



**Eastonville Road – Londonderry Drive to Rex Road  
Segment 1 Improvements  
Stationing 14+19.69 – 47+66.51**

**Final Drainage Report**

August 2024

HR Green Project No: 201662.08

**Prepared For:**

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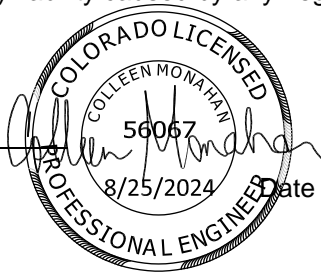
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EDARP File No.: CDR2321



### 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.



\_\_\_\_\_  
Colleen Monahan, P.E., LEED AP

State of Colorado No. 56067

For and on behalf of HR Green Development, LLC

### Owner/Developer's Statement:

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

By: \_\_\_\_\_

Authorized Signature

\_\_\_\_\_ Date

Address: D.R. Horton  
9555 S. Kingston Court  
Englewood, CO

### El Paso County Statement

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.

\_\_\_\_\_ Date

County Engineer/ECM Administrator

Conditions:





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# I. General Purpose, Location and Description

## a. Purpose

The purpose of this Final Drainage Report (FDR) for the Eastonville Road from Londonderry Drive to Rex Road Segment 1 Improvements is to describe the onsite and offsite drainage patterns, size drainage infrastructure to safely capture and convey developed runoff to water quality and detention facilities, and to safely route detained stormwater to adequate outfalls. This drainage report will detail the improvements of Eastonville Road from Londonderry Drive to Grandview Filing No. 1 (Stations 14+55.00 to 47+00.00). Stations 47+00.00 to 79+32.00 contain the Segment 2 Improvements for the Eastonville Road from Londonderry Drive to Rex Road for the portion of the project north of Grandview Filing No. 1. The project is all one project, however, the plan set has been broken into two segments to align with the Grandview Reserve Filings. A separate FDR describes Segment 2 of the project.

## b. Location

Eastonville Road from Londonderry Drive to Grandview Filing No. 1, referred to as 'the site' herein, is an existing 26' wide treated gravel road in El Paso County, Colorado. The site lies in existing 60' wide El Paso County Right-of-Way within Sections 21 and 28, Township 12 South, Range 64 West of the 6<sup>th</sup> Principal Meridian, in El Paso County, State of Colorado.

The site is bound by undeveloped land to the east and west that has historically been used as ranching lands. Falcon Regional Park, which contains ballparks and parking, and Falcon High School also border the site to the west. All lands to the east and west of the site are unplatted. A vicinity map is presented in Appendix A.

## c. Description of Property

The site is approximately 0.61 miles (2.06 acres) of existing treated gravel roadway north of Londonderry Drive and south of Grandview Reserve Filing No. 1. Per field inspection the existing Eastonville Road section is treated gravel and therefore described as 'temporary' for the purpose of this report. The existing treated gravel width for the length of the project is 26' wide. There are 4' wide gravel shoulders and native landscaped swales are located on both sides of the roadway. Offsite stormwater is bypassed under the road through a series of existing culverts. See Appendix A for an existing conditions photo.

The existing roadway has slopes ranging from 0.3% up to approximately 4%. The general topography of the surrounding area is typical of high desert, short prairie grass with gently rolling hillside with slopes ranging from 2% to 4%. The project site drains generally from the west to the east and is tributary to Black Squirrel Creek.

Per a NRCS soil survey, the site is made up of Type A Columbine gravelly sandy loam, Type A Blakeland loamy sand and Type B Stapleton sandy loam. The NRCS soil survey is presented in Appendix A.

Gieck Ranch Tributary #1 (Channel A) is the only drainageway that traverses the site in the west to east direction through an existing culvert under Eastonville Road that is just north of Segment 1. The channel is a mapped wetland and a wetland permit will be required for Segment 2 of this Eastonville Road improvement project. Channel A is not within a FEMA floodplain.

Existing utilities include an underground gas line that runs along the east and west sides of Eastonville, an existing raw water line that follows the west side of Eastonville north of Falcon Regional Park, an existing

underground electric line along the west side of Eastonville Road, and an existing aboveground electrical line along the east side of Eastonville Road. An existing drainage map with these facilities is presented in Appendix F.

**d. Floodplain Statement**

Based on FEMA Firm map 08041C0552G December 7, 2018, the site is not located in any FEMA designated floodplain. See FEMA Firm Map in Appendix A. There is a Zone A floodplain north of the site and a Zone AE south of the site, both of which will not be altered with the associated Eastonville Road Segment 1 improvements.

## II. Drainage Design Criteria

**a. Drainage Criteria**

Hydrologic data and calculations were performed using Drainage Criteria Manual Volume 1 of El Paso County (EPCDCM), with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs Drainage Criteria Manual (CCSDCM), May 2014 revised January 2021.

Onsite drainage improvements are designed for the 5-year storm (minor event) and 100-year storm (major event) using rainfall values from the NOAA Atlas 14 Point Precipitation Frequency Data Server. Runoff was calculated per CCSDCM Section 6.3.0 - Rational Method. Public, full spectrum pond design was completed using the latest version of Mile High Flood District’s (MHFD) UD-Detention per CCSDCM Section 13.3.2.1 – Public, full spectrum Detention. The detention pond allowable release rate will be limited to less than historic rates.

Rainfall Depths per NOAA Atlas 14		
Return Period (yr)	5	100
1-hr Rainfall Depth (in)	1.21	2.49

Inlet sizing was performed per the methods described in EPCDCM Section III Chapter 7 – Street Drainage and Storm Water Inlets. Storm sewer sizing was performed per the methods described in EPCDCM Section III Chapter 8 – Storm Drains and Appurtenances.

## III. Drainage Basins and Subbasins

**a. Major Basin Description**

The site is located within the Gieck Ranch Drainage Basin. The site’s drainage characteristics were previously studied in the following reports:

1. “Gieck Ranch Drainage Basin Planning Study” prepared by Drexel, Barrel & Co, February 2010.
2. “Master Development Drainage Plan Meridian Ranch” prepared by Tech Contractors, July 2021.
3. “Final Drainage Report for The Sanctuary Filing 1 at Meridian Ranch” by Tech Contractors, August 2022.

Gieck Ranch Drainage Basin is a 22.05 square mile watershed located in El Paso County, Colorado. Gieck Ranch Drainage Basin is tributary to Black Squirrel Creek which drains to the Arkansas River. The majority of the basin is undeveloped and is rolling range land typical of Colorado’s semi-arid climates.

Within the Gieck Ranch Drainage Basin, ranching has historically been the predominant land use, with rolling topography between 2%-4% slopes. Recently urbanization is occurring within the drainage basin, most notably for this project are Meridian Ranch and Latigo Trails Developments. Both are single family residential neighborhoods located upstream to the west and northwest of the Eastonville Segment 1 Improvements project site.

## **b. Existing Subbasin Description**

Basin E1 is 0.45 acres of treated gravel to the crown of Eastonville Road roadway and existing swale native landscaped area. Stormwater from this basin ( $Q_5 = 0.7$  cfs  $Q_{100} = 1.7$  cfs) is conveyed by an existing roadside swale on the northwest edge of Eastonville Road to DP1. Flows at DP1 then drain across Eastonville Road through an existing public 36" CMP culvert to DP2.

Basin E2.1 is 1.82 acres of treated gravel to the crown of Eastonville Road roadway and existing swale native landscaped area. Stormwater from this basin ( $Q_5 = 1.2$  cfs  $Q_{100} = 4.8$  cfs) is conveyed by an existing swale on the southeast edge of Eastonville Road to DP2. Flows at DP2 then drain southeast offsite in historic drainage patterns.

Basin E2.2 is 0.40 acres of treated gravel from the Eastonville Road roadway and existing native landscaped area. Stormwater from this basin ( $Q_5 = 0.1$  cfs  $Q_{100} = 1.0$  cfs) is conveyed by an existing swale on the southeast edge of Eastonville Road to DP2.2. Flows at DP2.2 then drain southwest offsite in historic drainage patterns.

Basin E3 is 0.72 acres of treated gravel to the crown of Eastonville Road roadway and existing swale native landscaped area. Stormwater from this basin ( $Q_5 = 1.0$  cfs  $Q_{100} = 2.5$  cfs) is conveyed by an existing roadside swale on the northwest edge of Eastonville Road to DP3. Flows at DP3 then drain across Eastonville Road through an existing public 24" CMP culvert do DP4.

Basin E4 is 3.17 acres of treated gravel to the crown of Eastonville Road roadway and existing swale native landscaped area. Stormwater from this basin ( $Q_5 = 1.9$  cfs  $Q_{100} = 7.8$  cfs) is conveyed by an existing swale on the southeast edge of Eastonville Road to DP4. Flows at DP4 then drain southeast offsite in historic drainage patterns.

Basin E5 is 0.23 acres of treated gravel to the crown of Eastonville Road roadway and existing swale native landscaped area. Stormwater from this basin ( $Q_5 = 0.5$  cfs  $Q_{100} = 1.1$  cfs) is conveyed by an existing roadside swale on the northwest edge of Eastonville Road to DP5. Flows at DP5 then drain across Eastonville Road through an existing public 18" CMP culvert to DP6.

Basin E6 is 0.79 acres of treated gravel to the crown of Eastonville Road roadway and existing swale native landscaped area. Stormwater from this basin ( $Q_5 = 0.7$  cfs  $Q_{100} = 2.6$  cfs) is conveyed by an existing swale on the southeast edge of Eastonville Road to DP6. Flows at DP6 then drain southeast offsite in historic drainage patterns ultimately to the Gieck Ranch Tributary #1.

Basin E7 is 0.23 acres of treated gravel to the crown of Eastonville Road roadway and existing swale native landscaped area. Stormwater from this basin ( $Q_5 = 0.5$  cfs  $Q_{100} = 1.2$  cfs) is conveyed by an existing roadside swale on the northwest edge of Eastonville Road to DP7.1. Flows at DP7.1 then drain across Eastonville Road through an existing public 18" CMP culvert to DP8.1.

Basin E8 is 0.70 acres of treated gravel to the crown of Eastonville Road roadway and existing swale native landscaped area. Stormwater from this basin ( $Q_5 = 0.6$  cfs  $Q_{100} = 2.1$  cfs) is conveyed by an existing swale on

the southeast edge of Eastonville Road to DP8.1. Flows at DP8.1 then drain southeast offsite in historic drainage patterns ultimately to the Gieck Ranch Tributary #1.

Basin E9 is 0.73 acres of treated gravel to the crown of Eastonville Road roadway and existing swale native landscaped area. Stormwater from this basin ( $Q_5 = 1.2$  cfs  $Q_{100} = 2.8$  cfs) is conveyed by an existing roadside swale on the northwest edge of Eastonville Road to DP7.2. Flows at DP7.2 then drain across Eastonville Road through an existing public 18" CMP culvert to DP8.2.

Basin E10.1 is 2.61 acres of treated gravel to the crown of Eastonville Road roadway and existing swale native landscaped area. Stormwater from this basin ( $Q_5 = 1.9$  cfs  $Q_{100} = 7.0$  cfs) is conveyed by an existing swale on the southeast edge of Eastonville Road to DP8.2. Flows at DP8.2 then drain southeast offsite in historic drainage patterns ultimately to the Gieck Ranch Tributary #1.

Basin E10.2 is 1.89 acres of existing native landscaped area. Stormwater from this basin ( $Q_5 = 0.7$  cfs  $Q_{100} = 4.4$  cfs) is conveyed via sheet flow southeast of Eastonville Road to DP8.3. Flows at DP8.3 then drain southeast offsite in historic drainage patterns ultimately to the Gieck Ranch Tributary #1.

Basin OS1 is 1.58 acres of offsite undeveloped area. Stormwater from this basin ( $Q_5 = 0.5$  cfs  $Q_{100} = 3.6$  cfs) drains via sheet flow into an existing roadside swale on the northwest side of Eastonville Road. Stormwater then drains to DP1. Flows at DP1 then drain across Eastonville Road through an existing public 36" CMP culvert to DP2. Flows at DP2 then drain southeast offsite in historic drainage patterns.

Basin OS2 is 12.21 acres of offsite undeveloped area. Stormwater from this basin ( $Q_5 = 3.6$  cfs  $Q_{100} = 24.3$  cfs) drains via sheet flow into an existing roadside swale on the northwest side of Eastonville Road. Stormwater then drains to DP3. Flows at DP3 then drain across Eastonville Road through an existing public 24" CMP culvert to DP4. Flows at DP4 then drain southeast offsite in historic drainage patterns.

Basin OS3.1 is 1.51 acres of offsite undeveloped area. Stormwater from this basin ( $Q_5 = 0.5$  cfs  $Q_{100} = 3.6$  cfs) drains via sheet flow into an existing roadside swale on the northwest side of Eastonville Road. Stormwater then drains to DP5. Flows at DP5 then drain across Eastonville Road through an existing public 18" CMP culvert to DP6. Flows at DP6 then drain southeast offsite in historic drainage patterns ultimately to the Gieck Ranch Tributary #1.

Basin OS3.2 is 2.86 acres of offsite undeveloped area. Stormwater from this basin ( $Q_5 = 1.0$  cfs  $Q_{100} = 6.6$  cfs) drains via sheet flow into an existing roadside swale on the northwest side of Eastonville Road. Stormwater then drains to DP7.1. Flows at DP7.1 then drain across Eastonville Road through an existing public 18" CMP culvert to DP8.1. Flows at DP8.1 then drain southeast offsite in historic drainage patterns ultimately to the Gieck Ranch Tributary #1.

Basin OS3.3 is 21.12 acres of offsite undeveloped area. Stormwater from this basin ( $Q_5 = 6.4$  cfs  $Q_{100} = 42.7$  cfs) drains via sheet flow into an existing roadside swale on the northwest side of Eastonville Road. Stormwater then drains to DP7.2. Flows at DP7.2 then drain across Eastonville Road through an existing public 18" CMP culvert to DP8.2. Flows at DP8.2 then drain southeast offsite in historic drainage patterns ultimately to the Gieck Ranch Tributary #1.

## c. Proposed Subbasin Description

### Description of Proposed Project

The proposed project includes improvements to Eastonville Road from Londonderry Drive to the north part of Grandview Filing No. 1. As described above, the current condition of the existing roadway in this area consists of 26' wide treated gravel roadway with 4' wide gravel shoulders and native landscaped swales located on both sides of the roadway. Offsite stormwater is bypassed under the proposed roadway via proposed public RCP culverts.

The proposed improvements to Eastonville Road from Londonderry Drive to the north part of Grandview Filing No. 1 include removal of the 26' wide treated gravel and replacing the road with a Modified Urban Minor Arterial Roadway Cross-Section consisting of 48' pavement and Type A EPC curb (53' back of curb to back of curb).

### Eastonville Road Basins

Basin EA1 is 0.62 acres of proposed pavement to the crown of Eastonville Road and proposed landscaped area. Stormwater ( $Q_5 = 2.6$  cfs  $Q_{100} = 4.7$  cfs) is conveyed by curb & gutter on the northwest side of Eastonville Road. Runoff is then captured in an on grade public 15' CDOT Type R Inlet at DP9. Flows from DP9 are conveyed through a proposed public storm sewer system which outfalls into SFB D. SFB D is located southeast of the proposed Eastonville Road Segment 1 improvements outside of the proposed right-of-way within a proposed drainage easement.

Basin EA2 is 1.21 acres of proposed pavement to the crown of Eastonville Road and proposed landscaped area. Stormwater ( $Q_5 = 2.5$  cfs  $Q_{100} = 5.6$  cfs) is conveyed by curb & gutter on the southeast side of Eastonville Road. Runoff is then captured in an on grade public 15' CDOT Type R Inlet at DP10. Flows from DP10 are conveyed through a proposed public storm sewer system which outfalls into Sand Filter Basin D. Sand Filter Basin D is located southeast of the proposed Eastonville Road Segment 1 improvements outside of the proposed right-of-way within a proposed drainage easement.

Basin EA3 is 0.44 acres of proposed pavement to the crown of Eastonville Road and proposed landscaped area. Stormwater ( $Q_5 = 1.8$  cfs  $Q_{100} = 3.0$  cfs) is conveyed by curb & gutter on the northwest side of Eastonville Road. Runoff is then captured in an on grade public 10' CDOT Type R Inlet at DP13. Flows at DP13 are conveyed across Eastonville Road through a public storm sewer system to Sand Filter Basin A. Sand Filter Basin A is located southeast of the proposed Eastonville Road Segment 1 improvements outside of the proposed right-of-way within a proposed drainage easement.

Basin EA4 is 0.77 acres of proposed pavement to the crown of Eastonville Road and proposed landscaped area. Stormwater ( $Q_5 = 1.7$  cfs  $Q_{100} = 2.9$  cfs) is conveyed by curb & gutter on the southeast side of Eastonville Road. Runoff is then captured in an on grade public 10' CDOT Type R Inlet at DP10. Flows at DP14 are conveyed through a public storm sewer system to Sand Filter Basin A. Sand Filter Basin A is located southeast of the proposed Eastonville Road Segment 1 improvements outside of the proposed right-of-way within a proposed drainage easement.

Basin EA5.1 is 0.37 acres of landscaped area, gravel access road, and contains the public full spectrum sand filter basin A. Stormwater ( $Q_5 = 0.3$  cfs  $Q_{100} = 0.4$  cfs) from this basin sheet flows directly into Sand Filter Basin A. Sand Filter Basin A is located southeast of the proposed Eastonville Road Segment 1 improvements outside of the proposed right-of-way within a proposed drainage easement.



Basin EA5.2 is 0.52 acres of landscaped area and the overflow path from SFB A. Stormwater ( $Q_5 = 0.2$  cfs  $Q_{100} = 0.3$  cfs) from this basin is conveyed via an existing drainage swale west to design point 4. Water quality will be accounted for via runoff reduction swales & grass buffers. This basin will ultimately be detained and treated by the Waterbury development. UD-BMP calculations for the disturbed area within this basin have been provided in the appendix.

Basin EA5.3 is 0.52 acres of landscaped area on the east side of Eastonville Rd. Stormwater ( $Q_5 = 0.4$  cfs  $Q_{100} = 2.9$  cfs) from this basin is conveyed via an existing drainage swale east to design point 4.1. Water quality will be accounted for via runoff reduction swales & grass buffers. This basin will ultimately be detained and treated by the Waterbury development. UD-BMP calculations for the disturbed area within this basin have been provided in the appendix.

Basin EA5.4 is 0.41 acres of landscaped area on the east side of Eastonville Rd. Stormwater ( $Q_5 = 0.1$  cfs  $Q_{100} = 1.0$  cfs) from this basin is conveyed via an existing drainage swale east to design point 6. Water quality will be accounted for via runoff reduction swales & grass buffers. This basin will ultimately be detained and treated by the Waterbury development. UD-BMP calculations for the disturbed area within this basin have been provided in the appendix.

Basin EA6 is 1.09 acres of proposed pavement to the crown of Eastonville Road and proposed landscaped area. Stormwater ( $Q_5 = 3.1$  cfs  $Q_{100} = 5.2$  cfs) is conveyed by curb & gutter on the west side of Eastonville Road. Runoff is then captured in a sump public 10' CDOT Type R Inlet at DP16. Flows at DP16 are conveyed across Eastonville Road through a public storm sewer system to Extended Detention Basin B. Extended Detention Basin B is located northeast of the proposed Eastonville Road Segment 1 improvements outside of the proposed right-of-way within a proposed drainage easement.

Basin EA7 is 1.92 acres of proposed pavement to the crown of Eastonville Road and proposed landscaped area. Stormwater ( $Q_5 = 3.2$  cfs  $Q_{100} = 5.4$  cfs) is conveyed by curb & gutter on the east side of Eastonville Road. Runoff is then captured in a sump public 10' CDOT Type R Inlet at DP17. Flows at DP17 are conveyed through a public storm sewer system to Extended Detention Basin B. Extended Detention Basin B is located northeast of the proposed Eastonville Road Segment 1 improvements outside of the proposed right-of-way within a proposed drainage easement.

Basin EA8 is 0.94 acres of landscaped area, gravel access road, and contains extended detention basin B. Stormwater ( $Q_5 = 0.5$  cfs  $Q_{100} = 0.9$  cfs) from this basin sheet flows directly into Extended Detention Basin B. Extended Detention Basin B is located northeast of the proposed Eastonville Road Segment 1 improvements outside of the proposed right-of-way within a proposed drainage easement.

Basin EA9 is 0.88 acres of landscaped area. Stormwater ( $Q_5 = 0.4$  cfs  $Q_{100} = 0.6$  cfs) from this basin sheet flows directly offsite towards DP20. Water quality will be accounted for via runoff reduction swales & grass buffers.

Basin EA10.1 is 0.36 acres of landscaped area and concrete/gravel trail. Stormwater ( $Q_5 = 0.4$  cfs  $Q_{100} = 0.6$  cfs) from this basin sheet flows directly offsite towards DP21. Water quality will be accounted for via runoff reduction swales & grass buffers. This basin will ultimately be detained and treated by the Grandview Reserve development. UD-BMP calculations for the disturbed area within this basin have been provided in the appendix.

Basin EA10.2 is 1.06 acres of landscaped area and concrete/gravel trail. Stormwater ( $Q_5 = 1.4$  cfs  $Q_{100} = 4.4$  cfs) from this basin sheet flows directly offsite towards DP8.2. Water quality will be accounted for via runoff

reduction swales & grass buffers. This basin will ultimately be detained and treated by the Grandview Reserve development. UD-BMP calculations for the disturbed area within this basin have been provided in the appendix.

Basin EA11 is 1.23 acres of landscaped area. Stormwater ( $Q_5 = 0.5$  cfs  $Q_{100} = 0.9$  cfs) from this basin sheet flows directly offsite towards DP22. Water quality will be accounted for via runoff reduction swales & grass buffers. This basin will ultimately be detained and treated by the Grandview Reserve development. UD-BMP calculations for the disturbed area within this basin have been provided in the appendix.

Basin EA12 is 0.47 acres of landscaped area and gravel maintenance access road. Stormwater ( $Q_5 = 0.6$  cfs  $Q_{100} = 1.7$  cfs) from this basin sheet flows directly into SFB D.

Basin EA13 is 0.21 acres of landscaped area. Stormwater ( $Q_5 = 0.3$  cfs  $Q_{100} = 0.7$  cfs) from this basin sheet flows directly offsite towards DP12. Water quality will be accounted for via runoff reduction swales & grass buffers. This basin will ultimately be detained and treated by the Waterbury development.

Basin OS1 is 1.63 acres of offsite undeveloped area. Stormwater from this basin ( $Q_5 = 0.5$  cfs  $Q_{100} = 3.6$  cfs) drains via sheet flow into a proposed roadside swale on the northwest side of Eastonville Road. Stormwater then drains to DP1. Flows at DP1 then drain across Eastonville Road through a proposed public 18" RCP culvert to DP2. Flows at DP2 then drain southeast offsite in historic drainage patterns. Water quality treatment for the disturbed area within this basin is accounted for by infiltration by grass overland flow.

Basin OS2 is 12.33 acres of offsite undeveloped area. Stormwater from this basin ( $Q_5 = 3.7$  cfs  $Q_{100} = 24.5$  cfs) drains via sheet flow into a proposed roadside swale on the northwest side of Eastonville Road. Stormwater then drains to DP3. Flows at DP3 then drain across Eastonville Road through a proposed public 30" RCP culvert to DP4. Flows at DP4 then drain southeast offsite in historic drainage patterns. Water quality treatment for the disturbed area within this basin is accounted for by infiltration by grass overland flow. UD-BMP calculations for the disturbed area within this basin have been provided in the appendix.

Basin OS3 is 25.35 acres of offsite undeveloped area. Stormwater from this basin ( $Q_5 = 7.9$  cfs  $Q_{100} = 53.3$  cfs) drains via sheet flow into a proposed roadside swale on the northwest side of Eastonville Road. Stormwater then drains to a proposed public CDOT type D inlet at DP7. Flows at DP7 then drain across Eastonville Road through a proposed public storm sewer system. This storm sewer system outfalls at DP8 into the Gieck Ranch Tributary #1 where drainage will follow historic patterns. Water quality treatment for the disturbed area within this basin is accounted for by infiltration by grass overland flow. UD-BMP calculations for the disturbed area within this basin have been provided in the appendix.

## IV. Drainage Facility Design

### a. General Concept

The proposed improvements to Eastonville Road from Londonderry Drive to the north part of Grandview Filing No. 1 include removal of the 26' wide treated gravel and replacing the road with a Modified Urban Minor Arterial Roadway Cross-Section consisting of 48' pavement and Type A EPC curb (53' back of curb to back of curb). Inlets will be placed at low points. Stormwater from this roadway will be piped to either a full spectrum detention basin or full spectrum sand filters. All detention basins and water quality features will discharge at less than historic rates. Runoff generated from the site will release at historic design points at less than historic flow rates. A flow comparison of existing/proposed stormwater release rates offsite from the project is below:

DESIGN POINT	EX Q <sub>5</sub> (cfs)	PR Q <sub>5</sub> (cfs)	EX Q <sub>100</sub> (cfs)	PR Q <sub>100</sub> (cfs)
DP2	2.3	0.7	9.3	5.0
DP4	6.3	4.1	33.9	26.2
DP6	1.5	0.4	6.7	2.0
DP8 (8.1, 8.2, & 8.3)	11.8	11.5	65.4	62.7
DP2.2/12	0.1	0.3	1.0	0.7
<b>TOTAL</b>	<b>22.0</b>	<b>17.0</b>	<b>116.0</b>	<b>96.6</b>

## b. Water Quality & Detention

### Sand Filter Basin A (Full Spectrum SFB).

Water quality and stormwater detention for Basins EA3-EA5 is provided in Sand Filter Basin A. SFB A is a public county owned, full spectrum sand filter basin within the ACM ALF VIII JV SUB II LLC (Waterbury) property within a proposed drainage easement. In SFB A, a total of 1.58 acres of disturbed area from the proposed project at 55% composite imperviousness will be detained and treated for water quality. The WQCV is 0.023 ac-ft, the EURV is 0.090 ac-ft, and the 100-year detention volume is 0.154 ac-ft. The WQCV, EURV and 100-year storms are released in 12, 40 and 52 hours, respectively. A 15' access and maintenance road is provided to the bottom of the pond to facilitate maintenance of the pond facilities. A 5' emergency overflow spillway is provided that conveys the developed, peak 100-yr flow rate with 1.0' of freeboard south toward DP4. SFB A outfalls towards DP4 at historic runoff rates. Runoff from DP4 will follow historic drainage patterns and not exceed historic flow rates.

Basin ID	Total Area (ac)	Total Proposed Disturbed Area (ac)	Area Trib to SFB A (ac)	Disturbed Area Treated via Runoff Reduction (ac)
EA3	0.44	0.44	0.44	0
EA4	0.77	0.77	0.77	0
EA5.1	0.37	0.37	0.37	0
Total	1.58	1.58	1.58	0

### Extended Detention Basin B (Full Spectrum EDB)

Water quality and detention for Basins EA6 – EA8 is provided in Extended Detention Basin B; a public county owned, full spectrum extended detention basin within Filing No. 1 of Grandview Reserve within a proposed drainage easement. A total of 3.95 acres of disturbed area from the proposed project at 53% composite imperviousness will be treated and detained by EDB B for this phase of the Eastonville Road Improvements. The pond has been sized with consideration for the future segments of Eastonville Road and provides water quality and detention for the ultimate conditions at a future date. The ultimate conditions of EDB B

calculations have been provided in the Appendix of this report. Ultimate conditions include fully built sections of Eastonville Road from Londonderry Road to Rex Road and is anticipated for Spring 2025. The ultimate condition of EDB B is further described and analyzed in the segment 2 report. Interim condition pond sizing calculations have also been provided in the Appendix of this report. Interim conditions only include Eastonville road from Londonderry to Grandview Filing No.1. The interim conditions WQCV is 0.071 ac-ft, the EURV is 0.245 ac-ft, and the 100-year detention volume is 0.384 ac-ft. The WQCV, EURV and 100-year storms are released in 43, 68 and 69 hours, respectively. A forebay is located at the outfall into the pond and a 40" trickle channel conveys flow towards the outlet structure. A 15' access and maintenance road is provided to the bottom of the pond to facilitate maintenance of the pond facilities. A 15.5' emergency overflow spillway is provided that conveys the developed, peak 100-yr flow rate with 1.0' of freeboard towards Gieck Ranch Tributary #1. EDB B outfalls towards DP8 at historic runoff rates. Runoff from DP8 will follow historic drainage patterns and not exceed historic flow rates.

<b>EDB B Water Quality Treatment Summary Table</b>				
<b>Basin ID</b>	<b>Total Area (ac)</b>	<b>Total Proposed Disturbed Area (ac)</b>	<b>Area Trib to SFB A (ac)</b>	<b>Disturbed Area Treated via Runoff Reduction (ac)</b>
EA6	1.09	1.09	1.09	0
EA7	1.92	1.92	1.92	0
EA8	0.94	0.94	0.94	0
<b>Total</b>	<b>3.95</b>	<b>3.95</b>	<b>3.95</b>	<b>0</b>

**Sand Filter Basin D (Full Spectrum SFB).**

Water quality and stormwater detention for Basins EA1-EA2, EA12, & OS1 is provided in Sand Filter Basin D. SFB D is a public county owned, full spectrum sand filter basin the ACM ALF VIII JV SUB II LLC (previous Waterbury) property within a proposed drainage easement. In SFB D, a total of 3.93 acres of disturbed area from the proposed project at 34% composite imperviousness will be detained and treated for water quality. The WQCV is 0.043 ac-ft, the EURV is 0.139 ac-ft, and the 100-year detention volume is 0.282 ac-ft. The WQCV, EURV and 100-year storms are released in 14, 42 and 54 hours, respectively. A 15' access and maintenance road is provided to the bottom of the pond to facilitate maintenance of the pond facilities. A 4' emergency overflow spillway is provided that conveys the developed, peak 100-yr flow rate with 1.0' of freeboard south toward DP2. SFB D outfalls towards DP2 at historic runoff rates. Runoff from DP2 will follow historic drainage patterns and not exceed historic flow rates

<b>SFB D Water Quality Treatment Summary Table</b>				
<b>Basin ID</b>	<b>Total Area (ac)</b>	<b>Total Proposed Disturbed Area (ac)</b>	<b>Area Trib to SFB A (ac)</b>	<b>Disturbed Area Treated via Runoff Reduction (ac)</b>
EA1	0.62	0.62	0.62	0
EA2	1.21	1.21	1.21	0
EA12	0.47	0.47	0.47	0
OS1	1.63	1.63	1.63	0

Total	3.93	3.93	3.93	0
-------	------	------	------	---

### c. Inspection and Maintenance

After completion of construction and upon the Board of County Commissioners acceptance, it is anticipated that all drainage facilities within the public Right-of-Way are to be owned and maintained by El Paso County.

All public detention ponds are to be owned and maintained by the Grandview Reserve Metropolitan District NO. 2 (DISTRICT), once established, unless an agreement is reached stating otherwise. Maintenance access for all full spectrum detention facilities will be provided from public Right-of-Way. Maintenance access for the drainageways will be provided through the proposed tracts.

## V. Wetlands Mitigation

There are no wetlands in Segment 1 of the project and therefore no wetland permit is required for Segment 1.

## VI. Four Step Method to Minimize Adverse Impacts of Urbanization

**Step 1 – Reducing Runoff Volumes:** Low impact development (LID) practices are utilized to reduce runoff at the source. Storm sewer outfalls have been designed at the upstream end of detention basins. This practice promotes infiltration in the detention basins and reduces peak runoff rates prior to runoff reaching outlet structures.

**Step 2 – Treat and slowly release the WQCV:** This step utilizes full spectrum water quality and detention to capture the WQCV and slowly release runoff from the site. Onsite full spectrum sand filter basins & an extended detention basin provide water quality treatment for the site. The WQCV is released over a period of at least 12 hours for SFBs and 40 hours for EDBs while the EURV is released over a period of 40-44 hours for SFBs and 68 - 72 hours for EDBs.

**Step 3 – Stabilize stream channels:** This step establishes practices to stabilize drainageways and provide scour protection at stormwater outfalls. Erosion protection is provided at all concentrated stormwater discharge points in the form of riprap pads. No impact will be made to the Gieck Ranch Tributary #1 by this project that requires additional stream stabilization.

**Step 4 – Consider the need for source controls:** No industrial or commercial uses are proposed within this development and therefore no source controls are proposed.

## VII. Drainage and Bridge Fees

Gieck Ranch drainage basin has not been established as a fee basin within El Paso County. Therefore, no drainage basin fees are due at time of platting.

## VIII. Opinion of Probable Cost

An engineer's opinion of probable cost has been provided below for public drainage infrastructure improvements. This includes cost estimates for the public full spectrum sand filter basin A, public full spectrum sand filter basin D and the public full spectrum extended detention basin B. All required stormwater



infrastructure will be installed per El Paso County Requirements. The unit cost includes both materials and labor.

<b>Public Infrastructure Cost Estimate</b>				
<b>Line Item</b>	<b>Quantity</b>	<b>Unit Price</b>		<b>Cost</b>
18" Reinforced Concrete Pipe	226.5	\$76	LF	\$17,214
24" Reinforced Concrete Pipe	609	\$91	LF	\$55,419
36" Reinforced Concrete Pipe	42	\$114	LF	\$4,788
42" Reinforced Concrete Pipe	736	\$187	LF	\$137,632
24" CDOT FES	2	\$684	EA	\$1,368
42" CDOT FES	1	\$912	EA	\$912
6' DIA Storm Manhole	9	\$7,734	EA	\$69,606
10' CDOT Type R Inlet	4	\$7,000	EA	\$28,000
15' CDOT Type R Inlet	2	\$7,500	EA	\$15,000
CDOT Type C Inlet	1	\$5,000	EA	\$5,000
CDOT Type D Inlet	1	\$6,931	EA	\$6,931
Rip Rap, d50 size from 6"-24"	5	\$97	Tons	\$485
10% Contingency				\$34,236
<b>TOTAL:</b>				<b>\$376,591</b>

<b>Public SFB A Cost Estimate</b>				
<b>Line Item</b>	<b>Quantity</b>	<b>Unit Price</b>		<b>Cost</b>
Rip Rap, d50 size from 6"-24" (Inflow)	2	\$97	Tons	\$194
Sand Filter Media	78	\$100	/CY	\$7,800
4" Perforated PVC Underdrain	100	\$10	/LF	\$1,000
12" ABC Maintenance Access	25	\$40	/CY	\$1,000
Outlet Structure w/ Orifice Plate	1	\$5,000	EA	\$5,000
Rip Rap, d50 size from 6"-24" (Spillway)	60.5	\$97	Tons	\$5,869
12" RCP Outlet Pipe	42.5	\$60	/LF	\$2,550
12" RCP FES	1	\$350	EA	\$350
10% Contingency				\$2,376
<b>TOTAL:</b>				<b>\$26,139</b>

<b>Public EDB B Cost Estimate</b>				
<b>Line Item</b>	<b>Quantity</b>	<b>Unit Price</b>		<b>Cost</b>
Concrete Forebay	1	\$5,000	EA	\$5,000
Rip Rap, d50 size from 6"-24" (Inflow)	2.75	\$97	Tons	\$267
Concrete Trickle Channel	36	\$100	/SY	\$3,600



12" ABC Maintenance Access	147	\$40 /CY	\$5,880
Outlet Structure w/ Micropool, Trash Rack, Railng, Orifice Plate	1	\$8,000 EA	\$8,000
Rip Rap, d50 size from 6"-24" (Spillway)	87	\$97 Tons	\$8,439
18" RCP Outlet Pipe	31	\$76 /LF	\$2,356
10% Contingency			\$3,354
<b>TOTAL:</b>			<b>\$36,896</b>

<b>Public SFB D Cost Estimate</b>				
<b>Line Item</b>	<b>Quantity</b>	<b>Unit Price</b>		<b>Cost</b>
Rip Rap, d50 size from 6"-24" (Inflow)	2	\$97 Tons		\$194
Sand Filter Media	78	\$100 /CY		\$7,800
4" Perforated PVC Underdrain	86	\$10 /LF		\$860
12" ABC Maintenance Access	107	\$40 /CY		\$4,280
Outlet Structure w/ Orifice Plate	1	\$5,000 EA		\$5,000
Rip Rap, d50 size from 6"-24" (Spillway)	25	\$97 Tons		\$2,425
12" RCP Outlet Pipe	54	\$60 /LF		\$3,240
12" RCP FES	1	\$350 EA		\$350
10% Contingency				\$2,415
<b>TOTAL:</b>				<b>\$26,564</b>

## IX. Hydraulic Grade Line Analysis

Hydraulic grade line analysis and final pipe sizes were analyzed, and calculations are provided in Appendix C. All proposed storm sewer has been designed in accordance with El Paso County Drainage Criteria Manuals.

## X. Summary

Eastonville Road lies within the Gieck Ranch Drainage Basin. Water quality and detention for the proposed improvements is provided in full spectrum extended detention basins and two full spectrum sand filter basins, both within proposed drainage easements. There is one major drainageway that traverses north of the Segment 1 site: Gieck Ranch Tributary 1. This major drainage way will not be impacted by the proposed improvements. The water quality and detention ponds will be owned and maintained by El Paso County. All drainage facilities were sized per the El Paso County Drainage Criteria Manuals.

The development of this project will not adversely affect downstream properties.

## XI. Drawings

Please refer to the appendices for vicinity and drainage basin maps.

## XII. References

1. City of Colorado Springs – Drainage Criteria Manual, May 2014, Revised January 2021.
2. Drainage Criteria Manual of El Paso, Colorado, October 2018.
3. Urban Storm Drainage Criteria Manual, Urban Drainage Flood Control District, January 2018.
4. “Gieck Ranch Drainage Basin Planning Study” prepared by Drexel, Barrel & Co, February 2010.
5. “Master Development Drainage Plan Meridian Ranch” prepared by Tech Contractors, July 2021.
6. “The Sanctuary Filing 1 at Meridian Ranch” prepared by Tech Contractors, August 2022.





**APPENDIX A – VICINITY MAP, PHOTOS, SOIL MAP, FEMA MAP**



MERIDIAN RANCH

FALCON REGIONAL PARK

GIECK RANCH TRIBUTARY 2

REX RD

EASTONVILLE ROAD

GRANDVIEW RESERVE METROPOLITAN DISTRICT NO. 2

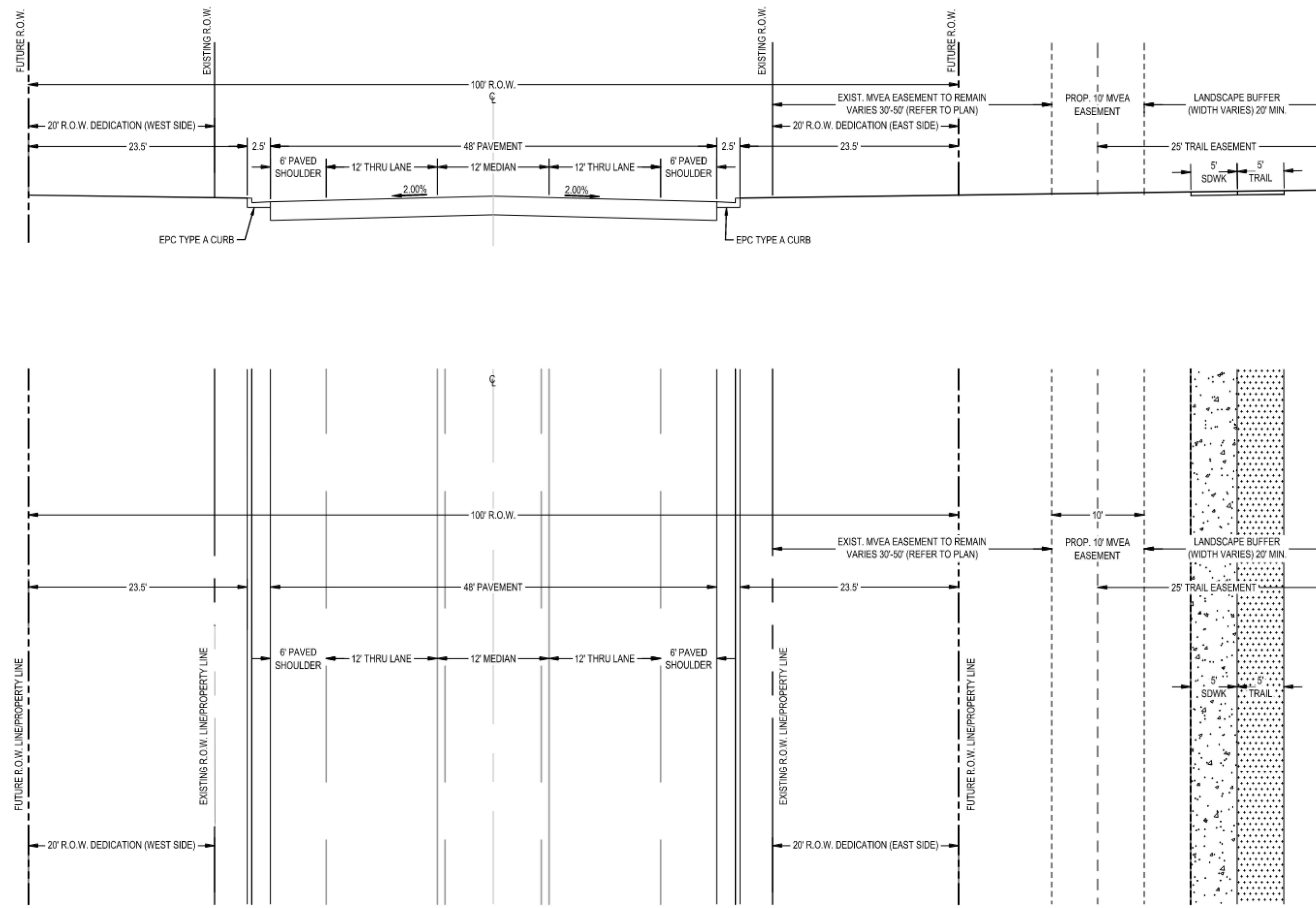
GIECK RANCH TRIBUTARY 1

GRANDVIEW RESERVE FILING 1

FALCON HIGH SCHOOL

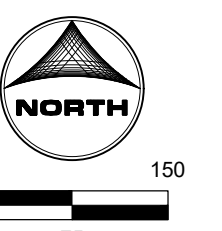
SEGMENT 1 MODIFIED MINOR ARTERIAL CROSS-SECTION WITH 48' PAVEMENT AND TYPE A EPC CURB (53' BACK OF CURB TO BACK OF CURB)

LONDONDERRY DR



EASTONVILLE RD ULTIMATE CROSS SECTION  
SCALE: N.T.S.  
\*TRAIL AND SIDEWALK TO REMAIN WITHIN TRAIL EASEMENT

VICINITY MAP  
N.T.S.



DRAWN BY: CPM  
 APPROVED: [Signature]  
 CAD DATE: 8/29/2023  
 CAD FILE: J:\2020\201662-08\CAD\Drawings\Exhibits-Overall-Exhibit

NO.	DATE	BY	REVISION DESCRIPTION

HR GREEN - COLORADO SPRINGS  
 7222 COMMERCE CENTER DR. SUITE 220  
 COLO. SPRINGS, CO 80919  
 PHONE: 719.622.6222  
 FAX: 844.273.1057

EASTONVILLE ROAD  
 DR HORTON  
 EL PASO COUNTY, CO

OVERALL EASTONVILLE PLAN

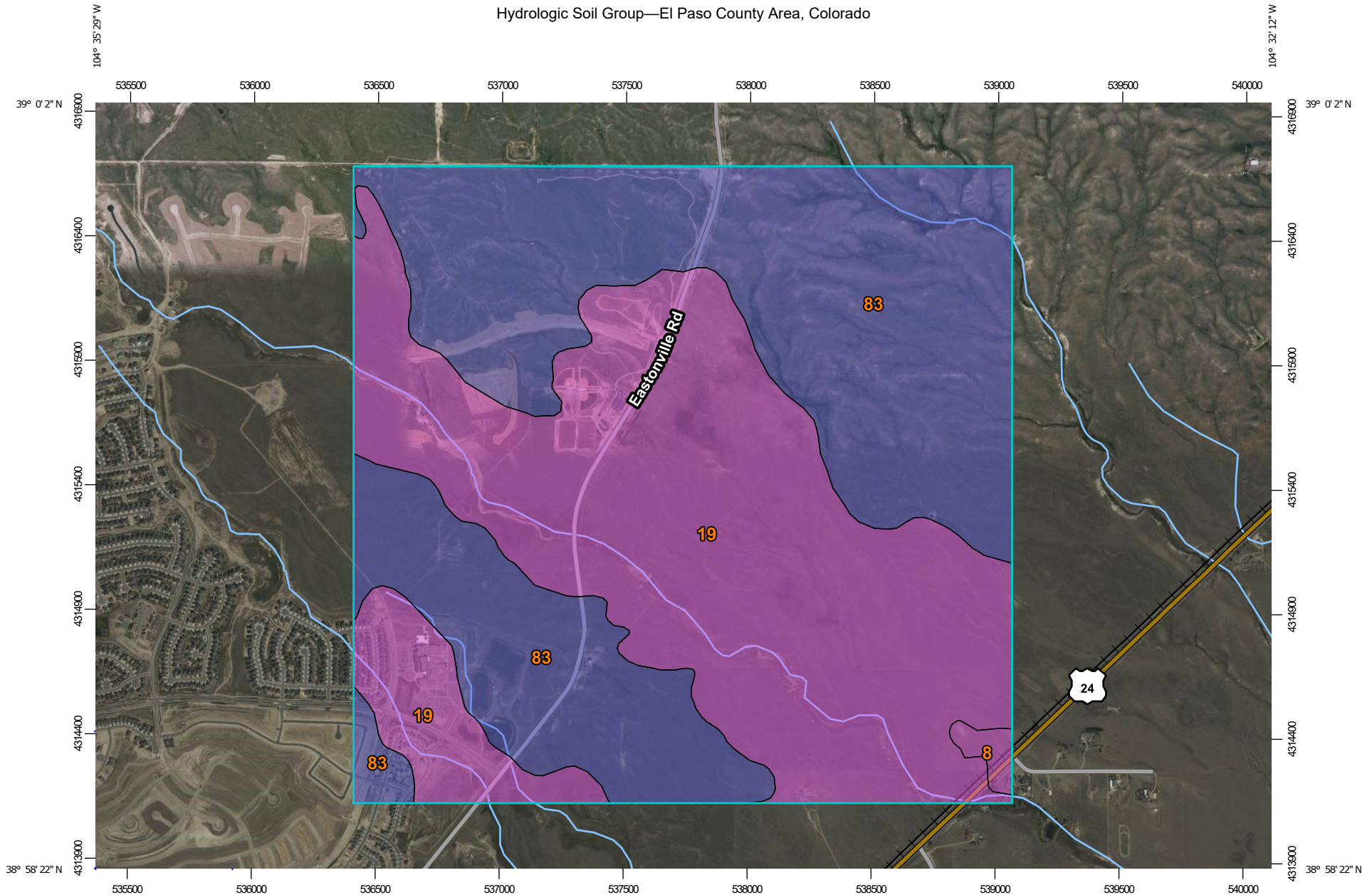
SHEET  
 1 1

HR GREEN (v) 8/29/2023 4:53 PM  
 J:\2020\201662-08\CAD\Drawings\Exhibits-Overall-Exhibit

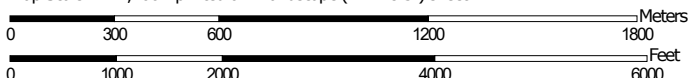
Photo - at Londonderry and Eastonville looking north



Hydrologic Soil Group—El Paso County Area, Colorado



Map Scale: 1:21,700 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.

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

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

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

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

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

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

Date(s) aerial images were photographed: Sep 11, 2018—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
8	Blakeland loamy sand, 1 to 9 percent slopes	A	10.4	0.6%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	839.5	49.8%
83	Stapleton sandy loam, 3 to 8 percent slopes	B	835.7	49.6%
<b>Totals for Area of Interest</b>			<b>1,685.6</b>	<b>100.0%</b>

### 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

**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)** 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 to landward of 0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

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

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

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

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

NGS Information Services  
NOAA, NNGS12  
National Geodetic Survey  
SSMC-3, #9022  
1313 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 form 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.

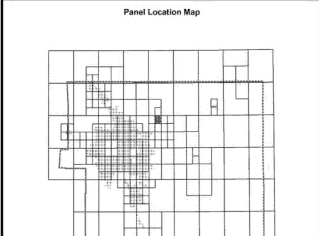
Contact **FEMA Map Service Center (MSC)** via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, Flood Insurance Study Report, and/or digital versions of this 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>.

**El Paso County Vertical Datum Offset Table**

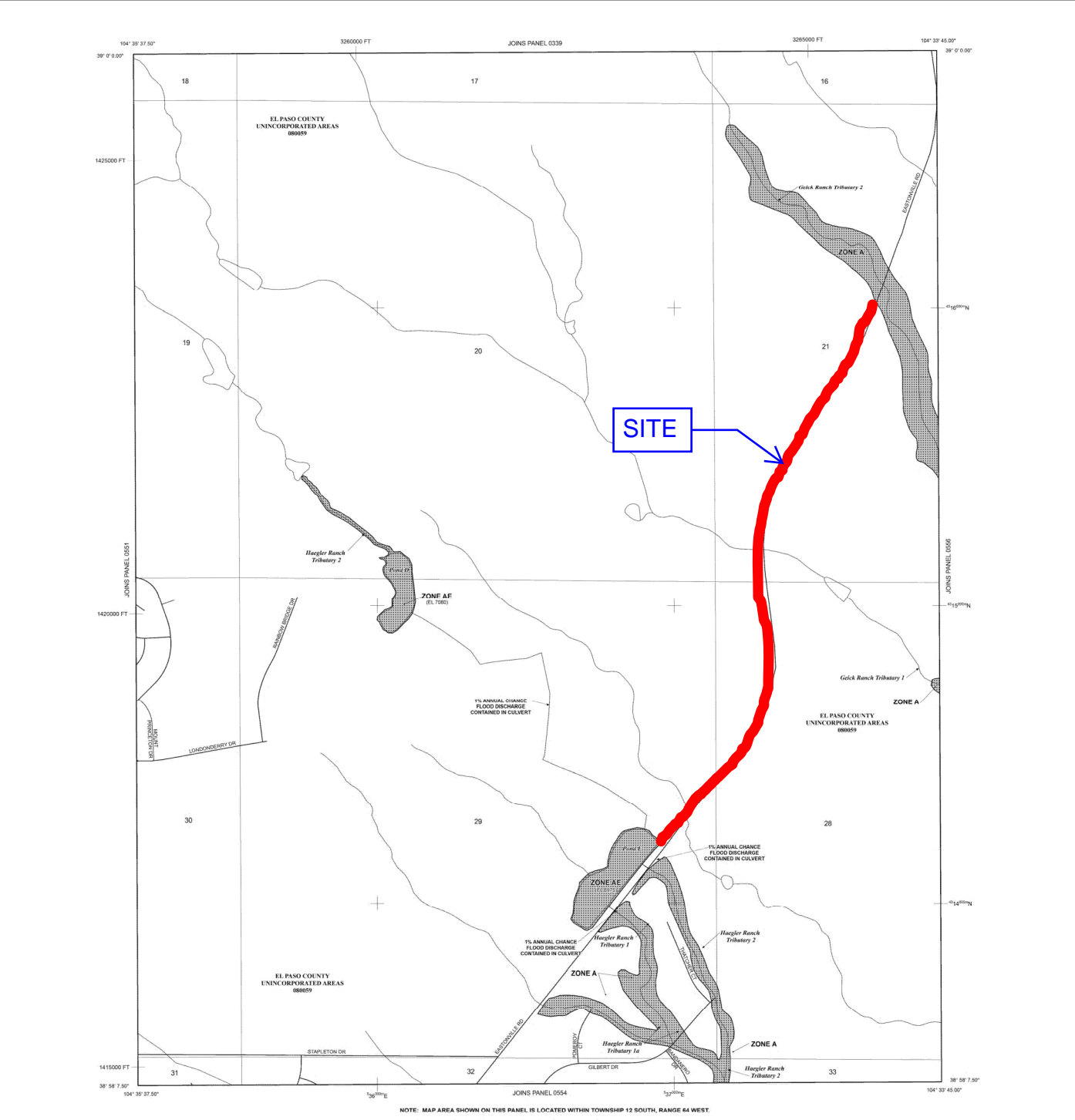
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY REPORT FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

**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.



**LEGEND**

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

- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AF** 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 destroyed. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE ASB** 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 average 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. Areas in which flood hazards are undetermined, but possible.
- ZONE D** Areas determined to be outside the 0.2% annual chance floodplain. 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 isolated within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary

Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities

Base Flood Elevation line and value, elevation in feet

Base Flood Elevation value where uniform within zone; elevation in feet

1" referenced to the North American Vertical Datum of 1988 (NAVD 88)

**Cross section line**

**Transect line**

Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)

1000-meter Universal Transverse Mercator grid ticks, zone 13

5000-foot grid ticks, Colorado State Plane coordinate system, central zone 10 (GPOZONE 0602), Lambert Conformal Conic Projection

Bench mark (see explanation in Notes to Users section of the FIRM panel)

M1.5 River Mile

**MAP REPOSITORIES**

Refer to Map Repository list on Map Index

**EFFECTIVE DATE OF COUNTRYWIDE 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'**

0 250 500 1000 FEET

0 150 300 METERS

**NFP NATIONAL FLOOD INSURANCE PROGRAM**

**PANEL 0552G**

**FIRM FLOOD INSURANCE RATE MAP**

**EL PASO COUNTY, COLORADO AND INCORPORATED AREAS**

**PANEL 552 OF 1300**

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	0552	100	G

Notice to User: The Map Number shown below should be used only during map sales. The Community Number shown above should be used on insurance applications for the highest community.

**MAP NUMBER 08041C0552G**

**MAP REVISED DECEMBER 7, 2018**

Federal Emergency Management Agency

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 SOUTH, RANGE 64 WEST





**NOAA Atlas 14, Volume 8, Version 2**  
**Location name: Elbert, Colorado, USA\***  
**Latitude: 38.9796°, Longitude: -104.5696°**  
**Elevation: 6996 ft\*\***



\* source: ESRI Maps  
 \*\* source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffrey Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

**PF tabular**

<b>PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)<sup>1</sup></b>										
<b>Duration</b>	<b>Average recurrence interval (years)</b>									
	<b>1</b>	<b>2</b>	<b>5</b>	<b>10</b>	<b>25</b>	<b>50</b>	<b>100</b>	<b>200</b>	<b>500</b>	<b>1000</b>
<b>5-min</b>	<b>0.239</b> (0.189-0.303)	<b>0.291</b> (0.231-0.370)	<b>0.381</b> (0.301-0.486)	<b>0.461</b> (0.361-0.589)	<b>0.576</b> (0.440-0.768)	<b>0.671</b> (0.499-0.904)	<b>0.770</b> (0.554-1.06)	<b>0.875</b> (0.604-1.24)	<b>1.02</b> (0.678-1.48)	<b>1.14</b> (0.733-1.67)
<b>10-min</b>	<b>0.350</b> (0.277-0.444)	<b>0.426</b> (0.338-0.542)	<b>0.558</b> (0.441-0.711)	<b>0.674</b> (0.529-0.863)	<b>0.844</b> (0.644-1.12)	<b>0.982</b> (0.731-1.32)	<b>1.13</b> (0.811-1.56)	<b>1.28</b> (0.884-1.81)	<b>1.49</b> (0.992-2.17)	<b>1.66</b> (1.07-2.44)
<b>15-min</b>	<b>0.426</b> (0.338-0.541)	<b>0.520</b> (0.412-0.660)	<b>0.681</b> (0.537-0.867)	<b>0.823</b> (0.645-1.05)	<b>1.03</b> (0.785-1.37)	<b>1.20</b> (0.891-1.62)	<b>1.37</b> (0.988-1.90)	<b>1.56</b> (1.08-2.21)	<b>1.82</b> (1.21-2.65)	<b>2.03</b> (1.31-2.98)
<b>30-min</b>	<b>0.608</b> (0.482-0.771)	<b>0.740</b> (0.586-0.940)	<b>0.968</b> (0.764-1.23)	<b>1.17</b> (0.916-1.49)	<b>1.46</b> (1.11-1.94)	<b>1.70</b> (1.26-2.28)	<b>1.94</b> (1.40-2.68)	<b>2.20</b> (1.52-3.12)	<b>2.57</b> (1.71-3.73)	<b>2.86</b> (1.84-4.19)
<b>60-min</b>	<b>0.775</b> (0.615-0.984)	<b>0.933</b> (0.739-1.18)	<b>1.21</b> (0.956-1.54)	<b>1.46</b> (1.15-1.87)	<b>1.84</b> (1.41-2.47)	<b>2.16</b> (1.61-2.92)	<b>2.49</b> (1.80-3.45)	<b>2.85</b> (1.97-4.05)	<b>3.37</b> (2.24-4.90)	<b>3.78</b> (2.44-5.54)
<b>2-hr</b>	<b>0.943</b> (0.754-1.19)	<b>1.12</b> (0.898-1.42)	<b>1.46</b> (1.16-1.84)	<b>1.76</b> (1.39-2.23)	<b>2.22</b> (1.72-2.97)	<b>2.62</b> (1.97-3.52)	<b>3.04</b> (2.21-4.19)	<b>3.50</b> (2.45-4.95)	<b>4.16</b> (2.80-6.03)	<b>4.70</b> (3.06-6.85)
<b>3-hr</b>	<b>1.03</b> (0.829-1.29)	<b>1.22</b> (0.978-1.53)	<b>1.57</b> (1.25-1.97)	<b>1.90</b> (1.51-2.40)	<b>2.41</b> (1.88-3.22)	<b>2.86</b> (2.17-3.84)	<b>3.34</b> (2.45-4.60)	<b>3.88</b> (2.73-5.48)	<b>4.66</b> (3.15-6.74)	<b>5.29</b> (3.46-7.69)
<b>6-hr</b>	<b>1.20</b> (0.968-1.48)	<b>1.40</b> (1.13-1.74)	<b>1.78</b> (1.44-2.22)	<b>2.16</b> (1.73-2.70)	<b>2.76</b> (2.18-3.66)	<b>3.28</b> (2.52-4.39)	<b>3.86</b> (2.86-5.29)	<b>4.51</b> (3.20-6.34)	<b>5.46</b> (3.73-7.86)	<b>6.24</b> (4.12-9.01)
<b>12-hr</b>	<b>1.38</b> (1.13-1.70)	<b>1.61</b> (1.31-1.98)	<b>2.05</b> (1.66-2.53)	<b>2.48</b> (2.00-3.07)	<b>3.15</b> (2.51-4.15)	<b>3.74</b> (2.89-4.96)	<b>4.39</b> (3.28-5.96)	<b>5.12</b> (3.66-7.13)	<b>6.17</b> (4.25-8.82)	<b>7.04</b> (4.69-10.1)
<b>24-hr</b>	<b>1.60</b> (1.31-1.95)	<b>1.87</b> (1.54-2.28)	<b>2.38</b> (1.94-2.91)	<b>2.85</b> (2.32-3.51)	<b>3.60</b> (2.88-4.67)	<b>4.24</b> (3.29-5.56)	<b>4.94</b> (3.71-6.63)	<b>5.71</b> (4.12-7.87)	<b>6.82</b> (4.73-9.66)	<b>7.73</b> (5.20-11.0)
<b>2-day</b>	<b>1.85</b> (1.54-2.24)	<b>2.18</b> (1.80-2.63)	<b>2.76</b> (2.28-3.34)	<b>3.29</b> (2.70-4.01)	<b>4.11</b> (3.30-5.27)	<b>4.80</b> (3.76-6.22)	<b>5.54</b> (4.19-7.36)	<b>6.35</b> (4.62-8.68)	<b>7.50</b> (5.25-10.5)	<b>8.44</b> (5.73-11.9)
<b>3-day</b>	<b>2.03</b> (1.69-2.44)	<b>2.39</b> (1.98-2.87)	<b>3.02</b> (2.50-3.64)	<b>3.60</b> (2.97-4.36)	<b>4.47</b> (3.60-5.69)	<b>5.20</b> (4.08-6.70)	<b>5.98</b> (4.55-7.90)	<b>6.83</b> (4.99-9.28)	<b>8.03</b> (5.65-11.2)	<b>9.00</b> (6.15-12.7)
<b>4-day</b>	<b>2.18</b> (1.82-2.61)	<b>2.56</b> (2.13-3.06)	<b>3.22</b> (2.68-3.87)	<b>3.82</b> (3.16-4.62)	<b>4.73</b> (3.83-6.00)	<b>5.49</b> (4.33-7.04)	<b>6.30</b> (4.81-8.30)	<b>7.18</b> (5.26-9.72)	<b>8.43</b> (5.94-11.7)	<b>9.43</b> (6.46-13.3)
<b>7-day</b>	<b>2.58</b> (2.17-3.07)	<b>2.98</b> (2.50-3.54)	<b>3.68</b> (3.08-4.39)	<b>4.32</b> (3.60-5.18)	<b>5.29</b> (4.30-6.65)	<b>6.09</b> (4.84-7.76)	<b>6.96</b> (5.34-9.09)	<b>7.89</b> (5.82-10.6)	<b>9.21</b> (6.55-12.8)	<b>10.3</b> (7.10-14.4)
<b>10-day</b>	<b>2.93</b> (2.48-3.47)	<b>3.36</b> (2.84-3.98)	<b>4.13</b> (3.47-4.90)	<b>4.81</b> (4.02-5.74)	<b>5.83</b> (4.76-7.28)	<b>6.68</b> (5.32-8.45)	<b>7.58</b> (5.85-9.86)	<b>8.55</b> (6.34-11.4)	<b>9.92</b> (7.08-13.7)	<b>11.0</b> (7.65-15.4)
<b>20-day</b>	<b>3.91</b> (3.33-4.58)	<b>4.51</b> (3.84-5.29)	<b>5.52</b> (4.68-6.50)	<b>6.39</b> (5.39-7.55)	<b>7.63</b> (6.25-9.37)	<b>8.62</b> (6.90-10.8)	<b>9.64</b> (7.47-12.4)	<b>10.7</b> (7.98-14.1)	<b>12.2</b> (8.74-16.6)	<b>13.3</b> (9.31-18.4)
<b>30-day</b>	<b>4.70</b> (4.02-5.47)	<b>5.44</b> (4.65-6.34)	<b>6.65</b> (5.66-7.78)	<b>7.66</b> (6.49-9.00)	<b>9.06</b> (7.44-11.0)	<b>10.1</b> (8.15-12.5)	<b>11.2</b> (8.74-14.3)	<b>12.3</b> (9.24-16.2)	<b>13.8</b> (9.98-18.7)	<b>15.0</b> (10.5-20.6)
<b>45-day</b>	<b>5.67</b> (4.88-6.57)	<b>6.55</b> (5.63-7.60)	<b>7.97</b> (6.82-9.27)	<b>9.12</b> (7.77-10.7)	<b>10.7</b> (8.79-12.9)	<b>11.9</b> (9.56-14.5)	<b>13.0</b> (10.2-16.4)	<b>14.2</b> (10.6-18.4)	<b>15.6</b> (11.3-21.0)	<b>16.7</b> (11.9-23.0)
<b>60-day</b>	<b>6.48</b> (5.60-7.48)	<b>7.46</b> (6.43-8.62)	<b>9.01</b> (7.74-10.4)	<b>10.3</b> (8.77-11.9)	<b>11.9</b> (9.82-14.3)	<b>13.1</b> (10.6-16.0)	<b>14.3</b> (11.2-18.0)	<b>15.5</b> (11.7-20.0)	<b>16.9</b> (12.3-22.6)	<b>18.0</b> (12.8-24.6)

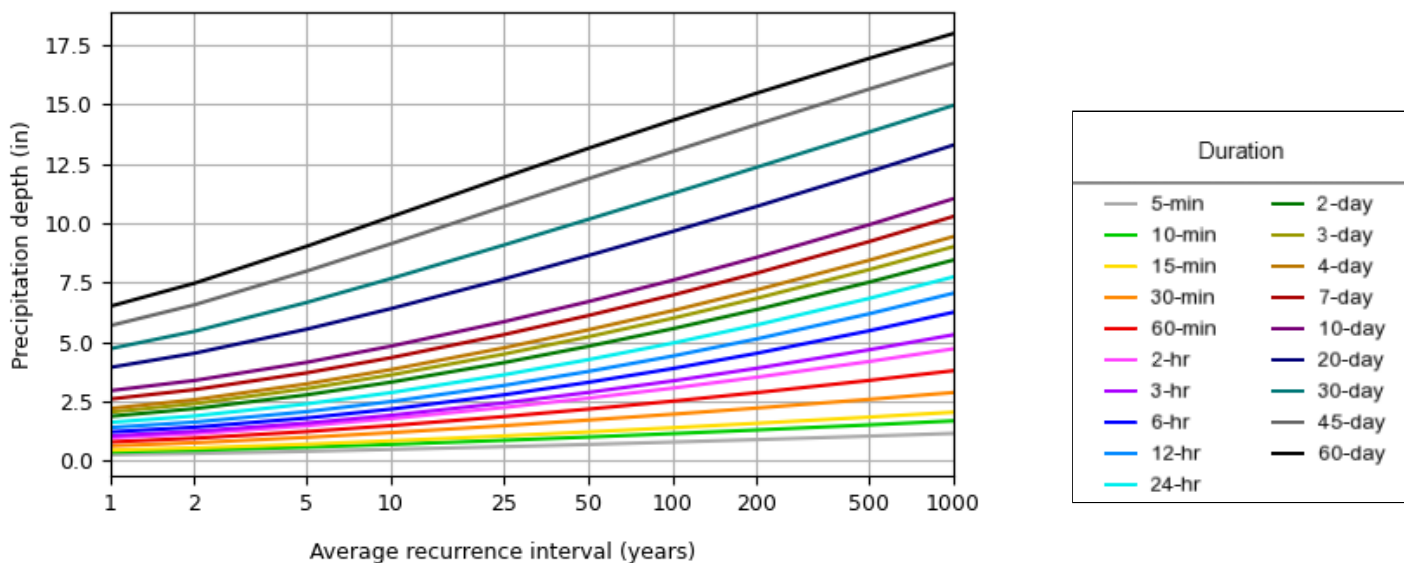
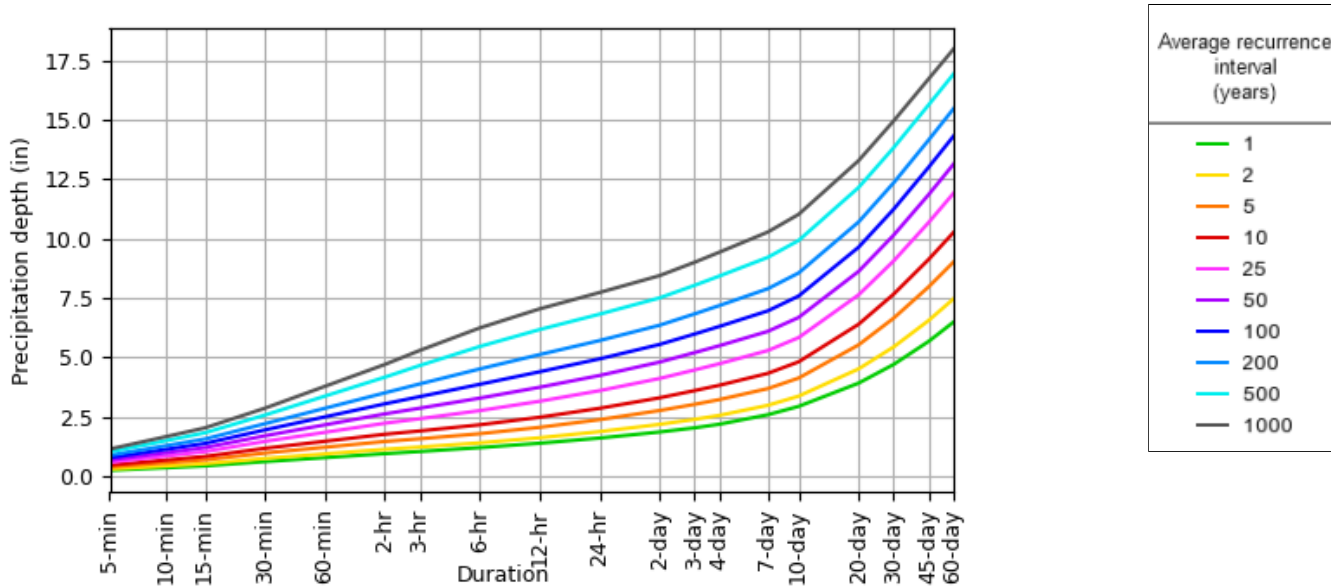
<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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**PF graphical**

PDS-based depth-duration-frequency (DDF) curves

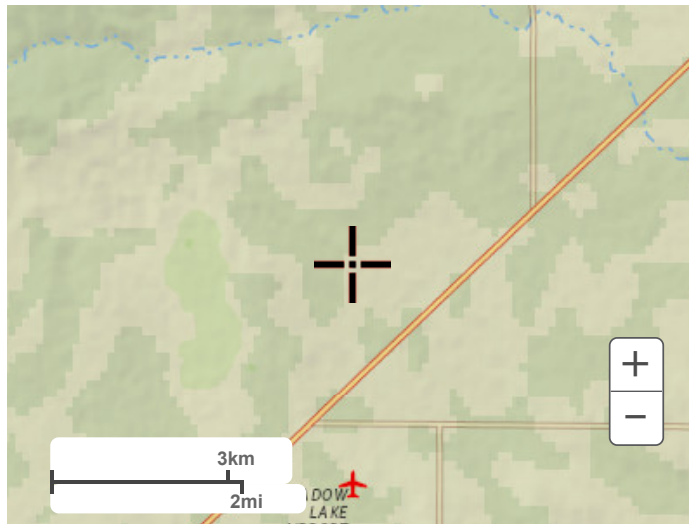
Latitude: 38.9796°, Longitude: -104.5696°



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**Maps & aerials**

**Small scale terrain**



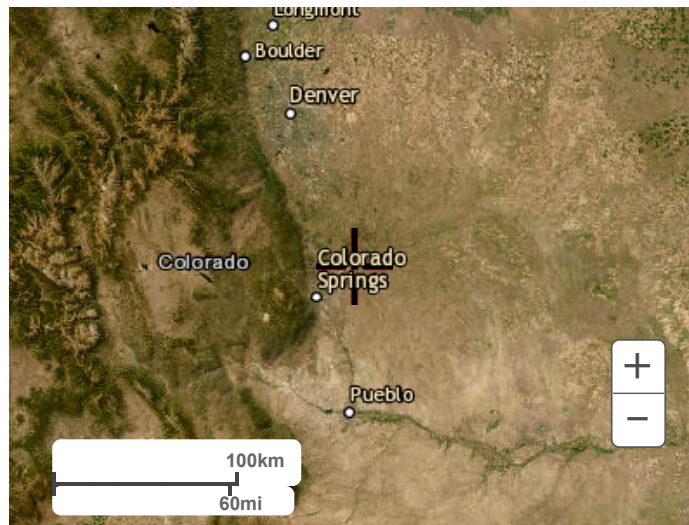
Large scale terrain



Large scale map



Large scale aerial



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## **APPENDIX B – HYDROLOGIC CALCULATIONS**





<b>EASTONVILLE ROAD</b>	<b>Calc'd by:</b>	<b>SPC</b>
<b>EXISTING CONDITIONS</b>	<b>Checked by:</b>	<b>CM</b>
<b>EL PASO COUNTY, CO</b>	<b>Date:</b>	<b>8/22/2024</b>

BASIN	AREA (ac)	% IMPERVIOUS	Q <sub>5</sub> (cfs)	Q <sub>100</sub> (cfs)
E1	0.47	46	0.7	1.7
E2.1	1.82	13	1.2	4.8
E2.2	0.40	2	0.1	1.0
E3	0.72	39	1.0	2.5
E4	3.17	12	1.9	7.8
E5	0.23	45	0.5	1.1
E6	0.79	14	0.7	2.6
E7	0.23	45	0.5	1.2
E8	0.70	16	0.6	2.1
E9	0.73	45	1.2	2.8
E10.1	2.61	15	1.9	7.0
E10.2	1.89	2	0.7	4.4
OS1	1.58	2	0.5	3.6
OS2	12.21	2	3.6	24.3
OS3.1	1.51	2	0.5	3.6
OS3.2	2.86	2	1.0	6.6
OS3.3	21.12	2	6.4	42.7


DESIGN POINT	CONTRIBUTING BASINS	ΣQ <sub>5</sub> (cfs)	ΣQ <sub>100</sub> (cfs)
1	E1,OS1	1.2	4.9
2	E2,DP1	2.3	9.3
2.2	E2.2	0.1	1.0
3	E3,OS2	4.6	26.6
4	DP3,E4	6.3	33.9
5	E5,OS3.1	0.9	4.5
6	DP5,E6	1.5	6.7
7.1	E7,OS3.2	1.4	7.5
8.1	DP7.1,E8	1.9	9.4
7.2	OS3.3,E9	7.5	45.3
8.2	DP7.2,E10.1	9.2	51.6
8.3	E10.2	0.7	4.4

	<b>EASTONVILLE ROAD</b>
	<b>EXISTING CONDITIONS</b>
	<b>EL PASO COUNTY, CO</b>

<b>Calc'd by:</b>	<b>SPC</b>
<b>Checked by:</b>	
<b>Date:</b>	<b>11/27/2023</b>

<b>SOIL TYPE:</b>	<b>HSG A&amp;B</b>
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<b>COMPOSITE 'C' FACTORS</b>																			
<b>BASIN</b>	<b>LAND USE TYPE</b>															<b>TOTAL</b>	<b>COMPOSITE IMPERVIOUSNESS &amp; C FACTOR</b>		
	<b>Paved</b>			<b>Historic Flow Analysis-- Greenbelts, Agriculture</b>			<b>Land Use Undefined</b>			<b>Land Use Undefined</b>			<b>Land Use Undefined</b>						
	<b>%I</b>	<b>C<sub>5</sub></b>	<b>C<sub>100</sub></b>	<b>%I</b>	<b>C<sub>5</sub></b>	<b>C<sub>100</sub></b>	<b>%I</b>	<b>C<sub>5</sub></b>	<b>C<sub>100</sub></b>	<b>%I</b>	<b>C<sub>5</sub></b>	<b>C<sub>100</sub></b>	<b>%I</b>	<b>C<sub>5</sub></b>	<b>C<sub>100</sub></b>				
	<b>100</b>	<b>0.90</b>	<b>0.96</b>	<b>2</b>	<b>0.09</b>	<b>0.36</b>	<b>0</b>	<b>0.00</b>	<b>0.00</b>	<b>0</b>	<b>0.00</b>	<b>0.00</b>	<b>0</b>	<b>0.00</b>	<b>0.00</b>				
<b>ACRES</b>	<b>ACRES</b>		<b>ACRES</b>			<b>ACRES</b>			<b>ACRES</b>			<b>ACRES</b>	<b>%I</b>	<b>C<sub>5</sub></b>	<b>C<sub>100</sub></b>				
E1	0.21	0.26											0.47	46	0.45	0.63			
E2.1	0.20	1.62											1.82	13	0.18	0.43			
E2.2		0.40											0.40	2	0.09	0.36			
E3	0.27	0.45											0.72	39	0.39	0.59			
E4	0.31	2.86											3.17	12	0.17	0.42			
E5	0.10	0.13											0.23	45	0.44	0.62			
E6	0.10	0.69											0.79	14	0.19	0.44			
E7	0.10	0.13											0.23	45	0.44	0.62			
E8	0.10	0.60											0.70	16	0.21	0.45			
E9	0.32	0.41											0.73	45	0.45	0.62			
E10.1	0.35	2.26											2.61	15	0.20	0.44			
E10.2		1.89											1.89	2	0.09	0.36			
OS1		1.58											1.58	2	0.09	0.36			
OS2		12.21											12.21	2	0.09	0.36			
OS3.1		1.51											1.51	2	0.09	0.36			
OS3.2		2.86											2.86	2	0.09	0.36			
OS3.3		21.12											21.12	2	0.09	0.36			

	<b>EASTONVILLE ROAD</b>	<b>Calc'd by:</b>	<b>SPC</b>
	<b>EXISTING CONDITIONS</b>	<b>Checked by:</b>	
	<b>EL PASO COUNTY, CO</b>	<b>Date:</b>	<b>8/22/2024</b>

**TIME OF CONCENTRATION**

BASIN DATA			OVERLAND TIME (T <sub>i</sub> )			TRAVEL TIME (T <sub>t</sub> )					TOTAL
DESIGNATION	C <sub>s</sub>	AREA (ac)	LENGTH (ft)	SLOPE %	t <sub>i</sub> (min)	C <sub>v</sub>	LENGTH (ft)	SLOPE %	V (ft/s)	t <sub>t</sub> (min)	t <sub>c</sub> (min)
E1	0.45	0.47	117	11.6	5.7	10	1162	3.4	1.8	10.5	16.2
E2.1	0.18	1.82	87	2.4	11.8	10	518	1.7	1.3	6.6	18.4
E2.2	0.09	0.40	92	2.0	14.1	10	89	3.4	1.8	0.8	14.9
E3	0.39	0.72	40	2.0	6.5	10	794	2.5	1.6	8.4	14.9
E4	0.17	3.17	113	5.5	10.3	10	830	2.5	1.6	8.7	19.0
E5	0.44	0.23	30	13.8	2.8	10	310	1.4	1.2	4.4	7.1
E6	0.19	0.79	30	13.8	3.8	10	310	1.4	1.2	4.4	8.2
E7	0.44	0.23	35	25.0	2.4	10	161	0.6	0.8	3.5	5.9
E8	0.21	0.70	25	1.0	8.2	10	161	0.6	0.8	3.5	11.7
E9	0.45	0.73	30	2.0	5.2	10	711	0.5	0.7	16.8	22.0
E10.1	0.20	2.61	30	2.0	7.2	10	711	0.5	0.7	16.8	23.9
E10.2	0.09	1.89	300	2.7	23.2	10	15	4.8	2.2	0.1	23.3
OS1	0.09	1.58	300	2.8	22.8	10	213	4.5	2.1	1.7	24.4
OS2	0.09	12.21	300	4.1	20.0	10	1042	3.4	1.8	9.4	29.5
OS3.1	0.09	1.51	136	3.9	13.7	10	150	8.9	3.0	0.8	14.6
OS3.2	0.09	2.86	174	8.6	11.9	10	267	4.4	2.1	2.1	14.0
OS3.3	0.09	21.12	300	6.0	17.7	10	930	3.4	1.8	8.4	26.1

**FORMULAS:**

$$t_i = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}} \quad V = C_v S_w^{0.5}$$

**Table 6-7. Conveyance Coefficient, C<sub>v</sub>**

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

\*For buried riprap, select C<sub>v</sub> value based on type of vegetative cover.





**EASTONVILLE ROAD**  
**EXISTING CONDITIONS**  
**DESIGN STORM: 5-YEAR**

Calc'd by:

SPC

Checked by:

Date:

8/22/2024

STREET	DESIGN POINT	BASIN ID	DIRECT RUNOFF					TOTAL RUNOFF					STREET			PIPE				TRAVEL TIME			REMARKS	
			AREA (ac)	C <sub>s</sub>	t <sub>c</sub> (min)	C <sub>s</sub> *A (ac)	I (in./hr.)	Q (cfs)	t <sub>c</sub> (min)	C <sub>s</sub> *A (ac)	I (in./hr.)	Q (cfs)	Q <sub>street</sub> (cfs)	C <sub>s</sub> *A (ac)	SLOPE %	Q <sub>PIPE</sub> (cfs)	C <sub>s</sub> *A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (FT)	VEL. (FPS)	TRAVEL TIME (min)		
		E1	0.47	0.45	16.2	0.21	3.41	0.7																BASIN E1 CAPTURED @ DP1
	1	OS1	1.58	0.09	12.9	0.14	3.75	0.5	16.2	0.35	3.41	1.2		1.2	0.35	0.6	3.0	73	7.5	0.16				BASIN E1 AND OS1 COMBINE @ DP1 CAPTURED IN 36" CMP CULVERT, PIPED TO BASIN E2
	2	E2.1	1.82	0.18	13.4	0.33	3.69	1.2	16.3	0.68	3.39	2.3												FLOW @ DP2 CONVEYED OFFSITE
	2.2	E2.2	0.40	0.09	11.0	0.04	3.99	0.1	11.0	0.04	3.99	0.1												FLOW @ DP2.2 CONVEYED OFFSITE
		E3	0.72	0.39	14.6	0.28	3.56	1.0																BASIN E3 CAPTURED @ DP3
	3	OS2	12.21	0.09	17.5	1.10	3.29	3.6	17.5	1.38	3.29	4.6		4.6	1.38	1.1	2.0	47	7.6	0.10				BASIN E3 AND OS2 COMBINE @ DP3 CAPTURED IN 24" CMP CULVERT, PIPED TO BASIN E4
	4	E4	3.17	0.17	15.2	0.54	3.50	1.9	17.6	1.92	3.28	6.3												FLOW @ DP4 CONVEYED OFFSITE
		E5	0.23	0.44	7.1	0.10	4.64	0.5																BASIN E5 CAPTURED @ DP5
	5	OS3.1	1.51	0.09	11.6	0.14	3.91	0.5	11.6	0.24	3.91	0.9		0.9	0.24	1.3	1.5	56	6.8	0.14				BASIN E5 AND OS3 COMBINE @ DP5 CAPTURED IN 18" CMP CULVERT, PIPED TO BASIN E6
	6	E6	0.79	0.19	8.2	0.15	4.43	0.7	11.7	0.39	3.89	1.5												FLOW @ DP6 CONVEYED OFFSITE
		E7	0.23	0.44	5.9	0.10	4.92	0.5																BASIN E7 CAPTURED @ DP7
	7.1	OS3.2	2.86	0.09	12.5	0.26	3.80	1.0	12.5	0.36	3.80	1.4		1.4	0.36	0.2	1.5	53	2.3	0.38				BASIN E7 AND OS4.1 COMBINE @ DP7.1 CAPTURED IN 18" CMP CULVERT, PIPED TO BASIN E8
	8.1	E8	0.70	0.21	11.0	0.14	3.98	0.6	12.8	0.50	3.75	1.9												FLOW @ DP8.1 CONVEYED OFFSITE
		E9	0.73	0.45	14.1	0.32	3.61	1.2																BASIN E9 CAPTURED @ DP7.2
	7.2	OS3.3	21.12	0.09	16.8	1.90	3.35	6.4	16.8	2.23	3.35	7.5		7.5	2.23	0.8	1.5	43	5.3	0.13				BASIN E9 AND OS 4.2 COMBINE @ DP7.2 CAPTURED IN 18" CMP CULVERT, PIPED TO BASIN E10
	8.2	E10.1	2.61	0.20	14.1	0.52	3.61	1.9	17.0	2.74	3.34	9.2												FLOW @ DP8.2 CONVEYED OFFSITE
	8.3	E10.2	1.89	0.09	11.8	0.17	3.89	0.7	11.8	0.17	3.89	0.7												FLOW @ DP8.3 CONVEYED OFFSITE



**EASTONVILLE ROAD**  
**EXISTING CONDITIONS**  
**DESIGN STORM: 100-YEAR**

Calc'd by: **SPC**  
 Checked by:  
 Date: **8/22/2024**

STREET	DESIGN POINT	BASIN ID	DIRECT RUNOFF					TOTAL RUNOFF					STREET			PIPE			TRAVEL TIME			REMARKS	
			AREA (ac)	C <sub>100</sub>	t <sub>c</sub> (min)	C <sub>100</sub> *A (ac)	I (in./hr.)	Q (cfs)	t <sub>c</sub> (min)	C <sub>100</sub> *A (ac)	I (in./hr.)	Q (cfs)	Q <sub>street</sub> (cfs)	C <sub>100</sub> *A (ac)	SLOPE %	Q <sub>PIPE</sub> (cfs)	C <sub>100</sub> *A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (ft)	VEL. (ft/s)		TRAVEL TIME (min)
		E1	0.47	0.63	16.2	0.30	5.72	1.7															BASIN E1 CAPTURED @ DP1
	1	OS1	1.58	0.36	12.9	0.57	6.30	3.6	16.2	0.86	5.72	4.9		4.9	0.86	0.6	3.0	73	7.5	0.16			BASIN E1 AND OS1 COMBINE @ DP1 CAPTURED IN 36" CMP CULVERT, PIPED TO BASIN E2
	2	E2.1	1.82	0.43	13.4	0.78	6.20	4.8	16.3	1.64	5.69	9.3											FLOW @ DP2 CONVEYED OFFSITE
	2.2	E2.2	0.40	0.36	11.0	0.14	6.69	1.0	11.0	0.14	6.69	1.0											FLOW @ DP2.2 CONVEYED OFFSITE
		E3	0.72	0.59	14.6	0.42	5.97	2.5															BASIN E3 CAPTURED @ DP3
	3	OS2	12.21	0.36	17.5	4.40	5.53	24.3	17.5	4.82	5.53	26.6		26.6	4.82	1.1	2.0	47	7.6	0.10			BASIN E3 AND OS2 COMBINE @ DP3 CAPTURED IN 24" CMP CULVERT, PIPED TO BASIN E4
	4	E4	3.17	0.42	15.2	1.33	5.87	7.8	17.6	6.14	5.51	33.9											FLOW @ DP4 CONVEYED OFFSITE
		E5	0.23	0.62	7.1	0.14	7.79	1.1															BASIN E5 CAPTURED @ DP5
	5	OS3.1	1.51	0.36	11.6	0.54	6.56	3.6	11.6	0.69	6.56	4.5		4.5	0.69	1.3	1.5	56	6.8	0.14			BASIN E5 AND OS3 COMBINE @ DP5 CAPTURED IN 18" CMP CULVERT, PIPED TO BASIN E6
	6	E6	0.79	0.44	8.2	0.34	7.44	2.6	11.7	1.03	6.53	6.7											FLOW @ DP6 CONVEYED OFFSITE
		E7	0.23	0.62	5.9	0.14	8.26	1.2															BASIN E7 CAPTURED @ DP7
	7.1	OS3.2	2.86	0.36	12.5	1.03	6.38	6.6	12.5	1.17	6.38	7.5		7.5	1.17	0.2	1.5	53	2.3	0.38			BASIN E7 AND OS4.1 COMBINE @ DP7.1 CAPTURED IN 18" CMP CULVERT, PIPED TO BASIN E8
	8.1	E8	0.70	0.45	11.0	0.31	6.68	2.1	12.8	1.48	6.30	9.4											FLOW @ DP8.1 CONVEYED OFFSITE
		E9	0.73	0.62	14.1	0.45	6.06	2.8															BASIN E9 CAPTURED @ DP7.2
	7.2	OS3.3	21.12	0.36	16.8	7.60	5.62	42.7	16.8	8.06	5.62	45.3		45.3	8.06	0.8	1.5	43	5.3	0.13			BASIN E9 AND OS 4.2 COMBINE @ DP7.2 CAPTURED IN 18" CMP CULVERT, PIPED TO BASIN E10
	8.2	E10.1	2.61	0.44	14.1	1.15	6.06	7.0	17.0	9.21	5.60	51.6											FLOW @ DP8.2 CONVEYED OFFSITE
	8.3	E10.2	1.89	0.36	11.8	0.68	6.53	4.4	11.8	0.68	6.53	4.4											FLOW @ DP8.3 CONVEYED OFFSITE



**EASTONVILLE ROAD**  
**PROPOSED CONDITIONS**  
**EL PASO COUNTY, CO**

**Calc'd by:** **SPC**  
**Checked by:** **CM**  
**Date:** **8/26/2024**

SUMMARY RUNOFF TABLE				
BASIN	AREA (ac)	% IMPERVIOUS	Q <sub>5</sub> (cfs)	Q <sub>100</sub> (cfs)
EA1	0.62	97	2.6	4.7
EA2	1.21	50	2.5	5.6
EA3	0.44	91	1.8	3.0
EA4	0.77	52	1.7	2.9
EA5.1	0.37	9	0.3	0.4
EA5.2	0.52	0	0.2	1.6
EA5.3	1.21	0	0.4	2.9
EA5.4	0.41	0	0.1	1.0
EA6	1.09	91	3.1	5.2
EA7	1.92	52	3.2	5.4
EA8	0.94	50	0.5	0.9
EA9	0.88	35	0.4	0.6
EA10.1	0.36	23	0.4	0.6
EA10.2	1.06	23	1.4	4.4
EA11	1.23	0	0.5	0.9
EA12	0.47	25	0.6	1.7
EA13	0.21	26	0.3	0.7
EA8 & EA9 *Per Segment 2 FDR	5.07	78	10.2	17.2
OS1	1.63	2	0.5	3.6
OS2	12.18	2	3.6	24.2
OS3	25.50	2	8.0	53.6

DESIGN POINT SUMMARY TABLE			
DESIGN POINT	CONTRIBUTING BASINS	ΣQ <sub>5</sub> (cfs)	ΣQ <sub>100</sub> (cfs)
1	OS1	0.5	3.6
2	DP20, SFB D Release	0.7	5.0
3	OS2	3.6	24.2
4	EA 5.2, OS2, DP4.1, SFB A RELEASE	4.1	28.6
4.1	EA5.3	0.6	3.5
6	EA5.4	0.4	2.0
7	OS3	8.0	53.6
8.3	DP 22, OS3, EDB B RELEASE	9.7	58.1
8.2	EA10.2	1.4	4.0
9	DP1, EA1	3.3	9.3
10	DP9, EA2	5.4	13.9
11	DP10, EA12	5.8	15.2
12	EA13	0.3	0.7
13	EA3	1.8	3.0
14	DP13, EA4	3.3	5.6
15	DP14, EA5	3.5	5.9
16	EA6	3.1	5.2
17	DP16, EA7	6.2	10.3
18	DP17	6.2	10.3
19	DP18, EA8	6.6	11.1
18U	DP17, EA8 & EA9 *PER SEGMENT 2 FDR	15.5	26.0
19U	DP18U, EA8	15.8	26.6
20	EA9	0.4	0.6
8.1	EA10	0.4	0.6
22	EA11	0.5	0.9

NOTE: "U" DENOTES ULTIMATE CONDITION AFTER COMPLETION OF EASTONVILLE ROAD SEGMENT 2 CONSTRUCTION



**EASTONVILLE ROAD**  
**PROPOSED CONDITIONS**  
 EL PASO COUNTY, CO

**Calc'd by:** SPC  
**Checked by:** CM  
**Date:** 11/27/2023

**SOIL TYPE: HSG A&B**

<b>COMPOSITE 'C' FACTORS</b>																			
<b>BASIN</b>	<b>LAND USE TYPE</b>															<b>TOTAL</b>	<b>COMPOSITE IMPERVIOUSNESS &amp; C FACTOR</b>		
	<b>Paved</b>			<b>Historic Flow Analysis-- Greenbelts, Agriculture</b>			<b>Lawns</b>			<b>Gravel</b>			<b>Drive and Walks</b>						
	<b>%I</b>	<b>C<sub>5</sub></b>	<b>C<sub>100</sub></b>	<b>%I</b>	<b>C<sub>5</sub></b>	<b>C<sub>100</sub></b>	<b>%I</b>	<b>C<sub>5</sub></b>	<b>C<sub>100</sub></b>	<b>%I</b>	<b>C<sub>5</sub></b>	<b>C<sub>100</sub></b>	<b>%I</b>	<b>C<sub>5</sub></b>	<b>C<sub>100</sub></b>				
	<b>100</b>	<b>0.90</b>	<b>0.96</b>	<b>2</b>	<b>0.09</b>	<b>0.36</b>	<b>0</b>	<b>0.08</b>	<b>0.35</b>	<b>80</b>	<b>0.59</b>	<b>0.70</b>	<b>100</b>	<b>0.90</b>	<b>0.96</b>				
	<b>ACRES</b>			<b>ACRES</b>			<b>ACRES</b>			<b>ACRES</b>			<b>ACRES</b>			<b>ACRES</b>	<b>%I</b>	<b>C<sub>5</sub></b>	<b>C<sub>100</sub></b>
EA1	0.60						0.02									0.62	97	0.87	0.94
EA2	0.60						0.61									1.21	50	0.49	0.65
EA3	0.40						0.04									0.44	91	0.82	0.90
EA4	0.40						0.37									0.77	52	0.50	0.67
EA5.1							0.33			0.04						0.37	9	0.13	0.39
EA5.2							0.52									0.52	0	0.08	0.35
EA5.3							1.21									1.21	0	0.08	0.35
EA5.4							0.41									0.41	0	0.08	0.35
EA6	0.99						0.10									1.09	91	0.83	0.91
EA7	0.99						0.93									1.92	52	0.50	0.67
EA8							0.83			0.09			0.01			0.94	9	0.14	0.39
EA9							0.88									0.88	0	0.08	0.35
EA10.1							0.30			0.01			0.05			0.36	16	0.21	0.44
EA10.2							0.81			0.06			0.20			1.06	23	0.26	0.48
EA11							1.23									1.23	0	0.08	0.35
EA12	0.06						0.34			0.07						0.47	25	0.26	0.48
EA13	0.06						0.15									0.21	26	0.30	0.51
OS1				1.63												1.63	2	0.09	0.36
OS2				12.18												12.18	2	0.09	0.36
OS3				25.50												25.50	2	0.09	0.36
EA8 & EA9 *Per Segment 2 FDR	3.94						1.13									5.07	78	0.72	0.82
SFB A	0.80			0.00			0.74			0.04			0.00			1.58	53		
EDB B	1.98			0.00			1.86			0.09			0.01			3.95	52		
EDB B (ULT)	5.92			0.00			2.99			0.09			0.01			9.02	67		

**COMPOSITE 'C' FACTORS**

BASIN	LAND USE TYPE															TOTAL	COMPOSITE IMPERVIOUSNESS & C FACTOR		
	Paved			Historic Flow Analysis-- Greenbelts, Agriculture			Lawns			Gravel			Drive and Walks				ACRES	%I	C <sub>5</sub>
	%I	C <sub>5</sub>	C <sub>100</sub>	%I	C <sub>5</sub>	C <sub>100</sub>	%I	C <sub>5</sub>	C <sub>100</sub>	%I	C <sub>5</sub>	C <sub>100</sub>	%I	C <sub>5</sub>	C <sub>100</sub>				
	100	0.90	0.96	2	0.09	0.36	0	0.08	0.35	80	0.59	0.70	100	0.90	0.96				
	ACRES			ACRES			ACRES			ACRES			ACRES			ACRES	%I	C <sub>5</sub>	C <sub>100</sub>
SFB D	1.26			1.63			0.97			0.07			0.00			3.93	34		



<b>EASTONVILLE ROAD</b>	<b>Calc'd by:</b>	<b>SPC</b>
<b>PROPOSED CONDITIONS</b>	<b>Checked by:</b>	<b>CM</b>
<b>EL PASO COUNTY, CO</b>	<b>Date:</b>	<b>8/26/2024</b>

TIME OF CONCENTRATION													
BASIN DATA			OVERLAND TIME (T <sub>i</sub> )			TRAVEL TIME (T <sub>t</sub> )					TOTAL	tc=(L/180)+10	Design tc
DESIGNATION	C <sub>s</sub>	AREA (ac)	LENGTH (ft)	SLOPE %	t <sub>i</sub> (min)	C <sub>v</sub>	LENGTH (ft)	SLOPE %	V (ft/s)	t <sub>t</sub> (min)	t <sub>c</sub> (min)	tc max	tc design (min)
EA1	0.87	0.62	26	2.0	1.7	20	734	1.6	2.5	4.9	6.6	14.2	6.6
EA2	0.49	1.21	26	2.0	4.6	20	734	1.6	2.5	4.9	9.5	14.2	9.5
EA3	0.82	0.44	26	2.0	2.0	20	326	0.5	1.4	3.8	5.9	12.0	5.9
EA4	0.50	0.77	26	2.0	4.4	20	326	0.5	1.4	3.8	8.3	12.0	8.3
EA5.1	0.13	0.37	25	25.0	3.0	10	100	0.5	0.7	2.4	5.4	10.7	5.4
EA5.2	0.08	0.52	35	33.0	3.4	10	110	5.5	2.3	0.8	5.0	10.8	5.0
EA5.3	0.08	1.21	68	10.0	7.1	10	286	2.3	1.5	3.1	10.3	12.0	10.3
EA5.4	0.08	0.41	78	4.6	9.9	10	145	1.4	1.2	2.0	12.0	11.2	11.2
EA6	0.83	1.09	26	2.0	2.0	20	1304	0.6	1.5	14.0	16.1	17.4	16.1
EA7	0.50	1.92	26	2.0	4.4	20	1304	0.6	1.5	14.0	18.5	17.4	17.4
EA8	0.14	0.94	100	9.0	8.4	10	102	0.5	0.7	2.4	10.8	11.1	10.8
EA9	0.08	0.88	50	24.4	4.6	10	0	0	0.0	0.0	5.0	10.3	5.0
EA10.1	0.21	0.36	35	24.4	3.3	10	0	0	0.0	0.0	5.0	10.2	5.0
EA10.2	0.26	1.06	50	15.0	4.4	10	0	0	0.0	0.0	5.0	10.3	5.0
EA11	0.08	1.23	23	18.0	3.4	10	0	0	0.0	0.0	5.0	10.1	5.0
EA12	0.26	0.47	117	12.0	7.3	10	0	0	0.0	0.0	7.3	10.7	7.3
EA13	0.30	0.21	82	2.0	10.6	10	0	0	0.0	0.0	10.6	10.5	10.5
EA8 & EA9 *Per Segment 2 FDR	0.72	5.07	26	2.0	2.8	20	2500	0.7	1.7	24.9	27.7	24.0	24.0
OS1	0.09	1.63	100	2.7	13.3	10	633	1.5	1.2	8.6	22.0	14.1	14.1
OS2	0.09	12.18	100	4.3	11.4	10	1243	3.2	1.8	11.6	23.0	17.5	17.5
OS3	0.09	25.50	100	6.5	9.9	10	879	3.2	1.8	8.2	18.1	15.4	15.4

**FORMULAS:**

$$t_i = \frac{0.395(1.1 - C_s)\sqrt{L}}{S^{0.33}} \quad V = C_v S_w^{0.5}$$

**Table 6-7. Conveyance Coefficient, C<sub>v</sub>**

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

\*For buried riprap, select C<sub>v</sub> value based on type of vegetative cover.



