	0.09	0.36	1405433	0.10	0.37	4.28%
3	*OS2a*	218316	5.01	0.0078	B	0.12	0.39	0	0.90	0.96	6435	0.09	0.36	211881	0.11	0.38	4.89%
4	*OS2b*	373332	8.57	0.0134	B	0.12	0.39	0	0.90	0.96	13773	0.09	0.36	359559	0.12	0.38	5.62%
5	*OS2c*	99203	2.28	0.0036	B	0.12	0.39	0	0.90	0.96	5222	0.09	0.36	93981	0.13	0.39	7.16%
6	*OS2d, OS2e*	258432	5.93	0.0093	B	0.12	0.39	0	0.90	0.96	12581	0.09	0.36	245851	0.13	0.39	6.77%
7	*OS3a*	212463	4.88	0.0076	B	0.12	0.39	0	0.90	0.96	0	0.09	0.36	212463	0.09	0.36	2.00%
8	*OS3b*	143157	3.29	0.0051	B	0.12	0.39	0	0.90	0.96	0	0.09	0.36	143157	0.09	0.36	2.00%
9	*PR-5*	255265	5.86	0.0092	B	0.12	0.39	255265	0.90	0.96	0	0.09	0.36	0	0.12	0.39	7.00%
10	*OS1b, OS2a, PR-1a*	3360866	77.15	0.1206	B	0.12	0.39	1737117	0.90	0.96	6435	0.09	0.36	1617314	0.11	0.38	4.77%
11a	*OS1a,PR-1b*	680789	15.63	0.0244	B	0.12	0.39	680789	0.90	0.96	0	0.09	0.36	0	0.12	0.39	7.00%
11b	*OS1a, OS2a, OS1b, PR-1a, PR-1b*	4041655	92.78	0.1450	B	0.12	0.39	2417906	0.90	0.96	6435	0.09	0.36	1617314	0.11	0.38	5.15%
12	*OS2b, PR-2*	1073606	24.65	0.0385	B	0.12	0.39	700274	0.90	0.96	13773	0.09	0.36	359559	0.12	0.39	6.52%
13	*OS2c, PR-3*	525149	12.06	0.0188	B	0.12	0.39	425946	0.90	0.96	5222	0.09	0.36	93981	0.12	0.39	7.03%
14	*OS2d, OS2e, PR-4*	1493463	34.29	0.0536	B	0.12	0.39	1235031	0.90	0.96	12581	0.09	0.36	245851	0.12	0.39	6.96%
15	*PR-6*	1949910	44.76	0.0699	B	0.12	0.39	1949910	0.90	0.96	0	0.09	0.36	0	0.12	0.39	7.00%
16	*OS3a, PR-7*	797595	18.31	0.0286	B	0.12	0.39	585132	0.90	0.96	0	0.09	0.36	212463	0.11	0.38	5.67%
17	*OS1a, OS1b, OS2a, PR-1a, PR-1b, PR-1c, DP-10, DP-11, DP-12, DP-13, DP-14*	9452259	216.99	0.3391	B	0.12	0.39	7097543	0.90	0.96	38011	0.09	0.36	2316705	0.12	0.38	6.15%
18a	*PR-8a*	206019	4.73	0.0074	B	0.12	0.39	0	0.90	0.96	129912	0.09	0.36	76107	0.60	0.74	63.80%
18b	*PR-6, PR-8a*	2155929	49.49	0.0773	B	0.12	0.39	1949910	0.90	0.96	129912	0.09	0.36	76107	0.17	0.42	12.43%
EDB-IN	*PR-6, PR-8a, PR-8b, PR-9*	2278670	52.31	0.0817	B	0.12	0.39	1949910	0.90	0.96	147085	0.09	0.36	207122	0.17	0.43	12.63%
EDB-OUT	*PR-6, PR-8a, PR-8b, PR-9*	2278670	52.31	0.0817	B	0.12	0.39	1949910	0.90	0.96	147085	0.09	0.36	207122	0.17	0.43	12.63%
19	*EDB-OUT, DP-14, DP-15*	12528524	287.62	0.4494	B	0.12	0.39	9632585	0.90	0.96	185096	0.09	0.36	2736290	0.13	0.39	7.30%
20	*DP-8, DP-18, PR-10*	13385027	307.28	0.4801	B	0.12	0.39	9632585	0.90	0.96	197073	0.09	0.36	3580816	0.12	0.39	7.04%
HC	*From PPRBD Regional floodplane Administrator*																

Flow Lengths										**Tc**	**Rainfall Intensity & Rational Flow Rate**						
Initial ft	True Initial Length ft	Channel ft	True Channel Length ft	Average (decimal) Slope	Initial Tc (min)	Average (%) Slope	Channel Flow Type (See Key above) Ground Type	Velocity (ft/s)	Channel Tc (min)	Total (min)	i5 in/hr	Q5 cfs	HEC-HMS Q5 cfs	i100 in/hr	Q100 cfs	HEC-HMS Q100 cfs	**Sub-basin**
300	300	672	672	0.10	14.23	9.9	4	2.20	5.09	19.31	3.07	**3.5**	**0.8**	5.15	**18.9**	**3.6**	*OS1a*
300	300	2754	2754	0.07	16.48	6.7	4	1.81	25.33	41.80	1.99	**12.3**	**2.6**	3.34	**74.6**	**14.2**	*OS1b*
300	300	203	203	0.25	10.54	24.8	4	3.49	0.97	11.51	3.88	**2.2**	**0.4**	6.52	**12.4**	**1.8**	*OS2a*
300	300	33	33	0.20	11.18	20.4	4	3.16	0.17	11.35	3.90	**4.0**	**0.7**	6.56	**21.6**	**3.2**	*OS2b*
280	280	0	0	0.35	8.91	35.0	4	3.50	0.00	8.90	4.28	**1.3**	**0.3**	7.19	**6.5**	**1.2**	*OS2c*
300	300	44	44	0.13	12.72	13.4	4	2.56	0.29	13.01	3.69	**1.3**	**0.3**	6.19	**6.7**	**1.1**	*OS2d*
285	285	0	0	0.15	11.87	15.4	4	2.75	0.00	11.86	3.83	**1.6**	**0.3**	6.44	**8.0**	**1.3**	*OS2e*
300	300	27	27	0.09	15.39	8.6	4	2.05	0.22	15.61	3.40	**1.5**	**0.1**	5.71	**10.1**	**0.9**	*OS3a*
300	300	195	195	0.22	11.24	22.0	4	3.28	0.99	12.22	3.79	**1.1**	**0.1**	6.36	**7.6**	**0.8**	*OS3b*
300	300	479	479	0.05	17.75	5.1	4	1.58	5.05	22.80	2.82	**4.4**	**0.9**	4.73	**24.1**	**4.3**	*PR-1a*
300	300	644	644	0.10	14.33	9.7	4	2.18	4.92	19.24	3.07	**2.3**	**0.5**	5.16	**12.7**	**2.5**	*PR-1b*
300	300	3863	3863	0.05	17.64	5.2	4	1.60	40.33	57.96	1.62	**10.4**	**3.4**	2.72	**56.9**	**15.7**	*PR-1c*
300	300	576	576	0.12	13.54	11.5	4	2.37	4.04	17.58	3.21	**6.2**	**1.4**	5.40	**34.1**	**6.5**	*PR-2*
300	300	764	764	0.10	14.28	9.8	4	2.19	5.81	20.08	3.01	**3.6**	**0.8**	5.05	**19.4**	**3.8**	*PR-3*
300	300	1015	1015	0.10	14.09	1.0	4	0.70	24.17	38.25	2.10	**7.2**	**2.2**	3.53	**39.3**	**10.3**	*PR-4*
206	206	0	0	0.29	8.28	28.6	4	3.50	0.00	8.27	4.39	**3.1**		7.38	**17.0**		*PR-5*
300	300	1504	1504	0.10	14.18	10.0	4	2.21	11.32	25.50	2.65	**14.4**	**3.7**	4.46	**78.4**	**17.0**	*PR-6*
300	300	1400	1400	0.10	14.18	10.0	4	2.21	10.54	24.72	2.70	**4.4**	**1.1**	4.53	**23.9**	**5.1**	*PR-7*
300	300	3558	3558	0.05	9.23	4.8	4	1.53	38.67	47.89	1.83	**5.2**	**3.3**	3.07	**10.8**	**7.8**	*PR-8a*
50	50	0	0	0.03	1.98	3.0	4	1.21	0.00	5.00	5.10	**1.8**	**0.8**	8.58	**3.3**	**1.7**	*PR-8b*
260	260	0	0	0.01	36.14	0.5	4	0.49	0.00	36.13	2.17	**0.6**		3.65	**4.0**		*PR-9*
300	300	395	395	0.04	19.25	4.2	4	1.43	4.59	23.84	2.75	**4.7**	**0.6**	4.62	**28.2**	**3.4**	*PR-10*
	0		0														*DESIGN POINTS*
300	300	672	672	0.10	14.23	9.9	4	2.20	5.09	19.31	3.07	**3.5**	**0.8**	5.15	**18.9**	**3.6**	*1*
300	300	2754	2754	0.07	16.48	6.7	4	1.81	25.33	41.80	1.99	**12.3**	**2.6**	3.34	**74.6**	**14.2**	*2*
300	300	203	203	0.25	10.54	24.8	4	3.49	0.97	11.51	3.88	**2.2**	**0.4**	6.52	**12.4**	**1.8**	*3*
300	300	33	33	0.20	11.18	20.4	4	3.16	0.17	11.35	3.90	**4.0**	**0.7**	6.56	**21.6**	**3.2**	*4*
280	280	0	0	0.35	8.91	35.0	4	3.50	0.00	8.90	4.28	**1.3**	**0.3**	7.19	**6.5**	**1.2**	*5*
300	300	44	44	0.13	12.74	13.4	4	2.56	0.29	13.02	3.69	**2.9**	**0.5**	6.19	**14.4**	**2.3**	*6*
300	300	27	27	0.09	15.39	8.6	4	2.05	0.22	15.61	3.40	**1.5**	**0.1**	5.71	**10.1**	**0.9**	*7*
300	300	195	195	0.22	11.24	22.0	4	3.28	0.99	12.22	3.79	**1.1**	**0.1**	6.36	**7.6**	**0.8**	*8*
206	206	0	0	0.29	8.28	28.6	4	3.50	0.00	8.27	4.39	**3.1**		7.38	**17.0**		*9*
300	300	3533	3533	0.07	16.42	6.7	4	1.81	32.50	48.91	1.80	**15.0**	**3.7**	3.03	**88.8**	**19.5**	*10*
300	300	1616	1616	0.10	14.23	9.9	4	2.20	12.23	26.45	2.60	**4.9**	**1.3**	4.37	**26.8**	**6.1**	*11a*
300	300	3533	3533	0.07	16.38	6.7	4	1.81	32.50	48.88	1.81	**18.4**	**5.0**	3.03	**107.5**	**25.2**	*11b*
300	300	908	908	0.12	13.54	11.5	4	2.37	6.38	19.91	3.02	**9.0**	**2.1**	5.08	**48.8**	**9.6**	*12*
300	300	764	764	0.10	14.24	9.8	4	2.19	5.81	20.05	3.01	**4.5**	**1.0**	5.06	**24.0**	**4.6**	*13*
300	300	1059	1059	0.10	14.06	1.0	4	0.70	25.21	39.27	2.07	**8.7**	**2.7**	3.47	**46.8**	**12.3**	*14*
300	300	1504	1504	0.10	14.18	10.0	4	2.21	11.32	25.50	2.65	**14.4**	**3.7**	4.46	**78.4**	**17.0**	*15*
300	300	1400	1400	0.10	14.30	10.0	4	2.21	10.54	24.83	2.69	**5.6**	**1.2**	4.52	**31.9**	**6.1**	*16*
300	300	8302	8302	0.05	17.71	5.2	4	1.60	86.68	104.39	1.09	**27.6**	**11.8**	1.83	**154.2**	**58.1**	*17*
300	300	3558	3558	0.05	9.23	4.8	4	1.53	38.67	47.89	1.83	**5.2**	**3.3**	3.07	**10.8**	**7.8**	*18a*
300	300	3558	3558	0.05	17.26	4.8	4	1.53	38.67	55.93	1.66	**13.7**	**6.6**	2.78	**58.8**	**24.3**	*18b*
300	300	3558	3558	0.05	17.21	4.8	4	1.53	38.67	55.87	1.66	**14.8**	**5.1**	2.79	**62.9**	**22.4**	*EDB-IN*
												5.8	**5.8**		**17.3**	**17.3**	*EDB-OUT*
												31.7	**12.5**		**176.3**	**64.7**	*19*
												37.5	**13.0**		**212.1**	**68.6**	*20*
																127.0	*HC*

INLET SUMMARY

Hay Creek

DESIGN POINT or SUB-BASIN	SUB-BASINS	TOTAL AREA (AC)	INLET SIZE (Ft.)	INLET TYPE	INLET CONDITION	Q(5) BYPASS FLOWS (cfs)	Q(5) TOTAL INFLOW	Q5 INLET CAPACTIY	Q(100) BYPASS FLOWS (cfs)	Q(100) TOTAL INFLOW (cfs)	MAX INLET CAPACITY	NOTES:
10	**OS1b, OS2a, PR-1a**	77.15	3x6	D	**SUMP**	**0.0**	3.70	**3.7**	**0.0**	19.50	**39.0**	
11a	**OS1a,PR-1b**	15.63	3x3	C	**SUMP**	**0.0**	1.30	**1.3**	**0.0**	6.10	**17.0**	
15	**PR-6**	44.76	3x3	C	**SUMP**	**0.0**	3.70	**3.7**	**0.0**	17.00	**17.0**	
18a	**PR-8a**	4.73	3x3	C	**SUMP**	**0.0**	3.50	**3.5**	**0.0**	8.30	**17.0**	



Culvert Report

Lots 11 & 12 Driveway Culvert

Invert Elev Dn (ft)	=	7030.00
Pipe Length (ft)	=	40.00
Slope (%)	=	6.00
Invert Elev Up (ft)	=	7032.40
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

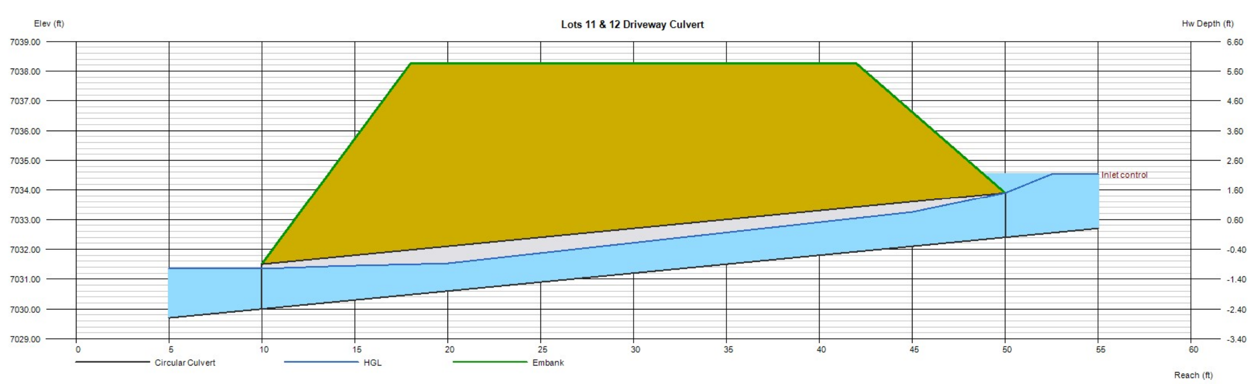
Top Elevation (ft)	=	7038.25
Top Width (ft)	=	24.00
Crest Width (ft)	=	30.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	9.60
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	9.60
Qpipe (cfs)	=	9.60
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.74
Veloc Up (ft/s)	=	6.36
HGL Dn (ft)	=	7031.35
HGL Up (ft)	=	7033.60
Hw Elev (ft)	=	7034.54
Hw/D (ft)	=	1.42
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 22 2023

Lot 13 Driveway Culvert

Invert Elev Dn (ft)	=	7000.00
Pipe Length (ft)	=	40.00
Slope (%)	=	2.80
Invert Elev Up (ft)	=	7001.12
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

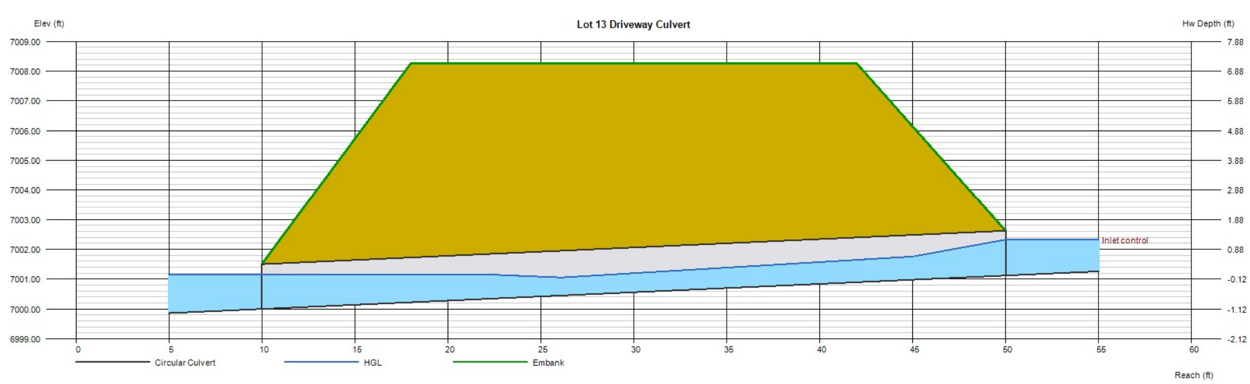
Top Elevation (ft)	=	7008.25
Top Width (ft)	=	24.00
Crest Width (ft)	=	30.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	4.60
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	4.60
Qpipe (cfs)	=	4.60
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	3.13
Veloc Up (ft/s)	=	4.63
HGL Dn (ft)	=	7001.16
HGL Up (ft)	=	7001.94
Hw Elev (ft)	=	7002.32
Hw/D (ft)	=	0.80
Flow Regime	=	Inlet Control



Culvert Report

Lots 14 - 16 Driveway Culverts

Invert Elev Dn (ft)	=	6950.00
Pipe Length (ft)	=	40.00
Slope (%)	=	4.80
Invert Elev Up (ft)	=	6951.92
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

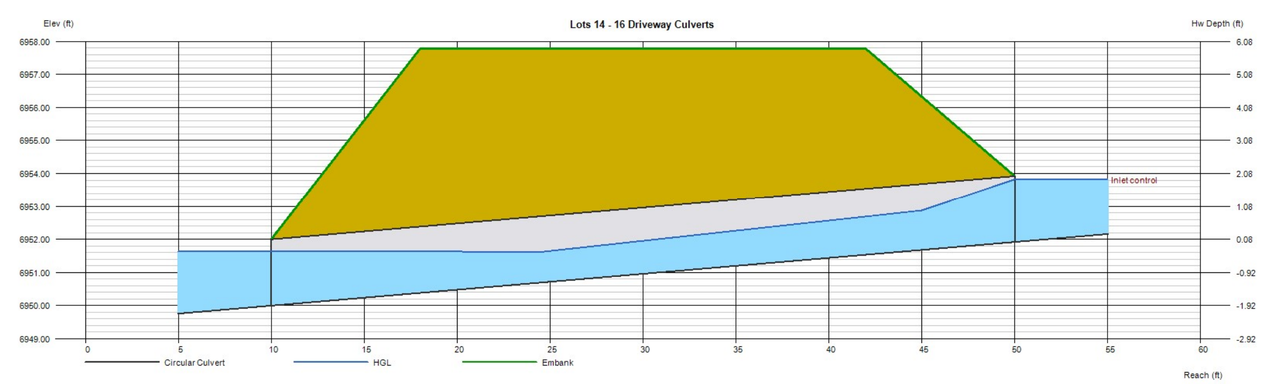
Top Elevation (ft)	=	6957.77
Top Width (ft)	=	24.00
Crest Width (ft)	=	30.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	12.30
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	12.30
Qpipe (cfs)	=	12.30
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.49
Veloc Up (ft/s)	=	5.90
HGL Dn (ft)	=	6951.63
HGL Up (ft)	=	6953.18
Hw Elev (ft)	=	6953.82
Hw/D (ft)	=	0.95
Flow Regime	=	Inlet Control



Culvert Report

Lots 17 - 19 Driveway Culverts

Invert Elev Dn (ft)	=	6870.00
Pipe Length (ft)	=	40.00
Slope (%)	=	2.80
Invert Elev Up (ft)	=	6871.12
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

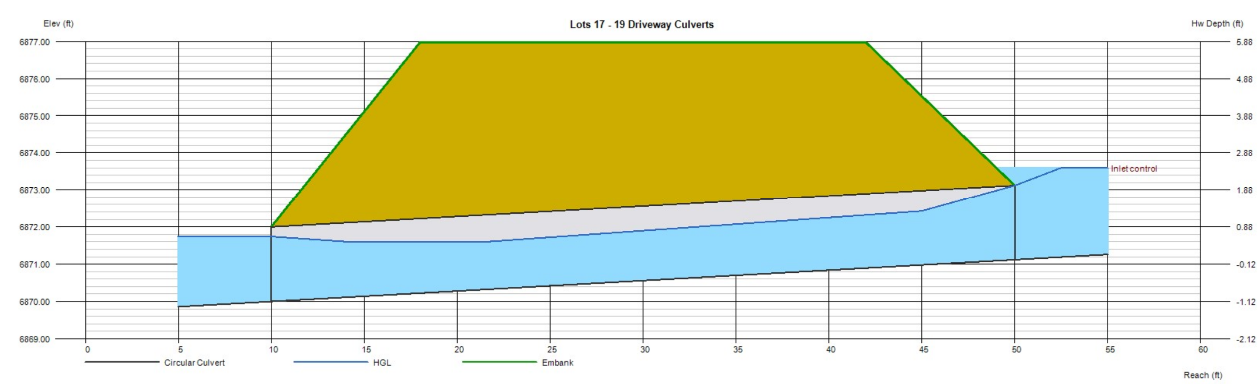
Top Elevation (ft)	=	6876.97
Top Width (ft)	=	24.00
Crest Width (ft)	=	30.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	17.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	17.00
Qpipe (cfs)	=	17.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.85
Veloc Up (ft/s)	=	6.80
HGL Dn (ft)	=	6871.74
HGL Up (ft)	=	6872.61
Hw Elev (ft)	=	6873.60
Hw/D (ft)	=	1.24
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. — Tuesday, Aug 22 2023

Lot 20 Driveway Culvert

Invert Elev Dn (ft)	=	6870.00
Pipe Length (ft)	=	40.00
Slope (%)	=	2.80
Invert Elev Up (ft)	=	6871.12
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

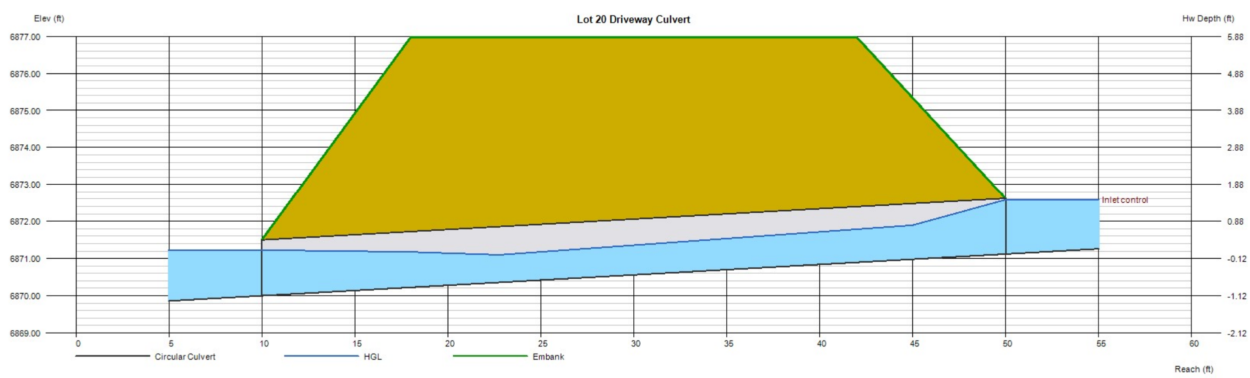
Top Elevation (ft)	=	6876.97
Top Width (ft)	=	24.00
Crest Width (ft)	=	30.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	6.10
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	6.10
Qpipe (cfs)	=	6.10
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	3.94
Veloc Up (ft/s)	=	5.15
HGL Dn (ft)	=	6871.23
HGL Up (ft)	=	6872.07
Hw Elev (ft)	=	6872.58
Hw/D (ft)	=	0.97
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 22 2023

Lots 1 - 10 Driveway Culverts

Invert Elev Dn (ft)	=	6870.00
Pipe Length (ft)	=	40.00
Slope (%)	=	2.80
Invert Elev Up (ft)	=	6871.12
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

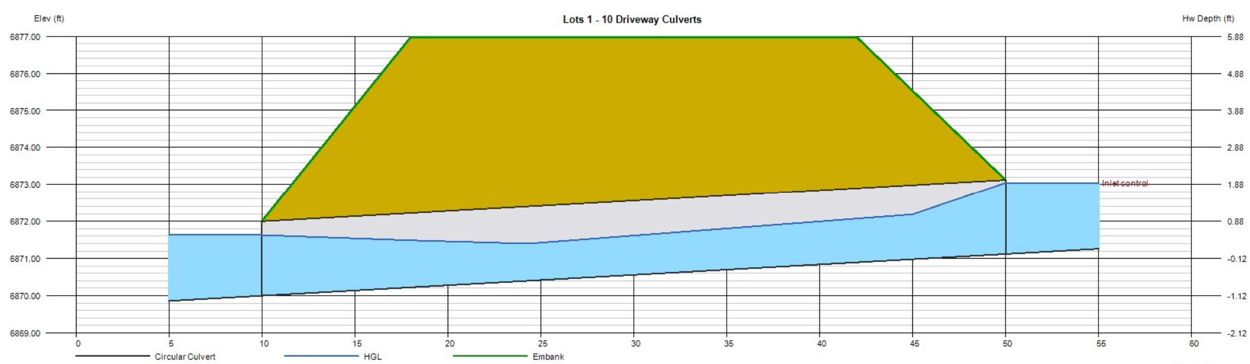
Top Elevation (ft)	=	6876.97
Top Width (ft)	=	24.00
Crest Width (ft)	=	30.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	12.30
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	12.30
Qpipe (cfs)	=	12.30
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.49
Veloc Up (ft/s)	=	5.90
HGL Dn (ft)	=	6871.63
HGL Up (ft)	=	6872.38
Hw Elev (ft)	=	6873.04
Hw/D (ft)	=	0.96
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Wednesday, Mar 29 2023

Existing Creek Crossing Culvert

Invert Elev Dn (ft)	=	6805.30
Pipe Length (ft)	=	40.00
Slope (%)	=	1.50
Invert Elev Up (ft)	=	6805.90
Rise (in)	=	24.0
Shape	=	Elliptical
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Horizontal Ellipse Concrete
Culvert Entrance	=	Groove end projecting (H)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

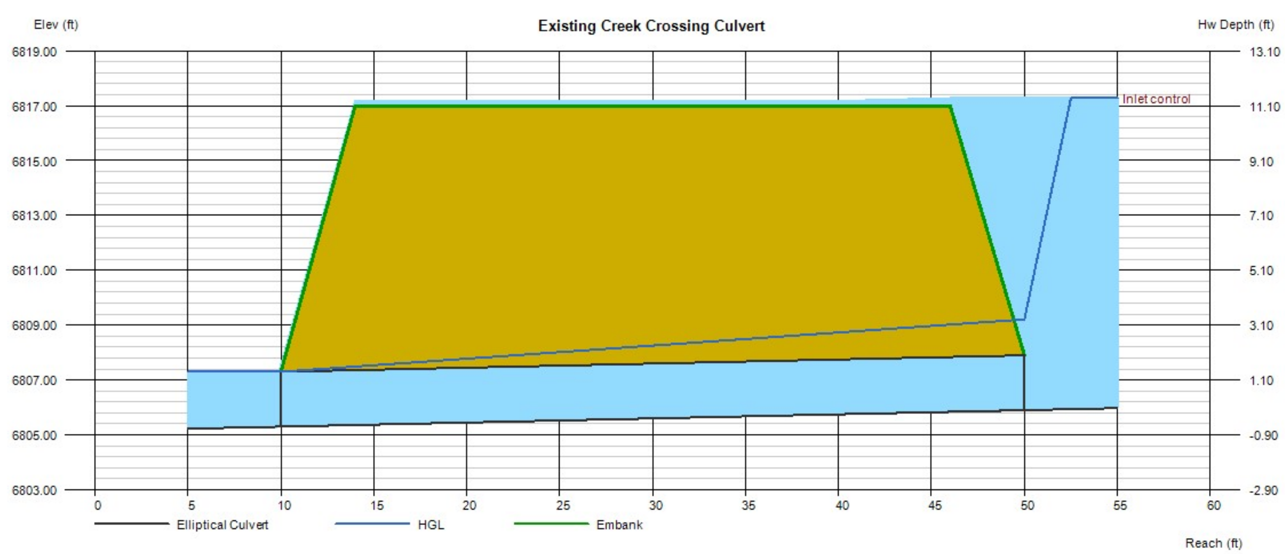
Top Elevation (ft)	=	6817.00
Top Width (ft)	=	32.00
Crest Width (ft)	=	100.00

Calculations

Qmin (cfs)	=	127.00
Qmax (cfs)	=	127.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	127.00
Qpipe (cfs)	=	83.74
Qovertop (cfs)	=	43.26
Veloc Dn (ft/s)	=	17.77
Veloc Up (ft/s)	=	17.77
HGL Dn (ft)	=	6807.30
HGL Up (ft)	=	6809.21
Hw Elev (ft)	=	6817.28
Hw/D (ft)	=	5.69
Flow Regime	=	Inlet Control



Culvert Report

PROPOSED CREEK CROSSING CULVERT

Invert Elev Dn (ft)	= 6809.03
Pipe Length (ft)	= 50.00
Slope (%)	= 4.46
Invert Elev Up (ft)	= 6811.26
Rise (in)	= 48.0
Shape	= Box
Span (in)	= 48.0
No. Barrels	= 1
n-Value	= 0.013
Culvert Type	= 90D Headwall, Chamfered or Beveled Inlet Edges
Culvert Entrance	= 90D headwall w/3/4-in chamfers
Coeff. K,M,c,Y,k	= 0.515, 0.667, 0.0375, 0.79, 0.2

Embankment

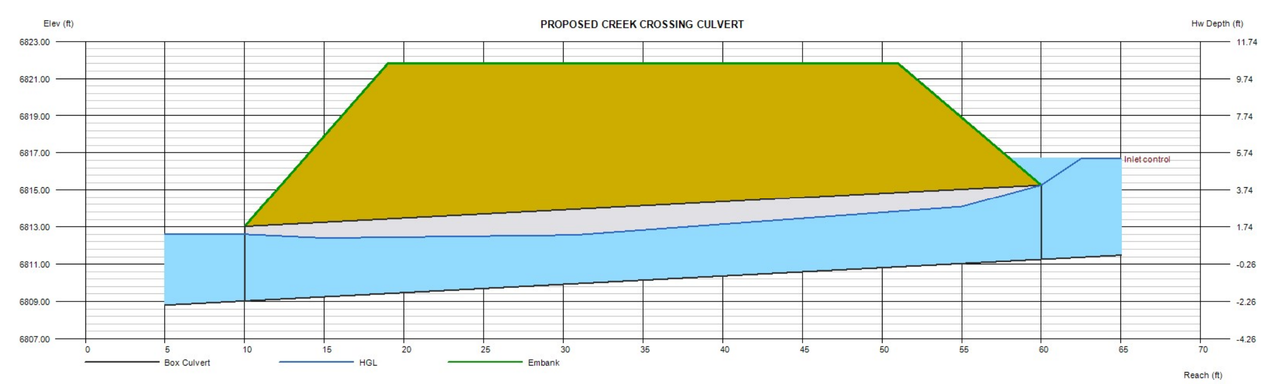
Top Elevation (ft)	= 6821.82
Top Width (ft)	= 32.00
Crest Width (ft)	= 100.00

Calculations

Qmin (cfs)	= 127.00
Qmax (cfs)	= 127.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 127.00
Qpipe (cfs)	= 127.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 8.88
Veloc Up (ft/s)	= 10.08
HGL Dn (ft)	= 6812.60
HGL Up (ft)	= 6814.41
Hw Elev (ft)	= 6816.69
Hw/D (ft)	= 1.36
Flow Regime	= Inlet Control



Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Designer: WCG
Company: Matrix Design Group
Date: August 29, 2023
Project: Hay Creek Valley
Location: El Paso County, CO

SITE INFORMATION (User Input in Blue Cells)

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

Area Type	SPA	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA	DCIA						
Area ID		1	2	3	4							
Downstream Design Point ID	Pond 1	Pond 1	Pond 1	Pond 1	Pond 1	Pond 1						
Downstream BMP Type	EDB	EDB	EDB	EDB	EDB	EDB						
DCIA (ft^2)	--	--	--	--	--	157,884						
UIA (ft^2)	--	38,589	30,400	30,400	30,523	--						
RPA (ft^2)	--	20,585	18,096	18,056	19,241	--						
SPA (ft^2)	1,914,896	--	--	--	--	--						
HSG A (%)	0%	0%	0%	0%	0%	--						
HSG B (%)	100%	100%	100%	100%	100%	--						
HSG C/D (%)	0%	0%	0%	0%	0%	--						
Average Slope of RPA (ft/ft)	--	0.057	0.028	0.050	0.057	--						
UIA:RPA Interface Width (ft)	--	1060.00	950.00	950.00	958.00	--						

CALCULATED RUNOFF RESULTS

Area ID		1	2	3	4							
UIA:RPA Area (ft^2)	--	59,174	48,496	48,456	49,764	--						
L / W Ratio	--	0.06	0.06	0.06	0.06	--						
UIA / Area	--	0.6521	0.6269	0.6274	0.6134	--						
Runoff (in)	0.00	0.00	0.00	0.00	0.00	0.50						
Runoff (ft^3)	0	0	0	0	0	6579						
Runoff Reduction (ft^3)	95745	1608	1267	1267	1272	0						

CALCULATED WQCV RESULTS

Area ID		1	2	3	4							
WQCV (ft^3)	0	1608	1267	1267	1272	6579						
WQCV Reduction (ft^3)	0	1608	1267	1267	1272	0						
WQCV Reduction (%)	0%	100%	100%	100%	100%	0%						
Untreated WQCV (ft^3)	0	0	0	0	0	6579						

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

Downstream Design Point ID	Pond 1											
DCIA (ft^2)	157,884											
UIA (ft^2)	129,912											
RPA (ft^2)	75,978											
SPA (ft^2)	1,914,896											
Total Area (ft^2)	2,278,670											
Total Impervious Area (ft^2)	287,796											
WQCV (ft^3)	11,992											
WQCV Reduction (ft^3)	5,413											
WQCV Reduction (%)	45%											
Untreated WQCV (ft^3)	6,579											

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

Total Area (ft^2)	2,278,670
Total Impervious Area (ft^2)	287,796
WQCV (ft^3)	11,992
WQCV Reduction (ft^3)	5,413
WQCV Reduction (%)	45%
Untreated WQCV (ft^3)	6,579

Please provide information in the text and on the maps to clarify what areas this refers too and the goal of the calculations.

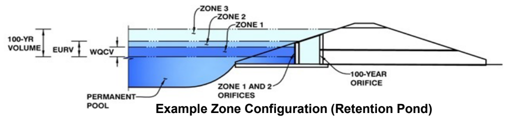
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)

Project: **Hay Creek Valley**

Basin ID: **Beaver Creek**

Please use the latest MHFD-Detention spreadsheet (v4.06) [as of July 2023]



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	52.31	acres
Watershed Length =	3,860	ft
Watershed Length to Centroid =	1,930	ft
Watershed Slope =	0.048	ft/ft
Watershed Imperviousness =	12.63%	percen
Percentage Hydrologic Soil Group A =	0.0%	percen
Percentage Hydrologic Soil Group B =	100.0%	percen
Percentage Hydrologic Soil Groups C/D =	0.0%	percen
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

why was the WQCV overrided? Please add a note stating why.