**EASTONVILLE ROAD  
PROPOSED CONDITIONS  
DESIGN STORM: 5-YEAR**

Calc'd by:

SPC

Checked by:

CM

Date:

8/26/2024

STREET	DESIGN POINT	BASIN ID	DIRECT RUNOFF					TOTAL RUNOFF				STREET			PIPE			TRAVEL TIME			REMARKS				
			AREA (ac)	C <sub>s</sub>	t <sub>c</sub> (min)	C <sub>s</sub> *A (ac)	I (in./hr.)	Q (cfs)	t <sub>c</sub> (min)	C <sub>s</sub> *A (ac)	I (in./hr.)	Q (cfs)	Q <sub>street</sub> (cfs)	C <sub>s</sub> *A (ac)	SLOPE %	Q <sub>PIPE</sub> (cfs)	C <sub>s</sub> *A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (FT)		VEL. (FPS)	TRAVEL TIME (min)		
	1	OS1	1.63	0.09	14.1	0.15	3.62	0.5	14.1	0.15	3.62	0.5						0.5	0.15	0.5	1.5	10	4.2	0.04	BASIN OS1 @ DP1 CAPTURED IN 18" RCP CULVERT, DRAINS TO BASIN DP9
	2								0.1	0.07	3.62	0.7													SFB D RELEASE @ 0.4 CFS AND DP 20 FLOW @ DP2 CONVEYED OFFSITE
	3	OS2	12.18	0.09	17.5	1.10	3.29	3.6	17.5	1.10	3.29	3.6						3.6	1.10	2.6	2.5	186	13.5	0.23	BASIN OS2 @ DP3 CAPTURED IN 30" RCP CULVERT, DRAINS TO BASIN DP4
	4	EA5.2	0.52	0.08	5.0	0.04	5.17	0.2	17.7	1.23	3.29	4.1													FLOW @ DP4 CONVEYED OFFSITE (INCLUDES DETENTION SFB A 5-YR RELEASE RATE @ 0.03 CFS)
	4.1	EA5.3	1.21	0.08	10.3	0.10	4.09	0.4	10.3	0.10	3.29	0.6													FLOW @ DP4.1 DRAINS SOUTH TO ULTIMATELY COMBINE WITH DP4
	6	EA5.4	0.41	0.08	11.2	0.03	3.95	0.1	11.2	0.03	3.29	0.4													FLOW @ DP6 DRAINS OFFSITE
	7	OS3	25.50	0.09	15.4	2.30	3.48	8.0	15.4	2.30	3.48	8.0						8.0	2.30	0.6	3.0	445	7.3	1.01	BASIN OS3 FLOW @ DP7 CAPTURED IN CDOT TYPE D INLET, PIPED TO DP8
	8.3								16.5	2.67	3.48	9.7													FLOW @ DP8 CONVEYED OFFSITE (INCLUDES EDB POND B 5-YR RELEASE RATE @ 0.4 CFS, DP7, & DP22)
	8.2	EA10.2	1.06	0.26	5.0	0.27	5.17	1.4	5.0	0.27	3.48	1.4													FLOW @ DP8.2 DRAINS NE TO ULTIMATELY COMBINE WITH DP8
	9	EA1	0.62	0.87	6.6	0.54	4.75	2.6	6.6	0.69	4.75	3.3						3.3	0.69	0.5	1.5	52	4.2	0.21	BASIN EA1 CAPTURED @ DP9 BY ON GRADE TYPE R INLET
	10	EA2	1.21	0.49	9.5	0.59	4.21	2.5	9.5	1.28	4.21	5.4						5.4	1.28	0.5	1.5	128	4.2	0.51	BASIN EA2 CAPTURED @ DP10 BY ON GRADE TYPE R INLET
	11	EA12	0.47	0.26	7.3	0.12	4.61	0.6	10.0	1.40	4.13	5.8						5.8	1.40	1.5	1.5	63	7.2	0.15	BASIN EA12 SHEET FLOWS DIRECTLY TO SFB D
	12	EA13	0.21	0.30	10.5	0.06	4.06	0.3	10.5	0.06	4.13	0.3													FLOW @ DP12 CONVEYED OFFSITE
	13	EA3	0.44	0.82	5.9	0.36	4.92	1.8	5.9	0.36	4.92	1.8						1.8	0.36	1.3	1.5	56	6.8	0.14	BASIN EA3 CAPTURED @ DP13 BY ON GRADE TYPE R INLET
	14	EA4	0.77	0.50	8.3	0.39	4.42	1.7	8.3	0.75	4.42	3.3						3.3	0.75	1.3	1.5	56	6.8	0.14	BASIN EA4 CAPTURED @ DP14 BY ON GRADE TYPE R INLET
	15	EA5.1	0.37	0.13	5.4	0.05	5.06	0.3	8.4	0.80	4.39	3.5						3.5	0.80	0.5	1.5	36	4.2	0.14	BASIN EA5 SHEET FLOWS DIRECTLY TO SFB A
	16	EA6	1.09	0.83	16.1	0.90	3.42	3.1	16.1	0.90	3.42	3.1						3.1	0.90	0.5	1.5	52	4.2	0.21	BASIN EA6 CAPTURED @ DP16 BY SUMP TYPE R INLET
	17	EA7	1.92	0.50	17.4	0.97	3.30	3.2	17.4	1.87	3.30	6.2						6.2	1.87	0.5	2.0	196	5.1	0.64	BASIN EA7 CAPTURED @ DP17 BY SUMP TYPE R INLET
	18								17.4	1.87	3.30	6.2						6.2	1.87	0.5	2.0	42	5.1	0.14	STORM MH @ D18, NO SEGMENT 2 FLOW
	19	EA8	0.94	0.14	10.8	0.13	4.01	0.5	17.5	2.00	3.29	6.6						6.6	2.00	0.5	2.0	196	5.1	0.64	BASIN EA8 SHEET FLOWS DIRECTLY TO EDB B (NO SEGMENT 2 FLOWS)
	18U	EA8 & EA9 *Per Segment 2 FDR	5.07	0.72	24.0	3.64	2.81	10.2	24.0	5.50	2.81	15.5						15.5	5.50	0.5	2.0	42	5.1	0.14	SEGMENT 2 FLOW COMBINES @ DP18 WITH SEGMENT 1 FLOWS @ STORM MH
	19U	EA8	0.94	0.14	10.8	0.13	4.01	0.5	24.2	5.64	2.81	15.8													BASIN EA8 SHEET FLOWS DIRECTLY TO EDB B INCLUDING FUTURE TRIBUTARY FLOW FROM SUBBASIN EA8 & EA9 PER THE EASTONVILLE ROAD SEGMENT 2 FDR
	20	EA9	0.88	0.08	5.0	0.07	5.17	0.4	5.0	0.07	5.17	0.4													BASIN EA9 SHEET FLOWS OFFSITE
	8.1	EA10.1	0.36	0.21	5.0	0.07	5.17	0.4	5.0	0.07	5.17	0.4													BASIN EA10 SHEET FLOWS OFFSITE
	22	EA11	1.23	0.08	5.0	0.10	5.17	0.5	5.0	0.10	5.17	0.5													BASIN EA11 SHEET FLOWS OFFSITE



**EASTONVILLE ROAD**  
**PROPOSED CONDITIONS**  
**DESIGN STORM: 100-YEAR**

Calc'd by: **SPC**  
 Checked by: **CM**  
 Date: **8/26/2024**

STREET	DESIGN POINT	BASIN ID	DIRECT RUNOFF					TOTAL RUNOFF				STREET			PIPE			TRAVEL TIME			REMARKS	
			AREA (ac)	C <sub>100</sub>	t <sub>c</sub> (min)	C <sub>100</sub> *A (ac)	I (in./hr.)	Q (cfs)	t <sub>c</sub> (min)	C <sub>100</sub> *A (ac)	I (in./hr.)	Q (cfs)	Q <sub>street</sub> (cfs)	C <sub>100</sub> *A (ac)	SLOPE %	Q <sub>PIPE</sub> (cfs)	C <sub>100</sub> *A (ac)	SLOPE %	PIPE SIZE (ft)	LENGTH (ft)		VEL. (ft/s)
	1	OS1	1.63	0.36	14.1	0.59	6.07	3.6	14.1	0.59	6.07	3.6			3.6	0.59	0.5	1.5	115	4.2	0.46	BASIN OS1 @ DP1 CAPTURED IN 18" RCP CULVERT, DRAINS TO BASIN DP2
	2								0.1	0.07	6.07	5.0										SFB D RELEASE @ 4.6 CFS AND DP 20 FLOW @ DP2 CONVEYED OFFSITE
	3	OS2	12.18	0.36	17.5	4.38	5.53	24.2	17.5	4.38	5.53	24.2		24.2	4.38	2.6	2.5	186	13.5	0.23	BASIN OS2 @ DP3 CAPTURED IN 30" RCP CULVERT, DRAINS TO BASIN DP4	
	4	EA5.2	0.52	0.35	5.0	0.18	8.68	1.6	17.7	4.99	5.53	28.6										FLOW @ DP4 CONVEYED OFFSITE (INCLUDES DETENTION SFB A 100-YR RELEASE RATE @ 1.0 CFS)
	4.1	EA5.3	1.21	0.35	10.3	0.42	6.86	2.9	10.3	0.42	5.53	3.5										FLOW @ DP4.1 DRAINS SOUTH TO ULTIMATELY COMBINE WITH DP4
	6	EA5.4	0.41	0.35	11.2	0.14	6.64	1.0	11.2	0.14	5.53	2.0										FLOW @ DP6 DRAINS OFFSITE
	7	OS3	25.50	0.36	15.4	9.18	5.84	53.6	15.4	9.18	5.84	53.6		53.6	9.18	0.6	3.0	445	7.3	1.01	BASIN OS3 FLOW @ DP7 CAPTURED IN CDOT TYPE D INLET, PIPED TO DP8	
	8.3								16.5	9.79	5.84	58.1										FLOW @ DP8 CONVEYED OFFSITE (INCLUDES EDB POND B 100-YR RELEASE RATE @ 1.0 CFS, DP7, & DP22)
	8.2	EA10.2	1.06	0.48	5.0	0.51	8.68	4.4	5.0	0.51	5.84	4.0										FLOW @ DP8.2 DRAINS NE TO ULTIMATELY COMBINE WITH DP8
	9	EA1	0.62	0.94	6.6	0.58	7.98	4.7	6.6	1.17	7.98	9.3		9.3	1.17	0.5	1.5	52	4.2	0.21	BASIN EA1 CAPTURED @ DP9 BY ON GRADE TYPE R INLET	
	10	EA2	1.21	0.65	9.5	0.79	7.07	5.6	9.5	1.96	7.07	13.9		13.9	1.96	0.5	1.5	128	4.2	0.51	BASIN EA2 CAPTURED @ DP10 BY ON GRADE TYPE R INLET	
	11	EA12	0.47	0.48	7.3	0.23	7.73	1.7	10.0	2.18	6.94	15.2		15.2	2.18	1.5	1.5	63	7.2	0.15	BASIN EA12 SHEET FLOWS DIRECTLY TO SFB D	
	12	EA13	0.21	0.51	10.5	0.11	6.82	0.7	10.5	0.11	6.94	0.7										FLOW @ DP12 CONVEYED OFFSITE
	13	EA3	0.44	0.82	5.9	0.36	8.27	3.0	5.9	0.36	8.27	3.0		3.0	0.36	1.3	1.5	56	6.8	0.14	BASIN EA3 CAPTURED @ DP13 BY ON GRADE TYPE R INLET	
	14	EA4	0.77	0.50	8.3	0.39	7.42	2.9	8.3	0.75	7.42	5.6		5.6	0.75	1.3	1.5	56	6.8	0.14	BASIN EA4 CAPTURED @ DP14 BY ON GRADE TYPE R INLET	
	15	EA5.1	0.37	0.13	5.4	0.05	8.49	0.4	8.4	0.80	7.37	5.9		5.9	0.80	0.5	1.5	36	4.2	0.14	BASIN EA5 SHEET FLOWS DIRECTLY TO SFB A	
	16	EA6	1.09	0.83	16.1	0.90	5.74	5.2	16.1	0.90	5.74	5.2		5.2	0.90	0.5	1.5	52	4.2	0.21	BASIN EA6 CAPTURED @ DP16 BY SUMP TYPE R INLET	
	17	EA7	1.92	0.50	17.4	0.97	5.54	5.4	17.4	1.87	5.54	10.3		10.3	1.87	0.5	2.0	196	5.1	0.64	BASIN EA7 CAPTURED @ DP17 BY SUMP TYPE R INLET	
	18								17.4	1.87	5.54	10.3		10.3	1.87	0.5	2.0	42	5.1	0.14	STORM MH @ D18, NO SEGMENT 2 FLOW	
	19	EA8	0.94	0.14	10.8	0.13	6.73	0.9	17.5	2.00	5.52	11.1		11.1	2.00	0.5	2.0	196	5.1	0.64	BASIN EA8 SHEET FLOWS DIRECTLY TO EDB B (NO SEGMENT 2 FLOWS)	
	18U	EA8 & EA9 *Per Segment 2 FDR	5.07	0.72	24.0	3.64	4.72	17.2	24.0	5.50	4.72	26.0		26.0	5.50	0.5	2.0	42	5.1	0.14	SEGMENT 2 FLOW COMBINES @ DP18 WITH SEGMENT 1 FLOWS @ STORM MH	
	19U	EA8	0.94	0.14	10.8	0.13	6.73	0.9	24.2	5.64	4.71	26.6										BASIN EA8 SHEET FLOWS DIRECTLY TO EDB B INCLUDING FUTURE TRIBUTARY FLOW FROM SUBBASIN EA8 & EA9 PER THE EASTONVILLE ROAD SEGMENT 2 FDR
	20	EA9	0.88	0.08	5.0	0.07	8.68	0.6	5.0	0.07	8.68	0.6										BASIN EA9 SHEET FLOWS OFFSITE
	8.1	EA10.1	0.36	0.21	5.0	0.07	8.68	0.6	5.0	0.07	8.68	0.6										BASIN EA10 SHEET FLOWS OFFSITE
	22	EA11	1.23	0.08	5.0	0.10	8.68	0.9	5.0	0.10	8.68	0.9										BASIN EA11 SHEET FLOWS OFFSITE



**Design Procedure Form: Runoff Reduction**

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 1

**Designer:** SPC  
**Company:** HR GREEN  
**Date:** August 26, 2024  
**Project:** Eastonville Segment 1 - RR  
**Location:** COLORADO SPRINGS, 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	SPA	SPA	SPA	UIA:RPA	UIA:RPA	SPA	SPA	SPA			
Area ID	EA5.2	EA5.3	EA5.4	EA9	EA10.1	EA10.2	EA11	OS2	OS3			
Downstream Design Point ID	4	4.1	6	20	8.1	8.2	22	3	7			
Downstream BMP Type	None	None	None	None	None	None	None	None	None			
DCIA (ft <sup>2</sup> )	--	--	--	--	--	--	--	--	--			
UIA (ft <sup>2</sup> )	--	--	--	--	3,606	10,620	--	--	--			
RPA (ft <sup>2</sup> )	--	--	--	--	3,309	21,115	--	--	--			
SPA (ft <sup>2</sup> )	10,105	20,228	5,422	14,605	--	--	6,572	13,994	37,875			
HSG A (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%			
HSG B (%)	100%	100%	100%	100%	100%	100%	100%	100%	100%			
HSG C/D (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%			
Average Slope of RPA (ft/ft)	--	--	--	--	0.020	0.100	--	--	--			
UIA:RPA Interface Width (ft)	--	--	--	--	285.00	860.00	--	--	--			

**CALCULATED RUNOFF RESULTS**

Area ID	EA5.2	EA5.3	EA5.4	EA9	EA10.1	EA10.2	EA11	OS2	OS3			
UIA:RPA Area (ft <sup>2</sup> )	--	--	--	--	6,915	31,735	--	--	--			
L / W Ratio	--	--	--	--	0.09	0.06	--	--	--			
UIA / Area	--	--	--	--	0.5215	0.3346	--	--	--			
Runoff (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
Runoff (ft <sup>3</sup> )	0	0	0	0	0	0	0	0	0			
Runoff Reduction (ft <sup>3</sup> )	505	1011	271	730	150	443	329	700	1894			

**CALCULATED WQCV RESULTS**

Area ID	EA5.2	EA5.3	EA5.4	EA9	EA10.1	EA10.2	EA11	OS2	OS3			
WQCV (ft <sup>3</sup> )	0	0	0	0	150	443	0	0	0			
WQCV Reduction (ft <sup>3</sup> )	0	0	0	0	150	443	0	0	0			
WQCV Reduction (%)	0%	0%	0%	0%	100%	100%	0%	0%	0%			
Untreated WQCV (ft <sup>3</sup> )	0	0	0	0	0	0	0	0	0			

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

Downstream Design Point ID	4	4.1	6	20	8.1	8.2	22	3	7			
DCIA (ft <sup>2</sup> )	0	0	0	0	0	0	0	0	0			
UIA (ft <sup>2</sup> )	0	0	0	0	3,606	10,620	0	0	0			
RPA (ft <sup>2</sup> )	0	0	0	0	3,309	21,115	0	0	0			
SPA (ft <sup>2</sup> )	10,105	20,228	5,422	14,605	0	0	6,572	13,994	37,875			
Total Area (ft <sup>2</sup> )	10,105	20,228	5,422	14,605	6,915	31,735	6,572	13,994	37,875			
Total Impervious Area (ft <sup>2</sup> )	0	0	0	0	3,606	10,620	0	0	0			
WQCV (ft <sup>3</sup> )	0	0	0	0	150	443	0	0	0			
WQCV Reduction (ft <sup>3</sup> )	0	0	0	0	150	443	0	0	0			
WQCV Reduction (%)	0%	0%	0%	0%	100%	100%	0%	0%	0%			
Untreated WQCV (ft <sup>3</sup> )	0	0	0	0	0	0	0	0	0			

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

Total Area (ft <sup>2</sup> )	147,451
Total Impervious Area (ft <sup>2</sup> )	14,226
WQCV (ft <sup>3</sup> )	593
WQCV Reduction (ft <sup>3</sup> )	593
WQCV Reduction (%)	100%
Untreated WQCV (ft <sup>3</sup> )	0



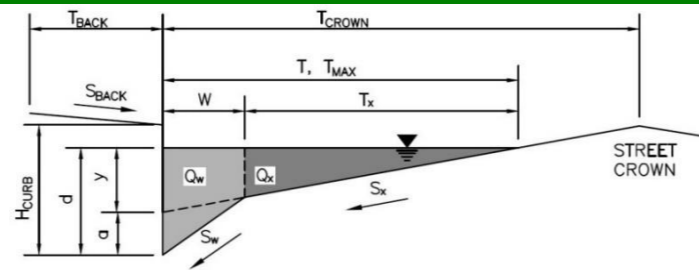
## **APPENDIX C – HYDRAULIC CALCULATIONS**



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

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

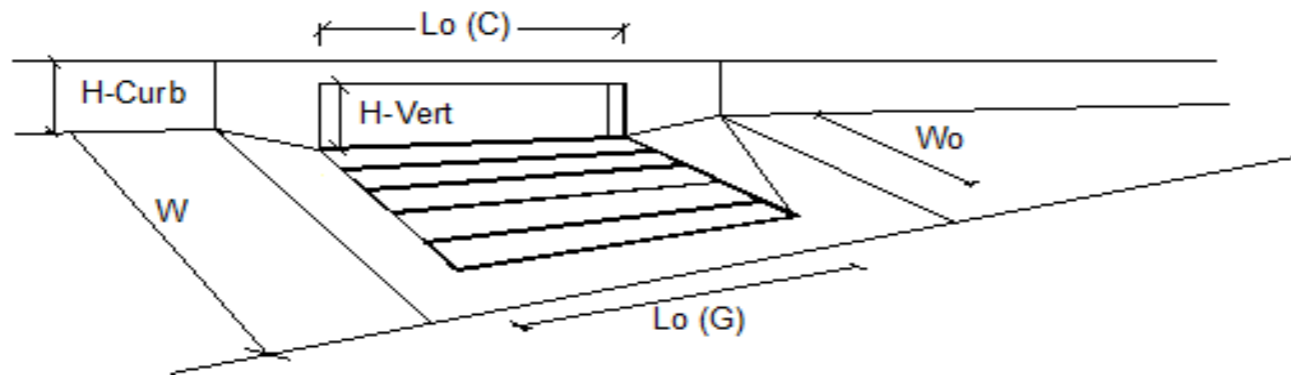
**Project:** Eastonville Road - Segment 1 Improvements  
**Inlet ID:** Inlet DP9



<b>Gutter Geometry:</b>									
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 2.5$ ft								
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft								
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.020$								
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches								
Distance from Curb Face to Street Crown	$T_{CROWN} = 26.0$ ft								
Gutter Width	$W = 2.00$ ft								
Street Transverse Slope	$S_x = 0.020$ ft/ft								
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft								
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.005$ ft/ft								
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.012$								
Max. Allowable Spread for Minor & Major Storm	<table style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td style="text-align: center;">Minor Storm</td> <td style="text-align: center;">Major Storm</td> <td></td> </tr> <tr> <td style="padding: 0 10px;"><math>T_{MAX} =</math></td> <td style="text-align: center; border: 1px solid black;">20.0</td> <td style="text-align: center; border: 1px solid black;">26.0</td> <td style="padding: 0 10px;">ft</td> </tr> </table>		Minor Storm	Major Storm		$T_{MAX} =$	20.0	26.0	ft
	Minor Storm	Major Storm							
$T_{MAX} =$	20.0	26.0	ft						
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td style="text-align: center;">Minor Storm</td> <td style="text-align: center;">Major Storm</td> <td></td> </tr> <tr> <td style="padding: 0 10px;"><math>d_{MAX} =</math></td> <td style="text-align: center; border: 1px solid black;">6.0</td> <td style="text-align: center; border: 1px solid black;">6.5</td> <td style="padding: 0 10px;">inches</td> </tr> </table>		Minor Storm	Major Storm		$d_{MAX} =$	6.0	6.5	inches
	Minor Storm	Major Storm							
$d_{MAX} =$	6.0	6.5	inches						
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)	<table style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td style="text-align: center;">Minor Storm</td> <td style="text-align: center;">Major Storm</td> <td></td> </tr> <tr> <td></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td></td> </tr> </table>		Minor Storm	Major Storm			<input type="checkbox"/>	<input type="checkbox"/>	
	Minor Storm	Major Storm							
	<input type="checkbox"/>	<input type="checkbox"/>							
MINOR STORM Allowable Capacity is based on Depth Criterion									
MAJOR STORM Allowable Capacity is based on Depth Criterion									
<b>Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.60 cfs on sheet 'Inlet Management'</b>									
<b>Major storm max. allowable capacity GOOD - greater than the design peak flow of 4.70 cfs on sheet 'Inlet Management'</b>									
<b><math>Q_{allow} = 13.0</math> (Minor Storm) <math>17.0</math> (Major Storm) cfs</b>									

# INLET ON A CONTINUOUS GRADE

*MHFD-Inlet, Version 5.03 (August 2023)*

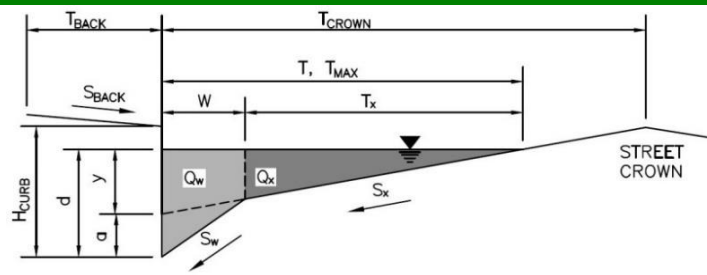


Design Information (Input)	MINOR		MAJOR	
Type of Inlet	CDOT Type R Curb Opening			
Local Depression (additional to continuous gutter depression 'a')	Type =	CDOT Type R Curb Opening		
Total Number of Units in the Inlet (Grate or Curb Opening)	$a_{LOCAL}$ =	3.0	3.0	inches
Length of a Single Unit Inlet (Grate or Curb Opening)	No =	3	3	
Width of a Unit Grate (cannot be greater than W, Gutter Width)	$L_o$ =	5.00	5.00	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	$W_o$ =	N/A	N/A	ft
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	$C_f (G)$ =	N/A	N/A	
Street Hydraulics: OK - $Q < \text{Allowable Street Capacity}$	$C_f (C)$ =	0.10	0.10	
Total Inlet Interception Capacity	$Q$ =	2.6	4.7	cfs
Total Inlet Carry-Over Flow (flow bypassing inlet)	$Q_b$ =	0.0	0.0	cfs
Capture Percentage = $Q_a/Q_o$	$C\%$ =	100	100	%

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

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

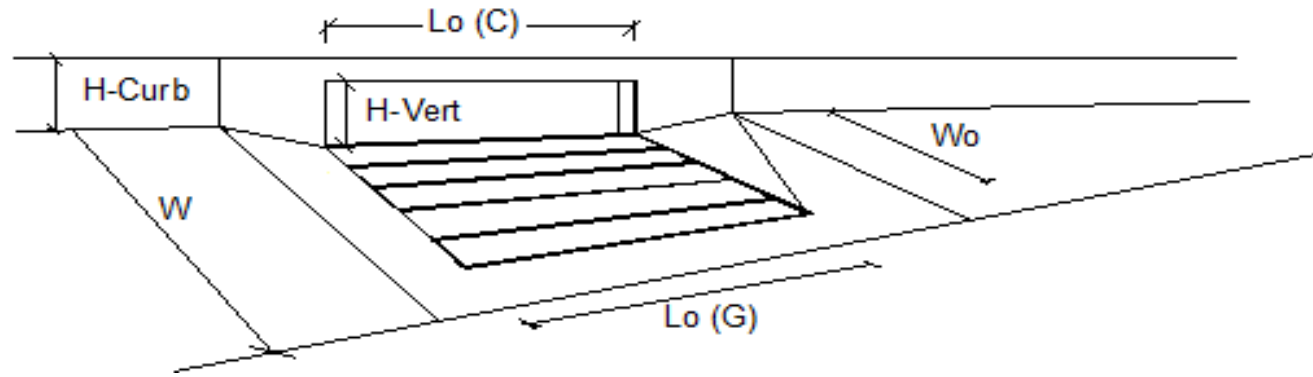
**Project:** Eastonville Road - Segment 1 Improvements  
**Inlet ID:** Inlet DP10



Gutter Geometry:							
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 23.5$ ft						
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft						
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.020$						
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches						
Distance from Curb Face to Street Crown	$T_{CROWN} = 26.0$ ft						
Gutter Width	$W = 2.00$ ft						
Street Transverse Slope	$S_x = 0.020$ ft/ft						
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft						
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.005$ ft/ft						
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.012$						
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px 5px;">Minor Storm</th> <th style="padding: 2px 5px;">Major Storm</th> <th style="padding: 2px 5px;">ft</th> </tr> <tr> <td style="text-align: center; padding: 2px 5px;"><math>T_{MAX} = 20.0</math></td> <td style="text-align: center; padding: 2px 5px;"><math>T_{MAX} = 26.0</math></td> <td></td> </tr> </table>	Minor Storm	Major Storm	ft	$T_{MAX} = 20.0$	$T_{MAX} = 26.0$	
Minor Storm	Major Storm	ft					
$T_{MAX} = 20.0$	$T_{MAX} = 26.0$						
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px 5px;">Minor Storm</th> <th style="padding: 2px 5px;">Major Storm</th> <th style="padding: 2px 5px;">inches</th> </tr> <tr> <td style="text-align: center; padding: 2px 5px;"><math>d_{MAX} = 6.0</math></td> <td style="text-align: center; padding: 2px 5px;"><math>d_{MAX} = 6.5</math></td> <td></td> </tr> </table>	Minor Storm	Major Storm	inches	$d_{MAX} = 6.0$	$d_{MAX} = 6.5$	
Minor Storm	Major Storm	inches					
$d_{MAX} = 6.0$	$d_{MAX} = 6.5$						
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)	<table style="display: inline-table; border-collapse: collapse;"> <tr> <td style="text-align: center; padding: 2px 5px;"><input type="checkbox"/></td> <td style="text-align: center; padding: 2px 5px;"><input type="checkbox"/></td> </tr> </table>	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/>	<input type="checkbox"/>						
MINOR STORM Allowable Capacity is based on Depth Criterion							
MAJOR STORM Allowable Capacity is based on Depth Criterion							
<b>Minor storm max. allowable capacity GOOD - greater than the design peak flow of 2.50 cfs on sheet 'Inlet Management'</b>							
<b>Major storm max. allowable capacity GOOD - greater than the design peak flow of 5.60 cfs on sheet 'Inlet Management'</b>							
<b>Q<sub>allow</sub> =</b>	<table border="1" style="display: inline-table; border-collapse: collapse;"> <tr> <th style="padding: 2px 5px;">Minor Storm</th> <th style="padding: 2px 5px;">Major Storm</th> <th style="padding: 2px 5px;">cfs</th> </tr> <tr> <td style="text-align: center; padding: 2px 5px;"><b>13.0</b></td> <td style="text-align: center; padding: 2px 5px;"><b>17.0</b></td> <td></td> </tr> </table>	Minor Storm	Major Storm	cfs	<b>13.0</b>	<b>17.0</b>	
Minor Storm	Major Storm	cfs					
<b>13.0</b>	<b>17.0</b>						

# INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

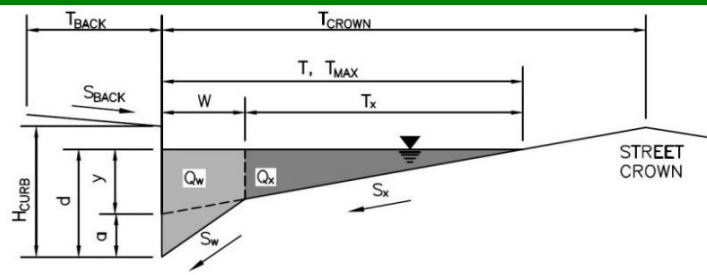


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	3	3	
Length of a Single Unit Inlet (Grate or Curb Opening)	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity			
Total Inlet Interception Capacity	<b>Q = 2.5</b>	<b>5.6</b>	<b>cfs</b>
Total Inlet Carry-Over Flow (flow bypassing inlet)	<b>Q<sub>b</sub> = 0.0</b>	<b>0.0</b>	<b>cfs</b>
Capture Percentage = Q <sub>a</sub> /Q <sub>o</sub>	<b>C% = 100</b>	<b>100</b>	<b>%</b>

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

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

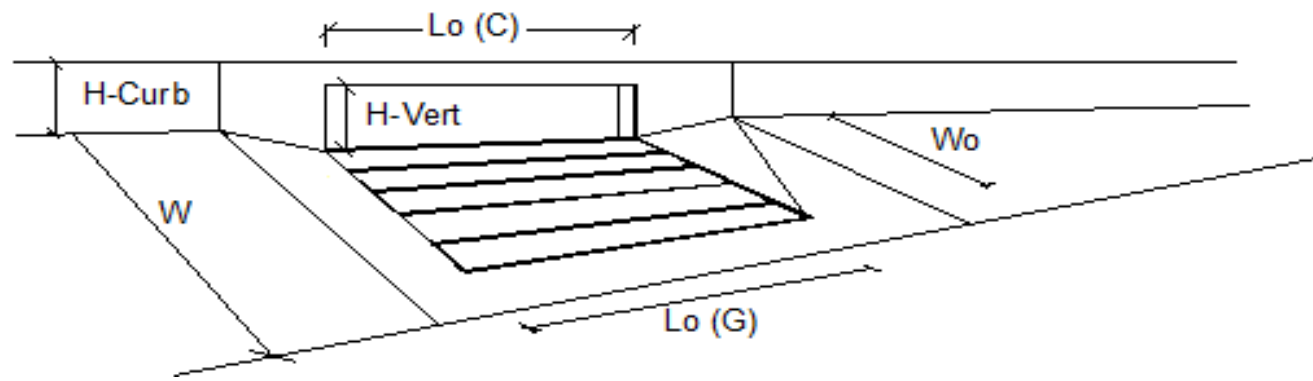
**Project:** Eastonville Road - Segment 1 Improvements  
**Inlet ID:** Inlet DP13



Gutter Geometry:							
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 2.5$ ft						
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft						
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.020$						
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches						
Distance from Curb Face to Street Crown	$T_{CROWN} = 26.0$ ft						
Gutter Width	$W = 2.00$ ft						
Street Transverse Slope	$S_X = 0.020$ ft/ft						
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_W = 0.083$ ft/ft						
Street Longitudinal Slope - Enter 0 for sump condition	$S_O = 0.018$ ft/ft						
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.012$						
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="padding: 2px 5px;">Minor Storm</th> <th style="padding: 2px 5px;">Major Storm</th> <th style="padding: 2px 5px;">ft</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; padding: 2px 5px;">20.0</td> <td style="text-align: center; padding: 2px 5px;">26.0</td> <td></td> </tr> </tbody> </table>	Minor Storm	Major Storm	ft	20.0	26.0	
Minor Storm	Major Storm	ft					
20.0	26.0						
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="padding: 2px 5px;">Minor Storm</th> <th style="padding: 2px 5px;">Major Storm</th> <th style="padding: 2px 5px;">inches</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; padding: 2px 5px;">6.0</td> <td style="text-align: center; padding: 2px 5px;">6.5</td> <td></td> </tr> </tbody> </table>	Minor Storm	Major Storm	inches	6.0	6.5	
Minor Storm	Major Storm	inches					
6.0	6.5						
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="padding: 2px 5px;">Minor Storm</th> <th style="padding: 2px 5px;">Major Storm</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; padding: 2px 5px;"><input type="checkbox"/></td> <td style="text-align: center; padding: 2px 5px;"><input type="checkbox"/></td> </tr> </tbody> </table>	Minor Storm	Major Storm	<input type="checkbox"/>	<input type="checkbox"/>		
Minor Storm	Major Storm						
<input type="checkbox"/>	<input type="checkbox"/>						
MINOR STORM Allowable Capacity is based on Depth Criterion							
MAJOR STORM Allowable Capacity is based on Depth Criterion							
<b>Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.80 cfs on sheet 'Inlet Management'</b>							
<b>Major storm max. allowable capacity GOOD - greater than the design peak flow of 3.00 cfs on sheet 'Inlet Management'</b>							
$Q_{allow} =$	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="padding: 2px 5px;">Minor Storm</th> <th style="padding: 2px 5px;">Major Storm</th> <th style="padding: 2px 5px;">cfs</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; padding: 2px 5px;">24.6</td> <td style="text-align: center; padding: 2px 5px;">29.2</td> <td></td> </tr> </tbody> </table>	Minor Storm	Major Storm	cfs	24.6	29.2	
Minor Storm	Major Storm	cfs					
24.6	29.2						

# INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)



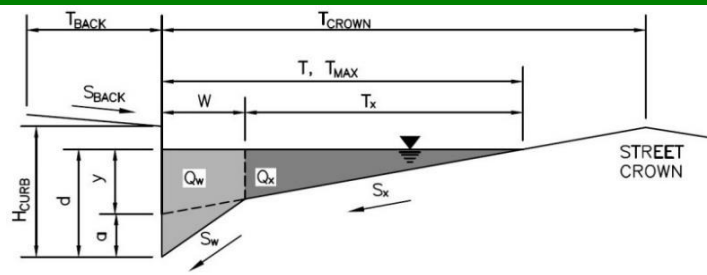
Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			
Total Inlet Interception Capacity	<b>Q = 1.8</b>	<b>3.0</b>	<b>cfs</b>
Total Inlet Carry-Over Flow (flow bypassing inlet)	<b>Q<sub>b</sub> = 0.0</b>	<b>0.0</b>	<b>cfs</b>
Capture Percentage = Q <sub>a</sub> /Q <sub>o</sub>	<b>C% = 100</b>	<b>100</b>	<b>%</b>



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

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

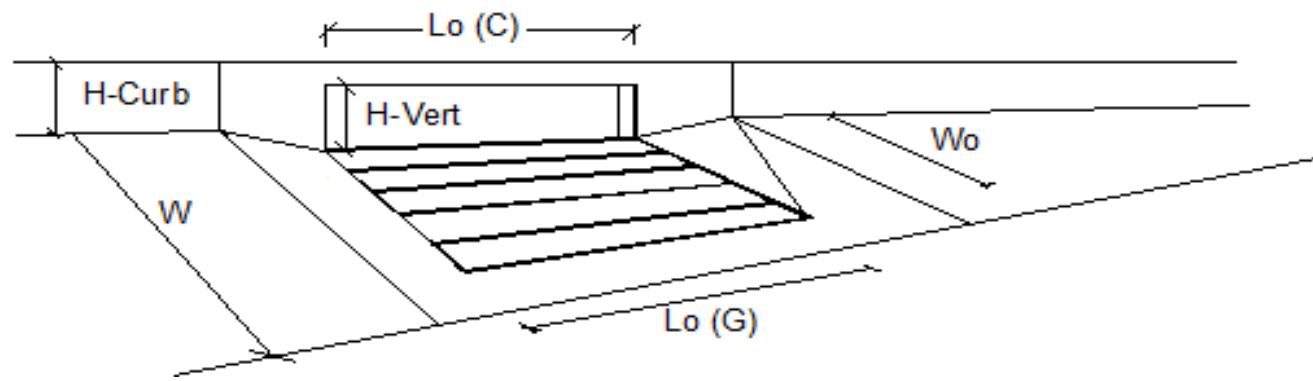
**Project:** Eastonville Road - Segment 1 Improvements  
**Inlet ID:** Inlet DP14



Gutter Geometry:							
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 23.5$ ft						
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft						
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.020$						
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches						
Distance from Curb Face to Street Crown	$T_{CROWN} = 26.0$ ft						
Gutter Width	$W = 2.00$ ft						
Street Transverse Slope	$S_x = 0.020$ ft/ft						
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_w = 0.083$ ft/ft						
Street Longitudinal Slope - Enter 0 for sump condition	$S_o = 0.018$ ft/ft						
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.012$						
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="padding: 2px 5px;">Minor Storm</th> <th style="padding: 2px 5px;">Major Storm</th> <th style="padding: 2px 5px;">ft</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; padding: 2px 5px;"><math>T_{MAX} = 20.0</math></td> <td style="text-align: center; padding: 2px 5px;"><math>26.0</math></td> <td></td> </tr> </tbody> </table>	Minor Storm	Major Storm	ft	$T_{MAX} = 20.0$	$26.0$	
Minor Storm	Major Storm	ft					
$T_{MAX} = 20.0$	$26.0$						
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="padding: 2px 5px;">Minor Storm</th> <th style="padding: 2px 5px;">Major Storm</th> <th style="padding: 2px 5px;">inches</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; padding: 2px 5px;"><math>d_{MAX} = 6.0</math></td> <td style="text-align: center; padding: 2px 5px;"><math>6.5</math></td> <td></td> </tr> </tbody> </table>	Minor Storm	Major Storm	inches	$d_{MAX} = 6.0$	$6.5$	
Minor Storm	Major Storm	inches					
$d_{MAX} = 6.0$	$6.5$						
Allow Flow Depth at Street Crown (check box for yes, leave blank for no)	<table style="display: inline-table; border-collapse: collapse;"> <tr> <td style="text-align: center; padding: 2px 5px;"><input type="checkbox"/></td> <td style="text-align: center; padding: 2px 5px;"><input type="checkbox"/></td> </tr> </table>	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/>	<input type="checkbox"/>						
MINOR STORM Allowable Capacity is based on Depth Criterion							
MAJOR STORM Allowable Capacity is based on Depth Criterion							
<b>Minor storm max. allowable capacity GOOD - greater than the design peak flow of 1.70 cfs on sheet 'Inlet Management'</b>							
<b>Major storm max. allowable capacity GOOD - greater than the design peak flow of 2.90 cfs on sheet 'Inlet Management'</b>							
<b>Q<sub>allow</sub> =</b>	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="padding: 2px 5px;">Minor Storm</th> <th style="padding: 2px 5px;">Major Storm</th> <th style="padding: 2px 5px;">cfs</th> </tr> </thead> <tbody> <tr> <td style="text-align: center; padding: 2px 5px;"><b>24.6</b></td> <td style="text-align: center; padding: 2px 5px;"><b>29.2</b></td> <td></td> </tr> </tbody> </table>	Minor Storm	Major Storm	cfs	<b>24.6</b>	<b>29.2</b>	
Minor Storm	Major Storm	cfs					
<b>24.6</b>	<b>29.2</b>						

# INLET ON A CONTINUOUS GRADE

MHFD-Inlet, Version 5.03 (August 2023)

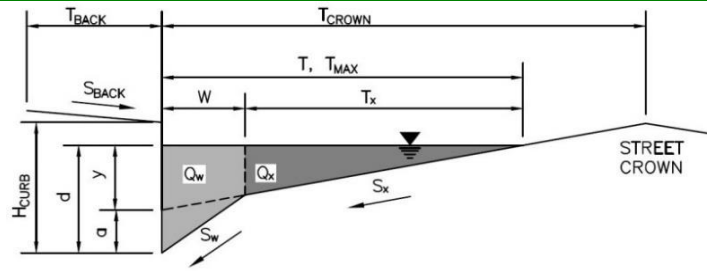


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	5.00	5.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'			
Total Inlet Interception Capacity	<b>Q = 1.7</b>	<b>2.9</b>	<b>cfs</b>
Total Inlet Carry-Over Flow (flow bypassing inlet)	<b>Q<sub>b</sub> = 0.0</b>	<b>0.0</b>	<b>cfs</b>
Capture Percentage = Q <sub>a</sub> /Q <sub>o</sub>	<b>C% = 100</b>	<b>100</b>	<b>%</b>

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

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

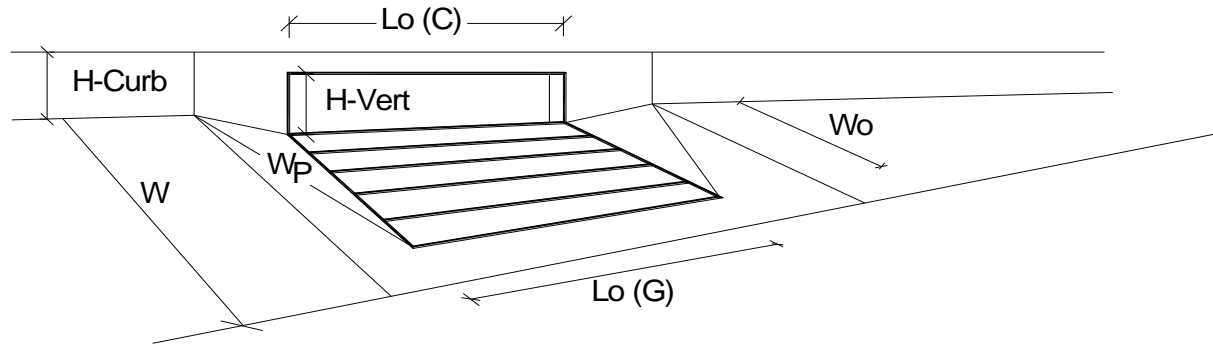
**Project:** Eastonville Road - Segment 1 Improvements  
**Inlet ID:** Inlet DP16



Gutter Geometry:							
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 2.5$ ft						
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft						
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.020$						
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches						
Distance from Curb Face to Street Crown	$T_{CROWN} = 26.0$ ft						
Gutter Width	$W = 2.00$ ft						
Street Transverse Slope	$S_X = 0.020$ ft/ft						
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_W = 0.083$ ft/ft						
Street Longitudinal Slope - Enter 0 for sump condition	$S_O = 0.000$ ft/ft						
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.012$						
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="padding: 2px 5px;">Minor Storm</th> <th style="padding: 2px 5px;">Major Storm</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px 5px;"><math>T_{MAX} = 20.0</math></td> <td style="padding: 2px 5px;"><math>T_{MAX} = 26.0</math></td> </tr> <tr> <td style="padding: 2px 5px;"><math>d_{MAX} = 6.0</math></td> <td style="padding: 2px 5px;"><math>d_{MAX} = 6.5</math></td> </tr> </tbody> </table>	Minor Storm	Major Storm	$T_{MAX} = 20.0$	$T_{MAX} = 26.0$	$d_{MAX} = 6.0$	$d_{MAX} = 6.5$
Minor Storm	Major Storm						
$T_{MAX} = 20.0$	$T_{MAX} = 26.0$						
$d_{MAX} = 6.0$	$d_{MAX} = 6.5$						
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="padding: 2px 5px;">Minor Storm</th> <th style="padding: 2px 5px;">Major Storm</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px 5px;"><math>d_{MAX} = 6.0</math></td> <td style="padding: 2px 5px;"><math>d_{MAX} = 6.5</math></td> </tr> </tbody> </table>	Minor Storm	Major Storm	$d_{MAX} = 6.0$	$d_{MAX} = 6.5$		
Minor Storm	Major Storm						
$d_{MAX} = 6.0$	$d_{MAX} = 6.5$						
Check boxes are not applicable in SUMP conditions	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="padding: 2px 5px;">Minor Storm</th> <th style="padding: 2px 5px;">Major Storm</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px 5px; text-align: center;"><input type="checkbox"/></td> <td style="padding: 2px 5px; text-align: center;"><input type="checkbox"/></td> </tr> </tbody> </table>	Minor Storm	Major Storm	<input type="checkbox"/>	<input type="checkbox"/>		
Minor Storm	Major Storm						
<input type="checkbox"/>	<input type="checkbox"/>						
MINOR STORM Allowable Capacity is not applicable to Sump Condition							
MAJOR STORM Allowable Capacity is not applicable to Sump Condition							
$Q_{allow} =$	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="padding: 2px 5px;">Minor Storm</th> <th style="padding: 2px 5px;">Major Storm</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px 5px; text-align: center;"><b>SUMP</b></td> <td style="padding: 2px 5px; text-align: center;"><b>SUMP</b></td> </tr> </tbody> </table> cfs	Minor Storm	Major Storm	<b>SUMP</b>	<b>SUMP</b>		
Minor Storm	Major Storm						
<b>SUMP</b>	<b>SUMP</b>						

# INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)

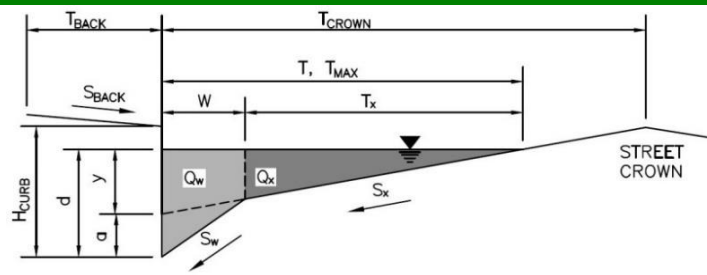


Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)			
Number of Unit Inlets (Grate or Curb Opening)			
Water Depth at Flowline (outside of local depression)			
<b>Grate Information</b>			
Length of a Unit Grate			
Width of a Unit Grate			
Open Area Ratio for a Grate (typical values 0.15-0.90)			
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)			
Grate Weir Coefficient (typical value 2.15 - 3.60)			
Grate Orifice Coefficient (typical value 0.60 - 0.80)			
<b>Curb Opening Information</b>			
Length of a Unit Curb Opening			
Height of Vertical Curb Opening in Inches			
Height of Curb Orifice Throat in Inches			
Angle of Throat			
Side Width for Depression Pan (typically the gutter width of 2 feet)			
Clogging Factor for a Single Curb Opening (typical value 0.10)			
Curb Opening Weir Coefficient (typical value 2.3-3.7)			
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)			
<b>Low Head Performance Reduction (Calculated)</b>			
Depth for Grate Midwidth			
Depth for Curb Opening Weir Equation			
Grated Inlet Performance Reduction Factor for Long Inlets			
Curb Opening Performance Reduction Factor for Long Inlets			
Combination Inlet Performance Reduction Factor for Long Inlets			
Total Inlet Interception Capacity (assumes clogged condition)			
<b>Inlet Capacity IS GOOD for Minor and Major Storms (&gt;Q Peak)</b>			
Type =	CDOT Type R Curb Opening		
$a_{local}$ =	3.00	3.00	inches
No =	2	2	
Ponding Depth =	6.0	6.5	inches
<input checked="" type="checkbox"/> Override Depths			
$L_o$ (G) =	N/A	N/A	feet
$W_o$ =	N/A	N/A	feet
$A_{ratio}$ =	N/A	N/A	
$C_r$ (G) =	N/A	N/A	
$C_w$ (G) =	N/A	N/A	
$C_o$ (G) =	N/A	N/A	
<b>MINOR                      MAJOR</b>			
$L_o$ (C) =	5.00	5.00	feet
$H_{vert}$ =	6.00	6.00	inches
$H_{throat}$ =	6.00	6.00	inches
Theta =	63.40	63.40	degrees
$W_p$ =	2.00	2.00	feet
$C_r$ (C) =	0.10	0.10	
$C_w$ (C) =	3.60	3.60	
$C_o$ (C) =	0.67	0.67	
<b>MINOR                      MAJOR</b>			
$d_{Grate}$ =	N/A	N/A	ft
$d_{Curb}$ =	0.33	0.38	ft
RF <sub>Grate</sub> =	N/A	N/A	
RF <sub>Curb</sub> =	0.93	0.96	
RF <sub>Combination</sub> =	N/A	N/A	
<b>MINOR                      MAJOR</b>			
$Q_a$ =	<b>8.3</b>	<b>10.2</b>	cfs
Q <sub>PEAK REQUIRED</sub> =	3.1	5.2	cfs

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

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

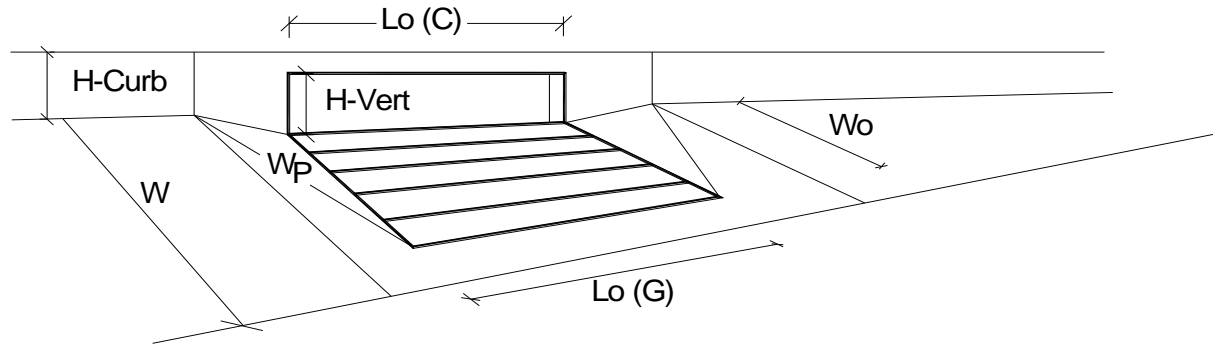
**Project:** Eastonville Road - Segment 1 Improvements  
**Inlet ID:** Inlet DP17



Gutter Geometry:							
Maximum Allowable Width for Spread Behind Curb	$T_{BACK} = 23.5$ ft						
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	$S_{BACK} = 0.020$ ft/ft						
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	$n_{BACK} = 0.020$						
Height of Curb at Gutter Flow Line	$H_{CURB} = 6.00$ inches						
Distance from Curb Face to Street Crown	$T_{CROWN} = 26.0$ ft						
Gutter Width	$W = 2.00$ ft						
Street Transverse Slope	$S_X = 0.020$ ft/ft						
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	$S_W = 0.083$ ft/ft						
Street Longitudinal Slope - Enter 0 for sump condition	$S_O = 0.000$ ft/ft						
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	$n_{STREET} = 0.012$						
Max. Allowable Spread for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="padding: 2px 5px;">Minor Storm</th> <th style="padding: 2px 5px;">Major Storm</th> <th style="padding: 2px 5px;">ft</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px 5px;"><math>T_{MAX} = 20.0</math></td> <td style="padding: 2px 5px;"><math>26.0</math></td> <td style="padding: 2px 5px;"></td> </tr> </tbody> </table>	Minor Storm	Major Storm	ft	$T_{MAX} = 20.0$	$26.0$	
Minor Storm	Major Storm	ft					
$T_{MAX} = 20.0$	$26.0$						
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="padding: 2px 5px;">Minor Storm</th> <th style="padding: 2px 5px;">Major Storm</th> <th style="padding: 2px 5px;">inches</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px 5px;"><math>d_{MAX} = 6.0</math></td> <td style="padding: 2px 5px;"><math>6.5</math></td> <td style="padding: 2px 5px;"></td> </tr> </tbody> </table>	Minor Storm	Major Storm	inches	$d_{MAX} = 6.0$	$6.5$	
Minor Storm	Major Storm	inches					
$d_{MAX} = 6.0$	$6.5$						
Check boxes are not applicable in SUMP conditions	<table style="display: inline-table; border-collapse: collapse;"> <tr> <td style="text-align: center; padding: 0 10px;"><input type="checkbox"/></td> <td style="text-align: center; padding: 0 10px;"><input type="checkbox"/></td> </tr> </table>	<input type="checkbox"/>	<input type="checkbox"/>				
<input type="checkbox"/>	<input type="checkbox"/>						
MINOR STORM Allowable Capacity is not applicable to Sump Condition							
MAJOR STORM Allowable Capacity is not applicable to Sump Condition							
$Q_{allow} =$	<table border="1" style="display: inline-table; border-collapse: collapse;"> <thead> <tr> <th style="padding: 2px 5px;">Minor Storm</th> <th style="padding: 2px 5px;">Major Storm</th> <th style="padding: 2px 5px;">cfs</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px 5px; text-align: center;"><b>SUMP</b></td> <td style="padding: 2px 5px; text-align: center;"><b>SUMP</b></td> <td style="padding: 2px 5px;"></td> </tr> </tbody> </table>	Minor Storm	Major Storm	cfs	<b>SUMP</b>	<b>SUMP</b>	
Minor Storm	Major Storm	cfs					
<b>SUMP</b>	<b>SUMP</b>						

# INLET IN A SUMP OR SAG LOCATION

MHFD-Inlet, Version 5.03 (August 2023)



Design Information (Input)	MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)			
Number of Unit Inlets (Grate or Curb Opening)	2		
Water Depth at Flowline (outside of local depression)			
<b>Grate Information</b>			
Length of a Unit Grate			
Width of a Unit Grate			
Open Area Ratio for a Grate (typical values 0.15-0.90)			
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)			
Grate Weir Coefficient (typical value 2.15 - 3.60)			
Grate Orifice Coefficient (typical value 0.60 - 0.80)			
<b>Curb Opening Information</b>			
Length of a Unit Curb Opening			
Height of Vertical Curb Opening in Inches			
Height of Curb Orifice Throat in Inches			
Angle of Throat			
Side Width for Depression Pan (typically the gutter width of 2 feet)			
Clogging Factor for a Single Curb Opening (typical value 0.10)			
Curb Opening Weir Coefficient (typical value 2.3-3.7)			
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)			
<b>Low Head Performance Reduction (Calculated)</b>			
Depth for Grate Midwidth			
Depth for Curb Opening Weir Equation			
Grated Inlet Performance Reduction Factor for Long Inlets			
Curb Opening Performance Reduction Factor for Long Inlets			
Combination Inlet Performance Reduction Factor for Long Inlets			
<b>Total Inlet Interception Capacity (assumes clogged condition)</b>			
<b>Inlet Capacity IS GOOD for Minor and Major Storms (&gt;Q Peak)</b>			
Type	CDOT Type R Curb Opening		
$a_{local}$ =	3.00	3.00	inches
No =	2	2	
Ponding Depth =	6.0	6.5	inches
<input checked="" type="checkbox"/> Override Depths			
$L_o$ (G) =	N/A	N/A	feet
$W_o$ =	N/A	N/A	feet
$A_{ratio}$ =	N/A	N/A	
$C_r$ (G) =	N/A	N/A	
$C_w$ (G) =	N/A	N/A	
$C_o$ (G) =	N/A	N/A	
<b>MINOR</b> <b>MAJOR</b>			
$L_o$ (C) =	5.00	5.00	feet
$H_{vert}$ =	6.00	6.00	inches
$H_{throat}$ =	6.00	6.00	inches
Theta =	63.40	63.40	degrees
$W_p$ =	2.00	2.00	feet
$C_r$ (C) =	0.10	0.10	
$C_w$ (C) =	3.60	3.60	
$C_o$ (C) =	0.67	0.67	
<b>MINOR</b> <b>MAJOR</b>			
$d_{Grate}$ =	N/A	N/A	ft
$d_{Curb}$ =	0.33	0.38	ft
$RF_{Grate}$ =	N/A	N/A	
$RF_{Curb}$ =	0.93	0.96	
$RF_{Combination}$ =	N/A	N/A	
<b>MINOR</b> <b>MAJOR</b>			
$Q_a$ =	<b>8.3</b>	<b>10.2</b>	cfs
$Q_{PEAK REQUIRED}$ =	3.2	5.4	cfs



# Eastonville Rd Segment 1

## Sump Inlet Capacity

El Paso County

**Calc'd by:** SPC  
**Checked by:** CM  
**Date:** 8/23/2024

Structure Type	Design Point	Required Inlet Capacity [cfs]	Flow Depth / Depth of Water Over Grate (d) [ft]	Inlet Operating as Weir / Orifice	Weir or Orifice Discharge Coefficient (C <sub>w</sub> /C <sub>o</sub> )	Clear Opening Area (A <sub>o</sub> ) [ft <sup>2</sup> ]	Weir Length (L <sub>w</sub> ) [ft]	Clogging Factor (%)	Clogged Effective Weir Length (L <sub>w</sub> ) [ft]	Clogged Opening Area (A <sub>o</sub> ) [ft <sup>2</sup> ]	Provided Inlet Capacity (CFS)
CDOT Type D - Standard Grate	7	53.6	2.75	ORIFICE	0.67	10.38	11.51	20	9.21	8.30	74.04
CDOT Type C - Standard Grate	1	3.6	0.50	WEIR	3	6.3	9	10	8.10	5.67	8.59
				ORIFICE	0	0	0	0	0.00	0.00	0.00
				ORIFICE	0	0	0	0	0.00	0.00	0.00
				ORIFICE	0	0	0	0	0.00	0.00	0.00

Table 7-8. Sump inlet discharge variables and coefficients  
 (Modified From Akan and Houghtalen 2002)

Urban Storm Drainage Criteria Manual (USDCM) Volume 1 Chapter 7 Section 3.2.7

The hydraulic capacity of grate, curb-opening, and slotted inlets operating as weirs is expressed as:

$$Q_i = C_w L_w d^{1.5} \quad \text{(Equation 7-37)}$$

Where:  
 Q<sub>i</sub> = inlet capacity (cfs)  
 C<sub>w</sub> = weir discharge coefficient  
 L<sub>w</sub> = weir length (ft)  
 d = flow depth (ft).

The hydraulic capacity of grate, curb-opening, and slotted inlets operating as orifices is expressed as:

$$Q_i = C_o A_o (2gd)^{0.5} \quad \text{(Equation 7-38)}$$

Where:  
 Q<sub>i</sub> = inlet capacity (cfs)  
 C<sub>o</sub> = orifice discharge coefficient  
 A<sub>o</sub> = orifice area (ft<sup>2</sup>)  
 d = characteristic depth (ft) as defined in Table 7-8  
 g = 32.2 ft/sec<sup>2</sup>

Inlet Type	C <sub>w</sub>	L <sub>w</sub> <sup>1</sup>	Weir Equation Valid For	Definitions of Terms
Grate Inlet	3.00	L + 2W	d < 1.79(A <sub>o</sub> /L <sub>w</sub> )	L = Length of grate (ft) W = Width of grate (ft) d = Depth of water over grate (ft) A <sub>o</sub> = Clear opening area <sup>2</sup> (ft <sup>2</sup> )
Curb-opening Inlet	3.00	L	d < h	L = Length of curb opening (ft) h = Height of curb opening (ft) d = d <sub>i</sub> - (h/2) (ft) d <sub>i</sub> = Depth of water at curb opening (ft)
Depressed Curb Opening Inlet <sup>3</sup>	2.30	L + 1.8W	d < (h + a)	W = Lateral width of depression (ft) a = Depth of curb depression (ft)
Slotted Inlets	2.48	L	d < 0.2 ft	L = Length of slot (ft) d = Depth at curb (ft)

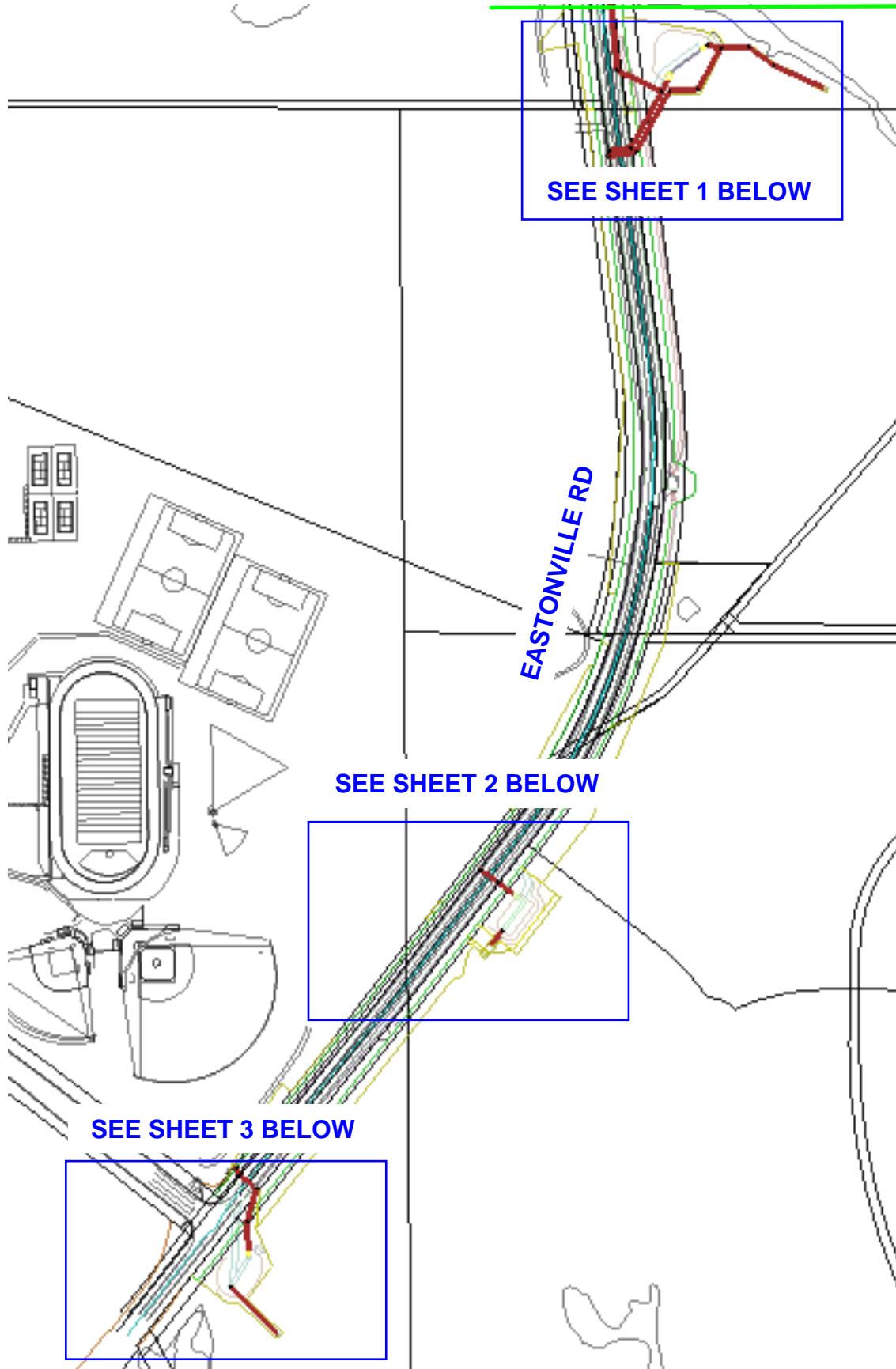
<sup>1</sup> The weir length should be reduced where clogging is expected.  
<sup>2</sup> Ratio of clear opening area to total area is 0.8 for P-1-7/8-4 and reticuline grates, 0.9 for P-1-7/8 and 0.6 for P-1-1/8 grates. Curved vane and tilt bar grates are not recommended at sump locations unless in combination with curb openings.  
<sup>3</sup> If L > 12 ft, use the expressions for curb-opening inlets without depression.

	C <sub>o</sub>	A <sub>o</sub> <sup>4</sup>	Orifice Equation Valid For	Definition of Terms
Grate Inlet	0.67	Clear opening area <sup>5</sup>	d > 1.79(A <sub>o</sub> /L <sub>w</sub> )	d = Depth of water over grate (ft)
Curb-opening Inlet (depressed or undepressed, horizontal orifice throat <sup>6</sup> )	0.67	(h)(L)	d <sub>i</sub> > 1.4h	d = d <sub>i</sub> - (h/2) (ft) d <sub>i</sub> = Depth of water at curb opening (ft) h = Height of curb opening (ft)
Slotted Inlet	0.80	(L)(W)	d > 0.40 ft	L = Length of slot (ft) W = Width of slot (ft) d = Depth of water over slot (ft)

<sup>4</sup> The orifice area should be reduced where clogging is expected.  
<sup>5</sup> The ratio of clear opening area to total area is 0.8 for P-1-7/8-4 and reticuline grates, 0.9 for P-1-7/8 and 0.6 for P-1-1/8 grates. Curved vane and tilt bar grates are not recommended at sump locations unless in combination with curb openings.  
<sup>6</sup> See Figure 7-12 for other types of throats.

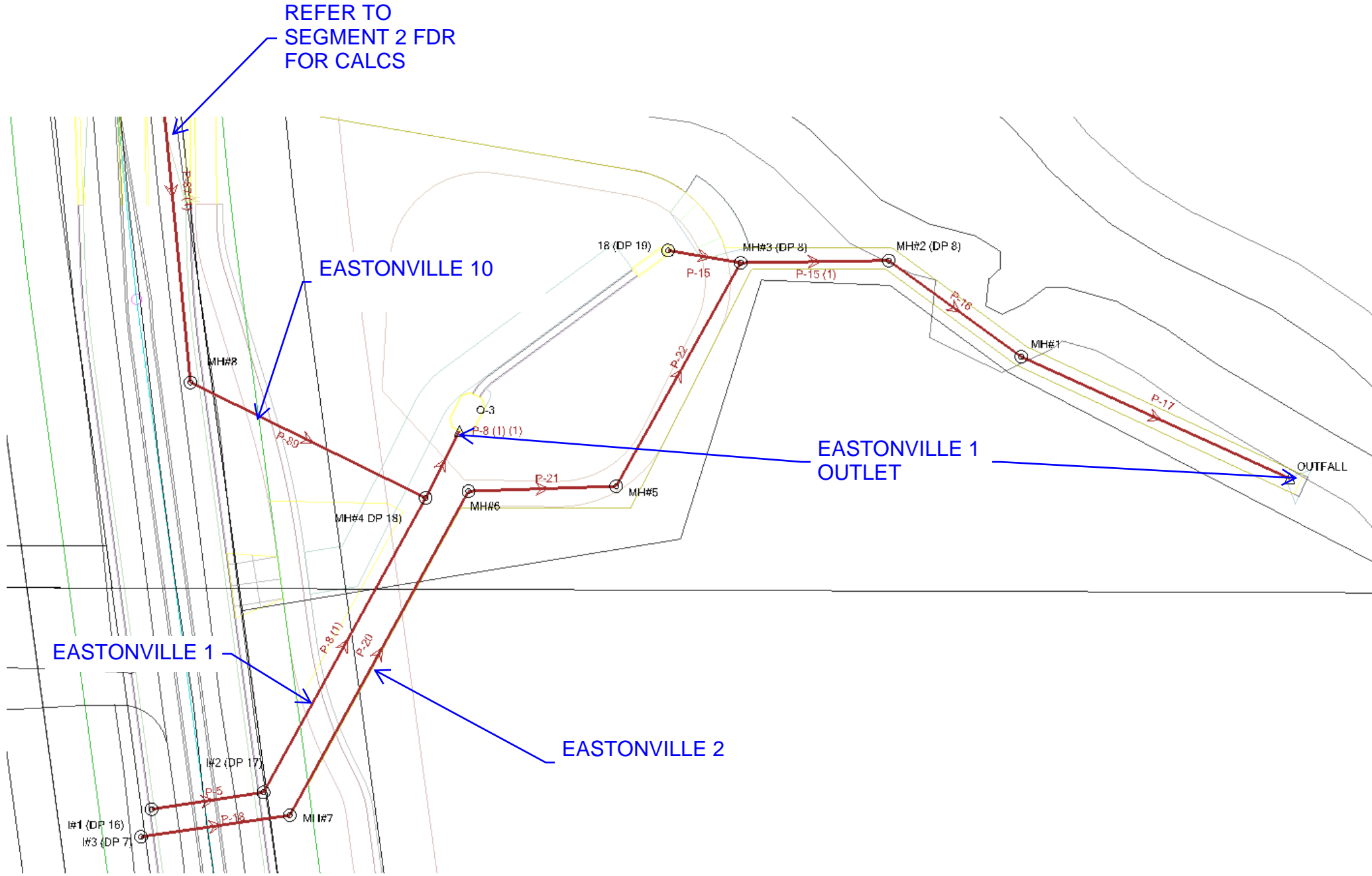
# STORMCAD NETWORK LAYOUT: SEGMENT 1

MATCHLINE REFER TO SEGMENT 2 FDR





REFER TO  
SEGMENT 2 FDR  
FOR CALCS

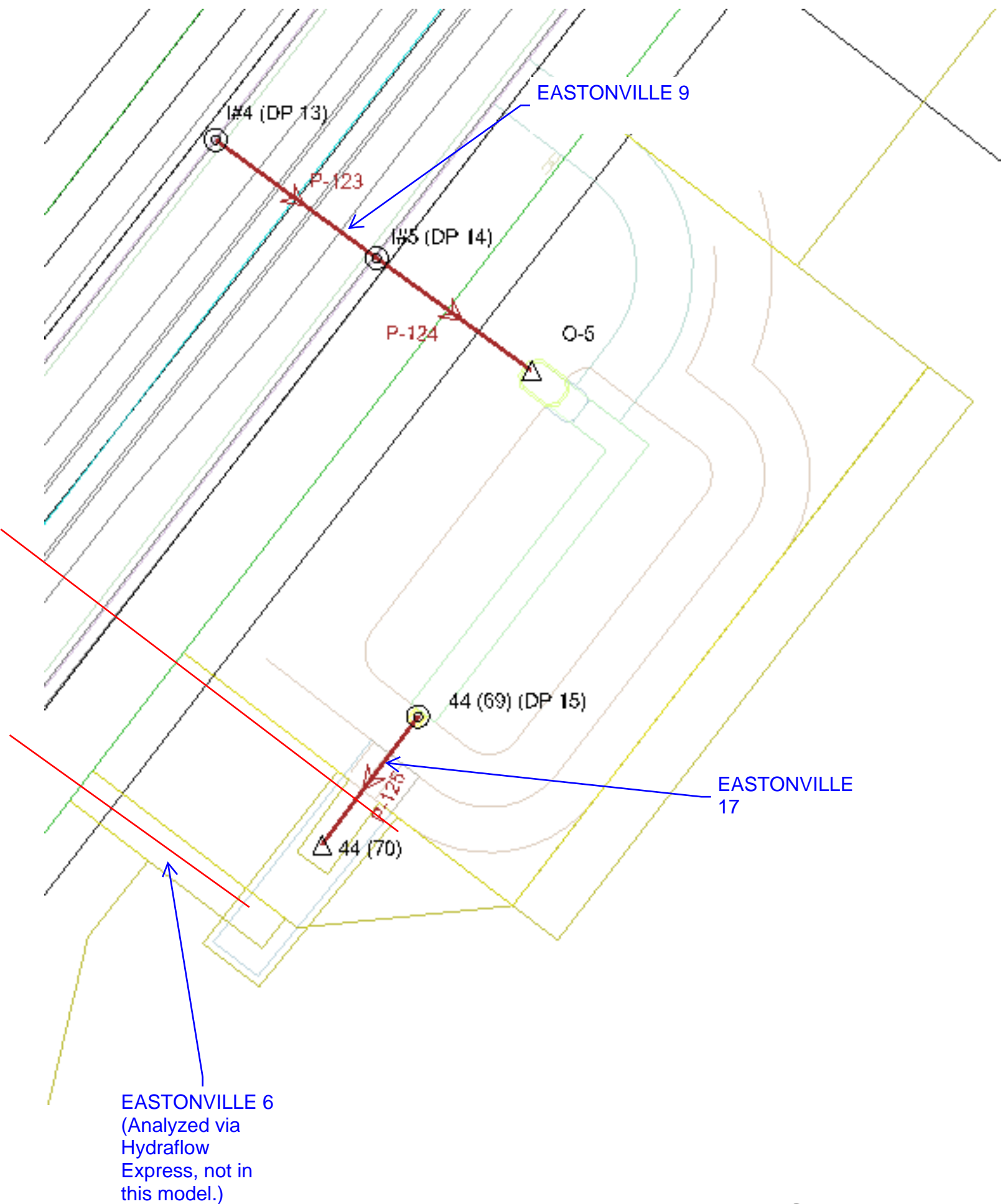


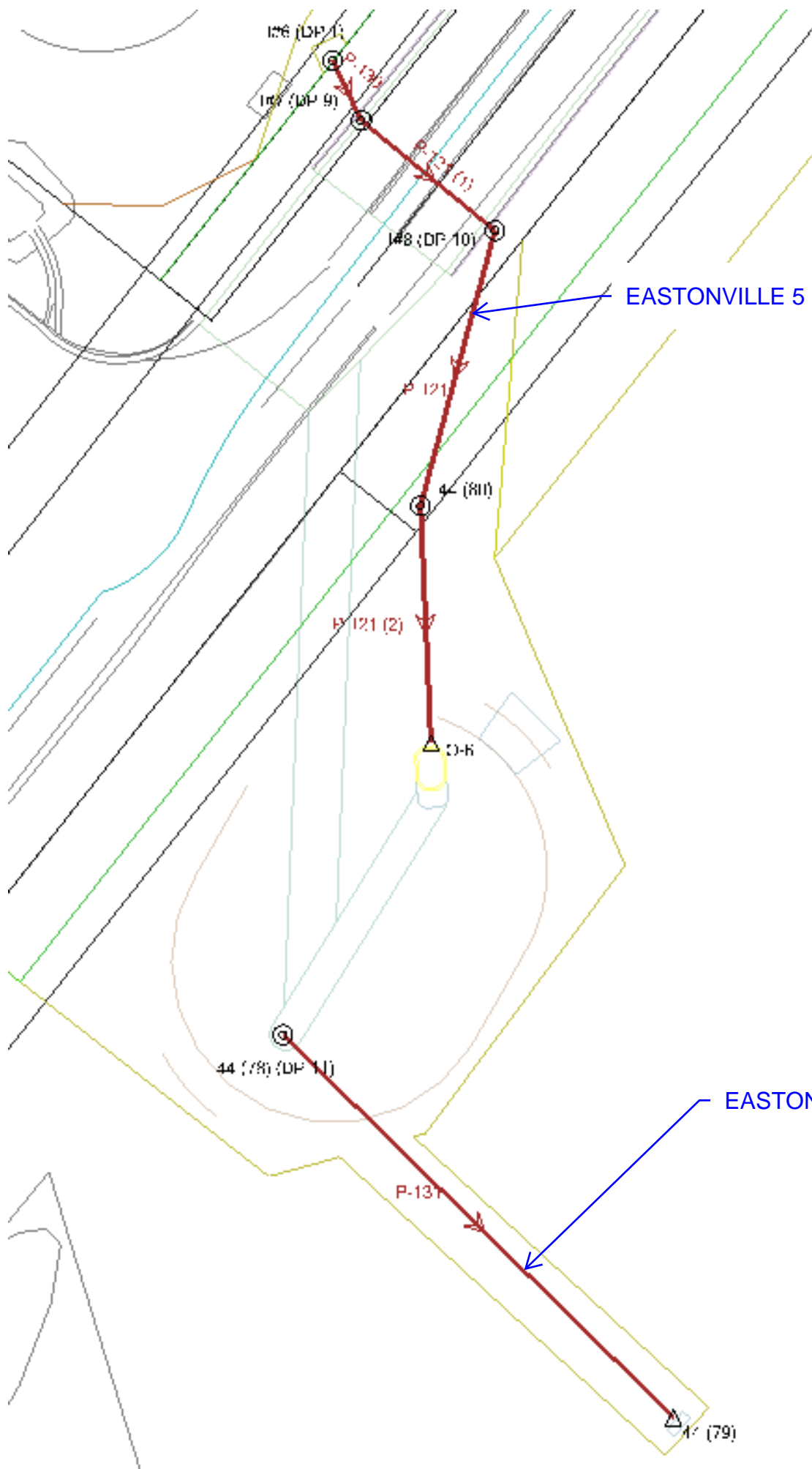
EASTONVILLE 10

EASTONVILLE 1  
OUTLET

EASTONVILLE 1

EASTONVILLE 2





## 100 YEAR TAILWATER CONDITION: PIPE SUMMARY TABLE

	Label	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n
66: P-8 (1) (1)	P-8 (1) (1)	MH#4 DP 18)	6,985.02	O-3	6,984.82	41.6	0.005	36.0	0.013
67: P-124	P-124	I#5 (DP 14)	6,983.07	O-5	6,981.82	50.1	0.025	18.0	0.013
68: P-121 (2)	P-121 (2)	44 (80)	6,966.45	O-6	6,966.08	74.1	0.005	24.0	0.013
69: P-18	P-18	I#3 (DP 7)	6,986.04	MH#7	6,985.68	71.3	0.005	42.0	0.013
70: P-20	P-20	MH#7	6,985.37	MH#6	6,983.61	175.6	0.010	42.0	0.013
71: P-5	P-5	I#1 (DP 16)	6,989.53	I#2 (DP 17)	6,989.27	52.7	0.005	18.0	0.013
72: P-8 (1)	P-8 (1)	I#2 (DP 17)	6,988.77	MH#4 DP 18)	6,986.02	147.0	0.019	24.0	0.013
73: P-21	P-21	MH#6	6,983.41	MH#5	6,982.59	82.2	0.010	42.0	0.013
74: P-22	P-22	MH#5	6,982.39	MH#3 (DP 8)	6,981.23	115.7	0.010	42.0	0.013
75: P-15	P-15	18 (DP 19)	6,983.25	MH#3 (DP 8)	6,983.03	30.8	0.007	18.0	0.013
76: P-15 (1)	P-15 (1)	MH#3 (DP 8)	6,981.03	MH#2 (DP 8)	6,980.65	75.1	0.005	42.0	0.013
77: P-16	P-16	MH#2 (DP 8)	6,980.55	MH#1	6,980.16	78.1	0.005	42.0	0.013
78: P-123	P-123	I#4 (DP 13)	6,983.43	I#5 (DP 14)	6,983.17	52.0	0.005	18.0	0.013
79: P-17	P-17	MH#1	6,980.06	OUTFALL	6,979.36	139.8	0.005	42.0	0.013
80: P-125	P-125	44 (69) (DP 15)	6,978.42	44 (70)	6,978.21	42.5	0.005	18.0	0.013
84: P-121	P-121	I#8 (DP 10)	6,966.90	44 (80)	6,966.45	89.0	0.005	24.0	0.013
85: P-130	P-130	I#6 (DP 1)	6,967.50	I#7 (DP 9)	6,967.37	19.6	0.007	18.0	0.013
87: P-121 (1)	P-121 (1)	I#7 (DP 9)	6,967.27	I#8 (DP 10)	6,967.00	53.0	0.005	18.0	0.013
88: P-131	P-131	44 (78) (DP 11)	6,963.40	44 (79)	6,962.52	167.9	0.005	18.0	0.013
127: P-89	P-89	MH#8	6,986.76	MH#4 DP 18)	6,986.02	116.1	0.006	24.0	0.013
146: P-87 (1)	P-87 (1)	MH#9	6,989.76	MH#8	6,986.86	193.5	0.015	24.0	0.013

	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
66: P-8 (1) (1)	26.00	3.68	46.25	56.2	6,988.25	6,988.19
67: P-124	5.60	8.48	16.60	33.7	6,983.98	6,982.43
68: P-121 (2)	13.90	5.73	15.98	87.0	6,967.89	6,967.42
69: P-18	53.60	8.15	71.48	75.0	6,988.34	6,988.30
70: P-20	53.60	10.63	100.73	53.2	6,987.66	6,986.34
71: P-5	5.20	4.52	7.38	70.5	6,990.51	6,990.40
72: P-8 (1)	10.30	8.86	30.94	33.3	6,989.92	6,988.63
73: P-21	53.60	10.61	100.49	53.3	6,985.70	6,985.32
74: P-22	53.60	10.63	100.72	53.2	6,984.68	6,984.42
75: P-15	3.00	4.54	8.88	33.8	6,984.43	6,984.42
76: P-15 (1)	56.50	8.24	71.57	78.9	6,983.69	6,983.58
77: P-16	56.50	8.20	71.10	79.5	6,982.91	6,982.52
78: P-123	3.00	3.98	7.43	40.4	6,984.40	6,984.38
79: P-17	56.50	8.21	71.18	79.4	6,982.41	6,981.71
80: P-125	1.20	3.10	7.45	16.1	6,978.83	6,978.62
84: P-121	13.90	5.76	16.08	86.4	6,968.34	6,967.92
85: P-130	3.60	2.04	8.55	42.1	6,969.95	6,969.92
87: P-121 (1)	9.30	5.26	7.50	124.0	6,969.28	6,968.86
88: P-131	1.40	3.28	7.61	18.4	6,963.84	6,962.96
127: P-89	17.20	5.47	18.06	95.3	6,989.30	6,988.63
146: P-87 (1)	17.20	9.29	27.70	62.1	6,991.26	6,989.59

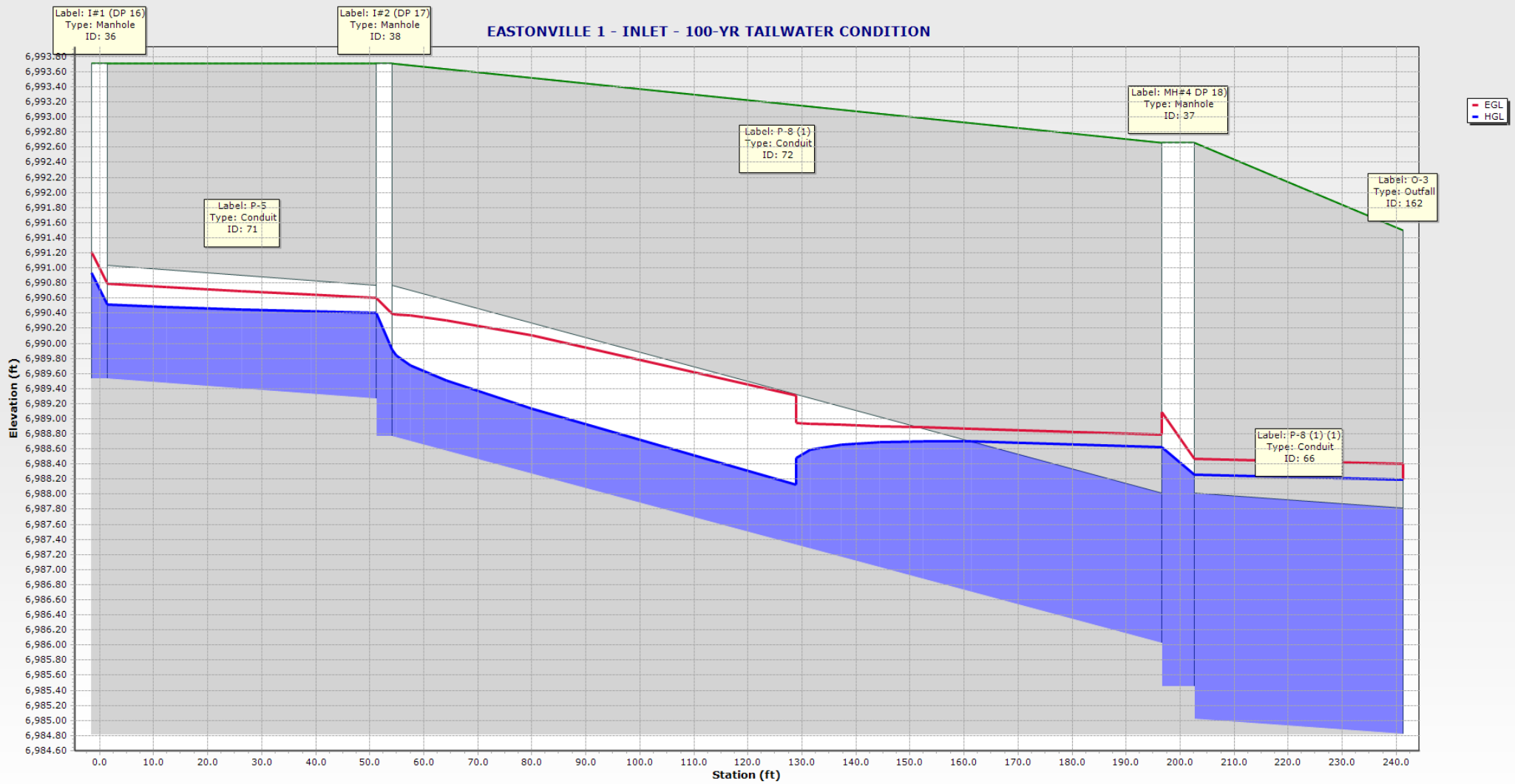
**NOTE: EASTONVILLE 1, 5, & 9 SEGMENTS HAVE BEEN ANALYZED IN THE FREE OUTFALL CONDITION BELOW TO MEET CAPACITY & VELOCITY REQUIREMENTS. SEGMENT 2 PIPES & STRUCTURES INCLUDED IN TABLE, REFER TO FDR FOR COMPLETE ANALYSIS.**

## 100 YEAR TAILWATER CONDITION: STRUCTURE SUMMARY TABLE

	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert in 1) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Hydraulic Grade Line (In) (ft)	Notes
35: MH#7	6,993.84	6,993.84	6,985.68	53.60	6,987.66	Standard	6,988.30	STORM MH
36: I#1 (DP 16)	6,993.71	6,993.71	(N/A)	5.20	6,990.51	Standard	6,990.93	CDOT Type-R
37: MH#4 DP	6,992.66	6,992.66	6,986.02	26.00	6,988.25	Standard	6,988.63	STORM MH
38: I#2 (DP 17)	6,993.71	6,993.71	6,989.27	10.30	6,989.92	Standard	6,990.40	CDOT Type-R
39: MH#6	6,992.82	6,992.82	6,983.61	53.60	6,985.70	Standard	6,986.34	STORM MH
40: MH#5	6,991.57	6,991.57	6,982.59	53.60	6,984.68	Standard	6,985.32	STORM MH
41: MH#3 (DP	6,990.99	6,990.99	6,981.23	56.50	6,983.69	Standard	6,984.42	STORM MH
42: I#3 (DP 7)	6,991.04	6,991.04	(N/A)	53.60	6,988.34	Standard	6,989.83	CDOT Type-D
43: 18 (DP 19)	6,988.70	6,988.70	(N/A)	3.00	6,984.43	Standard	6,984.52	CDOT Type-C
44: MH#2 (DP	6,985.73	6,985.73	6,980.65	56.50	6,982.91	Standard	6,983.58	STORM MH
45: I#4 (DP 13)	6,987.25	6,987.25	(N/A)	3.00	6,984.40	Standard	6,984.54	CDOT Type-R
46: I#5 (DP 14)	6,987.25	6,987.25	6,983.17	5.60	6,983.98	Standard	6,984.38	CDOT Type-R
47: MH#1	6,985.33	6,985.33	6,980.16	56.50	6,982.41	Standard	6,982.52	STORM MH
49: 44 (69) (D	6,982.25	6,982.25	(N/A)	1.20	6,978.83	Standard	6,978.85	CDOT Type-C
55: 44 (80)	6,976.21	6,976.21	6,966.45	13.90	6,967.89	Standard	6,967.92	STORM MH
57: I#7 (DP 9)	6,976.23	6,976.23	6,967.37	9.30	6,969.28	Standard	6,969.92	CDOT Type-R
58: I#8 (DP 10)	6,976.19	6,976.19	6,967.00	13.90	6,968.34	Standard	6,968.86	CDOT Type-R
59: I#6 (DP 1)	6,975.55	6,975.55	(N/A)	3.60	6,969.95	Standard	6,970.04	CDOT Type-c
60: 44 (78) (D	6,967.25	6,967.25	(N/A)	1.40	6,963.84	Standard	6,964.01	CDOT Type-C
120: MH#8	6,995.46	6,995.46	6,986.86	17.20	6,989.30	Standard	6,989.59	STORM MH

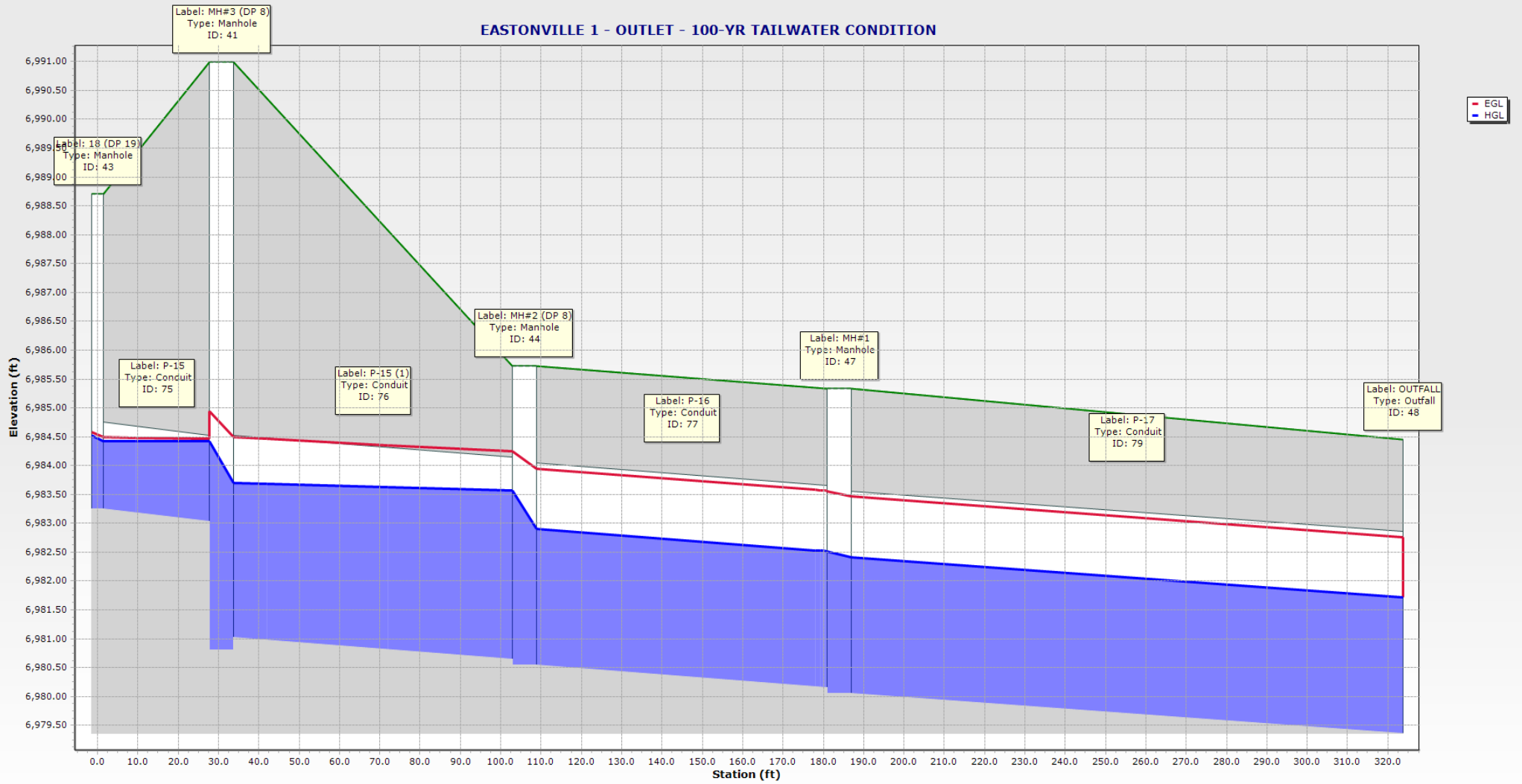
	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)	Notes
48: OUTFALL	6,984.45	6,979.36	Free Outfall		6,981.71	56.50	CDOT FES
53: 44 (70)	6,979.71	6,978.21	Free Outfall		6,978.62	1.20	CDOT FES
64: 44 (79)	6,964.02	6,962.52	Free Outfall		6,962.96	1.40	CDOT FES
162: O-3	6,991.50	6,984.82	User Defined Tailwater	6,988.19	6,988.19	26.00	Dummy Null
164: O-5	6,984.50	6,981.82	User Defined Tailwater	6,982.14	6,982.43	5.60	Dummy Null
165: O-6	6,970.50	6,966.08	User Defined Tailwater	6,967.26	6,967.42	13.90	Dummy Null

**NOTE: EASTONVILLE 1, 5 & 9 SEGMENTS HAVE BEEN ANALYZED IN THE FREE OUTFALL CONDITION BELOW TO MEET CAPACITY & VELOCITY REQUIREMENTS. SEGMENT 2 PIPES & STRUCTURES INCLUDED IN TABLE, REFER TO FDR FOR COMPLETE ANALYSIS.**

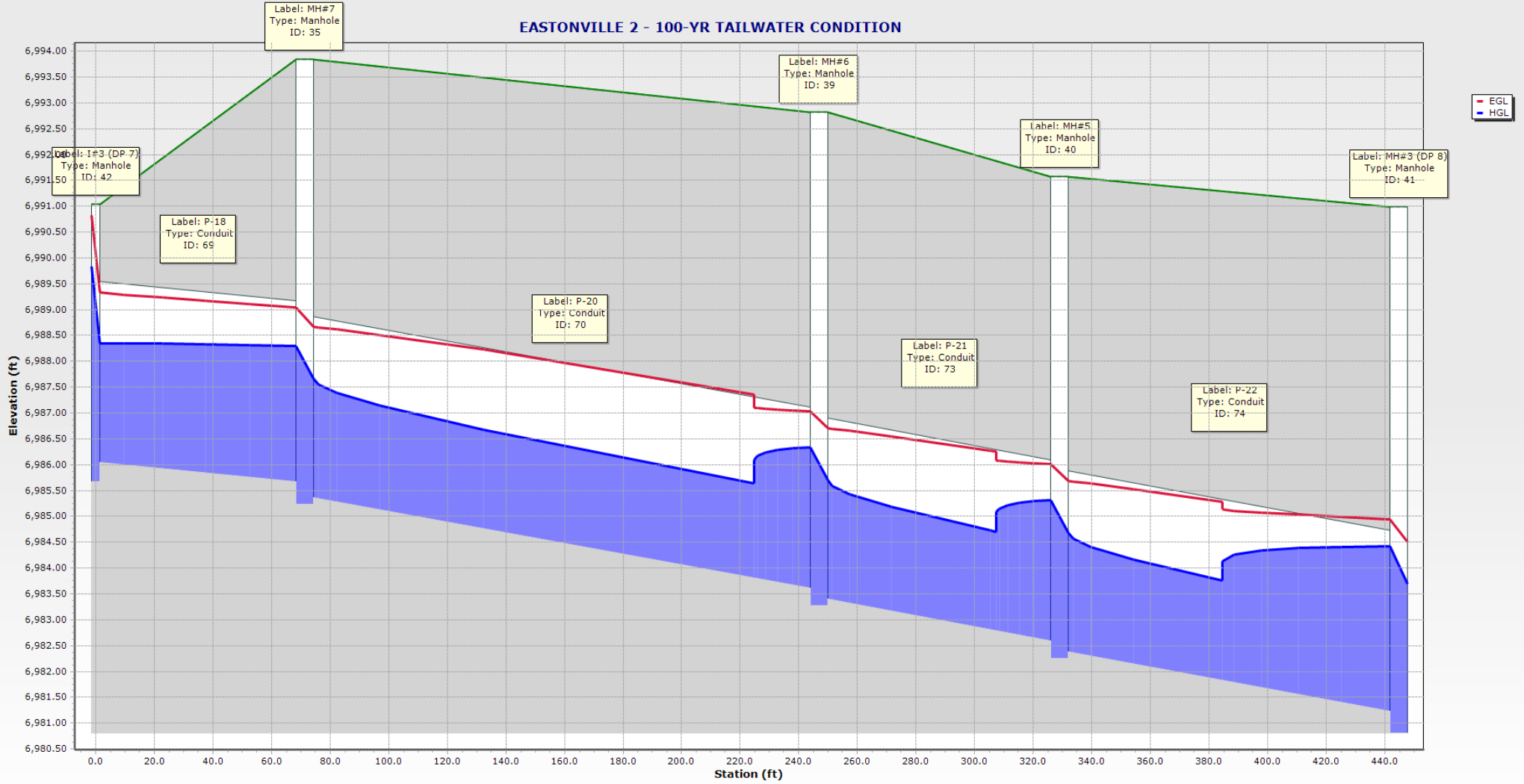


**NOTE: THIS SEGMENT HAS BEEN ANALYZED IN THE FREE  
OUTFALL CONDITION BLEW TO MEET CAPACITY & VELOCITY  
REQUIREMENTS**

### EASTONVILLE 1 - OUTLET - 100-YR TAILWATER CONDITION

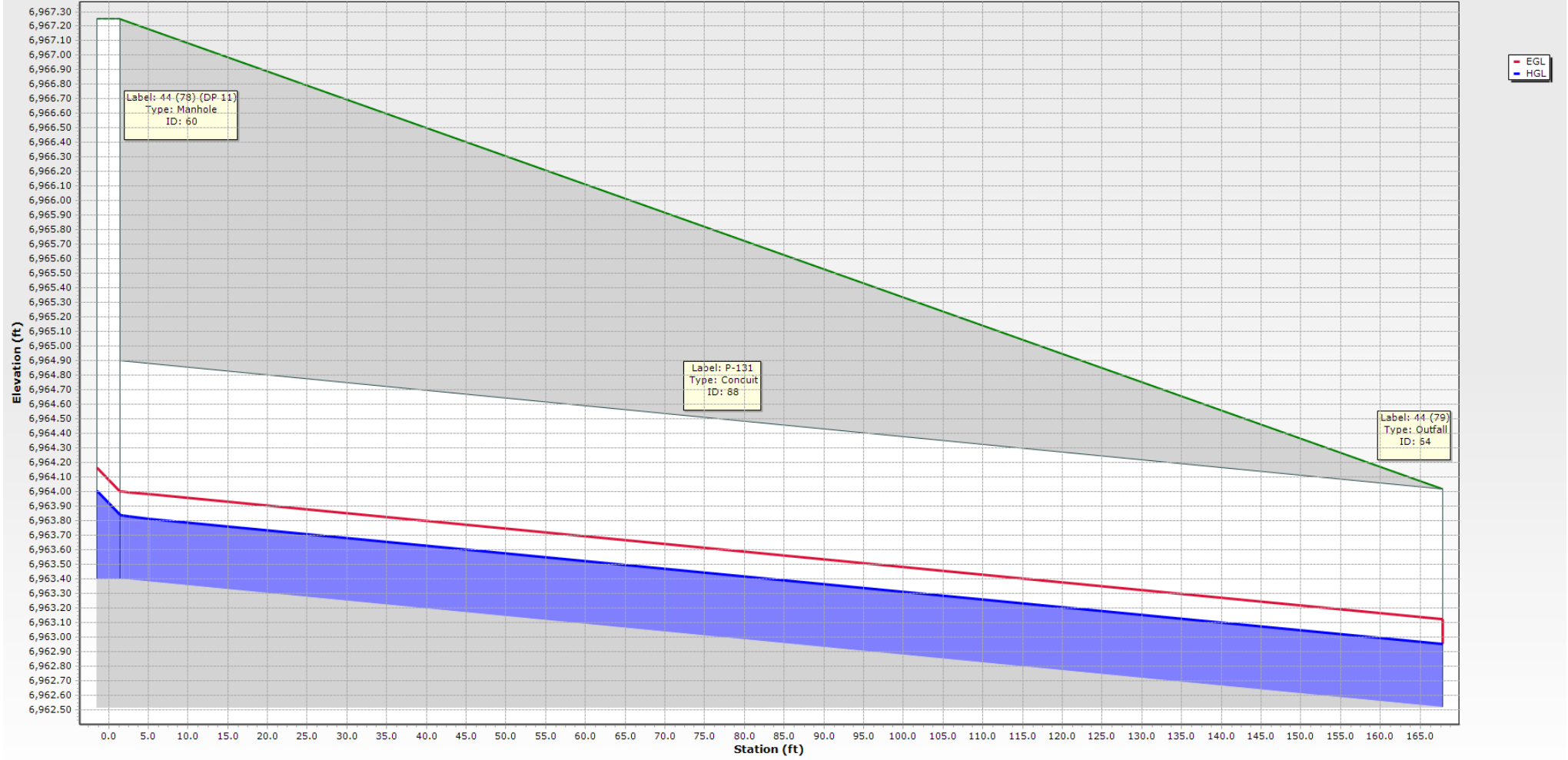


### EASTONVILLE 2 - 100-YR TAILWATER CONDITION

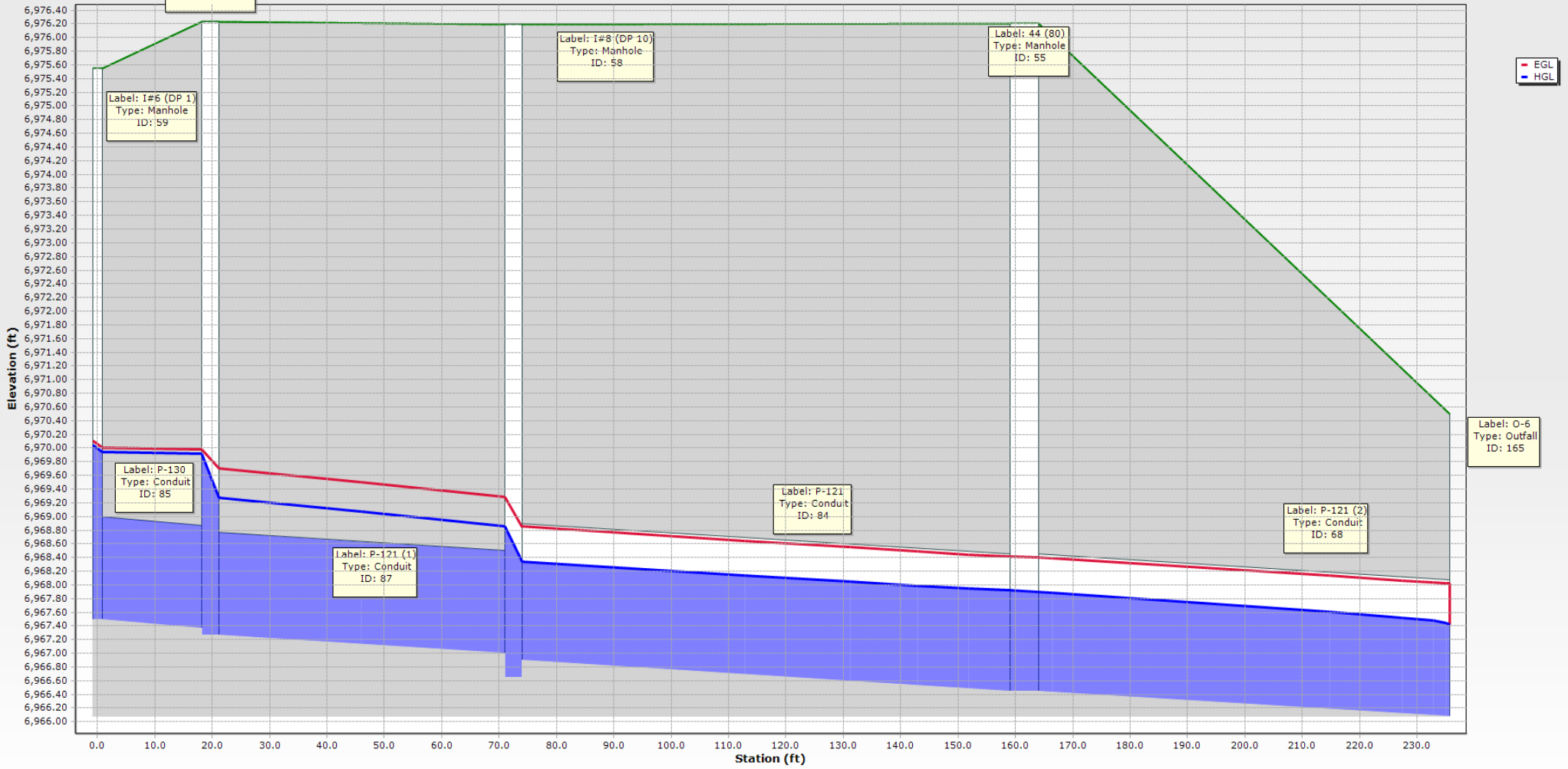




### EASTONVILLE 4 - 100-YR TAILWATER CONDITION

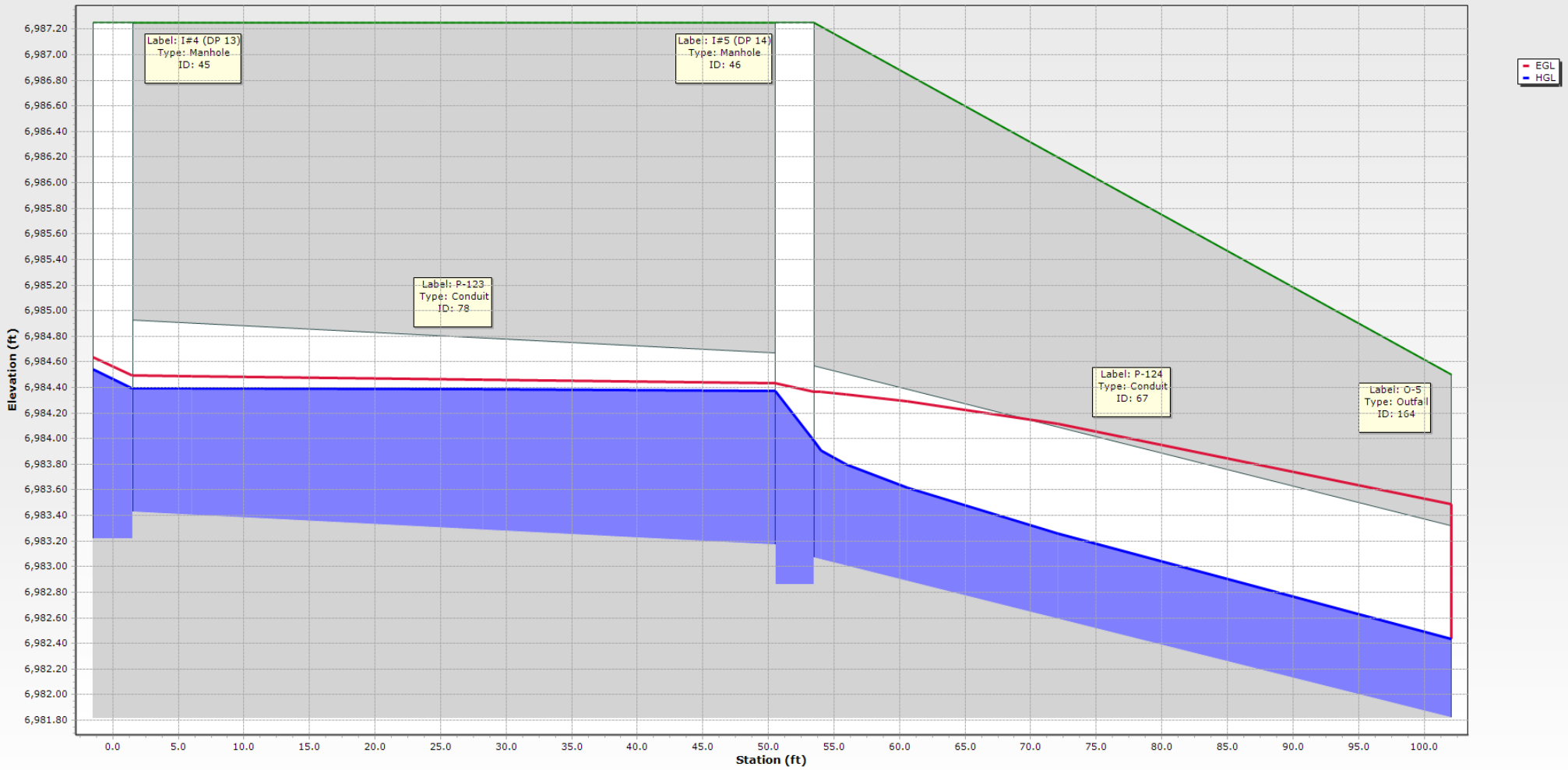


### EASTONVILLE 5 - 100-YR TAILWATER CONDITION



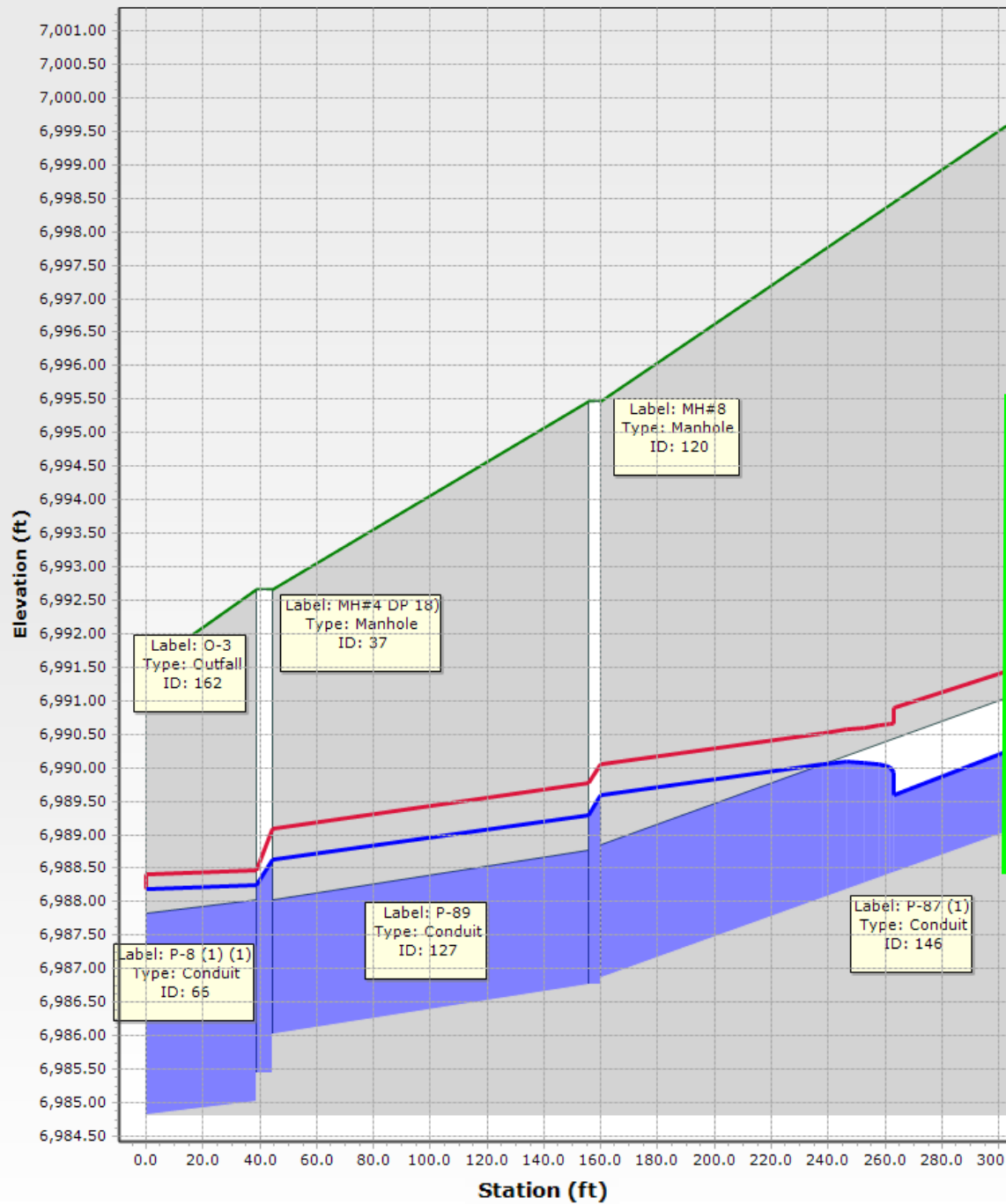
**NOTE: THIS SEGMENT HAS BEEN ANALYZED IN THE FREE  
OUTFALL CONDITION BLEW TO MEET CAPACITY & VELOCITY  
REQUIREMENTS**

### EASTONVILLE 9 - 100-YR TAILWATER CONDITION



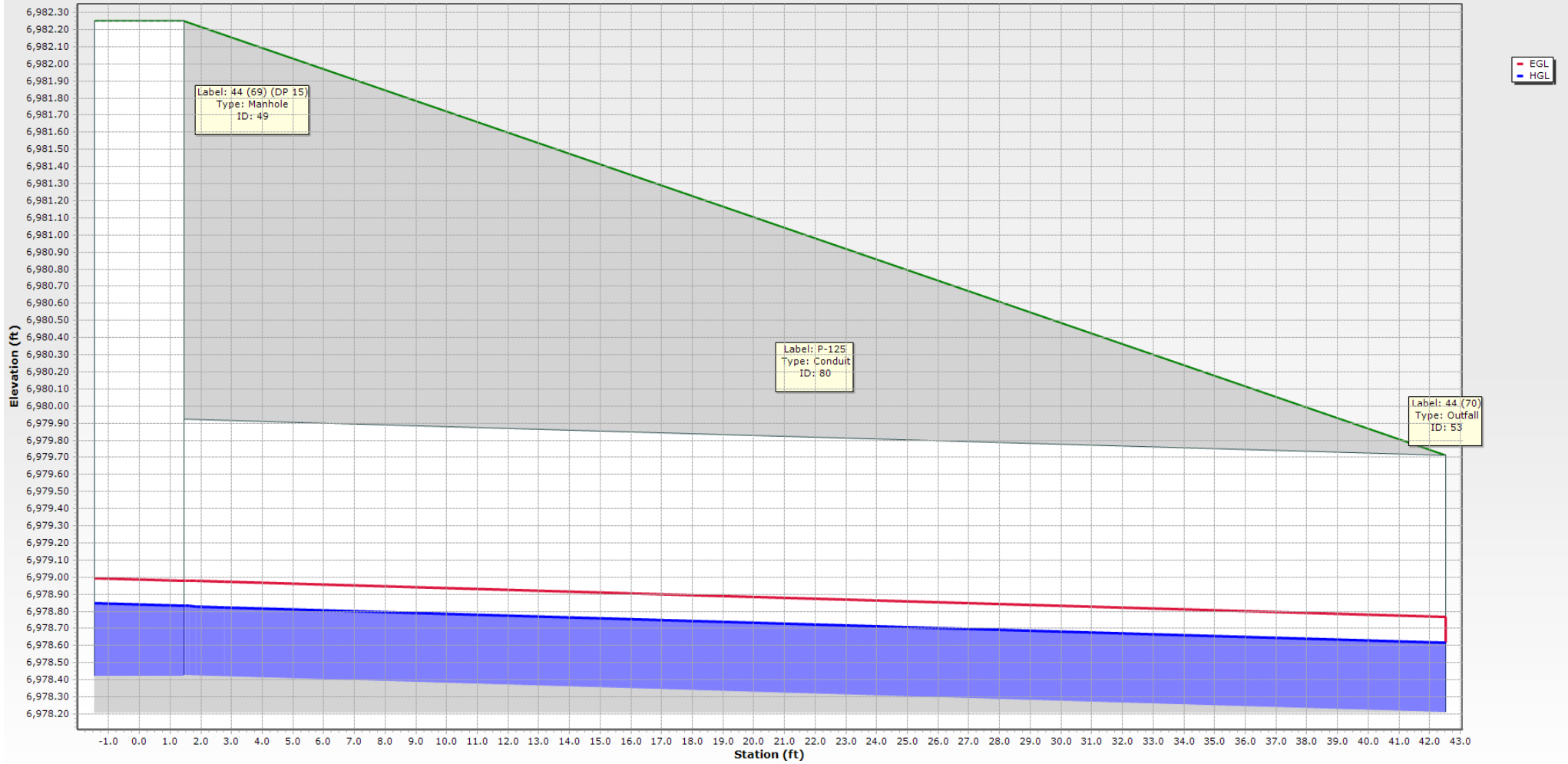
**NOTE: THIS SEGMENT HAS BEEN ANALYZED IN THE FREE  
OUTFALL CONDITION BLEW TO MEET CAPACITY & VELOCITY  
REQUIREMENTS**

# EASTONVILLE 10 - 100-YR TAILWATER CONDITION



MATCHLINE REFER TO SEGMENT 2 FDR

### EASTONVILLE 17 - 100-YR TAILWATER CONDITION



## 5 YEAR TAILWATER CONDITION: PIPE SUMMARY TABLE

	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n
66: P-8 (1) (1)	MH#4 DP 18)	6,985.02	O-3	6,984.82	41.6	0.005	36.0	0.013
67: P-124	I#5 (DP 14)	6,983.07	O-5	6,981.82	50.1	0.025	18.0	0.013
68: P-121 (2)	44 (80)	6,966.45	O-6	6,966.08	74.1	0.005	24.0	0.013
69: P-18	I#3 (DP 7)	6,986.04	MH#7	6,985.68	71.3	0.005	42.0	0.013
70: P-20	MH#7	6,985.37	MH#6	6,983.61	175.6	0.010	42.0	0.013
71: P-5	I#1 (DP 16)	6,989.53	I#2 (DP 17)	6,989.27	52.7	0.005	18.0	0.013
72: P-8 (1)	I#2 (DP 17)	6,988.77	MH#4 DP 18)	6,986.02	147.0	0.019	24.0	0.013
73: P-21	MH#6	6,983.41	MH#5	6,982.59	82.2	0.010	42.0	0.013
74: P-22	MH#5	6,982.39	MH#3 (DP 8)	6,981.23	115.7	0.010	42.0	0.013
75: P-15	18 (DP 19)	6,983.25	MH#3 (DP 8)	6,983.03	30.8	0.007	18.0	0.013
76: P-15 (1)	MH#3 (DP 8)	6,981.03	MH#2 (DP 8)	6,980.65	75.1	0.005	42.0	0.013
77: P-16	MH#2 (DP 8)	6,980.55	MH#1	6,980.16	78.1	0.005	42.0	0.013
78: P-123	I#4 (DP 13)	6,983.43	I#5 (DP 14)	6,983.17	52.0	0.005	18.0	0.013
79: P-17	MH#1	6,980.06	OUTFALL	6,979.36	139.8	0.005	42.0	0.013
80: P-125	44 (69) (DP 15)	6,978.42	44 (70)	6,978.21	42.5	0.005	18.0	0.013
84: P-121	I#8 (DP 10)	6,966.90	44 (80)	6,966.45	89.0	0.005	24.0	0.013
85: P-130	I#6 (DP 1)	6,967.50	I#7 (DP 9)	6,967.37	19.6	0.007	18.0	0.013
87: P-121 (1)	I#7 (DP 9)	6,967.27	I#8 (DP 10)	6,967.00	53.0	0.005	18.0	0.013
88: P-131	44 (78) (DP 11)	6,963.40	44 (79)	6,962.52	167.9	0.005	18.0	0.013
127: P-89	MH#8	6,986.76	MH#4 DP 18)	6,986.02	116.1	0.006	24.0	0.013
146: P-87 (1)	MH#9	6,989.76	MH#8	6,986.86	193.5	0.015	24.0	0.013

	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
66: P-8 (1) (1)	15.50	5.89	46.25	33.5	6,987.08	6,987.07
67: P-124	3.30	7.32	16.60	19.9	6,983.76	6,982.27
68: P-121 (2)	5.40	4.59	15.98	33.8	6,967.27	6,966.99
69: P-18	8.00	4.91	71.48	11.2	6,986.89	6,986.47
70: P-20	8.00	6.26	100.73	7.9	6,986.22	6,984.28
71: P-5	3.10	3.99	7.38	42.0	6,990.21	6,989.99
72: P-8 (1)	6.20	7.69	30.94	20.0	6,989.65	6,987.32
73: P-21	8.00	6.25	100.49	8.0	6,984.26	6,983.26
74: P-22	8.00	6.26	100.72	7.9	6,983.24	6,982.18
75: P-15	0.40	2.54	8.88	4.5	6,983.48	6,983.25
76: P-15 (1)	8.40	4.98	71.57	11.7	6,981.90	6,981.62
77: P-16	8.40	4.96	71.10	11.8	6,981.42	6,980.97
78: P-123	1.80	3.46	7.43	24.2	6,984.04	6,984.03
79: P-17	8.40	4.96	71.18	11.8	6,980.94	6,980.17
80: P-125	0.03	1.03	7.45	0.4	6,978.49	6,978.27
84: P-121	5.40	4.61	16.08	33.6	6,967.72	6,967.29
85: P-130	0.50	2.64	8.55	5.8	6,968.35	6,968.35
87: P-121 (1)	3.30	4.11	7.50	44.0	6,968.06	6,968.03
88: P-131	0.40	2.28	7.61	5.3	6,963.63	6,962.75
127: P-89	10.20	5.92	18.06	56.5	6,987.90	6,987.32
146: P-87 (1)	10.20	8.15	27.70	36.8	6,990.90	6,988.20

**NOTE: EASTONVILLE 1, 5 & 9 SEGMENTS HAVE BEEN ANALYZED IN THE FREE OUTFALL CONDITION BELOW TO MEET CAPACITY & VELOCITY REQUIREMENTS. SEGMENT 2 PIPES & STRUCTURES INCLUDED IN TABLE, REFER TO FDR FOR COMPLETE ANALYSIS.**

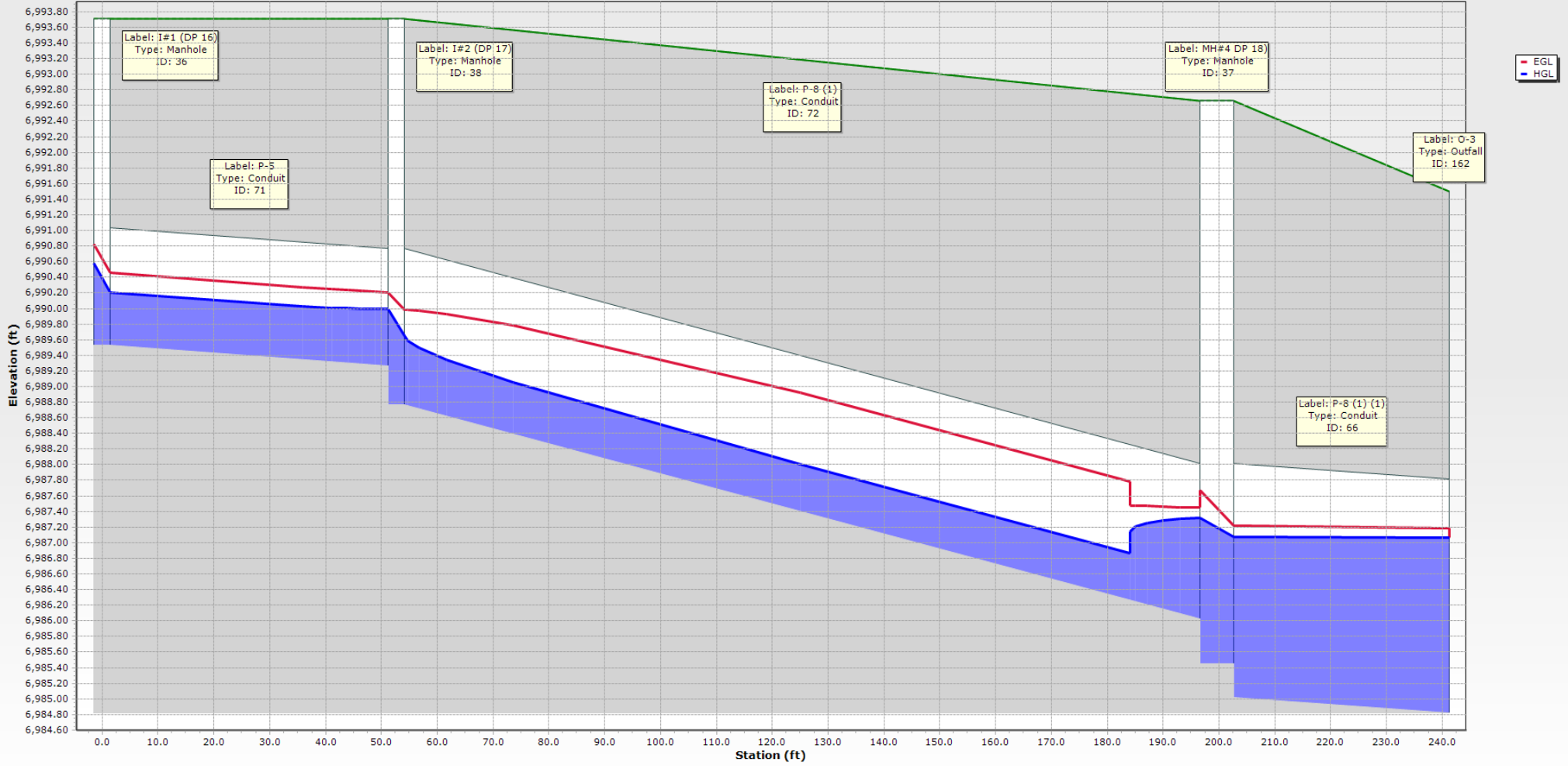
## 5 YEAR TAILWATER CONDITION: STRUCTURE SUMMARY TABLE

	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert in 1) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Hydraulic Grade Line (In) (ft)	Notes
35: MH#7	6,993.84	6,993.84	6,985.68	8.00	6,986.22	Standard	6,986.42	STORM MH
36: I#1 (DP 16)	6,993.71	6,993.71	(N/A)	3.10	6,990.21	Standard	6,990.58	CDOT Type-R
37: MH#4 DP	6,992.66	6,992.66	6,986.02	15.50	6,987.08	Standard	6,987.32	STORM MH
38: I#2 (DP 17)	6,993.71	6,993.71	6,989.27	6.20	6,989.65	Standard	6,989.99	CDOT Type-R
39: MH#6	6,992.82	6,992.82	6,983.61	8.00	6,984.26	Standard	6,984.46	STORM MH
40: MH#5	6,991.57	6,991.57	6,982.59	8.00	6,983.24	Standard	6,983.44	STORM MH
41: MH#3 (DP	6,990.99	6,990.99	6,981.23	8.40	6,981.90	Standard	6,982.18	STORM MH
42: I#3 (DP 7)	6,991.04	6,991.04	(N/A)	8.00	6,986.89	Standard	6,987.35	CDOT Type-D
43: 18 (DP 19)	6,988.70	6,988.70	(N/A)	0.40	6,983.48	Standard	6,983.60	CDOT Type-C
44: MH#2 (DP	6,985.73	6,985.73	6,980.65	8.40	6,981.42	Standard	6,981.62	STORM MH
45: I#4 (DP 13)	6,987.25	6,987.25	(N/A)	1.80	6,984.04	Standard	6,984.21	CDOT Type-R
46: I#5 (DP 14)	6,987.25	6,987.25	6,983.17	3.30	6,983.76	Standard	6,984.03	CDOT Type-R
47: MH#1	6,985.33	6,985.33	6,980.16	8.40	6,980.94	Standard	6,980.97	STORM MH
49: 44 (69) (D	6,982.25	6,982.25	(N/A)	0.03	6,978.49	Standard	6,978.49	CDOT Type-C
55: 44 (80)	6,976.21	6,976.21	6,966.45	5.40	6,967.27	Standard	6,967.29	STORM MH
57: I#7 (DP 9)	6,976.23	6,976.23	6,967.37	3.30	6,968.06	Standard	6,968.35	CDOT Type-R
58: I#8 (DP 10)	6,976.19	6,976.19	6,967.00	5.40	6,967.72	Standard	6,968.03	CDOT Type-R
59: I#6 (DP 1)	6,975.55	6,975.55	(N/A)	0.50	6,968.35	Standard	6,968.35	CDOT Type-c
60: 44 (78) (D	6,967.25	6,967.25	(N/A)	0.40	6,963.63	Standard	6,963.72	CDOT Type-C
120: MH#8	6,995.46	6,995.46	6,986.86	10.20	6,987.90	Standard	6,988.20	STORM MH

	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)	Notes
48: OUTFALL	6,984.45	6,979.36	Free Outfall		6,980.17	8.40	CDOT FES
53: 44 (70)	6,979.71	6,978.21	Free Outfall		6,978.27	0.03	CDOT FES
64: 44 (79)	6,964.02	6,962.52	Free Outfall		6,962.75	0.40	CDOT FES
162: O-3	6,991.50	6,984.82	User Defined Tailwater	6,987.07	6,987.07	15.50	Dummy Null
164: O-5	6,984.50	6,981.82	User Defined Tailwater	6,981.93	6,982.27	3.30	Dummy Null
165: O-6	6,970.50	6,966.08	User Defined Tailwater	6,966.99	6,966.99	5.40	Dummy Null

**NOTE: EASTONVILLE 1, 5 & 9 SEGMENTS HAVE BEEN ANALYZED IN THE FREE OUTFALL CONDITION BELOW TO MEET CAPACITY & VELOCITY REQUIREMENTS. SEGMENT 2 PIPES & STRUCTURES INCLUDED IN TABLE, REFER TO FDR FOR COMPLETE ANALYSIS.**

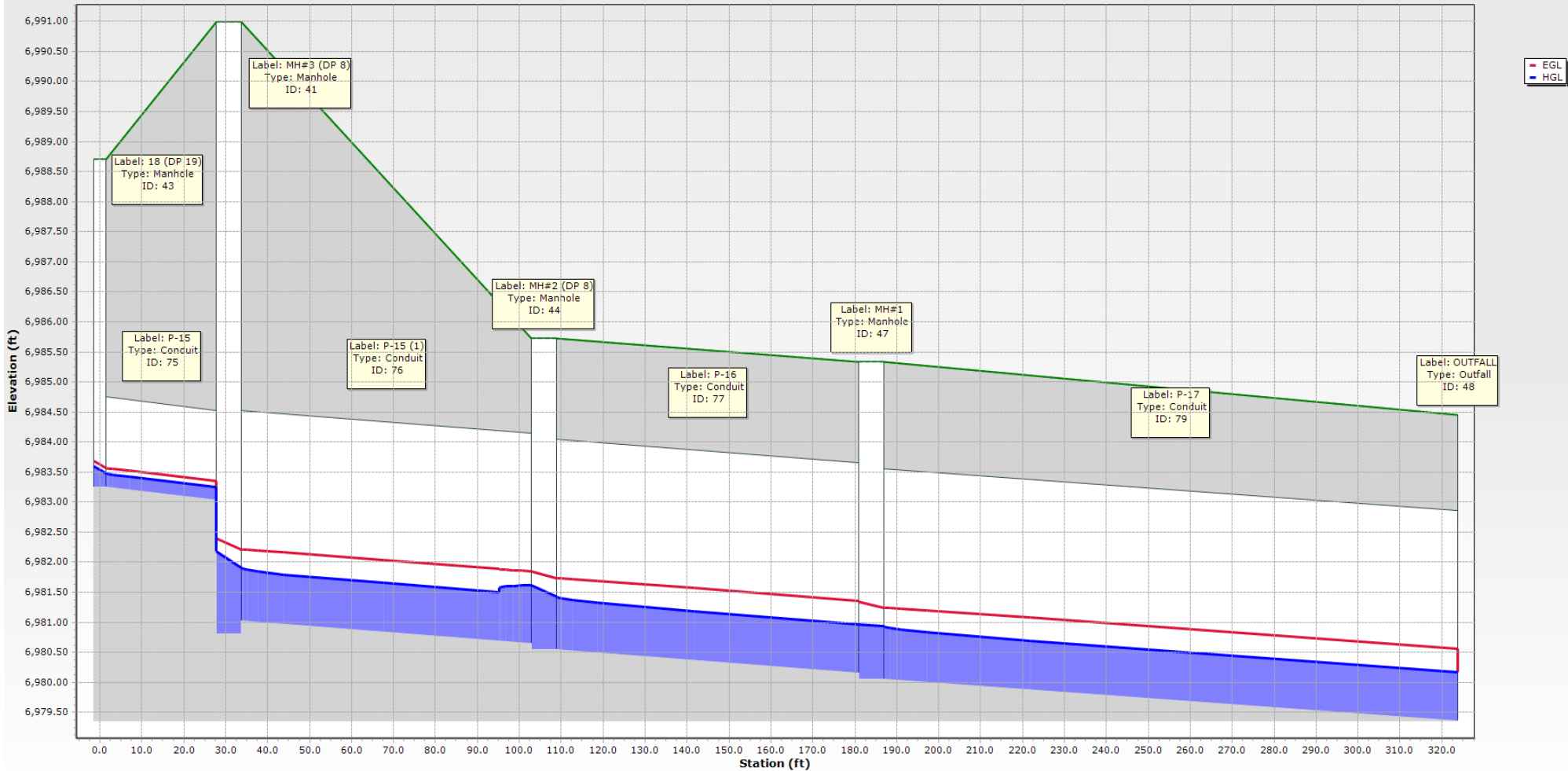
EASTONVILLE 1 - INLET - 5-YR TAILWATER CONDITION



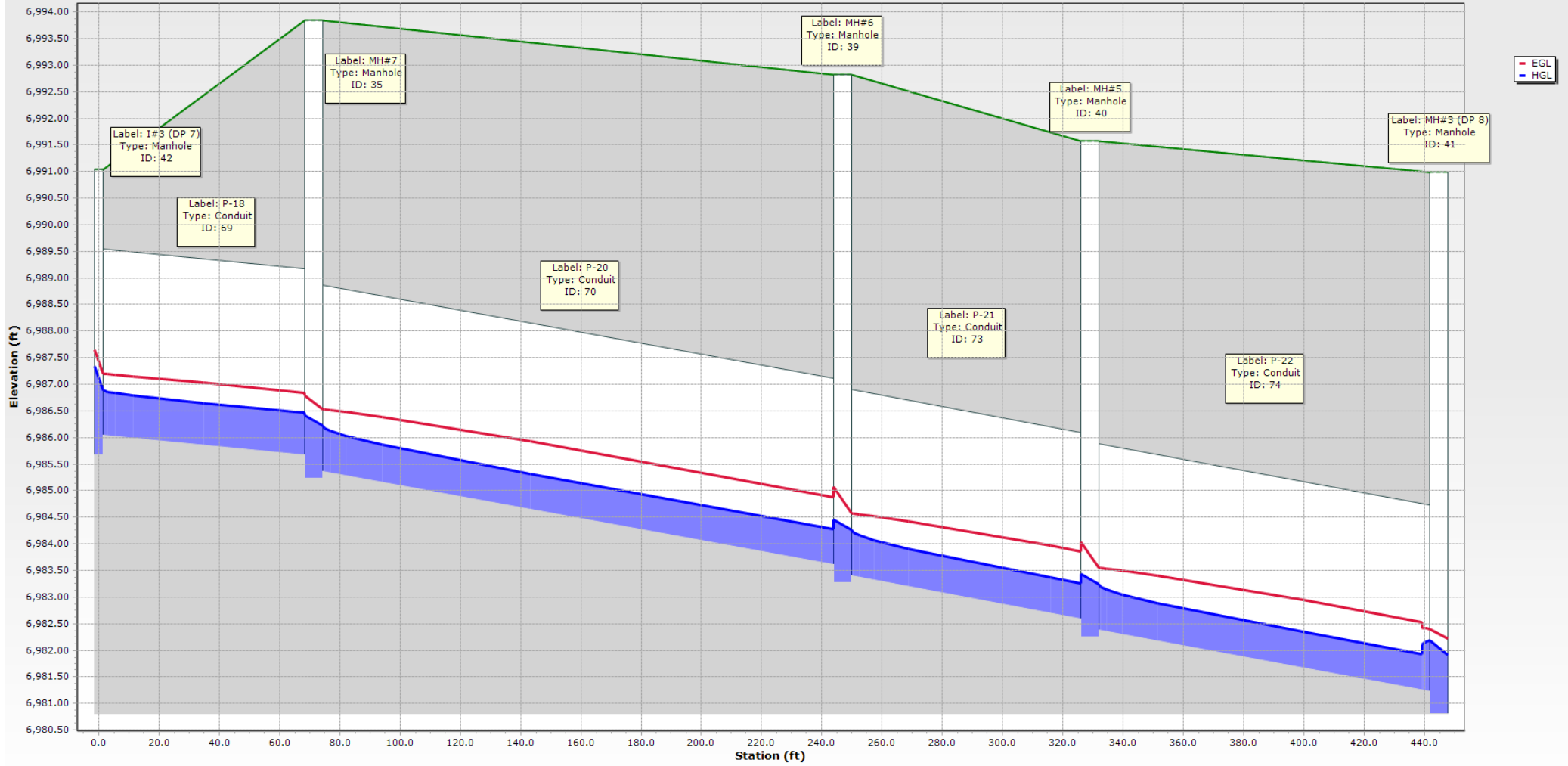
**NOTE: THIS SEGMENT HAS BEEN ANALYZED IN THE FREE  
OUTFALL CONDITION BLEW TO MEET CAPACITY & VELOCITY  
REQUIREMENTS**



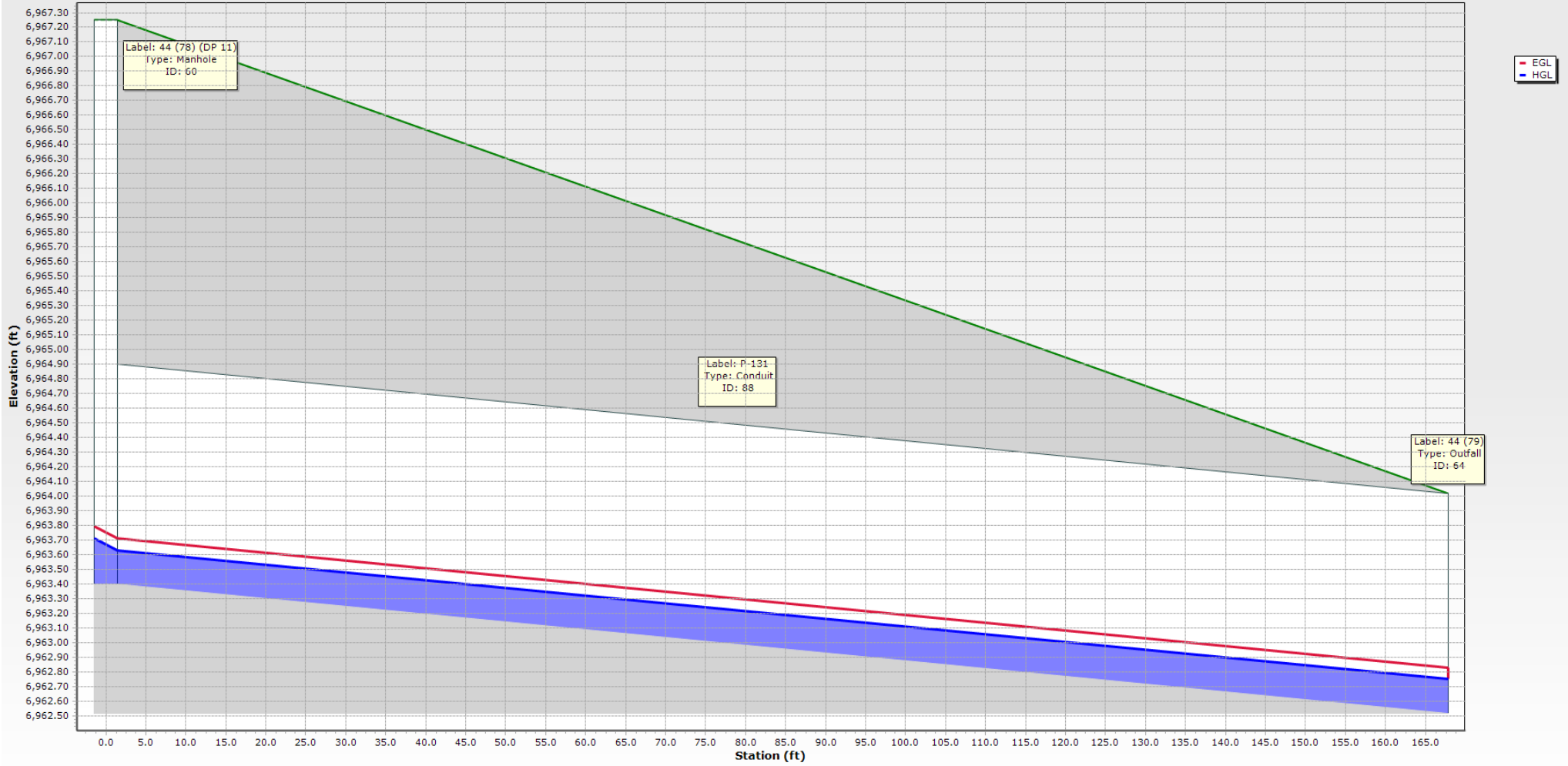
EASTONVILLE 1 - OUTLET - 5-YR TAILWATER CONDITION



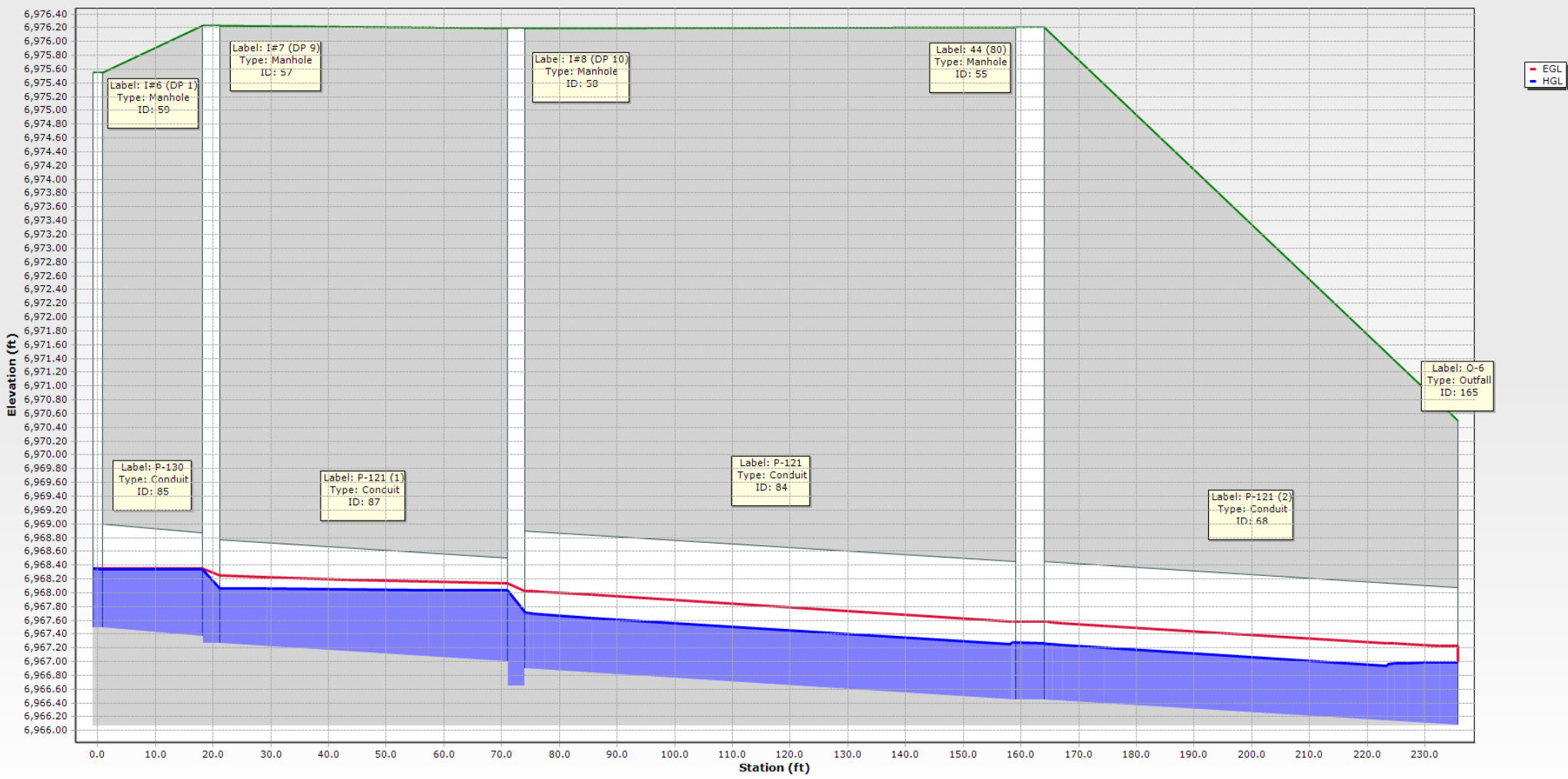
### EASTONVILLE 2 - 5-YR TAILWATER CONDITION



### EASTONVILLE 4 - 5-YR TAILWATER CONDITION

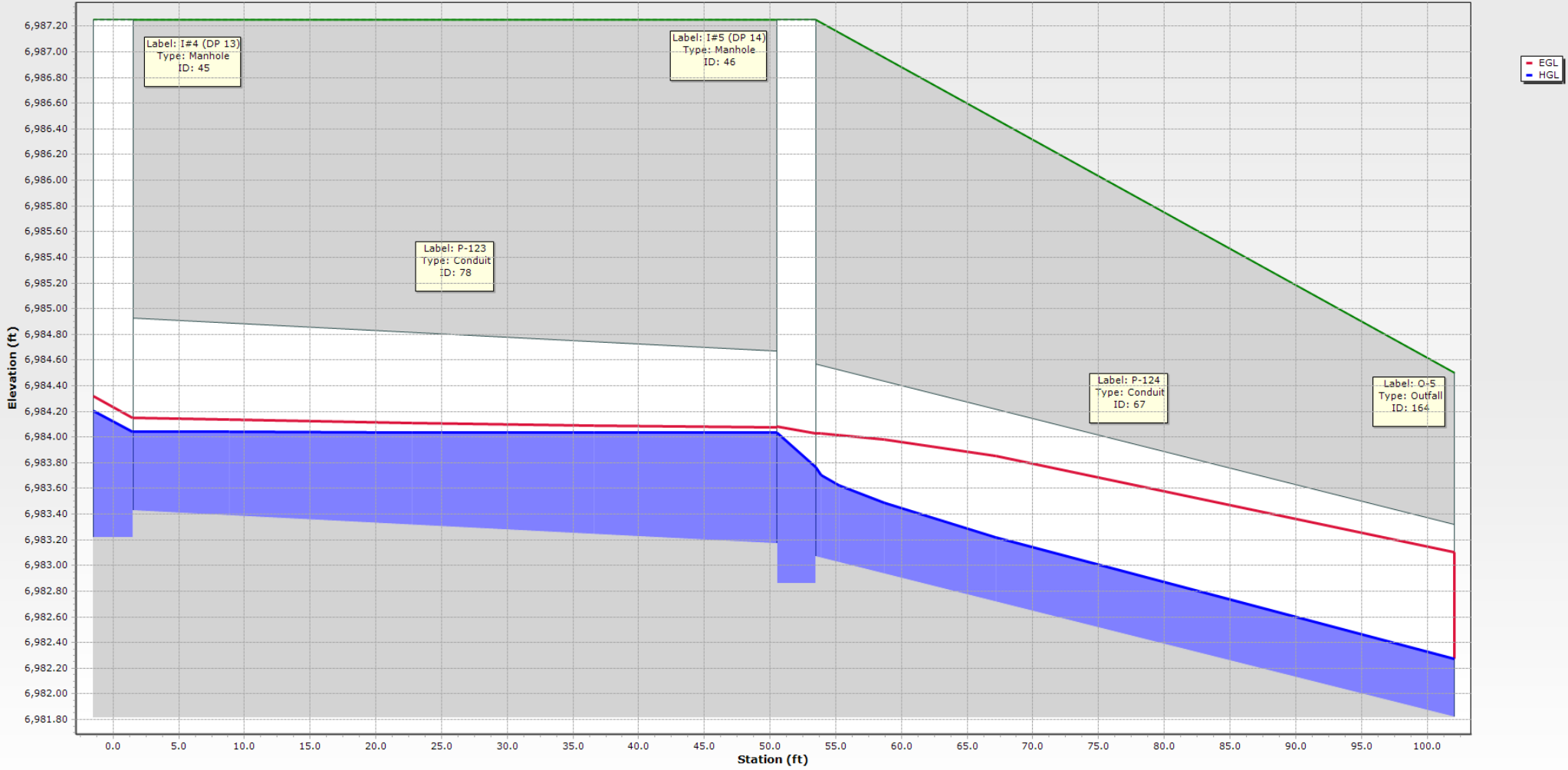


**EASTONVILLE 5 - 5-YR TAILWATER CONDITION**



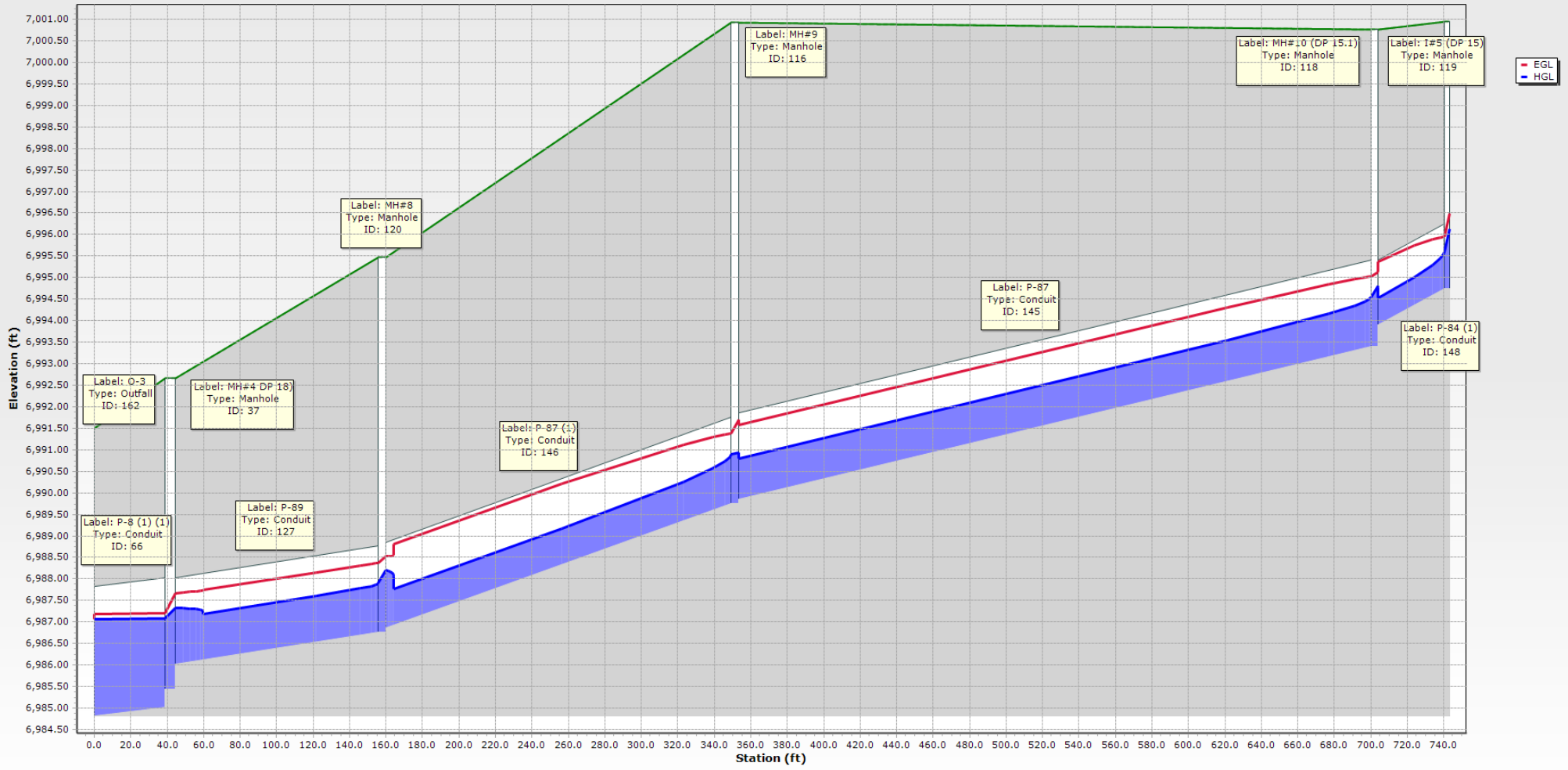
**NOTE: THIS SEGMENT HAS BEEN ANALYZED IN THE FREE  
OUTFALL CONDITION BLEW TO MEET CAPACITY & VELOCITY  
REQUIREMENTS**

EASTONVILLE 9 - 5-YR TAILWATER CONDITION

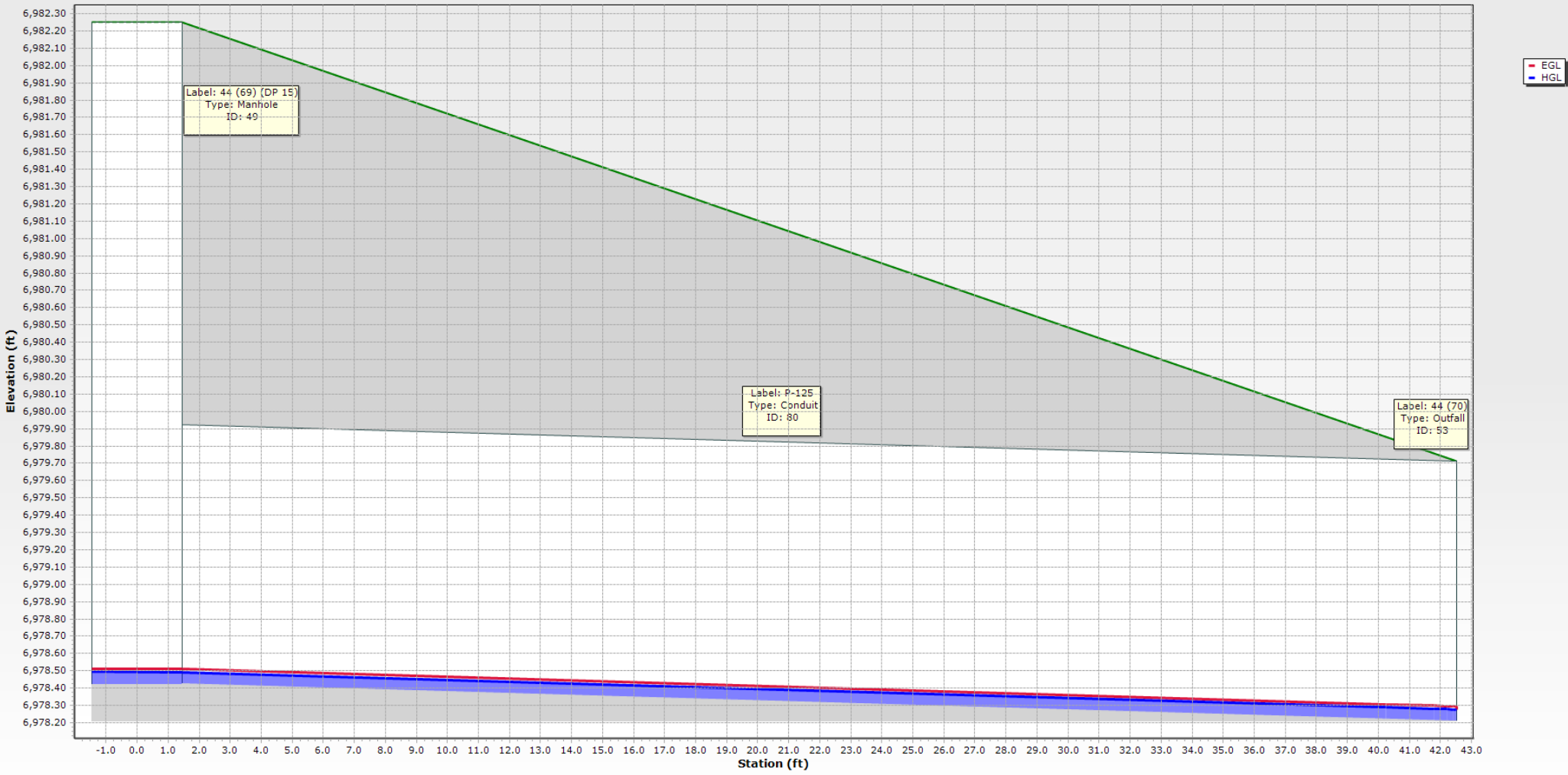


**NOTE: THIS SEGMENT HAS BEEN ANALYZED IN THE FREE  
OUTFALL CONDITION BLEW TO MEET CAPACITY & VELOCITY  
REQUIREMENTS**

EASTONVILLE 10 - 5-YR TAILWATER CONDITION



EASTONVILLE 17 - 5-YR TAILWATER CONDITION



## 100 YEAR FREE OUTFALL CONDITION: PIPE SUMMARY TABLE

	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n
66: P-8 (1) (1)	MH#4 DP 18)	6,985.02	O-3	6,984.82	41.6	0.005	36.0	0.013
67: P-124	I#5 (DP 14)	6,983.07	O-5	6,981.82	50.1	0.025	18.0	0.013
68: P-121 (2)	44 (80)	6,966.45	O-6	6,966.08	74.1	0.005	24.0	0.013
69: P-18	I#3 (DP 7)	6,986.04	MH#7	6,985.68	71.3	0.005	42.0	0.013
70: P-20	MH#7	6,985.37	MH#6	6,983.61	175.6	0.010	42.0	0.013
71: P-5	I#1 (DP 16)	6,989.53	I#2 (DP 17)	6,989.27	52.7	0.005	18.0	0.013
72: P-8 (1)	I#2 (DP 17)	6,988.77	MH#4 DP 18)	6,986.02	147.0	0.019	24.0	0.013
73: P-21	MH#6	6,983.41	MH#5	6,982.59	82.2	0.010	42.0	0.013
74: P-22	MH#5	6,982.39	MH#3 (DP 8)	6,981.23	115.7	0.010	42.0	0.013
75: P-15	18 (DP 19)	6,983.25	MH#3 (DP 8)	6,983.03	30.8	0.007	18.0	0.013
76: P-15 (1)	MH#3 (DP 8)	6,981.03	MH#2 (DP 8)	6,980.65	75.1	0.005	42.0	0.013
77: P-16	MH#2 (DP 8)	6,980.55	MH#1	6,980.16	78.1	0.005	42.0	0.013
78: P-123	I#4 (DP 13)	6,983.43	I#5 (DP 14)	6,983.17	52.0	0.005	18.0	0.013
79: P-17	MH#1	6,980.06	OUTFALL	6,979.36	139.8	0.005	42.0	0.013
80: P-125	44 (69) (DP 15)	6,978.42	44 (70)	6,978.21	42.5	0.005	18.0	0.013
84: P-121	I#8 (DP 10)	6,966.90	44 (80)	6,966.45	89.0	0.005	24.0	0.013
85: P-130	I#6 (DP 1)	6,967.50	I#7 (DP 9)	6,967.37	19.6	0.007	18.0	0.013
87: P-121 (1)	I#7 (DP 9)	6,967.27	I#8 (DP 10)	6,967.00	53.0	0.005	18.0	0.013
88: P-131	44 (78) (DP 11)	6,963.40	44 (79)	6,962.52	167.9	0.005	18.0	0.013
127: P-89	MH#8	6,986.76	MH#4 DP 18)	6,986.02	116.1	0.006	24.0	0.013
146: P-87 (1)	MH#9	6,989.76	MH#8	6,986.86	193.5	0.015	24.0	0.013

	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
66: P-8 (1) (1)	26.00	6.73	46.25	56.2	6,986.67	6,986.43
67: P-124	5.60	8.48	16.60	33.7	6,983.98	6,982.43
68: P-121 (2)	13.90	5.73	15.98	87.0	6,967.89	6,967.42
69: P-18	53.60	8.15	71.48	75.0	6,988.34	6,988.30
70: P-20	53.60	10.63	100.73	53.2	6,987.66	6,986.34
71: P-5	5.20	4.52	7.38	70.5	6,990.51	6,990.40
72: P-8 (1)	10.30	8.86	30.94	33.3	6,989.92	6,987.84
73: P-21	53.60	10.61	100.49	53.3	6,985.70	6,985.32
74: P-22	53.60	10.63	100.72	53.2	6,984.68	6,984.42
75: P-15	2.90	4.50	8.88	32.7	6,984.43	6,984.42
76: P-15 (1)	56.50	8.24	71.57	78.9	6,983.69	6,983.58
77: P-16	56.50	8.20	71.10	79.5	6,982.91	6,982.52
78: P-123	3.00	3.98	7.43	40.4	6,984.40	6,984.38
79: P-17	56.50	8.21	71.18	79.4	6,982.41	6,981.71
80: P-125	1.00	2.94	7.45	13.4	6,978.80	6,978.58
84: P-121	13.90	5.76	16.08	86.4	6,968.34	6,967.92
85: P-130	3.60	2.04	8.55	42.1	6,969.95	6,969.92
87: P-121 (1)	9.30	5.26	7.50	124.0	6,969.28	6,968.86
88: P-131	4.60	4.51	7.61	60.5	6,964.24	6,963.34
127: P-89	17.20	6.54	18.06	95.3	6,988.35	6,987.84
146: P-87 (1)	17.20	9.29	27.70	62.1	6,991.26	6,988.76

**NOTE: SEE PROFILES FOR PIPES STUDIED WITH THIS ANALYSIS**



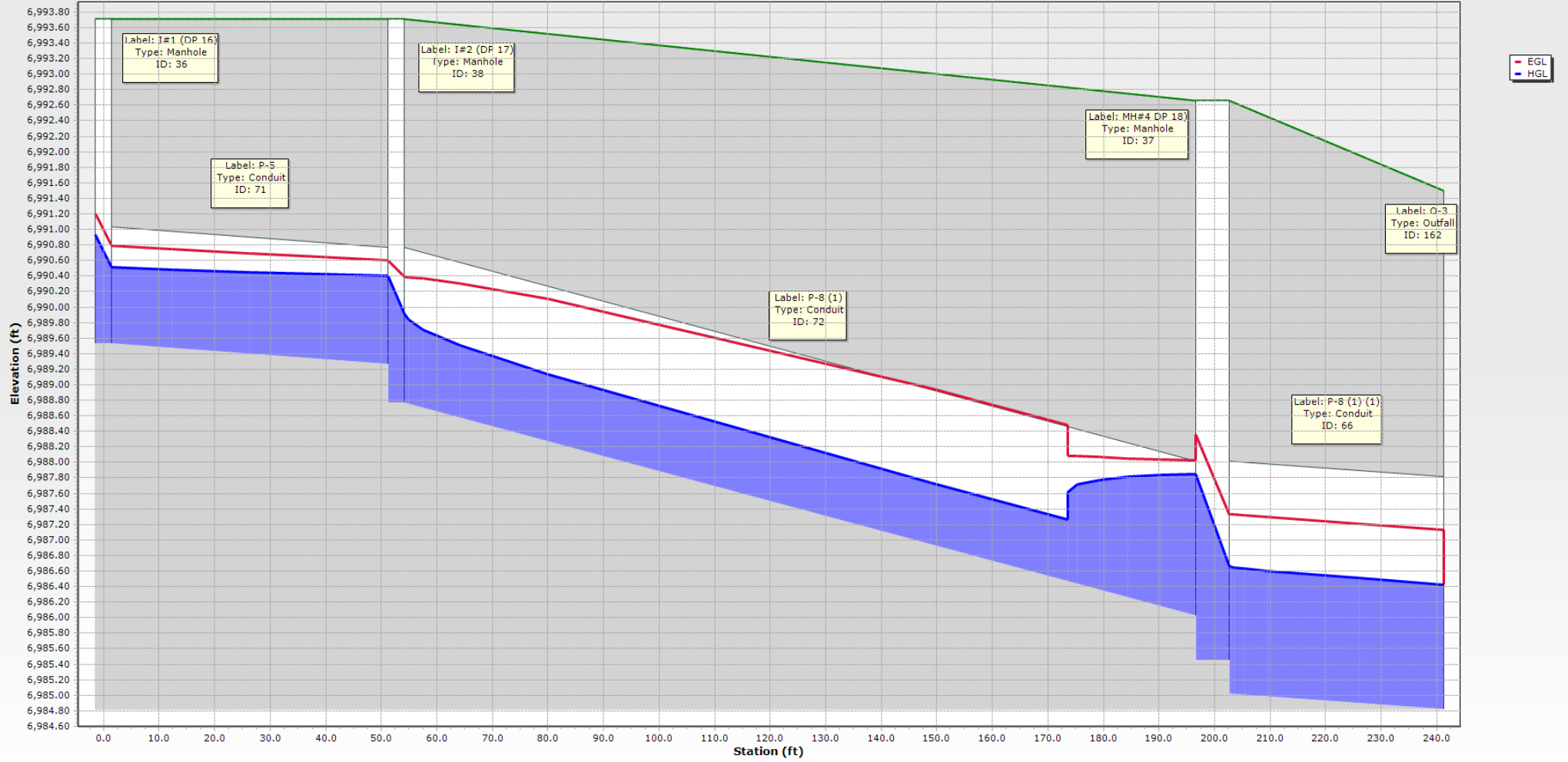
## 100 YEAR FREE OUTFALL CONDITION: STRUCTURE SUMMARY TABLE

	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert in 1) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Hydraulic Grade Line (In) (ft)	Notes
35: MH#7	6,993.84	6,993.84	6,985.68	53.60	6,987.66	Standard	6,988.30	STORM MH
36: I#1 (DP 16)	6,993.71	6,993.71	(N/A)	5.20	6,990.51	Standard	6,990.93	CDOT Type-R
37: MH#4 DP	6,992.66	6,992.66	6,986.02	26.00	6,986.67	Standard	6,987.84	STORM MH
38: I#2 (DP 17)	6,993.71	6,993.71	6,989.27	10.30	6,989.92	Standard	6,990.40	CDOT Type-R
39: MH#6	6,992.82	6,992.82	6,983.61	53.60	6,985.70	Standard	6,986.34	STORM MH
40: MH#5	6,991.57	6,991.57	6,982.59	53.60	6,984.68	Standard	6,985.32	STORM MH
41: MH#3 (DP)	6,990.99	6,990.99	6,981.23	56.50	6,983.69	Standard	6,984.42	STORM MH
42: I#3 (DP 7)	6,991.04	6,991.04	(N/A)	53.60	6,988.34	Standard	6,989.83	CDOT Type-D
43: 18 (DP 19)	6,988.70	6,988.70	(N/A)	2.90	6,984.43	Standard	6,984.51	CDOT Type-C
44: MH#2 (DP)	6,985.73	6,985.73	6,980.65	56.50	6,982.91	Standard	6,983.58	STORM MH
45: I#4 (DP 13)	6,987.25	6,987.25	(N/A)	3.00	6,984.40	Standard	6,984.54	CDOT Type-R
46: I#5 (DP 14)	6,987.25	6,987.25	6,983.17	5.60	6,983.98	Standard	6,984.38	CDOT Type-R
47: MH#1	6,985.33	6,985.33	6,980.16	56.50	6,982.41	Standard	6,982.52	STORM MH
49: 44 (69) (D)	6,982.25	6,982.25	(N/A)	1.00	6,978.80	Standard	6,978.81	CDOT Type-C
55: 44 (80)	6,976.21	6,976.21	6,966.45	13.90	6,967.89	Standard	6,967.92	STORM MH
57: I#7 (DP 9)	6,976.23	6,976.23	6,967.37	9.30	6,969.28	Standard	6,969.92	CDOT Type-R
58: I#8 (DP 10)	6,976.19	6,976.19	6,967.00	13.90	6,968.34	Standard	6,968.86	CDOT Type-R
59: I#6 (DP 1)	6,975.55	6,975.55	(N/A)	3.60	6,969.95	Standard	6,970.04	CDOT Type-c
60: 44 (78) (D)	6,967.25	6,967.25	(N/A)	4.60	6,964.24	Standard	6,964.56	CDOT Type-C
120: MH#8	6,995.46	6,995.46	6,986.86	17.20	6,988.35	Standard	6,988.76	STORM MH

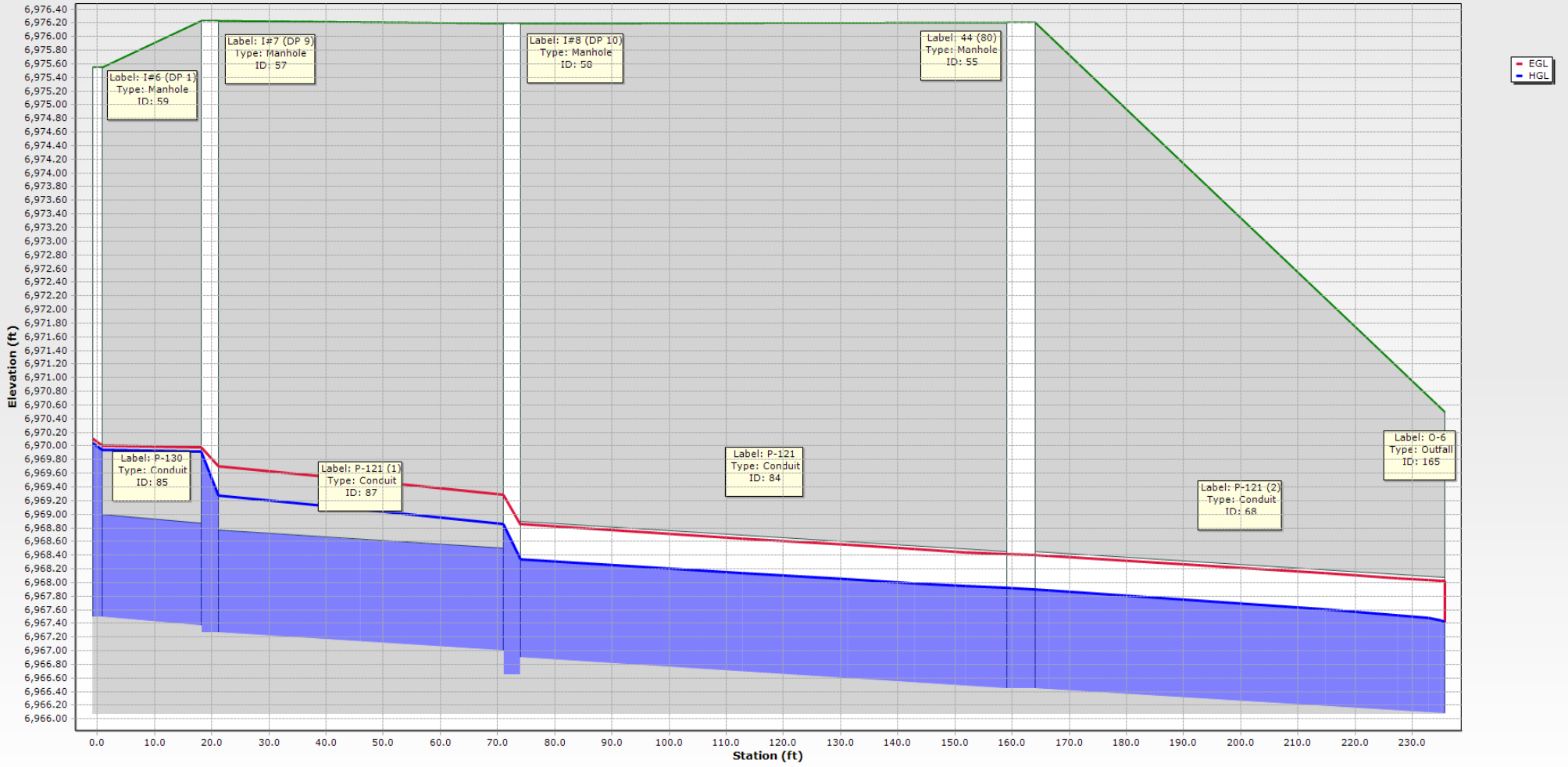
	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)	Notes
48: OUTFALL	6,984.45	6,979.36	Free Outfall		6,981.71	56.50	CDOT FES
53: 44 (70)	6,979.71	6,978.21	Free Outfall		6,978.58	1.00	CDOT FES
64: 44 (79)	6,964.02	6,962.52	Free Outfall		6,963.34	4.60	CDOT FES
162: O-3	6,991.50	6,984.82	Free Outfall		6,986.43	26.00	Dummy Null
164: O-5	6,984.50	6,981.82	Free Outfall		6,982.43	5.60	Dummy Null
165: O-6	6,970.50	6,966.08	Free Outfall		6,967.42	13.90	Dummy Null

**NOTE: SEE PROFILES FOR PIPES STUDIED WITH THIS ANALYSIS**

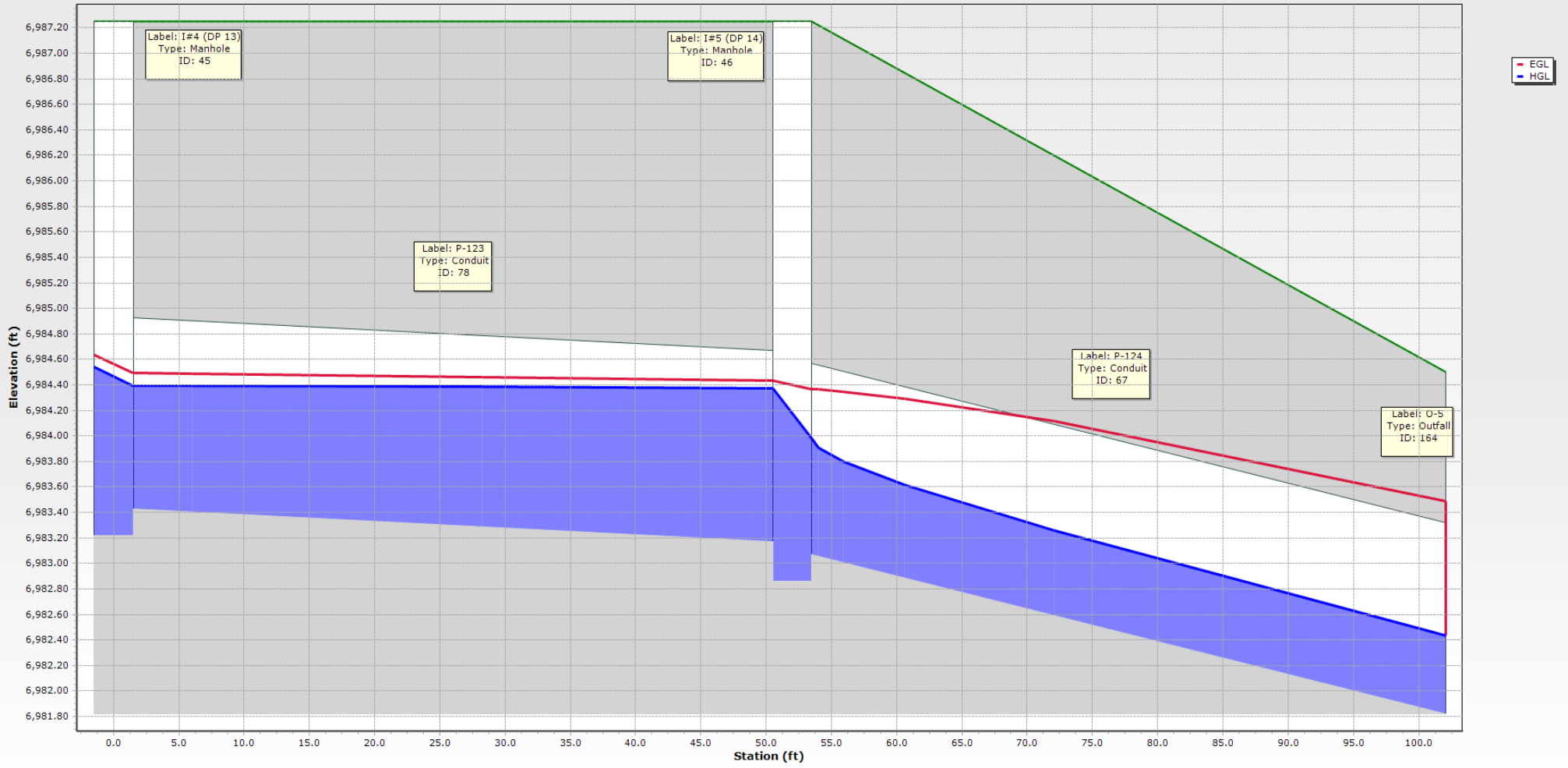
### EASTONVILLE 1 - INLET - 100-YR FREE OUTFALL CONDITION



### EASTONVILLE 5 - 100-YR FREE OUTFALL CONDITION



### EASTONVILLE 9 - 100-YR FREE OUTFALL CONDITION



## 5 YEAR FREE OUTFALL CONDITION: PIPE SUMMARY TABLE

	Start Node	Invert (Start) (ft)	Stop Node	Invert (Stop) (ft)	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n
66: P-8 (1) (1)	MH#4 DP 18)	6,985.02	O-3	6,984.82	41.6	0.005	36.0	0.013
67: P-124	I#5 (DP 14)	6,983.07	O-5	6,981.82	50.1	0.025	18.0	0.013
68: P-121 (2)	44 (80)	6,966.45	O-6	6,966.08	74.1	0.005	24.0	0.013
69: P-18	I#3 (DP 7)	6,986.04	MH#7	6,985.68	71.3	0.005	42.0	0.013
70: P-20	MH#7	6,985.37	MH#6	6,983.61	175.6	0.010	42.0	0.013
71: P-5	I#1 (DP 16)	6,989.53	I#2 (DP 17)	6,989.27	52.7	0.005	18.0	0.013
72: P-8 (1)	I#2 (DP 17)	6,988.77	MH#4 DP 18)	6,986.02	147.0	0.019	24.0	0.013
73: P-21	MH#6	6,983.41	MH#5	6,982.59	82.2	0.010	42.0	0.013
74: P-22	MH#5	6,982.39	MH#3 (DP 8)	6,981.23	115.7	0.010	42.0	0.013
75: P-15	18 (DP 19)	6,983.25	MH#3 (DP 8)	6,983.03	30.8	0.007	18.0	0.013
76: P-15 (1)	MH#3 (DP 8)	6,981.03	MH#2 (DP 8)	6,980.65	75.1	0.005	42.0	0.013
77: P-16	MH#2 (DP 8)	6,980.55	MH#1	6,980.16	78.1	0.005	42.0	0.013
78: P-123	I#4 (DP 13)	6,983.43	I#5 (DP 14)	6,983.17	52.0	0.005	18.0	0.013
79: P-17	MH#1	6,980.06	OUTFALL	6,979.36	139.8	0.005	42.0	0.013
80: P-125	44 (69) (DP 15)	6,978.42	44 (70)	6,978.21	42.5	0.005	18.0	0.013
84: P-121	I#8 (DP 10)	6,966.90	44 (80)	6,966.45	89.0	0.005	24.0	0.013
85: P-130	I#6 (DP 1)	6,967.50	I#7 (DP 9)	6,967.37	19.6	0.007	18.0	0.013
87: P-121 (1)	I#7 (DP 9)	6,967.27	I#8 (DP 10)	6,967.00	53.0	0.005	18.0	0.013
88: P-131	44 (78) (DP 11)	6,963.40	44 (79)	6,962.52	167.9	0.005	18.0	0.013
127: P-89	MH#8	6,986.76	MH#4 DP 18)	6,986.02	116.1	0.006	24.0	0.013
146: P-87 (1)	MH#9	6,989.76	MH#8	6,986.86	193.5	0.015	24.0	0.013

	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
66: P-8 (1) (1)	15.50	5.89	46.25	33.5	6,986.28	6,986.02
67: P-124	3.30	7.32	16.60	19.9	6,983.76	6,982.27
68: P-121 (2)	5.40	4.59	15.98	33.8	6,967.27	6,966.88
69: P-18	8.00	4.91	71.48	11.2	6,986.89	6,986.47
70: P-20	8.00	6.26	100.73	7.9	6,986.22	6,984.28
71: P-5	3.10	3.99	7.38	42.0	6,990.21	6,989.99
72: P-8 (1)	6.20	7.69	30.94	20.0	6,989.65	6,986.63
73: P-21	8.00	6.25	100.49	8.0	6,984.26	6,983.26
74: P-22	8.00	6.26	100.72	7.9	6,983.24	6,982.18
75: P-15	0.40	2.54	8.88	4.5	6,983.48	6,983.25
76: P-15 (1)	8.40	4.98	71.57	11.7	6,981.90	6,981.62
77: P-16	8.40	4.96	71.10	11.8	6,981.42	6,980.97
78: P-123	1.80	3.46	7.43	24.2	6,984.04	6,984.03
79: P-17	8.40	4.96	71.18	11.8	6,980.94	6,980.17
80: P-125	0.03	1.03	7.45	0.4	6,978.49	6,978.27
84: P-121	5.40	4.61	16.08	33.6	6,967.72	6,967.29
85: P-130	0.50	2.64	8.55	5.8	6,968.35	6,968.35
87: P-121 (1)	3.30	4.11	7.50	44.0	6,968.06	6,968.03
88: P-131	0.40	2.28	7.61	5.3	6,963.63	6,962.75
127: P-89	10.20	5.92	18.06	56.5	6,987.90	6,987.10
146: P-87 (1)	10.20	8.15	27.70	36.8	6,990.90	6,988.20

**NOTE: SEE PROFILES FOR PIPES STUDIED WITH THIS ANALYSIS**

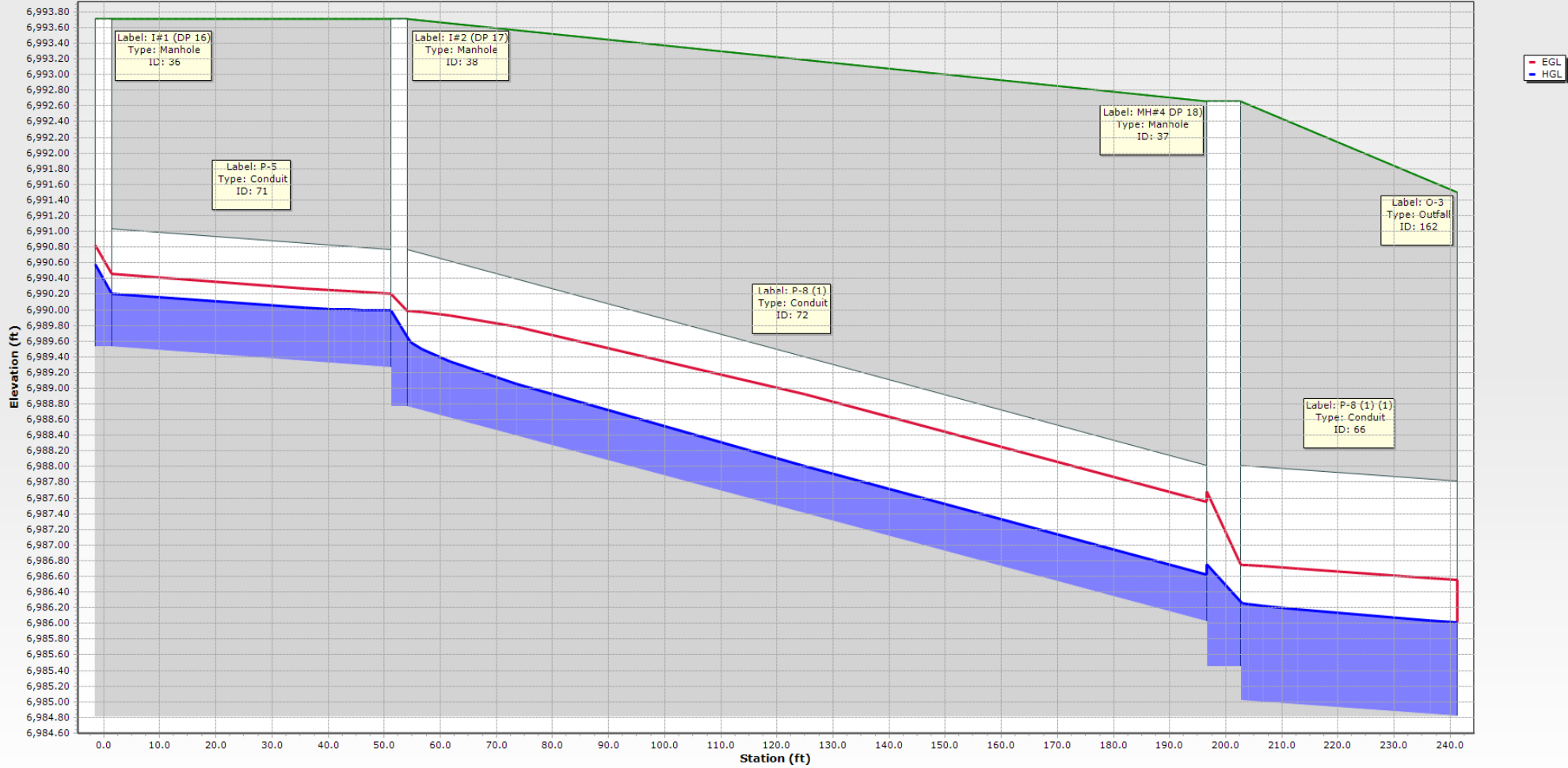
## 5 YEAR FREE OUTFALL CONDITION: STRUCTURE SUMMARY TABLE

	Elevation (Ground) (ft)	Elevation (Rim) (ft)	Elevation (Invert in 1) (ft)	Flow (Total Out) (cfs)	Hydraulic Grade Line (Out) (ft)	Headloss Method	Hydraulic Grade Line (In) (ft)	Notes
35: MH#7	6,993.84	6,993.84	6,985.68	8.00	6,986.22	Standard	6,986.42	STORM MH
36: I#1 (DP 16)	6,993.71	6,993.71	(N/A)	3.10	6,990.21	Standard	6,990.58	CDOT Type-R
37: MH#4 DP	6,992.66	6,992.66	6,986.02	15.50	6,986.28	Standard	6,986.76	STORM MH
38: I#2 (DP 17)	6,993.71	6,993.71	6,989.27	6.20	6,989.65	Standard	6,989.99	CDOT Type-R
39: MH#6	6,992.82	6,992.82	6,983.61	8.00	6,984.26	Standard	6,984.46	STORM MH
40: MH#5	6,991.57	6,991.57	6,982.59	8.00	6,983.24	Standard	6,983.44	STORM MH
41: MH#3 (DP	6,990.99	6,990.99	6,981.23	8.40	6,981.90	Standard	6,982.18	STORM MH
42: I#3 (DP 7)	6,991.04	6,991.04	(N/A)	8.00	6,986.89	Standard	6,987.35	CDOT Type-D
43: 18 (DP 19)	6,988.70	6,988.70	(N/A)	0.40	6,983.48	Standard	6,983.60	CDOT Type-C
44: MH#2 (DP	6,985.73	6,985.73	6,980.65	8.40	6,981.42	Standard	6,981.62	STORM MH
45: I#4 (DP 13)	6,987.25	6,987.25	(N/A)	1.80	6,984.04	Standard	6,984.21	CDOT Type-R
46: I#5 (DP 14)	6,987.25	6,987.25	6,983.17	3.30	6,983.76	Standard	6,984.03	CDOT Type-R
47: MH#1	6,985.33	6,985.33	6,980.16	8.40	6,980.94	Standard	6,980.97	STORM MH
49: 44 (69) (D	6,982.25	6,982.25	(N/A)	0.03	6,978.49	Standard	6,978.49	CDOT Type-C
55: 44 (80)	6,976.21	6,976.21	6,966.45	5.40	6,967.27	Standard	6,967.29	STORM MH
57: I#7 (DP 9)	6,976.23	6,976.23	6,967.37	3.30	6,968.06	Standard	6,968.35	CDOT Type-R
58: I#8 (DP 10)	6,976.19	6,976.19	6,967.00	5.40	6,967.72	Standard	6,968.03	CDOT Type-R
59: I#6 (DP 1)	6,975.55	6,975.55	(N/A)	0.50	6,968.35	Standard	6,968.35	CDOT Type-c
60: 44 (78) (D	6,967.25	6,967.25	(N/A)	0.40	6,963.63	Standard	6,963.72	CDOT Type-C
120: MH#8	6,995.46	6,995.46	6,986.86	10.20	6,987.90	Standard	6,988.20	STORM MH

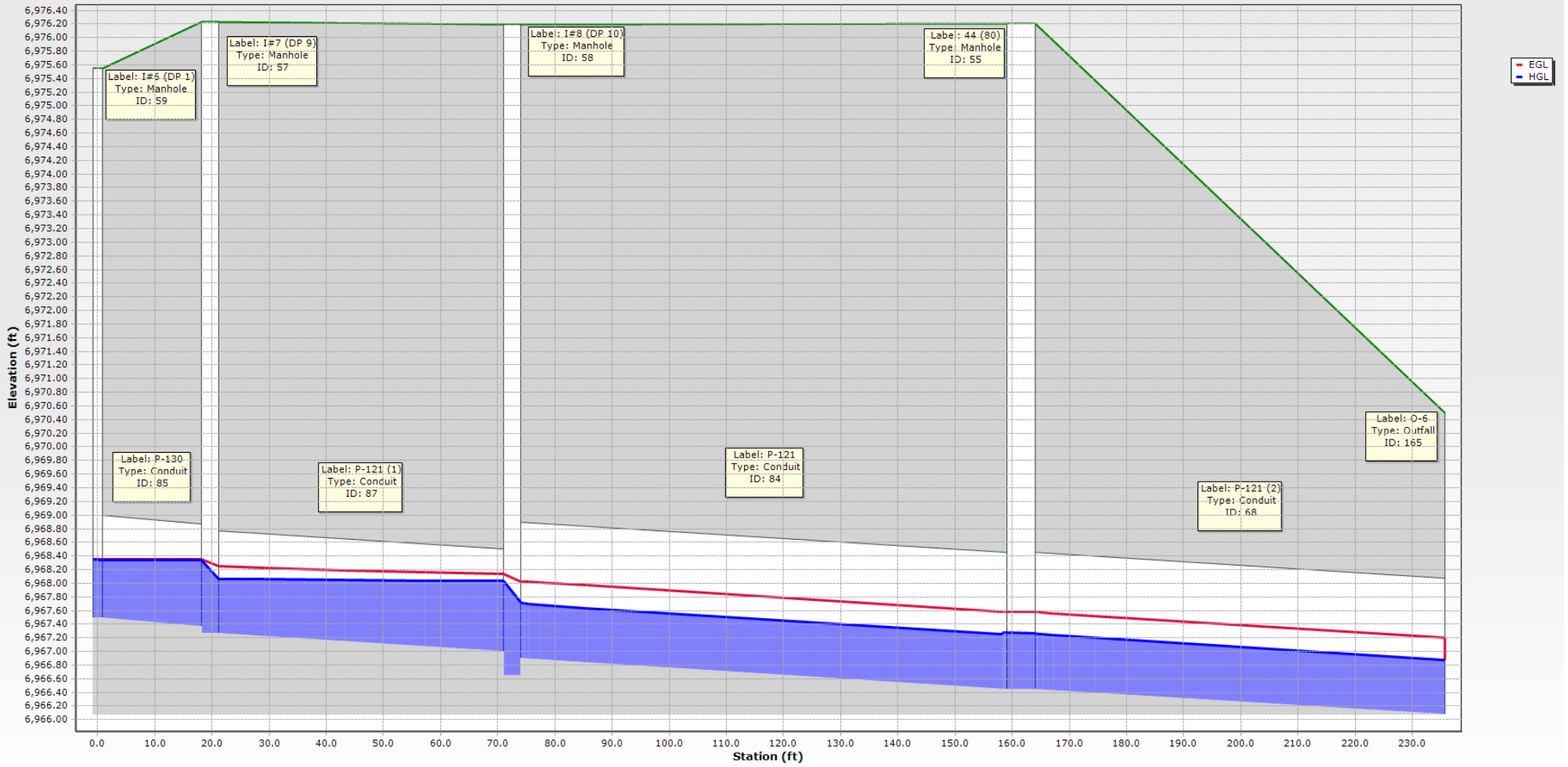
	Elevation (Ground) (ft)	Elevation (Invert) (ft)	Boundary Condition Type	Elevation (User Defined Tailwater) (ft)	Hydraulic Grade (ft)	Flow (Total Out) (cfs)	Notes
48: OUTFALL	6,984.45	6,979.36	Free Outfall		6,980.17	8.40	CDOT FES
53: 44 (70)	6,979.71	6,978.21	Free Outfall		6,978.27	0.03	CDOT FES
64: 44 (79)	6,964.02	6,962.52	Free Outfall		6,962.75	0.40	CDOT FES
162: O-3	6,991.50	6,984.82	Free Outfall		6,986.02	15.50	Dummy Null
164: O-5	6,984.50	6,981.82	Free Outfall		6,982.27	3.30	Dummy Null
165: O-6	6,970.50	6,966.08	Free Outfall		6,966.88	5.40	Dummy Null

**NOTE: SEE PROFILES FOR PIPES STUDIED WITH THIS ANALYSIS**

EASTONVILLE 1 - INLET - 5-YR FREE OUTFALL CONDITION

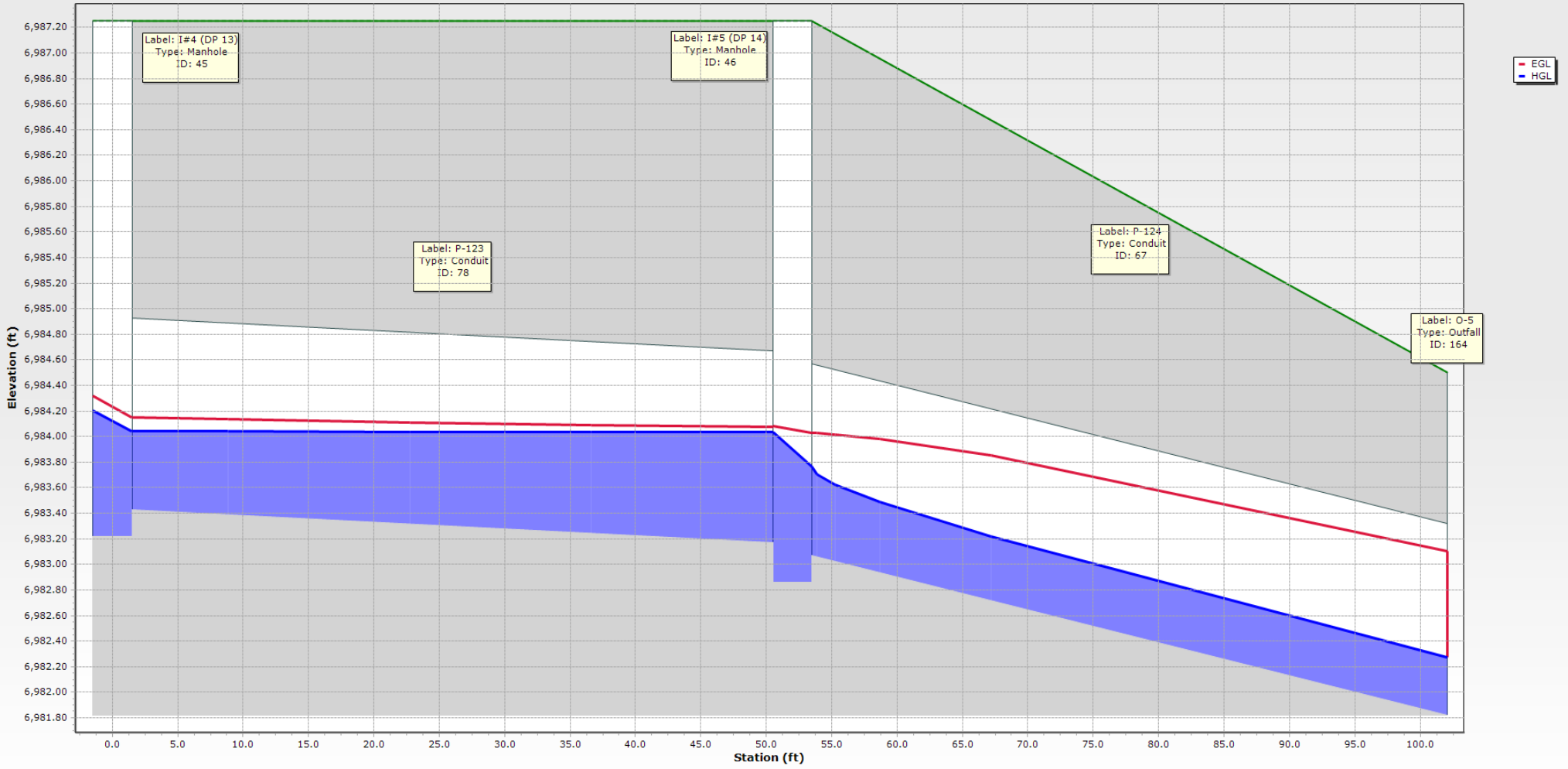


EASTONVILLE 5 - 5-YR FREE OUTFALL CONDITION





### EASTONVILLE 9 - 5-YR FREE OUTFALL CONDITION



# Culvert Report

## DP3

Invert Elev Dn (ft)	=	6976.11
Pipe Length (ft)	=	160.34
Slope (%)	=	1.27
Invert Elev Up (ft)	=	6978.15
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.012
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

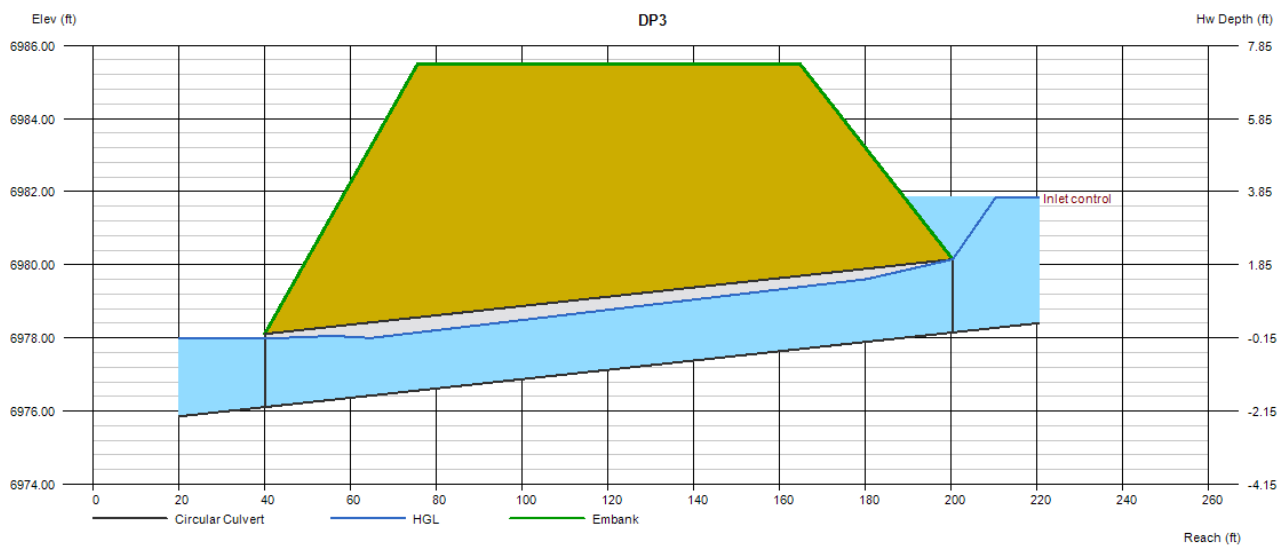
Top Elevation (ft)	=	6985.50
Top Width (ft)	=	89.00
Crest Width (ft)	=	15.00

### Calculations

Qmin (cfs)	=	24.20
Qmax (cfs)	=	24.20
Tailwater Elev (ft)	=	(dc+D)/2

### Highlighted

Qtotal (cfs)	=	24.20
Qpipe (cfs)	=	24.20
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.92
Veloc Up (ft/s)	=	8.34
HGL Dn (ft)	=	6977.98
HGL Up (ft)	=	6979.89
Hw Elev (ft)	=	6981.84
Hw/D (ft)	=	1.84
Flow Regime	=	Inlet Control



# Channel Report

## Roadside Swale Capacity DP1

### Triangular

Side Slopes (z:1) = 10.00, 10.00  
Total Depth (ft) = 0.50

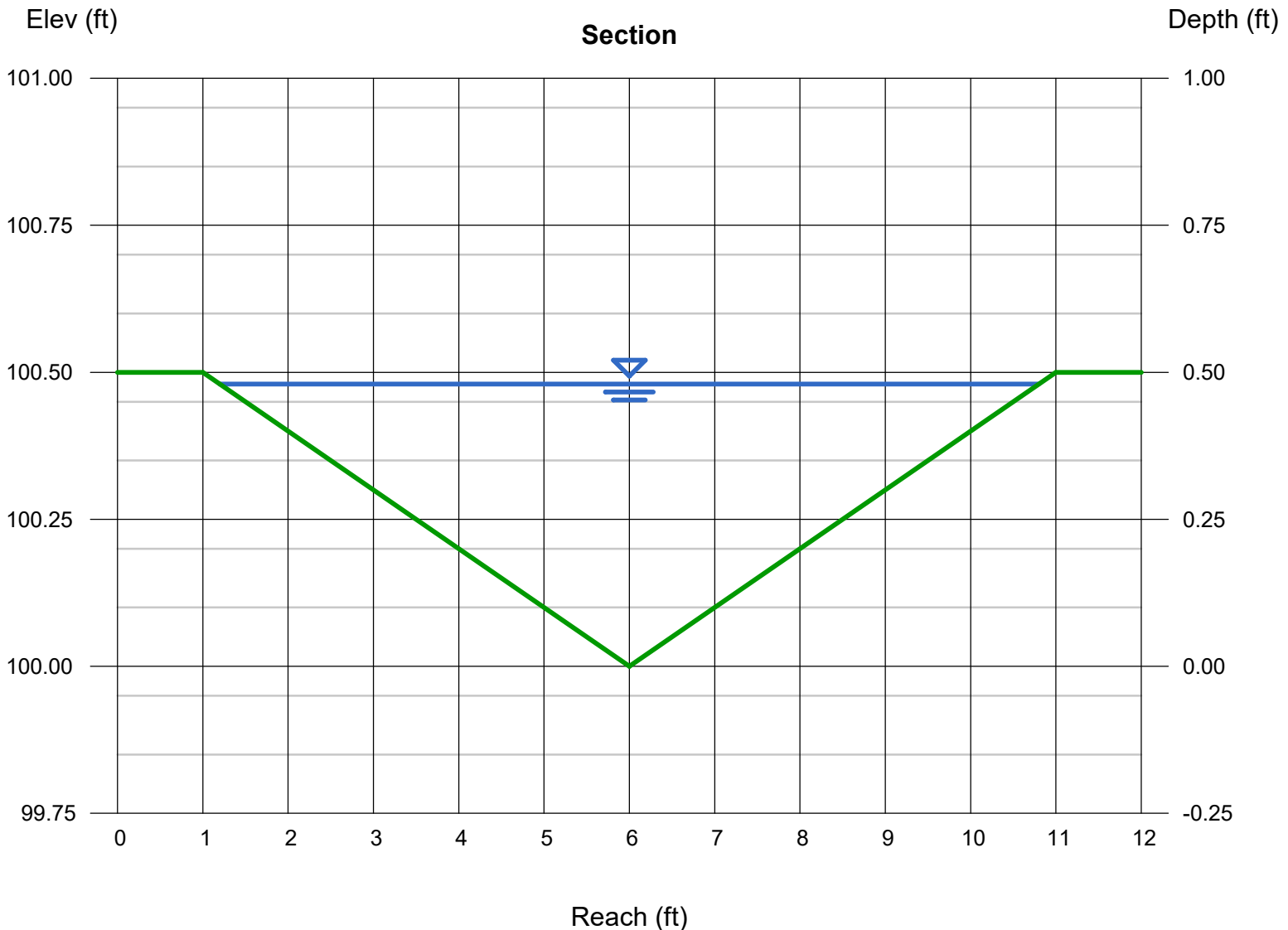
Invert Elev (ft) = 100.00  
Slope (%) = 0.50  
N-Value = 0.025

### Calculations

Compute by: Known Q  
Known Q (cfs) = 3.60

### Highlighted

Depth (ft) = 0.48  
Q (cfs) = 3.600  
Area (sqft) = 2.30  
Velocity (ft/s) = 1.56  
Wetted Perim (ft) = 9.65  
Crit Depth, Yc (ft) = 0.39  
Top Width (ft) = 9.60  
EGL (ft) = 0.52



# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Friday, Aug 23 2024

## Roadside Swale Capacity DP3

### Trapezoidal

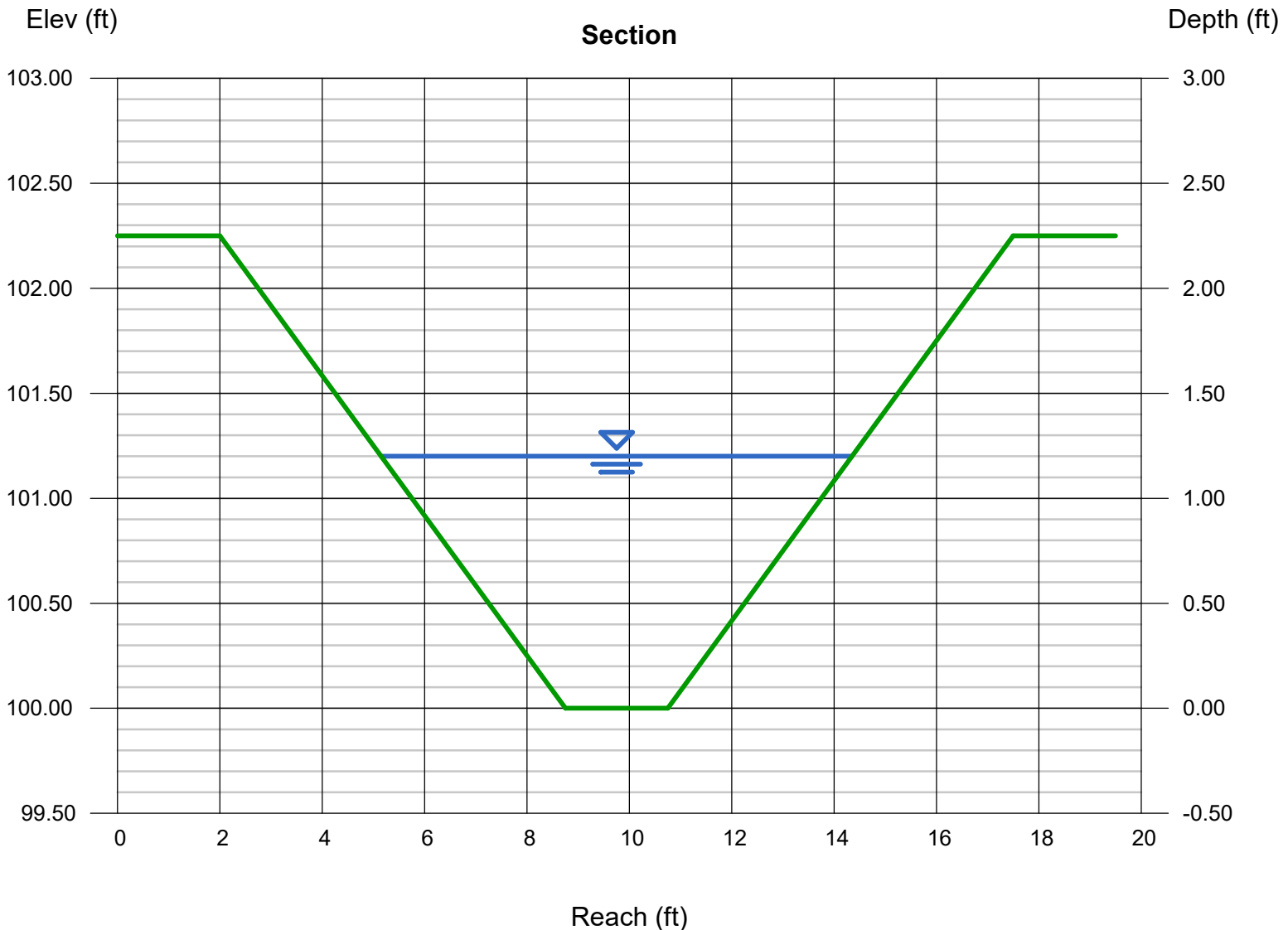
Bottom Width (ft) = 2.00  
Side Slopes (z:1) = 3.00, 3.00  
Total Depth (ft) = 2.25  
Invert Elev (ft) = 100.00  
Slope (%) = 0.60  
N-Value = 0.025

### Highlighted

Depth (ft) = 1.20  
Q (cfs) = 24.20  
Area (sqft) = 6.72  
Velocity (ft/s) = 3.60  
Wetted Perim (ft) = 9.59  
Crit Depth,  $Y_c$  (ft) = 1.04  
Top Width (ft) = 9.20  
EGL (ft) = 1.40

### Calculations

Compute by: Known Q  
Known Q (cfs) = 24.20



# Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc.