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

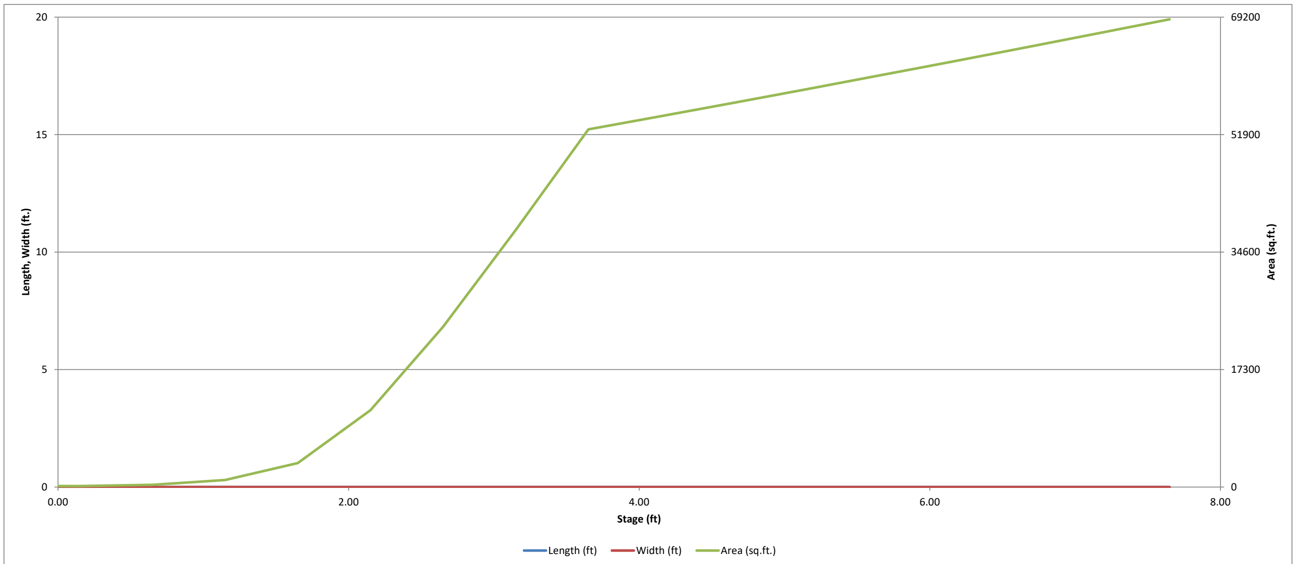
			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.151	acre-feet	0.151	acre-feet
Excess Urban Runoff Volume (EURV) =	0.633	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.814	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.687	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.547	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	4.039	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	5.071	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	6.542	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.55 in.) =	11.077	acre-feet	3.55	inches
Approximate 2-yr Detention Volume =	0.414	acre-feet		
Approximate 5-yr Detention Volume =	0.637	acre-feet		
Approximate 10-yr Detention Volume =	1.200	acre-feet		
Approximate 25-yr Detention Volume =	1.612	acre-feet		
Approximate 50-yr Detention Volume =	1.695	acre-feet		
Approximate 100-yr Detention Volume =	2.159	acre-feet		

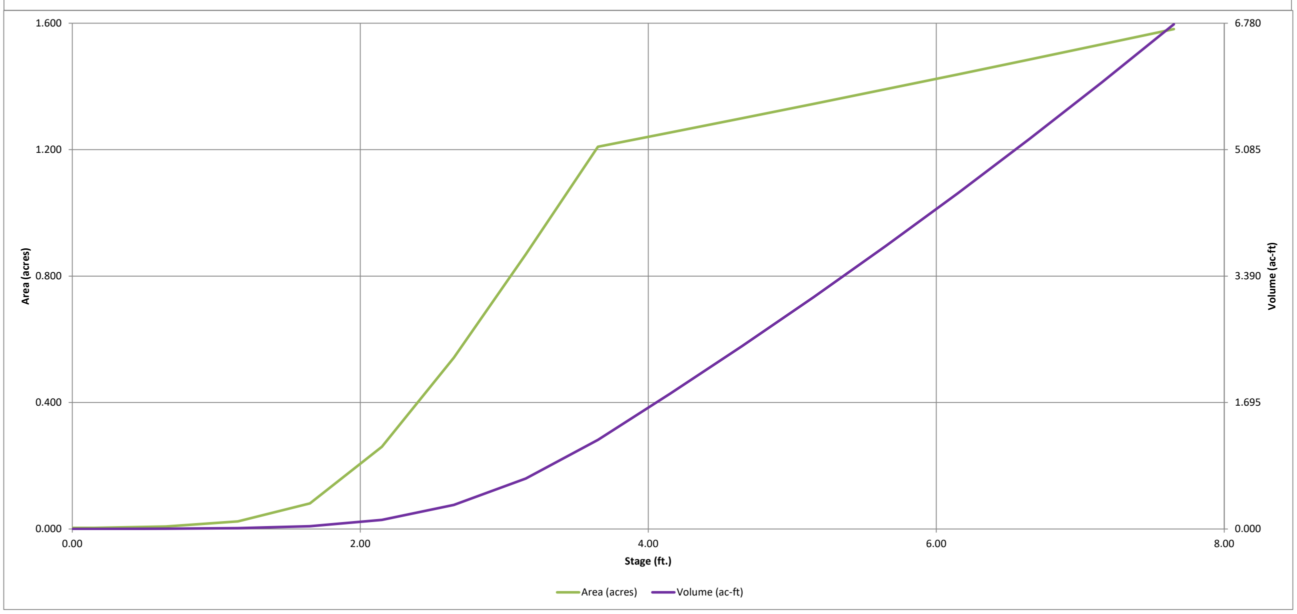
Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.151	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.482	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.527	acre-feet
Total Detention Basin Volume =	2.159	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = ____ ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	150	0.003		
6865.5	--	0.15	--	--	--	153	0.004	23	0.001
6866	--	0.65	--	--	--	334	0.008	144	0.003
	--	1.15	--	--	--	1,036	0.024	487	0.011
6867	--	1.65	--	--	--	3,527	0.081	1,628	0.037
	--	2.15	--	--	--	11,323	0.260	5,340	0.123
6868	--	2.65	--	--	--	23,599	0.542	14,071	0.323
	--	3.15	--	--	--	37,857	0.869	29,434	0.676
6869	--	3.65	--	--	--	52,672	1.209	52,067	1.195
	--	4.15	--	--	--	54,619	1.254	78,889	1.811
6870	--	4.65	--	--	--	56,587	1.299	106,691	2.449
	--	5.15	--	--	--	58,584	1.345	135,484	3.110
6871	--	5.65	--	--	--	60,610	1.391	165,282	3.794
	--	6.15	--	--	--	62,643	1.438	196,095	4.502
6872	--	6.65	--	--	--	64,709	1.486	227,933	5.233
	--	7.15	--	--	--	66,790	1.533	260,808	5.987
6873	--	7.65	--	--	--	68,887	1.581	294,727	6.766
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				
	--		--	--	--				

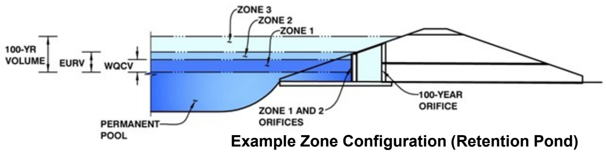

Length, Width (ft.)
Area (sq.ft.)
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)


Area (acres)
Volume (ac-ft)
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

Project: **Hay Creek Valley**
Basin ID: **Beaver Creek**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.25	0.151	Orifice Plate
Zone 2 (EURV)	3.10	0.482	Circular Orifice
Zone 3 (100-year)	4.43	1.527	Weir&Pipe (Restrict)
Total (all zones)		2.159	

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

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

Calculated Parameters for Underdrain

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

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

Centroid of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.25	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	0.63	sq. inches (diameter = 7/8 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	4.403E-03	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
✓ Stage of Orifice Centroid (ft)	0.00	1.00						
✓ Orifice Area (sq. inches)	0.63	0.63						

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

not shown correctly on the CDs detail.

	Zone 2 Circular	Not Selected	
X Invert of Vertical Orifice =	2.25	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	3.10	N/A	ft (relative to basin bottom at Stage = 0 ft)
✓ Vertical Orifice Diameter =	3.50	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.07	N/A	ft^2
Vertical Orifice Centroid =	0.15	N/A	feet

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

	Zone 3 Weir	Not Selected	
✓ Overflow Weir Front Edge Height, Ho =	3.11	N/A	ft (relative to basin bottom at Stage = 0 ft)
X Overflow Weir Front Edge Length =	4.00	N/A	feet
✓ Overflow Weir Grate Slope =	0.00	N/A	H:V
✓ Horiz. Length of Weir Sides =	3.00	N/A	feet
Overflow Grate Type =	Type C Grate	N/A	
Debris Clogging % =	50%	N/A	%

shown as 3ft on CDs.

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.11	N/A	feet
Overflow Weir Slope Length =	3.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	5.62	N/A	
Overflow Grate Open Area w/o Debris =	8.35	N/A	ft^2
Overflow Grate Open Area w/ Debris =	4.18	N/A	ft^2

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

	Zone 3 Restrictor	Not Selected	
✓ Depth to Invert of Outlet Pipe =	1.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
✓ Outlet Pipe Diameter =	18.00	N/A	inches
✓ Restrictor Plate Height Above Pipe Invert =	14.10		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.49	N/A	ft^2
Outlet Orifice Centroid =	0.64	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.17	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

✓ Spillway Invert Stage=	5.50	ft (relative to basin bottom at Stage = 0 ft)
✓ Spillway Crest Length =	50.00	feet
X Spillway End Slopes =	4.00	H:V
X Freeboard above Max Water Surface =	1.00	feet

Verify - not shown on the CD's

Verify - plans show 2.15'

Calculated Parameters for Spillway

Spillway Design Flow Depth=	0.52	feet
Stage at Top of Freeboard =	7.02	feet
Basin Area at Top of Freeboard =	1.52	acres
Basin Volume at Top of Freeboard =	5.79	acre-ft

Currently shown as ~10:1

Routed Hydrograph Results

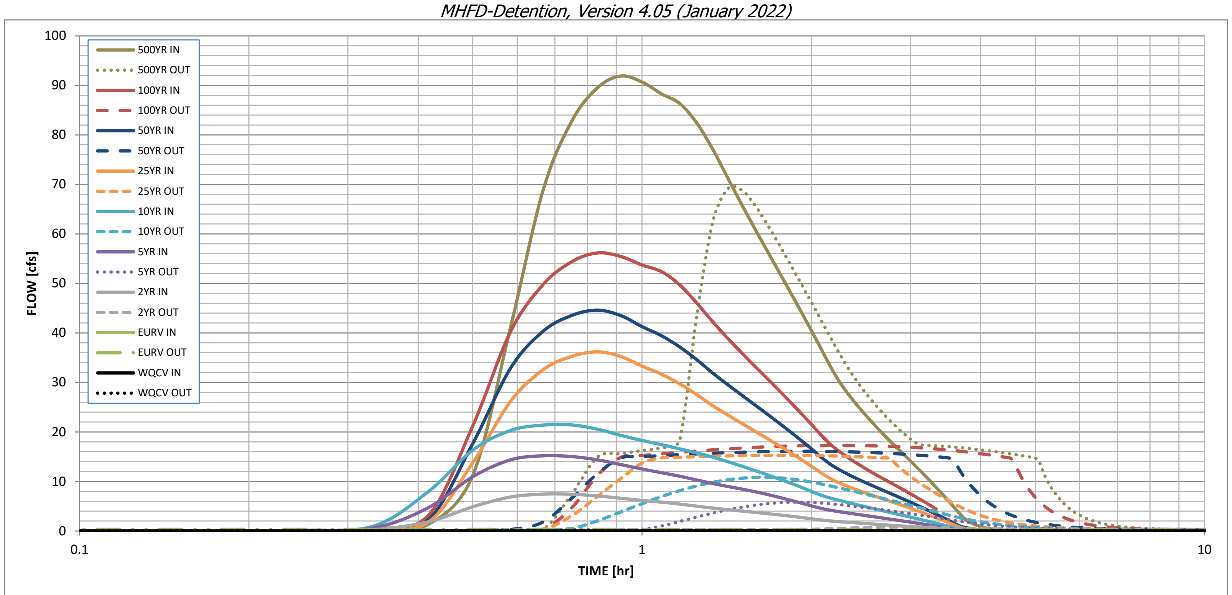
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

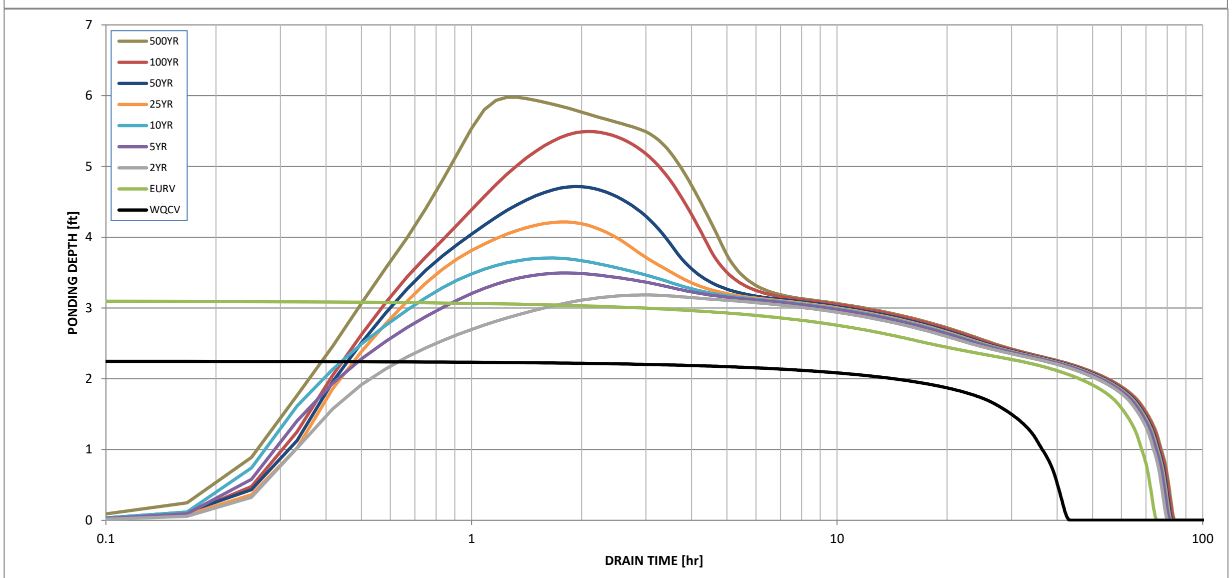
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.55
CUHP Runoff Volume (acre-ft) =	0.151	0.633	0.814	1.687	2.547	4.039	5.071	6.542	11.077
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.814	1.687	2.547	4.039	5.071	6.542	11.077
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	4.0	11.3	17.5	32.0	40.2	51.6	86.5
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.08	0.22	0.33	0.61	0.77	0.99	1.65
Peak Inflow Q (cfs) =	N/A	N/A	7.4	15.2	21.4	36.2	44.6	56.2	91.9
Peak Outflow Q (cfs) =	0.1	0.3	0.8	5.8	10.8	15.3	16.1	17.3	69.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	0.6	0.5	0.4	0.3	0.8
Structure Controlling Flow =	Plate	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	0.05	0.7	1.3	1.8	1.9	2.0	2.1
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	64	68	62	55	45	39	32	22
Time to Drain 99% of Inflow Volume (hours) =	**41**	69	73	71	69	65	63	60	50
Maximum Ponding Depth (ft) =	2.25	3.10	3.18	3.50	3.71	4.22	4.72	5.49	5.98
Area at Maximum Ponding Depth (acres) =	0.32	0.84	0.89	1.10	1.21	1.26	1.30	1.38	1.42
Maximum Volume Stored (acre-ft) =	0.151	0.633	0.702	1.011	1.256	1.886	2.527	3.573	4.244

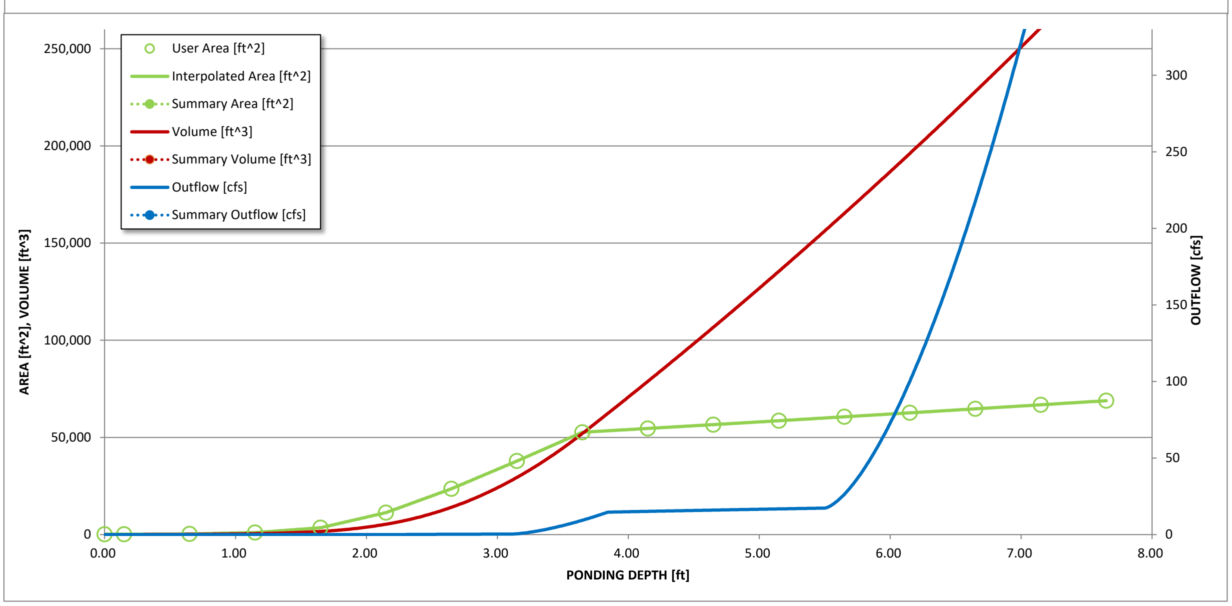
Per USDCMv2 Chap 12, Section 5.5.5 – "The design goal is that the outlet pipe orifice controls flow for the 100-yr event, and the grate controls for more frequent return periods." Review this section of MHFD guidance and consider revising the pond design accordingly.

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: *.\Outflow Hydrographs.xlsx*

Inflow Hydrographs

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval: 5.00 min

SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.04
0:15:00	0.00	0.00	0.06	0.10	0.13	0.08	0.11	0.10	0.21
0:20:00	0.00	0.00	0.27	0.64	0.99	0.28	0.33	0.43	1.33
0:25:00	0.00	0.00	1.84	4.69	7.92	1.78	2.26	3.12	11.19
0:30:00	0.00	0.00	4.89	10.95	16.33	13.76	17.64	21.21	41.01
0:35:00	0.00	0.00	6.85	14.36	20.28	26.13	32.83	40.20	68.76
0:40:00	0.00	0.00	7.44	15.18	21.38	32.56	40.32	49.75	82.78
0:45:00	0.00	0.00	7.41	15.02	21.41	35.27	43.53	54.39	89.52
0:50:00	0.00	0.00	7.07	14.36	20.55	36.17	44.60	56.16	91.89
0:55:00	0.00	0.00	6.60	13.41	19.30	35.24	43.50	55.44	90.68
1:00:00	0.00	0.00	6.17	12.51	18.28	33.30	41.27	53.72	88.27
1:05:00	0.00	0.00	5.82	11.77	17.42	31.65	39.42	52.38	86.35
1:10:00	0.00	0.00	5.43	11.05	16.58	29.71	37.17	49.70	82.47
1:15:00	0.00	0.00	5.01	10.30	15.77	27.55	34.62	46.08	77.25
1:20:00	0.00	0.00	4.63	9.60	14.93	25.36	31.95	42.35	71.55
1:25:00	0.00	0.00	4.31	9.02	14.03	23.50	29.64	39.04	66.16
1:30:00	0.00	0.00	4.03	8.48	13.13	21.81	27.53	36.08	61.25
1:35:00	0.00	0.00	3.77	7.96	12.25	20.22	25.54	33.38	56.70
1:40:00	0.00	0.00	3.51	7.40	11.38	18.72	23.66	30.86	52.42
1:45:00	0.00	0.00	3.25	6.81	10.52	17.27	21.84	28.44	48.32
1:50:00	0.00	0.00	2.99	6.22	9.69	15.86	20.06	26.08	44.34
1:55:00	0.00	0.00	2.73	5.64	8.84	14.46	18.32	23.78	40.46
2:00:00	0.00	0.00	2.46	5.07	7.97	13.08	16.60	21.54	36.69
2:05:00	0.00	0.00	2.21	4.55	7.20	11.70	14.87	19.31	33.03
2:10:00	0.00	0.00	2.01	4.16	6.61	10.52	13.40	17.40	29.93
2:15:00	0.00	0.00	1.86	3.86	6.13	9.63	12.28	15.93	27.44
2:20:00	0.00	0.00	1.73	3.59	5.68	8.90	11.34	14.68	25.28
2:25:00	0.00	0.00	1.61	3.34	5.27	8.25	10.50	13.56	23.33
2:30:00	0.00	0.00	1.50	3.10	4.87	7.65	9.73	12.54	21.55
2:35:00	0.00	0.00	1.39	2.87	4.49	7.10	9.02	11.60	19.89
2:40:00	0.00	0.00	1.28	2.64	4.13	6.57	8.33	10.71	18.33
2:45:00	0.00	0.00	1.17	2.42	3.78	6.06	7.68	9.89	16.88
2:50:00	0.00	0.00	1.07	2.20	3.44	5.56	7.05	9.09	15.49
2:55:00	0.00	0.00	0.97	1.99	3.11	5.07	6.42	8.30	14.13
3:00:00	0.00	0.00	0.87	1.78	2.80	4.58	5.81	7.52	12.79
3:05:00	0.00	0.00	0.77	1.58	2.48	4.10	5.20	6.74	11.45
3:10:00	0.00	0.00	0.67	1.37	2.17	3.62	4.59	5.96	10.12
3:15:00	0.00	0.00	0.58	1.17	1.87	3.14	3.99	5.19	8.79
3:20:00	0.00	0.00	0.48	0.97	1.56	2.66	3.38	4.41	7.47
3:25:00	0.00	0.00	0.38	0.78	1.26	2.18	2.78	3.64	6.15
3:30:00	0.00	0.00	0.29	0.58	0.96	1.71	2.19	2.87	4.83
3:35:00	0.00	0.00	0.20	0.39	0.67	1.24	1.59	2.10	3.54
3:40:00	0.00	0.00	0.12	0.25	0.48	0.79	1.03	1.38	2.42
3:45:00	0.00	0.00	0.09	0.18	0.38	0.51	0.70	0.93	1.72
3:50:00	0.00	0.00	0.07	0.15	0.30	0.35	0.49	0.64	1.24
3:55:00	0.00	0.00	0.05	0.12	0.25	0.24	0.35	0.44	0.89
4:00:00	0.00	0.00	0.04	0.09	0.20	0.17	0.25	0.29	0.63
4:05:00	0.00	0.00	0.03	0.08	0.16	0.12	0.18	0.19	0.43
4:10:00	0.00	0.00	0.03	0.06	0.12	0.08	0.13	0.12	0.28
4:15:00	0.00	0.00	0.02	0.05	0.09	0.06	0.09	0.07	0.18
4:20:00	0.00	0.00	0.02	0.03	0.07	0.04	0.07	0.05	0.14
4:25:00	0.00	0.00	0.01	0.03	0.05	0.03	0.05	0.04	0.10
4:30:00	0.00	0.00	0.01	0.02	0.04	0.03	0.04	0.03	0.08
4:35:00	0.00	0.00	0.01	0.01	0.03	0.02	0.03	0.03	0.06
4:40:00	0.00	0.00	0.01	0.01	0.02	0.01	0.02	0.02	0.05
4:45:00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.01	0.03
4:50:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02
4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 13-12b. Emergency Spillway Profile at Embankment

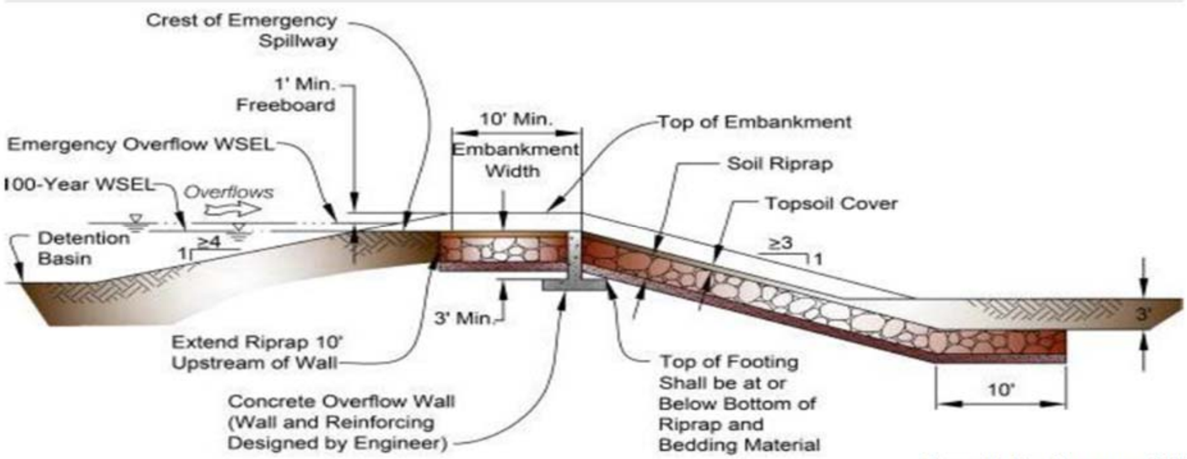
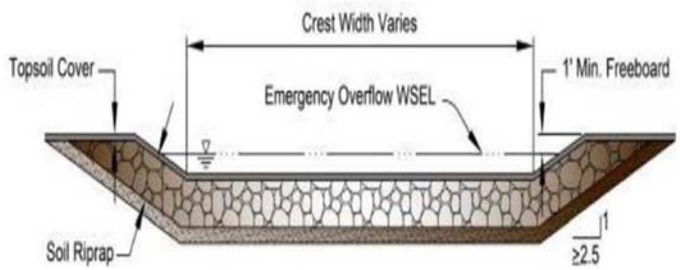


Figure 13-12c. Emergency Spillway Protection

Q=22.4 CFS
LENGTH=50 Feet
UNIT FLOW RATE: 0.45 CFS/FT

=> TYPE VL RIP RAP



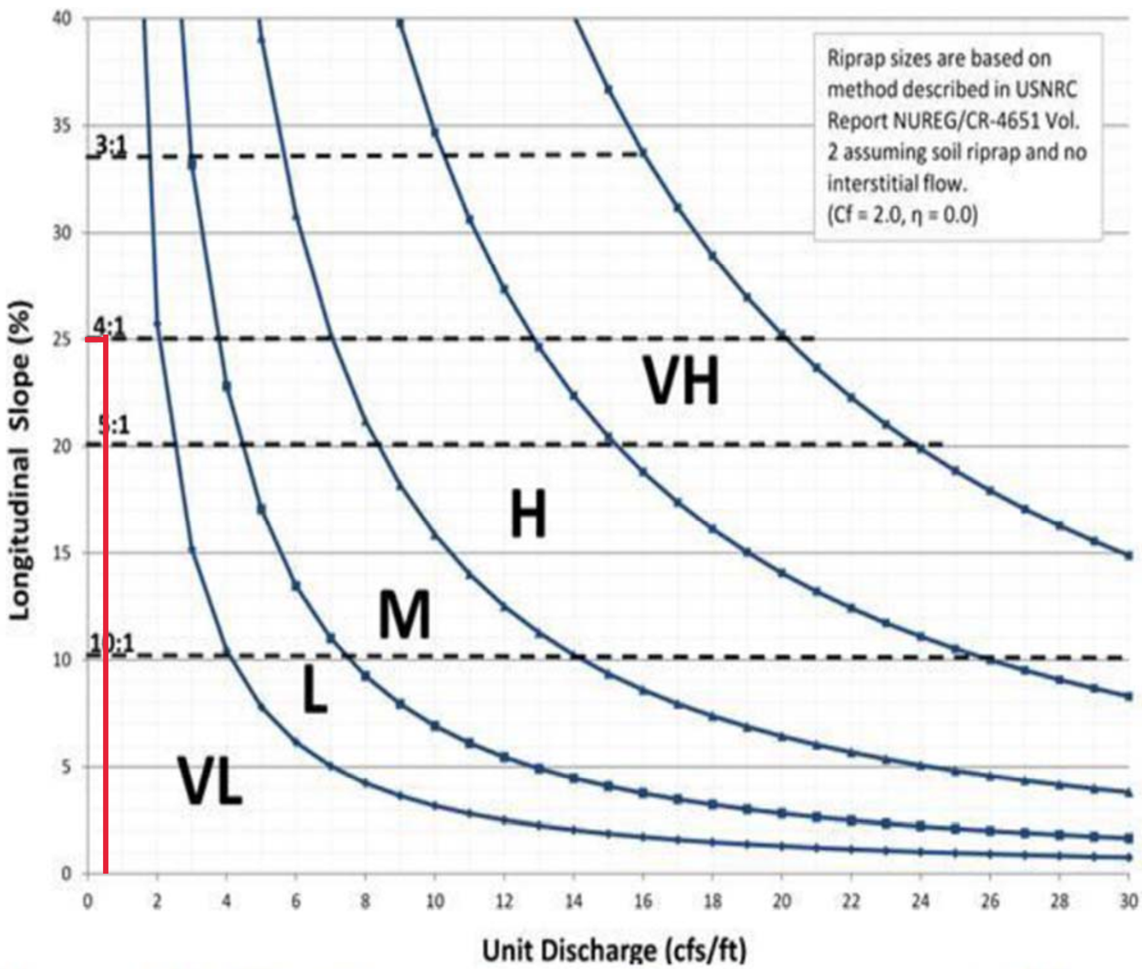


Figure 13-12d. Riprap Types for Emergency Spillway Protection

Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Sep 18 2023

Stilling Basin Outfall

Trapezoidal Weir

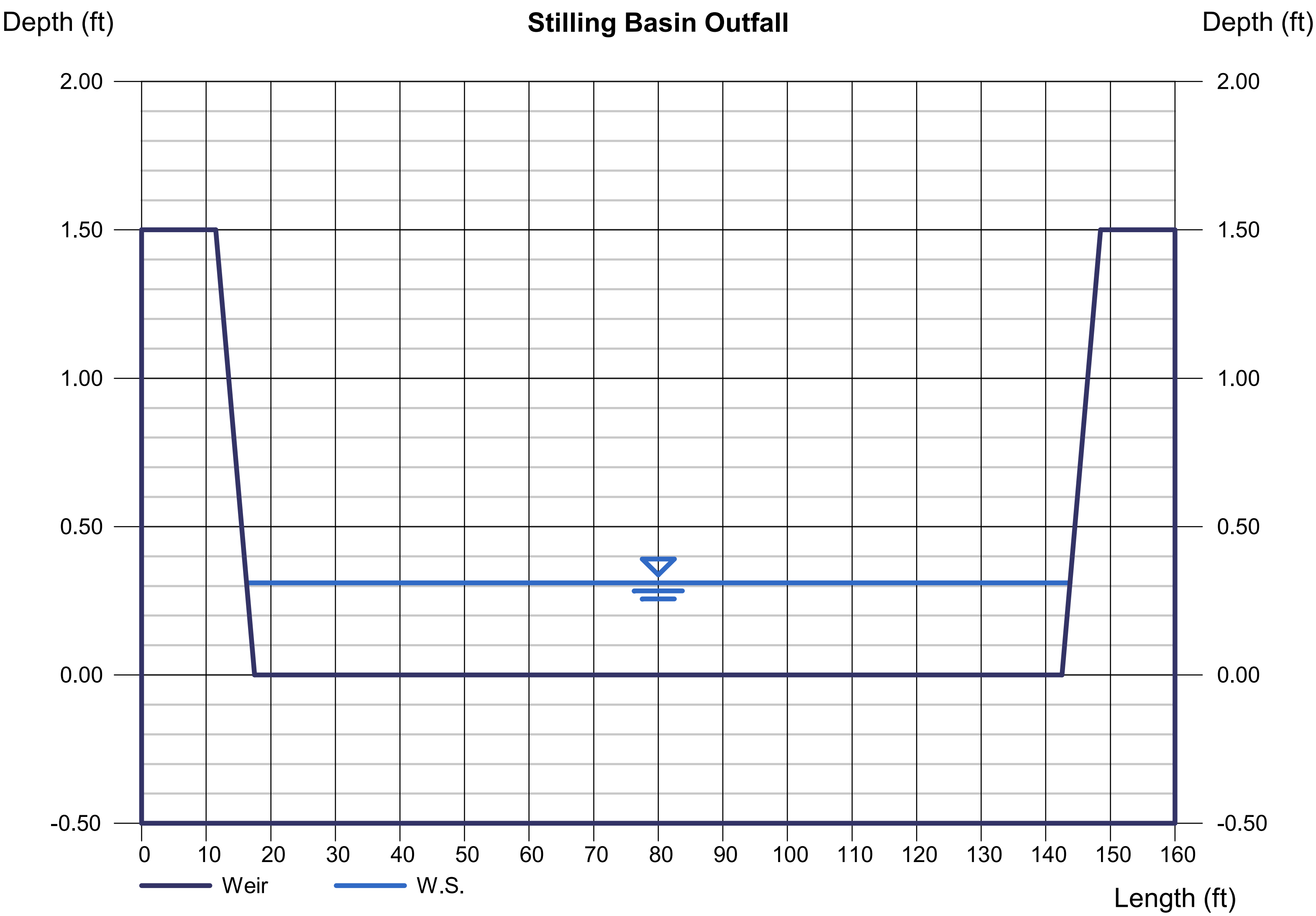
Crest	= Sharp
Bottom Length (ft)	= 125.00
Total Depth (ft)	= 1.50
Side Slope (z:1)	= 4.00

Calculations

Weir Coeff. Cw	= 3.10
Compute by:	Known Q
Known Q (cfs)	= 64.70

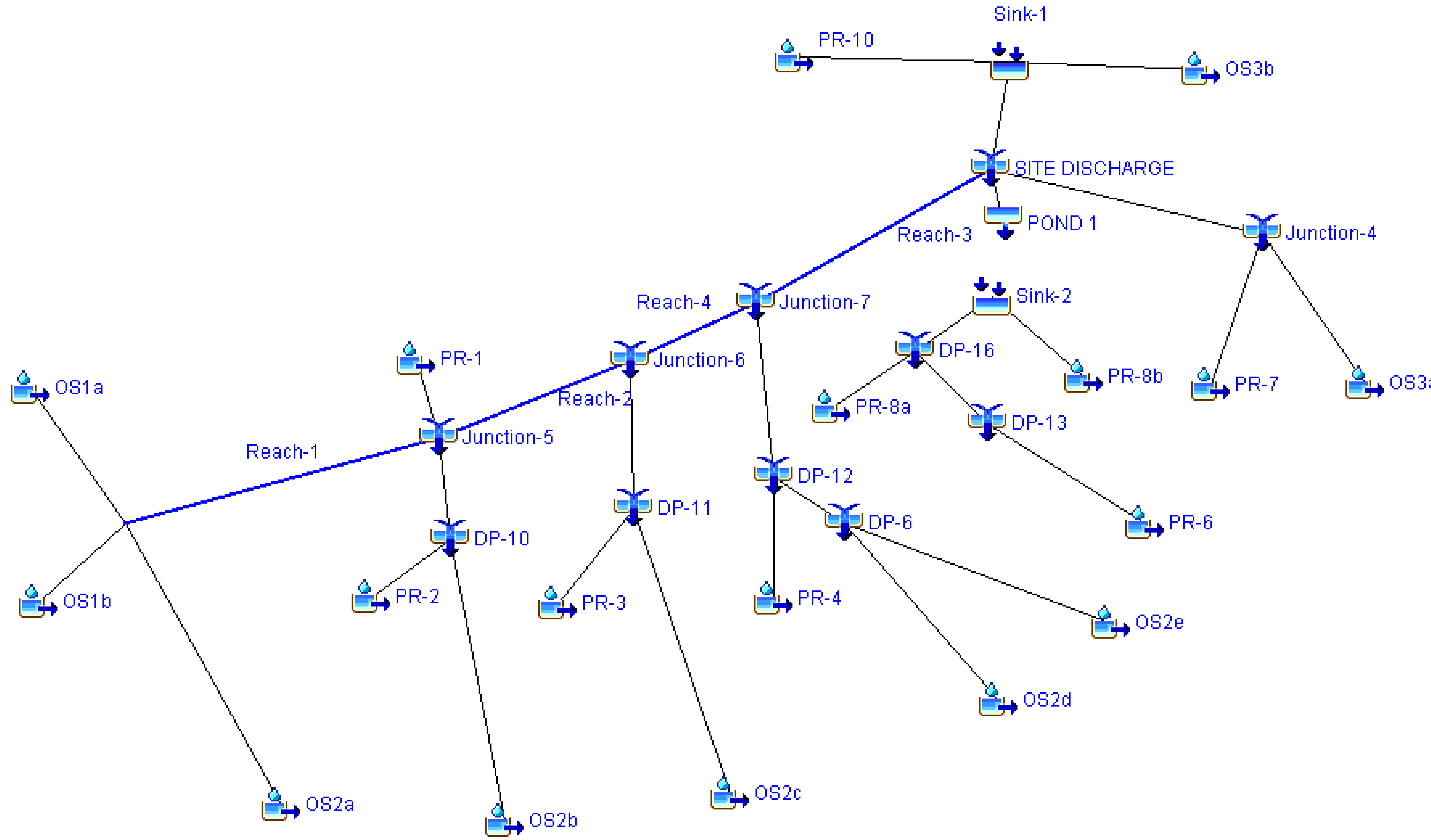
Highlighted

Depth (ft)	= 0.31
Q (cfs)	= 64.70
Area (sqft)	= 39.13
Velocity (ft/s)	= 1.65
Top Width (ft)	= 127.48



Model Name: **Hay_Creek_Forest_Manor**

These models reflect full development of the areas included in the Hay Creek development with full spectrum detention provided to maintain historic flows. Areas tributary to Pond 1 have been modeled to drain to "Sink 2" while the pond itself has been modeled using the outflow hydrographs from the MHFD-Detention Spreadsheet.