Friday, Aug 23 2024

## Roadside Swale Capacity DP7

### Trapezoidal

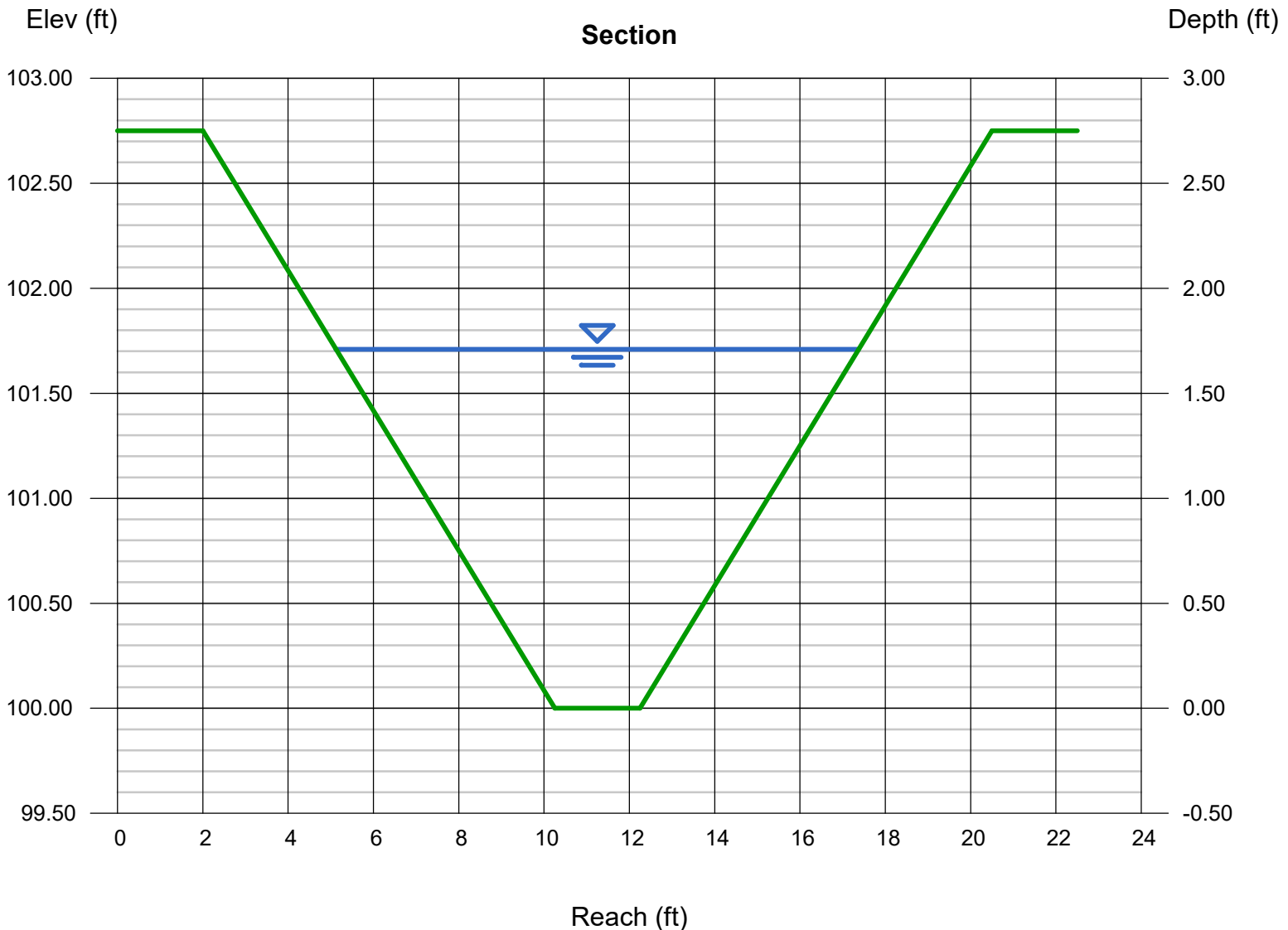
Bottom Width (ft) = 2.00  
Side Slopes (z:1) = 3.00, 3.00  
Total Depth (ft) = 2.75  
Invert Elev (ft) = 100.00  
Slope (%) = 0.60  
N-Value = 0.025

### Highlighted

Depth (ft) = 1.71  
Q (cfs) = 53.60  
Area (sqft) = 12.19  
Velocity (ft/s) = 4.40  
Wetted Perim (ft) = 12.81  
Crit Depth,  $Y_c$  (ft) = 1.53  
Top Width (ft) = 12.26  
EGL (ft) = 2.01

### Calculations

Compute by: Known Q  
Known Q (cfs) = 53.60



# Channel Report

## EDB B Trickle Channel Capacity

### Rectangular

Bottom Width (ft) = 3.33  
Total Depth (ft) = 0.50

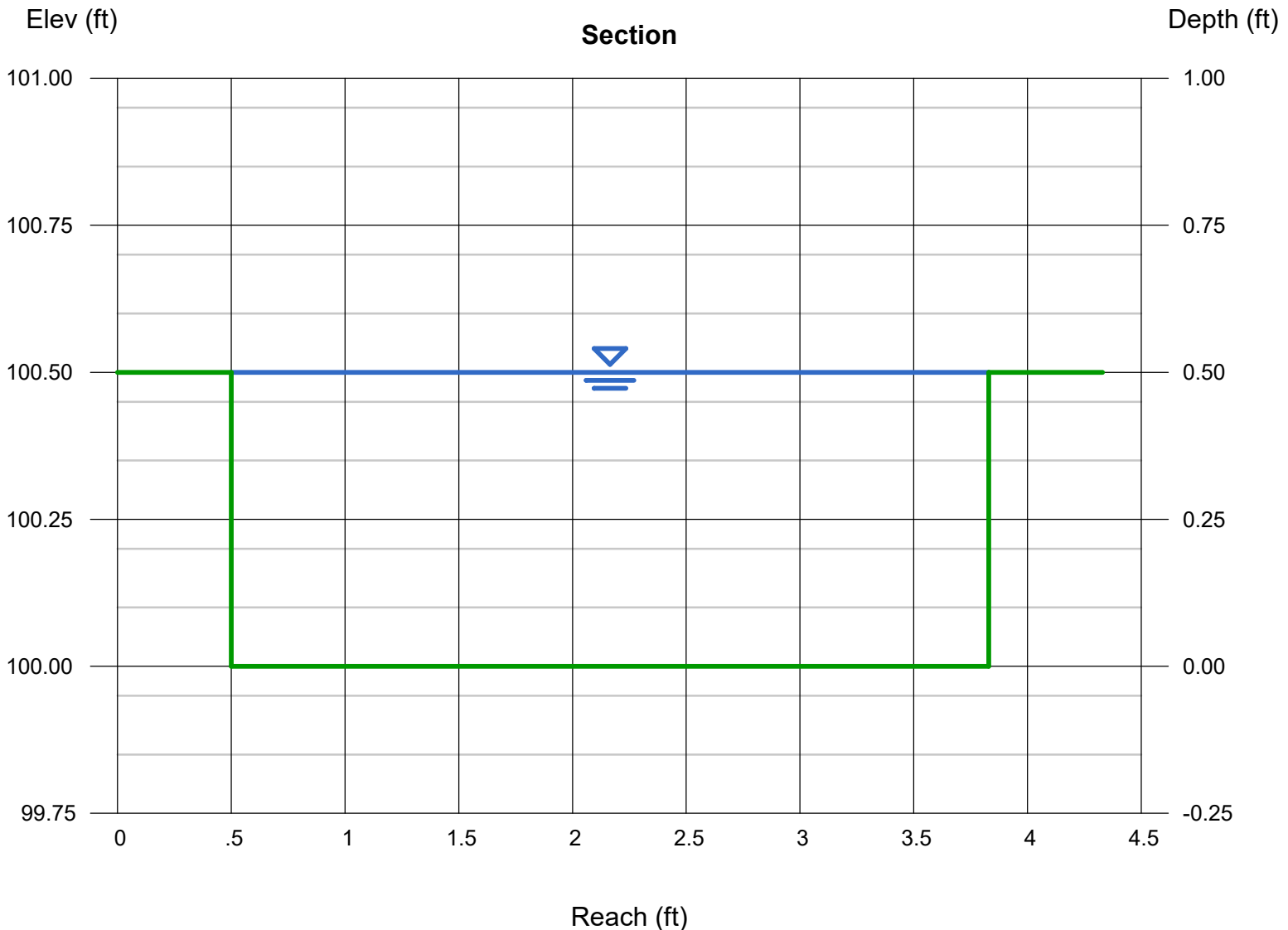
Invert Elev (ft) = 100.00  
Slope (%) = 0.50  
N-Value = 0.012

### Calculations

Compute by: Known Depth  
Known Depth (ft) = 0.50

### Highlighted

Depth (ft) = 0.50  
Q (cfs) = 7.707  
Area (sqft) = 1.67  
Velocity (ft/s) = 4.63  
Wetted Perim (ft) = 4.33  
Crit Depth, Yc (ft) = 0.50  
Top Width (ft) = 3.33  
EGL (ft) = 0.83





**EASTONVILLE RD SEG 1**

**Calc'd by:**

**SPC**

**201662.08**

**Checked by:**

**CM**

**DP2 (SFB D OUTLET)**

**Date:**

**8/23/2024**

Input Parameters	
Flow (Q)	4.6 cfs
Tailwater depth (Y <sub>t</sub> )	0.60 ft
Conduit Diameter (D <sub>c</sub> )	18 in
Expansion Factor (per Fig. 9-35)	6
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D <sup>2.5</sup> )	1.67
D <sub>50</sub> =	2.08 in
UDFCD Riprap Type =	Type VL
Design D <sub>50</sub> =	6 in
Minimum Mantle Thickness =	12 in
Minimum Length of Apron =	4.50 ft

Calculated D<sub>50</sub> for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left( \frac{1}{2 \tan \theta} \right) \left( \frac{A_t}{Y_t} - W \right)$$

Equation 9-11

$$A_t = \frac{Q}{V}$$

Equation 9-12

Where:

L<sub>p</sub> = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y<sub>t</sub> = tailwater depth (ft)

θ = the expansion angle of the culvert flow

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A<sub>t</sub> = required area of flow at allowable velocity (ft<sup>2</sup>)

Note:

<sup>1</sup> Calculations follow criteria in the USDCM Vol.2 Chapter 9

<sup>2</sup> Calculations assume a circular culvert

<sup>3</sup> This spreadsheet assumes y<sub>t</sub>/D<sub>c</sub>=0.4 in cases where y<sub>t</sub> is unknown or a hydraulic jump is suspected downstream of the outlet.

<sup>4</sup> Per the USDCM Vol.2 in no case should L<sub>p</sub> be less than 3D, nor does L<sub>p</sub> need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L<sub>p</sub> required by 1/4 D<sub>c</sub> for each whole number by which the Froude parameter is greater than 6



<b>EASTONVILLE RD SEG 1</b>	<b>Calc'd by:</b>	<b>SPC</b>
<b>201662.08</b>	<b>Checked by:</b>	<b>CM</b>
<b>DP4 (24" RCP CULVERT OUTLET)</b>	<b>Date:</b>	<b>8/23/2024</b>

Input Parameters	
Flow (Q)	24.2 cfs
Tailwater depth (Y <sub>t</sub> )	0.80 ft
Conduit Diameter (D <sub>c</sub> )	24 in
Expansion Factor (per Fig. 9-35)	3.25
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D <sup>2.5</sup> )	4.28
D <sub>50</sub> =	7.09 in
UDFCD Riprap Type =	Type L
Design D <sub>50</sub> =	9 in
Minimum Mantle Thickness =	18 in
Minimum Length of Apron =	13.16 ft

Calculated D<sub>50</sub> for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left( \frac{1}{2 \tan \theta} \right) \left( \frac{A_t}{Y_t} - W \right)$$

Equation 9-11

$$A_t = \frac{Q}{V}$$

Equation 9-12

Where:

- L<sub>p</sub> = length of protection (ft)
- W = width of the conduit (ft, use diameter for circular conduits)
- Y<sub>t</sub> = tailwater depth (ft)
- θ = the expansion angle of the culvert flow

Where:

- Q = design discharge (cfs)
- V = the allowable non-eroding velocity in the downstream channel (ft/sec)
- A<sub>t</sub> = required area of flow at allowable velocity (ft<sup>2</sup>)

Note:

- <sup>1</sup> Calculations follow criteria in the USDCM Vol.2 Chapter 9
- <sup>2</sup> Calculations assume a circular culvert
- <sup>3</sup> This spreadsheet assumes y<sub>t</sub>/D<sub>c</sub>=0.4 in cases where y<sub>t</sub> is unknown or a hydraulic jump is suspected downstream of the outlet.
- <sup>4</sup> Per the USDCM Vol.2 in no case should L<sub>p</sub> be less than 3D, nor does L<sub>p</sub> need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L<sub>p</sub> required by 1/4 D<sub>c</sub> for each whole number by which the Froude parameter is greater than 6





**EASTONVILLE RD SEG 1**

**Calc'd by:**

**SPC**

**201662.08**

**Checked by:**

**CM**

**DP4 (SFB A OUTLET)**

**Date:**

**8/23/2024**

Input Parameters	
Flow (Q)	1 cfs
Tailwater depth (Y <sub>t</sub> )	0.60 ft
Conduit Diameter (D <sub>c</sub> )	18 in
Expansion Factor (per Fig. 9-35)	6.5
Soil Type	Non-Cohesive Soils

Calculated Parameters	
Froude Parameter (Q/D <sup>2.5</sup> )	0.36
D <sub>50</sub> =	0.45 in
UDFCD Riprap Type =	Type VL
Design D <sub>50</sub> =	6 in
Minimum Mantle Thickness =	12 in
Minimum Length of Apron =	4.50 ft

Calculated D<sub>50</sub> for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left( \frac{1}{2 \tan \theta} \right) \left( \frac{A_t}{Y_t} - W \right)$$

Equation 9-11

$$A_t = \frac{Q}{V}$$

Equation 9-12

Where:

L<sub>p</sub> = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y<sub>t</sub> = tailwater depth (ft)

θ = the expansion angle of the culvert flow

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A<sub>t</sub> = required area of flow at allowable velocity (ft<sup>2</sup>)

Note:

<sup>1</sup> Calculations follow criteria in the USDCM Vol.2 Chapter 9

<sup>2</sup> Calculations assume a circular culvert

<sup>3</sup> This spreadsheet assumes y<sub>t</sub>/D<sub>c</sub>=0.4 in cases where y<sub>t</sub> is unknown or a hydraulic jump is suspected downstream of the outlet.

<sup>4</sup> Per the USDCM Vol.2 in no case should L<sub>p</sub> be less than 3D, nor does L<sub>p</sub> need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L<sub>p</sub> required by 1/4 D<sub>c</sub> for each whole number by which the Froude parameter is greater than 6



**EASTONVILLE RD SEG 1**

**Calc'd by:**

**SPC**

**201662.08**

**Checked by:**

**CM**

**DP8**

**Date:**

**8/23/2024**

Input Parameters	
Flow (Q)	60 cfs
Tailwater depth (Y <sub>t</sub> )	1.40 ft
Conduit Diameter (D <sub>c</sub> )	42 in
Expansion Factor (per Fig. 9-35)	5
Soil Type	Non-Cohesive Soils

**\*ULTIMATE FLOW TO DP8**

Calculated Parameters	
Froude Parameter (Q/D <sup>2.5</sup> )	2.62
D <sub>50</sub> =	7.59 in
UDFCD Riprap Type =	Type L
Design D <sub>50</sub> =	9 in
Minimum Mantle Thickness =	18 in
Minimum Length of Apron =	25.36 ft

Calculated D<sub>50</sub> for riprap was calculated using Equation 9-16 in the USDCM Vol 2.

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}}$$

Calculated minimum length of apron was calculated using Equations 9-11 and 9-12 in the USDCM Vol. 2

$$L_p = \left( \frac{1}{2 \tan \theta} \right) \left( \frac{A_r}{Y_t} - W \right)$$

Equation 9-11

$$A_r = \frac{Q}{V}$$

Equation 9-12

Where:

L<sub>p</sub> = length of protection (ft)

W = width of the conduit (ft, use diameter for circular conduits)

Y<sub>t</sub> = tailwater depth (ft)

θ = the expansion angle of the culvert flow

Where:

Q = design discharge (cfs)

V = the allowable non-eroding velocity in the downstream channel (ft/sec)

A<sub>r</sub> = required area of flow at allowable velocity (ft<sup>2</sup>)

Note:

<sup>1</sup> Calculations follow criteria in the USDCM Vol.2 Chapter 9

<sup>2</sup> Calculations assume a circular culvert

<sup>3</sup> This spreadsheet assumes y<sub>t</sub>/D<sub>c</sub>=0.4 in cases where y<sub>t</sub> is unknown or a hydraulic jump is suspected downstream of the outlet.

<sup>4</sup> Per the USDCM Vol.2 in no case should L<sub>p</sub> be less than 3D, nor does L<sub>p</sub> need to be greater than 10D whenever the Froude parameter is less than 6.0. whenever the Froude parameter is greater than 6, increase the maximum L<sub>p</sub> required by 1/4 D<sub>c</sub> for each whole number by which the Froude parameter is greater than 6

Riprap Sizing - Spillway					
q (cfs/ft)	S (ft/ft)	$C_f$	n	$D_{50}$ min. (in)	
SFB-A	0.50	0.02	3	0.025	1.44
EDB-B	1.14	0.02	3	0.025	2.29
SFB-D	1.78	0.02	3	0.025	2.94

**Type VL Riprap ( $D_{50} = 6"$ ) will be utilized for the spillway protection**

$$D_{50} = 5.23 S^{0.43} (1.35 C_f q)^{0.56}$$

Equation 13-9

Where:

- $D_{50}$  = median rock size (in)
- $S$  = longitudinal slope (ft/ft)
- $C_f$  = concentration factor (1.0 to 3.0)
- $q$  = unit discharge (cfs/ft)

When:

- $\eta$  (porosity) = 0.0 (i.e., for buried soil riprap)



## **APPENDIX D – WATER QUALITY & DETENTION**



## Design Procedure Form: Sand Filter (SF)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 2

**Designer:** SPC  
**Company:** HR Green  
**Date:** August 23, 2024  
**Project:** Eastonville Road - Segment 1 Improvements SFB A  
**Location:** El Paso County, CO

### 1. Basin Storage Volume

- A) Effective Imperviousness of Tributary Area,  $I_a$   
(100% if all paved and roofed areas upstream of sand filter)
- B) Tributary Area's Imperviousness Ratio ( $i = I_a/100$ )
- C) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time  
 $WQCV = 0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)$
- D) Contributing Watershed Area (including sand filter area)
- E) Water Quality Capture Volume (WQCV) Design Volume  
 $V_{WQCV} = WQCV / 12 * Area$
- F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm
- G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
- H) User Input of Water Quality Capture Volume (WQCV) Design Volume  
(Only if a different WQCV Design Volume is desired)

$I_a =$   %  
 $i =$    
 $WQCV =$   watershed inches  
 $Area =$   sq ft  
 $V_{WQCV} =$   cu ft  
 $d_6 =$   in  
 $V_{WQCV\ OTHER} =$   cu ft  
 $V_{WQCV\ USER} =$   cu ft

### 2. Basin Geometry

- A) WQCV Depth
- B) Sand Filter Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred). Use "0" if sand filter has vertical walls.
- C) Minimum Filter Area (Flat Surface Area)
- D) Actual Filter Area
- E) Volume Provided

$D_{WQCV} =$   ft  
 $Z =$   ft / ft  
 $A_{Min} =$   sq ft  
 $A_{Actual} =$   sq ft  
 $V_T =$   cu ft

### 3. Filter Material

Choose One

18" CDOT Class B or C Filter Material  
 Other (Explain): \_\_\_\_\_

### 4. Underdrain System

- A) Are underdrains provided?
- B) Underdrain system orifice diameter for 12 hour drain time
  - i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice
  - ii) Volume to Drain in 12 Hours
  - iii) Orifice Diameter, 3/8" Minimum

Choose One

YES  
 NO

$y =$   ft

**REFER TO MHFD  
DETENTION CALCS**

Design Procedure Form: Sand Filter (SF)

Sheet 2 of 2

Designer: SPC  
Company: HR Green  
Date: August 23, 2024  
Project: Eastonville Road - Segment 1 Improvements SFB A  
Location: El Paso County, CO

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric

A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?

Choose One

YES  NO

6. Inlet / Outlet Works

A) Describe the type of energy dissipation at inlet points and means of conveying flows in excess of the WQCV through the outlet

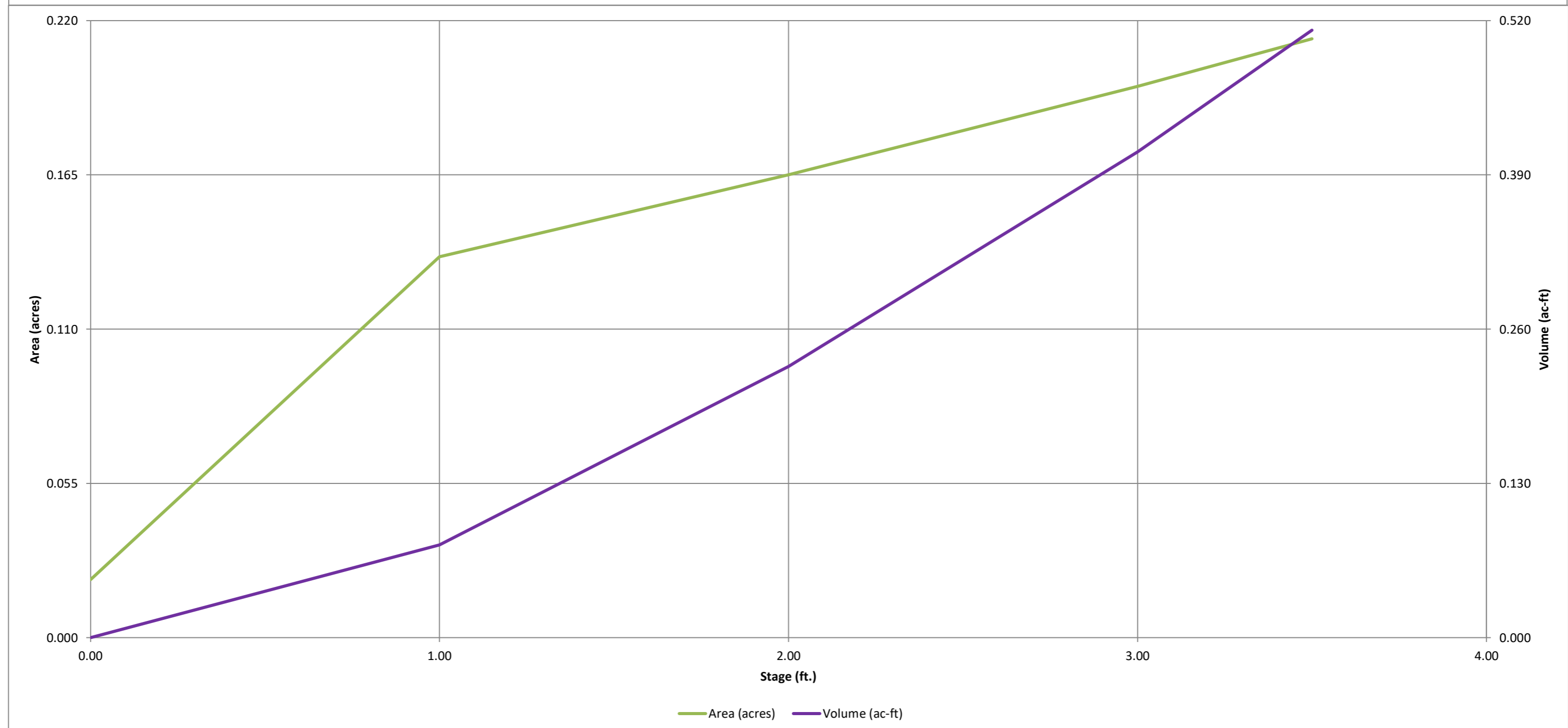
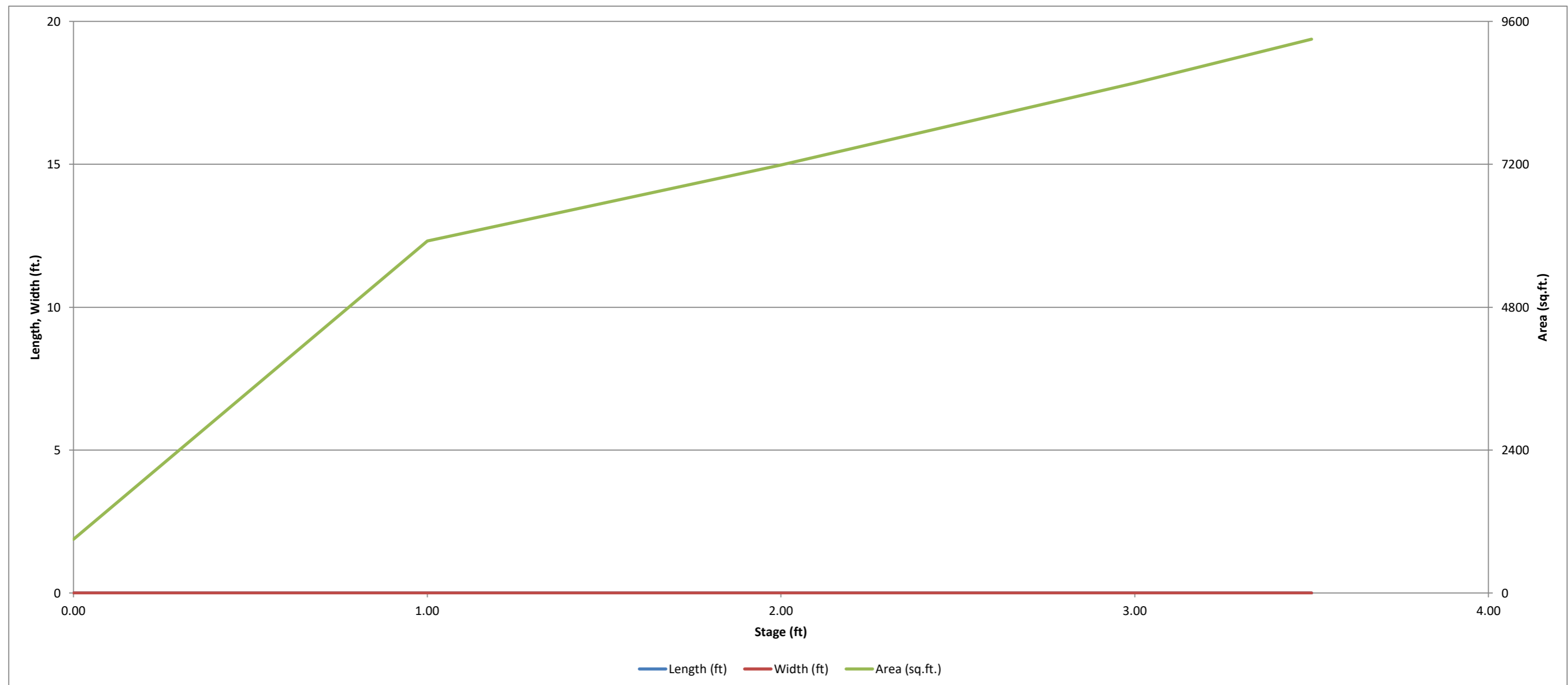
Energy dissipation at inlet points provided via riprap/forebay, and means of conveying flows in excess of the WQCV through the outlet is via the modified type 'C' inlet outlet structure grate, and a restricted outlet pipe.

Notes: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)



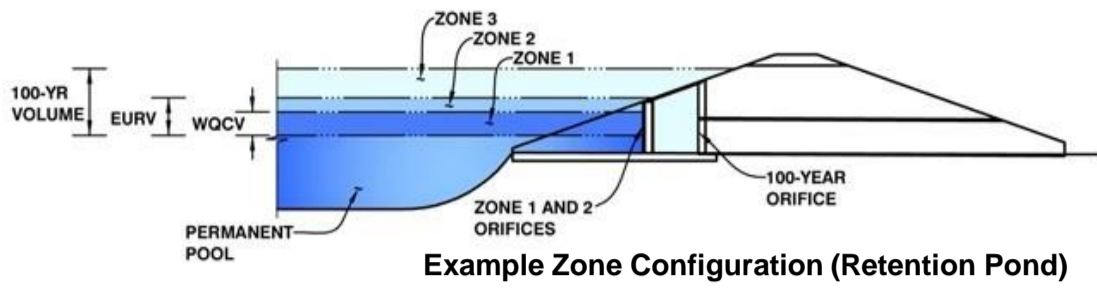


# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-*Detention, Version 4.05 (January 2022)*

**Project: Eastonville Road SEGMENT 1**

**Basin ID: SFB A**



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.48	0.023	Filtration Media
Zone 2 (EURV)	1.09	0.067	Circular Orifice
Zone 3 (100-year)	1.53	0.064	Weir&Pipe (Restrict)
<b>Total (all zones)</b>		<b>0.154</b>	

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

Underdrain Orifice Invert Depth =	2.33	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	0.75	inches

**Calculated Parameters for Underdrain**

Underdrain Orifice Area =	0.0	ft <sup>2</sup>
Underdrain Orifice Centroid =	0.03	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 =	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	N/A	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	sq. inches

**Calculated Parameters for Plate**

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

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**User Input: Vertical Orifice (Circular or Rectangular)**

	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	0.50	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	1.09	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	0.44	N/A	inches

**Calculated Parameters for Vertical Orifice**

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.00	N/A	ft <sup>2</sup>
Vertical Orifice Centroid =	0.02	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 =	1.25	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	3.00	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	%

**Calculated Parameters for Overflow Weir**

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H <sub>g</sub> =	1.25	N/A	feet
Overflow Weir Slope Length =	3.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	58.36	N/A	
Overflow Grate Open Area w/o Debris =	6.26	N/A	ft <sup>2</sup>
Overflow Grate Open Area w/ Debris =	3.13	N/A	ft <sup>2</sup>

**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 =	2.58	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 =	2.00	N/A	inches

**Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate**

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.11	N/A	ft <sup>2</sup>
Outlet Orifice Centroid =	0.10	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	0.68	N/A	radians

**User Input: Emergency Spillway (Rectangular or Trapezoidal)**

Spillway Invert Stage =	2.24	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	5.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

**Calculated Parameters for Spillway**

Spillway Design Flow Depth =	0.26	feet
Stage at Top of Freeboard =	3.50	feet
Basin Area at Top of Freeboard =	0.21	acres
Basin Volume at Top of Freeboard =	0.51	acre-ft

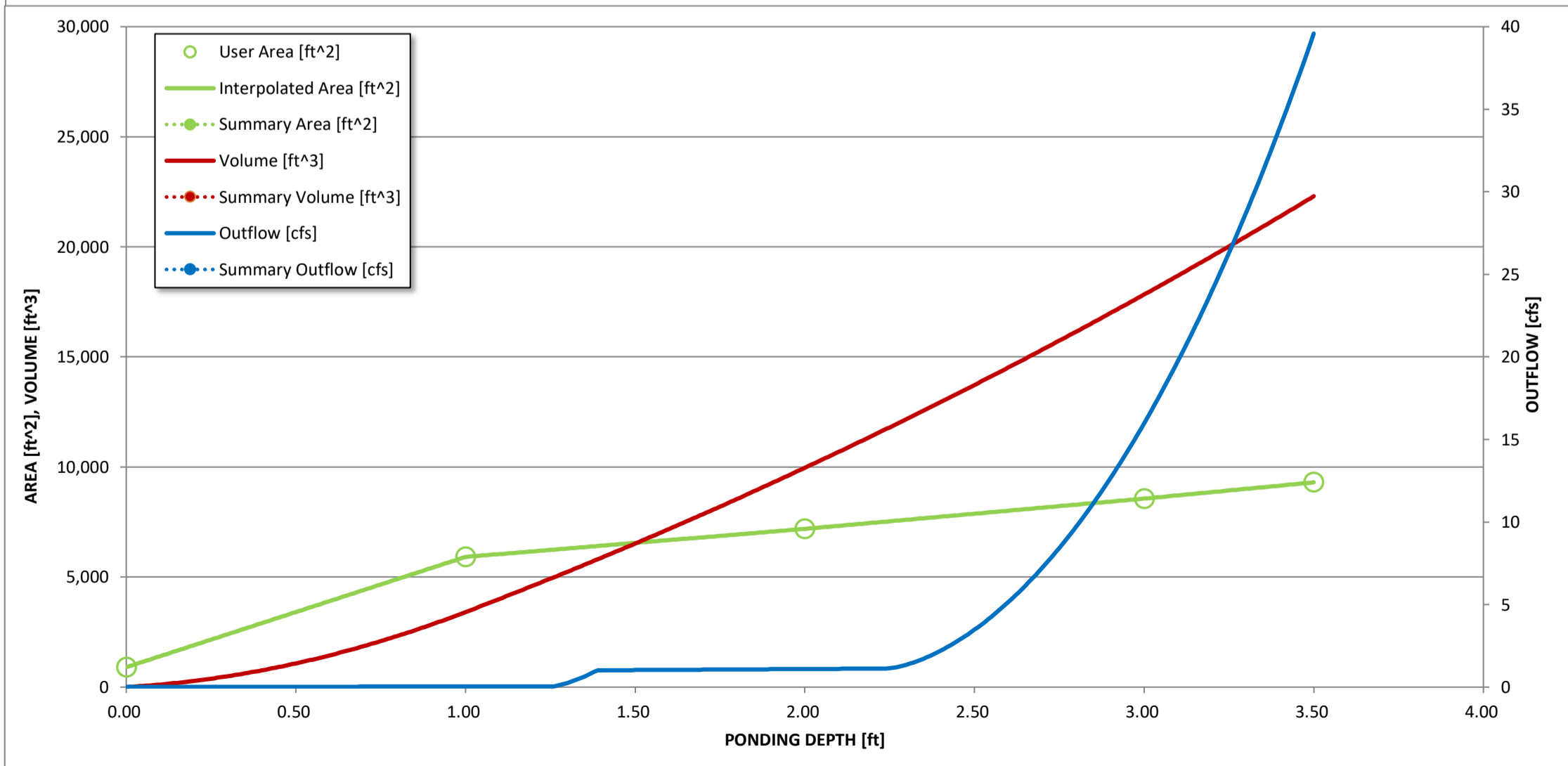
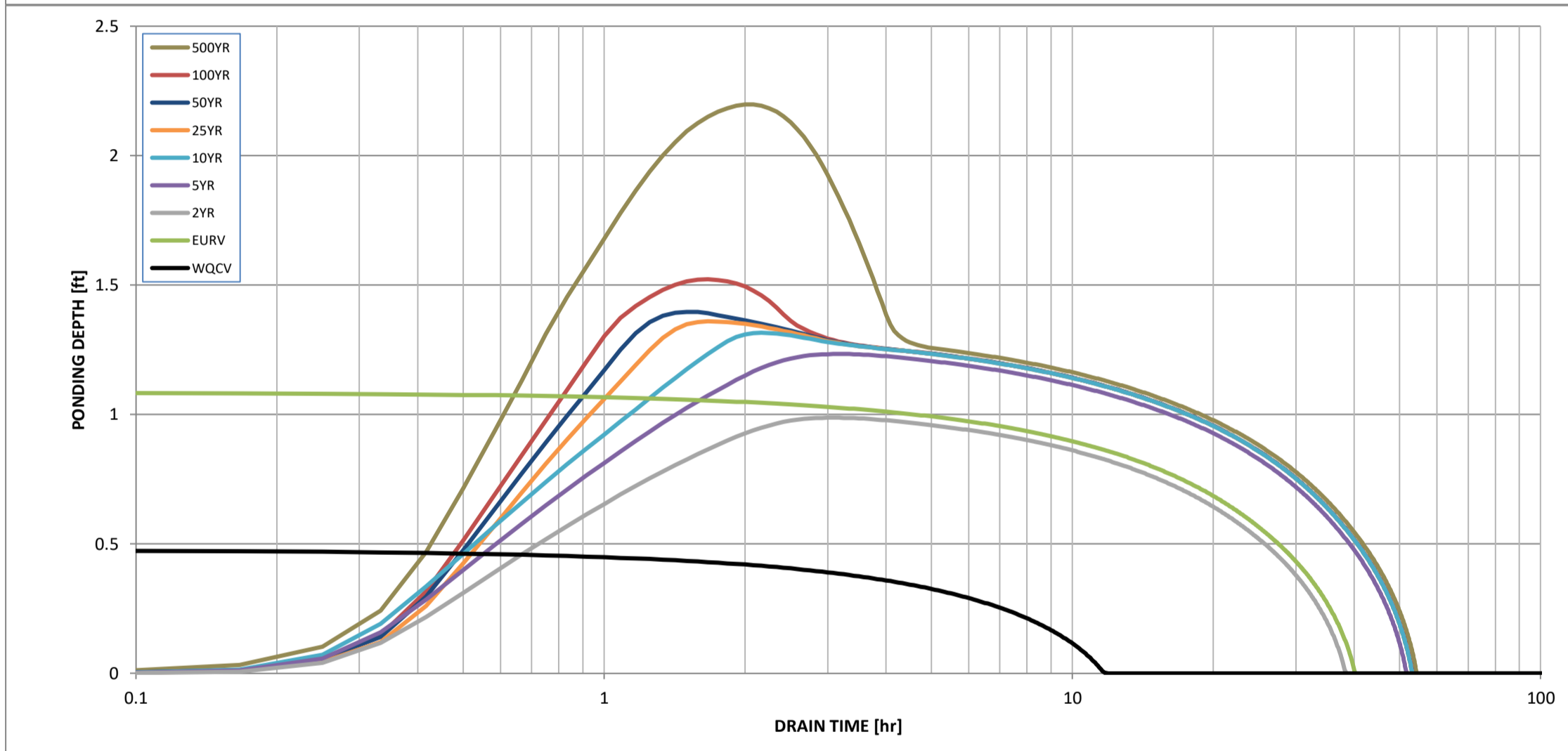
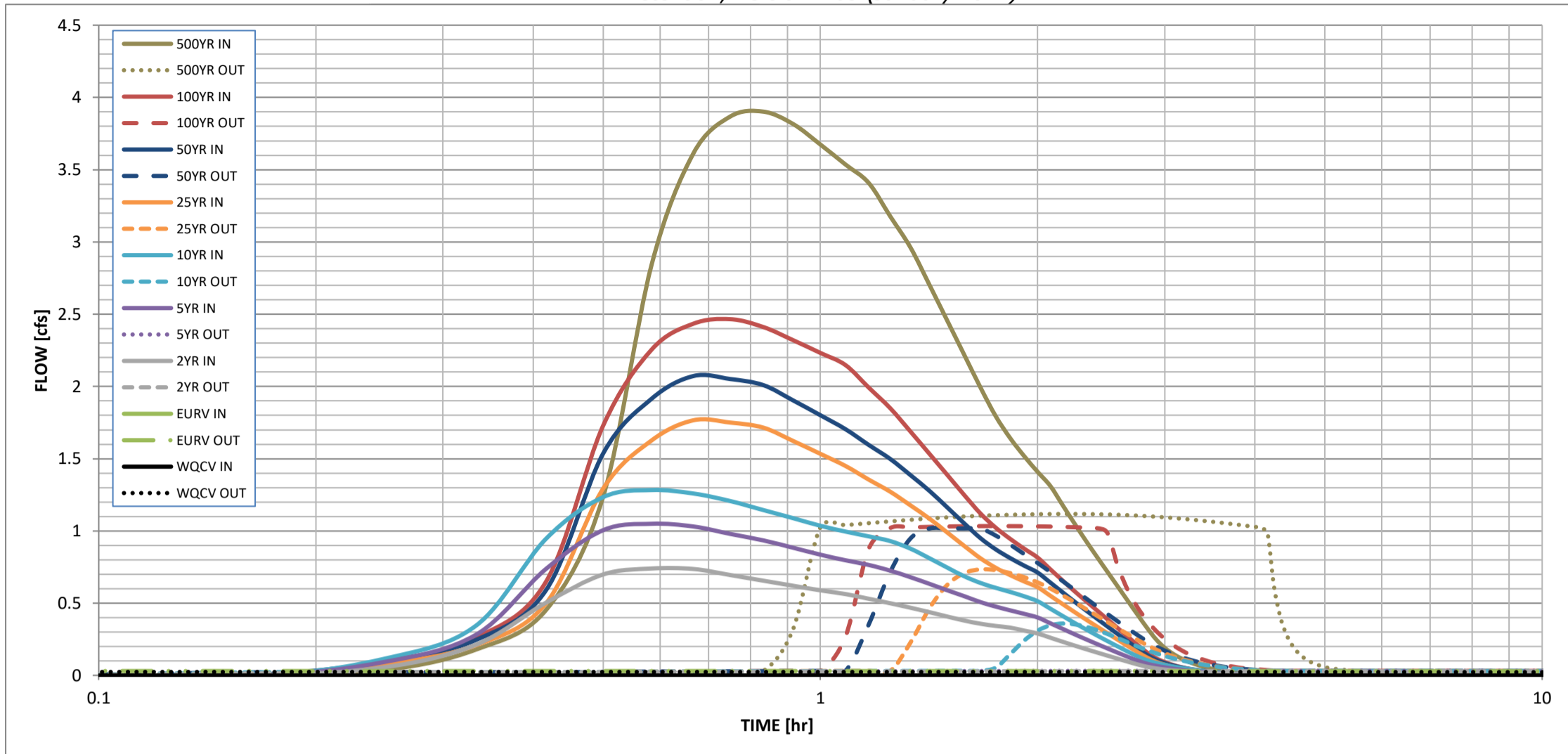
**Routed Hydrograph Results**

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
One-Hour Rainfall Depth (in) =	0.023	0.090	0.084	0.119	0.150	0.190	0.223	0.264	0.423
CUHP Runoff Volume (acre-ft) =	N/A	N/A	0.084	0.119	0.150	0.190	0.223	0.264	0.423
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.1	0.2	0.4	0.7	0.8	1.1	1.9
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.05	0.14	0.22	0.41	0.52	0.68	1.22
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.7	1.0	1.3	1.8	2.1	2.5	3.9
Peak Inflow Q (cfs) =	0.0	0.0	0.0	0.03	0.4	0.7	1.0	1.0	1.1
Peak Outflow Q (cfs) =	N/A	N/A	N/A	0.1	1.0	1.1	1.2	1.0	0.6
Ratio Peak Outflow to Predevelopment Q =	Filtration Media	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1
Structure Controlling Flow =	N/A	N/A	N/A	N/A	0.1	0.1	0.2	0.2	0.2
Max Velocity through Gate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Gate 2 (fps) =	11	39	37	50	51	50	50	49	48
Time to Drain 97% of Inflow Volume (hours) =	12	40	38	51	52	52	52	52	52
Time to Drain 99% of Inflow Volume (hours) =	0.48	1.09	0.99	1.23	1.32	1.36	1.40	1.52	2.20
Maximum Ponding Depth (ft) =	0.08	0.14	0.13	0.14	0.14	0.15	0.15	0.15	0.17
Area at Maximum Ponding Depth (acres) =	0.023	0.091	0.076	0.110	0.122	0.128	0.133	0.153	0.261
Maximum Volume Stored (acre-ft) =									

# 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: \_\_\_\_\_

## Inflow Hydrographs

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

Time Interval	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]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.04
	0:15:00	0.00	0.00	0.06	0.10	0.12	0.08	0.10	0.10	0.18
	0:20:00	0.00	0.00	0.21	0.28	0.35	0.21	0.25	0.26	0.45
	0:25:00	0.00	0.00	0.50	0.74	0.95	0.50	0.59	0.65	1.24
	0:30:00	0.00	0.00	0.70	1.01	1.23	1.29	1.54	1.73	2.84
	0:35:00	0.00	0.00	0.74	1.05	1.28	1.63	1.91	2.25	3.61
	0:40:00	0.00	0.00	0.74	1.03	1.26	1.77	2.07	2.43	3.87
	0:45:00	0.00	0.00	0.70	0.98	1.21	1.75	2.05	2.47	3.90
	0:50:00	0.00	0.00	0.66	0.94	1.15	1.72	2.01	2.41	3.82
	0:55:00	0.00	0.00	0.62	0.88	1.09	1.62	1.90	2.32	3.67
	1:00:00	0.00	0.00	0.59	0.84	1.04	1.53	1.80	2.23	3.54
	1:05:00	0.00	0.00	0.56	0.80	1.00	1.45	1.70	2.15	3.41
	1:10:00	0.00	0.00	0.53	0.77	0.96	1.36	1.60	1.99	3.18
	1:15:00	0.00	0.00	0.50	0.73	0.93	1.27	1.50	1.85	2.96
	1:20:00	0.00	0.00	0.47	0.68	0.88	1.18	1.39	1.69	2.70
	1:25:00	0.00	0.00	0.44	0.63	0.81	1.09	1.28	1.53	2.45
	1:30:00	0.00	0.00	0.41	0.59	0.75	0.99	1.16	1.39	2.22
	1:35:00	0.00	0.00	0.38	0.55	0.69	0.90	1.05	1.25	1.99
	1:40:00	0.00	0.00	0.36	0.51	0.64	0.81	0.95	1.12	1.79
	1:45:00	0.00	0.00	0.34	0.48	0.61	0.75	0.87	1.02	1.64
	1:50:00	0.00	0.00	0.33	0.45	0.58	0.69	0.81	0.94	1.52
	1:55:00	0.00	0.00	0.31	0.43	0.55	0.65	0.76	0.88	1.41
	2:00:00	0.00	0.00	0.29	0.40	0.51	0.61	0.71	0.82	1.31
	2:05:00	0.00	0.00	0.26	0.36	0.46	0.55	0.64	0.73	1.18
	2:10:00	0.00	0.00	0.23	0.32	0.41	0.49	0.58	0.66	1.05
	2:15:00	0.00	0.00	0.21	0.29	0.36	0.44	0.51	0.58	0.93
	2:20:00	0.00	0.00	0.18	0.25	0.32	0.39	0.45	0.52	0.82
	2:25:00	0.00	0.00	0.16	0.22	0.28	0.34	0.39	0.45	0.72
	2:30:00	0.00	0.00	0.14	0.19	0.24	0.29	0.34	0.39	0.62
	2:35:00	0.00	0.00	0.12	0.16	0.20	0.25	0.29	0.33	0.52
	2:40:00	0.00	0.00	0.10	0.13	0.17	0.20	0.24	0.27	0.42
	2:45:00	0.00	0.00	0.08	0.10	0.13	0.16	0.19	0.21	0.33
	2:50:00	0.00	0.00	0.06	0.08	0.11	0.13	0.14	0.16	0.25
	2:55:00	0.00	0.00	0.05	0.07	0.09	0.10	0.11	0.12	0.19
	3:00:00	0.00	0.00	0.04	0.06	0.07	0.07	0.09	0.09	0.15
	3:05:00	0.00	0.00	0.03	0.05	0.06	0.06	0.07	0.07	0.12
	3:10:00	0.00	0.00	0.03	0.04	0.05	0.05	0.06	0.06	0.09
	3:15:00	0.00	0.00	0.03	0.03	0.04	0.04	0.05	0.04	0.07
	3:20:00	0.00	0.00	0.02	0.03	0.04	0.03	0.04	0.04	0.06
	3:25:00	0.00	0.00	0.02	0.02	0.03	0.03	0.03	0.03	0.04
	3:30:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.04
	3:35:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	3:40:00	0.00	0.00	0.01	0.01	0.02	0.01	0.02	0.01	0.02
	3:45:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.02
	3:50:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	3:55:00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

## Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 3

**Designer:** SPC  
**Company:** HR Green  
**Date:** August 23, 2024  
**Project:** Eastonville Road - Segment 1 Improvements EDB B ULTIMATE CONDITIONS  
**Location:** EL PASO COUNTY, CO

<p>1. Basin Storage Volume</p> <p>A) Effective Imperviousness of Tributary Area, <math>I_a</math></p> <p>B) Tributary Area's Imperviousness Ratio (<math>i = I_a / 100</math>)</p> <p>C) Contributing Watershed Area</p> <p>D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm</p> <p>E) Design Concept (Select EURV when also designing for flood control)</p> <p>F) Design Volume (WQCV) Based on 40-hour Drain Time (<math>V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)</math>)</p> <p>G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume (<math>V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN} / 0.43))</math>)</p> <p>H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)</p> <p>I) NRCS Hydrologic Soil Groups of Tributary Watershed              i) Percentage of Watershed consisting of Type A Soils              ii) Percentage of Watershed consisting of Type B Soils              iii) Percentage of Watershed consisting of Type C/D Soils</p> <p>J) Excess Urban Runoff Volume (EURV) Design Volume              For HSG A: <math>EURV_A = 1.68 * i^{1.28}</math>              For HSG B: <math>EURV_B = 1.36 * i^{1.08}</math>              For HSG C/D: <math>EURV_{C/D} = 1.20 * i^{1.08}</math></p> <p>K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired)</p>	<p><math>I_a =</math> <input type="text" value="67.0"/> %</p> <p><math>i =</math> <input type="text" value="0.670"/></p> <p>Area = <input type="text" value="9.020"/> ac</p> <p><math>d_6 =</math> <input type="text" value="0.42"/> in</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Choose One</p> <p><input type="radio"/> Water Quality Capture Volume (WQCV)</p> <p><input checked="" type="radio"/> Excess Urban Runoff Volume (EURV)</p> </div> <p><math>V_{DESIGN} =</math> <input type="text"/> ac-ft</p> <p><math>V_{DESIGN\ OTHER} =</math> <input type="text" value="0.192"/> ac-ft</p> <p><math>V_{DESIGN\ USER} =</math> <input type="text"/> ac-ft</p> <p><math>HSG_A =</math> <input type="text" value="100"/> %</p> <p><math>HSG_B =</math> <input type="text" value="0"/> %</p> <p><math>HSG_{C/D} =</math> <input type="text" value="0"/> %</p> <p><math>EURV_{DESIGN} =</math> <input type="text" value="0.756"/> ac-ft</p> <p><math>EURV_{DESIGN\ USER} =</math> <input type="text"/> ac-ft</p>
<p>2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)</p>	<p><math>L : W =</math> <input type="text" value="2.0"/> : 1</p>
<p>3. Basin Side Slopes</p> <p>A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)</p>	<p><math>Z =</math> <input type="text" value="4.00"/> ft / ft</p>
<p>4. Inlet</p> <p>A) Describe means of providing energy dissipation at concentrated inflow locations:</p>	<p>_____</p> <p>_____</p> <p>_____</p>
<p>5. Forebay</p> <p>A) Minimum Forebay Volume (<math>V_{MIN} =</math> <input type="text" value="3%"/> of the WQCV)</p> <p>B) Actual Forebay Volume</p> <p>C) Forebay Depth (<math>D_F =</math> <input type="text" value="18"/> inch maximum)</p> <p>D) Forebay Discharge              i) Undetained 100-year Peak Discharge              ii) Forebay Discharge Design Flow (<math>Q_F = 0.02 * Q_{100}</math>)</p> <p>E) Forebay Discharge Design</p> <p>F) Discharge Pipe Size (minimum 8-inches)</p> <p>G) Rectangular Notch Width</p>	<p><math>V_{MIN} =</math> <input type="text" value="0.006"/> ac-ft</p> <p><math>V_F =</math> <input type="text" value="0.006"/> ac-ft</p> <p><math>D_F =</math> <input type="text" value="15.0"/> in</p> <p><math>Q_{100} =</math> <input type="text" value="26.00"/> cfs</p> <p><math>Q_F =</math> <input type="text" value="0.52"/> cfs</p> <div style="border: 1px solid black; padding: 5px; margin: 5px 0;"> <p>Choose One</p> <p><input type="radio"/> Berm With Pipe</p> <p><input checked="" type="radio"/> Wall with Rect. Notch</p> <p><input type="radio"/> Wall with V-Notch Weir</p> </div> <p style="color: blue; font-weight: bold;">Flow too small for berm w/ pipe</p> <p>Calculated <math>D_P =</math> <input type="text"/> in</p> <p>Calculated <math>W_N =</math> <input type="text" value="4.3"/> in</p>



**Design Procedure Form: Extended Detention Basin (EDB)**

**Designer:** SPC  
**Company:** HR Green  
**Date:** August 23, 2024  
**Project:** Eastonville Road - Segment 1 Improvements EDB B ULTIMATE CONDITIONS  
**Location:** EL PASO COUNTY, CO

<p>6. Trickle Channel</p> <p>A) Type of Trickle Channel</p> <p>F) Slope of Trickle Channel</p>	<div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">             Choose One  <input checked="" type="radio"/> Concrete  <input type="radio"/> Soft Bottom         </div> <p>S = <input style="width: 50px;" type="text" value="0.0050"/> ft / ft</p>
<p>7. Micropool and Outlet Structure</p> <p>A) Depth of Micropool (2.5-feet minimum)</p> <p>B) Surface Area of Micropool (10 ft<sup>2</sup> minimum)</p> <p>C) Outlet Type</p> <p>D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)</p> <p>E) Total Outlet Area</p>	<p>D<sub>M</sub> = <input style="width: 50px;" type="text" value="2.5"/> ft</p> <p>A<sub>M</sub> = <input style="width: 50px;" type="text" value="10"/> sq ft</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;">             Choose One  <input checked="" type="radio"/> Orifice Plate  <input type="radio"/> Other (Describe):         </div> <hr/> <hr/> <p>D<sub>orifice</sub> = <input style="width: 50px;" type="text" value="1.00"/> inches</p> <p>A<sub>ot</sub> = <input style="width: 50px;" type="text" value="5.50"/> square inches</p>
<p>8. Initial Surcharge Volume</p> <p>A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)</p> <p>B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)</p> <p>C) Initial Surcharge Provided Above Micropool</p>	<p>D<sub>IS</sub> = <input style="width: 50px;" type="text" value="4"/> in</p> <p>V<sub>IS</sub> = <input style="width: 50px;" type="text" value="25"/> cu ft</p> <p>V<sub>s</sub> = <input style="width: 50px;" type="text" value="3.3"/> cu ft</p>
<p>9. Trash Rack</p> <p>A) Water Quality Screen Open Area: <math>A_t = A_{ot} * 38.5 * (e^{-0.095D})</math></p> <p>B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open area to the total screen area for the material specified.)</p> <p style="text-align: right;">Other (Y/N): <input style="width: 50px;" type="text" value="N"/></p> <p>C) Ratio of Total Open Area to Total Area (only for type 'Other')</p> <p>D) Total Water Quality Screen Area (based on screen type)</p> <p>E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)</p> <p>F) Height of Water Quality Screen (H<sub>TR</sub>)</p> <p>G) Width of Water Quality Screen Opening (W<sub>opening</sub>) (Minimum of 12 inches is recommended)</p>	<p>A<sub>t</sub> = <input style="width: 50px;" type="text" value="193"/> square inches</p> <div style="border: 1px solid black; padding: 2px; margin-bottom: 10px; width: fit-content;">             S.S. Well Screen with 60% Open Area         </div> <hr/> <hr/> <p>User Ratio = <input style="width: 50px;" type="text"/></p> <p>A<sub>total</sub> = <input style="width: 50px;" type="text" value="321"/> sq. in.</p> <p>H = <input style="width: 50px;" type="text" value="5.05"/> feet</p> <p>H<sub>TR</sub> = <input style="width: 50px;" type="text" value="88.6"/> inches</p> <p>W<sub>opening</sub> = <input style="width: 50px;" type="text" value="12.0"/> inches <span style="color: red; font-weight: bold; font-size: small;">VALUE LESS THAN RECOMMENDED MIN. WIDTH. WIDTH HAS BEEN SET TO 12 INCHES.</span></p>

Design Procedure Form: Extended Detention Basin (EDB)

Designer: SPC  
Company: HR Green  
Date: August 23, 2024  
Project: Eastonville Road - Segment 1 Improvements EDB B ULTIMATE CONDITIONS  
Location: EL PASO COUNTY, CO

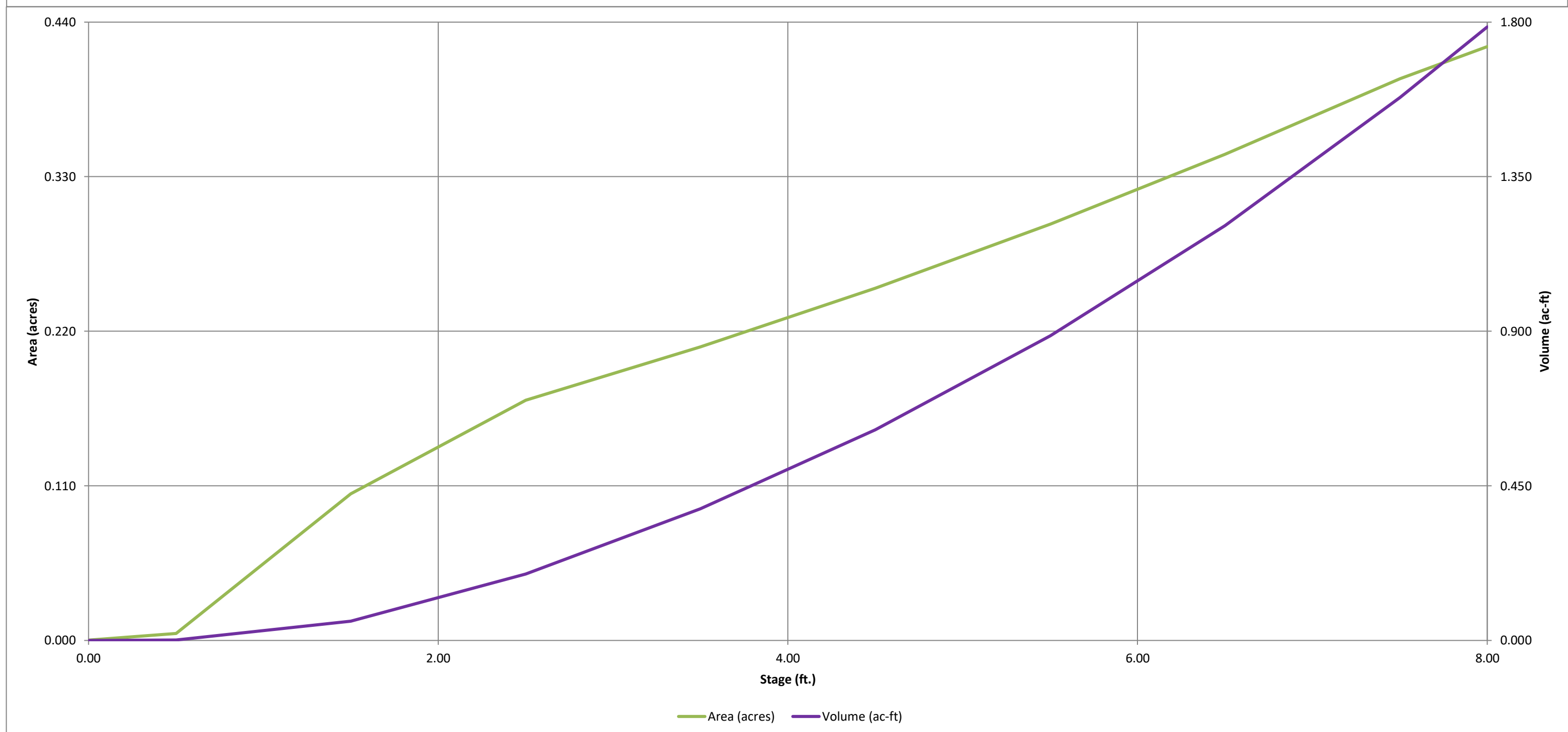
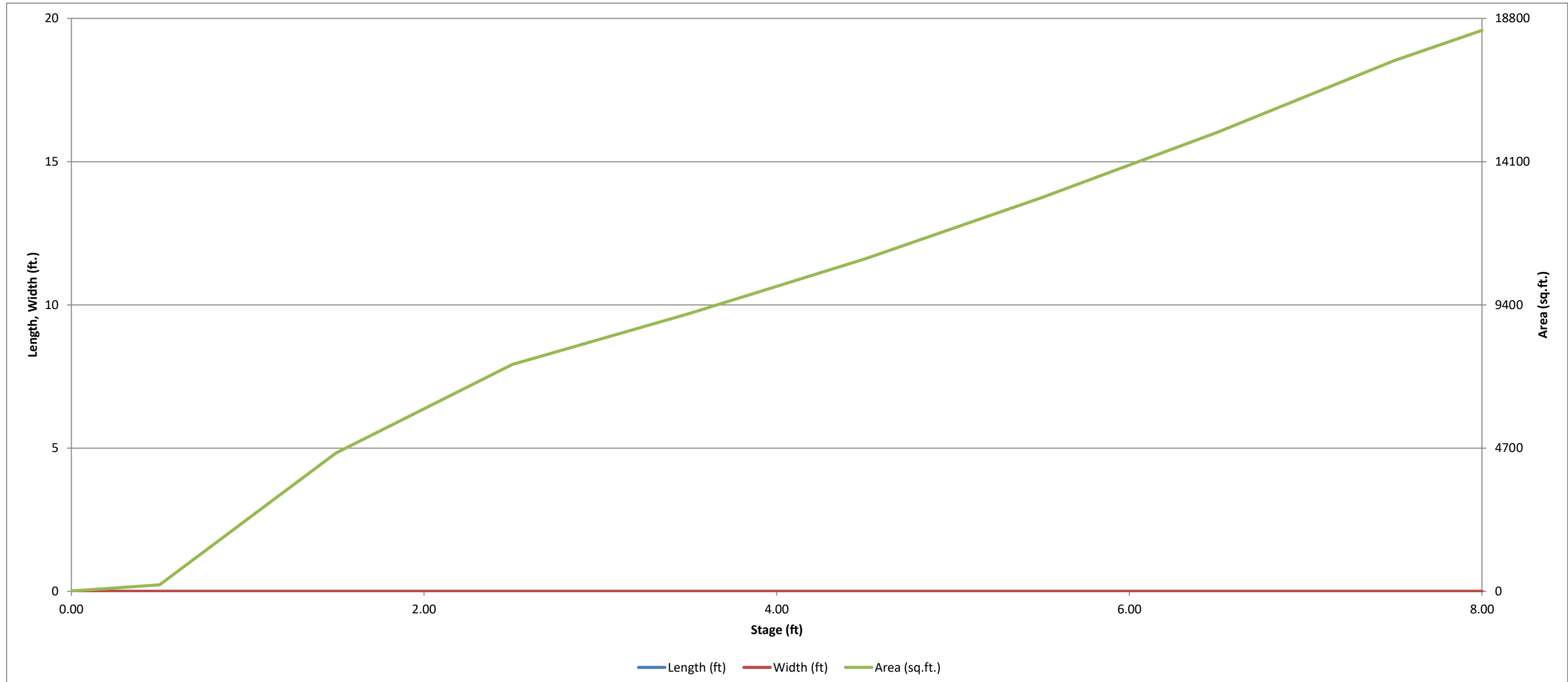
<p>10. Overflow Embankment</p> <p>A) Describe embankment protection for 100-year and greater overtopping:</p> <p>B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)</p>	<p>_____</p> <p>_____</p> <p>_____</p> <p>Ze = <input type="text" value="4.00"/> ft / ft</p>
<p>11. Vegetation</p>	<p>Choose One</p> <p><input type="radio"/> Irrigated</p> <p><input checked="" type="radio"/> Not Irrigated</p>
<p>12. Access</p> <p>A) Describe Sediment Removal Procedures</p>	<p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>
<p>Notes: _____</p> <p>_____</p> <p>_____</p>	





# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)

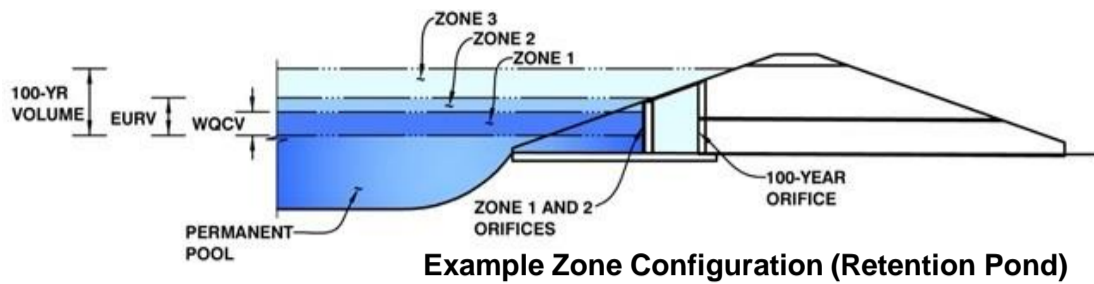


# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

**Project: Eastonville Road - Segment 1 Improvements**

**Basin ID: EDB B: INTERIM CONDITION, BASINS [EA6 - EA8]**



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.64	0.071	Orifice Plate
Zone 2 (EURV)	2.80	0.175	Rectangular Orifice
Zone 3 (100-year)	3.51	0.139	Weir&Pipe (Restrict)
Total (all zones)		0.384	

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 <sup>2</sup>
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 =	1.64	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	0.31	sq. inches (diameter = 5/8 inch)

Calculated Parameters for Plate

WQ Orifice Area per Row =	2.132E-03	ft <sup>2</sup>
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft <sup>2</sup>

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	0.60	1.20					
Orifice Area (sq. inches)	0.31	0.31	0.31					

	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)

	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	2.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	2.76	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Height =	8.00	N/A	inches
Vertical Orifice Width =	3.25		inches

Calculated Parameters for Vertical Orifice

	Zone 2 Rectangular	Not Selected	
Vertical Orifice Area =	0.18	N/A	ft <sup>2</sup>
Vertical Orifice Centroid =	0.33	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, H <sub>o</sub> =	5.20	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	3.00	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	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H <sub>t</sub> =	5.20	N/A	feet
Overflow Weir Slope Length =	3.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	3.54	N/A	
Overflow Grate Open Area w/o Debris =	6.26	N/A	ft <sup>2</sup>
Overflow Grate Open Area w/ Debris =	3.13	N/A	ft <sup>2</sup>

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

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	18.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	18.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.77	N/A	ft <sup>2</sup>
Outlet Orifice Centroid =	0.75	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage =	6.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	15.50	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

Spillway Design Flow Depth =	0.50	feet
Stage at Top of Freeboard =	8.00	feet
Basin Area at Top of Freeboard =	0.42	acres
Basin Volume at Top of Freeboard =	1.79	acre-ft

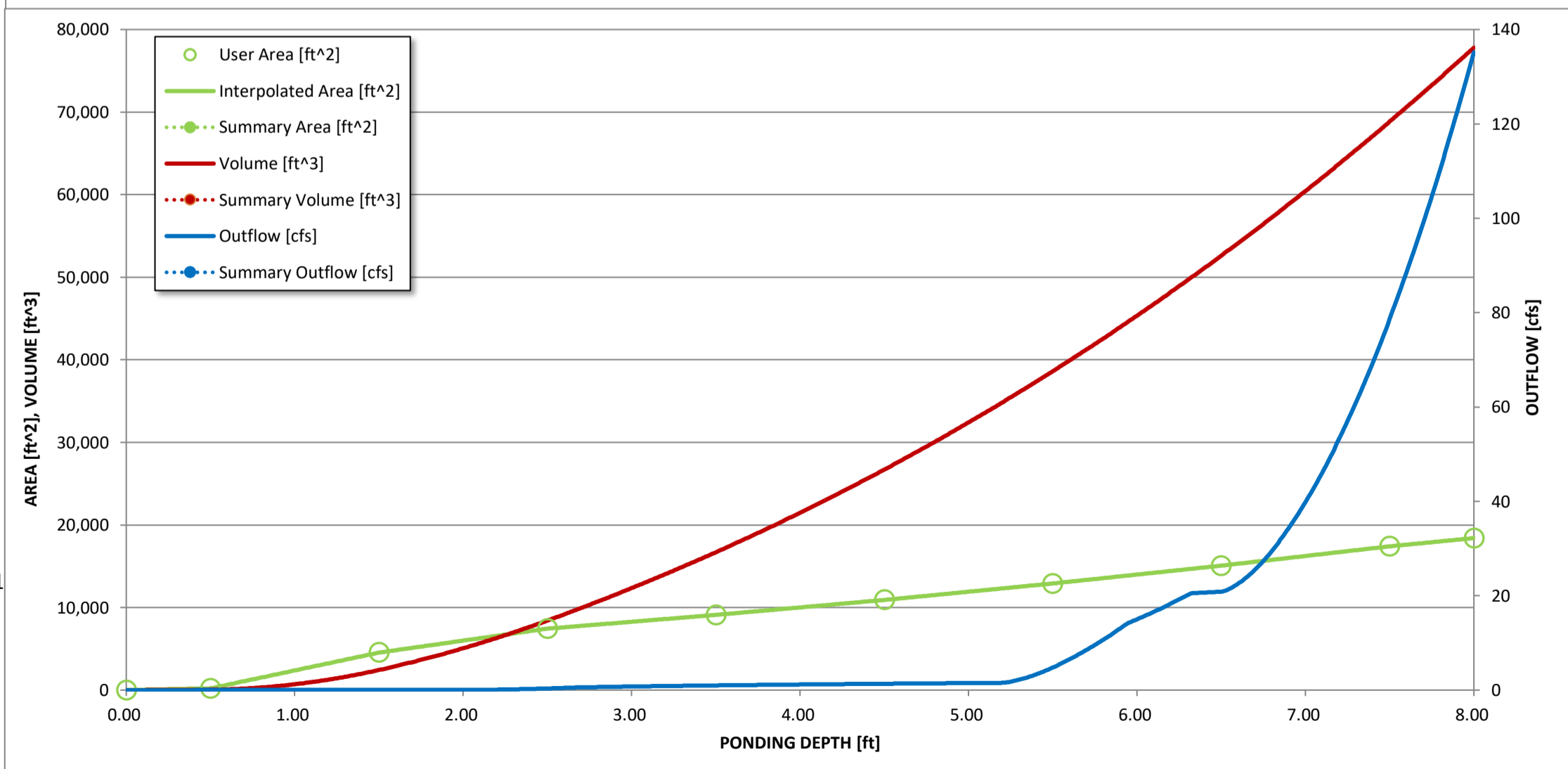
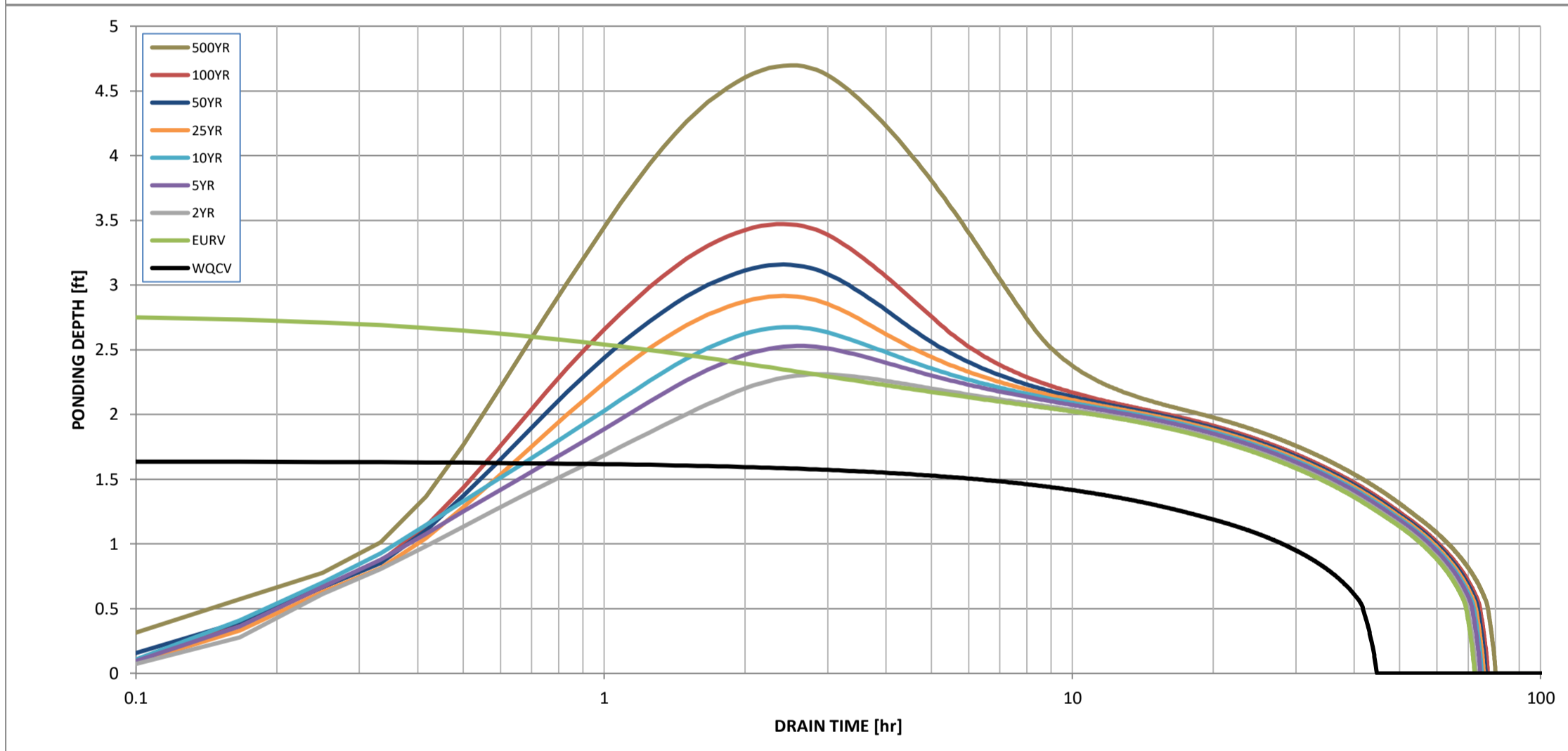
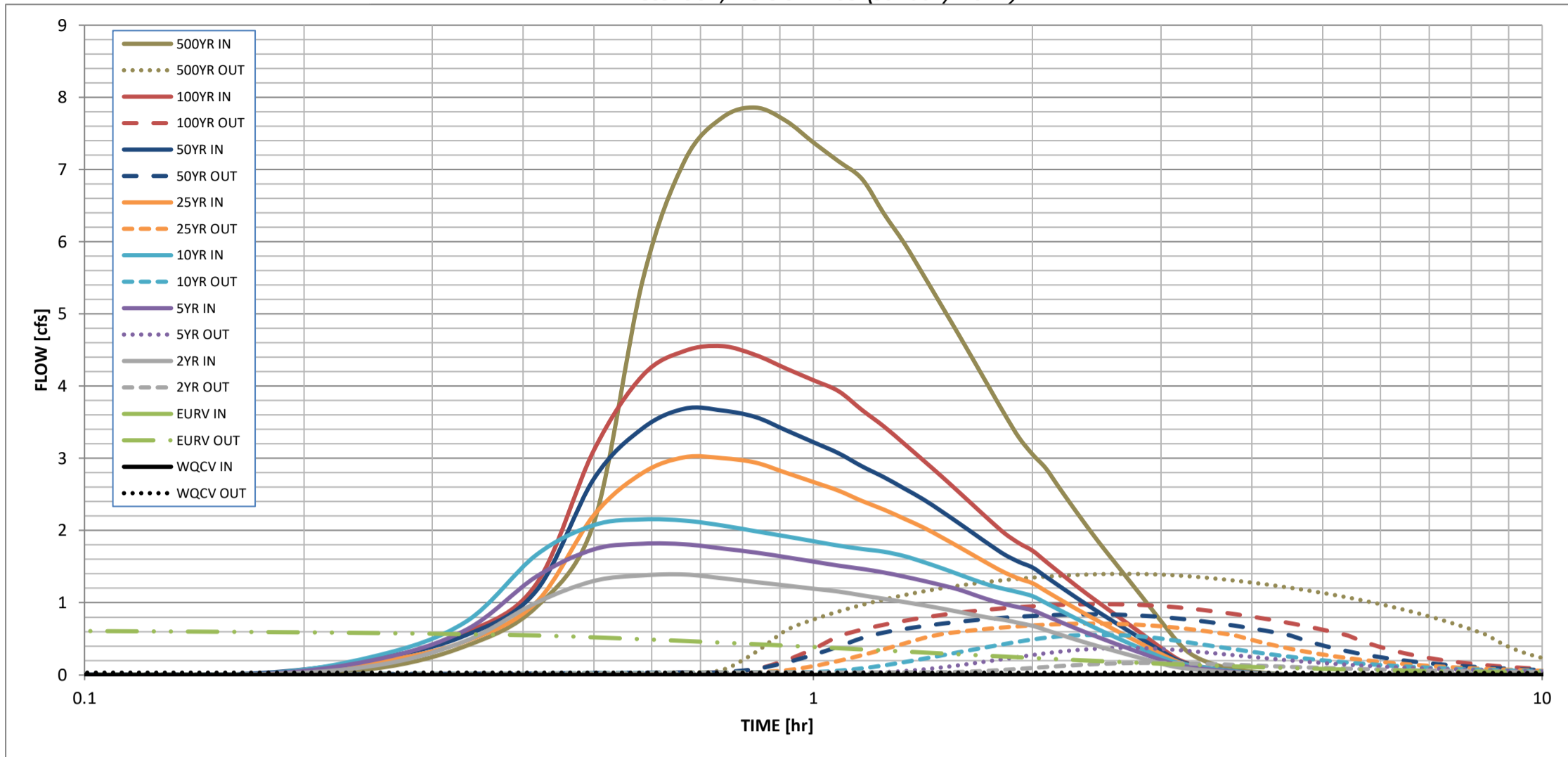
## Routed Hydrograph Results

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.071	0.245	0.184	0.244	0.292	0.364	0.435	0.524	0.895
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.184	0.244	0.292	0.364	0.435	0.524	0.895
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.0	0.0	0.3	0.6	1.0	2.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.01	0.01	0.08	0.15	0.26	0.70
Peak Inflow Q (cfs) =	N/A	N/A	1.4	1.8	2.2	3.0	3.7	4.6	7.9
Peak Outflow Q (cfs) =	0.0	0.6	0.2	0.4	0.6	0.7	0.8	1.0	1.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	16.2	17.1	2.4	1.4	1.0	0.5
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice
Max Velocity through Gate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Max Velocity through Gate 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) =	40	63	65	65	64	63	62	61	56
Time to Drain 99% of Inflow Volume (hours) =	43	68	69	70	70	70	70	69	69
Maximum Ponding Depth (ft) =	1.64	2.80	2.31	2.53	2.68	2.92	3.16	3.47	4.70
Area at Maximum Ponding Depth (acres) =	0.11	0.18	0.16	0.17	0.18	0.19	0.20	0.21	0.26
Maximum Volume Stored (acre-ft) =	0.071	0.246	0.162	0.197	0.223	0.267	0.312	0.377	0.661

# 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: \_\_\_\_\_

## Inflow Hydrographs

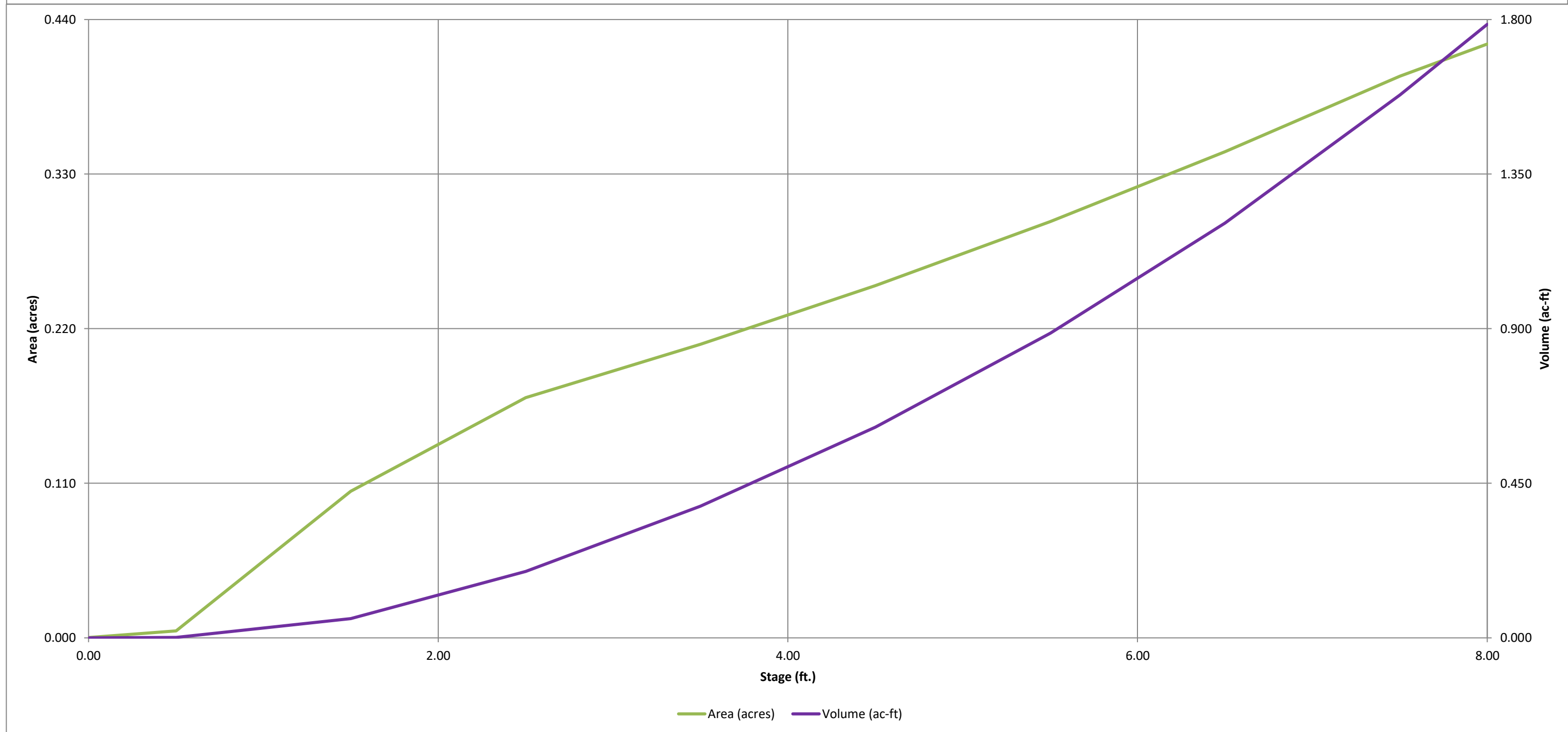
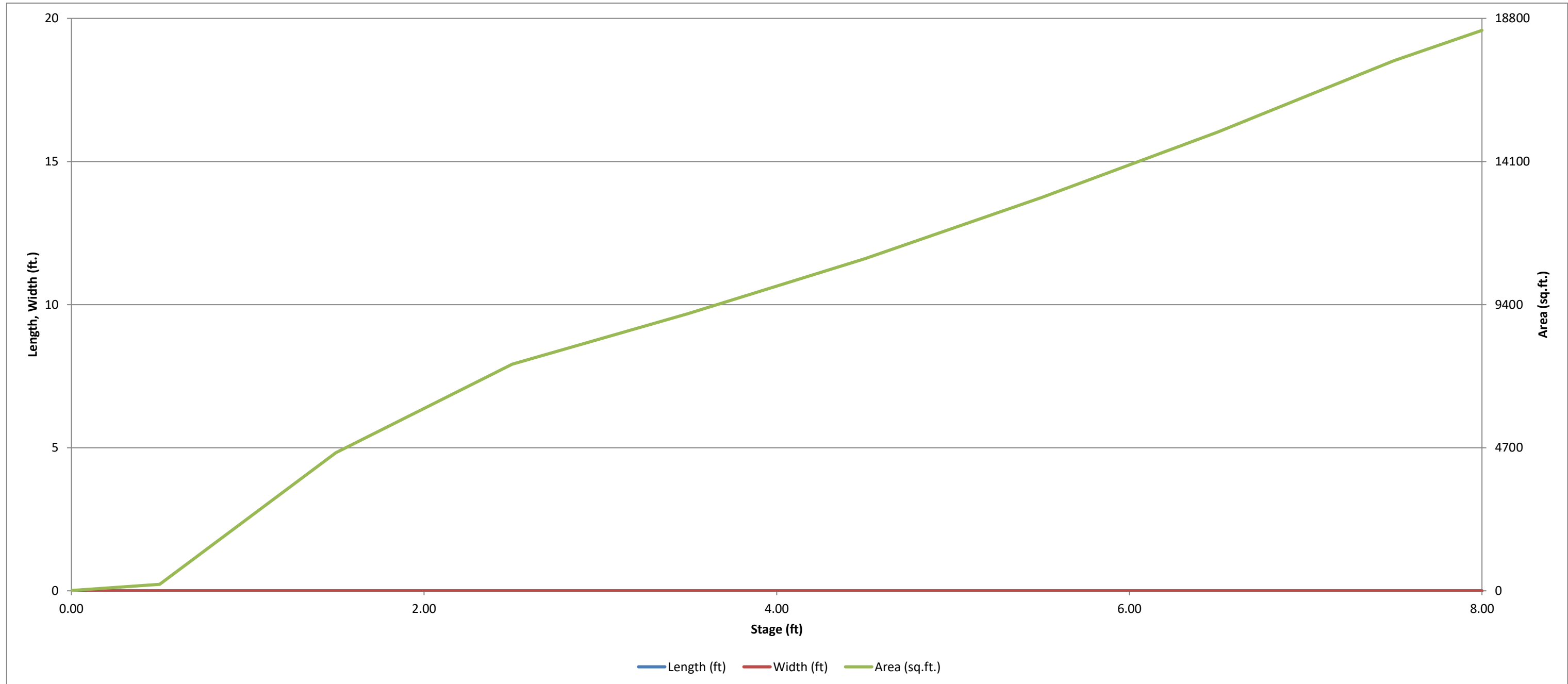
The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval	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]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.09
	0:15:00	0.00	0.00	0.13	0.21	0.26	0.17	0.22	0.21	0.40
	0:20:00	0.00	0.00	0.47	0.62	0.73	0.47	0.55	0.58	0.94
	0:25:00	0.00	0.00	1.00	1.36	1.66	1.00	1.16	1.26	2.11
	0:30:00	0.00	0.00	1.30	1.74	2.07	2.21	2.72	3.11	5.47
	0:35:00	0.00	0.00	1.38	1.82	2.15	2.80	3.42	4.15	7.13
	0:40:00	0.00	0.00	1.39	1.81	2.14	3.02	3.69	4.49	7.72
	0:45:00	0.00	0.00	1.34	1.75	2.07	3.00	3.66	4.55	7.86
	0:50:00	0.00	0.00	1.29	1.69	1.99	2.94	3.57	4.43	7.68
	0:55:00	0.00	0.00	1.24	1.63	1.92	2.80	3.39	4.25	7.38
	1:00:00	0.00	0.00	1.19	1.57	1.85	2.67	3.22	4.08	7.11
	1:05:00	0.00	0.00	1.15	1.51	1.79	2.55	3.07	3.93	6.87
	1:10:00	0.00	0.00	1.10	1.47	1.74	2.41	2.89	3.67	6.39
	1:15:00	0.00	0.00	1.05	1.42	1.71	2.29	2.74	3.44	5.98
	1:20:00	0.00	0.00	1.01	1.36	1.65	2.16	2.58	3.20	5.54
	1:25:00	0.00	0.00	0.96	1.30	1.56	2.04	2.43	2.97	5.12
	1:30:00	0.00	0.00	0.92	1.24	1.48	1.91	2.27	2.75	4.71
	1:35:00	0.00	0.00	0.87	1.18	1.39	1.77	2.10	2.54	4.33
	1:40:00	0.00	0.00	0.83	1.11	1.31	1.65	1.95	2.33	3.95
	1:45:00	0.00	0.00	0.79	1.03	1.24	1.52	1.80	2.13	3.60
	1:50:00	0.00	0.00	0.76	0.98	1.19	1.41	1.66	1.96	3.28
	1:55:00	0.00	0.00	0.72	0.94	1.14	1.33	1.56	1.82	3.05
	2:00:00	0.00	0.00	0.68	0.89	1.09	1.27	1.49	1.72	2.87
	2:05:00	0.00	0.00	0.62	0.82	1.00	1.16	1.36	1.57	2.62
	2:10:00	0.00	0.00	0.57	0.75	0.91	1.06	1.24	1.44	2.38
	2:15:00	0.00	0.00	0.51	0.68	0.82	0.97	1.13	1.30	2.16
	2:20:00	0.00	0.00	0.47	0.61	0.74	0.87	1.02	1.18	1.95
	2:25:00	0.00	0.00	0.42	0.55	0.67	0.79	0.92	1.06	1.76
	2:30:00	0.00	0.00	0.38	0.50	0.60	0.71	0.83	0.96	1.58
	2:35:00	0.00	0.00	0.34	0.44	0.53	0.63	0.74	0.85	1.40
	2:40:00	0.00	0.00	0.30	0.39	0.47	0.56	0.65	0.75	1.23
	2:45:00	0.00	0.00	0.26	0.34	0.41	0.49	0.57	0.65	1.07
	2:50:00	0.00	0.00	0.22	0.29	0.35	0.42	0.49	0.56	0.90
	2:55:00	0.00	0.00	0.19	0.25	0.30	0.35	0.41	0.47	0.75
	3:00:00	0.00	0.00	0.16	0.21	0.25	0.29	0.33	0.37	0.59
	3:05:00	0.00	0.00	0.13	0.17	0.20	0.23	0.26	0.29	0.45
	3:10:00	0.00	0.00	0.10	0.14	0.17	0.18	0.20	0.22	0.34
	3:15:00	0.00	0.00	0.09	0.12	0.14	0.14	0.16	0.17	0.26
	3:20:00	0.00	0.00	0.08	0.10	0.12	0.12	0.13	0.14	0.21
	3:25:00	0.00	0.00	0.06	0.09	0.11	0.10	0.11	0.11	0.17
	3:30:00	0.00	0.00	0.06	0.07	0.09	0.08	0.09	0.09	0.13
	3:35:00	0.00	0.00	0.05	0.06	0.08	0.07	0.08	0.07	0.11
	3:40:00	0.00	0.00	0.04	0.05	0.06	0.06	0.06	0.06	0.09
	3:45:00	0.00	0.00	0.03	0.04	0.05	0.05	0.05	0.05	0.07
	3:50:00	0.00	0.00	0.03	0.04	0.04	0.04	0.04	0.04	0.06
	3:55:00	0.00	0.00	0.02	0.03	0.03	0.03	0.03	0.03	0.04
	4:00:00	0.00	0.00	0.02	0.02	0.03	0.02	0.03	0.03	0.04
	4:05:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	4:10:00	0.00	0.00	0.01	0.01	0.02	0.01	0.02	0.01	0.02
	4:15:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	4:20:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	



# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

*MHFD-Detention, Version 4.05 (January 2022)*

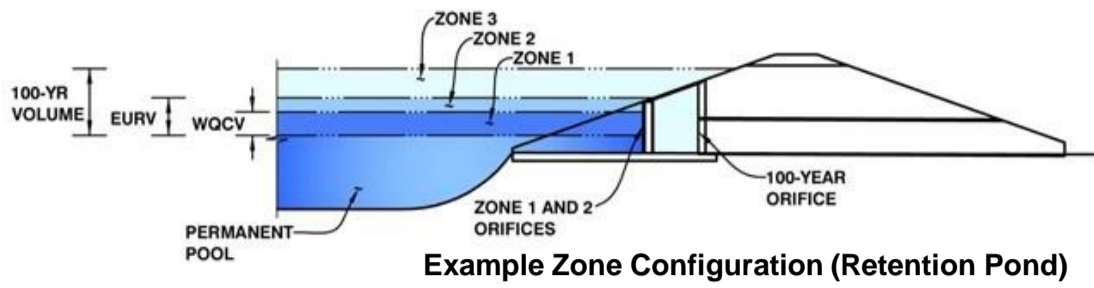


# DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

**Project: Eastonville Road**

**Basin ID: POND B: Ultimate Conditions (INCLUDES SEGMENT 2 FLOW) [BASINS EA6 - EA10]**



**Example Zone Configuration (Retention Pond)**

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.53	0.197	Orifice Plate
Zone 2 (EURV)	5.05	0.559	Circular Orifice
Zone 3 (100-year)	6.25	0.363	Weir&Pipe (Restrict)
<b>Total (all zones)</b>		<b>1.119</b>	

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

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

**Calculated Parameters for Underdrain**  
 Underdrain Orifice Area =  ft<sup>2</sup>  
 Underdrain Orifice Centroid =  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 =  ft (relative to basin bottom at Stage = 0 ft)  
 Depth at top of Zone using Orifice Plate =  ft (relative to basin bottom at Stage = 0 ft)  
 Orifice Plate: Orifice Vertical Spacing =  inches  
 Orifice Plate: Orifice Area per Row =  sq. inches (diameter = 1 inch)

**Calculated Parameters for Plate**  
 WQ Orifice Area per Row =  ft<sup>2</sup>  
 Elliptical Half-Width =  feet  
 Elliptical Slot Centroid =  feet  
 Elliptical Slot Area =  ft<sup>2</sup>

**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	0.87	1.73					
Orifice Area (sq. inches)	0.79	0.79	0.79					

	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)**

Invert of Vertical Orifice =    ft (relative to basin bottom at Stage = 0 ft)  
 Depth at top of Zone using Vertical Orifice =    ft (relative to basin bottom at Stage = 0 ft)  
 Vertical Orifice Diameter =    inches

**Calculated Parameters for Vertical Orifice**  
 Vertical Orifice Area =    ft<sup>2</sup>  
 Vertical Orifice Centroid =    feet

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

Overflow Weir Front Edge Height,  $H_o$  =    ft (relative to basin bottom at Stage = 0 ft)  
 Overflow Weir Front Edge Length =    feet  
 Overflow Weir Grate Slope =    H:V  
 Horiz. Length of Weir Sides =    feet  
 Overflow Grate Type =     
 Debris Clogging % =    %

**Calculated Parameters for Overflow Weir**  
 Height of Grate Upper Edge,  $H_t$  =    feet  
 Overflow Weir Slope Length =    feet  
 Grate Open Area / 100-yr Orifice Area =     
 Overflow Grate Open Area w/o Debris =    ft<sup>2</sup>  
 Overflow Grate Open Area w/ Debris =    ft<sup>2</sup>

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

Depth to Invert of Outlet Pipe =    ft (distance below basin bottom at Stage = 0 ft)  
 Outlet Pipe Diameter =    inches  
 Restrictor Plate Height Above Pipe Invert =    inches

**Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate**  
 Outlet Orifice Area =    ft<sup>2</sup>  
 Outlet Orifice Centroid =    feet  
 Half-Central Angle of Restrictor Plate on Pipe =    radians

**User Input: Emergency Spillway (Rectangular or Trapezoidal)**

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

**Calculated Parameters for Spillway**  
 Spillway Design Flow Depth =  feet  
 Stage at Top of Freeboard =  feet  
 Basin Area at Top of Freeboard =  acres  
 Basin Volume at Top of Freeboard =  acre-ft

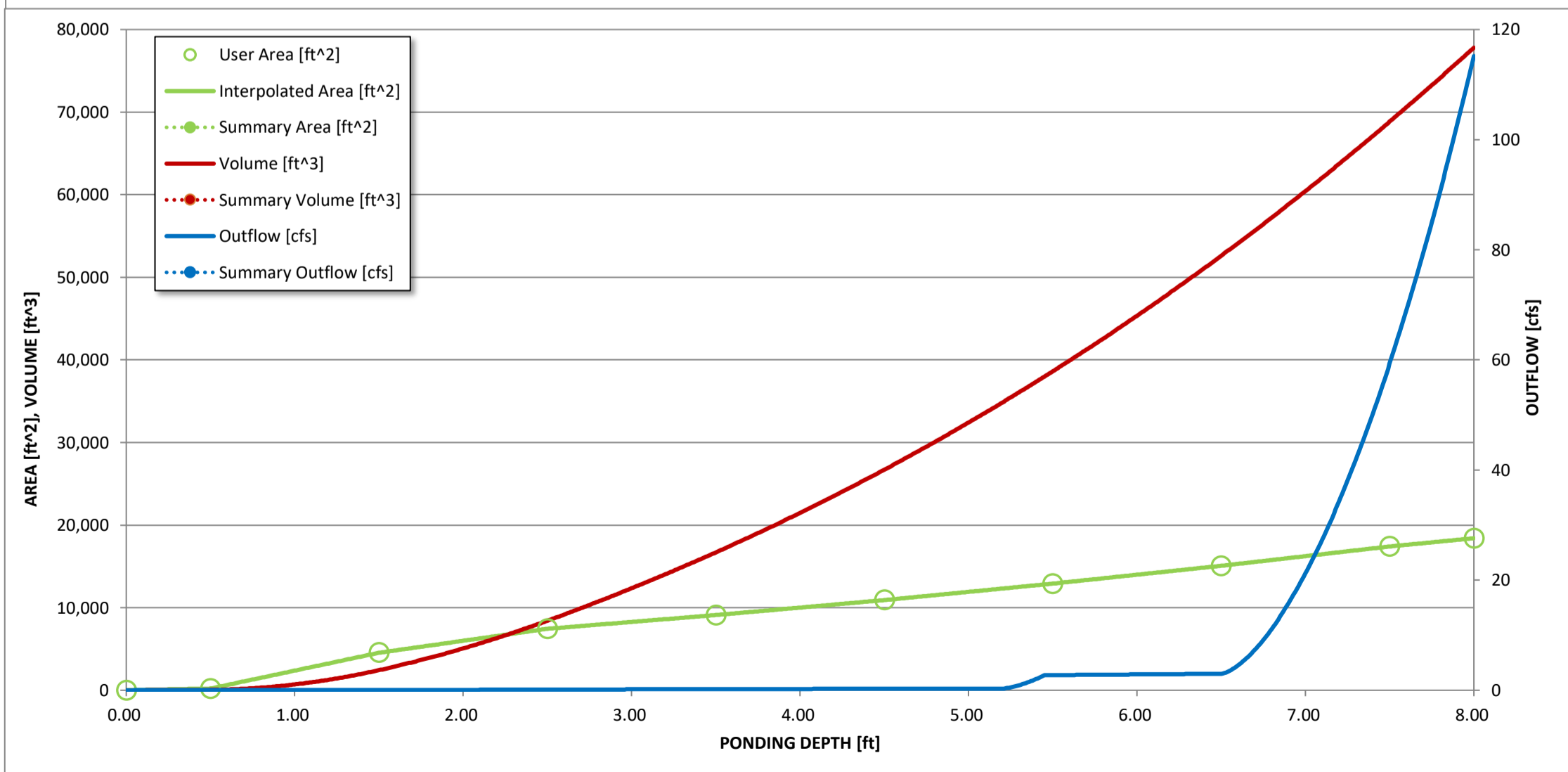
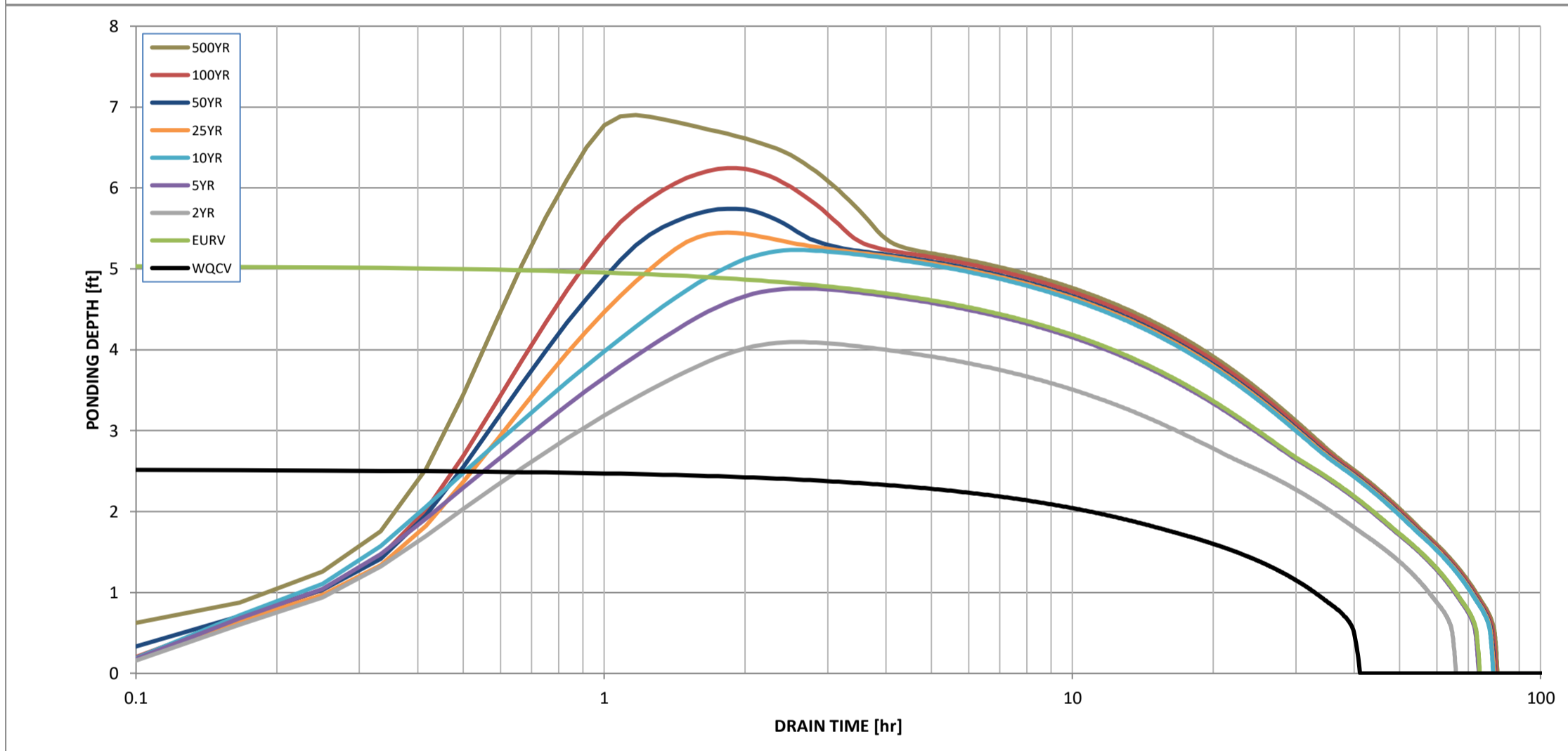
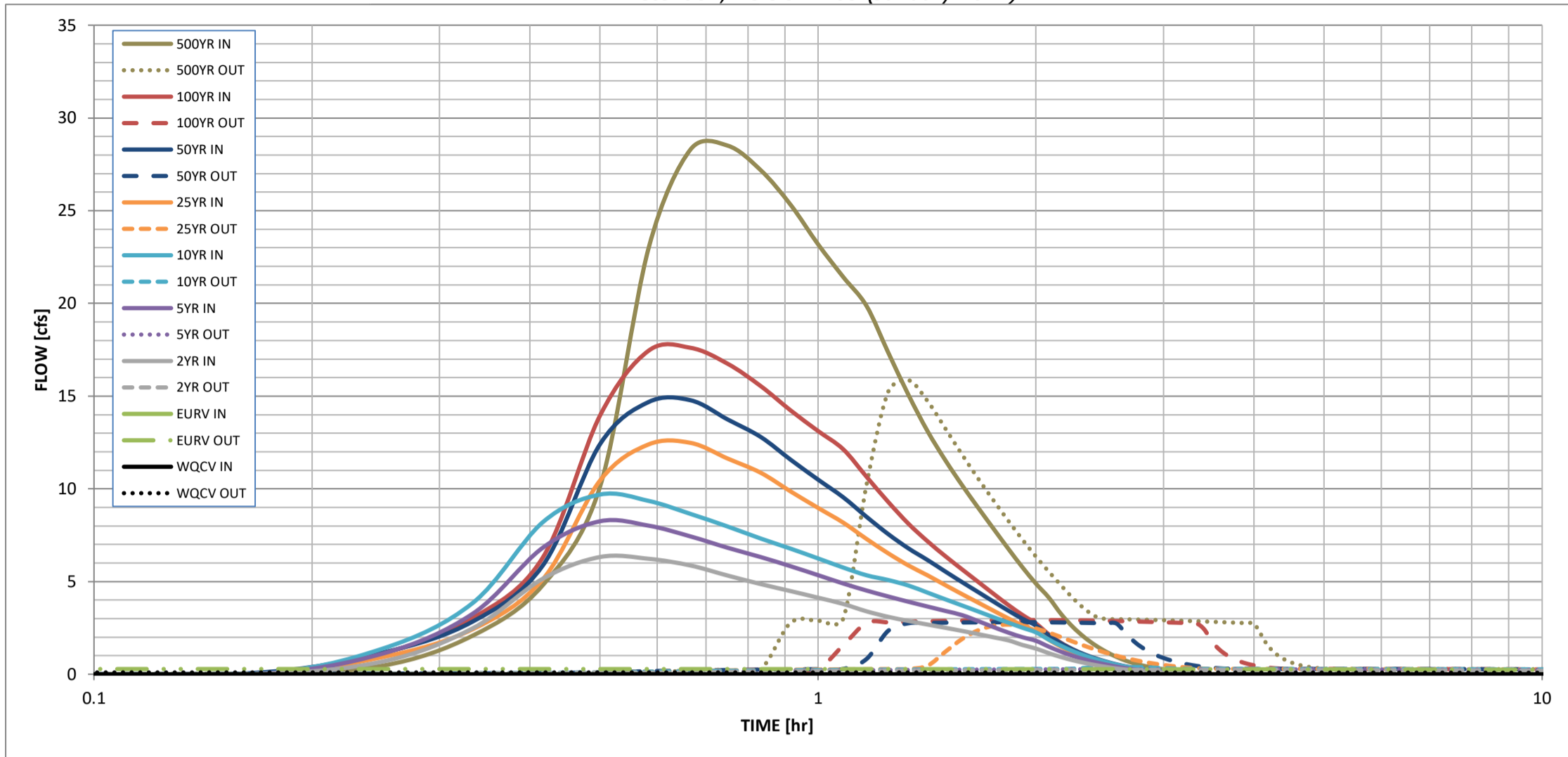
**Routed Hydrograph Results**

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.197	0.756	0.556	0.728	0.866	1.043	1.217	1.427	2.302
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.556	0.728	0.866	1.043	1.217	1.427	2.302
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.0	0.1	0.1	1.0	2.0	3.3	8.8
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.00	0.01	0.01	0.11	0.22	0.36	0.97
Peak Inflow Q (cfs) =	N/A	N/A	6.3	8.3	9.7	12.5	14.8	17.6	28.5
Peak Outflow Q (cfs) =	0.1	0.3	0.2	0.3	0.4	2.7	2.8	2.9	15.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	3.6	3.9	2.7	1.4	0.9	1.8
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Gate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.4	0.4	0.4	0.4
Max Velocity through Gate 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) =	37	64	58	64	68	67	66	65	59
Time to Drain 99% of Inflow Volume (hours) =	<b>40</b>	70	62	69	74	74	73	73	71
Maximum Ponding Depth (ft) =	2.53	5.05	4.09	4.76	5.23	5.45	5.74	6.25	6.90
Area at Maximum Ponding Depth (acres) =	0.17	0.28	0.23	0.26	0.28	0.29	0.31	0.33	0.37
Maximum Volume Stored (acre-ft) =	0.198	0.758	0.514	0.677	0.808	0.869	0.959	1.119	1.350

# 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: \_\_\_\_\_

**Inflow Hydrographs**

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

Time Interval	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]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.01	0.46
	0:15:00	0.00	0.00	0.68	1.11	1.37	0.92	1.16	1.13	2.08
	0:20:00	0.00	0.00	2.48	3.26	3.84	2.43	2.84	3.03	4.80
	0:25:00	0.00	0.00	5.15	6.82	8.20	5.12	5.86	6.29	10.12
	0:30:00	0.00	0.00	6.32	8.25	9.69	10.45	12.41	13.96	22.97
	0:35:00	0.00	0.00	6.23	8.02	9.35	12.39	14.68	17.45	28.30
	0:40:00	0.00	0.00	5.87	7.44	8.65	12.48	14.78	17.61	28.51
	0:45:00	0.00	0.00	5.33	6.82	7.97	11.64	13.74	16.75	27.19
	0:50:00	0.00	0.00	4.87	6.32	7.32	10.87	12.80	15.54	25.32
	0:55:00	0.00	0.00	4.49	5.83	6.77	9.86	11.57	14.23	23.19
	1:00:00	0.00	0.00	4.13	5.35	6.25	8.98	10.50	13.12	21.43
	1:05:00	0.00	0.00	3.79	4.90	5.76	8.18	9.55	12.14	19.87
	1:10:00	0.00	0.00	3.40	4.52	5.34	7.30	8.50	10.66	17.36
	1:15:00	0.00	0.00	3.10	4.20	5.08	6.53	7.56	9.30	15.07
	1:20:00	0.00	0.00	2.88	3.91	4.79	5.87	6.79	8.12	13.12
	1:25:00	0.00	0.00	2.68	3.65	4.40	5.34	6.16	7.17	11.53
	1:30:00	0.00	0.00	2.51	3.42	4.04	4.80	5.54	6.36	10.17
	1:35:00	0.00	0.00	2.33	3.18	3.70	4.31	4.96	5.64	8.95
	1:40:00	0.00	0.00	2.16	2.86	3.38	3.85	4.42	4.97	7.82
	1:45:00	0.00	0.00	1.99	2.54	3.07	3.42	3.91	4.32	6.75
	1:50:00	0.00	0.00	1.83	2.24	2.78	3.01	3.43	3.73	5.77
	1:55:00	0.00	0.00	1.58	2.00	2.51	2.64	2.99	3.20	4.89
	2:00:00	0.00	0.00	1.39	1.81	2.26	2.33	2.63	2.74	4.14
	2:05:00	0.00	0.00	1.14	1.49	1.87	1.86	2.10	2.16	3.25
	2:10:00	0.00	0.00	0.93	1.22	1.53	1.49	1.67	1.70	2.55
	2:15:00	0.00	0.00	0.76	0.99	1.25	1.19	1.34	1.34	2.00
	2:20:00	0.00	0.00	0.61	0.80	1.02	0.95	1.07	1.05	1.56
	2:25:00	0.00	0.00	0.50	0.65	0.82	0.76	0.86	0.83	1.22
	2:30:00	0.00	0.00	0.40	0.52	0.66	0.61	0.68	0.65	0.94
	2:35:00	0.00	0.00	0.32	0.41	0.52	0.48	0.54	0.50	0.72
	2:40:00	0.00	0.00	0.25	0.32	0.40	0.37	0.42	0.39	0.56
	2:45:00	0.00	0.00	0.20	0.25	0.32	0.29	0.32	0.30	0.44
	2:50:00	0.00	0.00	0.16	0.20	0.25	0.23	0.26	0.24	0.35
	2:55:00	0.00	0.00	0.12	0.15	0.19	0.18	0.20	0.19	0.27
	3:00:00	0.00	0.00	0.09	0.11	0.14	0.14	0.15	0.14	0.21
	3:05:00	0.00	0.00	0.06	0.08	0.10	0.10	0.11	0.10	0.15
	3:10:00	0.00	0.00	0.04	0.05	0.07	0.07	0.07	0.07	0.10
	3:15:00	0.00	0.00	0.02	0.03	0.04	0.04	0.05	0.04	0.06
	3:20:00	0.00	0.00	0.01	0.02	0.02	0.02	0.02	0.02	0.03
	3:25:00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

## Design Procedure Form: Sand Filter (SF)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 2

**Designer:** SPC  
**Company:** HR Green  
**Date:** August 23, 2024  
**Project:** Eastonville Road - Segment 1 Improvements SFBD  
**Location:** El Paso County, CO

<p>1. Basin Storage Volume</p> <p>A) Effective Imperviousness of Tributary Area, <math>I_a</math> (100% if all paved and roofed areas upstream of sand filter)</p> <p>B) Tributary Area's Imperviousness Ratio (<math>i = I_a/100</math>)</p> <p>C) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time <math>WQCV = 0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i)</math></p> <p>D) Contributing Watershed Area (including sand filter area)</p> <p>E) Water Quality Capture Volume (WQCV) Design Volume <math>V_{WQCV} = WQCV / 12 * Area</math></p> <p>F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm</p> <p>G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume</p> <p>H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)</p>	<p><math>I_a = </math> <input style="width: 50px;" type="text" value="34.0"/> %</p> <p><math>i = </math> <input style="width: 50px;" type="text" value="0.340"/></p> <p>WQCV = <input style="width: 50px;" type="text" value="0.13"/> watershed inches</p> <p>Area = <input style="width: 50px;" type="text" value="171,191"/> sq ft</p> <p><math>V_{WQCV} = </math> <input style="width: 50px;" type="text" value="1,865"/> cu ft</p> <p><math>d_6 = </math> <input style="width: 50px;" type="text" value=""/></p> <p><math>V_{WQCV\ OTHER} = </math> <input style="width: 50px;" type="text" value=""/> cu ft</p> <p><math>V_{WQCV\ USER} = </math> <input style="width: 50px;" type="text" value=""/> cu ft</p>
<p>2. Basin Geometry</p> <p>A) WQCV Depth</p> <p>B) Sand Filter Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred). Use "0" if sand filter has vertical walls.</p> <p>C) Minimum Filter Area (Flat Surface Area)</p> <p>D) Actual Filter Area</p> <p>E) Volume Provided</p>	<p><math>D_{WQCV} = </math> <input style="width: 50px;" type="text" value="1.0"/> ft</p> <p><math>Z = </math> <input style="width: 50px;" type="text" value="4.00"/> ft / ft</p> <p><math>A_{Min} = </math> <input style="width: 50px;" type="text" value="728"/> sq ft</p> <p><math>A_{Actual} = </math> <input style="width: 50px;" type="text" value="938"/> sq ft</p> <p><math>V_T = </math> <input style="width: 50px;" type="text" value="39003"/> cu ft</p>
<p>3. Filter Material</p>	<p>Choose One</p> <p><input checked="" type="radio"/> 18" CDOT Class B or C Filter Material</p> <p><input type="radio"/> Other (Explain):</p> <p>_____</p> <p>_____</p>
<p>4. Underdrain System</p> <p>A) Are underdrains provided?</p> <p>B) Underdrain system orifice diameter for 12 hour drain time</p> <p style="margin-left: 20px;">i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice</p> <p style="margin-left: 20px;">ii) Volume to Drain in 12 Hours</p> <p style="margin-left: 20px;">iii) Orifice Diameter, 3/8" Minimum</p>	<p>Choose One</p> <p><input checked="" type="radio"/> YES</p> <p><input type="radio"/> NO</p> <p><math>y = </math> <input style="width: 50px;" type="text" value="2.3"/> ft</p> <p><math>Vol_{12} = </math> <input style="width: 50px;" type="text" value="1,865"/> cu ft</p> <p><math>D_o = </math> <input style="width: 50px;" type="text" value="1"/> in</p>

Design Procedure Form: Sand Filter (SF)

Sheet 2 of 2

Designer: SPC  
Company: HR Green  
Date: August 23, 2024  
Project: Eastonville Road - Segment 1 Improvements SFBD  
Location: El Paso County, CO

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric

A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?

Choose One

YES  NO

6. Inlet / Outlet Works

A) Describe the type of energy dissipation at inlet points and means of conveying flows in excess of the WQCV through the outlet

Energy dissipation at inlet points provided via riprap/forebay, and means of conveying flows in excess of the WQCV through the outlet is via the modified type 'C' inlet outlet structure grate, and a restricted outlet pipe.

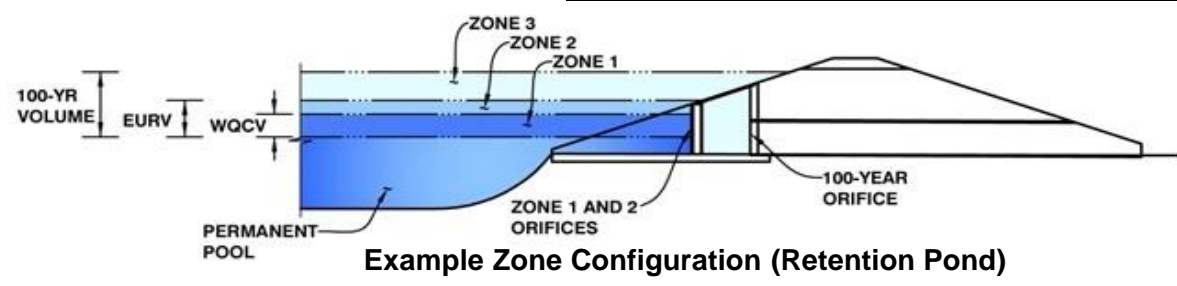
Notes: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)

**Project: Eastonville Road**

**Basin ID: SFB D**



**Watershed Information**

Selected BMP Type =	<b>SF</b>
Watershed Area =	3.93 acres
Watershed Length =	895 ft
Watershed Length to Centroid =	243 ft
Watershed Slope =	0.016 ft/ft
Watershed Imperviousness =	34.00% percent
Percentage Hydrologic Soil Group A =	0.0% percent
Percentage Hydrologic Soil Group B =	100.0% percent
Percentage Hydrologic Soil Groups C/D =	0.0% percent
Target WQCV Drain Time =	12.0 hours
Location for 1-hr Rainfall Depths =	User Input

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

Water Quality Capture Volume (WQCV) =	0.043	acre-feet
Excess Urban Runoff Volume (EURV) =	0.139	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.136	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.212	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.282	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.385	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	0.465	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	0.569	acre-feet
500-yr Runoff Volume (P1 = 3.68 in.) =	0.954	acre-feet
Approximate 2-yr Detention Volume =	0.100	acre-feet
Approximate 5-yr Detention Volume =	0.142	acre-feet
Approximate 10-yr Detention Volume =	0.202	acre-feet
Approximate 25-yr Detention Volume =	0.230	acre-feet
Approximate 50-yr Detention Volume =	0.242	acre-feet
Approximate 100-yr Detention Volume =	0.282	acre-feet

**Optional User Overrides**

acre-feet	acre-feet
acre-feet	acre-feet
1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
3.68	inches

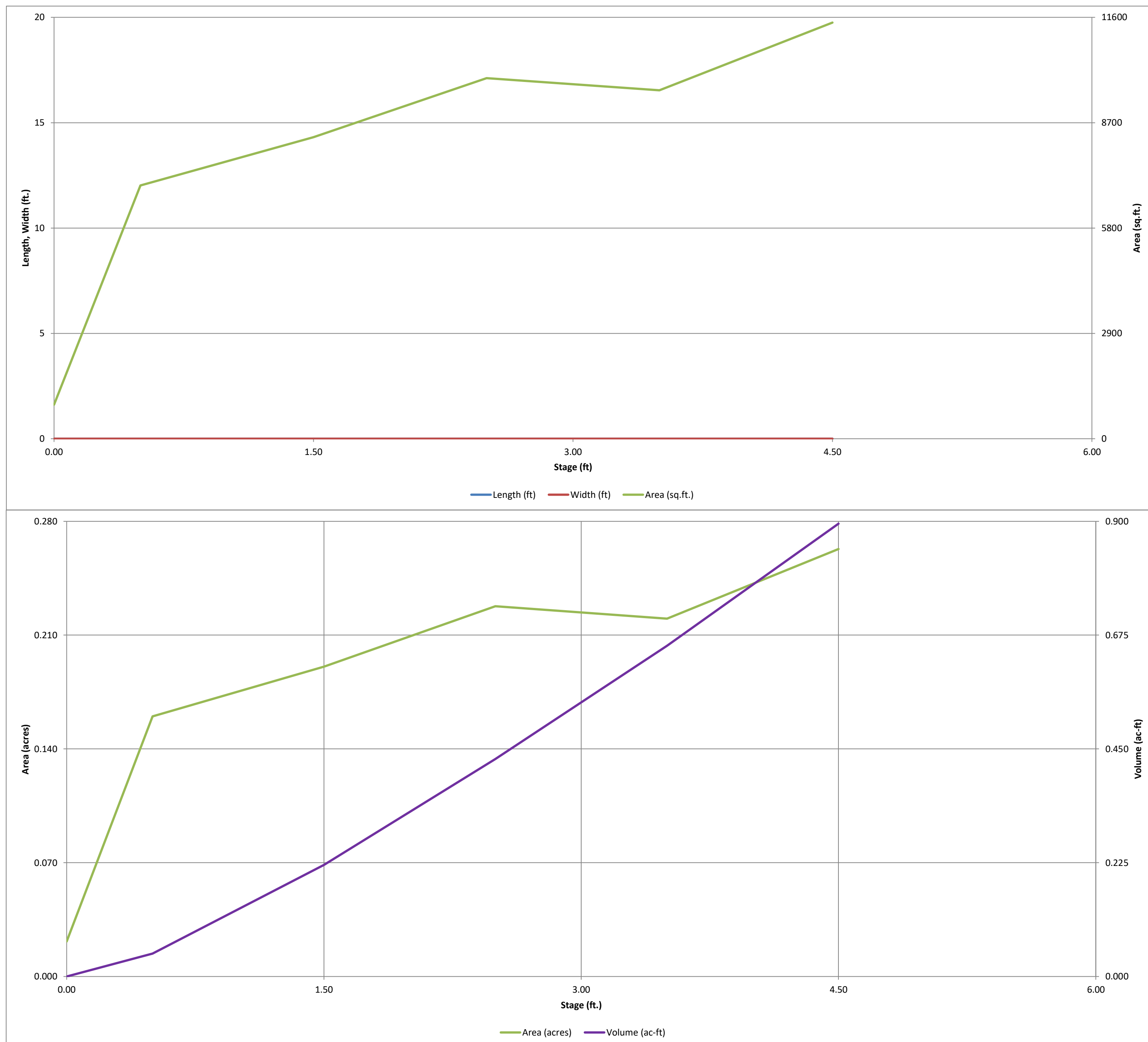
**Define Zones and Basin Geometry**

Zone 1 Volume (WQCV) =	0.043	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.096	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.144	acre-feet
Total Detention Basin Volume =	0.282	acre-feet
Initial Surcharge Volume (ISV) =	N/A	ft <sup>3</sup>
Initial Surcharge Depth (ISD) =	N/A	ft
Total Available Detention Depth (H <sub>total</sub> ) =	user	ft
Depth of Trickle Channel (H <sub>TC</sub> ) =	N/A	ft
Slope of Trickle Channel (S <sub>TC</sub> ) =	N/A	ft/ft
Slopes of Main Basin Sides (S <sub>main</sub> ) =	user	H:V
Basin Length-to-Width Ratio (R <sub>L/W</sub> ) =	user	
Initial Surcharge Area (A <sub>ISV</sub> ) =	user	ft <sup>2</sup>
Surcharge Volume Length (L <sub>ISV</sub> ) =	user	ft
Surcharge Volume Width (W <sub>ISV</sub> ) =	user	ft
Depth of Basin Floor (H <sub>FLOOR</sub> ) =	user	ft
Length of Basin Floor (L <sub>FLOOR</sub> ) =	user	ft
Width of Basin Floor (W <sub>FLOOR</sub> ) =	user	ft
Area of Basin Floor (A <sub>FLOOR</sub> ) =	user	ft <sup>2</sup>
Volume of Basin Floor (V <sub>FLOOR</sub> ) =	user	ft <sup>3</sup>
Depth of Main Basin (H <sub>MAIN</sub> ) =	user	ft
Length of Main Basin (L <sub>MAIN</sub> ) =	user	ft
Width of Main Basin (W <sub>MAIN</sub> ) =	user	ft
Area of Main Basin (A <sub>MAIN</sub> ) =	user	ft <sup>2</sup>
Volume of Main Basin (V <sub>MAIN</sub> ) =	user	ft <sup>3</sup>
Calculated Total Basin Volume (V <sub>total</sub> ) =	user	acre-feet

Depth Increment =		ft							
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft <sup>2</sup> )	Optional Override Area (ft <sup>2</sup> )	Area (acre)	Volume (ft <sup>3</sup> )	Volume (ac-ft)
6966 Media Surface	--	0.00	--	--	--	938	0.022		
<b>6966.5</b>	--	<b>0.50</b>	--	--	--	<b>6,972</b>	<b>0.160</b>	<b>1,977</b>	<b>0.045</b>
	--	1.50	--	--	--	8,300	0.191	9,613	0.221
	--	2.50	--	--	--	9,923	0.228	18,725	0.430
	--	3.50	--	--	--	9,589	0.220	28,481	0.654
<b>6,970.50</b>	--	<b>4.50</b>	--	--	--	<b>11,455</b>	<b>0.263</b>	<b>39,003</b>	<b>0.895</b>

# DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.05 (January 2022)

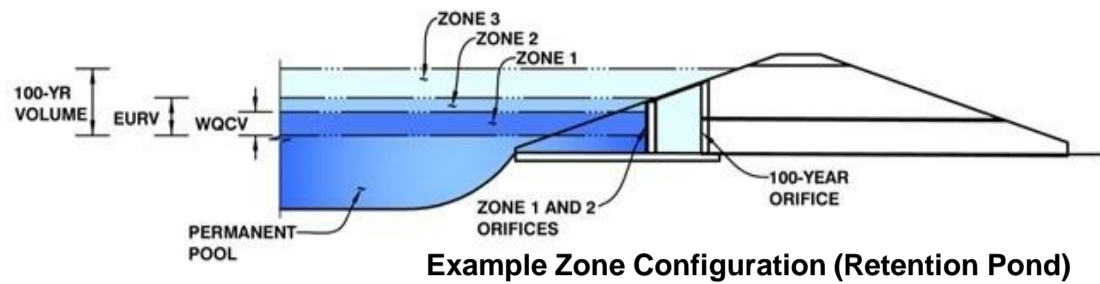


# DETENTION BASIN OUTLET STRUCTURE DESIGN

*MHFD-Detention, Version 4.05 (January 2022)*

**Project: Eastonville Road**

**Basin ID: SFB D**



	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	0.49	0.043	Filtration Media
Zone 2 (EURV)	1.06	0.096	Circular Orifice
Zone 3 (100-year)	1.82	0.144	Weir&Pipe (Restrict)
<b>Total (all zones)</b>		<b>0.282</b>	

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

Underdrain Orifice Invert Depth =	2.25	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	0.94	inches

**Calculated Parameters for Underdrain**

Underdrain Orifice Area =	0.0	ft <sup>2</sup>
Underdrain Orifice Centroid =	0.04	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 =	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	N/A	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	N/A	inches
Orifice Plate: Orifice Area per Row =	N/A	sq. inches

**Calculated Parameters for Plate**

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

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

	Row 1 (optional)	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

	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)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orifice Area (sq. inches)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**User Input: Vertical Orifice (Circular or Rectangular)**

	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	0.50	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	0.92	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	0.38	N/A	inches

**Calculated Parameters for Vertical Orifice**

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.00	N/A	ft <sup>2</sup>
Vertical Orifice Centroid =	0.02	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 =	1.25	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	3.00	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	%

**Calculated Parameters for Overflow Weir**

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H <sub>g</sub> =	1.25	N/A	feet
Overflow Weir Slope Length =	3.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	12.88	N/A	
Overflow Grate Open Area w/o Debris =	6.26	N/A	ft <sup>2</sup>
Overflow Grate Open Area w/ Debris =	3.13	N/A	ft <sup>2</sup>

**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 =	2.50	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 =	5.75		inches

**Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate**

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	0.49	N/A	ft <sup>2</sup>
Outlet Orifice Centroid =	0.28	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.20	N/A	radians

**User Input: Emergency Spillway (Rectangular or Trapezoidal)**

Spillway Invert Stage =	3.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	4.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

**Calculated Parameters for Spillway**

Spillway Design Flow Depth =	0.50	feet
Stage at Top of Freeboard =	4.50	feet
Basin Area at Top of Freeboard =	0.26	acres
Basin Volume at Top of Freeboard =	0.90	acre-ft

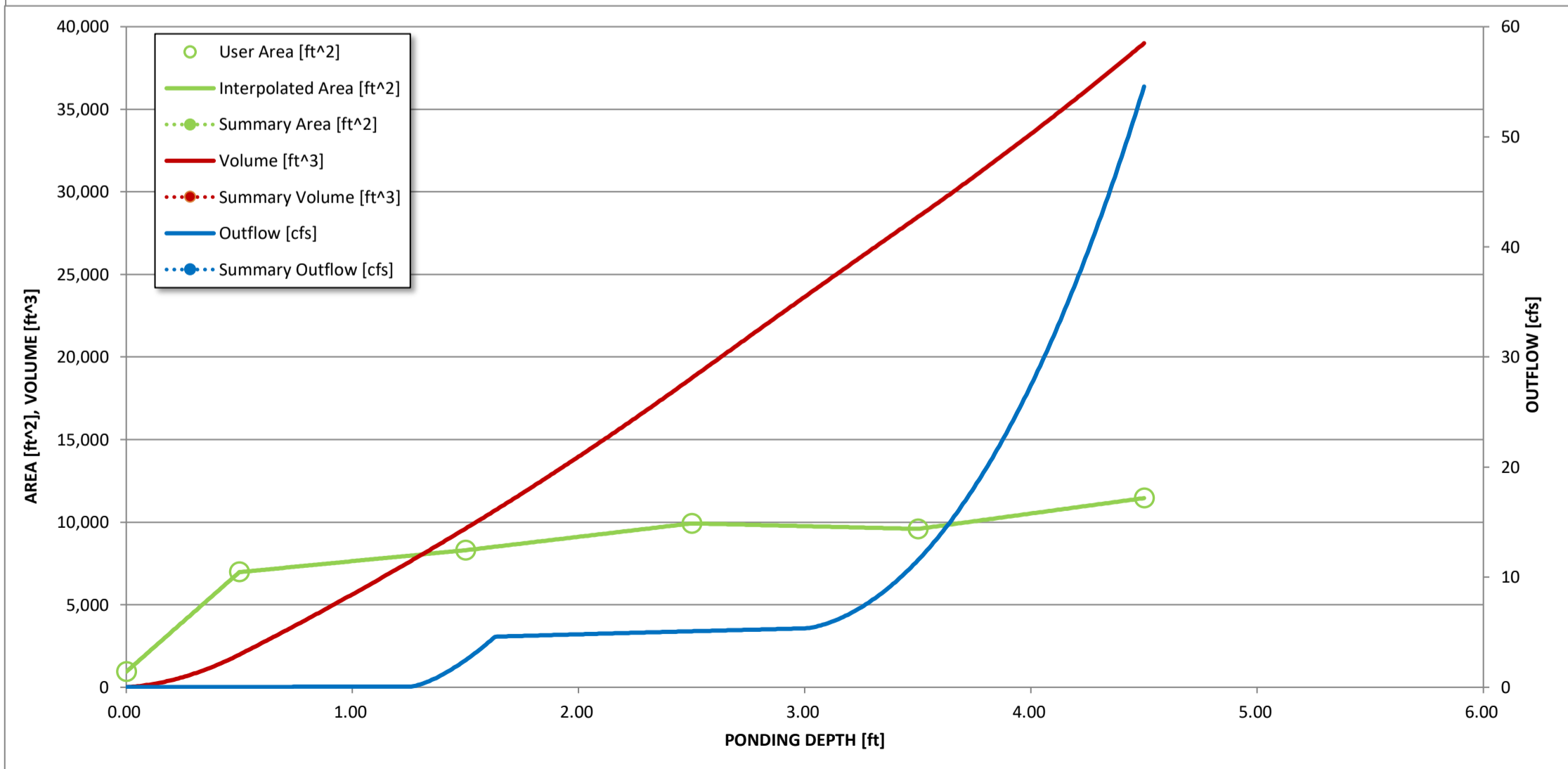
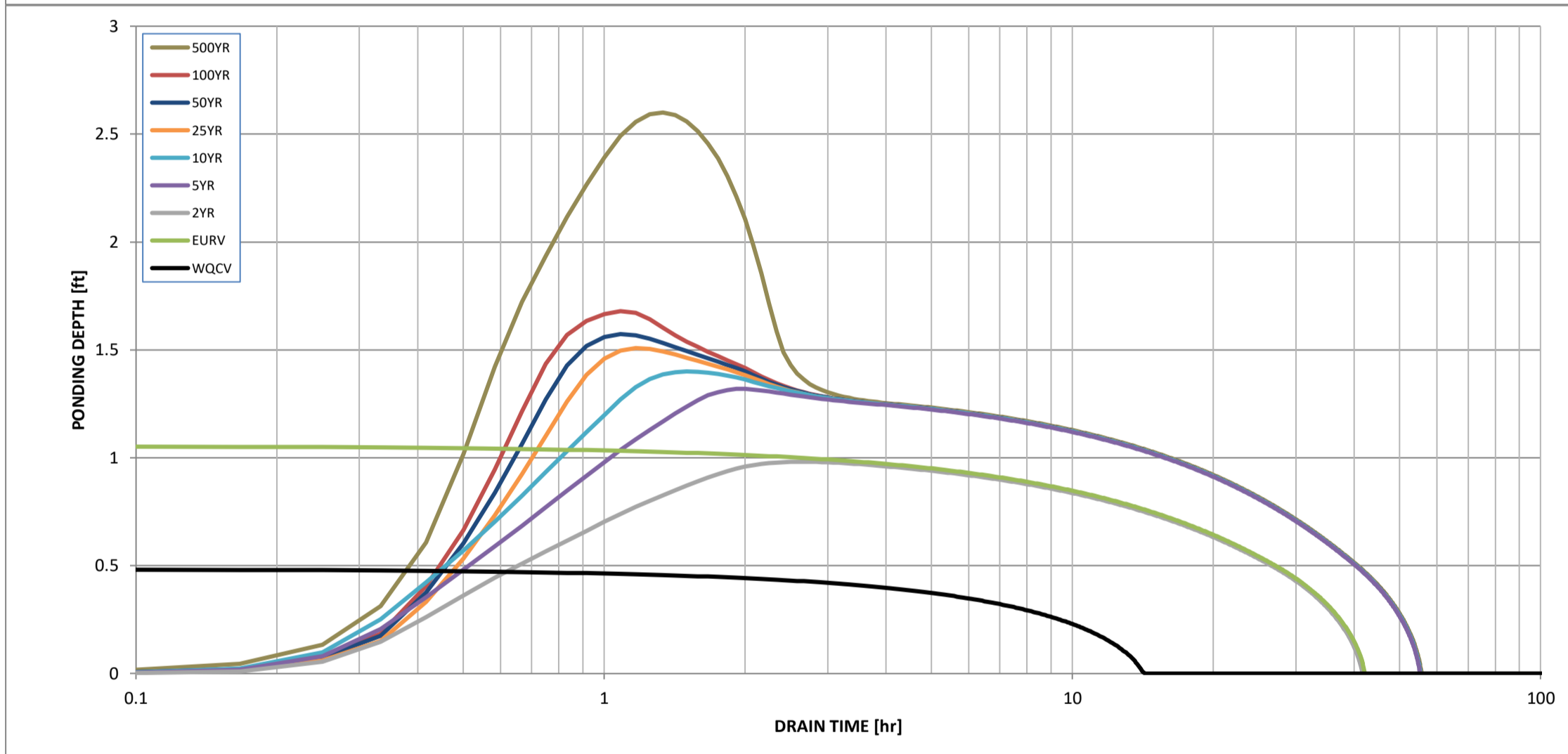
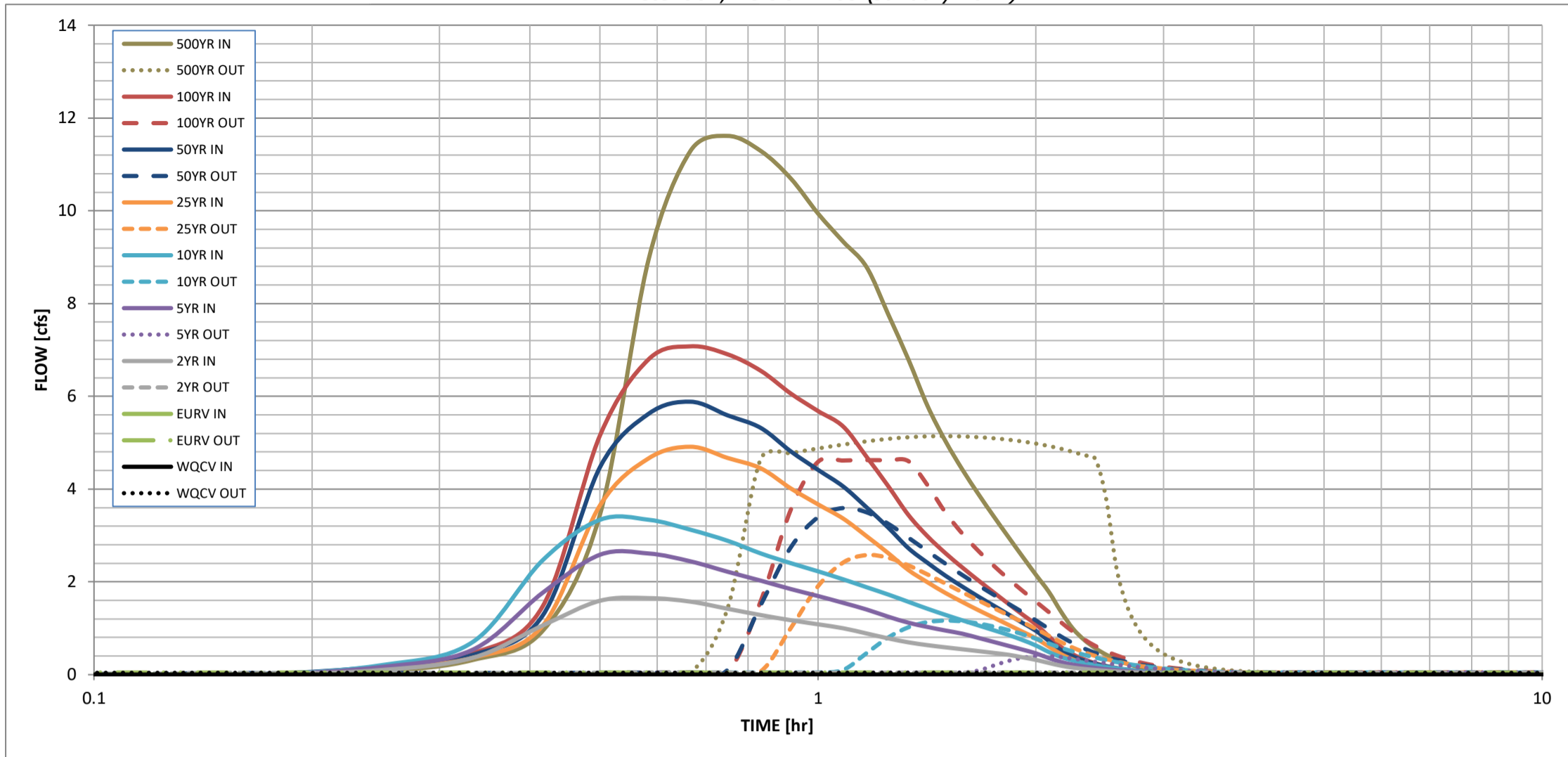
**Routed Hydrograph Results**

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

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
Design Storm Return Period =									
One-Hour Rainfall Depth (in) =	N/A	N/A	1.19	1.50	1.75	2.00	2.25	2.52	3.68
CUHP Runoff Volume (acre-ft) =	0.043	0.139	0.136	0.212	0.282	0.385	0.465	0.569	0.954
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.136	0.212	0.282	0.385	0.465	0.569	0.954
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.4	1.1	1.6	2.9	3.6	4.6	8.1
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.10	0.27	0.41	0.73	0.92	1.18	2.07
Peak Inflow Q (cfs) =	N/A	N/A	1.6	2.6	3.3	4.9	5.9	7.1	11.6
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.4	1.2	2.6	3.6	4.6	5.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.7	0.9	1.0	1.0	0.6
Structure Controlling Flow =	Filtration Media	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Gate 1 (fps) =	N/A	N/A	N/A	0.1	0.2	0.4	0.6	0.7	0.8
Max Velocity through Gate 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) =	14	41	40	53	53	51	51	50	46
Time to Drain 99% of Inflow Volume (hours) =	14	42	41	55	54	54	54	54	52
Maximum Ponding Depth (ft) =	0.49	1.06	0.98	1.32	1.40	1.51	1.57	1.68	2.60
Area at Maximum Ponding Depth (acres) =	0.16	0.18	0.17	0.18	0.19	0.19	0.19	0.20	0.23
Maximum Volume Stored (acre-ft) =	0.044	0.140	0.126	0.185	0.200	0.221	0.234	0.256	0.453

# 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:* \_\_\_\_\_

## Inflow Hydrographs

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

Time Interval	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]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.07
	0:15:00	0.00	0.00	0.10	0.16	0.20	0.14	0.17	0.17	0.31
	0:20:00	0.00	0.00	0.36	0.54	0.70	0.36	0.42	0.46	0.95
	0:25:00	0.00	0.00	1.06	1.77	2.47	1.06	1.27	1.47	3.46
	0:30:00	0.00	0.00	1.59	2.58	3.34	3.65	4.47	5.16	8.94
	0:35:00	0.00	0.00	1.65	2.61	3.34	4.66	5.62	6.80	11.29
	0:40:00	0.00	0.00	1.57	2.44	3.12	4.91	5.88	7.08	11.61
	0:45:00	0.00	0.00	1.42	2.22	2.89	4.67	5.59	6.91	11.29
	0:50:00	0.00	0.00	1.28	2.03	2.61	4.45	5.32	6.55	10.70
	0:55:00	0.00	0.00	1.17	1.85	2.40	4.02	4.82	6.06	9.94
	1:00:00	0.00	0.00	1.08	1.69	2.23	3.67	4.41	5.68	9.33
	1:05:00	0.00	0.00	1.00	1.55	2.05	3.36	4.06	5.35	8.79
	1:10:00	0.00	0.00	0.89	1.40	1.88	2.99	3.61	4.70	7.77
	1:15:00	0.00	0.00	0.78	1.25	1.73	2.62	3.17	4.07	6.79
	1:20:00	0.00	0.00	0.70	1.12	1.57	2.25	2.72	3.44	5.79
	1:25:00	0.00	0.00	0.64	1.03	1.42	1.99	2.41	2.98	5.03
	1:30:00	0.00	0.00	0.59	0.95	1.29	1.76	2.13	2.62	4.42
	1:35:00	0.00	0.00	0.55	0.88	1.17	1.56	1.90	2.31	3.89
	1:40:00	0.00	0.00	0.51	0.79	1.06	1.39	1.68	2.03	3.40
	1:45:00	0.00	0.00	0.47	0.70	0.95	1.23	1.48	1.77	2.96
	1:50:00	0.00	0.00	0.43	0.62	0.85	1.07	1.30	1.52	2.54
	1:55:00	0.00	0.00	0.37	0.54	0.75	0.92	1.11	1.29	2.15
	2:00:00	0.00	0.00	0.32	0.46	0.63	0.78	0.94	1.08	1.79
	2:05:00	0.00	0.00	0.25	0.36	0.49	0.60	0.73	0.83	1.35
	2:10:00	0.00	0.00	0.19	0.27	0.38	0.44	0.53	0.59	0.99
	2:15:00	0.00	0.00	0.15	0.21	0.30	0.32	0.39	0.44	0.74
	2:20:00	0.00	0.00	0.12	0.17	0.25	0.25	0.30	0.33	0.57
	2:25:00	0.00	0.00	0.10	0.14	0.20	0.19	0.23	0.24	0.43
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	2:35:00	0.00	0.00	0.07	0.09	0.13	0.11	0.14	0.14	0.24
	2:40:00	0.00	0.00	0.05	0.08	0.11	0.09	0.11	0.10	0.18
	2:45:00	0.00	0.00	0.04	0.06	0.08	0.07	0.08	0.07	0.13
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	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	





## **APPENDIX E – REFERENCE MATERIAL**





Final Drainage Report  
for  
**Meridian Ranch Filing 11A**



**MERIDIAN RANCH**

A GOLF & RECREATIONAL COMMUNITY

EL PASO COUNTY, COLORADO

Prepared For:

**GTL DEVELOPMENT, INC.**

3575 Kenyon Street  
San Diego, CA 92110

March 2014

Prepared By:  
Tech Contractors  
12311 Rex Road  
Falcon, CO 80831  
719.495.7444

CERTIFICATIONS

**Design Engineer's Statement:**

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

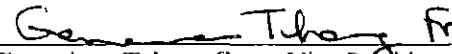
  
\_\_\_\_\_  
Thomas A. Kerby, P.E. #31429



2-18-14  
Date

**Owner/Developer's Statement:**

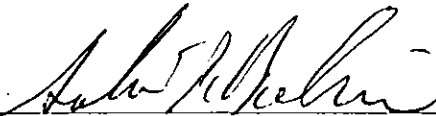
I, the owner/developer have read and will comply with all of the requirements specified in this drainage report and plan.

  
\_\_\_\_\_  
Genevieve Tchang Frost, Vice President  
GTL Development, Inc.  
P.O. Box 80036  
San Diego, CA 92138

February 18, 2014  
Date

**El Paso County:**

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

  
\_\_\_\_\_  
Andre P. Brackin, P.E.,  
County Engineer / ECM Administrator

3-20-2014  
Date

**Meridian Ranch Filing 11A  
Final Drainage Report**

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- Appendix I – Soil Resource Report

## **EXECUTIVE SUMMARY**

The purpose of the following Final Drainage Report (FDR) is to present proposed drainage patterns for the Meridian Ranch Filing 11A area after construction activities.

Runoff quantities and proposed facilities have been calculated using the current City of Colorado Springs/El Paso County Drainage Criteria Manual (DCM).

The Meridian Ranch Filing 11A Final Plat encompasses 106± acres of proposed residential development and is located in Sections 20 and 29, Township 12 South, Range 64 West of the 6<sup>th</sup> Principal Meridian. It is approximately 12 miles northeast of the city of Colorado Springs, 2.5 miles north of the unincorporated town of Falcon, and immediately north of the Woodmen Hills development.

The Meridian Ranch Filing 11A Final Drainage Report is being submitted to the county as part of the final plat submittal. The Board of County Commissioners placed a condition of approval for the overall Meridian Ranch Sketch Plan to not release greater than 80 percent of the historic flow rate across Eastonville Road along the easterly boundary of the overall project site. This report shows that the development of the project meets the requirements set forth by the Board of Commissioners.

Meridian Ranch Filing 11A is currently within the Gieck Ranch Drainage Basin which has been studied as part of the respective Drainage Basin Studies and is currently waiting for some minor revisions prior to final approval from the El Paso County. The condition set by the Board of Commissioners is more stringent than those anticipated in the DBPS. However, the project developer has agreed to be in substantial conformance with the appropriate "to-be approved" DBPS.

Based on the aforementioned design parameters the proposed grading will not adversely affect downstream properties.

## **INTRODUCTION**

### ***Purpose***

The purpose of the following Final Drainage Report (FDR) is to present final drainage patterns after the construction Meridian Ranch Filing 11A based on calculated final build-out design flows.

### ***Scope***

The scope of this report includes:

- Location and description of the proposed drainage facilities.
- Calculations for design peak flows within the proposed project area.
- Discussion and analysis of existing and proposed drainage characteristics.

Runoff quantities and proposed facilities have been calculated using the current City of Colorado Springs/El Paso County Drainage Criteria Manual (DCM).

## **EXISTING CONDITIONS**

### ***General Location***

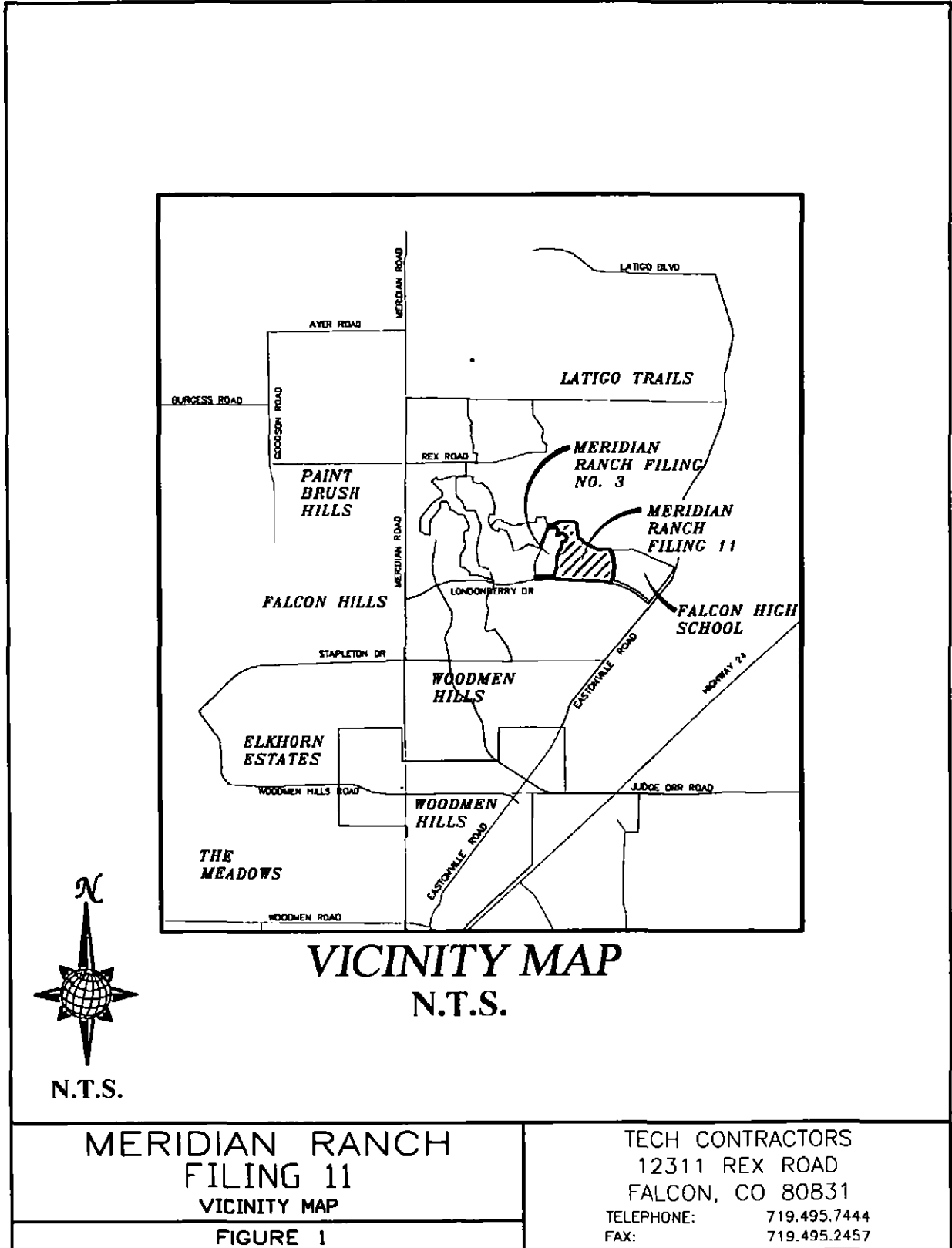
The Meridian Ranch Filing 11A encompasses 106± acres of proposed residential development and is located in Sections 20 and 29, Township 12 South, Range 64 West of the 6<sup>th</sup> Principal Meridian. It is approximately 12 miles northeast of the city of Colorado Springs, 2.5 miles north of the unincorporated town of Falcon, and immediately north of the Woodmen Hills development. Please see Figure 1: Meridian Ranch Filing 11A Vicinity Map.

### ***Land Use***

Historically, ranching dominated the area surrounding Meridian Ranch; however, currently urbanization has occurred in the general vicinity. Most notably, urbanization is occurring to the north with Latigo Trails, to the south in the Woodmen Hills Subdivision, to the east in Four Way Ranch, to the west in the Falcon Hills subdivision, and to the northwest in the Paint Brush Hills subdivision.

MERIDIAN RANCH FILING 11A

Figure 1: Vicinity Map





### ***Topography and Floodplains***

The topography of the site is typical of a high desert, short prairie grass with relatively flat slopes generally ranging from 2% to 4%. The Gieck and Haegler Basins drain generally from the northwest to southeast. The basin is tributary to the Black Squirrel Creek.

The Flood Insurance Rate Maps (FIRM No. 08041C0575-F dated 3/17/99) indicates that there are portions of the Meridian Ranch Filing 11A within or near a designated flood plain. The floodplain will be removed as a result of the construction of the improvements associated with this project. A Conditional Letter of Map Revision (CLOMR) was approved in October 2006 and will be finalized upon completion of the improvements through a final Letter of Map Revision (LOMR). CLOMR file number 05-08-0050R. Upon completion of the improvements there will be no portions of this project site is near a designated flood plain. Please see Figure 2: Meridian Ranch Filing 11A Federal Emergency Management Agency (FEMA) Floodplain Map.

### ***Geology***

The National Resources Conservation Service (NRCS) soil survey records indicate that the service area is predominately covered by soils classified in the Stapleton series which is categorized in the Hydrological Group B. There is also an area of Pring soils found, which is also categorized in the Hydrological Group B.

The Stapleton (83) sandy loam is a deep, non-calcareous, well-drained soil formed in alluvium derived from arkosic bedrock on uplands. Permeability of this soil is rapid. Available water capacity is moderate, surface runoff is slow, and the hazard of erosion and soil blowing is moderate.

This soil is suited to habitat for open land and rangeland wildlife. The main limitation of this soil for urban development is frost-action potential.

Typically, these soils are well-drained, gravelly sandy loams that form on alluvial terraces and fans and exhibit high permeability and low available water capacity with depth to bedrock greater than 6 feet.

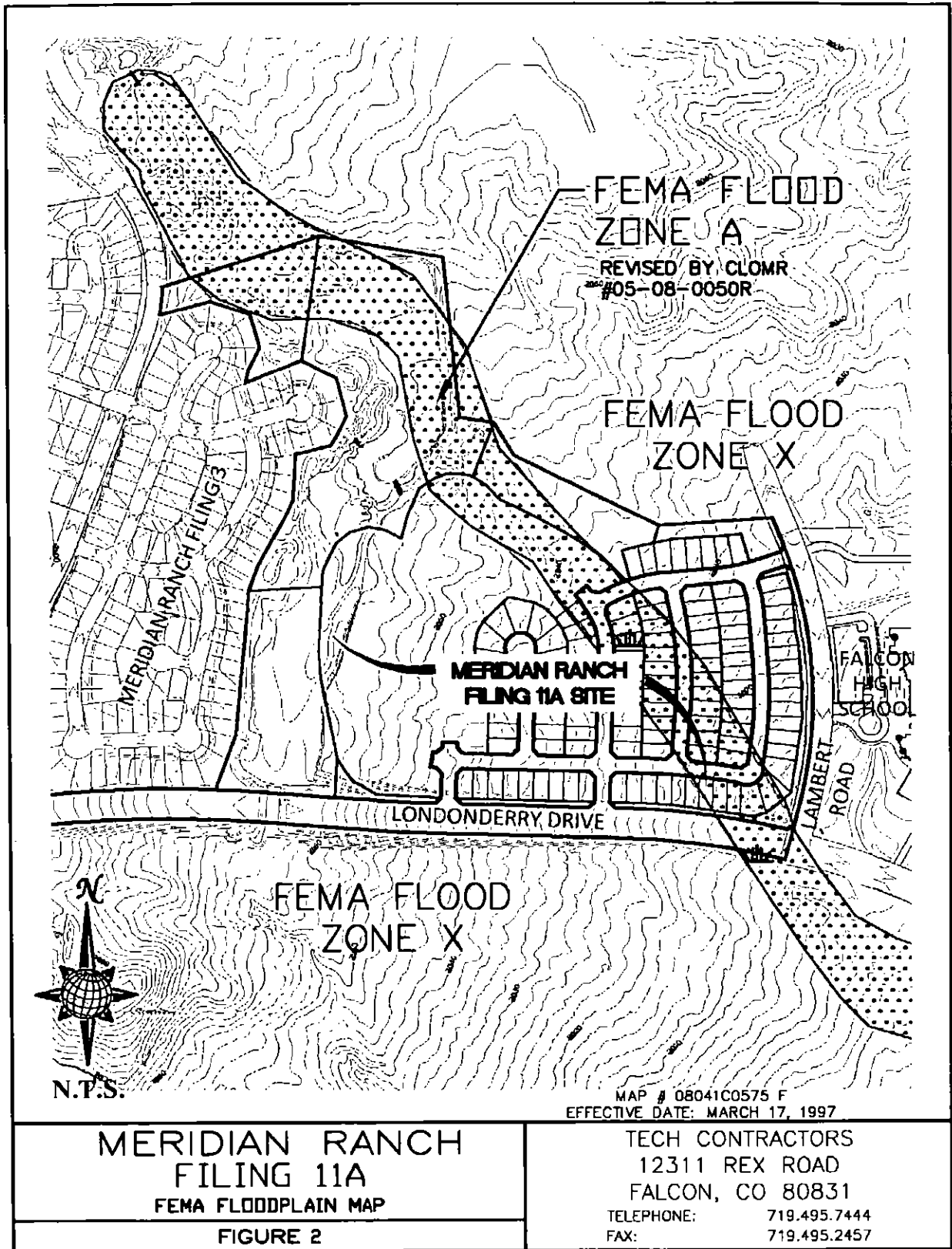
The Columbine (19) gravelly sandy loam is a deep, well-drained to excessively drained soil formed in coarse textured material on alluvial terraces, fans and flood plains. Permeability of this soil is very rapid. Available water capacity is low to moderate, surface runoff is slow, and the hazard of erosion is slight to moderate.

This soil is used mainly for grazing livestock, for wildlife habitat and for home sites. The main limitation of this soil for urban development is a hazard of flooding in some areas.

Note: (#) indicates Soil Conservation Survey soil classification number. See Figure 3. Meridian Ranch – Soils Map.

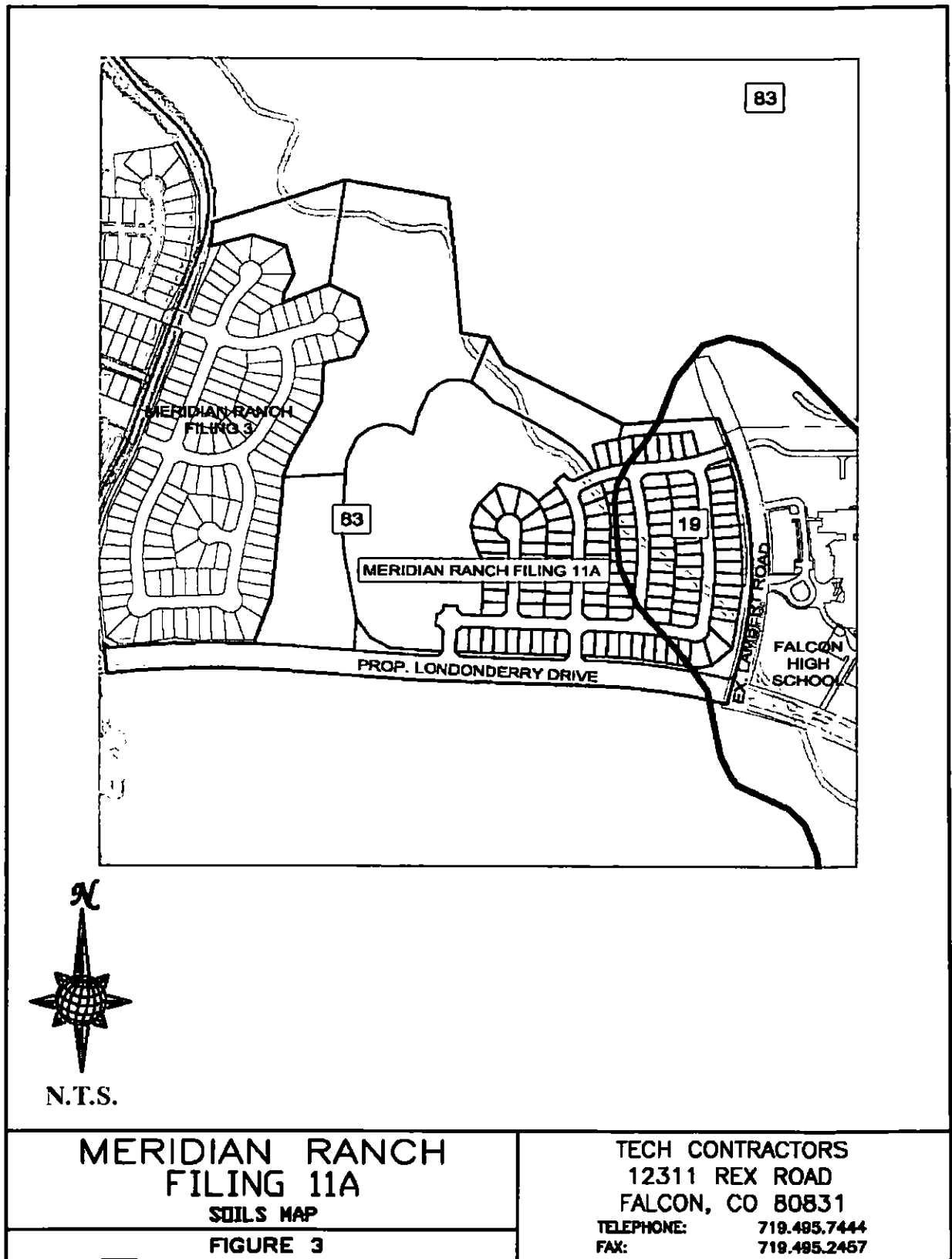
MERIDIAN RANCH FILING 11A

Figure 2: FEMA Floodplain Map



MERIDIAN RANCH FILING 11A

Figure 3: Soils Map



## *Climate*

Mild summers and winter, light precipitation; high evaporation and moderately high wind velocities characterize the climate of the study area. The average annual monthly temperature is 48.4 F with an average monthly low of 30.3 F in the winter and an average monthly high of 68.1 F in the summer. Two years in ten will have maximum temperature higher than 98 F and a minimum temperature lower than -16 F. Precipitation averages 15.73"es annually, with 80% of this occurring during the months of April through September. The average annual Class A pan evaporation is 45"es. (Soil Survey of El Paso County Area, Colorado).

## *Natural Hazards Analysis*

Natural hazards analysis indicates that no unusual surface or subsurface hazards are located near the vicinity. However, because the soils are cohesionless, sloughing of steep banks during drilling and/or excavation could occur. By citing improvements in a manner that provides and opportunity to lay the banks of excavations back at a 1:1 slope during construction, the problems associated with sloughing soils can be minimized.

## **DRAINAGE BASINS AND SUB-BASINS**

### **Gieck Basin**

The project site is located within the Gieck Ranch Drainage Basin and accepts flow from off-site areas to the north within Meridian Ranch.

Three different scenarios were analyzed for the drainage condition for the Meridian Ranch Filing 11A development. The first scenario analyzes the historic conditions, this condition has all of the area tributary to the project site in the pre-development state.

The second scenario, the developed conditions scenario, has existing conditions surrounding the site with the addition of project site in its developed condition. This condition was analyzed to ensure that developed drainage condition at Eastonville Road is similar to the historic condition after completion of the project.

The final scenario, the future conditions scenario, has the entire Meridian Ranch developed. This condition was analyzed to ensure that proposed detention pond is properly designed for the future developed drainage conditions within Meridian Ranch as dictated by the Board of County Commissioners.

## **DRAINAGE DESIGN CRITERIA**

### ***SCS Hydrograph Procedure***

The Soil Conservation Service (SCS) Hydrograph (HEC-HMS) procedure was used to determine design parameters for the major drainage facilities within the project. Onsite basin

areas were calculated using aerial topography of the site and approved final design data. Times of concentration were estimated using the SCS procedures described in the DCM. Based upon the hydrologic soil type, the natural conditions found in the basins and the runoff curve numbers (CN) chart from Table 5-4 and Table 5-5 of the DCM for Antecedent Moisture Condition II (AMC II), the following CN values were used for the given conditions.

**Table 1: SCS Runoff Curve Numbers**

Condition	CN
Residential Lots (2.5 acre)	66
Residential Lots (1 acre)	68
Residential Lots (1/2 acre)	70
Residential Lots (1/3 acre)	72
Residential Lots (1/4 acre)	75
Residential Lots (1/5 acre)	78
Residential Lots (1/6 acre)	80
School	80
Parks/Open Space	62
Light Industrial	92
Commercial	90
Roadways	98
Golf Course	62
Undeveloped	61
Graded	67

\*Curve Numbers were interpolated and based on amount of impervious area per lot. The 100-year, 24 hour storm precipitation selected from the NOAA is isopluvial map in Figure 5-4e from the DCM was 4.4". The 5-year, 24 hour storm precipitation selected from the rainfall depth-duration relationship chart in Figure 5-6 from the DCM was 2.6". These numbers along with SCS information were used as input to the U.S. Army Corp of Engineers HEC-HMS computer model to determine design runoffs.

***Rational Method Hydrologic Criteria***

The Rational Method was used to estimate stormwater runoff at Design Points with total tributary areas of less than 100 total acres, specifically those located within the developed area of Meridian Ranch Filing 11A. The Rational method is used to analyze the storm drainage system design within the project. The Rational Method Coefficients, "C-values", were selected from the rainfall depth-duration relationship chart in Figure 5-6 from the DCM requirements and the intensities for each basin are calculated from Figure 5-1 of the DCM based upon the basin time of concentration.

***Pond D Detention Storage Criteria***

Detention Pond D, constructed with Meridian Ranch Filing 3 is impacted by the improvements associated with Meridian Ranch Filing 11A. The permanent outfall control structure and drain pipe will be constructed with this most recent filing in Meridian Ranch.

As a part of the analysis, the pond was modeled using the as-built contours and recalculation of the WQCV stand pipe. The Pond D Stage Storage Table and WQCV calculation can be found in Appendix E - Detention Pond Information.

Two models were calculated for Pond D, the interim and future final, to determine the storage volume and maximum storage elevation with the pond for the 5-year storm event and the 100-year event. The current future maximum storage volume is determined to be 21.1 ac-ft at an elevation of 7056.4 ft. This elevation leaves sufficient freeboard below the emergency overflow spillway; the maximum volume of Pond D to the spillway is 32.0 ac-ft providing 50 percent additional capacity at final build out. Another model was created using current condition plus the Filing 11A downstream of Pond D. This model was used to help design the second pond constructed with this filing. This interim model used the as-built topographic survey information for Pond D and the upstream area tributary to the pond was modeled under its current existing state. This model yielded a maximum storage volume of 16.3 ac-ft with a maximum surface elevation of 7055.7 feet, leaving ample space for future upstream development.

A WQCV analysis was also performed on account of the changed conditions shown by the as-built survey of the pond after its construction. The analysis showed that a different water quality stand pipe could be installed with the construction of the permanent concrete outfall structure. These calculations can be found in the appendix and have been incorporated into the construction plans.

The storm drain outfall system including the permanent concrete outfall structure and the storm drain pipe from Pond D to Lambert Drive will be constructed ahead of the improvements for Meridian Ranch Filing 11A. This construction is necessary to complete the system associated with a CLOMR on file with FEMA so that the process can move forward to complete LOMR and remove the floodplain from the maps in this area. The design and construction of the Pond D outfall system is based on the calculations and analysis found in this report.

**Table 2: Pond D Summary Data**

POND D						
	PEAK INFLOW	PEAK OUTFLOW	TOTAL INFLOW	TOTAL OUTFLOW	PEAK STORAGE	PEAK ELEVATION
	CFS	CFS	AC-FT	AC-FT	AC-FT	FT
INTERIM CONDITIONS - FILING 11A						
100-YEAR STORM	361	64	34.5	29.6	16.3	7055.7
5-YEAR STORM	95	8	11.2	8.0	6.0	7053.5
FUTURE CONDITIONS						
100-YEAR STORM	495	105	45.7	40.3	21.1	7056.4
5-YEAR STORM	153	15.0	16.3	12.8	8.4	7054.1

***Pond E Detention Storage Criteria***

Detention Pond E is located south of Londonderry and west of Eastonville, southeast of the project site and will be owned and maintained by the Meridian Service Metropolitan District

(MSMD). A maintenance agreement between the Meridian Service Metropolitan District and El Paso County will be executed and recorded as a part of the Meridian Ranch Filing 11A Final Plat process.

The SCS calculation method was used to determine inflow and outflow from the detention pond to ensure that the additional runoff does not overcharge the pond and the discharges do not adversely impact drainage patterns downstream of Eastonville Road. Storm drainage runoff will enter the pond from the project site via an existing pipe network and overland through existing drainage swales. The ultimate future build-out design of the pond was analyzed to insure that additional grading and sizing of the pond would be unnecessary after development of Meridian Ranch Filing 11A other areas tributary to the detention pond. This SCS calculation can be found in the appendix.

The pond is designed to accommodate the final inflow from Meridian Ranch Filing 11A as well as the ultimate build out of all the tributary areas. Concrete control structures have been preliminarily designed to reduce the developed flows to at or below the historic peak flow rates and will be installed at a later date. Temporary CMP control structures that were installed with the grading operation will continue to be used in the interim to reduce the flow rates that will cross Eastonville Road at Design Points H08 and H09. The control structures will be analyzed with each development that is tributary to the pond.

The temporary control structure at DP H08 consists of a 12" CMP water quality control riser with a trash grate having a top elevation of 6968.00. The water quality control riser will be connected to a 54" CMP control riser with a 12" CMP pipe at 1%. The temporary control structure will consist of a 54" CMP with a top elevation of 6970.95 in order to accept storm flows from larger events. The pipe is to be equipped with a welded trash rack. The riser also has a 1.5'x 8' slot opening (elev. = 6969.45) is proposed along the front of the control structure to pass lower flows.

**Table 3: Pond E Summary Data**

POND E						
	PEAK INFLOW	PEAK OUTFLOW	TOTAL INFLOW	TOTAL OUTFLOW	PEAK STORAGE	PEAK ELEVATION
	CFS	CFS	AC-FT	AC-FT	AC-FT	FT
INTERIM CONDITIONS - FILING 11A						
Design Point H08						
100-YEAR STORM	333	74	70.9	65.2	17.6	6971.2
5-YEAR STORM	66	12	20.6	18.4	6.2	6969.7
Design Point H09						
100-YEAR STORM	333	67	70.9	65.2	17.6	6971.2
5-YEAR STORM	66	6.3	20.6	18.4	6.2	6969.7
FUTURE CONDITIONS						
Design Point H08						
100-YEAR STORM	707	155	107.3	91.9	33.5	6972.6
5-YEAR STORM	233	15.8	38.2	27.4	17.5	6971.2
Design Point H09						
100-YEAR STORM	707	62	107.3	91.9	33.5	6972.6
5-YEAR STORM	233	8.7	38.2	27.4	17.5	6971.2

The temporary control structure at DP H09 consists of a 12" CMP water quality control riser with a trash grate having a top elevation of 6968.00. The water quality control riser will be connected to a 54" CMP control riser with a 12" CMP pipe at 1%. The temporary control structure will consist of a 54" CMP with a top elevation of 6970.95 in order to accept storm flows from larger events. The pipe is to be equipped with a welded trash rack. The riser also has a 1.2' x 5' slot opening (elev. = 6969.75) is proposed along the front of the control structure to pass lower flows.

An analysis of the SCS calculations show that with the control structures in place for the developed flows, the flow rates are reduced sufficiently to reduce the peak rates below the target of 80-percent of historic at Eastonville Road during the post grading condition.

**Table 4: Eastonville Road at DP H08 and H09**

EASTONVILLE FLOW RATES					
EVENT	HISTORIC	FILING 11A	PERCENT OF HISTORIC	FUTURE	PERCENT OF HISTORIC
	PEAK FLOW (CFS)	PEAK FLOW (CFS)		PEAK FLOW (CFS)	
<b>H08</b>					
100-YEAR	232	74	32%	155	67%
5-YEAR	22	12	55%	15.8	72%
<b>H09</b>					
100-YEAR	87	67	77%	62	71%
5-YEAR	11	6.3	57%	8.7	79%

A water quality capture volume (WQCV) was added to the required storage volume for the final build out condition. The purpose of the WQCV is to allow particulates to settle out and accumulate over time to improve water quality and to maintain full volume for detention during the life of the facility for a major storm event. 332 acres are tributary to the detention pond during the developed condition resulting in a required WQCV of 1.6 ac-ft.

The WQCV of 1.6 ac-ft. was added to the detention of the minor storm and half (0.8 ac-ft.) was added to the detention volume of the major storm. This was accomplished with respect to the HEC-HMS computer run by providing a starting detention volume of 1.6 ft. for the 5-year storm and 0.8 ft. for the 100-year storm. The resulting storage elevations remain well below the emergency spillway elevation. See Appendix B for more information.

The WQCV was calculated by using the equations found in Volume 2, of the Drainage Criteria Manual (DCM). The release rate from the WQCV is generally very small, which helps minimize downstream impacts. Detaining the WQCV also serves to cleanse the "first flush" of runoff from the higher initial concentration of sediment and pollutants by allowing for settlement to occur. This greatly improves the quality of runoff, leaving the facility and reduces the potential for erosion. The positive impact on water quality is expected to be significant, particularly during the construction phase of the development.



## **DRAINAGE FACILITY DESIGN**

### ***General Concept***

The developed portions of the project site are located within the Gieck Drainage Basin. Storm water runoff will be conveyed across the site existing and proposed swales. The proposed project is within the Gieck Basin which has been studied as part of the Gieck Ranch Drainage Basin Study and is currently waiting for final approval from the El Paso County. The condition set by the Board of County Commissioners is more stringent than those anticipated in the DBPS. However, the project developer has agreed to be in substantial conformance with the appropriate “to-be approved” DBPS or the Board of County Commissioners condition, whichever is more stringent.

The facilities have been adequately sized such that the interim developed flows and final flows for the 100-year storm event from Filing 11A will be detained and released at or below the historic flow rate for the 100-year storm event. The Meridian Ranch MDDP has established that the discharge rates across Eastonville Road will be at or below 80% of the historic flow for the 100-year storm event upon full development of entire project.

Figure 4: Meridian Ranch SCS Calculations – Historic Conditions Map shows the drainage patterns of the site prior to development. Figure 5: Meridian Ranch Filing 11A SCS Calculations – Developed Conditions outlines the existing and build-out general drainage patterns for Filing No. 11. Figure 6: Meridian Ranch Filing 11A SCS Calculations – Future Conditions shows Meridian Ranch at full build-out and indicates the anticipated general drainage patterns for the areas tributary to Pond E.

The purpose of this report is to show that the development of Meridian Ranch Filing 11A will not adversely impact the existing drainage facilities adjacent and downstream of the development. Further evaluation will be necessary at each stage of future development within the Meridian Ranch and the anticipated build-out is reached.

### ***SCS Calculation Method***

#### **Gieck Ranch Drainage Basin**

The Meridian Ranch Filing 11A site is within the Gieck Drainage Basin. The project will affect the existing drainage characteristics of the basin and is to be mitigated by a detention facility that is located southeasterly of the intersection of Eastonville.

Of the key design points identified along Eastonville Road, as described in the Meridian Ranch MDDP, H08 and H09 are affected by Meridian Ranch Filing 11A. Historically, the 100-yr storm flow at H08 is 232 cfs and at H09 is 87 cfs; the interim flow at H08 after being detained at Pond E for the 100-yr storm flow is 74 cfs at H08 and 69 cfs at H09.

The construction of Pond E will result in a net decrease of peak flow rates at Eastonville Road (DP-H08) from 232 cfs to 74 cfs, a 68 percent decrease for the 100-yr storm for the interim conditions. The peak flow rate at DP-09 at Eastonville Road after the construction of Pond E will decrease from 87 cfs to 67 cfs a 23 percent decrease. Based on these net decreases in flow rates it is concluded that the grading of Meridian Ranch Filing 11A will have no adverse impact to the downstream facilities of the Gieck Ranch Drainage Basin in the interim.

As development continues to the upstream tributary areas in Meridian Ranch to Pond E, the model will be re-analyzed at the final plat process for each subdivision and the increased flow will be mitigated by the proposed detention pond. The current estimated detained outflow at H08 will be 155 cfs for the 100-year storm event and 62 cfs at H09. These calculations can be found in the appendix.

Historic Condition - SCS Calculation Method

Following is a tabulation of the surface drainage characteristics under Existing Conditions using the SCS calculation method. Please refer to Figure 4 - Meridian Ranch SCS Calculations - Historic Basin Map.

**Table 5: Historic Drainage Basins – SCS**

HISTORIC					
HYDROLOGIC ELEMENT	DRAINAGE AREA (SQ. MI.)	DISCHARGE PEAK Q <sub>100</sub> (CFS)	TOTAL VOLUME Q <sub>100</sub> (AC. FT.)	DISCHARGE PEAK Q <sub>5</sub> (CFS)	TOTAL VOLUME Q <sub>5</sub> (AC. FT.)
HG07	0.0984	41	5.3	5	1.2
HG07-G11	0.0984	41	5.3	5	1.2
HG08	0.1328	77	7.2	10	1.6
G11	0.2312	104	12.5	12	2.8
G11-G12	0.2312	104	12.4	11	2.7
HG09	0.1781	82	9.7	10	2.1
G12	0.4093	185	22.1	20	4.9
G12-H08	0.4093	183	21.8	20	4.8
HG10	0.1375	49	7.4	6	1.6
H08	0.5468	232	29.2	22	6.4
HG11	0.2047	87	11.1	11	2.4
H09	0.2047	87	11.1	11	2.4
HG15	0.2563	80	13.9	11	3.0
H13	0.2563	80	13.9	11	3.0

Developed Condition - SCS Calculation Method

Following is a tabulation of the surface drainage characteristics for the post developed conditions of Filing 11A using the SCS calculation method. Please refer to Figure 5 - Meridian Ranch SCS Calculations – Developed Basins Map

**Table 6: Developed Condition Basins-SCS**

<b>FILING 11A</b>					
<b>HYDROLOGIC ELEMENT</b>	<b>DRAINAGE AREA (SQ. MI.)</b>	<b>DISCHARGE PEAK Q<sub>100</sub> (CFS)</b>	<b>TOTAL VOLUME Q<sub>100</sub> (AC. FT.)</b>	<b>DISCHARGE PEAK Q<sub>5</sub> (CFS)</b>	<b>TOTAL VOLUME Q<sub>5</sub> (AC. FT.)</b>
HG08	0.1375	107	10.5	24	3.1
FG08-POND D	0.1375	107	10.5	24	3.1
FG13	0.1188	80	8.5	16	2.4
FG11	0.0608	85	7.2	30	2.8
FG09	0.0500	51	4.1	13	1.3
G05	0.1108	134	11.4	42	4.1
G05-POND D	0.1108	134	11.4	42	4.1
FG12	0.0328	55	4.1	21	1.7
<b>POND D</b>	<b>0.3999</b>	<b>64</b>	<b>29.6</b>	<b>8</b>	<b>8.0</b>
POND D-G17	0.3999	64	29.6	8	8.0
HG15	0.1344	58	7.5	8	1.7
FG15a	0.0156	20	1.4	6	0.4
G17	0.5499	91	38.4	11	10.1
G17-G18	0.5499	91	38.4	11	10.1
FG16	0.0773	97	8.0	31	2.9
G18	0.6272	161	46.4	41	13.0
G18-POND E	0.6272	161	46.4	41	13.0
FG31	0.0922	123	11.6	45	4.7
HG30	0.0766	49	4.2	6	0.9
HG30-POND HS	0.0766	48	4.1	6	0.9
<b>POND HS</b>	<b>0.1688</b>	<b>126</b>	<b>15.8</b>	<b>27</b>	<b>5.6</b>
HG18	0.1484	67	8.7	10	2.1
<b>POND E</b>	<b>0.9444</b>	<b>141</b>	<b>65.2</b>	<b>18</b>	<b>18.4</b>
FG33	0.0109	13	1.0	4	0.3
<b>H08</b>	0.9553	<b>74</b>	66.2	<b>12</b>	18.7
<b>H09</b>		<b>67</b>		<b>6.3</b>	
<b>* FROM OUTLET STAGE-STORAGE CALCULATION</b>					

A comparison of the peak flow rates at Eastonville Road for the design storms may be found in Table 5 – Eastonville Road at DP G6 (above). As a result of the grading of the Meridian Ranch Filing 11A area, the calculations do show that the project does not adversely affect the existing drainage facilities.

Future Condition - SCS Calculation Method

Following is a tabulation of the surface drainage characteristics for the future developed conditions using the SCS calculation method. Please refer to Figure 6 - Meridian Ranch SCS Calculations – Future Basins Map

**Table 7: Future Drainage Basins-SCS**

<b>FUTURE</b>					
HYDROLOGIC ELEMENT	DRAINAGE AREA (SQ. MI.)	DISCHARGE PEAK Q <sub>100</sub> (CFS)	TOTAL VOLUME Q <sub>100</sub> (AC. FT.)	DISCHARGE PEAK Q <sub>5</sub> (CFS)	TOTAL VOLUME Q <sub>5</sub> (AC. FT.)
FG08	0.1453	170	15.8	55	5.8
FG11	0.0608	85	7.2	30	2.8
FG09	0.0416	53	4.0	16	1.4
G05	0.2477	302	27.1	99	10.0
G05-POND D	0.2477	301	27.0	98	10.0
FG10	0.0953	94	9.2	27	3.2
FG13	0.075	53	5.2	10	1.4
FG12	0.0328	55	4.1	21	1.7
<b>POND D</b>	<b>0.4508</b>	<b>105</b>	<b>40.3</b>	<b>15</b>	<b>12.8</b>
POND D-G17	0.4508	105	40.3	15	12.8
FG15	0.1188	132	11.2	38	3.7
FG14	0.0313	47	3.6	17	1.4
FG14-G17	0.0313	47	3.6	16	1.4
G17a	0.1501	179	14.7	54	5.1
FG15a	0.0156	27	1.8	10	0.7
G17	0.6165	212	56.8	63	18.6
G17-G18	0.6165	212	56.7	63	18.6
FG16	0.0773	109	8.8	37	3.4
G18	0.6938	319	65.6	99	21.9
G18-POND E	0.6938	317	65.6	99	21.9
FG18	0.1641	198	16.9	62	6.0
FG18-POND E	0.1641	198	16.9	62	6.0
FG19	0.0977	203	13.2	83	5.6
FG31	0.0922	123	11.6	45	4.7
POND HS	0.0922	79	11.6	25	4.7
<b>POND E</b>	<b>1.0478</b>	<b>217</b>	<b>92.1</b>	<b>24</b>	<b>27.7</b>
FG33	0.0109	15	1.0	4	0.3
<b>H08</b>	1.0587	<b>155</b>	93.1	<b>15.8</b>	28
<b>H09</b>		<b>62</b>		<b>8.7</b>	
<b>* FROM OUTLET STAGE-STORAGE CALCULATION</b>					

A comparison of the peak flow rates at Eastonville Road for the design storms may be found in Table 5 – Eastonville Road at DP H08 and H09 (below). As a result of the development of Meridian Ranch Filing 11A and future development, the calculations do show that the project does not adversely affect the existing drainage facilities.

### ***Proposed On-site Surface Drainage-Rational Calculation Method***

Following is a discussion and tabulation of the on-site surface drainage characteristics for the developed conditions using the rational calculation method. Figure 7 - Meridian Ranch Rational Calculations – Basin Map found in the back pockets of this report, illustrates the sub-basin boundaries used for the hydrologic analysis for each of the basins located within the developed areas. Note that the SCS basin designations do not correspond to those used for developed conditions rational method analysis.

- Basin 1 (4.5 acres,  $Q_5 = 6.9$  cfs,  $Q_{100} = 15$  cfs) contains lots along the south side of Evening Vista Dr. and a portion of Boulder Ridge Dr. The surface runoff will sheet flow off of the residential lots and be conveyed to a proposed 20' Type R flow-by inlet located at DP I01. The flow captured by this inlet ( $Q_5 = 5.0$  cfs,  $Q_{100} = 9.6$  cfs) is conveyed via an 18" RCP to Junction J03. The remaining surface runoff ( $Q_5 = 1.9$  cfs,  $Q_{100} = 5.6$  cfs) continues along the curb and gutter toward DP I08.
- Basin 2 (2.0 acres,  $Q_5 = 3.5$  cfs,  $Q_{100} = 7.8$  cfs) contains lots along the north side of Evening Vista Dr. The surface runoff will sheet flow off of the residential lots and be conveyed to a proposed 15' Type R flow-by inlet located at DP I02. The captured by this inlet ( $Q_5 = 2.5$  cfs,  $Q_{100} = 4.9$  cfs) is conveyed via an 18" RCP to Junction J03. The remaining surface runoff ( $Q_5 = 1.0$  cfs,  $Q_{100} = 2.9$  cfs) continues along the curb and gutter toward DP I03. The total flow ( $Q_5 = 7.1$  cfs,  $Q_{100} = 14$  cfs) with flow from is conveyed to Junction J04 via an 18" RCP.
- The pipe flow from Pond D ( $Q_5 = 12$  cfs,  $Q_{100} = 100$  cfs) was calculated using the SCS method and then a  $T_c$  was estimated based on the flow rate calculated and upstream density tributary to Pond D. An existing 48" RCP conveys the flow to J01 where the pipe is downsized to a 42" RCP, this existing section of pipe exceeds the allowable velocity. The 42" continues to carry the flow to J02 and J05 where it is combined with pipe flow from J04. The total combined flow ( $Q_5 = 13$  cfs,  $Q_{100} = 102$  cfs) at DP05 is conveyed passed J06 to Junction J07 via a 42" RCP, this section of pipe exceeds the allowable velocity and will require Class IV RCP.
- Basin 3 (2.8 acres,  $Q_5 = 4.5$  cfs,  $Q_{100} = 9.8$  cfs) contains lots along the north side of Park Gate Dr. The residential runoff will sheet flow on to the curb and gutter of the streets and will travel to Inlet I03.
- Inlet I03 is a 15' Type R forced sump inlet that receives the total flow of 5.2 cfs for the 5-year storm and 12 cfs for the 100-year. The flow captured by the inlet is conveyed to J07, where it will combine with the flow from J06. The total combined flow ( $Q_5 = 14$  cfs,  $Q_{100} = 104$  cfs) at J07 is conveyed to Existing Junction EJ07 via an 54" RCP.
- The pipe flow from areas upstream of Existing EJ07 ( $Q_5 = 54$  cfs,  $Q_{100} = 179$  cfs) was calculated using the SCS method and then a  $T_c$  was estimated based on the flow rate calculated and upstream density tributary to Existing EJ07. An existing 60" RCP

conveys the flow to Existing EJ08. The total combined flow at DP08 is 54 cfs for the 5-year storm and 207 cfs for the 100-year.