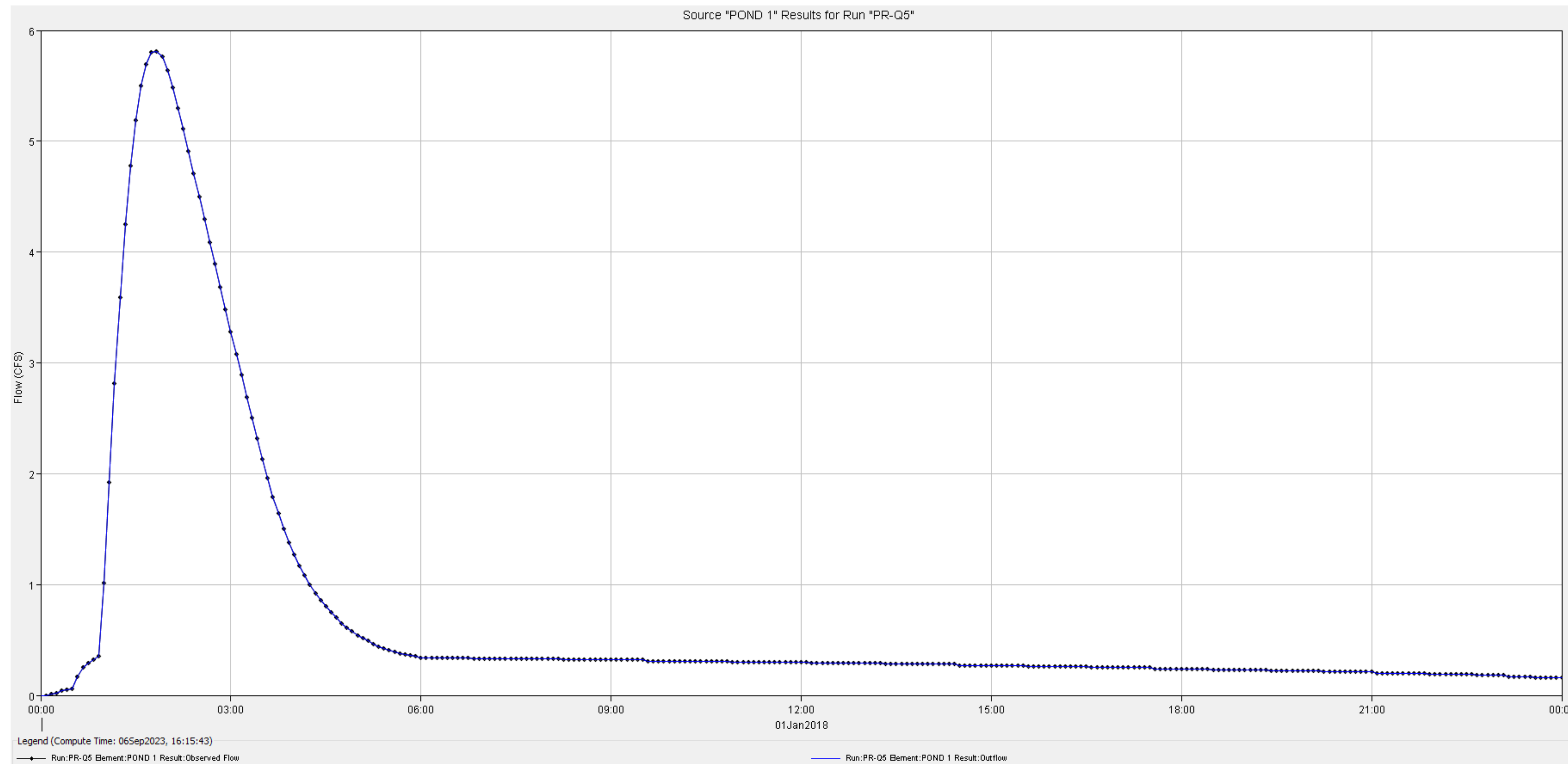


Project: Hay Creek Simulation Run: PR-Q5

Start of Run: 01Jan2018, 00:00 Basin Model: PR - HAY CREEK_FM
End of Run: 02Jan2018, 00:00 Meteorologic Model: 5 YEAR EVENT
Compute Time: 06Sep2023, 16:09:24 Control Specifications: 1 DAY

Volume Units: (●) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
DP-10	0.1205	3.7	01Jan2018, 12:50	0.14
DP-11a	0.0244	1.3	01Jan2018, 12:40	0.21
DP-11b	0.1449	5.0	01Jan2018, 12:50	0.16
DP-12	0.0385	2.1	01Jan2018, 12:35	0.20
DP-13	0.0189	1.0	01Jan2018, 12:35	0.21
DP-14	0.0535	2.7	01Jan2018, 12:40	0.21
DP-15	0.0699	3.7	01Jan2018, 12:40	0.21
DP-16	0.0286	1.2	01Jan2018, 12:40	0.17
DP-18	0.0773	6.6	01Jan2018, 12:50	0.39
DP-6	0.0092	0.5	01Jan2018, 12:30	0.20
Junction-5	0.2666	9.5	01Jan2018, 13:00	0.18
Junction-6	0.2855	10.0	01Jan2018, 13:05	0.18
Junction-7	0.3390	11.6	01Jan2018, 13:10	0.18
OS1a	0.0146	0.8	01Jan2018, 12:40	0.21
OS1b	0.0925	2.6	01Jan2018, 12:50	0.13
OS2a	0.0078	0.4	01Jan2018, 12:25	0.14
OS2b	0.0134	0.7	01Jan2018, 12:30	0.16
OS2c	0.0036	0.3	01Jan2018, 12:25	0.21
OS2d	0.0043	0.3	01Jan2018, 12:35	0.20
OS2e	0.0049	0.3	01Jan2018, 12:30	0.20
OS3a	0.0076	0.1	01Jan2018, 12:40	0.06
OS3b	0.0051	0.1	01Jan2018, 12:30	0.06
POND 1	0.0840	5.8	01Jan2018, 01:50	0.32
PR-10	0.0256	0.6	01Jan2018, 12:55	0.11
PR-1a	0.0202	0.9	01Jan2018, 12:50	0.21
PR-1b	0.0098	0.5	01Jan2018, 12:40	0.21
PR-1c	0.0832	3.4	01Jan2018, 13:00	0.21
PR-2	0.0251	1.4	01Jan2018, 12:35	0.21
PR-3	0.0153	0.8	01Jan2018, 12:40	0.21
PR-4	0.0443	2.2	01Jan2018, 12:45	0.21
PR-6	0.0699	3.7	01Jan2018, 12:40	0.21
PR-7	0.0210	1.1	01Jan2018, 12:40	0.21
PR-8a	0.0074	3.3	01Jan2018, 13:00	2.00
PR-8b	0.0006	0.8	01Jan2018, 12:15	2.66
Reach-1	0.1449	5.0	01Jan2018, 13:05	0.15
Reach-2	0.2666	9.4	01Jan2018, 13:10	0.18
Reach-3	0.3390	11.6	01Jan2018, 13:15	0.18
Reach-4	0.2855	10.0	01Jan2018, 13:15	0.18
Reach-5	0.0244	1.3	01Jan2018, 12:45	0.21
Reach-6	0.1205	3.7	01Jan2018, 12:50	0.14
Sink-1	0.4823	13.0	01Jan2018, 13:10	0.20
Sink-2	0.0779	6.8	01Jan2018, 12:45	0.40
SITE DISCH...	0.4516	12.5	01Jan2018, 13:15	0.21



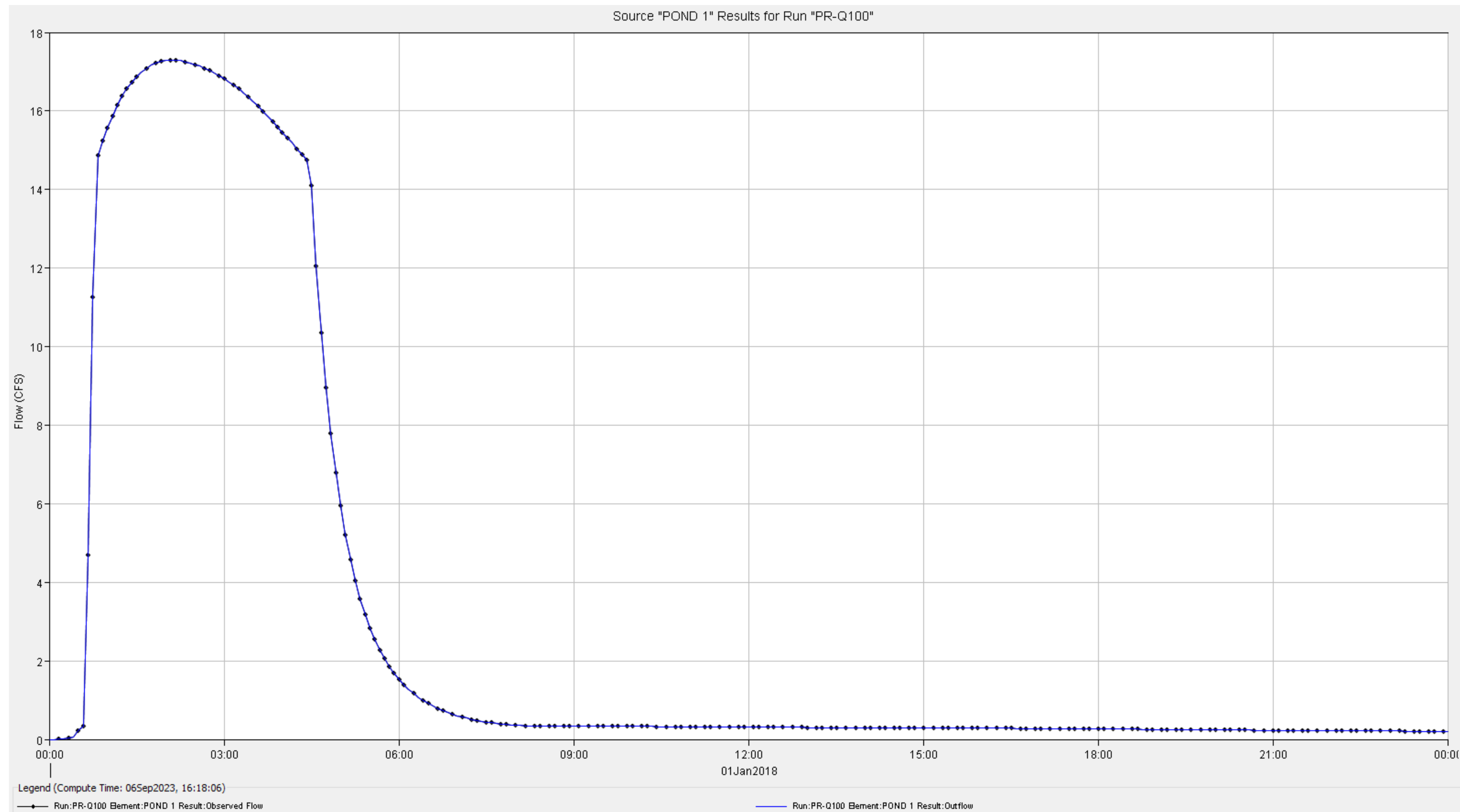
Project: Hay Creek Simulation Run: PR-Q100

Start of Run: 01Jan2018, 00:00
End of Run: 02Jan2018, 00:00
Compute Time: 06Sep2023, 16:18:06

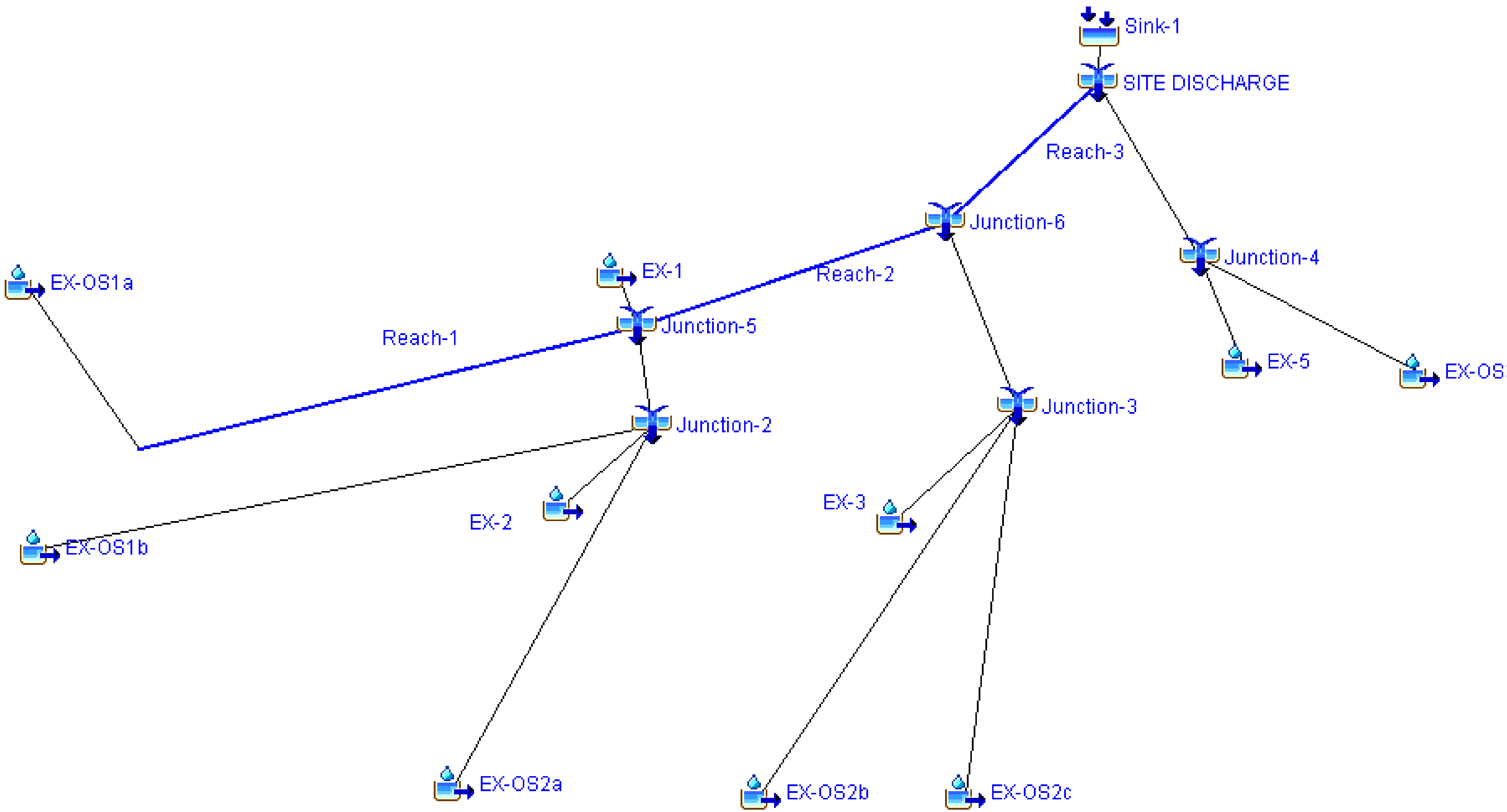
Basin Model: PR - HAY CREEK_FM
Meteorologic Model: 100 YEAR EVENT
Control Specifications: 1 DAY

Volume Units: (•) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
DP-10	0.1205	19.5	01Jan2018, 12:55	0.74
DP-11a	0.0244	6.1	01Jan2018, 12:45	0.92
DP-11b	0.1449	25.2	01Jan2018, 12:55	0.77
DP-12	0.0385	9.6	01Jan2018, 12:40	0.87
DP-13	0.0189	4.6	01Jan2018, 12:40	0.91
DP-14	0.0535	12.3	01Jan2018, 12:45	0.91
DP-15	0.0699	17.0	01Jan2018, 12:45	0.92
DP-16	0.0286	6.1	01Jan2018, 12:45	0.82
DP-18	0.0773	24.3	01Jan2018, 12:50	1.27
DP-6	0.0092	2.3	01Jan2018, 12:35	0.85
Junction-5	0.2666	46.9	01Jan2018, 13:05	0.82
Junction-6	0.2855	50.2	01Jan2018, 13:05	0.82
Junction-7	0.3390	60.0	01Jan2018, 13:05	0.83
OS1a	0.0146	3.6	01Jan2018, 12:45	0.92
OS1b	0.0925	14.2	01Jan2018, 13:00	0.70
OS2a	0.0078	1.8	01Jan2018, 12:30	0.71
OS2b	0.0134	3.2	01Jan2018, 12:35	0.76
OS2c	0.0036	1.2	01Jan2018, 12:25	0.89
OS2d	0.0043	1.1	01Jan2018, 12:40	0.86
OS2e	0.0049	1.3	01Jan2018, 12:35	0.84
OS3a	0.0076	0.9	01Jan2018, 12:50	0.53
OS3b	0.0051	0.8	01Jan2018, 12:35	0.53
POND 1	0.0840	17.3	01Jan2018, 02:05	1.40
PR-10	0.0256	3.4	01Jan2018, 13:05	0.65
PR-1a	0.0202	4.3	01Jan2018, 12:55	0.92
PR-1b	0.0098	2.5	01Jan2018, 12:45	0.92
PR-1c	0.0832	15.7	01Jan2018, 13:05	0.91
PR-2	0.0251	6.5	01Jan2018, 12:40	0.92
PR-3	0.0153	3.8	01Jan2018, 12:45	0.92
PR-4	0.0443	10.3	01Jan2018, 12:50	0.92
PR-6	0.0699	17.0	01Jan2018, 12:45	0.92
PR-7	0.0210	5.1	01Jan2018, 12:45	0.92
PR-8a	0.0074	7.8	01Jan2018, 13:00	4.55
PR-8b	0.0006	1.7	01Jan2018, 12:15	5.49
Reach-1	0.1449	25.0	01Jan2018, 13:05	0.76
Reach-2	0.2666	46.9	01Jan2018, 13:05	0.82
Reach-3	0.3390	59.7	01Jan2018, 13:10	0.83
Reach-4	0.2855	50.1	01Jan2018, 13:10	0.82
Reach-5	0.0244	6.1	01Jan2018, 12:45	0.92
Reach-6	0.1205	19.5	01Jan2018, 13:00	0.74
Sink-1	0.4823	68.6	01Jan2018, 13:05	0.92
Sink-2	0.0779	24.6	01Jan2018, 12:50	1.30
SITE DISCH...	0.4516	64.7	01Jan2018, 13:05	0.94



Model Name: **Hay_Creek_Forest_Manor**
These models reflect the existing conditions on the Hay Creek development.



Project: HAY_CREEK_FOREST_MANOR - UP   Simulation Run: EX-Q5

Start of Run: 01Jan2018, 00:00   Basin Model: EX - HAY CREEK_FM
End of Run: 02Jan2018, 00:00   Meteorologic Model: 5 YEAR EVENT
Compute Time: 28Mar2023, 08:56:35   Control Specifications: 1 DAY

Volume Units: (●) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
EX-1	0.0876	1.6	01Jan2018, 13:00	0.10
EX-2	0.0754	2.0	01Jan2018, 12:50	0.13
EX-3	0.0963	2.3	01Jan2018, 12:40	0.10
EX-5	0.0669	1.5	01Jan2018, 12:40	0.09
EX-OS1a	0.0146	0.8	01Jan2018, 12:40	0.23
EX-OS1b	0.0925	2.6	01Jan2018, 12:50	0.14
EX-OS2a	0.0248	1.5	01Jan2018, 12:25	0.18
EX-OS2b	0.0043	0.3	01Jan2018, 12:35	0.23
EX-OS2c	0.0049	0.3	01Jan2018, 12:30	0.22
EX-OS3	0.0127	0.2	01Jan2018, 12:30	0.07
Junction-2	0.1927	5.4	01Jan2018, 12:45	0.14
Junction-3	0.1055	2.9	01Jan2018, 12:35	0.11
Junction-4	0.0796	1.8	01Jan2018, 12:40	0.09
Junction-5	0.2949	7.5	01Jan2018, 12:50	0.13
Junction-6	0.4004	9.8	01Jan2018, 12:50	0.12
Reach-1	0.0146	0.8	01Jan2018, 13:00	0.23
Reach-2	0.2949	7.5	01Jan2018, 13:00	0.13
Reach-3	0.4004	9.8	01Jan2018, 12:55	0.12
Sink-1	0.4800	11.2	01Jan2018, 12:50	0.12
SITE DISCH...	0.4800	11.2	01Jan2018, 12:50	0.12

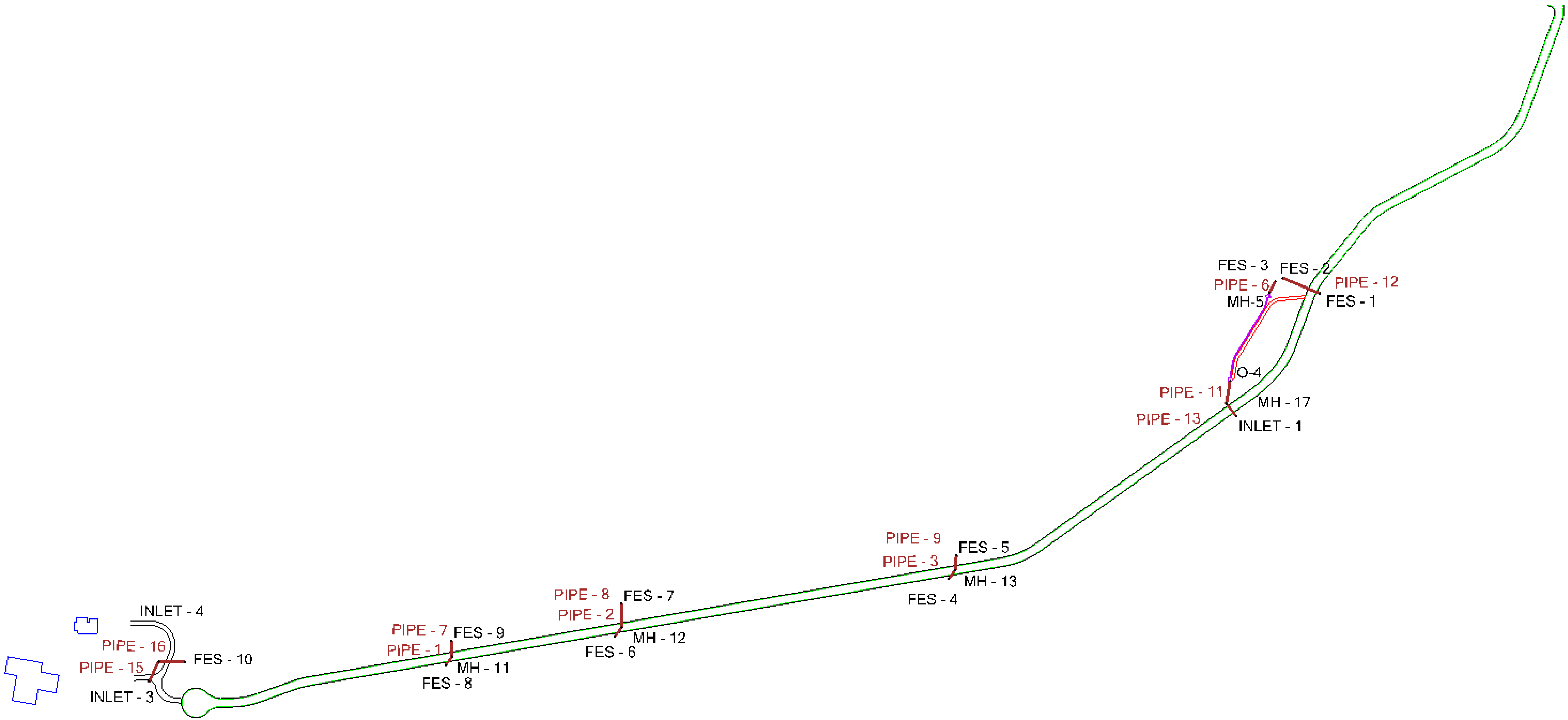
Project: HAY_CREEK_FOREST_MANOR - UP   Simulation Run: EX-Q100

Start of Run: 01Jan2018, 00:00   Basin Model: EX - HAY CREEK_FM
End of Run: 02Jan2018, 00:00   Meteorologic Model: 100 YEAR EVENT
Compute Time: 28Mar2023, 08:57:29   Control Specifications: 1 DAY

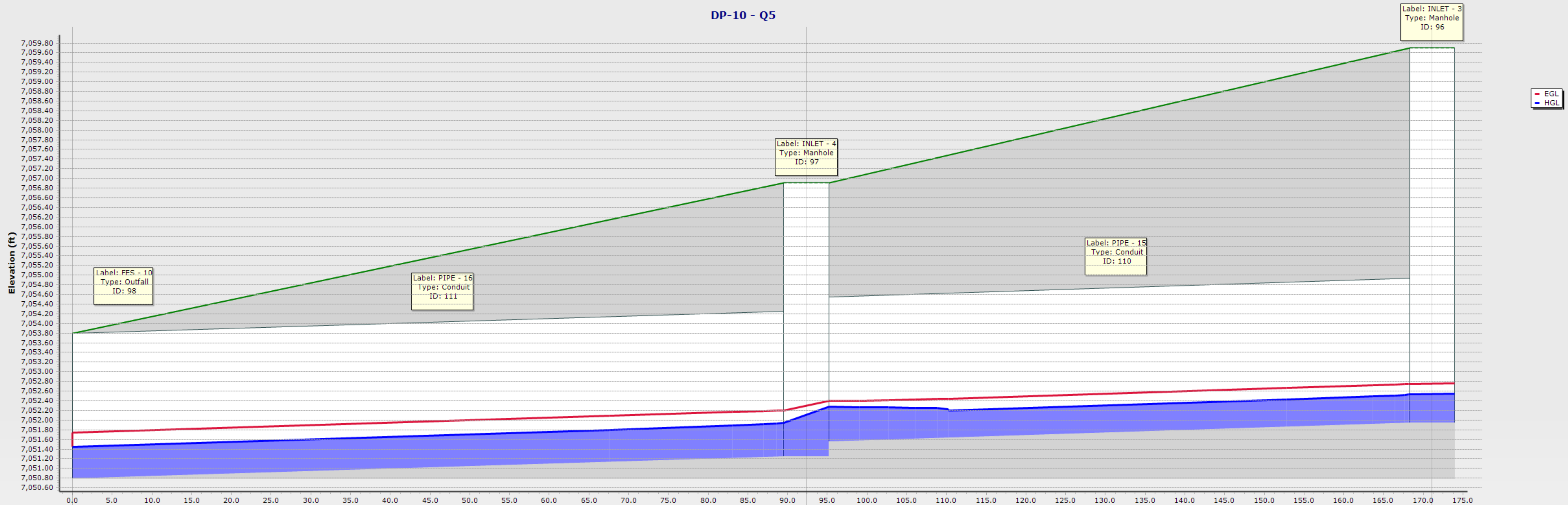
Volume Units: (●) IN ( ) AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
EX-1	0.0876	9.9	01Jan2018, 13:15	0.62
EX-2	0.0754	11.2	01Jan2018, 13:00	0.69
EX-3	0.0963	14.7	01Jan2018, 12:45	0.62
EX-5	0.0669	10.0	01Jan2018, 12:45	0.61
EX-OS1a	0.0146	4.1	01Jan2018, 12:45	1.01
EX-OS1b	0.0925	15.7	01Jan2018, 13:00	0.76
EX-OS2a	0.0248	8.0	01Jan2018, 12:30	0.89
EX-OS2b	0.0043	1.4	01Jan2018, 12:35	1.01
EX-OS2c	0.0049	1.6	01Jan2018, 12:30	0.99
EX-OS3	0.0127	2.0	01Jan2018, 12:40	0.57
Junction-2	0.1927	30.9	01Jan2018, 12:55	0.75
Junction-3	0.1055	17.4	01Jan2018, 12:45	0.65
Junction-4	0.0796	11.9	01Jan2018, 12:45	0.60
Junction-5	0.2949	43.9	01Jan2018, 13:00	0.72
Junction-6	0.4004	59.2	01Jan2018, 12:55	0.70
Reach-1	0.0146	4.1	01Jan2018, 12:55	1.00
Reach-2	0.2949	43.8	01Jan2018, 13:00	0.72
Reach-3	0.4004	59.1	01Jan2018, 13:00	0.70
Sink-1	0.4800	69.9	01Jan2018, 12:55	0.68
SITE DISCH...	0.4800	69.9	01Jan2018, 12:55	0.68

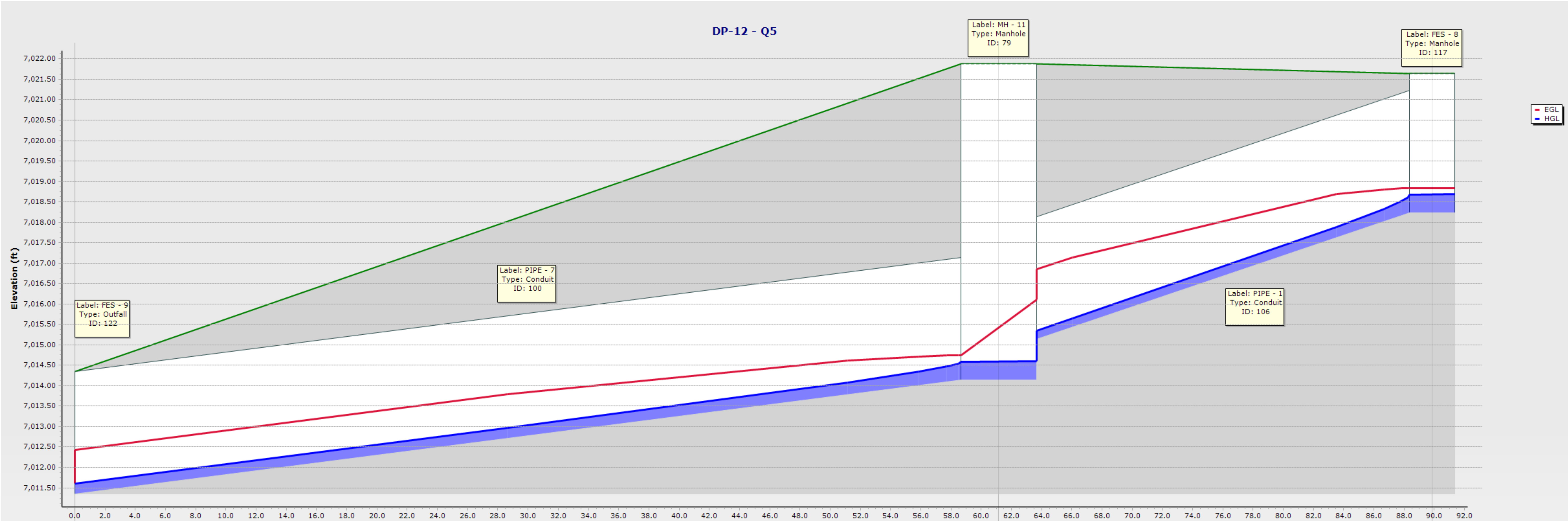
StormCAD LAYOUT



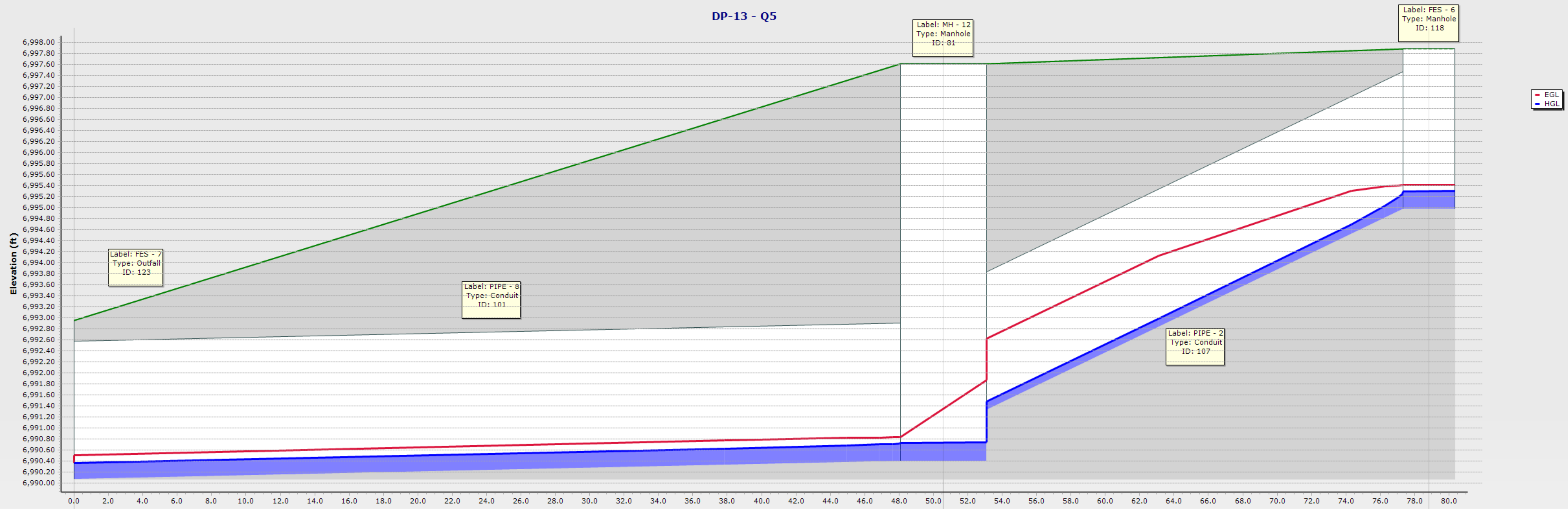
DP-10 - Q5



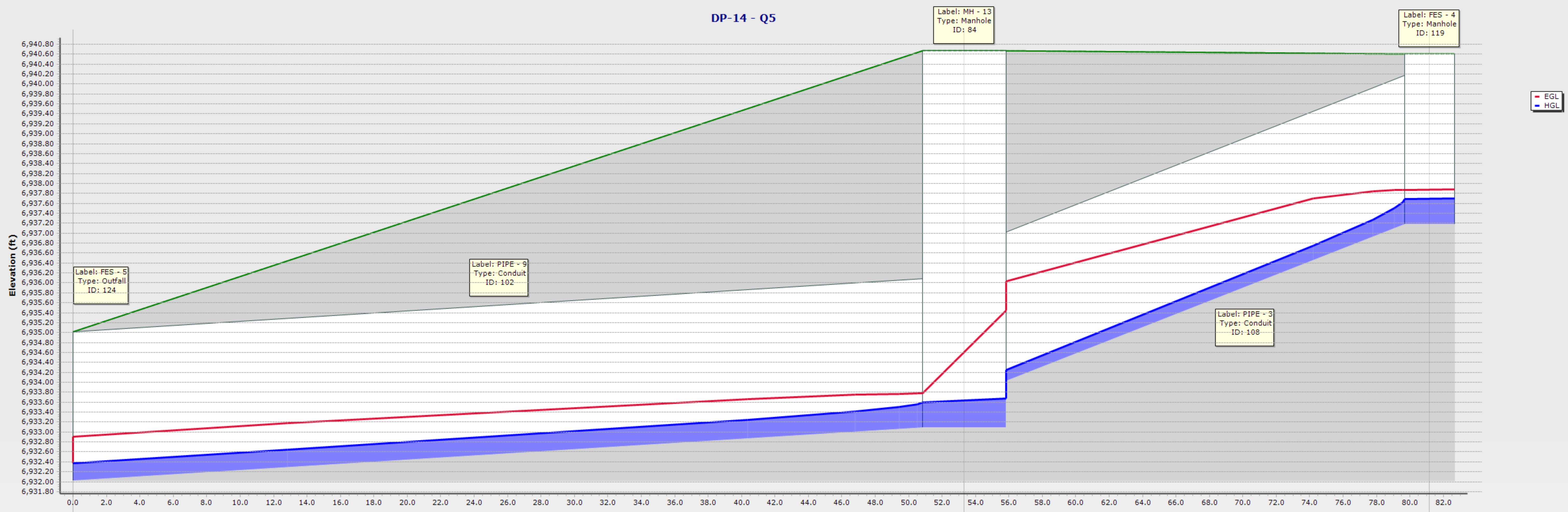
ID\Label		111 \ PIPE - 16		110 \ PIPE - 15	
Link Length (ft)		92.3		78.8	
Rise (in)\Material		36.0 \ Concrete		36.0 \ Concrete	
Flow (cfs)		5.00		3.70	
Slope (ft/ft)		0.005		0.005	
ID\Label	98 \ FES - 10		97 \ INLET - 4		96 \ INLET - 3
Ground (ft)	7053.79		7056.91		7059.70
Invert (ft)	7050.79		7051.25		7051.94
Station (ft)	0.0		92.3		171.1



ID\Label		100 \ PIPE - 7		106 \ PIPE - 1	
Link Length (ft)		61.2		28.7	
Rise (in)\Material		36.0 \ Concrete		36.0 \ Concrete	
Flow (cfs)		2.10		2.10	
Slope (ft/ft)		0.046		0.108	
ID\Label	122 \ FES - 9		79 \ MH - 11		117 \ FES - 8
Ground (ft)	7014.35		7021.88		7021.65
Invert (ft)	7011.35		7014.14		7018.23
Station (ft)	0.0		61.2		89.9



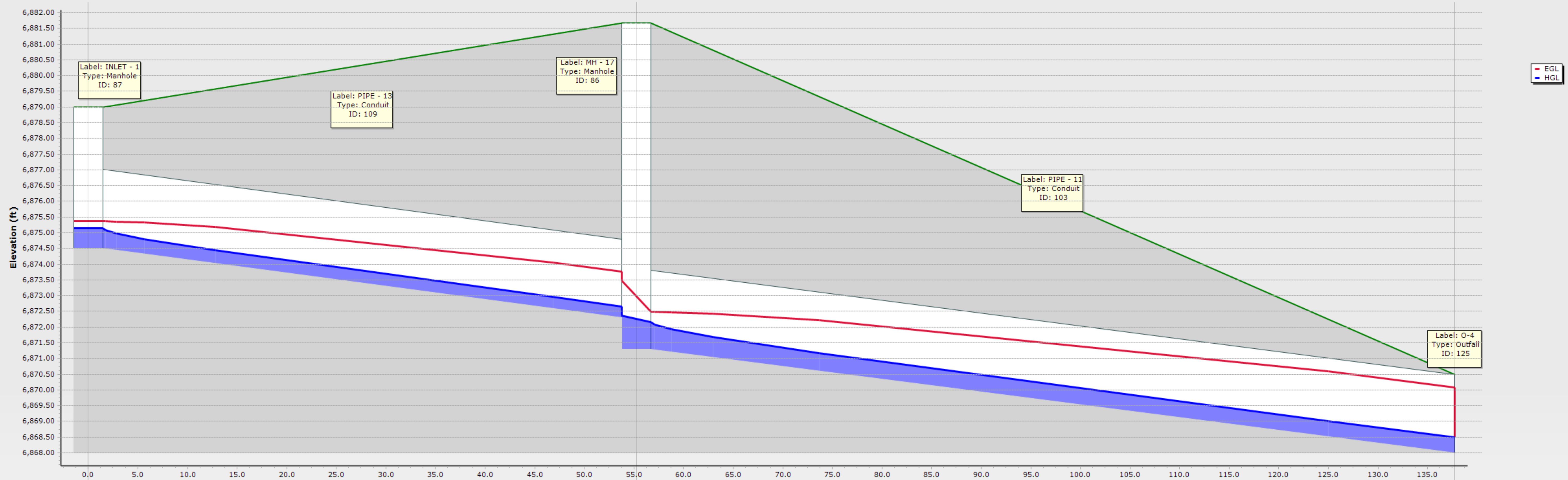
ID\Label		101 \ PIPE - 8		107 \ PIPE - 2	
Link Length (ft)		50.6		28.3	
Rise (in)\Material		30.0 \ Concrete		30.0 \ Concrete	
Flow (cfs)		1.00		1.00	
Slope (ft/ft)		0.007		0.129	
ID\Label	23 \ FES - 7		81 \ MH - 12		118 \ FES - 6
Ground (ft)	6992.95		6997.61		6997.88
Invert (ft)	6990.07		6990.40		6994.97
Station (ft)	0.0		50.6		78.8



ID\Label	102 \ PIPE - 9	108 \ PIPE - 3
Link Length (ft)	53.3	27.8
Rise (in)\Material	36.0 \ Concrete	36.0 \ Concrete
Flow (cfs)	2.70	2.70
Slope (ft/ft)	0.020	0.113

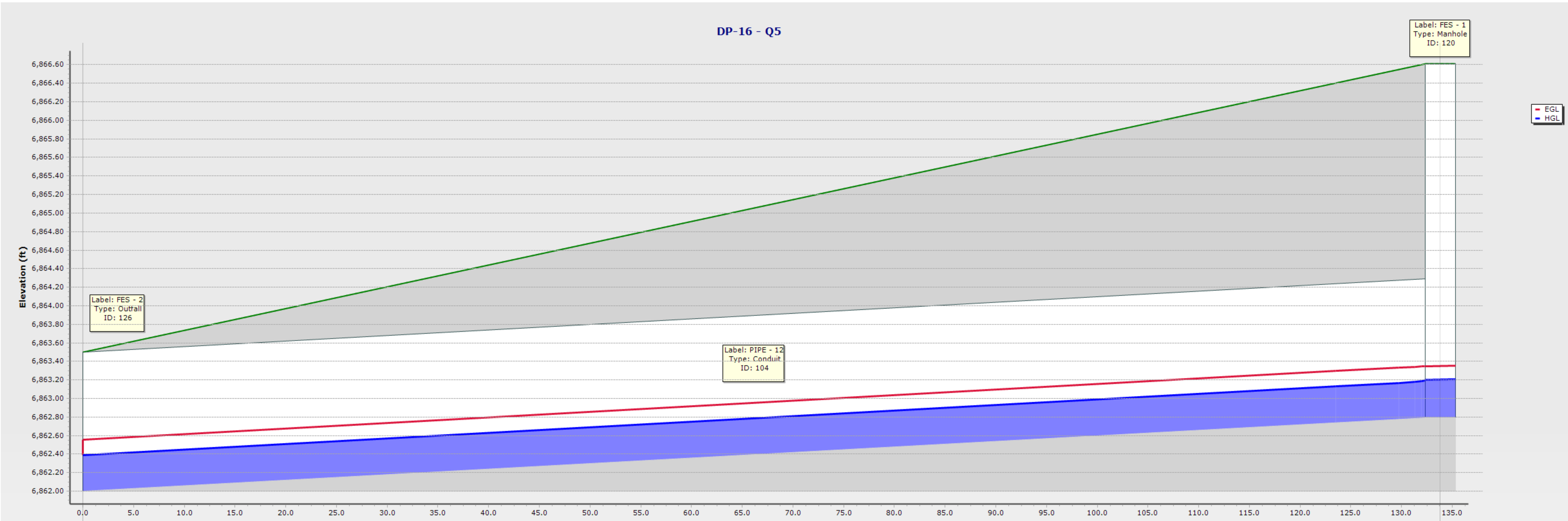
ID\Label	124 \ FES - 5	84 \ MH - 13	119 \ FES - 4
Ground (ft)	6935.02	6940.67	6940.60
Invert (ft)	6932.02	6933.09	6937.18
Station (ft)	0.0	53.3	81.2