- Basin 4 (1.1 acres,  $Q_5 = 2.1$  cfs,  $Q_{100} = 5.2$  cfs) contains the rear of lots along the west side of Lambert Road and the west half of Lambert Road. The runoff will sheet flow on to the curb and gutter of the street and will travel to Existing Inlet EI05.
- Existing Inlet EI05 is an existing 10' Type R flow-by inlet that receives the total flow of 2.1 cfs for the 5-year storm and 5.2 cfs for the 100-year storm and captures most of it. The flow captured by the inlet is conveyed to Existing EJ08, where it will combine with the flow from Existing EJ07. The total combined flow ( $Q_5 = 5.5$  cfs,  $Q_{100} = 20.7$  cfs) at Existing EJ08 is conveyed to Existing Junction EJ09 via an 60" RCP. The remaining flow not captured by the EI05 inlet ( $Q_5 = 0.6$  cfs,  $Q_{100} = 2.0$  cfs) continues southerly toward Existing Inlet EI07.
- Basin 6 (6.5 acres,  $Q_5 = 8.2$  cfs,  $Q_{100} = 19$  cfs) contains lots along the west side of Park Meadows Dr. The runoff will sheet flow on to the curb and gutter of the street and will travel to Inlet I04.
- Inlet I04 is a 20' Type R forced sump inlet that receives the total flow of 8.2 cfs for the 5-year storm and 19 cfs for the 100-year storm and captures most of it. The remaining flow not captured by the I04 inlet ( $Q_{100} = 0.5$  cfs) crosses the centerline to Inlet I05. The flow captured by the inlet is conveyed to J08, where it will combine with the flow from I05.
- Basin 7 (5.0 acres,  $Q_5 = 7.5$  cfs,  $Q_{100} = 17$  cfs) contains lots along the east side of Park Meadows Dr. and the west side of Boulder Ridge Dr. The runoff will sheet flow on to the curb and gutter of the street and will travel to Inlet I05.
- Inlet I05 is a 20' Type R forced sump inlet that receives the total flow of 7.5 cfs for the 5-year storm and 18 cfs for the 100-year storm and captures all of it. The flow captured by the inlet is conveyed to J08, where it will combine with the flow from I06. The total combined flow ( $Q_5 = 16$  cfs,  $Q_{100} = 37$  cfs) at J08 is conveyed to Junction J09 via a 24" RCP.
- Basin 8 (5.0 acres,  $Q_5 = 7.5$  cfs,  $Q_{100} = 16$  cfs) contains lots along the east side of Boulder Ridge Dr. and the west side of Prairie Ridge Ct. The runoff will sheet flow on to the curb and gutter of the street and will travel to Inlet I06.
- Inlet I06 is a 15' Type R forced sump inlet that receives the total flow of 7.5 cfs for the 5-year storm and 16 cfs for the 100-year storm and captures most of it. The remaining flow not captured by the I05 inlet ( $Q_{100} = 1.5$  cfs) continues easterly toward Inlet I08. The flow captured by the inlet is conveyed to J09, where it will combine with the flow from I04 and I05. The total combined flow ( $Q_5 = 23$  cfs,  $Q_{100} = 50$  cfs) at J09 is conveyed to Junction J10 via a 24" RCP.

- Basin 9 (4.6 acres,  $Q_5 = 7.2$  cfs,  $Q_{100} = 16$  cfs) contains lots along the west side of Prairie Ridge Ct. and the west side of Evening Vista Dr. The runoff will sheet flow on to the curb and gutter of the street and will travel to Inlet I08.
- Inlet I08 is a 20' Type R forced sump inlet that receives the total flow of 8.0 cfs for the 5-year storm and 20 cfs for the 100-year storm and captures most of it. The remaining flow not captured by the I08 inlet ( $Q_{100} = 1.4$  cfs) continues easterly toward Inlet I09. The flow captured by the inlet is conveyed to J10, where it will combine with the flow from J09.
- Basin 10 (2.1 acres,  $Q_5 = 4.1$  cfs,  $Q_{100} = 9.0$  cfs) contains lots along the south side of Park Meadows Dr. The runoff will sheet flow on to the curb and gutter of the street and will travel to Inlet I07.
- Inlet I07 is a 10' Type R forced sump inlet that receives the total flow of 4.1 cfs for the 5-year storm and 9.0 cfs for the 100-year storm and captures all of it. The flow captured by the inlet is conveyed to J10. The total combined flow ( $Q_5 = 33$  cfs,  $Q_{100} = 75$  cfs) at J10 is conveyed to Junction J11 via a 36" RCP.
- Basin 11 (5.1 acres,  $Q_5 = 7.4$  cfs,  $Q_{100} = 16$  cfs) contains lots along the west side of Evening Vista Dr. and the west side of Hidden Park Wy. The runoff will sheet flow on to the curb and gutter of the street and will travel to Inlet I09.
- Inlet I09 is a 15' Type R forced sump inlet that receives the total flow of 7.4 cfs for the 5-year storm and 16 cfs for the 100-year storm and captures most of it. The remaining flow not captured by the I09 inlet ( $Q_{100} = 1.4$  cfs) continues easterly toward Inlet I10. The flow captured by the inlet is conveyed to J12 and J14, where it will combine with the flow from J13. The total combined flow ( $Q_5 = 52$  cfs,  $Q_{100} = 111$  cfs) at J14 is conveyed to Junction J15 via a 42" RCP, this section of pipe exceeds the allowable velocity and will require Class IV RCP.
- Basin 12 (5.5 acres,  $Q_5 = 8.5$  cfs,  $Q_{100} = 19$  cfs) contains lots along the west side of Hidden Park Wy. and the west side of Park Meadows Dr. The runoff will sheet flow on to the curb and gutter of the street and will travel to Inlet I10.
- Inlet I10 is a 10' Type R sump inlet that receives the total flow of 8.5 cfs for the 5-year storm and 19 cfs for the 100-year storm and captures most of it. The remaining flow not captured by the I10 inlet ( $Q_{100} = 0.9$  cfs) crosses easterly across the centerline toward Inlet I11. The flow captured by the inlet is conveyed to Junction J13, where it will combine with the flow from I11.
- Basin 13 (3.8 acres,  $Q_5 = 6.4$  cfs,  $Q_{100} = 14$  cfs) contains lots along the south and east sides of Park Meadows Dr. The runoff will sheet flow on to the curb and gutter of the street and will travel to Inlet I11.

- Inlet 111 is a 10' Type R sump inlet that receives the peak flow of 6.4 cfs for the 5-year storm and 14 cfs for the 100-year storm at a TC of 15.6 min. and captures all of it. The peak flow-by from inlet 110 arrives later providing flow rates of 11 cfs for the 100-year storm and 4.7 cfs for the 5-year. The flow captured by the inlet is conveyed to J13 and J14. The total combined flow ( $Q_5 = 52$  cfs,  $Q_{100} = 111$  cfs) at J14 is conveyed to Junction J15 via a 42" RCP. The flow is conveyed to Existing EJ09 via a 48" RCP. At Existing EJ09 the pipe flow from J15 and Existing EJ08 are combined ( $Q_5 = 95$  cfs,  $Q_{100} = 303$  cfs) and sent southerly toward Existing EJ10.
- Basin 5 (1.6 acres,  $Q_5 = 3.5$  cfs,  $Q_{100} = 7.9$  cfs) contains the rear of lots along the west side of Lambert Road. The runoff will sheet flow on to the curb and gutter of the street and will travel to Existing Inlet EI07.
- Existing Inlet EI07 is an existing 10' Type R sump inlet that receives the total flow of 3.5 cfs for the 5-year storm and 9.1 cfs for the 100-year storm and captures all of it. The flow captured by the inlet is conveyed to Existing EJ10, where it will combine with the flow from Existing EJ09 and Existing EI08.
- Basin 20 (1.7 acres,  $Q_5 = 3.9$  cfs,  $Q_{100} = 8.4$  cfs) contains area along the east side of Lambert Road. The runoff will sheet flow on to the curb and gutter of the street and will travel to Existing Inlet EI08.
- Existing Inlet EI08 is an existing 10' Type R flow-by inlet that receives the total flow of 3.9 cfs for the 5-year storm and 8.4 cfs for the 100-year storm and captures most of it. The remaining flow not captured by the inlet ( $Q_5 = 0.9$  cfs,  $Q_{100} = 2.7$  cfs) continues easterly through on Londonderry Drive toward Eastonville Road. The flow captured by the inlet is conveyed to Existing EJ10, where it will combine with the flow from Existing EI07 and Existing EJ09. The total combined flow ( $Q_5 = 96$  cfs,  $Q_{100} = 307$  cfs) at Existing EJ10 is conveyed to Existing Junction EJ11 via a 66" RCP.
- Basin 14 (2.4 acres,  $Q_5 = 4.7$  cfs,  $Q_{100} = 11$  cfs) contains area along the east side of Rainbow Bridge Drive and the north side of Londonderry Drive. The runoff will sheet flow on to the curb and gutter of the street and will travel to Existing Inlet EI01.
- Existing Inlet EI01 is an existing 15' Type R flow-by inlet that receives the total flow of 4.7 cfs for the 5-year storm and 11 cfs for the 100-year storm and captures most of it. The remaining flow not captured by the inlet ( $Q_5 = 1.1$  cfs,  $Q_{100} = 3.6$  cfs) continues easterly toward Existing Inlet EI03. The flow captured by the inlet is conveyed to Existing EJ01, where it will combine with the flow from EI02, this existing section of pipe exceeds the allowable velocity.
- Basin 15 (1.9 acres,  $Q_5 = 4.0$  cfs,  $Q_{100} = 9.4$  cfs) contains area along the south side of Londonderry Drive. The runoff will sheet flow on to the curb and gutter of the street and will travel to Existing Inlet EI02.



- Existing Inlet EI02 is an existing 10' Type R flow-by inlet that receives the total flow of 4.0 cfs for the 5-year storm and 9.4 cfs for the 100-year storm and captures most of it. The remaining flow not captured by the inlet ( $Q_5 = 1.3$  cfs,  $Q_{100} = 4.3$  cfs) continues easterly through Basin 19 toward the intersection of Londonderry Drive and Lambert Road where it will travel overland southeasterly toward Pond E. Ultimately the by-pass flow will be intercepted by a future inlet located on a future street south of Londonderry Drive within a future single family residential development. The flow captured by the inlet is conveyed to Existing EJ01, where it will combine with the flow from Existing EI01. The total combined flow ( $Q_5 = 6.0$  cfs,  $Q_{100} = 12$  cfs) at Existing EJ01 is conveyed to Existing Junction EJ02 and Existing EJ03 via a 24" RCP.
- Basin 16 (1.5 acres,  $Q_5 = 2.9$  cfs,  $Q_{100} = 7.2$  cfs) contains area along the north side of Londonderry Drive. The runoff will sheet flow on to the curb and gutter of the street and will travel to Existing Inlet EI03.
- Existing Inlet EI03 is an existing 20' Type R flow-by inlet that receives the total flow of 3.2 cfs for the 5-year storm and 8.9 cfs for the 100-year storm and captures most of it. The remaining flow not captured by the inlet ( $Q_5 = 0.7$  cfs,  $Q_{100} = 3.1$  cfs) continues easterly toward Existing Inlet EI04. The flow captured by the inlet is conveyed to Existing EJ03, where it will combine with the flow from Existing EJ03. The total combined flow ( $Q_5 = 8.0$  cfs,  $Q_{100} = 17$  cfs) at Existing EJ03 is conveyed to Existing Junction EJ04 and Existing EJ05 via a 24" RCP, this existing section of pipe exceeds the allowable velocity.
- Basin 17 (1.7 acres,  $Q_5 = 3.2$  cfs,  $Q_{100} = 8.0$  cfs) contains area along the north side of Londonderry Drive. The runoff will sheet flow on to the curb and gutter of the street and will travel to Existing Inlet EI04.
- Existing Inlet EI04 is an existing 20' Type R flow-by inlet that receives the total flow of 3.2 cfs for the 5-year storm and 8.5 cfs for the 100-year storm and captures most of it. The remaining flow not captured by the inlet ( $Q_5 = 0.7$  cfs,  $Q_{100} = 2.9$  cfs) continues easterly toward Existing Inlet EI06. The flow captured by the inlet is conveyed to Existing EJ05, where it will combine with the flow from Existing EJ04. The total combined flow ( $Q_5 = 9.9$  cfs,  $Q_{100} = 21$  cfs) at Existing EJ05 is conveyed to Existing Junction EJ06 via a 30" RCP.
- Basin 18 (1.7 acres,  $Q_5 = 3.0$  cfs,  $Q_{100} = 7.2$  cfs) contains area along the north side of Londonderry Drive. The runoff will sheet flow on to the curb and gutter of the street and will travel to Existing Inlet EI06.
- Existing Inlet EI06 is an existing 15' Type R flow-by inlet that receives the total flow of 3.0 cfs for the 5-year storm and 7.9 cfs for the 100-year storm and captures most of it. The remaining flow not captured by the inlet ( $Q_5 = 0.5$  cfs,  $Q_{100} = 2.3$  cfs) continues easterly toward Existing Inlet EI07. The flow captured by the inlet is conveyed to Existing EJ06, where it will combine with the flow from Existing EJ05.

The total combined flow ( $Q_5 = 12$  cfs,  $Q_{100} = 27$  cfs) at Existing EJ05 is conveyed to Existing Junction EJ11 via a 30" RCP. The total combined flow ( $Q_5 = 99$  cfs,  $Q_{100} = 312$  cfs) at Existing EJ11 is conveyed to Pond E via a 66" RCP. Portions of this existing section of pipe exceeds the allowable velocity.

- Basin 19 (3.8 acres,  $Q_5 = 7.3$  cfs,  $Q_{100} = 18$  cfs) contains area along the south side of Londonderry Drive. The runoff will sheet flow on to the curb and gutter of the street and will travel to Design Point DP02 at the intersection of Londonderry Drive and Lambert Road. Ultimately the by-pass flow will be intercepted by a future inlet located on a future street south of Londonderry Drive within a future single family residential development. The flow at the end of the curb on Lambert will be 7.3 cfs for the 5-year storm and 18 cfs for the 100-year storm. This runoff will sheet flow overland to Pond E in the interim. Ultimately, sheet flow will be conveyed southerly by gutter in Lambert to an inlet.

### **DRAINAGE FEES**

The proposed development falls in the Gieck Drainage Basin. The entire development occupies 105.8 acres of residential development of which 35.8 acres are residential development and 19.2 acres are designated as right-of-way, 30.6 open space and 17.9 acres for the detention pond, the remainder is designated landscape tract.

The following is the imperviousness calculation:

#### ***Filing 11A (86.7 acres)***

	<u>Acres</u>	<u>Assumed Imperviousness</u>	<u>Impervious Acres</u>
Open Space	30.6	3%	0.92
Right-of-way	15.5	85%	13.18
Residential Lots	20.4	45% (118 Lots)	9.18
Landscape Tract	2.3	10%	0.23
Detention Pond	17.9	3%	0.54
Future Filing 11B	19.1	0% <sup>1</sup>	0.00
Total	105.8		24.05=27.73% imperv

Gieck Drainage Basin Fees: There are no drainage fees for this basin.

<sup>1</sup>See calculation below

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Bridge Fees: There are no bridge fees for this basin.

---

***Future Filing 11B (19.1 acres)***

	<u>Acres</u>	<u>Assumed Imperviousness</u>	<u>Impervious Acres</u>
Right-of-way	3.7	85%	3.15
Residential Lots	15.4	45% (118 Lots)	6.93
Total	19.1		10.08=52.77% imperv

Gieck Drainage Basin Fees: There are no drainage fees for this basin.

---

Bridge Fees: There are no bridge fees for this basin.

---

## **EROSION CONTROL DESIGN**

### ***General Concept***

Historically, erosion on this property has been held to a minimum by a variety of natural features and agricultural practices including:

- Substantial prairie grass growth
- Construction of drainage arresting berms
- Construction of multiple stock ponds along drainage courses

Existing detention ponds will also help to minimize erosion by reducing both the volume and velocity of the peak runoff.

During construction, best management practices (BMP) for erosion control will be employed based on El Paso county Criteria. BMP's will be utilized as deemed necessary by the contractor and/or engineer and are not limited to the measures shown on the construction drawing set. The contractor shall minimize the amount of area disturbed during all construction activities. Final erosion control plans will be prepared with final plat submittal.

In general the following shall be applied in developing the sequence of major activities:

- Install down-slope and side-slope perimeter BMP's before the land disturbing activity occurs.
- Do not disturb an area until it is necessary for the construction activity to proceed
- Cover or stabilize as soon as possible.
- Time the construction activities to reduce the impacts from seasonal climatic changes or weather events.
- The construction of filtration BMP's should wait until the end of the construction project when upstream drainage areas have been stabilized.
- Do not remove the temporary perimeter controls until after all upstream areas are stabilized.

### ***Detention Pond***

The proposed detention pond, once in place, will act as the primary sedimentation control facility for the areas upstream. Runoff will be diverted into the detention pond where practical. The pond will serve a dual purpose: first, by facilitating the settling of sediment in runoff during and after construction (by means of the WQCV) and, second, by maintaining runoff at or below existing levels.

### ***Silt Fence***

Silt fence will be placed along downstream limits of disturbed areas. This will prevent suspended sediment from leaving the site during infrastructure construction. Silt fencing is to remain in place until vegetation is reestablished.

### ***Erosion Bales***

Erosion bales will be placed ten (10) feet from the inlet of all culverts during construction to prevent culverts from filling with sediment. Erosion bales will remain in place until vegetation is reestablished. Erosion bale checks will be used on slopes greater than 1 percent to reduce flow velocities until vegetation is reestablished.

### ***Miscellaneous***

Best erosion control practices will be utilized as deemed necessary by the Contractor or Engineer and are not limited to the measures described above.

## ***REFERENCES***

1. "Volume 2, El Paso County/City of Colorado Springs Drainage Criteria Manual-Stormwater Quality Policies, Procedures and Best Management Practices" November 1, 2002.
2. "City of Colorado Springs/El Paso County Drainage Criteria Manual" September, 1987, Revised November 1991, Revised October 1994.
3. Flood Insurance Rate Study for El Paso County, Colorado and Incorporated Areas. Federal Emergency Management Agency, Revised March 17, 1997.
4. Soils Survey of El Paso County area, Natural Resources Conservation Services of Colorado.
5. Master Development Drainage Plan Meridian Ranch. May 2012. Prepared by Tech Contractors.

## **Appendices**

## **Appendix A - Rational Calculation Tables and Figures**



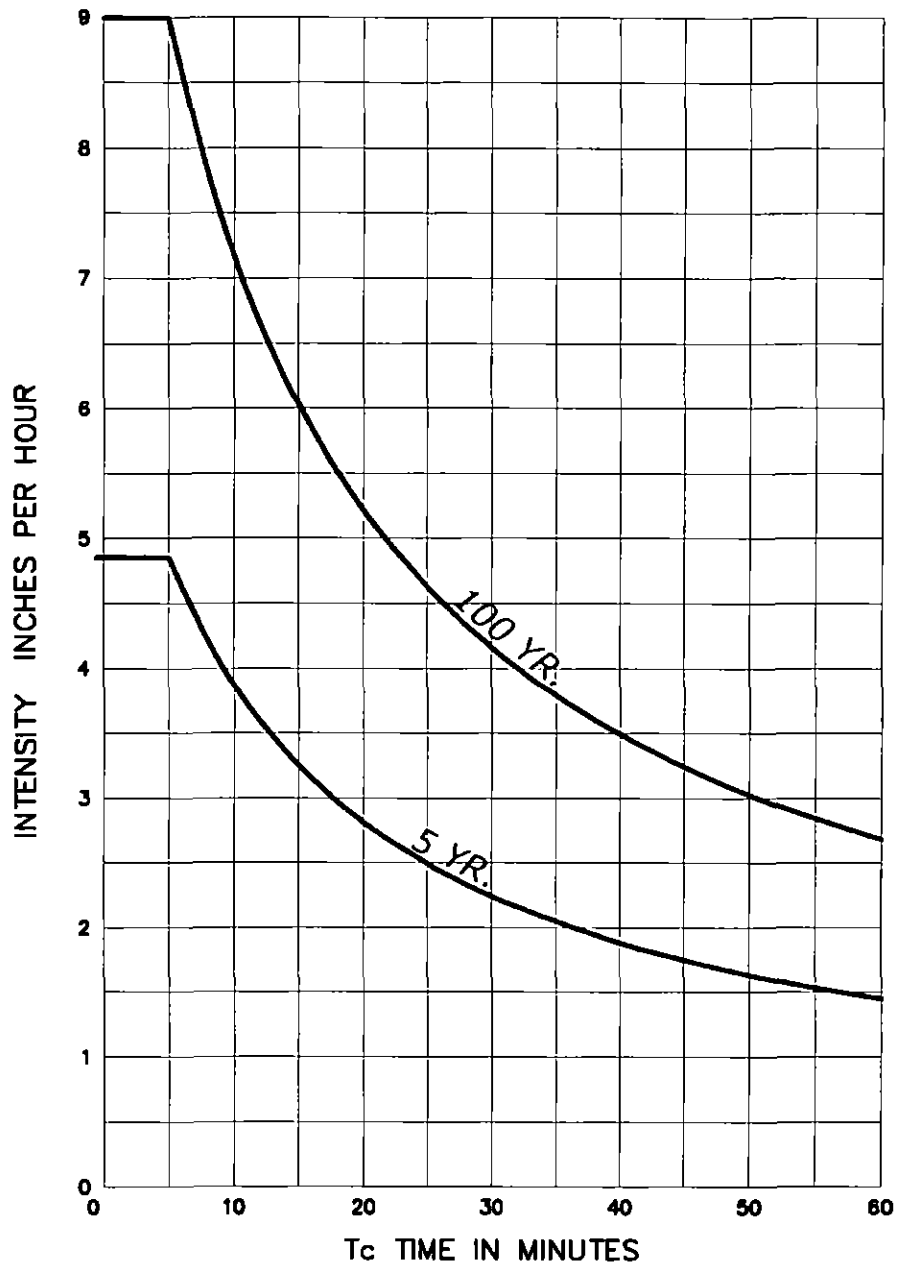
**TABLE 5-1**

**RECOMMENDED AVERAGE RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS**

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	"C" FREQUENCY			
		10		100	
		A&B*	C&D*	A&B*	C&D*
<b>Business</b>					
Commercial Areas	95	0.90	0.90	0.90	0.90
Neighborhood Areas	70	0.75	0.75	0.80	0.80
<b>Residential</b>					
1/8 Acre or less	65	0.60	0.70	0.70	0.80
1/4 Acre	40	0.50	0.60	0.60	0.70
1/3 Acre	30	0.40	0.50	0.55	0.60
1/2 Acre	25	0.35	0.45	0.45	0.55
1 Acre	20	0.30	0.40	0.40	0.50
<b>Industrial</b>					
Light Areas	80	0.70	0.70	0.80	0.80
Heavy Areas	90	0.80	0.80	0.90	0.90
<b>Parks and Cemeteries</b>	7	0.30	0.35	0.55	0.60
<b>Playgrounds</b>	13	0.30	0.35	0.60	0.65
<b>Railroad Yard Areas</b>	40	0.50	0.55	0.60	0.65
<b>Undeveloped Areas</b>					
Historic Flow Analysis- Greenbelts, Agricultural Pasture/Meadow	0	0.25	0.30	0.35	0.45
Forest	0	0.10	0.15	0.15	0.20
Exposed Rock	100	0.90	0.90	0.95	0.95
Offsite Flow Analysis (when land use not defined)	45	0.55	0.60	0.65	0.70
<b>Streets</b>					
Paved	100	0.90	0.90	0.95	0.95
Gravel	80	0.80	0.80	0.85	0.85
<b>Drive and Walks</b>	100	0.90	0.90	0.95	0.95
<b>Roofs</b>	90	0.90	0.90	0.95	0.95
<b>Lawns</b>	0	0.25	0.30	0.35	0.45

\* Hydrologic Soil Group

9/30/90



RE: BASED UPON PIKES PEAK AREA COUNCIL  
 OF GOVERNMENTS/ AREAWIDE URBAN RUNOFF  
 CONTROL MANUAL.

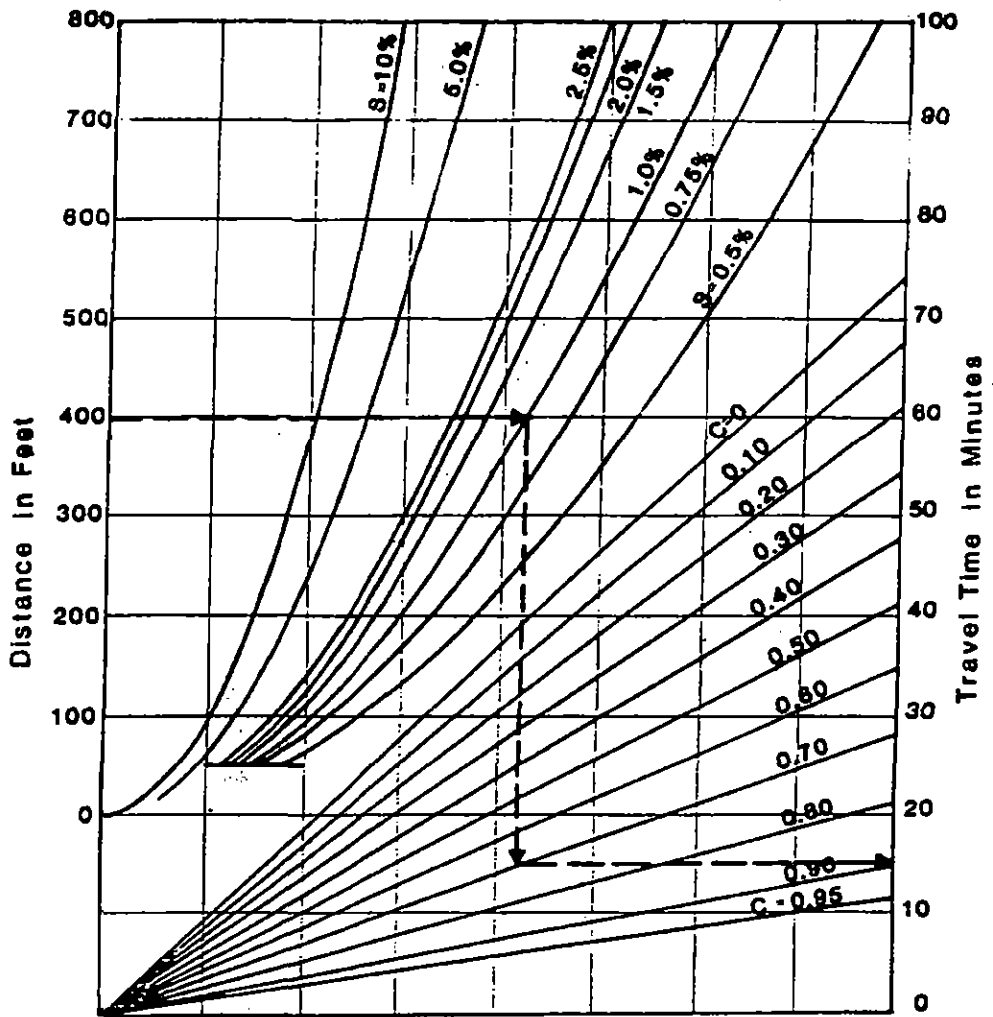
N.T.S.

MERIDIAN RANCH  
 STORM RAINFALL  
 TIME INTENSITY-FREQUENCY CURVES

FIGURE 6

TECH CONTRACTORS  
 12311 REX ROAD  
 FALCON, CO 80831

TELEPHONE: 719.495.7444  
 FAX: 719.495.2457



REFERENCE : Wright - McLaughlin Engineers, Urban Storm Drainage Criteria Manual, Vol. 1,  
 Denver Regional Council of Governments, Denver, Co. 1977



HDR Infrastructure, Inc.  
 A Centerra Company

The City of Colorado Springs / El Paso County  
 Drainage Criteria Manual

Overland Flow Curves

5-10

Date  
 OCT. 1987

Figure  
 5-2

## **Appendix B - Rational Hydrology Calculations**

<b>COMPOSITE 'C' FACTORS</b>									
PROJECT: Rational Calcs for Meridian Ranch Filing 11A						DESIGNED BY: TK			
BASIN DESIGNATION	AREA (AC.)							COMPOSITE FACTOR	
	UNDEVELOPED	5 DU/AC	6 DU/AC	STREETS	PARKS/ OPEN SP	SCHOOL	TOTAL	5-year	100-year
<b>DEVELOPED</b>									
1		4.5					4.5	0.53	0.63
2		2.0					2.0	0.53	0.63
3		2.8					2.8	0.53	0.63
4				0.4	0.7		1.1	0.52	0.70
5		0.7		0.5	0.4		1.6	0.59	0.71
6		5.0			1.5		6.5	0.47	0.61
7		5.0					5.0	0.53	0.63
8		5.0					5.0	0.53	0.63
9		4.6					4.6	0.53	0.63
10		2.1					2.1	0.53	0.63
11		5.1					5.1	0.53	0.63
12		5.5					5.5	0.53	0.63
13		3.8					3.8	0.53	0.63
14				1.2	1.2		2.4	0.60	0.75
15				0.9	1.0		1.9	0.58	0.74
16				0.5	1.0		1.5	0.50	0.80
17		0.4		0.4	0.9		1.7	0.49	0.86
18		0.9		0.2	0.6		1.7	0.49	0.64
19				1.8	2.0		3.8	0.58	0.74
20				1.2	0.5		1.7	0.72	0.83

<b>TIME OF CONCENTRATION</b>										
Rational Calculations										
PROJECT: Meridian Ranch Filing 11A				DESIGNED BY: TAK				DATE: 3/10/2014		
SUBBASIN DATA			INIT./OVERLAND TIME (Ti)			TRAVEL TIME (Tt)				TOTAL
BASIN DESIGNATION	C5	AREA (AC)	LENGTH (FT)	SLOPE %	Ti (Min.)*	LENGTH (FT)	DIF. EL.	VEL. (FPS)	Tt(Min.)**	Ti+Tt(Min)
1	0.53	4.5	300	2.7	12.9	805	19	2.35	5.7	18.6
2	0.53	2.0	192	3.7	9.3	660	20	2.47	4.4	13.8
3	0.53	2.8	272	2.6	12.5	620	14	2.18	4.7	17.2
4	0.52	1.1	20	2.0	5.0	650	8	1.74	6.2	11.2
5	0.59	1.6	65	15.4	5.0	565	7	1.69	5.6	10.6
6	0.47	6.5	148	1.4	12.4	1065	11	1.79	9.9	22.3
7	0.53	5.0	245	2.9	11.4	575	3	1.22	7.9	19.2
8	0.53	5.0	300	2.3	13.5	544	5	1.49	6.1	19.6
9	0.53	4.6	295	3.1	12.3	620	9	1.84	5.6	17.9
10	0.53	2.1	143	3.5	8.2	510	19	2.52	3.4	11.5
11	0.53	5.1	268	1.5	14.8	670	10	1.89	5.9	20.7
12	0.53	5.5	250	2.4	12.2	680	9	1.81	6.3	18.5
13	0.53	3.8	134	2.2	9.2	690	9	1.81	6.4	15.6
14	0.60	2.4	28	2.0	5.0	1485	29	2.52	9.8	14.8
15	0.58	1.9	45	2.0	5.0	995	23	2.45	6.8	11.8
16	0.50	1.5	45	2.0	5.8	815	33	2.90	4.7	10.4
17	0.49	1.7	45	2.0	5.8	700	28	2.79	4.2	10.0
18	0.49	1.7	145	3.4	8.8	400	10	2.05	3.3	12.0
19	0.58	3.8	45	2.0	5.0	2015	73	3.42	9.8	14.8
20	0.72	1.7	12	2.0	5.0	1285	16	2.05	10.5	15.5

**STORM DRAINAGE SYSTEM DESIGN  
(RATIONAL METHOD PROCEDURE)  
SURFACE ROUTING**

Date: 3/10/2014  
EL PASO COUNTY

PROJECT: Meridian Ranch Filing 11A

DESIGN POINT	DIRECT RUNOFF											TOTAL RUNOFF						OVERLAND TRAVEL TIME							
	BASIN	AREA (AC)	Tc (Min.)	I (in./hr.)		COEFF. C		CA		Q		Sum Tc (min.)	I (in./hr.)		CA		Q		DITCH OR GUTTER	ROUGHNESS	DESTINATION DP	SLOPE %	LENGTH (FT)	VEL. (FPS)	TRAVEL TIME (T)
				(5 YR)	(100 YR)	(5 YR)	(100 YR)	(5 YR)	(100 YR)	(5 YR)	(100 YR)		(5 YR)	(100 YR)	(5 YR)	(100 YR)	(5 YR)	(100 YR)							
1	4.5	18.6	2.92	5.41	0.53	0.63	2.36	2.81	7.0	15							7.0	15	G	0.015	108	1.35%	620	2.3	4.4
2	2.0	13.8	3.38	6.26	0.53	0.63	1.05	1.25	3.5	7.8							3.5	7.8	G	0.015	103	2.04%	785	2.9	4.6
3	2.8	17.2	3.04	5.63	0.53	0.63	1.47	1.75	4.5	9.8	18.3	2.94	5.45	1.77	2.22		5.2	12							
4	1.1	11.2	3.69	6.84	0.52	0.70	0.57	0.77	2.1	5.2							2.1	5.2	G	0.015	E107	1.25%	565	2.2	4.2
5	1.6	10.6	3.78	7.01	0.59	0.71	0.94	1.13	3.5	7.9	23.8	2.56	4.74	1.29	1.91		3.5	8.1							
6	6.5	22.3	2.65	4.92	0.47	0.61	3.09	3.96	8.2	19							8.2	19	G	0.015	105	3.38%	60	3.7	0.3
7	5.0	19.2	2.87	5.32	0.53	0.63	2.63	3.13	7.5	17	22.6	2.64	4.88	2.63	3.65		7.5	18							
8	5.0	19.6	2.84	5.27	0.53	0.63	2.63	3.13	7.5	16							7.5	16	G	0.015	108	3.73%	340	3.9	1.5
9	4.6	17.9	2.98	5.52	0.53	0.63	2.42	2.88	7.2	16	23.1	2.61	4.83	3.09	4.21		8.1	20	G	0.015	109	1.50%	325	2.4	2.2
10	2.1	11.5	3.65	6.77	0.53	0.63	1.12	1.33	4.1	9.0							4.1	9.0							
11	5.1	20.7	2.76	5.11	0.53	0.63	2.68	3.19	7.4	16	25.3	2.48	4.59	2.68	3.47		7.4	16	G	0.015	110	1.50%	375	2.4	2.6
12	5.5	18.5	2.93	5.43	0.53	0.63	2.89	3.44	8.5	19	27.8	2.34	4.34	2.89	3.70		8.5	19	G	0.015	111	2.00%	30	2.8	0.2
13	3.8	15.6	3.19	5.91	0.53	0.63	2.00	2.39	6.4	14	28.0	2.34	4.33	2.00	2.56		6.4	14							
14	2.4	14.8	3.26	6.05	0.60	0.75	1.44	1.80	4.7	11							4.7	11	G	0.015	E103	4.00%	805	4.0	3.4
15	1.9	11.8	3.62	6.71	0.58	0.74	1.11	1.41	4.0	9.4							4.0	9.4	G	0.015	DP02	4.00%	2015	4.0	8.4
16	1.5	10.4	3.80	7.05	0.50	0.68	0.75	1.03	2.9	7.2	18.2	2.95	5.47	1.09	1.63		3.2	8.9	G	0.015	E104	4.00%	700	4.0	2.9
17	1.7	10.0	3.87	7.17	0.49	0.66	0.84	1.12	3.2	8.0	21.1	2.73	5.07	1.07	1.68		3.2	8.5	G	0.015	E106	2.00%	410	2.8	2.4
18	1.7	12.0	3.59	6.65	0.49	0.64	0.83	1.08	3.0	7.2	23.5	2.58	4.78	1.09	1.65		3.0	7.9	G	0.015	E107	2.00%	50	2.8	0.3
19	3.8	14.8	3.27	6.05	0.58	0.74	2.22	2.81	7.3	17	20.2	2.80	5.19	2.59	3.44		7.3	18							
20	1.7	15.5	3.20	5.93	0.72	0.83	1.23	1.42	3.9	8.4							3.9	8.4							

**STORM DRAINAGE SYSTEM DESIGN  
INLET CALCULATIONS**

PROJECT: Meridian Ranch Filing 11A

Date: 3/10/2014

DP	Inlet size L(i)	Proposed or Existing <sup>2</sup>	INLET TYPE	CROSS SLOPE	STREET SLOPE	T <sub>c</sub>	Q <sub>Total</sub>		Q <sub>Capture</sub>				Q <sub>Flow-by</sub>				DEPTH (max)		SPREAD	
							Q <sub>5</sub> (cfs)	Q <sub>100</sub> (cfs)	Q <sub>5</sub> (cfs)	Q <sub>100</sub> (cfs)	CA <sub>eqv</sub> (5-yr)	CA <sub>eqv</sub> (100-yr)	Q <sub>5</sub> (cfs)	Q <sub>100</sub> (cfs)	CA <sub>eqv</sub> (5-yr)	CA <sub>eqv</sub> (100-yr)	Q <sub>5</sub> (ft)	Q <sub>100</sub> (ft)	Q <sub>5</sub> (ft)	Q <sub>100</sub> (ft)
<b>PROPOSED INLETS</b>																				
I01	20	PROP.	FLOW-BY	2.0%	2.7%	18.6	7.0	15	5.0	9.6	1.72	1.77	2.0	5.6	0.68	1.04	0.33	0.42	12.4	16.6
I02	15	PROP.	FLOW-BY	2.0%	2.7%	13.8	3.5	7.8	2.5	4.9	0.75	0.78	1.0	2.9	0.30	0.47	0.28	0.34	9.6	12.9
I03	15	PROP.	SUMP <sup>1</sup>	2.0%		18.3	5.2	12	5.2	12	1.77	2.22	-	-	-	-	0.50	0.50		
I04	20	PROP.	SUMP <sup>1</sup>	2.0%		22.3	8.2	19	8.2	19	3.09	3.85	-	0.5	-	0.11	0.50	0.50		
I05	20	PROP.	SUMP <sup>1</sup>	2.0%		22.6	7.5	18	7.5	18	2.86	3.65	-	-	-	-	0.50	0.50		
I06	15	PROP.	SUMP <sup>1</sup>	2.0%		19.6	7.5	16	7.5	15	2.63	2.83	-	1.5	-	0.29	0.50	0.50		
I07	10	PROP.	SUMP <sup>1</sup>	2.0%		11.5	4.1	9.0	4.1	9.0	1.12	1.33	-	-	-	-	0.50	0.50		
I08	20	PROP.	SUMP <sup>1</sup>	2.0%		23.1	8.1	20	8.1	19	3.09	3.93	-	1.4	-	0.29	0.50	0.50		
I09	15	PROP.	SUMP <sup>1</sup>	2.0%		20.7	7.4	16	7.4	15	2.68	2.92	-	1.4	-	0.27	0.50	0.50		
I10	10	PROP.	SUMP	2.0%		18.5	8.5	19	8.5	18	2.89	3.27	-	0.9	-	0.17	0.50	0.70		
I11	10	PROP.	SUMP	2.0%		15.6	6.4	14	6.4	14	2.00	2.39	-	-	-	-	0.50	0.70		
<b>EXISTING INLETS</b>																				
EI01	15	EXIST.	FLOW-BY	2.0%	1.0%	14.8	4.7	11	3.6	7.2	1.10	1.20	1.1	3.6	0.34	0.60	0.34	0.44	12.9	17.6
EI02	10	EXIST.	FLOW-BY	2.0%	1.0%	11.8	4.0	9.4	2.7	5.2	0.74	0.77	1.3	4.3	0.37	0.63	0.33	0.42	12.1	16.7
EI03	20	EXIST.	FLOW-BY	2.0%	4.0%	18.2	3.2	8.9	2.5	5.9	0.85	1.07	0.7	3.1	0.24	0.56	0.26	0.34	8.6	12.6
EI04	20	EXIST.	FLOW-BY	2.0%	4.0%	21.1	3.2	8.5	2.5	5.6	0.92	1.11	0.7	2.9	0.26	0.57	0.26	0.33	8.6	12.4
EI05	10	EXIST.	FLOW-BY	2.0%	1.3%	11.2	2.1	5.2	1.5	3.3	0.41	0.48	0.6	2.0	0.16	0.29	0.27	0.34	9.1	12.9
EI06	15	EXIST.	FLOW-BY	2.0%	1.0%	23.5	3.0	7.9	2.5	5.5	0.96	1.16	0.5	2.3	0.20	0.49	0.30	0.40	10.9	15.6
EI07	10	EXIST.	SUMP	2.0%		23.8	3.5	9.1	3.5	9.1	1.39	1.91	-	-	-	-	0.50	0.60		
EI08	15	EXIST.	FLOW-BY	2.0%	1.3%	15.5	3.9	8.4	3.0	5.7	0.95	0.96	0.9	2.7	0.28	0.46	0.32	0.39	11.6	15.3

<sup>1</sup> Forced sump at intersection

<sup>2</sup> Existing inlets were constructed as a part of the Londonderry and Lambert Improvements in 2007



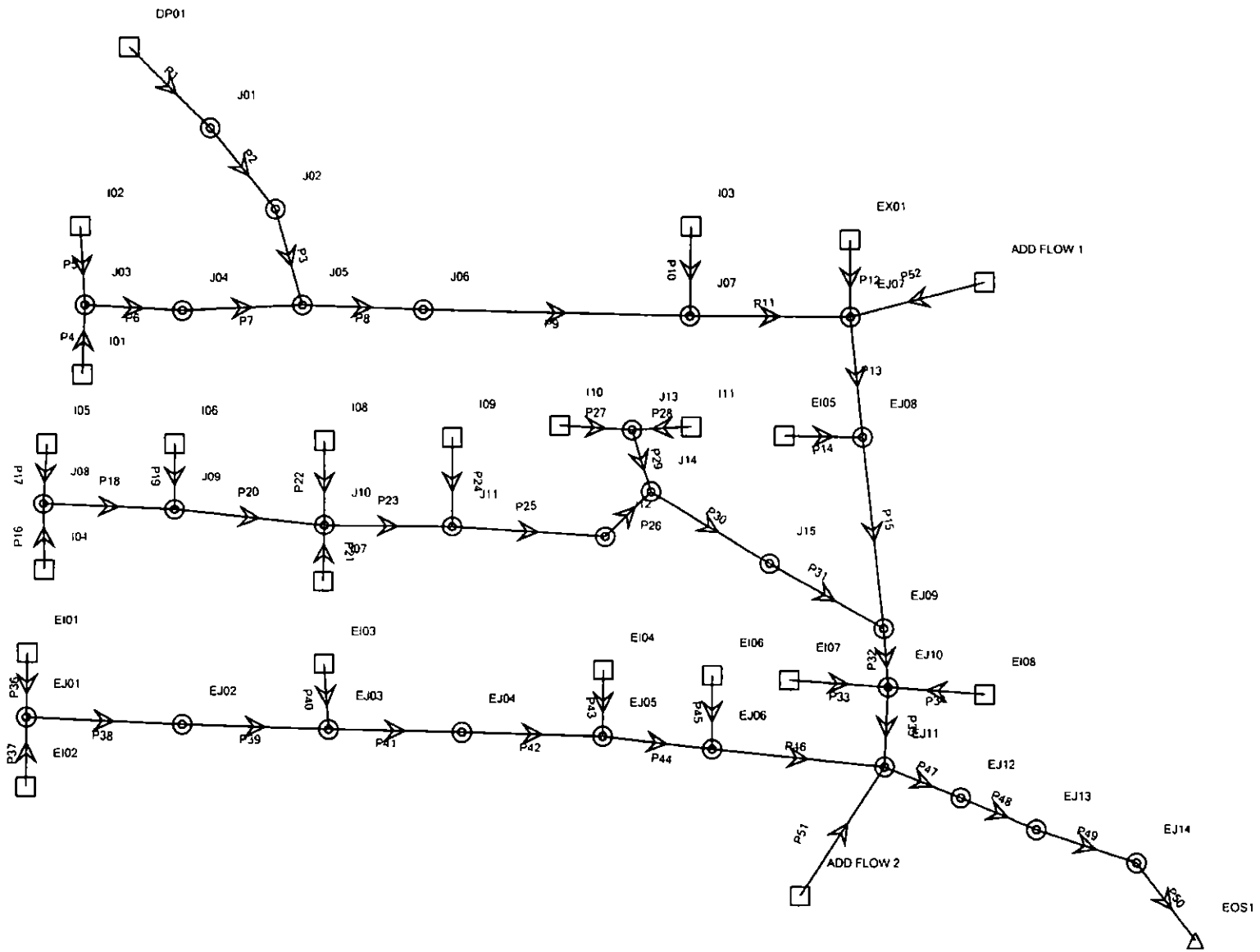


**STORM DRAINAGE SYSTEM DESIGN  
HYDRAULICS**

Calc. by: TAK  
Date: 3/10/2014

PROJECT: Meridian Ranch Filing 11A

Label	Upstream Node	Downstream Node	Inlet CA (acres)	Inlet Tc (min)	Inlet Flow (ft <sup>3</sup> /s)	System CA (acres)	System Flow Time (min)	System Intensity (in/hr)	Length (ft)	Section Size (in)	Slope (%)	Capacity (Full Flow) (ft <sup>3</sup> /s)	System Flow (ft <sup>3</sup> /s)	Velocity (Average) (ft/s)	Elevation Ground (Upstream) (ft)	Hydraulic Grade Line (Upstream) (ft)	Invert (Upstream) (ft)	Elevation Ground (Downstream) (ft)	Hydraulic Grade Line (Out) (ft)	Invert (Downstream) (ft)
P1	DP01	J01	289.00	206.0	100.4	90.17	206.0	1.11	145.9	48	7.28%	388	100	25.9	7054.80	7,051.5	7,048.50	7,050.00	7,039.4	7,037.88
P2	J01	J02	(N/A)	0.0	0.0	90.17	206.1	1.10	600.0	42	1.48%	122	100	14.2	7050.00	7,040.5	7,037.38	7,036.50	7,031.7	7,028.50
P3	J02	J05	(N/A)	0.0	0.0	90.17	206.8	1.10	201.1	42	1.84%	137	100	15.5	7036.50	7,031.1	7,028.00	7,032.30	7,028.3	7,024.30
P4	I01	J03	1.77	18.6	9.7	1.77	18.6	5.41	8.6	18	4.07%	21	10	11.7	7034.94	7,032.1	7,030.90	7,035.23	7,032.1	7,030.55
P5	I02	J03	0.78	13.8	4.9	0.78	13.8	6.25	25.2	18	0.99%	11	5	5.8	7034.82	7,031.8	7,030.80	7,035.23	7,031.8	7,030.55
P6	J03	J04	(N/A)	0.0	0.0	2.55	18.6	5.41	26.6	18	1.32%	12	14	7.9	7035.23	7,031.6	7,030.05	7,034.37	7,031.1	7,029.70
P7	J04	J05	(N/A)	0.0	0.0	2.55	18.7	5.40	170.3	18	1.70%	14	14	8.8	7034.37	7,030.6	7,029.20	7,032.30	7,027.6	7,026.30
P8	J05	J06	(N/A)	0.0	0.0	92.72	207.0	1.10	452.9	42	1.35%	117	103	13.7	7032.30	7,026.9	7,023.80	7,025.72	7,020.3	7,017.70
P9	J06	J07	(N/A)	0.0	0.0	92.72	207.6	1.10	161.8	42	4.17%	206	103	21.4	7025.72	7,020.3	7,017.20	7,018.68	7,013.6	7,010.45
P10	I03	J07	2.22	18.3	12.2	2.22	18.3	5.46	4.5	18	2.22%	16	12	6.9	7018.23	7,014.1	7,012.55	7,018.68	7,014.0	7,012.45
P11	J07	EJ07	(N/A)	0.0	0.0	94.94	207.7	1.10	87.4	54	0.49%	139	105	9.5	7018.68	7,013.5	7,009.45	7,019.36	7,013.4	7,009.12
P12	EX01	EJ07	96.00	51.7	179.0	80.00	51.7	2.96	52.8	54	2.82%	330	179	21.2	7019.60	7,014.5	7,010.61	7,019.36	7,013.1	7,009.12
P13	EJ07	EJ08	(N/A)	0.0	0.0	154.94	207.8	1.10	545.8	80	1.14%	278	208	15.5	7019.36	7,012.7	7,008.62	7,011.86	7,005.6	7,002.41
P14	EI05	EJ08	0.48	11.2	3.3	0.48	11.2	6.85	35.0	18	3.57%	20	3	8.3	7010.96	7,007.6	7,006.86	7,011.86	7,007.7	7,005.61
P15	EJ08	EJ09	(N/A)	0.0	0.0	155.42	208.4	1.10	499.2	60	1.39%	307	208	16.8	7011.86	7,006.2	7,002.11	7,005.16	7,002.2	6,995.16
P16	I04	J08	3.85	22.3	19.1	3.85	22.3	4.92	32.0	24	3.28%	41	19	12.8	7,049.13	7,046.0	7,044.45	7,048.68	7,045.6	7,043.40
P17	I05	J08	3.85	22.8	18.0	3.65	22.6	4.88	25.2	18	1.19%	12	18	10.2	7048.30	7,047.3	7,044.20	7,048.68	7,046.8	7,043.90
P18	J08	J09	(N/A)	0.0	0.0	7.50	22.6	4.88	295.0	24	3.23%	41	37	14.7	7048.68	7,044.8	7,042.90	7,039.32	7,035.5	7,033.38
P19	I06	J09	2.83	19.6	15.0	2.83	19.6	5.27	25.2	24	1.03%	23	15	7.8	7038.14	7,035.6	7,033.64	7,039.32	7,035.5	7,033.38
P20	J09	J10	(N/A)	0.0	0.0	10.33	23.0	4.84	303.8	30	4.11%	83	50	17.7	7039.32	7,035.2	7,032.88	7,026.96	7,023.1	7,020.40
P21	I07	J10	1.33	11.5	9.1	1.33	11.5	6.77	31.9	24	4.70%	49	9	11.9	7026.99	7,024.1	7,022.40	7,028.96	7,024.1	7,020.90
P22	I08	J10	3.93	23.1	19.1	3.93	23.1	4.83	25.2	18	4.76%	23	19	10.8	7026.70	7,024.9	7,022.60	7,028.96	7,024.1	7,021.40
P23	J10	J11	(N/A)	0.0	0.0	15.59	23.3	4.81	295.8	36	2.11%	97	76	15.1	7026.96	7,022.6	7,019.90	7,021.17	7,015.7	7,013.67
P24	I09	J11	2.92	25.3	13.5	2.92	25.3	4.59	24.3	24	4.65%	49	14	13.3	7020.38	7,017.1	7,015.80	7,017.17	7,017.1	7,014.67
P25	J11	J12	(N/A)	0.0	0.0	18.51	25.3	4.58	322.7	42	1.49%	123	86	13.8	7021.17	7,016.1	7,013.17	7,018.39	7,012.9	7,008.35
P26	J12	J14	(N/A)	0.0	0.0	18.51	25.7	4.55	35.3	42	0.99%	100	85	8.8	7016.39	7,012.1	7,007.85	7,015.97	7,011.9	7,007.50
P27	I10	J13	3.27	18.5	17.9	3.27	18.5	5.43	25.2	18	1.03%	11	18	10.1	7015.24	7,013.7	7,011.24	7,015.51	7,013.0	7,010.98
P28	I11	J13	2.39	15.6	14.2	2.39	15.6	5.91	5.2	18	5.00%	24	14	8.1	7015.24	7,012.9	7,011.24	7,015.51	7,012.8	7,010.98
P29	J13	J14	(N/A)	0.0	0.0	5.66	16.5	5.42	46.6	24	2.32%	34	31	12.4	7015.51	7,012.4	7,010.46	7,015.97	7,011.4	7,009.40
P30	J14	J15	(N/A)	0.0	0.0	24.17	25.8	4.54	172.8	42	5.31%	232	111	23.8	7015.97	7,010.2	7,007.00	7,010.25	7,004.4	6,997.82
P31	J15	EJ09	(N/A)	0.0	0.0	24.17	25.9	4.53	94.2	48	1.55%	179	110	8.8	7010.25	7,004.2	6,997.32	7,005.16	7,003.6	6,995.86
P32	EJ09	EJ10	(N/A)	0.0	0.0	179.59	208.9	1.09	90.5	66	0.83%	287	305	12.8	7005.16	7,001.8	6,994.76	7,004.39	7,001.0	6,994.19
P33	EI07	EJ10	1.91	23.8	9.1	1.91	23.8	4.75	42.7	18	4.47%	22	9	5.2	7,003.77	7,003.1	6,999.80	7,004.39	7,002.7	6,997.89
P34	EI08	EJ10	0.96	15.5	5.7	0.96	15.5	5.92	15.7	18	13.82%	39	6	3.2	7003.93	7,002.8	7,000.06	7,004.39	7,002.7	6,997.89
P35	EJ10	EJ11	(N/A)	0.0	0.0	182.46	209.0	1.09	34.0	66	0.76%	294	308	12.9	7004.39	7,000.6	6,993.89	7,004.13	7,000.3	6,993.63
P36	EI01	EJ01	1.20	14.8	7.3	1.20	14.8	6.05	5.5	18	42.55%	69	7	25.3	7077.47	7,074.2	7,073.11	7,077.74	7,071.3	7,070.77
P37	EI02	EJ01	0.77	11.8	5.2	0.77	11.8	6.70	61.4	18	4.53%	22	5	10.3	7077.47	7,074.3	7,073.45	7,077.74	7,071.2	7,070.67
P38	EJ01	EJ02	(N/A)	0.0	0.0	1.97	14.8	6.05	466.3	24	3.34%	41	12	11.4	7077.74	7,071.2	7,069.97	7,060.13	7,055.1	7,054.40
P39	EJ02	EJ03	(N/A)	0.0	0.0	1.97	15.5	5.93	350.7	24	4.16%	46	12	12.3	7060.13	7,055.2	7,054.00	7,045.89	7,040.1	7,039.42
P40	EI03	EJ03	1.07	18.2	5.9	1.07	18.2	5.47	5.2	18	5.96%	26	6	11.8	7045.82	7,041.1	7,040.13	7,045.89	7,040.9	7,039.82
P41	EJ03	EJ04	(N/A)	0.0	0.0	3.04	18.2	5.47	358.1	24	4.06%	46	17	13.4	7045.89	7,040.4	7,038.92	7,031.38	7,025.2	7,024.38
P42	EJ04	EJ05	(N/A)	0.0	0.0	3.04	18.7	5.41	347.2	24	3.92%	45	17	13.2	7031.38	7,025.7	7,024.18	7,017.38	7,011.4	7,010.58
P43	EI04	EJ05	1.11	21.1	5.7	1.11	21.1	5.07	5.2	18	21.92%	49	6	18.6	7017.11	7,013.0	7,012.10	7,017.38	7,011.9	7,010.96
P44	EJ05	EJ06	(N/A)	0.0	0.0	4.15	21.1	5.07	431.8	30	2.38%	63	21	11.6	7017.38	7,011.5	7,009.96	7,005.70	7,000.7	6,999.70
P45	EI06	EJ06	1.16	23.5	5.6	1.16	23.5	4.78	5.2	18	1.54%	13	6	3.2	7004.98	7,001.6	7,000.08	7,005.70	7,001.6	7,000.00
P46	EJ06	EJ11	(N/A)	0.0	0.0	5.31	23.5	4.78	73.3	30	3.78%	80	28	14.5	7005.70	7,001.1	6,999.40	7,004.13	6,999.0	6,996.63
P47	EJ11	EJ12	(N/A)	0.0	0.0	187.77	209.1	1.09	386.0	66	1.16%	382	313	17.2	7004.13	6,998.2	6,993.33	6,999.34	6,992.8	6,988.84
P48	EJ12	EJ13	(N/A)	0.0	0.0	187.77	209.4	1.09	448.3	66	0.88%	315	313	15.1	6,999.34	6,993.4	6,988.54	6,995.10	6,989.5	6,984.60
P49	EJ13	EJ14	(N/A)	0.0	0.0	187.77	209.9	1.09	452.2	66	2.77%	559	313	24.2	6,995.10	6,989.1	6,984.30	6,982.27	6,978.1	6,971.77
P50	EJ14	EOS1	(N/A)	0.0	0.0	187.77	210.2	1.09	134.1	66	0.67%	275	313	13.2	6,982.27	6,978.8	6,971.47	6,980.00	6,975.4	6,970.57



## **Appendix C – Street Flow Data**



## Worksheet for Ramp Full Street Section

### Results

Discharge		42.54	ft <sup>3</sup> /s
Elevation Range	-0.75 to 0.00 ft		
Flow Area		19.32	ft <sup>2</sup>
Wetted Perimeter		60.21	ft
Hydraulic Radius		0.32	ft
Top Width		60.00	ft
Normal Depth		0.75	ft
Critical Depth		0.66	ft
Critical Slope		0.01121	ft/ft
Velocity		2.20	ft/s
Velocity Head		0.08	ft
Specific Energy		0.83	ft
Froude Number		0.68	
Flow Type	Subcritical		

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.75	ft
Critical Depth	0.66	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.01121	ft/ft

## Cross Section for Ramp Full Street Section

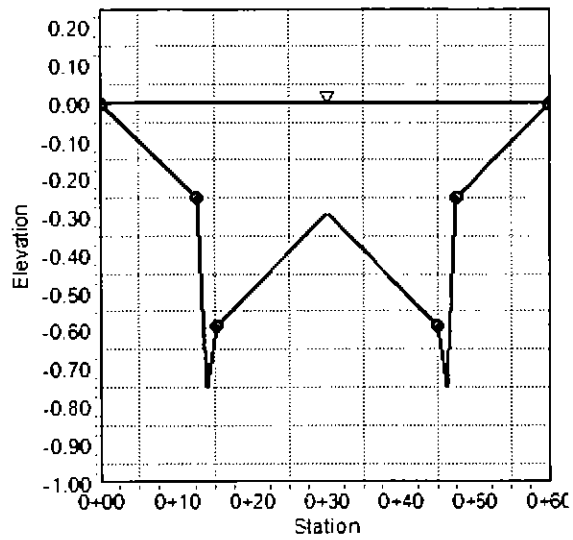
### Project Description

Friction Method                      Manning Formula  
Solve For                                Discharge

### Input Data

Channel Slope                              0.00500    ft/ft  
Normal Depth                                0.75        ft  
Discharge                                    42.54      ft<sup>3</sup>/s

### Cross Section Image



**RESIDENTIAL STREET SECTION  
RAMP CURB**

5-Year Storm Event Maximum Allowable Street Flows (Maximum Flow to Top of Curb)									
Channel Slope (ft/ft)	Full Street Width					Half Street Width			
	Discharge (ft <sup>3</sup> /s)	Velocity (ft/s)	Flow Area (ft <sup>2</sup> )	Wetted Perimeter (ft)	Top Width (ft)	Discharge (ft <sup>3</sup> /s)	Velocity (ft/s)	Flow Area (ft <sup>2</sup> )	Top Width (ft)
0.0050	19	2.5	7.45	35.2	35.0	9.4	2.5	3.7	17.5
0.0063	21	2.8	7.45	35.2	35.0	11	2.8	3.7	17.5
0.0075	23	3.1	7.45	35.2	35.0	12	3.1	3.7	17.5
0.0088	25	3.4	7.45	35.2	35.0	12	3.3	3.7	17.5
0.0100	27	3.6	7.45	35.2	35.0	13	3.6	3.7	17.5
0.0113	28	3.8	7.45	35.2	35.0	14	3.8	3.7	17.5
0.0125	30	4.0	7.45	35.2	35.0	15	4.0	3.7	17.5
0.0138	31	4.2	7.45	35.2	35.0	16	4.2	3.7	17.5
0.0150	33	4.4	7.45	35.2	35.0	16	4.4	3.7	17.5
0.0163	34	4.6	7.45	35.2	35.0	17	4.5	3.7	17.5
0.0175	35	4.7	7.45	35.2	35.0	18	4.7	3.7	17.5
0.0188	37	4.9	7.45	35.2	35.0	18	4.9	3.7	17.5
0.0200	38	5.1	7.45	35.2	35.0	19	5.0	3.7	17.5
0.0213	39	5.2	7.45	35.2	35.0	19	5.2	3.7	17.5
0.0225	40	5.4	7.45	35.2	35.0	20	5.4	3.7	17.5
0.0238	41	5.5	7.45	35.2	35.0	20	5.5	3.7	17.5
0.0250	42	5.7	7.45	35.2	35.0	21	5.6	3.7	17.5
0.0263	43	5.8	7.45	35.2	35.0	22	5.8	3.7	17.5
0.0275	44	5.9	7.45	35.2	35.0	22	5.9	3.7	17.5
0.0288	45	6.1	7.45	35.2	35.0	23	6.0	3.7	17.5
0.0300	46	6.2	7.45	35.2	35.0	23	6.2	3.7	17.5
0.0313	47	6.3	7.45	35.2	35.0	23	6.3	3.7	17.5
0.0325	48	6.5	7.45	35.2	35.0	24	6.4	3.7	17.5
0.0338	49	6.6	7.45	35.2	35.0	24	6.6	3.7	17.5
0.0350	50	6.7	7.45	35.2	35.0	25	6.7	3.7	17.5
0.0363	51	6.8	7.45	35.2	35.0	25	6.8	3.7	17.5
0.0375	52	6.9	7.45	35.2	35.0	26	6.9	3.7	17.5
0.0388	53	7.1	7.45	35.2	35.0	26	7.0	3.7	17.5
0.0400	53	7.2	7.45	35.2	35.0	27	7.1	3.7	17.5

100-Year Storm Event Maximum Allowable Street Flows (Maximum Flow to Right-of-Way)									
Channel Slope (ft/ft)	Full Street Width					Half Street Width			
	Discharge (ft <sup>3</sup> /s)	Velocity (ft/s)	Flow Area (ft <sup>2</sup> )	Wetted Perimeter (ft)	Top Width (ft)	Discharge (ft <sup>3</sup> /s)	Velocity (ft/s)	Flow Area (ft <sup>2</sup> )	Top Width (ft)
0.0050	43	2.2	19.32	60.2	60.0	21	2.2	9.7	30
0.0063	48	2.5	19.32	60.2	60.0	24	2.4	9.7	30
0.0075	52	2.7	19.32	60.2	60.0	26	2.7	9.7	30
0.0088	56	2.9	19.32	60.2	60.0	28	2.9	9.7	30
0.0100	60	3.1	19.32	60.2	60.0	30	3.1	9.7	30
0.0113	64	3.3	19.32	60.2	60.0	32	3.3	9.7	30
0.0125	67	3.5	19.32	60.2	60.0	33	3.5	9.7	30
0.0138	71	3.7	19.32	60.2	60.0	35	3.6	9.7	30
0.0150	74	3.8	19.32	60.2	60.0	36	3.8	9.7	30
0.0163	77	4.0	19.32	60.2	60.0	38	3.9	9.7	30
0.0175	80	4.1	19.32	60.2	60.0	39	4.1	9.7	30
0.0188	82	4.3	19.32	60.2	60.0	41	4.2	9.7	30
0.0200	85	4.4	19.32	60.2	60.0	42	4.4	9.7	30
0.0213	88	4.5	19.32	60.2	60.0	43	4.5	9.7	30
0.0225	90	4.7	19.32	60.2	60.0	45	4.6	9.7	30
0.0238	93	4.8	19.32	60.2	60.0	46	4.8	9.7	30
0.0250	95	4.9	19.32	60.2	60.0	47	4.9	9.7	30
0.0263	97	5.0	19.32	60.2	60.0	48	5.0	9.7	30
0.0275	100	5.2	19.32	60.2	60.0	49	5.1	9.7	30
0.0288	102	5.3	19.32	60.2	60.0	50	5.2	9.7	30
0.0300	104	5.4	19.32	60.2	60.0	52	5.3	9.7	30
0.0313	106	5.5	19.32	60.2	60.0	53	5.5	9.7	30
0.0325	108	5.6	19.32	60.2	60.0	54	5.6	9.7	30
0.0338	111	5.7	19.32	60.2	60.0	55	5.7	9.7	30
0.0350	113	5.8	19.32	60.2	60.0	56	5.8	9.7	30
0.0363	115	5.9	19.32	60.2	60.0	57	5.9	9.7	30
0.0375	117	6.0	19.32	60.2	60.0	58	6.0	9.7	30
0.0388	118	6.1	19.32	60.2	60.0	59	6.1	9.7	30
0.0400	120	6.2	19.32	60.2	60.0	60	6.2	9.7	30

**Street Flows Ramp Curb**  
(Maximum Flow to Crown of Roadway)

Channel Slope (ft/ft)	Full Street Width					Half Street Width			
	Discharge (ft <sup>3</sup> /s)	Velocity (ft/s)	Flow Area (ft <sup>2</sup> )	Wetted Perimeter (ft)	Top Width (ft)	Discharge (ft <sup>3</sup> /s)	Velocity (ft/s)	Flow Area (ft <sup>2</sup> )	Top Width (ft)
0.0050	13	2.2	6.05	35.0	34.8	6.7	2.2	3.0	17.4
0.0063	15	2.5	6.05	35.0	34.8	7.5	2.5	3.0	17.4
0.0075	16	2.7	6.05	35.0	34.8	8.2	2.7	3.0	17.4
0.0088	18	2.9	6.05	35.0	34.8	8.9	2.9	3.0	17.4
0.0100	19	3.1	6.05	35.0	34.8	9.5	3.1	3.0	17.4
0.0113	20	3.3	6.05	35.0	34.8	10	3.3	3.0	17.4
0.0125	21	3.5	6.05	35.0	34.8	11	3.5	3.0	17.4
0.0138	22	3.7	6.05	35.0	34.8	11	3.7	3.0	17.4
0.0150	23	3.8	6.05	35.0	34.8	12	3.8	3.0	17.4
0.0163	24	4.0	6.05	35.0	34.8	12	4.0	3.0	17.4
0.0175	25	4.1	6.05	35.0	34.8	13	4.1	3.0	17.4
0.0188	26	4.3	6.05	35.0	34.8	13	4.3	3.0	17.4
0.0200	27	4.4	6.05	35.0	34.8	13	4.4	3.0	17.4
0.0213	28	4.6	6.05	35.0	34.8	14	4.6	3.0	17.4
0.0225	28	4.7	6.05	35.0	34.8	14	4.7	3.0	17.4
0.0238	29	4.8	6.05	35.0	34.8	15	4.8	3.0	17.4
0.0250	30	5.0	6.05	35.0	34.8	15	5.0	3.0	17.4
0.0263	31	5.1	6.05	35.0	34.8	15	5.1	3.0	17.4
0.0275	31	5.2	6.05	35.0	34.8	16	5.2	3.0	17.4
0.0288	32	5.3	6.05	35.0	34.8	16	5.3	3.0	17.4
0.0300	33	5.4	6.05	35.0	34.8	16	5.4	3.0	17.4
0.0313	34	5.5	6.05	35.0	34.8	17	5.5	3.0	17.4
0.0325	34	5.7	6.05	35.0	34.8	17	5.6	3.0	17.4
0.0338	35	5.8	6.05	35.0	34.8	17	5.8	3.0	17.4
0.0350	35	5.9	6.05	35.0	34.8	18	5.9	3.0	17.4
0.0363	36	6.0	6.05	35.0	34.8	18	6.0	3.0	17.4
0.0375	37	6.1	6.05	35.0	34.8	18	6.1	3.0	17.4
0.0388	37	6.2	6.05	35.0	34.8	19	6.2	3.0	17.4
0.0400	38	6.3	6.05	35.0	34.8	19	6.3	3.0	17.4



## Worksheet for Vertical Full Street Section

### Project Description

Friction Method                      Manning Formula  
 Solve For                              Discharge

### Input Data

Channel Slope                                              0.00500    ft/ft  
 Normal Depth                                              0.75       ft  
 Section Definitions

Station (ft)	Elevation (ft)
--------------	----------------

0+00	0.00
0+13	-0.25
0+13	-0.25
0+13	-0.75
0+15	-0.58
0+30	-0.28
0+45	-0.58
0+47	-0.75
0+47	-0.25
0+48	-0.25
0+60	0.00

### Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
---------------	----------------	-----------------------

(0+00, 0.00)	(0+13, -0.25)	0.030
(0+13, -0.25)	(0+15, -0.58)	0.013
(0+15, -0.58)	(0+45, -0.58)	0.015
(0+45, -0.58)	(0+48, -0.25)	0.013
(0+48, -0.25)	(0+60, 0.00)	0.030
<None>	(0+60, 0.00)	0.030

### Options

Current Roughness weighted Method                      Pavlovskii's Method  
 Open Channel Weighting Method                      Pavlovskii's Method

## Worksheet for Vertical Full Street Section

### Options

Closed Channel Weighting Method      Pavlovskii's Method

### Results

Discharge		41.33	ft <sup>3</sup> /s
Elevation Range	-0.75 to 0.00 ft		
Flow Area		19.04	ft <sup>2</sup>
Wetted Perimeter		61.02	ft
Hydraulic Radius		0.31	ft
Top Width		60.00	ft
Normal Depth		0.75	ft
Critical Depth		0.66	ft
Critical Slope		0.01143	ft/ft
Velocity		2.17	ft/s
Velocity Head		0.07	ft
Specific Energy		0.82	ft
Froude Number		0.68	
Flow Type	Subcritical		

### GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

### GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.75	ft
Critical Depth	0.66	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.01143	ft/ft

## Cross Section for Vertical Full Street Section

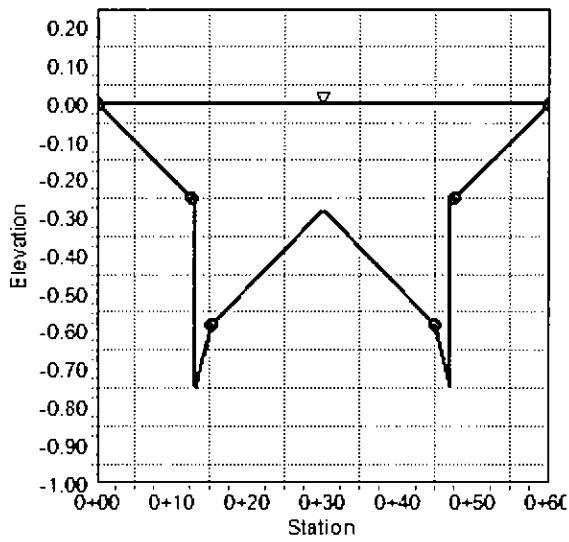
### Project Description

Friction Method                      Manning Formula  
Solve For                                Discharge

### Input Data

Channel Slope                              0.00500    ft/ft  
Normal Depth                                0.75        ft  
Discharge                                    41.33       ft<sup>3</sup>/s

### Cross Section Image



**RESIDENTIAL STREET SECTION  
RAMP CURB**

5-Year Storm Event Maximum Allowable Street Flows (Maximum Flow to Top of Curb)									
Channel Slope (ft/ft)	Full Street Width					Half Street Width			
	Discharge (ft <sup>3</sup> /s)	Velocity (ft/s)	Flow Area (ft <sup>2</sup> )	Wetted Perimeter (ft)	Top Width (ft)	Discharge (ft <sup>3</sup> /s)	Velocity (ft/s)	Flow Area (ft <sup>2</sup> )	Top Width (ft)
0.0050	19	2.5	7.45	35.2	35.0	9.4	2.5	3.7	17.5
0.0063	21	2.8	7.45	35.2	35.0	11	2.8	3.7	17.5
0.0075	23	3.1	7.45	35.2	35.0	12	3.1	3.7	17.5
0.0088	25	3.4	7.45	35.2	35.0	12	3.3	3.7	17.5
0.0100	27	3.6	7.45	35.2	35.0	13	3.6	3.7	17.5
0.0113	28	3.8	7.45	35.2	35.0	14	3.8	3.7	17.5
0.0125	30	4.0	7.45	35.2	35.0	15	4.0	3.7	17.5
0.0138	31	4.2	7.45	35.2	35.0	16	4.2	3.7	17.5
0.0150	33	4.4	7.45	35.2	35.0	16	4.4	3.7	17.5
0.0163	34	4.6	7.45	35.2	35.0	17	4.5	3.7	17.5
0.0175	35	4.7	7.45	35.2	35.0	18	4.7	3.7	17.5
0.0188	37	4.9	7.45	35.2	35.0	18	4.9	3.7	17.5
0.0200	38	5.1	7.45	35.2	35.0	19	5.0	3.7	17.5
0.0213	39	5.2	7.45	35.2	35.0	19	5.2	3.7	17.5
0.0225	40	5.4	7.45	35.2	35.0	20	5.4	3.7	17.5
0.0238	41	5.5	7.45	35.2	35.0	20	5.5	3.7	17.5
0.0250	42	5.7	7.45	35.2	35.0	21	5.6	3.7	17.5
0.0263	43	5.8	7.45	35.2	35.0	22	5.8	3.7	17.5
0.0275	44	5.9	7.45	35.2	35.0	22	5.9	3.7	17.5
0.0288	45	6.1	7.45	35.2	35.0	23	6.0	3.7	17.5
0.0300	46	6.2	7.45	35.2	35.0	23	6.2	3.7	17.5
0.0313	47	6.3	7.45	35.2	35.0	23	6.3	3.7	17.5
0.0325	48	6.5	7.45	35.2	35.0	24	6.4	3.7	17.5
0.0338	49	6.6	7.45	35.2	35.0	24	6.6	3.7	17.5
0.0350	50	6.7	7.45	35.2	35.0	25	6.7	3.7	17.5
0.0363	51	6.8	7.45	35.2	35.0	25	6.8	3.7	17.5
0.0375	52	6.9	7.45	35.2	35.0	26	6.9	3.7	17.5
0.0388	53	7.1	7.45	35.2	35.0	26	7.0	3.7	17.5
0.0400	53	7.2	7.45	35.2	35.0	27	7.1	3.7	17.5
100-Year Storm Event Maximum Allowable Street Flows (Maximum Flow to Right-of-Way)									
Channel Slope (ft/ft)	Full Street Width					Half Street Width			
	Discharge (ft <sup>3</sup> /s)	Velocity (ft/s)	Flow Area (ft <sup>2</sup> )	Wetted Perimeter (ft)	Top Width (ft)	Discharge (ft <sup>3</sup> /s)	Velocity (ft/s)	Flow Area (ft <sup>2</sup> )	Top Width (ft)
0.0050	43	2.2	19.32	60.2	60.0	21	2.2	9.7	30
0.0063	48	2.5	19.32	60.2	60.0	24	2.4	9.7	30
0.0075	52	2.7	19.32	60.2	60.0	26	2.7	9.7	30
0.0088	56	2.9	19.32	60.2	60.0	28	2.9	9.7	30
0.0100	60	3.1	19.32	60.2	60.0	30	3.1	9.7	30
0.0113	64	3.3	19.32	60.2	60.0	32	3.3	9.7	30
0.0125	67	3.5	19.32	60.2	60.0	33	3.5	9.7	30
0.0138	71	3.7	19.32	60.2	60.0	35	3.6	9.7	30
0.0150	74	3.8	19.32	60.2	60.0	36	3.8	9.7	30
0.0163	77	4.0	19.32	60.2	60.0	38	3.9	9.7	30
0.0175	80	4.1	19.32	60.2	60.0	39	4.1	9.7	30
0.0188	82	4.3	19.32	60.2	60.0	41	4.2	9.7	30
0.0200	85	4.4	19.32	60.2	60.0	42	4.4	9.7	30
0.0213	88	4.5	19.32	60.2	60.0	43	4.5	9.7	30
0.0225	90	4.7	19.32	60.2	60.0	45	4.6	9.7	30
0.0238	93	4.8	19.32	60.2	60.0	46	4.8	9.7	30
0.0250	95	4.9	19.32	60.2	60.0	47	4.9	9.7	30
0.0263	97	5.0	19.32	60.2	60.0	48	5.0	9.7	30
0.0275	100	5.2	19.32	60.2	60.0	49	5.1	9.7	30
0.0288	102	5.3	19.32	60.2	60.0	50	5.2	9.7	30
0.0300	104	5.4	19.32	60.2	60.0	52	5.3	9.7	30
0.0313	106	5.5	19.32	60.2	60.0	53	5.5	9.7	30
0.0325	108	5.6	19.32	60.2	60.0	54	5.6	9.7	30
0.0338	111	5.7	19.32	60.2	60.0	55	5.7	9.7	30
0.0350	113	5.8	19.32	60.2	60.0	56	5.8	9.7	30
0.0363	115	5.9	19.32	60.2	60.0	57	5.9	9.7	30
0.0375	117	6.0	19.32	60.2	60.0	58	6.0	9.7	30
0.0388	118	6.1	19.32	60.2	60.0	59	6.1	9.7	30
0.0400	120	6.2	19.32	60.2	60.0	60	6.2	9.7	30

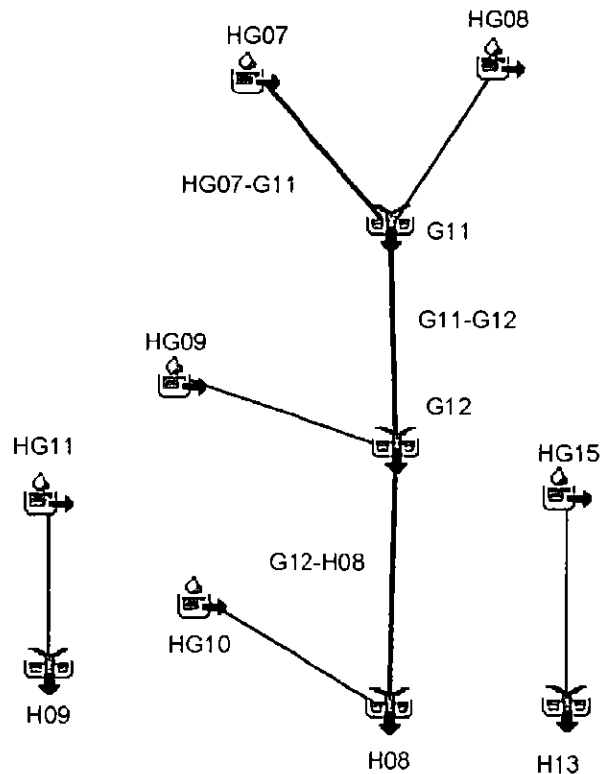
**Street Flows Ramp Curb**  
(Maximum Flow to Crown of Roadway)

Channel Slope (ft/ft)	Full Street Width					Half Street Width			
	Discharge (ft <sup>3</sup> /s)	Velocity (ft/s)	Flow Area (ft <sup>2</sup> )	Wetted Perimeter (ft)	Top Width (ft)	Discharge (ft <sup>3</sup> /s)	Velocity (ft/s)	Flow Area (ft <sup>2</sup> )	Top Width (ft)
0.0050	13	2.2	6.05	35.0	34.8	6.7	2.2	3.0	17.4
0.0063	15	2.5	6.05	35.0	34.8	7.5	2.5	3.0	17.4
0.0075	16	2.7	6.05	35.0	34.8	8.2	2.7	3.0	17.4
0.0088	18	2.9	6.05	35.0	34.8	8.9	2.9	3.0	17.4
0.0100	19	3.1	6.05	35.0	34.8	9.5	3.1	3.0	17.4
0.0113	20	3.3	6.05	35.0	34.8	10	3.3	3.0	17.4
0.0125	21	3.5	6.05	35.0	34.8	11	3.5	3.0	17.4
0.0138	22	3.7	6.05	35.0	34.8	11	3.7	3.0	17.4
0.0150	23	3.8	6.05	35.0	34.8	12	3.8	3.0	17.4
0.0163	24	4.0	6.05	35.0	34.8	12	4.0	3.0	17.4
0.0175	25	4.1	6.05	35.0	34.8	13	4.1	3.0	17.4
0.0188	26	4.3	6.05	35.0	34.8	13	4.3	3.0	17.4
0.0200	27	4.4	6.05	35.0	34.8	13	4.4	3.0	17.4
0.0213	28	4.6	6.05	35.0	34.8	14	4.6	3.0	17.4
0.0225	28	4.7	6.05	35.0	34.8	14	4.7	3.0	17.4
0.0238	29	4.8	6.05	35.0	34.8	15	4.8	3.0	17.4
0.0250	30	5.0	6.05	35.0	34.8	15	5.0	3.0	17.4
0.0263	31	5.1	6.05	35.0	34.8	15	5.1	3.0	17.4
0.0275	31	5.2	6.05	35.0	34.8	16	5.2	3.0	17.4
0.0288	32	5.3	6.05	35.0	34.8	16	5.3	3.0	17.4
0.0300	33	5.4	6.05	35.0	34.8	16	5.4	3.0	17.4
0.0313	34	5.5	6.05	35.0	34.8	17	5.5	3.0	17.4
0.0325	34	5.7	6.05	35.0	34.8	17	5.6	3.0	17.4
0.0338	35	5.8	6.05	35.0	34.8	17	5.8	3.0	17.4
0.0350	35	5.9	6.05	35.0	34.8	18	5.9	3.0	17.4
0.0363	36	6.0	6.05	35.0	34.8	18	6.0	3.0	17.4
0.0375	37	6.1	6.05	35.0	34.8	18	6.1	3.0	17.4
0.0388	37	6.2	6.05	35.0	34.8	19	6.2	3.0	17.4
0.0400	38	6.3	6.05	35.0	34.8	19	6.3	3.0	17.4

## **Appendix D - HEC-HMS Data**

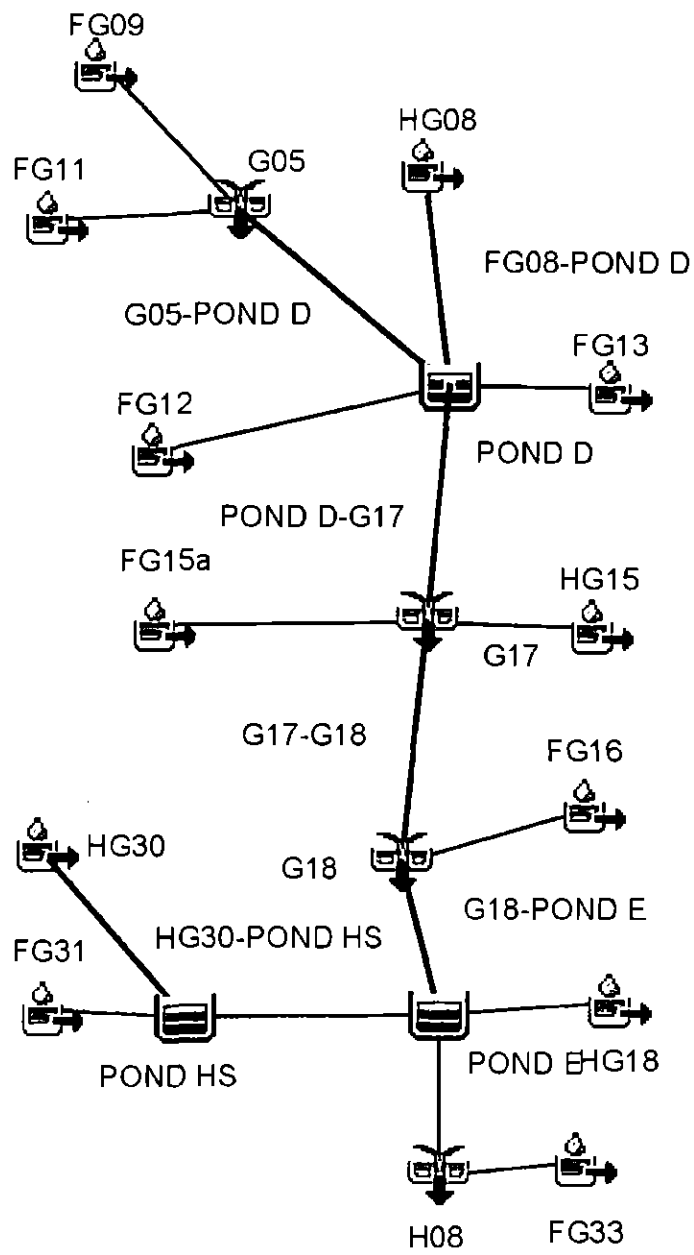
<b>COMPOSITE 'C' FACTORS</b>										
PROJECT: <b>SCS</b>		SCS Calcs for Meridian Ranch Filing 11A					Date		3/10/2014	
BASIN	AREA (AC.)	UNDEVELOPED	GRADED	5 DU/AC	6 DU/AC	STREETS	OPEN SPACE PARKS/GC	TOTAL	AREA (MI <sup>2</sup> )	COMPOSITE 'C' FACTOR
<b>HISTORIC</b>										
HG07	63.0							63	0.0984	<b>61.0</b>
HG08	85.0							85	0.1328	<b>61.0</b>
HG09	114.0							114	0.1781	<b>61.0</b>
HG10	88.0							88	0.1375	<b>61.0</b>
HG11	131.0							131	0.2047	<b>61.0</b>
HG15	164.0							164	0.2563	<b>61.0</b>
<b>DEVELOPED</b>										
HG08			83.1		4.9			88	0.1375	<b>69.7</b>
FG09			26.3		5.7			32	0.0500	<b>70.1</b>
FG11	FROM APPROVED MERIDIAN RANCH MDDP DATED MAY 2012							39	0.0609	<b>79.4</b>
FG12	FROM APPROVED MERIDIAN RANCH MDDP DATED MAY 2012							21	0.0328	<b>80.0</b>
FG13	30.6		35.3		10.1			76	0.1188	<b>68.8</b>
HG15	80.0		6.0					86	0.134	<b>61.5</b>
FG15a			6.3	3.0			0.7	10	0.016	<b>70.6</b>
FG16			12.2	25.9		4.1	7.3	50	0.077	<b>74.8</b>
HG17	72.0							72	0.113	<b>61.0</b>
HG18	72.5		22.5					95	0.148	<b>62.7</b>
HG30	49.0							49	0.077	<b>61.0</b>
FG31	FROM APPROVED MERIDIAN RANCH MDDP DATED MAY 2012 (OLD FG17)							59	0.0922	<b>80.0</b>
FG32	15					2.0		17	0.0273	<b>66.2</b>
FG33	5					2.0		7	0.0109	<b>71.6</b>
<b>FUTURE</b>										
FG08								93	0.1453	<b>76.0</b>
FG09								27	0.0422	<b>72.9</b>
FG10	FROM APPROVED MERIDIAN RANCH MDDP DATED MAY 2012							61	0.0953	<b>73.1</b>
FG11	FROM APPROVED MERIDIAN RANCH MDDP DATED MAY 2012							39	0.0609	<b>78.4</b>
FG12	FROM APPROVED MERIDIAN RANCH MDDP DATED MAY 2012							21	0.0328	<b>80.0</b>
FG13				10.1			37.9	48	0.0750	<b>65.8</b>
FG14	FROM APPROVED MERIDIAN RANCH MDDP DATED MAY 2012							20	0.0313	<b>77.4</b>
FG15			49.0				27.0	76	0.1188	<b>72.3</b>
FG15a			9.3				0.7	10	0.0156	<b>76.9</b>
FG16			38.1			4.1	7.3	50	0.0773	<b>77.3</b>
FG18								105	0.1641	<b>74.5</b>
FG19	FROM APPROVED MERIDIAN RANCH MDDP DATED MAY 2012							71	0.1109	<b>82.0</b>
FG31	FROM APPROVED MERIDIAN RANCH MDDP DATED MAY 2012 (OLD FG17)							59	0.0922	<b>80.0</b>
FG32	12.0					2.0		14	0.0219	<b>66.3</b>
FG33	5.0					2.0		7	0.0109	<b>71.6</b>

HISTORIC					
HYDROLOGIC ELEMENT	DRAINAGE AREA (SQ. MI.)	DISCHARGE PEAK Q <sub>100</sub> (CFS)	TOTAL VOLUME Q <sub>100</sub> (AC. FT.)	DISCHARGE PEAK Q <sub>5</sub> (CFS)	TOTAL VOLUME Q <sub>5</sub> (AC. FT.)
HG07	0.0984	41	5.3	5	1.2
HG07-G11	0.0984	41	5.3	5	1.2
HG08	0.1328	77	7.2	10	1.6
G11	0.2312	104	12.5	12	2.8
G11-G12	0.2312	104	12.4	11	2.7
HG09	0.1781	82	9.7	10	2.1
G12	0.4093	185	22.1	20	4.9
G12-H08	0.4093	183	21.8	20	4.8
HG10	0.1375	49	7.4	6	1.6
H08	0.5468	232	29.2	22	6.4
HG11	0.2047	87	11.1	11	2.4
H09	0.2047	87	11.1	11	2.4
HG15	0.2563	80	13.9	11	3.0
H13	0.2563	80	13.9	11	3.0

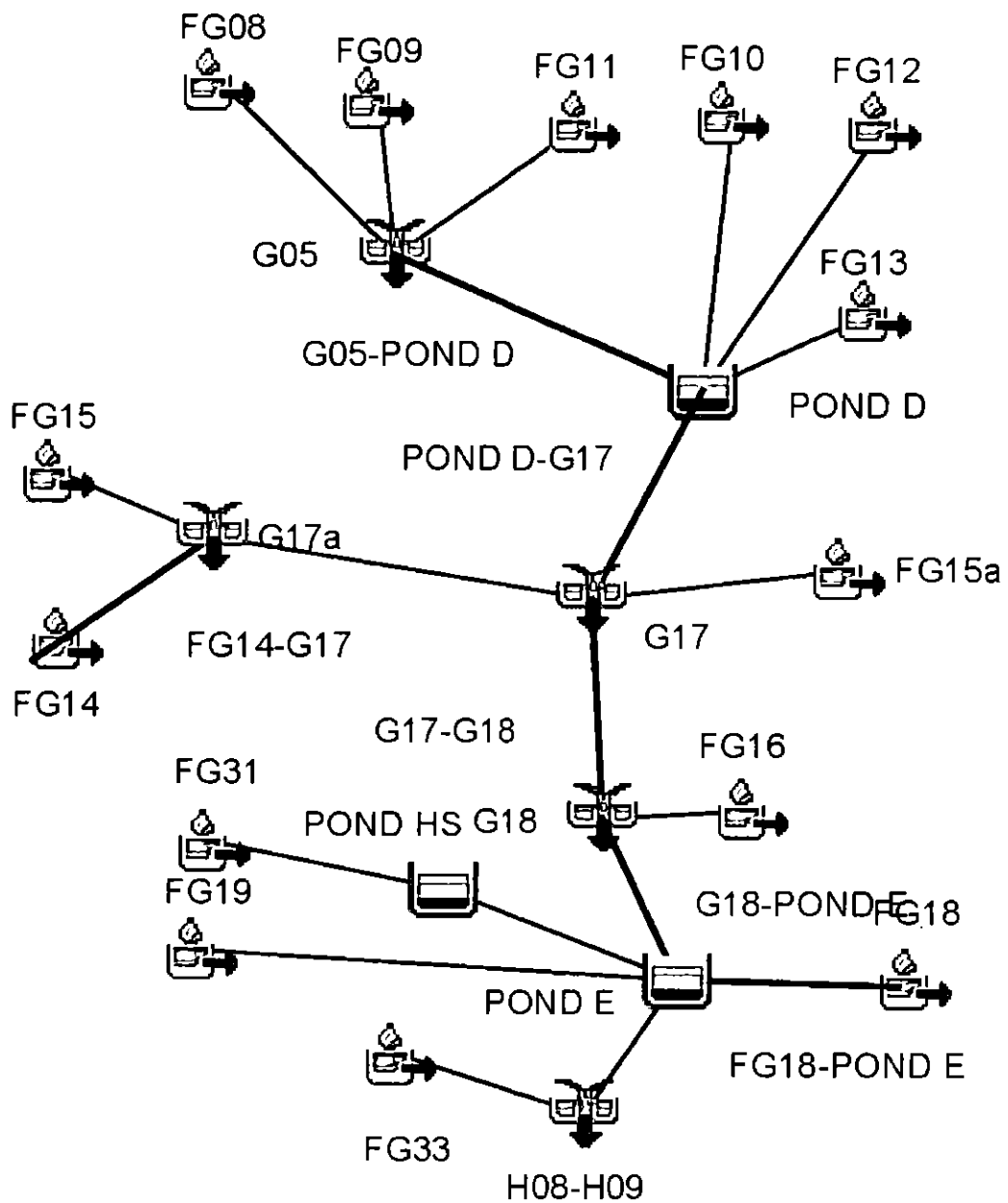




FILING 11A					
HYDROLOGIC ELEMENT	DRAINAGE AREA (SQ. MI.)	DISCHARGE PEAK Q <sub>100</sub> (CFS)	TOTAL VOLUME Q <sub>100</sub> (AC. FT.)	DISCHARGE PEAK Q <sub>5</sub> (CFS)	TOTAL VOLUME Q <sub>5</sub> (AC. FT.)
HG08	0.1375	107	10.5	24	3.1
FG08-POND D	0.1375	107	10.5	24	3.1
FG13	0.1188	80	8.5	16	2.4
FG11	0.0608	85	7.2	30	2.8
FG09	0.0500	51	4.1	13	1.3
G05	0.1108	134	11.4	42	4.1
G05-POND D	0.1108	134	11.4	42	4.1
FG12	0.0328	55	4.1	21	1.7
<b>POND D</b>	<b>0.3999</b>	<b>64</b>	<b>29.6</b>	<b>8</b>	<b>8.0</b>
POND D-G17	0.3999	64	29.6	8	8.0
HG15	0.1344	58	7.5	8	1.7
FG15a	0.0156	20	1.4	6	0.4
G17	0.5499	91	38.4	11	10.1
G17-G18	0.5499	91	38.4	11	10.1
FG16	0.0773	97	8.0	31	2.9
G18	0.6272	161	46.4	41	13.0
G18-POND E	0.6272	161	46.4	41	13.0
FG31	0.0922	123	11.6	45	4.7
HG30	0.0766	49	4.2	6	0.9
HG30-POND HS	0.0766	48	4.1	6	0.9
<b>POND HS</b>	<b>0.1688</b>	<b>126</b>	<b>15.8</b>	<b>27</b>	<b>5.6</b>
HG18	0.1484	67	8.7	10	2.1
<b>POND E</b>	<b>0.9444</b>	<b>141</b>	<b>65.2</b>	<b>18</b>	<b>18.4</b>
FG33	0.0109	13	1.0	4	0.3
H08	0.9553	74	66.2	12	18.7
H09		67		6.3	
* FROM OUTLET STAGE-STORAGE CALCULATION					



FUTURE					
HYDROLOGIC ELEMENT	DRAINAGE AREA (SQ. MI.)	DISCHARGE PEAK Q <sub>100</sub> (CFS)	TOTAL VOLUME Q <sub>100</sub> (AC. FT.)	DISCHARGE PEAK Q <sub>5</sub> (CFS)	TOTAL VOLUME Q <sub>5</sub> (AC. FT.)
FG08	0.1453	170	15.8	55	5.8
FG11	0.0608	85	7.2	30	2.8
FG09	0.0416	53	4.0	16	1.4
G05	0.2477	302	27.1	99	10.0
G05-POND D	0.2477	301	27.0	98	10.0
FG10	0.0953	94	9.2	27	3.2
FG13	0.075	53	5.2	10	1.4
FG12	0.0328	55	4.1	21	1.7
<b>POND D</b>	<b>0.4508</b>	<b>105</b>	<b>40.3</b>	<b>15</b>	<b>12.8</b>
POND D-G17	0.4508	105	40.3	15	12.8
FG15	0.1188	132	11.2	38	3.7
FG14	0.0313	47	3.6	17	1.4
FG14-G17	0.0313	47	3.6	16	1.4
G17a	0.1501	179	14.7	54	5.1
FG15a	0.0156	27	1.8	10	0.7
G17	0.6165	212	56.8	63	18.6
G17-G18	0.6165	212	56.7	63	18.6
FG16	0.0773	109	8.8	37	3.4
G18	0.6938	319	65.6	99	21.9
G18-POND E	0.6938	317	65.6	99	21.9
FG18	0.1641	198	16.9	62	6.0
FG18-POND E	0.1641	198	16.9	62	6.0
FG19	0.0977	203	13.2	83	5.6
FG31	0.0922	123	11.6	45	4.7
POND HS	0.0922	79	11.6	25	4.7
<b>POND E</b>	<b>1.0478</b>	<b>217</b>	<b>92.1</b>	<b>24</b>	<b>27.7</b>
FG33	0.0109	15	1.0	4	0.3
H08	1.0587	155	93.1	15.8	28
H09		62		8.7	
<b>* FROM OUTLET STAGE-STORAGE CALCULATION</b>					



## **Appendix E - Detention Pond Information**

**FILING 11 DEVELOPED CONDITION**  
**Simulation Run: F11A-100 YR Reservoir: POND D**

Start of Run:	09May2008, 08:00	Basin Model:	Estates Rough Grading
End of Run:	10May2008, 08:00	Meteorologic Model:	SCS TYPE IIA 100YR
Compute Time:	07Mar2014, 15:02:03	Control Specifications:	24 HR-2 MIN.

Volume Units: AC-FT

Computed Results:

Peak Inflow:	361 (CFS)	Date/Time of Peak Inflow:	09May2008, 14:14
Peak Outflow:	64 (CFS)	Date/Time of Peak Outflow:	09May2008, 15:04
Total Inflow :	34.5 (AC-FT)	Peak Storage:	16.3 (AC-FT)
Total Outflow:	29.6 (AC-FT)	Peak Elevation:	7055.7 (FT)

**Simulation Run: F11A-005 YR Reservoir: POND D**

Start of Run:	09May2008, 08:00	Basin Model:	Estates Rough Grading
End of Run:	10May2008, 08:00	Meteorologic Model:	SCS TYPE IIA 100YR
Compute Time:	07Mar2014, 14:33:20	Control Specifications:	24 HR-2 MIN.

Volume Units: AC-FT

Computed Results:

Peak Inflow:	95 (CFS)	Date/Time of Peak Inflow:	09May2008, 14:18
Peak Outflow:	8 (CFS)	Date/Time of Peak Outflow:	09May2008, 16:24
Total Inflow :	11.2 (AC-FT)	Peak Storage:	6.0 (AC-FT)
Total Outflow:	8.0 (AC-FT)	Peak Elevation:	7053.5 (FT)

**Simulation Run: F11A-100 YR Reservoir: POND E**

Start of Run:	09May2008, 08:00	Basin Model:	Estates Rough Grading
End of Run:	10May2008, 08:00	Meteorologic Model:	SCS TYPE IIA 100YR
Compute Time:	07Mar2014, 15:02:03	Control Specifications:	24 HR-2 MIN.

Volume Units: AC-FT

Computed Results:

Peak Inflow:	333(CFS)	Date/Time of Peak Inflow:	09May2008, 14:24
Peak Outflow:	141 (CFS)	Date/Time of Peak Outflow:	09May2008, 15:20
Total Inflow :	70.9 (AC-FT)	Peak Storage:	17.6 (AC-FT)
Total Outflow:	65.2 (AC-FT)	Peak Elevation:	6971.2 (FT)

**Simulation Run: F11A-005 YR Reservoir: POND E**

Start of Run: 09May2008, 08:00 Basin Model: Estates Rough Grading  
End of Run: 10May2008, 08:00 Meteorologic Model: SCS TYPE IIA 100YR  
Compute Time: 07Mar2014, 14:33:20 Control Specifications: 24 HR-2 MIN.

Volume Units: AC-FT

**Computed Results:**

Peak Inflow: 66 (CFS)	Date/Time of Peak Inflow: 09May2008, 14:20
Peak Outflow: 18 (CFS)	Date/Time of Peak Outflow: 09May2008, 16:52
Total Inflow : 20.6 (AC-FT)	Peak Storage: 6.2 (AC-FT)
Total Outflow: 18.4 (AC-FT)	Peak Elevation: 6969.7 (FT)

**FINAL FUTURE CONDITION**

**Simulation Run: F-100 YR Reservoir: POND D**

Start of Run: 09May2008, 08:00 Basin Model: Estates Rough Grading  
End of Run: 10May2008, 08:00 Meteorologic Model: SCS TYPE IIA 100YR  
Compute Time: 10Mar2014, 10:00:30 Control Specifications: 24 HR-2 MIN.

Volume Units: AC-FT

**Computed Results:**

Peak Inflow: 495 (CFS)	Date/Time of Peak Inflow: 09May2008, 14:14
Peak Outflow: 105 (CFS)	Date/Time of Peak Outflow: 09May2008, 14:56
Total Inflow : 45.7 (AC-FT)	Peak Storage: 21.1 (AC-FT)
Total Outflow: 40.3 (AC-FT)	Peak Elevation: 7056.4 (FT)

**Simulation Run: F-005 YR Reservoir: POND D**

Start of Run: 09May2008, 08:00 Basin Model: Estates Rough Grading  
End of Run: 10May2008, 08:00 Meteorologic Model: SCS TYPE IIA 100YR  
Compute Time: 10Mar2014, 09:50:40 Control Specifications: 24 HR-2 MIN.

Volume Units: AC-FT

**Computed Results:**

Peak Inflow: 153 (CFS)	Date/Time of Peak Inflow: 09May2008, 14:16
Peak Outflow: 15 (CFS)	Date/Time of Peak Outflow: 09May2008, 16:06
Total Inflow : 16.3 (AC-FT)	Peak Storage: 8.4 (AC-FT)
Total Outflow: 12.8 (AC-FT)	Peak Elevation: 7054.1 (FT)

**FINAL FUTURE CONDITION**  
**Simulation Run: F-100 YR Reservoir: POND E**

Start of Run:	09May2008, 08:00	Basin Model:	MERIDIAN RANCH
End of Run:	10May2008, 08:00	Meteorologic Model:	SCS TYPE IIA 100YR
Compute Time:	10Mar2014, 10:00:30	Control Specifications:	24 HR-2 MIN.

Volume Units: AC-FT

Computed Results:

Peak Inflow:	707 (CFS)	Date/Time of Peak Inflow:	09May2008, 14:10
Peak Outflow:	217 (CFS)	Date/Time of Peak Outflow:	09May2008, 15:02
Total Inflow :	107.3 (AC-FT)	Peak Storage:	33.4 (AC-FT)
Total Outflow:	92.1 (AC-FT)	Peak Elevation:	6972.6 (FT)

**Simulation Run: F-005 YR Reservoir: POND E**

Start of Run:	09May2008, 08:00	Basin Model:	MERIDIAN RANCH
End of Run:	10May2008, 08:00	Meteorologic Model:	SCS TYPE IIA 100YR
Compute Time:	10Mar2014, 09:50:40	Control Specifications:	24 HR-2 MIN.

Volume Units: AC-FT

Computed Results:

Peak Inflow:	233 (CFS)	Date/Time of Peak Inflow:	09May2008, 14:12
Peak Outflow:	24 (CFS)	Date/Time of Peak Outflow:	09May2008, 18:22
Total Inflow :	38.2 (AC-FT)	Peak Storage:	17.1 (AC-FT)
Total Outflow:	27.7 (AC-FT)	Peak Elevation:	6971.1 (FT)



**STAGE/STORAGE/DISCHARGE CURVES FOR DETENTION POND ANALYSIS**

**Meridian Ranch Proposed Detention Pond D - Interim AS-BUILT**

**Heagler Basin - El Paso County, Colorado**

Data for spillway and embankment:

embankment length =	710
embankment elev =	7060
spillway length =	100
spillway elevation =	7058
100 year storage elev. =	7055.8
100 year storage vol. =	16.8
100 year discharge =	57
5 year storage elev. =	7053.5
5 year storage vol. =	6.0
5 year discharge =	8
WQCV storage vol. =	1.0
WQCV depth =	2.3
1/2 WQCV storage vol. =	0.50

Data for outlet pipe and grate:

Type	Dimensions			Area (sqft)	Elev to cl =
	Width (ft.) X Height (ft.)	Dia. (in)			
Rectangular	Orifice 1: 0.03 X 2.3			0.069	7050.15
Circular	Orifice 2:	8		0.349	7051.3
Rectangular	Orifice 3: 5 X 0.5			2.500	7053.25
None Selected	Orifice 4:			0.000	

Stand Pipe Dimensions					
Rec Grate	3	x	4.25	Elev =	7054.8
Circ. Grate		dia.		Elev =	

Outlet Culvert Dimensions					
Outlet Culvert	Width (ft.)	x	Height (ft.)	Dia. (ft.)	Type
Area	12.6		TOP	4	Circular
Outlet I. E.	7048.5		7052.9		
Wall Thick.	5		in.		

STAGE		STORAGE				DISCHARGE										REALIZED CULVERT OUTFLOW	TOTAL FLOW			
ELEV	HEIGHT	AREA		VOLUME		TOP OF BANK	SPILLWAY	ORIFICE (max outflow)				GRATE (max outflow)	PIPE							
		sqft	acre	acft	cum acft			1	2	3	4		Rectangular	1	2					
7049	0	0	0.0	0.00	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-		
7050	1	10705	0.2	0.1	0.12	-	-	0.2	-	-	-	-	-	-	13	-	-	0.2	0.150	
7051	2	36676	0.8	0.5	0.67	-	-	0.3	0	-	-	-	-	-	33	-	-	0.8	0.791	
7052	3	71989	1.7	1.2	1.91	-	-	0.5	1	-	-	-	-	-	60	-	-	1.9	1.858	
7053	4	133440	3.1	2.4	4.27	-	-	0.6	2.2	-	-	-	-	-	90	-	-	2.8	2.752	
7054	5	178828	4.1	3.6	7.86	-	-	0.7	2.8	10.4	-	-	-	-	119	-	-	13.8	13.838	
7055	6	221269	5.1	4.6	12.45	-	-	0.7	3.2	15.9	-	-	-	-	139	-	-	23	22.975	
7055.5	6.5	245509	5.6	2.7	15.13	-	-	0.8	3.4	18.1	-	-	20.2	-	148	-	-	42	42.475	
7056	7	269749	6.2	5.6	18.08	-	-	0.8	3.6	20	-	-	45	-	157	-	-	70	69.761	
7058	9	337508	7.7	13.9	32.03	-	-	0.9	4.4	26	-	-	110	-	188	-	-	141	141.336	
7060	11	405520	9.3	31.0	49.09	-	848.5	1.0	5.0	31	-	-	140	-	214	-	-	177	1,025.796	
						-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes: 1) Top-of-bank and spillway flows are weir equations from section 11.3.1 in the DCM. Q=CLH<sup>1.5</sup> (C=3.0)

## STAGE/STORAGE/DISCHARGE CURVES FOR DETENTION POND ANALYSIS

### Meridian Ranch Proposed Detention Pond E-TEMP CMP RISER (TOTAL FLOWS)

Gieck Basin - El Paso County, Colorado

Data for spillway and embankment:

INTERIM - FILING 11A

embankment length =	1860
embankment elev =	6976
spillway length =	200
spillway elevation =	6974.5
100 year storage elev.=	6971.2
100 year storage vol.=	17.6
100 year discharge=	141
5 year storage elev.=	6969.7
5 year storage vol.=	6.2
5 year discharge=	18
WQCV storage elev.=	6967.9
WQCV storage vol.=	0.3
WQCV depth =	0.9
1/2 WQCV storage elev.=	6967.8
1/2 WQCV storage vol.=	0.2

STAGE		STORAGE				TOTAL DISCHARGE											
ELEV	HEIGHT	AREA		VOLUME		TOP OF BANK	SPILLWAY	ORIFICE (max outflow)				GRATE (max outflow)		PIPE		REALIZED CULVERT OUTFLOW	TOTAL FLOW
		sqft	acre	acft	cum acft			1	2	3	4	Circular		1	2		
6967	0	3110	0.07	0.0	0.0	-	-	-	-	-	-	-	-	0.9	-	-	-
6968	1	49719	1.14	0.6	0.6	-	-	0.19	-	-	-	-	-	17.7	-	0.2	0.186
6969	2	148073	3.40	2.3	2.9	-	-	0.4	-	7.6	-	-	-	51.6	-	7.9	7.929
6970	3	282553	6.49	4.9	7.8	-	-	0.5	11.7	10.7	-	-	-	97.2	-	23	22.833
6970.5	3.5	345630	7.93	3.6	11.4	-	-	0.5	35.6	12.0	-	-	-	121.6	-	48	48.041
6971	4	408706	9.38	7.9	15.8	-	-	0.6	67.3	13.1	-	-	-	145.4	-	92	92.316
6971.25	4.25	428868	9.85	2.4	18.2	-	-	0.6	85.4	13.6	-	-	167.3	-	157.4	-	157
6971.5	4.5	449030	10.31	4.9	20.7	-	-	0.6	96.9	14.1	-	-	415.2	-	168.2	-	168
6971.75	4.75	469192	10.77	2.6	23.3	-	-	0.6	106.1	14.6	-	-	728.3	-	178.2	-	178
6972	5	489354	11.23	5.4	26.1	-	-	0.6	114.6	15.1	-	-	1,095.2	-	187.2	-	187
6972.25	5.25	496911	11.41	2.8	28.9	-	-	0.7	122.6	15.6	-	-	1,508.7	-	195.4	-	195
6972.5	5.5	504468	11.58	5.7	31.8	-	-	0.7	130.0	16.0	-	-	1,964.2	-	203.4	-	203
6973	6	519582	11.93	11.6	37.6	-	-	0.7	143.7	16.9	-	-	2,987.6	-	218.8	-	219
6974	7	532469	12.22	12.1	49.7	-	-	0.8	167.8	18.5	-	-	5,421.8	-	247.3	-	247
6976	9	557640	12.80	25.0	74.7	-	1,102	0.9	207.8	21.4	-	-	11,551.3	-	297.1	-	1,399

- Notes:
- 1) Top-of-bank and spillway flows are weir equations from section 11.3.1 in the DCM.  $Q=CLH^{1.5}$  (C=3.0)
  - 2) Orifice flows are also from section 11.3.1.  $Q=CA(2gH)^{0.5}$  (C=6)
  - 3) Grate flows are determined from equations 7-2 and 7-3. Weir Flow  $Q=(3PH^{1.5})F$ , Orifice Flow  $Q=4.815*AH^{0.5}$

## STAGE/STORAGE/DISCHARGE CURVES FOR DETENTION POND ANALYSIS

### Meridian Ranch Proposed Detention Pond E-TEMP CMP RISER (H08)

Gieck Basin - El Paso County, Colorado

Data for spillway and embankment:

embankment length =	1860
embankment elev =	6975
spillway length =	200
spillway elevation =	6974
100 year storage elev. =	6971.2
100 year storage vol. =	17.6
100 year discharge =	74
5 year storage elev. =	6969.7
5 year storage vol. =	6.2
5 year discharge =	12
WQCV storage elev. =	6967.9
WQCV storage vol. =	0.3
1/2 WQCV storage elev. =	6967.8
1/2 WQCV storage vol. =	0.2

Data for outlet pipe and grate:

Type	Orifice	H or V	Dimensions		Dia (in)	Area =	Area =	
			Width (ft.)	Height (ft.)			sqft	Elev to cl =
Rectangular	Orifice 1:	V	0.0310	1.00		0.031	Elev to cl =	6967.50
Rectangular	Orifice 2:	V	8	1.5		12.000	Elev to cl =	6970.20
Circular	Orifice 3:	H			12	0.785	Elev to cl =	6968.00
None Selected	Orifice 4:	V				0.000	Elev to cl =	6967.50

Stand Pipe Dimensions			
Rec Grate		x	Elev = 6970.95
Circ. Grate	54	dia.	Elev = 6970.95

Outlet Culvert Dimensions

Outlet Culvert	Width (ft.)	Height (ft.)	Dia. (ft.)	Type
Area	9.6	x	3.5	Circular
Outlet I. E.	6966.8	TOP	6970.67	
Wall Thick.	5	in.		

STAGE		STORAGE				DISCHARGE								REALIZED CULVERT OUTFLOW		TOTAL FLOW	
ELEV	HEIGHT	AREA		VOLUME		TOP OF BANK	SPILLWAY	ORIFICE (max outflow)				GRATE (max outflow)		PIPE		OUTFLOW	FLOW
		sqft	acre	acft	cum acft			1	2	3	4	Circular	1	2			
6967	0	3110	0.07	0.0	0.0			-	-	-	-	-	0			-	-
6968	1	49719	1.14	0.6	0.6			0.1	-	-	-	-	9			0.1	0.093
6969	2	148073	3.40	2.3	2.9			0.2	-	3.8	-	-	26			4.0	3.964
6970	3	282553	6.49	4.9	7.8			0.2	9.8	5.3	-	-	49			15	15.373
6970.5	3.5	345629.5	7.93	3.6	11.4			0.3	25.8	6.0	-	-	61			32	32.060
6971	4	408706	9.38	7.9	15.8			0.3	46.3	6.6	-	-	73			59	58.833
6971.25	4.25	428868	9.85	2.4	18.2			0.3	58.0	6.8	-	-	84			78	78.450
6971.5	4.5	449030	10.31	4.9	20.7			0.3	65.9	7.1	-	-	208			83	83
6971.75	4.75	469192	10.77	2.6	23.3			0.3	71.9	7.3	-	-	364			88	88
6972	5	489354	11.23	5.4	26.1			0.3	77.5	7.6	-	-	548			92	92
6972.25	5.25	496911	11.41	2.8	28.9			0.3	82.7	7.8	-	-	754			97	97
6972.5	5.5	504468	11.58	5.7	31.8			0.3	87.6	8.0	-	-	982			101	101
6973	6	519582	11.93	11.6	37.6			0.4	96.7	8.5	-	-	1,494			108	108
6974	7	532469	12.22	12.1	49.7			0.4	112.6	9.3	-	-	2,711			122	122
6976	9	557640	12.80	25.0	74.7			0.4	139.2	10.7	-	-	5,776			146	146

- Notes:
- 1) Top-of-bank and spillway flows are weir equations from section 11.3.1 in the DCM.  $Q = CLH^{1.5}$  (C=3.0)
  - 2) Orifice flows are also from section 11.3.1.  $Q = CA(2gH)^{0.5}$  (C=.6)
  - 3) Grate flows are determined from equations 7-2 and 7-3. Weir Flow  $Q = (3PH^{1.5})/F$ , Orifice Flow  $Q = 4.815 * AH^{0.5}$
  - 4) Pipe flows use the lesser of: 1) Inlet control equations 27 & 28, page 146 of HDS No. 5 - or - 2) Allowable Pipe Flow equation on page 11-9 of the DCM. Use Table 9, page 147-148, HDS No. 5 for formulas 26 & 27.

## STAGE/STORAGE/DISCHARGE CURVES FOR DETENTION POND ANALYSIS

### Meridian Ranch Proposed Detention Pond E-TEMP CMP RISER (H09)

Gieck Basin - El Paso County, Colorado

Data for spillway and embankment:

embankment length =	1860
embankment elev =	6976
spillway length =	200
spillway elevation =	6974.5
100 year storage elev. =	6971.2
100 year storage vol. =	17.6
100 year discharge =	67
5 year storage elev. =	6969.7
5 year storage vol. =	6.2
5 year discharge =	6.3
WQCV storage elev. =	6967.9
WQCV storage vol. =	0.3
1/2 WQCV storage elev. =	6967.8
1/2 WQCV storage vol. =	0.2

Data for outlet pipe and grate:

Type	Orifice 1:	H or V	Dimensions		Dia. (in)	Area =	(sqft)	
			Width (ft.)	X Height (ft.)			Elev to cl =	
Rectangular	Orifice 1:	V	0.0310	1.00		0.031	Elev to cl =	6967.50
Rectangular	Orifice 2:	V	5	1.2		6.000	Elev to cl =	6970.35
Circular	Orifice 3:	H			12	0.785	Elev to cl =	6968.00
None Selected	Orifice 4:	V				0.000	Elev to cl =	6967.33

Stand Pipe Dimensions

Rec Grate		x	Elev =	6970.95
Circ. Grate	54	dia.	Elev =	6970.95

Outlet Culvert Dimensions

Outlet Culvert	Width (ft.)	Height (ft.)	Dia. (ft.)	Type
Outlet Culvert	x		3.5	Circular
Area	9.6	TOP		
Outlet I. E.	6966.8	6970.67		
Wall Thick.	5	in.		

STAGE		STORAGE				DISCHARGE										REALIZED CULVERT OUTFLOW	TOTAL FLOW
ELEV	HEIGHT	AREA		VOLUME		TOP OF BANK	SPILLWAY	ORIFICE (max outflow)				GRATE (max outflow) Circular	PIPE				
		sqft	acre	acft	cum acft			1	2	3	4		1	2			
6967	0	3110	0.07	0.0	0.0			-	-	-	-	-	0.5		-	-	
6968	1	49719	1.14	0.6	0.6			0.1	-	-	-	-	8.8		0.1	0.1	
6969	2	148073	3.40	2.3	2.9			0.2	-	3.8	-	-	26		4.0	4.0	
6970	3	282553	6.49	4.9	7.8			0.2	1.9	5.3	-	-	49		7.5	7.5	
6970.5	3.5	345629.5	7.93	3.6	11.4			0.3	9.7	6.0	-	-	61		16.0	16	
6971	4	408706	9.38	7.9	15.8			0.3	21.0	6.6	-	-	73	6	33.5	33.5	
6971.25	4.25	428868	9.85	2.4	18.2			0.3	27.4	6.8	-	-	79	84	78.9	78.9	
6971.5	4.5	449030	10.31	4.9	20.7			0.3	31.0	7.1	-	-	85	208	84.7	85	
6971.75	4.75	469192	10.77	2.6	23.3			0.3	34.2	7.3	-	-	90	364	90.1	90	
6972	5	489354	11.23	5.4	26.1			0.3	37.1	7.6	-	-	95	548	94.8	95	
6972.25	5.25	496911	11.41	2.8	28.9			0.3	39.8	7.8	-	-	99	754	98.7	99	
6972.5	5.5	504468	11.58	5.7	31.8			0.3	42.4	8.0	-	-	103	982	102.7	103	
6973	6	519582	11.93	11.6	37.6			0.4	47.0	8.5	-	-	111	1,494	110.5	111	
6974	7	532469	12.22	12.1	49.7			0.4	55.2	9.3	-	-	125	2,711	125.3	125	
6976	9	557640	12.80	25.0	74.7			0.4	68.7	10.7	-	-	151	5,776	151.4	151	

Notes:

- 1) Top-of-bank and spillway flows are weir equations from section 11.3.1 in the DCM.  $Q = CLH^{1.5}$  (C=3.0)
- 2) Orifice flows are also from section 11.3.1.  $Q = CA(2gH)^{0.5}$  (C=6)
- 3) Grate flows are determined from equations 7-2 and 7-3. Weir Flow  $Q = (3PH^{1.5})/F$ , Orifice Flow  $Q = 4.815 * AH^{0.5}$
- 4) Pipe flows use the lesser of: 1) Inlet control equations 27 & 28, page 146 of HDS No. 5 - or - 2) Allowable Pipe Flow equation on page 11-9 of the DCM. Use Table 9, page 147-148, HDS No. 5 for formulas 26 & 27.

**POND E OUTLET PIPE HYDRAULICS  
OUTLET AT H08 INTERIM - F11A**

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	6,974.50 ft	Headwater Depth/Height	1.19
Computed Headwater Elev.	6,970.88 ft	Discharge	70.00 cfs
Inlet Control HW Elev.	6,970.83 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	6,970.88 ft	Control Type	Outlet Control

Grades			
Upstream Invert	6,966.72 ft	Downstream Invert	6,966.44 ft
Length	66.68 ft	Constructed Slope	0.004199 ft/ft

Hydraulic Profile			
Profile	M2	Depth, Downstream	2.62 ft
Slope Type	Mild	Normal Depth	3.23 ft
Flow Regime	Subcritical	Critical Depth	2.62 ft
Velocity Downstream	9.05 ft/s	Critical Slope	0.005838 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	3.50 ft
Section Size	42 inch	Rise	3.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	6,970.88 ft	Upstream Velocity Head	1.04 ft
Ke	0.20	Entrance Loss	0.21 ft

Inlet Control Properties			
Inlet Control HW Elev.	6,970.83 ft	Flow Control	Transition
Inlet Type	Groove end w/headwall	Area Full	9.6 ft <sup>2</sup>
K	0.00180	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	2
C	0.02920	Equation Form	1
Y	0.74000		

**POND E OUTLET PIPE HYDRAULICS  
OUTLET AT H09 INTERIM**

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	6,974.50 ft	Headwater Depth/Height	1.01
Computed Headwater Elev:	6,970.27 ft	Discharge	55.00 cfs
Inlet Control HW Elev.	6,970.16 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	6,970.27 ft	Control Type	Entrance Control

Grades			
Upstream Invert	6,966.72 ft	Downstream Invert	6,966.34 ft
Length	69.88 ft	Constructed Slope	0.005438 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	2.24 ft
Slope Type	Steep	Normal Depth	2.24 ft
Flow Regime	Supercritical	Critical Depth	2.32 ft
Velocity Downstream	8.44 ft/s	Critical Slope	0.004932 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	3.50 ft
Section Size	42 inch	Rise	3.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	6,970.27 ft	Upstream Velocity Head	1.02 ft
Ke	0.20	Entrance Loss	0.20 ft

Inlet Control Properties			
Inlet Control HW Elev.	6,970.16 ft	Flow Control	Unsubmerged
Inlet Type	Beveled ring, 33.7° bevels	Area Full	9.6 ft <sup>2</sup>
K	0.00180	HDS 5 Chart	3
M	2.50000	HDS 5 Scale	B
C	0.02430	Equation Form	1
Y	0.83000		

**POND E OUTLET RATING TABLE**  
42" RCP Flows

@ H08

@ H09

Range Data:			
	Minimum	Maximum	Increment
Allowable HWE	6,967.00	6,976.00	0.50 ft

Range Data:			
	Minimum	Maximum	Increment
Allowable HWE	6,967.00	6,976.00	0.50 ft

HW Elev. (ft)	Discharge (cfs)
6,967.00	0.46
6,967.50	3.40
6,968.00	8.83
6,968.50	16.41
6,969.00	25.78
6,969.50	36.56
6,970.00	48.58
6,970.50	60.89
6,971.00	72.78
6,971.50	83.46
6,972.00	92.47
6,972.50	100.68
6,973.00	108.26
6,973.50	115.35
6,974.00	122.03
6,974.50	128.36
6,975.00	134.39
6,975.50	140.16
6,976.00	145.71

HW Elev. (ft)	Discharge (cfs)
6,967.00	0.45
6,967.50	3.40
6,968.00	8.83
6,968.50	16.41
6,969.00	25.78
6,969.50	36.56
6,970.00	48.35
6,970.50	60.72
6,971.00	72.62
6,971.50	84.73
6,972.00	94.76
6,972.50	102.71
6,973.00	110.53
6,973.50	118.08
6,974.00	125.31
6,974.50	132.24
6,975.00	138.88
6,975.50	145.26
6,976.00	151.40

The above tables are used to cross check the flows within the 42" RCP versus the flows allowed into the control structure. The lower of the two flows governs the total outflow of the pond.

## STAGE/STORAGE/DISCHARGE CURVES FOR DETENTION POND ANALYSIS

### Meridian Ranch Proposed Detention Pond D - Future AS-BUILT

Heagler Basin - El Paso County, Colorado

Data for spillway and embankment:

embankment length =	710
embankment elev =	7060
spillway length =	100
spillway elevation =	7058
100 year storage elev.=	7056.4
100 year storage vol.=	21.1
100 year discharge=	105
5 year storage elev.=	7054.1
5 year storage vol =	8.4
5 year discharge=	15
WQCV storage vol.=	1.0
WQCV depth =	2.3
1/2 WQCV storage vol.=	0.50

Data for outlet pipe and grate:

		Dimensions				
Type		Width (ft.)	X Height (ft.)	Dia (in)	Area =	(sqft)
Rectangular	Orifice 1:	0.03	2.3		0.069	Elev to cl = 7050.15
Circular	Orifice 2:			8	0.349	Elev to cl = 7051.30
Rectangular	Orifice 3:	5	0.5		2.500	Elev to cl = 7053.25
None Selected	Orifice 4:				0.000	Elev to cl =
Stand Pipe Dimensions						
Rec Grate		6	x	4.25	Elev =	7054.8
Circ. Grate			dia.		Elev =	
Outlet Culvert Dimensions						
Outlet Culvert		Width (ft.)	x	Height (ft.)	Dia. (ft.)	Type
Area		12.6		TOP	4	Circular
Outlet I. E.		7048.5		7052.9		
Wall Thick.		5	in.			

STAGE		STORAGE				DISCHARGE										REALIZED CULVERT OUTFLOW	TOTAL FLOW	
ELEV	HEIGHT	AREA		VOLUME		TOP OF BANK	SPILLWAY	ORIFICE (max outflow)				GRATE (max outflow) Rectangular	PIPE					
		sqft	acre	acft	cum acft			1	2	3	4		1	2				
7049	0	0	0.0	0.00	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-
7050	1	10705	0.2	0.1	0.1	-	-	0.2	-	-	-	-	-	13	-	-	0.2	0.15
7051	2	36676	0.8	0.5	0.7	-	-	0.3	0.5	-	-	-	-	33	-	-	0.8	0.79
7052	3	71989	1.7	1.2	1.9	-	-	0.5	1.4	-	-	-	-	60	-	-	1.9	1.9
7053	4	133440	3.1	2.4	4.3	-	-	0.6	2.2	-	-	-	-	90	-	-	2.8	2.8
7054	5	178828	4.1	3.6	7.9	-	-	0.7	2.8	10.4	-	-	-	119	-	-	13.8	14
7055	6	221269	5.1	4.6	12.4	-	-	0.7	3.2	15.9	-	-	3.9	139	-	-	24	24
7056	7	269749	6.2	5.6	18.1	-	-	0.8	3.6	20	-	-	57	157	-	-	82	82
7058	9	337508	7.7	13.9	32.0	-	-	0.9	4.4	26	-	-	220	188	-	-	188	188
7060	11	405520	9.3	31.0	49.1	-	848.5	1.0	5.0	31	-	-	280	214	-	-	214	1,063

- Notes:
- 1) Top-of-bank and spillway flows are weir equations from section 11.3.1 in the DCM.  $Q=CLH^{1.5}$  (C=3.0)
  - 2) Orifice flows are also from section 11.3.1.  $Q=CA(2gH)^{0.5}$  (C=6)
  - 3) Grate flows are determined from equations 7-2 and 7-3. Weir Flow  $Q=(3PH^{1.5})/F$ , Orifice Flow  $Q=4.815*AH^{0.5}$



**STAGE/STORAGE/DISCHARGE CURVES FOR DETENTION POND ANALYSIS**

**Meridian Ranch Proposed Detention Pond E- FINAL FUTURE (TOTAL FLOWS)**

Gieck Basin - El Paso County, Colorado

**FINAL**

embankment length =	1860
embankment elev =	6976
spillway length =	200
spillway elevation =	6974.5
100 year storage elev. =	6972.6
100 year storage vol. =	33.4
100 year discharge =	217
5 year storage elev. =	6971.1
5 year storage vol. =	17.1
5 year discharge =	24
WQCV storage elev. =	6968.4
WQCV storage vol. =	1.6
WQCV depth =	1.4
1/2 WQCV storage elev. =	6968.1
1/2 WQCV storage vol. =	0.8

STAGE		STORAGE				TOTAL DISCHARGE												
ELEV	HEIGHT	AREA		VOLUME		TOP OF BANK	SPILLWAY	ORIFICE (max outflow)				GRATE (max outflow)		PIPE		REALIZED CULVERT OUTFLOW	TOTAL FLOW	
		sqft	acre	acft	cum acft			1	2	3	4	Rectangular	1	2				
6967	0	3110	0.07	0.0	0.0	-	-	-	-	-	-	-	-	-	1.4	-	-	-
6968	1	49719	1.14	0.6	0.6	-	-	0.5	-	-	-	-	-	-	26	-	0.5	0.53
6969	2	148073	3.40	2.3	2.9	-	-	1.4	-	4.2	-	-	-	-	77	-	5.6	5.6
6970	3	282533	6.49	4.9	7.8	-	-	1.8	-	6.9	-	-	-	-	146	-	8.7	8.7
6970.5	3.5	345630	7.93	3.6	11	-	-	2.0	0.9	7.9	-	-	-	-	183	-	11	10.8
6971	4	408706	9.38	7.9	16	-	-	2.2	7.9	8.8	-	-	-	-	218	-	19	18.8
6971.25	4.25	428868	9.85	2.4	18	-	-	2.2	11.7	9.2	-	5.9	-	-	236	-	29	29.0
6971.5	4.5	449030	10.31	4.9	21	-	-	2.3	14.1	9.6	-	19.9	-	-	252	-	46	45.9
6971.75	4.75	469192	10.77	2.6	23	-	-	2.4	16.1	10.0	-	42.4	-	-	266	-	71	70.9
6972	5	489354	11.23	5.4	26	-	-	2.5	17.9	10.4	-	73.8	-	-	280	-	105	105
6972.25	5.25	496911	11.41	2.8	29	-	-	2.5	19.6	10.7	-	111.4	-	-	292	-	144	144
6972.5	5.5	504468	11.58	5.7	32	-	-	2.6	21.1	11.1	-	154.1	-	-	304	-	189	189
6973	6	519582	11.93	11.6	38	-	-	2.7	23.8	11.7	-	253.1	-	-	327	-	291	291
6974	7	532469	12.22	12.1	50	-	-	3.0	28.5	12.9	-	495.5	-	-	369	-	369	369
6976	9	557640	12.80	25.0	75	-	1.102	3.4	36.1	15.1	-	886.5	-	-	443	-	443	1,545

- Notes:
- 1) Top-of-bank and spillway flows are weir equations from section 11.3.1 in the DCM.  $Q=CLH^{1.5}$  (C=3.0)
  - 2) Orifice flows are also from section 11.3.1.  $Q=CA(2gH)^{0.5}$  (C=6)
  - 3) Grate flows are determined from equations 7-2 and 7-3. Weir Flow  $Q=(3PH^{1.5})/F$ . Orifice Flow  $Q=4.815*AH^{0.5}$
  - 4) Pipe flows use the lesser of: 1) Inlet control equations 27 & 28, page 146 of HDS No. 5 - or - 2) Allowable Pipe Flow equation on page 11-9 of the DCM. Use Table 9, page 147-148, HDS No. 5 for formulas 26 & 27.

## STAGE/STORAGE/DISCHARGE CURVES FOR DETENTION POND ANALYSIS

### Meridian Ranch Proposed Detention Pond E-FINAL DESIGN (H08)

Gieck Basin - El Paso County, Colorado

Data for spillway and embankment:

embankment length =	1860
embankment elev =	6975
spillway length =	200
spillway elevation =	6974
100 year storage elev. =	6972.6
100 year storage vol. =	33.4
100 year discharge =	155
5 year storage elev. =	6971.1
5 year storage vol. =	17.1
5 year discharge =	15.8
WQCV storage elev. =	6968.4
WQCV storage vol. =	1.6
1/2 WQCV storage elev. =	6968.1
1/2 WQCV storage vol. =	0.8

Data for outlet pipe and grate:

Type	Orifice	H or V	Dimensions		Dia. (in)	Area =	Area =	
			Width (ft.)	X Height (ft.)			(sqft)	Elev to cl =
Rectangular	Orifice 1:	V	0.0879	1.40		0.123	Elev to cl =	6967.70
Rectangular	Orifice 2:	V	4	0.5		2.000	Elev to cl =	6970.80
Circular	Orifice 3:	H			12	0.785	Elev to cl =	6968.40
None Selected	Orifice 4:	V				0.000	Elev to cl =	

Stand Pipe Dimensions					
Rec Grate		10	x	6	Elev = 6971.05
Circ. Grate			dia.		Elev = 6971.05

Outlet Culvert Dimensions

	Width (ft.)	Height (ft.)	Dia. (ft.)	Type
Outlet Culvert		x	3.5	Circular
Area	9.6		TOP	
Outlet I. E.	6966.8		6970.58	
Wall Thick.	4	in		

STAGE		STORAGE				DISCHARGE											
ELEV	HEIGHT	AREA		VOLUME		TOP OF BANK	SPILLWAY	ORIFICE (max outflow)				GRATE (max outflow)	PIPE		REALIZED CULVERT OUTFLOW	TOTAL FLOW	
		sqft	acre	acft	cum acft			1	2	3	4		Rectangular	1			2
6967	0	3110	0.07	0.0	0.0			-	-	-	-	-	-	1		-	-
6968	1	49719	1.14	0.6	0.6			0.3	-	-	-	-	-	18		0.3	0.3
6969	2	148073	3.40	2.3	2.9			0.7	-	2.9	-	-	-	52		3.6	3.6
6970	3	282553	6.49	4.9	7.8			0.9	-	4.8	-	-	-	97		6	5.7
6970.5	3.5	345629.5	7.93	3.6	11			1.0	-	5.5	-	-	-	122		6	6.5
6971	4	408706	9.38	7.9	16			1.1	3.6	6.1	-	-	-	146		11	11
6971.25	4.25	428868	9.85	2.4	18			1.1	6.5	6.4	-	-	-	157		20	20
6971.5	4.5	449030	10.31	4.9	21			1.2	8.1	6.7	-	-	20	167		36	36
6971.75	4.75	469192	10.77	2.6	23			1.2	9.4	6.9	-	-	39	176		56	56
6972	5	489354	11.23	5.4	26			1.2	10.5	7.2	-	-	61	185		80	80
6972.25	5.25	496911	11.41	2.8	29			1.3	11.6	7.4	-	-	87	193		107	107
6972.5	5.5	504468	11.58	5.7	32			1.3	12.6	7.7	-	-	115	201		137	137
6973	6	519582	11.93	11.6	38			1.4	14.3	8.1	-	-	180	217		203	203
6974	7	532469	12.22	12.1	50			1.5	17.2	8.9	-	-	334	244		244	244
6976	9	557640	12.80	25.0	75			1.7	22.0	10.4	-	-	643	291		291	291

Notes:

- 1) Top-of-bank and spillway flows are weir equations from section 11.3.1 in the DCM.  $Q = CLH^{1.5}$  (C=3.0)
- 2) Orifice flows are also from section 11.3.1.  $Q = CA(2gH)^{0.5}$  (C=.6)
- 3) Grate flows are determined from equations 7-2 and 7-3. Weir Flow  $Q = (3PH^{1.5})/F$ , Orifice Flow  $Q = 4.815 * AH^{0.5}$
- 4) Pipe flows use the lesser of: 1) Inlet control equations 27 & 28, page 146 of HDS No. 5 - or - 2) Allowable Pipe Flow equation on page 11-9 of the DCM. Use Table 9, page 147-148, HDS No. 5 for formulas 26 & 27.

## STAGE/STORAGE/DISCHARGE CURVES FOR DETENTION POND ANALYSIS

### Meridian Ranch Proposed Detention Pond E-FINAL DESIGN (H09)

Gieck Basin - El Paso County, Colorado

Data for spillway and embankment:

embankment length =	1860
embankment elev =	6976
spillway length =	200
spillway elevation =	6974.5
100 year storage elev. =	6972.6
100 year storage vol. =	33.4
100 year discharge =	62
5 year storage elev. =	6971.1
5 year storage vol. =	17.1
5 year discharge =	8.7
WQCV storage elev. =	6968.4
WQCV storage vol. =	1.6
1/2 WQCV storage elev. =	6968.1
1/2 WQCV storage vol. =	0.8

Data for outlet pipe and grate:

Type	Orifice	H or V	Dimensions		Dia (in)	Area =	Area =	
			Width (ft.)	X Height (ft.)			(sqft)	Elev to cl =
Rectangular	Orifice 1:	V	0.0879	1.40		0.123	Elev to cl =	6967.70
Rectangular	Orifice 2:	V	2.5	0.5		1.250	Elev to cl =	6970.50
Circular	Orifice 3:	H			8	0.349	Elev to cl =	6968.40
None Selected	Orifice 4:	V				0.000	Elev to cl =	6967.33

Stand Pipe Dimensions

Rec Grate	6	x	4	Elev =	6971.55
Circ. Grate		dia.		Elev =	6971.55

Outlet Culvert Dimensions

Outlet Culvert	Width (ft.)		Height (ft.)	Dia. (ft.)	Type
Area	9.6		TOP		Circular
Outlet I. E.	6966.8		6970.7		
Wall Thick.	5	in			

STAGE		STORAGE				DISCHARGE											
ELEV	HEIGHT	AREA sqft	acre	VOLUME		TOP OF BANK	SPILLWAY	ORIFICE (max outflow)				GRATE (max outflow)		PIPE		REALIZED CULVERT OUTFLOW	TOTAL FLOW
				acft	cum acft			1	2	3	4	Rectangular		1	2		
6967	0	3110	0.07	0.0	0.0			-	-	-	-	-	-	0.5		-	-
6968	1	49719	1.14	0.6	0.6			0.3	-	-	-	-	-	8.8		0.3	0.3
6969	2	148073	3.40	2.3	2.9			0.7	-	1.3	-	-	-	26		2.0	2.0
6970	3	282553	6.49	4.9	7.8			0.9	-	2.1	-	-	-	48		3.0	3.0
6970.5	3.5	345629.5	7.93	3.6	11			1.0	0.9	2.4	-	-	-	61		4.4	4.4
6971	4	408706	9.38	7.9	16			1.1	4.3	2.7	-	-	-	73		8.0	8.0
6971.25	4.25	428868	9.85	2.4	18			1.1	5.2	2.8	-	-	-	79		9.2	9.2
6971.5	4.5	449030	10.31	4.9	21			1.2	6.0	3.0	-	-	-	85		10.1	10.1
6971.75	4.75	469192	10.77	2.6	23			1.2	6.7	3.1	-	-	4	90		14.8	15
6972	5	489354	11.23	5.4	26			1.2	7.4	3.2	-	-	13	95		24.5	24
6972.25	5.25	496911	11.41	2.8	29			1.3	8.0	3.3	-	-	25	99		37.1	37
6972.5	5.5	504468	11.58	5.7	32			1.3	8.5	3.4	-	-	39	103		52.1	52
6973	6	519582	11.93	11.6	38			1.4	9.5	3.6	-	-	73	111		87.8	88
6974	7	532469	12.22	12.1	50			1.5	11.3	4.0	-	-	161	125		125.3	125
6976	9	557640	12.80	25.0	75			1.7	14.1	4.6	-	-	244	151		151.4	151

Notes: 1) Top-of-bank and spillway flows are weir equations from section 11.3.1 in the DCM.  $Q=CLH^{1.5}$  (C=3.0)

2) Orifice flows are also from section 11.3.1.  $Q=CA(2gH)^{0.5}$  (C=6)

3) Grate flows are determined from equations 7-2 and 7-3. Weir Flow  $Q=(3PH^{1.5})/F$ . Orifice Flow  $Q=4.815*AH^{0.5}$

4) Pipe flows use the lesser of: 1) Inlet control equations 27 & 28, page 146 of HDS No. 5 - or - 2) Allowable Pipe Flow equation on page 11-9 of the DCM. Use Table 9, page 147-148, HDS No. 5 for formulas 26 & 27.

**POND E OUTLET PIPE HYDRAULICS  
OUTLET AT H08 FUTURE**

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	6,974.50 ft	Headwater Depth/Height	1.29
Computed Headwater Elev.	6,971.25 ft	Discharge	157.00 cfs
Inlet Control HW Elev.	6,971.25 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	6,971.25 ft	Control Type	Outlet Control

Grades			
Upstream Invert	6,966.72 ft	Downstream Invert	6,966.44 ft
Length	66.68 ft	Constructed Slope	0.004199 ft/ft

Hydraulic Profile			
Profile	M2	Depth, Downstream	2.77 ft
Slope Type	Mild	Normal Depth	N/A ft
Flow Regime	Subcritical	Critical Depth	2.77 ft
Velocity Downstream	9.61 ft/s	Critical Slope	0.006510 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	3.50 ft
Section Size	42 inch	Rise	3.50 ft
Number Sections	2		

Outlet Control Properties			
Outlet Control HW Elev.	6,971.25 ft	Upstream Velocity Head	1.15 ft
Ke	0.20	Entrance Loss	0.23 ft

Inlet Control Properties			
Inlet Control HW Elev.	6,971.25 ft	Flow Control	Submerged
Inlet Type	Groove end w/headwall	Area Full	19.2 ft <sup>2</sup>
K	0.00180	HDS 5 Chart	1
M	2.00000	HDS 5 Scale	2
C	0.02920	Equation Form	1
Y	0.74000		

**POND E OUTLET PIPE HYDRAULICS  
OUTLET AT H09 FUTURE**

Solve For: Headwater Elevation

Culvert Summary			
Allowable HW Elevation	6,974.50 ft	Headwater Depth/Height	1.09
Computed Headwater Eleva	6,970.55 ft	Discharge	62.00 cfs
Inlet Control HW Elev.	6,970.45 ft	Tailwater Elevation	0.00 ft
Outlet Control HW Elev.	6,970.55 ft	Control Type	Entrance Control

Grades			
Upstream Invert	6,966.72 ft	Downstream Invert	6,966.34 ft
Length	69.88 ft	Constructed Slope	0.005438 ft/ft

Hydraulic Profile			
Profile	S2	Depth, Downstream	2.45 ft
Slope Type	Steep	Normal Depth	2.45 ft
Flow Regime	Supercritical	Critical Depth	2.47 ft
Velocity Downstream	8.63 ft/s	Critical Slope	0.005315 ft/ft

Section			
Section Shape	Circular	Mannings Coefficient	0.013
Section Material	Concrete	Span	3.50 ft
Section Size	42 inch	Rise	3.50 ft
Number Sections	1		

Outlet Control Properties			
Outlet Control HW Elev.	6,970.55 ft	Upstream Velocity Head	1.14 ft
Ke	0.20	Entrance Loss	0.23 ft

Inlet Control Properties			
Inlet Control HW Elev.	6,970.45 ft	Flow Control	Unsubmerged
Inlet Type	Beveled ring, 33.7° bevels	Area Full	9.6 ft <sup>2</sup>
K	0.00180	HDS 5 Chart	3
M	2.50000	HDS 5 Scale	B
C	0.02430	Equation Form	1
Y	0.83000		

## POND E OUTLET FUTURE RATING TABLES

@ H08 - 2-42" RCP Flows

Range Data:			
	Minimum	Maximum	Increment
Allowable HWE	6,967.00	6,976.00	0.50 ft

HW Elev. (ft)	Discharge (cfs)
6,967.00	0.91
6,967.50	6.80
6,968.00	17.66
6,968.50	32.81
6,969.00	51.56
6,969.50	73.13
6,970.00	97.16
6,970.50	121.78
6,971.00	145.55
6,971.50	166.92
6,972.00	184.94
6,972.50	201.35
6,973.00	216.53
6,973.50	230.70
6,974.00	244.06
6,974.50	256.72
6,975.00	268.78
6,975.50	280.33
6,976.00	291.42

@ H09 - 42" RCP Flow

Range Data:			
	Minimum	Maximum	Increment
Allowable HWE	6,967.00	6,976.00	0.50 ft

HW Elev. (ft)	Discharge (cfs)
6,967.00	0.45
6,967.50	3.40
6,968.00	8.83
6,968.50	16.41
6,969.00	25.78
6,969.50	36.56
6,970.00	48.35
6,970.50	60.72
6,971.00	72.62
6,971.50	84.73
6,972.00	94.76
6,972.50	102.71
6,973.00	110.53
6,973.50	118.08
6,974.00	125.31
6,974.50	132.24
6,975.00	138.88
6,975.50	145.26
6,976.00	151.40

The above tables were used to cross check the flows within the 42" RCP versus the flows allowed into the control structure. The lower of the two flows governs the total outflow of the pond.

### Rip Rap Outlet Protection Design

<b>H08</b>		<b>RIP-RAP SIZING</b>					
Q = <input type="text" value="155"/> cfs	Circular <input type="text" value="42"/> Dia (in)	$\text{Rip-Rap Sizing} = \frac{\left(\frac{d_{50}}{D}\right) \left(\frac{TW}{D}\right)^{1.2}}{\left(\frac{Q}{D^{2.5}}\right)}$					
TW = <input type="text" value="24.0"/> Tailwater (in)	Box Culvert <input type="text"/> Height (in) <input type="text"/> Width (in)						
TYPE: Circular		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td><math>d_{50} =</math></td> <td><input type="text" value="18"/> inch</td> </tr> <tr> <td>Rip-rap Type:</td> <td><input type="text" value="H"/></td> </tr> </table>		$d_{50} =$	<input type="text" value="18"/> inch	Rip-rap Type:	<input type="text" value="H"/>
$d_{50} =$	<input type="text" value="18"/> inch						
Rip-rap Type:	<input type="text" value="H"/>						
<b>HYDRAULIC CHARACTERISTICS</b>							
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td><input type="text" value="36.00"/> Normal Depth (in)</td> </tr> </table>		<input type="text" value="36.00"/> Normal Depth (in)					
<input type="text" value="36.00"/> Normal Depth (in)							
$Y_o/D =$	<input type="text" value="1"/> <input type="text" value="1.00"/>						
$TW/Y_o =$	<input type="text" value="0.67"/> <b>LOW TAILWATER DEPTH</b>						
$Y_o =$	<input type="text" value="36.00"/> Brink Depth (in)						
$A =$	<input type="text" value="1255"/> Brink Area (sq in)						
	<input type="text" value="8.7"/> Brink Area (sf)						
$V_o =$	<input type="text" value="17.8"/> Brink Velocity (fps)						
$Y_e =$	<input type="text" value="2.09"/> Equivalent Brink Depth (ft)						
$F =$	<input type="text" value="2.17"/> Froude						
Supercritical Test: <b>Supercritical</b>							
$D =$	<input type="text" value="39.0"/>						
$Q/D^{2.5} =$	<input type="text" value="6.76"/> Rounded: <input type="text" value="7.00"/>						
$Q/D^{1.5} =$	<input type="text" value="26.45"/> Rounded: <input type="text" value="26.45"/>						
$TW/D =$	<input type="text" value="0.57"/> Rounded: <input type="text" value="0.55"/>						
If TW unknown use:	<input type="text" value="0.40"/> TW: <input type="text" value="2.00"/>						
<b>EXTENT OF PROTECTION</b>							
$L_p = \left(\frac{l}{2 \tan \theta}\right) \left(\frac{A_r}{TW} \cdot W\right)$							
$L_p =$ Length of Protection $W =$ Width of the conduit $TW =$ Tailwater depth $\theta =$ Expansion angle of the culvert flow $A_r =$ Required area of flow at allowable velocity							
$A_r =$ <input type="text" value="28.2"/> sf							
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td><math>\frac{l}{2 \tan \theta}</math></td> <td>Expansion Factor</td> <td><input type="text" value="3.00"/></td> </tr> </table>				$\frac{l}{2 \tan \theta}$	Expansion Factor	<input type="text" value="3.00"/>	
$\frac{l}{2 \tan \theta}$	Expansion Factor	<input type="text" value="3.00"/>					
$L_p =$ <input type="text" value="32"/>							

### Rip Rap Outlet Protection Design

<b>H09</b>		<b>RIP-RAP SIZING</b>					
Q = <input type="text" value="62"/> cfs	Circular <input type="text" value="42"/> Dia (in)	$\text{Rip-Rap Sizing} = \frac{\left(\frac{d_{50}}{D}\right) \left(\frac{TW}{D}\right)^{1.2}}{\left(\frac{Q}{D^{2.5}}\right)}$					
TW = <input type="text" value="12.0"/> Tailwater (in)	Box Culvert <input type="text"/> Height (in) <input type="text"/> Width (in)						
TYPE: Circular		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td><math>d_{50} =</math></td> <td><input type="text" value="12"/> inch</td> </tr> <tr> <td>Rip-rap Type:</td> <td><input type="text" value="M"/></td> </tr> </table>		$d_{50} =$	<input type="text" value="12"/> inch	Rip-rap Type:	<input type="text" value="M"/>
$d_{50} =$	<input type="text" value="12"/> inch						
Rip-rap Type:	<input type="text" value="M"/>						
<b>HYDRAULIC CHARACTERISTICS</b>							
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td><input type="text" value="30.00"/> Normal Depth (in)</td> </tr> </table>		<input type="text" value="30.00"/> Normal Depth (in)					
<input type="text" value="30.00"/> Normal Depth (in)							
$Y_o/D =$	<input type="text" value="0.56"/> <input type="text" value="0.55"/>						
$TW/Y_o =$	<input type="text" value="0.51"/> <b>LOW TAILWATER DEPTH</b>						
$Y_o =$	<input type="text" value="23.52"/> Brink Depth (in)						
$A =$	<input type="text" value="798"/> Brink Area (sq in)						
	<input type="text" value="5.5"/> Brink Area (sf)						
$V_o =$	<input type="text" value="11.2"/> Brink Velocity (fps)						
$Y_e =$	<input type="text" value="1.66"/> Equivalent Brink Depth (ft)						
$F =$	<input type="text" value="1.53"/> Froude						
Supercritical Test: <b>Supercritical</b>							
$D =$	<input type="text" value="32.8"/>						
$Q/D^{2.5} =$	<input type="text" value="2.71"/> Rounded: <input type="text" value="2.50"/>						
$Q/D^{1.5} =$	<input type="text" value="13.75"/> Rounded: <input type="text" value="13.75"/>						
$TW/D =$	<input type="text" value="0.29"/> Rounded: <input type="text" value="0.30"/>						
If TW unknown use:	<input type="text" value="0.40"/> TW: <input type="text" value="1.00"/>						
<b>EXTENT OF PROTECTION</b>							
$L_p = \left(\frac{l}{2 \tan \theta}\right) \left(\frac{A_r}{TW} \cdot W\right)$							
$L_p =$ Length of Protection $W =$ Width of the conduit $TW =$ Tailwater depth $\theta =$ Expansion angle of the culvert flow $A_r =$ Required area of flow at allowable velocity							
$A_r =$ <input type="text" value="11.3"/> sf							
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td><math>\frac{l}{2 \tan \theta}</math></td> <td>Expansion Factor</td> <td><input type="text" value="3.43"/></td> </tr> </table>				$\frac{l}{2 \tan \theta}$	Expansion Factor	<input type="text" value="3.43"/>	
$\frac{l}{2 \tan \theta}$	Expansion Factor	<input type="text" value="3.43"/>					
$L_p =$ <input type="text" value="27"/>							

## WQCV Control Riser Calculations

### POND D WQCV Control Riser Calculations

TRIBUTARY AREA 289 acres  
 DRAIN TIME 6 hr  
 $a$  0.7  
 IMPERVIOUSNESS RATIO  $i$  0.35  
 DEPTH OF OUTLET 2.3  
  
 WQCV 0.12 inches  
  
 WQCV DESIGN VOL 1.0 ac-ft  
 $K_{10}$  0.47  
 AREA PER ROW<sup>1</sup>  $a$  1.05 in<sup>2</sup>  
  
 No. of columns 3 per riser  
 Hole size 1 1/16 in  
 Steel Plate Thickness 3/8 in  
 9 rows of holes per riser  
  
<sup>1</sup> AREA PER ROW PER RISER  
 Actual area per row per riser: 1.11 in<sup>2</sup>  
 Actual area per riser: 10.0 in<sup>2</sup>  
 Actual area per riser: 0.069 ft<sup>2</sup>

TABLE SB-2							
Hole Dia (in)		Area per Row (in <sup>2</sup> )					
Holes per Row		1	2	3	4	5	6
Min steel thickness		1/4	5/16	3/8	3/8	3/8	1/2
1/4	0.2500	0.05	0.10	0.15	0.20	0.25	0.29
5/16	0.3125	0.08	0.15	0.23	0.31	0.38	0.46
3/8	0.3750	0.11	0.22	0.33	0.44	0.55	0.66
7/16	0.4375	0.15	0.30	0.45	0.60	0.75	0.90
1/2	0.5000	0.20	0.39	0.59	0.79	0.98	1.18
9/16	0.5625	0.25	0.50	0.75	0.99	1.24	1.49
5/8	0.6250	0.31	0.61	0.92	1.23	1.53	1.84
11/16	0.6875	0.37	0.74	1.11	1.48	1.86	2.23
3/4	0.7500	0.44	0.88	1.33	1.77	2.21	2.65
7/8	0.8750	0.60	1.20	1.80	2.41	3.01	3.61
1	1.0000	0.79	1.57	2.36	3.14	3.93	4.71
1 1/8	1.1250	0.99	1.99	2.98	3.98	4.97	5.96
1 1/4	1.2500	1.23	2.45	3.68	4.91	6.14	7.36
1 3/8	1.3750	1.48	2.97	4.45	5.94	7.42	8.91
1 1/2	1.5000	1.77	3.53	5.30	7.07	8.84	10.60
1 5/8	1.6250	2.07	4.15	6.22	8.30	10.37	12.44
1 3/4	1.7500	2.41	4.81	7.22	9.62	12.03	14.43
1 7/8	1.8750	2.76	5.52	8.28	11.04	13.81	16.57
2	2.0000	3.14	6.28	9.42	12.57	15.71	18.85

n = Number of columns of perforations

### INTERIM FILING 11A POND E WQCV Control Riser Calculations

TRIBUTARY AREA 241 acres  
 DRAIN TIME 6 hr  
 $a$  0.7  
 IMPERVIOUSNESS RATIO  $i$  0.19  
 DEPTH OF OUTLET 1.0  
  
 WQCV 0.08 inches  
  
**WQCV DESIGN VOL 0.3 ac-ft**  
 $K_{10}$  0.13  
 AREA PER ROW<sup>1</sup>  $a$  1.11 in<sup>2</sup>  
  
 No. of columns 3 per riser  
 Hole size 1 1/16 in  
 Steel Plate Thickness 3/8 in  
 4 rows of holes per riser  
  
<sup>1</sup> AREA PER ROW PER RISER  
 Actual area per row per riser: 1.11 in<sup>2</sup>  
 Actual area per riser: 4.4 in<sup>2</sup>  
 Actual area per riser: 0.031 ft<sup>2</sup>

TABLE SB-2							
Hole Dia (in)		Area per Row (in <sup>2</sup> )					
Holes per Row		1	2	3	4	5	6
Min steel thickness		1/4	5/16	3/8	3/8	3/8	1/2
1/4	0.2500	0.05	0.10	0.15	0.20	0.25	0.29
5/16	0.3125	0.08	0.15	0.23	0.31	0.38	0.46
3/8	0.3750	0.11	0.22	0.33	0.44	0.55	0.66
7/16	0.4375	0.15	0.30	0.45	0.60	0.75	0.90
1/2	0.5000	0.20	0.39	0.59	0.79	0.98	1.18
9/16	0.5625	0.25	0.50	0.75	0.99	1.24	1.49
5/8	0.6250	0.31	0.61	0.92	1.23	1.53	1.84
11/16	0.6875	0.37	0.74	1.11	1.48	1.86	2.23
3/4	0.7500	0.44	0.88	1.33	1.77	2.21	2.65
7/8	0.8750	0.60	1.20	1.80	2.41	3.01	3.61
1	1.0000	0.79	1.57	2.36	3.14	3.93	4.71
1 1/8	1.1250	0.99	1.99	2.98	3.98	4.97	5.96
1 1/4	1.2500	1.23	2.45	3.68	4.91	6.14	7.36
1 3/8	1.3750	1.48	2.97	4.45	5.94	7.42	8.91
1 1/2	1.5000	1.77	3.53	5.30	7.07	8.84	10.60
1 5/8	1.6250	2.07	4.15	6.22	8.30	10.37	12.44
1 3/4	1.7500	2.41	4.81	7.22	9.62	12.03	14.43
1 7/8	1.8750	2.76	5.52	8.28	11.04	13.81	16.57
2	2.0000	3.14	6.28	9.42	12.57	15.71	18.85

n = Number of columns of perforations



**FUTURE POND E**  
WQCV Control Riser Calculations

TRIBUTARY AREA 332 acres  
 DRAIN TIME 6 hr  
 IMPERVIOUSNESS RATIO  $i$  0.7  
 DEPTH OF OUTLET  $a$  0.44  
 WQCV 1.4 inches  
 WQCV DESIGN VOL. 1.6 ac-ft  
 $K_{40}$  0.23  
 AREA PER ROW<sup>1</sup>  $a$  3.46 in<sup>2</sup>  
 No. of columns 2 per riser  
 Hole size 1 1/2 in  
 Steel Plate Thickness 5/16 in  
 5 rows of holes per riser  
<sup>1</sup> AREA PER ROW PER RISER  
 Actual area per row per riser: 3.53 in<sup>2</sup>  
 Actual area per riser: 17.7 in<sup>2</sup>  
 Actual area per riser: 0.123 ft<sup>2</sup>

TABLE SB-2							
Hole Dia (in)	Area per Row (in <sup>2</sup> )						
Holes per Row	1	2	3	4	5	6	
Min steel thickness	1/4	5/16	3/8	3/8	3/8	1/2	
1/4	0.2500	0.05	0.10	0.15	0.20	0.25	0.29
5/16	0.3125	0.08	0.15	0.23	0.31	0.38	0.46
3/8	0.3750	0.11	0.22	0.33	0.44	0.55	0.66
7/16	0.4375	0.15	0.30	0.45	0.60	0.75	0.90
1/2	0.5000	0.20	0.39	0.59	0.79	0.98	1.18
9/16	0.5625	0.25	0.50	0.75	0.99	1.24	1.49
5/8	0.6250	0.31	0.61	0.92	1.23	1.53	1.84
11/16	0.6875	0.37	0.74	1.11	1.48	1.86	2.23
3/4	0.7500	0.44	0.88	1.33	1.77	2.21	2.65
7/8	0.8750	0.60	1.20	1.80	2.41	3.01	3.61
1	1.0000	0.79	1.57	2.36	3.14	3.93	4.71
1 1/8	1.1250	0.99	1.99	2.98	3.98	4.97	5.96
1 1/4	1.2500	1.23	2.45	3.68	4.91	6.14	7.36
1 3/8	1.3750	1.48	2.97	4.45	5.94	7.42	8.91
1 1/2	1.5000	1.77	3.53	5.30	7.07	8.84	10.60
1 5/8	1.6250	2.07	4.15	6.22	8.30	10.37	12.44
1 3/4	1.7500	2.41	4.81	7.22	9.62	12.03	14.43
1 7/8	1.8750	2.76	5.52	8.28	11.04	13.81	16.57
2	2.0000	3.14	6.28	9.42	12.57	15.71	18.85

n = Number of columns of perforations

## **Appendix F – Drainage Channel Calculations**

## Rating Table for OPEN SPACE CHANNEL

### Project Description

Friction Method                      Manning Formula  
Solve For                                Normal Depth

### Input Data

Roughness Coefficient                      0.030  
Channel Slope                                0.04300 ft/ft  
Left Side Slope                              4.00 ft/ft (H:V)  
Right Side Slope                             4.00 ft/ft (H:V)  
Bottom Width                                10.00 ft  
Discharge                                      33.00 ft<sup>3</sup>/s

Channel Slope (ft/ft)	Normal Depth (ft)	Velocity (ft/s)	Flow Area (ft <sup>2</sup> )	Wetted Perimeter (ft)	Top Width (ft)
0.00500	0.89	2.75	12.01	17.31	17.09
0.01000	0.73	3.48	9.47	16.04	15.86
0.01500	0.65	4.00	8.24	15.39	15.23
0.02000	0.60	4.41	7.48	14.97	14.82
0.02500	0.57	4.75	6.94	14.67	14.53
0.03000	0.54	5.05	6.53	14.43	14.30
0.03500	0.51	5.32	6.20	14.24	14.11
0.04000	0.49	5.57	5.93	14.08	13.96
0.04500	0.48	5.79	5.70	13.95	13.83
0.05000	0.46	5.99	5.51	13.83	13.72

## **Appendix G – Filing 11A –Temporary Sedimentation Ponds**

MERIDIAN RANCH FILING 11A FINAL PLAT  
 TEMPORARY SEDIMENTATION SIZING  
 SEDIMENTATION #1

Tributary Area: 6.5 ac.      Required Volume: 0.3 ac-ft      Depth at Outlet: 3.4 ft.

Area required  
 per Row  
 0.45 in<sup>2</sup>

WS Elev: 7053.9

No. of columns: 1      Hole size: 3/4 in

STAGE			STORAGE			
STAGE	ELEV	HEIGHT	AREA		VOLUME	
			sqft	acre	acft	cum acft
1	7050.5	0		0.000	0.000	0.00
2	7051	0.5	679.1	0.02	0.00	0.00
3	7052	1.5	3762	0.09	0.05	0.05
4	7053	2.5	5924	0.14	0.11	0.17
5	7054	3.5	7738	0.18	0.16	0.32

TABLE SB-2

Minimum steel thickness		1	2	3	4	5	6
		1/4	5/16	3/8	3/8	3/8	1/2
1/4	0.2500	0.05	0.10	0.15	0.20	0.25	0.29
5/16	0.3125	0.08	0.15	0.23	0.31	0.38	0.46
3/8	0.3750	0.11	0.22	0.33	0.44	0.55	0.66
7/16	0.4375	0.15	0.30	0.45	0.60	0.75	0.90
1/2	0.5000	0.20	0.39	0.59	0.79	0.98	1.18
9/16	0.5625	0.25	0.50	0.75	0.99	1.24	1.49
5/8	0.6250	0.31	0.61	0.92	1.23	1.53	1.84
11/16	0.6875	0.37	0.74	1.11	1.48	1.86	2.23
3/4	0.7500	0.44	0.88	1.33	1.77	2.21	2.65
7/8	0.8750	0.60	1.20	1.80	2.41	3.01	3.61
1	1.0000	0.79	1.57	2.36	3.14	3.93	4.71
1 1/8	1.1250	0.99	1.99	2.98	3.98	4.97	5.96
1 1/4	1.2500	1.23	2.45	3.68	4.91	6.14	7.36
1 3/8	1.3750	1.48	2.97	4.45	5.94	7.42	8.91
1 1/2	1.5000	1.77	3.53	5.30	7.07	8.84	10.60
1 5/8	1.6250	2.07	4.15	6.22	8.30	10.37	12.44
1 3/4	1.7500	2.41	4.81	7.22	9.62	12.03	14.43
1 7/8	1.8750	2.76	5.52	8.28	11.04	13.81	16.57
2	2.0000	3.14	6.28	9.42	12.57	15.71	18.85

MERIDIAN RANCH FILING 11A FINAL PLAT  
 TEMPORARY SEDIMENTATION SIZING  
 SEDIMENTATION #2

Tributary Area: 3.4 ac.      Required Volume 0.1 ac-ft      Depth at Outlet 0.8 ft.

Area required  
 per Row  
 1.60 in<sup>2</sup>

WS Elev: 7049.4

No. of  
 columns      Hole size  
 2              1 in

STAGE			STORAGE			
STAGE	ELEV	HEIGHT	AREA		VOLUME	
			sqft	acre	acft	cum acft
1	7048.6	0		0.000	0.000	0.00
2	7049	0.4	3439	0.08	0.02	0.02
3	7050	1.4	13888	0.32	0.20	0.21

Minimum steel thickness		1	2	3	4	5	6
		1/4	5/16	3/8	3/8	3/8	1/2
1/4	0.2500	0.05	0.10	0.15	0.20	0.25	0.29
5/16	0.3125	0.08	0.15	0.23	0.31	0.38	0.46
3/8	0.3750	0.11	0.22	0.33	0.44	0.55	0.66
7/16	0.4375	0.15	0.30	0.45	0.60	0.75	0.90
1/2	0.5000	0.20	0.39	0.59	0.79	0.98	1.18
9/16	0.5625	0.25	0.50	0.75	0.99	1.24	1.49
5/8	0.6250	0.31	0.61	0.92	1.23	1.53	1.84
11/16	0.6875	0.37	0.74	1.11	1.48	1.86	2.23
3/4	0.7500	0.44	0.88	1.33	1.77	2.21	2.65
7/8	0.8750	0.60	1.20	1.80	2.41	3.01	3.61
1	1.0000	0.79	1.57	2.36	3.14	3.93	4.71
1 1/8	1.1250	0.99	1.99	2.98	3.98	4.97	5.96
1 1/4	1.2500	1.23	2.45	3.68	4.91	6.14	7.36
1 3/8	1.3750	1.48	2.97	4.45	5.94	7.42	8.91
1 1/2	1.5000	1.77	3.53	5.30	7.07	8.84	10.60
1 5/8	1.6250	2.07	4.15	6.22	8.30	10.37	12.44
1 3/4	1.7500	2.41	4.81	7.22	9.62	12.03	14.43
1 7/8	1.8750	2.76	5.52	8.28	11.04	13.81	16.57
2	2.0000	3.14	6.28	9.42	12.57	15.71	18.85

**MERIDIAN RANCH FILING 11A FINAL PLAT  
 TEMPORARY SEDIMENTATION SIZING  
 SEDIMENTATION #3**

Tributary Area: Required Volume Depth at Outlet  
 5.8 ac. 0.2 ac-ft 3.4 ft.

Area required  
 per Row  
 0.30 in<sup>2</sup>

WS Elev: 7039.9

No. of  
 columns 1  
 Hole size 5/8 in

STAGE			STORAGE			
STAGE	ELEV	HEIGHT	AREA		VOLUME	
			sqft	acre	acft	cum acft
1	7036.5	0		0.000	0.000	0.00
2	7037	0.5	1502	0.03	0.01	0.01
3	7038	1.5	2355	0.05	0.04	0.05
4	7039	2.5	3322	0.08	0.07	0.12
5	7040	3.5	4630	0.11	0.09	0.21

**TABLE SB-2**

Minimum steel thickness		1	2	3	4	5	6
		1/4	5/16	3/8	3/8	3/8	1/2
1/4	0.2500	0.05	0.10	0.15	0.20	0.25	0.29
5/16	0.3125	0.08	0.15	0.23	0.31	0.38	0.46
3/8	0.3750	0.11	0.22	0.33	0.44	0.55	0.66
7/16	0.4375	0.15	0.30	0.45	0.60	0.75	0.90
1/2	0.5000	0.20	0.39	0.59	0.79	0.98	1.18
9/16	0.5625	0.25	0.50	0.75	0.99	1.24	1.49
5/8	0.6250	0.31	0.61	0.92	1.23	1.53	1.84
11/16	0.6875	0.37	0.74	1.11	1.48	1.86	2.23
3/4	0.7500	0.44	0.88	1.33	1.77	2.21	2.65
7/8	0.8750	0.60	1.20	1.80	2.41	3.01	3.61
1	1.0000	0.79	1.57	2.36	3.14	3.93	4.71
1 1/8	1.1250	0.99	1.99	2.98	3.98	4.97	5.96
1 1/4	1.2500	1.23	2.45	3.68	4.91	6.14	7.36
1 3/8	1.3750	1.48	2.97	4.45	5.94	7.42	8.91
1 1/2	1.5000	1.77	3.53	5.30	7.07	8.84	10.60
1 5/8	1.6250	2.07	4.15	6.22	8.30	10.37	12.44
1 3/4	1.7500	2.41	4.81	7.22	9.62	12.03	14.43
1 7/8	1.8750	2.76	5.52	8.28	11.04	13.81	16.57
2	2.0000	3.14	6.28	9.42	12.57	15.71	18.85

## **Appendix H – Filing 11B – Drainage Calculation Addendum**

- HEC-HMS Data and Results
- Pond E Summary Sheets
- Pond E Stage Storage Tables

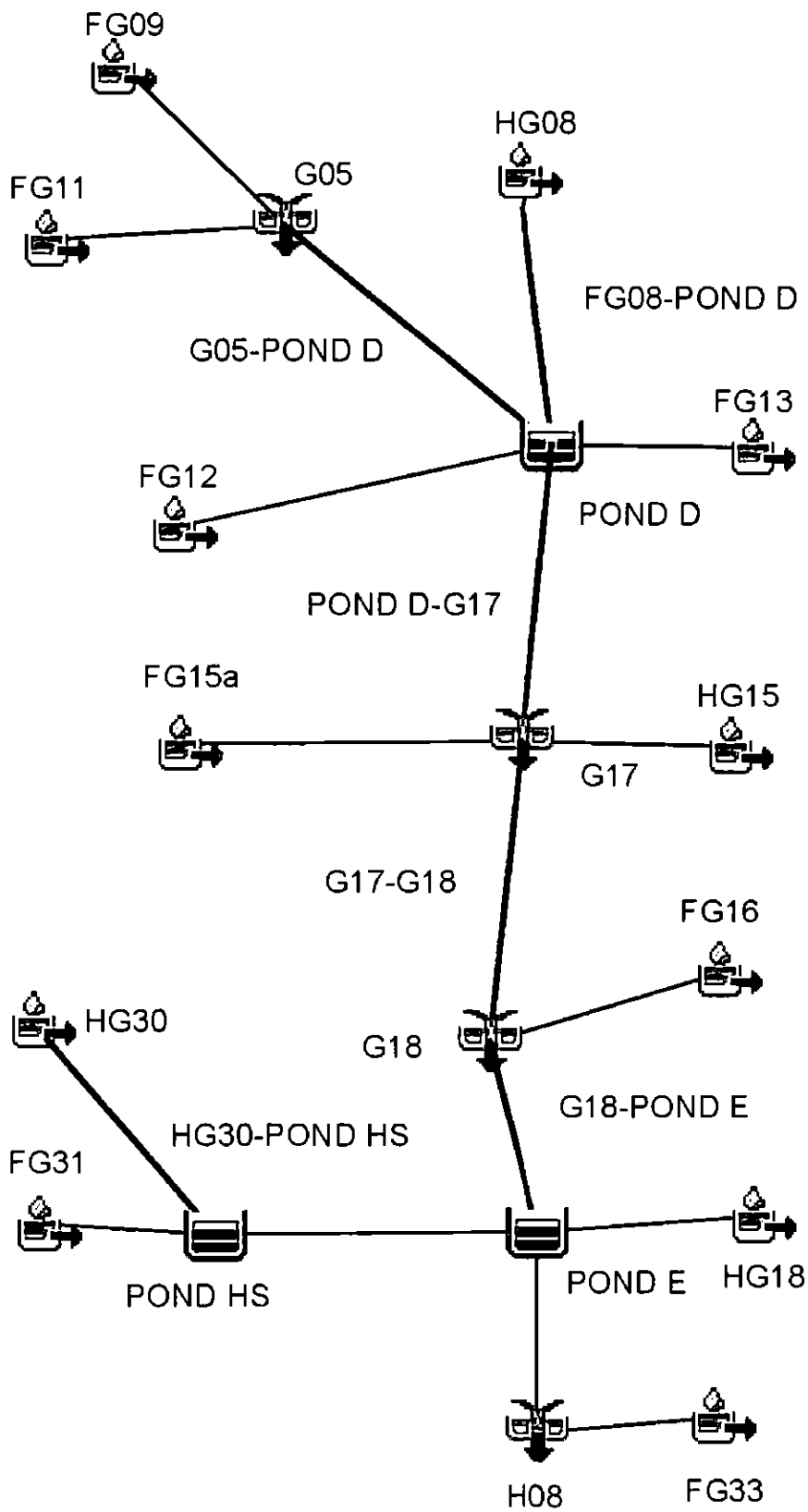


This appendix shows the impact that the development of Meridian Ranch Filings 11B will have to the storage capacity of Pond E. The below information includes the data input, schematic diagram and results of the proposed conditions for the development of Meridian Ranch Filing 11B. The calculations show a minor increase in total flow volume into Pond E. A fifty percent reduction of the opening on the Pond D top grate will reduce the peak flow out of Pond D and thus providing no major impact on Pond E. The additional development of Filing 11B does not adversely impact the property downstream of the project or Meridian Ranch.

### Input Data

BASIN	AREA		CURVE NO.	LAG TIME (min)	
	(acre)	(mi <sup>2</sup> )			
FILING 11B					
FG15a	10	0.0156	0.0	11.5	FILING 11A & 11B
FG16	50	0.0773	0.0	18.3	
HG17	72	0.1125	61.0	29.6	+
HG18	95	0.1484	62.7	27.5	
HG30	49	0.0766	61.0	14.8	
FG31	59	0.0922	80.0	24.0	* (FG17)
FG32	17	0.0273	65.2	14.5	+
FG33	7	0.0109	71.6	11.7	

\* FROM APPR MERIDIAN RANCH MDDP  
 + RATIONAL METHOD CALCULATION



<b>FILING 11B</b>					
<b>HYDROLOGIC ELEMENT</b>	<b>DRAINAGE AREA (SQ. MI.)</b>	<b>DISCHARGE PEAK Q<sub>100</sub> (CFS)</b>	<b>TOTAL VOLUME Q<sub>100</sub> (AC. FT.)</b>	<b>DISCHARGE PEAK Q<sub>5</sub> (CFS)</b>	<b>TOTAL VOLUME Q<sub>5</sub> (AC. FT.)</b>
HG08	0.1375	107	10.5	24	3.1
FG08-POND D	0.1375	107	10.5	24	3.1
FG13	0.1188	80	8.5	16	2.4
FG11	0.0608	85	7.2	30	2.8
FG09	0.0500	51	4.1	13	1.3
G05	0.1108	134	11.4	42	4.1
G05-POND D	0.1108	134	11.4	42	4.1
FG12	0.0328	55	4.1	21	1.7
<b>POND D</b>	<b>0.3999</b>	<b>57</b>	<b>29.5</b>	<b>8</b>	<b>8.0</b>
POND D-G17	0.3999	57	29.5	8	8.0
HG15	0.1344	58	7.5	8	1.7
FG15a	0.0156	27	1.8	10	0.7
G17	0.5499	85	38.7	13	10.3
G17-G18	0.5499	85	38.7	13	10.3
FG16	0.0773	109	8.8	37	3.4
G18	0.6272	175	47.6	50	13.7
G18-POND E	0.6272	175	47.5	50	13.7
FG31	0.0922	123	11.6	45	4.7
HG30	0.0766	49	4.2	6	0.9
HG30-POND HS	0.0766	48	4.1	6	0.9
<b>POND HS</b>	<b>0.1688</b>	<b>126</b>	<b>15.8</b>	<b>27</b>	<b>5.6</b>
HG18	0.1484	67	8.6	10	2.0
<b>POND E</b>	<b>0.9444</b>	<b>141</b>	<b>66.2</b>	<b>19</b>	<b>19.1</b>
FG33	0.0109	13	1.0	4	0.3
<b>H08</b>	0.9553	<b>73</b>	67.2	<b>14</b>	19.4
<b>H09</b>		<b>67</b>		<b>6.2</b>	
<b>* FROM OUTLET STAGE-STORAGE CALCULATION</b>					

**FILINGS 11A & 11B DEVELOPED CONDITION**  
**Simulation Run: F11A&B-100 YR Reservoir: POND D**

Start of Run: 09May2008, 08:00 Basin Model: Estates Rough Grading  
End of Run: 10May2008, 08:00 Meteorologic Model: SCS TYPE IIA 100YR  
Compute Time: 07Mar2014, 08:32:23 Control Specifications: 24 HR-2 MIN.

Volume Units: AC-FT

**Computed Results:**

Peak Inflow: 361 (CFS)	Date/Time of Peak Inflow: 09May2008, 14:14
Peak Outflow: 57 (CFS)	Date/Time of Peak Outflow: 09May2008, 15:08
Total Inflow : 34.5 (AC-FT)	Peak Storage: 16.7 (AC-FT)
Total Outflow: 29.5 (AC-FT)	Peak Elevation: 7055.8 (FT)

**Simulation Run: F11A&B-005 YR Reservoir: POND D**

Start of Run: 09May2008, 08:00 Basin Model: Estates Rough Grading  
End of Run: 10May2008, 08:00 Meteorologic Model: SCS TYPE IIA 100YR  
Compute Time: 06Mar2014, 11:52:28 Control Specifications: 24 HR-2 MIN.

Volume Units: AC-FT

**Computed Results:**

Peak Inflow: 95 (CFS)	Date/Time of Peak Inflow: 09May2008, 14:18
Peak Outflow: 8 (CFS)	Date/Time of Peak Outflow: 09May2008, 16:24
Total Inflow : 11.2 (AC-FT)	Peak Storage: 6.0 (AC-FT)
Total Outflow: 8.0 (AC-FT)	Peak Elevation: 7053.5 (FT)

**Simulation Run: F11A&B-100 YR Reservoir: POND E**

Start of Run: 09May2008, 08:00 Basin Model: Estates Rough Grading  
End of Run: 10May2008, 08:00 Meteorologic Model: SCS TYPE IIA 100YR  
Compute Time: 07Mar2014, 08:32:23 Control Specifications: 24 HR-2 MIN.

Volume Units: AC-FT

**Computed Results:**

Peak Inflow: 340(CFS)	Date/Time of Peak Inflow: 09May2008, 14:24
Peak Outflow: 141 (CFS)	Date/Time of Peak Outflow: 09May2008, 15:16
Total Inflow : 71.9 (AC-FT)	Peak Storage: 17.5 (AC-FT)
Total Outflow: 66.2 (AC-FT)	Peak Elevation: 6971.2 (FT)

**Simulation Run: F11A&B-005 YR Reservoir: POND E**

Start of Run: 09May2008, 08:00      Basin Model: Estates Rough Grading  
End of Run: 10May2008, 08:00      Meteorologic Model: SCS TYPE IIA 100YR  
Compute Time: 06Mar2014, 11:52:28      Control Specifications: 24 HR-2 MIN.

Volume Units: AC-FT

**Computed Results:**

Peak Inflow: 73 (CFS)	Date/Time of Peak Inflow: 09May2008, 14:18
Peak Outflow: 19 (CFS)	Date/Time of Peak Outflow: 09May2008, 16:46
Total Inflow : 21.3 (AC-FT)	Peak Storage: 6.5 (AC-FT)
Total Outflow: 19.1 (AC-FT)	Peak Elevation: 6969.7 (FT)

## STAGE/STORAGE/DISCHARGE CURVES FOR DETENTION POND ANALYSIS

### Meridian Ranch Proposed Detention Pond D - Interim AS-BUILT MERIDIAN RANCH FILINGS 11A & 11B Heagler Basin - El Paso County, Colorado

Data for spillway and embankment:

embankment length =	710
embankment elev =	7060
spillway length =	100
spillway elevation =	7058
100 year storage elev.=	7055.8
100 year storage vol.=	16.8
100 year discharge=	57
5 year storage elev.=	7053.5
5 year storage vol.=	6.0
5 year discharge=	8
WQCV storage vol.=	1.0
WQCV depth=	2.3
1/2 WQCV storage vol.=	0.50

Data for outlet pipe and grate:

		Dimensions					
Type		Width (ft.)	X Height (ft.)	Dia (in)	(sqft)		
Rectangular	Orifice 1:	0.03	2.3		Area =	0.069	Elev to cl = 7050.15
Circular	Orifice 2:			8	Area =	0.349	Elev to cl = 7051.3
Rectangular	Orifice 3:	5	0.5		Area =	2.500	Elev to cl = 7053.25
None Selected	Orifice 4:				Area =	0.000	Elev to cl =
Stand Pipe Dimensions							
Rec Grate		3	x	4.25	Elev =	7054.8	
Circ. Grate			dia.		Elev =		
Outlet Culvert Dimensions							
		Width (ft.)		Height (ft.)	Dia. (ft.)	Type	
Outlet Culvert		x			4	Circular	
Area		12.6		TOP			
Outlet I. E.		7048.5		7052.9			
Wall Thick.		5		in.			

STAGE		STORAGE				DISCHARGE										REALIZED CULVERT OUTFLOW	TOTAL FLOW
ELEV	HEIGHT	AREA		VOLUME		TOP OF BANK	SPILLWAY	ORIFICE (max outflow)				GRATE (max outflow) Rectangular	PIPE				
		sqft	acre	acft	cum acft			1	2	3	4		1	2			
7049	0	0	0.0	0.00	0.0	-	-	-	-	-	-	-	-	-	-	-	-
7050	1	10705	0.2	0.1	0.12	-	-	0.2	-	-	-	-	-	13	-	0.2	0.150
7051	2	36676	0.8	0.5	0.67	-	-	0.3	0	-	-	-	-	33	-	0.8	0.791
7052	3	71989	1.7	1.2	1.91	-	-	0.5	1	-	-	-	-	60	-	1.9	1.858
7053	4	133440	3.1	2.4	4.27	-	-	0.6	2.2	-	-	-	-	90	-	2.8	2.752
7054	5	178828	4.1	3.6	7.86	-	-	0.7	2.8	10.4	-	-	-	119	-	13.8	13.838
7055	6	221269	5.1	4.6	12.45	-	-	0.7	3.2	15.9	-	-	3.1	139	-	23	22.975
7055.5	6.5	245509	5.6	2.7	15.13	-	-	0.8	3.4	18.1	-	-	20.2	148	-	42	42.475
7056	7	269749	6.2	5.6	18.08	-	-	0.8	3.6	20	-	-	45	157	-	70	69.761
7058	9	337508	7.7	13.9	32.03	-	-	0.9	4.4	26	-	-	110	188	-	141	141.336
7060	11	405520	9.3	31.0	49.09	-	848.5	1.0	5.0	31	-	-	140	214	-	177	1,025.796

- Notes:
- 1) Top-of-bank and spillway flows are weir equations from section 11.3.1 in the DCM.  $Q=CLH^{1.5}$  (C=3.0)
  - 2) Orifice flows are also from section 11.3.1.  $Q=CA(2gH)^{0.5}$  (C=6)
  - 3) Grate flows are determined from equations 7-2 and 7-3 Weir Flow  $Q=(3PH^{1.5})/F$ , Orifice Flow  $Q=4.815*AH^{0.5}$
  - 4) Pipe flows use the lesser of: 1) Inlet control equations 27 & 28, page 146 of HDS No. 5 - or - 2) Allowable Pipe Flow equation on page 11-9 of the DCM. Use Table 9, page 147-148, HDS No. 5 for formulas 26 & 27.

## STAGE/STORAGE/DISCHARGE CURVES FOR DETENTION POND ANALYSIS

### Meridian Ranch Proposed Detention Pond E-TEMP CMP RISER (TOTAL FLOWS)

Geek Basin - El Paso County, Colorado

Data for spillway and embankment:

*INTERIM - FILINGS 11A & 11B*

embankment length =	1860
embankment elev =	6976
spillway length =	200
spillway elevation =	6974.5
100 year storage elev.=	6971.2
100 year storage vol.=	17.5
100 year discharge=	141
5 year storage elev.=	6969.7
5 year storage vol.=	6.5
5 year discharge=	19
WQCV storage elev.=	6968.4
WQCV storage vol.=	1.6
1/2 WQCV storage elev.=	6968.1
1/2 WQCV storage vol.=	0.8

STAGE		STORAGE				TOTAL DISCHARGE											
ELEV	HEIGHT	AREA		VOLUME		TOP OF BANK	SPILLWAY	ORIFICE (max outflow)				GRATE (max outflow)		PIPE		REALIZED CULVERT OUTFLOW	TOTAL FLOW
		sqft	acre	acft	cum acft			1	2	3	4	Circular		1	2		
6967	0	3110	0.07	0.0	0.0	-	-	-	-	-	-	-	-	0.9	-	-	-
6968	1	49719	1.14	0.6	0.6	-	-	0.2	-	-	-	-	-	17.7	-	0.2	0.2
6969	2	148073	3.40	2.3	2.9	-	-	0.4	-	7.6	-	-	-	51.6	-	7.9	7.9
6970	3	282553	6.49	4.9	7.8	-	-	0.5	11.7	10.7	-	-	-	97.2	-	23	23
6970.5	3.5	345630	7.93	3.6	11.4	-	-	0.5	35.6	12.0	-	-	-	121.6	-	48	48
6971	4	408706	9.38	7.9	15.8	-	-	0.6	67.3	13.1	-	-	11.4	145.4	-	92	92
6971.25	4.25	428868	9.85	2.4	18.2	-	-	0.6	85.4	13.6	-	-	167.3	157.4	-	157	157
6971.5	4.5	449030	10.31	4.9	20.7	-	-	0.6	96.9	14.1	-	-	415.2	168.2	-	168	168
6971.75	4.75	469192	10.77	2.6	23.3	-	-	0.6	106.1	14.6	-	-	728.3	178.2	-	178	178
6972	5	489354	11.23	5.4	26.1	-	-	0.6	114.6	15.1	-	-	1,095.2	187.2	-	187	187
6972.25	5.25	496911	11.41	2.8	28.9	-	-	0.7	122.6	15.6	-	-	1,508.7	195.4	-	195	195
6972.5	5.5	504468	11.58	5.7	31.8	-	-	0.7	130.0	16.0	-	-	1,964.2	203.4	-	203	203
6973	6	519582	11.93	11.6	37.6	-	-	0.7	143.7	16.9	-	-	2,987.6	218.8	-	219	219
6974	7	532469	12.22	12.1	49.7	-	-	0.8	167.8	18.5	-	-	5,421.8	247.3	-	247	247
6976	9	557640	12.80	25.0	74.7	-	1,102	0.9	207.8	21.4	-	-	11,551.3	297.1	-	297	1,399

- Notes:
- 1) Top-of-bank and spillway flows are weir equations from section 11.3.1 in the DCM.  $Q=CLH^{1.5}$  (C=3.0)
  - 2) Orifice flows are also from section 11.3.1.  $Q=CA(2gH)^{0.5}$  (C=6)
  - 3) Grate flows are determined from equations 7-2 and 7-3. Weir Flow  $Q=(3PH^{1.5})/F$ , Orifice Flow  $Q=4.815*AH^{0.5}$
  - 4) Pipe flows use the lesser of: 1) Inlet control equations 27 & 28, page 146 of HDS No. 5 - or - 2) Allowable Pipe Flow equation on page 11-9 of the DCM. Use Table 9, page 147-148, HDS No. 5 for formulas 26 & 27.

## STAGE/STORAGE/DISCHARGE CURVES FOR DETENTION POND ANALYSIS

### Meridian Ranch Proposed Detention Pond E-TEMP CMP RISER (H08)

Gieck Basin - El Paso County, Colorado

Data for spillway and embankment:

embankment length =	1860
embankment elev =	6975
spillway length =	200
spillway elevation =	6974
100 year storage elev.=	6971.2
100 year storage vol.=	17.5
100 year discharge=	73
5 year storage elev.=	6969.7
5 year storage vol.=	6.5
5 year discharge=	12
WQCV storage elev.=	6968.4
WQCV storage vol.=	1.6
1/2 WQCV storage elev.=	6968.1
1/2 WQCV storage vol.=	0.8

Data for outlet pipe and grate:

Type	Orifice	H or V	Dimensions		Dia.(in)	Area =	(sqft)	Elev to cl =	
			Width (ft.)	X Height (ft.)					
Rectangular	Orifice 1:	V	0.0310	1.00		0.031		6967.50	
Rectangular	Orifice 2:	V	8	1.5		12.000		6970.20	
Circular	Orifice 3:	H			12	0.785		6968.00	
None Selected	Orifice 4:	V				0.000		6967.50	

Stand Pipe Dimensions	
Rec Grate	Elev = 6970.95
Circ. Grate	Elev = 6970.95

Outlet Culvert Dimensions

Outlet Culvert	Width (ft.)	Height (ft.)	Dia. (ft.)	Type
Area	9.6	TOP	3.5	Circular
Outlet I. E.	6966.8	6970.67		
Wall Thick.	5	in.		

STAGE		STORAGE				DISCHARGE								REALIZED CULVERT OUTFLOW		TOTAL FLOW
ELEV	HEIGHT	AREA		VOLUME		TOP OF BANK	SPILLWAY	ORIFICE (max outflow)				GRATE (max outflow)	PIPE		REALIZED CULVERT OUTFLOW	TOTAL FLOW
		sqft	acre	acft	cum acft			1	2	3	4		Circular	1		
6967	0	3110	0.07	0.0	0.0			-	-	-	-	-	0		-	-
6968	1	49719	1.14	0.6	0.6			0.1	-	-	-	-	9		0.1	0.093
6969	2	148073	3.40	2.3	2.9			0.2	-	3.8	-	-	26		4.0	3.964
6970	3	282553	6.49	4.9	7.8			0.2	9.8	5.3	-	-	49		15	15.373
6970.5	3.5	345629.5	7.93	3.6	11.4			0.3	25.8	6.0	-	-	61		32	32.060
6971	4	408706	9.38	7.9	15.8			0.3	46.3	6.6	-	6	73		59	58.833
6971.25	4.25	428868	9.85	2.4	18.2			0.3	58.0	6.8	-	84	78		78	78.450
6971.5	4.5	449030	10.31	4.9	20.7			0.3	65.9	7.1	-	208	83		83	83
6971.75	4.75	469192	10.77	2.6	23.3			0.3	71.9	7.3	-	364	88		88	88
6972	5	489354	11.23	5.4	26.1			0.3	77.5	7.6	-	548	92		92	92
6972.25	5.25	496911	11.41	2.8	28.9			0.3	82.7	7.8	-	754	97		97	97
6972.5	5.5	504468	11.58	5.7	31.8			0.3	87.6	8.0	-	982	101		101	101
6973	6	519582	11.93	11.6	37.6			0.4	96.7	8.5	-	1,494	108		108	108
6974	7	532469	12.22	12.1	49.7			0.4	112.6	9.3	-	2,711	122		122	122
6976	9	557640	12.80	25.0	74.7			0.4	139.2	10.7	-	5,776	146		146	146

- Notes:
- 1) Top-of-bank and spillway flows are weir equations from section 11.3.1 in the DCM.  $Q=CLH^{1.5}$  (C=3.0)
  - 2) Orifice flows are also from section 11.3.1.  $Q=CA(2gH)^{0.5}$  (C=6)
  - 3) Grate flows are determined from equations 7-2 and 7-3. Weir Flow  $Q=(3P1^{1.5})/F$ , Orifice Flow  $Q=4.815*AH^{0.5}$
  - 4) Pipe flows use the lesser of: 1) Inlet control equations 27 & 28, page 146 of HDS No. 5 - or - 2) Allowable Pipe Flow equation on page 11-9 of the DCM. Use Table 9, page 147-148, HDS No. 5 for formulas 26 & 27.



## STAGE/STORAGE/DISCHARGE CURVES FOR DETENTION POND ANALYSIS

### Meridian Ranch Proposed Detention Pond E-TEMP CMP RISER (H09)

Gieck Basin - El Paso County, Colorado

Data for spillway and embankment:

embankment length =	1860
embankment elev =	6976
spillway length =	200
spillway elevation =	6974.5
100 year storage elev. =	6971.2
100 year storage vol. =	17.5
100 year discharge =	67
5 year storage elev. =	6969.7
5 year storage vol. =	6.5
5 year discharge =	6.6
WQCV storage elev. =	6968.4
WQCV storage vol. =	1.6
1/2 WQCV storage elev. =	6968.1
1/2 WQCV storage vol. =	0.8

Data for outlet pipe and grate:

Type	Orifice	H or V	Dimensions		Dia. (in)	Area =	Elev to cl =	
			Width (ft.)	X Height (ft.)				
Rectangular	Orifice 1:	V	0.0310	1.00		0.031	6967.50	
Rectangular	Orifice 2:	V	5	1.2		6.000	6970.35	
Circular	Orifice 3:	H			12	0.785	6968.00	
None Selected	Orifice 4:	V				0.000	6967.33	

Stand Pipe Dimensions	
Rec Grate	Elev = 6970.95
Circ. Grate	54 dia. Elev = 6970.95

Outlet Culvert Dimensions

Outlet Culvert	Width (ft.)	Height (ft.)	Dia. (ft.)	Type
	9.6	TOP	3.5	Circular
Area	6966.8	6970.67		
Outlet I. E.	5	in.		
Wall Thick.				

STAGE		STORAGE				DISCHARGE										
ELEV	HEIGHT	AREA		VOLUME		TOP OF BANK	SPILLWAY	ORIFICE (max outflow)				GRATE (max outflow)	PIPE		REALIZED CULVERT OUTFLOW	TOTAL FLOW
		sqft	acre	acft	cum acft			1	2	3	4		Circular	1		
6967	0	3110	0.07	0.0	0.0			-	-	-	-	-	0.5		-	-
6968	1	49719	1.14	0.6	0.6			0.1	-	-	-	-	8.8		0.1	0.1
6969	2	148073	3.40	2.3	2.9			0.2	-	3.8	-	-	26		4.0	4.0
6970	3	282553	6.49	4.9	7.8			0.2	1.9	5.3	-	-	49		7.5	7.5
6970.5	3.5	345629.5	7.93	3.6	11.4			0.3	9.7	6.0	-	-	61		16.0	16
6971	4	408706	9.38	7.9	15.8			0.3	21.0	6.6	-	6	73		33.5	33
6971.25	4.25	428868	9.85	2.4	18.2			0.3	27.4	6.8	-	84	79		78.9	79
6971.5	4.5	449030	10.31	4.9	20.7			0.3	31.0	7.1	-	208	85		84.7	85
6971.75	4.75	469192	10.77	2.6	23.3			0.3	34.2	7.3	-	364	90		90.1	90
6972	5	489354	11.23	5.4	26.1			0.3	37.1	7.6	-	548	95		94.8	95
6972.25	5.25	496911	11.41	2.8	28.9			0.3	39.8	7.8	-	754	99		98.7	99
6972.5	5.5	504468	11.58	5.7	31.8			0.3	42.4	8.0	-	982	103		102.7	103
6973	6	519582	11.93	11.6	37.6			0.4	47.0	8.5	-	1,494	111		110.5	111
6974	7	532469	12.22	12.1	49.7			0.4	55.2	9.3	-	2,711	125		125.3	125
6976	9	557640	12.80	25.0	74.7			0.4	68.7	10.7	-	5,776	151		151.4	151

- Notes:
- 1) Top-of-bank and spillway flows are weir equations from section 11.3.1 in the DCM.  $Q = CLH^{1.5}$  (C=3.0)
  - 2) Orifice flows are also from section 11.3.1.  $Q = CA(2gH)^{0.5}$  (C=.6)
  - 3) Grate flows are determined from equations 7-2 and 7-3. Weir Flow  $Q = (3PH^{1.5})/F$ , Orifice Flow  $Q = 4.815 \cdot AH^{0.5}$
  - 4) Pipe flows use the lesser of: 1) Inlet control equations 27 & 28, page 146 of HDS No 5 - or - 2) Allowable Pipe Flow equation on page 11-9 of the DCM. Use Table 9, page 147-148, HDS No 5 for formulas 26 & 27.

## **Appendix I – Soil Resource Report**



United States  
Department of  
Agriculture

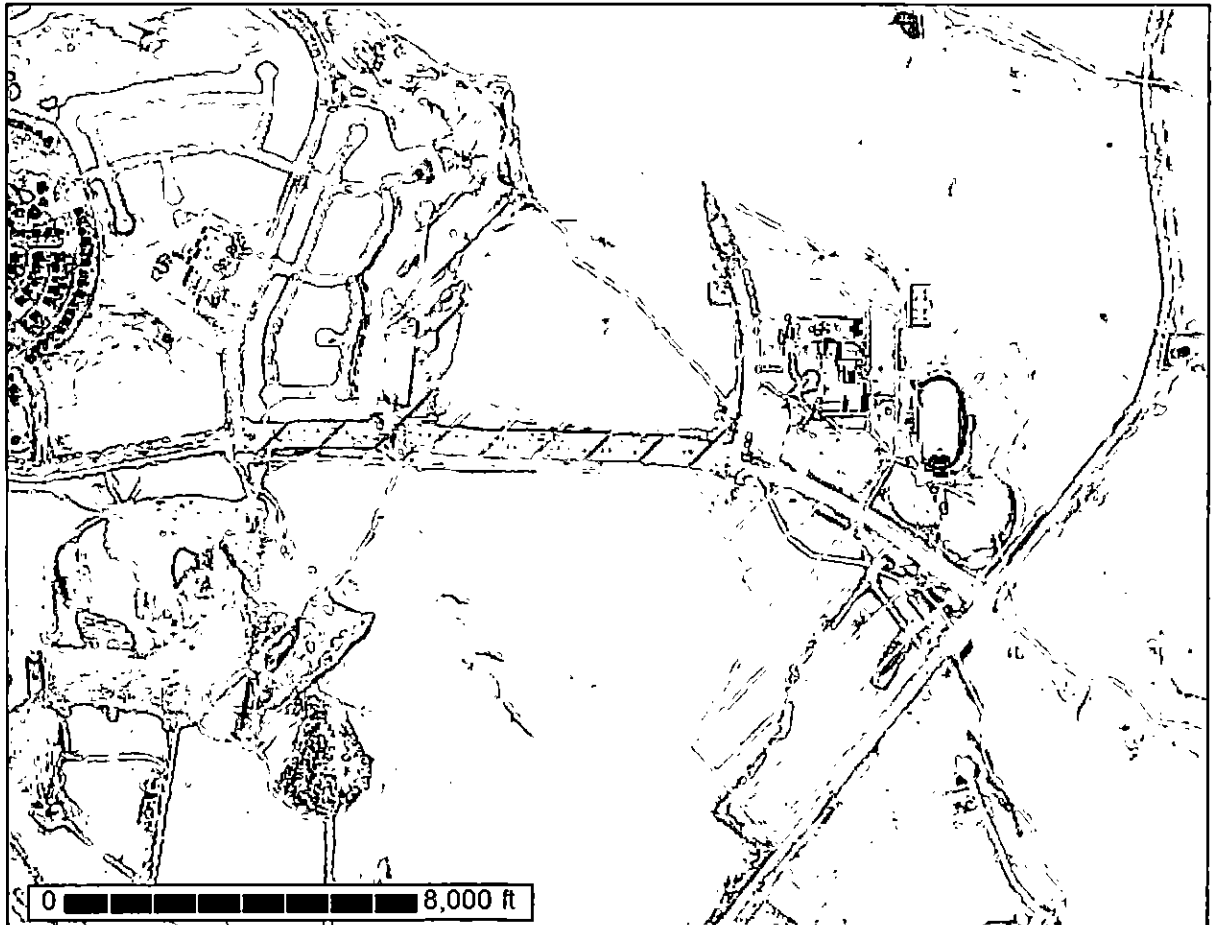


NRCS

Natural  
Resources  
Conservation  
Service

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

# Custom Soil Resource Report for El Paso County Area, Colorado



# Preface

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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://soils.usda.gov/sqi/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<http://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist ([http://soils.usda.gov/contact/state\\_offices/](http://soils.usda.gov/contact/state_offices/)).