DP-15 - Q5

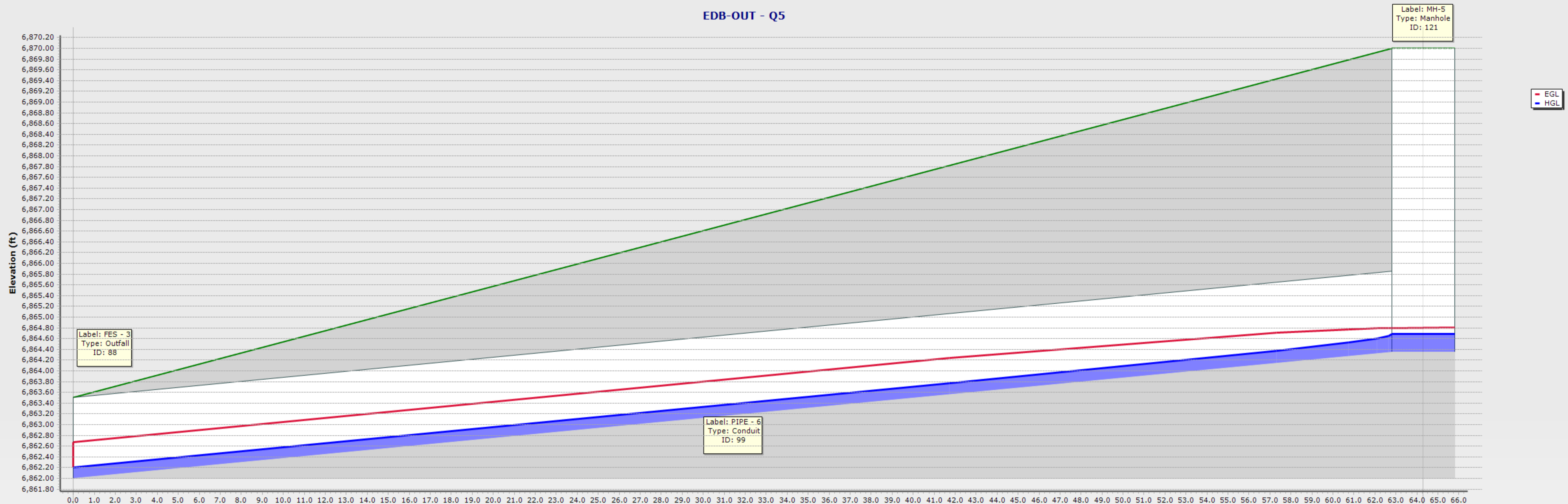


ID\Label	109 \ PIPE - 13		103 \ PIPE - 11
Link Length (ft)	55.2		82.5
Rise (in)\Material	30.0 \ Concrete		30.0 \ Concrete
Flow (cfs)	3.70		6.80
Slope (ft/ft)	0.040		0.040

ID\Label	87 \ INLET - 1	86 \ MH - 17	125 \ O-4
Ground (ft)	6879.00	6881.67	6870.50
Invert (ft)	6874.51	6871.30	6868.00
Station (ft)	0.0	55.2	137.7



ID\Label	104 \ PIPE - 12	
Link Length (ft)	133.8	
Rise (in)\Material	18.0 \ Concrete	
Flow (cfs)	1.20	
Slope (ft/ft)	0.006	
ID\Label	126 \ FES - 2	120 \ FES - 1
Ground (ft)	6863.50	6866.61
Invert (ft)	6862.00	6862.79
Station (ft)	0.0	133.8



ID\Label	99 \ PIPE - 6	
Link Length (ft)	64.3	
Rise (in)\Material	18.0 \ Concrete	
Flow (cfs)	0.80	
Slope (ft/ft)	0.037	
ID\Label	88 \ FES - 3	121 \ MH-5
Ground (ft)	6863.50	6870.00
Invert (ft)	6862.00	6864.35
Station (ft)	0.0	64.3

	Label	Velocity (ft/s)	Start Node	Invert (Start) (ft)	Hydraulic Grade Line (In) (ft)	Invert (Stop) (ft)	Hydraulic Grade Line (Out) (ft)	Stop Node	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Manning's n	Flow (cfs)	Capacity (Design) (cfs)	Depth (Normal) / Rise (%)	Diameter (in)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)
99: PIPE - 6	PIPE - 6	5.53	MH-5	6,864.35	6,864.68	6,862.00	6,862.20	FES - 3	64.3	0.037	0.013	0.80	20.08	13.6	18.0	6,870.00	6,863.50
100: PIPE - 7	PIPE - 7	7.28	MH - 11	7,014.14	7,014.59	7,011.35	7,011.60	FES - 9	61.2	0.046	0.013	2.10	142.45	8.5	36.0	7,021.88	7,014.35
101: PIPE - 8	PIPE - 8	3.02	MH - 12	6,990.40	6,990.72	6,990.07	6,990.37	FES - 7	50.6	0.007	0.013	1.00	33.13	11.9	30.0	6,997.61	6,992.95
102: PIPE - 9	PIPE - 9	5.89	MH - 13	6,933.09	6,933.60	6,932.02	6,932.37	FES - 5	53.3	0.020	0.013	2.70	94.48	11.6	36.0	6,940.67	6,935.02
103: PIPE - 11	PIPE - 11	10.11	MH - 17	6,871.30	6,872.16	6,868.00	6,868.49	O-4	82.5	0.040	0.013	6.80	82.04	19.5	30.0	6,881.67	6,870.50
104: PIPE - 12	PIPE - 12	3.28	FES - 1	6,862.79	6,863.20	6,862.00	6,862.39	FES - 2	133.8	0.006	0.013	1.20	8.07	26.1	18.0	6,866.61	6,863.50
106: PIPE - 1	PIPE - 1	9.82	FES - 8	7,018.23	7,018.68	7,015.14	7,015.35	MH - 11	28.7	0.108	0.013	2.10	218.84	6.9	36.0	7,021.65	7,021.88
107: PIPE - 2	PIPE - 2	8.56	FES - 6	6,994.97	6,995.29	6,991.33	6,991.48	MH - 12	28.3	0.129	0.013	1.00	147.20	5.9	30.0	6,997.88	6,997.61
108: PIPE - 3	PIPE - 3	10.79	FES - 4	6,937.18	6,937.69	6,934.02	6,934.25	MH - 13	27.9	0.113	0.013	2.70	224.66	7.7	36.0	6,940.60	6,940.67
109: PIPE - 13	PIPE - 13	8.45	INLET - 1	6,874.51	6,875.14	6,872.30	6,872.66	MH - 17	55.2	0.040	0.013	3.70	82.03	14.5	30.0	6,879.00	6,881.67
110: PIPE - 15	PIPE - 15	3.96	INLET - 3	7,051.94	7,052.54	7,051.55	7,052.28	INLET - 4	78.8	0.005	0.013	3.70	46.93	19.0	36.0	7,059.70	7,056.91
111: PIPE - 16	PIPE - 16	4.33	INLET - 4	7,051.25	7,051.95	7,050.79	7,051.45	FES - 10	92.3	0.005	0.013	5.00	47.07	22.0	36.0	7,056.91	7,053.79

Figure 1- Q5 CONDUIT SUMMARY

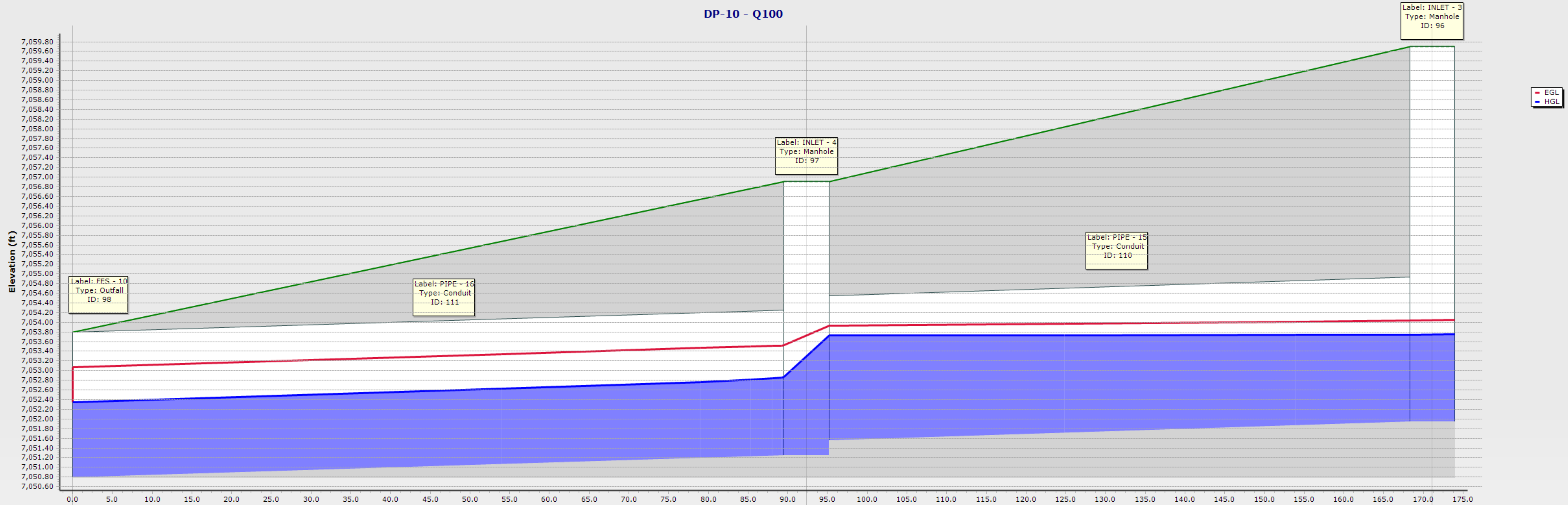
	ID	Label	Flow (Known) (cfs)	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Depth (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Headloss Coefficient (Standard)	Flow (Total Out) (cfs)
79: MH - 11	79	MH - 11	2.10	7,021.88	7,021.88	0.45	7,014.61	7,014.59	Standard	0.100	2.10
81: MH - 12	81	MH - 12	1.00	6,997.61	6,997.61	0.32	6,990.74	6,990.72	Standard	0.100	1.00
84: MH - 13	84	MH - 13	2.70	6,940.67	6,940.67	0.51	6,933.67	6,933.60	Standard	0.400	2.70
86: MH - 17	86	MH - 17	6.80	6,881.67	6,881.67	0.86	6,872.37	6,872.16	Standard	0.640	6.80
87: INLET - 1	87	INLET - 1	3.70	6,879.00	6,879.00	0.63	6,875.15	6,875.14	Standard	0.050	3.70
96: INLET - 3	96	INLET - 3	3.70	7,059.70	7,059.70	0.60	7,052.55	7,052.54	Standard	0.050	3.70
97: INLET - 4	97	INLET - 4	5.00	7,056.91	7,056.91	0.70	7,052.28	7,051.95	Standard	1.320	5.00
117: FES - 8	117	FES - 8	2.10	7,021.65	7,021.65	0.45	7,018.69	7,018.68	Standard	0.050	2.10
118: FES - 6	118	FES - 6	1.00	6,997.88	6,997.88	0.32	6,995.30	6,995.29	Standard	0.050	1.00
119: FES - 4	119	FES - 4	2.70	6,940.60	6,940.60	0.51	6,937.70	6,937.69	Standard	0.050	2.70
120: FES - 1	120	FES - 1	1.20	6,866.61	6,866.61	0.41	6,863.21	6,863.20	Standard	0.050	1.20
121: MH-5	121	MH-5	0.80	6,870.00	6,870.00	0.33	6,864.69	6,864.68	Standard	0.050	0.80

Figure 2- Q5 NODE SUMMARY

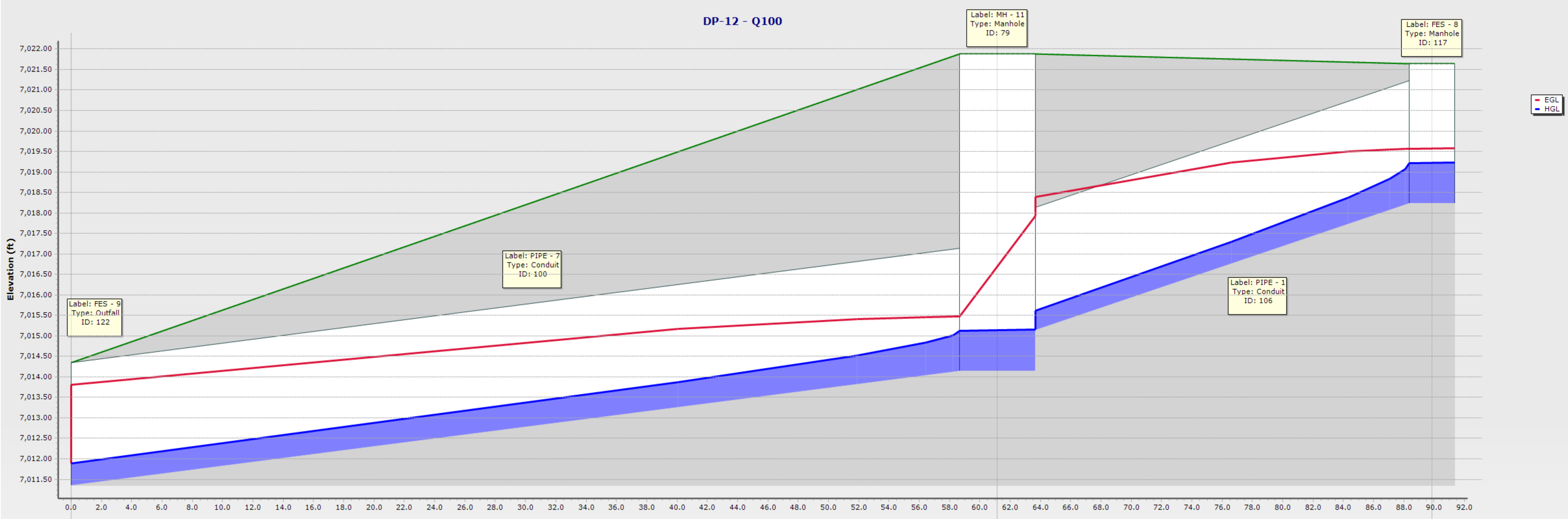
	ID	Label	Elevation (Ground) (ft)	Set Rim to Ground Elevation?	Elevation (Invert) (ft)	Boundary Condition Type	Hydraulic Grade (ft)	Flow (Total Out) (cfs)
88: FES - 3	88	FES - 3	6,863.50	☑	6,862.00	Free Outfall	6,862.20	0.80
98: FES - 10	98	FES - 10	7,053.79	☑	7,050.79	Free Outfall	7,051.45	5.00
122: FES - 9	122	FES - 9	7,014.35	☑	7,011.35	Free Outfall	7,011.60	2.10
123: FES - 7	123	FES - 7	6,992.95	☑	6,990.07	Free Outfall	6,990.37	1.00
124: FES - 5	124	FES - 5	6,935.02	☑	6,932.02	Free Outfall	6,932.37	2.70
125: O-4	125	O-4	6,870.50	☑	6,868.00	User Defined Tailwater	6,868.49	6.80
126: FES - 2	126	FES - 2	6,863.50	☑	6,862.00	Free Outfall	6,862.39	1.20

Figure 3- Q5 OUTFALL SUMMARY

why is free outfall selected and tailwater is not analyzed for 6 of the 7 storm drain outfalls? If there's a reason please add a note/discuss.

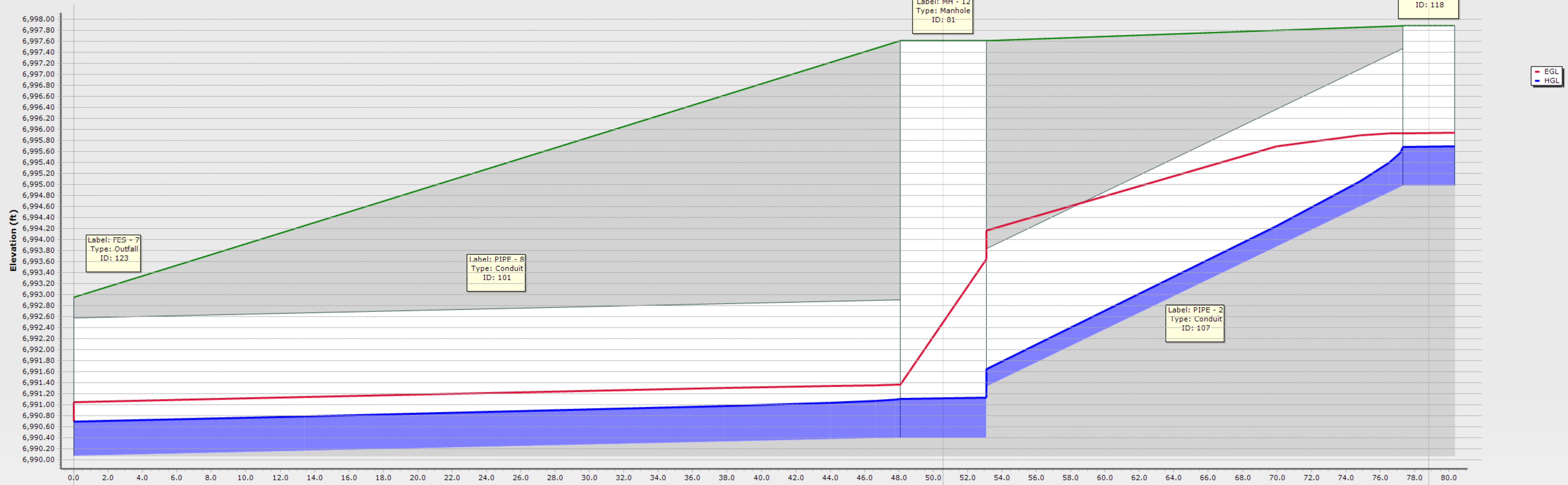


ID\Label		111 \ PIPE - 16		110 \ PIPE - 15	
Link Length (ft)		92.3		78.8	
Rise (in)\Material		36.0 \ Concrete		36.0 \ Concrete	
Flow (cfs)		25.20		19.50	
Slope (ft/ft)		0.005		0.005	
ID\Label	98 \ FES - 10		97 \ INLET - 4		96 \ INLET - 3
Ground (ft)	7053.79		7056.91		7059.70
Invert (ft)	7050.79		7051.25		7051.94
Station (ft)	0.0		92.3		171.1



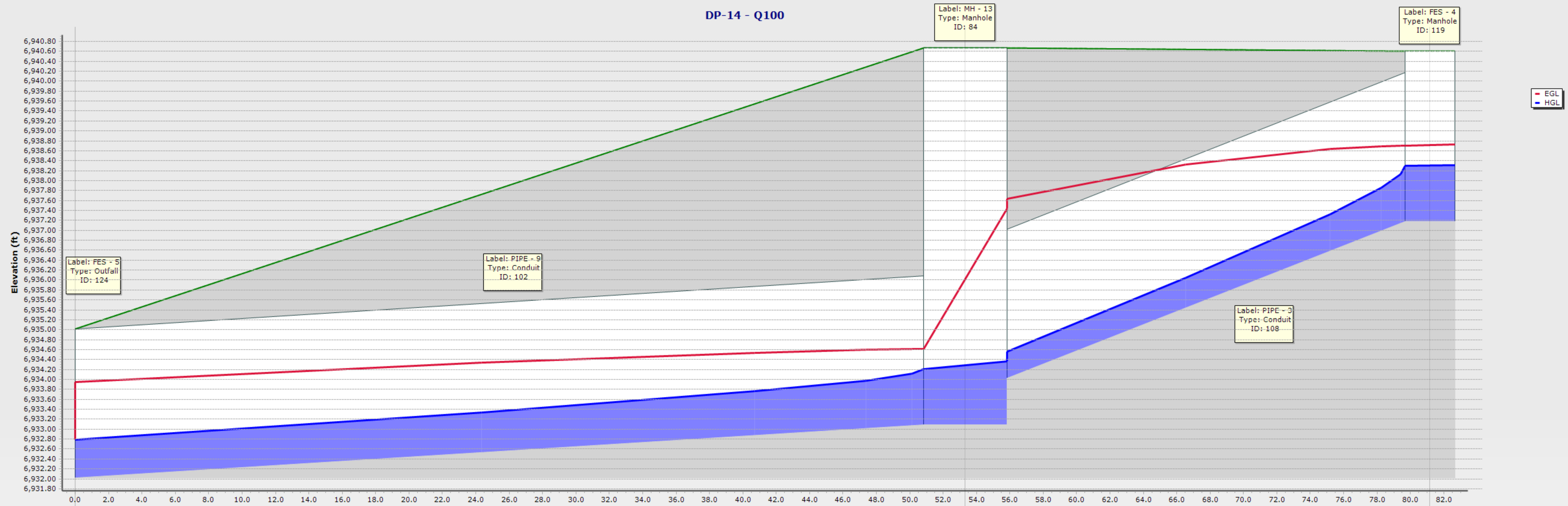
ID\Label	100 \ PIPE - 7		106 \ PIPE - 1
Link Length (ft)	61.2		28.7
Rise (in)\Material	36.0 \ Concrete		36.0 \ Concrete
Flow (cfs)	9.60		9.60
Slope (ft/ft)	0.046		0.108
ID\Label	122 \ FES - 9	79 \ MH - 11	117 \ FES - 8
Ground (ft)	7014.35	7021.88	7021.65
Invert (ft)	7011.35	7014.14	7018.23
Station (ft)	0.0	61.2	89.9

DP-13 - Q100



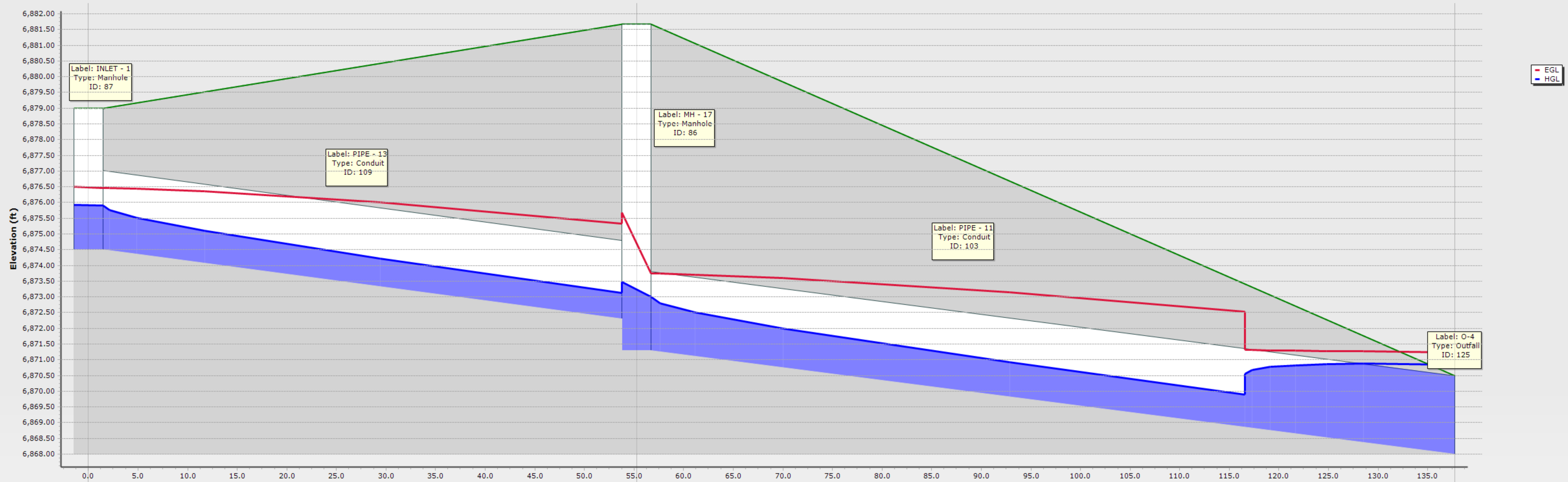
ID\Label	101 \ PIPE - 8	107 \ PIPE - 2
Link Length (ft)	50.6	28.3
Rise (in)\Material	30.0 \ Concrete	30.0 \ Concrete
Flow (cfs)	4.60	4.60
Slope (ft/ft)	0.007	0.129

ID\Label	123 \ FES - 7	81 \ MH - 12	118 \ FES - 6
Ground (ft)	6992.95	6997.61	6997.88
Invert (ft)	6990.07	6990.40	6994.97
Station (ft)	0.0	50.6	78.8

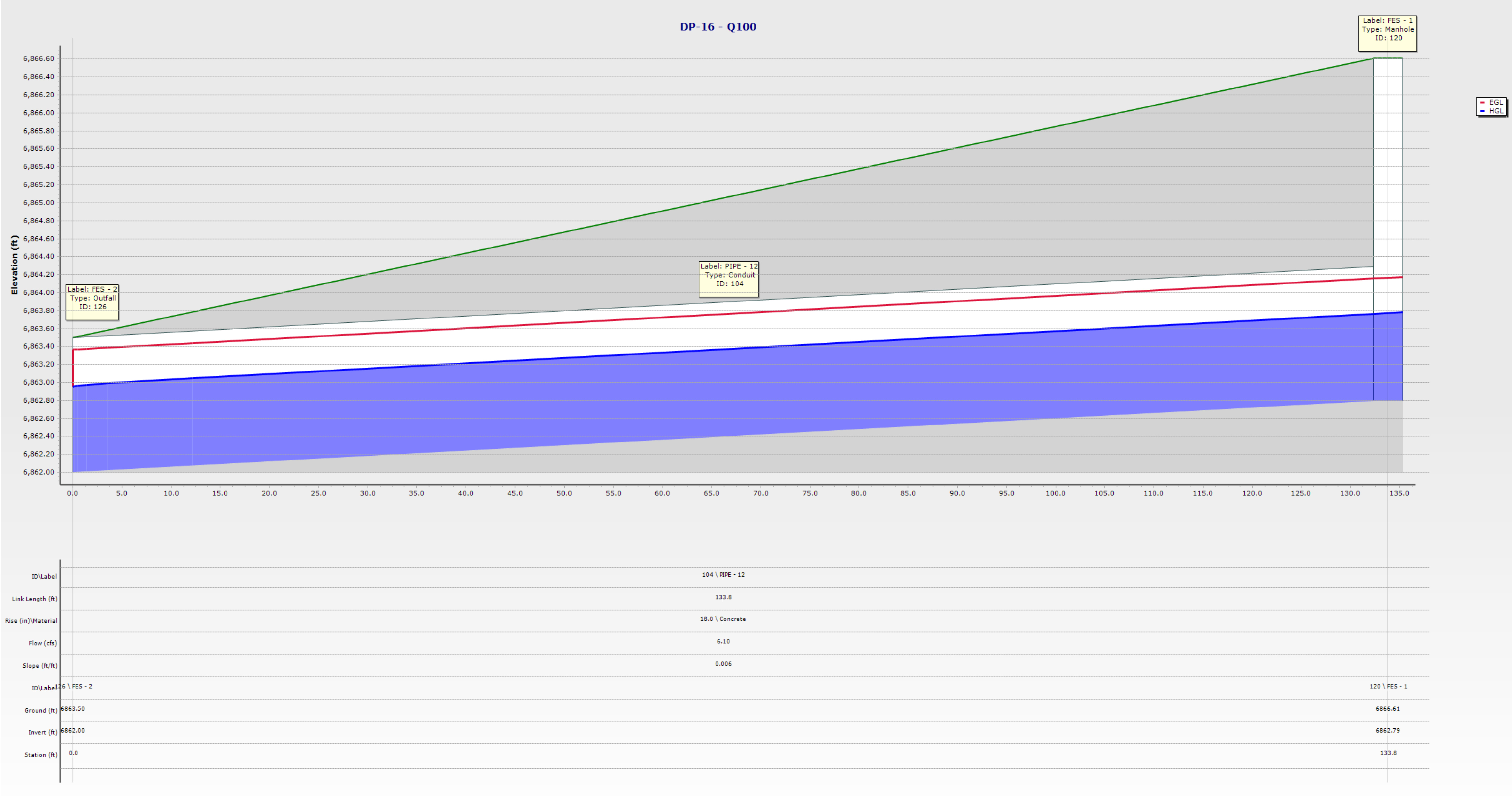


ID\Label		102 \ PIPE - 9		108 \ PIPE - 3	
Link Length (ft)		53.3		27.8	
Rise (in)\Material		36.0 \ Concrete		36.0 \ Concrete	
Flow (cfs)		12.30		12.30	
Slope (ft/ft)		0.020		0.113	
ID\Label	124 \ FES - 5		84 \ MH - 13		119 \ FES - 4
Ground (ft)	6935.02		6940.67		6940.60
Invert (ft)	6932.02		6933.09		6937.18
Station (ft)	0.0		53.3		81.2

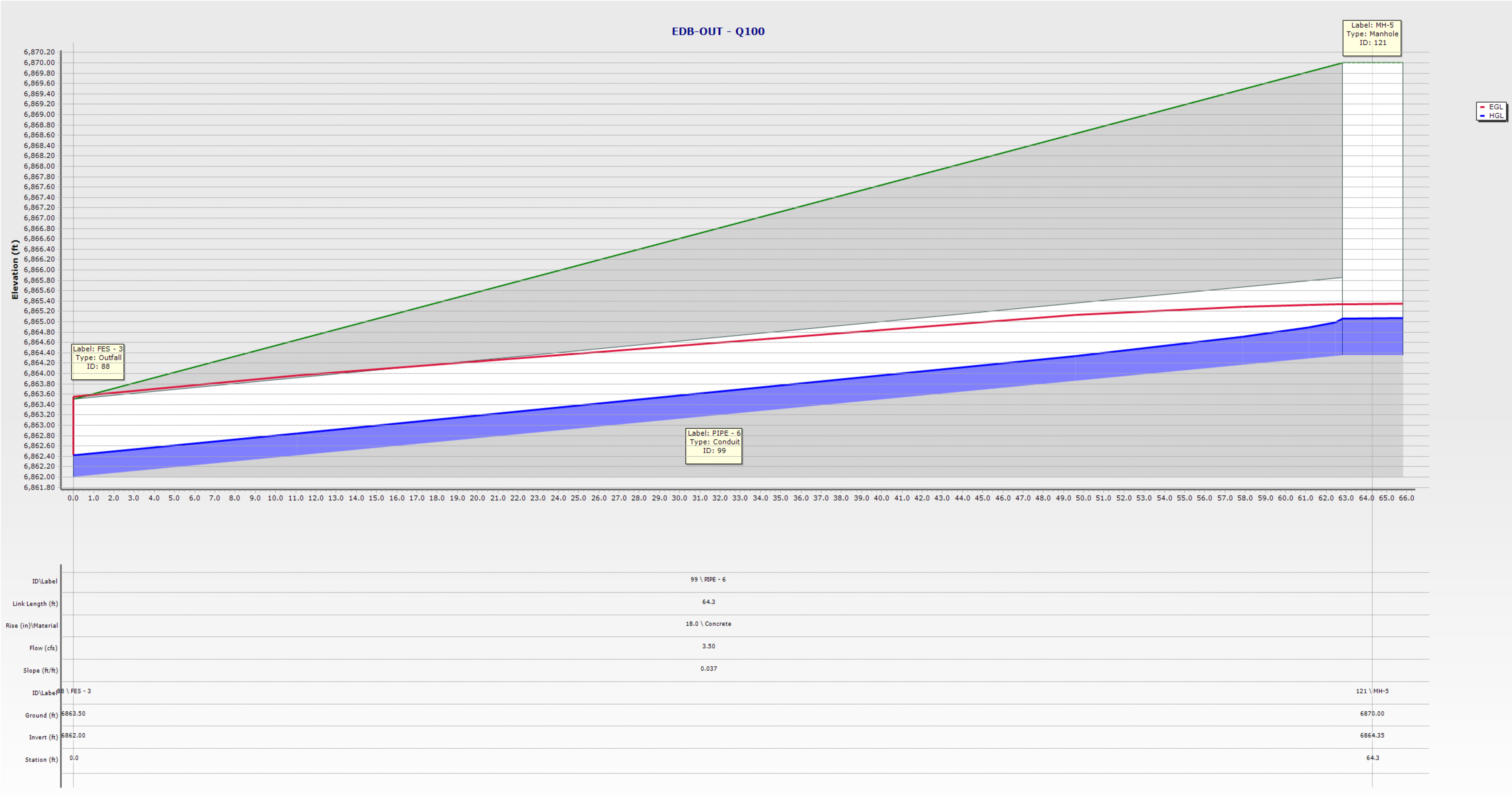
DP-15 - Q100



ID\Label		109 \ PIPE - 13		103 \ PIPE - 11	
Link Length (ft)		55.2		82.5	
Rise (in)\Material		30.0 \ Concrete		30.0 \ Concrete	
Flow (cfs)		17.00		24.70	
Slope (ft/ft)		0.040		0.040	
ID\Label	87 \ INLET - 1		86 \ MH - 17		125 \ O-4
Ground (ft)	6879.00		6881.67		6870.50
Invert (ft)	6874.51		6871.30		6868.00
Station (ft)	0.0		55.2		137.7



DP-16 - Q100
Label: FES - 1
Type: Manhole
ID: 120
Label: PIPE - 12
Type: Conduit
ID: 104
Label: FES - 2
Type: Outfall
ID: 126
EGL
HGL
Elevation (ft)
6,866.60
6,866.40
6,866.20
6,866.00
6,865.80
6,865.60
6,865.40
6,865.20
6,865.00
6,864.80
6,864.60
6,864.40
6,864.20
6,864.00
6,863.80
6,863.60
6,863.40
6,863.20
6,863.00
6,862.80
6,862.60
6,862.40
6,862.20
6,862.00
0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0 55.0 60.0 65.0 70.0 75.0 80.0 85.0 90.0 95.0 100.0 105.0 110.0 115.0 120.0 125.0 130.0 135.0
ID\Label: 104 \ PIPE - 12
Link Length (ft): 133.8
Rise (in)\Material: 18.0 \ Concrete
Flow (cfs): 6.10
Slope (ft/ft): 0.006
ID\Label: 126 \ FES - 2; 120 \ FES - 1
Ground (ft): 6863.50; 6866.61
Invert (ft): 6862.00; 6862.79
Station (ft): 0.0; 133.8



EDB-OUT - Q100
Elevation (ft)
Label: MH-5
Type: Manhole
ID: 121
EGL
HGL
Label: FES - 3
Type: Outfall
ID: 88
Label: PIPE - 6
Type: Conduit
ID: 99
ID\Label
99 \ PIPE - 6
Link Length (ft)
64.3
Rise (in)\Material
18.0 \ Concrete
Flow (cfs)
3.50
Slope (ft/ft)
0.037
ID\Label
88 \ FES - 3
121 \ MH-5
Ground (ft)
6863.50
6870.00
Invert (ft)
6862.00
6864.35
Station (ft)
0.0
64.3

	Label	Velocity (ft/s)	Start Node	Invert (Start) (ft)	Hydraulic Grade Line (In) (ft)	Invert (Stop) (ft)	Hydraulic Grade Line (Out) (ft)	Stop Node	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Manning's n	Flow (cfs)	Capacity (Design) (cfs)	Depth (Normal) / Rise (%)	Diameter (in)	Elevation Ground (Start) (ft)	Elevation Ground (Stop) (ft)
99: PIPE - 6	PIPE - 6	8.53	MH-5	6,864.35	6,865.06	6,862.00	6,862.42	FES - 3	64.3	0.037	0.013	3.50	20.08	28.2	18.0	6,870.00	6,863.50
100: PIPE - 7	PIPE - 7	11.48	MH - 11	7,014.14	7,015.12	7,011.35	7,011.89	FES - 9	61.2	0.046	0.013	9.60	142.45	17.6	36.0	7,021.88	7,014.35
101: PIPE - 8	PIPE - 8	4.75	MH - 12	6,990.40	6,991.11	6,990.07	6,990.70	FES - 7	50.6	0.007	0.013	4.60	33.13	25.2	30.0	6,997.61	6,992.95
102: PIPE - 9	PIPE - 9	9.23	MH - 13	6,933.09	6,934.20	6,932.02	6,932.78	FES - 5	53.3	0.020	0.013	12.30	94.48	24.4	36.0	6,940.67	6,935.02
103: PIPE - 11	PIPE - 11	14.63	MH - 17	6,871.30	6,872.99	6,868.00	6,870.84	O-4	82.5	0.040	0.013	24.70	82.04	37.6	30.0	6,881.67	6,870.50
104: PIPE - 12	PIPE - 12	5.02	FES - 1	6,862.79	6,863.76	6,862.00	6,862.95	FES - 2	133.8	0.006	0.013	6.10	8.07	65.0	18.0	6,866.61	6,863.50
106: PIPE - 1	PIPE - 1	15.52	FES - 8	7,018.23	7,019.21	7,015.14	7,015.62	MH - 11	28.7	0.108	0.013	9.60	218.84	14.3	36.0	7,021.65	7,021.88
107: PIPE - 2	PIPE - 2	13.58	FES - 6	6,994.97	6,995.68	6,991.33	6,991.65	MH - 12	28.3	0.129	0.013	4.60	147.20	12.1	30.0	6,997.88	6,997.61
108: PIPE - 3	PIPE - 3	17.01	FES - 4	6,937.18	6,938.29	6,934.02	6,934.56	MH - 13	27.9	0.113	0.013	12.30	224.66	15.9	36.0	6,940.60	6,940.67
109: PIPE - 13	PIPE - 13	13.18	INLET - 1	6,874.51	6,875.90	6,872.30	6,873.13	MH - 17	55.2	0.040	0.013	17.00	82.03	30.9	30.0	6,879.00	6,881.67
110: PIPE - 15	PIPE - 15	6.33	INLET - 3	7,051.94	7,053.74	7,051.55	7,053.73	INLET - 4	78.8	0.005	0.013	19.50	46.93	44.9	36.0	7,059.70	7,056.91
111: PIPE - 16	PIPE - 16	6.77	INLET - 4	7,051.25	7,052.87	7,050.79	7,052.35	FES - 10	92.3	0.005	0.013	25.20	47.07	52.1	36.0	7,056.91	7,053.79

Figure 4- Q100 CONDUIT SUMMARY

	ID	Label	Flow (Known) (cfs)	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Depth (Out) (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Headloss Coefficient (Standard)	Flow (Total Out) (cfs)
79: MH - 11	79	MH - 11	9.60	7,021.88	7,021.88	0.98	7,015.16	7,015.12	Standard	0.100	9.60
81: MH - 12	81	MH - 12	4.60	6,997.61	6,997.61	0.71	6,991.13	6,991.11	Standard	0.100	4.60
84: MH - 13	84	MH - 13	12.30	6,940.67	6,940.67	1.11	6,934.37	6,934.20	Standard	0.400	12.30
86: MH - 17	86	MH - 17	24.70	6,881.67	6,881.67	1.69	6,873.48	6,872.99	Standard	0.640	24.70
87: INLET - 1	87	INLET - 1	17.00	6,879.00	6,879.00	1.39	6,875.93	6,875.90	Standard	0.050	17.00
96: INLET - 3	96	INLET - 3	19.50	7,059.70	7,059.70	1.80	7,053.75	7,053.74	Standard	0.050	19.50
97: INLET - 4	97	INLET - 4	25.20	7,056.91	7,056.91	1.62	7,053.73	7,052.87	Standard	1.320	25.20
117: FES - 8	117	FES - 8	9.60	7,021.65	7,021.65	0.98	7,019.23	7,019.21	Standard	0.050	9.60
118: FES - 6	118	FES - 6	4.60	6,997.88	6,997.88	0.71	6,995.69	6,995.68	Standard	0.050	4.60
119: FES - 4	119	FES - 4	12.30	6,940.60	6,940.60	1.11	6,938.31	6,938.29	Standard	0.050	12.30
120: FES - 1	120	FES - 1	6.10	6,866.61	6,866.61	0.97	6,863.78	6,863.76	Standard	0.050	6.10
121: MH-5	121	MH-5	3.50	6,870.00	6,870.00	0.71	6,865.08	6,865.06	Standard	0.050	3.50

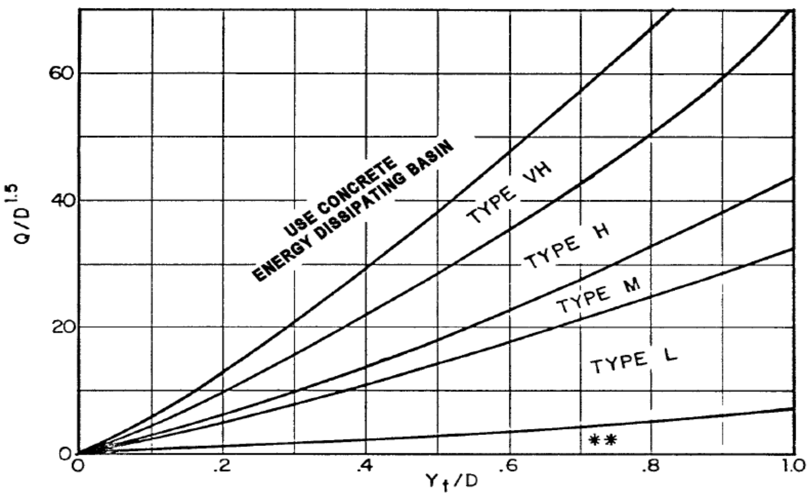
Figure 5- Q100 NODE SUMMARY

	ID	Label	Elevation (Ground) (ft)	Set Rim to Ground Elevation?	Elevation (Invert) (ft)	Boundary Condition Type	Hydraulic Grade (ft)	Flow (Total Out) (cfs)
88: FES - 3	88	FES - 3	6,863.50	☑	6,862.00	Free Outfall	6,862.42	3.50
98: FES - 10	98	FES - 10	7,053.79	☑	7,050.79	Free Outfall	7,052.35	25.20
122: FES - 9	122	FES - 9	7,014.35	☑	7,011.35	Free Outfall	7,011.89	9.60
123: FES - 7	123	FES - 7	6,992.95	☑	6,990.07	Free Outfall	6,990.70	4.60
124: FES - 5	124	FES - 5	6,935.02	☑	6,932.02	Free Outfall	6,932.78	12.30
125: O-4	125	O-4	6,870.50	☑	6,868.00	User Defined Tailwater	6,870.84	24.70
126: FES - 2	126	FES - 2	6,863.50	☑	6,862.00	Free Outfall	6,862.95	6.10

Figure 6- Q100 OUTFALL SUMMARY

why is free outfall selected and tailwater is not analyzed for 6 of the 7 storm drain outfalls? If there's a reason please add a note/discuss.

	DP16		DP EDB-OUT	
Pipe Size (D)	18	Inches	18	Inches
Q	6.1	cfs	17.3	cfs
L	4.5	Feet	4.5	Feet
W	4.5	Feet	4.5	Feet
D	0	Feet	0	Feet
d50	0.07	Feet	0.31	Feet
	0.87	Inches	3.69	Inches
Depth of Flow	1.56	Feet	1.12	Feet
Q/D^1.5	3.32		9.42	
Yt/D	1.040		0.747	
Rip Rap	Type L for 3 x Pipe Dia Downstream		Type L for 3 x Pipe Dia Downstream	
Length of Rock	4.5	Feet	4.5	Feet
Width of Rock	4.5	Feet	4.5	Feet



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

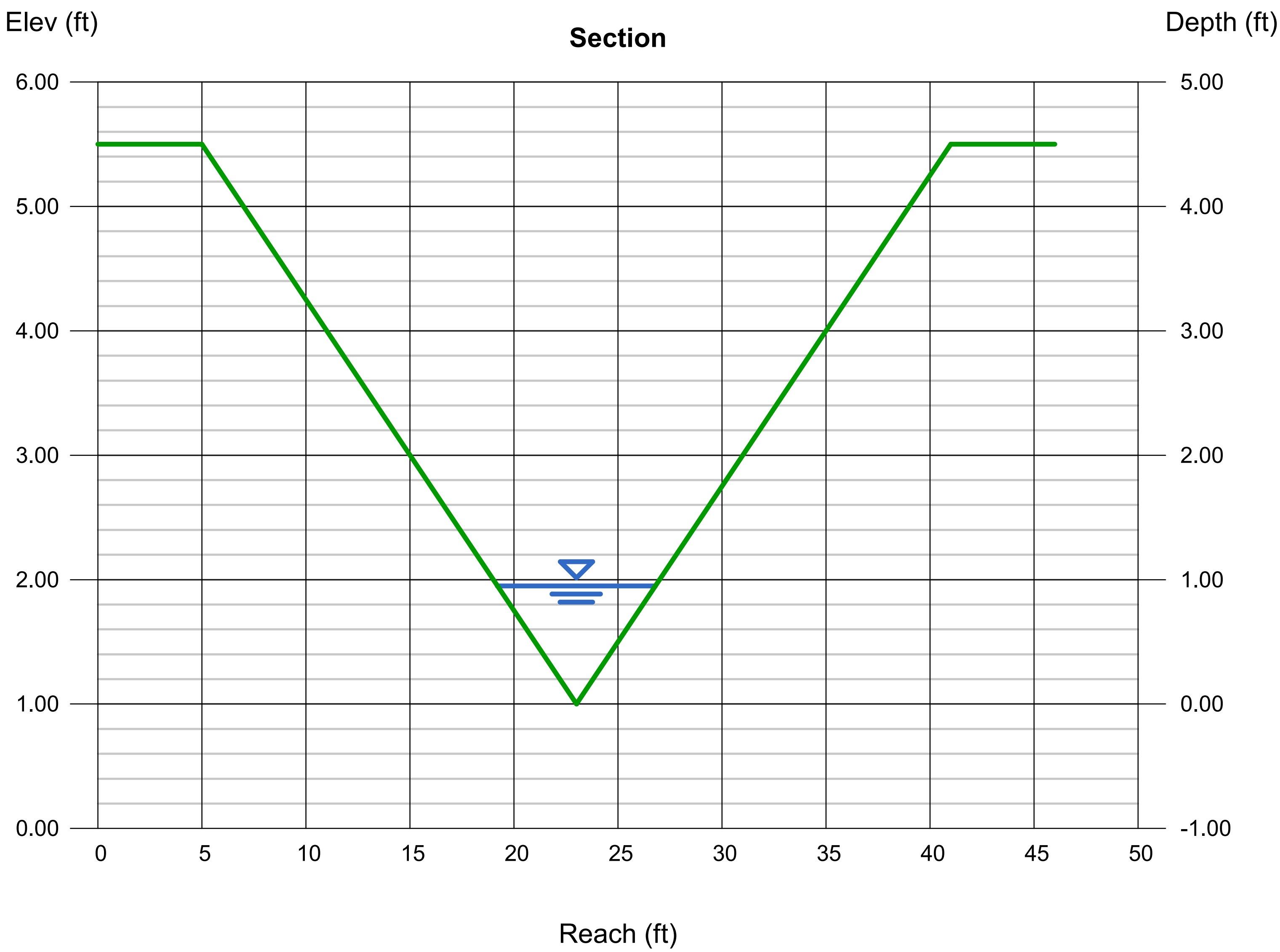
Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for Q/D2.5 ≤ 6.0)

Swale Calculations

Channel Report

DP-12 Q100

Triangular		**Highlighted**	
Side Slopes (z:1)	= 4.00, 4.00	Depth (ft)	= 0.95
Total Depth (ft)	= 4.50	Q (cfs)	= 9.600
		Area (sqft)	= 3.61
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 2.66
Slope (%)	= 5.70	Wetted Perim (ft)	= 7.83
N-Value	= 0.079	Crit Depth, Yc (ft)	= 0.82
		Top Width (ft)	= 7.60
Calculations		EGL (ft)	= 1.06
Compute by:	Known Q		
Known Q (cfs)	= 9.60		



Channel Report

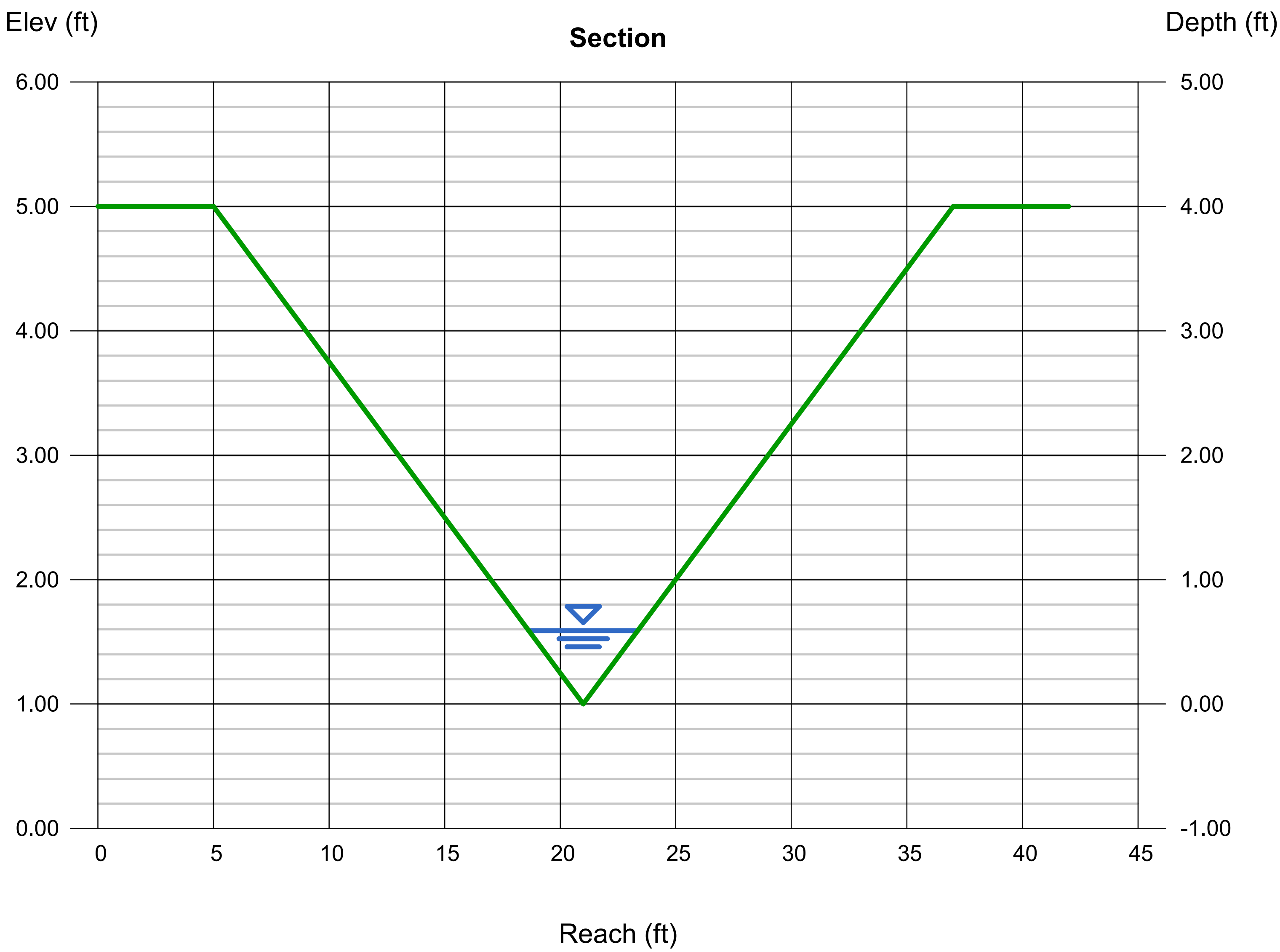
DP-13 Q100

Triangular
Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 4.00

Invert Elev (ft) = 1.00
Slope (%) = 2.80
N-Value = 0.032

Calculations
Compute by: Known Q
Known Q (cfs) = 4.60

Highlighted
Depth (ft) = 0.59
Q (cfs) = 4.600
Area (sqft) = 1.39
Velocity (ft/s) = 3.30
Wetted Perim (ft) = 4.87
Crit Depth, Yc (ft) = 0.61
Top Width (ft) = 4.72
EGL (ft) = 0.76



Channel Report

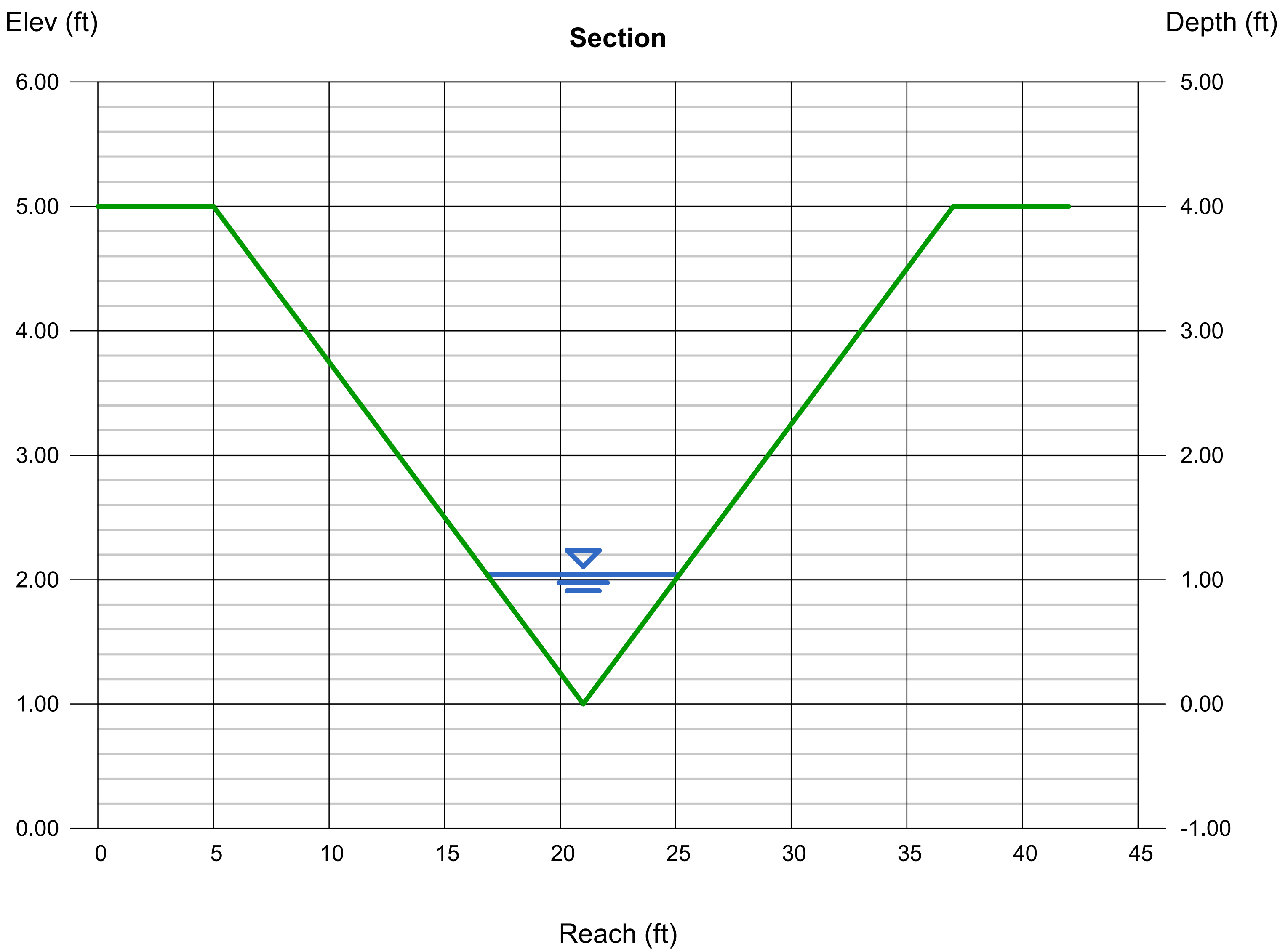
DP-14 Q100

Triangular
Side Slopes (z:1) = 4.00, 4.00
Total Depth (ft) = 4.00

Invert Elev (ft) = 1.00
Slope (%) = 5.00
N-Value = 0.074

Calculations
Compute by: Known Q
Known Q (cfs) = 12.30

Highlighted
Depth (ft) = 1.04
Q (cfs) = 12.30
Area (sqft) = 4.33
Velocity (ft/s) = 2.84
Wetted Perim (ft) = 8.58
Crit Depth, Yc (ft) = 0.90
Top Width (ft) = 8.32
EGL (ft) = 1.17



Channel Report

DP-15 Q100

Triangular

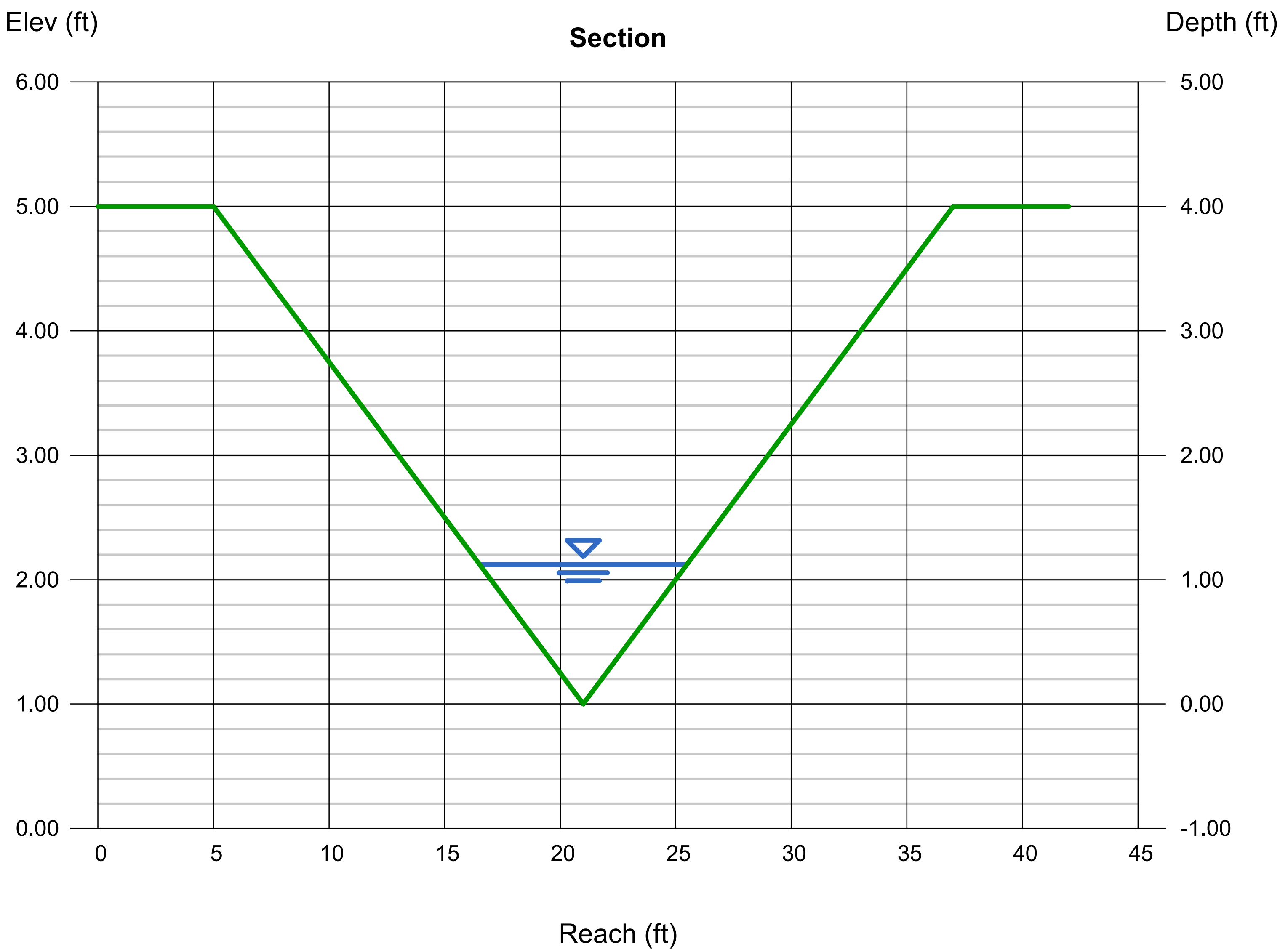
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 1.00
Slope (%)	= 5.70
N-Value	= 0.069

Calculations

Compute by:	Known Q
Known Q (cfs)	= 17.00

Highlighted

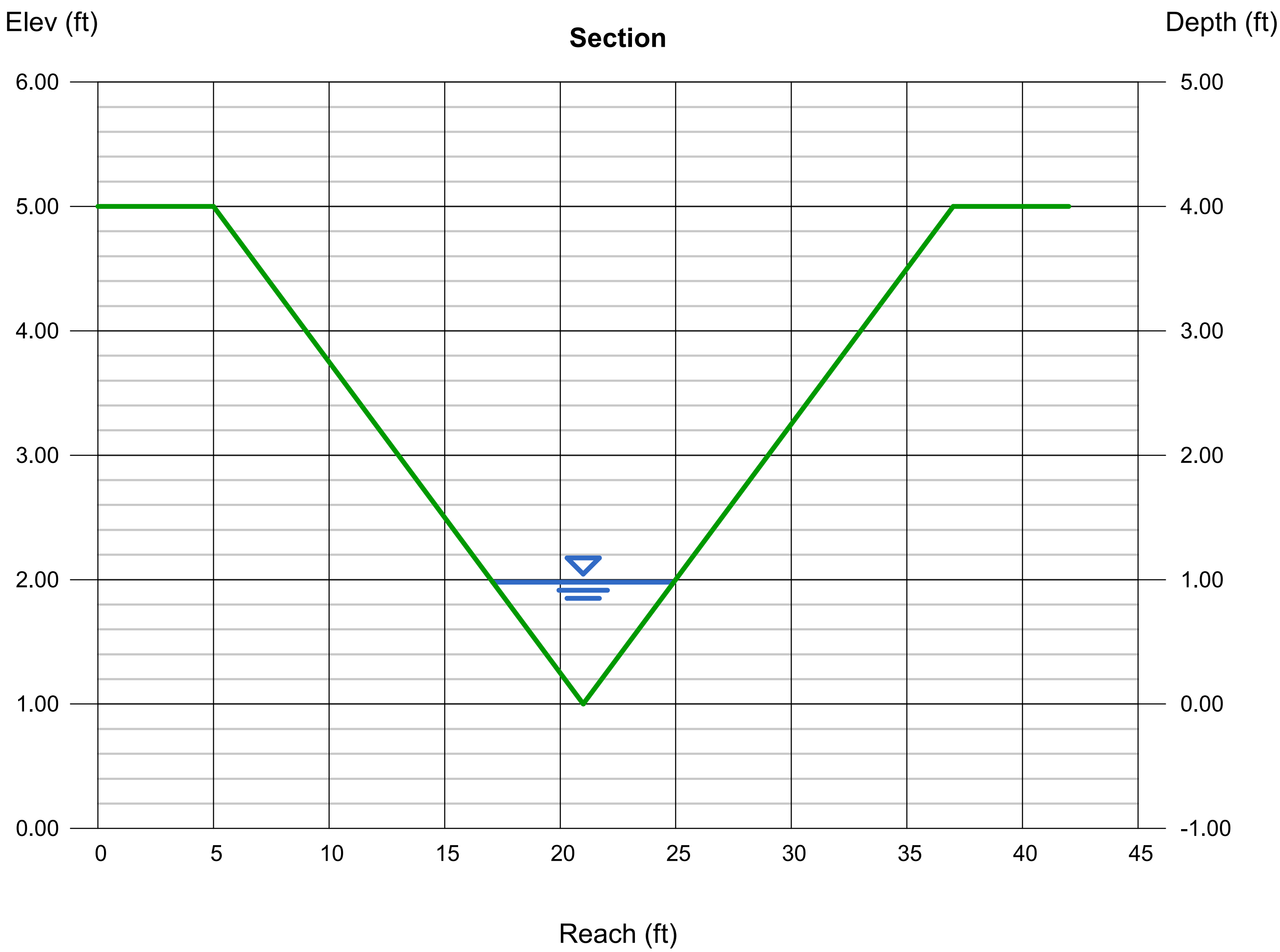
Depth (ft)	= 1.12
Q (cfs)	= 17.00
Area (sqft)	= 5.02
Velocity (ft/s)	= 3.39
Wetted Perim (ft)	= 9.24
Crit Depth, Yc (ft)	= 1.03
Top Width (ft)	= 8.96
EGL (ft)	= 1.30



Channel Report

DP-16 Q100

Triangular		**Highlighted**	
Side Slopes (z:1)	= 4.00, 4.00	Depth (ft)	= 0.98
Total Depth (ft)	= 4.00	Q (cfs)	= 6.100
		Area (sqft)	= 3.84
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 1.59
Slope (%)	= 2.80	Wetted Perim (ft)	= 8.08
N-Value	= 0.094	Crit Depth, Yc (ft)	= 0.68
		Top Width (ft)	= 7.84
Calculations		EGL (ft)	= 1.02
Compute by:	Known Q		
Known Q (cfs)	= 6.10		



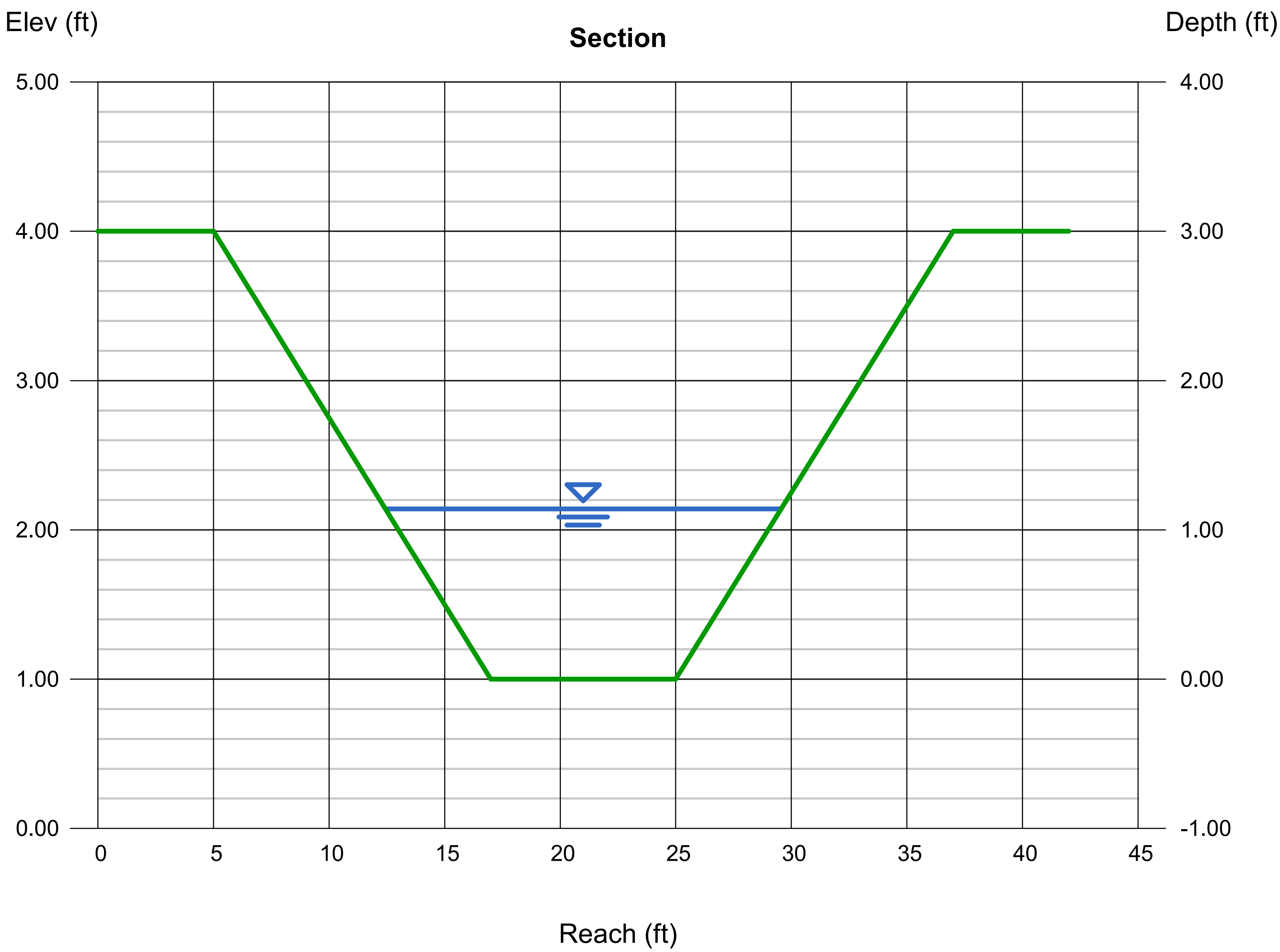
Channel Report

DP-17 Q100

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 8.00	Depth (ft)	= 1.14
Side Slopes (z:1)	= 4.00, 4.00	Q (cfs)	= 58.10
Total Depth (ft)	= 3.00	Area (sqft)	= 14.32
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 4.06
Slope (%)	= 4.50	Wetted Perim (ft)	= 17.40
N-Value	= 0.068	Crit Depth, Yc (ft)	= 1.00
		Top Width (ft)	= 17.12
		EGL (ft)	= 1.40

Calculations

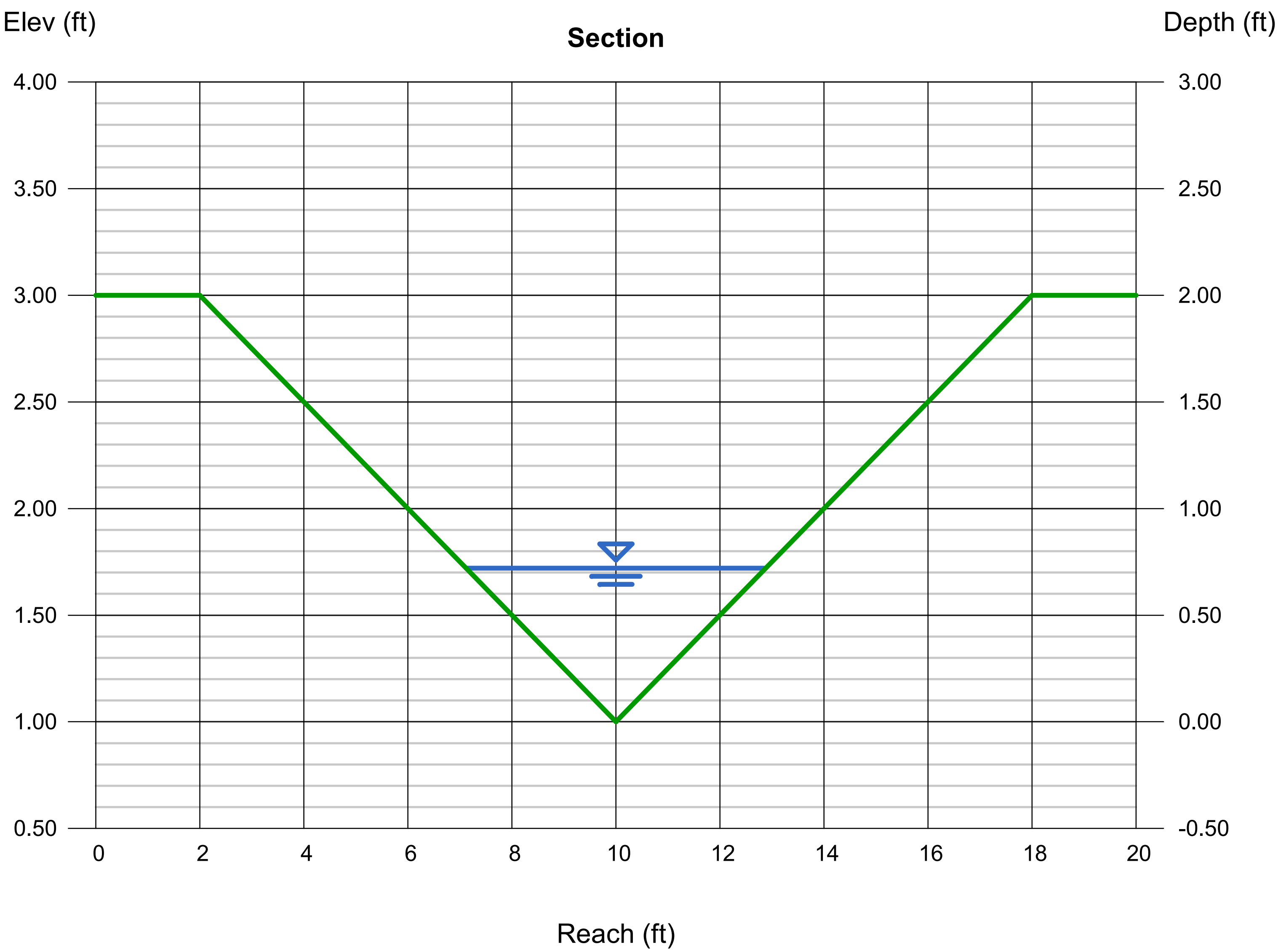
Compute by:	Known Q
Known Q (cfs)	= 58.10



Channel Report

DP-18 (2.8%) Q100

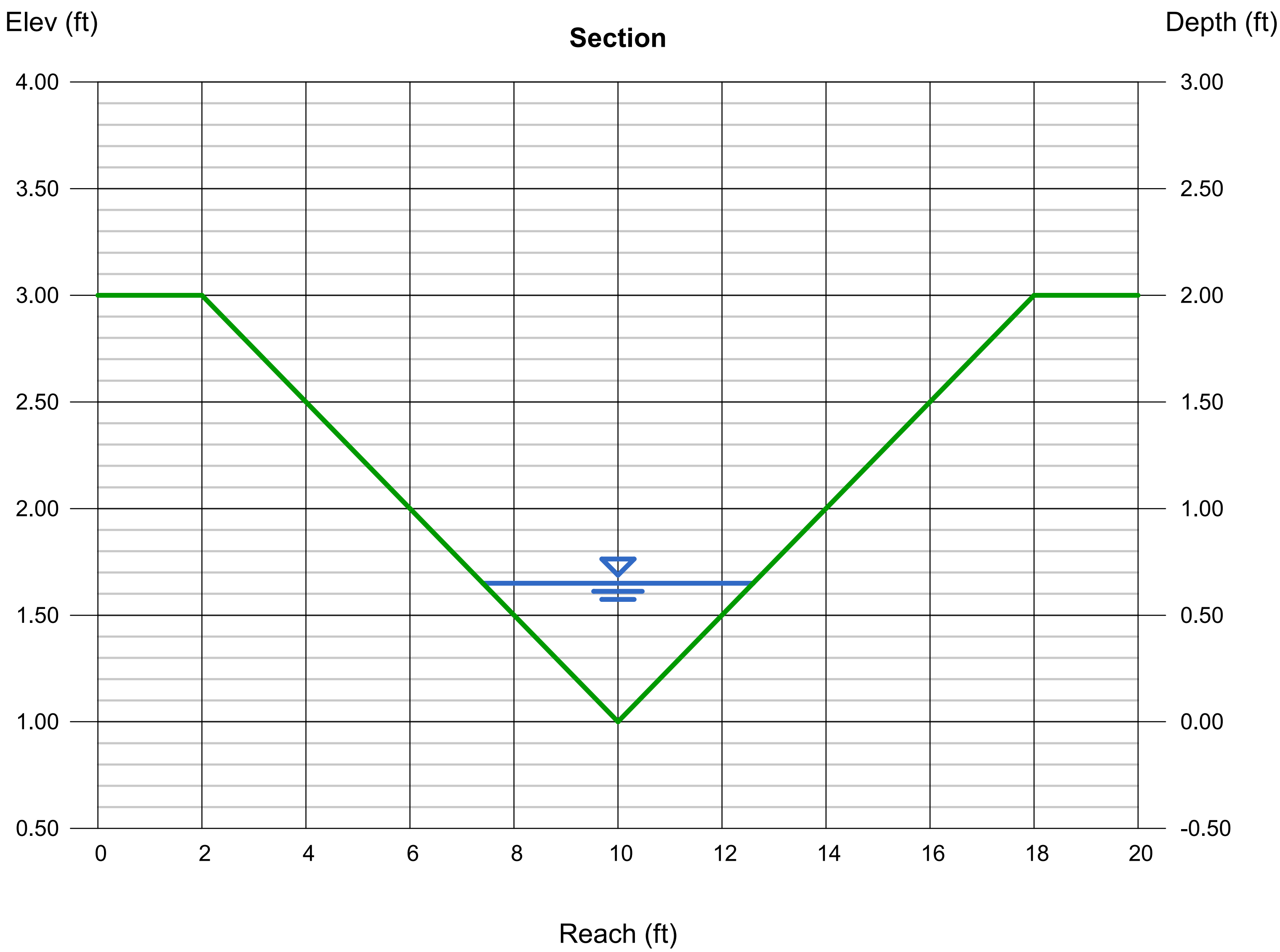
Triangular		**Highlighted**	
Side Slopes (z:1)	= 4.00, 4.00	Depth (ft)	= 0.72
Total Depth (ft)	= 2.00	Q (cfs)	= 7.800
		Area (sqft)	= 2.07
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 3.76
Slope (%)	= 2.80	Wetted Perim (ft)	= 5.94
N-Value	= 0.032	Crit Depth, Yc (ft)	= 0.75
		Top Width (ft)	= 5.76
Calculations		EGL (ft)	= 0.94
Compute by:	Known Q		
Known Q (cfs)	= 7.80		