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 Soil Data Mart Web site or the NRCS Web Soil Survey. The Soil Data Mart is the data storage site for the official soil survey information.

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# 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

## Custom Soil Resource Report

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.

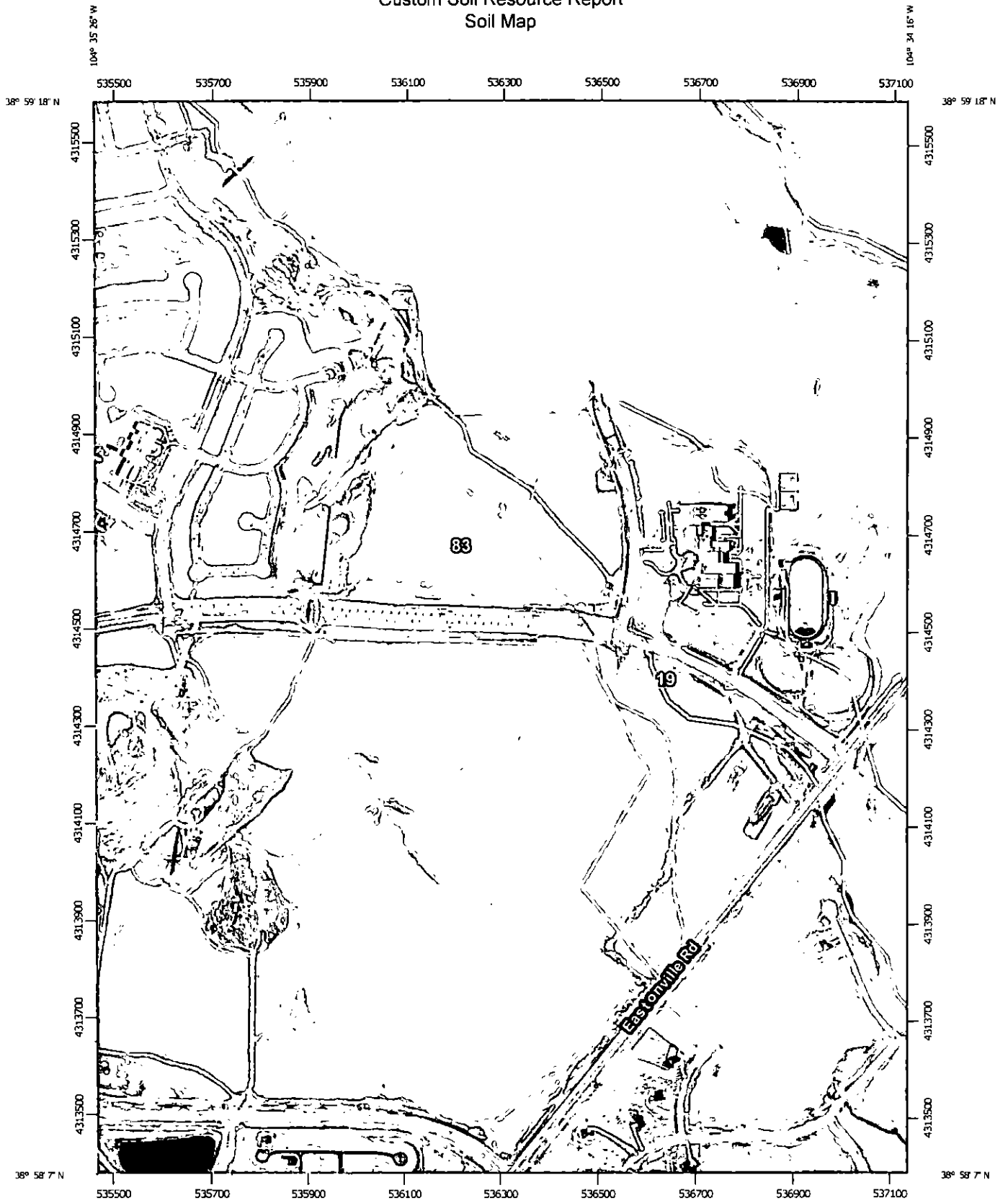


# Soil Map

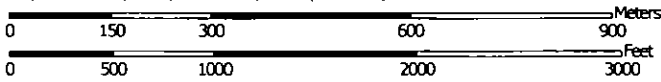
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The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce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

# Custom Soil Resource Report Soil Map







































Map Scale: 1:10,800 if printed on A portrait (8.5" x 11") sheet.



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

# Custom Soil Resource Report

## MAP LEGEND

<b>Area of Interest (AOI)</b>		 Spoil Area
 Area of Interest (AOI)		 Stony Spot
<b>Soils</b>		 Very Stony Spot
 Soil Map Unit Polygons		 Wet Spot
 Soil Map Unit Lines		 Other
 Soil Map Unit Points		 Special Line Features
<b>Special Point Features</b>		<b>Water Features</b>
 Blowout		 Streams and Canals
 Borrow Pit		<b>Transportation</b>
 Clay Spot		 Rails
 Closed Depression		 Interstate Highways
 Gravel Pit		 US Routes
 Gravelly Spot		 Major Roads
 Landfill		 Local Roads
 Lava Flow		<b>Background</b>
 Marsh or swamp		 Aerial Photography
 Mine or Quarry		
 Miscellaneous Water		
 Perennial Water		
 Rock Outcrop		
 Saline Spot		
 Sandy Spot		
 Severely Eroded Spot		
 Sinkhole		
 Slide or Slip		
 Sodic Spot		

## 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: <http://websoilsurvey.nrcs.usda.gov>  
 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 9, Sep 17, 2012

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

Date(s) aerial images were photographed: Apr 15, 2011—Sep 22, 2011

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

El Paso County Area, Colorado (CO625)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	53.7	34.7%
83	Stapleton sandy loam, 3 to 8 percent slopes	100.9	65.3%
<b>Totals for Area of Interest</b>		<b>154.5</b>	<b>100.0%</b>

## 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

## Custom Soil Resource Report

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

### 19—Columbine gravelly sandy loam, 0 to 3 percent slopes

#### Map Unit Setting

*Elevation:* 6,500 to 7,300 feet  
*Mean annual precipitation:* 14 to 16 inches  
*Mean annual air temperature:* 46 to 50 degrees F  
*Frost-free period:* 125 to 145 days

#### Map Unit Composition

*Columbine and similar soils:* 85 percent

#### Description of Columbine

##### Setting

*Landform:* Fan terraces, fans, flood plains  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Alluvium

##### Properties and qualities

*Slope:* 0 to 3 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Well drained  
*Capacity of the most limiting layer to transmit water (Ksat):* High to very high (5.95 to 19.98 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water capacity:* Very low (about 2.5 inches)

##### Interpretive groups

*Farmland classification:* Not prime farmland  
*Land capability classification (irrigated):* 4e  
*Land capability (nonirrigated):* 6e  
*Hydrologic Soil Group:* A  
*Ecological site:* Gravelly Foothill (R049BY214CO)

##### Typical profile

*0 to 14 inches:* Gravelly sandy loam  
*14 to 60 inches:* Very gravelly loamy sand

#### Minor Components

##### Fluvaquentic haplaquolls

*Percent of map unit:*  
*Landform:* Swales

##### Other soils

*Percent of map unit:*

##### Pleasant

*Percent of map unit:*  
*Landform:* Depressions

## 83—Stapleton sandy loam, 3 to 8 percent slopes

### Map Unit Setting

*Elevation:* 6,500 to 7,300 feet  
*Mean annual precipitation:* 14 to 16 inches  
*Mean annual air temperature:* 46 to 48 degrees F  
*Frost-free period:* 125 to 145 days

### Map Unit Composition

*Stapleton and similar soils:* 80 percent

### Description of Stapleton

#### Setting

*Landform:* Hills  
*Landform position (three-dimensional):* Side slope  
*Down-slope shape:* Linear  
*Across-slope shape:* Linear  
*Parent material:* Sandy alluvium derived from arkose

#### Properties and qualities

*Slope:* 3 to 8 percent  
*Depth to restrictive feature:* More than 80 inches  
*Drainage class:* Well drained  
*Capacity of the most limiting layer to transmit water (Ksat):* High (2.00 to 6.00 in/hr)  
*Depth to water table:* More than 80 inches  
*Frequency of flooding:* None  
*Frequency of ponding:* None  
*Available water capacity:* Low (about 4.7 inches)

#### Interpretive groups

*Farmland classification:* Not prime farmland  
*Land capability (nonirrigated):* 3e  
*Hydrologic Soil Group:* B  
*Ecological site:* Gravelly Foothill (R049BY214CO)

#### Typical profile

*0 to 11 inches:* Sandy loam  
*11 to 17 inches:* Gravelly sandy loam  
*17 to 60 inches:* Gravelly loamy sand

### Minor Components

#### Fluvaquentic haplaquolls

*Percent of map unit:*  
*Landform:* Swales

#### Other soils

*Percent of map unit:*

## Custom Soil Resource Report

### **Pleasant**

*Percent of map unit:*

*Landform:* Depressions



# References

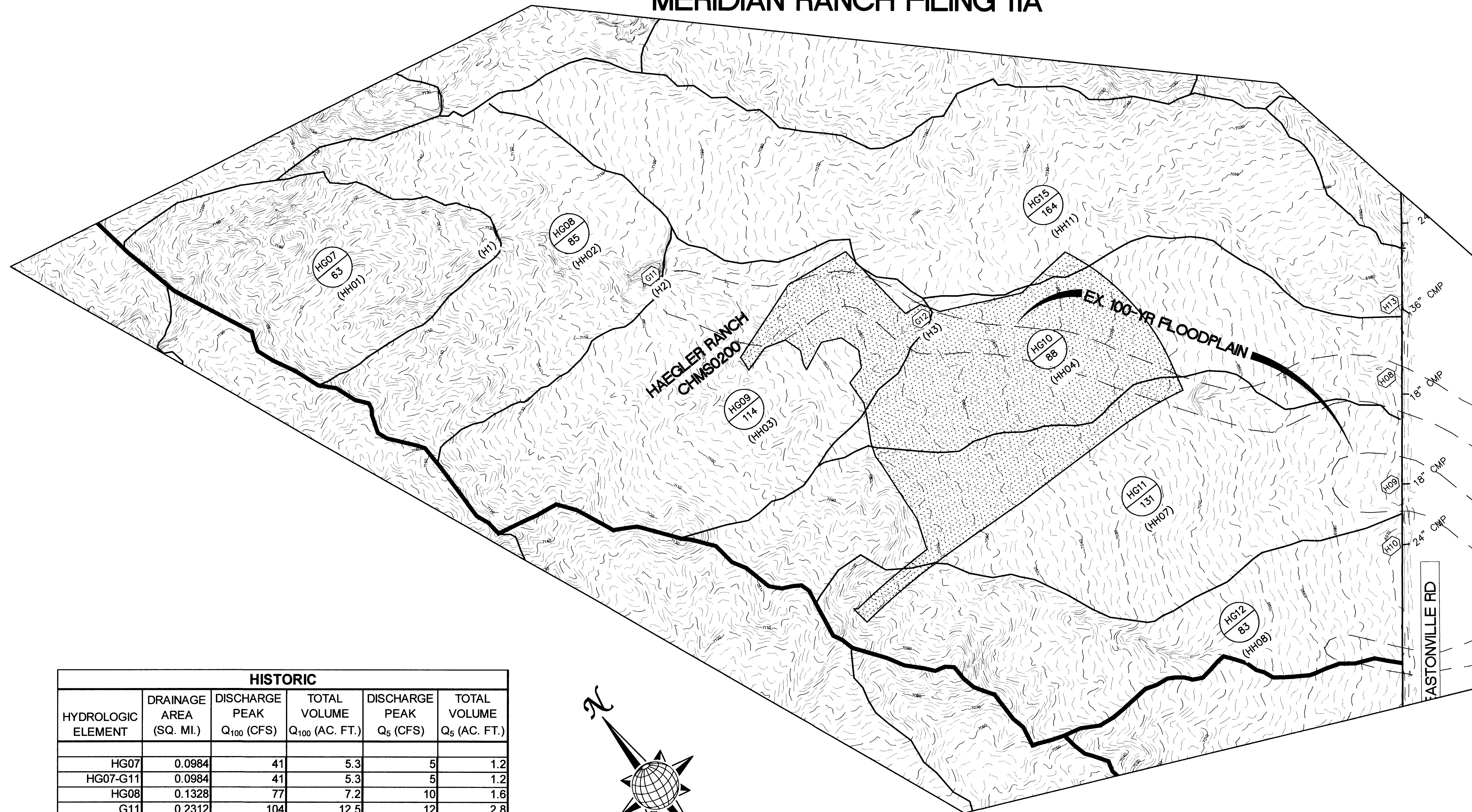
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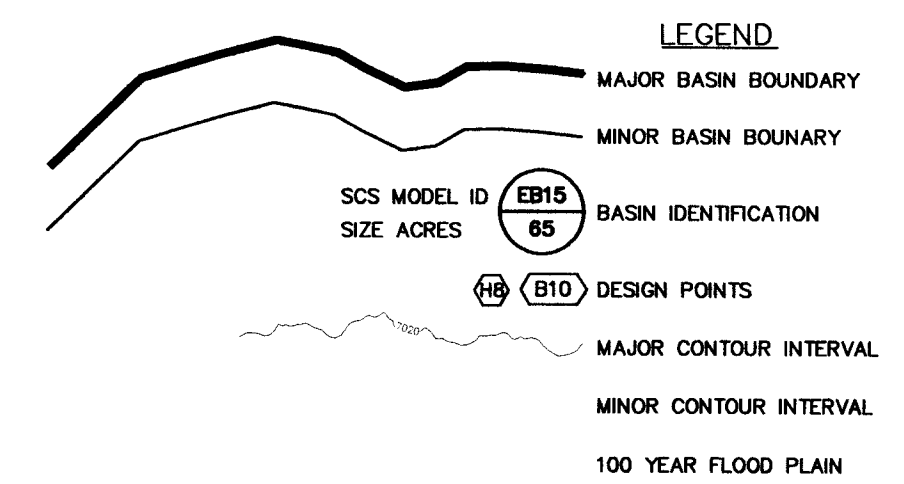
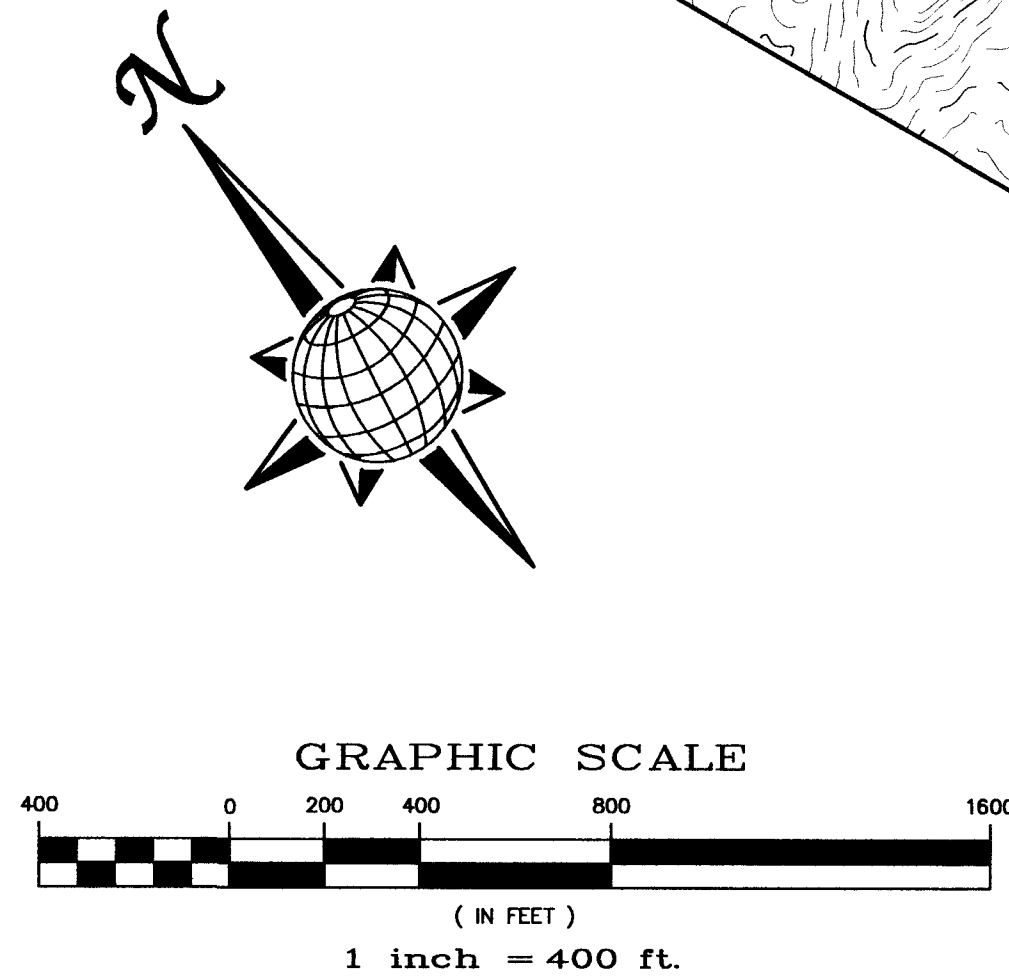
## Custom Soil Resource Report

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# SCS DRAINAGE MAP MERIDIAN RANCH FILING 11A



HISTORIC					
HYDROLOGIC ELEMENT	DRAINAGE AREA (SQ. MI.)	DISCHARGE PEAK Q <sub>100</sub> (CFS)	TOTAL VOLUME Q <sub>100</sub> (AC. FT.)	DISCHARGE PEAK Q <sub>5</sub> (CFS)	TOTAL VOLUME Q <sub>5</sub> (AC. FT.)
HG07	0.0984	41	5.3	5	1.2
HG07-G11	0.0984	41	5.3	5	1.2
HG08	0.1328	77	7.2	10	1.6
G11	0.2312	104	12.5	12	2.8
G11-G12	0.2312	104	12.4	11	2.7
HG09	0.1781	82	9.7	10	2.1
G12	0.4093	185	22.1	20	4.9
G12-H08	0.4093	183	21.8	20	4.8
HG10	0.1375	49	7.4	6	1.6
H08	0.5468	232	29.2	22	6.4
HG11	0.2047	87	11.1	11	2.4
H09	0.2047	87	11.1	11	2.4
HG15	0.2563	80	13.9	11	3.0
H13	0.2563	80	13.9	11	3.0



## FINAL DRAINAGE REPORT HISTORIC CONDITIONS

TECH CONSTRUCTION CORP.  
10305 ANGELES ROAD  
PEYTON, CO 80831  
TELEPHONE: 719.495.7444  
FAX: 719.495.7608

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FIGURE 4

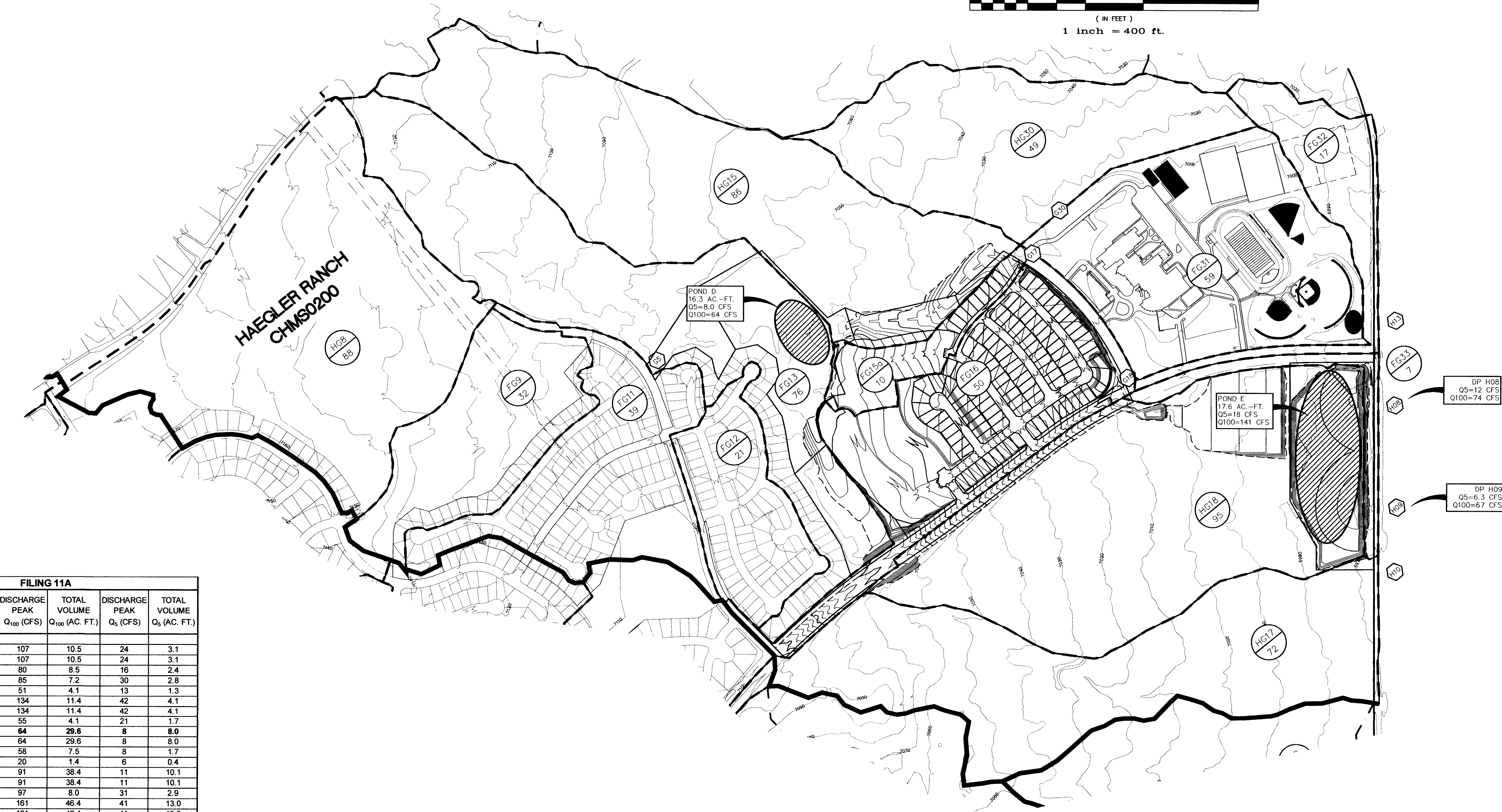
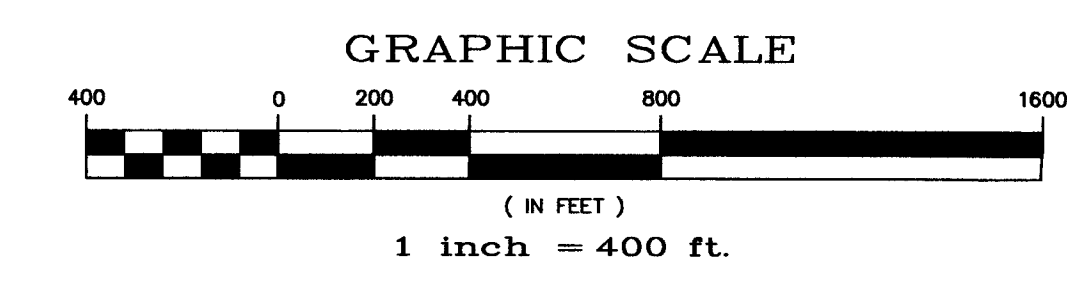
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# SCS DRAINAGE MAP MERIDIAN RANCH FILING #11A



**LEGEND**

- MAJOR BASIN BOUNDARY
- - - MINOR BASIN BOUNDARY
- SCS MODEL ID **EB15** BASIN IDENTIFICATION
- SIZE ACRES **65**
- ⬡ B10 DESIGN POINTS
- MAJOR CONTOUR INTERVAL
- MINOR CONTOUR INTERVAL
- 100 YEAR FLOOD PLAIN



FILING 11A					
HYDROLOGIC ELEMENT	DRAINAGE AREA (SQ. MI.)	DISCHARGE PEAK Q <sub>100</sub> (CFS)	TOTAL VOLUME Q <sub>100</sub> (AC. FT.)	DISCHARGE PEAK Q <sub>5</sub> (CFS)	TOTAL VOLUME Q <sub>5</sub> (AC. FT.)
HG08	0.1375	107	10.5	24	3.1
FG08-POND D	0.1375	107	10.5	24	3.1
FG13	0.1188	80	8.5	16	2.4
FG11	0.0608	85	7.2	30	2.8
FG09	0.0500	51	4.1	13	1.3
G05	0.1108	134	11.4	42	4.1
G05-POND D	0.1108	134	11.4	42	4.1
FG12	0.0328	55	4.1	21	1.7
POND D	0.3999	64	29.6	8	8.0
POND D-G17	0.3999	64	29.6	8	8.0
HG15	0.1344	58	7.5	8	1.7
FG15a	0.0156	20	1.4	6	0.4
G17	0.5499	91	38.4	11	10.1
G17-G18	0.5499	91	38.4	11	10.1
FG16	0.0773	97	8.0	31	2.9
G18	0.6272	161	46.4	41	13.0
G18-POND E	0.6272	161	46.4	41	13.0
FG31	0.0922	123	11.6	45	4.7
HG30	0.0766	49	4.2	6	0.9
HG30-POND HS	0.0766	49	4.2	6	0.9
POND HS	0.1688	126	15.8	27	5.6
HG18	0.1484	67	8.7	10	2.1
POND E	0.9444	141	65.2	18	18.4
FG33	0.0109	13	1.0	4	0.3
H08	0.9553	74	66.2	12	18.7
H09		67		6.3	

\* FROM OUTLET STAGE STORAGE CALCULATION

## FINAL DRAINAGE REPORT DEVELOPED CONDITIONS FILING 11A

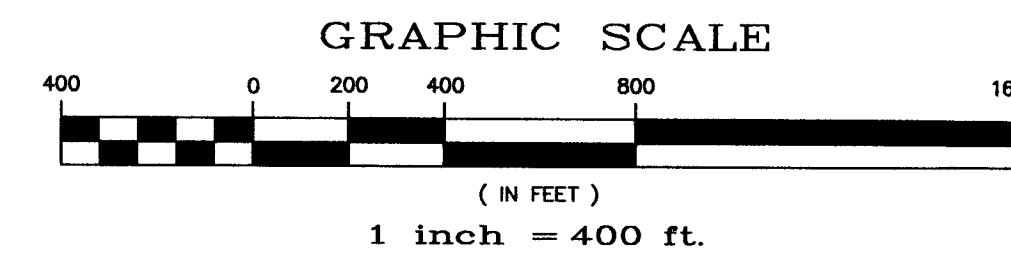
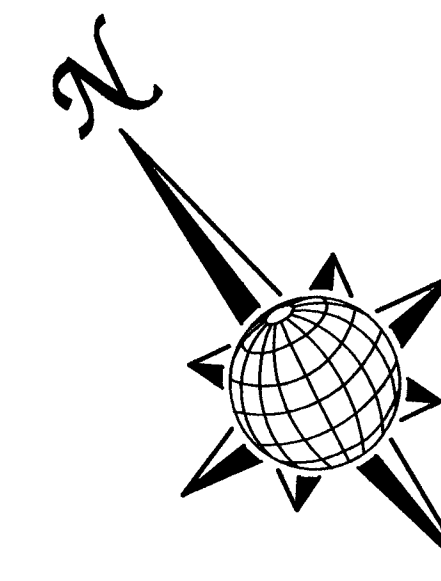
TECH CONSTRUCTION CORP.  
12311 REX ROAD  
PEYTON, CO 80831  
TELEPHONE: 719.495.7444  
FAX: 719.495.3349

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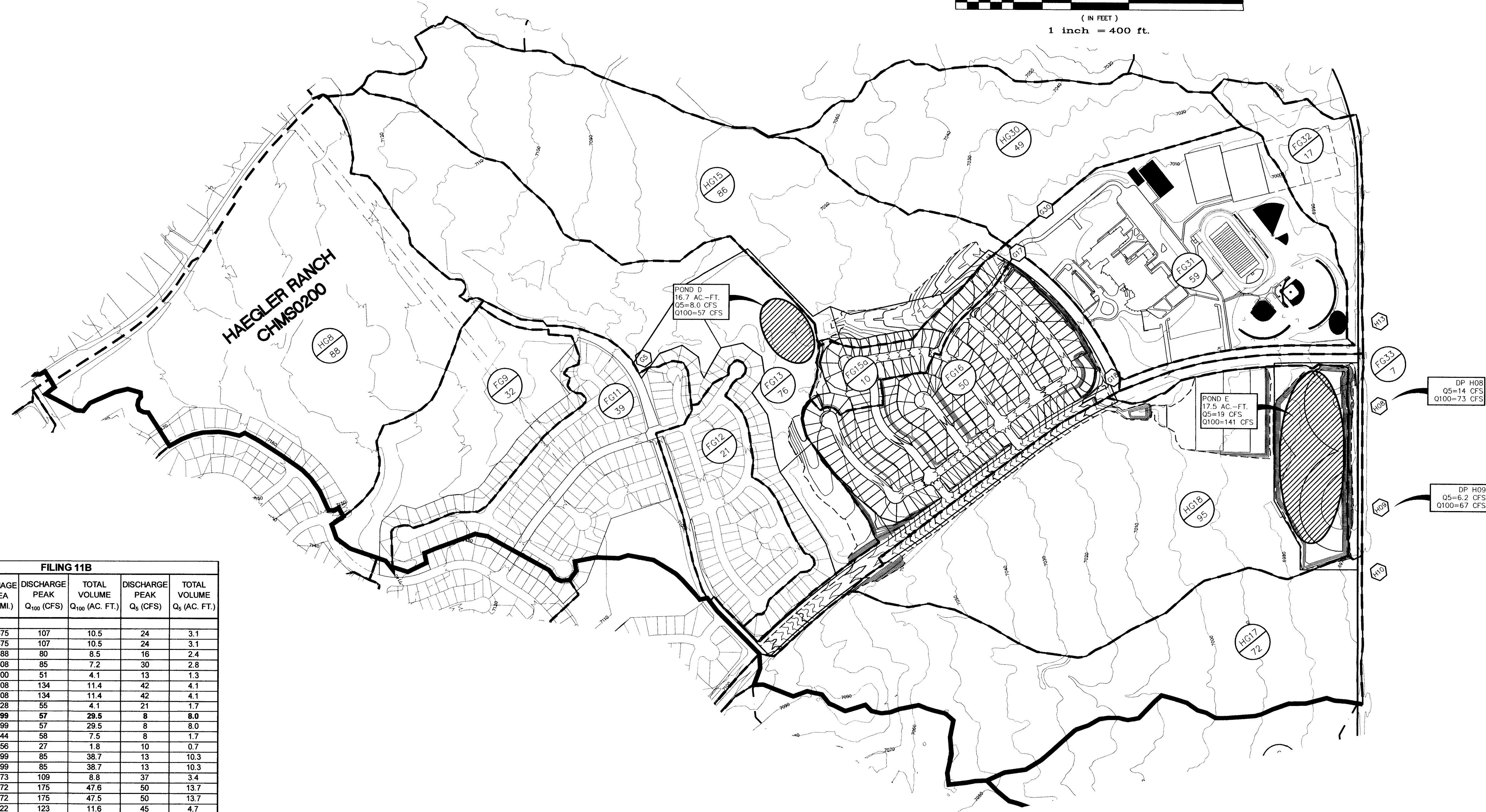
FIGURE 5

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# SCS DRAINAGE MAP MERIDIAN RANCH FILING #11B



- LEGEND**
- MAJOR BASIN BOUNDARY
  - MINOR BASIN BOUNDARY
  - SCS MODEL ID **EB15** BASIN IDENTIFICATION  
SIZE ACRES **65**
  - (H8) (B10) DESIGN POINTS
  - MAJOR CONTOUR INTERVAL
  - MINOR CONTOUR INTERVAL
  - 100 YEAR FLOOD PLAIN



FILING 11B					
HYDROLOGIC ELEMENT	DRAINAGE AREA (SQ. MI.)	DISCHARGE PEAK Q <sub>100</sub> (CFS)	TOTAL VOLUME Q <sub>100</sub> (AC. FT.)	DISCHARGE PEAK Q <sub>5</sub> (CFS)	TOTAL VOLUME Q <sub>5</sub> (AC. FT.)
HG08	0.1375	107	10.5	24	3.1
FG08-POND D	0.1375	107	10.5	24	3.1
FG13	0.1188	80	8.5	16	2.4
FG11	0.0608	85	7.2	30	2.8
FG09	0.0500	51	4.1	13	1.3
G05	0.1108	134	11.4	42	4.1
G05-POND D	0.1108	134	11.4	42	4.1
FG12	0.0328	55	4.1	21	1.7
<b>POND D</b>	<b>0.3999</b>	<b>57</b>	<b>29.5</b>	<b>8</b>	<b>8.0</b>
POND D-G17	0.3999	57	29.5	8	8.0
HG15	0.1344	58	7.5	8	1.7
FG15a	0.0156	27	1.8	10	0.7
G17	0.5499	85	38.7	13	10.3
G17-G18	0.5499	85	38.7	13	10.3
FG16	0.0773	109	8.8	37	3.4
G18	0.6272	175	47.6	50	13.7
G18-POND E	0.6272	175	47.5	50	13.7
FG31	0.0922	123	11.6	45	4.7
HG30	0.0766	49	4.2	6	0.9
HG30-POND HS	0.0766	48	4.1	6	0.9
<b>POND HS</b>	<b>0.1688</b>	<b>126</b>	<b>15.8</b>	<b>27</b>	<b>5.6</b>
HG18	0.1484	67	8.6	10	2.0
<b>POND E</b>	<b>0.9444</b>	<b>141</b>	<b>66.2</b>	<b>19</b>	<b>19.1</b>
FG33	0.0109	13	1.0	4	0.3
H08	0.9553	73	67.2	14	19.4
H09		67		6.2	

\* FROM OUTLET STAGE-STORAGE CALCULATION

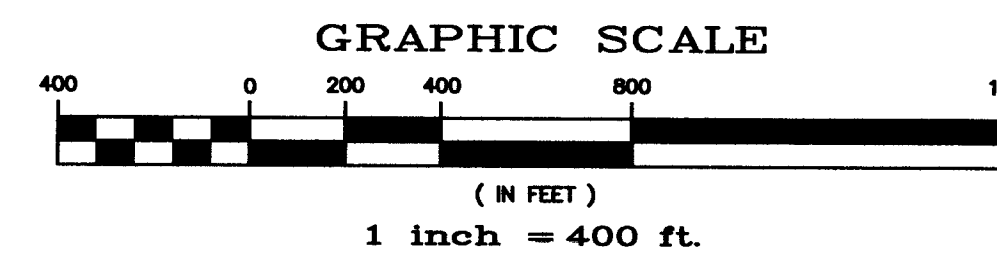
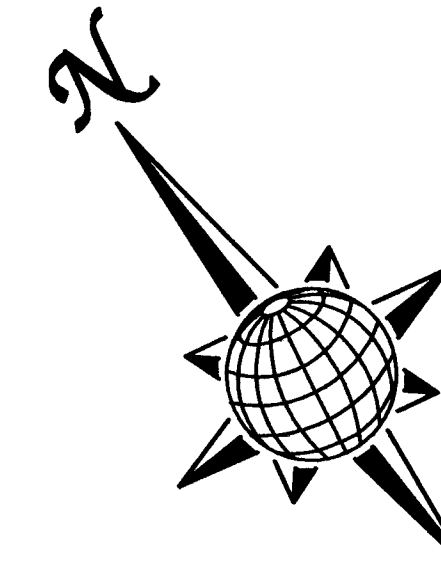
## FINAL DRAINAGE REPORT DEVELOPED CONDITIONS FILING 11B

TECH CONSTRUCTION CORP.  
12311 REX ROAD  
PEYTON, CO 80831  
TELEPHONE: 719.495.7444  
FAX: 719.495.3349

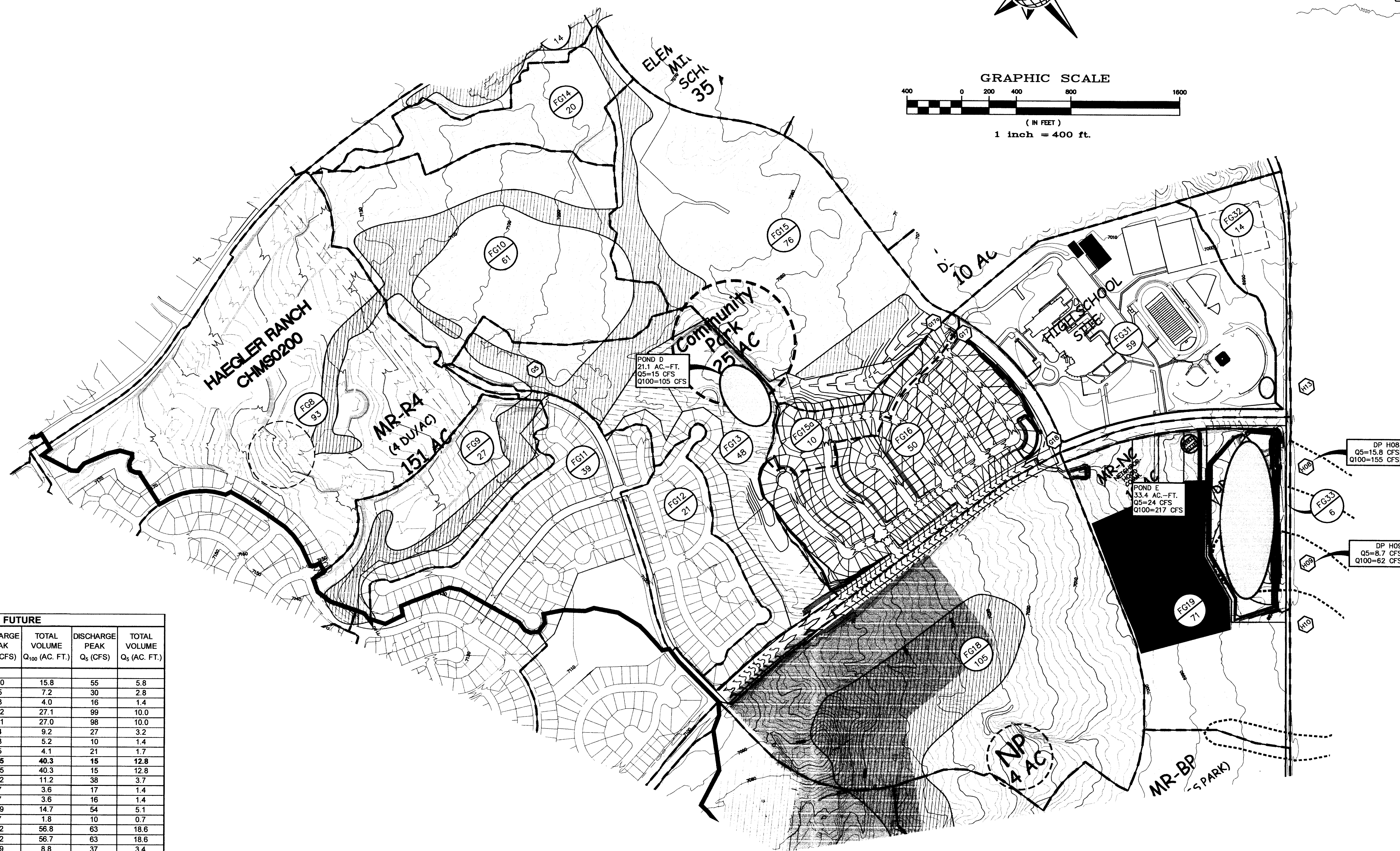
MAR 2014

FIGURE 6

# SCS DRAINAGE MAP MERIDIAN RANCH FILING 11A



- LEGEND**
- MAJOR BASIN BOUNDARY
  - MINOR BASIN BOUNDARY
  - SCS MODEL ID **EB15**  
SIZE ACRES **65** BASIN IDENTIFICATION
  - B10** DESIGN POINTS
  - MAJOR CONTOUR INTERVAL
  - MINOR CONTOUR INTERVAL
  - 100 YEAR FLOOD PLAIN



FUTURE					
HYDROLOGIC ELEMENT	DRAINAGE AREA (SQ. MI.)	DISCHARGE PEAK Q <sub>100</sub> (CFS)	TOTAL VOLUME Q <sub>100</sub> (AC. FT.)	DISCHARGE PEAK Q <sub>5</sub> (CFS)	TOTAL VOLUME Q <sub>5</sub> (AC. FT.)
FG08	0.1453	170	15.8	55	5.8
FG11	0.0608	85	7.2	30	2.8
FG09	0.0416	53	4.0	16	1.4
G05	0.2477	302	27.1	99	10.0
G05-POND D	0.2477	301	27.0	98	10.0
FG10	0.0953	94	9.2	27	3.2
FG13	0.075	53	5.2	10	1.4
FG12	0.0328	55	4.1	21	1.7
POND D	0.4508	105	40.3	15	12.8
POND D-G17	0.4508	105	40.3	15	12.8
FG15	0.1188	132	11.2	38	3.7
FG14	0.0313	47	3.6	17	1.4
FG14-G17	0.0313	47	3.6	16	1.4
G17a	0.1501	179	14.7	54	5.1
FG15a	0.0156	27	1.8	10	0.7
G17	0.6165	212	56.8	63	18.6
G17-G18	0.6165	212	56.7	63	18.6
FG16	0.0773	109	8.8	37	3.4
G18	0.6938	319	65.6	99	21.9
G18-POND E	0.6938	317	65.6	99	21.9
FG18	0.1641	198	16.9	62	6.0
FG18-POND E	0.1641	198	16.9	62	6.0
FG19	0.0977	203	13.2	83	5.6
FG31	0.0922	123	11.6	45	4.7
POND HS	0.0922	79	11.6	25	4.7
POND E	1.0478	217	92.1	24	27.7
FG33	0.0109	15	1.0	4	0.3
H08		155		15.8	
H09	1.0587	62	93.1	8.7	28

\* FROM OUTLET STAGE-STORAGE CALCULATION

## FINAL DRAINAGE REPORT FUTURE CONDITIONS

TECH CONSTRUCTION CORP.  
12311 REX ROAD  
PEYTON, CO 80831  
TELEPHONE: 719.495.7444  
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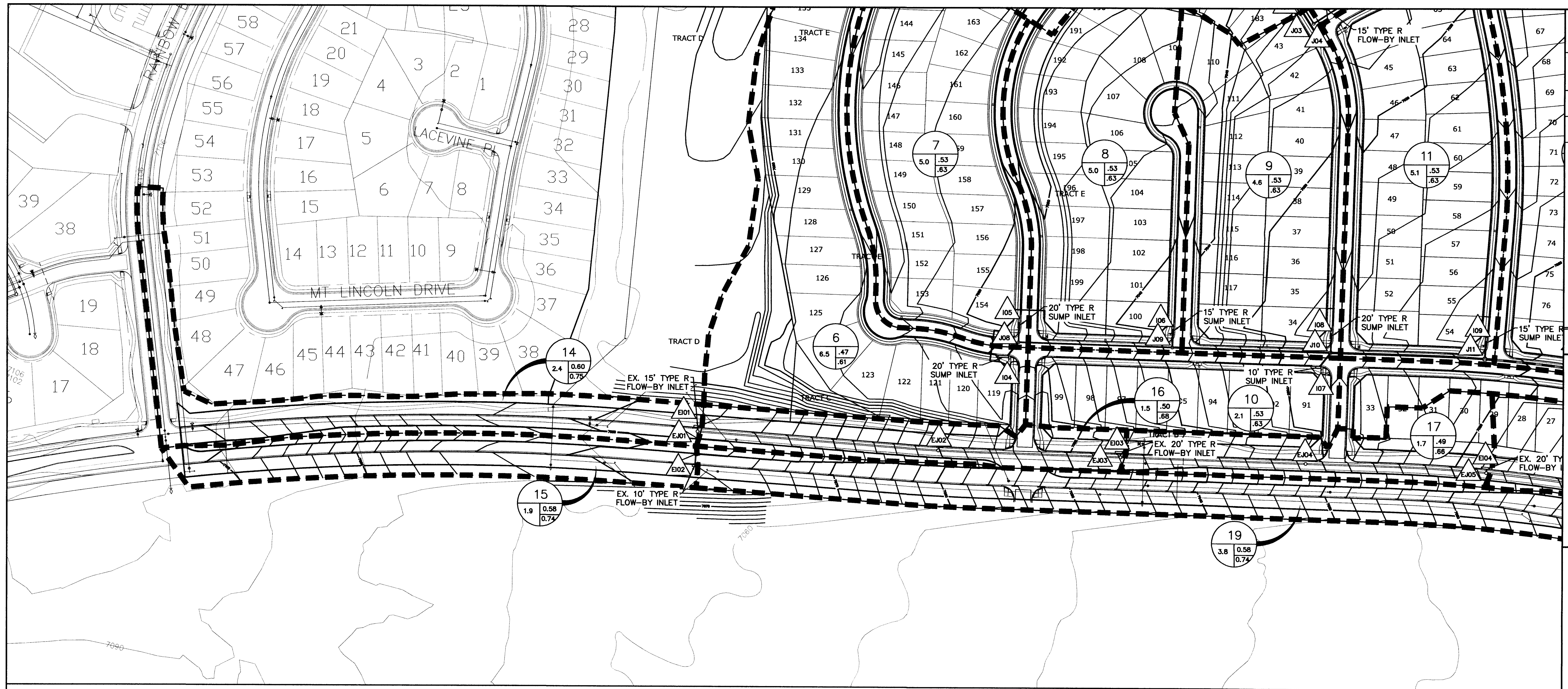
MAR 2014

FIGURE 7









No.	Revisions	Date	Appr.	Date

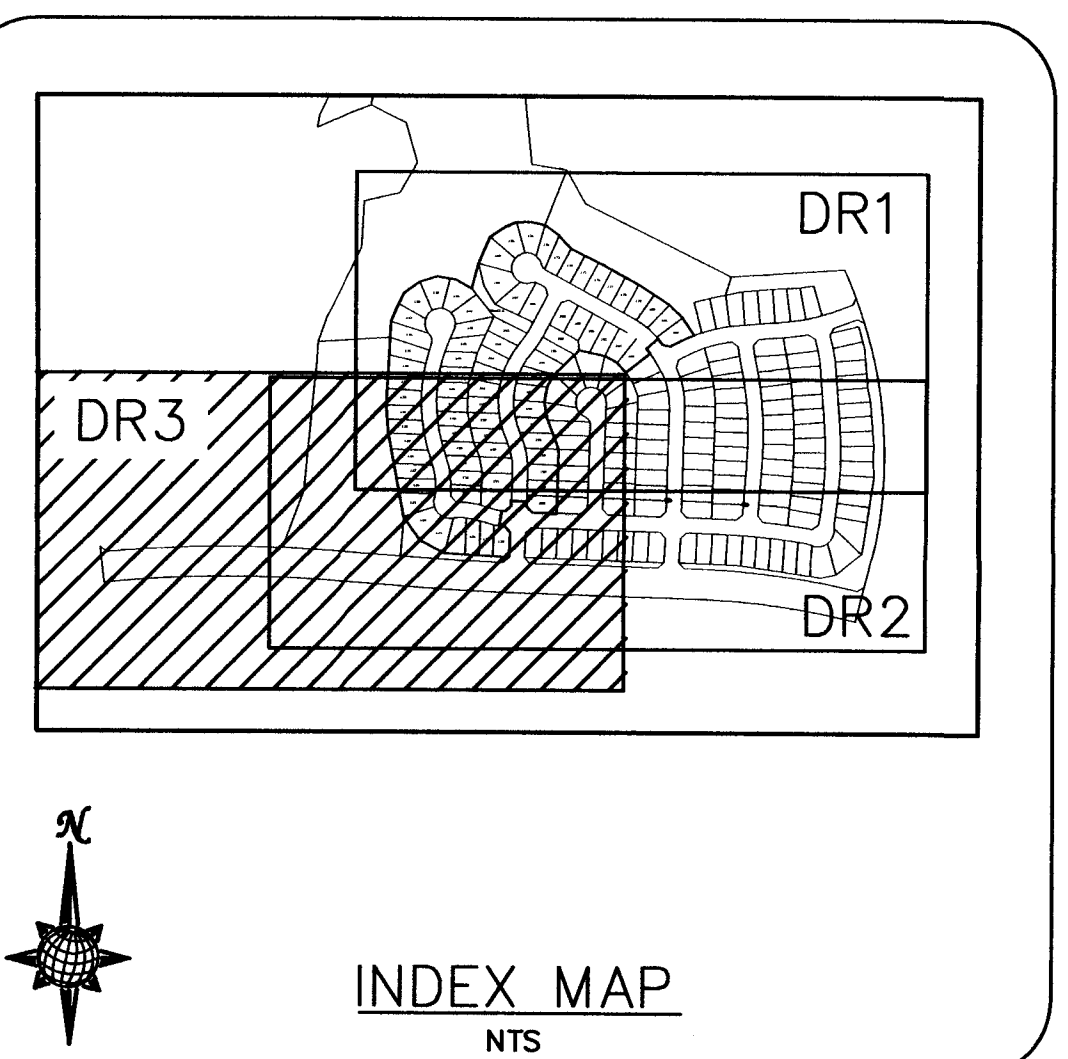
TECH CONSTRUCTION CORP.  
 10305 ANGELES ROAD  
 PEYTON, CO 80831  
 TELEPHONE: 719.495.7444  
 FAX: 719.495.7608

**MERIDIAN RANCH**

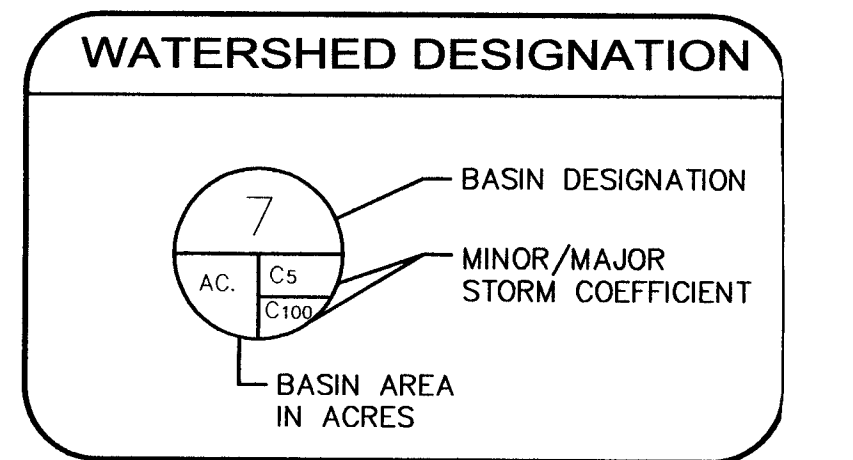
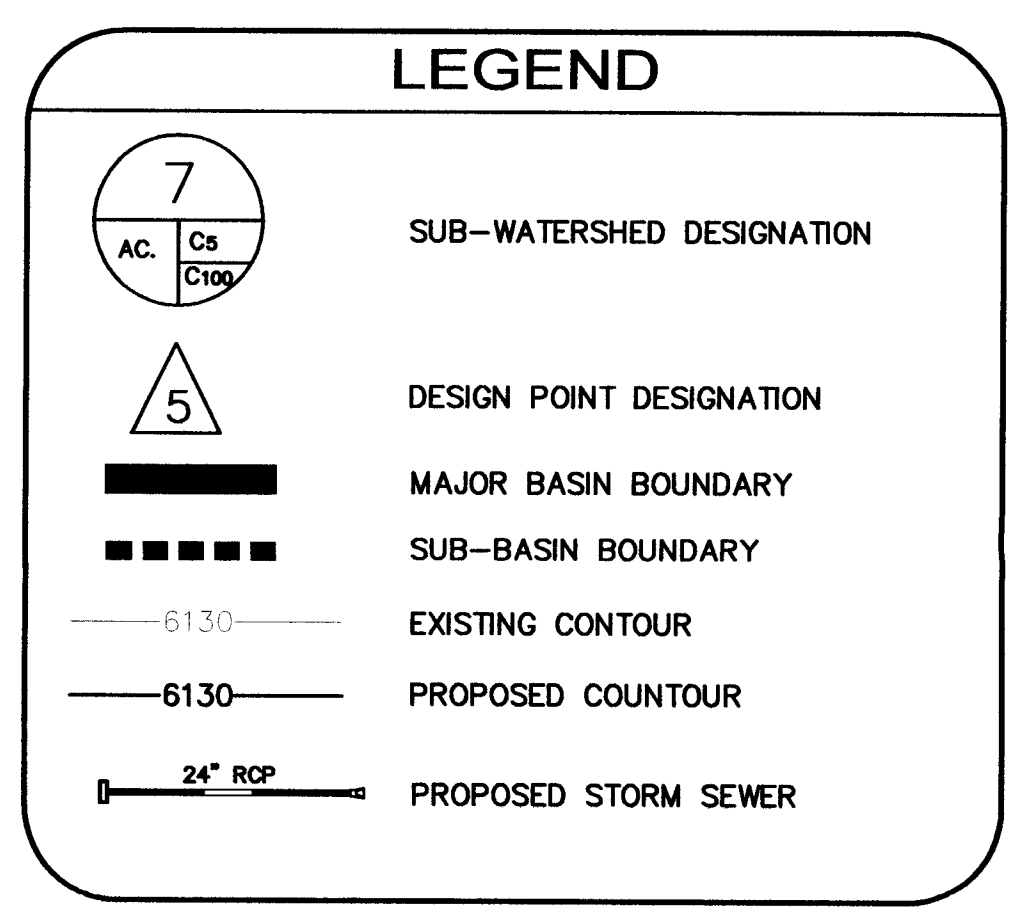
MERIDIAN RANCH ESTATES FLING 11  
 FINAL DRAINAGE PLAN  
 FIGURE 7

Scale AS SHOWN  
 Sheet Number DR8  
 Drawn by LQ  
 Checked by JIK  
 Date OCT 2008

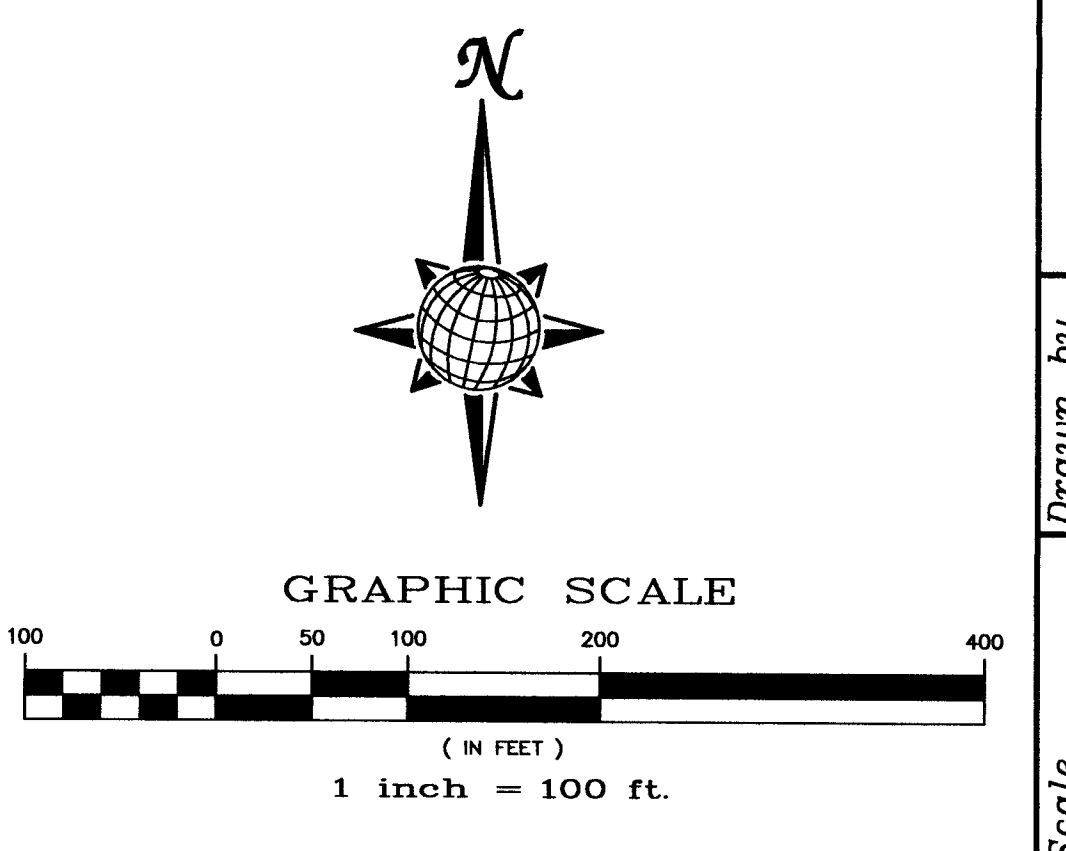
BASIN	AREA (AC)	Tc (Min.)	DIRECT RUNOFF				TOTAL RUNOFF				Sum Tc (min.)	TOTAL RUNOFF					
			I (in./hr.) (5 YR)	I (in./hr.) (100 YR)	COEFF. C (5 YR)	COEFF. C (100 YR)	CA (5 YR)	CA (100 YR)	Q (5 YR)	Q (100 YR)		I (in./hr.) (5 YR)	I (in./hr.) (100 YR)	CA (5 YR)	CA (100 YR)	Q (5 YR)	Q (100 YR)
1	4.5	18.6	2.92	5.41	0.53	0.63	2.36	2.81	7.0	15						7.0	15
2	2.0	13.8	3.38	6.26	0.53	0.63	1.05	1.25	3.5	7.8						3.5	7.8
3	2.8	17.2	3.04	5.63	0.53	0.63	1.47	1.75	4.5	9.8	18.3	2.94	5.45	1.77	2.22	5.2	12
4	1.1	11.2	3.69	6.84	0.52	0.70	0.57	0.77	2.1	5.2						2.1	5.2
5	1.6	10.6	3.78	7.01	0.59	0.71	0.94	1.13	3.5	7.9	23.8	2.56	4.74	1.29	1.91	3.5	9.1
6	6.5	22.3	2.65	4.92	0.47	0.61	3.09	3.96	8.2	19						8.2	19
7	5.0	19.2	2.87	5.32	0.53	0.63	2.63	3.13	7.5	17	22.6	2.64	4.88	2.63	3.65	7.5	18
8	5.0	19.6	2.84	5.27	0.53	0.63	2.63	3.13	7.5	16						7.5	16
9	4.6	17.9	2.98	5.52	0.53	0.63	2.42	2.88	7.2	16	23.1	2.61	4.83	3.09	4.21	8.1	20
10	2.1	11.5	3.65	6.77	0.53	0.63	1.12	1.33	4.1	9.0						4.1	9.0
11	5.1	20.7	2.76	5.11	0.53	0.63	2.68	3.19	7.4	16	25.3	2.48	4.59	2.68	3.47	7.4	16
12	5.5	18.5	2.93	5.43	0.53	0.63	2.89	3.44	8.5	19	27.8	2.34	4.34	2.89	3.70	8.5	19
13	3.8	15.6	3.19	5.91	0.53	0.63	2.00	2.39	6.4	14	28.0	2.34	4.33	2.00	2.56	6.4	14
14	2.4	14.8	3.26	6.05	0.60	0.75	1.44	1.80	4.7	11						4.7	11
15	1.9	11.8	3.62	6.71	0.58	0.74	1.11	1.41	4.0	9.4						4.0	9.4
16	1.5	10.4	3.80	7.05	0.50	0.68	0.75	1.03	2.9	7.2	18.2	2.95	5.47	1.09	1.63	3.2	8.9
17	1.7	10.0	3.87	7.17	0.49	0.66	0.84	1.12	3.2	8.0	21.1	2.73	5.07	1.07	1.68	3.2	8.5
18	1.7	12.0	3.59	6.65	0.49	0.64	0.83	1.08	3.0	7.2	23.5	2.58	4.78	1.09	1.65	3.0	7.9
19	3.8	14.8	3.27	6.05	0.58	0.74	2.22	2.81	7.3	17	20.2	2.80	5.19	2.59	3.44	7.3	18
20	1.7	15.5	3.20	5.93	0.72	0.83	1.23	1.42	3.9	8.4						3.9	8.4



NOTE:  
 COUNTY PLAN REVIEW IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH COUNTY DESIGN CRITERIA. THE COUNTY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSIONS, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. THE COUNTY THROUGH THE APPROVAL OF THIS DOCUMENT ASSUMES NO RESPONSIBILITY FOR THE COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.



**PROJECT BENCHMARK**  
 INTERSECTION OF WOODMEN RD AND MERIDIAN ROAD AT SW CORNER (BRASS CAP W/ NO. GF-9)  
 ELEVATION = 6874.00





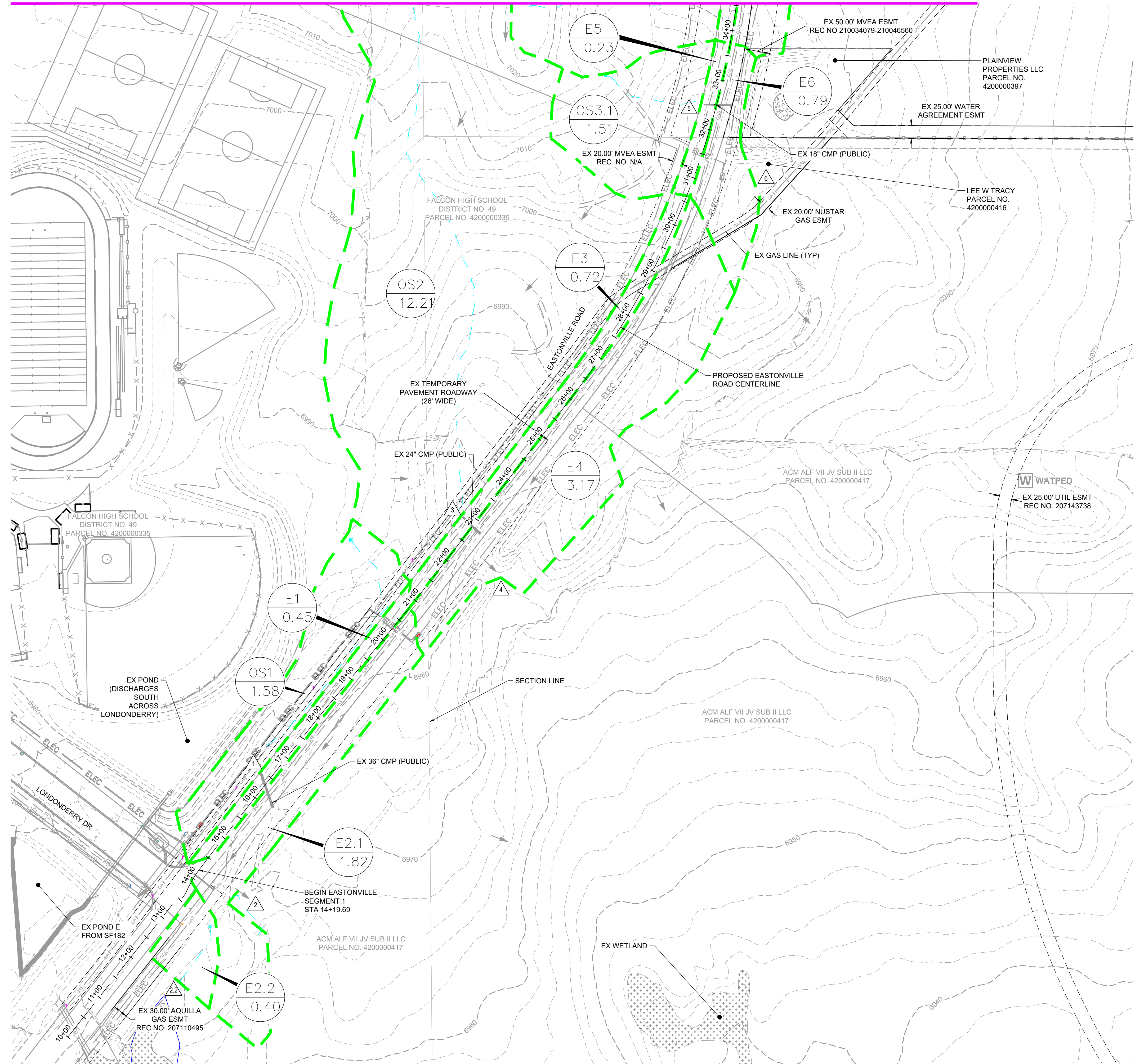
## **APPENDIX F – DRAINAGE MAPS**



SEE SHEET 2

**LEGEND:**

- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- EX STORM SEWER
- EX DRAINAGE SWALE
- EX PROPERTY LINE
- EXISTING FLOW DIRECTION
- PROPOSED DRAINAGE BASIN
- DESIGN POINT
- PROPOSED BASIN LABEL

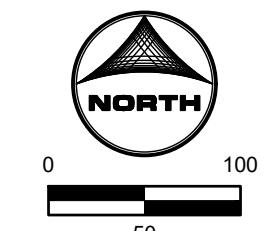


**SUMMARY RUNOFF TABLE**

BASIN	AREA (ac)	% IMPERVIOUS	Q5 (cfs)	Q100 (cfs)
E1	0.47	46	0.7	1.7
E2.1	1.82	13	1.2	4.8
E2.2	0.40	2	0.1	1.0
E3	0.72	39	1.0	2.5
E4	3.17	12	1.9	7.8
E5	0.23	45	0.5	1.1
E6	0.79	14	0.7	2.6
E7	0.23	45	0.5	1.2
E8	0.70	16	0.6	2.1
E9	0.73	45	1.2	2.8
E10.1	2.61	15	1.9	7.0
E10.2	1.89	2	0.7	4.4
OS1	1.58	2	0.5	3.6
OS2	12.21	2	3.6	24.3
OS3.1	1.51	2	0.5	3.6
OS3.2	2.86	2	1.0	6.6
OS3.3	21.12	2	6.4	42.7

**DESIGN POINT SUMMARY TABLE**

DESIGN POINT	CONTRIBUTING BASINS	SQ5 (cfs)	SQ100 (cfs)
1	E1, OS1	1.2	4.9
2	E2, DP1	2.3	9.3
2.2	E2.2	0.1	1.0
3	E3, OS2	4.6	26.6
4	DP3, E4	6.3	33.9
5	E5, OS3.1	0.9	4.5
6	DP5, E6	1.5	6.7
7.1	E7, OS3.2	1.4	7.5
8.1	DP7.1, E8	1.9	9.4
7.2	OS3.3, E9	7.5	45.3
8.2	DP7.2, E10.1	9.2	51.6
8.3	E10.2	0.7	4.4



DRAWN BY: \_\_\_\_\_ JOB DATE: \_\_\_\_\_  
 APPROVED: \_\_\_\_\_ JOB NUMBER: \_\_\_\_\_  
 CAD DATE: \_\_\_\_\_  
 CAD FILE: \_\_\_\_\_

BAR IS ONE INCH ON OFFICIAL DRAWINGS.  
 IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO. DATE BY REVISION DESCRIPTION

**HRGreen**  
 HR GREEN - COLORADO SPRINGS  
 1975 RESEARCH PKWY SUITE 230  
 COLORADO SPRINGS CO 80920  
 PHONE: 719.300.4140  
 FAX: 713.965.0044

EASTONVILLE ROAD  
 D.R. HORTON  
 EL PASO COUNTY, CO



EXISTING CONDITIONS - DRAINAGE MAP

SHEET

**LEGEND:**

- EXISTING MAJOR CONTOUR  5250
- EXISTING MINOR CONTOUR
- EX STORM SEWER
- EX DRAINAGE SWALE
- EX PROPERTY LINE
- EXISTING FLOW DIRECTION ←
- PROPOSED DRAINAGE BASIN

DESIGN POINT ▲

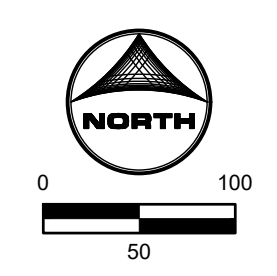
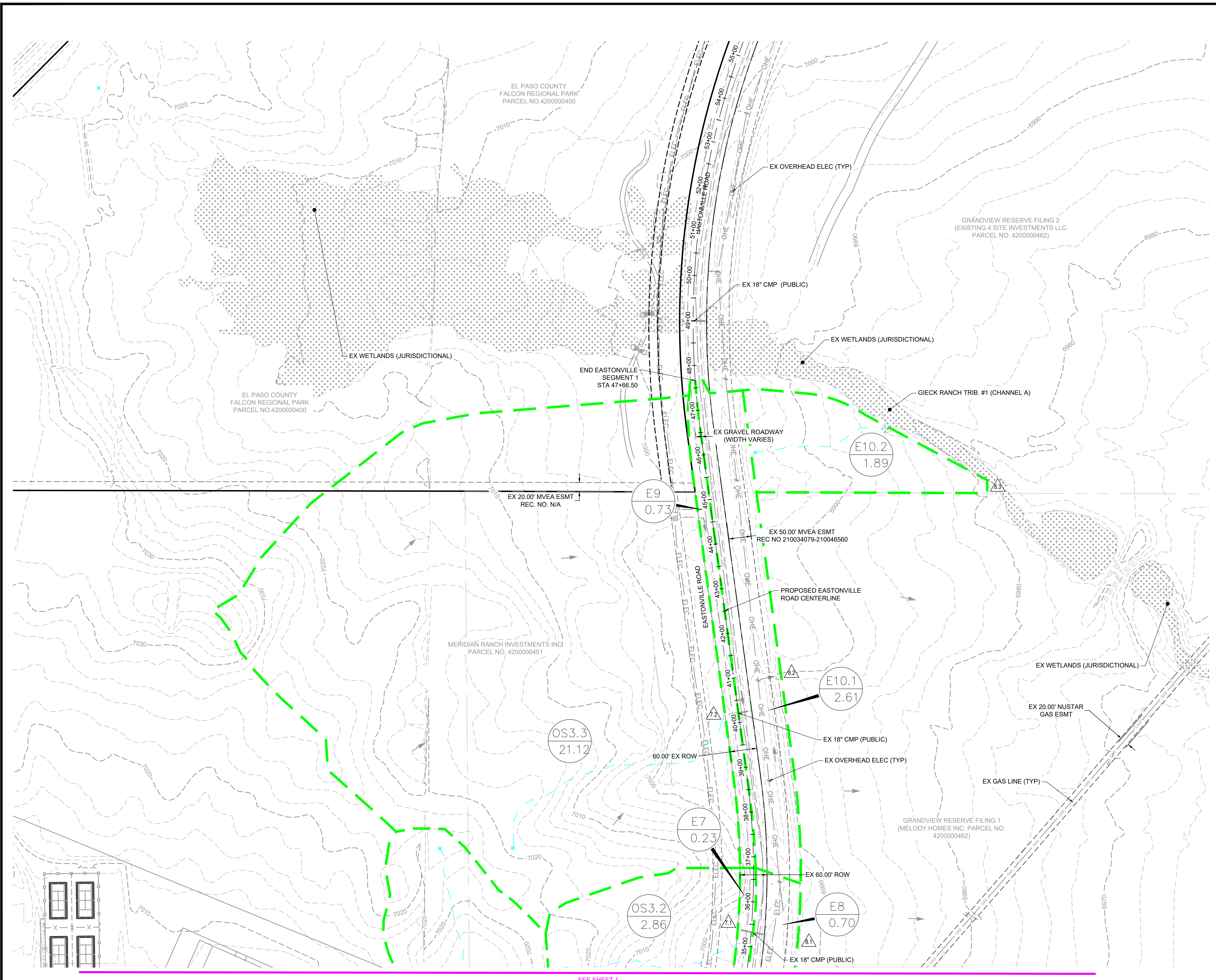
PROPOSED BASIN LABEL NAME  
AREA

**SUMMARY RUNOFF TABLE**

BASIN	AREA (ac)	% IMPERVIOUS	Q5 (cfs)	Q100 (cfs)
E1	0.47	46	0.7	1.7
E2.1	1.82	13	1.2	4.8
E2.2	0.40	2	0.1	1.0
E3	0.72	39	1.0	2.5
E4	3.17	12	1.9	7.8
E5	0.23	45	0.5	1.1
E6	0.79	14	0.7	2.6
E7	0.23	45	0.5	1.2
E8	0.70	16	0.6	2.1
E9	0.73	45	1.2	2.8
E10.1	2.61	15	1.9	7.0
E10.2	1.89	2	0.7	4.4
OS1	1.58	2	0.5	3.6
OS2	12.21	2	3.6	24.3
OS3.1	1.51	2	0.5	3.6
OS3.2	2.86	2	1.0	6.6
OS3.3	21.12	2	6.4	42.7

**DESIGN POINT SUMMARY TABLE**

DESIGN POINT	CONTRIBUTING BASINS	SQ5 (cfs)	SQ100 (cfs)
1	E1,OS1	1.2	4.9
2	E2,DP1	2.3	9.3
2.2	E2.2	0.1	1.0
3	E3,OS2	4.6	26.6
4	DP3,E4	6.3	33.9
5	E5,OS3.1	0.9	4.5
6	DP5,E6	1.5	6.7
7.1	E7,OS3.2	1.4	7.5
8.1	DP7.1,E8	1.9	9.4
7.2	OS3.3,E9	7.5	45.3
8.2	DP7.2,E10.1	9.2	51.6
8.3	E10.2	0.7	4.4



DRAWN BY: \_\_\_\_\_ JOB DATE: \_\_\_\_\_  
 APPROVED: \_\_\_\_\_ JOB NUMBER: \_\_\_\_\_  
 CAD DATE: \_\_\_\_\_  
 CAD FILE: \_\_\_\_\_

BAR IS ONE INCH ON OFFICIAL DRAWINGS.  
 IF NOT ONE INCH, ADJUST SCALE ACCORDINGLY.

NO.	DATE	BY	REVISION DESCRIPTION

SEE SHEET 1

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 COLORADO SPRINGS CO 80920  
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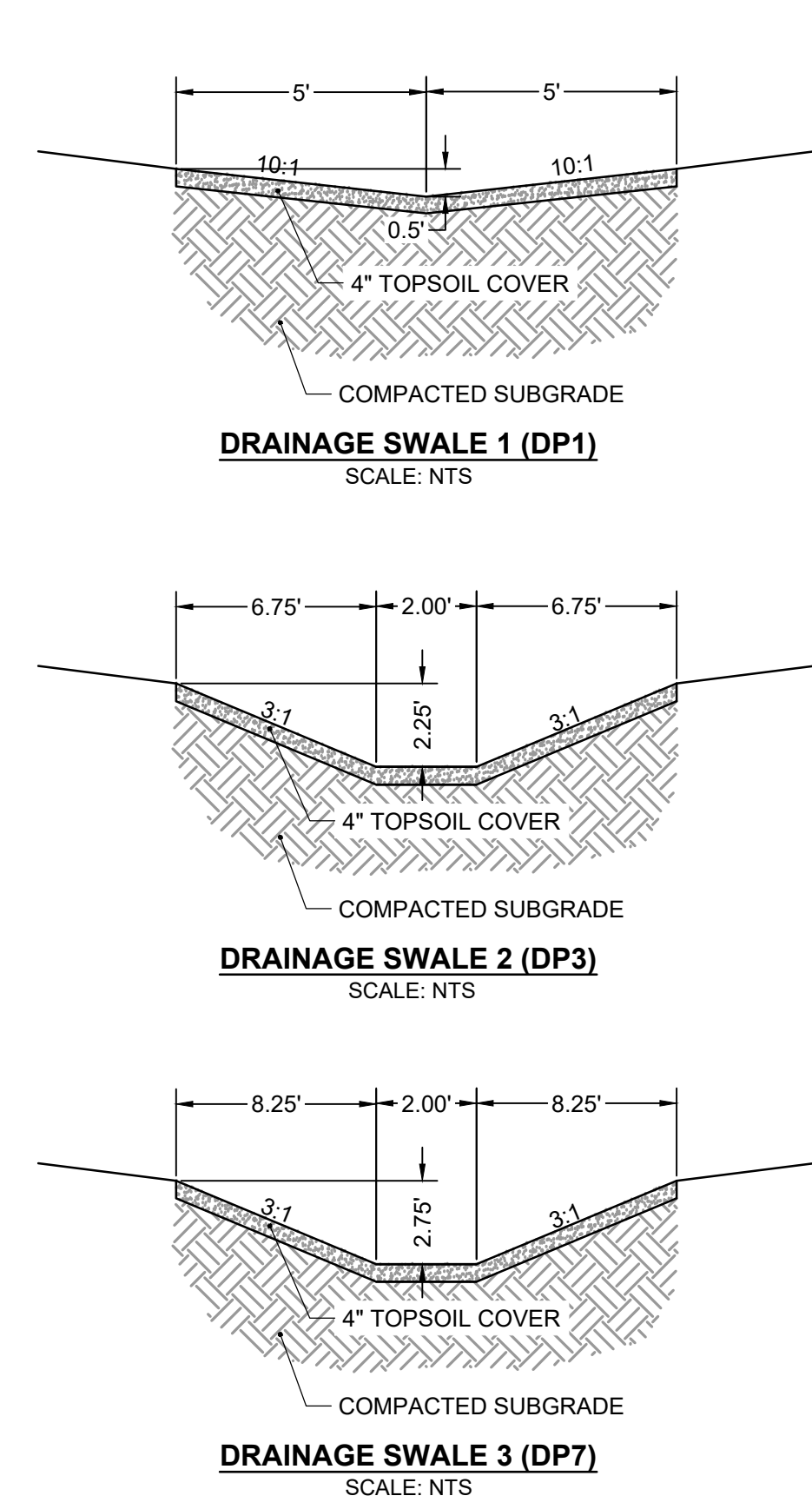
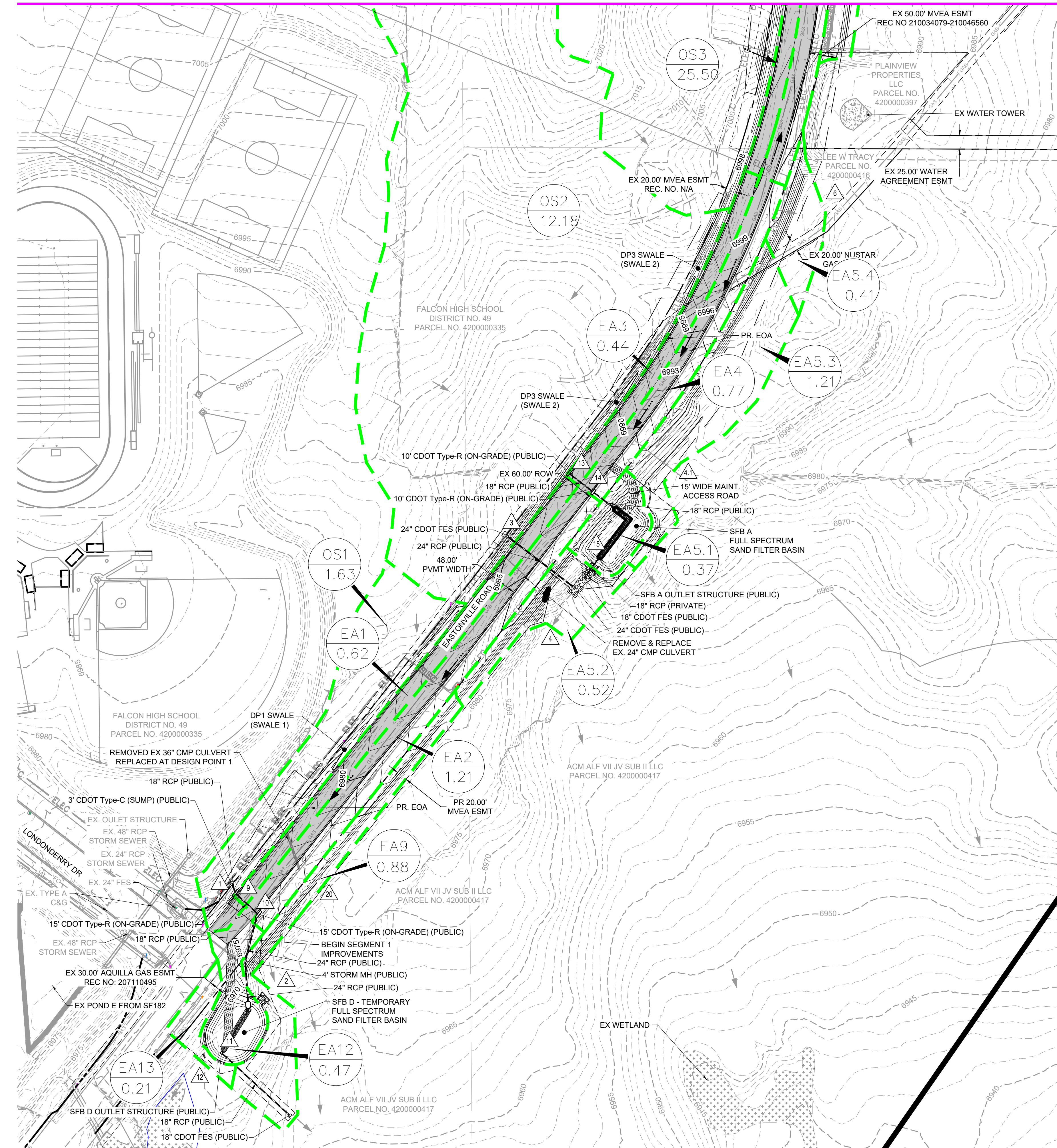
**EASTONVILLE ROAD**  
 D.R. HORTON  
 EL PASO COUNTY, CO

America's Builder

EXISTING CONDITIONS - DRAINAGE MAP

SHEET

SEE SHEET 2



**LEGEND:**

- PROPOSED MAJOR CONTOUR ——— 5250 ———
- PROPOSED MINOR CONTOUR - - - - - 5250 - - - - -
- EXISTING MAJOR CONTOUR ——— 5250 ———
- EXISTING MINOR CONTOUR - - - - - 5250 - - - - -
- PROPOSED STORM SEWER ————
- PROPOSED DRAINAGE SWALE ————
- PROPERTY LINE ————
- PROPOSED FLOW DIRECTION ————
- EXISTING FLOW DIRECTION ————
- PROPOSED DRAINAGE BASIN DESIGN POINT ————
- PROPOSED BASIN LABEL (NAME AREA)
- PRELIMINARY 100-YR FLOODPLAIN ————
- WETLANDS [Pattern]

**SUMMARY RUNOFF TABLE**

BASIN	AREA (ac)	% IMPERVIOUS	Q5 (cfs)	Q100 (cfs)
EA1	0.62	97	2.6	4.7
EA2	1.21	50	2.5	5.6
EA3	0.44	91	1.8	3.0
EA4	0.77	52	1.7	2.9
EA5.1	0.37	9	0.3	0.4
EA5.2	0.52	0	0.2	1.6
EA5.3	1.21	0	0.4	2.9
EA5.4	0.41	0	0.1	1.0
EA6	1.09	91	3.1	5.2
EA7	1.92	52	3.2	5.4
EA8	0.94	50	0.5	0.9
EA9	0.88	35	0.4	0.6
EA10.1	0.36	23	0.4	0.6
EA10.2	1.06	23	1.4	4.4
EA11	1.23	0	0.5	0.9
EA12	0.47	25	0.6	1.7
EA13	0.21	26	0.3	0.7
EA8 & EA9 *Per Segment 2 FDR	5.07	78	10.2	17.2
OS1	1.63	2	0.5	3.6
OS2	12.18	2	3.6	24.2
OS3	25.50	2	8.0	53.6

**DESIGN POINT SUMMARY TABLE**

DESIGN POINT	CONTRIBUTING BASINS	SQ5 (cfs)	SQ100 (cfs)
1	OS1	0.5	3.6
2	DP20, SFB D Release	0.7	5.0
3	OS2	3.6	24.2
4	EA 5.2, OS2, DP4.1, SFB A RELEASE	4.1	28.6
4.1	EA5.3	0.6	3.5
6	EA5.4	0.4	2.0
7	OS3	8.0	53.6
8.3	DP 22, OS3, EDB B RELEASE	9.7	58.1
8.2	EA10.2	1.4	4.0
9	DP1, EA1	3.3	9.3
10	DP9, EA2	5.4	13.9
11	DP10, EA12	5.8	15.2
12	EA13	0.3	0.7
13	EA3	1.8	3.0
14	DP13, EA4	3.3	5.6
15	DP14, EA5	3.5	5.9
16	EA6	3.1	5.2
17	DP16, EA7	6.2	10.3
18	DP17	6.2	10.3
19	DP18, EA8	6.6	11.1
18U	DP17, EA8 & EA9 *PER SEGMENT 2 FDR	15.5	26.0
19U	DP18U, EA8	15.8	26.6
20	EA9	0.4	0.6
8.1	EA10	0.4	0.6
22	EA11	0.5	0.9

NOTE: "U" DESIGNATION INDICATES ULTIMATE CONDITION AFTER CONSTRUCTION OF SEGMENT 2

DRAWN BY: NQJ JOB DATE: 8/26/2024  
 APPROVED: CM JOB NUMBER: 201662.08  
 CAD DATE: 8/26/2024  
 CAD FILE: J:\2020\201662\CAD\DWG\C\Eastonville\_Road\_662.08\Drainage\201662.08\_FDR\_map\_Seg1

NO.	DATE	BY	REVISION DESCRIPTION

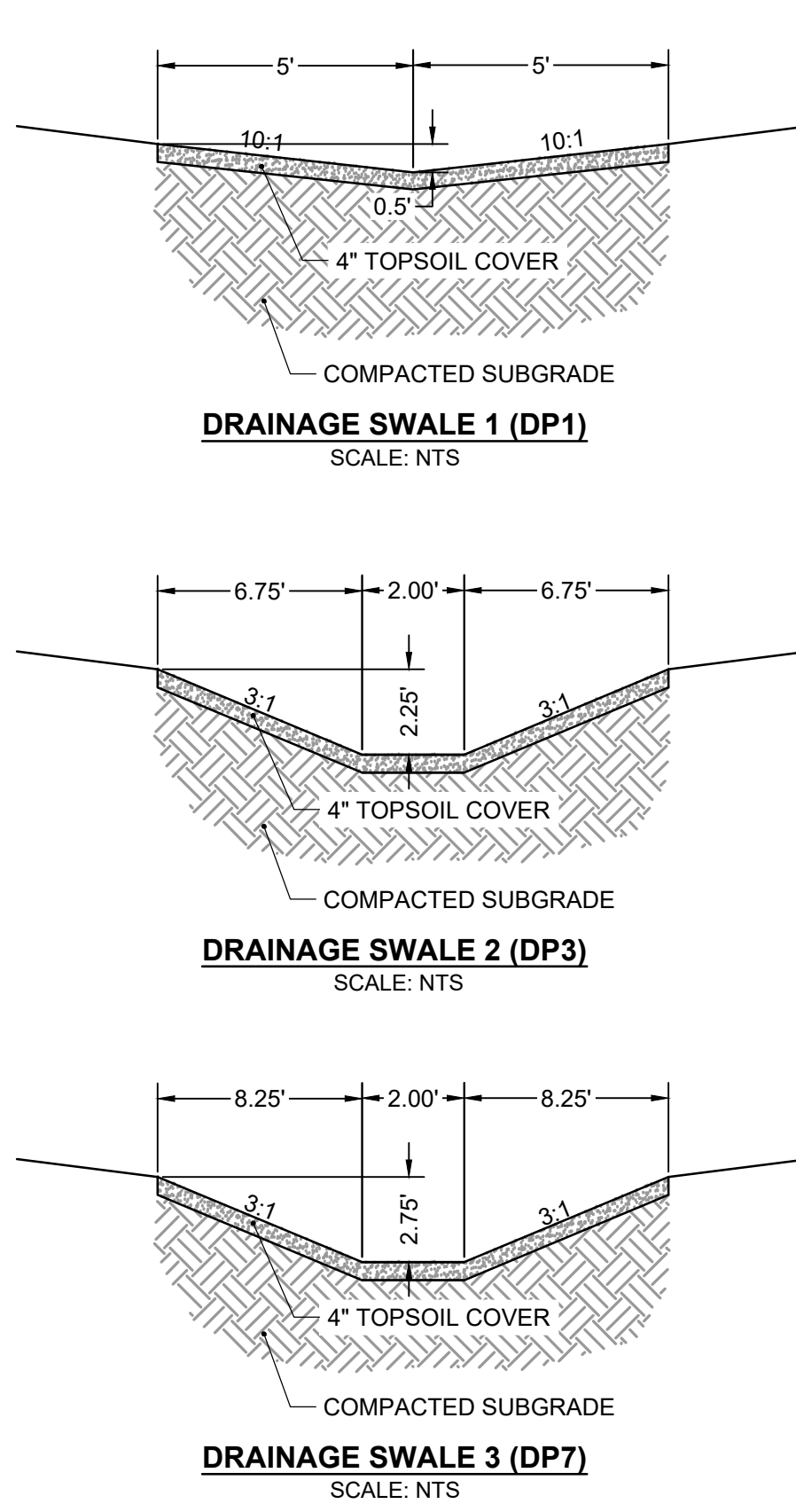
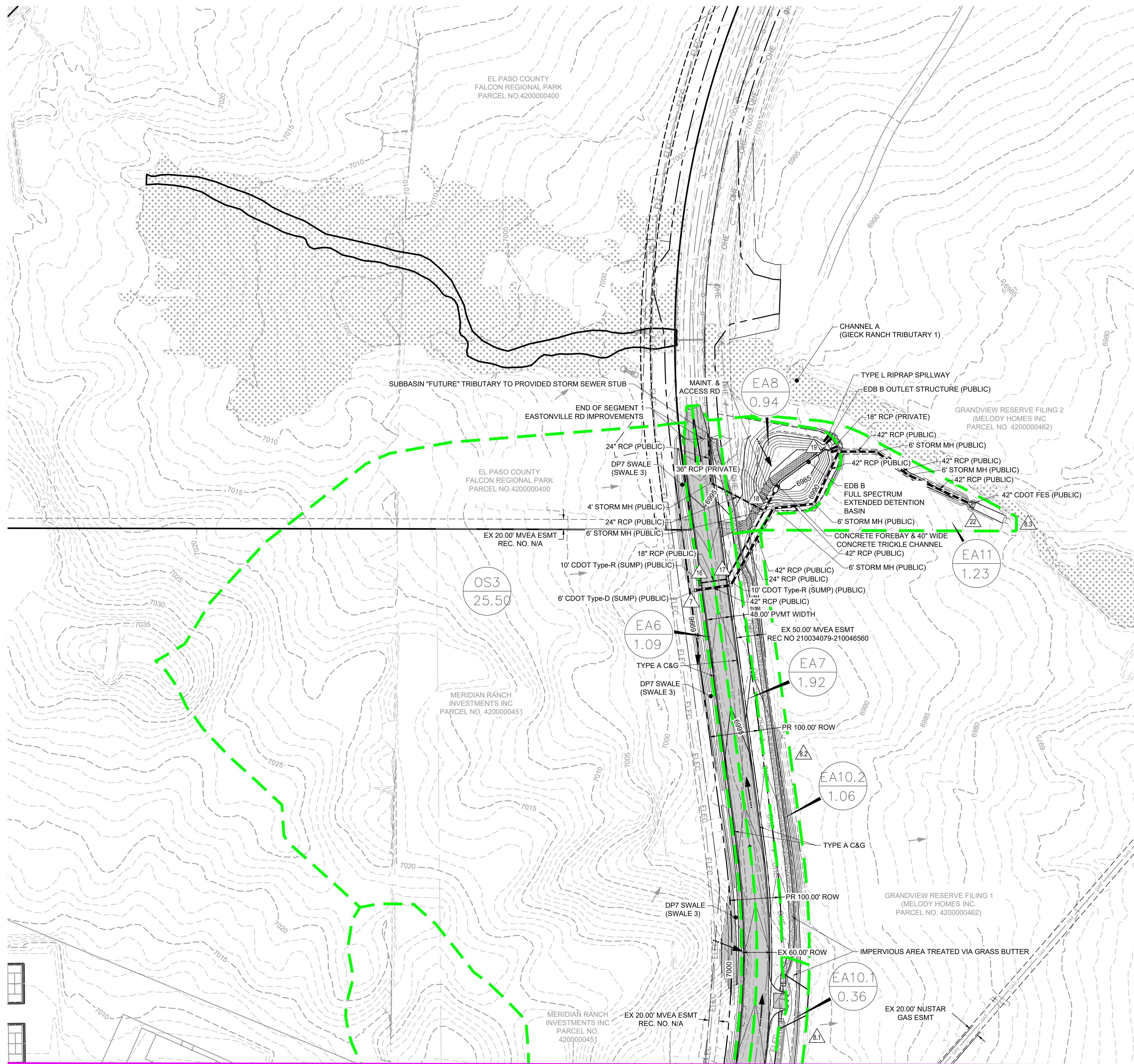
**HRGreen**  
 HR GREEN - COLORADO SPRINGS  
 1975 RESEARCH PKWY SUITE 230  
 COLORADO SPRINGS CO 80920  
 PHONE: 719.300.4140  
 FAX: 713.965.0044

EASTONVILLE ROAD  
 D.R. HORTON  
 EL PASO COUNTY, CO



EASTONVILLE ROAD - SEGMENT 1  
 PROPOSED CONDITIONS DRAINAGE MAP

SHEET DRN 1



**LEGEND:**

- PROPOSED MAJOR CONTOUR (solid line)
- PROPOSED MINOR CONTOUR (dashed line)
- EXISTING MAJOR CONTOUR (dotted line)
- EXISTING MINOR CONTOUR (dash-dot line)
- PROPOSED STORM SEWER (thick solid line)
- PROPOSED DRAINAGE SWALE (dashed line)
- PROPERTY LINE (thin solid line)
- PROPOSED FLOW DIRECTION (arrow)
- EXISTING FLOW DIRECTION (arrow)
- PROPOSED DRAINAGE BASIN DESIGN POINT (triangle)
- PROPOSED BASIN LABEL (circle)
- PRELIMINARY 100-YR FLOODPLAIN (dotted area)
- WETLANDS (stippled area)

**SUMMARY RUNOFF TABLE**

BASIN	AREA (ac)	% IMPERVIOUS	Q5 (cfs)	Q100 (cfs)
EA1	0.62	97	2.6	4.7
EA2	1.21	50	2.5	5.6
EA3	0.44	91	1.8	3.0
EA4	0.77	52	1.7	2.9
EA5.1	0.37	9	0.3	0.4
EA5.2	0.52	0	0.2	1.6
EA5.3	1.21	0	0.4	2.9
EA5.4	0.41	0	0.1	1.0
EA6	1.09	91	3.1	5.2
EA7	1.92	52	3.2	5.4
EA8	0.94	50	0.5	0.9
EA9	0.88	35	0.4	0.6
EA10.1	0.36	23	0.4	0.6
EA10.2	1.06	23	1.4	4.4
EA11	1.23	0	0.5	0.9
EA12	0.47	25	0.6	1.7
EA13	0.21	26	0.3	0.7
EA8 & EA9 *Per Segment 2 FDR	5.07	78	10.2	17.2
OS1	1.63	2	0.5	3.6
OS2	12.18	2	3.6	24.2
OS3	25.50	2	8.0	53.6

**DESIGN POINT SUMMARY TABLE**

DESIGN POINT	CONTRIBUTING BASINS	SQ5 (cfs)	SQ100 (cfs)
1	OS1	0.5	3.6
2	DP20, SFB D Release	0.7	5.0
3	OS2	3.6	24.2
4	EA 5.2, OS2, DP4.1, SFB A RELEASE	4.1	28.6
4.1	EA5.3	0.6	3.5
6	EA5.4	0.4	2.0
7	OS3	8.0	53.6
8.3	DP 22, OS3, EDB B RELEASE	9.7	58.1
8.2	EA10.2	1.4	4.0
9	DP1, EA1	3.3	9.3
10	DP9, EA2	5.4	13.9
11	DP10, EA12	5.8	15.2
12	EA13	0.3	0.7
13	EA3	1.8	3.0
14	DP13, EA4	3.3	5.6
15	DP14, EA5	3.5	5.9
16	EA6	3.1	5.2
17	DP16, EA7	6.2	10.3
18	DP17	6.2	10.3
19	DP18, EA8	6.6	11.1
18U	DP17, EA8 & EA9 *PER SEGMENT 2 FDR	15.5	26.0
19U	DP18U, EA8	15.8	26.6
20	EA9	0.4	0.6
8.1	EA10	0.4	0.6
22	EA11	0.5	0.9

NOTE: "U" DESIGNATION INDICATES ULTIMATE CONDITION AFTER CONSTRUCTION OF SEGMENT 2

DRAWN BY: NQJ JOB DATE: 8/26/2024  
 APPROVED: CM JOB NUMBER: 201662.08  
 CAD DATE: 8/26/2024  
 CAD FILE: J:\2020\201662\CADD\dwg\C\Eastonville\_Road\_662.08\Drainage\201662.08\_FDR\_map\_Seg1

NO.	DATE	BY	REVISION DESCRIPTION

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 1975 RESEARCH PKWY SUITE 230  
 COLORADO SPRINGS CO 80920  
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EASTONVILLE ROAD  
 D.R. HORTON  
 EL PASO COUNTY, CO



EASTONVILLE ROAD - SEGMENT 1  
 PROPOSED CONDITIONS DRAINAGE MAP

SHEET DRN 2