Channel Report

DP-18 (5.0%) Q100

Triangular		**Highlighted**	
Side Slopes (z:1)	= 4.00, 4.00	Depth (ft)	= 0.65
Total Depth (ft)	= 2.00	Q (cfs)	= 7.800
		Area (sqft)	= 1.69
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 4.62
Slope (%)	= 5.00	Wetted Perim (ft)	= 5.36
N-Value	= 0.032	Crit Depth, Yc (ft)	= 0.75
		Top Width (ft)	= 5.20
Calculations		EGL (ft)	= 0.98
Compute by:	Known Q		
Known Q (cfs)	= 7.80		

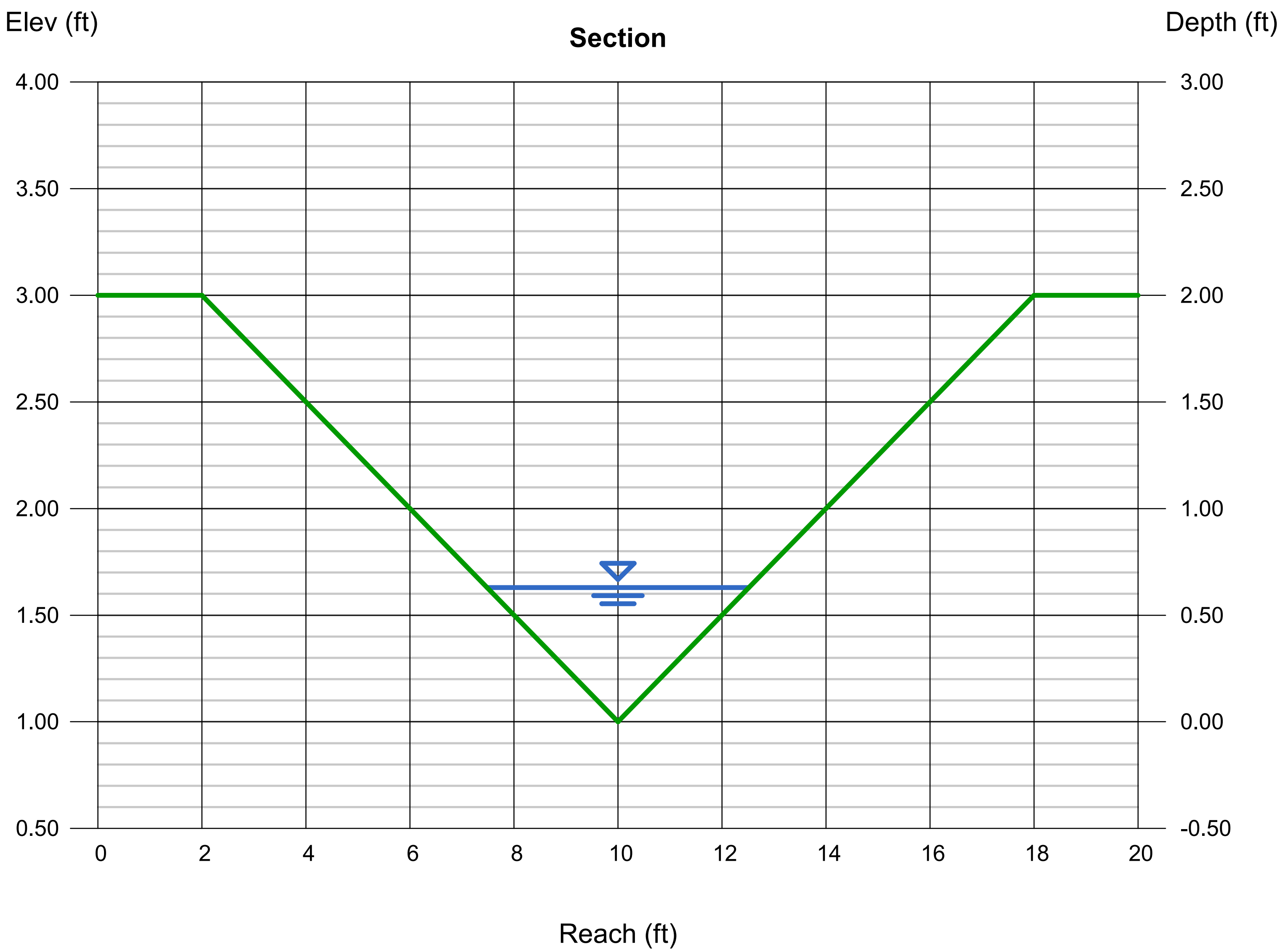


Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. — Friday, Sep 1 2023

DP-18 (5.7%) Q100

Triangular		**Highlighted**	
Side Slopes (z:1)	= 4.00, 4.00	Depth (ft)	= 0.63
Total Depth (ft)	= 2.00	Q (cfs)	= 7.800
		Area (sqft)	= 1.59
Invert Elev (ft)	= 1.00	Velocity (ft/s)	= 4.91
Slope (%)	= 5.70	Wetted Perim (ft)	= 5.20
N-Value	= 0.032	Crit Depth, Yc (ft)	= 0.75
		Top Width (ft)	= 5.04
Calculations		EGL (ft)	= 1.01
Compute by:	Known Q		
Known Q (cfs)	= 7.80		



Hydraulic Analysis Report

Project Data

Project Title: Hay Creek

Designer:

Project Date: Thursday, January 12, 2023

Project Units: U.S. Customary Units

Notes:

Channel Analysis: DP-12

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0570 ft/ft

Manning's n: 0.0790

Flow: 9.6000 cfs

Result Parameters

Depth: 0.9475 ft

Area of Flow: 3.5909 ft^2

Wetted Perimeter: 7.8132 ft

Hydraulic Radius: 0.4596 ft

Average Velocity: 2.6734 ft/s

Top Width: 7.5799 ft

Froude Number: 0.6845

Critical Depth: 0.8142 ft

Critical Velocity: 3.6205 ft/s

Critical Slope: 0.1280 ft/ft

Critical Top Width: 6.51 ft

Calculated Max Shear Stress: 3.3700 lb/ft^2

Calculated Avg Shear Stress: 1.6347 lb/ft^2

Channel Lining Analysis: Channel Lining Design Analysis DP-12

Notes:

Lining Input Parameters

Channel Lining Type: Riprap, Cobble, or Gravel

D50: 0.75 ft

Riprap Specific Weight: 165 lb/ft^3

Water Specific Weight: 62.4 lb/ft^3

Riprap Shape is Angular

Safety Factor: 1

Calculated Safety Factor: 1.12916

Lining Results

Angle of Repose: 41.7 degrees

Relative Flow Depth: 0.631869

Manning's n method: Bathurst

Manning's n: 0.0790259

Channel Bottom Shear Results

V*: 1.31894

Reynold's Number: 81282.1

Shield's Parameter: 0.0735754

shear stress on channel bottom: 3.37115 lb/ft^2

Permissible shear stress for channel bottom: 5.23606 lb/ft^2

channel bottom is stable

Stable D50: 0.545243 ft

Channel Side Shear Results

K1: 0.934

K2: 1

Kb: 0

shear stress on side of channel: 3.37115 lb/ft^2

Permissible shear stress for side of channel: 5.23606 lb/ft^2

Stable Side D50: 0.509257 lb/ft^2

side of channel is stable

Channel Lining Stability Results

the channel is stable

Channel Summary

Name of Selected Channel: DP-12

Channel Analysis: DP-14

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0500 ft/ft

Manning's n: 0.0744

Flow: 12.3000 cfs

Result Parameters

Depth: 1.0416 ft

Area of Flow: 4.3398 ft^2

Wetted Perimeter: 8.5893 ft

Hydraulic Radius: 0.5053 ft

Average Velocity: 2.8343 ft/s

Top Width: 8.3328 ft

Froude Number: 0.6921

Critical Depth: 0.8990 ft

Critical Velocity: 3.8045 ft/s

Critical Slope: 0.1096 ft/ft

Critical Top Width: 7.19 ft

Calculated Max Shear Stress: 3.2498 lb/ft^2

Calculated Avg Shear Stress: 1.5764 lb/ft^2

Channel Lining Analysis: Channel Lining Design Analysis DP-14

Notes:

Lining Input Parameters

Channel Lining Type: Riprap, Cobble, or Gravel

D50: 0.75 ft

Riprap Specific Weight: 165 lb/ft^3

Water Specific Weight: 62.4 lb/ft^3

Riprap Shape is Angular

Safety Factor: 1

Calculated Safety Factor: 1.12682

Lining Results

Angle of Repose: 41.7 degrees

Relative Flow Depth: 0.707087

Manning's n method: Bathurst

Manning's n: 0.0780488

Channel Bottom Shear Results

V*: 1.30676

Reynold's Number: 80531.5

Shield's Parameter: 0.0730921

shear stress on channel bottom: 3.30917 lb/ft^2

Permissible shear stress for channel bottom: 5.22044 lb/ft^2

channel bottom is stable

Stable D50: 0.535705 ft

Channel Side Shear Results

K1: 0.934

K2: 1

Kb: 0

shear stress on side of channel: 3.30917 lb/ft^2

Permissible shear stress for side of channel: 5.22044 lb/ft^2

Stable Side D50: 0.500348 lb/ft^2

side of channel is stable

Channel Lining Stability Results

the channel is stable

Channel Summary

Name of Selected Channel: DP-14

Channel Analysis: DP-15 (5.7%)

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0570 ft/ft

Manning's n: 0.0689

Flow: 17.0000 cfs

Result Parameters

Depth: 1.1152 ft

Area of Flow: 4.9743 ft^2

Wetted Perimeter: 9.1959 ft

Hydraulic Radius: 0.5409 ft

Average Velocity: 3.4175 ft/s

Top Width: 8.9213 ft

Froude Number: 0.8065

Critical Depth: 1.0233 ft

Critical Velocity: 4.0589 ft/s

Critical Slope: 0.0902 ft/ft

Critical Top Width: 8.19 ft

Calculated Max Shear Stress: 3.9664 lb/ft^2

Calculated Avg Shear Stress: 1.9240 lb/ft^2

Channel Lining Analysis: Channel Lining Design Analysis DP-15 (5.7%)

Notes:

Lining Input Parameters

Channel Lining Type: Riprap, Cobble, or Gravel

D50: 0.75 ft

Riprap Specific Weight: 165 lb/ft^3

Water Specific Weight: 62.4 lb/ft^3

Riprap Shape is Angular

Safety Factor: 1

Calculated Safety Factor: 1.15291

Lining Results

Angle of Repose: 41.7 degrees

Relative Flow Depth: 0.755533

Manning's n method: Bathurst

Manning's n: 0.0719488

Channel Bottom Shear Results

V*: 1.44224

Reynold's Number: 88880.9

Shield's Parameter: 0.0784671

shear stress on channel bottom: 4.03092 lb/ft^2

Permissible shear stress for channel bottom: 5.52618 lb/ft^2

channel bottom is stable

Stable D50: 0.630717 ft

Channel Side Shear Results

K1: 0.934

K2: 1

Kb: 0

shear stress on side of channel: 4.03092 lb/ft^2

Permissible shear stress for side of channel: 5.52618 lb/ft^2

Stable Side D50: 0.58909 lb/ft^2

side of channel is stable

Channel Lining Stability Results

the channel is stable

Channel Summary

Name of Selected Channel: DP-15 (5.7%)

Channel Analysis: DP-16 (2.8%)

Notes:

Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Longitudinal Slope: 0.0280 ft/ft

Manning's n: 0.0936

Flow: 6.1000 cfs

Result Parameters

Depth: 0.9731 ft

Area of Flow: 3.7874 ft^2

Wetted Perimeter: 8.0241 ft

Hydraulic Radius: 0.4720 ft

Average Velocity: 1.6106 ft/s

Top Width: 7.7845 ft

Froude Number: 0.4069

Critical Depth: 0.6791 ft

Critical Velocity: 3.3066 ft/s

Critical Slope: 0.1906 ft/ft

Critical Top Width: 5.43 ft

Calculated Max Shear Stress: 1.7001 lb/ft^2

Calculated Avg Shear Stress: 0.8247 lb/ft^2

Channel Lining Analysis: Channel Lining Design Analysis DP-16 (2.8%)

Notes:

Lining Input Parameters

Channel Lining Type: Riprap, Cobble, or Gravel

D50: 0.75 ft

Riprap Specific Weight: 165 lb/ft^3

Water Specific Weight: 62.4 lb/ft^3

Riprap Shape is Angular

Safety Factor: 1

Calculated Safety Factor: 1.05793

Lining Results

Angle of Repose: 41.7 degrees

Relative Flow Depth: 0.666049

Manning's n method: Bathurst

Manning's n: 0.100413

Channel Bottom Shear Results

V*: 0.949086

Reynold's Number: 58489.3

Shield's Parameter: 0.0589025

shear stress on channel bottom: 1.74558 lb/ft^2

Permissible shear stress for channel bottom: 4.53255 lb/ft^2

channel bottom is stable

Stable D50: 0.305575 ft

Channel Side Shear Results

K1: 0.934

K2: 0.931169

Kb: 0

shear stress on side of channel: 1.74558 lb/ft^2

Permissible shear stress for side of channel: 4.22056 lb/ft^2

Stable Side D50: 0.306504 lb/ft^2

side of channel is stable

Channel Lining Stability Results

the channel is stable

Channel Summary

Name of Selected Channel: DP-16 (2.8%)

Channel Analysis: DP-17

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Channel Width: 8.0000 ft

Longitudinal Slope: 0.0450 ft/ft

Manning's n: 0.0679

Flow: 58.1000 cfs

Result Parameters

Depth: 1.1374 ft

Area of Flow: 14.2731 ft^2

Wetted Perimeter: 17.3789 ft

Hydraulic Radius: 0.8213 ft

Average Velocity: 4.0706 ft/s

Top Width: 17.0988 ft

Froude Number: 0.7852

Critical Depth: 0.9917 ft

Critical Velocity: 4.8956 ft/s

Critical Slope: 0.0756 ft/ft

Critical Top Width: 15.93 ft

Calculated Max Shear Stress: 3.1937 lb/ft^2

Calculated Avg Shear Stress: 2.3062 lb/ft^2

Channel Lining Analysis: Channel Lining Design Analysis DP-17

Notes:

Lining Input Parameters

Channel Lining Type: Riprap, Cobble, or Gravel

D50: 0.75 ft

Riprap Specific Weight: 165 lb/ft^3

Water Specific Weight: 62.4 lb/ft^3

Riprap Shape is Angular

Safety Factor: 1

Calculated Safety Factor: 1.12239

Lining Results

Angle of Repose: 41.7 degrees

Relative Flow Depth: 1.11299

Manning's n method: Bathurst

Manning's n: 0.0678818

Channel Bottom Shear Results

V*: 1.28375

Reynold's Number: 79113.9

Shield's Parameter: 0.0721795

shear stress on channel bottom: 3.19369 lb/ft^2

Permissible shear stress for channel bottom: 5.55422 lb/ft^2

channel bottom is stable

Stable D50: 0.484031 ft

Channel Side Shear Results

K1: 0.934

K2: 0.931169

Kb: 0

shear stress on side of channel: 3.19369 lb/ft^2

Permissible shear stress for side of channel: 5.17191 lb/ft^2

Stable Side D50: 0.485503 lb/ft^2

side of channel is stable

Channel Lining Stability Results

the channel is stable

Channel Summary

Name of Selected Channel: DP-17

Channel Analysis: DP-19

Notes:

Input Parameters

Channel Type: Trapezoidal

Side Slope 1 (Z1): 4.0000 ft/ft

Side Slope 2 (Z2): 4.0000 ft/ft

Channel Width: 20.0000 ft

Longitudinal Slope: 0.0330 ft/ft

Manning's n: 0.1024

Flow: 67.3000 cfs

Result Parameters

Depth: 1.1023 ft

Area of Flow: 26.9056 ft^2

Wetted Perimeter: 29.0896 ft

Hydraulic Radius: 0.9249 ft

Average Velocity: 2.5013 ft/s

Top Width: 28.8182 ft

Froude Number: 0.4562

Critical Depth: 0.6737 ft

Critical Velocity: 4.4019 ft/s

Critical Slope: 0.1826 ft/ft

Critical Top Width: 25.39 ft

Calculated Max Shear Stress: 2.2698 lb/ft^2

Calculated Avg Shear Stress: 1.9046 lb/ft^2

Channel Lining Analysis: Channel Lining Design Analysis DP-19

Notes:

Lining Input Parameters

Channel Lining Type: Riprap, Cobble, or Gravel

D50: 1 ft

Riprap Specific Weight: 165 lb/ft^3

Water Specific Weight: 62.4 lb/ft^3

Riprap Shape is Angular

Safety Factor: 2.5

Calculated Safety Factor: 1.15306

Lining Results

Angle of Repose: 41.7 degrees

Relative Flow Depth: 0.933631

Manning's n method: Bathurst

Manning's n: 0.102434

Channel Bottom Shear Results

V*: 1.08226

Reynold's Number: 88928.2

Shield's Parameter: 0.0784975

shear stress on channel bottom: 2.26981 lb/ft^2

Permissible shear stress for channel bottom: 8.05385 lb/ft^2

channel bottom is stable

Stable D50: 0.704572 ft

Channel Side Shear Results

K1: 0.934

K2: 0.931169

Kb: 0

shear stress on side of channel: 2.26981 lb/ft^2

Permissible shear stress for side of channel: 7.49949 lb/ft^2

Stable Side D50: 0.706715 lb/ft^2

side of channel is stable

Channel Lining Stability Results

the channel is stable

Channel Summary

Name of Selected Channel: DP-19

APPENDIX B

STANDARD DESIGN CHARTS AND TABLES

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis-- Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

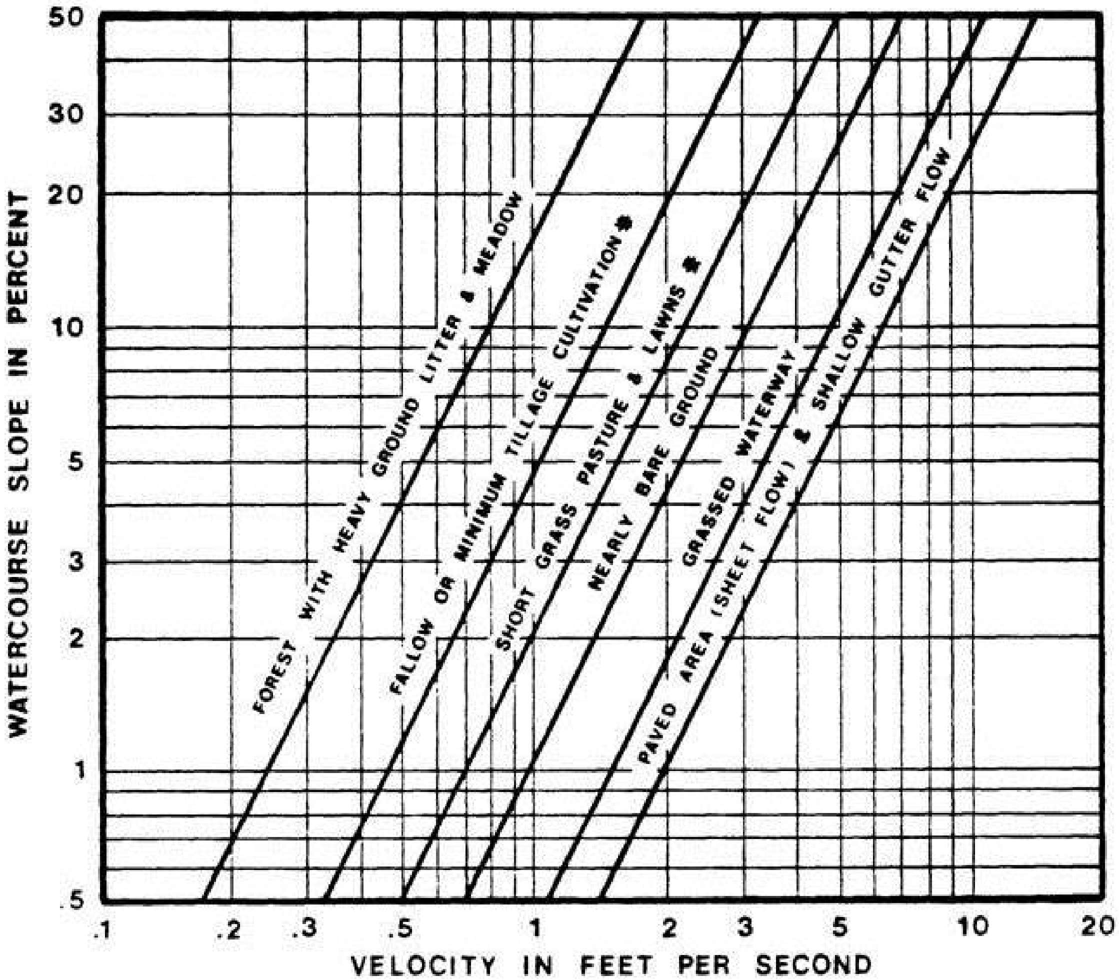
3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

Type of Development	Percent Impervious
Commercial	95%
Industrial	85%
Multi-Family	65%
Single Family - 0.1377 acre lots (6,000 SF)	53%
Single-Family - 0.20 acre lots	43%
Single-Family - 0.25 acre lots	40%
Single-Family - 0.33 acre lots	30%
Single-Family - 0.5 acre lots	25%
Single-Family - 1.0 acre lots	20%
Single-Family - 2.5 acre lots	11%
Single-Family - 5 acre lots	7%

Figure 6-25. Estimate of Average Concentrated Shallow Flow



El Paso County Drainage Basin Fees

Resolution No. 22-442

Basin Number	Receiving Waters	Year Studied	Drainage Basin Name	2023 Drainage Fee (per Impervious Acre)	2023 Bridge Fee (per Impervious Acre)
Drainage Basins with DBPS's:					
CHMS0200	Chico Creek	2013	Haegler Ranch	$12,985	$1,916
CHWS1200	Chico Creek	2001	Bennett Ranch	$14,536	$5,576
CHWS1400	Chico Creek	2013	Falcon	$37,256	$5,118
FOFO2000	Fountain Creek	2001	West Fork Jimmy Camp Creek	$15,802	$4,675
FOFO2600	Fountain Creek	1991*	Big Johnson / Crews Gulch	$23,078	$2,980
FOFO2800	Fountain Creek	1988*	Widefield	$23,078	$0
FOFO2900	Fountain Creek	1988*	Security	$23,078	$0
FOFO3000	Fountain Creek	1991*	Windmill Gulch	$23,078	$346
FOFO3100 / FOFO3200	Fountain Creek	1988*	Carson Street / Little Johnson	$14,077	$0
FOFO3400	Fountain Creek	1984*	Peterson Field	$16,646	$1,262
FOFO3600	Fountain Creek	1991*	Fisher's Canyon	$23,078	$0
FOFO4000	Fountain Creek	1996	Sand Creek	$23,821	$9,743
FOFO4200	Fountain Creek	1977	Spring Creek	$11,969	$0
FOFO4600	Fountain Creek	1984*	Southwest Area	$23,078	$0
FOFO4800	Fountain Creek	1991	Bear Creek	$23,078	$1,262
FOFO5800	Fountain Creek	1964	Camp Creek	$2,557	$0
FOMO1000	Monument Creek	1981	Douglas Creek	$14,514	$321
FOMO1200	Monument Creek	1977	Templeton Gap	$14,900	$346
FOMO2000	Monument Creek	1971	Pulpit Rock	$7,653	$0
FOMO2200	Monument Creek	1994	Cottonwood Creek / S. Pine	$23,078	$1,262
FOMO2400	Monument Creek	1966	Dry Creek	$18,219	$660
FOMO3600	Monument Creek	1989*	Black Squirrel Creek	$10,478	$660
FOMO3700	Monument Creek	1987*	Middle Tributary	$19,259	$0
FOMO3800	Monument Creek	1987*	Monument Branch	$23,078	$0
FOMO4000	Monument Creek	1996	Smith Creek	$9,409	$1,262
FOMO4200	Monument Creek	1989*	Black Forest	$23,078	$628
FOMO5200	Monument Creek	1993*	Dirty Woman Creek	$23,078	$1,262
FOMO5300	Fountain Creek	1993*	Crystal Creek	$23,078	$1,262
Miscellaneous Drainage Basins: [1]					
CHBS0800	Chico Creek		Book Ranch	$21,654	$3,135
CHEC0400	Chico Creek		Upper East Chico	$11,797	$342
CHWS0200	Chico Creek		Telephone Exchange	$12,962	$304
CHWS0400	Chico Creek		Livestock Company	$21,351	$254
CHWS0600	Chico Creek		West Squirrel	$11,129	$4,619
CHWS0800	Chico Creek		Solberg Ranch	$23,078	$0
FOFO1200	Fountain Creek		Crooked Canyon	$6,968	$0
FOFO1400	Fountain Creek		Calhan Reservoir	$5,817	$339
FOFO1600	Fountain Creek		Sand Canyon	$4,203	$0
FOFO2000	Fountain Creek		Jimmy Camp Creek[3]	$23,078	$1,079
FOFO2200	Fountain Creek		Fort Carson	$18,219	$660
FOFO2700	Fountain Creek		West Little Johnson	$1,521	$0
FOFO3800	Fountain Creek		Stratton	$11,070	$495
FOFO5000	Fountain Creek		Midland	$18,219	$660
FOFO6000	Fountain Creek		Palmer Trail	$18,219	$660
FOFO6800	Fountain Creek		Black Canyon	$18,219	$660
FOMO4600	Monument Creek		Beaver Creek	$13,797	$0
FOMO3000	Monument Creek		Kettle Creek	$12,463	$0
FOMO3400	Monument Creek		Elkhorn	$2,094	$0
FOMO5000	Monument Creek		Monument Rock	$10,003	$0
FOMO5400	Monument Creek		Palmer Lake	$15,995	$0
FOMO5600	Monument Creek		Raspberry Mountain	$5,380	$0
PLPL0200	Monument Creek		Bald Mountain	$11,465	$0
Interim Drainage Basins: [2]					
FOFO1800	Fountain Creek		Little Fountain Creek	$2,950	$0
FOMO4400	Monument Creek		Jackson Creek	$9,135	$0
FOMO4800	Monument Creek		Teachout Creek	$6,343	$953

1. The miscellaneous drainage fee previous to September 1999 resolution was the average of all drainage fees for basins with Basin Planning Studies performed within the last 14 years.

2. Interim Drainage Fees are based upon draft Drainage Basin Planning Studies or the Drainage Basin Identification and Fee Estimation Report. (Best available information suitable for setting a fee.)

3. This is an interim fee and will be adjusted when a DBPS is completed. In addition to the Drainage Fee a surety in the amount of $7,285 per impervious acre shall be provided to secure payment of additional fees in the event that the DBPS results in a fee greater than the current fee. Fees paid in excess of the future revised fee will be reimbursed. See Resolution 06-326 (9/14/06) and Resolution 16-320 (9/07/16).

EPC Stormwater Management ______ *Joshua Palmer, P.E.* ______

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

Channel Slope	Lining	Permissible Mean Channel Velocity* (ft/sec)
	Bermudagrass	5
	Reed canarygrass	4
	Tall fescue	4
	Kentucky bluegrass	4
	Grass-legume mixture	3
Greater than 10%	Sodded grass	5
	Bermudagrass	4
	Reed canarygrass	3
	Tall fescue	3
	Kentucky bluegrass	3
*For highly erodible soils, decrease permissible velocities by 25%.		
*Grass lined channels are dependent upon assurances of continuous growth and maintenance of grass.		

APPENDIX C

REPORT REFERENCES

```
1*****************************************************
          **************************************
 *  WATER SURFACE PROFILES                           *
          *  U.S. ARMY CORPS OF ENGINEERS      *
 *  VERSION OF SEPTEMBER 1988                        *
          *  THE HYDROLOGIC ENGINEERING CENTER  *
 *  ERROR: 01,02                                     *
          *  609 SECOND STREET, SUITE D         *
 *  UPDATED:  4 APRIL    1989                        *
          *  DAVIS, CALIFORNIA 95616-4687       *
 *  RUN DATE    11/ 3/ 3   TIME   12:40:22           *
          *  (916) 756-1104, (916) 551-1748     *
 *****************************************************
          **************************************
```

THIS DOCUMENT IS THE HEC-2 MODEL PRINT OUT FOR THE 2003 LOMR FOR BEAVER CREEK. IT WAS SOURCED FROM THE REGIONAL FLOODPLAIN ADMINISTRATOR AT PIKES PEAK REGIONAL BUILDING DEPARTMENT (PPRBD).

```
                                             X     X  XXXXXXX   XXXXX
XXXXX
                                             X     X  X        X     X            X
    X
                                             X     X  X        X
    X
                                             XXXXXXX  XXXX     X           XXXXX
XXXXX
                                             X     X  X        X                  X
                                             X     X  X        X     X            X
                                             X     X  XXXXXXX   XXXXX
XXXXXXX
 END OF BANNER
1
    11/ 3/ 3      12:40:22
                                        PAGE    1



 THIS RUN EXECUTED 11/ 3/ 3    12:40:22
 **************************************************
   HEC2 RELEASE DATED SEP 88 UPDATED APR  1989


   ERROR CORR -  01,02
   MODIFICATION -
 **************************************************


 T1      BEAVER CREEK LOMR PROJECT NO. 03012
 T2      BEAVER CREEK FROM MONUMENT CREEK CONFLUENCE THROUGH SOUTH FORK
```

```
 T3      FILE NAME BVREFF.DAT
 T3      100-YEAR FREQUENCY CROSS-SECTIONS L TO R FACING UPSTREAM

 J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q
 WSEL      FQ

        0         3         0         0         0         0         0         0
6733.2

 J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW
CHNIM      ITRACE

       1         0        -1
```

THE QT ROW/CARD REPRESENTS THE FLOW VALUES USED IN THE HEC-2 MODELS. THIS QT CARD IS AT THE CONFLUENCE OF BEAVER AND MONUMENT CREEK WHICH IS LOCATED JUST DOWNSTREAM OF THE HAY AND BEAVER CREEK CONFLUENCE.

```
 QT        2       6317      20974

 NC      .07        .07        .05        .2         .4

         CONFLUENCE WITH MONUMENT CREEK
 X1       60         15       1280       1360          0          0          0

 GR     6752       1000       6750       1085       6740       1170       6735
     1235       6730       1250
 GR     6725       1280       6720       1295       6718       1305       6720
     1310       6725       1360
 GR     6730       1445       6735       1525       6740       1560       6745
     1670       6750       1810
```

THIS QT CARD IS APPROXIMATELY AT THE HAY CREEK CONFLUENCE WITH BEAVER CREEK AND DEMONSTRATES A 127 CFS INCREASE OVER THE UPSTREAM QT CARD. (6915 CFS -6788 CFS=127 CFS). WE THEREFORE BELIEVE 127 CFS TO BE A REASONABLE FLOW TO USE FOR HAY CREEK.

```
 QT        2       3507       6915

 NC      .07        .07        .05        .1         .3

 X1        1         14       1507       1545       1047       1047       1047

 GR     6748       1000       6744       1163       6742       1193       6740
     1313       6740       1358
 GR     6738       1386       6736       1507       6734       1520       6732
     1526       6732       1541
 GR     6740       1548       6746       1563       6746       1748       6748
     1798

 NC      .07        .07        .05        .1         .3

 X1        2         11       1136       1195        759        759        759

 GR     6758       1034       6756       1049       6750       1064       6748
     1076       6748       1136
 GR     6746       1147       6746       1184       6748       1195       6750
     1227       6756       1254
 GR     6758       1274


 QT        2       1847       5128
```

```
NC     .013       .013       .015         .1          .3

        HAY CREEK ROAD 2-72", 1-78" AND 1-84" CMP'S
        CROSS SECTION MODELED FOR ROAD PROFILE
        FLOW OVER ROAD REDUCED FOR CULVERTS CAPACITY
        CULVERTS CALCULATED CAPACITY = 1660 cfs
X1        3          6       1130       1250         845         845         845

GR     6778       1000       6772       1130        6772        1250        6774
    1390        6776        1500
GR     6778       1720

1
    11/ 3/ 3      12:40:22
                                        PAGE     2

NC     .025       .025       .025         .1          .3

QT        2       3107       6788

        DELACROCE RANCH ROAD CROSSING 1-84" AND 1-72" CMP
        CROSS SECTION MODELED FOR ROAD PROFILE
        FLOW OVER ROAD REDUCED FOR CULVERTS CAPACITY
        CULVERTS CALCULATED CAPACITY = 400 cfs
X1        4          5       1070       1280         984         984         984

X4        1       6786       1000

GR     6790        900       6784       1070        6784        1280        6790
    1420        6796        1520

NC      .07        .07        .08

X1        5         14       1243       1314         722         722         722

GR     6806       1188       6804       1198        6800        1211        6798
    1221        6786        1246
GR     6786       1272       6788       1314        6790        1344        6796
    1391        6796        1427
GR     6798       1428       6800       1435        6804        1475        6806
    1512

NC     .013       .013       .013         .1          .3

QT        2       3216       6154

NC     .013       .013       .015         .1          .3

X1      6.1          9       1209       1230        1160        1160        1160

GR     6840       1000       6828       1091        6828        1209      6806.6
    1209      6806.6        1230
GR     6828       1230       6828       1316        6830        1457        6840
    1619
```

NOTE THAT, ONCE THE FLOW THROUGH THE CULVERTS IS ACCOUNTED FOR, THE QT CARD MATCHES THE UPSTREAM QT CARD AT 6788 CFS. (5128 CFS + 1660 CFS = 6788 CFS)

THIS QT CARD IS AT THE HAY CREEK ROAD CULVERT JUST UPSTREAM OF THE CONFLUENCE WITH HAY CREEK.

```
SB     1.05      1.25       2.6         0         20         1.0         210
       0     6807.3     6806.6
NC     .013      .013      .015        .3         .5

        LONG VALLEY DRIVE, EXISITNG 2-10' x 10' CBC FACE
X1      6.2         9      1209      1230         48          48          48

X2        0         0         1    6817.3       6828

BT        9      1000      6840      6840       1091        6828        6828
    1209        6828       6828
BT     1209      6828    6817.3      1230       6828      6817.3        1230
    6828        6828       1316
BT     6828      6828      1457      6830       6830        1619        6840
    6840
GR     6840      1000      6828      1091       6828        1209      6807.3
    1209      6807.3       1230
GR     6828      1230      6828      1316       6830        1457        6840
    1619

NC      .07       .07       .08        .1         .3

X1        7         9      1146      1193        856         856         856

GR     6862      1033      6858      1042       6856        1071        6854
    1146        6854       1193
GR     6856      1279      6858      1312       6860        1326        6862
    1354

NC     .015      .015       .02

        BRISTLECONE LAKE CONCRETE SPILLWAY
X1        8         8      1080      1520       1026        1026        1026

GR     6910      1000      6908      1020       6900        1050        6890
    1080        6889       1090
GR     6889      1500      6890      1520       6908        1580


QT        2      4860      8624

NC      .07       .07       .05

        FLOW INTO BRISTLECONE LAKE
X1        9        13      1484      1817       2638        2638        2638

GR     6910      1000      6908      1050       6906        1135        6900
    1173        6894       1260
GR     6890      1484      6890      1817       6894        1824        6894
    1845        6900       1871
GR     6902      1905      6908      1982       6910        1991
```

```
X1      10      15    1169    1529     590     590     590

GR    6916    1000    6910    1044    6908    1064    6904
    1112    6900    1230
GR    6898    1270    6898    1334    6896    1349    6896
    1361    6898    1379
GR    6900    1392    6902    1530    6910    1614    6912
    1645    6916    1662

NC      .1      .1     .08

X1      11      13    1149    1363     701     701     701

GR    6924    1000    6920    1041    6918    1069    6916
    1077    6910    1149
GR    6908    1165    6904    1177    6904    1216    6906
    1226    6906    1346
GR    6916    1381    6918    1392    6924    1456


X1      12      14    1213    1240     643     643     643

GR    6936    1000    6928    1110    6926    1162    6922
    1176    6922    1213
GR    6916    1226    6916    1228    6922    1240    6922
    1246    6918    1256
GR    6916    1317    6916    1447    6930    1486    6936
    1566

X1      13      10    1139    1345     689     689     689

GR    6948    1000    6944    1053    6940    1139    6938
    1152    6928    1195
GR    6928    1221    6930    1230    6932    1274    6934
    1321    6948    1429

X1      14      11    1184    1401     834     834     834

GR    6964    1000    6956    1071    6954    1119    6948
    1234    6946    1305
GR    6944    1316    6944    1342    6946    1392    6956
    1414    6958    1435
GR    6964    1527


X1      15      17    1091    1278     764     764     764

GR    6978    1000    6970    1047    6966    1081    6962
    1091    6962    1133
GR    6960    1145    6958    1161    6958    1177    6960
    1219    6962    1278
GR    6962    1312    6960    1319    6960    1333    6962
    1336    6970    1371
```

```
GR     6974       1430       6978       1448


X1       16         15       1266       1400         718         718         718

GR     6994       1000       6992       1025        6986        1193        6984
    1205        6980        1266
GR     6974       1321       6974       1331        6976        1364        6980
    1400        6982        1505
GR     6986       1572       6988       1584        6990        1609        6992
    1615        6994        1618

QT        2       4772       8270

        CONFLUENCE OF NORTH AND SOUTH BEAVER CREEK
X1       17         16       1101       1378         547         547         547

GR     7008       1000       7002       1072        6998        1101        6994
    1117        6992        1121
GR     6988       1139       6988       1169        6990        1196        6992
    1213        6996        1277
GR     6996       1324       6998       1378        7000        1410        7002
    1427        7004        1489
GR     7008       1552


QT        2       3757       6754

        BEAVER CREEK SOUTH FORK
X1       18         10       1075       1269         598         598         598

GR     7022       1000       7018       1075        7016        1088        7004
    1122        7002        1128
GR     7002       1151       7008       1187        7012        1237        7020
    1269        7022        1285
```



```
X1       19         16       1115       1341         800         800         800

GR     7046       1000       7044       1021        7038        1072        7034
    1115        7032        1129
GR     7030       1177       7028       1198        7026        1207        7026
    1228        7030        1242
GR     7032       1259       7034       1341        7038        1412        7040
    1473        7042        1536
GR     7046       1578


X1       20         14       1046       1295         625         625         625

GR     7068       1000       7062       1031        7058        1046        7056
    1061        7052        1072
```

```
 GR     7050       1099       7048       1122        7048        1178        7050
     1185       7052       1201
 GR     7058       1264       7060       1295        7062        1384        7068
     1656

 X1       21         17       1066       1246         879         879         879

 GR     7092       1000       7084       1032        7080        1066        7078
     1109       7074       1133
 GR     7072       1139       7072       1171        7074        1180        7076
     1200       7076       1229
 GR     7078       1239       7080       1246        7084        1271        7086
     1306       7086       1328
 GR     7088       1368       7092       1445


 X1       22          8       1032       1179         554         554         554

 GR     7104       1000       7096       1032        7094        1079        7092
     1085       7092       1094
 GR     7094       1108       7096       1179        7104        1252


 X1       23          7       1119       1165         514         514         514

 GR     7124       1000       7110       1119        7108        1145        7108
     1158       7110       1165
 GR     7120       1189       7124       1205
```



```
    SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS
BANK ELEV
    Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA
LEFT/RIGHT
    TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN
   SSTA
    SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID
   ENDST


 *PROF 1
0

 CCHV=     .200 CEHV=     .400
 *SECNO 60.000
 3720 CRITICAL DEPTH ASSUMED
         CONFLUENCE WITH MONUMENT CREEK
     60.00    15.36  6733.36  6733.36  6733.20  6736.77     3.41      .00      .00
6725.00
```

```
    20974.    1400.   15429.    4145.     193.     921.     588.       0.       0.
 6725.00
       .00     7.27    16.75     7.05     .070     .050     .070     .000  6718.00
1239.93
   .012557       0.       0.       0.        0        4        0      .00   258.76
1498.70
0
 CCHV=     .100 CEHV=     .300
 *SECNO 1.000

 3301 HV CHANGED MORE THAN HVINS

      1.00    11.87  6743.87      .00      .00  6744.18      .30     7.10      .31
6736.00
     6915.    4409.    2319.     187.    1514.     359.      74.      44.       8.
 6732.00
       .07     2.91     6.46     2.53     .070     .050     .070     .000  6732.00
1164.88
   .002082    1047.    1047.    1047.        3        0        0      .00   392.81
1557.69
0
 CCHV=     .100 CEHV=     .300
 *SECNO 2.000

 3301 HV CHANGED MORE THAN HVINS

 3685 20 TRIALS ATTEMPTED WSEL,CWSEL
 3693 PROBABLE MINIMUM SPECIFIC ENERGY
 3720 CRITICAL DEPTH ASSUMED
      2.00     5.95  6751.95  6751.95      .00  6753.89     1.94     3.60      .49
6748.00
     6915.    1999.    4311.     605.     277.     329.     103.      67.      13.
 6748.00
       .09     7.21    13.09     5.87     .070     .050     .070     .000  6746.00
1059.12
   .019770     759.     759.     759.       20        8        0      .00   176.67
1235.79
0
 CCHV=     .100 CEHV=     .300
 *SECNO 3.000

 3301 HV CHANGED MORE THAN HVINS

1
    11/ 3/ 3      12:40:22
                                PAGE    6


    SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS
BANK ELEV
    Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA
LEFT/RIGHT
    TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN
   SSTA
    SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID
   ENDST
```

```
 3685 20 TRIALS ATTEMPTED WSEL,CWSEL
 3693 PROBABLE MINIMUM SPECIFIC ENERGY
 3720 CRITICAL DEPTH ASSUMED
         HAY CREEK ROAD 2-72", 1-78" AND 1-84" CMP'S
         CROSS SECTION MODELED FOR ROAD PROFILE
         FLOW OVER ROAD REDUCED FOR CULVERTS CAPACITY
         CULVERTS CALCULATED CAPACITY = 1660 cfs
      3.00     2.75  6774.75  6774.75      .00  6775.69      .94     4.43      .10
6772.00
     5128.     506.    2806.    1817.      82.     330.     260.      80.      18.
 6772.00
       .12     6.18     8.51     6.99     .013     .015     .013     .000  6772.00
1070.47
   .001918     845.     845.     845.       20       14        0      .00   360.65
1431.12
0
 CCHV=     .100 CEHV=     .300
 *SECNO 4.000
 3685 20 TRIALS ATTEMPTED WSEL,CWSEL
 3693 PROBABLE MINIMUM SPECIFIC ENERGY
 3720 CRITICAL DEPTH ASSUMED
         DELACROCE RANCH ROAD CROSSING 1-84" AND 1-72" CMP
         CROSS SECTION MODELED FOR ROAD PROFILE
         FLOW OVER ROAD REDUCED FOR CULVERTS CAPACITY
         CULVERTS CALCULATED CAPACITY = 400 cfs
      4.00     2.82  6786.82  6786.82      .00  6787.96     1.14     3.30      .06
6784.00
     6788.     884.    5375.     530.     136.     592.      93.      97.      26.
 6784.00
       .15     6.52     9.08     5.72     .025     .025     .025     .000  6784.00
 979.55
   .005866     984.     984.     984.       20        8        0      .00   366.20
1345.75
0
 *SECNO 5.000

 3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .54

      5.00     7.93  6793.93      .00      .00  6795.16     1.23     7.17      .03
6798.00
     6788.       0.    5205.    1583.       0.     563.     208.     110.      30.
 6788.00
       .18      .00     9.25     7.59     .000     .080     .070     .000  6786.00
1229.48
   .020365     722.     722.     722.        3        0        0      .00   145.32
1374.79
0
 CCHV=     .100 CEHV=     .300
 CCHV=     .100 CEHV=     .300
 *SECNO 6.100
1
    11/ 3/ 3      12:40:22
```

```
    SECNO    DEPTH    CWSEL    CRIWS    WSELK     EG        HV        HL        OLOSS
BANK ELEV
    Q        QLOB     QCH      QROB     ALOB      ACH       AROB      VOL       TWA
LEFT/RIGHT
    TIME     VLOB     VCH      VROB     XNL       XNCH      XNR       WTN       ELMIN
   SSTA
    SLOPE    XLOBL    XLCH     XLOBR    ITRIAL    IDC       ICONT     CORAR     TOPWID
   ENDST



 3301 HV CHANGED MORE THAN HVINS

 3685 20 TRIALS ATTEMPTED WSEL,CWSEL
 3693 PROBABLE MINIMUM SPECIFIC ENERGY
 3720 CRITICAL DEPTH ASSUMED
      6.10    13.82  6820.42  6820.42      .00  6827.40     6.98     9.61     1.73
6828.00
     6154.       0.    6154.       0.       0.     290.       0.     125.      33.
 6828.00
       .19      .00    21.20      .00     .000     .015     .000     .000  6806.60
1209.00
   .004232    1160.    1160.    1160.       20       14        0      .00    21.00
1230.00
0

 SPECIAL BRIDGE

 5227 DOWNSTREAM ELEV IS    6818.62 , NOT    6820.42 HYDRAULIC JUMP OCCURS
DOWNSTREAM (IF LOW FLOW CONTROLS)

 SB  XK        XKOR      COFQ      RDLEN     BWC       BWP       BAREA     SS
 ELCHU     ELCHD
      1.05      1.25      2.60       .00     20.00      1.00    210.00       .00
6807.30   6806.60

 CCHV=     .300 CEHV=     .500
 *SECNO 6.200

 3301 HV CHANGED MORE THAN HVINS


 3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.45

 PRESSURE AND WEIR FLOW,  Weir Submergence Based on TRAPEZOIDAL Shape


  EGPRS      EGLWC       H3       QWEIR      QPR       BAREA   TRAPEZOID      ELLC
   ELTRD     WEIRLN
                                                                AREA
    6837.09   6829.67       .00     1566.     4591.      210.      190.     6817.30
  6828.00      358.


        LONG VALLEY DRIVE, EXISITNG 2-10' x 10' CBC FACE
```

```
      6.20    18.51  6825.81      .00      .00  6829.70     3.89     2.30      .00
6828.00
     6154.       0.    6154.       0.       0.     389.       0.     125.      33.
 6828.00
       .19      .00    15.84      .00     .000     .015     .000     .000  6807.30
1209.00
   .002023      48.      48.      48.        6        0        5      .00    21.00
1230.00
0
 CCHV=     .100 CEHV=     .300
1
    11/ 3/ 3      12:40:22
                                PAGE    8


    SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS
BANK ELEV
    Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA
LEFT/RIGHT
    TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN
   SSTA
    SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID
   ENDST


 *SECNO 7.000

 3301 HV CHANGED MORE THAN HVINS

 3685 20 TRIALS ATTEMPTED WSEL,CWSEL
 3693 PROBABLE MINIMUM SPECIFIC ENERGY
 3720 CRITICAL DEPTH ASSUMED
      7.00     3.79  6857.79  6857.79      .00  6859.09     1.29     4.78      .26
6854.00
     6154.    2041.    1773.    2340.     233.     178.     267.     135.      35.
 6854.00
       .22     8.77     9.94     8.78     .070     .080     .070     .000  6854.00
1045.01
   .048456     856.     856.     856.       20       21        0      .00   263.57
1308.58
0
 *SECNO 8.000
 3685 20 TRIALS ATTEMPTED WSEL,CWSEL
 3693 PROBABLE MINIMUM SPECIFIC ENERGY
 3720 CRITICAL DEPTH ASSUMED
         BRISTLECONE LAKE CONCRETE SPILLWAY
      8.00     1.86  6890.86  6890.86      .00  6891.77      .91    11.36      .04
6890.00
     6154.       4.    6145.       5.       1.     802.       1.     153.      44.
 6890.00
       .26     3.76     7.66     3.78     .015     .020     .015     .000  6889.00
1077.43
   .004781    1026.    1026.    1026.       20       11        0      .00   445.42
1522.85
0
 *SECNO 9.000
```

```
 3301 HV CHANGED MORE THAN HVINS


 3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  3.00

         FLOW INTO BRISTLECONE LAKE
      9.00     6.25  6896.25      .00      .00  6896.39      .14     4.54      .08
6890.00
     8624.    1738.    6774.     112.     988.    2081.      88.     273.      76.
 6890.00
       .51     1.76     3.26     1.28     .070     .050     .070     .000  6890.00
1227.40
   .001042    2638.    2638.    2638.        6        0        0      .00   627.35
1854.74
0
 *SECNO 10.000

 3301 HV CHANGED MORE THAN HVINS

 3685 20 TRIALS ATTEMPTED WSEL,CWSEL
1
    11/ 3/ 3      12:40:22
                                PAGE    9


    SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS
BANK ELEV
    Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA
LEFT/RIGHT
    TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN
   SSTA
    SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID
   ENDST


 3693 PROBABLE MINIMUM SPECIFIC ENERGY
 3720 CRITICAL DEPTH ASSUMED
     10.00     6.42  6902.42  6902.42      .00  6903.79     1.37     1.64      .37
6904.00
     8624.       0.    7868.     756.       0.     806.     197.     301.      83.
 6900.00
       .52      .00     9.76     3.84     .000     .050     .070     .000  6896.00
1158.67
   .020723     590.     590.     590.       20        8        0      .00   375.72
1534.39
0
 *SECNO 11.000

 3301 HV CHANGED MORE THAN HVINS


 3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.51

     11.00     8.51  6912.51      .00      .00  6913.11      .60     9.25      .08
6910.00
```

```
     8624.      63.    8336.     226.      38.    1323.      74.     321.      88.
 6906.00
       .55     1.65     6.30     3.04    .100     .080     .100     .000  6904.00
1118.82
   .009130     701.     701.     701.       5        0        0      .00   249.98
1368.80
0
 *SECNO 12.000

 3265 DIVIDED FLOW


 3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .58

     12.00     5.74  6921.74      .00      .00  6922.57      .83     9.39      .07
6922.00
     8624.       0.     489.    8135.       0.      80.    1101.     340.      92.
 6922.00
       .58      .00     6.08     7.39    .000     .080     .100     .000  6916.00
1213.54
   .027002     643.     643.     643.       2        0        0      .00   242.34
1463.02
0
 *SECNO 13.000
     13.00     9.37  6937.37      .00      .00  6938.49     1.12    15.83      .09
6940.00
     8624.       0.    8495.     129.       0.     993.      44.     357.      95.
 6934.00
       .60      .00     8.55     2.94    .000     .080     .100     .000  6928.00
1154.72
   .019789     689.     689.     689.       3        0        0      .00   192.27
1346.98
0
 *SECNO 14.000
     14.00     8.38  6952.38      .00      .00  6953.10      .72    14.57      .04
6954.00
     8624.       0.    8455.     169.       0.    1234.      45.     380.     100.
 6946.00
       .64      .00     6.85     3.77    .000     .080     .100     .000  6944.00
1150.04
   .015530     834.     834.     834.       5        0        0      .00   255.99
1406.04
0
1
    11/ 3/ 3      12:40:22
                                PAGE   10


    SECNO    DEPTH    CWSEL    CRIWS    WSELK    EG       HV       HL       OLOSS
BANK ELEV
    Q        QLOB     QCH      QROB     ALOB     ACH      AROB     VOL      TWA
LEFT/RIGHT
    TIME     VLOB     VCH      VROB     XNL      XNCH     XNR      WTN      ELMIN
   SSTA
    SLOPE    XLOBL    XLCH     XLOBR    ITRIAL   IDC      ICONT    CORAR    TOPWID
   ENDST
```

```
 *SECNO 15.000
     15.00     7.44  6965.44       .00       .00  6966.26       .82    13.13       .03
6962.00
     8624.       42.     7240.     1342.       15.      953.      264.      402.      104.
 6962.00
       .67     2.81      7.60      5.09      .100      .080      .100      .000  6958.00
1082.39
   .019128      764.      764.      764.         4         0         0       .00   268.67
1351.06
0
 *SECNO 16.000

 3301 HV CHANGED MORE THAN HVINS

     16.00     8.28  6982.28   6981.98       .00  6983.91      1.63    17.41       .24
6980.00
     8624.      114.     8093.      417.       39.      767.      134.      420.      109.
 6980.00
       .69     2.88     10.55      3.10      .100      .080      .100      .000  6974.00
1231.31
   .031727      718.      718.      718.         7         8         0       .00   278.30
1509.60
0
 *SECNO 17.000

 3301 HV CHANGED MORE THAN HVINS

         CONFLUENCE OF NORTH AND SOUTH BEAVER CREEK
     17.00     9.53  6997.53       .00       .00  6998.36       .82    14.36       .08
6998.00
     8270.        0.     8270.        0.        0.     1137.        0.      433.      112.
 6998.00
       .71      .00      7.28       .00      .000      .080      .000      .000  6988.00
1102.86
   .021938      547.      547.      547.         5         0         0       .00   262.59
1365.45
0
 *SECNO 18.000

 3301 HV CHANGED MORE THAN HVINS

         BEAVER CREEK SOUTH FORK
     18.00     9.92  7011.92       .00       .00  7013.30      1.38    14.78       .17
7018.00
     6754.        0.     6754.        0.        0.      716.        0.      445.      115.
 7020.00
       .72      .00      9.43       .00      .000      .080      .000      .000  7002.00
1099.55
   .028896      598.      598.      598.         3         0         0       .00   136.51
1236.06
0
 *SECNO 19.000
     19.00     8.79  7034.79       .00       .00  7035.68       .89    22.33       .05
7034.00
```

```
     6754.        4.    6742.        7.        3.      890.        6.      460.      118.
 7034.00
       .75      1.31      7.58      1.31      .100      .080      .100      .000   7026.00
1106.50
   .026968      800.      800.      800.         4         0         0       .00    248.53
1355.03
0
1
    11/ 3/ 3      12:40:22
                                PAGE   11


    SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS
BANK ELEV
    Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA
LEFT/RIGHT
    TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN
   SSTA
    SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID
   ENDST


 *SECNO 20.000

 3301 HV CHANGED MORE THAN HVINS

     20.00      6.36   7054.36       .00       .00   7055.81      1.45     19.96       .17
7058.00
     6754.        0.    6754.        0.        0.      698.        0.      472.      121.
 7060.00
       .77       .00      9.67       .00      .000      .080      .000      .000   7048.00
1065.51
   .038415      625.      625.      625.         2         0         0       .00    160.28
1225.79
0
 *SECNO 21.000
     21.00      8.56   7080.56       .00       .00   7081.53       .97     25.68       .05
7080.00
     6754.        1.    6752.        1.        1.      854.        1.      487.      125.
 7080.00
       .80       .96      7.90       .96      .100      .080      .100      .000   7072.00
1061.22
   .022960      879.      879.      879.         5         0         0       .00    188.29
1249.51
0
 *SECNO 22.000

 3301 HV CHANGED MORE THAN HVINS


 3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =   .65

     22.00      6.61   7098.61   7098.55       .00   7100.44      1.83     18.65       .26
7096.00
     6754.       55.    6570.      128.       14.      598.       31.      497.      127.
 7096.00
```

```
      .82     4.05    10.98     4.11     .100     .080     .100     .000  7092.00
1021.54
   .054047     554.     554.     554.        6       19        0      .00   181.31
1202.86
0
 *SECNO 23.000

 3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE,  KRATIO =  1.42

     23.00     9.38  7117.38      .00      .00  7119.39     2.01    18.90      .05
7110.00
     6754.    1332.    5064.     358.     231.     398.      65.     505.     129.
 7110.00
      .83     5.76    12.71     5.49     .100     .080     .100     .000  7108.00
1056.30
   .026617     514.     514.     514.        4        0        0      .00   126.40
1182.70
0
1
    11/ 3/ 3      12:40:22
                                PAGE   12
```

```
 THIS RUN EXECUTED 11/ 3/ 3    12:40:22
 **************************************************
   HEC2 RELEASE DATED SEP 88 UPDATED APR  1989


   ERROR CORR -  01,02
   MODIFICATION -
 **************************************************


 NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF
ERRORS LIST


 100-YEAR FREQUENCY CROSS

 SUMMARY PRINTOUT TABLE  150


       SECNO     XLCH      ELTRD     ELLC      ELMIN       Q       CWSEL     CRIWS
    EG       10*KS      VCH      AREA      .01K

 *     60.000       .00       .00       .00   6718.00  20974.00   6733.36   6733.36
  6736.77    125.57     16.75   1701.40  1871.69

        1.000   1047.00       .00       .00   6732.00   6915.00   6743.87       .00
  6744.18     20.82      6.46   1946.76  1515.58

 *      2.000    759.00       .00       .00   6746.00   6915.00   6751.95   6751.95
  6753.89    197.70     13.09    709.71   491.80
```

*	3.000	845.00	.00	.00	6772.00	5128.00	6774.75	6774.75	6775.69	19.18	8.51	671.52	1171.06
*	4.000	984.00	.00	.00	6784.00	6788.00	6786.82	6786.82	6787.96	58.66	9.08	820.00	886.28
*	5.000	722.00	.00	.00	6786.00	6788.00	6793.93	.00	6795.16	203.65	9.25	771.30	475.67
*	6.100	1160.00	.00	.00	6806.60	6154.00	6820.42	6820.42	6827.40	42.32	21.20	290.26	946.04
*	6.200	48.00	6828.00	6817.30	6807.30	6154.00	6825.81	.00	6829.70	20.23	15.84	388.61	1368.18
*	7.000	856.00	.00	.00	6854.00	6154.00	6857.79	6857.79	6859.09	484.56	9.94	677.64	279.57
*	8.000	1026.00	.00	.00	6889.00	6154.00	6890.86	6890.86	6891.77	47.81	7.66	804.16	890.04
*	9.000	2638.00	.00	.00	6890.00	8624.00	6896.25	.00	6896.39	10.42	3.26	3157.00	2671.12
*	10.000	590.00	.00	.00	6896.00	8624.00	6902.42	6902.42	6903.79	207.23	9.76	1002.54	599.08
*	11.000	701.00	.00	.00	6904.00	8624.00	6912.51	.00	6913.11	91.30	6.30	1435.60	902.54
*	12.000	643.00	.00	.00	6916.00	8624.00	6921.74	.00	6922.57	270.02	6.08	1181.02	524.82
	13.000	689.00	.00	.00	6928.00	8624.00	6937.37	.00	6938.49	197.89	8.55	1036.84	613.05
	14.000	834.00	.00	.00	6944.00	8624.00	6952.38	.00	6953.10	155.30	6.85	1278.76	692.03
	15.000	764.00	.00	.00	6958.00	8624.00	6965.44	.00	6966.26	191.28	7.60	1231.38	623.56

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10*KS	VCH	AREA	.01K
16.000	718.00	.00	.00	6974.00	8624.00	6982.28	6981.98	6983.91	317.27	10.55	940.80	484.16
17.000	547.00	.00	.00	6988.00	8270.00	6997.53	.00	6998.36	219.38	7.28	1136.59	558.36

	18.000	598.00	.00	.00	7002.00	6754.00	7011.92	.00
	7013.30	288.96	9.43	716.36	397.32			
	19.000	800.00	.00	.00	7026.00	6754.00	7034.79	.00
	7035.68	269.68	7.58	898.56	411.28			
	20.000	625.00	.00	.00	7048.00	6754.00	7054.36	.00
	7055.81	384.15	9.67	698.47	344.60			
	21.000	879.00	.00	.00	7072.00	6754.00	7080.56	.00
	7081.53	229.60	7.90	856.49	445.74			
*	22.000	554.00	.00	.00	7092.00	6754.00	7098.61	7098.55
	7100.44	540.47	10.98	643.15	290.52			
*	23.000	514.00	.00	.00	7108.00	6754.00	7117.38	.00
	7119.39	266.17	12.71	694.80	413.98			

100-YEAR FREQUENCY CROSS

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	60.000	20974.00	6733.36	.00	.00	.16	258.76	.00
	1.000	6915.00	6743.87	.00	10.52	.00	392.81	1047.00
*	2.000	6915.00	6751.95	.00	8.08	.00	176.67	759.00
*	3.000	5128.00	6774.75	.00	22.79	.00	360.65	845.00
*	4.000	6788.00	6786.82	.00	12.07	.00	366.20	984.00
*	5.000	6788.00	6793.93	.00	7.11	.00	145.32	722.00
*	6.100	6154.00	6820.42	.00	26.49	.00	21.00	1160.00
*	6.200	6154.00	6825.81	.00	5.38	.00	21.00	48.00
*	7.000	6154.00	6857.79	.00	31.99	.00	263.57	856.00
*	8.000	6154.00	6890.86	.00	33.06	.00	445.42	1026.00
*	9.000	8624.00	6896.25	.00	5.39	.00	627.35	2638.00
*	10.000	8624.00	6902.42	.00	6.17	.00	375.72	590.00
*	11.000	8624.00	6912.51	.00	10.10	.00	249.98	701.00

*	12.000	8624.00	6921.74	.00	9.23	.00	242.34	643.00
	13.000	8624.00	6937.37	.00	15.63	.00	192.27	689.00
	14.000	8624.00	6952.38	.00	15.01	.00	255.99	834.00
	15.000	8624.00	6965.44	.00	13.06	.00	268.67	764.00
	16.000	8624.00	6982.28	.00	16.84	.00	278.30	718.00
	17.000	8270.00	6997.53	.00	15.26	.00	262.59	547.00
	18.000	6754.00	7011.92	.00	14.39	.00	136.51	598.00
	19.000	6754.00	7034.79	.00	22.87	.00	248.53	800.00
	20.000	6754.00	7054.36	.00	19.57	.00	160.28	625.00
	21.000	6754.00	7080.56	.00	26.21	.00	188.29	879.00
*	22.000	6754.00	7098.61	.00	18.05	.00	181.31	554.00

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	23.000	6754.00	7117.38	.00	18.77	.00	126.40	514.00

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO= 60.000 PROFILE= 1 CRITICAL DEPTH ASSUMED

CAUTION SECNO= 2.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 2.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 3.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 3.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 3.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 4.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 4.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 4.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL

```
WARNING SECNO=      5.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=      6.100  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      6.100  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      6.100  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=      6.200  PROFILE=  1  HYDRAULIC JUMP D.S.
WARNING SECNO=      6.200  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=      7.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      7.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      7.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO=      8.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      8.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      8.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO=      9.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

CAUTION SECNO=     10.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     10.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     10.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO=     11.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=     12.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=     22.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE

WARNING SECNO=     23.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RANGE
```

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

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

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

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

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

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

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

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

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

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

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

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

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

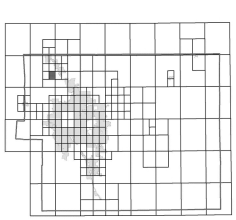
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this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

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

El Paso County Vertical Datum Offset Table

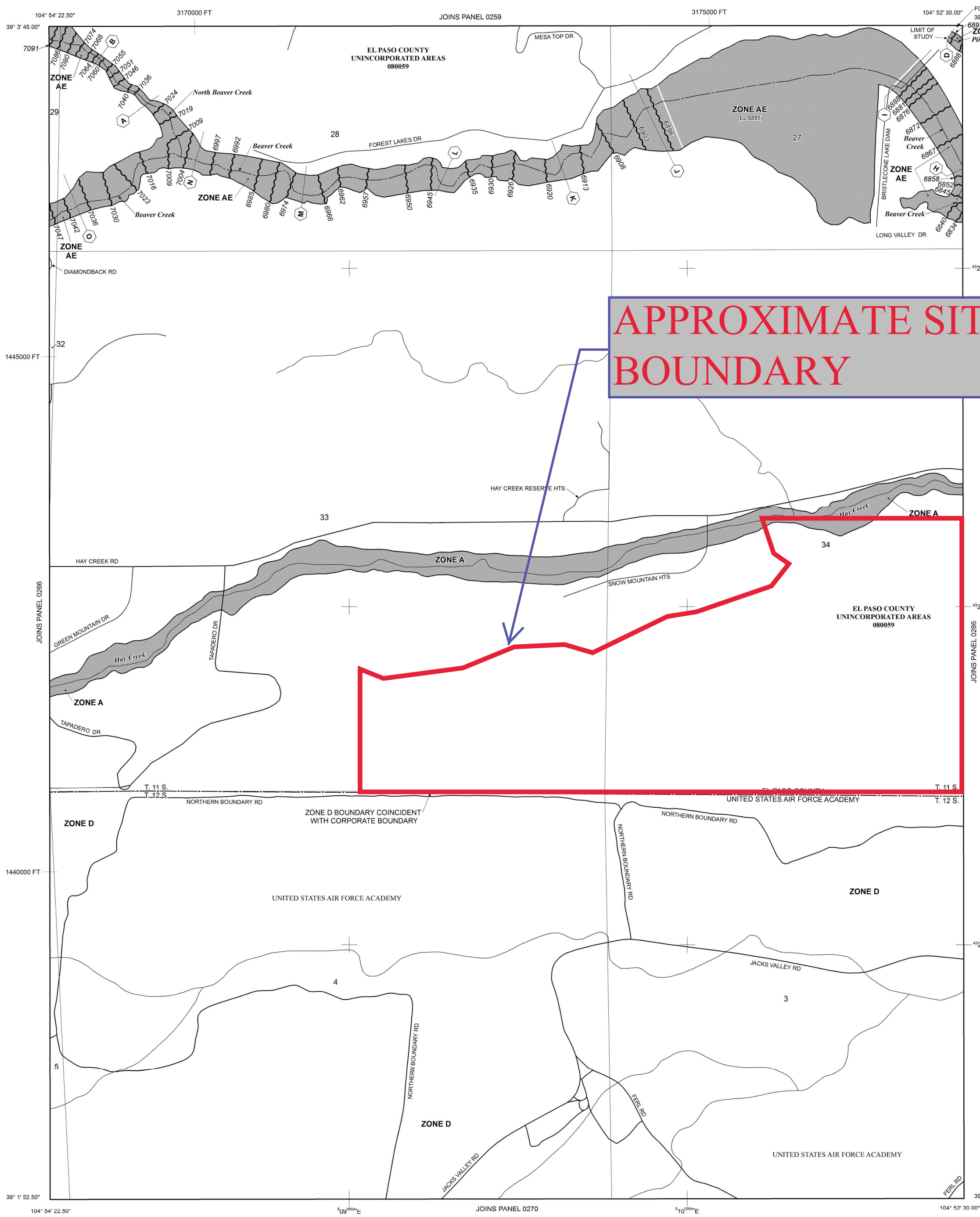
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



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

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



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 11 SOUTH, RANGE 67 WEST, AND TOWNSHIP 12 SOUTH, RANGE 67 WEST.

LEGEND

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

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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

Floodplain boundary
Floodway boundary
Zone D Boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
~~ 513 ~~ Base Flood Elevation line and value; elevation in feet*
(EL 987) Base Flood Elevation value where uniform within zone; elevation in feet*

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

(A)——(A) Cross section line
(23)--------(23) Transect line
97° 07' 30.00" 32° 22' 30.00" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
4275000mN 1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 × Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5 River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

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

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

PANEL 0267G

NATIONAL FLOOD INSURANCE PROGRAM

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

PANEL 267 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0267	G

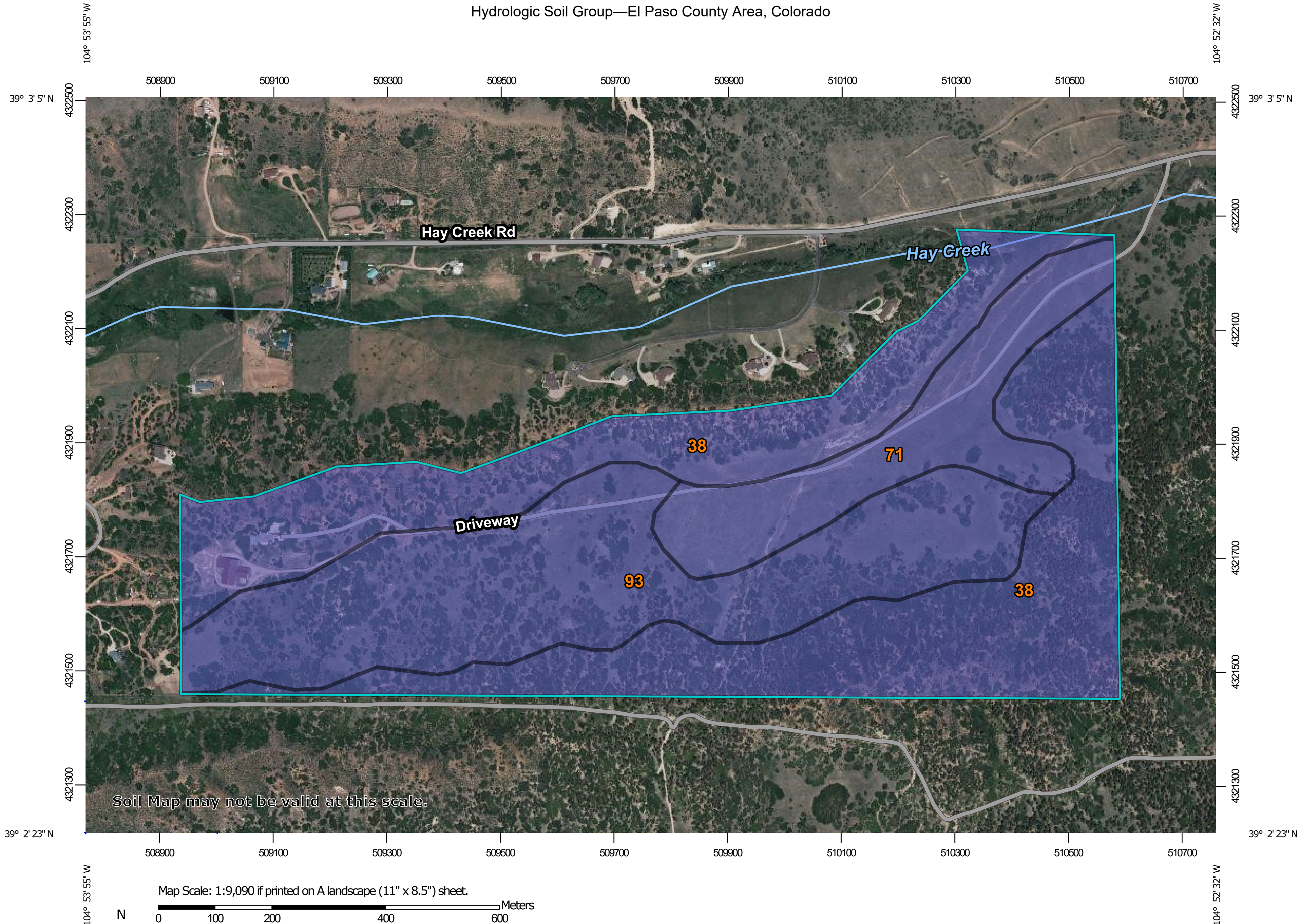
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 08041C0267G

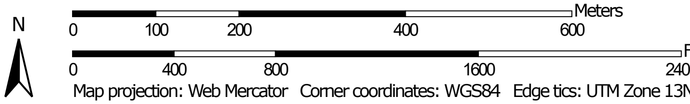
MAP REVISED DECEMBER 7, 2018

Federal Emergency Management Agency

Hydrologic Soil Group—El Paso County Area, Colorado



Map Scale: 1:9,090 if printed on A landscape (11" x 8.5") sheet.



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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

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

Warning: Soil Map may not be valid at this scale.

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

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
38	Jarre-Tecolote complex, 8 to 65 percent slopes	B	109.5	50.8%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	31.1	14.5%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	B	74.8	34.7%
Totals for Area of Interest			**215.4**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

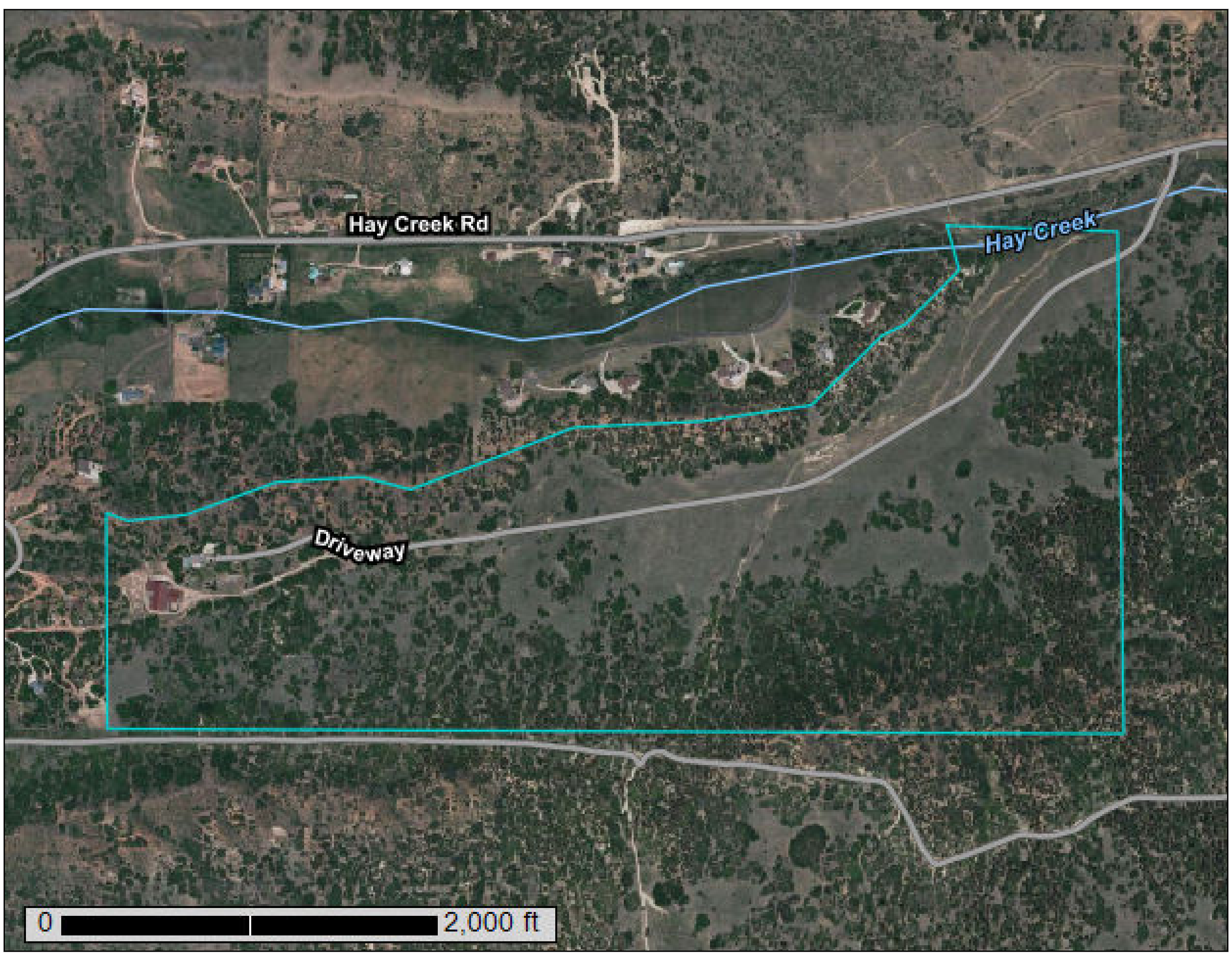
United States Department of Agriculture

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

El Paso County Area, Colorado



December 27, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Preface........ 2
How Soil Surveys Are Made........ 5
Soil Map........ 8
Soil Map........ 9
Legend........ 10
Map Unit Legend........ 11
Map Unit Descriptions........ 11
El Paso County Area, Colorado........ 13
38—Jarre-Tecolote complex, 8 to 65 percent slopes........ 13
71—Pring coarse sandy loam, 3 to 8 percent slopes........ 14
93—Tomah-Crowfoot complex, 8 to 15 percent slopes........ 15
References........ 18

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

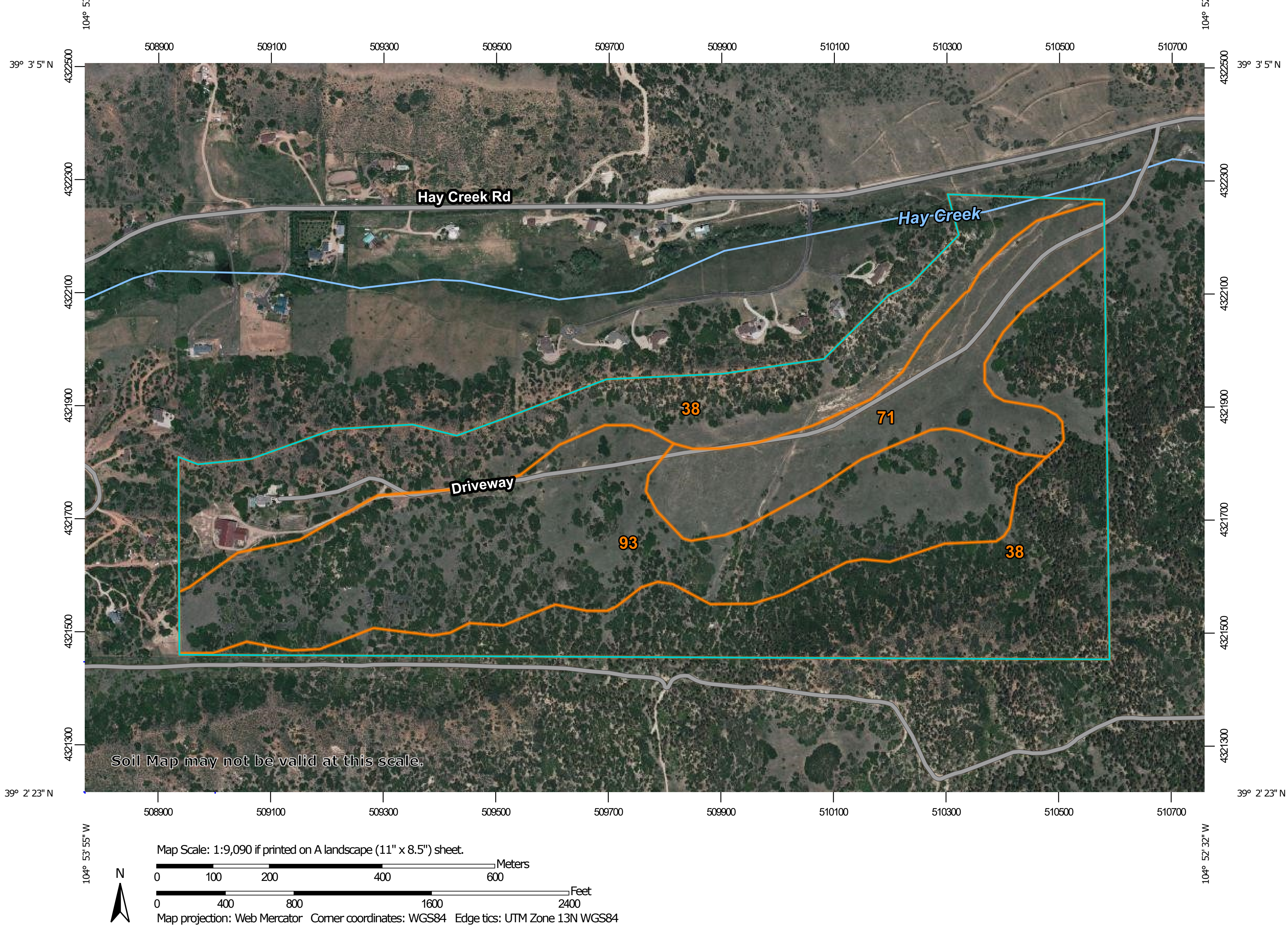
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

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

Warning: Soil Map may not be valid at this scale.

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

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

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

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 20, Sep 2, 2022

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
38	Jarre-Tecolote complex, 8 to 65 percent slopes	109.5	50.8%
71	Pring coarse sandy loam, 3 to 8 percent slopes	31.1	14.5%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	74.8	34.7%
Totals for Area of Interest		**215.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

El Paso County Area, Colorado

38—Jarre-Tecolote complex, 8 to 65 percent slopes

Map Unit Setting

National map unit symbol: 368c
Elevation: 6,700 to 7,500 feet
Frost-free period: 90 to 125 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Jarre

Setting

Landform: Alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 5 inches: gravelly sandy loam
Bt - 5 to 22 inches: gravelly sandy clay loam
2C - 22 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 8 to 30 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R048AY222CO - Loamy Park
Hydric soil rating: No

Description of Tecolote

Setting

Landform: Alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 3 inches: very stony loam
E - 3 to 12 inches: very gravelly loamy sand
Bt - 12 to 45 inches: extremely gravelly sandy clay loam
C - 45 to 60 inches: extremely gravelly loamy sand

Properties and qualities

Slope: 8 to 65 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: B
Ecological site: R048AY255CO - Pine Grasslands
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

71—Pring coarse sandy loam, 3 to 8 percent slopes

Map Unit Setting

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

Map Unit Composition

Pring and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pring

Setting

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

Parent material: Arkosic alluvium derived from sedimentary rock

Typical profile

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

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups

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

Minor Components

Pleasant

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

Other soils

Percent of map unit:
Hydric soil rating: No

93—Tomah-Crowfoot complex, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 36bb
Elevation: 7,300 to 7,600 feet
Farmland classification: Not prime farmland

Map Unit Composition

Tomah and similar soils: 50 percent
Crowfoot and similar soils: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tomah

Setting

Landform: Hills, alluvial fans

Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkose and/or residuum weathered from arkose

Typical profile

A - 0 to 10 inches: loamy sand
E - 10 to 22 inches: coarse sand
Bt - 22 to 48 inches: stratified coarse sand to sandy clay loam
C - 48 to 60 inches: coarse sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R049XY216CO - Sandy Divide
Hydric soil rating: No

Description of Crowfoot

Setting

Landform: Hills, alluvial fans
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 12 inches: loamy sand
E - 12 to 23 inches: sand
Bt - 23 to 36 inches: sandy clay loam
C - 36 to 60 inches: coarse sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R049XY216CO - Sandy Divide
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit:
Hydric soil rating: No

Pleasant

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

References

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

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

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

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

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

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

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

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

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

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

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

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

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

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

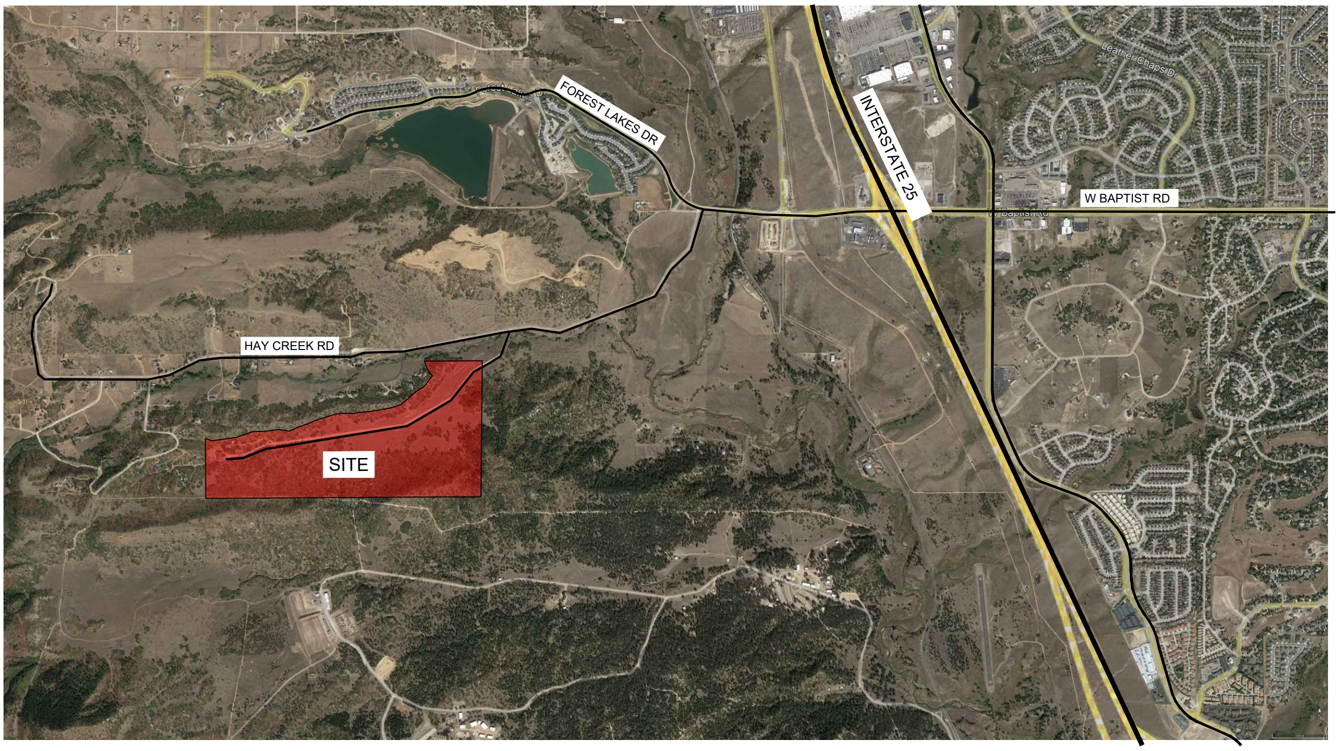
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

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

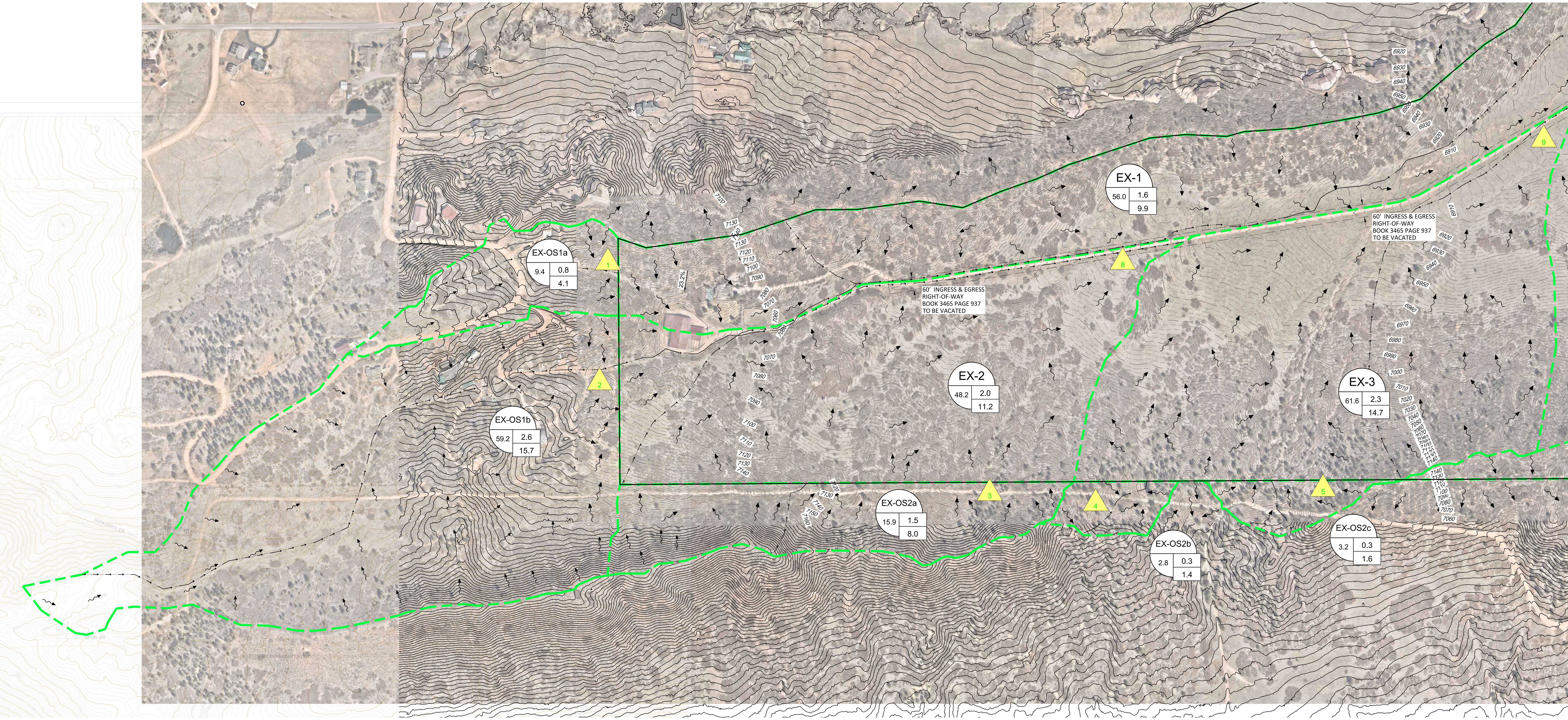
United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

APPENDIX D

MAPS

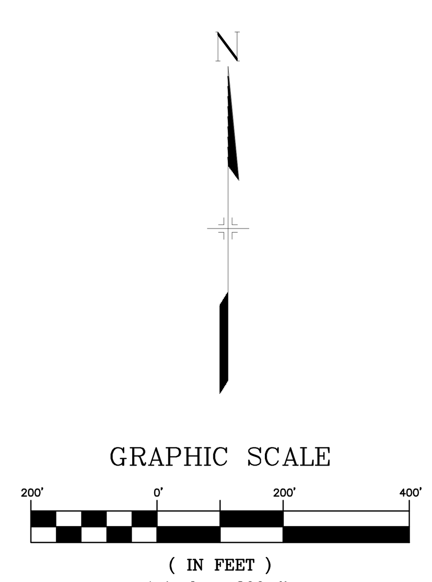


VICINITY MAP
HAY CREEK VALLEY
(NTS)



LEGEND

- BASIN BOUNDARY
- EXISTING PROPERTY LINE
- EXISTING CONTOUR
- FLOW DIRECTION
- 2 — DESIGN POINT
- EX-2 — SUB BASIN DESIGNATION
- 5-YEAR STORM EVENT PEAK FLOW (CFS)
- 100-YEAR STORM EVENT PEAK FLOW (CFS)
- SUB BASIN AREA (AC.)



Hay Creek Existing Conditions Sub-basin Summary			
Basin	**Area**	Q5	Q100
	acres	cfs	cfs
EX-OS1a	9.4	0.8	4.1
EX-OS1b	59.2	2.6	15.7
EX-OS2a	15.9	1.5	8.0
EX-OS2b	2.8	0.3	1.4
EX-OS2c	3.2	0.3	1.6
EX-OS3	8.1	0.2	2.0
EX-1	56.0	1.6	9.9
EX-2	48.2	2.0	11.2
EX-3	61.6	2.3	14.7
EX-4	5.9	2.3	15.6
EX-5	42.8	1.5	10.0

Existing Design Point Summary Hay Creek				
Design Point	**Sub-Basins**	**Total Area (ac.)**	**Q(5) (cfs)**	**Q(100) (cfs)**
1	EX-OS1a	9.35	0.80	4.10
2	EX-OS1b	59.21	2.60	15.70
3	EX-OS2a	15.90	1.50	8.00
4	EX-OS2b	2.77	0.30	1.40
5	EX-OS2c	3.17	0.30	1.60
6	EX-OS3	8.15	0.20	2.00
7	EX-4	5.88	2.30	15.60
8	EX-OS1b, EX-OS2a, EX-2	123.33	5.40	30.90
9	EX-OS2b, EX-OS2c, EX-3	67.57	2.90	17.40
10	EX-OS3, EX-5	50.97	1.80	11.90
11	DP-8, DP-9, DP-10, EX-OS1a, EX-1	307.27	11.20	69.90
HC	From PPRBD Regional floodplane Administrator			127.00

EL PASO COUNTY

HAY CREEK
FINAL DRAINAGE REPORT

OFFSITE DRAINAGE BASINS

DESIGNED BY: WCG
DRAWN BY: WCG
CHECKED BY: JTS

SCALE
HORIZ.
VERT.

DATE ISSUED: SEPTEMBER 2023
SHEET 1 OF 4

DRAWING No. DR01

SEAL

PRELIMINARY
THIS DRAWING HAS NOT BEEN APPROVED BY GOVERNING AGENCIES AND IS SUBJECT TO CHANGE

FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.
PROJECT No. 22.886.076

PREPARED BY:
Matrix
Excellence by Design

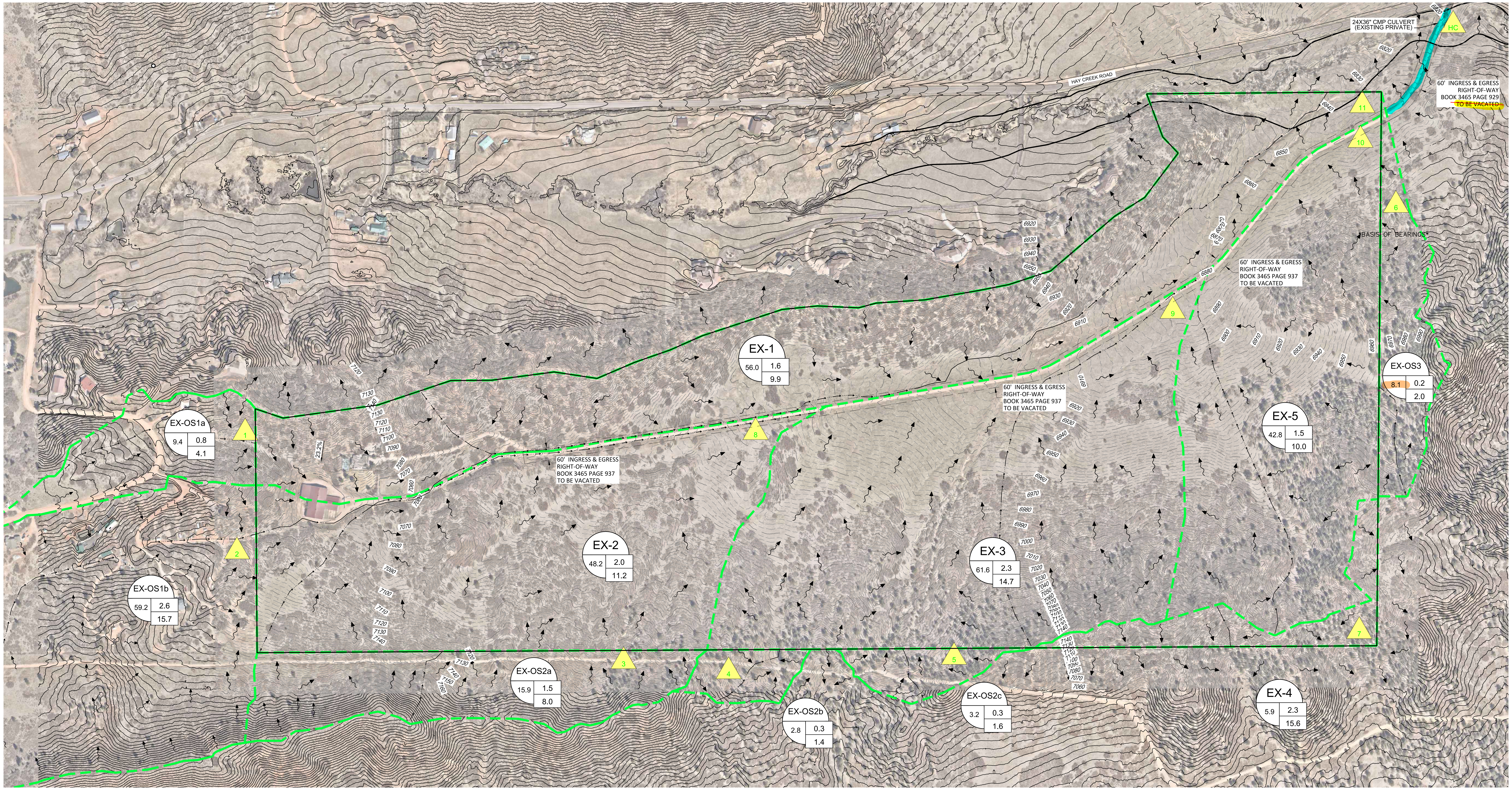
SHEET KEY

REFERENCE DRAWINGS

No.	DATE	DESCRIPTION	BY
###	###	###	###
###	###	###	###
###	###	###	###
###	###	###	###
###	###	###	###

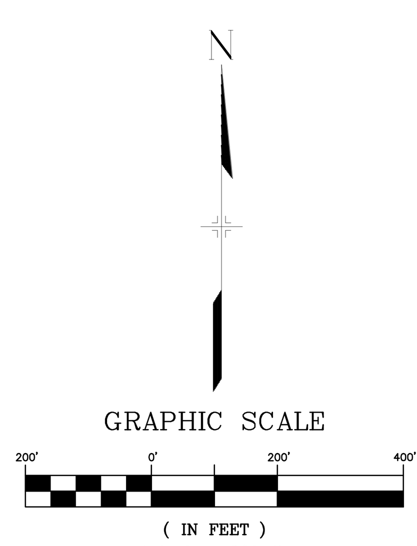
REVISIONS

COMPUTER FILE MANAGEMENT
FILE NAME: S:\22.886.076 Hay Creek-Forest Manor-O'Leary Properties\200 Design\220 Drainage-WR\222 Reports\FDR\DWG\DR01 - HAY CREEK.dwg
CTB FILE: ---
PLOT DATE: August 30, 2023 12:46:44 PM
THIS DRAWING IS CURRENT AS OF PLOT DATE AND MAY BE SUBJECT TO CHANGE.



LEGEND

- BASIN BOUNDARY
- EXISTING CONTOUR
- FLOW DIRECTION
- DESIGN POINT (2)
- SUB BASIN DESIGNATION (EX-2)
- 5-YEAR STORM EVENT PEAK FLOW (CFS) (x.x)
- 100-YEAR STORM EVENT PEAK FLOW (CFS) (x.x)
- SUB BASIN AREA (AC.) (####)



Hay Creek Existing Conditions Sub-basin Summary			
Basin	**Area**	Q5	Q100
	acres	cfs	cfs
EX-OS1a	9.4	0.8	4.1
EX-OS1b	59.2	2.6	15.7
EX-OS2a	15.9	1.5	8.0
EX-OS2b	2.8	0.3	1.4
EX-OS2c	3.2	0.3	1.6
EX-OS3	8.1	0.2	2.0
EX-1	56.0	1.6	9.9
EX-2	48.2	2.0	11.2
EX-3	61.6	2.3	14.7
EX-4	5.9	2.3	15.6
EX-5	42.8	1.5	10.0

Existing Design Point Summary

Hay Creek

Design Point	Sub-Basins	Total Area (ac.)	Q(5) (cfs)	Q(100) (cfs)
1	EX-OS1a	9.35	0.80	4.10
2	EX-OS1b	59.21	2.60	15.70
3	EX-OS2a	15.90	1.50	8.00
4	EX-OS2b	2.77	0.30	1.40
5	EX-OS2c	3.17	0.30	1.60
6	EX-OS3	8.15	0.20	2.00
7	EX-4	5.88	2.30	15.60
8	EX-OS1b, EX-OS2a, EX-2	123.33	5.40	30.90
9	EX-OS2b, EX-OS2c, EX-3	67.57	2.90	17.40
10	EX-OS3, EX-5	50.97	1.80	11.90
11	DP-8, DP-9, DP-10, EX-OS1a, EX-1	307.27	11.20	69.90
HC	From PPRBD Regional floodplane Administrator			127.00

EL PASO COUNTY

HAY CREEK
FINAL DRAINAGE REPORT

PRE DEVELOPMENT DRAINAGE CONDITIONS

DESIGNED BY: WCG
DRAWN BY: WCG
CHECKED BY: JTS

SCALE
HORIZ.
VERT.

DATE ISSUED: SEPTEMBER 2023
SHEET 2 OF 4
DRAWING No. DR02

SEAL

PRELIMINARY
THIS DRAWING HAS NOT BEEN APPROVED BY GOVERNING AGENCIES AND IS SUBJECT TO CHANGE

FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.
PROJECT No. 22.886.076

PREPARED BY:
Matrix
Excellence by Design

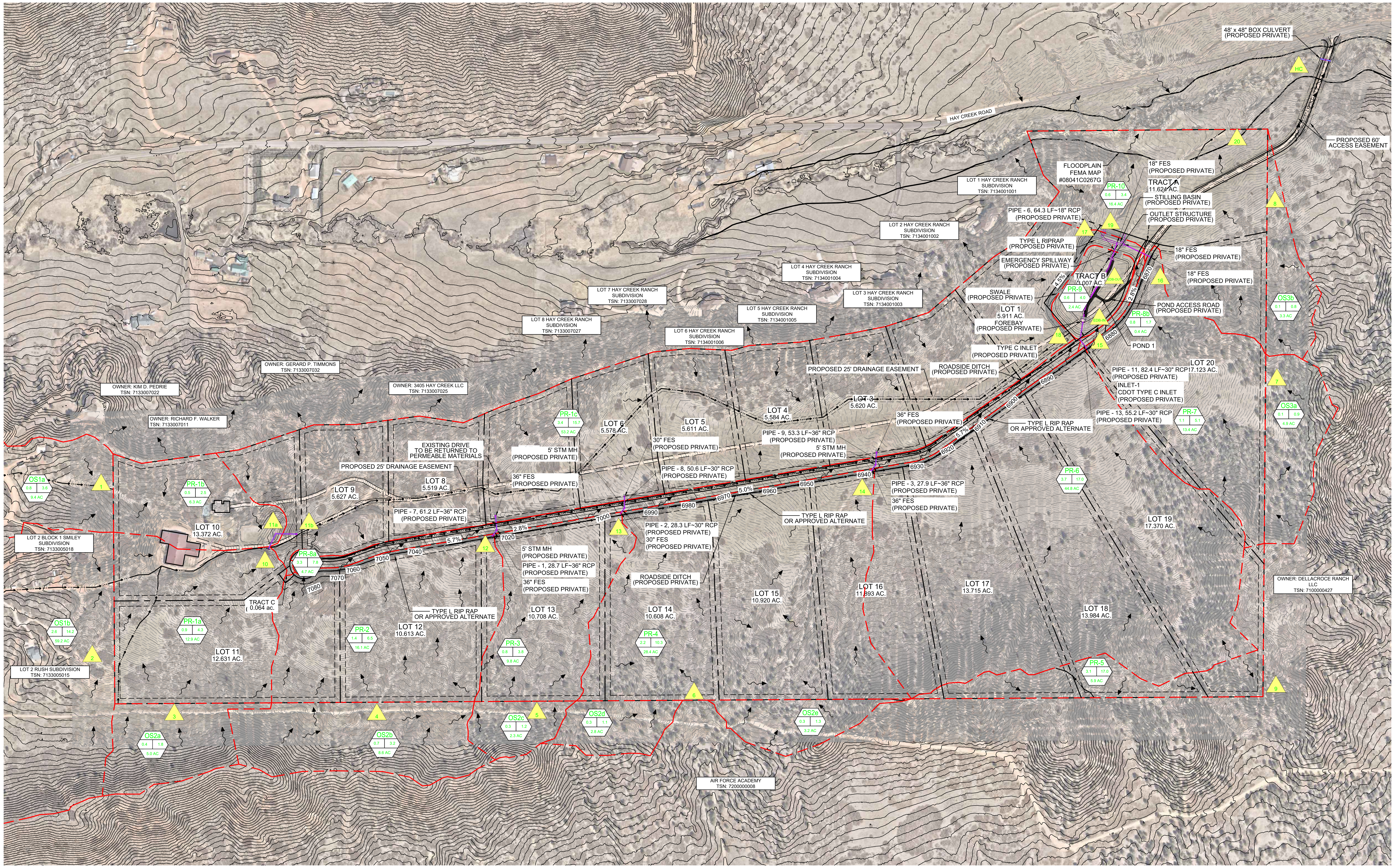
SHEET KEY

No.	DATE	DESCRIPTION	BY
####	####		####
####	####		####
####	####		####
####	####		####
####	####		####
####	####		####

REVISIONS

REFERENCE DRAWINGS

COMPUTER FILE MANAGEMENT
FILE NAME: S:\22.886.076 Hay Creek-Forest Manor-O'Leary Properties\200 Design\220 Drainage-WR\222 Reports\FDR\DWG\DR01 - HAY CREEK.dwg
CTB FILE: ---
PLOT DATE: August 30, 2023 10:42:58 AM
THIS DRAWING IS CURRENT AS OF PLOT DATE AND MAY BE SUBJECT TO CHANGE.



LEGEND

PR BASIN BOUNDARY
EXISTING CONTOUR
PROPOSED CONTOUR
PROPOSED STORM DRAIN PIPE
EXISTING EDGE OF ROAD
PROPOSED PROPERTY LINE
PROPOSED SETBACK
PROPOSED FLOW DIRECTION
DESIGN POINT
PROPOSED MAINTENANCE ACCESS ROAD
PROPOSED RIP RAP
EMERGENCY FLOW PATHS
BASIN — SUB BASIN DESIGNATION
Q5 — 5-YEAR STORM EVENT PEAK FLOW (CFS)
Q100 — 100-YEAR STORM EVENT PEAK FLOW (CFS)
AREA — SUB BASIN AREA (AC.)

GRAPHIC SCALE
200' 0 200' 400'
(IN FEET)
1 inch = 200 ft.

Hay Creek
Proposed Conditions
Sub-basin Summary

Basin	Area	Q5	Q100
	acres	cfs	cfs
OS1a	9.4	0.8	3.6
OS1b	59.2	2.6	14.2
OS2a	5.0	0.4	1.8
OS2b	8.6	0.7	3.2
OS2c	2.3	0.3	1.2
OS2d	2.8	0.3	1.1
OS2e	3.2	0.3	1.3
OS3a	4.9	0.1	0.9
OS3b	3.3	0.1	0.8
PR-1a	12.9	0.9	4.3
PR-1b	6.3	0.5	2.5
PR-1c	53.2	3.4	15.7
PR-2	16.1	1.4	6.5
PR-3	9.8	0.8	3.8
PR-4	28.4	2.2	10.3
PR-5	5.9	0.0	0.0
PR-6	44.8	3.7	17.0
PR-7	13.4	1.1	5.1
PR-8a	4.7	3.3	7.8
PR-8b	0.4	0.8	1.7
PR-9	2.4	0.0	0.0
PR-10	16.4	0.6	3.4

Proposed Design Point Summary - Central Basin

Hay Creek

Design Point	Sub-Basins	Total Area (ac.)	Q(5) (cfs)	Q(100) (cfs)
1	OS1a	9.35	0.80	3.60
2	OS1b	59.21	2.60	14.20
3	OS2a	5.01	0.40	1.80
4	OS2b	8.57	0.70	3.20
5	OS2c	2.28	0.30	1.20
6	OS2d, OS2e	5.93	0.50	2.30
7	OS3a	4.88	0.10	0.90
8	OS3b	3.29	0.10	0.80
9	PR-5	5.86	3.11	17.01
10	OS1b, OS2a, PR-1a	77.15	3.70	19.50
11a	OS1a,PR-1b	15.63	1.30	6.10
11b	OS1a, OS2a, OS1b, PR-1a, PR-1b	92.78	5.00	25.20
12	OS2b, PR-2	24.65	2.10	9.60
13	OS2c, PR-3	12.06	1.00	4.60
14	OS2d, OS2e, PR-4	34.29	2.70	12.30
15	PR-6	44.76	3.70	17.00
16	OS3a, PR-7	18.31	1.20	6.10
17	OS1a, OS1b, OS2a, PR-1a, PR-1b, PR-1c, DP-10, DP-11, DP-12, DP-13, DP-14	216.99	11.80	58.10
18a	PR-8a	4.73	3.30	7.80
18b	PR-6, PR-8a	49.49	6.60	24.30
EDB-IN	PR-6, PR-8a, PR-8b, PR-9	52.31	5.10	22.40
EDB-OUT	PR-6, PR-8a, PR-8b, PR-9	52.31	5.80	17.30
19	EDB-OUT, DP-14, DP-15	287.62	12.50	64.70
20	DP-8, DP-18, PR-10	307.28	13.00	68.60
HC	From PPRBD Regional floodplane Administrator			127.00

EL PASO COUNTY

HAY CREEK
FINAL DRAINAGE REPORT

POST DEVELOPMENT DRAINAGE CONDITIONS

DESIGNED BY: WCG
DRAWN BY: WCG
CHECKED BY: JTS
SCALE HORIZ. VERT.
DATE ISSUED: SEPTEMBER 2023
SHEET 3 OF 4
DRAWING No. DR03

SEAL

PRELIMINARY
THIS DRAWING HAS NOT BEEN APPROVED BY GOVERNING AGENCIES AND IS SUBJECT TO CHANGE

FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.
PROJECT No. 22.886.076

PREPARED BY:
Matrix
Excellence by Design

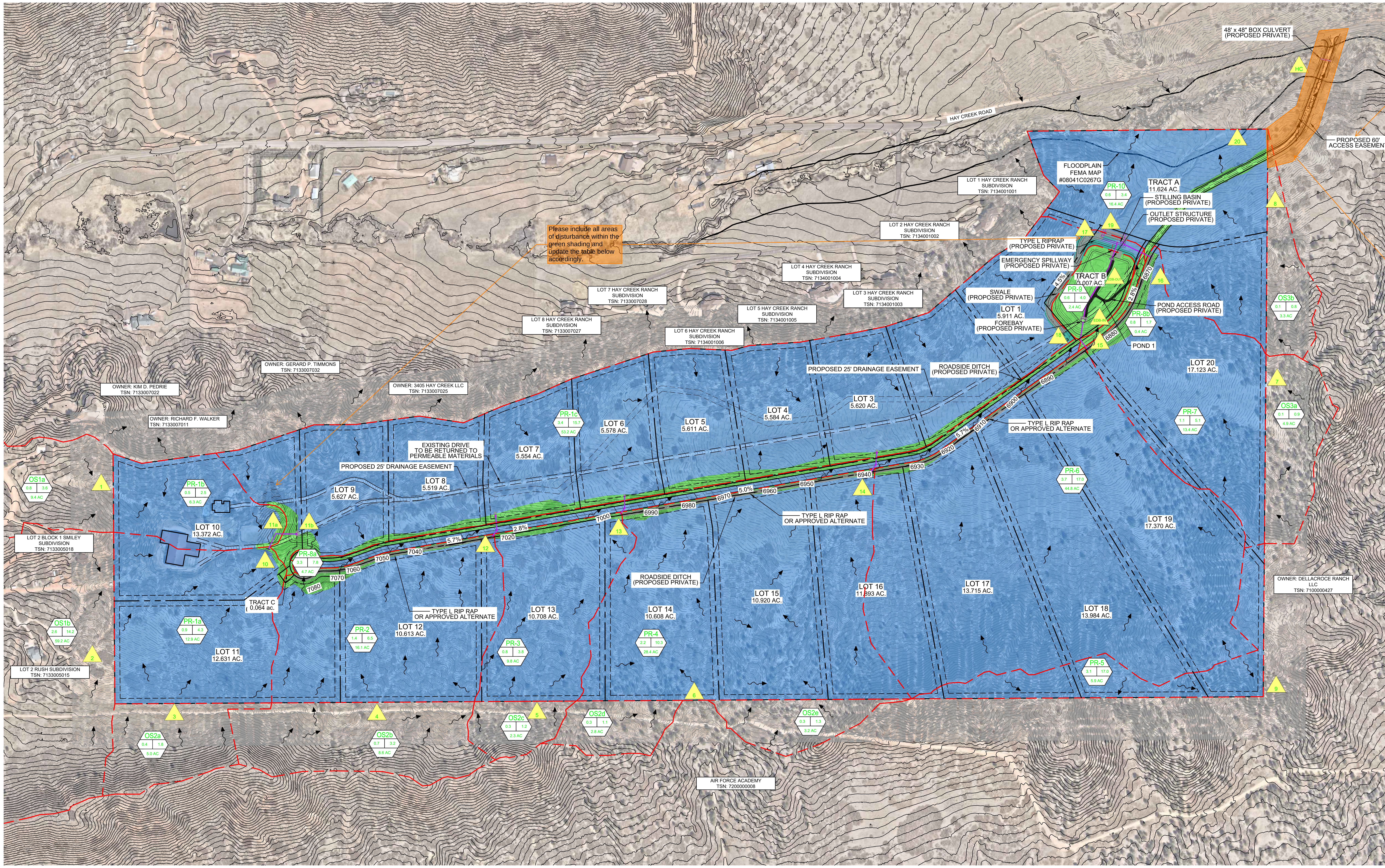
SHEET KEY

No.	DATE	DESCRIPTION	BY

REVISIONS

REFERENCE DRAWINGS

COMPUTER FILE MANAGEMENT
FILE NAME: S:\22.886.076 Hay Creek-Forest Manor-O'Leary Properties\200 Design\220 Drainage-WR\222 Reports\FDR\DWG\DR02 - HAY CREEK.dwg
CTB FILE: ----
PLOT DATE: September 19, 2023 1:28:21 PM
THIS DRAWING IS CURRENT AS OF PLOT DATE AND MAY BE SUBJECT TO CHANGE.



This exclusion applies to disturbed areas that will be returned to existing grade and vegetation. Because the proposed project will permanently alter the terrain this exclusion would not apply. You can treat these areas by using runoff reduction, please provide calcs to support that if used. Grading within the lots themselves would qualify under the large lot exclusion.

LEGEND

- PR BASIN BOUNDARY
- EXISTING CONTOUR
- PROPOSED CONTOUR
- PROPOSED STORM DRAIN PIPE
- EXISTING EDGE OF ROAD
- PROPOSED SETBACK
- PROPOSED PROPERTY LINE
- PROPOSED FLOW DIRECTION
- 2 — DESIGN POINT
- PROPOSED MAINTENANCE ACCESS ROAD
- PROPOSED RIP RAP
- DISTURBED AREA
- UNDISTURBED AREA
- EMERGENCY FLOW PATHS
- BASIN — SUB BASIN DESIGNATION
- Q5 — 5-YEAR STORM EVENT PEAK FLOW (CFS)
- Q100 — 100-YEAR STORM EVENT PEAK FLOW (CFS)
- AREA — SUB BASIN AREA (AC.)

GRAPHIC SCALE

200' 0' 200' 400'

(IN FEET)
1 inch = 200 ft.

Hay Creek — Disturbed Area

Basin ID	Total Area (ac)	Total Proposed Disturbed Area (ac)	Disturbed Area Tributary to Pond 1 (ac)	Disturbed Area which will be returned to permeable/undeveloped (Excl. I.7.1.B.7) (ac)	Impervious areas which are not practicable to detain (Excl. I.7.1.C.1.a) (ac)
PR-1a	12.94	0.13	0.00	0.13	0.00
PR-1b	6.28	0.18	0.00	0.18	0.00
PR-1c	53.22	3.83	0.00	3.83	0.00
PR-2	16.08	1.01	0.00	1.01	0.00
PR-3	9.78	0.37	0.00	0.37	0.00
PR-4	28.35	0.76	0.00	0.76	0.00
PR-5	5.86	0.00	0.00	0.00	0.00
PR-6	44.76	0.74	0.74	0.00	0.00
PR-7	13.43	0.86	0.00	0.86	0.00
PR-8a	4.73	4.73	4.73	0.00	0.00
PR-8b	0.41	0.41	0.41	0.00	0.00
PR-9	2.41	2.41	2.41	0.00	0.00
PR-10	16.38	0.73	0.00	0.00	0.73
Total	214.63	16.16	8.29	7.14	0.73

NOTE: FUTURE RESIDENTIAL CONSTRUCTION FALLS UNDER THE LARGE LOT EXCLUSION FROM WQ TREATMENT, HOWEVER MUCH, IF NOT ALL, OF THE IMPROVEMENTS ASSOCIATED WITH THE RESIDENCES WILL DRAIN ACROSS VEGETATED AREAS AND UNDER THE RUNOFF REDUCTION METHODOLOGY WILL HAVE THE REQUIRED WQ TREATMENT VOLUME REDUCED TO ZERO.

EL PASO COUNTY

HAY CREEK
FINAL DRAINAGE REPORT

POST DEVELOPMENT DISTURBED AREAS

DESIGNED BY: WCG
DRAWN BY: WCG
CHECKED BY: JTS
SCALE HORIZ. VERT.
DATE ISSUED: SEPTEMBER 2023
SHEET 4 OF 4
DRAWING No. DR04

SEAL

PRELIMINARY
THIS DRAWING HAS NOT BEEN APPROVED BY GOVERNING AGENCIES AND IS SUBJECT TO CHANGE

FOR AND ON BEHALF OF MATRIX DESIGN GROUP, INC.
PROJECT No. 22.886.076

PREPARED BY:
Matrix
Excellence by Design

SHEET KEY

No.	DATE	DESCRIPTION	BY

REVISIONS

REFERENCE DRAWINGS

COMPUTER FILE MANAGEMENT
FILE NAME: S:\22.886.076 Hay Creek-Forest Manor-O'Leary Properties\200 Design\220 Drainage-WR\222 Reports\FDR\DWG\DR02 - HAY CREEK.dwg
CTB FILE:
PLOT DATE: September 19, 2023 1:29:12 PM
THIS DRAWING IS CURRENT AS OF PLOT DATE AND MAY BE SUBJECT TO CHANGE